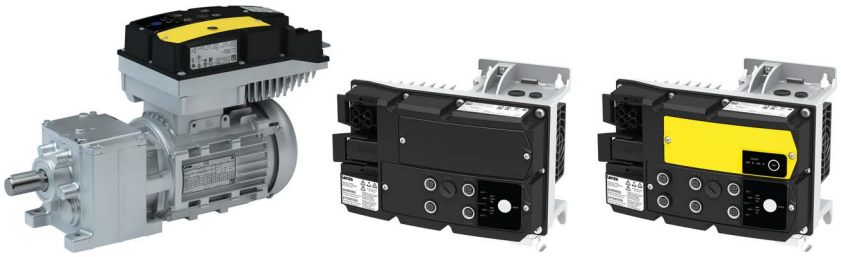
i550/i650 motec frequency inverters



0.37 ... 45 kW
0.5 ... 60 hp

Contents

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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
Mounting sheet	General safety instructions and important UL/CSA instructions, connection diagram and technical data. • The mounting sheet is included in the delivery of the product.
Operating instructions	Basic information on installing and commissioning the product.
Commissioning manual	Detailed information on setting and parameterizing the product.

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: "EASY Starter", "PLC Designer"
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

In this document, "i□□□" is used as a wildcard for the "i550" or "i650" product series.

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 i550 motec and i650 motec frequency inverters for wall mounting and motor mounting in protection class IP66 (UL Type 4X indoor) are the ideal decentralized drive solution. The inverters can be extended for universal use with an extension box with disconnect switch with/without Type E combination motor controller and operating elements.

Fast mounting and easy commissioning thanks to user-friendly tools as well as connections for commercially available connectors are the focus of these inverters. Parameters, drive behavior and usability correspond to our proven frequency inverters. Rounded off by high energy efficiency, we thus offer a modern and sustainable drive solution.

The i650 motec frequency inverter stands out from the i550 motec due to its extended range of functions: For simple automation tasks, a logic PLC based on CODESYS in accordance with the IEC 61131-3 standard is integrated in the i650 motec. Table positioning is available for the realization of independent axes and machine modules. The “Extended Safety“ option (safety technology with various functions) rounds off the overall package.

The requirements of the Ecodesign Directive, standard EN IEC 61800-9-2, are met.

Application areas: Conveyor drives, traveling drives, winding drives, hoist drives, extruders, packaging machines, pumps, fans, ...

Overview			
Power range	0.37 ... 45 kW		
Mains connection	3 x 230 V	3 x 400 V	3 x 480 V
Degree of protection	IP66		
Communication	EtherCAT, EtherNet/IP, Modbus TCP, PROFINET		

Highlights

- Compact solution for decentralized drive technology, wall-mounted or motor-mounted, with high protection class IP66 (UL Type 4X indoor)
- Wall-mounted expandable: Extension box with disconnect switch with/without Type E combination motor controller and operating elements
- Fast mounting due to pluggable, standardized connections (plug & play)
- Four IO-Link ports with limited master functionality for easy data exchange between IO-Link sensors and actuators
- Integrated regenerative module for very high energy efficiency – a brake resistor is no longer required
- Extended range of functions with the i650 motec:
  - Logic PLC
  - Table positioning
  - "Safe Torque Off (STO)" over CIP Safety

Features

The following figures provide an overview of the elements and connec ions on the devices. Posi ion, size and appearance of elements and connec ions may vary depending on the performance and size of the devices.

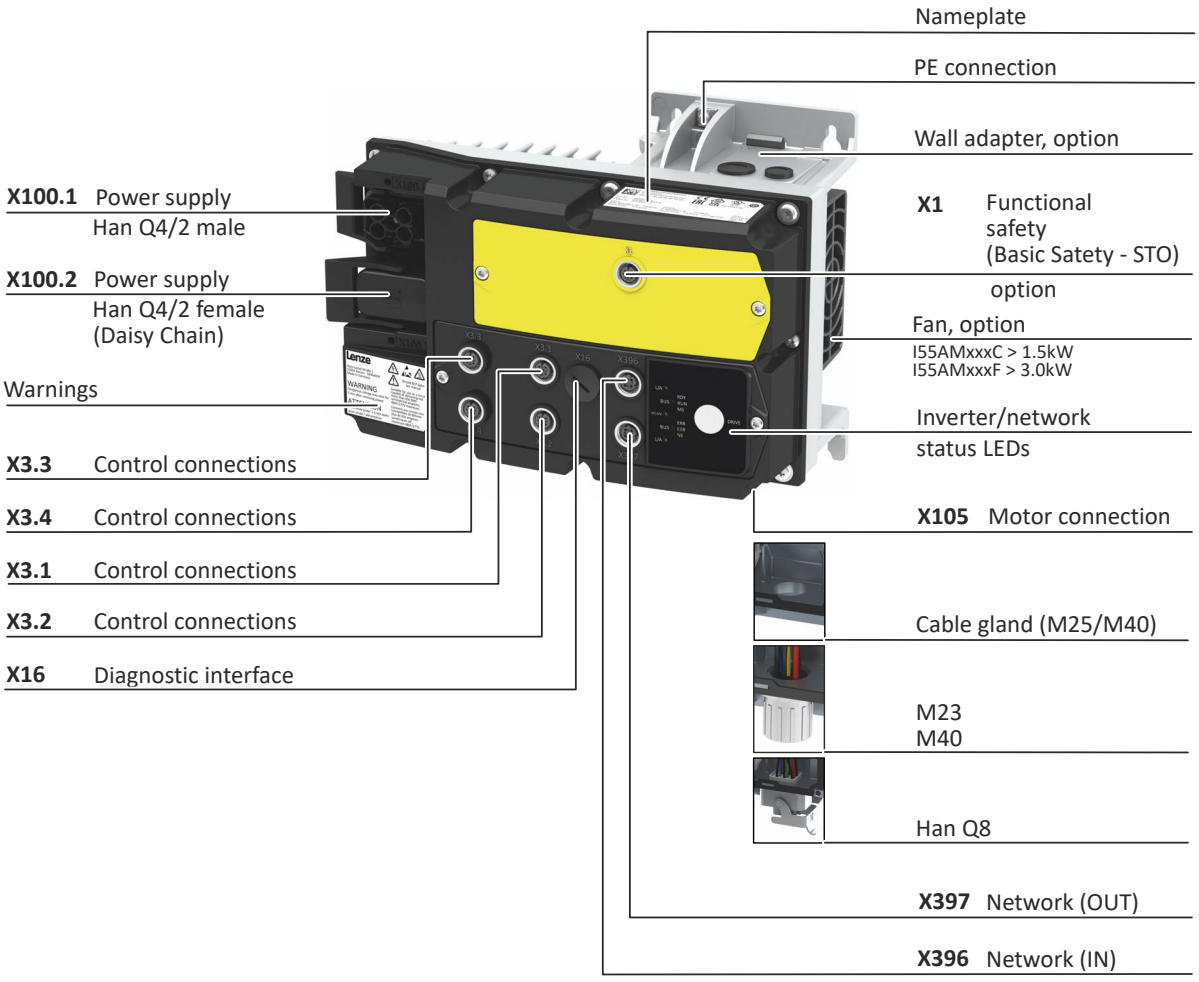


Fig. 1: Example for i550 motec with integrated safety technology

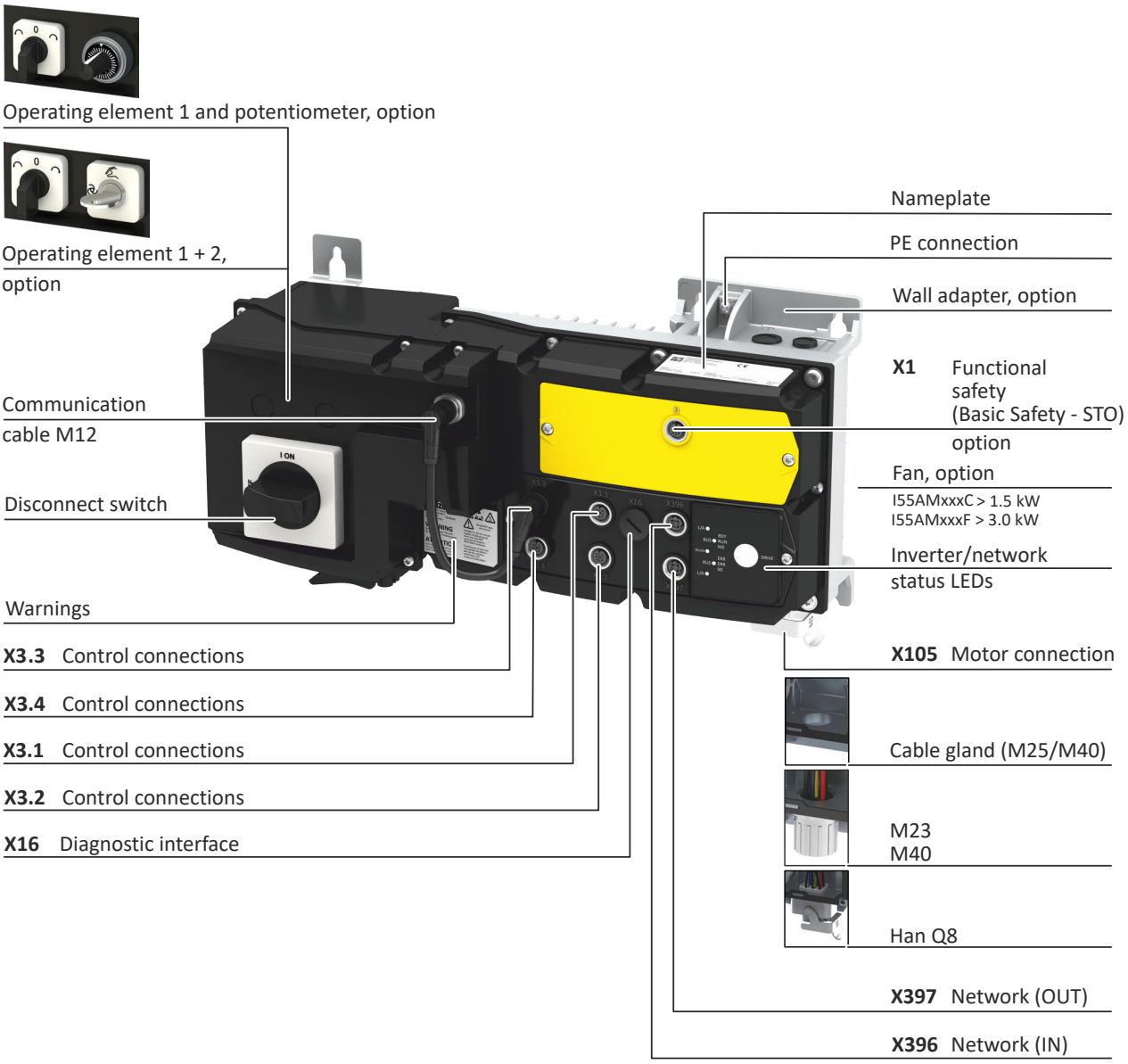


Fig. 2: Example for i550 motec with integrated safety technology and extension box with disconnect switch

Control element	Function
Disconnect switch	Mains voltage on/off
Operating element 1	Forward/Reverse/Stop
Operating element 2, lockable	Local control/network control
Potentiometer	Setpoint frequency

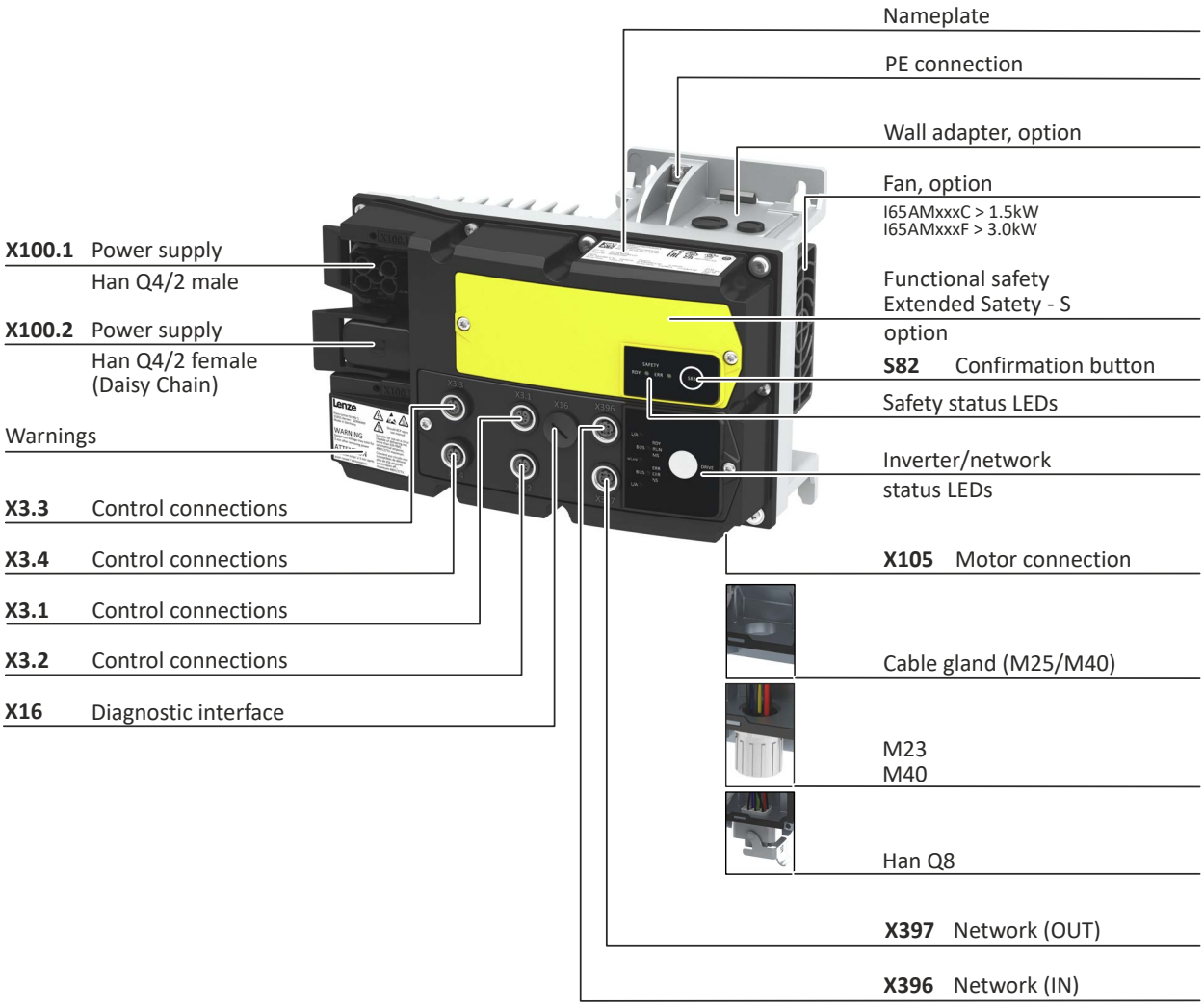


Fig. 3: Example of i650 motec with integrated functional safety "Extended Safety - S"

Connections and interfaces

The i550/i650 motec frequency inverters have these interfaces:

- External power supply DC 24 or 48 V (20.5 ... 49.9 V) and internal 24 V power supply unit
- Motor PTC input
- Holding brake control
- Diagnostic interface (USB-C)
- Network interface (2 x M12 connector, D coded)
- Control connections
  - Standard I/O: 2 x M12 connector, A coded (only available for i550 motec)
  - Application I/O: 4 x M12 connector, A coded

Integrated functional safety

Option "Basic Safety - STO"

- Stop functions:
  - Safe torque off (STO)
- Operation and diagnostics:
  - Safe input (M12 connector, A coded)

Option "Extended Safety - S" (only available for i650 motec)

- Stop functions:
  - Safe torque off (STO)
  - Safe stop 1 (SS1)
- Operation and diagnostics:
  - Safety bus (CIP Safety™)
  - Safe Muting (MUT)

Function assignment of the control terminals

By default, all control terminals are configured as digital inputs. Depending on the device version (with standard I/O or application I/O), different functions can be assigned to the M12 connectors X3.x.

"Standard I/O" option

X3.1	Function assignment			
Pin	Default setting	Further possible settings		
1	24 V	24 V	24 V	
2	DI2	DI2	DI2	
3	GND	GND	GND	
4	DI1	DO1	Pulse train	

X3.2	Function assignment		
Pin	Default setting	Further possible settings	
1	24 V	24 V	
2	DI4	Encoder (A)	
3	GND	GND	
4	DI3	Encoder (B)	

"DIx" function assignment:

- Normal digital inputs for control tasks.
- Logic level "HIGH-active" or "LOW-active", debounce time, and inversion can be parameterized.

"DOx" function assignment:

- Normal digital outputs.
- Switch-on delay and switch-off delay can be parameterized.

"Encoder" function assignment:

- For connecting a single-track or two-track HTL encoder (max. 200 kHz).
- A single-track HTL encoder (track A) cannot be used for motor speed feedback.
- A two-track HTL encoder (track A and B) must have a phase offset of exactly 90° between track A and B (error ≤ ± 10°). Inverted tracks are not required.
- Encoder increments: ≤ 16384 increments per revolution

"Pulse-Train" function assignment:

- For output of a reference frequency ("Pulse Train").
- Other inverters can interpret this signal as a setpoint signal, for example.

"Application I/O" option

X3.1	Function assignment				
Pin	Default setting	Further possible settings			
1	24 V	24 V	24 V / L+	24 V	
2	DI2	DI2	DI2	DI2	
3	GND	GND	GND / L-	GND	
4	DI1	DO1	IO-Link port 1	Pulse train	

X3.2	Function assignment							
Pin	Default setting	Further possible settings						
1	24 V	24 V	24 V	24 V / L+	24 V	24 V	24 V / L+	24 V
2	DI4	Encoder (A)	DI4	DI4	Pulse-In	Pulse-In	Pulse-In	Pulse-In
3	GND	GND	GND	GND / L-	GND	GND	GND / L-	GND
4	DI3	Encoder (B)	DO2	IO-Link port 2	DI3	DO2	IO-Link port 2	Pulse-Direction

X3.3	Function assignment			
Pin	Default setting	Further possible settings		
1	24 V	24 V	24 V / L+	
2	DI6	DI6	DI6	
3	GND	GND	GND / L-	
4	DI5	DO3	IO-Link port 3	

X3.4	Function assignment			
Pin	Default setting	Further possible settings		
1	24 V	24 V	24 V / L+	
2	DI8	DI8	DI8	
3	GND	GND	GND / L-	
4	DI7	DO4	IO-Link port 4	

"DIx" function assignment:

- Normal digital inputs for control tasks.
- Assertion level "HIGH active" or "LOW active", debounce time and inversion are parameterizable.

"DOx" function assignment:

- Normal digital outputs.
- Switch-on delay and switch-off delay can be parameterized.

"IO-Link port x" function assignment:

- For communicating with sensors and actuators (IO-Link devices) with port class A.
- The inverter (IO-Link master) supports IO-Link version 1.1
- Further details: IO-Link 142

"Pulse-Train" function assignment:

- For output of a reference frequency ("Pulse Train").
- Other inverters can interpret this signal as a setpoint signal, for example.

"Pulse-In" function assignment:

- To evaluate the signal of a low-cost HTL encoder or a reference frequency ("Pulse-Train") and to accept it as a setpoint signal.
- The detection of a direction signal ("Pulse-Direction") is also supported.

"Encoder" function assignment:

- For connecting a single-track or two-track HTL encoder (max. 200 kHz).
- A single-track HTL encoder (track A) cannot be used for motor speed feedback.
- A two-track HTL encoder (track A and B) must have a phase offset of exactly 90° between track A and B (error ≤ ± 10°). Inverted tracks are not required.
- Encoder increments: ≤ 16384 increments per revolution

Further details on configuring the function assignment can be found in the commissioning document.

Status LEDs

You can quickly obtain information on some operating states via the large "DRIVE" LED status display on the inverter. This status display is composed of a blue LED "RDY" and a red LED "ERR", which emit specific blinking patterns depending on the operating status:

"RDY" LED (blue)	"ERR" LED (red)	Status/meaning
off	off	No supply voltage
on	on	Initialisation (inverter is started)
blinking (1 Hz)	off	Safe torque off (STO) active. The inverter has been disabled by the integrated functional safety. ▸ Safe torque off (STO) 🕮 160
	blinking fast (4 Hz)	Safe torque off (STO) active, warning present. The inverter has been disabled by the integrated functional safety. ▸ Safe torque off (STO) 🕮 160
blinking (2 Hz)	off	Inverter disabled
	blinking fast (4 Hz)	Inverter disabled, warning present.
	on	Inverter disabled, error active.
	on briefly every 1.5 s	Inverter disabled, no DC-bus voltage.
on	off	Inverter enabled. The motor rotates according to the specified setpoint or quick stop active.
	blinking fast (4 Hz)	Inverter enabled, warning present. The motor rotates according to the specified setpoint or quick stop active.
	blinking (1 Hz)	Inverter enabled, quick stop as response to fault active.
Both LEDs are blinking in a rapidly alternating mode		Firmware update is active
Both LEDs are blinking in a very rapidly synchronous mode		"Visual tracking" function is active

For the meaning of the status LEDs for the network, see the commissioning document.

For the meaning of the status LEDs for Safety see 🕮 169.

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:

Modbus	The Modbus protocol is an open communication protocol based on a client/server architecture and developed for the communication with programmable logic controllers. Further development is carried out by the international user organisation Modbus Organization, USA.
EtherCAT®	EtherCAT® (Ethernet for Controller and Automation Technology) is an Ethernet-based fieldbus system meeting the application profile for industrial real-time 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
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®	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

To provide the user with the expected functionality of one of these systems, the inverter is ordered for a specific network. The ordered network is then preset in the inverter.

The inverter itself has the firmware of all available networks on board and the user has the possibility to switch the inverter to another network.

Functions

Overview

The functions of the frequency inverters i550/i650 motec are adapted to extensive applications.

Functions		
Motor control		**Monitoring**
V/f characteristic control linear/square-law (VFC plus)		Short circuit
V/f characteristic control (VFC closed loop)		Earth fault
Energy-saving function (VFC-Eco)		Device overload (ixt)
Sensorless vector control (SLVC)		Motor overload (i^2xt)
Sensorless control for synchronous motors (SL-PSM/SLSM-PSM)		Mains phase failure
(up to 15 kW at 3 x 230/240 V and up to 30 kW at 3 x 400/480 V)		Stalling protection
Servo control for asynchronous motors (SC-ASM)		Motor current limit
Motor functions		Maximum torque
Flying restart circuit		Ultimate motor current
Slip compensation		Motor speed
DC braking		Load loss detection
Oscillation damping		Motor temperature
Skip frequencies		**Diagnostics**
Automatic identification of the motor data		Error history buffer
Brake energy management		Logbook
Holding brake control		LED status displays
"Voltage add" function		**Network**
Rational Energy Ride Through (RERT)		EtherCAT
Speed feedback (HTL encoder)		EtherNet/IP
Frequency setpoint		Modbus TCP
Application functions		PROFINET
Process controller		**Safety functions**
Access protection		See chapter "Connections and interfaces". 📖 14
Process controller sleep mode and rinse function		**Additional functions**
Freely assignable favorite menu		Logic PLC (i650 motec only)
Parameter change-over		Table positioning (i650 motec only)
S-shaped ramps for smooth acceleration		
Motor potentiometer		
Flexible I/O configuration		
Automatic restart		
OEM parameter set		
Frequency output via digital output DO1		

Motor control types

The following table contains the possible control types with Lenze motors.

Motors	V/f characteristic control VFCplus	Sensorless vector control SLVC	ASM servo control SC ASM
Three-phase AC motors			
MD	●	●	●
MF	●	●	●
mH	●	●	●
m500	●	●	●

Lenze synchronous servo motors are not suitable for use with inverters, e.g. the types MCS, MCM or m850.

Motor functions

Motor setting range

Rated point 120 Hz

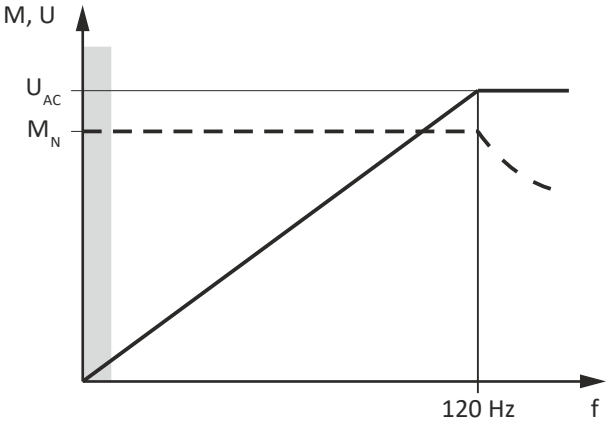
Only possible with Lenze MF motors.

The rated motor torque is available up to 120 Hz.

Compared to the 50-Hz operation, the setting range increases by 2.5 times.

Thus, a smaller motor can be selected at the same rated power.

V/f at 120 Hz



V	Voltage	V_{AC}	Mains voltage
M	Torque	M_N	Rated torque
f	Frequency		

Rated point 87 Hz

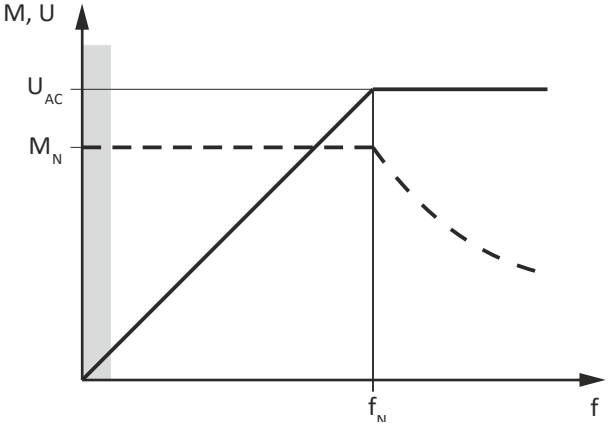
The rated motor torque is available up to 87 Hz.

Compared to the 50-Hz operation, the setting range increases by 1.74 times.

For this purpose, a motor with 230/400 V in a triangle is driven by a 400 V inverter.

The inverter must be dimensioned for a rated motor current of 230 V.

V/f at 87 Hz

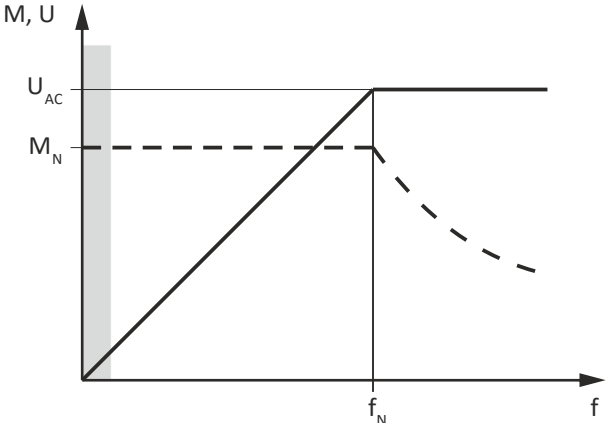


V	Voltage	U_{AC}	Mains voltage
M	Torque	M_{rated}	Rated torque
f	Frequency	f_{rated}	Rated frequency

Rated point 50 Hz

The rated motor torque is available up to 50 Hz.

V/f at 50 Hz



V	Voltage	U_{AC}	Mains voltage
M	Torque	M_{rated}	Rated torque
f	Frequency	f_{rated}	Rated frequency

Identification of the products

Product name

The product name is used when listing the technical data for the various product variants and when assigning accessories. The assignment of product name to type code can be found in chapter "Purchase order". 📖 175.

The product name contains:

- the name of the product series - "i□□□" as wildcard for "i550" or "i650"
- the version - "M" for "motec" = inverter for decentralized mounting locations/motor mounting
- the power - in kW of the "Heavy Duty" load characteristic
- the mains voltage class - e.g. 230/240 V or 400 V
- the number of mains phases

Device series	Type	Rated power	Rated mains voltage	No. of phases	Product name
		kW	V		
i□□□	M	0.37	240	3	i□□□-M0.37/230-3
		0.55			i□□□-M0.55/230-3
		0.75			i□□□-M0.75/230-3
		1.1			i□□□-M1.1/230-3
		1.5			i□□□-M1.5/230-3
		2.2			i□□□-M2.2/230-3
		3			i□□□-M3.0/230-3
		4			i□□□-M4.0/230-3
		5.5			i□□□-M5.5/230-3
		7.5			i□□□-M7.5/230-3
		11			i□□□-M11/230-3
		15			i□□□-M15/230-3
		18.5			i□□□-M18/230-3
		22			i□□□-M22/230-3

Device series	Type	Rated power	Rated mains voltage	No. of phases	Product name
		kW	V		
i□□□	M	0.37	400	3	i□□□-M0.37/400-3
		0.55			i□□□-M0.55/400-3
		0.75			i□□□-M0.75/400-3
		1.1			i□□□-M1.1/400-3
		1.5			i□□□-M1.5/400-3
		2.2			i□□□-M2.2/400-3
		3			i□□□-M3.0/400-3
		4			i□□□-M4.0/400-3
		5.5			i□□□-M5.5/400-3
		7.5			i□□□-M7.5/400-3
		11			i□□□-M11/400-3
		15			i□□□-M15/400-3
		18.5			i□□□-M18/400-3
		22			i□□□-M22/400-3
		30			i□□□-M30/400-3
		37			i□□□-M37/400-3
		45			i□□□-M45/400-3

Device series	Type	Rated power	Rated mains voltage	No. of phases	Product name
		kW	V		
i□□□	M	0.37	480	3	i□□□-M0.37/400-3
		0.55			i□□□-M0.55/400-3
		0.75			i□□□-M0.75/400-3
		1.1			i□□□-M1.1/400-3
		1.5			i□□□-M1.5/400-3
		2.2			i□□□-M2.2/400-3
		3			i□□□-M3.0/400-3
		4			i□□□-M4.0/400-3
		5.5			i□□□-M5.5/400-3
		7.5			i□□□-M7.5/400-3
		11			i□□□-M11/400-3
		15			i□□□-M15/400-3
		18.5			i□□□-M18/400-3
		22			i□□□-M22/400-3
		30			i□□□-M30/400-3
		37			i□□□-M37/400-3
		45			i□□□-M45/400-3

Type code structure

			I	□□	A	M	□□□	□	□	□	□	□	□	□	□	S
Product type	Inverter		I													
Product	i550			55												
	i650			65												
Product generation	Generation 1				A											
Mounting type	Motor and wall mounting					M										
Rated power	0.37 kW	0.5 hp					137									
	0.55 kW	0.75 hp					155									
	0.75 kW	1 hp					175									
	1.1 kW	1.5 hp					211									
	1.5 kW	2 hp					215									
	2.2 kW	3 hp					222									
	3 kW	4 hp					230									
	4 kW	5.5 hp					240									
	5.5 kW	7.5 hp					255									
	7.5 kW	10 hp					275									
	11 kW	15 hp					311									
	15 kW	20 hp					315									
	18.5 kW	25 hp					318									
	22 kW	30 hp					322									
	30 kW	40 hp					330									
	37 kW	50 hp					337									
	45 kW	60 hp					345									
Mains voltage and connection type	3/PE AC 230/240 V							C								
	3/PE AC 400 V 3/PE AC 480 V							F								
Extension box	Without extension box								0							
	Extension box for inverter up to • 5.5 kW (230/240 V) • 11 kW (400/480 V)	with mains terminals							1							
		with disconnect switch							A							
		with disconnect switch with status feedback							B							
		with Type E combination motor controller							C							
		with Type E combination motor controller and status feedback							D							
		with disconnect switch with status feedback and operating elements							E							
		with disconnect switch with status feedback, operating element and potentiometer							F							
Integrated functional safety	Without functional safety									0						
	Basic Safety - STO									A						
	Extended Safety - S									E						
Degree of protection	IP54, coated	UL type 12 / 12K									B					
	IP66, coated	UL type 4X indoor									D					
Continuation ...																

Type code structure (continuation)

			I	□□	A	M	□□□	□	□	□	□	□	□	□	□	□	S
Motor connection	Without adapter											0					
	Wall adapter	with Han Q8										A					
		with heatsink fan and Han Q8										D					
		with M23										C					
		with heatsink fan and M23										F					
		with M40										H					
		with cable gland (M25)										B					
		with heatsink fan and cable gland (M25)										E					
		with cable gland (M40)										G					
	Motor adapter	for BG063 - BG071										I					
		for BG080 - BG112										J					
		for BG132										K					
		for BG160 - BG180										L					
Application area	Default parameter setting: Region EU (50-Hz networks)												0				
	Default parameter setting: Region US (60-Hz networks)												1				
Additional functions	Without additional functions													0			
	Logic PLC & Table positioning													P			
Control connections	Standard-I/O														0		
	Application-I/O														1		
Network	EtherCAT															K	
	PROFINET															L	
	EtherNet/IP															M	
	Modbus TCP															W	

Information on EC-Dual-Use Regulation

By limiting the maximum output frequency to ± 599 Hz, the devices are not subject to the export restrictions of the EU Dual-Use Regulation 2021/821.

Ways of commissioning

The inverter can be commissioned quickly and easily via the "EASY Starter" engineering tool.

Thanks to Lenze’s engineering philosophy, the high functionality is still easy to grasp. Parameterization and commissioning are impressive thanks to clear structure and simple dialogs, leading to the desired outcome quickly and reliably.

Connect your engineering PC on which the software is installed to the diagnostic interface. This requires a USB cable with a USB-C plug.

Safety instructions

Basic safety instructions

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

- Only use the product as directed.
- Never commission the product in the event of visible damage.
- Never modify the product technically.
- Never commission the product before assembly has been completed.
- Never operate the product without the required covers.
- Connect/disconnect all pluggable connections only in deenergized condition!
- Only remove the product from the installation in the deenergized state.
- The product can – depending on their degree of protection – have live, movable or rotating parts during or after operation. Surfaces can be hot.
- Observe the specifications of the corresponding documentation. This is the condition for safe and trouble-free operation and the achievement of the specified product features.
- The procedural notes and circuit details given in the associated documentation are suggestions and their transferability to the respective application has to be checked. The manufacturer of the product does not take responsibility for the suitability of the process and circuit proposals.
- All work with and on the product may only be carried out by qualified personnel.
  IEC 60364 and CENELEC HD 384 define the qualifications of these persons:
  - They are familiar with installing, mounting, commissioning, and operating the product.
  - They have the corresponding qualifications for their work.
  - They know and can apply all regulations for the prevention of accidents, directives, and laws applicable at the place of use.

Please observe the specific safety information in the other sections!

Application as directed

- The product is a professional equipment intended for use by trades, specific professions or industry and not for sale to the general public. IEC 60050 [IEV 161-05-05]
- To prevent personal injury and damage to property, higher-level safety and protection systems must be used!
- All transport locks must be removed.
- The product may only be operated under the specified operating conditions and in the specified mounting positions.
- The product is exclusively suitable for installation in control cabinets and, depending on the protection class and design, for wall and motor mounting.
- The product must only be actuated with motors that are suitable for the operation with inverters.
- The product must not be operated in private areas, in potentially explosive atmospheres and in areas with harmful gases, oils, acids and radiation.

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.

Use of explosion-protected motors

Explosion-protected motors that are not designed for use with an inverter lose their approval if they are used for variable speed applications. Due to the many areas of liability that may arise when handling these applications, the following policy statement applies:

Lenze inverters are sold without warranty of suitability for use with explosion-protected motors. Lenze assumes no responsibility for direct, incidental or consequential damages, costs or losses that may result from the use of AC inverters with explosion-protected motors. Buyer expressly agrees to assume any risk of loss, expense or damage that may result from such application.

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.

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.

Protection in the event of short circuit or earth fault

To ensure protection according to EN 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 meet the requirements of the IEC 60364.
- 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 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 is permitted for three-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 [UKCA: S.I. 2008/1597] . The notes on the integrated functional safety provided in this documentation must be observed.

The user is not allowed to change inverters that come with integrated functional safety. In the event of a defect, the inverter must be replaced.

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!

Degree of protection - protection of persons and device protection

- Information applies to the mounted and ready-for-use state.

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 20 minutes.
- The power terminals X100 and X105 remain live even when the motor is stopped.

Device protection

- The maximum test voltage for insulation tests between a control potential of 48 V and PE must not exceed 110 V DC (EN 61800-5-1).

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.

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°).

Information on project planning

Project planning process

Dimensioning

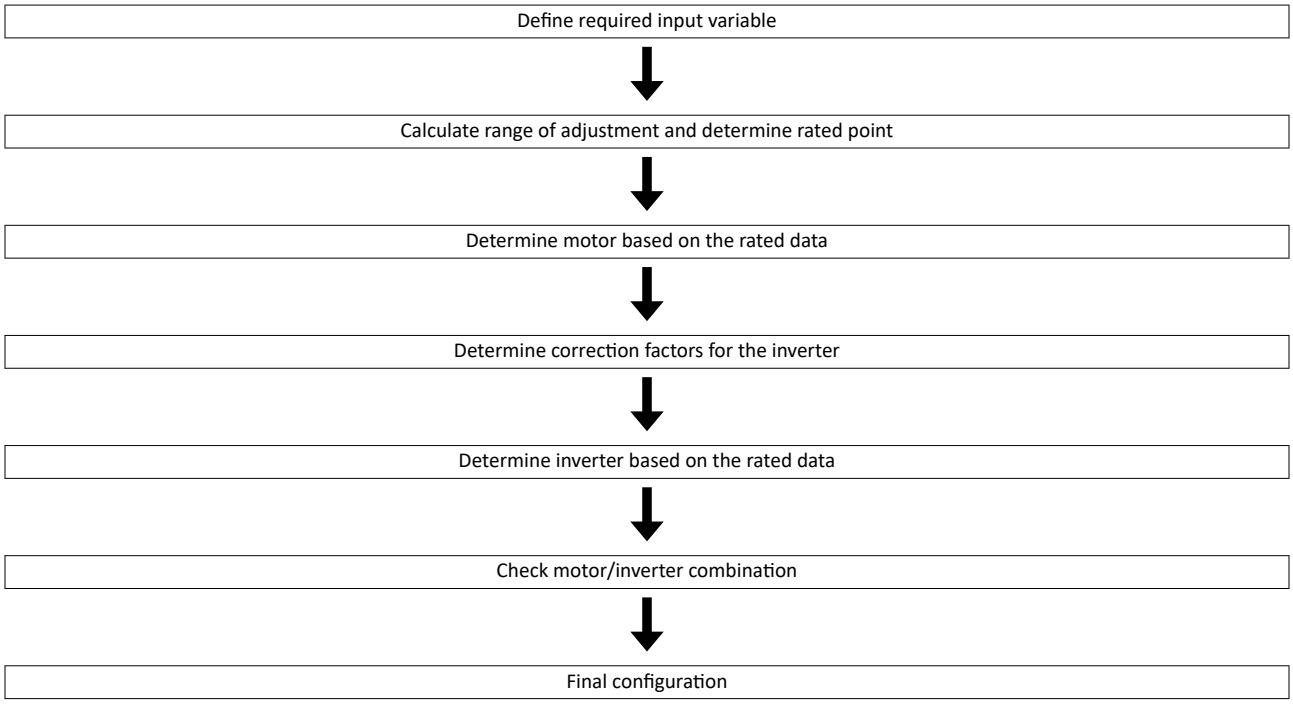
3 methods for dimensioning

Fast: Selection of the inverter based on the motor data of a 4-pole asynchronous motor.

Detailed: In order to optimize the selection of the inverter and all drive components, it is worthwhile to execute the detailed system dimensioning based on the physical requirements of the application. For this purpose, Lenze provides the Drive Solution Designer (DSD) design program.

Manual: The following chapter guides you step by step through the selection of a drive system.

Workflow of a configuration process



Define required input variables

Operating mode			S1 or S6
Max. load torque	$M_{L,max}$	Nm	
Max. load speed	$n_{L,max}$	rpm	
Min. load speed	$n_{L,min}$	rpm	
Site altitude	H	m	
Ambient temperature (inverter)	T_U	°C	

Calculate range of adjustment and determine rated point

	Calculation
Setting range	$V = \frac{n_{L,max}}{n_{L,min}}$

	Setting range	Rated point
Motor with integral fan	≤ 2.50 (20 - 50 Hz) ≤ 4.35 (20 - 87Hz) ≤ 6 (20 - 120Hz)	50 Hz 87 Hz 120 Hz
Motor with blower	≤ 10.0 (5 - 50 Hz) ≤ 17.4 (5 - 87Hz) ≤ 24 (5 - 120Hz)	50 Hz 87 Hz 120 Hz
Motor with integral fan (reduced torque)		

Determine motor based on the rated data

			Check
Rated torque			
Operating mode S1	M_{rated}	Nm	$M_N \geq \frac{M_{L,max}}{T_{H,Mot} \times T_{U,Mot}}$
Operating mode S6	M_{rated}	Nm	$M_N \geq \frac{M_{L,max}}{2 \times T_{H,Mot} \times T_{U,Mot}}$
Rated speed	n_{rated}	rpm	$n_{rated} \geq n_{L,max}$ $\frac{n_n}{V} \leq n_{L,min}$

			Note
Rated torque	M_{rated}	Nm	→ Rated motor data
Rated speed	n_{rated}	rpm	
Rated point at		Hz	→ setting range
Power factor	cos ϕ		→ Rated motor data
Rated current	$I_{N,MOT}$	A	
Rated power	P_{rated}	kW	
Correction factor - site altitude	$T_{H,MOT}$		→ Technical motor data
Correction factor - ambient temperature	$T_{U,MOT}$		
Select motor			

Keep in mind when sizing the motor: The maximum possible output voltage of the inverter is approx. 87 % of the mains voltage.

Correction factors for the inverter

Site altitude amsl		H				
	[m]	≤ 1000	≤ 2000	≤ 3000	≤ 4000
$k_{H,INV}$		1.00	0.95	0.90	0.85

Temperature in the control cabinet		T_U				
		[°C]	≤ 40	≤ 45	≤ 50	≤ 60
Switching frequency						
8, 12 or 16 kHz	$k_{TU,INV}$		1.00	0.875	0.750	0.50

Determine the inverter based on the rated data

			Check
Output current			
Continuous operation	I_{out}	A	$I_{out} \geq I_{N,Mot} / (k_{H,INV} \times k_{TU,INV})$
Overcurrent operation cycle 15 s	I_{out}	A	$I_{out} \geq I_{N,Mot} \times 2 / (k_{H,INV} \times k_{TU,INV})$
Overcurrent operation cycle 180 s	I_{out}	A	$I_{out} \geq I_{N,Mot} \times 1.5 / (k_{H,INV} \times k_{TU,INV})$

Check motor/inverter combination

			Calculation
Motor torque	M	Nm	$M = \sqrt{\left(\frac{I_{out,INV}}{I_{N,MOT}}\right)^2 - \left(1 - \cos\varphi^2\right)} \times \frac{M_N}{\cos\varphi}$

		Check
Inverter overload capacity		$\frac{M_{L,max}}{M} \leq 1.5$

Final configuration

Product extensions and accessories can be found here:

- Product extensions 📖 140
- Accessories 📖 173

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 excess energy is fed back into the mains.

Integrated regenerative module

The inverter has an intelligent, integrated regenerative module that enables braking energy to be fed back into the mains. This function is always active and does not need to be parameterized.

The regenerative module integrated in the inverter offers important advantages:

- Braking energy can be used despite decentralized topology.
- Dimensioning and installation of a brake resistor is not required.
- Rated power specifications including overload behavior also apply to regenerative mode with a few exceptions (see table below). The possible braking power can be increased without additional costs (compared to the concept with brake resistor). This enables:
  - Larger, regenerative power peaks
  - Shortening braking processes
  - Shorter consecutive braking processes
- The device structure is such that the system perturbations (harmonic currents) during motor and generator operation is below that of conventional industrial inverters and the increased requirements for operation on public networks are met. See also chapter "Technical data" on "Operation on public networks". 📖 72

In principle, the inverter can be operated on all standard industrial and public networks. The occasional energy recovery into the mains in generator operation is also permitted in principle.

There are a few exceptions in which an individual assessment must be made and tests carried out if necessary:

- The mains has an Rsce value < 250. See also chapter "Technical data" on "Operation on public networks". 📖 72
- The inverter is operated on a mains transformer or generator with low rated power.
- The inverter is operated on a 3-phase-phase UPS system.
  - The UPS system must generate a sinusoidal voltage.
  - The regenerative energy must be consumed in the UPS network.

- In motor operation, the usual short phase interruptions are not a problem. In regenerative operation, even short phase interruptions lead to a fault state of the inverter. This causes the motor to freewheel.
- A single-phase feed-in is not possible.

Deviating power specifications in regenerative operation

Rated power [kW]	Rated mains voltage	Regenerative power [%]
7.5	3 AC 230/240 V	90
15	3 AC 230/240 V	80
18.5	3 AC 230/240 V	80
22	3 AC 230/240 V	75
15	3 AC 400/480 V	90
30	3 AC 400/480 V	80
37	3 AC 400/480 V	80
45	3 AC 400/480 V	75

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

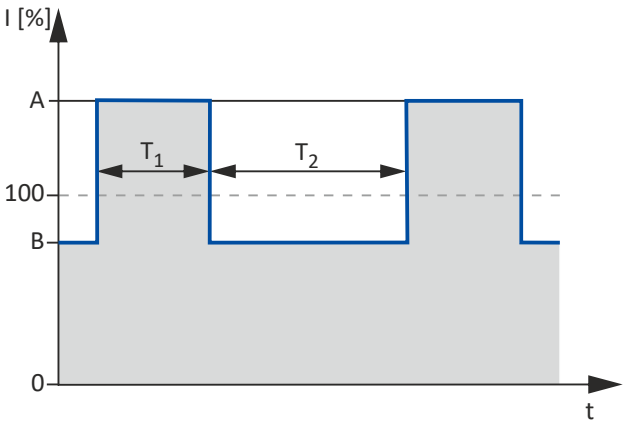
During this operation, the inverter may be loaded for 60 s with up to 150 % of the rated current if afterwards a recovery time of 120 s with max. 75 % of the rated current is observed. A cycle corresponds to 180 s.

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.



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

For the inverters

- i□□□-M18/230-3,
- i□□□-M22/230-3,
- i□□□-M37/400-3 and
- i□□□-M45/400-3

the following overload cycles apply:

Cycle	Max. output current	Max. overload time	Max. output current during the recovery time	Min. recovery time
	A	T_1	B	T_2
s	%	s	%	s
15	166	3	62.5	12
180	125	60	62.5	120

Decentralized topologies

The frequency inverters i550/i650 motec support decentralized concepts for machines and electrical installation in particular.

Advantages

- Saves installation costs
  - Less expensive shielded motor cables, no EMC collective filters
  - Fewer circuit breakers, protection devices and mains cables
  - Fewer I/O gateways and cabling thanks to decentralized I/Os
  - Smaller control cabinet
- New solutions when less space is available
- Combination of functionally independent machine modules
- Less cooling units, higher efficiency

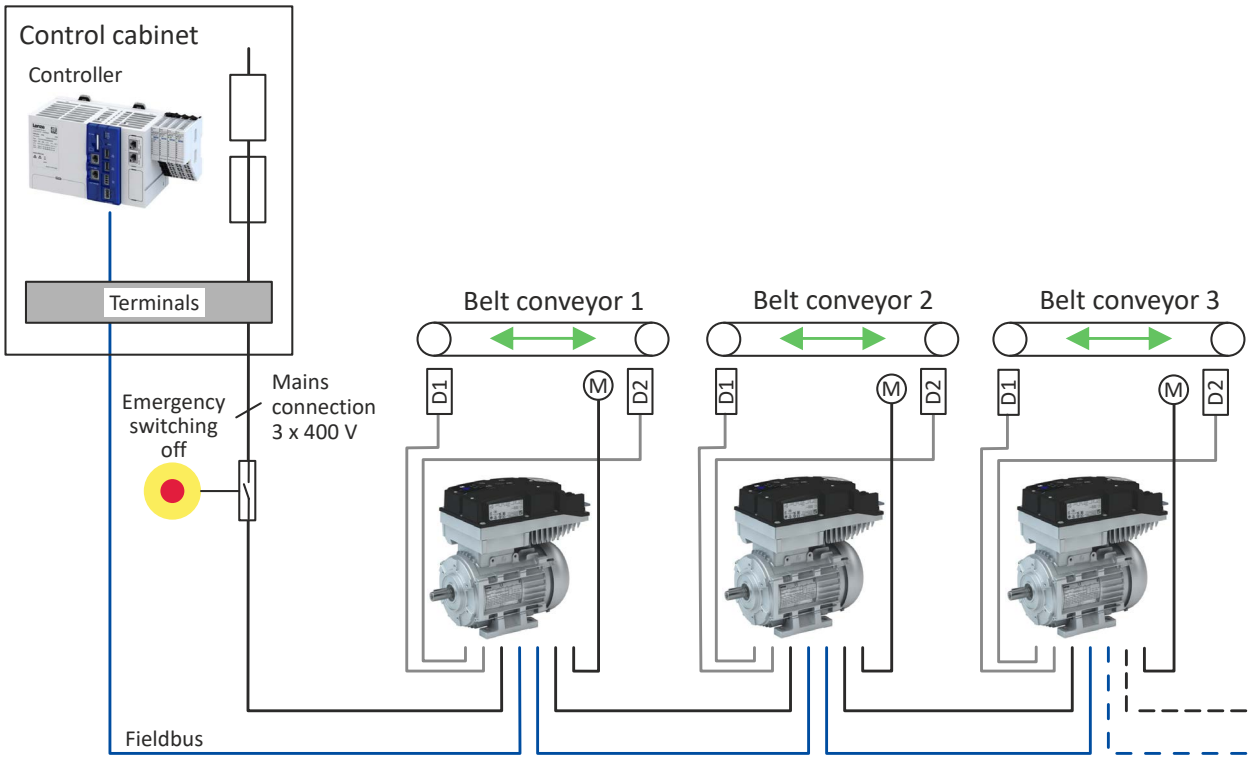


Fig. 4: Example setup

Extended by functional safety

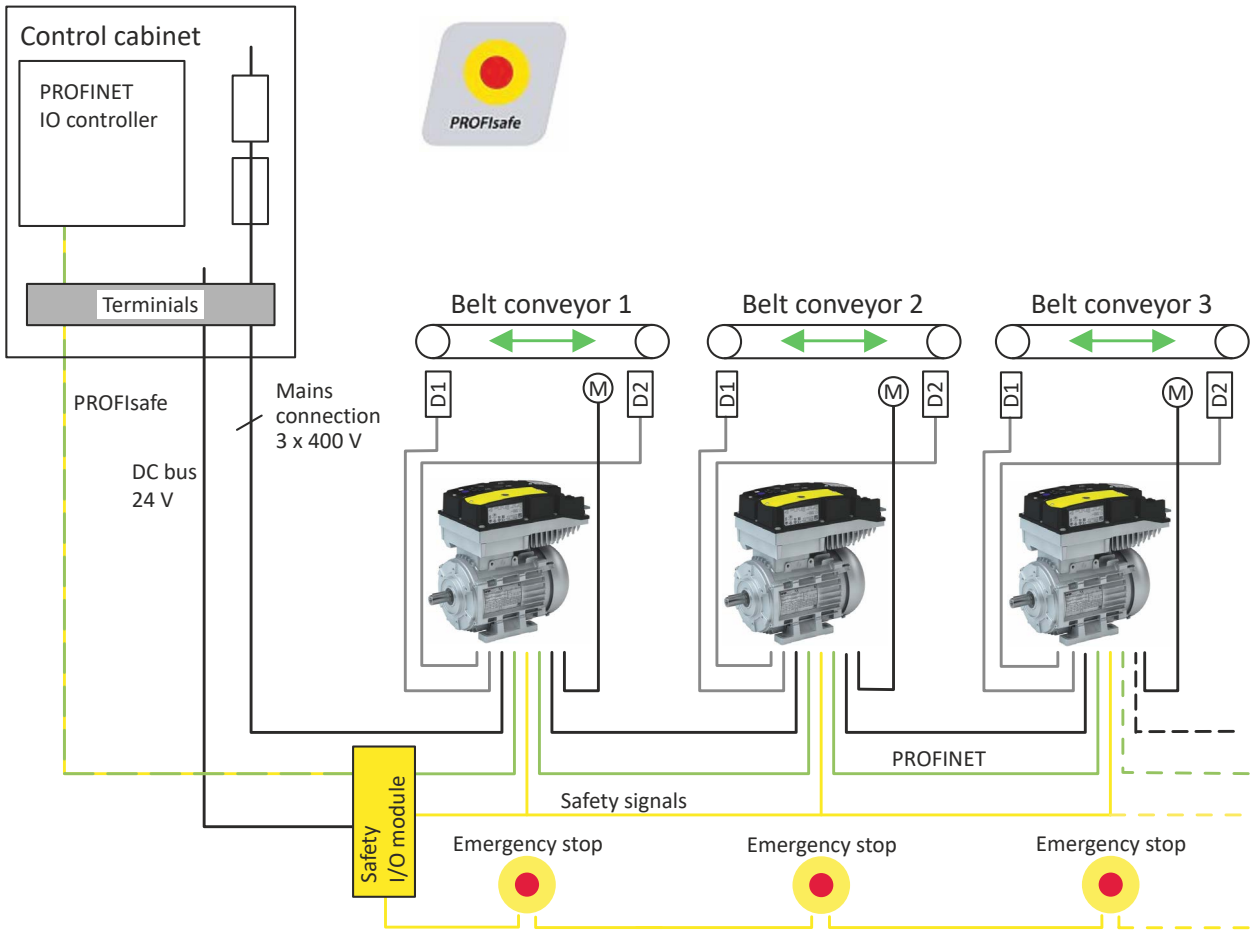


Fig. 5: Example setup with PROFIsafe solution

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.

See also chapter "Accessories": ▸ System cables 🕮 174

Mechanical installation

Important notes

⚠CAUTION!

Sharp edges or residual burrs

Possible consequences: Cut injuries

► Wear suitable protective gloves against mechanical risks during mounting (PPE category II in accordance with EN 388).

Measures for cooling during operation

- Ensure unimpeded ventilation of cooling air and outlet of exhaust air.

Preparation

Free spaces

- Maintain the specified free spaces to the other installations.

Mechanical fastening

- 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.

Mounting

Wall mounting

Inverters		Data for mounting the inverter to M25/M40 wall adapter		
Mains connection	Rated power	Tool	Screws	Tightening torque
3/PE AC 230/240 V	0.37 ... 3 kW	Torx key 25	4x M5	2.5 Nm
	4 ... 22 kW	Torx key 30	4x M6	8 Nm
3/PE AC 400/480 V	0.37 ... 5.5 kW	Torx key 25	4x M5	2.5 Nm
	7.5 ... 45 kW	Torx key 30	4x M6	8 Nm

How to mount the inverter with wall adapter on a mounting surface:

Required:

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

1. Prepare mounting area 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 area via keyhole suspension.
5. Only tighten the screws hand-tight.
6. Pre-assemble other devices if necessary.
   a) Adjust the devices.
   b) Screw the devices onto the mounting area.

The inverters are mounted on the mounting area. You can start wiring.

Note on floor mounting an inverter without fan:

If the inverter with wall adapter is mounted upright on the floor (i.e. the control connections are at the top), the rated output values must be reduced by approx. 15 %. Your Lenze contact will help you with a precise assessment.

Motor mounting

Torques for Lenze motors		
	Screws	Tightening torque
When using a Lenze motor, the following torques must be used to attach the motor adapter to the motor:	4x M4x16	3 Nm
	4x M5x16	5.9 Nm
	4x M6x20	7.5 Nm

Inverters		Data for mounting the inverter on the motor adapter		
Mains connection	Rated power	Tool	Screws	Tightening torque
3/PE AC 230/240 V	0.37 ... 3 kW	Torx key 25	4x M5	2.5 Nm
	4 ... 22 kW	Torx key 30	4x M6	8 Nm
3/PE AC 400/480 V	0.37 ... 5.5 kW	Torx key 25	4x M5	2.5 Nm
	7.5 ... 45 kW	Torx key 30	4x M6	8 Nm

How to mount the inverter with motor adapter on the motor:

Required:

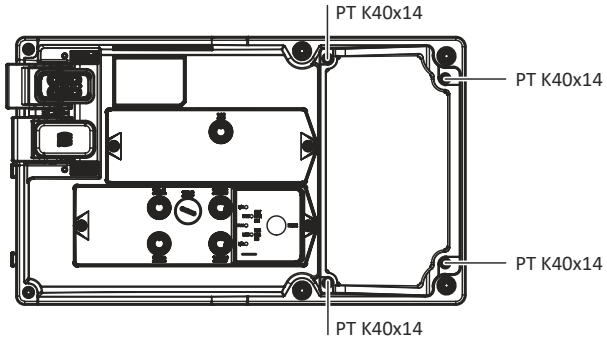
- Screwdriver

1. Dismount motor terminal box. ▸ Video tutorials 📖 46
2. Mount motor adapter.
3. Wire the motor terminal block and, if necessary, the PTC and holding brake to the terminal strip of the inverter.
4. Mount inverter to motor adapter.

The inverter is mounted on the motor. You can start wiring.

Open and close the cover screw connection

For the wiring, loosen the 4 or 6 screws in the cover with a Torx key. After completion, close the cover again with the 4 or 6 screws so that the degree of protection remains guaranteed.



Inverters		Data for cover screw connection		
Mains connection	**Rated power**	**Tool**	**Screws**	**Tightening torque**
3/PE AC 230/240 V	0.37 ... 3 kW	Without cover		
	4 ... 5.5 kW	Torx key 20	4x oval head screw PT K40x14	1.4 Nm
	7.5 ... 22 kW	Torx key 20	6x oval head screw PT K40x14	1.4 Nm
3/PE AC 400/480 V	0.37 ... 5.5 kW	Without cover		
	7.5 ... 11 kW	Torx key 20	4x oval head screw PT K40x14	1.4 Nm
	15 ... 45 kW	Torx key 20	6x oval head screw PT K40x14	1.4 Nm

Video tutorials

Mount Lenze i550 motec frequency inverter (e.g. 0.75 kW) on Lenze three-phase geared motor

The following video shows the installation of an i550 motec frequency inverter (0.75 kW) on a Lenze three-phase geared motor (BG 063 - 071) with terminal box.

https://www.youtube.com/watch?v=KwPP_7sIb9I&t=2s

NOTICE

Bridge arrangement for star or delta connection according to the requirements of the application.

Applicable for the following rated powers:

- 0.37 … 3 kW (3 AC 230/240 V)
- 0.37 … 5.5 kW (3 AC 400/480 V)

Electrical installation

Important notes

⚠ DANGER!

Dangerous electrical voltage

During operation and up to 20 minutes after power-off, hazardous electrical voltages may be present at the connections of the product.

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

Possible consequences: Death or serious injury from electric shock

Protective measures

- ► Any work on the product must only be carried out in a deenergized state.
- ► Check that no voltage is present!
- ► After switching off the mains voltage, observe the signs on the product.
- ► After switching off, wait until the drive comes to a standstill.
- ► Implement the measures required by EN 61800-5-1 or EN 60204-1, i.e. fixed installation and standard-compliant PE connection.

⚠ WARNING!

Dangerous electrical voltage

Error on device leads to overvoltage in the system.

- ► For auxiliary power supply with DC 20.5 ... 49.9 V only use a safely isolated power supply in accordance with the applicable 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 and no. of phases = 1 or 1/3

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

Mounting not according to protection class

Possible consequences: Material damage due to penetrating humidity and foreign bodies.

► All cable glands and mounting parts must at least correspond to the protection class of the inverter.

► All openings in the housing must be closed according to the protection class.

► Device screws must be tightened to the specified tightening torque.

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".

Automatic disconnection of the supply according to IEC/HD 60364-4-41

IEC/HD 60364-4-41 (DIN VDE 0100-410; VDE 0100-410) requires fault protection for the output circuits.

Preconditions

Installation in TN network and TT network

- The inverters are installed according to the specifications in the documentation.
- The system complies with the requirements of the applicable standards of the series IEC/HD 60364 (DIN VDE 0100; VDE 0100).
- The continuity of all associated PE conductors and equipotential bonding conductors is ensured including the bonding and connection points.
- Additional measures in the TT network:
  - Use of earth-leakage circuit breakers or the additional protective grounding according to IEC 60361-4-41, section 415.

Under these conditions, the inverters meet the protective measure "automatic disconnection of the supply" according to IEC/HD 60364-4-41
(DIN VDE 0100-410; VDE 0100-410):2007-06, section 411.3.2.5.

This means that in the event of a short circuit with negligible impedance to a protective conductor or to earth, the inverters reduce the output voltage within the time required in table 41.1 of IEC/HD 60364-4-41 (DIN VDE 0100-410; VDE 0100-410):2007-06.

Preparation

Further data and information

- EMC-compliant installation 📖 50
- Standards and operating conditions 📖 71

EMC-compliant installation

The drive system (inverter and drive) only complies with the directive 2014/30/EU: EMC Directive [UKCA: S.I. 2016/1091 - The Electromagnetic Compatibility Regulations 2016] 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.

NOTICE

Electromagnetic interferences

Product and peripheral devices may be affected during operation.

► Use integrated conductive shield connections for control lines and motor lines.

► Use central earthing points.

Mains connection

Inverters may only be connected to the mains via unshielded single cores or unshielded cables.

Connection according to UL

Important notes

⚠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.

⚠WARNING!

► **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) with Standard Fuses or Circuit Breaker

Standard Fault Short Circuit Current Ratings (SCCR)

(Tested per UL 61800-5-1, reference UL file E132659)

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

Inverter	Standard Fuses (UL 248)			Circuit Breaker (UL 489)	
	SCCR	Max. rated current	Class	SCCR	Max. rated current
	kA	A		kA	A
I□5AM137C	5	30	CC, CF, J, T	5	30
I□5AM155C	5	30	CC, CF, J, T	5	30
I□5AM175C	5	30	CC, CF, J, T	5	30
I□5AM211C	5	30	CC, CF, J, T	5	30
I□5AM215C	5	30	CC, CF, J, T	5	30
I□5AM222C	5	30	CC, CF, J, T	5	30
I□5AM230C	5	30	CC, CF, J, T	5	30
I□5AM240C	5	30	CC, CF, J, T	5	30
I□5AM255C	5	30	CC, CF, J, T	5	30
I□5AM275C	10	125	CF, J, T	10	100
I□5AM311C	10	125	CF, J, T	10	100
I□5AM315C	10	125	CF, J, T	10	100
I□5AM318C	10	125	CF, J, T	10	100
I□5AM322C	10	125	CF, J, T	10	100
I□5AM137F	5	30	CC, CF, J, T	5	30
I□5AM155F	5	30	CC, CF, J, T	5	30
I□5AM175F	5	30	CC, CF, J, T	5	30
I□5AM211F	5	30	CC, CF, J, T	5	30
I□5AM215F	5	30	CC, CF, J, T	5	30
I□5AM222F	5	30	CC, CF, J, T	5	30
I□5AM230F	5	30	CC, CF, J, T	5	30
I□5AM240F	5	30	CC, CF, J, T	5	30
I□5AM255F	5	30	CC, CF, J, T	5	30
I□5AM275F	5	30	CC, CF, J, T	5	30
I□5AM311F	5	30	CC, CF, J, T	5	30
I□5AM315F	10	125	CF, J, T	10	100
I□5AM318F	10	125	CF, J, T	10	100
I□5AM322F	10	125	CF, J, T	10	100
I□5AM330F	10	125	CF, J, T	10	100
I□5AM337F	10	125	CF, J, T	10	100
I□5AM345F	10	125	CF, J, T	10	100

High Fault Short Circuit Current Ratings (SCCR)

(Tested per UL 61800-5-1, reference UL file E132659)

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

Inverter	Standard Fuses (UL 248)			Circuit Breaker (UL 489)	
	SCCR	Max. rated current	Class	SCCR	Max. rated current
	kA	A		kA	A
I□5AM137C	65	30	CC, CF, J, T	42	20
I□5AM155C	65	30	CC, CF, J, T	42	20
I□5AM175C	65	30	CC, CF, J, T	42	20
I□5AM211C	65	30	CC, CF, J, T	42	20
I□5AM215C	65	30	CC, CF, J, T	42	20
I□5AM222C	65	30	CC, CF, J, T	42	20
I□5AM230C	65	30	CC, CF, J, T	42	20
I□5AM240C	65	30	CC, CF, J, T	65	30
I□5AM255C	65	30	CC, CF, J, T	65	30
I□5AM275C	65	125	CF, J, T	65	100
I□5AM311C	65	125	CF, J, T	65	100
I□5AM315C	65	125	CF, J, T	65	100
I□5AM318C	65	125	CF, J, T	65	100
I□5AM322C	65	125	CF, J, T	65	100
I□5AM137F	65	30	CC, CF, J, T	42	20
I□5AM155F	65	30	CC, CF, J, T	42	20
I□5AM175F	65	30	CC, CF, J, T	42	20
I□5AM211F	65	30	CC, CF, J, T	42	20
I□5AM215F	65	30	CC, CF, J, T	42	20
I□5AM222F	65	30	CC, CF, J, T	42	20
I□5AM230F	65	30	CC, CF, J, T	42	20
I□5AM240F	65	30	CC, CF, J, T	42	20
I□5AM255F	65	30	CC, CF, J, T	42	20
I□5AM275F	65	30	CC, CF, J, T	65	30
I□5AM311F	65	30	CC, CF, J, T	65	30
I□5AM315F	65	125	CF, J, T	65	100
I□5AM318F	65	125	CF, J, T	65	100
I□5AM322F	65	125	CF, J, T	65	100
I□5AM330F	65	125	CF, J, T	65	100
I□5AM337F	65	125	CF, J, T	65	100
I□5AM345F	65	125	CF, J, T	65	100

Branch Circuit Protection (BCP) with Semiconductor Fuses

High Fault Short Circuit Current Ratings (SCCR)

(Tested per UL 61800-5-1, reference UL file E132659)

These devices are suitable for single motor installation when used with Semiconductor Fuses.

Inverter	Semiconductor Fuses	
	SCCR	Max. rated current
	kA	A
I□5AM137C	65	30
I□5AM155C	65	30
I□5AM175C	65	30
I□5AM211C	65	30
I□5AM215C	65	30
I□5AM222C	65	30
I□5AM230C	65	30
I□5AM240C	65	30
I□5AM255C	65	30
I□5AM275C	65	125
I□5AM311C	65	125
I□5AM315C	65	125
I□5AM318C	65	125
I□5AM322C	65	125
I□5AM137F	65	30
I□5AM155F	65	30
I□5AM175F	65	30
I□5AM211F	65	30
I□5AM215F	65	30
I□5AM222F	65	30
I□5AM230F	65	30
I□5AM240F	65	30
I□5AM255F	65	30
I□5AM275F	65	30
I□5AM311F	65	30
I□5AM315F	65	125
I□5AM318F	65	125
I□5AM322F	65	125
I□5AM330F	65	125
I□5AM337F	65	125
I□5AM345F	65	125

Approved Manufacturers for Semiconductor Fuses

Manufacturer	Max. rated current	Designation
	A	
Eaton / Cooper Bussmann	30	FWP-30A14F
	125	FWP-125A

Branch Circuit Protection (BCP) with Type E Combination Motor Controller

High Fault Short Circuit Current Ratings (SCCR)

(Tested per UL 61800-5-1, reference UL file E132659)

These devices are suitable for single motor installation when used with a Type E Combination Motor Controller.

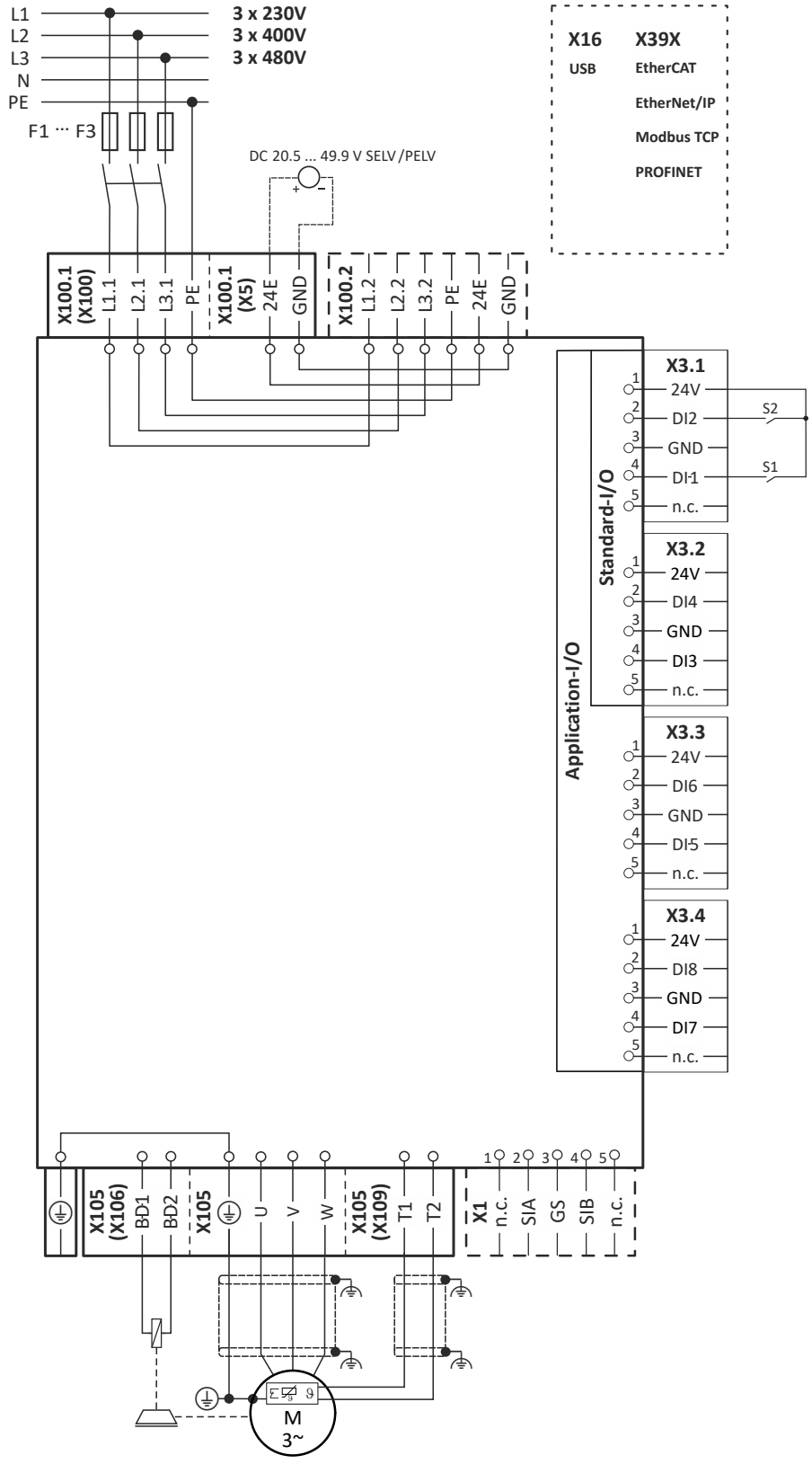
Inverter	Type E Combination Motor Controller	
	SCCR	Max. rated current
	kA	A
I□5AM137C	30	16
I□5AM155C	30	16
I□5AM175C	30	16
I□5AM211C	30	16
I□5AM215C	30	16
I□5AM222C	30	16
I□5AM230C	30	16
I□5AM240C	30	32
I□5AM255C	30	32
I□5AM137F	30	16
I□5AM155F	30	16
I□5AM175F	30	16
I□5AM211F	30	16
I□5AM215F	30	16
I□5AM222F	30	16
I□5AM230F	30	16
I□5AM240F	30	16
I□5AM255F	30	16
I□5AM275F	30	32
I□5AM311F	30	32

Approved Manufacturers for Type E Combination Motor Controller

Manufacturer	Max. rated current	Designation
	A	
ABB	16	MS132-16
	32	MS132-32

Mains connection

The inverters are connected directly to the AC mains. RFI filters are already integrated in all inverters.



For the mains connection, the inverter is equipped with Han-Q4/2 connectors or with terminals for a cable gland, depending on the version.

Connection data

See chapter "Technical data":

- 3-phase mains connection 230/240 V ▸ Connection data 80
- 3-phase mains connection 400 V ▸ Connection data 90
- 3-phase mains connection 480 V ▸ Connection data 100

Mains cables

Mains cables with Han-Q4/2 connectors are available for the inverter as 4-pole cables (mains connection) or 6-pin cables (mains connection and 24 V supply) in the following versions:

- Connecting cable for mains/inverter connection
- Extension for the inverter/inverter connection

For more information on mains cables and other accessories, refer to the "Accessories for frequency and servo inverters" brochure.

Mains installation with several devices

Several inverters in close proximity can be connected to the mains using the integrated Han-Q4/2 connectors. The mains cables are looped through from one inverter to the next via the Han-Q4/2 connector.

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

For the motor connection, the inverter is equipped with a Han Q8 connector, an M23/M40 connector, or terminals for use with a cable gland (M25/M40), depending on the version.

Connection data

See chapter "Technical data":

- 3-phase mains connection 230/240 V ▸ Connection data 🕮 80
- 3-phase mains connection 400 V ▸ Connection data 🕮 90
- 3-phase mains connection 480 V ▸ Connection data 🕮 100

Motor cables

Ready-made motor cables in various designs are available for the inverter. For more information on motor cables and other accessories, refer to the "Accessories for frequency and servo inverters" brochure.

Switching in the motor cable

Some applications require switching on the motor side of the inverter. Switching on the motor side of the inverter is permitted if you observe the following basic conditions.

Preconditions:

- The switching elements on the motor side must be dimensioned for with the maximum occurring loads.
- Connect the shield of the motor cable to the mounting plate immediately before and after the switching element in an EMC-compliant manner.

Possible applications:

- Galvanic isolation of the motor from the inverter
  - A controller must ensure that the switching element in the motor cable does not switch until the inverter is inhibited.
- Operation of several motors on one inverter in V/f characteristic control mode
  - Monitoring functions of the inverter for motor protection (e.g. i^2xt) cannot be used.
  - Ensure temperature monitoring of all motors by external measures.
  - Disable the inverter when overload protection and cable protection in the individual motor cables respond. Do not disconnect the motor circuit.

Please note the following:

- If switching is performed on the motor side when the inverter is enabled, error messages can be triggered.
- It is not possible to predict whether an error message will be triggered or not. This can only be determined by testing under real operating conditions.
- Error messages to be expected:
  - Overcurrent
  - Motor phase failure

Connection of motor temperature monitoring

The inverter offers extensive protection against overload through the use of an overcurrent relay or temperature monitoring. We recommend using a PTC thermistor or thermal contact to monitor the temperature of the motor. We also recommend using the "Motor overload monitoring (i^2xt)" function to monitor the motor.

In the Lenze setting, the motor temperature monitoring is activated!

If the terminals T1 and T2 are used, e.g. to connect an external PTC thermistor or a thermal contact, ensure at least one basic insulation to the potentials of motor, mains, and M12 connectors as well as to the auxiliary power supply to not restrict the safe isolation of the M12 connectors.

Connection	Connections T1 and T2
Use	Connection of PTC or thermal contact
Sensor types	PTC single sensor (DIN 44081) PTC triple sensor (DIN 44082) Thermal contact
	Note: The PT1000 temperature sensor is not supported.

Depending on the version, the connections T1 and T2 are located at connector X105 or at terminal X105/X109.

Connection data

See chapter "Technical data":

- 3-phase mains connection 230/240 V ▸ Connection data 80
- 3-phase mains connection 400 V ▸ Connection data 90
- 3-phase mains connection 480 V ▸ Connection data 100

Motor holding brake connection

An electromagnetically released spring-applied brake can be connected to the inverter at terminals BD1 and BD2 as a motor holding brake.

- The voltage for controlling the motor holding brake is generated in the inverter independently of the height of the mains voltage.
- Safe release of the motor holding brake is ensured by applying 133 % of the nominal coil voltage to the coil for 0.5 s. The coil is then released. This is then reduced to 66% of the nominal coil voltage.

Motor holding brakes with the following technical data can be connected to the inverter:

Inverter		Motor holding brake	
Mains connection	**Rated power**	**Rated coil voltage**	**Max. Rated power**
3/PE AC 230/240 V	0.37 … 22 kW	104 V DC 180 V DC 205 V DC	80 W
3/PE AC 400/480 V	0.37 … 45 kW	180 V DC 205 V DC 215 V DC	80 W

Depending on the version, the connections BD1 and BD2 are located at connector X105 or at terminal X105/X106.

When the motor adapter is used, the connection is made via an M12 cable gland.

Connection data

See chapter "Technical data":

- 3-phase mains connection 230/240 V ▸ Connection data 80
- 3-phase mains connection 400 V ▸ Connection data 90
- 3-phase mains connection 480 V ▸ Connection data 100

Supply voltage connection

The connections 24E and GND are used for the mains-independent DC supply of the control electronics (incl. communication). The connections 24E and GND are located on the mains connection X100.1/X100.2 or on terminal X5, depending on the version.

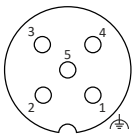
Control connections

The control connections of the inverter are designed as configurable connectors. By default, all control connections are configured as digital inputs.

Details on configuring the function assignment can be found in the commissioning document.

Standard I/O

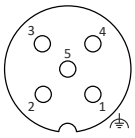
Connection designation			X3.1						X3.2					
Pin			1	2	3	4	5	Funktionserde	1	2	3	4	5	Funktionserde
Pin name			24V	DI2	GND	DI1	n.c.	Functional earth	24V	DI4	GND	DI3	n.c.	Functional earth

M12 (A coded)


Application I/O

Connection designation			X3.1						X3.2					
Pin			1	2	3	4	5	Funktionserde	1	2	3	4	5	Funktionserde
Pin name			24V	DI2	GND	DI1	n.c.	Functional earth	24V	DI4	GND	DI3	n.c.	Functional earth

Connection designation			X3.3						X3.4					
Pin			1	2	3	4	5	Funktionserde	1	2	3	4	5	Funktionserde
Pin name			24V	DI6	GND	DI5	n.c.	Functional earth	24V	DI8	GND	DI7	n.c.	Functional earth

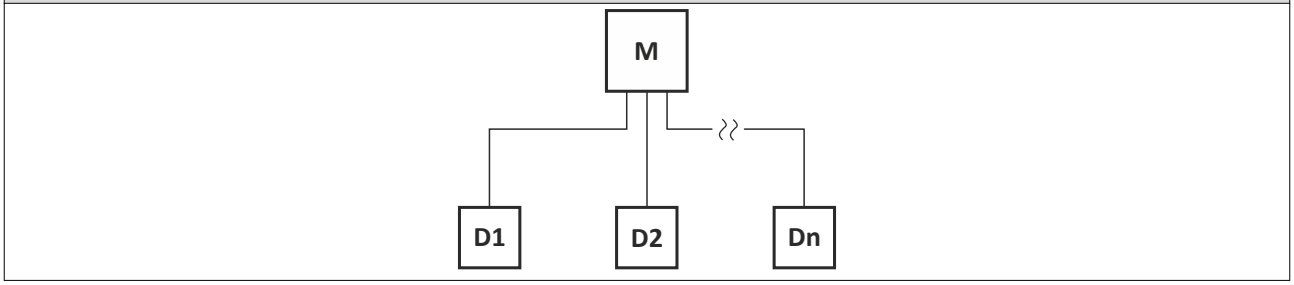
M12 (A coded)


IO-Link

The inverter provides four IO-Link master ports via the application I/O. One IO-Link device can be connected to each port (point-to-point communication).

Typical topologies

Tree



M Master D Device

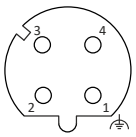
Networks

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-resistance 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 M12 connectors (D coded). Additional shield connections are not required.
- Cables must comply with CAT5 and be suitable for ≥ 10 Mbps.
- Only certified, tested and prefabricated cables with M12 connectors 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.

Connection designation			X396					X397				
Pin			1	2	3	4	Functional earth	1	2	3	4	Functional earth
Pin name			TX+0	RX+0	TX-0	RX-0	Functional earth	TX+0	RX+0	TX-0	RX-0	Functional earth

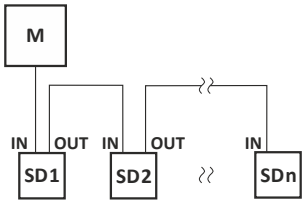
M12 (D coded)



EtherCAT

Typical topologies

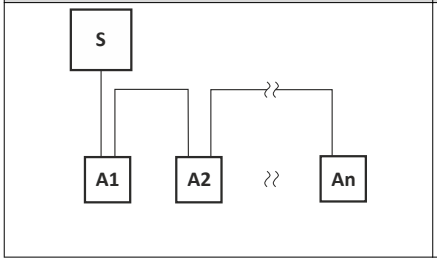
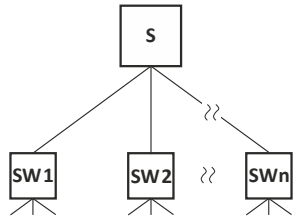
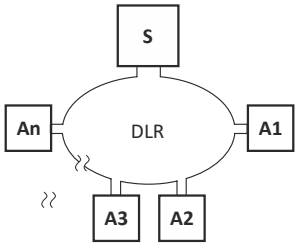
Line



M Master
SD Slave Device

EtherNet/IP

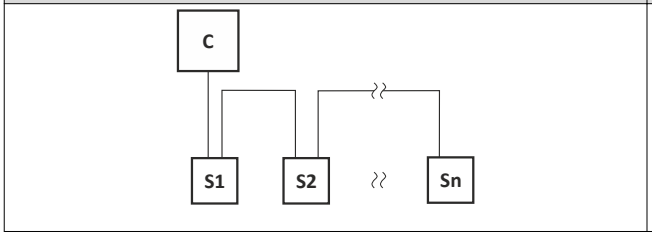
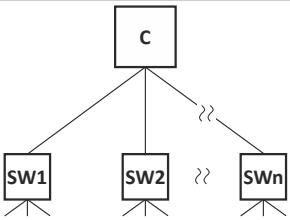
Typical topologies

Line	Tree	Ring
		

S Scanner
A Adapter
SW Switch

Modbus TCP

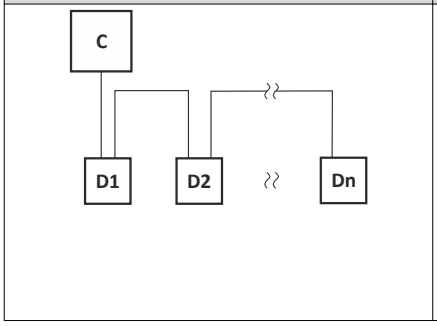
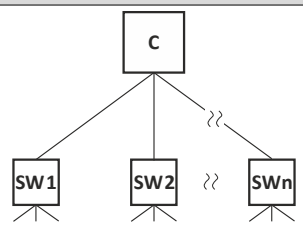
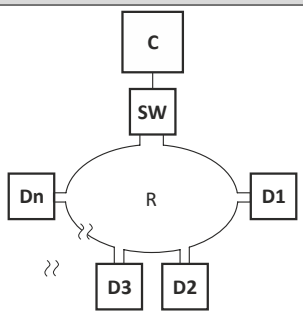
Typical topologies

Line	Tree
	

C Client
S Server
SW Switch

PROFINET

Typical topologies

Line	Tree	Ring
		

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

Functional safety

⚠ DANGER!

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

Possible consequences: Death or severe injuries

- ► Safety components 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 inverters, controllers and other safety components 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

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 variants I55AM□□□□□**A** and I65AM□□□□□**A**.

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.

⚠ DANGER!

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

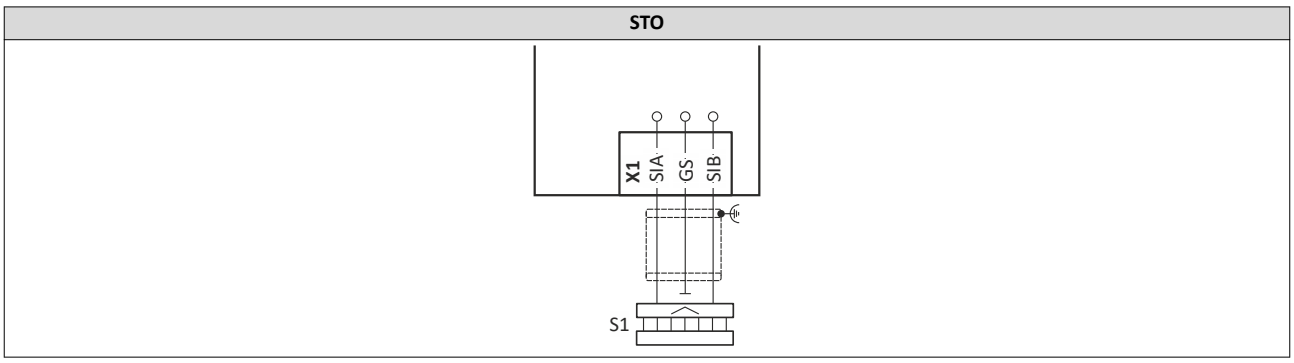
Possible consequences: Death or severe injuries

► "Emergency switching off" requires electrical isolation, e. g. by a central mains contactor.

Connection diagram

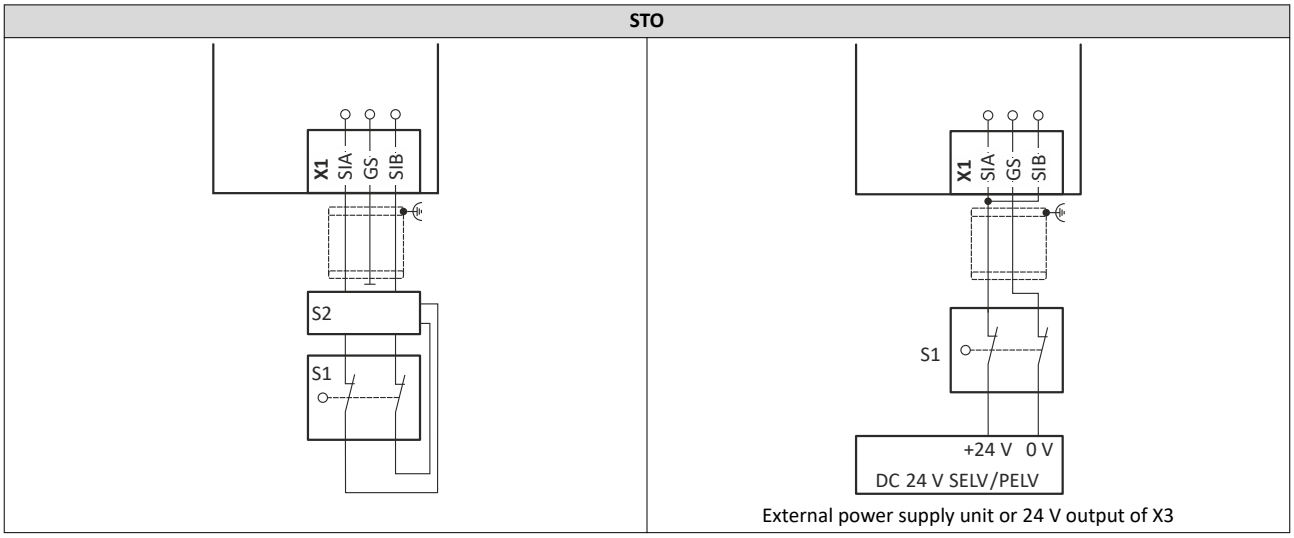
The connection diagrams shown are only example circuits. The user is responsible for the correct safety-related design and selection of the components!

Active sensors



S1 Active sensor - example of lightgrid

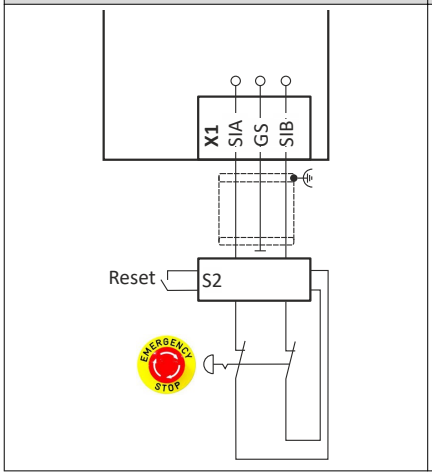
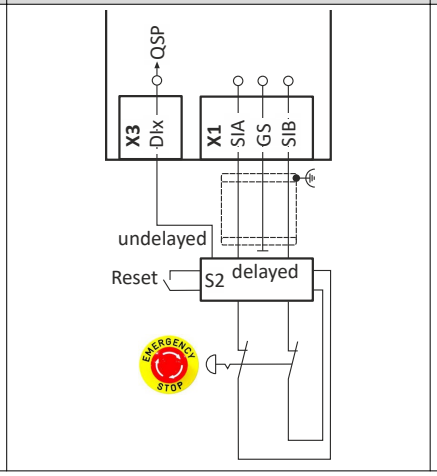
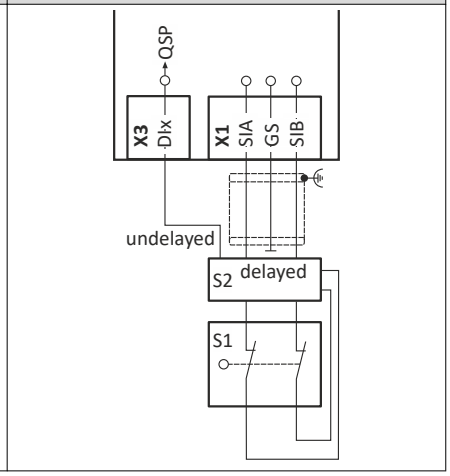
Passive sensors



S1 Passive sensor
S2 Safety switching device

S1 Passive sensor

Passive sensors - further examples

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

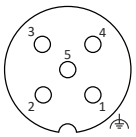
S2 Safety switching device

S2 Safety switching device with delayed contacts
QSP "Quick stop" function

S1 Passive sensor
S2 Safety switching device with delayed contacts
QSP "Quick stop" function

Connection data

Connection designation			X1					
Pin			1	2	3	4	5	Funktionserde
Pin name			n.c.	SIA	GS	SIB	n.c.	Functional earth

M12 (A coded)


Connection			STO
Connection designation			**X1**
Max. cable cross-section		mm²	0.34
Max. cable cross-section		AWG	22
Min. cable cross-section		mm²	0.34
Min. cable cross-section		AWG	22

X1	Specification	Unit	min.	typ.	max.
SIA, SIB	LOW signal	V	-3	0	+5
	HIGH signal	V	+15	+24	+30
	Switch-on time	ms		3	
	Clear time	ms		50	60
	Input current SIA	mA		10	14
	Input current SIB	mA		7	12
	Input peak current	mA		100	
	Test pulse duration	ms			1
	Test pulse interval	ms	10		
GS	Reference potential for SIA and SIB				

- Maximum cable length: 100 m
- From 30 m cable length, a shielded version is required!

Extended Safety

"Extended Safety - S" is part of the product variant I65AM□□□□□**E**.

The "Extended Safety - S" version has no safe inputs for controlling the safety functions.

The safety functions are controlled exclusively via the safety bus.

▸ Safe network interfaces 🕮 155

▸ Safety functions 🕮 159

Technical data

Standards and operating conditions

Conformities and approvals

Conformities			
CE	2006/42/EC		Machinery Directive only relevant for safety components
	2009/125/EC		Ecodesign Directive
	2011/65/EU		RoHS Directive
	2014/30/EU		EMC Directive
	2014/35/EU		Low-Voltage Directive
UKCA	S.I. 2008/1597		The Supply of Machinery (Safety) Regulations 2008
	S.I. 2012/3032		The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012
	S.I. 2016/1091		The Electromagnetic Compatibility Regulations 2016
	S.I. 2021/745		The Ecodesign for Energy-Related Products and Energy Information Regulations 2021
Approvals			
cULus	UL 61800-5-1		File No. E132659
			For USA and Canada

Declarations of conformity, certificates and approvals can be found on the Internet:

www.Lenze.com → Products → Inverters → Frequency inverters
→ i550 motec frequency inverter
→ i650 motec frequency inverter

(Section "Product support")

Protection of persons and device protection

Degree of protection			Information applies to the mounted and ready-for-use state.
EN	EN IEC 60529	IP54	Extension box with disconnect switch with overload / short-circuit protection
			Extension box with disconnect switch and operating elements
		IP66	Extension box with disconnect switch
			Inverter without extension box
UL	UL 50E	Type 12 / 12K	Extension box with disconnect switch with overload / short-circuit protection
			Extension box with disconnect switch and operating elements
			UL 50E Type 12 / 12K comparable to NEMA 12 / 12K
		Type 4X indoor	Extension box with disconnect switch
			Housing parts UV-resistant (f1 rating)
			UL 50E Type 4X comparable to NEMA 4X
			Inverter without extension box
Protection against electric shock			
Isolation of control circuits	EN IEC 61800-5-1	Safe mains isolation	Double/reinforced insulation
Overvoltage category	UL 61800-5-1	II	>2000 m amsl
		III	0 … 2000 m amsl
Degree of pollution		2	
Leakage current			
AC	EN IEC 61800-5-1	> 3.5 mA	Observe regulations and safety instructions!
DC		> 10 mA	
Starting current			
		≤ 3 x rated mains current	
Protective measures			
Earth fault strength			Earth-fault protected depending on operating status
Motor stalling protection			
Short-circuit strength			
Overvoltage resistance			
Motor overtemperature			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	EN IEC 61000-3-2	No additional measures	
> 1 kW, mains current ≤ 16 A			
Mains current > 16 A ... ≤ 75 A	EN IEC 61000-3-12		When designed for rated power.
Rsce		≥ 250	Rsce: Short circuit power ratio at the connection point between the machine/system and the public network
Noise emission			
Category C1	EN IEC 61800-3		see rated data
Category C2			
Category C3			
Noise immunity			
	EN IEC 61800-3	Requirements fulfilled	

Motor connection

Requirements for the shielded motor cable			
Capacitance per unit length		< 150/300 pF/m	≥ 4 mm² / AWG 12
		< 75/150 pF/m	≤ 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			
Efficiency level	EN IEC 61800-9-2	Energy efficiency class IE2	according to REGULATION (EU) 2019/1781
Climate			
Storage	EN 60721-3-1:1997	1K3 (-30 ... +60°C)	
Transport	EN 60721-3-2:1997	2K3 (-30 ... +70 °C)	
Operation	EN 60721-3-3:1995 + A2:1997	3S3	For mechanically active substances
		3K3 (-30 ... +60 °C)	Operation at a switching frequency of 4, 8, 12 or 16 kHz: Above +40°C: reduce rated output current by 2.5 %/°C
		3C3	For chemically active substances
Site altitude			
0 … 1000 m amsl			Without current derating
1000 … 4000 m amsl			Reduce rated output current by 5 %/1000 m
Vibration resistance			
Transport	EN 60721-3-2:1998	2M2 (sine, shock)	In original packaging
		Amplitude 3.5 mm	2 ... 9 Hz
		Acceleration resistant up to 1 g	9 ... 200 Hz
		Acceleration resistant up to 1.5 g	200 ... 500 Hz
		Type 2	Peak acceleration value 30 g
Operation	DNV-CG-0339	Amplitude 1 mm	5 ... 13.2 Hz
		Acceleration resistant up to 0.7 g	13.2 ... 100 Hz
	EN 60721-3-3:1995 + A2:1997	3M6 (sine, shock)	at 3 ... 11 kW
		3M7 (sine, shock)	up to 2.2 kW
		Amplitude 10 mm	2 ... 9 Hz
		Amplitude 7 mm	
		Acceleration resistant up to 2 g	9 ... 200 Hz
		Acceleration resistant up to 3 g	
		Type 2	Peak acceleration value 25 g
	EN 60721-3-3:2019	3M12	up to 11 kW
	EN IEC 61800-5-1	Amplitude 0.075 mm	10 ... 57 Hz
		Acceleration resistant up to 1 g	57 ... 150 Hz

Electrical supply conditions

Power systems			
TN			Voltage against earth: max. 300 V
TT			

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

The following is supported:

- 3-phase mains connection 230/240 V 📖 75
- 3-phase mains connection 400 V 📖 84
- 3-phase mains connection 480 V 📖 94

Certification of the integrated functional safety

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

EN ISO 13849-1:2023	Safety of machinery – Safety-related parts of control systems – Part 1
EN 61508, Part 1-7:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems
EN 61800-5-1:2007 + A1:2017 + A11:2021	Adjustable speed electrical power drive systems – Part 5-1: Safety requirements – Electrical, thermal and energy requirements
EN 61800-5-2:2007 EN 61800-5-2:2017	Adjustable speed electrical power drive systems – Part 5-2: Safety requirements – Functional safety

Declarations of conformity, certificates and approvals can be found on the Internet:

www.Lenze.com → Products → Inverters → Frequency inverters
→ i550 motec frequency inverter
→ i650 motec frequency inverter

(Section "Product support")

3-phase mains connection 230/240 V

Rated data

- The output currents apply to an ambient temperature of max. 40 °C (104 °F).
- The maximally possible output voltage is approx. 87 % of the mains voltage.

Product name			**i□□□-M0.37/230-3**	**i□□□-M0.55/230-3**	**i□□□-M0.75/230-3**	**i□□□-M1.1/230-3**
Rated power	**P_{rated}**	**kW**	**0.37**	**0.55**	**0.75**	**1.1**
Rated power	**P_{rated}**	**hp**	**0.5**	**0.75**	**1**	**1.5**
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	2.2	2.9	3.8	5.4
with mains choke		A	-			
Apparent output power		kVA	0.9	1.2	1.5	2.2
Rated output current						
2 kHz		A	2.4	3.2	4.2	6
8 kHz		A	2.4	3.2	4.2	6
12 kHz		A	1.9	2.6	3.4	4.8
16 kHz		A	1.7	2.1	2.8	4
Power loss						
2 kHz		W	19	23	29	39
8 kHz		W	24	30	38	52
12 kHz		W	23	29	36	49
16 kHz		W	23	29	36	49
when the inverter is disabled		W	6			
Overcurrent cycle 180 s						
Max. output current (≤ 8 kHz)		A	3.6	4.8	6.3	9
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	4.5
Overcurrent cycle 15 s						
Max. output current (≤ 8 kHz)		A	4.8	6.4	8.4	12
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	4.5
Cyclic mains switching			3 times per minute			
Max. motor cable length shielded						
without EMC category		m	50			
Category C1 (8 kHz)		m	-			
Category C2 (8 kHz)		m	10			
Category C3 (8 kHz)		m	35			
Max. motor cable length unshielded						
without EMC category		m	100			

Product name			**i□□□-M1.5/230-3**	**i□□□-M2.2/230-3**	**i□□□-M3.0/230-3**	**i□□□-M4.0/230-3**
Rated power	**P_{rated}**	**kW**	**1.5**	**2.2**	**3**	**4**
Rated power	**P_{rated}**	**hp**	**2**	**3**	**4**	**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	6.3	8.6	10.8	14
with mains choke		A	-			
Apparent output power		kVA	2.5	3.5	4.3	6
Rated output current						
2 kHz		A	7	9.6	12	16.5
8 kHz		A	7	9.6	12	16.5
12 kHz		A	6	8.2	10.2	14.0
16 kHz		A	5	6.9	8.6	12.4
Power loss						
2 kHz		W	44	58	71	96
8 kHz		W	59	79	97	131
12 kHz		W	60	80	98	125
16 kHz		W	60	81	99	135
when the inverter is disabled		W	6			
Overcurrent cycle 180 s						
Max. output current (≤ 8 kHz)		A	10.5	14.4	18	24.8
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	5.3	7.2	9	12.4
Overcurrent cycle 15 s						
Max. output current (≤ 8 kHz)		A	14	19.2	24	33
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	5.3	7.2	9	12.4
Cyclic mains switching			3 times per minute			
Max. motor cable length shielded						
without EMC category		m	50			
Category C1 (8 kHz)		m	-			
Category C2 (8 kHz)		m	10			
Category C3 (8 kHz)		m	35			
Max. motor cable length unshielded						
without EMC category		m	100			

Product name			i□□□-M5.5/230-3	i□□□-M7.5/230-3	i□□□-M11/230-3	i□□□-M15/230-3
Rated power	**P_{rated}**	**kW**	**5.5**	**7.5**	**11**	**15**
Rated power	**P_{rated}**	**hp**	**7.5**	**10**	**15**	**20**
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	19.6	24.7	35.7	45.9
with mains choke		A	-			
Apparent output power		kVA	8.3	10.5	15.2	19.5
Rated output current						
2 kHz		A	23	29	42	54
8 kHz		A	23	29	42	54
12 kHz		A	19.6	24.7	35.7	-
16 kHz		A	17.3	21.8	31.5	-
Power loss						
2 kHz		W	131	163	234	299
8 kHz		W	181	226	325	416
12 kHz		W	172	229	329	-
16 kHz		W	186	233	334	-
when the inverter is disabled		W	6			
Overcurrent cycle 180 s						
Max. output current (≤ 8 kHz)		A	34.5	43.5	63	81
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	17.3	21.8	31.5	40.5
Overcurrent cycle 15 s						
Max. output current (≤ 8 kHz)		A	46	58	84	108
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	17.3	21.8	31.5	40.5
Cyclic mains switching			3 times per minute			
Max. motor cable length shielded						
without EMC category		m	50			
Category C1 (8 kHz)		m	-			
Category C2 (8 kHz)		m	10			
Category C3 (8 kHz)		m	35			
Max. motor cable length unshielded						
without EMC category		m	100			

Product name			**i□□□-M18/230-3**	**i□□□-M22/230-3**
Rated power	**P_{rated}**	**kW**	**18.5**	**22**
Rated power	**P_{rated}**	**hp**	**25**	**30**
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	57.8	68
with mains choke		A	-	
Apparent output power		kVA	24.6	28.9
Rated output current				
2 kHz		A	68	80
4 kHz		A	68	80
Power loss				
2 kHz		W	375	440
4 kHz		W	399	469
when the inverter is disabled		W	6	
Overcurrent cycle 180 s				
Max. output current (≤ 8 kHz)		A	85	100
Overload time	T_1	s	60	60
Recovery time	T_2	s	120	120
Max. output current during the recovery time		A	51	60
Overcurrent cycle 15 s				
Max. output current (≤ 8 kHz)		A	113	133
Overload time	T_1	s	3	3
Recovery time	T_2	s	12	12
Max. output current during the recovery time		A	51	60
Cyclic mains switching			3 times per minute	
Max. motor cable length shielded				
without EMC category		m	50	
Category C1 (4 kHz)		m	-	
Category C2 (4 kHz)		m	10	
Category C3 (4 kHz)		m	35	
Max. motor cable length unshielded				
without EMC category		m	100	

Fusing data (EN 60204-1)

- A residual current device (**RCD**) is optional.
- **Icc** = Rated conditional short-circuit current
- Fusing data for UL/NEC compliant installations:
  ▸ Connection according to UL, Fusing data 52

Standard Fault Short Circuit Current Ratings (SCCR)

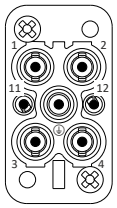
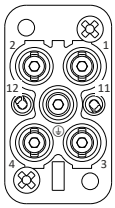
Inverter	Schmelzsicherung (IEC 60269-1)			Sicherungsautomat (IEC 60947-2)			RCD (IEC 62423)	
	Icc	Characteristic	Max. rated current	Icc	Characteristic	Max. rated current		Type
	kA		A	kA		A	mA	
I□5AM137C	5	gG/gL, gRL	32	5	B	32	≥ 30	Typ B
I□5AM155C	5	gG/gL, gRL	32	5	B	32	≥ 30	Typ B
I□5AM175C	5	gG/gL, gRL	32	5	B	32	≥ 30	Typ B
I□5AM211C	5	gG/gL, gRL	32	5	B	32	≥ 30	Typ B
I□5AM215C	5	gG/gL, gRL	32	5	B	32	≥ 30	Typ B
I□5AM222C	5	gG/gL, gRL	32	5	B	32	≥ 30	Typ B
I□5AM230C	5	gG/gL, gRL	32	5	B	32	≥ 30	Typ B
I□5AM240C	5	gG/gL, gRL	32	5	B	32	≥ 30	Typ B
I□5AM255C	5	gG/gL, gRL	32	5	B	32	≥ 30	Typ B
I□5AM275C	10	gR	125	10	B	100	≥ 30	Typ B
I□5AM311C	10	gR	125	10	B	100	≥ 30	Typ B
I□5AM315C	10	gR	125	10	B	100	≥ 30	Typ B
I□5AM318C	10	gR	125	10	B	100	≥ 30	Typ B
I□5AM322C	10	gR	125	10	B	100	≥ 30	Typ B

High Fault Short Circuit Current Ratings (SCCR)

Inverter	Schmelzsicherung (IEC 60269-1)			Sicherungsautomat (IEC 60947-2)			RCD (IEC 62423)	
	Icc	Characteristic	Max. rated current	Icc	Characteristic	Max. rated current		Type
	kA		A	kA		A	mA	
I□5AM137C	65	gG/gL, gRL	30	42	B	20	≥ 30	Typ B
I□5AM155C	65	gG/gL, gRL	30	42	B	20	≥ 30	Typ B
I□5AM175C	65	gG/gL, gRL	30	42	B	20	≥ 30	Typ B
I□5AM211C	65	gG/gL, gRL	30	42	B	20	≥ 30	Typ B
I□5AM215C	65	gG/gL, gRL	30	42	B	20	≥ 30	Typ B
I□5AM222C	65	gG/gL, gRL	30	42	B	20	≥ 30	Typ B
I□5AM230C	65	gG/gL, gRL	30	42	B	20	≥ 30	Typ B
I□5AM240C	65	gG/gL, gRL	30	65	B	30	≥ 30	Typ B
I□5AM255C	65	gG/gL, gRL	30	65	B	30	≥ 30	Typ B
I□5AM275C	65	gR	125	65	B	100	≥ 30	Typ B
I□5AM311C	65	gR	125	65	B	100	≥ 30	Typ B
I□5AM315C	65	gR	125	65	B	100	≥ 30	Typ B
I□5AM318C	65	gR	125	65	B	100	≥ 30	Typ B
I□5AM322C	65	gR	125	65	B	100	≥ 30	Typ B

Connection data

Rated power	**P_{rated}**	**kW**	**0.37 ... 5.5**													
Connection			**Mains connection**													
Connection type			**Han Q4/2**													
Connector name			**Q4/2 male**							**Q4/2 female (Daisy Chain)**						
Connection designation			**X100.1**							**X100.2**						
Pin			PE	1	2	3	4	11	12	PE	1	2	3	4	11	12
Pin name			PE	L1.1	L2.1	L3.1	n.c.	24E	GND	PE	L1.2	L2.2	L3.2	n.c.	24E	GND
Max. cable cross-section		mm²	6	6	6	6	6	2.5	2.5	6	6	6	6	6	2.5	2.5
Max. cable cross-section		AWG	10	10	10	10	10	14	14	10	10	10	10	10	14	14
Min. cable cross-section		mm²	1.5	1.5	1.5	1.5	1.5	0.14	0.14	1.5	1.5	1.5	1.5	1.5	0.14	0.14
Min. cable cross-section		AWG	16	16	16	16	16	26	26	16	16	16	16	16	26	26

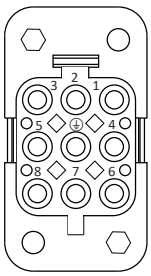
Han Q4/2 male	**Han Q4/2 female**
	

Rated power	**P_{rated}**	**kW**	**7.5 ... 22**
Connection			**Mains connection**
Connection designation			**X100**
Connection system			Screw terminal
Connection type			Non-pluggable
Max. cable cross-section		mm²	35
Max. cable cross-section		AWG	2
Min. cable cross-section		mm²	0.5
Min. cable cross-section		AWG	20
Stripping length		mm	18
Stripping length		in	0.7
Tightening torque		Nm	3.8
Tightening torque		lb-in	33.6
Required tools			Torx key 20

Rated power	P_{rated}	**kW**	**0.37 ... 3**	**4 ... 5.5**	**7.5 ... 22**
Connection			**Protective earth (PE)**		
Connection designation			**Symbol for protective earth (PE)**		
Connection system			Screw		
Max. cable cross-section		mm²	6	16	25
Max. cable cross-section		AWG	10	6	3
Min. cable cross-section		mm²	1.5	2.5	4
Min. cable cross-section		AWG	16	14	12
Stripping length		mm	10	12	18
Stripping length		in	0.4	0.47	0.7
Tightening torque		Nm	2	3.4	4
Tightening torque		lb-in	18	30	35
Required tool			Torx key 20	Torx key 25	Torx key 30

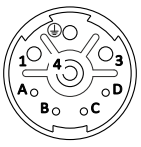
Rated power	P_{rated}	**kW**	**0.37 ... 5.5**							
Connection			**Motor connection**							
Connection designation			**X105**							
Connection type			**Han Q8**							
Pin			1	3	4	5	6	7	8	PE
Pin name			U	W	BD1	T1	BD2	V	T2	Symbol for protective earth (PE)

Han Q8

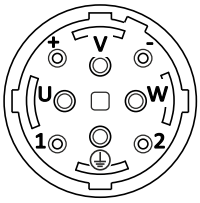


Rated power	P_{rated}	**kW**	**0.37 ... 5.5**							
Connection			**Motor connection**							
Connection designation			**X105**							
Connection type			**M23**							
Pin			1	3	4	A	B	C	D	PE
Pin name			U	V	W	T1	T2	BD1	BD2	Symbol for protective earth (PE)

M23



Rated power	P_{rated}	kW	7.5 ... 11							
Connection			**Motor connection**							
Connection designation			**X105**							
Connection type			**M40**							
Pin			-	+	1	2	PE	V	V	W
Pin name			BD2	BD1	T1	T2	Symbol for protective earth (PE)	U	V	W

M40


Rated power	P_{rated}	kW	0.37 ... 3	4 ... 5.5	7.5 ... 22
Connection			**Motor connection**		
Connection designation			**X105**		
Connection system			**Spring terminal**		**Screw terminal**
Connection type			Non-pluggable		
Max. cable cross-section		mm²	2.5	16	35
Max. cable cross-section		AWG	14	4	2
Min. cable cross-section		mm²	0.14	0.75	0.5
Min. cable cross-section		AWG	26	20	20
Stripping length		mm	8	18	18
Stripping length		in	0.3	0.7	0.7
Tightening torque		Nm	-	-	3.8
Tightening torque		lb-in	-	-	33.6
Required tools			Slotted screwdriver 0.6 x 3.5	Slotted screwdriver 0.8 x 4.0	Torx key 20

Rated power	P_{rated}	kW	7.5 ... 22	
Connection			**24 V supply for control electronics**	
Connection designation			**X5**	
Connection system			**Spring terminal**	
Pin name			24E	GND
Max. cable cross-section		mm²	2.5	
Max. cable cross-section		AWG	12	
Min. cable cross-section		mm²	0.25	0.25
Min. cable cross-section		AWG	26	26
Stripping length		mm	9	
Stripping length		in	0.3	
Required tools			Slotted screwdriver 0.5 x 3.0	

Rated power	**P_{rated}**	**kW**	**4 ... 22**	
Connection			**Motor brake**	
Connection designation			**X106**	
Connection system			**Spring terminal**	
Pin name			BD2	BD1
Max. cable cross-section		mm²	2.5	
Max. cable cross-section		AWG	12	
Min. cable cross-section		mm²	0.25	0.25
Min. cable cross-section		AWG	26	26
Stripping length		mm	9	
Stripping length		in	0.3	
Required tools			Slotted screwdriver 0.5 x 3.0	

Rated power	**P_{rated}**	**kW**	**4 ... 22**	
Connection			**PTC, thermal contact**	
Connection designation			**X109**	
Connection system			**Spring terminal**	
Pin name			T1	T2
Max. cable cross-section		mm²	1.5	
Max. cable cross-section		AWG	16	
Min. cable cross-section		mm²	0.25	0.25
Min. cable cross-section		AWG	26	26
Stripping length		mm	9	
Stripping length		in	0.3	
Required tools			Slotted screwdriver 0.4 x 2.5	

3-phase mains connection 400 V

Rated data

- The output currents apply to an ambient temperature of max. 40 °C (104 °F).
- The maximally possible output voltage is approx. 87 % of the mains voltage.

Product name			**i□□□-M0.37/400-3**	**i□□□-M0.55/400-3**	**i□□□-M0.75/400-3**	**i□□□-M1.1/400-3**
Rated power	P_{rated}	**kW**	**0.37**	**0.55**	**0.75**	**1.1**
Rated power	P_{rated}	**hp**	**0.5**	**0.75**	**1**	**1.5**
Mains voltage range			3/PE AC 340 V ... 440 V, 45 Hz ... 65 Hz			
Output voltage			3 AC 0 - 400/480 V			
Rated mains current						
without mains choke		A	1.2	1.6	2.2	2.9
with mains choke		A	-			
Apparent output power		kVA	0.8	1.1	1.4	1.9
Rated output current						
2 kHz		A	1.3	1.8	2.4	3.2
8 kHz		A	1.3	1.8	2.4	3.2
12 kHz		A	1	1.4	1.9	2.6
16 kHz		A	0.9	1.2	1.6	2.1
Power loss						
2 kHz		W	18	22	28	35
8 kHz		W	22	29	36	47
12 kHz		W	22	28	35	45
16 kHz		W	22	28	35	45
when the inverter is disabled		W	6			
Overcurrent cycle 180 s						
Max. output current (≤ 8 kHz)		A	2	2.7	3.6	4.8
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	1.4	1.8	2.4
Overcurrent cycle 15 s						
Max. output current (≤ 8 kHz)		A	2.6	3.6	4.8	6.4
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	1.4	1.8	2.4
Cyclic mains switching			3 times per minute			
Max. motor cable length shielded						
without EMC category		m	50			
Category C1 (8 kHz)		m	-			
Category C2 (8 kHz)		m	10			
Category C3 (8 kHz)		m	35			
Max. motor cable length unshielded						
without EMC category		m	100			

Product name			**i□□□-M1.5/400-3**	**i□□□-M2.2/400-3**	**i□□□-M3.0/400-3**	**i□□□-M4.0/400-3**
Rated power	**P_{rated}**	**kW**	**1.5**	**2.2**	**3**	**4**
Rated power	**P_{rated}**	**hp**	**2**	**3**	**4**	**5**
Mains voltage range			3/PE AC 340 V ... 440 V, 45 Hz ... 65 Hz			
Output voltage			3 AC 0 - 400/480 V			
Rated mains current						
without mains choke		A	3.5	5.0	6.6	8.6
with mains choke		A	-			
Apparent output power		kVA	2.4	3.4	4.4	5.7
Rated output current						
2 kHz		A	3.9	5.6	7.3	9.5
8 kHz		A	3.9	5.6	7.3	9.5
12 kHz		A	3.1	4.5	6.2	8.1
16 kHz		A	2.6	3.7	5.2	6.8
Power loss						
2 kHz		W	41	57	72	92
8 kHz		W	55	77	98	126
12 kHz		W	53	74	100	128
16 kHz		W	53	74	101	129
when the inverter is disabled		W	6			
Overcurrent cycle 180 s						
Max. output current (≤ 8 kHz)		A	5.9	8.4	11	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	2.9	4.2	5.5	7.1
Overcurrent cycle 15 s						
Max. output current (≤ 8 kHz)		A	7.8	11.2	14.6	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	2.9	4.2	5.5	7.1
Cyclic mains switching			3 times per minute			
Max. motor cable length shielded						
without EMC category		m	50			
Category C1 (8 kHz)		m	-			
Category C2 (8 kHz)		m	10			
Category C3 (8 kHz)		m	35			
Max. motor cable length unshielded						
without EMC category		m	100			

Product name			**i□□□-M5.5/400-3**	**i□□□-M7.5/400-3**	**i□□□-M11/400-3**	**i□□□-M15/400-3**
Rated power	**P_{rated}**	**kW**	**5.5**	**7.5**	**11**	**15**
Rated power	**P_{rated}**	**hp**	**7.5**	**10**	**15**	**20**
Mains voltage range			3/PE AC 340 V ... 440 V, 45 Hz ... 65 Hz			
Output voltage			3 AC 0 - 400/480 V			
Rated mains current						
without mains choke		A	11.7	14	20	27.2
with mains choke		A	-			
Apparent output power		kVA	7.8	9.9	14.2	19.3
Rated output current						
2 kHz		A	13	16.5	23.5	32
8 kHz		A	13	16.5	23.5	32
12 kHz		A	11.1	14	20	28.8
16 kHz		A	9.3	11.9	17	22.4
Power loss						
2 kHz		W	124	155	218	295
8 kHz		W	171	215	303	411
12 kHz		W	173	217	307	416
16 kHz		W	174	222	313	424
when the inverter is disabled		W	6			
Overcurrent cycle 180 s						
Max. output current (≤ 8 kHz)		A	19.5	24.8	35.3	48
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	9.8	12.4	17.6	24
Overcurrent cycle 15 s						
Max. output current (≤ 8 kHz)		A	26	33	47	64
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	9.8	12.4	17.6	24
Cyclic mains switching			3 times per minute			
Max. motor cable length shielded						
without EMC category		m	50			
Category C1 (8 kHz)		m	-			
Category C2 (8 kHz)		m	10			
Category C3 (8 kHz)		m	35			
Max. motor cable length unshielded						
without EMC category		m	100			

Product name			**i□□□-M18/400-3**	**i□□□-M22/400-3**	**i□□□-M30/400-3**
Rated power	**P_{rated}**	**kW**	**18.5**	**22**	**30**
Rated power	**P_{rated}**	**hp**	**25**	**30**	**40**
Mains voltage range			3/PE AC 340 V ... 440 V, 45 Hz ... 65 Hz		
Output voltage			3 AC 0 - 400/480 V		
Rated mains current					
without mains choke		A	34	40	51.9
with mains choke		A	-		
Apparent output power		kVA	24.1	28.3	36.8
Rated output current					
2 kHz		A	40	47	61
8 kHz		A	40	47	61
12 kHz		A	36	40.0	-
16 kHz		A	29.2	32.0	-
Power loss					
2 kHz		W	368	431	558
8 kHz		W	512	601	778
12 kHz		W	548	643	-
16 kHz		W	585	601	-
when the inverter is disabled		W	6		
Overcurrent cycle 180 s					
Max. output current (≤ 8 kHz)		A	60	70.5	91.5
Overload time	T_1	s	60	60	60
Recovery time	T_2	s	120	120	120
Max. output current during the recovery time		A	30	35.3	45.8
Overcurrent cycle 15 s					
Max. output current (≤ 8 kHz)		A	80	94	122
Overload time	T_1	s	3	3	3
Recovery time	T_2	s	12	12	12
Max. output current during the recovery time		A	30	35.3	45.8
Cyclic mains switching			3 times per minute		
Max. motor cable length shielded					
without EMC category		m	50		
Category C1 (8 kHz)		m	-		
Category C2 (8 kHz)		m	10		
Category C3 (8 kHz)		m	35		
Max. motor cable length unshielded					
without EMC category		m	100		

Product name			**i□□□-M37/400-3**	**i□□□-M45/400-3**
Rated power	**P_{rated}**	**kW**	**37**	**45**
Rated power	**P_{rated}**	**hp**	**50**	**60**
Mains voltage range			3/PE AC 340 V ... 440 V, 45 Hz ... 65 Hz	
Output voltage			3 AC 0 - 400/480 V	
Rated mains current				
without mains choke		A	64.6	71.4
with mains choke		A	-	
Apparent output power		kVA	45.8	50.6
Rated output current				
2 kHz		A	76	84
4 kHz		A	76	84
Power loss				
2 kHz		W	693	765
4 kHz		W	739	816
when the inverter is disabled		W	6	
Overcurrent cycle 180 s				
Max. output current (≤ 8 kHz)		A	95	105
Overload time	T_1	s	60	60
Recovery time	T_2	s	120	120
Max. output current during the recovery time		A	47.5	52.5
Overcurrent cycle 15 s				
Max. output current (≤ 8 kHz)		A	127	140
Overload time	T_1	s	3	3
Recovery time	T_2	s	12	12
Max. output current during the recovery time		A	47.5	52.5
Cyclic mains switching			3 times per minute	
Max. motor cable length shielded				
without EMC category		m	50	
Category C1 (4 kHz)		m	-	
Category C2 (4 kHz)		m	10	
Category C3 (4 kHz)		m	35	
Max. motor cable length unshielded				
without EMC category		m	100	

Fusing data (EN 60204-1)

- A residual current device (**RCD**) is optional.
- **Icc** = Rated conditional short-circuit current
- Fusing data for UL/NEC compliant installations:
  ▸ Connection according to UL, Fusing data 52

Standard Fault Short Circuit Current Ratings (SCCR)

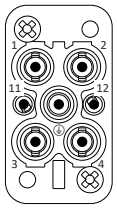
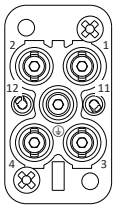
Inverter	Schmelzsicherung (IEC 60269-1)			Sicherungsautomat (IEC 60947-2)			RCD (IEC 62423)	
	Icc	Characteristic	Max. rated current	Icc	Characteristic	Max. rated current		Type
	kA		A	kA		A	mA	
I□5AM137F	5	gG/gL, gRL	32	5	B	32	≥ 30	Typ B
I□5AM155F	5	gG/gL, gRL	32	5	B	32	≥ 30	Typ B
I□5AM175F	5	gG/gL, gRL	32	5	B	32	≥ 30	Typ B
I□5AM211F	5	gG/gL, gRL	32	5	B	32	≥ 30	Typ B
I□5AM215F	5	gG/gL, gRL	32	5	B	32	≥ 30	Typ B
I□5AM222F	5	gG/gL, gRL	32	5	B	32	≥ 30	Typ B
I□5AM230F	5	gG/gL, gRL	32	5	B	32	≥ 30	Typ B
I□5AM240F	5	gG/gL, gRL	32	5	B	32	≥ 30	Typ B
I□5AM255F	5	gG/gL, gRL	32	5	B	32	≥ 30	Typ B
I□5AM275F	5	gG/gL, gRL	32	5	B	32	≥ 30	Typ B
I□5AM311F	5	gG/gL, gRL	32	5	B	32	≥ 30	Typ B
I□5AM315F	10	gR	125	10	B	100	≥ 30	Typ B
I□5AM318F	10	gR	125	10	B	100	≥ 30	Typ B
I□5AM322F	10	gR	125	10	B	100	≥ 30	Typ B
I□5AM330F	10	gR	125	10	B	100	≥ 30	Typ B
I□5AM337F	10	gR	125	10	B	100	≥ 30	Typ B
I□5AM345F	10	gR	125	10	B	100	≥ 30	Typ B

High Fault Short Circuit Current Ratings (SCCR)

Inverter	Schmelzsicherung (IEC 60269-1)			Sicherungsautomat (IEC 60947-2)			RCD (IEC 62423)	
	Icc	Characteristic	Max. rated current	Icc	Characteristic	Max. rated current		Type
	kA		A	kA		A	mA	
I□5AM137F	65	gG/gL, gRL	30	42	B	20	≥ 30	Typ B
I□5AM155F	65	gG/gL, gRL	30	42	B	20	≥ 30	Typ B
I□5AM175F	65	gG/gL, gRL	30	42	B	20	≥ 30	Typ B
I□5AM211F	65	gG/gL, gRL	30	42	B	20	≥ 30	Typ B
I□5AM215F	65	gG/gL, gRL	30	42	B	20	≥ 30	Typ B
I□5AM222F	65	gG/gL, gRL	30	42	B	20	≥ 30	Typ B
I□5AM230F	65	gG/gL, gRL	30	42	B	20	≥ 30	Typ B
I□5AM240F	65	gG/gL, gRL	30	42	B	20	≥ 30	Typ B
I□5AM255F	65	gG/gL, gRL	30	42	B	20	≥ 30	Typ B
I□5AM275F	65	gG/gL, gRL	30	65	B	30	≥ 30	Typ B
I□5AM311F	65	gG/gL, gRL	30	65	B	30	≥ 30	Typ B
I□5AM315F	65	gR	125	65	B	100	≥ 30	Typ B
I□5AM318F	65	gR	125	65	B	100	≥ 30	Typ B
I□5AM322F	65	gR	125	65	B	100	≥ 30	Typ B
I□5AM330F	65	gR	125	65	B	100	≥ 30	Typ B
I□5AM337F	65	gR	125	65	B	100	≥ 30	Typ B
I□5AM345F	65	gR	125	65	B	100	≥ 30	Typ B

Connection data

Rated power	**P_{rated}**	**kW**	**0.37 ... 11**													
Connection			**Mains connection**													
Connection type			**Han Q4/2**													
Connector name			**Q4/2 male**							**Q4/2 female (Daisy Chain)**						
Connection designation			**X100.1**							**X100.2**						
Pin			PE	1	2	3	4	11	12	PE	1	2	3	4	11	12
Pin name			PE	L1.1	L2.1	L3.1	n.c.	24E	GND	PE	L1.2	L2.2	L3.2	n.c.	24E	GND
Max. cable cross-section		mm²	6	6	6	6	6	2.5	2.5	6	6	6	6	6	2.5	2.5
Max. cable cross-section		AWG	10	10	10	10	10	14	14	10	10	10	10	10	14	14
Min. cable cross-section		mm²	1.5	1.5	1.5	1.5	1.5	0.14	0.14	1.5	1.5	1.5	1.5	1.5	0.14	0.14
Min. cable cross-section		AWG	16	16	16	16	16	26	26	16	16	16	16	16	26	26

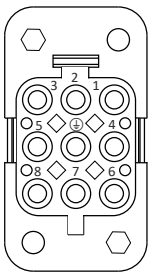
Han Q4/2 male	**Han Q4/2 female**
	

Rated power	**P_{rated}**	**kW**	**15 ... 45**
Connection			**Mains connection**
Connection designation			**X100**
Connection system			Screw terminal
Connection type			Non-pluggable
Max. cable cross-section		mm²	35
Max. cable cross-section		AWG	2
Min. cable cross-section		mm²	0.5
Min. cable cross-section		AWG	20
Stripping length		mm	18
Stripping length		in	0.7
Tightening torque		Nm	3.8
Tightening torque		lb-in	33.6
Required tools			Torx key 20

Rated power	**P_{rated}**	**kW**	**0.37 ... 5.5**	**7.5 ... 11**	**15 ... 45**
Connection			**Protective earth (PE)**		
Connection designation			**Symbol for protective earth (PE)**		
Connection system			Screw		
Max. cable cross-section		mm²	6	16	25
Max. cable cross-section		AWG	10	6	3
Min. cable cross-section		mm²	1.5	2.5	4
Min. cable cross-section		AWG	16	14	12
Stripping length		mm	10	12	18
Stripping length		in	0.4	0.47	0.7
Tightening torque		Nm	2	3.4	4
Tightening torque		lb-in	18	30	35
Required tool			Torx key 20	Torx key 25	Torx key 30

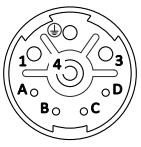
Rated power	**P_{rated}**	**kW**	**0.37 ... 11**							
Connection			**Motor connection**							
Connection designation			**X105**							
Connection type			**Han Q8**							
Pin			1	3	4	5	6	7	8	PE
Pin name			U	W	BD1	T1	BD2	V	T2	Symbol for protective earth (PE)

Han Q8

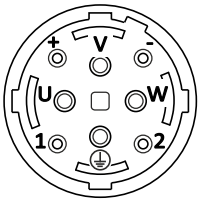


Rated power	**P_{rated}**	**kW**	**0.37 ... 11**							
Connection			**Motor connection**							
Connection designation			**X105**							
Connection type			**M23**							
Pin			1	3	4	A	B	C	D	PE
Pin name			U	V	W	T1	T2	BD1	BD2	Symbol for protective earth (PE)

M23



Rated power	P_{rated}	**kW**	**15 ... 22**							
Connection			**Motor connection**							
Connection designation			**X105**							
Connection type			**M40**							
Pin			-	+	1	2	PE	V	V	W
Pin name			BD2	BD1	T1	T2	Symbol for protective earth (PE)	U	V	W

M40


Rated power	P_{rated}	**kW**	**0.37 ... 5.5**	**7.5 ... 11**	**15 ... 45**
Connection			**Motor connection**		
Connection designation			**X105**		
Connection system			**Spring terminal**		**Screw terminal**
Connection type			Non-pluggable		
Max. cable cross-section		mm²	2.5	16	35
Max. cable cross-section		AWG	14	4	2
Min. cable cross-section		mm²	0.14	0.75	0.5
Min. cable cross-section		AWG	26	20	20
Stripping length		mm	8	18	18
Stripping length		in	0.3	0.7	0.7
Tightening torque		Nm	-	-	3.8
Tightening torque		lb-in	-	-	33.6
Required tools			Slotted screwdriver 0.6 x 3.5	Slotted screwdriver 0.8 x 4.0	Torx key 20

Rated power	P_{rated}	**kW**	**15 ... 45**	
Connection			**24 V supply for control electronics**	
Connection designation			**X5**	
Connection system			**Spring terminal**	
Pin name			24E	GND
Max. cable cross-section		mm²	2.5	
Max. cable cross-section		AWG	12	
Min. cable cross-section		mm²	0.25	0.25
Min. cable cross-section		AWG	26	26
Stripping length		mm	9	
Stripping length		in	0.3	
Required tools			Slotted screwdriver 0.5 x 3.0	

Rated power	**P_{rated}**	**kW**	**7.5 ... 45**	
Connection			**Motor brake**	
Connection designation			**X106**	
Connection system			**Spring terminal**	
Pin name			BD2	BD1
Max. cable cross-section		mm²	2.5	
Max. cable cross-section		AWG	12	
Min. cable cross-section		mm²	0.25	0.25
Min. cable cross-section		AWG	26	26
Stripping length		mm	9	
Stripping length		in	0.3	
Required tools			Slotted screwdriver 0.5 x 3.0	

Rated power	**P_{rated}**	**kW**	**7.5 ... 45**	
Connection			**PTC, thermal contact**	
Connection designation			**X109**	
Connection system			**Spring terminal**	
Pin name			T1	T2
Max. cable cross-section		mm²	1.5	
Max. cable cross-section		AWG	16	
Min. cable cross-section		mm²	0.25	0.25
Min. cable cross-section		AWG	26	26
Stripping length		mm	9	
Stripping length		in	0.3	
Required tools			Slotted screwdriver 0.4 x 2.5	

3-phase mains connection 480 V

Rated data

- The output currents apply to an ambient temperature of max. 40 °C (104 °F).
- The maximally possible output voltage is approx. 87 % of the mains voltage.

Product name			**i□□□-M0.37/400-3**	**i□□□-M0.55/400-3**	**i□□□-M0.75/400-3**	**i□□□-M1.1/400-3**
Rated power	**P_{rated}**	**kW**	**0.37**	**0.55**	**0.75**	**1.1**
Rated power	**P_{rated}**	**hp**	**0.5**	**0.75**	**1**	**1.5**
Mains voltage range			3/PE AC 432 V ... 528 V, 45 Hz ... 65 Hz			
Output voltage			3 AC 0 - 400/480 V			
Rated mains current						
without mains choke		A	1.0	1.4	1.9	2.7
with mains choke		A	-			
Apparent output power		kVA	0.8	1.2	1.5	2.2
Rated output current						
2 kHz		A	1.1	1.6	2.1	3
8 kHz		A	1.1	1.6	2.1	3
12 kHz		A	0.9	1.3	1.7	2.4
16 kHz		A	0.7	1.1	1.4	2
Power loss						
2 kHz		W	18	23	29	39
8 kHz		W	23	30	38	52
12 kHz		W	22	29	36	49
16 kHz		W	22	29	36	49
when the inverter is disabled		W	6			
Overcurrent cycle 180 s						
Max. output current (≤ 8 kHz)		A	1.7	2.4	3.2	4.5
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	0.8	1.2	1.6	2.3
Overcurrent cycle 15 s						
Max. output current (≤ 8 kHz)		A	2.2	3.2	4.2	6
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	0.8	1.2	1.6	2.3
Cyclic mains switching			3 times per minute			
Max. motor cable length shielded						
without EMC category		m	50			
Category C1 (8 kHz)		m	-			
Category C2 (8 kHz)		m	10			
Category C3 (8 kHz)		m	35			
Max. motor cable length unshielded						
without EMC category		m	100			

Product name			**i□□□-M1.5/400-3**	**i□□□-M2.2/400-3**	**i□□□-M3.0/400-3**	**i□□□-M4.0/400-3**
Rated power	**P_{rated}**	**kW**	**1.5**	**2.2**	**3**	**4**
Rated power	**P_{rated}**	**hp**	**2**	**3**	**4**	**5**
Mains voltage range			3/PE AC 432 V ... 528 V, 45 Hz ... 65 Hz			
Output voltage			3 AC 0 - 400/480 V			
Rated mains current						
without mains choke		A	3.2	4.3	5.7	7.4
with mains choke		A	-			
Apparent output power		kVA	2.5	3.5	4.6	5.9
Rated output current						
2 kHz		A	3.5	4.8	6.3	8.2
8 kHz		A	3.5	4.8	6.3	8.2
12 kHz		A	2.8	3.8	5.4	7.0
16 kHz		A	2.3	3.2	4.5	5.9
Power loss						
2 kHz		W	44	58	74	95
8 kHz		W	59	79	102	131
12 kHz		W	57	75	103	132
16 kHz		W	57	75	104	134
when the inverter is disabled		W	6			
Overcurrent cycle 180 s						
Max. output current (≤ 8 kHz)		A	5.3	7.2	9.5	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	2.6	3.6	4.7	6.2
Overcurrent cycle 15 s						
Max. output current (≤ 8 kHz)		A	7	9.6	12.6	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	2.6	3.6	4.7	6.2
Cyclic mains switching			3 times per minute			
Max. motor cable length shielded						
without EMC category		m	50			
Category C1 (8 kHz)		m	-			
Category C2 (8 kHz)		m	10			
Category C3 (8 kHz)		m	35			
Max. motor cable length unshielded						
without EMC category		m	100			

Product name			**i□□□-M5.5/400-3**	**i□□□-M7.5/400-3**	**i□□□-M11/400-3**	**i□□□-M15/400-3**
Rated power	**P_{rated}**	**kW**	**5.5**	**7.5**	**11**	**15**
Rated power	**P_{rated}**	**hp**	**7.5**	**10**	**15**	**20**
Mains voltage range			3/PE AC 432 V ... 528 V, 45 Hz ... 65 Hz			
Output voltage			3 AC 0 - 400/480 V			
Rated mains current						
without mains choke		A	9.9	11.9	17.9	23
with mains choke		A	-			
Apparent output power		kVA	8.0	10.1	15.2	19.5
Rated output current						
2 kHz		A	11	14	21	27
8 kHz		A	11	14	21	27
12 kHz		A	9.4	11.9	17.9	24.3
16 kHz		A	7.9	10.1	15.2	18.9
Power loss						
2 kHz		W	125	158	234	299
8 kHz		W	173	219	325	416
12 kHz		W	175	221	329	421
16 kHz		W	177	226	335	430
when the inverter is disabled		W	6			
Overcurrent cycle 180 s						
Max. output current (≤ 8 kHz)		A	16.5	21	31.5	40.5
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	8.3	10.5	15.8	20.3
Overcurrent cycle 15 s						
Max. output current (≤ 8 kHz)		A	22	28	42	54
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	8.3	10.5	15.8	20.3
Cyclic mains switching			3 times per minute			
Max. motor cable length shielded						
without EMC category		m	50			
Category C1 (8 kHz)		m	-			
Category C2 (8 kHz)		m	10			
Category C3 (8 kHz)		m	35			
Max. motor cable length unshielded						
without EMC category		m	100			

Product name			**i□□□-M18/400-3**	**i□□□-M22/400-3**	**i□□□-M30/400-3**
Rated power	**P_{rated}**	**kW**	**18.5**	**22**	**30**
Rated power	**P_{rated}**	**hp**	**25**	**30**	**40**
Mains voltage range			3/PE AC 432 V ... 528 V, 45 Hz ... 65 Hz		
Output voltage			3 AC 0 - 400/480 V		
Rated mains current					
without mains choke		A	28.9	34.3	44.2
with mains choke		A	-		
Apparent output power		kVA	24.6	29.2	37.6
Rated output current					
2 kHz		A	34	40.4	52
8 kHz		A	34	40.4	52
12 kHz		A	30.6	34.3	-
16 kHz		A	24.8	27.5	-
Power loss					
2 kHz		W	375	444	570
8 kHz		W	522	620	796
12 kHz		W	559	663	-
16 kHz		W	596	620	-
when the inverter is disabled		W	6		
Overcurrent cycle 180 s					
Max. output current (≤ 8 kHz)		A	51	60.6	78
Overload time	T_1	s	60	60	60
Recovery time	T_2	s	120	120	120
Max. output current during the recovery time		A	25.5	30.3	39
Overcurrent cycle 15 s					
Max. output current (≤ 8 kHz)		A	68	80.8	104
Overload time	T_1	s	3	3	3
Recovery time	T_2	s	12	12	12
Max. output current during the recovery time		A	25.5	30.3	39
Cyclic mains switching			3 times per minute		
Max. motor cable length shielded					
without EMC category		m	50		
Category C1 (8 kHz)		m	-		
Category C2 (8 kHz)		m	10		
Category C3 (8 kHz)		m	35		
Max. motor cable length unshielded					
without EMC category		m	100		

Product name			**i□□□-M37/400-3**	**i□□□-M45/400-3**
Rated power	**P_{rated}**	**kW**	**37**	**45**
Rated power	**P_{rated}**	**hp**	**50**	**60**
Mains voltage range			3/PE AC 432 V ... 528 V, 45 Hz ... 65 Hz	
Output voltage			3 AC 0 - 400/480 V	
Rated mains current				
without mains choke		A	55.3	65.5
with mains choke		A	-	
Apparent output power		kVA	47	55.7
Rated output current				
2 kHz		A	65	77
4 kHz		A	65	77
Power loss				
2 kHz		W	711	841
4 kHz		W	758	897
when the inverter is disabled		W	6	
Overcurrent cycle 180 s				
Max. output current (≤ 8 kHz)		A	81.3	96.3
Overload time	T_1	s	60	60
Recovery time	T_2	s	120	120
Max. output current during the recovery time		A	48.8	57.8
Overcurrent cycle 15 s				
Max. output current (≤ 8 kHz)		A	108	128
Overload time	T_1	s	3	3
Recovery time	T_2	s	12	12
Max. output current during the recovery time		A	48.8	57.8
Cyclic mains switching			3 times per minute	
Max. motor cable length shielded				
without EMC category		m	50	
Category C1 (4 kHz)		m	-	
Category C2 (4 kHz)		m	10	
Category C3 (4 kHz)		m	35	
Max. motor cable length unshielded				
without EMC category		m	100	

Fusing data (EN 60204-1)

- A residual current device (**RCD**) is optional.
- **Icc** = Rated conditional short-circuit current
- Fusing data for UL/NEC compliant installations:
  ▸ Connection according to UL, Fusing data 🕮 52

Standard Fault Short Circuit Current Ratings (SCCR)

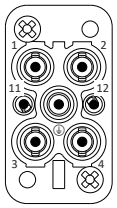
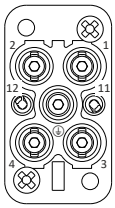
Inverter	Schmelzsicherung (IEC 60269-1)			Sicherungsautomat (IEC 60947-2)			RCD (IEC 62423)	
	Icc	Characteristic	Max. rated current	Icc	Characteristic	Max. rated current		Type
	kA		A	kA		A	mA	
I□5AM137F	5	gG/gL, gRL	32	5	B	32	≥ 30	Typ B
I□5AM155F	5	gG/gL, gRL	32	5	B	32	≥ 30	Typ B
I□5AM175F	5	gG/gL, gRL	32	5	B	32	≥ 30	Typ B
I□5AM211F	5	gG/gL, gRL	32	5	B	32	≥ 30	Typ B
I□5AM215F	5	gG/gL, gRL	32	5	B	32	≥ 30	Typ B
I□5AM222F	5	gG/gL, gRL	32	5	B	32	≥ 30	Typ B
I□5AM230F	5	gG/gL, gRL	32	5	B	32	≥ 30	Typ B
I□5AM240F	5	gG/gL, gRL	32	5	B	32	≥ 30	Typ B
I□5AM255F	5	gG/gL, gRL	32	5	B	32	≥ 30	Typ B
I□5AM275F	5	gG/gL, gRL	32	5	B	32	≥ 30	Typ B
I□5AM311F	5	gG/gL, gRL	32	5	B	32	≥ 30	Typ B
I□5AM315F	10	gR	125	10	B	100	≥ 30	Typ B
I□5AM318F	10	gR	125	10	B	100	≥ 30	Typ B
I□5AM322F	10	gR	125	10	B	100	≥ 30	Typ B
I□5AM330F	10	gR	125	10	B	100	≥ 30	Typ B
I□5AM337F	10	gR	125	10	B	100	≥ 30	Typ B
I□5AM345F	10	gR	125	10	B	100	≥ 30	Typ B

High Fault Short Circuit Current Ratings (SCCR)

Inverter	Schmelzsicherung (IEC 60269-1)			Sicherungsautomat (IEC 60947-2)			RCD (IEC 62423)	
	Icc	Characteristic	Max. rated current	Icc	Characteristic	Max. rated current		Type
	kA		A	kA		A	mA	
I□5AM137F	65	gG/gL, gRL	30	42	B	20	≥ 30	Typ B
I□5AM155F	65	gG/gL, gRL	30	42	B	20	≥ 30	Typ B
I□5AM175F	65	gG/gL, gRL	30	42	B	20	≥ 30	Typ B
I□5AM211F	65	gG/gL, gRL	30	42	B	20	≥ 30	Typ B
I□5AM215F	65	gG/gL, gRL	30	42	B	20	≥ 30	Typ B
I□5AM222F	65	gG/gL, gRL	30	42	B	20	≥ 30	Typ B
I□5AM230F	65	gG/gL, gRL	30	42	B	20	≥ 30	Typ B
I□5AM240F	65	gG/gL, gRL	30	42	B	20	≥ 30	Typ B
I□5AM255F	65	gG/gL, gRL	30	42	B	20	≥ 30	Typ B
I□5AM275F	65	gG/gL, gRL	30	65	B	30	≥ 30	Typ B
I□5AM311F	65	gG/gL, gRL	30	65	B	30	≥ 30	Typ B
I□5AM315F	65	gR	125	65	B	100	≥ 30	Typ B
I□5AM318F	65	gR	125	65	B	100	≥ 30	Typ B
I□5AM322F	65	gR	125	65	B	100	≥ 30	Typ B
I□5AM330F	65	gR	125	65	B	100	≥ 30	Typ B
I□5AM337F	65	gR	125	65	B	100	≥ 30	Typ B
I□5AM345F	65	gR	125	65	B	100	≥ 30	Typ B

Connection data

Rated power	P_{rated}	kW	0.37 ... 11													
Connection			Mains connection													
Connection type			Han Q4/2													
Connector name			Q4/2 male							Q4/2 female (Daisy Chain)						
Connection designation			X100.1							X100.2						
Pin			PE	1	2	3	4	11	12	PE	1	2	3	4	11	12
Pin name			PE	L1.1	L2.1	L3.1	n.c.	24E	GND	PE	L1.2	L2.2	L3.2	n.c.	24E	GND
Max. cable cross-section		mm²	6	6	6	6	6	2.5	2.5	6	6	6	6	6	2.5	2.5
Max. cable cross-section		AWG	10	10	10	10	10	14	14	10	10	10	10	10	14	14
Min. cable cross-section		mm²	1.5	1.5	1.5	1.5	1.5	0.14	0.14	1.5	1.5	1.5	1.5	1.5	0.14	0.14
Min. cable cross-section		AWG	16	16	16	16	16	26	26	16	16	16	16	16	26	26

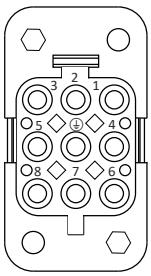
Han Q4/2 male	Han Q4/2 female
	

Rated power	P_{rated}	kW	15 ... 45
Connection			Mains connection
Connection designation			X100
Connection system			Screw terminal
Connection type			Non-pluggable
Max. cable cross-section		mm²	35
Max. cable cross-section		AWG	2
Min. cable cross-section		mm²	0.5
Min. cable cross-section		AWG	20
Stripping length		mm	18
Stripping length		in	0.7
Tightening torque		Nm	3.8
Tightening torque		lb-in	33.6
Required tools			Torx key 20

Rated power	P_{rated}	**kW**	**0.37 ... 5.5**	**7.5 ... 11**	**15 ... 45**
Connection			**Protective earth (PE)**		
Connection designation			**Symbol for protective earth (PE)**		
Connection system			Screw		
Max. cable cross-section		mm²	6	16	25
Max. cable cross-section		AWG	10	6	3
Min. cable cross-section		mm²	1.5	2.5	4
Min. cable cross-section		AWG	16	14	12
Stripping length		mm	10	12	18
Stripping length		in	0.4	0.47	0.7
Tightening torque		Nm	2	3.4	4
Tightening torque		lb-in	18	30	35
Required tool			Torx key 20	Torx key 25	Torx key 30

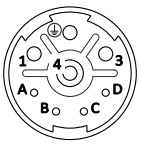
Rated power	P_{rated}	**kW**	**0.37 ... 11**							
Connection			**Motor**							
Connection designation			**X105**							
Connection type			**Han Q8**							
Pin			1	3	4	5	6	7	8	PE
Pin name			U	W	BD1	T1	BD2	V	T2	Symbol for protective earth (PE)

Han Q8

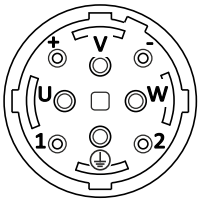


Rated power	P_{rated}	**kW**	**0.37 ... 11**							
Connection			**Motor**							
Connection designation			**X105**							
Connection type			**M23**							
Pin			1	3	4	A	B	C	D	PE
Pin name			U	V	W	T1	T2	BD1	BD2	Symbol for protective earth (PE)

M23



Rated power	P_{rated}	kW	15 ... 22							
Connection			**Motor**							
Connection designation			**X105**							
Connection type			**M40**							
Pin			-	+	1	2	PE	V	V	W
Pin name			BD2	BD1	T1	T2	Symbol for protective earth (PE)	U	V	W

M40


Rated power	P_{rated}	kW	0.37 ... 5.5	7.5 ... 11	15 ... 45
Connection			**Motor connection**		
Connection designation			**X105**		
Connection system			**Spring terminal**		**Screw terminal**
Connection type			Non-pluggable		
Max. cable cross-section		mm²	2.5	16	35
Max. cable cross-section		AWG	14	4	2
Min. cable cross-section		mm²	0.14	0.75	0.5
Min. cable cross-section		AWG	26	20	20
Stripping length		mm	8	18	18
Stripping length		in	0.3	0.7	0.7
Tightening torque		Nm	-	-	3.8
Tightening torque		lb-in	-	-	33.6
Required tools			Slotted screwdriver 0.6 x 3.5	Slotted screwdriver 0.8 x 4.0	Torx key 20

Rated power	P_{rated}	kW	15 ... 45	
Connection			**24 V supply for control electronics**	
Connection designation			**X5**	
Connection system			**Spring terminal**	
Pin name			24E	GND
Max. cable cross-section		mm²	2.5	
Max. cable cross-section		AWG	12	
Min. cable cross-section		mm²	0.25	0.25
Min. cable cross-section		AWG	26	26
Stripping length		mm	9	
Stripping length		in	0.3	
Required tools			Slotted screwdriver 0.5 x 3.0	

Rated power	**P_{rated}**	**kW**	**7.5 ... 45**	
Connection			**Motor brake**	
Connection designation			**X106**	
Connection system			**Spring terminal**	
Pin name			BD2	BD1
Max. cable cross-section		mm²	2.5	
Max. cable cross-section		AWG	12	
Min. cable cross-section		mm²	0.25	0.25
Min. cable cross-section		AWG	26	26
Stripping length		mm	9	
Stripping length		in	0.3	
Required tools			Slotted screwdriver 0.5 x 3.0	

Rated power	**P_{rated}**	**kW**	**7.5 ... 45**	
Connection			**PTC, thermal contact**	
Connection designation			**X109**	
Connection system			**Spring terminal**	
Pin name			T1	T2
Max. cable cross-section		mm²	1.5	
Max. cable cross-section		AWG	16	
Min. cable cross-section		mm²	0.25	0.25
Min. cable cross-section		AWG	26	26
Stripping length		mm	9	
Stripping length		in	0.3	
Required tools			Slotted screwdriver 0.4 x 2.5	

Ecodesign Directive

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

Legend

□□	Wildcard for product series (55 for i550, 65 for i650)
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 can be found in the additional product documentation on the Internet.

Performance losses										
0; 25	f; I	%	2.8	2.7	1.8	1.6	1.5	1.6	2.0	1.7
0; 50	f; I	%	2.9	2.7	1.9	1.8	1.7	1.8	2.3	2.0
0; 100	f; I	%	3.1	3.0	2.4	2.4	2.2	2.3	3.0	2.7
50; 25	f; I	%	2.9	2.7	1.8	1.6	1.6	1.6	2.1	1.8
50; 50	f; I	%	2.9	2.8	2.0	1.9	1.8	1.9	2.4	2.1
50; 100	f; I	%	3.3	3.2	2.5	2.5	2.3	2.4	3.2	2.9
90; 50	f; I	%	3.0	2.8	2.1	2.0	1.8	1.9	2.5	2.2
90; 100	f; I	%	3.0	3.0	2.4	2.4	2.2	2.3	3.0	2.8
In standby mode		%	0.6	0.5	0.4	0.3	0.2	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			I□□AM137C	I□□AM155C	I□□AM175C	I□□AM211C	I□□AM215C	I□□AM222C	I□□AM230C	I□□AM240C
Apparent output power		kVA	0.8	1.1	1.5	2.1	2.4	3.3	4.2	5.7
Indicative rated output power of the motor		kW	0.37	0.55	0.75	1.1	1.5	2.2	3	4
Rated output current		A	2.4	3.2	4.2	6	7	9.6	12	16.5
Maximum operating temperature		°C	40							
Rated input frequency		Hz	50							
Rated input voltage		V	230							
Switching frequency		kHz	8							
Rated apparent output power		kVA	0.977	1.19	1.71	2.29	3.3	4.44	4.44	5.85

Performance losses										
0; 25	f; I	%	1.0	0.8	0.9	1.1	0.7	0.7	3.6	3.2
0; 50	f; I	%	1.2	1.0	1.1	1.5	0.9	0.9	3.6	3.2
0; 100	f; I	%	1.9	1.7	1.9	2.5	1.7	1.8	3.8	3.4
50; 25	f; I	%	1.0	0.9	0.9	1.2	0.7	0.7	3.6	3.2
50; 50	f; I	%	1.3	1.1	1.2	1.6	1.1	1.1	3.6	3.2
50; 100	f; I	%	2.1	1.8	2.1	2.7	2.0	2.1	3.9	3.5
90; 50	f; I	%	1.4	1.2	1.3	1.7	1.2	1.2	3.7	3.3
90; 100	f; I	%	2.1	1.9	2.0	2.8	2.2	2.3	3.4	3.1
In standby mode		%	0.1	0.1	0.1	0.1	0.1	0.1	0.6	0.5
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			I□□AM255 C	I□□AM275 C	I□□AM311 C	I□□AM315 C	I□□AM318 C	I□□AM322 C	I□□AM137 F	I□□AM155 F
Apparent output power		kVA	8.0	10.0	14.6	18.7	23.6	27.7	0.8	1.1
Indicative rated output power of the motor		kW	5.5	7.5	11.0	15.0	18.5	22.0	0.37	0.55
Rated output current		A	23	29	42	54	68	80	1.3	1.8
Maximum operating temperature		°C	40							
Rated input frequency		Hz	50							
Rated input voltage		V	230						400	
Switching frequency		kHz	8				4		8	
Rated apparent output power		kVA	9.95	14.4	19.5	19.5	23.9	28.3	0.977	1.19

Performance losses										
0; 25	f; I	%	2.1	1.8	1.4	1.3	1.9	1.9	1.2	1.3
0; 50	f; I	%	2.3	1.9	1.5	1.5	2.1	2.1	1.4	1.5
0; 100	f; I	%	2.6	2.3	1.8	1.8	2.6	2.6	1.9	2.2
50; 25	f; I	%	2.2	1.8	1.4	1.3	1.9	1.9	1.2	1.3
50; 50	f; I	%	2.3	2.0	1.5	1.5	2.2	2.1	1.4	1.6
50; 100	f; I	%	2.7	2.3	1.9	1.9	2.7	2.7	2.0	2.3
90; 50	f; I	%	2.3	2.0	1.6	1.5	2.2	2.2	1.4	1.7
90; 100	f; I	%	2.4	2.1	1.7	1.8	2.4	2.4	1.8	2.2
In standby mode		%	0.4	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			I□□AM175F	I□□AM211F	I□□AM215F	I□□AM222F	I□□AM230F	I□□AM240F	I□□AM255F	I□□AM275F
Apparent output power		kVA	1.5	1.9	2.4	3.4	4.4	5.7	7.8	10.0
Indicative rated output power of the motor		kW	0.75	1.1	1.5	2.2	3	4	5.5	7.5
Rated output current		A	2.4	3.2	3.9	5.6	7.3	9.5	13	16.5
Maximum operating temperature		°C	40							
Rated input frequency		Hz	50							
Rated input voltage		V	400							
Switching frequency		kHz	8							
Rated apparent output power		kVA	1.71	2.29	3.3	4.44	4.44	5.85	9.95	9.95

Performance losses										
0; 25	f; l	%	1.1	1.1	0.9	0.9	0.7	0.9	0.5	0.5
0; 50	f; l	%	1.3	1.3	1.2	1.1	0.9	1.2	0.7	0.7
0; 100	f; l	%	2.0	2.0	1.9	1.7	1.5	2.0	1.3	1.3
50; 25	f; l	%	1.1	1.1	1.0	0.9	0.8	1.0	0.5	0.5
50; 50	f; l	%	1.4	1.4	1.2	1.2	1.0	1.3	0.8	0.7
50; 100	f; l	%	2.2	2.2	2.0	1.9	1.6	2.1	1.4	1.4
90; 50	f; l	%	1.5	1.5	1.3	1.2	1.0	1.3	0.8	0.8
90; 100	f; l	%	2.1	2.1	1.9	1.7	1.5	2.0	1.5	1.5
In standby mode		%	0.1	0.1	0.1	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			I□□AM311F	I□5AM311F	I□□AM315F	I□□AM318F	I□□AM322F	I□□AM330F	I□□AM337F	I□□AM345F
Apparent output power		kVA	14.2	14.2	19.3	24.1	28.3	36.8	45.8	50.6
Indicative rated output power of the motor		kW	11.0	11.0	15.0	18.5	22.0	30.0	37.0	45.0
Rated output current		A	23.5	23.5	32	40	47	61	76	84
Maximum operating temperature		°C	40							
Rated input frequency		Hz	50							
Rated input voltage		V	400							
Switching frequency		kHz	8						4	
Rated apparent output power		kVA	14.4	14.4	19.5	28.3	38.2	38.2	47.0	56.2

Data of control connections

Digital inputs | Standard I/O

Connection		X3.1 / DI1 + DI2 X3.2 / DI3 + DI4	
Switching type		PNP, NPN	Parameterizable
PNP switching level			
LOW	V	< +5	IEC 61131-2, type 1
HIGH	V	> +15	
NPN switching level			
LOW	V	> +15	
HIGH	V	< +5	
Input resistance	kΩ	4.6	
Cycle time	ms	1	
External-voltage protection	V	±30	The following restriction applies to DI1 due to the switchability to DO1: External-voltage protection = +30 V. In the event of a negative voltage, the integrated freewheeling diode conducts.

Digital inputs | Application I/O

Connection		X3.1 / DI1 + DI2 X3.2 / DI3 + DI4 X3.3 / DI5 + DI6 X3.4 / DI7 + DI8	
Switching type		PNP, NPN	Parameterizable
PNP switching level			
LOW	V	< +5	IEC 61131-2, type 1
HIGH	V	> +15	
NPN switching level			
LOW	V	> +15	
HIGH	V	< +5	
Input resistance	kΩ	4.6	
Cycle time	ms	1	
External-voltage protection	V	±30	

Encoder input			
Type		Incremental HTL encoder	
Two-track connection		X3.2 / DI3 X3.2 / DI4	Track A Track B
Frequency range	kHz	0 … 200	

Digital outputs | Standard I/O

Connection		X3.1 / DO1	
Switching level			
LOW	V	< +5	IEC 61131-2, type 1
HIGH	V	> +15	
max. output current	mA	100	
Cycle time	ms	1	
Short-circuit strength		Unlimited period	
External-voltage protection	V	+30	In the event of a negative voltage, the integrated freewheeling diode conducts.
Polarity reversal protection		Integrated freewheeling diode for switching the inductive load	
Overload behavior		Voltage reduction or switching off and on periodically	
Reset or switch-on behavior		Output is switched off	LOW

Digital outputs | Application I/O

Connection		X3.1 / DO1 X3.2 / DO2 X3.3 / DO3 X3.4 / DO4	
Switching level			
LOW	V	< +5	IEC 61131-2, type 1
HIGH	V	> +15	
max. output current	mA	100	
Cycle time	ms	1	
Short-circuit strength		Unlimited period	
External-voltage protection	V	±30	
Polarity reversal protection		Integrated freewheeling diode for switching the inductive load	
Overload behavior		Voltage reduction or switching off and on periodically	
Reset or switch-on behavior		Output is switched off	LOW

DC input

Use		Input for mains-independent DC supply of the control electronics (incl. communication)	
Connection		X100.1 / 24E + GND X100.2 / 24E + GND	Applies to inverters: • 0.37 ... 5.5 kW and mains voltage 230/240 V • 0.37 ... 11 kW and mains voltage 400/480 V
		X5 / 24E + GND	Applies to inverters: • 7.5 ... 22 kW and mains voltage 230/240 V • 15 ... 45 kW and mains voltage 400/480 V
Capacity to be charged	µF	440	
Polarity reversal protection		In case of polarity reversal: No function and no destruction	
Suppression of voltage pulses		Suppressor diode 48 V, bidirectional	
Power supply unit		SELV/PELV	Externally to create a mains-independent DC supply
Rated current	A	10	While looping-through

Rated data DC input for version with standard I/O			
DC input voltage			
Typical	V	24 or 48	IEC 61131-2
Range	V	20.5 ... 49.9	
Input power			Depending on the use and state of inputs and outputs.
Typical	W	3.6	
Max.	W	13.2	
Input current			
Typical	A	0.15	
Max.	A	0.55	
Short-term inrush current			
Typical	A	2.5	
Max.	A	8.5	

Rated data DC input for version with application I/O			
DC input voltage			
Typical	V	24 or 48	IEC 61131-2
Range	V	20.5 ... 49.9	
Input power			Depending on the use and state of inputs and outputs.
Typical	W	3.6	
Max.	W	27.6	
Input current			
Typical	A	0.15	
Max.	A	1.15	
Short-term inrush current			
Typical	A	3	
Max.	A	9.5	

24 V outputs | Standard-I/O

Application		Primarily for the supply of digital inputs.	
Connection		X3.1 / 24 V X3.2 / 24 V	
DC output voltage			
Typical	V	24	SELV/PELV
Range	V	16 … 28	
max. output current	mA	400	Total current for all I/Os (M12 plug connector) • The maximum output current is limited to 400 mA even with an external supply. • Above +40 °C the max. output current is reduced by 2.5 %/°C
Short-circuit strength		Unlimited period	
External-voltage protection	V	+30	
Overcurrent fusing		Automatically resettable	

24 V outputs | application I/O

Application		Primarily for the supply of digital inputs.	
Connection		X3.1 / 24 V X3.2 / 24 V X3.3 / 24 V X3.4 / 24 V	
DC output voltage			
Typical	V	24	SELV/PELV
Range	V	16 … 28	
max. output current	mA	400/1000	Total current for all I/Os (M12 plug connector) • The maximum output current of 1000 mA is only possible with an external power supply. Otherwise, the maximum output current is limited to 400 mA. • Above +40 °C the max. output current is reduced by 2.5 %/°C • An external power supply is recommended for IO-Link.
Short-circuit strength		Unlimited period	
External-voltage protection	V	+30	
Overcurrent fusing		Automatically resettable	

Extension box

Current consumption	mA	60	Current consumption of the Extension Box in operation Applies to Extension Box • with disconnect switch with status feedback and operating elements • with disconnect switch with status feedback, operating element and potentiometer

Dimensions

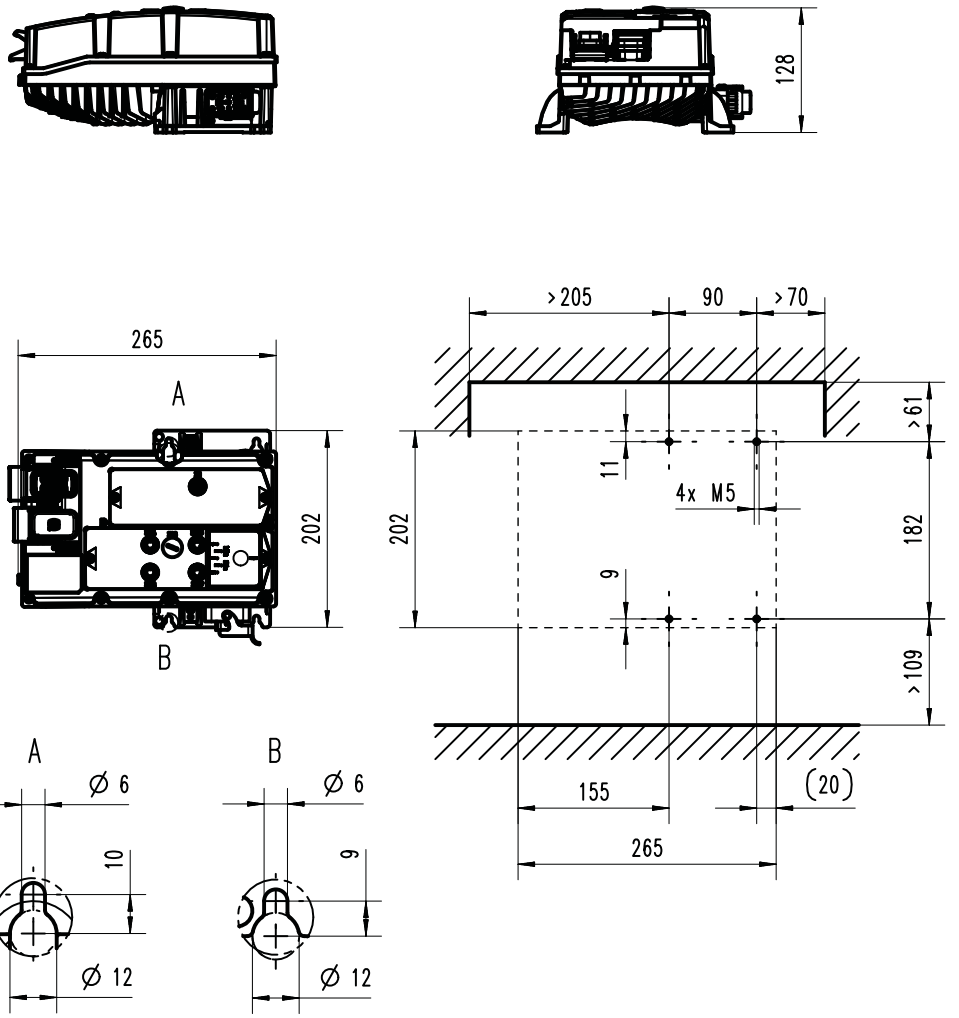
Inverters without extension box, Design/installation: wall

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 ... 2.2 kW

The dimensions in mm apply to:

0.37 kW	i□□□-M0.37/230-3	i□□□-M0.37/400-3
0.55 kW	i□□□-M0.55/230-3	i□□□-M0.55/400-3
0.75 kW	i□□□-M0.75/230-3	i□□□-M0.75/400-3
1.1 kW	i□□□-M1.1/230-3	i□□□-M1.1/400-3
1.5 kW		i□□□-M1.5/400-3
2.2 kW		i□□□-M2.2/400-3
Weight	3.2 kg	3.2 kg



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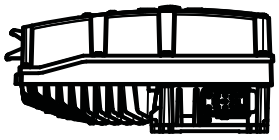
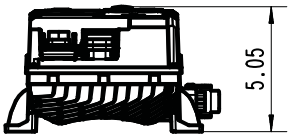
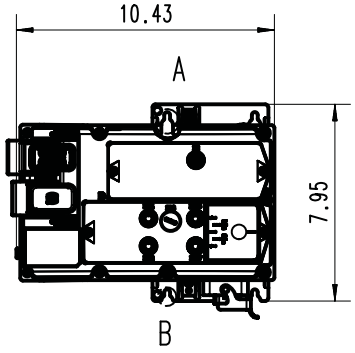
0.5 hp ... 3 hp

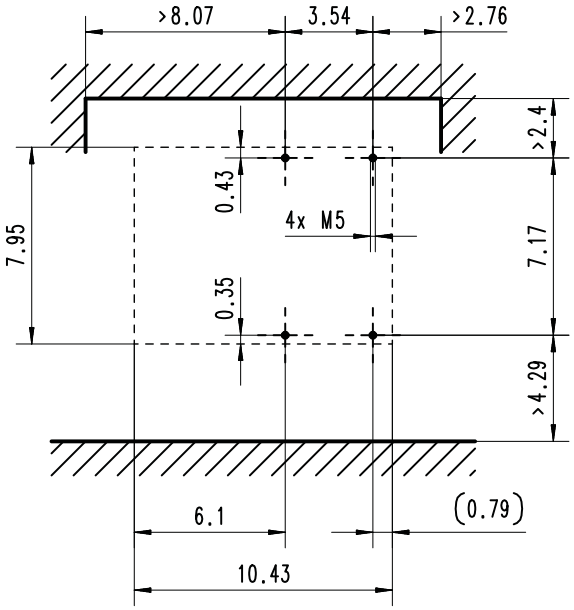
The dimensions in inch apply to:

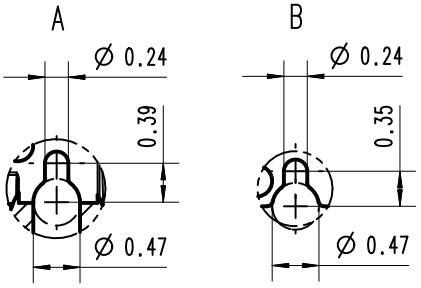
0.5 hp	i□□□-M0.37/230-3	i□□□-M0.37/400-3
0.75 hp	i□□□-M0.55/230-3	i□□□-M0.55/400-3
1 hp	i□□□-M0.75/230-3	i□□□-M0.75/400-3
1.5 hp	i□□□-M1.1/230-3	i□□□-M1.1/400-3
2 hp		i□□□-M1.5/400-3
3 hp		i□□□-M2.2/400-3
Weight	7 lb	7 lb











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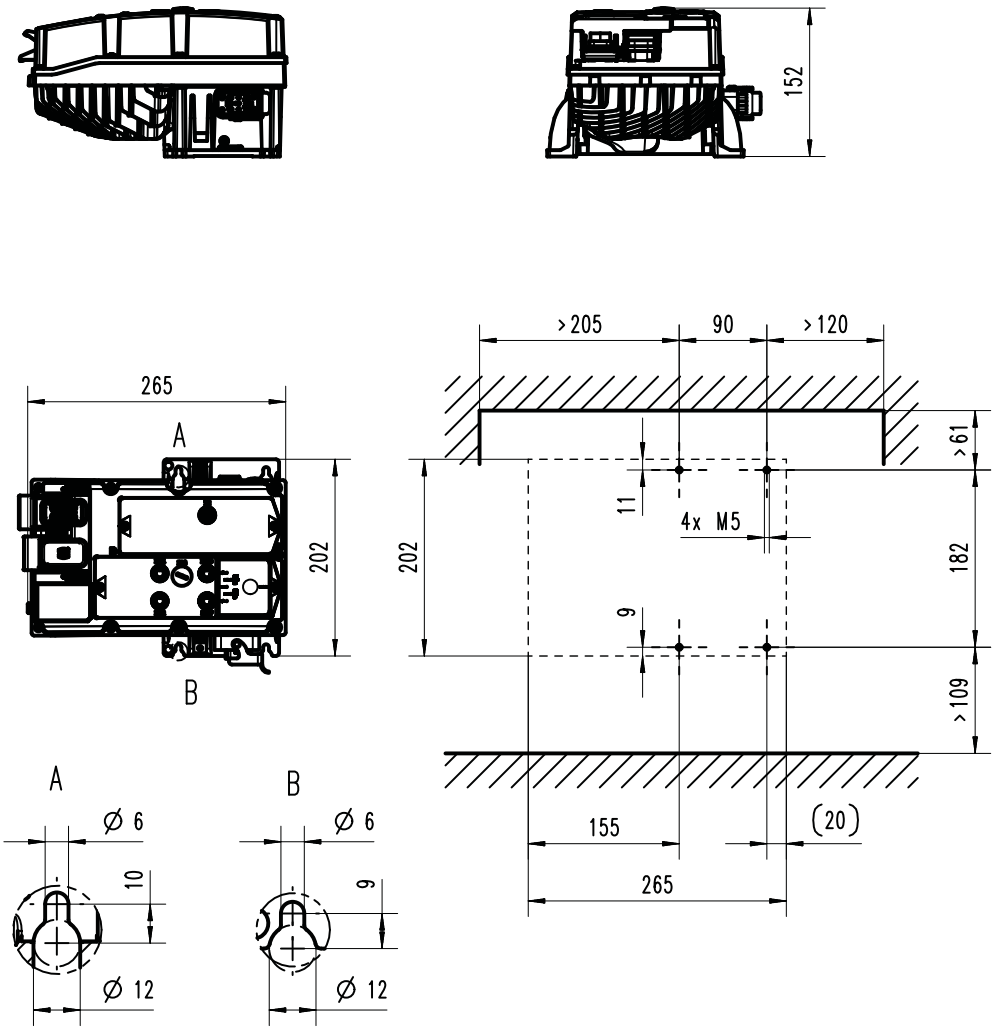
1.5 kW ... 5.5 kW

The dimensions in mm apply to:

1.5 kW	i□□□-M1.5/230-3	
2.2 kW	i□□□-M2.2/230-3	
3 kW	i□□□-M3.0/230-3	i□□□-M3.0/400-3
4 kW		i□□□-M4.0/400-3
5.5 kW		i□□□-M5.5/400-3
Weight	3.8 kg	3.8 kg



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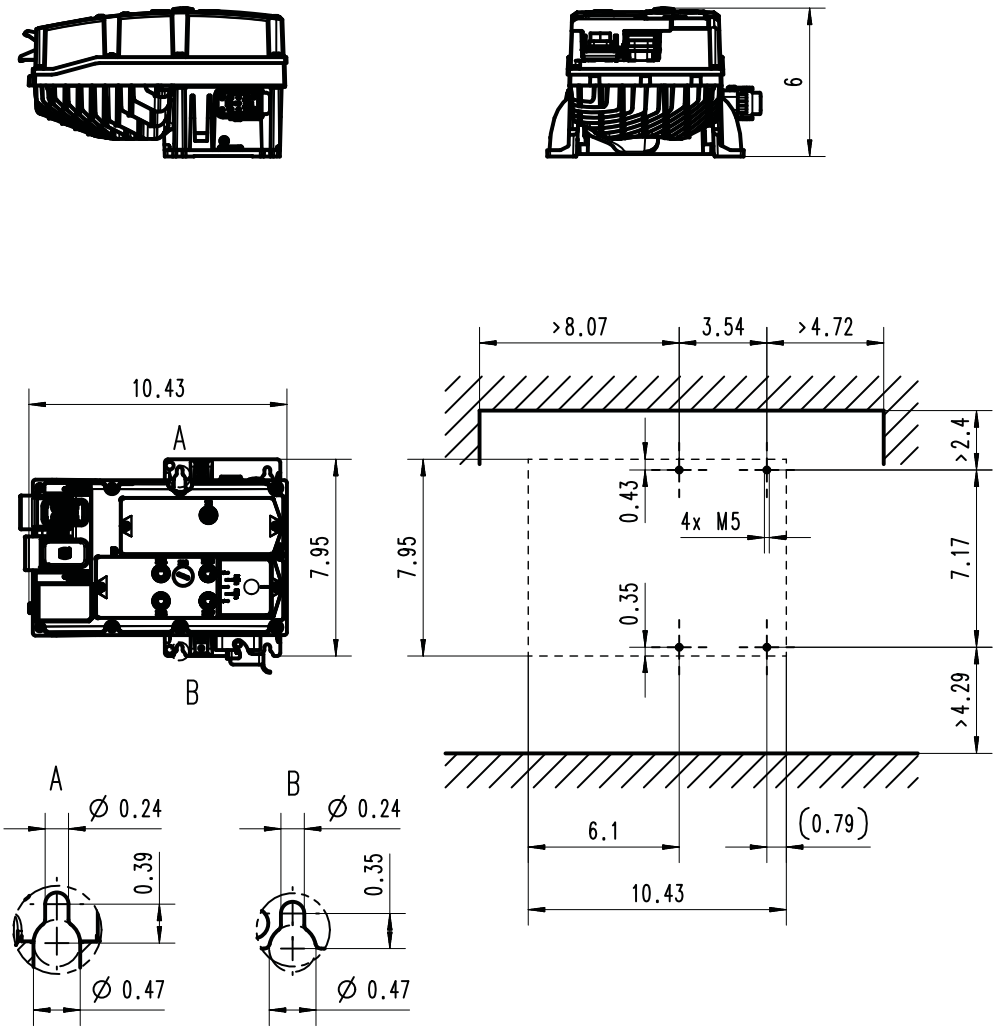
2 hp ... 7.5 hp

The dimensions in inch apply to:

2 hp	i□□□-M1.5/230-3	
3 hp	i□□□-M2.2/230-3	
4 hp	i□□□-M3.0/230-3	i□□□-M3.0/400-3
5 hp		i□□□-M4.0/400-3
7.5 hp		i□□□-M5.5/400-3
Weight	8.4 lb	8.4 lb



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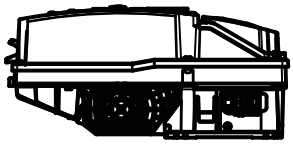
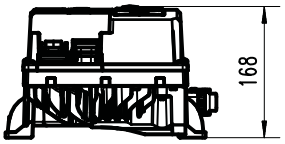
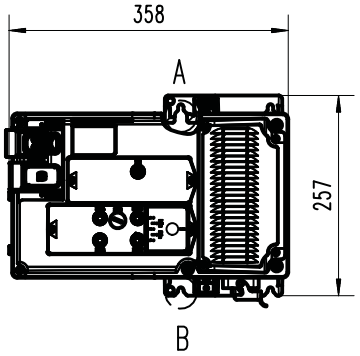
4 kW ... 11 kW

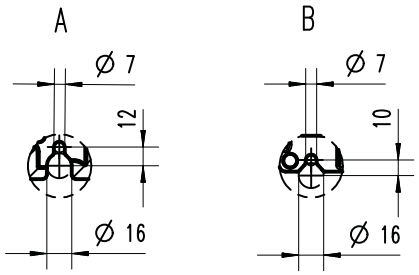
The dimensions in mm apply to:

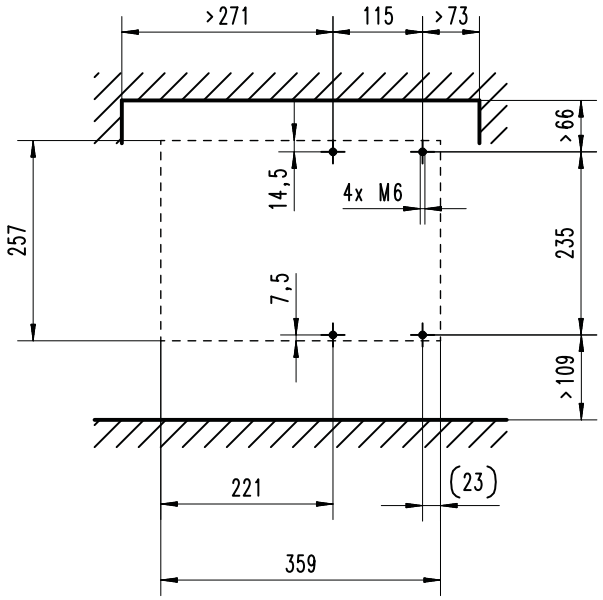
4 kW	i□□□-M4.0/230-3	
5.5 kW	i□□□-M5.5/230-3	
7.5 kW		i□□□-M7.5/400-3
11 kW		i□□□-M11/400-3
Weight	6 kg	6 kg











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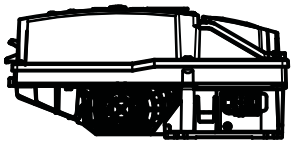
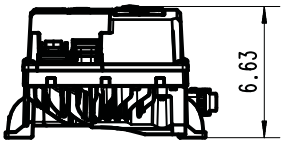
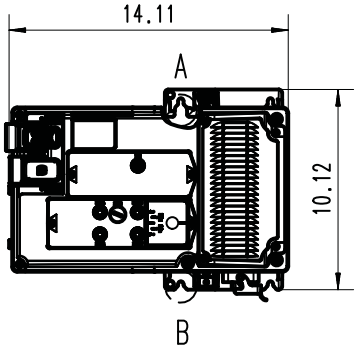
5 hp ... 15 hp

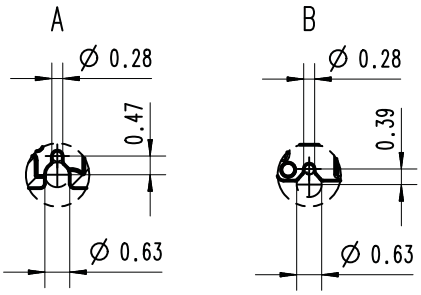
The dimensions in inch apply to:

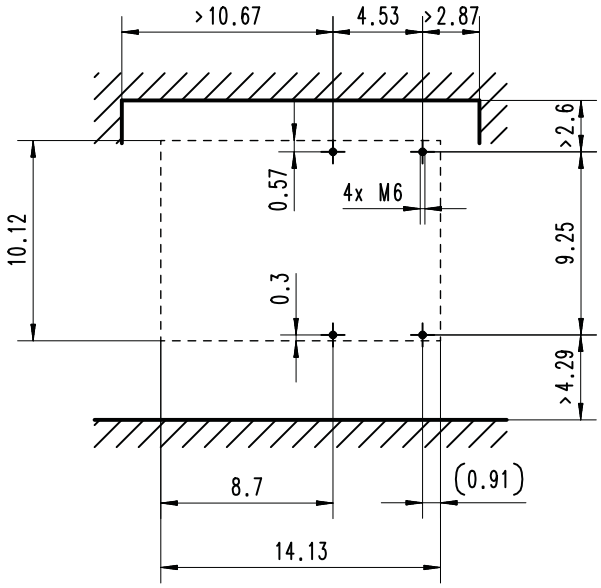
5 hp	i□□□-M4.0/230-3	
7.5 hp	i□□□-M5.5/230-3	
10 hp		i□□□-M7.5/400-3
15 hp		i□□□-M11/400-3
Weight	13.2 lb	13.2 lb











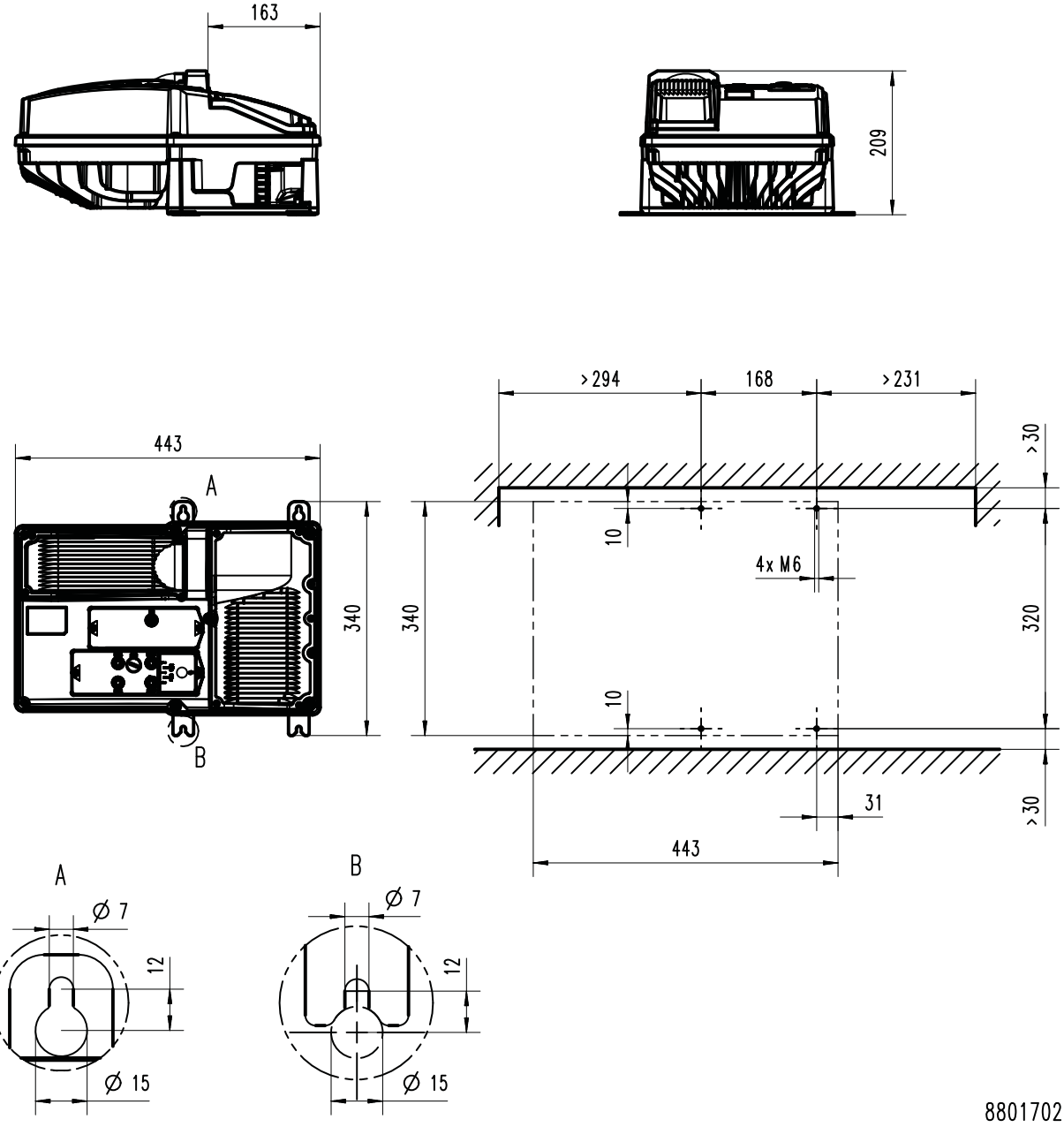
8801725

7.5 kW ... 45 kW

The dimensions in mm apply to:

7.5 kW	i□□□-M7.5/230-3	
11 kW	i□□□-M11/230-3	
15 kW	i□□□-M15/230-3	i□□□-M15/400-3
18.5 kW	i□□□-M18/230-3	i□□□-M18/400-3
22 kW	i□□□-M22/230-3	i□□□-M22/400-3
30 kW		i□□□-M30/400-3
37 kW		i□□□-M37/400-3
45 kW		i□□□-M45/400-3
Weight	13.3 kg	13.3 kg

Motor connection design: Wall adapter for cable gland (M40)

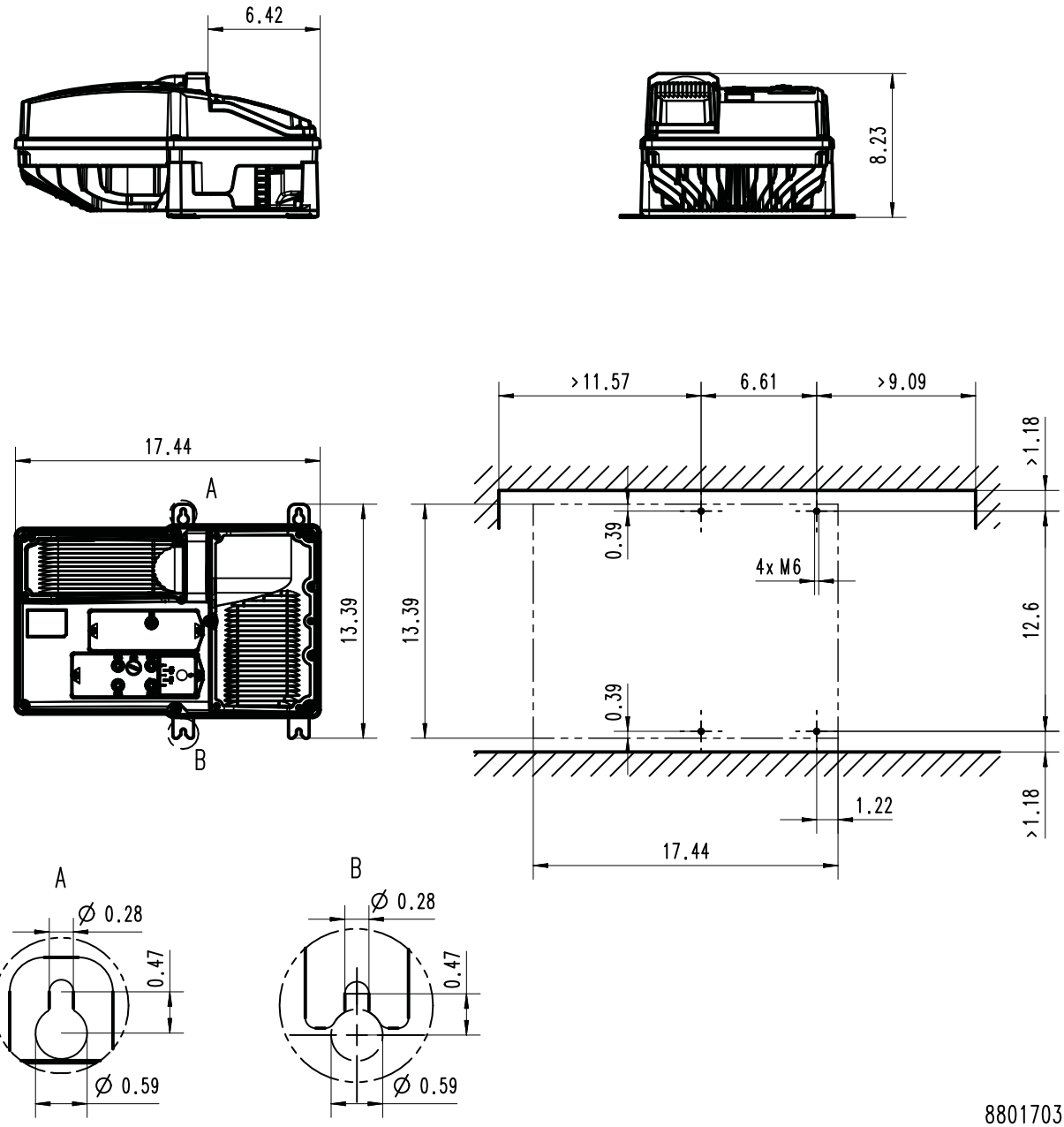


10 hp ... 60 hp

The dimensions in inch apply to:

10 hp	i□□□-M7.5/230-3	
15 hp	i□□□-M11/230-3	
20 hp	i□□□-M15/230-3	i□□□-M15/400-3
25 hp	i□□□-M18/230-3	i□□□-M18/400-3
30 hp	i□□□-M22/230-3	i□□□-M22/400-3
40 hp		i□□□-M30/400-3
50 hp		i□□□-M37/400-3
60 hp		i□□□-M45/400-3
Weight	29.3 lb	29.3 lb

Motor connection design: Wall adapter for cable gland (M40)

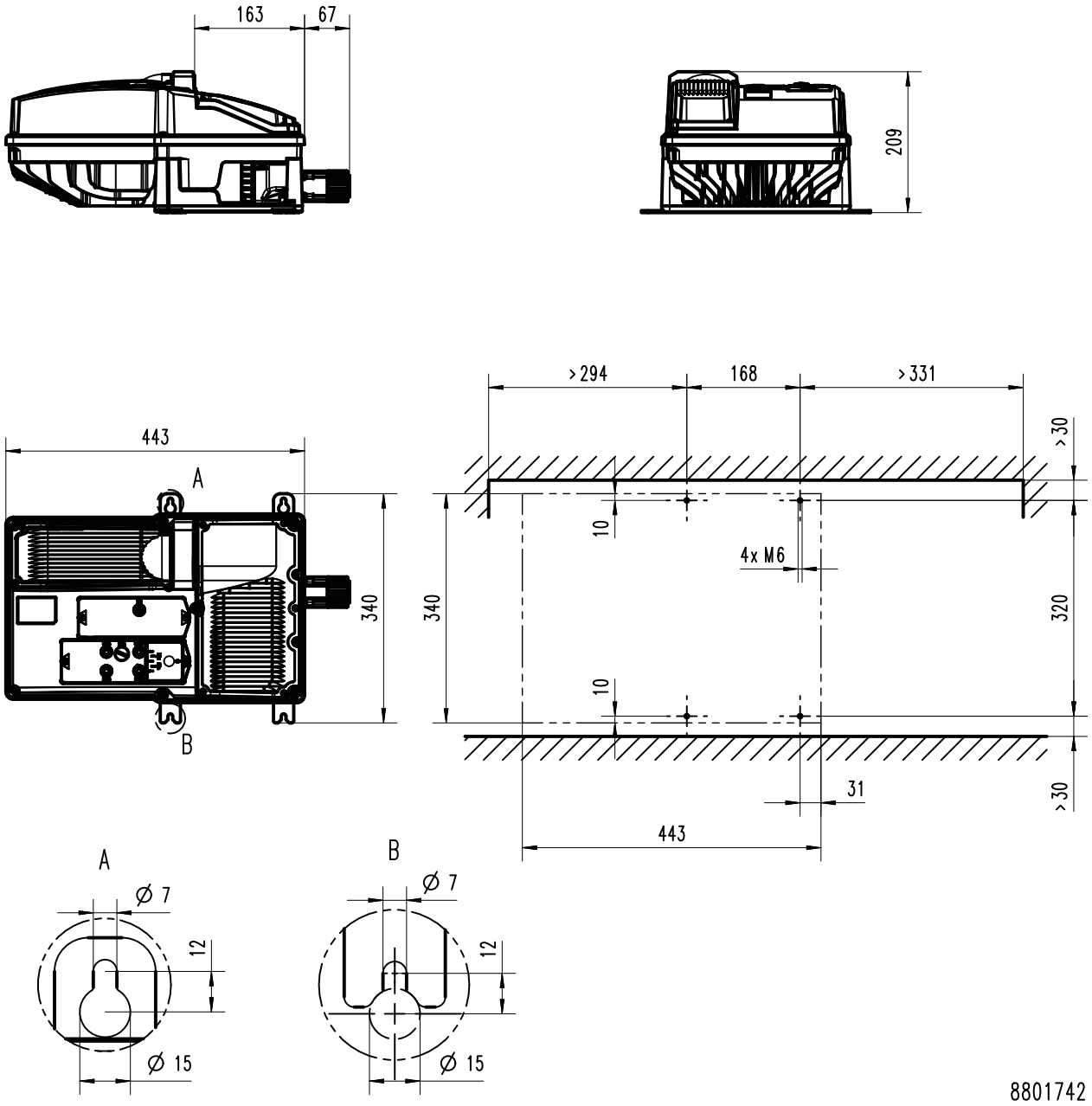


7.5 kW ... 22 kW

The dimensions in mm apply to:

7.5 kW	i□□□-M7.5/230-3	
11 kW	i□□□-M11/230-3	
15 kW		i□□□-M15/400-3
18.5 kW		i□□□-M18/400-3
22 kW		i□□□-M22/400-3
Weight	13.3 kg	13.3 kg

Motor connection design: Wall adapter with M40

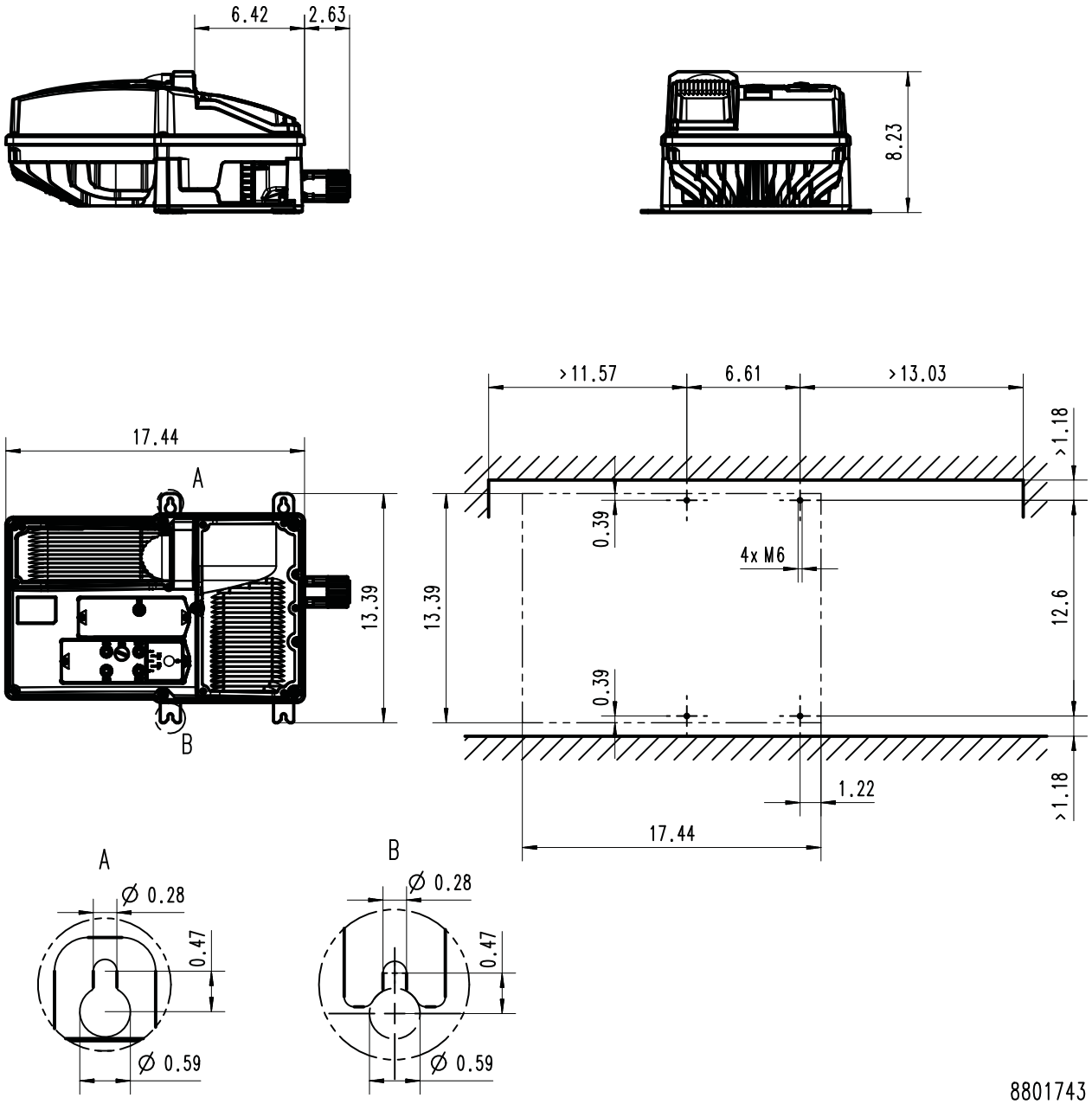


10 hp ... 30 hp

The dimensions in inch apply to:

10 hp	i□□□-M7.5/230-3	
15 hp	i□□□-M11/230-3	
20 hp		i□□□-M15/400-3
25 hp		i□□□-M18/400-3
30 hp		i□□□-M22/400-3
Weight	29.3 lb	29.3 lb

Motor connection design: Wall adapter with M40



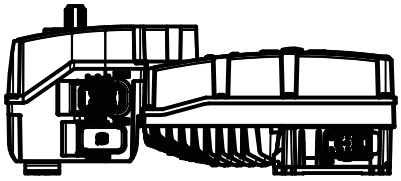
Inverters with extension box, Design/installation: wall

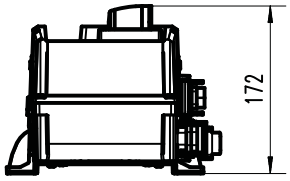
The specified installation clearances are minimum dimensions to ensure a sufficient air circulation for cooling purposes. They do not consider the bend radiuses of the connecting cables.

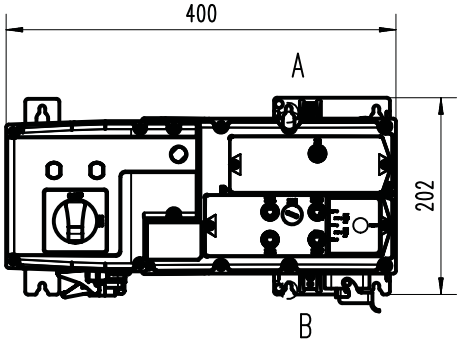
0.37 kW ... 2.2 kW

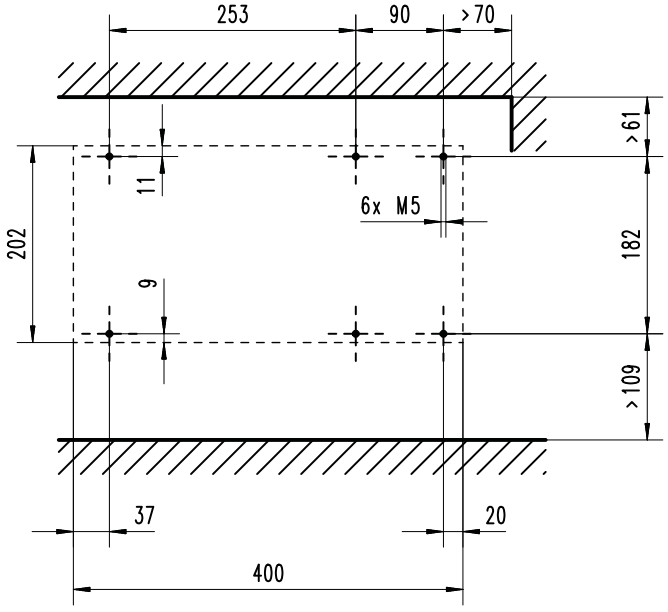
The dimensions in mm apply to:

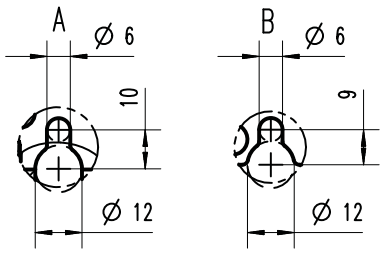
0.37 kW	i□□□-M0.37/230-3	i□□□-M0.37/400-3
0.55 kW	i□□□-M0.55/230-3	i□□□-M0.55/400-3
0.75 kW	i□□□-M0.75/230-3	i□□□-M0.75/400-3
1.1 kW	i□□□-M1.1/230-3	i□□□-M1.1/400-3
1.5 kW	i□□□-M1.5/230-3	i□□□-M1.5/400-3
2.2 kW	i□□□-M2.2/230-3	i□□□-M2.2/400-3
Weight	4.3 kg	4.3 kg









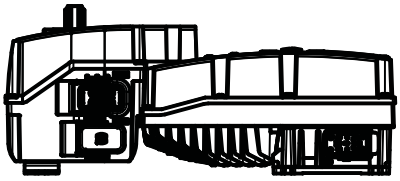


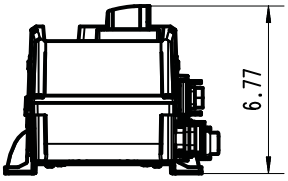
8801653

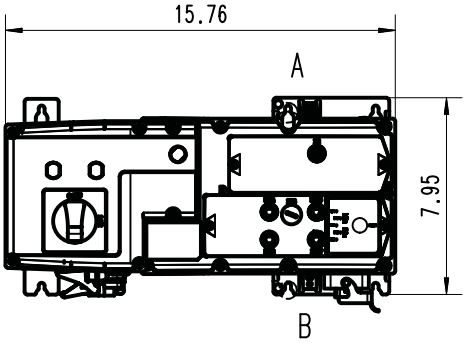
0.5 hp ... 3 hp

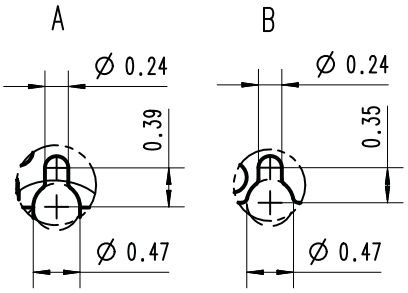
The dimensions in inch apply to:

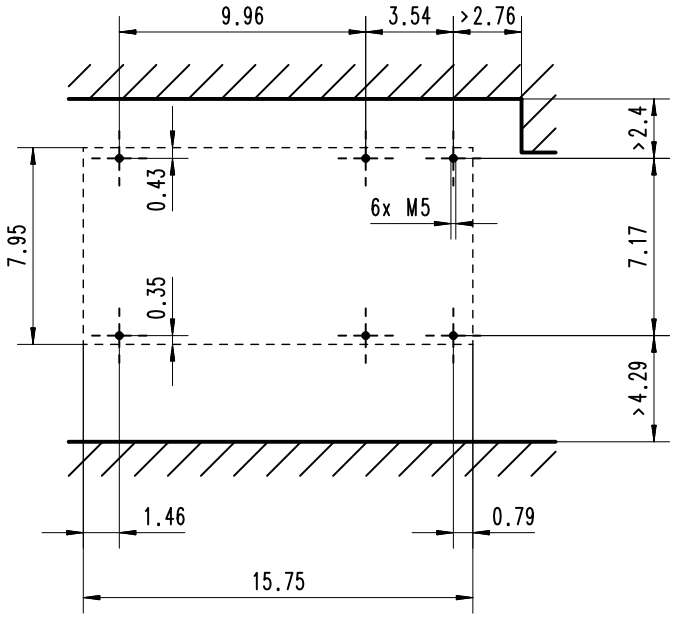
0.5 hp	i□□□-M0.37/230-3	i□□□-M0.37/400-3
0.75 hp	i□□□-M0.55/230-3	i□□□-M0.55/400-3
1 hp	i□□□-M0.75/230-3	i□□□-M0.75/400-3
1.5 hp	i□□□-M1.1/230-3	i□□□-M1.1/400-3
2 hp	i□□□-M1.5/230-3	i□□□-M1.5/400-3
3 hp	i□□□-M2.2/230-3	i□□□-M2.2/400-3
Weight	9.5 lb	9.5 lb









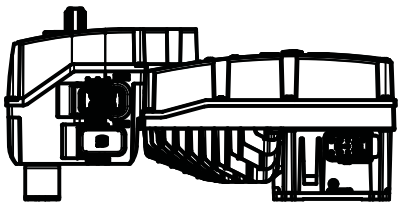


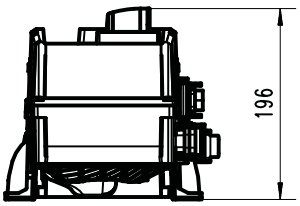
8801654

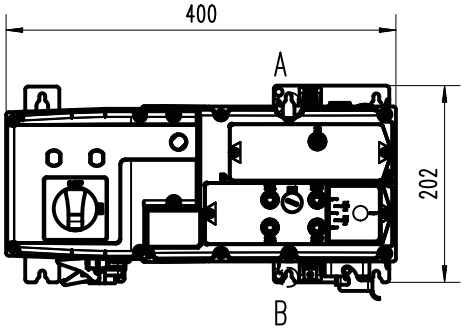
3 kW ... 5.5 kW

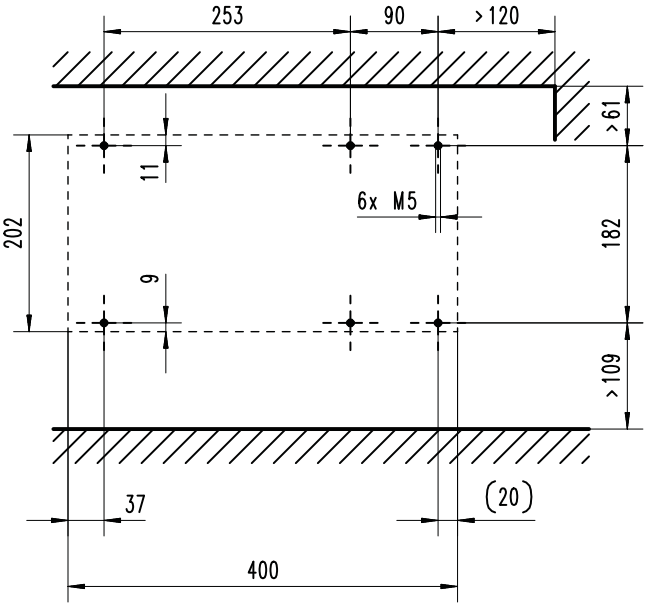
The dimensions in mm apply to:

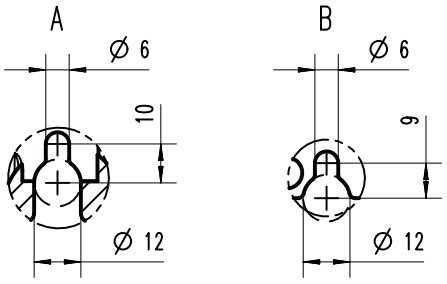
3 kW	i□□□-M3.0/230-3	i□□□-M3.0/400-3
4 kW		i□□□-M4.0/400-3
5.5 kW		i□□□-M5.5/400-3
Weight	5 kg	5 kg









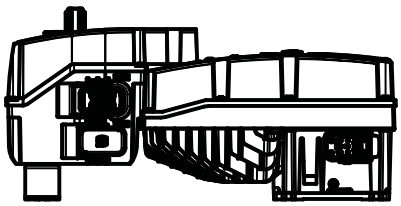


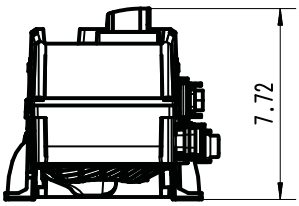
8801655

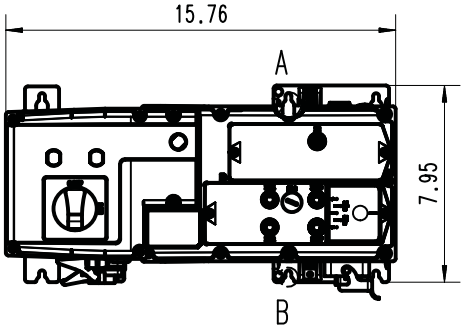
4 hp ... 7.5 hp

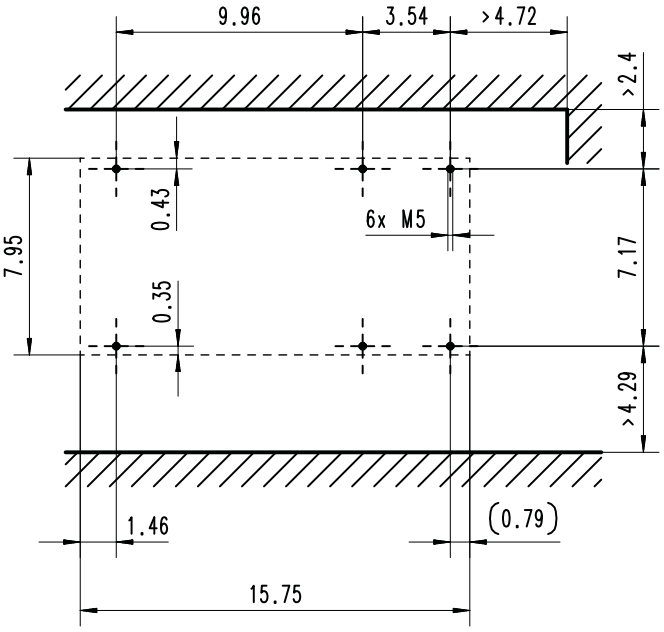
The dimensions in inch apply to:

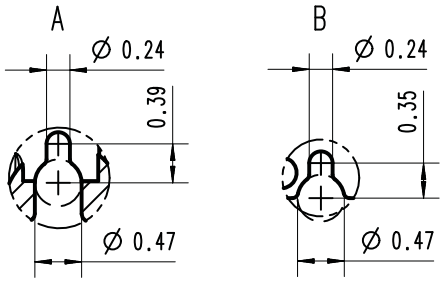
4 hp	i□□□-M3.0/230-3	i□□□-M3.0/400-3
5 hp		i□□□-M4.0/400-3
7.5 hp		i□□□-M5.5/400-3
Weight	11 lb	11 lb









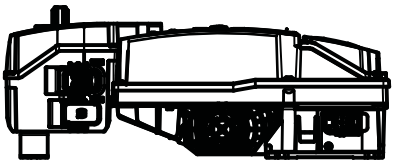


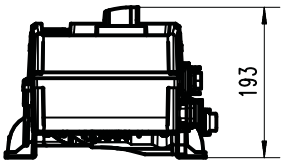
8801656

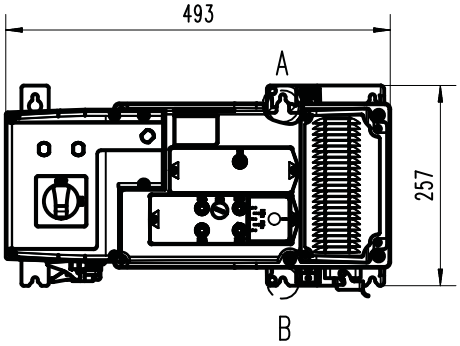
4 kW ... 11 kW

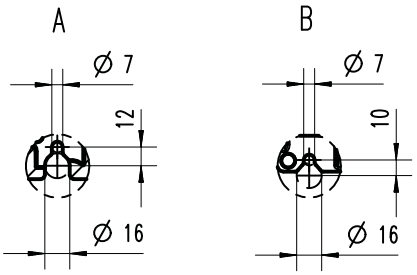
The dimensions in mm apply to:

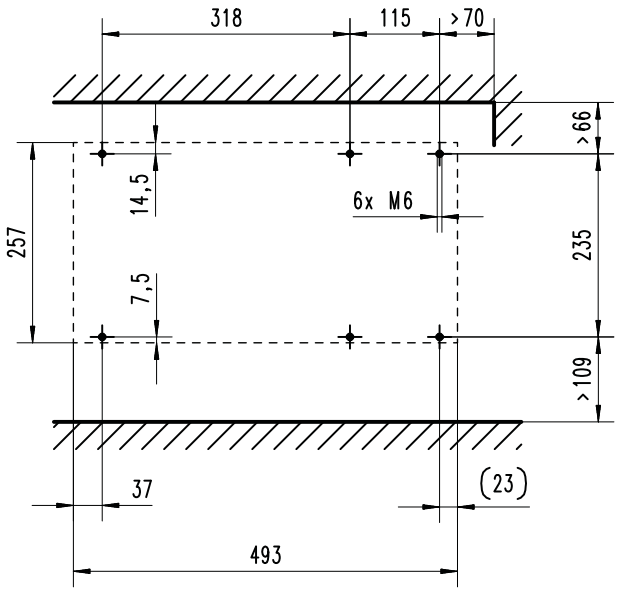
4 kW	i□□□-M4.0/230-3	
5.5 kW	i□□□-M5.5/230-3	
7.5 kW		i□□□-M7.5/400-3
11 kW		i□□□-M11/400-3
Weight	7.4 kg	7.4 kg









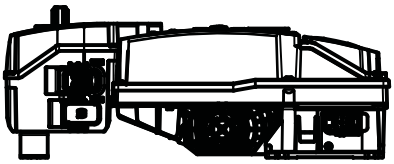


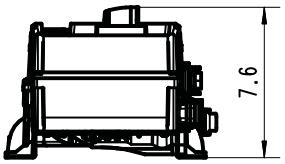
8801726

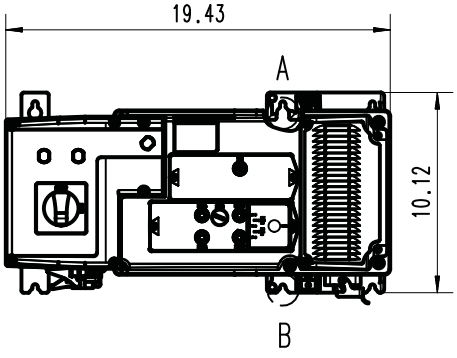
5 hp ... 15 hp

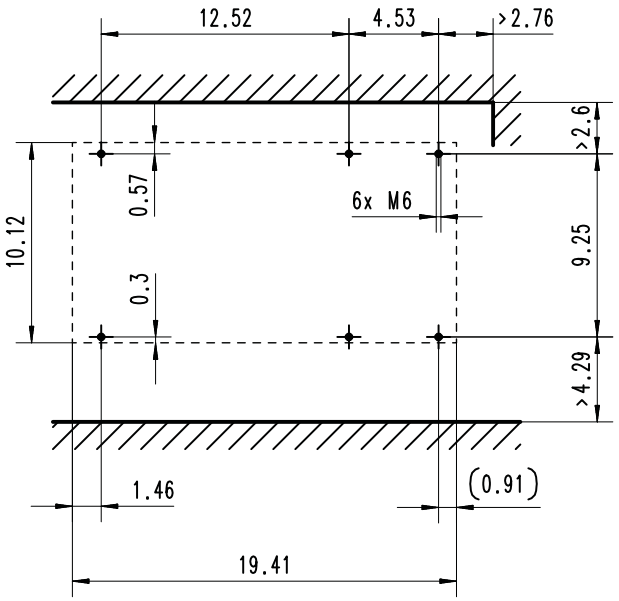
The dimensions in inch apply to:

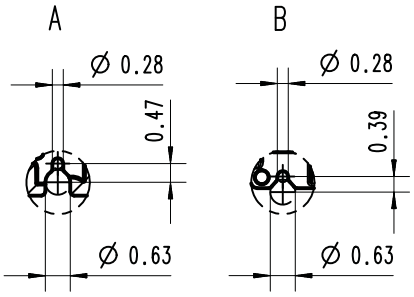
5 hp	i□□□-M4.0/230-3	
7.5 hp	i□□□-M5.5/230-3	
10 hp		i□□□-M7.5/400-3
15 hp		i□□□-M11/400-3
Weight	16.3 lb	16.3 lb











8801727

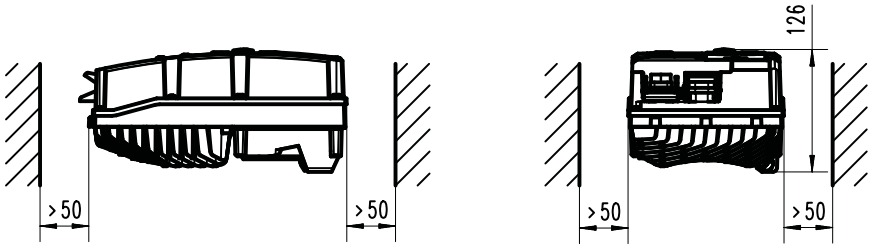
Inverters without extension box, Design/installation: motor

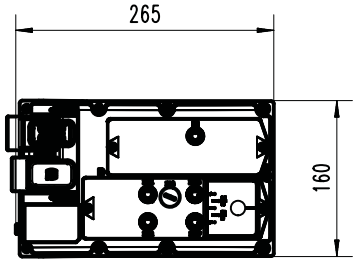
The specified installation clearances are minimum dimensions to ensure a sufficient air circulation for cooling purposes. They do not consider the bend radiuses of the connecting cables.

0.37 kW ... 2.2 kW

The dimensions in mm apply to:

0.37 kW	i□□□-M0.37/230-3	i□□□-M0.37/400-3
0.55 kW	i□□□-M0.55/230-3	i□□□-M0.55/400-3
0.75 kW	i□□□-M0.75/230-3	i□□□-M0.75/400-3
1.1 kW	i□□□-M1.1/230-3	i□□□-M1.1/400-3
1.5 kW		i□□□-M1.5/400-3
2.2 kW		i□□□-M2.2/400-3
Weight	2.9 kg	2.9 kg



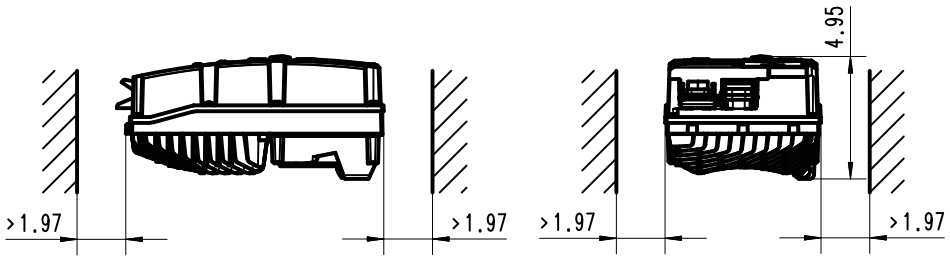


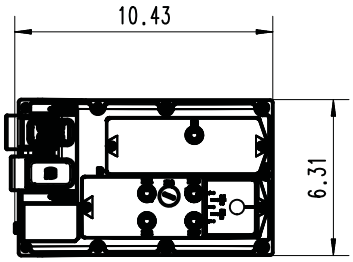
8801680

0.5 hp ... 3 hp

The dimensions in inch apply to:

0.5 hp	i□□□-M0.37/230-3	i□□□-M0.37/400-3
0.75 hp	i□□□-M0.55/230-3	i□□□-M0.55/400-3
1 hp	i□□□-M0.75/230-3	i□□□-M0.75/400-3
1.5 hp	i□□□-M1.1/230-3	i□□□-M1.1/400-3
2 hp		i□□□-M1.5/400-3
3 hp		i□□□-M2.2/400-3
Weight	6.4 lb	6.4 lb



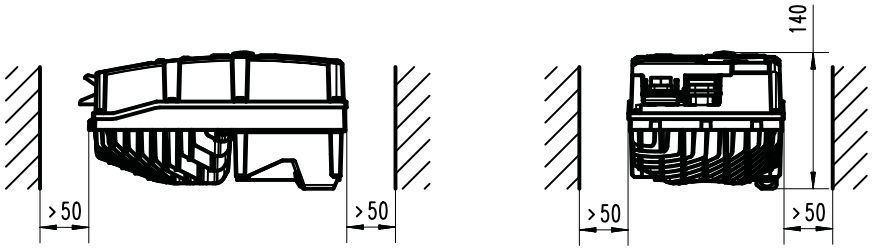


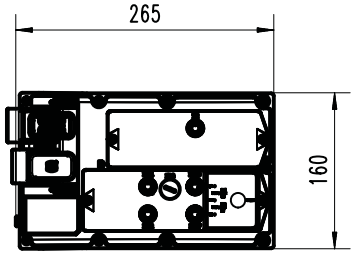
8801681

1.5 kW ... 5.5 kW

The dimensions in mm apply to:

1.5 kW	i□□□-M1.5/230-3	
2.2 kW	i□□□-M2.2/230-3	
3 kW	i□□□-M3.0/230-3	i□□□-M3.0/400-3
4 kW		i□□□-M4.0/400-3
5.5 kW		i□□□-M5.5/400-3
Weight	3.4 kg	3.4 kg



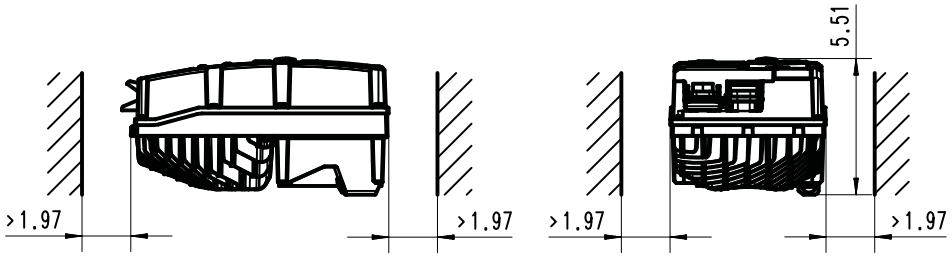


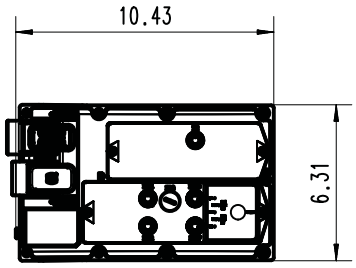
8801682

2 hp ... 7.5 hp

The dimensions in inch apply to:

2 hp	i□□□-M1.5/230-3	
3 hp	i□□□-M2.2/230-3	
4 hp	i□□□-M3.0/230-3	i□□□-M3.0/400-3
5 hp		i□□□-M4.0/400-3
7.5 hp		i□□□-M5.5/400-3
Weight	7.5 lb	7.5 lb



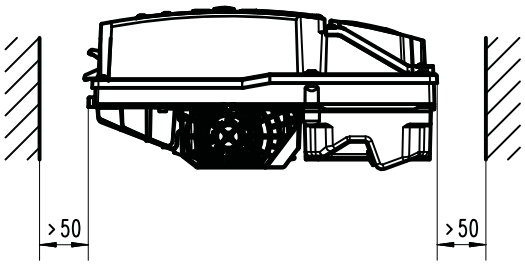


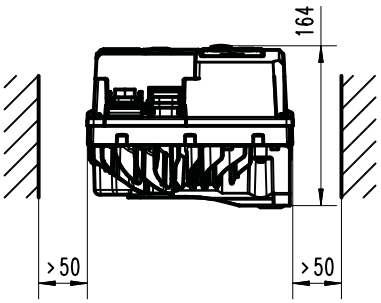
8801683

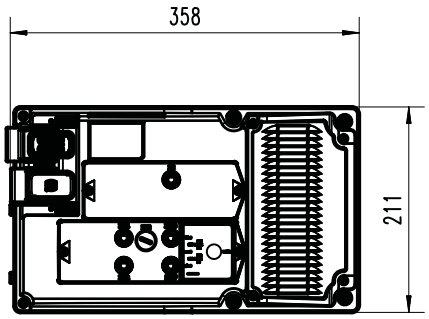
4 kW ... 11 kW

The dimensions in mm apply to:

4 kW	i□□□-M4.0/230-3	
5.5 kW	i□□□-M5.5/230-3	
7.5 kW		i□□□-M7.5/400-3
11 kW		i□□□-M11/400-3
Weight	5.4 kg	5.4 kg





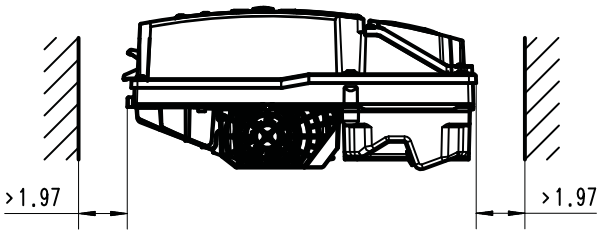


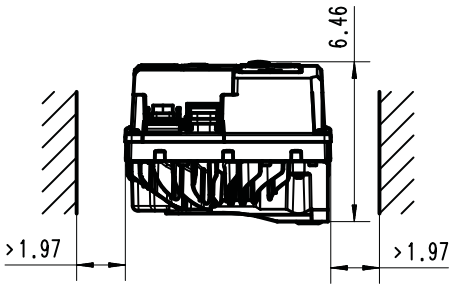
8801722

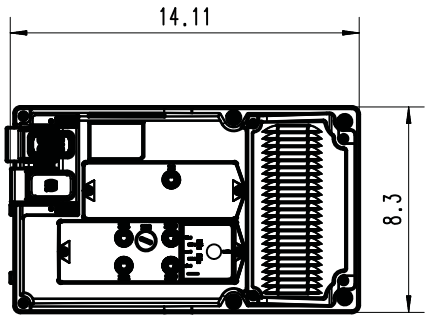
5 hp ... 15 hp

The dimensions in inch apply to:

5 hp	i□□□-M4.0/230-3	
7.5 hp	i□□□-M5.5/230-3	
10 hp		i□□□-M7.5/400-3
15 hp		i□□□-M11/400-3
Weight	11.9 lb	11.9 lb





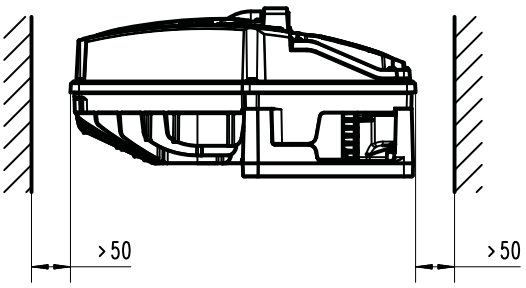


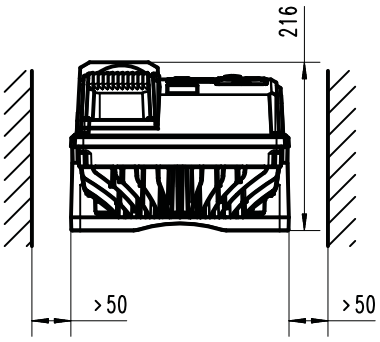
8801723

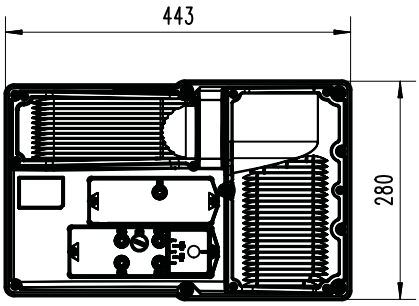
7.5 kW ... 45 kW

The dimensions in mm apply to:

7.5 kW	i□□□-M7.5/230-3	
11 kW	i□□□-M11/230-3	
15 kW	i□□□-M15/230-3	i□□□-M15/400-3
18.5 kW	i□□□-M18/230-3	i□□□-M18/400-3
22 kW	i□□□-M22/230-3	i□□□-M22/400-3
30 kW		i□□□-M30/400-3
37 kW		i□□□-M37/400-3
45 kW		i□□□-M45/400-3
Weight	12.5 kg	12.5 kg





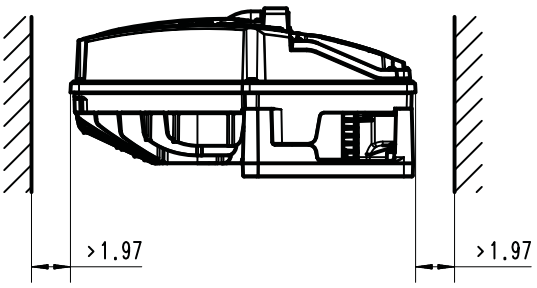


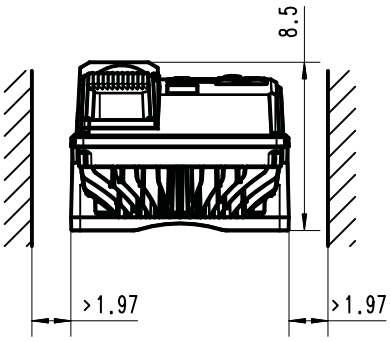
8801732

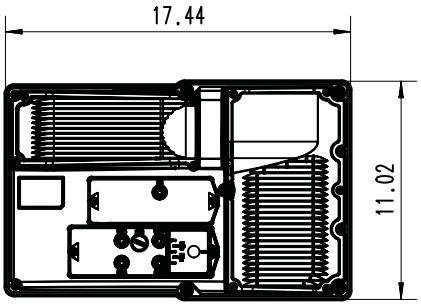
10 hp ... 60 hp

The dimensions in inch apply to:

10 hp	i□□□-M7.5/230-3	
15 hp	i□□□-M11/230-3	
20 hp	i□□□-M15/230-3	i□□□-M15/400-3
25 hp	i□□□-M18/230-3	i□□□-M18/400-3
30 hp	i□□□-M22/230-3	i□□□-M22/400-3
40 hp		i□□□-M30/400-3
50 hp		i□□□-M37/400-3
60 hp		i□□□-M45/400-3
Weight	27.6 lb	27.6 lb



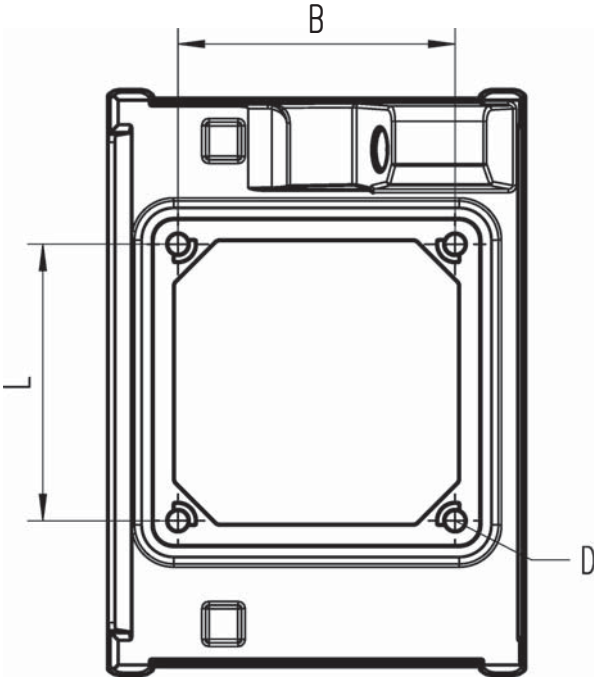




8801733

Motor adapter

Distance of the fixing screws



Motor design	L [mm]	B [mm]	D [mm]
BG063 - BG071	60	60	4.4
BG080 - BG112	73	73	5.4
BG132	82	82	6.4
BG160 - BG180	95	95	6.4

Product extensions

Overview

I/O extensions

By default, the inverters are equipped with either standard I/O or application I/O. In the device version with application I/O, four ports can be configured as IO-Link master ports to communicate with sensors and actuators (IO-Link devices).

▸ IO-Link 142

Networks

By default, the inverters are equipped with a network interface. When ordering, select the network required for your application. The ordered network is then preset in the inverter.

The following networks are available for selection:

▸ EtherCAT 143
▸ EtherNet/IP 144
▸ Modbus TCP 145
▸ PROFINET 146

The inverter itself has the firmware of all available networks on board and the user has the possibility to switch the inverter to another network.

Functional safety

The inverters can **optionally** be equipped with integrated functional safety.

▸ Functional safety 147

I/O extensions

I/O extensions

Depending on the device version (with standard I/O or application I/O), various functions are available that can be assigned to M12 connectors X3.1 ... X3.4 can be assigned.

Further details can be found in the following subchapters.

HTL encoder

Both standard I/O and application I/O support the connection of a single or dual track HTL encoder.

- A single-track HTL encoder (track A) cannot be used for motor speed feedback.
- A two-track HTL encoder (track A and B) must have a phase offset of exactly 90° between track A and B (error ≤ ± 10°). Inverted tracks are not required.
- Encoder increments: ≤ 16384 increments per revolution

Pulse-Train/Pulse-In

Both standard I/O and application I/O support the output of a reference frequency ("pulse train"). Other inverters can interpret this signal as a setpoint signal, for example.

The application I/O can also evaluate the signal of a low-cost HTL encoder or a reference frequency and accept it as a setpoint signal ("Pulse-In"). The detection of a direction signal ("pulse direction") is also supported here.

IO-Link

IO-Link

IO-Link is a registered trademark. It may only be used by members of the IO-Link community and non-members that have purchased the corresponding license. Detailed information on use can be found in the IO-Link Community Rules:

https://io-link.com

IO-Link is the standardized IO technology (IEC 61131-9) for communication with sensors and actuators. Point-to-point communication is based on the three-wire sensor and actuator connection without additional requirements concerning the cable material.

IO-Link is no fieldbus but the further development of the existing connection technology for sensors and actuators.

Bus-related information			
Name		IO-Link V 1.1	
Communication medium		Unshielded 3-wire standard cable	
Use		Connection of I/O-Link devices (port class A) to the inverter (I/O-Link master)	
Connection technology		M12 connector (A coded)	
Status display		1 LED	
Connection designation		X3.x: L+, C/Q, L-	

Technical data			
Topology			
Master - device		Tree (point to point)	
Station			
Type		Master	
Master - device		1:1	
Baud rate	kbps	230.4	COM3
Max. Length	m	20	
Max. cable length between IO-Link master and IO-Link device	m	20	
Process data IO-Link master			
Input		32 Byte	
Output		32 Byte	

Processing time of process data			
Cycle time	ms	2	

Networks

EtherCAT

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

General information			
Version		Optionally	
DC supply of the control electronics and optional fieldbus		Internally via the inverter	Network-dependent
		Alternatively: External supply to X100/24E ... GND	Mains-independent DC 24 ... 48 V (20.5 ... 49.9 V)

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		X396 (IN) X397 (OUT)	

Technical data			
Communication profile		EtherCAT	
		CANopen over EtherCAT	
		File over Ethernet (FoE)	
		Ethernet over EtherCAT (EoE)	
Safety over EtherCAT (FSoE)		No	
Vendor ID [hex]		0x3B	
Network topology		Line, tree, ring	
Device			
Type		EtherCAT slave	
Max. number		65535	In the entire network
Max. cable length	m	Not limited	The length between the devices is decisive.
Max. cable length between two devices	m	100	
Process data			PDOs can be configured for 1-, 2- and 4-byte parameters of the device
Transmit PDOs	Bytes	max. 32	
Receive PDOs	Bytes	max. 32	
Cycle time	ms	Integer multiple of 1 ms	

Communication time			
Communication time depends on		Processing time in the inverter	Time between start of a request and arrival of response
		Telegram runtime (baud rate, telegram length)	
		Nesting depth of network	
		Bus load	

Processing time of process data			
Update cycle	ms	1	In the inverter
Processing time	ms	0 ... 1	
Application task runtime of the technology application used (tolerance)	ms	1 ... x	

Other data
Note: There are no interdependencies between parameter data and process data.

EtherNet/IP

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

General information			
Version		Optionally	
DC supply of the control electronics and optional fieldbus		Internally via the inverter	Network-dependent
		Alternatively: External supply to X100/24E ... GND	Mains-independent DC 24 ... 48 V (20.5 ... 49.9 V)

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		X396 (IN) X397 (OUT)	

Technical data			
Communication profile		EtherNet/IP	
		AC Drive	
Bus terminating resistor		Not required	
Integrated bus terminating resistor		No	
Network topology			
Without repeater		Line, tree, ring	
With repeater		-	
Device			
Type		Adapter (Device)	
Max. number		254	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			PDOs can be configured for 1-, 2- and 4-byte parameters of the device
Transmit PDOs	Bytes	max. 32	
Receive PDOs	Bytes	max. 32	
Cycle time	ms	> 4	
Switching method		Store and forward Cut-through	
Switch latency	µs	~ 125	With maximum telegram length
Other data		Additional TCP/IP channel	

Communication time			
Communication time depends on		Processing time in the inverter	Time between start of a request and arrival of response
		Telegram runtime (baud rate, telegram length)	
		Nesting depth of network	
		Bus load	

Processing time of process data			
Update cycle	ms	1	In the inverter
Processing time	ms	0 ... 1	
Application task runtime of the technology application used (tolerance)	ms	1 ... x	

Other data
Note: There are no interdependencies between parameter data and process data.

Modbus TCP

Modbus is an internationally approved Ethernet-based communication protocol, designed for commercial and industrial automation applications.

General information			
Version		Optionally	
DC supply of the control electronics and optional fieldbus		Internally via the inverter	Network-dependent
		Alternatively: External supply to X100/24E ... GND	Mains-independent DC 24 ... 48 V (20.5 ... 49.9 V)

Bus-related information			
Name		Modbus TCP	
Communication medium		Ethernet 10 Mbps, 100 Mbps, half duplex, full duplex	
Use		Connection as a Modbus TCP server (secondary) to a client (primary)	
Status display		2 LEDs	
Connection designation		X396 (IN) X397 (OUT)	

Technical data			
Communication profile		Modbus/TCP	
Bus terminating resistor		Not required	
Integrated bus terminating resistor		No	
Network topology			
Without repeater		Line, tree, ring	
With repeater		-	
Device			
Type		Server	
Max. Number		254	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			
Transmit PDOs	Bytes	256	
Receive PDOs	Bytes	256	
Cycle time	ms	> 4	
Switching method		-	
Switch latency	µs	~ 125	At maximum telegram length
Other data		Additional TCP/IP channel	

Communication time			
Communication time depends on		Processing time in the inverter	Time between start of a request and arrival of response
		Telegram runtime (baud rate, telegram length)	
		Nesting depth of network	
		Bus load	

Processing time of process data			
Update cycle	ms	1	In the inverter
Processing time	ms	0 ... 1	
Application task runtime of the technology application used (tolerance)	ms	1 ... x	

Other data
Note: There are no interdependencies between parameter data and process data.

PROFINET

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

General information			
Version		Optionally	
DC supply of the control electronics and optional fieldbus		Internally via the inverter	Network-dependent
		Alternatively: External supply to X100/24E ... GND	Mains-independent DC 24 ... 48 V (20.5 ... 49.9 V)

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		X396 (IN) X397 (OUT)	

Technical data			
Communication profile		PROFINET	
Bus terminating resistor		Not required	
Integrated bus terminating resistor		Yes	
Network topology			
Without repeater		Line, tree, ring	
With repeater		-	
Device			
Type		IO device with real-time communication properties (RT) Conformance class B	
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			PDOs can be configured for 1-, 2- and 4-byte parameters of the device
Transmit PDOs	Bytes	max. 32	
Receive PDOs	Bytes	max. 32	
Cycle time	ms	1, 2, 4, 8, 16	
Switching method		Cut-through	
Other data		Additional TCP/IP channel	

Other data
Note: There are no interdependencies between parameter data and process data.

Functional safety

General information and basics

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 functional errors.

Protective devices prevent any human access to dangerous 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 functional safety

Integrated functional safety provides the conditions in the controls and drives to implement protective functions. Planning and installation expenditure is reduced. Using integrated functional safety increases machine functionality and availability. Integrated functional safety can be used for the protection of persons working on machines in accordance with the Machinery Directive.

Safety component

The safety component in the inverter provides the safe interfaces (e.g. safe inputs or safe network interfaces). If the STO safety function is requested, the safety component immediately brings about the torque-free state according to EN 61800-5-2.

In the "Advanced Safety" or "Extended Safety" version, the safety component also monitors safe compliance with the limit values. If monitored limit values are exceeded, the safety component reacts with safety functions according to EN 61800-5-2.

Safety components are marked in yellow.

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 functional safety 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 [UKCA: S.I. 2008/1597 - The Supply of Machinery (Safety) Regulations 2008] 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!

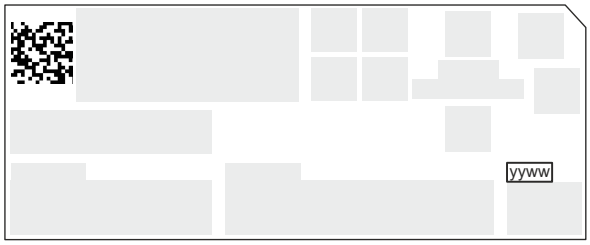
The mission time for the safety functions cannot be reset by a special proof test.

The specified mission time starts at the date of manufacture.

Mission time ▸ Safety-related data 🕮 171

Manufacturing date

The manufacturing date can be found on the nameplate:



yyww Year of manufacture and week of manufacture (2144 = CW 44 2021)

Stop functions

The stop functions differ according to how they are triggered:

- Normal stop (simple stop)
  - Triggering via a safe input (if available) with the parameterized stop function (e.g. STO or SS1).
  - Triggering via a safety bus by activating the corresponding bit (e.g. STO or SS1) in the control data.
- Emergency stop
  - The "Safe emergency stop (SSE)" safety function is required for an emergency stop.
  - Triggering via a safe input (if available) with the parameterized SSE function.
  - Triggering via a safety bus by activating the corresponding SSE bit in the control data.
  - 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.

Prioritisation

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

Hierarchy:

1. Safe torque off (STO)
   - STO has the highest priority and hence precedence over all other functions.
   - Functions that have already been initiated (e.g. SS1 or SS2) are canceled and the drive is switched off.
2. Safe stop 1 (SS1)
   - SS1 has priority over SS2.
   - Observing the defined stop time for SS1 and SS2 as well as the SS1 mode, the drive is rendered torqueless.

The monitoring functions have equal priorities and can be executed simultaneously with the stop function.

Acceptance

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

- The machine manufacturer must authorize a person as an inspector who can carry out the test on the basis of their technical training and knowledge of the safety functions.
- The inspector must document and sign the result of the test of each safety function in a test report.

A complete test includes:

- Document the installation including the safety functions:
  - Create an overview image of the installation.
  - Describe the installation.
  - Describe safety devices.
  - Document the safety functions used.
  - Complete validation of the safety functions used.
    (The validation must also include tests under fault conditions.)
- Create test report:
  - Document the functional test.
  - Check parameters.
  - Sign test report.
- Create an annex with test records:
  - Protocols for the installation.
  - External recordings

As of »EASY Starter« version 1.25, the »Safety-Validation Tool« is available. It accelerates the approval processes for safety applications:

- Guides the user through the test steps - no paper checklists.
- Saves test results - no copying and pasting of files created during the approval process.
- Avoids errors through automation - no manual work.
- Automatically generates all documents and files required for approval.

Video instructions for the "Safety Validation Tool"

Periodic inspections

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

The user must document these tests.

The correct sequence of the safety−oriented functions must be checked in periodic inspections. The risk analysis or applicable regulations determine the time distances between the tests.

The inspection interval should not exceed one year.

Device exchange

Exchange a maximum of one safe device before recommissioning.

The following procedure assumes that the safe parameter set for the application is available as a file. Otherwise, a complete commissioning of the functional safety must be carried out.

How to replace a safe device with Extended Safety:

Preconditions:

- The safe parameter set for the application is available as a file.
- There is an online connection between the engineering tool and the replacement device.

1. Check the compatibility of the replacement device.
2. Reset the safe parameter set to the default settings if the replacement device was previously used for test purposes or for another application:
   a) In the **+Safety parameter list+**, execute the command "Reset safe parameter set in device".
   b) Enter password (default setting: "Lenze Safety").
   c) Confirm the query as to whether the safe parameter set in the device should be reset with "Yes".
3. Load the safe parameter set for the application from the file into the replacement device:
   a) In the **+Safety parameter list+**, execute the command "Load safe parameter set from file".
   b) Enter password (default setting: "Lenze Safety").
   c) Confirm the query as to whether the existing safe parameter set should be overwritten with the parameter set from the file with "Yes".
4. Transfer the safe parameter set to the replacement device.
5. Carry out a functional test.

Safe parameter setting

Safety parameters can only be set and transferred in the »EASY Starter« and »PLC Designer« via the **+safety parameter list+**. This dialog is available when you select a device with integrated safety technology or a safety module.

Open **+safety parameter list+**:

- »EASY Starter«: Open the **+safety parameter list+** tab.
- »PLC Designer«: Open the **Safety parameter set** object under the axis in the device tree.

The safe parameterization is checked for plausibility.

The plausibility check rejects ambiguous or contradictory settings until they have been parameterized correctly. Only then can the parameters be saved.

Safety address

The unambiguousness of an axis with safety functions in a drive system can be achieved by means of the safety address. The parameter set is saved in the safety option (and, depending on the device, on the SD card) with a unique safety address. When initializing the safety option, i.e. when loading the safe parameter set, the safety address is checked for conformity. If no compliance exists, an initialization error is reported.

- In drive systems with activated PROFIsafe or FSoE safety bus, the safety address is also used as the safety bus target address. The unique assignment of the safety address must be configured in the safety PLC.
- In drive systems without activated safety bus or with CIP Safety™ safety bus, unambiguousness and correct assignment of the safety address must be checked. For this purpose, use the »Easy Starter« or the »PLC Designer«.

Clearly define the safety address in a drive system or plant.

Document the safety address in circuit diagrams and markings.

If the device detects a changed safety address during initialization, the device requests an acknowledgement with confirmation button S82.

Acknowledgement with confirmation button S82

If the device detects a modified parameter set or a changed safety address during initialization, for example, the device requests an acknowledgement with confirmation button S82.

Display for requested acknowledgement

LED "RDY" (yellow)	LED "ERR" (red)	Status	Meaning
on	off	Restart acknowledgement requested	The device is working correctly.
	blinking red 1 Hz		During start-up, a modified parameter set was detected in the "Init" state.
	blinking red 2 Hz		During start-up, a changed safety address was detected in the "Init" state.

All requests are acknowledged with the same steps.

The acknowledgement procedure is aborted if the reaction time of 2.5 seconds is exceeded. The acknowledgement procedure must be repeated.

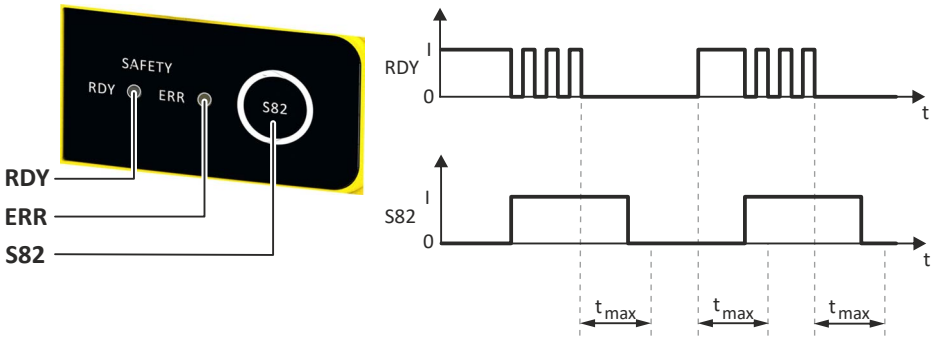


Fig. 6: Sequence of the acknowledgement procedure

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

To acknowledge the request with the S82 confirmation button:

Precondition:

- 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 after a maximum of 2.5 seconds.
   The "RDY" LED is lit.
4. Press and hold the S82 button after a maximum of 2.5 seconds.
   The "RDY" LED starts blinking.
5. The "RDY" LED goes off after 3 seconds.
6. Release the S82 button after a maximum of 2.5 seconds.
   The acknowledgement is successfully completed.

   The action is recorded in the inverter logbook.
7. Use a function test to ensure that the acknowledgement has led to the correct result.

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

Safe interfaces

Overview: Safe interfaces in Lenze inverters

Functional safety design	Products	Safe inputs	Safe output	Safe network interfaces		
				PROFIsafe	FSoE	CIP Safety™
Basic Safety - STO	i550, i650, i750, i950	1 (STO)				
Advanced Safety - L	i750 cabinet				●	
Extended Safety - S	i650 motec					●
Extended Safety - L	i750 cabinet				●	
Extended Safety - LT	i950 cabinet	4	●	●	●	

Abbreviations used:

CIP	Common Industrial Protocol	155
FSoE	FailSafe over EtherCAT	-
PROFIsafe	Process field safety	-
STO	Safe torque off (STO)	160

The i550/i650 motec frequency inverter is available in the following functional safety versions:

- Basic Safety - STO
- Extended Safety - S (only available for i650 motec)

Safe inputs

Function included in variant:	Basic Safety - STO		

The components used must comply with the risk reduction required for the application.

Passive sensors

Passive sensors are 2-channel switching elements with contacts.

Please note the following:

- The switches must be wired according to the closed-circuit principle.
- Passive sensors are connected to the inverter via a safety switching device.
- An external safety component must monitor the connecting cables and the function of the sensors if complete exclusion of faults cannot be guaranteed.

The contacts must switch at the same time (equivalent). Safety functions will be activated if only one channel is switched. Switching of only one channel points to faulty sensors or impermissible wiring.

Examples of passive sensors:

- Door contact switch
- Emergency stop control units

Active sensors

Active sensors are units with 2-channel semiconductor outputs (OSSD outputs).

Test pulses for monitoring the outputs and cables are permissible.

P/M-switching sensors switch the positive and negative cable or the signal and ground cable of a sensor signal.

Please note the following:

- The maximum permissible connection capacity of the outputs.
- Active sensors are connected directly to the inverter.
- Monitoring for short circuits must be carried out by the active sensor.

The outputs must switch at the same time (equivalent). Safety functions will be activated if only one channel is switched. The active control of only one channel points to faulty sensors or impermissible wiring.

Examples of active sensors:

- Lightgrid
- Laser scanner
- Controllers

Further information on connecting passive and active sensors

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Safe network interfaces

CIP Safety connection

Function included in variant:			Extended Safety

CIP Safety™ is the certified safety protocol for the transmission of safety-related data via EtherNet/IP® in accordance with the specification "The CIP Networks Library Volume 5 CIP Safety" of the Open DeviceNet Vendor Association (ODVA).

Preconditions

- The CIP Safety™ safety protocol is supported (bit 2 in 0x212C:003 is set).
- The network selection is set to "EtherNet/IP".
- Current EDS file
  - The EDS file can be used to integrate Lenze EtherNet/IP devices into the EtherNet/IP configuration software of PLC manufacturers.
  - Download of the EDS file

Configure safety configuration

- Before integrating the inverter into a safety network, the safe parameter set must be reset for each device.
- The "Safety Network Number" (SNN) must be unique for each safety network or safety subnet in the entire system.
- The user must carefully check the effects of device combinations with different SIL levels in the safety network.

Verify safety configuration

- The signature of the security configuration (SCID) is automatically verified via the checksums.
- The user must visually check whether all safe configuration data has been correctly downloaded to the inverter.
- When a safety device is configured directly from a workstation, the user must compare the transferred SCID data and configuration data with the SCID data and configuration data originally viewed in the workstation.
- If the user configures safety connections with a SCID = 0, the user is responsible for ensuring that the originator (safety master) and target (inverter) are configured correctly.

Please note the following:

- This configuration setting bypasses the standard, automated safety configuration check!
- This poses a higher risk to the safety integrity of the system.

Test and validate safety configuration

- After installation, after each change to the safety configuration and after a device replacement, the user must test the safety configuration loaded into the inverter with user tests:
  - To test and verify the configuration of an originator with connection data, it must first be downloaded to the inverter. This is the only way to confirm the SCID of the inverter.
  - Check the signature of the safety configuration (SCID). Only then can the safety configuration be considered verified.
  - Check and prove the operability of the safety configuration used.
  - Test the configurations of the safety connections after they have been applied in the originator (safety master). Only then is it ensured that the target connection functions as intended.
- Further information:
  - Acceptance 📖 149
  - Periodic inspections 📖 150
  - Device exchange 📖 150

Extended Safety

Structure of the CIP Safety output data (instance ID: 161)

The safety controller transmits CIP Safety output data (control commands) to the inverter:

- Data length: 24 bytes
- Control commands are LOW-active, the bit state "0" activates the function.
- Exceptions: See details in the table.
  The detail "0↗1" means a change of state from "0" to "1".

Byte offset	Bit offset							
	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	AIE (0↗1)	-	-	-	-	-	SS1	STO
Byte 1	-	-	-	-	-	-	-	AIS (0↗1)
Byte 2	-	-	-	-	-	-	-	-
Byte 3	-	-	-	-	-	-	-	-
Byte 4	-							
Byte 5	-							
Byte 6	-							
Byte 7	-							
Byte 8	Mode Byte							
Byte 9	CRC-S3 (low-byte)							
Byte 10	CRC-S3 (high-byte)							
Byte 11	Complement Data							
Byte 12								
Byte 13								
Byte 14								
Byte 15								
Byte 16								
Byte 17								
Byte 18								
Byte 19	CRC-S5_0							
Byte 20	CRC-S5_1							
Byte 21	Timestamp16 (low-byte)							
Byte 22	Timestamp16 (high-byte)							
Byte 23	CRC-S5_2							

Structure of the CIP Safety input data (instance ID: 171)

The inverter transmits CIP Safety input data (status information) to the safety controller:

- Data length: 32 bytes
- Status information is HIGH-active, the bit status "1" indicates the active status information.

CIP Safety-Inputdaten (Statusinformationen) sendet der Umrichter an die Sicherheitssteuerung:

Byte offset	Bit offset							
	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	Error active	-	-	-	-	-	-	STO active
Byte 1	-	-	-	-	-	-	-	SS1 active
Byte 2	-	-	-	-	-	-	-	-
Byte 3	-	-	-	-	-	-	-	-
Byte 4	-	-	-	-	-	-	-	-
Byte 5	-	-	-	-	MUT active	-	.	-
Byte 6	-	-	-	-	-	-	-	-
Byte 7	-	-	-	-	-	-	-	-
Byte 8	-							
Byte 9	-							
Byte 10	-							
Byte 11	-							
Byte 12	Mode Byte							
Byte 13	CRC-S3 (low-byte)							
Byte 14	CRC-S3 (high-byte)							
Byte 15	Complement Data							
Byte 16								
Byte 17								
Byte 18								
Byte 19								
Byte 20								
Byte 21								
Byte 22								
Byte 23								
Byte 24								
Byte 25								
Byte 26								
Byte 27	CRC-S5_0							
Byte 28	CRC-S5_1							
Byte 29	Timestamp16 (low-byte)							
Byte 30	Timestamp16 (high-byte)							
Byte 31	CRC-S5_2							

Safety functions

Overview: Safety functions in Lenze inverters

Functional safety design	Products	Stop functions							Monitoring functions								Operation and diagnostics		
		Without feedback					With feedback		Without feedback			With feedback							
		STO	SS1	SSE	SBC	CAS	SS2	SOS	SMS	SLS	SSM	SDI	SLI	PDSS	SLP	SCA	MUT	Safety bus	I/Os
Basic Safety - STO	i550, i650, i750, i950	●																	●
Advanced Safety - L	i750 cabinet	●	●		●												●	●	
Extended Safety - S	i650 motec	●	●														●	●	
Extended Safety - L	i750 cabinet	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	
Extended Safety - LT	i950 cabinet	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

Abbreviations used:

STO	Safe torque off (STO)	160
SS1	Safe stop 1 (SS1)	165
SSE	Safe stop emergency (SSE)	-
SBC	Safe brake control (SBC)	-
CAS	STO cascading (CAS)	-
SS2	Safe stop 2 (SS2)	-
SOS	Safe operating stop (SOS)	-
SMS	Safe maximum speed (SMS)	-
SLS	Safely-limited speed (SLS)	-
SSM	Safe speed monitor (SSM)	-
SDI	Safe direction (SDI)	-
SLI	Safely-limited increment (SLI)	-
PDSS	Position-dependent safe speed (PDSS)	-
SLP	Safely-limited position (SLP)	-
SCA	Safe cam (SCA)	-
MUT	Safe Muting (MUT)	168
I/Os	Safe inputs	154
	Safe output	-

The i550/i650 motec frequency inverter is available in the following functional safety versions:

- Basic Safety - STO
- Extended Safety - S (only available for i650 motec)

With the safety bus, a distinction is made between the PROFIsafe, FSoE and CIP Safety™ safety protocols. The "Extended Safety - S" version of the i650 motec frequency inverter supports the CIP Safety™ safety protocol. Further information can be found in the chapter "Safe network interfaces". 155

Note on the function diagrams shown in this chapter

In the function diagrams shown for each safety function, the y-axis is indicated by "n" (for speed).

In contrast to a servo inverter, the output frequency is decisive for a frequency inverter. Therefore, all trigger thresholds and limits for the frequency inverter must also be set in the form of frequency values in [Hz].

Safe torque off (STO)

The "Safe Torque Off (STO)" safety function safely switches off the drive. The drive coasts down.

STO corresponds to an uncontrolled shutdown according to EN 60204-1, category 0.

With STO, additional measures are required for an "emergency switching off" according to EN 60204-1.

▸ Basic Safety - STO 161

▸ Extended Safety 163

Basic Safety - STO

Function included in variant:	Basic Safety - STO		

Preconditions

- Additional measures are required to prevent movement caused by external forces.
- When assessing risk, also take into account overtravel distances.

Important notes

⚠ DANGER!

No "emergency switching off" in terms with EN 60204-1

With the "Safe torque off" (STO) function, no "emergency switching off" in terms with EN 60204-1 can be executed 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 switching off" requires electrical isolation, e. g. by a central mains contactor.

⚠ DANGER!

The power supply is not safely disconnected.

Possible consequences: Death or severe injuries due to electrical voltage.

► Turn off the power supply.

⚠ DANGER!

Uncontrolled rotation of the motor possible.

Possible consequences: Death or severe injuries

► Set the motor to standstill mechanically.

⚠ DANGER!

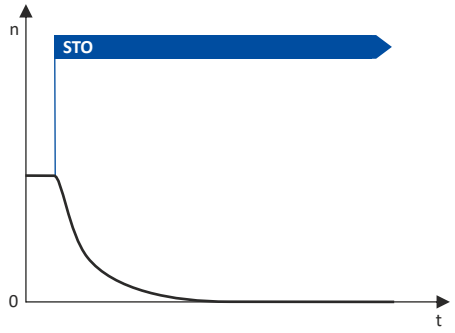
Automatic restart can occur if the request of the safety function is deactivated.

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.

Functional description

STO



- The transmission of the pulse width modulation is safely switched off by STO. The power drivers do not generate a rotating field anymore.
- The motor is safely switched to torqueless operation.

Activation

STO is activated via the safe input X1 with the channels SIA and SIB:

Safe input X1		Inverter device state
SIA	SIB	
LOW	LOW	STO active
LOW	HIGH	Impermissible state (drive disabled)
HIGH	LOW	
HIGH	HIGH	Drive enabled

If the GS connection is interrupted, or in case of a short circuit/cross-circuit of GS to SIA/SIB, STO is active.

Extended Safety

Function included in variant:			Extended Safety

Preconditions

- Additional measures are required to prevent movement caused by external forces.
- When assessing risk, also take into account overtravel distances.

Important notes

⚠ DANGER!

No "emergency switching off" in terms with EN 60204-1

With the "Safe torque off" (STO) function, no "emergency switching off" in terms with EN 60204-1 can be executed 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 switching off" requires electrical isolation, e. g. by a central mains contactor.

⚠ DANGER!

The power supply is not safely disconnected.

Possible consequences: Death or severe injuries due to electrical voltage.

► Turn off the power supply.

⚠ DANGER!

Uncontrolled rotation of the motor possible.

Possible consequences: Death or severe injuries

► Set the motor to standstill mechanically.

⚠ DANGER!

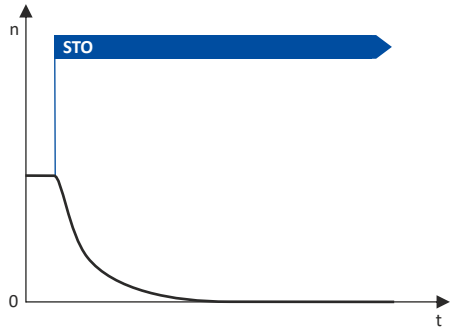
Automatic restart can occur if the request of the safety function is deactivated.

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.

Functional description

STO



- The transmission of the pulse width modulation is safely switched off by STO. The power drivers do not generate a rotating field anymore.
- The motor is safely switched to torqueless operation.

Activation

Directly:

- Via a safety bus
- Via a safe input (depending on the version)

Automatically after the safety functions have expired:

- Safe stop 1 (SS1)

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.

Safe stop 1 (SS1)

The "Safe Stop 1 (SS1)" safety function monitors whether a deceleration ramp in the application causes the drive to come to a standstill.

SS1 corresponds to a controlled stop according to EN 60204-1, stop category 1.

Safe stop 1 time controlled (SS1-t)

Function included in variant:			Extended Safety

SS1-t triggers the normal stop STO after the stop time has elapsed or after reaching standstill.

Preconditions

- A deceleration ramp in the application guides the drive to standstill.
- Additional measures are required to prevent movement caused by external forces.

Important notes

⚠ DANGER!

The power supply is not safely disconnected.

Possible consequences: Death or severe injuries due to electrical voltage.

► Turn off the power supply.

⚠ DANGER!

Uncontrolled rotation of the motor possible.

Possible consequences: Death or severe injuries

► Set the motor to standstill mechanically.

⚠ DANGER!

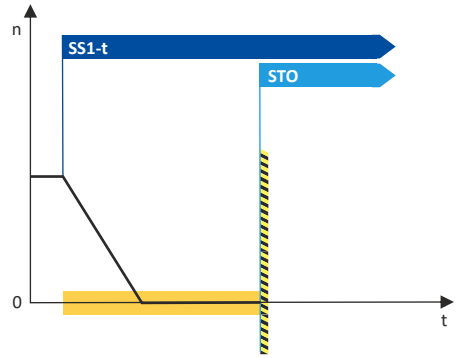
Automatic restart can occur if the request of the safety function is deactivated.

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.

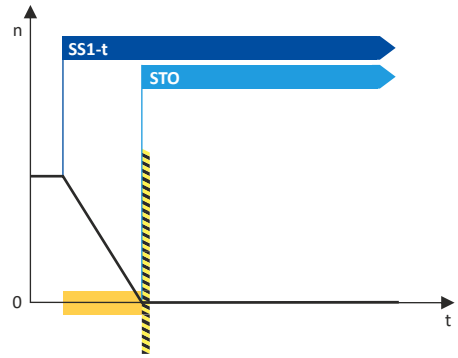
Functional description

SS1-t (STO after stop time)



- SS1-t activates the normal stop STO when the parameterized stop time has elapsed.
- If standstill has not yet been reached, the motor coasts down.

SS1-t (STO at standstill)



- SS1-t activates the normal stop STO when standstill is detected.
- A waiting time can also be parameterized.
  - The waiting time starts when the standstill is detected.
  - SS1-t activates the normal stop STO when the waiting time has elapsed.
- Detection of standstill:
  - Output frequency of the inverter ≤ 0.5 Hz for 100 ms

Activation

Directly:

- Via a safety bus
- Via a safe input (depending on the version)

Restart

- The restart sets the drive in motion after it was previously brought to a standstill via a stop function.
- Restarting is only possible after the stop time has elapsed completely.
- Whether the restart needs to be acknowledged or if it launches automatically can be parameterized in a manner dependent on the preceding stop function.

Error behavior

States that trigger an event and an error stop:

- The drive does not stop after the stop time has elapsed.
  - Event: SS1/SS2 - Stop time exceeded (0x2A00FF88)
  - Error stop STO

Safe Muting (MUT)

Function included in variant:			Extended Safety

This function deactivates all functions of the safety bus.

"Safe Muting" is used to move the drive even if the inverter is in a safety state.

- The function may only be used during commissioning or for maintenance work.
- The function is active for a maximum of 30 minutes.
- It can be ended at any time.

Preconditions

To activate the Safe Muting function, you need:

- A PC with »EASY Starter« or »PLC Designer«.
- A permanent communication link between engineering tool and inverter.
- In a network, the Safe Muting function can only be activated for one inverter at a time.
- The muting password was assigned via the password dialog in the**+Safety parameter list+**.
- The active safe parameter set in the inverter must contain the settings for safe muting:
  - The sources to be hidden.
  - The muting password.

Important notes

⚠ DANGER!

Activating the Safe Muting function deactivates safety functions!

Possible consequences: Death or severe injuries

► Only authorized personnel may activate the Safe Muting function.

► An emergency stop switch-off must be present that cannot be deactivated by Safe Muting.

Activation

How to activate and deactivate Safe Muting:

1. Open **+Safety parameter list+**:
   a) »EASY Starter«: Open the **+Safety parameter list+** tab.
   b) »PLC Designer«: Open the **Safe parameter set** object under the axis in the device tree.
2. Click muting dialog.
   The password dialog opens.
3. Enter muting password.
   The muting dialog opens.
4. Use the displayed data to ensure that the correct inverter has been selected.
   Optical device identification is activated automatically. The two LEDs "RDY" and "ERR" on the front of the selected inverter flash quickly.
5. **Start** activates the function.
   The function is now active for a maximum of 30 minutes. The remaining time is displayed.
6. End function
   a) The function is automatically ended after 30 minutes.
   b) **Stop** ends the function manually.
   c) If the connection between engineering tool and inverter is disconnected, the function is aborted immediately with an error message.

   Monitored operation is reactivated immediately.

   All previously deactivated safety functions are active again.

Diagnostics

Status LEDs

Function included in variant:			Extended Safety

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

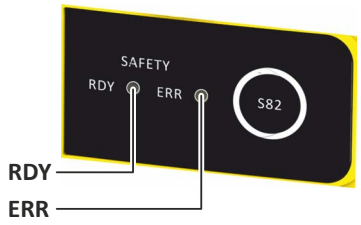


Fig. 7: Position of the RDY and ERR LEDs

⚠ DANGER!

Unreliable status information possible due to LEDs.

LEDs are not reliable status indicators. There is no guarantee that the LEDs provide accurate information.

Possible consequences: Death or severe injuries

► Only use LEDs for general diagnostics during commissioning or troubleshooting.

► Do not use LEDs as status displays.

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

Display for requested acknowledgement

LED "RDY" (yellow)	LED "ERR" (red)	Status	Meaning
on	off	Restart acknowledgement requested	The device is working correctly.
	blinking red 1 Hz		During start-up, a modified parameter set was detected in the "Init" state.
	blinking red 2 Hz		During start-up, a changed safety address was detected in the "Init" state.

Display in the event of errors

	LED "ERR" (red)	Status	Meaning
	off	-	The device is working correctly.
	blinking red 1 Hz	Error	One of the following errors has been detected: • A monitoring device has been activated. • An acknowledgeable error is active. • Discrepancy of the inputs
blinking yellow 1 Hz	blinking red 1 Hz		One of the following errors has been detected: • Discrepancy of the configuration parameters • CRC checksum error
	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.

Display for critical device errors

LED "RDY" (yellow)	LED "ERR" (red)	Status	Meaning
blinking yellow	 blinking red	Critical system error	• "Lock-out" (CPU stopped) • STO is active. • If the system error occurs again after switching the 24 V supply, the device is defective. It must be replaced.

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

Safety-related data

Safety-related characteristics Basic Safety - STO

Basics of the safety-related characteristics			
	Source of failure rates	SN 29500	When no values from the component manufacturers were available.
	Average max. ambient temperature	60 °C	
Basic Safety - STO			
EN IEC 61508, part 1-7 EN 62061	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
	Proof test interval T	20 years	Mission time
EN ISO 13849-1	Category	4	
	Performance Level	e	
	$MTTF_d$	High	> 3200 years
	Mean diagnostic coverage DC_{avg}		99 %

Further data and information

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Safety-related characteristics Extended Safety

Basics of the safety-related characteristics			
	Source of failure rates	SN 29500	When no values from the component manufacturers were available.
	Average max. ambient temperature	60 °C	
Extended Safety - S			
EN IEC 61508, part 1-7 EN 62061	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
	Proof test interval T	20 years	Mission time
EN ISO 13849-1	Category	4	
	Performance Level	e	
	$MTTF_d$	High	> 130 years
	Mean diagnostic coverage DC_{avg}		95 %

Further data and information

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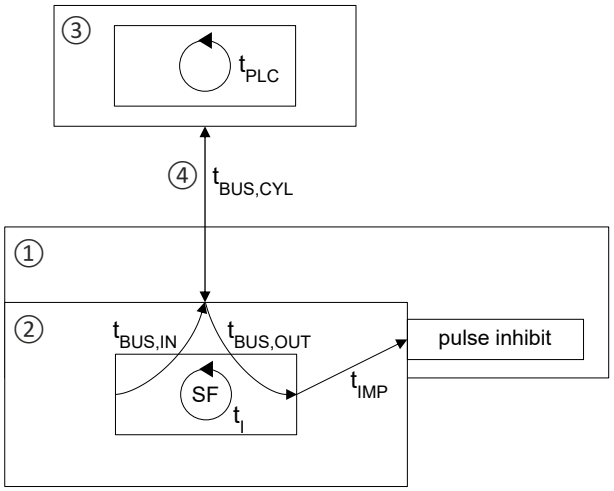
Response times of the safety unit

For the calculation of the response time to the request of a safety function, the overall system must be taken into account:

- Response time of the connected safety sensors.
- Internal processing time.
- Deceleration times, braking times, and stop times from the parameterized safety functions.
- Safety bus:
  - Monitoring time for cyclic services.
  - Monitoring time in the safety PLC.
  - Processing time in the safety PLC
- Deceleration times due to further components.



1 Basic device
2 Integrated safety technology
3 Safety PLC
4 Safety bus
SF Triggered safety function

Response times of the safety modules		
t_I	Processing time of the integrated safety technology (taking into account the feedback from the status flags to the input)	4 ms
$t_{BUS,IN}$	Sending a secure telegram to the controller CIP Safety	 20 ms
$t_{BUS,OUT}$	Receiving a safe telegram from the controller CIP Safety	 32 ms
$t_{BUS,CYL}$	Cycle time safety bus CIP Safety	See project planning in the controller
t_{PLC}	Cycle time controller	See manufacturer's specifications for the controller
t_{IMP}	Time delay of the safe pulse inhibit	6 ms

Response times of a function		
Triggering STO via safety bus	$t_{PLC} + t_{BUS,CYL} + t_{BUS,OUT} + t_{IMP}$	$t_{PLC} + t_{BUS,CYL}$ + 32 ms + 6 ms
Feedback STO status flag via safety bus	$t_{PLC} + t_{BUS,CYL} + t_{BUS,OUT} + t_I + t_{BUS,IN} + t_{PLC}$	$t_{PLC} + t_{BUS,CYL}$ + 32 ms + 4 ms + 20 ms + t_{PLC}

- 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 has elapsed. The safety bus communication is passivated.
- Include the times of the safety functions in the calculation, e.g. for SS1 the stop time until STO is active (0x2894:001).

Accessories

Screw connection membrane set

A pressure compensation element with membrane technology prevents condensed water from forming in the device and ensures trouble-free operation. This ensures maintenance of the protection class.

Possible applications include scenarios with large differences in temperature and humidity between indoor and outdoor areas. The resulting negative pressure inside the device causes air flow from the outside to the inside and can lead to condensed water forming inside the unit.

Screwed connection, membrane set		
Type designation	**Design**	
EZAMBHXX026		5 x M12 screw connection with integrated membrane

System cables

Pre-assembled system cables are the ideal solution for easily connecting or interconnecting Lenze products. Wiring errors are thus reliably prevented.

Mains, motor, feedback and blower cables are available. Depending on the application, the cables are equipped with standard connectors, making integration into the machine's peripherals very easy.

Further information on system cables and other accessories can be found in the brochure "Accessories for frequency inverters and servo inverters".

Purchase order

Notes on ordering

»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 details

The following is a list of the information required to order an i550 motec frequency inverter.

Order example

Description of the component		Type code
i550 motec frequency inverter	I55AM	I55AM 222 F 0 A D B 0 0 0 K S
Rated power 2.2 kW / 3 hp	222	
3-phase mains connection 400 V	F	
Extension box: Without extension box	0	
Integrated functional safety: Basic Safety - STO	A	
Protection class: IP66, coated / UL Type 4X indoor	D	
Motor connection: Wall adapter with cable gland (M25)	B	
Default parameter setting: Region EU (50-Hz networks)	0	
Additional functions: Without	0	
Control connections: Standard I/O	0	
Network: EtherCAT	K	
Packaging: Packed individually	S	

Assignment of product name and type code

When listing the technical data of the various variants, the easily legible product name is used.

The product name contains:

- the name of the product series - "i□□□" as wildcard for "i550" or "i650"
- the version - "M" for "motec" = inverter for decentralized mounting locations/motor mounting
- the power - in kW of the "Heavy Duty" load characteristic
- the mains voltage class - e.g. 230/240 V or 400 V
- the number of mains phases

This information results in the first 9 characters of the type code:

Complete inverter				
Power		Product name	Type code	
kW	hp		i550 motec	i650 motec
3-phase mains connection 230/240 V				
0.37	0.5	i□□□-M0.37/230-3	I55AM137C	I65AM137C
0.55	0.75	i□□□-M0.55/230-3	I55AM155C	I65AM155C
0.75	1	i□□□-M0.75/230-3	I55AM175C	I65AM175C
1.1	1.5	i□□□-M1.1/230-3	I55AM211C	I65AM211C
1.5	2	i□□□-M1.5/230-3	I55AM215C	I65AM215C
2.2	3	i□□□-M2.2/230-3	I55AM222C	I65AM222C
3	4	i□□□-M3.0/230-3	I55AM230C	I65AM230C
4	5.5	i□□□-M4.0/230-3	I55AM240C	I65AM240C
5.5	7.5	i□□□-M5.5/230-3	I55AM255C	I65AM255C
7.5	10	i□□□-M7.5/230-3	I55AM275C	I65AM275C
11	15	i□□□-M11/230-3	I55AM311C	I65AM311C
15	20	i□□□-M15/230-3	I55AM315C	I65AM315C
18.5	25	i□□□-M18/230-3	I55AM318C	I65AM318C
22	30	i□□□-M22/230-3	I55AM322C	I65AM322C
Three-phase mains connection 400/480 V				
0.37	0.5	i□□□-M0.37/400-3	I55AM137F	I65AM137F
0.55	0.75	i□□□-M0.55/400-3	I55AM155F	I65AM155F
0.75	1	i□□□-M0.75/400-3	I55AM175F	I65AM175F
1.1	1.5	i□□□-M1.1/400-3	I55AM211F	I65AM211F
1.5	2	i□□□-M1.5/400-3	I55AM215F	I65AM215F
2.2	3	i□□□-M2.2/400-3	I55AM222F	I65AM222F
3	4	i□□□-M3.0/400-3	I55AM230F	I65AM230F
4	5	i□□□-M4.0/400-3	I55AM240F	I65AM240F
5.5	7.5	i□□□-M5.5/400-3	I55AM255F	I65AM255F
7.5	10	i□□□-M7.5/400-3	I55AM275F	I65AM275F
11	15	i□□□-M11/400-3	I55AM311F	I65AM311F
15	20	i□□□-M15/400-3	I55AM315F	I65AM315F
18.5	25	i□□□-M18/400-3	I55AM318F	I65AM318F
22	30	i□□□-M22/400-3	I55AM322F	I65AM322F
30	40	i□□□-M30/400-3	I55AM330F	I65AM330F
37	50	i□□□-M37/400-3	I55AM337F	I65AM337F
45	60	i□□□-M45/400-3	I55AM345F	I65AM345F

Type code structure

			I	□□	A	M	□□□	□	□	□	□	□	□	□	□	S
Product type	Inverter		I													
Product	i550			55												
	i650			65												
Product generation	Generation 1				A											
Mounting type	Motor and wall mounting					M										
Rated power	0.37 kW	0.5 hp					137									
	0.55 kW	0.75 hp					155									
	0.75 kW	1 hp					175									
	1.1 kW	1.5 hp					211									
	1.5 kW	2 hp					215									
	2.2 kW	3 hp					222									
	3 kW	4 hp					230									
	4 kW	5.5 hp					240									
	5.5 kW	7.5 hp					255									
	7.5 kW	10 hp					275									
	11 kW	15 hp					311									
	15 kW	20 hp					315									
	18.5 kW	25 hp					318									
	22 kW	30 hp					322									
	30 kW	40 hp					330									
	37 kW	50 hp					337									
	45 kW	60 hp					345									
Mains voltage and connection type	3/PE AC 230/240 V							C								
	3/PE AC 400 V 3/PE AC 480 V							F								
Extension box	Without extension box								0							
	Extension box for inverter up to • 5.5 kW (230/240 V) • 11 kW (400/480 V)	with mains terminals							1							
		with disconnect switch							A							
		with disconnect switch with status feedback							B							
		with Type E combination motor controller							C							
		with Type E combination motor controller and status feedback							D							
		with disconnect switch with status feedback and operating elements							E							
		with disconnect switch with status feedback, operating element and potentiometer							F							
Integrated functional safety	Without functional safety									0						
	Basic Safety - STO									A						
	Extended Safety - S									E						
Degree of protection	IP54, coated	UL type 12 / 12K									B					
	IP66, coated	UL type 4X indoor									D					
Continuation ...																

Type code structure (continuation)

			I	□□	A	M	□□□	□	□	□	□	□	□	□	□	□	S
Motor connection	Without adapter											0					
	Wall adapter	with Han Q8										A					
		with heatsink fan and Han Q8										D					
		with M23										C					
		with heatsink fan and M23										F					
		with M40										H					
		with cable gland (M25)										B					
		with heatsink fan and cable gland (M25)										E					
		with cable gland (M40)										G					
	Motor adapter	for BG063 - BG071										I					
		for BG080 - BG112										J					
		for BG132										K					
		for BG160 - BG180										L					
Application area	Default parameter setting: Region EU (50-Hz networks)												0				
	Default parameter setting: Region US (60-Hz networks)												1				
Additional functions	Without additional functions													0			
	Logic PLC & Table positioning													P			
Control connections	Standard-I/O														0		
	Application-I/O														1		
Network	EtherCAT															K	
	PROFINET															L	
	EtherNet/IP															M	
	Modbus TCP															W	

Environmental notes and recycling

Lenze has been certified to the worldwide environmental management standard for many years (DIN EN ISO 14001). 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:

CE

Lenze products are partly subject to the EU Directive on the restriction of certain hazardous substances in electrical and electronic equipment 2011/65/EU: RoHS Directive [UKCA: S.I. 2012/3032 - The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012]. This is documented accordingly in the EU declaration of conformity and with the CE mark.

The crossed-out wheeled bin symbol is located on the equipment. This information indicates that used electrical and electronic products must not be disposed of with normal household waste.
The EU Directive 2012/19/EU: Directive on waste electrical and electronic equipment (WEEE) [UKCA: S.I. 2013/3113 - The Waste Electrical and Electronic Equipment Regulations 2013], which has been transposed into national law by the respective EU member states, applies to the disposal of equipment. As a customer, you have the option of disposing of the electrical and electronic equipment that you have purchased from us and that is subject to WEEE via the Lenze branch in your country.
Lenze addresses in Europe: https://www.lenze.com/en-de/company/global-presence

Some Lenze products contain batteries/rechargeable batteries in accordance with EU Directive 2006/66/EC: Battery Directive [UKCA: S.I. 2009/890 - The Waste Batteries and Accumulators Regulations 2009]. 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: Directive on packaging and packaging waste [UKCA: S.I. 1997/648 - The Producer Responsibility Obligations (Packaging Waste) Regulations 1997]. The required disposal route is indicated by material-specific labels with the "recycling triangle". Example: "21 - other cardboard"

REACH

Lenze products are subject to REGULATION (EC) No 1907/2006: REACH Regulation [UKCA: S.I. 2008/2852 - The REACH Enforcement Regulations 2008]. 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

Good to know

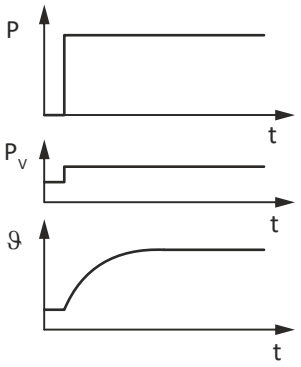
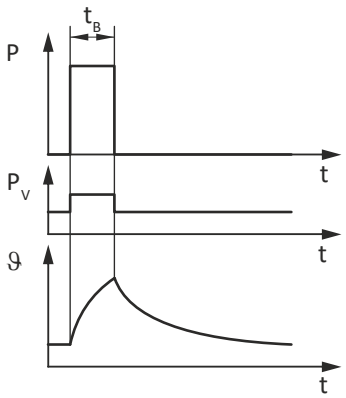
Operating modes of the motor

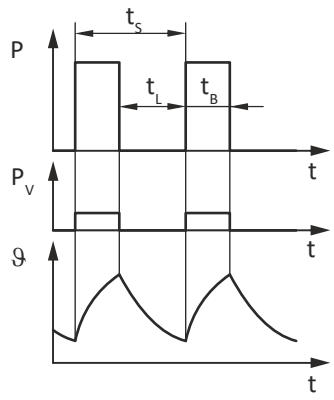
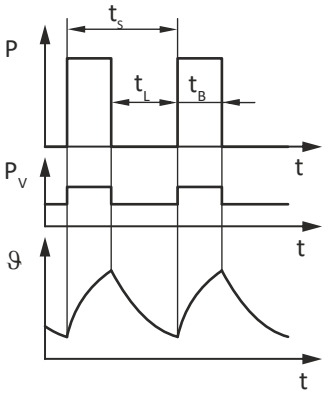
Operating modes S1 ... S10 as specified by EN 60034-1 describe the basic stress of an electrical machine.

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		

Motor control types

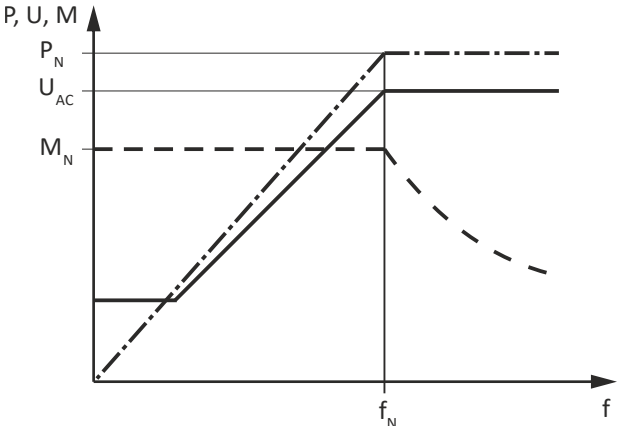
The inverter provides various motor control types.

Linear V/f characteristic control

The output voltage is increased proportionately to the output frequency.

In case of low output frequencies, the motor voltage can be increased to ensure a minimum current for the breakaway torque. In the field weakening range, the output voltage of the inverter is constant (mains voltage) and the frequency can be further increased depending on the load. The maximum torque of the motor is reduced proportionately to the square of the frequency increase, the maximum output power of the motor being constant.

Application areas are for instance: Single drives with constant load.



P	Power	P_N	Rated power
V	Voltage	U_{AC}	Mains voltage
M	Torque	M_N	Rated torque
f	Frequency	f_N	Rated frequency

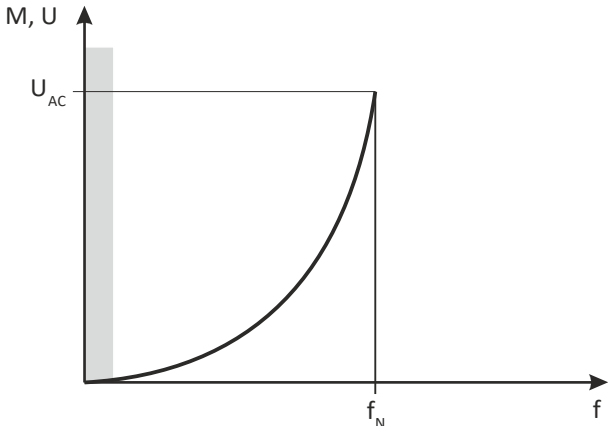
Square-law V/f characteristic control

The output voltage is increased squarely to the output frequency.

In case of low output frequencies, the motor voltage can be increased to ensure a minimum current for the breakaway torque. In the field weakening range, the output voltage of the inverter is constant (mains voltage) and the frequency can be further increased depending on the load. The maximum torque of the motor is reduced squarely to the frequency increase, the maximum output power of the motor being constant.

Application areas are for instance:

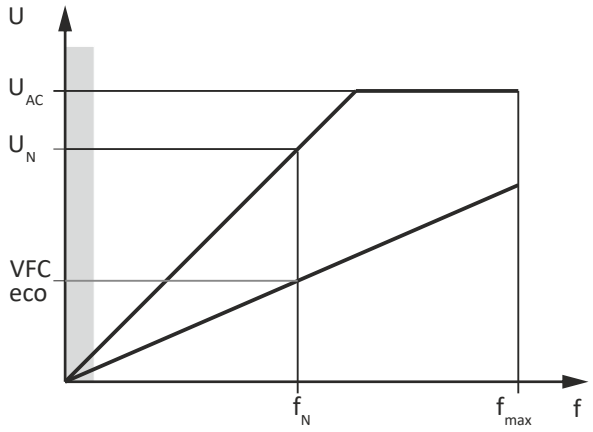
- Pumps
- Fans
- Ventilators



V	Voltage	U_{AC}	Mains voltage
f	Frequency	f_N	Rated frequency
M	Torque		

VFCeco

The VFCeco mode has a special effect in the partial load operational range. Usually, three-phase AC motors are supplied there with a higher magnetising current than required by the operating conditions. The VFCeco mode reduces the losses in the partial load operational range so that savings up to 30 % are possible.



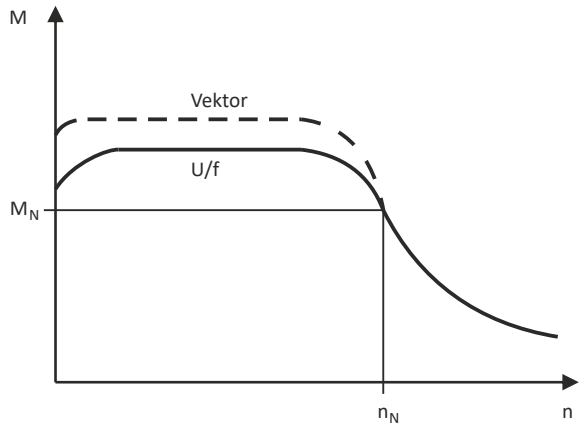
V	Voltage	f	Frequency
U_{AC}	Mains voltage	f_N	Rated frequency
U_N	Rated voltage	f_{max}	Max. frequency

Sensorless vector control (SLVC)

In vector control, an inverted voltage model is used for calculation. The parameters are detected via a parameter identification. The inverter determines the angle between current and voltage. This imposes a current on the motor”.

Compared to the V/f characteristic control, the vector control serves to achieve improved drive characteristics thanks to:

- higher torque throughout the entire speed range
- higher speed accuracy and higher concentricity factor
- higher efficiency



M	Torque	M_N	Rated torque
n	Speed	n_N	Rated speed

Application areas are for instance:

- Single drives with changing loads
- Single drives with high starting duty
- Sensorless speed control of three-phase AC motors

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:

- 8 kHz
- 12 kHz
- 16 kHz
- variable (automatic adaptation)

Enclosures

The protection class indicates the suitability of a product for specific ambient conditions with regard to humidity as well as the protection against contact and the ingress of foreign particles. The protection classes are classified in the EN 60034-5/ EN IEC 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

Definitions in functional safety

Abbreviation	Meaning
AIE	Acknowledge In Error, error acknowledgement
AIS	Acknowledge In Stop, restart acknowledgement
OFF state	Triggered signal status of the safety 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 sensors 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 according to EN ISO 13849-1
nBD	Speed value Base-Drive, internally determined actual speed from standard application
nSD	Safe-Drive speed value, internally determined actual speed from the safety application
n_safe	Actual speed determined from validation of nBD and nSD. Enters the further processing of the speed-dependent safety functions.
OSSD	Output Signal Switching Device, tested signal output
pBD	Base-Drive position value, internally determined actual position from standard application
pSD	Safe-Drive position value, internally determined actual position from the safety application
p_safe	Actual position determined from validation of pBD and pSD. Enters the further processing of the position-dependent safety functions.
PELV	Protective Extra Low Voltage
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 Creeping Speed
SD–In	Safe Digital Input
SD–Out	Safe Digital Output
SELV	Safety Extra Low Voltage
SFF	Safe Failure Fraction
SIL	Safety Integrity Level according to EN IEC 61508

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