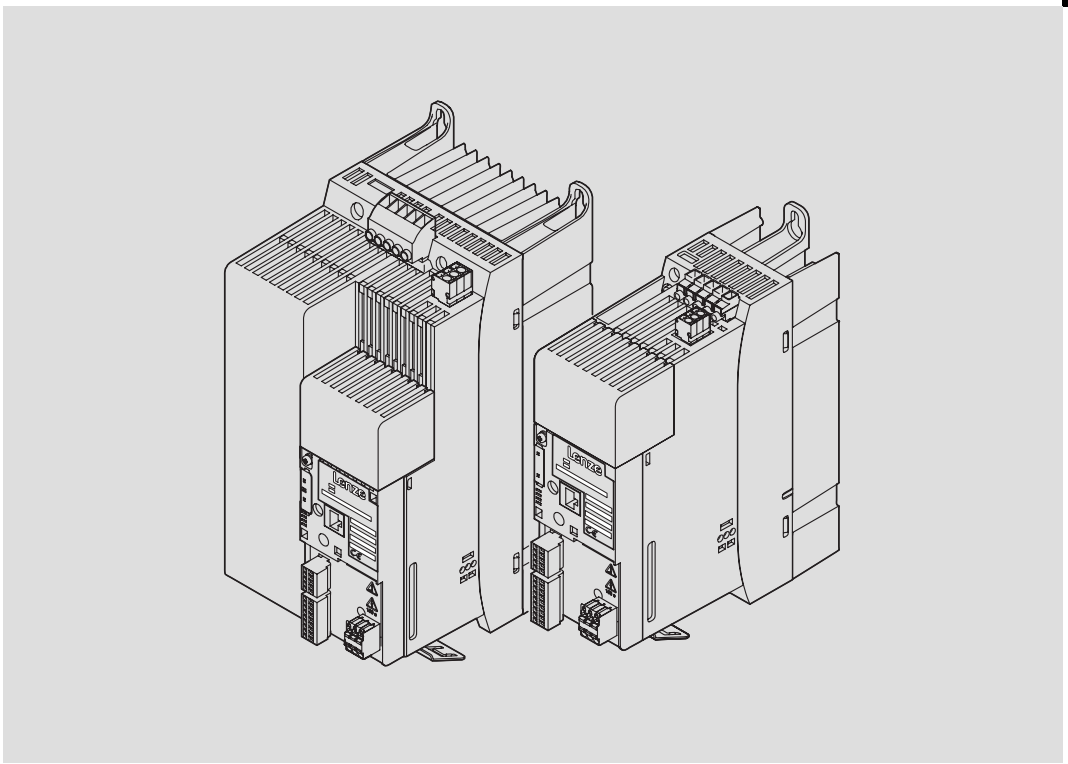
EDS84ASC552
13277975

L-force *Drives*

Hardware Manual

8400 *0.25 ... 15 kW*



E84Axxxx StateLine C/HighLine C

8400 frequency inverter

Lenze

1 About this documentation

Contents

The Hardware Manual contains the complete information on the intended use of the 8400 controllers in the StateLine C and HighLine C versions.

Validty

Type	Type designation	From hardware version	From software version
8400 StateLine C	E84AVSCxxxxX0	VA	01.00
8400 HighLine C	E84AVHCxxxxX0	VA	01.00

Target group

This Hardware Manual is intended for all persons who design, install, commission, and adjust controllers of the 8400 Inverter Drives product range.

Tip!

Documentations and software updates for further Lenze products can be found on the Internet in the ”Services & Downloads” area under

http://www.Lenze.com

1.1 Document history

Material number	Version			Description
13234980	1.0	02/2008	TD14	First edition
13252301	2.0	05/2008	TD14	Complete revision
13255657	2.1	06/2008	TD14	Supplements to the chapter ”Electrical installation”
13261567	3.0	07/2008	TD31	Supplemented by devices in the HighLineversion
13277975	4.0	11/2008	TD36	Supplemented by devices in device size 5

1.2 Conventions used

This documentation uses the following conventions to distinguish between different types of information:

Type of information	Writing	Examples/notes
Notation of numbers		
Decimal separator	Point	The decimal point is always used. For example: 1234.56
Warnings		
UL warnings	ⓤL	Are only given in English.
UR warnings	ᵘR	
Text font style		
Program name	» «	Lenze software For example: »Engineer«
Symbols		
Cross-reference	🕮	Refers to additional information. For example 🕮 16 = see page 16.

1.3 Terms and abbreviations used

Term	Meaning
Device size	Used as generic term for a group of devices which have the same dimensions (depth, height and width) but different power ratings.
Standard device	Used as generic term when actions and features are described which are very similar or the same for different versions or device sizes, e.g. ● mechanical installation or ● power terminals

Abbreviation	Meaning
Cat.	Category according to EN ISO 13849-1
OSSD	Output Signal Switching Device, tested signal output
PWM	Pulse width modulation
SIL	Safety Integrity Level according to IEC 61508
SU	Safety Unit
OFF state	Signal status of the safety sensors when safety sensors are activated or respond
ON state	Signal status of the safety sensors during normal operation
STO	Safe Torque Off Former designation: safe standstill

1.4 Notes used

The following pictographs and signal words are used in this documentation to indicate dangers and important information:

Safety instructions

Structure of safety instructions:

Danger!

(characterises the type and severity of danger)

Note

(describes the danger and gives information about how to prevent dangerous situations)

Pictograph and signal word	Meaning
 **Danger!**	**Danger of personal injury through dangerous electrical voltage.** Reference to an imminent danger that may result in death or serious personal injury if the corresponding measures are not taken.
 **Danger!**	**Danger of personal injury through a general source of danger.** Reference to an imminent danger that may result in death or serious personal injury if the corresponding measures are not taken.
 **Stop!**	**Danger of property damage.** Reference to a possible danger that may result in property damage if the corresponding measures are not taken.

Application notes

Pictograph and signal word	Meaning
 **Note!**	Important note to ensure troublefree operation
 **Tip!**	Useful tip for simple handling
	Reference to another documentation

Special safety instructions and application notes for UL and UR

Pictograph and signal word	Meaning
 **Warnings!**	**Safety or application note for the operation of a UL-approved device in UL-approved systems.** Possibly the drive system is not operated in compliance with UL if the corresponding measures are not taken.
 **Warnings!**	**Safety or application note for the operation of a UR-approved device in UL-approved systems.** Possibly the drive system is not operated in compliance with UL if the corresponding measures are not taken.

2 Safety instructions

2.1 General safety and application notes for Lenze controllers

(in accordance with Low-Voltage Directive 2006/95/EC)

For your personal safety

Disregarding the following safety measures can lead to severe injury to persons and damage to material:

- Only use the product as directed.
- Never commission the product in the event of visible damage.
- Never commission the product before assembly has been completed.
- Do not carry out any technical changes on the product.
- Only use the accessories approved for the product.
- Only use original spare parts from Lenze.
- Observe all regulations for the prevention of accidents, directives and laws applicable on site.
- Transport, installation, commissioning and maintenance work must only be carried out by qualified personnel.
  - Observe IEC 364 and CENELEC HD 384 or DIN VDE 0100 and IEC report 664 or DIN VDE 0110 and all national regulations for the prevention of accidents.
  - According to this basic safety information, qualified, skilled personnel are persons who are familiar with the assembly, installation, commissioning, and operation of the product and who have the qualifications necessary for their occupation.
- Observe all specifications in this 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 described in this documentation are only proposals. It's up to the user to check whether they can be transferred to the particular applications. Lenze Drives GmbH does not accept any liability for the suitability of the procedures and circuit proposals described.
- Depending on their degree of protection, some parts of the Lenze controllers (frequency inverters, servo inverters, DC speed controllers) and their accessory components can be live, moving and rotating during operation. Surfaces can be hot.
  - Non-authorised removal of the required cover, inappropriate use, incorrect installation or operation, creates the risk of severe injury to persons or damage to material assets.
  - For more information, please see the documentation.
- High amounts of energy are produced in the controller. Therefore it is required to wear personal protective equipment (body protection, headgear, eye protection, ear protection, hand guard).

Application as directed

Controllers are components which are designed for installation in electrical systems or machines. They are not to be used as domestic appliances, but only for industrial purposes according to EN 61000-3-2.

When controllers are installed into machines, commissioning (i.e. starting of the operation as directed) is prohibited until it is proven that the machine complies with the regulations of the EC Directive 98/37/EC (Machinery Directive); EN 60204 must be observed.

Commissioning (i.e. starting of the operation as directed) is only allowed when there is compliance with the EMC Directive (2004/108/EC).

The controllers meet the requirements of the Low-Voltage Directive 2006/95/EC. The harmonised standard EN 61800-5-1 applies to the controllers.

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

Warning: Controllers are products which can be installed in drive systems of category C2 according to EN 61800-3. These products can cause radio interferences in residential areas. In this case, special measures can be necessary.

Transport, storage

Please observe the notes on transport, storage, and appropriate handling.

Observe the climatic conditions according to the technical data.

Installation

The controllers must be installed and cooled according to the instructions given in the corresponding documentation.

The ambient air must not exceed degree of pollution 2 according to EN 61800-5-1.

Ensure proper handling and avoid excessive 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.

Controllers contain electrostatic sensitive devices which can easily be damaged by inappropriate handling. Do not damage or destroy any electrical components since this might endanger your health!

Electrical connection

When working on live controllers, observe the applicable national regulations for the prevention of accidents (e.g. VBG 4).

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.

This documentation contains information on installation in compliance with EMC (shielding, earthing, filter, and cables). These notes must also be observed for CE-marked controllers. The manufacturer of the system is responsible for compliance with the limit values demanded by EMC legislation. The controllers must be installed in housings (e.g. control cabinets) to meet the limit values for radio interferences valid at the site of installation. The housings must enable an EMC-compliant installation. Observe in particular that e.g. the control cabinet doors have a circumferential metal connection to the housing. Reduce housing openings and cutouts to a minimum.

Lenze controllers can cause a DC current in the PE conductor. If a residual current device (RCD) is used for protection in the event of direct or indirect contact, a residual current device (RCD) of type B must be used on the supply side of the controller in case of a three-phase controller supply. Otherwise, a different protective measure must be taken, e.g. separation from the environment through double or reinforced insulation or separation from the supply system by means of a transformer.

Operation

If necessary, systems including controllers must be equipped with additional monitoring and protection devices according to the valid safety regulations (e.g. law on technical equipment, regulations for the prevention of accidents). The controllers can be adapted to your application. Please observe the corresponding information given in the documentation.

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

All protection covers and doors must be shut during operation.

Notes for UL-approved systems with integrated controllers: UL warnings are notes that only apply to UL systems. The documentation contains special UL notes.

Safety functions

Special controller variants support safety functions (e.g. ”safe torque off”, formerly ”safe standstill”) according to the requirements of appendix I No. 1.2.7 of the EC Directive ”Machinery” 98/37/EC, EN 954-1 category 3 and EN 1037. Strictly observe the notes on the safety functions given in the documentation on the respective variants.

Maintenance and servicing

The controllers do not require any maintenance if the prescribed operating conditions are observed.

Disposal

Recycle metal and plastic materials. Ensure professional disposal of assembled PCBs.

The product-specific safety and application notes given in these instructions must be observed!

2.2 General safety and application instructions for Lenze motors

(According to: Low-Voltage Directive 2006/95/EC)

General

Low-voltage machines have hazardous live and rotating parts and possibly also hot surfaces.

Synchronous machines induce voltages at open terminals during operation.

All operations concerning transport, connections, commissioning and maintenance must be carried out by qualified, skilled personnel (EN 50110-1 (VDE 0105-100) and IEC 60364 must be observed). Inappropriate use creates the risk of severe injury to persons and damage to material assets.

Low-voltage machines may only be operated under the conditions that are indicated in the section ”Application as directed”.

The conditions at the place of installation must comply with the data given on the nameplate and in the documentation.

Application as directed

Low-voltage machines are intended for commercial installations. They comply with the harmonised standards of the series EN 60034 (VDE 0530). Their use in potentially explosive atmospheres is prohibited unless they are expressly intended for such use (follow additional instructions).

Low-voltage machines are components for installation into machines as defined in the Machinery Directive 98/37/EC. Commissioning is prohibited until the conformity of the end product with this directive has been established (follow i. a. EN 60204-1).

Low-voltage machines with IP23 protection or less are only intended for outdoor use when applying special protective features.

The integrated brakes must not be used as safety brakes. It cannot be ruled out that factors which cannot be influenced, such as oil ingress due to a defective A-side shaft seal, cause a brake torque reduction.

Transport, storage

Damage must be reported immediately to the forwarder upon receipt; if required, commissioning must be excluded. Tighten screwed-in ring bolts before transport. They are designed for the weight of the low-voltage machines, do not apply extra loads. If necessary, use suitable and adequately dimensioned means of transport (e. g. rope guides).

Remove transport locking devices before commissioning. Reuse them for further transport. When storing low-voltage machines, ensure a dry, dust-free and low-vibration ($v_{eff} \leq 0.2$ mm/s) environment (bearing damage while being stored).

Installation

Ensure an even surface, solid foot/flange mounting and exact alignment if a direct clutch is connected. Avoid resonances with the rotational frequency and double mains frequency which may be caused by the assembly. Turn rotor by hand, listen for unusual slipping noises. Check the direction of rotation when the clutch is not active (observe section ”Electrical connection”).

Use appropriate means to mount or remove belt pulleys and clutches (heating) and cover them with a touch guard. Avoid impermissible belt tensions.

The machines are half-key balanced. The clutch must be half-key balanced, too. The visible jutting out part of the key must be removed.

If required, provide pipe connections. Designs with shaft end at bottom must be protected with a cover which prevents the ingress of foreign particles into the fan. Free circulation of the cooling air must be ensured. The exhaust air - also the exhaust air of other machines next to the drive system - must not be taken in immediately.

Electrical connection

All operations must only be carried out by qualified and skilled personnel on the low-voltage machine at standstill and deenergised and provided with a safe guard to prevent an unintentional restart.This also applies to auxiliary circuits (e. g. brake, encoder, blower).

Check safe isolation from supply!

If the tolerances specified in EN 60034-1; IEC 34 (VDE 0530-1) - voltage ±5 %, frequency ±2 %, waveform, symmetry - are exceeded, more heat will be generated and the electromagnetic compatibility will be affected.

Observe the data on the nameplate, operating notes, and the connection diagram in the terminal box.

The connection must ensure a continuous and safe electrical supply (no loose wire ends); use appropriate cable terminals. The connection to the PE conductor must be safe. The plug-in connectors must be bolted tightly (to stop).

The clearances between blank, live parts and to earth must not fall below 8 mm at $U_r \leq 550$ V, 10 mm at $U_r \leq 725$ V, 14 mm at $U_r \leq 1000$ V.

The terminal box must be free of foreign particles, dirt and moisture. All unused cable entries and the box itself must be sealed against dust and water.

Commissioning and operation

Before commissioning after longer storage periods, measure insulation resistance. In the case of values $\leq$ 1 kΩ per volt of rated voltage, dry winding.

For trial run without output elements, lock the featherkey. Do not deactivate the protective devices, not even in a trial run.

Check the correct operation of the brake before commissioning low-voltage machines with brakes.

Integrated thermal detectors do not provide full protection for the machine. If necessary, limit the maximum current. Parameterise the controller so that the motor will be switched off with $I > I_r$ after a few seconds of operation, especially at the risk of blocking.

Vibrational severities $v_{eff} \leq 3.5$ mm/s ($P_r \leq 15$ kW) or 4.5 mm/s ($P_r > 15$ kW) are acceptable if the clutch is activated.

If deviations from normal operation occur, e.g. increased temperatures, noises, vibrations, find the cause and, if required, contact the manufacturer. In case of doubt, switch off the low-voltage machine.

If the machine is exposed to dirt, clean the air paths regularly.

Shaft sealing rings and roller bearings have a limited service life.

Regrease bearings with relubricating devices while the low-voltage machine is running. Only use the grease recommended by the manufacturer. If the grease drain holes are sealed with a plug, (IP54 drive end; IP23 drive and non-drive end), remove plug before commissioning. Seal bore holes with grease. Replace prelubricated bearings (2Z bearing) after approx. 10,000 h - 20,000 h, at the latest however after 3 - 4 years.

The product-specific safety and application notes given in these instructions must be observed!

2.3 Residual hazards

Protection of persons

- Before working on the controller, check that no voltage is applied to the power terminals, because
  - depending on the controller - the power terminals U, V, W, +UG, -UG, Rb1 and Rb2 carry hazardous voltages for up to 3 to 20 minutes after mains disconnection.
  - the power terminals L1, L2, L3; U, V, W, +UG, -UG, Rb1 and Rb2 carry hazardous voltages when the motor is stopped.

Device protection

- Connect/disconnect all pluggable terminals only in deenergised condition!
- Detach the controllers from the installation, e.g. from the rear panel of the control cabinet, only in deenergised condition!

Motor protection

- Depending on the controller settings, the connected motor can be overheated by:
  - For instance, longer DC-braking operations.
  - Longer operation of self-ventilated motors at low speed.

Protection of the machine/system

- Drives can reach dangerous overspeeds (e.g. setting of high output frequencies in connection with motors and machines unsuitable for such conditions):
  - The controllers do not offer any protection against such operating conditions. Use additional components for this purpose.

Parameter set transfer

- During the parameter set transfer, control terminals of the controllers can adopt undefined states!
  - Therefor it is required to remove the plug X4 (digital input signals) before the transfer starts. This ensures that the controller is inhibited and all control terminals have the firmly defined ”LOW” status.
- Switch **contactors in the motor cable** only if the controller is inhibited.

  When switching contactors in the motor cable while the controller is enabled, you can activate monitoring functions of the controller. If no monitoring function is activated, switching is permissible.

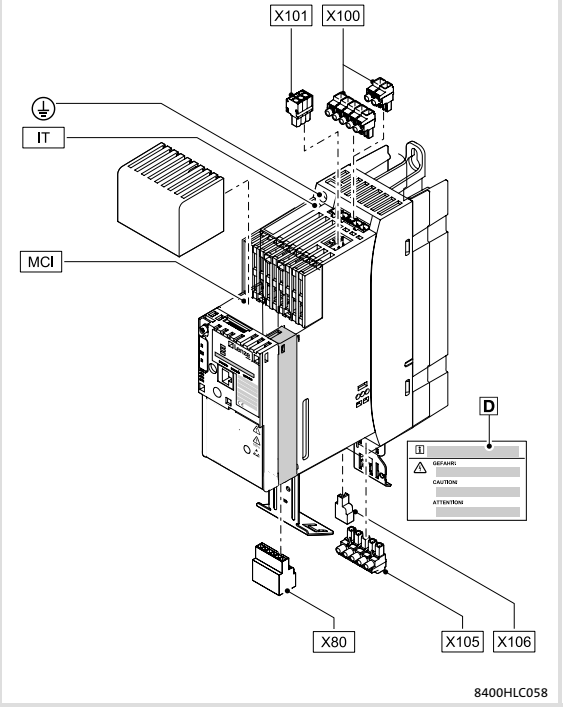
3 Product description

3.1 Device features

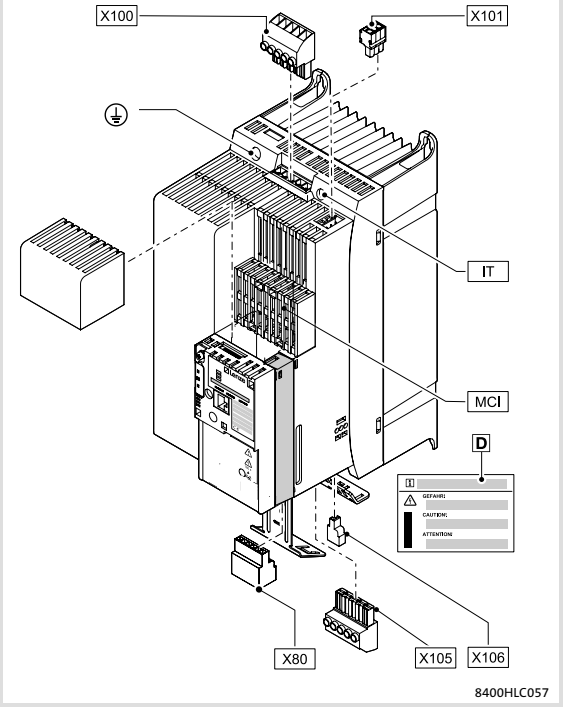
Features	Version	
	StateLine C	HighLine C
Power range from 250 W to 15 kW	✓	✓
Interface for communication modules and diagnostic adapters	✓	✓
Integrated interference suppression according to EN 61800-3	✓	✓
Integrated DC-bus connection for devices with 400 V mains connection	✓	✓
Flying restart circuit	✓	✓
Integrated brake management	✓	✓
Integrated brake transistor	✓	✓
Drive-based safety "safe torque off (STO)"	✓	✓
Operating modes: – VFCplus: V/f open loop, linear and square-law – SLVC: sensorless vector control (torque/speed) – VFCplus: V/f closed loop for speed-controlled applications	✓	✓
S-shaped ramps for smooth acceleration and deceleration	✓	✓
200 % overload current (3 s)	✓	✓
Usability on IT system	✓	✓
Protection against restart for cyclic mains switching	✓	✓
CANopen baud rate	up to 500 kbit/s	up to 1000 kbit/s
Incremental encoder evaluation: two-track	10 kHz	10 kHz and 100 kHz
Point-to-point positioning	-	✓
Digital output 2.5 A with integrated spark suppressor, e.g. for the direct control of a 24 V motor holding brake	-	✓

3.2 Overview of standard devices

Standard device in device size GG 1 ... 3

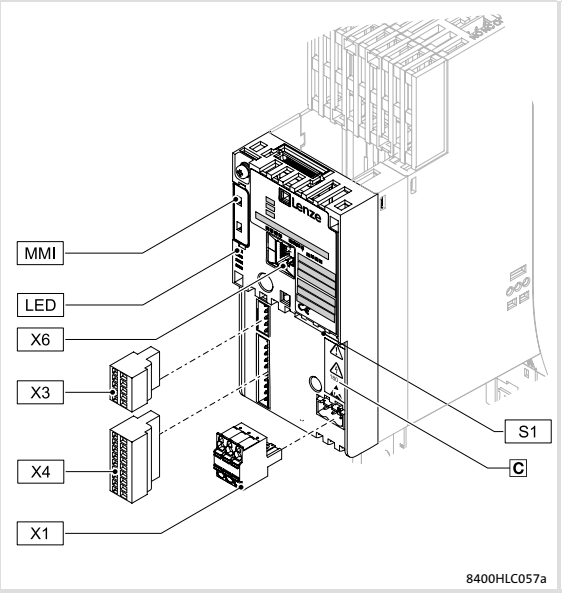
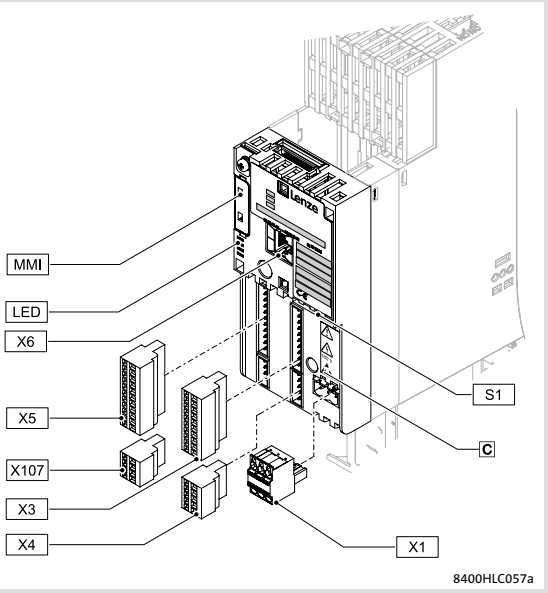


Standard device in device size GG 4 ... 5



		Information	
Position	**Description**	**230 V**	**400 V**
X80	Pluggable terminal strip for the safety unit	📖 154	
X100	Mains/DC-bus voltage (for 400 V devices)	📖 95	📖 106
X101	Switching contact	📖 114	
X105	Motor/external brake resistor	📖 99	📖 107
X106	Motor temperature monitoring	📖 98	📖 108
IT	Contact screw for interference suppression (on the supply side/on the motor side)	📖 96	📖 105
MCI	Slot for communication module (Module Communication Interface)	📖 168	
D	Sticker with warning	📖 55	

3.3 Overview of control terminals

Control terminals for devices in the StateLine version	Control terminals for devices in the HighLine version
	

		Information	
Position	Description	StateLine	HighLine
X1	System bus connection (CANopen)	📖 113	
S1	System bus settings (CANopen)		
X3	Analog inputs/outputs; 10 V reference voltage	📖 117	📖 123
X4	Digital inputs; controller enable	📖 116	-
	24 V supply of the control electronics		
	Digital outputs		📖 125
	24 V voltage output		
X5	Digital inputs; controller enable	-	📖 125
	24 V supply of the control electronics; internal 24 V supply fused via PTC		
X6	Diagnostics	📖 115	
X107	24 V brake supply;	-	📖 127
	+ BD1 / - BD2: Connection for DC brake coil		
MMI	Slot for memory module (Memory Module Interface)	📖 167	

© Icon	Description
⚠	**Long discharge time**: All power terminals remain live for a few minutes after mains disconnection! The duration is given under the warning symbol on the device.
⚠	**High discharge current**: Carry out fixed installation and PE connection according to EN 61800-5-1!
⚠	**Electrostatic sensitive devices**: Before working on the device, the personnel must be free of electrostatic charge!
⚠	**Hot surface**: Risk of burns! Hot surfaces should not be touched without wearing protective gloves.

3.3.1 Determining the device type

The type data used in this manual refer to the nameplate ① which is placed at the front of the controller (Fig. 3-1).

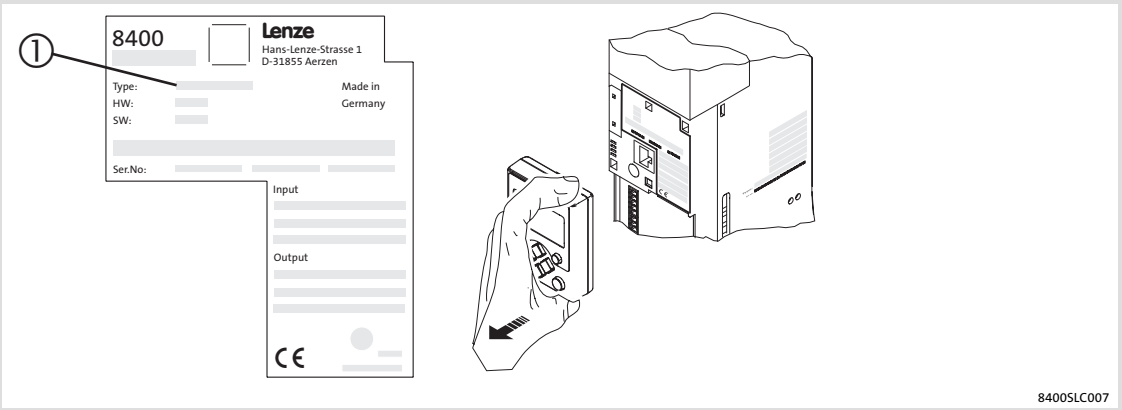


Fig. 3-1 Placement of the nameplate

3.3.2 Type code

	E84	A	V	xx	x	xxx	x	x	x	0

Product range
8400 Inverter Drives

Version
A = 1. generation

Inverter type
V = vector-controlled inverter

Version
SC = StateLine C
HC = HighLine C

Mounting type
E = installation
D = push-through technique
C = cold-plate technique

Power e.g.
251 = 25 x 101 W = 0.25 kW
222 = 22 x 10^2 W = 2.2 kW

Voltage class
2 = 230/240 V, 1/N/PE AC (0.25 ... 2.2 kW)
4 = 400/500 V, 3/PE AC (0.37 ... 15 kW)

Ambient conditions
S = standard industrial environment IE33 according to IEC 60721-3-3
V = rough environment (coated printed circuit boards)

Safety engineering
X = no safety function
B = with drive-based safety ”safe torque off (STO)”

4 Technical data

4.1 General data and operating conditions

Conformity and approval		
Conformity		
CE	2006/95/EG	Low-Voltage Directive
Approval		
UL	UL 508C	● Approved: – Device size 1 ... 3 (0.25 ... 2.2 kW) – Device size 4 (3.0 ... 5.5 kW) with nameplate data E84AVxC**E**... ● In preparation: – Device size 4 (3.0 ... 5.5 kW) with nameplate data E84AVxC**D**... and E84AVxC**C**... – Device size 5 (7.5 ... 15kW) – Device E84AV ... with safety unit

Protection of persons and devices			
Enclosure	EN 60529	IP 20 📖 96	in ready-for-use mounted state
	NEMA 250	Protection against accidental contact according to type 1	
Insulation resistance	EN 61800-5-1	Overvoltage category III above 2000 m amsl: overvoltage category II	
Insulation of control circuits	EN 61800-5-1	Safe mains isolation by double/reinforced insulation.	
Short-circuit strength	EN 61800-5-1	Motor connection: limited, controller is inhibited, error acknowledgement is required Control terminals: full	
Protective measures against		● Short circuit ● Earth fault ● Overvoltage ● Motor stalling ● Motor overtemperature (PTC or thermal contact, I^2t monitoring)	
Discharge current	EN 61800-5-1	> 3.5 mA AC, > 10 mA DC	Observe the regulations and safety instructions!
Cyclic mains switching		Cyclic mains switching at intervals of 3 min is permissible. If the mains is exceptionally switched three times in one minute, a pause of 9 min must follow. A circuit that can be reset automatically protects the device against destruction.	
Starting current		$\leq 2 \times I_N$	

Supply conditions		
AC mains operation		Direct connection
Power systems		
TT		Operation is permitted without restrictions.
TN		
IT		Observe instructions with regard to specific measures.
DC-bus operation		Direct connection for devices with 400 V mains connection possible
Motors	EN 60034	Only use motors suitable for inverter operation. Insulation resistance: min. û ≥1.5 kV, min. du/dt ≥5 kV/µs

Environmental conditions		
Climate		
Storage	IEC/EN 60721-3-1	1K3 (-25 ... +60 °C)
Transport	IEC/EN 60721-3-2	2K3 (-25 ... +70 °C)
Operation	IEC/EN 60721-3-3	3K3 (-10 ... +55 °C) Operation at 2/4 kHz, +45 ... +55 °C: Operation at 8/16 kHz, +40 ... +55 °C: For operation above +40 ... +45°C, reduce rated output current by 2.5 %/°C
Site altitude		0 ... 4000 m amsl 1000 ... 4000 m amsl: Reduce rated output current by 5 %/1000 m 2000 ... 4000 m amsl: overvoltage category II
Pollution	EN 61800-5-1	Pollution Degree 2
Vibration resistance (9.81 m/s² = 1 g)		
Transport	IEC/EN 60721-3-2	2M2
	EN 61800-5-1	2 ... 9 Hz: amplitude 3.5 mm
		10 ... 200 Hz: acceleration resistant up to 10 m/s²
		200 ... 500 Hz: acceleration resistant up to 15 m/s²
Operation	Germanischer Lloyd	5 ... 13,2 Hz: amplitude ±1 mm 13.2 ... 100 Hz: acceleration resistant up to 0.7 g
	EN 61800-5-1	10 ... 57 Hz: amplitude 0.075 mm
		57 ... 150 Hz: acceleration resistant up to 10 m/s² (1 g)

Requirements on the motor cable		
Capacitance per unit length		
≤ 1.5 mm²/AWG 16		$C_{Core/core}/C_{Core/shield} \leq 75/150$ pF/m
≥ 2.5 mm²/AWG 12		$C_{core/core}/C_{Core/shield} \leq 100/\leq 150$ pF/m
Electric strength		
	VDE 0250-1	$U_0/U_{\sim}$ 0.6/1.0 kV (U_0 = r.m.s. value external - conductor/PE, U = r.m.s. value - external conductor/external conductor)
	UL	U ≥ 600 V (U = r.m.s. value external conductor/external conductor)

EMC		
Noise emission		
cable-guided	EN 61800-3	up to 25 m of shielded motor cable: category C2
Radiation		Category C2
Noise immunity (according to requirements of EN 61800-3)		
Electrostatic discharge (ESD)	EN 61000-4-2	8 kV with air discharge, 4 kV with contact discharge against housing
Radio frequency		
cable-guided	EN 61000-4-6	150 kHz ... 80 MHz, 10 V/m 80 % AM (1kHz)
Interference (housing)	EN 61000-4-3	80 MHz ... 1000 MHz, 10 V/m 80 % AM (1kHz)
Burst		
Power terminals and interfaces	EN 61000-4-4	2 kV/5 kHz
Signal interfaces	EN 61000-4-4	1 kV/5 kHz
Control terminals	EN 61000-4-4	2 kV/5 kHz
Surge		
Power terminals	EN 61000-4-5	1.2/50 µs, 1 kV phase/phase, 2 kV phase/PE
Control terminals	EN 61000-4-5	1.2/50 µs, 1 kV
Operation on public supply systems	EN 61000-3-2 EN 61000-3-12	The devices are intended for use in an industrial environment. When being used on public network, additional measures must be taken to limit the expected radio interference. The compliance with the requirements for the machine/plant is the responsibility of the manufacturer of the machine or system!
	EN 61000-3-2	< 0.5 kW: with mains choke
		0.5 ... 1 kW: with active filter
		> 1 kW at mains current ≤ 16 A: No limit values for harmonic currents
	EN 61000-3-12	Mains current > 16 A: further measures are required for compliance with the standard

Open and closed loop control			
Open and closed loop control modes			
		VFCplus: ● V loop (linear or square-law) ● V/f closed loop SLVC: ● Sensorless vector control (torque/speed)	
Switching frequency			
		2 kHz, 4 kHz, 8 kHz, 16 kHz, Optionally noise optimised or power loss optimised	
Torque behaviour			
	Maximum torque	1.8 x M_N for 60 s 2.1 x M_N for 3 s	if rated motor power = rated controller power
	Setting range	1 : 10	in the speed range 3 ... 50 Hz
Sensorless vector control (speed)			
	Minimum output frequency	0.5 Hz (0 ... M_N)	
	Setting range	1 : 10	referring to 50 Hz and M_N
	Accuracy	±0.5 %	in the speed range 3 ... 50 Hz
	Smooth running	±0.1 Hz	
Output frequency			
	Range	-1000 Hz ... +1000 Hz	
	Absolute resolution	0.2 Hz	
	Standardised resolution	Parameter data: 0.01 %, process data: 0.006 % (= 2^{14})	
Digital setpoint selection			
	Accuracy	±0.01 %	
Analog setpoint selection			
	Accuracy	±0.5 %	referring to final value

4.2 Rated data

4.2.1 Overview

Input data

Basis of the data			
Mains	Voltage U_{LN} [V]	Voltage range U_{LN} [V]	Frequency range f [Hz]
1/N/PE AC	230	100 - 0 % ... 264 + 0 %	45 - 0 % ... 65 + 0 %
3/PE AC	400	320 - 0 % ... 440 + 0 %	45 - 0 % ... 65 + 0 %
3/PE AC	500	400 - 0 % ... 550 + 0 %	45 - 0 % ... 65 + 0 %

	Voltage	Frequency	Current [A]		Number of phases
Type	[V]	[Hz]	max. +45 °C ①	max. +55 °C ①	
E84AVxxx2512	230	50/60	3.4	2.6	1
E84AVxxx3712	230	50/60	5.0	3.8	1
E84AVxxx5512	230	50/60	5.3	4.0	1
E84AVxxx7512	230	50/60	8.0	6.0	1
E84AVxxx1122	230	50/60	12.0	9.0	1
E84AVxxx1522	230	50/60	13.7	10.3	1
E84AVxxx2222	230	50/60	21.8	16.3	1
E84AVxxx3714	400/500	50/60	1.8/1.4	1.4/1.1	3
E84AVxxx5514	400/500	50/60	2.7/2.2	2.0/1.7	3
E84AVxxx7514	400/500	50/60	3.6/2.9	2.7/2.2	3
E84AVxxx1124	400/500	50/60	4.4/3.6	3.3/2.7	3
E84AVxxx1524	400/500	50/60	5.5/4.4	4.1/3.3	3
E84AVxxx2224	400/500	50/60	7.3/5.8	5.5/4.4	3
E84AVxxx3024	400/500	50/60	9.8/7.8	7.35/5.8	3
E84AVxxx4024	400/500	50/60	13.1/10.5	9.8/7.8	3
E84AVxxx5524	400/500	50/60	18/14.4	13.5/10.8	3
E84AVxxx7524	400/500	50/60	20.0/16.0	15.0/12.0	3
E84AVxxx1134	400/500	50/60	29.0/23.2	21.7/17.4	3
E84AVxxx1534	400/500	50/60	29.0[2)]/23.2[2)]	21.4[2)]/17.4[2)]	3

① Ambient temperature in the control cabinet, switching frequency 2 and 4 kHz, operation without mains choke
2) only with mains choke

Output data

Type	Voltage [V]	Frequency [Hz]	Current [A]		Number of phases
			max. +45 °C ①	max. +55 °C ①	
E84AVxxx2512	0 - 230	0 - 1000	1.7	1.3	3
E84AVxxx3712	0 - 230	0 - 1000	2.4	1.8	3
E84AVxxx5512	0 - 230	0 - 1000	3.0	2.3	3
E84AVxxx7512	0 - 230	0 - 1000	4.0	3.0	3
E84AVxxx1122	0 - 230	0 - 1000	5.5	4.1	3
E84AVxxx1522	0 - 230	0 - 1000	7	5.3	3
E84AVxxx2222	0 - 230	0 - 1000	9.5	7.1	3
E84AVxxx3714	0 - 400/500	0 - 1000	1.3/1.0	1.0/0.8	3
E84AVxxx5514	0 - 400/500	0 - 1000	1.8/1.4	1.4/1.0	3
E84AVxxx7514	0 - 400/500	0 - 1000	2.4/1.9	1.8/1.4	3
E84AVxxx1124	0 - 400/500	0 - 1000	3.2/2.6	2.4/2.0	3
E84AVxxx1524	0 - 400/500	0 - 1000	3.9/3.1	2.9/2.3	3
E84AVxxx2224	0 - 400/500	0 - 1000	5.6/4.5	4.2/3.4	3
E84AVxxx3024	0 - 400/500	0 - 1000	7.3/5.8	5.5/4.4	3
E84AVxxx4024	0 - 400/500	0 - 1000	9.5/7.6	7.1/5.7	3
E84AVxxx5524	0 - 400/500	0 - 1000	13/10.4	9.8/7.8	3
E84AVxxx7524	0 - 400/500	0 - 1000	16.5/13.2	12.4/9.9	3
E84AVxxx1134	0 - 400/500	0 - 1000	23.5/18.8	17.6/14.1	3
E84AVxxx1534	0 - 400/500	0 - 1000	32.0/25.6	24.0/19.2	3

① Temperature in the control cabinet

Note!

The indicated output voltage will not be reached under certain operating conditions.

- ► Output power in the maximum range
- ► High switching frequencies
- ► Use of mains filters or mains chokes
- ► Mains supply with high impedance (U_k > 5 %)

Power losses

Type	Power loss P_V [W]	
	when operating with rated output current I_{aN}	when controller is inhibited
E84AVxxx2512	45	20
E84AVxxx3712	50	
E84AVxxx5512	60	
E84AVxxx7512	75	
E84AVxxx1122	95	
E84AVxxx1522	110	
E84AVxxx2222	140	
E84AVxxx3714	50	
E84AVxxx5514	65	
E84AVxxx7514	80	
E84AVxxx1124	95	
E84AVxxx1524	105	
E84AVxxx2224	135	
E84AVxxx3024	165	25
E84AVxxx4024	205	
E84AVxxx5524	275	
E84AVxxx7524	320	30
E84AVxxx1134	435	35
E84AVxxx1534	470	

4.2.2 Operation at rated mains voltage 230 V

Basis of the data			
Mains	Voltage U_{LN} [V]	Voltage range U_{LN} [V]	Frequency range f [Hz]
1/N/PE AC	230	100 - 0 % ... 264 + 0 %	45 - 0 % ... 65 + 0 %

	Mains current at I_{aN}		Output power	Motor power
	with external mains choke	without external mains choke	U, V, W	4 pol. ASM
Type	I_{LN} [A]	I_{LN} [A]	S_{aN} [kVA]	P_{aN} [kW]
E84AVxxx2512	3.0	3.4	0.6	0.25
E84AVxxx3712	4.2	5.0	0.9	0.37
E84AVxxx5512	5.0	5.3	1.1	0.55
E84AVxxx7512	7.0	8.0	1.4	0.75
E84AVxxx1122	9.9	12.0	2.0	1.1
E84AVxxx1522	11.4	13.7	2.5	1.5
E84AVxxx2222	16.4	21.8	3.4	2.2

Assignment	
Type	**Mains choke**
E84AVxxx2512	ELN1-0900H005
E84AVxxx3712	
E84AVxxx5512	ELN1-0500H009
E84AVxxx7512	
E84AVxxx1122	ELN1-0250H018
E84AVxxx1522	
E84AVxxx2222	

Type	Output currents [A] at switching frequency							
	2 kHz		4 kHz		8 kHz		16 kHz	
	I_{aN2}	I_{aM2}	I_{aN4}	I_{aM4}	I_{aN8}	I_{aM8}	I_{aN16}	I_{aM16}
E84AVxxx2512	1.7	3.4	1.7	3.4	1.7	3.4	1.1	2.8
E84AVxxx3712	2.4	4.8	2.4	4.8	2.4	4.8	1.6	4.0
E84AVxxx5512	3.0	6.0	3.0	6.0	3.0	6.0	2.0	5.0
E84AVxxx7512	4.0	8.0	4.0	8.0	4.0	8.0	2.7	6.6
E84AVxxx1122	5.5	11.0	5.5	11.0	5.5	11.0	3.7	9.1
E84AVxxx1522	7.0	14.0	7.0	14.0	7.0	14.0	4.7	11.6
E84AVxxx2222	9.5	19.0	9.5	19.0	9.5	19.0	6.3	15.7

I_{aNx}	Rated value of continuous output current
I_{aMx}	Maximum output current (overload current) ● Periodic load change of 3 s with I_{aMx} and recovery time of 12 s according to the tables under chapter 📖 4.2.5 ● Can be obtained in the setting "x kHz fixed/..." in C00018
Switching frequency	If the maximum heatsink temperature is reached, the switching frequency is reduced to 4 kHz. In the setting "x kHz var./..." in C00018 the switching frequency is reduced dynamically.

Rated data for internal brake chopper

Switching threshold V_{BRmax}: 380 V, adjustable

Type	R_{Bmin} [Ω]	I_{BRmax} [A]	P_{BRmax} [kW]	I_{BRd} [A]	P_{Bd} [kW]	t_Z [s]	t_{on} [s]	t_{fp} [s]
E84AVxxx2512	180	2.1	0.8	1.6	0.6	-	∞	-
E84AVxxx3712	180	2.1	0.8	1.6	0.6	-	∞	-
E84AVxxx5512	100	3.8	1.4	2.8	1.1	-	∞	-
E84AVxxx7512	100	3.8	1.4	2.8	1.1	-	∞	-
E84AVxxx1122	33	11.5	4.4	8.6	3.3	-	∞	-
E84AVxxx1522	33	11.5	4.4	8.6	3.3	-	∞	-
E84AVxxx2222	33	11.5	4.4	8.6	3.3	-	∞	-

R_{Bmin}	Minimum brake resistance, nominal value ±10 %
I_{BRmax}	Peak current
P_{BRmax}	Peak braking power
I_{BRd}	Continuous current RMS - important for cable dimensioning
P_{Bd}	Continuous braking power
t_Z	Cycle time, periodic load change with running time and recovery time
t_{on}	Running time in a cycle without reducing the scanning ratio (∞= no time limit)
$t_Z - t_{on}$	Recovery time
t_{fp}	Maximum running time without initial load and observing the recovery time

Fuses and cable cross-sections

Operation without external mains choke/mains filter								
Type	Installation according to EN 60204-1 [1]					Installation according to UL [2]		FI [3]
	①	②	L1, N - laying system			③	L1, N	
			B2	C	F			
	[A]	[A]	[mm²]	[mm²]	[mm²]	[A]	[AWG]	[mA]
E84AVxxx2512	C 6	6	1	-	-	6	18	≥ 30 [3]
E84AVxxx3712	C 6	6	1	-	-	10	16	
E84AVxxx5512	C 10	10	1.5	-	-	10	16	≥ 30 [3]
E84AVxxx7512	C 10	10	1.5	-	-	15	14	
E84AVxxx1122	C16	16	2.5	-	-	20	12	≥ 30 [3]
E84AVxxx1522	C 20	20	4.0	-	-	25	10	
E84AVxxx2222	C 25	25	6.0	-	-	30	10	

1) These values are recommendations only. Other dimensioning values/laying systems are possible (e.g. according to VDE 0298-4).
The cable-cross sections apply under the following conditions: Use of PVC-insulated copper cables, conductor temperature < 70 °C, ambient temperature < 45°C, no bundling of cables or cores, two loaded cores. Smaller cable cross-sections are not permissible for technical reasons.

2) Use UL-approved cable, fuses, and fuse holders only.
UL fuse: voltage ≥ 240 V, tripping characteristic for example "H", "K5" or "CC".
The cable cross-sections apply under the following conditions: conductor temperature < 75 °C, ambient temperature < 45°C. Smaller cable cross-sections are not permissible for technical reasons.

3) Pulse-current sensitive or universal-current sensitive earth-leakage circuit breaker, short-time delay
If cables are longer than 50 m, the protective circuit-breaker may respond, depending on the cable type and switching frequency.

① Circuit breaker
② Fuse of gG/gL utilisation category or semiconductor fuses of gRL utilisation category
③ Fuse

Observe national and regional regulations

Operation with external mains choke/mains filter

Type	Installation according to EN 60204-1 [1]					Installation according to UL [2]		FI [3]
	①	②	L1, N - laying system			③	L1, N	
			B2	C	F			
	[A]	[A]	[mm²]	[mm²]	[mm²]	[A]	[AWG]	[mA]
E84AVxxx2512	C 6	6	1	-	-	6	18	≥ 30 [3]
E84AVxxx3712	C 6	6	1	-	-	10	16	
E84AVxxx5512	C 10	10	1.5	-	-	10	16	≥ 30 [3]
E84AVxxx7512	C 10	10	1.5	-	-	15	14	
E84AVxxx1122	C 16	16	2.5	-	-	20	12	≥ 30 [3]
E84AVxxx1522	C 16	16	2.5	-	-	25	10	
E84AVxxx2222	C 20	20	4.0	-	-	30	10	

1) These values are recommendations only. Other dimensioning values/laying systems are possible (e.g. according to VDE 0298-4).
The cable-cross sections apply under the following conditions: Use of PVC-insulated copper cables, conductor temperature < 70 °C, ambient temperature < 45°C, no bundling of cables or cores, two loaded cores. Smaller cable cross-sections are not permissible for technical reasons.

2) Use UL-approved cable, fuses, and fuse holders only.
UL fuse: voltage ≥ 240 V, tripping characteristic for example "H", "K5" or "CC".
The cable cross-sections apply under the following conditions: conductor temperature < 75 °C, ambient temperature < 45°C. Smaller cable cross-sections are not permissible for technical reasons.

3) Pulse-current sensitive or universal-current sensitive earth-leakage circuit breaker, short-time delay
If cables are longer than 50 m, the protective circuit-breaker may respond, depending on the cable type and switching frequency.

① Circuit breaker
② Fuse of gG/gL utilisation category or semiconductor fuses of gRL utilisation category
③ Fuse

Observe national and regional regulations

4.2.3 Operation at rated mains voltage 400 V

Basis of the data			
Mains	Voltage U_{LN} [V]	Voltage range U_{LN} [V]	Frequency range f [Hz]
3/PE AC	400	320 - 0 % ... 440 + 0 %	45 - 0 % ... 65 + 0 %

	Mains current at I_{aN}		Output power	Motor power
	with external mains choke	without external mains choke	U, V, W	4 pol. ASM
Type	I_{LN} [A]	I_{LN} [A]	S_{aN} [kVA]	P_{aN} [kW]
E84AVxxx3714	1.4	1.8	0.8	0.37
E84AVxxx5514	2.2	2.7	1.1	0.55
E84AVxxx7514	2.5	3.6	1.5	0.75
E84AVxxx1124	3.2	4.4	2.0	1.1
E84AVxxx1524	3.9	5.5	2.4	1.5
E84AVxxx2224	5.1	7.3	3.5	2.2
E84AVxxx3024	7.0	9.8	4.6	3.0
E84AVxxx4024	8.8	13.1	5.9	4.0
E84AVxxx5524	12.0	18	8.1	5.5
E84AVxxx7524	15.0	20.0	10.3	7.5
E84AVxxx1134	21.0	29.0	14.7	11.0
E84AVxxx1534[1)]	29.0	-	20.0	15.0

1) only with mains choke

Assignment	
Type	**Mains choke**
E84AVxxx3714	ELN3-1500H003-001
E84AVxxx5514	
E84AVxxx7514	
E84AVxxx1124	ELN3-0680H006-001
E84AVxxx1524	
E84AVxxx2224	
E84AVxxx3024	ELN3-02500H013-001
E84AVxxx4024	
E84AVxxx5524	
E84AVxxx7524	ELN3-0150H024-001
E84AVxxx1134	
E84AVxxx1534	ELN3-0088H035-001

Basis of the data			
Mains	Voltage U_{DC} [V]	Voltage range U_{DC} [V]	Frequency range f [Hz]
2/PE DC	565	455 - 0 % ... 620 + 0 %	-

Type	Input current at I_{aN} I_{DC} [A]	Frequency range f [Hz]	Number of phases
E84AVxxx3714	2.2	0 (DC)	2
E84AVxxx5514	3.3	0 (DC)	2
E84AVxxx7514	4.4	0 (DC)	2
E84AVxxx1124	5.4	0 (DC)	2
E84AVxxx1524	6.7	0 (DC)	2
E84AVxxx2224	8.9	0 (DC)	2
E84AVxxx3024	12.0	0 (DC)	2
E84AVxxx4024	16.0	0 (DC)	2
E84AVxxx5524	22.0	0 (DC)	2
E84AVxxx7524	24.5	0 (DC)	2
E84AVxxx1134	35.5	0 (DC)	2
E84AVxxx1534	35.5	0 (DC)	2

	Output currents [A] at switching frequency							
	2 kHz		4 kHz		8 kHz		16 kHz	
Type	I_{aN2}	I_{aM2}	I_{aN4}	I_{aM4}	I_{aN8}	I_{aM8}	I_{aN16}	I_{aM16}
E84AVxxx3714	1.3	2.6	1.3	2.6	1.3	2.6	0.9	2.1
E84AVxxx5514	1.8	3.6	1.8	3.6	1.8	3.6	1.2	3.0
E84AVxxx7514	2.4	4.8	2.4	4.8	2.4	4.8	1.6	4.0
E84AVxxx1124	3.2	6.4	3.2	6.4	3.2	6.4	2.1	5.3
E84AVxxx1524	3.9	7.8	3.9	7.8	3.9	7.8	2.6	6.4
E84AVxxx2224	5.6	11.2	5.6	11.2	5.6	11.2	3.7	9.2
E84AVxxx3024	7.3	14.6	7.3	14.6	7.3	14.6	4.9	9.5
E84AVxxx4024	9.5	19.0	9.5	19.0	9.5	15.2	6.3	9.5
E84AVxxx5524	13.0	26.0	13.0	26.0	13.0	19.5	8.7	11.7
E84AVxxx7524	16.5	33.0	16.5	33.0	16.5	26.4	11.0	16.5
E84AVxxx1134	23.5	47.0	23.5	47.0	23.5	32.9	15.7	21.2
E84AVxxx1534	32.0	64.0	32.0	57.1	32.0	43.2	21.3	27.2

I_{aNx}	Rated value of continuous output current
I_{aMx}	Maximum output current (overload current) ● Periodic load change of 3 s with I_{aMx} and recovery time of 12 s according to the tables under chapter 📖 4.2.5 ● Can be obtained in the setting "x kHz fixed/..." in C00018
Switching frequency	If the maximum heatsink temperature is reached, the switching frequency is reduced to 4 kHz. In the setting "x kHz var./..." in C00018 the switching frequency is reduced dynamically.

Rated data for internal brake chopper

Switching threshold V_{BRmax}: 725 V, adjustable

Type	R_{Bmin} [Ω]	I_{BRmax} [A]	P_{BRmax} [kW]	I_{BRd} [A]	P_{Bd} [kW]	t_Z [s]	t_{on} [s]	t_{fp} [s]
E84AVxxx3714	390	1.9	1.3	1.9	1.3	-	∞	-
E84AVxxx5514	390	1.9	1.3	1.9	1.3	-	∞	-
E84AVxxx7514	390	1.9	1.3	1.9	1.3	-	∞	-
E84AVxxx1124	180	4.0	2.9	4.0	2.9	-	∞	-
E84AVxxx1524	180	4.0	2.9	4.0	2.9	-	∞	-
E84AVxxx2224	150	4.8	3.5	4.8	3.5	-	∞	-
E84AVxxx3024	47	15.4	11.2	13.0	9.4	-	∞	-
E84AVxxx4024	47	15.4	11.2	13.0	9.4	-	∞	-
E84AVxxx5524	47	15.4	11.2	13.0	9.4	-	∞	-
E84AVxxx7524	27	26.9	19.5	26.9	19.5	-	∞	-
E84AVxxx1134	27	26.9	19.5	26.9	19.5	-	∞	-
E84AVxxx1534	18	40.3	29.2	40.3	29.2	-	∞	-

R_{Bmin}	Minimum brake resistance, nominal value ±10 %
I_{BRmax}	Peak current
P_{BRmax}	Peak braking power
I_{BRd}	Continuous current RMS - important for cable dimensioning
P_{Bd}	Continuous braking power
t_Z	Cycle time, periodic load change with running time and recovery time
t_{on}	Running time in a cycle without reducing the scanning ratio (∞= no time limit)
$t_Z - t_{on}$	Recovery time
t_{fp}	Maximum running time without initial load and observing the recovery time

Fuses and cable cross-sections

Operation without external mains choke/mains filter

Type	Installation according to EN 60204-1 [1]					Installation according to UL [2]		FI [3]
	①	②	L1, L2, L3 - Laying system			③	L1, L2, L3	
			B2	C	F			
	[A]	[A]	[mm²]	[mm²]	[mm²]	[A]	[AWG]	[mA]
E84AVxxx3714	C 6	6	1.0	-	-	6	18	≥ 30 [3]
E84AVxxx5514	C 6	6	1.0	-	-	6	18	
E84AVxxx7514	C 6	6	1.0	-	-	6	18	
E84AVxxx1124	C 10	10	1.5	-	-	10	16	≥ 30 [3]
E84AVxxx1524	C 10	10	1.5	-	-	10	16	
E84AVxxx2224	C 10	10	1.5	-	-	10	16	
E84AVxxx3024	C 16	16	2.5	-	-	15	14	≥ 30 [3]
E84AVxxx4024	C 16	16	2.5	-	-	20	12	
E84AVxxx5524	C 25	25	4	-	-	20	12	
E84AVxxx7524	C 32	32	10	-	-	-	-	≥ 30 [3]
E84AVxxx1134	C 32	32	10	-	-	-	-	
E84AVxxx1534	-	-	-	-	-	-	-	-

1) These values are recommendations only. Other dimensioning values/laying systems are possible (e.g. according to VDE 0298-4). The cable cross-sections apply under the following conditions: Use of PVC-insulated copper cables, conductor temperature < 70 °C, ambient temperature < 45°C, no bundling of cables or cores, three loaded cores.

2) Use UL-approved cables, fuses and fuse holders only.
UL fuse: voltage ≥ 500 V, tripping characteristic for example "H", "K5" or "CC". The cable cross-sections apply under the following conditions: conductor temperature < 75 °C, ambient temperature < 45°C.

3) Universal-current sensitive earth-leakage circuit breaker, short-time delay
If cables are longer than 50 m, the protective circuit-breaker may respond, depending on the cable type and switching frequency.

① Circuit breaker
② Fuse of gG/gL utilisation category or semiconductor fuses of gRL utilisation category
③ Fuse

Observe national and regional regulations

Operation with external mains choke/mains filter

Type	Installation according to EN 60204-1 [1]					Installation according to UL [2]		FI [3]
	①	②	L1, L2, L3 - Laying system			③	L1, L2, L3	
			B2	C	F			
	[A]	[A]	[mm²]	[mm²]	[mm²]	[A]	[AWG]	[mA]
E84AVxxx3714	C 6	6	1.0	-	-	6	18	
E84AVxxx5514	C 6	6	1.0	-	-	6	18	≥ 30 [3]
E84AVxxx7514	C 6	6	1.0	-	-	6	18	
E84AVxxx1124	C 6	6	1.0	-	-	10	16	
E84AVxxx1524	C 6	6	1.0	-	-	10	16	≥ 30 [3]
E84AVxxx2224	C 10	10	1.5	-	-	10	16	
E84AVxxx3024	C 10	10	1.5	-	-	15	14	
E84AVxxx4024	C 16	16	2.5	-	-	20	12	≥ 30 [3]
E84AVxxx5524	C 20	20	4	-	-	20	12	
E84AVxxx7524	C 20	20	4	-	-	-	-	
E84AVxxx1134	C 32	32	10	-	-	-	-	≥ 30 [3]
E84AVxxx1534	C 32	32	10	-	-	-	-	

[1] These values are recommendations only. Other dimensioning values/laying systems are possible (e.g. according to VDE 0298-4). The cable cross-sections apply under the following conditions: Use of PVC-insulated copper cables, conductor temperature < 70 °C, ambient temperature < 45°C, no bundling of cables or cores, three loaded cores.

[2] Use UL-approved cables, fuses and fuse holders only.
UL fuse: voltage ≥ 500 V, tripping characteristic for example "H", "K5" or "CC". The cable cross-sections apply under the following conditions: conductor temperature < 75 °C, ambient temperature < 45°C.

[3] Universal-current sensitive earth-leakage circuit breaker, short-time delay
If cables are longer than 50 m, the protective circuit-breaker may respond, depending on the cable type and switching frequency.

① Circuit breaker
② Fuse of gG/gL utilisation category or semiconductor fuses of gRL utilisation category
③ Fuse

Observe national and regional regulations

4.2.4 Operation at rated mains voltage 500 V

Basis of the data			
Mains	Voltage U_{LN} [V]	Voltage range U_{LN} [V]	Frequency range f [Hz]
3/PE AC	500	400 - 0 % ... 550 + 0 %	45 - 0 % ... 65 + 0 %

	Mains current at I_{aN}		Output power	Motor power
	with external mains choke	without external mains choke	U, V, W	4 pol. ASM
Type	I_{LN} [A]	I_{LN} [A]	S_{aN} [kVA]	P_{aN} [kW]
E84AVxxx3714	1.1	1.4	0.8	0.37
E84AVxxx5514	1.7	2.2	1.1	0.55
E84AVxxx7514	2.0	2.9	1.5	0.75
E84AVxxx1124	2.6	3.6	2.0	1.1
E84AVxxx1524	3.1	4.4	2.4	1.5
E84AVxxx2224	4.1	5.8	3.5	2.2
E84AVxxx3024	5.6	7.8	4.5	3.0
E84AVxxx4024	7.0	10.5	5.9	4.0
E84AVxxx5524	9.6	14.4	8.1	5.5
E84AVxxx7524	12.0	16.0	10.3	7.5
E84AVxxx1134	16.8	23.2	14.7	11.0
E84AVxxx1534[1)]	24.0	-	20.0	15.0

[2)] only with mains choke

Assignment	
Type	**Mains choke**
E84AVxxx3714	ELN3-1500H003-001
E84AVxxx5514	
E84AVxxx7514	
E84AVxxx1124	ELN3-0680H006-001
E84AVxxx1524	
E84AVxxx2224	
E84AVxxx3024	ELN3-02500H013-001
E84AVxxx4024	
E84AVxxx5524	
E84AVxxx7524	ELN3-0150H024-001
E84AVxxx1134	
E84AVxxx1534	ELN3-0088H035-001

Basis of the data			
Mains	Voltage U_{DC} [V]	Voltage range U_{DC} [V]	Frequency range f [Hz]
2/PE DC	705	565 - 0 % ... 775 + 0 %	-

Type	Input current at I_{aN} I_{DC} [A]	Frequency range f [Hz]	Number of phases
E84AVxxx3714	1.7	0 (DC)	2
E84AVxxx5514	2.7	0 (DC)	2
E84AVxxx7514	3.6	0 (DC)	2
E84AVxxx1124	4.4	0 (DC)	2
E84AVxxx1524	5.4	0 (DC)	2
E84AVxxx2224	7.1	0 (DC)	2
E84AVxxx3024	9.6	0 (DC)	2
E84AVxxx4024	12.9	0 (DC)	2
E84AVxxx5524	17.6	0 (DC)	2
E84AVxxx7524	19.6	0 (DC)	2
E84AVxxx1134	28.4	0 (DC)	2
E84AVxxx1534	28.4	0 (DC)	2

	Output currents [A] at switching frequency							
	2 kHz		4 kHz		8 kHz		16 kHz	
Type	I_{aN2}	I_{aM2}	I_{aN4}	I_{aM4}	I_{aN8}	I_{aM8}	I_{aN16}	I_{aM16}
E84AVxxx3714	1.0	2.6	1.0	2.4	1.0	2.4	0.7	1.7
E84AVxxx5514	1.4	3.6	1.4	3.3	1.4	3.3	0.9	2.3
E84AVxxx7514	1.9	4.8	1.9	4.4	1.9	4.4	1.3	3.1
E84AVxxx1124	2.6	6.4	2.6	5.9	2.6	5.9	1.7	4.1
E84AVxxx1524	3.1	7.8	3.1	7.2	3.1	7.2	2.1	5.0
E84AVxxx2224	4.5	11.2	4.5	10.4	4.5	10.4	3.0	7.2
E84AVxxx3024	5.8	14.6	5.8	13.5	5.8	13.5	3.9	7.4
E84AVxxx4024	7.6	19.0	7.6	17.6	7.6	11.9	5.1	7.3
E84AVxxx5524	10.4	26.0	10.4	24.1	10.4	15.2	6.9	9.0
E84AVxxx7524	13.2	33.0	13.2	30.5	13.2	20.6	8.8	12.7
E84AVxxx1134	18.8	47.0	18.8	43.5	18.8	25.6	12.5	16.2
E84AVxxx1534	25.6	64.0	25.6	49.0	25.6	33.6	17.1	20.8

I_{aNx}	Rated value of continuous output current
I_{aMx}	Maximum output current (overload current) ● Periodic load change of 3 s with I_{aMx} and recovery time of 12 s according to the tables under chapter 📖 4.2.5 ● Can be obtained in the setting "x kHz fixed/..." in C00018
Switching frequency	If the maximum heatsink temperature is reached, the switching frequency is reduced to 4 kHz. In the setting "x kHz var./..." in C00018 the switching frequency is reduced dynamically.

Rated data for internal brake chopper

Switching threshold V_{BRmax}: 790 V, adjustable

Type	R_{Bmin} [Ω]	I_{BRmax} [A]	P_{BRmax} [kW]	I_{BRd} [A]	P_{Bd} [kW]	t_Z [s]	t_{on} [s]	t_{fp} [s]
E84AVxxx3714	390	2.0	1.6	2.0	1.6	-	∞	-
E84AVxxx5514	390	2.0	1.6	2.0	1.6	-	∞	-
E84AVxxx7514	390	2.0	1.6	2.0	1.6	-	∞	-
E84AVxxx1124	180	4.4	3.5	4.4	3.5	-	∞	-
E84AVxxx1524	180	4.4	3.5	4.4	3.5	-	∞	-
E84AVxxx2224	150	5.3	4.2	5.3	4.2	-	∞	-
E84AVxxx3024	47	16.8	13.3	13.0	10.3	-	∞	-
E84AVxxx4024	47	16.8	13.3	13.0	10.3	-	∞	-
E84AVxxx5524	47	16.8	13.3	13.0	10.3	-	∞	-
E84AVxxx7524	27	29.3	23.1	29.3	23.1	-	∞	-
E84AVxxx1134	27	29.3	23.1	29.3	23.1	-	∞	-
E84AVxxx1534	18	43.9	34.7	43.9	34.7	-	∞	-

R_{Bmin}	Minimum brake resistance, nominal value ±10 %
I_{BRmax}	Peak current
P_{BRmax}	Peak braking power
I_{BRd}	Continuous current RMS - important for cable dimensioning
P_{Bd}	Continuous braking power
t_Z	Cycle time, periodic load change with running time and recovery time
t_{on}	Running time in a cycle without reducing the scanning ratio (∞= no time limit)
$t_Z - t_{on}$	Recovery time
t_{fp}	Maximum running time without initial load and observing the recovery time

Fuses and cable cross-sections

Operation without external mains choke/mains filter

Type	Installation according to EN 60204-1 [1]					Installation according to UL [2]		FI [3]
	①	②	L1, L2, L3 - Laying system			③	L1, L2, L3	
			B2	C	F			
	[A]	[A]	[mm²]	[mm²]	[mm²]	[A]	[AWG]	[mA]
E84AVxxx3714	C 6	6	1.0	-	-	6	18	≥ 30 [3]
E84AVxxx5514	C 6	6	1.0	-	-	6	18	
E84AVxxx7514	C 6	6	1.0	-	-	6	18	
E84AVxxx1124	C 10	10	1.5	-	-	10	16	≥ 30 [3]
E84AVxxx1524	C 10	10	1.5	-	-	10	16	
E84AVxxx2224	C 10	10	1.5	-	-	10	16	
E84AVxxx3024	C 16	16	2.5	-	-	15	14	≥ 30 [3]
E84AVxxx4024	C 16	16	2.5	-	-	20	12	
E84AVxxx5524	C 25	25	4	-	-	20	12	
E84AVxxx7524	C 32	32	10	-	-	-	-	≥ 30 [3]
E84AVxxx1134	C 32	32	10	-	-	-	-	
E84AVxxx1534	-	-	-	-	-	-	-	-

1) These values are recommendations only. Other dimensioning values/laying systems are possible (e.g. according to VDE 0298-4). The cable cross-sections apply under the following conditions: Use of PVC-insulated copper cables, conductor temperature < 70 °C, ambient temperature < 45°C, no bundling of cables or cores, three loaded cores.

2) Use UL-approved cables, fuses and fuse holders only.
UL fuse: voltage ≥ 500 V, tripping characteristic for example "H", "K5" or "CC". The cable cross-sections apply under the following conditions: conductor temperature < 75 °C, ambient temperature < 45°C.

3) Universal-current sensitive earth-leakage circuit breaker, short-time delay
If cables are longer than 50 m, the protective circuit-breaker may respond, depending on the cable type and switching frequency.

① Circuit breaker
② Fuse of gG/gL utilisation category or semiconductor fuses of gRL utilisation category
③ Fuse

Observe national and regional regulations

Operation with external mains choke/mains filter

Type	Installation according to EN 60204-1 [1]					Installation according to UL [2]		FI [3]
	①	②	L1, L2, L3 - Laying system			③	L1, L2, L3	
			B2	C	F			
	[A]	[A]	[mm²]	[mm²]	[mm²]	[A]	[AWG]	[mA]
E84AVxxx3714	C 6	6	1.0	-	-	6	18	
E84AVxxx5514	C 6	6	1.0	-	-	6	18	≥ 30 [3]
E84AVxxx7514	C 6	6	1.0	-	-	6	18	
E84AVxxx1124	C 6	6	1.0	-	-	10	16	
E84AVxxx1524	C 6	6	1.0	-	-	10	16	≥ 30 [3]
E84AVxxx2224	C 10	10	1.5	-	-	10	16	
E84AVxxx3024	C 10	10	1.5	-	-	15	14	
E84AVxxx4024	C 16	16	2.5	-	-	20	12	≥ 30 [3]
E84AVxxx5524	C 20	20	4	-	-	20	12	
E84AVxxx7524	C 20	20	4	-	-	-	-	
E84AVxxx1134	C 32	32	10	-	-	-	-	≥ 30 [3]
E84AVxxx1534	C 32	32	10	-	-	-	-	

1) These values are recommendations only. Other dimensioning values/laying systems are possible (e.g. according to VDE 0298-4). The cable cross-sections apply under the following conditions: Use of PVC-insulated copper cables, conductor temperature < 70 °C, ambient temperature < 45°C, no bundling of cables or cores, three loaded cores.

2) Use UL-approved cables, fuses and fuse holders only.
UL fuse: voltage ≥ 500 V, tripping characteristic for example "H", "K5" or "CC". The cable cross-sections apply under the following conditions: conductor temperature < 75 °C, ambient temperature < 45°C.

3) Universal-current sensitive earth-leakage circuit breaker, short-time delay
If cables are longer than 50 m, the protective circuit-breaker may respond, depending on the cable type and switching frequency.

① Circuit breaker
② Fuse of gG/gL utilisation category or semiconductor fuses of gRL utilisation category
③ Fuse

Observe national and regional regulations

4.2.5 Overcurrent operation

The controllers are designed for an overcurrent limited in time. The load due to defined, cyclic operation is determined by the "Ixt" monitoring function. The "Ixt" function comprises two moving averaging procedures which are checked in parallel:

- ► temporary moving averaging of the apparent motor current for pulse loads
- ► continuous moving averaging of the apparent motor current for permanent loads

Type of load	Load cycle	Monitoring function	
		Condition	Code
Pulse load	15 s	I_{aNx} > 160 %	• Display in C00064/2 • Display of the maximum value in C00064/1
Permanent load	180 s	The monitoring function is permanently activated.	• Display in C00064/3 • Display of the maximum value in C00064/1

If the maximum value in code C00064/1 exceeds 100 %, a "warning" will be generated or a "trip" will be triggered (according to setting).

The curves of typical load functions and the simulation of the "Ixt" function are shown in the following illustration:

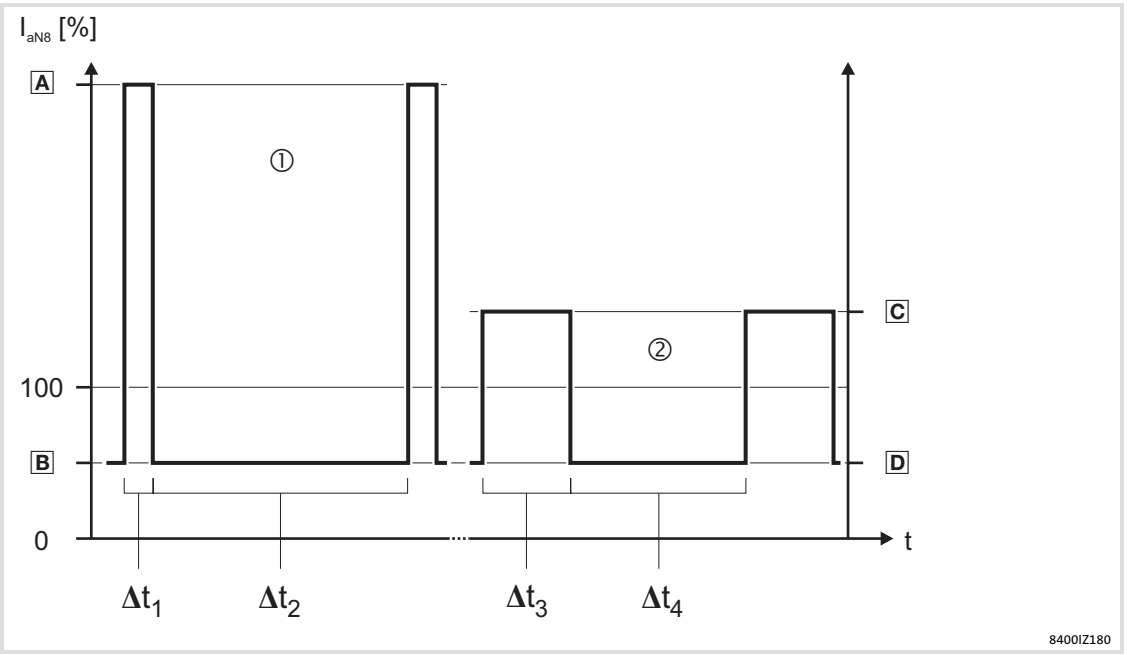


Fig. 4-1 Overcurrent capacity in 230/400 V operation at 45° C

① Pulse load (15 s cycle)
A Peak current
B Unloading current
Δt_1 Continuous peak current
Δt_2 Continuous unloading current

Calculation equation:

$$\frac{A \cdot \Delta t_1 + B \cdot \Delta t_2}{\Delta t_1 + \Delta t_2} \leqq 100\%$$

② Permanent load (180 s cycle)
C Peak current
D Unloading current
Δt_3 Continuous peak current
Δt_4 Continuous unloading current

Calculation equation:

$$\frac{C \cdot \Delta t_3 + D \cdot \Delta t_4}{\Delta t_3 + \Delta t_4} \leqq 100\%$$

According to the calculation equations, the following peak currents and unloading currents are typical for:

- Pulse load (15 s cycle) with Δt_1 = 3 s and Δt_2 = 12 s
- Permanent load (180 s cycle) with Δt_3 = 60 s and Δt_4 = 120 s

The data given in the representation apply to a device with an output power of 250 W.

	I_{amax}/I_{aN8} [%] in 15-s cycle ①							
	f = 2 kHz		f = 4 kHz		f = 8 kHz		f = 16 kHz	
Type	A	B	A	B	A	B	A	B
E84AVxxx251x	200	75	200	75	200	75	133	50

	I_{amax}/I_{aN8} [%] in 180-s cycle ②							
	f = 2 kHz		f = 4 kHz		f = 8 kHz		f = 16 kHz	
Type	C	D	C	D	C	D	C	D
E84AVxxx251x	150	75	150	75	150	75	100	50

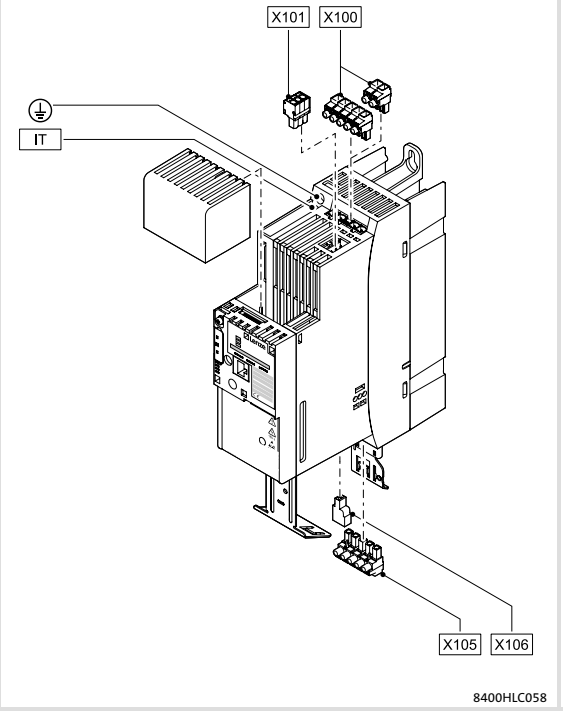
Tip!

For calculations of application-specific cycles please contact your Lenze contact person.

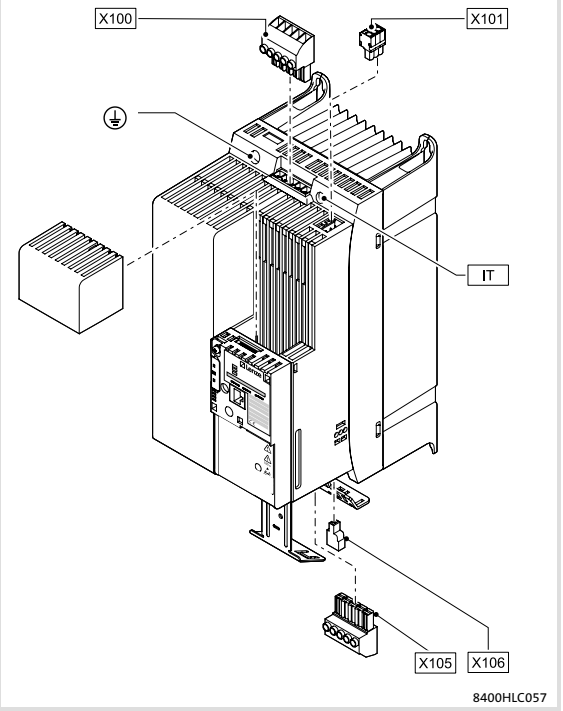
4.3 Terminal description

4.3.1 Overview

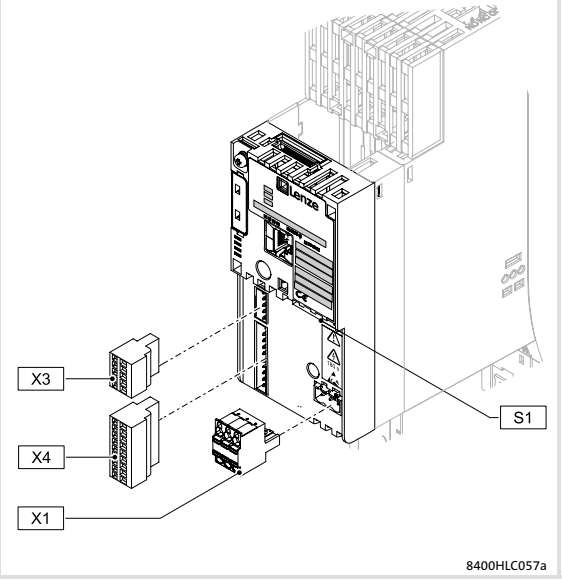
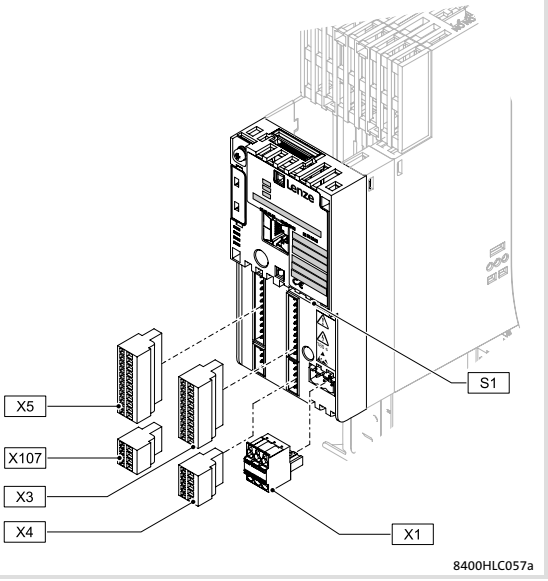
Standard device in device size GG 1 ... 3



Standard device in device size GG 4 ... 5



Pos.	Description	Number
X100	Mains/DC-bus voltage (for 400 V devices)	1
X101	Switching contact	1
X105	Motor/external brake resistor	1
X106	Motor temperature monitoring	1
⏚	PE conductor (on the supply side/on the motor side)	2
IT	Contact screw for interference suppression (on the supply side/on the motor side)	2

Control terminals for devices in the StateLine version	Control terminals for devices in the HighLine version
	

Pos.	Description	Number	
		StateLine	HighLine
X1	System bus (CANopen)	1	1
S1	System bus settings (CANopen)	1	1
X3	Analog inputs (voltage/current)	1/1	2/2
	Analog outputs (voltage/current)	1/-	2/2
	10 V reference voltage	1	1
X4	Digital inputs	4	-
	Digital outputs	1	3
	Controller enable	1	-
	24 V supply of the control electronics	1	-
	24 V voltage output	1	1
X5	Digital inputs	-	7
	Controller enable	-	1
	24 V supply of the control electronics	-	1
	24 V internal supply	-	1
X107	Motor holding brake connection	-	1

4.4 StateLine C control terminals

4.4.1 External supply voltage 24 V

Labelling	Feature	Rated value
24E GIO	Connection for external 24 V supply voltage by a safely separated power supply unit (required for mains-independent supply of the control electronics and the communication module)	24 V in accordance with IEC 61131-2 19.2 ... 28.8 V Residual ripple max. ± 5 % SELV/PELV
	Suppression of voltage pulses	Suppressor diode 36 V, bidirectional
	Polarity reversal protection	When polarity is reversed: no function and no destruction
	Current consumption	Approx. 0.6 A during operation
		Max. 1.5 A starting current for 100 ms
	Capacity to be charged	1000 µF

Labelling	Feature	Rated value
24I GIO	24-V voltage output to connect digital inputs via potential-free contacts	External supply at 24E: voltage drop < 2.5 V Internal supply: DC 18 ... 28 V
	Max. output current	50 mA
	Electric strength of external voltage	+30 V
	Excess current release	Automatically resettable

4.4.2 Analog inputs

Labelling	Feature	Rated value	
A1U GA	Input	± 10 V	
	Input resistance	> 80 kΩ	
	Input voltage in the case of open circuit	Display ”0” (U < 0.2 V, absolute)	
	Sampling frequency	1 kHz (1 ms)	
	Accuracy	± 0.1 V	
	Electric strength of external voltage	± 15 V, permanent	
	A/D converter	Resolution 10 bits + sign Error 1 digit ≡ 0.1 % relating to the final value	
A1I GA	Input	0 ... +20 mA	Parameterisable
		4 ... +20 mA, fail-safe	
	Input resistance	215 Ω	
	Input current in case of open circuit	Display ”0” (I < 0.1 mA)	
	Sampling frequency	1 kHz (1 ms)	
	Accuracy	± 0.1 mA	
	Electric strength of external voltage	± 7 V, permanent	
	A/D converter	10 bit resolution Error 1 digit ≡ 0.1 % relating to the final value	

4.4.3 Analog outputs

Labelling	Features	Rated value
O1U GA	Output voltage	0 ... 10 V
	Output current	2 mA
	Capacitive load	max 1 µF
	Voltage - 0 V	Display ”0” (U < 0.1 V, absolute)
	Output voltage at reset	< 0.5 V
	Accuracy	±2 % with regard to final value
	Short-circuit strength	Unlimited period
	Electric strength of external voltage	Not guaranteed
Controller GA	Reference 10 V	10.5 V
	Tolerance	±0.5 V
	Capacitive load	max 1 µF
	Short-circuit strength	Unlimited period
	Electric strength of external voltage	Not guaranteed
	Permissible current loading	10 mA

4.4.4 Digital inputs

Labelling	Features	Rated value
DI1, DI2	Digital input 1/2	In accordance with IEC61131-2, type 1 or two-track frequency input for HTL encoder 0 ... 10 kHz
DI3, DI4	Digital input 3/4	In accordance with IEC61131-2, type 1
RFR	Controller inhibit	In accordance with IEC61131-2, type 1
	Input resistance	3.3 kΩ (2.5 kΩ ... 6 kΩ)
	Electric strength of external voltage	Up to ±30 V, permanent
	Isolation	📖 77
	Level	LOW < +5V HIGH > +15V
	Cycle time	1 ms, can be changed by software filtering

4.4.5 Digital outputs

Labelling	Features	Rated value
DO1 GIO	Digital output	In accordance with IEC61131-2, type 1, max. 50 mA
	External-voltage protected	Up to +30 V Integrated polarity reversal protection diode for switching inductive loads
	Isolation	📖 77
	Level	LOW < +5 V High > +15 V
	Time-dependent behaviour	LOW - HIGH / HIGH - LOW max. 250 µs
	Behaviour during overload	Reduced voltage or periodical switch-off/on
	Behaviour during reset and switch-on	Outputs are switched off (LOW)
	Cycle time	1 ms

4.4.6 Relay output connection

Marking	Description/features	Rated value
COM	Central contact of relay	AC 250 V, 3 A DC 24 V, 2 A DC 240 V, 0.16 A ● According to UL508C: – 3 A, 250 V AC (general purpose) – 2 A, 24 V DC (resistive) – 0.16 A, 240 V DC (general purpose)
NC COM	NC contact (normally closed) Position is displayed via TRIP software message (Lenze setting)	
NO COM	NO contact (normally open)	

4.5 HighLine C control terminals

4.5.1 External supply voltage 24 V

Labelling	Feature	Rated value
24E GI	Connection for external 24 V supply voltage by a safely separated power supply unit (required for mains-independent supply of the control electronics and the communication module)	24 V in accordance with IEC 61131-2 19.2 ... 28.8 V Residual ripple max. ± 5 % SELV/PELV
	Suppression of voltage pulses	Suppressor diode 36 V, bidirectional
	Polarity reversal protection	When polarity is reversed: no function and no destruction
	Current consumption	Approx. 0.6 A during operation
		Max. 1.5 A starting current for 100 ms
	Capacity to be charged	1000 µF

Labelling	Feature	Rated value
24O GO	Connection for external 24 V supply voltage by a safely separated Power supply unit (required for the supply of the digital outputs)	24 V in accordance with IEC 61131-2 19.2 ... 28.8 V Residual ripple max. ± 5 % SELV/PELV
	Suppression of voltage pulses	Suppressor diode 36 V, bidirectional
	Polarity reversal protection	When polarity is reversed: no function and no destruction
	Current consumption	Approx. 0.15 A if all digital outputsare loaded with rated current

Labelling	Feature	Rated value
24I GI	24-V voltage output for connecting digital inputs via potential-free contacts	External supply at 24E: voltage drop < 2.5 V Internal supply: DC 18 ... 28 V
	Max. output current	50 mA
	Electric strength of external voltage	+30 V
	Excess current release	Automatically resettable

4.5.2 Analog inputs

Labelling	Feature	Rated value	
A1U, A2U GA	Input	± 10 V	
	Input resistance	> 80 kΩ	
	Input voltage in the case of open circuit	Display ”0” (U < 0.2 V, absolute)	
	Sampling frequency	1 kHz (1 ms)	
	Accuracy	± 0.1 V	
	Electric strength of external voltage	± 15 V, permanent	
	A/D converter	Resolution 10 bits + sign Error 1 digit ≡ 0.1 % relating to the final value	
A1I, A2I GA	Input	0 ... +20 mA	Parameterisable
		4 ... +20 mA, fail-safe	
	Input resistance	215 Ω	
	Input current in case of open circuit	Display ”0” (I < 0.1 mA)	
	Sampling frequency	1 kHz (1 ms)	
	Accuracy	± 0.1 mA	
	Electric strength of external voltage	± 7 V, permanent	
	A/D converter	10 bit resolution Error 1 digit ≡ 0.1 % relating to the final value	

4.5.3 Analog outputs

Labelling	Features	Rated value	
O1U, O2U GA	Output voltage	0 ... 10 V	
	Output current	2 mA	
	Capacitive load	Max 1 µF	
	Voltage - 0 V	Display ”0” (U < 0.1 V, absolute)	
	Output voltage at reset	< 0.5 V	
	Accuracy	± 2 % relating to the final value	
	Short-circuit strength	Unlimited period	
	Electric strength of external voltage	Not guaranteed	
O1I, O2I GA	Output current	0 ... 20 mA	Parameterisable
		4 ... 20 mA, fail-safe	
	Output voltage	0 ... 10 V	
	Current for output 0 mA	I < 0.1 mA abs.	
	Output current in the case of reset	< 1 mA	
	Accuracy	± 2 % relating to the final value	
	Short-circuit strength	Unlimited period	
	External voltage protection	Not guaranteed	
Controller GA	Reference 10 V	10.5 V	
	Tolerance	±0.5 V	
	Capacitive load	Max 1 µF	
	Short-circuit strength	Unlimited period	
	Electric strength of external voltage	Not guaranteed	
	Permissible current loading	10 mA	

4.5.4 Digital inputs

Labelling	Features	Rated value
DI1, DI2 GI	Digital input 1/2	In accordance with IEC61131-2, type 1 or two-track frequency input for HTL encoder 0 ... 100 kHz
DI3, DI4, DI5 GI	Digital input 3/4/5	In accordance with IEC61131-2, type 1
DI6, DI7 GI	Digital input 6/7	In accordance with IEC61131-2, type 1 or two-track frequency input for HTL encoder 0 ... 10 kHz
RFR	Controller inhibit	In accordance with IEC61131-2, type 1
	Input resistance	3.3 kΩ (2.5 kΩ ... 6 kΩ)
	Electric strength of external voltage	Up to ±30 V, permanent
	Level	LOW < +5V HIGH > +15V
	Cycle time	1 ms, can be changed by software filtering
	Isolation	🕮 77

4.5.5 Digital outputs

Labelling	Features	Rated value
DO1, DO2, DO3 GO	Digital output 1/2/3 - for operation of the digital outputs an external voltage source is required (🕮 51)	In accordance with IEC61131-2, type 1, max. 50 mA
	External-voltage protected	Up to +30 V
	Isolation	🕮 77
	Level	LOW < +5 V High > +15 V
	Time-dependent behaviour	LOW - HIGH / HIGH - LOW max. 250 µs
	Behaviour during overload	Reduced voltage or periodical switch-off/on
	Behaviour during reset and switch-on	Outputs are switched off (LOW)
	Cycle time	1 ms

4.5.6 Relay output connection

Marking	Description/features	Rated value
COM	Central contact of relay	AC 250 V, 3 A DC 24 V, 2 A DC 240 V, 0.16 A ● According to UL508C: – 3 A, 250 V AC (general purpose) – 2 A, 24 V DC (resistive) – 0.16 A, 240 V DC (general purpose)
NC COM	NC contact (normally closed) Position is displayed via TRIP software message (Lenze setting)	
NO COM	NO contact (normally open)	

4.5.7 Motor holding brake connection

Labelling	Feature	Rated value
24B GB	Connection for external 24 V supply voltage by a safely separated power supply unit (required for the supply of the brake output)	24 V in accordance with IEC 61131-2 19.2 ... 28.8 V Residual ripple max. ± 5 % SELV/PELV
	Suppression of voltage pulses	Suppressor diode 36 V, bidirectional
	Polarity reversal protection	No
	Rated current	2.5 A DC
	Capacity to be charged	1 µF
BD1 BD2	• 24 V voltage output for connecting a motor holding brake via potential-free contacts • The brake output can also be used as a potential-free, digital output that can exceed a certain resistance value, e.g. for switching a relay or valve.	
	Max. output current	2.5 A
	Max. voltage drop in the high state	< 3 V for rated current
	Breaking energy	Max. 5 Ws
	Isolation	Basic insulation (📖 77)
	Level	LOW < +5 V High > +15 V
	Time-dependent behaviour	LOW - HIGH / HIGH - LOW max. 500µs
	Behaviour during overload	Reduced voltage or periodical switch-off/on
	Behaviour during reset and switch-on	Outputs are switched off
	Cycle time	1 ms
	Operating frequency	Max. 6/min for max. breaking energy

5 Mechanical installation

5.1 Important notes

Danger!
Sticker with warning note must be displayed prominently and close to the device!

Note!
The devices must be installed in housings (e.g. control cabinets) to meet applicable regulations.

- If the cooling air is polluted (fluff, (conductive) dust, soot, aggressive gases), take adequate countermeasures, as e.g.:
  - Separate air guide
  - Installation of filters
  - Regular cleaning
- Possible mounting position:
  - Vertical on the mounting plate (mains connections at the top, motor connection at the bottom)
- Maintain the specified free spaces above and below the controller to other installations!
  - Ensure unimpeded ventilation of cooling air and outlet of exhaust air.
  - You can install several controllers of the 8400 L-force Inverter Drives product range next to each other without any clearance in the control cabinet.
- The mounting plate of the control cabinet must be electrically conductive.
- In case of continuous vibrations or shocks use vibration dampers.

5.2 Standard devices in the power range 0.25 ... 2.2 kW

5.2.1 Assembly in built-in technique (standard)

You can choose between three variants for mounting the ”built-in unit” version of the controllers:

- Assembly without filter
  – in ”standard” technique
- Assembly with filter:
  – in ”standard” technique (footprint filter)
  – in mounting variant (side-mounted filter)

The following filters can be used for the controllers:

- on the supply side
  – RFI filters

Assembly without filter in ”standard” technique

For mounting, use two screws M5 x >10 mm. The mounting location and material must ensure a durable mechanical connection.

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

How to proceed:

1. Prepare the fixing holes on the mounting surface.
2. Screw the controller directly to the mounting surface.

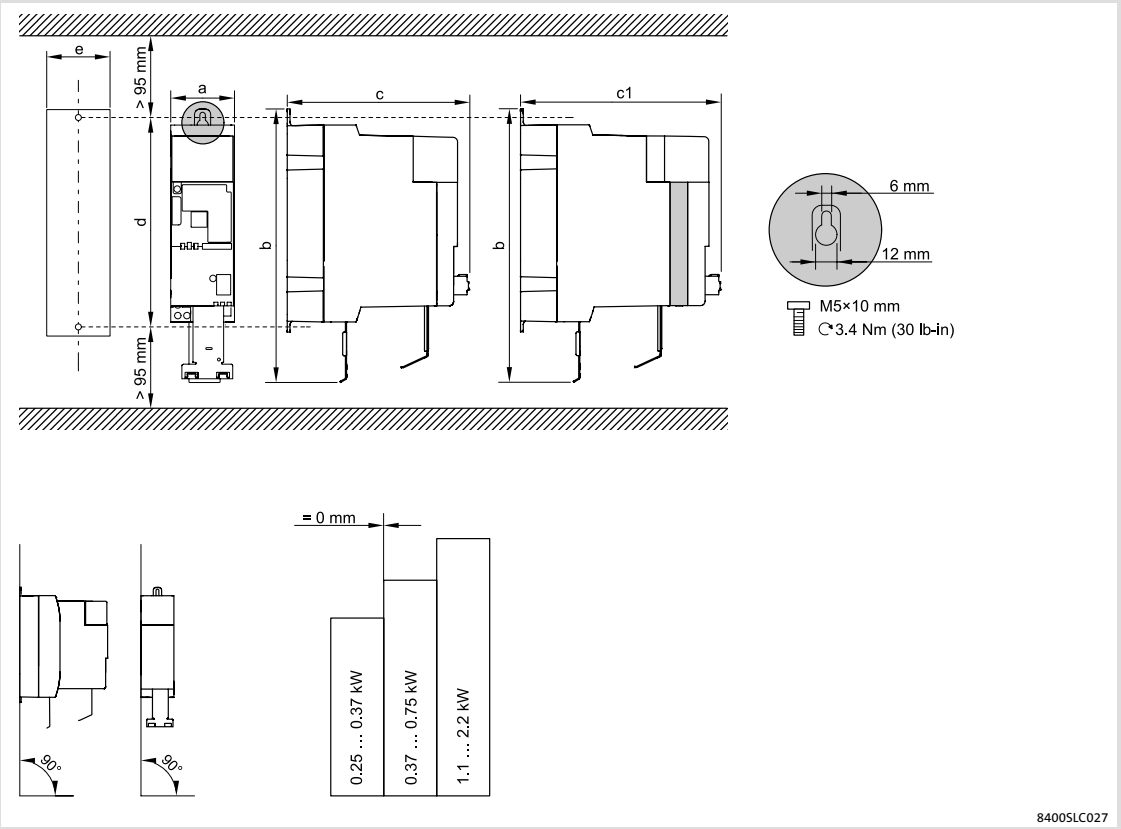


Fig. 5-1 Assembly without filter

		a	b	c	c1	d	e	
	[kW]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[kg]
E84AVxxE2512 E84AVxxE3712	0.25 ... 0.37	70	235	199	219	180	70	1.3
E84AVxxE551x E84AVxxE751x E84AVxxE3714	0.37 ... 0.75	70	285	199	219	230	70	1.8
E84AVxxE112x E84AVxxE152x E84AVxxE222x	1.1 ... 2.2	70	340	199	219	285	70	2.1

Filter mounting in ”standard” technique

For mounting, use two screws M5 x >10 mm. The mounting location and material must ensure a durable mechanical connection.

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

RFI filter		Controller	
Type	Device size	Type	Device size
E84AZESR3712LL E84AZESR3712SD E84AZESR3712LD	GG1	E84AVxxx2512 E84AVxxx3712	GG1
E84AZESR5512LL	GG2	E84AVxxx5512	GG2
E84AZESR7512SD E84AZESR7512LD	GG2	E84AVxxx5512 E84AVxxx7512	GG2
E84AZESR2222LL E84AZESR2222SD E84AZESR2222LD	GG3	E84AVxxx1122 E84AVxxx1522 E84AVxxx2222	GG3
E84AZESR7514SD E84AZESR7514LD	GG2	E84AVxxx3714 E84AVxxx5514 E84AVxxx7514	GG2
E84AZESR2224SD E84AZESR2224LD	GG3	E84AVxxx1124 E84AVxxx1524 E84AVxxx2224	GG3

A Footprint filter

Typ	a	b	b1
	[mm]		
E84AZESR3712xx	190	45	70
E84AZESR5512xx E84AZESR7512xx E84AZESR7514xx	240		
E84AZESR2222xx E84AZESR2224xx	295		

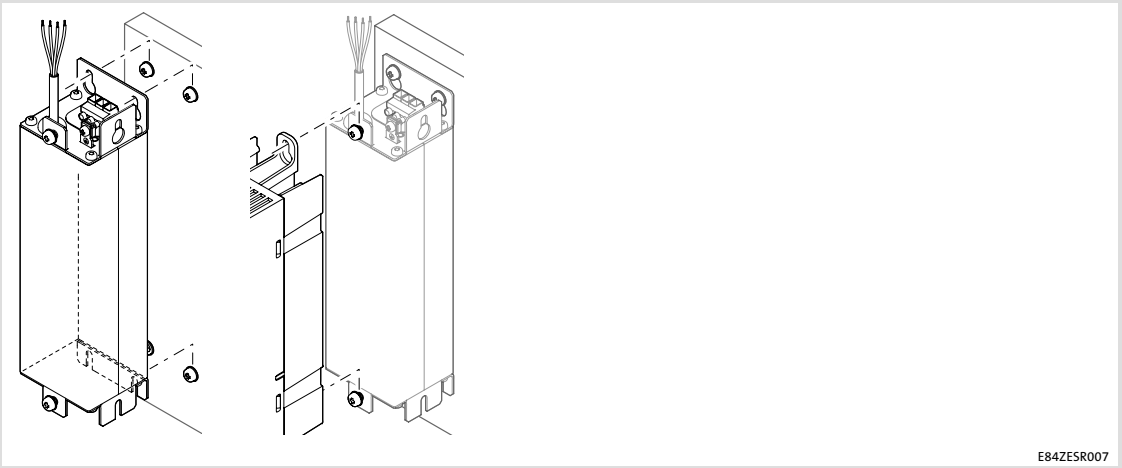


Fig. 5-2 Assembly with footprint filter

Proceed as follows for installation:

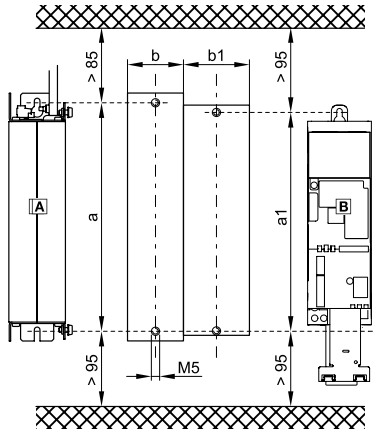
1. Prepare M5 threaded holes on the mounting plate and equip them with screws and washers.
   – Use four M5 screw and washer assemblies or M5 hexagon socket screws with washers.
   – Do not yet tighten the screws.
2. Mount the filter onto the prepared mounting plate.
   – Only tighten the screws hand-tight.
3. Loosen the two screw and washer assemblies to fix the standard device on the filter.
   – Two M5 × 14 mm screw and washer assemblies.
4. Mount the standard device onto the filter and tighten the screws.
   – Observe the instructions in the documentation for the standard device.
   – Tightening torque: 3.4 Nm (30 lb-in)
5. If necessary, preassemble additional units.
6. Align all units.
7. Screw all units onto the mounting plate.
   – Tightening torque: 3.4 Nm (30 lb-in)

Filter mounting variant

For mounting, use two screws M5 x >10 mm. The mounting location and material must ensure a durable mechanical connection.

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

RFI filter		Controller	
Type	Device size	Type	Device size
E84AZESR3712LL E84AZESR3712SD E84AZESR3712LD	GG1	E84AVxxx2512 E84AVxxx3712	GG1
E84AZESR5512LL	GG2	E84AVxxx5512	GG2
E84AZESR7512SD E84AZESR7512LD	GG2	E84AVxxx5512 E84AVxxx7512	GG2
E84AZESR2222LL E84AZESR2222SD E84AZESR2222LD	GG3	E84AVxxx1122 E84AVxxx1522 E84AVxxx2222	GG3
E84AZESR7514SD E84AZESR7514LD	GG2	E84AVxxx3714 E84AVxxx5514 E84AVxxx7514	GG2
E84AZESR2224SD E84AZESR2224LD	GG3	E84AVxxx1124 E84AVxxx1524 E84AVxxx2224	GG3



E84ZESR011

A Side-by-side filter
B Standard device

Type	a	a1	b	b1
	[mm]			
E84AZESR3712xx	190	180	60	70
E84AZESR5512xx E84AZESR7512xx E84AZESR7514xx	240	230		
E84AZESR2222xx E84AZESR2224xx	295	285		

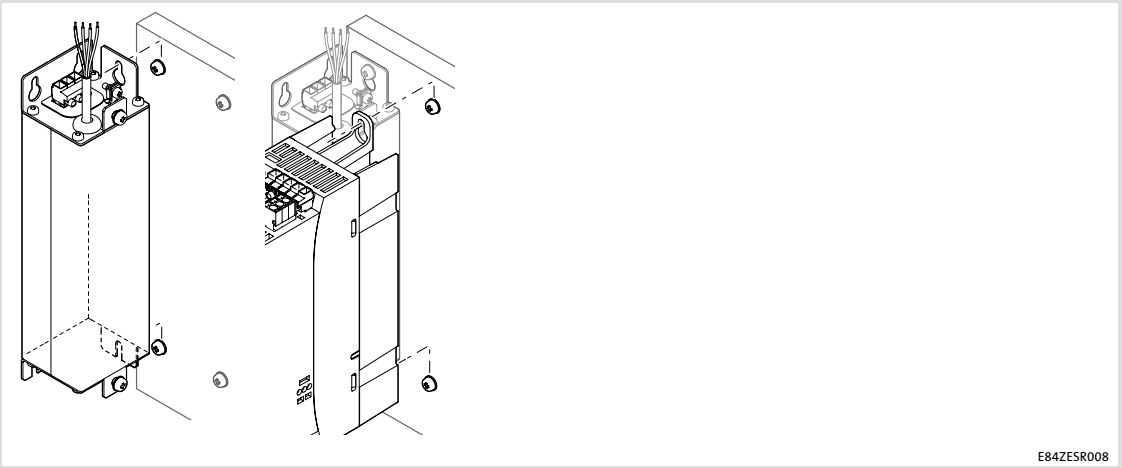


Fig. 5-3 Assembly with side-mounted filter

Proceed as follows for installation:

1. Prepare M5 threaded holes on the mounting plate and equip them with screws and washers.
   – Two M5 screw and washer assemblies or M5 hexagon socket screws with washers for the filter.
   – Two M5 screw and washer assemblies or M5 hexagon socket screws with washers for the standard device.
   – Do not yet tighten the screws.
2. Remove the screw and washer assemblies from the filter to fix the standard device.
3. Mount the filter onto the prepared mounting plate.
   – Only tighten the screws hand-tight.
4. Mount the standard device onto the prepared mounting plate.
   – Observe the instructions in the documentation for the standard device.
   – Only tighten the screws hand-tight.
5. If necessary, preassemble additional units.
6. Align all units.
7. Screw all units onto the mounting plate.
   – Tightening torque: 3.4 Nm (30 lb-in)

5.2.2 Assembly in push-through technique (thermal separation)

The E84AVxx**D**... controllers are designed for mounting in push-through design. The scope of supply includes all parts required for mounting.

Installation steps

How to proceed:

1. Prepare mounting cutout and mounting holes (threaded holes M5 recommended).
2. Insert the 8400 frequency inverter into the mounting cutout.
3. Tighten with 6 screw and washer assemblies M5 x 10 (cross screw connection recommended).
4. Seal the screws to ensure the IP54 enclosure or UL type 12.

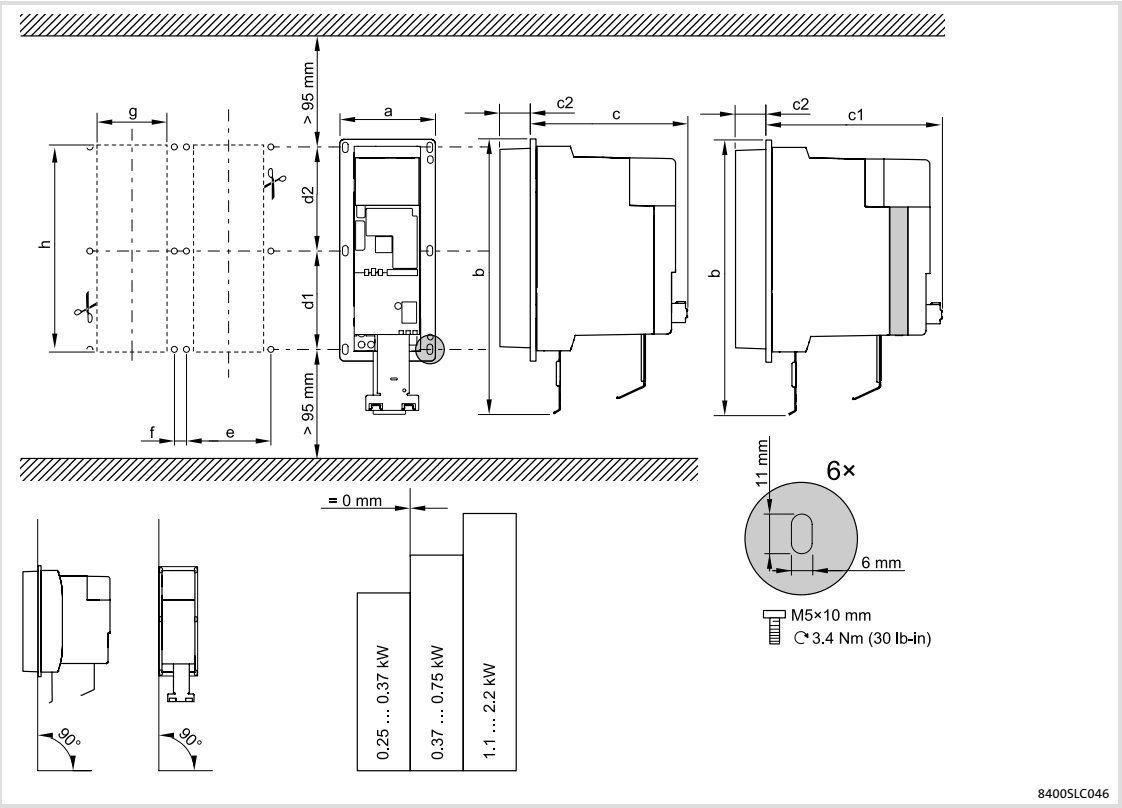


Fig. 5-4 Dimensions: Mounting in push-through technique

		a	b	c	c1	c2	d1	d2	e	f	g	h	
	[kW]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[kg]
E84AVxxD2512 E84AVxxD3712	0.25 ... 0.37	102	226	185	205	14	80	85	90	12	74.6 ± 1	170.2 ± 1	1.4
E84AVxxD3714 E84AVxxD551x E84AVxxD751x	0.37 ... 0.75	102	276	163	183	36	105	110	90	12	74.6 ± 1	220.5 ± 1	1.9
E84AVxxD112x E84AVxxD152x E84AVxxD222x	1.1 ... 2.2	137	335	163	183	60	135	135	125	12	108.7 ± 1	273.5 ± 1	3.5

5.2.3 Mounting in ”cold plate” technique

The E84AVxx**C**... controllers are designed for assembly on coolers (e.g. collective coolers) in ”cold-plate” technique.

Requirements for collective coolers

The following points are important for the safe operation of drive controllers:

- Good thermal connection to the cooler
  - The contact surface between collective cooler and drive controller must be at least as large as the cooling plate of the drive controller.
  - Flat contact surface, max. deviation 0.05 mm.
  - Connect the collective cooler with all specified screw connections with the drive controller.
- Do not exceed the thermal resistance R_{th} given in the table. The values apply to the operation of drive controllers under rated conditions.

	Power to be dissipated	Heatsink environment
Type	**$P_{v\,[W]}$**	**R_{th} [K/W]**
E84AVxxC2512	15	≤ 1.5
E84AVxxC3712	20	≤ 1.5
E84AVxxC5512	30	≤ 1.0
E84AVxxC7512	40	≤ 1.0
E84AVxxC1122	60	≤ 0.3
E84AVxxC1522	75	≤ 0.3
E84AVxxC2222	100	≤ 0.3
E84AVxxC3714	25	≤ 1.0
E84AVxxC5514	35	≤ 1.0
E84AVxxC7514	50	≤ 1.0
E84AVxxC1124	60	≤ 0.3
E84AVxxC1524	70	≤ 0.3
E84AVxxC2224	100	≤ 0.3

Ambient conditions

- The rated data and the derating factors at increased temperature also apply to the ambient temperature of the drive controllers.
- Temperature at the cooling plate of the drive controller: max. 75 °C.

Note!

- Apply heat conducting paste onto the cooler and cooling plate of the controller before you screw the controller onto the cooler to troller on the cooler to keep the heat transfer resistance as low as possible. For this purpose a standard heat conducting paste can be used.

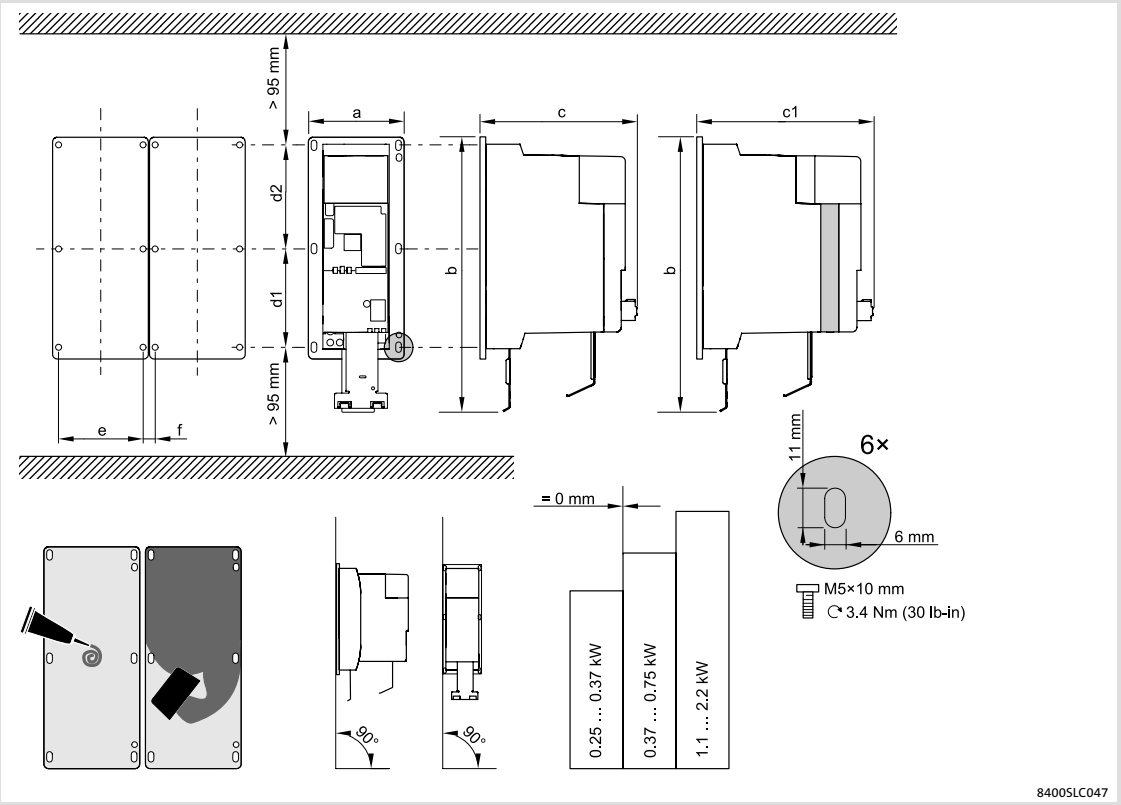


Fig. 5-5 Dimensions: Mounting in ”cold-plate” technique

		a	b	c	c1	d1	d2	e	f	
	[kW]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[kg]
E84AVxxC2512 E84AVxxC3712	0.25 ... 0.37	102	226	185	205	80	85	90	12	1.3
E84AVxxC3714 E84AVxxC551x E84AVxxC751x	0.37 ... 0.75	102	276	163	183	105	110	90	12	1.5
E84AVxxC112x E84AVxxC152x E84AVxxC222x	1.1 ... 2.2	137	335	163	183	135	135	125	12	1.9

5.3 Standard devices in the power range 3 ... 15 kW

5.3.1 Assembly in built-in technique (standard)

You can choose between three variants for mounting the ”built-in unit” version of the controllers:

- Assembly without filter
  – in ”standard” technique
- Assembly with filter:
  – in ”standard” technique (footprint filter)
  – in mounting variant (side-mounted filter)

The following filters can be used for the controllers:

- on the supply side
  – RFI filters

Assembly without filter in ”standard” technique

For mounting, use two screws M5 x >10 mm. The mounting location and material must ensure a durable mechanical connection.

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

How to proceed:

1. Prepare the fixing holes on the mounting surface.
2. Screw the controller directly to the mounting surface.

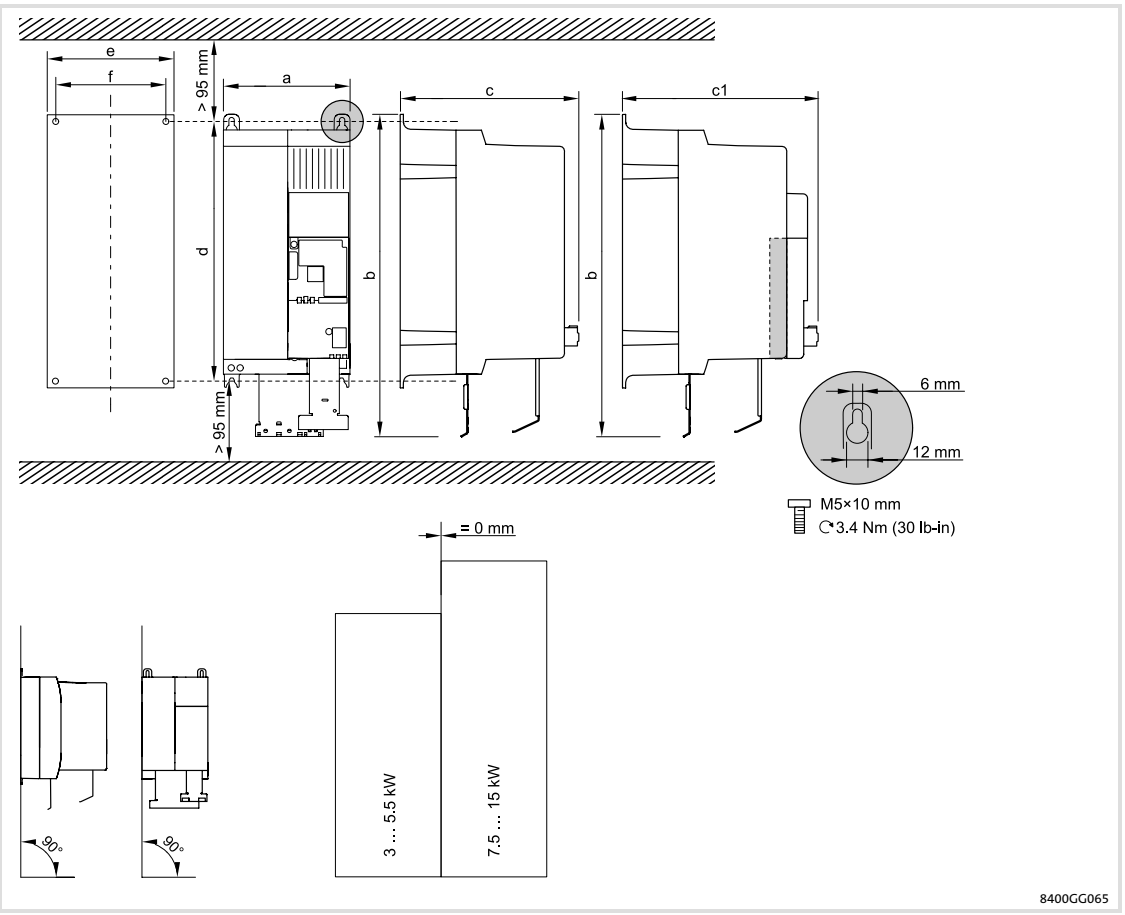


Fig. 5-6 Assembly without filter

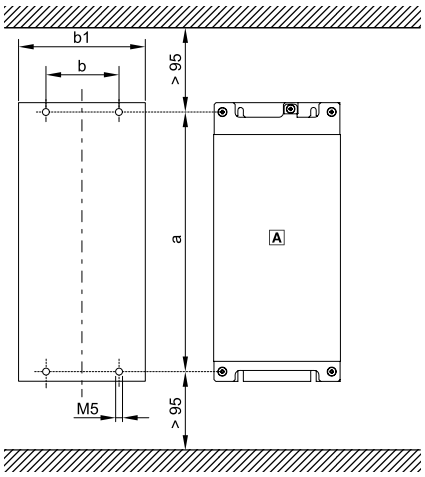
		a	b	c	c1	d	e	f	
	[kW]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[kg]
E84AVxxE3024 E84AVxxE4024 E84AVxxE5524	3 ... 5.5	140	360	199	219	285	140	120	4.4
E84AVxxE7524 E84AVxxE1134 E84AVxxE1534	7.5 ... 15	140	416	199	219	340	140	120	5.8

Filter mounting in ”standard” technique

For mounting, use two screws M5 x >10 mm. The mounting location and material must ensure a durable mechanical connection.

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

RFI filter		Controller	
Type	Device size	Type	Device size
E84AZESR5524SD E84AZESR5524LD	GG4	E84AVxxx3024 E84AVxxx4024 E84AVxxx5524	GG4
E84AZESR1534SD E84AZESR1534LD	GG5	E84AVxxx7524 E84AVxxx1134 E84AVxxx1534	GG5



A Footprint filter

Type	a	b	b1
	[mm]		
E84AZESR5524xx	285	80	140
E84AZESR1534xx	340	80	140

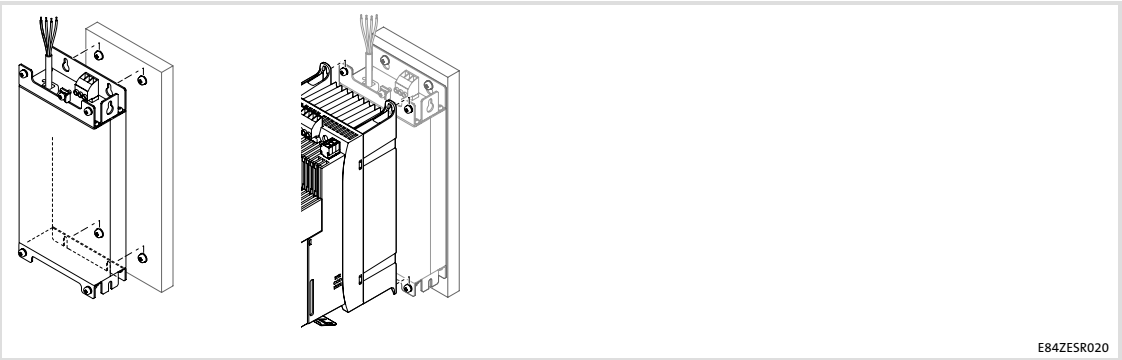


Fig. 5-7 Assembly with footprint filter

Proceed as follows for installation:

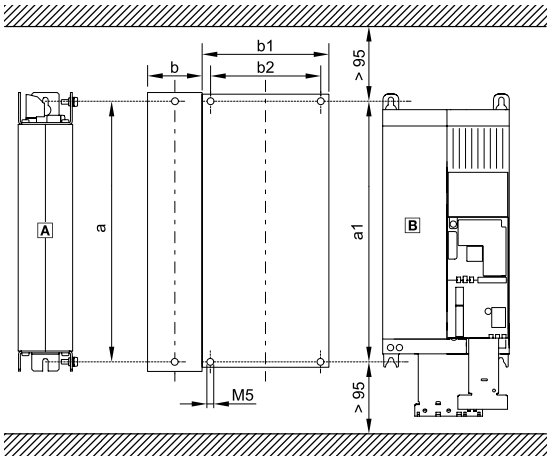
1. Prepare M5 threaded holes on the mounting plate and equip them with screws and washers.
   – Use four M5 screw and washer assemblies or M5 hexagon socket screws with washers.
   – Do not yet tighten the screws.
2. Mount the filter onto the prepared mounting plate.
   – Only tighten the screws hand-tight.
3. Loosen the two screw and washer assemblies to fix the standard device on the filter.
   – Two M5 × 14 mm screw and washer assemblies.
4. Mount the standard device onto the filter and tighten the screws.
   – Observe the instructions in the documentation for the standard device.
   – Tightening torque: 3.4 Nm (30 lb-in)
5. If necessary, preassemble additional units.
6. Align all units.
7. Screw all units onto the mounting plate.
   – Tightening torque: 3.4 Nm (30 lb-in)

Filter mounting variant

For mounting, use two screws M5 x >10 mm. The mounting location and material must ensure a durable mechanical connection.

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

RFI filter		Controller	
Type	Device size	Type	Device size
E84AZESR5524SD E84AZESR5524LD	GG4	E84AVxxx3024 E84AVxxx4024 E84AVxxx5524	GG4
E84AZESR1534SD E84AZESR1534LD	GG5	E84AVxxx7524 E84AVxxx1134 E84AVxxx1534	GG5



A Side-by-side filter
B Standard device

	a	a1	b	b1	b2
Type	[mm]	[mm]	[mm]	[mm]	[mm]
E84AZESR5524xx	285	285	60	140	120
E84AZESR1534xx	340	340	60	140	120

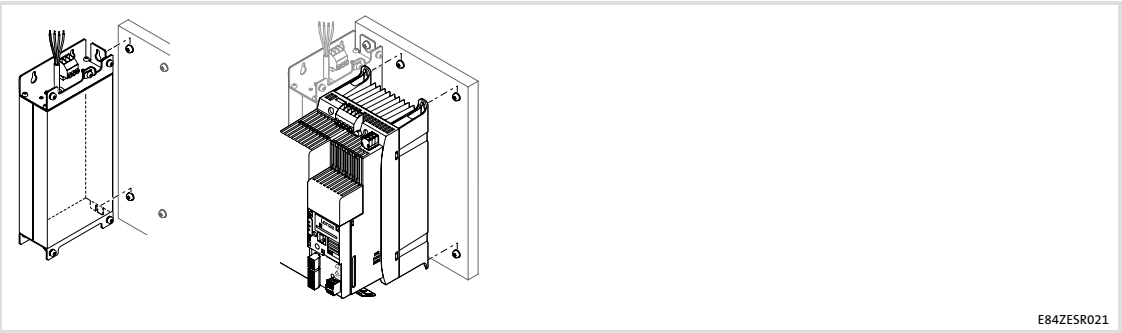


Fig. 5-8 Assembly with side-mounted filter

Proceed as follows for installation:

1. Prepare M5 threaded holes on the mounting plate and equip them with screws and washers.
   – Two M5 screw and washer assemblies or M5 hexagon socket screws with washers for the filter.
   – Two M5 screw and washer assemblies or M5 hexagon socket screws with washers for the standard device.
   – Do not yet tighten the screws.
2. Remove the screw and washer assemblies from the filter to fix the standard device.
3. Mount the filter onto the prepared mounting plate.
   – Only tighten the screws hand-tight.
4. Mount the standard device onto the prepared mounting plate.
   – Observe the instructions in the documentation for the standard device.
   – Only tighten the screws hand-tight.
5. If necessary, preassemble additional units.
6. Align all units.
7. Screw all units onto the mounting plate.
   – Tightening torque: 3.4 Nm (30 lb-in)

5.3.2 Assembly in push-through technique (thermal separation)

The E84AVxx**D**... controllers are designed for mounting in push-through design. The scope of supply includes all parts required for mounting.

Installation steps

How to proceed:

1. Prepare mounting cutout and mounting holes (threaded holes M5 recommended).
2. Insert the 8400 frequency inverter into the mounting cutout.
3. Tighten with 6 screw and washer assemblies M5 x 10 (cross screw connection recommended).
4. Seal the screws to ensure the IP54 enclosure or UL type 12.

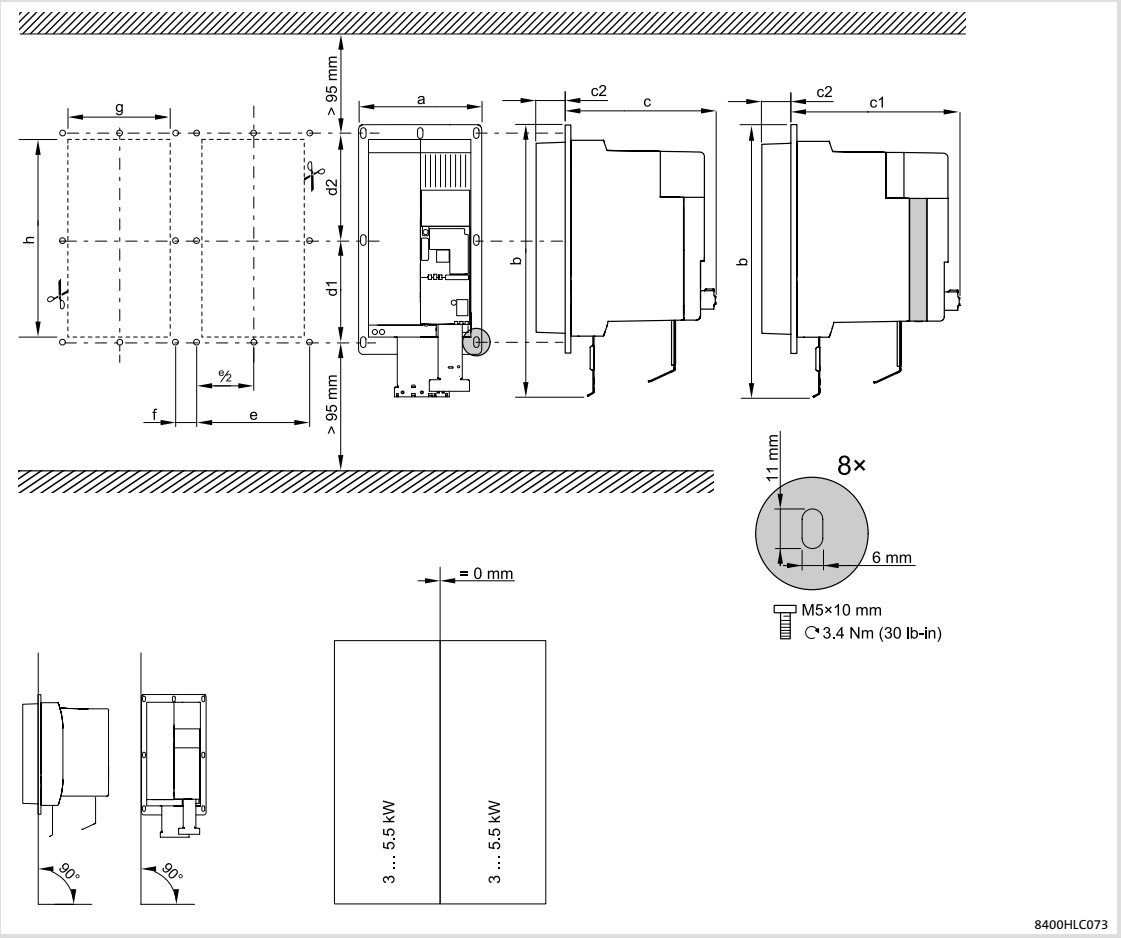


Fig. 5-9 Dimensions: Mounting in push-through technique

		a	b	c	c1	c2	d1	d2	e	f	g	h	
	[kW]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[kg]
E84AVxxD3024 E84AVxxD4024 E84AVxxD5524	3 ... 5.5	174	366	141	161	64	150	150	160	15	145.2 ± 1	277.2 ± 1	4.9

5.3.3 Mounting in ”cold plate” technique

The E84AVxx**C**... controllers are designed for assembly on coolers (e.g. collective coolers) in ”cold-plate” technique.

Requirements for collective coolers

The following points are important for the safe operation of drive controllers:

- Good thermal connection to the cooler
  - The contact surface between collective cooler and drive controller must be at least as large as the cooling plate of the drive controller.
  - Flat contact surface, max. deviation 0.05 mm.
  - Connect the collective cooler with all specified screw connections with the drive controller.
- Do not exceed the thermal resistance R_{th} given in the table. The values apply to the operation of drive controllers under rated conditions.

	Power to be dissipated	Heatsink environment
Type	**$P_{v\,[W]}$**	**R_{th} [K/W]**
E84AVxxC3024	115	≤ 0.23
E84AVxxC4024	155	≤ 0.23
E84AVxxC5524	215	≤ 0.23

Ambient conditions

- The rated data and the derating factors at increased temperature also apply to the ambient temperature of the drive controllers.
- Temperature at the cooling plate of the drive controller: max. 75 °C.

Note!

- Apply heat conducting paste onto the cooler and cooling plate of the controller before you screw the controller onto the cooler to troller on the cooler to keep the heat transfer resistance as low as possible. For this purpose a standard heat conducting paste can be used.

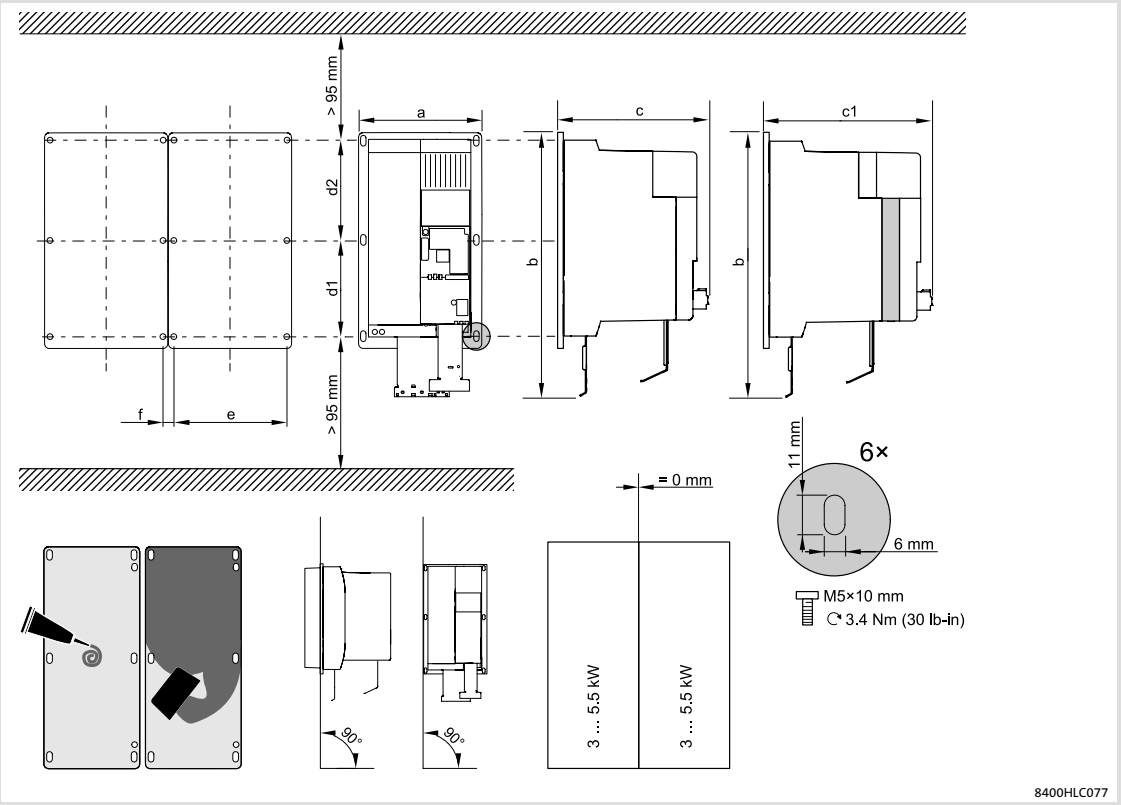


Fig. 5-10 Dimensions: Mounting in "cold-plate" technique

		a	b	c	c1	d1	d2	e	f	
	[kW]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[kg]
E84AVxxC3024 E84AVxxC4024 E84AVxxC5524	3.0 ... 5.5	174	366	141	161	150	150	160	15	2.7

6 Electrical installation

6.1 Important notes

Danger!

Hazardous electrical voltage

Depending on the device, all power connections remain live up to 3 ... 20 minutes after the mains has been switched off.

Possible consequences:

► Death or severe injuries when touching the power terminals.

Protective measures:

► Wait for at least 3 ... 20 minutes before working on the power terminals.

► Make sure that all power terminals are deenergised.

Danger!

Dangerous voltage

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

Possible consequences:

► Death or severe injuries when the device is touched in the event of a fault.

Protective measures:

► Implement the actions required in the EN 61800-5-1. Especially:
  – Fixed installation
  – PE connection must conform to standards (PE conductor diameter $\geq 10\ mm^2$ or PE conductor must be connected twice)

Danger!

Connection of an external signal reduces the insulation degree of the control terminals

After a PTC thermistor or a thermal contact has been connected, all control terminals are only basically insulated (single isolating distance).

Possible consequences:

► If the isolating distance is defective, the protection of the user against accidental contact may not be guaranteed anymore. An electric shock may be the consequence.

Protective measures:

► When the isolating distance is defective, protection against accidental contact can only be guaranteed by external measures, e.g. double insulation.

Stop!

No device protection in the event of too high mains voltages

The mains input is not fused internally.

Possible consequences:

► Destruction of the device if the mains voltage is too high.

Protective measures:

► Observe the max. permissible mains voltage.

► Fuse the device correctly on the supply side against mains fluctuations and voltage peaks.

Stop!

Overvoltage at devices with 230-V mains connection

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

Possible consequences:

► Destruction of the device

Protective measures:

► Provide for the use of isolating transformers.

Stop!

The drive controller contains electrostatically sensitive components.

The personnel must be free of electrostatic charge when carrying out assembly and service operations.

Stop!

Pluggable terminal strips

Plugging or removing the terminal strips during operation can cause high voltages and arcing.

Possible consequences:

► Damage of the devices

Protective measures:

► Switch off device.

► Only plug or remove the terminal strips in deenergised status.

Stop!

Abolishment of the protection concept in the IT system through the use of RFI filters

Operation of the controllers with standard RFI filters abolishes the protection concept in IT systems.

Possible consequences:

► The filters may be destroyed.

► Monitoring of the IT system may be triggered.

Protective measures:

► Do not use standard RFI filters in the IT system.

► Use special RFI filters.

► Check the use of mains chokes instead.

Stop!

Overvoltage on components:

On IT systems, an earth fault in the installation can lead to impermissible overvoltages.

Possible consequences:

Destruction of the device.

Protective measures:

Before operating the controllers on IT systems, remove the contact screws on the supply side and on the motor side.

Note!

Switching on the controller motor side is permissible for safety shutdown (emergency stop) and for operation of several motor on the controller (only in V/f operating mode!).

Please observe the following:

► When switching with the controller enabled, you can activate monitoring functions of the controller. If no monitoring function is activated, switching is permissible.

► The switching elements on the motor side must be dimensioned in accordance with the maximum occurring load.

6.1.1 Electrical isolation

The protective insulation of the ”8400 Inverter Drives” controllers is implemented according to EN 61800-5-1. The following illustration shows the insulation concept.

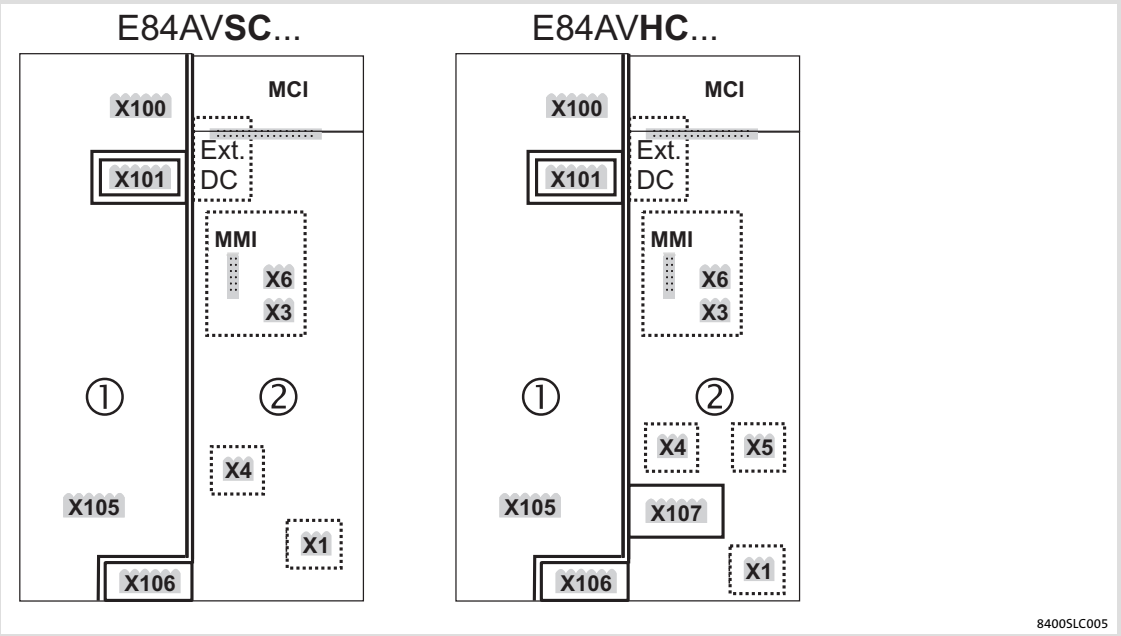


Fig. 6-1 Electrical isolation between power terminals, control terminals and housing

Note!

– If the terminal X106 is used, e.g. to connect an external PTC thermistor or a thermal contact, ensure at least one basic insulation to the motor or mains potential to not restrict the protective separation of the control terminals.
– The terminal X106 is connected to PE inside the device but cannot be used for protective earth.

Note!

– If terminal X107 is used for connecting a motor holding brake, at least one basic insulation to the motor or mains potential has to be provided, so that the protective separation of the control terminals is not limited

Legend	
⋮	Isolation by functional insulation
|	Isolation by basic insulation
||	Safe isolation by double or reinforced insulation Protection against accidental contact is guaranteed without any further measures.

Range	Connection	Name	Explanation
Power ①	X100	Mains	Protective separation towards X101, X106 and all control terminals
		DC bus	
	X105	Motor	
		Brake resistor	
	X101	Relay contact	Protective separation towards X100, X105 and all control terminals
	X106	Motor temperature	Protective separation towards X100, X105 and X101 Isolation by basic insulation towards all control terminals
			Degree of insulation of thermal contact, PTC, or cable can influence the isolation.
Control ②	X1	System bus (CANopen)	Isolation by functional insulation towards other control terminals
	X3	Analog IO	
	X4	Digital IO	
		24 V external supply	
			The degree of insulation of the voltage source influences the degree of insulation of the controller.
	X5	Digital inputs	Isolation by functional insulation towards other control terminals
		24 V external supply	The degree of insulation of the voltage source influences the degree of insulation of the controller.
	X6	Diagnostics	Isolation by functional insulation towards other control terminals
	X107	24 V brake supply	Isolation by basic insulation towards other control terminals
	MCI	Communication	Isolation by functional insulation towards other control terminals
	MMI	Memory	

6.1.2 Device protection

- In case of condensation, do not connect the controller to the mains voltage before the moisture has evaporated completely.
- The controller must be protected by external fuses.
- Provide unused control inputs and outputs with terminal strips.

6.1.3 Maximum motor cable length

- The motor cable must be as short as possible for having a positive effect on the drive behaviour.
- For group drives (several motors connected to one drive controller) the resulting cable length l_{res} is the crucial factor:

$l_{res}\,[m] = (l_1 + l_2 + l_3 \ldots + l_i) \cdot \sqrt{i}$	l_x	Length of the individual motor cable
	l_{res}	Resulting length of the motor cable
	i	Number of the individual motor cables

- At rated mains voltage and a switching frequency of 8 kHz and without additional output filters, the maximum permissible length of the motor cable is as follows:
  - 50 m shielded
  - 100 m unshielded

Note!

For compliance with EMC regulations, the permissible cable lengths must be changed.

6.1.4 Motor protection

- Extensive protection against overload:
  - Through overcurrent relay or temperature monitoring.
  - We recommend to use PTC thermistors or thermostats to monitor the motor temperature.
  - PTC thermistors or thermostats can be connected to the controller.
- Only use motors which have a suitable insulation for the inverter operation:
  - Insulation resistance: min. $\hat{u}$ = 1.5 kV, min. du/dt = 5 kV/µs
  - When using motors with an unknown insulation resistance, please contact your motor supplier.

6.1.5 Interaction with compensation equipment

- Controllers only consume very little reactive power of the fundamental wave from the AC supply mains. Therefore a compensation is not required.
- If the controllers are connected to a supply system with compensation equipment, this equipment must be used with chokes.
  - For this, contact the supplier of the compensation equipment.

6.1.6 Safety notes for the installation according to U_L or U_R

Warnings!

- ► The device has no overspeed protection.
- ► Must be provided with external or remote overload protection.
- ► The integral solid state protection does not provide branch circuit protection and that branch circuit protection has to be provided externally in accordance with manufacturers instructions, the National Electrical Code and any additional codes.
- ► Branch circuit protection:
  - – Suitable for use on a circuit capable of delivering not more than 5000 rms symmetrical amperes, 240 V maximum. Branch Circuit Short Circuit Protection with fuses in accordance with UL248 or circuit breaker in accordance with UL489 listed in table below (240 V devices).
  - – Suitable for use on a circuit capable of delivering not more than 10k rms symmetrical amperes, 400 V/500 V maximum. Branch Circuit Short Circuit Protection with fuses in accordance with UL248 or circuit breaker, 400/480 V Y maximum, in accordance with UL489 listed in table below (400/500 V devices).

  Voltage of the fuses or circuit breaker must at least be suitable with the input voltage of the drive.
- ► For information on the protection level of the internal overload protection for a motor load, see the corresponding Manual or Online Help. This function has to be activated; i. e. the reaction must be changed from ”Warning” (factory setting) to ”Fault”.
- ► For information on rating and proper connection of the thermal protector (only for connection to motors having integral thermal protection), see the corresponding Manual or Online Help.
- ► Shall be installed in a pollution degree 2 macro-environment.
- ► Maximum surrounding air temperature: 55 °C.
- ► Use 75 °C copper wire only, except for control circuits.
- ► Control card protection:
  - – External fuse for 24 V DC supply voltage of control terminal X107.
  - – Rated 4 A DC fuse UL248-14.

Type	Branch circuit protection				
	Fuse [A]		Circuit breaker		
	with mains choke	without mains choke	Schneider Electric	Moeller	Rating
E84AVxxx2512	6	6	Multi9 c60 Charact. C	FAZ-C Charact. C	15 A
E84AVxxx3712	10	10			15 A
E84AVxxx5512	10	10			15 A
E84AVxxx7512	15	15			15 A
E84AVxxx1122	20	20			20 A
E84AVxxx1522	25	25			25 A
E84AVxxx2222	30	30			30 A
E84AVxxx3714	6	6	Multi9 c60 Charact. C	FAZ-C Charact. C	15 A
E84AVxxx5514	6	6			15 A
E84AVxxx7514	6	6			15 A
E84AVxxx1124	10	10			15 A
E84AVxxx1524	10	10			15 A
E84AVxxx2224	10	10			15 A
E84AVxxx3024	15	15	Multi9 c60 Charact. C	FAZ-C Charact. C	15 A
E84AVxxx4024	20	20			20 A
E84AVxxx5524	20	20			20 A

6.2 Installation according to EMC (installation of a CE-typical drive system)

Design of the cables

- It is imperative to comply with the regulations concerning 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.
- The cables used must comply with the approvals required for the location (e.g. UL).

6.2.1 Shielding

Requirements

- The effectiveness of a shielded cable is reached by:
  - Providing a good shield connection through large-surface shield contact.
  - Using only braided shields with low shield resistance made of tin-plated or nickel-plated copper braid.
  - Using braided shields with an overlap rate > 70 % and an overlap angle of 90 °.
  - Keeping unshielded cable ends as short as possible.

Use system cables or shielded cables for these connections:

- Motor
- Encoder
- Motor holding brake (shielding is required when being integrated into the motor cable; connection to optional motor brake control)
- Motor temperature monitoring
- Analog signals (inputs and outputs; single-sided shield connection to the controller)
- System bus (CANopen)

The following connections need not be shielded:

- 24-V supply
- Digital signals (inputs and outputs) up to a cable length of 3 m

Connection system

- Connect the shield with a large surface and fix it with metal cable binders or a conductive clamp.
- Connect the shield directly to the corresponding device shield sheet.
  - If required, additionally connect the shield to the conductive and earthed mounting plate in the control cabinet.
  - If required, additionally connect the shield to the cable clamp rail.

Realisation

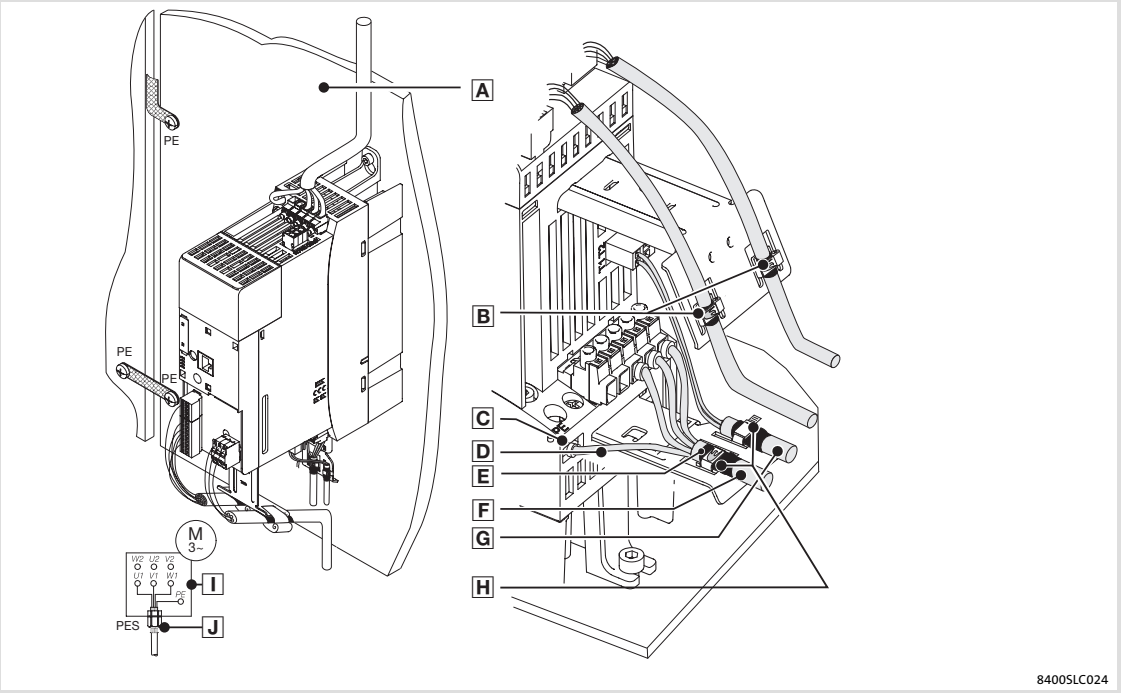


Fig. 6-2 Wiring in compliance with EMC standards

- A Mounting plate with electrically conductive surface
- B Control cables, connect shielding to the upper shield sheet (PES) with a surface as large as possible
- C Terminal for motor PE
- D PE of the motor cable
- E Shield of the motor cable
- F Shielded motor cable, low-capacitance
  (Core/core 1.5 $mm^2 \leq 75$ pF/m; from 2.5 $mm^2 \leq 100$ pF/m; core/shield ≤ 150 pF/m)
- G Shielded PTC cable or thermal contact cable (preferentially installed separately)
- H Connect cable shields to the lower shield sheet (PES) with a large surface. Preferentially use metal cable binders from the accessories.
- I Star or delta connection as indicated on the motor nameplate
- J EMC cable gland (not included in the scope of supply)

6.2.2 Mains connection, DC supply

- Controllers, mains chokes, or mains filters may only be connected to the mains via unshielded single cores or unshielded cables.
- When a mains filter or RFI filter is used, shield the cable between mains filter or RFI filter and controller if its length exceeds 300 mm. Unshielded cores must be twisted.
- In DC-bus operation or DC supply, use shielded cables.
- The cable cross-section must be dimensioned for the assigned fusing (observe national and regional regulations).

6.2.3 Motor cables

- Only use shielded motor cables with braids made of tinned or nickel-plated copper. Shields made of steel braids are not suitable.
  - The overlap rate of the braid must be at least 70 % with an overlap angle of 90 °.
- The cables used must correspond to the requirements at the location (e.g. EN 60204-1).
- Shield the cable for motor temperature monitoring (PTC or thermal contact) and install it separately from the motor cable.
  - In Lenze system cables, the cable for brake control is integrated into the motor cable. If this cable is not required for brake control, it can also be used to connect the motor temperature monitoring up to a length of 50 m.
- Connect the shield with a large surface and fix it with metal cable binders or a conductive clamp.
- Connect the shield directly to the corresponding device shield sheet.
  - If required, additionally connect the shield to the conductive and earthed mounting plate in the control cabinet.
- The motor cable is optimally installed if
  - it is separated from mains cables and control cables,
  - it only crosses mains cables and control cables at right angles,
  - it is not interrupted.
- If the motor cable must be opened all the same (e.g. due to chokes, contactors, or terminals):
  - The unshielded cable ends may not be longer than 100 mm (depending on the cable cross-section).
  - Install chokes, contactors, terminals etc. spatially separated from other components (with a min. distance of 100 mm).
  - Install the shield of the motor cable directly before and behind the point of separation to the mounting plate with a large surface.
- Connect the shield with a large surface to PE in the terminal box of the motor at the motor housing.
  - Metal EMC cable glands at the motor terminal box ensure a large surface connection of the shield with the motor housing.

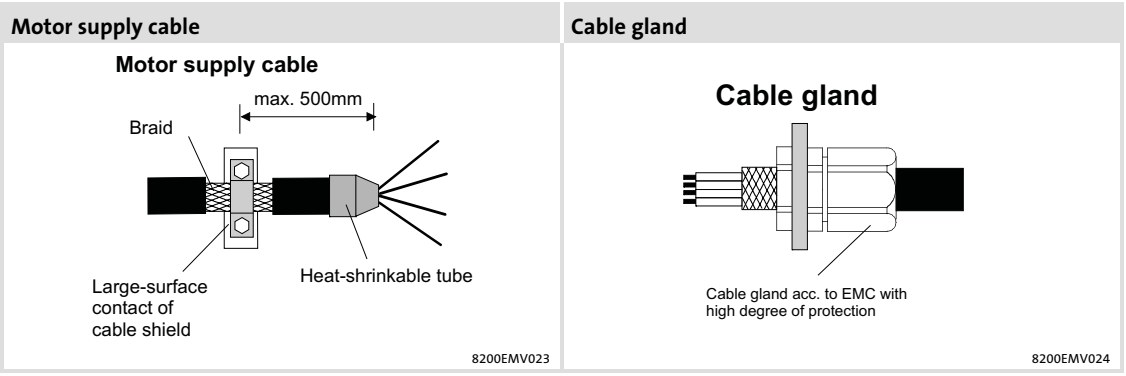


Fig. 6-3 Shielding of the motor cable

6.2.4 Control cables

- Control cables must be shielded to minimise interference injections.
- For lengths of 200 mm and more, use only shielded cables for analog and digital inputs and outputs. Under 200 mm, unshielded but twisted cables may be used.
- Connect the shield correctly:
  - The shield connections of the control cables must be at a distance of at least 50 mm from the shield connections of the motor cables and DC cables.
  - Connect the shield of digital input and output cables at both ends.
  - Connect the shield of analog input and output cables at one end (at the drive controller).
- To achieve an optimum shielding effect (in case of very long cables, with high interference) one shield end of analog input and output cables can be connected to PE potential via a capacitor (e.g. 10 nF/250 V) (see sketch).

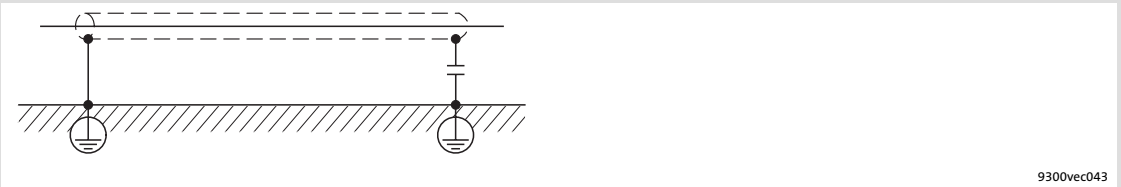


Fig. 6-4 Shielding of long, analog control cables

6.2.5 Installation in the control cabinet

Mounting plate requirements

- Only use mounting plates with conductive surfaces (zinc-coated or V2A-steel).
- Painted mounting plates are not suitable even if the paint is removed from the contact surfaces.
- If several mounting plates are used, ensure a large-surface connection between the mounting plates (e.g. by using earthing strips).

Mounting of the components

- Connect the controller and RFI filter to the grounded mounting plate with a surface as large as possible.
- No DIN rail mounting!

Optimum cable routing

- The motor cable is optimally installed if
  – it is separated from mains cables and control cables,
  – it crosses mains cables and control cables at right angles.
- Always install cables close to the mounting plate (reference potential), as freely suspended cables act like aerials.
- Lead the cables to the terminals in a straight line (avoid tangles of cables).
- Use separated cable channels for motor cables and control cables. Do not mix up different cable types in one cable channel.
- Minimise coupling capacities and coupling inductances by avoiding unnecessary cable lengths and reserve loops.
- Short-circuit unused cores to the reference potential.
- Install the positive and negative wires for DC 24 V close to each other over the entire length to avoid loops.

Earth connections

- Connect all components (drive controllers, chokes, filters) to a central earthing point (PE rail).
- Set up a star-shape earthing system.
- Comply with the corresponding minimum cable cross-sections.

Continuation of cable routing

Separation of the ”hot” motor cable from the control, signal, and mains cables:

- Never install motor and signal cables in parallel and only cross at right angles
- The cables of a 24 V power supply unit (plus and minus cable) must be installed closely together over their entire length in order that no loops may occur.

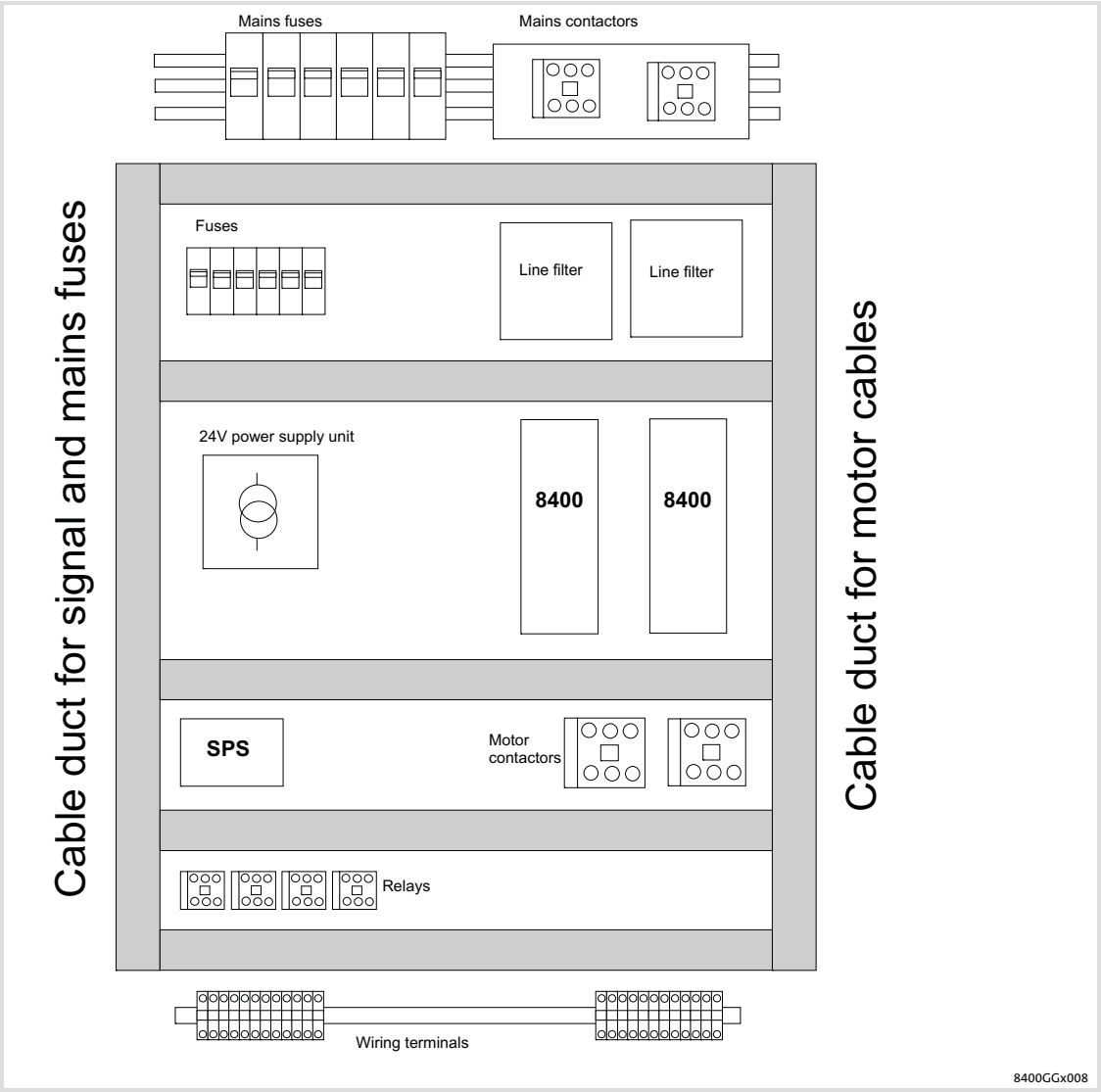


Fig. 6-5 Cable routing in the control cabinet

6.2.6 Wiring outside the control cabinet

Notes for cable routing outside the control cabinet:

- The longer the cables the greater the space between the cables must be.
- If cables for different signal types are routed in parallel, the interferences can be minimized by means of a metal barrier or separated cable ducts.

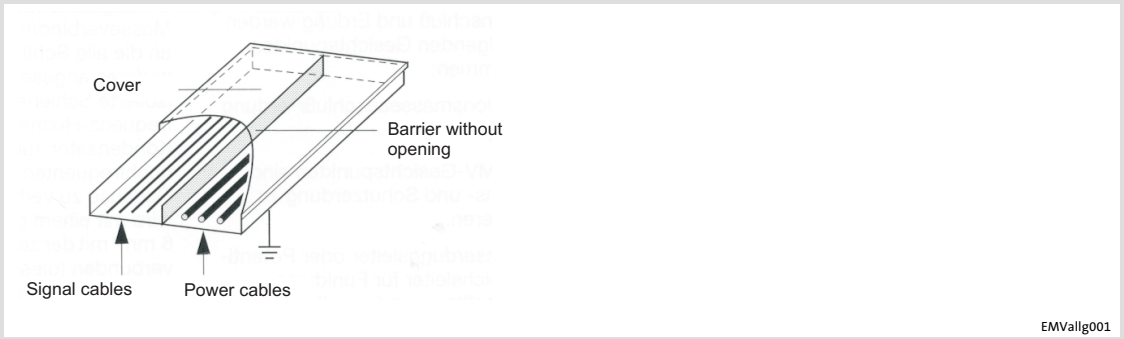


Fig. 6-6 Cable routing in the cable duct with barrier

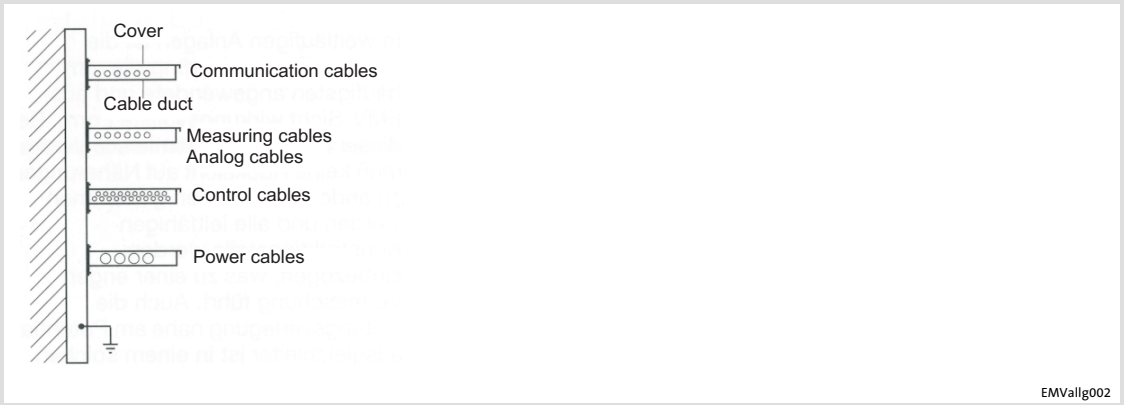


Fig. 6-7 Cable routing in separated cable ducts

Wiring on the mains side

- ► It is possible to connect the controller, mains choke or RFI filter to the mains via single cores or unshielded cables.
- ► The cable cross-section must be rated for the assigned fuse protection (VDE 0160).

Wiring on the motor side

Stop!

The motor cable is highly susceptible to interference. Therefore you will achieve an optimum wiring on the motor side if you

- ► exclusively use shielded and low-capacitance motor cables.
- ► do **not** integrate any further cable into the motor cable (e.g. for blowers etc.).
- ► shield the supply cable for temperature monitoring of the motor (PTC or thermostat) and install it separately from the motor cable.

Special conditions allow you to integrate the supply cable for temperature monitoring of the motor into the motor cable: (📖 85)

6.2.7 Detecting and eliminating EMC interferences

Fault	Cause	Remedy
Interferences of analog setpoints of your own or other devices and measuring systems	Unshielded motor cable	Use shielded motor cable
	Shield contact is not extensive enough	Carry out optimal shielding as specified
	Shield of the motor cable is interrupted by terminal strips, switched, etc.	• Separate components from other component part with a minimum distance of 100 mm • Use motor choke/motor filter
	Install additional unshielded cables inside the motor cable (e.g. for motor temperature monitoring)	Install and shield additional cables separately
	Too long and unshielded cable ends of the motor cable	Shorten unshielded cable ends to maximally 40 mm
Conducted interference level is exceeded on the supply side	Terminal strips for the motor cable are directly located next to the mains terminals	Spatially separate the terminal strips for the motor cable from main terminals and other control terminals with a minimum distance of 100 mm
	Mounting plate varnished	Optimise PE connection: • Remove varnish • Use zinc-coated mounting plate
	HF short circuit	Check cable routing

6.3 Devices in the power range 0.25 ... 2.2 kW (1/N/PE AC 230 V)

6.3.1 Example circuits

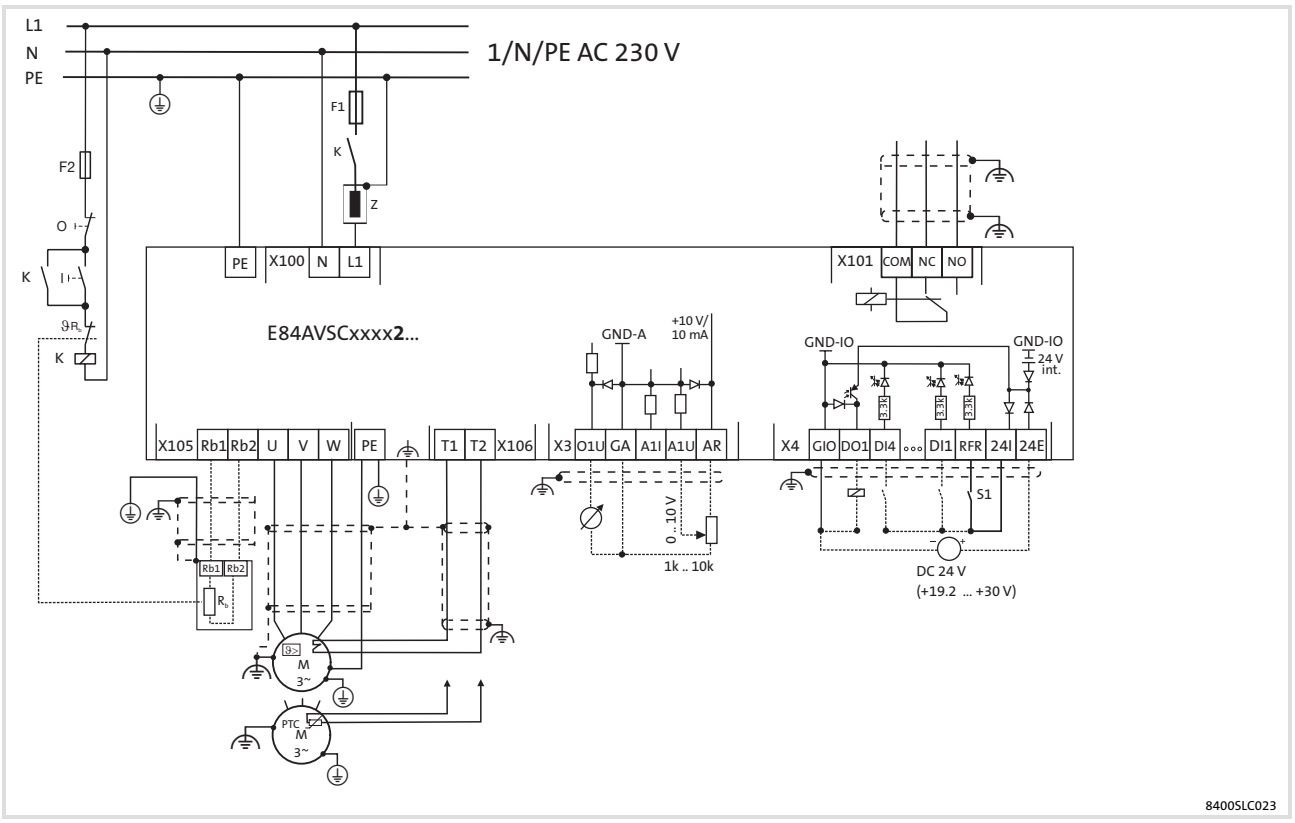


Fig. 6-8 Wiring for controllers with 230-V mains connection

6.3.2 Terminal assignment of the power connections

Preparing the cable installation

To connect the shield of the motor cable, use the shield lug of the rear shield sheet. Position the shield sheet as follows:

1. Release the holding screw of the shield sheet.
2. Bring the shield sheet into the lock-in position.
3. Tighten the holding screw to lock the shield sheet.

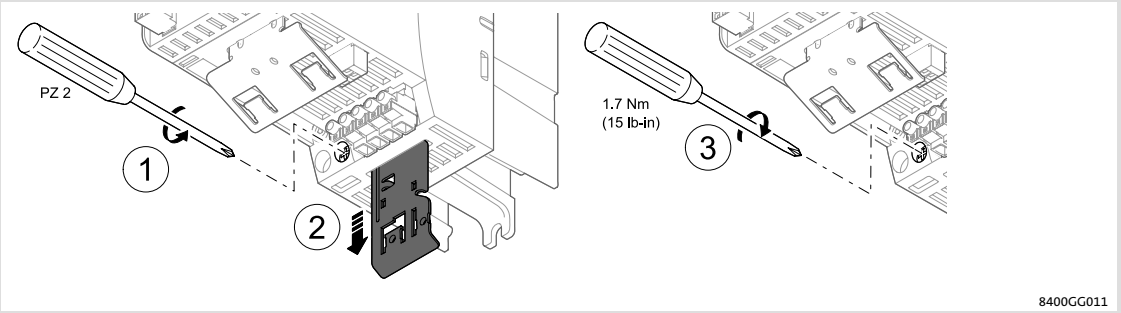
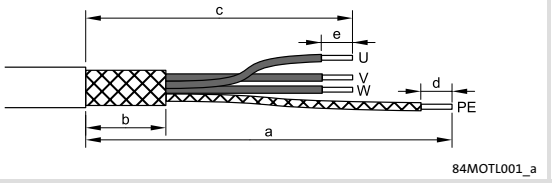


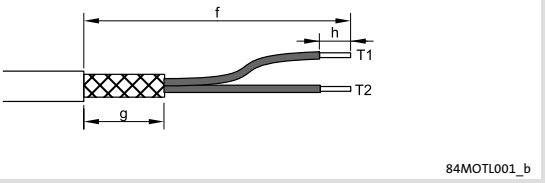
Fig. 6-9 Locate shield sheet in position

Strip cables

X105



X106



	U, V, W			PE		T1, T2		
	b	c	e	a	d	f	g	h
	[mm]			[mm]		[mm]		
E84AVxxx2512	25	65	7	90	9	95	25	10
E84AVxxx3712								
E84AVxxx5512	30	65	7	90	9	95	30	10
E84AVxxx7512								
E84AVxxx1122	30	65	7	90	9	95	30	10
E84AVxxx1522								
E84AVxxx2222								

How to proceed:

1. Strip motor cable and cable for motor temperature monitoring according to specified dimensions.
2. Fold back the shield of the motor cable and motor temperature cable over the cable sheath. Keep unshielded ends short.
3. Fix shield on the cable sheath (e.g. using a heat-shrinkable tube).
4. Fasten wire end ferrule to PE cable.
   – The other cables may be wired without using wire end ferrules.
5. Connect the shields separately to the shield sheet using (metal) cable ties or shield clamps.
   – left: motor cable
   – right: cable of motor temperature monitoring
   – For strain relief of the cables, measures are required.

Connecting the controller to protective earth

Using the PE connection on the motor side the controller and the motor cable can be connected to protective earth. Additional protective earthing of the controller can be carried out via this connection in order to comply with the requirements regarding the operation of devices with an increased discharge current to PE.

How to proceed:

1. Observe the above-mentioned steps regarding stripping and shielding.
2. Connect a second cable to the PE connection and earth it. (📖 92).

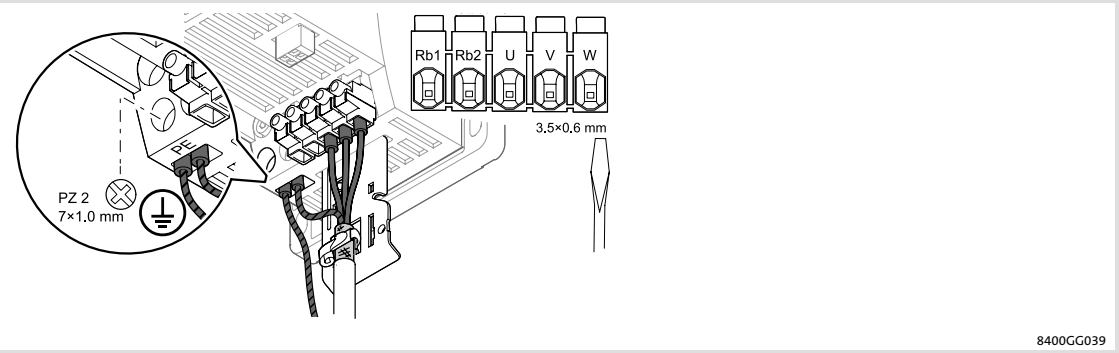
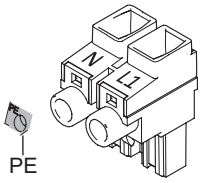


Fig. 6-10 Connection of controllers with device sizes 1 ... 3 to protective earth

Mains connection

Terminal X100	Labelling	Description
	L1	Mains phase L
	n	Neutral conductor
	PE	PE conductor on the supply side

Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
E84AVxxx2512 E84AVxxx3712 E84AVxxx5512 E84AVxxx7512	2.5	12	0.5	4.4	3.5 x 0.6
E84AVxxx1122 E84AVxxx1522 E84AVxxx2222	6.0	10	0.5	4.4	3.5 x 0.6

IT system

Danger!

- ► The release or removal of both contact screws for interference suppression reduces the degree of protection of the E84AV ... inverters from IP 20 to IP 10 in the area of these screws. The contact screws are removed when controllers are used in IT operation or when external filters of E84AZESRxxxxLL or E84AZESRxxxxSD type are used.
- ► Please observe further data in the hardware manual and the mounting instructions of the inverters and filters.

Tip!

You can increase the degree of protection to IP 20 again by screwing plastic bolts made of polyamide into the open threaded holes. The thickness of the bolt head including the washer must be greater than 3.2mm, as for example in case of cheese head screws with internal hexagon (similar to DIN EN ISO 4762)

According to the relevant EMC product standard EN 61800-3 there are no limit values for noise emission in the high-frequency range. Therefore, the technical data for EMC do not apply.

Before using the controller in the IT system, loose both contact screws for interference suppression:

– Two hexagon socket screws M4 x 16 mm with washers.

– Insert for Allen key: 3mm

The tightening torque of the contact screws for connecting the drive to other networks is 1 Nm (8 lb-in).

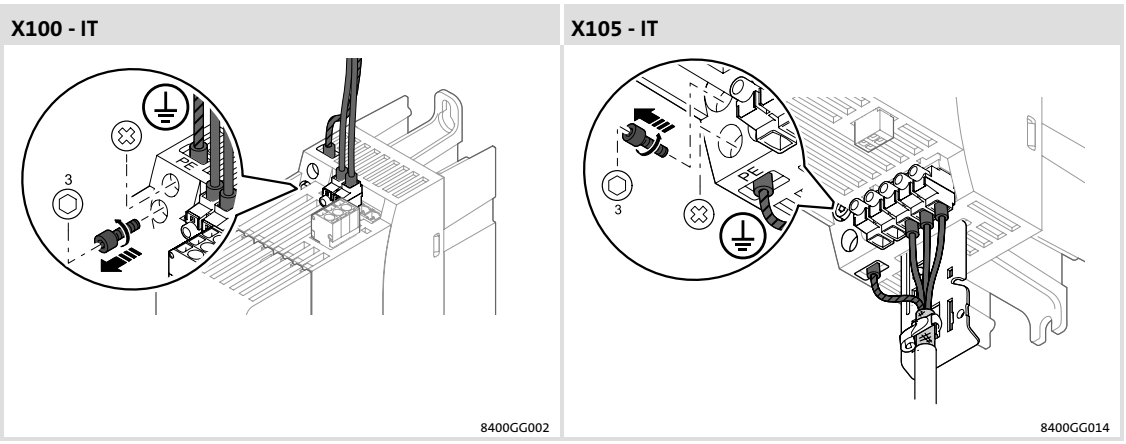
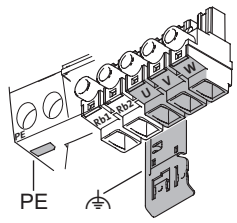


Fig. 6-11 Removal of the contact screws for device sizes 1 ... 3 (on the supply side and on the motor side)

Motor connection

Terminal X105	Labelling	Description
 8400GGXx002b	U, V, W	Motor
	PE	PE conductor
	⏚	Functional earth HF-shield termination by connection to PE

Terminal data

	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
E84AVxxx2512 E84AVxxx3712 E84AVxxx5512 E84AVxxx7512 E84AVxxx1122 E84AVxxx1522 E84AVxxx2222	2.5	12	0.5	4.4	3.5 x 0.6

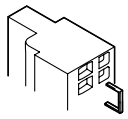
Motor temperature monitoring

Note!

In the Lenze setting, motor temperature monitoring is activated! In the delivery status, there is a wire jumper between the terminals X106/T1 and X106/T2. Before connecting a thermal sensor, remove the wire jumper.

Note!

– If the terminal X106 is used, e.g. to connect an external PTC thermistor or a thermal contact, ensure at least one basic insulation to the motor or mains potential to not restrict the protective separation of the control terminals.
– The terminal X106 is connected to PE inside the device but cannot be used for protective earth.

Terminal X106	Labelling	Description
 8400GG016b	T1 T2	Motor temperature monitoring with PTC element (type-A sensor, switching performance acc. to EN 60947-8 for type-A tripping units) or thermostat (NC contact). Lenze setting: activated, error message Setting in C00585

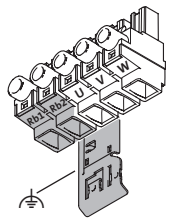
Terminal data	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
E84AVxxx2512 E84AVxxx3712 E84AVxxx5512 E84AVxxx7512 E84AVxxx1122 E84AVxxx1522 E84AVxxx2222	0.2 ... 1.5	24 ... 16	-	-	2.5 x 0.4

Tip!

For an easy removal of the wire jumper:

1. Cut the wire jumper with side-cutting pliers.
2. Overcome the spring pressure of the terminal with a screwdriver.
3. Remove both wire ends individually.

Connection of external brake resistor

Terminal X105	Labelling	Description
 8400GGXx002b	Rb1, Rb2	Brake resistor
	⏚	Functional earth HF-shield termination by connection to PE

Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
E84AVxxx2512 E84AVxxx3712 E84AVxxx5512 E84AVxxx7512 E84AVxxx1122 E84AVxxx1522 E84AVxxx2222	2.5	12	0.5	4.4	3.5 x 0.6

Please read the information on how to install and connect the brake resistor in the corresponding mounting instructions.

6.4 Devices in the power range 0.37 ... 15 kW (3/PE AC 400 V)

6.4.1 Example circuits

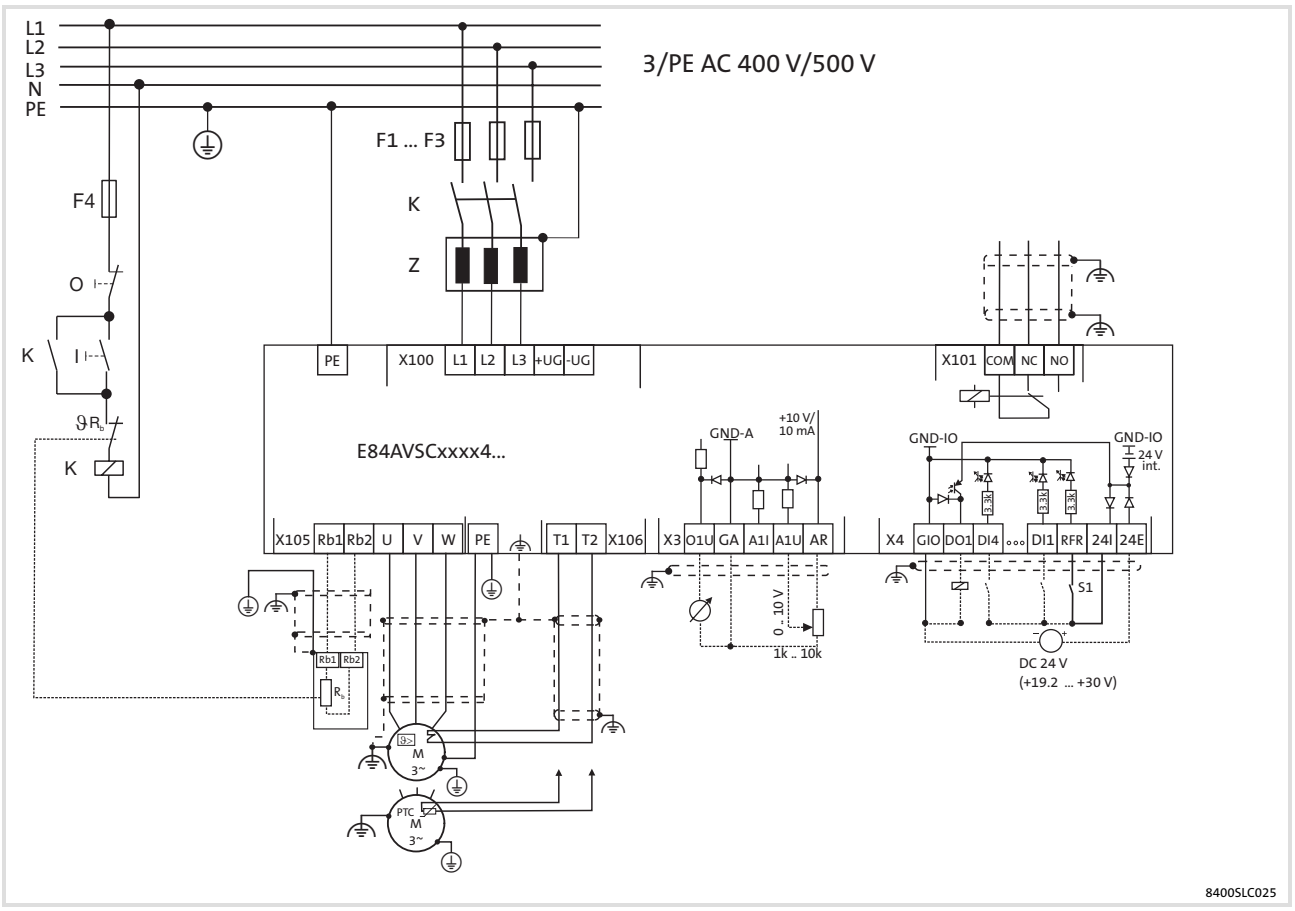


Fig. 6-12 Wiring for controllers with 400-V/500-V mains connection

6.4.2 Terminal assignment of the power connections

Preparing the cable installation

To connect the shield of the motor cable, use the shield lug of the rear shield sheet. Position the shield sheet as follows:

1. Release the holding screw of the shield sheet.
2. Bring the shield sheet into the lock-in position.
3. Tighten the holding screw to lock the shield sheet.

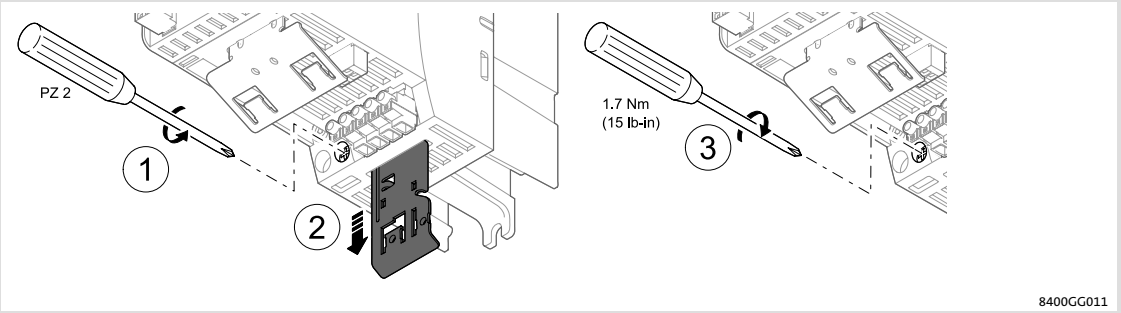
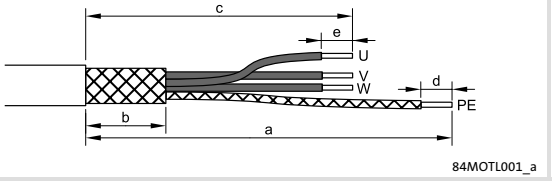


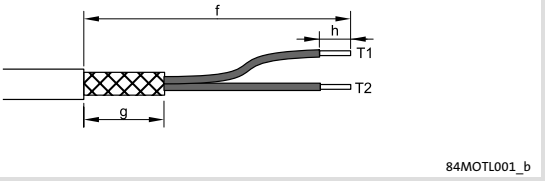
Fig. 6-13 Locate shield sheet in position

Strip cables

X105



X106



	U, V, W			PE		T1, T2		
	b	c	e	a	d	f	g	h
	[mm]			[mm]		[mm]		
E84AVxxx3714 E84AVxxx5514 E84AVxxx7514 E84AVxxx1124 E84AVxxx1524 E84AVxxx2224	30	65	7	90	9	95	30	10
E84AVxxx3024 E84AVxxx4024 E84AVxxx5524	25	70	12 ... 14	125	12 ... 14	105	25	10
E84AVxxx7524 E84AVxxx1134 E84AVxxx1534	25	80	14	120	14	115	25	10

How to proceed:

1. Strip motor cable and cable for motor temperature monitoring according to specified dimensions.
2. Fold back the shield of the motor cable and motor temperature cable over the cable sheath. Keep unshielded ends short.
3. Fix shield on the cable sheath (e.g. using a heat-shrinkable tube).
4. Fasten wire end ferrule to PE cable.
   – The other cables may be wired without using wire end ferrules.
5. Connect the shields separately to the shield sheet using (metal) cable ties or shield clamps.
   – left: motor cable
   – right: cable of motor temperature monitoring
   – For strain relief of the cables, measures are required.

Connecting the controller to protective earth

Using the PE connection on the motor side the controller and the motor cable can be connected to protective earth. Additional protective earthing of the controller can be carried out via this connection in order to comply with the requirements regarding the operation of devices with an increased discharge current to PE.

How to proceed:

1. Observe the above-mentioned steps regarding stripping and shielding.
2. Connect a second cable to the PE connection and earth it. (📖 100).

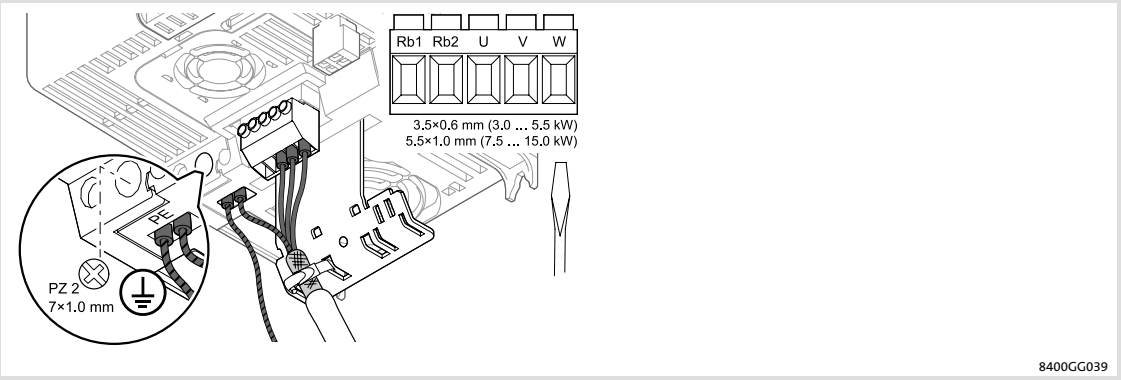
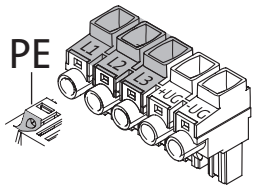


Fig. 6-14 Connection of controllers with device sizes 4 ... 5 to protective earth

Mains connection

Terminal X100	Labelling	Description
 8400GGx001b	L1 L2 L3	Connection of the mains phases L1, L2, L3
	PE	Connection for the PE conductor

Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
E84AVxxx3714 E84AVxxx5514 E84AVxxx7514 E84AVxxx1124 E84AVxxx1524 E84AVxxx2224	1 ... 2.5	18 ... 12	0.5	4.4	3.5 x 0.6
E84AVxxx3024 E84AVxxx4024 E84AVxxx5524	1 ... 6	18 ... 10	0.5	4.4	3.5 x 0.6
E84AVxxx7524 E84AVxxx1134 E84AVxxx1534	1 ... 16	18 ... 6	1.2	10.6	5.5 x 1

IT system

Danger!

- The release or removal of both contact screws for interference suppression reduces the degree of protection of the E84AV ... inverters from IP 20 to IP 10 in the area of these screws. The contact screws are removed when controllers are used in IT operation or when external filters of E84AZESRxxxxLL or E84AZESRxxxxSD type are used.
- Please observe further data in the hardware manual and the mounting instructions of the inverters and filters.

Stop!

Overvoltage at components:

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

Possible consequences:

Destruction of the device.

Protective measures:

Before using the controller in the IT system, remove the contact screws on the supply side and the motor side. (📖 Fig. 6-15).

Tip!

You can increase the degree of protection to IP 20 again by screwing plastic bolts made of polyamide into the open threaded holes. The thickness of the bolt head including the washer must be greater than 3.2mm, as for example in case of cheese head screws with internal hexagon (similar to DIN EN ISO 4762)

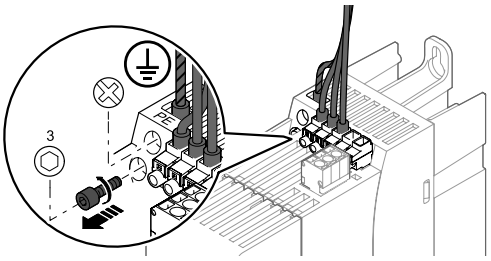
According to the relevant EMC product standard EN 61800-3 there are no limit values for noise emission in the high-frequency range. Therefore, the technical data for EMC do not apply.

Before using the controller in the IT system, loose both contact screws for interference suppression:

– Two hexagon socket screws M4 x 16 mm with washers.
– Insert for Allen key: 3mm

The tightening torque of the contact screws for connecting the drive to other networks is 1 Nm (8 lb-in).

X100 - IT



X105 - IT

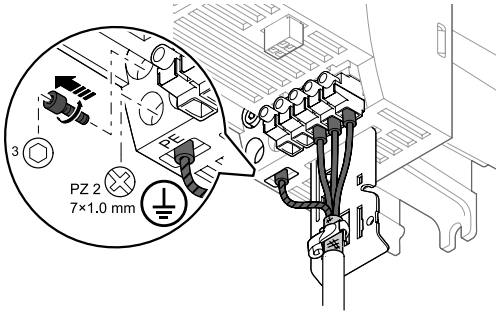
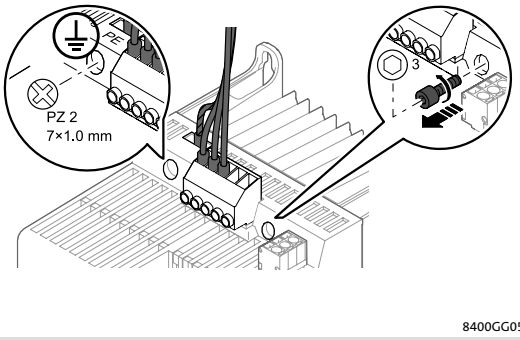


Fig. 6-15 Removal of the contact screws for device sizes 1 ... 3 (on the supply side and on the motor side)

X100 - IT



X105 - IT

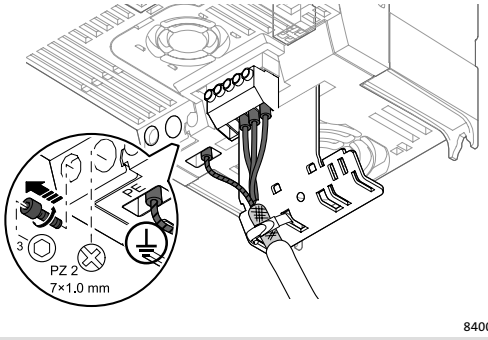
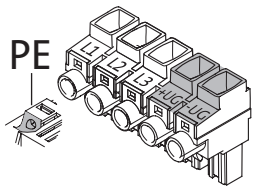


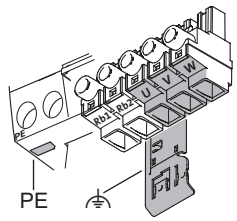
Fig. 6-16 Removal of the contact screws for device sizes 4 ... 5 (on the supply side and on the motor side)

Connection to the DC bus ($+U_G$, $-U_G$)

Terminal X100	Labelling	Description
 8400GGx001b	+UG -UG	Alternative connection of the DC-bus voltage
	PE	Connection for the PE conductor

Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm^2]	[AWG]	[Nm]	[lb-in]	
E84AVxxx3714 E84AVxxx5514 E84AVxxx7514 E84AVxxx1124 E84AVxxx1524 E84AVxxx2224	1 ... 2.5	18 ... 12	0.5	4.4	3.5 x 0.6
E84AVxxx3024 E84AVxxx4024 E84AVxxx5524	1 ... 6	18 ... 10	0.5	4.4	3.5 x 0.6
E84AVxxx7524 E84AVxxx1134 E84AVxxx1534	1 ... 16	18 ... 6	1.2	10.6	5.5 x 1

Motor connection

Terminal X105	Labelling	Description
 8400GGXx002b	U, V, W	Motor
	PE	PE conductor
	⏚	Functional earth HF-shield termination by connection to PE

Terminal data

	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
E84AVxxx3714 E84AVxxx5514 E84AVxxx7514 E84AVxxx1124 E84AVxxx1524 E84AVxxx2224	1 ... 2.5	18 ... 12	0.5	4.4	3.5 x 0.6
E84AVxxx3024 E84AVxxx4024 E84AVxxx5524	1 ... 6	18 ... 10	0.5	4.4	3.5 x 0.6
E84AVxxx7524 E84AVxxx1134 E84AVxxx1534	1 ... 16	18 ... 6	1.2	10.6	5.5 x 1

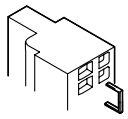
Motor temperature monitoring

Note!

In the Lenze setting, motor temperature monitoring is activated! In the delivery status, there is a wire jumper between the terminals X106/T1 and X106/T2. Before connecting a thermal sensor, remove the wire jumper.

Note!

– If the terminal X106 is used, e.g. to connect an external PTC thermistor or a thermal contact, ensure at least one basic insulation to the motor or mains potential to not restrict the protective separation of the control terminals.
– The terminal X106 is connected to PE inside the device but cannot be used for protective earth.

Terminal X106	Labelling	Description
 8400GG016b	T1 T2	Motor temperature monitoring with PTC element (type-A sensor, switching performance acc. to EN 60947-8 for type-A tripping units) or thermostat (NC contact). Lenze setting: activated, error message Setting in C00585

Terminal data

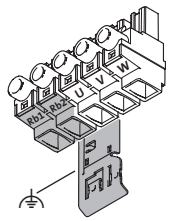
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
E84AVxxx3714 E84AVxxx5514 E84AVxxx7514 E84AVxxx1122 E84AVxxx1524 E84AVxxx2224	0.2 ... 1.5	24 ... 16	-	-	2.5 x 0.4
E84AVxxx3024 E84AVxxx4022 E84AVxxx5524	0.2 ... 1.5	24 ... 16	-	-	2.5 x 0.4
E84AVxxx7524 E84AVxxx1134 E84AVxxx1534	0.2 ... 1.5	24 ... 16	-	-	2.5 x 0.4

Tip!

For an easy removal of the wire jumper:

1. Cut the wire jumper with side-cutting pliers.
2. Overcome the spring pressure of the terminal with a screwdriver.
3. Remove both wire ends individually.

Connection of external brake resistor

Terminal X105	Labelling	Description
 8400GGXx002b	Rb1, Rb2	Brake resistor
	⏚	Functional earth HF-shield termination by connection to PE

Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
E84AVxxx3714 E84AVxxx5514 E84AVxxx7514 E84AVxxx1124 E84AVxxx1524 E84AVxxx2224	1 ... 2.5	18 ... 12	0.5	4.4	3.5 x 0.6
E84AVxxx3024 E84AVxxx4024 E84AVxxx5524	1 ... 6	18 ... 10	0.5	4.4	3.5 x 0.6
E84AVxxx7524 E84AVxxx1134 E84AVxxx1534	1 ... 16	18 ... 6	1.2	10.6	5.5 x 1

Please read the information on how to install and connect the brake resistor in the corresponding mounting instructions.

6.5 Common control terminals

6.5.1 Important notes

Stop!

The device contains components that can be destroyed by electrostatic discharge!

Before working on the device, the personnel must ensure that they are free of electrostatic charge by using appropriate measures.

Note!

– If the terminal X106 is used, e.g. to connect an external PTC thermistor or a thermal contact, ensure at least one basic insulation to the motor or mains potential to not restrict the protective separation of the control terminals.
– The terminal X106 is connected to PE inside the device but cannot be used for protective earth.

Design of the cables

- The cables used must comply with the approvals required for the location (e.g. UL).
- The effectiveness of a shielded cable is reached by:
  – Providing a good shield connection through large-surface shield contact.
  – Using only braided shields with low shield resistance made of tin-plated or nickel-plated copper braid.
  – Using braided shields with an overlap rate > 70 % and an overlap angle of 90 °.
  – Keeping unshielded cable ends as short as possible.

These terminals must be shielded:

- Encoder
- Analog signals (inputs and outputs; single-sided shield connection to the controller)
- System bus (CANopen)

The following connections need not be shielded:

- 24-V supply
- Digital signals (inputs and outputs) up to a cable length of 3 m

Preparing the cable installation

The shields of the control cables are connected to the left shield lug of the front shield sheet. For this, proceed as shown in the illustration.

1. Release the holding screw of the shield sheet.
2. Bring the shield sheet into one of the two possible lock-in positions.
3. Tighten the holding screw to lock the shield sheet.

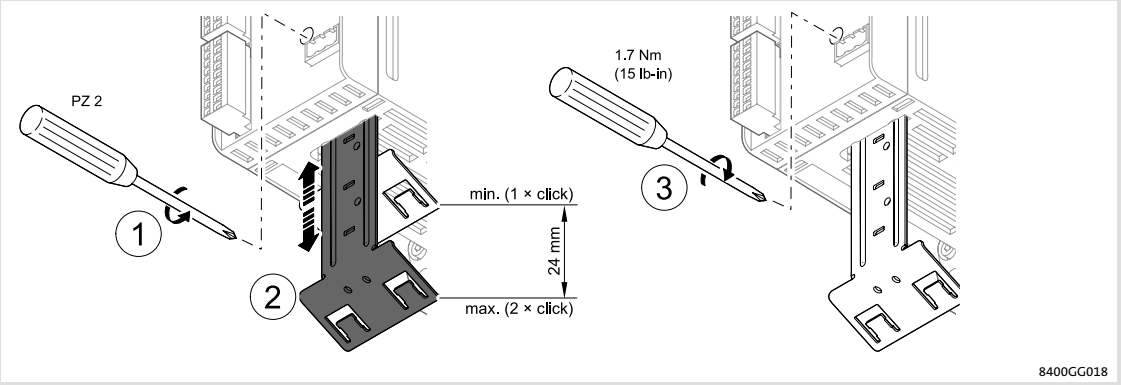
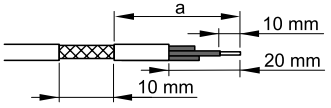
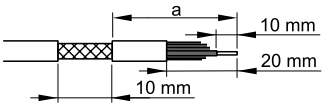


Fig. 6-17 Locate shield sheet in position

Strip cables

According to the selected lock-in position of the shield sheet, strip the control cables. For this, strip the cable ends and the cable sheath at the shield lug.

The following table contains the stripping dimensions for the control cables ((I) = analog; (II) = digital) as a function of the lock-in position selected for the controller.

X1	X3, X4, X5, X107
	

► StateLine: stripping dimensions

X1			X3			X4		
min.	max.		min.	max.		min.	max.	
a	a		a	a		a	a	
[mm]	[mm]	[mm²] [*AWG*]	[mm]	[mm]	[mm²] [*AWG*]	[mm]	[mm]	[mm²] [*AWG*]
110	135	0.2 ... 1.5 *24 ... 16*	150	175	0.2 ... 1.5 *24 ... 16*	130	155	0.2 ... 1.5 *24 ... 16*

► HighLine: stripping dimensions

X1			X3/X5			X4/X107		
min.	max.		min.	max.		min.	max.	
a	a		a	a		a	a	
[mm]	[mm]	[mm²] [*AWG*]	[mm]	[mm]	[mm²] [*AWG*]	[mm]	[mm]	[mm²] [*AWG*]
110	135	0.2 ... 1.5 *24 ... 16*	150	175	0.2 ... 1.5 *24 ... 16*	115	140	0.2 ... 1.5 *24 ... 16*

Note!

Devices including safety engineering have an increased stripping length ”a”:
► by 10 mm when the shield sheet is pulled out to its minimum length
► by 15 mm when the shield sheet is pulled out to its maximum length

Shield and connect cables

The stripped control cables can be connected in a well-conductive way to the left shield lug with a (metal) cable binder via the exposed cable shield.

As shown in the illustration, the cable ends (if required, provided with wire end ferrule) must be inserted into the corresponding spring terminals with a suitable screwdriver (for max. width, see illustration).

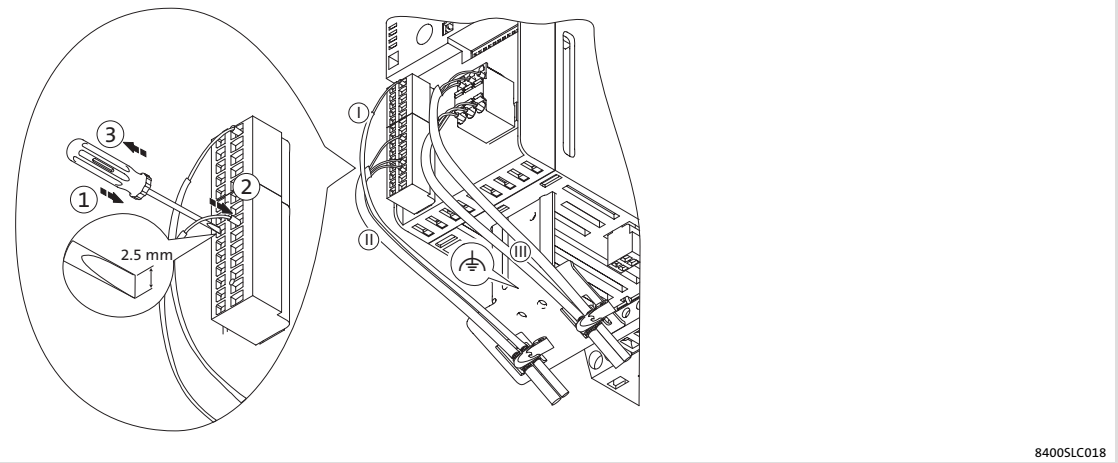


Fig. 6-18 Shielding and connecting control cables

6.5.2 System bus connection (CANopen)

X1

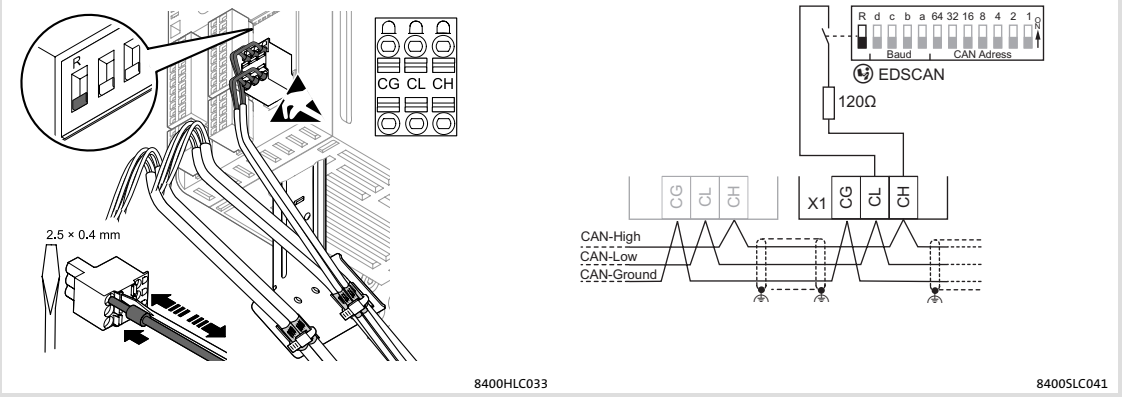


Fig. 6-19 CANopen connection

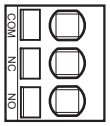
Terminal data

	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
flexible with wire end ferrule	0.2 ... 1.5	24 ... 16	-	-	2.5 x 0.4

Note!

► Detailed information on the system bus interface and switch settings can be obtained from the ”CAN communication manual”, chapter ”CAN on board 8400”.

6.5.3 Relay output connection

Terminal X101	Labelling	Description
 8400GGx003	COM	Central contact of relay
	NC	Relay output NC (normally closed) Position is displayed via TRIP software message (Lenze setting)
	NO	Relay output NO (normally open)

Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
flexible with wire end ferrule	0.2 ... 1.5	24 ... 16	-	-	3.5 x 0.6

Fig. 6-20 Wiring of the relay outputs

Note!

- ► Switching of control signals:
  - – Use shielded cables
  - – HF-shield termination by PE connection
  - – The minimum load for a correct through-connection of the relay contacts is 10 V DC and 10 mA. Both values must be exceeded at the same time.
- ► Use shielded cables for switching the control signals and establish the HF-shield termination through a PE connection.
- ► For the switching operation of mains potentials, shielded cables are sufficient.
- ► To protect the relay contacts, use a corresponding suppressor circuit in case of an inductive or capacitive load!
- ► The service life of the relay depends on the load type (ohmic, inductive, or capacitive) and the height of capacity to be switched.

Note!

The following notes are described in detail in the software manual ”Parameter setting” in the section ”I/O terminals”, ”Relay output”:

- ► Use code C00118 to define the relay switching status.
- ► The minimum period for a valid HIGH or LOW signal to control the relay can be defined via the codes C00423/3 and C00423/4.

6.5.4 Diagnostics

The following can be optionally connected to the X6 diagnostic interface:

- E94AZCUSdiagnostic USB adapter
- EZAEBK1001 keypad
- EZAEBK2001 diagnosis terminal

In combination with the Lenze PC software »Engineer«, the diagnostic adapter serves to make comprehensive settings via dialogs, e.g. for initial commissioning.

The keypad serves to check or change individual settings. It is directly plugged onto the controller.

Using the keypad, the controller can be parameterised with regard to basic settings in a quick commissioning menu.

The diagnosis terminal combines the keypad with a housing and a connecting cable. The diagnosis terminal can also be used for installation, e.g. into a control cabinet door.

Socket X6	Labelling	Description
 8400HLC009	X6	Diagnostic interface for connection of a keypad or a diagnostic USB adapter for online diagnostics

6.6 StateLine C control terminals

6.6.1 External supply voltage 24 V

X4

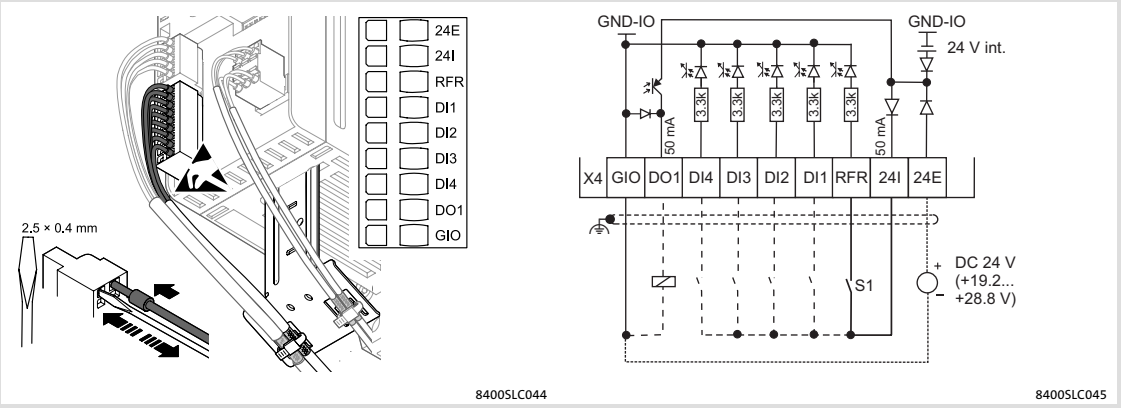
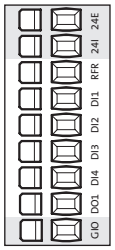


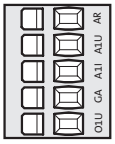
Fig. 6-21 Connection to an external supply voltage

Terminal X4	Labelling	Description	
 8400SLC014	24E	Connection for an external 24 V supply by a safely separated power supply unit (SELV/PELV), IEC 61131-2 (required for mains-independent supply of the control electronics and the communication module)	
	24I	Output 24 V, max. 50 mA for connecting digital inputs via potential-free contacts	
	GIO	GND-IO	Ground reference potential for the digital inputs and outputs

Terminal data

	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
flexible with wire end ferrule	0.2 ... 1.5	24 ... 16	-	-	2.5 x 0.4

6.6.2 Analog inputs and outputs

Terminal X3	Labelling	Description	
 8400SLC008	Controller	Reference voltage 10 V	
	A1U	Analog input 1	±10 V (📖 4.4.2)
	A1I		0 ...+20 mA/+4 ...+20 mA (📖 4.4.2)
	GA	GND analog signals	
	O1U	Analog output 1	0 ... +10 V (📖 4.4.3)

Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
flexible with wire end ferrule	0.2 ... 1.5	24 ... 16	-	-	2.5 x 0.4

Example circuit

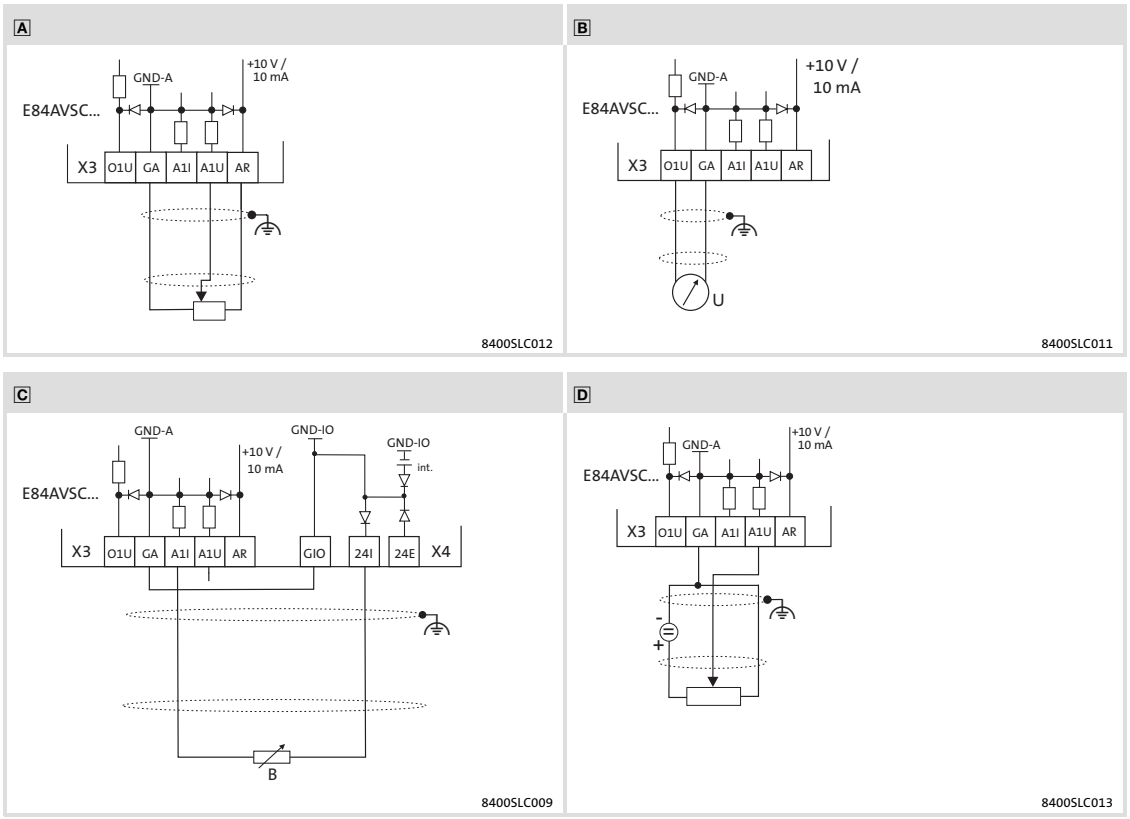
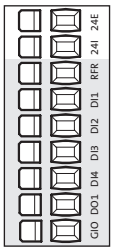


Fig. 6-22 Wiring examples of the analog inputs and outputs

A	Potentiometer with internal controller supply
B	Terminal assignment of the analog output signal, e.g. by a measuring instrument
C	External master current selection based on a sensor signal 0 - 20 mA. If GA and GIO are electrically connected, the digital cables have to be shielded as well.
D	Potentiometer with external supply
X3	Terminal for the analog inputs and outputs
X4	Terminal for the digital inputs and outputs
GA	GND-A Ground reference potential for the analog inputs and outputs
GIO	GND-IO Ground reference potential for the digital inputs and outputs
⏚	EMC shield connection
U	Measuring device
B	Measuring transducer

6.6.3 Digital inputs and outputs

Terminal X4	Labelling	Description	
 8400SLC014	RFR	Controller enable/controller inhibit, always required	
	DI1	Digital input 1	📖 4.4.4 IEC61131-2, type 1 or two-track frequency input, for HTL encoding 0 ... 10 kHz
	DI2	Digital input 2	
	DI3	Digital input 3	📖 4.4.4
	DI4	Digital input 4	
	DO1	Digital output 1	📖 4.4.5
	GIO	GND digital signals	

Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
flexible with wire end ferrule	0.2 ... 1.5	24 ... 16	-	-	2.5 x 0.4

Example circuit

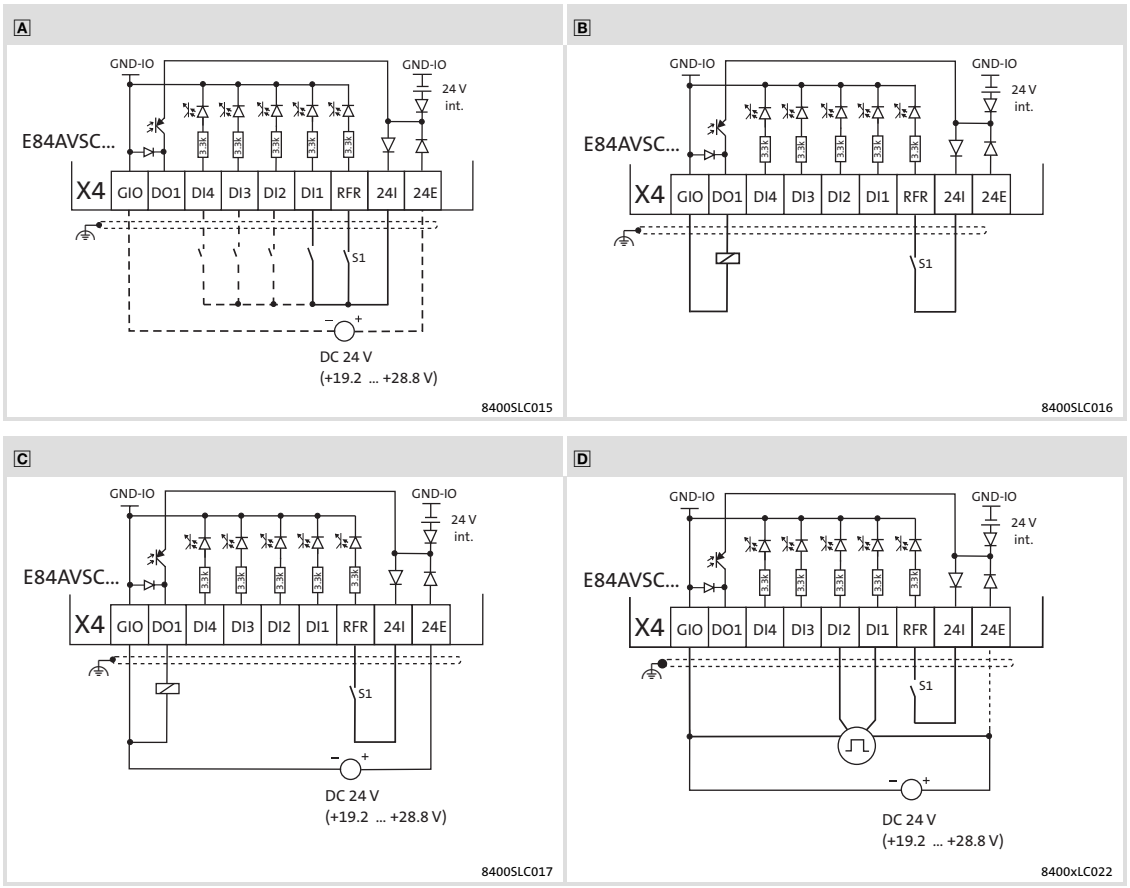


Fig. 6-23 Wiring examples of the digital inputs and outputs

A	Wiring with one (or several) digital input (here: DI1), e.g. a PLC; optional: external 24 V supply	
B	Digital control (relay, valve, ...) with internal 24 V supply	
C	Digital control (relay, valve, ...) with external 24 V supply	
D	Connection of an HTL incremental encoder with a maximum input frequency of 10 kHz	
	DI1	track A
	DI2	track B
RFR	Input for controller enable; wiring is always required.	
GIO	GND-IO	Ground reference potential for the digital inputs and outputs
X4	Terminal for the digital inputs and outputs	

6.7 HighLine C control terminals

6.7.1 External supply voltage 24 V

X5

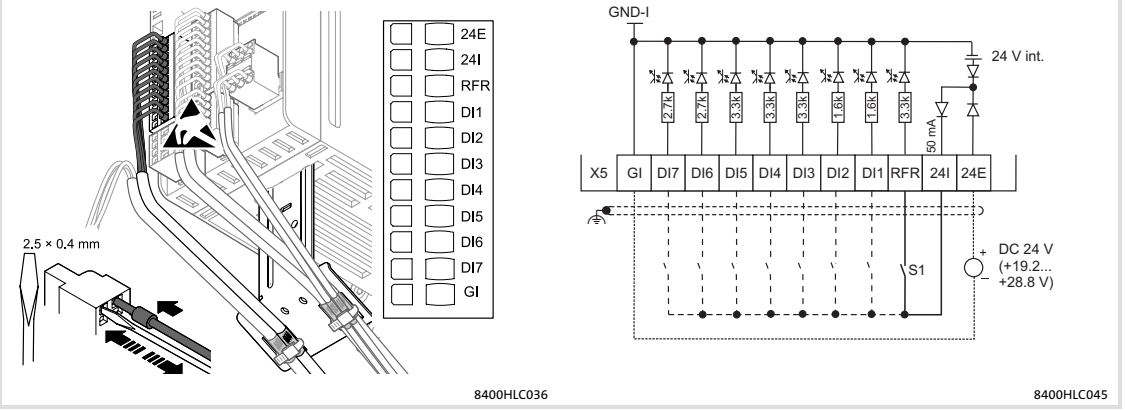
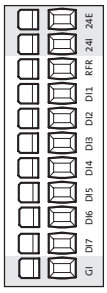


Fig. 6-24 Connection to an external supply voltage

Terminal X5	Labelling	Description	
 8400HLC014	24E	Connection for an external 24 V supply by a safely separated power supply unit (SELV/PELV), IEC 61131-2 (required for mains-independent supply of the control electronics and the communication module)	
	24I	Output 24 V, max. 50 mA for connecting digital inputs via potential-free contacts	
	GI	GND-I	Ground reference potential for the digital inputs

Terminal data

	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
flexible with wire end ferrule	0.2 ... 1.5	24 ... 16	-	-	2.5 x 0.4

X4

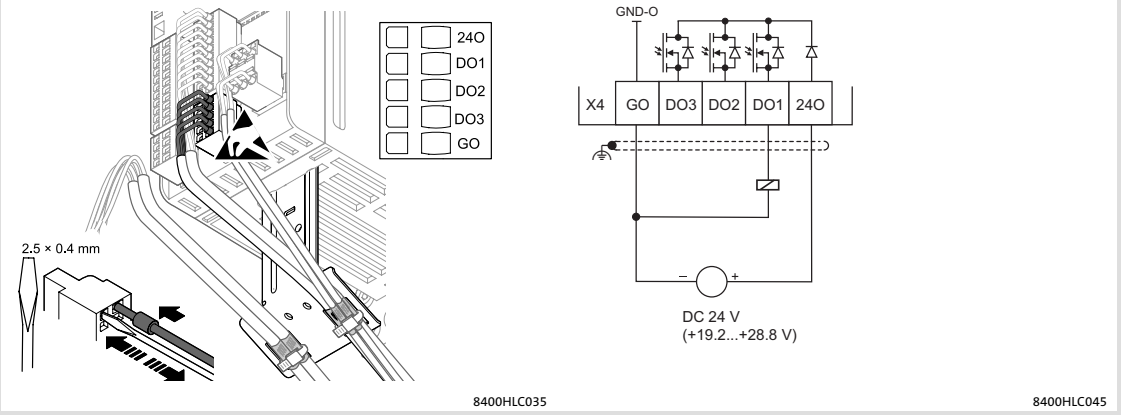
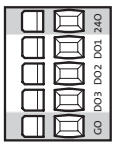


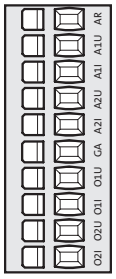
Fig. 6-25 Connection to an external supply voltage

Terminal X4	Labelling	Description	
 8400HLC008	24O	Connection for an external 24 V supply by a safely separated power supply unit (SELV/PELV), IEC 61131-2 (required for mains-independent supply of the control electronics and the communication module)	
	GO	GND-O	Ground reference potential for the digital outputs

Terminal data

	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
flexible with wire end ferrule	0.2 ... 1.5	24 ... 16	-	-	2.5 x 0.4

6.7.2 Analog inputs and outputs

Terminal X3	Labelling	Description	
 8400HLC008	Controller	Reference voltage 10 V	
	A1U	Analog input 1	± 10 V
	A1I		0 ...+20 mA/+4 ...+20 mA
	A2U	Analog input 2	± 10 V
	A2I		0 ...+20 mA/+4 ...+20 mA
	GA	GND analog signals	
	O1U	Analog voltage output 1	0 ... +10 V
	O1I	Analog current output 1	0 ...+20 mA/+4 ...+20 mA
	O2U	Analog voltage output 2	0 ... +10 V
	O2I	Analog current output 2	0 ...+20 mA/+4 ...+20 mA

Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
flexible with wire end ferrule	0.2 ... 1.5	24 ... 16	-	-	2.5 x 0.4

Example circuit

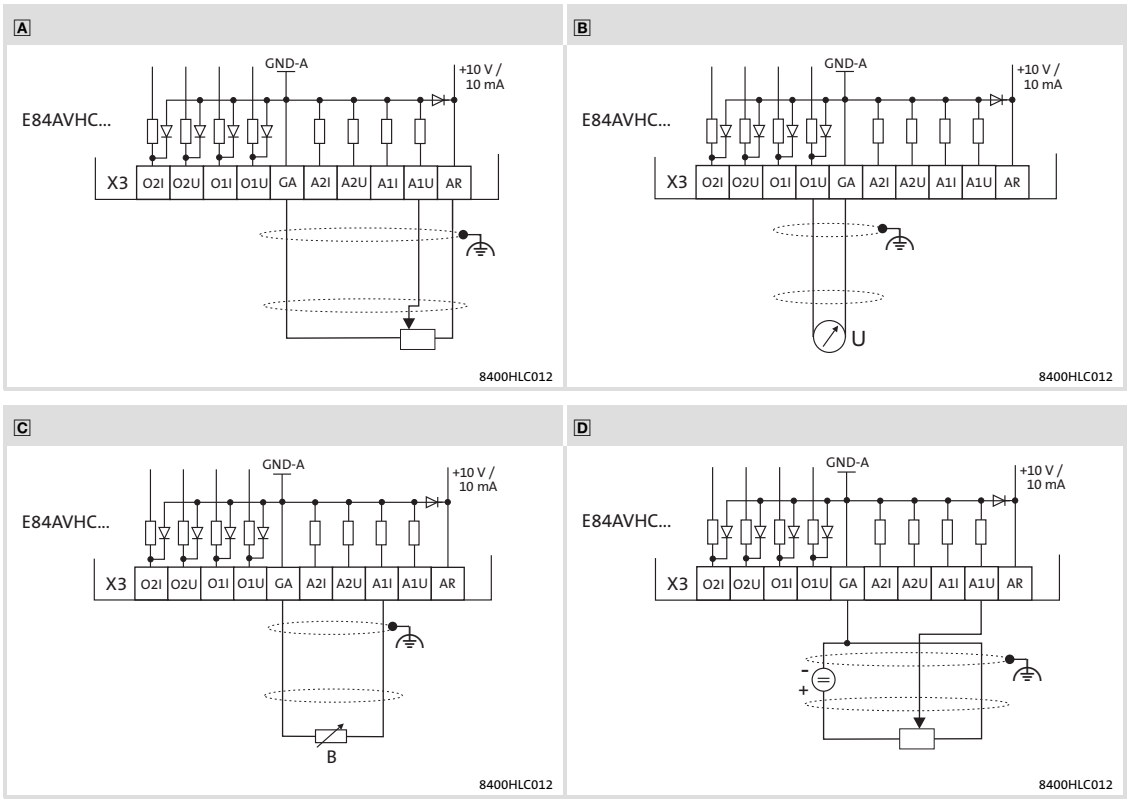
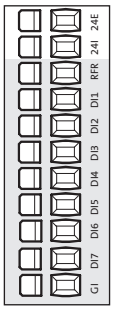


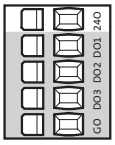
Fig. 6-26 Wiring examples of the analog inputs and outputs

A	Potentiometer with internal controller supply
B	Terminal assignment of the analog output signal, e.g. by a measuring instrument
C	External master current selection based on a sensor signal 0-20 mA.
D	Potentiometer with external supply
X3	Terminal for the analog inputs and outputs
GA	GND-A Ground reference potential for the analog inputs and outputs
⏚	EMC shield connection
U	Measuring device

6.7.3 Digital inputs and outputs

Terminal X5	Labelling	Description	
 8400HLC014	RFR	Controller enable/controller inhibit, always required	
	DI1	Digital input 1	IEC61131-2, type 1 or two-track frequency input, for HTL encoder 0 ... 100 kHz
	DI2	Digital input 2	
	DI3	Digital input 3	IEC61131-2, type 1
	DI4	Digital input 4	
	DI5	Digital input 5	
	DI6	Digital input 6	IEC61131-2, type 1 or two-track frequency input for HTL encoder 0 ... 10 kHz
	DI7	Digital input 7	
	GI	GND digital inputs	

Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
flexible with wire end ferrule	0.2 ... 1.5	24 ... 16	-	-	2.5 x 0.4

Terminal X4	Labelling	Description	
 8400HLC008	DO1	Digital output 1	IEC61131-2, type 1
	DO2	Digital output 2	
	DO3	Digital output 3	
	GO	GND digital outputs	

Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
flexible with wire end ferrule	0.2 ... 1.5	24 ... 16	-	-	2.5 x 0.4

Example circuit

Note!

For stable digital output states, in particular during the starting phase of the controller, you must use an external 24V supply for the digital outputs.

Note!

Digital inputs and digital outputs have separated reference potentials (GI and GO). If you interconnect inputs and outputs, the reference potentials are connected as well by an external bridge.

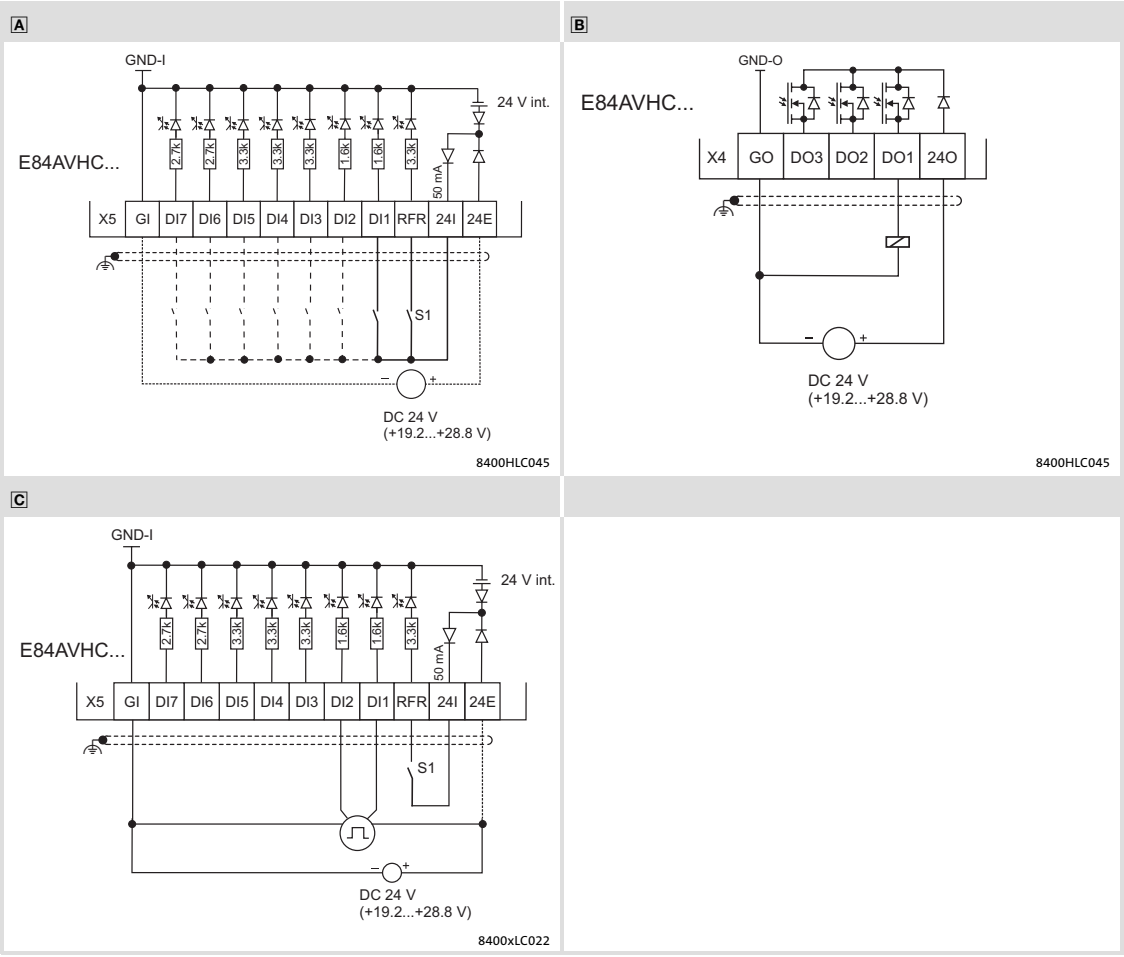


Fig. 6-27 Wiring examples of the digital inputs and outputs

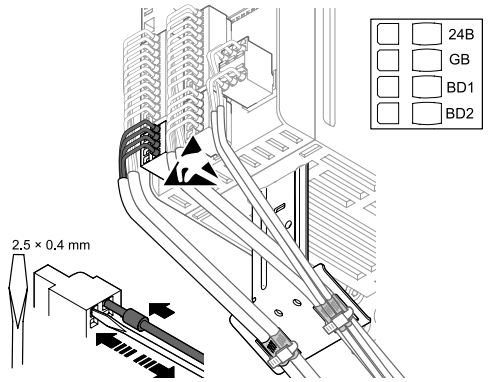
A	Wiring with one (or several) digital input (here: DI1), e.g. a PLC; optional: external 24 V supply	
B	Digital control (relay, valve, ...) with external 24 V supply	
C	Connection of an HTL incremental encoder with a maximum input frequency of 100 kHz	
	DI1	track A
	DI2	track B
X4	Terminal for the digital outputs	
X5	Terminal for the digital inputs	
GI	GND-I	Ground reference potential for the digital inputs
GO	GND-O	Ground reference potential for the digital outputs

6.7.4 Motor holding brake connection

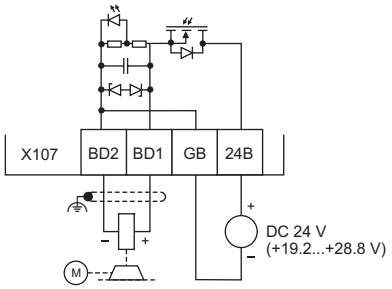
Note!

– If terminal X107 is used for connecting a motor holding brake, at least one basic insulation to the motor or mains potential has to be provided, so that the protective separation of the control terminals is not limited

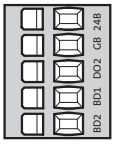
X107



8400HLC037



8400HLC045

Terminal X107	Labelling	Description	
 8400HLC008	24B	Connection for external 24 V supply voltage of the motor holding brake **Observe correct polarity!**	DC 19.2 ... 28.8 V, IEC 61131-2 SELV/PELV Example circuit 📖 8.3
	GB	GND connection for external supply	
	BD1	Pos. connection of the motor holding brake (Lenze: WH)	
	BD2	Neg. connection of the motor holding brake (Lenze: BN)	

Terminal data

	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
flexible with wire end ferrule	0.2 ... 1.5	24 ... 16	-	-	2.5 x 0.4

7 Commissioning

Note!

Please observe the general safety instructions and the residual hazards in chapter 2.1 and 2.3.

7.1 Before switching on

Note!

- ► Comply with the corresponding switch-on sequence.
- ► In case of faults during commissioning please use:
  - – the chapter ”Diagnostics”
  - – the online help in the »Engineer«
  - – the 8400 StateLine C or 8400 HighLine C software manual

To prevent injury to persons or damage to material assets, check ...

... before connecting the mains voltage:

- ► Wiring for completeness, short circuit, and earth fault
- ► The ”EMERGENCY STOP” function of the entire system
- ► The motor circuit configuration (star/delta) must be adapted to the output voltage of the controller
- ► The in-phase connection of the motor
- ► The direction of rotation or the incremental encoder (if available)

... the most important drive parameter settings before the controller is enabled:

- ► Is the V/f rated frequency adapted to the motor circuit configuration?
- ► Are the drive parameters relevant for your application set correctly?
- ► Is the configuration of the analog and digital inputs and outputs adapted to wiring?

Tip!

Use the L-force ”Engineer” to carry out extensive parameter setting and configuration. The L-force keypad can be used for quick commissioning and checking individual parameters. If you want to use the L-force ”Engineer”, the online help and the software documentation for the controller assist you.

Selection of the appropriate commissioning tool

There are two ways to commission the 8400 frequency inverter:

- Commissioning using the keypad for simple drive tasks, e.g. quick commissioning of the standard application ”speed closed-loop control”
- Commissioning using the »Engineer« for more complex drive tasks, e.g. ”table positioning” (see the 8400 StateLine software manual or the 8400 HighLine software manual)

Tip!

Use the »Engineer« to carry out extensive parameter setting and configuration. The online help which is available for each device and the accompanying software documentation will assist you.

The L-force keypad can be used for quick commissioning and checking individual parameters on the controller.

Notes for motor operation

Danger!

- ► Continuous operation at low field frequency with rated motor current is thermally not permissible when self-ventilated machines are used. If required, activate a motor temperature monitoring with C00585.
  - – Motor temperature monitoring with I^2xt (see software manual)
  - – Motor temperature monitoring with motor PTC (see software manual).
- ► If an asynchronous motor with the nameplate data 400 V⅄ /230 V△ is operated in delta connection on a frequency inverter for a supply voltage of 400 V, set the code C00015 (V/f base frequency) to 87 Hz.

Tip!

In the Lenze setting, the ”linear V/f characteristic” operating mode is set as motor control. The parameter settings are preset so that if the frequency inverter and the 50 Hz asynchronous machine match in terms of power, the controller is ready for operation without any further need for parameterisation and the motor operates satisfactorily.

Recommendations for the following application cases

- ► If the frequency inverter and the motor differ strongly in terms of power
  - – Set code C00022 (I_{max} limit in motor mode) to 2.0 $I_{N(motor)}$.
- ► If a high starting torque is required
  - – When the motor is idling, set the code C00016 (V_{min} boost) so that a rated motor current flows with a field frequency f = 3 Hz (C00058).
- ► For noise reduction
  - – Set code C00018 to the value ”3” (switching frequency 16 $kHz_{sin\ var}$).
- ► If a high torque without feedback is to be available at low speeds, we recommend the ”vector control” mode.

7.2 Quick commissioning

Target

For test and demonstration purposes, the load-free motor shall be rotated in best time with an amount of wiring as little as possible and few settings.

Keypad or setpoint potentiometer

For this simple application, you can choose between two drive control options:

- Keypad control (📖 132), i.e. the X400 keypad is used as setpoint source
- Terminal control (📖 134), i.e. a setpoint potentiometer connected to the controller terminals is used as setpoint source

Diagnostics

In addition to the X400 keypad, also use the LEDs on the front of the controller for drive diagnostics:

- Two LEDs indicate the device status (DRIVE READY and DRIVE ERROR): chapter ”Diagnostics” (📖 150)
- Two LEDs indicate the bus status (CAN-RUN and CAN-ERROR): chapter ”Diagnostics” (📖 150)

The LEDs for the bus status are less important during quick commissioning.

Tip!

The handling of the X400 keypad is described in the mounting instructions included in electronic form on the CD ”L-force Inverter Drives 8400”.

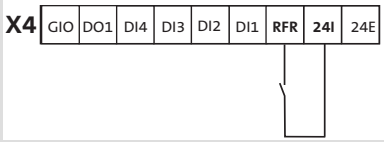
7.2.1 Keypad control

Step-by-step commissioning

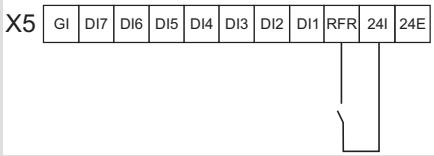
1. Wiring of power terminals

Make use of the chapter ”Electrical installation” or the Mounting Instructions to wire the power terminals according to the requirements of your device.

2. Wiring of control terminals.
   – StateLine

Digital inputs at terminal X4	Assignment	Information
	RFR	● Controller enable RFR = High ● Reset error High → Low (edge-controlled)

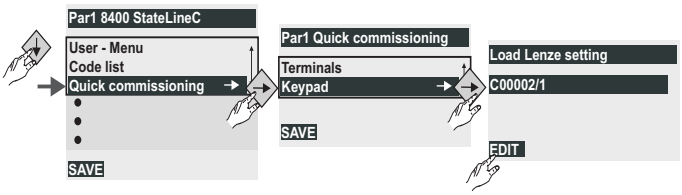
   – HighLine

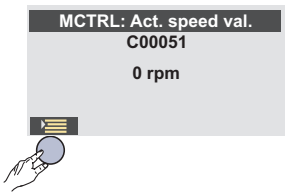
Digital inputs at terminal X5	Assignment	Information
	RFR	● Controller enable RFR = High ● Reset error High → Low (edge-controlled)

3. Load Lenze setting to controller

Note!

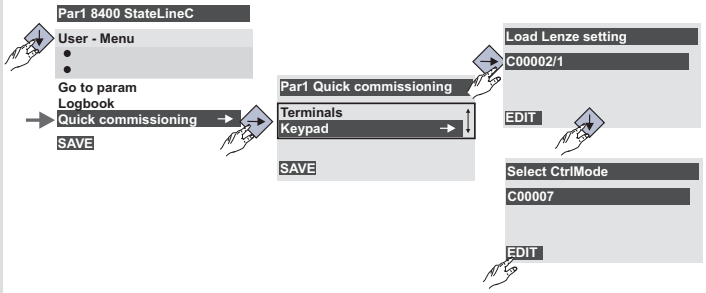
The application ”actuating drive speed” is implemented with the Lenze setting.

	After attaching the keypad or switching on the controller with keypad attached, the connection between keypad and controller is established. The connection has been established when the code C00051 appears in the display. ● Then press the left function key.
	● Starting from ”User menu” scroll down with button to ”Quick commissioning” menu ● Click right button. ● Select ”Keypad” menu. ● Click right button. ● Code 00002/1: – Parameterise with left ”Edit” function key – Select value ”1”- -> On/Start and confirm with right ”OK” function key.



- When the Lenze setting is loaded, the display goes off for a short time.
- When the display goes on again, the main menu appears.
  – The main menu settings can be defined by the user using codes C00465 ... C00469.
- Press the left function key to go to the "User menu".

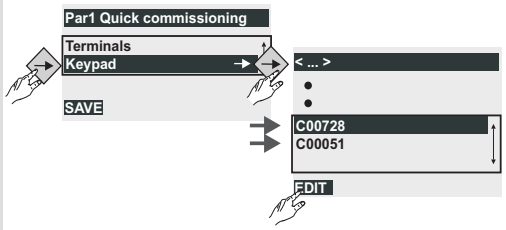
4. Set keypad control



Continue as with commissioning step ▶ 3. Load Lenze setting to controller:
– "Quick commissioning" menu
– Keypad
– Load Lenze setting

Use the "down" navigation key to go to code C00007 for selecting the control mode:
- Select parameter code 00007 and parameterise with "Edit"
- Select value "20"- -> Keypad and confirm with "OK".

5. Enable controller:
   – StateLine: Set terminal X4/RFR to HIGH potential (reference: X4/24I).
   – HighLine: Set terminal X5/RFR to HIGH potential (reference: X5/24I).
6. Vary the motor speed with the keypad or by defining different fixed setpoints:

Keypad	Code	Subcode	Motor speed
	C00728	3	CCW rotation: -199.99 % .... 0 (of C00011) CW rotation: 0 .... +199.99 % (of C00011)
	C00051	-	Display of actual speed value

▶ Please observe:
   – the actual speed value: C00051

7. Save the settings with SAVE in the keypad.

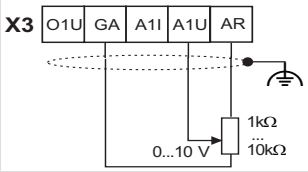
7.2.2 Terminal control

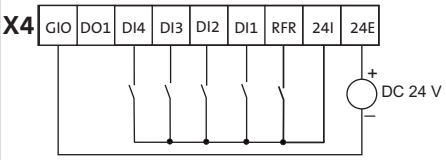
Step-by-step commissioning

1. Wiring of power terminals

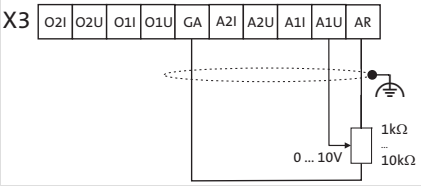
Make use of the Mounting Instructions supplied with the frequency inverter to wire the power terminals according to the requirements of your device.

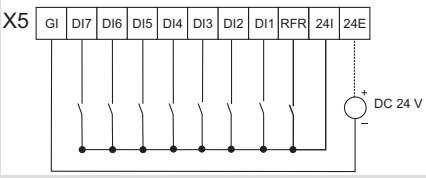
2. Wiring of control terminals.
   – StateLine

Analog inputs at X3	Assignment	Terminal control
	A1U	Setpoint selection 10 V (=100 %): 1500 min^{-1} (with 4-pole motor)

Wiring of the digital outputs at X4	Assignment	Terminal control
	RFR	• Controller enable: RFR = High • Reset error: High → Low (edge-controlled)
	DI1	Fixed frequency 1 ... fixed frequency 3, see table below
	DI2	
	DI3	DCB
DI1 ... DI4: all active = High	DI4	Direction of rotation left/right (CCW/CW)

   – HighLine

Analog inputs at X3	Assignment	Terminal control
	A1U	Setpoint selection 10 V (=100 %): 1500 min^{-1} (with 4-pole motor)

Wiring of the digital outputs at X5	Assignment	Terminal control
	RFR	• Controller enable: RFR = High • Reset error: High → Low (edge-controlled)

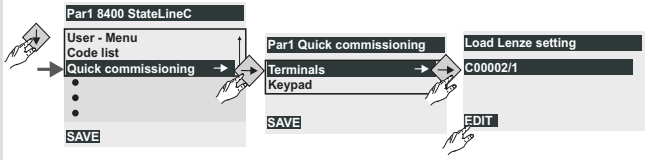
3. If you can be sure that the frequency inverter is in the default state (Lenze setting), you can skip the following step. If not, establish the Lenze setting of the frequency inverter. We recommend to use the keypad for this.

Note!

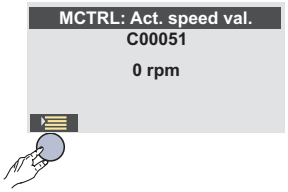
The application ”actuating drive speed” is implemented with the Lenze setting.

After attaching the keypad or switching on the controller with keypad attached, the connection between keypad and controller is established.
The connection has been established when the code C00051 appears in the display.

- Then press the left function key.



- Starting from "User menu" scroll down with button to "Quick commissioning" menu
- Click right button.
- Select "Keypad" menu.
- Click right button.
- Code 00002/1:
  – Parameterise with left "Edit" function key



- When the Lenze setting is loaded, the display goes off for a short time.
- When the display goes on again, the main menu appears.
  – The main menu settings can be defined by the user using codes C00465 ... C00469.
- Press the left function key to go to the "User menu".

4. Enable controller:
   – StateLine: Set terminal X4/RFR to HIGH potential (reference: X4/GIO).
   – HighLine: Set terminal X5/RFR to HIGH potential (reference: X5/GI).
5. Vary the motor speed with the potentiometer or by defining different fixed setpoints:

DI2	DI1	Motor speed
0	0	Setpoint by potentiometer
0	1	40 % of C00011 (reference speed)
1	0	60 % of C00011 (reference speed)
1	1	80 % of C00011 (reference speed)

► Please observe
   – the actual speed value: C00051
   – the front LEDs (📖 150)

6. Save the settings with SAVE in the keypad.

8 Braking operation

8.1 Braking operation without additional measures

Decelerating small masses

To decelerate small masses, the ”DC injection brake DCB” functions can be parameterised. DC-injection braking enables a quick deceleration of the drive to standstill without using an external brake resistor.

- Code C00036 can be used to select the braking current.
- The maximum braking torque to be realised by the DC braking current amounts to approx. 20 ... 30 % of the rated motor torque. It is lower compared to braking action in generator mode with external brake resistor.
- Automatic DC-injection braking (Auto-DCB) improves the starting performance of the motor when the operation mode without speed feedback is used.

Further information on the relevant parameters can be obtained from the software manual.

8.2 Braking operation with external brake resistor

To decelerate greater moments of inertia or with a longer operation in generator mode an external brake resistor is required. It converts braking energy into heat.

The brake resistor is connected if the DC-bus voltage exceeds the switching threshold. This prevents the controller from setting pulse inhibit through the ”Overvoltage” fault and the drive from coasting. The external brake resistor serves to control the braking process at any time.

The brake chopper integrated in the controller connects the external brake resistor.

► Adapt the switching threshold to the mains voltage (C00173/C00714, see software manual).

8.2.1 Operation at rated mains voltage 230 V

Switching threshold V_{BRmax}: 380 V, adjustable

Type	R_{Bmin} [Ω]	I_{BRmax} [A]	P_{BRmax} [kW]	I_{BRd} [A]	P_{Bd} [kW]	t_Z [s]	t_{on} [s]	t_{fp} [s]
E84AVxxx2512	180	2.1	0.8	1.6	0.6	-	∞	-
E84AVxxx3712	180	2.1	0.8	1.6	0.6	-	∞	-
E84AVxxx5512	100	3.8	1.4	2.8	1.1	-	∞	-
E84AVxxx7512	100	3.8	1.4	2.8	1.1	-	∞	-
E84AVxxx1122	33	11.5	4.4	8.6	3.3	-	∞	-
E84AVxxx1522	33	11.5	4.4	8.6	3.3	-	∞	-
E84AVxxx2222	33	11.5	4.4	8.6	3.3	-	∞	-

R_{Bmin}	Minimum brake resistance, nominal value ±10 %
I_{BRmax}	Peak current
P_{BRmax}	Peak braking power
I_{BRd}	Continuous current RMS - important for the dimensioning of the cables
P_{Bd}	Continuous braking power
t_Z	Cycle time, periodic load change with running time and recovery time
t_{on}	Running time
$t_Z - t_{on}$	Recovery time
t_{fp}	Maximum running time without initial load and compliance with the recovery time

8.2.2 Operation at rated mains voltage 400 V

Switching threshold V_{BRmax}: 725 V, adjustable

Type	R_{Bmin} [Ω]	I_{BRmax} [A]	P_{BRmax} [kW]	I_{BRd} [A]	P_{Bd} [kW]	t_Z [s]	t_{on} [s]	t_{fp} [s]
E84AVxxx3714	390	1.9	1.3	1.9	1.3	-	∞	-
E84AVxxx5514	390	1.9	1.3	1.9	1.3	-	∞	-
E84AVxxx7514	390	1.9	1.3	1.9	1.3	-	∞	-
E84AVxxx1124	180	4.0	2.9	4.0	2.9	-	∞	-
E84AVxxx1524	180	4.0	2.9	4.0	2.9	-	∞	-
E84AVxxx2224	150	4.8	3.5	4.8	3.5	-	∞	-
E84AVxxx3024	47	15.4	11.2	13.0	9.4	-	∞	-
E84AVxxx4024	47	15.4	11.2	13.0	9.4	-	∞	-
E84AVxxx5524	47	15.4	11.2	13.0	9.4	-	∞	-
E84AVxxx7524	27	26.9	19.5	26.9	19.5	-	∞	-
E84AVxxx1134	27	26.9	19.5	26.9	19.5	-	∞	-
E84AVxxx1534	18	40.3	29.2	40.3	29.2	-	∞	-

R_{Bmin}	Minimum brake resistance, nominal value ±10 %
I_{BRmax}	Peak current
P_{BRmax}	Peak braking power
I_{BRd}	Continuous current RMS - important for the dimensioning of the cables
P_{Bd}	Continuous braking power
t_Z	Cycle time, periodic load change with running time and recovery time
t_{on}	Running time
$t_Z - t_{on}$	Recovery time
t_{fp}	Maximum running time without initial load and compliance with the recovery time

8.2.3 Operation at rated mains voltage 500 V

Switching threshold V_{BRmax}: 790 V, adjustable

Type	R_{Bmin} [Ω]	I_{BRmax} [A]	P_{BRmax} [kW]	I_{BRd} [A]	P_{Bd} [kW]	t_Z [s]	t_{on} [s]	t_{fp} [s]
E84AVxxx3714	390	2.0	1.6	2.0	1.6	-	∞	-
E84AVxxx5514	390	2.0	1.6	2.0	1.6	-	∞	-
E84AVxxx7514	390	2.0	1.6	2.0	1.6	-	∞	-
E84AVxxx1124	180	4.4	3.5	4.4	3.5	-	∞	-
E84AVxxx1524	180	4.4	3.5	4.4	3.5	-	∞	-
E84AVxxx2224	150	5.3	4.2	5.3	4.2	-	∞	-
E84AVxxx3024	47	16.8	13.3	13.0	10.3	-	∞	-
E84AVxxx4024	47	16.8	13.3	13.0	10.3	-	∞	-
E84AVxxx5524	47	16.8	13.3	13.0	10.3	-	∞	-
E84AVxxx7524	27	29.3	23.1	29.3	23.1	-	∞	-
E84AVxxx1134	27	29.3	23.1	29.3	23.1	-	∞	-
E84AVxxx1534	18	43.9	34.7	43.9	34.7	-	∞	-

R_{Bmin}	Minimum brake resistance, nominal value ±10 %
I_{BRmax}	Peak current
P_{BRmax}	Peak braking power
I_{BRd}	Continuous current RMS - important for the dimensioning of the cables
P_{Bd}	Continuous braking power
t_Z	Cycle time, periodic load change with running time and recovery time
t_{on}	Running time
$t_Z - t_{on}$	Recovery time
t_{fp}	Maximum running time without initial load and compliance with the recovery time

8.2.4 Selection of the brake resistors

The recommended Lenze brake resistors are adapted to the corresponding controller (with regard to 150 % of regenerative power). They are suitable for most of the applications.

For special applications, e.g. centrifuges, the brake resistor must meet the following criteria:

Brake resistor	Application	
Criterion	With active load	With passive load
Continuous braking power [W]	$\geq P_{max} \cdot \eta_e \cdot \eta_m \cdot \frac{t_1}{t_{cycl}}$	$\geq \frac{P_{max} \cdot \eta_e \cdot \eta_m}{2} \cdot \frac{t_1}{t_{cycl}}$
Thermal capacity [Ws]	$\geq P_{max} \cdot \eta_e \cdot \eta_m \cdot t_1$	$\geq \frac{P_{max} \cdot \eta_e \cdot \eta_m}{2} \cdot t_1$
Resistor [Ω]	$R_{min} \leq R \leq \frac{U_{DC}^2}{P_{max} \cdot \eta_e \cdot \eta_m}$	

Active load	Can start to move independent of the drive (e.g. unwinder)
Passive load	Can stop independent of the drive (e.g. horizontal travelling drives, centrifuges, fans)
U_{DC} [V]	Brake chopper switching threshold from C0174
P_{max} [W]	Maximum occurring braking power determined by the application
η_e	Electrical efficiency (controller + motor) Guide value: 0.54 (0.25 kW) ... 0.85 (11 kW)
η_m	Mechanical efficiency (gearbox, machine)
t_1 [s]	Braking time
t_{cycl} [s]	Cycle time = time between two successive braking processes (= t1 + dead time)
R_{min} [Ω]	Minimum permissible brake resistance (see rated data of the integrated brake chopper)

8.2.5 Rating for Lenze brake resistors

To decelerate greater moments of inertia or with a longer operation in generator mode an external brake resistor is required. It converts braking energy into heat.

The brake resistors (IP20) recommended in the table are designed for a 1.5-fold regenerative power. The cycle time is 150 s and contains a maximum braking time of 15 s and a minimum recovery time (break) of 135 s.

- The brake resistors are equipped with a thermostat (potential-free NC contact, switching capacity: AC 250 V, 0.5 A).
- To increase the power, brake resistors can be connected in parallel or in series.
  - The resistance for the controller must not fall below the lowest permissible value.
  - The thermostat of several brake resistors at a controller must always be connected in series.

Product key		Rated data - brake resistor		
Controller	Brake resistor	Resistor R [Ω]	Continuous power P [W]	Thermal capacity WK [kWs]
E84AVxxx2512	ERBM180R050W	180	50	7.5
E84AVxxx3712				
E84AVxxx5512	ERBM100R100W	100	100	15
E84AVxxx7512				
E84AVxxx1122	ERBP033R200W	33	200	30
E84AVxxx1522	ERBP033R200W			
E84AVxxx2222	ERBP033R300W		300	45
E84AVxxx3714	ERBM390R100W	390	100	15
E84AVxxx5514	ERBM390R100W			
E84AVxxx7514				
E84AVxxx1124	ERBP180R200W	180	200	30
E84AVxxx1524	ERBP180R200W			
E84AVxxx2224	ERBP180R300W		300	45
E84AVxxx3024 E84AVxxx4024 E84AVxxx5524	ERBP047R200W	47	200	30
	ERBS047R400W		400	60
	ERBS047R800W		800	120
E84AVxxx7524 E84AVxxx1134	ERBP027R200W	27	200	30
	ERBS027R600W		600	90
	ERBS027R01K2		1200	180
E84AVxxx1534	ERBS018R800W	18	800	120
	ERBS018R01K4		1400	210
	ERBS018R02K8		2800	420
	ERBD020R03K0RB	20	3000	450

8.2.6 Wiring of brake resistor

Danger!

Hazardous electrical voltage

During operation of the standard device and **up to 3 minutes after power-off** hazardous electrical voltages may occur at the terminals of the brake resistor.

Possible consequences:

► Death or severe injuries when touching the terminals.

Protective measures:

► Disconnect the standard device from the mains before working on the brake resistor.

► Check all power terminals for isolation from supply.

► Select the mounting location so that the operating conditions mentioned in the mounting instructions for the brake resistor are permanently guaranteed.

Danger!

Hot surface

The brake resistor may get very hot. (For temperatures see the mounting instructions for the brake resistor.)

Possible consequences:

► Severe burns when touching the brake resistor.

► Fire or smouldering fire if flammable material is placed near the brake resistor or may get to it.

Protective measures:

► Before working on the brake resistor, check its surface temperature.

► Select the mounting location so that the operating conditions mentioned in the mounting instructions for the brake resistor are permanently guaranteed.

► Protect the mounting location through fire prevention.

Protect the brake resistor and controller against destruction caused by overload:

► Establish a safety shutdown using the thermostat of the brake resistor to disconnect the controller from the mains.

Connecting cable version

► up to 0.5 m: twisted and unshielded

► from 0.5 to 5 m: shielded

– Use shielded cables to meet the EMC requirements.

Wiring principle

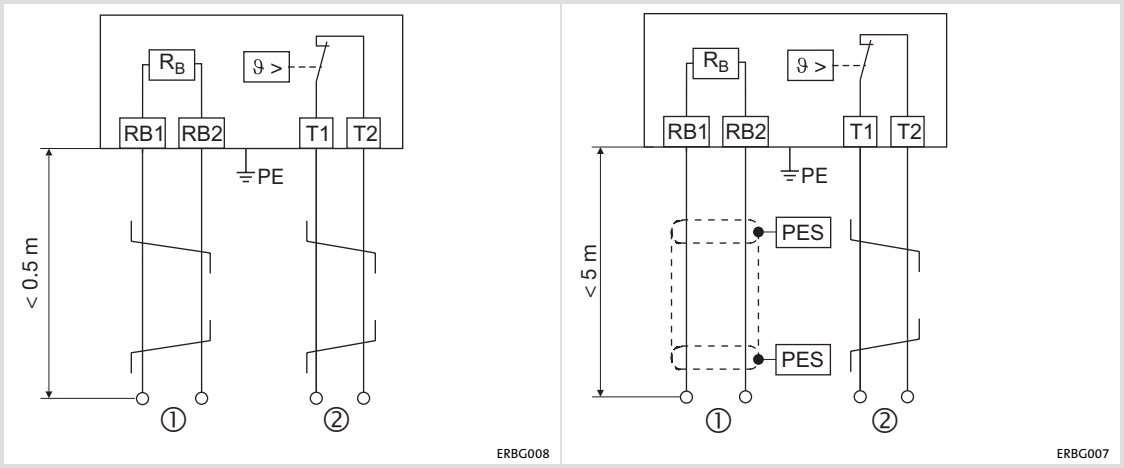


Fig. 8-1 Wiring of a brake resistor to the controller

PES	HF-shield termination by PE connection via shield clamp
Rb1, Rb2	Terminals of the brake resistor
①	Supply cable to the controller
T1, T2	Terminals temperature monitoring of the brake resistor (thermal contact/NC contact)
②	Supply cable for evaluation of temperature monitoring (to be integrated e.g. into the latch circuit of the mains contactor of the supply)

8.3 Operation with spring-applied brake

8.3.1 Introduction

Lenze three-phase AC motors and G-motion geared motors can be fitted with spring-applied brakes (motor holding brakes). An external motor brake control module is required for switching operation and for the DC supply of the spring-applied brakes.

The suitable motor brake control module is selected according to the rated data of the spring-applied brakes.

Controllers in the HighLine version offer an integrated control for brakes with 24 V connection and a braking current of up to 2.5 A.

Switching the brake

For controllers in the StateLine version the switching operation of the brake can be controlled:

- Via an external control contact (e.g. PLC)
- Via an external motor brake control module which is connected to one of the digital outputs of the controller. The digital output has to be parameterised accordingly.

For controllers in the HighLine version the switching operation of the brake can be controlled additionally:

- Via an integrated motor brake control module

The software manual contains further information on the parameterisation and the integrated brake management.

Stop!

The motor brake control includes an electronic switch which can control a 24 V motor holding brake.

The motor brake control may only be connected with motor holding brakes which correspond to the permissible data mentioned in the technical data. (If required, the holding brake without motor brake control must be controlled via a digital output and a coupling relay).

If the permissible data mentioned in the technical data are not complied with:

- the motor brake control can be destroyed.
- a safe operation of the motor holding brake cannot be guaranteed.

Further notes in the documentation of the basic device must be observed!

Stop!

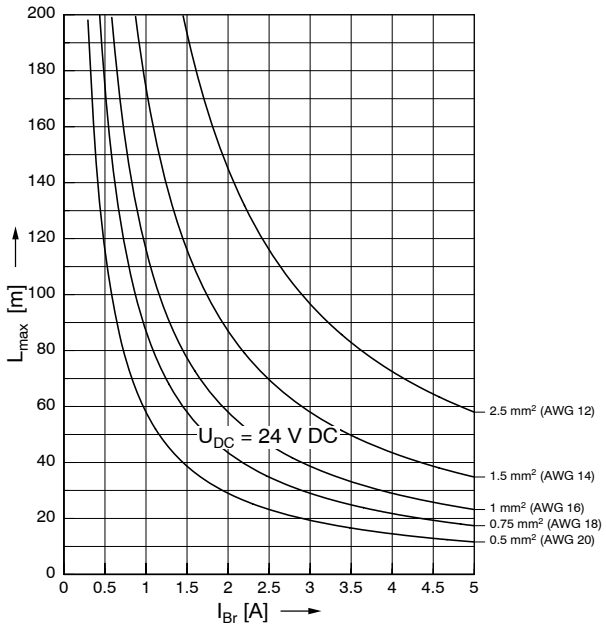
Requirements with regard to the brake cable (connection BD1/BD2):

- ► Brake cables must be shielded if they are incorporated in the motor cable.
  - – Operation with unshielded brake cables can destroy the motor brake control.
  - – We recommend the use of Lenze system cables (motor cable with separately shielded additional cores).
- ► In the case of a permanent magnet holding brake, observe the correct polarity of the brake cable.
  - – If the terminals are inverted, the brake does not release. As the motor is running against the closed brake, the brake can be destroyed.
- ► Apply the shield to PE on both sides.

Requirements with regard to the supply voltage U_{DC} (connection +/-):

- ► Always supply the motor brake control with a separate 24 V supply.
  - – A common supply of the motor brake control and the controller control card is not permissible, as otherwise the basic insulation between the two components is reduced.
- ► Set U_{DC} so that the operating voltage of the brake is within the permissible range and the maximum supply voltage of the motor brake control is not exceeded.

Cable lengths



E94AZHY004

L_{max} Maximum brake cable length in [m]
I_{BR} Brake current in [A]
U_{DC} Supply voltage of the motor brake control

8.3.2 Rated data

► E82ZWBRB brake switch

Range	Values	
Input voltage	1/N/PE AC 230 V (AC 180 ... 264 V), 45 ... 65 Hz 2/PE AC 230 V (AC 180 ... 264 V), 45 ... 65 Hz	
Input current	AC 0.1 ... 0.54 A	
Output voltage		
	DC 205 V	at AC 230 V mains voltage
Maximum brake current		
	DC 0.41 A	Installation in 8200 motec
	DC 0.54 A	Installation in control cabinet
Control input		
Control voltage	DC 24 V, PLC-level	
	HIGH LOW	DC +15 ... 30 V DC 0 ... +3 V
Control current	5 ... 10 mA	
Protective function	Protected against polarity reversal until DC 60 V	
Maximally connectable cable cross-section	1.5 mm^2 AWG 16	

► E82ZWBRE brake switch

Range	Values	
Input voltage	3/PE AC 400 V (AC 320 ... 550 V), 45 ... 65 Hz	
Input current	AC 0.1 ... 0.61 A	
Output voltage		
	DC 180 V	at AC 400 V mains voltage
	DC 225 V	at AC 500 V mains voltage
Maximum brake current		
	DC 0.47 A	Installation in 8200 motec
	DC 0.61 A	Installation in control cabinet
Control input		
Control voltage	DC 24 V, PLC-level	
	HIGH LOW	DC +15 ... 30 V DC 0 ... +3 V
Control current	5 ... 10 mA	
Protective function	Protected against polarity reversal until DC 60 V	
Min. permissible off time	t_{off} >20 ms	
Maximally connectable cable cross-section	1.5 mm^2	

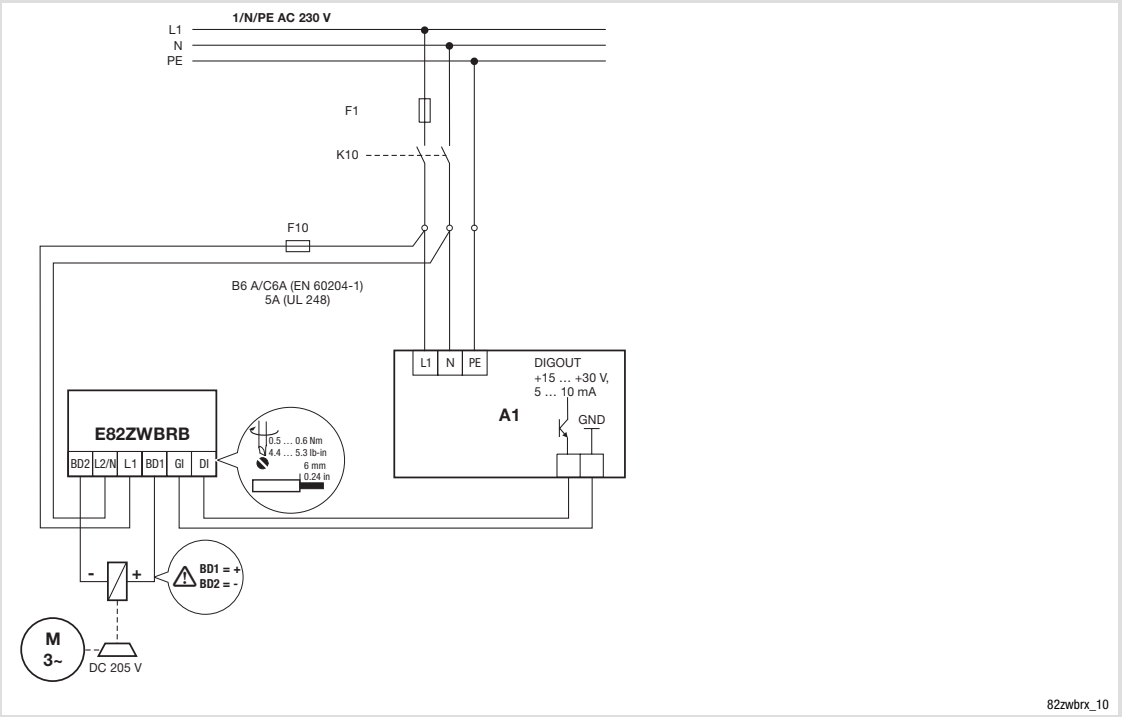
► Integrated brake control for devices in the HighLine version

Range	Values
Input voltage	DC 24 V in accordance with IEC 61131-2 19.2 ... 28.8 V
Input current	DC 0.1 ... 2.6 A
Output voltage	DC 24 V
Maximum brake current	DC 2.5 A
Internal control	Information on the internal control can be found in chapter 12.1 from the 8400 Inverter Drives HighLine C software manual.
Maximally connectable cable cross-section	1.5 mm^2 AWG 16

Further technical data regarding the brake control can be found in chapter 3.6.7.

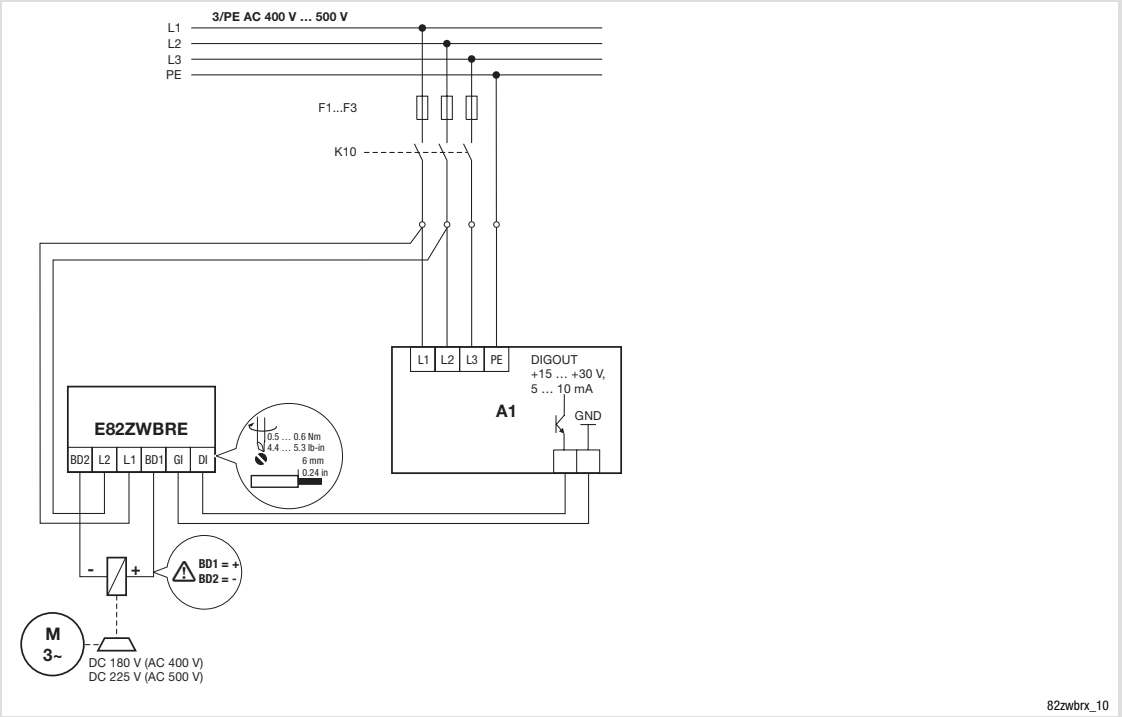
8.3.3 Wiring

► E82ZWBRB brake switch



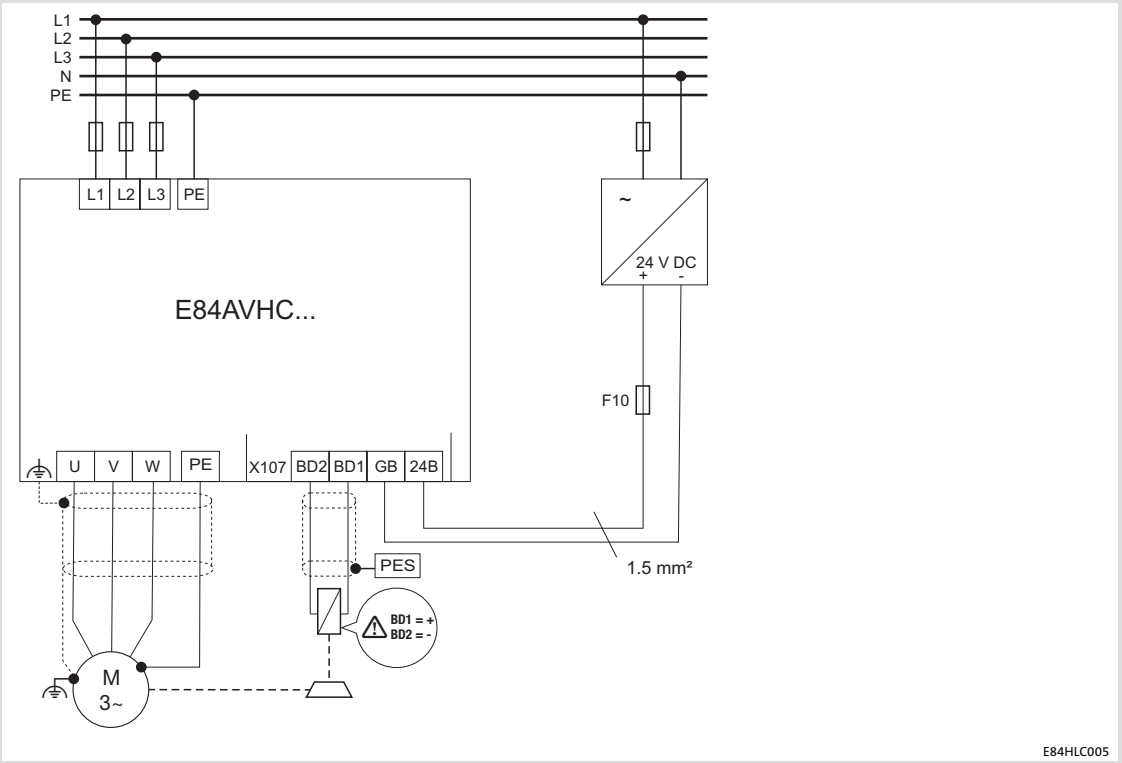
A1 Lenze controller with digital output
F10 Additional cable protection

► E82ZWBRE brake switch



A1 Lenze controller with digital output
F10 Additional cable protection

► Integrated brake control for devices in the HighLine version



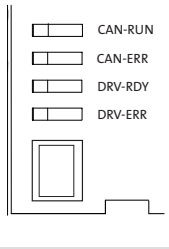
E84AVHC...	Controller in the HighLine version
F10	Cable protection in secondary circuit. **For dimensioning the fuse, observe the standards of the cable protection and the safety instructions for the installation according to UL or UR!**
PES	HF-shield termination by large surface connection to PE.

9 Diagnostics

9.1 Display of operating data, diagnostics

9.1.1 Status display via LEDs at the controller

During operation, the operating status of the controller is indicated by four light-emitting diodes.These are located at the front of the device. The upper two LEDs indicate the current status of the CAN bus connection and the lower two LEDs indicate the status of the controller.

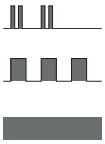
LED	Labelling	Colour	Description
	CAN-RUN	green	CAN-BUS o.k.
	CAN-ERR	red	CAN-BUS error
	DRV RDY	green	Controller is ready for operation
	DRV ERR	red	Error in the controller or through the application

Legend

The symbols used for indicating the LED states have the following meaning:

	LED flashes once approx. every 3 seconds (slow flash)
	LED flashes once approx. every 1.25 seconds (flash)
	LED flashes twice approx. every 1.25 seconds (double flash)
	LED blinks every second
	LED is permanently on

The LEDs ”DRIVE READY” and ”DRIVE ERROR” can blink in different ways depending on the device states which are explained in the following. This permits an easy device diagnostics without additional tools.

DRIVE READY (green)	DRIVE ERROR (red)	Status	Description
OFF	OFF	→ ”Init” state	**Initialisation is active**
	OFF	→ ”MotorIdent” state	**Motor data identification** – The ”MotorIdent” device state can only be reached by the ”SwitchON” device state and jumps back to that state after the action is completed.
	OFF	→ ”SafeTorqueOff” state	**This state is only possible in relation with a connected safety module and an existing power section supply!**
	OFF	→ ”ReadyToSwitchOn” state	**Device is ready to start** – This is the controller’s state directly after the initialisation has been completed.
	OFF	→ ”SwitchedOn” state	**Device is switched on** – This is the controller’s device state if the DC bus voltage is applied and the controller is still inhibited by the user (controller inhibit).
	OFF	→ ”OperationEnabled” state	**Operation** – In this device state, the motor follows the setpoint defined in the application.
		→ ”Warning” status display	**Operation/warning is active** – This display may occur in all device states if a monitoring mode responds the error response ”Warning” or ”Warning locked” has been parameterised for.
		→ ”TroubleQSP” state	**TroubleQSP is active** – This device state will be active as soon as a monitoring mode responds, the error response ”TroubleQSP” has been parameterised for.
OFF		→ ”Trouble” state	**Message is active** – This device state will be active as soon as a monitoring mode responds, the error response ”Message” has been parameterised for.
OFF		→ ”Fault” state	**Fault is active** – This device state will be active as soon as a monitoring mode responds, the error response ”Fault” has been parameterised for.
OFF		→ ”SystemFail” state	**System fault is active** – This device state will be active if a system fault occurs.

9.1.2 Drive diagnostics via keypad

Important operating parameters are measured by the controller. They can be displayed with the keypad or PC.

Some operating data can be calibrated to be displayed or selected directly with the unit of the process quantity (e.g. pressure, temperature, speed).

Note!

The calibration always affects all specified codes simultaneously.

Display of the controller status on the keypad

– If the keypad at the front of the controller is connected to the diagnostic interface X6, the area ① of the LCD displays the controller status via different symbols.

Icon	Meaning	Note
RDY	Controller is switched on.	→ "SwitchedON" state
RUN	Controller is enabled.	
STP	Application in the controller is stopped.	
QSP	Quick stop is active.	
CINH	Controller is inhibited.	The power outputs are inhibited.
OFF	Controller is ready to start	→ "ReadyToSwitchOn" state
Mmax	Speed controller 1 in the limitation	The drive is torque-controlled.
Imax	The set current limit is exceeded in motor or generator mode	
IMP	Pulse inhibit is active	The power outputs are inhibited.
!SFLT	System fault is active	
!FLT	Fault	→ "Fault" state
!TRB	Trouble	→ "Trouble" state
!TQSP	TroubleQSP	→ "TroubleQSP" state
WRN	Warning is active	→ "Warning" status display

Display parameters

The parameters listed in the following table serve to query current states and actual values of the controller for diagnostic purposes, e.g. by means of the keypad, via a bus system, or using the »Engineer« (when an online connection to the controller has been established)

– In the »Engineer« parameter list and in the keypad these parameters are classified in the **Diagnostics** category.
– A detailed description of these parameters can be found in the software manual for StateLine C and HighLine C.

Parameter	Display
C00183	Device state
C00168	Error number
C00051	Actual speed value
C00052	Motor voltage
C00054	Motor current
C00057/1	Maximum torque
C00057/2	Torque at maximum current
C00059	Motor - number of pole pairs
C00061	Heatsink temperature
C00062	Temp. inside the controller
C00063	Motor temperature
C00064	Device utilisation (I x t) over the last 180 seconds
C00065	Ext. 24-V voltage
C00066	Thermal motor load (I^2xt)
C00178	Time the controller was enabled (elapsed-time meter)
C00179	Time the mains was switched on (power-on time meter)

Identification data

The parameters listed in the following table which are classified in the »Engineer« parameter list and the keypad in the category **Identification → Controller** serve to display the identification data of the controller.

Parameter	Display
C00099	Firmware version
C00200	Firmware product type
C00201	Firmware compilation date
C00203/1 ... 9	HW product types
C00204/1 ... 9	HW serial numbers
C00205/1 ... 6	HW descriptions
C00206/1 ... 6	HW manufacturing data
C00208/1 ... 6	HW manufacturer
C00209/1 ... 6	HW countries of origin
C00210/1 ... 6	HW version

10 Safety engineering

10.1 Introduction

With increasing automation, protection of persons against hazardous movements is becoming more important. Functional safety describes the measures needed by means of electrical or electronic equipment to reduce or remove danger caused by failures.

During normal operation, safety equipment prevents people accessing hazardous areas. In certain operating modes, e.g. set-up mode, work needs to be carried out in hazardous areas. In these situations the machine operator must be protected by integrated drive and control measures.

Drive-based safety provides the conditions in the controls and drives to optimise the safety functions. Planning and installation expenditure is reduced. In comparison to the use of standard safety engineering, drive-based safety increases machine functionality and availability.

Drive-based safety with Inverter Drives 8400

The controllers of the 8400 series are available with drive-based safety ”safe torque off (STO)”.

Drive-based safety can be used for the protection of persons working on machines.

The drive function continues to be executed by the controller. The safety unit provides the safe inputs. When the safety function is activated the safety unit starts control functions according to EN 60204-1 directly in the controller for the case of an error.

10.2 Important notes

Application as directed

The controllers of the 8400 series that are equipped with drive-based safety must not be modified by the user. This concerns the unauthorised exchange or removal of the drive-based safety.

Danger!

Danger to life through improper installation

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

Possible consequences:

► Death or severe injuries

Protective measures:

► Safety engineering systems may only be installed and commissioned by qualified and skilled personnel.

► All control components (switches, relays, PLC, ...) and the control cabinet must comply with the requirements of ISO 13849-1 and ISO 138492. This includes i.a.:
  – Switches, relays in IP54 enclosure.
  – Control cabinet in IP54 enclosure.
  – Please refer to ISO 13849-1 and ISO 138492 for all further requirements.

► 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 there are no short circuits.
  – For further measures see ISO 138492.

► 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!

Danger!

When the “safe torque off” (STO) function is used, an ”emergency-off” according to EN 60204 is not possible without additional measures. There is no electrical isolation, no service switch or repair switch between motor and controller!

“Emergency-off” requires an electrical isolation, e.g. by a central mains contactor!

During operation

After the installation is completed, the operator must check the wiring of the safety function.

The functional test must be repeated at regular intervals. The time intervals to be selected depend on the application, the entire system and the corresponding risk analysis. The inspection interval should not exceed one year.

Residual hazards

In case of a short-circuit of two power transistors a residual movement of the motor of up to 180 °/number of pole pairs may occur! (Example: 4-pole motor ⇒ residual movement max. 180 °/2 = 90 °)

This residual movement must be considered in the risk analysis, e.g. safe torque off for main spindle drives.

10.2.1 Hazard and risk analysis

This documentation can only accentuate the need for a hazard analysis. The user of drive-based safety must concentrate on dealing with the standards and legal position:

Before putting a machine into circulation, the manufacturer of the machine must carry out a hazard analysis according to the Machinery Directive 98/37/EC to find out the hazards related to the application of the machine. To achieve a level of safety as high as possible the Machinery Directive contains three principles:

- Removing or minimising the hazards by the construction itself.
- Taking the protective measures required against hazards that cannot be removed.
- Documentation of the existing residual risks and training of the user regarding these risks.

The execution of the hazard analysis is specified in EN 1050, guidelines for risk assessment. The result of the hazard analysis determines the category of safety-based control modes according to EN ISO 13849-1 which the safety-oriented parts of the machine control must comply with.

10.2.2 Standards

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

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

10.3 Overview of sensors

Passive sensors

Passive sensors are two-channel switching elements with contacts. The connecting cables and the sensor function must be monitored.

The contacts must switch simultaneously (equivalently). Nevertheless, safety functions will be activated as soon as at least one channel is switched.

The switches must be wired according to the closed-circuit principle.

Examples of passive sensors:

- Door contact switch
- Emergency-off control units

Active sensors

Active sensors are units with two-channel semiconductor outputs (OSSD outputs). Drive-based safety integrated in this device series allows for test pulses < 1 ms to monitor the outputs and cables.

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

The outputs must switch simultaneously. Nevertheless, safety functions will be activated as soon as at least one channel is switched.

Examples of active sensors:

- Lightgrid
- Laser scanner
- Control

Sensor inputs

Deactivated sensors connected can give the impression of safety. This is why the deactivation of sensors by mere parameter setting is not permissible and not possible.

10.4 Operating mode

Danger!

If the request for the safety function is cancelled, the drive will restart automatically.

You must provide external measures which ensure that the drive only restarts after a confirmation (EN 60204).

The transmission of the pulse width modulation is safely switched (off) by the safety unit. After this, the power drivers do not generate a rotating field. The motor is safely switched to torqueless operation (STO).

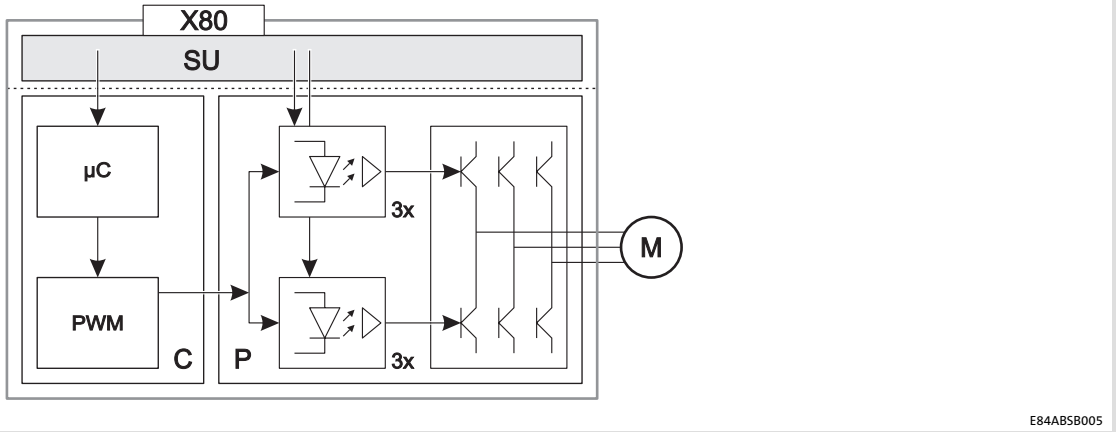


Fig. 10-1 Operating principle of safety unit

SU	Safety unit
X80	Control terminals of safety unit (pluggable terminal strip)
C	Control section
µC	Microcontroller
PWM	Pulse width modulation
P	Power section
M	Motor

Safety status

When the controller is disconnected from the safety unit, the ”safe torque off” (STO) status is set (C00137 bit 10 = 1).

Fail-safe status

When internal errors of the safety unit are detected, the motor is safely switched to torqueless operation (fail-safe status).

10.5 Technical data

Supply

The inputs and outputs are isolated and designed for a low-voltage supply through a safely separated power supply unit (SELV/PELV) of 24 V DC. P/N switching input signals and test pulses ≤ 1 ms are permissible.

Active sensors are directly wired to the X80 terminal strip.

Passive sensors are wired to the X80 terminal strip via a switching device. The switching device must comply with the required control category of the application.

There is no monitoring for short circuits.

Detailed features of the inputs and outputs of the safety unit

Terminal	Specification	[Unit]	min.	typ.	max.
SIA, SIB	Low signal	V	-3	0	5
	High signal	V	15	24	30
	Input capacitance at switch-off	nF		4	
	Input delay (tolerated test pulse)	ms			1
	Switch-off time (depending on the controller)	ms	2.5	4	
	Running time	ms		3	
SIA	Input current	mA		100	170
	Input capacitance at switch-on, reduced	µF		20	
SIB	Input current	mA		28	35
	Input capacitance at switch-on, reduced	µF		5	
GI	Ground for SIA/SIB				
24O, GO	Supply voltage through safely separated power supply unit (SELV/PELV)	V	18	24	30
DO	Low signal	V		0	0.8
	High signal	V	17	24	29
24O, GO, DO	Output current	A			0.7

Truth table

Inputs		Outputs	Description	Enable
SIA	SIB	DO1		
0	0	1	”Safe torque off” is activated	0
0	1	0		0
1	0	0		0
1	1	0	Drive is active	1

10.6 Electrical installation

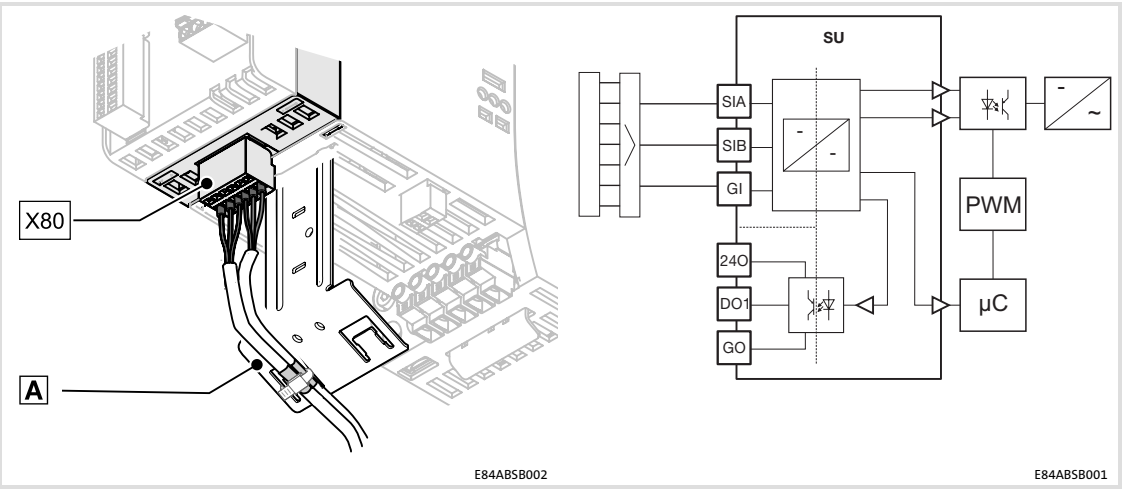
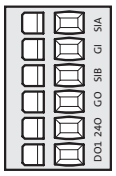


Fig. 10-2 Block diagram - safe torque off (STO)

SU	Safety unit
X80	Pluggable terminal strip for the safety unit
SIA, SIB, GI	Connections for shutdown paths
24O, DO1, GO	Feedback connections
µC	Microcontroller
PWM	Pulse width modulation
A	Shield sheet

Note!

For trouble-free operation of the safety unit, connect the supply cables to the shield sheet (strain relief).

X80	Marking	Description	Electrical data
	SIA	Input first shutdown path	SIA: I_{typ} = 100 mA
	GI	GND potential for SIA/SIB	LOW: -3 ... 5 V, HIGH: 15 ... 30 V
	SIB	Input second shutdown path	SIB: I_{typ} = 28 mA Supply through safely separated power supply unit (SELV/PELV)
	GO	GND potential feedback	24 V, max. 0.7 A short-circuit-proof LOW-active Supply through safely separated power supply unit (SELV/PELV)
	24O	24-V voltage supply feedback	
E84ABSB003	DO1	Non-safe signalling output: "Safe pulse inhibit"	

Terminal data				
	Conductor cross-section		Tightening torque	
	[mm²]	[AWG]	[Nm]	[lb-in]
Rigid	0.14 ... 1.5	26 ... 16	Spring terminal	
With wire end ferrule	0.25 ... 0.5	24 ... 20		

10.7 Certification

The certification of drive-based safety in the controllers of the 8400 series is based on the following test fundamentals:

- EN ISO 13849-1
- EN 60204-1
- EN 50178
- EN 61800-3
- IEC 61508, part 1-7
- EN 62061
- EN 61800-5-2

The function of the safety unit meets the requirements of the following standards:

- Category 4 and PL e according to EN ISO 13849-1
  - To comply with category 4, the external wiring and the cable monitoring must meet the requirements of category 4.
  - Ensure that short circuits cannot occur in the external wiring.
- SIL 3 according to IEC 61508
  - The safety unit does not contribute to the probability of failure on demand (PFD) and probability of failure per hour (PFH) of IEC 61508.

Tip!

The ”TÜV Rheinland Group” certificate is available on the Internet under:
http://www. Lenze.com

11 Accessories (overview)

Note!

More information on the accessories can be found in the catalog of this product series.

11.1 Overview

Coordinated accessories for 8400 L-force:

- Device modules - for different functional areas

  Communication
  – PROFIBUS E84AYCPM
  – EtherCAT E84AYCET

  Memory
  – MM100 E84AYM10x

- USB diagnostic adapter E94AZCUS
  – Connecting cables EWL007x
- Keypad EZAEBK0001
- Diagnosis terminal EZAEBK1001
- RFI filter E84AZESRxxxxxx
- Brake resistors ERBMxxxRxxxW/ERBPxxxRxxxW
- Prefabricated and pluggable system cables
- Motor holding brake control modules E82ZWBRx
- 24-V power supply units EZVxx00-00x
- Shield cable binders EZAMBKBM

11.2 Mains chokes

Assignment	
Type	**Mains choke**
E84AVxxx2512	ELN1-0900H005
E84AVxxx3712	
E84AVxxx5512	ELN1-0500H009
E84AVxxx7512	
E84AVxxx1522	ELN1-0250H018
E84AVxxx2222	
E84AVxxx5514	ELN3-1500H003-001
E84AVxxx7514	
E84AVxxx1524	ELN3-0680H006-001
E84AVxxx2224	
E84AVxxx3024	ELN3-02500H013-001
E84AVxxx4024	
E84AVxxx5524	
E84AVxxx7524	ELN3-0150H024-001
E84AVxxx1134	
E84AVxxx1534	ELN3-0088H035-001

11.3 RFI filters

Assignment			
	RFI filter		
Type	SD	LD	LL
E84AVxxx2512	E84AZESR3712SD	E84AZESR3712LD	E84AZESR3712LL
E84AVxxx3712	E84AZESR7512SD	E84AZESR7512LD	E84AZESR5512LL
E84AVxxx5512			
E84AVxxx7512			-
E84AVxxx1522	E84AZESR2222SD	E84AZESR2222LD	
E84AVxxx2222			
E84AVxxx5514	E84AZESR7514SD	E84AZESR7514LD	-
E84AVxxx7514			
E84AVxxx1524	E84AZESR2224SD	E84AZESR2224LD	
E84AVxxx2224			
E84AVxxx3024	E84AZESR5524SD	E84AZESR5524LD	-
E84AVxxx4024			
E84AVxxx5524			
E84AVxxx7524	-	E84AZESR1534LD	-
E84AVxxx1134			
E84AVxxx1534			

Basis of the data			
	Voltage	Voltage range	Frequency range
Mains	V_{LN} [V]	V_{LN} [V]	f [Hz]
1/PE AC	230	180 - 0 % ... 264 + 0 %	45 ... 65
3/PE AC	400/500	320 - 0 % ... 550 + 0 %	45 ... 65

	Voltage	Frequency	Current		Number of phases
			① max. +45 °C	① max. +55 °C	
Type	[V]	[Hz]	[A]	[A]	
E84AZESR3712	230	50/60	5.0	3.5	1
E84AZESR5512	230	50/60	6.0	4.5	1
E84AZESR7512	230	50/60	9.0	6.5	1
E84AZESR2222	230	50/60	22	16.5	1
E84AZESR7514	400	50/60	3.3	2.4	3
E84AZESR2224	400	50/60	7.3	5.4	3
E84AZESR5524	400	50/60	18	13.5	3
E84AZESR1534	400	50/60	29	21.8	3

① Temperature in the control cabinet

11.4 Sinusoidal filters

Controller	Sinusoidal filter	Voltage range	Switching frequency	Inductance	Mass
		U [V]	f_{ch} [kHz]	L [mH]	m [kg]
E84AVxxx2512	EZS3-004A200	0 ... 550 V AC	4 ... 8	11.0	4.0
E84AVxxx371x					
E84AVxxx5514					
E84AVxxx7514					
E84AVxxx1124					
E84AVxxx7512	EZS3-010A200	0 ... 550 V AC	4 ... 8	5.1	5.5
E84AVxxx1122					
E84AVxxx152x					
E84AVxxx2224					
E84AVxxx3024					
E84AVxxx2222	EZS3-017A200	0 ... 550 V AC	4 ... 8	3.1	8.5
E84AVxxx4024					
E84AVxxx5524					
E84AVxxx7524	EZS3-024A200	0 ... 550 V AC	4 ... 8	2.5	14.5
E84AVxxx1134	EZS3-032A200			2.0	19.0
E84AVxxx1534	EZS3-037A200			1.7	21.0

11.5 External brake resistors

Product key		Rated data - brake resistor		
Controller	Brake resistor	Resistor R [Ω]	Continuous power P [W]	Thermal capacity WK [kWs]
E84AVxxx2512	ERBM180R050W	180	50	7.5
E84AVxxx3712				
E84AVxxx5512	ERBM100R100W	100	100	15
E84AVxxx7512				
E84AVxxx1122	ERBP033R200W	33	200	30
E84AVxxx1522	ERBP033R200W			
E84AVxxx2222	ERBP033R300W		300	45
E84AVxxx3714	ERBM390R100W	390	100	15
E84AVxxx5514	ERBM390R100W			
E84AVxxx7514				
E84AVxxx1124	ERBP180R200W	180	200	30
E84AVxxx1524	ERBP180R200W			
E84AVxxx2224	ERBP180R300W		300	45
E84AVxxx3024 E84AVxxx4024 E84AVxxx5524	ERBP047R200W	47	200	30
	ERBS047R400W		400	60
	ERBS047R800W		800	120
E84AVxxx7524 E84AVxxx1134	ERBP027R200W	27	200	30
	ERBS027R600W		600	90
	ERBS027R01K2		1200	180
E84AVxxx1534	ERBS018R800W	18	800	120
	ERBS018R01K4		1400	210
	ERBS018R02K8		2800	420
	ERBD020R03K0RB	20	3000	450

11.6 Memory modules

Name: MM100

Type designation: E84AYM10x

Slot: MMI

The parameters of the controller are stored in the memory module.

The pluggable memory module provides a fast parameter set transfer to a controller identical in construction. Possible reasons for a parameter set transfer:

- Duplication of identical applications in a series of identical drives.
- Recovery of an application after device exchange.

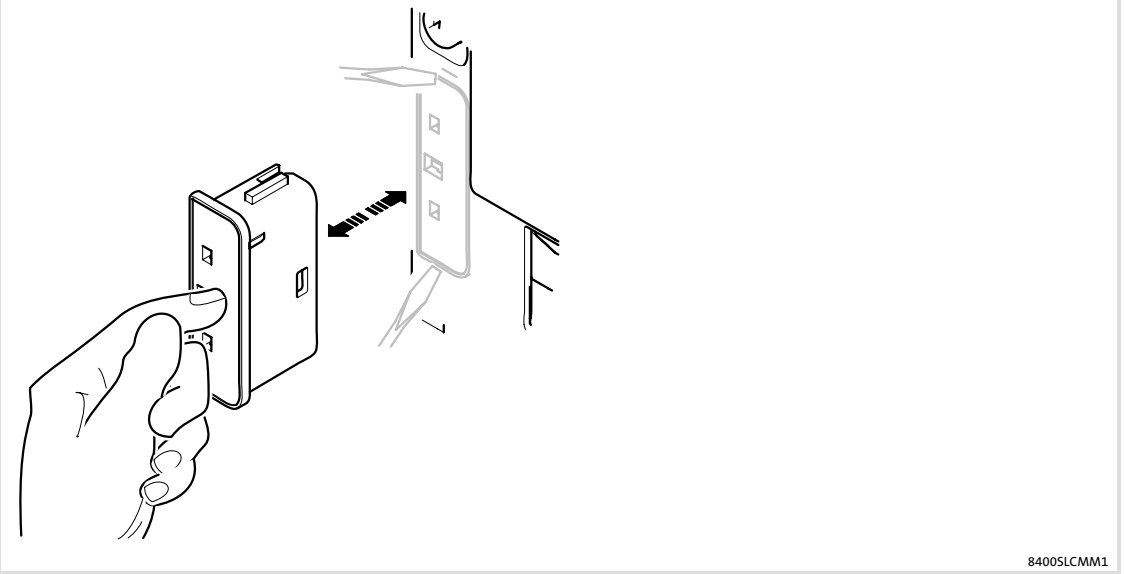
The required steps of a parameter set transfer are described in the software manual.

To remove the memory module, lever it out at the upper or lower groove using a suitable screwdriver. To plug it in, insert the memory module into the slot and pull it with light pressure to the end position.

Stop!

The device contains components that can be destroyed by electrostatic discharge!

Before working on the device, the personnel must ensure that they are free of electrostatic charge by using appropriate measures.



11.7 Communication modules

Name: PROFIBUS communication module

Type designation: E84AYCPM

Slot: MCI

The PROFIBUS communication module is a slave coupling module with the PROFIBUS-DP communication profile. It serves to network the control system and the controller with a high process speed.

Features

- 2 LEDs for status display of the communication
- Address can be set via DIP switch
- Electrical isolation from the bus
- Sub-D connection
- Suitable for Inverter Drives 8400 StateLine C and HighLine C

Name: EtherCAT communication module

Type designation: E84AYCET

Slot: MCI

The EtherCAT communication module is a real-time capable slave coupling module. It connects the controller with the EtherCAT communication system.

Features

- Node type: EtherCAT slave
- Connection for external voltage supply (24 VDC)
- 2 EtherCAT ports (IN/OUT)
  – Design: RJ45-socket according to IEC/EN 60603-7
- Electrical isolation from the bus
- 2 LEDs (EtherCAT IN/OUT) and 5 additional LEDs for communication status display
- Suitable for Inverter Drives 8400 StateLine C and HighLine C

11.8 Keypad

The X400 keypad allows you to easily carry out local parameter setting and diagnostics. The data can be quickly accessed via structured menus and a plain text display. The keypad is plugged into the X6 diagnostic interface at the front of the controller.

Keypad version

Type designation: EZAEBK100x

Slot: X6

Features

- Menu-driven diagnostics and parameter setting
- Backlighted graphic display for representing information
- 4 navigation keys, 2 context-sensitive keys
- Adjustable RUN/STOP function
- Hot-plug capable
- Suitable from 8400 StateLine
- Enclosure IP20

Diagnosis terminal version

Type designation: EZAEBK200x

Slot: X6

Features

- see keypad
- in a robust housing
- suitable for installation into the control cabinet door
- 2.5 m connecting cable, exchangeable
- Enclosure IP65 is possible for installation into the control cabinet

11.9 Power supply units

External power supply units are available for supplying the control electronic with an external 24-V supply, if required.

Advantages of an external supply: Parameter setting and diagnostics of the controller with a deenergised mains input.

	Mains		Secondary	
Type	V_{LN} [V]	I_{LN} [A]	V_{DC} [V]	I_{DC} [A]
EZV1200-000	230 (1/N/PE AC)	0.8	24 (22.5 ... 28.5)	5
EZV2400-000		1.2		10
EZV4800-000		2.3		20
EZV1200-001	400 (3/PE AC)	0.3		5
EZV2400-001		0.6		10
EZV4800-001		1.0		20

12 Appendix

12.1 Total index

T

V

W

Lenze Drives GmbH
Postfach 10 13 52
D-31763 Hameln
Germany

+49 (0)51 54 / 82-0

+49 (0)51 54 / 82-28 00

Lenze@Lenze.de

www.Lenze.com

Service Lenze Service GmbH
Breslauer Straße 3
D-32699 Extertal
Germany

00 80 00 / 24 4 68 77 (24 h helpline)

+49 (0)51 54 / 82-11 12

Service@Lenze.de

EDS84ASC552 ■ 13277975 ■ EN ■ 4.0 ■ TD36

10 9 8 7 6 5 4 3 2 1