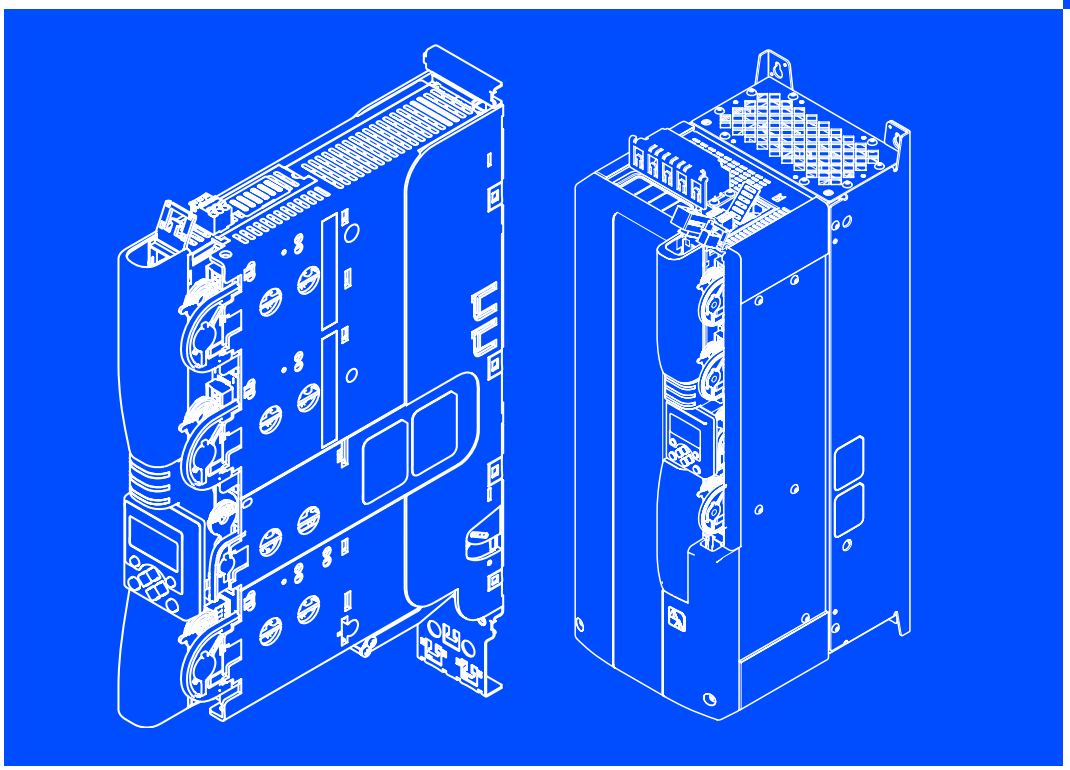
EDS94SPP101
13200339

L-force *Drives*

Hardware Manual

9400



E94A...

Servo Drives 9400

Lenze

EDS94SPP101
13200339

Hardware Manual

Servo Drives 9400

0.37 kW ... 400 kW

Lenze Drive Systems GmbH
Postfach 101352
31763 Hameln

1 Preface

Contents

1.1 The 9400 Servo Drives product range

The system

9400 Servo Drives range is the product family with the components required for an intelligent servo drive system in automation. The product range comprises

- servo drive controllers
- I/O components
- software
- accessories
- motors
- gearboxes
- DC-supply modules

Features

The 9400 Servo Drives feature

- compact design
- wide power range
- innovative installation concept
- intelligent technology functions
- high control precision
- scalable safety technology

1.2 About this Hardware Manual

1.2.1 Information provided by the Hardware Manual

Target group

This Hardware Manual is intended for all persons who install, commission, and adjust 9400 servo controllers.

Together with the catalog it forms the basis of project planning for the manufacturers of machines and plants.

Contents

This Hardware Manual is meant as an addition to the Mounting Instructions included in the scope of supply:

- The features and functions are described in detail.
- It provides detailed information on additional ranges of application.

How to find information

Each chapter forms a complete unit and informs you about an individual subject:

- You therefore only have to read the chapter containing the information you need.
- The Table of Contents and Index help you to find all information about a certain topic.
- Descriptions and data of other Lenze products (drive PLC, Lenze geared motors, Lenze motors, ...) can be found in the corresponding catalogs, Operating Instructions and Manuals. The required documentation can be ordered at your Lenze sales partner or downloaded as PDF file from the Internet.

Availability

This Hardware Manual is designed as a loose-leaf collection and available as a PDF file on the Internet. At the bottom of each page you can see the version and publication date.

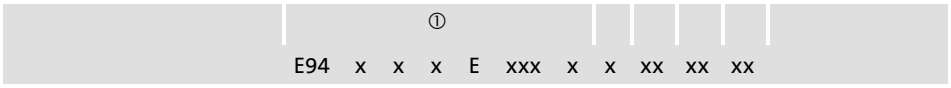
Tip!

Current documentation and software updates concerning Lenze products can be found on the Internet in the ”Services & Downloads” area under

http://www.Lenze.com

1.2.2 Products to which the Hardware Manual applies

Power modules



Type / product range

9400 Servo Drives

Generation

A = 1.
N = not relevant

Design

S = single-axis controller (Single Drive)
M = multi-axis controller (Multi Drive)
P = power supply module
B = brake chopper module

Version

S = StateLine
H = HighLine
T = TopLine
N = not relevant

Mechanical version

E = installation

Rated current (rounded)

e.g.
007 = 7 A
024 = 23.5 A
...

Voltage class

2 = 230 V ~ / 300 V =
4 = 400 V ~ / 540 V =

Safety module

A ... D

Memory module

11 ... 44

Extension module 1

xx

Extension module 2

xx

Extension modules

Type / product range

9400 Servo Drives

Generation

A = 1.
N = not relevant

Identification

Y = module

Module group

C = communication
I = I/O
F = feedback
M = memory
A = safety

Module identification

EP = Ethernet Powerlink

EN = Ethernet

PM = PROFIBUS MC

CA = CANopen

LF = LF-in/LF-out

1x = memory module 1xx

2x = memory module 2xx

3x = memory module 3xx

4x = memory module 4xx

x1 = memory module x with MC StateLevel licence

x2 = memory module x with MC HighLevel licence

x3 = memory module x with MC TopLevel licence

x4 = memory module x with PLC licence

A = safety module 0

B = safety module 100

D = safety module 300

Power-related accessories

①						
E94	A	Z	x	x	xxx	x

Type / product range
9400 Servo Drives

Generation

Identification
Z = accessories

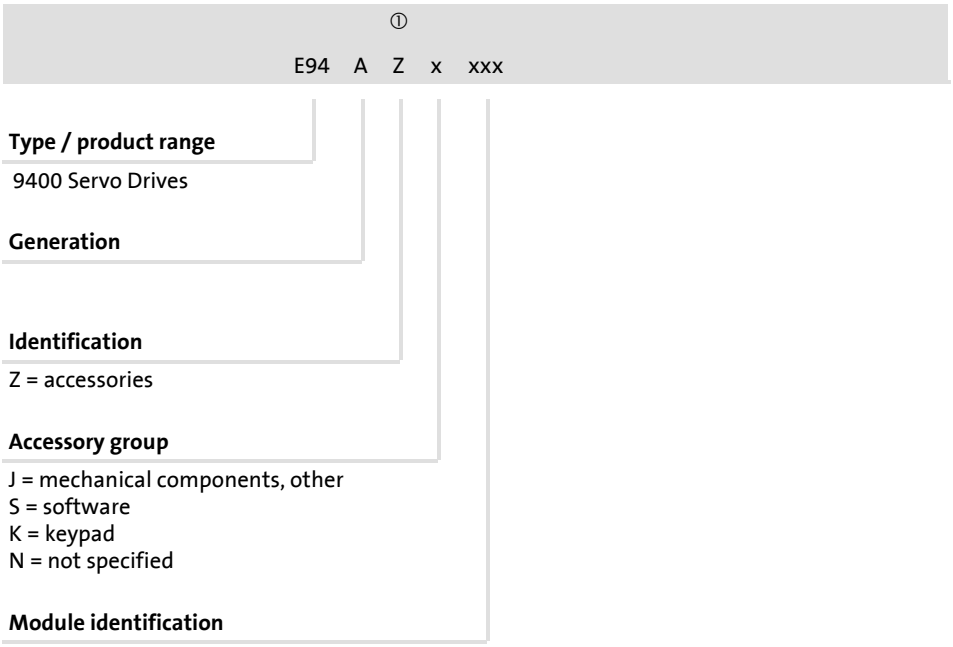
Component class 1
H = brake control
P = mounting backplane
M = mains filter
R = RFI filter

Component class 2
M = multiple axes
P = power supply module
R = regenerative module
S = single axis
X,Y = type
N = not specified

Rated current (rounded)
e.g.
008 = 8 A
024 = 23.5 A
...

Voltage class
1 = 24 V =
2 = 230 V ~ / 300 V =
4 = 400 V ~ / 540 V =

Power-independent accessories



1.3 Legal regulations

Labelling

Lenze drive controllers are clearly labelled and defined by the contents of the nameplate.

Manufacturer

Lenze Drive Systems GmbH, Postfach 101352, D-31763 Hameln

CE conformity

Complies with the ”Low voltage” EC Directive

Application as directed

The following applies to 9400 servo controllers and the accessories:

- ► They must only be operated under the operating conditions described in this Hardware Manual.
- ► They are components for open and closed loop control of control variable speed drives with asynchronous standard motors, asynchronous servo motors, PM synchronous servo motors.
- ► They are components for installation into a machine.
- ► They are components used for assembly together with other components to form a machine.
- ► They comply with the protection requirements of the ”Low Voltage” EC Directive.
- ► They are not machines for the purposes of the ”EC ”Machinery” Directive.
- ► They are not to be used as household appliances but for industrial purposes only.

The following applies to drives with 9400 servo controllers:

- ► They comply with the EC ”Electromagnetic Compatibility” Directive if they are installed according to the guidelines of CE-typical drive systems.
- ► They can be used for operation at public and non-public mains.
- ► They can be used in industrial premises as well as residential and commercial premises.
- ► The user is responsible for the compliance of his application with the EC Directives.

Any other use shall be deemed inappropriate!

Liability

The information, data, and notes in this Hardware Manual met the state of the art at the time of printing. Claims referring to drive systems which have already been supplied cannot be derived from the information, illustrations, and descriptions given in this Manual.

The specifications, processes, and circuitry described in this Hardware Manual are for guidance only and must be adapted to your own application. Lenze does not take any responsibility for the suitability of the process and circuit proposals.

The specifications in this Hardware Manual describe the product features without guaranteeing them.

Lenze does not accept any liability for damage and failures caused by:

- ► Disregarding the Hardware Manual
- ► Unauthorised modifications to the controller
- ► Operating errors
- ► Improper working on and with the controller

Warranty

See Terms of sale and delivery.

Warranty claims must be made to your Lenze representative immediately after detecting the deficiency or fault.

The warranty is void in all cases where liability claims cannot be made.

2 Guide

Contents

2.1 Glossary

2.1.1 Terminology and abbreviations used

🕮	Cross-reference to a chapter with the corresponding page number
AC	AC current or AC voltage
Axis, drive	Lenze controller combined with a motor or geared motor and other Lenze drive components
CE	Communauté Européene
Controller	Any frequency inverter, servo inverter, or DC speed controller
Cxxxxx/y	Subcode y of code Cxxxx (e.g. C0410/3 = subcode 3 of code C0410)
DC	DC current or DC voltage
DIN	Deutsches Institut für Normung
EMC	Electromagnetic compatibility
EN	European standard
f_{max} [Hz]	Maximum frequency
I_{aM} [A]	Maximum output current
I_{aN} [A]	Rated output current
IEC	International Electrotechnical Commission
I_{LN} [A]	Rated mains current
IP	International Protection Code
I_{PE} [mA]	Discharge current
L [mH]	Inductance
M_N [Nm]	Rated torque
NEMA	National Electrical Manufacturers Association
P_{DC} [kW]	Power on the DC voltage side
P_N [kW]	Rated motor power
P_V [W]	Inverter power loss
R [Ω]	Resistor
S_N [kVA]	Apparent output power of controller
U_{DC} [V]	DC voltage
UL	Underwriters Laboratories
U_{LN} [V]	Rated mains voltage

U_M [V]	Output voltage / voltage at the motor terminals
VDE	Verband deutscher Elektrotechniker
Xk/y	Terminal y on terminal strip Xk (e.g. X3/28 = terminal 28 on terminal strip X3)

2.2 Total index

3 Safety instructions

Contents

3.1 General safety and application instructions for Lenze controllers

(According to: Low-Voltage Directive 73/23/EEC)

General

Depending on their degree of protection, some parts of Lenze controllers (frequency inverters, servo inverters, DC 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.

All operations concerning transport, installation, and commissioning as well as maintenance must be carried out by qualified, skilled personnel (IEC 364 and CENELEC HD 384 or DIN VDE 0100 and IEC report 664 or DIN VDE 0110 and national regulations for the prevention of accidents must be observed).

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.

Application as directed

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

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

Commissioning (i.e. starting of operation as directed) is only allowed when there is compliance with the EMC Directive (89/336/EEC).

The controllers meet the requirements of the Low-Voltage Directive 73/23/EEC. The harmonised standard EN 61800-5-1 applies to the controllers.

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

Warning: The controllers are products which can be installed in drive systems of category C2 according to EN 61800-3. These products can cause radio interference 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.

Ensure proper handling and avoid mechanical stress. Do not bend any components and do not change any insulation distances during transport or handling. Do not touch any electronic components and contacts.

Controllers contain electrostatically sensitive components, 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, the valid national regulations for the prevention of accidents (e.g. VBG 4) must be observed.

Carry out the electrical installation in compliance with the corresponding regulations (e.g. cable cross-sections, fuses, PE connection). More detailed information is given in the corresponding documentation.

Notes about installation according to EMC regulations (shielding, earthing, filters and cable routing) are included in the documentation. These notes also apply to CE-marked controllers. The compliance with limit values required by the EMC legislation is the responsibility of the manufacturer of the machine or system. 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 should 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 protective conductor. If a residual current device (RCD) is used as a protective means in the case of direct or indirect contact, only a residual current device (RCD) of type B may be used on the current supply side of the controller. Otherwise, another protective measure, such as separation from the environment through double or reinforced insulation or disconnection from the mains by means of a transformer must be used.

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 controller can be adapted to your application. Please observe the corresponding information given in the documentation.

After a controller has been disconnected from the voltage supply, 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.

Note 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 Annex 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 conditions of operation are observed.

If the ambient air is polluted, the cooling surfaces of the controller may become dirty or the air vents of the controller may be obstructed. Therefore, clean the cooling surfaces and air vents periodically under these operating conditions. Do not use sharp or pointed tools for this purpose!

Waste 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!

3.2 General safety and application instructions for Lenze motors

(According to: Low-Voltage Directive 73/23/EEC)

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

Damages must be reported immediately upon receipt to the forwarder; 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 bolt 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 case of values ≤ 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!

3.3 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

- Plug on or pull off all pluggable terminals only in deenergised condition!
- Detach the controllers only in deenergised conditions from their installation backplanes or the back panel of the control cabinet!
- **Cyclic** switching on and off of the mains voltage can overload and destroy the input current limitation of the controller:
  - – Cyclic mains switching of 5-times in 5 minutes is permissible without restrictions.

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.

3.4 Definition of 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.

4 Single-axis controllers

Contents

4.1 Device features

- Space-saving installation by compact design
- Innovative installation concept
- Power range: 370 W to 400 kW
- Pluggable and uniform connection for control cables over the complete power range
- Direct AC mains connection for ”Single Drive” design
- DC busbar integrated or can be retrofit (for devices up to 24 A/11 kW)
- Direct connection of resolver or encoder feedback
  - Easy connection via predesigned system cable (accessories)
- Integrated phase controller for drift-free standstill
- Field-oriented control for asynchronous and synchronous motors
- Digital synchronisation system via bus system or digital frequency (extension module required)
- User configuration for control functions and input/output signals
  - Comprehensive library with function blocks
  - High flexibility with regard to the adaptation of the internal control structure to the drive task
- Extension interfaces for
  - Communication
  - Controller functionality
  - Safety engineering
- System bus (CANopen) for
  - servo inverter connection
  - input and output terminal extensions
  - connecting keypad and display units (HMI)

4.2 General data and operating conditions

General data

Conformity and approval			
Conformity			
CE	73/23/EEC	Low-Voltage Directive	
Approval			
UL	UL 508C	Power Conversion Equipment, 1D74, File No. 132659	

Protection of persons and devices			
Enclosure	EN 60529	IP 20	Not in the wire range of the terminals on the motor side
	NEMA 250	Protection against contact to type 1	
Insulation resistance	EN 61800-5-1	Overvoltage category III Reduction from 2000 m amsl onwards: 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: with restrictions, fault acknowledgement required Control connections: without restrictions	
Motor 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 regulations and safety instructions!
Cyclic mains switching		Cyclic mains switching of 5 times in 5 minutes is permissible without restrictions.	

Design			
Housing			
Carrier housing	Device sizes 1, 2 and 3	Glass-fiber reinforced plastic	
Carrier housing	Device sizes as of 6	Metal	
Dimensions		see "Mechanical installation"	
Weight		see "Mechanical installation"	

Mounting conditions			
Mounting place		In the control cabinet	
Mounting position		Vertical	
Mounting clearances			
Above/below		≥ 80 mm / ≥ 120 mm	Observe the device-related notes on mounting.
To the sides		Side-by-side mounting without any clearance	

”Single Drive” **supply conditions**		
AC-mains operation		Direct connection
DC-bus operation		Direct connection via terminals or busbars(can be retrofitted) For more information, please see the chapter DC-bus operation.
Power systems		
TT		Operation permitted without restrictions.
TN		
With grounded phase		Operation with additional measures permitted: ● Protection of persons according to EN 61800-5-1 requires the supplementary insulation of the control cables. ● Measures described for IT systems must be applied.
IT		Additional device-internal measure required
Motors	EN 60034	Only use motors suitable for inverter operation. Insulation resistance: max. û ≥1.5 kV, max. du/dt ≥5 kV/µs

Operating conditions

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) Current derating at +45 ... +55 °C: 2.5 %/°C
Site altitude		0 ... 4000 m amsl 1000 ... 4000 m amsl: current derating of 5 %/1000 m
Pollution	EN 61800-5-1	Pollution degree 2
Vibration resistance (9.81 m/s^2 = 1 g)		
Transport	IEC/EN 60721-3-2	2M2
	EN 61800-2	2 ... 9 Hz: amplitude 3.5 mm
		10 ... 200 Hz: acceleration resistant up to 10 m/s^2
		200 ... 500 Hz: acceleration resistant up to 15 m/s^2
Operation	Germanischer Lloyd	5 ... 13.2 Hz: amplitude ±1 mm 13.2 ... 100 Hz: acceleration resistant up to 0.7 g
	EN 50178	10 ... 57 Hz: amplitude 0.075 mm
		57 ... 150 Hz: acceleration resistant up to 10 m/s^2

General electrical data

Motor cable requirements		
Capacitance per unit length		
≤ 2.5 mm^2/AWG 14		$C_{Core/core}/C_{Core/shield}$ < 75/150 pF/m
≥ 4 mm^2/AWG 12		$C_{Core/core}/C_{Core/shield}$ < 150/300 pF/m
Electric strength		
	VDE 0250-1	U_0/U = 0.6/1.0 kV (U_0 = r.m.s. value of external conductor to PE, U = r.m.s. value of external conductor to external conductor)
	UL	U ≥ 600 V (U = r.m.s. value of external conductor to external conductor)

Maximum motor and feedback cable lengths in [m] (for shielded motor cable with rated mains voltage)			
Type	Device size	with encoder	without encoder
E94AMxE0024 E94AMxE0034 E94AMxE0044	1	50	50
E94ASxE0024 E94ASxE0034			
E94AMxE0074 ... E94AMxE0244	2 ... 3	100	100
E94ASxE0044 ... E94ASxE0244			
E94ASxE0324 ... E94ASxE1044	6 ... 7	100	100
E94ASxE1454 ... E94ASxE3664	8S ... 9	150	150
E94ASxE4604 ... E94ASxE6954	10	150	150
If EMC conditions must be met, the permissible cable lengths can be reduced.			

Tab. 4.2-1

	Max. shielded motor cable lengths for compliance with EMC protection requirement C1/C2		
Type	with RFI filter	with mains filter	without filter
E94ASxE0024 E94ASxE0034	E94AZRS0044 -/50 m	E94AZMS0034 25 m/50 m	-/10 m
E94ASxE0044 E94ASxE0074	E94AZRS0104 -/50 m	E94AZMS0094 25 m/100 m	-/10 m
E94ASxE0134 E94ASxE0174	E94AZRS0294 -/50 m	E94AZMS0184 25 m/100 m	-/10 m
E94ASxE0244		E94AZMS0314 25 m/100 m	-/10 m
E94ASxE0324 E94ASxE0474 E94ASxE0594	E94AZRS0544 50 m/100 m	-	-/50 m
E94ASxE0864 E94ASxE1044	E94AZRS0954 50 m/100 m	-	-/50 m
E94ASxE1454	-	-	-/150 m
E94ASxE1724 E94ASxE2024			
E94ASxE2454 E94ASxE2924 E94ASxE3664			
E94ASxE4604 E94ASxE5724 E94ASxE6354 E94ASxE6954			

Tab. 4.2-2

EMC limit value class for conducted noise emission in TN/TT systems:
C2 to EN 61800-3 corresponds to class A to EN 55011
C1 to EN 61800-3 corresponds to class B to EN 55011

EMC		
Operation on public supply systems	EN 61800-3	The controllers are designed for use in an industrial environment. Operation on public networks requires measures to be taken for limiting the expected emission of radio interferences.
Noise emission, in cables		
Design "Single Drive"	EN 61800-3	see Tab. 4.2-2 EMC protection requirements
Design "Multi Drive"		Depending on the filter at the central DC supply module.
Noise immunity (to 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 (1 kHz)
Interference (housing)	EN 61000-4-3	80 MHz ... 1000 MHz, 10 V/m 80 % AM (1 kHz)
Burst		
Power terminals and interfaces	EN 61000-4-4	2 kV/5 kHz
Signal interfaces	EN 61000-4-4	1 kV/5 kHz
Control connections	EN 61000-4-4	2 kV/5 kHz
Surge (surge voltage)		
Power terminals	EN 61000-4-5	1.2/50 µs, 1 kV phase/phase, 2 kV phase/PE

Protective insulation

Danger!

Operation of the controller on a phase earthed mains with a rated mains voltage of ≥ 400 V:

- ► The protection against accidental contact is not ensured without external measures.
- ► If protection against accidental contact acc. to EN 61800-5-1 is required for the control terminals of the controller and the terminals for the plugged-in device modules,
  - – an additional basic insulation must be available.
  - – the components to be connected must have the second basic insulation.

Danger!

Dangerous electrical voltage

When one common voltage source is used for control voltages in separate potential areas, the protective insulation between the separate potential areas is deactivated.

Possible consequences:

- ► The specified protective insulations are not complied with.

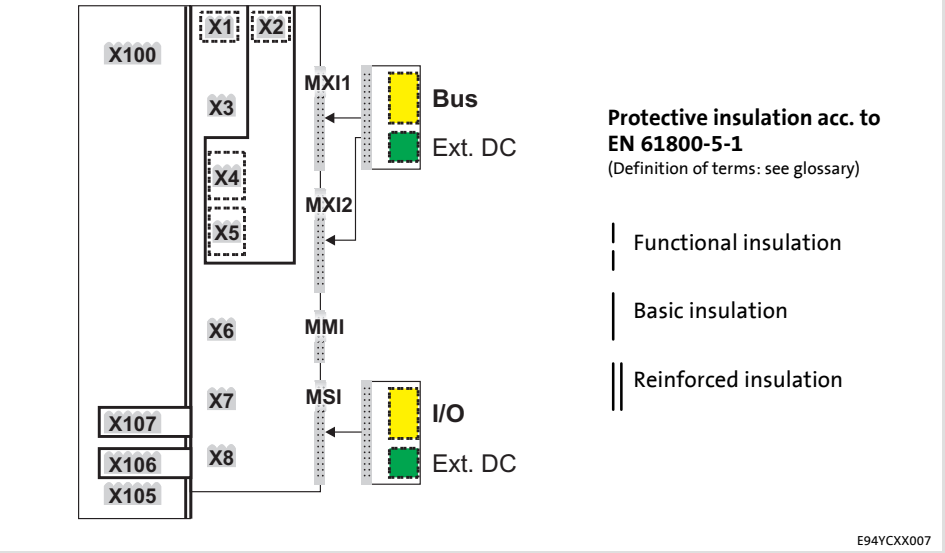
Protective measures:

- ► Use independent voltage sources.

The protective insulation of the 9400 Servo Drives controllers complies with EN 61800-5-1.

The following illustration

- ► shows the arrangement of the terminal strips and the separate potential areas of the controller.
- ► serves to determine the decisive protective insulation between two terminals located in different separate potential areas.



Terminal strip	Terminal	Terminal strip	Terminal
X100	• L1, L2, L3 • +UG, -UG	X1	CAN on board 9400
		X2	• State bus • 24 V (ext.)
X105	• U, V, W • Rb1, Rb2	X3	Analog input / output
X106	Motor PTC	X4	Digital output
X107	Control of motor holding brake	X5	Digital input
		X6	Diagnostics
		X7	Resolver
		X8	Encoder
		MXI1, MXI2	Extension module
		MMI	Memory module
		MSI	Safety module

Example

Which type of protective insulation is used between the bus terminal of the device module in slot MXI1 or MXI2 and the mains terminal X100?

The separate potential area with the better protective insulation is decisive.

- ► The separate potential area of the device module bus terminal is ”functionally insulated”.
- ► The separate potential area of the mains terminal has a ”reinforced insulation”.

Result: The insulation between the mains terminal X100 and the bus terminal is of the ”reinforced insulation” type.

4.3 Rated data (devices for 400/500V mains)

The E94ASxExxx**4** devices can be used in the voltage range of 180 V ... 550 V AC.

Note!
To ensure a faultless operation of the devices the code C00173 must be set according to the mains voltage connected.

4.3.1 Overview

Input data

Type	Voltage [V]	Frequency [Hz]	Current [A] max. +45 °C ①	Current [A] max. +55 °C ①	Number of phases
E94ASxE0024	230/400/500	50/60	2.1/2.1/1.8	1.6/1.6/1.4	3
E94ASxE0034	230/400/500	50/60	3.5/3.5/3.1	2.6/2.6/2.3	3
E94ASxE0044	230/400/500	50/60	5.5/5.5/4.8	4.1/4.1/3.6	3
E94ASxE0074	230/400/500	50/60	9.9/9.9/8.6	7.4/7.4/6.5	3
E94ASxE0134	230/400/500	50/60	16.8/16.8/14.7	12.6/12.6/11.0	3
E94ASxE0174	230/400/500	50/60	21/21/18.3	15.8/15.8/13.8	3
E94ASxE0244	230/400/500	50/60	29/29/25.4	21.8/21.8/19.1	3
E94ASxE0324	230/400/500	50/60	29/29/26	22/22/20	3
E94ASxE0474	230/400/500	50/60	43/43/39	32/32/29	3
E94ASxE0594	230/400/500	50/60	47/47/41	35/35/31	3
E94ASxE0864	230/400/500	50/60	79/79/70	59/59/52	3
E94ASxE1044	230/400/500	50/60	95/95/84	71/71/63	3
E94ASxE1454	400/500	50/60	140/140	126/126	3
E94ASxE1724	400/500	50/60	166/166	149/149	3
E94ASxE2024	400/500	50/60	195/195	176/176	3
E94ASxE2454	400/500	50/60	237/237	213/213	3
E94ASxE2924	400/500	50/60	280/280	252/252	3
E94ASxE3664	400/500	50/60	354/354	319/319	3
E94ASxE4604	400/500	50/60	444/444	400/400	3
E94ASxE5724	400/500	50/60	553/553	498/498	3
E94ASxE6354	400/500	50/60	614/614	553/553	3
E94ASxE6954	400/500	50/60	672/672	605/605	3

① Temperature in the control cabinet

Output data

Type	Voltage [V]	Frequency [1] [Hz]	Current [A] max. +45 °C ①	Current [A] max. +55 °C ①	Number of phases
E94ASxE0024	0 - 230/400/500	0 - 599	1.5/1.5/1.3	1.1/1.1/1.0	3
E94ASxE0034	0 - 230/400/500	0 - 599	2.5/2.5/2.2	1.9/1.9/1.7	3
E94ASxE0044	0 - 230/400/500	0 - 599	4/4/3.5	3/3/2.6	3
E94ASxE0074	0 - 230/400/500	0 - 599	7/7/6.1	5.3/5.3/4.6	3
E94ASxE0134	0 - 230/400/500	0 - 599	13/13/11.4	9.8/9.8/8.6	3
E94ASxE0174	0 - 230/400/500	0 - 599	16.5/16.5/14.4	12.4/12.4/10.8	3
E94ASxE0244	0 - 230/400/500	0 - 599	23.5/23.5/20.6	17.6/17.6/15.5	3
E94ASxE0324	0 - 230/400/500	0 - 599	32/32/28	24/24/21	3
E94ASxE0474	0 - 230/400/500	0 - 599	47/47/41.1	35.3/35.3/30.8	3
E94ASxE0594	0 - 230/400/500	0 - 599	59/59/51.6	44.3/44.3/38.7	3
E94ASxE0864	0 - 230/400/500	0 - 599	86/86/75.3	64.5/64.5/56.4	3
E94ASxE1044	0 - 230/400/500	0 - 599	104/104/91	78/78/68.3	3
E94ASxE1454	0 - 400/500	0 - 599	145/145	131/131	3
E94ASxE1724	0 - 400/500	0 - 599	172/172	155/155	3
E94ASxE2024	0 - 400/500	0 - 599	202/202	182/182	3
E94ASxE2454	0 - 400/500	0 - 599	245/245	221/221	3
E94ASxE2924	0 - 400/500	0 - 599	292/292	263/263	3
E94ASxE3664	0 - 400/500	0 - 599	366/366	329/329	3
E94ASxE4604	0 - 400/500	0 - 480	460/460	414/414	3
E94ASxE5724	0 - 400/500	0 - 480	572/572	515/515	3
E94ASxE6304	0 - 400/500	0 - 480	635/635	572/572	3
E94ASxE6954	0 - 400/500	0 - 480	695/695	626/626	3

① Temperature in the control cabinet
1) The output frequency is limited to 1/8 of the selected chopper frequency (see C00018).

Power losses

Type	Power loss P_V [W]	
	when operating with rated output current I_{aN}	when controller is inhibited
E94ASxE0024	110	40
E94ASxE0034	130	
E94ASxE0044	160	
E94ASxE0074	210	
E94ASxE0134	320	
E94ASxE0174	380	
E94ASxE0244	500	
E94ASxE0324	750	75
E94ASxE0474	1050	
E94ASxE0594	1122	
E94ASxE0864	1500	100
E94ASxE1044	1800	
E94ASxE1454	2120	50
E94ASxE1724	2200	50
E94ASxE2024	2600	50
E94ASxE2454	3300	50
E94ASxE2924	4100	50
E94ASxE3664	4900	50
E94ASxE4604	9200	100
E94ASxE5724	11300	100
E94ASxE6354	12500	100
E94ASxE6954	14700	100

4.3.2 Operation at rated mains voltage 230 V

Device size 1 ... 6

Basis of the data			
Mains	Voltage U_{LN} [V]	Voltage range U_{LN} [V]	Frequency range f [Hz]
3/PE AC	230	180 - 0 % ... 264 + 0 %	45 - 0 % ... 65 + 0 %
2/PE DC	325	260 - 0 % ... 370 + 0 %	-

	Mains current at I_{aN}		Output power	Motor power (typical)	
	with external mains choke	without external mains choke	U, V, W	4-pole ASM	
Type	I_{LN} [A]	I_{LN} [A]	S_{aN} [kVA]	P_{aN} [kW]	P_{aN} [hp]
E94ASxE0024	1.5	2.1	0.5	0.18	0.25
E94ASxE0034	2.5	3.5	0.9	0.37	0.5
E94ASxE0044	3.9	5.5	1.4	0.75	1
E94ASxE0074	7.0	9.9	2.5	1.5	2
E94ASxE0134	12.0	16.8	4.7	3	4
E94ASxE0174	15.0	21.0	5.9	4	5.5
E94ASxE0244	20.5	29.0	8.4	5.5	7.5
E94ASxE0324	-	29.0	11.5	7.5	10
E94ASxE0474	-	43.0	16.9	11	15
E94ASxE0594	-	54.0	21.2	15	20

Device size 7

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

	Mains current at I_{aN}		Output power	Motor power (typical)	
	with external mains choke	without external mains choke	U, V, W	4-pole ASM	
Type	I_{LN} [A]	I_{LN} [A]	S_{aN} [kVA]	P_{aN} [kW]	P_{aN} [hp]
E94ASxE0864	-	79.0	30.8	22	29
E94ASxE1044	-	95.0	37.3	30	40

	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}
E94ASxE0024	1.9 3)	6.0	1.9 3)	6.0	**1.5**	4.8	1.1
E94ASxE0034	3.1 3)	10.0	3.1 3)	10.0	**2.5**	8.0	1.9
E94ASxE0044	5.0 3)	16.0	5.0 3)	16.0	**4.0**	12.8	3.0
E94ASxE0074	8.8 3)	21.0	8.8 3)	21.0	**7.0**	16.8	5.3
E94ASxE0134	16.3 3)	39.0	16.3 3)	39.0	**13.0**	31.2	9.8
E94ASxE0174	20.6 3)	49.5	20.6 3)	49.5	**16.5**	39.6	12.4
E94ASxE0244	29.4 3)	58.8	29.4 3)	58.8	**23.5**	47.0	17.6
E94ASxE0324	38.4	76.8	38.4	76.8	**32.0**	70.4	19.2
E94ASxE0474	47.0	94.0	**47.0**	94.0	41.0	82.0	28.2
E94ASxE0594	59.0	118	**59.0**	118	41.0	82.0	35.4
E94ASxE0864	86.0	172	**86.0**	172	73.0	146	48.6
E94ASxE1044	104	208	**104**	208	78.0	156	62.4

I_{aN2}	Rated value of permanent output current at a frequency of ≥ 0 Hz
I_{aM2}	Maximum output current (overload current) ● Periodic load change of 0.5 s with I_{aM2} and recovery time of 4.5 s with 75 % I_{aN2}
I_{aN4}, I_{aN8}, I_{aN16}	Rated value of permanent output current at a frequency of ≥ 5 Hz (reduce to 0.66 * I_{aNx} for 0 ... 5 Hz)
I_{aM4}, I_{aM8}	Maximum output current (overload current) ● Periodic load change of 0.5 s with I_{aMx} and recovery time of 4.5 s with 75 % I_{aNx} ● Can be achieved using the setting "x kHz fixed" in C00018
bold	Nominal value I_{aN}
3)	Operation with permanent currents > I_{aN8} requires an external mains choke.

Rated values for internal brake chopper

Type	Switching threshold (adjustable) U_{BRmax} [V]	Minimum brake resistor R_{Bmin} [Ω]	Peak current I_{BRmax} [A]	Peak braking power P_{BRmax} [kW]	Continuous current RMS I_{BRd} [A]	Continuous braking power P_{Bd} [kW]
E94ASxE0024	390	47	8.3	3.2	3.7	0.64
E94ASxE0034	390	47	8.3	3.2	3.7	0.64
E94ASxE0044	390	27	14.4	5.6	5.9	0.95
E94ASxE0074	390	27	14.4	5.6	6.9	1.3
E94ASxE0134	390	18	21.7	8.5	10.6	2.0
E94ASxE0174	390	9	43.3	16.9	20.3	3.7
E94ASxE0244	390	9	43.3	16.9	24.5	5.4
E94ASxE0324	390	9	43.3	16.9	28.5	7.3
E94ASxE0474	390	7.5	52.0	20.3	37.9	10.8
E94ASxE0594	390	7.5	52.0	20.3	44.2	14.7
E94ASxE0864	390	3.8	102.6	40.0	75.5	21.6
E94ASxE1044	390	3.8	102.6	40.0	83.5	26.4

I_{BRmax}, P_{BRmax}	Periodic load change of 0.5 s and recovery time of 4.5 s
R_{Bmin}	Nominal value, ±10 %
Permanent current, r.m.s.	R.m.s. value - important for cable dimensioning

4.3.3 Operation at rated mains voltage 400 V

Device size 1 ... 6

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 %
2/PE DC	565	455 - 0 % ... 620 + 0 %	-

	Mains current at I_{aN}		Output power	Motor power (typical)	
	with external mains choke	without external mains choke	U, V, W	4-pole ASM	
Type	I_{LN} [A]	I_{LN} [A]	S_{aN} [kVA]	P_{aN} [kW]	P_{aN} [hp]
E94ASxE0024	1.5	2.1	0.9	0.37	0.5
E94ASxE0034	2.5	3.5	1.6	0.75	1
E94ASxE0044	3.9	5.5	2.5	1.5	2
E94ASxE0074	7.0	9.9	4.4	3	4
E94ASxE0134	12.0	16.8	8.1	5.5	7.5
E94ASxE0174	15.0	21.0	10.3	7.5	11
E94ASxE0244	20.5	29.0	14.7	11	15
E94ASxE0324	-	29.0	20.0	15	20
E94ASxE0474	-	43.0	29.3	22	29
E94ASxE0594	-	54.0	36.8	30	40

Device size 7

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 (typical)	
	with external mains choke	without external mains choke	U, V, W	4-pole ASM	
Type	I_{LN} [A]	I_{LN} [A]	S_{aN} [kVA]	P_{aN} [kW]	P_{aN} [hp]
E94ASxE0864	-	79.0	53.6	45	60
E94ASxE1044	-	95.0	64.8	55	73

Device size 8S ... 10

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 %	48 - 0 % ... 65 + 0 %

	Mains current at I_{aN}		Output power	Motor power (typical)	
	with external mains choke	without external mains choke	U, V, W	4-pole ASM	
Type	I_{LN} [A]	I_{LN} [A]	S_{aN} [kVA]	P_{aN} [kW]	P_{aN} [hp]
E94ASxE1454	-	140	90	75	100
E94ASxE1724	-	166	107	90	125
E94ASxE2024	-	195	126	105	140
E94ASxE2454	-	237	153	130	170
E94ASxE2924	-	280	182	150	205
E94ASxE3664	-	354	228	190	255
E94ASxE4604	-	444	287	240	320
E94ASxE5724	-	553	357	300	400
E94ASxE6354	-	614	396	335	445
E94ASxE6954	-	672	433	370	495

	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}
E94ASxE0024	1.9 3)	6.0	1.9 3)	6.0	**1.5**	4.8	1.1
E94ASxE0034	3.1 3)	10.0	3.1 3)	10.0	**2.5**	8.0	1.9
E94ASxE0044	5.0 3)	16.0	5.0 3)	16.0	**4.0**	12.8	3.0
E94ASxE0074	8.8 3)	21.0	8.8 3)	21.0	**7.0**	16.8	5.3
E94ASxE0134	16.3 3)	39.0	16.3 3)	39.0	**13.0**	31.2	9.8
E94ASxE0174	20.6 3)	49.5	20.6 3)	49.5	**16.5**	39.6	12.4
E94ASxE0244	29.4 3)	58.8	29.4 3)	58.8	**23.5**	47.0	17.6
E94ASxE0324	38.4	76.8	38.4	76.8	**32.0**	70.4	19.2
E94ASxE0474	47.0	94.0	**47.0**	94.0	41.0	82.0	24.6
E94ASxE0594	59.0	118	**59.0**	118	41.0	82.0	24.6
E94ASxE0864	86.0	172	**86.0**	172	73.0	146	43.8
E94ASxE1044	104	208	**104**	208	78.0	156	46.8
E94ASxE1454	145	261	**145**	261	102	184	-
E94ASxE1724	172	310	**172**	310	120	216	-
E94ASxE2024	202	364	**202**	364	131	236	-
E94ASxE2454	**245**	441	209	376	160	288	-
E94ASxE2924	**292**	526	250	450	191	344	-
E94ASxE3664	**366**	659	313	563	240	432	-
E94ASxE4604	**460**	828	368	662	260	468	-
E94ASxE5724	**572**	1030	458	824	286	515	-
E94ASxE6354	**635**	1143	508	914	318	572	-
E94ASxE6954	**695**	1251	556	1001	348	626	-

I_{aN2} Rated value of permanent output current at a frequency of ≥ 0 Hz

I_{aM2} Maximum output current (overload current)
- Periodic load change of 0.5 s with I_{aM2} and recovery time of 4.5 s with 75 % I_{aN2}

I_{aN4}, I_{aN8}, I_{aN16} Rated value of permanent output current at a frequency of ≥ 5 Hz
(reduce to 0.66 * I_{aNx} for 0 ... 5 Hz)

I_{aM4}, I_{aM8} Maximum output current (overload current)
- Periodic load change of 0.5 s with I_{aMx} and recovery time of 4.5 s with 75 % I_{aNx}
- Can be achieved using the setting "x kHz fixed" in C00018

bold Nominal value I_{aN}

3) Operation with permanent currents > I_{aN8} requires an external mains choke.

Rated values for internal brake chopper

Type	Switching threshold (adjustable) U_{BRmax} [V]	Minimum brake resistor R_{Bmin} [Ω]	Peak current I_{BRmax} [A]	Peak braking power P_{BRmax} [kW]	Continuous current RMS I_{BRd} [A]	Continuous braking power P_{Bd} [kW]
E94ASxE0024	725	82	8.8	6.4	3.9	1.3
E94ASxE0034	725	82	8.8	6.4	3.9	1.3
E94ASxE0044	725	47	15.4	11.2	6.3	1.9
E94ASxE0074	725	47	15.4	11.2	7.4	2.6
E94ASxE0134	725	27	26.9	19.5	13.2	4.7
E94ASxE0174	725	18	40.3	29.2	18.9	6.4
E94ASxE0244	725	18	40.3	29.2	22.8	9.3
E94ASxE0324	725	18	40.3	29.2	26.5	12.6
E94ASxE0474	725	15	48.3	35.0	35.2	18.6
E94ASxE0594	725	15	48.3	35.0	41.0	25.3
E94ASxE0864	725	7.5	96.7	70.1	71.1	37.9
E94ASxE1044	725	7.5	96.7	70.1	78.7	46.3
E94ASxE1454	725	5.0	145	105	79	31.5
E94ASxE1724	725	4.3	169	122	93	36.7
E94ASxE2024	725	3.5	207	150	113	45.1
E94ASxE2454	725	2.8	259	188	142	56.3
E94ASxE2924	725	2.3	315	229	173	68.6
E94ASxE3664	725	1.8	414	300	227	90.1
E94ASxE4604	725	1.4	518	375	227	90
E94ASxE5724	725	1.2	604	438	287	99
E94ASxE6354	725	1.1	659	478	300	99
E94ASxE6954	725	1.1	659	478	300	99

I_{BRmax}, P_{BRmax}	Periodic load change of 0.5 s and recovery time of 4.5 s
R_{Bmin}	Nominal value, ±10 %
Permanent current, r.m.s.	R.m.s. value - important for cable dimensioning

4.3.4 Operation at rated mains voltage 500 V

Device size 1 ... 6

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 %
2/PE DC	705	565 - 0 % ... 775 + 0 %	-

	Mains current at I_{aN}		Output power	Motor power (typical)	
	with external mains choke	without external mains choke	U, V, W	4-pole ASM	
Type	I_{LN} [A]	I_{LN} [A]	S_{aN} [kVA]	P_{aN} [kW]	P_{aN} [hp]
E94ASxE0024	1.3	1.8	1.0	0.37	0.5
E94ASxE0034	2.2	3.1	1.7	0.75	1
E94ASxE0044	3.4	4.8	2.7	1.5	2
E94ASxE0074	6.1	8.7	4.8	3	4
E94ASxE0134	10.5	14.7	8.9	5.5	7.5
E94ASxE0174	13.1	18.4	11.2	7.5	10
E94ASxE0244	17.9	25.4	16.1	11	15
E94ASxE0324	-	26.0	21.8	15	20
E94ASxE0474	-	39.0	32.0	22	29
E94ASxE0594	-	48.0	40.2	30	40

Device size 7

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 (typical)	
	with external mains choke	without external mains choke	U, V, W	4-pole ASM	
Type	I_{LN} [A]	I_{LN} [A]	S_{aN} [kVA]	P_{aN} [kW]	P_{aN} [hp]
E94ASxE0864	-	70.0	58.7	45	60
E94ASxE1044	-	84.0	70.9	55	73

Device size 8S ... 10

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 %	48 - 0 % ... 65 + 0 %

	Mains current at I_{aN}		Output power	Motor power (typical)	
	with external mains choke	without external mains choke	U, V, W	4-pole ASM	
Type	I_{LN} [A]	I_{LN} [A]	S_{aN} [kVA]	P_{aN} [kW]	P_{aN} [hp]
E94ASxE1454	-	140	113	95	130
E94ASxE1724	-	166	134	110	150
E94ASxE2024	-	195	157	130	180
E94ASxE2454	-	237	191	160	215
E94ASxE2924	-	280	228	190	255
E94ASxE3664	-	354	285	235	320
E94ASxE4604	-	444	359	300	405
E94ASxE5724	-	553	446	375	510
E94ASxE6354	-	614	495	420	570
E94ASxE6954	-	672	542	460	625

	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}
E94ASxE0024	1.9 3)	6.0	1.9 3)	6.0	1.3	4.2	1.0
E94ASxE0034	3.1 3)	10.0	3.1 3)	10.0	2.2	7.0	1.6
E94ASxE0044	5.0 3)	16.0	5.0 3)	16.0	3.5	11.2	2.6
E94ASxE0074	8.8 3)	21.0	8.8 3)	21.0	6.1	14.7	4.6
E94ASxE0134	16.3 3)	39.0	16.3 3)	39.0	11.4	27.3	8.5
E94ASxE0174	20.6 3)	49.5	20.6 3)	49.5	14.4	34.7	10.8
E94ASxE0244	29.4 3)	58.8	29.4 3)	58.8	20.6	41.1	15.4
E94ASxE0324	38.4	76.8	33.6	67.2	28.0	61.6	16.8
E94ASxE0474	47.0	94.0	41.1	82.2	35.8	71.6	24.7
E94ASxE0594	59.0	118	51.6	103.2	35.9	71.8	31.0
E94ASxE0864	86.0	172	75.3	150.6	63.9	127.8	42.5
E94ASxE1044	104.0	208	91.0	182	68.3	136.6	54.6
E94ASxE1454	145	261	**145**	261	89	161	-
E94ASxE1724	172	310	**172**	310	105	189	-
E94ASxE2024	202	364	**202**	364	115	206	-
E94ASxE2454	**245**	441	209	376	140	252	-
E94ASxE2924	**292**	526	250	450	167	301	-
E94ASxE3664	**366**	659	313	563	210	378	-
E94ASxE4604	**460**	828	368	662	228	410	-
E94ASxE5724	**572**	1030	458	824	250	450	-
E94ASxE6354	**635**	1143	508	914	278	500	-
E94ASxE6954	**695**	1251	556	1001	305	549	-

I_{aN2} Rated value of permanent output current at a frequency of ≥ 0 Hz

I_{aM2} Maximum output current (overload current)
- Periodic load change of 0.5 s with I_{aM2} and recovery time of 4.5 s with 75 % I_{aN2}

I_{aN4}, I_{aN8}, I_{aN16} Rated value of permanent output current at a frequency of ≥ 5 Hz
(reduce to 0.66 * I_{aNx} for 0 ... 5 Hz)

I_{aM4}, I_{aM8} Maximum output current (overload current)
- Periodic load change of 0.5 s with I_{aMx} and recovery time of 4.5 s with 75 % I_{aNx}
- Can be achieved using the setting "x kHz fixed" in C00018

bold Nominal value I_{aN}

3) Operation with permanent currents > I_{aN8} requires an external mains choke.

Rated values for internal brake chopper

Type	Switching threshold (adjustable) U_{BRmax} [V]	Minimum brake resistor R_{Bmin} [Ω]	Peak current I_{BRmax} [A]	Peak braking power P_{BRmax} [kW]	Continuous current RMS I_{BRd} [A]	Continuous braking power P_{Bd} [kW]
E94ASxE0024	790	82	9.6	7.6	4.3	1.5
E94ASxE0034	790	82	9.6	7.6	4.3	1.5
E94ASxE0044	790	47	16.8	13.3	6.9	2.3
E94ASxE0074	790	47	16.8	13.3	8.1	3.1
E94ASxE0134	790	27	29.3	23.1	14.4	5.5
E94ASxE0174	790	18	43.9	34.7	20.6	7.6
E94ASxE0244	790	18	43.9	34.7	24.8	11.1
E94ASxE0324	790	18.0	43.9	34.7	28.9	15.0
E94ASxE0474	790	15.0	52.7	41.6	38.4	22.0
E94ASxE0594	790	15.0	52.7	41.6	44.8	30.0
E94ASxE0864	790	7.5	105.3	83.2	77.5	45.0
E94ASxE1044	790	7.5	105.3	83.2	85.7	55.0
E94ASxE1454	790	5.0	158	125	87	37.4
E94ASxE1724	790	4.3	184	145	101	43.5
E94ASxE2024	790	3.5	226	178	124	53.5
E94ASxE2454	790	2.8	282	223	154	66.9
E94ASxE2924	790	2.3	343	271	188	81.4
E94ASxE3664	790	1.8	451	357	247	107
E94ASxE4604	790	1.4	564	446	289	117
E94ASxE5724	790	1.2	658	520	312	117
E94ASxE6354	790	1.1	718	567	327	117
E94ASxE6954	790	1.1	718	567	327	117

I_{BRmax}, P_{BRmax}	Periodic load change of 0.5 s and recovery time of 4.5 s
R_{Bmin}	Nominal value, ±10 %
Permanent current, r.m.s.	R.m.s. value - important for cable dimensioning

4.3.5 Fuses and cable cross-sections

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

Operation with external mains choke								
Type	Installation according to EN 60204-1 [1]					Installation according to UL [2]		FI [3]
	①	②	L1, L2, L3			③	L1, L2, L3	
			Laying system					
			B2	c	F			
	[A]	[A]	[mm²]	[mm²]	[mm²]	[A]	[AWG]	[mA]
E94ASxE0024	C10	-	1,5	1,5	-	10	16	≥ 300
E94ASxE0034	C10	-	1.5	1.5	-	10	16	≥ 300
E94ASxE0044	C10	-	1.5	1.5	-	10	16	≥ 300
E94ASxE0074	C16	-	2.5	2.5	-	15	14	≥ 300
E94ASxE0134	C20	-	2.5	2.5	-	20	12	≥ 300
E94ASxE0174	C25	-	4	4	-	25	10	≥ 300
E94ASxE0244	C32	-	10	6	-	40	8	≥ 300

1) The data are recommendations. Other dimensioning/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 leads, 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 ... 600 V, tripping characteristic "H", "K5" or "CC".

3) Universal-current sensitive earth-leakage circuit breaker. With cable lengths > 50 m, circuit breakers may respond depending on the cable type and switching frequency.

① Circuit breaker
② Fuse of utilisation category gG/gL
③ Fuse

Observe national and regional regulations

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]
E94ASxE0024	C10	-	1,5	1,5	-	10	18	≥ 300
E94ASxE0034	C10	-	1.5	1.5	-	10	18	≥ 300
E94ASxE0044	C10	-	1.5	1.5	-	10	18	≥ 300
E94ASxE0074	C16	-	2.5	2.5	-	15	16	≥ 300
E94ASxE0134	C20	-	2.5	2.5	-	20	12	≥ 300
E94ASxE0174	C25	-	4	4	-	25	10	≥ 300
E94ASxE0244	C32	-	10	6	-	40	8	≥ 300
E94ASxE0324 [4]	-	40	10	6	40	-	8	≥ 300
E94ASxE0474 [4]	-	63	16	10	60	-	4	≥ 300
E94ASxE0594 [4]	-	80	25	25	80	-	2	≥ 300
E94ASxE0864 [4]	-	100	50	35	-	100	1	≥ 300
E94ASxE1044 [4]	-	125	70	50	-	125	0	≥ 300
E94ASxE1454 [4]	-	200	-	-	70	250	000	≥ 300
E94ASxE1724 [4]	-	250	-	-	95	300	350 mcm	≥ 300
E94ASxE2024 [4]	-	315	-	-	150	350	500 mcm	≥ 300
E94ASxE2454 [4]	-	350	-	-	150	2 x 200	0000	≥ 300
E94ASxE2924 [4]	-	400	-	-	185	2 x 250	2 x 250 mcm	≥ 300
E94ASxE3664 [4]	-	500	-	-	240	2 x 300	2 x 350 mcm	≥ 300
E94ASxE4604 [4]	-	2 x 350	-	-	150	2 x 350	500 mcm	≥ 300
E94ASxE5724 [4]	-	2 x 400	-	-	185	2 x 400	600 mcm	≥ 300
E94ASxE6354 [4]	-	2 x 450	-	-	240	2 x 400	600 mcm	≥ 300
E94ASxE6954 [4]	-	2 x 500	-	-	240	2 x 400	600 mcm	≥ 300

1) The data are recommendations. Other dimensioning/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 leads, 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 ... 600 V, tripping characteristic "H", "K5" or "CC".

3) Universal-current sensitive earth-leakage circuit breaker. With cable lengths > 50 m, circuit breakers may respond depending on the cable type and switching frequency.

4) Device with integrated mains choke

① Circuit breaker

② Fuse of utilisation category gG/gL

③ Fuse

Observe national and regional regulations

4.3.6 Overcurrent operation

The controllers are designed for two overcurrent modes:

- ► 5-s-cycle ①
  - – 0.5 s load period with peak current A
  - – 4.5 s recovery time with limited current B
- ► 3-min cycle ②
  - – 1 min load period with peak current C
  - – 2 min recovery time with limited current D

A load period must be followed by a recovery time. During the recovery time the current must not exceed the value given.

The values given refer to the rated output current I_{aN8}.

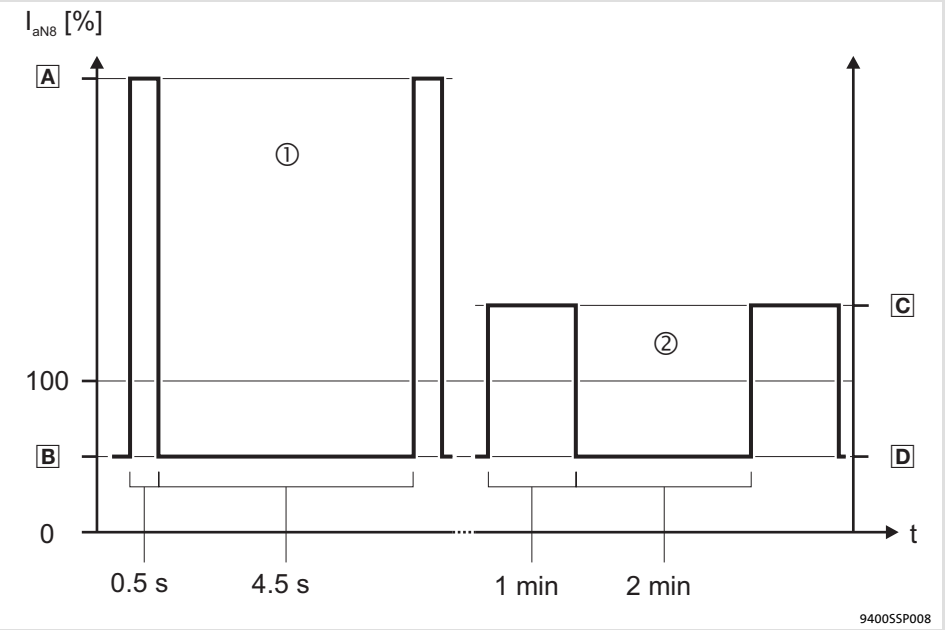


Fig. 4.3-1 Overcurrent capacity at 45° C

A Peak current for 0.5 s
B Max. current in the recovery time for 4.5 s
① 5-s cycle
C Peak current for 1 min
D Max. current in the recovery time for 2 min
② 3-min cycle

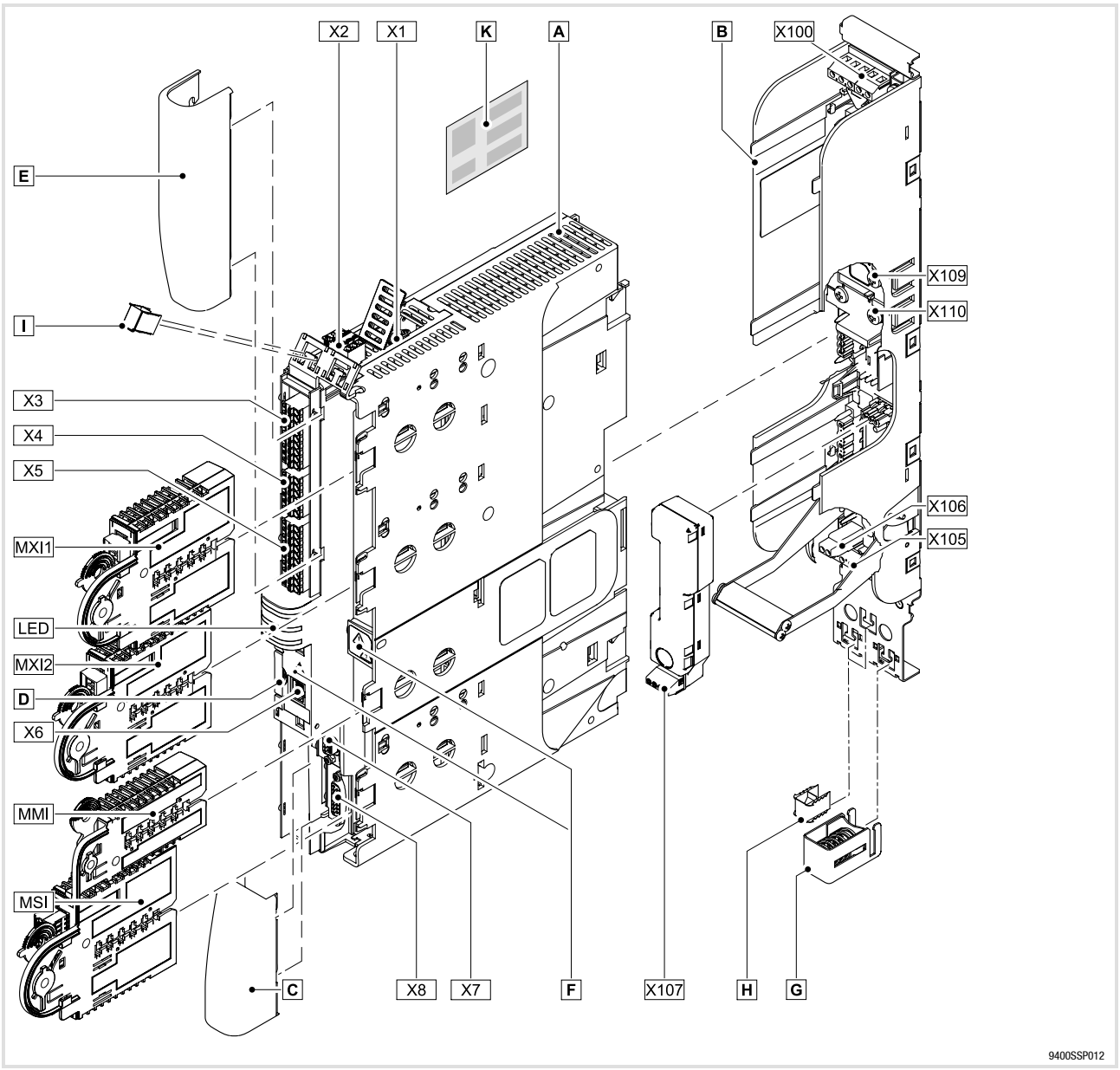
Type	I_{amax}/I_{aN} [%] in a 5-s cycle ①							
	f = 2 kHz		f = 4 kHz		f = 8 kHz		f = 16 kHz	
	A	B	A	B	A	B	A	B
E94ASxE0024 E94ASxE0034 E94ASxE0044	400	94	400	94	320	75	-	
E94ASxE0074 E94ASxE0134 E94ASxE0174	300		300		240			
E94ASxE0244	250		250		200			
E94ASxE0324	240	90	240	90				
E94ASxE0474	200	75	200	75	174	65		
E94ASxE0594					139	52		
E94ASxE0864					170	64		
E94ASxE1044					150	56		
E94ASxE1454	180		180		135	56		
E94ASxE1724								
E94ASxE2024								
E94ASxE2454			154	64	118	49		
E94ASxE2924								
E94ASxE3664								
E94ASxE4604	180	75	144	60	102	42	-	
E94ASxE5724					90	38		
E94ASxE6354								
E94ASxE6954								

Type	I_{amax}/I_{aN} [%] in a 3-min cycle ②							
	f = 2 kHz		f = 4 kHz		f = 8 kHz		f = 16 kHz	
	C	D	C	D	C	D	C	D
E94ASxE0024 E94ASxE0034 E94ASxE0044 E94ASxE0074 E94ASxE0134 E94ASxE0174 E94ASxE0244	188	94	188	94	150	75	-	
E94ASxE0324	180	90	180	90				
E94ASxE0474	150	75	150	75	131	65		
E94ASxE0594					104	52		
E94ASxE0864					127	64		
E94ASxE1044					113	56		
E94ASxE1454					113	56		
E94ASxE1724								
E94ASxE2024								
E94ASxE2454			128	64	98	49		
E94ASxE2924								
E94ASxE3664								
E94ASxE4604	150	75	120	60	85	42	-	
E94ASxE5724					75	38		
E94ASxE6354								
E94ASxE6954								

4.4 Device description

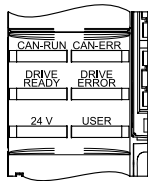
This page remains blank to give you a clearly arranged overview of the following subject on the next double page.

4.4.1 Devices in the range 2 ... 24 A (0.37 ... 11 kW)



Standard device A		Design	
Pos.	**Description**	**HighLine**	**StateLine**
MXI1	Module receptacle for extension 1, e.g. communication	☑	☑
MXI2	Module receptacle for extension 2, e.g. communication	☑	☐
MMI	Module receptacle for memory modules	☑	☑
MSI	Module receptacle for safety modules	☑	☑
X1	System bus (CAN), under the cover	☑	☐
X2	24-V supply and state bus	☑	☑
X3	Analog inputs and analog outputs	2/2	1/0
X4	Digital outputs	4	1
X5	Digital inputs	8	4
X6	Diagnostics	☑	☑
X7	Resolver	☑	☑
X8	Encoder	☑	☑
C	Lower cap	☑	☑
D	Nameplate, retractable	☑	☑
E	Upper cap	☑	☑
I	EMC clamp	1	1
K	Warning sticker - place close to the device in a clearly visible manner!	☑	☑

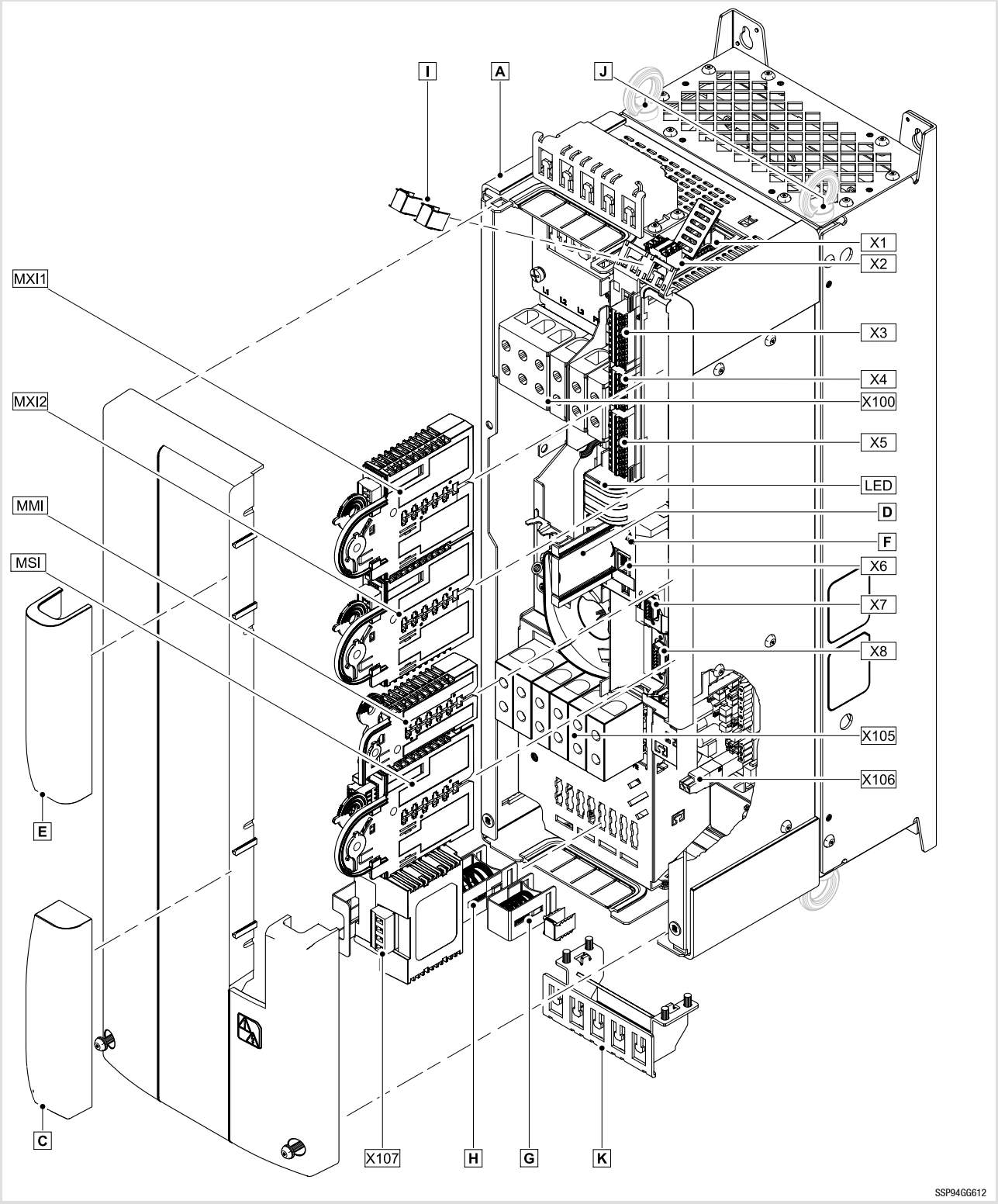
The LED display enables fast indication of several operating states.

LED	Labelling	Colour	Description	
 SSP94LED01	CAN-RUN	green	CAN bus o.k.	Inoperable when "StateLine" design is used
	CAN-ERR	red	CAN bus error	
	DRIVE READY	green	Standard device is ready for operation	
	DRIVE ERROR	red	Error in the standard device or due to the application	
	24 V	green	24-V supply voltage o.k.	
	USER	yellow	Message parameterised by the application	

Pos.	Symbol	Description
F		**Long discharge time**: All power terminals carry hazardous voltages for at least 3 minutes after mains disconnection!
		**High discharge current**: Fixed installation and PE connection to EN 61800-5-1 required!
		**Electrostatic sensitive devices**: Before working on the device, personnel must ensure that they are free of electrostatic charge!

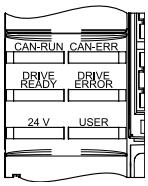
Installation backplane B		Design	
Pos.	**Description**	**HighLine**	**StateLine**
X100	Mains / DC-bus voltage	☑	
X105	Motor / external brake resistor	☑	
X106	Motor temperature monitoring	☑	
X107	Control of motor holding brake	Optional	
X109	DC busbar +	Optional (for DC-bus connection)	
X110	DC busbar -		
G	EMC wire clamp (for device sizes II + III), replaces 1x H	1	
H	EMC shield clamp	3 or 2	

4.4.2 Devices in the range 32 ... 104 A (15 ... 55 kW)



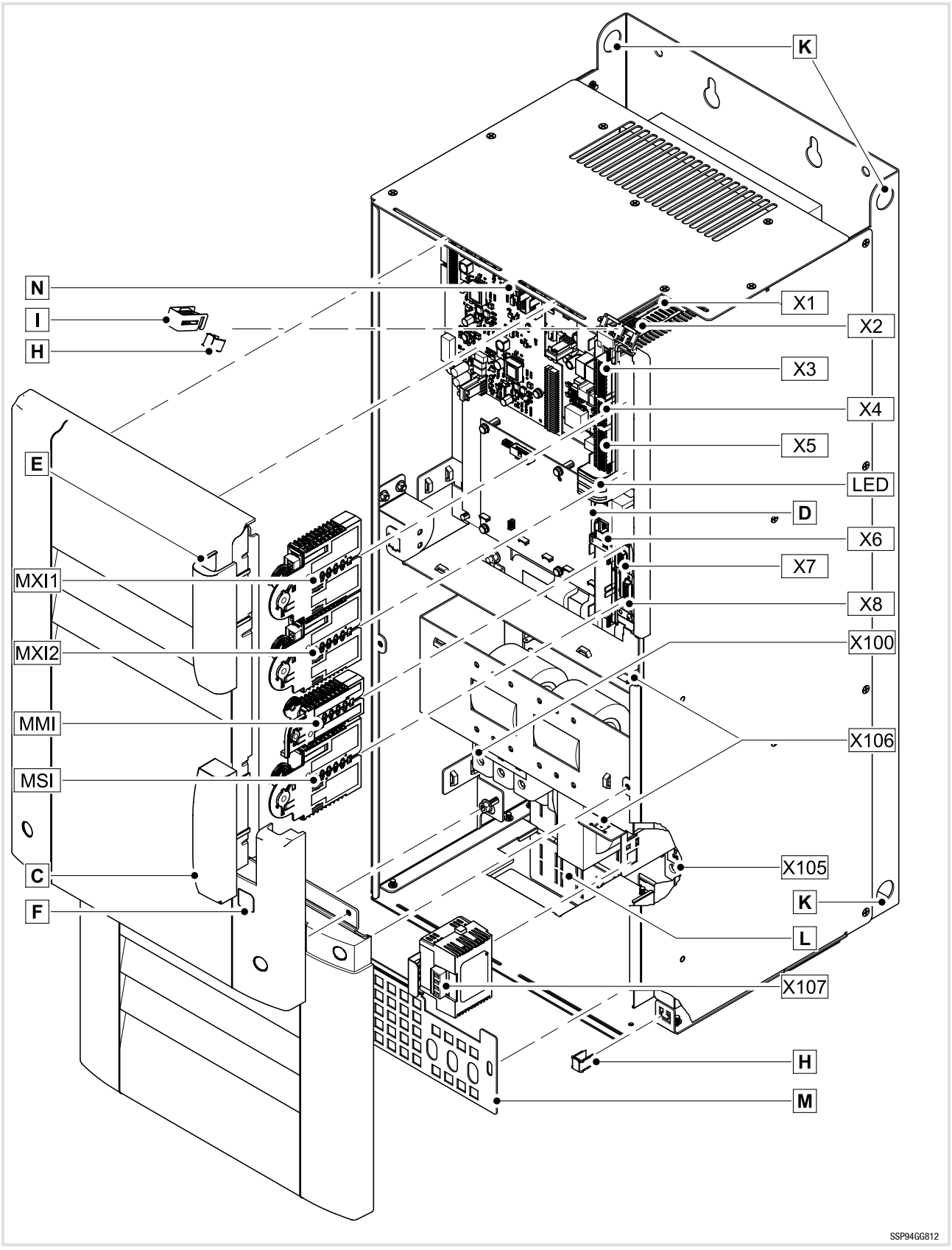
Standard device A		Design	
Pos.	**Description**	**HighLine**	**StateLine**
MXI1	Module receptacle for extension 1, e.g. communication	☑	☑
MXI2	Module receptacle for extension 2, e.g. communication	☑	☐
MMI	Module receptacle for memory modules	☑	☑
MSI	Module receptacle for safety modules	☑	☑
X1	System bus (CAN), under the cover	☑	☐
X2	24-V supply and state bus	☑	☑
X3	Analog inputs and analog outputs	2/2	1/0
X4	Digital outputs	4	1
X5	Digital inputs	8	4
X6	Diagnostics	☑	☑
X7	Resolver	☑	☑
X8	Encoder	☑	☑
C	Lower cap	☑	☑
D	Nameplate, retractable	☑	☑
E	Upper cap	☑	☑
I	EMC clamp	1	1
K	Warning sticker - place close to the device in a clearly visible manner!	☑	☑
X100	Mains / DC-bus voltage	☑	☑
X105	Motor / external brake resistor	☑	☑
X106	Motor temperature monitoring	☑	☑
X107	Control of motor holding brake	Optional	Optional
G H	EMC wire clamp Device size 6: ∅ 10 ... 20 mm and ∅ 15 ... 28 mm Device size 7: ∅ 15 ... 28 mm and ∅ 20 ... 37 mm	2	2
J	Internal thread for M6 eye bolt (not included in the scope of supply)	4	4
K	Strain relief and lifting aid, removable	2	2

The LED display enables fast indication of several operating states.

LED	Labelling	Colour	Description	
 SSP94LED01	CAN-RUN	green	CAN bus o.k.	Inoperable when "StateLine" design is used
	CAN-ERR	red	CAN bus error	
	DRIVE READY	green	Standard device is ready for operation	
	DRIVE ERROR	red	Error in the standard device or due to the application	
	24 V	green	24-V supply voltage o.k.	
	USER	yellow	Message parameterised by the application	

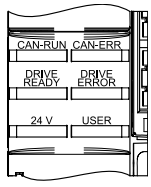
Pos.	Symbol	Description
F		**Long discharge time**: All power terminals carry hazardous voltages for at least 3 minutes after mains disconnection!
		**High discharge current**: Fixed installation and PE connection to EN 61800-5-1 required!
		**Electrostatic sensitive devices**: Before working on the device, personnel must ensure that they are free of electrostatic charge!

4.4.3 Devices in the range 145 ... 695 A (75 ... 400 kW)



Pos.	Description	Design	
		HighLine	StateLine
MXI1	Module receptacle for extension 1, e.g. communication	☑	☑
MXI2	Module receptacle for extension 2, e.g. communication	☑	☐
MMI	Module receptacle for memory modules	☑	☑
MSI	Module receptacle for safety equipment	☑	☑
X1	System bus (CAN), under the cover	☑	☐
X2	24-V supply / Statebus	☑	☑
X3	Analog inputs / analog outputs	2/2	1/0
X4	Digital outputs	4	1
X5	Digital inputs	8	4
X6	Diagnostics (with diagnostic adapter or keypad)	☑	☑
X7	Resolver	☑	☑
X8	Encoder	☑	☑
C	Lower cap	☑	☑
D	Nameplate, retractable	☑	☑
E	Upper cap	☑	☑
I	EMC wire clamp	Optional	
X100	Mains / DC-bus voltage	☑	☑
X105	Motor / external brake resistor	☑	☑
X106	Motor temperature monitoring (position depends on the device size)	☑	☑
X107	Control of motor holding brake	Optional	
H	EMC shield clamp	2	2
K	Holes for transport and assembly guides	4	4
L	Shield connection/strain relief (device sizes: 8S, 8 and 9)	☑	☑
M	Barrier between mains input and other power terminals (device sizes: 8S, 8 and 9)	☑	☑
N	Switch for operation in IT systems	☑	☑

The LED display enables fast indication of several operating states.

LED	Labelling	Colour	Description	
 SSP94LED01	CAN-RUN	green	CAN bus o.k.	Inoperable when "StateLine" design is used
	CAN-ERR	red	CAN bus error	
	DRIVE READY	green	Standard device is ready for operation	
	DRIVE ERROR	red	Error in the standard device or due to the application	
	24 V	green	24-V supply voltage o.k.	
	USER	yellow	Message parameterised by the application	

Pos.	Symbol	Description
F		**Long discharge time**: All power terminals carry hazardous voltages for at least 20 minutes after mains disconnection!
		**High discharge current**: Fixed installation and PE connection to EN 61800-5-1 required!
		**Electrostatic sensitive devices**: Before working on the device, the personnel must remove any electrostatic charges using suitable measures!

4.5 Mechanical installation

4.5.1 Important notes

Note!

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

4.5.2 Devices in the range 2 ... 24 A (0.37 ... 11 kW)

Proceed as follows for the installation:

1. Prepare M5 threaded holes on the mounting plate according to the mounting grid.
2. When using footprint filters: Screw installation backplane and footprint filter together.
   – Use screw and washer assemblies M5 x 20 mm or hexagon socket screws M5 x 20 mm with washers.
   – Tightening torque: 3.4 Nm (30 lb-in)
3. Screw the installation backplane or footprint filter with installation backplane onto the mounting plate. Do not yet tighten the screws.
   – Use M5 screw and washer assemblies or M5 hexagon socket screws with washers.
   – The screw joint in the installation backplane may jut out no more than 7 mm.
4. Repeat steps 2 and 3 with further installation backplanes which are mounted side by side.
5. Align all installation backplanes.
6. Screw all installation backplanes/footprint filters onto the mounting plate.
   – Tightening torque: 3.4 Nm (30 lb-in).

Mounting grid

We recommend to provide the mounting plate with a grid pattern of M5 threaded holes for attaching the devices. This preparation enables easy attachment of the devices and the device sizes 1, 2, ... n can thus be mounted directly adjacent to each other.

Note!

- ► M5 screw and washer assemblies or hexagon socket screws with washers are permitted.
- ► Tightening torque: 3.4 Nm / 30 lb-in.
- ► In the installation backplane, the screwed connection may not jut out more than 7 mm.

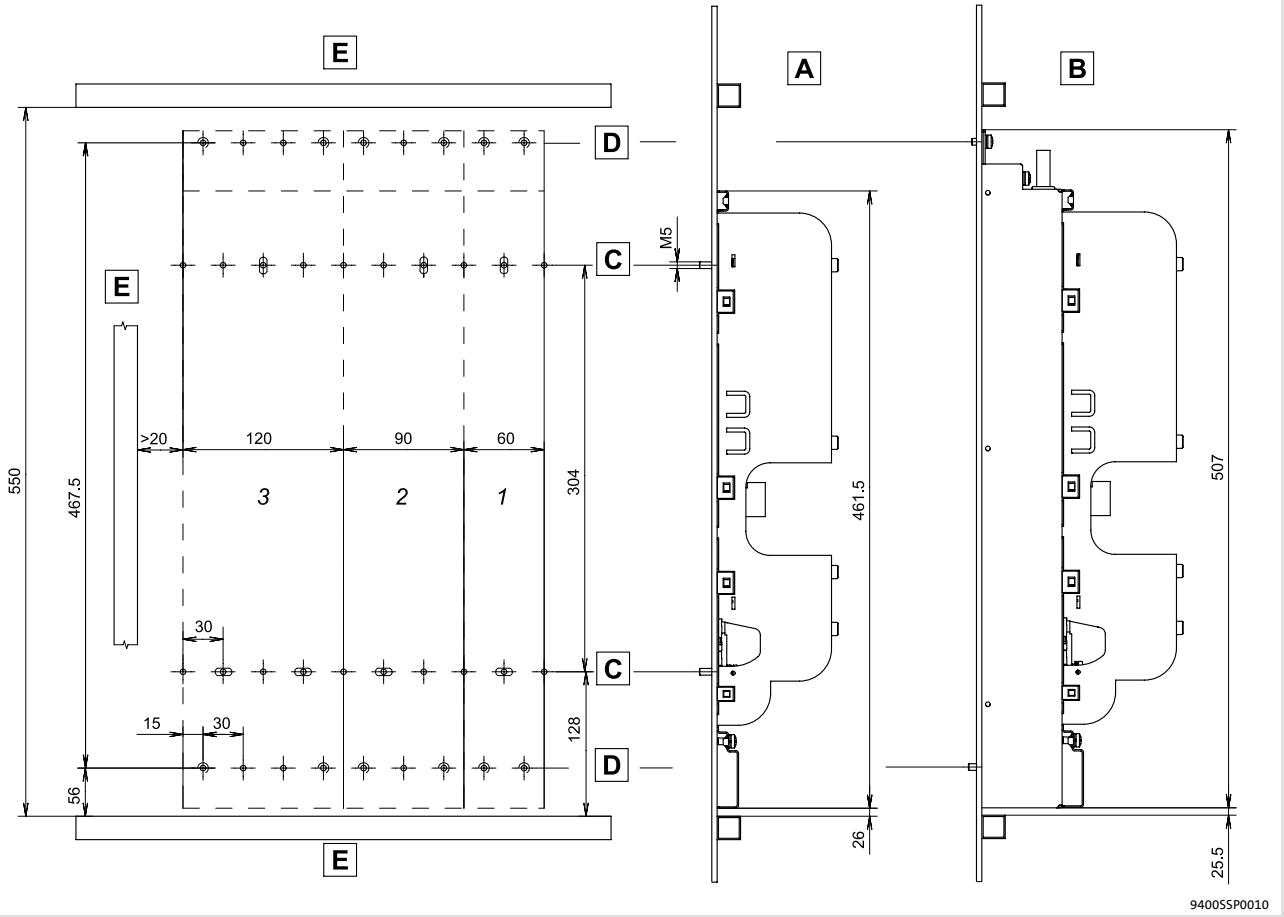


Fig. 4.5-1 Mounting grid for installation backplane and filter of device sizes 1 ... 3

- A Installation backplane without footprint filter (mains or RFI filter)
- B Installation backplane with footprint filter
- C Grid hole pattern for installation backplane (M5 threaded holes)
- D Grid hole pattern for footprint filter (M5 threaded holes)
- E Cable duct
- 1 ... 3 Device size, mounting holes used

Standard device with installation backplane

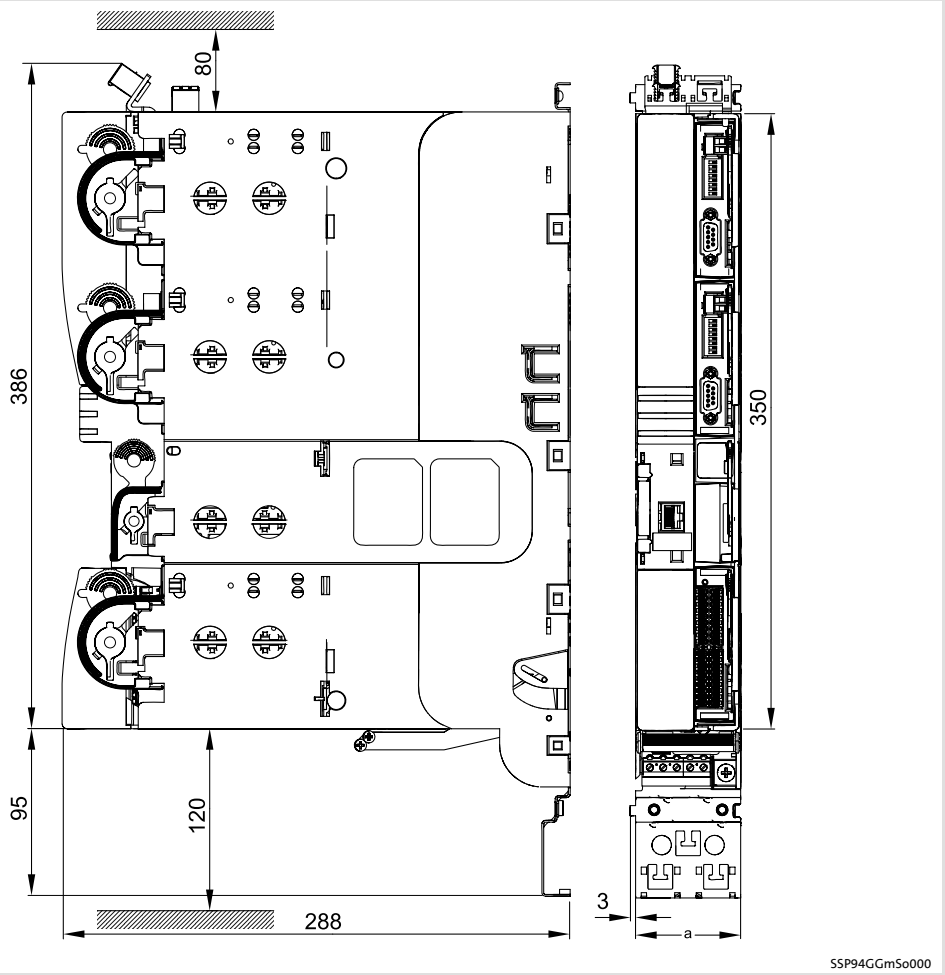


Fig. 4.5-2 Dimensions [mm]

Type	Dimensions [mm] a	Weight [kg]	Device size
E94ASxE0024	60	4.0	1
E94ASxE0034			
E94ASxE0044	90	5.3	2
E94ASxE0074			
E94ASxE0134	120	8.1	3
E94ASxE0174			
E94ASxE0244			

4.5.3 Devices in the range 32 ... 104 A (15 ... 55 kW)

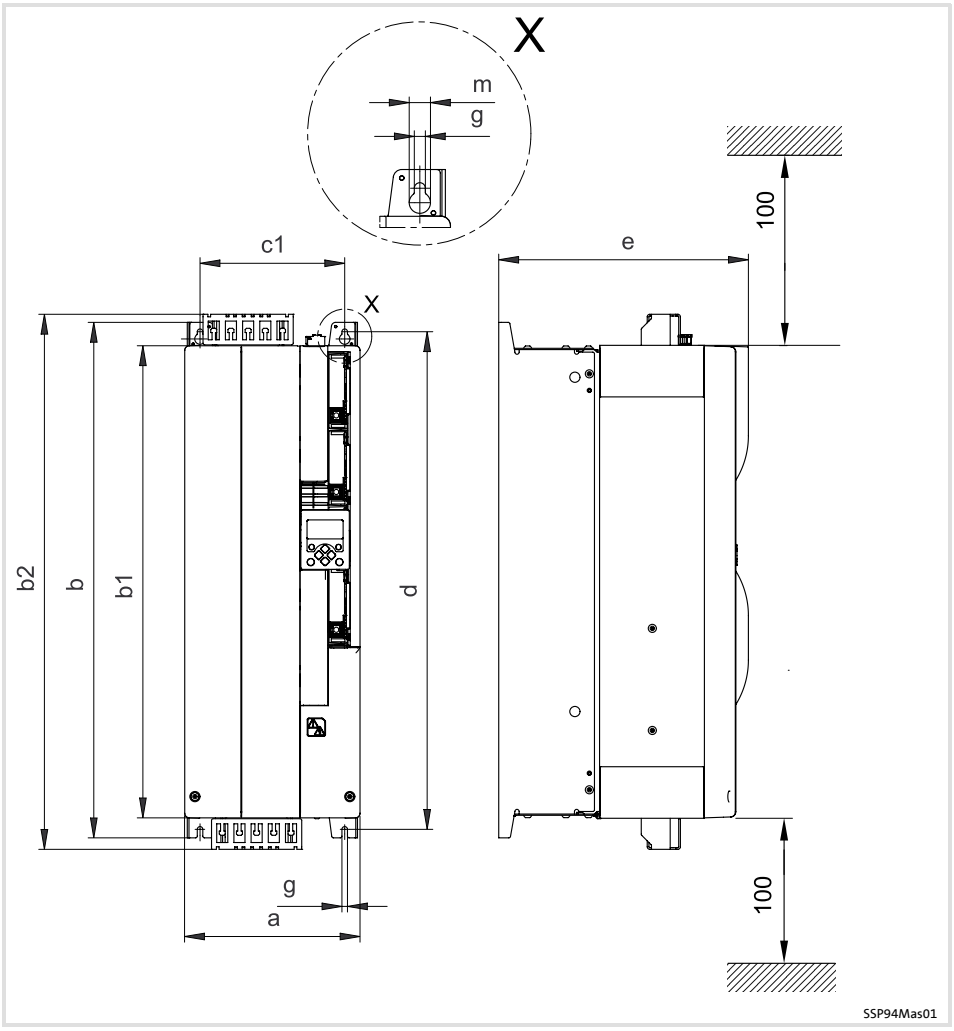


Fig. 4.5-3 Dimensions [mm]

Type	Dimensions [mm]									Weight [kg]	Device size
	a	b	b1	b2	e	c1	d	g	m		
E94ASxE0324	206	606	556	630	294	170	585	6.5	12.5	26.5	6
E94ASxE0474											
E94ASxE0594											
E94ASxE0864	266	706	655	729	370	230	685			42	7
E94ASxE1044											

4.5.4 Devices in the range 145 ... 366 A (75 ... 200 kW)

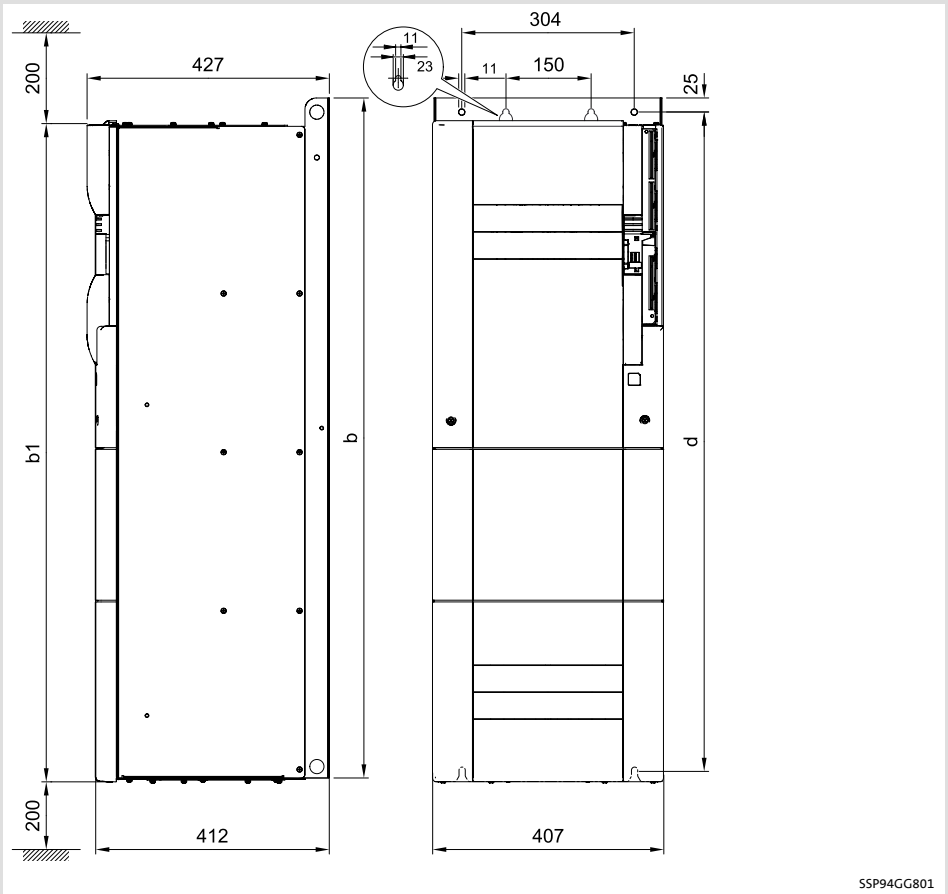


Fig. 4.5-4 Dimensions [mm]

Type	Dimensions [mm]			Weight	Device size
	b	b1	d	[kg]	
E94ASxE1454	930	897	885	95	8S
E94ASxE1724	1199	1166	1154	107	8
E94ASxE2024				109	
E94ASxE2454	1580	1546	1535	132	9
E94ASxE2924				132	
E94ASxE3664				161	

4.5.5 Devices in the range 460 ... 695 A (250 ... 400 kW)

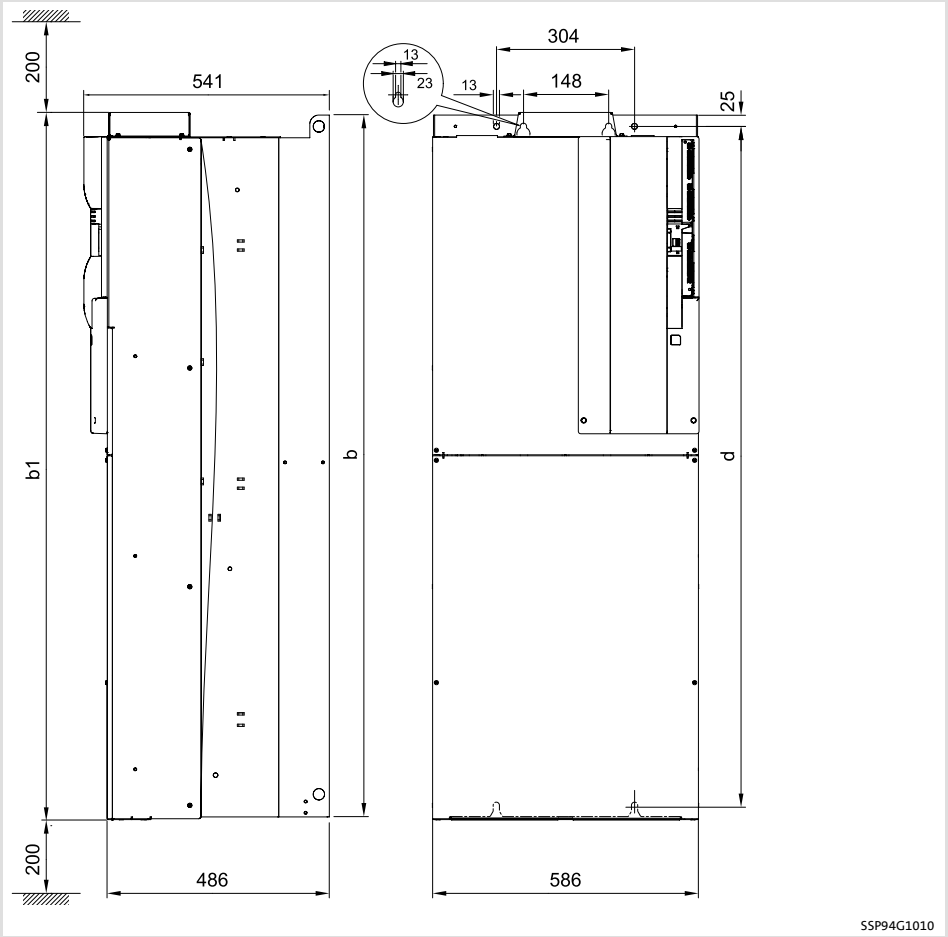


Fig. 4.5-5 Dimensions [mm]

Type	Dimensions [mm]			Weight	Device size
	b	b1	d	[kg]	
E94ASxE4604	1547	1559	1502	266	10
E94ASxE5724				278	
E94ASxE6354				300	
E94ASxE6954				321	

4.6 Wiring

4.6.1 Important notes

Danger!

Dangerous voltage

All power terminals remain live for at least three minutes after mains disconnection.

Possible consequences:

► Death or severe injuries when touching the power terminals.

Protective measures:

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

► Check 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 ≥ 10 mm^2 or PE conductor must be connected twice)

Stop!

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

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

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 on components:

On IT systems an earth fault in the installation can cause impermissible overvoltages.

Possible consequences:

Destruction of the device.

Protective measures:

If the devices are operated on IT systems, the internal connection of the filters to the protective earth in the installation backplane has to be disconnected.

Note!

Switching operations on the motor side of the controller are permitted for safety switch-off (emergency off).

Please observe:

► When the controller is enabled, switching operations may lead to a response of the controller monitoring functions.

► The switching elements on the motor side must be rated for DC voltages with U_{DCmax} = 800 V.

4.6.2 Safety notes for the installation according to U_L or U_R

Device size 1 ... 3

Warnings!

- Branch circuit protection:
  Suitable for use on a circuit capable of delivering not more than 5000 rms symmetrical amperes, 500 V max., when protected by H, K5 or CC fuses.
- Voltage of the fuses must at least be suitable with the input voltage of the drive.
- 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.
- For information on the protection level of the internal overload protection for a motor load, see the corresponding Application Manuals or Software Helps.
- For information on rating and proper connection of the thermal protector (only for connection to motors having integral thermal protection), see the corresponding Application Manuals or Software Helps.
- Maximum surrounding air temperature: 55 °C.
- Use 60/75 °C copper wire only, except for control circuits.
- Control card protection:
  External fuse for 24 Vdc supply voltage of control terminal X2. Rated 4 A DC fuse UL248-14.

Type	Branch circuit protection Fuse [A]
E94ASxE0024	10
E94ASxE0034	10
E94ASxE0044	10
E94ASxE0074	15
E94ASxE0134	20
E94ASxE0174	25
E94ASxE0244	40

Device size 6 and 7

Warnings!

- Branch circuit protection:

  Suitable for use on a circuit capable of delivering not more than 10000 rms symmetrical amperes, 500 V max., when protected by H, K5 or CC fuses.
- Voltage of the fuses must at least be suitable with the input voltage of the drive.
- 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.
- For information on the protection level of the internal overload protection for a motor load, see the corresponding Application Manuals or Software Helps.
- For information on rating and proper connection of the thermal protector (only for connection to motors having integral thermal protection), see the corresponding Application Manuals or Software Helps.
- Maximum surrounding air temperature: 55 °C.
- Use 60/75 °C copper wire only, except for control circuits.
- Control card protection:

  External fuse for 24 Vdc supply voltage of control terminal X2. Rated 4 A DC fuse UL248-14.

	Branch circuit protection
Type	Fuse [A]
E94ASxE0324	40
E94ASxE0474	60
E94ASxE0594	80
E94ASxE0864	100
E94ASxE1044	125

Device size 8S ... 10

Warnings!

- Branch circuit protection:
  Suitable for use on a circuit capable of delivering not more than 100000 rms symmetrical amperes, 500 V max., when protected by the specified fuses (📖 Tab. 4.6-1).
- Voltage of the fuses must at least be suitable with the input voltage of the drive.
- 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.
- For information on the protection level of the internal overload protection for a motor load, see the corresponding Application Manuals or Software Helps.
- For information on rating and proper connection of the thermal protector (only for connection to motors having integral thermal protection), see the corresponding Application Manuals or Software Helps.
- Maximum surrounding air temperature: 55 °C with derating.
- Use 75 °C copper wire only, except for control circuits.
- Control card protection:
  External fuse for 24 Vdc supply voltage of control terminal X2. Rated 4 A DC fuse UL248-14.

Branch circuit protection (UL Guide No. JHFR2)

	Bussmann		Alternate type	
Type	Fuse rating	Type	Ferraz-Shawmut	SIBA
E94ASxE1454	250 A, 700 V	170M3016	2061032.250	6.6URD30D08A0250
E94ASxE1724	315 A, 700 V	170M3017	2061032.315	6.6URD30D08A0315
E94ASxE2024	350 A, 700 V	170M3018	2061032.350	6.6URD30D08A0350
E94ASxE2454	400 A, 700 V	170M4012	2061032.400	6.6URD30D08A0400
E94ASxE2924	500 A, 700 V	170M4014	2061032.500	6.6URD30D08A0500
E94ASxE3664	630 A, 700 V	170M4016	206xx32.600	A50-P600
E94ASxE4604	700 A, 700 V	170M4017	2061032.700	6.6URD31D08A0700
E94ASxE5724	900 A, 700 V	170M6013	2063032.900	6.6URD33D08A0900
E94ASxE6354	900 A, 700 V	170M6013	2063032.900	6.6URD33D08A0900
E94ASxE6954	900 A, 700 V	170M6013	2063032.900	6.6URD33D08A0900

Tab. 4.6-1

- 100 kA SCCR with above fuses. (Short Circuit Current Rating)
- Ferraz-Schawmut A50QS fuses may be substituted for A50-P fuses.
- 170M fuses from Bussmann shown use -/80 visual indicator. -TN80 Type T, -/110 or TN/110 Type T indicater fuses of the same size and amperage may be substituted.

4.6.3 Devices in the range 2 ... 24 A (0.37 ... 11 kW)

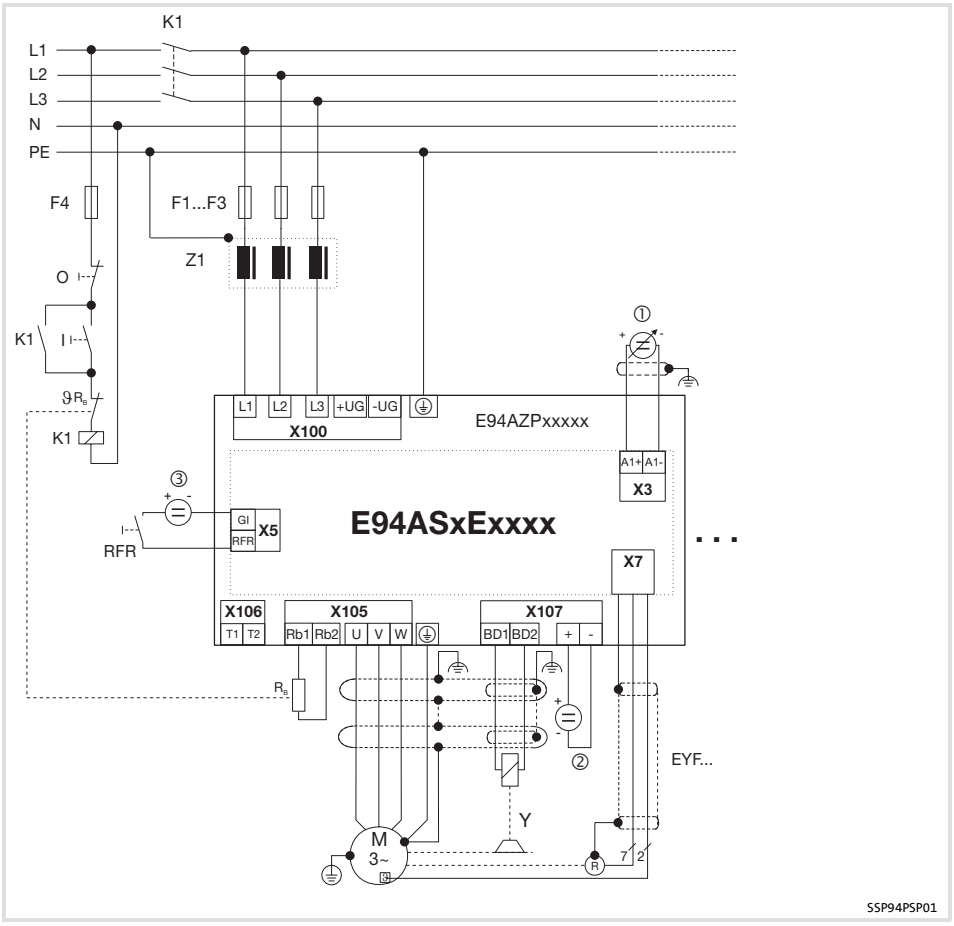


Fig. 4.6-1 Basic circuit diagram of the drive system

E94ASxExxxx	9400 Single Drive servo axis module
E94AZPxxxxx	Installation backplane
F1 ... F4	Fuses
Z1	Mains filter/RFI filter (optional)
⏚	HF shield termination through large-surface connection to functional earth
EYF...	System cable for resolver feedback
RFR	Controller enable
K1	Mains contactor
R	Resolver
RB	Brake resistor
Y	Motor holding brake (connected to optional motor brake control)
①	Speed setpoint selection via analog input 1 (-10 ... 0 ... +10 V)
②	Voltage source for the motor holding brake
③	24-V voltage source for the digital inputs according to IEC 61131-2

Tip!

Complete the wiring of the installation backplane before plugging in the standard device. The upper terminals of the installation backplane cannot be connected with a plugged-in standard device.

Design of the cables

- The cables used must comply with the approvals required for the location (e.g. UL).
- 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 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.

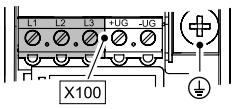
Use system cables or shielded cables for these connections:

- Motor
- Motor holding brake (connected to optional motor brake control)
- Motor temperature monitoring
- External brake resistor (📖 Mounting Instructions of the brake resistor)

The following connections need not be shielded:

- Mains
- DC bus

Mains

Terminal X100 (left part)	Labelling	Description
 SSP940X100	L1 L2 L3	Connection of the mains phases L1, L2, L3
	⏚	Connection for the supply-side PE conductor with M5 ring cable lug

Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device sizes 1+2: flexible with wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 6.2	PZ0
Device size 3: flexible with wire end ferrule	10	6	1.2 ... 1.5	10.6 ... 13.3	PZ1

IT system

Stop!

Overvoltage on components:

On IT systems an earth fault in the installation can cause impermissible overvoltages.

Possible consequences:

Destruction of the device.

Protective measures:

If the devices are operated on IT systems, the internal connection of the filters to the protective earth in the installation backplane has to be disconnected.

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.

Proceed as follows to disconnect the internal connection of the filters to the protective earth:

1. Remove the IT insulating cap from its parking position ①.
   – To do so, place a screw driver at the right or left side and lever off the insulating cap.
   – Alternatively, the insulating cap can be pulled off carefully using an appropriate pair of pliers.
2. Plug the IT insulating cap onto the earthing jumper ② until it snaps into place.

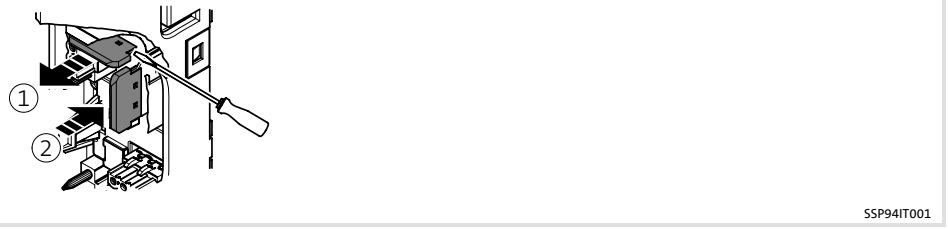
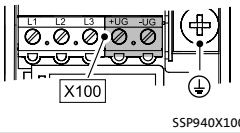


Fig. 4.6-2 Plugging the IT insulating cap onto the earthing jumper

① Remove the IT insulating cap from its parking position.
Place a screw driver at the right or left side and lever off the insulating cap or remove it using pliers.

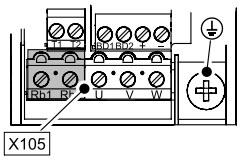
② Plug the IT insulating cap onto the earthing jumper until it snaps into place.

DC bus

Terminal X100 (right part)	Labelling	Description
 SSP940X100	+UG -UG	Alternative option for DC-bus voltage connection (compatible to 9300 series).

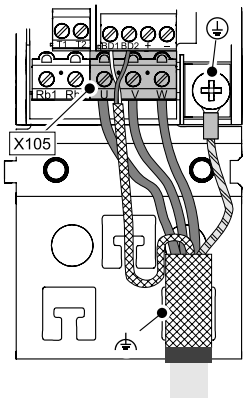
Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device sizes 1+2: flexible with wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 6.2	PZ0
Device size 3: flexible with wire end ferrule	10	6	1.2 ... 1.5	10.6 ... 13.3	PZ1

External brake resistor

Terminal X105 (left part)	Labelling	Description
 SSP94LX105	Rb1 Rb2	External brake resistor

Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device sizes 1+2: flexible with wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 6.2	PZ0
Device size 3: flexible with wire end ferrule	10	6	1.2 ... 1.5	10.6 ... 13.3	PZ1

Motor

Terminal X105 (right part)	Labelling	Description
 SSP940X105	U V W	Connection of the motor phases
	⏚	Functional earth Connect the shields of the motor phases and of the optional motor brake control separately and with a surface as large as possible to the shield sheet. Use EMC wire clamp or EMC shield clamp for fixing.
	⏚	Connection for the PE conductor on the motor side with M5 ring cable lug

Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device sizes 1+2: flexible with wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 6.2	PZ0
Device size 3: flexible with wire end ferrule	10	6	1.2 ... 1.5	10.6 ... 13.3	PZ1

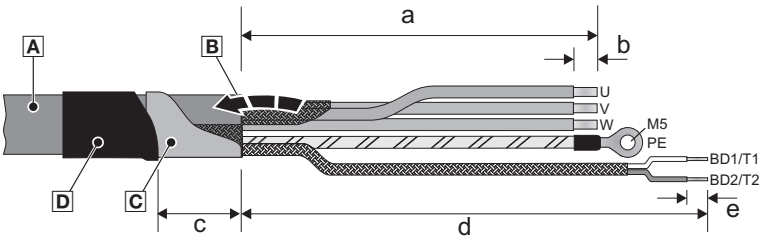
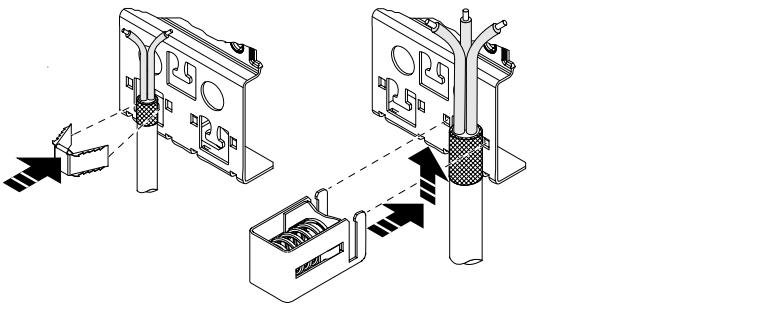


Fig. 4.6-3 Stripping lengths of the motor cable

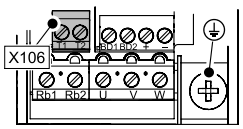
	Dimensions [mm]				
Type	a	b	c	d	e
Device size 1	80	8	25	150	8
Device size 2	90	8	30	160	8
Device size 3	100	10	30	170	8

How to proceed:

1. Strip the motor cable A according to dimensions given.
2. Fold back the shield of the motor cable B over the cable sheath.
3. Stabilise the shield with self-adhesive conductive foil C (recommendation).
4. Fix the shield and conductive foil with heat-shrinkable tube D on the cable sheath.
5. Fasten cable lugs or wire end ferrules.
6. Connect the shields separately to the shield sheet using shield clamps (no strain relief).

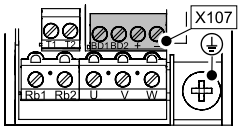


Motor temperature monitoring

Terminal X106	Labelling	Description
 SSP940X106	T1 T2	Motor temperature monitoring with PTC element (type-A sensor, switching performance according to EN 60947-8 for type-A tripping units) or thermostat (NC contact).

Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Flexible With wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 6.2	PZ0

Motor brake control (optional)

Terminal X107	Labelling	Description
 SSP940X107	BD1 BD2	Connection of the motor holding brake + (Lenze: WH) - (Lenze: BN) E94AZHX0051: 24 V DC, max. 2.5 A Observe correct polarity!
	+ / -	Supply voltage for the motor holding brake (18 ... 30 V DC) Observe correct polarity!

Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Flexible With wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 6.2	PZ0

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 on the brake cable (connection BD1/BD2):

- ► The 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).
- ► When using a permanent magnet holding brake, ensure the correct polarity of the brake cable.
  - – If the terminals are reversed, the brake does not release. Since the motor runs against the closed brake, the brake can be destroyed.
- ► Connect the shield on both sides of PE.

Requirements on the supply voltage U_{DC} (connection +/-):

- ► The motor brake control must always be supplied with a separate 24 V supply.
  - – A common supply of the motor brake control and the control card of the controller is not permissible since otherwise the double insulation between both components would be reduced.
- ► Set U_{DC} so that the operating voltage of the brake is within the admissible range and the maximum supply voltage of the motor brake control will not be exceeded.

General electrical data

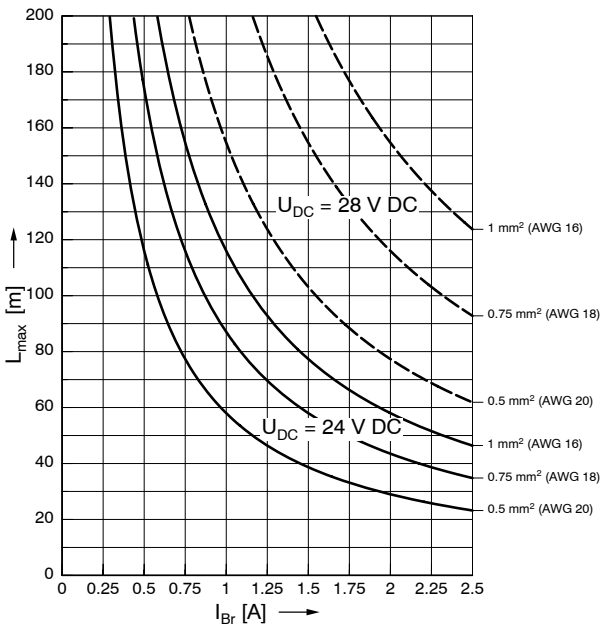
Operating frequency	max. 6/min
Operating times	Can be ignored compared to the delay time of the brake. See documentation of the brake.
Service life	> 10 millions of cycles
Protection against	
Overload	No
Short circuit of the terminals	Yes
Polarity reversal at the input	Yes
Isolation [1)]	Double insulation (EN61800-5-1: V_{rated} = 300 V AC), Separation (UL: V_{rated} = 500 V AC)

1) Brake connection against control card of the controller

Rated data

Type	Voltage U_{DC} [V]	Current I_{DC} [A]	Power P_{DC} [W]	Breaking energy E [Ws]
E94AZHX0051	18 ... 30	0.3 ... 2.5	max. 55	max. 5

Cable lengths



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

4.6.4 Devices in the range 32 ... 104 A (15 ... 55 kW)

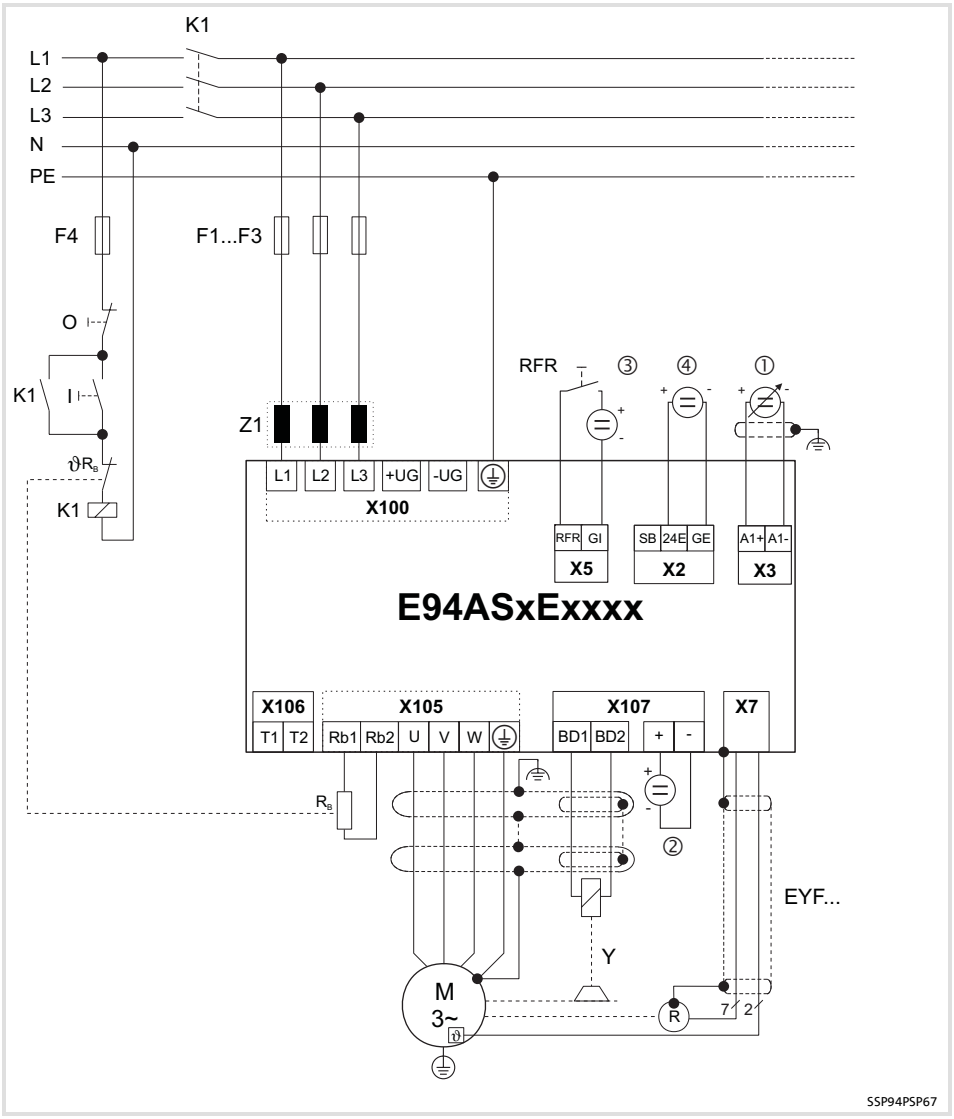


Fig. 4.6-4 Basic circuit diagram of the drive system

E94ASxExxxx	Servo axis module 9400 Single
F1 ... F4	Fuses
Z1	Toroidal core, effective in the high-frequency range 30 ... 60 MHz
⏚	HF-shield termination through large-surface connection to functional earth
EYF...	System cable - resolver feedback
RFR	Controller enable
K1	Mains contactor
R	Resolver
RB	Brake resistor
Y	Motor holding brake (an optimum motor brake control)
①	Speed setpoint selection via analog input 1 (-10 ... 0 ... +10 V)
②	Voltage source for the motor holding brake
③	24-V voltage source for digital inputs according to IEC 61131-2
④	24-V voltage source for the control electronics

Design of the cables

- The cables used must comply with the approvals required for the location (e.g. UL).
- 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 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.

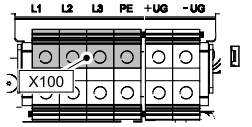
Use system cables or shielded cables for these connections:

- Motor
- Motor holding brake (connected to optional motor brake control)
- Motor temperature monitoring
- External brake resistor (📖 Mounting Instructions of the brake resistor)

The following connections need not be shielded:

- Mains
- DC bus

Mains

Terminal X100 (left part)	Labelling	Description
 SSP94X6100	L1 L2 L3 PE	Connection of the mains phases L1, L2, L3 Connection for the PE conductor on the supply side

Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device size 6: Flexible With wire end ferrule	50	0	10	88.5	Hexagon socket 5
Device size 7: Flexible With wire end ferrule	95	000	14	124	Hexagon socket 5

IT system

STOP

Stop!

Overvoltage on components:

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

Possible consequences:

Destruction of the device.

Protective measures:

When using the devices in IT systems, separate the internal connection of filters to the protective earth. For this purpose carry out the device-specific measure as described.

Proceed as follows to disconnect the internal connection between the filters and PE:

1. Find the screw over terminals X100 (+UG/-UG) in the position ”TT-TN” (📖 Fig. 4.6-5).
2. Unscrew the screw and screw it in again at position ”IT”.
   – Tightening torque: 3.4 Nm (30 lb-in)

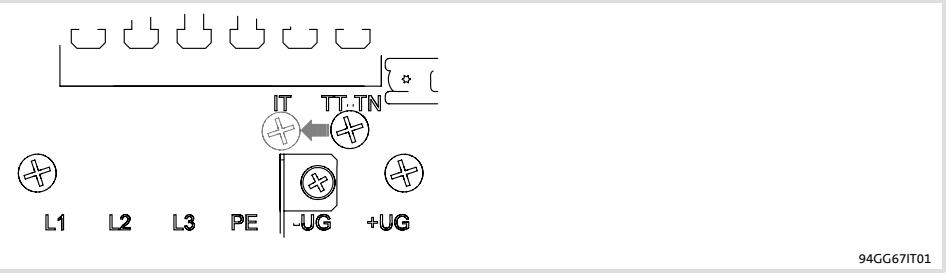
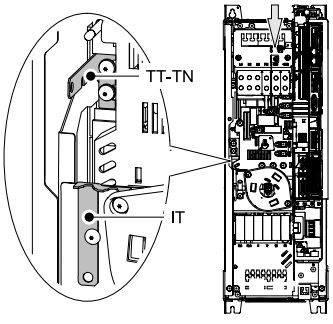


Fig. 4.6-5

3. Find the metal strap on the left of the device (📖 Fig. 4.6-6).
4. Unbolt the screws to remove the metal strap.
5. Unbolt the screw at position ”IT” and insert the metal strap.
6. Tighten all screws.
   – Tightening torque: 3.4 Nm (30 lb-in)

Device size 6



Device size 7

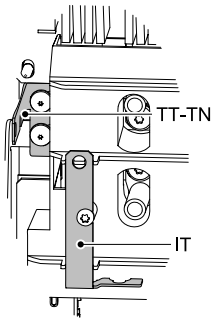
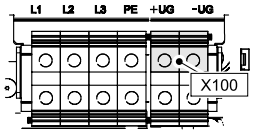


Fig. 4.6-6

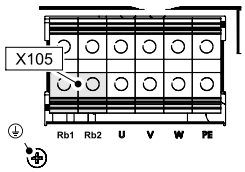
After this, the device is suitable for operation in IT systems.

DC bus

Terminal X100 (right part)	Labelling	Description
 SSP94X6100	+UG -UG	Alternative option for DC-bus voltage connection (compatible to 9300 series).

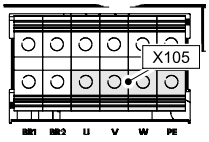
Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device size 6: Flexible With wire end ferrule	50	0	10	88.5	Hexagon socket 5
Device size 7: Flexible With wire end ferrule	95	000	14	124	Hexagon socket 5

External brake resistor

Terminal X105 (left part)	Labelling	Description
 SSP94X6105	Rb1 Rb2	External brake resistor
	⏚	Connection for the PE conductor with M5 ring cable lug

Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device size 6: Flexible With wire end ferrule	50	0	10	88.5	Hexagon socket 5
Device size 7: Flexible With wire end ferrule	95	000	14	124	Hexagon socket 5

Motor

Terminal X105 (right part)	Labelling	Description
 SSP94X6105	U V W PE	Motor phases Connection for the motor-side PE conductor

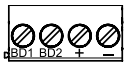
Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device size 6: Flexible With wire end ferrule	50	0	10	88.5	Hexagon socket 5
Device size 7: Flexible With wire end ferrule	95	000	14	124	Hexagon socket 5

Motor temperature monitoring

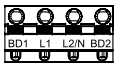
Terminal X106	Labelling	Description
 SSP94X6106	T1 T2	Motor temperature monitoring with PTC element (type-A sensor, switching performance according to EN 60947-8 for type-A tripping units) or thermostat (NC contact).

Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Flexible With wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 6.2	Slot 0.6 x 3.5

Motor brake control (optional)

Terminal X107	Labelling	Description
 SSP94X6107		Connection of the motor holding brake
	BD1 BD2	+ (Lenze: WH) - (Lenze: BN) E94AZHY0101: 24 V DC, max. 5.0 A Observe correct polarity!
	+ / -	Supply voltage for the motor holding brake (18 ... 30 V DC) Observe correct polarity!

Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Flexible With wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 6.2	Slot 0.6 x 3.5

Terminal X107	Labelling	Description
 SSP94A6107		Connection of the motor holding brake:
	BD1 BD2	+ (Lenze: WH) - (Lenze: BN) E94AZHY0025: 205 V DC, max. 0.75 A Ensure correct polarity!
	L1 L2/N	Supply voltage of the motor holding brake

Terminal data	Conductor cross-section		Tightening torque	
	[mm²]	[AWG]	[Nm]	[lb-in]
Flexible With wire end ferrule	0.5 ... 2.5	20 ... 12	Spring terminal	

Stripping length or contact length: 8 mm

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 on the brake cable (connection BD1/BD2):

- ► The 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).
- ► When using a permanent magnet holding brake, ensure the correct polarity of the brake cable.
  - – If the terminals are reversed, the brake does not release. Since the motor runs against the closed brake, the brake can be destroyed.
- ► Connect the shield on both sides of PE.

Requirements on the supply voltage U_{DC} (connection +/-):

- ► The motor brake control must always be supplied with a separate 24 V supply.
  - – A common supply of the motor brake control and the control card of the controller is not permissible since otherwise the double insulation between both components would be reduced.
- ► Set U_{DC} so that the operating voltage of the brake is within the admissible range and the maximum supply voltage of the motor brake control will not be exceeded.

General electrical data

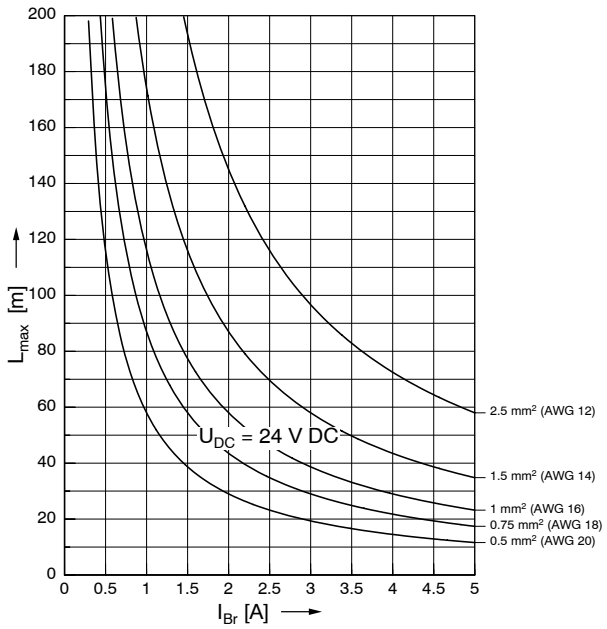
Operating frequency	max. 6/min
Operating times	Can be ignored compared to the delay time of the brake. See documentation of the brake.
Service life	> 10 millions of cycles
Protection against	
Overload	No
Short circuit of the terminals	Yes
Polarity reversal at the input	Yes
Isolation [1]	Double insulation (EN61800-5-1: V_{rated} = 300 V AC), Separation (UL: V_{rated} = 500 V AC)

1) Brake connection against control card of the controller

Rated data

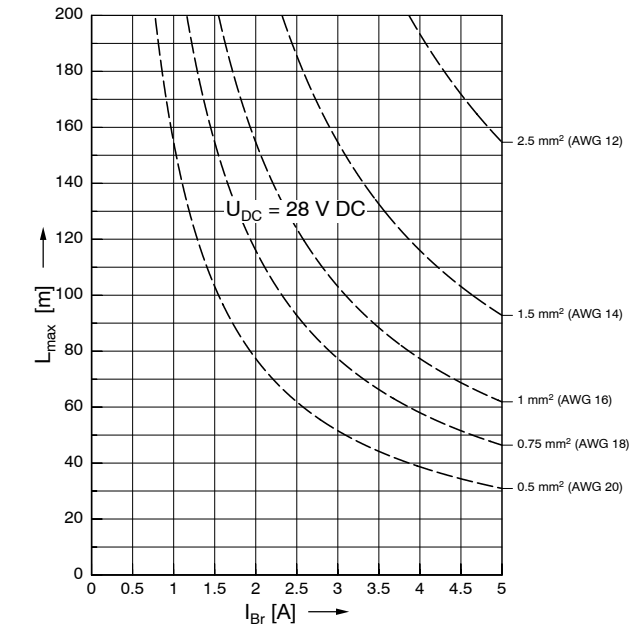
Type	Voltage U_{DC} [V]	Current I_{DC} [A]	Power P_{DC} [W]	Breaking energy E [Ws]
E94AZHY0101	18 ... 30	0.3 ... 5.0	max. 110	max. 10

Supply voltage 24 V



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

Supply voltage 28 V



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

4.6.5 Devices in the range 145 ... 695 A (75 ... 400 kW)

Device size 8S

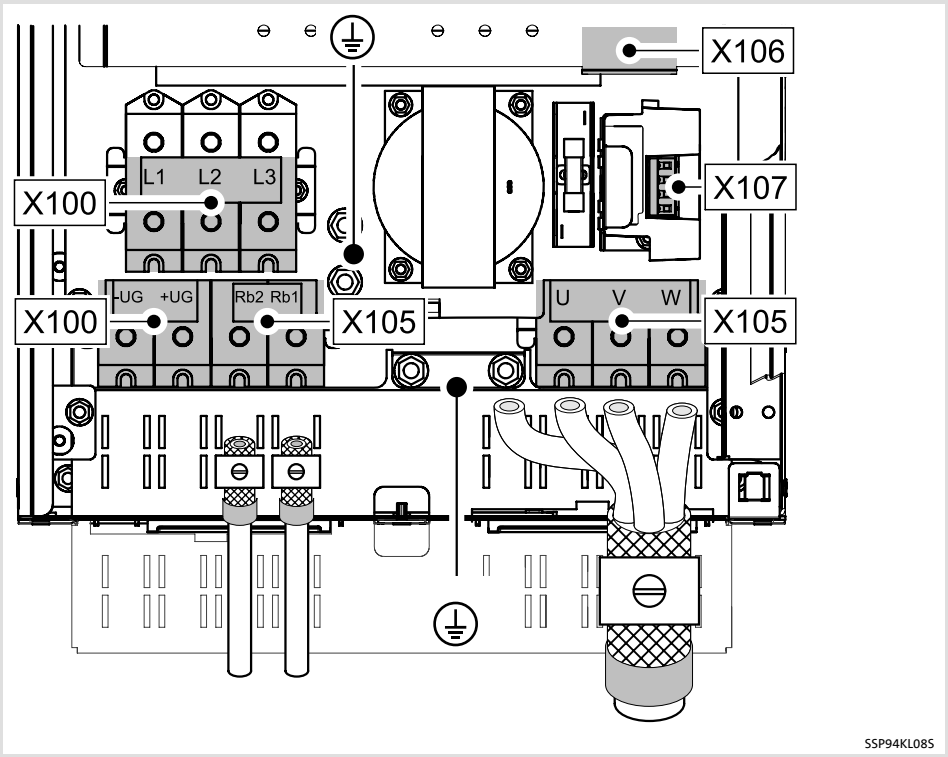


Fig. 4.6-7 Arrangement of the power connections

Tip!

The barrier between mains input and power terminals can be dismounted to have more free space for wiring.

Motor

Terminal X105	Marking	Description
	U V W	Motor phases
SSP94KL0X8	⏚	Connection for the PE conductor on the motor side with M8 ring cable lug

Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device size 8S: Flexible With wire end ferrule	95	000	14	124	Inbus 5
M8 ring cable lug	95	000	9.5	84	WAF 13

External brake resistor

Terminal X105	Labelling	Description
	Rb1 Rb2	Connection of external brake resistor

Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device size 8S: Flexible With wire end ferrule	95	000	14	124	Inbus 5

DC bus

Terminal X100	Labelling	Description
	+UG -UG	Alternative option for DC-bus voltage connection (compatible to 9300 series).

Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device size 8S: Flexible With wire end ferrule	95	000	14	124	Inbus 5

Tip!

Now mount the barrier between mains input and power terminals, if had been removed to have more free space for wiring.

Mains

Terminal X100	Marking	Description
	L1 L2 L3	Connection of the mains phases L1, L2, L3
SSP94KL0X8	⏚	Connection for the PE conductor on the supply side with M8 ring cable lug

Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device size 8S: Flexible With wire end ferrule	95	000	14	124	Inbus 5
M8 ring cable lug	95	000	9.5	84	WAF 13

IT system

Stop!

Overvoltage on components:

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

Possible consequences:

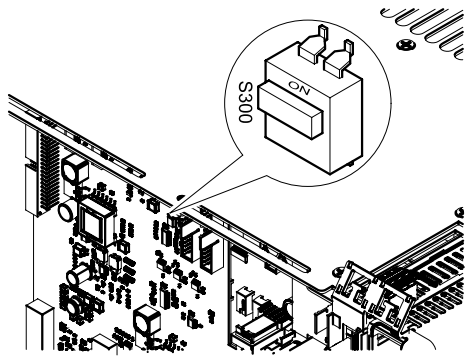
Destruction of the device.

Protective measures:

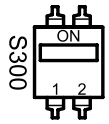
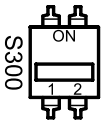
When using the devices in IT systems, separate the internal connection of filters to the protective earth. For this purpose carry out the device-specific measure as described.

How to separate the internal connection of filters to the protective earth:

1. Remove the upper housing cover.
2. The S300 switch can be found on the Interface card. The Interface card is located in the top of the device.
   – ON position: Standard operation at earthed-neutral systems (Lenze).
   – OFF position: Operation at IT systems.
3. Push the S300 switch into the OFF position.



94ITSW8001

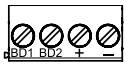
ON - Standard	OFF - IT
	
IF-Card-SW	IF-Card-SW

Motor temperature monitoring

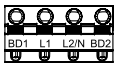
Terminal X106	Labelling	Description
 SSP94X6106	T1 T2	Motor temperature monitoring with PTC element (type-A sensor, switching performance according to EN 60947-8 for type-A tripping units) or thermostat (NC contact).

Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Flexible With wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 6.2	Slot 0.6 x 3.5

Motor brake control (optional)

Terminal X107	Labelling	Description
 SSP94X6107		Connection of the motor holding brake
	BD1 BD2	+ (Lenze: WH) - (Lenze: BN) E94AZHY0101: 24 V DC, max. 5.0 A Observe correct polarity!
	+ / -	Supply voltage for the motor holding brake (18 ... 30 V DC) Observe correct polarity!

Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Flexible With wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 6.2	Slot 0.6 x 3.5

Terminal X107	Labelling	Description
		Connection of the motor holding brake:
	BD1 BD2	+ (Lenze: WH) - (Lenze: BN) E94AZHY0025: 205 V DC, max. 0.75 A Ensure correct polarity!
SSP94A6107	L1 L2/N	Supply voltage of the motor holding brake

Terminal data	Conductor cross-section		Tightening torque	
	[mm²]	[AWG]	[Nm]	[lb-in]
Flexible With wire end ferrule	0.5 ... 2.5	20 ... 12	Spring terminal	

Stripping length or contact length: 8 mm

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 on the brake cable (connection BD1/BD2):

- ► The 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).
- ► When using a permanent magnet holding brake, ensure the correct polarity of the brake cable.
  - – If the terminals are reversed, the brake does not release. Since the motor runs against the closed brake, the brake can be destroyed.
- ► Connect the shield on both sides of PE.

Requirements on the supply voltage U_{DC} (connection +/-):

- ► The motor brake control must always be supplied with a separate 24 V supply.
  - – A common supply of the motor brake control and the control card of the controller is not permissible since otherwise the double insulation between both components would be reduced.
- ► Set U_{DC} so that the operating voltage of the brake is within the admissible range and the maximum supply voltage of the motor brake control will not be exceeded.

General electrical data

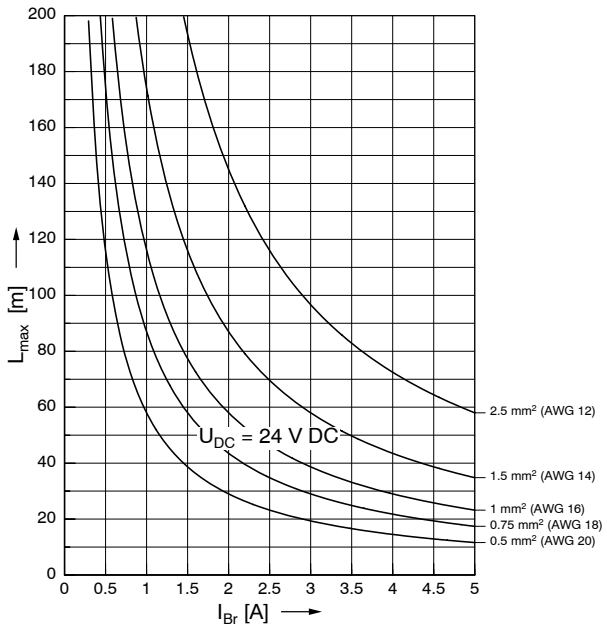
Operating frequency	max. 6/min
Operating times	Can be ignored compared to the delay time of the brake. See documentation of the brake.
Service life	> 10 millions of cycles
Protection against	
Overload	No
Short circuit of the terminals	Yes
Polarity reversal at the input	Yes
Isolation [1]	Double insulation (EN61800-5-1: V_{rated} = 300 V AC), Separation (UL: V_{rated} = 500 V AC)

1) Brake connection against control card of the controller

Rated data

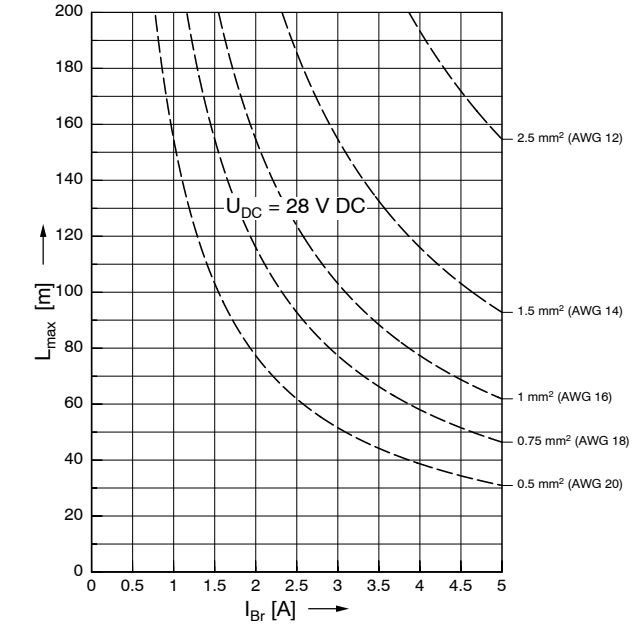
Type	Voltage U_{DC} [V]	Current I_{DC} [A]	Power P_{DC} [W]	Breaking energy E [Ws]
E94AZHY0101	18 ... 30	0.3 ... 5.0	max. 110	max. 10

Supply voltage 24 V



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

Supply voltage 28 V



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

Device sizes 8 and 9

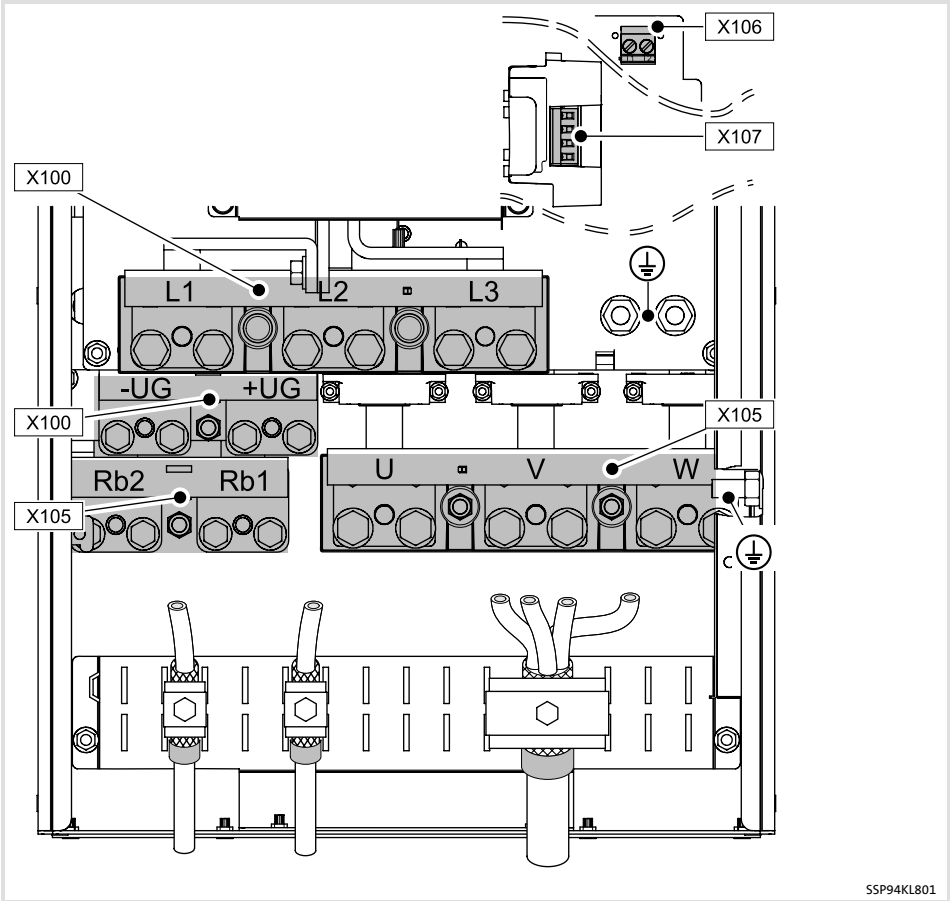


Fig. 4.6-8 Arrangement of the power connections

Tip!

The barrier between mains input and power terminals can be dismounted to have more free space for wiring.

Motor

Terminal X105	Marking	Description
Connection with ring cable lug for M10	U V W	Connection of the motor phases
SSP94KL801	⏚	Connection for the PE conductor on the motor side

Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device size 8: E94ASxE1724 E94ASxE2024	2 x 240	2 x 500 mcm	19	168	WAF 16
Device size 9: E94ASxE2454 E94ASxE2924 E94ASxE3664					

External brake resistor

Terminal X105	Marking	Description
Connection with ring cable lug for M8 SSP94KL801	Rb1 Rb2	Connection of external brake resistor

Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device size 8: E94ASxE1724 E94ASxE2024	2 x 240	2 x 500 mcm	9.5	84	WAF 13
Device size 9: E94ASxE2454 E94ASxE2924 E94ASxE3664					

DC bus

Terminal X100	Marking	Description
Connection with ring cable lug for M8 SSP94KL801	+UG -UG	Alternative option for DC-bus voltage connection (compatible to 9300 series).

Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device size 8: E94ASxE1724 E94ASxE2024	2 x 240	2 x 500 mcm	9.5	84	WAF 13
Device size 9: E94ASxE2454 E94ASxE2924 E94ASxE3664					

Tip!

Now mount the barrier between mains input and power terminals, if had been removed to have more free space for wiring.

Mains

Terminal X100	Marking	Description
Connection with ring cable lug for M10	L1 L2 L3	Connection of the mains phases
SSP94KL801	⏚	Connection for the PE conductor on the supply side

Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device size 8: E94ASxE1724 E94ASxE2024	2 x 240	2 x 500 mcm	19	168	WAF 16
Device size 9: E94ASxE2454 E94ASxE2924 E94ASxE3664					

IT system

Stop!

Overvoltage on components:

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

Possible consequences:

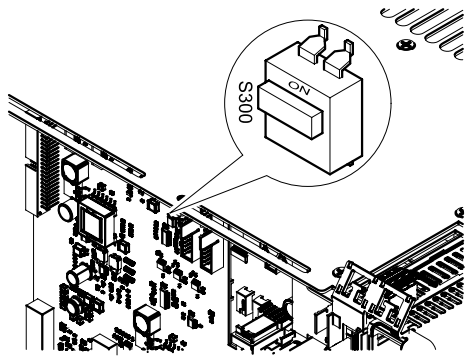
Destruction of the device.

Protective measures:

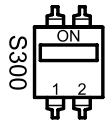
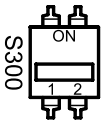
When using the devices in IT systems, separate the internal connection of filters to the protective earth. For this purpose carry out the device-specific measure as described.

How to separate the internal connection of filters to the protective earth:

1. Remove the upper housing cover.
2. The S300 switch can be found on the Interface card. The Interface card is located in the top of the device.
   – ON position: Standard operation at earthed-neutral systems (Lenze).
   – OFF position: Operation at IT systems.
3. Push the S300 switch into the OFF position.



94ITSW8001

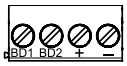
ON - Standard	OFF - IT
	
IF-Card-SW	IF-Card-SW

Motor temperature monitoring

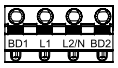
Terminal X106	Labelling	Description
 SSP94X6106	T1 T2	Motor temperature monitoring with PTC element (type-A sensor, switching performance according to EN 60947-8 for type-A tripping units) or thermostat (NC contact).

Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Flexible With wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 6.2	Slot 0.6 x 3.5

Motor brake control (optional)

Terminal X107	Labelling	Description
 SSP94X6107	BD1 BD2	Connection of the motor holding brake + (Lenze: WH) - (Lenze: BN) E94AZHY0101: 24 V DC, max. 5.0 A Observe correct polarity!
	+ / -	Supply voltage for the motor holding brake (18 ... 30 V DC) Observe correct polarity!

Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Flexible With wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 6.2	Slot 0.6 x 3.5

Terminal X107	Labelling	Description
 SSP94A6107		Connection of the motor holding brake:
	BD1 BD2	+ (Lenze: WH) - (Lenze: BN) E94AZHY0025: 205 V DC, max. 0.75 A Ensure correct polarity!
	L1 L2/N	Supply voltage of the motor holding brake

Terminal data	Conductor cross-section		Tightening torque	
	[mm²]	[AWG]	[Nm]	[lb-in]
Flexible With wire end ferrule	0.5 ... 2.5	20 ... 12	Spring terminal	

Stripping length or contact length: 8 mm

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 on the brake cable (connection BD1/BD2):

- ► The 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).
- ► When using a permanent magnet holding brake, ensure the correct polarity of the brake cable.
  - – If the terminals are reversed, the brake does not release. Since the motor runs against the closed brake, the brake can be destroyed.
- ► Connect the shield on both sides of PE.

Requirements on the supply voltage U_{DC} (connection +/-):

- ► The motor brake control must always be supplied with a separate 24 V supply.
  - – A common supply of the motor brake control and the control card of the controller is not permissible since otherwise the double insulation between both components would be reduced.
- ► Set U_{DC} so that the operating voltage of the brake is within the admissible range and the maximum supply voltage of the motor brake control will not be exceeded.

General electrical data

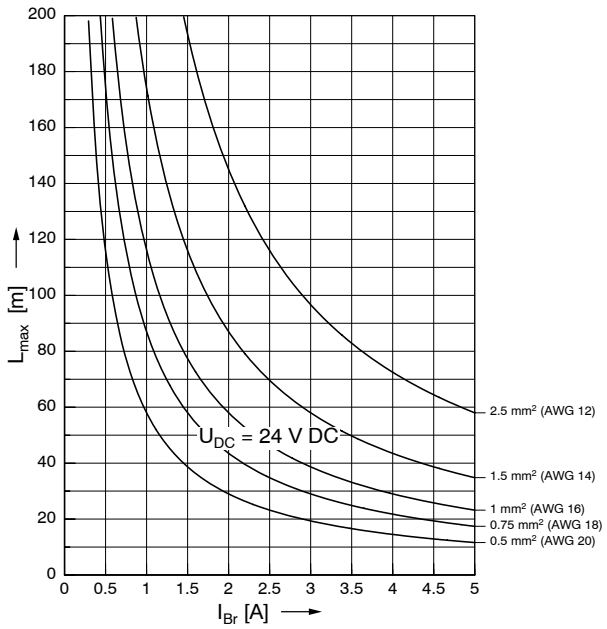
Operating frequency	max. 6/min
Operating times	Can be ignored compared to the delay time of the brake. See documentation of the brake.
Service life	> 10 millions of cycles
Protection against	
Overload	No
Short circuit of the terminals	Yes
Polarity reversal at the input	Yes
Isolation [1]	Double insulation (EN61800-5-1: V_{rated} = 300 V AC), Separation (UL: V_{rated} = 500 V AC)

1) Brake connection against control card of the controller

Rated data

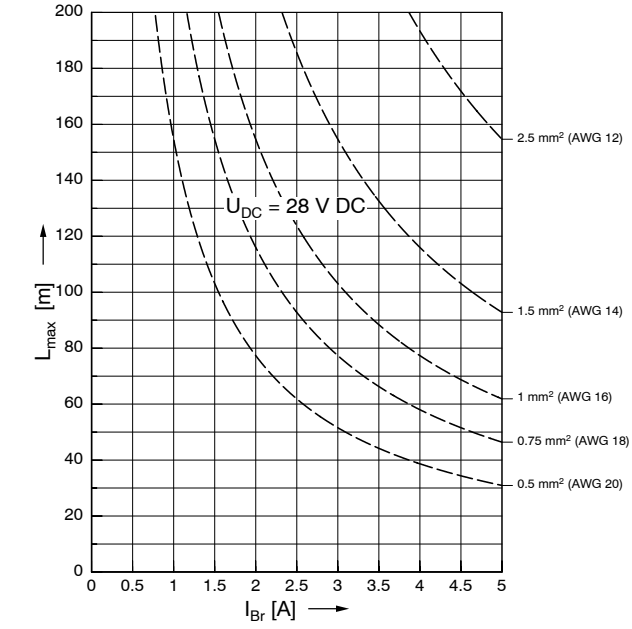
Type	Voltage U_{DC} [V]	Current I_{DC} [A]	Power P_{DC} [W]	Breaking energy E [Ws]
E94AZHY0101	18 ... 30	0.3 ... 5.0	max. 110	max. 10

Supply voltage 24 V



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

Supply voltage 28 V



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

Device size 10

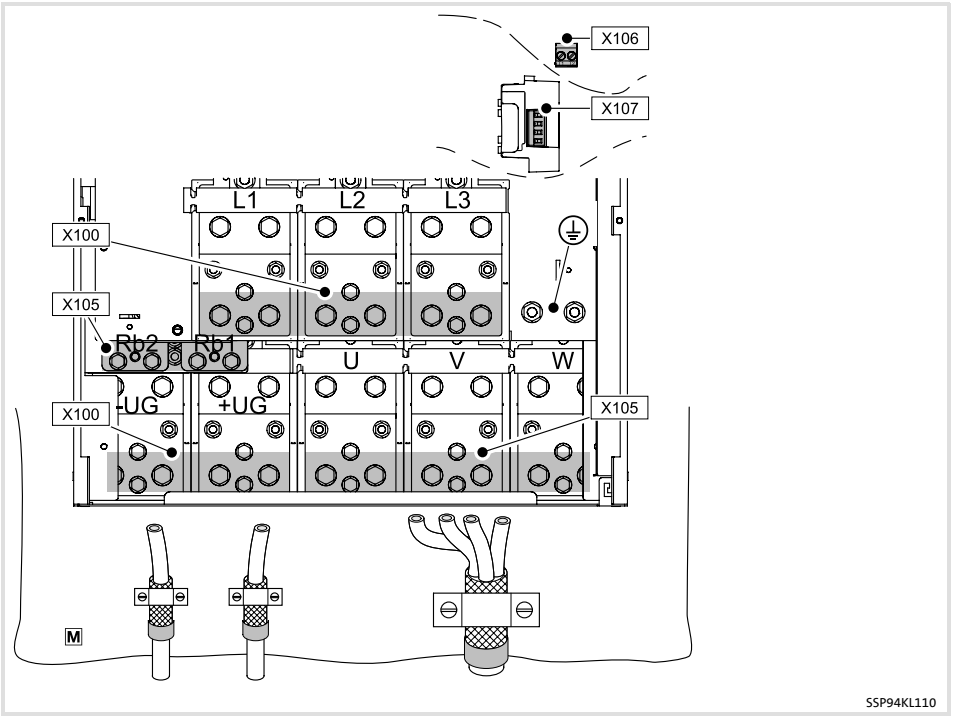


Fig. 4.6-9 Arrangement of the power connections

M Mounting plate
The shield of singles cores and multi-core cables must be connected to the mounting plate M of the control cabinet.

Motor

Terminal X105	Marking	Description
Connection with ring cable lug for M10	U V W	Connection of the motor phases
SSP94KL801	⏚	Connection for the PE conductor on the motor side

Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device size 10: E94ASxE4604 E94ASxE5724 E94ASxE6354 E94ASxE6954	2 x 400 3 x 150	2 x 750 mcm 3 x 350 mcm	19	168	WAF 16

External brake resistor

Terminal X105	Marking	Description
Connection with ring cable lug for M8	Rb1 Rb2	Connection of external brake resistor
SSP94KL801		

Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device size 10: E94ASxE4604 E94ASxE5724 E94ASxE6354 E94ASxE6954	2 x 70	2 x 00	19	168	13

DC bus

Terminal X100	Labelling	Description
Connection with ring cable lug for M10	+Ug -Ug	Alternative option for DC-bus voltage connection (compatible to 9300 series).

Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device size 10: E94ASxE4604 E94ASxE5724 E94ASxE6354 E94ASxE6954	2 x 400 3 x 150	2 x 750 mcm 3 x 350 mcm	19	168	WAF 16

Mains

Terminal X100	Marking	Description
Connection with ring cable lug for M10	L1 L2 L3	Connection of the mains phases
SSP94KL801	⏚	Connection for the PE conductor on the supply side

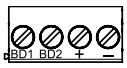
Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device size 10: E94ASxE4604 E94ASxE5724 E94ASxE6354 E94ASxE6954	2 x 400 3 x 150	2 x 750 mcm 3 x 350 mcm	19	168	WAF 16

Motor temperature monitoring

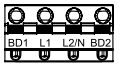
Terminal X106	Labelling	Description
 SSP94X6106	T1 T2	Motor temperature monitoring with PTC element (type-A sensor, switching performance according to EN 60947-8 for type-A tripping units) or thermostat (NC contact).

Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Flexible With wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 6.2	Slot 0.6 x 3.5

Motor brake control (optional)

Terminal X107	Labelling	Description
 SSP94X6107	BD1 BD2	Connection of the motor holding brake + (Lenze: WH) - (Lenze: BN) E94AZHY0101: 24 V DC, max. 5.0 A Observe correct polarity!
	+ / -	Supply voltage for the motor holding brake (18 ... 30 V DC) Observe correct polarity!

Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Flexible With wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 6.2	Slot 0.6 x 3.5

Terminal X107	Labelling	Description
		Connection of the motor holding brake:
	BD1 BD2	+ (Lenze: WH) - (Lenze: BN) E94AZHY0025: 205 V DC, max. 0.75 A Ensure correct polarity!
SSP94A6107	L1 L2/N	Supply voltage of the motor holding brake

Terminal data	Conductor cross-section		Tightening torque	
	[mm²]	[AWG]	[Nm]	[lb-in]
Flexible With wire end ferrule	0.5 ... 2.5	20 ... 12	Spring terminal	

Stripping length or contact length: 8 mm

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 on the brake cable (connection BD1/BD2):

- ► The 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).
- ► When using a permanent magnet holding brake, ensure the correct polarity of the brake cable.
  - – If the terminals are reversed, the brake does not release. Since the motor runs against the closed brake, the brake can be destroyed.
- ► Connect the shield on both sides of PE.

Requirements on the supply voltage U_{DC} (connection +/-):

- ► The motor brake control must always be supplied with a separate 24 V supply.
  - – A common supply of the motor brake control and the control card of the controller is not permissible since otherwise the double insulation between both components would be reduced.
- ► Set U_{DC} so that the operating voltage of the brake is within the admissible range and the maximum supply voltage of the motor brake control will not be exceeded.

General electrical data

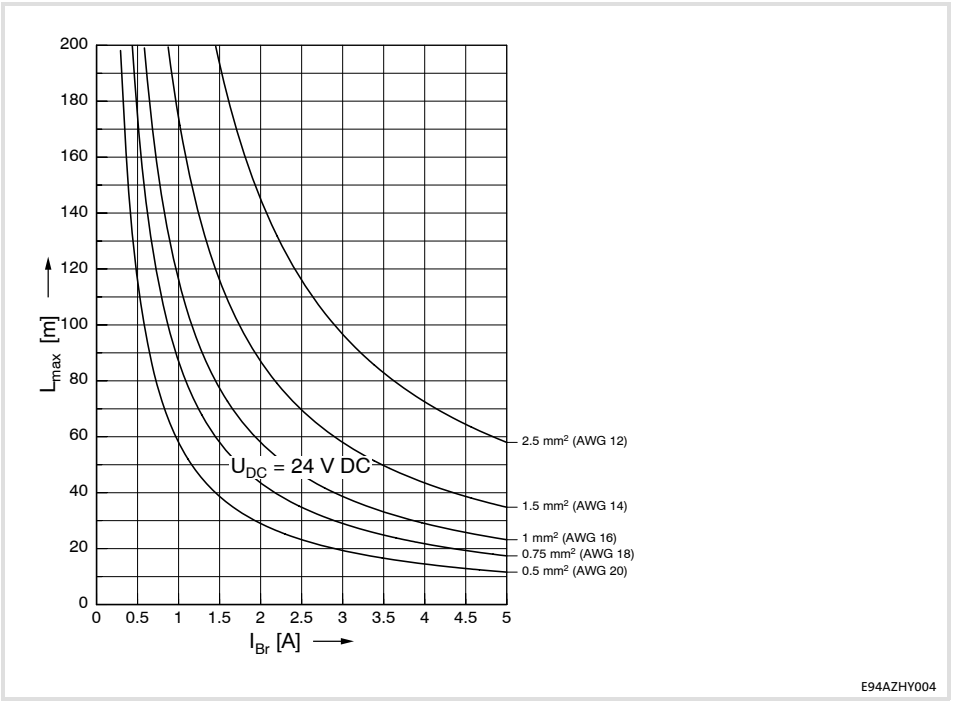
Operating frequency	max. 6/min
Operating times	Can be ignored compared to the delay time of the brake. See documentation of the brake.
Service life	> 10 millions of cycles
Protection against	
Overload	No
Short circuit of the terminals	Yes
Polarity reversal at the input	Yes
Isolation [1)]	Double insulation (EN61800-5-1: V_{rated} = 300 V AC), Separation (UL: V_{rated} = 500 V AC)

1) Brake connection against control card of the controller

Rated data

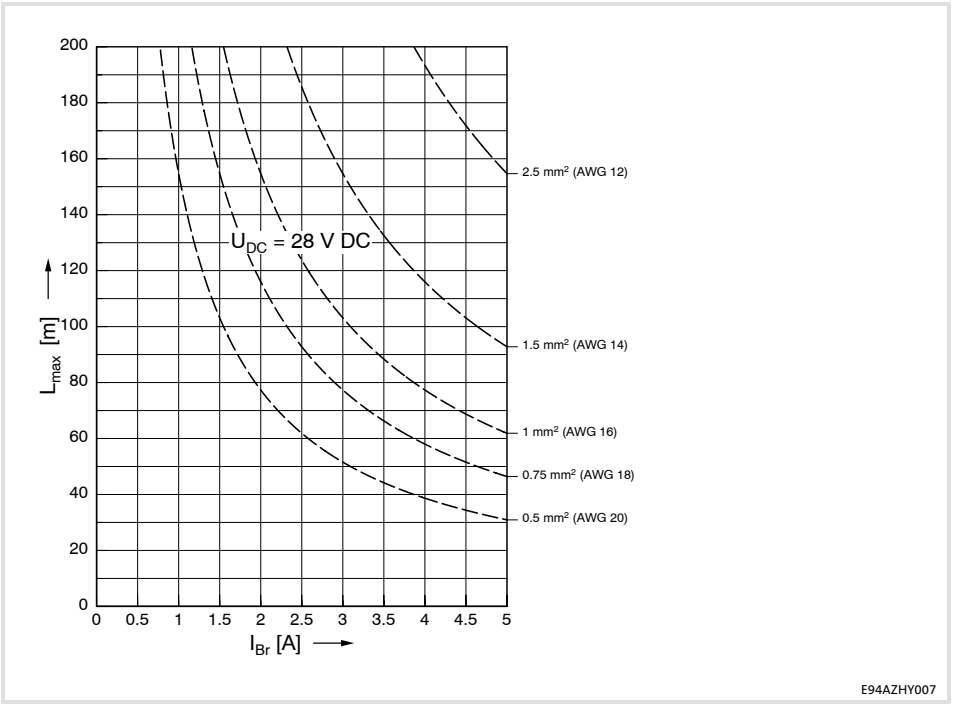
Type	Voltage U_{DC} [V]	Current I_{DC} [A]	Power P_{DC} [W]	Breaking energy E [Ws]
E94AZHY0101	18 ... 30	0.3 ... 5.0	max. 110	max. 10

Supply voltage 24 V



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

Supply voltage 28 V



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

4.7 Control terminals

Danger!

Dangerous voltage

All power terminals remain live for at least three minutes after mains disconnection.

Possible consequences:

► Death or severe injuries when touching the power terminals.

Protective measures:

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

► Check that all power terminals are deenergised.

Stop!

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

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

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.

Use system cables or shielded cables for these connections:

- Analog signals (inputs and outputs)
- System bus CAN
- Resolver
- Encoder

The following connections need not be shielded:

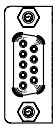
- 24 V supply
- Digital signals (inputs and outputs)

Tip!

Parameter setting and configuration can be carried out using the L-force »Engineer«. For this purpose the Online Help and the Software Manual for the standard device will guide you.

System bus CAN on board

The controller features an integrated CANopen system bus interface to exchange process data and parameter values between different nodes and to connect further modules as e.g. distributed terminals, operator and input devices (”HMIs”) and external control units.

Terminal X1	Labelling	Description
 9400SSP000X1	Pin 2	CAN-LOW
	Pin 3	CAN-GND
	Pin 7	CAN-HIGH
	(Housing)	CAN-Shield

Note!

The X1 connection is not available in the ”StateLine” design.

24 V supply

The controller generates the supply voltage for the control electronics from the mains voltage. As an option, the supply voltage can be fed by a mains-independent 24 V source. Thus, the control functions remain active even after power is removed.

Electrical data		
24 V	Rated voltage	24 V According to IEC 61131-2
	Voltage range	19.2 ... 28.8 V Residual ripple max. ± 5 %
	Current consumption	Approx. 1.2 A during operation Max. 3 A starting current for 100 ms
	Fuse	Circuit breaker with tripping characteristic B or C, Standard blade-type fuses
	Looping through	Max. 12 devices with 2.5 mm^2 Fusing: 16/15 A
		Max. 8 devices with 1.5 mm^2 Fusing: 10/10 A
	Connectable cross-sections	See terminal data
	Cable length	Max. 5 m

Warnings!

In UL-approved systems the fuse of the 24 V supply must not exceed 4 A.

State bus

The state bus is a bus system exclusively designed for Lenze controllers via which up to 20 controllers can be connected and which serves to simulate a ”release cord” function. The state is controlled via the system module SFBDigitalOutput.

- The state bus knows the states ”OK” and ”fault”.
- The state bus is multi-master-compliant, i.e. each node connected to the state bus can set the state bus to ”fault” by changing to LOW level.
- In the ”fault” status, all nodes activate their programmed response, e.g. synchronised braking of the drive system.

Stop!

Do not connect an external voltage to the state bus, otherwise the function will be disturbed.

Electrical data		
State bus	Rated voltage	24 V According to IEC 61131-2
	Looping through	Max. 20 devices DC-bus operation with 9300 devices is possible.
	Connectable cross-cuttings	See terminal data
	Cable length	Max. 5 m

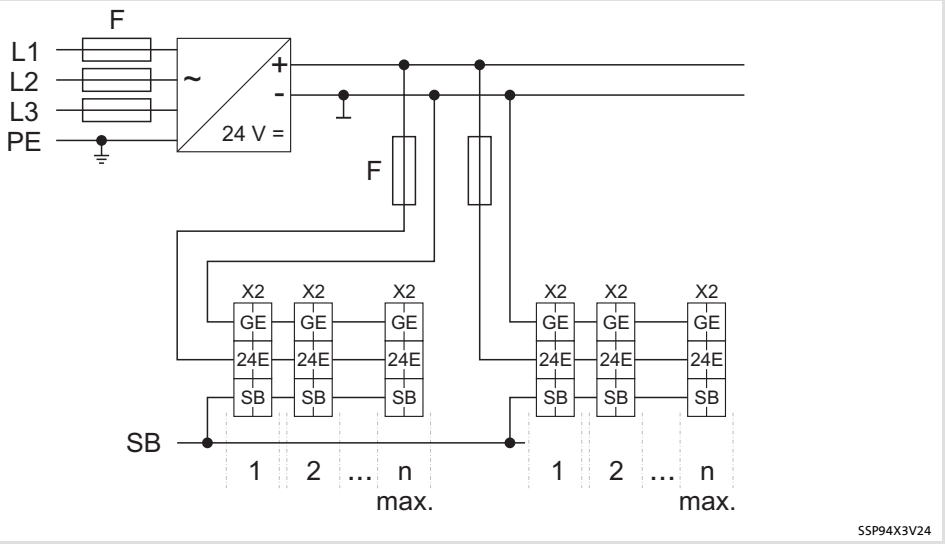


Fig. 4.7-1 Wiring principle

L1 ... L3	Mains phases
PE	Protective earth
F	Fuse
X2	Terminal for 24 V and state bus
GE/24E/SB	Labelling on the terminal
SB	State bus
1 ... 7	Device number during loop-through connection

Terminal X2	Labelling	Description
	GE	GND external supply
	24E	24 V external supply via a safely separated power supply unit (SELV/PELV) (only required for mains-independent supply of the control electronics)
9400SSP000X2	SB	State bus in/out (reference GE)

Terminal data	Conductor cross-section		Tightening torque	
	[mm²]	[AWG]	[Nm]	[lb-in]
Flexible	0.2 ... 2.5	24 ... 12	Spring terminal	
With wire end ferrule				

Analog inputs, analog outputs

The controller features two analog inputs which are able to detect differential voltage signals in the range ±10 V, e.g. an analog speed setpoint selection or the voltage signal of an external sensor (temperature, pressure, etc.).

► The analog signal 1 can also detect a current setpoint.

The controller features two analog outputs, which can output internal analog signals as voltage signals, e.g. for the control of analog indicating instruments or as a setpoint for slave drives.

Electrical data		
Analog input 1 Analog input 2	Level:	-10 V ... +10 V
	Resolution:	11 bits + sign
	Scaling:	±10 V ≡ ±16384
Analog input 1 as current input (A1R and A1- bridged)	Level:	-20 mA ... +20 mA
	Resolution:	10 bits + sign
	Scaling:	±20 mA ≡ ±16384
	Open-circuit monitoring:	Configurable
Analog output 1 Analog output 2	Level:	-10 V ... +10 V, max. 2 mA
	Resolution:	11 bits + sign
	Scaling:	±16384 ≡ ±10 V

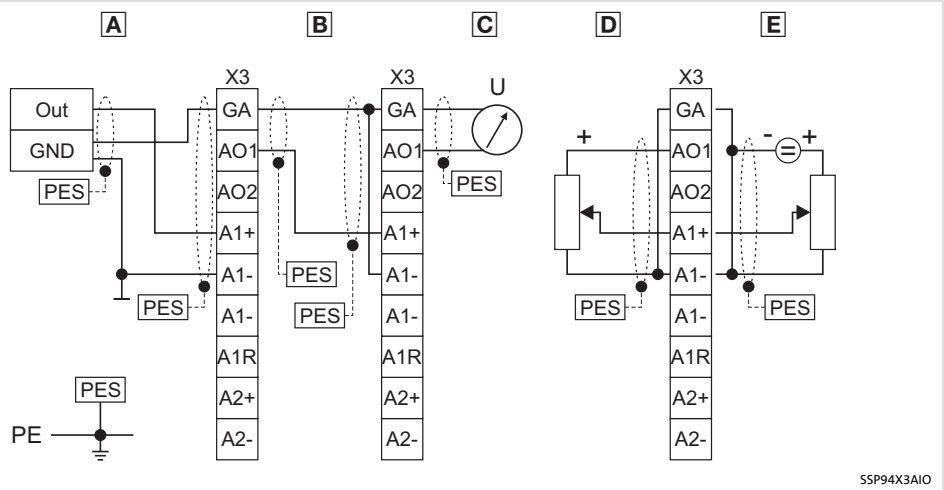
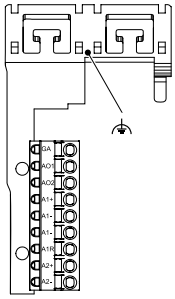


Fig. 4.7-2 Wiring principle

A	Wiring of an external analog signal
B	Wiring with a slave drive
C	Wiring with a measuring device
D	Potentiometer supplied by analog output 1
E	Potentiometer with external supply
Out	Analog output signal, e.g. of a control
GND	Earth reference potential
X3	Terminal for the analog inputs and outputs
PES	EMC shield connection
PE	Protective earth
U	Measuring device

"HighLine" version:

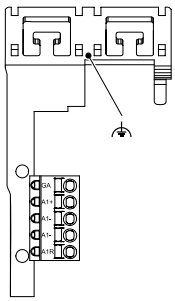
Terminal X3	Labelling	Description
 SSP94000X3	GA	GND analog signals
	AO1	Analog output 1
	AO2	Analog output 2
	A1+	Analog input 1 +
	A1-	Analog input 1 -
	A1-	Analog input 1 -
	A1R	Terminating resistor for ±20mA
	A2+	Analog input 2 +
	A2-	Analog input 2 -
	⏚	Shield connection: Fix the shield with EMC wire clamp.

Terminal data	Conductor cross-section		Tightening torque	
	[mm²]	[AWG]	[Nm]	[lb-in]
Flexible	0.2 ... 2.5	24 ... 12	Spring terminal	
With wire end ferrule				

Note!

If the control terminals are completely wired, we recommend to use a cable cross-section of max. 0.75 mm² to save space. The mechanical cover can then be attached.

"StateLine" version:

Terminal X3	Labelling	Description
 SSP94SL0X3	GA	GND analog signals
	A1+	Analog input 1 +
	A1-	Analog input 1 -
	A1-	Analog input 1 -
	A1R	Terminating resistor for ±20mA
	⏚	Shield connection: Fix the shield with EMC wire clamp.

Digital outputs

The controller features four freely configurable digital outputs.

Electrical data		
24O (external voltage source, optional)	Rated voltage	24 V According to IEC 61131-2
	Current consumption	Max. 300 mA
DO1 ... DO4	Switching level	According to IEC 61131-2
	LOW	0 V ... +5 V
	HIGH	+15 V ... +30 V
	Output current	Max. 50 mA
	Load	> 480 Ω at 24 V

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.

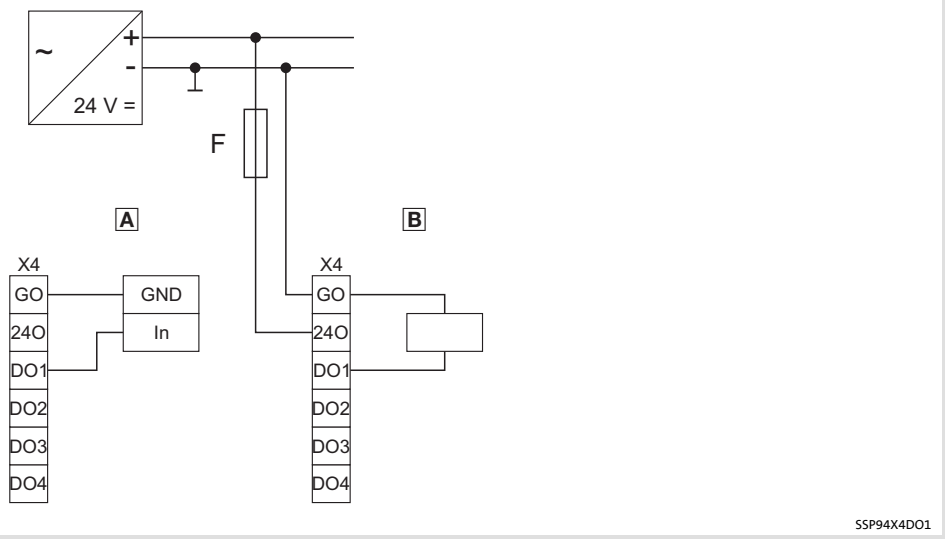
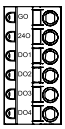


Fig. 4.7-3 Wiring principle

A	Wiring with a digital input, e.g. a PLC
B	Digital control (relay, valve, ...) with an external 24-V supply
X4	Terminal for the digital outputs
In	Digital input, e.g. of a control
GND	Earth reference potential
F	Fuse

”HighLine” version:

Terminal X4	Labelling	Description
	GO	GND digital out
	24O	24-V digital out
	DO1	Digital output 1
	DO2	Digital output 2
	DO3	Digital output 3
9400SSP000X4	DO4	Digital output 4

Terminal data	Conductor cross-section		Tightening torque	
	[mm²]	[AWG]	[Nm]	[lb-in]
Flexible	0.2 ... 2.5	24 ... 12	Spring terminal	
With wire end ferrule				

”StateLine” version:

Terminal X4	Labelling	Description
	GO	GND digital out
	24O	24-V digital out
9400SSPxxx	DO1	Digital output 1

Digital inputs

The drive controller is equipped with freely configurable digital inputs.

- The following digital inputs are with touch-probe capability (edge-controlled event)):
  - "HighLine": all inputs
  - "StateLine": DI1
- The control input RFR for controller enable is firmly connected with the device control. It must be wired to enable the controller with a HIGH signal.

Electrical data		
24O (external voltage source, optional)	Rated voltage	24 V According to IEC 61131-2
	Current consumption	Max. 50 mA
RFR DI1 ... DI8	Switching level	According to IEC 61131-2
	LOW	0 V ... +5 V
	HIGH	+15 V ... +30 V
	Input current	Max. 8 mA

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.

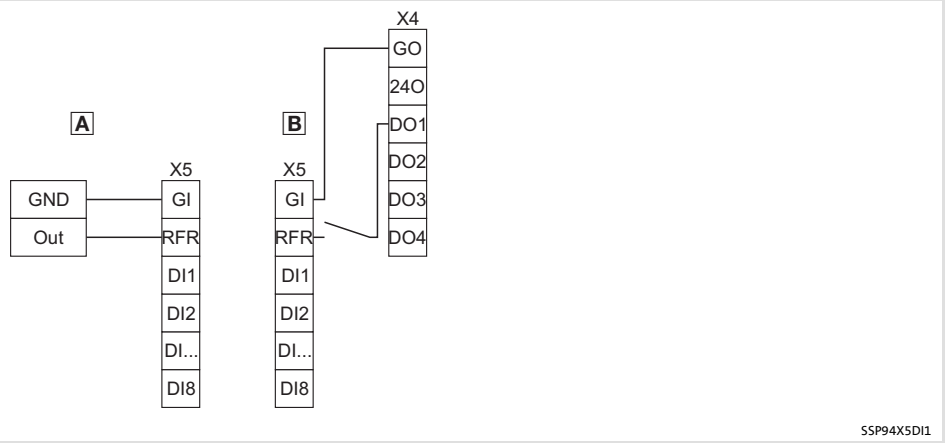
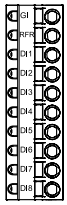


Fig. 4.7-4 Wiring principle

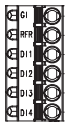
A	Wiring of an external digital signal, e.g. a PLC
B	Wiring with a slave drive
X4	Terminal for the digital outputs
X5	Terminal for the digital inputs
Out	digital output signal, e.g. of a control
GND	Earth reference potential

”HighLine” version:

Terminal X5	Labelling	Description
	GI	GND digital in
	RFR	Controller enable
	DI1	Digital input 1
	DI2	Digital input 2
	DI3	Digital input 3
	DI4	Digital input 4
	DI5	Digital input 5
	DI6	Digital input 6
	DI7	Digital input 7
9400SSP000X5	DI8	Digital input 8

Terminal data	Conductor cross-section		Tightening torque	
	[mm²]	[AWG]	[Nm]	[lb-in]
Flexible	0.2 ... 2.5	24 ... 12	Spring terminal	
With wire end ferrule				

”StateLine” version:

Terminal X5	Labelling	Description
	GI	GND digital in
	RFR	Controller enable
	DI1	Digital input 1
	DI2	Digital input 2
	DI3	Digital input 3
9400SSPxxx	DI4	Digital input 4

Diagnostics/keypad

The following can be connected to this interface:

► USB diagnostic adapter E94AZCUS

or

► Keypad E94AZKAE.

The diagnostic adapter and a computer with the Lenze software »Engineer« serve to carry out comprehensive settings, e.g. for initial commissioning.

The keypad enables experienced users to check or change individual settings.

Terminal X6	Labelling	Description
		Internal interface, RJ69 socket, for keypad or diagnostic adapter
9400SSP000X6		

Resolver

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

The use of third-party resolvers is permissible. For this purpose the number of pole pairs of the resolver in C00080 must be adapted to the resolver used. When the stator coils are excited with 4 kHz, the apparent impedance of the connected resolver must not fall below 65 Ohm. When lower impedances are connected, the overload protection integrated in the resolver output limits the output current and can falsify the resolver evaluation.

Resolvers are operated in reverse mode:

- ► Supply to the sine and cosine track,
- ► Both signals are controlled in a way that the current flow on the reference track is reduced to zero.

Electrical data		
General	Cable length (system cable recommended)	Max. 150 m
V_{CC}	Supply voltage	5 V
	Maximum output current	110 mA
+REF, -REF	Input frequency	Max. 250 kHz
+COS, -COS +SIN, -SIN	Excitation voltage	10 V_{SS}
	Carrier frequency	4 kHz, fix
+KTY, -KTY	Type	KTY 83-110

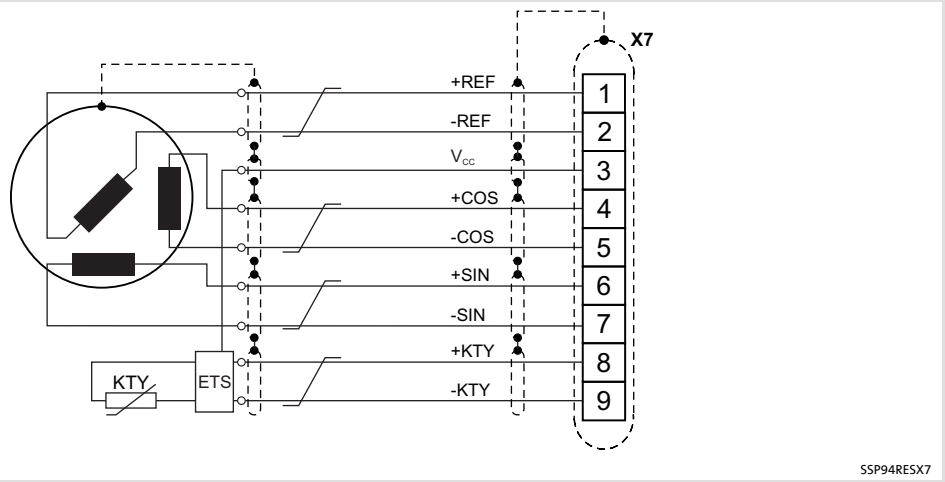
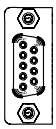


Fig. 4.7-5 Wiring principle

Terminal X7	Labelling	Description
	1	+REF
	2	-REF
	3	V_{CC}
	4	+COS
	5	-COS
	6	+SIN
	7	-SIN
	8	+KTY
9400SSP000X7	9	-KTY

Encoder

Encoders are connected to X8 (15-pole Sub-D socket).

- Absolute and incremental encoders are supported:
  - TTL encoder 5 V (incremental)
  - Sin/cos encoder 1 V_{ss} (incremental)
  - Sin/cos absolute value encoder 1 V_{ss} with Hiperface protocol
  - Sin/cos absolute value encoder 1 V_{ss} with EnDat protocol (2.1)
- Improved determination of low speeds with TTL encoders through additional time measuring method.
- SinCos absolute value encoders are serially read during initialisation (power-on). After this, the sin/cos signals are evaluated.
- Open-circuit monitoring:
  - for sin/cos encoders by comparing the sin/cos signals with the sine shape (radius monitoring)
  - for TTL encoders by means of mean value and amplitude monitoring
- The following encoders are not supported:
  - HTL encoders
  - SSI encoders

Electrical data		
General	Cable length (system cable recommended)	Max. 150 m
	Encoder types	TTL 1 V_{SS}
	Protocols	Hiperface EnDat 2.1
	Number of increments	1 ... 16384
	Input frequency	Max. 250 kHz
VCC (GND)	Supply voltage	5 V ... 9 V
	Current	Max. 250 mA
+Sense, -Sense	Measuring lead for readjusting V_{CC}	
+KTY, -KTY	Type	KTY 83-110

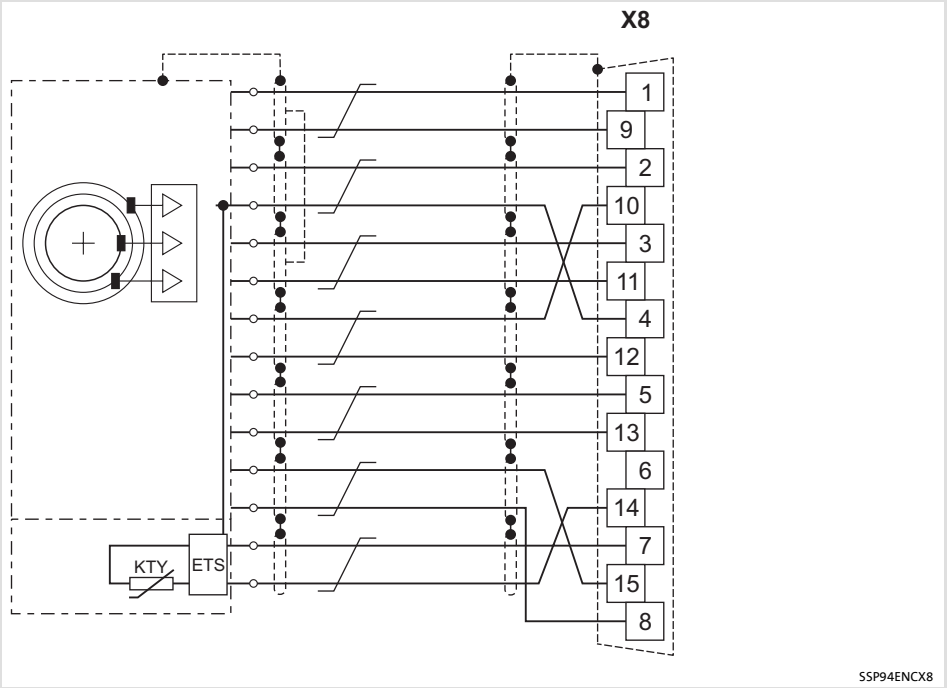
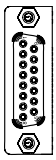


Fig. 4.7-6 Wiring principle

Terminal X8	Labelling	Description			
		Cable EYF001...			EYF002...
		TTL	1 V_{SS}	1 V_{SS} Hiperface	1 V_{SS} EnDat 2.1
	1	A	A	COS	A
	2	GND	GND	GND	GND
	3	B	B	Sin	B
	4	V_{CC}	V_{CC}	V_{CC}	V_{CC}
	5	Z	Z	+RS485	Data (Z)
	6	n. c.	n. c.	n. c.	n. c.
	7	-KTY	-KTY	-KTY	-KTY
	8	-	-	-	Clock
	9	/A	/A	Ref COS	/A
	10	-	-	-	-Sense
	11	/B	/B	Ref SIN	/B
	12	-	-	-	+Sense
	13	/Z	/Z	-RS485	/Data (/Z)
	14	+KTY	+KTY	+KTY	+KTY
9400SSP000X8	15	-	-	-	/Clock

Setting the supply voltage

The supply voltage of the encoder must be adapted to the cable length.

For this, use the parameter ”encoder voltage”, C00421.

Encoder			Voltage setting [V] under C00421 for cable length [m]						
Manufacturer / Type	KiMT	U_r [V]	0 - 10	10 - 30	30 - 50	50 - 70	70 - 90	90 - 100	100 -150
TTL									
Thalheim									
ITD21...	-Txx	5 ±5%	5.0	5.0	5.1	5.1	5.2	5.2	5,3
Sin-cos									
Thalheim									
ITD22...	-S20	5 ±5%	5.0	5.0	5.1	5.1	5.2	5.2	5,3
Sin-cos (Hiperface)									
Sick/Stegmann									
SCS70 SCM70 SRS50 SRM50	-SCS -SCM -SRS -SRM	8 (7 ... 12)	8.0						
Sin-cos (Endat)									
Heidenhain									
ECN1313 EQN1325 EQI1329	-ECN -EQN -EQI	5 ±5%	5.0	5.1	5.2	5.3	5.4	5.5	5,7

Tab. 4.7-1

KiMT	Designation in the motor type code
U_r	Rated encoder voltage

The values listed in Tab. 4.7-1 are valid for the use of Lenze system cables at typical ambient temperatures.

Other cables, other cable cross-sections or extreme ambient temperatures may require adaptations determined by means of measurements.

5 Multi-axis controllers

Contents

5.1 Device features

- Three options of direct supply of the DC-bus voltage:
  - using a DC supply module via the integrated DC busbar
  - using a DC input module via the integrated DC busbar
  - via terminals +UG and -UG
- Space-saving installation by compact design
- Innovative installation concept
- Power range: 370 W to 11 kW
- Pluggable and uniform connection system for control cables over the complete power range
- Integrated DC busbar
- Direct connection of resolver and/or encoder feedback
  - Easy connection via predesigned system cables (accessories)
- Integrated phase controller for drift-free standstill
- Field-oriented control for asynchronous and synchronous motors
- Digital synchronisation system via bus system or digital frequency (extension module required)
- User configuration for control functions and input/output signals
  - Comprehensive library with function blocks
  - High flexibility with regard to the adaptation of the internal control structure to the drive task
- Extension interfaces for
  - communication
  - controller functionality
  - safety engineering
- System bus (CANopen)for
  - servo inverter connection
  - input and output terminal extensions
  - connecting keypad and display units (HMI)

5.2 General data and operating conditions

General data

Conformity and approval			
Conformity			
CE	73/23/EEC	Low-Voltage Directive	
Approval			
UL	UL 508C	Power Conversion Equipment, 1D74, File No. 132659	

Protection of persons and devices			
Enclosure	EN 60529	IP 20	Not in the wire range of the terminals on the motor side
	NEMA 250	Protection against contact to type 1	
Insulation resistance	EN 61800-5-1	Overvoltage category III Reduction from 2000 m amsl onwards: 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: with restrictions, fault acknowledgement required Control connections: without restrictions	
Motor 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 regulations and safety instructions!
Cyclic mains switching		Cyclic mains switching of 5 times in 5 minutes is permissible without restrictions.	

Design			
Housing			
Carrier housing	Device sizes 1, 2 and 3	Glass-fiber reinforced plastic	
Dimensions		see ”Mechanical installation”	
Weight		see ”Mechanical installation”	

Mounting conditions			
Mounting place		In the control cabinet	
Mounting position		Vertical	
Mounting clearances			
Above/below		≥ 80 mm / ≥ 120 mm	Observe the device-related notes on mounting.
To the sides		Side-by-side mounting without any clearance	

"Multi Drive" **supply conditions**		
AC-mains operation		No direct connection, DC supply module or "Single Drive" network required
DC-bus operation		Direct connection via terminals or busbars For more information, please see the chapter DC-bus operation.
Power systems		
TT		Operation permitted without restrictions.
TN		
With grounded phase		Operation with additional measures permitted: ● Protection of persons according to EN 61800-5-1 requires the supplementary insulation of the control cables. ● Measures described for IT systems must be applied.
IT		Additional device-internal measure required
Motors	EN 60034	Only use motors suitable for inverter operation. Insulation resistance: min. û ≥ 1.5 kV, min. du/dt ≥ 5 kV/µs

Operating conditions

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) Current derating at +45 ... +55 °C: 2.5 %/°C
Site altitude		0 ... 4000 m amsl 1000 ... 4000 m amsl: current derating of 5 %/1000 m
Pollution	EN 61800-5-1	Pollution degree 2
Vibration resistance (9.81 m/s^2 = 1 g)		
Transport	IEC/EN 60721-3-2	2M2
	EN 61800-2	2 ... 9 Hz: amplitude 3.5 mm
		10 ... 200 Hz: acceleration resistant up to 10 m/s^2
		200 ... 500 Hz: acceleration resistant up to 15 m/s^2
Operation	Germanischer Lloyd	5 ... 13.2 Hz: amplitude ±1 mm 13.2 ... 100 Hz: acceleration resistant up to 0.7 g
	EN 50178	10 ... 57 Hz: amplitude 0.075 mm
		57 ... 150 Hz: acceleration resistant up to 10 m/s^2

General electrical data

Motor cable requirements		
Capacitance per unit length		
≤ 2.5 mm^2/AWG 14		$C_{Core/core}/C_{Core/shield}$ < 75/150 pF/m
≥ 4 mm^2/AWG 12		$C_{Core/core}/C_{Core/shield}$ < 150/300 pF/m
Electric strength		
	VDE 0250-1	U_0/U = 0.6/1.0 kV (U_0 = r.m.s. value of external conductor to PE, U = r.m.s. value of external conductor to external conductor)
	UL	U ≥ 600 V (U = r.m.s. value of external conductor to external conductor)

Maximum motor and feedback cable lengths in [m] (for shielded motor cable with rated mains voltage)			
Type	Device size	with encoder	without encoder
E94AMxE0024 E94AMxE0034 E94AMxE0044	1	50	50
E94ASxE0024 E94ASxE0034			
E94AMxE0074 ... E94AMxE0244	2 ... 3	100	100
E94ASxE0044 ... E94ASxE0244			
E94ASxE0324 ... E94ASxE1044	6 ... 7	100	100
E94ASxE1454 ... E94ASxE3664	8S ... 9	150	150
E94ASxE4604 ... E94ASxE6954	10	150	150
If EMC conditions must be met, the permissible cable lengths can be reduced.			

Tab. 5.2-1

EMC		
Operation on public supply systems	EN 61800-3	The controllers are designed for use in an industrial environment. Operation on public networks requires measures to be taken for limiting the expected emission of radio interferences.
Noise emission, in cables		
Design "Single Drive"	EN 61800-3	see Tab. 4.2-2 EMC protection requirements
Design "Multi Drive"		Depending on the filter at the central DC supply module.
Noise immunity (to 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 (1 kHz)
Interference (housing)	EN 61000-4-3	80 MHz ... 1000 MHz, 10 V/m 80 % AM (1 kHz)
Burst		
Power terminals and interfaces	EN 61000-4-4	2 kV/5 kHz
Signal interfaces	EN 61000-4-4	1 kV/5 kHz
Control connections	EN 61000-4-4	2 kV/5 kHz
Surge (surge voltage)		
Power terminals	EN 61000-4-5	1.2/50 µs, 1 kV phase/phase, 2 kV phase/PE

Protective insulation

Danger!

Operation of the controller on a phase earthed mains with a rated mains voltage of ≥ 400 V:

- ► The protection against accidental contact is not ensured without external measures.
- ► If protection against accidental contact acc. to EN 61800-5-1 is required for the control terminals of the controller and the terminals for the plugged-in device modules,
  - – an additional basic insulation must be available.
  - – the components to be connected must have the second basic insulation.

Danger!

Dangerous electrical voltage

When one common voltage source is used for control voltages in separate potential areas, the protective insulation between the separate potential areas is deactivated.

Possible consequences:

- ► The specified protective insulations are not complied with.

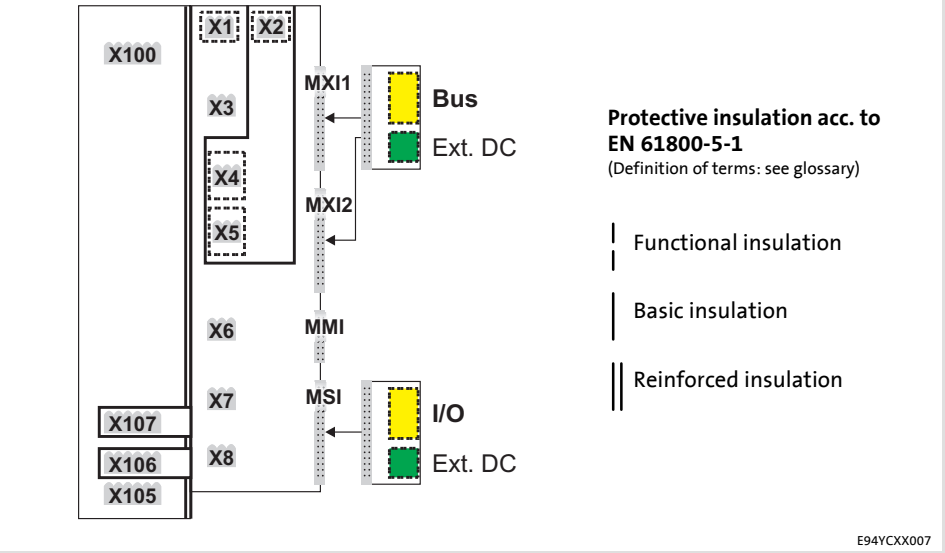
Protective measures:

- ► Use independent voltage sources.

The protective insulation of the 9400 Servo Drives controllers complies with EN 61800-5-1.

The following illustration

- shows the arrangement of the terminal strips and the separate potential areas of the controller.
- serves to determine the decisive protective insulation between two terminals located in different separate potential areas.



Terminal strip	Terminal	Terminal strip	Terminal
X100	• L1, L2, L3 • +UG, -UG	X1	CAN on board 9400
		X2	• State bus • 24 V (ext.)
X105	• U, V, W • Rb1, Rb2	X3	Analog input / output
X106	Motor PTC	X4	Digital output
X107	Control of motor holding brake	X5	Digital input
		X6	Diagnostics
		X7	Resolver
		X8	Encoder
		MXI1, MXI2	Extension module
		MMI	Memory module
		MSI	Safety module

Example

Which type of protective insulation is used between the bus terminal of the device module in slot MXI1 or MXI2 and the mains terminal X100?

The separate potential area with the better protective insulation is decisive.

- The separate potential area of the device module bus terminal is ”functionally insulated”.
- The separate potential area of the mains terminal has a ”reinforced insulation”.

Result: The insulation between the mains terminal X100 and the bus terminal is of the ”reinforced insulation” type.

5.3 Rated data

The E94A**M**xExxx**4** devices can be used in the voltage range of 260 ... 775 V DC.

Note!
To ensure a faultless operation of the devices the code C00173 must be set according to the mains voltage connected.

5.3.1 Overview

Input data

Type	Voltage [V]	Frequency [Hz]	Current [A] max. +45 °C ①	Current [A] max. +55 °C ①	Number of phases
E94AMxE0024	325/565/705	0 (DC)	2.6/2.6/2.3	2.0/2.0/1.7	2
E94AMxE0034	325/565/705	0 (DC)	4.3/4.3/3.8	3.2/3.2/2.9	2
E94AMxE0044	325/565/705	0 (DC)	6.7/6.7/5.9	5.0/5.0/4.4	2
E94AMxE0074	325/565/705	0 (DC)	12.1/12.1/10.6	9.1/9.1/8.0	2
E94AMxE0094	325/565/705	0 (DC)	15.4/15.4/13.5	11.6/11.6/10.1	2
E94AMxE0134	325/565/705	0 (DC)	20.6/20.6/18.0	15.5/15.5/13.5	2
E94AMxE0174	325/565/705	0 (DC)	25.7/25.7/22.5	19.3/19.3/16.9	2
E94AMxE0244	325/565/705	0 (DC)	35.5/35.5/31.1	26.3/26.3/23.3	2

① Temperature in the control cabinet

Output data

Type	Voltage [V]	Frequency [Hz] 1)	Current [A] max. +45 °C ①	Current [A] max. +55 °C ①	Number of phases
E94AMxE0024	0 - 230/400/500	0 - 599	1.5/1.5/1.3	1.1/1.1/1.0	3
E94AMxE0034	0 - 230/400/500	0 - 599	2.5/2.5/2.2	1.9/1.9/1.7	3
E94AMxE0044	0 - 230/400/500	0 - 599	4/4/3.5	3/3/2.6	3
E94AMxE0074	0 - 230/400/500	0 - 599	7/7/6.1	5.3/5.3/4.6	3
E94AMxE0094	0 - 230/400/500	0 - 599	9.3/9.3/8.2	7.0/7.0/6.2	3
E94AMxE0134	0 - 230/400/500	0 - 599	13/13/11.4	9.8/9.8/8.6	3
E94AMxE0174	0 - 230/400/500	0 - 599	16.5/16.5/14.4	12.4/12.4/10.8	3
E94AMxE0244	0 - 230/400/500	0 - 599	23.5/23.5/20.6	17.6/17.6/15.5	3

① Temperature in the control cabinet
1) The output frequency is limited to 1/8 of the selected chopper frequency (see C00018).

Type	Power loss P_V [W] when operating with rated output current I_{aN}	Power loss P_V [W] when controller is inhibited
E94AMxE0024	100	40
E94AMxE0034	120	
E94AMxE0044	150	
E94AMxE0074	190	
E94AMxE0094	230	
E94AMxE0134	280	
E94AMxE0174	320	
E94AMxE0244	420	

5.3.2 Devices for 400/500V-mains

5.3.2.1 Operation on 230 V_{AC} mains

Basis of the data			
Mains	Rated voltage U_{DC} [V]	Voltage range U_{DC} [V]	Frequency range [Hz]
2/PE DC	325	260 - 0 % ... 370 + 0 %	-

	Input current at I_{aN8} (without external mains choke)	Output power 8 kHz, U, V, W	Motor power (typical) 8 kHz, 4 pol. ASM	
Type	I_{DC} [A]	S_{aN8} [kVA]	P_{aN} [kW]	P_{aN} [hp]
E94AMxE0024	2.6	0.6	0.18	0.25
E94AMxE0034	4.3	1.0	0.37	0.5
E94AMxE0044	6.7	1.6	0.75	1
E94AMxE0074	12.1	2.8	1.5	2
E94AMxE0094	15.4	3.7	2.2	3
E94AMxE0134	20.6	5.2	3	4
E94AMxE0174	25.7	6.6	4	5.5
E94AMxE0244	35.5	9.4	5	7.5

	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}
E94AMxE0024	1.9	6.0	1.9	6.0	**1.5**	4.8	1.1
E94AMxE0034	3.1	10.0	3.1	10.0	**2.5**	8.0	1.9
E94AMxE0044	5.0	16.0	5.0	16.0	**4.0**	12.8	3.0
E94AMxE0074	8.8	21.0	8.8	21.0	**7.0**	16.8	5.3
E94AMxE0094	11.7	28.0	11.7	28.0	**9.3**	22.4	7.0
E94AMxE0134	16.3	39.0	16.3	39.0	**13.0**	31.2	9.8
E94AMxE0174	20.6	49.5	20.6	49.5	**16.5**	39.6	12.4
E94AMxE0244	29.4	70.5	29.4	70.5	**23.5**	47.0	17.6

I_{aN2}	Rated value of permanent output current at a frequency of ≥ 0 Hz
I_{aM2}	Maximum output current (overload current) ● Periodic load change of 0.5 s with I_{aM2} and recovery time of 4.5 s with 75 % I_{aN2}
I_{aN4}, I_{aN8}, I_{aN16}	Rated value of permanent output current at a frequency of ≥ 5 Hz (reduce to 0.66 * I_{aNx} for 0 ... 5 Hz)
I_{aM4}, I_{aM8}	Maximum output current (overload current) ● Periodic load change of 0.5 s with I_{aMx} and recovery time of 4.5 s with 75 % I_{aNx} ● Can be achieved using the setting "x kHz fixed" in C00018
bold	Nominal value I_{aN}

5.3.2.2 Operation on 400 V_{AC} mains

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

	Input current at I_{aN8} (without external mains choke)	**Output power** 8 kHz, U, V, W	**Motor power (typical)** 8 kHz, 4 pol. ASM	
Type	I_{DC} [A]	S_{aN8} [kVA]	P_{aN} [kW]	P_{aN} [hp]
E94AMxE0024	2.6	1.0	0.37	0.5
E94AMxE0034	4.3	1.7	0.75	1
E94AMxE0044	6.7	2.8	1.5	2
E94AMxE0074	12.1	4.8	3	4
E94AMxE0094	15.4	6.5	4	5
E94AMxE0134	20.6	9.0	5.5	7.5
E94AMxE0174	25.7	11.4	7.5	11
E94AMxE0244	35.5	16.3	11	15

	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}
E94AMxE0024	1.9	6.0	1.9	6.0	**1.5**	4.8	1.1
E94AMxE0034	3.1	10.0	3.1	10.0	**2.5**	8.0	1.9
E94AMxE0044	5.0	16.0	5.0	16.0	**4.0**	12.8	3.0
E94AMxE0074	8.8	21.0	8.8	21.0	**7.0**	16.8	5.3
E94AMxE0094	11.7	28.0	11.7	28.0	**9.3**	22.4	7.0
E94AMxE0134	16.3	39.0	16.3	39.0	**13.0**	31.2	9.8
E94AMxE0174	20.6	49.5	20.6	49.5	**16.5**	39.6	12.4
E94AMxE0244	29.4	70.5	29.4	70.5	**23.5**	56.4	17.6

I_{aN2} Rated value of permanent output current at a frequency of ≥ 0 Hz

I_{aM2} Maximum output current (overload current)
- Periodic load change of 0.5 s with I_{aM2} and recovery time of 4.5 s with 75 % I_{aN2}

I_{aN4}, I_{aN8}, I_{aN16} Rated value of permanent output current at a frequency of ≥ 5 Hz
(reduce to 0.66 * I_{aNx} for 0 ... 5 Hz)

I_{aM4}, I_{aM8} Maximum output current (overload current)
- Periodic load change of 0.5 s with I_{aMx} and recovery time of 4.5 s with 75 % I_{aNx}
- Can be achieved using the setting "x kHz fixed" in C00018

bold Nominal value I_{aN}

5.3.2.3 Operation on 500 V_{AC} mains

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

	Input current at I_{aN8} (without external mains choke)	**Output power** 8 kHz, U, V, W	**Motor power (typical)** 8 kHz, 4 pol. ASM	
Type	I_{DC} [A]	S_{aN8} [kVA]	P_{aN} [kW]	P_{aN} [hp]
E94AMxE0024	2.3	1.1	0.37	0.5
E94AMxE0034	3.8	1.9	0.75	1
E94AMxE0044	5.9	3.0	1.5	2
E94AMxE0074	10.6	5.3	3	4
E94AMxE0094	13.5	7.1	4	5
E94AMxE0134	18.0	9.8	5.5	7.5
E94AMxE0174	22.5	12.5	7.5	10
E94AMxE0244	31.1	17.8	11	15

	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}
E94AMxE0024	1.9	6.0	1.9	6.0	**1.3**	4.2	1.0
E94AMxE0034	3.1	10.0	3.1	10.0	**2.2**	7.0	1.7
E94AMxE0044	5.0	16.0	5.0	16.0	**3.5**	11.2	2.6
E94AMxE0074	8.8	21.0	8.8	21.0	**6.1**	14.7	4.6
E94AMxE0094	11.7	28.0	11.7	28.0	**8.2**	19.6	6.1
E94AMxE0134	16.3	39.0	16.3	39.0	**11.4**	27.3	8.6
E94AMxE0174	20.6	49.5	20.6	49.5	**14.4**	34.7	10.9
E94AMxE0244	29.4	70.5	29.4	70.5	**20.6**	49.4	15.4

I_{aN2} Rated value of permanent output current at a frequency of ≥ 0 Hz

I_{aM2} Maximum output current (overload current)
- Periodic load change of 0.5 s with I_{aM2} and recovery time of 4.5 s with 75 % I_{aN2}

I_{aN4}, I_{aN8}, I_{aN16} Rated value of permanent output current at a frequency of ≥ 5 Hz
(reduce to 0.66 * I_{aNx} for 0 ... 5 Hz)

I_{aM4}, I_{aM8} Maximum output current (overload current)
- Periodic load change of 0.5 s with I_{aMx} and recovery time of 4.5 s with 75 % I_{aNx}
- Can be achieved using the setting "x kHz fixed" in C00018

bold Nominal value I_{aN}

5.3.2.4 Fuses and cable cross-sections

Basis of the data			
Mains	Rated voltage U_{DC} [V]	Voltage range U_{DC} [V]	Frequency range [Hz]
2/PE DC (alternativ)	325 ... 705	260 - 0 % ... 775 + 0 %	0

When the integrated DC busbar is used, wiring is not required. The mounting backplane already includes an integrated fuse.

When terminals +UG/-UG are used, dimension the cables and fuses as described in the chapter DC-bus operation.

5.3.3 Overcurrent operation

The controllers are designed for two overcurrent modes:

- ► 5-s-cycle ①
  - – 0.5 s load period with peak current A
  - – 4.5 s recovery time with limited current B
- ► 3-min cycle ②
  - – 1 min load period with peak current C
  - – 2 min recovery time with limited current D

A load period must be followed by a recovery time. During the recovery time the current must not exceed the value given.

The values given refer to the rated output current I_{aN8}.

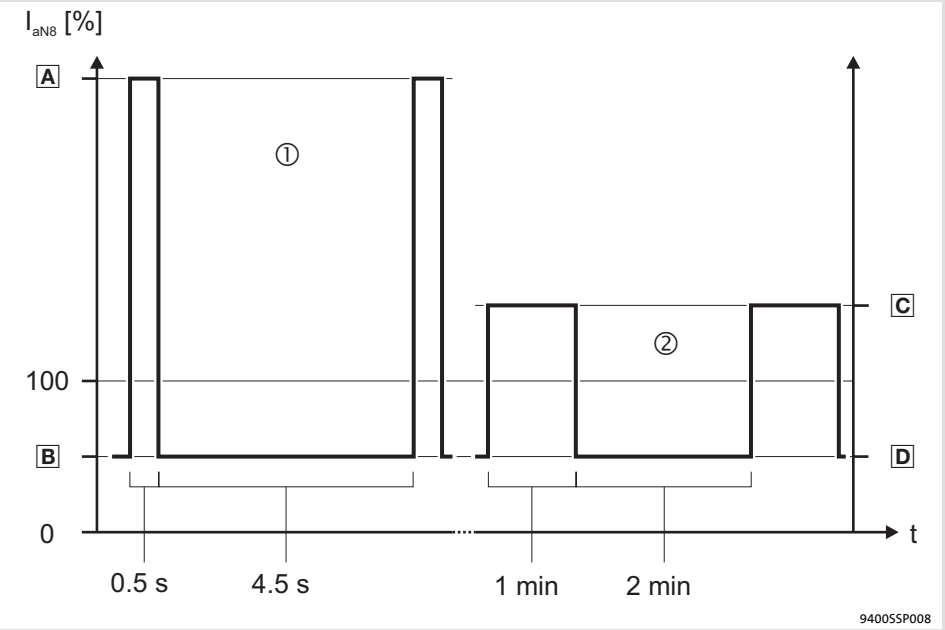


Fig. 5.3-1 Overcurrent capacity at 45° C

A Peak current for 0.5 s
B Max. current in the recovery time for 4.5 s
① 5-s cycle
C Peak current for 1 min
D Max. current in the recovery time for 2 min
② 3-min cycle

Type	I_{amx}/I_{aN8} [%] in a 5-s cycle ①							
	f = 2/4 kHz		f = 2/4 kHz		f = 8 kHz		f = 16 kHz	
	A	B	A	B	A	B	A	B
E94AMxE0024 E94AMxE0034 E94AMxE0044	400	94	400	94	320	75	-	
E94AMxE0074 E94AMxE0094 E94AMxE0134 E94AMxE0174	300		300		240			
E94AMxE0244					200			

Type	I_{amx}/I_{aN8} [%] in a 3-min cycle ②							
	f = 2 kHz		f = 4 kHz		f = 8 kHz		f = 16 kHz	
	C	D	C	D	C	D	C	D
E94AMxE0024 E94AMxE0034 E94AMxE0044 E94AMxE0074 E94AMxE0094 E94AMxE0134 E94AMxE0174 E94AMxE0244	188	94	188	94	150	75	-	

5.4 Mechanical installation

5.4.1 Important notes

Note!

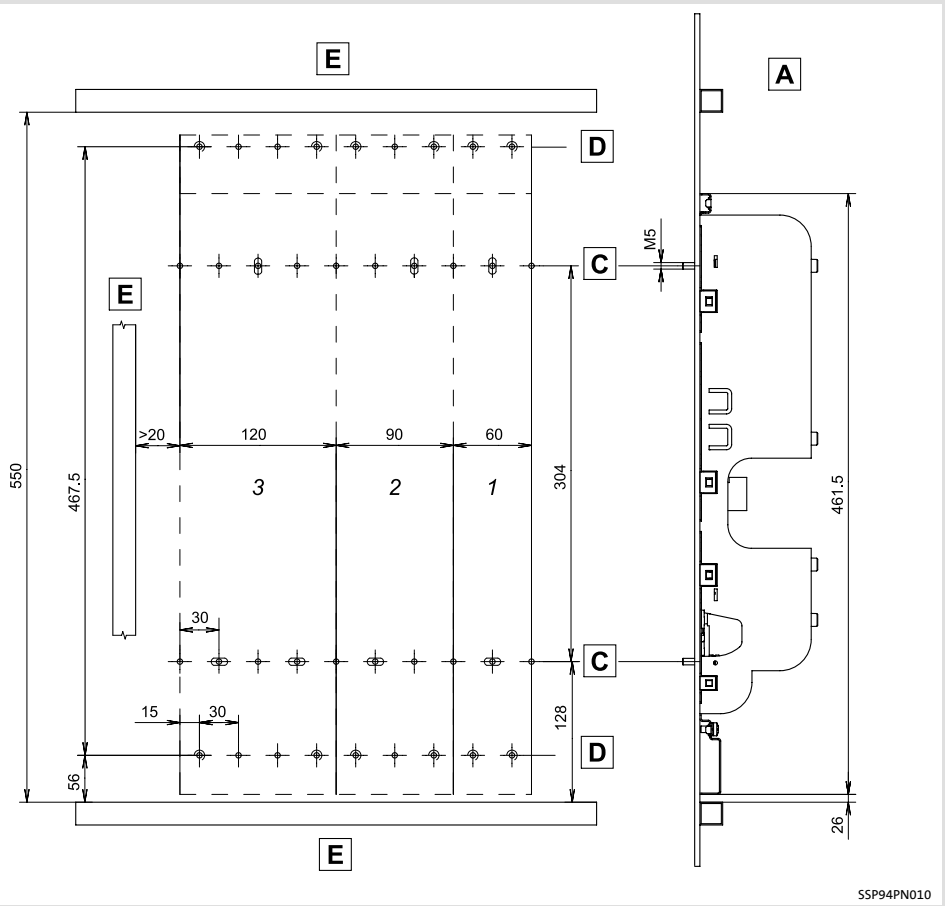
The devices must be installed in housings (e.g. control cabinets) to meet applicable regulations.

Mounting grid

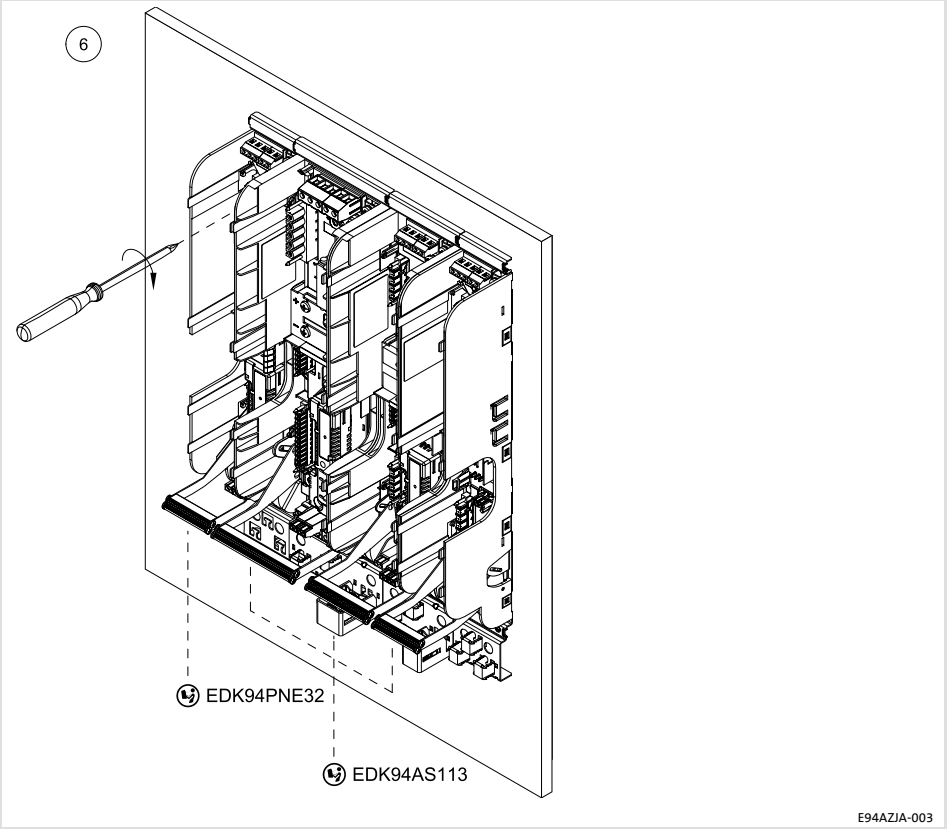
We recommend to provide the mounting plate with a grid pattern of M5 threaded holes for attaching the devices. This preparation enables easy attachment of the devices and the device sizes 1, 2, ... n can thus be mounted directly adjacent to each other.

Note!

- ► M5 screw and washer assemblies or hexagon socket screws with washers are permitted.
- ► Tightening torque: 3.4 Nm / 30 lb-in.
- ► In the installation backplane, the screwed connection may not jut out more than 7 mm.



- A Mounting with backplane for attaching the power supply module
- C Grid hole pattern for installation backplane
- D Grid hole pattern for other device sizes or built-on/footprint filters (only Single Drive)
- E Cable duct
- 1 ... 3 Device size, mounting holes used



Mounting procedure:

1. Prepare M5 threaded holes on the mounting plate according to the mounting grid.
   – Start on the left with the installation backplane of DC-supply module E94AZPNxxxx or with DC input module E94AZEX100.
   – Install the axis modules from the left to the right with decreasing rated power.
2. Screw the installation backplane onto the mounting plate. Do not yet tighten the screws. ⑥
   – Use M5 screw and washer assembly or M5 hexagon socket screws with washer.
   – The screw joint in the installation backplane may jut out no more than 7 mm.
3. Align all components.
4. Insert the busbars each towards the left device and tighten the screws. ⑦/⑧
   – Tightening torque: 3.2 Nm ... 3.5 Nm (28 lb-in ... 31 lb-in).
5. Screw the components onto the mounting plate.
   – Tightening torque: 3.4 Nm (30 lb-in).

How to proceed:

1. Prepare the mounting plate with M5 fixing holes according to the grid.
2. Screw the installation backplane onto the mounting plate.
3. If you want to use the DC busbar:
   – Install the DC supply module on the left,
   – Mount the installation backplanes of the axis modules from the left to the right. Install the device with the highest power first and the device with the lowest power last.

5.4.2 Devices in the range 2 ... 24 A (0.37 ... 11 kW)

Standard device with installation backplane

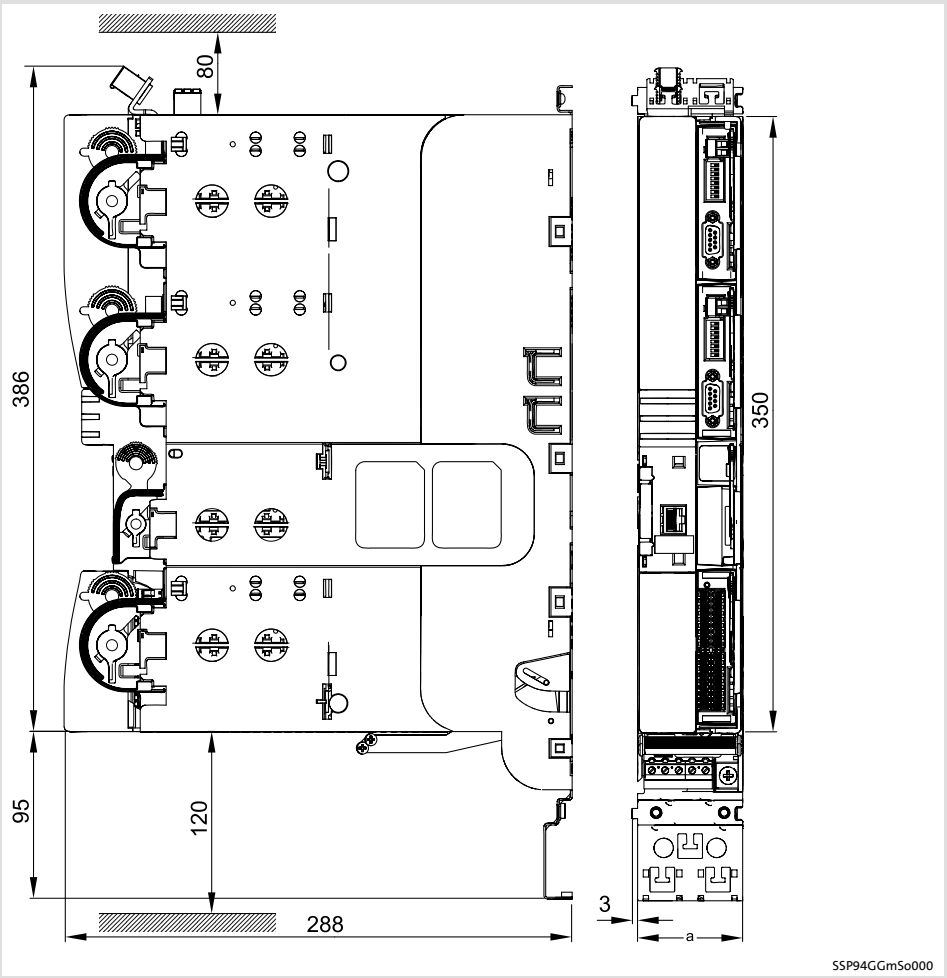


Fig. 5.4-1 Dimensions [mm]

Type	Dimensions a [mm]	Mass [kg]
E94AMxE0024	60	4.0
E94AMxE0034		
E94AMxE0044		
E94AMxE0074	90	5.3
E94AMxE0094		
E94AMxE0134	120	8.1
E94AMxE0174		
E94AMxE0244		

5.5 Wiring

5.5.1 Important notes

Danger!

Dangerous voltage

All power terminals remain live for at least three minutes after mains disconnection.

Possible consequences:

► Death or severe injuries when touching the power terminals.

Protective measures:

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

► Check 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 ≥ 10 mm^2 or PE conductor must be connected twice)

Stop!

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

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

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.

Note!

Switching operations on the motor side of the controller are permitted for safety switch-off (emergency off).

Please observe:

► When the controller is enabled, switching operations may lead to a response of the controller monitoring functions.

► The switching elements on the motor side must be rated for DC voltages with U_{DCmax} = 800 V.

5.5.2 Safety notes for the installation according to U_L or U_R

Warnings!

- Branch circuit protection:

  Suitable for use on a circuit capable of delivering not more than 5000 rms symmetrical amperes, 500 V max., when protected by H, K5 or CC fuses.
- Voltage of the fuses must at least be suitable with the input voltage of the drive.
- 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.
- For information on the protection level of the internal overload protection for a motor load, see the corresponding Application Manuals or Software Helps.
- For information on rating and proper connection of the thermal protector (only for connection to motors having integral thermal protection), see the corresponding Application Manuals or Software Helps.
- Maximum surrounding air temperature: 55 °C.
- Use 60/75 °C copper wire only, except for control circuits.
- Control card protection:

  External fuse for 24 Vdc supply voltage of control terminal X2. Rated 4 A DC fuse UL248-14.

5.5.3 Devices in the range 2 ... 24 A (0.37 ... 11 kW)

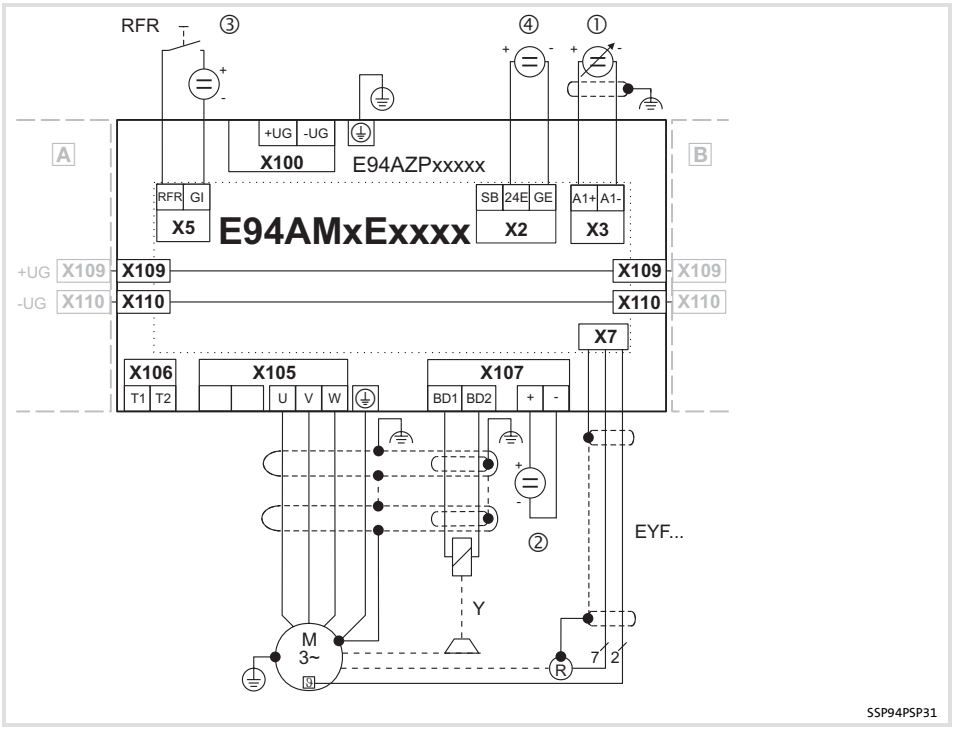


Fig. 5.5-1 Basic circuit diagram of the drive system

E94AMxExxxx	9400 Multi Drive servo axis module
E94AZPxxxxx	Installation backplane
A	DC power supply module or DC feeding point or axis module
B	Next axis module
⏚	HF shield termination through large-surface connection to functional earth
EYF...	System cable for resolver feedback
RFR	Controller enable
R	Resolver
Y	Motor holding brake (connected to optional motor brake control)
①	Speed setpoint selection via analog input 1 (-10 ... 0 ... +10 V)
②	Voltage source for the motor holding brake
③	24-V voltage source for the digital inputs according to IEC 61131-2
④	24-V voltage source for control electronics according to IEC 61131-2

Tip!

Complete the wiring of the installation backplane before plugging in the standard device. The upper terminals of the installation backplane cannot be connected with a plugged-in standard device.

IT system

Stop!

Overvoltage on components:

On IT systems an earth fault in the installation can cause impermissible overvoltages.

Possible consequences:

Destruction of the device.

Protective measures:

If the devices are operated on IT systems, the internal connection of the filters to the protective earth in the installation backplane has to be disconnected.

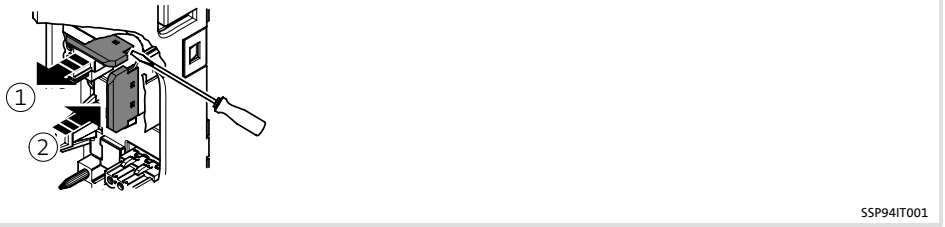


Fig. 5.5-2 Plugging the IT insulating cap onto the earthing jumper

Proceed as follows to disconnect the internal connection of the filters to the protective earth:

1. Remove the IT insulating cap from its parking position ①.
   – To do so, place a screw driver at the right or left side and lever off the insulating cap.
   – Alternatively, the insulating cap can be pulled off carefully using an appropriate pair of pliers.
2. Plug the IT insulating cap onto the earthing jumper ② until it snaps into place.

Design of the cables

- The cables used must comply with the approvals required for the location (e.g. UL).
- 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 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
- Motor holding brake (connected to optional motor brake control)
- Motor temperature monitoring

The following connections need not be shielded:

- DC bus

DC bus

Use the integrated DC busbars (X109 and X110) to connect the DC bus. The mounting backplane of the multi-axis controllers is already equipped with a fuse.
The busbar mounting set (accessories) can also be used to integrate single-axis controllers into a drive network. The busbar mounting set for single-axis controllers also contains the fuse required for the mounting backplane.

The DC bus is supplied via a DC supply module or a DC-feeding point which always have to be located on the left-hand side.

Compatible with the 9300 series, the DC-bus voltage can also be supplied via terminals +UG/-UG (X100, right part) for all devices.

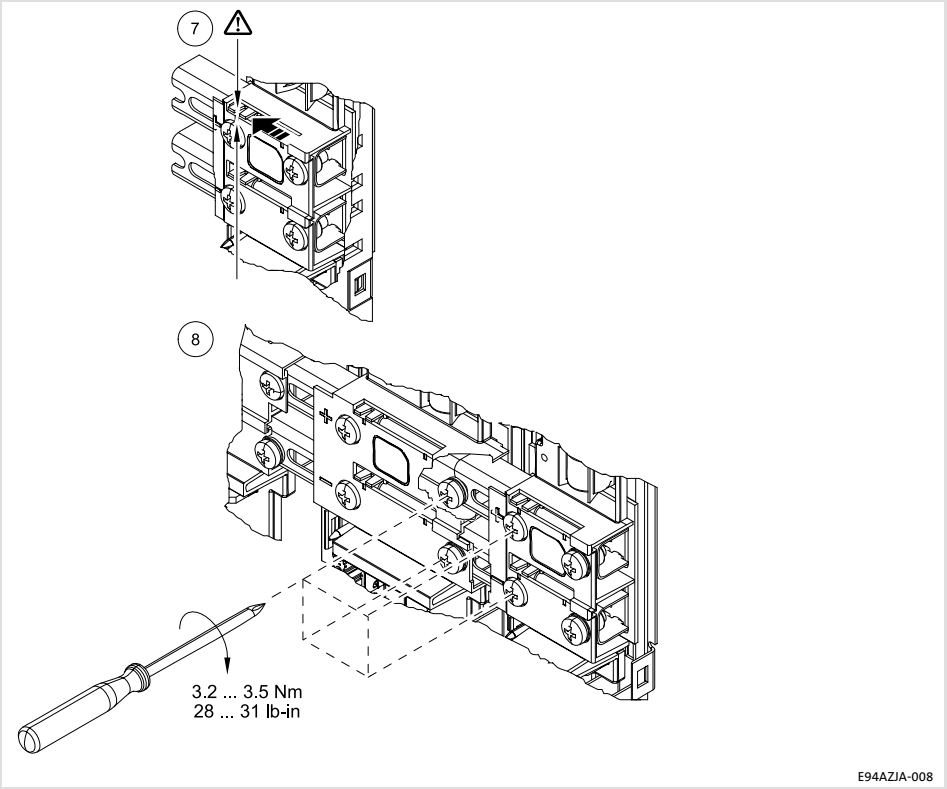
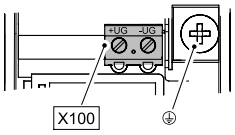


Fig. 5.5-3 Example: connecting busbars to DC power supply module

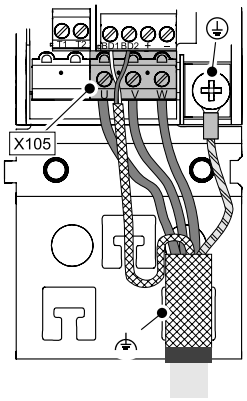
Proceed as follows to connect the busbars:

1. If devices of the interconnected system have already been in operation:
   – Ensure that the power supply system is switched off by checking the voltage at the supply terminals.
   – If necessary, switch off the power supply and wait at least 3 minutes.
2. Loosen the busbar screws but do not remove them completely.
3. Push the busbars as far as possible to the left towards the adjacent busbar.
   – Ensure that there is good contact to the adjacent busbar.
4. Tighten the busbar screws.
   – Tightening torque: 3.2 ... 3.5 Nm (28 ... 31 lb-in).
5. Screw all components onto the mounting plate.
   – Tightening torque: 3.4 Nm (30 lb-in).

Terminal X100 (right part)	Labelling	Description
 SSP942X100	+UG -UG	Alternative option for DC-bus voltage connection (compatible to 9300 series).

Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device sizes 1+2: flexible with wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 6.2	PZ0
Device size 3: flexible with wire end ferrule	10	6	1.2 ... 1.5	10.6 ... 13.3	PZ1

Motor

Terminal X105 (right part)	Labelling	Description
 SSP940X105	U V W	Connection of the motor phases
	⏚	Functional earth Connect the shields of the motor phases and of the optional motor brake control separately and with a surface as large as possible to the shield sheet. Use EMC wire clamp or EMC shield clamp for fixing.
	⏚	Connection for the PE conductor on the motor side with M5 ring cable lug

Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device sizes 1+2: flexible with wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 6.2	PZ0
Device size 3: flexible with wire end ferrule	10	6	1.2 ... 1.5	10.6 ... 13.3	PZ1

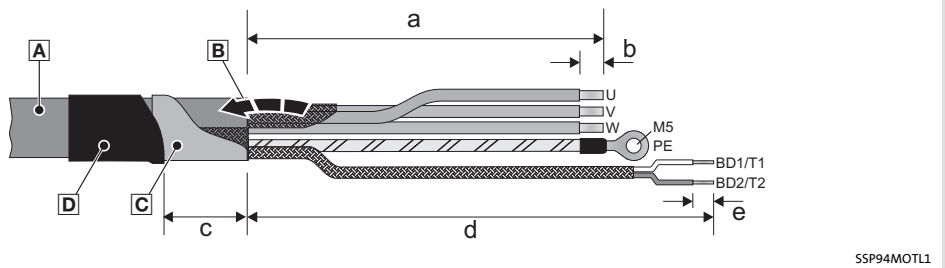
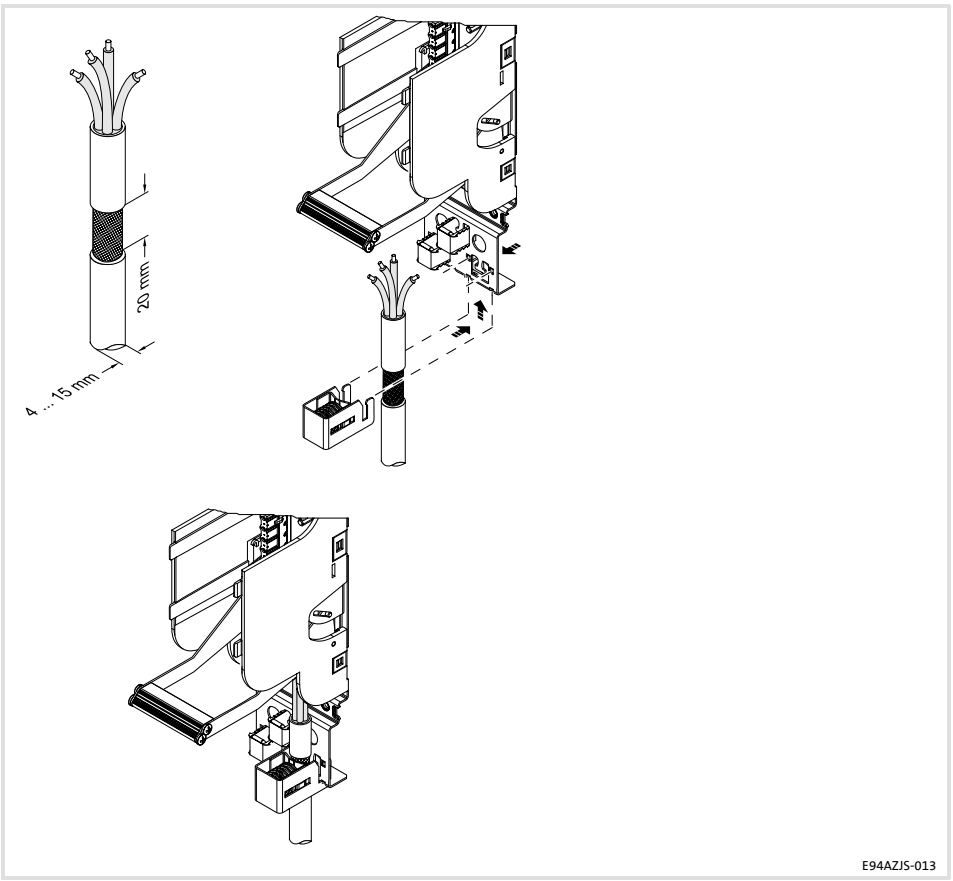


Fig. 5.5-4 Stripping lengths of the motor cable

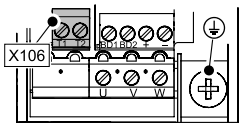
Type	Dimensions [mm]				
	a	b	c	d	e
Device size 1	80	8	25	150	8
Device size 2	90	8	30	160	8
Device size 3	100	10	30	170	8

How to proceed:

1. Strip the motor cable [A] according to dimensions given.
2. Fold back the shield of the motor cable [B] over the cable sheath.
3. Stabilise the shield with self-adhesive conductive foil [C] (recommendation).
4. Fix the shield and conductive foil with heat-shrinkable tube [D] on the cable sheath.
5. Fasten cable lugs or wire end ferrules.
6. Connect the shields separately to the shield sheet using shield clamps (no strain relief).

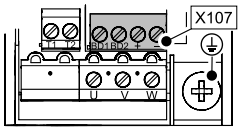


Motor temperature monitoring

Terminal X106	Labelling	Description
 SSP940X106	T1 T2	Motor temperature monitoring with PTC element (type-A sensor, switching performance according to EN 60947-8 for type-A tripping units) or thermostat (NC contact).

Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Flexible With wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 6.2	PZ0

Motor brake control (optional)

Terminal X107	Labelling	Description
 SSP940X107		Connection of the motor holding brake
	BD1 BD2	+ (Lenze: WH) - (Lenze: BN) E94AZHX0051: 24 V DC, max. 2.5 A Observe correct polarity!
	+ / -	Supply voltage for the motor holding brake (18 ... 30 V DC) Observe correct polarity!

Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Flexible With wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 6.2	PZ0

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 on the brake cable (connection BD1/BD2):

- ► The 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).
- ► When using a permanent magnet holding brake, ensure the correct polarity of the brake cable.
  - – If the terminals are reversed, the brake does not release. Since the motor runs against the closed brake, the brake can be destroyed.
- ► Connect the shield on both sides of PE.

Requirements on the supply voltage U_{DC} (connection +/-):

- ► The motor brake control must always be supplied with a separate 24 V supply.
  - – A common supply of the motor brake control and the control card of the controller is not permissible since otherwise the double insulation between both components would be reduced.
- ► Set U_{DC} so that the operating voltage of the brake is within the admissible range and the maximum supply voltage of the motor brake control will not be exceeded.

General electrical data

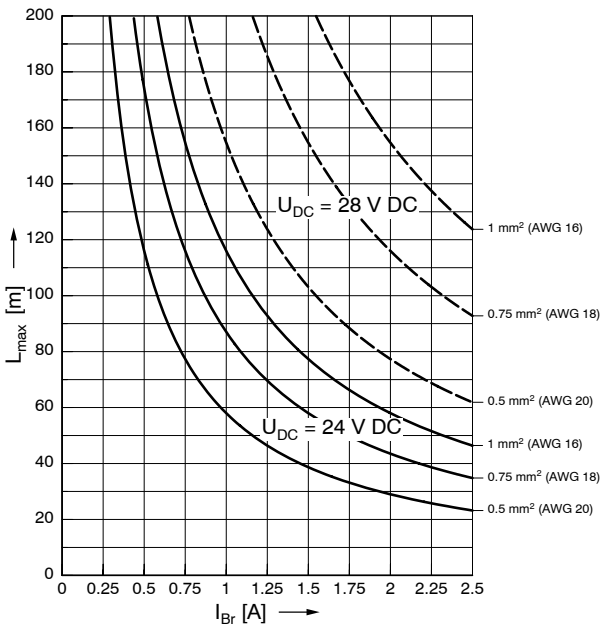
Operating frequency	max. 6/min
Operating times	Can be ignored compared to the delay time of the brake. See documentation of the brake.
Service life	> 10 millions of cycles
Protection against	
Overload	No
Short circuit of the terminals	Yes
Polarity reversal at the input	Yes
Isolation [1)]	Double insulation (EN61800-5-1: V_{rated} = 300 V AC), Separation (UL: V_{rated} = 500 V AC)

1) Brake connection against control card of the controller

Rated data

Type	Voltage U_{DC} [V]	Current I_{DC} [A]	Power P_{DC} [W]	Breaking energy E [Ws]
E94AZHX0051	18 ... 30	0.3 ... 2.5	max. 55	max. 5

Cable lengths



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

5.6 Installation of the standard device

How to proceed:

1. Insert the device into the installation backplane without twisting it until resistance is felt.
2. Press the device into the installation backplane until it audibly snaps into place. The locking clip moves downwards and back into the locking position.
3. The end position is reached when the locking clip can be pressed against the device. Now the device is locked.

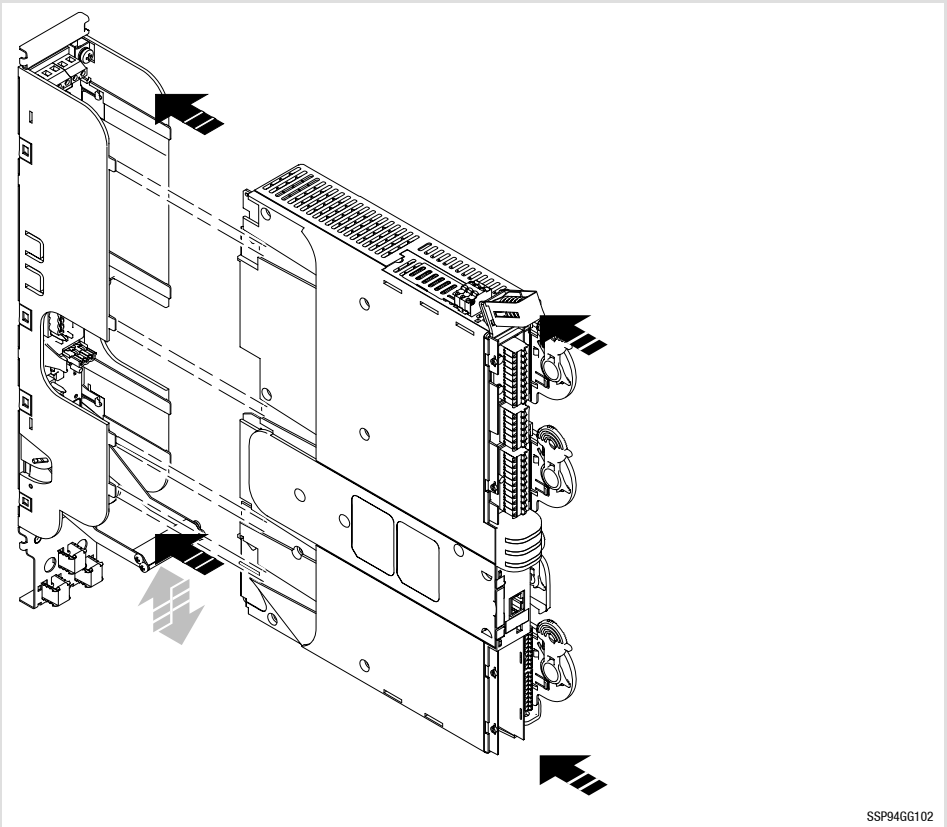


Fig. 5.6-1 Installation of the device

Proceed as follows to remove the device:

1. Disconnect already wired connectors at the device.
2. Push the locking clip downwards to release the device and disengage it from the contacts.
3. Pull the device completely out of the installation backplane and remove it. The locking clip moves back into the locking position.

5.7 Control terminals

Danger!

Dangerous voltage

All power terminals remain live for at least three minutes after mains disconnection.

Possible consequences:

► Death or severe injuries when touching the power terminals.

Protective measures:

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

► Check that all power terminals are deenergised.

Stop!

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

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

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.

Use system cables or shielded cables for these connections:

- Analog signals (inputs and outputs)
- System bus CAN
- Resolver
- Encoder

The following connections need not be shielded:

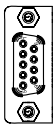
- 24 V supply
- Digital signals (inputs and outputs)

Tip!

Parameter setting and configuration can be carried out using the L-force »Engineer«. For this purpose the Online Help and the Software Manual for the standard device will guide you.

System bus CAN on board

The controller features an integrated CANopen system bus interface to exchange process data and parameter values between different nodes and to connect further modules as e.g. distributed terminals, operator and input devices (”HMIs”) and external control units.

Terminal X1	Labelling	Description
 9400SSP000X1	Pin 2	CAN-LOW
	Pin 3	CAN-GND
	Pin 7	CAN-HIGH
	(Housing)	CAN-Shield

Note!

The X1 connection is not available in the ”StateLine” design.

24 V supply

The controller of the ”MultiDrive” version requires a 24-V supply voltage for the control electronics. This serves to maintain the control functions, even if the DC bus is not loaded.

Electrical data		
24 V	Rated voltage	24 V According to IEC 61131-2
	Voltage range	19.2 ... 28.8 V Residual ripple max. ± 5 %
	Current consumption	Approx. 2.4 A during operation Max. 4 A starting current for 100 ms
	Fuse	Circuit breaker with tripping characteristic B or C, Standard blade-type fuses
	Looping through	Max. 7 devices with 2.5 mm^2 Fusing: 16/15 A
		Max. 4 devices with 1.5 mm^2 Fusing: 10/10 A
	Connectable cross-cuttings	See terminal data
	Cable length	Max. 5 m

Warnings!

In UL-approved systems the fuse of the 24 V supply must not exceed 4 A.

State bus

The state bus is a bus system exclusively designed for Lenze controllers via which up to 20 controllers can be connected and which serves to simulate a ”release cord” function. The state is controlled via the system module SFBDigitalOutput.

- The state bus knows the states ”OK” and ”fault”.
- The state bus is multi-master-compliant, i.e. each node connected to the state bus can set the state bus to ”fault” by changing to LOW level.
- In the ”fault” status, all nodes activate their programmed response, e.g. synchronised braking of the drive system.

Stop!

Do not connect an external voltage to the state bus, otherwise the function will be disturbed.

Electrical data		
State bus	Rated voltage	24 V According to IEC 61131-2
	Looping through	Max. 20 devices DC-bus operation with 9300 devices is possible.
	Connectable cross-cuttings	See terminal data
	Cable length	Max. 5 m

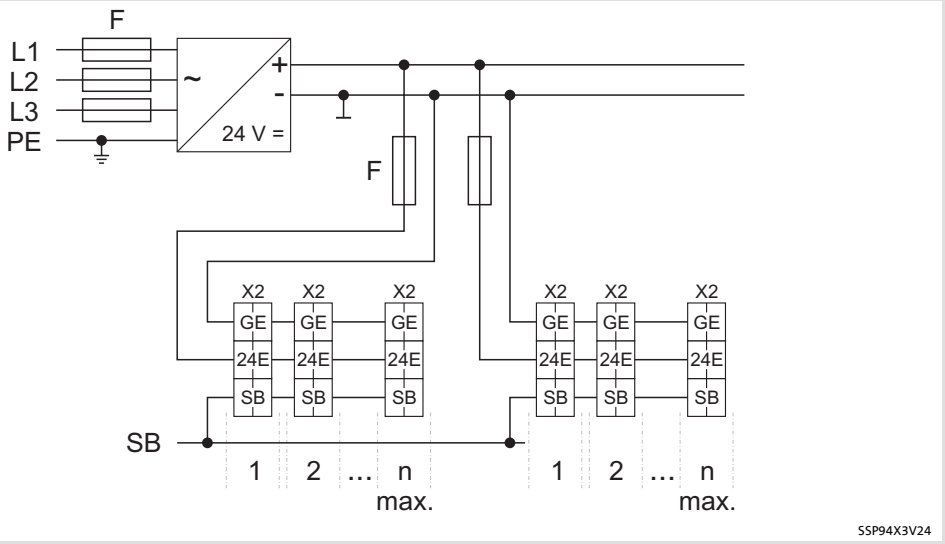


Fig. 5.7-1 Wiring principle

L1 ... L3	Mains phases
PE	Protective earth
F	Fuse
X2	Terminal for 24 V and state bus
GE/24E/SB	Labelling on the terminal
SB	State bus
1 ... 7	Device number during loop-through connection

Terminal X2	Labelling	Description
 9400SSP000X2	GE	GND external supply
	24E	24 V external supply via a safely separated power supply unit (SELV/PELV) (only required for mains-independent supply of the control electronics)
	SB	State bus in/out (reference GE)

Terminal data	Conductor cross-section		Tightening torque	
	[mm²]	[AWG]	[Nm]	[lb-in]
Flexible	0.2 ... 2.5	24 ... 12	Spring terminal	
With wire end ferrule				

Analog inputs, analog outputs

The controller features two analog inputs which are able to detect differential voltage signals in the range ±10 V, e.g. an analog speed setpoint selection or the voltage signal of an external sensor (temperature, pressure, etc.).

► The analog signal 1 can also detect a current setpoint.

The controller features two analog outputs, which can output internal analog signals as voltage signals, e.g. for the control of analog indicating instruments or as a setpoint for slave drives.

Electrical data		
Analog input 1 Analog input 2	Level:	-10 V ... +10 V
	Resolution:	11 bits + sign
	Scaling:	±10 V ≡ ±16384
Analog input 1 as current input (A1R and A1- bridged)	Level:	-20 mA ... +20 mA
	Resolution:	10 bits + sign
	Scaling:	±20 mA ≡ ±16384
	Open-circuit monitoring:	Configurable
Analog output 1 Analog output 2	Level:	-10 V ... +10 V, max. 2 mA
	Resolution:	11 bits + sign
	Scaling:	±16384 ≡ ±10 V

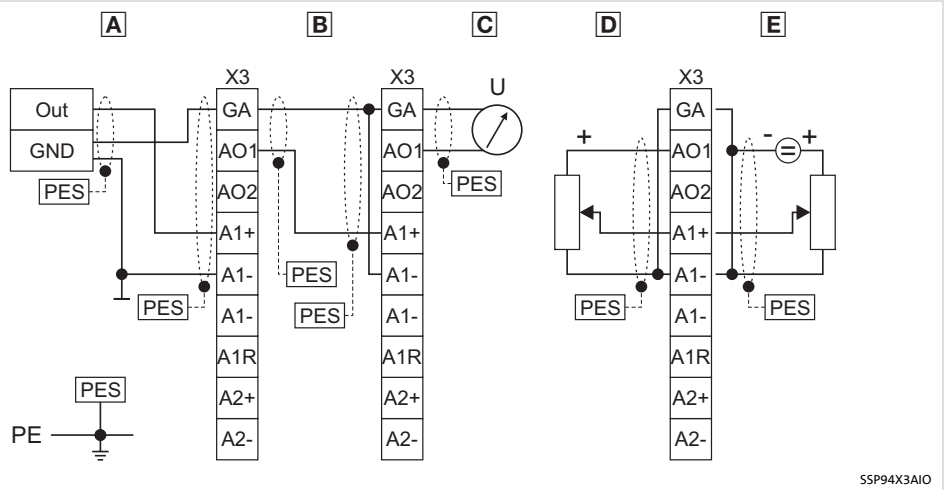
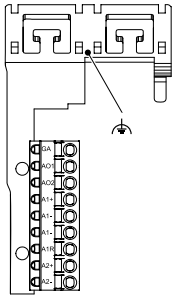


Fig. 5.7-2 Wiring principle

A	Wiring of an external analog signal
B	Wiring with a slave drive
C	Wiring with a measuring device
D	Potentiometer supplied by analog output 1
E	Potentiometer with external supply
Out	Analog output signal, e.g. of a control
GND	Earth reference potential
X3	Terminal for the analog inputs and outputs
PES	EMC shield connection
PE	Protective earth
U	Measuring device

"HighLine" version:

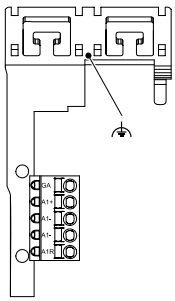
Terminal X3	Labelling	Description
 SSP94000X3	GA	GND analog signals
	AO1	Analog output 1
	AO2	Analog output 2
	A1+	Analog input 1 +
	A1-	Analog input 1 -
	A1-	Analog input 1 -
	A1R	Terminating resistor for ±20mA
	A2+	Analog input 2 +
	A2-	Analog input 2 -
	⏚	Shield connection: Fix the shield with EMC wire clamp.

Terminal data	Conductor cross-section		Tightening torque	
	[mm²]	[AWG]	[Nm]	[lb-in]
Flexible	0.2 ... 2.5	24 ... 12	Spring terminal	
With wire end ferrule				

Note!

If the control terminals are completely wired, we recommend to use a cable cross-section of max. 0.75 mm² to save space. The mechanical cover can then be attached.

"StateLine" version:

Terminal X3	Labelling	Description
 SSP94SL0X3	GA	GND analog signals
	A1+	Analog input 1 +
	A1-	Analog input 1 -
	A1-	Analog input 1 -
	A1R	Terminating resistor for ±20mA
	⏚	Shield connection: Fix the shield with EMC wire clamp.

Digital outputs

The controller features four freely configurable digital outputs.

Electrical data		
24O (external voltage source, optional)	Rated voltage	24 V According to IEC 61131-2
	Current consumption	Max. 300 mA
DO1 ... DO4	Switching level	According to IEC 61131-2
	LOW	0 V ... +5 V
	HIGH	+15 V ... +30 V
	Output current	Max. 50 mA
	Load	> 480 Ω at 24 V

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.

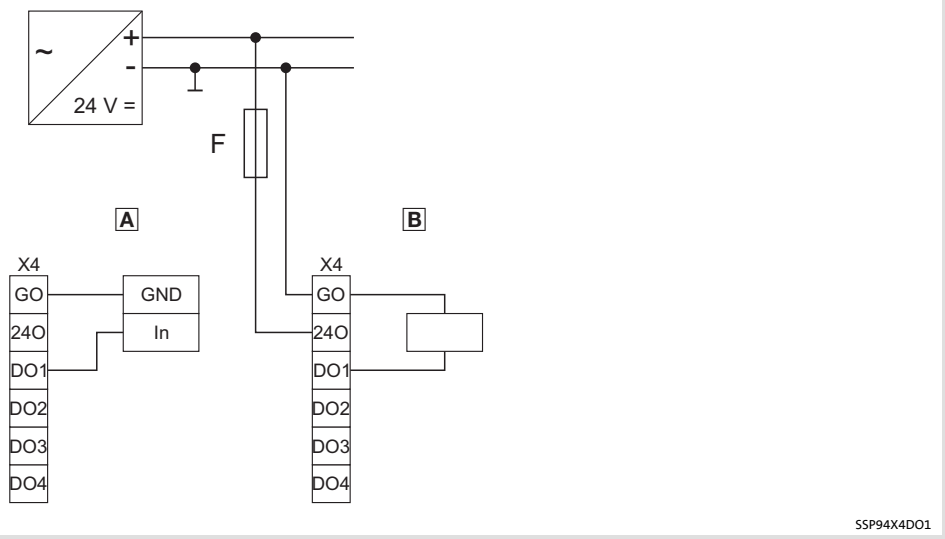
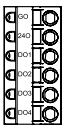


Fig. 5.7-3 Wiring principle

A	Wiring with a digital input, e.g. a PLC
B	Digital control (relay, valve, ...) with an external 24-V supply
X4	Terminal for the digital outputs
In	Digital input, e.g. of a control
GND	Earth reference potential
F	Fuse

"HighLine" version:

Terminal X4	Labelling	Description
	GO	GND digital out
	24O	24-V digital out
	DO1	Digital output 1
	DO2	Digital output 2
	DO3	Digital output 3
9400SSP000X4	DO4	Digital output 4

Terminal data	Conductor cross-section		Tightening torque	
	[mm²]	[AWG]	[Nm]	[lb-in]
Flexible	0.2 ... 2.5	24 ... 12	Spring terminal	
With wire end ferrule				

"StateLine" version:

Terminal X4	Labelling	Description
	GO	GND digital out
	24O	24-V digital out
9400SSPxxx	DO1	Digital output 1

Digital inputs

The drive controller is equipped with freely configurable digital inputs.

- The following digital inputs are with touch-probe capability (edge-controlled event)):
  - "HighLine": all inputs
  - "StateLine": DI1
- The control input RFR for controller enable is firmly connected with the device control. It must be wired to enable the controller with a HIGH signal.

Electrical data		
24O (external voltage source, optional)	Rated voltage	24 V According to IEC 61131-2
	Current consumption	Max. 50 mA
RFR DI1 ... DI8	Switching level	According to IEC 61131-2
	LOW	0 V ... +5 V
	HIGH	+15 V ... +30 V
	Input current	Max. 8 mA

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.

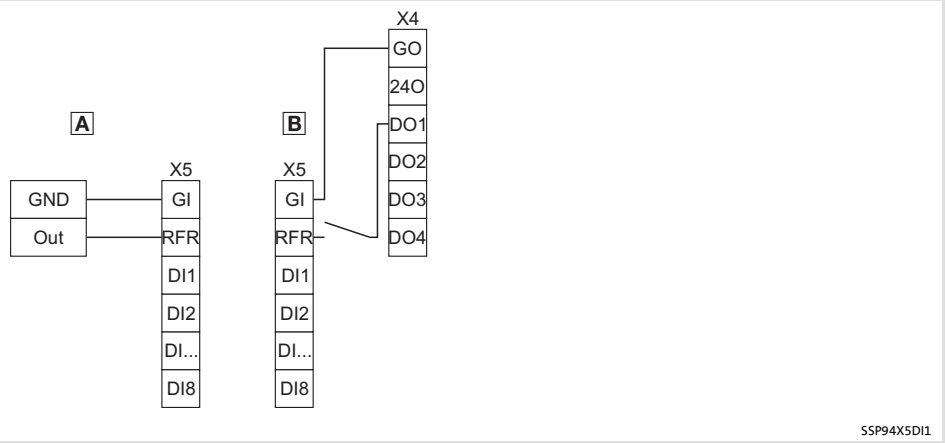


Fig. 5.7-4 Wiring principle

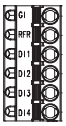
A	Wiring of an external digital signal, e.g. a PLC
B	Wiring with a slave drive
X4	Terminal for the digital outputs
X5	Terminal for the digital inputs
Out	digital output signal, e.g. of a control
GND	Earth reference potential

”HighLine” version:

Terminal X5	Labelling	Description
	GI	GND digital in
	RFR	Controller enable
	DI1	Digital input 1
	DI2	Digital input 2
	DI3	Digital input 3
	DI4	Digital input 4
	DI5	Digital input 5
	DI6	Digital input 6
	DI7	Digital input 7
9400SSP000X5	DI8	Digital input 8

Terminal data	Conductor cross-section		Tightening torque	
	[mm²]	[AWG]	[Nm]	[lb-in]
Flexible	0.2 ... 2.5	24 ... 12	Spring terminal	
With wire end ferrule				

”StateLine” version:

Terminal X5	Labelling	Description
	GI	GND digital in
	RFR	Controller enable
	DI1	Digital input 1
	DI2	Digital input 2
	DI3	Digital input 3
9400SSPxxx	DI4	Digital input 4

Diagnostics/keypad

The following can be connected to this interface:

► USB diagnostic adapter E94AZCUS

or

► Keypad E94AZKAE.

The diagnostic adapter and a computer with the Lenze software »Engineer« serve to carry out comprehensive settings, e.g. for initial commissioning.

The keypad enables experienced users to check or change individual settings.

Terminal X6	Labelling	Description
 9400SSP000X6		Internal interface, RJ69 socket, for keypad or diagnostic adapter

Resolver

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

The use of third-party resolvers is permissible. For this purpose the number of pole pairs of the resolver in C00080 must be adapted to the resolver used. When the stator coils are excited with 4 kHz, the apparent impedance of the connected resolver must not fall below 65 Ohm. When lower impedances are connected, the overload protection integrated in the resolver output limits the output current and can falsify the resolver evaluation.

Resolvers are operated in reverse mode:

- ► Supply to the sine and cosine track,
- ► Both signals are controlled in a way that the current flow on the reference track is reduced to zero.

Electrical data		
General	Cable length (system cable recommended)	Max. 150 m
V_{CC}	Supply voltage	5 V
	Maximum output current	110 mA
+REF, -REF	Input frequency	Max. 250 kHz
+COS, -COS +SIN, -SIN	Excitation voltage	10 V_{SS}
	Carrier frequency	4 kHz, fix
+KTY, -KTY	Type	KTY 83-110

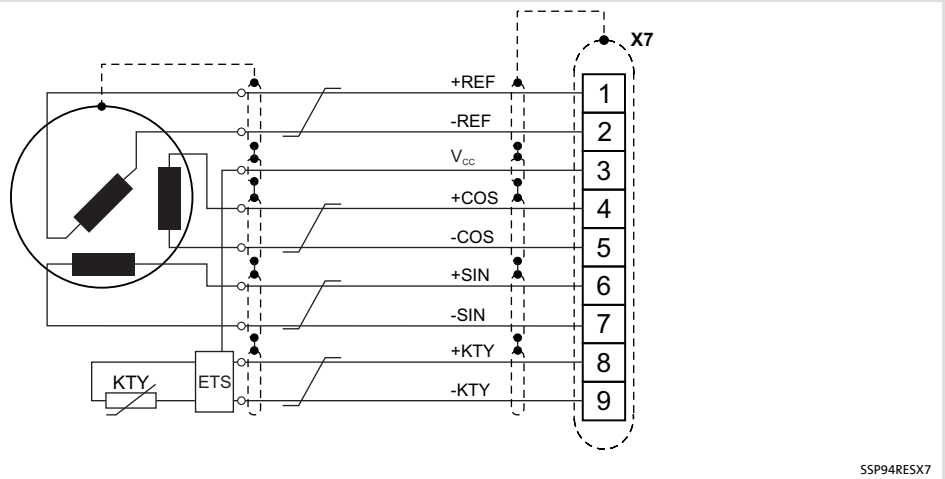
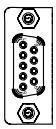


Fig. 5.7-5 Wiring principle

Terminal X7	Labelling	Description
	1	+REF
	2	-REF
	3	V_{CC}
	4	+COS
	5	-COS
	6	+SIN
	7	-SIN
	8	+KTY
9400SSP000X7	9	-KTY

Encoder

Encoders are connected to X8 (15-pole Sub-D socket).

- Absolute and incremental encoders are supported:
  - TTL encoder 5 V (incremental)
  - Sin/cos encoder 1 V_{ss} (incremental)
  - Sin/cos absolute value encoder 1 V_{ss} with Hiperface protocol
  - Sin/cos absolute value encoder 1 V_{ss} with EnDat protocol (2.1)
- Improved determination of low speeds with TTL encoders through additional time measuring method.
- SinCos absolute value encoders are serially read during initialisation (power-on). After this, the sin/cos signals are evaluated.
- Open-circuit monitoring:
  - for sin/cos encoders by comparing the sin/cos signals with the sine shape (radius monitoring)
  - for TTL encoders by means of mean value and amplitude monitoring
- The following encoders are not supported:
  - HTL encoders
  - SSI encoders

Electrical data		
General	Cable length (system cable recommended)	Max. 150 m
	Encoder types	TTL 1 V_{SS}
	Protocols	Hiperface EnDat 2.1
	Number of increments	1 ... 16384
	Input frequency	Max. 250 kHz
VCC (GND)	Supply voltage	5 V ... 9 V
	Current	Max. 250 mA
+Sense, -Sense	Measuring lead for readjusting V_{CC}	
+KTY, -KTY	Type	KTY 83-110

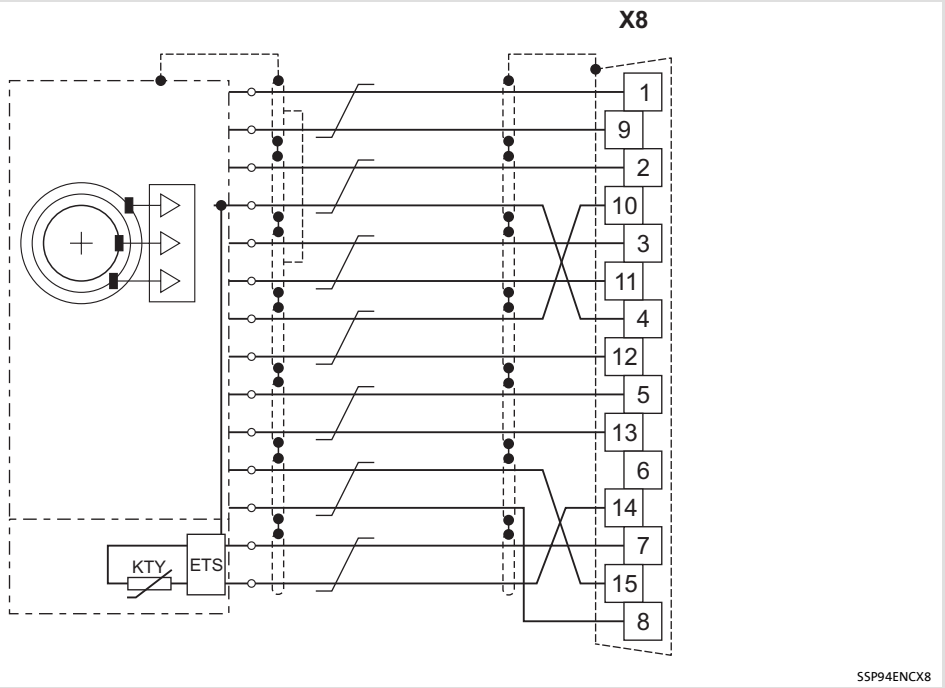
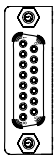


Fig. 5.7-6 Wiring principle

Terminal X8	Labelling	Description			
		Cable EYF001...			EYF002...
		TTL	1 V_{SS}	1 V_{SS} Hiperface	1 V_{SS} EnDat 2.1
	1	A	A	COS	A
	2	GND	GND	GND	GND
	3	B	B	Sin	B
	4	V_{CC}	V_{CC}	V_{CC}	V_{CC}
	5	Z	Z	+RS485	Data (Z)
	6	n. c.	n. c.	n. c.	n. c.
	7	-KTY	-KTY	-KTY	-KTY
	8	-	-	-	Clock
	9	/A	/A	Ref COS	/A
	10	-	-	-	-Sense
	11	/B	/B	Ref SIN	/B
	12	-	-	-	+Sense
	13	/Z	/Z	-RS485	/Data (/Z)
	14	+KTY	+KTY	+KTY	+KTY
9400SSP000X8	15	-	-	-	/Clock

Setting the supply voltage

The supply voltage of the encoder must be adapted to the cable length.

For this, use the parameter ”encoder voltage”, C00421.

Encoder			Voltage setting [V] under C00421						
Manufacturer	KiMT	U_r	for cable length [m]						
Type		[V]	0 - 10	10 - 30	30 - 50	50 - 70	70 - 90	90 - 100	100 -150
TTL									
Thalheim									
ITD21...	-Txx	5 ±5%	5.0	5.0	5.1	5.1	5.2	5.2	5,3
Sin-cos									
Thalheim									
ITD22...	-S20	5 ±5%	5.0	5.0	5.1	5.1	5.2	5.2	5,3
Sin-cos (Hiperface)									
Sick/Stegmann									
SCS70 SCM70 SRS50 SRM50	-SCS -SCM -SRS -SRM	8 (7 ... 12)	8.0						
Sin-cos (Endat)									
Heidenhain									
ECN1313 EQN1325 EQI1329	-ECN -EQN -EQI	5 ±5%	5.0	5.1	5.2	5.3	5.4	5.5	5,7

Tab. 5.7-1

KiMT	Designation in the motor type code
U_r	Rated encoder voltage

The values listed in Tab. 5.7-1 are valid for the use of Lenze system cables at typical ambient temperatures.

Other cables, other cable cross-sections or extreme ambient temperatures may require adaptations determined by means of measurements.

6 DC power supply module

Contents

6.1 Device features

The most important device features at a glance:

- DC power supply modules supply the DC buses of several controllers of a drive system with energy.
- DC power supply modules are the central AC mains connection in a DC-bus operation.
- DC power supply modules have an internal brake chopper and a terminal for a brake resistor.
- DC power supply modules of the 9400 series have a busbar port for the easy connection and side-by-side mounting of the 9400 controllers up to 100 A. Ports for higher currents or compatible device series are available.
- DC power supply modules generally supply controllers of the ”Multi Drive” version. However, also controllers of the ”Single Drive” version can be implemented in a DC-bus operation if the data and notes in the ”DC-bus operation” chapter are observed.
- DC power supply modules are designed as multi-range voltage units (230/400/480/500 V).
- Four types of DC power supply modules are available:
  - **E94APNE0104**,
    Rated current: 10 A,
    Device size: 1,
    Version: compact standard device with installation backplane
  - **E94APNE0364**,
    Rated current: 36 A,
    Device size: 3,
    Version: compact standard device with installation backplane
  - **E94APNE1004**,
    Rated current: 100 A,
    Device size: 4,
    Version: compact total device
  - **E94APNE2454**,
    Rated current: 245 A,
    Device size: 5,
    Version: compact total device
- DC power supply modules are assigned to specially designed mains filters and RFI filters.
- DC power supply modules and filters can be mounted in the mounting grid of the 9400 series.

When drive systems are used in a DC-bus connection, the connected controllers can exchange energy on the DC voltage level (DC bus).

Energy exchange in the DC bus

If one or more controllers operate in generator mode (braking), the energy will be fed into the shared DC bus. The energy will then be available to the controllers in the system which operate in motor mode.

The energy for the drive system can be supplied from the three-phase AC mains via:

- ► a E94APNExxx4 DC supply module
- ► a regenerative power supply module
- ► one or more controllers

Advantages of the drive system

Interconnecting the drives in a DC bus minimises the DC power to be supplied and to be regenerated. The rated power of the brake and supply units is thus reduced. The energy consumption from the three-phase AC mains is reduced and the number of mains input modules and the related expenses (e.g. wiring) can be perfectly adapted to your application.

6.2 General data and operating conditions

General data

Conformity and approval			
Conformity			
CE	73/23/EEC	Low-Voltage Directive	
Approval			
In preparation: UL	UL 508C	Industrial Control Equipment, file no. 132659	

Supply system data			
Supply forms	With earthed ⏚ point	Unrestricted use	
	IT systems	Observe instructions about special measures!	
Noise emission	EN 61800-3	Conducted: cannot be specified because dependent on the conditions present in the interconnected system	
		Radiation: category C3	
Noise immunity (according to requirements of EN 61800-3)			
Electrostatic discharge (ESD)	EN 61000-4-2	8 kV for air discharge, 4 kV for contact discharge to housing	
Radio frequency			
Conducted	EN 61000-4-6	150 kHz ... 80 MHz, 10 V/m 80 % AM (1 kHz)	
Radiation (housing)	EN 61000-4-3	80 MHz ... 1000 MHz, 10 V/m 80 % AM (1 kHz)	

Protection of persons and equipment			
Enclosure	EN 60529	IP 20	Not in the wiring area of the lower terminals
	NEMA 250	Protection against contact to type 1	
Insulation resistance	EN 61800-5-1	Overvoltage category III Derating at and 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	DC-bus connection: not short-circuit-proof Brake resistor connection: fully short-circuit proof Control connections: fully short-circuit proof	
Leakage current	EN 61800-5-1	> 3.5 mA	Observe regulations and safety instructions!
Cyclic mains switching		Cyclic mains switching of 5 times within 5 minutes is permitted without restrictions.	

Design		
Housing		
Carrier housing	Device sizes 1 and 3	Glass-fiber reinforced plastic
Carrier housing	Device sizes 4 and 5	Metal
Dimensions		see "Mechanical installation"
Weight		see "Mechanical installation"

Mounting conditions			
Mounting place		In the control cabinet	
Mounting position		Vertical	
Mounting clearances			
Above/below		≥ 80 mm / ≥ 120 mm	Observe the device-related notes on mounting.
To the sides		Side-by-side mounting without any clearance	

Connection conditions for DC power supply module		
AC mains operation		Direct connection
DC-bus operation		Direct connection of axis modules via terminals or busbar system More information can be found in the Hardware Manual, chapter "DC-bus operation".
Supply systems		
TT		Operation permitted without restrictions.
TN		
With earthed phase		Operation permitted if additional measures are taken: ● The protection of persons according to EN 61800-5-1 requires the supplementary insulation of control cables. ● The measures described for IT systems have to be taken.
IT		Operation permitted without restrictions.

Operating conditions

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) Current derating at +45 ... +55 °C: 2.5 %/°C
Site altitude		0 ... 4000 m amsl 1000 ... 4000 m amsl: current derating of 5 %/1000 m
Pollution	EN 61800-5-1	Pollution degree 2
Vibration resistance (9.81 m/s^2 = 1 g)		
Transport	IEC/EN 60721-3-2	2M2
	EN 61800-2	2 ... 9 Hz: amplitude 3.5 mm
		10 ... 200 Hz: acceleration resistant up to 10 m/s^2
		200 ... 500 Hz: acceleration resistant up to 15 m/s^2
Operation	Germanischer Lloyd	5 ... 13.2 Hz: amplitude ±1 mm 13.2 ... 100 Hz: acceleration resistant up to 0.7 g
	EN 50178	10 ... 57 Hz: amplitude 0.075 mm
		57 ... 150 Hz: acceleration resistant up to 10 m/s^2

6.3 Rated data (devices for 400/500V mains)

General data

Type	Power loss P_V [W]	
	Total (when operating with I_{aN})	Constant (control electronics only)
E94APNE0104	55	5
E94APNE0364	110	5
E94APNE1004	230	7
E94APNE2454	550	7

6.3.1 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]
3/PE AC	230	180 - 0 % ... 264 + 0 %	45 - 0 % ... 65 + 0 %

Input data

Type	Voltage [V]	Frequency [Hz]	Current [A]		Number of phases
			max. +45 °C ①	max. +55 °C ①	
E94APNE0104	230	50/60	8	6	3
E94APNE0364	230	50/60	29	21.8	3
E94APNE1004	230	50/60	82	61	3
E94APNE2454	230	50/60	200	150	3

① Temperature in the control cabinet

Type	Voltage [V]	Continuous input power S_L [kVA]
E94APNE0104	230	3.2
E94APNE0364	230	11.5
E94APNE1004	230	32.6
E94APNE2454	230	79.6

Output data

Basis of the data			
Mains	Rated voltage U_{DC} [V]	Voltage range U_{DC} [V]	Frequency range [Hz]
2/PE DC	325	260 - 0 % ... 370 + 0 %	-

Type	Voltage [V]	Frequency [Hz]	Current [A]		Number of phases
			max. +45 °C ①	max. +55 °C ①	
E94APNE0104	325	0 (DC)	10	7.5	2
E94APNE0364	325	0 (DC)	36	27	2
E94APNE1004	325	0 (DC)	100	75	2
E94APNE2454	325	0 (DC)	245	184	2

① Temperature in the control cabinet

Type	Output current and output power					
	100 %		Cycle 1		Cycle 2	
	I_{DC} [A]	P_{DC} [kW]	I_{DC} [A]	P_{DC} [kW]	I_{DC} [A]	P_{DC} [kW]
E94APNE0104	10	2.1	40	8.4	15	3.2
E94APNE0104 + E94AZMP0084	10	2.8	40	11.2	15	4.2
E94APNE0364	36	7.5	108	22.5	54	11.3
E94APNE0364 + E94AZMP0294	36	10.1	108	30.3	54	15.5
E94APNE1004	100	20.8	200	62.4	150	31.2
E94APNE1004 + E94AZMP0824	100	27.9	200	83.7	150	41.9
E94APNE2454	245	51	368	153	368	76.5
E94APNE2454 + E94AZMP2004	245	68.5	368	206	368	103

100 %	Permanent rated values
Cycle 1	Cycle for the second-range (0.5 s overload/4.5 s recovery time with 75 % of the permanent rated value)
Cycle 2	Cycle for the minute-range (60 s overload/120 s recovery time with 75 % of the permanent rated value)

Internal brake chopper data

Type	Switching threshold (adjustable) U_{BRmax} [V]	Minimum brake resistor R_{Bmin} [Ω]	Peak current I_{BRmax} [A]	Peak braking power P_{BRmax} [kW]	Continuous current RMS I_{BRd} [A]	Continuous braking power P_{Bd} [kW]
E94APNE0104	390	18.0	21.7	8.5	7.9	1.1
E94APNE0364	390	6.0	65.0	25.4	29.1	5.1
E94APNE1004	390	2.5	156	60.8	62.7	9.8
E94APNE2454	390	1.4	279	109	112	17.5

I_{BRmax}, P_{BRmax}	Periodic load change of 0.5 s and recovery time of 4.5 s
R_{Bmin}	Nominal value, ±10 %
Permanent current, r.m.s.	R.m.s. value - important for cable dimensioning

6.3.2 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 %

Input data

Type	Voltage [V]	Frequency [Hz]	Current [A]		Number of phases
			max. +45 °C ①	max. +55 °C ①	
E94APNE0104	400	50/60	8	6	3
E94APNE0364	400	50/60	29	21.8	3
E94APNE1004	400	50/60	82	61	3
E94APNE2454	400	50/60	200	150	3

① Temperature in the control cabinet

Type	Voltage [V]	Continuous input power S_L [kVA]
E94APNE0104	400	5.5
E94APNE0364	400	20.1
E94APNE1004	400	56.7
E94APNE2454	400	138

Output data

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

Type	Voltage [V]	Frequency [Hz]	Current [A] max. +45 °C ①	Current [A] max. +55 °C ①	Number of phases
E94APNE0104	565	0 (DC)	10	7.5	2
E94APNE0364	565	0 (DC)	36	27	2
E94APNE1004	565	0 (DC)	100	75	2
E94APNE2454	565	0 (DC)	245	184	2

① Temperature in the control cabinet

	Output current and output power					
	100 %		Cycle 1		Cycle 2	
Type	I_{DC} [A]	P_{DC} [kW]	I_{DC} [A]	P_{DC} [kW]	I_{DC} [A]	P_{DC} [kW]
E94APNE0104	10	3.6	40	14.4	15	5.4
E94APNE0104 + E94AZMP0084	10	4.9	40	19.6	15	7.4
E94APNE0364	36	13.0	108	39.0	54	19.5
E94APNE0364 + E94AZMP0294	36	17.5	108	52.5	54	26.3
E94APNE1004	100	36.2	200	109	150	54.3
E94APNE1004 + E94AZMP0824	100	48.6	200	146	150	72.9
E94APNE2454	245	88.6	368	266	368	133
E94APNE2454 + E94AZMP2004	245	119	368	357	368	179

100 %	Permanent rated values
Cycle 1	Cycle for the second-range (0.5 s overload/4.5 s recovery time with 75 % of the permanent rated value)
Cycle 2	Cycle for the minute-range (60 s overload/120 s recovery time with 75 % of the permanent rated value)

Internal brake chopper data

Type	Switching threshold (adjustable) U_{BRmax} [V]	Minimum brake resistor R_{Bmin} [Ω]	Peak current I_{BRmax} [A]	Peak braking power P_{BRmax} [kW]	Continuous current RMS I_{BRd} [A]	Continuous braking power P_{Bd} [kW]
E94APNE0104	725	27.0	26.9	19.5	9.7	2.6
E94APNE0364	725	12.0	60.4	43.8	27.0	8.7
E94APNE1004	725	5.0	145	105	58.2	17.0
E94APNE2454	725	2.8	259	188	104	30.3

I_{BRmax}, P_{BRmax}	Periodic load change of 0.5 s and recovery time of 4.5 s
R_{Bmin}	Nominal value, ±10 %
Permanent current, r.m.s.	R.m.s. value - important for cable dimensioning

6.3.3 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 %

Input data

Type	Voltage [V]	Frequency [Hz]	Current [A]		Number of phases
			max. +45 °C ①	max. +55 °C ①	
E94APNE0104	500	50/60	8	6	3
E94APNE0364	500	50/60	29	21.8	3
E94APNE1004	500	50/60	82	61	3
E94APNE2454	500	50/60	200	150	3

① Temperature in the control cabinet

Type	Voltage [V]	Continuous input power S_L [kVA]
E94APNE0104	500	6.9
E94APNE0364	500	25.1
E94APNE1004	500	70.9
E94APNE2454	500	173

Output data

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

Type	Voltage [V]	Frequency [Hz]	Current [A] max. +45 °C ①	Current [A] max. +55 °C ①	Number of phases
E94APNE0104	705	0 (DC)	10	7.5	2
E94APNE0364	705	0 (DC)	36	27	2
E94APNE1004	705	0 (DC)	100	75	2
E94APNE2454	705	0 (DC)	245	184	2

① Temperature in the control cabinet

	Output current and output power					
	100 %		Cycle 1		Cycle 2	
Type	I_{DC} [A]	P_{DC} [kW]	I_{DC} [A]	P_{DC} [kW]	I_{DC} [A]	P_{DC} [kW]
E94APNE0104	10	4.5	40	18.0	15	6.8
E94APNE0104 + E94AZMP0084	10	6.1	40	24.4	15	9.2
E94APNE0364	36	16.3	108	48.9	54	24.5
E94APNE0364 + E94AZMP0294	36	21.9	108	65.7	54	32.9
E94APNE1004	100	45.2	200	136	150	67.8
E94APNE100 + E94AZMP0824	100	60.8	200	182	150	91.2
E94APNE2454	245	111	368	333	368	167
E94APNE2454 + E94AZMP2004	245	149	368	447	368	224

100 %	Permanent rated values
Cycle 1	Cycle for the second-range (0.5 s overload/4.5 s recovery time with 75 % of the permanent rated value)
Cycle 2	Cycle for the minute-range (60 s overload/120 s recovery time with 75 % of the permanent rated value)

Internal brake chopper data

Type	Switching threshold (adjustable) U_{BRmax} [V]	Minimum brake resistor R_{Bmin} [Ω]	Peak current I_{BRmax} [A]	Peak braking power P_{BRmax} [kW]	Continuous current RMS I_{BRd} [A]	Continuous braking power P_{Bd} [kW]
E94APNE0104	790	27.0	29.3	23.1	10.6	3.0
E94APNE0364	790	12.0	65.8	52.0	29.4	10.4
E94APNE1004	790	5.0	158	125	63.5	20.1
E94APNE2454	790	2.8	282	223	113	36.0

I_{BRmax}, P_{BRmax}	Periodic load change of 0.5 s and recovery time of 4.5 s
R_{Bmin}	Nominal value, ±10 %
Permanent current, r.m.s.	R.m.s. value - important for cable dimensioning

6.3.4 Fuses and cable cross-sections

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

Operation with external mains choke								
Type	Installation according to EN 60204-1 [1]					Installation according to UL [2]		FI [3]
	①	②	L1, L2, L3			③	L1, L2, L3	
			Laying system					
			B2	c	F			
	[A]	[A]	[mm²]	[mm²]	[mm²]	[A]	[AWG]	[mA]
E94APNE0104	C16	-	2,5		2,5	15	14	≥ 300
E94APNE0244	C32	-	10		10	40	8	≥ 300
E94APNE1004	-	125	-		50 F: 50	100	1/0	≥ 300
E94APNE2454	-	315	-		F: 150 (2 x 70)	250	250 mcm (2 x 1/0)	≥ 300

1) The data are recommendations. Other dimensioning/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 leads, 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 ... 600 V, tripping characteristic "H", "K5" or "CC".
3) Universal-current sensitive earth-leakage circuit breaker. With cable lengths > 50 m, circuit breakers may respond depending on the cable type and switching frequency.
4) Device with integrated mains choke
① Circuit breaker
② Fuse of utilisation category gG/gL
③ Fuse
Observe national and regional regulations

Operation without external mains choke/mains filter

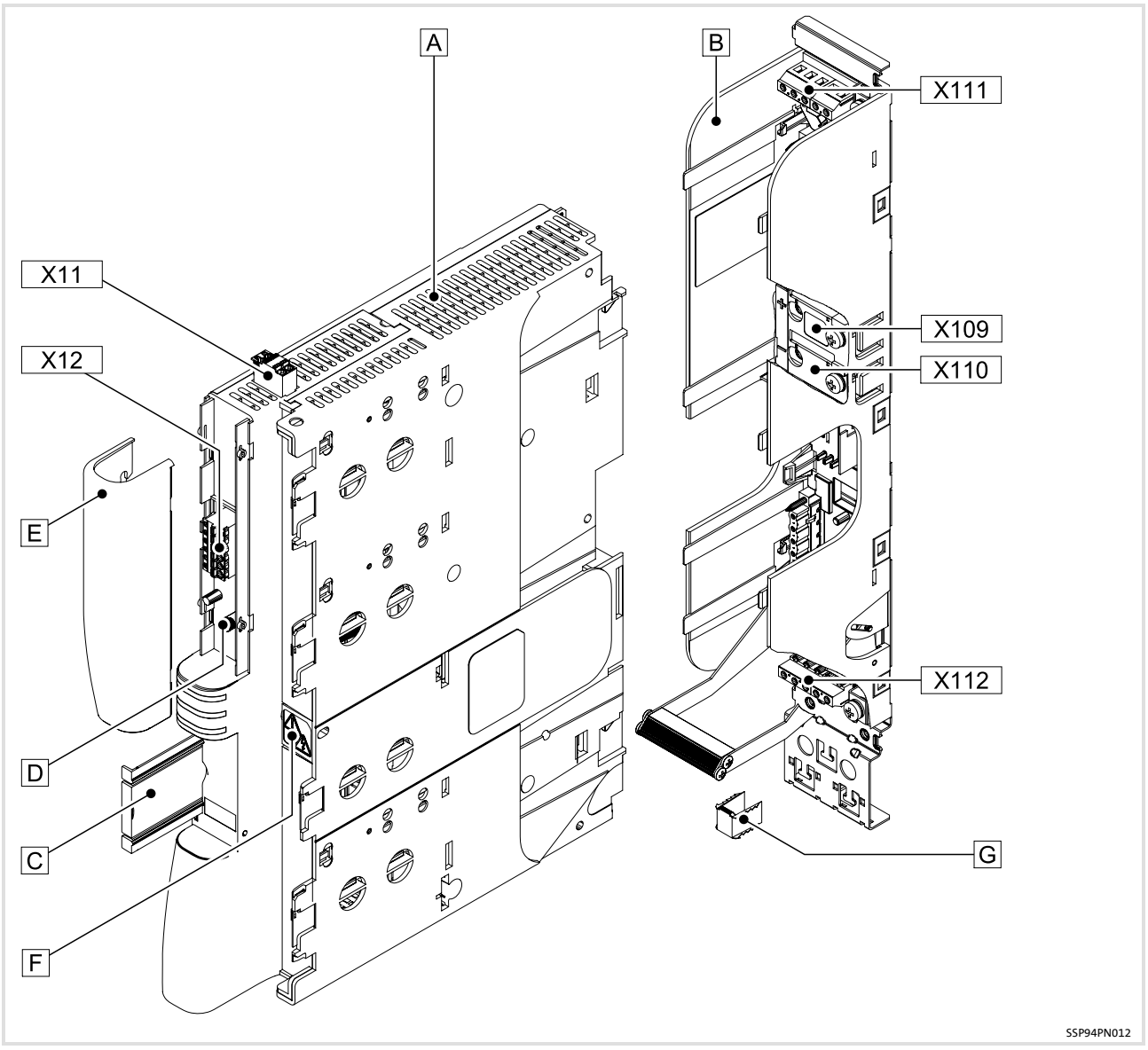
Type	Installation according to EN 60204-1 [1]					Installation according to UL [2]		FI [3]
	①	②	L1, L2, L3			③	L1, L2, L3	
			Laying system					
			B2	c	F			
	[A]	[A]	[mm²]	[mm²]	[mm²]	[A]	[AWG]	[mA]
E94APNE0104	C16	-	2,5		2,5	15	14	≥ 300
E94APNE0244	C32	-	10		10	40	8	≥ 300
E94APNE1004	-	125	-		50 F: 50	100	1/0	≥ 300
E94APNE2454	-	315	-		F: 150 (2 x 70)	250	250 mcm (2 x 1/0)	≥ 300

1) The data are recommendations. Other dimensioning/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 leads, 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 ... 600 V, tripping characteristic "H", "K5" or "CC".
3) Universal-current sensitive earth-leakage circuit breaker. With cable lengths > 50 m, circuit breakers may respond depending on the cable type and switching frequency.
4) Device with integrated mains choke
① Circuit breaker
② Fuse of utilisation category gG/gL
③ Fuse
Observe national and regional regulations

6.4 Device description

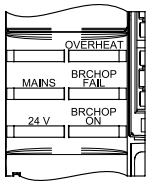
This page remains blank to give you a clearly arranged overview of the following subject on the next double page.

6.4.1 Devices in the range 10 ... 36 A (4 ... 18 kW)



Standard device A	
Pos.	**Description**
X11	24 V supply
X12	4 digital outputs
	1 digital input
C	Nameplate, retractable
D	Setting of mains voltage/brake chopper threshold
E	Upper cap

The LED display enables fast indication of several operating states.



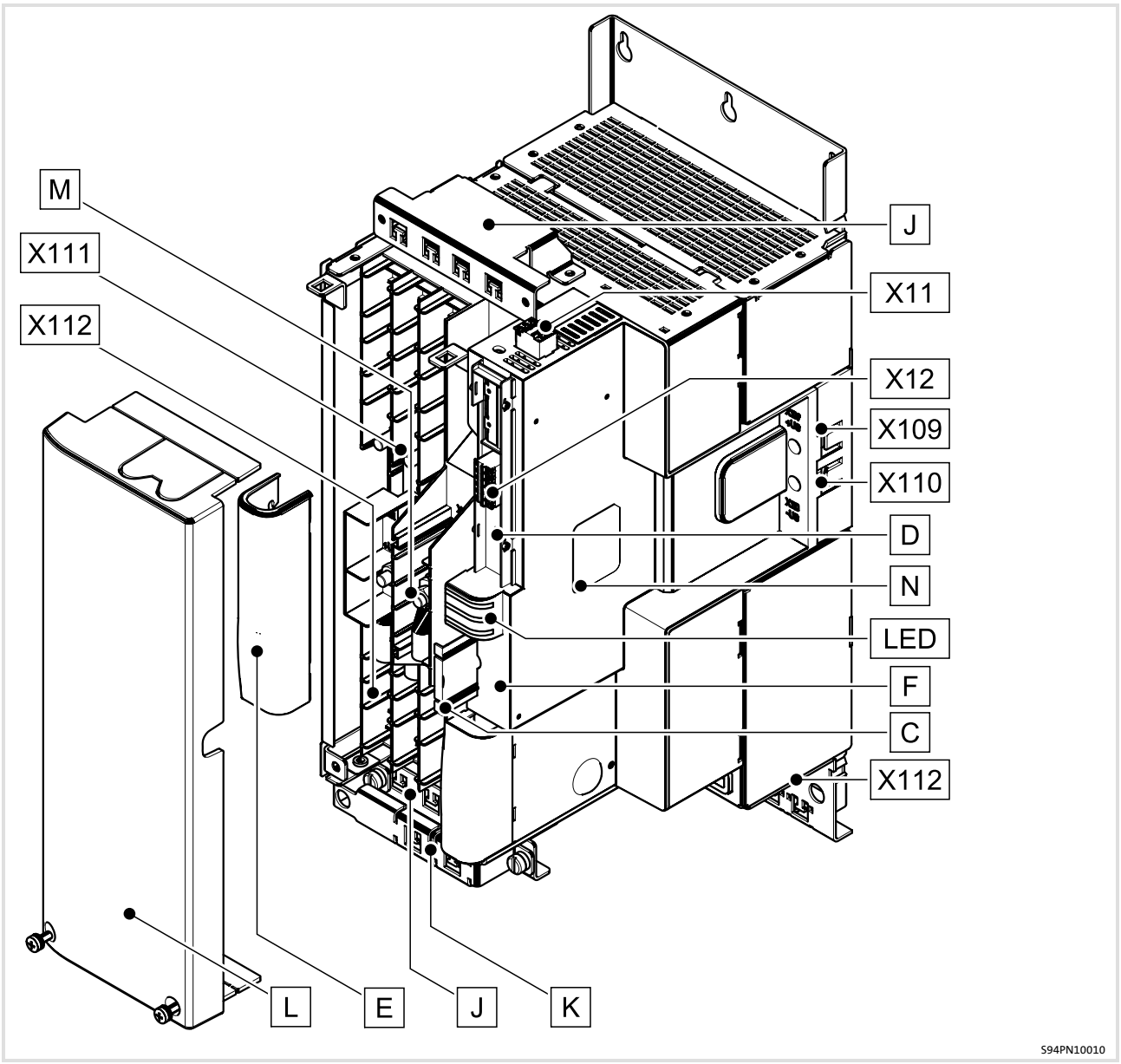
SSP94LED21

LED	Labelling	Colour	Description
	-	-	-
	OVERHEAT	Red	Overtemperature
	MAINS	Green	Mains voltage OK
	BRCHOP FAIL	Red	Short circuit on brake chopper
	24 V	Green	24 V supply voltage OK
	BRCHOP ON	Yellow	Brake chopper active

Pos.	Symbol	Description
F		**Long discharge time**: All power terminals carry hazardous voltages for at least 3 minutes after mains disconnection!
		High discharge current: Fixed installation and PE connection to EN 61800-5-1 required!
		Electrostatic sensitive devices: Before working on the device, personnel must ensure that they are free of electrostatic charge!

Mounting base B		
Pos.	**Description**	
X111	Mains (supply from above, e.g. from top filters)	
	DC-bus voltage (compatible with 9300 series)	
X112	Mains (supply from below, e.g. from built-on filter)	
	External brake resistor	
X109	DC-bus busbar +	Direct connection of 9400 axis modules, device sizes 1 ... 3
X110	DC busbar -	
G	EMC shield clamp	

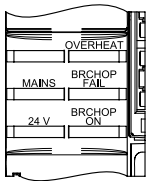
6.4.2 Devices in the range 100 ... 245 A (48 ... 119 kW)



Pos.	Description
X11	External 24 V supply
X12	4 digital outputs
	1 digital input
C	Nameplate, retractable
D	Setting of mains voltage/brake chopper threshold
E	Upper cap
J	Cable fixation for L1 ... L3, ⏚, also serves as a lifting aid, at the top and bottom, can be removed
K	Cable fixation for +UG/-UG, can be mounted at the top and bottom
L	Module front with removable cable opening covers
M	Cable connection +UG/-UG (also specified as part of X111 or X112)
N	Nameplate 2

Pos.	Description (connections)	
X111	Mains (supply from above, e.g. through top-mounted filter)	For cables being routed upwards
	DC-bus voltage (compatible to 9300 series)	
X112	Mains (supply from below, e.g. through side-mounted filter)	For cables being routed downwards
	External brake resistor	
	DC bus	
X109	DC busbar +	Direct connection of 9400 series axis modules, device size 1 ... 3
X110	DC busbar -	

The LED display enables fast indication of several operating states.

LED	Labelling	Colour	Description
 SSP94LED21	-	-	-
	OVERHEAT	Red	Overtemperature
	MAINS	Green	Mains voltage OK
	BRCHOP FAIL	Red	Short circuit on brake chopper
	24 V	Green	24 V supply voltage OK
	BRCHOP ON	Yellow	Brake chopper active

Pos.	Symbol	Description
F	⚠	**Long discharge time**: All power terminals carry hazardous voltages for at least 3 minutes after mains disconnection!
	⚠	**High discharge current**: Fixed installation and PE connection to EN 61800-5-1 required!
	⚠	**Electrostatic sensitive devices**: Before working on the device, personnel must ensure that they are free of electrostatic charge!

6.5 Mechanical installation

6.5.1 Important notes

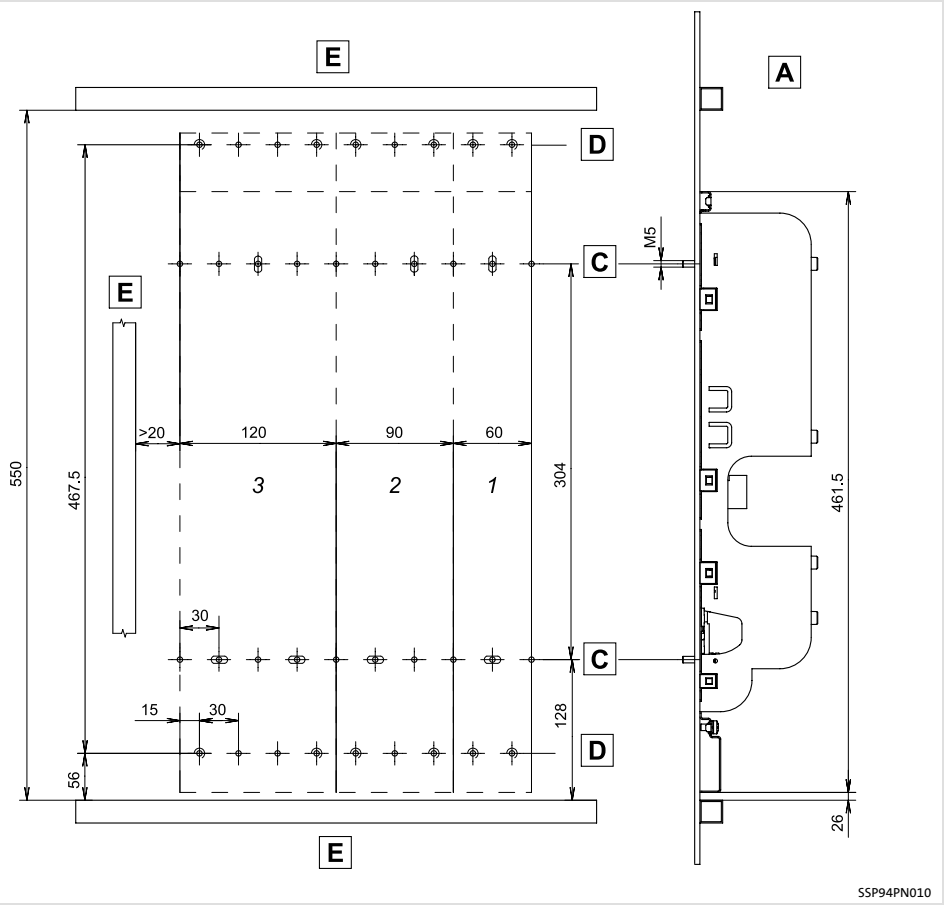
Note!

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

6.5.2 Devices in the range 10 ... 36 A (4 ... 18 kW)

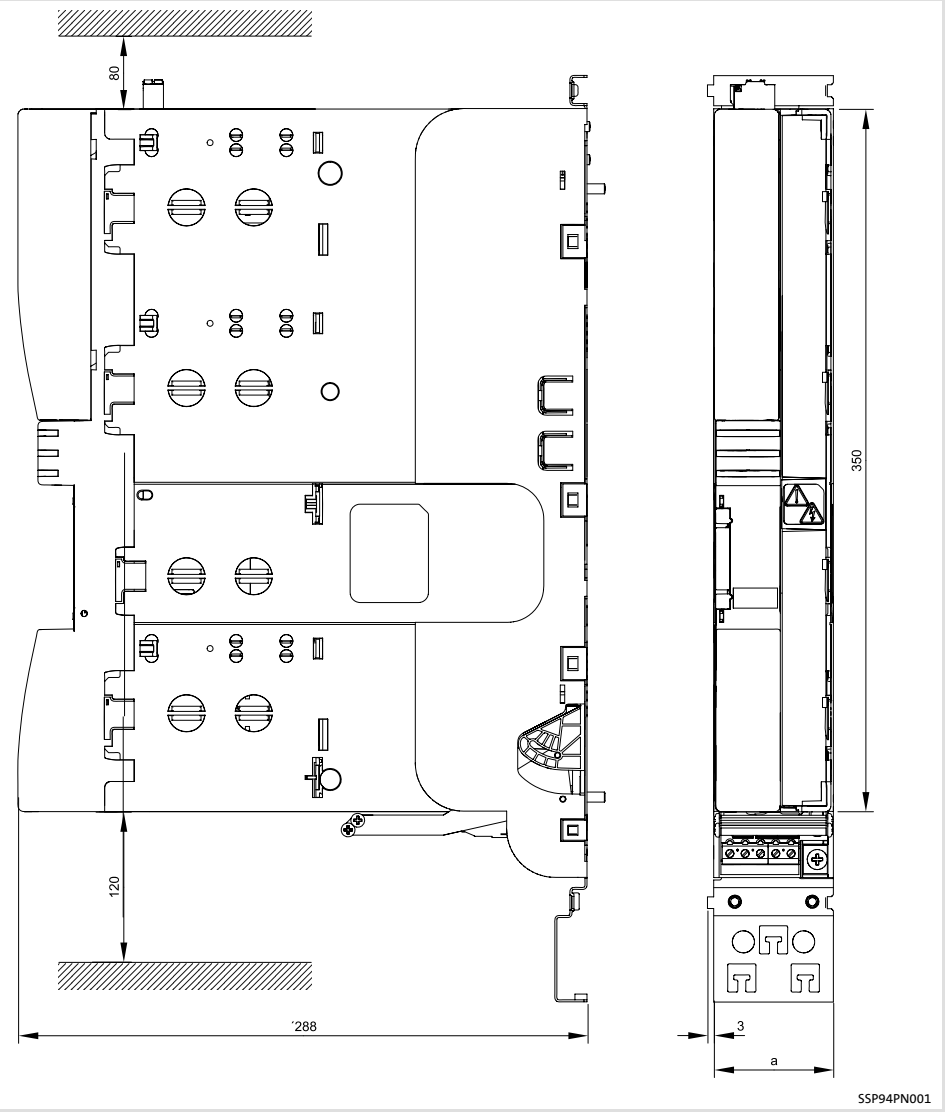
Mounting grid

We recommend to provide the mounting plate with a grid pattern of M5 threaded holes for attaching the devices. This preparation enables easy attachment of the devices and the device sizes 1, 2, ... n can thus be mounted directly adjacent to each other.



A Mounting with backplane for attaching the power supply module
C Grid hole pattern for installation backplane
D Grid hole pattern for other device sizes or built-on/footprint filters (only Single Drive)
E Cable duct
1 ... 3 Device size, mounting holes used

Standard device with installation backplane



Type		Dimensions a	Weight
Power supply module	**Installation backplane**	[mm]	[kg]
E94APNE0104	E94AZPP0104	60	1.9
E94APNE0364	E94AZPP0364	120	3.9

Arrangement of the devices

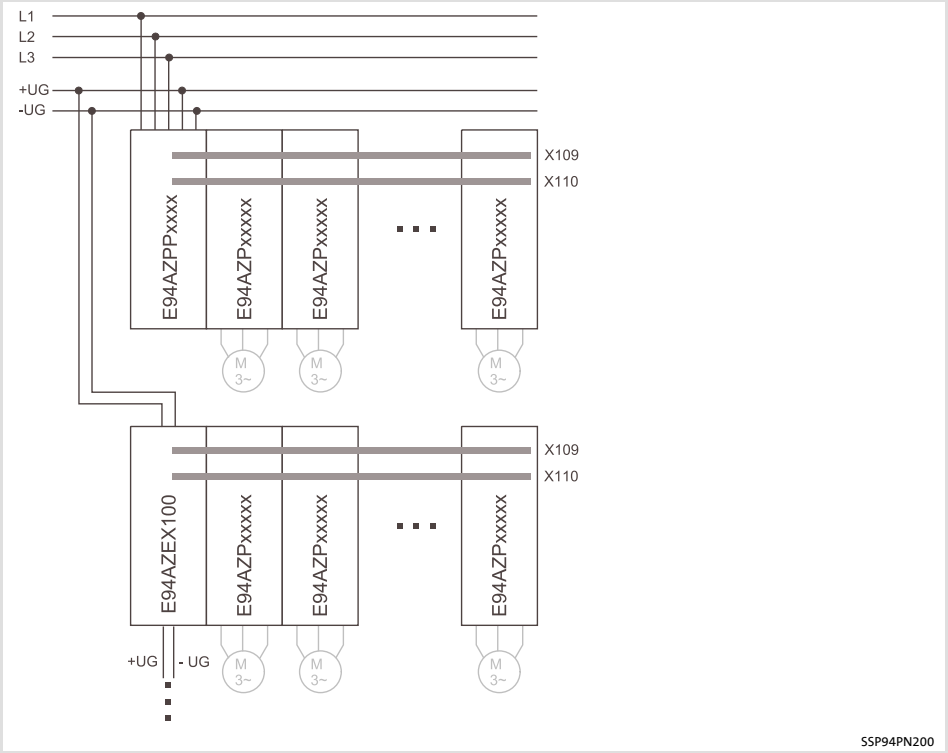


Fig. 6.5-1 Arrangement concept

The technical data must be taken into account when planning and dimensioning a DC-bus interconnection.

Arrange the devices as follows for operation in DC-bus interconnection via the DC busbars:

- ► Mount the devices side by side from the left to the right.
- ► Install the supplying device on the left side:
  - – DC power supply module (in a first row),
  - – DC feeding point (in following rows).
- ► Install the Multi Drive axis controllers from left to right with decreasing powers.
- ► Single Drive axis controllers can be integrated to increase the braking power. These axis controllers must be equipped with the optional busbar set (E94AZJAxxx).

Installation steps

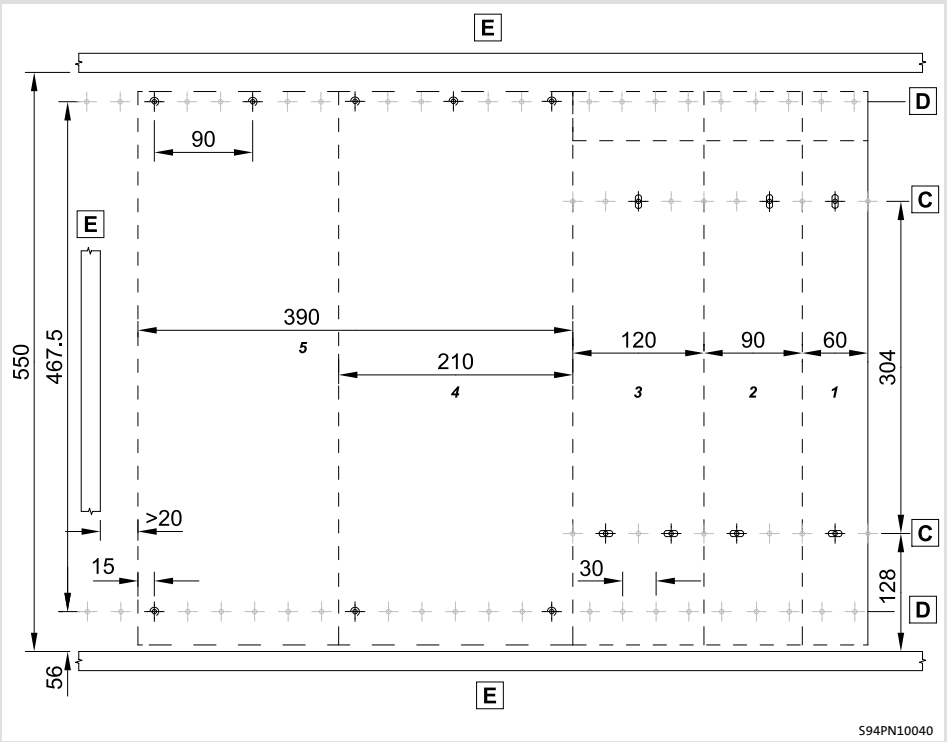
Proceed as follows for the installation:

1. Prepare M5 threaded holes on the mounting plate according to the mounting grid.
2. Screw the installation backplane onto the mounting plate. Do not yet tighten the screws.
   – Use M5 screw and washer assemblies or M5 hexagon socket screws with washers.
   – The screw joint in the installation backplane may not jut out more than 7 mm.
3. Repeat step 2 for other installation backplanes, which can be mounted directly adjacent to one another.
4. Align all installation backplanes.
5. If busbars are used: connect the busbars.
6. Tightly screw all installation backplanes onto the mounting plate.
   – Tightening torque: 3.4 Nm (30 lb-in).

6.5.3 Devices in the range 100 ... 245 A (48 ... 119 kW)

Mounting grid

We recommend to provide the mounting plate with a grid pattern of M5 threaded holes for attaching the devices. This preparation enables easy attachment of the devices and the device sizes 1, 2, ... n can thus be mounted directly adjacent to each other.



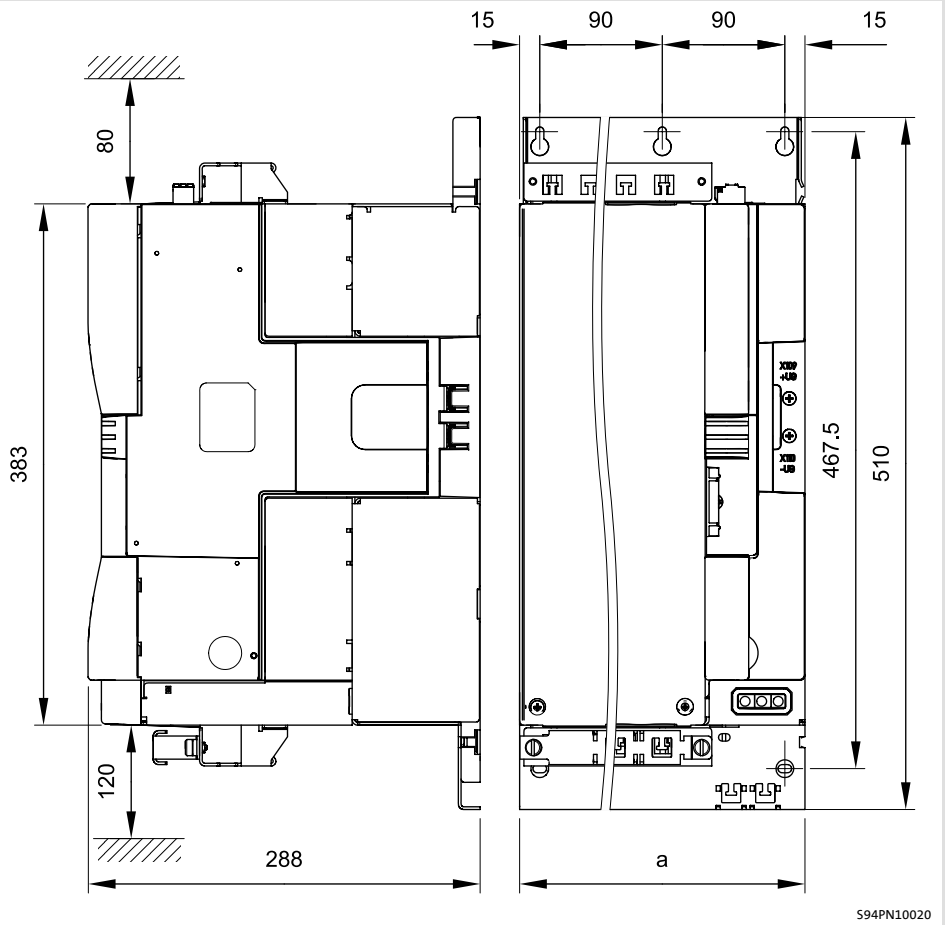
C Grid hole pattern for installation backplane

D Grid hole pattern for other device sizes or filters mounted below or beside the device (only for Single Drive)

E Cable duct

1 ... *5* Device size, mounting holes used

Dimensions



Type Power supply module	Dimension a [mm]	Mass [kg]	Device size
E94APNE1004	210	13.5	4
E94APNE2454	390	28.5	5

Arrangement of the devices

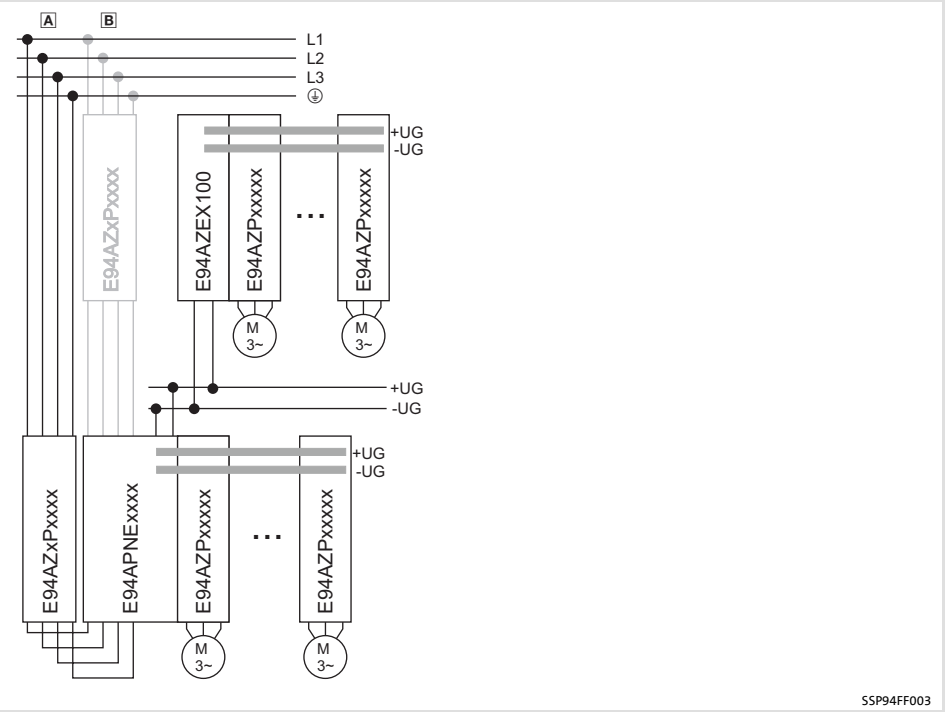


Fig. 6.5-2 Arrangement concept

A	Standard mounting: Side-by-side mounting
B	Mounting variant: On top
E94AZxPxxxx	Filter
E94APNExxxx	9400 DC power supply module
E94AZEX100	DC input module
E94AZPxxxxx	Mounting base - 9400 axis module

The technical data must be taken into account when planning and dimensioning a DC-bus interconnection.

Arrange the devices as follows for operation in DC-bus interconnection via the DC busbars:

- ► Mount the devices side by side from the left to the right.
- ► Install the supplying device on the left side:
  - – DC power supply module (in a first row),
  - – DC feeding point (in following rows).
- ► Install the Multi Drive axis controllers from left to right with decreasing powers.
- ► Single Drive axis controllers can be integrated to increase the braking power. These axis controllers must be equipped with the optional busbar set (E94AZJAxxx).

Installation steps

Proceed as follows for the installation:

1. Prepare M5 threaded holes on the mounting plate according to the mounting grid.
2. Screw the device onto the mounting plate. Do not yet tighten the screws.
   – Use M5 screw and washer assemblies or M5 hexagon socket screws with washers.
3. Repeat step 2 for installation backplanes, which can be mounted directly adjacent to one another.
4. Align all devices and installation backplanes.
5. If busbars are used: connect the busbars.
6. Tightly screw all devices and installation backplanes onto the mounting plate.
   – Tightening torque: 3.4 Nm (30 lb-in).

6.6 Wiring

6.6.1 Important notes

Danger!

Dangerous voltage

All power terminals remain live for at least three minutes after mains disconnection.

Possible consequences:

► Death or severe injuries when touching the power terminals.

Protective measures:

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

► Check 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 ≥ 10 mm^2 or PE conductor must be connected twice)

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.

6.6.2 Safety notes for the installation according to U_L or U_R

E94APNE0104/E94APNE0364

Warnings!

- ► Maximum surrounding air temperature: 55 °C.
- ► Branch circuit protection:
  Suitable for use on a circuit capable of delivering not more than 5000 rms symetrical amperes, 500 V max., when protected by H, K5 or CC fuses.
- ► Voltage of the fuses must at least be suitable with the input voltage of the drive.
- ► Control card protection:
  External fuse for 24 Vdc supply voltage of control terminal X11. Rated 4 A DC fuse UL248-14.
- ► Use 60/75 °C copper wire only, except for control circuits.

	Branch circuit protection
Type	Fuse [A]
E94APNE0104	15
E94APNE0364	40

E94APNE1004/E94APNE2454

Warnings!

- ► Maximum surrounding air temperature: 55 °C.
- ► Branch circuit protection:
  Suitable for use on a circuit capable of delivering not more than 18000 rms symetrical amperes, 500 V max., when protected by H or K5 fuses.
- ► Voltage of the fuses must at least be suitable with the input voltage of the drive.
- ► Use 60/75 °C copper wire only, except for control circuits.

	Branch circuit protection
Type	Fuse [A]
E94APNE1004	100
E94APNE2454	250

6.6.3 Design of the cables

- The cables used must comply with the approvals required for the location (e.g. UL).
- 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 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:

- External brake resistor (Mounting Instructions of the brake resistor)

The following connections need not be shielded:

- Mains

6.6.4 Devices in the range 10 ... 36 A (4 ... 18 kW)

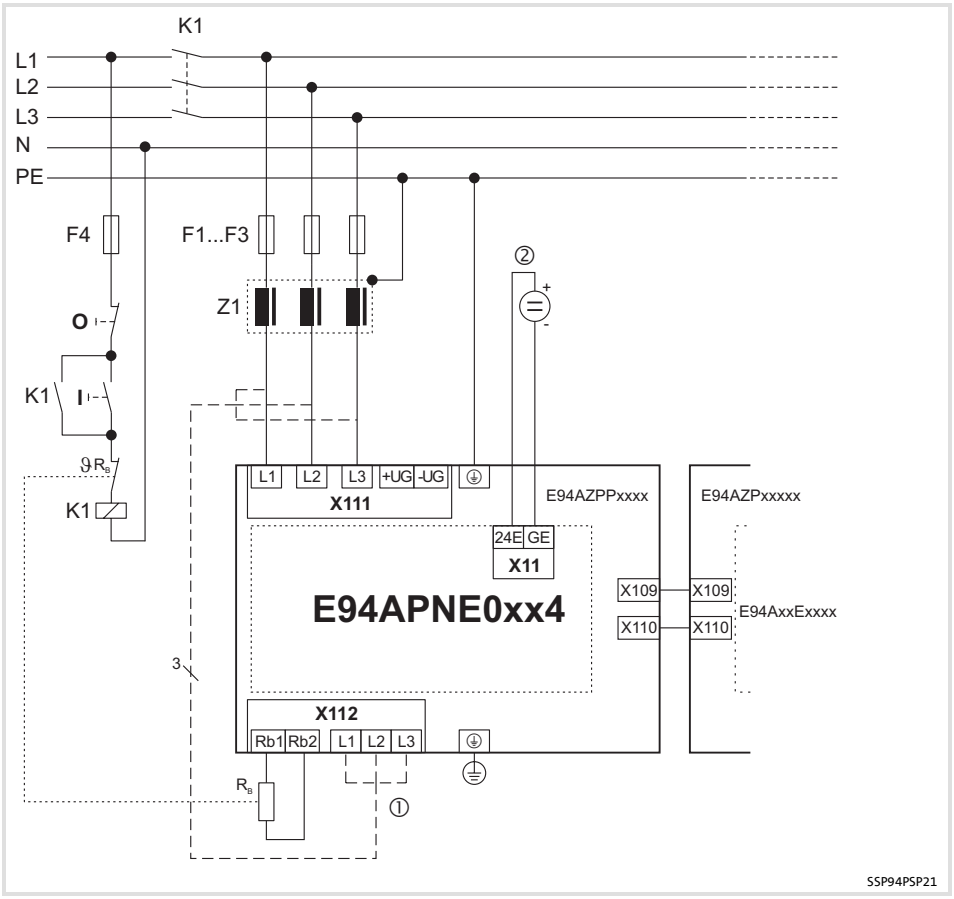


Fig. 6.6-1 Example circuit for installation backplane and DC power supply module

E94APNE0xx4	9400 DC power supply module
E94AZPxxxxx	Installation backplane
E94AxxExxxx	9400 axis module
F1 ... F4	Fuses
Z1	Mains filter/RFI filter (optional)
K1	Mains contactor
RB	Brake resistor
①	Alternative: mains connection at the bottom
②	24 V supply voltage for control electronics according to IEC 61131-2

Tip!

Complete the wiring of the installation backplane before plugging in the standard device. The upper terminals of the installation backplane cannot be connected with a plugged-in standard device.

6.6.5 Connecting busbars

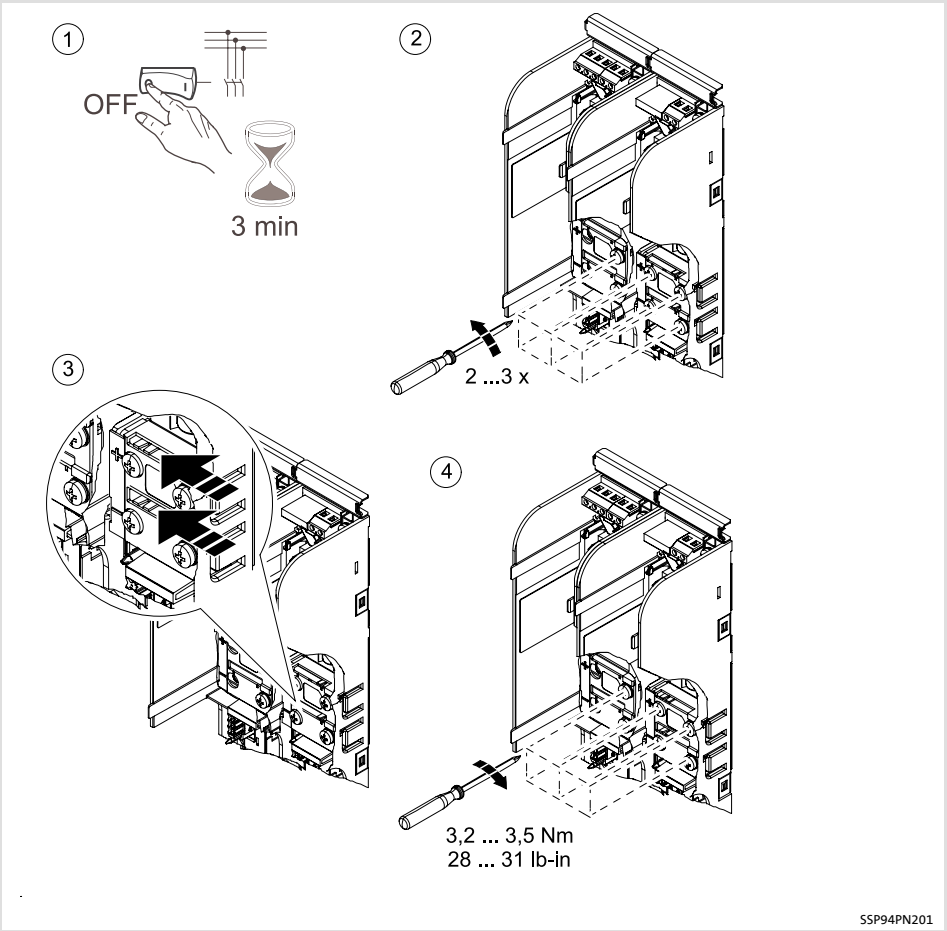


Fig. 6.6-2 Example: connecting busbars to DC power supply module

Proceed as follows to connect the busbars:

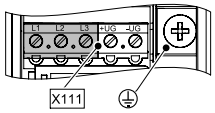
1. If devices of the interconnected system have already been in operation:
   – Ensure that the power supply system is switched off by checking the voltage at the supply terminals.
   – If necessary, switch off the power supply and wait at least 3 minutes.
2. Loosen the busbar screws but do not remove them completely.
3. Push the busbars as far as possible to the left towards the adjacent busbar.
   – Ensure that there is good contact to the adjacent busbar.
4. Tighten the busbar screws.
   – Tightening torque: 3.2 ... 3.5 Nm (28 ... 31 lb-in).
5. Screw all components onto the mounting plate.
   – Tightening torque: 3.4 Nm (30 lb-in).

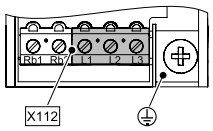
6.6.6 Terminal assignment

Tip!

Complete the wiring of the installation backplane before plugging in the standard device. The upper terminals of the installation backplane cannot be connected with a plugged-in standard device.

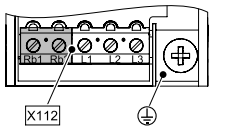
Mains

Terminal X111 (left part)	Labelling	Description
 SSP940X111	L1 L2 L3	Connection of the mains phases L1, L2, L3
	⏚	Connection for the supply-side PE conductor with M5 ring cable lug

Terminal X112 (right part)	Labelling	Description
 SSP940X112	L1 L2 L3	Alternative connection at the bottom: mains phases L1, L2, L3
	⏚	Connection for the supply-side PE conductor with M5 ring cable lug

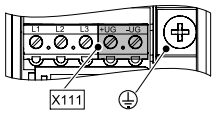
Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device sizes 1+2: flexible with wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 6.2	PZ0
Device size 3: flexible with wire end ferrule	10	6	1.2 ... 1.5	10.6 ... 13.3	PZ1

External brake resistor

Terminal X112 (left part)	Labelling	Description
 SSP940X112	Rb1 Rb2	External brake resistor

Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device sizes 1+2: flexible with wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 6.2	PZ0
Device size 3: flexible with wire end ferrule	10	6	1.2 ... 1.5	10.6 ... 13.3	PZ1

DC bus

Terminal X111 (right part)	Labelling	Description
 SSP940X111	+UG -UG	Alternative option for DC-bus voltage connection (compatible to 9300 series)

Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device sizes 1+2: flexible with wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 6.2	PZ0
Device size 3: flexible with wire end ferrule	10	6	1.2 ... 1.5	10.6 ... 13.3	PZ1

6.6.7 Devices in the range 100 ... 245 A (48 ... 119 kW)

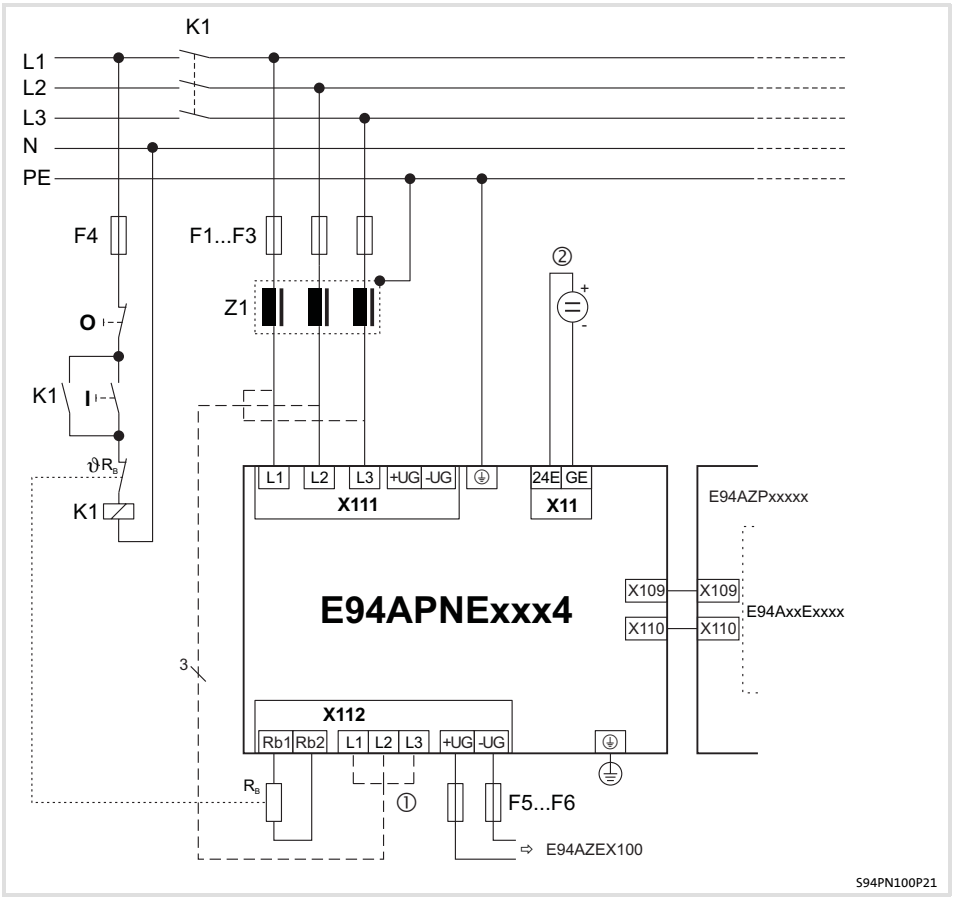


Fig. 6.6-3 Connection concept

E94APNExxx4	9400 DC power supply module
E94AZPxxxxx	Installation backplane
E94AxxExxxx	9400 axis module
E94AZEX100	DC input module
F1 ... Fx	Fuses
Z1	Mains filter/RFI filter (optional)
K1	Mains contactor
RB	Brake resistor
①	Alternative: mains connection at the bottom
②	24 V supply voltage for control electronics according to IEC 61131-2

6.6.8 Connecting busbars

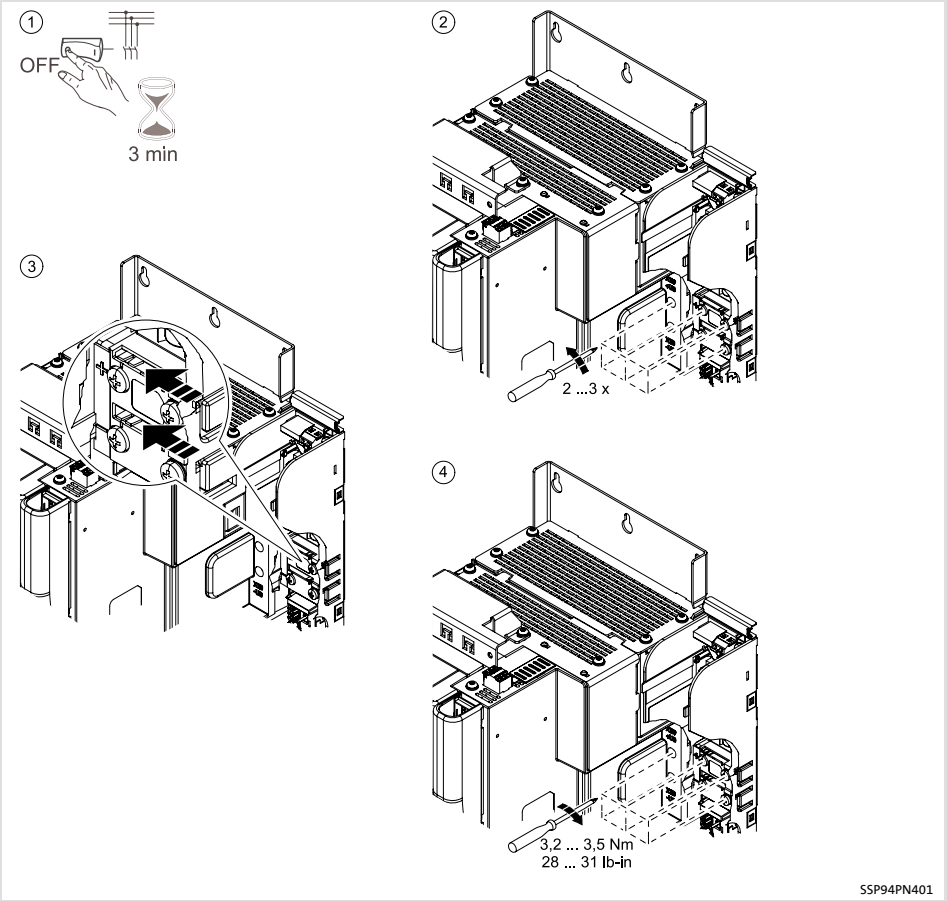


Fig. 6.6-4 Example: connecting busbars to DC power supply module

Proceed as follows to connect the busbars:

1. If devices of the interconnected system have already been in operation:
   – Ensure that the power supply system is switched off by checking the voltage at the supply terminals.
   – If necessary, switch off the power supply and wait at least 3 minutes.
2. Loosen the busbar screws but do not remove them completely.
3. Push the busbars as far as possible to the left towards the adjacent busbar.
   – Ensure that there is good contact to the adjacent busbar.
4. Tighten the busbar screws.
   – Tightening torque: 3.2 ... 3.5 Nm (28 ... 31 lb-in).
5. Screw all components onto the mounting plate.
   – Tightening torque: 3.4 Nm (30 lb-in).

6.6.9 Terminal assignment

The wiring area of the power terminals is designed for the cables being routed upwards and/or downwards. Usually the AC mains cables come from above. When filters are used, the connection cables are fed from below (for filters mounted beside the module) or from above (for filters mounted above the module). The protection against contact in the cover can be removed accordingly.

To improve the cable handling, the cable cross-section can also be divided onto two cables.

The ring cable lugs used must not exceed the dimensions specified here.

- ► E94APNE1004 (device size 4, connection M8): max. cable lug width 20 mm
- ► E94APNE2454 (device size 5, connection M10): max. cable lug width 33 mm

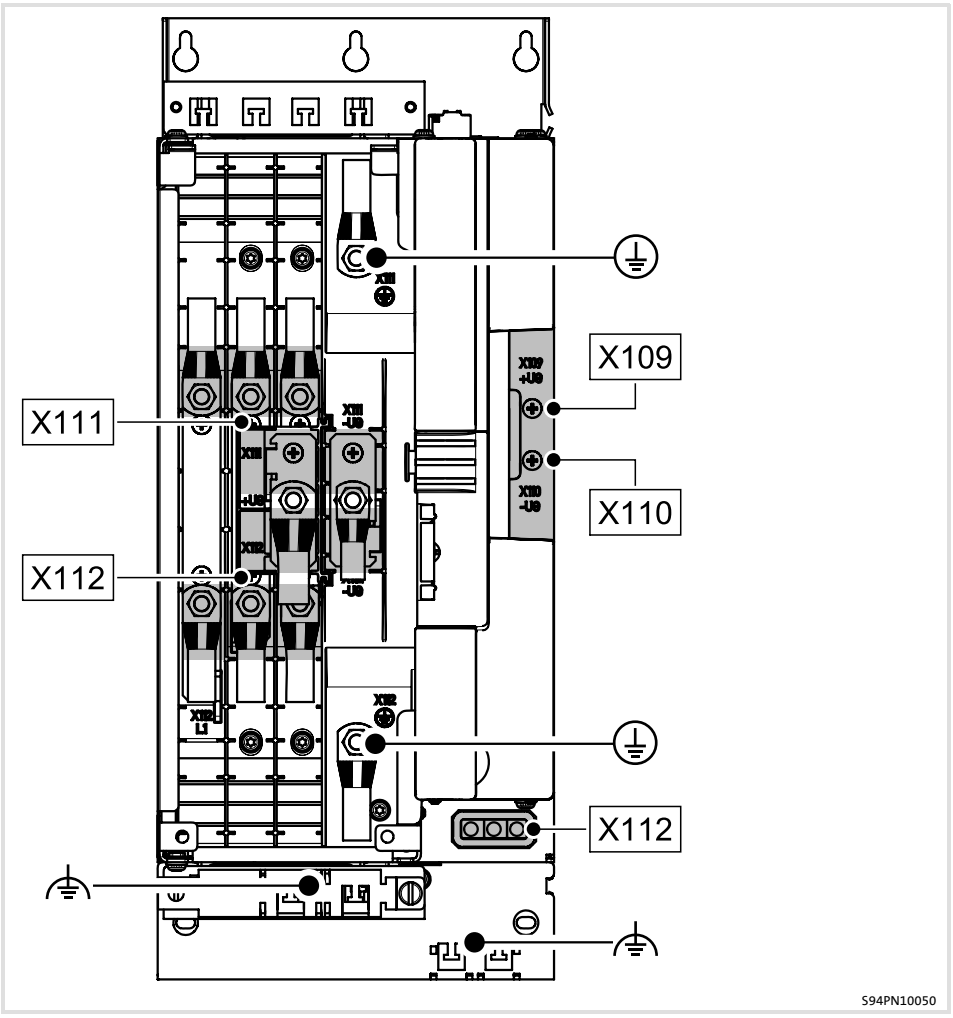


Fig. 6.6-5 Arrangement of the power connections

Mains

Terminal X111	Labelling	Description
🕮 Fig. 6.6-5	L1 L2 L3	Connection of the mains phases L1, L2, L3
	⏚	Connection for the supply-side PE conductor

Terminal X112	Labelling	Description
🕮 Fig. 6.6-5	L1 L2 L3	Alternative connection at the bottom: mains phases L1, L2, L3
	⏚	Connection for the supply-side PE conductor

Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device size 4: Connection with ring cable lug M8	50 (2 x 25)	1/0 -	8	71	SW13
Device size 5: Connection with ring cable lug M10	120 (2 x 50)	4/0 (2 x 1/0)	15	133	SW15

DC bus

Terminal X111	Labelling	Description
🕮 Fig. 6.6-5	+UG -UG	Connection of DC-bus voltage Cables routed upwards

Terminal X112	Labelling	Description
🕮 Fig. 6.6-5	+UG -UG	Connection of DC-bus voltage Cables routed downwards

Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device size 4: Connection with ring cable lug M8	70 (2 x 35)	2/0 -	8	71	SW13
Device size 5: Connection with ring cable lug M10	150 (2 x 70)	300 mcm (2 x 2/0)	15	133	SW15

External brake resistor

Terminal X112	Labelling	Description
🕮 Fig. 6.6-5	Rb1 Rb2	External brake resistor

Terminal data	Max. conductor cross-section		Tightening torque		Screw drive
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device size 4: flexible with wire end ferrule	16	4	0.5 ... 0.6	4.5 ... 6.2	6 x 2
Device size 5: flexible with wire end ferrule	35	1	1.2 ... 1.5	10.6 ... 13.3	6 x 2

6.7 Control terminals

Danger!

Dangerous voltage

All power terminals remain live for at least three minutes after mains disconnection.

Possible consequences:

► Death or severe injuries when touching the power terminals.

Protective measures:

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

► Check that all power terminals are deenergised.

Stop!

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

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

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.

The following connections need not be shielded:

- 24 V supply
- Digital signals (inputs and outputs)

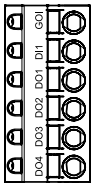
24 V supply

Terminal X11	Labelling	Description
 9400SSP000X2	GE	GND external supply
	24E	24 V external supply through safely separated power supply unit (SELV/PELV) Required for mains-independent power supply of control electronics. IEC 61131-2, 19.2 ... 28.8 V, residual ripple max. ±5 % Current during operation: 1.4 A Starting current: 4 A for 100 ms
	SB	Reserved

Terminal data	Conductor cross-section		Tightening torque	
	[mm²]	[AWG]	[Nm]	[lb-in]
Flexible	0.2 ... 2.5	24 ... 12	Spring terminal	
With wire end ferrule				

Stripping length / contact length: 10 mm

Digital inputs, digital outputs

Terminal X12	Labelling	Description
 SSP9400X12	GOI	GND digital out / in
	DI1	Activation of brake chopper - for discharging after mains disconnection only (external 24 V supply required)
	DO1	Mains OK
	DO2	Brake chopper active
	DO3	Short circuit in brake chopper
	DO4	Heatsink overtemperature

Terminal data	Conductor cross-section		Tightening torque	
	[mm²]	[AWG]	[Nm]	[lb-in]
Flexible	0.2 ... 2.5	24 ... 12	Spring terminal	
With wire end ferrule				

Stripping length / contact length: 10 mm

6.8 Final works

Danger!

Dangerous voltage!

When the mains voltage is switched off, the DC bus is still charged for at least about 3 minutes.

- ► The state of charge is not indicated!
- ► On synchronous motors self-discharge only starts after a possible feedback operation has been completed.
- ► Discharging the DC bus in a controlled manner via the brake chopper/brake resistor requires the external 24 V supply (📖 digital input DI1).

Possible consequences:

- ► Death or severe injuries when touching the terminals.

Protective measures:

- ► Before starting work on the system check that it is deenergised.
- ► Wait at least 3 minutes after switching off the mains voltage.
- ► Only remove deenergised devices from the installation backplanes and do not touch any terminals.

How to proceed:

- ► Adjust the setting for the mains voltage/brake chopper threshold to the mains
- ► Switch on the 24 V supply
- ► Check the operating status by means of the LED display

If you want to continue with the commissioning:

- ► Switch on the mains

7 Network of several drives

Contents

7.1 Introduction

7.1.1 Terminology and abbreviations used

DC bus:
The energy store in the controller or supply module from which the controller modulates the AC voltage for the motor. The DC buses of several controllers can be networked.

DC bus:
Electrical connection of the DC connections of several controllers via cable or busbar.

DC-voltage level:
DC-voltage level in the DC bus

DC-supply module:
Module with AC mains connection used to supply the DC bus of a drive system with DC voltage.

Regenerative power supply module:
DC-supply module with additional power regeneration into the AC mains.

Multi-axis controllers (Multi Drive):
Controllers for connection to a DC bus. Multi-axis controllers have no AC mains connection and no brake chopper.

Single-axis controllers (Single Drive):
Controllers for connection to an AC mains or a DC bus. Single-axis controllers have an integrated brake chopper.

Brake chopper:
Switching element in the controller used to dissipate excess energy via a brake resistor.

Brake resistor:
High-performance resistor used to convert excess energy in the DC-bus into heat.

Braking operation:
Motor operation in generator mode with energy feedback from the motor to the controller.

Mains chokes:
Inductances for damping conducted harmonic interferences which may arise from reloading the DC bus and the switching frequency of the inverter.

RFI filters:
RFI filters are capacitive accessories for compliance with the requirements acc. to EN 61800-3 for conducted interference emission. RFI filters can be directly connected upstream of the power supply modules. RFI filters are also called EMC filters.

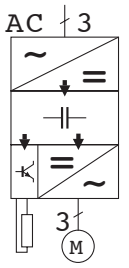
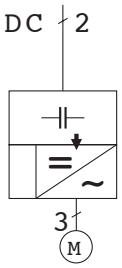
Mains filters:
Mains filters reduce the conducted interference emission into the mains for compliance with the requirements acc. to EN 61800-3. Mains filters are a combination of mains choke and RFI filter in one housing.

7.1.2 Comparison single-axis controllers / multi-axis controllers

In the power range < 11 kW, the ”Single Drive, E94A**S**…” and ”Multi Drive, E94A**M**…” are available as controllers of the 9400 servo drives series.

The single-axis controllers (”Single Drive”) are designed for connection to AC mains (3/PE AC). They are equipped with mains rectifiers, mains filters and brake choppers.

The multi-axis controllers (”Multi Drive”) are exclusively designed for connection to DC mains (2/PE DC). They are equipped with DC busbars for easy assembly. In DC-bus connections, DC-supply modules are used that contain mains rectifiers and brake choppers. Mains filters must be specially dimensioned for each DC-bus.

E94AS...	E94AM...
 AR principle	 AR principle

Tab. 7.1-1 Single Drive/Multi Drive

7.1.3 Advantages of a drive system

When several controllers are operated in a DC-bus connection (DC bus), this offers the following advantages:

- Energy exchange between controllers in generator-mode (braking) and motor-mode operation.
- The energy exchange reduces the supply power from the AC mains.
- DC-supply modules or feeding single-axis controllers can be dimensioned with a lower rated power.
- The energy exchange reduces the braking losses in generator-mode operation.

Advantages for installation:

- Only one AC-mains connection (e.g. at the DC-supply module).
- Reduced wiring costs.

7.1.4 General information on the accessories

Fuses in the DC bus

For device protection, multi-axis controllers up to 11 kW are equipped with a fuse in the installation backplane. The fuse is only integrated into the current path if the busbar system (X109) is used.

When operated in a DC-bus connection, single-axis controllers can be retrofit with a fuse in the installation backplane for device protection (see busbar mounting set).

When the alternative terminal connections are used for DC-bus wiring, external fuses must be integrated into both current paths (+UG/-UG).

Busbar mounting set

With the busbar mounting set (E94AZJA0xx) you can connect a single-axis controller via a busbar to a DC bus, e.g. to provide additional brake power. The busbar mounting set also includes the corresponding fuse.

DC-input module

With the DC-input module (E94AZEX100) you can establish the electrical connection between the DC cables and the busbar. Multi-row or distributed arrangements are possible.

Filters

RFI filters and mains filters are available for the devices connected to the AC mains (supply modules or single-axis controllers).

Depending on the application, additional filters may be required for compliance with the EMC regulations. When dimensioning the filters, please consider:

- ► Motor cable lengths
- ► Number of axis controllers
- ► Motor powers

7.2 Conditions for a trouble-free network of several drives

7.2.1 Voltages

Controllers can only be operated in a DC-bus connection, if the rated mains voltage/the rated DC-bus voltage is the same. All brake choppers in the DC-bus system must have the same thresholds.

7.2.2 Number of feeding points

The 9400 servo drives series has been designed for drive systems with a central AC mains feeding point. For this you can use DC supply modules of different power categories.

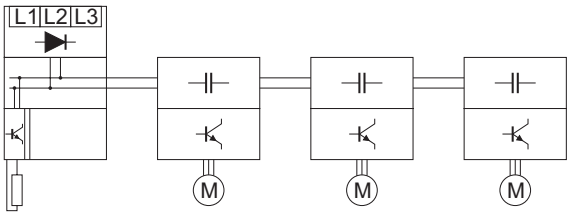
Several AC mains feeding points are only permitted in drive systems with two single-axis controllers of the same power category with inverse operation in motor and generator mode.

7.2.3 Other conditions

- The entire DC power P_{DC} must be provided by the feeding point (DC-supply module or "Single Drive" controller).
- The controllers in the DC bus may only start operation when the DC bus has been completely loaded. I.e. controller enable may only be set after "State bus OK" (see terminal X2).
- Up to a total current of 100 A, devices up to 24 1 3A (device sizes 1 ... 3) can be operated via the integrated DC busbar. Maximum busbar overload for 60 s: 150 % * I_r, followed by a relief phase of 120 s: 75 % * I_r.
- The DC bus must at no time be overloaded through the required maximum total power. For this, a time/performance diagram has to be created and considered (see Basic dimensioning).
- The cable protection measures described for the DC-bus operation must be observed.

7.3 DC-bus variants

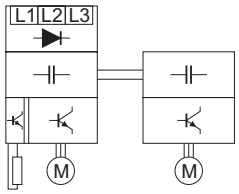
7.3.1 Supply from a supply module



A DC supply module with direct AC mains connection supplies energy into the DC bus of several controllers. The DC supply module is equipped with an integrated brake chopper to which you can connect a brake resistor.

Possible combinations	
Components to be used	**Components not to be used**
For supply	
Power supply modules	
E94AZPNExxx4 (10 ... 245 A)	-
Single-axis controllers	
-	-
As DC-bus component	
Multi-axis controllers	
E94AMxExxx4 (2 ... 24 A)	-
Single-axis controllers	
E94ASxE0024 ... E94ASxE0594 (2 ... 59 A or device sizes 1 ... 6)	E94ASxE0864 ... E94ASxE6954 (86 ... 695 A or device sizes 7 ... 10)

7.3.2 Supply from controllers



A single-axis controller with direct AC mains connection supplies energy into the DC bus of other controllers. The single-axis controller is equipped with an integrated brake chopper to which you can connect a brake resistor.

Possible combinations	
Components to be used	**Components not to be used**
For supply	
Power supply modules	
-	-
Single-axis controllers	
E94ASxE0024 ... E94ASxE0594 (2 ... 59 A or device sizes 1 ... 6)	E94ASxE0864 ... E94ASxE6954 (86 ... 695 A or device sizes 7 ... 10) → Possible to a certain degree when considering Application Reports.
As DC-bus component	
Multi-axis controllers	
E94AMxExxx4 (2 ... 24 A)	-
Single-axis controllers	
E94ASxE0024 ... E94ASxE0594 (2 ... 59 A or device sizes 1 ... 6)	E94ASxE0864 ... E94ASxE6954 (86 ... 695 A or device sizes 7 ... 10)

7.4 Rated data

7.4.1 General data

For dimensioning the DC cables, you must know the input current.

The number of devices in a drive system can be limited by the DC-bus capacity and the charging current.

Additional data			
Type	Input current I_{DC} with I_{aN8} [A]	DC-bus capacity [µF]	Charging resistor [Ω]
Multi Drives			
E94AMxE0024	2.6	165	200
E94AMxE0034	4.3	165	200
E94AMxE0044	6.7	330	200
E94AMxE0074	12.1	330	200
E94AMxE0094	15.4	495	200
E94AMxE0134	20.6	495	100
E94AMxE0174	25.7	825	100
E94AMxE0244	35.5	990	100
Single Drives			
E94ASxE0024	2.6	165	400
E94ASxE0034	4.3	165	400
E94ASxE0044	6.7	330	200
E94ASxE0074	12.1	330	200
E94ASxE0134	20.6	495	100
E94ASxE0174	25.7	825	100
E94ASxE0244	35.5	990	100
E94ASxE0324	35.5	2200	68
E94ASxE0474	45.9	2200	68
E94ASxE0594	45.9	2200	68
E94ASxE0864 [1)]	82.2	3300	68
E94ASxE1044 [1)]	87.3	3300	68
E94ASxE1454 [1)]	120	7050	32
E94ASxE1724 [1)]	142	7050	32
E94ASxE2024 [1)]	156	7050	32
E94ASxE2454 [1)]	190	7050	32
E94ASxE2924 [1)]	223	9040	32
E94ASxE3664 [1)]	282	11750	32

Tab. 7.4-1

1) Devices may not be used as direct DC bus devices on the DC-bus level because the charging current is not limited.

7.4.2 DC-supply power

The parameters relevant for the selection of a supply unit with a suitable supply power (even in the overload range) are listed in the below table:

U_{Lr}	Rated AC voltage
Cycle 1	Cycle for the second-range
Cycle 2	Cycle for the minute-range
$P_{DC\ 100\%}$	Permanent power of DC-voltage level
P_{ol}	Power during overload
t_{ol}	Overload time
P_{re}	Power during relief
t_{re}	Relief time

Any other cycles are calculated with the following formula:

$$\frac{(P_{ol} \cdot t_{ol}) + (P_{re} \cdot t_{re})}{t_{ol} + t_{re}} \leq P_{DC\ 100\%}$$

Cycles other than the above cycles must not exceed the specified power and time values, i.e. the values must be used as maximum values.

The values depend on the rated AC voltage U_{Lr}.

230 V

Supply power U_{Lr} = 230 V		Cycle 1		Cycle 2	
Type	$P_{DC\ 100\%}$ [kW]	$P_{ol} \cdot t_{ol}$ [kW] · [s]	$P_{re} \cdot t_{re}$ [kW] · [s]	$P_{ol} \cdot t_{ol}$ [kW] · [s]	$P_{re} \cdot t_{re}$ [kW] · [s]
Supply modules (+ filter)					
E94APNE0104	2.1	8.4 · 0.5	1.6 · 4.5	3.2 · 60	1.6 · 120
E94APNE0104 + E94AZMP0084	2.8	11.2 · 0.5	2.1 · 4.5	4.2 · 60	2.1 · 120
E94APNE0364	7.5	22.5 · 0.5	5.6 · 4.5	11.3 · 60	5.6 · 120
E94APNE0364 + E94AZMP0294	10.1	30.3 · 0.5	7.6 · 4.5	15.5 · 60	7.6 · 120
Single Drives					
E94ASxE0024 + E94AZMS0034	1.2	3.8 · 0.5	0.9 · 4.5	1.8 · 60	0.9 · 120
E94ASxE0034 + E94AZMS0034	1.2	3.9 · 0.5	0.9 · 4.5	1.8 · 60	0.9 · 120
E94ASxE0044 + E94AZMS0094	2.0	6.4 · 0.5	1.5 · 4.5	3.0 · 60	1.5 · 120
E94ASxE0074 + E94AZMS0094	3.4	8.1 · 0.5	2.6 · 4.5	5.1 · 60	2.6 · 120
E94ASxE0134 + E94AZMS0314	6.1	14.6 · 0.5	4.6 · 4.5	9.2 · 60	4.6 · 120
E94ASxE0174 + E94AZMS0314	7.8	18.7 · 0.5	5.9 · 4.5	11.7 · 60	5.9 · 120
E94ASxE0244 + E94AZMS0314	11.0	22.0 · 0.5	8.3 · 4.5	16.5 · 60	8.3 · 120
E94ASxE0324	20.1	40.2 · 0.5	15.1 · 4.5	30.2 · 60	15.1 · 120
E94ASxE0474	20.1	40.2 · 0.5	15.1 · 4.5	30.2 · 60	15.1 · 120
E94ASxE0594	20.1	40.2 · 0.5	15.1 · 4.5	30.2 · 60	15.1 · 120
E94ASxE0864	39.1	78.2 · 0.5	29.3 · 4.5	58.7 · 60	29.3 · 120
E94ASxE1044	39.1	78.2 · 0.5	29.3 · 4.5	58.7 · 60	29.3 · 120

Tab. 7.4-2

400 V

Supply power U_{Lr} = 400 V		Cycle 1		Cycle 2	
Type	$P_{DC\ 100\%}$ [kW]	$P_{ol} \cdot t_{ol}$ [kW] · [s]	$P_{re} \cdot t_{re}$ [kW] · [s]	$P_{ol} \cdot t_{ol}$ [kW] · [s]	$P_{re} \cdot t_{re}$ [kW] · [s]
Supply modules (+ filter)					
E94APNE0104	3.6	14.4 · 0.5	2.7 · 4.5	5.4 · 60	2.7 · 120
E94APNE0104 + E94AZMP0084	4.9	19.6 · 0.5	3.7 · 4.5	7.4 · 60	3.7 · 120
E94APNE0364	13.0	39.0 · 0.5	9.8 · 4.5	19.5 · 60	9.8 · 120
E94APNE0364 + E94AZMP0294	17.5	52.5 · 0.5	13.1 · 4.5	26.3 · 60	13.1 · 120
Single Drives					
E94ASxE0024 + E94AZMS0034	2.0	6.3 · 0.5	1.5 · 4.5	3.0 · 60	1.5 · 120
E94ASxE0034 + E94AZMS0034	2.0	6.5 · 0.5	1.5 · 4.5	3.0 · 60	1.5 · 120
E94ASxE0044 + E94AZMS0094	3.3	10.6 · 0.5	2.5 · 4.5	5.0 · 60	2.5 · 120
E94ASxE0074 + E94AZMS0094	5.7	13.6 · 0.5	4.3 · 4.5	8.6 · 60	4.3 · 120
E94ASxE0134 + E94AZMS0314	10.5	25.1 · 0.5	7.9 · 4.5	15.8 · 60	7.9 · 120
E94ASxE0174 + E94AZMS0314	13.2	31.7 · 0.5	9.9 · 4.5	19.8 · 60	9.9 · 120
E94ASxE0244 + E94AZMS0314	18.8	37.6 · 0.5	14.1 · 4.5	28.2 · 60	14.1 · 120
E94ASxE0324	34.2	68.4 · 0.5	25.7 · 4.5	51.3 · 60	25.7 · 120
E94ASxE0474	34.2	68.4 · 0.5	25.7 · 4.5	51.3 · 60	25.7 · 120
E94ASxE0594	34.2	68.4 · 0.5	25.7 · 4.5	51.3 · 60	25.7 · 120
E94ASxE0864	66.6	133 · 0.5	50.0 · 4.5	100 · 60	50.0 · 120
E94ASxE1044	66.6	133 · 0.5	50.0 · 4.5	100 · 60	50.0 · 120
E94ASxE1454	92.0	166 · 10	69.0 · 30	138 · 60	69.0 · 120
E94ASxE1724	109	196 · 10	81.8 · 30	164 · 60	81.8 · 120
E94ASxE2024	129	232 · 10	96.8 · 30	194 · 60	96.8 · 120
E94ASxE2454	156	281 · 10	117 · 30	234 · 60	117 · 120
E94ASxE2924	186	335 · 10	140 · 30	279 · 60	140 · 120
E94ASxE3664	233	419 · 10	175 · 30	350 · 60	175 · 120
E94ASxE4604	296	532 · 10	222 · 30	444 · 60	222 · 120
E94ASxE5724	368	662 · 10	276 · 30	552 · 60	276 · 120
E94ASxE6354	409	736 · 10	306 · 30	613 · 60	306 · 120
E94ASxE6954	448	806 · 10	336 · 30	672 · 60	336 · 120

Tab. 7.4-3

500 V

Supply power U_{Lr} = 500 V		Cycle 1		Cycle 2	
Type	$P_{DC\ 100\%}$ [kW]	$P_{ol} \cdot t_{ol}$ [kW] · [s]	$P_{re} \cdot t_{re}$ [kW] · [s]	$P_{ol} \cdot t_{ol}$ [kW] · [s]	$P_{re} \cdot t_{re}$ [kW] · [s]
Supply modules (+ filter)					
E94APNE0104	4.5	18.0 · 0.5	3.4 · 4.5	6.8 · 60	3.4 · 120
E94APNE0104 + E94AZMP0084	6.1	24.4 · 0.5	4.6 · 4.5	9.2 · 60	4.6 · 120
E94APNE0364	16.3	48.9 · 0.5	12.2 · 4.5	24.5 · 60	12.2 · 120
E94APNE0364 + E94AZMP0294	21.9	65.7 · 0.5	16.4 · 4.5	32.9 · 60	16.4 · 120
Single Drive					
E94ASxE0024 + E94AZMS0034	2.5	7.9 · 0.5	1.9 · 4.5	3.8 · 60	1.9 · 120
E94ASxE0034 + E94AZMS0034	2.5	8.1 · 0.5	1.9 · 4.5	3.8 · 60	1.9 · 120
E94ASxE0044 + E94AZMS0094	4.1	13.1 · 0.5	3.1 · 4.5	6.2 · 60	3.1 · 120
E94ASxE0074 + E94AZMS0094	7.1	16.9 · 0.5	5.3 · 4.5	10.7 · 60	5.3 · 120
E94ASxE0134 + E94AZMS0314	13.0	31.1 · 0.5	9.8 · 4.5	19.5 · 60	9.8 · 120
E94ASxE0174 + E94AZMS0314	16.5	39.6 · 0.5	12.4 · 4.5	24.8 · 60	12.4 · 120
E94ASxE0244 + E94AZMS0314	23.4	46.8 · 0.5	17.6 · 4.5	35.1 · 60	17.6 · 120
E94ASxE0324	42.5	85.0 · 0.5	31.9 · 4.5	63.8 · 60	31.9 · 120
E94ASxE0474	42.5	85.0 · 0.5	31.9 · 4.5	63.8 · 60	31.9 · 120
E94ASxE0594	42.5	85.0 · 0.5	31.9 · 4.5	63.8 · 60	31.9 · 120
E94ASxE0864	82.9	166 · 0.5	62.2 · 4.5	124 · 60	62.2 · 120
E94ASxE1044	82.9	166 · 0.5	62.2 · 4.5	124 · 60	62.2 · 120
E94ASxE1454	115	207 · 10	86.3 · 30	173 · 60	86.3 · 120
E94ASxE1724	136	245 · 10	102 · 30	204 · 60	102 · 120
E94ASxE2024	160	288 · 10	120 · 30	240 · 60	120 · 120
E94ASxE2454	194	349 · 10	146 · 30	291 · 60	146 · 120
E94ASxE2924	232	418 · 10	174 · 30	348 · 60	174 · 120
E94ASxE3664	290	522 · 10	218 · 30	435 · 60	218 · 120
E94ASxE4604	368	662 · 10	276 · 30	552 · 60	276 · 120
E94ASxE5724	457	882 · 10	342 · 30	685 · 60	342 · 120
E94ASxE6354	508	914 · 10	381 · 30	762 · 60	381 · 120
E94ASxE6954	557	1002 · 10	417 · 30	835 · 60	417 · 120

Tab. 7.4-4

7.4.3 DC-power requirements

Use the below table to determine the power requirements of the devices used in the DC bus for the rated mains voltage U_{Lr} and the device-dependent power loss.

Power requirements P_{ar} [W] with rated current				Power loss
Type	U_{Lr} = 230 V	U_{Lr} = 400 V	U_{Lr} = 500 V	P_V [W]
Multi Drives				
E94AMxE0024	500	900	1000	100
E94AMxE0034	900	1600	1700	120
E94AMxE0044	1400	2500	2700	150
E94AMxE0074	2500	4400	4800	190
E94AMxE0094	3300	5800	6400	230
E94AMxE0134	4700	8100	8900	280
E94AMxE0174	5900	10300	11200	320
E94AMxE0244	8400	14700	16100	420
Single Drives				
E94ASxE0024	500	900	1000	110
E94ASxE0034	900	1600	1700	130
E94ASxE0044	1400	2500	2700	160
E94ASxE0074	2500	4400	4800	210
E94ASxE0134	4700	8100	8900	320
E94ASxE0174	5900	10300	11200	380
E94ASxE0244	8400	14700	16100	500
E94ASxE0324	11500	20000	21800	750
E94ASxE0474	16900	29300	32000	1050
E94ASxE0594	19000	33100	40200	1100
E94ASxE0864	30800	53600	58700	1500
E94ASxE1044	37300	64800	70900	1800
E94ASxE1454	-	90000	113000	2100
E94ASxE1724	-	107000	134000	2200
E94ASxE2024	-	126000	157000	2600
E94ASxE2454	-	153000	191000	3300
E94ASxE2924	-	182000	228000	4100
E94ASxE3664	-	228000	285000	4900
E94ASxE4604	-	287000	359000	9200
E94ASxE5724	-	357000	446000	11300
E94ASxE6354	-	396000	495000	12500
E94ASxE6954	-	433000	542000	14700

Tab. 7.4-5

7.4.4 DC fuses

Fuse the individual +UG/-UG cables to protect the DC-bus connection. The DC-bus connection is protected against damage through a DC earth fault or short circuit in a device.

Controller/DC fuse assignment				
Type	Rated value [A]	Type (SIBA)	Size [mm] or size	Number per +UG/-UG
Multi Drives				
E94AMxE0024 E94AMxE0034 E94AMxE0044	16	EFSGR0160AYHz	14 x 51	1
		EFSGR0160AYIz	22 x 58	
E94AMxE0074 E94AMxE0094	32	EFSGR0320AYHz	14 x 51	
		EFSGR0320AYIz	22 x 58	
E94AMxE0134 E94AMxE0174 E94AMxE0244	63	EFSGR0630AYIz	22 x 58	
Single Drives				
E94ASxE0024 E94ASxE0034	16	EFSGR0160AYHz	14 x 51	1
		EFSGR0160AYIz	22 x 58	
E94ASxE0044 E94ASxE0074	32	EFSGR0320AYHz	14 x 51	
		EFSGR0320AYIz	22 x 58	
E94ASxE0134 E94ASxE0174 E94ASxE0244	63	EFSGR0630AYIz	22 x 58	
E94ASxE0324 E94ASxE0474 E94ASxE0594	100	EFSGR1000AYIz	22 x 58	
		EFSGR1000ANVz	NH1	
E94ASxE0864 E94ASxE1044	200	EFSGR2000ANVz	NH1	
E94ASxE1454	250	EFSGR2500ANWz	NH2	
E94ASxE1724 E94ASxE2024	350	EFSGR3500ANWz	NH2	
E94ASxE2454 E94ASxE2924	500	EFSGR5000ANWz	NH2	
E94ASxE3664	350	EFSGR3500ANWz	NH2	2 (in parallel)
E94ASxE4604	350	EFSGR3500ANWz	NH2	3 (in parallel)
E94ASxE5724	350	EFSGR3500ANWz	NH2	
E94ASxE6354	400	EFSGR4000ANWz	NH2	
E94ASxE6954	400	EFSGR4000ANWz	NH2	

Tab. 7.4-6

z K = indicator, N = no indicator

If fuses have tripped in case of an error, fuses connected upstream of other devices may have been damaged before. If so, we recommend to replace them.

Warnings!

For installation to UL, select approved fuses with the same tripping characteristic and a suitable voltage class.

7.5 Basic dimensioning

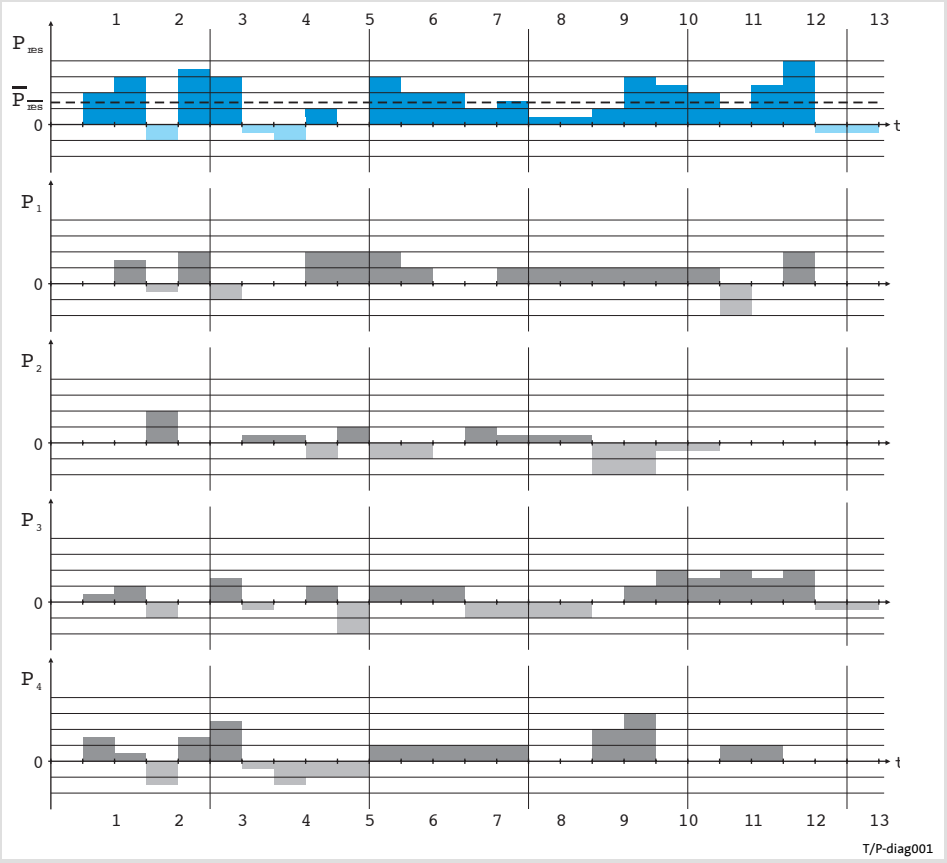
7.5.1 General information

The Drive Solution Designer (DSD) PC software helps you to dimension your drive network.

For expert advice, you may also contact your Lenze sales representative when dimensioning your application.

Time/performance diagram

For determining the performance of your drive network, create a time/performance diagram for all axes for a complete machine cycle. The power requirements of the drive network are calculated by adding the individual performances occurring at the same time. Positive results show the AC requirements for the dimensioning of the power supply units. Negative results show the brake power to be dissipated via brake choppers at the brake resistor.



Tab. 7.5-1 Example time/performance diagram

P_1 ... P_4	Individual performances of axes 1 ... 4
P_{total}	Addition of the individual performances
$\overline{P_{total}}$	Average of the individual performances

Use the time/performance diagram to optimise the DC-bus performance of all axes for a complete machine cycle.

Utilisation factor

Please consider the utilisation factors when determining $P_{DCtotal}$. Reduce the power requirements if the rated power is not fully used.

Simultaneity factor

Please consider the simultaneity factor when determining $P_{DCtotal}$. Reduce the power requirements if the drives do not run simultaneously or in opposite direction (braking).

Braking

After determining the brake power $P_{BRtotal}$, ensure that the brake power can be provided by the brake choppers and brake resistors in the DC bus.

Other conditions

The power supply unit must be able to provide the required power (arithmetic mean).

The overload requirements must be within the permissible range:

(📖 7.4.2)

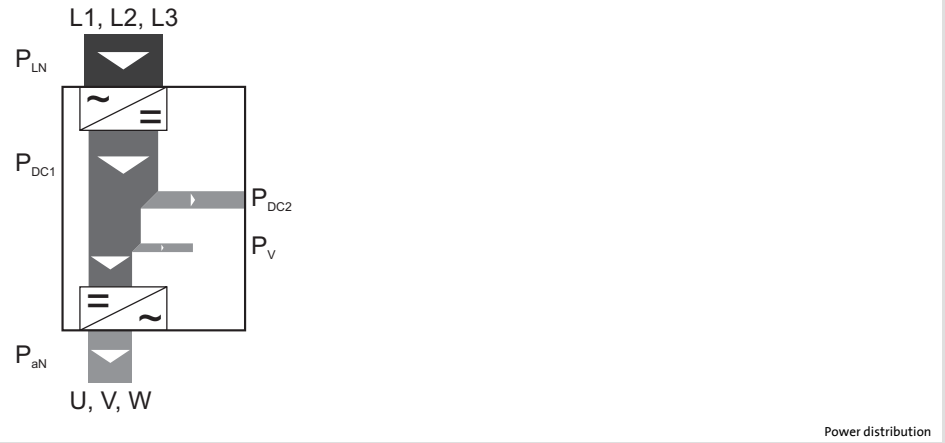
► 3-min cycle (1 min overload with 150 %/2 min recovery time with 75 %)

► 5-s cycle (0.5 s overload and 4.5 s recovery time with 75 %)

For detailed information on the overload capacity, please see the Technical data.

7.5.2 Power distribution of controllers

In a DC-bus operation, the power from the AC mains is stored in the DC bus and consumed by several controllers. Drive groups with non-synchronous power consumption, partial load or excess energy from braking operations are suitable for establishing a DC-bus connection.



Power distribution

L1, L2, L3	Mains connection (3/PE AC)
P_{Lr}	Input mains power
P_{DC1}	Total DC-bus power
P_{DC2}	DC-bus power available for the DC bus
P_{loss}	Power loss
P_{ar}	Output power
U, V, W	Motor connection

7.5.3 Motor efficiency

For determining the power requirements, you have to consider the shaft power P_{shaft} and the motor efficiency. The motor efficiency can be found under the motor data.

7.5.4 Power loss of devices

When determining the power requirements, the power loss of the devices must be considered (📖 Tab. 7.4-5).

7.5.5 Determining the power requirements

For determining the power requirements of the drive system you need to know the rated power of the motors and their efficiency as well as the power losses of the controllers. The power requirements are calculated with the following formula:

$$P_{DCtotal} = \sum_{i=1}^{n} \left\{ \frac{\left(P_{shaft}\right)_i}{\eta_i} + (P_{loss})_i \right\}$$

$P_{DCtotal}$	Total power required by the drive system
P_{shaft}	Rated power of a connected motor
P_{loss}	Power loss of a controller
η	Motor efficiency
I	Index variable for device identification
n	Number of devices in the drive system

The supply unit must be able to supply the calculated power requirements.

For application examples, please see 7.7 .

7.5.6 Determining the regenerative power requirements

Power regeneration into the AC mains is presently not yet possible with the 9400 servo drives series. Use the regenerative power for the dimensioning of the brake chopper(s) and the brake resistor.

7.5.7 Cable protection

In case of interferences, the cables have to be adequately protected (7.4.4).

Please consider the following when dimensioning the DC bus for a plant or machine:

- Mains fuses can be used to protect the DC cables if the wiring is designed for 122 % of the rated fuse current. Otherwise, the cable protection for the DC cables must be specially determined.
- Select the fuses for the currents resulting from power $P_{DC100\%}$. Please observe the standards and regulations applicable for the particular location and application.
- Fuse the DC-supply modules according to the Technical data on the AC mains side.
- The DC outputs of the supply modules need not be fused if all connected controllers are fused in accordance with the specifications.
- ”Multi Drive” controllers are default equipped with a fuse in the installation backplane. The fuse is only effective if the DC busbar is used. In this case, a single pole fusing against short-circuit is sufficient.
- ”Single Drive” controllers can be retrofit with a fuse in the mounting backplane. The fuse will only be effective if the DC busbar is used. In this case, a single-pole fusing against short-circuit is sufficient.
  For retrofitting, use the E94AZJA0xx busbar mounting set.
- If the DC bus is wired via the terminals +UG/-UG, always select a 2-pole cable protection.

7.5.8 Filters

The following filters can be used for the DC-supply modules.

Mains filter		DC-supply module	
Type	Device size	Type	Device size
E94AZMP0084	2	E94APNE0104	1
E94AZMP0294	3	E94APNE0364	3
E94AZMP0824	-	E94APNE1004	4
E94AZMP2004	-	E94APNE2454	5

The mains filters are designed for the following conditions:

- ► 10 DC-bus devices,
- ► each with a 50 m-motor cable,
- ► EMC category C2.

RFI filter		DC-supply module	
Type	Device size	Type	Device size
E94AZRP0084	1	E94APNE0104	1
E94AZRP0294	1	E94APNE0364	3
E94AZRP0824	4	E94APNE1004	4
E94AZRP2004	4	E94APNE2454	5

The RFI filters are designed for the following conditions:

- ► 6 DC-bus devices,
- ► each with a 10 m-motor cable,
- ► EMC category C2.

In applications with a different number of DC-bus devices or different motor cable lengths, the filters may have to be specially dimensioned.

7.5.9 Cables

Select the cable cross-sections for the currents resulting from power $P_{DC100\%}$. Please observe the standards and regulations applicable for the particular location and application.

7.6 Braking operation in a drive system

7.6.1 Basic considerations

If the regenerative power of a drive exceeds the storage capacity of the DC bus, the excessive energy must be consumed or dissipated. Target of the DC bus is to use the excessive energy for other axes.

Check for all DC-bus operations if the brake power provided by the brake choppers is high enough for the maximum regenerative power that may occur. If necessary, controllers with an integrated brake chopper (single-axis controller instead of a multi-axis controller) must be integrated into the drive system to increase the brake power.

If several brake choppers are used, the following conditions must be met:

- The thresholds of the brake choppers must be the same for all controllers.
- The brake choppers of several controllers are independent of each other. The brake choppers are protected by changing the duty cycle or switching them off temporarily. They are automatically switched on again.
- The limiting monitorings must be considered when dimensioning the continuous brake power for the DC bus:
  - Brake chopper monitoring
  - Brake resistor monitoring
- The temperature monitoring of the brake resistors must lead to power-off, otherwise the brake resistors or devices may be destroyed.
- The peak brake power can be used for 0.5 s in 5-s cycles.

7.7 Application examples

7.7.1 Example 1 - supply module with multi-axis controllers

Assumptions:

- ► 400 V, 3 AC/PE
- ► 7 axes in 2 power categories
- ► no particular dynamic performance requirements

The following motors (Mx) are selected:

Index	Motor type	Rated power [kW]	Efficiency	Rated current [A]
M1 ... M5	MCS14H15	2.5	0.92	6.6
M6 ... M7	MCS09F38	1.2	0.90	2.5

For the above motor data, the following controllers (Gx) are selected:

Index	Controller	Rated power [kW]	Typical motor power [kW]	Power loss P_l [kW]	Rated current [A]
G1 ... G5	E94AMxE0074	4.8	3.0	0.19	7.0
G6 ... G7	E94AMxE0034	1.7	0.75	0.12	2.5

The power required by the drive system is determined with the below formula (📖 7.5.5):

$P_{DCtotal}$ = 5 * (2.5 kW / 0.92 + 0.19 kW) + 2 * (1.2 kW / 0.90 + 0.12 kW)

$P_{DCtotal}$ = 17.4 kW

The calculated power requirement is used to select the supply module:

Index	Supply module (+ mains filter)	Rated power ($P_{DC100\%}$) [kW]
V1	E94APNE0364 + E94AZMP0294	17.5

Note: Only the supply module with mains filter reaches the required power.

Checking the power efficiency:

With 17.5 kW > 17.4 kW, $P_{DC100\%} > P_{DCtotal}$.

Select cables and fuses in accordance with the Technical data.

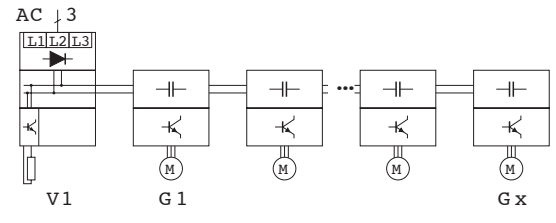


Fig. 7.7-1 Basic circuit diagram

7.7.2 Example 2 - single-axis controller with multi axes

Assumptions:

- ► 400 V, 3 AC/PE
- ► 4 axes in 3 power categories
- ► no particular dynamic performance requirements

The following motors (Mx) are selected:

Index	Motor type	Rated power [kW]	Efficiency	Rated current [A]
M1	MCS19P30	10.0	0.93	19
M2	MCS14H15	2.5	0.92	6.6
M3 ... M4	MCS09F38	1.2	0.90	2.5

For the above motor data, the following controllers (Gx) are selected:

Index	Controller	Rated power [kW]	Typical motor power [kW]	Power loss P_l [kW]	Rated current [A]
G1	E94ASxE0244	16.3	11.0	0.50	23.5
G2	E94AMxE0074	4.8	3.0	0.19	7.0
G3 ... G4	E94AMxE0034	1.7	0.75	0.12	2.5

The power required by the drive system is determined with the below formula (📖 7.5.5):

$P_{DCtotal}$ = (10 kW / 0.93 + 0.50 kW) + (2.5 kW / 0.92 + 0.19 kW) + 2 * (1.2 kW / 0.90 + 0.12 kW)

$P_{DCtotal}$ = 17.1 kW

The calculated power requirement is used to select the single-axis controller with mains choke:

Index	Controller (+ mains choke)	Rated power ($P_{DC100\%}$) [kW]
(G1)	E94ASxE0244 + E94AZMS0314	18.8

Note: Only the controller with mains choke reaches the required power.

Checking the power efficiency:

With 18.8 kW > 17.1 kW, $P_{DC100\%} > P_{DCtotal}$.

Select cables and fuses in accordance with the Technical data.

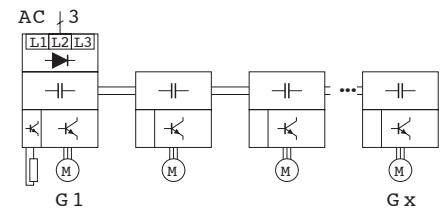


Fig. 7.7-2 Basic circuit diagram

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