L-force catalogue

Automation systems
Drive solutions

Controls
Inverter
Motors
Gearboxes
Engineering Tools

Inverter: Servo Drives 9400 HighLine, Inverter Drives 8400 TopLine, Servo-Inverter i700

Lenze

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Selected portfolio

Additional portfolio

Lenze makes many things easy for you.

With our motivated and committed approach, we work together with you to create the best possible solution and set your ideas in motion - whether you are looking to optimise an existing machine or develop a new one. We always strive to make things easy and seek perfection therein. This is anchored in our thinking, in our services and in every detail of our products. It's as easy as that!

1

Developing ideas

Are you looking to build the best machine possible and already have some initial ideas? Then get these down on paper together with us, starting with small innovative details and stretching all the way to completely new machines. Working together, we will develop an intelligent and sustainable concept that is perfectly aligned with your specific requirements.

2

Drafting concepts

We see welcome challenges in your machine tasks, supporting you with our comprehensive expertise and providing valuable impetus for your innovations. We take a holistic view of the individual motion and control functions here and draw up consistent, end-to-end drive and automation solutions for you - keeping everything as easy as possible and as extensive as necessary.

3

Implementing solutions

Our easy formula for satisfied customers is to establish an active partnership with fast decision making processes and an individually tailored offer. We have been using this principle to meet the ever more specialised customer requirements in the field of machine engineering for many years.

4

Manufacturing machines

Functional diversity in perfect harmony: as one of the few full-range providers in the market, we can provide you with precisely those products that you actually need for any machine task – no more and no less. Our L-force product portfolio, a consistent platform for implementing drive and automation tasks, is invaluable in this regard.

5

Ensuring productivity

Productivity, reliability and new performance peaks on a daily basis – these are our key success factors for your machine. After delivery, we offer you cleverly devised service concepts to ensure continued safe operation. The primary focus here is on technical support, based on the excellent application expertise of our highly-skilled and knowledgeable after-sales team.

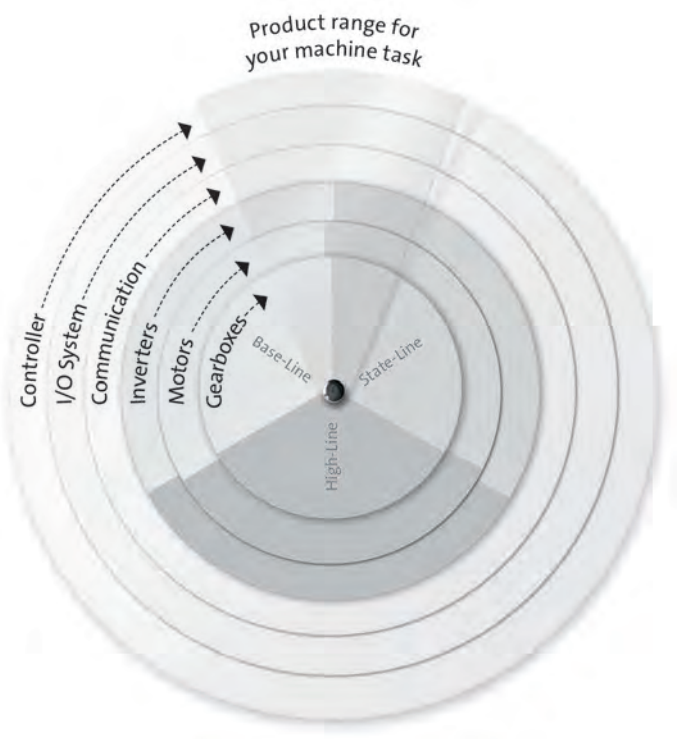
A matter of principle: the right products for every application.

Lenze's extensive L-force product portfolio follows a very simple principle. The functions of our finely scaled products are assigned to the three lines Base-Line, State-Line or High-Line.

But what does this mean for you? It allows you to quickly recognise which products represent the best solution for your own specific requirements.

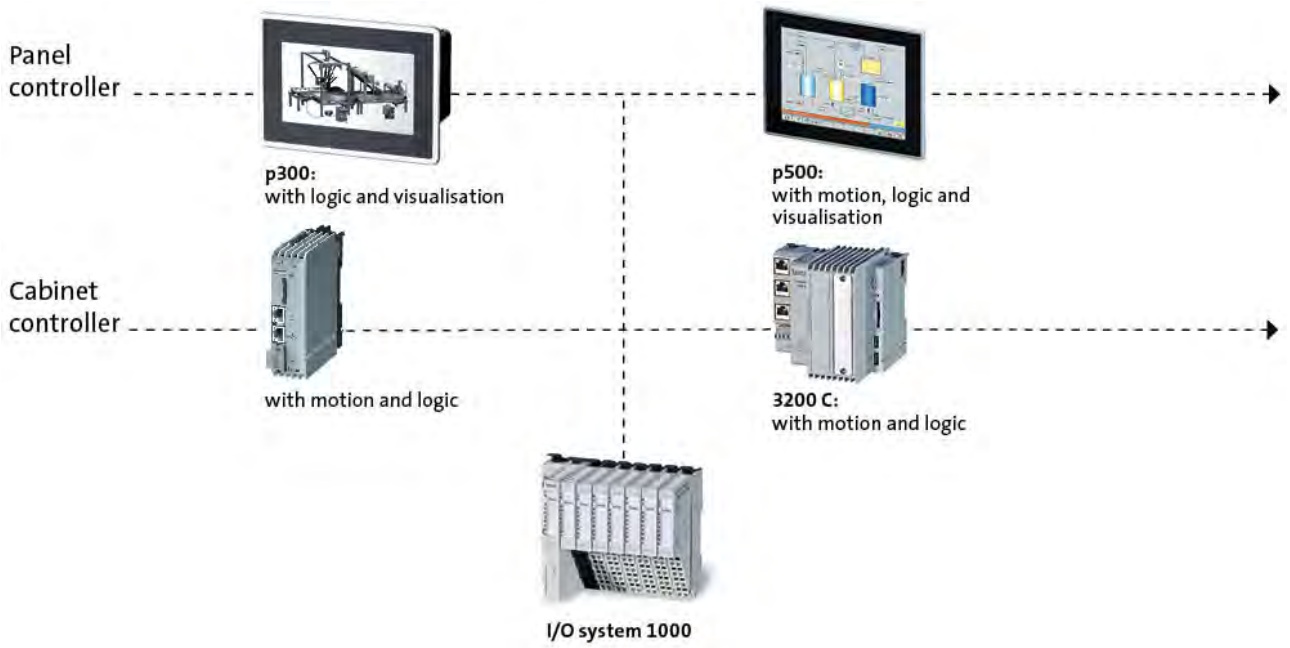
Powerful products with a major impact:
- Easy handling
- High quality and durability
- Reliable technologies in tune with the latest developments

Lenze products undergo the most stringent testing in our own laboratory. This allows us to ensure that you will receive consistently high quality and a long service life. In addition to this, five logistics centres ensure that the Lenze products you select are available for quick delivery anywhere across the globe. It's as easy as that!

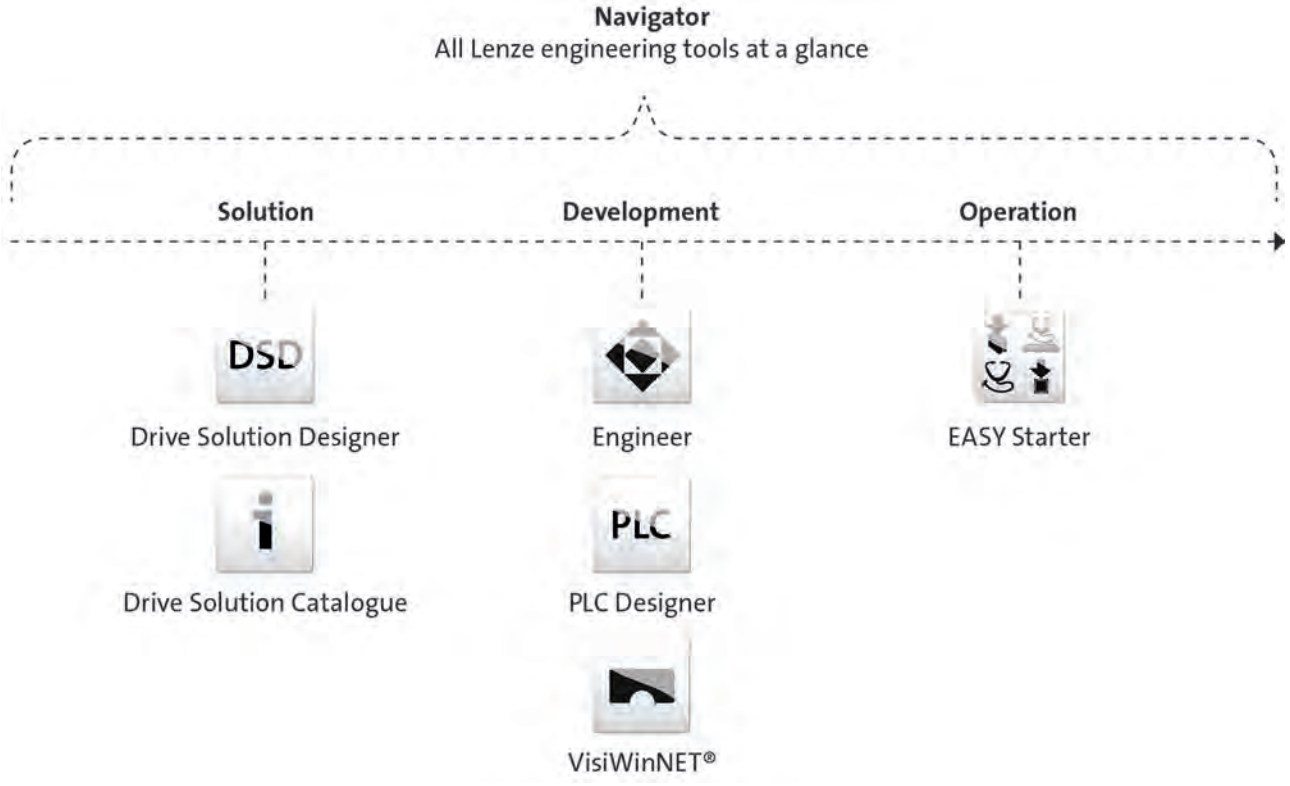


L-force product portfolio

Controls

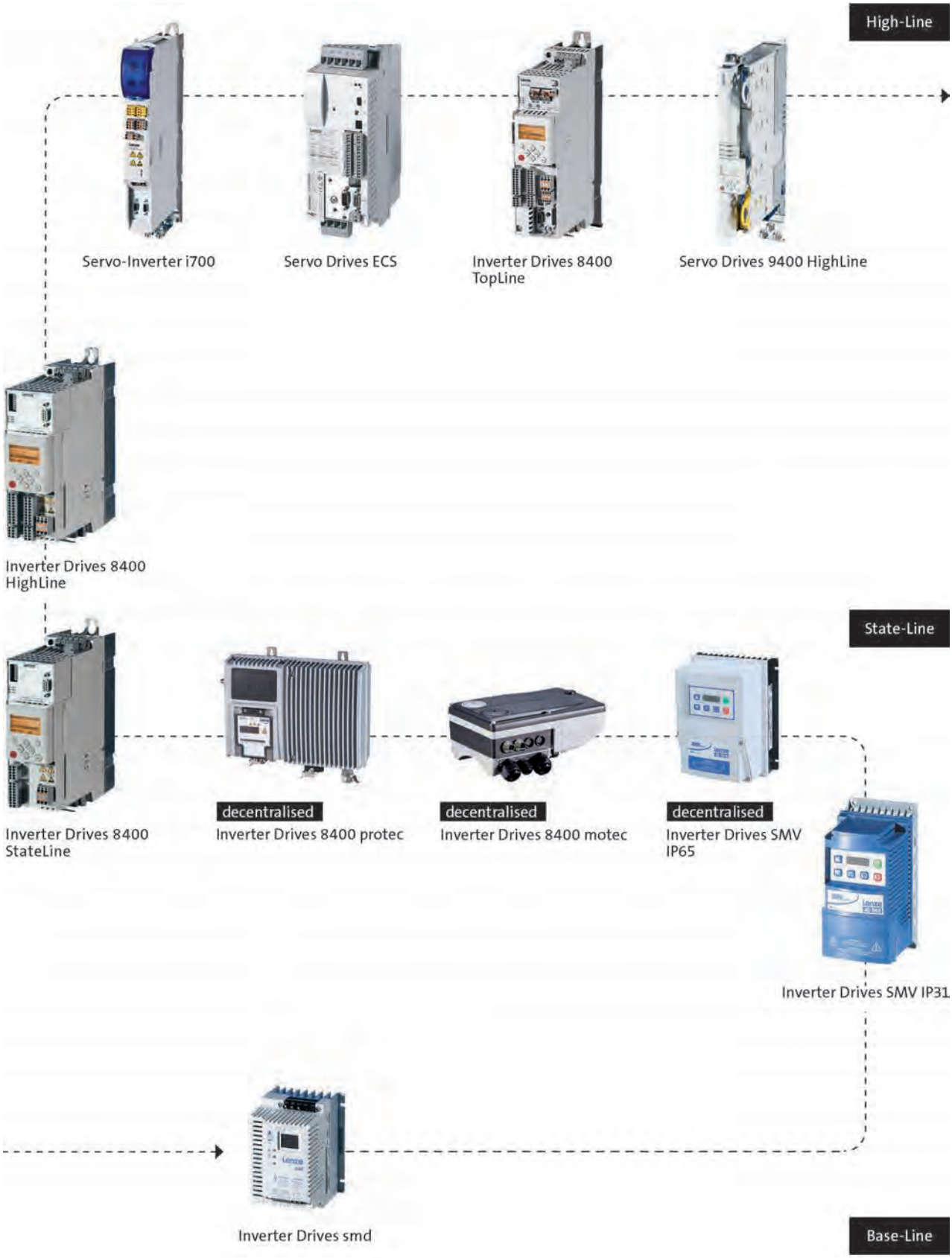


Engineering Tools



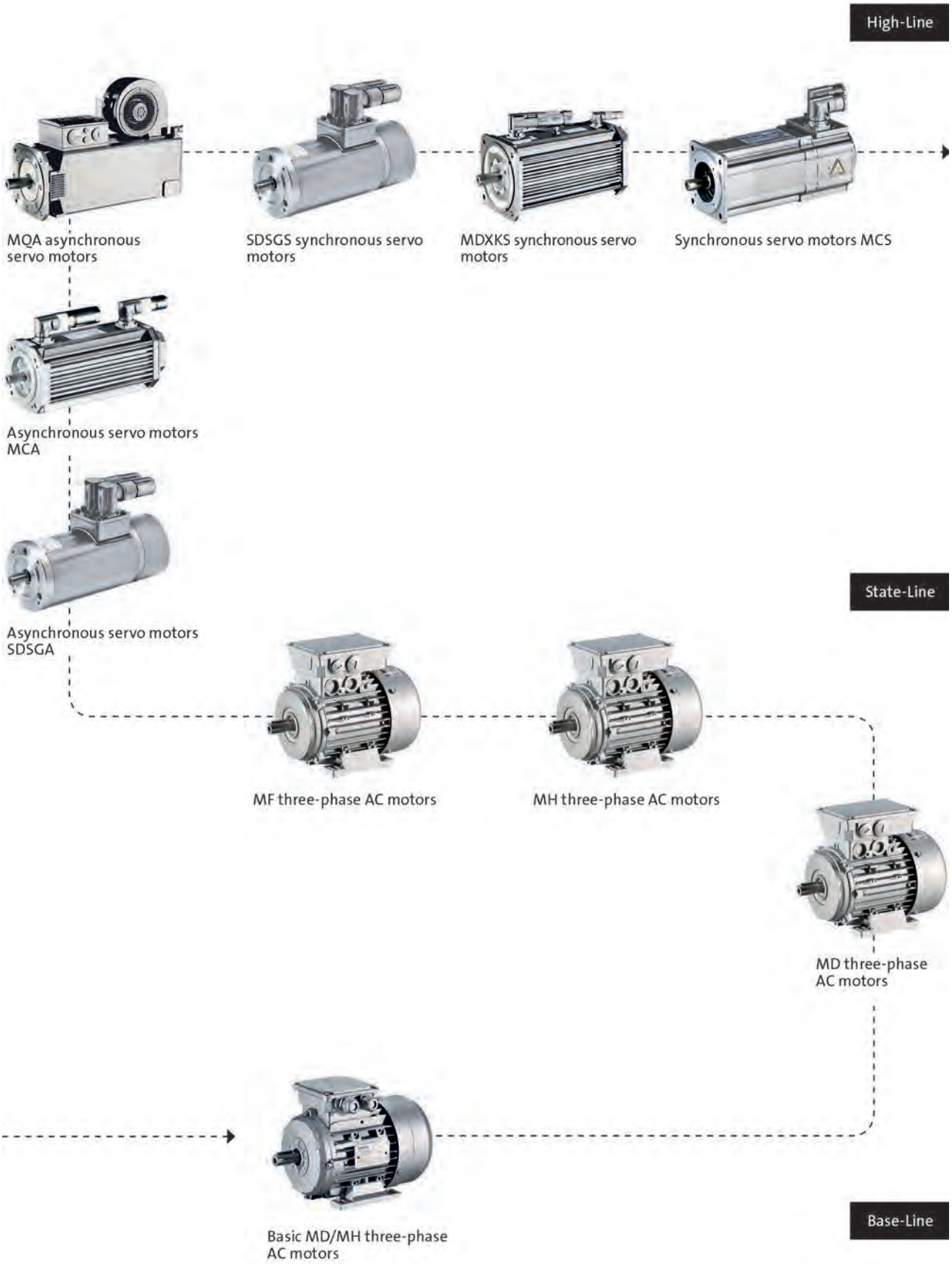
L-force product portfolio

Inverter



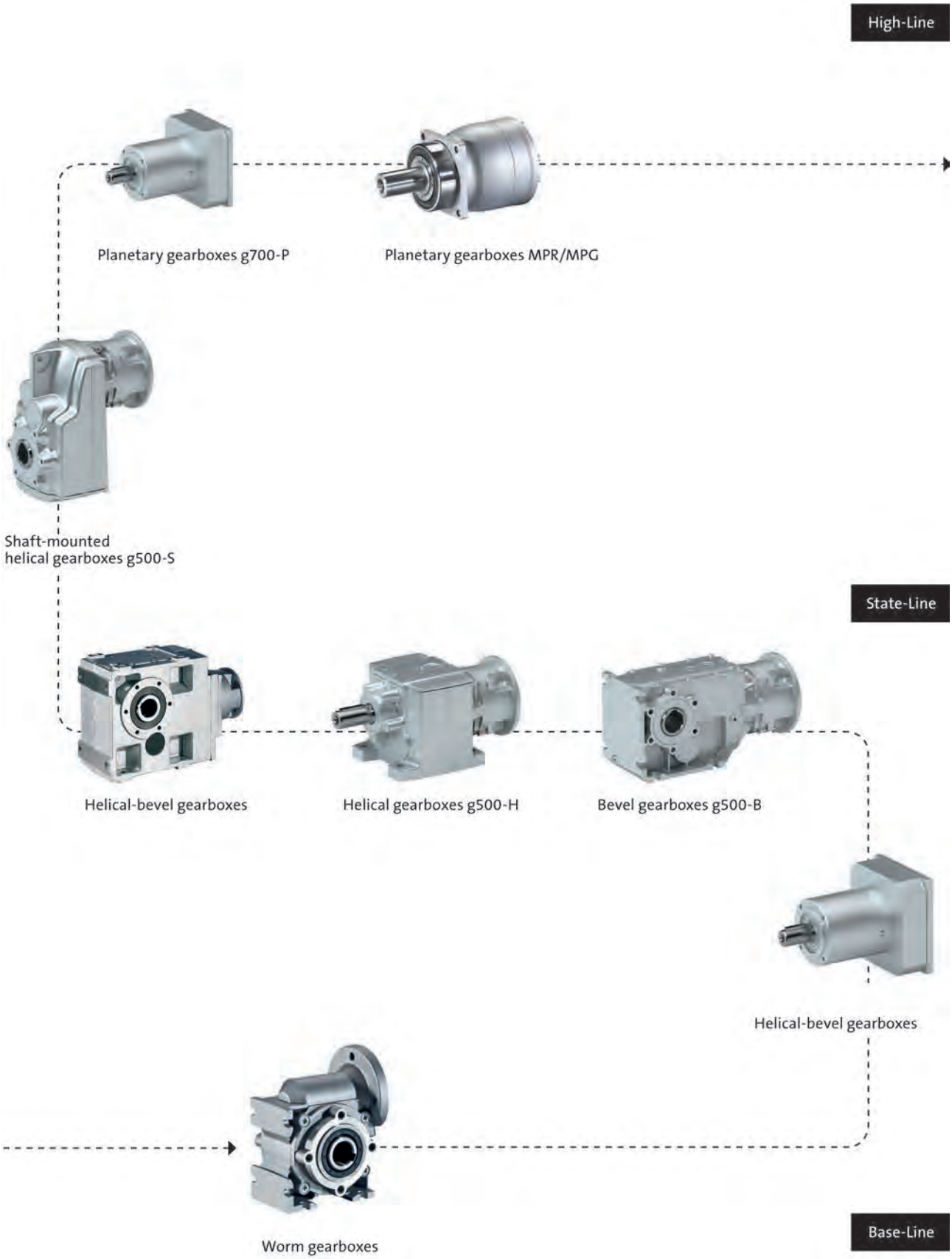
L-force product portfolio

Motors



L-force product portfolio

Gearboxes



Inverter

Servo Drives 9400 HighLine

0.37 ... 240 kW



Servo Drives 9400 HighLine



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Product key

E94A S H E 002 4 A 33 EN PM –

1)

Version
S – Single Drive
M – Multi Drive

Series
S – StateLine
H – HighLine

Design
E – Installation

Rated current [A]
(rounded)

002	032	245
003	047	292
004	059	366
007	086	460
009	104	
013	145	
017	172	
024	202	

Voltage class of drive
4 – 3 x 400 V

MXI 1
LF
CA
DN
ET
EN
EO
PM
ER
NN

MXI 2
LF
CA
DN
ET
EN
EO
PM
ER
NN

MMI
11 – MM110
22 – MM220
33 – MM330
43 – MM430

MSI
A – SM0
B – SM100
D – SM300
E – SM301
F – SM302



LF – Digital frequency
CA – CANopen
DN – DeviceNet
ET – EtherCAT
EN – EtherNet
EO – EtherNet/IP
PM – PROFIBUS
ER – PROFINET
NN – no module

MXI 1 – Slot for extensions module 1
MXI 2 – Slot for extensions module 2
MMI – Slot for memory module
MSI – Slot for safety module

1) generation
A – 0,37 ... 55 kW
B – 75 ... 240 kW



H Y 010 1 from 15 kW (without installation backplane)

S 003 4 H X 005 1 up to 11 kW (with installation backplane)

Base design
S – Single Drive
M – Multi Drive

Rated current for base [A]
(rounded)
003
004
007
009
024

Voltage class of base
4 – 3 x 400 V

Additional component
N – no additional component
H – with brake module

Mounting
X – integrated into installation backplane
Y – integrated into drive

Current identification
(rounded)
002 – 1.0 A
005 – 2.5 A
010 – 5.0 A

Voltage class
1 – 24 V
5 – 205 V
6 – 180 V



Product key for power supply modules and regenerative power supply modules

E94A P N E 036 4 — P 036 (from 36.2 kW without installation backplane)

E94A R N E 024 4 A 22 EN PM – P 036

Version
P – Power supply module
R – Regenerative power supply module

Design
E – Installation

Rated current [A] (rounded)
Power supply module
010
036
100
245
Regenerative power supply module (data for regenerative feedback)
013
024

Voltage class of drive
4 – 3 x 400 V

Rated current for base [A]
010
036

Base design
P - Power suply module

MXI 1
CA
EN
PM
NN

MXI 2
CA
EN
PM
NN

MMI
22 – MM220

MSI
A – SM0



CA – CANopen
EN – Ethernet
PM – PROFIBUS
NN – no module

MXI 1 – Slot for extension module 1
MXI 2 – Slot for extension module 2
MMI – Slot for memory module
MSI – Slot for safety module



List of abbreviations

b	[mm]	Dimensions
C_{th}	[KWs]	Thermal capacity
f_{ch}	[kHz]	Rated switching frequency
h	[mm]	Dimensions
i		Ratio
$I_{N, out}$	[A]	Rated output current
$I_{N, AC}$	[A]	Rated mains current
$I_{N, DC}$	[A]	Rated DC-bus current
$I_{red, out}$	[A]	Reduced output current
$I_{red, DC}$	[A]	Reduced DC-bus current
m	[kg]	Mass
n_{max}	[r/min]	Max. speed
P	[kW]	Typical motor power
P_N	[kW]	Rated power
$P_{max, 1}$	[kW]	Max. output power
$P_{max, 2}$	[kW]	Max. short-time output power
P_V	[kW]	Power loss
R_N	[Ω]	Rated resistance
R_{min}	[Ω]	Min. brake resistance
t	[mm]	Dimensions
U	[V]	Voltage drop
U_{AC}	[V]	Mains voltage
U_{DC}	[V]	DC supply
$U_{N, AC}$	[V]	Rated voltage
$U_{N, DC}$	[V]	Rated voltage
U_{out}	[V]	Output voltage

DIAG	Slot for diagnostic adapter
DIN	Deutsches Institut für Normung e.V.
EN	European standard
EN 60529	Degrees of protection provided by enclosures (IP code)
EN 60721-3	Classification of environmental conditions; Part 3: Classes of environmental parameters and their limit values
EN 61800-3	Electrical variable speed drives Part 3: EMC requirements including special test methods
IEC 61131-2	Programmable logic controllers Part 2: Equipment and tests
IEC	International Electrotechnical Commission
IEC 61508	Functional safety of electrical/electronic/programmable electronic safety-related systems
IM	International Mounting Code
IP	International Protection Code
MMI	Modular memory interface (memory module)
MSI	Modular safety interface (safety module)
NEMA	National Electrical Manufacturers Association
UL	Underwriters Laboratory Listed Product
UR	Underwriters Laboratory Recognized Product
VDE	Verband deutscher Elektrotechniker (Association of German Electrical Engineers)



Servo Drives 9400 Single Drive and Multi Drive

Many technical advances make our day-to-day life easier.
A simply click is all that is needed and

- the lights come on
- a safety belt is engaged
- you can surf the Internet
- you can take a snapshot of your family.

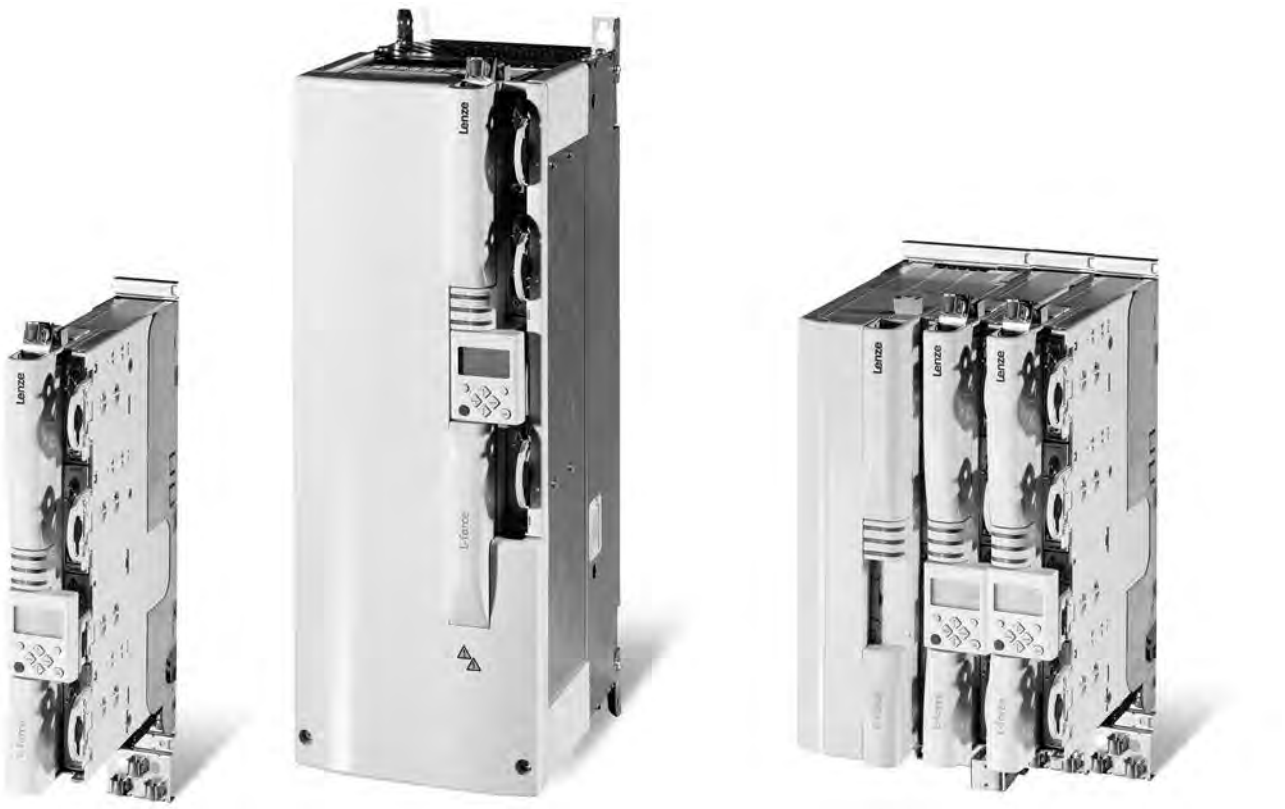
The Servo Drives 9400 will revolutionise your servo technology – with simple clicks.

Single drive
Our single-axis devices combine mains supply, DC bus and inverter in a single unit. The filter elements and the brake chopper are integrated in the servo inverter and allow autonomous use in distributed control cabinet installations. By using corresponding footprint filters (up to 55 kW), greater interference suppression can be achieved without additional mounting area.

Multi Drive
Our multi-axis drives are particularly suitable for centralised, compact multi-axis installations. The energy exchange via the DC bus reduces the power requirement on the mains side. The axes share the same mains supply, brake chopper and EMC filter. The parts requirements and installation work are thus significantly reduced. The integrated DC busbar system provides for compact installations for drives rated up to 15 kW.

HighLine - for decentralised control concepts
The Servo Drives 9400 HighLine feature intelligence in the drive and are therefore designed for decentralised motion control applications as well as for centralised control topologies.
Lenze provides pre-programmed technology applications, e.g. table positioning, electronic gearbox and synchronism with mark registration for solving various applications simply by parameter setting. The function block editor integrated into the L-force Engineer HighLevel (PC setup tool) enables you to adapt the functions in an easy and flexible manner.
The HighLine Servo Drive comes with the CANopen fieldbus, conventional I/Os, diagnostic LEDs, a diagnostic interface, a resolver and a universal encoder input on board.
In addition, the HighLine is equipped with two extension slots for communication or extension modules as well as one slot each for a memory module and a safety module, so that the drive can be optimally adapted to your requirements.

4.3



Servo Drives 9400 Single Drive and Servo Drives 9400 Multi Drive



Functions and features

Mode	
	Servo Drives 9400 HighLine
Conrol types, motor control	
Field-oriented servo control (SC)	For synchronous servo motors, asynchronous servo motors and three-phase asynchronous motors
Sensorless control (SLPSM)	For synchronous servo motors
V/f control (VFCplus)	For three-phase AC motors and asynchronous servo motor (linear or square-law)
Basic functions	
	Freely assignable user menu Free function block interconnection with extensive function library Parameter change-over DC brake function Brake management for brake control with low rate of wear Flying restart circuit S-shaped ramps for smooth acceleration PID controller
Operating modes to CiA 402	- Homing mode Interpolated position mode Cyclic synchronous position (csp) - cyclic position setpoint Cyclic synchronous velocity (csv) - cyclic velocity setpoint Cyclic synchronous torque (cst) - cyclic torque setpoint
Evaluation of ENP (ETS)	For Lenze servo motors
Technology applications	
	Speed actuating drive Torque actuating drive Electronic gearbox Synchronism with mark registration Table positioning Positioning sequence control
Advanced functions	Function blocks for cam function
Monitoring and protective measures	
	Short circuit Earth fault Overvoltage Undervoltage Motor phase failure Overcurrent I^2 x t-Motor monitoring Overtemperature Motor overtemperature Brake chopper, brake resistance Fan Motor stalling
Diagnostics	
	Data logger, logbook, oscilloscope functions
Status display	6 LEDs
Diagnostic interface	Integrated For USB diagnostic adapter or keypad (diagnosis terminal)
Braking operation	
Brake chopper	Integrated in Single Drives
Brake resistor	External



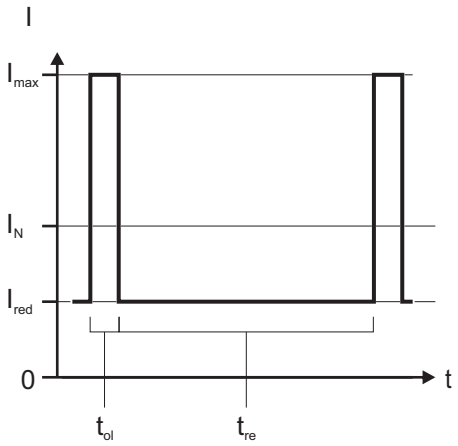
Basic dimensioning of axis modules

The most important steps for dimensioning Single Drive and Multi Drive axis modules are listed here:

- **Motor power required**
  First, the maximum torque required M_{max}, the maximum speed n_{max}, the effective torque M_{eff} and - for geared motors - the transmission ratio i are determined from the system data.

- **Motor selection**
  Based on these values, the appropriate servo motor can be selected from the MCS (synchronous motors), MCA, MQA or MDFQA (asynchronous motors) ranges.

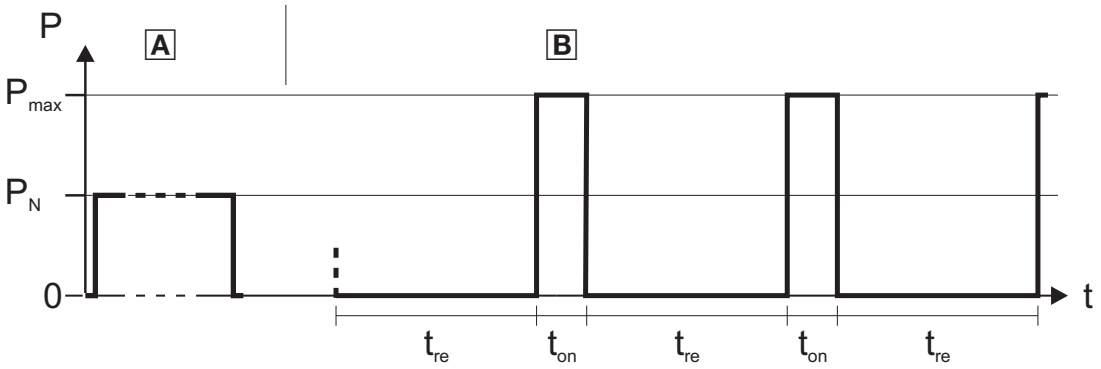
- **Selecting the axis module**
  The axis modules are selected on the basis of the maximum currents and power required.
  Depending on the drive, the 9400 Servo Drives and the power supply modules can be operated for overload time t_{ol} with maximum output current I_{max}, provided that the drive is then operated for recovery time t_{re} with a reduced output current.
  The switching frequency is automatically adapted to the rate of utilisation.



Maximum output current cycle

- **Braking operation**

If high moments of inertia are to be braked or if extended operation in generator mode is to be executed, braking energy can be transferred to an external brake resistor or converted into heat with Single Drive axis modules or with power supply modules via the integrated brake chopper.
The brake chopper can dissipate the continuous braking power P_N on a continual basis (case A) or the peak braking power P_{max} for the running time t_{on} followed by the recovery time t_{re} (case B).



Brake chopper output power

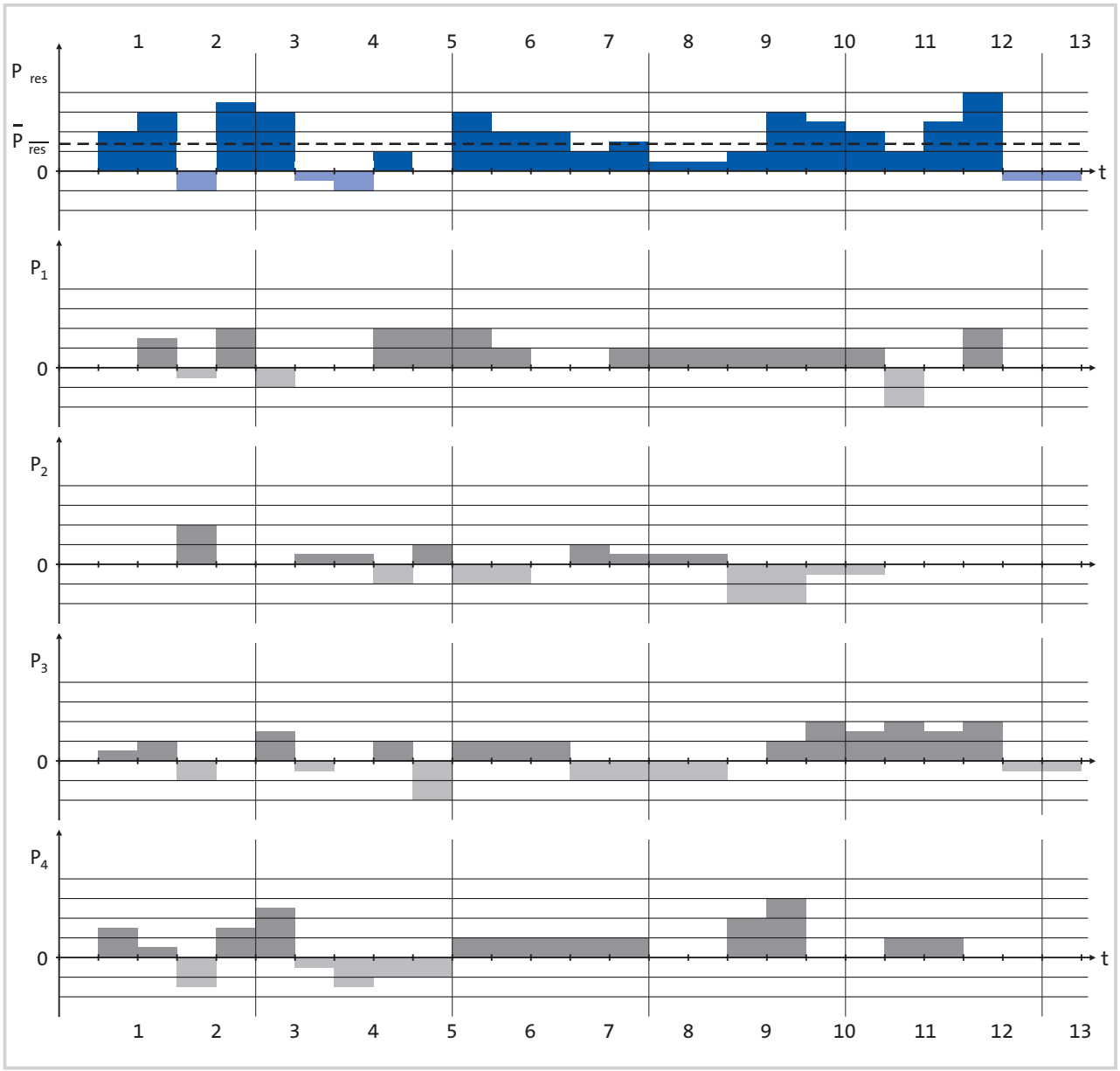


Dimensioning for DC-bus operation

Dimensioning of DC-bus operation for axis modules

The most effective way of determining the correct power supply module for a multi-axis application is if the time/power diagrams for the complete machine cycle are available for all axis modules. Adding together the simultaneous individual power levels gives the required overall power and thereby the minimum power of the power supply module. The necessary braking power or regenerative power can be determined in the same way.

► The axis modules in the interconnection can be easily implemented using DSD. Including an energy analysis and Energy Performance Certificate.



Time/power diagram of a multi-axis servo system
P_{1}...P_{4} = individual power of axis 1...axis 4
P_{res} = addition of individual powers
$P_{res\ 1\text{-}4}$ = mean value of individual powers





Standards and operating conditions

Conformity			
CE			Low-Voltage Directive
			2014/35/EU [UKCA: S.I. 2016/1101]
Approval			
UL 61800-5-1			Power Conversion Equipment (file no. E132659)
Degree of protection			
EN 60529			IP20 [1]
NEMA 250			Type 1
Climatic conditions			
Storage (EN 60721-3-1)			1K3 (temperature: -25 °C ... +60 °C)
Transport (EN 60721-3-2)			2K3 (temperature: -25 °C ... +70 °C)
Operation (EN 60721-3-3)			3K3 (temperature: -10°C ... +55°C)
Site altitude			
Amsl	H_{max}	[m]	4000
Current derating at over 1000 m		[%/1000 m]	5
Vibration resistance			
Transport (EN 60721-3-2)			2M2
Operation (Germanischer Lloyd)			5 Hz ≤ f ≤ 13.2 Hz: ± 1 mm amplitude 13.2 Hz ≤ f ≤ 100 Hz: 0.7 g

[1] Not in the wire range of the on the motor-side terminals

Supply form			
			Systems with earthed star point (TN and TT systems) Systems with high-resistance or isolated star point (IT systems) [2]
Discharge current to PE			
EN 61800-5-1	I	[mA]	> 3.5 mA, fixed installation required, PE must be reinforced
Noise emission			
EN 61800-3			Cable-guided disturbance: Max. shielded motor cable lengths for compliance with EMC protection requirement C2 without external filters E94AS□E0024 to E94AS□E0244: 10 m E94AS□E0324 to E94AS□E1044: 50 m Max. shielded motor cable lengths for compliance with EMC protection requirement C3 without external filters E94BS□E1454 up to E94BS□E4604: 150 m
Noise immunity			
EN 61800-3			Category C3
Insulation resistance			
EN 61800-5-1			Overvoltage category III Above 2000 m amsl overvoltage category II
Degree of pollution			
EN 61800-5-1			2
Protective insulation of control circuits			
EN 61800-5-1			for digital inputs and outputs Safe mains isolation: double/reinforced insulation

[2] For the device sizes 366 A and 460 A on request



Rated data for Single Drive

- ► The data is valid for operation at 3/PE AC 400 V or DC 565 V.
- ► Unless otherwise specified, the data refers to the default setting.

						
Typical motor power						
4-pole asynchronous motor	P	[kW]	0.37	0.75	1.50	3.00
Product key [2]						
Single Drive			E94AS□E0024	E94AS□E0034	E94AS□E0044	E94AS□E0074
Mains voltage range						
	U_{AC}	[V]	3/PE AC 340 V-0% ... 528 V+0 %, 45 Hz-0 % ... 65 Hz+0 %			
Rated mains current						
With mains choke	$I_{N, AC}$	[A]	1.5	2.5	3.9	7.0
Without mains choke	$I_{N, AC}$	[A]	2.1	3.5	5.5	9.9
Rated output current						
	$I_{N, out}$	[A]	1.5	2.5	4.0	7.0
Rated switching frequency						
	f_{ch}	[kHz]	8			
Output current						
2 kHz	I_{out}	[A]	1.9 [3]	3.1 [3]	5.0 [3]	8.8 [3]
4 kHz	I_{out}	[A]	1.9 [3]	3.1 [3]	5.0 [3]	8.8 [3]
8 kHz	I_{out}	[A]	1.5	2.5	4.0	7.0
16 kHz	I_{out}	[A]	1.1	1.9	3.0	5.3

Data for 60 s overload

Max. output current [1, 4]						
	$I_{max, out}$	[A]	2.8	4.7	7.5	13.1
Reduced output current [1, 4]						
	$I_{red, out}$	[A]	1.40	2.30	3.80	6.60
Overload time [1, 4]						
	t_{ol}	[s]	60.0			
Recovery time [1, 4]						
	t_{re}	[s]	120.0			

Data for 0.5 s overload

Max. short-time output current [1, 4]						
	$I_{max, out}$	[A]	6.0	10.0	16.0	21.0
Reduced output current [1, 4]						
	$I_{red, out}$	[A]	1.40	2.30	3.80	6.60
Overload time [1, 4]						
	t_{ol}	[s]	0.5			
Recovery time [1, 4]						
	t_{re}	[s]	4.5			

[2] 1 - Please refer to the Product key section

[1] 10 - See diagram

[3] Operation only permitted with mains choke or mains filter

[4] Mains filter necessary. Without a mains filter, the indicated values for I_{max} and I_{red} decrease



Rated data for Single Drive

- The data is valid for operation at 3/PE AC 400 V or DC 565 V.
- Unless otherwise specified, the data refers to the default setting.
- $I_{N, DC}$: R.m.s. value, consisting of DC current and harmonic current.

						
Typical motor power						
4-pole asynchronous motor	P	[kW]	0.37	0.75	1.50	3.00
Product key [2]						
Single Drive			E94AS□E0024	E94AS□E0034	E94AS□E0044	E94AS□E0074
DC supply						
	U_{DC}	[V]	DC 460 -0% ... 740 V +0%			
Rated DC-bus current						
	$I_{N, DC}$	[A]	2.6	4.3	6.7	12.1
Power loss						
	P_V	[kW]	0.110	0.130	0.160	0.210
Dimensions						
Height	h	[mm]	350			
Height, including fastening	h	[mm]	481			
Width	b	[mm]	60		90	
Depth	t	[mm]	288			
Mass						
	m	[kg]	4.0		5.3	
Max. cable length						
shielded C1 with external measures	I_{max}	[m]	25			
shielded C2 without external measures	I_{max}	[m]	10			
shielded C2 with external measures	I_{max}	[m]	50		100	

Brake chopper rated data

Rated power, Brake chopper [1]					
	P_N	[kW]	1.3	1.9	2.6
Max. output power, Brake chopper [1]					
	$P_{max, 1}$	[kW]	6.4	11.2	
Running time [1]					
	t_{on}	[s]	1.0		
Recovery time [1]					
	t_{re}	[s]	4.3	4.4	4.2
Min. brake resistance [1]					
	R_{min}	[Ω]	82.0	47.0	

[2] 1 - Please refer to the Product key section

[1] 10 - See diagram



Rated data for Single Drive

- ► The data is valid for operation at 3/PE AC 400 V or DC 565 V.
- ► Unless otherwise specified, the data refers to the default setting.

					
Typical motor power					
4-pole asynchronous motor	P	[kW]	5.50	7.50	11.0
Product key [1]					
Single Drive			E94AS□E0134	E94AS□E0174	E94AS□E0244
Mains voltage range					
	U_{AC}	[V]	3/PE AC 340 V-0% ... 528 V+0 %, 45 Hz-0 % ... 65 Hz+0 %		
Rated mains current					
With mains choke	$I_{N, AC}$	[A]	11.8	15.0	20.5
Without mains choke	$I_{N, AC}$	[A]	16.8	21.0	29.0
Rated output current					
	$I_{N, out}$	[A]	13.0	16.5	23.5
Rated switching frequency					
	f_{ch}	[kHz]	8		
Output current					
2 kHz	I_{out}	[A]	16.3 [3]	20.6 [3]	29.4 [3]
4 kHz	I_{out}	[A]	16.3 [3]	20.6 [3]	29.4 [3]
8 kHz	I_{out}	[A]	13.0	16.5	23.5
16 kHz	I_{out}	[A]	9.8	12.4	17.6

4.3

Data for 60 s overload

Max. output current [2, 4]					
	$I_{max, out}$	[A]	24.4	30.9	44.1
Reduced output current [2, 4]					
	$I_{red, out}$	[A]	12.2	15.5	22.1
Overload time [2, 4]					
	t_{ol}	[s]	60.0		
Recovery time [2, 4]					
	t_{re}	[s]	120.0		

Data for 0.5 s overload

Max. short-time output current [2, 4]					
	$I_{max, out}$	[A]	39.0	49.5	58.8
Reduced output current [2, 4]					
	$I_{red, out}$	[A]	12.2	15.5	22.1
Overload time [2, 4]					
	t_{ol}	[s]	0.5		
Recovery time [2, 4]					
	t_{re}	[s]	4.5		

[1] 1 - Please refer to the Product key section

[2] 10 - See diagram

[3] Operation only permitted with mains choke or mains filter

[4] Mains filter necessary. Without a mains filter, the indicated values for I_{max} and I_{red} decrease



Rated data for Single Drive

- The data is valid for operation at 3/PE AC 400 V or DC 565 V.
- Unless otherwise specified, the data refers to the default setting.
- $I_{N, DC}$: R.m.s. value, consisting of DC current and harmonic current.

					
Typical motor power					
4-pole asynchronous motor	P	[kW]	5.50	7.50	11.0
Product key [2]					
Single Drive			E94AS□E0134	E94AS□E0174	E94AS□E0244
DC supply					
	U_{DC}	[V]	DC 460 -0% ... 740 V +0%		
Rated DC-bus current					
	$I_{N, DC}$	[A]	20.6	25.7	35.5
Power loss					
	P_V	[kW]	0.320	0.380	0.500
Dimensions					
Height	h	[mm]	350		
Height, including fastening	h	[mm]	481		
Width	b	[mm]	120		
Depth	t	[mm]	288		
Mass					
	m	[kg]	8.1		
Max. cable length					
shielded C1 with external measures	I_{max}	[m]	25		
shielded C2 without external measures	I_{max}	[m]	10		
shielded C2 with external measures	I_{max}	[m]	100		

Brake chopper rated data

Rated power, Brake chopper [1]					
	P_N	[kW]	4.7	6.4	9.3
Max. output power, Brake chopper [1]					
	$P_{max, 1}$	[kW]	19.5	29.2	
Running time [1]					
	t_{on}	[s]	1.0		
Recovery time [1]					
	t_{re}	[s]	4.2	4.3	3.9
Min. brake resistance [1]					
	R_{min}	[Ω]	27.0	18.0	

[2] 1 - Please refer to the Product key section

[1] 10 - See diagram



Rated data for Single Drive

- ► The data is valid for operation at 3/PE AC 400 V or DC 565 V.
- ► Unless otherwise specified, the data refers to the default setting.

					
Typical motor power					
4-pole asynchronous motor	P	[kW]	15.0	22.0	30.0
Product key [1]					
Single Drive			E94AS□E0324	E94AS□E0474	E94AS□E0594
Mains voltage range					
	U_{AC}	[V]	3/PE AC 340 V-0% ... 528 V+0 %, 45 Hz-0 % ... 65 Hz+0 %		
Rated mains current					
With mains choke	$I_{N, AC}$	[A]	29.0	43.0	54.0
Without mains choke	$I_{N, AC}$	[A]	29.0	43.0	54.0
Rated output current					
	$I_{N, out}$	[A]	32.0	47.0	59.0
Rated switching frequency					
	f_{ch}	[kHz]	8	4	
Output current					
2 kHz	I_{out}	[A]	38.4	47.0	59.0
4 kHz	I_{out}	[A]	38.4	47.0	59.0
8 kHz	I_{out}	[A]	32.0	41.0	
16 kHz	I_{out}	[A]	16.8	21.5	

Data for 60 s overload

Max. output current [2]					
	$I_{max, out}$	[A]	57.6	70.5	88.5
Reduced output current [2]					
	$I_{red, out}$	[A]	28.8	35.3	44.3
Overload time [2]					
	t_{ol}	[s]	60.0		
Recovery time [2]					
	t_{re}	[s]	120.0		

Data for 0.5 s overload

Max. short-time output current [2]					
	$I_{max, out}$	[A]	76.8	94.0	118.0
Reduced output current [2]					
	$I_{red, out}$	[A]	28.8	35.3	44.3
Overload time [2]					
	t_{ol}	[s]	0.5		
Recovery time [2]					
	t_{re}	[s]	4.5		

[1] 1 - Please refer to the Product key section

[2] 10 - See diagram



Rated data for Single Drive

- The data is valid for operation at 3/PE AC 400 V or DC 565 V.
- Unless otherwise specified, the data refers to the default setting.
- $I_{N, DC}$: R.m.s. value, consisting of DC current and harmonic current.

					
Typical motor power					
4-pole asynchronous motor	P	[kW]	15.0	22.0	30.0
Product key [2]					
Single Drive			E94AS□E0324	E94AS□E0474	E94AS□E0594
DC supply					
	U_{DC}	[V]	DC 460 -0% ... 740 V +0%		
Rated DC-bus current					
	$I_{N, DC}$	[A]	36.0	53.0	66.0
Power loss					
	P_V	[kW]	0.700	1.050	1.122
Dimensions					
Height	h	[mm]	556		
Height, including fastening	h	[mm]	606		
Width	b	[mm]	206		
Depth	t	[mm]	294		
Mass					
	m	[kg]	26.5		
Max. cable length					
shielded C1 with external measures	I_{max}	[m]	50		
shielded C2 without external measures	I_{max}	[m]	50		
shielded C2 with external measures	I_{max}	[m]	100		

Brake chopper rated data

Rated power, Brake chopper [1]					
	P_N	[kW]	12.6	18.6	25.3
Max. output power, Brake chopper [1]					
	$P_{max, 1}$	[kW]	29.2	35.0	
Running time [1]					
	t_{on}	[s]	260.0	320.0	430.0
Recovery time [1]					
	t_{re}	[s]	340.0	280.0	170.0
Min. brake resistance [1]					
	R_{min}	[Ω]	18.0	15.0	

[2] 1 - Please refer to the Product key section

[1] 10 - See diagram



Rated data for Single Drive

- ► The data is valid for operation at 3/PE AC 400 V or DC 565 V.
- ► Unless otherwise specified, the data refers to the default setting.

				
Typical motor power				
4-pole asynchronous motor	P	[kW]	45.0	55.0
Product key [1]				
Single Drive			E94AS□E0864	E94AS□E1044
Mains voltage range				
	U_{AC}	[V]	3/PE AC 340 V-0% ... 528 V+0 %, 45 Hz-0 % ... 65 Hz+0 %	
Rated mains current				
With mains choke	$I_{N, AC}$	[A]	79.0	95.0
Without mains choke	$I_{N, AC}$	[A]	79.0	95.0
Rated output current				
	$I_{N, out}$	[A]	86.0	104.0
Rated switching frequency				
	f_{ch}	[kHz]	4	
Output current				
2 kHz	I_{out}	[A]	86.0	104.0
4 kHz	I_{out}	[A]	86.0	104.0
8 kHz	I_{out}	[A]	73.0	78.0
16 kHz	I_{out}	[A]	38.3	41.0

Data for 60 s overload

Max. output current [2]				
	$I_{max, out}$	[A]	129.0	156.0
Reduced output current [2]				
	$I_{red, out}$	[A]	64.5	78.0
Overload time [2]				
	t_{ol}	[s]	60.0	
Recovery time [2]				
	t_{re}	[s]	120.0	

Data for 0.5 s overload

Max. short-time output current [2]				
	$I_{max, out}$	[A]	172.0	208.0
Reduced output current [2]				
	$I_{red, out}$	[A]	64.5	78.0
Overload time [2]				
	t_{ol}	[s]	0.5	
Recovery time [2]				
	t_{re}	[s]	4.5	

[1] 1 - Please refer to the Product key section

[2] 10 - See diagram



Rated data for Single Drive

- The data is valid for operation at 3/PE AC 400 V or DC 565 V.
- Unless otherwise specified, the data refers to the default setting.
- $I_{N, DC}$: R.m.s. value, consisting of DC current and harmonic current.

				
Typical motor power				
4-pole asynchronous motor	P	[kW]	45.0	55.0
Product key [2]				
Single Drive			E94AS□E0864	E94AS□E1044
Rated DC-bus current				
	$I_{N, DC}$	[A]	96.8	116.4
Power loss				
	P_V	[kW]	1.500	1.800
Dimensions				
Height	h	[mm]	655	
Height, including fastening	h	[mm]	706	
Width	b	[mm]	266	
Depth	t	[mm]	370	
Mass				
	m	[kg]	42.0	
Max. cable length				
shielded C2 without external measures	l_{max}	[m]	50	
shielded C2 with external measures	l_{max}	[m]	100	

Brake chopper rated data

Rated power, Brake chopper [1]				
	P_N	[kW]	37.9	46.3
Max. output power, Brake chopper [1]				
	$P_{max, 1}$	[kW]	70.1	
Running time [1]				
	t_{on}	[s]	320.0	400.0
Recovery time [1]				
	t_{re}	[s]	280.0	200.0
Min. brake resistance [1]				
	R_{min}	[Ω]	7.5	

[2] 1 - Please refer to the Product key section

[1] 10 - See diagram



Rated data for Single Drive

- ► The data is valid for operation at 3/PE AC 400 V or DC 565 V.
- ► Unless otherwise specified, the data refers to the default setting.

											
Typical motor power											
4-pole asynchronous motor	P	[kW]	75.0	85.0 [3]	95.0 [4]	90.0	105 [3]	110 [4]	105	125 [3]	135 [4]
Product key [1]											
Single Drive			E94BS□E1454			E94BS□E1724			E94BS□E2024		
Mains voltage range											
	U_{AC}	[V]	3/PE AC 340 V-0% ... 528 V+0 %, 45 Hz-0 % ... 65 Hz+0 %								
Rated mains current											
With mains choke	$I_{N, AC}$	[A]	138.0			164.0			192.0		
Rated output current											
	$I_{N, out}$	[A]	145.0			172.0			202.0		
Rated switching frequency											
	f_{ch}	[kHz]	4								
Output current											
2 kHz	I_{out}	[A]	145.0	160.0	177.0	172.0	195.0	212.0	202.0	240.0	260.0
4 kHz	I_{out}	[A]	145.0			172.0			202.0		
8 kHz	I_{out}	[A]	102.0			120.0			131.0		
16 kHz	I_{out}	[A]									

Data for 60 s overload

Max. output current [2]											
	$I_{max, out}$	[A]	218.0		195.0	258.0		233.0	303.0		286.0
Reduced output current [2]											
	$I_{red, out}$	[A]	109	145	168	129	180	201	152	226	247
Overload time [2]											
	t_{ol}	[s]	60.0								
Recovery time [2]											
	t_{re}	[s]	120.0								

Data for 10 s overload

Max. short-time output current [2]											
	$I_{max, out}$	[A]	261.0	218.0	195.0	310.0	258.0	233.0	364.0	303.0	286.0
Reduced output current [2]											
	$I_{red, out}$	[A]	109	145	168	129	180	201	152	226	247

[1] 1 - Please refer to the Product key section

[2] 10 - See diagram

[3] This column applies to an ambient temperature of 40 °C and a fixed switching frequency of 2 kHz.

[4] The column is valid at an ambient temperature of 40 degrees Celsius, with a fixed switching frequency of 2 kHz and a max. mains voltage of AC 440 V.



Rated data for Single Drive

- The data is valid for operation at 3/PE AC 400 V or DC 565 V.
- Unless otherwise specified, the data refers to the default setting.
- $I_{N, DC}$: R.m.s. value, consisting of DC current and harmonic current.

											
Typical motor power											
4-pole asynchronous motor	P	[kW]	75.0	85.0	95.0	90.0	105	110	105	125	135
Product key [2]											
Single Drive			E94BS□E1454			E94BS□E1724			E94BS□E2024		
Rated DC-bus current											
	$I_{N, DC}$	[A]	171.0			203.0			239.0		
Power loss											
	P_V	[kW]	2.100			2.200			2.600		
Dimensions											
Height	h	[mm]	923								
Height, including fastening	h	[mm]	950								
Width	b	[mm]	285			345					
Depth	t	[mm]	395								
Mass											
	m	[kg]	64.0			77.0					
Max. cable length											
shielded C3 without external measures	I_{max}	[m]	150								
shielded C2 with external measures	I_{max}	[m]	150								

Brake chopper rated data

Rated power, Brake chopper [1]					
	P_N	[kW]	31.5	36.7	45.1
Max. output power, Brake chopper [1]					
	$P_{max, 1}$	[kW]	105.1	122.2	150.2
Running time [1]					
	t_{on}	[s]	60.0		
Recovery time [1]					
	t_{re}	[s]	540.0		
Min. brake resistance [1]					
	R_{min}	[Ω]	5.0	4.3	3.5

[2] 1 - Please refer to the Product key section

[1] 10 - See diagram



Rated data for Single Drive

- ► The data is valid for operation at 3/PE AC 400 V or DC 565 V.
- ► Unless otherwise specified, the data refers to the default setting.



Typical motor power								
4-pole asynchronous motor	P	[kW]	130	160 [3]	165 [4]	150	190 [3]	210 [4]
Product key [1]								
Single Drive			E94BS□E2454			E94BS□E2924		
Mains voltage range								
	U_{AC}	[V]	3/PE AC 340 V-0% ... 528 V+0 %, 45 Hz-0 % ... 65 Hz+0 %					
Rated mains current								
With mains choke	$I_{N, AC}$	[A]	236.0			285.0		
Rated output current								
	$I_{N, out}$	[A]	245.0			292.0		
Rated switching frequency								
	f_{ch}	[kHz]	2					
Output current								
2 kHz	I_{out}	[A]	245.0	302.0	315.0	292.0	361.0	395.0
4 kHz	I_{out}	[A]	209.0			251.0		
8 kHz	I_{out}	[A]	160.0			191.0		
16 kHz	I_{out}	[A]						

Data for 60 s overload

Max. output current [2]								
	$I_{max, out}$	[A]	368.0		347.0	438.0		435.0
Reduced output current [2]								
	$I_{red, out}$	[A]	184	275	299	219	330	375
Overload time [2]								
	t_{ol}	[s]	60.0					
Recovery time [2]								
	t_{re}	[s]	120.0					

Data for 10 s overload

Max. short-time output current [2]								
	$I_{max, out}$	[A]	441.0	368.0	347.0	526.0	438.0	435.0
Reduced output current [2]								
	$I_{red, out}$	[A]	184	275	299	219	330	375

[1] 1 - Please refer to the Product key section

[2] 10 - See diagram

[3] This column applies to an ambient temperature of 40 °C and a fixed switching frequency of 2 kHz.

[4] The column is valid at an ambient temperature of 40 degrees Celsius, with a fixed switching frequency of 2 kHz and a max. mains voltage of AC 440 V.



Rated data for Single Drive

- The data is valid for operation at 3/PE AC 400 V or DC 565 V.
- Unless otherwise specified, the data refers to the default setting.
- $I_{N, DC}$: R.m.s. value, consisting of DC current and harmonic current.

Typical motor power								
4-pole asynchronous motor	P	[kW]	130	160	165	150	190	210
Product key [2]			E94BS□E2454			E94BS□E2924		
Single Drive								
Rated DC-bus current								
	$I_{N, DC}$	[A]	290.0			343.0		
Power loss								
	P_V	[kW]	3.300			4.100		
Dimensions								
Height	h	[mm]	923			1063		
Height, including fastening	h	[mm]	950			1090		
Width	b	[mm]	345					
Depth	t	[mm]	395					
Mass								
	m	[kg]	77.0			80.0		
Max. cable length								
shielded C3 without external measures	l_{max}	[m]	150					
shielded C2 with external measures	l_{max}	[m]	150					

Brake chopper rated data

Rated power, Brake chopper [1]				
	P_N	[kW]	56.3	68.6
Max. output power, Brake chopper [1]				
	$P_{max, 1}$	[kW]	187.7	228.5
Running time [1]				
	t_{on}	[s]	60.0	
Recovery time [1]				
	t_{re}	[s]	540.0	
Min. brake resistance [1]				
	R_{min}	[Ω]	2.8	2.3

[2] 1 - Please refer to the Product key section

[1] 10 - See diagram



Rated data for Single Drive

- ► The data is valid for operation at 3/PE AC 400 V or DC 565 V.
- ► Unless otherwise specified, the data refers to the default setting.

								
Typical motor power								
4-pole asynchronous motor	P	[kW]	190	235 [3]	250 [4]	240	290 [3]	315 [4]
Product key [1]								
Single Drive			E94BS□E3664			E94BS□E4604		
Mains voltage range								
	U_{AC}	[V]	3/PE AC 340 V-0% ... 528 V+0 %, 45 Hz-0 % ... 65 Hz+0 %					
Rated mains current								
With mains choke	$I_{N, AC}$	[A]	349.0			436.0		
Rated output current								
	$I_{N, out}$	[A]	366.0			460.0		
Rated switching frequency								
	f_{ch}	[kHz]	2					
Output current								
2 kHz	I_{out}	[A]	366.0	443.0	480.0	460.0	550.0	600.0
4 kHz	I_{out}	[A]	313.0			368.0		
8 kHz	I_{out}	[A]	240.0			260.0		
16 kHz	I_{out}	[A]						

4.3

Data for 60 s overload

Max. output current [2]								
	$I_{max, out}$	[A]	549.0		528.0	690.0		660.0
Reduced output current [2]								
	$I_{red, out}$	[A]	275	415	456	345	522	570
Overload time [2]								
	t_{ol}	[s]	60.0					
Recovery time [2]								
	t_{re}	[s]	120.0					

Data for 10 s overload

Max. short-time output current [2]								
	$I_{max, out}$	[A]	659.0	549.0	528.0	828.0	690.0	660.0
Reduced output current [2]								
	$I_{red, out}$	[A]	275	415	456	345	522	570

[1] 1 - Please refer to the Product key section

[2] 10 - See diagram

[3] This column applies to an ambient temperature of 40 °C and a fixed switching frequency of 2 kHz.

[4] The column is valid at an ambient temperature of 40 degrees Celsius, with a fixed switching frequency of 2 kHz and a max. mains voltage of AC 440 V.



Rated data for Single Drive

- The data is valid for operation at 3/PE AC 400 V or DC 565 V.
- Unless otherwise specified, the data refers to the default setting.
- $I_{N, DC}$: R.m.s. value, consisting of DC current and harmonic current.

								
Typical motor power								
4-pole asynchronous motor	P	[kW]	190	235	250	240	290	315
Product key [2]								
Single Drive			E94BS□E3664			E94BS□E4604		
Rated DC-bus current								
	$I_{N, DC}$	[A]	434.0			544.0		
Power loss								
	P_V	[kW]	4.900			6.200		
Dimensions								
Height	h	[mm]	1522					
Height, including fastening	h	[mm]	1522					
Width	b	[mm]	500					
Depth	t	[mm]	544					
Mass								
	m	[kg]	189.0					
Max. cable length								
shielded C3 without external measures	I_{max}	[m]	150					
shielded C2 with external measures	I_{max}	[m]	150					

Brake chopper rated data

Rated power, Brake chopper [1]				
	P_N	[kW]	90.1	99.0
Max. output power, Brake chopper [1]				
	$P_{max, 1}$	[kW]	300.4	375.0
Running time [1]				
	t_{on}	[s]	60.0	30.0
Recovery time [1]				
	t_{re}	[s]	540.0	270.0
Min. brake resistance [1]				
	R_{min}	[Ω]	1.8	1.4

[2] 1 - Please refer to the Product key section

[1] 10 - See diagram



Rated data for Multi Drive

- ► The data is valid for operation at DC 565 V.
- ► Unless otherwise specified, the data refers to the default setting.

					
Typical motor power					
4-pole asynchronous motor	P	[kW]	0.37	0.75	1.50
Product key [1]					
Multi Drive			E94AM□E0024	E94AM□E0034	E94AM□E0044
DC supply					
	U_{DC}	[V]	DC 460 -0% ... 740 V +0%		
Rated output current					
	$I_{N, out}$	[A]	1.5	2.5	4.0
Rated switching frequency					
	f_{ch}	[kHz]	8		
Output current					
2 kHz	I_{out}	[A]	1.9	3.1	5.0
4 kHz	I_{out}	[A]	1.9	3.1	5.0
8 kHz	I_{out}	[A]	1.5	2.5	4.0
16 kHz	I_{out}	[A]	1.1	1.9	3.0

Data for 60 s overload

Max. output current [2]					
	$I_{max, out}$	[A]	2.8	4.7	7.5
Reduced output current [2]					
	$I_{red, out}$	[A]	1.40	2.30	3.80
Overload time [2]					
	t_{ol}	[s]	60.0		
Recovery time [2]					
	t_{re}	[s]	120.0		

Data for 0.5 s overload

Max. short-time output current [2]					
	$I_{max, out}$	[A]	6.0	10.0	16.0
Reduced output current [2]					
	$I_{red, out}$	[A]	1.40	2.30	3.80
Overload time [2]					
	t_{ol}	[s]	0.5		
Recovery time [2]					
	t_{re}	[s]	4.5		

[1] 1 - Please refer to the Product key section

[2] 10 - See diagram



Rated data for Multi Drive

- The data is valid for operation at DC 565 V.
- Unless otherwise specified, the data refers to the default setting.
- $I_{N, DC}$: R.m.s. value, consisting of DC current and harmonic current.

					
Typical motor power					
4-pole asynchronous motor	P	[kW]	0.37	0.75	1.50
Product key [1)]					
Multi Drive			E94AM□E0024	E94AM□E0034	E94AM□E0044
Rated DC-bus current					
	$I_{N, DC}$	[A]	2.6	4.3	6.7
Power loss					
	P_V	[kW]	0.100	0.120	0.150
Dimensions					
Height	h	[mm]	350		
Height, including fastening	h	[mm]	481		
Width	b	[mm]	60		
Depth	t	[mm]	288		
Mass					
	m	[kg]	4.0		
Max. cable length					
shielded C1 with external measures	I_{max}	[m]	25		
shielded C2 without external measures	I_{max}	[m]	10		
shielded C2 with external measures	I_{max}	[m]	50		

[1)] 1 - Please refer to the Product key section



Rated data for Multi Drive

- ► The data is valid for operation at DC 565 V.
- ► Unless otherwise specified, the data refers to the default setting.

					
Typical motor power					
4-pole asynchronous motor	P	[kW]	3.00	4.00	5.50
Product key [1]					
Multi Drive			E94AM□E0074	E94AM□E0094	E94AM□E0134
DC supply					
	U_{DC}	[V]	DC 460 -0% ... 740 V +0%		
Rated output current					
	$I_{N, out}$	[A]	7.0	9.3	13.0
Rated switching frequency					
	f_{ch}	[kHz]	8		
Output current					
2 kHz	I_{out}	[A]	8.8	11.7	16.3
4 kHz	I_{out}	[A]	8.8	11.7	16.3
8 kHz	I_{out}	[A]	7.0	9.3	13.0
16 kHz	I_{out}	[A]	5.3	7.0	9.8

Data for 60 s overload

Max. output current [2]					
	$I_{max, out}$	[A]	13.1	17.5	24.4
Reduced output current [2]					
	$I_{red, out}$	[A]	6.60	8.80	12.2
Overload time [2]					
	t_{ol}	[s]	60.0		
Recovery time [2]					
	t_{re}	[s]	120.0		

Data for 0.5 s overload

Max. short-time output current [2]					
	$I_{max, out}$	[A]	21.0	28.0	39.0
Reduced output current [2]					
	$I_{red, out}$	[A]	6.60	8.80	12.2
Overload time [2]					
	t_{ol}	[s]	0.5		
Recovery time [2]					
	t_{re}	[s]	4.5		

[1] 1 - Please refer to the Product key section

[2] 10 - See diagram



Rated data for Multi Drive

- The data is valid for operation at DC 565 V.
- Unless otherwise specified, the data refers to the default setting.
- $I_{N, DC}$: R.m.s. value, consisting of DC current and harmonic current.

					
Typical motor power					
4-pole asynchronous motor	P	[kW]	3.00	4.00	5.50
Product key [1)]					
Multi Drive			E94AM□E0074	E94AM□E0094	E94AM□E0134
Rated DC-bus current					
	$I_{N, DC}$	[A]	12.1	15.4	20.6
Power loss					
	P_V	[kW]	0.190	0.230	0.280
Dimensions					
Height	h	[mm]	350		
Height, including fastening	h	[mm]	481		
Width	b	[mm]	90		120
Depth	t	[mm]	288		
Mass					
	m	[kg]	5.3		8.1
Max. cable length					
shielded C1 with external measures	I_{max}	[m]	25		
shielded C2 without external measures	I_{max}	[m]	10		
shielded C2 with external measures	I_{max}	[m]	100		

[1)] 1 - Please refer to the Product key section



Rated data for Multi Drive

- ► The data is valid for operation at DC 565 V.
- ► Unless otherwise specified, the data refers to the default setting.

					
Typical motor power					
4-pole asynchronous motor	P	[kW]	7.50	11.0	15.0
Product key [1]					
Multi Drive			E94AM□E0174	E94AM□E0244	E94AM□E0324
DC supply					
	U_{DC}	[V]	DC 460 -0% ... 740 V +0%		
Rated output current					
	$I_{N, out}$	[A]	16.5	23.5	32.0
Rated switching frequency					
	f_{ch}	[kHz]	8		
Output current					
2 kHz	I_{out}	[A]	20.6	29.4	40.0
4 kHz	I_{out}	[A]	20.6	29.4	40.0
8 kHz	I_{out}	[A]	16.5	23.5	32.0
16 kHz	I_{out}	[A]	12.4	17.6	24.0

4.3

Data for 60 s overload

Max. output current [2]					
	$I_{max, out}$	[A]	30.9	44.1	60.0
Reduced output current [2]					
	$I_{red, out}$	[A]	15.5	22.1	30.0
Overload time [2]					
	t_{ol}	[s]	60.0		
Recovery time [2]					
	t_{re}	[s]	120.0		

Data for 0.5 s overload

Max. short-time output current [2]					
	$I_{max, out}$	[A]	49.5	70.5	76.8
Reduced output current [2]					
	$I_{red, out}$	[A]	15.5	22.1	30.0
Overload time [2]					
	t_{ol}	[s]	0.5		
Recovery time [2]					
	t_{re}	[s]	4.5		

[1] 1 - Please refer to the Product key section

[2] 10 - See diagram



Rated data for Multi Drive

- The data is valid for operation at DC 565 V.
- Unless otherwise specified, the data refers to the default setting.
- $I_{N, DC}$: R.m.s. value, consisting of DC current and harmonic current.

					
Typical motor power					
4-pole asynchronous motor	P	[kW]	7.50	11.0	15.0
Product key [1)]					
Multi Drive			E94AM□E0174	E94AM□E0244	E94AM□E0324
Rated DC-bus current					
	$I_{N, DC}$	[A]	25.7	35.5	48.0
Power loss					
	P_V	[kW]	0.320	0.420	0.490
Dimensions					
Height	h	[mm]	350		
Height, including fastening	h	[mm]	481		
Width	b	[mm]	120		
Depth	t	[mm]	288		
Mass					
	m	[kg]	8.1		
Max. cable length					
shielded C1 with external measures	I_{max}	[m]	25		
shielded C2 without external measures	I_{max}	[m]	10		
shielded C2 with external measures	I_{max}	[m]	100		

[1)] 1 - Please refer to the Product key section



Rated data for Multi Drive

- ► The data is valid for operation at DC 565 V.
- ► Unless otherwise specified, the data refers to the default setting.

				
Typical motor power				
4-pole asynchronous motor	P	[kW]	22.0	30.0
Product key [-1)]				
Multi Drive			E94AM□E0474	E94AM□E0594
DC supply				
	U_{DC}	[V]	DC 460 -0% ... 740 V +0%	
Rated output current				
	$I_{N, out}$	[A]	47.0	59.0
Rated switching frequency				
	f_{ch}	[kHz]	4	
Output current				
2 kHz	I_{out}	[A]	47.0	59.0
4 kHz	I_{out}	[A]	47.0	59.0
8 kHz	I_{out}	[A]	41.0	
16 kHz	I_{out}	[A]	21.5	

4.3

Data for 60 s overload

Max. output current [2)]				
	$I_{max, out}$	[A]	70.5	88.5
Reduced output current [2)]				
	$I_{red, out}$	[A]	35.3	44.3
Overload time [2)]				
	t_{ol}	[s]	60.0	
Recovery time [2)]				
	t_{re}	[s]	120.0	

Data for 0.5 s overload

Max. short-time output current [2)]				
	$I_{max, out}$	[A]	94.0	118.0
Reduced output current [2)]				
	$I_{red, out}$	[A]	35.3	44.3
Overload time [2)]				
	t_{ol}	[s]	0.5	
Recovery time [2)]				
	t_{re}	[s]	4.5	

[1)] 1 - Please refer to the Product key section

[2)] 10 - See diagram



Rated data for Multi Drive

- The data is valid for operation at DC 565 V.
- Unless otherwise specified, the data refers to the default setting.
- $I_{N, DC}$: R.m.s. value, consisting of DC current and harmonic current.

				
Typical motor power				
4-pole asynchronous motor	P	[kW]	22.0	30.0
Product key [1)]				
Multi Drive			E94AM□E0474	E94AM□E0594
Rated DC-bus current				
	$I_{N, DC}$	[A]	53.0	66.0
Power loss				
	P_V	[kW]	1.050	1.122
Dimensions				
Height	h	[mm]	556	
Height, including fastening	h	[mm]	606	
Width	b	[mm]	206	
Depth	t	[mm]	294	
Mass				
	m	[kg]	26.5	
Max. cable length				
shielded C1 with external measures	I_{max}	[m]	50	
shielded C2 without external measures	I_{max}	[m]	50	
shielded C2 with external measures	I_{max}	[m]	100	

[1)] 1 - Please refer to the Product key section



Mains connection

- The mains fuse and cable cross-section specifications are for a mains connection of 1 x 230V or 3 x 400V.
- Class gG/gl fuses or class gRL semiconductor fuses.
- The cable cross-sections apply to PVC-insulated copper cables.
- Use for installation with UL-approved cables, fuses and brackets.

Operation with mains choke

Typical motor power	Mains voltage	Product key	Circuit breaker	Fuse		Mains connection
4-pole asynchronous motor		Single Drive		EN 60204-1	UL	Cross-section (with mains choke)
P	U_{AC}		I	I	I	q
[kW]	[V]		[A]	[A]	[A]	[mm2]
0.37	3 AC 340 ... 528	E94AS□E0024	C10	10	10	1.5
0.75		E94AS□E0034				
1.50		E94AS□E0044				
3.00		E94AS□E0074	C16	16	15	2.5
5.50		E94AS□E0134	C20	20	20	
7.50		E94AS□E0174	C25	32	25	4.0
11.0		E94AS□E0244	C32		30	10.0



Mains connection

- The mains fuse and cable cross-section specifications are for a mains connection of 1 x 230V or 3 x 400V.
- Class gG/gl fuses or class gRL semiconductor fuses.
- The cable cross-sections apply to PVC-insulated copper cables.
- Use for installation with UL-approved cables, fuses and brackets.

Operation without mains choke

Typical motor power	Mains voltage	Product key	Circuit breaker	Fuse		Mains connection
4-pole asynchronous motor		Single Drive		EN 60204-1	UL	Cross-section (without mains choke)
P	U_{AC}		I	I	I	q
[kW]	[V]		[A]	[A]	[A]	[mm2]
0.37	3 AC 340 ... 528	E94AS□E0024	C10	10	10	1.5
0.75		E94AS□E0034				
1.50		E94AS□E0044				
3.00		E94AS□E0074	C16	16	15	2.5
5.50		E94AS□E0134	C20	20	20	
7.50		E94AS□E0174	C25	32	25	4.0
11.0		E94AS□E0244	C40	50	40	10.0
15.0		E94AS□E0324				
22.0		E94AS□E0474		63	60	16.0
30.0		E94AS□E0594		80	80	25.0
45.0		E94AS□E0864		100	100	50.0
55.0		E94AS□E1044		125	125	70.0
75.0		E94BS□E1454		200		
90.0		E94BS□E1724		250		95.0
105		E94BS□E2024		315		150.0
130		E94BS□E2454		350		
150		E94BS□E2924		400		185.0
190		E94BS□E3664		500		240.0
240		E94BS□E4604				150.0



Motor connection

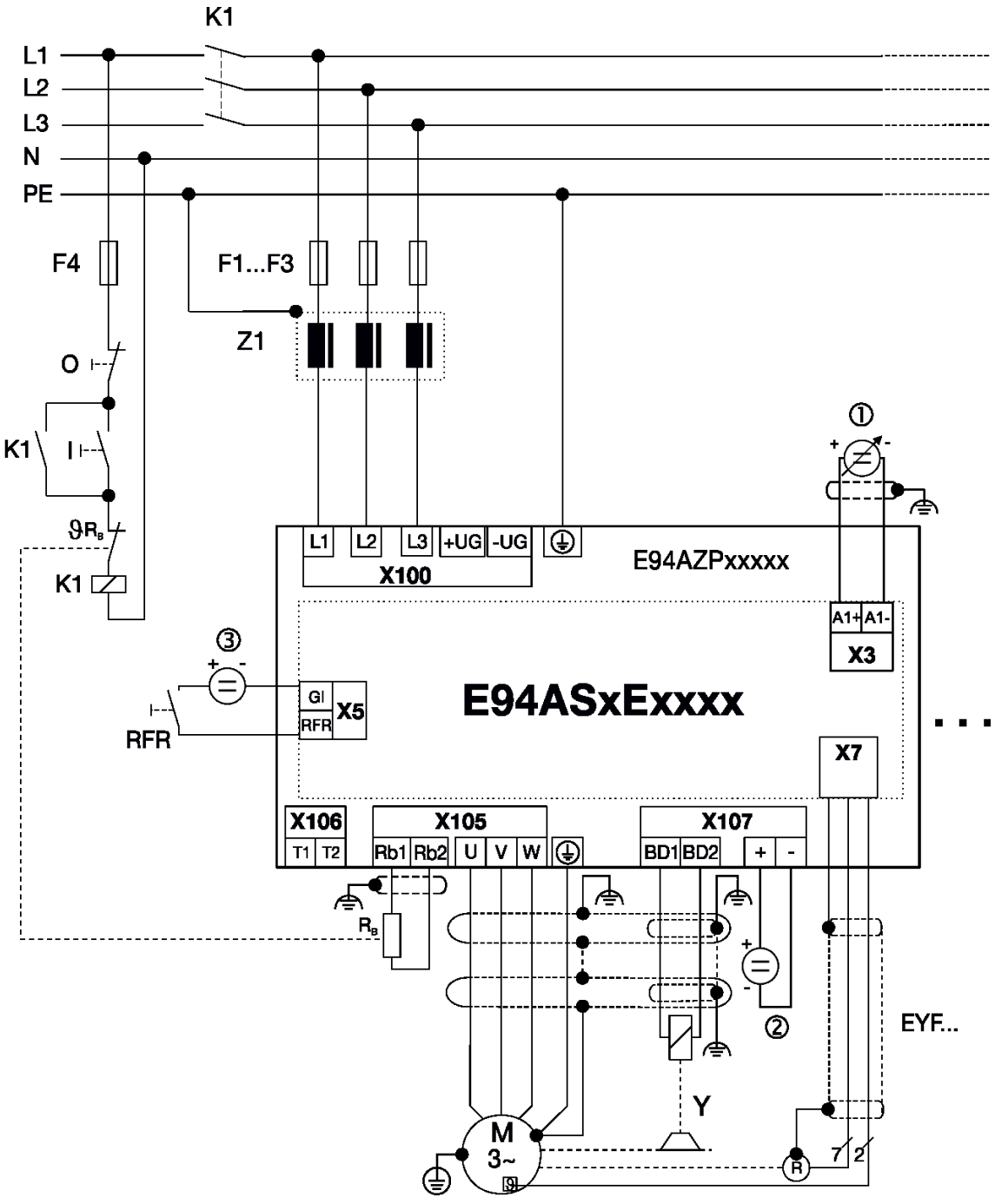
- ► Keep motor cables as short as possible, as this has a positive effect on the drive behaviour.
- ► With group drives (multiple motors on one inverter), the resulting cable length is the key factor. This can be calculated using the hardware manual.
- ► Electric strength of the motor cable: 1 kV as per VDE 250-1.

Typical motor power	Mains voltage	Product key	Max. cable length			
4-pole asynchronous motor		Single Drive	shielded C1 with external measures	shielded C2 without external measures	shielded C2 with external measures	shielded C3 without external measures
P	U_{AC}		l_{max}	l_{max}	l_{max}	l_{max}
[kW]	[V]		[m]	[m]	[m]	[m]
0.37	3 AC 340 ... 528	E94AS□E0024	25	10	50	100
0.75		E94AS□E0034				
1.50		E94AS□E0044			100	
3.00		E94AS□E0074				
5.50		E94AS□E0134				
7.50		E94AS□E0174				
11.0		E94AS□E0244				
15.0		E94AS□E0324	50	50		
22.0		E94AS□E0474				
30.0		E94AS□E0594				
45.0		E94AS□E0864				
55.0		E94AS□E1044				
75.0		E94BS□E1454			150	150
90.0		E94BS□E1724				
105		E94BS□E2024				
130		E94BS□E2454				
150		E94BS□E2924				
190		E94BS□E3664				
240		E94BS□E4604				



Connection diagrams

Wiring example for connecting Servo Drives 9400 HighLine to 3 x 400V





Control connections

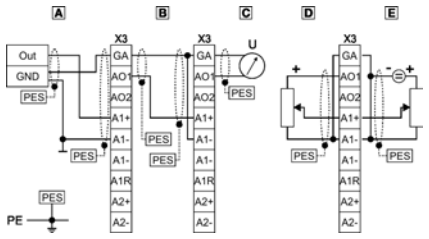
Mode	
	Servo Drives 9400 HighLine
Analog inputs	
Number	2
Resolution	11 bits + sign
Value range	+/- 10 V 1 x switchable 20 mA
Analog outputs	
Number	2
Resolution	10 bits + sign
Value range	+/- 10 V max. 2 mA
Digital inputs	
Number	8
Touch-probe-capable	8
Switching level	PLC (IEC 61131-2)
Max. input current	8 mA
Digital outputs	
Number	4
Switching level	PLC (IEC 61131-2)
Max. output current	50 mA
Load capacity	>480 Ω at 24 V
External DC supply	
Rated voltage	24 V in accordance with IEC 61131-2
Voltage range	19.2 ... 28.8 V, max. residual ripple ± 5%
Current	Single Drive: approx. 1.2 A during operation, max. 3 A starting current for 100 ms [1)] Multi Drive: approx. 2.4 A during operation, max. 4 A starting current for 100 ms
Interfaces	
CANopen	Integrated
Extensions	Via slot MXI 2: extension 2 Via slot MXI 1: extension 1
State bus	Integrated
Memory	Slot MMI
Safety engineering	Slot MSI
Drive interface	
Resolver input	Integrated Sub-D, 9-pin
Encoder input	Sub-D, 15-pin Multiple encoder input for: SinCos/TTL incremental encoder, SinCos absolute value encoder single-turn/multi-turn (HIPERFACE® / Endat V2.1) SSI encoder with Stegmann SSI protocol as position encoder or master encoder with minimum cycle time of 1 ms
Motor temperature	Input on the device: PTC evaluation Via feedback: KTY evaluation
Motor brake	Optional, in installation backplane up to 32 A or in axis module from 32 A

[1)] The supply voltage for the control electronics comes from the mains voltage. Alternatively, it can be provided by a 24 V supply that is independent of the mains (available as an option).

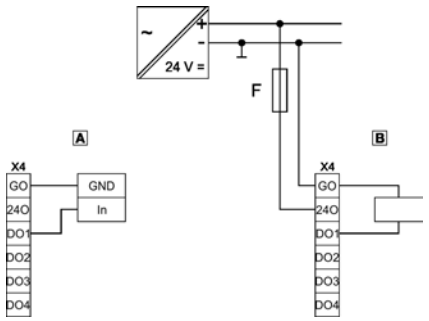


Control connections

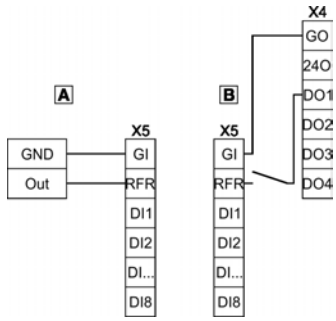
Connection of analog inputs and outputs



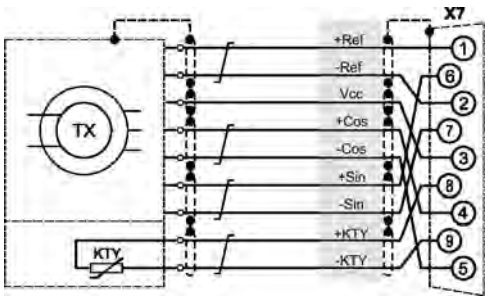
Connection of digital inputs and outputs



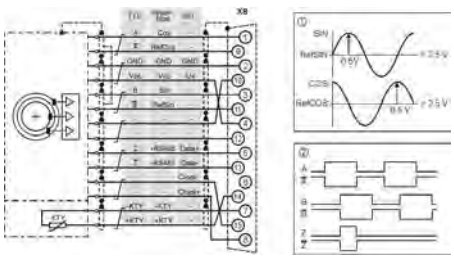
Connection of digital inputs and outputs



Resolver connection



Encoder connection



4.3



Overview of modules

For adaptation to the machine requirements, up to four different modules can be used to adjust the Servo Drives 9400 and regenerative power supply modules. The following slots are available:

- memory modules:
  (slot MMI) required for operation,
- safety modules:
  (slot MSI) required for operation
- extension modules:
  (slot MXI 1 and/or MXI 2)

The tables below show the modules available for Servo Drive 9400 and the regenerative power supply modules.



Axis module with module slots MXI, MMI and MSI

Memory module

Slot		Mode	Product key	Mode	
		Memory module		HighLine	Regen. module
MMI		Motion control HighLevel MM220	E94AYM22	Standard	Standard
MMI		Motion control TopLevel MM330	E94AYM33	Option	
MMI		Motion control TopLevel MM430	E94AYM43	Option	



Overview of modules

Safety modules

Slot		Mode	Product key	Mode	
		Safety module		HighLine	Regen. module
MSI		SM0	E94AYAA	Standard	Standard
MSI		SM100	E94AYAB	Option	
MSI		SM301	E94AYAE	Option	
MSI		SM302	E94AYAF	Option	



Overview of modules

Extension modules

Slot		Mode	Product key	Mode	
		Extension module		HighLine	Regen. module
MXI1 MXI2		Digital frequency	E94AYFLF	Option	

Communication modules

Slot		Mode	Product key	Mode	
		Communication module		HighLine	Regen. module
MXI1 MXI2		CANopen	E94AYCCA	Option	Option
MXI1 MXI2		DeviceNet	E94AYCDN	Option	Option
MXI1 MXI2		EtherCAT	E94AYCET	Option	Option
MXI1 MXI2		Ethernet	E94AYCEN	Option	Option
MXI1 MXI2		EtherNet/IP	E94AYCEO	Option	Option
MXI1 MXI2		PROFIBUS	E94AYCPM	Option	Option
MXI1 MXI2		PROFINET	E94AYCER	Option	Option



Overview of modules

Assignment of extension modules and module slots (HighLine)

Two module slots on the Servo Drives 9400 are intended for extensions. The following table lists the possible combinations.

MXI 1 / MXI 2	E94AYFLF	E94AYCCA	E94AYCDN	E94AYCET	E94AYCEN	E94AYCEO	E94AYCPM	E94AYCER
E94AYFLF		●	●	●	●	●	●	●
E94AYCCA	●			●	●	●	●	●
E94AYCDN	●				●	●	●	●
E94AYCET	●	●			●	●		●
E94AYCEN	●	●	●	●		●	●	●
E94AYCEO	●	●	●	●	●		●	●
E94AYCPM [1)]	●	●	●		●	●		●
E94AYCER [1)]	●	●	●	●	●	●	●	

[1)] Module slot MXI 1 must be used for PROFIsafe.

Assignment of extension modules and the module slot for the regenerative power supply module

Two module slots on the regenerative power supply modules are intended for extensions. The following table lists the possible combinations.

MXI 1 / MXI 2	E94AYCCA	E94AYCDN	E94AYCET	E94AYCEN	E94AYCEO	E94AYCPM	E94AYCER
E94AYCCA			●	●	●	●	●
E94AYCDN				●	●	●	●
E94AYCET	●	●		●	●		
E94AYCEN	●	●	●		●	●	●
E94AYCEO	●	●	●	●		●	●
E94AYCPM	●	●		●	●		
E94AYCER	●	●	●	●	●		



Memory module

Various memory modules are available for the Servo Drives 9400:
- Motion Control HighLevel (MM220)
- Motion Control TopLevel (MM330 and MM430)

With these modules, the functions described below are activated.
The functions can be loaded into the drive using L-force Engineer.
In addition to the different functions of the Runtime software versions, different memory sizes or a real-time clock function (battery-backed) are available, depending on which memory module is used.



MM330 memory module

Mode		Features	Slot	Product key
Memory module				
Motion control HighLevel MM220		• Application and parameter storage • - • Address switch and baud rate setting for onboard system bus CANopen	MMI	E94AYM22
Motion control TopLevel MM330		• Application and parameter storage • - • Address switch and baud rate setting for onboard system bus CANopen	MMI	E94AYM33



Memory module

Mode		Features	Slot	Product key
Memory module				
Motion control TopLevel MM430		• Application and parameter storage • - • Address switch and baud rate setting for onboard system bus CANopen • Real-time clock (battery-buffered)	MMI	E94AYM43

Product key		E94AYM22	E94AYM33	E94AYM43
Mode				
Memory module		Motion control HighLevel MM220	Motion control TopLevel MM330	Motion control TopLevel MM430
Storage medium				
Flash memory	[MB]	2.00	4.00	8.00
Additional function				
Real-time clock		No		Yes
System bus addressing switch (CAN)		Yes		



Safety modules

For virtually any application, the provision of extensive safety engineering is one of the most important tasks of the plant constructor. However, this issue can only be solved with the help of complicated wiring. Thanks to the "Drive-based Safety" solution that can be integrated in servo drives 9400, this can be implemented using axis modules. The safety engineering, which can be integrated as an option, has a modular structure.
The range of functions begins with the "safe torque off" function (formerly "safe standstill") and extends as far as integration in safety bus systems. The modular approach of drive-based safety also provides the option for expanding systems in future and, at the same time, ensures flexibility.



SM301 safety module

The following modules are available with safety functions in accordance with IEC 61800-5-2:
- SM0 (necessary for the MSI slot if no safety functions are required)
- SM100
- SM301
- SM302

Mode			
Safety module	SM100	SM301	SM302
Function			
Safe torque off (STO)	●	●	●
Safety sensor connection	●	●	●
Safe stop 1 (SS1)		●	●
Safe stop 2 (SS2) [1)]		●	●
Safe operational stop (SOS) [1)]		●	●
Safely limited speed (SLS) [1)]		●	●
Safe maximum speed (SMS) [1)]		●	●
Safe speed monitoring (SSM) [1)]		●	●
Safe direction (SDI) [1)]		●	●
Operation mode selector (OMS) with enable switch (ES)		●	●
Safely limited increment (SLI) [1)]		●	●
Cascading of the STO safety function		●	●
Safe limited position (SLP) [1)]			●
Position-dependent safely limited speed (PDSS) [1)]			●
Safe cam (SCA) [1)]			●
Safety bus PROFIsafe		PROFIBUS DP PROFINET IO (optionally via MXI1)	PROFINET IO (optionally via MXI1)
Safety bus FSoE			EtherCAT (optionally via MXI1)
Operation with safety PLC		Optional	Optional
Transmission of position and speed data to safety control			PROFIsafe or FSoE
Certification according to IEC 61508	Cat 4 PL e / SIL 3	Cat 3 PL e / SIL 3	Cat 4 PL e / SIL 3

[1)] For speed-dependent safety functions, the motor-feedback system combinations listed on the following page are available.



Safety modules

Product key						
			E94AYAA	E94AYAB	E94AYAE	E94AYAF
Mode						
Safety module			SM0	SM100	SM301	SM302
Certification						
EN 954-1				Category 4	Category 3	Category 4
EN ISO 13849-1				PLe	PLe	PLe
Fail-safe state						
				Safe torque off	Safe torque off	Safe torque off
Safe inputs/outputs						
Number of connectable active safety sensors				1	4, choice between active or passive	4, choice between active or passive
Number of connectable passive safety sensors					4, choice between active or passive	4, choice between active or passive
Monitor (1-channel output)				1		
Diagnostics						
Status display				2 LEDs	6 LEDs	6 LEDs
Rated voltage						
	$U_{N, DC}$	[V]		24.0	24.0	24.0

Speed-dependent safety functions in connection with the safety modules SM301 and SM 302

For the following speed-dependent safety functions, the motor-feedback system combinations listed in the following table are available:

- Safe stop 1 (SS1)
- Safe stop 2 (SS2)
- Safe operational stop (SOS)
- Safely limited speed (SLS)
- Safe maximum speed (SMS)
- Safe direction (SDI)
- Operation mode selector (OMS) with enable switch (ES)
- Safe speed monitor (SSM)
- Safely limited increment (SLI).
- Position-dependent safely limited speed (PDSS)
- Safely limited position (SLP)
- Safe cam (SCA)

	Encoder type	Encoder type	Product key		Safe speed monitoring
Synchronous servo motors (MCS, MDXKS)	SinCos absolute value	Single-turn	AS1024-8V-K2		PL d/SIL 2
		Multi-turn	AM1024-8V-K2		
	Resolver		RV03		PL e/SIL 3
				2-encoder concept	up to PL e / SIL 3

	Encoder type	Encoder type	Product key		Safe speed monitoring
Asynchronous servo motors (MCA, MQA)	SinCos incremental	Multi-turn	IG1024-5V-V3		PL e/SIL 3
	Resolver		RV03		
				2-encoder concept	up to PL e / SIL 3

Please refer to the servo motors catalogue for details on the concrete assignments of the individual motor frame sizes and the corresponding technical properties.

A "2-encoder concept" is a resolver as motor feedback unit and, at the same time, an absolute value encoder (SinCos), and incremental encoder (TTL), an SSI encoder or bus encoder as position encoder at the machine



Extension module: digital frequency

Some applications require several axes to be operated in synchronism. What was formerly implemented by means of the line shaft, can now be achieved in the Servo Drives 9400 HighLine with the digital frequency extension module.
The extension module provides a digital frequency input and output. The signals of the different axes can thus be looped through and simulated.



Extension module: digital frequency

Mode		Features	Slot	Product key
Communication module				
		• Digital frequency 0 to 500 kHz • Up to three slave drives connectable • Sub-D connection for LFin and LFout	MXI1 MXI2	E94AYFLF

4.3

Standards and operating conditions

Product key			
			E94AYFLF
Mode			
Communication module			
Degree of protection			
EN 60529			IP20
Vibration resistance			
			Sinusoidal vibration Amplitude/Acceleration Acceleration resistant up to 0.7 g acc. to Germanischer Lloyd 10 Hz ≤ f ≤ 57 Hz: ±0.075 mm amplitude,
Site altitude			
Amsl	H_{max}	[m]	4000
Climatic conditions			
Storage (EN 60721-3-1)			1K3 (temperature: -25 °C ... +60 °C)
Transport (EN 60721-3-2)			2K3 (temperature: -25 °C ... +70 °C)
Operation (EN 60721-3-3)			3K3 (temperature: -10°C ... +55 °C)
Insulation voltage to reference earth/PE			
	U_{AC}	[V]	50.0



Extension module: digital frequency

Rated data

Product key			
			E94AYFLF
Mode			
System cables			Type: EYD
Digital frequency			
Input	f	[kHz]	0 to 500 (TTL)
Output	f	[kHz]	0 to 500 (TTL)
Feedback			
Incremental encoder type			TTL encoder
Incremental encoder signal			2 signals of 5 V offset by 90°
Sequence connections			
In parallel			3 drives
In series			For 250 kHz 20 drives For 500 kHz 10 drives
Max. cable length			
between two nodes	l_{max}	[m]	50
Rated voltage			
	$U_{N, DC}$	[V]	24.0



Communication module: CANopen

The Servo Drives 9400 HighLine and the regenerative power supply modules have a CANopen interface on board as a standard feature. It enables the axis modules to communicate with each other and with other system bus components (e.g. I/O systems or HMIs).
If a second CANopen interface is necessary for system networking, the CANopen communication module can be used for this purpose.
CANopen is a communication protocol based on CAN physics. Its specifications are determined by the CiA user group (**C**AN **i**n **A**utomation). Compatibility with the Lenze system bus (CAN) can be established by means of configuration.



Communication module: AS-Interface

Mode		Features	Slot	Product key
Communication module				
CANopen		• CANopen profile DS301, V4.02 Lenze system bus • Automatic baud rate detection • 2 LEDs for communication status display • DIP switch for selecting baud rate and address • Sub-D connection	MXI1 MXI2	E94AYCCA

4.3

Standards and operating conditions

Product key			
			E94AYCCA
Mode			
Communication module			CANopen
Degree of protection			
EN 60529			IP20
Vibration resistance			
			Sinusoidal vibration Amplitude/Acceleration Acceleration resistant up to 0.7 g acc. to Germanischer Lloyd 5 Hz ≤ f ≤ 13.2 Hz ± 1 mm amplitude, 13.2 Hz ≤ f ≤ 100 Hz: 10 Hz ≤ f ≤ 57 Hz: ±0.075 mm amplitude,
Site altitude			
Amsl	H_{max}	[m]	4000
Climatic conditions			
Storage (EN 60721-3-1)			1K3 (temperature: -25 °C ... +60 °C)
Transport (EN 60721-3-2)			2K3 (temperature: -25 °C ... +70 °C)
Operation (EN 60721-3-3)			3K3 (temperature: -10°C ... +55 °C)
Insulation voltage to reference earth/PE			
	U_{AC}	[V]	50.0



Communication module: CANopen

Rated data

Product key			
			E94AYCCA
Communication			
Medium			DIN ISO 11898
Communication profile			CANopen, DS301 V4.02 Lenze system bus
Baud rate			
	b	[kBit/s]	10 20 50 125 250 500 800 1000
Node			
			Slave Multi-master
Network topology			
			Line with terminating resistors (120 ohm) at both ends
Number of logical process data channels			
			4 (each with 1 - 8 bytes)
Number of logic parameter data channels			
			5
Number of bus nodes			
			127 Without repeaters: 110
Max. cable length			
between two nodes	l_{max}	[m]	100
per bus segment [1)]	l_{max}	[m]	17 for 1000 kbps 40 for 800 kbps 110 for 500 kbps 290 for 250 kbps 630 for 125 kbps 1500 for 50 kbps 3900 for 20 kbps 8000 for 10 kbps
Rated voltage			
	$U_{N, DC}$	[V]	24.0

[1)] Max. bus cable lengths also depend on the number of nodes and the cable cross-section used.



DeviceNet communication module

The American automation specialist Allan Bradley developed the DeviceNet fieldbus based on the CAN controller. This communication profile is published by the ODVA (Open DeviceNet Vendor Association) user organisation. A large number of sensors and actuators are available. Similar to CANopen, a DeviceNet master is used to control the DeviceNet.



DeviceNet communication module

Mode		Features	Slot	Product key
Communication module				
DeviceNet		• "Group 2 Only Server" functionality (slave) • DIP switch for selecting baud rate and address • 1 LED for communication status display • Push-on terminal strip with screw connection, 5-pin	MXI1 MXI2	E94AYCDN

4.3

Standards and operating conditions

Product key			
			E94AYCDN
Mode			
Communication module			DeviceNet
Degree of protection			
EN 60529			IP20
Vibration resistance			
			Sinusoidal vibration Amplitude/Acceleration Acceleration resistant up to 0.7 g acc. to Germanischer Lloyd 10 Hz ≤ f ≤ 57 Hz: ±0.075 mm amplitude,
Site altitude			
Amsl	H_{max}	[m]	4000
Climatic conditions			
Storage (EN 60721-3-1)			1K3 (temperature: -25 °C ... +60 °C)
Transport (EN 60721-3-2)			2K3 (temperature: -25 °C ... +70 °C)
Operation (EN 60721-3-3)			3K3 (temperature: -10°C ... +55 °C)
Insulation voltage to reference earth/PE			
	U_{AC}	[V]	50.0



DeviceNet communication module

Rated data

Product key			
			E94AYCDN
Communication			
Medium			DIN ISO 11898
Communication profile			DeviceNet
Baud rate			
	b	[kBit/s]	125 250 500
Node			
			Slave
Network topology			
			Line with terminating resistors (120 ohm) at both ends
Process data words (PCD)			
16 Bit			32
Number of bus nodes			
			Max. 64
Max. cable length			
per bus segment	I_{max}	[m]	100 for 500 kbps, Thick Cable 250 for 250 kbps, Thick Cable 500 for 125 kbps, Thick Cable 100 for 500 kbps, Thin Cable 100 for 250 kbps, Thin Cable 100 for 125 kbps, Thin Cable
Rated voltage			
	$U_{N, DC}$	[V]	24.0



EtherCAT® communication module

Physically speaking, EtherCAT® is a ring system that uses a one-total-frame protocol, where the device manipulates the data during the cycle. It has two physical variants, the E-bus and Ethernet. E-bus is only suitable for short distances within a device; only the Ethernet version offers the benefits of an Ethernet system.



EtherCAT® communication module

Mode		Features	Slot	Product key
Communication module				
EtherCAT		• CANopen over EtherCAT (CoE) • Distributed clock • 2 RJ45 connections with LEDs for link and activity • 2 LEDs for communication status display • External voltage supply possible	MXI1 MXI2	E94AYCET

4.3

Standards and operating conditions

Product key			
			E94AYCET
Mode			
Communication module			EtherCAT
Degree of protection			
EN 60529			IP20
Vibration resistance			
			Sinusoidal vibration Amplitude/Acceleration Acceleration resistant up to 0.7 g acc. to Germanischer Lloyd 10 Hz ≤ f ≤ 57 Hz: ±0.075 mm amplitude,
Site altitude			
Amsl	H_{max}	[m]	4000
Climatic conditions			
Storage (EN 60721-3-1)			1K3 (temperature: -25 °C ... +60 °C)
Transport (EN 60721-3-2)			2K3 (temperature: -25 °C ... +70 °C)
Operation (EN 60721-3-3)			3K3 (temperature: -10°C ... +55 °C)
Insulation voltage to reference earth/PE			
	U_{AC}	[V]	50.0



EtherCAT® communication module

Rated data

Product key			
			E94AYCET
Communication			
Medium			CAT5e S/FTP according to ISO/ICE11801 (2002)
Communication profile			CoE (CANopen over EtherCAT) PROFIsafe in combination with SM302
Baud rate			
	b	[MBit/s]	100
Node			
			Slave
Network topology			
			Line (internal ring)
Number of logical process data channels			
			1
Process data words (PCD)			
16 Bit			1 ... 32
Number of bus nodes			
			Max. 65535
Max. cable length			
between two nodes	l_{max}	[m]	100
Rated voltage			
	$U_{N, DC}$	[V]	24.0



EtherNet communication module

Initially the EtherNet network was reserved for the office, but today this communication system is also often used for system parameterisation. The Servo Drives 9400 can be expanded for this purpose using an EtherNet module.
The EtherNet module can be integrated into general IT infrastructures (e.g. control centres, production data acquisition) and is suitable for remote maintenance applications. It is intended for parameter setting, but not for real-time transmission of process data.



EtherNet communication module

Mode		Features	Slot	Product key
Communication module				
Ethernet		• Automatic setting of baud rate and transmission mode • 2 RJ45 connections with LEDs for link and activity • Automatic detection of wiring errors and polarity reversal • Integrated 2-port switch • Electrical isolation from the bus • Automatic switching between transmit and receive paths (auto-crossing)	MXI1 MXI2	E94AYCEN

4.3

Standards and operating conditions

Product key			
			E94AYCEN
Mode			
Communication module			Ethernet
Degree of protection			
EN 60529			IP20
Vibration resistance			
			Sinusoidal vibration Amplitude/Acceleration Acceleration resistant up to 0.7 g acc. to Germanischer Lloyd 10 Hz ≤ f ≤ 57 Hz: ±0.075 mm amplitude,
Site altitude			
Amsl	H_{max}	[m]	4000
Climatic conditions			
Storage (EN 60721-3-1)			1K3 (temperature: -25 °C ... +60 °C)
Transport (EN 60721-3-2)			2K3 (temperature: -25 °C ... +70 °C)
Operation (EN 60721-3-3)			3K3 (temperature: -10°C ... +55 °C)
Insulation voltage to reference earth/PE			
	U_{AC}	[V]	50.0



EtherNet communication module

Rated data

Product key			
			E94AYCEN
Communication			
Medium			Twisted Pair, CAT5e to IEEE802.3
Communication profile			GCI, based on TCP/IP
Baud rate			
	b	[MBit/s]	100
Signalling			
			Link Activity
Max. cable length			
between two nodes	l_{max}	[m]	100
Network topology			
			Star Use of hubs/switches
Transmission			
Mode			Half duplex/full duplex
Rated voltage			
	$U_{N, DC}$	[V]	24.0



EtherNet/IP communication module

The communication module serves to connect the Servo Drives 9400 to an Ethernet/IP network.
It can be both supplied internally by the standard device and externally by a separate voltage source. The access to all Lenze parameters can be configured via TCP/IP with the Engineer engineering tool. Further advantages of the EtherNet/IP:

- Support of multicast messages,
- "IGMP snooping" (V2 according to RFC 2236),
- UCMM, ACD, BOOTP/DHCP and VLAN-Tagging/DSCP.



EtherNet/IP communication module

Mode		Features	Slot	Product key
Communication module				
EtherNet/IP		• EtherNet/IP adapter with "Level 2" functionality • Integrated 2-port switch • Up to zu 3 TCP/IP socket connections for communication with the Lenze »Engineer« Support of the "IP Config Pending • Support of the redundancy protocol DLR (Device Level Ring) as "Beacon-based Ring Node"	MXI1 MXI2	E94AYCEO

4.3

Standards and operating conditions

Product key			
			E94AYCEO
Mode			
Communication module			EtherNet/IP
Degree of protection			
EN 60529			IP20
Vibration resistance			
			Sinusoidal vibration Amplitude/Acceleration Acceleration resistant up to 0.7 g acc. to Germanischer Lloyd 10 Hz ≤ f ≤ 57 Hz: ±0.075 mm amplitude,
Site altitude			
Amsl	H_{max}	[m]	4000
Climatic conditions			
Storage (EN 60721-3-1)			1K3 (temperature: -25 °C ... +60 °C)
Transport (EN 60721-3-2)			2K3 (temperature: -25 °C ... +70 °C)
Operation (EN 60721-3-3)			3K3 (temperature: -10°C ... +55 °C)
Insulation voltage to reference earth/PE			
	U_{AC}	[V]	50.0



EtherNet/IP communication module

Rated data

Product key			
			E94AYCEO
Communication			
Medium			S/FTP (Screened Foiled Twisted Pair), ISO/IEC 11801 or EN 50173, CAT 5e
Communication profile			EtherNet/IP
Baud rate			
	b	[MBit/s]	10/100
Signalling			
			Link Activity CIP™ states
Max. cable length			
between two nodes	l_{max}	[m]	100
Network topology			
			Star Use of hubs/switches
Transmission			
Mode			Half duplex/full duplex
Rated voltage			
	$U_{N, DC}$	[V]	24.0



PROFIBUS communication module

One of the most commonly used industrial communication channels is PROFIBUS. The Servo Drives 9400 range offers the corresponding interface module for this communication.
The PROFIBUS module is a slave connection module with the PROFIBUS-DP communication profile. It is used for networking between control and inverter at fast processing speeds. This allows the inverter to be easily and conveniently integrated into the installation's entire network.



PROFIBUS communication module

Mode		Features	Slot	Product key
Communication module				
PROFIBUS		• Electrical isolation from the bus • 2 LEDs for communication status display • Address can be set via DIP switch • Compatibility switch for communication module EMF2133 IB	MXI1 MXI2	E94AYCPM

Standards and operating conditions

Product key			
			E94AYCPM
Mode			
Communication module			PROFIBUS
Degree of protection			
EN 60529			IP20
Vibration resistance			
			Sinusoidal vibration Amplitude/Acceleration Acceleration resistant up to 0.7 g acc. to Germanischer Lloyd 10 Hz ≤ f ≤ 57 Hz: ±0.075 mm amplitude,
Site altitude			
Amsl	H_{max}	[m]	4000
Climatic conditions			
Storage (EN 60721-3-1)			1K3 (temperature: -25 °C ... +60 °C)
Transport (EN 60721-3-2)			2K3 (temperature: -25 °C ... +70 °C)
Operation (EN 60721-3-3)			3K3 (temperature: -10°C ... +55 °C)
Insulation voltage to reference earth/PE			
	U_{AC}	[V]	50.0



PROFIBUS communication module

Rated data

Product key			
			E94AYCPM
Communication			
Medium			RS 485, shielded twisted pair
Communication profile			PROFIBUS-DP-V1 PROFIBUS-DP-V0 PROFIsafe in combination with SM301
Device profile			Lenze device control
Baud rate			
	b	[kBit/s]	9.6 ... 12 000 (automatic detection)
Node			
			Slave
Network topology			
			Line with repeater: Line or tree without repeater:
Process data words (PCD)			
16 Bit			1 ... 32
DP user data length			
			Optional parameter channel (4 words) + process data words
Number of bus nodes			
			31 slaves + 1 master per bus segment With repeaters: 125
Max. cable length			
per bus segment	l_{max}	[m]	1200 (depending on the baud rate and the cable type used)
Rated voltage			
	$U_{N, DC}$	[V]	24.0



PROFINET communication module

The Ethernet-based PROFINET bus system, the successor to PROFIBUS, is often used. There are currently various versions of PROFINET available, which differ with regard to deterministics and thereby also possible cycle times. The most commonly used system is the RT version of PROFINET I/O, which is suitable for networking between control and inverter, although not for motion control applications.



PROFINET communication module

Mode		Features	Slot	Product key
Communication module				
PROFINET		• 2 RJ45 connections with LEDs for link and activity • Integrated 2-port switch • PROFINET I/O device • Soft Real Time (RT) • 2 LEDs for communication status display • External voltage supply possible	MXI1 MXI2	E94AYCER

Standards and operating conditions

Product key			
			E94AYCER
Mode			
Communication module			PROFINET
Degree of protection			
EN 60529			IP20
Vibration resistance			
			Sinusoidal vibration Amplitude/Acceleration Acceleration resistant up to 0.7 g acc. to Germanischer Lloyd 10 Hz ≤ f ≤ 57 Hz: ±0.075 mm amplitude,
Site altitude			
Amsl	H_{max}	[m]	4000
Climatic conditions			
Storage (EN 60721-3-1)			1K3 (temperature: -25 °C ... +60 °C)
Transport (EN 60721-3-2)			2K3 (temperature: -25 °C ... +70 °C)
Operation (EN 60721-3-3)			3K3 (temperature: -10°C ... +55 °C)
Insulation voltage to reference earth/PE			
	U_{AC}	[V]	50.0



PROFINET communication module

Rated data

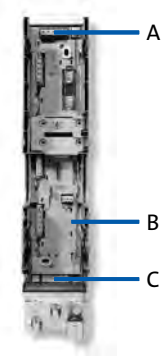
Product key			
			E94AYCER
Communication			
Medium			CAT5e S/FTP according to ISO/ICE11801 (2002)
Communication profile			PROFINET I/O (RT) PROFIsafe in combination with SM301 and SM302
Baud rate			
	b	[kBit/s]	100
Node			
			PROFINET I/O device
Network topology			
			Star Use of switches
Process data words (PCD)			
16 Bit			1 ... 32
Max. cable length			
between two nodes	l_{max}	[m]	100
Rated voltage			
	$U_{N, DC}$	[V]	24.0



Installation backplane

Up to a rated current of 23.5 A, the Servo Drives 9400 consist of an axis module and an installation backplane. The backplane can initially be mounted in the control cabinet without the axis module. This mechanical structure is also used for power supply modules up to a rated power of 17.5 kW and for regenerative power supply modules for a supply power of up to 27 kW, which simplifies installation. This also offers additional advantages in terms of reduced spare part inventories and time savings in the event of drive replacements. Further features of the installation backplane:

- A brake module for a 24 V DC, 2.5 A brake can be installed as an option
- Shields for power and control cables can be connected



Installation backplane for Single Drive:

A: mains connection
B: brake module (optional)
C: motor connection

Assignment of Single Drive axes and backplanes

Typical motor power	Mains voltage	Product key		Mode
4-pole asynchronous motor		Single Drive	Installation backplane	Installation backplane
P	U_{AC}			
[kW]	[V]			
0.37	3 AC 340 ... 528	E94AS□E0024	E94AZPS0034N	Without brake module
			E94AZPS0034H□0051	With brake module
0.75		E94AS□E0034	E94AZPS0034N	Without brake module
			E94AZPS0034H□0051	With brake module
1.50		E94AS□E0044	E94AZPS0074N	Without brake module
			E94AZPS0074H□0051	With brake module
3.00		E94AS□E0074	E94AZPS0074N	Without brake module
			E94AZPS0074H□0051	With brake module
5.50		E94AS□E0134	E94AZPS0244N	Without brake module
			E94AZPS0244H□0051	With brake module
7.50		E94AS□E0174	E94AZPS0244N	Without brake module
			E94AZPS0244H□0051	With brake module
11.0		E94AS□E0244	E94AZPS0244N	Without brake module
			E94AZPS0244H□0051	With brake module

DC busbar set for Single Drive installation backplane

Running the Single Drive axis module in a DC-bus connection (multi-axis application) requires retrofitting the DC busbar system and using DC fuses.
Mechanical coupling is possible with the following components:

- Power supply module
- DC input module
- Single Drive axis modules
- Multi Drive axis modules

For retrofitting the DC busbar system and the DC fuse have to be installed in the axis module's installation backplane, which is provided with the appropriate fixtures.
The DC fuse required is part of the DC busbar set. Spare fuses are not contained in the scope of supply.

Product key		
Installation backplane	DC busbar mounting set	DC fuses
E94AZPS0034N	E94AZJA003	EFSAR0016ARHN
E94AZPS0034H□0051		
E94AZPS0074N	E94AZJA007	EFSAR0040ARHN
E94AZPS0074H□0051		
E94AZPS0244N	E94AZJA024	EFSAR0100ARZN
E94AZPS0244H□0051		



Installation backplane

Assignment of Multi Drive axes and backplanes

Typical motor power	Mains voltage	Product key		Mode
4-pole asynchronous motor		Multi Drive	Installation backplane	
P	U_{AC}			
[kW]	[V]			
0.37	3 AC 340 ... 528	E94AM□E0024	E94AZPM0044N	Without brake module
			E94AZPM0044H□0051	With brake module
0.75		E94AM□E0034	E94AZPM0044N	Without brake module
			E94AZPM0044H□0051	With brake module
1.50		E94AM□E0044	E94AZPM0044N	Without brake module
			E94AZPM0044H□0051	With brake module
3.00		E94AM□E0074	E94AZPM0094N	Without brake module
			E94AZPM0094H□0051	With brake module
4.00		E94AM□E0094	E94AZPM0094N	Without brake module
			E94AZPM0094H□0051	With brake module
5.50		E94AM□E0134	E94AZPM0244N	Without brake module
			E94AZPM0244H□0051	With brake module
7.50		E94AM□E0174	E94AZPM0244N	Without brake module
			E94AZPM0244H□0051	With brake module
11.0		E94AM□E0244	E94AZPM0244N	Without brake module
			E94AZPM0244H□0051	With brake module
15.0		E94AM□E0324	E94AZPM0324N	Without brake module
			E94AZPM0324H□0051	With brake module

Assignment: power supply modules /regenerative power supply modules and mounting backplane

Rated power	Mains voltage	Product key		
With mains filter/mains choke		Power supply module	Supply- / regenerative module	Installation backplane
P_N	U_{AC}			
[kW]	[V]			
4.90	3 AC 340 ... 528	E94APNE0104		E94AZPP0104
17.5		E94APNE0364		E94AZPP0364
15.0			E94ARNE0134	
27.0			E94ARNE0244	

Replacement DC fuses for Multi Drive installation backplane

If you need to replace the DC fuse in the Multi Drive installation backplane, the available types are listed in the table below.

Product key	
Installation backplane	DC fuses
E94AZPM0044N	EFSAR0016ARHN
E94AZPM0044H□0051	
E94AZPM0094N	EFSAR0040ARHN
E94AZPM0094H□0051	
E94AZPM0244N	EFSAR0100ARZN
E94AZPM0244H□0051	
E94AZPM0324N	
E94AZPM0324H□0051	



Brake modules

Internal activation

An intelligent motor brake logic system is included as standard in the axis modules' device software in the form of a function block.
The brake modules are available in numerous designs.
The optionally integrable brake modules enable a DC 24 V, DC 180 V or DC 205 V brake to be easily connected and this logic to be used.

- For axis modules up to 23.5 A, the brake module is integrated into the installation backplane.
- For axis modules above 32 A, the brake module is integrated into the axis modules.



Brake module, can be integrated into installation backplane

Mode		Features	Product key
Brake module			
24 V DC/0.3 - 2.5 A		• 24 V DC external supply voltage • Monitoring of power supply and brake cable for open circuit and short circuit • Polarity reversal protection for supply voltage • Can be integrated into the installation backplanes, up to 32 A	E94AZHX0051
24 V DC/1.0 - 5.0 A		• 24 V DC external supply voltage • Monitoring of power supply and brake cable for open circuit and short circuit • Polarity reversal protection for supply voltage • Can be integrated into the axis modules, from 32 A	E94AZHY0101
180 V DC/0.1 - 0.61 A		• 400 V AC external supply voltage • Monitoring of power supply and brake cable for open circuit and short circuit • Polarity reversal protection for supply voltage • Can be integrated into the axis modules, from 32 A	E94AZHY0026
205 V DC/0.1 - 0.75 A		• External supply voltage 230 V AC • Monitoring of power supply and brake cable for open circuit and short circuit • Polarity reversal protection for supply voltage • Can be integrated into the axis modules, from 32 A	E94AZHY0025

External activation

Due to their functional principle, the motor brake in Single Drives cannot be released if there is no mains or DC-bus voltage. Brake modules which can be activated externally are therefore provided for a 24V brake.

Mode	Features	Product key
Brake module		
24 V DC/0.3 - 2.5 A	• 24 V DC external supply voltage • Monitoring of power supply and brake cable for open circuit and short circuit • Polarity reversal protection for supply voltage • Can be integrated into the installation backplanes, up to 32 A	E94AZHA0051
24 V DC/1.0 - 5.0 A	• 24 V DC external supply voltage • Monitoring of power supply and brake cable for open circuit and short circuit • Polarity reversal protection for supply voltage • Can be integrated into the axis modules, from 32 A	E94AZHB0101



Brake modules

External brake modules

The external brake modules are provided for DIN rail installation and can be used if axis modules up to 23.5 A require brake voltages of 180 V DC and 205 V DC.

Mode		Features	Product key
Brake module			
180 V DC/0.1 - 0.75 A		• 400 V AC external supply voltage • Monitoring of power supply and brake cable for open circuit and short circuit • Polarity reversal protection for supply voltage • Preconfigured for DIN rail mounting	E94AZHN0026
205 V DC/0.1 - 0.75 A		• External supply voltage 230 V AC • Monitoring of power supply and brake cable for open circuit and short circuit • Polarity reversal protection for supply voltage • Preconfigured for DIN rail mounting	E94AZHN0025



Brake resistors

The assignment of brake resistors to the Single Drive axis modules is shown in the table below.



Brake resistor 82 ohms

Typical motor power	Mains voltage	Product key		Rated resistance	Rated power	Thermal capacity	Dimensions	Mass
4-pole asynchronous motor		Single Drive	Brake resistor					
P	U_{AC}			R_N	P_N	C_{th}	h x b x t	m
[kW]	[V]			[Ω]	[kW]	[KWs]	[mm]	[kg]
0.37	3 AC 340 ... 528 [1]	E94AS□E0024	ERBP082R200W	82.0	0.20	30.0	320 x 41 x 122	1.0
0.75		E94AS□E0034						
1.50		E94AS□E0044	ERBP047R200W	47.0				
			ERBS047R400W		0.40	60.0	400 x 110 x 105	2.3
			ERBS047R800W		0.80	120	710 x 110 x 105	3.9
3.00		E94AS□E0074	ERBP047R200W		0.20	30.0	320 x 41 x 122	1.0
			ERBS047R400W		0.40	60.0	400 x 110 x 105	2.3
			ERBS047R800W		0.80	120	710 x 110 x 105	3.9
5.50		E94AS□E0134	ERBP027R200W	27.0	0.20	30.0	320 x 41 x 122	1.0
			ERBS027R600W		0.60	90.0	550 x 110 x 105	3.1
			ERBS027R01K2		1.20	180	1020 x 110 x 105	5.6
7.50		E94AS□E0174	ERBP018R300W	18.0	0.30	30.0	240 x 41 x 122	1.4
			ERBS018R800W		0.80	120	710 x 110 x 105	3.9
			ERBS018R02K8		2.80	420	1110 x 200 x 105	12.0
11.0		E94AS□E0244	ERBP018R300W		0.30	30.0	240 x 41 x 122	1.4
			ERBS018R01K2		1.20	180	1020 x 110 x 105	5.6
			ERBS018R02K8		2.80	420	1110 x 200 x 105	12.0
15.0		E94AS□E0324	ERBS018R800W		0.80	120	710 x 110 x 105	3.9
			ERBS018R01K4		1.40	210	1110 x 110 x 105	6.2
			ERBG018R04K3		4.30	645	380 x 426 x 302	13.5
22.0		E94AS□E0474	ERBS015R800W	15.0	0.80	120	710 x 110 x 105	3.9
			ERBS015R02K4		2.40	420	1020 x 200 x 105	10.0
			ERBG015R06K2		6.20	883	380 x 526 x 302	17.0
30.0		E94AS□E0594	ERBS015R01K2		1.20	180	1020 x 110 x 105	5.6
			ERBG015R03K3		3.30	480	486 x 326 x 302	12.6
			ERBG015R10K0		10.0	1440	380 x 736 x 302	22.0

[1] For 230 V mains voltage a different brake resistor assignment applies.



Brake resistors

The assignment of brake resistors to Single Drive axis modules is shown in the table below.

- Two resistors should be connected in parallel for the following combinations:
  E94BS□E3664 and ERBG035D03K3
  E94BS□E4604 and ERBG028D04K1.



3.5 ohm brake resistor

Typical motor power	Mains voltage	Product key		Rated resistance	Rated power	Thermal capacity	Dimensions	Mass
4-pole asynchronous motor		Single Drive	Brake resistor					
P	U_{AC}			R_N	P_N	C_{th}	h x b x t	m
[kW]	[V]			[Ω]	[kW]	[KWs]	[mm]	[kg]
45.0	3 AC 340 ... 528 [1)]	E94AS□E0864	ERBG075D01K9	7.5	1.90	285	486 x 236 x 302	9.5
55.0		E94AS□E1044						
75.0		E94BS□E1454	ERBG005R02K6	5.0	2.60	390	486 x 326 x 302	12.6
90.0		E94BS□E1724	ERBG043D03K0	4.3	3.00	450		11.8
105		E94BS□E2024	ERBG035D03K3	3.5	3.30	495		12.6
130		E94BS□E2454	ERBG028D04K1	2.8	4.10	615	486 x 426 x 302	12.8
150		E94BS□E2924	ERBG023D05K6	2.3	5.60	840		15.9
190		E94BS□E3664	ERBG035D03K3	3.5	3.30	495	486 x 326 x 302	12.6
240		E94BS□E4604	ERBG028D04K1	2.8	4.10	615	486 x 426 x 302	12.8

[1)] For 230 V mains voltage a different brake resistor assignment applies.



Mains chokes

A mains choke is an inductive resistor which is connected in the mains cable of the power supply module. The use of a mains choke provides the following advantages:

- **Fewer effects on the mains:**
  The wave form of the mains current is a close approximation to a sine wave.
- **Reduction in the effective mains current:**
  Reduction of mains, cable and fuse loads

Mains chokes can be used without restrictions in conjunction with RFI filters and/or sinusoidal filters.

Please note:
: The use of a mains choke slightly reduces the mains voltage at the input of the inverter - the typical voltage drop across the mains choke at the rated values is around 4%.



Mains choke

Typical motor power	Mains voltage	Product key		Rated current	Dimensions	Mass
4-pole asynchron-ous motor		Single Drive	Mains choke			
P	U_{AC}			I_N	h x b x t	m
[kW]	[V]			[A]	[mm]	[kg]
0.37	3 AC 340 ... 528	E94AS□E0024	EZAELN3002B153	2.00	56 x 77 x 100	0.5
0.75		E94AS□E0034	EZAELN3004B742	4.00	60 x 95 x 115	1.3
1.50		E94AS□E0044	EZAELN3006B492	6.00	69 x 95 x 120	1.5
3.00		E94AS□E0074	EZAELN3010B292	10.0	85 x 120 x 140	2.0
5.50		E94AS□E0134	EZAELN3020B152	20.0	95 x 155 x 165	3.8
7.50		E94AS□E0174	EZAELN3025B122	25.0	110 x 155 x 170	5.8
11.0		E94AS□E0244	EZAELN3035B841	35.0		6.0

► The mains choke is integrated in the Single Drives as of a 32 A rated current.



RFI and mains filters

RFI filters

RFI filters are capacitive accessory components which can be connected directly upstream of the axis modules. This measure enables compliance with the corresponding conducted noise emission requirements according to EN61800-3.

Typical motor power	Mains voltage	Product key		Rated current	Power loss	Max. cable length		Dimensions	Mass
4-pole asynchronous motor		Single Drive	RFI filter			shielded C1 with external measures	shielded C2 with external measures		
P	U_{AC}			I_N	P_V	l_{max}	l_{max}	h x b x t	m
[kW]	[V]			[A]	[kW]	[m]	[m]	[mm]	[kg]
0.37	3 AC 340 ... 528	E94AS□E0024	E94AZRS0044	3.50	0.004	0	50	522 x 60 x 60	1.8
0.75		E94AS□E0034							
1.50		E94AS□E0044	E94AZRS0104	10.0	0.008			522 x 90 x 60	2.3
3.00		E94AS□E0074							
5.50		E94AS□E0134	E94AZRS0294	29.0	0.022			522 x 120 x 60	3.6
7.50		E94AS□E0174							
11.0		E94AS□E0244							
15.0		E94AS□E0324	E94AZRS0544	54.0	0.050	50	100	670 x 201 x 60	9.0
22.0		E94AS□E0474							
30.0		E94AS□E0594							
45.0		E94AS□E0864	E94AZRS0954	95.0	0.070			780 x 261 x 60	13.0
55.0		E94AS□E1044							

Typical motor power									
4-pole asynchronous motor	P	[kW]	75.0	90.0	105	130	150	190	240
Mains voltage									
	U_{AC}	[V]	3 AC 340 ... 528						
Product key									
Single Drive			E94BS□E1454	E94BS□E1724	E94BS□E2024	E94BS□E2454	E94BS□E2924	[illegible]	[illegible]
RFI filter			E94AZRS1804		E94AZRS3004			E94AZRS4154	
Rated current									
	I_N	[A]	180		300			415	
Power loss									
	P_V	[kW]	0.014		0.021			0.027	
Max. cable length									
shielded C2 with external measures	l_{max}	[m]	150						
Dimensions									



	h x b x t	[mm]	264 x 135 x 265	
Mass				
	m	[kg]	7.9	12.0

► Filter name for E94B:
Type: E94AZRS1804 - filter name: 3F480-180.290EM
Type: E94AZRS3004 - filter name: 3F480-300.290EM
Type: E94AZRS4154 - filter name: 3F480-415.290EM



RFI and mains filters

Mains filters

A mains filter is a combination of mains choke and RFI filter in a single housing. It reduces line-bound noise emission into the mains, thus ensuring that the line-bound interference voltage is reduced to a permissible level according to EN61800-3.



Mains filter, can be mounted beside or below the axis module

Typical motor power	Mains voltage	Product key		Rated current	Voltage drop	Max. cable length		Dimensions	Mass
4-pole asynchronous motor		Single Drive	Mains filter			shielded C1 with external measures	shielded C2 with external measures		
P	U_{AC}			I_N	U	l_{max}	l_{max}	h x b x t	m
[kW]	[V]			[A]	[V]	[m]	[m]	[mm]	[kg]
0.37	3 AC 340 ... 528	E94AS□E0024	E94AZMS0034	3.20	10.0	25	50	522 x 60 x 60	3.3
0.75		E94AS□E0034							
1.50		E94AS□E0044	E94AZMS0094	9.00			100	522 x 90 x 60	3.9
3.00		E94AS□E0074							
5.50		E94AS□E0134	E94AZMS0184	18.0	7.4			522 x 120 x 60	8.4
7.50		E94AS□E0174							
11.0		E94AS□E0244	E94AZMS0314	31.0	7.3				8.8



Sinusoidal filters

A sinusoidal filter in the motor cable limits the rate of voltage rise and the capacitive charge/discharge currents that occur during inverter operation. In combination with the specified line filter, the EMC requirements of the limit class C2 for conducted noise emissions are still met, even if longer shielded or even unshielded motor cables are used.

Application range:

- Only use a sinusoidal filter with standard 0 to 550 V asynchronous motors
- Operation only with V/f or V/f^2 characteristic control
- Set the switching frequency permanently to the specified value
- Limit the output frequency of the Servo Drives 9400 to the specified value



Sinusoidal filters

Typical motor power	Mains voltage	Product key				Rated inductance	Switching frequency	Mass
4-pole asynchronous motor		Single Drive	RFI filter	Mains filter	Sinusoidal filter			
P	U_{AC}					L_N	f_{ch}	m
[kW]	[V]					[mH]	[kHz]	[kg]
0.37	3 AC 340 ... 528	E94AS□E0024		E94AZMS0034	EZS3-004A200	11.0	4 8	4.0
0.75		E94AS□E0034						
1.50		E94AS□E0044		E94AZMS0094	EZS3-010A200	5.10		5.5
3.00		E94AS□E0074						
5.50		E94AS□E0134		E94AZMS0184	EZS3-024A200	2.50		14.5
7.50		E94AS□E0174						
11.0		E94AS□E0244		E94AZMS0314	EZS3-037A200	1.70		21.0
15.0		E94AS□E0324	E94AZRS0544		EZS3-048A200	1.20		25.5
22.0		E94AS□E0474			EZS3-061A200	1.00		33.5
30.0		E94AS□E0594			EZS3-072A200	0.95		37.0
45.0		E94AS□E0864	E94AZRS0954		EZS3-115A200	0.70	2 4	66.0
55.0		E94AS□E1044			EZS3-150A200	0.50		69.0

Typical motor power	Mains voltage	Product key		Max. output frequency	Rated inductance	Switching frequency	Mass
4-pole asynchronous motor		Single Drive	Sinusoidal filter				
P	U_{AC}			$f_{max, 2}$	L_N	f_{ch}	m
[kW]	[V]			[Hz]	[mH]	[kHz]	[kg]
75.0	3 AC 340 ... 528	E94BS□E1454	EZS3-180A200 [2]		0.40	2 4	64.0
90.0		E94BS□E1724	EZS3-250A200 [2]		0.35		77.0
105		E94BS□E2024					
130		E94BS□E2454	EZS3-350A200 [2]		0.21		
150		E94BS□E2924					80.0
190		E94BS□E3664	EZS3-480A200 [2]		0.14		189.0
240		E94BS□E4604 [1]	EZS3-350A200 [2]		0.21		

[1] Two sinusoidal filters must be connected in parallel

[2] If the parameters for devices over 75 kW/145 A are set for operation with "increased rated output current" (code C01199), different assignments may be necessary.



Rated data for power supply modules

► The data is valid for operation at 3/PE AC 400 V.

						
Product key						
Power supply module			E94APNE0104	E94APNE0364	E94APNE1004	E94APNE2454
Rated power						
With mains filter/mains choke	P_N	[kW]	4.90	17.5	48.6	119
Without mains filter/mains choke	P_N	[kW]	3.60	13.0	36.2	88.6
Mains voltage range						
	U_{AC}	[V]	3/PE AC 340 V-0% ... 528 V+0 %, 45 Hz-0 % ... 65 Hz+0 %			
Rated mains current						
	$I_{N, AC}$	[A]	8.0	29.0	82.0	200.0
Rated DC-bus current						
	$I_{N, DC}$	[A]	10.0	36.0	100.0	245.0

4.3

Data for 60 s overload

Max. DC-bus current						
	I_{max}	[A]	15.0	54.0	150.0	368.0
Reduced DC-bus current						
	$I_{red, DC}$	[A]	7.5	27.0	75.0	183.5
Overload time						
	t_{ol}	[s]	120.0			
Recovery time						
	t_{re}	[s]	60.0			
Max. output power [1)]						
	$P_{max, 1}$	[kW]	7.4	26.3	72.9	179.0

Data for 0.5 s overload

Max. short-time DC-bus current						
	I_{max}	[A]	40.0	108.0	200.0	368.0
Reduced DC-bus current						
	$I_{red, DC}$	[A]	7.5	27.0	75.0	183.5
Overload time						
	t_{ol}	[s]	0.5			
Recovery time						
	t_{re}	[s]	4.5			
Max. short-term output power [1)]						
	$P_{max, 2}$	[kW]	19.6	52.5	146.0	357.0

[1)] Mains filter required; if no mains filter is installed, the stated values for P_{max} decrease



Rated data for power supply modules

► The data is valid for operation at 3/PE AC 400 V.

						
Product key						
Power supply module			E94APNE0104	E94APNE0364	E94APNE1004	E94APNE2454
Rated power						
With mains filter/mains choke	P_N	[kW]	4.90	17.5	48.6	119
Without mains filter/mains choke	P_N	[kW]	3.60	13.0	36.2	88.6
Rated DC-bus current						
	$I_{N, DC}$	[A]	10.0	36.0	100.0	245.0
Power loss						
	P_V	[kW]	0.055	0.110	0.230	0.550
Dimensions						
Height	h	[mm]	350		383	
Height, including fastening	h	[mm]	481		510	
Width	b	[mm]	60	120	210	390
Depth	t	[mm]	288			
Mass						
	m	[kg]	2.6	5.3	13.5	28.5

Brake chopper rated data

Rated power, Brake chopper						
	P_N	[kW]	2.6	8.7	17.0	30.3
Max. output power, Brake chopper						
	$P_{max, 1}$	[kW]	19.5	43.8	105.1	187.7
Running time						
	t_{on}	[s]	1.0			
Recovery time						
	t_{re}	[s]	3.8	2.5	3.1	
Min. brake resistance						
	R_{min}	[Ω]	27.0	12.0	5.0	2.8



Rated data for regenerative power supply modules

- ► The data is valid for operation at 3/PE AC 400 V.
- ► Mains filter required, please refer to the following pages

						
Product key						
Supply- / regenerative module			E94ARNE0134		E94ARNE0244	
Operating mode						
			Feed	Feedback	Feed	Feedback
Rated power						
With mains filter/mains choke	P_N	[kW]	15.0	7.50	27.0	13.5
Mains voltage range						
	U_{AC}	[V]	3/PE AC 340 V-0% ... 528 V+0 %, 45 Hz-0 % ... 65 Hz+0 %			
Rated mains current						
	$I_{N, AC}$	[A]	26.0	13.0	47.0	23.5
Rated DC-bus current						
	$I_{N, DC}$	[A]	32.0	16.0	57.0	29.0

4.3

Data for 60 s overload

Max. DC-bus current						
	I_{max}	[A]	48.0	24.0	86.0	44.0
Reduced DC-bus current						
	$I_{red, DC}$	[A]	20.0	9.8	35.0	18.0
Overload time						
	t_{ol}	[s]	60.0			
Recovery time						
	t_{re}	[s]	120.0			
Max. output power						
	$P_{max, 1}$	[kW]	22.4	11.2	40.5	20.2

Data for 0.5 s overload

Max. short-time DC-bus current						
	I_{max}	[A]	96.0	48.0	171.0	87.0
Reduced DC-bus current						
	$I_{red, DC}$	[A]	20.0	9.8	35.0	18.0
Max. short-term output power						
	$P_{max, 2}$	[kW]	44.9	22.4	81.1	40.5
with brake chopper support	$P_{max, 2}$	[kW]		35.1		59.6



Rated data for regenerative power supply modules

- ► The data is valid for operation at 3/PE AC 400 V.
- ► Mains filter required, please refer to the following pages

						
Product key						
Supply- / regenerative module			E94ARNE0134		E94ARNE0244	
Operating mode						
			Feed	Feedback	Feed	Feedback
Rated power						
With mains filter/mains choke	P_N	[kW]	15.0	7.50	27.0	13.5
Rated DC-bus current						
	$I_{N, DC}$	[A]	32.0	16.0	57.0	29.0
Power loss						
	P_V	[kW]	0.150	0.110	0.230	0.190
Dimensions						
Height	h	[mm]	350			
Height, including fastening	h	[mm]	481			
Width	b	[mm]	120			
Depth	t	[mm]	288			
Mass						
	m	[kg]	6.0			

Brake chopper rated data

Rated power, Brake chopper				
	P_N	[kW]	4.7	9.3
Max. output power, Brake chopper				
	$P_{max, 1}$	[kW]	19.5	29.2
Running time				
	t_{on}	[s]	1.0	
Recovery time				
	t_{re}	[s]	4.2	3.9
Min. brake resistance				
	R_{min}	[Ω]	27.0	18.0



Control connections

Mode	Power supply modules	Regenerative power supply modules
Analog inputs		
Number		2
Resolution		11 bits + sign
Value range		+/- 10 V 1 x switchable 20 mA
Analog outputs		
Number		2
Resolution		10 bits + sign
Value range		+/- 10 V max. 2 mA
Digital inputs		
Number	1 Permanently configured	8
Switching level	PLC (IEC 61131-2)	
Max. input current	8 mA	
Digital outputs		
Number	4 fest konfiguriert	4
Switching level	PLC (IEC 61131-2)	
Max. output current	50 mA per output	
Load capacity	>480 Ω at 24 V	
External DC supply		
Rated voltage	24 V in accordance with IEC 61131-2	
Voltage range	19.2 ... 28.8 V, max. residual ripple ± 5%	
Current	Approx. 1.4 A during operation, max. 4 A starting current for 100 ms	Approx. 1.2 A during operation, max. 3 A starting current for 100 ms [1)]
Interfaces		
CANopen		Integrated
Extensions		Via slot MXI 2: extension 2 Via slot MXI 1: extension 1
State bus		Integrated
Memory		Slot MMI
Safety engineering		Slot MSI
Drive interface		
Resolver input		Integrated (no function)
Mains synchronisation input		Integrated Sub-D, 15-pin

[1)] The supply to the control electronics comes from the mains voltage. Alternatively, it can be provided by a 24 V supply that is independent of the mains (available as an option).



Brake resistors of the regenerative power supply modules

Assignment of brake resistors to the supply and regenerative power supply modules is shown in the tables below.



Brake resistor 27 ohms

Brake resistors for power supply modules

Rated power	Mains voltage	Product key		Rated resistance	Rated power	Thermal capacity	Dimensions	Mass
Without mains filter/mains choke		Power supply module	Brake resistor					
P_N	U_{AC}			R_N	P_N	C_{th}	h x b x t	m
[kW]	[V]			[Ω]	[kW]	[KWs]	[mm]	[kg]
3.60	3 AC 340 ... 528 [1]	E94APNE0104	ERBP027R200W	27.0	0.20	30.0	320 x 41 x 122	1.0
			ERBS027R600W		0.60	90.0	550 x 110 x 105	3.1
			ERBS027R01K2		1.20	180	1020 x 110 x 105	5.6
13.0		E94APNE0364	ERBG012R01K9	12.0	1.90	285	486 x 236 x 302	13.0
			ERBG012R05K2		5.20	750	486 x 426 x 302	28.0
36.2		E94APNE1004	ERBG005R02K6	5.0	2.60	390	486 x 326 x 302	12.6
88.6		E94APNE2454	ERBG028D04K1	2.8	4.10	615	486 x 426 x 302	12.8

[1] For 230 V mains voltage a different brake resistor assignment applies.

Brake resistors for regenerative power supply modules

Rated power	Mains voltage	Product key		Rated resistance	Rated power	Thermal capacity	Dimensions	Mass
With mains filter/mains choke		Supply- / regenerative module	Brake resistor					
P_N	U_{AC}			R_N	P_N	C_{th}	h x b x t	m
[kW]	[V]			[Ω]	[kW]	[KWs]	[mm]	[kg]
15.0	3 AC 340 ... 528 [1]	E94ARNE0134	ERBP027R200W	27.0	0.20	30.0	320 x 41 x 122	1.0
			ERBS027R600W		0.60	90.0	550 x 110 x 105	3.1
			ERBS027R01K2		1.20	180	1020 x 110 x 105	5.6
27.0		E94ARNE0244	ERBP018R300W	18.0	0.30	30.0	240 x 41 x 122	1.4
			ERBS018R01K2		1.20	180	1020 x 110 x 105	5.6
			ERBS018R02K8		2.80	420	1110 x 200 x 105	12.0

[2] For 230 V mains voltage a different brake resistor assignment applies.



Mains chokes of the power supply modules

A mains choke is an inductive resistor which is connected in the mains cable of the power supply module. The use of a mains choke provides the following advantages:

- **Fewer effects on the mains:**
  The wave form of the mains current is a close approximation to a sine wave.
- **Reduction in the effective mains current:**
  Reduction of mains, cable and fuse loads

Mains chokes can be used without restrictions in conjunction with RFI filters and/or sinusoidal filters.

Please note:
: The use of a mains choke slightly reduces the mains voltage at the input of the inverter - the typical voltage drop across the mains choke at the rated values is around 4%.



Mains choke

Rated power	Mains voltage	Product key		Rated current	Dimensions	Mass
With mains filter/mains choke		Power supply module	Mains choke			
P_N	U_{AC}			I_N	h x b x t	m
[kW]	[V]			[A]	[mm]	[kg]
4.90	3 AC 340 ... 528	E94APNE0104	EZAELN3008B372	8.00	85 x 120 x 140	1.9
17.5		E94APNE0364	EZAELN3030B982	30.0	110 x 155 x 167	5.9
48.6		E94APNE1004	EZAELN3080B371	80.0	125 x 210 x 240	12.5
119		E94APNE2454	EZAELN3200B151	200	352 x 144 x 264	32.0



Interference suppression of the regenerative power supply modules

RFI filters and mains filters enable compliance with the interference voltage categories of the European standard EN 61800-3. There a distinction is drawn between category C1 and category C2.
Category C1 describes the use on public supply networks.
Category C2 describes the use of drives which are intended to be used for industrial purposes in areas also comprising residential areas.
For Multi Drives external filters must be used to comply with the EMC Directive.



RFI filter, can be mounted beside the power supply module

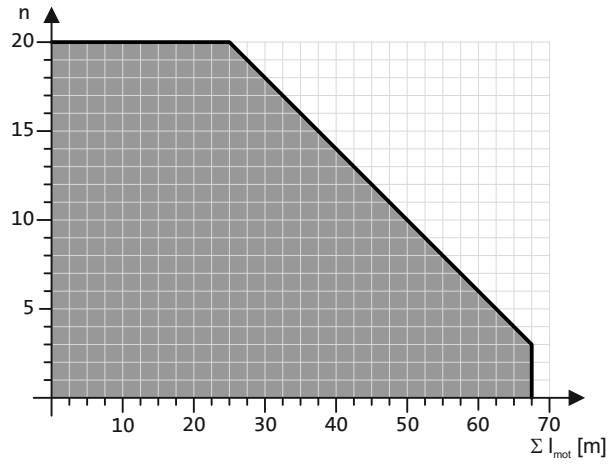
RFI filters

RFI filters are primarily capacitive accessory components which can be connected directly upstream from the power supply modules. This measure enables compliance with the corresponding conducted noise emission requirements according to EN 61800-3.

Rated power	Mains voltage	Product key		Rated current	Power loss	Max. cable length	Dimensions	Mass
Without mains filter/mains choke		Power supply module	RFI filter			Reference group C2		
P_N	U_{AC}			I_N	P_V	l_{max}	h x b x t	m
[kW]	[V]			[A]	[kW]	[m]	[mm]	[kg]
3.60	3 AC 340 ... 528	E94APNE0104	E94AZRP0084	8.00	0.020	6 axes of 10 m each	485 x 60 x 261	4.2
13.0		E94APNE0364	E94AZRP0294	29.0	0.050			4.5
36.2		E94APNE1004	E94AZRP0824	82.0	0.080		490 x 209 x 272	18.5
88.6		E94APNE2454	E94AZRP2004	200	0.150			20.5

The following diagram shows the possible number of axes and the possible sum of motor cable lengths to ensure compliance with interference suppression according to category C2.

Number of axes (n) / sum of the motor cable length (l)





Interference suppression of the regenerative power supply modules

Mains filters

A mains filter is a combination of mains choke and RFI filter in a single housing. It reduces line-bound noise emission into the mains, thus ensuring that the line-bound interference voltage is reduced to a permissible level according to EN61800-3.



Mains filter, can be mounted beside the power supply modules (right) or the regenerative power supply modules (left)

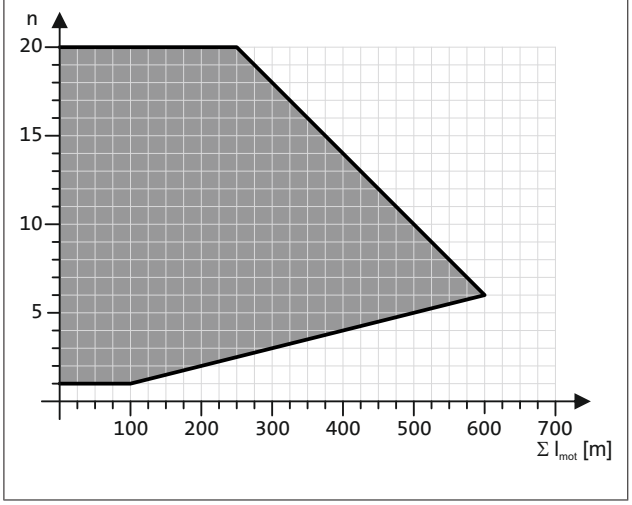
RFI filters

Rated power	Mains voltage	Product key		Rated current	Voltage drop	Max. cable length	Dimensions	Mass
With mains filter/mains choke		Power supply module	Mains filter			Reference group C2		
P_N	U_{AC}			I_N	U	l_{max}	h x b x t	m
[kW]	[V]			[A]	[V]	[m]	[mm]	[kg]
4.90	3 AC 340 ... 528	E94APNE0104	E94AZMP0084	8.00	10.0	10 axes of 50 m each	485 x 90 x 261	8.6
17.5		E94APNE0364	E94AZMP0294	29.0	7.3		485 x 120 x 261	16.5
48.6		E94APNE1004	E94AZMP0824 [1)]	82.0	6.4		490 x 270 x 272	29.0
119		E94APNE2454	E94AZMP2004 [1)]	200	6.3		490 x 330 x 272	52.0

[1)] External 24 V supply from a safely separated power supply unit (SELV/PELV) required for integrated fan.

The following diagram shows the possible number of axes and the possible sum of motor cable lengths to ensure compliance with interference suppression according to category C2.

Number of axes (n) / sum of the motor cable length (l)





Interference suppression of the regenerative power supply modules

Mains filters for regenerative power supply modules

Rated power	Mains voltage	Product key		Rated current	Voltage drop	Max. cable length	Dimensions	Mass
With mains filter/mains choke		Supply- / regenerative module	Mains filter			Reference group C2		
P_N	U_{AC}			I_N	U	I_{max}	h x b x t	m
[kW]	[V]			[A]	[V]	[m]	[mm]	[kg]
15.0	3 AC 340 ... 528	E94ARNE0134	E94AZMR0264SDB [1]	26.0	6.3	6 axes of 10 m each	485 x 149 x 272	25.0
			E94AZMR0264LDB [1]			10 axes of 50 m each		26.0
27.0		E94ARNE0244	E94AZMR0474SDB [1]	47.0	6.2	6 axes of 10 m each	485 x 209 x 272	36.0
			E94AZMR0474LDB [1]			10 axes of 50 m each		37.0

[1] External 24 V supply through safely separated power supply unit (SELV/PELV) required for integrated mains voltage recording.



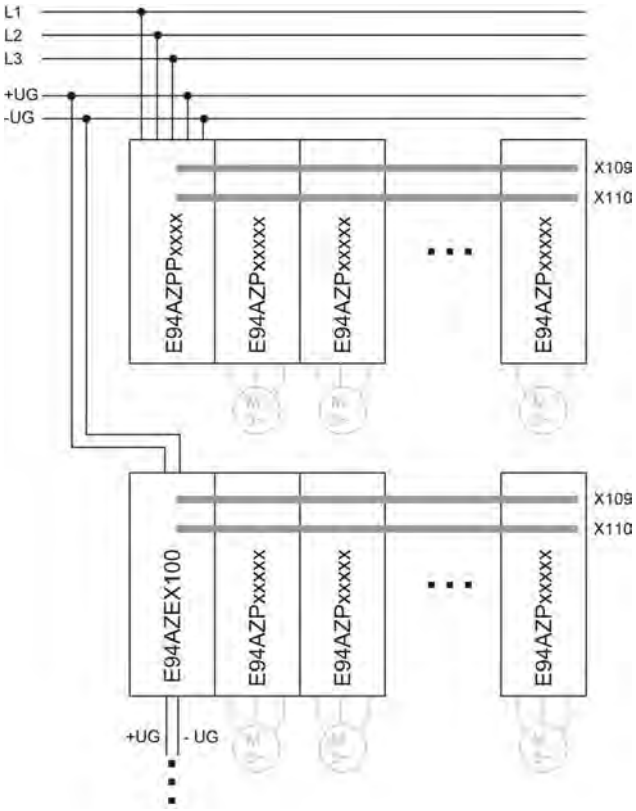
DC input module

Via a DC input module, an axis module interconnection can be supplied with power from a central DC source (power supply module, Single Drive axis modules, Multi Drive axis modules). This is required for example if a drive system with a multi-level structure installed in a control cabinet is to be supplied via a central DC power supply unit. The rated current of the DC input module is defined to be 100 A (DC). The DC input module can be connected at the top or bottom, offering great flexibility with regard to integration into the system wiring. This provides an ideal way of connecting multi-row axis modules in particular.



DC input module 100 A

Mode	Product key	Dimensions	Mass
	Input module		
		h x b x t	m
		[mm]	[kg]
DC input module 100 A	E94AZEX100	422 x 60 x 95	0.9



Wiring example for multi-row mounting of axis modules



DC-bus connection

The Servo Drives 9400 HighLine can be operated in a DC-bus connection. The 400 V devices have a direct connection for this.
The components listed here are used to interconnect the individual devices for operation with or without a regenerative power supply module. With a DC-bus connection, energy can be exchanged between the individual devices. This makes particular sense with cyclic operation of multiple devices.
The design of a DC-bus connection requires extremely precise dimensioning of the devices' energy requirements among one another. Lenze Sales is happy to advise you here to ensure the most energy-efficient drive dimensioning. The components listed here form the basis for this.

- Two DC fuses are always required.
- The fuse holders EFH10005 and EFH10004 are single-pole, while the holders EFH20005 and EFH20007 are 2-pole.
- The DC fuses are not UL-approved
- Please consult Lenze Sales to ensure the right dimensioning.

Components for DC-bus connection

Product key	Rated current	Design
DC fuses		
	I_N	
	[A]	
EFSGR0060AYHN	6.00	14x51 without indicator
EFSGR0100AYHN	10.0	
EFSGR0160AYHN	16.0	
EFSGR0200AYHN	20.0	
EFSGR0250AYHN	25.0	
EFSGR0320AYHN	32.0	
EFSGR0400AYHN	40.0	
EFSGR0060AYHK	6.00	14x51 with indicator
EFSGR0100AYHK	10.0	
EFSGR0160AYHK	16.0	
EFSGR0200AYHK	20.0	
EFSGR0250AYHK	25.0	
EFSGR0320AYHK	32.0	
EFSGR0400AYHK	40.0	
EFSGR1000ANVN	100	NH1
EFSGR2000ANVN	200	
EFSGR2500ANVN	250	NH2
EFSGR3500ANVN	350	
EFSGR4000ANVN	400	
EFSGR5000ANVN	500	

Product key	Rated current	Design
DC fuses		
	I_N	
	[A]	
EFSGR0120AYIN	12.0	22x58 without indicator
EFSGR0160AYIN	16.0	
EFSGR0200AYIN	20.0	
EFSGR0250AYIN	25.0	
EFSGR0320AYIN	32.0	
EFSGR0400AYIN	40.0	
EFSGR0500AYIN	50.0	
EFSGR0630AYIN	63.0	
EFSGR0800AYIN	80.0	
EFSGR1000AYIN	100	
EFSGR0120AYIK	12.0	22x58 with indicator
EFSGR0160AYIK	16.0	
EFSGR0200AYIK	20.0	
EFSGR0250AYIK	25.0	
EFSGR0320AYIK	32.0	
EFSGR0400AYIK	40.0	
EFSGR0500AYIK	50.0	
EFSGR0630AYIK	63.0	
EFSGR0800AYIK	80.0	
EFSGR1000AYIK	100	

Mode	Features	Product key
DC busbar	• Busbar system 14 x 51 • DC busbar length 1m, cross-section 25 mm ^{2}	EWZ0036
	• Busbar system 22 x 58 • DC busbar length 1m, cross-section 25 mm ^{2}	EWZ0037
End cap	• End caps for DC busbar (packaging unit 10 pcs)	EWZ0038
Terminal	• Single-pole terminal for internal supply	EWZ0039



DC-bus connection

DC fuses size 14 x 51 mm

Typical motor power	Mains voltage	Product key					
4-pole asynchron-ous motor		Single Drive	Multi Drive	DC fuses			
P	U_{AC}						
[kW]	[V]						
0.37	3 AC 340 ... 528	E94AS□E0024		EFSGR0200AYHN	EFH20005	EFSGR0200AYHK	EFH10005
			E94AM□E0024				
0.75		E94AS□E0034					
			E94AM□E0034				
1.50		E94AS□E0044		EFSGR0320AYHN		EFSGR0320AYHK	
			E94AM□E0044	EFSGR0200AYHN		EFSGR0200AYHK	
3.00		E94AS□E0074		EFSGR0320AYHN		EFSGR0320AYHK	
			E94AM□E0074				
4.00			E94AM□E0094				

4.3

DC fuses size 22 x 58 mm

Typical motor power	Mains voltage	Product key					
4-pole asynchron-ous motor		Single Drive	Multi Drive	DC fuses			
P	U_{AC}						
[kW]	[V]						
0.37	3 AC 340 ... 528	E94AS□E0024		EFSGR0200AYIN	EFH20007	EFSGR0200AYIK	EFH10004
			E94AM□E0024				
0.75		E94AS□E0034					
			E94AM□E0034				
1.50		E94AS□E0044		EFSGR0320AYIN		EFSGR0320AYIK	
			E94AM□E0044	EFSGR0200AYIN		EFSGR0200AYIK	
3.00		E94AS□E0074		EFSGR0320AYIN		EFSGR0320AYIK	
			E94AM□E0074				
4.00			E94AM□E0094				
5.50		E94AS□E0134		EFSGR0630AYIN		EFSGR0630AYIK	
			E94AM□E0134				
7.50		E94AS□E0174					
			E94AM□E0174				
11.0		E94AS□E0244		EFSGR1000AYIN		EFSGR1000AYIK	
			E94AM□E0244				
15.0		E94AS□E0324					
			E94AM□E0324				
22.0		E94AS□E0474					



DC-bus connection

NH1 and NH2 DC fuses

Typical motor power	Mains voltage	Product key					
4-pole asynchron-ous motor		Single Drive	Multi Drive	DC fuses			
P	U_{AC}						
[kW]	[V]						
11.0	3 AC 340 ... 528	E94AS□E0244		EFSGR1000ANVN			
15.0		E94AS□E0324					
22.0		E94AS□E0474					
30.0		E94AS□E0594		EFSGR2000ANVN			
45.0		E94AS□E0864					
55.0		E94AS□E1044		EFSGR2500ANVN			

► The inverters E94BS□E1454, E94BS□E1724, E94BS□E2024, E94BS□E2454, E94BS□E2924, E94BS□E3664, E94BS□E4604 come with an integrated DC fuse.



24 V power supply unit

Multi-axis applications with Multi Drive axis modules require an external power supply unit to feed the control electronics. Depending on the number of axis modules, power supply units with a rated current of 5, 10 or 20 A can be selected with a voltage supply of 1 x 230 V AC or 3 x 400 V AC.
Single Drive axis modules generally do not require the use of the power supply unit. If, however, separate power supplies are needed for the control electronics and power section in a single-axis application, the same power supply units can be used.



24 V power supply unit

Rated data

Product key			EZV1200-000	EZV2400-000	EZV4800-000	EZV1200-001	EZV2400-001	EZV4800-001
Rated voltage								
	$U_{N, AC}$	[V]	230			400		
Rated mains current								
	$I_{N, AC}$	[A]	0.8	1.2	2.3	0.3	0.6	1.0
Output voltage								
	U_{out}	[V]	DC 22.5 ...28.5					
Rated current								
	I_N	[A]	5.00	10.0	20.0	5.00	10.0	20.0
Dimensions								
Height	h	[mm]	130					
Width	b	[mm]	55	85	157	73	85	160
Depth	t	[mm]	125					
Mass								
	m	[kg]	0.8	1.2	2.5	1.0	1.1	1.9

CAN bus connector

The connector is used to connect the CAN to inverters which are provided with a Sub-D connection for the CAN bus. An integrated CAN terminating resistor can be switched on/off. Internal spring terminals make the use of special mounting tools superfluous. The switch setting can be read from two sides.



CAN bus connector

Mode	Product key
CAN bus connector: Switch	EWZ0046



USB diagnostic adapter

The operation, parameter setting and diagnostics of the Inverter Drives 8400 and the Servo Drives 9400 via the L-force diagnostics is made with the keypad X400 or a PC. The connection of a PC can be made via a USB interface and the USB diagnostic adapter.

For connecting the USB diagnostic adapter with the L-force diagnostics interface (DIAG) tat the inverter, three different connecting cables are separately available in the lengths 2.5 m, 5 m and 10 m. The connection can be established during operation. The engineering tools EASY Starter or Engineer can be used to carry out the operation, parameter setting or diagnostics of the inverters. Both tools have simple intuitive surfaces. This enables a quick and easy commissioning.

Optionally to the USB diagnostic adapter, the PC system bus adapter can be used. For this purpose, a CANopen interface must be available at the inverter.



USB diagnostic adapter incl. connecting cable to the PC

► The engineering tools EASY Starter or Engineer are used for operation, parameter setting and diagnostics of the inverters.

Mode		Features	Product key
USB diagnostic adapter		• Input-side voltage supply via USB connection on PC • Output-side voltage supply via inverter's diagnostic interface • Diagnostic LEDs • Electrical isolation of PC and inverter • Hot-pluggable	E94AZCUS

Connecting cables for USB diagnostic adapter

Mode	Features	Product key
Connecting cable for USB diagnostic adapter	• Length: 2.5 m	EWL0070
	• Length: 5 m	EWL0071
	• Length: 10 m	EWL0072

Inverter Drives 8400 TopLine

0.25 to 45 kW



Inverter Drives 8400 TopLine

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Product key

E84AV SC E 751 2 S X 0 - PM K XX

Type
SC - StateLine (0.25 ...45.0 kW)
HC - HighLine (0.25 ... 45.0 kW)
TC - TopLine (0.25 ... 45.0 kW)

Design
E - installation
D - push-through technique (0.25 ... 15.0 kW)
C - cold-plate technology (0.25 ... 5.5 kW)

Power

251 - 0.25 kW	552 - 5.5 kW
371 - 0.37 kW	752 - 7.5 kW
551 - 0.55 kW	113 - 11.0 kW
751 - 0.75 kW	153 - 15.0 kW
112 - 1.1 kW	183 - 18.5 kW
152 - 1.5 kW	223 - 22.0 kW
222 - 2.2 kW	303 - 30.0 kW
302 - 3.0 kW	373 - 37.0 kW
402 - 4.0 kW	453 - 45.0 kW

Voltage class
2 - 230/240 V, 1/N/PE AC (0.25 ... 2.2 kW)
4 - 400/500 V, 3/PE AC (0.37 ... 45.0 kW)

Ambient conditions
S - standard (0.25 ... 15.0 kW)
V - rough environment (coated printed circuit boards, 0.25 ... 45.0 kW)

Safety engineering
X - without safety engineering
B - with safety engineering (STO)

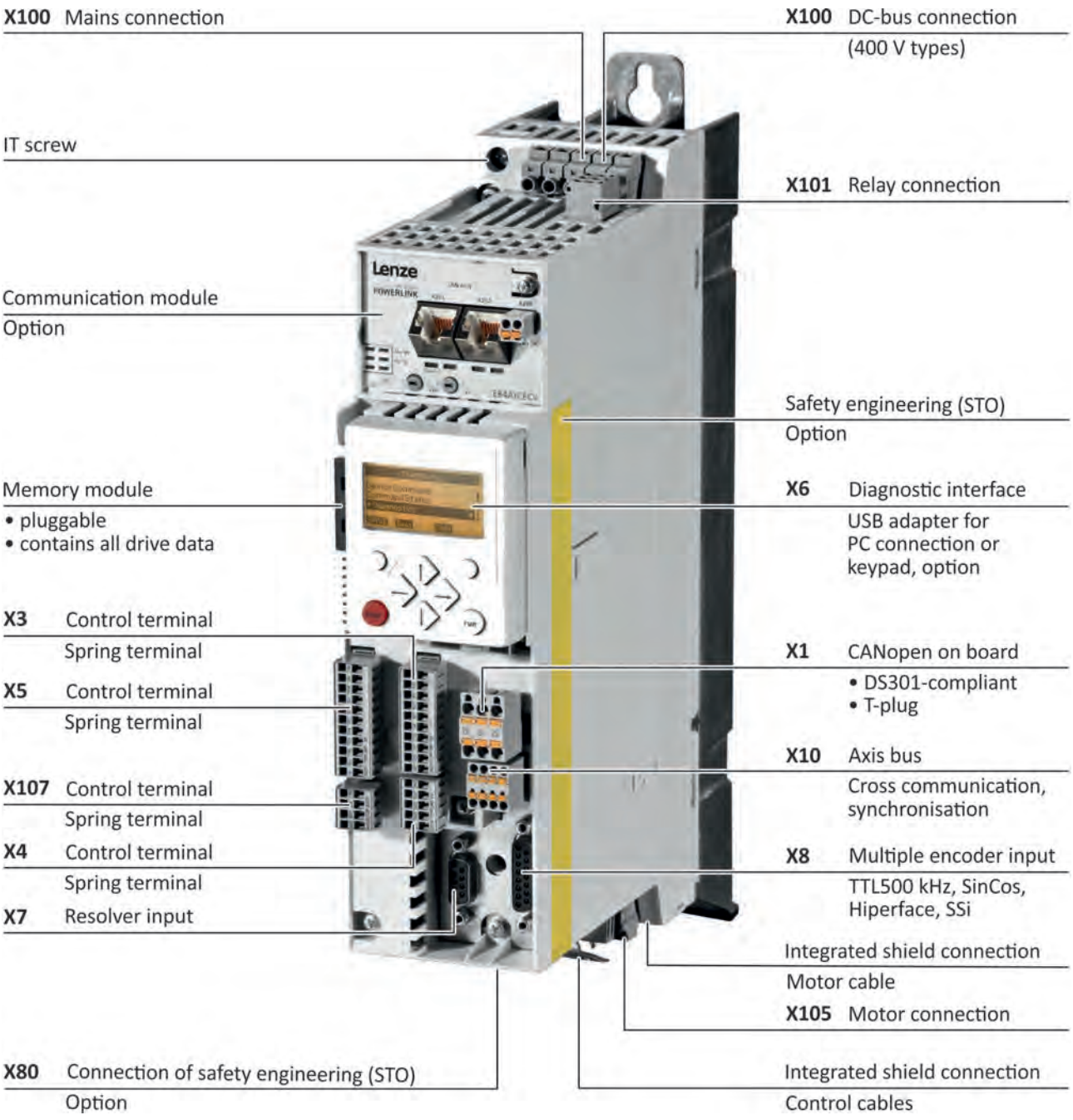
Version identifier
0 - 599 Hz
S - 599 Hz
7 - 1000 Hz

Communication module plugged in
XX - without communication module
ET - EtherCAT
EO - EtherNET/IP
EC - POWERLINK
PM - PROFIBUS
ER - PROFINET

Operating module plugged in
X - without keypad
K - with keypad



Equipment


X100 Mains connection
IT screw
Communication module
Option
Memory module
• pluggable
• contains all drive data
X3 Control terminal
Spring terminal
X5 Control terminal
Spring terminal
X107 Control terminal
Spring terminal
X4 Control terminal
Spring terminal
X7 Resolver input
X80 Connection of safety engineering (STO)
Option
X100 DC-bus connection
(400 V types)
X101 Relay connection
Safety engineering (STO)
Option
X6 Diagnostic interface
USB adapter for
PC connection or
keypad, option
X1 CANopen on board
• DS301-compliant
• T-plug
X10 Axis bus
Cross communication,
synchronisation
X8 Multiple encoder input
TTL500 kHz, SinCos,
Hiperface, SSi
Integrated shield connection
Motor cable
X105 Motor connection
Integrated shield connection
Control cables



List of abbreviations

b	[mm]	Dimensions
C_{th}	[KWs]	Thermal capacity
f_{ch}	[kHz]	Switching frequency
h	[mm]	Dimensions
H_{max}	[m]	Site altitude
I_{max}	[A]	Max. DC-bus current
$I_{max, out}$	[A]	Max. output current
$I_{N, AC}$	[A]	Rated mains current
$I_{N, DC}$	[A]	Rated DC-bus current
$I_{N, out}$	[A]	Rated output current
l_{max}	[m]	Max. cable length
m	[kg]	Mass
P	[kW]	Typical motor power
$P_{max, 1}$	[kW]	Max. output power
P_V	[kW]	Power loss
P_N	[kW]	Rated power
R_{min}	[Ω]	Min. brake resistance
R_N	[Ω]	Rated resistance
t	[mm]	Dimensions
U_{AC}	[V]	Mains voltage
U_{DC}	[V]	DC supply
$U_{N, AC}$	[V]	Rated voltage
U_{out}	[V]	Max. output voltage

ASM	Asynchronous motor
DIAG	Slot for diagnostic adapter
DIN	Deutsches Institut für Normung e.V.
EN	European standard
EN 60529	Degrees of protection provided by enclosures (IP code)
EN 60721-3	Classification of environmental conditions; Part 3: Classes of environmental parameters and their limit values
EN 61800-3	Electrical variable speed drives Part 3: EMC requirements including special test methods
IEC	International Electrotechnical Commission
IEC 61508	Functional safety of electrical/electronic/programmable electronic safety-related systems
IM	International Mounting Code
IP	International Protection Code
MCI	Slot for communication module (module communication interface)
NEMA	National Electrical Manufacturers Association
UL	Underwriters Laboratory Listed Product
UR	Underwriters Laboratory Recognized Product
VDE	Verband deutscher Elektrotechniker (Association of German Electrical Engineers)



Inverter Drives 8400

Cost-efficiency, time savings and quality enhancement are the challenges of the future. Lenze is facing these challenges with its L-force product portfolio – the holistic solution portfolio with precisely matched interfaces and components. For faster configuration and commissioning, better performance and more flexibility in production.

As such, the four versions of Inverter Drives 8400 - BaseLine, StateLine, HighLine and TopLine - have been designed for consistent process optimisation – throughout your entire value-added chain. They reduce your costs, from component selection, through project planning, manufacturing and commissioning, all the way up to servicing. We call this "rightsizing".

Rightsized for versatile applications
Are you looking to control a three-phase AC motor or perform positioning with or without feedback? Then select exactly the inverter you need from the scaled solution space of the Inverter Drives 8400 with units in the power range from 0.25 kW to 45 kW. You are sure to find exactly what you are looking for here, as the modular 8400 range of inverters offers the right solution for a broad spectrum of applications.

While the BaseLine is excellent for basic applications, the TopLine offers servo qualities and thereby fulfils with the strict requirements in terms of dynamics and accuracy.

8400 TopLine - for servo applications
8400 TopLine – the inverter with servo qualities within the 8400 range. Equipped with everything needed for high dynamic performance and accuracy in complex applications. Alongside a resolver input, a multiple encoder input (which can be used at the same time) is also provided which optimally supplements the range of feedback systems that can be used. Cross communication between multiple TopLine units requires minimum wiring (3-core), as it runs via the separate axis bus. Alongside asynchronous motors, TopLine also supports dynamic synchronous motors via feedback.

Benefit from precisely tailored, cost-optimised Lenze drive units, consisting of prepared system cables, motors and gearboxes, feedback, brakes, fans and of course the 8400 TopLine.
The 8400 TopLine is, for example, recommended for storage and retrieval units, synchronised line drives and pick-and-place applications.



Functions and features

Mode	
	8400 TopLine
Conrol types, motor control	
Field-oriented servo control (SC)	For synchronous servo motors, asynchronous servo motors and three-phase asynchronous motors
Sensorless control (SLPSM)	For synchronous servo motors
Sensorless vector control (SLVC)	For three-phase asynchronous motors
V/f control (VFCplus)	For three-phase AC motors and asynchronous servo motor (linear or square-law)
Energy saving function (VFC eco)	For three-phase asynchronous motors
Basic functions	
	Freely assignable user menu Free function block interconnection with extensive function library Parameter change-over DC brake function Braking operation without brake resistor Brake management for brake control with low rate of wear Flying restart circuit S-shaped ramps for smooth acceleration PID controller 15 fixed frequencies Masking frequencies Inversion of motor phase sequence
Technology applications	
	Speed actuating drive Switch-off positioning without feedback Table positioning without feedback (with sequential positioning)
Advanced functions	Function blocks for positioning sequence control Function blocks for electrical shaft (speed and angular synchronism) Function blocks for dancer control Function blocks for mains failure control
Monitoring and protective measures	
	Short circuit Earth fault Overvoltage Motor phase failure Overcurrent I^2 x t-Motor monitoring Motor overtemperature Mains phase failure Protection against restart for cyclic mains switching Motor stalling
Diagnostics	
	Data logger, logbook, oscilloscope functions
Status display	6 LEDs
Diagnostic interface	Integrated For USB diagnostic adapter or keypad (diagnosis terminal)
Braking operation	
Brake chopper	Integrated
Brake resistor	External



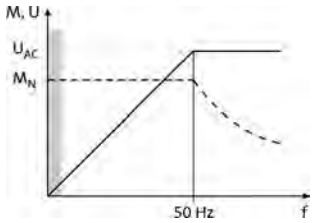
Operating modes

An inverter enables energy-efficient operation of a system in virtually all application cases. The various operating modes, which can be created by making just a few simple settings, facilitate this. The following characteristics and corresponding specifications listed on the following pages can be used to calculate the optimum operating mode during the project planning phase.

Standard setting

In its initial state when delivered, the inverter is set up for basic operation with a three-phase AC motor with V/f control. When operated in this mode, the rated torque of the motor is available in a setting range up to 50 Hz.

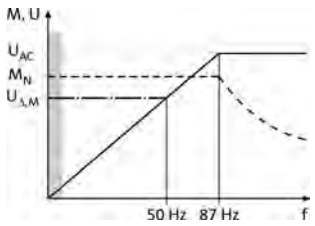
V/f at 50 Hz



Extended setting range up to 87 Hz

If the V/f reference point on the inverter is set to 87 Hz, the rated torque can be used across an extended setting range. Here, a 230/400V motor is for example used and operated in a delta layout with a 400V inverter. The setting range is then increased by 40 %. The inverter must be dimensioned for a rated motor current of 230 V.

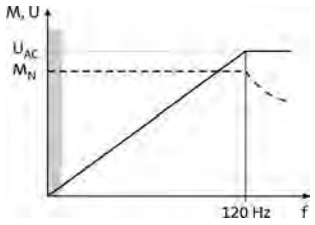
V/f at 87 Hz



Operation with inverter-optimised MF motors

Large setting ranges and optimum operation at the rated torque: these are the strengths of the MF motor when used in combination with an inverter. The motors are optimised for a setting range up to 120 Hz. Compared to conventional 50Hz operation, the setting range increases by 250 %. It is quite simply not possible for a drive to be operated any more efficiently in a machine.

V/f at 120 Hz





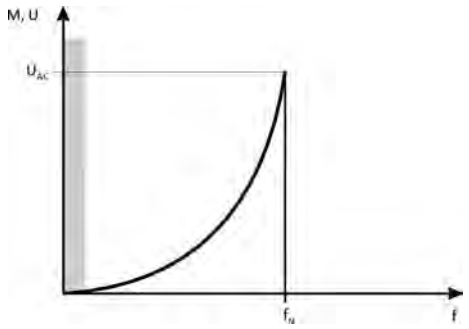
Operating modes

Square-law V/f characteristic control

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

Application areas are for instance:
- Pumps
- Blowers
- Fans

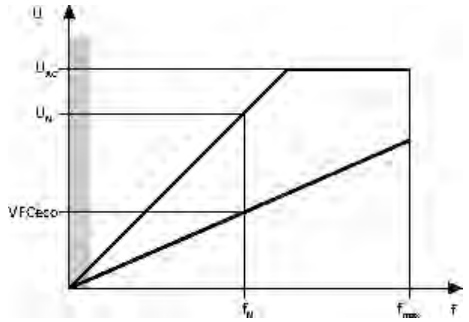
Square-law characteristic



VFCeco energy saving mode

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

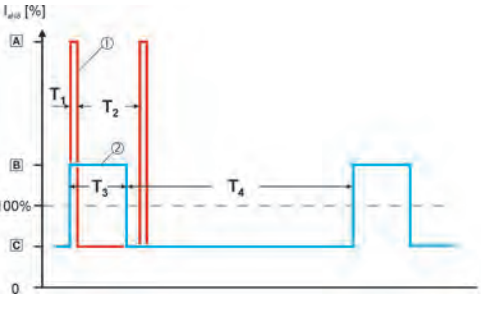
VFCeco energy saving mode



Overcurrent operation

The inverters can be driven at higher amperages beyond the rated current if the duration of this overcurrent operation is time limited. Two utilisation cycles with a duration of 15 s and 180 s are defined. Within these utilisation cycles, an overcurrent is possible for a certain time if afterwards an accordingly long recovery phase takes place. For both utilisation cycles, a moving average is determined separately. The adjacent diagram shows both cycles: 15 s in red and 180 s in blue. The overload times t_{ol} are 3 s (T_1) and 60 s (T_3) respectively, the corresponding recovery times t_{re} are 12 s (T_2) and 120 s (T_4) respectively. The following tables show the resulting maximum output currents. Monitoring of the device utilisation (I x t) activates the set error response (trip or warning if one of the two utilisation values exceeds the limit of 100 %.

Overcurrent operation





Standards and operating conditions

Mode			
Product			8400 TopLine
Conformity			
CE			Low-Voltage Directive
			2014/35/EU [UKCA: S.I. 2016/1101]
Approval			
UL 508C			for USA and Canada (requirements of the CSA 22.2 No. 14) [2] Power Conversion Equipment (file no. E132659)
Degree of protection			
EN 60529 [3]			IP20
NEMA 250			Type 1
Climatic conditions			
Storage (EN 60721-3-1)			1K3 (temperature: -25 °C ... +60 °C)
Transport (EN 60721-3-2)			2K3 (temperature: -25 °C ... +70 °C)
Operation (EN 60721-3-3)			3K3 (temperature: -10°C ... +55 °C)
Current derating at over 45°C			2.5% / K
Site altitude			
Amsl	H_{max}	[m]	4000
Current derating at over 1000 m		[%/1000 m]	5
Vibration resistance			
Transport (EN 60721-3-2)			2M2
Operation (EN 61800-5-1)			10 Hz ≤ f ≤ 57 Hz: ±0.075 mm amplitude, 57 Hz ≤ f ≤ 150 Hz: 1.0 g
Operation (Germanischer Lloyd)			5 Hz ≤ f ≤ 13.2 Hz: ± 1 mm amplitude 13.2 Hz ≤ f ≤ 100 Hz: 0.7 g

Mode	
Product	8400 TopLine
Supply form	
	Systems with earthed star point (TN and TT systems) Systems with high-resistance or isolated star point (IT systems)
Noise emission	
EN 61800-3	Integrated RFI suppression: category C2 up to 25 m shielded motor cable [1]
Insulation resistance	
EN 61800-5-1	Overvoltage category III Above 2000 m amsl overvoltage category II
Degree of pollution	
EN 61800-5-1	2
Protective insulation of control circuits	
EN 61800-5-1	Safe mains isolation: double/reinforced insulation

[1] 37 - Please also refer to the Motor connection section

[2] CSA when using an external mains choke or a module for reducing transients.
[3] Mounted and ready-to-use



Rated data 230 V

► Unless otherwise specified, the data refers to the default setting.

Data in left column per device

Operation with rated data: rated output current $I_{N,out}$ at a mains voltage 230 V, switching frequency 8 kHz variable and an ambient temperature 45 °C (default setting).
Output currents I_{out} apply to:
Ambient temperature 45 °C operating with constant switching frequency 2 kHz or 4 kHz.
Ambient temperature 40 °C operating with constant switching frequency 8 kHz or 16 kHz.

Data in right column per device

Operation with increased power: rated output current $I_{N,out}$ at mains voltage 230 V, switching frequency 4 kHz and max. ambient temperature 40 °C.
Output currents apply to:
Ambient temperature 40 °C operating with switching frequency 2 kHz or 4 kHz.

						
Typical motor power						
4-pole asynchronous motor	P	[kW]	0.25	0.37	0.37	0.55 [1]
Product key			E84AVTC□2512□□0 E84AVTC□2512□□S		E84AVTC□3712□□0 E84AVTC□3712□□S	
Mains voltage range						
	U_{AC}	[V]	1/N/PE AC 180 V-0 % ... 264 V+0 %, 45 Hz-0 % ... 65 Hz+0 %			
Rated mains current						
With mains choke	$I_{N, AC}$	[A]	3.0	3.6	4.2	5.0
Without mains choke	$I_{N, AC}$	[A]	3.4	4.1	5.0	
Rated output current						
	$I_{N, out}$	[A]	1.7	2.1	2.4	2.9
Output current						
2 kHz	I_{out}	[A]	1.7	2.1	2.4	2.9
4 kHz	I_{out}	[A]	1.7	2.1	2.4	2.9
8 kHz	I_{out}	[A]	1.7		2.4	
16 kHz	I_{out}	[A]	1.1		1.6	

Data for 60 s overload

Max. output current				
	$I_{max, out}$	[A]	2.6	3.6
Overload time				
	t_{ol}	[s]	60.0	
Recovery time				
	t_{re}	[s]	120.0	

Data for 3 s overload

Max. short-time output current				
	$I_{max, out}$	[A]	3.4	4.8
Overload time				
	t_{ol}	[s]	3.0	
Recovery time				
	t_{re}	[s]	12.0	

[1] Operation only permitted with mains choke



Rated data 230 V

► Unless otherwise specified, the data refers to the default setting.

						
Typical motor power						
4-pole asynchronous motor	P	[kW]	0.25	0.37	0.37	0.55
Product key						
			E84AVTC□2512□□0 E84AVTC□2512□□S		E84AVTC□3712□□0 E84AVTC□3712□□S	
Power loss						
	P_V	[kW]	0.045		0.050	
Max. cable length [1]						
Shielded motor cable	I_{max}	[m]	50			

Brake chopper rated data

Rated power, Brake chopper				
	P_N	[kW]	0.6	0.6
Max. output power, Brake chopper				
	$P_{max, 1}$	[kW]	0.8	0.8
Min. brake resistance				
	R_{min}	[Ω]	180.0	180.0

Dimensions and weights

Standard installation design

Dimensions				
Height	h	[mm]	215	215
Width	b	[mm]	70	70
Depth [2]	t	[mm]	214	214
Mass				
	m	[kg]	2.0	2.0

[1] Technically possible cable lengths, irrespective of EMC requirements
[2] With safety engineering plus 20 mm



Rated data 230 V

► Unless otherwise specified, the data refers to the default setting.

Data in left column per device

Operation with rated data: rated output current $I_{N,out}$ at a mains voltage 230 V, switching frequency 8 kHz variable and an ambient temperature 45 °C (default setting).
Output currents I_{out} apply to:
Ambient temperature 45 °C operating with constant switching frequency 2 kHz or 4 kHz.
Ambient temperature 40 °C operating with constant switching frequency 8 kHz or 16 kHz.

Data in right column per device

Operation with increased power: rated output current $I_{N,out}$ at mains voltage 230 V, switching frequency 4 kHz and max. ambient temperature 40 °C.
Output currents apply to:
Ambient temperature 40 °C operating with switching frequency 2 kHz or 4 kHz.

						
Typical motor power						
4-pole asynchronous motor	P	[kW]	0.55	0.75	0.75	1.10 [1]
Product key			E84AVTC□5512□□0 E84AVTC□5512□□S		E84AVTC□7512□□0 E84AVTC□7512□□S	
Mains voltage range						
	U_{AC}	[V]	1/N/PE AC 180 V-0 % ... 264 V+0 %, 45 Hz-0 % ... 65 Hz+0 %			
Rated mains current						
With mains choke	$I_{N, AC}$	[A]	5.0	6.0	7.0	8.4
Without mains choke	$I_{N, AC}$	[A]	5.3	6.4	8.0	
Rated output current						
	$I_{N, out}$	[A]	3.0	3.6	4.0	4.8
Output current						
2 kHz	I_{out}	[A]	3.0	3.6	4.0	4.8
4 kHz	I_{out}	[A]	3.0	3.6	4.0	4.8
8 kHz	I_{out}	[A]	3.0		4.0	
16 kHz	I_{out}	[A]	2.0		2.7	

Data for 60 s overload

Max. output current				
	$I_{max, out}$	[A]	4.5	6.0
Overload time				
	t_{ol}	[s]	60.0	
Recovery time				
	t_{re}	[s]	120.0	

Data for 3 s overload

Max. short-time output current				
	$I_{max, out}$	[A]	6.0	8.0
Overload time				
	t_{ol}	[s]	3.0	
Recovery time				
	t_{re}	[s]	12.0	

[1] Operation only permitted with mains choke



Rated data 230 V

► Unless otherwise specified, the data refers to the default setting.

						
Typical motor power						
4-pole asynchronous motor	P	[kW]	0.55	0.75	0.75	1.10
Product key						
			E84AVTC□5512□□0 E84AVTC□5512□□S		E84AVTC□7512□□0 E84AVTC□7512□□S	
Power loss						
	P_V	[kW]	0.060		0.075	
Max. cable length [1]						
Shielded motor cable	I_{max}	[m]	50			

Brake chopper rated data

Rated power, Brake chopper				
	P_N	[kW]	1.1	1.1
Max. output power, Brake chopper				
	$P_{max, 1}$	[kW]	1.4	1.4
Min. brake resistance				
	R_{min}	[Ω]	100.0	100.0

Dimensions and weights

Standard installation design

Dimensions				
Height	h	[mm]	215	215
Width	b	[mm]	70	70
Depth [2]	t	[mm]	214	214
Mass				
	m	[kg]	2.0	2.0

[1] Technically possible cable lengths, irrespective of EMC requirements
[2] With safety engineering plus 20 mm



Rated data 230 V

► Unless otherwise specified, the data refers to the default setting.

Data in left column per device

Operation with rated data: rated output current $I_{N,out}$ at a mains voltage 230 V, switching frequency 8 kHz variable and an ambient temperature 45 °C (default setting).
Output currents I_{out} apply to:
Ambient temperature 45 °C operating with constant switching frequency 2 kHz or 4 kHz.
Ambient temperature 40 °C operating with constant switching frequency 8 kHz or 16 kHz.

Data in right column per device

Operation with increased power: rated output current $I_{N,out}$ at mains voltage 230 V, switching frequency 4 kHz and max. ambient temperature 40 °C.
Output currents apply to:
Ambient temperature 40 °C operating with switching frequency 2 kHz or 4 kHz.



Typical motor power								
4-pole asynchronous motor	P	[kW]	1.10	1.50	1.50	2.20 [1]	2.20	
Product key			E84AVTC□1122□□0 E84AVTC□1122□□S		E84AVTC□1522□□0 E84AVTC□1522□□S		E84AVTC□2222□□0 E84AVTC□2222□□S	
Mains voltage range								
	U_{AC}	[V]	1/N/PE AC 180 V-0 % ... 264 V+0 %, 45 Hz-0 % ... 65 Hz+0 %					
Rated mains current								
With mains choke	$I_{N, AC}$	[A]	9.9	11.9	11.4	13.7	16.4	
Without mains choke	$I_{N, AC}$	[A]	12.0	14.4	13.7		21.8	
Rated output current								
	$I_{N, out}$	[A]	5.5	6.8	7.0	8.4	9.5	
Output current								
2 kHz	I_{out}	[A]	5.5	6.8	7.0	8.4	9.5	
4 kHz	I_{out}	[A]	5.5	6.8	7.0	8.4	9.5	
8 kHz	I_{out}	[A]	5.5		7.0		9.5	
16 kHz	I_{out}	[A]	3.7		4.7		6.3	

Data for 60 s overload

Max. output current					
	$I_{max, out}$	[A]	8.3	10.5	14.3
Overload time					
	t_{ol}	[s]	60.0		
Recovery time					
	t_{re}	[s]	120.0		

Data for 3 s overload

Max. short-time output current					
	$I_{max, out}$	[A]	11.0	14.0	19.0
Overload time					
	t_{ol}	[s]	3.0		
Recovery time					
	t_{re}	[s]	12.0		

[1] Operation only permitted with mains choke



Rated data 230 V

► Unless otherwise specified, the data refers to the default setting.

								
Typical motor power								
4-pole asynchronous motor	P	[kW]	1.10	1.50	1.50	2.20	2.20	
Product key								
			E84AVTC□1122□□0 E84AVTC□1122□□S		E84AVTC□1522□□0 E84AVTC□1522□□S		E84AVTC□2222□□0 E84AVTC□2222□□S	
Power loss								
	P_V	[kW]	0.095		0.110		0.140	
Max. cable length [1]								
Shielded motor cable	I_{max}	[m]	50					

Brake chopper rated data

Rated power, Brake chopper					
	P_N	[kW]	3.3	3.3	3.3
Max. output power, Brake chopper					
	$P_{max, 1}$	[kW]	4.4	4.4	4.4
Min. brake resistance					
	R_{min}	[Ω]	33.0	33.0	33.0

Dimensions and weights

Standard installation design

Dimensions					
Height	h	[mm]	270	270	270
Width	b	[mm]	70	70	70
Depth [2]	t	[mm]	214	214	214
Mass					
	m	[kg]	2.3	2.3	2.3

[1] Technically possible cable lengths, irrespective of EMC requirements
[2] With safety engineering plus 20 mm



Rated data 400 V

► Unless otherwise specified, the data refers to the default setting.

Data in left column per device

Operation with rated data: rated output current $I_{N,out}$ at mains voltage 400 V, switching frequency 8 kHz variable and max. ambient temperature 45 °C (default setting).
Output currents I_{out} apply to:
Ambient temperature 45 °C operating with constant switching frequency 2 kHz or 4 kHz.
Ambient temperature 40 °C operating with constant switching frequency 8 kHz or 16 kHz.

Data in right column per device

Operation with increased power: rated output current $I_{N,out}$ at mains voltage 400 V, switching frequency 4 kHz constant and max. ambient temperature 40 °C.
Output currents apply to:
Ambient temperature 40 °C operating with constant switching frequency 2 kHz or 4 kHz.



Typical motor power								
4-pole asynchronous motor	P	[kW]	0.37	0.55	0.55	0.75	0.75	1.10 [1]
Product key			E84AVTC□3714□□0 E84AVTC□3714□□S		E84AVTC□5514□□0 E84AVTC□5514□□S		E84AVTC□7514□□0 E84AVTC□7514□□S	
Mains voltage range								
	U_{AC}	[V]	3/PE AC 320 V-0 % ... 550 V+0 %, 45 Hz-0 % ... 65 Hz+0 %					
Rated mains current								
With mains choke	$I_{N, AC}$	[A]	1.4	1.7	2.0	2.6		3.0
Without mains choke	$I_{N, AC}$	[A]	1.8	2.2	2.5	3.2	3.6	
Rated output current								
	$I_{N, out}$	[A]	1.3	1.6	1.8	2.2	2.4	2.9
Output current								
2 kHz	I_{out}	[A]	1.3	1.6	1.8	2.2	2.4	2.9
4 kHz	I_{out}	[A]	1.3	1.6	1.8	2.2	2.4	2.9
8 kHz	I_{out}	[A]	1.3		1.8		2.4	
16 kHz	I_{out}	[A]	0.9		1.2		1.6	

Data for 60 s overload

Max. output current					
	$I_{max, out}$	[A]	2.0	2.7	3.6
Overload time					
	t_{ol}	[s]	60.0		
Recovery time					
	t_{re}	[s]	120.0		

Data for 3 s overload

Max. short-time output current					
	$I_{max, out}$	[A]	2.6	3.6	4.8
Overload time					
	t_{ol}	[s]	3.0		
Recovery time					
	t_{re}	[s]	12.0		

[1] Operation only permitted with mains choke



Rated data 400 V

► Unless otherwise specified, the data refers to the default setting.

								
Typical motor power								
4-pole asynchronous motor	P	[kW]	0.37	0.55	0.55	0.75	0.75	1.10
Product key								
			E84AVTC□3714□□0 E84AVTC□3714□□S		E84AVTC□5514□□0 E84AVTC□5514□□S		E84AVTC□7514□□0 E84AVTC□7514□□S	
DC supply								
	U_{DC}	[V]	DC 455 V -0 % ... 775 V +0 %					
Rated DC-bus current								
	$I_{N, DC}$	[A]	2.2		3.3		4.4	
Power loss								
	P_V	[kW]	0.050		0.065		0.080	
Max. cable length [1]								
Shielded motor cable	I_{max}	[m]	50					

4.4

Brake chopper rated data

Rated power, Brake chopper					
	P_N	[kW]	1.3	1.3	1.3
Max. output power, Brake chopper					
	$P_{max, 1}$	[kW]	1.3	1.3	1.3
Min. brake resistance					
	R_{min}	[Ω]	390.0	390.0	390.0

Dimensions and weights

Standard installation design

Dimensions					
Height	h	[mm]	215	215	215
Width	b	[mm]	70	70	70
Depth [2]	t	[mm]	214	214	214
Mass					
	m	[kg]	2.0	2.0	2.0

[1] Technically possible cable lengths, irrespective of EMC requirements
[2] With safety engineering plus 20 mm



Rated data 400 V

► Unless otherwise specified, the data refers to the default setting.

Data in left column per device

Operation with rated data: rated output current $I_{N,out}$ at mains voltage 400 V, switching frequency 8 kHz variable and max. ambient temperature 45 °C (default setting).
Output currents I_{out} apply to:
Ambient temperature 45 °C operating with constant switching frequency 2 kHz or 4 kHz.
Ambient temperature 40 °C operating with constant switching frequency 8 kHz or 16 kHz.

Data in right column per device

Operation with increased power: rated output current $I_{N,out}$ at mains voltage 400 V, switching frequency 4 kHz constant and max. ambient temperature 40 °C.
Output currents apply to:
Ambient temperature 40 °C operating with constant switching frequency 2 kHz or 4 kHz.



Typical motor power										
4-pole asynchronous motor	P	[kW]	1.10	1.50	1.50	2.20	2.20	3.00 [1]	3.00	4.00 [1]
Product key										
			E84AVTC□1124□□0 E84AVTC□1124□□S		E84AVTC□1524□□0 E84AVTC□1524□□S		E84AVTC□2224□□0 E84AVTC□2224□□S		E84AVTC□3024□□S	
Mains voltage range										
	U_{AC}	[V]	3/PE AC 320 V-0 % ... 550 V+0 %, 45 Hz-0 % ... 65 Hz+0 %							
Rated mains current										
With mains choke	$I_{N, AC}$	[A]	3.2	3.8	3.9	4.7	5.1	6.1	7.0	8.4
Without mains choke	$I_{N, AC}$	[A]	4.4	5.3	5.5	6.6	7.3		9.8	11.8
Rated output current										
	$I_{N, out}$	[A]	3.2	3.8	3.9	4.8	5.6	6.7	7.3	8.8
Output current										
2 kHz	I_{out}	[A]	3.2	3.8	3.9	4.8	5.6	6.7	7.3	8.8
4 kHz	I_{out}	[A]	3.2	3.8	3.9	4.8	5.6	6.7	7.3	8.8
8 kHz	I_{out}	[A]	3.2		3.9		5.6		7.3	
16 kHz	I_{out}	[A]	2.1		2.6		3.7		4.9	

Data for 60 s overload

Max. output current						
	$I_{max, out}$	[A]	4.8	5.9	8.4	11.0
Overload time						
	t_{ol}	[s]	60.0			
Recovery time						
	t_{re}	[s]	120.0			

Data for 3 s overload

Max. short-time output current						
	$I_{max, out}$	[A]	6.4	7.8	11.2	14.6
Overload time						
	t_{ol}	[s]	3.0			
Recovery time						
	t_{re}	[s]	12.0			

[1] Operation only permitted with mains choke



Rated data 400 V

► Unless otherwise specified, the data refers to the default setting.



Typical motor power										
4-pole asynchronous motor	P	[kW]	1.10	1.50	1.50	2.20	2.20	3.00	3.00	4.00
Product key										
			E84AVTC□1124□□0 E84AVTC□1124□□S		E84AVTC□1524□□0 E84AVTC□1524□□S		E84AVTC□2224□□0 E84AVTC□2224□□S		E84AVTC□3024□□S	
DC supply										
	U_{DC}	[V]	DC 455 V -0 % ... 775 V +0 %							
Rated DC-bus current										
	$I_{N, DC}$	[A]	5.4		6.7		8.9		12.0	
Power loss										
	P_V	[kW]	0.095		0.105		0.135		0.165	
Max. cable length [1]										
Shielded motor cable	I_{max}	[m]	50							

Brake chopper rated data

Rated power, Brake chopper						
	P_N	[kW]	2.9	2.9	3.5	6.4
Max. output power, Brake chopper						
	$P_{max, 1}$	[kW]	2.9	2.9	3.5	6.4
Min. brake resistance						
	R_{min}	[Ω]	180.0	180.0	150.0	82.0

Dimensions and weights

Standard installation design

Dimensions						
Height	h	[mm]	270	270	270	270
Width	b	[mm]	70	70	70	70
Depth [2]	t	[mm]	214	214	214	214
Mass						
	m	[kg]	2.3	2.3	2.3	2.3

[1] Technically possible cable lengths, irrespective of EMC requirements
[2] With safety engineering plus 20 mm



Rated data 400 V

► Unless otherwise specified, the data refers to the default setting.

Data in left column per device

Operation with rated data: rated output current $I_{N,out}$ at mains voltage 400 V, switching frequency 8 kHz variable and max. ambient temperature 45 °C (default setting).
Output currents I_{out} apply to:
Ambient temperature 45 °C operating with constant switching frequency 2 kHz or 4 kHz.
Ambient temperature 40 °C operating with constant switching frequency 8 kHz or 16 kHz.

Data in right column per device

Operation with increased power: rated output current $I_{N,out}$ at mains voltage 400 V, switching frequency 4 kHz constant and max. ambient temperature 40 °C.
Output currents apply to:
Ambient temperature 40 °C operating with constant switching frequency 2 kHz or 4 kHz.



Typical motor power								
4-pole asynchronous motor	P	[kW]	3.00	4.00	4.00	5.50	5.50	7.50 [1]
Product key								
			E84AVTC□3024□□0		E84AVTC□4024□□0		E84AVTC□5524□□0	
Mains voltage range								
	U_{AC}	[V]	3/PE AC 320 V-0 % ... 550 V+0 %, 45 Hz-0 % ... 65 Hz+0 %					
Rated mains current								
With mains choke	$I_{N, AC}$	[A]	7.0	8.4	8.8	10.6	12.0	18.0
Without mains choke	$I_{N, AC}$	[A]	9.8	11.8	13.1	15.7	18.0	
Rated output current								
	$I_{N, out}$	[A]	7.3	8.8	9.5	11.5	13.0	15.6
Output current								
2 kHz	I_{out}	[A]	7.3	8.8	9.5	11.5	13.0	15.6
4 kHz	I_{out}	[A]	7.3	8.8	9.5	11.5	13.0	15.6
8 kHz	I_{out}	[A]	7.3		9.5		13.0	
16 kHz	I_{out}	[A]	4.9		6.3		8.7	

Data for 60 s overload

Max. output current					
	$I_{max, out}$	[A]	11.0	14.3	19.5
Overload time					
	t_{ol}	[s]	60.0		
Recovery time					
	t_{re}	[s]	120.0		

Data for 3 s overload

Max. short-time output current					
	$I_{max, out}$	[A]	14.6	19.0	26.0
Overload time					
	t_{ol}	[s]	3.0		
Recovery time					
	t_{re}	[s]	12.0		

[1] Operation only permitted with mains choke



Rated data 400 V

► Unless otherwise specified, the data refers to the default setting.

								
Typical motor power								
4-pole asynchronous motor	P	[kW]	3.00	4.00	4.00	5.50	5.50	7.50
Product key								
			E84AVTC□3024□□0		E84AVTC□4024□□0		E84AVTC□5524□□0	
DC supply								
	U_{DC}	[V]	DC 455 V -0 % ... 775 V +0 %					
Rated DC-bus current								
	$I_{N, DC}$	[A]	12.0		16.0		22.0	
Power loss								
	P_V	[kW]	0.165		0.205		0.275	
Max. cable length [1]								
Shielded motor cable	l_{max}	[m]	50					

4.4

Brake chopper rated data

Rated power, Brake chopper					
	P_N	[kW]	6.4	9.4	9.4
Max. output power, Brake chopper					
	$P_{max, 1}$	[kW]	6.4	11.2	11.2
Min. brake resistance					
	R_{min}	[Ω]	82.0	47.0	47.0

Dimensions and weights

Standard installation design

Dimensions					
Height	h	[mm]	270	270	270
Width	b	[mm]	140	140	140
Depth [2]	t	[mm]	214	214	214
Mass					
	m	[kg]	4.6	4.6	4.6

[1] Technically possible cable lengths, irrespective of EMC requirements
[2] With safety engineering plus 20 mm



Rated data 400 V

► Unless otherwise specified, the data refers to the default setting.

Data in left column per device

Operation with rated data: rated output current $I_{N,out}$ at mains voltage 400 V, switching frequency 8 kHz variable and max. ambient temperature 45 °C (default setting).
Output currents I_{out} apply to:
Ambient temperature 45 °C operating with constant switching frequency 2 kHz or 4 kHz.
Ambient temperature 40 °C operating with constant switching frequency 8 kHz or 16 kHz.

Data in right column per device

Operation with increased power: rated output current $I_{N,out}$ at mains voltage 400 V, switching frequency 4 kHz constant and max. ambient temperature 40 °C.
Output currents apply to:
Ambient temperature 40 °C operating with constant switching frequency 2 kHz or 4 kHz.



Typical motor power								
4-pole asynchronous motor	P	[kW]	7.50	11.0	11.0	15.0 [1]	15.0 [1]	
Product key								
			E84AVTC□7524□□0		E84AVTC□1134□□0		E84AVTC□1534□□0	
Mains voltage range								
	U_{AC}	[V]	3/PE AC 320 V-0 % ... 550 V+0 %, 45 Hz-0 % ... 65 Hz+0 %					
Rated mains current								
With mains choke	$I_{N, AC}$	[A]	15.0	21.0		29.0		
Without mains choke	$I_{N, AC}$	[A]	20.0	28.0	29.0			
Rated output current								
	$I_{N, out}$	[A]	16.5	21.0	23.5	28.2	32.0	
Output current								
2 kHz	I_{out}	[A]	16.5	21.0	23.5	28.2	32.0	
4 kHz	I_{out}	[A]	16.5	21.0	23.5	28.2	32.0	
8 kHz	I_{out}	[A]	16.5		23.5		32.0	
16 kHz	I_{out}	[A]	11.0		15.7		21.3	

Data for 60 s overload

Max. output current					
	$I_{max, out}$	[A]	26.4	35.3	48.0
Overload time					
	t_{ol}	[s]	60.0		
Recovery time					
	t_{re}	[s]	120.0		

Data for 3 s overload

Max. short-time output current					
	$I_{max, out}$	[A]	33.0	47.0	64.0
Overload time					
	t_{ol}	[s]	3.0		
Recovery time					
	t_{re}	[s]	12.0		

[1] Operation only permitted with mains choke



Rated data 400 V

► Unless otherwise specified, the data refers to the default setting.

										
Typical motor power										
4-pole asynchronous motor	P	[kW]	7.50	11.0	11.0	15.0	15.0			
Product key										
			E84AVTC□7524□□0		E84AVTC□1134□□0		E84AVTC□1534□□0			
DC supply										
	U_{DC}	[V]	DC 455 V -0 % ... 775 V +0 %							
Rated DC-bus current										
	$I_{N, DC}$	[A]	24.5		35.5					
Power loss										
	P_V	[kW]	0.320		0.435		0.470			
Max. cable length [1]										
Shielded motor cable	I_{max}	[m]	50							

4.4

Brake chopper rated data

Rated power, Brake chopper					
	P_N	[kW]	19.5	19.5	29.2
Max. output power, Brake chopper					
	$P_{max, 1}$	[kW]	19.5	19.5	29.2
Min. brake resistance					
	R_{min}	[Ω]	27.0	27.0	18.0

Dimensions and weights

Standard installation design

Dimensions					
Height	h	[mm]	325	325	325
Width	b	[mm]	140	140	140
Depth [2]	t	[mm]	214	214	214
Mass					
	m	[kg]	6.0	6.0	6.0

[1] Technically possible cable lengths, irrespective of EMC requirements
[2] With safety engineering plus 20 mm



Rated data 400 V

► Unless otherwise specified, the data refers to the default setting.

Data in left column per device

Operation with rated data: rated output current $I_{N,out}$ at mains voltage 400 V, switching frequency 8 kHz variable and max. ambient temperature 45 °C (default setting).
Output currents I_{out} apply to:
Ambient temperature 45 °C operating with constant switching frequency 2 kHz or 4 kHz.
Ambient temperature 40 °C operating with constant switching frequency 8 kHz or 16 kHz.

Data in right column per device

Operation with increased power: rated output current $I_{N,out}$ at mains voltage 400 V, switching frequency 4 kHz constant and max. ambient temperature 40 °C.
Output currents apply to:
Ambient temperature 40 °C operating with constant switching frequency 2 kHz or 4 kHz.



Typical motor power						
4-pole asynchronous motor	P	[kW]	18.5	22.0 [1)]	22.0 [1)]	30.0 [1)]
Product key						
			E84AVTC□1834□□0		E84AVTC□2234□□0	
Mains voltage range						
	U_{AC}	[V]	3/PE AC 320 V-0 % ... 550 V+0 %, 45 Hz-0 % ... 65 Hz+0 %			
Rated mains current						
With mains choke	$I_{N, AC}$	[A]	36.0	42.2	42.0	50.8
Without mains choke	$I_{N, AC}$	[A]	50.4			
Rated output current						
	$I_{N, out}$	[A]	40.0	46.8	47.0	56.4
Output current						
2 kHz	I_{out}	[A]	40.0	46.8	47.0	56.4
4 kHz	I_{out}	[A]	40.0	46.8	47.0	56.4
8 kHz	I_{out}	[A]	40.0		47.0	
16 kHz	I_{out}	[A]	27.0		31.3	

Data for 60 s overload

Max. output current				
	$I_{max, out}$	[A]	60.0	70.5
Overload time				
	t_{ol}	[s]	60.0	
Recovery time				
	t_{re}	[s]	120.0	

Data for 3 s overload

Max. short-time output current				
	$I_{max, out}$	[A]	78.0	89.3
Overload time				
	t_{ol}	[s]	3.0	
Recovery time				
	t_{re}	[s]	12.0	

[1)] Operation only permitted with mains choke or mains filter



Rated data 400 V

► Unless otherwise specified, the data refers to the default setting.

						
Typical motor power						
4-pole asynchronous motor	P	[kW]	18.5	22.0	22.0	30.0
Product key						
			E84AVTC□1834□□0		E84AVTC□2234□□0	
DC supply						
	U_{DC}	[V]	DC 455 V -0 % ... 775 V +0 %			
Rated DC-bus current						
	$I_{N, DC}$	[A]	44.1		51.4	
Power loss						
	P_V	[kW]	0.540		0.640	
Max. cable length [1]						
Shielded motor cable	l_{max}	[m]	100			

4.4

Brake chopper rated data

Rated power, Brake chopper				
	P_N	[kW]	35.0	35.0
Max. output power, Brake chopper				
	$P_{max, 1}$	[kW]	35.0	35.0
Min. brake resistance				
	R_{min}	[Ω]	15.0	15.0

Dimensions and weights

Standard installation design

Dimensions				
Height	h	[mm]	350	350
Width	b	[mm]	205	205
Depth [2]	t	[mm]	265	265
Mass				
	m	[kg]	12.2	12.2

[1] Technically possible cable lengths, irrespective of EMC requirements
[2] With safety engineering plus 20 mm



Rated data 400 V

► Unless otherwise specified, the data refers to the default setting.

Data in left column per device

Operation with rated data: rated output current $I_{N,out}$ at mains voltage 400 V, switching frequency 8 kHz variable and max. ambient temperature 45 °C (default setting).
Output currents I_{out} apply to:
Ambient temperature 45 °C operating with constant switching frequency 2 kHz or 4 kHz.
Ambient temperature 40 °C operating with constant switching frequency 8 kHz or 16 kHz.

Data in right column per device

Operation with increased power: rated output current $I_{N,out}$ at mains voltage 400 V, switching frequency 4 kHz constant and max. ambient temperature 40 °C.
Output currents apply to:
Ambient temperature 40 °C operating with constant switching frequency 2 kHz or 4 kHz.



Typical motor power								
4-pole asynchronous motor	P	[kW]	30.0 [1]	37.0 [1]	37.0 [1]	45.0 [1]	45.0 [1]	55.0 [1]
Product key								
			E84AVTC□3034□□0		E84AVTC□3734□□0		E84AVTC□4534□□0	
Mains voltage range								
	U_{AC}	[V]	3/PE AC 320 V-0 % ... 550 V+0 %, 45 Hz-0 % ... 65 Hz+0 %					
Rated mains current								
With mains choke	$I_{N, AC}$	[A]	55.0	66.0	68.0	81.6	80.0	96.0
Without mains choke	$I_{N, AC}$	[A]						
Rated output current								
	$I_{N, out}$	[A]	61.0	73.2	76.0	91.2	89.0	106.8
Output current								
2 kHz	I_{out}	[A]	61.0	73.2	76.0	91.2	89.0	106.8
4 kHz	I_{out}	[A]	61.0	73.2	76.0	91.2	89.0	106.8
8 kHz	I_{out}	[A]	61.0		76.0		89.0	
16 kHz	I_{out}	[A]	41.0		51.0		60.0	

Data for 60 s overload

Max. output current					
	$I_{max, out}$	[A]	91.5	114.0	133.5
Overload time					
	t_{ol}	[s]	60.0		
Recovery time					
	t_{re}	[s]	120.0		

Data for 3 s overload

Max. short-time output current					
	$I_{max, out}$	[A]	112.1	136.8	169.1
Overload time					
	t_{ol}	[s]	3.0		
Recovery time					
	t_{re}	[s]	12.0		

[1] Operation only permitted with mains choke or mains filter



Rated data 400 V

► Unless otherwise specified, the data refers to the default setting.

								
Typical motor power								
4-pole asynchronous motor	P	[kW]	30.0	37.0	37.0	45.0	45.0	55.0
Product key								
			E84AVTC□3034□□0		E84AVTC□3734□□0		E84AVTC□4534□□0	
DC supply								
	U_{DC}	[V]	DC 455 V -0 % ... 775 V +0 %					
Rated DC-bus current								
	$I_{N, DC}$	[A]	67.4		83.3		98.0	
Power loss								
	P_V	[kW]	0.840		0.980		1.300	
Max. cable length [1]								
Shielded motor cable	I_{max}	[m]	100					

4.4

Brake chopper rated data

Rated power, Brake chopper					
	P_N	[kW]	70.1	70.1	70.1
Max. output power, Brake chopper					
	$P_{max, 1}$	[kW]	70.1	70.1	70.1
Min. brake resistance					
	R_{min}	[Ω]	7.5	7.5	7.5

Dimensions and weights

Standard installation design

Dimensions					
Height	h	[mm]	450	450	450
Width	b	[mm]	250	250	250
Depth [2]	t	[mm]	265	265	265
Mass					
	m	[kg]	17.4	17.4	17.4

[1] Technically possible cable lengths, irrespective of EMC requirements
[2] With safety engineering plus 20 mm



"Cold plate" design

Inverters in cold-plate design dissipate some of their waste heat (heat loss) via a cooler adapted to the application. For this purpose, the inverters are provided with a planed cooling plate which is connected to a separate cooler in a thermally conductive way. Using the cold plate technology, the main part of the heat energy can be transferred directly to the external cooling units.

The use of cold-plate technology is advantageous for the following application cases:

- Minimising the expense of cooling the control cabinet. Here, the main part of the power loss is directly transferred to a cooling unit outside of the control cabinet, e.g. convection cooler or water cooler.
- Heavily polluted ambient air or control cabinets with a high degree of protection which do not allow for a use of a forced air cooling of the control cabinets.
- Low mounting depth in the control cabinet.

Product key	Power to be dissipated	Thermal resistance
	P_V	R_{th}
	[W]	[K/W]
E84AVTCC2512□□S	15.0	≤ 1.5
E84AVTCC3712□□S	20.0	≤ 1.5
E84AVTCC5512□□S	30.0	≤ 1.0
E84AVTCC7512□□S	40.0	≤ 1.0
E84AVTCC1122□□S	60.0	≤ 0.6
E84AVTCC1522□□S	75.0	≤ 0.5
E84AVTCC2222□□S	100	≤ 0.4
E84AVTCC3714□□S	25.0	≤ 1.0
E84AVTCC5514□□S	35.0	≤ 1.0
E84AVTCC7514□□S	50.0	≤ 1.0
E84AVTCC1124□□S	60.0	≤ 0.6
E84AVTCC1524□□S	70.0	≤ 0.5
E84AVTCC2224□□S	100	≤ 0.4
E84AVTCC3024□□S	100	≤ 0.4
E84AVTCC4024□□0	155	≤ 0.25
E84AVTCC5524□□0	215	≤ 0.18

Dimensions and weights

Product key			E84AVTCC2512□□S	E84AVTCC3712□□S	E84AVTCC5512□□S	E84AVTCC7512□□S
Dimensions						
Height, including fastening	h	[mm]	236			
Width, including fastening	b	[mm]	70			
Depth	t	[mm]	178			
Mass						
	m	[kg]	1.7			

Product key			E84AVTCC1122□□S	E84AVTCC1522□□S	E84AVTCC2222□□S
Dimensions					
Height, including fastening	h	[mm]	295		
Width, including fastening	b	[mm]	70		
Depth	t	[mm]	178		
Mass					
	m	[kg]	2.2		



"Cold plate" design

Dimensions and weights

Product key			E84AVTCC3714□□S	E84AVTCC5514□□S	E84AVTCC7514□□S
Dimensions					
Height, including fastening	h	[mm]	236		
Width, including fastening	b	[mm]	70		
Depth [1)]	t	[mm]	178		
Mass					
	m	[kg]	1.7		

Product key			E84AVTCC1124□□S	E84AVTCC1524□□S	E84AVTCC2224□□S
Dimensions					
Height, including fastening	h	[mm]	295		
Width, including fastening	b	[mm]	70		
Depth [1)]	t	[mm]	178		
Mass					
	m	[kg]	2.2		

Product key			E84AVTCC3024□□S	E84AVTCC4024□□0	E84AVTCC5524□□0
Dimensions					
Height, including fastening	h	[mm]	295	318	
Width, including fastening	b	[mm]	70	174	
Depth [1)]	t	[mm]	178	156	
Mass					
	m	[kg]	2.2	2.9	

[1)] With safety engineering plus 20 mm



Push-through technique design

The inverters in push-through design reduce the waste heat in the control cabinet.
The inverter is mounted in the control cabinet such that the heatsink of the inverter is outside the control cabinet. Thus, the entire waste heat can be dissipated outside the control cabinet via convection or forced air cooling for almost all device performances. For inverters with a power below 2.2 kW, restrictions may occur.

Using the push-through technology is advantageous in the following application cases:

- Minimising the expense for control cabinet cooling. For this purpose, the main part of the power loss is directly transferred to the ambience outside the control cabinet (e.g. convection cooling).
- In case of control cabinets with a high degree of protection > IP54 by using separate mounting and cooling areas.
- Low mounting depth in the control cabinet.



Push-through technique design

Dimensions and weights

Product key			E84AVTCD2512□□0	E84AVTCD3712□□0	E84AVTCD5512□□0	E84AVTCD7512□□0
Dimensions						
Height, including fastening	h	[mm]	236			
Width, including fastening	b	[mm]	102			
Depth (in control cabinet) [1]	t	[mm]	178			
Mass						
	m	[kg]	2.1			

Product key			E84AVTCD1122□□0	E84AVTCD1522□□0	E84AVTCD2222□□0	E84AVTCD3714□□0
Dimensions						
Height, including fastening	h	[mm]	295			236
Width, including fastening	b	[mm]	137			102
Depth (in control cabinet) [1]	t	[mm]	178			
Mass						
	m	[kg]	3.7			2.1

Product key			E84AVTCD5514□□0	E84AVTCD7514□□0	E84AVTCD1124□□0	E84AVTCD1524□□0
Dimensions						
Height, including fastening	h	[mm]	236		295	
Width, including fastening	b	[mm]	102		137	
Depth (in control cabinet) [1]	t	[mm]	178			
Mass						
	m	[kg]	2.1		3.7	

Product key			E84AVTCD2224□□0	E84AVTCD3024□□0	E84AVTCD4024□□0	E84AVTCD5524□□0
Dimensions						
Height, including fastening	h	[mm]	295	318		
Width, including fastening	b	[mm]	137	174		
Depth (in control cabinet) [1]	t	[mm]	178	156		
Mass						
	m	[kg]	3.7	5.1		

Product key			E84AVTCD7524□□0	E84AVTCD1134□□0	E84AVTCD1534□□0
Dimensions					
Height, including fastening	h	[mm]	378		
Width, including fastening	b	[mm]	174		
Depth (in control cabinet) [1]	t	[mm]	156		
Mass					
	m	[kg]	6.4		

[1] With safety engineering plus 20 mm





Mains connection

- The mains fuse and cable cross-section specifications are for a mains connection of 1 x 230V or 3 x 400V.
- Class gG/gl fuses or class gRL semiconductor fuses.
- The cable cross-sections apply to PVC-insulated copper cables.
- Use for installation with UL-approved cables, fuses and brackets.

Operation with mains choke

Typical motor power	Mains voltage	Product key	Circuit breaker	Fuse		Mains connection
4-pole asynchronous motor		Inverter		EN 60204-1	UL	Cross-section (with mains choke)
P	U_{AC}		I	I	I	q
[kW]	[V]		[A]	[A]	[A]	[mm2]
0.25	1 AC 180 ... 264	E84AV□□□2512□□□	C6	6	6	1.0
0.37		E84AV□□□3712□□□			10	
0.55		E84AV□□□5512□□□	C10	10		1.5
0.75		E84AV□□□7512□□□			15	
1.10		E84AV□□□1122□□□	C16	16	20	2.5
1.50		E84AV□□□1522□□□			25	
2.20		E84AV□□□2222□□□	C20	20	30	4.0
0.37	3 AC 320 ... 550	E84AV□□□3714□□□	C6	6	6	1.0
0.55		E84AV□□□5514□□□				
0.75		E84AV□□□7514□□□				
1.10		E84AV□□□1124□□□			10	
1.50		E84AV□□□1524□□□				
2.20		E84AV□□□2224□□□	C10	10		1.5
3.00		E84AV□□□3024□□□			15	
4.00		E84AV□□□4024□□□	C16	16	20	2.5
5.50		E84AV□□□5524□□□	C20	20		4.0
7.50		E84AV□□□7524□□□				
11.0		E84AV□□□1134□□□	C32	32	30	10.0
15.0		E84AV□□□1534□□□			40	
18.5		E84AV□□□1834□□□	C50	50		16.0
22.0		E84AV□□□2234□□□	C63	63	50	25.0
30.0		E84AV□□□3034□□□	C80	80	70	
37.0		E84AV□□□3734□□□	C100	100	80	50.0
45.0		E84AV□□□4534□□□	C125	125	100	



Mains connection

Operation without mains choke

Typical motor power	Mains voltage	Product key	Circuit breaker	Fuse		Mains connection
4-pole asynchronous motor		Inverter		EN 60204-1	UL	Cross-section (without mains choke)
P	U_{AC}		I	I	I	q
[kW]	[V]		[A]	[A]	[A]	[mm2]
0.25	1 AC 180 ... 264	E84AV□□□2512□□□	C6	6	6	1.0
0.37		E84AV□□□3712□□□			10	
0.55		E84AV□□□5512□□□	C10	10		1.5
0.75		E84AV□□□7512□□□			15	
1.10		E84AV□□□1122□□□	C16	16	20	2.5
1.50		E84AV□□□1522□□□	C20	20	25	4.0
2.20		E84AV□□□2222□□□	C25	25	30	6.0
0.37	3 AC 320 ... 550	E84AV□□□3714□□□	C6	6	6	1.0
0.55		E84AV□□□5514□□□				
0.75		E84AV□□□7514□□□				
1.10		E84AV□□□1124□□□	C10	10	10	1.5
1.50		E84AV□□□1524□□□				
2.20		E84AV□□□2224□□□				
3.00		E84AV□□□3024□□□	C16	16	15	2.5
4.00		E84AV□□□4024□□□			20	
5.50		E84AV□□□5524□□□	C25	25		4.0
7.50		E84AV□□□7524□□□	C32	32	25	10.0
11.0		E84AV□□□1134□□□			40	
18.5		E84AV□□□1834□□□	C80	80	60	25.0



Motor connection

- Keep motor cables as short as possible, as this has a positive effect on the drive behaviour.
- With group drives (multiple motors on one inverter), the resulting cable length is the key factor. This can be calculated using the hardware manual.
- Electric strength of the motor cable: 1 kV as per VDE 250-1.
- Capacitance per unit length
  ≤ 1.5 mm ^{2} / AWG 16: C $_{core-core}$ / C $_{core-shield}$ ≤ 75 / ≤150 pF/m
  ≥ 2.5 mm ^{2} / AWG 12: C $_{core-core}$ / C $_{core-shield}$ ≤ 100 / ≤ 150 pF/m.

Maximum shielded motor cable length without EMC limit values at switching frequency

Rated mains voltage	Typical motor power	Product key	4 kHz (without limit value)		8 kHz (without limit value)	16 kHz (without limit value)
	4-pole asynchronous motor	Inverter	45 °C	40 °C	40 °C	40 °C
U_{in}	P		I_{max}	I_{max}	I_{max}	I_{max}
[V]	[kW]		[m]	[m]	[m]	[m]
230	0.25	E84AV□□□2512□□□	50	100	50	50
	0.37	E84AV□□□3712□□□				
	0.55	E84AV□□□5512□□□				
	0.75	E84AV□□□7512□□□				
	1.10	E84AV□□□1122□□□				
	1.50	E84AV□□□1522□□□				
	2.20	E84AV□□□2222□□□				
400	0.37	E84AV□□□3714□□□				25
	0.55	E84AV□□□5514□□□				
	0.75	E84AV□□□7514□□□				
	1.10	E84AV□□□1124□□□				
	1.50	E84AV□□□1524□□□				
	2.20	E84AV□□□2224□□□				
	3.00	E84AV□□□3024□□□				
	4.00	E84AV□□□4024□□□				50
	5.50	E84AV□□□5524□□□				
	7.50	E84AV□□□7524□□□				
	11.0	E84AV□□□1134□□□				
	15.0	E84AV□□□1534□□□				
	18.5	E84AV□□□1834□□□	100	150	100	100
	22.0	E84AV□□□2234□□□				
	30.0	E84AV□□□3034□□□				
	37.0	E84AV□□□3734□□□				
	45.0	E84AV□□□4534□□□				
500	0.37	E84AV□□□3714□□□	50	100	25	15
	0.55	E84AV□□□5514□□□				
	0.75	E84AV□□□7514□□□				
	1.10	E84AV□□□1124□□□				
	1.50	E84AV□□□1524□□□				
	2.20	E84AV□□□2224□□□				
	3.00	E84AV□□□3024□□□				



Motor connection

Maximum shielded motor cable length without EMC limit values at switching frequency

Rated mains voltage	Typical motor power	Product key	4 kHz (without limit value)		8 kHz (without limit value)	16 kHz (without limit value)
	4-pole asynchronous motor	Inverter	45 °C	40 °C	40 °C	40 °C
U_{in}	P		I_{max}	I_{max}	I_{max}	I_{max}
[V]	[kW]		[m]	[m]	[m]	[m]
500	4.00	E84AV□□□4024□□□	50	100	50	50
	5.50	E84AV□□□5524□□□				
	7.50	E84AV□□□7524□□□				
	11.0	E84AV□□□1134□□□				
	15.0	E84AV□□□1534□□□				
	18.5	E84AV□□□1834□□□	100	150	100	100
	22.0	E84AV□□□2234□□□				
	30.0	E84AV□□□3034□□□				
	37.0	E84AV□□□3734□□□				
	45.0	E84AV□□□4534□□□				

Maximum shielded motor cable length acc. to category C2 (industry), conducted

► The values for I_{max} are valid for an ambient temperature of up to 40°C.

Rated mains voltage	Typical motor power	Product key	Integrated filter		RFI filter SD		RFI filter LD	
	4-pole asynchronous motor	Inverter	4 kHz	8 kHz	4 kHz	8 kHz	4 kHz	8 kHz
U_{in}	P		I_{max}	I_{max}	I_{max}	I_{max}	I_{max}	I_{max}
[V]	[kW]		[m]	[m]	[m]	[m]	[m]	[m]
230	0.25	E84AV□□□2512□□□	25	25	50	50	100	50
	0.37	E84AV□□□3712□□□						
	0.55	E84AV□□□5512□□□						
	0.75	E84AV□□□7512□□□						
	1.10	E84AV□□□1122□□□						
	1.50	E84AV□□□1522□□□						
	2.20	E84AV□□□2222□□□						
400	0.37	E84AV□□□3714□□□						
	0.55	E84AV□□□5514□□□						
	0.75	E84AV□□□7514□□□						
	1.10	E84AV□□□1124□□□						
	1.50	E84AV□□□1524□□□						
	2.20	E84AV□□□2224□□□						
	3.00	E84AV□□□3024□□□						
	4.00	E84AV□□□4024□□□						
	5.50	E84AV□□□5524□□□						
	7.50	E84AV□□□7524□□□						
	11.0	E84AV□□□1134□□□						
	15.0	E84AV□□□1534□□□						



Motor connection

Maximum shielded motor cable length acc. to category C2 (industry), conducted

► The values for I_{max} are valid for an ambient temperature of up to 40°C.

Rated mains voltage	Typical motor power	Product key	Integrated filter		RFI filter SD		RFI filter LD	
	4-pole asynchronous motor	Inverter	4 kHz	8 kHz	4 kHz	8 kHz	4 kHz	8 kHz
U_{in}	P		I_{max}	I_{max}	I_{max}	I_{max}	I_{max}	I_{max}
[V]	[kW]		[m]	[m]	[m]	[m]	[m]	[m]
400	18.5	E84AV□□□1834□□□	25	25			100	100
	22.0	E84AV□□□2234□□□						
	30.0	E84AV□□□3034□□□						
	37.0	E84AV□□□3734□□□						
	45.0	E84AV□□□4534□□□						
500	0.37	E84AV□□□3714□□□			50	25		25
	0.55	E84AV□□□5514□□□						
	0.75	E84AV□□□7514□□□						
	1.10	E84AV□□□1124□□□						
	1.50	E84AV□□□1524□□□						
	2.20	E84AV□□□2224□□□						
	3.00	E84AV□□□3024□□□						
	4.00	E84AV□□□4024□□□				50		50
	5.50	E84AV□□□5524□□□						
	7.50	E84AV□□□7524□□□						
	11.0	E84AV□□□1134□□□						
	15.0	E84AV□□□1534□□□						
	18.5	E84AV□□□1834□□□						100
	22.0	E84AV□□□2234□□□						
	30.0	E84AV□□□3034□□□						
	37.0	E84AV□□□3734□□□						
	45.0	E84AV□□□4534□□□						



Motor connection

Operation with earth-leakage circuit breaker

If the inverter is connected via an earth-leakage circuit breaker, the following cable lengths are permissible, although the table must also be taken into account:

Earth-leakage circuit breaker 30 mA:
- 0.25 ... 2.2 kW to 25 m shielded motor cable with integrated RFI measures
- 0.25 ... 15 kW to 25 m shielded motor cable with RFI fiter SD.

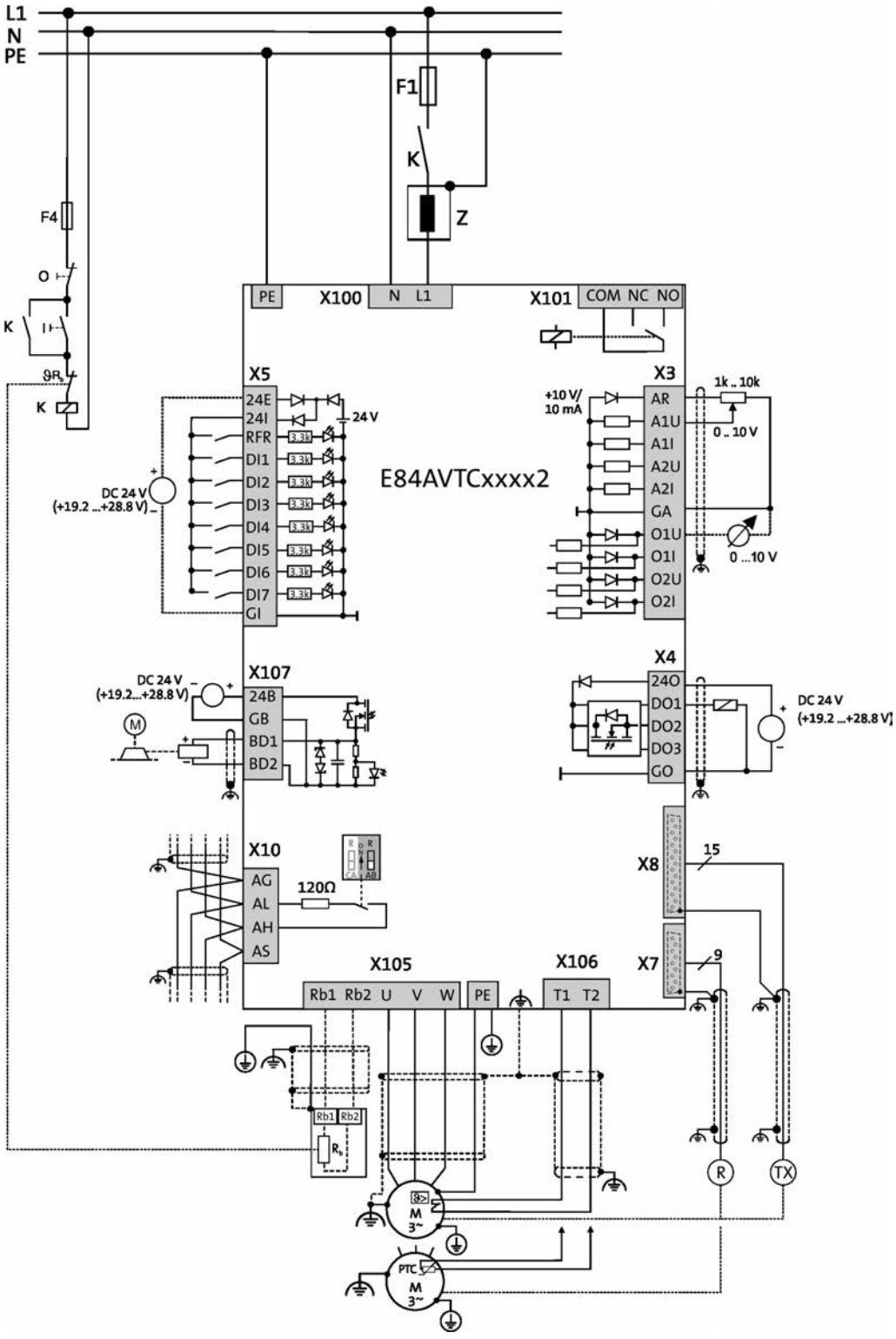
Earth-leakage circuit breaker 300 mA:
- 0.25 to 45 kW up to 25 m shielded motor cable with integrated RFI measures
- 0.25 to 45 kW up to 50 m shielded motor cable with RFI filter LD.

► When RFI filters SD are used, C1 can be complied with in a conducted manner (a shielded motor cable up to 25 m).
► In case of 0.25 ... 2.2 kW (230 V) with RFI filter LL, C1 and a fault current <3.5 mA can be realised (a shielded motor cable of up to 5 m).



Connection diagrams

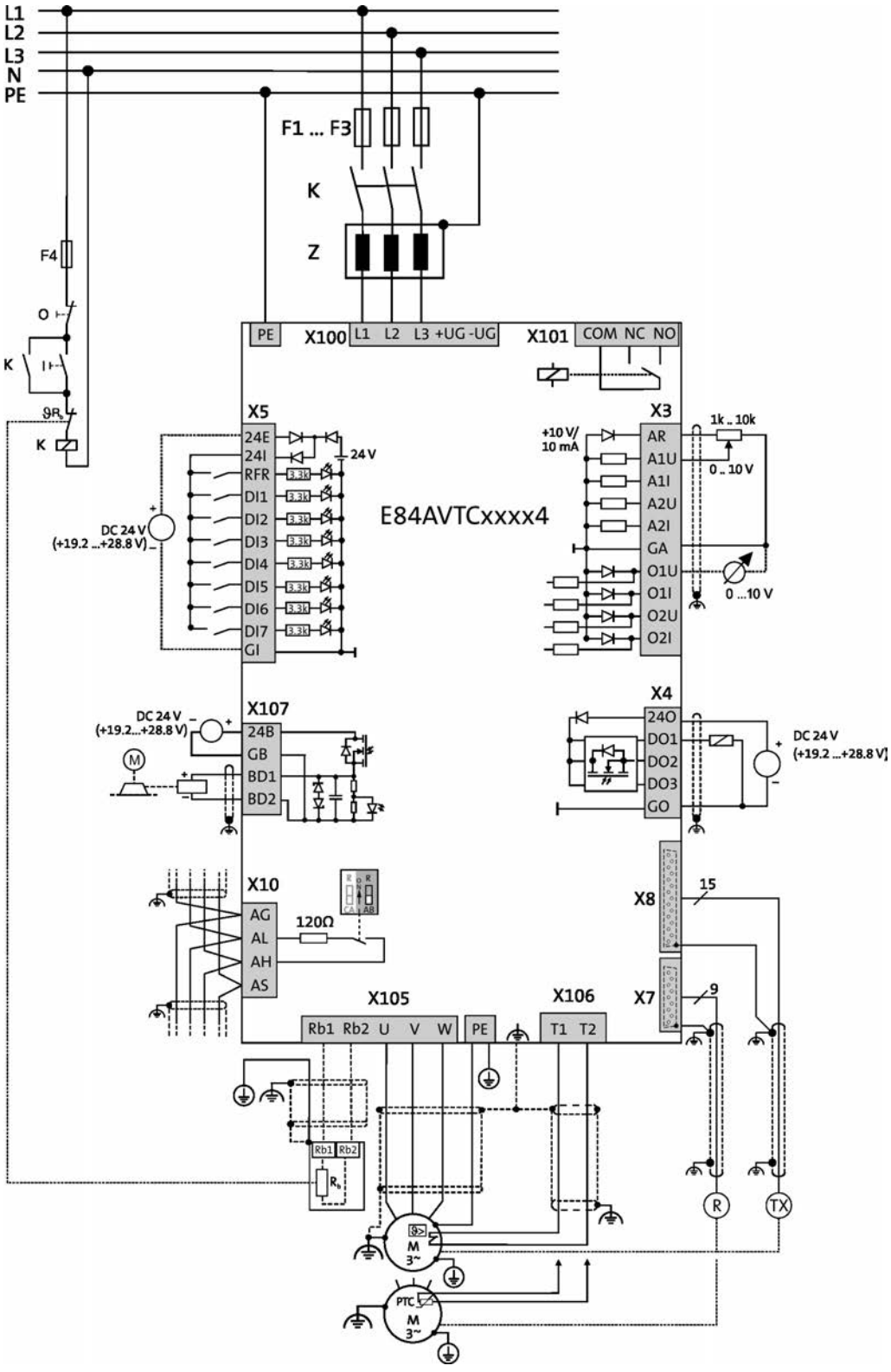
Wiring example for connecting Inverter Drives 8400 TopLine to 1 x 230V





Connection diagrams

Verdrahtungsbeispiel Inverter Drives 8400 TopLine an 3 x 400 V





Control connections

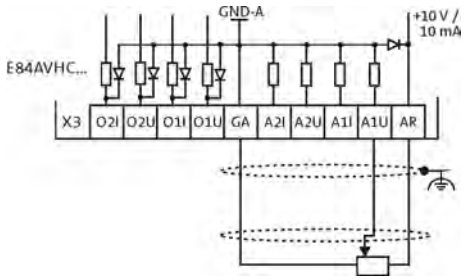
Mode	
	8400 TopLine
Analog inputs	
Number	2 Optional: voltage or current input
Resolution	10 bits + sign
Value range	0 ... +/- 10V, 0/4 ... 20 mA
Analog outputs	
Number	2 Optional: voltage or current output
Resolution	10 bits
Value range	0 ... 10V, 0/4 ... 20mA
Digital inputs	
Number	8
Switching level	PLC (IEC 61131-2)
Max. input current	11mA
Function	4 inputs can optionally be used as frequency input (200 kHz, 2-track)
Digital outputs	
Number	4
Switching level	PLC (IEC 61131-2)
Max. output current	1 x 2.5A, (basic insulation, with spark suppressor, e.g. for 24 V service brake) 3 x 50mA
Relay	
Number	1
Contact	Changeover contact
AC connection	250V, 3A
DC connection	24V, 2A ... 240V, 0.16A
External DC supply	
Rated voltage [1)]	24 V
Interfaces	
CANopen	Integrated functional insulated Max. baud rate 1000 kbps DIP switch for address, baud rate, bus termination
Extensions	optional communication module
Safety engineering	Optional Safe torque off (STO)
Drive interface	
Axis bus	for cross communication and synchronisation of several 8400 TopLine devices
Encoder input	Sub-D, 15-pin Multiple encoder input for: TTL incremental encoder, SinCos incremental or absolute value encoder, SSI absolute value encoder KTY temperature sensor evaluation Via 4 digital inputs: HTL, 2/4-track, 200 kHz
Resolver input	Sub-D, 9-pin

[1)] For mains-independent control electronics supply

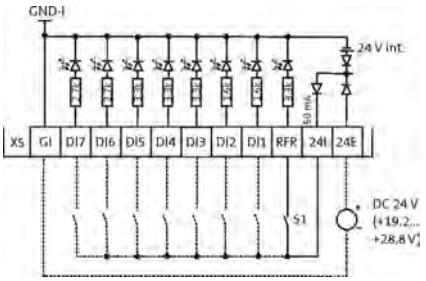


Control connections

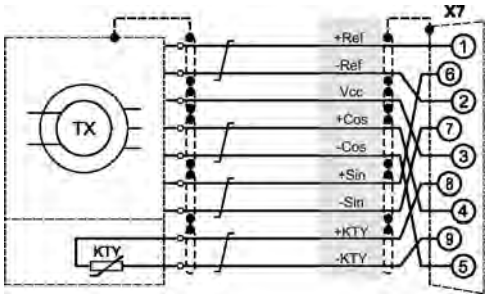
Connection of analog inputs and outputs



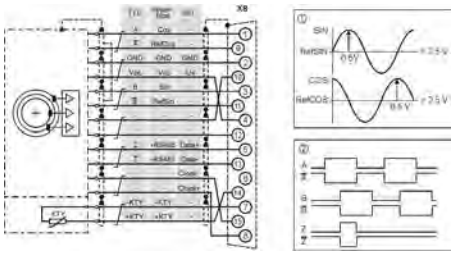
Connection of digital inputs and outputs



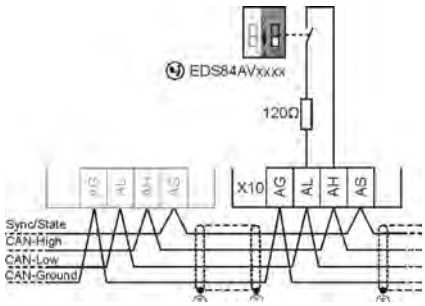
Resolver connection



Encoder connection



Axis bus connection





Memory module

All drive settings for the 8400 are stored on the memory module, which is a pluggable memory chip. The memory module ensures that drives can be replaced quickly and without errors being made.

Mode	Features	Product key
Memory module	• For 8400 StateLine, HighLine, Topline and protec • Packaging unit: 5 items	E84AYM10S/M

► Each inverter is equipped with a memory module in the factory

Safety system (STO)

The 8400 StateLine, HighLine and TopLine models are optionally available with "STO safe torque off" safety engineering. This helps reduce control system costs, save space in the control cabinet and keep wiring to a minimum. The safety engineering is certified to EN ISO 13849-1 (Cat. 4, PL e), EN 61508/EN 62061 (SIL 3).

The inverters can optionally be ordered with integrated safety engineering (STO). In this case, the product key of the inverter has a "**B**" as the 14th character.
For example, a StateLine 230 V, 0.55 kW built-in unit with safety engineering would be: E84AVSCE5512S**B**0



8400 StateLine with safety engineering



EtherCAT® communication module

A communication module is used to connect the 8400 StateLine, HighLine or TopLine to a bus system.



EtherCAT® communication module

Mode		Features	Slot	Product key
Communication module				
EtherCAT		• Distributed clock • 5 LEDs for status display • 2 RJ45 connections with LEDs for link and activity • Connection option for separate 24 V supply	MCI	E84AYCETV/S

4.4

► The Inverter Drives 8400 can be ordered with a plug-in EtherCAT® communication module already installed. If you would like to order the products in this complete form, please add the inverter product key as follows when placing your order: E84AV to X-**ETXXX**

► The product key with the supplement for the applied module is provided in our sales documents. This information is not part of the nameplate of the device.

Standards and operating conditions

Product key			
			E84AYCETV/S
Mode			
Communication module			EtherCAT
Degree of protection			
EN 60529			IP20
Climatic conditions			
Storage (EN 60721-3-1)			1K3 (temperature: -25 °C ... +60 °C)
Transport (EN 60721-3-2)			2K3 (temperature: -25 °C ... +70 °C)
Operation (EN 60721-3-3)			3K3 (temperature: -10°C ... +55 °C)
Insulation voltage to reference earth/PE			
EN 61800-5-1	U_{AC}	[V]	50.0



EtherCAT® communication module

Rated data

Product key			
			E84AYCETV/S
Communication			
Medium			CAT5e S/FTP according to ISO/ICE11801 (2002)
Communication profile			CoE (CANopen over EtherCAT)
Baud rate			
	b	[MBit/s]	100
Node			
			Slave
Network topology			
			Line
Number of logical process data channels			
			1
Process data words (PCD)			
16 Bit			1 ... 16
Number of bus nodes			
			Max. 65535
Max. cable length			
between two nodes	l_{max}	[m]	100



EtherNet/IP communication module

A communication module is used to connect the 8400 StateLine, HighLine or TopLine to a bus system.



EtherNet/IP communication module

Mode		Features	Slot	Product key
Communication module				
EtherNet/IP		• 5 LEDs for status display • 2 RJ45 connections with LEDs for link and activity • Address can be set via 2 rotary DIP switches • TCP/IP channel • ODVA certification (Open Device Vendor Association) • Supported assembly object instances as per ODVA: 20, 21, 22, 23 and 70, 71, 72, 73 • Manufacturer-specific supported assembly object instances (custom): 110 and 111 • Connection option for separate 24 V supply	MCI	E84AYCEOV/S

4.4

► The Inverter Drives 8400 can be ordered with a plug-on PROFINET communication module already installed. If you would like to order the products in this complete form, please add the inverter product key as follows when placing your order: E84AV to X-**EOXXX**

► The product key with the supplement for the applied module is provided in our sales documents. This information is not part of the nameplate of the device.

Standards and operating conditions

Product key			
			E84AYCEOV/S
Mode			
Communication module			EtherNet/IP
Degree of protection			
EN 60529			IP20
Climatic conditions			
Storage (EN 60721-3-1)			1K3 (temperature: -25 °C ... +60 °C)
Transport (EN 60721-3-2)			2K3 (temperature: -25 °C ... +70 °C)
Operation (EN 60721-3-3)			3K3 (temperature: -10°C ... +55 °C)
Insulation voltage to reference earth/PE			
EN 61800-5-1	U_{AC}	[V]	50.0



EtherNet/IP communication module

Rated data

Product key			
			E84AYCEOV/S
Communication			
Medium			CAT5e S/FTP according to ISO/ICE11801 / EN50173
Communication profile			EtherNET/IP, AC Drive
Baud rate			
	b	[MBit/s]	10/100 (full duplex/half duplex)
Node			
			Slave (Adapter)
Network topology			
			Tree, star and line
Process data words (PCD)			
16 Bit			1 ... 16
Number of bus nodes			
			max. 254 im Subnetz
Max. cable length			
between two nodes	l_{max}	[m]	100



Ethernet POWERLINK communication module

A communication module is used to connect the 8400 StateLine, HighLine or TopLine to a bus system.



POWERLINK communication module

Mode		Features	Slot	Product key
Communication module				
Ethernet POWERLINK CN		• Sync mode, Multiplex mode • 5 LEDs for status display • 2 x RJ45 connections with LEDs for link and collision • Address can be set via 2 rotary DIP switches • Connection option for separate 24 V supply	MCI	E84AYCECV/S

4.4

► The Inverter Drives 8400 can be ordered with a plug-in POWERLINK communication module already installed. If you would like to order the products in this complete form, please add the inverter product key as follows when placing your order: E84AV to X-**ECXXX**

► The product key with the supplement for the applied module is provided in our sales documents. This information is not part of the nameplate of the device.

Standards and operating conditions

Product key			
			E84AYCECV/S
Mode			
Communication module			Ethernet POWERLINK CN
Degree of protection			
EN 60529			IP20
Climatic conditions			
Storage (EN 60721-3-1)			1K3 (temperature: -25 °C ... +60 °C)
Transport (EN 60721-3-2)			2K3 (temperature: -25 °C ... +70 °C)
Operation (EN 60721-3-3)			3K3 (temperature: -10°C ... +55 °C)
Insulation voltage to reference earth/PE			
EN 61800-5-1	U_{AC}	[V]	50.0



Ethernet POWERLINK communication module

Rated data

Product key			
			E84AYCECV/S
Communication			
Medium			CAT5e S/FTP according to ISO/ICE11801 (2002)
Communication profile			EPL2.0
Baud rate			
	b	[MBit/s]	100
Node			
			Controlled node (CN)
Network topology			
			Tree, star and line
Number of logical process data channels			
			1
Process data words (PCD)			
16 Bit			1 ... 16
Number of bus nodes			
			max. 239
Max. cable length			
between two nodes	l_{max}	[m]	100



PROFIBUS communication module

A communication module is used to connect the 8400 StateLine, HighLine or TopLine to a bus system.



PROFIBUS communication module

Mode		Features	Slot	Product key
Communication module				
PROFIBUS		• 5 LEDs for status display • Sub-D connection • Address can be set via DIP switch	MCI	E84AYCPMV/S

4.4

► The Inverter Drives 8400 can be ordered with a plug-in PROFIBUS communication module already installed. If you would like to order the products in this complete form, please add the inverter product key as follows when placing your order: E84AV to X-**PMXXX**

► The product key with the supplement for the applied module is provided in our sales documents. This information is not part of the nameplate of the device.

Standards and operating conditions

Product key			
			E84AYCPMV/S
Mode			
Communication module			PROFIBUS
Degree of protection			
EN 60529			IP20
Climatic conditions			
Storage (EN 60721-3-1)			1K3 (temperature: -25 °C ... +60 °C)
Transport (EN 60721-3-2)			2K3 (temperature: -25 °C ... +70 °C)
Operation (EN 60721-3-3)			3K3 (temperature: -10°C ... +55 °C)
Insulation voltage to reference earth/PE			
EN 61800-5-1	U_{AC}	[V]	50.0



PROFIBUS communication module

Rated data

Product key			
			E84AYCPMV/S
Communication			
Medium			RS 485
Communication profile			PROFIBUS-DP-V1 PROFIBUS-DP-V0
Device profile			PROFIDrive, version 3
Baud rate			
	b	[kBit/s]	9.6 ... 12 000 (automatic detection)
Node			
			Slave
Network topology			
			Line with repeater: Line or tree without repeater:
Process data words (PCD)			
16 Bit			1 ... 16
DP user data length			
			Optional parameter channel (4 words) + process data words
Number of bus nodes			
			31 slaves + 1 master per bus segment With repeaters: 125
Max. cable length			
per bus segment	l_{max}	[m]	1200 (depending on the baud rate and the cable type used)



PROFINET communication module

A communication module is used to connect the 8400 StateLine, HighLine or TopLine to a bus system.



PROFINET communication module

Mode		Features	Slot	Product key
Communication module				
PROFINET		• 5 LEDs for status display • 2 RJ45 connections with LEDs for link and activity • TCP/IP channel • Connection option for separate 24 V supply	MCI	E84AYCERV/S

4.4

- ► The Inverter Drives 8400 can be ordered with a plug-on PROFINET communication module already installed. If you would like to order the products in this complete form, please add the inverter product key as follows when placing your order: E84AV to X-**ER-XXX**
- ► The product key with the supplement for the applied module is provided in our sales documents. This information is not part of the nameplate of the device.

Standards and operating conditions

Product key			
			E84AYCERV/S
Mode			
Communication module			PROFINET
Degree of protection			
EN 60529			IP20
Climatic conditions			
Storage (EN 60721-3-1)			1K3 (temperature: -25 °C ... +60 °C)
Transport (EN 60721-3-2)			2K3 (temperature: -25 °C ... +70 °C)
Operation (EN 60721-3-3)			3K3 (temperature: -10°C ... +55 °C)
Insulation voltage to reference earth/PE			
EN 61800-5-1	U_{AC}	[V]	50.0



PROFINET communication module

Rated data

Product key			
			E84AYCERV/S
Communication			
Medium			CAT5e S/FTP according to ISO/ICE11801 (2002)
Communication profile			PROFINET RT Conf. Class B
Baud rate			
	b	[MBit/s]	100
Node			
			Slave (Device)
Network topology			
			Line
Number of logical process data channels			
			1
Process data words (PCD)			
16 Bit			1 ... 16
Max. cable length			
between two nodes	l_{max}	[m]	100





Brake resistors

An external brake resistor is required to brake high moments of inertia or in the event of prolonged operation in generator mode; this resistor converts braking energy into heat.

The brake resistors recommended in the table below have been dimensioned for approx. 1.5 times the regenerative power, with a cycle time of 15/135 s (brake/rest ratio). These brake resistors generally meet the usual requirements of standard applications.

The brake resistors are fitted with a thermostat (potential-free NC contact).



ERBM...(IP50) brake resistor

Typical motor power	Mains voltage	Product key		Rated resistance	Rated power	Thermal capacity	Dimensions	Mass
4-pole asynchronous motor		Inverter	Brake resistor					
P	U_{AC}			R_N	P_N	C_{th}	h x b x t	m
[kW]	[V]			[Ω]	[kW]	[KWs]	[mm]	[kg]
0.25	1 AC 180 ... 264	E84AV□□□2512□□□	ERBM180R050W	180.0	0.050	7.50	175 x 20.6 x 40	0.3
0.37		E84AV□□□3712□□□						
0.55		E84AV□□□5512□□□	ERBM100R100W	100.0	0.10	15.0	240 x 80 x 95	0.5
0.75		E84AV□□□7512□□□						
1.10		E84AV□□□1122□□□	ERBP033R200W	33.0	0.20	30.0	240 x 41 x 122	1.0
1.50		E84AV□□□1522□□□						
2.20		E84AV□□□2222□□□	ERBP033R300W		0.30	45.0	320 x 41 x 122	1.4
0.37	3 AC 320 ... 550	E84AV□□□3714□□□	ERBM390R100W	390.0	0.10	15.0	235 x 20.6 x 40	0.4
0.55		E84AV□□□5514□□□						
0.75		E84AV□□□7514□□□						
1.10		E84AV□□□1124□□□	ERBP180R200W	180.0	0.20	30.0	240 x 41 x 122	1.0
1.50		E84AV□□□1524□□□						
2.20		E84AV□□□2224□□□	ERBP180R300W		0.30	45.0	320 x 41 x 122	1.4



Brake resistors

For standard applications, we recommend the following combinations:
E84AV□□□3024□□0 and ERBP082R200W
E84AV□□□4024□□0 and ERBS047R400W
E84AV□□□5524□□0 and ERBS047R800W
E84AV□□□7524□□0 and ERBS027R01K2
E84AV□□□1134□□0 and ERBS027R01K2
E84AV□□□1534□□0 and ERBS018R01K4
E84AV□□□1834□□0 and ERBS015R02K4
E84AV□□□2234□□0 and ERBS015R02K4.

Other possible combinations:



ERBP...(IP21) and ERBS...(IP65) brake resistor

Typical motor power	Mains voltage	Product key		Rated resistance	Rated power	Thermal capacity	Dimensions	Mass
4-pole asynchronous motor		Inverter	Brake resistor					
P	U_{AC}			R_N	P_N	C_{th}	h x b x t	m
[kW]	[V]			[Ω]	[kW]	[KWs]	[mm]	[kg]
3.00	3 AC 320 ... 550	E84AV□□□3024□□□	ERBP082R200W	82.0	0.20	30.0	320 x 41 x 122	1.0
			ERBS082R780W		0.78	117	666 x 124 x 122	4.0
4.00		E84AV□□□4024□□□	ERBS047R400W	47.0	0.40	60.0	400 x 110 x 105	2.3
			ERBS047R800W		0.80	120	710 x 110 x 105	3.9
5.50		E84AV□□□5524□□□	ERBS047R400W		0.40	60.0	400 x 110 x 105	2.3
			ERBS047R800W		0.80	120	710 x 110 x 105	3.9
7.50		E84AV□□□7524□□□	ERBP027R200W	27.0	0.20	30.0	320 x 41 x 122	1.0
			ERBS027R600W		0.60	90.0	550 x 110 x 105	3.1
			ERBS027R01K2		1.20	180	1020 x 110 x 105	5.6
11.0		E84AV□□□1134□□□	ERBP027R200W		0.20	30.0	320 x 41 x 122	1.0
			ERBS027R600W		0.60	90.0	550 x 110 x 105	3.1
			ERBS027R01K2		1.20	180	1020 x 110 x 105	5.6
15.0		E84AV□□□1534□□□	ERBS018R800W	18.0	0.80	120	710 x 110 x 105	3.9
			ERBS018R01K4		1.40	210	1110 x 110 x 105	6.2
			ERBS018R02K8		2.80	420	1110 x 200 x 105	12.0
18.5		E84AV□□□1834□□□	ERBS015R800W	15.0	0.80	120	710 x 110 x 105	3.9
			ERBS015R01K2		1.20	180	1020 x 110 x 105	5.6
			ERBS015R02K4		2.40	420	1020 x 200 x 105	10.0
22.0		E84AV□□□2234□□□	ERBS015R800W		0.80	120	710 x 110 x 105	3.9
			ERBS015R01K2		1.20	180	1020 x 110 x 105	5.6
			ERBS015R02K4		2.40	420	1020 x 200 x 105	10.0
30.0		E84AV□□□3034□□□	ERBG075D01K9	7.5	1.90	285	486 x 236 x 302	9.5
37.0		E84AV□□□3734□□□						
45.0		E84AV□□□4534□□□						



Mains chokes

A mains choke is an inductive resistor which is connected in the mains cable of the power supply module. The use of a mains choke provides the following advantages:

- **Fewer effects on the mains:**
  The wave form of the mains current is a close approximation to a sine wave.
- **Reduction in the effective mains current:**
  Reduction of mains, cable and fuse loads

Mains chokes can be used without restrictions in conjunction with RFI filters and/or sinusoidal filters.

Please note:
: The use of a mains choke slightly reduces the mains voltage at the input of the inverter - the typical voltage drop across the mains choke at the rated values is around 4%.



Mains choke

Operation at rated power

Typical motor power	Mains voltage	Product key		Rated current	Dimensions	Mass
4-pole asynchron-ous motor		Inverter	Mains choke			
P	U_{AC}			I_N	h x b x t	m
[kW]	[V]			[A]	[mm]	[kg]
0.25	1 AC 180 ... 264	E84AV□□□2512□□□	ELN1-0900H005	5.00	75 x 66 x 82	1.1
0.37		E84AV□□□3712□□□				
0.55		E84AV□□□5512□□□	ELN1-0500H009	9.00		
0.75		E84AV□□□7512□□□				
1.10		E84AV□□□1122□□□	ELN1-0250H018	18.0	96 x 96 x 90	2.1
1.50		E84AV□□□1522□□□				
2.20		E84AV□□□2222□□□				
0.37	3 AC 320 ... 550	E84AV□□□3714□□□	EZAELN3002B153	2.00	56 x 77 x 100	0.5
0.55		E84AV□□□5514□□□	EZAELN3004B742	4.00	60 x 95 x 115	1.3
0.75		E84AV□□□7514□□□				
1.10		E84AV□□□1124□□□				
1.50		E84AV□□□1524□□□	EZAELN3006B492	6.00	69 x 95 x 120	1.5
2.20		E84AV□□□2224□□□				
3.00		E84AV□□□3024□□□	EZAELN3008B372	8.00	85 x 120 x 140	1.9
4.00		E84AV□□□4024□□□	EZAELN3010B292	10.0		2.0
5.50		E84AV□□□5524□□□	EZAELN3016B182	16.0	95 x 120 x 140	2.7
7.50		E84AV□□□7524□□□	EZAELN3020B152	20.0	95 x 155 x 165	3.8
11.0		E84AV□□□1134□□□	EZAELN3025B122	25.0	110 x 155 x 170	5.8
15.0		E84AV□□□1534□□□ [1)]	EZAELN3035B841	35.0		6.0
18.5		E84AV□□□1834□□□	EZAELN3045B651	45.0	112 x 185 x 200	8.3
22.0		E84AV□□□2234□□□ [1)]	EZAELN3050B591	50.0	112 x 185 x 210	8.4
30.0		E84AV□□□3034□□□ [1)]	EZAELN3063B471	63.0	122 x 185 x 210	9.7
37.0		E84AV□□□3734□□□ [1)]	EZAELN3080B371	80.0	125 x 210 x 240	12.5
45.0		E84AV□□□4534□□□ [1)]	EZAELN3090B331	90.0	115 x 267 x 205	11.5

[1)] Operation only permitted with mains choke

► On some inverters, a mains filter (combination of RFI filter and mains choke) can be used in place of a mains choke. Information on this can be found in the "Interference suppression" section.



Mains chokes

Operation with increased power output



Mains choke

Typical motor power	Mains voltage	Product key		Rated current	Dimensions	Mass
4-pole asynchron-ous motor		Inverter	Mains choke			
P	U_{AC}			I_N	h x b x t	m
[kW]	[V]			[A]	[mm]	[kg]
0.37	1 AC 180 ... 264	E84AV□□□2512□□□	ELN1-0900H005	5.00	75 x 66 x 82	1.1
0.55		E84AV□□□3712□□□ 1)				
0.75		E84AV□□□5512□□□	ELN1-0500H009	9.00		
1.10		E84AV□□□7512□□□ 1)				
1.50		E84AV□□□1122□□□	ELN1-0250H018	18.0	96 x 96 x 90	2.1
2.20		E84AV□□□1522□□□ 1)				
0.55	3 AC 320 ... 550	E84AV□□□3714□□□	EZAELN3002B153	2.00	56 x 77 x 100	0.5
0.75		E84AV□□□5514□□□	EZAELN3004B742	4.00	60 x 95 x 115	1.3
1.10		E84AV□□□7514□□□ 1)				
1.50		E84AV□□□1124□□□				
2.20		E84AV□□□1524□□□	EZAELN3006B492	6.00	69 x 95 x 120	1.5
3.00		E84AV□□□2224□□□ 1)	EZAELN3008B372	8.00	85 x 120 x 140	1.9
4.00		E84AV□□□3024□□S 1)	EZAELN3010B292	10.0		2.0
		E84AV□□□3024□□0				
5.50		E84AV□□□4024□□□	EZAELN3016B182	16.0	95 x 120 x 140	2.7
7.50		E84AV□□□5524□□□ 1)	EZAELN3020B152	20.0	95 x 155 x 165	3.8
11.0		E84AV□□□7524□□□	EZAELN3025B122	25.0	110 x 155 x 170	5.8
15.0		E84AV□□□1134□□□ 1)	EZAELN3030B982	30.0	110 x 155 x 167	5.9
22.0		E84AV□□□1834□□□ 1)	EZAELN3045B651	45.0	112 x 185 x 200	8.3
30.0		E84AV□□□2234□□□ 1)	EZAELN3063B471	63.0	122 x 185 x 210	9.7
37.0		E84AV□□□3034□□□ 1)	EZAELN3080B371	80.0	125 x 210 x 240	12.5
45.0		E84AV□□□3734□□□ 1)	EZAELN3090B331	90.0	115 x 267 x 205	11.5
55.0		E84AV□□□4534□□□ 1)	EZAELN3100B301	100	139 x 267 x 205	16.5

1) Operation only permitted with mains choke



Interference suppression

RFI and mains filters are used to ensure compliance with the EMC requirements of European Standard EN 61800-3. This standard defines the EMC requirements for electrical drive system in various categories.
Category C1 applies to public networks (residential areas). Category C1 corresponds to Class B with regard to the limit values of Class B in line with EN 55011.
Category C2 is applicable in industrial premises; use in residential areas is left to the user's discretion. With regard to limit values, Category C2 corresponds to Class A according to EN 55011.



RFI filters

When working with stricter line-bound noise emission requirements, which cannot be met using the radio interference suppression measures integrated in the inverter (C2 up to 25 m shielded motor cable), external filters can be used. The filters can be installed below or next to the inverters.

Available RFI and mains filters

Mode				
Filter	RFI filter LL (Low Leakage) E84AZESR□□□□LL	RFI filter SD (Short Distance) E84AZESR□□□□SD	RFI filter LD (Long Distance) E84AZESR□□□□LD	Mains filter LD (Long Distance) I0FAE□□□F100D000□S
Category C1				
	Up to 5 m shielded motor cable [1)]	Up to 25 m shielded motor cable [1)]	Up to 50 m shielded motor cable [1)]	Up to 50 m shielded motor cable [1)]
Category C2				
		Up to 50 m shielded motor cable [1)]	Up to 100 m shielded motor cable [1)]	Up to 100 m shielded motor cable [1)]
Power range				
	0.25 to 2.2 kW, 230 V	0.25 to 15 kW	0.25 to 18.5 kW	22 to 45 kW
Features				
	• For installation in mobile systems, leakage current < 3.5 mA (up to 5 m shielded motor cable)	• Optimised for low leakage current.	• 0,25 up to 15 kW: 50 - 100 m at max. 40 °C ambient temperature and max. 4 kHz switching frequency.	• Combination of mains choke and RFI filter.

[1)] 37 - Details on maximum motor cable lengths.



Interference suppression

Operation at rated power

► RFI filter LL (Low Leakage)

Typical motor power	Mains voltage	Product key		Rated current	Dimensions	Mass
4-pole asynchronous motor		Inverter	RFI filter			
P	U_{AC}			I_N	h x b x t	m
[kW]	[V]			[A]	[mm]	[kg]
0.25	1 AC 180 ... 264	E84AV□□□2512□□□	E84AZESR3712LL	5.00	212 x 70 x 60	0.8
0.37		E84AV□□□3712□□□				
0.55		E84AV□□□5512□□□	E84AZESR7512LL	9.00	262 x 70 x 60	1.0
0.75		E84AV□□□7512□□□				
1.10		E84AV□□□1122□□□	E84AZESR2222LL	22.0	317 x 70 x 60	1.6
1.50		E84AV□□□1522□□□				
2.20		E84AV□□□2222□□□				

4.4

► RFI filter SD (Short Distance)

Typical motor power	Mains voltage	Product key		Rated current	Dimensions	Mass
4-pole asynchronous motor		Inverter	RFI filter			
P	U_{AC}			I_N	h x b x t	m
[kW]	[V]			[A]	[mm]	[kg]
0.25	1 AC 180 ... 264	E84AV□□□2512□□□	E84AZESR3712SD	5.00	212 x 70 x 60	0.8
0.37		E84AV□□□3712□□□				
0.55		E84AV□□□5512□□□	E84AZESR7512SD	9.00	262 x 70 x 60	1.0
0.75		E84AV□□□7512□□□				
1.10		E84AV□□□1122□□□	E84AZESR2222SD	22.0	317 x 70 x 60	1.6
1.50		E84AV□□□1522□□□				
2.20		E84AV□□□2222□□□				
0.37	3 AC 320 ... 550	E84AV□□□3714□□□	E84AZESR7514SD	3.30	262 x 70 x 60	1.1
0.55		E84AV□□□5514□□□				
0.75		E84AV□□□7514□□□				
1.10		E84AV□□□1124□□□	E84AZESR2224SD	7.30	317 x 70 x 60	1.4
1.50		E84AV□□□1524□□□				
2.20		E84AV□□□2224□□□				
3.00		E84AV□□□3024□□S	E84AZESR3024SD	9.80		1.5
		E84AV□□□3024□□0	E84AZESR5524SD	18.0	306 x 140 x 60	3.1
4.00		E84AV□□□4024□□□				
5.50		E84AV□□□5524□□□				
7.50		E84AV□□□7524□□□	E84AZESR1534SD	29.0	361 x 140 x 60	4.4
11.0		E84AV□□□1134□□□				
15.0		E84AV□□□1534□□□				



Interference suppression

Operation at rated power

► RFI filter LD (Long Distance)

Typical motor power	Mains voltage	Product key		Rated current	Dimensions	Mass
4-pole asynchronous motor		Inverter	RFI filter			
P	U_{AC}			I_N	h x b x t	m
[kW]	[V]			[A]	[mm]	[kg]
0.25	1 AC 180 ... 264	E84AV□□□2512□□□	E84AZESR3712LD	5.00	212 x 70 x 60	0.8
0.37		E84AV□□□3712□□□				
0.55		E84AV□□□5512□□□	E84AZESR7512LD	9.00	262 x 70 x 60	1.0
0.75		E84AV□□□7512□□□				
1.10		E84AV□□□1122□□□	E84AZESR2222LD	22.0	317 x 70 x 60	1.6
1.50		E84AV□□□1522□□□				
2.20		E84AV□□□2222□□□				
0.37	3 AC 320 ... 550	E84AV□□□3714□□□	E84AZESR7514LD	3.30	262 x 70 x 60	1.1
0.55		E84AV□□□5514□□□				
0.75		E84AV□□□7514□□□				
1.10		E84AV□□□1124□□□	E84AZESR2224LD	7.30	317 x 70 x 60	1.2
1.50		E84AV□□□1524□□□				
2.20		E84AV□□□2224□□□				
3.00		E84AV□□□3024□□S	E84AZESR3024LD	9.80		1.3
		E84AV□□□3024□□0	E84AZESR5524LD	18.0	306 x 140 x 60	2.4
4.00		E84AV□□□4024□□□				
5.50		E84AV□□□5524□□□				
7.50		E84AV□□□7524□□□	E84AZESR1534LD	29.0	361 x 140 x 60	3.3
11.0		E84AV□□□1134□□□				
15.0		E84AV□□□1534□□□				
18.5		E84AV□□□1834□□□	I0FAE318F100D0000S	50.4	436 x 205 x 90	7.1

► Mains filter LD (Long Distance)

Typical motor power	Mains voltage	Product key		Rated current	Dimensions	Mass
4-pole asynchronous motor		Inverter	Mains filter			
P	U_{AC}			I_N	h x b x t	m
[kW]	[V]			[A]	[mm]	[kg]
22.0	3 AC 320 ... 550	E84AV□□□2234□□□	I0FAE322F100D0000S	43.0	436 x 205 x 90	14.0
30.0		E84AV□□□3034□□□	I0FAE330F100D0000S	55.0	590 x 250 x 105	23.0
37.0		E84AV□□□3734□□□	I0FAE337F100D0000S	69.0		25.0
45.0		E84AV□□□4534□□□	I0FAE345F100D0001S	100	519 x 250 x 105	32.0



Interference suppression

Operation with increased power output

► RFI filter LL (Low Leakage)

Typical motor power	Mains voltage	Product key		Rated current	Dimensions	Mass
4-pole asynchronous motor		Inverter	RFI filter			
P	U_{AC}			I_N	h x b x t	m
[kW]	[V]			[A]	[mm]	[kg]
0.37	1 AC 180 ... 264	E84AV□□□2512□□□	E84AZESR3712LL	5.00	212 x 70 x 60	0.8
0.55		E84AV□□□3712□□□				
0.75		E84AV□□□5512□□□	E84AZESR7512LL	9.00	262 x 70 x 60	1.0
1.10		E84AV□□□7512□□□				
1.50		E84AV□□□1122□□□	E84AZESR2222LL	22.0	317 x 70 x 60	1.6
2.20		E84AV□□□1522□□□				

► RFI filter SD (Short Distance)

4.4

Typical motor power	Mains voltage	Product key		Rated current	Dimensions	Mass
4-pole asynchronous motor		Inverter	RFI filter			
P	U_{AC}			I_N	h x b x t	m
[kW]	[V]			[A]	[mm]	[kg]
0.37	1 AC 180 ... 264	E84AV□□□2512□□□	E84AZESR3712SD	5.00	212 x 70 x 60	0.8
0.55		E84AV□□□3712□□□				
0.75		E84AV□□□5512□□□	E84AZESR7512SD	9.00	262 x 70 x 60	1.0
1.10		E84AV□□□7512□□□				
1.50		E84AV□□□1122□□□	E84AZESR2222SD	22.0	317 x 70 x 60	1.6
2.20		E84AV□□□1522□□□				
0.55	3 AC 320 ... 550	E84AV□□□3714□□□	E84AZESR7514SD	3.30	262 x 70 x 60	1.1
0.75		E84AV□□□5514□□□				
1.10		E84AV□□□7514□□□				
1.50		E84AV□□□1124□□□	E84AZESR2224SD	7.30	317 x 70 x 60	1.4
2.20		E84AV□□□1524□□□				
3.00		E84AV□□□2224□□□				
4.00		E84AV□□□3024□□S	E84AZESR3024SD	9.80		1.5
		E84AV□□□3024□□0	E84AZESR5524SD	18.0	306 x 140 x 60	3.1
5.50		E84AV□□□4024□□□				
7.50		E84AV□□□5524□□□				
11.0		E84AV□□□7524□□□	E84AZESR1534SD	29.0	361 x 140 x 60	4.4
15.0		E84AV□□□1134□□□				



Interference suppression

Operation with increased power output

► RFI filter LD (Long Distance)

Typical motor power	Mains voltage	Product key		Rated current	Dimensions	Mass
4-pole asynchronous motor		Inverter	RFI filter			
P	U_{AC}			I_N	h x b x t	m
[kW]	[V]			[A]	[mm]	[kg]
0.37	1 AC 180 ... 264	E84AV□□□2512□□□	E84AZESR3712LD	5.00	212 x 70 x 60	0.8
0.55		E84AV□□□3712□□□				
0.75		E84AV□□□5512□□□	E84AZESR7512LD	9.00	262 x 70 x 60	1.0
1.10		E84AV□□□7512□□□				
1.50		E84AV□□□1122□□□	E84AZESR2222LD	22.0	317 x 70 x 60	1.6
2.20		E84AV□□□1522□□□				
0.55	3 AC 320 ... 550	E84AV□□□3714□□□	E84AZESR7514LD	3.30	262 x 70 x 60	1.1
0.75		E84AV□□□5514□□□				
1.10		E84AV□□□7514□□□				
1.50		E84AV□□□1124□□□	E84AZESR2224LD	7.30	317 x 70 x 60	1.2
2.20		E84AV□□□1524□□□				
3.00		E84AV□□□2224□□□				
4.00		E84AV□□□3024□□S	E84AZESR3024LD	9.80		1.3
		E84AV□□□3024□□0	E84AZESR5524LD	18.0	306 x 140 x 60	2.4
5.50		E84AV□□□4024□□□				
7.50		E84AV□□□5524□□□				
11.0		E84AV□□□7524□□□	E84AZESR1534LD	29.0	361 x 140 x 60	3.3
15.0		E84AV□□□1134□□□				

► Mains filter LD (Long Distance)

Typical motor power	Mains voltage	Product key		Rated current	Dimensions	Mass
4-pole asynchronous motor		Inverter	Mains filter			
P	U_{AC}			I_N	h x b x t	m
[kW]	[V]			[A]	[mm]	[kg]
22.0	3 AC 320 ... 550	E84AV□□□1834□□□	I0FAE322F100D0000S	43.0	436 x 205 x 90	14.0
30.0		E84AV□□□2234□□□	I0FAE322F100D0001S	55.0	365 x 205 x 90	18.5
37.0		E84AV□□□3034□□□	I0FAE337F100D0000S	69.0	590 x 250 x 105	25.0
45.0		E84AV□□□3734□□□	I0FAE345F100D0001S	100	519 x 250 x 105	32.0
55.0		E84AV□□□4534□□□				



Sinusoidal filters

A sinusoidal filter in the motor cable limits the rate of voltage rise and the capacitive charge/discharge currents that occur during inverter operation.

Application range:
- Only use a sinusoidal filter with standard asynchronous motors of 0 ... 550 V
- Operation only with V/f or V/f² characteristic control
- Set the switching frequency permanently to the specified value
- Limit the output frequency of the Inverter Drives 8400 to the specified value



Sinusoidal filters

Operation at rated power

Typical motor power	Mains voltage	Product key		Rated inductance	Switching frequency	Mass
4-pole asynchronous motor		Inverter	Sinusoidal filter			
P	U_{AC}			L_N	f_{ch}	m
[kW]	[V]			[mH]	[kHz]	[kg]
0.37	3 AC 320 ... 550	E84AV□□□3714□□□	EZS3-004A200	11.0	4 8	4.0
0.55		E84AV□□□5514□□□				
0.75		E84AV□□□7514□□□				
1.10		E84AV□□□1124□□□				
1.50		E84AV□□□1524□□□	EZS3-010A200	5.10		5.5
2.20		E84AV□□□2224□□□				
3.00		E84AV□□□3024□□□				
4.00		E84AV□□□4024□□□	EZS3-017A200	3.07		8.5
5.50		E84AV□□□5524□□□				
7.50		E84AV□□□7524□□□	EZS3-024A200	2.50		14.5
11.0		E84AV□□□1134□□□	EZS3-032A200	2.00		19.0
15.0		E84AV□□□1534□□□	EZS3-037A200	1.70		21.0
18.5		E84AV□□□1834□□□	EZS3-048A200	1.20		25.5
22.0		E84AV□□□2234□□□	EZS3-061A200	1.00		33.5
30.0		E84AV□□□3034□□□	EZS3-072A200	0.95		37.0
37.0		E84AV□□□3734□□□	EZS3-090A200	0.80		53.0
45.0		E84AV□□□4534□□□	EZS3-115A200	0.70	2 4	66.0



Sinusoidal filters

Operation with increased power output

Typical motor power	Mains voltage	Product key		Rated inductance	Switching frequency	Mass
4-pole asynchronous motor		Inverter	Sinusoidal filter			
P	U_{AC}			L_N	f_{ch}	m
[kW]	[V]			[mH]	[kHz]	[kg]
0.55	3 AC 320 ... 550	E84AV□□□3714□□□	EZS3-010A200	5.10	4 8	5.5
0.75		E84AV□□□5514□□□				
1.10		E84AV□□□7514□□□				
1.50		E84AV□□□1124□□□				
2.20		E84AV□□□1524□□□				
3.00		E84AV□□□2224□□□				
4.00		E84AV□□□3024□□□	EZS3-017A200	3.07		8.5
5.50		E84AV□□□4024□□□				
7.50		E84AV□□□5524□□□	EZS3-024A200	2.50		14.5
11.0		E84AV□□□7524□□□				
15.0		E84AV□□□1134□□□	EZS3-037A200	1.70		21.0
22.0		E84AV□□□1834□□□	EZS3-061A200	1.00		33.5
30.0		E84AV□□□2234□□□				
37.0		E84AV□□□3034□□□	EZS3-072A200	0.95		37.0
45.0		E84AV□□□3734□□□	EZS3-090A200	0.80		53.0
55.0		E84AV□□□4534□□□	EZS3-115A200	0.70	2 4	66.0



Rated data for power supply modules

► The data is valid for operation at 3/PE AC 400 V.

						
Product key						
Power supply module			E94APNE0104	E94APNE0364	E94APNE1004	E94APNE2454
Rated power						
With mains filter/mains choke	P_N	[kW]	4.90	17.5	48.6	119
Without mains filter/mains choke	P_N	[kW]	3.60	13.0	36.2	88.6
Mains voltage range						
	U_{AC}	[V]	3/PE AC 340 V-0% ... 528 V+0 %, 45 Hz-0 % ... 65 Hz+0 %			
Rated mains current						
	$I_{N, AC}$	[A]	8.0	29.0	82.0	200.0
Rated DC-bus current						
	$I_{N, DC}$	[A]	10.0	36.0	100.0	245.0

4.4

Data for 60 s overload

Max. DC-bus current						
	I_{max}	[A]	15.0	54.0	150.0	368.0
Reduced DC-bus current						
	$I_{red, DC}$	[A]	7.5	27.0	75.0	183.5
Overload time						
	t_{ol}	[s]	120.0			
Recovery time						
	t_{re}	[s]	60.0			
Max. output power [1)]						
	$P_{max, 1}$	[kW]	7.4	26.3	72.9	179.0

Data for 0.5 s overload

Max. short-time DC-bus current						
	I_{max}	[A]	40.0	108.0	200.0	368.0
Reduced DC-bus current						
	$I_{red, DC}$	[A]	7.5	27.0	75.0	183.5
Overload time						
	t_{ol}	[s]	0.5			
Recovery time						
	t_{re}	[s]	4.5			
Max. short-term output power [1)]						
	$P_{max, 2}$	[kW]	19.6	52.5	146.0	357.0

[1)] Mains filter required; if no mains filter is installed, the stated values for P_{max} decrease



Rated data for power supply modules

► The data is valid for operation at 3/PE AC 400 V.

						
Product key						
Power supply module			E94APNE0104	E94APNE0364	E94APNE1004	E94APNE2454
Rated power						
With mains filter/mains choke	P_N	[kW]	4.90	17.5	48.6	119
Without mains filter/mains choke	P_N	[kW]	3.60	13.0	36.2	88.6
Rated DC-bus current						
	$I_{N, DC}$	[A]	10.0	36.0	100.0	245.0
Power loss						
	P_V	[kW]	0.055	0.110	0.230	0.550
Dimensions						
Height	h	[mm]	350		383	
Height, including fastening	h	[mm]	481		510	
Width	b	[mm]	60	120	210	390
Depth	t	[mm]	288			
Mass						
	m	[kg]	2.6	5.3	13.5	28.5

Brake chopper rated data

Rated power, Brake chopper						
	P_N	[kW]	2.6	8.7	17.0	30.3
Max. output power, Brake chopper						
	$P_{max, 1}$	[kW]	19.5	43.8	105.1	187.7
Running time						
	t_{on}	[s]	1.0			
Recovery time						
	t_{re}	[s]	3.8	2.5	3.1	
Min. brake resistance						
	R_{min}	[Ω]	27.0	12.0	5.0	2.8



Rated data for regenerative power supply modules

- ► The data is valid for operation at 3/PE AC 400 V.
- ► Mains filter required, please refer to the following pages

						
Product key						
Supply- / regenerative module			E94ARNE0134		E94ARNE0244	
Operating mode						
			Feed	Feedback	Feed	Feedback
Rated power						
With mains filter/mains choke	P_N	[kW]	15.0	7.50	27.0	13.5
Mains voltage range						
	U_{AC}	[V]	3/PE AC 340 V-0% ... 528 V+0 %, 45 Hz-0 % ... 65 Hz+0 %			
Rated mains current						
	$I_{N, AC}$	[A]	26.0	13.0	47.0	23.5
Rated DC-bus current						
	$I_{N, DC}$	[A]	32.0	16.0	57.0	29.0

4.4

Data for 60 s overload

Max. DC-bus current						
	I_{max}	[A]	48.0	24.0	86.0	44.0
Reduced DC-bus current						
	$I_{red, DC}$	[A]	20.0	9.8	35.0	18.0
Overload time						
	t_{ol}	[s]	60.0			
Recovery time						
	t_{re}	[s]	120.0			
Max. output power						
	$P_{max, 1}$	[kW]	22.4	11.2	40.5	20.2

Data for 0.5 s overload

Max. short-time DC-bus current						
	I_{max}	[A]	96.0	48.0	171.0	87.0
Reduced DC-bus current						
	$I_{red, DC}$	[A]	20.0	9.8	35.0	18.0
Max. short-term output power						
	$P_{max, 2}$	[kW]	44.9	22.4	81.1	40.5
with brake chopper support	$P_{max, 2}$	[kW]		35.1		59.6



Rated data for regenerative power supply modules

- ► The data is valid for operation at 3/PE AC 400 V.
- ► Mains filter required, please refer to the following pages

						
Product key						
Supply- / regenerative module			E94ARNE0134		E94ARNE0244	
Operating mode						
			Feed	Feedback	Feed	Feedback
Rated power						
With mains filter/mains choke	P_N	[kW]	15.0	7.50	27.0	13.5
Rated DC-bus current						
	$I_{N, DC}$	[A]	32.0	16.0	57.0	29.0
Power loss						
	P_V	[kW]	0.150	0.110	0.230	0.190
Dimensions						
Height	h	[mm]	350			
Height, including fastening	h	[mm]	481			
Width	b	[mm]	120			
Depth	t	[mm]	288			
Mass						
	m	[kg]	6.0			

Brake chopper rated data

Rated power, Brake chopper				
	P_N	[kW]	4.7	9.3
Max. output power, Brake chopper				
	$P_{max, 1}$	[kW]	19.5	29.2
Running time				
	t_{on}	[s]	1.0	
Recovery time				
	t_{re}	[s]	4.2	3.9
Min. brake resistance				
	R_{min}	[Ω]	27.0	18.0



Control connections

Mode	Power supply modules	Regenerative power supply modules
Analog inputs		
Number		2
Resolution		11 bits + sign
Value range		+/- 10 V 1 x switchable 20 mA
Analog outputs		
Number		2
Resolution		10 bits + sign
Value range		+/- 10 V max. 2 mA
Digital inputs		
Number	1 Permanently configured	8
Switching level	PLC (IEC 61131-2)	
Max. input current	8 mA	
Digital outputs		
Number	4 fest konfiguriert	4
Switching level	PLC (IEC 61131-2)	
Max. output current	50 mA per output	
Load capacity	>480 Ω at 24 V	
External DC supply		
Rated voltage	24 V in accordance with IEC 61131-2	
Voltage range	19.2 ... 28.8 V, max. residual ripple ± 5%	
Current	Approx. 1.4 A during operation, max. 4 A starting current for 100 ms	Approx. 1.2 A during operation, max. 3 A starting current for 100 ms [1)]
Interfaces		
CANopen		Integrated
Extensions		Via slot MXI 2: extension 2 Via slot MXI 1: extension 1
State bus		Integrated
Memory		Slot MMI
Safety engineering		Slot MSI
Drive interface		
Resolver input		Integrated (no function)
Mains synchronisation input		Integrated Sub-D, 15-pin

[1)] The supply to the control electronics comes from the mains voltage. Alternatively, it can be provided by a 24 V supply that is independent of the mains (available as an option).



Brake resistors of the regenerative power supply modules

Assignment of brake resistors to the supply and regenerative power supply modules is shown in the tables below.



Brake resistor 27 ohms

Brake resistors for power supply modules

Rated power	Mains voltage	Product key		Rated resistance	Rated power	Thermal capacity	Dimensions	Mass
Without mains filter/mains choke		Power supply module	Brake resistor					
P_N	U_{AC}			R_N	P_N	C_{th}	h x b x t	m
[kW]	[V]			[Ω]	[kW]	[KWs]	[mm]	[kg]
3.60	3 AC 340 ... 528 [1]	E94APNE0104	ERBP027R200W	27.0	0.20	30.0	320 x 41 x 122	1.0
			ERBS027R600W		0.60	90.0	550 x 110 x 105	3.1
			ERBS027R01K2		1.20	180	1020 x 110 x 105	5.6
13.0		E94APNE0364	ERBG012R01K9	12.0	1.90	285	486 x 236 x 302	13.0
			ERBG012R05K2		5.20	750	486 x 426 x 302	28.0
36.2		E94APNE1004	ERBG005R02K6	5.0	2.60	390	486 x 326 x 302	12.6
88.6		E94APNE2454	ERBG028D04K1	2.8	4.10	615	486 x 426 x 302	12.8

[1] For 230 V mains voltage a different brake resistor assignment applies.

Brake resistors for regenerative power supply modules

Rated power	Mains voltage	Product key		Rated resistance	Rated power	Thermal capacity	Dimensions	Mass
With mains filter/mains choke		Supply- / regenerative module	Brake resistor					
P_N	U_{AC}			R_N	P_N	C_{th}	h x b x t	m
[kW]	[V]			[Ω]	[kW]	[KWs]	[mm]	[kg]
15.0	3 AC 340 ... 528 [1]	E94ARNE0134	ERBP027R200W	27.0	0.20	30.0	320 x 41 x 122	1.0
			ERBS027R600W		0.60	90.0	550 x 110 x 105	3.1
			ERBS027R01K2		1.20	180	1020 x 110 x 105	5.6
27.0		E94ARNE0244	ERBP018R300W	18.0	0.30	30.0	240 x 41 x 122	1.4
			ERBS018R01K2		1.20	180	1020 x 110 x 105	5.6
			ERBS018R02K8		2.80	420	1110 x 200 x 105	12.0

[2] For 230 V mains voltage a different brake resistor assignment applies.



Mains chokes of the power supply modules

A mains choke is an inductive resistor which is connected in the mains cable of the power supply module. The use of a mains choke provides the following advantages:

- **Fewer effects on the mains:**
  The wave form of the mains current is a close approximation to a sine wave.
- **Reduction in the effective mains current:**
  Reduction of mains, cable and fuse loads

Mains chokes can be used without restrictions in conjunction with RFI filters and/or sinusoidal filters.

Please note:
: The use of a mains choke slightly reduces the mains voltage at the input of the inverter - the typical voltage drop across the mains choke at the rated values is around 4%.



Mains choke

Rated power	Mains voltage	Product key		Rated current	Dimensions	Mass
With mains filter/mains choke		Power supply module	Mains choke			
P_N	U_{AC}			I_N	h x b x t	m
[kW]	[V]			[A]	[mm]	[kg]
4.90	3 AC 340 ... 528	E94APNE0104	EZAELN3008B372	8.00	85 x 120 x 140	1.9
17.5		E94APNE0364	EZAELN3030B982	30.0	110 x 155 x 167	5.9
48.6		E94APNE1004	EZAELN3080B371	80.0	125 x 210 x 240	12.5
119		E94APNE2454	EZAELN3200B151	200	352 x 144 x 264	32.0



Interference suppression of the regenerative power supply modules

RFI filters and mains filters enable compliance with the interference voltage categories of the European standard EN 61800-3. There a distinction is drawn between category C1 and category C2.
Category C1 describes the use on public supply networks.
Category C2 describes the use of drives which are intended to be used for industrial purposes in areas also comprising residential areas.
For Multi Drives external filters must be used to comply with the EMC Directive.



RFI filter, can be mounted beside the power supply module

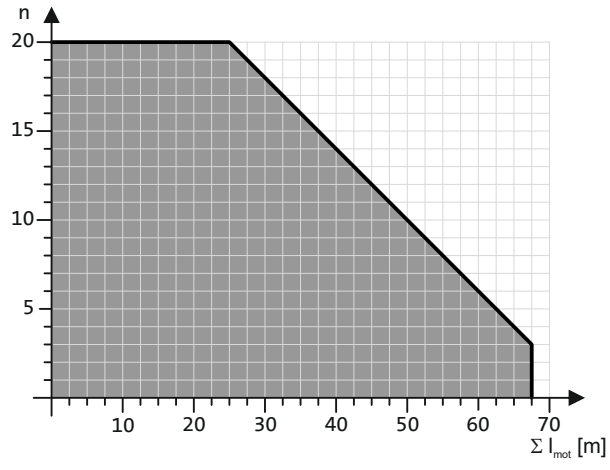
RFI filters

RFI filters are primarily capacitive accessory components which can be connected directly upstream from the power supply modules. This measure enables compliance with the corresponding conducted noise emission requirements according to EN 61800-3.

Rated power	Mains voltage	Product key		Rated current	Power loss	Max. cable length	Dimensions	Mass
Without mains filter/mains choke		Power supply module	RFI filter			Reference group C2		
P_N	U_{AC}			I_N	P_V	l_{max}	h x b x t	m
[kW]	[V]			[A]	[kW]	[m]	[mm]	[kg]
3.60	3 AC 340 ... 528	E94APNE0104	E94AZRP0084	8.00	0.020	6 axes of 10 m each	485 x 60 x 261	4.2
13.0		E94APNE0364	E94AZRP0294	29.0	0.050			4.5
36.2		E94APNE1004	E94AZRP0824	82.0	0.080		490 x 209 x 272	18.5
88.6		E94APNE2454	E94AZRP2004	200	0.150			20.5

The following diagram shows the possible number of axes and the possible sum of motor cable lengths to ensure compliance with interference suppression according to category C2.

Number of axes (n) / sum of the motor cable length (l)





Interference suppression of the regenerative power supply modules

Mains filters

A mains filter is a combination of mains choke and RFI filter in a single housing. It reduces line-bound noise emission into the mains, thus ensuring that the line-bound interference voltage is reduced to a permissible level according to EN61800-3.



Mains filter, can be mounted beside the power supply modules (right) or the regenerative power supply modules (left)

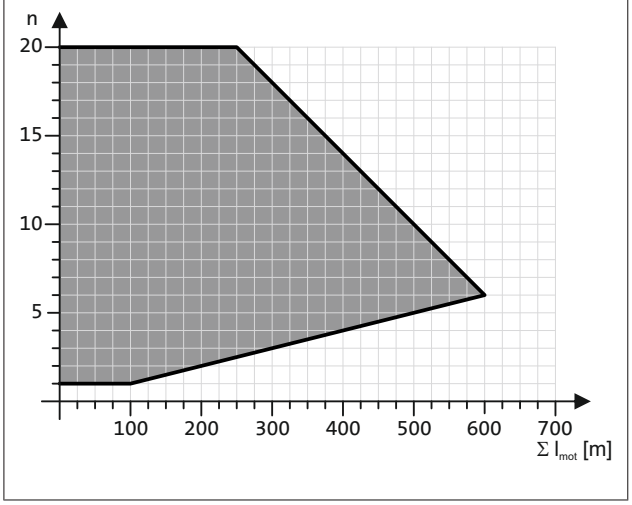
RFI filters

Rated power	Mains voltage	Product key		Rated current	Voltage drop	Max. cable length	Dimensions	Mass
With mains filter/mains choke		Power supply module	Mains filter			Reference group C2		
P_N	U_{AC}			I_N	U	I_{max}	h x b x t	m
[kW]	[V]			[A]	[V]	[m]	[mm]	[kg]
4.90	3 AC 340 ... 528	E94APNE0104	E94AZMP0084	8.00	10.0	10 axes of 50 m each	485 x 90 x 261	8.6
17.5		E94APNE0364	E94AZMP0294	29.0	7.3		485 x 120 x 261	16.5
48.6		E94APNE1004	E94AZMP0824 [1)]	82.0	6.4		490 x 270 x 272	29.0
119		E94APNE2454	E94AZMP2004 [1)]	200	6.3		490 x 330 x 272	52.0

[1)] External 24 V supply from a safely separated power supply unit (SELV/PELV) required for integrated fan.

The following diagram shows the possible number of axes and the possible sum of motor cable lengths to ensure compliance with interference suppression according to category C2.

Number of axes (n) / sum of the motor cable length (l)





Interference suppression of the regenerative power supply modules

Mains filters for regenerative power supply modules

Rated power	Mains voltage	Product key		Rated current	Voltage drop	Max. cable length	Dimensions	Mass
With mains filter/mains choke		Supply- / regenerative module	Mains filter			Reference group C2		
P_N	U_{AC}			I_N	U	I_{max}	h x b x t	m
[kW]	[V]			[A]	[V]	[m]	[mm]	[kg]
15.0	3 AC 340 ... 528	E94ARNE0134	E94AZMR0264SDB [1]	26.0	6.3	6 axes of 10 m each	485 x 149 x 272	25.0
			E94AZMR0264LDB [1]			10 axes of 50 m each		26.0
27.0		E94ARNE0244	E94AZMR0474SDB [1]	47.0	6.2	6 axes of 10 m each	485 x 209 x 272	36.0
			E94AZMR0474LDB [1]			10 axes of 50 m each		37.0

[1] External 24 V supply through safely separated power supply unit (SELV/PELV) required for integrated mains voltage recording.



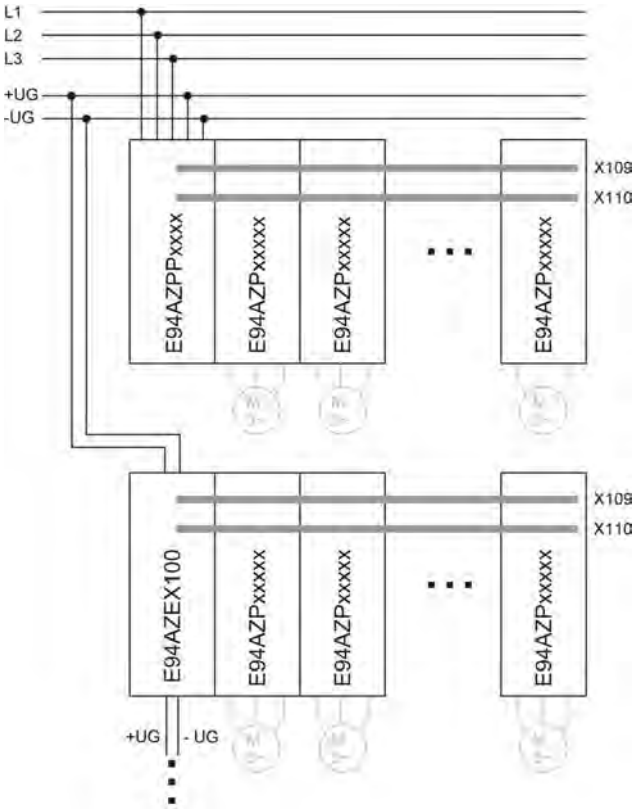
DC input module

Via a DC input module, an axis module interconnection can be supplied with power from a central DC source (power supply module, Single Drive axis modules, Multi Drive axis modules). This is required for example if a drive system with a multi-level structure installed in a control cabinet is to be supplied via a central DC power supply unit. The rated current of the DC input module is defined to be 100 A (DC). The DC input module can be connected at the top or bottom, offering great flexibility with regard to integration into the system wiring. This provides an ideal way of connecting multi-row axis modules in particular.



DC input module 100 A

Mode	Product key	Dimensions	Mass
	Input module		
		h x b x t	m
		[mm]	[kg]
DC input module 100 A	E94AZEX100	422 x 60 x 95	0.9



Wiring example for multi-row mounting of axis modules



DC-bus connection

The Inverter Drives 8400 can be operated in a DC-bus connection. The 400 V devices have a direct connection for this.
The components listed here are used to interconnect the individual devices for operation with or without a regenerative power supply module. With a DC-bus connection, energy can be exchanged between the individual devices. This makes particular sense with cyclic operation of multiple devices.
The design of a DC-bus connection requires extremely precise dimensioning of the devices' energy requirements among one another. Lenze Sales is happy to advise you here to ensure the most energy-efficient drive dimensioning. The components listed here form the basis for this.

- Two DC fuses are always required.
- The fuse holders EFH10005 and EFH10004 are single-pole, while the holders EFH20005 and EFH20007 are 2-pole.
- The fuses are not UL-approved for the DC operation.
- Please consult Lenze Sales to ensure the right dimensioning.

Components for DC-bus connection

Product key	Rated current	Design
DC fuses		
	I_N	
	[A]	
EFSGR0060AYHN	6.00	14x51 without indicator
EFSGR0100AYHN	10.0	
EFSGR0160AYHN	16.0	
EFSGR0200AYHN	20.0	
EFSGR0250AYHN	25.0	
EFSGR0320AYHN	32.0	
EFSGR0400AYHN	40.0	
EFSGR0060AYHK	6.00	14x51 with indicator
EFSGR0100AYHK	10.0	
EFSGR0160AYHK	16.0	
EFSGR0200AYHK	20.0	
EFSGR0250AYHK	25.0	
EFSGR0320AYHK	32.0	
EFSGR0400AYHK	40.0	

Product key	Rated current	Design
DC fuses		
	I_N	
	[A]	
EFSGR0120AYIN	12.0	22x58 without indicator
EFSGR0160AYIN	16.0	
EFSGR0200AYIN	20.0	
EFSGR0250AYIN	25.0	
EFSGR0320AYIN	32.0	
EFSGR0400AYIN	40.0	
EFSGR0500AYIN	50.0	
EFSGR0800AYIN	80.0	
EFSGR0120AYIK	12.0	22x58 with indicator
EFSGR0160AYIK	16.0	
EFSGR0200AYIK	20.0	
EFSGR0250AYIK	25.0	
EFSGR0320AYIK	32.0	
EFSGR0400AYIK	40.0	
EFSGR0500AYIK	50.0	
EFSGR0800AYIK	80.0	

Mode	Features	Product key
DC busbar	• Busbar system 14 x 51 • DC busbar length 1m, cross-section 25 mm ^{2}	EWZ0036
	• Busbar system 22 x 58 • DC busbar length 1m, cross-section 25 mm ^{2}	EWZ0037
End cap	• End caps for DC busbar (packaging unit 10 pcs)	EWZ0038
Terminal	• Single-pole terminal for internal supply	EWZ0039



DC-bus connection

DC fuses size 14 x 51 mm

Typical motor power	Mains voltage	Product key				
4-pole asynchron-ous motor		Inverter	DC fuses			
P	U_{AC}					
[kW]	[V]					
0.37	3 AC 320 ... 550	E84AV□□□3714□□□	EFSGR0160AYHN	EFH20005	EFSGR0160AYHK	EFH10005
0.55		E84AV□□□5514□□□				
0.75		E84AV□□□7514□□□				
1.10		E84AV□□□1124□□□				
1.50		E84AV□□□1524□□□				
2.20		E84AV□□□2224□□□	EFSGR0200AYHN		EFSGR0200AYHK	
3.00		E84AV□□□3024□□□				
4.00		E84AV□□□4024□□□	EFSGR0320AYHN		EFSGR0320AYHK	
5.50		E84AV□□□5524□□□	EFSGR0400AYHN		EFSGR0400AYHK	
7.50		E84AV□□□7524□□□				
11.0		E84AV□□□1134□□□				
15.0		E84AV□□□1534□□□				

4.4

DC fuses size 22 x 58 mm

Typical motor power	Mains voltage	Product key				
4-pole asynchron-ous motor		Inverter	DC fuses			
P	U_{AC}					
[kW]	[V]					
0.37	3 AC 320 ... 550	E84AV□□□3714□□□	EFSGR0120AYIN	EFH20007	EFSGR0120AYIK	EFH10004
0.55		E84AV□□□5514□□□				
0.75		E84AV□□□7514□□□				
1.10		E84AV□□□1124□□□				
1.50		E84AV□□□1524□□□				
2.20		E84AV□□□2224□□□	EFSGR0200AYIN		EFSGR0200AYIK	
3.00		E84AV□□□3024□□□				
4.00		E84AV□□□4024□□□	EFSGR0320AYIN		EFSGR0320AYIK	
5.50		E84AV□□□5524□□□	EFSGR0400AYIN		EFSGR0400AYIK	
7.50		E84AV□□□7524□□□	EFSGR0500AYIN		EFSGR0500AYIK	
11.0		E84AV□□□1134□□□	EFSGR0800AYIN		EFSGR0800AYIK	
15.0		E84AV□□□1534□□□				



24 V power supply unit

External power supply units are available for supplying the control electronics of the 8400 StateLine, HighLine or TopLine. With an external supply, the inverters can be parameterised and diagnosed while the mains input is deenergised.



24 V power supply unit

Rated data

Product key			EZV1200-000	EZV2400-000	EZV4800-000	EZV1200-001	EZV2400-001	EZV4800-001
Rated voltage								
AC	$U_{N, AC}$	[V]	230			400		
Input voltage								
	U_{in}	[V]	AC 85 ... 264 DC 90 ...350			AC 320 ... 575 DC 450 ...800		
Rated mains current								
	$I_{N, AC}$	[A]	0.8	1.2	2.3	0.3	0.6	1.0
Output voltage								
	U_{out}	[V]	DC 22.5 ...28.5					
Rated output current								
	$I_{N, out}$	[A]	5.0	10.0	20.0	5.0	10.0	20.0
Dimensions								
Height	h	[mm]	130					
Width	b	[mm]	55	85	157	73	85	160
Depth	t	[mm]	125					
Mass								
	m	[kg]	0.8	1.2	2.5	1.0	1.1	1.9

Brake switch

The brake switch consists of a rectifier and an electronic circuit breaker for the switching of an electromechanical brake switch. The brake switch is mounted on the control cabinet plate by means of two screws. Control is performed using a digital output on the inverter.



Brake switch

Mode	Features	Product key
Half-wave rectification	• Input voltage: AC 320 ... 550 V • Output voltage: DC 180 V (at AC 400 V), DC 225 V (at AC 500 V) • Max. brake current: DC 0.61 A • IP00 degree of protection	E82ZWBRE
Bridge rectification	• Input voltage: AC 180 ... 317 V • Output voltage: DC 205 V (at AC 230 V) • Max. brake current: DC 0.54 A • IP00 degree of protection	E82ZWBRB



USB diagnostic adapter

The operation, parameter setting and diagnostics of the Inverter Drives 8400 and the Servo Drives 9400 via the L-force diagnostics is made with the keypad X400 or a PC. The connection of a PC can be made via a USB interface and the USB diagnostic adapter.

For connecting the USB diagnostic adapter with the L-force diagnostics interface (DIAG) tat the inverter, three different connecting cables are separately available in the lengths 2.5 m, 5 m and 10 m. The connection can be established during operation. The engineering tools EASY Starter or Engineer can be used to carry out the operation, parameter setting or diagnostics of the inverters. Both tools have simple intuitive surfaces. This enables a quick and easy commissioning.

Optionally to the USB diagnostic adapter, the PC system bus adapter can be used. For this purpose, a CANopen interface must be available at the inverter.



USB diagnostic adapter incl. connecting cable to the PC

► The engineering tools EASY Starter or Engineer are used for operation, parameter setting and diagnostics of the inverters.

4.4

Mode		Features	Product key
USB diagnostic adapter		• Input-side voltage supply via USB connection on PC • Output-side voltage supply via inverter's diagnostic interface • Diagnostic LEDs • Electrical isolation of PC and inverter • Hot-pluggable	E94AZCUS

Connecting cables for USB diagnostic adapter

Mode	Features	Product key
Connecting cable for USB diagnostic adapter	• Length: 2.5 m	EWL0070
	• Length: 5 m	EWL0071
	• Length: 10 m	EWL0072



X400 keypad

As an alternative to the PC, the X400 keypad can be used for local operation, parameter setting or diagnostics.
The X400 keypad plugs into the L-force diagnostics interface (DIAG) on the front of the inverter.



X400 keypad

Mode		Features	Slot	Product key
X400 keypad		• Menu navigation • Graphics display with background lightning for clear presentation of information • 4 navigation keys, 2 context-sensitive keys • Adjustable RUN/STOP function	DIAG	EZAEBK1001

► The Inverter Drives 8400 can be ordered with a plug-in keypad already installed. If you would like to order the products in this complete form, please add the inverter product key as follows when placing your order: E84AV to X-**XXKXX**
► The product key with the supplement for the applied module is provided in our sales documents. This information is not part of the nameplate of the device.

X400 diagnosis terminal

Mode		Features	Slot	Product key
X400 diagnosis terminal		• X400 keypad in a robust housing • Also suitable for installation in the control cabinet door • incl. 2.5 m cable • IP20 degree of protection, IP65 for control cabinet installation on front face	DIAG	EZAEBK2001



PC system bus adapter

The operation, parameterisation and diagnostics of the Inverter Drives 8400 using a PC can also be carried out via the CANopen interface using a PC system bus adapter. This requires a PC system bus adapter instead of a USB diagnostic adapter. This adapter is plugged into the parallel interface or USB connection of the PC. The corresponding drivers will be installed automatically. The voltage for the adapter is supplied via the USB connection of the PC. The CANopen interface is integrated or available with a variant (BaseLine C).

Advantage:
- Operation, parameterisation and diagnostics in parallel with the keypad
- In interconnected systems, multiple inverters can be addressed simultaneously from one point (remote parameterisation via CANopen)



EMF2177IB adapter

4.4

Mode	Features	Product key
PC system bus adapter	• Voltage supply via USB port on PC • Electrical isolation from the bus	EMF2177IB

Shield mounting

A shield mounting is used to connect the motor cable shield on the inverter's shield connection.

Mode	Features	Product key
Metal cable tie	• Cable diameter: 8...30 mm • Packaging unit: 50 items	EZAMBKBM
Fixing clip	• Cable diameter: 4...10 mm • Packaging unit: 20 items	EZAMBHXM007/M
Wire clamp	• Cable diameter: 4...15 mm • Packaging unit: 10 items	EZAMBHXM006/M
	• Cable diameter: 10...20 mm • Packaging unit: 10 items	EZAMBHXM003/M
	• Cable diameter: 15...28 mm • Packaging unit: 10 items	EZAMBHXM004/M
	• Cable diameter: 20...37 mm • Packaging unit: 10 items	EZAMBHXM005/M



Terminal strips

All connections are equipped with pluggable connectors, with power connections up to 15 kW. These pluggable connectors are available separately for service purposes or if cable harnesses need to be physically separated.

► Power connections

Product key	Terminal strip	Features	Product key	Terminal strip	Features	Product key
Inverter						
E84AV□□□2512□□□	X100	• Connection: mains • Packaging unit: 10 items	E84AZEVS001X100/M	X105	• Connection: motor • Packaging unit: 5 items	E84AZEVS010X105/M
E84AV□□□3712□□□						
E84AV□□□5512□□□						
E84AV□□□7512□□□						
E84AV□□□1122□□□			E84AZEVS002X100/M			
E84AV□□□1522□□□						
E84AV□□□2222□□□						
E84AV□□□3714□□□		• Connection: mains • Packaging unit: 5 items	E84AZEVS003X100/M			
E84AV□□□5514□□□						
E84AV□□□7514□□□						
E84AV□□□1124□□□						
E84AV□□□1524□□□						
E84AV□□□2224□□□						
E84AV□□□3024□□□						
E84AV□□□4024□□□			E84AZEVS004X100/M			E84AZEVS011X105/M
E84AV□□□5524□□□						
E84AV□□□7524□□□			E84AZEVS005X100/M			E84AZEVS012X105/M
E84AV□□□1134□□□						
E84AV□□□1534□□□						

► Control connections

Terminal strip	Features	Product key
X1	• Connection: CANopen • Packaging unit: 10 items	E84AZEVS040X001/M
X3	• Connection: analog inputs and outputs • Packaging unit: 5 items	E84AZEVS060X003/M
X4	• Connection: digital outputs • Packaging unit: 10 items	E84AZEVS060X004/M
X5	• Connection: digital inputs • Packaging unit: 5 items	E84AZEVS060X005/M
X10	• Connection: axis bus • Packaging unit: 10 items	E84AZEVS060X010/M
X80	• Connection: safety engineering • Packaging unit: 10 items	E84AZEVS070X080/M
X101	• Connection: relay • Packaging unit: 10 items	E84AZEVS020X101/M
X106	• Connection: PTC • Packaging unit: 10 items	E84AZEVS030X106/M
X107	• Connection: 2.5 A digital output • Packaging unit: 10 items	E84AZEVS060X107/M



Setpoint potentiometer

The setpoint selection (e.g. speed) can be made via an external potentiometer.
The setpoint potentiometer is connected to the inverter's analog input terminals. A scale and a rotary knob are also available.



Setpoint potentiometer with scale and rotary knob

Mode	Product key
10 kOhm / 1 Watt potentiometer	ERPD0010K0001W
Rotary knob, 36 mm diameter	ERZ0001
Scale 0 ... 100%, 62 mm diameter	ERZ0002





Inverter

Servo-Inverter i700

5 to 64 A



Servo-Inverter i700

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Product key

Single/double axis E70A — C M S E 005 4 S A 1 ET R

Design
C - inverter - control cabinet

Type
M - single axis or double axis

Device version
D - 599 Hz
S - up to 2000 Hz are possible

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

Max. short-time output current
005 - 5 A
010 - 10 A
020 - 20 A
032 - 32 A
048 - 48 A
064 - 64 A

Voltage class
4 - 230/400/480 V; 3/PE AC

Ambient conditions
S - standard
V - rough environment (coated printed circuit boards)

Safety engineering
A - with Basic Safety (STO) function
B - with Extended Safety function

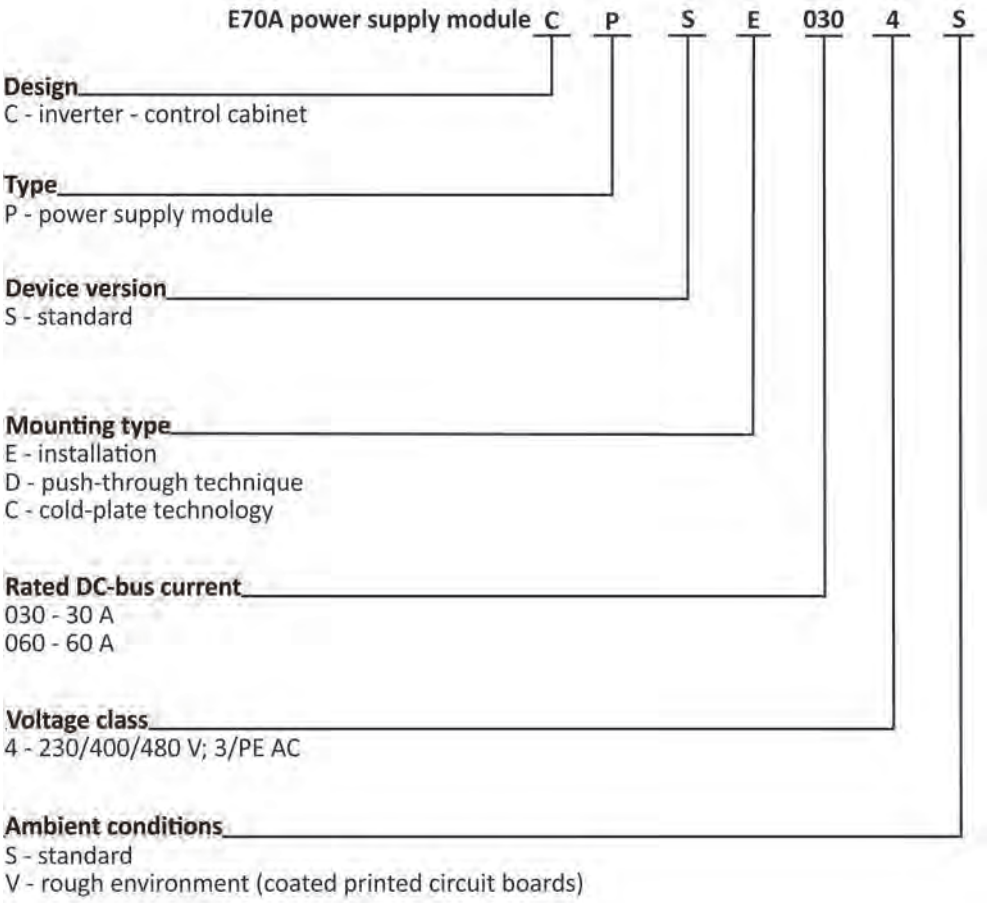
Motor outputs
1 - single axis
2 - double axis

Communication
ET - EtherCAT®

Encoder input
R - resolver
E - encoder/absolute value encoder



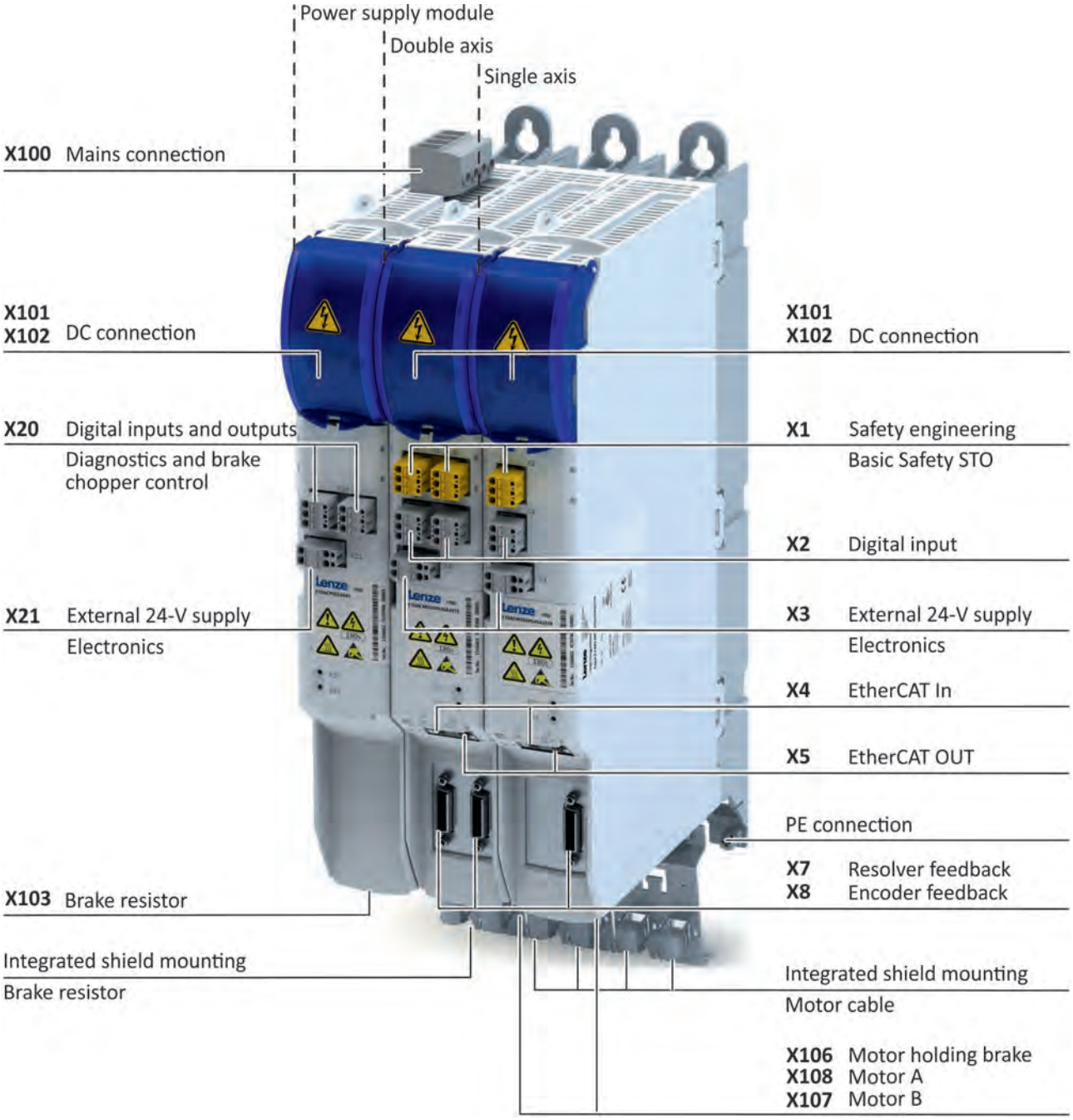
Product key


E70A power supply module C P S E 030 4 S
Design
C - inverter - control cabinet
Type
P - power supply module
Device version
S - standard
Mounting type
E - installation
D - push-through technique
C - cold-plate technology
Rated DC-bus current
030 - 30 A
060 - 60 A
Voltage class
4 - 230/400/480 V; 3/PE AC
Ambient conditions
S - standard
V - rough environment (coated printed circuit boards)





Equipment with Basic Safety STO





List of abbreviations

b	[mm]	Dimensions
C_{th}	[KWs]	Thermal capacity
f_{ch}	[kHz]	Switching frequency
h	[mm]	Dimensions
H_{max}	[m]	Site altitude
I_{max}	[A]	Max. DC-bus current
$I_{max, out}$	[A]	Max. output current
$I_{N, AC}$	[A]	Rated mains current
$I_{N, DC}$	[A]	Rated DC-bus current
$I_{N, out}$	[A]	Rated output current
l_{max}	[m]	Max. cable length
m	[kg]	Mass
P	[kW]	Typical motor power
$P_{max, 1}$	[kW]	Max. output power
P_V	[kW]	Power loss
P_N	[kW]	Rated power
R_{min}	[Ω]	Min. brake resistance
R_N	[Ω]	Rated resistance
t	[mm]	Dimensions
U_{AC}	[V]	Mains voltage
U_{DC}	[V]	DC supply
$U_{N, AC}$	[V]	Rated voltage
U_{out}	[V]	Max. output voltage

ASM	Asynchronous motor
DIAG	Slot for diagnostic adapter
DIN	Deutsches Institut für Normung e.V.
EN	European standard
EN 60529	Degrees of protection provided by enclosures (IP code)
EN 60721-3	Classification of environmental conditions; Part 3: Classes of environmental parameters and their limit values
EN 61800-3	Electrical variable speed drives Part 3: EMC requirements including special test methods
IEC	International Electrotechnical Commission
IEC 61508	Functional safety of electrical/electronic/programmable electronic safety-related systems
IM	International Mounting Code
IP	International Protection Code
MCI	Slot for communication module (module communication interface)
NEMA	National Electrical Manufacturers Association
UL	Underwriters Laboratory Listed Product
UR	Underwriters Laboratory Recognized Product
VDE	Verband deutscher Elektrotechniker (Association of German Electrical Engineers)



Generation Easy for multi-axis applications

The innovative Servo-Inverter i700 for central motion control is characterised by its compact and highly flexible design. Dual axes keep the drive size to a minimum, dynamic motor control makes it suitable for use in a wide range of applications. Drive integration, commissioning and maintenance have been substantially simplified thanks to its installation concept and easy engineering.

Highlights:
- Easy to use: from installation to service
- Compact: both in size and connection system
- Flexible: motor control for synchronous and asynchronous motors
- High performance, e. g. with real-time EtherCAT® bus system

i700 – in use

Powerful central motion control of demanding machine tasks is best achieved with our Controller-based Automation. The Servo-Inverter i700 for multiaxis application can drive all centrally controlled motors in your machine module – from three-phase AC motor to servo motor.

i700 features:
- Multi-axis system
- Single and double axes
- Power supply modules
- DC-bus connection via busbar system
- Pluggable connection system
- Automatic parameter/firmware download via the control system
- Motor control:
  -Servo with field weakening and torque pre-control
  -V/f control for standard asynchronous motors without encoder





Functions and features

The Servo-Inverter i700 can be directly implemented into the Controller-based Automation applications via the integrated EtherCAT® interface. The interaction of the different Lenze controllers provide for a high number of sophisticated Lenze Motion applications.

The speed and position control modes are directly executed in the servo inverter which ensures very short cycle times (0.25 ms). The selection of the right control mode for the application is determined via the application in the Controller. The "Controller-based Automation" chapter summarises which controller optimally solves the individual applications together with the i700.

Mode	
	Servo-Inverter i700
Conrol types, motor control	
Field-oriented servo control (SC)	For synchronous servo motors, asynchronous servo motors and three-phase asynchronous motors
V/f control (VFCplus)	For three-phase AC motors and asynchronous servo motor (linear or square-law)
Basic functions	
	Brake management for brake control with low rate of wear PID controller
Operating modes to CiA 402	Velocity mode (VL) - non-cyclic velocity setpoint Cyclic synchronous position (csp) - cyclic position setpoint Cyclic synchronous velocity (csv) - cyclic velocity setpoint Cyclic synchronous torque (cst) - cyclic torque setpoint
Overload behaviour	
	200% maximum current (with regard to 4kHz rated current)
Functions with FAST Application Software	
	Comprehensive library of function and technology modules e.g. for positioning, cam functions, electrical shaft etc.
Monitoring and protective measures	
	Overload Short circuit Earth fault Overvoltage Undervoltage DC-bus voltage Motor phase failure Overcurrent I^2 x t-Motor monitoring Overtemperature Motor overtemperature Brake chopper, brake resistance Motor stalling
Diagnostics	
	Axis modules: Error codes to CiA 402 Power supply modules: Status message via 2 digital outputs Oscilloscope functions
Status display	2 LEDs
Braking operation	
Brake chopper	Integrated in power supply module
Brake resistor	External
Mounting conditions	
Mounting type	Installation Cold plate technique (on request) Push-through technique (on request)
Mounting place	In the control cabinet
Mounting position	Vertical
Free spaces	At the top: minimum 90 mm Side–by–side mounting without any clearance At the bottom: minimum 70 mm



Operating modes

Overcurrent operation

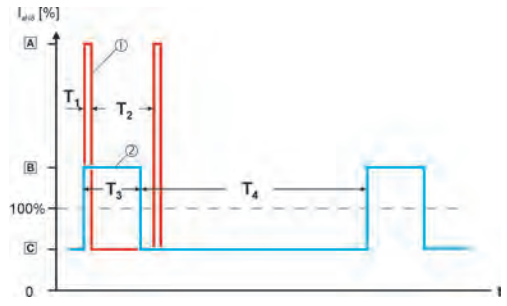
Axis modules and power supply modules

Power supply modules and axis modules can be operated with higher currents beyond the rated current if this overcurrent is only active for a limited operating time. Within the efficiency cycles, the overcurrent can flow for a certain period of time if afterwards an accordingly long recovery phase takes place afterwards. Two efficiency cycles of 15 s [1] in red and 180 s [2] in blue are defined.

- 15-s cycle
  - 3 s (T_1) load period with peak current [A] (200 %)
  - 12 s (T_2) recovery time with limited current [C] (75 %)
- 180-s cycle
  - 60 s (T_3) load period with peak current [B] (150 %)
  - 120 s (T_4) recovery time with limited current [C] (75 %)

A load period with peak current must be followed by a recovery time. In the recovery time, the current must not exceed the given value.

Overcurrent operation



► From a maximum device current of 32 A, the following restriction applies:
With field frequencies lower than 5 Hz, the cycle time of the short time behaviour is reduced from 15 s to 3 s.



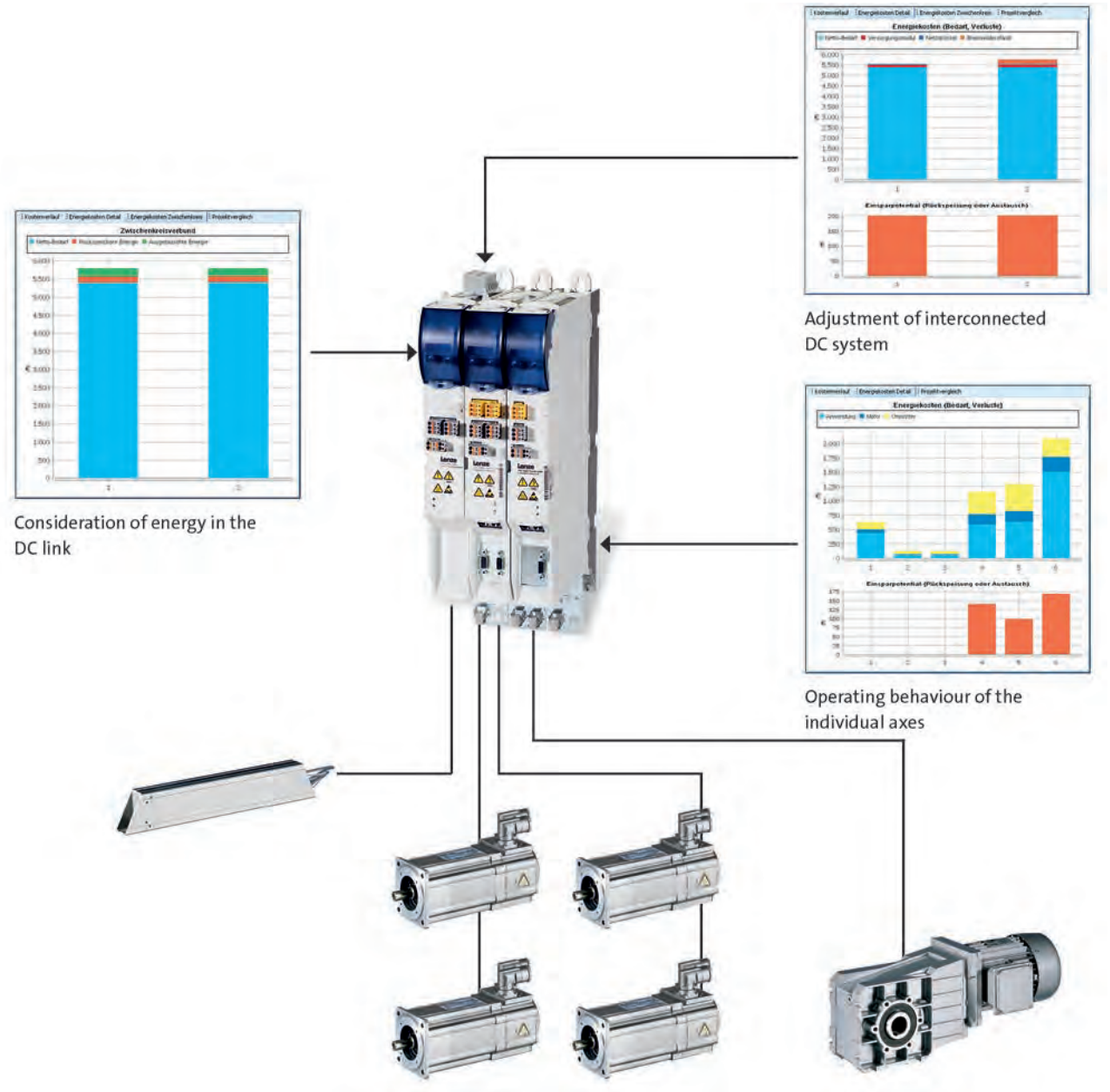
Dimensioning of a multi-axis system

Drive dimensioning of multi-axis systems with Servo-Inverters i700 can be easily carried out using the DSD (Drive Solution Designer) engineering tool. This tool can be downloaded from the Lenze homepage (http://www.lenze.com/download/software-downloads). It considers various, frequently recurring applications, the ambient conditions and the entire mechatronic system and their operating mode as for instance coordinated or uncoordinated multi-axis operation with energy exchange in the DC-bus system. It provides comprehensible dimensioning protocols and an Energy Performance Certificate for the axes and for the multi-axis system. The Energy Performance Certificate clearly displays the energy efficiency of all drive components under the given operation modes and provides potential for energy optimisations for entire plants.

Functions and features

Mode	
	Engineering Tool DSD
Applications	
	Comprehensive applications as for instance linear and rotating drives, positioning-, wheel, hoist and synchronous drives, winders, pumps, fans, ...
Components	
	Inverter Motors (brake, feedback) Geared motors Power supply modules
Check of components and drive system	
	Monitoring functions of the inverters Maximum limits of the components Product data in the applications Consideration and check of the entire drive system Limit loads (electrical/mechanical) M-n characteristic fields and system checks Possible combinations of the drive components Losses and energy efficiency
Optimisation and evaluation	
	Energy consumption of the components and of the application Energy exchange in multi-axis applications Representation of working points, e.g. as characteristic
Presentation of the result	
	Evaluation of the dimensioning Representation of energy consumption Logging of dimensioning Creating CAD data
Basic functions	
	Metric and imperial unit systems Intuitive interfaces with simple dialogs Comprehensive online help with physical basics and overviews Fast and easy drive dimensioning and product configuration Editor for the motion sequence Creating alternative solutions with comparison operations

Dimensioning of a multi-axis system







Standards and operating conditions

Mode			
Product			Servo-Inverter i700
Conformity			
CE			Low-Voltage Directive
			2014/35/EU [UKCA: S.I. 2016/1101]
Approval			
UL 508C			Power Conversion Equipment (file no. E132659)
CSA			CSA 22.2 No. 14
Certification			
			RoHs
Degree of protection			
EN 60529			IP20
NEMA 250			Type 1
Climatic conditions			
Storage (EN 60721-3-1)			1K3 (temperature: -25 °C ... +60 °C)
Storage (EN 60721-3-1) > 6 months			1K3 (temperature: -25 °C ... +40 °C)
Transport (EN 60721-3-2)			2K3 (temperature: -25 °C ... +70 °C)
Operation (EN 60721-3-3)			3K3 (temperature: -10°C ... +55 °C)
Current derating at over 40°C			2.5 % / K
Site altitude			
Amsl	H_{max}	[m]	4000
Current derating at over 1000 m		[%/1000 m]	5
Vibration resistance			
Transport (EN 60721-3-2)			2M2
Operation (EN 61800-5-1)			10 Hz ≤ f ≤ 57 Hz: ±0.075 mm amplitude, 57 Hz ≤ f ≤ 150 Hz: 1.0 g
Operation (Germanischer Lloyd)			5 Hz ≤ f ≤ 13.2 Hz: ± 1 mm amplitude 13.2 Hz ≤ f ≤ 100 Hz: 0.7 g

Mode	
Product	Servo-Inverter i700
Supply form	
	Systems with earthed star point (TN and TT systems) Systems with high-resistance or isolated star point (IT systems)
Mains switching	
	Cyclic mains switching of 5 times in 5 minutes is permissible without restrictions.
Noise emission	
EN 61800-3	Cable-guided disturbance: According to category C1 with special measures According to category C2 with standard accessories According to category C3 without additional measures
Insulation resistance	
EN 61800-5-1	Overvoltage category III Above 2000 m amsl overvoltage category II
Degree of pollution	
EN 61800-5-1	2
Shock current	
EN 61800-5-1	> 3.5 mA AC, > 10 mA DC
Protective insulation of control circuits	
EN 61800-5-1	Safe mains isolation: double/reinforced insulation



Rated data for single axes

					
Max. short-time output current					
	$I_{max, out}$	[A]	5.0	10.0	20.0
Product key					
			E70ACM□□0054□□1ET□	E70ACM□□0104□□1ET□	E70ACM□□0204□□1ET□
DC supply					
	U_{DC}	[V]	DC 260 V -0 % ... 775 V +0 %		
Typical motor power					
4-pole asynchronous motor	P	[kW]	0.75	1.50	4.00
Rated output current					
	$I_{N, out}$	[A]	2.5	5.0	10.0
Rated switching frequency					
	f_{ch}	[kHz]	4		
Output current					
4 kHz	I_{out}	[A]	2.5	5.0	10.0
8 kHz	I_{out}	[A]	2.5	5.0	10.0
16 kHz	I_{out}	[A]	1.5	3.0	6.0
Power loss					
	P_V	[kW]	0.050	0.080	0.130

4.5

Dimensions and weights

Standard installation design

Dimensions			
Height	h	[mm]	350
Height, including fastening	h	[mm]	410
Width	b	[mm]	50
Depth	t	[mm]	261
Mass			
	m	[kg]	2.7



Rated data for single axes

					
Max. short-time output current					
	$I_{max, out}$	[A]	32.0	48.0	64.0
Product key					
			E70ACM□□0324□□1ET□	E70ACM□□0484□□1ET□	E70ACM□□0644□□1ET□
DC supply					
	U_{DC}	[V]	DC 260 V -0 % ... 775 V +0 %		
Typical motor power					
4-pole asynchronous motor	P	[kW]	7.50	11.0	15.0
Rated output current					
	$I_{N, out}$	[A]	16.0	24.0	32.0
Rated switching frequency					
	f_{ch}	[kHz]	4		
Output current					
4 kHz	I_{out}	[A]	16.0	24.0	32.0
8 kHz	I_{out}	[A]	12.8	19.2	25.6
16 kHz	I_{out}	[A]	9.6	14.4	19.2
Power loss					
	P_V	[kW]	0.210	0.290	0.390

Dimensions and weights

Standard installation design

Dimensions			
Height	h	[mm]	350
Height, including fastening	h	[mm]	410
Width	b	[mm]	100
Depth	t	[mm]	261
Mass			
	m	[kg]	5.2



Rated data for double axes

				
Max. short-time output current				
	$I_{max, out}$	[A]	5.0	10.0
Product key				
			E70ACM□□0054□□2ET□	E70ACM□□0104□□2ET□
DC supply				
	U_{DC}	[V]	DC 260 V -0 % ... 775 V +0 %	
Typical motor power				
4-pole asynchronous motor	P	[kW]	0.75	1.50
Rated output current				
	$I_{N, out}$	[A]	2.5	5.0
Rated switching frequency				
	f_{ch}	[kHz]	4	
Output current				
4 kHz	I_{out}	[A]	2.5	5.0
8 kHz	I_{out}	[A]	2.5	5.0
16 kHz	I_{out}	[A]	1.5	3.0
Power loss				
	P_V	[kW]	0.090	0.140

4.5

Dimensions and weights

Standard installation design

Dimensions			
Height	h	[mm]	350
Height, including fastening	h	[mm]	410
Width	b	[mm]	50
Depth	t	[mm]	261
Mass			
	m	[kg]	2.9



Rated data for double axes

				
Max. short-time output current				
	$I_{max, out}$	[A]	20.0	32.0
Product key				
			E70ACM□□0204□□2ET□	E70ACM□□0324□□2ET□
DC supply				
	U_{DC}	[V]	DC 260 V -0 % ... 775 V +0 %	
Typical motor power				
4-pole asynchronous motor	P	[kW]	4.00	7.50
Rated output current				
	$I_{N, out}$	[A]	10.0	16.0
Rated switching frequency				
	f_{ch}	[kHz]	4	
Output current				
4 kHz	I_{out}	[A]	10.0	16.0
8 kHz	I_{out}	[A]	10.0	12.8
16 kHz	I_{out}	[A]	6.0	9.6
Power loss				
	P_V	[kW]	0.260	0.370

Dimensions and weights

Standard installation design

Dimensions				
Height	h	[mm]	350	350
Width	b	[mm]	100	100
Depth	t	[mm]	261	261
Mass				
	m	[kg]	5.2	5.2



Rated data for power supply modules

- ► Operation at 3/PE AC 230/400 and 480 V possible.
- ► The data is valid for operation at 3/PE AC 400 V.

				
Product key				
Power supply module			E70ACP□□0304□	E70ACP□□0604□
Rated power				
With mains filter/mains choke	P_N	[kW]	15.4	30.9
Without mains filter/mains choke	P_N	[kW]	10.3	20.6
Max. short-term output power				
	$P_{max, 2}$	[kW]	20.6	41.2
Mains voltage range				
	U_{AC}	[V]	3/PE AC 180 V-0 % ... 528 V+0 %, 45 Hz-0 % ... 65 Hz+0 %	
Rated mains current				
	$I_{N, AC}$	[A]	24.5	49.0
Rated DC-bus current				
	$I_{N, DC}$	[A]	30.0	60.0
Max. DC-bus current				
	I_{max}	[A]	45.0	90.0
Power loss				
	P_V	[kW]	0.060	0.110

4.5

Brake chopper rated data

Rated power, Brake chopper				
	P_N	[kW]	5.0	10.1
Max. output power, Brake chopper				
	$P_{max, 1}$	[kW]	32.5	65.5
Running time				
	t_{on}	[s]	15.0	
Recovery time				
	t_{re}	[s]	82.0	
Min. brake resistance				
	R_{min}	[Ω]	18.0	9.0

Dimensions and weights

Standard installation design

Dimensions				
Height	h	[mm]	350	
Height, including fastening	h	[mm]	410	
Width	b	[mm]	50	100
Depth	t	[mm]	261	
Mass				
	m	[kg]	2.8	5.8





"Cold plate" design (on request)

Inverters in cold-plate design dissipate some of their waste heat (heat loss) via a cooler adapted to the application. For this purpose, the inverters are provided with a planed cooling plate which is connected to a separate cooler in a thermally conductive way. Using the cold plate technology, the main part of the heat energy can be transferred directly to the external cooling units.

The use of cold-plate technology is advantageous for the following application cases:

- Minimising the expense of cooling the control cabinet. Here, the main part of the power loss is directly transferred to a cooling unit outside of the control cabinet, e.g. convection cooler or water cooler.
- Heavily polluted ambient air or control cabinets with a high degree of protection which do not allow for a use of a forced air cooling of the control cabinets.
- Low mounting depth in the control cabinet.

Requirements for the cooler

When cold-plate technology is used, the following basic conditions must be considered:

- Good thermal connection to the external cooling unit, i.e. the implementation of the heat transfer resistance (Rth) according to the power loss.
- The contact surface must at least be as big as the cooling plate of the inverter.
- The planarity of the contact surface must not exceed 0.05 mm.
- The contact surface of the external coolers and cooling plate must be connected by means of the intended screwed connection.
- The maximum temperature of the cooling plate of the inverter ((75 °C) must not be exceeded.

Single axes

Product key	Power to be dissipated	Thermal resistance
	P_V	R_{th}
	[W]	[K/W]
E70ACM□C0054□□1ET□	25.0	≤ 1.6
E70ACM□C0104□□1ET□	50.0	≤ 0.8
E70ACM□C0204□□1ET□	95.0	≤ 0.45
E70ACM□C0324□□1ET□	140	≤ 0.25
E70ACM□C0484□□1ET□	215	≤ 0.2
E70ACM□C0644□□1ET□	290	≤ 0.15

Double axes

Product key	Power to be dissipated	Thermal resistance
	P_V	R_{th}
	[W]	[K/W]
E70ACM□C0054□□2ET□	50.0	≤ 0.8
E70ACM□C0104□□2ET□	95.0	≤ 0.45
E70ACM□C0204□□2ET□	185	≤ 0.2
E70ACM□C0324□□2ET□	275	≤ 0.15

Power supply modules

Product key	Power to be dissipated	Thermal resistance
	P_V	R_{th}
	[W]	[K/W]
E70ACP□C0304□	45.0	≤ 0.95
E70ACP□C0604□	85.0	≤ 0.45



"Cold plate" design (on request)

Dimensions and weights

Single axes

Product key			E70ACM□C0054□□1ET□	E70ACM□C0104□□1ET□	E70ACM□C0204□□1ET□
Dimensions					
Height, including fastening	h	[mm]	410		
Width	b	[mm]	50		
Depth	t	[mm]	221		
Mass					
	m	[kg]	2.3		

Product key			E70ACM□C0324□□1ET□	E70ACM□C0484□□1ET□	E70ACM□C0644□□1ET□
Dimensions					
Height, including fastening	h	[mm]	410		
Width	b	[mm]	100		
Depth	t	[mm]	221		
Mass					
	m	[kg]	5.3		

4.5

Double axes

Product key			E70ACM□C0054□□2ET□ E70ACM□C0104□□2ET□	E70ACM□C0204□□2ET□ E70ACM□C0324□□2ET□
Dimensions				
Height, including fastening	h	[mm]	410	
Width	b	[mm]	50	100
Depth	t	[mm]	221	
Mass				
	m	[kg]	2.5	5.3

Power supply modules

Product key			E70ACP□C0304□	E70ACP□C0604□
Dimensions				
Height, including fastening	h	[mm]	410	
Width	b	[mm]	50	100
Depth	t	[mm]	221	
Mass				
	m	[kg]	2.6	5.6



Push-through technique design (on request)

The inverters in push-through design reduce the waste heat in the control cabinet.
The inverter is mounted in the control cabinet so that the heatsink on the inverter is outside the control cabinet. Thus, the entire waste heat can be dissipated outside the control cabinet via convection or forced air cooling for almost all device performances.

Using the push-through technology is advantageous in the following application cases:

- Minimising the expense for control cabinet cooling. For this purpose, the main part of the power loss is directly transferred to the ambience outside the control cabinet,e.g. convection cooling.
- In case of control cabinets with a high degree of protection > IP54 by using separate mounting and cooling areas.
- Low mounting depth in the control cabinet.

Single axes

Product key	Power to be dissipated
	P_V
	[W]
E70ACM□D0054□□1ET□	25.0
E70ACM□D0104□□1ET□	50.0
E70ACM□D0204□□1ET□	95.0
E70ACM□D0324□□1ET□	140
E70ACM□D0484□□1ET□	215
E70ACM□D0644□□1ET□	290

Double axes

Product key	Power to be dissipated
	P_V
	[W]
E70ACM□D0054□□2ET□	50.0
E70ACM□D0104□□2ET□	95.0
E70ACM□D0204□□2ET□	185
E70ACM□D0324□□2ET□	275

Power supply modules

Product key	Power to be dissipated
	P_V
	[W]
E70ACP□D0304□	45.0
E70ACP□D0604□	85.0



Push-through technique design (on request)

Dimensions and weights

Single axes

Product key			E70ACM□D0054□□1ET□	E70ACM□D0104□□1ET□	E70ACM□D0204□□1ET□
Dimensions					
Height, including fastening	h	[mm]	410		
Width	b	[mm]	50		
Depth (in control cabinet)	t	[mm]	221		
Mass					
	m	[kg]	3.0		

Product key			E70ACM□D0324□□1ET□	E70ACM□D0484□□1ET□	E70ACM□D0644□□1ET□
Dimensions					
Height, including fastening	h	[mm]	410		
Width	b	[mm]	100		
Depth (in control cabinet)	t	[mm]	221		
Mass					
	m	[kg]	7.1		

Double axes

Product key			E70ACM□D0054□□2ET□	E70ACM□D0104□□2ET□
Dimensions				
Height, including fastening	h	[mm]	410	
Width	b	[mm]	50	
Depth	t	[mm]	261	
Mass				
	m	[kg]	3.2	

Product key			E70ACM□D0204□□2ET□	E70ACM□D0324□□2ET□
Dimensions				
Height, including fastening	h	[mm]	410	
Width	b	[mm]	100	
Depth	t	[mm]	261	
Mass				
	m	[kg]	7.1	

Power supply modules

Product key			E70ACP□D0304□	E70ACP□D0604□
Dimensions				
Height, including fastening	h	[mm]	410	
Width	b	[mm]	50	100
Depth (in control cabinet)	t	[mm]	221	
Mass				
	m	[kg]	2.8	5.8





Mains connection

Interference voltage categories according to the European standard EN 61800-3 are divided into category C1, C2 and the category C3.

Category C1
- Describes the use in public networks.

Category C2
- Describes the use of devices intended for industrial purposes in areas also comprising residential areas.

Category C3
- Describes the use of devices intended for industrial purposes only.

28 - The interference voltage categories achievable due to the filter measures are shown in conjunction with the motor cables.

With an upstream mains choke or mains filter, the maximum continuous power of the power supply modules can be used since the effective current will be reduced.
If no filter or an RFI filter is used, the permissible continuous power (rated power) of the power supply module is reduced.
The mains choke and the RFI filter can also be combined without any restrictions.

38 - Mains chokes, RFI filters, Mains filters

Mains fuses and cable cross-sections

- ► The mains fuse and cable cross-section specifications apply to a mains connection of 3AC 230/400/480 V.
- ► Class gG/gl fuses or class gRL semiconductor fuses.
- ► The cable cross-sections apply to PVC-insulated copper cables.
- ► Use for installation with UL-approved cables, fuses and brackets.

Mains voltage	Product key	Circuit breaker	Fuse		Mains connection
	Power supply module		EN 60204-1	UL[1)]	Cross-section (with mains choke)
U_{AC}		I	I	I	q
[V]		[A]	[A]	[A]	[mm2]
3 AC 180 ... 528	E70ACP□□0304□	C40	40		10.0
	E70ACP□□0604□	C63	63		16.0

[1)] In preparation.



Motor connection

- ► Electric strength of the motor cable: 1 kV as per VDE 250-1.
- ► Keep motor cables as short as possible, as this has a positive effect on the drive behaviour.
- ► Maximum motor cable length 50 m per axis.
- ► With group drives (multiple motors on one inverter), the resulting cable length is the key factor. This can be calculated using the hardware manual.

Motor cable lengths and interference voltage categories

When using the i700 system, use external filters to comply with the EMC Directives.

Category C1
- With special measures; please contact your Lenze sales office.

Category C2
- With RFI filters, 6 axes with 50 m motor cable each
- With mains filters, 10 axes with 50 m motor cable each

Category C3
- Without external measures, 4 axes with 50 m motor cable each
- With mains choke, 10 axes with 50 m motor cable each

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38 - Mains chokes, RFI filters, Mains filters



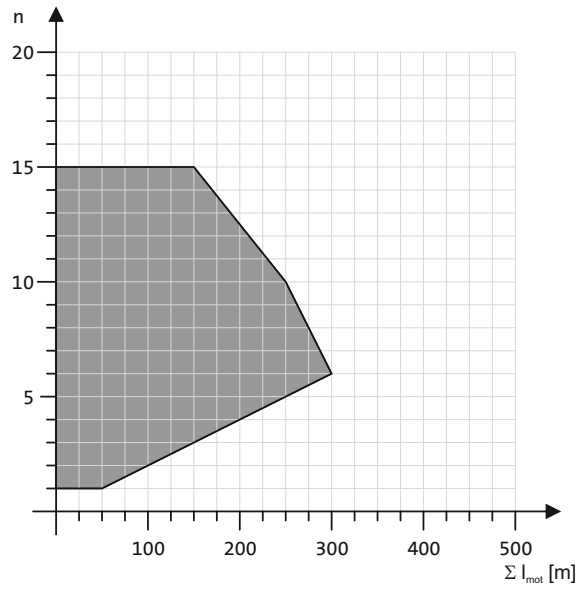
Motor connection

The following diagrams show the possible number of axes and the possible sum of motor cable lengths to ensure compliance with interference suppression according to category .

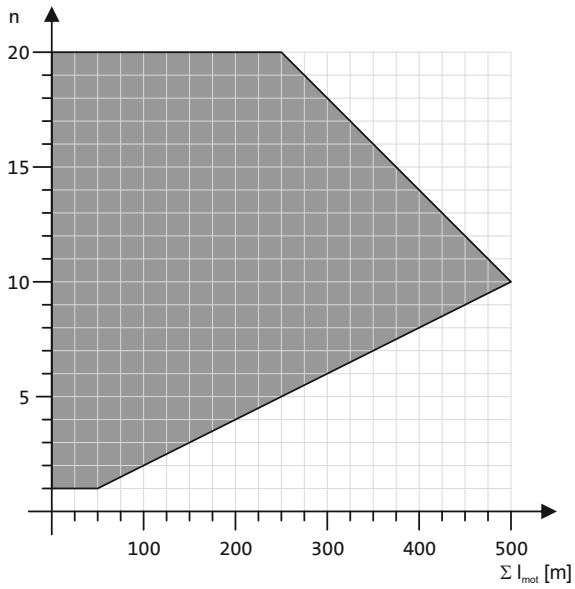
► Number of axes (n) / sum of the motor cable length (l)

Category C2

With RFI filters

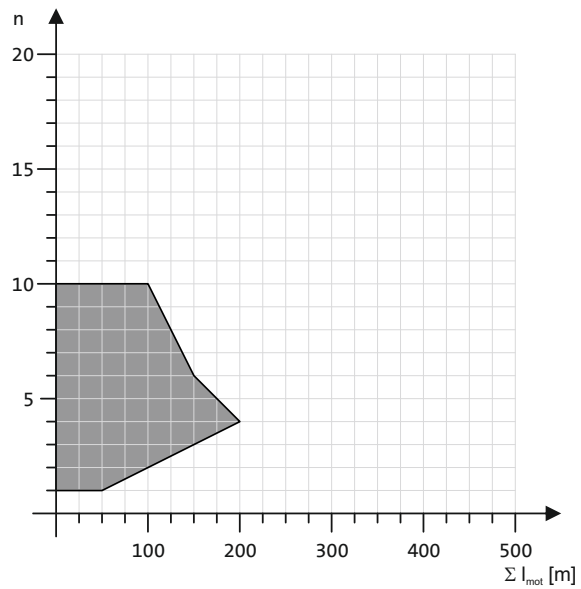


With mains filters

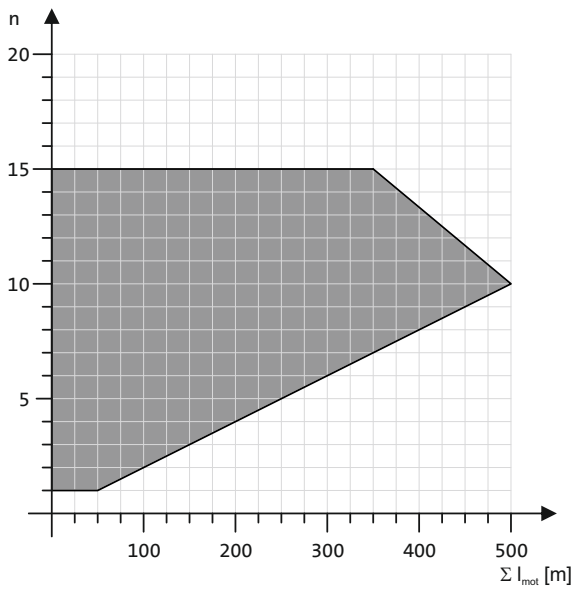


Category C3

Without external measures

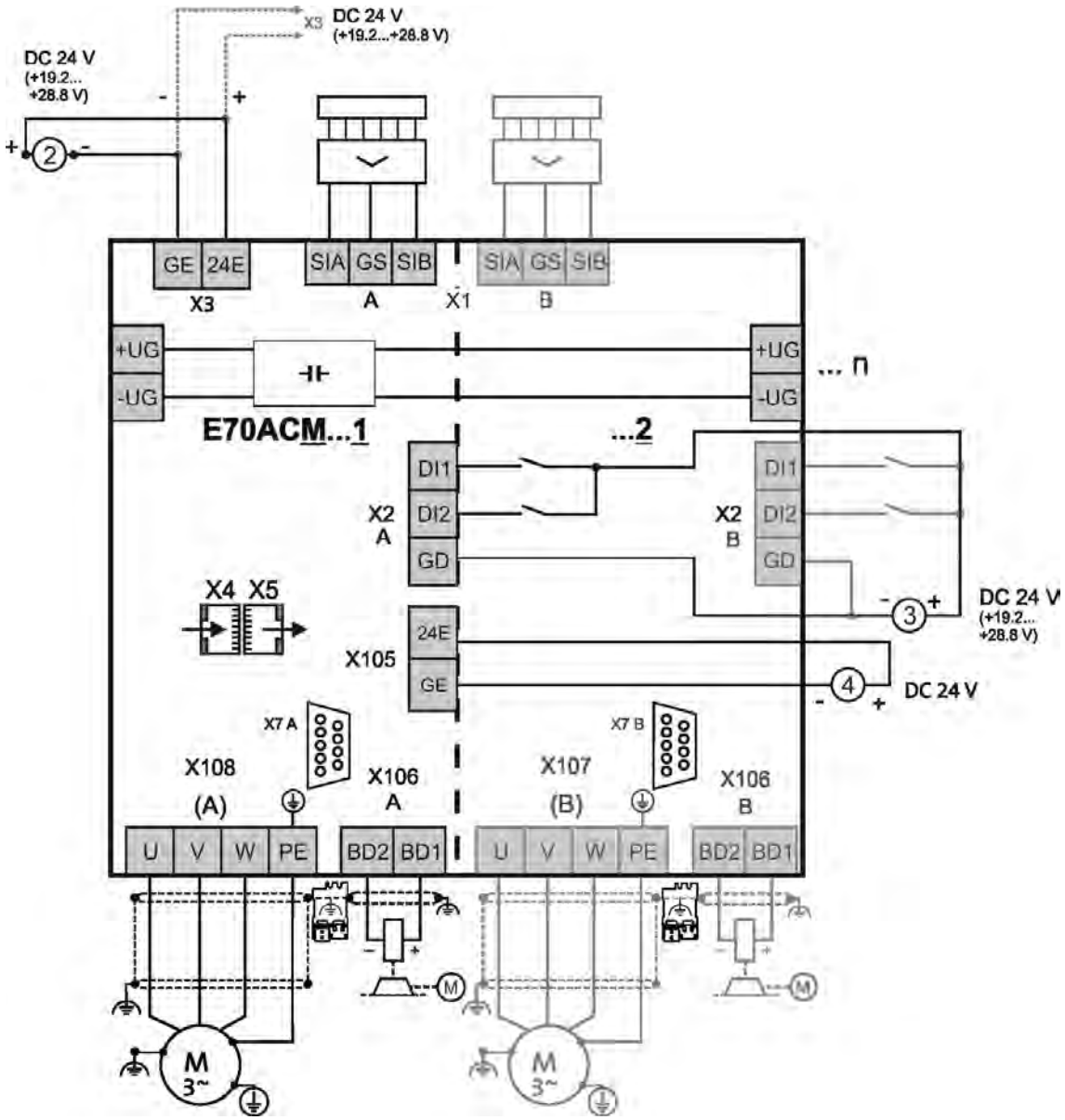


With mains chokes



Connection diagrams

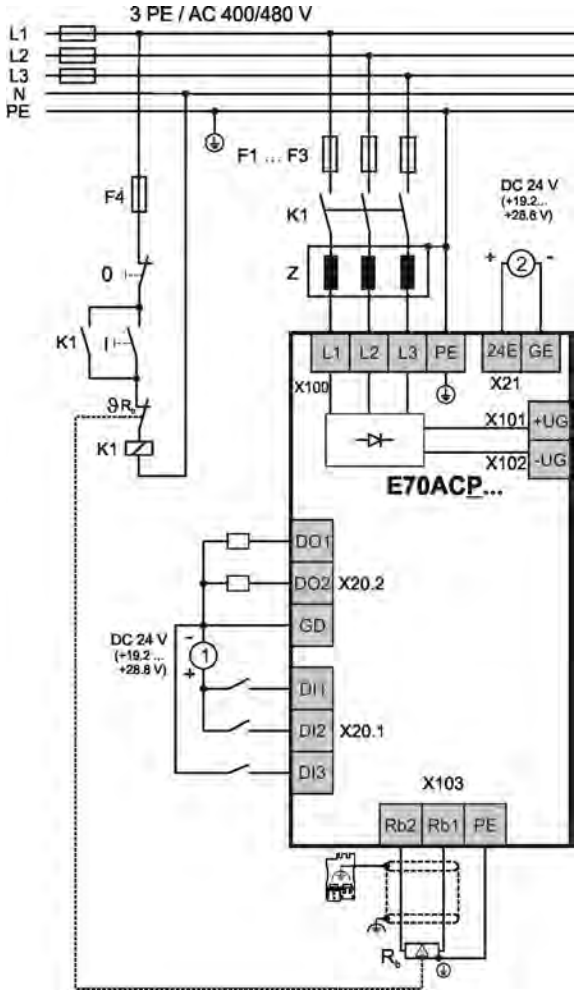
Wiring example for i700 servo inverter, axis modules, Basic Safety STO



[2] 24 supply for control electronics
[3] 24 V supply for digital inputs
[4] 24 V supply for motor holding brake(s)

Connection diagrams

Servo-Inverter i700 wiring example, power supply modules



[1] 24 V supply for digital inputs
[2] 24 V supply for control electronics

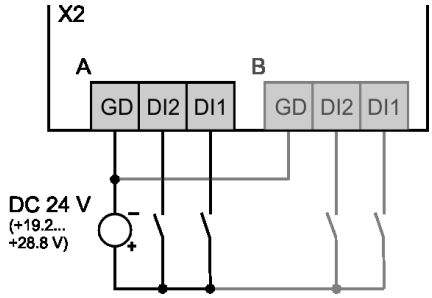


Control connections

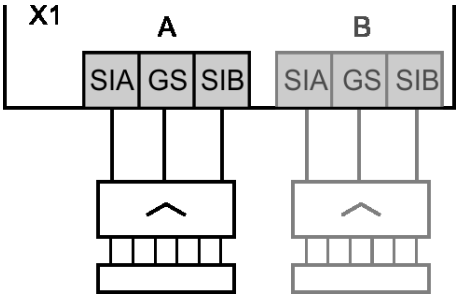
Mode	
	Servo-Inverter i700
Digital inputs	
Number	2
Touch-probe-capable	2 with time and position stamp
Switching level	PLC (IEC 61131-2)
Max. input current	8 mA
External DC supply	
Rated voltage	24 V in accordance with IEC 61131-2
Voltage range	19.2 ... 28.8 V, max. residual ripple ± 5%
Interfaces	
EtherCAT	2 (in/out)
Safety engineering	Safe torque off (STO) 2 channel design
Drive interface	
Resolver input	Sub-D, 9-pin
Encoder input	Sub-D, 15-pin SinCos absolute value encoder single-turn (with zero pulse) or multi-turn (Hiperface®)
Motor brake	24V holding brake per axis can be directly controlled

4.5

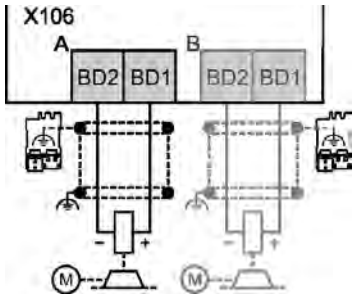
Connection of digital inputs



Connection of Basic Safety STO safety system



Motor brake connection





Control connections

External 24 V supply

The control electronics of the Servo-Inverter i700 has to be supplied with an external 24-V supply. For this purpose, Lenze provides power supply units. The following table shows the corresponding current consumptions of the devices.

41 - 24 V power supply unit

Single axes

Max. short-time output current	Product key	External DC supply
		Current
$I_{max, out}$		
[A]		
5.0	E70ACM□□0054□□1ET□	1.0 A
10.0	E70ACM□□0104□□1ET□	
20.0	E70ACM□□0204□□1ET□	
32.0	E70ACM□□0324□□1ET□	2.0 A
48.0	E70ACM□□0484□□1ET□	
64.0	E70ACM□□0644□□1ET□	

Double axes

Max. short-time output current	Product key	External DC supply
		Current
$I_{max, out}$		
[A]		
5.0	E70ACM□□0054□□2ET□	1.0 A
10.0	E70ACM□□0104□□2ET□	
20.0	E70ACM□□0204□□2ET□	2.0 A
32.0	E70ACM□□0324□□2ET□	



Safety engineering

Safety engineering has been certified acc. to EN ISO 13849-1 (cat. 4, PL e), EN 61508/EN 62061 (SIL 3).

Basic Safety STO

By default, the i700 servo inverters are available with the "safe torque off, STO“ safety function. This helps reduce the control system costs, save space in the control cabinet and keep wiring to a minimum. A "safe stop 1, SS1" can be implemented easily using a safety switching device.

The product key of the inverter has an ""**A**"" as the 14th character. For example, a servo inverter 5A, built-in unit with Basic Safety STO safety engineering would be: E70ACMSE0054S**A**1ETR



Double axis with connection for "Basic Safety STO" safety system



EtherCAT® communication

EtherCAT enables the i700 servo inverter to be controlled with digital control signals via the EtherCAT® bus system. It is integrated in the i700 servo inverter. It can be seen in the product key at the positions 16 and 17: E70ACM□□□□4S□□**ET**□.

The advantages of the system are:
- fast and very powerful bus system
- ideally suited for Controller-based Automation solutions
- easy system integration since a wide range of sensors and actuators is available on the market.
- the basic features of a servo drive are available in the axes according to the CiA402 device profile and can be easily used via the EtherCAT®.

Mode	Features
Communication	
EtherCAT [1)]	• CANopen over EtherCAT (CoE) • Distributed clock • 2 RJ45 connections with LEDs for link and activity

[1)] EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

Technical data

Product key			
Communication			
Medium			CAT5e S/FTP according to ISO/ICE11801 (2002)
Communication profile			CoE (CANopen over EtherCAT)
Baud rate			
	b	[MBit/s]	100
Node			
			Slave
Network topology			
			Line (internal ring)
Number of logical process data channels			
			1
Process data words (PCD)			
16 Bit			1 ... 32
Number of bus nodes			
			Max. 65535
Max. cable length			
between two nodes	l_{max}	[m]	100
Rated voltage			
	$U_{N, DC}$	[V]	24.0





Brake resistors for power supply modules

The assignment of brake resistors to the power supply modules is shown in the following tables.



Brake resistor 27 ohms

Product key		Rated resistance	Rated power	Thermal capacity	Dimensions	Mass
Power supply module	Brake resistor					
		R_N	P_N	C_{th}	h x b x t	m
		[Ω]	[kW]	[KWs]	[mm]	[kg]
E70ACP□□0304□	ERBP027R200W	27.0	0.20	30.0	320 x 41 x 122	1.0
	ERBS027R600W		0.60	90.0	550 x 110 x 105	3.1
	ERBS027R01K2		1.20	180	1020 x 110 x 105	5.6
E70ACP□□0604□	ERBG012R01K9	12.0	1.90	285	486 x 236 x 302	13.0
	ERBG012R05K2		5.20	750	486 x 426 x 302	28.0



Mains chokes for power supply modules

A mains choke is an inductive resistor which is connected in the mains cable of the power supply module. The use of a mains choke provides the following advantages:

- **Fewer effects on the mains:**
  The wave form of the mains current is a close approximation to a sine wave.
- **Reduction in the effective mains current:**
  Reduction of mains, cable and fuse loads
- **Current balancing of power supply modules connected in parallel**

Mains chokes can be used without restrictions in conjunction with RFI filters.



Mains choke

Please note:
The use of a mains choke slightly reduces the mains voltage at the input of the power supply module – the typical voltage drop across the mains choke at the rated values is around 5%.
The selection of the correct mains chokes for the power supply modules depends on the number of connected axes. For this purpose, different mains chokes are available. For the following efficiencies of the power supply modules, we have dimensioned model mains chokes:

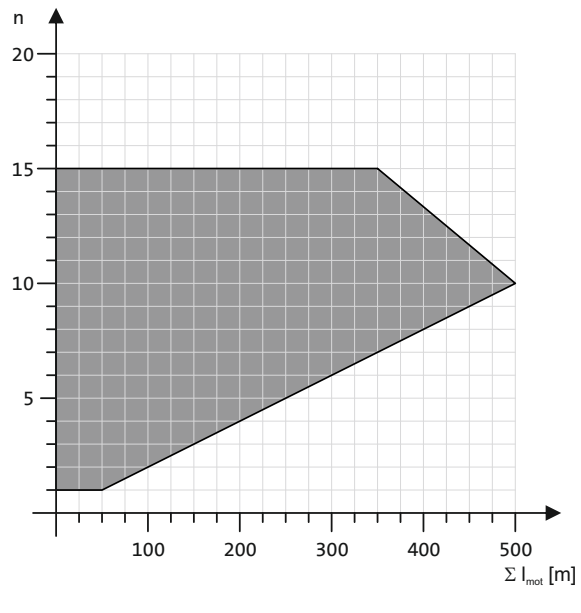
- Power supply modules for 30 A operation with rated data
- Power supply modules for 60 A operation with rated data

4.5

Product key		Output power	Rated current	Dimensions	Mass
Power supply module	Mains choke	at 400 V			
		P_{out}	I_N	h x b x t	m
		[kW]	[A]	[mm]	[kg]
E70ACP□□0304□	EZAELN3025B122	15.4	25.0	110 x 155 x 170	5.8
E70ACP□□0604□	EZAELN3050B591	30.9	50.0	112 x 185 x 210	8.4

The following diagram shows the possible number of axes and the possible sum of motor cable lengths to ensure compliance with interference suppression according to category C3.

Number of axes (n) / sum of the motor cable length (l)





Interference suppression of power supply modules

RFI filters

RFI filters are primarily capacitive accessory components which can be connected directly upstream from the power supply modules. This measure enables compliance with the corresponding conducted noise emission requirements according to EN 61800-3.

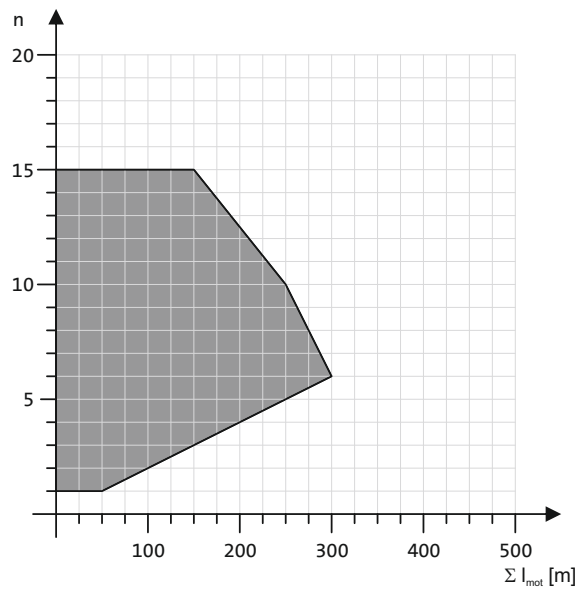


RFI filter, can be mounted beside the power supply module

Product key		Output power	Rated current	Power loss	Max. cable length	Dimensions	Mass
Power supply module	RFI filter	at 400 V			Reference group C2		
		P_{out}	I_N	P_V	l_{max}	h x b x t	m
		[kW]	[A]	[kW]	[m]	[mm]	[kg]
E70ACP□□0304□	E94AZRP0084	3.60	8.00	0.020	6 axes of 50 m each	485 x 60 x 261	4.2
	E94AZRP0294	10.3	29.0	0.050			4.5
E70ACP□□0604□	E94AZRP0824	20.6	82.0	0.080		490 x 209 x 272	18.5

The following diagram shows the possible number of axes and the possible sum of motor cable lengths to ensure compliance with interference suppression according to category C2.

Number of axes (n) / sum of the motor cable length (l)





Interference suppression of power supply modules

Mains filters

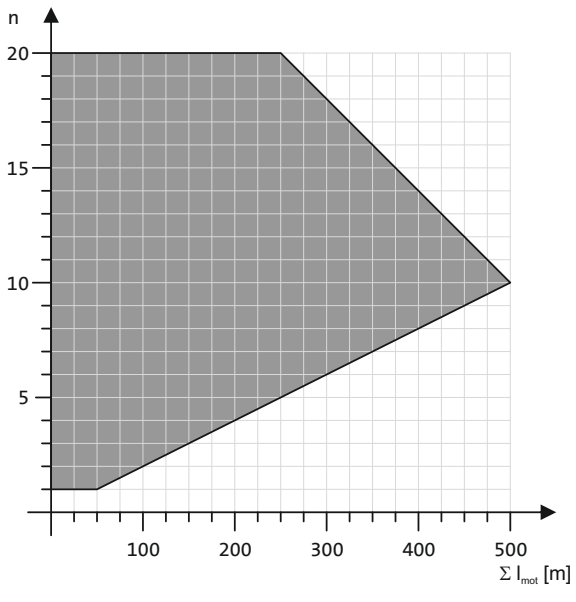
A mains filter is a combination of mains choke and RFI filter in one housing. It reduces the conducted interference emission into the mains in order that the conducted interference voltage is reduced to the area permissible according EN61800-3.
This results in the following advantages:

- Fewer effects on the mains:
  The wave form of the mains current is a close approximation to a sine wave.
- Reduction in the effective mains current:
  Reduction of mains, cable and fuse loads
- Current balancing when power supply modules are connected in parallel

Product key		Output power	Rated current	Voltage drop	Max. cable length	Dimensions	Mass
Power supply module	Mains filter	at 400 V			Reference group C2		
		P_{out}	I_N	U	I_{max}	h x b x t	m
		[kW]	[A]	[V]	[m]	[mm]	[kg]
E70ACP□□0304□	E94AZMP0084	4.90	8.00	10.0	10 axes of 50 m each	485 x 90 x 261	8.6
	E94AZMP0294	15.4	29.0	7.3		485 x 120 x 261	16.5
E70ACP□□0604□	E94AZMP0824	30.6	82.0	6.4		490 x 270 x 272	29.0

The following diagram shows the possible number of axes and the possible sum of motor cable lengths to ensure compliance with interference suppression according to category C2.

Number of axes (n) / sum of the motor cable length (l)





24 V power supply unit

The control electronics of the axis and power supply modules must be supplied by external 24-V power supply units. For this purpose, various power supply units are available. The power supply units can be supplied with AC voltage and DC voltage from the DC bus of the drive system. This ensures a continuous supply of the electronics in case of mains failure to ensure a controlled braking process.

Electrical isolation
The i700 components have a "save separation" between mains and electronic potential according to IEC 61131–2. For maintaining this feature, the successive power supply units can be used with SELV (Safety Extra Low Voltage) or PELF (Protective Extra Low Voltage).



24 V power supply unit

Product key			EZV1200-000	EZV2400-000	EZV4800-000	EZV1200-001	EZV2400-001	EZV4800-001
Rated voltage								
AC	$U_{N, AC}$	[V]	230			400		
Input voltage								
	U_{in}	[V]	AC 85 ... 264 DC 90 ...350			AC 320 ... 575 DC 450 ...800		
Rated mains current								
	$I_{N, AC}$	[A]	0.8	1.2	2.3	0.3	0.6	1.0
Output voltage								
	U_{out}	[V]	DC 22.5 ...28.5					
Rated output current								
	$I_{N, out}$	[A]	5.0	10.0	20.0	5.0	10.0	20.0
Dimensions								
Height	h	[mm]	130					
Width	b	[mm]	55	85	157	73	85	160
Depth	t	[mm]	125					
Mass								
	m	[kg]	0.8	1.2	2.5	1.0	1.1	1.9

Installation sets for Servo-Inverter i700

The installation sets include:
- All plug-in terminals
- Shield sheets plus shield terminals
- EtherCAT® cable (100 mm) for connecting the next axis

Mode	**Features**	**Product key**
Installation set for single axes	• For axes 5 to 20 A	E70AZEVK001
	• For axes 32 to 64 A	E70AZEVK003
Installation set for double axes	• For axes 5 to 10 A	E70AZEVK002
	• For axes 20 to 32 A	E70AZEVK004
Installation set for power supply modules	• For power supply module 30 A	E70AZEVK005
	• For power supply module 60 A	E70AZEVK006
	• For parallel connection	E70AZEVK007
Infeed adapter i700 DC Terminal	• For extending the DC-bus connection, energy exchange	E70AZEVE001



Installation material for i700 servo inverter

► For customers who order large quantities.

Single axes 5 to 20 A

Mode	Packaging	Product key
	VPE	
	[Stück]	
STO terminal	50	EZAEVE001/M
DigIN terminal	50	EZAEVE002/M
Terminal - external 24-V supply	50	EZAEVE003/M
Brake terminal	50	EZAEVE004/M
Motor terminal 2.5 mm²	50	EZAEVE005/M
Shield plate BF1	25	EZAMBHXM008/M
Fixing clip	20	EZAMBHXM007/M
Wire clamp	10	EZAMBHXM006/M
EtherCAT® cable 100 mm (connection to the next axis)	10	EYC0000A0000X001/M

Single axes 32 to 64 A

4.5

Mode	Packaging	Product key
	VPE	
	[Stück]	
STO terminal	50	EZAEVE001/M
DigIN terminal	50	EZAEVE002/M
Terminal - external 24-V supply	50	EZAEVE003/M
Brake terminal	50	EZAEVE004/M
Motor terminal 6.0 mm²	25	EZAEVE006/M
Shield plate BF2	25	EZAMBHXM009/M
Fixing clip	20	EZAMBHXM007/M
Wire clamp	10	EZAMBHXM003/M
EtherCAT® cable 100 mm (connection to the next axis)	10	EYC0000A0000X001/M

Double axes 5 to 10 A

Mode	Packaging	Product key
	VPE	
	[Stück]	
STO terminal	50	EZAEVE001/M
DigIN terminal	50	EZAEVE002/M
Terminal - external 24-V supply	50	EZAEVE003/M
Brake terminal	50	EZAEVE004/M
Motor terminal 2.5 mm²	50	EZAEVE005/M
Shield plate BF1	25	EZAMBHXM008/M
Fixing clip	20	EZAMBHXM007/M
Wire clamp	10	EZAMBHXM006/M
EtherCAT® cable 100 mm (connection to the next axis)	10	EYC0000A0000X001/M



Installation material for i700 servo inverter

► For customers who order large quantities.

Double axes 20 to 32 A

Mode	Packaging	Product key
	VPE	
	[Stück]	
STO terminal	50	EZAEVE001/M
DigIN terminal	50	EZAEVE002/M
Terminal - external 24-V supply	50	EZAEVE003/M
Brake terminal	50	EZAEVE004/M
Motor terminal 2.5 mm^2	50	EZAEVE005/M
Shield plate BF2	25	EZAMBHXM009/M
Fixing clip	20	EZAMBHXM007/M
Wire clamp	10	EZAMBHXM003/M
EtherCAT® cable 100 mm (connection to the next axis)	10	EYC0000A0000X001/M

Power supply module 30 A

Mode	Packaging	Product key
	VPE	
	[Stück]	
Terminal - external 24-V supply	50	EZAEVE003/M
Mains terminal	50	EZAEVE008/M
DigIN terminal	50	EZAEVE009/M
DigOUT terminal	50	EZAEVE010/M
Brake resistor terminal	50	EZAEVE011/M
Shield plate BF1	25	EZAMBHXM008/M
Fixing clip	20	EZAMBHXM007/M
Wire clamp	10	EZAMBHXM006/M

Power supply module 60 A

Mode	Packaging	Product key
	VPE	
	[Stück]	
Terminal - external 24-V supply	50	EZAEVE003/M
Mains terminal	50	EZAEVE008/M
DigIN terminal	50	EZAEVE009/M
DigOUT terminal	50	EZAEVE010/M
Brake resistor terminal	50	EZAEVE011/M
Shield plate BF2	25	EZAMBHXM009/M
Fixing clip	20	EZAMBHXM007/M
Wire clamp	10	EZAMBHXM003/M



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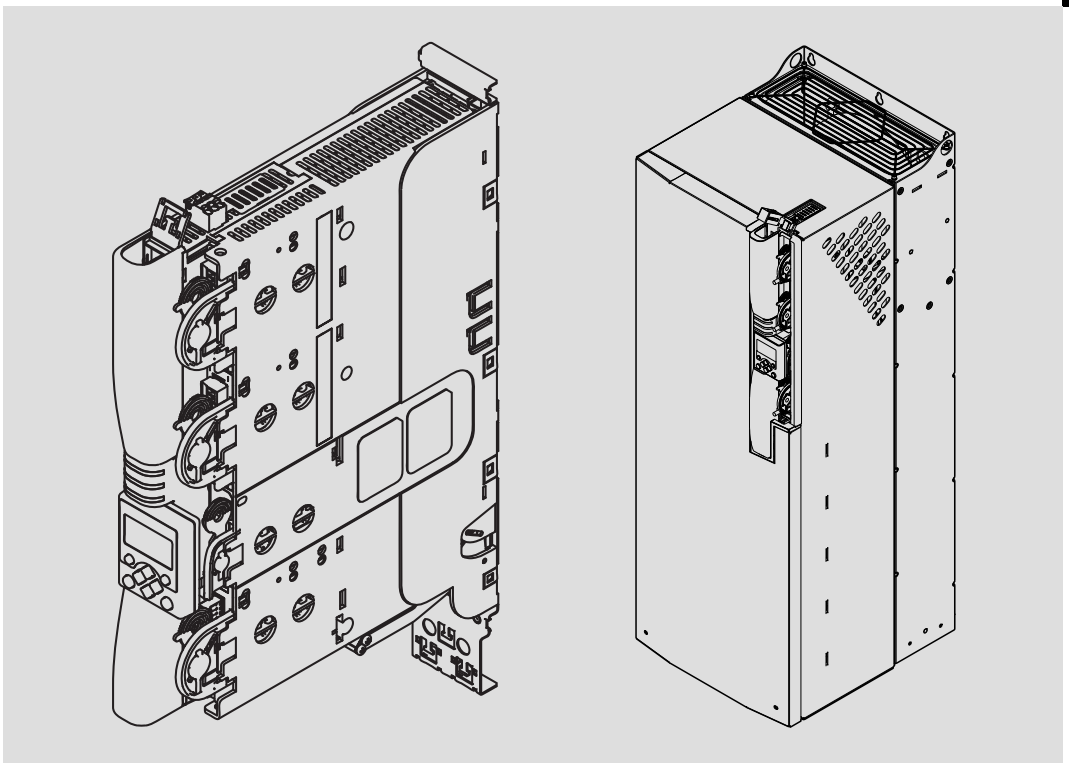
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EDS94SPP101
13550980

L-force *Drives*

Hardware Manual

9400



E94A..., E94B..., E94C..., E94D...

Servo Drives 9400

Lenze

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1 Preface

1.1 The 9400 Servo Drives product range

1.1.1 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

1.1.2 Features

The Servo Drives 9400 feature:

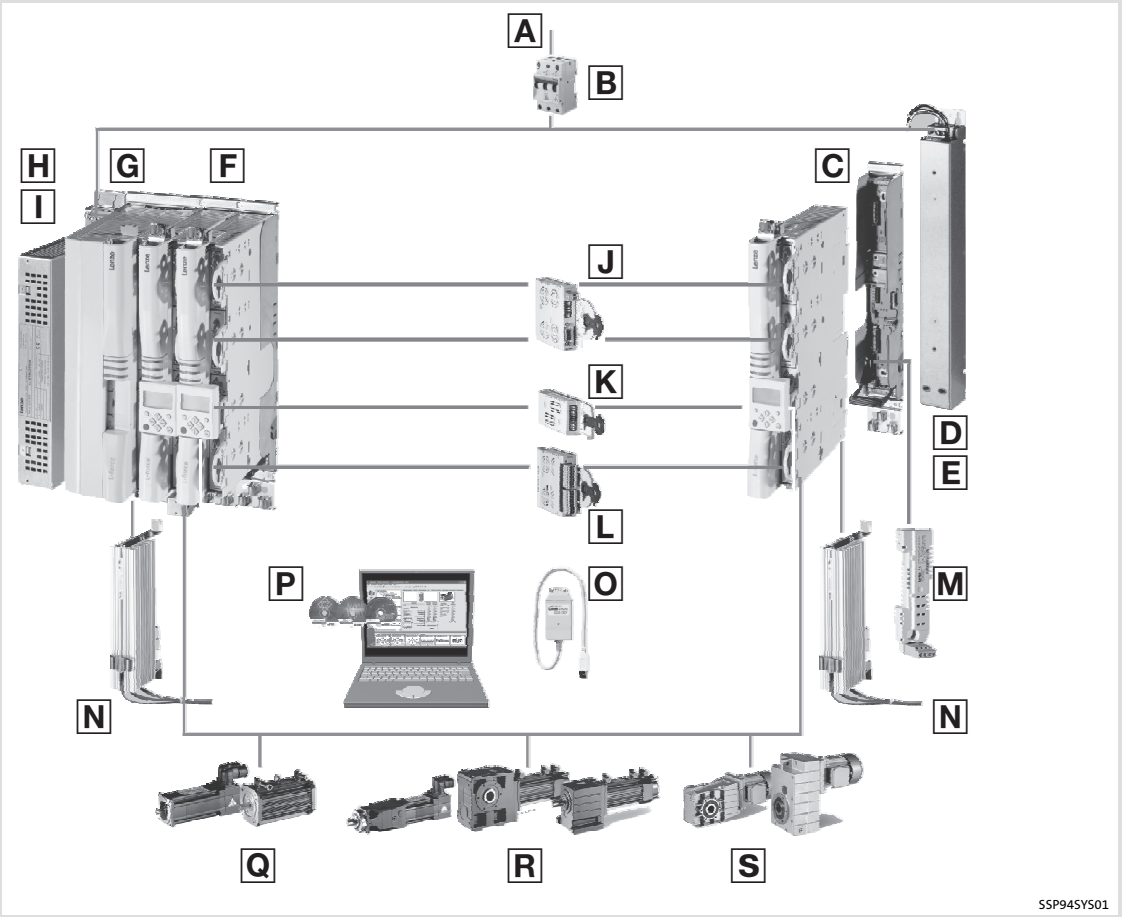
- compact design
- wide power range
- innovative installation concept
- intelligent technology functions
- high control precision
- scalable safety technology

1.1.3 System overview

The following figure shows the most important components for the implementation of a drive system with the Servo Drives 9400 product range.

On the way from the mains connection to the motor, you can see the basic principle of a drive system on the left path. On the right path, the basic principle of a single-axis drive is described.

In accordance with the requirements of your drive solution, your drive system can be equipped or extended with specially adapted components.



A Mains voltage 3/PE AC 180 ... 528 V ±0 % or 3/PE AC 340 ... 528 V ±0 %
(depending on the device size/device power)
B Mains fusing (not contained in the delivery programme)
C Single Drives 9400 📖 31
and corresponding installation backplanes
D Mains filter for Single Drives 9400 📖 542
E RFI filter for Single Drives 9400 📖 571
F Multi Drives 9400 📖 167
and corresponding installation backplanes
G Power supply modules 9400
📖 241, 📖 289
(for DC bus installations with Multi Drives 9400)
H Mains filter for power supply modules 9400 📖 549
I RFI filter for power supply modules 9400 📖 589

Equipment for all axis modules (device-dependent options):
J Communication modules and extension modules 📖 371
K Memory modules 📖 419
L Safety modules 📖 428
M Motor holding brake control modules 📖 448
N Brake resistors 📖 625
O Diagnostic adapters 📖 507
P L-force Engineer (software)
Q Servo motors (motor catalogue)
R Geared servo motors (")
S Standard geared motors (")
Motor cables/system cables
(manual "System cables")

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.



Tip!

Information and tools concerning the Lenze products can be found in the download area at

www.lenze.com

1.2.2 Products to which the Hardware Manual applies

Power modules

	1 2 3	4	5	6	7	8 9 10	11	12	13 14	15 16	17 18	19
	E94	x	x	x	E	xxx	x	x	xx	xx	xx	-

Type / product range

9400 Servo Drives

Version

A = 1. (max. 1999 Hz)
B = 2. (from 145 A/75 kW, max. 1999 Hz)
C = 2. (max. 599 Hz)
D = 3. (max. 599 Hz)

Version

S = single-axis controller (Single Drive)
M = multi-axis controller (Multi Drive)
P = power supply module
R = regenerative power supply module

Variant

H = HighLine
N = not relevant
P = PLC

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 in MSI (place 7 of the extension modules)

A ... F

Memory module in MMI (places 7 and 8 of the extension modules)

22 ... 44

Extension module in MXI2 (places 7 and 8 of the extension modules)

xx

Extension module in MXI1 (places 7 and 8 of the extension modules)

xx

In the case of complete devices, the type code can contain a 5-place item of information regarding the configured installation backplane, whereby this information appears at place 19 after the separator (see places 7 to 14, power-related accessories). In addition, a 6-place item of information regarding an integrated motor holding brake control module can be contained (see places 6 to 14, performance-related accessories. ”N” means ”Not relevant”.

With the help of the type code, you can identify supplied products on the basis of the information on the nameplate. In the product catalogue, you can find the possible configuration in order to order the product.

Extension modules

123	4	5	6	78
E94	x	Y	x	xx

Type / product range

9400 Servo Drives

Version

A = 1.
N = not relevant

Identification

Y = module

Module group

C = communication
F = feedback
M = memory
A = safety

Module identification

communication

CA = CANopen®
DN = DeviceNet™
EN = Ethernet 2 port
EO = EtherNet/IP™
EP = POWERLINK
EC = POWERLINK CN
ET = EtherCAT®
PM = PROFIBUS®
ER = PROFINET®
IB = INTERBUS

Feedback

LF = digital frequency

Memory

22 = Memory module MM220 with MC HighLevel licence
33 = Memory module MM330 with MC TopLevel licence
34 = Memory module MM340 with PLC licence
43 = Memory module MMx20 with MC TopLevel licence
44 = Memory module MMx40 with PLC licence

Safety

A = SM0 safety module
B = SM100 safety module
E = SM301safety module
F = SM302 safety module

Power-related accessories

1 2 3	4	5	6	7	9 10 11	14
E94	A	Z	x	x	xxx	x

Type / product range

9400 Servo Drives

Version

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

123	4	5	6	789
E94	A	Z	x	xxx

Type / product range

9400 Servo Drives

Version

Identification

Z = accessories

Accessory group

J = mechanical components, other
S = software
K = keypad
N = not specified

Module identification

1.3 Document history

Material number	Version			Description
13550980	11.1	02/2023	TD00	New version E94D... Additions, corrections
13550980	11.0	06/2018	TD29	New version E94C...
13543133	10.2	02/2018	TD29	Corrected device features
13543133	10.1	01/2018	TD29	Data concerning UL fuses added
13543133	10.0	09/2017	TD29	General corrections and standardisation
13514043	9.0	11/2016	TD29	New devices inserted; old devices removed New UL specifications in preparation Corrections
13480643	8.0	09/2015	TD15	Additions: Conformity with EAC Corrections Document structure updated
13344991	7.1	07/2010	TD29	Additions, corrections
13344991	7.0	07/2010	TD29	Additions, corrections
13320181	6.0	11/2009	TD15	Additions, corrections
13280002	5.0	11/2008	TD15	Additions, corrections
13261288	4.2	07/2008	TD15	Additions, corrections
13256547	4.1	06/2008	TD15	Additions, corrections
13225695	4.0	04/2007	TD15	Additions, corrections
13192254	3.1	03/2007	TD15	Additions, corrections
13192254	3.0	02/2007	TD15	Additions, corrections
13095102	2.0	09/2006	TD15	Additions, corrections (field test)
13095102	1.0	12/2005	TD15	First edition (field test)

1.4 Conventions used

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

Spelling of numbers		
Decimal separator	Point	In general, the decimal point is used. For instance: 1234.56
Warnings		
UL warnings		Given in English and French
UR warnings		
Text		
Program name	» «	PC software For example: »Engineer«, »Global Drive Control« (GDC)
Icons		
Page reference	🕮	Reference to another page with additional information For instance: 🕮 16 = see page 16
Documentation reference		Reference to another documentation with additional information For example: EDKxxx = see documentation EDKxxx

1.5 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

Pictograph and signal word	Meaning
 **Warnings!**	**Safety note or application note for the operation according to UL or CSA requirements.** The measures are required to meet the requirements according to UL or CSA.
 **Warnings!**	

1.6 Legal regulations

Labelling

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

Manufacturer

Lenze SE, Postfach 10 13 52 · 31763 Hameln, Hans-Lenze-Str. 1 · 31855 Aerzen

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.

1.7 Terms and abbreviations used

Controller	Any frequency inverter, servo inverter, or DC speed controller
Axis, drive	Lenze controller combined with a motor or geared motor and other Lenze drive components
Basic insulation	Insulation for the basic protection against dangerous shock currents
Functional insulation	Insulation for perfect operation
Double insulation	Basic insulation and additional insulation
Reinforced insulation	Standardised insulating system, equivalent protection to double insulation
Cxxxxx/y	Subcode y of code Cxxxx (e.g. C0410/3 = subcode 3 of code C0410)
Xk/y	Terminal y on terminal strip Xk (e.g. X3/28 = terminal 28 on terminal strip X3)
🕮	Cross-reference to a chapter with the corresponding page number
AC	AC current or AC voltage
DC	DC current or DC voltage
U_{LN} [V]	Rated mains voltage
U_{DC} [V]	DC voltage
U_{M} [V]	Output voltage/voltage across the motor terminals
I_{LN} [A]	Rated mains current
I_{aN} [A]	Rated output current
I_{aM} [A]	Maximum output current
I_{PE} [mA]	Discharge current
I_{DC} [A]	Direct current, r.m.s. value from direct current and harmonic currents, for the dimensioning of DC-bus cables and DC-bus fuses
P_{N} [kW]	Rated motor power
P_{V} [W]	Inverter power loss
P_{DC} [kW]	Power on the DC voltage side
S_{N} [kVA]	Apparent output power of controller
M_{N} [Nm]	Rated torque
f_{max} [Hz]	Maximum frequency
L [mH]	Inductance
R [Ω]	Resistance
DIN	Deutsches Institut für Normung

EMC	Electromagnetic compatibility
EN	European standard
IEC	International Electrotechnical Commission
IP	International Protection Code
NEMA	National Electrical Manufacturers Association
VDE	Verband deutscher Elektrotechniker
CE	Communauté Européene
UL	Underwriters Laboratories

2 Safety instructions

2.1 General safety and application notes for Lenze controllers

(in accordance with Low-Voltage Directive 2014/35/EU)

For your pesonal safety

Disregarding the following basic safety measures may lead to severe personal injury and damage to material assets:

- Only use the product as directed.
- Never commission the product in the event of visible damage.
- Never commission the product before assembly has been completed.
- Do not carry out any technical changes on the product.
- Only use the accessories approved for the product.
- Only use original spare parts from Lenze.
- Observe all regulations for the prevention of accidents, directives and laws applicable on site.
- Transport, installation, commissioning and maintenance work must only be carried out by qualified personnel.
  - 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 the basic safety information, qualified, skilled personnel are persons who are familiar with the assembly, installation, commissioning, and operation of the product and who have the qualifications necessary for their occupation.
- Observe all specifications in this documentation.
  - This is the condition for safe and trouble-free operation and the achievement of the specified product features.
  - The procedural notes and circuit details described in this documentation are only proposals. It's up to the user to check whether they can be transferred to the particular applications. Lenze SE does not accept any liability for the suitability of the procedures and circuit proposals described.
- According to their enclosure, Lenze controllers (frequency inverters, servo inverters, DC speed controllers) and their components can carry a voltage, or parts of the controllers can move or rotate during operation. Surfaces can be hot.
  - Non-authorised removal of the required cover, inappropriate use, incorrect installation or operation create the risk of severe injury to persons or damage to material assets.
  - For more information, please see the documentation.
- There is a high amount of energy within the controller. Therefore always wear personal protective equipment (body protection, headgear, eye protection, ear protection, hand guard) when working on the controller when it is live.

Intended use

Drive controllers are components designed for the installation in electrical systems or machinery. They must not be used as household appliances. They are intended exclusively professional and commercial purposes according to EN 61000-3-2.

When controllers are installed into machines, commissioning (i.e. starting of the operation as directed) is prohibited until it is proven that the machine complies with the regulations of the EC Directive 2006/42/EC (Machinery Directive); EN 60204 must be observed.

Commissioning (i.e. starting of the operation as directed) is only allowed when there is compliance with the EMC Directive (2014/30/EU).

The inverters meet the requirements of the Low-Voltage Directive 2014/35/EU. The harmonised standard EN 61800-5-1 applies to the inverters.

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

The actuation of the inverters in specific areas in compliance with EN61800-3 (EMC categories) possibly requires the use of filters.
Warning: in residential environments, this product may cause high-frequency interferences which may make the implementation of interference suppression measures necessary.

Transport, storage

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

Observe the climatic conditions according to the technical data.

Installation

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

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

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

Controllers contain electrostatically sensitive components which can easily be damaged by inappropriate handling. Do not damage or destroy any electrical component since doing so might endanger your health!

Electrical connection

When working on live inverters, observe the applicable national regulations for the prevention of accidents.

Carry out the electrical installation according to the relevant regulations (e. g. cable cross-sections, fusing, connection to the PE conductor). Additional notes are included in the documentation.

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

Lenze controllers may cause a DC current in the PE conductor. If a residual current device (RCD) is used for protection against direct or indirect contact for a controller with three-phase supply, only a residual current device (RCD) of type B is permissible on the supply side of the controller. If the controller has a single-phase supply, a residual current device (RCD) of type A is also permissible. Apart from using a residual current device (RCD), other protective measures can be taken as well, e.g. electrical isolation by double or reinforced insulation or isolation from the supply system by means of a transformer.

Operation

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

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

Keep all protective covers and doors closed during operation.

Safety functions

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

Maintenance and servicing

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

Waste disposal

Recycle metal and plastic materials. Assembled PCBs must be disposed of professionally.

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

2.2 General safety and application notes for Lenze motors

(according to Low-Voltage Directive 2014/35/EU)

General

Low-voltage machines have dangerous, live and rotating parts as well as possibly hot surfaces.

Synchronous machines induce voltages at open terminals during operation.

All operations serving transport, connection, commissioning and maintenance are to be carried out by skilled, responsible technical personnel (observe EN 50110-1 (VDE 0105-1) and IEC 60364). Improper handling can cause severe injuries or damages.

Lowvoltage 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

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

Lowvoltage machines are components for installation into machines as defined in the Machinery Directive 2006/42/EC. Commissioning is prohibited until the conformity of the end product with this directive has been established (follow i. a. EN 60204-1).

Lowvoltage 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 Aside 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 screwedin ring bolts before transport. They are designed for the weight of the lowvoltage 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, dustfree 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 halfkey balanced. The clutch must be halfkey 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 lowvoltage 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 600341; IEC 34 (VDE 05301) 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 (tostop).

The clearances between blank, live parts and to earth must not fall below 8 mm at $V_{rated} \leq 550$ V, 10 mm at $V_{rated} \leq 725$ V, 14 mm at $V_{rated} \leq 1000$ 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 lowvoltage 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 $I > I_{rated}$ after a few seconds of operation, especially at the risk of blocking.

Vibrational severities $v_{eff} \leq 3.5$ mm/s ($P_{rated} \leq 15$ kW) or 4.5 mm/s ($P_{rated} > 15$ 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 lowvoltage 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 lowvoltage 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 nondrive end), remove plug before commissioning. Seal bore holes with grease. Replace prelubricated bearings (2Z bearing) after approx. 10,000 h 20,000 h, at the latest however after 3 4 years.

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

2.3 Residual hazards

Protection of persons

- Before working on the controller, check if no voltage is applied to the power terminals because
  - because the power terminals U, V, W, +UG, -UG, Rb1 and Rb2 carry hazardous voltages for up to 20 minutes after power-off depending on the device.
  - 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 Single-axis controllers

3.1 Device features

- Space-saving installation by compact design
- Innovative installation concept
- Power range: 370 W to 240 kW
- Pluggable and same connection system for the control cables in the entire power range
- Direct AC mains connection for ”Single Drive” design
- DC link busbar (DC-bus) integrated or can be retrofitted (devices up to 24 A/11 kW)
- Integrated brake chopper
- 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 system
- System bus (CANopen)
  – servo inverter connection
  – for extending input and output terminals
  – connecting keypad and display units (HMI)

3.2 Overview of the devices

Note!

For reasons of clarity, device types in this manual are placed together in groups with shared device characteristics. For example:

- ”Devices in the range 2 ... 24 A (0.37 ... 11 kW)” (often from project planner’s viewpoint) or
- ”Device sizes 1, 2 and 3” (often from installation point of view)

The following table gives you an overview of the different device characteristics:

Type	Rated current (rounded)	Motor power (typ.)	Device size (DS)
E94xSxE0024 E94xSxE0034	2 A 3 A	0.37 kW 0.75 kW	1
E94xSxE0044 E94xSxE0074	4 A 7 A	1.5 kW 3.0 kW	2
E94xSxE0134 E94xSxE0174 E94xSxE0244	13 A 17 A 24 A	5.5 kW 7.5 kW 11 kW	3
E94xSxE0324 E94xSxE0474 E94xSxE0594	32 A 47 A 59 A	15 kW 22 kW 30 kW	6
E94xSxE0864 E94xSxE1044	86 A 104 A	45 kW 55 kW	7
E94xSxE1454	145 A	75 kW	81
E94xSxE1724 E94xSxE2024 E94xSxE2454	172 A 202 A 245 A	90 kW 105 kW 130 kW	82
E94xSxE2924	292 A	150 kW	83
E94xSxE3664 E94xSxE4604	366 A 460 A	190 kW 240 kW	91

3.3 General data and operating conditions

General data

Conformity and approval			
Conformity			
CE	2014/35/EU	Low-Voltage Directive	
CE	2014/30/EU	EMC Directive	
UKCA	S.I. 2016/1101	The Electrical Equipment (Safety) Regulations 2016	
UKCA	S.I. 2016/1091	The Electromagnetic Compatibility Regulations 2016	
Approval			
E94xSxE0024 (0.37 kW) ... E94xSxE1044 (55 kW):			
$_{C}UL_{US}$	UL61800-5-1	Industrial Control Equipment (File No. E132659) for USA	
	CSA C22.2 No. 274-13	Industrial Control Equipment (File No. E132659) for Canada	
E94xSxE1454 (75 kW) ... E94xSxE2924 (150 kW):			
$_{C}UL_{US}$	UL 508C	Industrial Control Equipment (File No. E132659) for USA	
	CSA C22.2 No. 274-13	Industrial Control Equipment (File No. E132659) for Canada	

Protection of persons and device protection			
Type of protection	EN 60529	IP 20	Outside the wire range of the terminals on the motor side
	NEMA 250	Protection against accidental contact in accordance with type 1	
Insulation resistance	EN 61800-5-1	Overvoltage category III from 2000 m amsl: external measures for compliance with the overvoltage category II are required, e.g. ● upstream connection of transformer ● upstream connection of overvoltage protection system	
Control circuit isolation	EN 61800-5-1	up to 2000 m amsl: Safe mains isolation by double/reinforced insulation for mains with neutral earthing with a rated voltage for the external conductor/star point up to 300 V. from 2000 m amsl: If an overvoltage protection system is connected upstream to the device instead of an isolating transformer, additional external measures are required for maintaining the safe isolation.	
Short-circuit strength	EN 61800-5-1	Motor connection: with restrictions, error acknowledgement required Control terminals: full	
Motor - protective measures against		● Short circuit ● Earth fault ● Overvoltage ● motor stalling ● Motor overtemperature (PTC or thermal contact, I^2t monitoring)	
Leakage 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
Clearance		
above/beneath		Comply with the device-relating mounting instructions.
at the side		Can be installed in a row without any clearance

Supply conditions "Single Drive"		
AC mains operation		Device size 1 ... 7: Direct connection Device size 81 ... 91: Direct connection via terminals with wire end ferrules; alternatively via ring cable lugs
DC-bus operation		Device size 1 ... 7: Direct connection via terminals or busbar system (retrofittable) Device size 81 ... 91: Direct connection via terminals with wire end ferrules; alternatively via ring cable lugs For more information, please see the chapter DC-bus operation.
Power systems		
TT		Operation allowed without restrictions.
TN		
IT		Up to device size 83: additional measure necessary inside device (see "Earthing of internal EMC filter", 📖 109) device size 91: Specify when ordering
Motors	EN 60034	Only use motors that are suitable for inverter operation. Insulation strength: max. $\hat{u} \geq 1.5$ 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	Device size 1 ... 6: 2K3 (-25 ... +70 °C)
Operation	IEC/EN 60721-3-3	3K3 (-10 ... +55 °C) Current derating at +45 ... +55 °C: Device size 1 ... 7: 2.5 %/°C Device size 81 ... 91: 1 %/°C
Site altitude		0 ... 4000 m amsl Device size 1 ... 7 with 1000 ... 4000 m amsl: Current derating 5 %/1000 m Device size 81 ... 91 with 1000 ... 4000 m amsl: Current derating 10 %/1000 m
Pollution	EN 61800-5-1	Degree of pollution 2
Vibration resistance (9.81 m/s² = 1 g)		
Transport (only tested for device size 1 ... 7)	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/s²
		200 ... 500 Hz: acceleration resistant up to 15 m/s²
Operation	Germanischer Lloyd	5 ... 13.2 Hz: Amplitude ±1 mm 13.2 ... 100 Hz: acceleration resistant up to 0.7 g Device size 81 ... 83: Mounting must be executed with vibration dampers by the customer. Please consult Lenze. Device size 91: The control cabinet has to be vibration-damped.
	IEC/EN 60068-2-6	10 ... 57 Hz: Amplitude 0.075 mm
		57 ... 150 Hz: Acceleration resistant up to 1 g

Assignment of installation backplane – standard device

Assignment		Device size	Accessories: busbar mounting set/spare fuse
Axis module	Installation backplane		
E94xSxE0024 E94xSxE0034	E94AZPS0034	1	E94AZJA003: 16 A, 700 V DC / EFSAR0016ARHN
E94xSxE0044 E94xSxE0074	E94AZPS0074	2	E94AZJA007: 40 A, 700 V DC / EFSAR0040ARHN
E94xSxE0134 E94xSxE0174 E94xSxE0244	E94AZPS0244	3	E94AZJA024: 100 A, 700 V DC / EFSAR0100ARZN

Motor cable length

Requirements on the motor cable		
Capacitance per unit length		
≤ 2.5 mm²/AWG 14		$C_{Core/core}/C_{Core/shield}$ < 75/150 pF/m
≥ 4 mm²/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 external - conductor/PE, U = r.m.s. value - external conductor/external conductor)
	UL	U ≥ 600 V (U = r.m.s. value external conductor/external conductor)

Maximum motor and feedback cable lengths
(for shielded motor cable with rated mains voltage)
If EMC conditions must be met, the permissible cable lengths can be reduced.

Type	Device size	[m]
E94xSxE0024 E94xSxE0034	1	50
E94xSxE0044 E94xSxE0074	2	100
E94xSxE0134 E94xSxE0174 E94xSxE0244	3	100
E94xSxE0324 E94xSxE0474 E94xSxE0594	6	100
E94xSxE0864 E94xSxE1044	7	100
E94xSxE1454	81	150 (100 [1)])
E94xSxE1724 E94xSxE2024 E94xSxE2454	82	150 (100 [1)])
E94xSxE2924	83	150 (100 [1)])
E94xSxE3664 E94xSxE4604	91	150 (100 [1)])

Tab. 3-1

[1)] If safety functions with SM301/SM302, which require reliable speed and position detection, are used.

Type	Max. shielded motor cable lengths for compliance with the conducted interference emission according to C1/C2		
	with RFI filter	with mains filter	without filter
E94xSxE0024 E94xSxE0034	E94AZRS0044 [1] -/50 m	E94AZMS0034 [3] 25 m/50 m	-/10 m [4]
E94xSxE0044 E94xSxE0074	E94AZRS0104 [1] -/50 m	E94AZMS0094 [3] 25 m/100 m	-/10 m [4]
E94xSxE0134 E94xSxE0174	E94AZRS0294 [1] -/50 m	E94AZMS0184 [3] 25 m/100 m	-/10 m [4]
E94xSxE0244		E94AZMS0314 [3] 25 m/100 m	-/10 m [4]
E94xSxE0324 E94xSxE0474 E94xSxE0594	E94AZRS0544 [2] 50 m/100 m	-	-/50 m [4]
E94xSxE0864 E94xSxE1044	E94AZRS0954 [2] 50 m/100 m	-	-/50 m [4]

Tab. 3-2

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

[1] Universal-current-sensitive earth-leakage circuit breaker 30 mA
If several devices or cable lengths > 50 m are used, it is possible that the circuit breaker will respond, depending on the type of cable and the switching frequency.

[2] Universal-current-sensitive earth-leakage circuit breaker 300 mA
If several devices or cable lengths > 50 m are used, it is possible that the circuit breaker will respond, depending on the type of cable and the switching frequency.

[3] Universal-current-sensitive earth-leakage circuit breaker, cable length ≤ 25 m: 30 mA, cable length > 25 m: 300 mA,
If several devices or cable lengths > 50 m are used, it is possible that the circuit breaker will respond, depending on the type of cable and the switching frequency.

[4] See chapter "Fuses and cable cross-sections", (📖 61).

Type	Max. shielded motor cable lengths for compliance with the conducted interference emission according to C2		
	with RFI filter	with mains filter	without filter
E94xSxE1454	E94AZRS1804 (3F480-180.290EM), 150 m	-	-
E94xSxE1724	E94AZRS1804 (3F480-180.290EM), 150 m	-	-
E94xSxE2024	E94AZRS3004 (3F480-300.290EM), 150 m	-	-
E94xSxE2454	E94AZRS3004 (3F480-300.290EM), 150 m	-	-
E94xSxE2924	E94AZRS3004 (3F480-300.290EM), 150 m	-	-
E94xSxE3664	E94AZRS4154 (3F480-415.290EM), 150 m	-	-
E94xSxE4604	E94AZRS4154 (3F480-415.290EM), 150 m	-	-

Type	Max. shielded motor cable lengths for compliance with the conducted interference emission according to C3		
	with RFI filter	with mains filter	without filter
E94xSxE1454	-	-	150 m
E94xSxE1724	-	-	150 m
E94xSxE2024	-	-	150 m
E94xSxE2454	-	-	150 m
E94xSxE2924	-	-	150 m
E94xSxE3664	-	-	150 m
E94xSxE4604	-	-	150 m

Longer motor cables can be achieved when line filters are used in combination with sinusoidal filters. Further conditions to be observed:

- V/f control mode
- Switching frequency is permanently set (C00018)

Max. motor cable lengths for compliance with the conducted interference emission according to C2 when sinusoidal filters and line filters are used

Type	RFI filter	Mains filter	Sine filter	shielded unshielded	Switching frequency
E94xSxE0024	-	E94AZMS0034	EZS3-004A200	100 m 300 m	4 kHz or 8 kHz
E94xSxE0034					
E94xSxE0044	-	E94AZMS0094	EZS3-010A200		
E94xSxE0074					
E94xSxE0134	-	E94AZMS0184	EZS3-024A200		
E94xSxE0174					
E94xSxE0244	-	E94AZMS0314	EZS3-037A200		
E94xSxE0324	E94AZRS0544	-	EZS3-048A200	150 m 300 m	4 kHz or 8 kHz
E94xSxE0474			EZS3-061A200		
E94xSxE0594			EZS3-072A200		
E94xSxE0864	E94AZRS0954	-	EZS3-115A200	150 m 300 m	2 kHz or 4 kHz
E94xSxE1044			EZS3-150A200		
E94xSxE1454	E94AZRS1804 3F480-180.290EM	-	EZS3-180A200	150 m - m	2 kHz or 4 kHz
E94xSxE1724	E94AZRS1804 3F480-180.290EM	-	EZS3-250A200		
E94xSxE2024	E94AZRS3004 3F480-300.290EM	-	EZS3-250A200		
E94xSxE2454	E94AZRS3004 3F480-300.290EM	-	EZS3-350A200		
E94xSxE2924	E94AZRS3004 3F480-300.290EM	-	EZS3-350A200		
E94xSxE3664	E94AZRS4154 3F480-415.290EM	-	EZS3-480A200		
E94xSxE4604	E94AZRS4154 3F480-415.290EM	-	EZS3-350A200 (2 in parallel)		

Tab. 3-3

EMC limit classes of the conducted interference emission in TN/TT systems:
C2 according to EN 61800-3, corresponds to class A according 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. 3-2 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 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!

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.

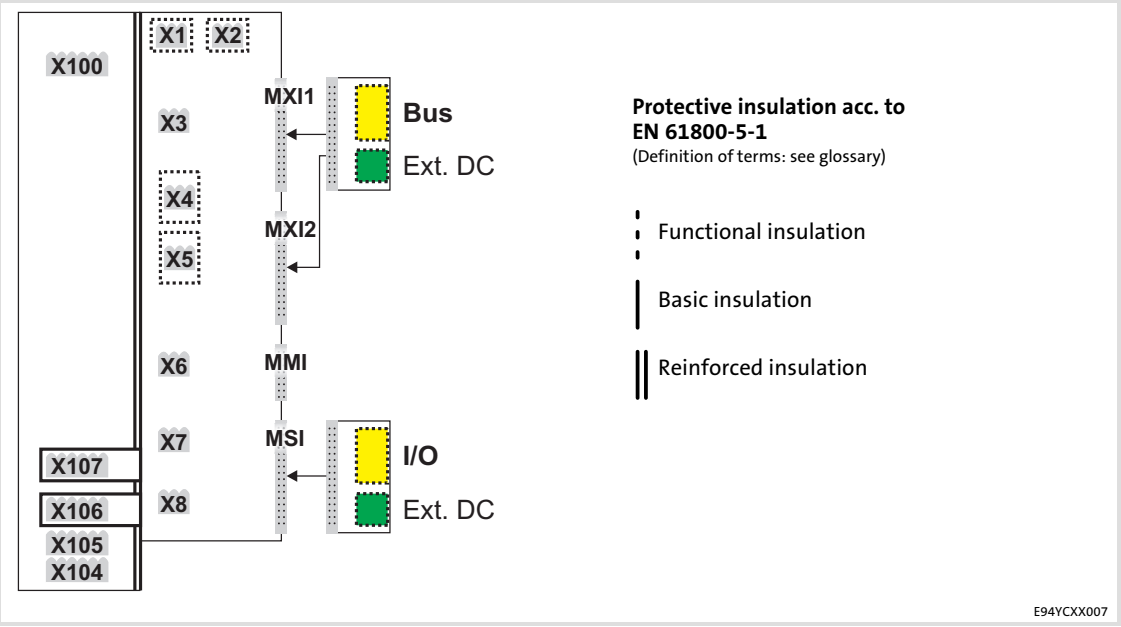
Protective measures:

► Use independent voltage sources.

The available protective insulation within the controller of the ” 9400 Servo Drives” series in accordance with EN 61800-5-1 is implemented with a rated voltage for the external conductor/star point of up to 300 V for mains with neutral earthing.

The following graphic representation

- shows the arrangement of the terminal strips and the separate potential areas of the controller.
- serves to determine the relevant protective insulation between two terminals in differently insulated separate potential areas.



Terminal strip	Connection		Terminal strip	Connection
	Device size 1 ... 7	Device size 81 ... 91		
X100	L1, L2, L3 (only single drive) +UG, -UG	L1, L2, L3	X1	CAN on board 9400
X104	not available	+UG/Rb1, -UG, Rb2	X2	• State bus • 24 V (ext.)
X105	U, V, W Rb1, Rb2 (only single drive)	U, V, W	X3	Analog input/output
X106	Motor PTC	Motor PTC	X4	Digital outputs
X107	Control of motor holding brake	Control of motor holding brake	X5	Digital inputs
			X6	Diagnostics
			X7	Resolvers
			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.

3.4 Rated data

The devices in the power range of 0.37 ... 55 kW (GG 1 ... 7) can be used in the voltage range of 180 ... 528 V AC.

The devices in the power range of 75 ... 240 kW (GG 81 ... 91) can be used in the voltage range of 340 ... 528 V AC.

Note!

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

Emergency operation

Operation of the E94xSxxxx4 devices with an emergency voltage supply at +UG, -UG, is possible from $U_{DC} \geq 260$ V. The settings in C00173 and C00174 are to be adapted accordingly.

3.4.1 Overview

Input data

	Voltage [V AC] [V DC]	Frequency [Hz]	Rated current [A] up to +45 °C ①	Rated current [A] up to +55 °C ①	Number of phases
E94xSxE0024	230/400/480 325/565/675	50/60 -	2.1/2.1/1.8 2.6/2.6/2.3	1.6/1.6/1.4 1.9/1.9/1.7	3 -
E94xSxE0034	230/400/480 325/565/675	50/60 -	3.5/3.5/3.1 4.3/4.3/3.8	2.6/2.6/2.3 3.2/3.2/2.9	3 -
E94xSxE0044	230/400/480 325/565/675	50/60 -	5.5/5.5/4.8 6.7/6.7/5.9	4.1/4.1/3.6 5.0/5.0/4.4	3 -
E94xSxE0074	230/400/480 325/565/675	50/60 -	9.9/9.9/8.6 12.1/12.1/10.6	7.4/7.4/6.5 9.1/9.1/8.0	3 -
E94xSxE0134	230/400/480 325/565/675	50/60 -	16.8/16.8/14.7 20.6/20.6/18.0	12.6/12.6/11.0 15.5/15.5/13.5	3 -
E94xSxE0174	230/400/480 325/565/675	50/60 -	21.0/21.0/18.3 25.7/25.7/22.5	15.8/15.8/13.8 19.3/19.3/16.9	3 -
E94xSxE0244	230/400/480 325/565/675	50/60 -	29.0/29.0/25.4 35.5/35.5/31.1	21.8/21.8/19.1 26.6/26.6/23.3	3 -
E94xSxE0324	230/400/480	50/60	29.0/29.0/26.0	22.0/22.0/20.0	3
E94xSxE0474	230/400/480 325/565/675	50/60 -	43.0/43.0/39.0 71.0/71.0/62.0	32.0/32.0/29.0 53.3/53.3/46.5	3 -
E94xSxE0594	230/400/480 325/565/675	50/60 -	54.0/54.0/47.0 89.0/89.0/77.0	40.5/40.5/35.3 66.8/66.8/57.8	3 -
E94xSxE0864	230/400/480	50/60	79.0/79.0/70.0	59.0/59.0/52.0	3
E94xSxE1044	230/400/480	50/60	95.0/95.0/84.0	71.0/71.0/63.0	3
E94xSxE1454	400/480	50/60	138/138	124/124	3
E94xSxE1724	400/480	50/60	164/164	148/148	3
E94xSxE2024	400/480	50/60	192/192	173/173	3
E94xSxE2454	400/480	50/60	236/236	212/212	3
E94xSxE2924	400/480	50/60	285/285	257/257	3
E94xSxE3664	400/480	50/60	349/349	314/314	3
E94xSxE4604	400/480	50/60	436/436	392/392	3

① Temperature in the control cabinet

Output data

Type	Voltage [V]	Current [A] up to +45 °C ①	Current [A] up to +55 °C ①	Number of phases
E94xSxE0024	0 - 230/400/480	1.5/1.5/1.3	1.1/1.1/1.0	3
E94xSxE0034	0 - 230/400/480	2.5/2.5/2.2	1.9/1.9/1.7	3
E94xSxE0044	0 - 230/400/480	4.0/4.0/3.5	3.0/3.0/2.6	3
E94xSxE0074	0 - 230/400/480	7.0/7.0/6.1	5.3/5.3/4.6	3
E94xSxE0134	0 - 230/400/480	13.0/13.0/11.4	9.8/9.8/8.6	3
E94xSxE0174	0 - 230/400/480	16.5/16.5/14.4	12.4/12.4/10.8	3
E94xSxE0244	0 - 230/400/480	23.5/23.5/20.6	17.6/17.6/15.5	3
E94xSxE0324	0 - 230/400/480	32.0/32.0/28.0	24.0/24.0/21.0	3
E94xSxE0474	0 - 230/400/480	47.0/47.0/42.0	35.3/35.3/30.8	3
E94xSxE0594	0 - 230/400/480	59.0/59.0/52.0	44.3/44.3/38.7	3
E94xSxE0864	0 - 230/400/480	86.0/86.0/76.0	64.5/64.5/56.4	3
E94xSxE1044	0 - 230/400/480	104/104/92.0	78.0/78.0/68.3	3
E94xSxE1454	0 - 400/480	145/145	131/131	3
E94xSxE1724	0 - 400/480	172/172	155/155	3
E94xSxE2024	0 - 400/480	202/202	182/182	3
E94xSxE2454	0 - 400/480	245/245	221/221	3
E94xSxE2924	0 - 400/480	292/292	263/263	3
E94xSxE3664	0 - 400/480	366/366	329/329	3
E94xSxE4604	0 - 400/480	460/460	414/414	3

① Temperature in the control cabinet

Note!

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

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

Power losses

Type	Power loss P_V [W] at a switching frequency of 4 kHz			
	U_{Lr} = 230 V	U_{Lr} = 400 V	U_{LN} = 480 V	when controller is inhibited
E94xSxE0024	70	90	100	40
E94xSxE0034	85	105	120	
E94xSxE0044	100	130	145	
E94xSxE0074	125	160	180	
E94xSxE0134	200	260	290	
E94xSxE0174	240	300	340	
E94xSxE0244	310	400	450	
E94xSxE0324	750	750	750	75
E94xSxE0474	1050	1050	1050	
E94xSxE0594	1100	1100	1100	
E94xSxE0864	1500	1500	1500	100
E94xSxE1044	1800	1800	1800	
E94xSxE1454	-	2100	2100	< 100
E94xSxE1724	-	2200	2200	< 100
E94xSxE2024	-	2600	2600	
E94xSxE2454	-	3300	3300	
E94xSxE2924	-	4100	4100	< 100
E94xSxE3664	-	4900	4900	< 100
E94xSxE4604	-	6200	6200	< 150

3.4.2 Operation at rated mains voltage 230 V

Device size 1 ... 6

Mains	Voltage	Voltage range	Frequency range
	U_{Lrated} [V]	U_{Lrated} [V]	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 pol. ASM	
Type	I_{LN} [A]	I_{LN} [A]	S_{aN} [kVA]	P_{aN} [kW]	P_{aN} [hp]
E94xSxE0024	1.5	2.1	0.5	0.18	0.25
E94xSxE0034	2.5	3.5	0.9	0.37	0.5
E94xSxE0044	3.9	5.5	1.4	0.75	1
E94xSxE0074	7.0	9.9	2.5	1.5	2
E94xSxE0134	12.0	16.8	4.7	3	4
E94xSxE0174	15.0	21.0	5.9	4	5.5
E94xSxE0244	20.5	29.0	8.4	5.5	7.5
E94xSxE0324	-	29.0	11.5	7.5	10
E94xSxE0474	-	43.0	16.9	11	15
E94xSxE0594	-	54.0	21.2	15	20

Device size 7

Mains	Voltage	Voltage range	Frequency range
	U_{Lrated} [V]	U_{Lrated} [V]	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 pol. ASM	
Type	I_{LN} [A]	I_{LN} [A]	S_{aN} [kVA]	P_{aN} [kW]	P_{aN} [hp]
E94xSxE0864	-	79.0	30.8	22	29
E94xSxE1044	-	95.0	37.3	30	40

Device size 1 ... 91

	Output currents [A] at switching frequency						
	2 kHz		4 kHz		8 kHz		16 kHz
	I_{aN2}	I_{aM2}	I_{aN4}	I_{aM4}	I_{aN8}	I_{aM8}	I_{aN16}
E94xSxE0024	1.9 3)	6.0	1.9 3)	6.0	**1.5**	4.8	1.1
E94xSxE0034	3.1 3)	10.0	3.1 3)	10.0	**2.5**	8.0	1.9
E94xSxE0044	5.0 3)	16.0	5.0 3)	16.0	**4.0**	12.8	3.0
E94xSxE0074	8.8 3)	21.0	8.8 3)	21.0	**7.0**	16.8	5.3
E94xSxE0134	16.3 3)	39.0	16.3 3)	39.0	**13.0**	31.2	9.8
E94xSxE0174	20.6 3)	49.5	20.6 3)	49.5	**16.5**	39.6	12.4
E94xSxE0244	29.4 3)	58.8	29.4 3)	58.8	**23.5**	47.0	17.6
E94xSxE0324	38.4	76.8	38.4	76.8	**32.0**	64.0	16.8
E94xSxE0474	47.0	94.0	**47.0**	94.0	41.0	82.0	21.5
E94xSxE0594	59.0	118	**59.0**	118	41.0	82.0	21.5
E94xSxE0864	86.0	172	**86.0**	172	73.0	146	38.3
E94xSxE1044	104	208	**104**	208	78.0	156	40.9

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

I_{aM2} Maximum output current (overload current) at frequency ≥ 0 Hz
- 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 continuous 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) at frequency ≥ 5 Hz
(reduce to 0.66 * I_{aMx} for 0 ... 5 Hz)
- 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.

4) Depending on the heatsink temperature, the mains voltage and the motor cable length, the switching frequency can be changed even at smaller currents.

Rated data for internal brake chopper

Type	R_{Bmin} [Ω]	I_{BRmax} [A]	P_{BRmax} [kW]	I_{BRd} [A]	P_{Bd} [kW]	t_Z [s]	t_{on} [s]	t_{fp} [s]
E94xSxE0024	47	8.3	3.2	3.7	0.64	150	15	15
E94xSxE0034	47	8.3	3.2	3.7	0.64	150	15	15
E94xSxE0044	27	14.4	5.6	5.9	0.95	150	15	15
E94xSxE0074	27	14.4	5.6	6.9	1.3	150	15	15
E94xSxE0134	18	21.7	8.5	10.6	2.0	150	15	15
E94xSxE0174	9	43.3	16.9	20.3	3.7	150	15	15
E94xSxE0244	9	43.3	16.9	24.5	5.4	150	15	15
E94xSxE0324	9	43.3	16.9	28.5	7.3	600	260	600
E94xSxE0474	7.5	52.0	20.3	37.9	10.8	600	320	600
E94xSxE0594	7.5	52.0	20.3	44.2	14.7	600	430	600
E94xSxE0864	3.8	102.6	40.0	75.5	21.6	600	320	600
E94xSxE1044	3.8	102.6	40.0	83.5	26.4	600	400	600

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

Note on the brake chopper data

Due to thermal load, the resistance value changes and therefore the dependent rated data as well.

The brake chopper can output the peak braking power maximally for the specified time t_{on} within a cycle time t_Z.

The brake chopper can output the peak braking power from unloaded states once for the time t_{fp}, e. g. after mains connection or after a recovery time of > 5 x t_Z.

If the times are exceeded, the brake chopper is clocked so that only the continuous braking power is output. This serves to the protection of the brake chopper, however, it does not protect the brake resistor. The brake resistor connected can be protected separately by parameterisation (C00129 ... C00133) or a thermal contact.

Further information can be found in the software manual.

3.4.3 Operation at rated mains voltage 400 V

Device size 1 ... 6

Mains	Voltage	Voltage range	Frequency range
	U_{Lrated} [V]	U_{Lrated} [V]	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 pol. ASM	
Type	I_{LN} [A]	I_{LN} [A]	S_{aN} [kVA]	P_{aN} [kW]	P_{aN} [hp]
E94xSxE0024	1.5	2.1	0.9	0.37	0.5
E94xSxE0034	2.5	3.5	1.6	0.75	1
E94xSxE0044	3.9	5.5	2.5	1.5	2
E94xSxE0074	7.0	9.9	4.4	3	4
E94xSxE0134	12.0	16.8	8.1	5.5	7.5
E94xSxE0174	15.0	21.0	10.3	7.5	11
E94xSxE0244	20.5	29.0	14.7	11	15
E94xSxE0324	-	29.0	20.0	15	20
E94xSxE0474	-	43.0	29.3	22	29
E94xSxE0594	-	54.0	36.8	30	40

Device size 7

Mains	Voltage	Voltage range	Frequency range
	U_{Lrated} [V]	U_{Lrated} [V]	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 pol. ASM	
Type	I_{LN} [A]	I_{LN} [A]	S_{aN} [kVA]	P_{aN} [kW]	P_{aN} [hp]
E94xSxE0864	-	79.0	53.6	45	60
E94xSxE1044	-	95.0	64.8	55	73

Device size 81 ... 91

Mains	Voltage	Voltage range	Frequency range
	U_{Lrated} [V]	U_{Lrated} [V]	f [Hz]
3/PE AC	400	340 - 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 pol. ASM	
Type	I_{LN} [A]	I_{LN} [A]	S_{aN} [kVA]	P_{aN} [kW]	P_{aN} [hp]
E94xSxE1454	-	138	90	75	100
E94xSxE1724	-	164	107	90	125
E94xSxE2024	-	192	126	105	140
E94xSxE2454	-	236	153	130	170
E94xSxE2924	-	285	182	150	205
E94xSxE3664	-	349	228	190	255
E94xSxE4604	-	436	287	240	320

Device size 1 ... 91

	Output currents [A] at switching frequency						
	2 kHz		4 kHz		8 kHz		16 kHz
	I_{aN2}	I_{aM2}	I_{aN4}	I_{aM4}	I_{aN8}	I_{aM8}	I_{aN16}
E94xSxE0024	1.9 [3]	6.0	1.9 [3]	6.0	**1.5**	4.8	1.1
E94xSxE0034	3.1 [3]	10.0	3.1 [3]	10.0	**2.5**	8.0	1.9
E94xSxE0044	5.0 [3]	16.0	5.0 [3]	16.0	**4.0**	12.8	3.0
E94xSxE0074	8.8 [3]	21.0	8.8 [3]	21.0	**7.0**	16.8	5.3
E94xSxE0134	16.3 [3]	39.0	16.3 [3]	39.0	**13.0**	31.2	9.8
E94xSxE0174	20.6 [3]	49.5	20.6 [3]	49.5	**16.5**	39.6	12.4
E94xSxE0244	29.4 [3]	58.8	29.4 [3]	58.8	**23.5**	47.0	17.6
E94xSxE0324	38.4	76.8	38.4	76.8	**32.0**	56.0	16.8
E94xSxE0474	47.0	94.0	**47.0**	94.0	41.0	82.0	21.5
E94xSxE0594	59.0	118	**59.0**	118	41.0	82.0	21.5
E94xSxE0864	86.0	172	**86.0**	172	73.0	146	38.3
E94xSxE1044	104	208	**104**	208	78.0	156	40.9
E94xSxE1454	145	261	**145**	261	102	184	-
E94xSxE1724	172	310	**172**	310	120	216	-
E94xSxE2024	202	364	**202**	364	131	236	-
E94xSxE2454	**245**	441	209	376	160	288	-
E94xSxE2924	**292**	526	250	450	191	344	-
E94xSxE3664	**366**	659	313	563	240	432	-
E94xSxE4604	**460**	828	368	662	260	468	-

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

I_{aM2} Maximum output current (overload current) at a frequency ≥ 0 Hz

E94xSxE0024 ... E94xSxE1044:
- Periodic load change of 0.5 s with I_{aM2} and recovery time of 4.5 s with 75 % I_{aN2}

E94xSxE1454 ... E94xSxE4604:
- Periodic load change of 10 s with I_{aM2} and recovery time of 50 s with 75 % I_{aN2}

I_{aN4}, I_{aN8}, I_{aN16} Rated value of continuous output current at a frequency ≥ 5 Hz

(reduce to 0.66 * I_{aNx} for 0 ... 5 Hz)

I_{aM4}, I_{aM8} Maximum output current (overload current) at a frequency ≥ 5 Hz

(reduce to 0.66 * I_{aMx} for 0 ... 5 Hz)
- can be achieved using the setting "x kHz fixed" in C00018

E94xSxE0024 ... E94xSxE1044:
- Periodic load change of 0.5 s with I_{aMx} and recovery time of 4.5 s with 75 % I_{aNx}

E94xSxE1454 ... E94xSxE4604:
- Periodic load change of 10 s with I_{aM2} and recovery time of 50 s with 75 % I_{aN2}

bold Rated value I_{aN}

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

4) Depending on the heatsink temperature, the mains voltage and the motor cable length, the switching frequency can be changed even at smaller currents.

Operation with increased continuous power

If required, an operation with increased continuous power can be activated for certain inverters at a switching frequency of 2 kHz. This operating mode is only possible under the following conditions:

- Inverter pf E94xSxE1454 ... E94xSxE4604 type, (device size 81 ... 91).
- The mains voltage for "Mode 2" is ≤ 440 V.
- The max. permissible ambient temperature in the control cabinet is ≤ 40 °C.
- Reduce the maximum output current in C00022 according to the following data for I_{aMhc}.
- Activate the operation with increased continuous power in C01199 with "Mode 1" or "Mode 2".
  – To activate it, disable the inverter.

For the currents differing from the standard, refer to the following tables.

Note!

The "activated" setting in C01199 is reset automatically to "deactivated" (without error message) if the previously mentioned conditions are not fulfilled (anymore).

- This, for example, also applies if the memory module is plugged into an inverter of device size 1 ... 6 (device replacement).

For the "Mode 1" selection:

	Output currents [A] at switching frequency			
	2 kHz			
Type	I_{aN2}	I_{aNhc}	I_{aMhc}	I_{aMre}
E94xSxE1454	145	160	218	145
E94xSxE1724	172	195	258	180
E94xSxE2024	202	240	303	226
E94xSxE2454	245	302	368	275
E94xSxE2924	292	361	438	330
E94xSxE3664	366	443	549	415
E94xSxE4604	460	550	690	522

I_{aN2}	Rated value of continuous output current at a frequency ≥ 0 Hz (Standard operation)
I_{aNhc}	increased continuous output current at a frequency ≥ 0 Hz
I_{aMhc}	Maximum output current (overload current) ● Periodic load change of 10 s with I_{aMhc} and recovery time of 50 s with I_{aMre}
I_{aMre}	Maximum output current during a recovery time of 50 s

Sinusoidal filter assignments changed for this operating mode:

Max. motor cable lengths for compliance with the conducted interference emission according to C2 when sinusoidal filters and line filters are used				
Type	Setting C01199	Sine filter	shielded unshielded	Switching frequency
E94xSxE2924	"Mode 1"	**EZS3-480A200**	150 m - m	2 kHz or 4 kHz

For the "Mode 2" selection:

	Output currents [A] at switching frequency			
	2 kHz			
Type	I_{aN2}	I_{aNhc}	I_{aMhc}	I_{aMre}
E94xSxE1454	145	177	195	168
E94xSxE1724	172	212	233	201
E94xSxE2024	202	260	286	247
E94xSxE2454	245	315	347	299
E94xSxE2924	292	395	434	375
E94xSxE3664	366	480	528	456
E94xSxE4604	460	600	660	570

I_{aN2}	Rated value of continuous output current at a frequency ≥ 0 Hz (Standard operation)
I_{aNhc}	Increased continuous output current at a frequency ≥ 0 Hz
I_{aMhc}	Maximum output current (overload current) ● Periodic load change of 60 s with I_{aMhc} and recovery time of 120 s with I_{aMre}
I_{aMre}	Maximum output current during the recovery time

Sinusoidal filter assignments changed for this operating mode:

Max. motor cable lengths for compliance with the conducted interference emission according to C2 when sinusoidal filters and line filters are used				
Type	Setting C01199	Sine filter	shielded unshielded	Switching frequency
E94xSxE2024	"Mode 2"	**EZS3-350A200**	150 m - m	2 kHz or 4 kHz
E94xSxE2924		**EZS3-480A200**		
E94xSxE4604		**EZS3-480A200** (2 in parallel)		

Rated data for internal brake chopper

Type	R_{Bmin} [Ω]	I_{BRmax} [A]	P_{BRmax} [kW]	I_{BRd} [A]	P_{Bd} [kW]	t_Z [s]	t_{on} [s]	t_{fp} [s]
E94xSxE0024	82	8.8	6.4	3.9	1.3	150	15	15
E94xSxE0034	82	8.8	6.4	3.9	1.3	150	15	15
E94xSxE0044	47	15.4	11.2	6.3	1.9	150	15	15
E94xSxE0074	47	15.4	11.2	7.4	2.6	150	15	15
E94xSxE0134	27	26.9	19.5	13.2	4.7	150	15	15
E94xSxE0174	18	40.3	29.2	18.9	6.4	150	15	15
E94xSxE0244	18	40.3	29.2	22.8	9.3	150	15	15
E94xSxE0324	18	40.3	29.2	26.5	12.6	600	260	600
E94xSxE0474	15	48.3	35.0	35.2	18.6	600	320	600
E94xSxE0594	15	48.3	35.0	41.0	25.3	600	430	600
E94xSxE0864	7.5	96.7	70.1	71.1	37.9	600	320	600
E94xSxE1044	7.5	96.7	70.1	78.7	46.3	600	400	600
E94xSxE1454	4.4	165	119	90	35.9	600	300	360
E94xSxE1724	3.1	234	169	128	50.9	600	300	360
E94xSxE2024	3.1	234	169	128	50.9	600	300	360
E94xSxE2454	2.8	259	188	142	56.3	600	300	360
E94xSxE2924	2.3	315	229	173	68.6	600	300	360
E94xSxE3664	1.75	414	300	227	90.1	600	300	360
E94xSxE4604	1.4	518	375	266	99.0	600	300	360

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

Note on the brake chopper data

Due to thermal load, the resistance value changes and therefore the dependent rated data as well.

The brake chopper can output the peak braking power maximally for the specified time t_{on} within a cycle time t_Z.

The brake chopper can output the peak braking power from unloaded states once for the time t_{fp}, e. g. after mains connection or after a recovery time of > 5 x t_Z.

If the times are exceeded, the brake chopper is clocked so that only the continuous braking power is output. This serves to the protection of the brake chopper, however, it does not protect the brake resistor. The brake resistor connected can be protected separately by parameterisation (C00129 ... C00133) or a thermal contact.

Further information can be found in the software manual.

3.4.4 Operation with rated mains voltage 480 V

Device size 1 ... 6

Mains	Voltage	Voltage range	Frequency range
	U_{Lrated} [V]	U_{Lrated} [V]	f [Hz]
3/PE AC	480	340 - 0 % ... 528 + 0 %	45 - 0 % ... 65 + 0 %
2/PE DC	675	480 - 0 % ... 746 + 0 %	-

	Mains current at I_{aN}		Output power	Motor power (typical)	
	with external mains choke	without external mains choke	U, V, W	4 pol. ASM	
Type	I_{LN} [A]	I_{LN} [A]	S_{aN} [kVA]	P_{aN} [kW]	P_{aN} [hp]
E94xSxE0024	1.3	1.8	1.0	0.37	0.5
E94xSxE0034	2.2	3.1	1.6	0.75	1
E94xSxE0044	3.4	4.8	2.6	1.5	2
E94xSxE0074	6.1	8.6	4.6	3	4
E94xSxE0134	10.5	14.7	8.5	5.5	7.5
E94xSxE0174	13.1	18.4	10.8	7.5	10
E94xSxE0244	17.9	25.4	15.4	11	15
E94xSxE0324	-	26.0	21.0	15	20
E94xSxE0474	-	39.0	31.4	22	29
E94xSxE0594	-	47.0	38.9	30	40

Device size 7

Mains	Voltage	Voltage range	Frequency range
	U_{Lrated} [V]	U_{Lrated} [V]	f [Hz]
3/PE AC	480	340 - 0 % ... 528 + 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 pol. ASM	
Type	I_{LN} [A]	I_{LN} [A]	S_{aN} [kVA]	P_{aN} [kW]	P_{aN} [hp]
E94xSxE0864	-	70.0	58.0	45	60
E94xSxE1044	-	84.0	70.0	55	73

Device size 81 ... 91

Mains	Voltage	Voltage range	Frequency range
	U_{Lrated} [V]	U_{Lrated} [V]	f [Hz]
3/PE AC	480	340 - 0 % ... 528 + 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 pol. ASM	
Type	I_{LN} [A]	I_{LN} [A]	S_{aN} [kVA]	P_{aN} [kW]	P_{aN} [hp]
E94xSxE1454	-	138	108	95	130
E94xSxE1724	-	164	129	110	150
E94xSxE2024	-	192	151	130	180
E94xSxE2454	-	236	183	160	215
E94xSxE2924	-	285	218	190	255
E94xSxE3664	-	349	274	235	320
E94xSxE4604	-	436	344	300	405

Device size 1 ... 91

	Output currents [A] at switching frequency						
	2 kHz		4 kHz		8 kHz		16 kHz
	I_{aN2}	I_{aM2}	I_{aN4}	I_{aM4}	I_{aN8}	I_{aM8}	I_{aN16}
E94xSxE0024	1.9 3)	6.0	1.9 3)	6.0	1.3	4.2	1.0
E94xSxE0034	3.1 3)	10.0	3.1 3)	10.0	2.2	7.0	1.6
E94xSxE0044	5.0 3)	16.0	5.0 3)	16.0	3.5	11.2	2.6
E94xSxE0074	8.8 3)	21.0	8.8 3)	21.0	6.1	14.7	4.6
E94xSxE0134	16.3 3)	39.0	16.3 3)	39.0	11.4	27.3	8.5
E94xSxE0174	20.6 3)	49.5	20.6 3)	49.5	14.4	34.7	10.8
E94xSxE0244	29.4 3)	58.8	29.4 3)	58.8	20.6	41.1	15.4 5)
E94xSxE0324	38.4	76.8	33.6	67.2	28.0	64.0	16.8
E94xSxE0474	47.0	94.0	41.1	82.2	35.8	71.6	21.5
E94xSxE0594	59.0	118	51.6	103	35.9	71.8	21.5
E94xSxE0864	86.0	172	75.3	150	63.9	127	38.3
E94xSxE1044	104	208	91.0	182	68.3	136	40.9
E94xSxE1454	145	261	**145**	261	89	161	-
E94xSxE1724	172	310	**172**	310	105	189	-
E94xSxE2024	202	364	**202**	364	115	206	-
E94xSxE2454	**245**	441	209	376	140	252	-
E94xSxE2924	**292**	526	250	450	167	301	-
E94xSxE3664	**366**	659	313	563	210	378	-
E94xSxE4604	**460**	828	368	662	228	410	-

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

I_{aM2} Maximum output current (overload current) at a frequency ≥ 0 Hz

E94xSxE0024 ... E94xSxE1044:
- Periodic load change of 0.5 s with I_{aM2} and recovery time of 4.5 s with 75 % I_{aN2}

E94xSxE1454 ... E94xSxE4604:
- Periodic load change of 10 s with I_{aM2} and recovery time of 50 s with 75 % I_{aN2}

I_{aN4}, I_{aN8}, I_{aN16} Rated value of continuous output current at a frequency ≥ 5 Hz

(reduce to 0.66 * I_{aNx} for 0 ... 5 Hz)

I_{aM4}, I_{aM8} Maximum output current (overload current) at a frequency ≥ 5 Hz

(reduce to 0.66 * I_{aMx} for 0 ... 5 Hz)
- can be achieved using the setting "x kHz fixed" in C00018

E94xSxE0024 ... E94xSxE1044:
- Periodic load change of 0.5 s with I_{aMx} and recovery time of 4.5 s with 75 % I_{aNx}

E94xSxE1454 ... E94xSxE4604:
- Periodic load change of 10 s with I_{aM2} and recovery time of 50 s with 75 % I_{aN2}

bold Rated value I_{aN}

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

4) Depending on the heatsink temperature, the mains voltage and the motor cable length, the switching frequency can be changed even at smaller currents.

5) Temperature inside the control cabinet = +35 ... +55 °C: 2.5 %/K current derating

Operation with increased continuous power

If required, operation with increased continuous power can be activated for specific controllers at the switching frequency 2 kHz. This operating mode can only be performed under the following conditions:

- ► Inverters of the types E94xSxE1454 ... E94xSxE4604, (device size 81 ... 91).
- ► The maximum permissible ambient temperature inside the control cabinet is ≤ 40 °C.
- ► The maximum output current in C00022 is to be reduced according to the following data for I_{aMhc}.
- ► Operation with increased continuous power has to be activated in C01199 with ”Mode 1”.
  – For activation controller inhibit has to be set.

The currents deviating from the standard can be gathered from the following tables.

Note!

The ”activated” setting in C01199 is reset to ”deactivated” automatically (without error message) if the above-mentioned conditions are not (no longer) met.

► This, for instance, is also the case if the memory module is plugged into a controller of device size 1 ... 6 (device replacement).

For the selection ”Mode 1“:

	Output currents [A] at switching frequency 2 kHz			
Type	I_{aN2}	I_{aNhc}	I_{aMhc}	I_{aMre}
E94xSxE1454	145	160	218	145
E94xSxE1724	172	195	258	180
E94xSxE2024	202	240	303	226
E94xSxE2454	245	302	368	275
E94xSxE2924	292	361	438	330
E94xSxE3664	366	443	549	415
E94xSxE4604	460	550	690	522

I_{aN2}	Rated value of continuous output current at a frequency of ≥ 0 Hz (standard operation)
I_{aNhc}	Increased continuous output current at a frequency of ≥ 0 Hz
I_{aMhc}	Maximum output current (overload current) ● Periodic load change of 10 s with I_{aMhc} and recovery time of 50 s with I_{aMre}
I_{aMre}	Maximum output current during the recovery time of 50 s

Sinusoidal filter assignments changed for this operating mode:

Max. motor cable lengths for compliance with the conducted interference emission according to C2 when sinusoidal filters and line filters are used				
Type	Setting C01199	Sine filter	shielded unshielded	Switching frequency
E94xSxE2924	”Mode 1”	**EZS3-480A200**	150 m - m	2 kHz or 4 kHz

The selection ”Mode 2“ is only permissible for mains voltages ≤ 440 V.

Rated data for internal brake chopper

Type	R_{Bmin} [Ω]	I_{BRmax} [A]	P_{BRmax} [kW]	I_{BRd} [A]	P_{Bd} [kW]	t_Z [s]	t_{on} [s]	t_{fp} [s]
E94xSxE0024	82	9.3	7.1	4.2	1.4	150	15	15
E94xSxE0034	82	9.3	7.1	4.2	1.4	150	15	15
E94xSxE0044	47	16.3	12.5	6.7	2.1	150	15	15
E94xSxE0074	47	16.3	12.5	7.8	2.9	150	15	15
E94xSxE0134	27	28.3	21.7	13.9	5.2	150	15	15
E94xSxE0174	18	42.5	32.5	19.9	7.2	150	15	15
E94xSxE0244	18	42.5	32.5	24.0	10.4	150	15	15
E94xSxE0324	18.0	42.5	32.5	28.0	14.1	600	260	600
E94xSxE0474	15.0	51.0	39.0	37.1	20.7	600	320	600
E94xSxE0594	15.0	51.0	39.0	43.3	28.2	600	430	600
E94xSxE0864	7.5	102.0	78.0	75.0	42.2	600	320	600
E94xSxE1044	7.5	102.0	78.0	83.0	51.6	600	400	600
E94xSxE1454	4.4	174	133	95	39.9	600	300	360
E94xSxE1724	3.1	247	188	135	56.6	600	300	360
E94xSxE2024	3.1	247	188	135	56.6	600	300	360
E94xSxE2454	2.8	273	209	150	61.7	600	300	360
E94xSxE2924	2.3	333	254	182	76.3	600	300	360
E94xSxE3664	1.75	437	334	239	100	600	300	360
E94xSxE4604	1.4	546	418	280	110	600	300	360

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

Note on the brake chopper data

Due to thermal load, the resistance value changes and therefore the dependent rated data as well.

The brake chopper can output the peak braking power maximally for the specified time t_{on} within a cycle time t_Z.

The brake chopper can output the peak braking power from unloaded states once for the time t_{fp}, e. g. after mains connection or after a recovery time of > 5 x t_Z.

If the times are exceeded, the brake chopper is clocked so that only the continuous braking power is output. This serves to the protection of the brake chopper, however, it does not protect the brake resistor. The brake resistor connected can be protected separately by parameterisation (C00129 ... C00133) or a thermal contact.

Further information can be found in the software manual.

3.4.5 Fuses and cable cross-sections

The recommendations for the dimensioning of fuses and cable cross-sections apply to the operation of devices with the assigned typical motor ratings and indicated installation conditions.

In the case of other permissible operating modes, e.g. additional use of reserve power in the interconnected system, the dimensioning of fuses and cables must be adapted to the ratings and currents in accordance with the relevant technical standards.

Mains	Voltage	Voltage range	Frequency range
	U_{Lrated} [V]	U_{Lrated} [V]	f [Hz]
3/PE AC	230 ... 480	180 - 0 % ... 528 + 0 %	45 ... 65

Operation with external mains choke/mains filter, installation according to EN 60204-1

The data are recommendations. Other dimensioning/laying systems are possible (e.g. according VDE 0298-4).

The cable cross-sections apply under the following conditions:

- Use of PVC-insulated copper cables
- Conductor temperature < 70 °C, ambient temperature < 45°C
- No bundling of cables or cores
- Three loaded cores

Type	①	②	L1, L2, L3 - laying system			FI [1)]
			B2	C	F	
	[A]	[A]	[mm²]	[mm²]	[mm²]	[mA]
E94xSxE0024	C10	-	1.5	1.5	-	≥ 300
E94xSxE0034	C10	-	1.5	1.5	-	≥ 300
E94xSxE0044	C10	-	1.5	1.5	-	≥ 300
E94xSxE0074	C16	-	2.5	2.5	-	≥ 300
E94xSxE0134	C20	-	6	2.5	-	≥ 300
E94xSxE0174	C25	-	6	4	-	≥ 300
E94xSxE0244	C40	-	10	10	-	≥ 300

① Circuit breaker
② Fuse of the utilisation category gG/gL or semiconductor fuses or the utilisation category gRL
1) Universal-current-sensitive earth-leakage circuit breaker, RCD type B
If several devices or cable lengths > 50 m are used, it is possible that the circuit breaker will respond, depending on the type of cable and the switching frequency.
Observe national and regional regulations!

Operation with external mains choke/mains filter, installation according to UL

Only use UL-approved cables, fuses and fuse holders.

UL fuse: Voltage 600 V; CC, J or T class fuses

Type	standard installation		motor group installation		FI [1]
	① valeur nominale (max.)	L1, L2, L3	① valeur nominale (max.)	L1, L2, L3	
	[A]	[AWG]	[A]	[AWG]	[mA]
E94xSxE0024	8	14	15	14	≥ 300
E94xSxE0034	10	14	15	14	≥ 300
E94xSxE0044	15	14	20	12	≥ 300
E94xSxE0074	20	12	20	12	≥ 300
E94xSxE0134	45	8	60	6	≥ 300
E94xSxE0174	60	6	60	6	≥ 300
E94xSxE0244	60	6	60	6	≥ 300

① Fuse

1) Universal-current-sensitive earth-leakage circuit breaker, RCD type B
If several devices or cable lengths > 50 m are used, it is possible that the circuit breaker will respond, depending on the type of cable and the switching frequency.

Observe national and regional regulations!

Operation without external mains choke/mains filter, installation according to EN 60204-1

The data are recommendations. Other dimensioning/laying systems are possible (e.g. according VDE 0298-4).

The cable cross-sections apply under the following conditions:

- Use of PVC-insulated copper cables
- Conductor temperature < 70 °C, ambient temperature < 45°C
- No bundling of cables or cores
- Three loaded cores

Type	①	②	L1, L2, L3 - laying system			FI [1]
			B2	C	F	
	[A]	[A]	[mm²]	[mm²]	[mm²]	[mA]
E94xSxE0024	C10	-	1.5	1.5	-	≥ 300
E94xSxE0034	C10	-	1.5	1.5	-	≥ 300
E94xSxE0044	C10	-	1.5	1.5	-	≥ 300
E94xSxE0074	C16	-	2.5	2.5	-	≥ 300
E94xSxE0134	C20	-	6	2.5	-	≥ 300
E94xSxE0174	C25	-	6	4	-	≥ 300
E94xSxE0244	C40	-	10	10	-	≥ 300
E94xSxE0324 [2]	-	50	16	10	-	≥ 300
E94xSxE0474 [2]	-	63	25	16	-	≥ 300
E94xSxE0594 [2]	-	80	25	25	-	≥ 300
E94xSxE0864 [2]	-	100	-	35	-	≥ 300
E94xSxE1044 [2]	-	125	-	50	-	≥ 300
E94xSxE1454 [2]	-	200	-	-	70	≥ 300
E94xSxE1724 [2]	-	250	-	-	95	≥ 300
E94xSxE2024 [2]	-	315	-	-	150	≥ 300
E94xSxE2454 [2]	-	350	-	-	150	≥ 300
E94xSxE2924 [2]	-	400	-	-	185	≥ 300
E94xSxE3664 [2]	-	450	-	-	240	≥ 300
E94xSxE4604 [2]	-	500	-	-	2 x 150	≥ 300

① Circuit breaker
② Fuse of the utilisation category gG/gL or semiconductor fuses or the utilisation category gRL
1) Universal-current-sensitive earth-leakage circuit breaker, RCD type B
If several devices or cable lengths > 50 m are used, it is possible that the circuit breaker will respond, depending on the type of cable and the switching frequency.
2) Device with integrated mains choke
Observe national and regional regulations!

Operation without external mains choke/mains filter, installation according to UL

Only use UL-approved cables, fuses and fuse holders.

UL fuse: Voltage 600 V; CC, J or T class fuses

Type	standard installation		motor group installation		FI [1]
	① valeur nominale (max.)	L1, L2, L3	① valeur nominale (max.)	L1, L2, L3	
	[A]	[AWG]	[A]	[AWG]	[mA]
E94xSxE0024	8	14	15	14	≥ 300
E94xSxE0034	10	14	15	14	≥ 300
E94xSxE0044	15	14	20	12	≥ 300
E94xSxE0074	20	12	20	12	≥ 300
E94xSxE0134	45	8	60	6	≥ 300
E94xSxE0174	60	6	60	6	≥ 300
E94xSxE0244	60	6	60	6	≥ 300
E94xSxE0324 [2]	50	6	125	0	≥ 300
E94xSxE0474 [2]	60	4	125	0	≥ 300
E94xSxE0594 [2]	60	4	125	0	≥ 300
E94xSxE0864 [2]	100	1	300	2 x 2/0 500 mcm [3]	≥ 300
E94xSxE1044 [2]	125	0	300	2 x 2/0 500 mcm [3]	≥ 300
E94xSxE1454 [2]	175 (only J class fuses)	4/0	-	-	≥ 300
E94xSxE1724 [2]	200 (only J class fuses)	300 mcm/ 2x 1/0	-	-	≥ 300
E94xSxE2024 [2]	250 (only J class fuses)	600 mcm/ 2 x 4/0	-	-	≥ 300
E94xSxE2454 [2]	- (in preparation)	600 mcm/ 2 x 4/0	-	-	≥ 300
E94xSxE2924 [2]	- (in preparation)	700 mcm/ 2 x 4/0	-	-	≥ 300
E94xSxE3664 [2]	- 📖 103	2 x 300 mcm	-	-	≥ 300
E94xSxE4604 [2]	- 📖 103	2 x 300 mcm	-	-	≥ 300

① Fuse

1) Universal-current-sensitive earth-leakage circuit breaker, RCD type B
If several devices or cable lengths > 50 m are used, it is possible that the circuit breaker will respond, depending on the type of cable and the switching frequency.

2) Device with integrated mains choke

3) The directive for a "group installation" according to UL508A or NEC, CEC must be considered.

Observe national and regional regulations!

3.4.6 Overcurrent operation

The controllers are designed for two overcurrent modes.

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}.

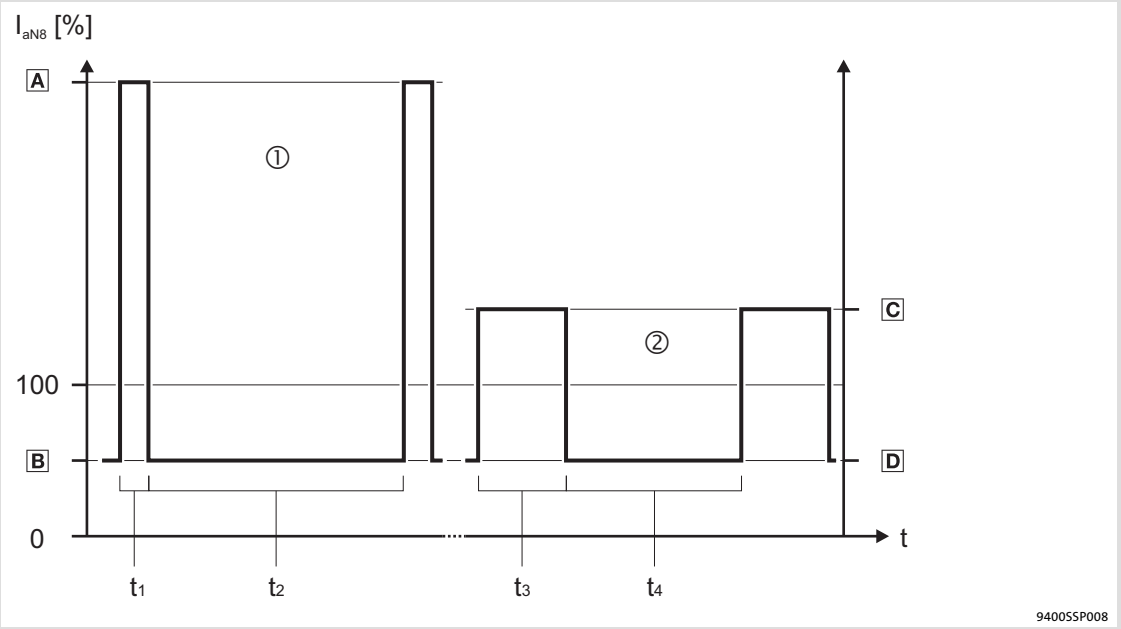


Fig. 3-1 Overcurrent capacity at 45° C

E94xSxE0024 ... E94xSxE1044 E94xMxE0024 ... E94xMxE0594	E94xSxE1454 ... E94xSxE4604
• 5 s cycle ① – t_1 = 0.5 s load time with peak current A – t_2 = 4.5 s recovery time with limited current B	• 1-min cycle ① – t_1 = 10 s load time with peak current A – t_2 = 50 s recovery time with limited current B
• 3-min cycle ② – t_3 = 60 s load time with peak current C – t_4 = 120 s recovery time with limited current D	• 3-min cycle ② – t_3 = 60 s load time with peak current C – t_4 = 120 s recovery time with limited current D

230 V

E94xSxE0024 ... E94xSxE1044:

Type	I [A] in a cycle of 5 seconds ① (📖 65)							
	f = 2 kHz		f = 4 kHz		f = 8 kHz		f = 16 kHz	
	A	B	A	B	A	B	A	B
E94xSxE0024	6.0	1.4	6.0	1.4	4.8	1.1	-	-
E94xSxE0034	10.0	2.3	10.0	2.3	8.0	1.9	-	-
E94xSxE0044	16.0	3.8	16.0	3.8	12.8	3.0	-	-
E94xSxE0074	21.0	6.6	21.0	6.6	16.8	5.3	-	-
E94xSxE0134	39.0	12.2	39.0	12.2	31.2	9.8	-	-
E94xSxE0174	49.5	15.5	49.5	15.5	39.6	12.4	-	-
E94xSxE0244	58.8	22.0	58.8	22.0	47.0	17.6	-	-
E94xSxE0324	76.8	28.8	76.8	28.8	64.0	24.0	-	-
E94xSxE0474	94.0	35.3	94.0	35.3	81.8	30.6	-	-
E94xSxE0594	118	44.3	118	44.3	82.0	30.7	-	-
E94xSxE0864	172	64.5	172	64.5	146	55.0	-	-
E94xSxE1044	208	78.0	208	78.0	156	58.2	-	-

Type	I [A] in a cycle of 3 minute ② (📖 65)							
	f = 2 kHz		f = 4 kHz		f = 8 kHz		f = 16 kHz	
	C	D	C	D	C	D	C	D
E94xSxE0024	2.8	1.4	2.8	1.4	2.3	1.1	-	-
E94xSxE0034	4.7	2.4	4.7	2.4	3.8	1.9	-	-
E94xSxE0044	7.5	3.8	7.5	3.8	6.0	3.0	-	-
E94xSxE0074	13.2	6.6	13.2	6.6	10.5	5.3	-	-
E94xSxE0134	24.4	12.2	24.4	12.2	19.5	9.8	-	-
E94xSxE0174	31.0	15.5	31.0	15.5	24.8	12.4	-	-
E94xSxE0244	44.2	22.1	44.2	22.1	35.3	17.6	-	-
E94xSxE0324	57.6	28.8	57.6	28.8	48.0	24.0	-	-
E94xSxE0474	70.5	35.3	70.5	35.3	61.6	30.6	-	-
E94xSxE0594	88.5	44.3	88.5	44.3	61.4	30.7	-	-
E94xSxE0864	129	64.5	129	64.5	109	55.0	-	-
E94xSxE1044	156	78.0	156	78.0	118	58.2	-	-

400 V

E94xSxE0024 ... E94xSxE1044:

Type	I [A] in a cycle of 5 seconds ① (📖 65)							
	f = 2 kHz		f = 4 kHz		f = 8 kHz		f = 16 kHz	
	A	B	A	B	A	B	A	B
E94xSxE0024	6.0	1.4	6.0	1.4	4.8	1.1	-	-
E94xSxE0034	10.0	2.3	10.0	2.3	8.0	1.9	-	-
E94xSxE0044	16.0	3.8	16.0	3.8	12.8	3.0	-	-
E94xSxE0074	21.0	6.6	21.0	6.6	16.8	5.3	-	-
E94xSxE0134	39.0	12.2	39.0	12.2	31.2	9.8	-	-
E94xSxE0174	49.5	15.5	49.5	15.5	39.6	12.4	-	-
E94xSxE0244	58.8	22.0	58.8	22.0	47.0	17.6	-	-
E94xSxE0324	76.8	28.8	76.8	28.8	64.0	24.0	-	-
E94xSxE0474	94.0	35.3	94.0	35.3	81.8	30.6	-	-
E94xSxE0594	118	44.3	118	44.3	82.0	30.7	-	-
E94xSxE0864	172	64.5	172	64.5	146	55.0	-	-
E94xSxE1044	208	78.0	208	78.0	156	58.2	-	-

Type	I [A] in a cycle of 3 minute ② (📖 65)							
	f = 2 kHz		f = 4 kHz		f = 8 kHz		f = 16 kHz	
	C	D	C	D	C	D	C	D
E94xSxE0024	2.8	1.4	2.8	1.4	2.3	1.1	-	-
E94xSxE0034	4.7	2.4	4.7	2.4	3.8	1.9	-	-
E94xSxE0044	7.5	3.8	7.5	3.8	6.0	3.0	-	-
E94xSxE0074	13.2	6.6	13.2	6.6	10.5	5.3	-	-
E94xSxE0134	24.4	12.2	24.4	12.2	19.5	9.8	-	-
E94xSxE0174	31.0	15.5	31.0	15.5	24.8	12.4	-	-
E94xSxE0244	44.2	22.1	44.2	22.1	35.3	17.6	-	-
E94xSxE0324	57.6	28.8	57.6	28.8	48.0	24.0	-	-
E94xSxE0474	70.5	35.3	70.5	35.3	61.6	30.6	-	-
E94xSxE0594	88.5	44.3	88.5	44.3	61.4	30.7	-	-
E94xSxE0864	129	64.5	129	64.5	109	55.0	-	-
E94xSxE1044	156	78.0	156	78.0	118	58.2	-	-

E94xSxE1454 ... E94xSxE4604:

Type	I [A] in a cycle of 1 minute ① (📖 65)							
	f = 2 kHz		f = 4 kHz		f = 8 kHz		f = 16 kHz	
	A	B	A	B	A	B	A	B
E94xSxE1454	261	109	261	109	196	81.2	-	-
E94xSxE1724	310	129	310	129	232	96.3	-	-
E94xSxE2024	364	152	364	152	273	113	-	-
E94xSxE2454	441	184	377	157	289	120	-	-
E94xSxE2924	526	219	450	187	345	143	-	-
E94xSxE3664	659	275	564	234	432	179	-	-
E94xSxE4604	828	345	662	276	469	193	-	-

Type	I [A] in a cycle of 3 minute ② (📖 65)							
	f = 2 kHz		f = 4 kHz		f = 8 kHz		f = 16 kHz	
	C	D	C	D	C	D	C	D
E94xSxE1454	218	109	218	109	164	81.2	-	-
E94xSxE1724	258	129	258	129	194	96.3	-	-
E94xSxE2024	303	152	303	152	228	113	-	-
E94xSxE2454	368	184	314	157	240	120	-	-
E94xSxE2924	438	219	374	187	286	143	-	-
E94xSxE3664	549	275	468	234	359	179	-	-
E94xSxE4604	690	345	552	276	391	193	-	-

480 V

E94xSxE0024 ... E94xSxE1044:

Type	I [A] in a cycle of 5 seconds ① (📖 65)							
	f = 2 kHz		f = 4 kHz		f = 8 kHz		f = 16 kHz	
	A	B	A	B	A	B	A	B
E94xSxE0024	6.0	1.4	6.0	1.4	4.2	1.0	-	-
E94xSxE0034	10.0	2.3	10.0	2.3	7.0	1.6	-	-
E94xSxE0044	16.0	3.8	16.0	3.8	11.2	2.6	-	-
E94xSxE0074	21.0	6.6	21.0	6.6	14.7	4.6	-	-
E94xSxE0134	39.0	12.2	39.0	12.2	27.3	8.5	-	-
E94xSxE0174	49.5	15.5	49.5	15.5	34.7	10.8	-	-
E94xSxE0244	58.8	22.0	58.8	22.0	41.1	15.4	-	-
E94xSxE0324	76.8	28.8	76.8	28.8	56.0	21.0	-	-
E94xSxE0474	94.0	35.3	94.0	35.3	71.6	26.7	-	-
E94xSxE0594	118	44.3	118	44.3	71.8	26.8	-	-
E94xSxE0864	172	64.5	172	64.5	128	48.2	-	-
E94xSxE1044	208	78.0	208	78.0	137	51.0	-	-

Type	I [A] in a cycle of 3 minute ② (📖 65)							
	f = 2 kHz		f = 4 kHz		f = 8 kHz		f = 16 kHz	
	C	D	C	D	C	D	C	D
E94xSxE0024	2.8	1.4	2.8	1.4	2.0	1.0	-	-
E94xSxE0034	4.7	2.4	4.7	2.4	3.3	1.6	-	-
E94xSxE0044	7.5	3.8	7.5	3.8	5.3	2.6	-	-
E94xSxE0074	13.2	6.6	13.2	6.6	9.2	4.6	-	-
E94xSxE0134	24.4	12.2	24.4	12.2	17.1	8.5	-	-
E94xSxE0174	31.0	15.5	31.0	15.5	21.7	10.8	-	-
E94xSxE0244	44.2	22.1	44.2	22.1	30.8	15.4	-	-
E94xSxE0324	57.6	28.8	57.6	28.8	42.0	21.0	-	-
E94xSxE0474	70.5	35.3	70.5	35.3	53.9	26.7	-	-
E94xSxE0594	88.5	44.3	88.5	44.3	53.7	26.8	-	-
E94xSxE0864	129	64.5	129	64.5	96	48.2	-	-
E94xSxE1044	156	78.0	156	78.0	103	51.0	-	-

E94xSxE1454 ... E94xSxE4604:

Type	I [A] in a cycle of 1 minute ① (📖 65)							
	f = 2 kHz		f = 4 kHz		f = 8 kHz		f = 16 kHz	
	A	B	A	B	A	B	A	B
E94xSxE1454	261	109	261	109	196	81.2	-	-
E94xSxE1724	310	129	310	129	232	96.3	-	-
E94xSxE2024	364	152	364	152	273	113	-	-
E94xSxE2454	441	184	377	157	289	120	-	-
E94xSxE2924	526	219	450	187	345	143	-	-
E94xSxE3664	659	275	564	234	432	179	-	-
E94xSxE4604	828	345	662	276	469	193	-	-

Type	I [A] in a cycle of 3 minute ② (📖 65)							
	f = 2 kHz		f = 4 kHz		f = 8 kHz		f = 16 kHz	
	C	D	C	D	C	D	C	D
E94xSxE1454	218	109	218	109	164	81.2	-	-
E94xSxE1724	258	129	258	129	194	96.3	-	-
E94xSxE2024	303	152	303	152	228	113	-	-
E94xSxE2454	368	184	314	157	240	120	-	-
E94xSxE2924	438	219	374	187	286	143	-	-
E94xSxE3664	549	275	468	234	359	179	-	-
E94xSxE4604	690	345	552	276	391	193	-	-

3.4.7 Current-time diagrams

In addition to the data for overcurrent operation, here you are provided with information on the dimensioning of application-oriented cycles.

By means of the following information you determine permissible load periods with overcurrents and required recovery times with limited currents. If the currents and times determined are observed, the Ixt monitoring function for the protection of the devices will not respond.

Characteristics

The following characteristics (”Current-time diagrams”) describe the device utilisation via amperage and the duration of current flow.
The left part of the diagram (negative time data) represents the overload phase, while the right part of the diagram (positive time data) shows the relieving phase.
Devices with an identical Ixt behaviour are combined within a diagram. A second diagram enlarges a cutout area to improve the clearness of display.

Requirements

- Switching frequency

  The curves shown always refer to the variable rated switching frequency (f_{chopp}) at which the rated device current is permissible permanently. As this rated switching frequencies are different for the individual devices, they are specified with the diagrams. This means that the switching frequency is reduced automatically during the overload phase. During the recovery phase the switching frequency set is maintained.

- Mains voltage

  In the diagrams a mains voltage of U_N = 400 V was assumed. Where applicable, a current derating depending on the mains voltage may be necessary for the devices, depending on the switching frequency that is reached. This means that the currents are weighted differently in the Ixt monitoring. The devices for which a derating is required can be gathered from the ”Rated values” section. The continuous currents specified there then are the 100% values which are required for working with the diagrams.

- Ambient temperature

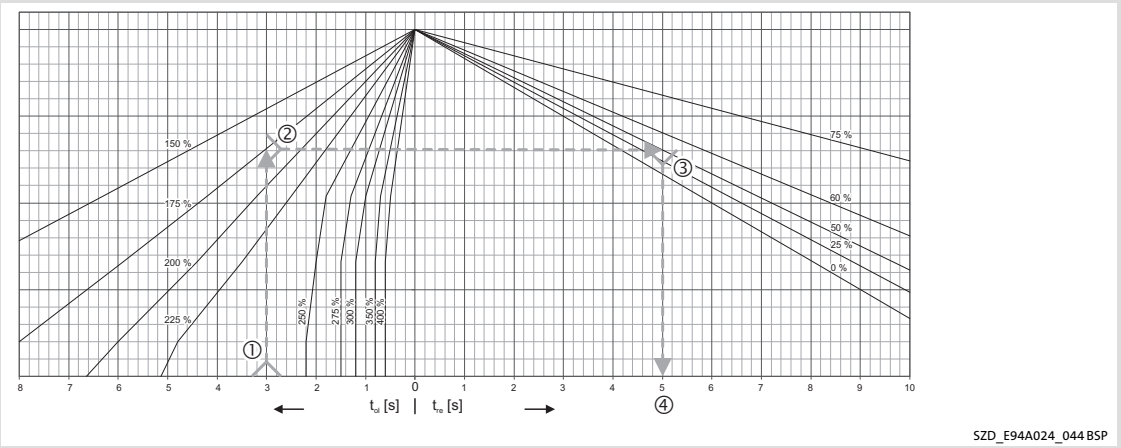
  The ambient temperature may be maximally T_{Amb} < 45 °C. In the case of higher ambient temperatures the reduced continuous currents have to be taken into consideration.

- Output frequency

  In the diagrams an output frequency (= field frequency) f_{out} > 5 Hz has been assumed. In the case of smaller output frequencies (f_{out} = 0 ... 5 Hz), a different switching frequency results in a different device utilisation due to a different continuous current. When the diagrams were created, this device behaviour was not taken into consideration.
  If a fixed switching frequency f > 4 kHz is selected, the reduction of the permissible continuous current has to be considered (100 % = reduced continuous current) for smaller output frequencies (f_{out} = 0 ... 5 Hz).

Application example

- Drive task
  - A current I_{ol} = 4.0 A is required for a time t_{ol} = 3 s.
  - During the recovery phase there is a current I_{re} = 1.0 A.
  - During the overload phase a switching frequency of 4 kHz is accepted.
  - The switching frequency during the recovery phase is to be 8 kHz.
  - The mains voltage is 400 V.
  - The times with output frequencies under 5 Hz are insignificant.
- Problem
  - How long does the recovery phase t_{re} have to be when the E94AxxE0034 controller is used?
- The currents required are based on the rated device current:
  - I_{ol} = 4.0 A/2.5 A = 160 % - selected characteristic: 175 %
  - I_{re} = 1.0A/2.5 A = 40 % - selected characteristic: 50 %
  - Because of the short overcurrent time t_{ol} = 3 s, the cutout diagram of the E94AxxE0034 device is taken into consideration.
  - The switching frequency f_{chopp} = 8 kHz, var does not have to be considered separately.
- Procedure within the diagram
  - ① Starting from the time axis at t_{ol} = 3 s, a perpendicular line is drawn to the selected characteristic at 175 % (corresponds to the minimum required current I_{ol}).
  - ② Draw a straight line from the point of intersection horizontally to the right to the selected characteristic, the recovery phase, at 50 %.
  - ③ Draw a perpendicular line from the point of intersection back to the time axis.
  - ④ Read the minimum required duration of recovery on the time axis.



- Result in the example
  - The duration of recovery has to be at least t_{re} = 5 s!

Guide

Type	Diagram
E94xxxE0024	Page 74 Fig. 3-2/ Fig. 3-3
E94xxxE0034	
E94xxxE0044	
E94xxxE0074	Page 75 Fig. 3-4/ Fig. 3-5
E94xxxE0134	
E94xxxE0174	
E94xxxE0244	
E94xMxE0324	
E94xxxE0474	Page 77 Fig. 3-8 / Fig. 3-9
E94xxxE0594	

Guide

Type	Diagram
E94xxxE0024	Page 74 Fig. 3-2/ Fig. 3-3
E94xxxE0034	
E94xxxE0044	
E94xxxE0074	Page 75 Fig. 3-4/ Fig. 3-5
E94xxxE0134	
E94xxxE0174	
E94xxxE0244	
E94xMxE0324	
E94xxxE0474	Page 77 Fig. 3-8 / Fig. 3-9
E94xxxE0594	
E94xSxE0864	Page 78 Fig. 3-10/ Fig. 3-11
E94xSxE1044	
E94xSxE1454	Page 79 Fig. 3-12 / Fig. 3-13
E94xSxE1724	
E94xSxE2024	
E94xSxE2454	
E94xSxE2924	
E94xSxE3664	
E94xSxE4604	

E94xxxE0024 ... E94xxxE0044

Type	U_r	100 %	f_{chopp}
	[V]	[A]	[Setting]
E94xxxE0024	400	1.5	8 kHz var
E94xxxE0034		2.5	
E94xxxE0044		4.0	

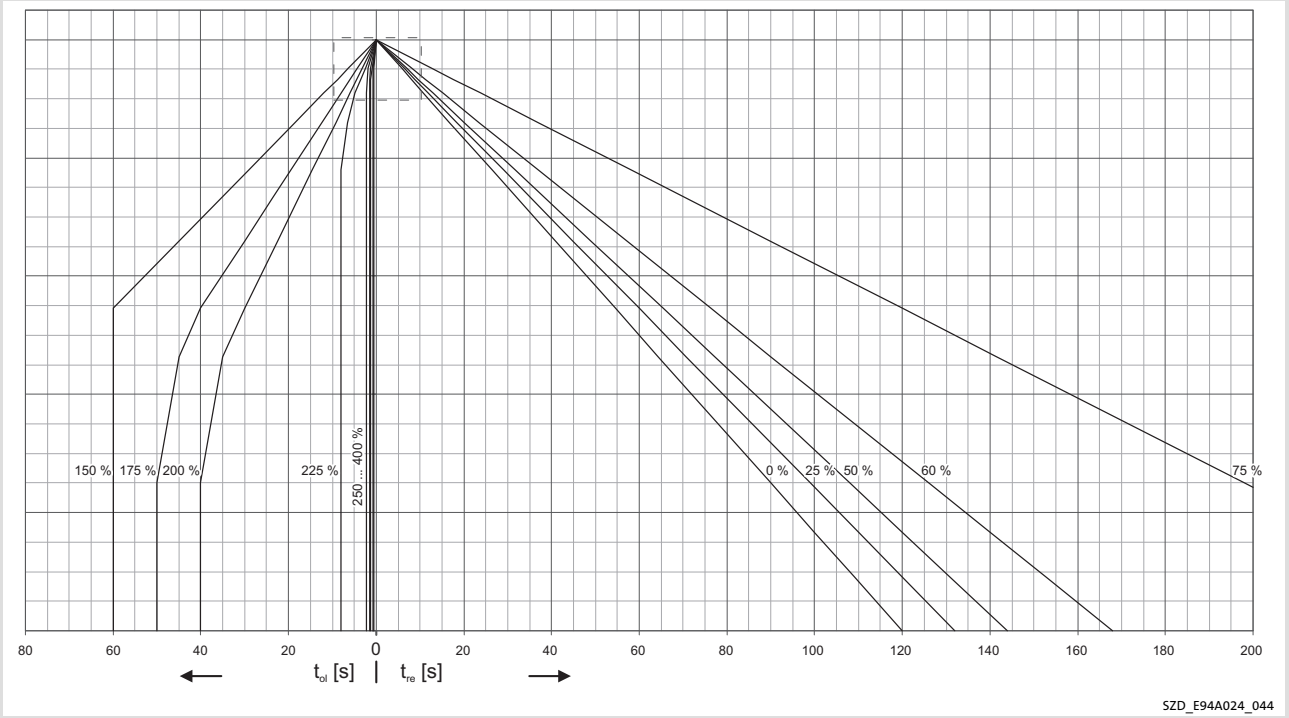


Fig. 3-2 Diagram for E94xxxE0024 and E94xxxE0044

t_{ol} Duration of the load phase
t_{re} Duration of the recovery phase

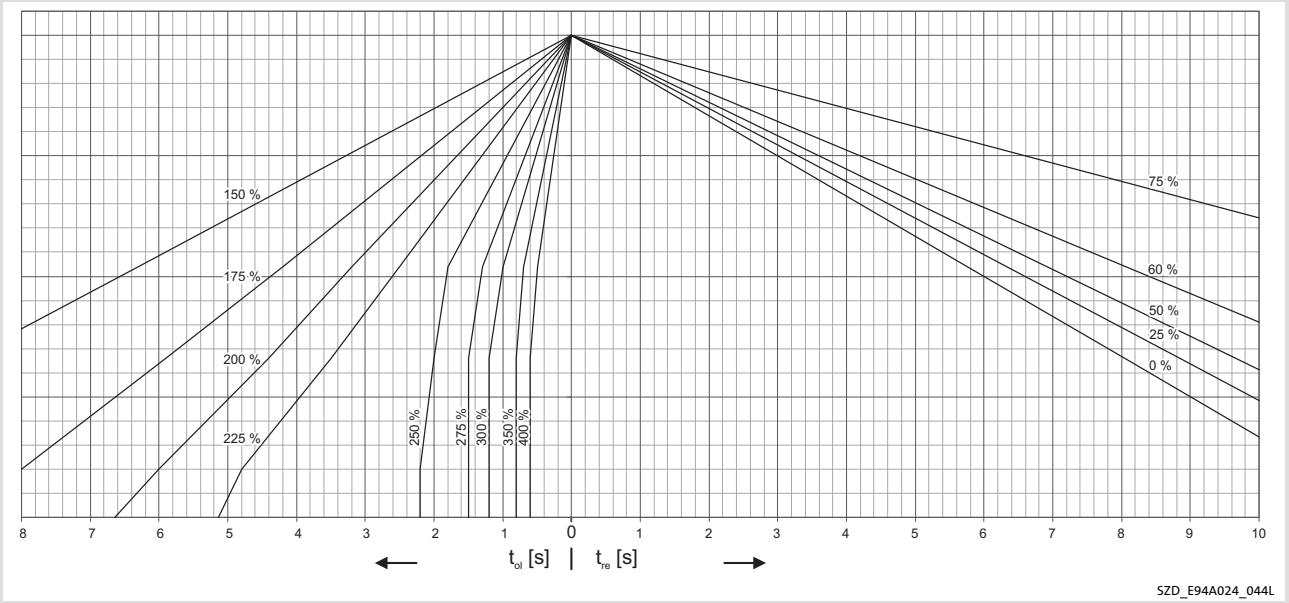


Fig. 3-3 Area cutout for E94xxxE0024 and E94xxxE0044

E94xxxE0074 ... E94xxxE0244 and E94xMxE0324

Type	V_r	100 %	f_{chopp}
	[V]	[A]	[Setting]
E94xxxE0074	400	7.0	8 kHz var
E94xMxE0094		9.3	8 kHz var
E94xxxE0134		13.0	8 kHz var
E94xxxE0174		16.5	
E94xxxE0244		23.5	
E94xMxE0324		32.0	8 kHz var

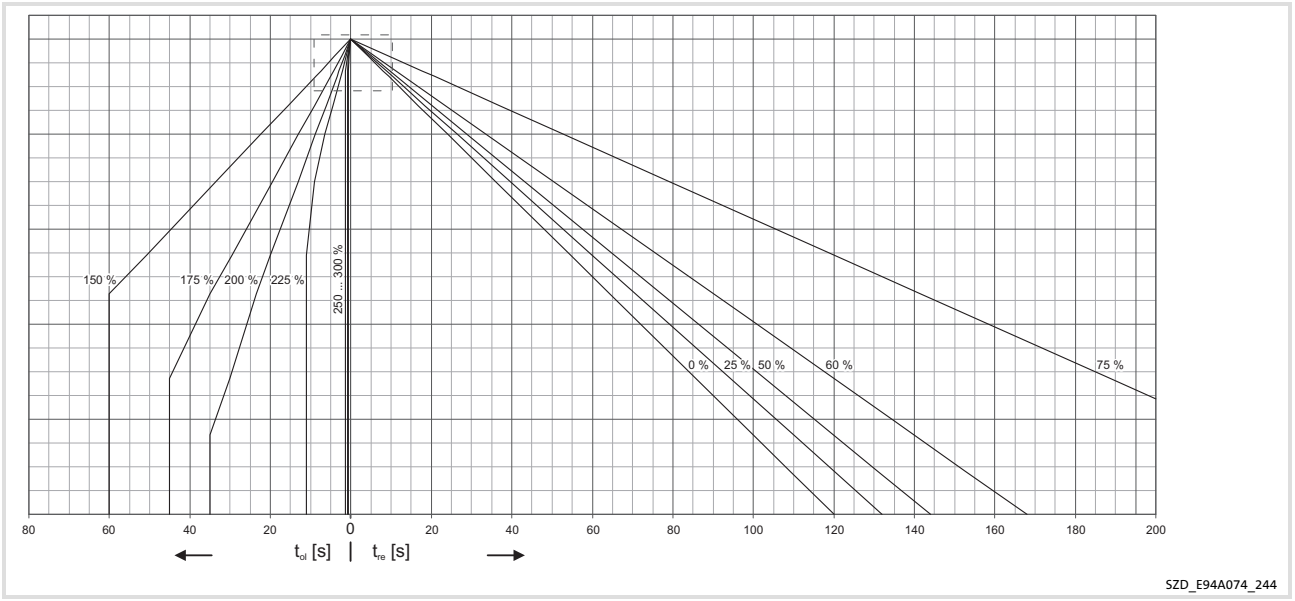


Fig. 3-4 Diagram for E94xxxE0074 ... E94xxxE0244, E94xMxE0324

t_{ol} Duration of the load phase
t_{re} Duration of the recovery phase

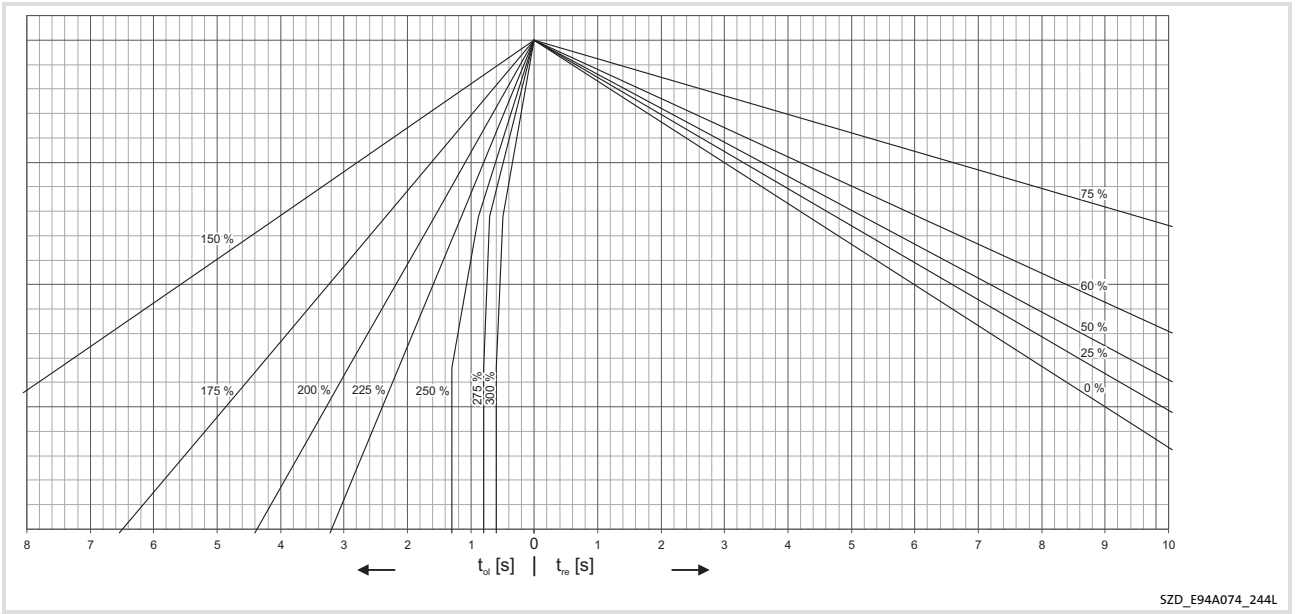


Fig. 3-5 Area cutout for E94xxxE0074 ... E94xxxE0244, E94xMxE0324

E94xxxE0324

Type	U_r	100 %	f_{chopp}
	[V]	[A]	[Setting]
E94xxxE0324	400	32.0	4 kHz var

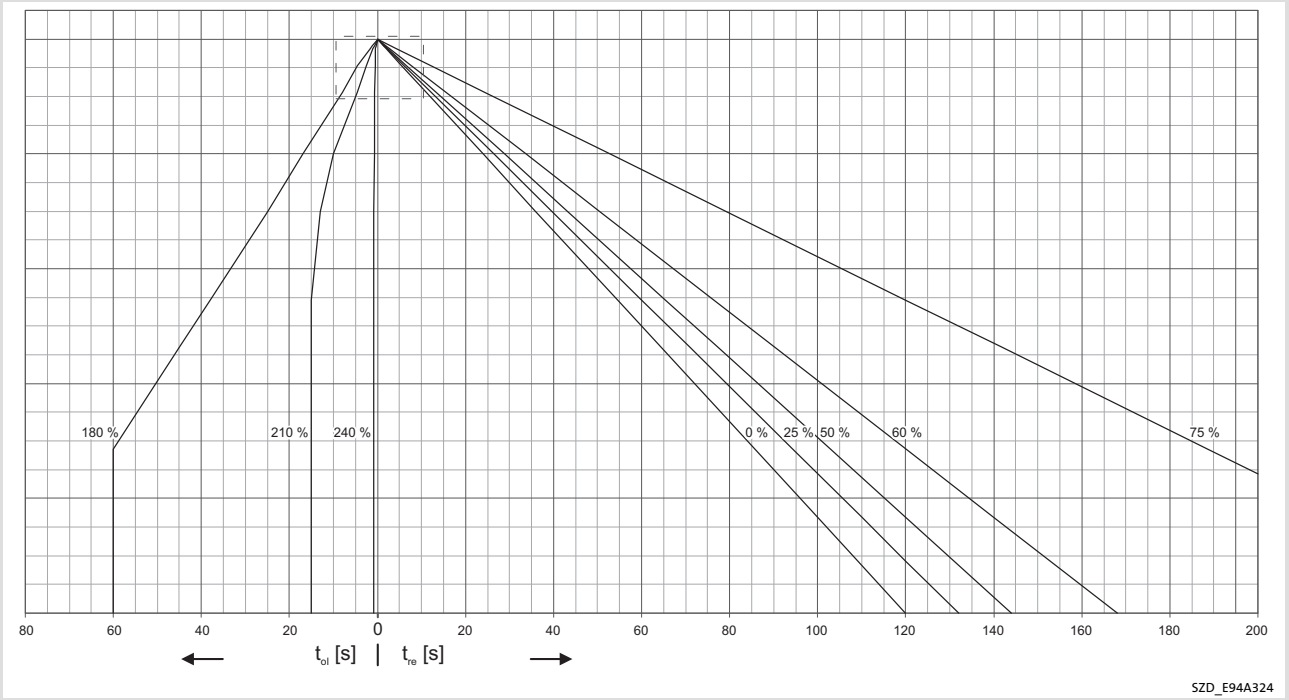


Fig. 3-6 Diagram for E94xxxE0324

t_{ol} Duration of the load phase
t_{re} Duration of the recovery phase

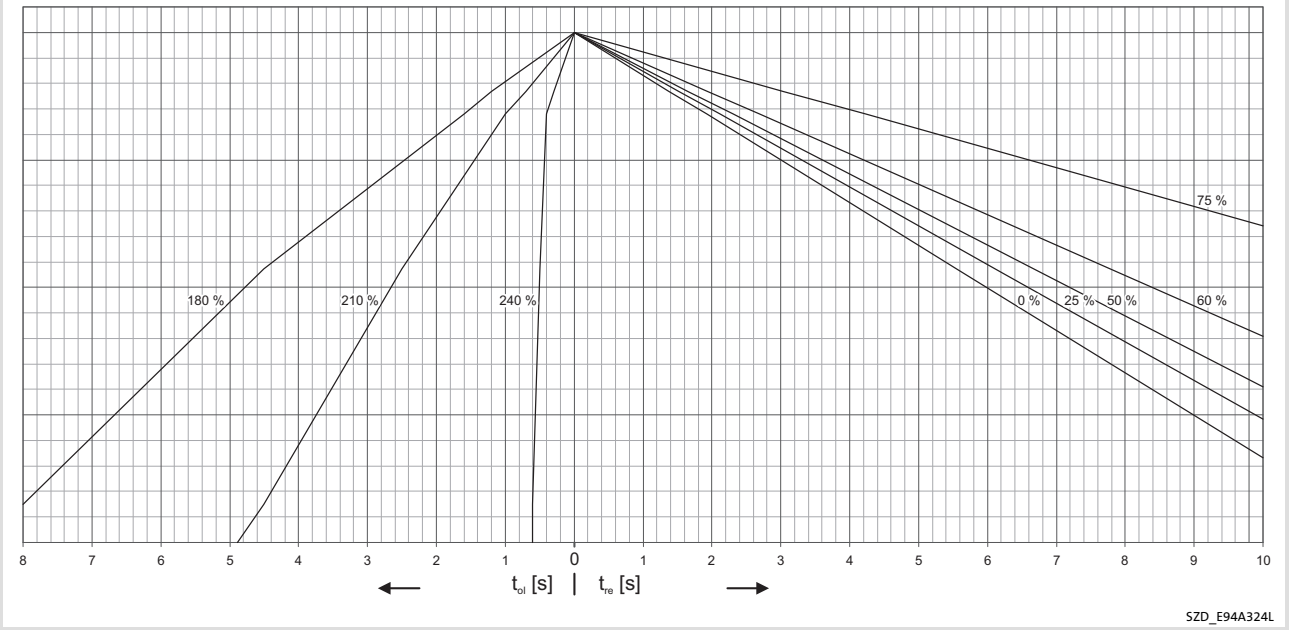


Fig. 3-7 Area cutout for E94xxxE0324

E94xxxE0474 and E94xxxE0594

Type	U_r	100 %	f_{chopp}
	[V]	[A]	[Setting]
E94xxxE0474	400	47.0	4 kHz var
E94xxxE0594		59.0	

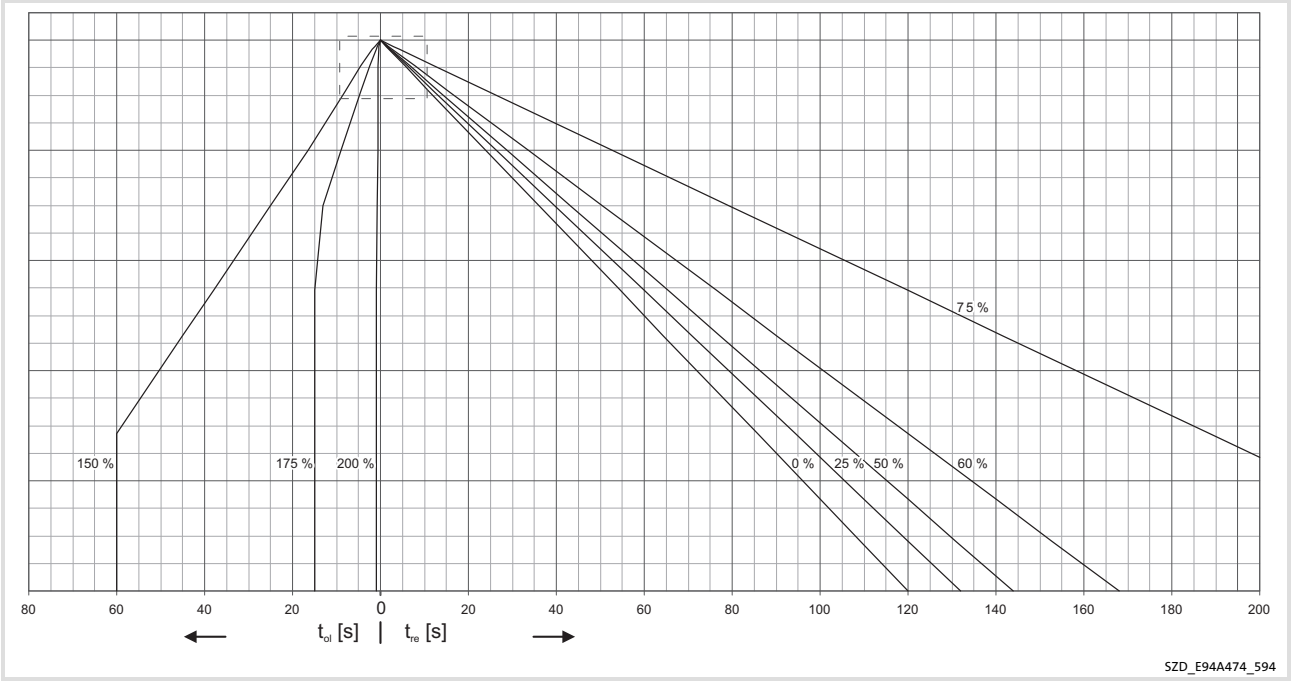


Fig. 3-8 Diagram for E94xxxE0474 and E94xxxE0594

t_{ol} Duration of the load phase
t_{re} Duration of the recovery phase

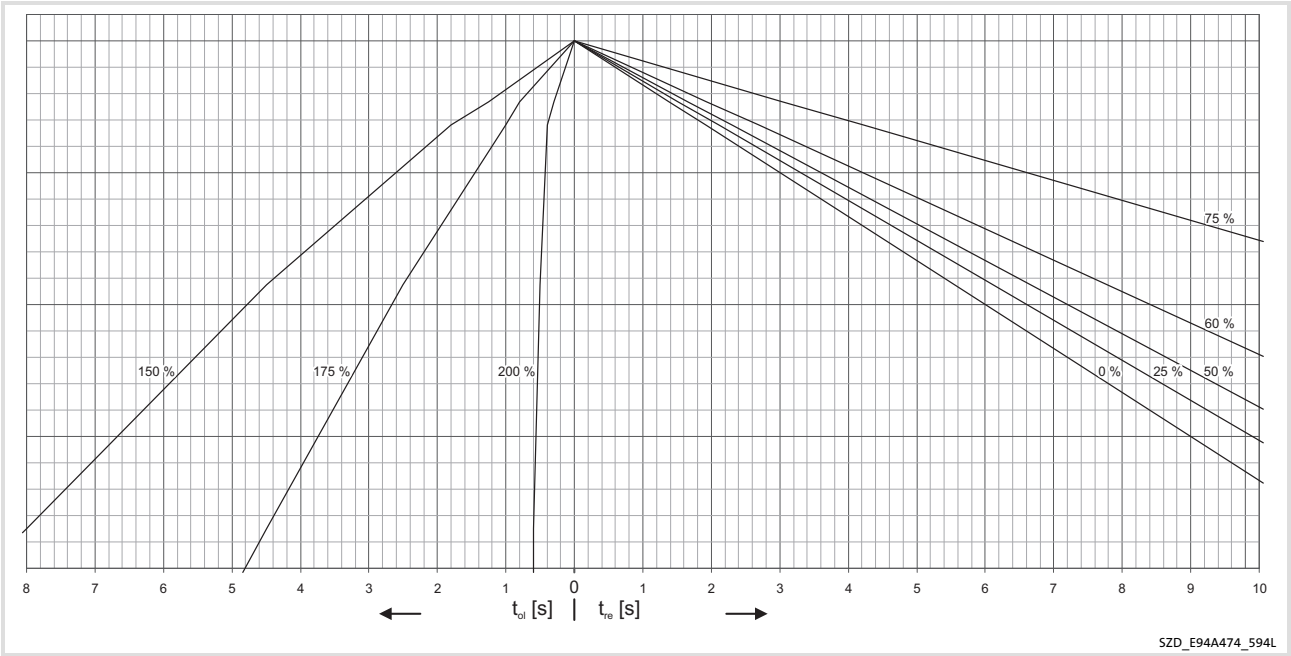


Fig. 3-9 Area cutout for E94xxxE0474 and E94xxxE0594

E94xxxE0864 and E94xxxE1044

Type	U_r	100 %	f_{chopp}
	[V]	[A]	[Setting]
E94xxxE0864	400	86.0	4 kHz var
E94xxxE1044		104	

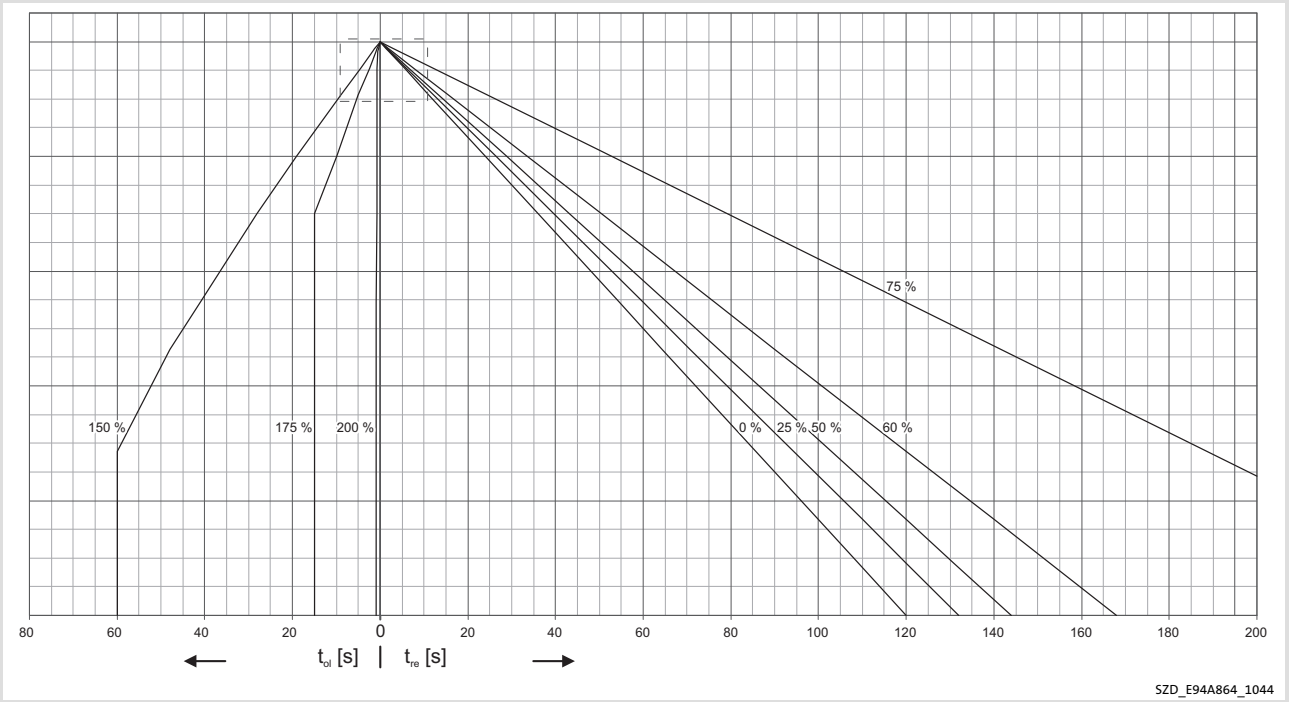


Fig. 3-10 Diagram for E94xxxE0864 and E94xxxE1044

t_{ol} Duration of the load phase
t_{re} Duration of the recovery phase

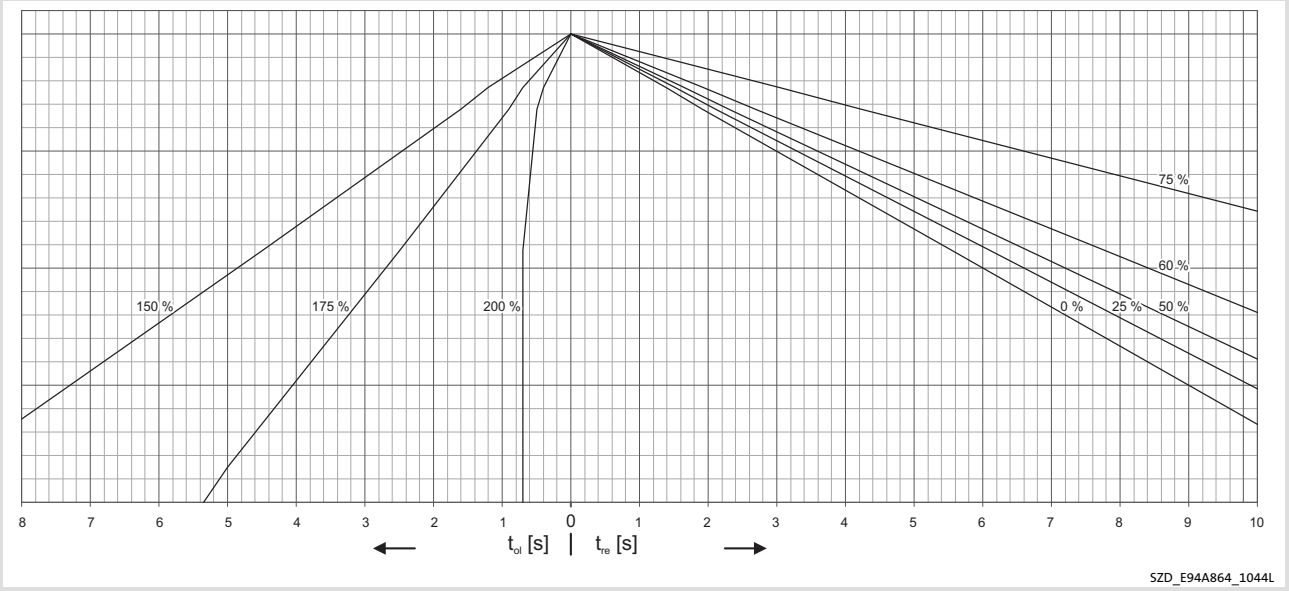


Fig. 3-11 Area cutout for E94xxxE0864 and E94xxxE1044

E94xxxE1454 ... E9xBxxE4604

Type	V_r	100 %	f_{chopp}
	[V]	[A]	[Setting]
E94xxxE1454	400	145	4 kHz var
E94xxxE1724		172	
E94xxxE2024		202	
E94xxxE2454	400	245	2 kHz var
E94xxxE2924		292	
E94xxxE3664		366	
E94xxxE4604		460	

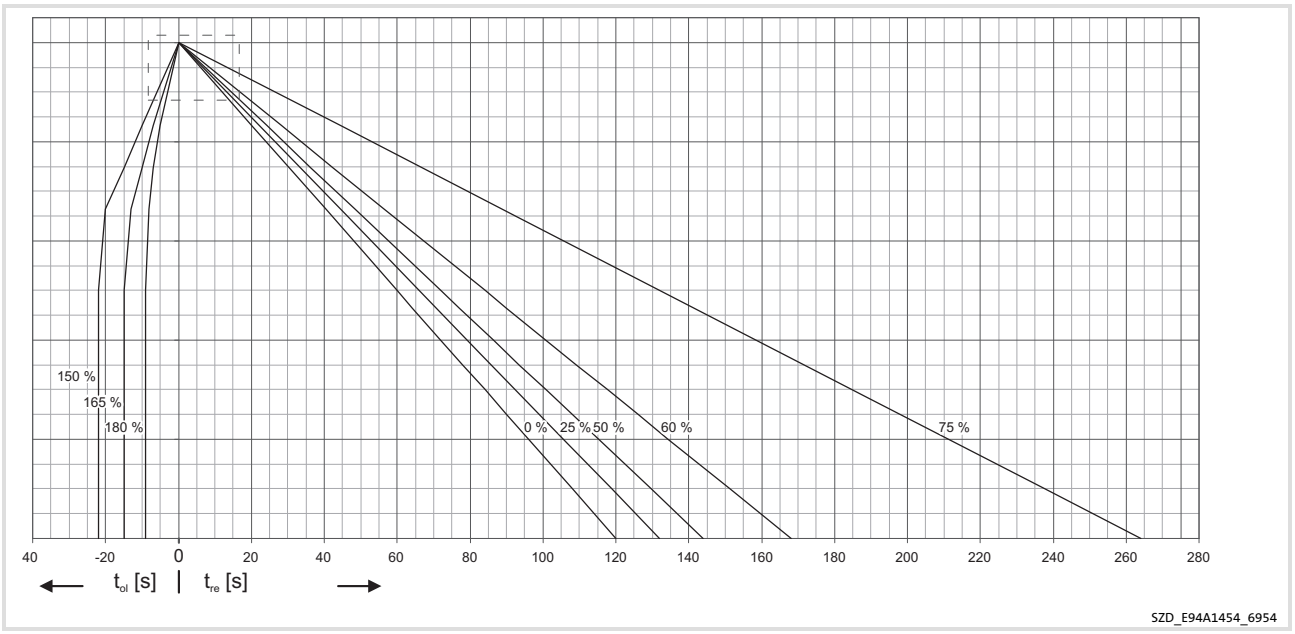


Fig. 3-12 Diagram for E94xxxE1454 ... E94xxxE4604

t_{ol} Duration of the load phase
t_{re} Duration of the recovery phase

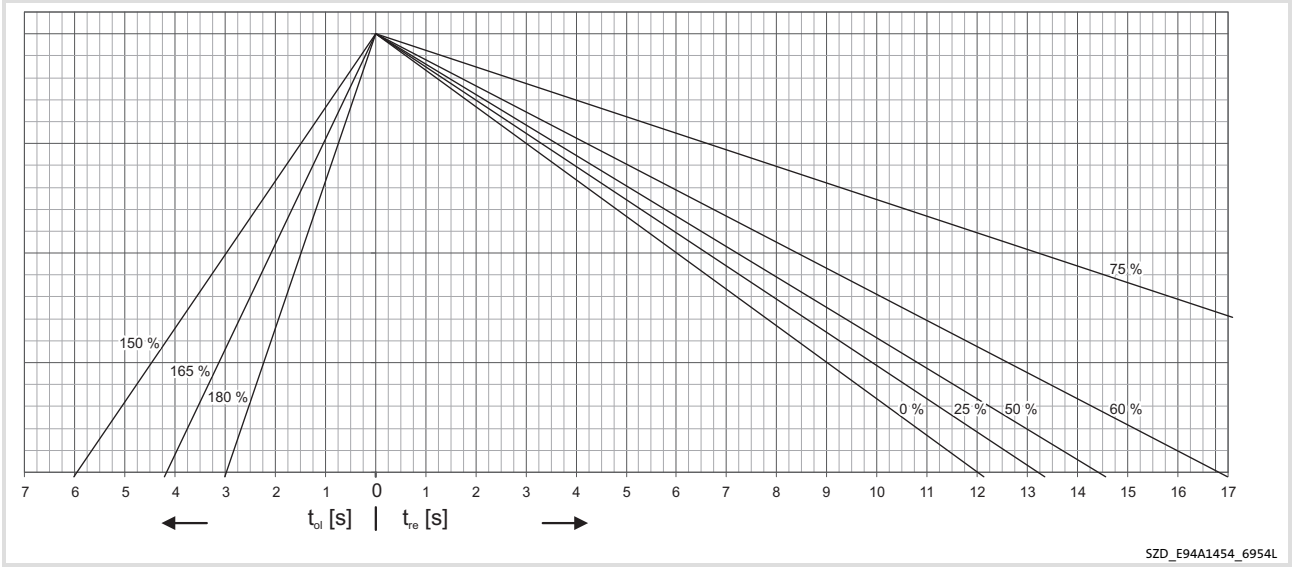
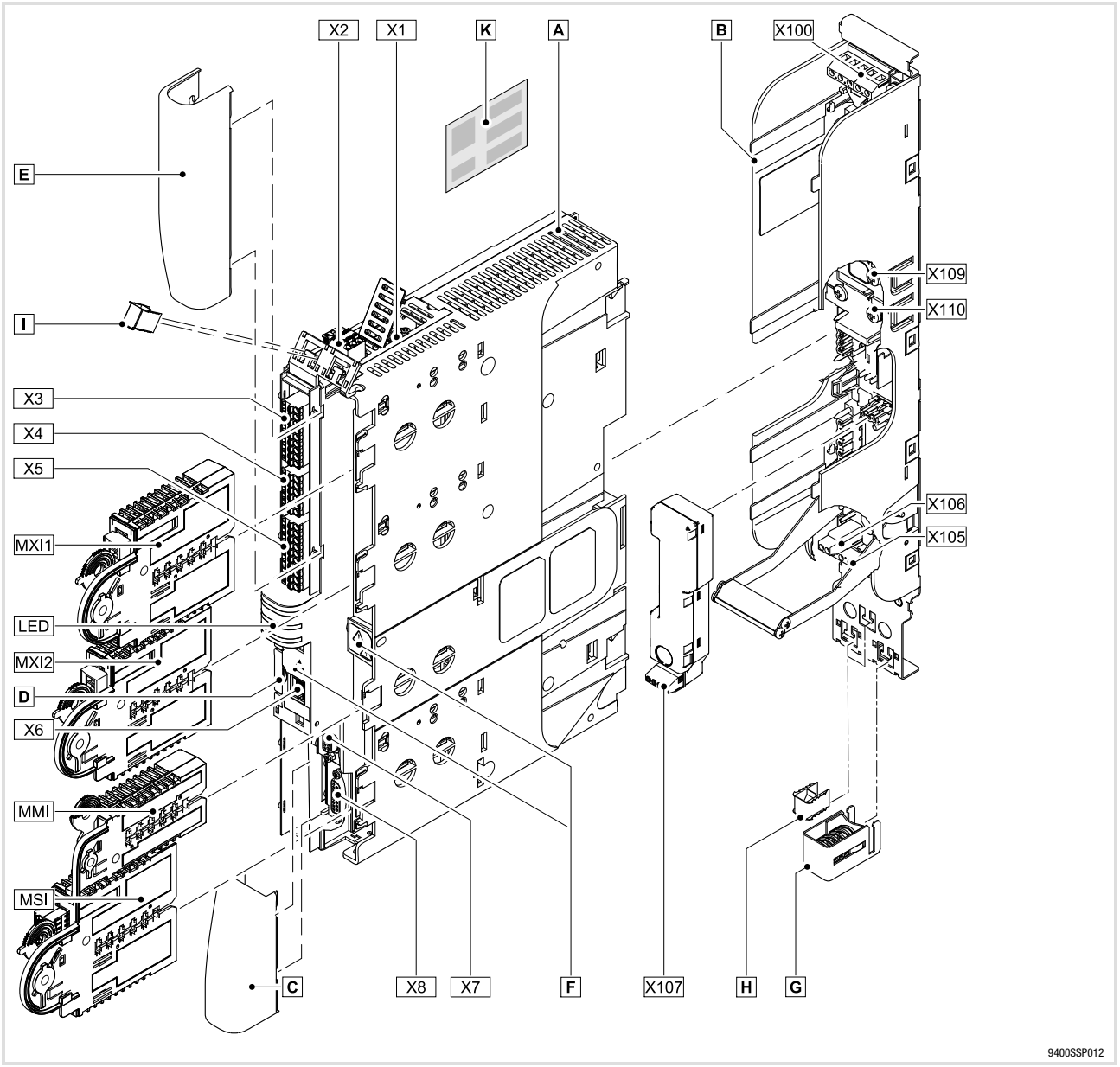


Fig. 3-13 Area section for E94xxxE1454 ... E94xxxE4604

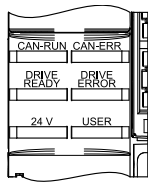
3.5 Device description

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



Standard device A	
Pos.	**Description**
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 and statebus
X3	Analog inputs and analog outputs
X4	Digital outputs
X5	Digital inputs
X6	Diagnostics
X7	Resolver
X8	Encoder
C	Lower cover
D	Retractable nameplate
E	Upper cover
I	EMC clip
K	Prominent warning label close to the device!

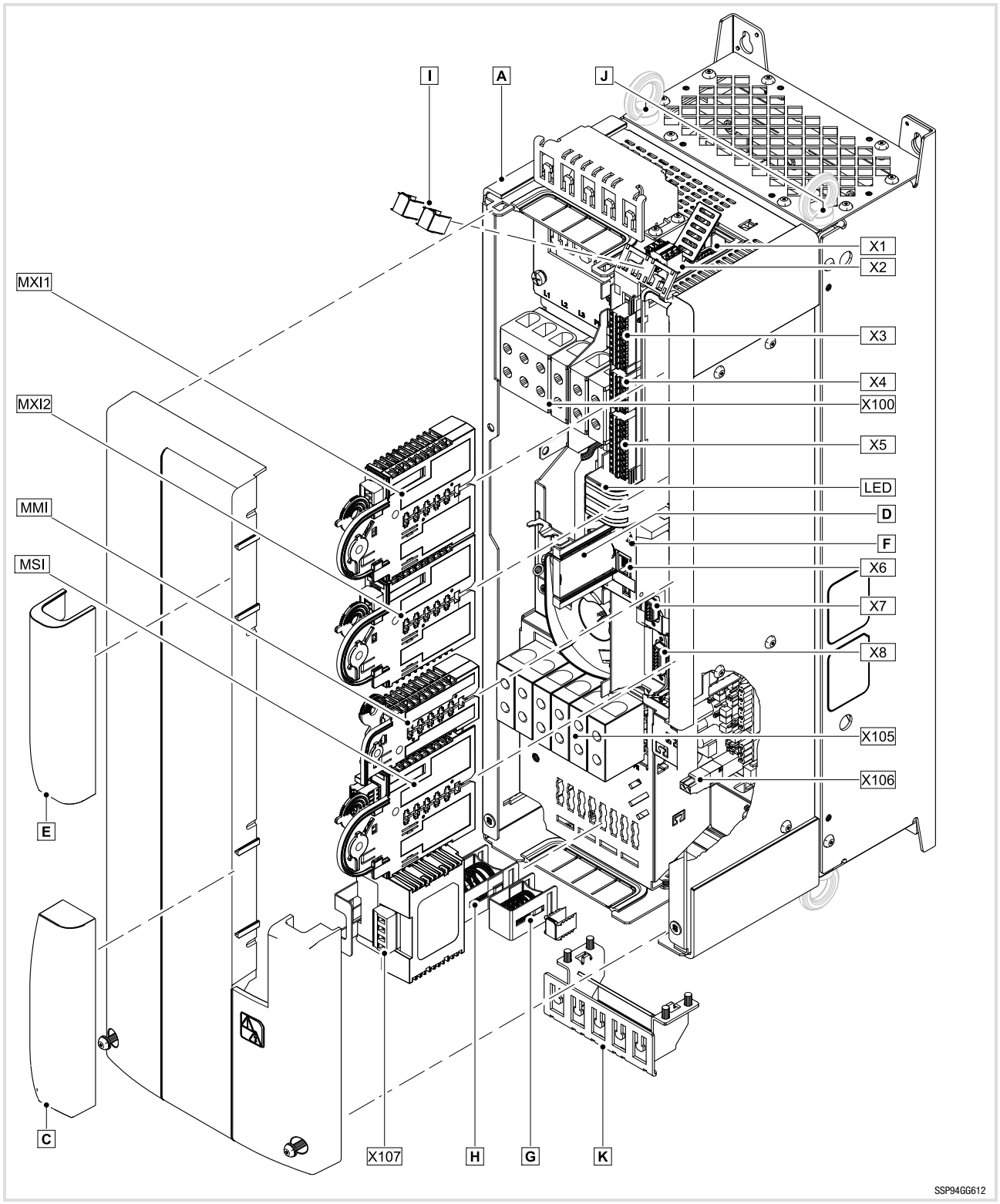
The LED display enables fast indication of several operating states.

LED	Labelling	Colour	Description
 SSP94LED01	CAN-RUN	green	CAN bus ok
	CAN-ERR	red	CAN bus error
	DRIVE READY	green	Standard device is ready for operation
	DRIVE ERROR	red	Error in the standard device or application-induced
	24 V	green	24 V supply voltage ok
	USER	yellow	Message parameterised by the application

Pos.	Symbol	Description
F		**Long discharge time**: All power terminals carry hazardous electrical voltages for a longer period of time after mains disconnection! Depending on the device, this period of time may be up to 20 minutes.
		**High discharge current**: Carry out fixed installation and PE connection according to EN 61800-5-1!
		**Electrostatic sensitive devices**: Before working on the device, the personnel must be free of electrostatic charge!

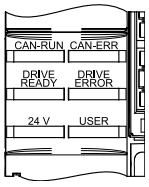
Installation backplane B	
Pos.	**Description**
X100	Mains / DC-bus voltage
X105	Motor / external brake resistor
X106	Motor temperature monitoring
X107	Control of motor holding brake
X109	DC busbar +
X110	DC busbar -
G	EMC wire clamp (for device sizes 2 + 3), replaces 1 x H
H	EMC shield clamp

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



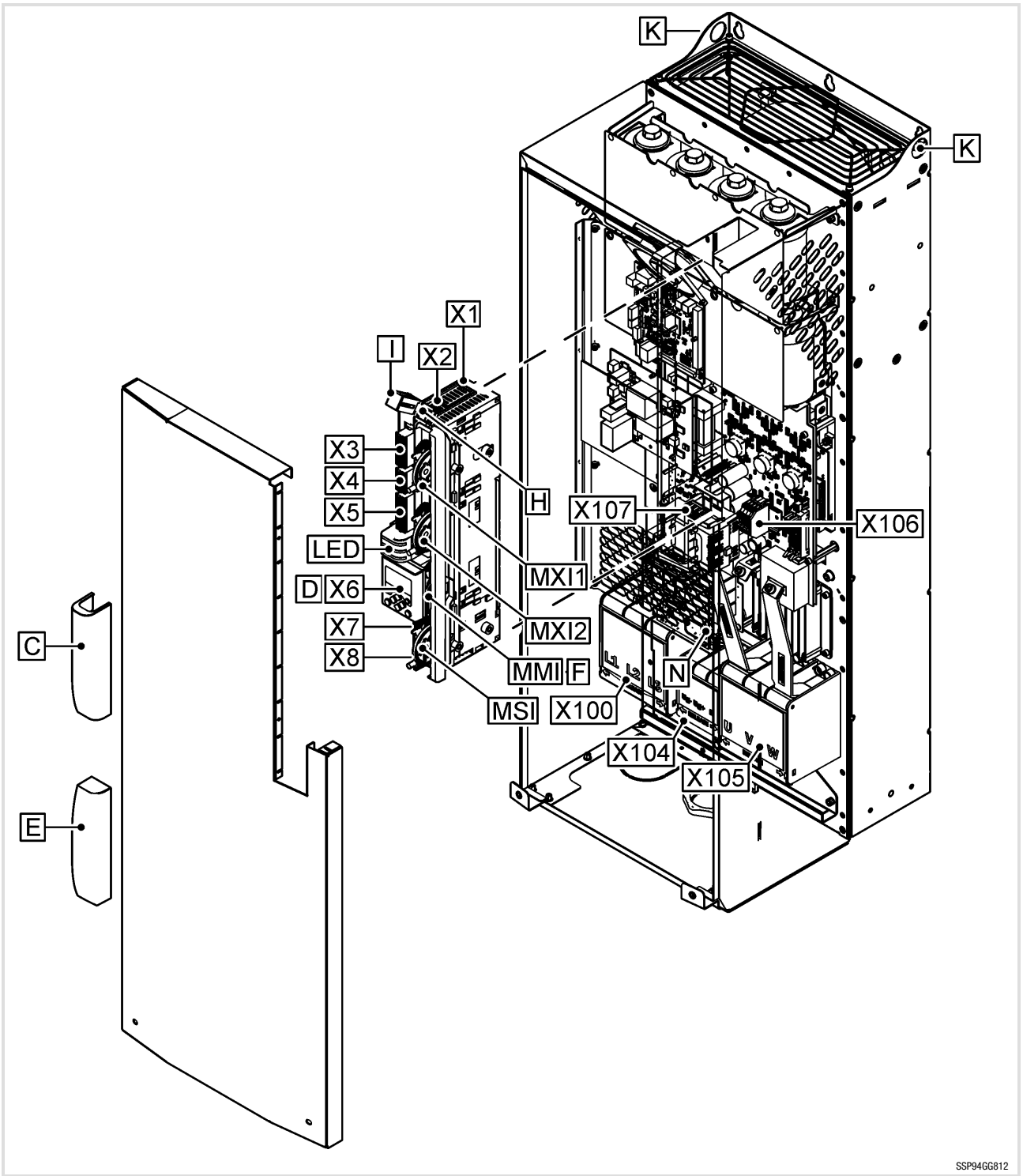
Standard device A	
Pos.	**Description**
MXI1	Module receptacle for extension 1, e.g. communication
MXI2	Module receptacle for extension 2, e.g. communication
MMI	Module receptacle for memory modules
MSI	Module receptacle for safety equipment
X1	System bus (CAN), under the cover
X2	24 V supply and statebus
X3	Analog inputs and analog outputs
X4	Digital outputs
X5	Digital inputs
X6	Diagnostics
X7	Resolver
X8	Encoder
C	Lower cover
D	Retractable nameplate
E	Upper cover
I	EMC clip
K	Prominent warning label close to the device!
X100	Mains / DC-bus voltage
X105	Motor / external brake resistor
X106	Motor temperature monitoring
X107	Control of motor holding brake
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
J	Internal thread for M6 eye bolt (not included in the scope of supply)
K	Strain relief and lifting aid, removable

The LED display enables fast indication of several operating states.

LED	Labelling	Colour	Description
 SSP94LED01	CAN-RUN	green	CAN bus ok
	CAN-ERR	red	CAN bus error
	DRIVE READY	green	Standard device is ready for operation
	DRIVE ERROR	red	Error in the standard device or application-induced
	24 V	green	24 V supply voltage ok
	USER	yellow	Message parameterised by the application

Pos.	Symbol	Description
F		**Long discharge time**: All power terminals carry hazardous electrical voltages for a longer period of time after mains disconnection! Depending on the device, this period of time may be up to 20 minutes.
		**High discharge current**: Carry out fixed installation and PE connection according to EN 61800-5-1!
		**Electrostatic sensitive devices**: Before working on the device, the personnel must be free of electrostatic charge!

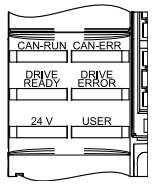
3.5.3 Devices in the range 145 ... 245 A (75 ... 130 kW)



The control unit is firmly connected to the device. For a better presentation, it has been removed.

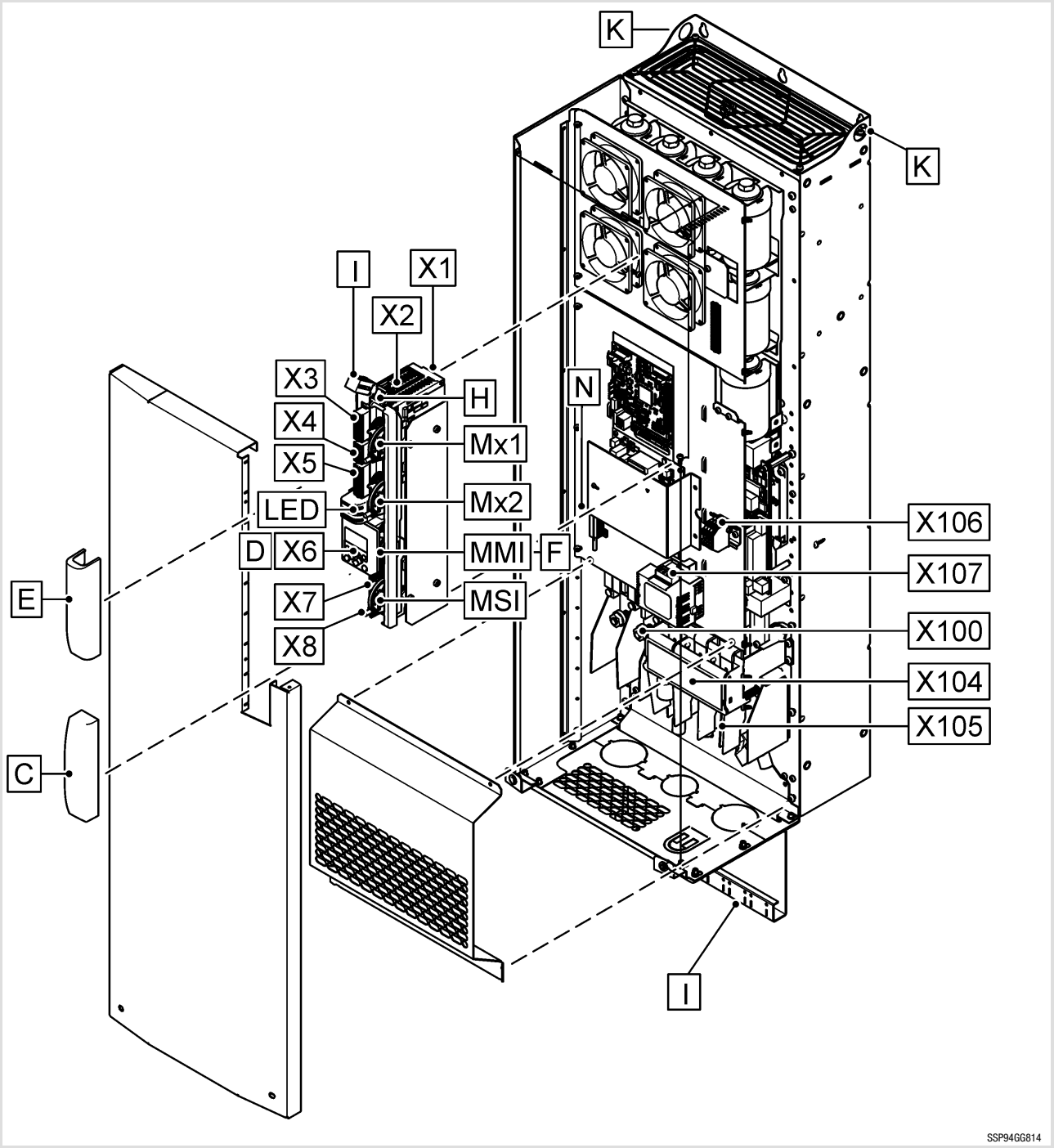
Pos.	Description
MXI1	Module receptacle for extension 1, e.g. communication
MXI2	Module receptacle for extension 2, e.g. communication
MMI	Module receptacle for memory modules
MSI	Module receptacle for safety equipment
X1	System bus (CAN), under the cover
X2	24-V supply / Statebus
X3	Analog inputs / analog outputs
X4	Digital outputs
X5	Digital inputs
X6	Diagnostics (with diagnostic adapter or keypad)
X7	Resolver
X8	Encoder
C	Lower cover
D	Retractable nameplate
E	Upper cover
I	EMC wire clamp
X100	Mains voltage
X104	DC-bus voltage/external brake resistor
X105	Motor
X106	Motor temperature monitoring (position depends on the device size)
X107	Control of motor holding brake
H	EMC shield clamp
K	Holes for transport and assembly guides
N	Bridge for operation in TT/TN or IT systems

The LED display enables fast indication of several operating states.

LED	Labelling	Colour	Description
 SSP94LED01	CAN-RUN	green	CAN bus ok
	CAN-ERR	red	CAN bus error
	DRIVE READY	green	Standard device is ready for operation
	DRIVE ERROR	red	Error in the standard device or application-induced
	24 V	green	24 V supply voltage ok
	USER	yellow	Message parameterised by the application

Pos.	Symbol	Description
F		**Long discharge time**: All power terminals carry hazardous electrical voltages for a longer period of time after mains disconnection! Depending on the device, this period of time may be up to 20 minutes.
		**High discharge current**: Carry out fixed installation and PE connection according to EN 61800-5-1!
		**Electrostatic sensitive devices**: Before working on the device, the personnel must be free of electrostatic charge!

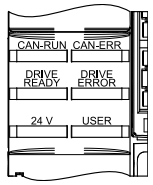
3.5.4 Device 292 A (150 kW)



The control unit is firmly connected to the device. For a better presentation, it has been removed.

Pos.	Description
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
X4	Digital outputs
X5	Digital inputs
X6	Diagnostics (with diagnostic adapter or keypad)
X7	Resolver
X8	Encoder
C	Lower cover
D	Retractable nameplate
E	Upper cover
I	EMC wire clamp
X100	Mains voltage
X104	DC-bus voltage/external brake resistor
X105	Motor
X106	Motor temperature monitoring (position depends on the device size)
X107	Control of motor holding brake
H	EMC shield clamp
K	Holes for transport and assembly guides
N	Bridge for operation in TT/TN or IT systems

The LED display enables fast indication of several operating states.

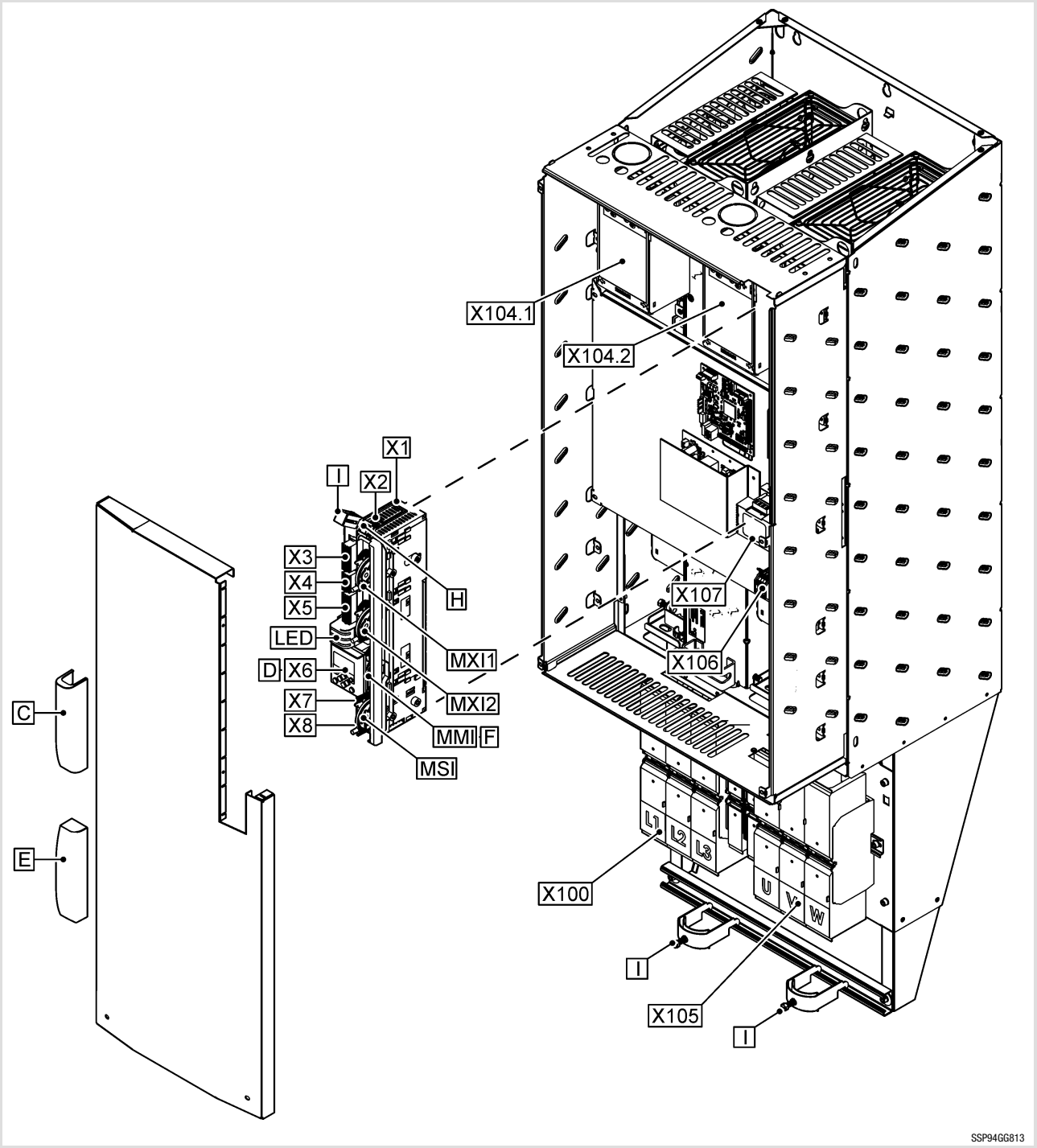


SSP94LED01

LED	Labelling	Colour	Description
	CAN-RUN	green	CAN bus ok
	CAN-ERR	red	CAN bus error
	DRIVE READY	green	Standard device is ready for operation
	DRIVE ERROR	red	Error in the standard device or application-induced
	24 V	green	24 V supply voltage ok
	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!

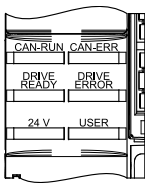
3.5.5 Devices in the range 366 ... 460 A (190 ... 240 kW)



The control unit is firmly connected to the device. For a better presentation, it has been removed.

Pos.	Description
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
X4	Digital outputs
X5	Digital inputs
X6	Diagnostics (with diagnostic adapter or keypad)
X7	Resolver
X8	Encoder
C	Lower cover
D	Retractable nameplate
E	Upper cover
I	EMC wire clamp
X100	Mains voltage
X104	DC-bus voltage/external brake resistor
X105	Motor
X106	Motor temperature monitoring
X107	Control of motor holding brake
H	EMC shield clamp
K	Holes for transport and assembly guides

The LED display enables fast indication of several operating states.

LED	Labelling	Colour	Description
 SSP94LED01	CAN-RUN	green	CAN bus ok
	CAN-ERR	red	CAN bus error
	DRIVE READY	green	Standard device is ready for operation
	DRIVE ERROR	red	Error in the standard device or application-induced
	24 V	green	24 V supply voltage ok
	USER	yellow	Message parameterised by the application

Pos.	Symbol	Description
F		**Long discharge time**: All power terminals carry hazardous electrical voltages for a longer period of time after mains disconnection! Depending on the device, this period of time may be up to 20 minutes.
		**High discharge current**: Carry out fixed installation and PE connection according to EN 61800-5-1!
		**Electrostatic sensitive devices**: Before working on the device, the personnel must be free of electrostatic charge!

3.6 Mechanical installation

3.6.1 Important notes

Note!

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

- The mounting location must always comply with the operating conditions specified in the technical data (📖 33). Take additional measures if necessary.
- The mounting plate of the control cabinet must have the following properties:
  – electrically conductive
  – free of lacquer
- The mechanical connections must always be ensured.
- A free air circulation must be ensured for dissipating the heat.
- The described EMC properties are provided if the following conditions are complied with:
  – The devices are mounted according to the arrangement concept described.
  – The prepared cables are used and remain unchanged.

3.6.2 Devices in the range 2 ... 24 A (0.37 ... 11 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.

Note!

- ► Permissible are M5 screw and washer assemblies or hexagon socket screws with washer.
- ► Tightening torque: 3.0 Nm / 26 lb-in.
- ► The screw joint in the installation backplane may jut out no more than 7 mm.

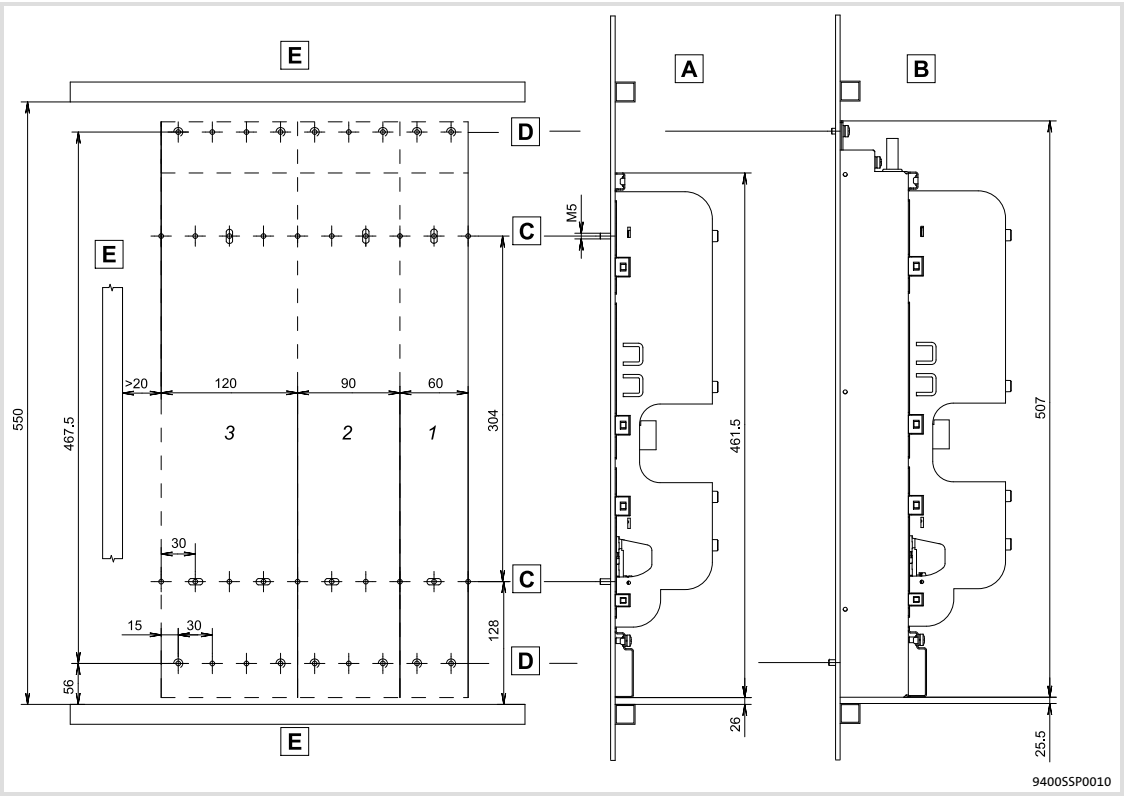


Fig. 3-14 Mounting grid for installation backplane and filter of device sizes 1 ... 3

- 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

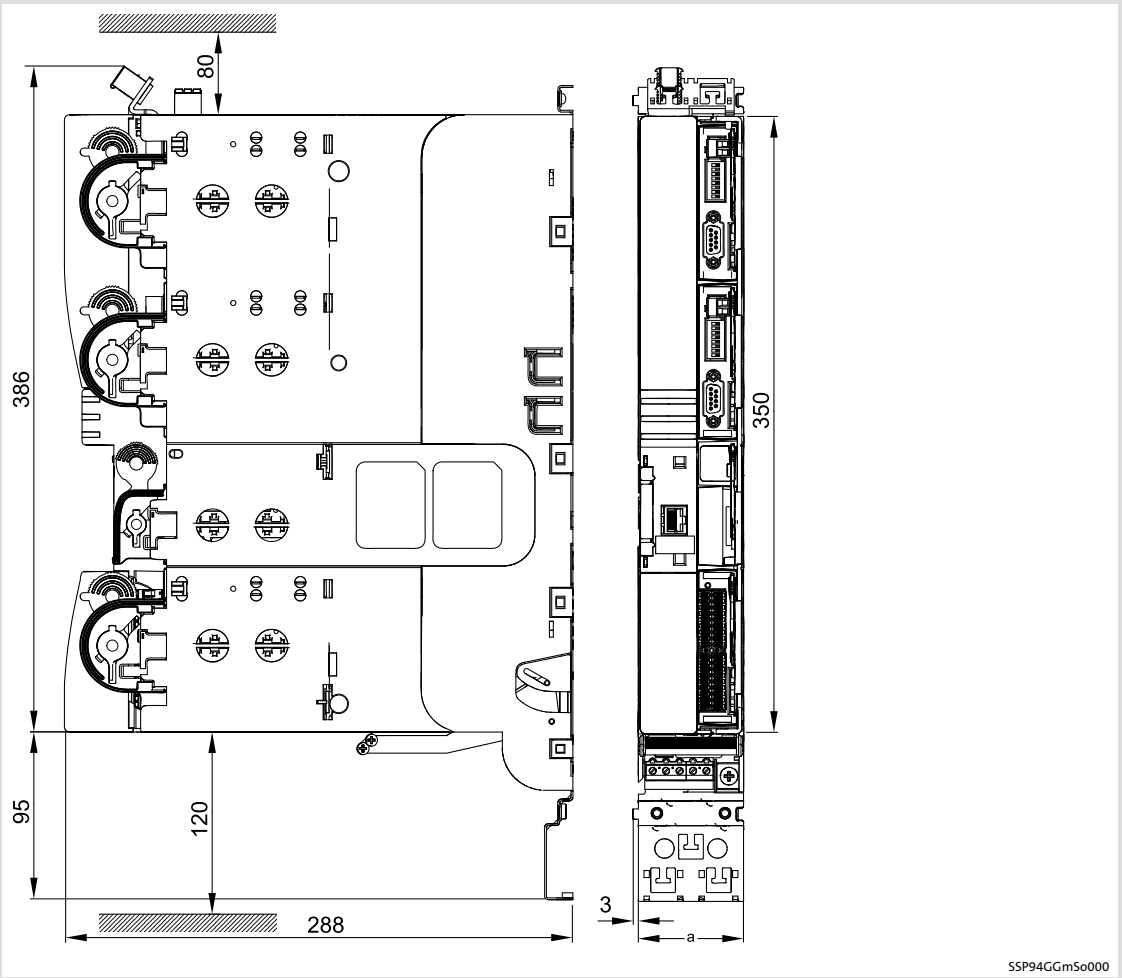


Fig. 3-15 Dimensions [mm]

Type	Dimensions a [mm]	Mass [kg]	Device size
E94xSxE0024	60	4.0	1
E94xSxE0034			
E94xSxE0044	90	5.3	2
E94xSxE0074			
E94xSxE0134	120	8.1	3
E94xSxE0174			
E94xSxE0244			

Installation steps

Proceed as follows for installation:

1. Prepare M5 threaded holes on the mounting plate according to the mounting grid.
2. When footprint filters are used: 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 washer
   – Starting torque: 3.0 Nm (26 lb-in)
3. Screw the installation backplane or the footprint filter with installation backplane onto the mounting plate. Do not tighten the screws yet.
   – Use M5 screw and washer assemblies or M5 hexagon socket screws with washer.
   – 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 to be installed.
5. Align all installation backplanes.
6. Tightly screw all installation backplanes/footprint filters onto the mounting plate.
   – Tightening torque: 3.0 Nm (26 lb-in).

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

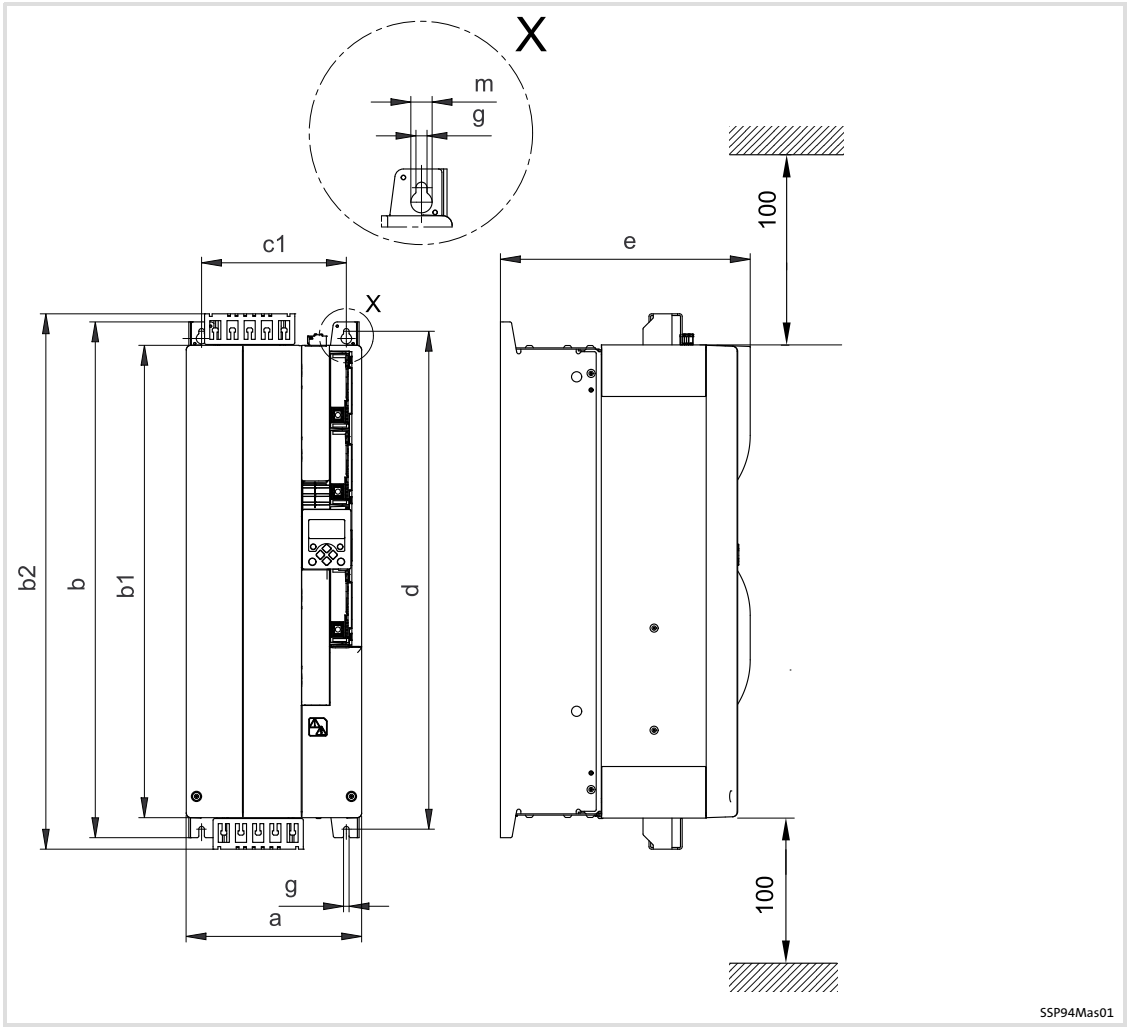


Fig. 3-16 Dimensions [mm]

Type	Dimensions [mm]									Weight [kg]	Device size
	a	b	b1	b2	e	c1	d	g	m		
E94xSxE0324	206	606	556	630	294	170	585	6.5	12.5	26.5	6
E94xSxE0474											
E94xSxE0594											
E94xSxE0864	266	706	655	729	370	230	685			42	7
E94xSxE1044											

3.6.4 Devices in the range 145 ... 292 A (75 ... 150 kW)

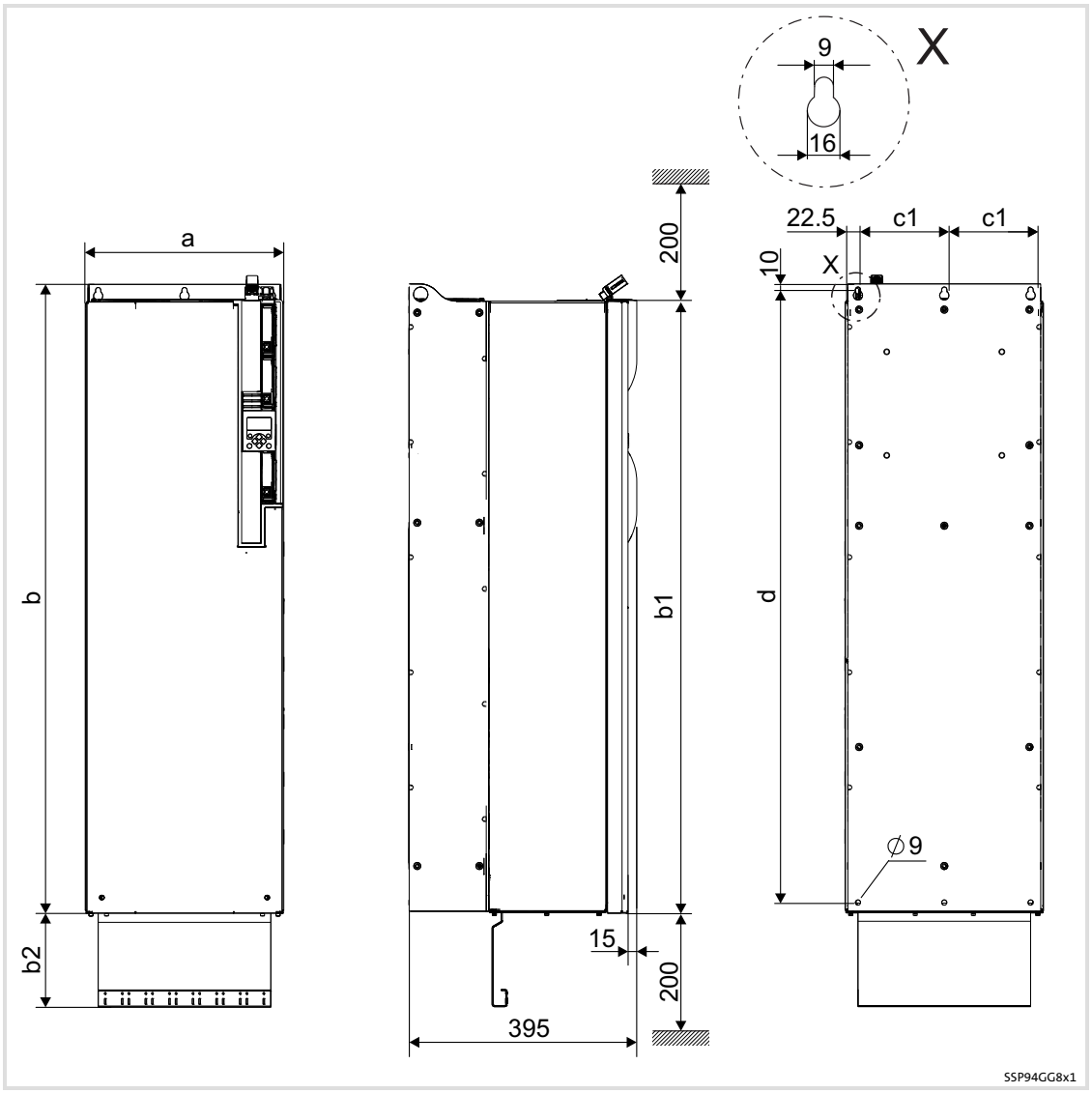


Fig. 3-17 Dimensions [mm]

Type	Dimensions [mm]						Mass	Device size
	a	b	b1	b2	c1	d	[kg]	
E94xSxE1454	285	950	923	-	120	925	64	81
E94xSxE1724	345	950	923	-	150	925	77	82
E94xSxE2024								
E94xSxE2454								
E94xSxE2924	345	1090	1063	160	150	1065	80	83

3.6.5 Devices in the range 366 ... 460 A (190 ... 240 kW)

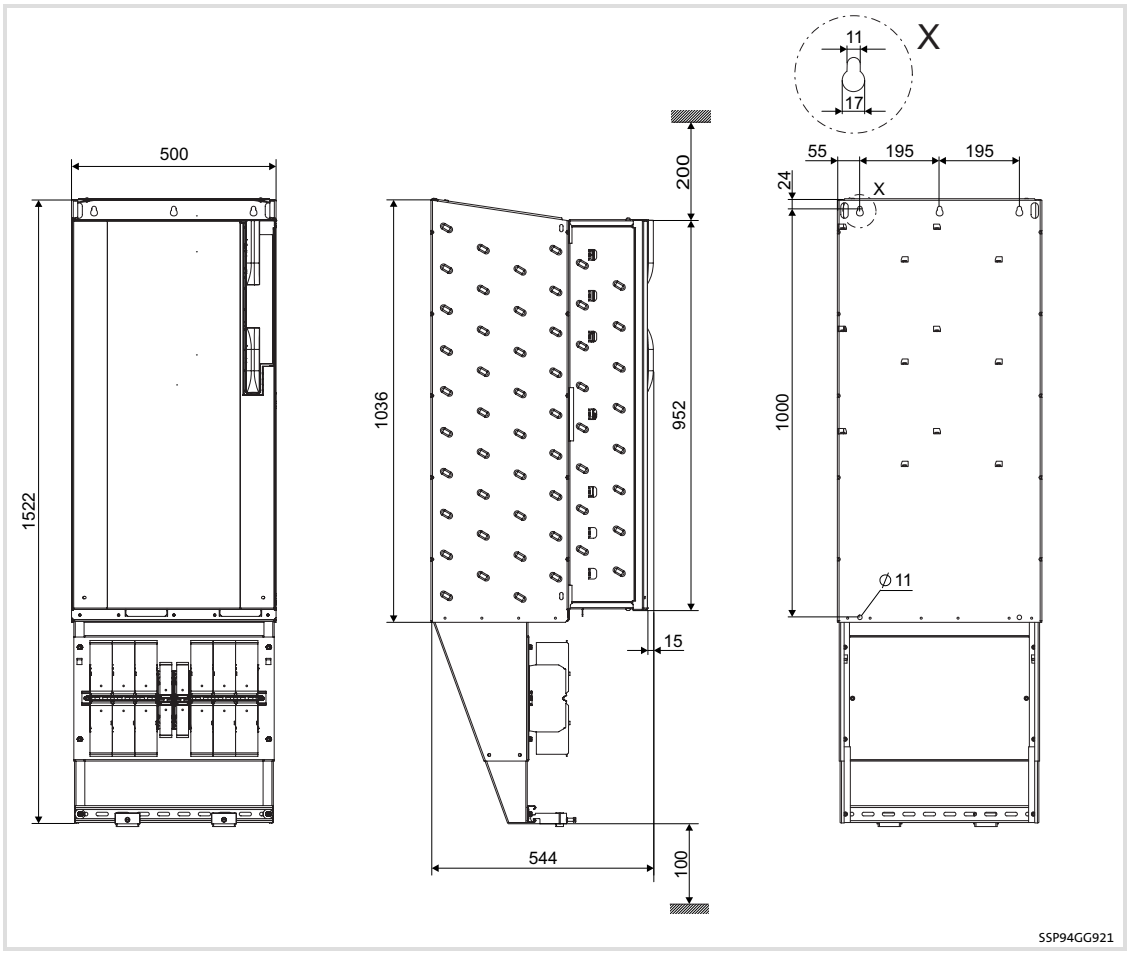


Fig. 3-18 Dimensions [mm]

Type	Mass [kg]	Device size
E94xSxE3664	189	91
E94xSxE4604		

3.7 Wiring

3.7.1 Important notes

Danger!

Hazardous electrical voltage

All power connections carry a hazardous electrical voltage for a longer time after mains disconnection. Observe the information regarding the discharge time on the device.

Possible consequences:

► Death or severe injuries when touching the power terminals.

Protective measures:

► Before working on the power connections, wait at least until the discharge time has passed (depending on the device, this may be up to 20 minutes).

► Make sure that all power terminals are deenergised.

Danger!

Hazardous electrical voltage

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

Possible consequences:

► Death or severe injuries when touching the device in the event of an error.

Protective measures:

Implement the measures required in EN 61800-5-1. Especially:

► Fixed installation
  – Implement PE connection in compliance with standards.
  – Connect PE conductor twice or PE conductor cross-section ≥ 10 mm^2.

► Connection with a connector for industrial applications according to IEC 60309 (CEE):
  – PE conductor cross-section ≥ 2.5 mm^2 as part of a multi-core supply cable.
  – Provide for suitable strain relief.

Stop!

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

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

Stop!

No device protection if the mains voltage is too high

The mains input is not internally fused.

Possible consequences:

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

Protective measures:

► Observe the maximally 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 (📖 109).

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.

3.7.2 Safety instructions for the installation according to UL/CSA

Note!

The fuse current given in the following is the maximum permissible value. This prevents fire and electrical hazard in the event of an error of the device.

The fuse must be smaller or equal to the maximum permissible value, taking the following into consideration:

- The maximum possible cable cross-section
- the laying system (e.g. tap installation)
- the ambient temperature
- the relevant regulations (e.g. UL508A, NEC70 and others).

Original - English

Device size 1 ... 3

Warnings!

- Branch circuit protection:
  - Suitable for use on a circuit capable of delivering not more than 100 000 rms symmetrical amperes, 480 V max., when protected by CC, J or T class fuses.
  - Suitable for motor group installation on a circuit capable of delivering not more than 100 000 rms symmetrical amperes, 480 V max., when protected by class CC, J or T class fuses.
  - Suitable for motor group installation on a circuit capable of delivering not more than 100 000 rms amperes, when supplied by a rectified AC-power supply of 480 V maximum, when protected by specified fuses.
  - Suitable for motor group installation on a circuit capable of delivering not more than 50 000 rms amperes (30 000 rms Amperes with fuse type 202922...), when supplied by a rectified AC-power supply of 480/277 V maximum, when protected by specified fuses.
  - Use specified fuses as shown in the table.
  - Above Short Circuit ratings are only valid when the Assembly Bases are used.
  - Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electrical Code / Canadian Electrical Code and any additional local codes.
- The opening of the branch circuit protective device may be an indication that a fault current has been interrupted. To reduce the risk of fire or electrical shock, current-carrying parts and other components of the controller should be examined and replaced if damaged. If burnout of the current element of an overload relay occurs, the complete overload relay must be replaced.
- For information on the protection level of the internal overload protection for a motor load in percent of FLA, 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.
- Max. surrounding air temperature is 45 °C.
- Max. surrounding air temperature with derating is 55 °C.
- Use 60/75 °C copper wire only, except for control circuits.
- Secondary circuit shall supplied from an external isolating source.
- These products are intended for use in a pollution degree 2 environment.
- These products are intended for use in overvoltage category III.

Type	Branch circuit/short circuit protection with fuses in accordance with UL248	
	Standard installation	**Motor group installation**
	Nominal value (max.) [A]	Nominal value (max.) [A]
E94xSxE0024	8	15
E94xSxE0034	10	15
E94xSxE0044	15	20
E94xSxE0074	20	20
E94xSxE0134	45	60
E94xSxE0174	60	60
E94xSxE0244	60	60

Assignment of devices - DC-fuses

Type	+UG/-UG (X100)		Busbar (X109/X110)	
	Nominal value (max.) [A]	Type	Nominal value (max.) [A]	Type
E94xSxE0024 E94xSxE0034	16	Siba 5020106.16 Siba 5020206.16	315	Eaton 170M1761 Eaton 170M1741
	63	Eaton 170M1754 Eaton 170M1734		
E94xSxE0044 E94xSxE0074	40	Siba 5020106.40 Siba 5020206.40		
	125	Eaton 170M1757 Eaton 170M1737		
E94xSxE0134 E94xSxE0174 E94xSxE0244	100	Siba 2029220.100 Siba 2029221.100		
	200	Eaton 170M1759 Eaton 170M1739		

Recommended fuse holder for type 170M...: Eaton (Bussmann) 170H1007

Device size 6 and 7

Warnings!

- ► Branch circuit protection:
  - – Suitable for use on a circuit capable of delivering not more than 100000 rms symmetrical amperes, 480 V max., when protected by CC, J or T class fuses.
  - – Suitable for motor group installation on a circuit capable of delivering not more than 100000 rms symmetrical amperes, 480 V max., when protected by class CC, J or T class fuses.
  - – Use specified fuses as shown in the table.
  - – Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electrical Code / Canadian Electrical Code and any additional local codes.
- ► The opening of the branch circuit protective device may be an indication that a fault current has been interrupted. To reduce the risk of fire or electrical shock, current-carrying parts and other components of the controller should be examined and replaced if damaged. If burnout of the current element of an overload relay occurs, the complete overload relay must be replaced.
- ► For information on the protection level of the internal overload protection for a motor load in percent of FLA, 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.
- ► Max. surrounding air temperature is 45 °C.
- ► Max. surrounding air temperature with derating is 55 °C.
- ► E94xSxE0324 ... E94xSxE0594: Use 60/75 °C copper wire only, except for control circuits.
- ► E94xSxE0864 ... E94xSxE1044: Use 75 °C copper wire only, except for control circuits.
- ► Secondary circuit shall supplied from an external isolating source.
- ► These products are intended for use in a pollution degree 2 environment.
- ► These products are intended for use in overvoltage category III.

Type	Branch circuit/short circuit protection with fuses in accordance with UL248	
	Standard installation	Motor group installation
	Nominal value (max.) [A]	Nominal value (max.) [A]
E94xSxE0324	50	125
E94xSxE0474	60	125
E94xSxE0594	60	125
E94xSxE0864	100	300
E94xSxE1044	125	300

Device size 81 ... 91

Warnings!

- ► Branch circuit protection:
  - – Suitable for use on a circuit capable of delivering not more than 100000 rms symmetrical amperes, 500 V max.
  - – Use specified fuses as shown in the table. 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 in percent of FLA, 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: 40 °C.
- ► Use 75 °C copper wire only, except for control circuits.
- ► These products are intended for use in a pollution degree 2 environment.

Branch circuit protection
Any class J fuse rated 600 Vac, limited to high-interrupting capacity 100 kA min.
Current limiting types below:

Type	Nominal value (max.)
E94xSxE1454	175 A
E94xSxE1724	200 A
E94xSxE2024	250 A
E94xSxE2454	300 A
E94xSxE2924	350 A
E94xSxE3664	Supply input wire protection - The drive shall be protected by any UL Listed fuse in accordance with the NEC. (Note: The discrete internal semiconductor fuses are considered branch circuit protection)
E94xSxE4604	

Tab. 3-4

Original - French

Device size 1 ... 3

Avertissement !

- ► Protection par disjoncteur :
  - – Convient aux circuits non susceptibles de délivrer plus de 100 000 ampères symétriques eff., maximum 480 V, avec protection par des fusibles de calibre CC, J, ou T.
  - – Convient aux installations de groupe moteur sur des circuits non susceptibles de délivrer plus de 100 000 ampères symétriques eff., maximum 480 V, avec protection par des fusibles de calibre CC, J, ou T.
  - – Convient aux installations de groupe moteur sur des circuits non susceptibles de délivrer plus de 100 000 ampères eff., lorsque l'alimentation est fournie par une source de CA redressé de 480 V maximum, et lorsque cette source est protégée par des fusibles spécifiques.
  - – Convient aux installations de groupe moteur sur des circuits non susceptibles de délivrer plus de 50 000 ampères eff. (30 000 ampères eff. avec type de fusible 202922...), lorsque l'alimentation est fournie par une source de CA redressé de 480/277 V maximum, et lorsque cette source est protégée par des fusibles spécifiques.
  - – Utiliser les fusibles spécifiés comme indiqué dans le tableau.
  - – Les courants nominaux de court-circuit ci-dessus sont valables uniquement en cas d'utilisation de plaques de montage.
  - – La protection statique intégrée n'offre pas la même protection qu'un disjoncteur. Une protection par disjoncteur externe doit être fournie, conformément au National Electrical Code / Canadian Electrical Code, et aux autres dispositions applicables au niveau local.
- ► Le déclenchement du dispositif de protection du circuit de dérivation peut être dû à une coupure qui résulte d'un courant de défaut. Pour limiter le risque d'incendie ou de choc électrique, examiner les pièces porteuses de courant et les autres éléments du contrôleur ; les remplacer s'ils sont endommagés. Le relais de surcharge doit être remplacé en cas de grillage de l'élément traversé par le courant.
- ► Pour obtenir des informations sur le niveau de protection offert par la protection intégrée contre les surcharges du moteur (pourcentage de l'intensité assignée à pleine charge), se reporter aux manuels d'application ou aux systèmes d'aide logiciels.
- ► Pour obtenir des informations sur les caractéristiques assignées et sur le câblage du dispositif de protection thermique (concerne uniquement le raccordement aux moteurs dotés d'un dispositif de protection thermique intégré), se reporter aux manuels d'application ou aux systèmes d'aide logiciels.

- ► Température ambiante maximale : 45 °C
- ► Température ambiante maximale avec réduction de puissance : 55 °C
- ► Utiliser exclusivement des conducteurs en cuivre 60/75 °C, sauf pour la partie commande.
- ► Prévoir un circuit auxiliaire alimenté par une source de tension avec isolation galvanique.
- ► Ces produits sont destinés à un environnement caractérisé par le degré de pollution 2.
- ► Ces produits sont conçus pour une utilisation dans la catégorie de surtension III.

Type	Protection du circuit de dérivation / protection contre les courts-circuits par fusibles conformément à UL248	
	Installation standard	Installation au sein d'un groupe moteur
	Valeur nominale (max.) [A]	Valeur nominale (max.) [A]
E94xSxE0024	8	15
E94xSxE0034	10	15
E94xSxE0044	15	20
E94xSxE0074	20	20
E94xSxE0134	45	60
E94xSxE0174	60	60
E94xSxE0244	60	60

Combinaison entre les appareils et les fusibles CC

Type	+UG/-UG (X100)		Barre conductrice (X109/X110)	
	Valeur nominale (max.) [A]	Type	Valeur nominale (max.) [A]	Type
E94xSxE0024 E94xSxE0034	16	Siba 5020106.16 Siba 5020206.16	315	Eaton 170M1761 Eaton 170M1741
	63	Eaton 170M1754 Eaton 170M1734		
E94xSxE0044 E94xSxE0074	40	Siba 5020106.40 Siba 5020206.40		
	125	Eaton 170M1757 Eaton 170M1737		
E94xSxE0134 E94xSxE0174 E94xSxE0244	100	Siba 2029220.100 Siba 2029221.100		
	200	Eaton 170M1759 Eaton 170M1739		

Porte-fusible recommandé pour Typ 170M... : Eaton (Bussmann) 170H1007

Device size 6 and 7

Avertissement !

- ► Protection par disjoncteur :
  - – Convient aux circuits non susceptibles de délivrer plus de 100000 ampères symétriques eff., maximum 480 V, avec protection par des fusibles de calibre CC, J, ou T.
  - – Convient aux installations de groupe moteur sur des circuits non susceptibles de délivrer plus de 100 000 ampères symétriques eff., maximum 480 V, avec protection par des fusibles de calibre CC, J, ou T.
  - – Utiliser les fusibles spécifiés comme indiqué dans le tableau.
  - – La protection statique intégrée n'offre pas la même protection qu'un disjoncteur. Une protection par disjoncteur externe doit être fournie, conformément au National Electrical Code / Canadian Electrical Code, et aux autres dispositions applicables au niveau local.
- ► Le déclenchement du dispositif de protection du circuit de dérivation peut être dû à une coupure qui résulte d'un courant de défaut. Pour limiter le risque d'incendie ou de choc électrique, examiner les pièces porteuses de courant et les autres éléments du contrôleur ; les remplacer s'ils sont endommagés. Le relais de surcharge doit être remplacé en cas de grillage de l'élément traversé par le courant.
- ► Pour obtenir des informations sur le niveau de protection offert par la protection intégrée contre les surcharges du moteur (pourcentage de l'intensité assignée à pleine charge), se reporter aux manuels d'application ou aux systèmes d'aide logiciels.
- ► Pour obtenir des informations sur les caractéristiques assignées et sur le câblage du dispositif de protection thermique (concerne uniquement le raccordement aux moteurs dotés d'un dispositif de protection thermique intégré), se reporter aux manuels d'application ou aux systèmes d'aide logiciels.
- ► Température ambiante maximale : 45 °C
- ► Température ambiante maximale avec réduction de puissance : 55 °C
- ► E94xSxE0324 ... E94xSxE0594 : Utiliser exclusivement des conducteurs en cuivre 60/75 °C, sauf pour les circuits de commande.
- ► E94xSxE0864 ... E9xASxE1044 : Utiliser exclusivement des conducteurs en cuivre 75 °C, sauf pour les circuits de commande.
- ► Prévoir un circuit auxiliaire alimenté par une source de tension avec isolation galvanique.
- ► Ces produits sont destinés à un environnement caractérisé par le degré de pollution 2.
- ► Ces produits sont conçus pour une utilisation dans la catégorie de surtension III.

Type	Protection du circuit de dérivation / protection contre les courts-circuits par fusibles conformément à UL248	
	Installation standard	Installation au sein d'un groupe moteur
	Valeur nominale (max.) [A]	Valeur nominale (max.) [A]
E94xSxE0324	50	125
E94xSxE0474	60	125
E94xSxE0594	60	125
E94xSxE0864	100	300
E94xSxE1044	125	300

Device size 81 ... 91

Avertissement !

- ► Protection par disjoncteur :
  - – Convient aux circuits non susceptibles de délivrer plus de 100000 ampères symétriques eff., maximum 500 V.
  - – Utiliser les fusibles indiqués dans le tableau. La tension des fusibles doit être adaptée à la tension d'entrée de l'entraînement.
- ► La protection statique intégrée n'offre pas la même protection qu'un disjoncteur. Une protection par disjoncteur externe doit être fournie, conformément aux indications du fabricant, au National Electrical Code et aux autres dispositions applicables.
- ► Pour obtenir des informations sur le niveau de protection offert par la protection intégrée contre les surcharges du moteur (pourcentage de l'intensité assignée à pleine charge), se reporter aux manuels d'application ou aux systèmes d'aide logiciels.
- ► Pour obtenir des informations sur les caractéristiques assignées et sur le câblage du dispositif de protection thermique (concerne uniquement le raccordement aux moteurs dotés d'un dispositif de protection thermique intégré), se reporter aux manuels d'application ou aux systèmes d'aide logiciels.
- ► Température ambiante maximale : 40 °C.
- ► Utiliser exclusivement des conducteurs en cuivre 75 °C, sauf pour la partie commande.
- ► Ces produits sont destinés à un environnement caractérisé par le degré de pollution 2.

Protection du circuit de dérivation
Tout fusible de classe J à tension assignée de 600 Vac, limité à une haute capacité de coupure de 100 kA mini.
Types de limitation actuels ci-dessous :

Type	Valeur nominale (max.)
E94xSxE1454	175 A
E94xSxE1724	200 A
E94xSxE2024	250 A
E94xSxE2454	300 A
E94xSxE2924	350 A
E94xSxE3664	Fournir la protection de câble d'entrée - Le moteur peut être protégé par tout fusible certifié UL conformément au NEC (National Electrical Code). (Remarque : les fusibles internes et discrets pour semi-conducteurs sont considérés comme une protection de circuit de dérivation)
E94xSxE4604	

Tab. 3-5

3.7.3 Earthing of internal EMC filters

Device-internal EMC filters have been implemented to reduce interference emission. These EMC filters are connected to protective earth to discharge interference currents.

Under certain conditions the EMC filters must be disconnected from:

- Operation in an IT system

  The devices are protected from damages or destruction due to incompatible overvoltages in the case of an error (earth fault).

Note!

Internal components have earth/ground potential

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

- Upstream an isolation transformer.
- Before connection to an IT system be absolutely sure to follow the measures described below.

- DC-bus operation
- Operation with power supply modules or regenerative power supply modules
- Operating multiple devices with a common filter

  The EMC properties can only be reached by carrying out the described measures.

  The triggering behaviour of applicable earth-leakage circuit breakers remains undisturbed.

Overview of the measures

The measures which are to be carried out once have been prepared in relation to the devices and are each described together with installation and wiring.

Device (GG = device size)	Measure in the case of operation ...	
	in the IT system	in the interconnected system, with power supply modules or shared filters
Inverter		
with installation backplane (GG1 ... GG3)	Insert plastic cap elsewhere	
without installation backplane (GG6 ... GG7)	Change screwed connection	
without installation backplane (GG81 ... GG83)	Change screwed connection	
without installation backplane (GG91)	Only factory-set measures are possible. Please specify when ordering.	
Power supply modules		
with installation backplane (GG1 und GG3)	No measure necessary	
without installation backplane (GG4 ... GG5)	No measure necessary	
Regenerative power supply modules		
with installation backplane (GG3)	Insert plastic cap elsewhere	
associated mains filter	Change screwed connection	No measure necessary

Device size 1 ... 3

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

1. Remove IT insulating cap from the parking position ① in the installation backplane.
   – For this apply a screwdriver on the right or left and lever off the insulating cap.
   – Optionally the insulating cap can be carefully removed using an appropriate pliers.
2. Attach IT insulating cap to the earthing jumper ② until it clicks into place.



Fig. 3-19 Plugging the IT insulating cap onto the earthing jumper

Device size 6 and 7

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

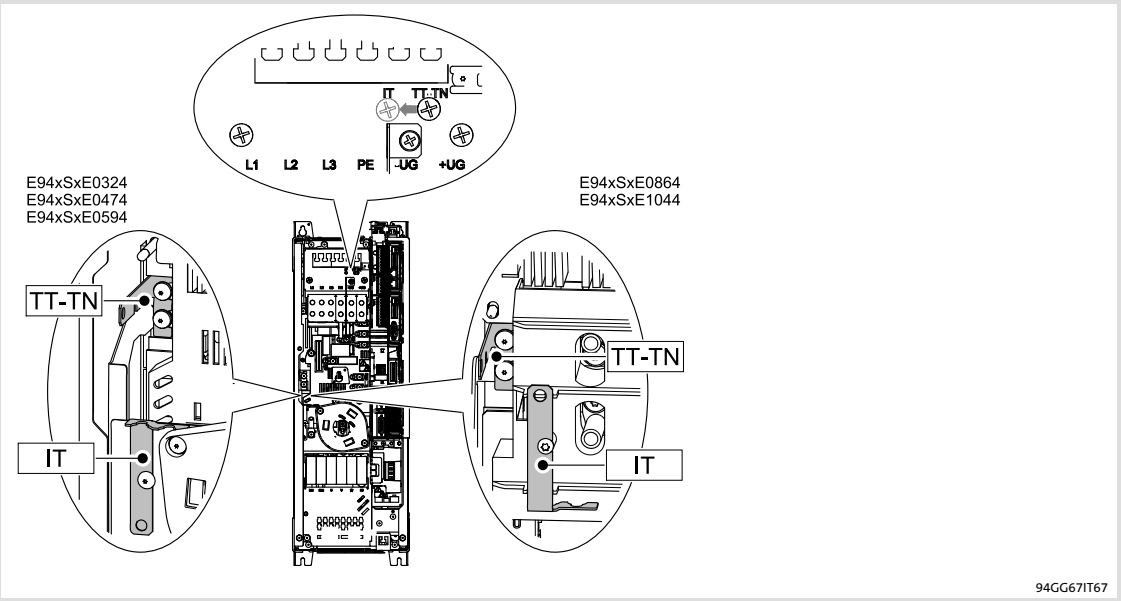


Fig. 3-20

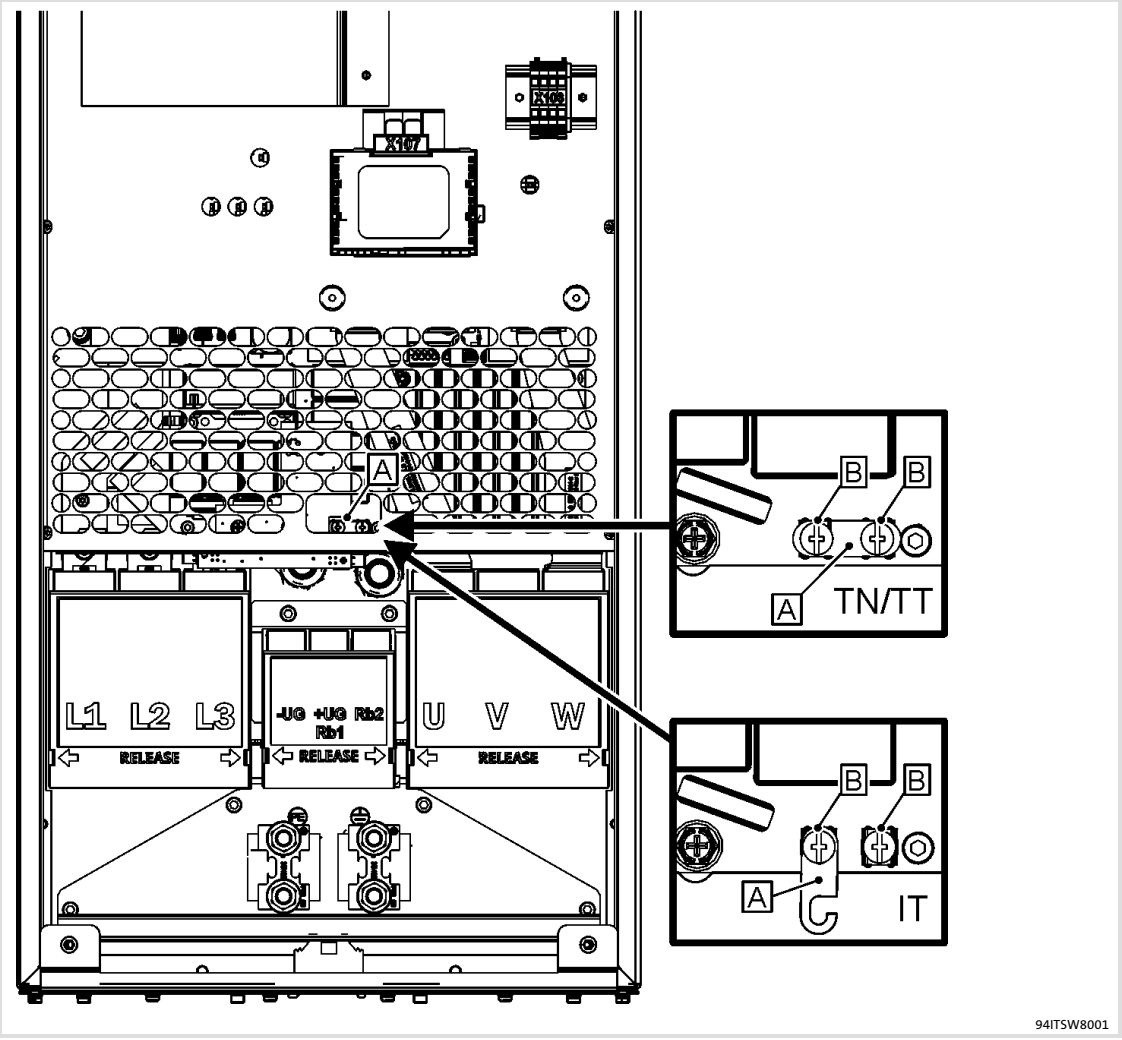
1. There is a screw above the X100 (+UG/-UG) terminals in the position ”TT-TN”.
2. Unscrew the screw and screw it in again at position ”IT”.
   – Tightening torque: 3.4 Nm (30 lb-in)
3. There is a metal lug on the left in the device.
4. Unbolt the screws to remove the metal strap.
5. Unbolt the screw at position ”IT” and insert the metal strap.
6. Tighten all screws.
   – Tightening torque: 3.4 Nm (30 lb-in)

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

Device sizes 81 and 82

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

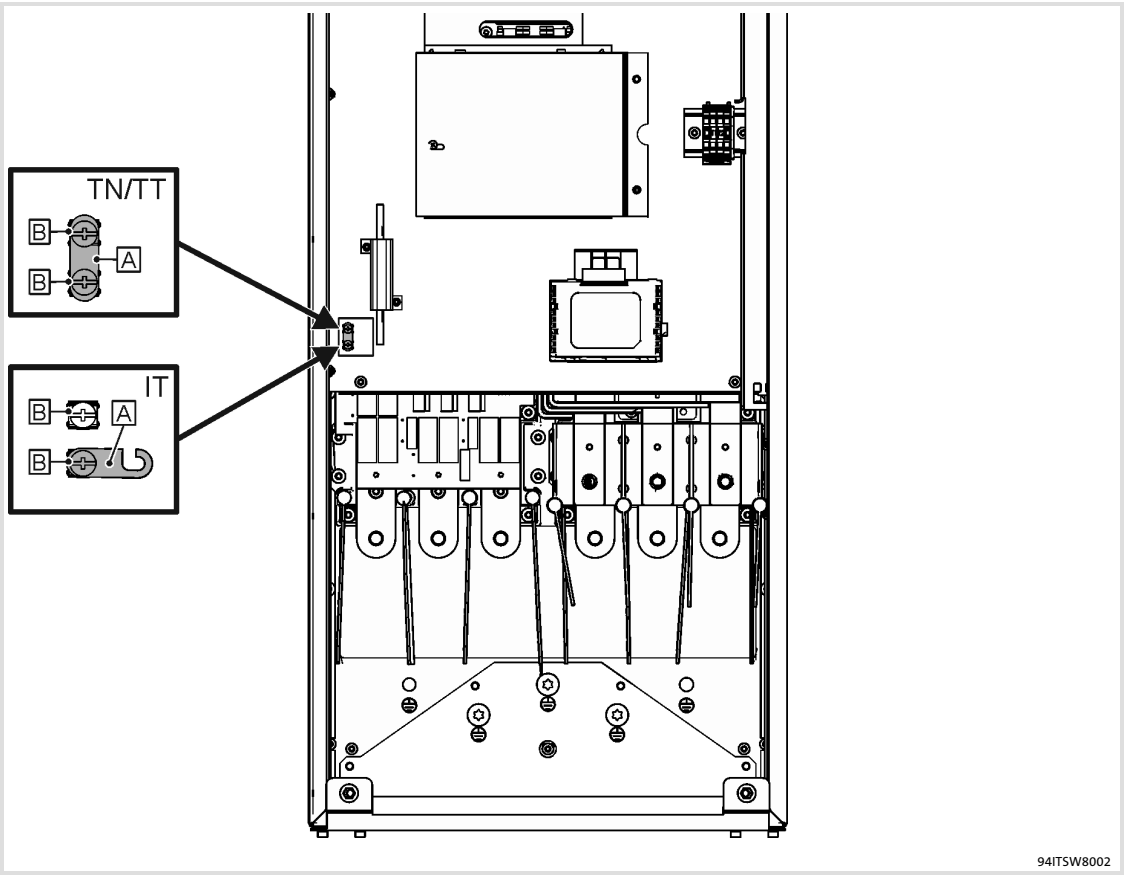
1. The bridge A that connects the filter with the protective earth can be found at the indicated position.
2. Loosen both screws B (do not remove them).
3. Fold the bridge A downwards clockwise by 90°.
4. Tighten both screws A.
   – Starting torque: 3.4 Nm (30 lb-in)



Device size 83

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

1. The bridge [A] that connects the filter with the protective earth can be found at the indicated position.
2. Loosen both screws [B] (do not remove them).
3. Fold bridge [A] 90° clockwise.
4. Tighten both screws [A].
   – Starting torque: 3.4 Nm (30 lb-in)



Device size 91

If devices of this size are to be used in IT systems, factory-set measures have to be taken. Please consider this when ordering.

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

Example circuit

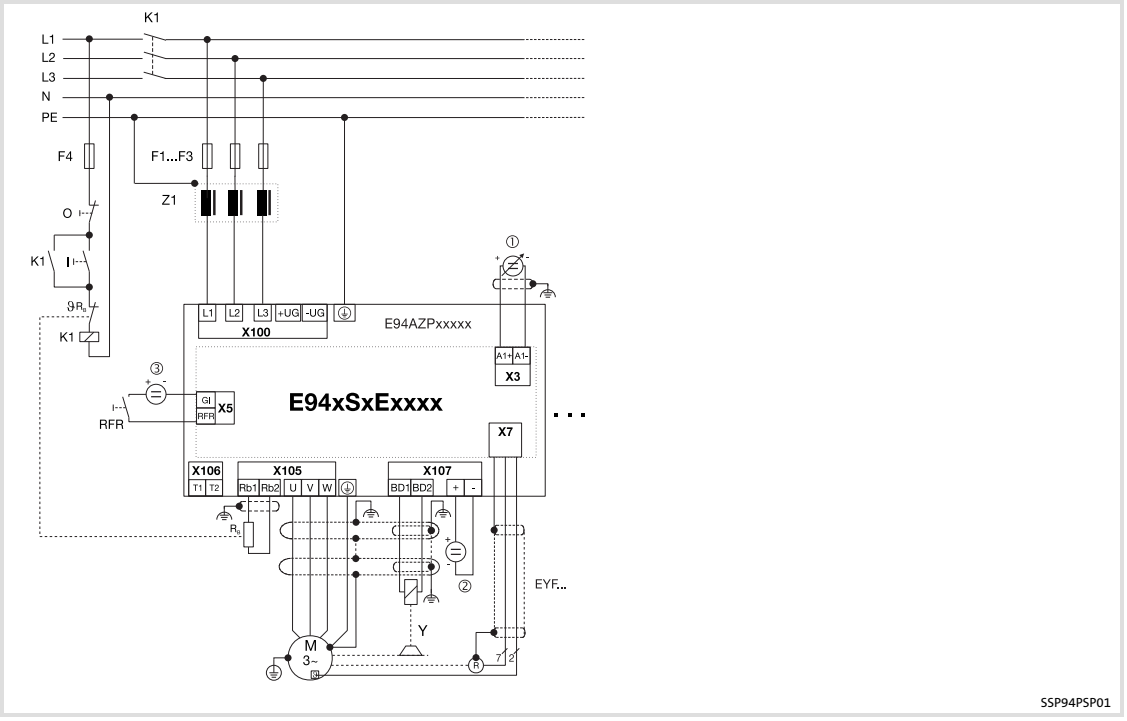


Fig. 3-21 Basic circuit diagram of the drive system

E94xSxExxxx	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).
- The cross-section of the PE conductor must be dimensioned according to the relevant national regulations.
- 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.

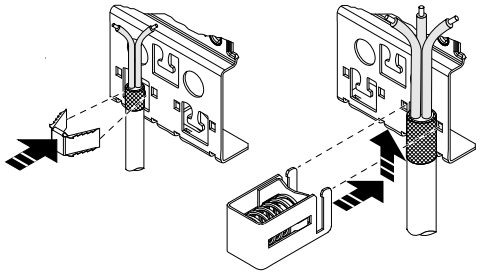
Use system cables or shielded cables for these connections:

- Motor
- Motor holding brake (shielding is required when being integrated into the motor cable; connection to optional motor brake control)
- Motor temperature monitoring
- External brake resistor (Mounting Instructions of the brake resistor)
- DC bus, cable length from 0.3 m

The following connections need not be shielded:

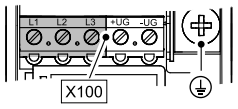
- Mains
- DC bus, cable length up to 0.3 m

How to connect the shield



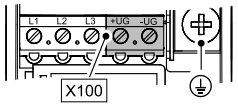
E94AZPS004

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

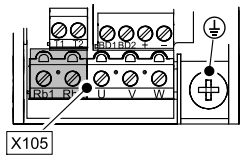
Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device sizes 1 + 2: flexible with wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 5.3	PZ0
Device size 3: flexible with/without wire end ferrule	10/16	6	1.2 ... 1.5	10.6 ... 13.3	PH1

DC bus

Terminal X100 (right part)	labelling	Description
 SSP940X100	+UG -UG	Alternative way of connecting the DC-bus voltage (compatible with the 9300 series). Max. continuous current I_{dc}: Device size 1: 5.3 A Device size 2: 15.2 A Device size 3: 44.4 A Device size 6: 66 A Device size 7: 116 A

Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device sizes 1 + 2: flexible with wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 5.3	PZ0
Device size 3: flexible with/without wire end ferrule	10/16	6	1.2 ... 1.5	10.6 ... 13.3	PH1

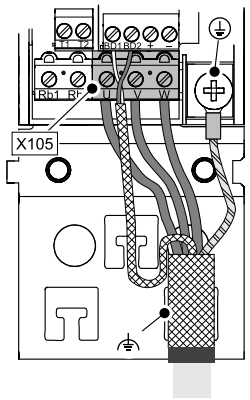
External brake resistor

Terminal X105 (left part)	Labelling	Description
 SSP94LX105	Rb1 Rb2	External brake resistor
	⏚	Connection for the PE conductor with M5 ring cable lug.

Terminal data

	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device sizes 1 + 2: flexible with wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 5.3	PZ0
Device size 3: flexible with/without wire end ferrule	10/16	6	1.2 ... 1.5	10.6 ... 13.3	PH1

Motor

Terminal X105 (right part)	Labelling	Description
	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		
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device sizes 1 + 2: flexible with wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 5.3	PZ0
Device size 3: flexible with/without wire end ferrule	10/16	6	1.2 ... 1.5	10.6 ... 13.3	PH1

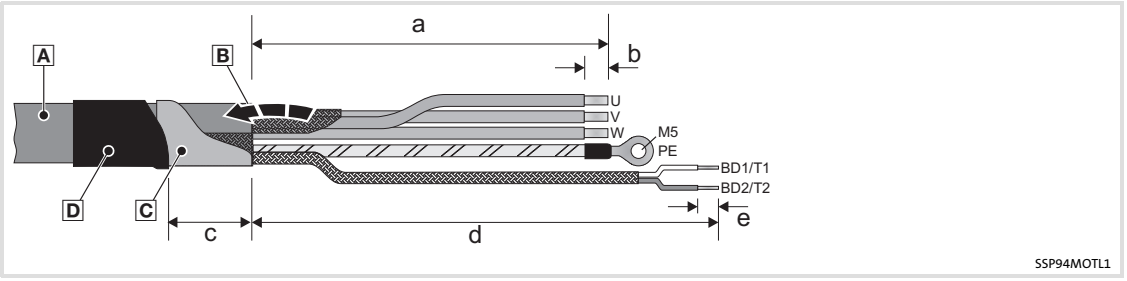
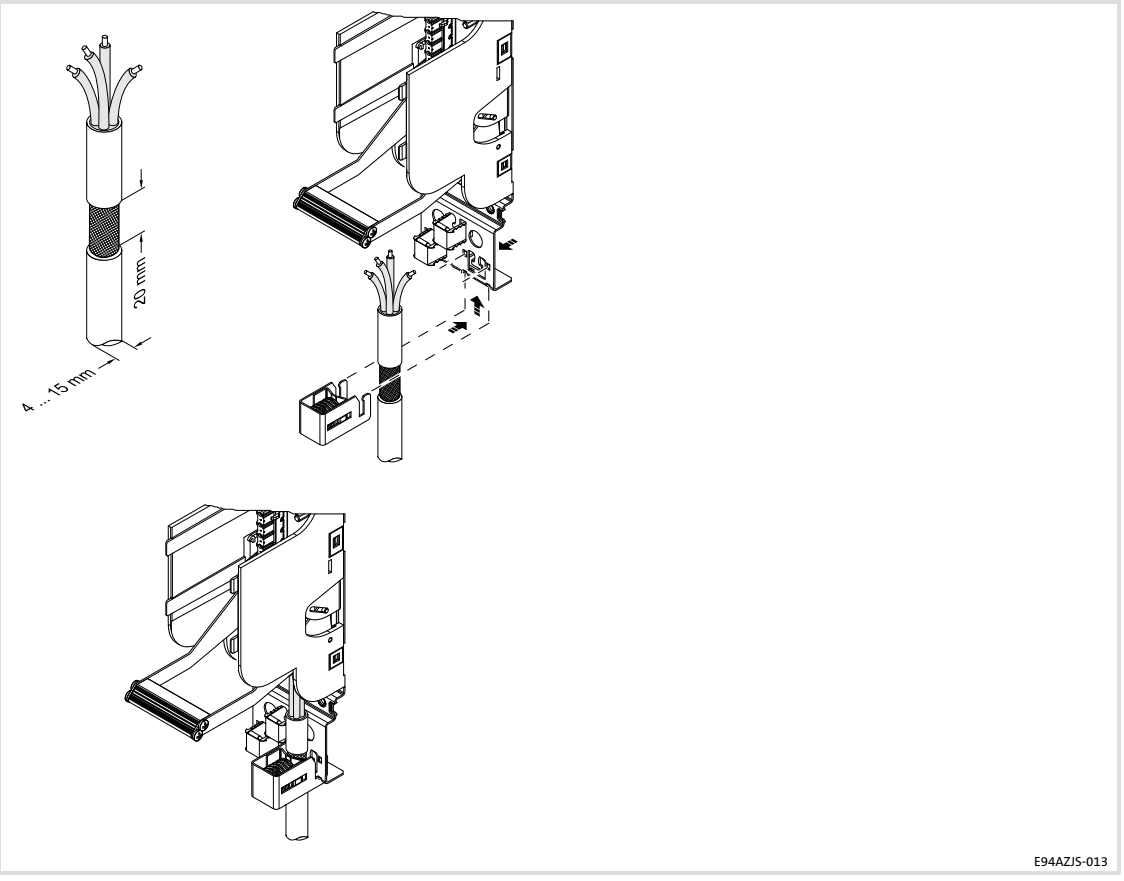


Fig. 3-22 Stripping lengths of the motor cable

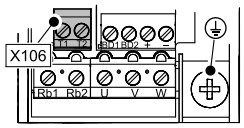
Type	Dimensions [mm]				
	a	b	c	d	e
Device size 1	80	8	25	150	8
Device size 2	90	8	30	160	8
Device size 3	100	10	30	170	8

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		
	[mm²]	[AWG]	[Nm]	[lb-in]	
Flexible With wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 5.3	PZ0

Motor brake control (optional)

Note!

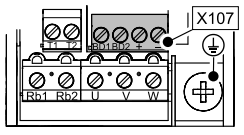
When the 24 V supply voltages (at X2) are applied and a motor holding brake is available, the devices respond as follows:

- ► Single Drive without mains or DC-bus voltage: The motor holding brake **cannot** be released.
- ► Multi Drive without DC-bus voltage: The motor holding brake can be released.

Tip!

For detailed information on the motor holding brake control modules, please see the chapter Accessories (📖 141).

For information on the E94AZHX0051 motor holding brake control module optionally contained in the installation backplane, please see the chapter Accessories starting on page 456.

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		
	[mm²]	[AWG]	[Nm]	[lb-in]	
Flexible With wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 5.3	PZ0

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 standard device must be observed!

Stop!

Requirements concerning 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 concerning 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.

Installation of the standard device

After the wiring of the installation backplane has been fully completed, install the standard device. Then continue with the wiring of the control terminals.

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.

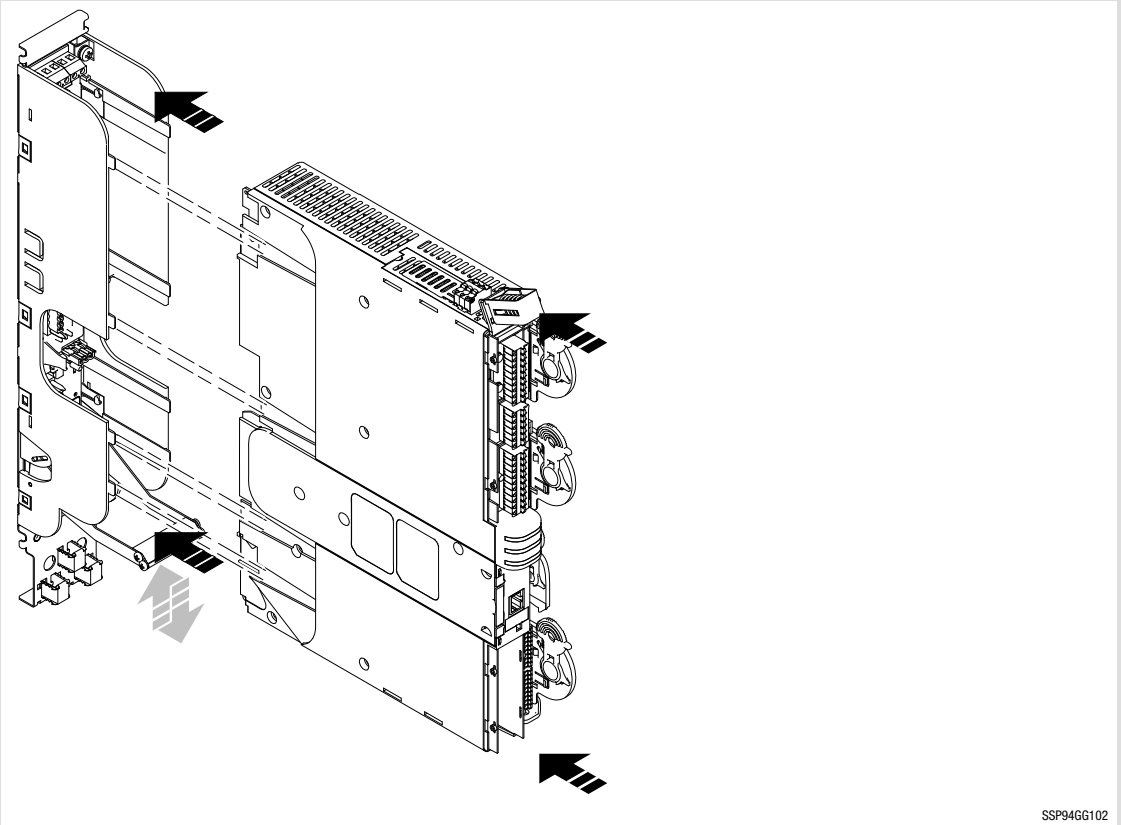


Fig. 3-23 Installation of the device

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.

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

Example circuit

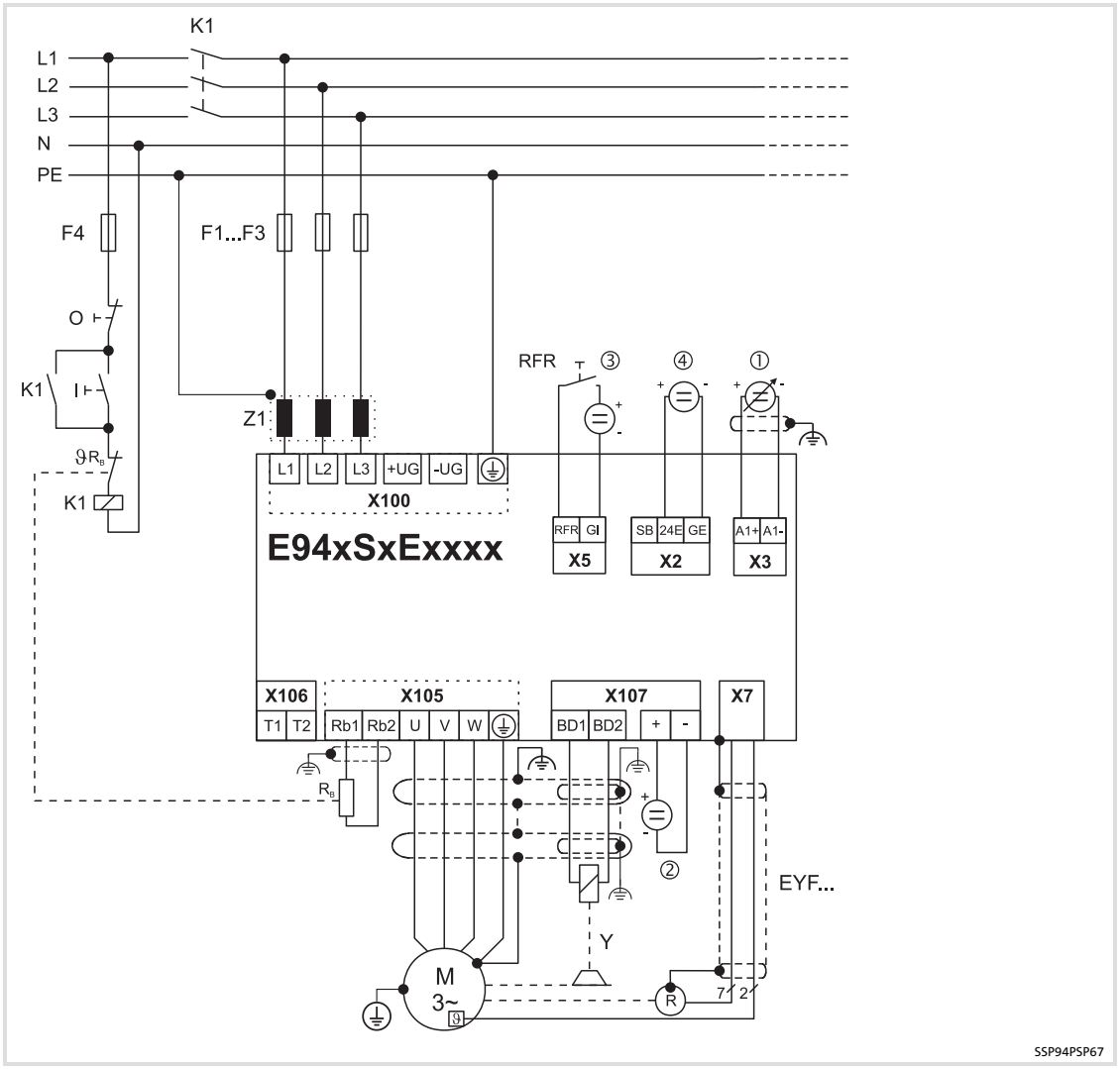


Fig. 3-24 Basic circuit diagram of the drive system

E94xSxExxxx	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).
- The cross-section of the PE conductor must be dimensioned according to the relevant national regulations.
- 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.

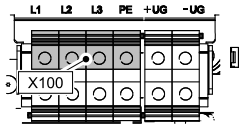
Use system cables or shielded cables for these connections:

- Motor
- Motor holding brake (shielding is required when being integrated into the motor cable; connection to optional motor brake control)
- Motor temperature monitoring
- External brake resistor (Mounting Instructions of the brake resistor)

The following connections need not be shielded:

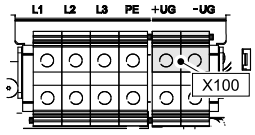
- Mains
- DC bus, cable length up to 0.3 m

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

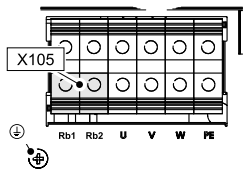
Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device size 6: Flexible With wire end ferrule	50	0	10	88.5	Hexagon socket 5
Device size 7: Flexible With wire end ferrule	95	000	14	124	Hexagon socket 5

DC bus

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

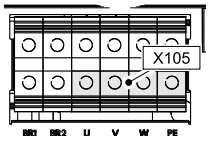
Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device size 6: Flexible With wire end ferrule	50	0	10	88.5	Hexagon socket 5
Device size 7: Flexible With wire end ferrule	95	000	14	124	Hexagon socket 5

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		
	[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		
	[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		
	[mm²]	[AWG]	[Nm]	[lb-in]	
flexible with wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 5.3	Slot 0.6 x 3.5

Motor brake control (optional)

Note!

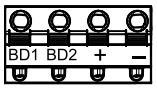
When the 24 V supply voltages (at X2) are applied and a motor holding brake is available, the devices respond as follows:

- ► Single Drive without mains or DC-bus voltage: The motor holding brake **cannot** be released.
- ► Multi Drive without DC-bus voltage: The motor holding brake can be released.

Tip!

For detailed information on the motor holding brake control modules, please see the chapter Accessories (📖 141).

For information on the E94AZHX0051 motor holding brake control module optionally contained in the installation backplane, please see the chapter Accessories starting on page 456.

Terminal X107	Labelling	Description
 SSP94X6107	BD1 BD2	Connection of the motor holding brake + (Lenze: WH) - (Lenze: BN) E94AZHx0101: 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		
	[mm²]	[AWG]	[Nm]	[lb-in]	
flexible with wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 5.3	Slot 0.6 x 3.5

Stripping length or contact length: 8 mm

3.7.6 Devices in the range 145 ... 245 A (75 ... 130 kW)

Example circuit

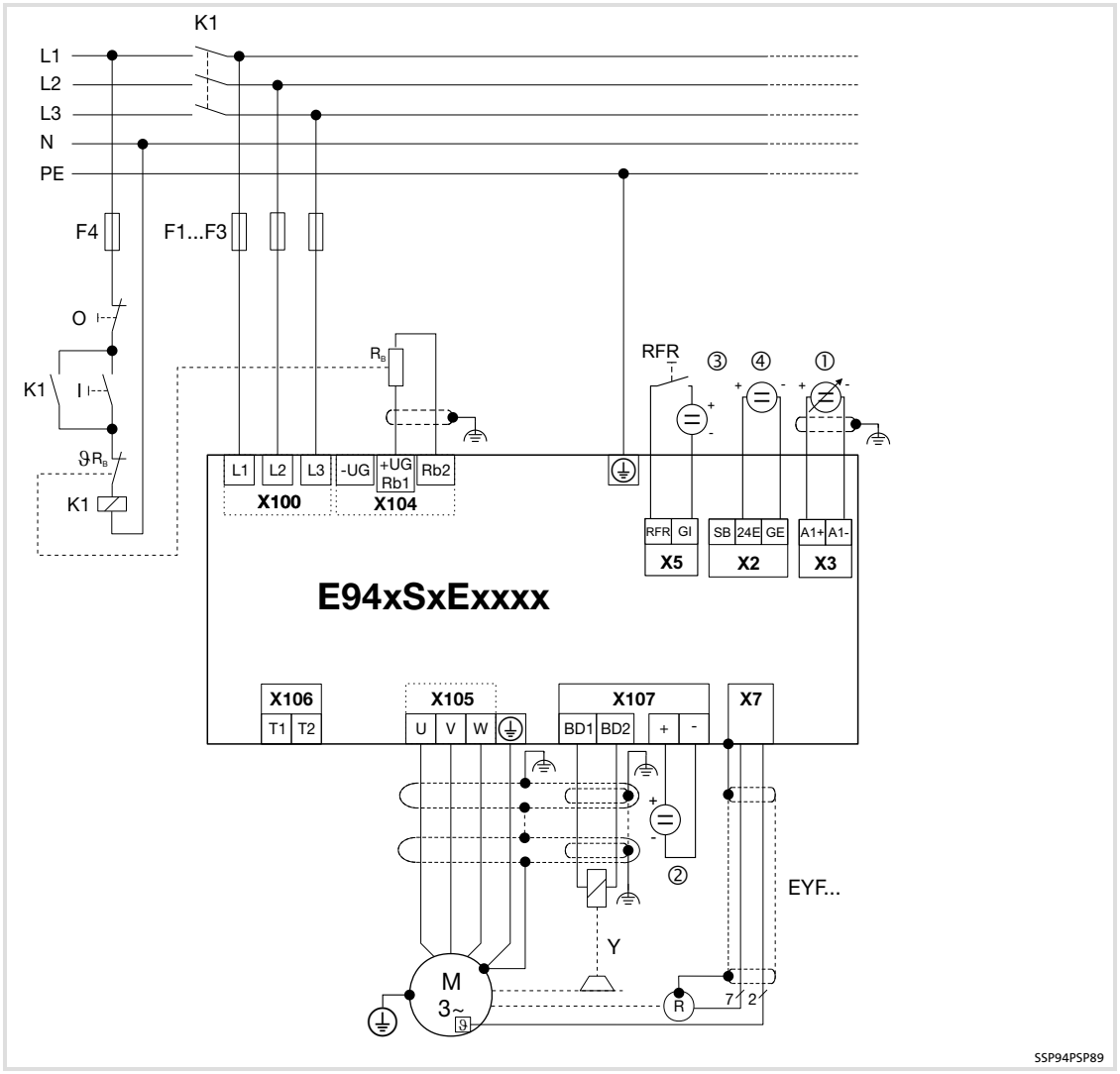


Fig. 3-25 Basic circuit diagram of the drive system

E94xSxExxxx	9400 Single Drive servo axis module
F1 ... F4	Fusing
⏚	HF-shield termination through large-surface connection to PE
EYF...	System cable for resolver feedback
RFR	Controller enable
K1	Mains contactor
R	Resolvers
RB	Brake resistor
Y	Motor holding brake
①	Speed setpoint selection via analog input 1 (-10 ... 0 ... +10 V)
②	Voltage source of the brake
③	24 V voltage source for the 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).
- The cross-section of the PE conductor must be dimensioned according to the relevant national regulations.
- 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 (shielding is required when being integrated into the motor cable; connection 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, cable length up to 0.3 m

Arrangement of the connections

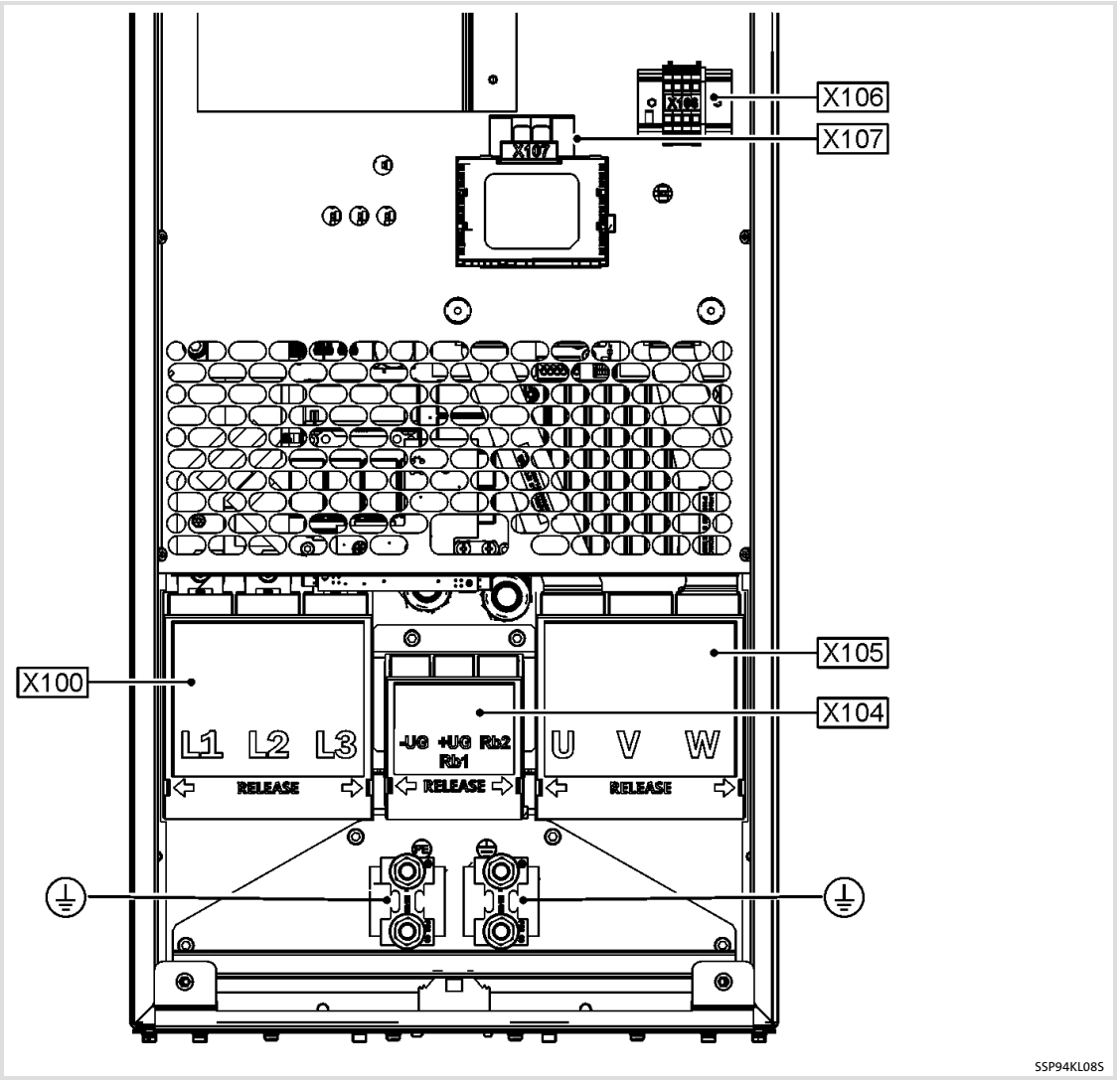
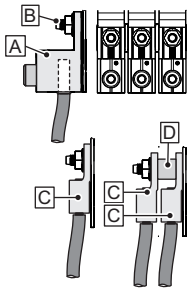


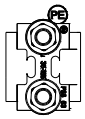
Fig. 3-26 Arrangement of the power connections

Mains

Terminal X100	Labelling	Description
 SSP94KLB	L1 L2 L3	Connection of the mains phases L1, L2, L3. A: Terminal (scope of supply); conductor connection with wire end ferrule B: Threaded bolt M10 (at the device) C: Ring cable lug for M10 (not included in the scope of supply) D: Sleeve (scope of supply) Wiring: **Standard:** With terminal A and wire end ferrule **Variant:** With ring cable lug C for threaded bolt M10 B (remove terminal A first). In case of a double assignment, use the sleeve D from the scope of supply.

Terminal data

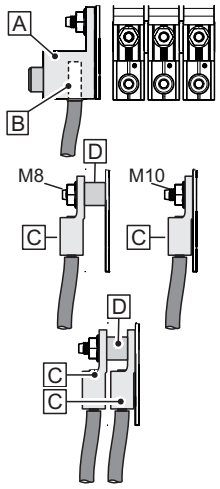
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
Terminal A					
Device size 81	150	300 mcm	42	375	Inbus 8
Device size 82	240	500 mcm	56	500	Inbus 10
Threaded bolt B	-	-	25	221	SW17

	Labelling	Description
 SSP94KL0X8	PE	Connection for the PE conductor on the supply side

Terminal data

	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
Terminal PE	70	2/0	10	88	SW13

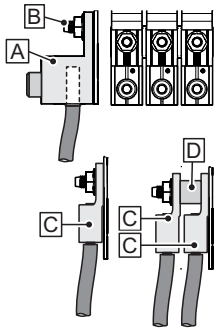
DC bus and external brake resistor

Terminal X104	Labelling	Description
	-UG +UG/Rb1 Rb2	Connection for DC-bus voltage and external brake resistor A: Terminal (scope of supply); conductor connection with wire end ferrule B: M8 threaded bolt (GG81)/M10 (GG82) C: Ring cable lug (not in the scope of supply) D: Sleeve (scope of supply) Wiring: **Standard:** With terminal Aand wire end ferrule **Variant 1: Single assignment**(First, removal terminal A) GG81: With M8 ring cable lug Cand sleeve D GG82: With M10 ring cable lug C(Sleeve Dnot necessary) **Variant 2: Double assignment**(First, remove terminal A) With two M10 ring cable lugs Cand sleeve D

Terminal data

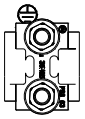
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
Terminal A	120	250 mcm	42	375	Inbus 8
Threaded bolt B	-	-	42	375	SW13

Motor

Terminal X105	Labelling	Description
 SSP94KLB	U V W	Connection of the motor phases U, V, W A: Terminal (scope of supply); conductor connection with wire end ferrule B: Threaded bolt M10 (at the device) C: Ring cable lug for M10 (not included in the scope of supply) D: Sleeve (scope of supply) Wiring: **Standard:** With terminal A and wire end ferrule **Variant:** With ring cable lug C for threaded bolt M10 B (remove terminal A first). In case of a double assignment, use the sleeve D from the scope of supply.

Terminal data

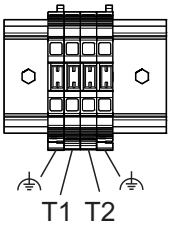
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
Terminal A					
Device size 81	150	300 mcm	42	375	Inbus 8
Device size 82	240	500 mcm	56	500	Inbus 10
Threaded bolt B	-	-	25	221	SW17

	Labelling	Description
 SSP94KL0X8	⏚	Connection for the PE conductor on the motor side with wire end ferrule

Terminal data

	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
Terminal PE	70	2/0	10	88	SW13

Motor temperature monitoring

Terminal X106	Labelling	Description
	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).
	⏚	Shield connection

Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
flexible with wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 5.3	Slot 0.6 x 3.5

Motor brake control (optional)

Note!

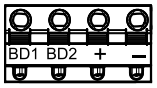
When the 24 V supply voltages (at X2) are applied and a motor holding brake is available, the devices respond as follows:

- ► Single Drive without mains or DC-bus voltage: The motor holding brake **cannot** be released.
- ► Multi Drive without DC-bus voltage: The motor holding brake can be released.

Tip!

For detailed information on the motor holding brake control modules, please see the chapter Accessories (📖 141).

For information on the E94AZHX0051 motor holding brake control module optionally contained in the installation backplane, please see the chapter Accessories starting on page 456.

Terminal X107	Labelling	Description
 SSP94X6107	BD1 BD2	Connection of the motor holding brake + (Lenze: WH) - (Lenze: BN) E94AZHx0101: 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		
	[mm²]	[AWG]	[Nm]	[lb-in]	
flexible with wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 5.3	Slot 0.6 x 3.5

Stripping length or contact length: 8 mm

3.7.7 Device 292 A (150 kW)

Arrangement of the connections

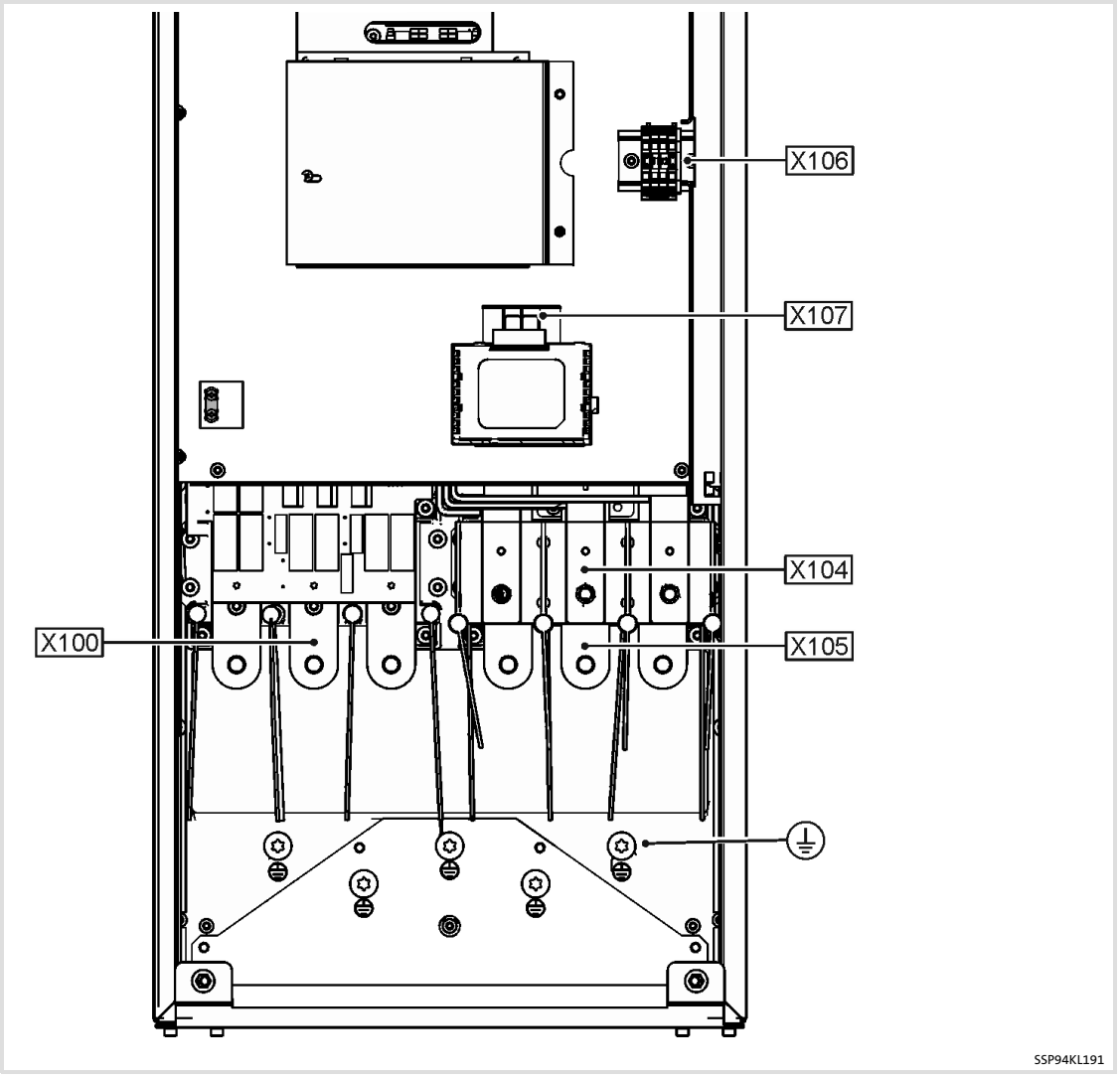
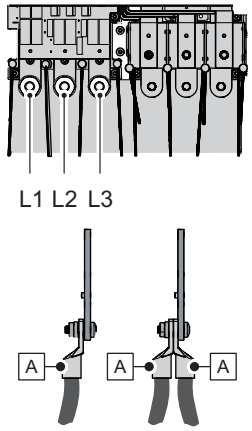


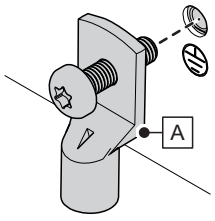
Fig. 3-27 Arrangement of the power connections

Mains

Terminal X100	Labelling	Description
	L1 L2 L3	Connection of phases L1, L2, L3 with ring cable lug for M10 (A).

Terminal data

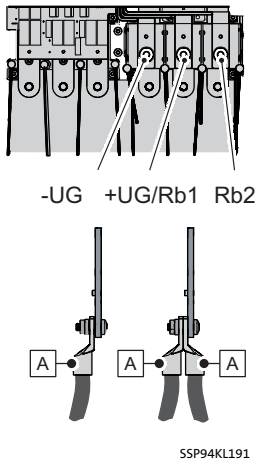
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
L1, L2, L3, flexible	240	500 mcm	47	416	SW17

	Labelling	Description
	⏚	Connection for protective conductor (PE) with ring cable lug for M8 (A).

Terminal data

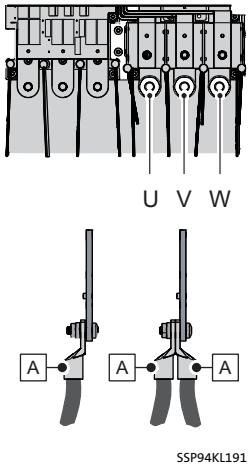
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
⏚	-	-	8	71	-

DC bus and external brake resistor

Terminal X104	Labelling	Description
	-UG +UG/Rb1 Rb2	Connection for DC-bus voltage and external brake resistor with ring cable lug for M8 (A).

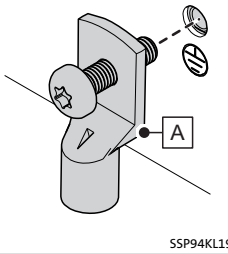
Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
flexible	185	350 mcm	24	212	SW13

Motor

Terminal X105	Labelling	Description
	U V W	Connection of phases U, V, W with ring cable lug for M10 (A).

Terminal data

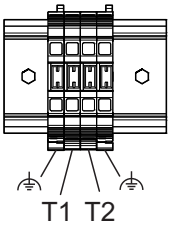
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
U, V, W, flexible	240	500 mcm	47	416	SW17

	Labelling	Description
	⏚	Connection for protective conductor (PE) with ring cable lug for M8 (A).

Terminal data

	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
⏚	-	-	8	71	-

Motor temperature monitoring

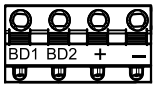
Terminal X106	Labelling	Description
 SSP94KL0X8	T1 T2	Motor temperature monitoring with PTC element (type-A sensor, switching performance according to EN 60947-8 for type-A tripping units) or thermostat (NC contact).
	⏚	Shield connection

Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
flexible with wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 5.3	Slot 0.6 x 3.5

Motor brake control (optional)

Note!

The motor holding brake **cannot** be released without mains or DC-bus voltage.

Terminal X107	Labelling	Description
 SSP94X6107	BD1 BD2	Connection of the motor holding brake + (Lenze: WH) - (Lenze: BN) E94AZHx0101: 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		
	[mm²]	[AWG]	[Nm]	[lb-in]	
flexible with wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 5.3	Slot 0.6 x 3.5

Stripping length or contact length: 8 mm

The motor brake control modules differ in the following features:

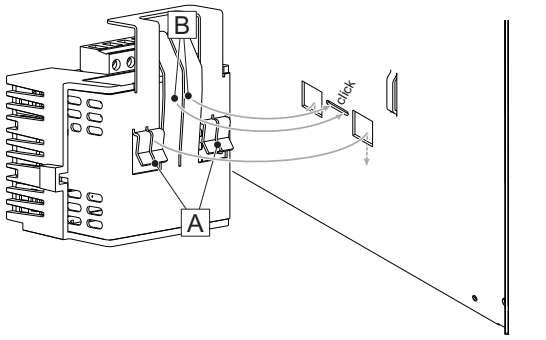
- Rated voltage
- Device size assignment
- Mounting type

The table shows the module/controller assignments according to the features listed.

Single-axis controllers		Rated voltage of motor holding brake (control module)		
Type		24 V	205 V	180 V
E94xSxE1454	GG81	E94AZHY0101 ② ③	E94AZHN0025 ④ ⑤	E94AZHN0026 ④ ⑤
...	...			
E94xSxE4604	GG91	E94AZHB0101 ② ④	E94AZHY0025 ② ③	E94AZHY0026 ② ③

Tab. 3-6 Motor holding brake/control module assignment

GGx	Device size
①	integrated in the installation backplane, already used or retrofittable
②	integrated in the device, already applied or retrofittable (recommended variant for the same rated voltage)
③	integrated control module (automatic brake operation can be activated)
④	external control (via digital output/digital input)
⑤	external mounting (DIN rail or mounting plate)



Mounting of motor brake control module

1. Insert motor brake control module with both clips [A] into the openings of the basic device and press downwards until the two detents [B] engage audibly.
2. Check that the motor brake control module is securely connected.

3.7.8 Devices in the range 366 ... 460 A (190 ... 240 kW)

Example circuit

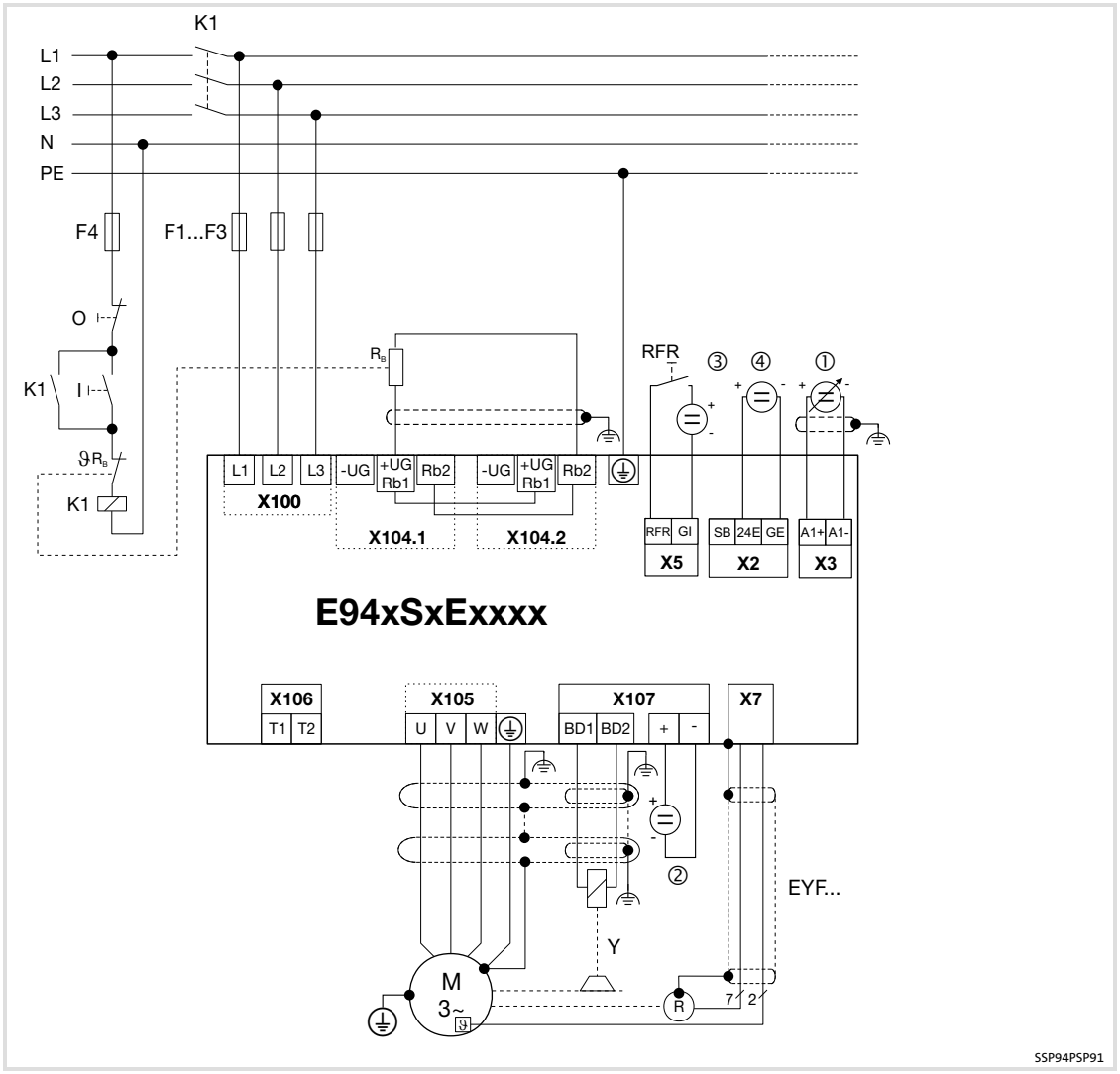


Fig. 3-28 Basic circuit diagram of the drive system

E94xSxExxxx	9400 Single Drive servo axis module
F1 ... F4	Fusing
⏚	HF-shield termination through large-surface connection to PE
EYF...	System cable for resolver feedback
RFR	Controller enable
K1	Mains contactor
R	Resolvers
RB	Brake resistor
Y	Motor holding brake
①	Speed setpoint selection via analog input 1 (-10 ... 0 ... +10 V)
②	Voltage source of the brake
③	24 V voltage source for the digital inputs according to IEC 61131-2
④	24 V voltage source for the control electronics

Note!

If you use the DC bus differently, please consult Lenze.

Design of the cables

- The cables used must comply with the approvals required for the location (e.g. UL).
- The cross-section of the PE conductor must be dimensioned according to the relevant national regulations.
- 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 (shielding is required when being integrated into the motor cable; connection 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, cable length up to 0.3 m

Arrangement of the connections

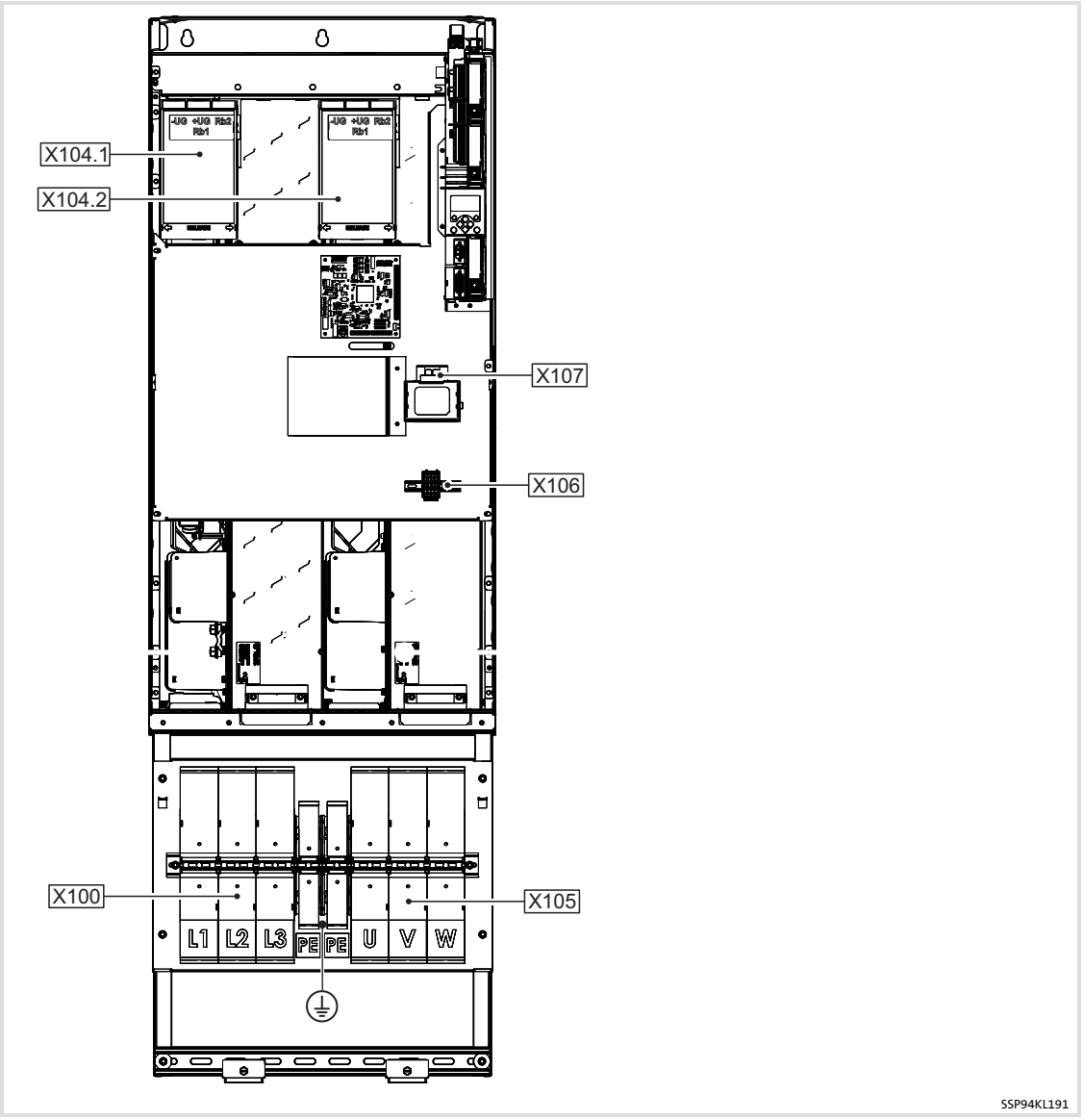
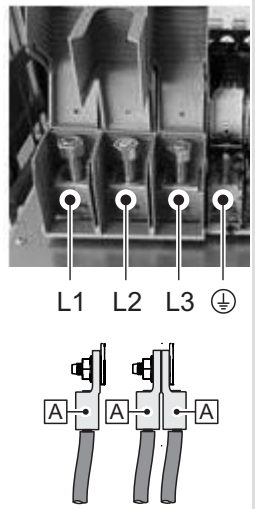


Fig. 3-29 Arrangement of the power connections

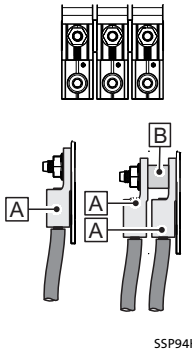
Mains

Terminal X100	Labelling	Description
	L1 L2 L3 ⏚	Connection of the phases L1, L2, L3 with ring cable lug for M16 (A). Connection for the PE conductor on the supply side with ring cable lug for M10 (A).

Note!
For mounting the cables, you need an extra large spanner socket.

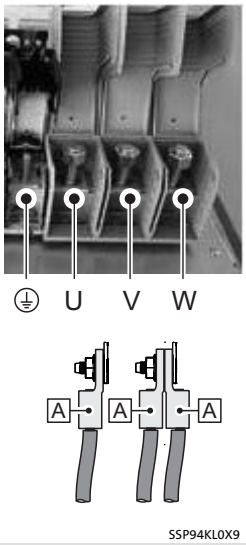
Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
U, V, W, flexible	300	600 mcm	35	315	SW24
⏚	150	300 mcm	20	180	SW17

DC bus and external brake resistor

Terminal X104.1/X104.2	Labelling	Description
	+UG/Rb1 -UG Rb2	Connection of DC-bus voltage and external brake resistor with ring cable lug M10 (A). In case of double assignment, use sleeve Bfrom the scope of supply.

Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
flexible	2 x 240	2 x 500 mcm	56	500	Inbus 10 or SW17

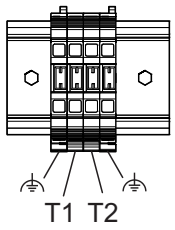
Motor

Terminal X105	Labelling	Description
	U V W ⏚	Connection of the phases U, V, W with ring cable lug for M16 (A). Connection for the PE conductor on the motor side with ring cable lug for M10 (A).

Note!
For mounting the cables, you need an extra large spanner socket.

Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
U, V, W, flexible	300	600 mcm	35	315	SW24
⏚	150	300 mcm	20	180	SW17

Motor temperature monitoring

Terminal X106	Labelling	Description
	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).
	⏚	Shield connection

Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
flexible with wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 5.3	Slot 0.6 x 3.5

Motor brake control (optional)

Note!

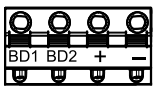
When the 24 V supply voltages (at X2) are applied and a motor holding brake is available, the devices respond as follows:

- ► Single Drive without mains or DC-bus voltage: The motor holding brake **cannot** be released.
- ► Multi Drive without DC-bus voltage: The motor holding brake can be released.

Tip!

For detailed information on the motor holding brake control modules, please see the chapter Accessories (📖 141).

For information on the E94AZHX0051 motor holding brake control module optionally contained in the installation backplane, please see the chapter Accessories starting on page 456.

Terminal X107	Labelling	Description
 SSP94X6107	BD1 BD2	Connection of the motor holding brake + (Lenze: WH) - (Lenze: BN) E94AZHx0101: 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		
	[mm²]	[AWG]	[Nm]	[lb-in]	
flexible with wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 5.3	Slot 0.6 x 3.5

Stripping length or contact length: 8 mm

3.8 Control terminals



Danger!

Hazardous electrical voltage

All power connections carry a hazardous electrical voltage for a longer time after mains disconnection. Observe the information regarding the discharge time on the device.

Possible consequences:

► Death or severe injuries when touching the power terminals.

Protective measures:

► Before working on the power connections, wait at least until the discharge time has passed (depending on the device, this may be up to 20 minutes).

► Make sure that all power terminals are deenergised.



Stop!

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

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



Note!

Installation inside the control cabinet

► Always install cables close to the mounting plate (reference potential), as freely suspended cables act like antennas.

► Use separated cable ducts for motor cables and control cables. Do not mix up different cable types in one cable duct.

► Before leaving the control cabinet, connect the shield of the fieldbus cable to the mounting plate in accordance with EMC requirements.



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.

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)

System bus CAN on board

The drive controller has an integrated CANopen system bus interface for the exchange of process data and parameter values between different nodes and for the connection of additional modules such as distributed terminals, operator and input devices (”HMIs”) as well as external control units. The software manual contains additional information in this regard.

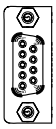
Overview of general data and conditions of use	
Field	**Values**
Communication profile	CANopen (DS301, V4.02)
Communication medium	CAN cable in accordance with ISO 11898-2
Network topology	Line closed at both ends (e.g. closed with Lenze system connector EWZ0046)
Node addresses that can be set	1 ... 127 (can be set by means of DIP switch or code)
Max. number of nodes	127
Transfer rates [kBit/s]	10 ... 1000 (can be set by means of DIP switch or code)
Conformity, approvals	• CE • UL

The transfer rate limits the overall cable length.

Transfer rate [kBit]	Maximum bus length [m]
10	8075
20	4012
50	1575
125	600
250	275
500	112
800	38
1000	12

The segment cable length is limited by the cable cross-section used and the number of nodes. Repeaters divide the overall cable length into segments. Without repeaters, the segment cable length is the same as the overall cable length.

Max. number of nodes per segment	**Segment length [m] in relation to cable cross-section** (Interpolation is permissible)			
	0.25 mm² (AWG 24)	0.50 mm² (AWG 21)	0.75 mm² (AWG 19)	1.00 mm² (AWG 18)
2	240	430	650	940
5	230	420	640	920
10	230	410	620	900
20	210	390	580	850
32	200	360	550	800
63	170	310	470	690
100	150	270	410	600

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

24 V supply

The supply voltage for the control electronics should be fed by a mains-independent 24 V source. Thus, the control functions remain active even after power is removed.
As an option, the controller can generate the supply voltage for the control electronics from the DC-bus voltage. Then, the control functions will not be active when power is removed.

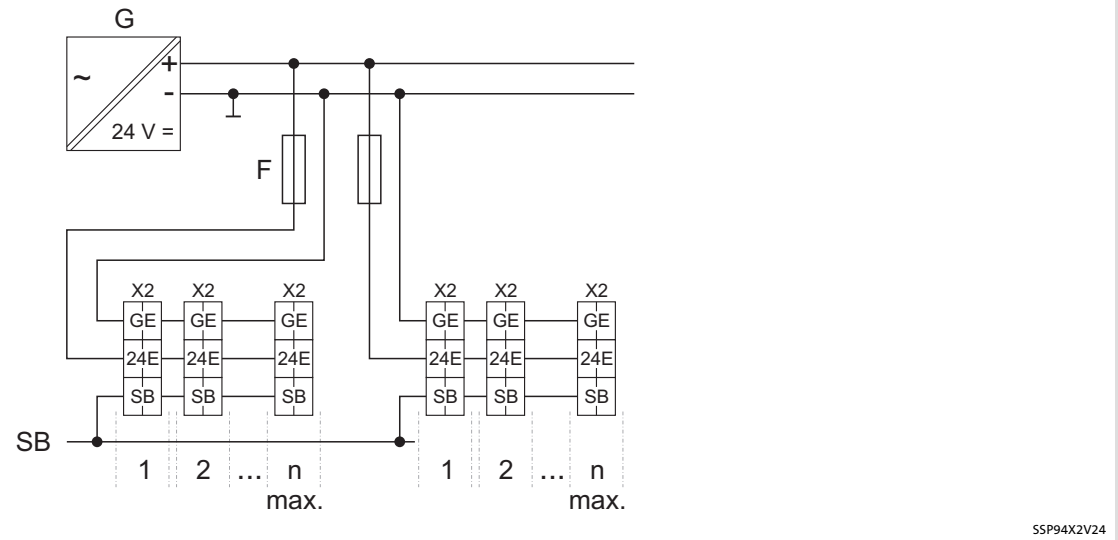


Fig. 3-30 Wiring principle

g	24 V external supply (e.g. EZV...)
F	Fuse
X2	Terminal for 24 V and state bus
GE/24E/SB	Labelling on the terminal
SB	State bus
1 ... n	E94x... 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				

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 mm² Fusing: 16/15 A
		Max. 8 devices with 1.5 mm² Fusing: 10/10 A
	Connectable cross-cuttings	See terminal data

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
	Switching level	According to IEC 61131-2
	LOW	0 V ... +5 V
	HIGH	+15 V ... +30 V
	Looping through	Max. 20 devices DC-bus operation with 9300 devices is possible.
	Connectable cross-cuttings	See terminal data

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 ... +10 V
	Resolution:	11 bits + sign
	Scaling:	±10 V ≡ $\pm 2^{30}$
	Conversion rate:	1 kHz
Analog input 1 as current input (A1R and A1- bridged)	Level:	-20 ... +20 mA
	Resolution:	10 bits + sign
	Scaling:	For C00034 = ”1” -20 ... -4 mA ≡-2^{30} ... 0 +4 ... +20 mA ≡0 ... $+2^{30}$
		For C00034 = ”2” ±20 mA ≡ $\pm 2^{30}$
	Conversion rate:	1 kHz
	Open-circuit monitoring:	Configurable
Analog output 1 Analog output 2	Level:	-10 ... +10 V (max. 2 mA)
	Resolution:	11 bits + sign
	Scaling:	±10 V ≡ $\pm 2^{30}$
	Conversion rate:	1 kHz

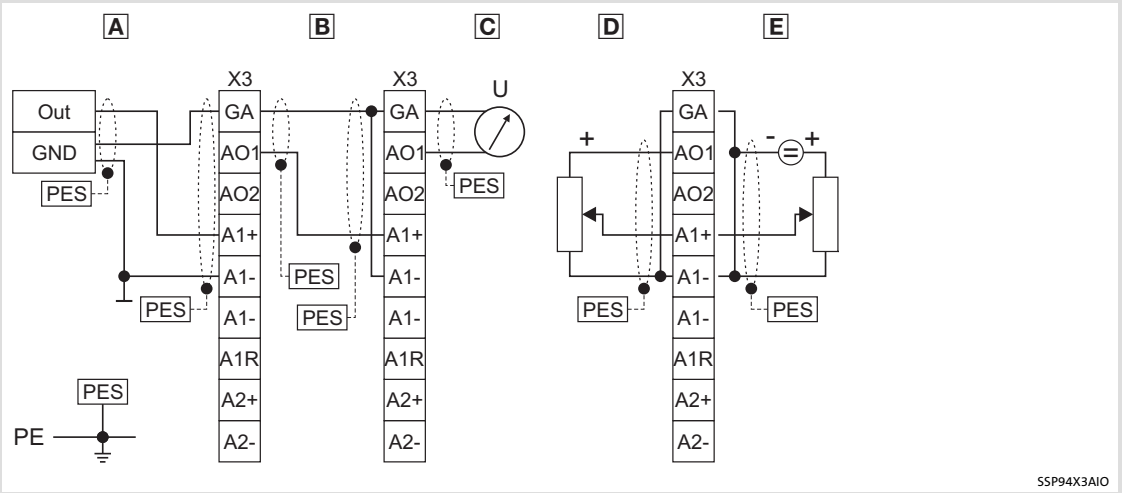


Fig. 3-31 Wiring principle

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

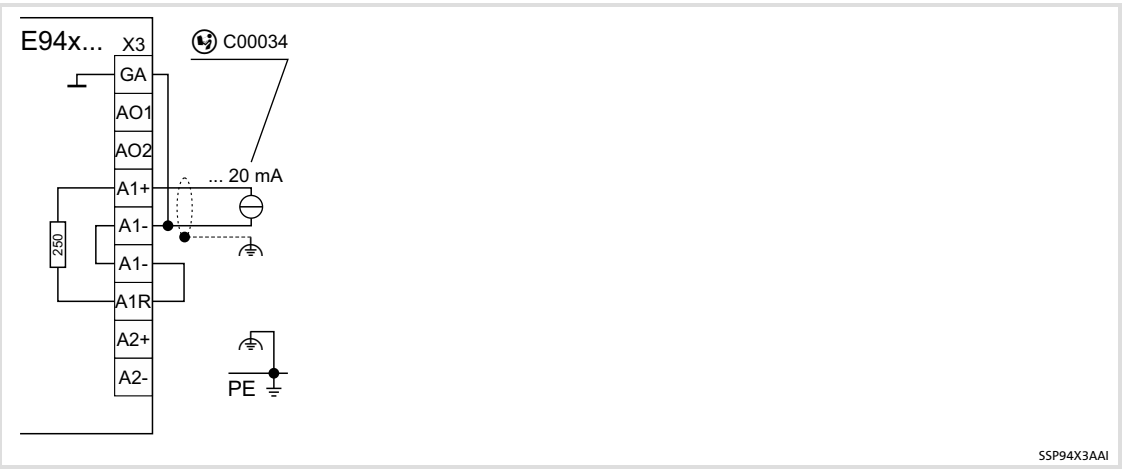
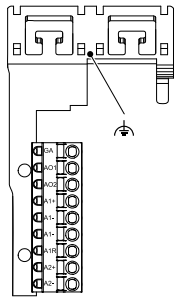


Fig. 3-32 Wiring principle of current input

F Wiring of a current signal
X3 Terminal for the analog inputs and outputs
Read information on the input configuration (software manual)
Functional earth
PE Protective earth

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.

Digital outputs

The controller features four freely configurable digital outputs.

Electrical data			
24O GO	24 V external voltage source, optional		according to IEC 61131-2 SELV/PELV
	Current consumption		Max. 300 mA
DO1 ... DO4 GO	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.

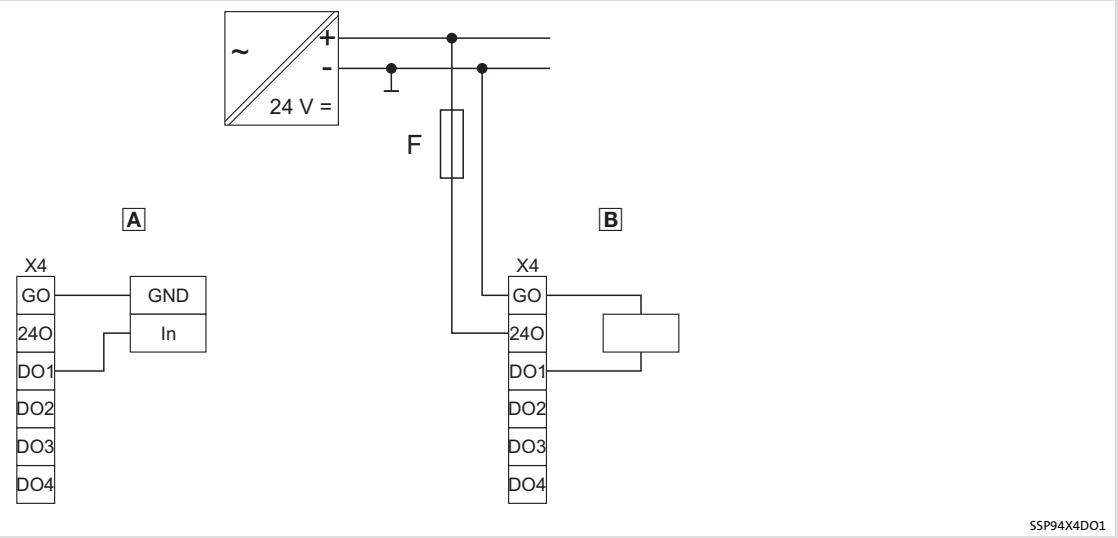


Fig. 3-33 Wiring principle

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

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				

Digital inputs

The controller is provided with freely configurable digital inputs which can be used for touch probe measurement (edge-controlled event).

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.

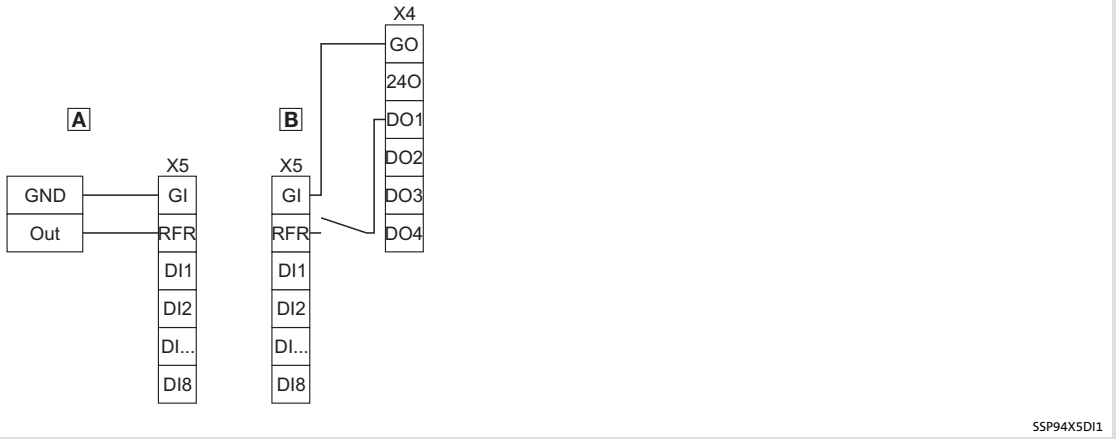


Fig. 3-34 Wiring principle

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

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				

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 (100 m [1])
V_{CC}, -KTY (GND)	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

[1] If safety functions with SM301 are used which require safe speed and position detection.

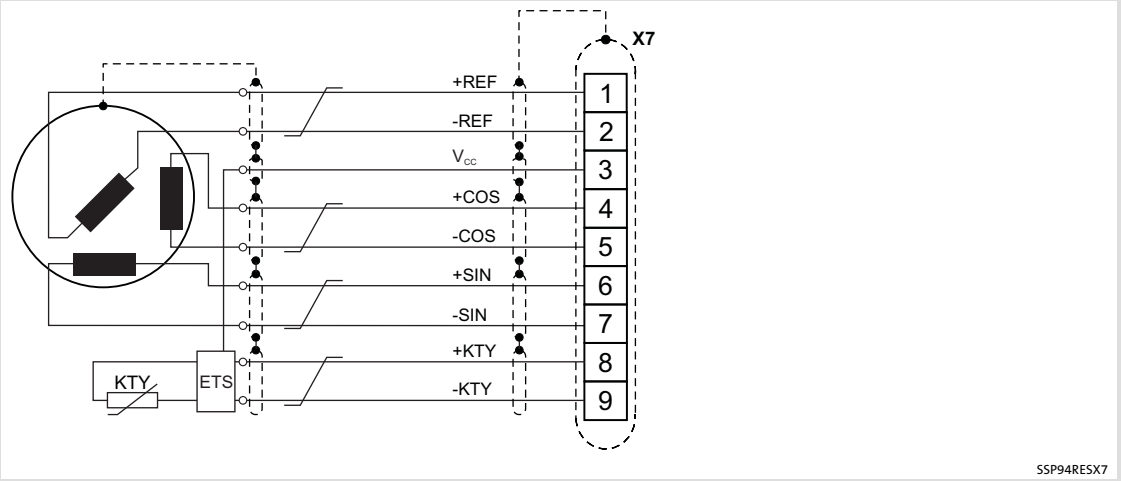
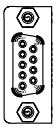


Fig. 3-35 Wiring principle

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)
  - SSI load encoder with Stegmann protocol (as of 9400 with firmware 05.00)
- 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
  - not with SSI encoders
- The following encoders are not supported:
  - HTL encoders

Electrical data			
General	Cable length (system cable recommended)		max. 150 m (100 m [1])
	Encoder types		TTL 1 V_{SS}
	Protocols		Hiperface EnDat 2.1 SSI-Stegmann
	Number of increments		1 ... 16384
	Input frequency		max. 500 kHz
VCC (GND)	Supply voltage		5 V ... 12 V
	Max. load capacity,	5 ... 9 V	330 mA
		9 ... 12 V	3 W
		at 12 V	250 mA
+Sense, -Sense	Measuring lead for readjusting V_{CC}		
+KTY, -KTY	Type		KTY 83-110

[1] If safety functions with SM301 are used which require safe speed and position detection.

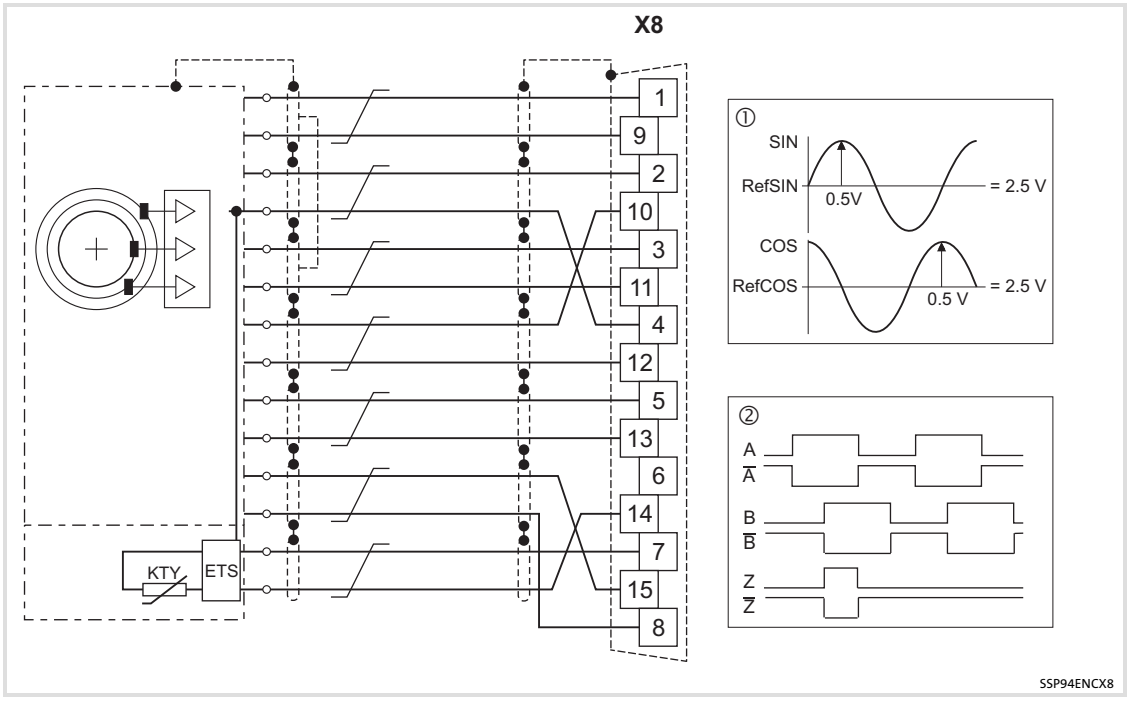
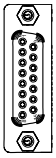


Fig. 3-36 Wiring principle

① Signals of a sin/cos encoder
② Signals with CW rotation

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

Setting the supply voltage

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

The voltage is adapted by means of the parameter ”Encoder voltage”, C00421.

Encoder	U_r	Voltage setting [V] in C00421 for cable length [m]						
Product key	[V]	0 - 10	10 - 30	30 - 50	50 - 70	70 - 90	90 - 100	100 -150
TTL								
IG2048-5V-T	5 ±5%	5.0	5.0	5.1	5.1	5.2	5.2	5.3
IG4096-5V-T								
IK2048-5V-T								
Sin-cos								
IG1024-5V-V	5 ±5%	5.0	5.0	5.1	5.1	5.2	5.2	5.3
IG2048-5V-S								
Sin-cos (Hiperface)								
AM1024-8V-H	8 (7 ... 12)	8.0						
Sin-cos (Endat)								
AM32-5V-E	5 ±5%	5.0						
AS2048-5V-E								
AM2048-5V-E								

Tab. 3-7

U_r Rated encoder voltage

The values listed in Tab. 3-7 are valid for the use of Lenze system cables at typical ambient temperatures.

Other cables, other cable cross-sections or extreme ambient temperatures can require metrologically determined adaptations.

For a higher encoder supply power, e.g. for laser-based length measuring systems, an external encoder supply must be provided.

3.9 Device modules

Depending on the device version or the application, the device is equipped with device modules. A nameplate attached to the side of the device serves to identify the already equipped device modules .

The possible modules are briefly described in the Accessories chapter. Detailed information can be found in the respective documentation.

3.10 Preparing the commissioning procedure

You need the following for commissioning:

- Keypad EZAEBK0001

or

- Computer with Windows® operating system (XP or 2000)
- Lenze PC software »Engineer«
- Connection with the controller via an interface, e.g.
  – Diagnostic interface X6 with USB diagnostic adapter
  – System bus (CANopen)
  – Communication module
- Software manual for the technology application used
- The communication manual for the network of the automation platform
- Mains voltage or 24-V voltage supply for the control electronics of the controller

Follow the instructions of the software and/or read the documentation.

4 Multi-axis controllers

4.1 Device features

- Three options of direct supply of the DC-bus voltage:
  - Power supply module or ”Single Drive” axis module via the integrated DC-link busbar (DC-bus)
  - DC input point via the integrated DC-link busbar (DC-bus)
  - Via terminals +UG and -UG
- Space-saving installation by compact design
- Innovative installation concept
- Power range: 370 W to 30 kW
- Pluggable and same connection system for the control cables in the entire power range
- Integrated DC busbar and DC fuse
- 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 system
- System bus (CANopen)
  - servo inverter connection
  - for extending input and output terminals
  - connecting keypad and display units (HMI)
- Emergency operation with reduced mains voltage possible
  - Control of motor holding brake possible

4.2 Overview of the devices

Note!

For reasons of clarity, device types in this manual are placed together in groups with shared device characteristics. For example:

- ”Devices in the range 2 ... 24 A (0.37 ... 11 kW)” (often from project planner’s viewpoint) or
- ”Device sizes 1, 2 and 3” (often from installation point of view)

The following table gives you an overview of the different device characteristics:

Type	Rated current (rounded)	Motor power (typ.)	Device size (DS)
E94xMxE0024 E94xMxE0034 E94xMxE0044	2 A 3 A 4 A	0.37 kW 0.75 kW 1.5 kW	1
E94xMxE0074 E94xMxE0094	7 A 9 A	3.0 kW 4.0 kW	2
E94xMxE0134 E94xMxE0174 E94xMxE0244 E94xMxE0324	13 A 17 A 24 A 32 A	5.5 kW 7.5 kW 11 kW 15 kW	3
E94xMxE0474 E94xMxE0594	47 A 59 A	22 kW 30 kW	6

4.3 General data and operating conditions

General data

Conformity and approval			
Conformity			
CE	2014/35/EU	Low-Voltage Directive	
CE	2014/30/EU	EMC Directive	
UKCA	S.I. 2016/1101	The Electrical Equipment (Safety) Regulations 2016	
UKCA	S.I. 2016/1091	The Electromagnetic Compatibility Regulations 2016	
Approval			
$_{c}UL_{US}$	UL61800-5-1	Industrial Control Equipment (File No. E132659) for USA	
	CSA C22.2 No. 274-13	Industrial Control Equipment (File No. E132659) for Canada	

Protection of persons and device protection			
Type of protection	EN 60529	IP 20	Outside the wire range of the terminals on the motor side
	NEMA 250	Protection against accidental contact in accordance with type 1	
Insulation resistance	EN 61800-5-1	Overvoltage category III from 2000 m amsl: external measures for compliance with the overvoltage category II are required, e.g. ● upstream connection of transformer ● upstream connection of overvoltage protection system	
Control circuit isolation	EN 61800-5-1	up to 2000 m amsl: Safe mains isolation by double/reinforced insulation for mains with neutral earthing with a rated voltage for the external conductor/star point up to 300 V. from 2000 m amsl: If an overvoltage protection system is connected upstream to the device instead of an isolating transformer, additional external measures are required for maintaining the safe isolation.	
Short-circuit strength	EN 61800-5-1	Motor connection: with restrictions, error acknowledgement required Control terminals: full	
Motor - protective measures against		● Short circuit ● Earth fault ● Overvoltage ● motor stalling ● Motor overtemperature (PTC or thermal contact, I^2t monitoring)	
Leakage 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
Clearance		
above/beneath		Comply with the device-relating mounting instructions.
at the side		Can be installed in a row without any clearance

Supply conditions ”Single Drive”		
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 allowed without restrictions.
TN		
IT		Additional device-internal measure required (see (”Earthing of internal EMC filters”, 📖 207)
Motors	EN 60034	Only use motors that are suitable for inverter operation. Insulation strength: max. $\hat{u} \geq 1.5$ kV, max. $du/dt \geq 5$ 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 from +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	Degree of pollution 2
Vibration resistance (9.81 m/s² = 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/s²
		200 ... 500 Hz: acceleration resistant up to 15 m/s²
Operation	Germanischer Lloyd	5 ... 13.2 Hz: Amplitude ±1 mm 13.2 ... 100 Hz: acceleration resistant up to 0.7 g
	IEC/EN 60068-2-6	10 ... 57 Hz: Amplitude 0.075 mm
		57 ... 150 Hz: Acceleration resistant up to 1 g

General electrical data

Assignment		Device size	Accessories: busbar mounting set/spare fuse
Axis module	Installation backplane		
E94xMxE0024 E94xMxE0034 E94xMxE0044	E94AZPM0044	1	- / 16 A, 700 V DC, EFSAR0016ARHN
E94xMxE0074 E94xMxE0094	E94AZPM0094	2	- / 40 A, 700 V DC, EFSAR0040ARHN
E94xMxE0134 E94xMxE0174 E94xMxE0244	E94AZPM0244	3	- / 100 A, 700 V DC, EFSAR0100ARZN
E94xMxE0324	E94AZPM0324		

Requirements on the motor cable		
Capacitance per unit length		
≤ 2.5 mm²/AWG 14		$C_{Core/core}/C_{Core/shield}$ < 75/150 pF/m
≥ 4 mm²/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 external - conductor/PE, U = r.m.s. value - external conductor/external conductor)
	UL	U ≥ 600 V (U = r.m.s. value external conductor/external conductor)

Maximum motor and feedback cable lengths (for shielded motor cable with rated mains voltage)		
Type	Device size	[m]
E94xMxE0024 E94xMxE0034 E94xMxE0044	1	50
E94xMxE0074 E94xMxE0094	2	100
E94xMxE0134 E94xMxE0174 E94xMxE0244 E94xMxE0324	3	100
E94xMxE0474 E94xMxE0594	6	100
If EMC conditions must be met, the permissible cable lengths can be reduced.		

Tab. 4-1

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. 3-2 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 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!

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.

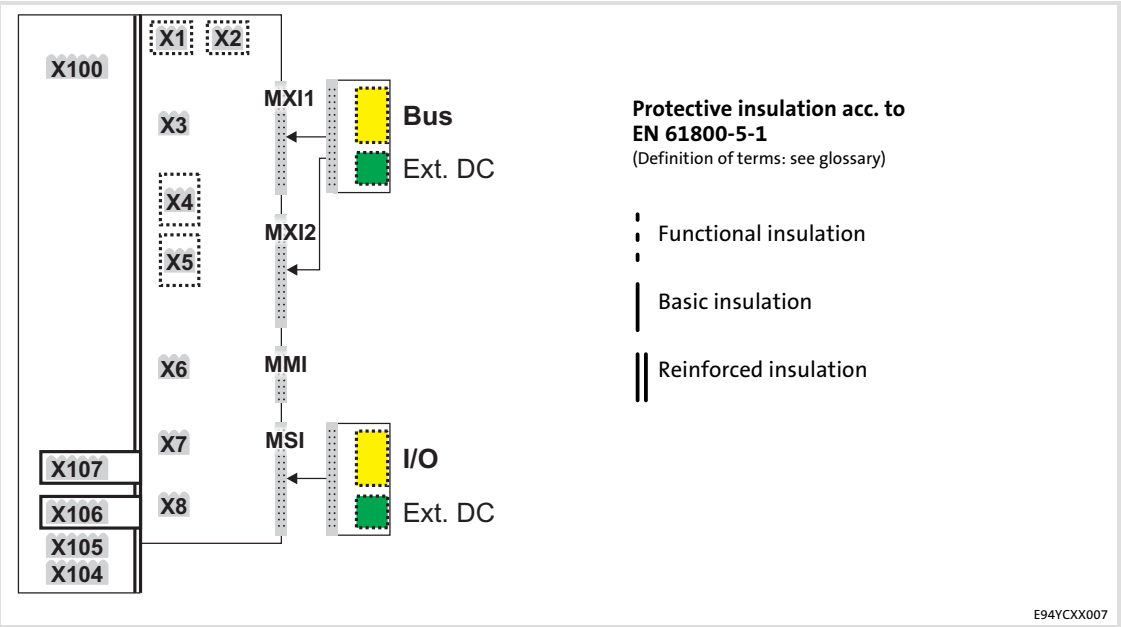
Protective measures:

► Use independent voltage sources.

The available protective insulation within the controller of the " 9400 Servo Drives" series in accordance with EN 61800-5-1 is implemented with a rated voltage for the external conductor/star point of up to 300 V for mains with neutral earthing.

The following graphic representation

- ► shows the arrangement of the terminal strips and the separate potential areas of the controller.
- ► serves to determine the relevant protective insulation between two terminals in differently insulated separate potential areas.



Terminal strip	Connection Device size 1 ... 6
X100	+UG, -UG
X104	not available
X105	U, V, W
X106	Motor PTC
X107	Control of motor holding brake

Terminal strip	Connection
X1	CAN on board 9400
X2	• State bus • 24 V (ext.)
X3	Analog input/output
X4	Digital outputs
X5	Digital inputs
X6	Diagnostics
X7	Resolvers
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.

4.4 Rated data

The E94x**M**xExxx**4** devices can be used in the voltage range of 260 ... 746 V DC.

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

Emergency operation

Operation of the E94xMxxxx4 devices with an emergency voltage supply at +UG, -UG, is possible with $V_{DC} \leq 260$ V. The settings in C00173 and C00174 are to be adapted accordingly. A 24-V supply at X2 is required.

4.4.1 Overview

Input data

	Voltage	Frequency	Rated current [A]		Number of phases
	[V]	[Hz]	up to +45 °C ①	up to +55 °C ①	
E94xMxE0024	325/565/675	0 (DC)	2.6/2.6/2.3	2.0/2.0/1.7	-
E94xMxE0034	325/565/675	0 (DC)	4.3/4.3/3.8	3.2/3.2/2.9	-
E94xMxE0044	325/565/675	0 (DC)	6.7/6.7/5.9	5.0/5.0/4.4	-
E94xMxE0074	325/565/675	0 (DC)	12.1/12.1/10.6	9.1/9.1/8.0	-
E94xMxE0094	325/565/675	0 (DC)	15.4/15.4/13.5	11.6/11.6/10.1	-
E94xMxE0134	325/565/675	0 (DC)	20.6/20.6/18.0	15.5/15.5/13.5	-
E94xMxE0174	325/565/675	0 (DC)	25.7/25.7/22.5	19.3/19.3/16.9	-
E94xMxE0244	325/565/675	0 (DC)	35.5/35.5/31.1	26.3/26.3/23.3	-
E94xMxE0324	325/565/675	0 (DC)	48.0/48.0/38.9	36.0/36.0/29.1	-
E94xMxE0474	325/565/675	0 (DC)	71.0/71.0/62.0	53.3/53.3/46.5	-
E94xMxE0594	325/565/675	0 (DC)	89.0/89.0/77.0	66.8/66.8/57.8	-

① Temperature in the control cabinet

Output data

	Voltage	Current [A]		Number of phases
Type	[V]	up to +45 °C ①	up to +55 °C ①	
E94xMxE0024	0 - 230/400/480	1.5/1.5/1.3	1.1/1.1/1.0	3
E94xMxE0034	0 - 230/400/480	2.5/2.5/2.2	1.9/1.9/1.7	3
E94xMxE0044	0 - 230/400/480	4/4/3.5	3/3/2.6	3
E94xMxE0074	0 - 230/400/480	7/7/6.1	5.3/5.3/4.6	3
E94xMxE0094	0 - 230/400/480	9.3/9.3/8.2	7.0/7.0/6.2	3
E94xMxE0134	0 - 230/400/480	13/13/11.4	9.8/9.8/8.6	3
E94xMxE0174	0 - 230/400/480	16.5/16.5/14.4	12.4/12.4/10.8	3
E94xMxE0244	0 - 230/400/480	23.5/23.5/20.6	17.6/17.6/15.5	3
E94xMxE0324	0 - 230/400/480	32.0/32.0/25.9	24.0/24.0/19.4	3
E94xMxE0474	0 - 230/400/480	47.0/47.0/42.0	35.3/35.3/30.8	3
E94xMxE0594	0 - 230/400/480	59.0/59.0/52.0	44.3/44.3/38.7	3

① Temperature in the control cabinet

Power losses

	Power loss P_V [W] at a switching frequency of 4 kHz			
Type	U_{Lr} = 230 V	U_{Lr} = 400 V	U_{LN} = 480 V	when controller is inhibited
E94xMxE0024	65	80	95	40
E94xMxE0034	75	95	110	
E94xMxE0044	90	120	135	
E94xMxE0074	105	145	165	
E94xMxE0094	130	170	200	
E94xMxE0134	160	215	245	
E94xMxE0174	185	255	290	
E94xMxE0244	235	320	375	
E94xMxE0324	290	405	470	
E94xMxE0474	960	960	960	75
E94xMxE0594	980	980	980	

4.4.2 Operation in 230-V-AC system

Mains	Voltage U_{DC} [V]	Voltage range U_{DC} [V]	Frequency range f [Hz]
2/PE DC	325	260 - 0 % ... 370 + 0 %	-

	Input current at I_{aN8} (without external mains choke)	Output power U, V, W	Motor power (typical) 4-pole ASM	
Type	I_{DC} [A]	S_{aN} [kVA]	P_{aN} [kW]	P_{aN} [hp]
E94xMxE0024	2.6	0.5	0.18	0.25
E94xMxE0034	4.3	0.9	0.37	0.5
E94xMxE0044	6.7	1.4	0.75	1
E94xMxE0074	12.1	2.5	1.5	2
E94xMxE0094	15.4	3.3	2.2	3
E94xMxE0134	20.6	4.7	3	4
E94xMxE0174	25.7	5.9	4	5.5
E94xMxE0244	35.5	8.4	5	7.5
E94xMxE0324	48.0	11.5	7.5	10.2
E94xMxE0474	71.0	16.9	11	15
E94xMxE0594	89.0	21.2	15	20

	Output currents [A] at switching frequency						
	2 kHz		4 kHz		8 kHz		16 kHz
	I_{aN2}	I_{aM2}	I_{aN4}	I_{aM4}	I_{aN8}	I_{aM8}	I_{aN16}
E94xMxE0024	1.9	6.0	1.9	6.0	**1.5**	4.8	1.1
E94xMxE0034	3.1	10.0	3.1	10.0	**2.5**	8.0	1.9
E94xMxE0044	5.0	16.0	5.0	16.0	**4.0**	12.8	3.0
E94xMxE0074	8.8	21.0	8.8	21.0	**7.0**	16.8	5.3
E94xMxE0094	11.7	28.0	11.7	28.0	**9.3**	22.4	7.0
E94xMxE0134	16.3	39.0	16.3	39.0	**13.0**	31.2	9.8
E94xMxE0174	20.6	49.5	20.6	49.5	**16.5**	39.6	12.4
E94xMxE0244	29.4	70.5	29.4	70.5	**23.5**	56.4	17.6
E94xMxE0324	40.0	76.8	40.0	76.8	**32.0**	76.8	16.0
E94xMxE0474	47.0	94.0	**47.0**	94.0	41.0	82.0	21.5
E94xMxE0594	59.0	118	**59.0**	118	41.0	82.0	21.5

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

I_{aM2} Maximum output current (overload current) at frequency ≥ 0 Hz
- 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 continuous 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) at frequency ≥ 5 Hz (reduce to 0.66 * I_{aMx} for 0 ... 5 Hz)
- 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}

4) Depending on the heatsink temperature, the mains voltage and the motor cable length, the switching frequency can be changed even at smaller currents.

4.4.3 Operation in 400-V-AC system

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

	Input current at I_{aN8} (without external mains choke)	Output power U, V, W	Motor power (typical) 4-pole ASM	
Type	I_{DC} [A]	S_{aN} [kVA]	P_{aN} [kW]	P_{aN} [hp]
E94xMxE0024	2.6	0.9	0.37	0.5
E94xMxE0034	4.3	1.6	0.75	1.0
E94xMxE0044	6.7	2.5	1.5	2.0
E94xMxE0074	12.1	4.4	3.0	4.0
E94xMxE0094	15.4	5.8	4.0	5.0
E94xMxE0134	20.6	8.1	5.5	7.5
E94xMxE0174	25.7	10.3	7.5	11.0
E94xMxE0244	35.5	14.7	11.0	15.0
E94xMxE0324	48.0	20.0	15.0	20.4
E94xMxE0474	71.0	29.3	22	29
E94xMxE0594	89.0	36.8	30	40

	Output currents [A] at switching frequency						
	2 kHz		4 kHz		8 kHz		16 kHz
	I_{aN2}	I_{aM2}	I_{aN4}	I_{aM4}	I_{aN8}	I_{aM8}	I_{aN16}
E94xMxE0024	1.9	6.0	1.9	6.0	**1.5**	4.8	1.1
E94xMxE0034	3.1	10.0	3.1	10.0	**2.5**	8.0	1.9
E94xMxE0044	5.0	16.0	5.0	16.0	**4.0**	12.8	3.0
E94xMxE0074	8.8	21.0	8.8	21.0	**7.0**	16.8	5.3
E94xMxE0094	11.7	28.0	11.7	28.0	**9.3**	22.4	7.0
E94xMxE0134	16.3	39.0	16.3	39.0	**13.0**	31.2	9.8
E94xMxE0174	20.6	49.5	20.6	49.5	**16.5**	39.6	12.4
E94xMxE0244	29.4	70.5	29.4	70.5	**23.5**	56.4	17.6
E94xMxE0324	40.0	76.8	40.0	76.8	**32.0**	76.8	16.0
E94xMxE0474	47.0	94.0	**47.0**	94.0	41.0	82.0	21.5
E94xMxE0594	59.0	118	**59.0**	118	41.0	82.0	21.5

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

I_{aM2} Maximum output current (overload current) at frequency ≥ 0 Hz
- 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 continuous 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) at frequency ≥ 5 Hz (reduce to 0.66 * I_{aMx} for 0 ... 5 Hz)
- 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}

4) Depending on the heatsink temperature, the mains voltage and the motor cable length, the switching frequency can be changed even at smaller currents.

4.4.4 Operation in 480-V-AC system

Mains	Voltage U_{DC} [V]	Voltage range U_{DC} [V]	Frequency range f [Hz]
2/PE DC	675	540 - 0 % ... 746 + 0 %	-

	Input current at I_{aN8} (without external mains choke)	Output power U, V, W	Motor power (typical) 4-pole ASM	
Type	I_{DC} [A]	S_{aN} [kVA]	P_{aN} [kW]	P_{aN} [hp]
E94xMxE0024	2.3	1.0	0.37	0.5
E94xMxE0034	3.8	1.6	0.75	1.0
E94xMxE0044	5.9	2.6	1.5	2.0
E94xMxE0074	10.6	4.6	3.0	4.0
E94xMxE0094	13.5	8.5	4.0	5.0
E94xMxE0134	18.0	10.8	5.5	7.5
E94xMxE0174	22.5	15.4	7.5	10.0
E94xMxE0244	31.1	19.4	11.0	15.0
E94xMxE0324	38.9	31.4	15.0	20.4
E94xMxE0474	62.0	38.1	22	29
E94xMxE0594	77.0	38.9	30	40

	Output currents [A] at switching frequency						
	2 kHz		4 kHz		8 kHz		16 kHz
	I_{aN2}	I_{aM2}	I_{aN4}	I_{aM4}	I_{aN8}	I_{aM8}	I_{aN16}
E94xMxE0024	1.9	6.0	1.9	6.0	**1.3**	4.2	1.0
E94xMxE0034	3.1	10.0	3.1	10.0	**2.2**	7.0	1.7
E94xMxE0044	5.0	16.0	5.0	16.0	**3.5**	11.2	2.6
E94xMxE0074	8.8	21.0	8.8	21.0	**6.1**	14.7	4.6
E94xMxE0094	11.7	28.0	11.7	28.0	**8.2**	19.6	6.1
E94xMxE0134	16.3	39.0	16.3	39.0	**11.4**	27.3	8.6
E94xMxE0174	20.6	49.5	20.6	49.5	**14.4**	34.7	10.9
E94xMxE0244	29.4	70.5	29.4	70.5	**20.6**	49.4	15.4
E94xMxE0324	40.0	76.8	40.0	76.8	**25.9**	62.1	13.0
E94xMxE0474	47.0	94.0	41.1	82.2	35.8	71.6	21.5
E94xMxE0594	59.0	118	51.6	103	35.9	71.8	21.5

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

I_{aM2} Maximum output current (overload current) at frequency ≥ 0 Hz
- 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 continuous 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) at frequency ≥ 5 Hz (reduce to 0.66 * I_{aMx} for 0 ... 5 Hz)
- 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}

4) Depending on the heatsink temperature, the mains voltage and the motor cable length, the switching frequency can be changed even at smaller currents.

4.4.5 Fuses and cable cross-sections

Mains	Voltage U_{DC} [V]	Voltage range U_{DC} [V]	Frequency range f [Hz]
2/PE DC (alternatively)	325 ... 675	260 - 0 % ... 746 + 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.

4.4.6 Overcurrent operation

The controllers are designed for two overcurrent modes.

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}.

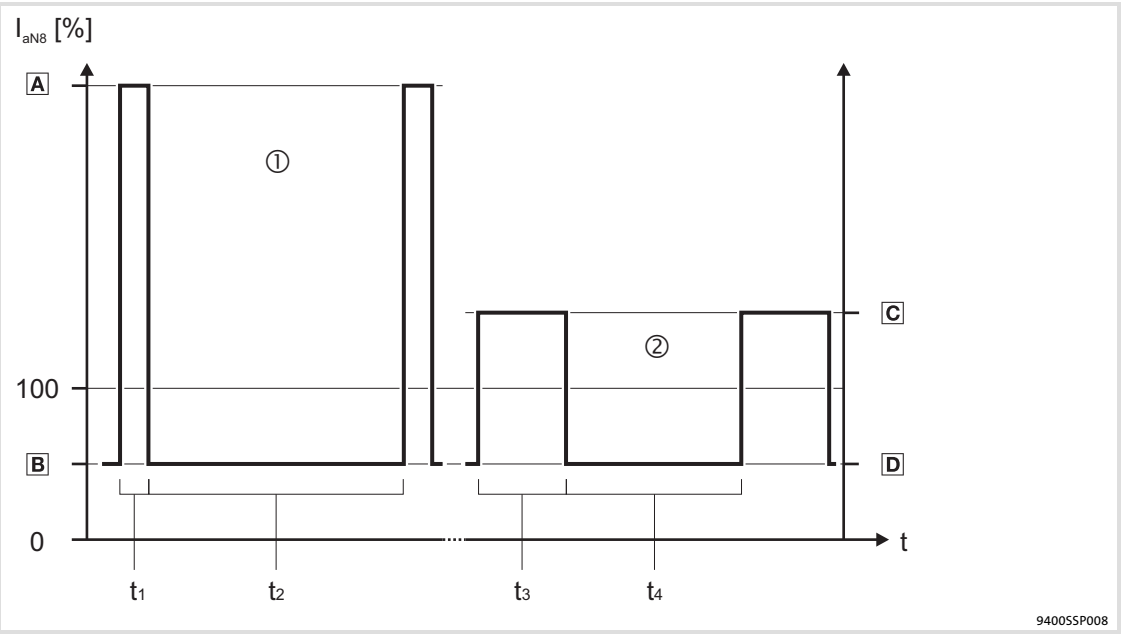


Fig. 4-1 Overcurrent capacity at 45° C

E94xSxE0024 ... E94xSxE1044 E94xMxE0024 ... E94xMxE0594	E94xSxE1454 ... E94xSxE4604
● 5 s cycle ① – t_1 = 0.5 s load time with peak current A – t_2 = 4.5 s recovery time with limited current B	● 1-min cycle ① – t_1 = 10 s load time with peak current A – t_2 = 50 s recovery time with limited current B
● 3-min cycle ② – t_3 = 60 s load time with peak current C – t_4 = 120 s recovery time with limited current D	● 3-min cycle ② – t_3 = 60 s load time with peak current C – t_4 = 120 s recovery time with limited current D

230 V

Type	I [A] in a cycle of 5 seconds ① (📖 179)							
	f = 2 kHz		f = 4 kHz		f = 8 kHz		f = 16 kHz	
	A	B	A	B	A	B	A	B
E94xMxE0024	6.0	1.4	6.0	1.4	4.8	1.1	-	-
E94xMxE0034	10.0	2.3	10.0	2.3	8.0	1.9	-	-
E94xMxE0044	16.0	3.8	16.0	3.8	12.8	3.0	-	-
E94xMxE0074	21.0	6.6	21.0	6.6	16.8	5.3	-	-
E94xMxE0094	27.9	8.7	27.9	8.7	22.3	7.0	-	-
E94xMxE0134	39.0	12.2	39.0	12.2	31.2	9.8	-	-
E94xMxE0174	49.5	15.5	49.5	15.5	39.6	12.4	-	-
E94xMxE0244	70.5	22.0	70.5	22.0	47.0	17.6	-	-
E94xMxE0324	76.8	30.0	76.8	30.0	76.8	24.0	-	-
E94xMxE0474	94.0	35.3	94.0	35.3	81.8	30.6	-	-
E94xMxE0594	118	44.3	118	44.3	82.0	30.7	-	-

Type	I [A] in a cycle of 3 minute ② (📖 179)							
	f = 2 kHz		f = 4 kHz		f = 8 kHz		f = 16 kHz	
	C	D	C	D	C	D	C	D
E94xMxE0024	2.8	1.4	2.8	1.4	2.3	1.1	-	-
E94xMxE0034	4.7	2.4	4.7	2.4	3.8	1.9	-	-
E94xMxE0044	7.5	3.8	7.5	3.8	6.0	3.0	-	-
E94xMxE0074	13.2	6.6	13.2	6.6	10.5	5.3	-	-
E94xMxE0094	17.5	8.7	17.5	8.7	14.0	7.0	-	-
E94xMxE0134	24.4	12.2	24.4	12.2	19.5	9.8	-	-
E94xMxE0174	31.0	15.5	31.0	15.5	24.8	12.4	-	-
E94xMxE0244	44.2	22.1	44.2	22.1	35.3	17.6	-	-
E94xMxE0324	60.0	30.0	60.0	30.0	48.0	24.0	-	-
E94xMxE0474	70.5	35.3	70.5	35.3	61.6	30.6	-	-
E94xMxE0594	88.5	44.3	88.5	44.3	61.4	30.7	-	-

400 V

Type	I [A] in a cycle of 5 seconds ① (📖 179)							
	f = 2 kHz		f = 4 kHz		f = 8 kHz		f = 16 kHz	
	A	B	A	B	A	B	A	B
E94xMxE0024	6.0	1.4	6.0	1.4	4.8	1.1	-	-
E94xMxE0034	10.0	2.3	10.0	2.3	8.0	1.9	-	-
E94xMxE0044	16.0	3.8	16.0	3.8	12.8	3.0	-	-
E94xMxE0074	21.0	6.6	21.0	6.6	16.8	5.3	-	-
E94xMxE0094	27.9	8.7	27.9	8.7	22.3	7.0	-	-
E94xMxE0134	39.0	12.2	39.0	12.2	31.2	9.8	-	-
E94xMxE0174	49.5	15.5	49.5	15.5	39.6	12.4	-	-
E94xMxE0244	70.5	22.0	70.5	22.0	47.0	17.6	-	-
E94xMxE0324	76.8	30.0	76.8	30.0	76.8	24.0	-	-
E94xMxE0474	94.0	35.3	94.0	35.3	81.8	30.6	-	-
E94xMxE0594	118	44.3	118	44.3	82.0	30.7	-	-

Type	I [A] in a cycle of 3 minute ② (📖 179)							
	f = 2 kHz		f = 4 kHz		f = 8 kHz		f = 16 kHz	
	C	D	C	D	C	D	C	D
E94xMxE0024	2.8	1.4	2.8	1.4	2.3	1.1	-	-
E94xMxE0034	4.7	2.4	4.7	2.4	3.8	1.9	-	-
E94xMxE0044	7.5	3.8	7.5	3.8	6.0	3.0	-	-
E94xMxE0074	13.2	6.6	13.2	6.6	10.5	5.3	-	-
E94xMxE0094	17.5	8.7	17.5	8.7	14.0	7.0	-	-
E94xMxE0134	24.4	12.2	24.4	12.2	19.5	9.8	-	-
E94xMxE0174	31.0	15.5	31.0	15.5	24.8	12.4	-	-
E94xMxE0244	44.2	22.1	44.2	22.1	35.3	17.6	-	-
E94xMxE0324	60.0	30.0	60.0	30.0	48.0	24.0	-	-
E94xMxE0474	70.5	35.3	70.5	35.3	61.6	30.6	-	-
E94xMxE0594	88.5	44.3	88.5	44.3	61.4	30.7	-	-

480 V

Type	I [A] in a cycle of 5 seconds ① (📖 179)							
	f = 2 kHz		f = 4 kHz		f = 8 kHz		f = 16 kHz	
	A	B	A	B	A	B	A	B
E94xMxE0024	6.0	1.4	6.0	1.4	4.2	1.0	-	-
E94xMxE0034	10.0	2.3	10.0	2.3	7.0	1.6	-	-
E94xMxE0044	16.0	3.8	16.0	3.8	11.2	2.6	-	-
E94xMxE0074	21.0	6.6	21.0	6.6	14.7	4.6	-	-
E94xMxE0094	27.9	8.7	27.9	8.7	19.5	6.1	-	-
E94xMxE0134	39.0	12.2	39.0	12.2	27.3	8.5	-	-
E94xMxE0174	49.5	15.5	49.5	15.5	34.7	10.8	-	-
E94xMxE0244	70.5	22.0	70.5	22.0	41.1	15.4	-	-
E94xMxE0324	76.8	30.0	76.8	30.0	62.2	19.4	-	-
E94xMxE0474	94.0	35.3	94.0	35.3	71.6	26.7	-	-
E94xMxE0594	118	44.3	118	44.3	71.8	26.8	-	-

Type	I [A] in a cycle of 3 minute ② (📖 179)							
	f = 2 kHz		f = 4 kHz		f = 8 kHz		f = 16 kHz	
	C	D	C	D	C	D	C	D
E94xMxE0024	2.8	1.4	2.8	1.4	2.0	1.0	-	-
E94xMxE0034	4.7	2.4	4.7	2.4	3.3	1.6	-	-
E94xMxE0044	7.5	3.8	7.5	3.8	5.3	2.6	-	-
E94xMxE0074	13.2	6.6	13.2	6.6	9.2	4.6	-	-
E94xMxE0094	17.5	8.7	17.5	8.7	12.2	6.1	-	-
E94xMxE0134	24.4	12.2	24.4	12.2	17.1	8.5	-	-
E94xMxE0174	31.0	15.5	31.0	15.5	21.7	10.8	-	-
E94xMxE0244	44.2	22.1	44.2	22.1	30.8	15.4	-	-
E94xMxE0324	60.0	30.0	60.0	30.0	38.9	19.4	-	-
E94xMxE0474	70.5	35.3	70.5	35.3	53.9	26.7	-	-
E94xMxE0594	88.5	44.3	88.5	44.3	53.7	26.8	-	-

4.4.7 Current-time diagrams

In addition to the data for overcurrent operation, here you are provided with information on the dimensioning of application-oriented cycles.

By means of the following information you determine permissible load periods with overcurrents and required recovery times with limited currents. If the currents and times determined are observed, the Ixt monitoring function for the protection of the devices will not respond.

Characteristics

The following characteristics (”Current-time diagrams”) describe the device utilisation via amperage and the duration of current flow.
The left part of the diagram (negative time data) represents the overload phase, while the right part of the diagram (positive time data) shows the relieving phase.
Devices with an identical Ixt behaviour are combined within a diagram. A second diagram enlarges a cutout area to improve the clearness of display.

Requirements

- Switching frequency

  The curves shown always refer to the variable rated switching frequency (f_{chopp}) at which the rated device current is permissible permanently. As this rated switching frequencies are different for the individual devices, they are specified with the diagrams. This means that the switching frequency is reduced automatically during the overload phase. During the recovery phase the switching frequency set is maintained.

- Mains voltage

  In the diagrams a mains voltage of U_N = 400 V was assumed. Where applicable, a current derating depending on the mains voltage may be necessary for the devices, depending on the switching frequency that is reached. This means that the currents are weighted differently in the Ixt monitoring. The devices for which a derating is required can be gathered from the ”Rated values” section. The continuous currents specified there then are the 100% values which are required for working with the diagrams.

- Ambient temperature

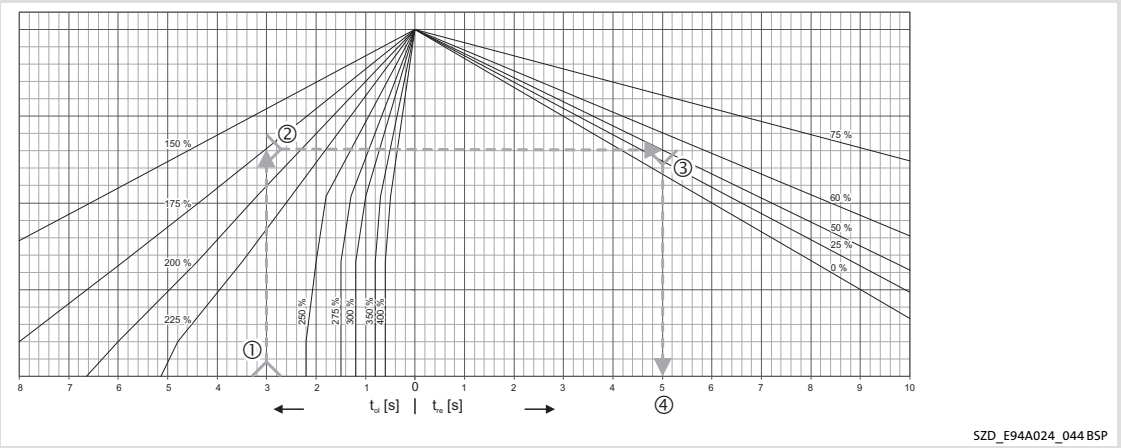
  The ambient temperature may be maximally T_{Amb} < 45 °C. In the case of higher ambient temperatures the reduced continuous currents have to be taken into consideration.

- Output frequency

  In the diagrams an output frequency (= field frequency) f_{out} > 5 Hz has been assumed. In the case of smaller output frequencies (f_{out} = 0 ... 5 Hz), a different switching frequency results in a different device utilisation due to a different continuous current. When the diagrams were created, this device behaviour was not taken into consideration.
  If a fixed switching frequency f > 4 kHz is selected, the reduction of the permissible continuous current has to be considered (100 % = reduced continuous current) for smaller output frequencies (f_{out} = 0 ... 5 Hz).

Application example

- Drive task
  - A current I_{ol} = 4.0 A is required for a time t_{ol} = 3 s.
  - During the recovery phase there is a current I_{re} = 1.0 A.
  - During the overload phase a switching frequency of 4 kHz is accepted.
  - The switching frequency during the recovery phase is to be 8 kHz.
  - The mains voltage is 400 V.
  - The times with output frequencies under 5 Hz are insignificant.
- Problem
  - How long does the recovery phase t_{re} have to be when the E94AxxE0034 controller is used?
- The currents required are based on the rated device current:
  - I_{ol} = 4.0 A/2.5 A = 160 % - selected characteristic: 175 %
  - I_{re} = 1.0A/2.5 A = 40 % - selected characteristic: 50 %
  - Because of the short overcurrent time t_{ol} = 3 s, the cutout diagram of the E94AxxE0034 device is taken into consideration.
  - The switching frequency f_{chopp} = 8 kHz, var does not have to be considered separately.
- Procedure within the diagram
  - ① Starting from the time axis at t_{ol} = 3 s, a perpendicular line is drawn to the selected characteristic at 175 % (corresponds to the minimum required current I_{ol}).
  - ② Draw a straight line from the point of intersection horizontally to the right to the selected characteristic, the recovery phase, at 50 %.
  - ③ Draw a perpendicular line from the point of intersection back to the time axis.
  - ④ Read the minimum required duration of recovery on the time axis.



- Result in the example
  - The duration of recovery has to be at least t_{re} = 5 s!

Guide

Type	Diagram
E94xxxE0024	Page 186 Fig. 4-2/ Fig. 4-3
E94xxxE0034	
E94xxxE0044	
E94xxxE0074	Page 187 Fig. 4-4/ Fig. 4-5
E94xxxE0134	
E94xxxE0174	
E94xxxE0244	
E94xMxE0324	
E94xxxE0474	Page 188 Fig. 4-6 / Fig. 4-7
E94xxxE0594	

Guide

Type	Diagram
E94xxxE0024	Page 186 Fig. 4-2/ Fig. 4-3
E94xxxE0034	
E94xxxE0044	
E94xxxE0074	Page 187 Fig. 4-4/ Fig. 4-5
E94xxxE0134	
E94xxxE0174	
E94xxxE0244	
E94xMxE0324	
E94xxxE0474	Page 188 Fig. 4-6 / Fig. 4-7
E94xxxE0594	

E94xxxE0024 ... E94xxxE0044

Type	U_r	100 %	f_{chopp}
	[V]	[A]	[Setting]
E94xxxE0024	400	1.5	8 kHz var
E94xxxE0034		2.5	
E94xxxE0044		4.0	

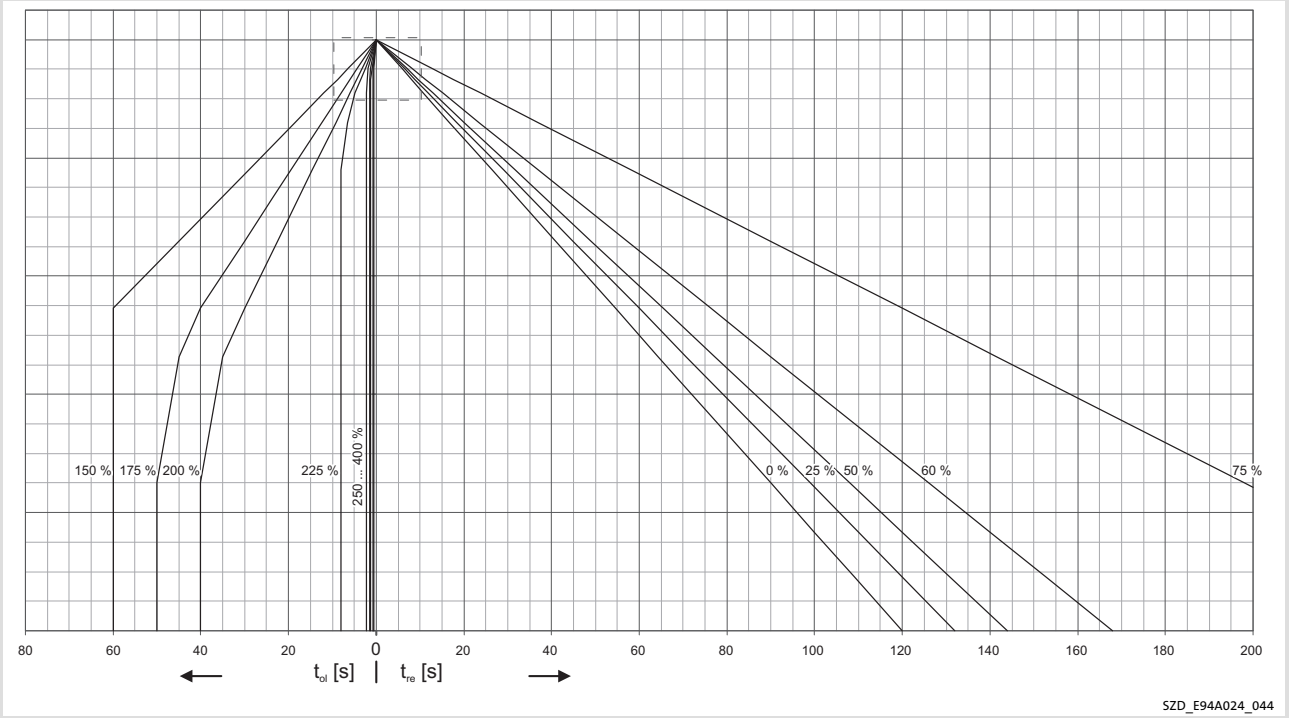


Fig. 4-2 Diagram for E94xxxE0024 and E94xxxE0044

t_{ol} Duration of the load phase
t_{re} Duration of the recovery phase

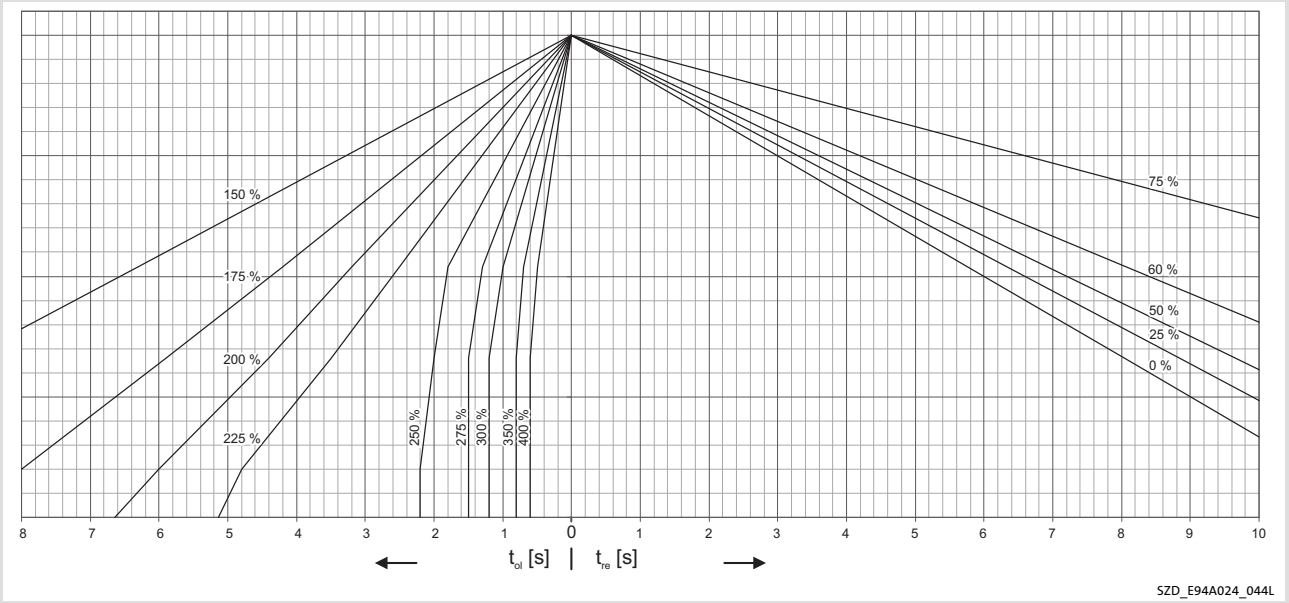


Fig. 4-3 Area cutout for E94xxxE0024 and E94xxxE0044

E94xxxE0074 ... E94xxxE0244 and E94xMxE0324

Type	V_r	100 %	f_{chopp}
	[V]	[A]	[Setting]
E94xxxE0074	400	7.0	8 kHz var
E94xMxE0094		9.3	8 kHz var
E94xxxE0134		13.0	8 kHz var
E94xxxE0174		16.5	
E94xxxE0244		23.5	
E94xMxE0324		32.0	8 kHz var

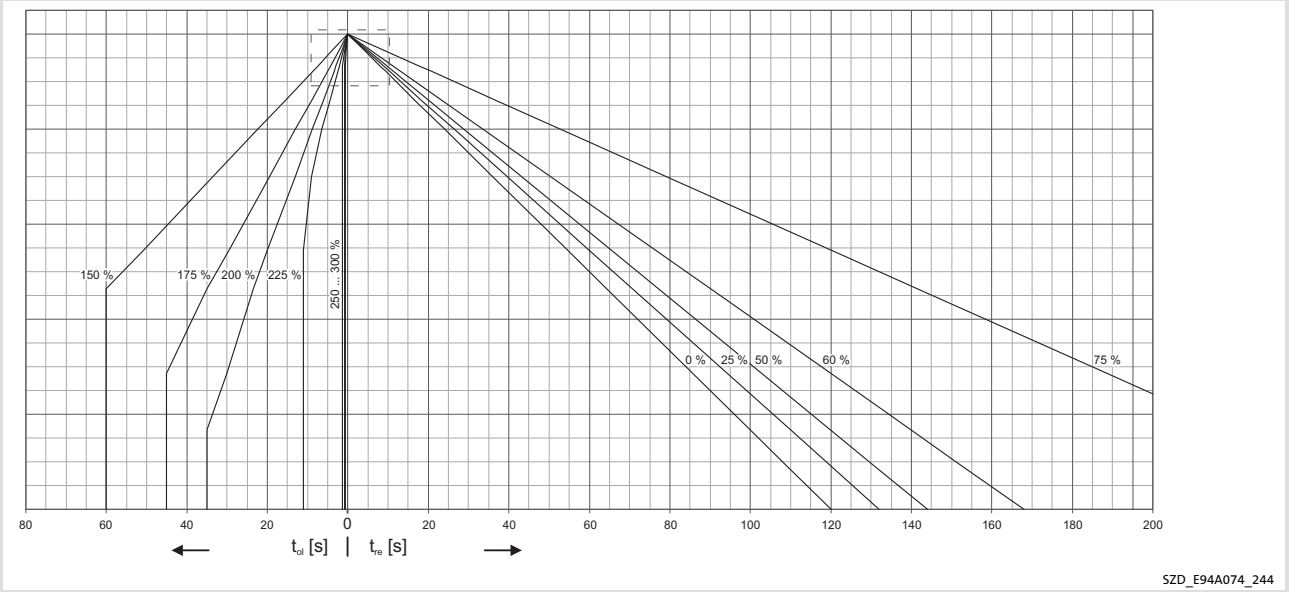


Fig. 4-4 Diagram for E94xxxE0074 ... E94xxxE0244, E94xMxE0324

t_{ol} Duration of the load phase
t_{re} Duration of the recovery phase

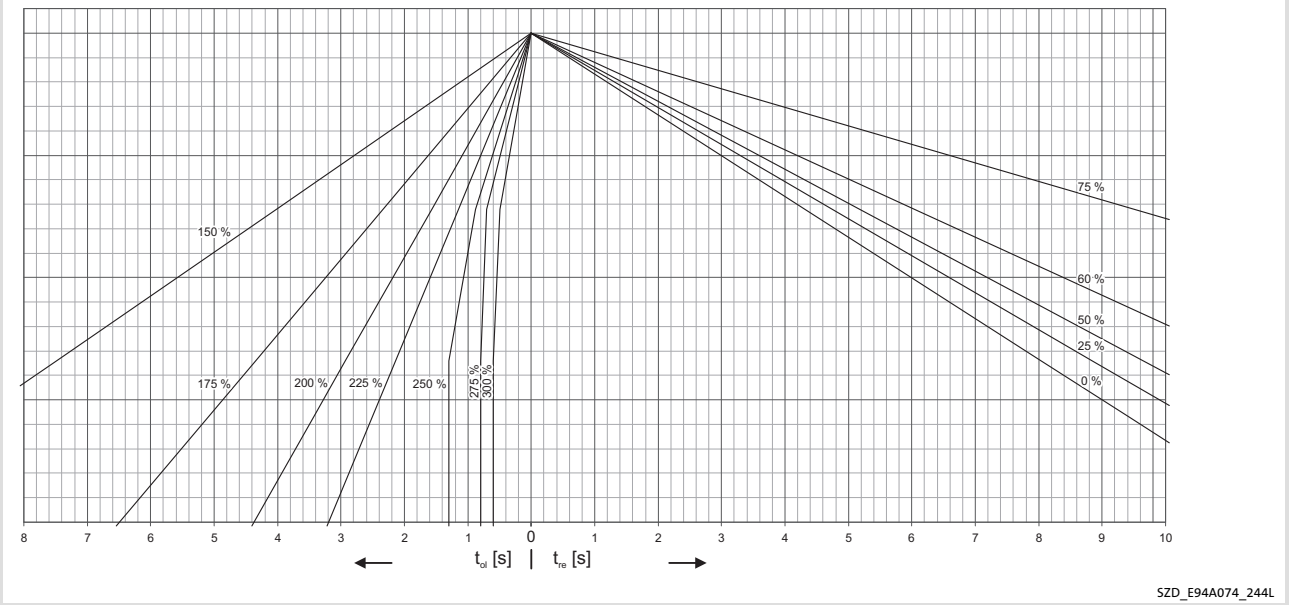


Fig. 4-5 Area cutout for E94xxxE0074 ... E94xxxE0244, E94xMxE0324

E94xxxE0474 and E94xxxE0594

Type	U_r	100 %	f_{chopp}
	[V]	[A]	[Setting]
E94xxxE0474	400	47.0	4 kHz var
E94xxxE0594		59.0	

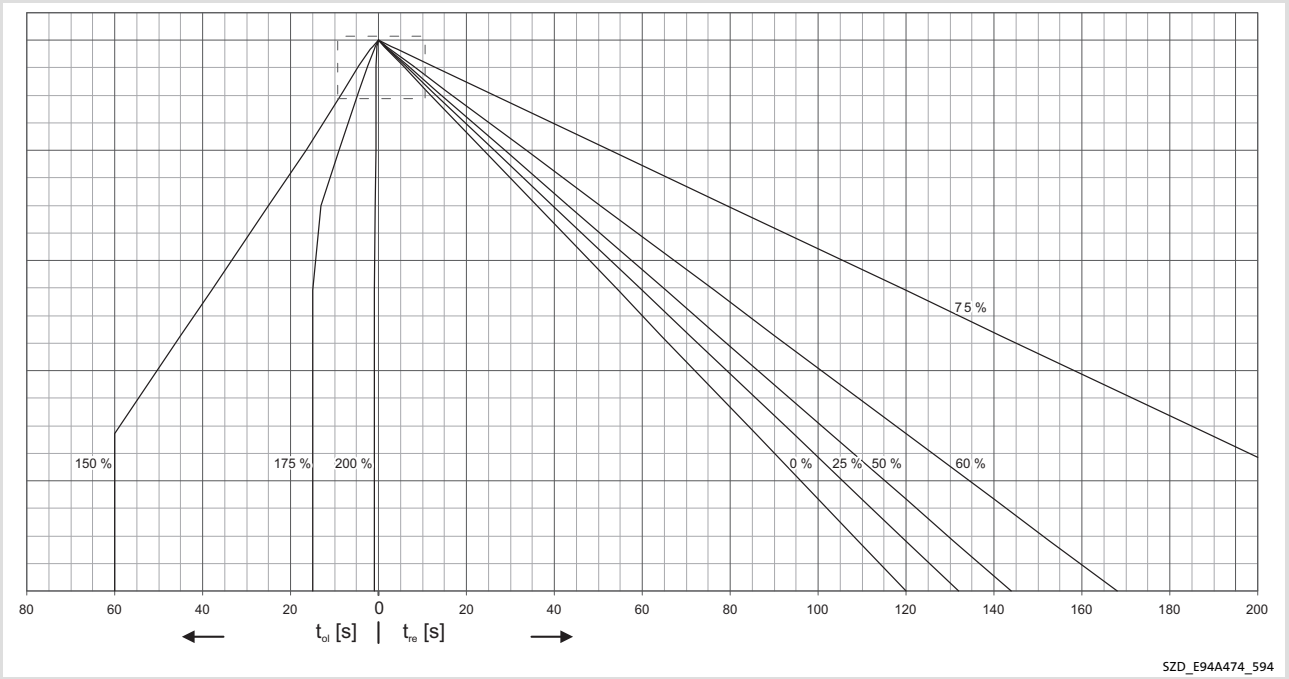


Fig. 4-6 Diagram for E94xxxE0474 and E94xxxE0594

t_{ol} Duration of the load phase
t_{re} Duration of the recovery phase

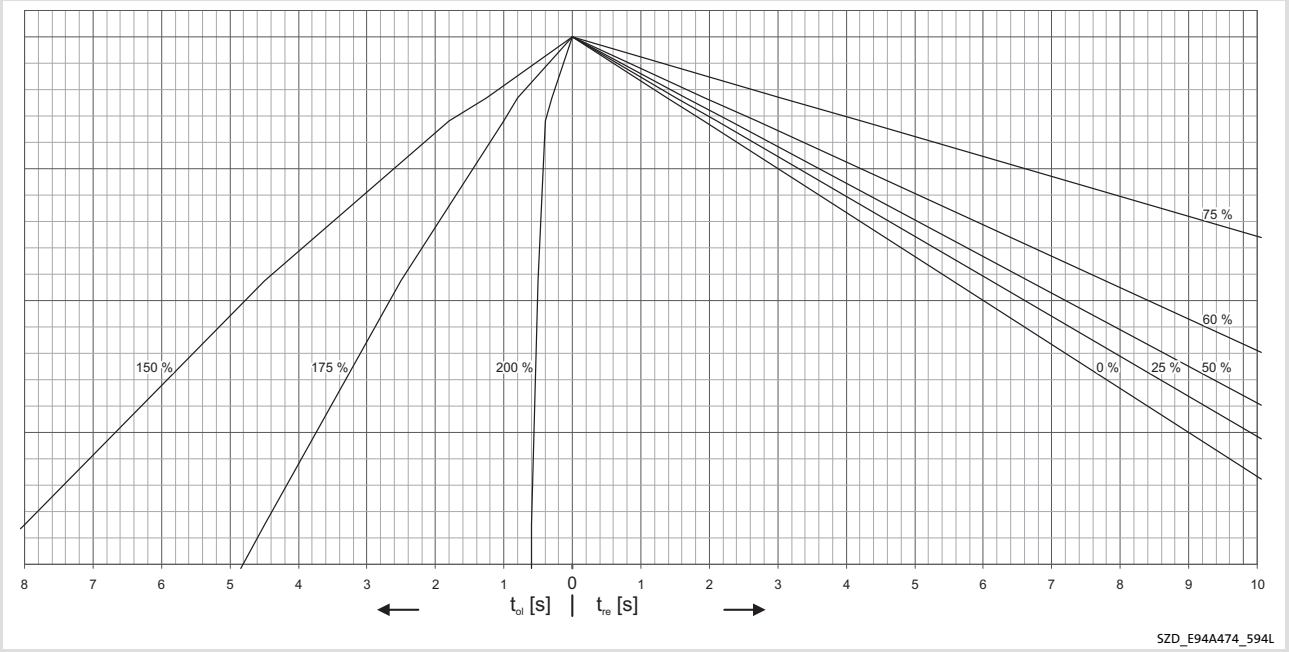
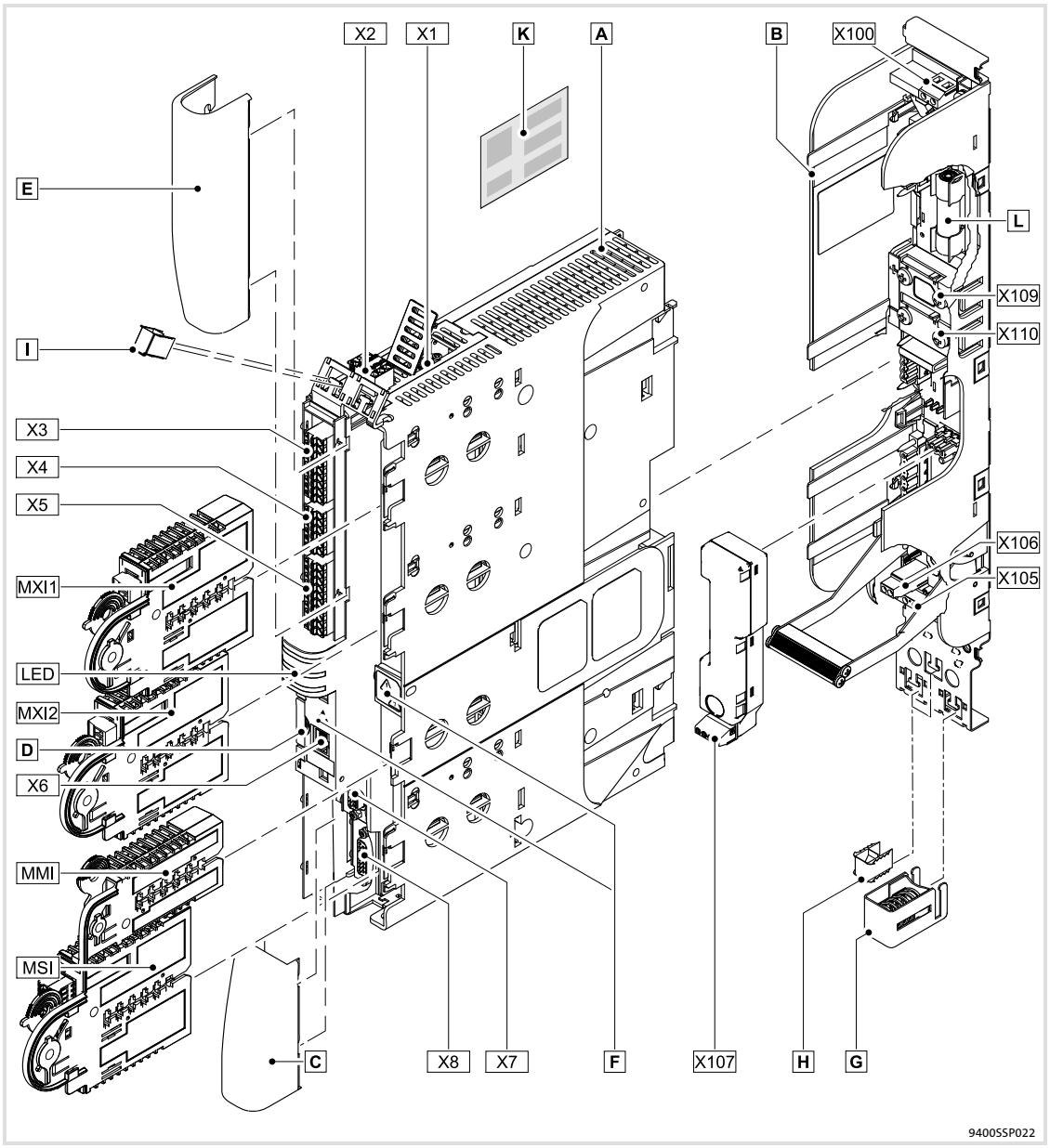


Fig. 4-7 Area cutout for E94xxxE0474 and E94xxxE0594

4.5 Device description

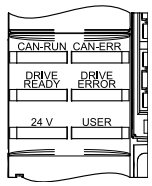
This page remains blank to give you a clearly arranged overview of the following subject on the next double page.

4.5.1 Devices in the range 2 ... 32 A (0.37 ... 15 kW)



Standard device A	
Pos.	**Description**
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 and statebus
X3	Analog inputs and analog outputs
X4	Digital outputs
X5	Digital inputs
X6	Diagnostics
X7	Resolver
X8	Encoder
C	Lower cover
D	Retractable nameplate
E	Upper cover
I	EMC clip
K	Prominent warning label close to the device!

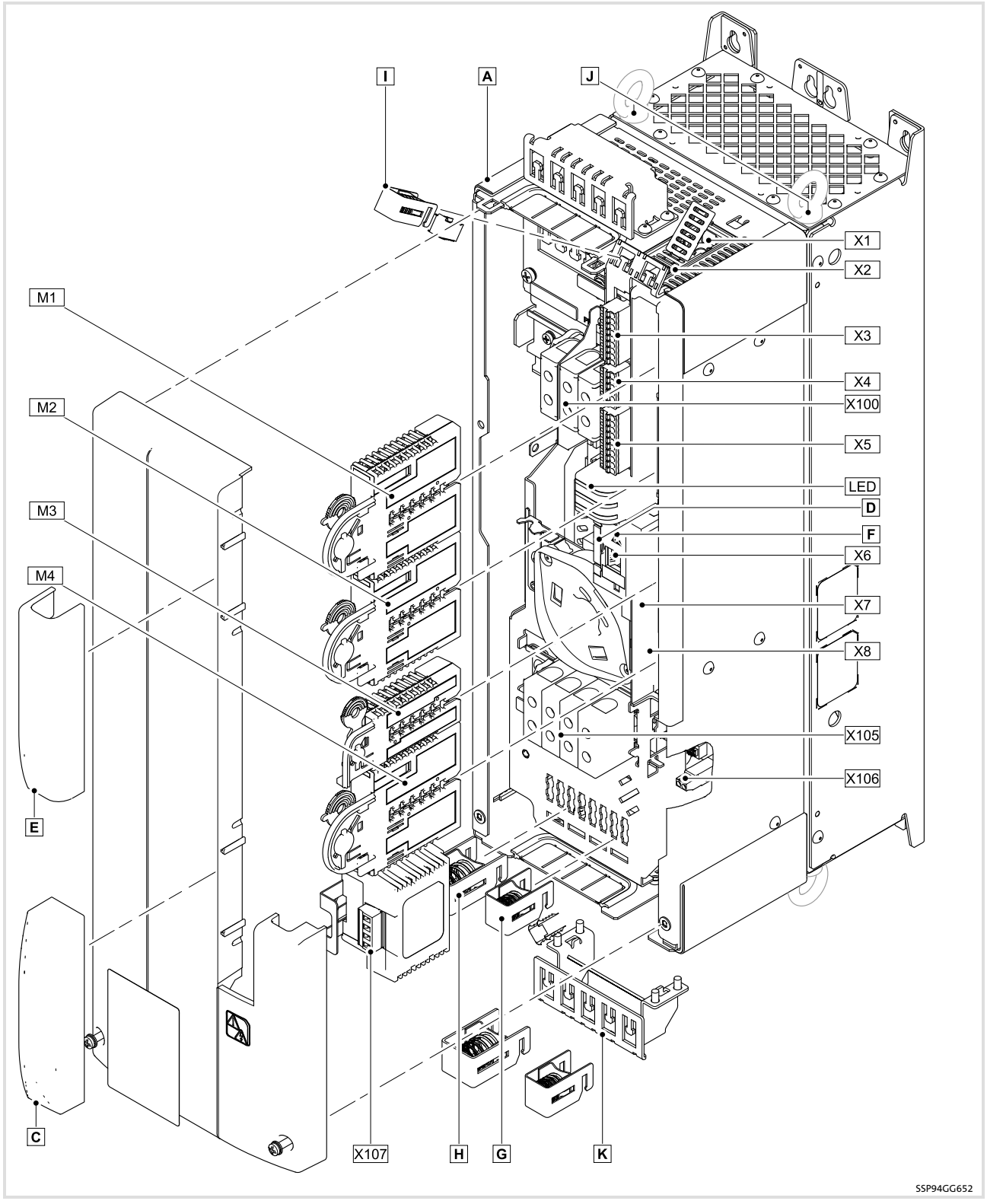
The LED display enables fast indication of several operating states.

LED	Labelling	Colour	Description
 SSP94LED01	CAN-RUN	green	CAN bus ok
	CAN-ERR	red	CAN bus error
	DRIVE READY	green	Standard device is ready for operation
	DRIVE ERROR	red	Error in the standard device or application-induced
	24 V	green	24 V supply voltage ok
	USER	yellow	Message parameterised by the application

Pos.	Symbol	Description
F		**Long discharge time**: All power terminals carry hazardous electrical voltages for a longer period of time after mains disconnection! Depending on the device, this period of time may be up to 20 minutes.
		**High discharge current**: Carry out fixed installation and PE connection according to EN 61800-5-1!
		**Electrostatic sensitive devices**: Before working on the device, the personnel must be free of electrostatic charge!

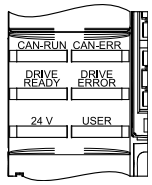
Installation backplane B	
Pos.	**Description**
X100	DC-bus voltage (compatible to 9300 series)
X105	Motor
X106	Motor temperature monitoring
X107	Control of motor holding brake
X109	DC busbar +
X110	DC busbar -
G	EMC wire clamp (for device sizes 2 + 3), replaces 1 x H
H	EMC shield clamp
L	DC-bus fuse

4.5.2 Devices in the range 47 ... 59 A (22 ... 30 kW)



Standard device A	
Pos.	**Description**
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 and statebus
X3	Analog inputs and analog outputs
X4	Digital outputs
X5	Digital inputs
X6	Diagnostics
X7	Resolver
X8	Encoder
C	Lower cover
D	Retractable nameplate
E	Upper cover
I	EMC clip
X100	DC-bus voltage
X105	Motor
X106	Motor temperature monitoring
X107	Control of motor holding brake
G H	EMC wire clamp Device size 6: ∅ 10 ... 20 mm and ∅ 15 ... 28 mm
J	Internal thread for M6 eye bolt (not included in the scope of supply)
K	Strain relief and lifting aid, removable

The LED display enables fast indication of several operating states.

LED	Labelling	Colour	Description
 SSP94LED01	CAN-RUN	green	CAN bus ok
	CAN-ERR	red	CAN bus error
	DRIVE READY	green	Standard device is ready for operation
	DRIVE ERROR	red	Error in the standard device or application-induced
	24 V	green	24 V supply voltage ok
	USER	yellow	Message parameterised by the application

Pos.	Symbol	Description
		**Long discharge time**: All power terminals carry hazardous electrical voltages for a longer period of time after mains disconnection! Depending on the device, this period of time may be up to 20 minutes.
F		**High discharge current**: Carry out fixed installation and PE connection according to EN 61800-5-1!
		**Electrostatic sensitive devices**: Before working on the device, the personnel must be free of electrostatic charge!

4.6 Mechanical installation

4.6.1 Important notes

Note!

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

- The mounting location must always comply with the operating conditions specified in the technical data (📖 169). Take additional measures if necessary.
- The mounting plate of the control cabinet must have the following properties:
  – electrically conductive
  – free of lacquer
- The mechanical connections must always be ensured.
- A free air circulation must be ensured for dissipating the heat.
- The described EMC properties are provided if the following conditions are complied with:
  – The devices are mounted according to the arrangement concept described.
  – The prepared cables are used and remain unchanged.

4.6.2 Devices in the range 2 ... 32 A (0.37 ... 15 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.

Note!

- ► Permissible are M5 screw and washer assemblies or hexagon socket screws with washer.
- ► Tightening torque: 3.0 Nm / 26 lb-in.
- ► The screw joint in the installation backplane may jut out no more than 7 mm.

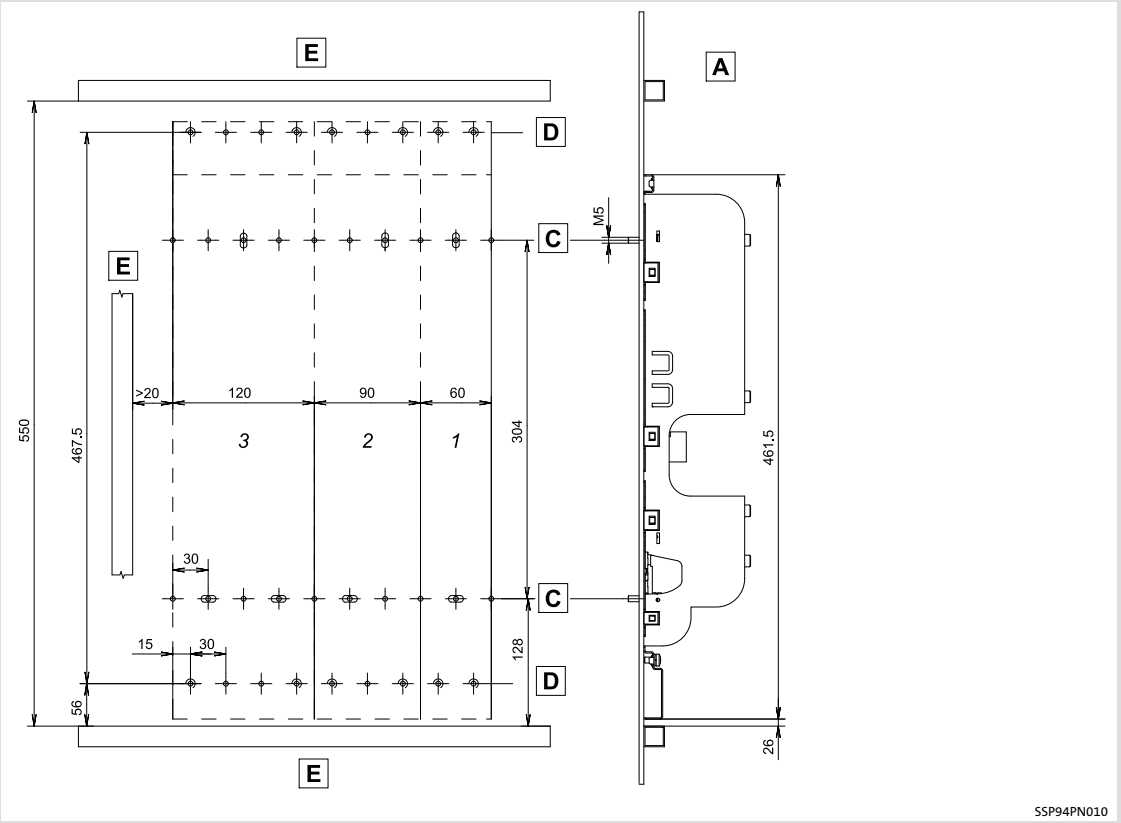


Fig. 4-8 Mounting grid for device size 1 ... 3 installation backplanes

- A Installation backplane
- C Grid hole pattern for installation backplane (M5 threaded holes)
- D Grid hole pattern for footprint filter (not relevant here)
- E Cable duct
- 1 ... 3 Device size, mounting holes used

Standard device with installation backplane

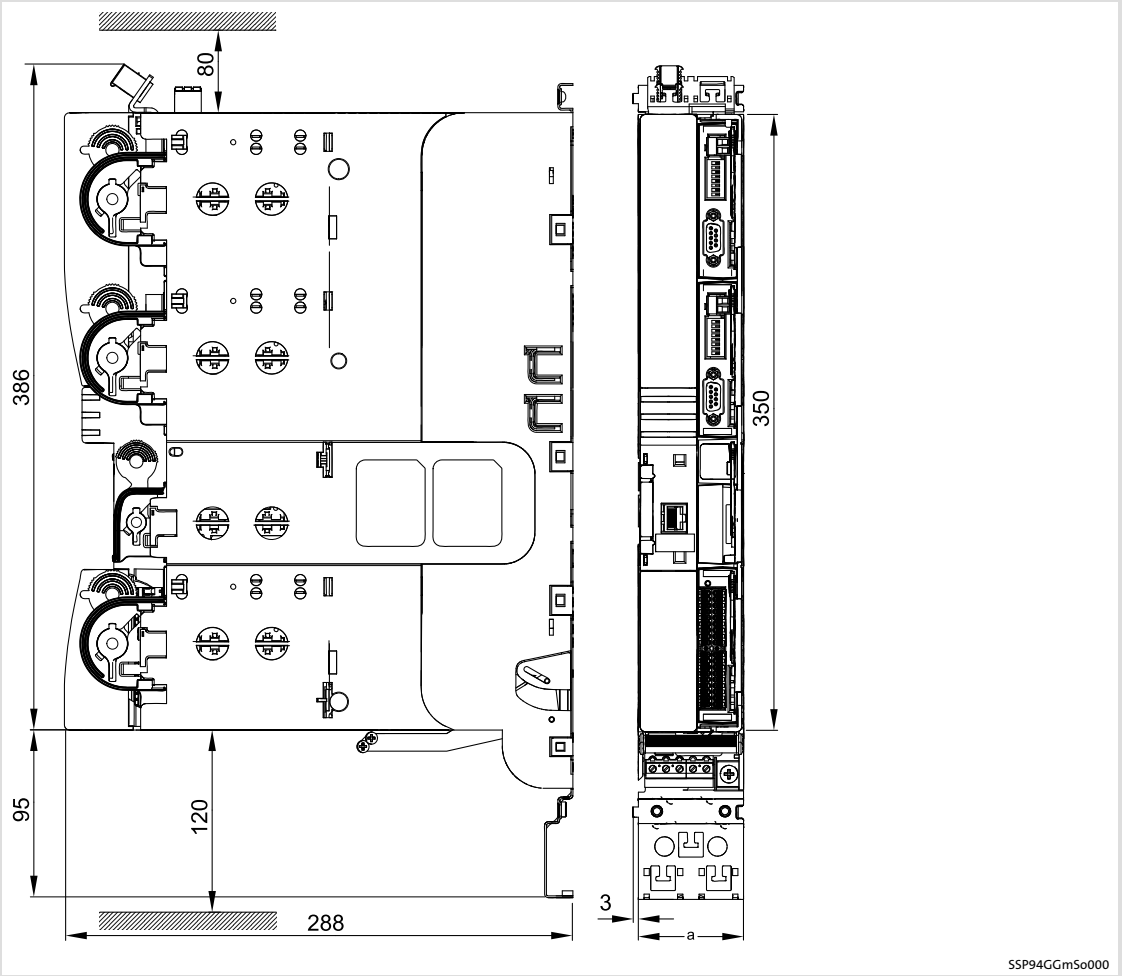


Fig. 4-9 Dimensions [mm]

Typ	Abmessung a [mm]	Masse [kg]
E94xMxE0024	60	4.0
E94xMxE0034		
E94xMxE0044		
E94xMxE0074	90	5.3
E94xMxE0094		
E94xMxE0134	120	8.1
E94xMxE0174		
E94xMxE0244		
E94xMxE0324	120	8.5

Note!

Axis modules E94xMxE0324 and installation backplane E94AZPM0324 can only be connected directly to each other! A use with another device or installation backplane of size 3 is not permissible and is prevented through a plug protection.

Please consider this when planning drive systems where the devices are mounted side by side.

Arrangement of the devices

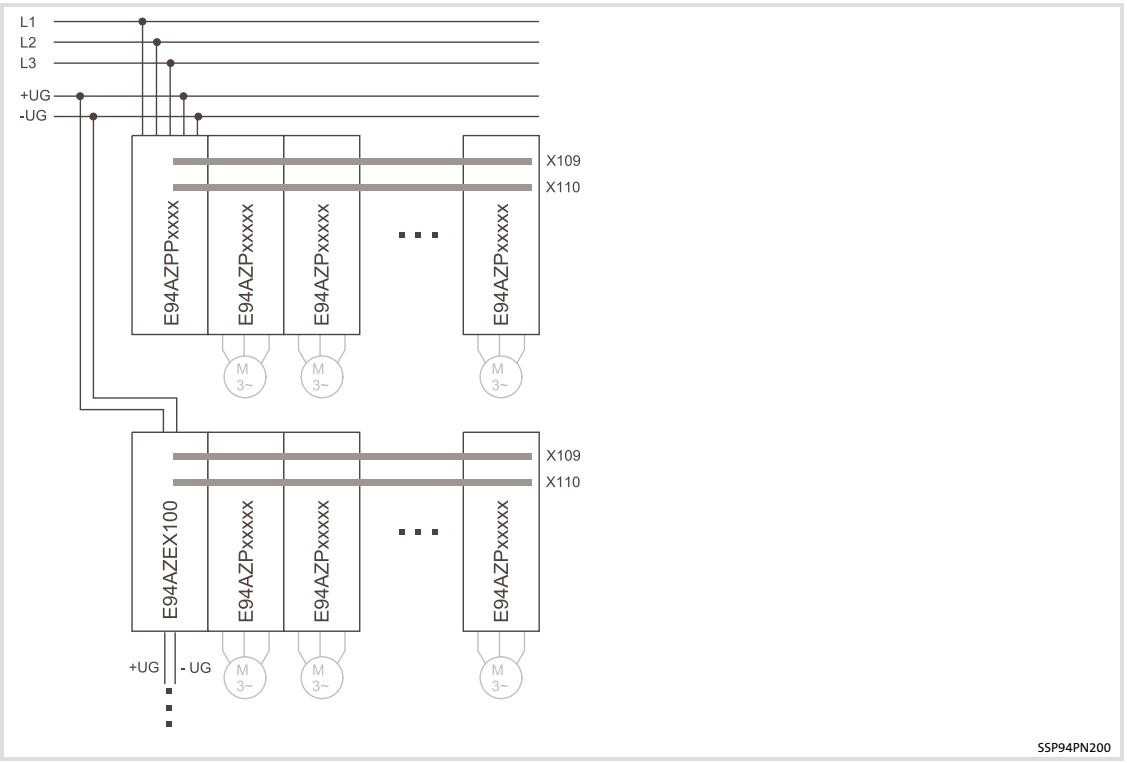


Fig. 4-10 Arrangement concept

Installation steps

Proceed as follows for installation:

1. Prepare M5 threaded holes on the mounting plate according to the mounting grid.
   – Start on the left with the mounting backplane of the E94AZPNxxxx DC power supply module or with the E94AZEX100 DC input module.
   – Install the axis modules from the left to the right with decreasing rated power.
   – Axis modules E94xMxE0324 and installation backplane E94AZPM0324 can only be connected directly to each other! A use with another device or installation backplane of size 3 is not permissible and is prevented through a plug protection.
2. Screw the mounting 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 must not jut out more than 7 mm.
3. Align all components.
4. When busbars are used: connect busbars.
5. Screw the components onto the mounting plate.
   – Tightening torque: 3.0 Nm (26 lb-in).

4.6.3 Devices in the range 47 ... 59 A (22 ... 30 kW)

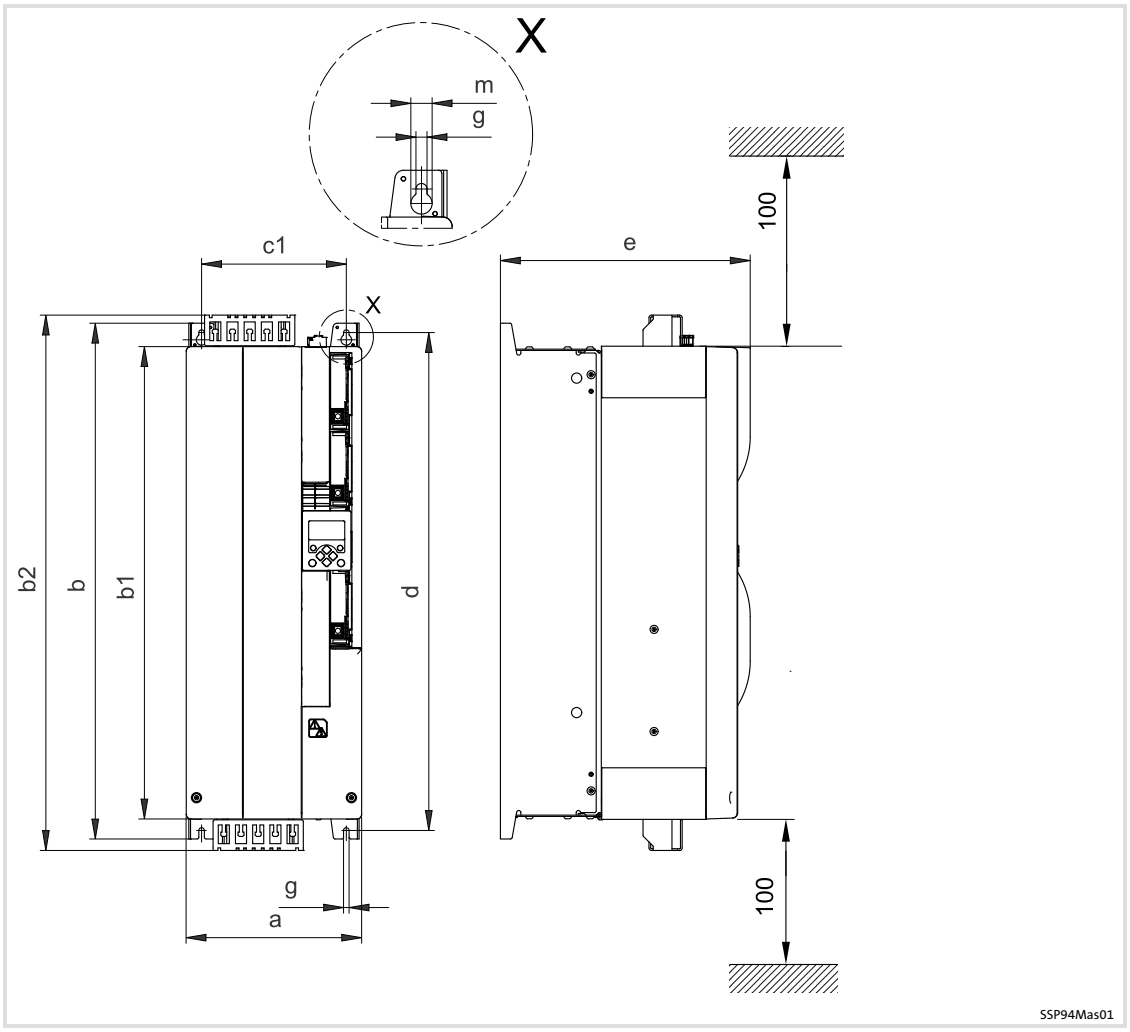


Fig. 4-11 Dimensions [mm]

Type	Dimensions [mm]									Weight [kg]	Device size
	a	b	b1	b2	e	c1	d	g	m		
E94xMxE0474	206	606	556	630	294	170	585	6.5	12.5	20.0	6
E94xMxE0594											

4.7 Wiring

4.7.1 Important notes

Danger!

Hazardous electrical voltage

All power connections carry a hazardous electrical voltage for a longer time after mains disconnection. Observe the information regarding the discharge time on the device.

Possible consequences:

► Death or severe injuries when touching the power terminals.

Protective measures:

► Before working on the power connections, wait at least until the discharge time has passed (depending on the device, this may be up to 20 minutes).

► Make sure that all power terminals are deenergised.

Danger!

Hazardous electrical voltage

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

Possible consequences:

► Death or severe injuries when touching the device in the event of an error.

Protective measures:

Implement the measures required in EN 61800-5-1. Especially:

► Fixed installation
  – Implement PE connection in compliance with standards.
  – Connect PE conductor twice or PE conductor cross-section ≥ 10 mm^2.

► Connection with a connector for industrial applications according to IEC 60309 (CEE):
  – PE conductor cross-section ≥ 2.5 mm^2 as part of a multi-core supply cable.
  – Provide for suitable strain relief.

Stop!

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

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



Stop!

No device protection if the mains voltage is too high

The mains input is not internally fused.

Possible consequences:

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

Protective measures:

► Observe the maximally permissible mains voltage.

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



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.



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.

4.7.2 Safety instructions for the installation according to UL/CSA

Note!

The fuse current given in the following is the maximum permissible value. This prevents fire and electrical hazard in the event of an error of the device.

The fuse must be smaller or equal to the maximum permissible value, taking the following into consideration:

- The maximum possible cable cross-section
- the laying system (e.g. tap installation)
- the ambient temperature
- the relevant regulations (e.g. UL508A, NEC70 and others).

Original - English

Warnings!

- Branch circuit protection:
  - Suitable for use on a circuit capable of delivering not more than 100 000 rms symmetrical amperes, 480 V max., when supplied by a rectified AC-supply as an UL listed Lenze unit, cat. no. E94A
  - Suitable for motor group installation on a circuit capable of delivering not more than 100 000 rms amperes, when supplied by a rectified AC-power supply of 480 V maximum, when protected by specified fuses.
  - Suitable for motor group installation on a circuit capable of delivering not more than 50 000 rms amperes (30 000 rms Amperes with fuse type 202922...), when supplied by a rectified AC-power supply of 480/277 V maximum, when protected by specified fuses.
  - Use specified fuses as shown in the table.
  - Above Short Circuit ratings are only valid when the assembly bases are used.
  - Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electrical Code / Canadian Electrical Code and any additional local codes.
- The opening of the branch circuit protective device may be an indication that a fault current has been interrupted. To reduce the risk of fire or electrical shock, current-carrying parts and other components of the controller should be examined and replaced if damaged. If burnout of the current element of an overload relay occurs, the complete overload relay must be replaced.
- For information on the protection level of the internal overload protection for a motor load in percent of FLA, 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.
- Max. surrounding air temperature is 45 °C.
- Max. surrounding air temperature with derating is 55 °C.
- Use 60/75 °C copper wire only, except for control circuits.
- Secondary circuit shall supplied from an external isolating source.
- These products are intended for use in a pollution degree 2 environment.
- These products are intended for use in overvoltage category III.

Assignment of devices - DC-fuses				
	+UG/-UG (X100)		Busbar (X109/X110)	
	Nominal value (max.)	Type	Nominal value (max.)	Type
Type	[A]		[A]	
E94xMxE0024 E94xMxE0034 E94xMxE0044	16	Siba 5020106.16 Siba 5020206.16	315	Eaton 170M1761 Eaton 170M1741
	63	Eaton 170M1754 Eaton 170M1734		
E94xMxE0074 E94xMxE0094	40	Siba 5020106.40 Siba 5020206.40		
	125	Eaton 170M1757 Eaton 170M1737		
E94xMxE0134 E94xMxE0174	100	Siba 2029220.100 Siba 2029221.100		
E94xMxE0244 E94xMxE0324	200	Eaton 170M1759 Eaton 170M1739		
E94xMxE0474 E94xMxE0594	315	170M1761 170M1741	-	-

Recommended fuse holder for type 170M...: Eaton (Bussmann) 170H1007

Original - French

Avertissement !

► Protection par disjoncteur :
- – Convient aux circuits non susceptibles de délivrer plus de 100 000 ampères symétriques eff., maxi. 480 V max., lorsque l'alimentation est fournie par une source de CA redressé en tant qu'unité Lenze certifié UL, n° de cat. E94A.
- – Convient aux installations de groupe moteur sur des circuits non susceptibles de délivrer plus de 50 000 ampères symétriques eff., lorsque l'alimentation est fournie par une source de CA redressé de 480/277 V maxi, et lorsque cette source est protégée par des fusibles fabriqués par Bussmann (Eaton).
- – Convient aux installations de groupe moteur sur des circuits non susceptibles de délivrer plus de 100 000 ampères eff., lorsque l'alimentation est fournie par une source de CA redressé de 480 V maximum, et lorsque cette source est protégée par des fusibles spécifiques.
- – Convient aux installations de groupe moteur sur des circuits non susceptibles de délivrer plus de 50 000 ampères eff. (30 000 ampères eff. avec type de fusible 202922...), lorsque l'alimentation est fournie par une source de CA redressé de 480/277 V maximum, et lorsque cette source est protégée par des fusibles spécifiques.
- – Utiliser les fusibles spécifiés comme indiqué dans le tableau.
- – Les courants nominaux de court-circuit ci-dessus sont valables uniquement en cas d'utilisation de plaques de montage.
- – La protection statique intégrée n'offre pas la même protection qu'un disjoncteur. Une protection par disjoncteur externe doit être fournie, conformément au National Electrical Code / Canadian Electrical Code, et aux autres dispositions applicables au niveau local.

► Le déclenchement du dispositif de protection du circuit de dérivation peut être dû à une coupure qui résulte d'un courant de défaut. Pour limiter le risque d'incendie ou de choc électrique, examiner les pièces porteuses de courant et les autres éléments du contrôleur ; les remplacer s'ils sont endommagés. Le relais de surcharge doit être remplacé en cas de grillage de l'élément traversé par le courant.

► Pour obtenir des informations sur le niveau de protection offert par la protection intégrée contre les surcharges du moteur (pourcentage de l'intensité assignée à pleine charge), se reporter aux manuels d'application ou aux systèmes d'aide logiciels.

► Pour obtenir des informations sur les caractéristiques assignées et sur le câblage du dispositif de protection thermique (concerne uniquement le raccordement aux moteurs dotés d'un dispositif de protection thermique intégré), se reporter aux manuels d'application ou aux systèmes d'aide logiciels.

- ► Température ambiante maximale : 45 °C
- ► Température ambiante maximale avec réduction de puissance : 55 °C
- ► Utiliser exclusivement des conducteurs en cuivre 60/75 °C, sauf pour les circuits de commande.
- ► Prévoir un circuit auxiliaire alimenté par une source de tension avec isolation galvanique.
- ► Ces produits sont destinés à un environnement caractérisé par le degré de pollution 2.
- ► Ces produits sont conçus pour une utilisation dans la catégorie de surtension III.

Combinaison entre les appareils et les fusibles CC

	+UG/-UG (X100)		Barre conductrice (X109/X110)	
	Valeur nominale (max.)	Type	Valeur nominale (max.)	Type
Type	[A]		[A]	
E94xMxE0024 E94xMxE0034 E94xMxE0044	16	Siba 5020106.16 Siba 5020206.16	315	Eaton 170M1761 Eaton 170M1741
	63	Eaton 170M1754 Eaton 170M1734		
E94xMxE0074 E94xMxE0094	40	Siba 5020106.40 Siba 5020206.40		
	125	Eaton 170M1757 Eaton 170M1737		
E94xMxE0134 E94xMxE0174	100	Siba 2029220.100 Siba 2029221.100		
E94xMxE0244 E94xMxE0324	200	Eaton 170M1759 Eaton 170M1739		
E94xMxE0474 E94xMxE0594	315	170M1761 170M1741	-	-

Porte-fusible recommandé pour Typ 170M... : Eaton (Bussmann) 170H1007

4.7.3 Earthing of internal EMC filters

Device-internal EMC filters have been implemented to reduce interference emission. These EMC filters are connected to protective earth to discharge interference currents.

Under certain conditions the EMC filters must be disconnected from:

- Operation in an IT system

  The devices are protected from damages or destruction due to incompatible overvoltages in the case of an error (earth fault).

- DC-bus operation
- Operation with power supply modules or regenerative power supply modules
- Operating multiple devices with a common filter

  The EMC properties can only be reached by carrying out the described measures.

  The triggering behaviour of applicable earth-leakage circuit breakers remains undisturbed.

Overview of the measures

The measures which are to be carried out once have been prepared in relation to the devices and are each described together with installation and wiring.

Device (GG = device size)	Measure in the case of operation ...	
	in the IT system	in the interconnected system, with power supply modules or shared filters
Inverter		
with installation backplane (GG1 ... GG3)	Insert plastic cap elsewhere	
without installation backplane (GG6 ... GG7)	Change screwed connection	
without installation backplane (GG81 ... GG83)	Change screwed connection	
without installation backplane (GG91)	Only factory-set measures are possible. Please specify when ordering.	
Power supply modules		
with installation backplane (GG1 und GG3)	No measure necessary	
without installation backplane (GG4 ... GG5)	No measure necessary	
Regenerative power supply modules		
with installation backplane (GG3)	Insert plastic cap elsewhere	
associated mains filter	Change screwed connection	No measure necessary

Device size 1 ... 3

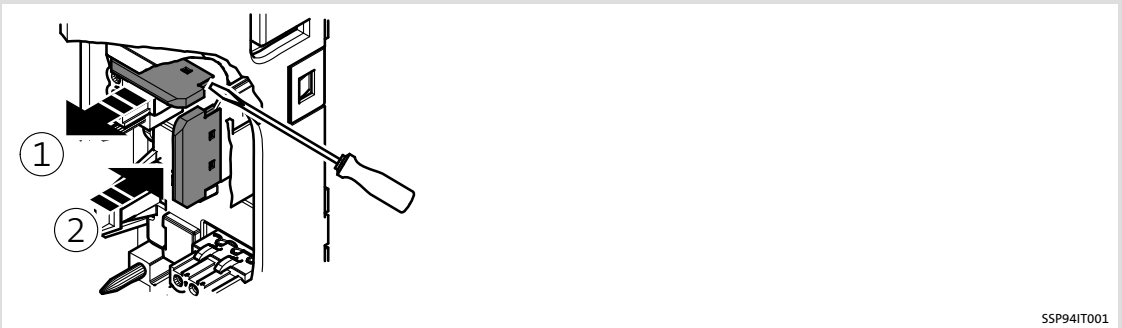


Fig. 4-12 Plugging the IT insulating cap onto the earthing jumper

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

1. Remove IT insulating cap from the parking position ① in the installation backplane.
   – For this apply a screwdriver on the right or left and lever off the insulating cap.
   – Optionally the insulating cap can be carefully removed using an appropriate pliers.
2. Attach IT insulating cap to the earthing jumper ② until it clicks into place.

Device size 6

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

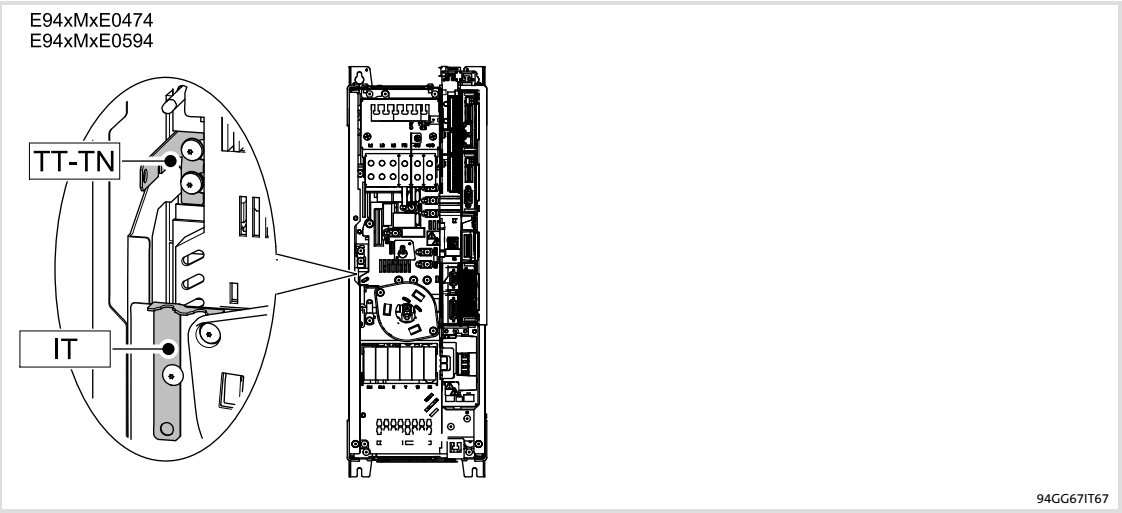


Fig. 4-13

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

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

4.7.4 Devices in the range 2 ... 32 A (0.37 ... 15 kW)

Example circuit

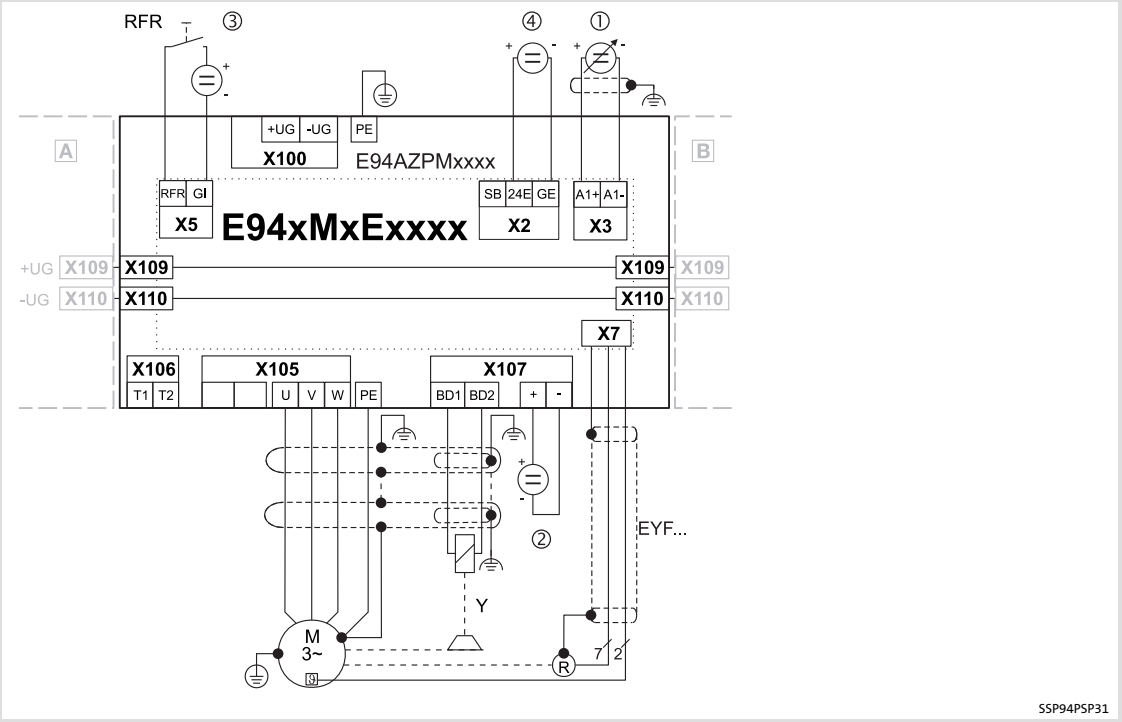


Fig. 4-14 Basic circuit diagram of the drive system

E94xMxExxxx	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.

Design of the cables

- The cables used must comply with the approvals required for the location (e.g. UL).
- The cross-section of the PE conductor must be dimensioned according to the relevant national regulations.
- 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.

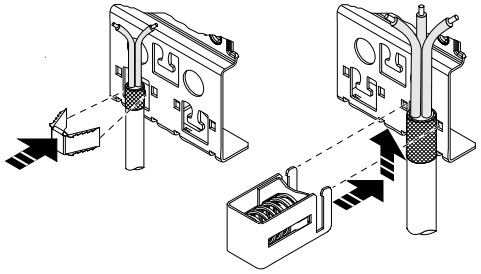
Use system cables or shielded cables for these connections:

- Motor
- Motor holding brake (shielding is required when being integrated into the motor cable; connection to optional motor brake control)
- Motor temperature monitoring
- DC bus, cable length from 0.3 m

The following connections need not be shielded:

- DC bus, cable length up to 0.3 m

How to connect the shield



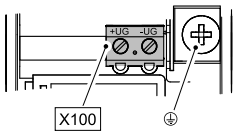
E94AZPS004

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.

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

Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device sizes 1 + 2: flexible with wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 5.3	PZ0
Device size 3: flexible with/without wire end ferrule	10/16	6	1.2 ... 1.5	10.6 ... 13.3	PH1

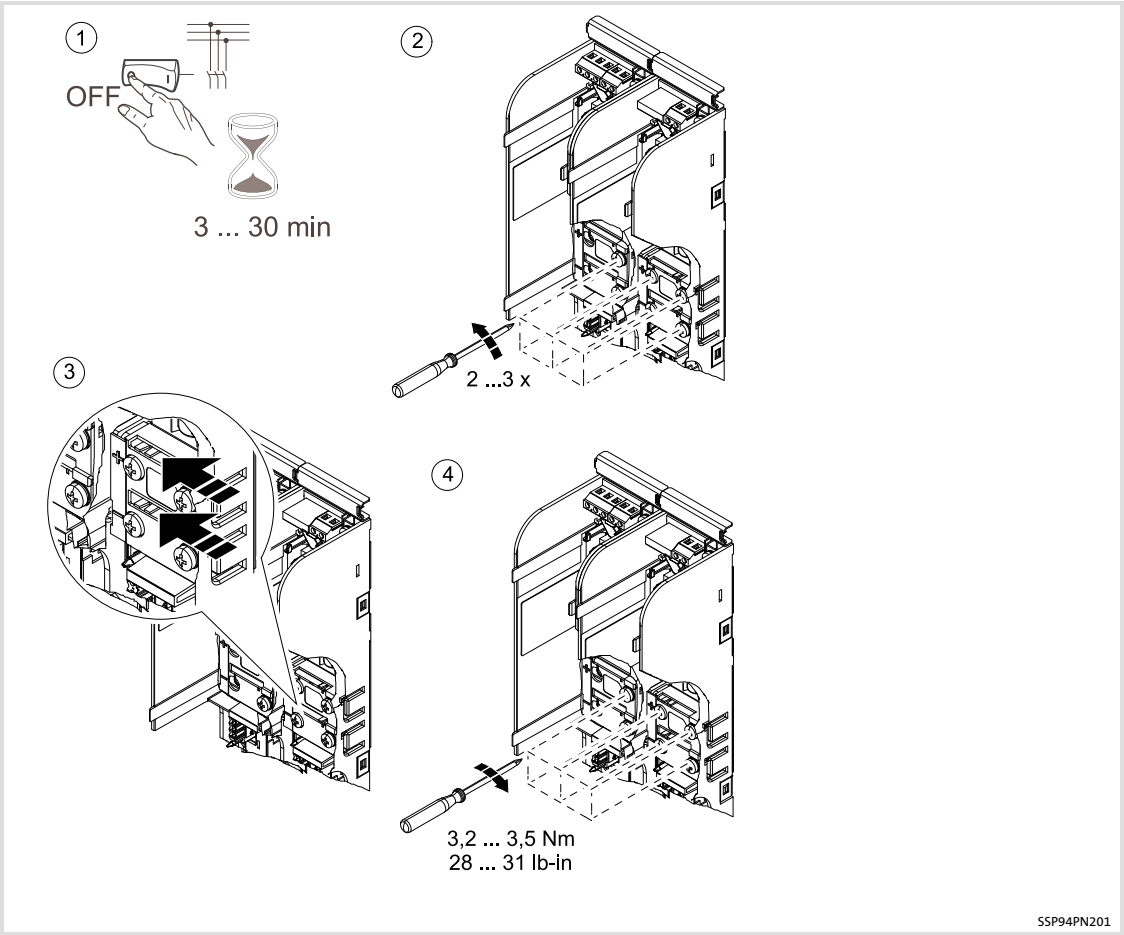
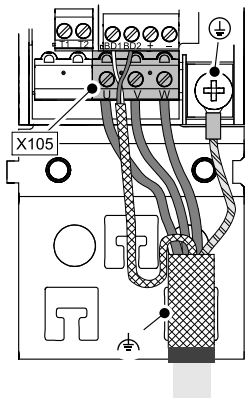


Fig. 4-15 Example: Connecting busbars

Proceed as follows to connect the busbars:

1. If devices of the interconnected system have already been in operation:
   – If necessary, switch off the supply system and wait until the discharge time has elapsed (depending on the device, this may take up to 20 minutes).
   – Make sure that all power terminals are deenergised.
2. Loosen the busbar screws (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 the components onto the mounting plate, if necessary.
   – Tightening torque: 3.0 Nm (26 lb-in).

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		
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device sizes 1 + 2: flexible with wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 5.3	PZ0
Device size 3: flexible with/without wire end ferrule	10/16	6	1.2 ... 1.5	10.6 ... 13.3	PH1

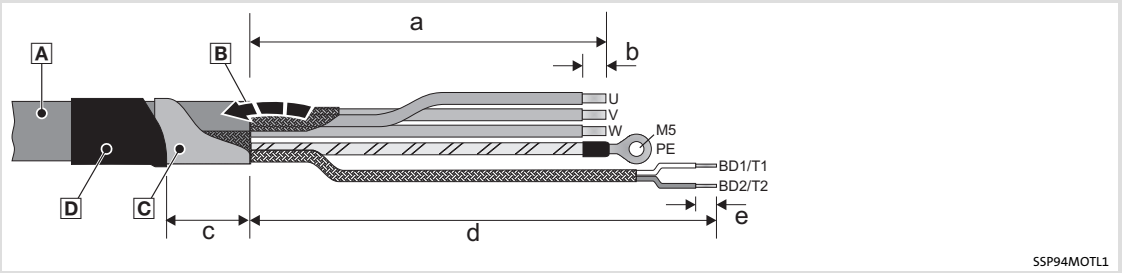


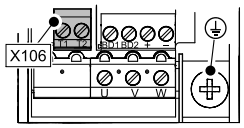
Fig. 4-16 Stripping lengths of the motor cable

	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		
	[mm²]	[AWG]	[Nm]	[lb-in]	
Flexible With wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 5.3	PZ0

Motor brake control (optional)

Note!

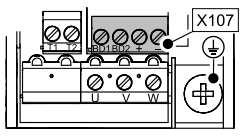
When the 24 V supply voltages (at X2) are applied and a motor holding brake is available, the devices respond as follows:

- ► Single Drive without mains or DC-bus voltage: The motor holding brake **cannot** be released.
- ► Multi Drive without DC-bus voltage: The motor holding brake can be released.

Tip!

For detailed information on the motor holding brake control modules, please see the chapter Accessories (📖 141).

For information on the E94AZHX0051 motor holding brake control module optionally contained in the installation backplane, please see the chapter Accessories starting on page 456.

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		
	[mm²]	[AWG]	[Nm]	[lb-in]	
Flexible With wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 5.3	PZ0

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 standard device must be observed!



Stop!

Requirements concerning 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 concerning 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.

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.

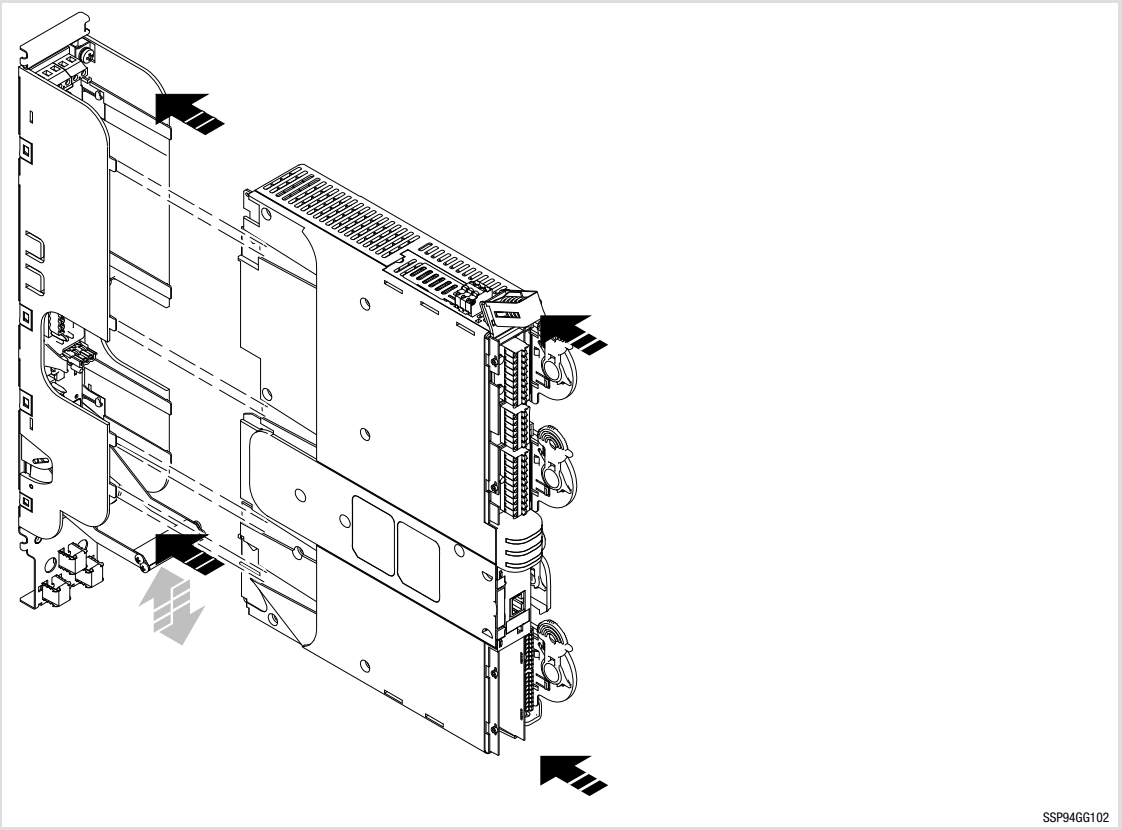


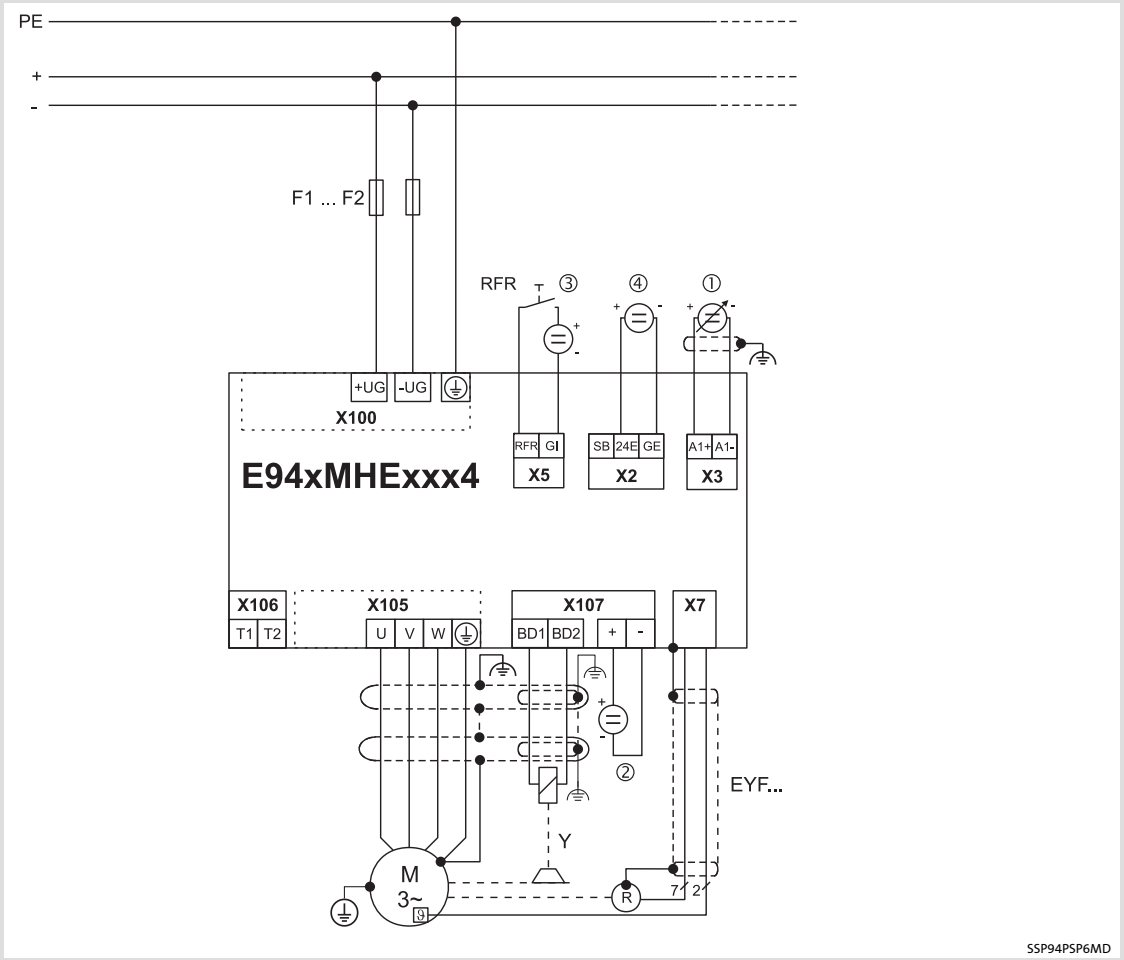
Fig. 4-17 Installation of the device

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.

4.7.5 Devices in the range 47 ... 59 A (22 ... 30 kW)

Example circuit



E94xMxExxxx	9400 Multi Drive servo axis module
F1 ... F2	Fuses, UL-certified types: 170M1761 or 170M1741, max. 315 A
⏚	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 the control electronics

Design of the cables

- The cables used must comply with the approvals required for the location (e.g. UL).
- The cross-section of the PE conductor must be dimensioned according to the relevant national regulations.
- 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.

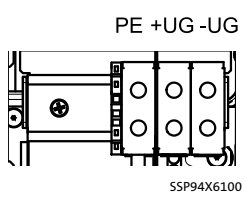
Use system cables or shielded cables for these connections:

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

The following connections need not be shielded:

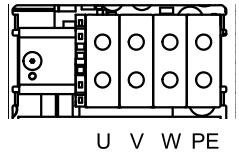
- 24 V supply
- Digital signals (inputs and outputs)

DC bus

Terminal X100	Labelling	Description
 SSP94X6100	+UG -UG	DC-bus voltage connection
	PE	Connection for the PE conductor on the supply side

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

Motor

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

Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device size 6: Flexible With wire end ferrule	50	0	10	88.5	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		
	[mm²]	[AWG]	[Nm]	[lb-in]	
flexible with wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 5.3	Slot 0.6 x 3.5

Motor brake control (optional)

Note!

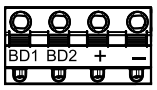
When the 24 V supply voltages (at X2) are applied and a motor holding brake is available, the devices respond as follows:

- ► Single Drive without mains or DC-bus voltage: The motor holding brake **cannot** be released.
- ► Multi Drive without DC-bus voltage: The motor holding brake can be released.

Tip!

For detailed information on the motor holding brake control modules, please see the chapter Accessories (📖 141).

For information on the E94AZHX0051 motor holding brake control module optionally contained in the installation backplane, please see the chapter Accessories starting on page 456.

Terminal X107	Labelling	Description
 SSP94X6107	BD1 BD2	Connection of the motor holding brake + (Lenze: WH) - (Lenze: BN) E94AZHx0101: 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		
	[mm²]	[AWG]	[Nm]	[lb-in]	
flexible with wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 5.3	Slot 0.6 x 3.5

4.8 Control terminals



Danger!

Hazardous electrical voltage

All power connections carry a hazardous electrical voltage for a longer time after mains disconnection. Observe the information regarding the discharge time on the device.

Possible consequences:

► Death or severe injuries when touching the power terminals.

Protective measures:

► Before working on the power connections, wait at least until the discharge time has passed (depending on the device, this may be up to 20 minutes).

► Make sure that all power terminals are deenergised.



Stop!

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

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



Note!

Installation inside the control cabinet

► Always install cables close to the mounting plate (reference potential), as freely suspended cables act like antennas.

► Use separated cable ducts for motor cables and control cables. Do not mix up different cable types in one cable duct.

► Before leaving the control cabinet, connect the shield of the fieldbus cable to the mounting plate in accordance with EMC requirements.



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.

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)

System bus CAN on board

The drive controller has an integrated CANopen system bus interface for the exchange of process data and parameter values between different nodes and for the connection of additional modules such as distributed terminals, operator and input devices (”HMIs”) as well as external control units. The software manual contains additional information in this regard.

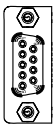
Overview of general data and conditions of use	
Field	**Values**
Communication profile	CANopen (DS301, V4.02)
Communication medium	CAN cable in accordance with ISO 11898-2
Network topology	Line closed at both ends (e.g. closed with Lenze system connector EWZ0046)
Node addresses that can be set	1 ... 127 (can be set by means of DIP switch or code)
Max. number of nodes	127
Transfer rates [kBit/s]	10 ... 1000 (can be set by means of DIP switch or code)
Conformity, approvals	• CE • UL

The transfer rate limits the overall cable length.

Transfer rate [kBit]	Maximum bus length [m]
10	8075
20	4012
50	1575
125	600
250	275
500	112
800	38
1000	12

The segment cable length is limited by the cable cross-section used and the number of nodes. Repeaters divide the overall cable length into segments. Without repeaters, the segment cable length is the same as the overall cable length.

Max. number of nodes per segment	**Segment length [m] in relation to cable cross-section** (Interpolation is permissible)			
	0.25 mm^2 (AWG 24)	0.50 mm^2 (AWG 21)	0.75 mm^2 (AWG 19)	1.00 mm^2 (AWG 18)
2	240	430	650	940
5	230	420	640	920
10	230	410	620	900
20	210	390	580	850
32	200	360	550	800
63	170	310	470	690
100	150	270	410	600

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

24 V supply

The controller of the ”Multi Drive” 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.

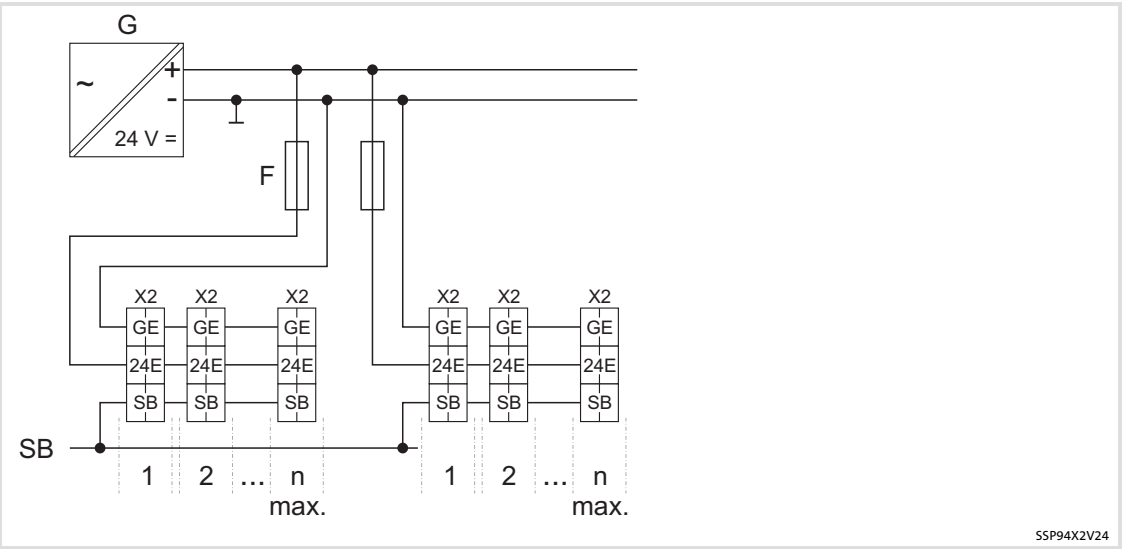


Fig. 4-18 Wiring principle

g	24 V external supply (e.g. EZV...)
F	Fuse
X2	Terminal for 24 V and state bus
GE/24E/SB	Labelling on the terminal
SB	State bus
1 ... n	E94x... 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)
	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				

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	Continuous operation: 2.4 A Switch-on: 4 A for 100 ms Controller enable: 4 A for 300 ms
	Fuse	Circuit breaker with tripping characteristic B or C, Standard blade-type fuses
	Looping through	Max. 7 devices with 2.5 mm² Fusing: 16/15 A
		Max. 4 devices with 1.5 mm² Fusing: 10/10 A
	Connectable cross-cuttings	See terminal data

Warnings!

Up to hardware version 1x, take the following tino consideration:
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
	Switching level	According to IEC 61131-2
	LOW	0 V ... +5 V
	HIGH	+15 V ... +30 V
	Looping through	Max. 20 devices DC-bus operation with 9300 devices is possible.
	Connectable cross-cuttings	See terminal data

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 ... +10 V
	Resolution:	11 bits + sign
	Scaling:	±10 V ≡ $\pm 2^{30}$
	Conversion rate:	1 kHz
Analog input 1 as current input (A1R and A1- bridged)	Level:	-20 ... +20 mA
	Resolution:	10 bits + sign
	Scaling:	For C00034 = "1" -20 ... -4 mA ≡-2^{30} ... 0 +4 ... +20 mA ≡0 ... $+2^{30}$
		For C00034 = "2" ±20 mA ≡ $\pm 2^{30}$
	Conversion rate:	1 kHz
	Open-circuit monitoring:	Configurable
Analog output 1 Analog output 2	Level:	-10 ... +10 V (max. 2 mA)
	Resolution:	11 bits + sign
	Scaling:	±10 V ≡ $\pm 2^{30}$
	Conversion rate:	1 kHz

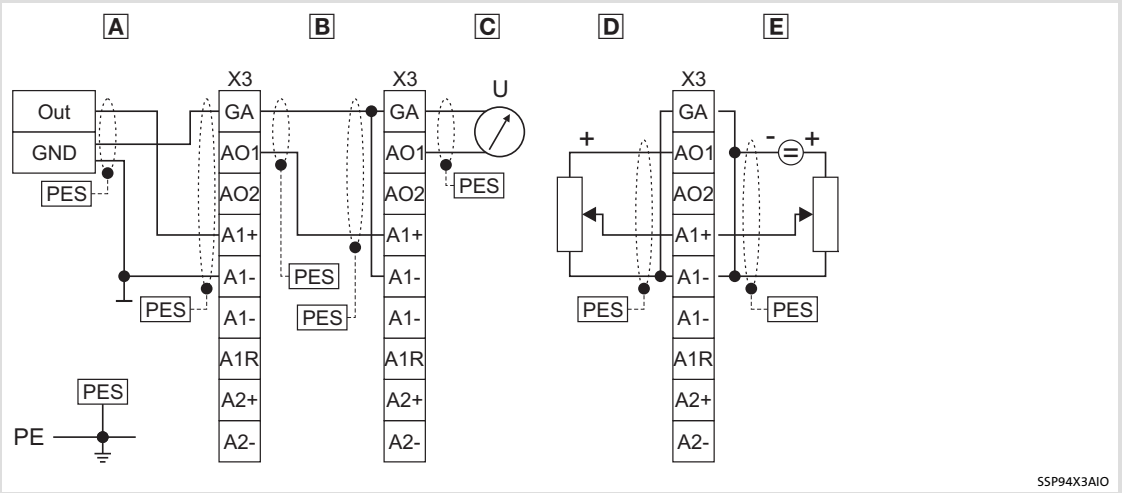


Fig. 4-19 Wiring principle

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

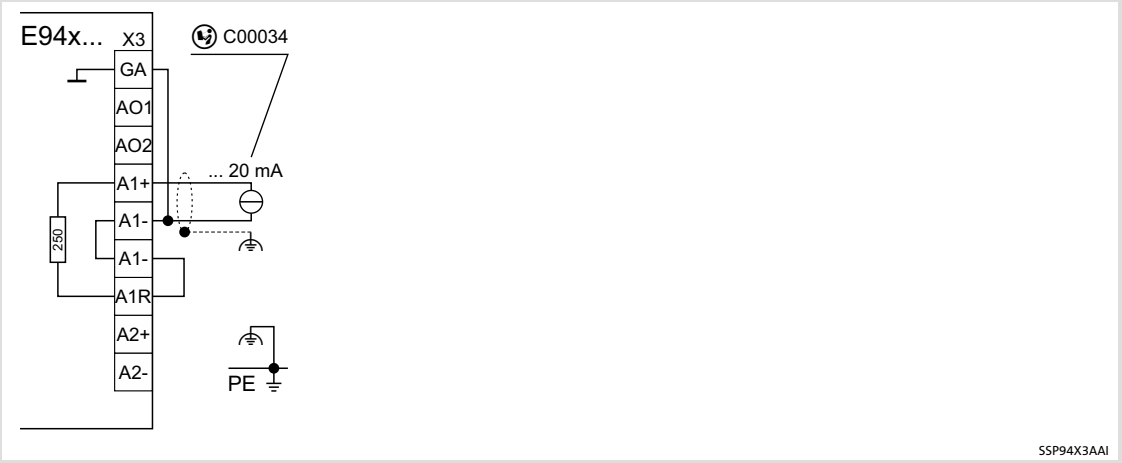
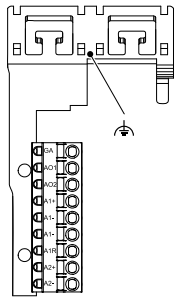


Fig. 4-20 Wiring principle of current input

F Wiring of a current signal
X3 Terminal for the analog inputs and outputs
Read information on the input configuration (software manual)
Functional earth
PE Protective earth

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.

Digital outputs

The controller features four freely configurable digital outputs.

Electrical data			
24O GO	24 V external voltage source, optional		according to IEC 61131-2 SELV/PELV
	Current consumption		Max. 300 mA
DO1 ... DO4 GO	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.

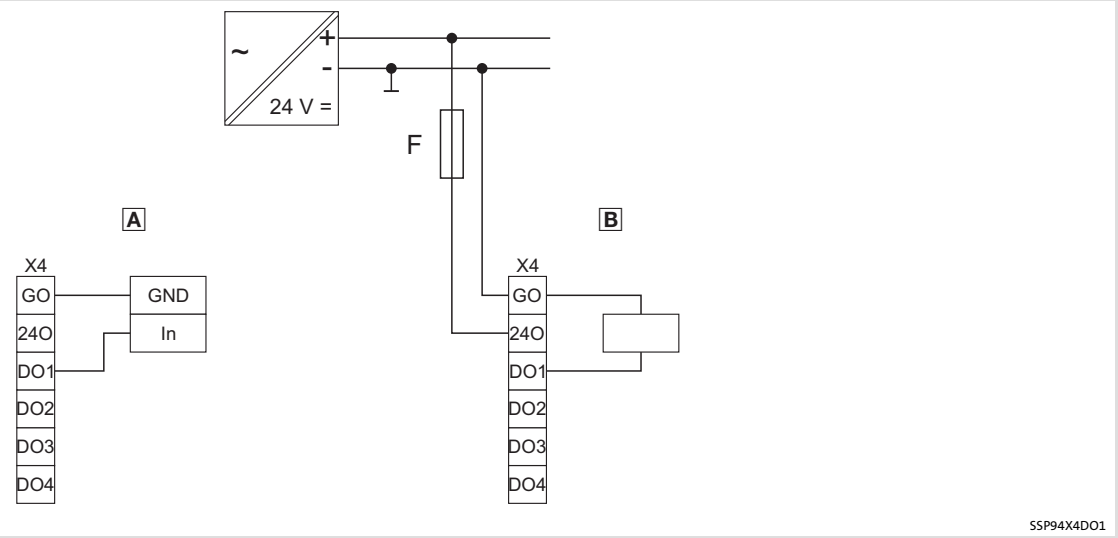


Fig. 4-21 Wiring principle

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

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				

Digital inputs

The controller is provided with freely configurable digital inputs which can be used for touch probe measurement (edge-controlled event).

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.

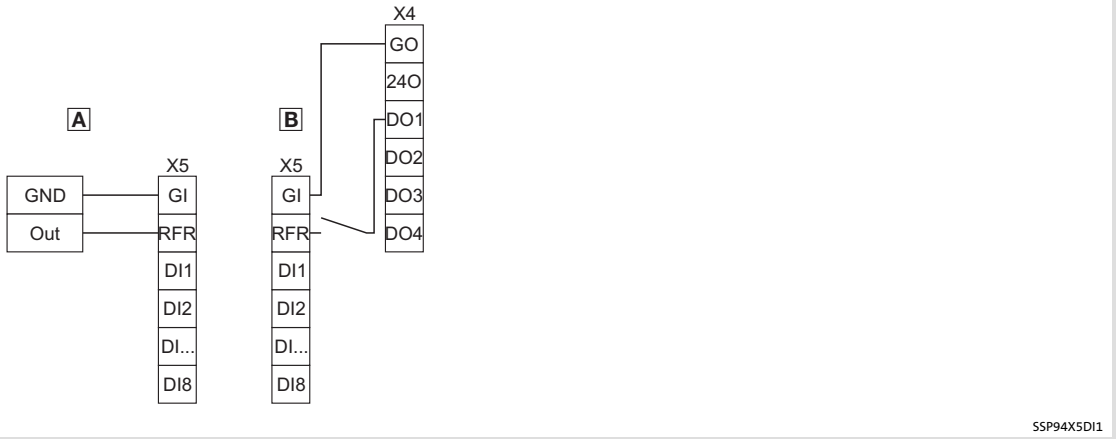


Fig. 4-22 Wiring principle

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

Terminal X5	Labelling	Description
 9400SSP000X5	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
	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				

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 (100 m [1])
V_{CC}, -KTY (GND)	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

[1] If safety functions with SM301 are used which require safe speed and position detection.

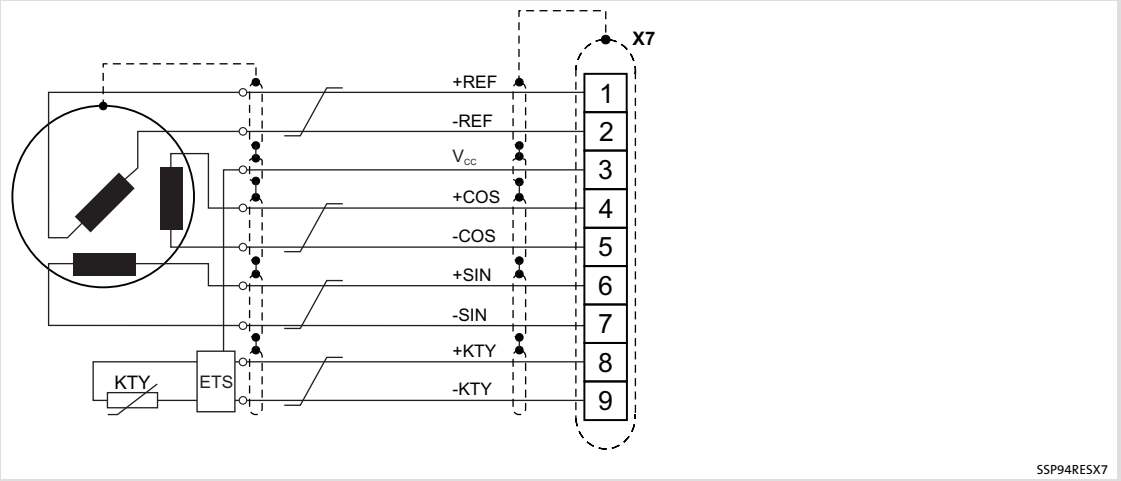
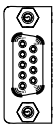


Fig. 4-23 Wiring principle

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)
  - SSI load encoder with Stegmann protocol (as of 9400 with firmware 05.00)
- 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
  - not with SSI encoders
- The following encoders are not supported:
  - HTL encoders

Electrical data			
General	Cable length (system cable recommended)		max. 150 m (100 m [1])
	Encoder types		TTL 1 V_{SS}
	Protocols		Hiperface EnDat 2.1 SSI-Stegmann
	Number of increments		1 ... 16384
	Input frequency		max. 500 kHz
VCC (GND)	Supply voltage		5 V ... 12 V
	Max. load capacity,	5 ... 9 V	330 mA
		9 ... 12 V	3 W
		at 12 V	250 mA
+Sense, -Sense	Measuring lead for readjusting V_{CC}		
+KTY, -KTY	Type		KTY 83-110

[1] If safety functions with SM301 are used which require safe speed and position detection.

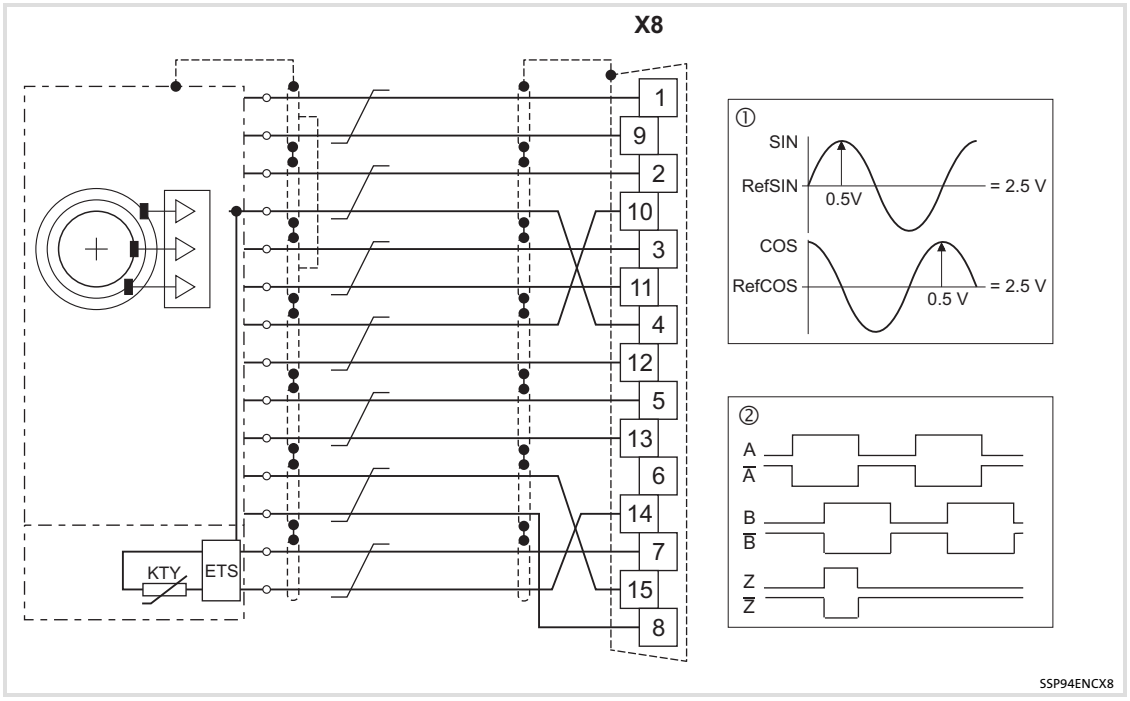
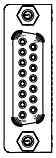


Fig. 4-24 Wiring principle

① Signals of a sin/cos encoder
② Signals with CW rotation

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

Setting the supply voltage

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

The voltage is adapted by means of the parameter ”Encoder voltage”, C00421.

Encoder	U_r	Voltage setting [V] in C00421 for cable length [m]						
Product key	[V]	0 - 10	10 - 30	30 - 50	50 - 70	70 - 90	90 - 100	100 -150
TTL								
IG2048-5V-T	5 ±5%	5.0	5.0	5.1	5.1	5.2	5.2	5.3
IG4096-5V-T								
IK2048-5V-T								
Sin-cos								
IG1024-5V-V	5 ±5%	5.0	5.0	5.1	5.1	5.2	5.2	5.3
IG2048-5V-S								
Sin-cos (Hiperface)								
AM1024-8V-H	8 (7 ... 12)	8.0						
Sin-cos (Endat)								
AM32-5V-E	5 ±5%	5.0						
AS2048-5V-E								
AM2048-5V-E								

Tab. 4-2

U_r Rated encoder voltage

The values listed in Tab. 4-2 are valid for the use of Lenze system cables at typical ambient temperatures.

Other cables, other cable cross-sections or extreme ambient temperatures can require metrologically determined adaptations.

For a higher encoder supply power, e.g. for laser-based length measuring systems, an external encoder supply must be provided.

4.9 Device modules

Depending on the device version or the application, the device is equipped with device modules. A nameplate attached to the side of the device serves to identify the already equipped device modules .

The possible modules are briefly described in the Accessories chapter. Detailed information can be found in the respective documentation.

4.10 Preparing the commissioning procedure

For commissioning you require:

- A computer with Windows® operating system (XP or 2000)
- The Lenze PC software »Engineer«
- A connection to the controller via an interface, e.g.:
  – Diagnostic interface X6 with USB diagnostic adapter
  – System bus CAN
  – Communication modules in the extension slots MXI1/MXI2
- The Software Manual for the technology application used
- The Communication Manual for the automation platform network
- 24-V voltage supply for control electronics of the controller
- DC-bus voltage

Follow the software instructions and/or read the documentation.

5 Power supply module

5.1 Device features

The most important device features at a glance:

- Power supply modules supply the DC buses of several controllers of a drive system with energy.
- Power supply modules are the central AC mains connection in a DC-bus operation.
- Power supply modules have an internal brake chopper and a terminal for a brake resistor.
- 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.
- 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.
- Power supply modules are designed as multi-range voltage units (230/400/480 V).
- Four types of 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
- Power supply modules are assigned to specially designed mains filters and RFI filters.
- Power supply modules and filters can be mounted in the mounting grid of the 9400 series.

5.2 General data and operating conditions

General data

Conformity and approval			
Conformity			
CE	2014/35/EU	Low-Voltage Directive	
CE	2014/30/EU	EMC Directive	
UKCA	S.I. 2016/1101	The Electrical Equipment (Safety) Regulations 2016	
UKCA	S.I. 2016/1091	The Electromagnetic Compatibility Regulations 2016	
Approval			
$_{C}UL_{US}$	UL61800-5-1	Industrial Control Equipment (File No. E132659) for USA	
	CSA C22.2 No. 274-13	Industrial Control Equipment (File No. E132659) for Canada	

Mains data			
Mains types	With earthed Y point	Unrestricted use	
	IT systems	Unrestricted use Observe instructions about special measures concerning the axis controllers connected!	
Noise emission	EN 61800-3	Conducted: cannot be specified because dependent on the conditions present in the interconnected system	
		Radiation: category C3	
Noise immunity (in accordance with EN 61800-3)			
Electrostatic discharge (ESD)	EN 61000-4-2	8 kV with air discharge, 4 kV with contact discharge to housing	
High frequency			
Cable-guided	EN 61000-4-6	150 kHz ... 80 MHz, 10 V/m 80 % AM (1kHz)	
Interference (housing)	EN 61000-4-3	80 MHz ... 1000 MHz, 10 V/m 80 % AM (1kHz)	

Protection of persons and devices			
Enclosure	EN 60529	IP 20	Not in the wire range of the lower terminals
	NEMA 250	Protection against contact in accordance with type 1	
Insulation resistance	EN 61800-5-1	Overvoltage category III from 2000 m amsl: external measures for complying with the overvoltage category II are required, e.g. ● connecting isolating transformer upstream ● connecting overvoltage protection system upstream	
Insulation of control circuits	EN 61800-5-1	up to 2000 m amsl: Safe mains isolation by double/reinforced insulation for mains with neutral earthing with a rated voltage for the external conductor/star point up to 300 V. from 2000 m amsl: If an overvoltage protection system is connected upstream, additional external separating measures are required for maintaining the safe mains isolation.	
Short-circuit strength	EN 61800-5-1	DC-bus connection: Not short-circuit-proof Brake resistor connection: without restrictions Control connections: without restrictions	
Discharge current	EN 61800-5-1	> 3.5 mA	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 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
Clearance		
above/beneath		Comply with the device-relating mounting instructions.
at the side		Can be installed in a row 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”.

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 from +45 ... +55 °C: 2.5 %/°C Operation with mains choke: Current derating from +40 ... +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	Degree of pollution 2
Vibration resistance (9.81 m/s² = 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/s²
		200 ... 500 Hz: acceleration resistant up to 15 m/s²
Operation	Germanischer Lloyd	5 ... 13.2 Hz: Amplitude ±1 mm 13.2 ... 100 Hz: acceleration resistant up to 0.7 g
	IEC/EN 60068-2-6	10 ... 57 Hz: Amplitude 0.075 mm
		57 ... 150 Hz: Acceleration resistant up to 1 g

Assignment of filters to standard devices

DC power supply module	Mains filter (corresponds to "long distance")	RFI filter (corresponds to "short distance")	Mains choke
E94APNE0104	E94AZMP0084	E94AZRP0084	EZAELN3008B372
E94APNE0364	E94AZMP0294	E94AZRP0294	EZAELN3030B981
E94APNE1004	E94AZMP0824	E94AZRP0824	EZAELN3080B371
E94APNE2454	E94AZMP2004	E94AZRP2004	EZAELN3200B151

With RFI filters, EMC categories can be achieved.

With mains filters, EMC categories and a power increase P_{DC} can be achieved.

With mains chokes, a power increase P_{DC} is achieved (through reduction of the harmonic content). For adherence to EMC categories, additional further measures are necessary.

General electrical data

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

5.3 Rated data

5.3.1 Overview

Input data

	Voltage	Frequency	Rated current [A]		Number of phases
	[V]	[Hz]	up to +45 °C ①	up to +55 °C ①	
E94APNE0104	230/400/480	50/60	8/8/8	6/6/6	3
E94APNE0364	230/400/480	50/60	29/29/29	21.8/21.8/21.8	3
E94APNE1004	230/400/480	50/60	82/82/82	61/61/61	3
E94APNE2454	230/400/480	50/60	200/200/200	150/150/150	3

① Temperature in the control cabinet

Output data

	Voltage	Current [A]		Number of phases
Type	[V]	up to +45 °C ①	up to +55 °C ①	
E94APNE0104	325/565/675	10/10/10	7.5/7.5/7.5	-
E94APNE0364	325/565/675	36/36/36	27/27/27	-
E94APNE1004	325/565/675	100/100/100	75/75/75	-
E94APNE2454	325/565/675	245/245/245	184/184/184	-

① Temperature in the control cabinet

5.3.2 Operation at rated mains voltage 230 V

Input data

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

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

Mains	Voltage	Voltage range	Frequency range
	U_{DC} [V]	U_{DC} [V]	f [Hz]
2/PE DC	325	260 - 0 % ... 370 + 0 %	-

Type	Output current and output power					
	100 %		5-s cycle		3-min cycle	
	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	41.6	150	31.2
E94APNE1004 + E94AZMP0824	100	27.9	200	55.8	150	41.9
E94APNE2454	245	51	368	76.5	368	76.5
E94APNE2454 + E94AZMP2004	245	68.5	368	103	368	103

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

Rated data for internal brake chopper

Type	R_{Bmin} [Ω]	I_{BRmax} [A]	P_{BRmax} [kW]	I_{BRd} [A]	P_{Bd} [kW]	t_Z [s]	t_{on} [s]	t_{fp} [s]
E94APNE0104	18.0	21.7	8.5	7.9	1.1	4.3	0.5	0.5
E94APNE0364	6.0	65.0	25.4	29.1	5.1	3.0	0.5	0.5
E94APNE1004	2.5	156	60.8	62.7	9.8	3.6	0.5	0.5
E94APNE2454	1.4	279	109	112	17.5	3.6	0.5	0.5

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

Note on the brake chopper data

Due to thermal load, the resistance value changes and therefore the dependent rated data as well.

The brake chopper can output the peak braking power maximally for the specified time t_{on} within a cycle time t_Z.

The brake chopper can output the peak braking power from unloaded states once for the time t_{fp}, e. g. after mains connection or after a recovery time of > 5 x t_Z.

If the times are exceeded, the brake chopper is clocked so that only the continuous braking power is output. This serves to the protection of the brake chopper, however, it does not protect the brake resistor. The brake resistor connected can be protected separately by a thermal contact.

5.3.3 Operation at rated mains voltage 400 V

Input data

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

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

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

Type	Output current and output power					
	100 %		5-s cycle		3-min cycle	
	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	72.4	150	54.3
E94APNE1004 + E94AZMP0824	100	48.6	200	97.2	150	72.9
E94APNE2454	245	88.6	368	133	368	133
E94APNE2454 + E94AZMP2004	245	119	368	179	368	179

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

Rated data for internal brake chopper

Type	R_{Bmin} [Ω]	I_{BRmax} [A]	P_{BRmax} [kW]	I_{BRd} [A]	P_{Bd} [kW]	t_Z [s]	t_{on} [s]	t_{fp} [s]
E94APNE0104	27.0	26.9	19.5	9.7	2.6	4.3	0.5	0.5
E94APNE0364	12.0	60.4	43.8	27.0	8.7	3.0	0.5	0.5
E94APNE1004	5.0	145	105	58.2	17.0	3.6	0.5	0.5
E94APNE2454	2.8	259	188	104	30.3	3.6	0.5	0.5

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

Note on the brake chopper data

Due to thermal load, the resistance value changes and therefore the dependent rated data as well.

The brake chopper can output the peak braking power maximally for the specified time t_{on} within a cycle time t_Z.

The brake chopper can output the peak braking power from unloaded states once for the time t_{fp}, e. g. after mains connection or after a recovery time of > 5 x t_Z.

If the times are exceeded, the brake chopper is clocked so that only the continuous braking power is output. This serves to the protection of the brake chopper, however, it does not protect the brake resistor. The brake resistor connected can be protected separately by a thermal contact.

5.3.4 Operation with rated mains voltage 480 V

Input data

Mains	Voltage	Voltage range	Frequency range
	U_{Lrated} [V]	U_{Lrated} [V]	f [Hz]
3/PE AC	480	340 - 0 % ... 528 + 0 %	45 - 0 % ... 65 + 0 %

Type	Voltage [V]	Continuous input power S_L [kVA]
E94APNE0104	480	6.6
E94APNE0364	480	24.1
E94APNE1004	480	68.1
E94APNE2454	480	166

Output data

Mains	Voltage	Voltage range	Frequency range
	U_{DC} [V]	U_{DC} [V]	f [Hz]
2/PE DC	675	480 - 0 % ... 746 + 0 %	-

Type	Output current and output power					
	100 %		5-s cycle		3-min cycle	
	I_{DC} [A]	P_{DC} [kW]	I_{DC} [A]	P_{DC} [kW]	I_{DC} [A]	P_{DC} [kW]
E94APNE0104	10	4.3	40	17.2	15	6.5
E94APNE0104 + E94AZMP0084	10	5.8	40	23.3	15	8.7
E94APNE0364	36	15.6	108	48.8	54	23.4
E94APNE0364 + E94AZMP0294	36	21.0	108	63.0	54	31.5
E94APNE1004	100	43.4	200	86.8	150	65.1
E94APNE100 + E94AZMP0824	100	58.3	200	117	150	87.5
E94APNE2454	245	106	368	159	368	159
E94APNE2454 + E94AZMP2004	245	143	368	215	368	215

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

Rated data for internal brake chopper

Type	R_{Bmin} [Ω]	I_{BRmax} [A]	P_{BRmax} [kW]	I_{BRd} [A]	P_{Bd} [kW]	t_Z [s]	t_{on} [s]	t_{fp} [s]
E94APNE0104	27.0	28.3	21.7	10.3	2.8	4.3	0.5	0.5
E94APNE0364	12.0	63.8	48.8	28.5	9.7	3.0	0.5	0.5
E94APNE1004	5.0	153	117	61.4	18.9	3.6	0.5	0.5
E94APNE2454	2.8	273	209	110	33.7	3.6	0.5	0.5

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

Note on the brake chopper data

Due to thermal load, the resistance value changes and therefore the dependent rated data as well.

The brake chopper can output the peak braking power maximally for the specified time t_{on} within a cycle time t_Z.

The brake chopper can output the peak braking power from unloaded states once for the time t_{fp}, e. g. after mains connection or after a recovery time of > 5 x t_Z.

If the times are exceeded, the brake chopper is clocked so that only the continuous braking power is output. This serves to the protection of the brake chopper, however, it does not protect the brake resistor. The brake resistor connected can be protected separately by a thermal contact.

5.3.5 Fuses and cable cross-sections

Mains	Voltage	Voltage range	Frequency range
	U_{Lrated} [V]	U_{Lrated} [V]	f [Hz]
3/PE AC	230 ... 480	180 - 0 % ... 528 + 0 %	45 ... 65

Installation in accordance with EN 60204-1

The data are recommendations. Other dimensioning/laying systems are possible (e.g. according VDE 0298-4).

The cable cross-sections apply under the following conditions:

- Use of PVC-insulated copper cables
- Conductor temperature < 70 °C, ambient temperature < 45°C
- No bundling of cables or cores
- Three loaded cores

Type	①	②	L1, L2, L3 - laying system			FI [1]
			B2	C	F	
	[A]	[A]	[mm²]	[mm²]	[mm²]	[mA]
E94APNE0104	C16	-	2.5	2.5	-	≥ 300
E94APNE0364	C40	-	10.0	10.0	-	≥ 300
E94APNE1004	-	125	-	50	50	≥ 300
E94APNE2454	-	315	-	-	150 (2 x 70)	≥ 300

① Circuit breaker
② Fuse of the utilisation category gG/gL or semiconductor fuses or the utilisation category gRL
1) Universal-current-sensitive earth-leakage circuit breaker, RCD type B
If several devices or cable lengths > 50 m are used, it is possible that the circuit breaker will respond, depending on the type of cable and the switching frequency.
2) Device with integrated mains choke
Observe national and regional regulations!

Installation to UL

Only use UL-approved cables, fuses and fuse holders.

UL fuse: Voltage 600 V; CC, J or T class fuses

Type	standard installation		motor group installation		FI [1]
	① valeur nominale (max.)	L1, L2, L3	① valeur nominale (max.)	L1, L2, L3	
	[A]	[AWG]	[A]	[AWG]	[mA]
E94APNE0104	15	14	15	14	≥ 300
E94APNE0364	60	6	60	6	≥ 300
E94APNE1004	125	1	125	1	≥ 300
E94APNE2454	300	300 mcm 2 x 1/0	300	300 mcm 2 x 1/0	≥ 300

① Fuse

1) Universal-current-sensitive earth-leakage circuit breaker, RCD type B
If several devices or cable lengths > 50 m are used, it is possible that the circuit breaker will respond, depending on the type of cable and the switching frequency.

2) Device with integrated mains choke

3) The directive for a "group installation" according to UL508A or NEC, CEC must be considered.

Observe national and regional regulations!

5.3.6 Mains filters for power supply modules

When using the mains filters assigned, conditions must be observed for compliance with EMC class C2:

- The measures for the use on IT systems must be applied to all axis modules in the interconnection (separation of internal filter components from PE, (📖 358)).
- The maximum sum total of all motor cable lengths ($\Sigma\ l_{mot}$) for the filter used must be observed.

Motor cable lengths in the interconnection

The assigned filters are designed for $\Sigma\ l_{mot}$
(E94AZRPxxx4: 60 m (= 6 x 10 m), E94AZMPxxx4: 500 m (= 10 x 50 m)).

For a different number of axis modules, $\Sigma\ l_{mot}$ can be determined from the following diagrams.

Maximum total of motor cable lengths [m] for the achievement of EMC Category C2

Number of axes	Power supply module with	
	RFI filter E94AZRPxxx4 (short distance)	**Mains filter E94AZMPxxx4** (long distance)
1	67.5	100
2	67.5	200
3	67.5	300
4	65	400
5	62.5	500
6	60	600
7	57.5	575
8	55	550
9	52.5	525
10	50	500
11	47.5	475
12	45	450
13	42.5	425
14	40	400
15	37.5	375
16	35	350
17	32.5	325
18	30	300
19	27.5	275
20	25	250

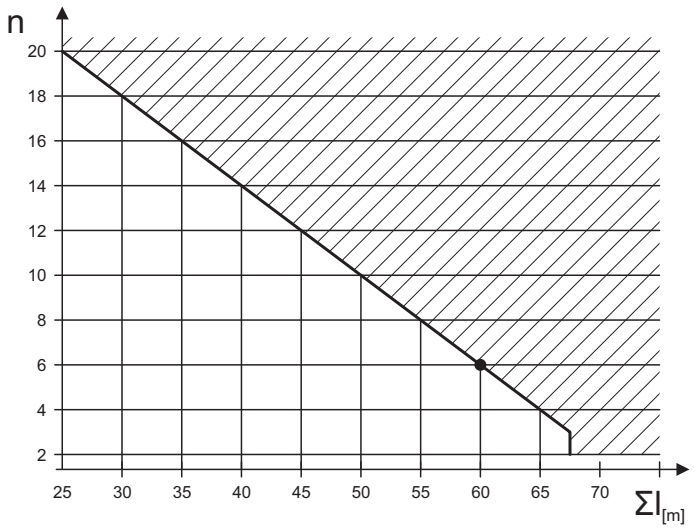


Fig. 5-1 Filter E94AZMP...SDB (short distance): total motor lengths according to number of axis modules

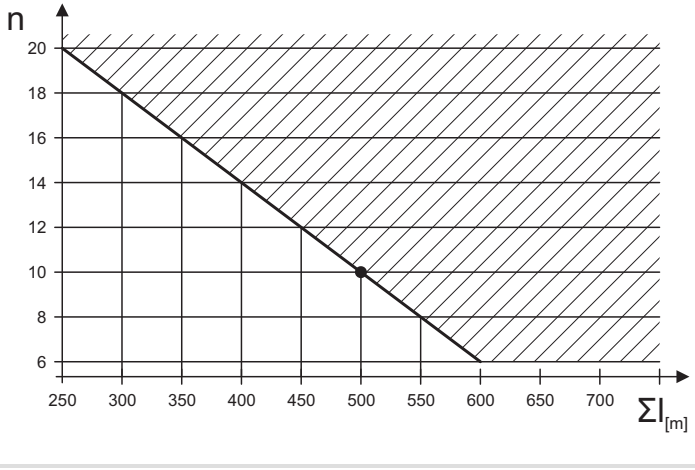


Fig. 5-2 Filter E94AZMP...LDB (long distance): total motor lengths according to axis modules

With different motor cable lengths, per axis at least 25 % of the longest cable must be considered when calculating the total motor cable length.

Example: 1	Motor cable length l_{mot} [m]		
Axis	**Actual value**	**min. 25 % of the longest cable**	**To be considered**
1	6	0.25 * 20 = 5	6
2 ... 4	3 * 10		3 * 10
5	20	⇦	20
Total	56	max. permissible for 5 axes: ∑< 60	**56**
		EMC class C2 will be complied with.	☑

Example 2	Motor cable length l_{mot} [m]		
Axis	**Actual value**	**min. 25 % of the longest cable**	**To be considered**
1 ... 4	4 * 5	0.25 * 40 = 10	4 * 10
5	40	⇦	40
Total	60	max. permissible for 5 axes: ∑< 60	**80**
		EMC class C2 will not be complied with.	☒

Constellations with unfavourable or intensifying parasitic couplings

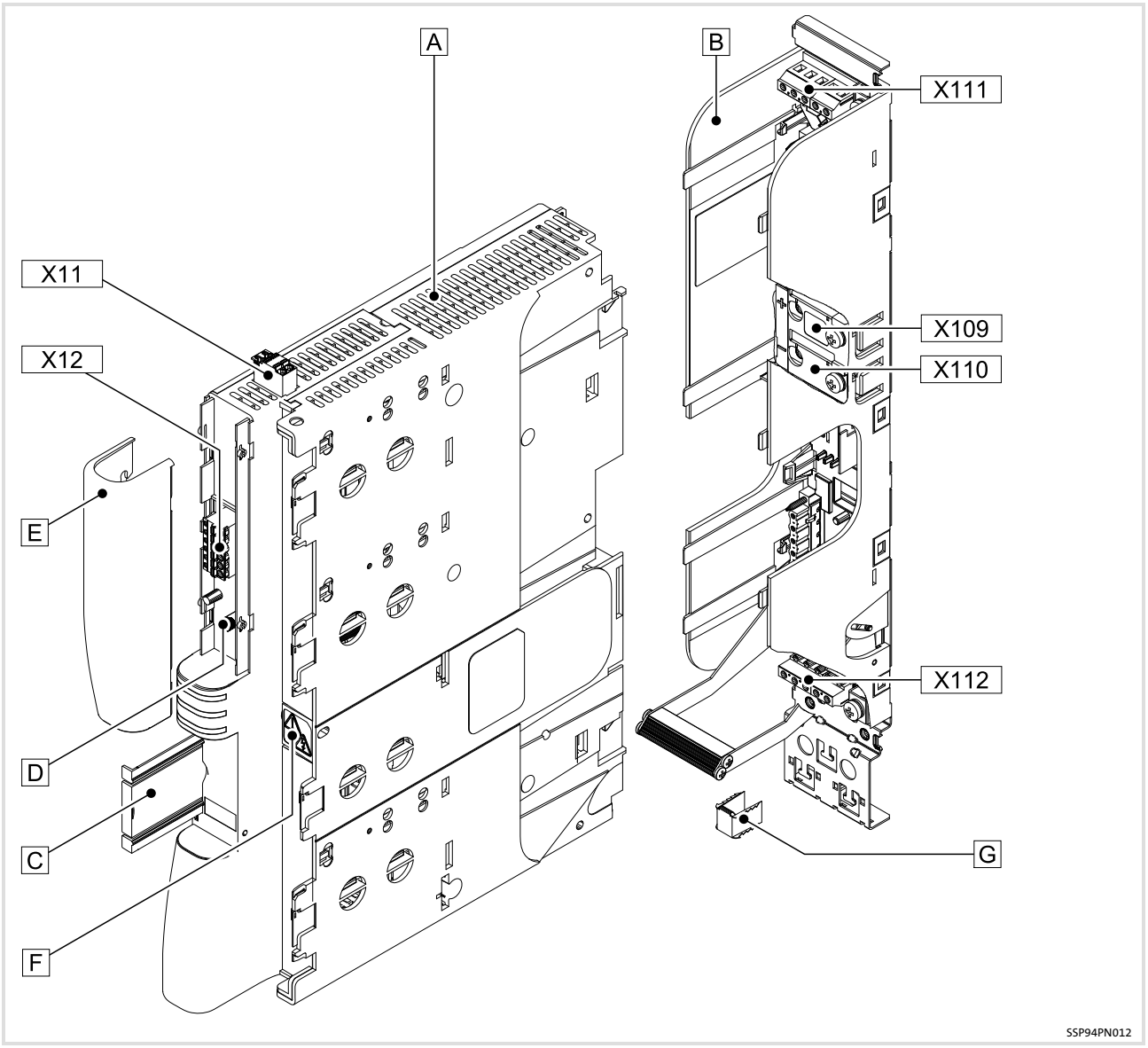
Compliance with EMC category C2 may also be interfered with by other circumstances:

- Distribution of the axis modules over several control cabinets without efficient HF equipotential bonding between the mounting plates
- No use of Lenze system cables or cables with the same specifications
- Poor connection of motor cable shields
- Motor cable interruptions
- Other interference sources (e.g. switched-mode power supplies)
- Isochronous switching of the inverter output stages

5.4 Device description

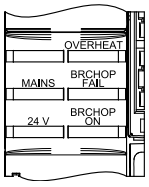
This page remains blank to give you a clearly arranged overview of the following subject on the next double page.

5.4.1 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.



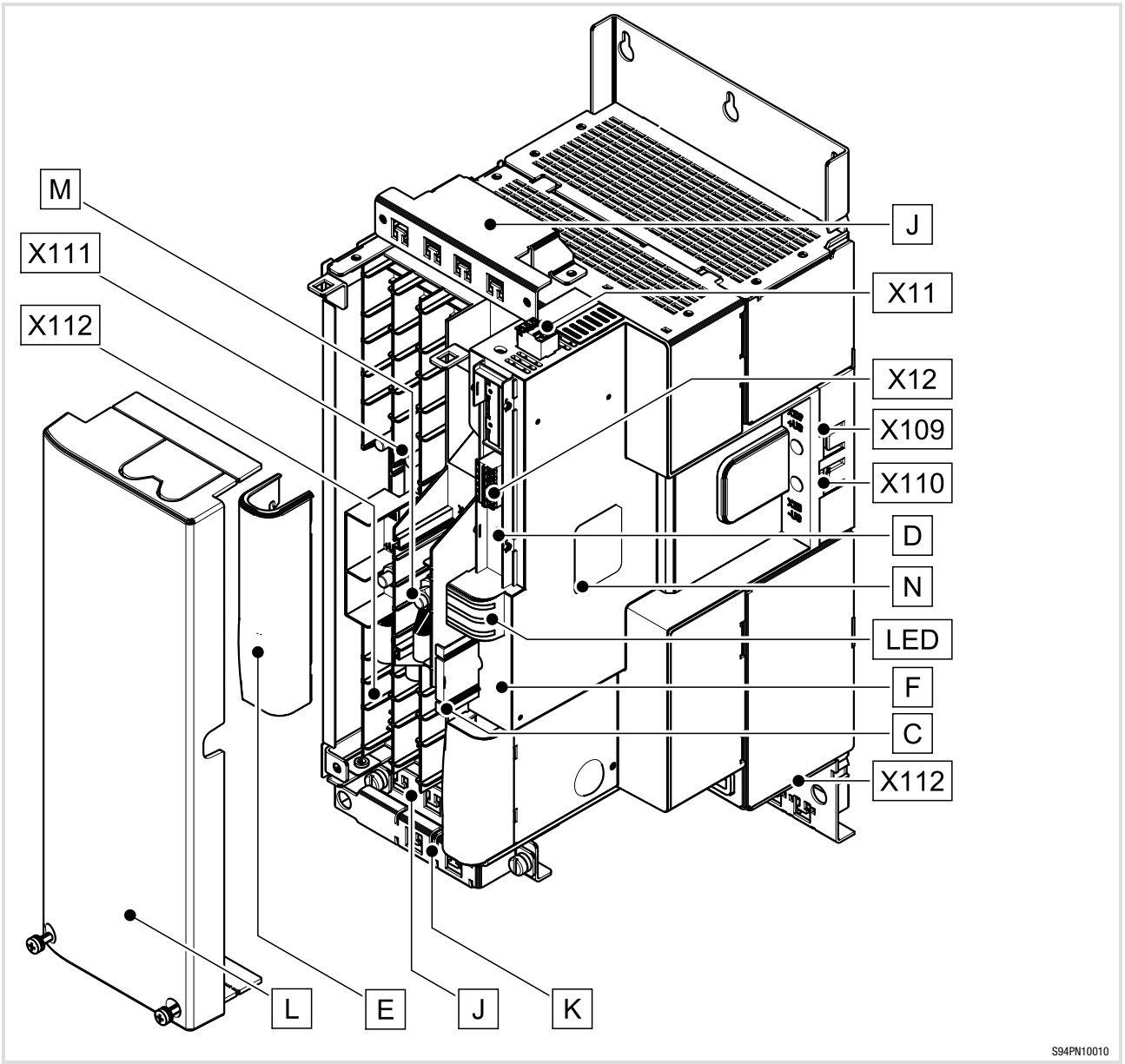
SSP94LED21

LED	labelling	Colour	Description
	-	-	-
	OVERHEAT	red	Overtemperature
	MAINS	green	without function
	BRCHOP FAIL	red	Short circuit in brake chopper
	24 V	green	24 V supply voltage o.k.
	BRCHOP ON	yellow	Brake chopper active

Pos.	Symbol	Description
F		**Long discharge time**: All power terminals carry hazardous electrical voltages for a longer period of time after mains disconnection! Depending on the device, this period of time may be up to 20 minutes.
		High discharge current: Carry out fixed installation and PE connection according to EN 61800-5-1!
		Electrostatic sensitive devices: Before working on the device, the personnel must be free of electrostatic charge!

Installation backplane 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	

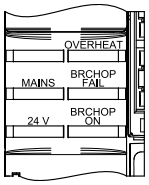
5.4.2 Devices in the range 100 ... 245 A (48 ... 119 kW)



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	without function
	BRCHOP FAIL	red	Short circuit in brake chopper
	24 V	green	24 V supply voltage o.k.
	BRCHOP ON	yellow	Brake chopper active

Pos.	Symbol	Description
F		**Long discharge time**: All power terminals carry hazardous electrical voltages for a longer period of time after mains disconnection! Depending on the device, this period of time may be up to 20 minutes.
		**High discharge current**: Carry out fixed installation and PE connection according to EN 61800-5-1!
		**Electrostatic sensitive devices**: Before working on the device, the personnel must be free of electrostatic charge!

5.5 Mechanical installation

5.5.1 Important notes

Note!

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

- The mounting location must always comply with the operating conditions specified in the technical data (📖 242). Take additional measures if necessary.
- The mounting plate of the control cabinet must have the following properties:
  – electrically conductive
  – free of lacquer
- The mechanical connections must always be ensured.
- A free air circulation must be ensured for dissipating the heat.
- The described EMC properties are provided if the following conditions are complied with:
  – The devices are mounted according to the arrangement concept described.
  – The prepared cables are used and remain unchanged.

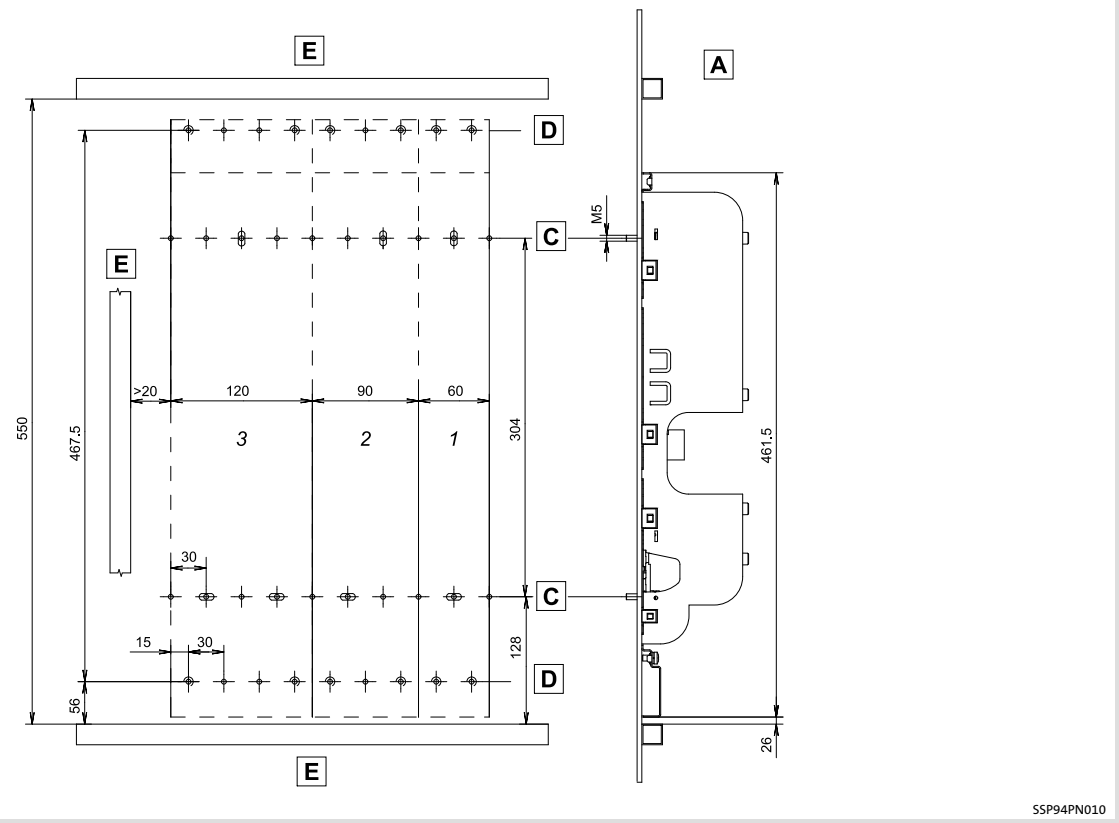
5.5.2 Devices in the range 10 ... 36 A (4 ... 18 kW)

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.

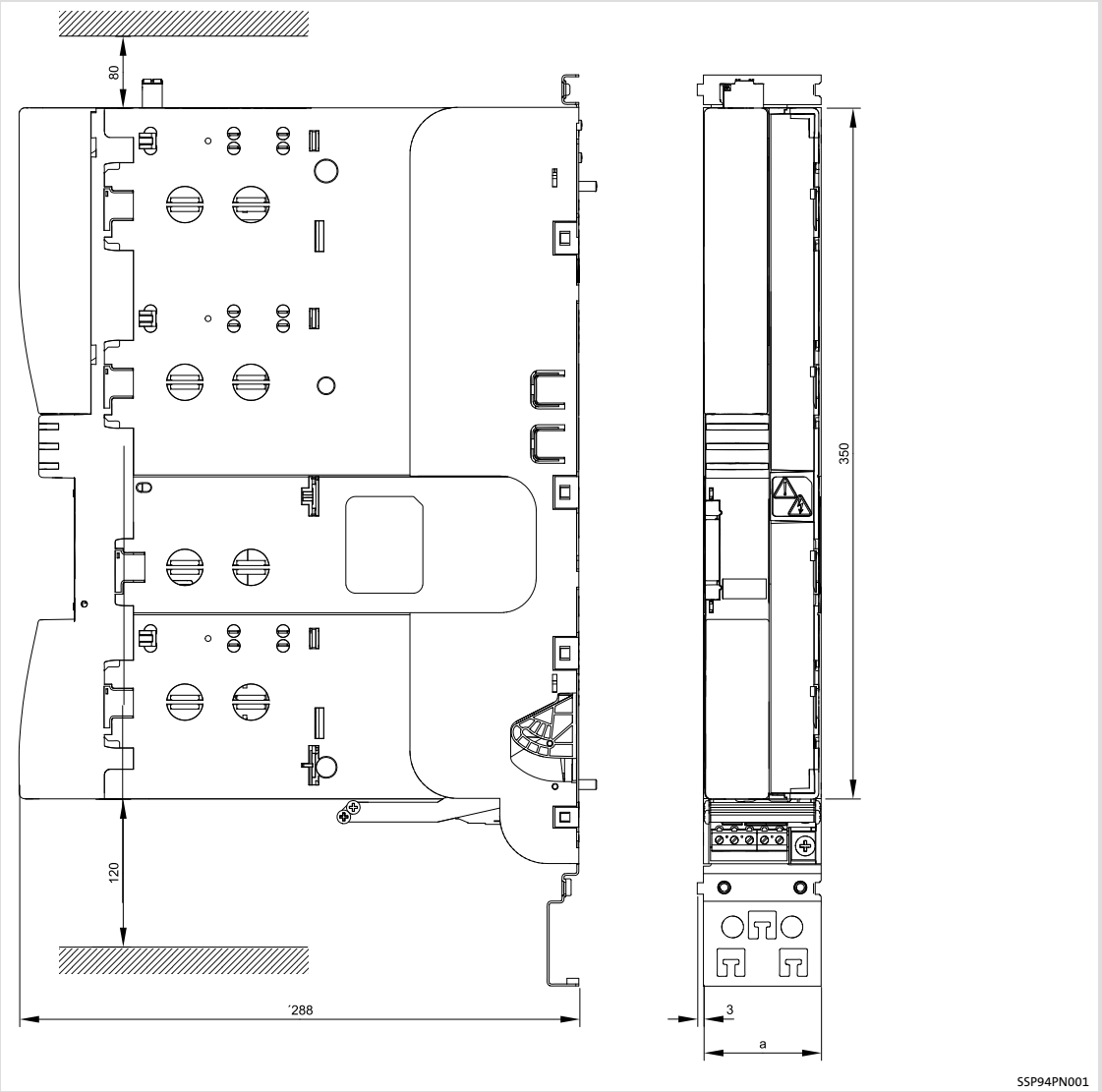
Note!

- ► Permissible are M5 screw and washer assemblies or hexagon socket screws with washer.
- ► Tightening torque: 3.0 Nm / 26 lb-in.
- ► The screw joint in the installation backplane may jut out no 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

Standard device with installation backplane



Type		Dimensions a	Weight
Power supply module	**Installation backplane**	[mm]	[kg]
E94APNE0104	E94AZPP0104	60	2.6
E94APNE0364	E94AZPP0364	120	5.3

Arrangement of the devices

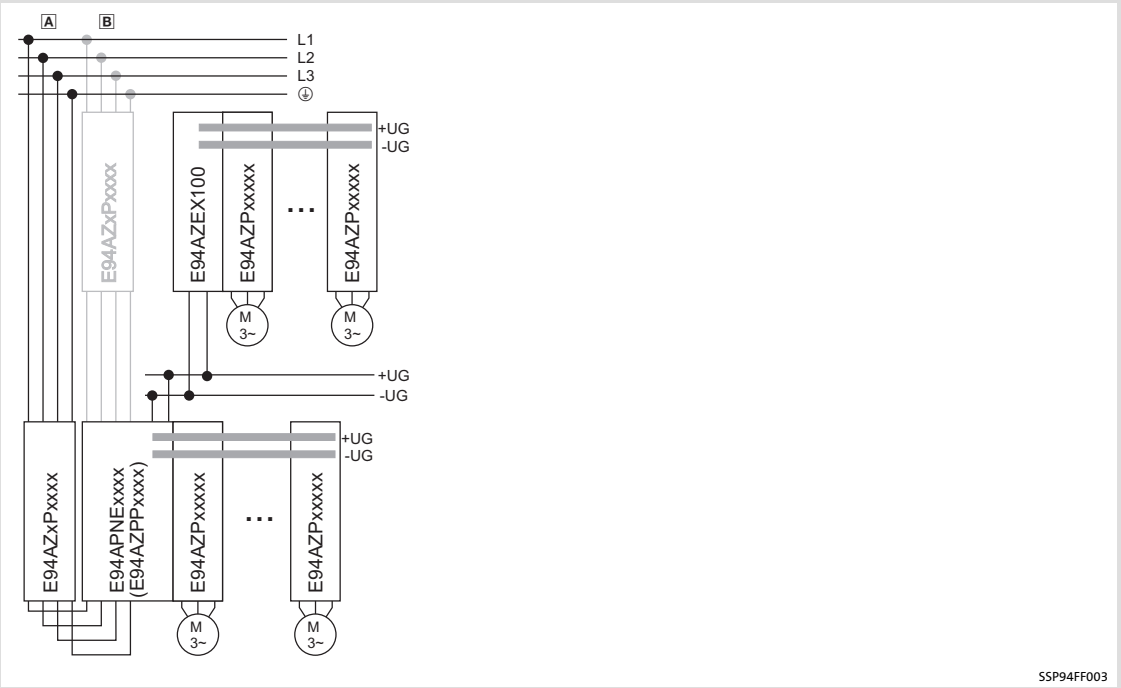


Fig. 5-3 Arrangement concept

A	Standard mounting: side mounting
B	Mounting variant: top mounting
E94AZxPxxxx	Filter
E94APNExxxx	9400 DC power supply module
	(up to 36 A/18 kW with E94AZPPxxxx installation backplane)
E94AZEX100	DC input module
E94AZPxxxxx	Installation backplane for 9400 axis module

A DC-bus connection has to be planned and dimensioned taking the technical data into account.

How to arrange the devices via the DC busbars for operation in the DC-bus connection:

- ► Arrange the devices in a row from left to right.
- ► Install the supplying device on the left:
  - – DC power supply module (in a first row),
  - – DC input module (in the following rows).
- ► Install the multi drive axis controllers to the right from the highest to the lowest power (recommendation).
- ► For increasing the braking power also single drive axis controllers can be integrated. For this purpose these axis controllers have to be equipped with the optional busbar mounting set (E94AZJAxxx).

Note!

If the first axis module is not connected to the DC busbar, the cable between power supply module and axis module must not be longer than 5 m.

Installation steps

Proceed as follows for installation:

1. Prepare mounting plate with M5 threaded holes according to the mounting grid.
   – Start on the left with the installation backplane of the DC power supply module E94AZPNxxxx.
   – 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 tighten the screws yet.
   – Use M5 screw and washer assemblies 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. When busbars are used: Connect busbars.
5. Tightly screw the components onto the mounting plate.
   – Tightening torque: 3.0 Nm (26 lb-in).

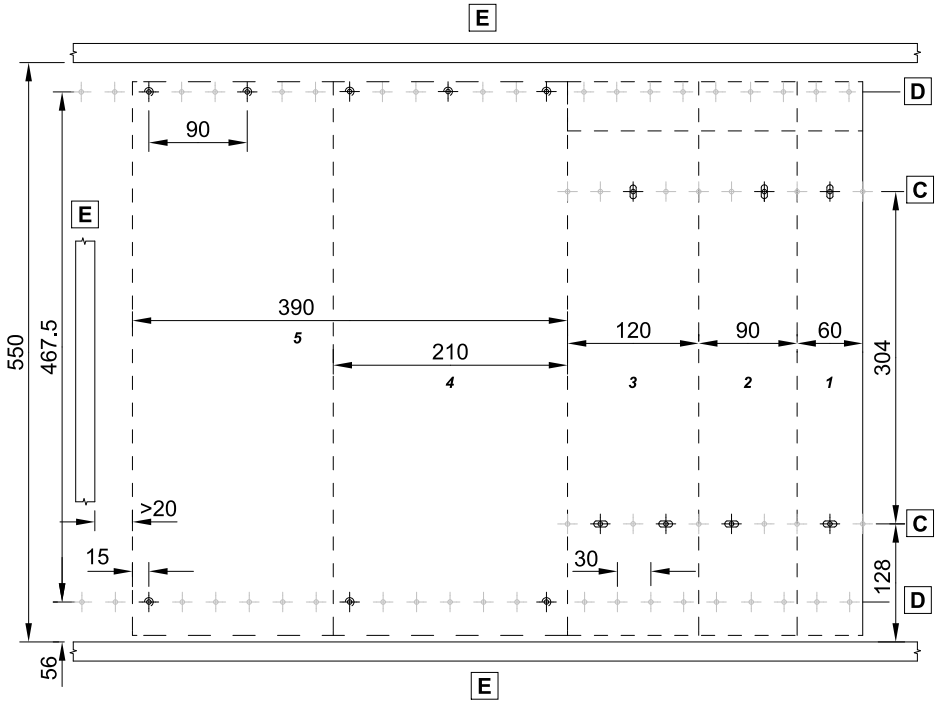
5.5.3 Devices in the range 100 ... 245 A (48 ... 119 kW)

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.

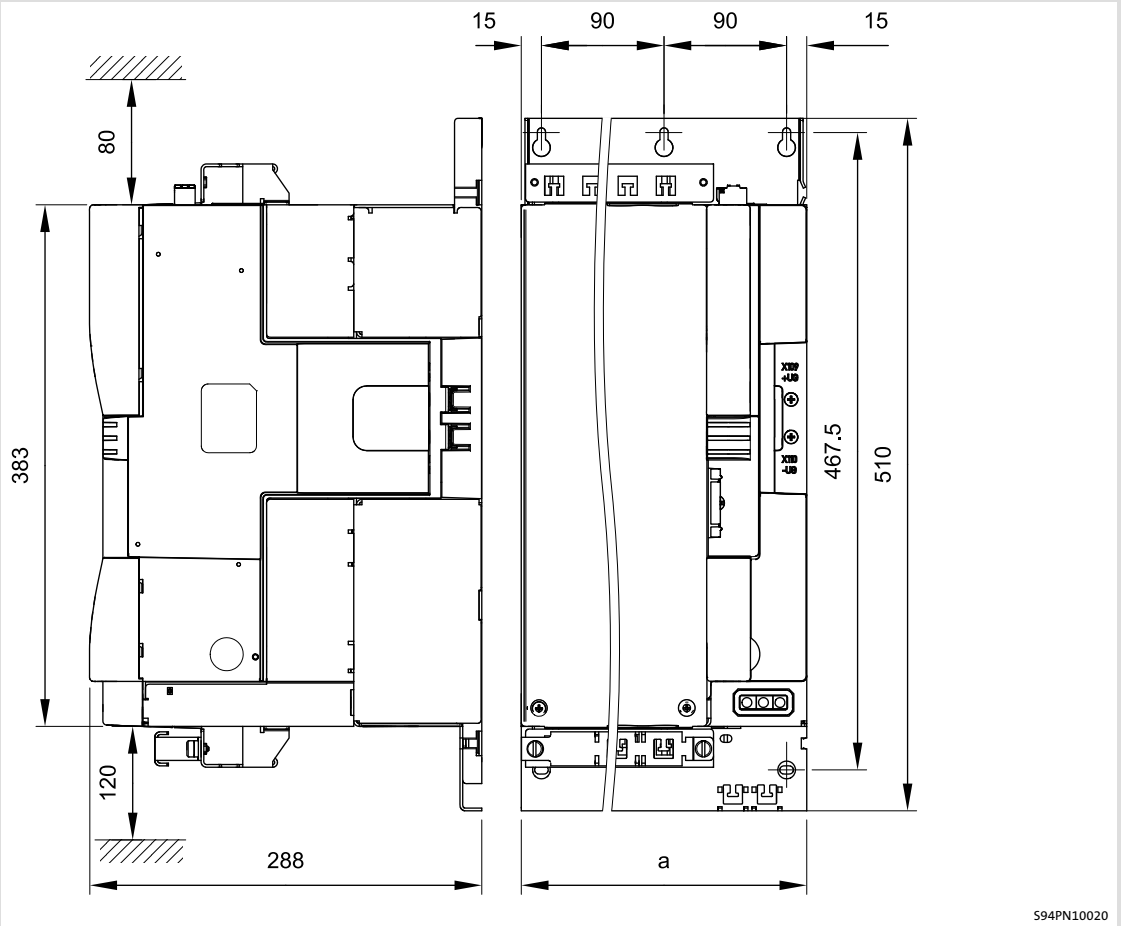
Note!

- ► Permissible are M5 screw and washer assemblies or hexagon socket screws with washer.
- ► Tightening torque: 3.0 Nm / 26 lb-in.
- ► The screw joint in the installation backplane may jut out no more than 7 mm.



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

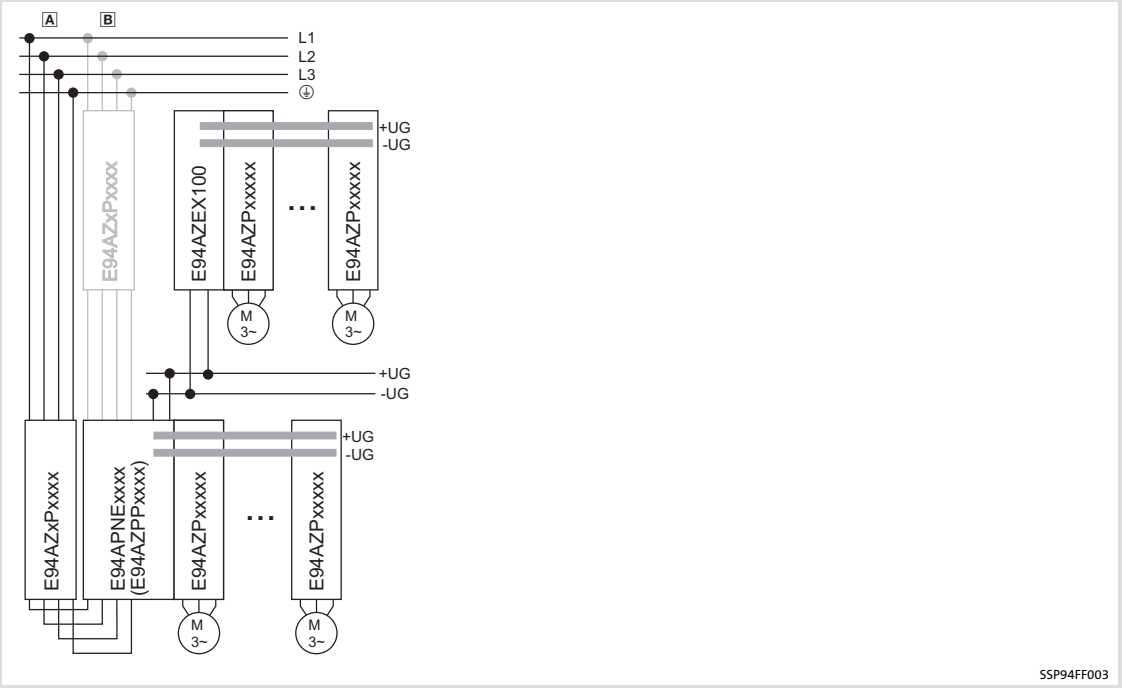


Fig. 5-4 Arrangement concept

A	Standard mounting: side mounting
B	Mounting variant: top mounting
E94AZxPxxxx	Filter
E94APNExxxx	9400 DC power supply module
	(up to 36 A/18 kW with E94AZPPxxxx installation backplane)
E94AZEX100	DC input module
E94AZPxxxxx	Installation backplane for 9400 axis module

A DC-bus connection has to be planned and dimensioned taking the technical data into account.

How to arrange the devices via the DC busbars for operation in the DC-bus connection:

- ► Arrange the devices in a row from left to right.
- ► Install the supplying device on the left:
  - – DC power supply module (in a first row),
  - – DC input module (in the following rows).
- ► Install the multi drive axis controllers to the right from the highest to the lowest power (recommendation).
- ► For increasing the braking power also single drive axis controllers can be integrated. For this purpose these axis controllers have to be equipped with the optional busbar mounting set (E94AZJAxxx).

Installation steps

Proceed as follows for installation:

1. Prepare M5 threaded holes on the mounting plate according to the mounting grid.
   – Always use all specified fixing points.
2. Screw the device onto the mounting plate. Do not tighten the screws yet.
   – Use M5 screw and washer assemblies or M5 hexagon socket screws with washer.
3. Repeat step 2 with installation backplanes that can be directly installed.
4. Align all devices and installation backplanes.
5. When busbars are used: Connect the busbars now.
6. Tightly screw all devices and installation backplanes onto the mounting plate.
   – Tightening torque: 3.0 Nm (26 lb-in).

5.6 Wiring

5.6.1 Important notes



Danger!

Hazardous electrical voltage

All power connections carry a hazardous electrical voltage for a longer time after mains disconnection. Observe the information regarding the discharge time on the device.

Possible consequences:

► Death or severe injuries when touching the power terminals.

Protective measures:

► Before working on the power connections, wait at least until the discharge time has passed (depending on the device, this may be up to 20 minutes).

► Make sure that all power terminals are deenergised.



Danger!

Hazardous electrical voltage

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

Possible consequences:

► Death or severe injuries when touching the device in the event of an error.

Protective measures:

Implement the measures required in EN 61800-5-1. Especially:

► Fixed installation
  – Implement PE connection in compliance with standards.
  – Connect PE conductor twice or PE conductor cross-section ≥ 10 mm^2.

► Connection with a connector for industrial applications according to IEC 60309 (CEE):
  – PE conductor cross-section ≥ 2.5 mm^2 as part of a multi-core supply cable.
  – Provide for suitable strain relief.

Stop!

No device protection if the mains voltage is too high

The mains input is not internally fused.

Possible consequences:

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

Protective measures:

► Observe the maximally permissible mains voltage.

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

Stop!

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

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

5.6.2 Safety instructions for the installation according to UL/CSA

Note!

The fuse current given in the following is the maximum permissible value. This prevents fire and electrical hazard in the event of an error of the device.

The fuse must be smaller or equal to the maximum permissible value, taking the following into consideration:

► The maximum possible cable cross-section

► the laying system (e.g. tap installation)

► the ambient temperature

► the relevant regulations (e.g. UL508A, NEC70 and others).

Original - English

Warnings!

- Branch circuit protection:
  - Suitable for use on a circuit capable of delivering not more than 100 000 rms symmetrical amperes, 480 V max., when protected by CC, J or T class fuses.
  - Suitable for motor group installation on a circuit capable of delivering not more than 100 000 rms symmetrical amperes, 480 V max., when protected by class CC, J or T class fuses.
  - Use specified fuses as shown in the table.
  - Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electrical Code / Canadian Electrical Code and any additional local codes.
- The opening of the branch circuit protective device may be an indication that a fault current has been interrupted. To reduce the risk of fire or electrical shock, current-carrying parts and other components of the controller should be examined and replaced if damaged. If burnout of the current element of an overload relay occurs, the complete overload relay must be replaced.
- Max. surrounding air temperature is 45 °C.
- Max. surrounding air temperature with derating is 55 °C.
- E94APNE0104 ... E94APNE01004: Use 60/75 °C copper wire only, except for control circuits.
  E94APNE2454: Use 75 °C copper wire only, except for control circuits.
- Secondary circuit shall supplied from an external isolating source.
- These products are intended for use in a pollution degree 2 environment.
- These products are intended for use in overvoltage category III.

Type	Branch circuit/short circuit protection with fuses in accordance with UL248	
	Standard installation	Motor group installation
	Nominal value (max.) [A]	Nominal value (max.) [A]
E94APNE0104	15	15
E94APNE0364	60	60
E94APNE1004	125	125
E94APNE2454	300	300

Original - French

Avertissement !

- ► Protection par disjoncteur :
  - – Convient aux circuits non susceptibles de délivrer plus de 100 000 ampères symétriques eff., maximum 480 V, avec protection par des fusibles de calibre CC, J, ou T.
  - – Convient aux installations de groupe moteur sur des circuits non susceptibles de délivrer plus de 100 000 ampères symétriques eff., maximum 480 V, avec protection par des fusibles de calibre CC, J, ou T.
  - – Utiliser les fusibles spécifiés comme indiqué dans le tableau.
  - – La protection statique intégrée n'offre pas la même protection qu'un disjoncteur. Une protection par disjoncteur externe doit être fournie, conformément au National Electrical Code / Canadian Electrical Code, et aux autres dispositions applicables au niveau local.
- ► Le déclenchement du dispositif de protection du circuit de dérivation peut être dû à une coupure qui résulte d'un courant de défaut. Pour limiter le risque d'incendie ou de choc électrique, examiner les pièces porteuses de courant et les autres éléments du contrôleur ; les remplacer s'ils sont endommagés. Le relais de surcharge doit être remplacé en cas de grillage de l'élément traversé par le courant.
- ► Température ambiante maximale : 45 °C
- ► Température ambiante maximale avec réduction de puissance : 55 °C
- ► E94APNE0104 ... E94APNE01004 : utiliser exclusivement des conducteurs en cuivre 60/75 °C, circuits de commande exceptés.
  E94APNE2454 : utiliser exclusivement des conducteurs en cuivre 75 °C, circuits de commande exceptés.
- ► Prévoir un circuit auxiliaire alimenté par une source de tension avec isolation galvanique.
- ► Ces produits sont destinés à un environnement caractérisé par le degré de pollution 2.
- ► Ces produits sont conçus pour une utilisation dans la catégorie de surtension III.

Type	Protection du circuit de dérivation / protection contre les courts-circuits par fusibles conformément à UL248	
	Installation standard	Installation au sein d'un groupe moteur
	Valeur nominale (max.) [A]	Valeur nominale (max.) [A]
E94APNE0104	15	15
E94APNE0364	60	60
E94APNE1004	125	125
E94APNE2454	300	300

5.6.3 Design of the cables

- The cables used must comply with the approvals required for the location (e.g. UL).
- The cross-section of the PE conductor must be dimensioned according to the relevant national regulations.
- 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)
- DC bus, cable length from 0.3 m

The following connections need not be shielded:

- Mains
- DC bus, cable length up to 0.3 m

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

Example circuit

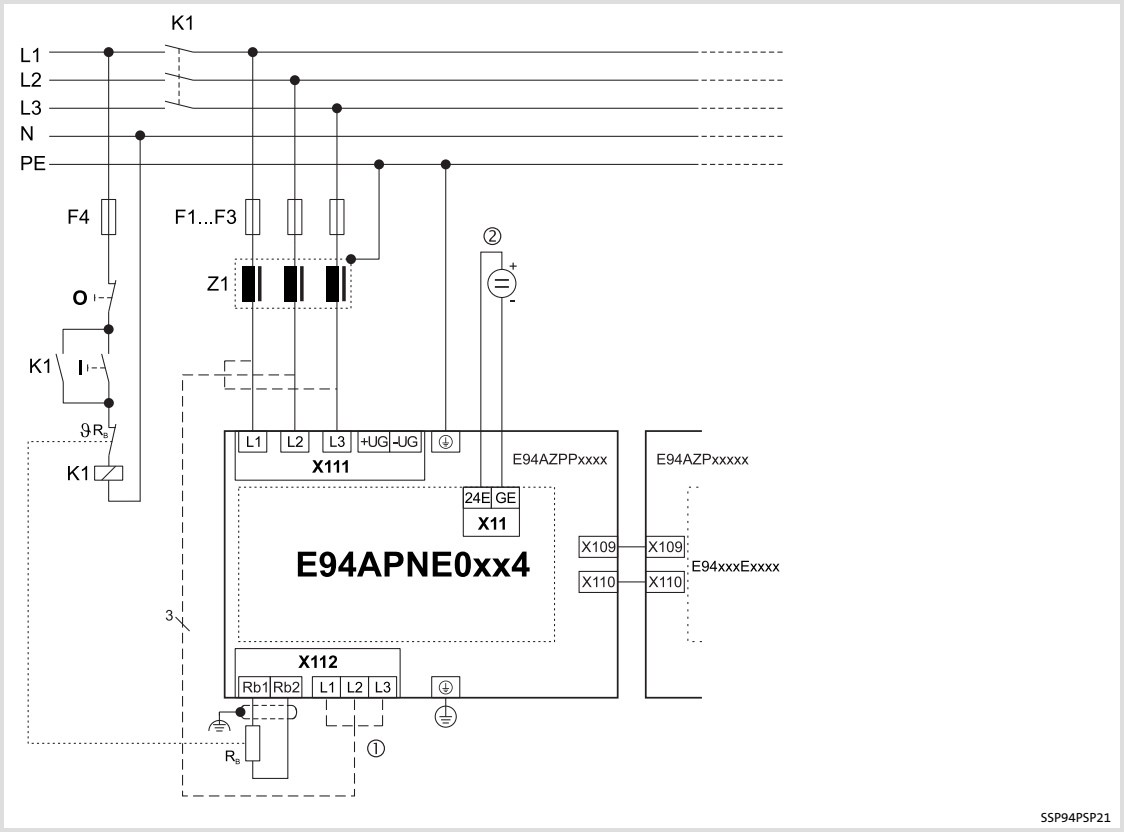


Fig. 5-5 Example circuit for installation backplane and DC power supply module

E94APNExxx4	9400 DC power supply module
E94AZPxxxxx	Installation backplane
E94xxxExxxx	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

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.

Connecting busbars

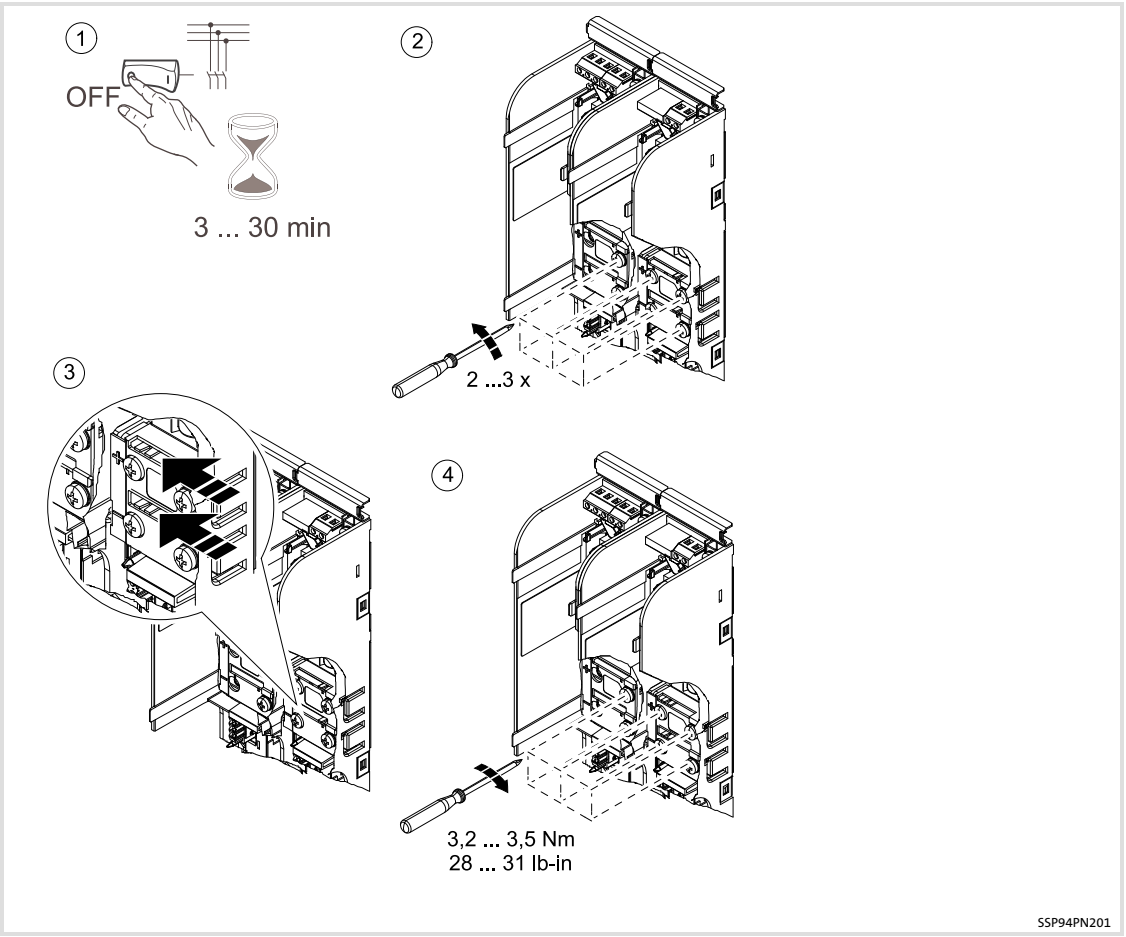


Fig. 5-6 Example: Connecting busbars

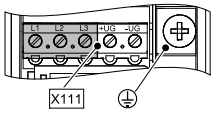
Proceed as follows to connect the busbars:

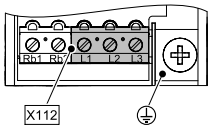
1. If devices of the interconnected system have already been in operation:
   – If necessary, switch off the supply system and wait until the discharge time has elapsed (depending on the device, this may take up to 20 minutes).
   – Make sure that all power terminals are deenergised.
2. Loosen the busbar screws (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 the components onto the mounting plate, if necessary.
   – Tightening torque: 3.0 Nm (26 lb-in).

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

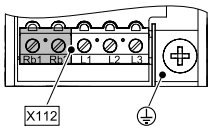
Terminal X111 (left part)	Labelling	Description
 SSP940X111	L1 L2 L3	Connection of the mains phases L1, L2, L3
	⏚	Connection for the supply-side PE conductor with M5 ring cable lug

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

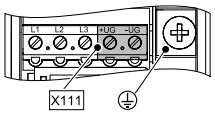
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device sizes 1 + 2: flexible with wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 5.3	PZ0
Device size 3: flexible with/without wire end ferrule	10/16	6	1.2 ... 1.5	10.6 ... 13.3	PH1

External brake resistor

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

Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device sizes 1 + 2: flexible with wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 5.3	PZ0
Device size 3: flexible with/without wire end ferrule	10/16	6	1.2 ... 1.5	10.6 ... 13.3	PH1

DC bus

Terminal X111 (right part)	Labelling	Description
 SSP940X111	+UG -UG	Alternative option for DC-bus voltage connection (compatible to 9300 series) E94ARNE0244: maximum current I_{dc} = 50 A

Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device sizes 1 + 2: flexible with wire end ferrule	2.5	12	0.5 ... 0.6	4.5 ... 5.3	PZ0
Device size 3: flexible with/without wire end ferrule	10/16	6	1.2 ... 1.5	10.6 ... 13.3	PH1

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

Example circuit

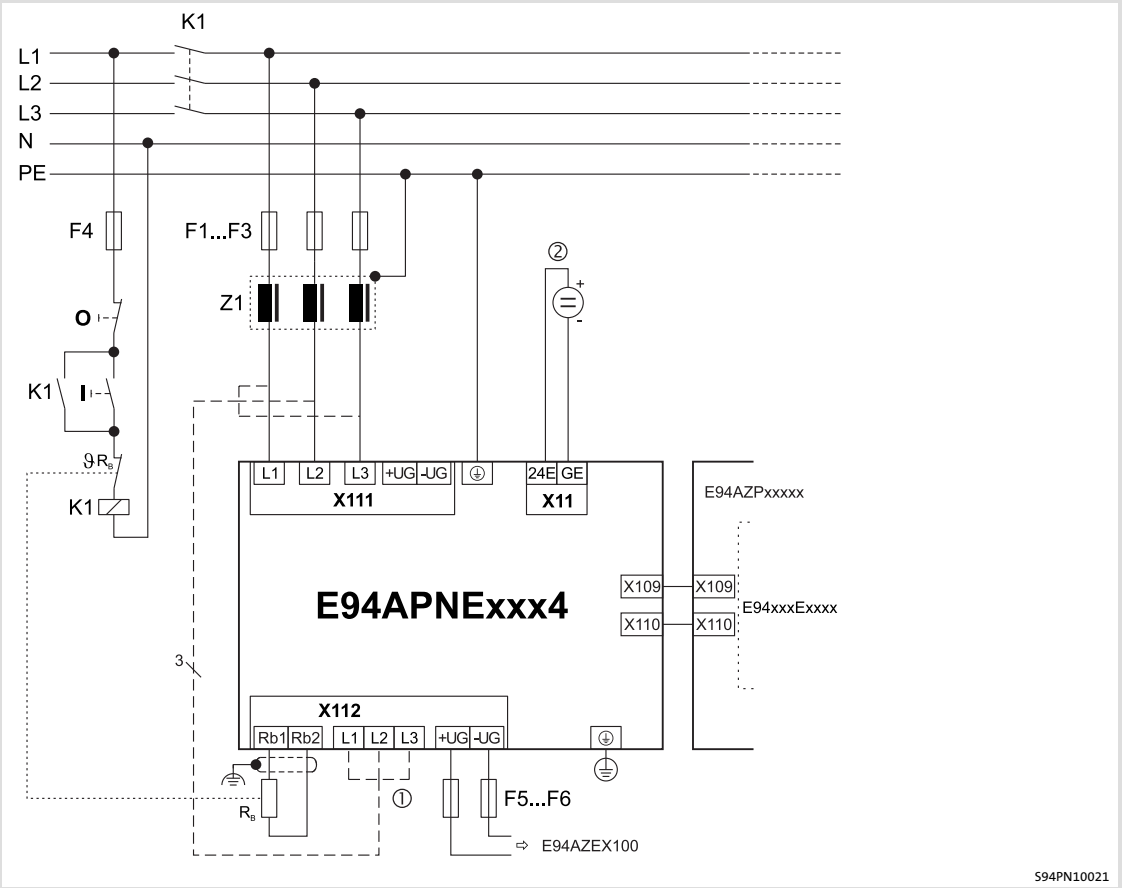


Fig. 5-7 Connection concept

E94APNExxx4	9400 DC power supply module
E94AZPxxxxx	Installation backplane
E94xxxExxxx	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

Connecting busbars

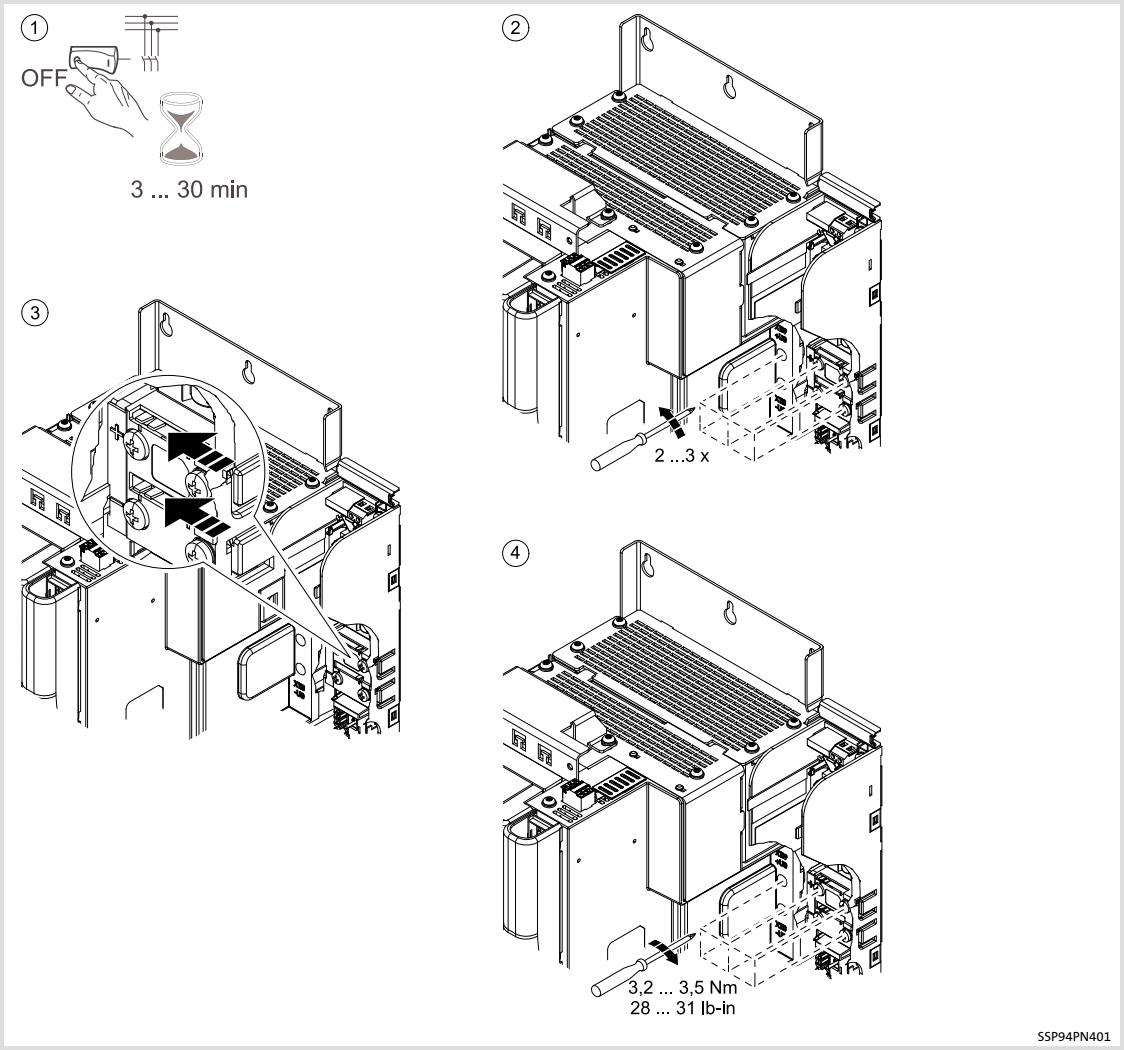


Fig. 5-8 Example: Connecting busbars

Proceed as follows to connect the busbars:

1. If devices of the interconnected system have already been in operation:
   – If necessary, switch off the supply system and wait until the discharge time has elapsed (depending on the device, this may take up to 20 minutes).
   – Make sure that all power terminals are deenergised.
2. Loosen the busbar screws (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 the components onto the mounting plate, if necessary.
   – Tightening torque: 3.0 Nm (26 lb-in).

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

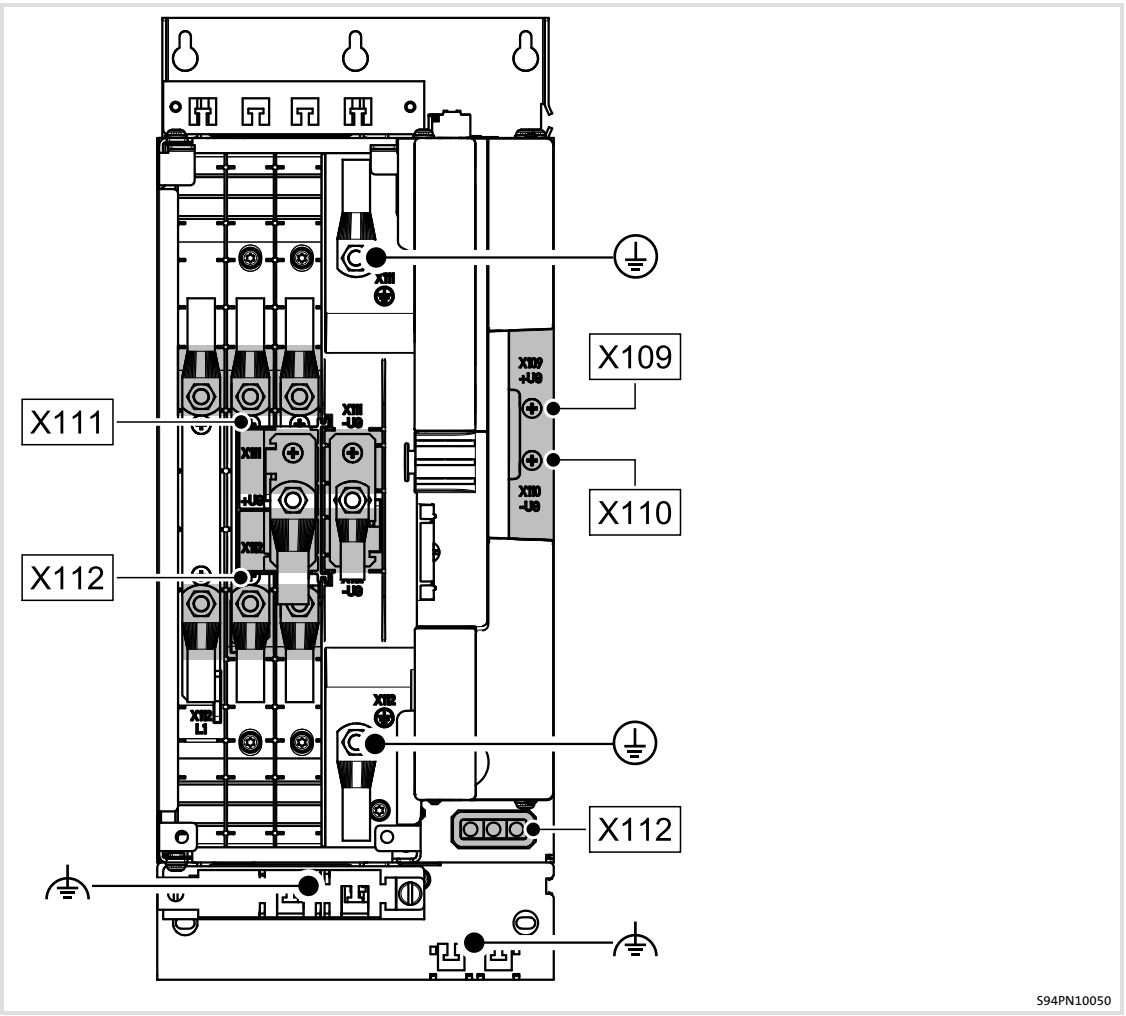


Fig. 5-9 Arrangement of the power connections

Mains

Terminal X111	Labelling	Description
🕮 Fig. 5-9	L1 L2 L3	Connection of the mains phases L1, L2, L3
	⏚	Connection for the supply-side PE conductor

Terminal X112	Labelling	Description
🕮 Fig. 5-9	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		
	[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. 5-9	+UG -UG	Connection of DC-bus voltage Cables routed upwards

Terminal X112	Labelling	Description
🕮 Fig. 5-9	+UG -UG	Connection of DC-bus voltage Cables routed downwards

Terminal data

	Max. conductor cross-section		Tightening torque		
	[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. 5-9	Rb1 Rb2	External brake resistor

Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device size 4: flexible with wire end ferrule	16	4	2.5 ... 3.0	22.2 ... 26.6	6 x 2
Device size 5: flexible with wire end ferrule	35	1	3.2 ... 3.7	28.4 ... 32.8	6 x 2

5.7 Control terminals



Danger!

Hazardous electrical voltage

All power connections carry a hazardous electrical voltage for a longer time after mains disconnection. Observe the information regarding the discharge time on the device.

Possible consequences:

► Death or severe injuries when touching the power terminals.

Protective measures:

► Before working on the power connections, wait at least until the discharge time has passed (depending on the device, this may be up to 20 minutes).

► Make sure that all power terminals are deenergised.



Stop!

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

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

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

The devices can only function correctly when the 24-V supply is switched on!

E94APNE0104 and E94APNE0364:

Terminal X11	Labelling	Description
 SSP9400X11	GE	GND external supply
	24E	24 V external supply through safely separated power supply unit (SELV/PELV) IEC 61131-2, 19.2 ... 28.8 V, residual ripple max. ±5 % Current during operation: 450 mA Starting current: 4 A for 100 ms

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

E94APNE1004 and E94APNE2454:

Terminal X11	Labelling	Description
 9400SSP000X2	GE	GND external supply
	24E	24 V external supply through safely separated power supply unit (SELV/PELV) 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

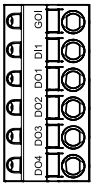
Terminal data				
	Conductor cross-section		Tightening torque	
	[mm²]	[AWG]	[Nm]	[lb-in]
Flexible	0.2 ... 2.5	24 ... 12	Spring terminal	
With wire end ferrule				

Stripping length / contact length: 10 mm

State bus

Power supply modules are not designed as nodes on the state bus of the controller.

Digital inputs, digital outputs

Terminal X12	labelling	Description	
 SSP9400X12	GOI	GND digital out/in	
	DI1	External control of the brake chopper; its only purpose is to synchronise the brake choppers if a second power supply module is used.	
	DO1	without function	
	DO2	Brake chopper active: HIGH level	
	DO3	Short circuit of brake chopper, active: LOW level (fail-safe)	Reset by switching of 24 V at X11.
	DO4	Overtemperature of heatsink, active: LOW level (fail-safe)	

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

Synchronisation

The device-internal brake chopper operates automatically and independently even if the control inputs are not wired.

Depending on the selected mains voltage, the brake resistor is connected if the DC-bus voltage is exceeded (e.g. due to excessive braking energy).

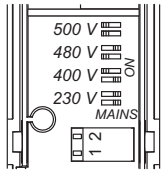
If the brake choppers of power supply modules in a DC-bus connection need to be synchronised, proceed as follows:

1. The 24-V supply of the control card (X11) must be independent of the mains voltage at the mains connection and switched on.
2. All power supply modules of the DC-bus connection must have the same brake chopper threshold (according to the mains).
3. The DO2 (X12) digital output of the master power supply module needs to be wired to the DI1 (X12) digital input of every other power supply module of the DC-bus connection. The GOI connections (X12) of all power supply modules of the DC-bus connection must be interconnected.

5.8 Final works

How to proceed:

► Adjust the setting for the mains voltage/brake chopper threshold to the mains

Setting of mains voltage/brake chopper threshold			2
Pos. D	U_{LN} [V]	U_{BRmax} [V]	1
	500	790	OFF OFF
	480	765	ON OFF
	400	725	OFF ON
	230	390	ON ON

► Switch on the 24 V supply

► Check the operating status by means of the LED display

If you want to continue commissioning:

► Switch on the mains

6 Regenerative power supply modules

6.1 Device features

The most important device features at a glance:

- Regenerative power supply modules supply the DC buses of several controllers of a drive system with energy.
- Regenerative power supply modules feed braking energy back to the AC mains.
- Regenerative power supply modules with the assigned mains filter are the central AC mains connection within DC-bus operation.
- Regenerative power supply modules have an internal brake chopper and a terminal for a brake resistor.
- Regenerative power supply modules of the 9400 series are equipped with a busbar connection (max. 100 A) for the simple connection and side-by-side mounting of the 9400 controllers.
- Regenerative 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.
  - Required accessories (📖 341)
  - Set-up for operation on IT systems (📖 358)
- Regenerative power supply modules are designed as multi-range voltage units (230/400/480 V).
- There are two types of regenerative power supply modules:
  - **E94ARNE0134**,
    rated current: in motor mode 26 A, in generator mode 13 A,
    device size: 3,
    Design: compact basic device with installation backplane
  - **E94ARNE0244**,
    rated current: in motor mode 47 A, in generator mode 23.5 A,
    device size: 3,
    Design: compact basic device with installation backplane
- Regenerative power supply modules are assigned to specifically designed mains filters and can only be operated with them.
- Regenerative power supply modules and filters can be mounted in the mounting grid of the 9400 series.
- Regenerative power supply modules allow parallel supply. Your Lenze contact will be pleased to help you with the dimensioning.

6.2 General data and operating conditions

General data

Conformity and approval			
Conformity			
CE	2014/35/EU	Low-Voltage Directive	
CE	2014/30/EU	EMC Directive	
UKCA	S.I. 2016/1101	The Electrical Equipment (Safety) Regulations 2016	
UKCA	S.I. 2016/1091	The Electromagnetic Compatibility Regulations 2016	
Approval			
$_{c}UL_{US}$	UL61800-5-1	Industrial Control Equipment (File No. E132659) for USA	
	CSA C22.2 No. 274-13	Industrial Control Equipment (File No. E132659) for Canada	

Mains data			
Mains types	With earthed Y point	Unrestricted use	The measures described for IT systems must be observed and carried out in all systems (TN, TT and IT) and for all interconnected modules (📖 324)!
	IT systems	Unrestricted use	
Noise emission	EN 61800-3	With E94AZMR0xx4**S**DB mains filter: 6 x 10 m, C2 With E94AZMR0xx4**L**DB mains filter: 10 x 50 m, C2	
		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 (1kHz)	
Interference (housing)	EN 61000-4-3	80 MHz ... 1000 MHz, 10 V/m 80% AM (1kHz)	

Protection of persons and devices			
Enclosure	EN 60529	IP 20	Not in the wire range of the lower terminals
	NEMA 250	Protection against contact in accordance with type 1	
Insulation resistance	EN 61800-5-1	Overvoltage category III from 2000 m amsl: external measures for complying with the overvoltage category II are required, e.g. ● connecting isolating transformer upstream ● connecting overvoltage protection system upstream	
Insulation of control circuits	EN 61800-5-1	up to 2000 m amsl: Safe mains isolation by double/reinforced insulation for mains with neutral earthing with a rated voltage for the external conductor/star point up to 300 V. from 2000 m amsl: If an overvoltage protection system is connected upstream, additional external separating measures are required for maintaining the safe mains isolation.	
Short-circuit strength	EN 61800-5-1	DC-bus connection: Not short-circuit-proof Brake resistor connection: without restrictions Control connections: without restrictions	
Discharge current	EN 61800-5-1	> 3.5 mA	Observe regulations and safety instructions!
Cyclic mains switching		Cyclic mains switching of 5 times in 5 minutes is permissible without restrictions.	

Mounting conditions		
Mounting place		in the control cabinet
Mounting position		vertical
Clearance		
above/beneath		Comply with the device-relating mounting instructions.
at the side		Can be installed in a row without any clearance

Supply conditions for the regenerative power supply module		
AC mains operation		Connection at the assigned mains filter
DC-bus operation		Direct connection of the axis modules via terminals or busbar systems See the chapter on DC-bus operation in the Hardware Manual for further information.

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 from +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	Degree of pollution 2
Vibration resistance (9.81 m/s² = 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/s²
		200 ... 500 Hz: acceleration resistant up to 15 m/s²
Operation	Germanischer Lloyd	5 ... 13.2 Hz: Amplitude ±1 mm 13.2 ... 100 Hz: acceleration resistant up to 0.7 g
	IEC/EN 60068-2-6	10 ... 57 Hz: Amplitude 0.075 mm
		57 ... 150 Hz: Acceleration resistant up to 1 g

Assignment of filters to standard devices

Note!

The operation of the regenerative power supply modules is only permissible with an assigned mains filter.

Mains filter	Regenerative power supply module		Device size
	Standard device	Installation backplane	
E94AZMR0264SDB E94AZMR0264LDB	E94ARNE0134	E94AZPP0364	GG3
E94AZMR0474SDB E94AZMR0474LDB	E94ARNE0244		

E94AZMR0xx**SD**B -> "**s**hort **d**istance" E94AZMR0xx**LD**B -> "**l**ong **d**istance"

General electrical data

Type	Power loss P_V [W]	
	Total (when operating with I_{aN})	Constant (control electronics only)
E94ARNE0134	150	40
E94ARNE0244	230	40

	Power loss	Inductance	Regenerative inductance	Voltage drop
	P_V [W]	L [mH]	L_{gen} [mH]	ΔU [V]
E94AZMR0264SDB	65	0.77 ±10 %	0.84 ±10 %	6.3
E94AZMR0264LDB	72			
E94AZMR0474SDB	85	0.42 ±10 %	1.54 ±10 %	6.2
E94AZMR0474LDB	101			

6.3 Rated data

6.3.1 Overview

Input data (on the supply side)

	Voltage [V]	Frequency [Hz]	Rated current [A]		Number of phases
			up to +45 °C ①	up to +55 °C ①	
E94ARNE0134					
In motor mode	230/400/480	50/60	26/26/26	19.5/19.5/19.5	3
In generator mode	230/400/480	50/60	13/13/13	9.8/9.8/9.8	3
E94ARNE0244					
In motor mode	230/400/480	50/60	47/47/47	35/35/35	3
In generator mode	230/400/480	50/60	23.5/23.5/23.5	17.6/17.6/17.6	3

① Temperature in the control cabinet

Output data (on the DC side)

	Voltage [V]	Frequency [Hz]	Rated current [A]		Number of phases
			up to +45 °C ①	up to +55 °C ①	
E94ARNE0134					
In motor mode	325/565/675	0 (DC)	32/32/32	24/24/24	-
In generator mode	345/586/699	0 (DC)	16/16/16	12/12/12	-
E94ARNE0244					
In motor mode	325/565/675	0 (DC)	57/57/57	43/43/43	-
In generator mode	325/565/699	0 (DC)	28.5/28.5/28.5	21.4/21.4/21.4	-

① Temperature in the control cabinet

6.3.2 Operation at rated mains voltage 230 V

Input data (on the supply side)

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

Type	Voltage [V]	Continuous input power S_L [kVA]
E94ARNE0134		
In motor mode	230	10.3
In generator mode	230	5.2
E94ARNE0244		
In motor mode	230	18.7
In generator mode	230	9.4

Output data (on the DC side)

Mains	Voltage U_{DC} [V]	Voltage range U_{DC} [V]	Frequency range f [Hz]
2/PE DC	325	260 - 0 % ... 370 + 0 %	-

Type	Output current and output power					
	100 %		5-s cycle		3-min cycle	
	I_{DC} [A]	P_{DC} [kW]	I_{DC} [A]	P_{DC} [kW]	I_{DC} [A]	P_{DC} [kW]
E94ARNE0134						
In motor mode	32	8.6	96	25.8	48	12.9
In generator mode	16	4.3	48	12.9	24	6.4
E94ARNE0244						
In motor mode	57	15.6	171	46.6	86	23.3
In generator mode	28.5	7.8	87	23.3	44	11.6

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

Rated data for internal brake chopper

Switching threshold U_{BRmax}: 345 V

Type	R_{Bmin} [Ω]	I_{BRmax} [A]	P_{BRmax} [kW]	I_{BRd} [A]	P_{Bd} [kW]	t_Z [s]	t_{on} [s]	t_{fp} [s]
E94ARNE0134	18.0	19.2	6.6	9.4	1.6	150	15	15
E94ARNE0244	9.0	38.3	13.2	21.7	4.2	150	15	15

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

Note on the brake chopper data

Due to thermal load, the resistance value changes and therefore the dependent rated data as well.

The brake chopper can output the peak braking power maximally for the specified time t_{on} within a cycle time t_Z.

The brake chopper can output the peak braking power from unloaded states once for the time t_{fp}, e. g. after mains connection or after a recovery time of > 5 x t_Z.

If the times are exceeded, the brake chopper is clocked so that only the continuous braking power is output. This serves to the protection of the brake chopper, however, it does not protect the brake resistor. The brake resistor connected can be protected separately by parameterisation (C00129 ... C00133) or a thermal contact.

Further information can be found in the software manual.

6.3.3 Operation at rated mains voltage 400 V

Input data (on the supply side)

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

Type	Voltage [V]	Continuous input power S_L [kVA]
E94ARNE0134		
In motor mode	400	18.0
In generator mode	400	9.0
E94ARNE0244		
In motor mode	400	32.5
In generator mode	400	16.3

Output data (on the DC side)

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

	Output current and output power					
	100 %		5-s cycle		3-min cycle	
Type	I_{DC} [A]	P_{DC} [kW]	I_{DC} [A]	P_{DC} [kW]	I_{DC} [A]	P_{DC} [kW]
E94ARNE0134						
In motor mode	32	15	96	44.9	48	22.4
In generator mode	16	7.5	48	22.4	24	11.2
E94ARNE0244						
In motor mode	57	27	171	81.1	86	40.5
In generator mode	28.5	13.5	87	40.5	44	20.2

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

Rated data for internal brake chopper

Switching threshold U_{BRmax}: 586 V

Type	R_{Bmin} [Ω]	I_{BRmax} [A]	P_{BRmax} [kW]	I_{BRd} [A]	P_{Bd} [kW]	t_Z [s]	t_{on} [s]	t_{fp} [s]
E94ARNE0134	27.0	21.7	12.7	10.6	3.0	150	15	15
E94ARNE0244	18.0	32.6	19.1	18.4	6.1	150	15	15

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

Note on the brake chopper data

Due to thermal load, the resistance value changes and therefore the dependent rated data as well.

The brake chopper can output the peak braking power maximally for the specified time t_{on} within a cycle time t_Z.

The brake chopper can output the peak braking power from unloaded states once for the time t_{fp}, e. g. after mains connection or after a recovery time of > 5 x t_Z.

If the times are exceeded, the brake chopper is clocked so that only the continuous braking power is output. This serves to the protection of the brake chopper, however, it does not protect the brake resistor. The brake resistor connected can be protected separately by parameterisation (C00129 ... C00133) or a thermal contact.

Further information can be found in the software manual.

6.3.4 Operation with rated mains voltage 480 V

Input data (on the supply side)

Mains	Voltage	Voltage range	Frequency range
	U_{Lrated} [V]	U_{Lrated} [V]	f [Hz]
3/PE AC	480	340 - 0 % ... 528 + 0 %	45 - 0 % ... 65 + 0 %

Type	Voltage [V]	Continuous input power S_L [kVA]
E94ARNE0134		
In motor mode	480	21.6
In generator mode	480	10.8
E94ARNE0244		
In motor mode	480	39.0
In generator mode	480	19.5

Output data (on the DC side)

Mains	Voltage U_{DC} [V]	Voltage range U_{DC} [V]	Frequency range f [Hz]
2/PE DC	675	480 - 0 % ... 746 + 0 %	-

Type	Output current and output power					
	100 %		5-s cycle		3-min cycle	
	I_{DC} [A]	P_{DC} [kW]	I_{DC} [A]	P_{DC} [kW]	I_{DC} [A]	P_{DC} [kW]
E94ARNE0134						
In motor mode	32	18.0	96	53.8	48	26.9
In generator mode	16	9.0	48	26.9	24	13.4
E94ARNE0244						
In motor mode	57	32.4	171	97.3	86	48.7
In generator mode	28.5	16.2	87	48.6	44	24.3

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

Rated data for internal brake chopper

Switching threshold U_{BRmax}: 727 V

Type	R_{Bmin} [Ω]	I_{BRmax} [A]	P_{BRmax} [kW]	I_{BRd} [A]	P_{Bd} [kW]	t_Z [s]	t_{on} [s]	t_{fp} [s]
E94ARNE0134	27.0	25.9	18.1	12.7	4.3	150	15	15
E94ARNE0244	18.0	38.8	27.9	21.9	8.7	150	15	15

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

Note on the brake chopper data

Due to thermal load, the resistance value changes and therefore the dependent rated data as well.

The brake chopper can output the peak braking power maximally for the specified time t_{on} within a cycle time t_Z.

The brake chopper can output the peak braking power from unloaded states once for the time t_{fp}, e. g. after mains connection or after a recovery time of > 5 x t_Z.

If the times are exceeded, the brake chopper is clocked so that only the continuous braking power is output. This serves to the protection of the brake chopper, however, it does not protect the brake resistor. The brake resistor connected can be protected separately by parameterisation (C00129 ... C00133) or a thermal contact.

Further information can be found in the software manual.

6.3.5 Regenerative feedback with brake chopper

Operation in motor mode

The regenerative power supply modules provide the energy for the DC bus from which the axis controllers are supplied. If the peak voltage of the mains is higher than the peak voltage of the DC bus, a current flows from the mains via the DC-bus into the DC-bus connection.

Operation in generator mode

When drives are decelerated, the excessive energy is fed into the DC bus via the controllers. The DC-bus voltage rises.

Regenerative feedback

If the DC-bus voltage exceeds the peak value of the mains voltage, the regenerative feedback is activated.

Up to the maximum regenerative power P_{Mmax}, the controller can dissipate the energy into the mains. If the regenerative energy and, accordingly, the DC-bus voltage continues to rise, the ”Clamp mode” device protection is activated. This leads to an overvoltage switch-off.

In this way, the devices are protected, but the drives coast to standstill.

Regenerative feedback with brake chopper

It is possible to use the integrated brake chopper to avoid the ”Clamp mode”. For this, connect the brake resistor recommended as additional component.

With regenerative powers of $P_{gen} > P_{Bron}$, the brake chopper starts to dissipate part of the energy via the brake resistor. The following formula applies: $P_{gen} = P_{Mgen} + P_{Br}$.

The following diagram shows how the regenerative power is divided between the mains and the brake resistor.

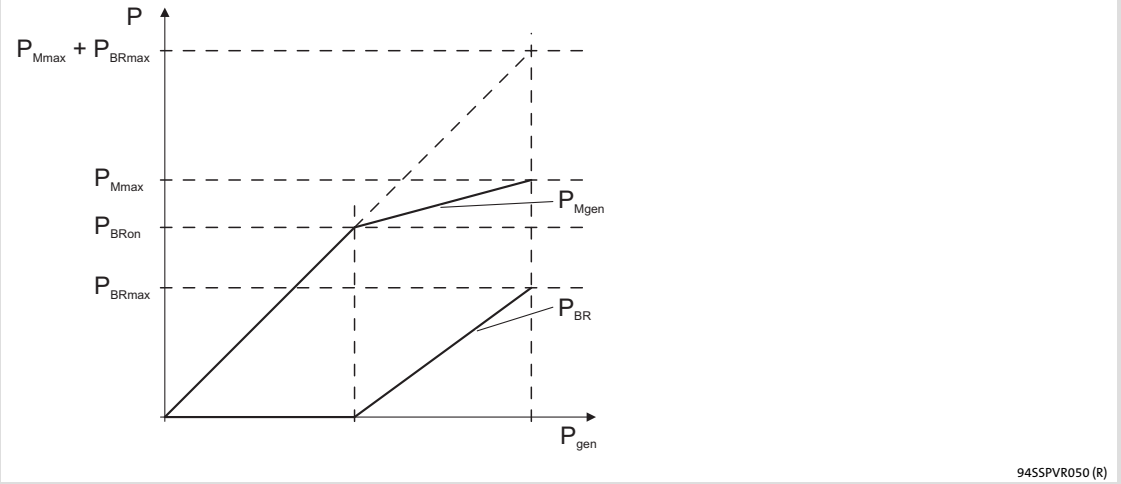


Fig. 6-1 Power regeneration - power characteristics for deceleration in the limit range (legend: Fig. 6-2)

Example: Deceleration with power recovery and brake chopper
The following diagram shows the time characteristics of the speed and the corresponding power. Regenerative powers (into the DC bus connection) are shown as negative values. This energy must be dissipated by the regenerative power supply module to the supply system. In the example, the regenerative power is that high that a brake chopper is required.

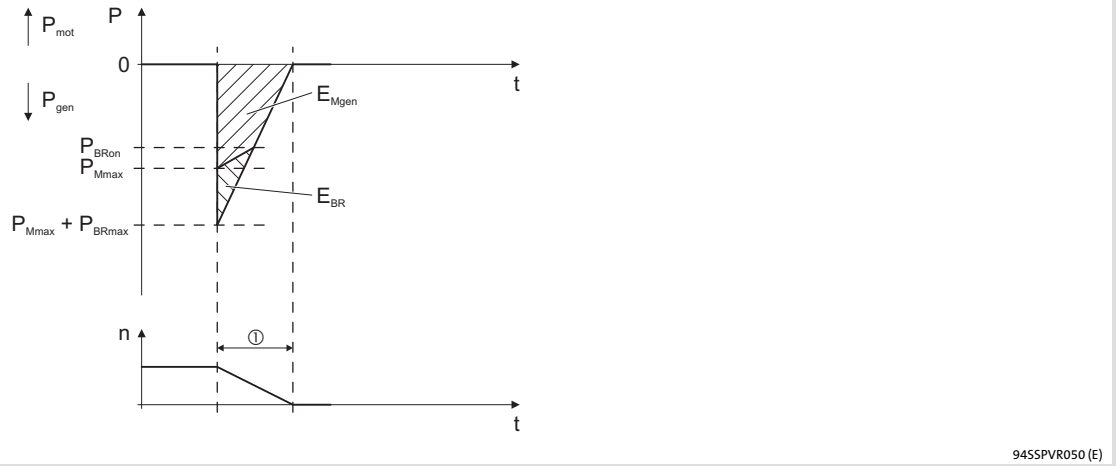


Fig. 6-2 Power regeneration - energy characteristics for deceleration in the limit range

P	Power (general)
t	Time axis
n	Speed
P_{mot}	Power in motor mode
P_{gen}	Regenerative power
P_{Mgen}	Regenerative power into mains
P_{Mmax}	max. regenerative power into mains (= cycle 1, P_{DC})
P_{BR}	Power loss via brake resistor
P_{BRmax}	max. power loss via brake resistor
P_{Bron}	Switch-on position of brake chopper
E_{Mgen}	Regenerative energy into mains
E_{BR}	Energy loss via brake resistor
①	Braking

The hatched area E_{Mgen} shows the energy dissipated to the supply system. The hatched area E_{Br} shows the power loss in the brake resistor. With cyclic processes, the power loss must be referred to the cycle time t (mean time between two deceleration processes) to obtain the mean power loss (=continuous power) of the brake resistor: $P_{BrAV} = E_{Br} / t$. The mean power loss is important for the dimensioning of the brake resistor. Mains voltage tolerances and resistance value changes due to the tolerance and the temperature rise must be considered.

Type	U_r [V]	$P_{DC\,(100\,\%)}$ [kW]	P_{Mmax} [kW]	P_{BRmax} [kW]	$P_{Mmax} + P_{BRmax}$ [kW]	P_{Bron} [kW]	U_{BRmax} [V]
E94ARNE0134	230	4.3	12.9	6.6	19.5	9.9	345
E94ARNE0244		7.8	23.3	13.2	36.5	17.9	
E94ARNE0134	400	7.5	22.4	12.7	35.1	17.2	586
E94ARNE0244		13.5	40.5	19.1	59.6	31.0	
E94ARNE0134	480	9.0	26.9	18.1	45.0	18.8	699
E94ARNE0244		16.2	48.6	27.1	75.7	34.0	

6.3.6 Fuses and cable cross-sections

Mains	Voltage	Voltage range	Frequency range
	U_{Lrated} [V]	U_{Lrated} [V]	f [Hz]
3/PE AC	230 ... 480	180 - 0 % ... 528 + 0 %	45 ... 65

Installation in accordance with EN 60204-1

The data are recommendations. Other dimensioning/laying systems are possible (e.g. according VDE 0298-4).

The cable cross-sections apply under the following conditions:

- Use of PVC-insulated copper cables
- Conductor temperature < 70 °C, ambient temperature < 45°C
- No bundling of cables or cores
- Three loaded cores

Type	①	②	L1, L2, L3 - laying system			FI [1]
			B2	C	F	
	[A]	[A]	[mm²]	[mm²]	[mm²]	[mA]
E94AZMR0264xDB E94ARNE0134	C32	-	10	6	-	–
E94AZMR0474xDB E94ARNE0244	-	80	25	16	-	–

① Circuit breaker
② Fuse of the utilisation category gG/gL or semiconductor fuses or the utilisation category gRL
1) Universal-current-sensitive earth-leakage circuit breaker, RCD type B
If several devices or cable lengths > 50 m are used, it is possible that the circuit breaker will respond, depending on the type of cable and the switching frequency.
Observe national and regional regulations!

Installation to UL

Only use UL-approved cables, fuses and fuse holders.

UL fuse: Voltage 600 V; CC, J or T class fuses

Type	standard installation		motor group installation		FI [1]
	① valeur nominale (max.)	L1, L2, L3	① valeur nominale (max.)	L1, L2, L3	
	[A]	[AWG]	[A]	[AWG]	[mA]
E94AZMR0264xDB E94ARNE0134	45	6	70	3	–
E94AZMR0474xDB E94ARNE0244	70	3	70	3	–

① Fuse
1) Universal-current-sensitive earth-leakage circuit breaker, RCD type B
If several devices or cable lengths > 50 m are used, it is possible that the circuit breaker will respond, depending on the type of cable and the switching frequency.
Observe national and regional regulations!

6.3.7 Current-time diagrams

In addition to the data for overcurrent operation within the 5-s cycle or 3-min cycle, here you are provided with information on the dimensioning of application-oriented cycles.

You can use the following information to find out permissible load periods with overcurrents and necessary recovery times with limited mains currents. If the thus determined mains currents and times are adhered to, the Ixt monitoring function for the protection of devices will not respond.

Characteristics

The following characteristics (”Current-time diagrams”) describe the device utilisation via amperage and the duration of current flow.
The left part of the diagram (negative time data) represents the overload phase, while the right part of the diagram (positive time data) shows the relieving phase.
Devices with an identical Ixt behaviour are combined within a diagram. A second diagram enlarges a cutout area to improve the clearness of display.

Requirements

- Mains voltage

  In the diagrams, a mains voltage of U_N = 400 V is assumed. Current derating depending on the mains voltage is also necessary in the case of the devices. In other words, the currents are weighted differently in the Ixt monitoring function. The continuous currents indicated there are then the 100 % values that are needed for working with the diagrams.

- Ambient temperature

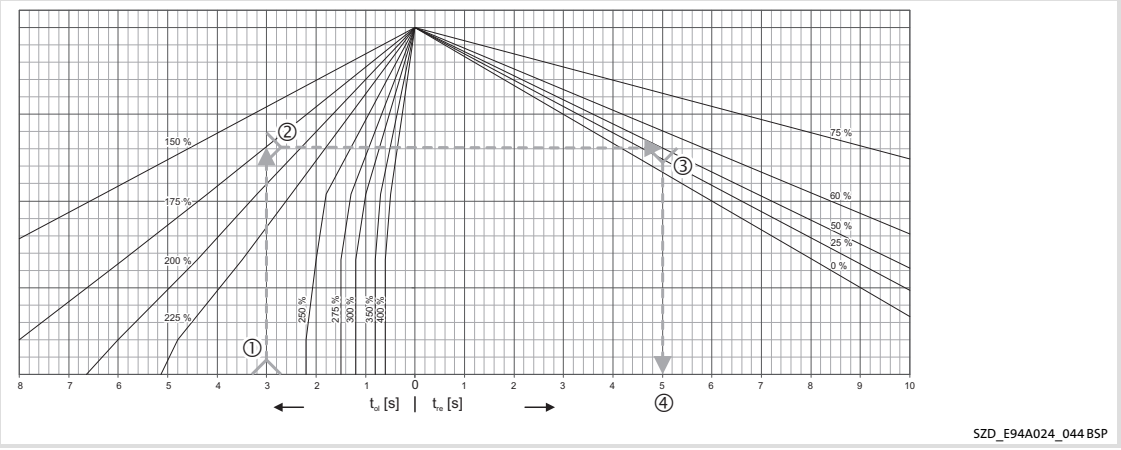
  The ambient temperature may be maximally T_{Amb} < 45 °C. In the case of higher ambient temperatures the reduced continuous currents have to be taken into consideration.

- Regenerative mode/motoring mode

  The application example relates to regenerative mode. In motoring mode, the permissible mains currents are doubled (c.f. rated data).

Application example

- Drive task
  - A mains current of I_{ol} = 4.0 A is needed for a time of t_{ol} = 3 s.
  - During the recovery phase, a mains current of I_{re} = 1.0 A flows.
- Problem
  - How long is the recovery phase t_{re} when the E94ARNE0xx4 controller is used?
- The currents required are based on the rated device current:
  - I_{ol} = 4.0 A/2.5 A = 160 % - selected characteristic: 175 %
  - I_{re} = 1.0A/2.5 A = 40 % - selected characteristic: 50 %
  - Due to the short overcurrent time of t_{ol} = 3 s, the diagram of part of the E94ARNE0xx4 device is made use of.
- Procedure within the diagram
  - ① Beginning from the time axis at t_{ol} = 3 s, draw a straight line to the selected characteristic at 175 % (corresponds to the minimum required mains current I_{ol}).
  - ② Draw a straight line from the point of intersection horizontally to the right to the selected characteristic, the recovery phase, at 50 %.
  - ③ Draw a perpendicular line from the point of intersection back to the time axis.
  - ④ Read the minimum required duration of recovery on the time axis.



- Result in the example
  - The duration of recovery has to be at least t_{re} = 5 s!

E94ARNE0134 and E94ARNE0244

Type	V_r	100 %	f_{chopp}
	[V]	[A]	[Setting]
E94ARNE0134	400/480	in motor mode: 26.0 in generator mode: 13.0	not relevant
E94ARNE0244		in motor mode: 47.0 in generator mode: 23.5	

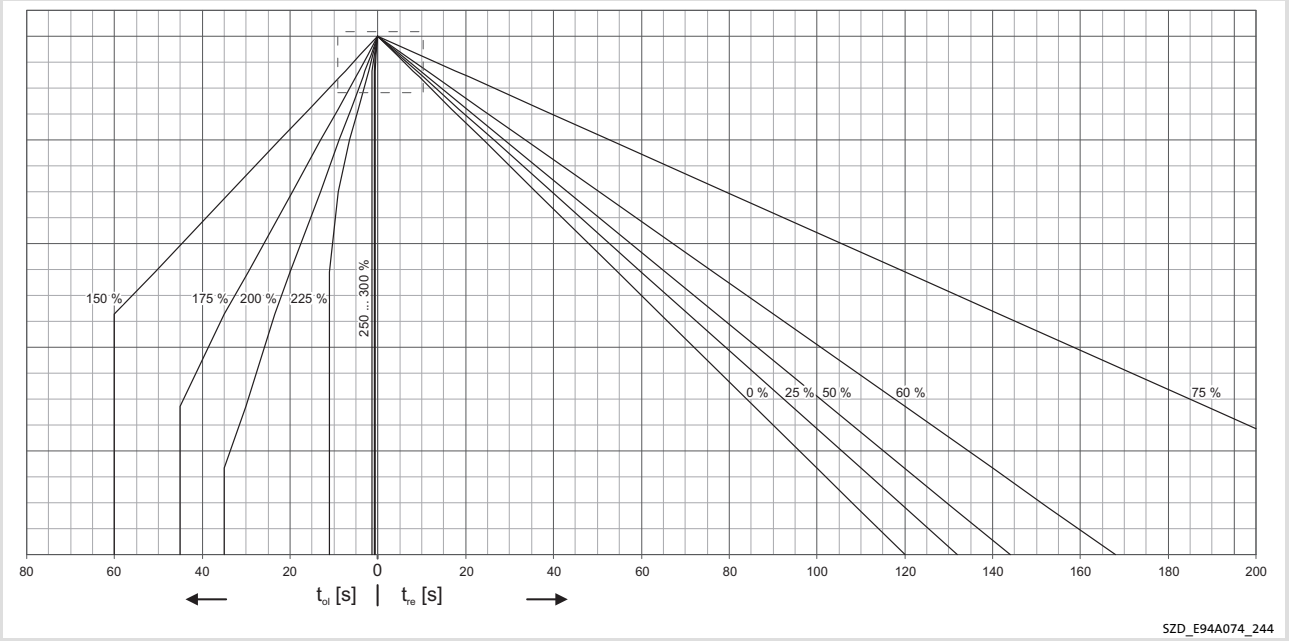


Fig. 6-3 Diagram for E94ARNE0134 and E94ARNE0244

t_{ol} Duration of the load phase
t_{re} Duration of the recovery phase

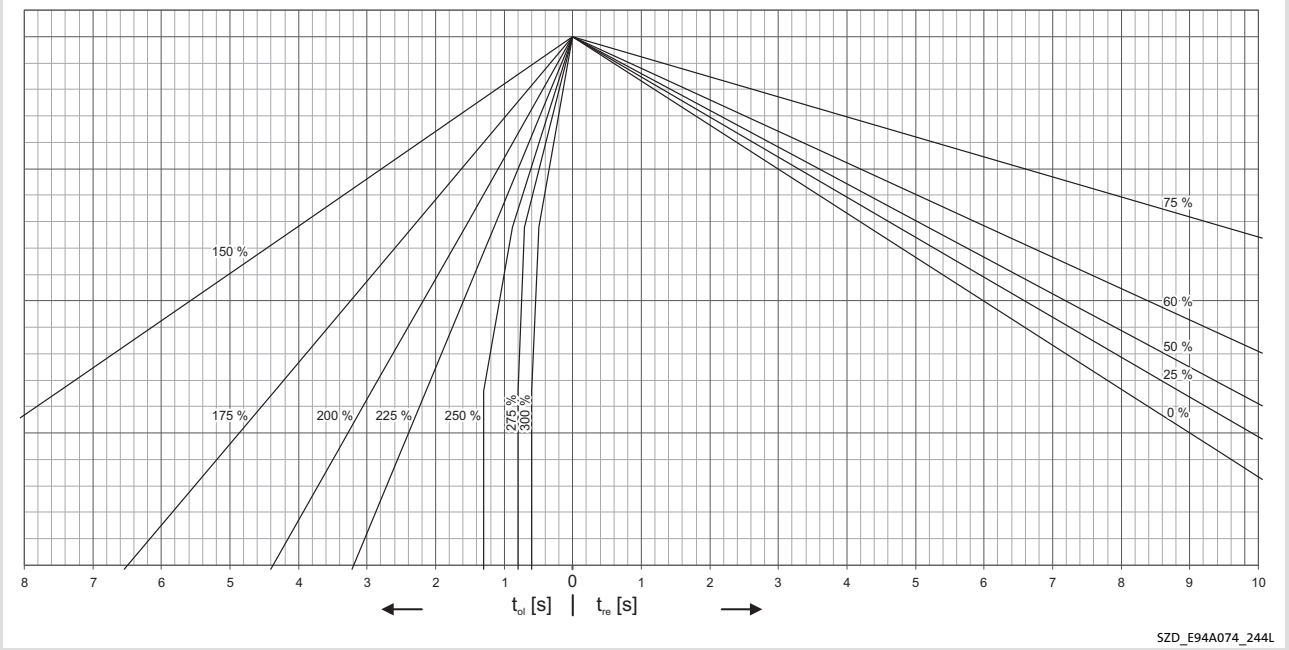


Fig. 6-4 Area cutout for E94ARNE0134 and E94ARNE0244

6.3.8 Mains filters for regenerative power supply modules

When using the mains filters assigned, conditions must be observed for compliance with EMC class C2:

- The measures for the use on IT systems must be applied to all axis modules in the interconnection (separation of internal filter components from PE, (📖 358)).
- The maximum sum total of all motor cable lengths ($\Sigma\ l_{mot}$) for the filter used must be observed.

Motor cable lengths in the interconnection

The assigned filters are designed for $\Sigma\ l_{mot}$
(E94AZMR...SDB: 60 m (= 6 x 10 m), E94AZMR...LDB: 500 m (= 10 x 50 m)).

For a different number of axis modules, $\Sigma\ l_{mot}$ can be determined from the following diagrams.

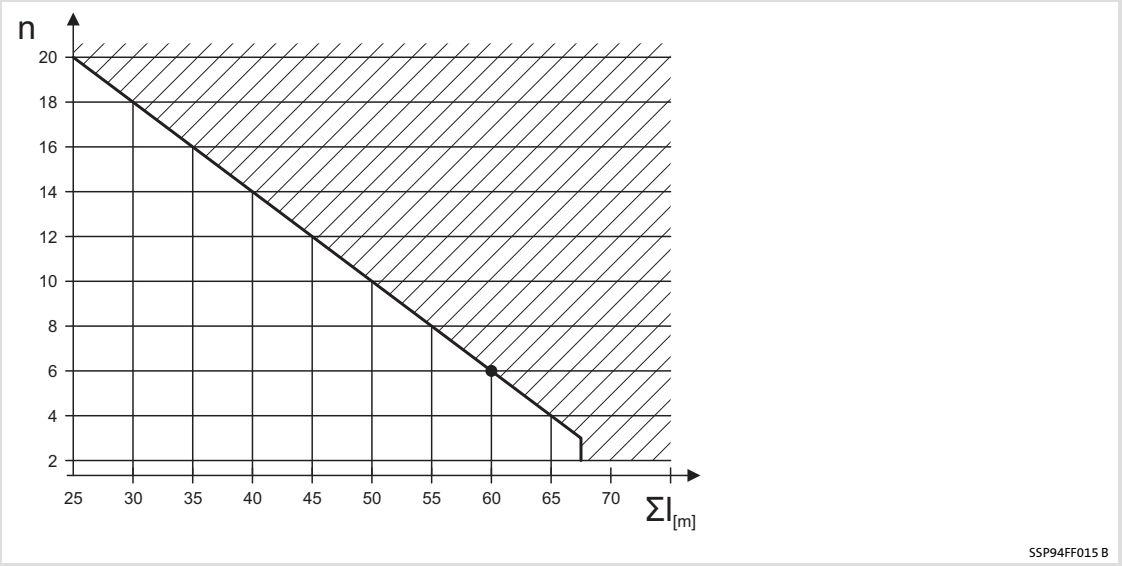


Fig. 6-5 Filter E94AZMP...SDB (short distance): total motor lengths according to number of axis modules

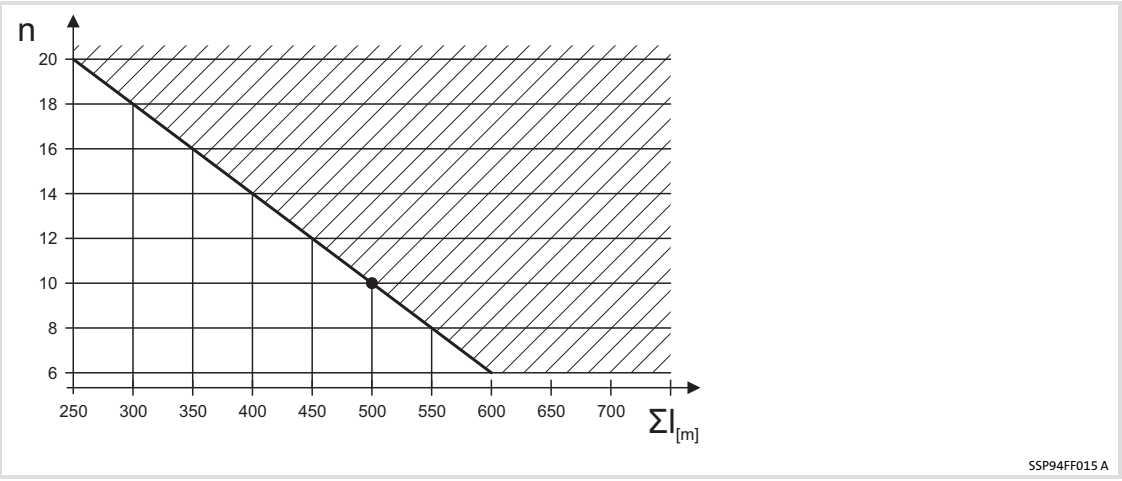


Fig. 6-6 Filter E94AZMP...LDB (long distance): total motor lengths according to axis modules

With different motor cable lengths, per axis at least 25 % of the longest cable must be considered when calculating the total motor cable length.

Example: 1	Motor cable length l_{mot} [m]		
Axis	**Actual value**	**min. 25 % of the longest cable**	**To be considered**
1	6	0.25 * 20 = 5	6
2 ... 4	3 * 10		3 * 10
5	20	⇦	20
Total	56	max. permissible for 5 axes: ∑< 60	**56**
		EMC class C2 will be complied with.	☑

Example 2	Motor cable length l_{mot} [m]		
Axis	**Actual value**	**min. 25 % of the longest cable**	**To be considered**
1 ... 4	4 * 5	0.25 * 40 = 10	4 * 10
5	40	⇦	40
Total	60	max. permissible for 5 axes: ∑< 60	**80**
		EMC class C2 will not be complied with.	☒

Example: 3	Motor cable length l_{mot} [m]		
Axis	**Actual value**	**min. 25 % of the longest cable**	**To be considered**
1 ... 3	3 * 100	⇦ 0.25 * 100 = 25	3 * 100
4	50		50
5 ... 10	6 * 15		6 * 25
Total	410	max. permissible for 10 axes: ∑ < 500	**500**
		EMC class C2 will be complied with.	☑

Example: 4	Motor cable length l_{mot} [m]		
Axis	**Actual value**	**min. 25 % of the longest cable**	**To be considered**
1 ... 4	4 * 100	⇦	4 * 100
5 ... 10	6 * 15	0.25 * 100 = 25	6 * 25
Total	490	max. permissible for 10 axes: ∑ < 500	**550**
		EMC class C2 will not be complied with.	☒

Constellations with unfavourable or intensifying parasitic couplings

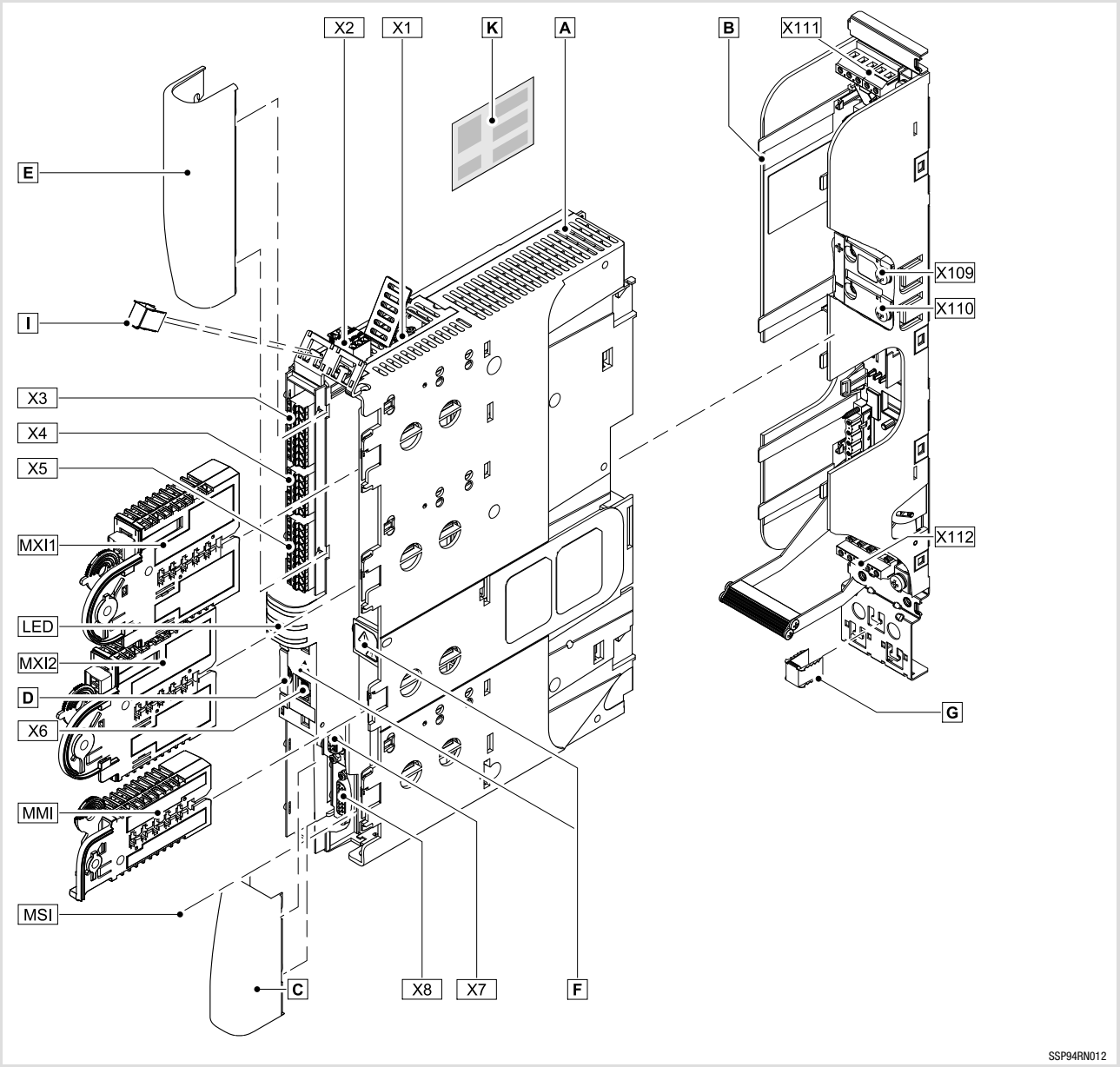
Compliance with EMC category C2 may also be interfered with by other circumstances:

- Distribution of the axis modules over several control cabinets without efficient HF equipotential bonding between the mounting plates
- No use of Lenze system cables or cables with the same specifications
- Poor connection of motor cable shields
- Motor cable interruptions
- Other interference sources (e.g. switched-mode power supplies)
- Isochronous switching of the inverter output stages

6.4 Device description

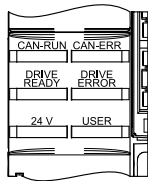
This page remains blank to give you a clearly arranged overview of the following subject on the next double page.

Standard device



Standard device A		Design
Pos.	Description	VR module
MXI1	Expansion slot 1, e.g. for communication	☑
MXI2	Expansion slot 2, e.g. for communication	☑
MMI	Storage module slot	☑
MSI	Reserved	☐
X1	System bus (CAN), under the cover	☑
X2	24 V supply and statebus	☑
X3	Analog inputs and analog outputs	2/2
X4	Digital outputs	4
X5	Digital inputs	8
X6	Diagnostics	☑
X7	Reserved (resolver)	☐
X8	Control signals for mains filter (encoder)	☑
C	Lower cover	☑
D	Retractable nameplate	☑
E	Upper cover	☑
K	Prominent warning label close to the device!	☑

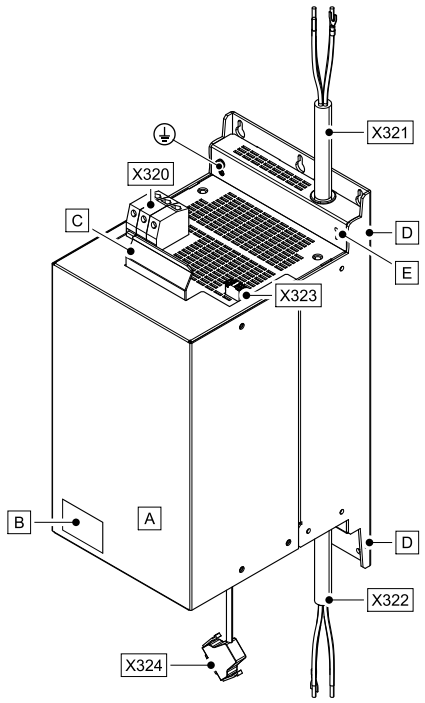
The LED display enables fast indication of several operating states.

LED	Labelling	Colour	Description
 SSP94LED01	CAN-RUN	green	CAN bus ok
	CAN-ERR	red	CAN bus error
	DRIVE READY	green	Standard device is ready for operation
	DRIVE ERROR	red	Error in the standard device or application-induced
	24 V	green	24 V supply voltage ok
	USER	yellow	Message parameterised by the application

Pos.	Symbol	Description
F		**Long discharge time**: All power terminals carry hazardous electrical voltages for a longer period of time after mains disconnection! Depending on the device, this period of time may be up to 20 minutes.
		**High discharge current**: Carry out fixed installation and PE connection according to EN 61800-5-1!
		**Electrostatic sensitive devices**: Before working on the device, the personnel must be free of electrostatic charge!

Installation backplane B		Design
Pos.	Description	VR module
X111	Mains supply via mains filter/DC-bus voltage	☑
X112	Mains supply and mains power recovery via mains filter/external brake resistor	☑
X109	DC busbar +	☑
X110	DC busbar -	
G	EMC shield clamp	☑

Mains filter



Pos.	Description
A	Mains filter
	Mounting Instructions
Pos.	**Description**
B	Nameplate
C	Lifting aid
D	Mounting aid for mounting base
E	Parking position of the IT screw
⏚	PE terminal
X320	Terminal L1 ... L3
X321	Connecting cable L1.1 ... L3.1
X322	Connecting cable L1.2 ... L3.2
X323	Terminal for 24-V supply voltage (use safely separated power supply unit (SELV/PELV), in accordance with IEC 61131-2)
X324	Mains filter control signal

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.

Stop!

Heavy device weight

The device is very heavy and must be lifted for the mounting.

Possible consequences:

- ► Injury to persons, particularly backache when lifting and holding the device, respectively
- ► Injury to persons and damage to material assets due to the device falling down

Protective measures:

- ► The device must only be carried with a load bearing system such as an indoor crane permitted for the device weight
- ► Before the transport, the hoist, the load bearing system and lifting accessories must be checked for sufficient payload and faultless status
- ► Do not remove the hoist and the lifting accessories until the device lies safe on a stable surface or is finally mounted.

- ► The mounting location must always comply with the operating conditions specified in the technical data (📖 290). Take additional measures if necessary.
- ► The mounting plate of the control cabinet must have the following properties:
  – electrically conductive
  – free of lacquer
- ► The mechanical connections must always be ensured.
- ► A free air circulation must be ensured for dissipating the heat.

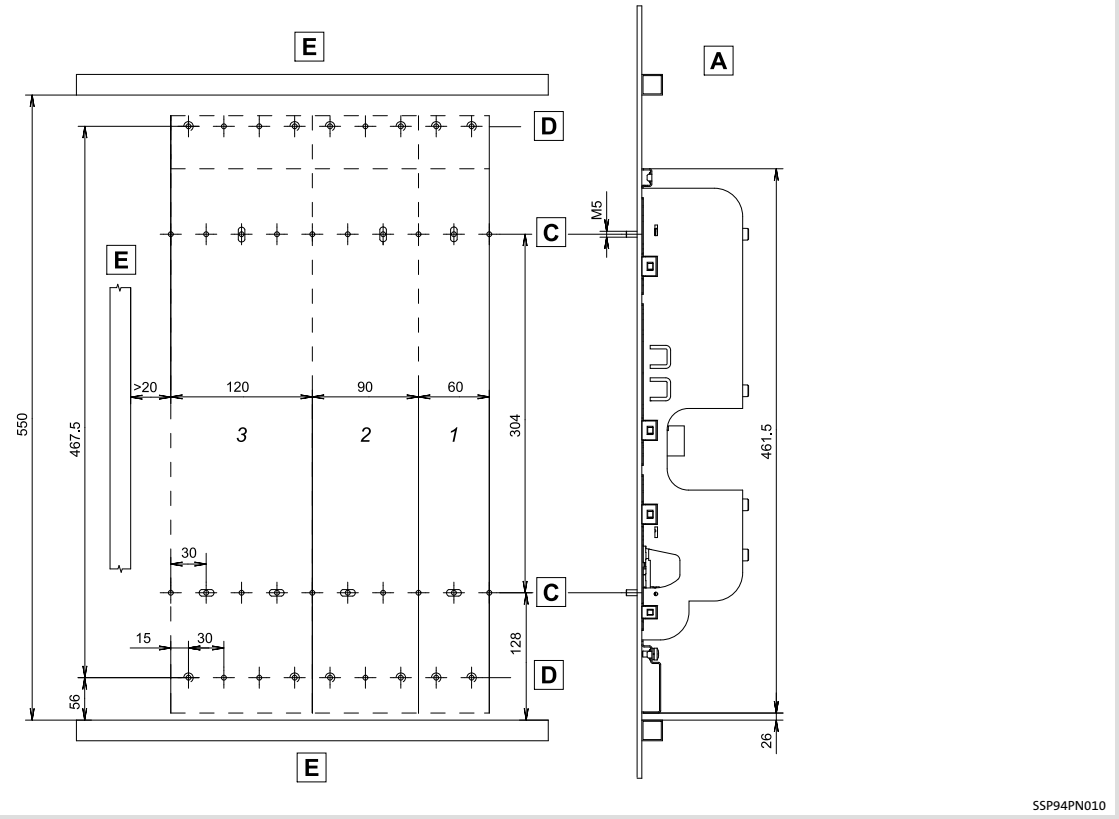
6.5.2 Dimensions

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.

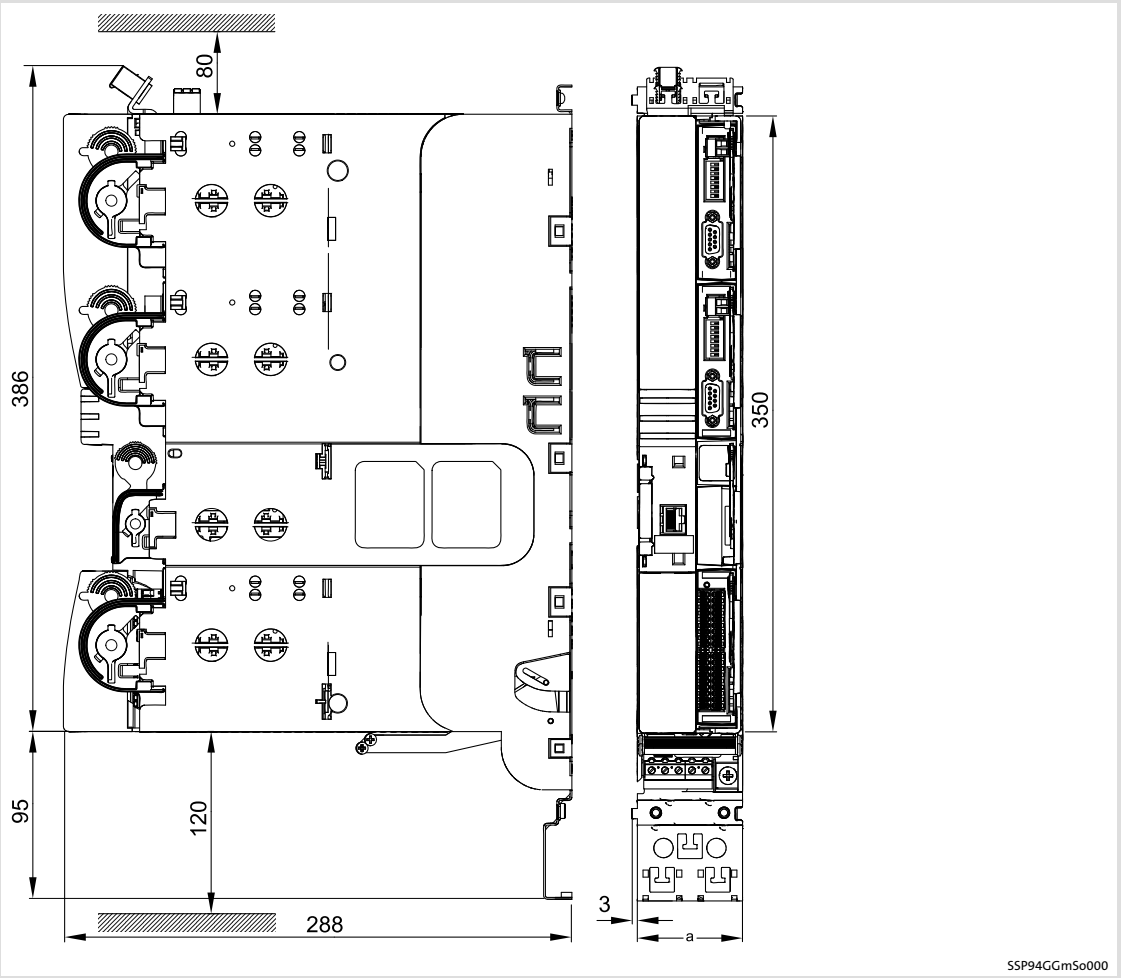
Note!

- ► Permissible are M5 screw and washer assemblies or hexagon socket screws with washer.
- ► Tightening torque: 3.0 Nm / 26 lb-in.
- ► The screw joint in the installation backplane may jut out no more than 7 mm.



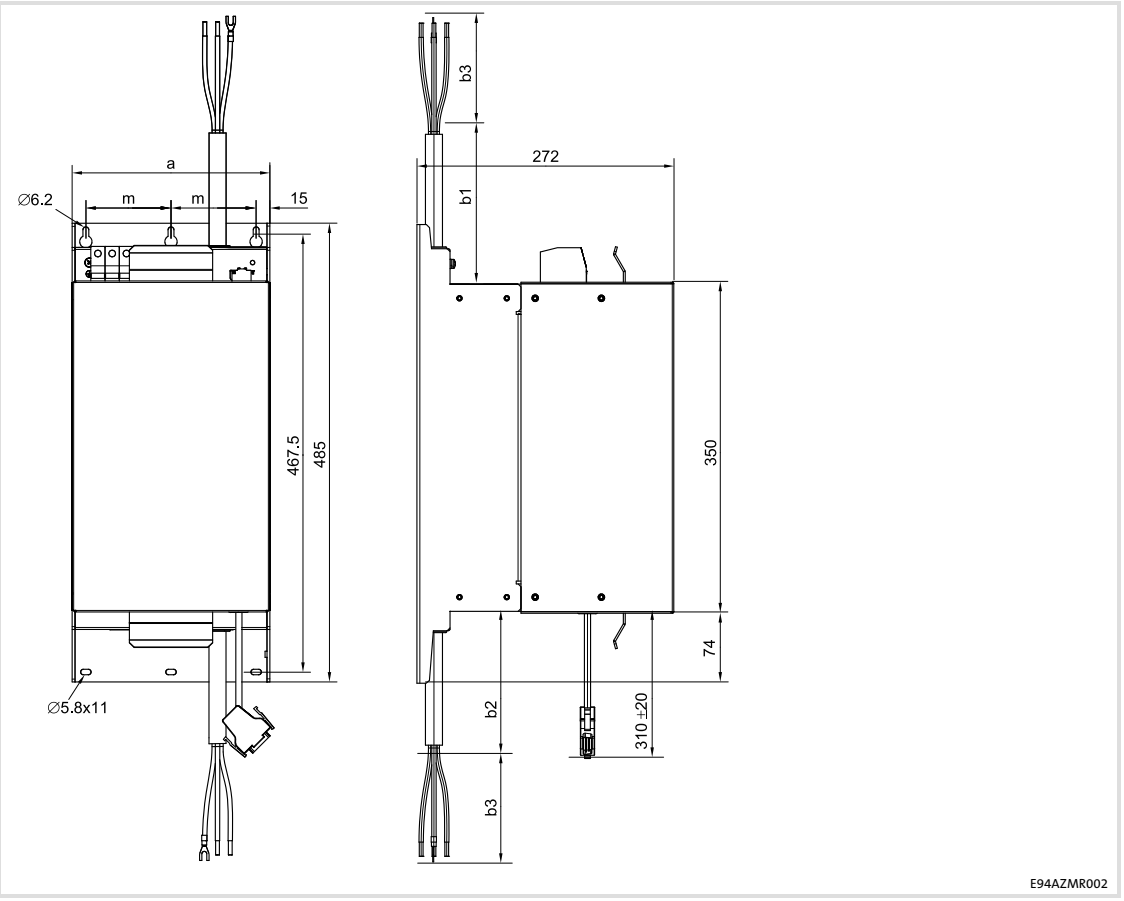
A Mounting with backplane for attaching the power supply module
C Grid hole pattern for installation backplane
D Grid hole pattern for other device sizes or built-on/footprint filters (only Single Drive)
E Cable duct
1 ... 3 Device size, mounting holes used

Standard device with installation backplane



Regenerative power supply module		a	
Standard device	Installation backplane	[mm]	[kg]
E94ARNE0134 E94ARNE0244	E94AZPP0364	120	8.1

Mains filter



	a	m	b1	b2	b3	
	[mm]					[kg]
E94AZRM0264SDB	149	60	240 ±5	260 ±5	100 ±5	25
E94AZRM0264LDB						26
E94AZRM0474SDB	209	90	250 ±5	270 ±5	110 ±5	36
E94AZRM0474LDB						37

6.5.3 Arrangement of the devices

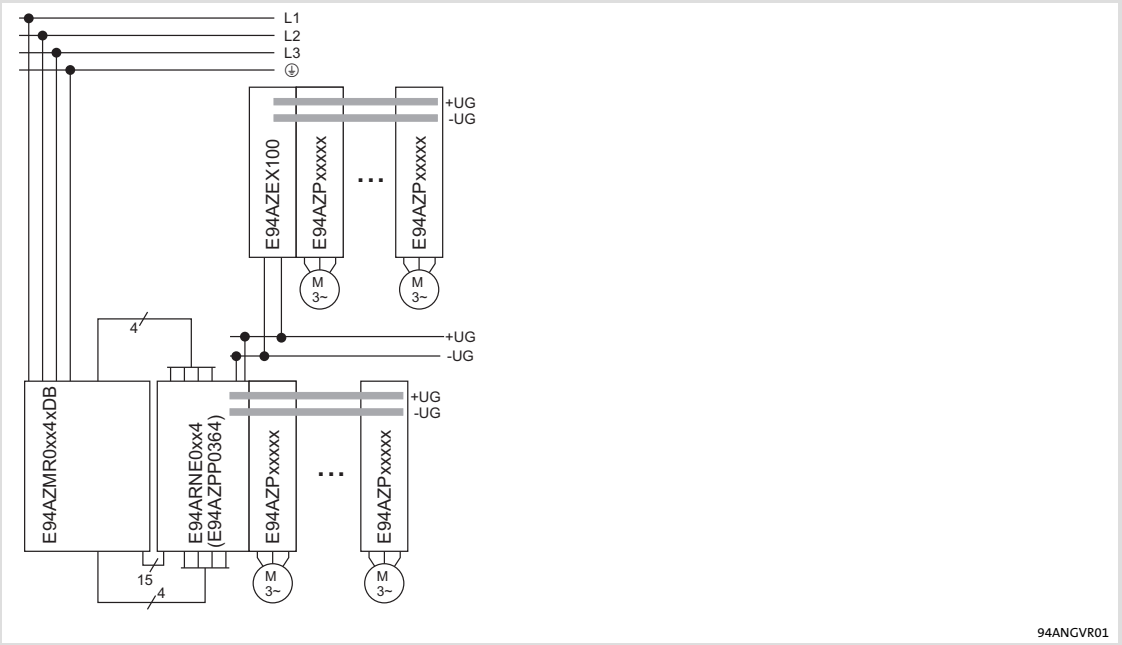


Fig. 6-7 Arrangement concept

E94AZMR0xx4xDB	Mains filter
E94ARNE0xx4	Regenerative power supply module (with E94AZPP0364 installation backplane)
E94AZEX100	DC-input module
E94AZPxxxxx	installation backplane for 9400 axis module
+UG/-UG	DC bus

A DC-bus connection with regenerative power supply module has to be planned and dimensioned taking the technical data into account.

How to arrange the devices for operation in the DC-bus connection via the DC busbars:

- ► Arrange the devices in a row from left to right.
- ► Install the supplying device on the left:
  - – Regenerative power supply module with assigned mains filter (in a first row),
  - – Input module (in the following rows).
- ► Install the multi drive axis controllers to the right from the highest to the lowest power (recommendation).
- ► For increasing the braking power also single drive axis controllers can be integrated. For this purpose, these axis controllers have to be equipped with the optional busbar mounting set (E94AZJAxxx). In order to carry out multi-supply applications, consult Lenze.

6.5.4 Mounting steps

Proceed as follows for installation:

1. Prepare mounting plate with M5 threaded holes according to the mounting grid.
   – Start on the left with the installation backplane of the DC power supply module E94AZPNxxxx.
   – 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 tighten the screws yet.
   – Use M5 screw and washer assemblies 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. When busbars are used: Connect busbars.
5. Tightly screw the components onto the mounting plate.
   – Tightening torque: 3.0 Nm (26 lb-in).



Tip!

Before plugging the standard device into the installation backplane, read the chapters ”Disconnect internal PE connection” (📖 324) and ”Connecting busbars” (📖 327).

6.6 Wiring

6.6.1 Important notes

- Installation must
  - always be in accordance with the operating conditions specified in the Technical data (📖 290).
  - be carried out to EN 60204-1.
- Please observe the following when selecting the cable type:
  - The cables used must comply with the approvals required for the application (e. g. VDE, UL etc.).
  - Fuses and cable cross-sections must be dimensioned in accordance with the specifications in the documentation for the basic device.
- The described EMC properties are provided if the following conditions are complied with:
  - The devices are mounted according to the arrangement concept described.
  - The prepared cables are used and remain unchanged.



Danger!

Hazardous electrical voltage

All power connections carry a hazardous electrical voltage for a longer time after mains disconnection. Observe the information regarding the discharge time on the device.

Possible consequences:

- Death or severe injuries when touching the power terminals.

Protective measures:

- Before working on the power connections, wait at least until the discharge time has passed (depending on the device, this may be up to 20 minutes).
- Make sure that all power terminals are deenergised.



Danger!

Hazardous electrical voltage

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

Possible consequences:

► Death or severe injuries when touching the device in the event of an error.

Protective measures:

Implement the measures required in EN 61800-5-1. Especially:

► Fixed installation
  – Implement PE connection in compliance with standards.
  – Connect PE conductor twice or PE conductor cross-section ≥ 10 mm².
► Connection with a connector for industrial applications according to IEC 60309 (CEE):
  – PE conductor cross-section ≥ 2.5 mm² as part of a multi-core supply cable.
  – Provide for suitable strain relief.



Stop!

No device protection if the mains voltage is too high

The mains input is not internally fused.

Possible consequences:

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

Protective measures:

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



Stop!

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

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



Stop!

Overtemperature

The mains filter may become hot if permissible limit values are exceeded during operation.

Possible consequences:

► The device may be damaged or destroyed.

Protective measures:

► Wire the overtemperature disconnection with the digital DO2 output according to circuit proposal.

6.6.2 Safety instructions for the installation according to UL/CSA

Original - English

Warnings!

- Branch circuit protection:
  - Suitable for use on a circuit capable of delivering not more than 100 000 rms symmetrical amperes, 480 V max., when protected by CC, J or T class fuses.
  - Suitable for motor group installation on a circuit capable of delivering not more than 100 000 rms symmetrical amperes, 480 V max., when protected by class CC, J or T class fuses.
  - Use specified fuses as shown in the table.
  - Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electrical Code / Canadian Electrical Code and any additional local codes.
- The opening of the branch circuit protective device may be an indication that a fault current has been interrupted. To reduce the risk of fire or electrical shock, current-carrying parts and other components of the controller should be examined and replaced if damaged. If burnout of the current element of an overload relay occurs, the complete overload relay must be replaced.
- Max. surrounding air temperature is 45 °C.
- Max. surrounding air temperature with derating is 55 °C.
- Use 60/75 °C copper wire only, except for control circuits.
- Secondary circuit shall supplied from an external isolating source.
- These products are intended for use in a pollution degree 2 environment.
- These products are intended for use in overvoltage category III.

Type	Branch circuit/short circuit protection with fuses in accordance with UL248	
	Standard installation	Motor group installation
	Nominal value (max.) [A]	Nominal value (max.) [A]
E94ARNE0134	45	70
E94ARNE0244	70	70

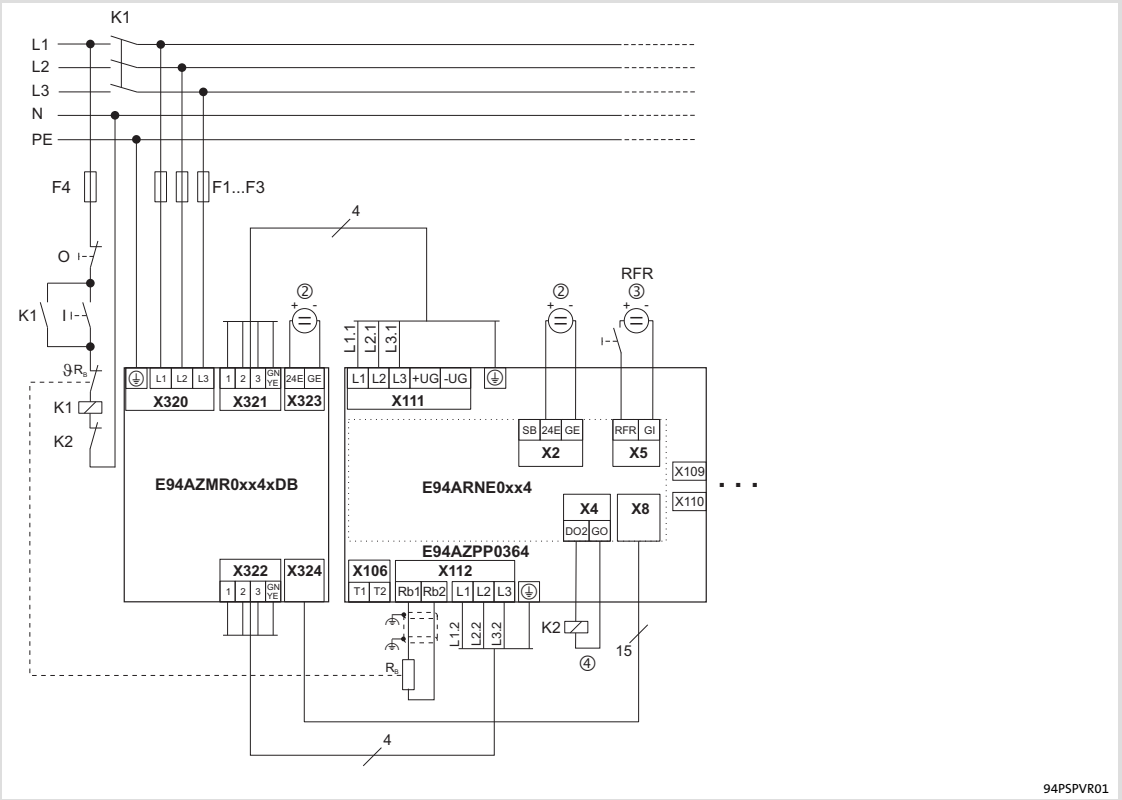
Original - French

Avertissement !

- ► Protection par disjoncteur :
  - – Convient aux circuits non susceptibles de délivrer plus de 100 000 ampères symétriques eff., maximum 480 V, avec protection par des fusibles de calibre CC, J, ou R.
  - – Convient aux installations de groupe moteur sur des circuits non susceptibles de délivrer plus de 100 000 ampères symétriques eff., maximum 480 V, avec protection par des fusibles de calibre CC, J, ou T.
  - – Utiliser les fusibles spécifiés comme indiqué dans le tableau.
  - – La protection statique intégrée n'offre pas la même protection qu'un disjoncteur. Une protection par disjoncteur externe doit être fournie, conformément au National Electrical Code / Canadian Electrical Code, et aux autres dispositions applicables au niveau local.
- ► Le déclenchement du dispositif de protection du circuit de dérivation peut être dû à une coupure qui résulte d'un courant de défaut. Pour limiter le risque d'incendie ou de choc électrique, examiner les pièces porteuses de courant et les autres éléments du contrôleur ; les remplacer s'ils sont endommagés. Le relais de surcharge doit être remplacé en cas de grillage de l'élément traversé par le courant.
- ► Température ambiante maximale : 45 °C
- ► Température ambiante maximale avec réduction de puissance : 55 °C
- ► Utiliser exclusivement des conducteurs en cuivre 60/75 °C, sauf pour les circuits de commande.
- ► Prévoir un circuit auxiliaire alimenté par une source de tension avec isolation galvanique.
- ► Ces produits sont destinés à un environnement caractérisé par le degré de pollution 2.
- ► Ces produits sont conçus pour une utilisation dans la catégorie de surtension III.

Type	Protection du circuit de dérivation / protection contre les courts-circuits par fusibles conformément à UL248	
	Installation standard	Installation au sein d'un groupe moteur
	Valeur nominale (max.) [A]	Valeur nominale (max.) [A]
E94ARNE0134	45	70
E94ARNE0244	70	70

6.6.3 Connection plan



E94ARNE0xx4	Regenerative power supply module
E94AZPP0364	Installation backplane for the regenerative power supply module
E94AZMR0...	Mains filter
F1 ... F4	Fuses
RFR	Controller enable (only for regenerative feedback)
K1	Mains contactor
RB	Brake resistor (Mounting instructions brake resistor)
②	24 V voltage source for the control electronics (safely separated power supply unit (SELV/PELV) according to IEC 61131-2)
③	24 V voltage source for the digital inputs according to IEC 61131-2
④	From FW 02.00: Overtemperature disconnection DO2 load: max. 50 mA

6.6.4 Earthing of internal EMC filters

Device-internal EMC filters have been implemented to reduce interference emission. These EMC filters are connected to protective earth to discharge interference currents.

Under certain conditions the EMC filters must be disconnected from:

- Operation in an IT system

  The devices are protected from damages or destruction due to incompatible overvoltages in the case of an error (earth fault).

- DC-bus operation
- Operation with power supply modules or regenerative power supply modules
- Operating multiple devices with a common filter

  The EMC properties can only be reached by carrying out the described measures.

  The triggering behaviour of applicable earth-leakage circuit breakers remains undisturbed.

Overview of the measures

The measures which are to be carried out once have been prepared in relation to the devices and are each described together with installation and wiring.

Device (GG = device size)	Measure in the case of operation ...	
	in the IT system	in the interconnected system, with power supply modules or shared filters
Inverter		
with installation backplane (GG1 ... GG3)	Insert plastic cap elsewhere	
without installation backplane (GG6 ... GG7)	Change screwed connection	
without installation backplane (GG81 ... GG83)	Change screwed connection	
without installation backplane (GG91)	Only factory-set measures are possible. Please specify when ordering.	
Power supply modules		
with installation backplane (GG1 und GG3)	No measure necessary	
without installation backplane (GG4 ... GG5)	No measure necessary	
Regenerative power supply modules		
with installation backplane (GG3)	Insert plastic cap elsewhere	
associated mains filter	Change screwed connection	No measure necessary

Implementing the measures

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

1. Remove IT insulating cap from the parking position ① in the installation backplane.
   – For this apply a screwdriver on the right or left and lever off the insulating cap.
   – Optionally the insulating cap can be carefully removed using an appropriate pliers.
2. Attach IT insulating cap to the earthing jumper ② until it clicks into place.



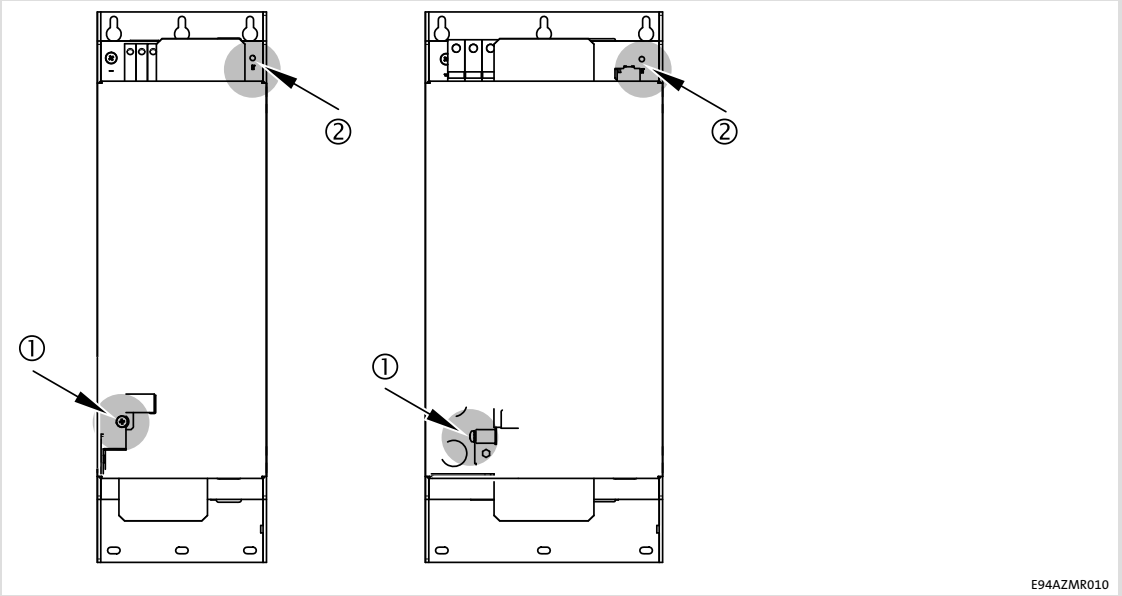
Fig. 6-8 Plugging the IT insulating cap onto the earthing jumper

The measure for the mains filter of the power supply/regenerative feedback modules (only in the case of operation in the IT system)

Carry out the measure before installation and wiring.

How to proceed:

- ► Undo 8 fixing screws of the housing cover
- ► Remove housing cover
- ► Unscrew and remove IT screw with spring washer ①
- ► Screw in IT screw with spring washer at the parking position ②
- ► Fit housing cover
- ► Screw in and tighten 8 fixing screws of the housing cover



6.6.5 Connecting busbars

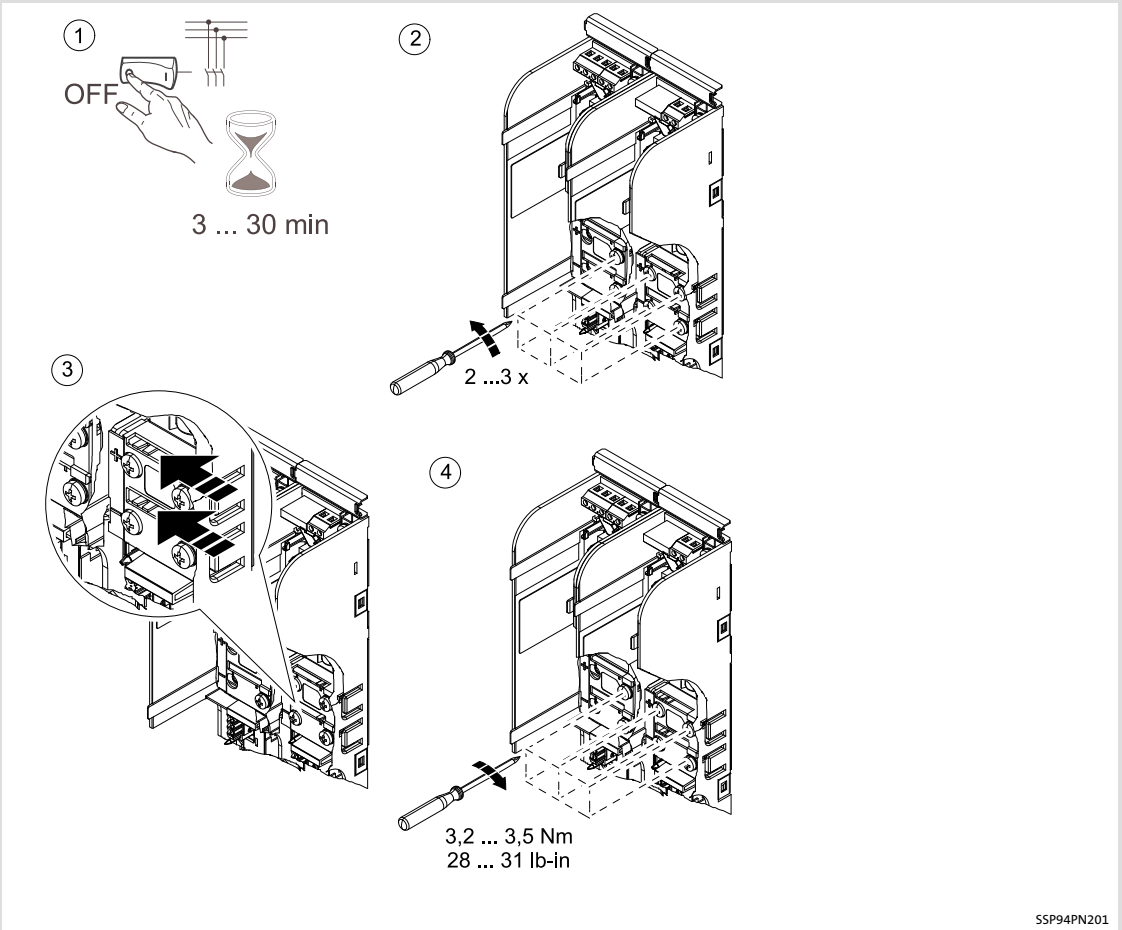


Fig. 6-9 Example: Connecting busbars

Proceed as follows to connect the busbars:

1. If devices of the interconnected system have already been in operation:
   – If necessary, switch off the supply system and wait until the discharge time has elapsed (depending on the device, this may take up to 20 minutes).
   – Make sure that all power terminals are deenergised.
2. Loosen the busbar screws (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 the components onto the mounting plate, if necessary.
   – Tightening torque: 3.0 Nm (26 lb-in).

6.6.6 Design of the cables

- The cables used must comply with the approvals required for the location (e.g. UL).
- The cross-section of the PE conductor must be dimensioned according to the relevant national regulations.
- 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.

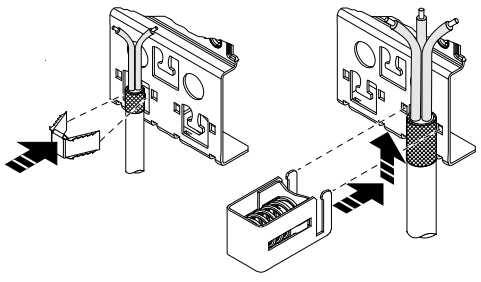
Use system cables or shielded cables for these connections:

- External brake resistor (Mounting Instructions of the brake resistor)
- Analog signals (inputs and outputs)
- CAN system bus
- Resolver
- System connection for synchronisation
- DC bus, cable length from 0.3 m

The following connections need not be shielded:

- Mains
- DC bus, cable length up to 0.3 m
- 24 V supply
- Digital signals (inputs and outputs)

6.6.7 How to connect the shield



E94AZPS004

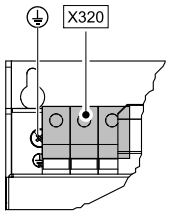
6.6.8 Terminal assignment



Tip!

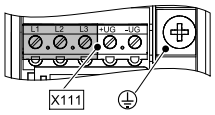
Complete the wiring of the installation backplane before plugging in the standard device. The upper terminals of the installation backplane cannot be connected with a plugged-in standard device.

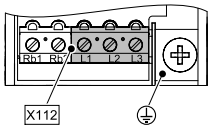
Mains

Terminal X320	Labelling	Description
 SSP94NF406	L1 L2 L3	Connection of the L1, L2, L3 mains phases
	⏚	Connection for the supply-side PE conductor with M5 ring cable lug

Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
E94AZMR0264xDB	10	6	1.2 ... 1.5	10.6 ... 13.3	1.0 x 4.0
E94AZMR0474xDB	25	2	2.5	22.1	1.0 x 6.5

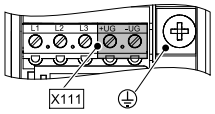
PE connection data				
	∅	Starting torque		
	[mm]	[Nm]	[lb-in]	
E94AZMR0264xDB	M5	3	26.5	PH2
E94AZMR0474xDB				

Terminal X111 (left part)	Labelling	Description
 SSP940X111	L1 L2 L3	Connection of the mains phases E94APNE0xx4/E94AZxPxxx4: L1, L2, L3 E94ARNE0xx4/E94AZMR0xx4xDB: L1.1, L2.1, L3.1
	⏚	Terminal for the supply-side PE conductor with M5 ring cable lug

Terminal X112 (right part)	Labelling	Description
 SSP940X112	L1 L2 L3	Connection of the mains phases E94APNE0xx4/E94AZxPxxx4: alternatively at the bottom L1, L2, L3 E94ARNE0xx4/E94AZMR0xx4xDB: L1.2, L2.2, L3.2
	⏚	Terminal for the supply-side PE conductor with M5 ring cable lug

Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device size 3: Flexible With wire end ferrule	10	6	1.2 ... 1.5	10.6 ... 13.3	PH1

DC bus

Terminal X111 (right part)	Labelling	Description
 SSP940X111	+UG -UG	Alternative option for DC-bus voltage connection (compatible to 9300 series) E94ARNE0244: maximum current I_{dc} = 50 A

Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device size 3: Flexible With wire end ferrule	10	6	1.2 ... 1.5	10.6 ... 13.3	PH1

External brake resistor

Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
Device size 3: Flexible With wire end ferrule	10	6	1.2 ... 1.5	10.6 ... 13.3	PH1

6.6.9 Wiring of control connections



Danger!

Hazardous electrical voltage

All power connections carry a hazardous electrical voltage for a longer time after mains disconnection. Observe the information regarding the discharge time on the device.

Possible consequences:

► Death or severe injuries when touching the power terminals.

Protective measures:

► Before working on the power connections, wait at least until the discharge time has passed (depending on the device, this may be up to 20 minutes).

► Make sure that all power terminals are deenergised.



Stop!

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

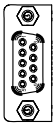
Before working on the device, the personnel must ensure that they are free of electrostatic charge by using appropriate measures.



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

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

24 V supply

Terminal X323	Labelling	Description
 SSP9400X11	GE	GND external supply
	24E	24 V external supply through safely separated power supply unit (SELV/PELV) IEC 61131-2, 22.8 ... 28.8 V, residual ripple max. ±5 % Current during operation: 450 mA Starting current: max. 4 A for 100 ms

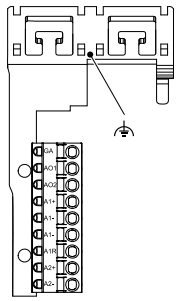
Terminal data				
	Conductor cross-section		Tightening torque	
	[mm²]	[AWG]	[Nm]	[lb-in]
Flexible	0.2 ... 2.5	24 ... 12	Spring terminal	
With wire end ferrule				

Stripping length / contact length: 10 mm

Terminal X2	Labelling	Description
 9400SSP000X2	GE	GND external supply
	24E	24 V external supply via a safely separated power supply unit (SELV/PELV)
	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

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.

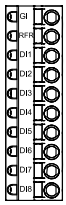
Terminal data				
	Conductor cross-section		Tightening torque	
	[mm²]	[AWG]	[Nm]	[lb-in]
Flexible	0.2 ... 2.5	24 ... 12	Spring terminal	
With wire end ferrule				

Digital outputs

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				

Digital inputs

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

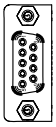
Terminal data				
	Conductor cross-section		Tightening torque	
	[mm²]	[AWG]	[Nm]	[lb-in]
Flexible	0.2 ... 2.5	24 ... 12	Spring terminal	
With wire end ferrule				

Diagnostics/keypad

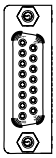
Terminal X6	Labelling	Description
 9400SSP000X6		Internal interface, RJ69 socket, for keypad or diagnostic adapter

Resolver

(without function)

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

System connection for synchronisation

X8terminal	Labelling	Description
	1	Must only be used in conjunctionwith the E94AZMR0xx4xDB mains filter, X324
	...	
9400SSP000X8	15	

6.7 Device modules

Depending on the device version or the application, the device is equipped with device modules. A nameplate attached to the side of the device serves to identify the already equipped device modules .

The possible modules are briefly described in the Accessories chapter. Detailed information can be found in the respective documentation.

6.8 Final works

6.8.1 Initial commissioning on 400 V mains voltage

After the installation has been carried out according to the Mounting Instructions, the regenerative power supply module can be operated on a mains voltage of 400 V.

The regenerative feedback is activated via the digital input RFR.

How to proceed:

1. Switch on 24 V supply voltages:
   – for the mains filter
   – for the regenerative power supply module (optional)
2. Switch on 400 V mains voltage.
3. Activate/deactivate regenerative feedback via the digital input RFR.

6.8.2 Initial commissioning on 230 V or 480 V mains voltage

For operation on a mains voltage of 230 V or 480 V, first the mains voltage within the regenerative power supply module has to be set. The setting is effected in C00173 and can be carried out using a keypad or the Lenze PC software »Engineer«.

For commissioning you require:

► An EZAEBKx00xkeypad,

or

► A computer with Windows® operating system (XP or 2000)
► The Lenze PC software »Engineer«
► A connection to the regenerative power supply module via an interface, e. g.
   – Diagnostic interface X6 with USB diagnostic adapter
   – CAN system bus
   – Communication modules in the expansion slots M1/M2
► The software manual for the technology application used
► The communication manual (KHB) for the network of the automation platform
► Switch on 24 V supply voltages:
   – for the mains filter
   – for the regenerative power supply module

After the setting has been carried out according to the mains voltage available:

1. Switch on mains voltage.
2. Activate/deactivate regenerative feedback via the digital input RFR.

6.8.3 Further settings

Follow the instructions of the software and/or read the documentation for the parameterisation of the regenerative power supply module.

7 DC-bus operation

7.1 Introduction



Tip!

The information regarding DC-bus operation is based on standard applications.

If you have any questions regarding other possible solutions for DC-bus operation, get in touch with your Lenze contact person.

7.1.1 Terminology and abbreviations used

Term	Description
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
Power supply module	Module with AC mains connection used to supply the DC bus of a drive system with DC voltage.
Regenerative power supply module	Power 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 in the DC bus 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.

7.1.2 Comparison single-axis controllers / multi-axis controllers

As controllers of the 9400 Servo Drives series, the ”Single Drive, E94x**S**…” are available in the power range up to 460 A (240 kW) and ”Multi Drive, E94x**M**…” are available up to 59 A (30 kW).

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, power supply modules are used that contain mains rectifiers and brake choppers. Mains filters must be specially dimensioned for each DC-bus.

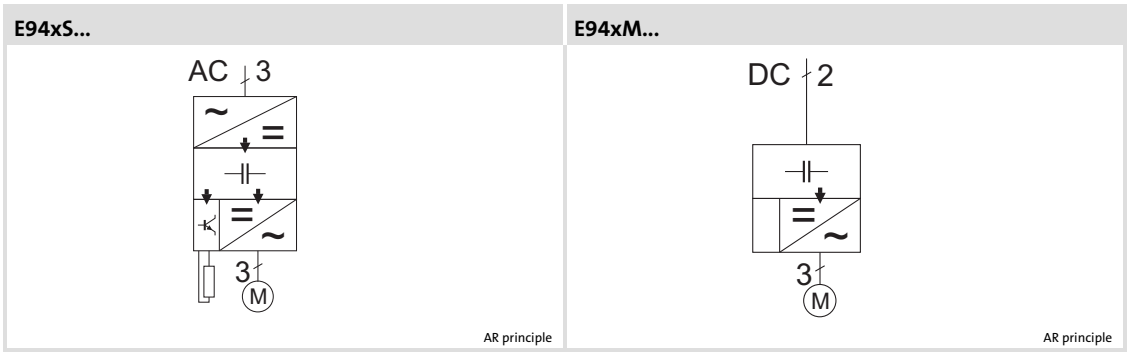


Fig. 7-1 Single Drive/Multi Drive

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-feeding point

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 trouble-free DC-bus operation

7.2.1 Voltages

The DC-bus operation of controllers is only possible if the rated values of the mains voltage or DC-bus voltage are identical. The switching thresholds of all brake choppers in the interconnected system have to be set identically and the control has to be synchronised by master/slave interconnection.

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 permissible in the interconnected system of two single-axis drive controllers with the same power rating.

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).



Stop!

The 24 V supply is not switched on for all inverters in the DC bus.

Possible consequences:

- Charging relay or charging hybrid can be destroyed.

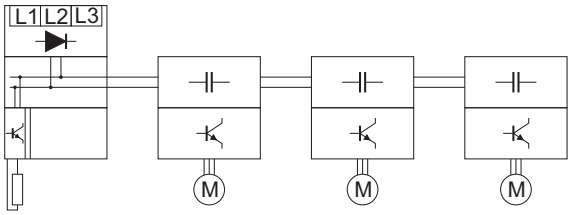
Protective measures:

- Feed all inverters in the DC-bus connection via a common and stable 24 V supply.
- With split 24 V supply and fuse protection: If a fuse responds, shut down the entire drive train if possible to avoid cyclical voltage strokes in the DC bus.

- Up to a total current of 100 A, devices up to 24 A (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

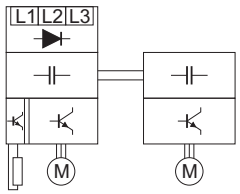
7.3.1 Supply from a supply module



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	
E94APNExxx4 (10 ... 245 A)	-
Regenerative power supply modules	
E94ARNE0xx4 + E94AZMR0xx4xDB (13 ... 24 A)	-
As DC-bus component	
Multi-axis controllers	
E94xMxExxx4 (2 ... 59 A)	-
Single-axis controllers	
E94xSxE0024 ... E94xSxE0594 (2 ... 59 A or device sizes 1 ... 6)	E94xSxE0864 ... E94xSxE4604 (86 ... 460 A or device size 7 ... 91)

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	
Single-axis controllers	
E94xSxE0024 ... E94xSxE0594 (2 ... 59 A or device sizes 1 ... 6)	E94xSxE0864 ... E94xSxE4604 (86 ... 460 A or device size 7 ... 91) → Possible to a certain degree when considering Application Reports.
As DC-bus component	
Multi-axis controllers	
E94xMxExxx4 (2 ... 59 A)	-
Single-axis controllers	
E94xSxE0024 ... E94xSxE0594 (2 ... 59 A or device sizes 1 ... 6)	E94xSxE0864 ... E94xSxE4604 (86 ... 460 A or device size 7 ... 91)

7.4 Rated data

7.4.1 General data

The total current of the nominal input currents I_{DC} to be provided by the power supply module or one or several single-axis controllers must be determined. The DC cables must be dimensioned in accordance with the total current.

The number of devices in a drive system can be limited by the DC-bus capacity and the charging current ($I_{charging,\ permissible} > \Sigma(I_{charging\ at}\ U_r)$).

Additional data						
	Input current	DC-bus capacity	Charging resistor	$I_{charging}$ at V_{Lr}		permissible
Type	I_{DC} at I_{ar} [A]	[µF]	[Ω]	400 V [A]	480 V [A]	[A]
Power supply modules						
E94APNE0104	-	-	-	-	-	90
E94APNE0364	-	-	-	-	-	154
E94APNE1004	-	-	-	-	-	278
E94APNE2454	-	-	-	-	-	520
Regenerative power supply modules						
E94ARNE0134	20.6	495	100	5.7	7.1	154
E94ARNE0244	35.5	990	50	11.3	14.1	154
Multi Drives						
E94xMxE0024	2.6	165	100	5.7	7.1	-
E94xMxE0034	4.3	165	100	5.7	7.1	-
E94xMxE0044	6.7	330	100	5.7	7.1	-
E94xMxE0074	12.1	330	100	5.7	7.1	-
E94xMxE0094	15.4	495	50	11.3	14.1	-
E94xMxE0134	20.6	495	100	5.7	7.1	-
E94xMxE0174	25.7	825	50	11.3	14.1	-
E94xMxE0244	35.5	990	50	11.3	14.1	-
E94xMxE0324	48.0	1320	50	11.3	14.1	-
E94xMxE0474	52.6	2200	27	21.0	25.1	154
E94xMxE0594	66.1	2200	27	21.0	25.1	154

Additional data						
	Input current	DC-bus capacity	Charging resistor	$I_{charging}$ at V_{Lr}		permissible
Type	I_{DC} at I_{ar} [A]	[µF]	[Ω]	400 V [A]	480 V [A]	[A]
Single Drives						
E94xSxE0024	2.6	165	100	5.7	6.8	20.4
E94xSxE0034	4.3	165	100	5.7	6.8	20.4
E94xSxE0044	6.7	330	100	5.7	6.8	49.0
E94xSxE0074	12.1	330	100	5.7	6.8	49.0
E94xSxE0134	20.6	495	100	5.7	6.8	154
E94xSxE0174	25.7	825	50	11.3	13,6	154
E94xSxE0244	35.5	990	50	11.3	13,6	154
E94xSxE0324	35.5	2200	27	21.0	25.1	154
E94xSxE0474	52.6	2200	27	21.0	25.1	154
E94xSxE0594	66.1	2200	27	21.0	25.1	154

Tab. 7-1

DCbus = DC bus

$I_{charging}$ = charging current

The devices listed below are not permissible as direct DC-connection nodes on the DC link level. Get in touch with your Lenze contact person to find out whether solutions and measures have been worked out for your particular application.

Additional data						
	Input current	DC-bus capacity	Charging resistor	$I_{charging}$ at V_{Lr}		permissible
Type	I_{DC} at I_{ar} [A]	[µF]	[Ω]	400 V [A]	480 V [A]	[A]
E94xSxE0864	96.8	3300	68	8.3	10.0	358
E94xSxE1044	116	3300	68	8.3	10.0	358
E94xSxE1454	171	6000	- [1)]	5.0	5.0	356
E94xSxE1724	203	8000	- [1)]	6.7	6.7	423
E94xSxE2024	239	8000	- [1)]	6.7	6.7	496
E94xSxE2454	290	8000	- [1)]	6.7	6.7	603
E94xSxE2924	343	8000	- [1)]	6.7	6.7	713
E94xSxE3664	434	16000	- [1)]	13.4	13.4	901
E94xSxE4604	544	16000	- [1)]	13.4	13.4	1130

Tab. 7-2

DCbus = DC bus

$I_{charging}$ = charging current

1) Charge with constant current

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 supply during overload time
t_{ol}	Overload time
P_{re}	Power supply during unloading time
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 V_{Lr}.

230 V

Supply power V_{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
E94APNE1004	20.8	41.6 · 0.5	18.5 · 4.5	31.2 · 60	15.6 · 120
E94APNE1004 + E94AZMP0824	27.9	55.8 · 0.5	24.8 · 4.5	41.9 · 60	20.9 · 120
E94APNE2454	51	76.5 · 0.5	48.2 · 4.5	76.5 · 60	38.3 · 120
E94APNE2454 + E94AZMP2004	68.5	103 · 0.5	64.7 · 4.5	103 · 60	51.3 · 120
Regenerative power supply modules + filters					
E94ARNE0134 + E94AZMR0264xDB	8.6	25.8 · 0.5	6.5 · 4.5	12.9 · 60	6.5 · 120
E94ARNE0244 + E94AZMR0474xDB	15.6	46.6 · 0.5	11.7 · 4.5	23.3 · 60	11.7 · 120
Single Drives					
E94xSxE0024	1.0	4.0 · 0.5	0.8 · 4.5	1.8 · 60	0.8 · 120
E94xSxE0034	1.0	4.0 · 0.5	0.8 · 4.5	1.8 · 60	0.8 · 120
E94xSxE0044	1.6	6.4 · 0.5	1.2 · 4.5	3.0 · 60	1.2 · 120
E94xSxE0074	2.7	10.8 · 0.5	2.0 · 4.5	4.1 · 60	2.0 · 120
E94xSxE0134	5.0	20.0 · 0.5	3.8 · 4.5	9.5 · 60	3.8 · 120
E94xSxE0174	6.3	25.2 · 0.5	4.7 · 4.5	9.5 · 60	4.7 · 120
E94xSxE0244	8.9	35.6 · 0.5	6.7 · 4.5	13.4 · 60	6.7 · 120
E94xSxE0324	15.8	63.2 · 0.5	11.9 · 4.5	23.7 · 60	11.9 · 120
E94xSxE0474	22.3	80.4 · 0.5	15.1 · 4.5	30.2 · 60	15.1 · 120
E94xSxE0594	22.3	80.4 · 0.5	15.1 · 4.5	30.2 · 60	15.1 · 120
E94xSxE0864	39.1	70.4 · 0.5	29.3 · 4.5	58.7 · 60	29.3 · 120
E94xSxE1044	39.1	70.4 · 0.5	29.3 · 4.5	58.7 · 60	29.3 · 120

Tab. 7-3

400 V

Power supply V_{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
E94APNE1004	36.2	72.4 · 0.5	32.2 · 4.5	54.3 · 60	27.2 · 120
E94APNE1004 + E94AZMP0824	48.6	97.2 · 0.5	43.2 · 4.5	72.9 · 60	36.5 · 120
E94APNE2454	88.6	133 · 0.5	83.7 · 4.5	133 · 60	66.4 · 120
E94APNE2454 + E94AZMP2004	119	179 · 0.5	112 · 4.5	179 · 60	89.0 · 120
Regenerative power supply modules + filters					
E94ARNE0134 + E94AZMR0264xDB	15.0	44.9 · 0.5	11.3· 4.5	22.4 · 60	11.3 · 120
E94ARNE0244 + E94AZMR0474xDB	27.0	81.1 · 0.5	20.3· 4.5	40.5 · 60	20.3 · 120
Single Drives					
E94xSxE0024	2.0	8.0 · 0.5	1.3 · 4.5	3.0 · 60	1.5 · 120
E94xSxE0034	2.0	8.0 · 0.5	1.3 · 4.5	3.0 · 60	1.5 · 120
E94xSxE0044	3.2	12.8 · 0.5	2.1 · 4.5	4.8 · 60	2.4 · 120
E94xSxE0074	5.7	17.1 · 0.5	4.4 · 4.5	8.6 · 60	4.3 · 120
E94xSxE0134	10.5	31.5 · 0.5	8.2 · 4.5	15.8 · 60	7.9 · 120
E94xSxE0174	13.1	39.3 · 0.5	10.2 · 4.5	19.7 · 60	9.8 · 120
E94xSxE0244	18.7	46.8 · 0.5	15.6 · 4.5	28.1 · 60	14.0 · 120
E94xSxE0324	26.7	64.0 · 0.5	22.6 · 4.5	40.0 · 60	20.0 · 120
E94xSxE0474	37.9	75.8 · 0.5	33.7 · 4.5	57.0 · 60	28.4 · 120
E94xSxE0594	37.9	75.8 · 0.5	33.7 · 4.5	57.0 · 60	28.4 · 120
E94xSxE0864	66.6	133 · 0.5	59.2 · 4.5	100 · 60	50.0 · 120
E94xSxE1044	66.6	133 · 0.5	59.2 · 4.5	100 · 60	50.0 · 120
E94xSxE1454	92.0	166 · 10	69.0 · 30	138 · 60	69.0 · 120
E94xSxE1724	109	196 · 10	82.0 · 30	164 · 60	82.0 · 120
E94xSxE2024	129	232 · 10	97.0 · 30	194 · 60	97.0 · 120
E94xSxE2454	156	280 · 10	117 · 30	234 · 60	117 · 120
E94xSxE2924	186	334 · 10	139 · 30	279 · 60	139 · 120
E94xSxE3664	233	419 · 10	175 · 30	350 · 60	175 · 120
E94xSxE4604	293	527 · 10	220 · 30	440 · 60	220 · 120

Tab. 7-4

480 V

Power supply V_{Lr} = 480 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
E94APNE1004	45.2	90.4 · 0.5	40.2 · 4.5	67.8 · 60	33.9 · 120
E94APNE1004 + E94AZMP0824	60.8	122 · 0.5	54.0 · 4.5	91.2 · 60	45.6 · 120
E94APNE2454	111	167 · 0.5	105 · 4.5	167 · 60	83.0 · 120
E94APNE2454 + E94AZMP2004	149	224 · 0.5	141 · 4.5	224 · 60	112 · 120
Regenerative power supply modules + filters					
E94ARNE0134 + E94AZMR0264xDB	18.6	56.1 · 0.5	14.0 · 4.5	28.0 · 60	14.0 · 120
E94ARNE0244 + E94AZMR0474xDB	33.8	101.4 · 0.5	25.4 · 4.5	50.7 · 60	25.4 · 120
Single Drive					
E94xSxE0024	2.4	9.6 · 0.5	1.6 · 4.5	3.6 · 60	1.8 · 120
E94xSxE0034	2.4	9.6 · 0.5	1.6 · 4.5	3.6· 60	1.8 · 120
E94xSxE0044	3.8	15.2 · 0.5	2.5 · 4.5	5.7 · 60	2.9 · 120
E94xSxE0074	6.8	20.4 · 0.5	5.3 · 4.5	10.2 · 60	5.1 · 120
E94xSxE0134	12.5	37.5 · 0.5	9.7 · 4.5	18.8 · 60	9.4 · 120
E94xSxE0174	15.7	47.1 · 0.5	12.2 · 4.5	23.6 · 60	11.8 · 120
E94xSxE0244	22.5	56.3 · 0.5	18.7 · 4.5	33.8 · 60	16.9 · 120
E94xSxE0324	28.0	67.0 · 0.5	23.7 · 4.5	42.0 · 60	21.0 · 120
E94xSxE0474	45.2	108 · 0.5	38.2 · 4.5	67.8 · 60	33.9 · 120
E94xSxE0594	45.2	108 · 0.5	38.2 · 4.5	67.8 · 60	33.9 · 120
E94xSxE0864	79.6	159 · 0.5	70.8 · 4.5	119 · 60	59.7 · 120
E94xSxE1044	79.6	159 · 0.5	70.8 · 4.5	119 · 60	59.7 · 120
E94xSxE1454	92.0	166 · 10	69.0 · 30	138 · 60	69.0 · 120
E94xSxE1724	109	196 · 10	82.0 · 30	164 · 60	82.0 · 120
E94xSxE2024	129	232 · 10	97.0 · 30	194 · 60	97.0 · 120
E94xSxE2454	156	280 · 10	117 · 30	234 · 60	117 · 120
E94xSxE2924	186	334 · 10	139 · 30	279 · 60	139 · 120
E94xSxE3664	233	419 · 10	175 · 30	350 · 60	175 · 120
E94xSxE4604	293	527 · 10	220 · 30	440 · 60	220 · 120

Tab. 7-5

7.4.3 DC-power requirements

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

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

Power requirements P_{ar} [W] with rated current			
Type	U_{Lr} = 230 V	U_{Lr} = 400 V	U_{LN} = 480 V
Multi Drives			
E94xMxE0024	500	900	1000
E94xMxE0034	900	1600	1600
E94xMxE0044	1400	2500	2600
E94xMxE0074	2500	4400	4600
E94xMxE0094	3300	5800	6100
E94xMxE0134	4700	8100	8500
E94xMxE0174	5900	10300	10800
E94xMxE0244	8400	14700	15400
E94xMxE0324	11500	20000	19400
E94xMxE0474	16900	29300	30800
E94xMxE0594	19000	33100	38600
Single Drives			
E94xSxE0024	500	900	1000
E94xSxE0034	900	1600	1600
E94xSxE0044	1400	2500	2600
E94xSxE0074	2500	4400	4600
E94xSxE0134	4700	8100	8500
E94xSxE0174	5900	10300	10800
E94xSxE0244	8400	14700	15400
E94xSxE0324	11500	20000	21000
E94xSxE0474	16900	29300	30800
E94xSxE0594	19000	33100	38600
E94xSxE0864	30800	53600	56300
E94xSxE1044	37300	64800	68100
E94xSxE1454	-	90000	100000
E94xSxE1724	-	107000	129000
E94xSxE2024	-	126000	151000
E94xSxE2454	-	153000	183000
E94xSxE2924	-	182000	218000
E94xSxE3664	-	228000	274000
E94xSxE4604	-	287000	344000

Tab. 7-6

Type	Power loss P_V [W] at a switching frequency of 4 kHz			
	U_{Lr} = 230 V	U_{Lr} = 400 V	U_{LN} = 480 V	when controller is inhibited
Multi Drives				
E94xMxE0024	65	80	95	40
E94xMxE0034	75	95	110	
E94xMxE0044	90	120	135	
E94xMxE0074	105	145	165	
E94xMxE0094	130	170	200	
E94xMxE0134	160	215	245	
E94xMxE0174	185	255	290	
E94xMxE0244	235	320	375	
E94xMxE0324	290	405	470	
Single Drives				
E94xSxE0024	70	90	100	40
E94xSxE0034	85	105	120	
E94xSxE0044	100	130	145	
E94xSxE0074	125	160	180	
E94xSxE0134	200	260	290	
E94xSxE0174	240	300	340	
E94xSxE0244	310	400	450	
E94xSxE0324	750	750	750	75
E94xSxE0474	1050	1050	1050	
E94xSxE0594	1100	1100	1100	
E94xSxE0864	1500	1500	1500	100
E94xSxE1044	1800	1800	1800	
E94xSxE1454	-	2100	2100	< 100
E94xSxE1724	-	2200	2200	< 100
E94xSxE2024	-	2600	2600	
E94xSxE2454	-	3300	3300	
E94xSxE2924	-	4100	4100	< 100
E94xSxE3664	-	4900	4900	< 100
E94xSxE4604	-	6200	6200	< 150

7.4.4 DC fuses

Note!

The fuse current I_{max} specified in the table is the maximum permissible value for the approved fuse types. This prevents fire and electrical hazard in the event of an error of the device.

The fuse must be smaller or equal to the maximum permissible value, taking the following into consideration:

- ► the maximum possible cable cross-section
- ► the laying system (e.g. tap installation)
- ► the ambient temperature
- ► the relevant regulations (e.g. UL508A, NEC70 and others).

Assignment devices - DC-fuses

	+UG/-UG (X100)									
	Eaton		Siba		Mersen		Siemens		Littlefuse	
Type	I_{max} [A]	Type	I_{max} [A]	Type	I_{max} [A]	Type	I_{max} [A]	Type	I_{max} [A]	Type
E94xSxE0024 E94xSxE0034	63	170M1754 170M1734	16	5020106.16 5020206.16	-	-	-	-	-	-
E94xSxE0044 E94xSxE0074	125	170M1757 170M1737	40	5020106.40 5020206.40	-	-	-	-	-	-
E94xSxE0134 E94xSxE0174 E94xSxE0244	200	170M1759 170M1739	100	2029220.100 2029221.100	-	-	-	-	-	-
E94xMxE0024 E94xMxE0034 E94xMxE0044	63	170M1754 170M1734	16	5020106.16 5020206.16	-	-	-	-	-	-
E94xMxE0074 E94xMxE0094	125	170M1757 170M1737	40	5020106.40 5020206.40	-	-	-	-	-	-
E94xMxE0134 E94xMxE0174 E94xMxE0244 E94xMxE0324	200	170M1759 170M1739	100	2029220.100 2029221.100	-	-	-	-	-	-
E94xMxE0474 E94xMxE0594	315	170M1761 170M1741	200	5020106.xx 5020206.xx 2029220.xxx	200	A70QSxx-14F A70QSxx-14FI A70QSxxx-22F A70QSxxx-22FI A70QSxxx-4 A70QSxxx-4K	200	3NC1405 ... 3NC1450 3NC2220 ... 3NC2200 3NE8714-1 ... 3NE8725-1	200	L70QSxxx
	200	FWP-xxA14FA FWP-xxxA22FA FWP-xxB FWP-xxA 170M1308 ... 170M1320 170M1358 ... 170M1370 170M1408 ... 170M1420								

Recommended fuse holder for type 170M...: Eaton (Bussmann) 170H1007

Assignment devices - DC-fuses

Type	DC busbar (X109/X110)									
	Eaton		Siba		Mersen		Siemens		Littlefuse	
	I_{max} [A]	Type	I_{max} [A]	Type	I_{max} [A]	Type	I_{max} [A]	Type	I_{max} [A]	Type
E94xSxE0024 E94xSxE0034 E94xSxE0044 E94xSxE0074 E94xSxE0134	315	170M1761 170M1741	200	5020106.xx 5020206.xx 2029220.xxx	200	A70QSxx-14F A70QSxx-14FI A70QSxxx-22F A70QSxxx-22FI A70QSxxx-4 A70QSxxx-4K	200	3NC1405 ... 3NC1450 3NC2220 ... 3NC2200 3NE8714-1 ... 3NE8725-1	200	L70QSxxx
E94xSxE0174 E94xSxE0244 E94xMxE0024 E94xMxE0034 E94xMxE0044 E94xMxE0074 E94xMxE0094 E94xMxE0134 E94xMxE0174 E94xMxE0244 E94xMxE0324	200	FWP-xxA14FA FWP-xxxA22FA FWP-xxB FWP-xxA 170M1308 ... 170M1320 170M1358 ... 170M1370 170M1408 ... 170M1420								

Recommended fuse holder for type 170M...: Eaton (Bussmann) 170H1007

7.5 Basic dimensioning

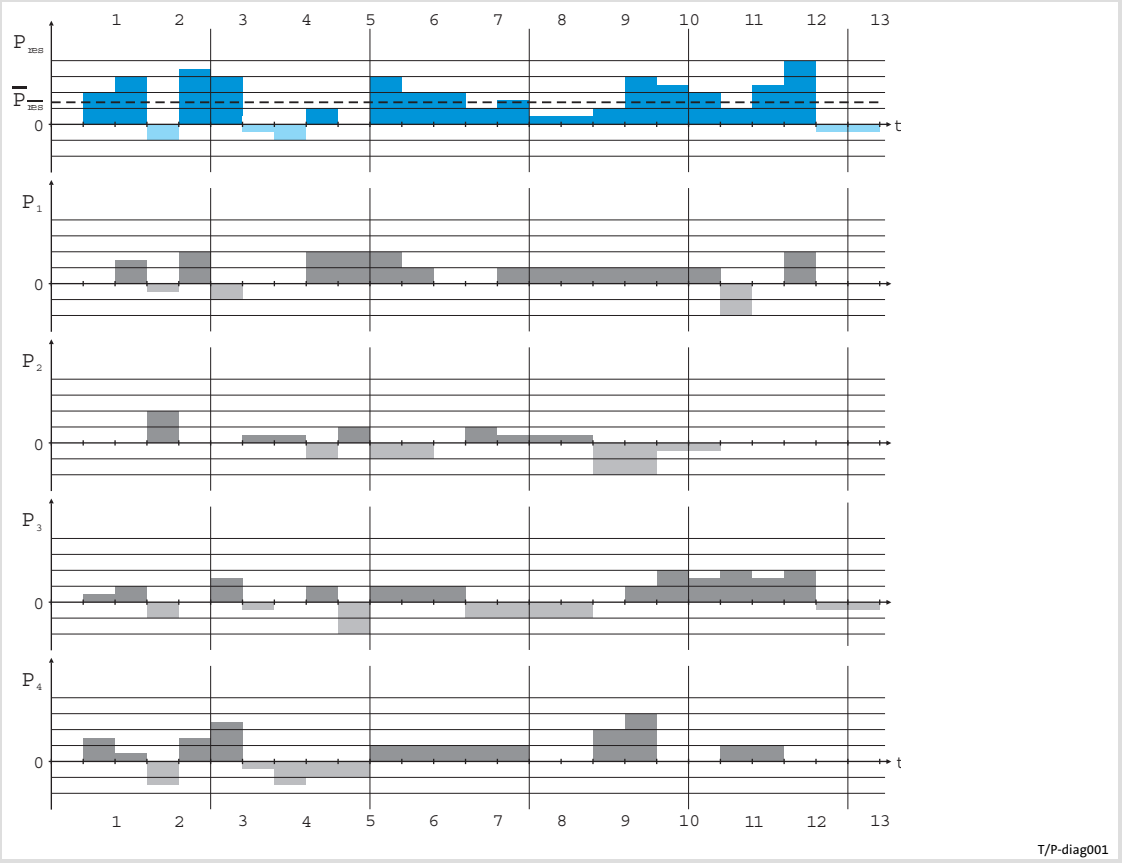
7.5.1 General information

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. 7-7 Example time/performance diagram

$P_1 \ldots P_4$	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:

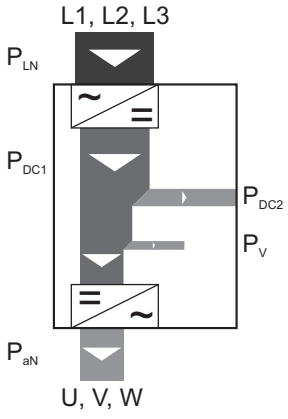
(📖 7.4.2)

- 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. 7-6).

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:

$$P_{DCges} = \sum_{i=1}^{n} \left\{ \frac{(P_{Welle})_i}{\eta_i} + (P_{Verl})_i \right\}$$

$P_{DCtotal}$	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 supplying device must be able to supply the calculated power requirements.

For application examples, please see 7.7 .

7.5.6 Determining the regenerative power requirements

With the regenerative power supply modules of the ”Servo Drives 9400” series, power regeneration into the AC mains is possible. Use the determined regenerative power for the dimensioning of the regenerative power supply module.

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 power supply module	
Type	Device size	Type	Device size
E94AZMP0084	2	E94APNE0104	1
E94AZMP0294	3	E94APNE0364	3
E94AZMP0824	4	E94APNE1004	4
E94AZMP2004	5	E94APNE2454	5

The mains filters are designed for the following conditions:

- 10 interconnected devices,
- each with a 50 m motor cable,
- EMC category C2.

RFI filter		DC power 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 interconnected devices,
- each with a 10 m motor cable,
- EMC category C2.

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

Note!

To observe EMC category C2, measures must be carried out on the device-internal EMC filters of the drive components in the network system. The measures for the individual devices are described in the chapter ”Wiring”, section ”Earthing of internal EMC filters”.

When using the mains filters assigned, conditions must be observed for compliance with EMC class C2:

- The measures for the use on IT systems must be applied to all axis modules in the interconnection (separation of internal filter components from PE).
- The maximum sum total of all motor cable lengths ($\Sigma\, l_{mot}$) for the filter used must be observed.

Motor cable lengths in the interconnection

The assigned filters are designed for $\Sigma\ l_{mot}$ for 6 axis modules (E94AZRP...: 60 m (= 6 x 10 m), E94AZMP...: 600 m (= 6 x 100 m)).

For a different number of axis modules, $\Sigma\ l_{mot}$ can be determined from the following diagrams.

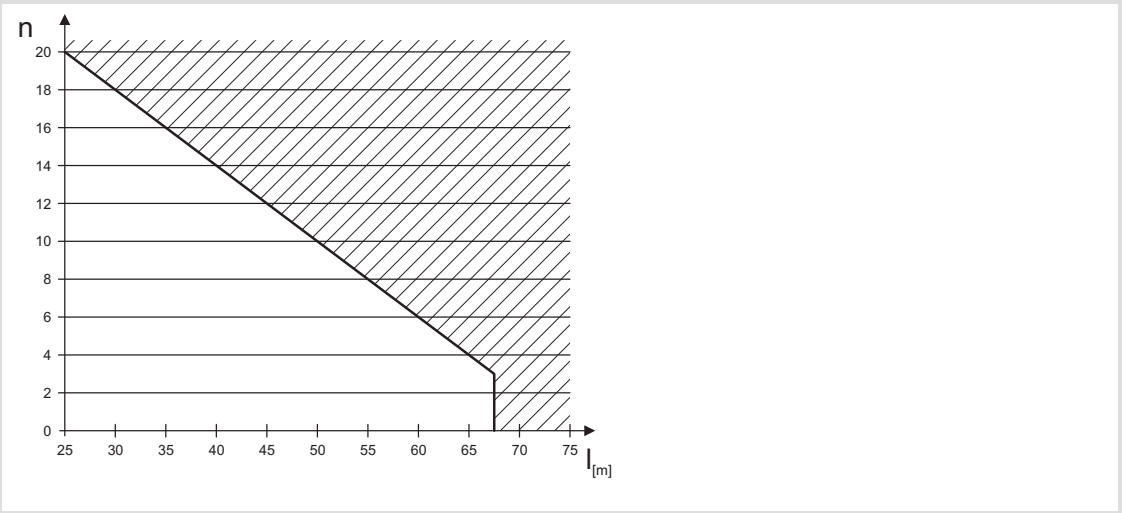


Fig. 7-2 Filter E94AZRP...: Sum total of motor cable lengths as a function of the number of axis modules

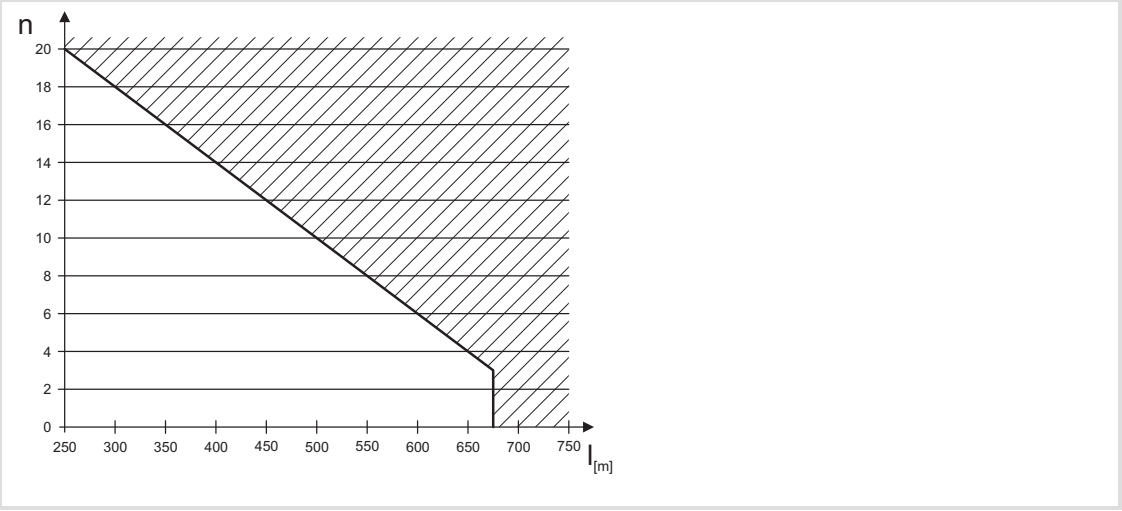


Fig. 7-3 Filter E94AZMP...: Sum total of motor cable lengths as a function of the number of axis modules

Constellations with unfavourable or intensifying parasitic couplings

Compliance with EMC category C2 may also be interfered with by other circumstances:

- Distribution of the axis modules over several control cabinets without efficient HF equipotential bonding between the mounting plates
- No use of Lenze system cables or cables with the same specifications
- Poor connection of motor cable shields
- Motor cable interruptions
- Other interference sources (e.g. switched-mode power supplies)
- Isochronous switching of the inverter output stages

With different motor cable lengths, per axis at least 25 % of the longest cable must be considered when calculating the total motor cable length.

Example: 1	Motor cable length l_{mot} [m]		
Axis	**Actual value**	**min. 25 % of the longest cable**	**To be considered**
1	6	0.25 * 20 = 5	6
2 ... 4	3 * 10		3 * 10
5	20	⇦	20
Total	56	max. permissible for 5 axes: ∑< 60	**56**
		EMC class C2 will be complied with.	☑

Example 2	Motor cable length l_{mot} [m]		
Axis	**Actual value**	**min. 25 % of the longest cable**	**To be considered**
1 ... 4	4 * 5	0.25 * 40 = 10	4 * 10
5	40	⇦	40
Total	60	max. permissible for 5 axes: ∑< 60	**80**
		EMC class C2 will not be complied with.	☒

Example: 3	Motor cable length l_{mot} [m]		
Axis	**Actual value**	**min. 25 % of the longest cable**	**To be considered**
1 ... 3	3 * 100	⇦	3 * 100
4	50	0.25 * 100 = 25	50
5 ... 10	6 * 15		6 * 25
Total	410	max. permissible for 10 axes: ∑ < 500	**500**
		EMC class C2 will be complied with.	☑

Example: 4	Motor cable length l_{mot} [m]		
Axis	**Actual value**	**min. 25 % of the longest cable**	**To be considered**
1 ... 4	4 * 100	⇦	4 * 100
5 ... 10	6 * 15	0.25 * 100 = 25	6 * 25
Total	490	max. permissible for 10 axes: ∑ < 500	**550**
		EMC class C2 will not be complied with.	☒

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	E94xMxE0074	4.8	3.0	0.19	7.0
G6 ... G7	E94xMxE0034	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.

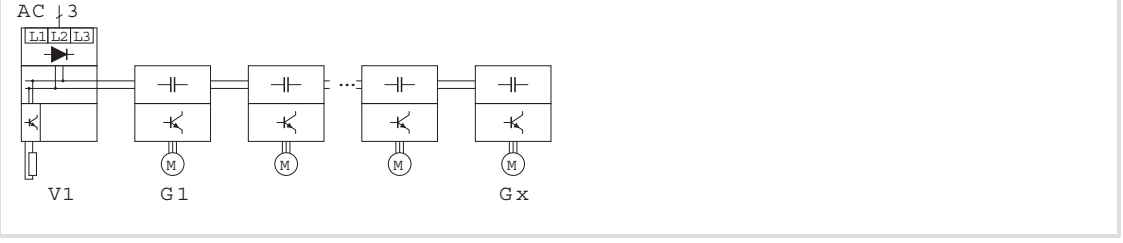


Fig. 7-4 Basic circuit diagram

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	E94xSxE0244	16.3	11.0	0.50	23.5
G2	E94xMxE0074	4.8	3.0	0.19	7.0
G3 ... G4	E94xMxE0034	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)	E94xSxE0244 + 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.

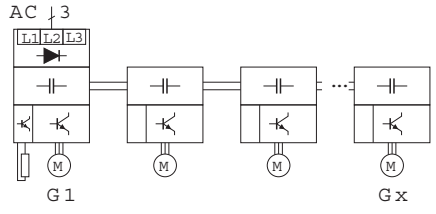


Fig. 7-5 Basic circuit diagram

8 Accessories (overview)

Note!

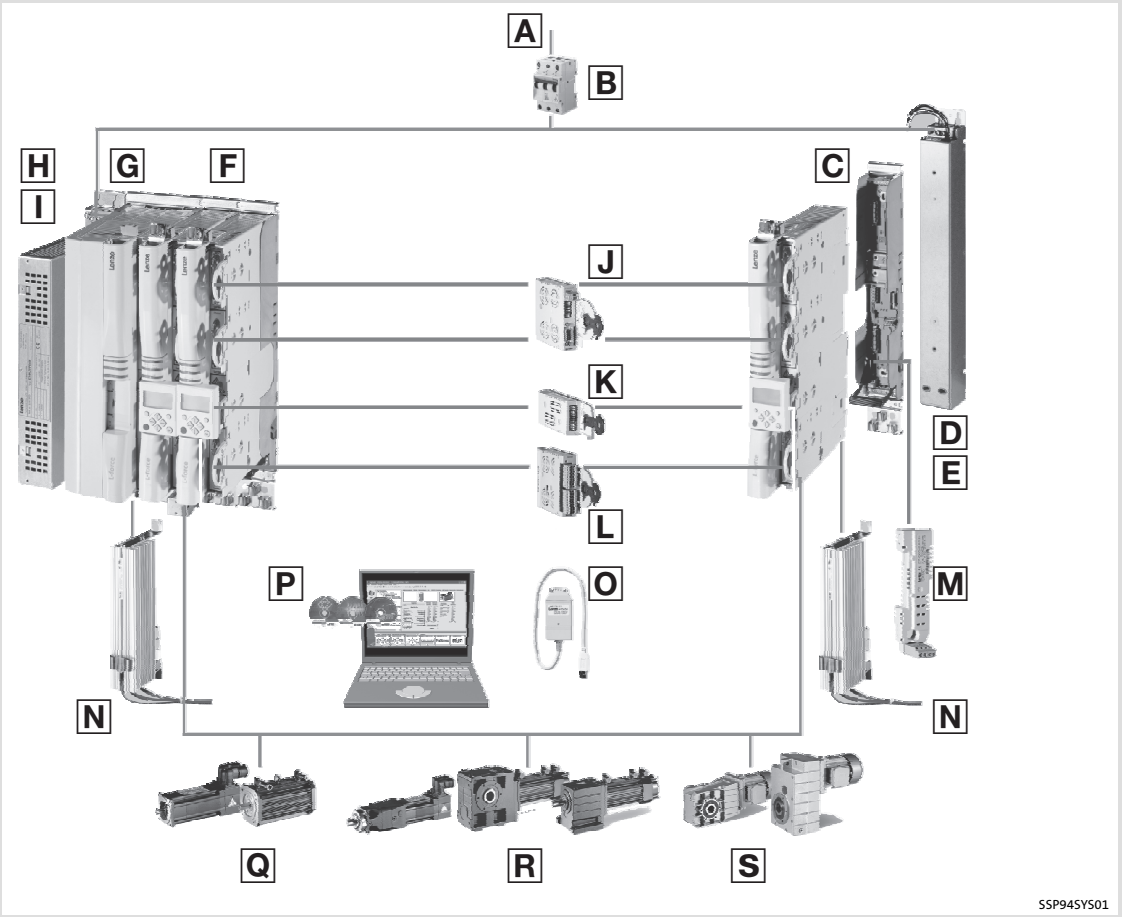
You can find additional information on the accessories in the catalogue to this product series.

8.1 System overview

The following figure shows the most important components for the implementation of a drive system with the Servo Drives 9400 product range.

On the way from the mains connection to the motor, you can see the basic principle of a drive system on the left path. On the right path, the basic principle of a single-axis drive is described.

In accordance with the requirements of your drive solution, your drive system can be equipped or extended with specially adapted components.



A Mains voltage 3/PE AC 180 ... 528 V ±0 % or 3/PE AC 340 ... 528 V ±0 %
(depending on the device size/device power)
B Mains fusing (not contained in the delivery programme)
C Single Drives 9400 📖 31
and corresponding installation backplanes
D Mains filter for Single Drives 9400 📖 542
E RFI filter for Single Drives 9400 📖 571
F Multi Drives 9400 📖 167
and corresponding installation backplanes
G Power supply modules 9400
📖 241, 📖 289
(for DC bus installations with Multi Drives 9400)
H Mains filter for power supply modules 9400 📖 549
I RFI filter for power supply modules 9400 📖 589

Equipment for all axis modules (device-dependent options):
J Communication modules and extension modules 📖 371
K Memory modules 📖 419
L Safety modules 📖 428
M Motor holding brake control modules 📖 448
N Brake resistors 📖 625
O Diagnostic adapters 📖 507
P L-force Engineer (software)
Q Servo motors (motor catalogue)
R Geared servo motors (")
S Standard geared motors (")
Motor cables/system cables
(manual "System cables")

8.2 Overview of accessories

With the accessories available, the standard devices of the controllers of the Servo Drives 9400 series are directly equipped with functions, interfaces, etc. required for specific drive solutions.

The following overview shows the accessories assigned to the controllers and power supply modules.

1)	Component from this range is absolutely necessary
+	Can be used without restrictions
o	Can be used with restrictions
-	Can be used, but check alternative
^	Already included
---	No use

Accessories	Single Drive			Multi Drive		Power supply modules		VR modules	
Field	GG (device size)			GG		GG		GG	
Designation	1 ... 3	6 ... 7	81 ... 91	1 ... 3	6	1 & 3	4 & 5	1 & 3	Page
Device modules									
Communication modules									from 371
CANopen® E94AYCCA	+	+	+	+	+	---	---	+	
DeviceNet™ E94AYCDN	+	+	+	+	+	---	---	+	
Ethernet 2 Port E94AYCEN	+	+	+	+	+	---	---	+	
EtherNet/IP™ E94AYCEO	+	+	+	+	+	---	---	+	
POWERLINK MN/CN E94AYCEP	+	+	+	+	+	---	---	+	
POWERLINK CN E94AYCEC	+	+	+	+	+	---	---	+	
EtherCAT® E94AYCET	+	+	+	+	+	---	---	+	
PROFIBUS® E94AYCPM	+	+	+	+	+	---	---	+	
PROFINET® E94AYCER	+	+	+	+	+	---	---	+	
INTERBUS E94AYCIB	+	+	+	+	+	---	---	+	
Function modules									from 413
Digital frequency E94AYFLF	+	+	+	+	+	---	---	---	
Cover module	+	+	+	+	+	---	---	+	
Memory modules 1)									from 419
MM220 E94AYM220	---	---	---	---	---	---	---	+	
MM330 E94AYM330	+	+	+	+	+	---	---	---	
MM340 E94AYM340	+	+	+	+	+	---	---	---	
MM430 E94AYM430	+	+	+	+	+	---	---	---	
MM440 E94AYM440	+	+	+	+	+	---	---	---	
Safety modules 1)									from 428
SM0 E94AYAA	+	+	+	+	+	---	---	+	
SM100 E94AYAB	+	+	+	+	+	---	---	---	
SM301 E94AYAE	+	+	+	+	+	---	---	---	
SM302 E94AYAF	+	+	+	+	+	---	---	---	
Motor holding brake control modules									from 448
Voltage class 24 V									
E94AZHX0051 E94AZHA0051	+	---	---	+	---	---	---	---	

Accessories	Single Drive			Multi Drive		Power supply modules		VR modules	
Field	GG (device size)			GG		GG		GG	
Designation	1 ... 3	6 ... 7	81 ... 91	1 ... 3	6	1 & 3	4 & 5	1 & 3	Page
E94AZHY0101 E94AZHB0101	---	+	+	---	+	---	---	---	
Voltage class 205 V									
E94AZHN0025	+	-	-	+	---	---	---	---	
E94AZHY0025 E94AZHN0025	---	+	+	+	+	---	---	---	
Voltage class 180 V									
E94AZHN0026	+	-	-	+	---	---	---	---	
E94AZHY0026 E94AZHN0026	---	+	+	---	+	---	---	---	
Filters									
Mains filter									
E94AZMSxxxx 3 ... 31 A	+	+	---	---	---	---	---	---	542
E94AZMSxxxx 180 ... 415 A (3F480-xxx.290EM)	---	---	+	---	---	---	---	---	585
E94AZMPxxxx 8 ... 29 A	---	---	---	---	---	+	+	---	549
E94AZMPxxxx 82 ... 200 A	---	---	---	---	---	+	+	---	556
E94AZMRxxxx 26 ... 47 A	---	---	---	---	---	---	---	+	564
RFI filter									
E94AZRSxxxx 4 ... 29 A	+	+	---	---	---	---	---	---	571
E94AZRSxxxx 54 ... 95 A	+	+	---	---	---	---	---	---	578
E94AZMSxxxx 180 ... 415 A (3F480-xxx.290EM)	---	---	+	---	---	---	---	---	585
E94AZRPxxxx 8 ... 29 A	---	---	---	---	---	+	+	---	589
E94AZRPxxxx 82 ... 200 A	---	---	---	---	---	+	+	---	596
Sine filter									
EZS3-xxxA200 4 ... 90 A	+	+	-	-	-	---	---	---	603
EZS3-xxxA200 115 ... 150 A	+	+	-	-	-	---	---	---	611
EZS3-xxxA200 180 ... 480 A	+	+	-	-	-	---	---	---	617
Installation accessories									
EMC kit									from 622
E94A...	+	+	+	+	+	+	+	+	
Busbar mounting sets									from 531
E94AZJA003	+	---	---	^	---	---	---	---	
E94AZJA007	+	---	---	^	---	---	---	---	
E94AZJA024	+	---	---	^	---	---	---	---	
Input module									from 521
E94AZEX100	+	o	o	+	+	+	+	+	
Brake resistors									from 625
ERBxxxxxRxxxW	+	+	+	---	---	+	+	+	
Diagnostics									from 507
PC connection									
E94ACUS USB adapter	+	+	+	+	+	---	---	+	

Accessories	Single Drive			Multi Drive		Power supply modules		VR modules	
Field	GG (device size)			GG		GG		GG	
Designation	1 ... 3	6 ... 7	81 ... 91	1 ... 3	6	1 & 3	4 & 5	1 & 3	Page
Keypad									
E94AZKAE keypad	+	+	+	+	+	---	---	+	
E94AZKHT hand-held terminal	+	+	+	+	+	---	---	+	
24 V DC power supply units									from 639
EZV1200-000	+	+	+	+	+	+	+	+	
EZV2400-000	+	+	+	+	+	+	+	+	
EZV4800-000	+	+	+	+	+	+	+	+	
EZV1200-001	+	+	+	+	+	+	+	+	
EZV2400-001	+	+	+	+	+	+	+	+	
EZV4800-001	+	+	+	+	+	+	+	+	
DC fuses									
EFSARxxxxARHN EFSGRxxxxAYxz	+	---	---	+	+	---	---	---	
EFSGRXXXXANVN	---	+	---	---	---	---	---	---	
EFSGRXXXXANWN	---	---	+	---	---	---	---	---	
System cables									
see manual "System cables"	+	+	+	+	+	+	+	+	

8.3 Communication modules

8.3.1 Safety instructions



Danger!

Improper use of the module and the standard device may cause serious injury and property damage.

Observe the chapters ”Safety instructions” and ”Residual hazards” contained in the instructions for the standard device.



Stop!

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

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



Stop!

Before mounting/dismounting, switch off the supply voltage to prevent electronic modules from damage.

8.3.2 Important notes



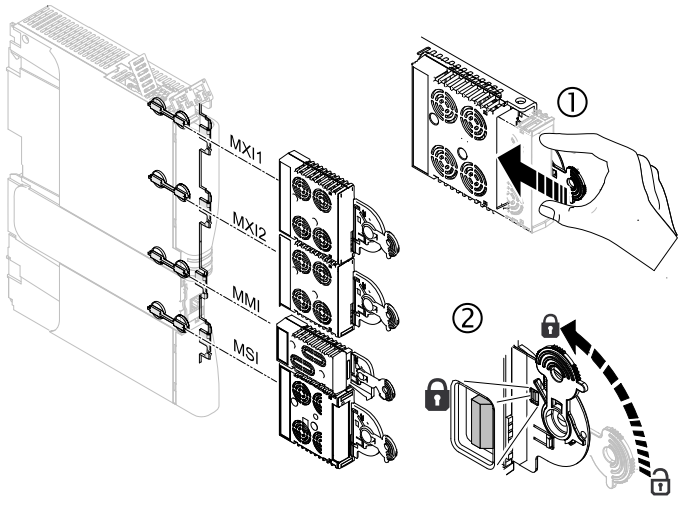
Communication manuals

Further information on the communication modules is provided in the respective communication manuals.

The PDF files are provided on the Internet in the download area at

http://www. Lenze.com

8.3.3 Mounting



E94YCXX001G

8.3.4 Dismounting



E94AYCXX001H

8.3.5 Possible device module combinations

Communication and extension modules can be used to adapt the Servo Drives 9400 to the machine requirements. For this, the HighLine version is equipped with module slots MXI1 and MXI2.

The following possible combinations are permissible:

	MXI1										
MXI2	E94AYFLF	E94AYCCA	E94AYCDN	E94AYCET	E94AYCEN	E94AYCEP	E94AYCEC	E94AYCPM	E94AYCER	E94AYCEO	E94AYCIB
E94AYFLF	-	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
E94AYCCA	☑	-	☑	☑	☑	☑	☑	☑	☑	☑	☑
E94AYCDN	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
E94AYCET	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
E94AYCEN	☑	☑	☑	☑	-	☑	☑	☑	☑	☑	☑
E94AYCEP	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
E94AYCEC	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
E94AYCPM [1)]	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
E94AYCER [1)]	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
E94AYCEO	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
E94AYCIB	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑

☑ Permissible
- Not possible
1) PROFIsafe can only be used in MXI1

E94AYFLF	Master frequency
E94AYCCA	CANopen®
E94AYCDN	DeviceNet™
E94AYCET	EtherCAT®
E94AYCEN	Ethernet 2 Port
E94AYCEP	POWERLINK MN/CN
E94AYCEC	POWERLINK CN
E94AYCPM	PROFIBUS®
E94AYCER	PROFINET®
E94AYCEO	EtherNet/IP™
E94AYCIB	INTERBUS

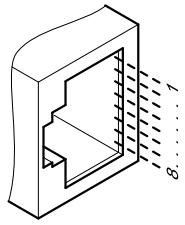
8.3.6 Ethernet interface

Ethernet cable specifications

Note!
Only use cables complying with the below specifications.

Ethernet cable specifications	
Ethernet standard	Standard Ethernet (according to IEEE 802.3), 100base TX (fast Ethernet)
Cable type	S/FTP (Screened Foiled Twisted Pair), ISO/IEC 11801 or EN 50173, CAT 5e
Damping	23.2 dB (at 100 MHz and per 100 m)
Crosstalk damping	24 dB (at 100 MHz and per 100 m)
Return loss	10 dB (per 100 m)
Surge impedance	100 Ω

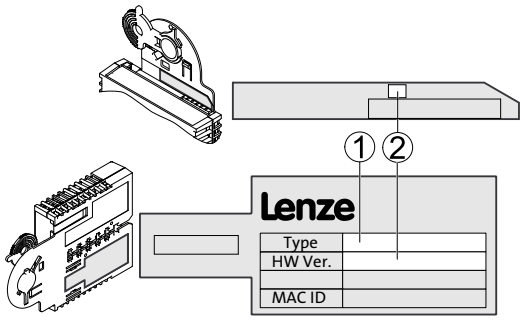
Ethernet connection

RJ45 socket	PIN	Signal
 E94AYCXX004C	1	Tx +
	2	Tx -
	3	Rx +
	4	-
	5	-
	6	Rx -
	7	-
	8	-

Note!
Plug/remove the Ethernet cable plug in a straight manner (at right angles) into/from the socket to make sure that the RJ45 socket will not be damaged.

8.3.6.1 Ethernet

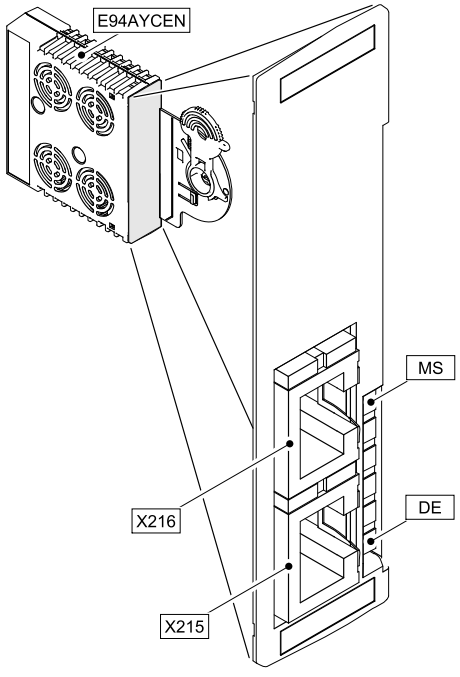
Identification



E94YCEN008

	①					②
Type code	**E94**	**A**	**Y**	**C**	**EN**	**Vx**
Product series						
Device generation						
Module identification: extension module						
Module type: communication module						
Ethernet						
Hardware version						

Elements



E94YCEN001A

Connections

Pos.	Description
X215	Ethernet connections Design: RJ45 socket to IEC 60603-7
X216	

Displays

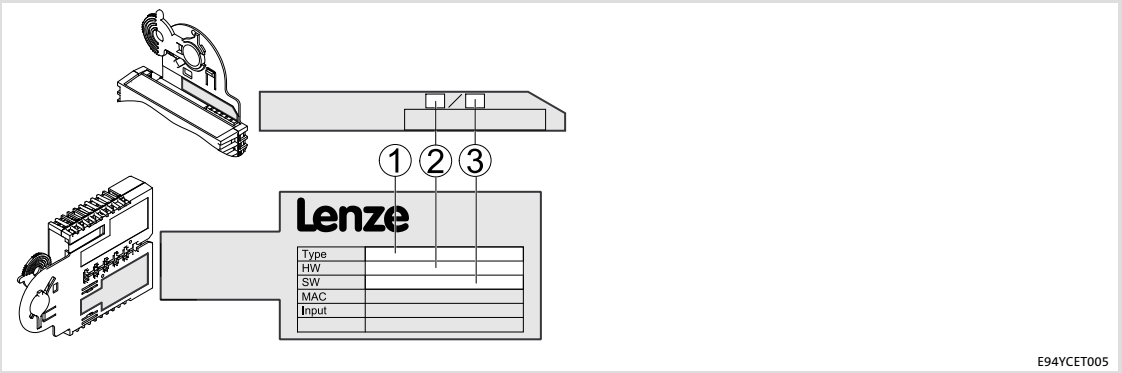
LED			
Pos.	Colour	Condition	Description
MS	green	on	The communication module is supplied with voltage.
DE	red	on	The communication module is not accepted by the standard device (see notes provided in the instructions for the standard device).
LEDs at connection X215/X216:			
-	yellow	On / blinking	Data is being exchanged via Ethernet.
-	green	on	Ethernet connection is available.

8.3.6.2 POWERLINK

Supported functionalities:

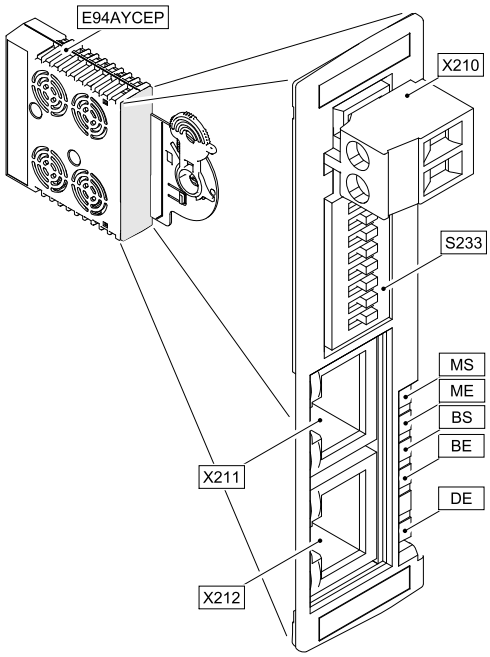
- Managing node (with up to 50 nodes)
- Controlled node

Identification



	①					②	③
	E94	**A**	**Y**	**C**	**EP**	**VA**	**0.50**
Product range							
Version							
Module description: extension module							
Module type: communication module							
POWERLINK MN/CN							
Hardware version							
Software version							

Elements



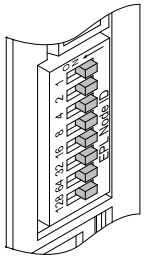
Connections

Pos.	Description
X210	Connection for the external supply of the communication module Design: Plug connector with screw connection, 2-pole
X211	Connection for POWERLINK Design: RJ45 socket according to IEC 60603-7, with integrated LEDs
X212	

Displays

LED			
Pos.	**Colour**	**Condition**	**Description**
MS	green	blinking	The communication module is supplied with voltage but has no connection to the standard device (standard device is either switched off, in the initialisation phase, or not available).
		on	The communication module is being supplied with voltage and is connected to the standard device.
ME	red	on	A communication module error has occurred.
BS	green	The LED functions are controlled by the NMT state machine.	
		off	The communication module is not active at the fieldbus. Status: NMT_GS_OFF, NMT_GS_INITIALISATION, NMT_CS_NOT_ACTIVE / NMT_MS_NOT_ACTIVE
			The POWERLINK network is in the initialisation phase. (The LED flashed once per second.) Status: NMT_CS_PREOPERATIONAL_1 / NMT_MS_PREOPERATIONAL_1
			The POWERLINK network is in the initialisation phase with cyclic traffic. (The LED flashed twice per second.) Status: NMT_CS_PREOPERATIONAL_2 / NMT_MS_PREOPERATIONAL_2
			The POWERLINK node waits for the start signal. (The LED flashes three times per second.) Status: NMT_CS_READY_TO_OPERATE / NMT_MS_READY_TO_OPERATE
			The POWERLINK node has not found any managing node and is in the "BASIC-Ethernet" operating mode. (The LED is blinking with a frequency of 10 Hz.) Status: NMT_CS_BASIC_ETHERNET
			The POWERLINK node is in the "Stopped" state; waiting for switch-off. (The LED is blinking with a frequency of 2.5 Hz.) Status: NMT_CS_STOPPED
			The POWERLINK node is in the operating phase. (The LED is permanently lit.) Status: NMT_CS_OPERATIONAL / NMT_MS_OPERATIONAL
BE	red	on	A fieldbus error has occurred.
DE	red	on	The communication module is not accepted by the standard device. See notes provided in the documentation for the standard device.
Signalling at the RJ45 sockets (X211, X212):			
-	red	on	A POWERLINK collision has occurred.
-	green	off	No POWERLINK connection
		on	Die POWERLINK connection is available.
		blinking	Active data communication via POWERLINK

DIP switch



E94YCEP001D

Pos.	Description
S233	Node addressing: The node address results from the sum of all switches being set to "ON". ● Example: Switches 32, 8, 4 = ON → address = 44 ● E94AYCEP address as master: 240 ● E94AYCEP address as slave: 1 ... 100 with E94AYCEP as master 1 ... 239 with another master

Note!

The Lenze setting of all switches is OFF.

Observe the information on the setting of the node address in the POWERLINK communication module.

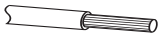
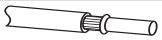
External voltage supply

Supply the communication module via the connection X210 by means of a separate supply voltage.

Designation	Explanation
+	External voltage supply U = 24 V DC (20.4 V - 0 % ... 28.8 V + 0 %) I = 140 mA
-	Reference potential for external voltage supply

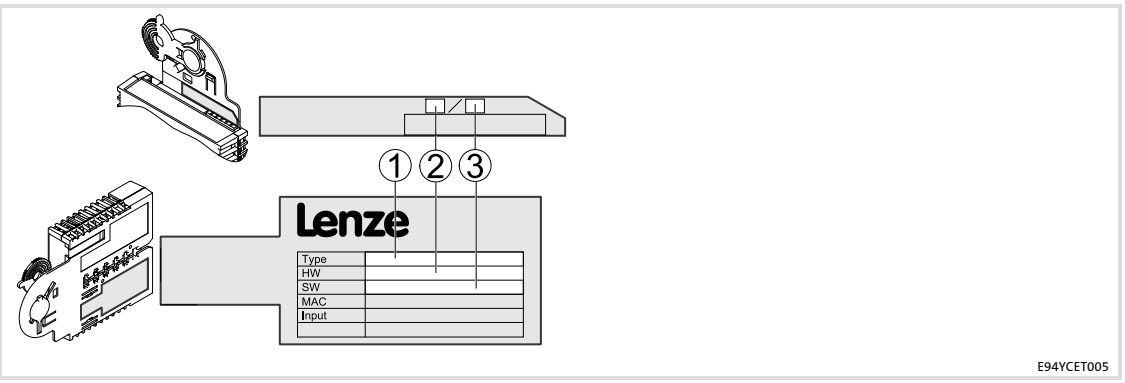
For greater distances between the control cabinets, use a power supply unit in each control cabinet.

Screw terminal data

Area	Values	
Electrical connection	Plug connector with screw connection	
Possible connections	rigid:	
		1.5 mm^2 (AWG 16)
	flexible:	
		without wire end ferrule 1.5 mm^2 (AWG 16)
		with wire end ferrule, without plastic sleeve 1.5 mm^2 (AWG 16)
		with wire end ferrule, with plastic sleeve 1.5 mm^2 (AWG 16)
Tightening torque	0.5 ... 0.6 Nm (4.4 ... 5.3 lb-in)	
Stripping length	6 mm	

8.3.6.3 POWERLINK CN

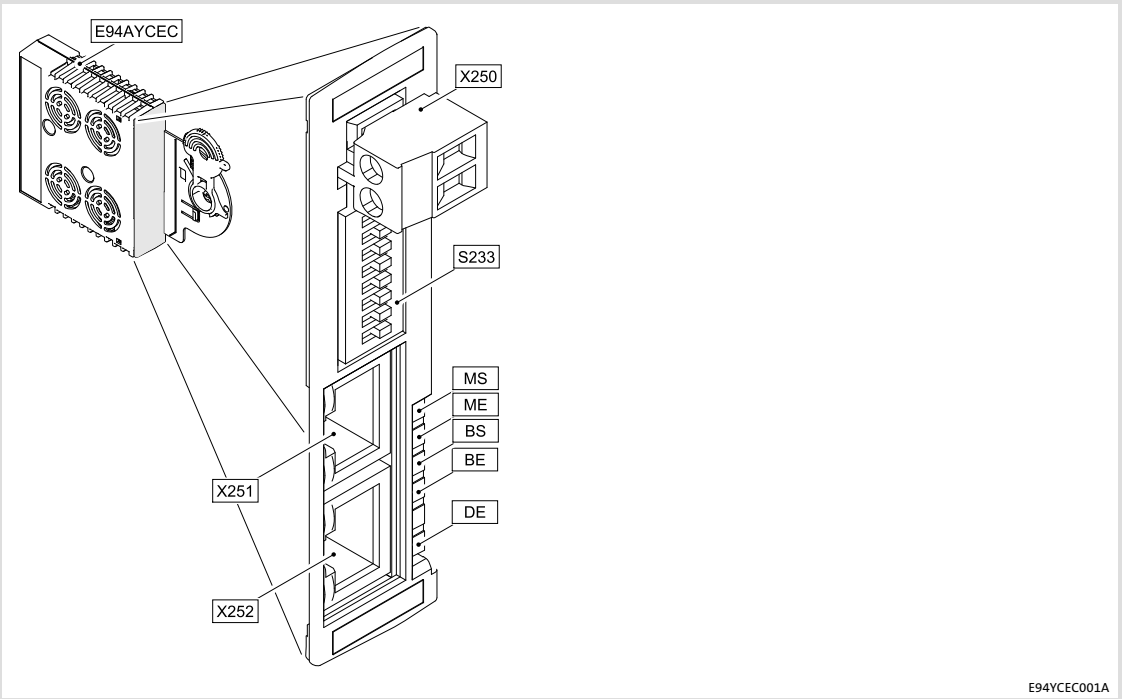
Identification



①					②	③
E94	**A**	**Y**	**C**	**EC**	**VC**	**1.0**

Product range
Version
Module description: extension module
Module type: communication module
POWERLINK CN
Hardware version
Software version

Elements



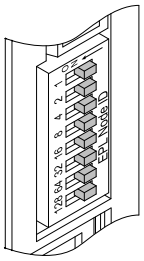
Connections

Pos.	Description
X250	Connection for the external supply of the communication module Design: Plug connector with screw connection, 2-pole
X251	Connection for POWERLINK Design: RJ45 socket according to IEC 60603-7, with integrated LEDs
X252	

Displays

LED			
Pos.	Colour	Condition	Description
MS	green	blinking	The communication module is supplied with voltage but has no connection to the standard device (standard device is either switched off, in the initialisation phase, or not available).
		on	The communication module is being supplied with voltage and is connected to the standard device.
ME	red	on	A communication module error has occurred.
BS	green	The LED functions are controlled by the NMT state machine.	
		off	The communication module is not active at the fieldbus. Status: NMT_GS_OFF, NMT_GS_INITIALISATION, NMT_CS_NOT_ACTIVE / NMT_MS_NOT_ACTIVE
			The POWERLINK network is in the initialisation phase. (The LED flashed once per second.) Status: NMT_CS_PREOPERATIONAL_1 / NMT_MS_PREOPERATIONAL_1
			The POWERLINK network is in the initialisation phase with cyclic traffic. (The LED flashed twice per second.) Status: NMT_CS_PREOPERATIONAL_2 / NMT_MS_PREOPERATIONAL_2
			The POWERLINK node waits for the start signal. (The LED flashes three times per second.) Status: NMT_CS_READY_TO_OPERATE / NMT_MS_READY_TO_OPERATE
			The POWERLINK node has not found any managing node and is in the ”BASIC-Ethernet” operating mode. (The LED is blinking with a frequency of 10 Hz.) Status: NMT_CS_BASIC_ETHERNET
			The POWERLINK node is in the ”Stopped” state; waiting for switch-off. (The LED is blinking with a frequency of 2.5 Hz.) Status: NMT_CS_STOPPED
			The POWERLINK node is in the operating phase. (The LED is permanently lit.) Status: NMT_CS_OPERATIONAL / NMT_MS_OPERATIONAL
BE	red	on	A fieldbus error has occurred.
DE	red	on	The communication module is not accepted by the standard device. See notes provided in the documentation for the standard device.
Signalling at the RJ45 sockets (X211, X212):			
-	red	on	A POWERLINK collision has occurred.
-	green	off	No POWERLINK connection
		on	Die POWERLINK connection is available.
		blinking	Active data communication via POWERLINK

DIP switch



Pos.	Description
S233	Node addressing: The node address results from the sum of all switches being set to "ON". ● Example: Switches 32, 8, 4 = ON → address = 44 ● Address area: 1 ... 100 1 ... 100 with E94AYCEP as master 1 ... 239 with another master

Note!

The Lenze setting of all switches is OFF.

Observe the information on the setting of the node address in the POWERLINK communication module.

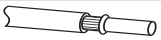
External voltage supply

Supply the communication module via the connection X210 by means of a separate supply voltage.

Designation	Explanation
+	External voltage supply U = 24 V DC (20.4 V - 0 % ... 28.8 V + 0 %) I = 140 mA
-	Reference potential for external voltage supply

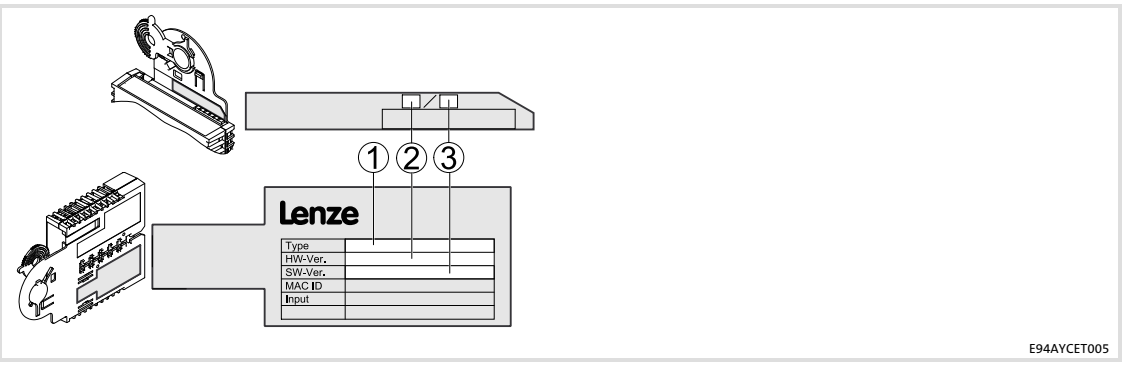
For greater distances between the control cabinets, use a power supply unit in each control cabinet.

Screw terminal data

Area	Values	
Electrical connection	Plug connector with screw connection	
Possible connections	rigid:	
		1.5 mm² (AWG 16)
	flexible:	
		without wire end ferrule 1.5 mm² (AWG 16)
		with wire end ferrule, without plastic sleeve 1.5 mm² (AWG 16)
		with wire end ferrule, with plastic sleeve 1.5 mm² (AWG 16)
Tightening torque	0.5 ... 0.6 Nm (4.4 ... 5.3 lb-in)	
Stripping length	6 mm	

8.3.6.4 EtherCAT®

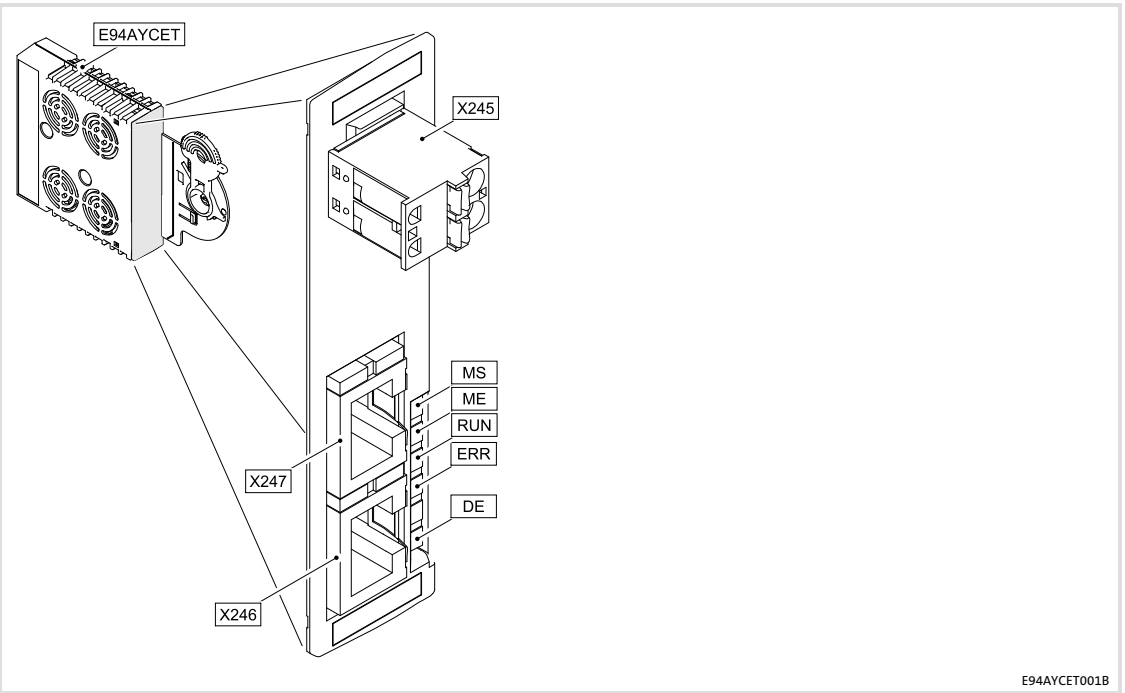
Identification



	①					②	③
	E94	A	Y	C	ET	VE	03.00

- Product range
- Version
- Module ID: extension module
- Module type: communication module
- EtherCAT
- Hardware version
- Software version

Elements



Connections

Pos.	Description
X245	Connection for the external supply of the communication module Design: Plug connector with spring connection, 2-pole
X246	EtherCAT input (IN) Design: RJ45 socket according to IEC 60603-7
X247	EtherCAT output (OUT) Design: RJ45 socket according to IEC 60603-7

Displays

LED			
Pos.	Colour	Condition	Description
MS	green	on	 The communication module is supplied with voltage and has a connection to the standard device.
		blinking	 The communication module is supplied with voltage but has no connection to the standard device (standard device is either switched off, in the initialisation phase, or not available).
ME	red	on	 An error in the communication module has occurred.
RUN	green	off	The communication module is not active on the fieldbus or is in the ”Init” status.
		blinking	 ”Pre-operational” status active: ● Access to parameters and objects possible. ● No process data exchange
		blinking once (single flash)	 ”Safe-operational” status active: ● The data are not active in the standard device yet.
		on	 The communication module is in the ”Operational” status.
ERR	red	off	No error
		blinking	 The configuration is invalid/faulty.
		blinking once (single flash)	 ● A state change that was not requested has occurred. (The slave application has changed the EtherCAT status independently.) ● Synchronisation error (The EtherCAT node changes to the ”Safe-operational” status automatically.)
		blinking twice (double flash)	 An ”Application Watchdog Timeout” or a ”Sync Manager Watchdog Timeout” has occurred.
DE	red	on	 The communication module is not accepted by the standard device, or the standard device is not active. (See notes in the documentation for the standard device.)
L/A	green	on	 Physical EtherCAT connection is available.
		flickering	 Data are exchanged via EtherCAT.
B	red	off	This LED is not used.

External voltage supply

Note!

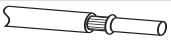
In the case of an external voltage supply and for greater distances between the control cabinets, always use a separate power supply unit (SELV/PELV) that is safely separated in accordance with EN 61800-5-1 in each control cabinet.

The external voltage supply of the communication module is required if EtherCAT communication is to remain intact in case the supply of the standard device fails.

Supply the communication module via the 2-pole plug connector (X245) with a separate supply voltage.

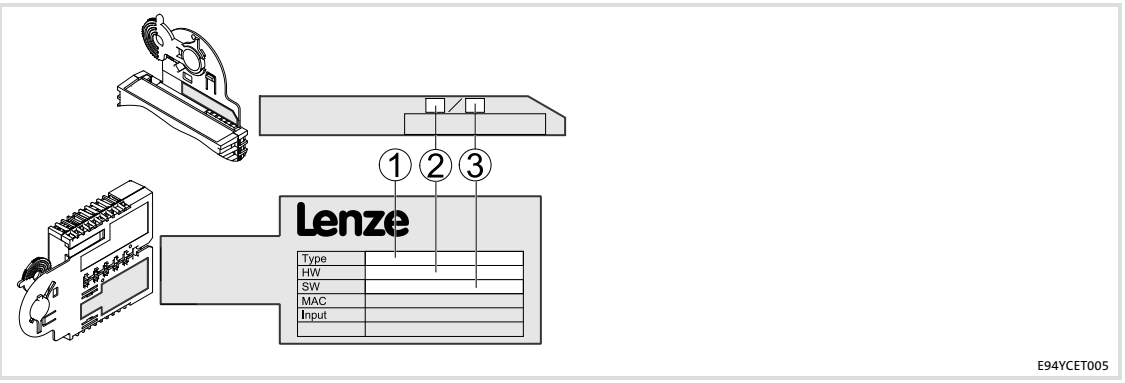
Designation	Description
+	External voltage supply U = 24 V DC (20.4 V - 0 % ... 28.8 V + 0 %) I = 130 mA
-	Reference potential for external voltage supply

Terminal data

Field	Values	
Electrical connection	2-pin plug connector with spring connection	
Possible connections	rigid:	
		1.5 mm² (AWG 16)
	flexible:	
		without wire end ferrule 1.5 mm² (AWG 16)
		with wire end ferrule, without plastic sleeve 1.5 mm² (AWG 16)
		with wire end ferrule, with plastic sleeve 1.5 mm² (AWG 16)
Stripping length	9 mm	

8.3.6.5 EtherNet/IP™

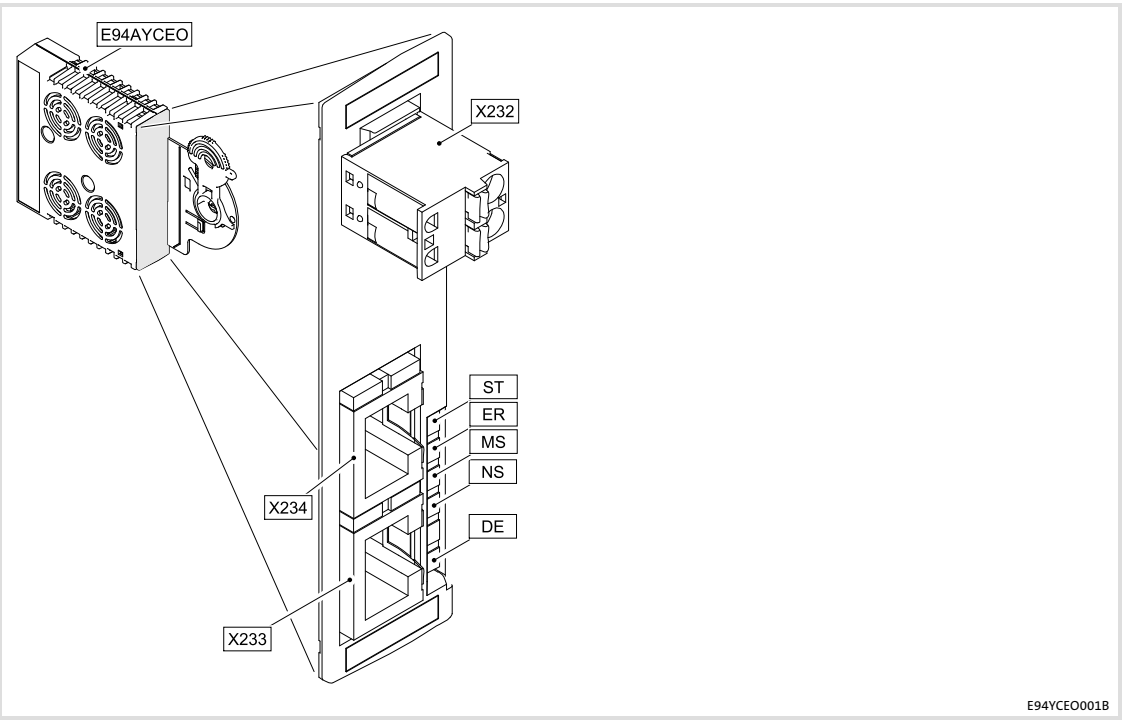
Identification



	①				②	③
	E94	**A**	**Y**	**C**	**EO**	**VE**	**1.00**

Product series
Device generation
Module identification: extension module
Module type: communication module
EtherNet/IP
Hardware version
Software version

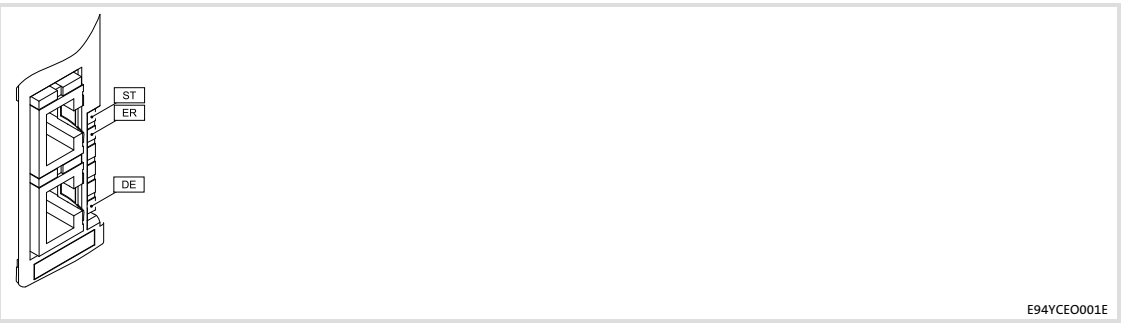
Elements



Pos.	Description
X232	Connection for external voltage supply ● 2-pole plug connector with spring connection
X233 X234	EtherNet/IP connections ● RJ45 sockets ● With 2 LED status displays, respectively, for diagnostics
ST ER MS NS DE	LED status displays for diagnostics

Module status displays

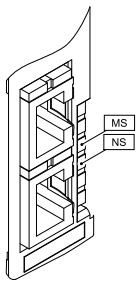
Module status displays are displayed by the LEDs **ST**, **ER** and **DE**.



LED	Colour	Status	Description
ST	green	on	The communication module is being supplied with voltage and is connected to the standard device.
		blinking	250 ms 250 ms The communication module is supplied with voltage but has no connection to the standard device (The standard device is either switched off, in the initialisation phase, or not available).
ER	red	on	A communication module error has occurred.
DE	red	on	The communication module is not accepted by the standard device or the standard device is not active. (See notes provided in the documentation for the standard device.)

CIP status displays

CIP status displays are indicated by the LEDs **MS** and **NS**.



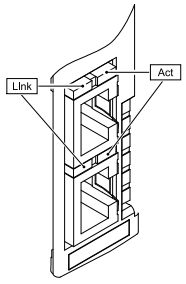
E94YCEO001E

LED	Colour / status		Description
	green	red	
MS	off	off	CIP module status: ”Nonexistent” The communication module is not supplied with voltage.
	off	on	 CIP module status: ”Major Unrecoverable Fault” The communication module has an unrecoverable fault. The status is set if the pending, status determining device fault is responded with a system fault.
	off	blinking	 CIP module status: ”Major Recoverable Fault” The communication module has a recoverable fault. The status is set if the pending, status determining device fault is responded with a fault, trouble, quick stop .by trouble, warning locked or warning.
	on	off	 CIP module status: ”Operational” The communication module operates correctly.

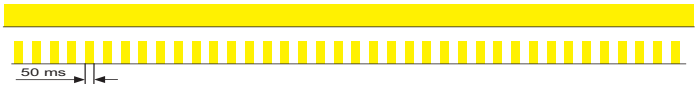
LED	Colour / status		Description
	green	red	
MS	blinking	off	 CIP module status: ”Standby” The communication module has not been configured completely or the configuration is faulty.
	blinking	blinking	 CIP module status: ”Device Self Testing” The communication module is performing a self test.
NS	off	off	CIP network status: ”No IP Address” The communication module is not supplied with voltage or has not received an IP address yet.
	off	on	 CIP network status: ”Duplicate IP” The communication module cannot access the fieldbus (IP address conflict).
	off	blinking	 CIP network status: ”Connection Timeout” A time-out has occurred.
	on	off	 CIP network status: ”Connected” The communication module operates correctly and is connected to the scanner.
	blinking	off	 CIP network status: ”No Connections” The communication module ... ● operates correctly; ● has been assigned with an IP address; ● has not been integrated yet into the network by the scanner.
	blinking	blinking	 CIP network status: ”Self-Test” The communication module is performing a self test.

Status displays at the RJ45 sockets (X233, X234)

The LEDs **Link** and **Act** at the RJ45 sockets display the Ethernet connection status.

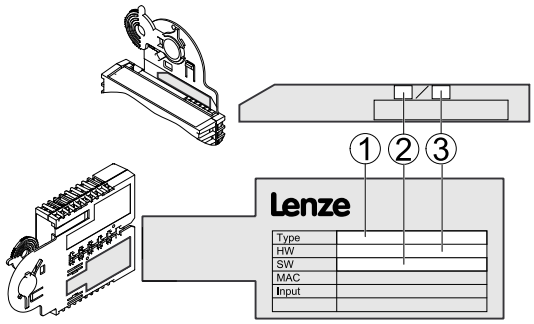


E94YCEO001E

LED	Colour	Status	Description
Link	Green	Off	No Ethernet connection
		On	 Physical Ethernet connection is available.
Act	yellow	Off	No Ethernet data transfer
		On or flickering	 Data is being exchanged via Ethernet.

8.3.7 DeviceNet™

Identification

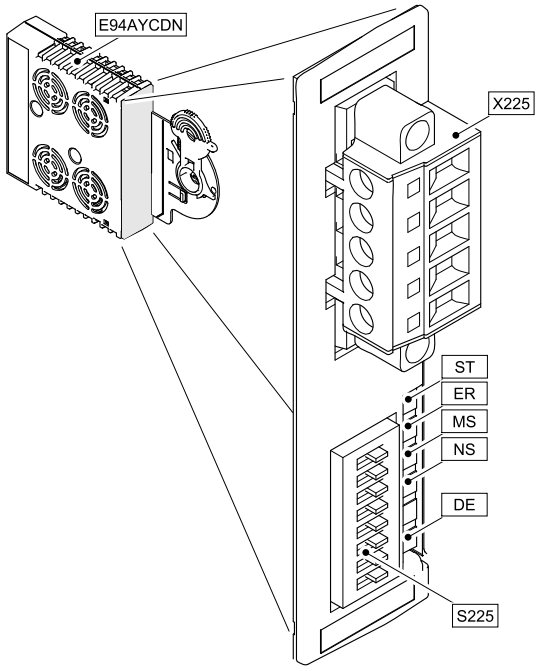


E94YCDN005

	①				②	③
	E94	A	Y	C	DN	VA	1.00

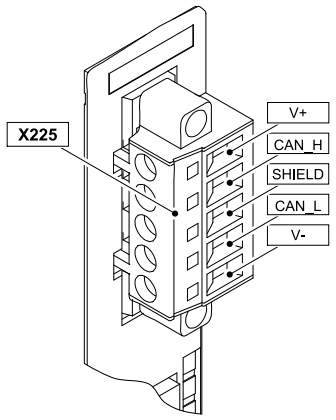
Product range
Version
Module identification: extension module
Module type: communication module
DeviceNet
Hardware version
Software version

Elements



E894YCDN001B

Connections



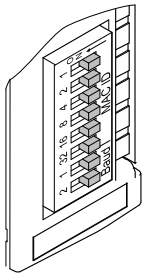
E94YCDN001C

Designation	Cable colour	Description
V+	red	External voltage supply ● U = 24 V DC ● I_{max} = 170 mA
CAN_H	white	Data line / input for bus terminating resistor (120 Ω)
SHIELD		Shielding
CAN_L	blue	Data line / input for bus terminating resistor (120 Ω)
V-	black	Reference potential for external voltage supply

Displays

Pos.	Colour / status		Description
ST	green is on		The communication module is supplied with voltage and has a connection to the standard device.
	green is blinking		The communication module is supplied with voltage but is not connected to the standard device (standard device is switched off, being initialised, or not available).
ER	red is on		An error has occurred on the communication module.
MS	**green**	**red**	
	off	off	The communication module is not supplied with voltage.
	off	on	The communication module is defective and must be replaced.
	off	blinking	The error in the communication module can be removed.
	on	off	The communication module works properly.
	blinking	off	The communication module has not been completely configured yet or configuration is faulty.
	blinking	blinking	The communication module is in self-test mode.
NS	**green**	**red**	
	off	off	The communication module is not supplied with voltage via DeviceNet or the ”Duplicate MAC ID” test has not been completed yet.
	off	on	The communication module cannot access the bus (e.g. ”Duplicate MAC ID”, bus off, invalid baud rate etc.).
	off	blinking	The error in the communication module can be removed.
	on	off	The communication module works properly and has established a connection to the scanner.
	blinking	off	The communication module ... ● works properly; ● has completed the ”Duplicate MAC ID” test; ● has not yet been integrated by the scanner.
	blinking	blinking	The communication module ... ● is in error status; ● has received and accepted a telegram for identifying the faulty devices (”Identify Communication Faulted Request”).
DE	red is on		The communication module is not accepted by the standard device (see notes given in the documentation of the standard device).

DIP switch



E94YCDN001D

Pos.	Switch positions								
	Baud rate			Node address (MAC ID)					
	2	1	kbps	32	16	8	4	2	1
S225	OFF	OFF	125	The station address results from the sum of the binary values of switches 1 ... 32. ● Example: Station address 44 → switches 32, 8, 4 = ON (32 + 8 + 4 = 44) ● Valid address range: 0 ... 63 ● The Lenze setting for all switches is OFF.					
	OFF	**ON**	250						
	ON	OFF	500						
	ON	ON	No function						

Note!

Please observe the information about the setting of the DIP switches given in the ”Commissioning” and ”Appendix” chapters of the E94AYCDN communication manual (DeviceNet).

Bus cable length

Depending on the baud rate and the cable type used (thick cable/thin cable), the following bus cable lengths are possible:

Baud rate [kbps]	Bus cable lengths [m]	
	Thick cable	Thin cable
125	500	100
250	250	
500	100	

If both thick and thin cable types are used, the maximum cable lengths can be defined according to the baud rates as follows:

Baud rate [kbps]	Max. bus cable length
125	500 m = L_{thick} + 5 L_{thin}
250	250 m = L_{thick} + 2.5 L_{thin}
500	100 m = L_{thick} + L_{thin}

L_{thick}: thick cable length

L_{thin} : thin cable length

Note!

Select a baud rate in dependency of the data volume, cycle time and number of nodes just high enough to suit your application.

External supply

The communication module is externally supplied with voltage via the DeviceNet cable at the 5-pole plug connector (X225).

Note!

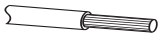
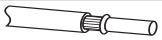
Use a safely separated power supply unit (”SELV”/”PELV”) according to EN 61800-5-1.

► The external voltage supply of the communication module is always required.

► Communication with a standard device which is separated from the mains is not possible.

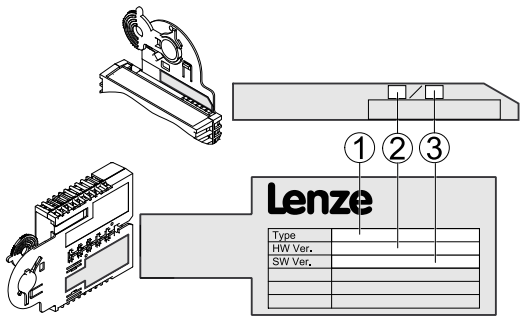
Terminal	Cable colour	Description
V+	Red	External voltage supply ● U = +24 V DC ● I_{max} = 170 mA
V-	black	Reference potential for external voltage supply

Terminal data

Type	Values	
Electrical connection	Plug connector with double screw connection	
Possible connections	rigid:	
		2.5 mm² (AWG 14)
	flexible:	
		without wire end ferrule 2.5 mm² (AWG 14)
		with wire end ferrule, without plastic sleeve 2.5 mm² (AWG 14)
		with wire end ferrule, with plastic sleeve 2.5 mm² (AWG 14)
Tightening torque	0.5 ... 0.6 Nm (4.4 ... 5.3 lb-in)	
Stripping length	7 mm	

8.3.8 PROFIBUS®

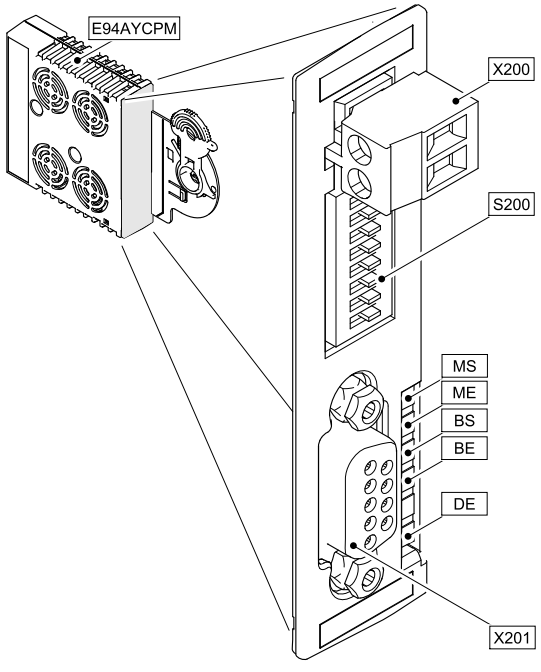
Identification



E94YCPM005

	①					②	③
	E94	A	Y	C	PM	1A	01.00
Product series							
Version							
Module identification: extension module							
Module type: communication module							
PROFIBUS							
Hardware version							
Software version							

Elements



E94YCPM001A

Connections

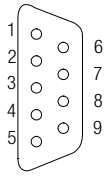
Pos.	Description
X200	External supply of the communication module Design: Plug connector with screw connection, 2-pole
X201	Connection for PROFIBUS Design: Sub-D socket, 9-pole

Displays

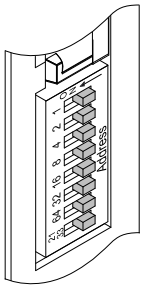
LED			
Pos.	Colour	Condition	Description
MS	Green	On	The communication module is supplied with voltage and connected to the standard device.
		Blinking	The communication module is supplied with voltage, but has no connection to the standard device. (The standard device is switched off, initialising, or not present.)
ME	Red	On	An error in the communication module has occurred.
BS	Green	Blinking	Communication via the communication module has been established. PROFIBUS communication is active.
BE	Red	On	Bus monitoring has been triggered.
DE	Red	On	The communication module is not accepted by the standard device. (See notes in the documentation for the standard device.)

Assignment of the Sub-D socket

Connection of PROFIBUS to 9-pin Sub-D socket (X201):

View	Pin	Designation	Explanation
	1	free	-
	2	free	-
	3	RxD/TxD-P	Data line B (received data/transmitted data plus)
	4	RTS	Request To Send (received data/transmitted data, no differential signal)
	5	M5V2	Data ground (ground to 5V)
	6	P5V2	5 V DC / 30 mA (bus termination)
	7	free	-
	8	RxD/TxD-N	Data line A (received data/transmitted data minus)
	9	free	-

DIP switch



E94YCPM001D

Pos.	Description
S200	**Switches 1 ... 64:** bus station addressing The station address results from the sum of all switches in "ON" position. ● Example: switches 32, 8, 4 = ON → address = 44 ● Address range: 1 ... 126 **Switch 2133:** establishing compatibility with the communication module EMF2133IB

Note!

The Lenze setting of all switches is OFF.

Please observe the information provided in the PROFIBUS Communication Manual about the setting of the station address and the EMF2133IB compatibility.

External voltage supply

Note!

In the case of an external voltage supply and for greater distances between the control cabinets, always use a separate power supply unit (SELV/PELV) that is safely separated in accordance with EN 61800-5-1 in each control cabinet.

The external voltage supply of the communication module is required if communication via the bus system is to continue in the event of a power supply failure of the standard device.

- The external voltage supply of the communication module is required if communication is to continue when the power supply of the standard device fails.
- Access to parameters of a standard device disconnected from the mains is not possible.
- The external voltage supply is effected via the 2-pole plug connector.

Assignment of the 2-pole plug connector (X200)

Designation	Description
+	U = 24 V DC (20.4 V - 0 % ... 28.8 V + 0 %) I = 130 mA
-	Reference potential for external voltage supply

Terminal data

Area	Values	
Electrical connection	Plug connector with screw connection	
Possible connections	rigid:	
		1.5 mm² (AWG 16)
	flexible:	
		without wire end ferrule 1.5 mm² (AWG 16)
		with wire end ferrule, without plastic sleeve 1.5 mm² (AWG 16)
		with wire end ferrule, with plastic sleeve 1.5 mm² (AWG 16)
Tightening torque	0.5 ... 0.6 Nm (4.4 ... 5.3 lb-in)	
Stripping length	6 mm	

Specification of the transmission cable

Note!

Only use cables complying with the listed specifications of the PROFIBUS user organisation.

Field	Values
Specific resistance	135 ... 165 Ω/km, (f = 3 ... 20 MHz)
Capacitance per unit length	≤ 30 nF/km
Loop resistance	< 110 Ω/km
Core diameter	> 0.64 mm
Core cross-section	> 0.34 mm^2
Cores	Twisted double, insulated and shielded

Baud rate / length of bus cable

The length of the bus cable depends on the baud rate used:

Baud rate [kbps]	Length [m]
9.6 ... 93.75	1200
187.5	1000
500	400
1500	200
3000 ... 12000	100

Note!

The baud rate depending of the data volume, cycle time and number of nodes should only be selected as high as required for the application.

Tip!

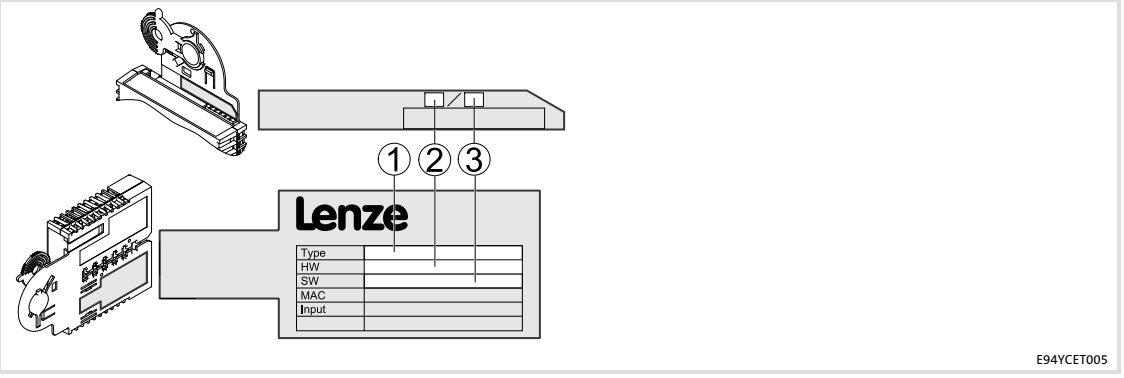
For high baud rates we recommend to consider the application of optical fibres.

Advantages of optical fibres:

- Electromagnetic interferences on the transmission path remain ineffective.
- Bus lengths of several kilometres are also possible with higher baud rates. The bus length is
  - independent of the baud rate.
  - dependent on the optical fibre used.

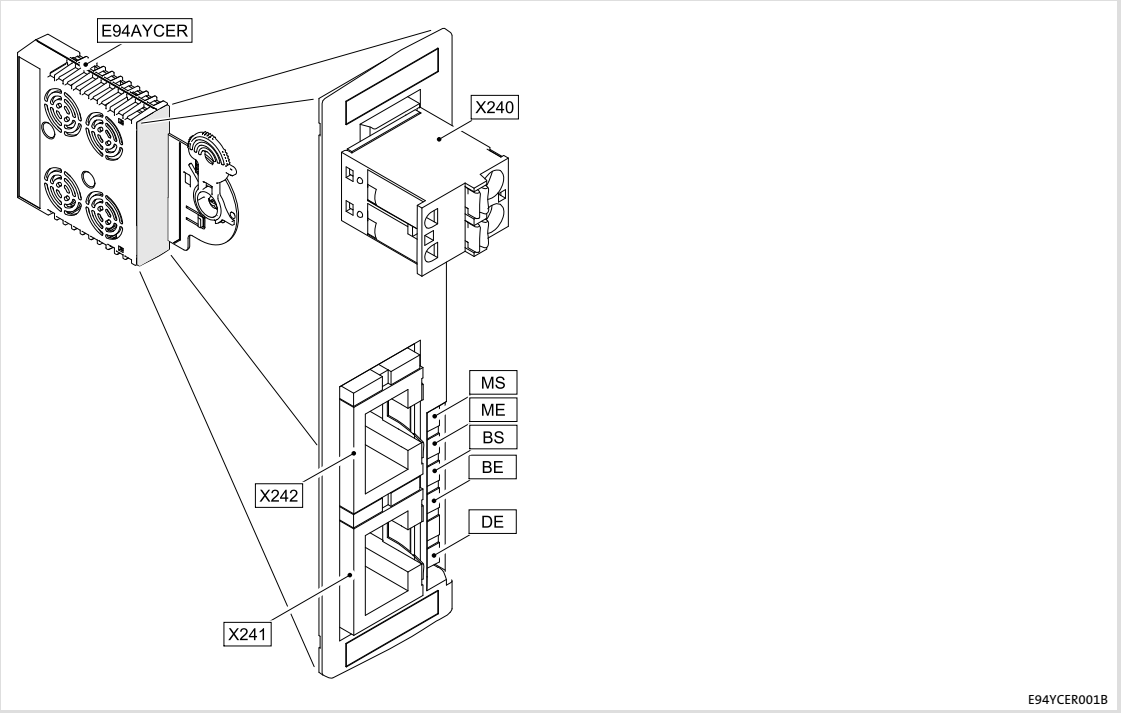
8.3.9 PROFINET®

Identification



	①				②	③
	E94	**A**	**Y**	**C**	**ER**	**VE**	**1.20**
Product series							
Version							
Module identification: extension module							
Module type: communication module							
PROFINET							
Hardware version							
Software version							

Elements



Connections

Pos.	Description
X240	Connection for the external supply of the communication module Design: Plug connector with spring connection, 2-pole
X241	PROFINET connections Design: RJ45 socket according to IEC 60603-7
X242	

Displays

LED			
Pos.	Colour	Condition	Description
MS	Green	Blinking	The communication module is supplied with voltage but has no connection to the basic device (basic device is either switched off, in the initialisation phase, or not available).
		On	The communication module is supplied with voltage and has a connection to the basic device.
ME	Red	On	There is an error in the area of the communication module.
BS	Green	Off	The PROFINET module is not active at the fieldbus.
		Blinking	The PROFINET module is in the ”Data_Exchange” state.
BE	Red	On	Bus error/trouble is active, e.g. the Ethernet cable is unplugged. (The LED is blinking in parallel to the BS LED.)
DE	Red	On	The communication module is not accepted by the basic device (see notes in the instructions for the basic device)or the standard device is not active.
Signalling on the connection X241/X242:			
-	yellow	on/blinking	Data is exchanged via PROFINET.
-	Green	On	PROFINET connection is available.

External voltage supply

Note!

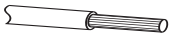
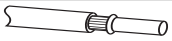
In the case of an external voltage supply and for greater distances between the control cabinets, always use a separate power supply unit (SELV/PELV) that is safely separated in accordance with EN 61800-5-1 in each control cabinet.

The external voltage supply of the communication module is required if PROFINET communication is to remain intact in case the supply of the standard device fails.

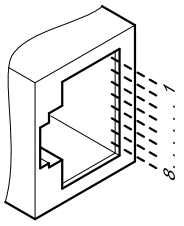
If required, feed the communication module with a separate supply voltage via the 2-pin plug connector (X240).

Designation	Explanation
+	External voltage supply U = 24 V DC (20.4 ... 28.8 V) I = 140 mA
-	Reference potential for external voltage supply

Terminal data

Field	Values	
Electrical connection	2-pin plug connector with spring connection	
Possible connections	rigid:	
		1.5 mm² (AWG 16)
	flexible:	
		without wire end ferrule 1.5 mm² (AWG 16)
		with wire end ferrule, without plastic sleeve 1.5 mm² (AWG 16)
		with wire end ferrule, with plastic sleeve 1.5 mm² (AWG 16)
Stripping length	9 mm	

Ethernet connection



E94AYCET004C

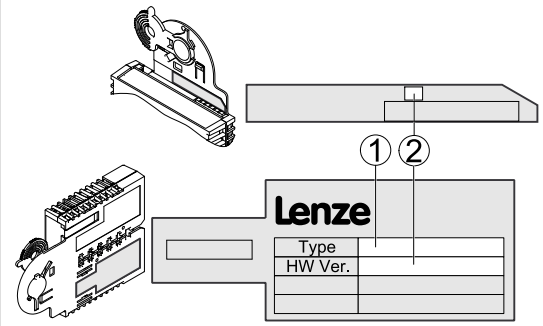
Pin	Signal
1	Tx +
2	Tx -
3	Rx +
4	-
5	-
6	Rx -
7	-
8	-

Note!

Plug/remove the Ethernet cable plug in a straight manner (at right angles) into/from the socket to make sure that the RJ45 socket will not be damaged.

8.3.10 CANopen®

Identification

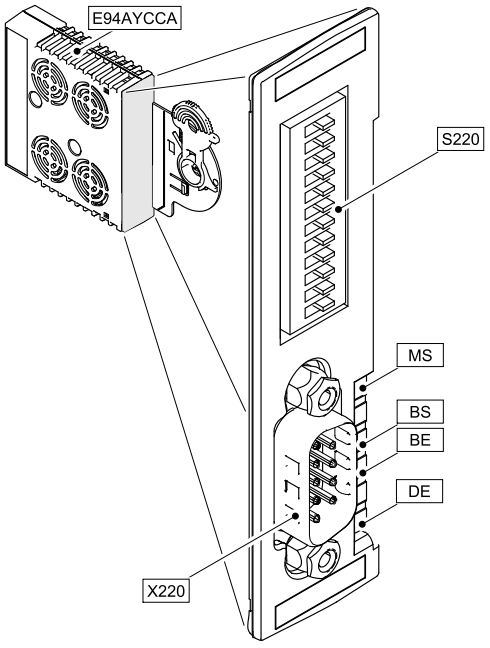


E94YCCA002

	①				②
	E94	A	Y	C	CA	VA

- Product series
- Device generation
- Module identification: extension module
- Module type: communication module
- CANopen
- Hardware version

Elements



E94YCCA001B

Connections

Pos.	Description
X220	Connection for CAN Design: Sub-D plug connector, 9-pin

Displays

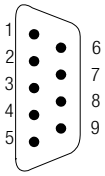
Pos.	Colour	Status	Description
MS	Green	On	Communication module is supplied with voltage.
DE	Red	On	The communication module is not accepted by the basic device (see notes in the Instructions for the basic device)
BS	Green	see table 📖 409; "Signalling according to DR303-3"	CANopen status ("**Z**")
BE	Red		CANopen error ("**F**")

DIP switch

Pos.	Description
A	Addressing of the bus node

Assignment of the Sub-D plug connector

Connection of the CAN to the 9-pin Sub-D plug connector, pos. "X220":

View	Pin	Designation	Explanation
	1	-	
	2	CAN_L	Signal core CAN
	3	CAN_GND	Ground CAN
	4	-	
	5	-	
	6	-	
	7	CAN_H	Signal core CAN
	8	-	
	9	-	
	Housing	CAN_Shield	Shield (connected to the housing)

Specification of the transmission cable

We recommend the use of CAN cables in accordance with ISO 11898-2:

CAN cable in accordance with ISO 11898-2	
Cable type	Paired with shielding
Impedance	120 Ω (95 ... 140 Ω)
Cable resistance/cross-section	
Cable length ≤ 300 m	≤ 70 mΩ/m / 0.25 ... 0.34 mm² (AWG22)
Cable length 301 ... 1000 m	≤ 40 mΩ/m / 0.5 mm² (AWG20)
Signal propagation delay	≤ 5 ns/m

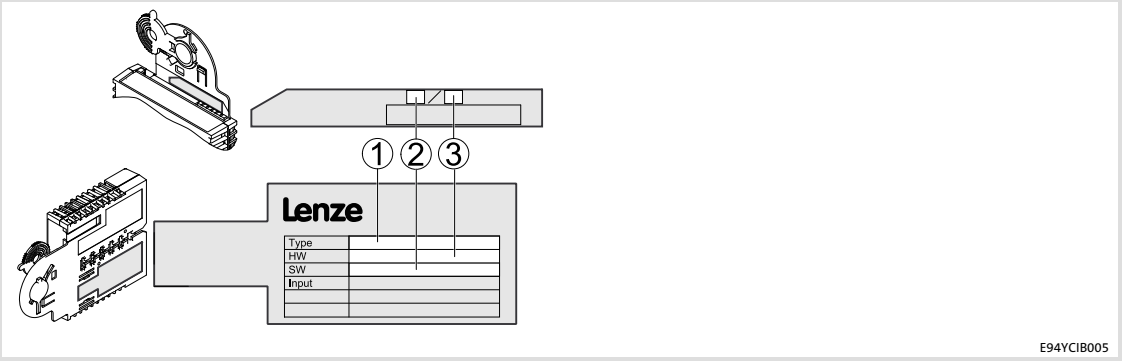
Signalling

Status display (LED)	Explanation
Connection status to the bus with the following signalling:	
off green red	No connection to the master CANopen status ("**S**") CANopen fault ("**F**")
Constant red	**F**: bus off
Flickering	Automatic detection of the baud rate is active
Green blinking every 0.2 s	**S**: pre-operational, **F**: none
Green blinking every 0.2 s Red blinking 1 x, 1 s OFF	**S**: pre-operational, **F**: warning limit reached
Green blinking every 0.2 s Red blinking 2 x, 1 s OFF	**S**: pre-operational, **F**: node guard event
Constant green	**Z**: operational, **F**: no errors
Constant green Red blinking 1 x, 1 s OFF	**Z**: operational, error: warning limit reached
Constant green Red blinking 2 x, 1 s OFF	**Z**: operational, **F**: node guarding event
Constant green Red blinking 3 x, 1 s OFF	**Z**: operational, **F**: sync message error
Green blinking every 1 s	**Z**: stopped, **F**: no errors
Green blinking every 1 s Red blinking 1 x, 1 s OFF	**S**: stopped, **F**: warning limit reached
Green blinking every 1 s Red blinking 2 x, 1 s OFF	**S**: stopped, **F**: node guard event

Tab. 8-1 Signalling according to DR303-3

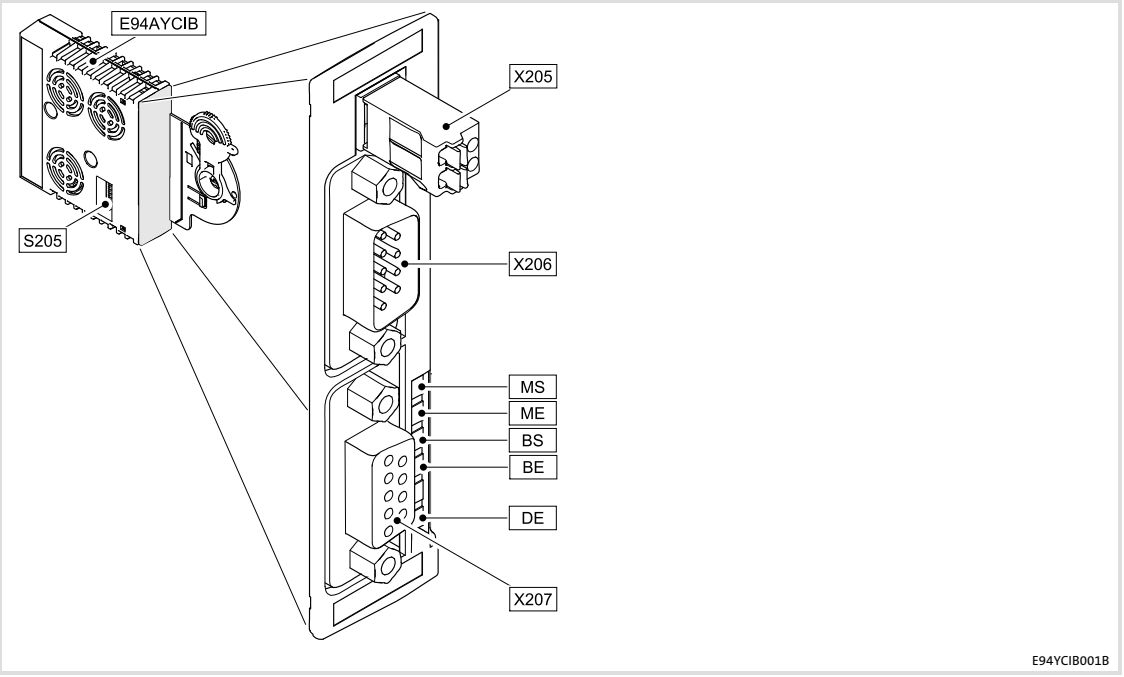
8.3.11 INTERBUS

Identification



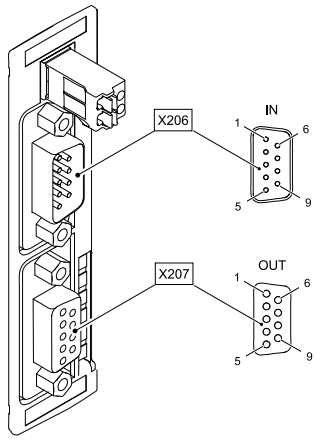
	①				②	③
	E94	**A**	**Y**	**C**	**IB**	**PA**	**01.00**
Product series							
Version							
Module code: extension module							
Module type: communication module							
INTERBUS							
Hardware version							
Software version							

Elements



Connections

The INTERBUS is connected to the communication module by means of X206 (input, 9-pin Sub-D connector) and X207 (output, 9-pin Sub-D socket).



E94YCIB001C

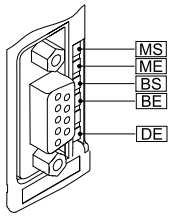
Assignment of the 9-pin Sub-D connector X206 (IN)

Pin	Designation	Input/Output	Description
1	DO1	Input	RS485: DO1 not inverted
2	DI1	Output	RS485: DI1 not inverted
3	GND		Reference potential
4	free		not assigned
5	Vcc5	Output	5 V DC
6	/DO1	Input	RS485: DO1 inverted
7	/DI1	Output	RS485: DI1 inverted
8	Vcc5	Output	5 V DC
9	free		not assigned

Assignment of the 9-pin Sub-D socket X207 (OUT)

Pin	Designation	Input/Output	Description
1	DO2	Output	RS485: DO2 not inverted
2	DI2	Input	RS485: DI2 not inverted
3	GND		Reference potential
4	GND		
5	Vcc5	Output	5 V DC
6	/DO2	Output	RS485: DO2 inverted
7	/DI2	Input	RS485: DI2 inverted
8	Vcc5	Output	5 V DC
9	RBST	Signal input	Connection to outgoing INTERBUS plugged in.

Displays



E94YCIB001F

LED			
Pos.	**Colour**	**Condition**	**Description**
MS	green	flashes	The communication module is being supplied with voltage but is not connected to the standard device. (The standard device has been switched off in the initialisation phase or does not exist.)
MS	green	on	The communication module is being supplied with voltage and is connected to the standard device.
ME	red	on	There is a fault in the area of the communication module.
BS	green	off	The communication module is not active on the field bus. Data cycles are not being executed.
		flashes	Communication via the communication module has been set up. The INTERBUS is active. Data cycles are being executed.
BE	red	flashes	Impermissible setting: ● Total number of data words (PD + PCP) > 10 ● Total number of data words (PD + PCP) = 0 The communication module has been initialised and is working internally with the following values: ● PD = 2 (words) ● PCP = 1 (word)
		on	INTERBUS communication interrupted. Data cycles are not being executed.
DE	red	on	The communication module is not accepted by the standard device (see notes in the documentation for the standard device) or the standard device is not active.

8.4 Function modules

8.4.1 Safety instructions



Danger!

Improper use of the module and the standard device may cause serious injury and property damage.

Observe the chapters ”Safety instructions” and ”Residual hazards” contained in the instructions for the standard device.



Stop!

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

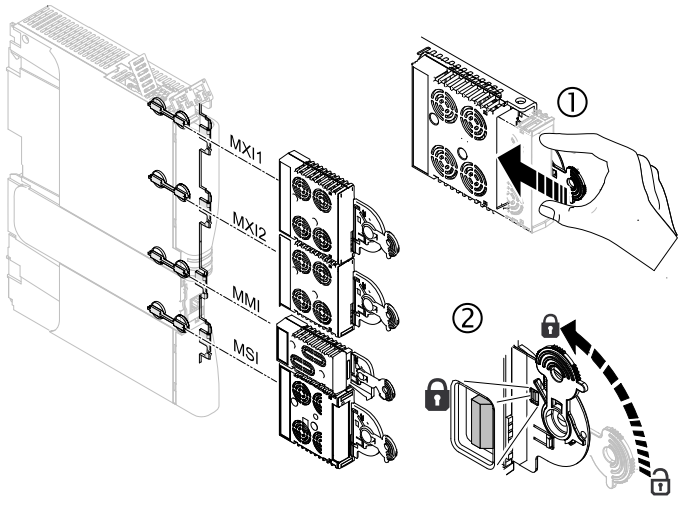
Before working on the device, the personnel must ensure that they are free of electrostatic charge by using appropriate measures.



Stop!

Before mounting/dismounting, switch off the supply voltage to prevent electronic modules from damage.

8.4.2 Mounting



E94YCXX001G

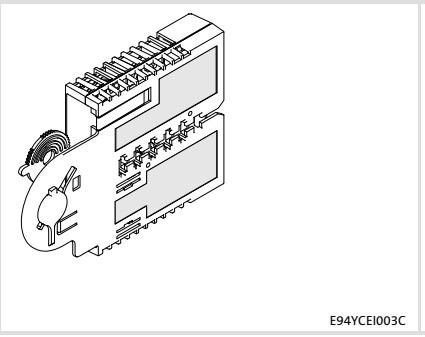
8.4.3 Dismounting

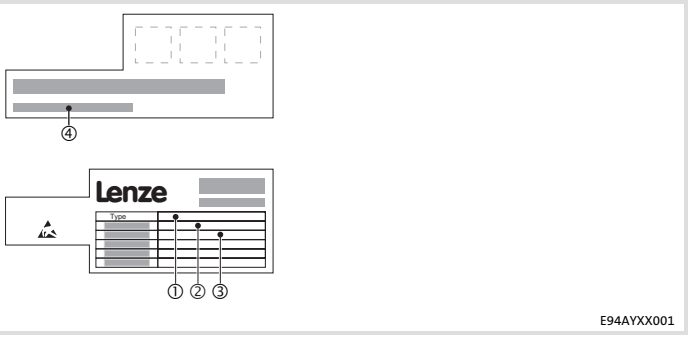


E94AYCXX001H

8.4.4 Digital frequency

Identification





	①				②	③	④
	E94	A	Y	F	xx	xx	xx	nn

Product series
Device generation
Module identification: extension module
Module type: feedback module
Design
LF = master frequency
Hardware version

Application range

This module may be used in conjunction with basic devices of the 9400 product series as of nameplate designation

● Type	E94AxxExxxx
● HW version	VB
● SW version	04.01

Stop!

Malfunctions

If E94xxHExxx4 standard devices, firmware (SW) up to and including 04.00.21.00, are used, the output signals of the digital frequency module can be faulty.

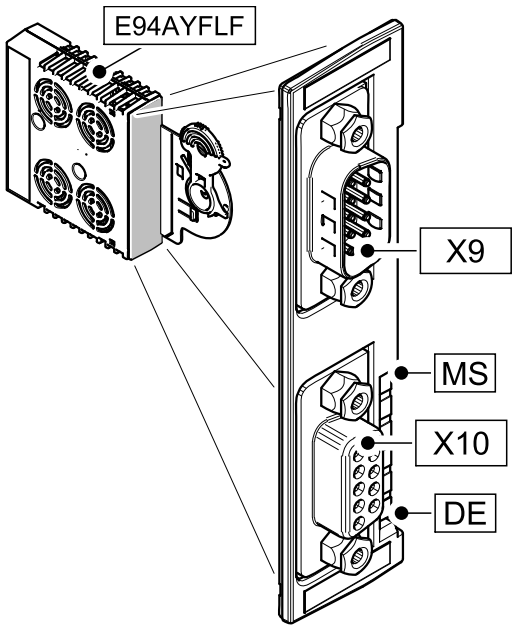
Possible consequences:

► Damage to machines through unexpected movements of slave drives.

Protective measures:

► Only use digital frequency modules together with E94xxHExxx4 standard devices of firmware (SW) 04.01.00.00 or higher. The firmware version is indicated in parameter C00099 and on the nameplate.
Example: C00099 = 04.01.00.00 or SW nameplate data: 04.01

Elements



E94AYFLF004

Connections

Pos.	Description
X9	Input for digital frequency, 9-pole Sub-D plug
X10	Output for digital frequency, 9-pole Sub-D socket

Displays

Pos.	Colour	Condition	Description
MS	Green	ON	The module is supplied with voltage.
DE	Red	ON	The module is not accepted by the standard device (see notes given in the documentation for the standard device).

Note!

Only one module per basic device may be used, either in module receptacle MXI1 or MXI2.

Rated data

Logic level [V]	Inputs		Outputs	
	low	high	low	high
TTL 5 V (standard)	0 ... 0.8	2.0 ... 5.0	0 ... 0.4	2.4 ... 5.0

Functions on X9

- Input for encoder signals with TTL level
- Voltage supply +5 V for encoder
- Sensor lead (sense) at regulated voltage supply (Lenze setting)
  - max. control range of the voltage drop on the cable: 4 V (corresponds to 5 ... 9 V output voltage on X9/4)
- Digital input signal (only with regard to unused or external voltage supply)

Functions on X10

- Output for encoder signals with TTL level, directly or simulated
- Voltage supply +5 V
- Digital output signal

Assignment of the Sub-D plug connector

Stop!

The output voltages on X9/4 and on X10/4 may only be charged at a total of max. 150 mA.

If the output voltage on X9/4 is used, no digital input signal may be applied to X9/8. In this case, the cable serves as a sensor lead. In case of a connection error, the components connected to X9 are damaged.

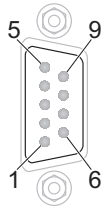
Stop!

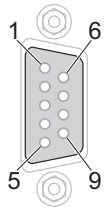
The output voltages on X9/4 and on X10/4 may not be interconnected. This applies to both the wiring of several modules and to the wiring of one module (e. g. for purposes of simulation).

Use system cables not connecting pin 4 for this applications only.

Tip!

We recommend the use of Lenze system cables. For this purpose, please read the documentation for the basic device.

X9	Pin	Designation	Explanation
 SUBD09010	1	B	TTL input signal by encoder or encoder simulation
	2	$\overline{A}$	
	3	A	
	4	+5 V	Regulated voltage supply for encoder (pin 8 = sense must be used, max. control range 5 ... 9 V)
	5	GND	-
	6	$\overline{Z}$	TTL input signal by encoder or encoder simulation
	7	Z	
	8	● **S** ● Lc ● E	The function of this cable has to be set in the basic device: ● **Sense** (sensor lead for voltage regulation, **Lenze setting**) ● Lamp control ● Enable
	9	$\overline{B}$	TTL input signal by encoder or encoder simulation

X10	Pin	Designation	Explanation
 SUBD09010	1	B	TTL output signal from the encoder or encoder simulation Maximum output current: 20 mA per channel
	2	$\overline{A}$	
	3	A	
	4	+5 V	V_{CC} ±6 %
	5	GND	-
	6	$\overline{Z}$	TTL output signal from the encoder or encoder simulation Maximum output current: 20 mA per channel
	7	Z	
	8	Enable	Digital output signal
	9	$\overline{B}$	TTL output signal from the encoder or encoder simulation Maximum output current: 20 mA per channel

8.5 Memory modules

Use these modules in slot ☐ MXI1 ☐MXI2 ☑MMI ☐MSI.

8.5.1 Safety instructions

Stop!

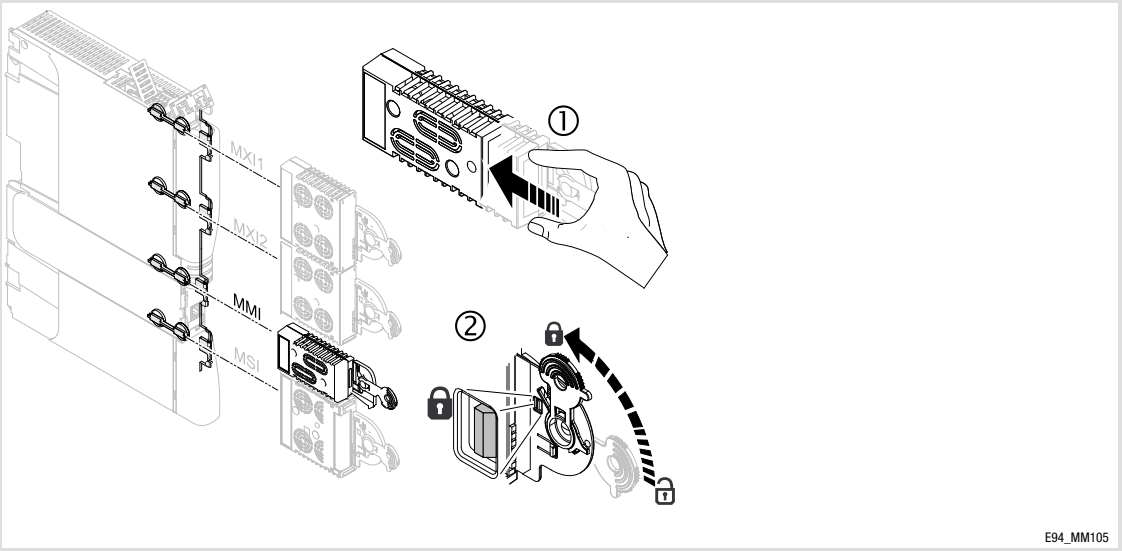
The ⚠ symbol visible at the front indicates the presence of electronic components which can be damaged or destroyed by electrostatic discharge.

Take appropriate measures to protect these components before touching the module!

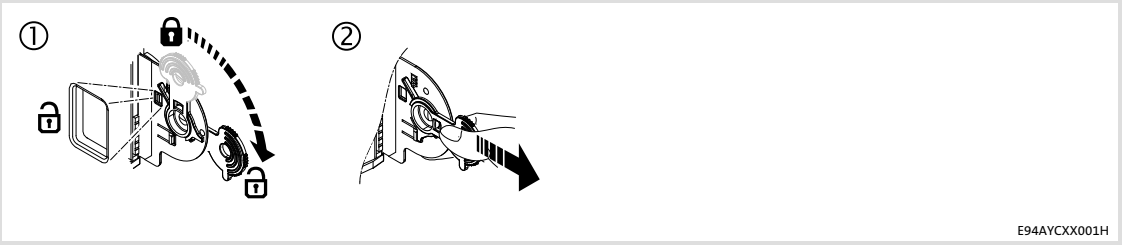
Stop!

Before mounting/dismounting, switch off the supply voltage to prevent electronic modules from damage.

8.5.2 Mounting



8.5.3 Dismounting



8.5.4 Setting CAN node address and baud rate

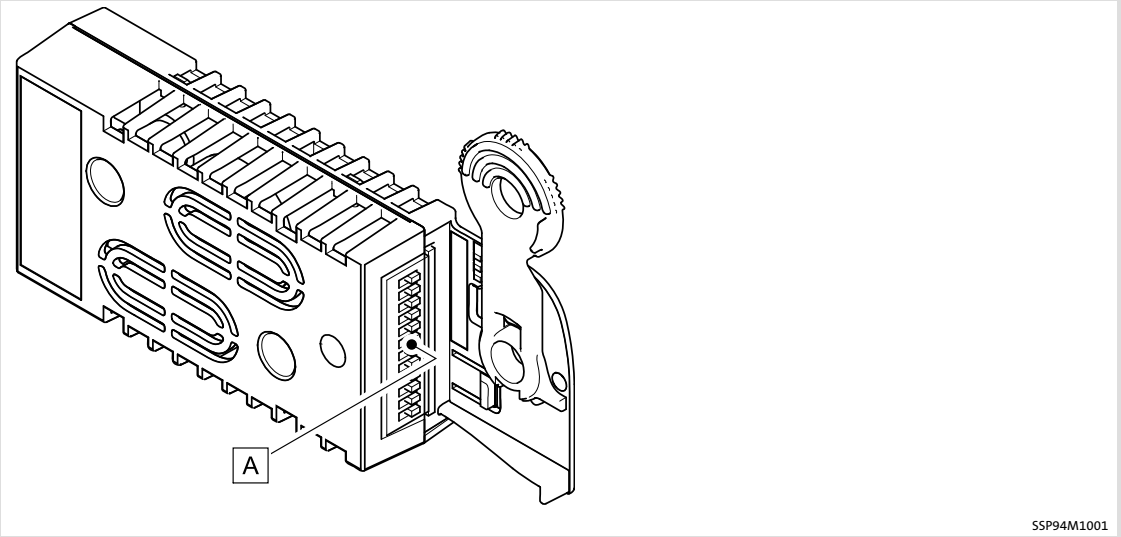


Fig. 8-1 Memory module with DIP switch (as of order designation E94AYM22)

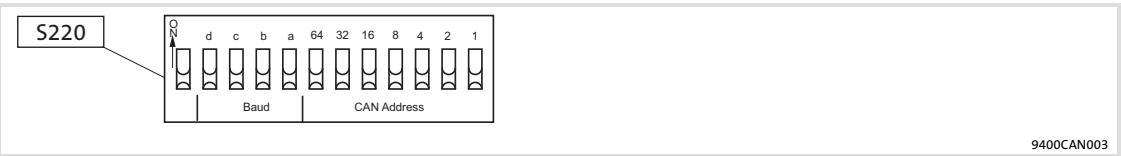


Fig. 8-2 Arrangement and labelling of the DIP switches

Via the DIP switches on the front, you can set:

- the node address (labelling ”1” ... ”64”) and
- baud rate (labelling ”a” ... ”d”)

Note!

If DIP switches 1 ... 64 = OFF (”Lenze setting”): When the standard device is switched on, the parameterisation of codes C00350 (node address) and C00351 (baud rate) is activated.

Switch the voltage supply of the standard device off and then on again to activate altered settings.

Setting the node address

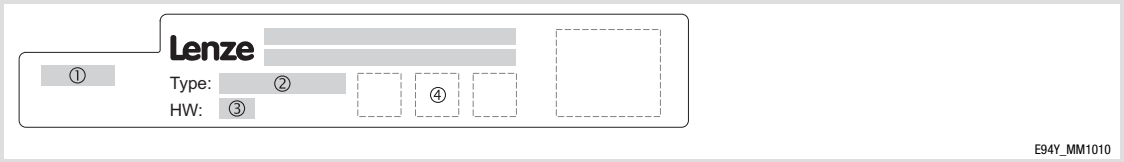
The node address of the drive is calculated from the sum of all address switches in the ”ON” position.

Setting the baud rate

d	c	b	a	Baud rate
OFF	ON	ON	OFF	10 kbps
OFF	ON	OFF	ON	20 kbps
OFF	OFF	ON	ON	50 kbps
OFF	OFF	ON	OFF	125 kbps
OFF	OFF	OFF	ON	250 kbps
OFF	OFF	OFF	OFF	500 kbps
ON	ON	ON	OFF	800 kbps
OFF	ON	OFF	OFF	1000 kbps
OFF	ON	ON	ON	Automated recognition

8.5.5 Memory module MM220

Identification



Designation ③: **MM220**

①					②
E94	**A**	**Y**	**M**	**22**	**VA**

Product range

Version

Module description: extension module

Module type: memory module

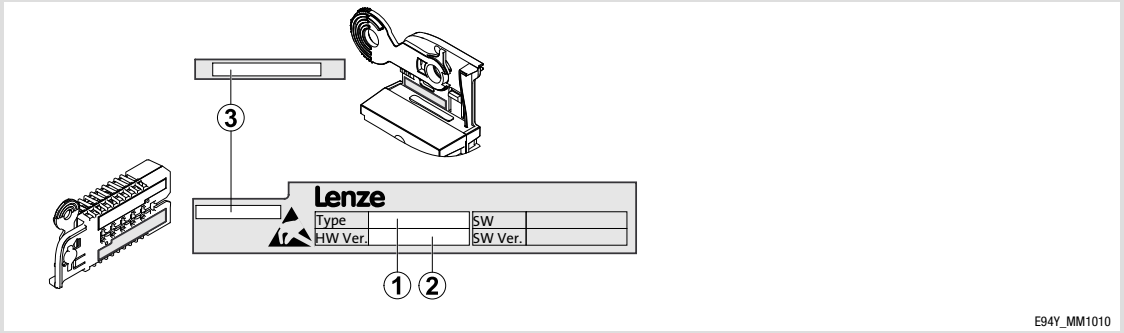
Design:
- 2 MB flash
- Possible logbook entries: 7
- DIP switch

Licence: Motion Control HighLevel

Hardware version

8.5.6 Memory module MM330

Identification



Designation ③: **MM330**

①					②
E94	**A**	**Y**	**M**	**33**	**VA**

Product range

Version

Module description: extension module

Module type: memory module

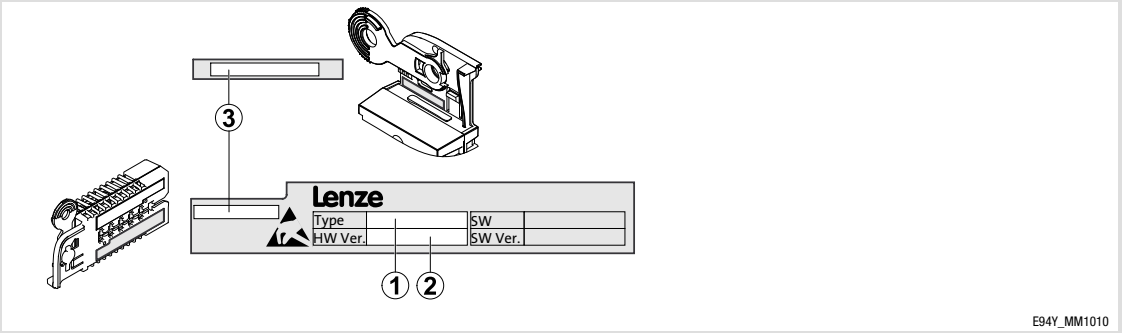
Design:
- 4 MB flash
- Possible logbook entries: 439
- DIP switch

Licence: Motion Control TopLevel

Hardware version

8.5.7 Memory module MM340

Identification



Designation ③: **MM340**

①					②
E94	**A**	**Y**	**M**	**34**	**VA**

Product range

Version

Module description: extension module

Module type: memory module

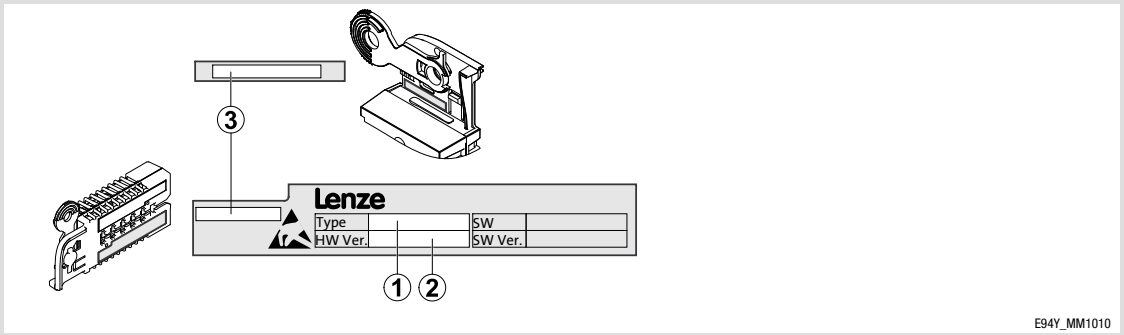
Design:
- 4 MB flash
- Possible logbook entries: 439
- DIP switch

Licence: Motion Control PLC

Hardware version

8.5.8 Memory module MM430

Identification



Designation ③: **MM430**

①					②
E94	**A**	**Y**	**M**	**43**	**VA**

Product range

Version

Module description: extension module

Module type: memory module

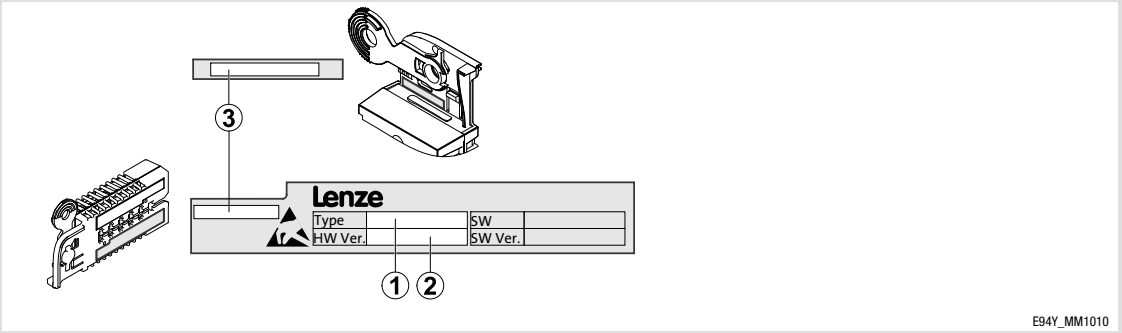
Design:
- 8 MB flash
- Possible logbook entries: 439
- DIP switch
- Real-time clock

Licence: Motion Control TopLevel

Hardware version

8.5.9 Memory module MM440

Identification



Designation ③: **MM440**

①					②
E94	**A**	**Y**	**M**	**44**	**VA**

Product range

Version

Module description: extension module

Module type: memory module

Design:
- 8 MB flash
- Possible logbook entries: 439
- DIP switch
- Real-time clock

Licence: Motion Control PLC

Hardware version

8.6 Safety modules

8.6.1 Safety instructions

Danger!

Improper use of the module and the standard device may cause serious injury and property damage.

Observe the chapters ”Safety instructions” and ”Residual hazards” contained in the instructions for the standard device.

Stop!

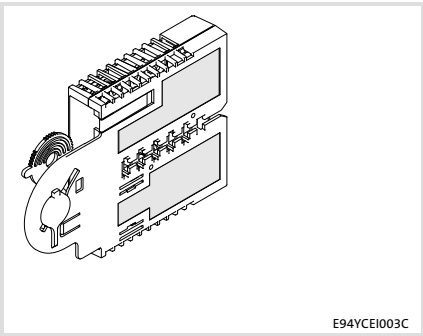
Mounting/dismounting must be carried out when the supply voltage is switched off to protect the electronic components against damage.

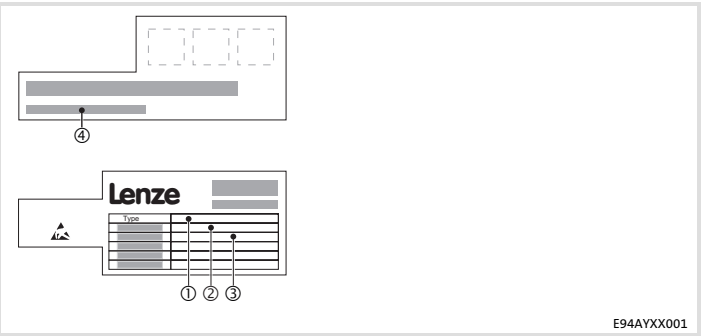
Only use safety modules in the module slot for safety modules (MSI).

Note!

The entry in code C00214 must correspond to the type of the plugged-on safety module. Otherwise, the controller will report the following error: ”Safety module: Incompatible to setting in C00214”.

8.6.2 Identification





①					②	③	④
E94	A	Y	A	x	xx	xx	nn

Product series

Version

Module identification: Device module

Module type: Safety module

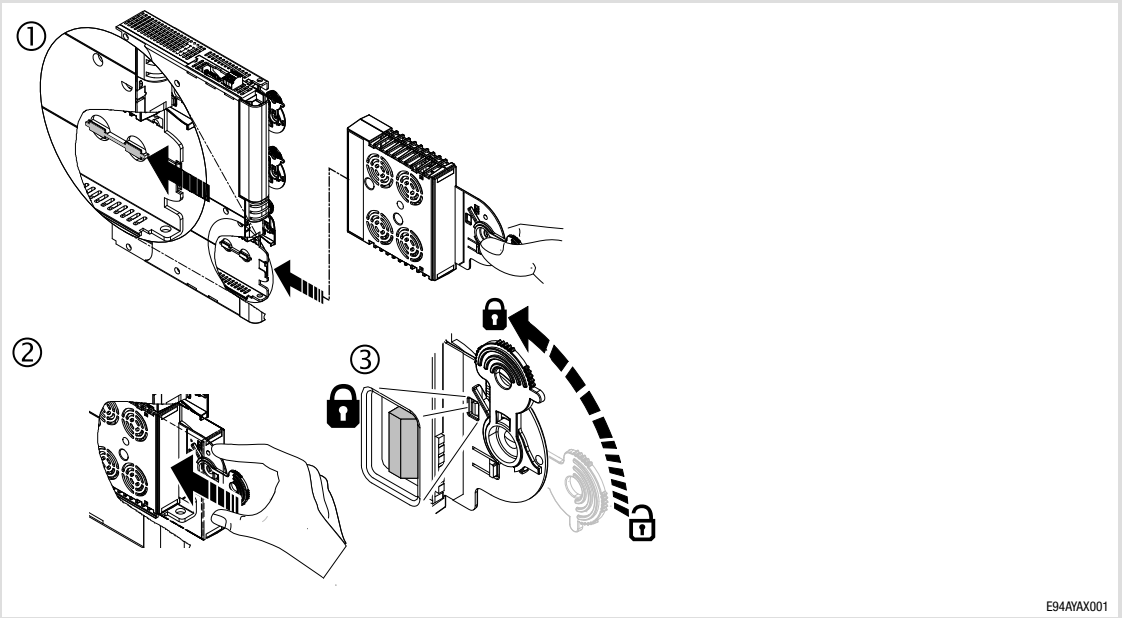
Design
A = SM0
B = SM100
E = SM301
F = SM302

Hardware version

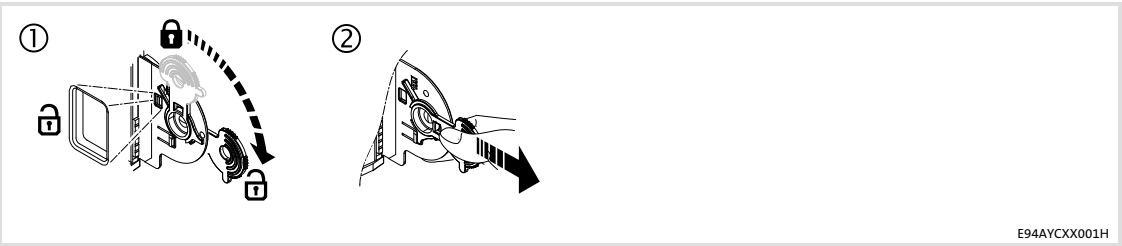
Software version (SM30x only)

Serial number

8.6.3 Mounting

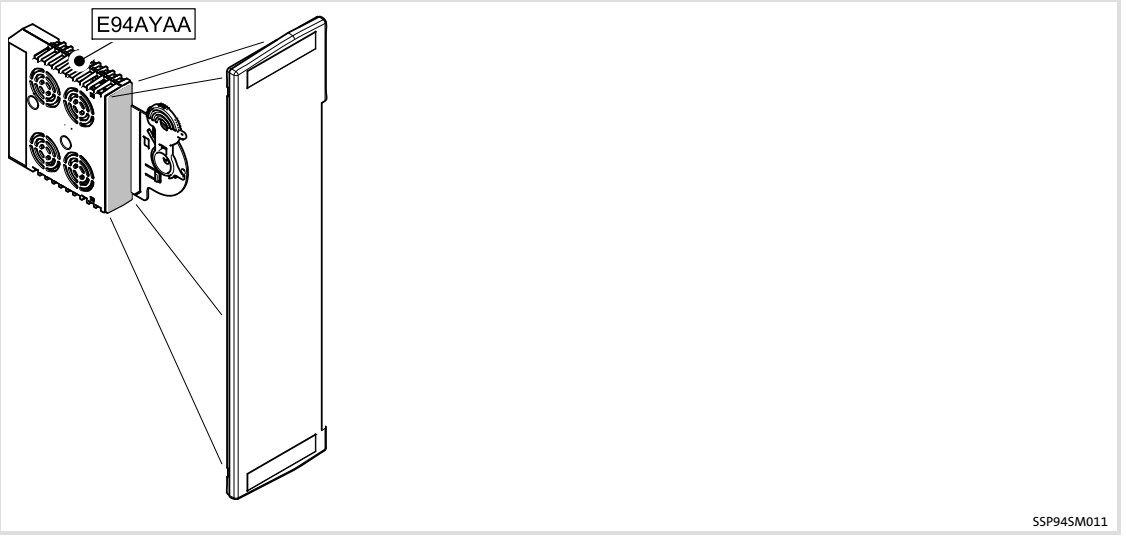


8.6.4 Dismounting



8.6.5 SM0

Elements



Pos.	Description
-	There are no elements.

Function

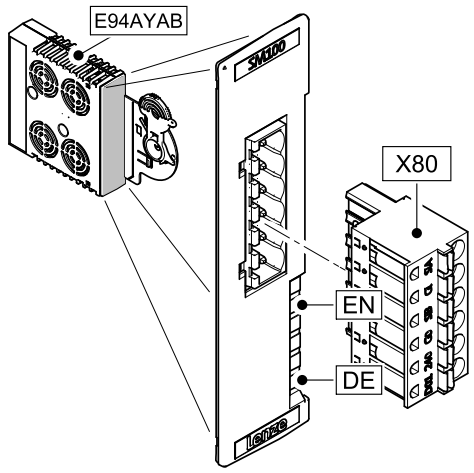
- **No**safety functions are available.
- This module is necessary for operation of the drive controller without safety functions.

Note!

If safety functions are necessary, replace the SM0 module with a module with safety functions (SM100, SM301 oder SM302).

8.6.6 SM100

Elements



Connections

Pos.	Description
X80	Pluggable terminal strip for input and output signals

Displays

Pos.	Colour	Condition	Description
EN	Yellow	On	Controller enabled
		Off	Non-safe display "Safe pulse inhibit"
DE	Red	On	The module is not accepted by the standard device (see notes given in the documentation for the standard device).

Application range

This accessory component may only be used in conjunction with

► E94xxxExxxx axis module

as of nameplate data

	HW	SW
E94xxxExxxx	VA	1.10

Safety instructions



Danger!

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

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



Danger!

Unexpected motor rotation possible

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

Possible consequences:

► People may be injured by the machine movements (unexpected start-up).

Protective measures:

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



Warnings!

► Secondary circuit shall supplied from an external isolating source.

► Maximum surrounding air temperature: 55 °C.

Avertissement !

- ► Prévoir un circuit auxiliaire alimenté par une source de tension avec isolation galvanique.
- ► Température ambiante maximale : 55 °C.

Function

► Safe torque off
(previously: safe standstill, protection against unexpected start-up)

Technical data

Rated data input (sensor)

Type	Voltage U_N [V]	Current I_{max} [A]
E94AYAB - SM100	24	0.9

Rated data output (feedback)

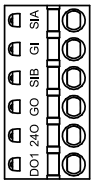
Type	Voltage U_N [V]	Current I_{max} [A]
E94AYAB - SM100	24	0.7

Block diagram



SM100	Safety module
SIA, SIB, GI	Two-channel sensor signal connections, supply through safely separated power supply unit (SELV/PELV)
	(old labelling up to HW version VB: SI1, SI2, GI)
24O, DO1, GO	Non-safe feedback connections, supply through safely separated power supply unit (SELV/PELV)
µC	Microcontroller
PWM	Pulse width modulation

Connection data

X80	Marking	Description	Electrical data
 SSP9400X80	SIA	Input first shutdown path	SIA: I_{typ} = 160 mA
	GI	GND potential for SIA/SIB	LOW: -3 ... 5 V, HIGH: 15 ... 30 V,
	SIB	Input second shutdown path	SIB: I_{typ} = 28 mA Supply through safely separated power supply unit (SELV/PELV)
	GO	GND potential feedback	24 V, max. 0.7 A, short-circuit-proof, LOW-active, Supply through safely separated power supply unit (SELV/PELV)
	24O	24 V supply feedback	
	DO1	Non-safe signalling output: "Safe pulse inhibit"	

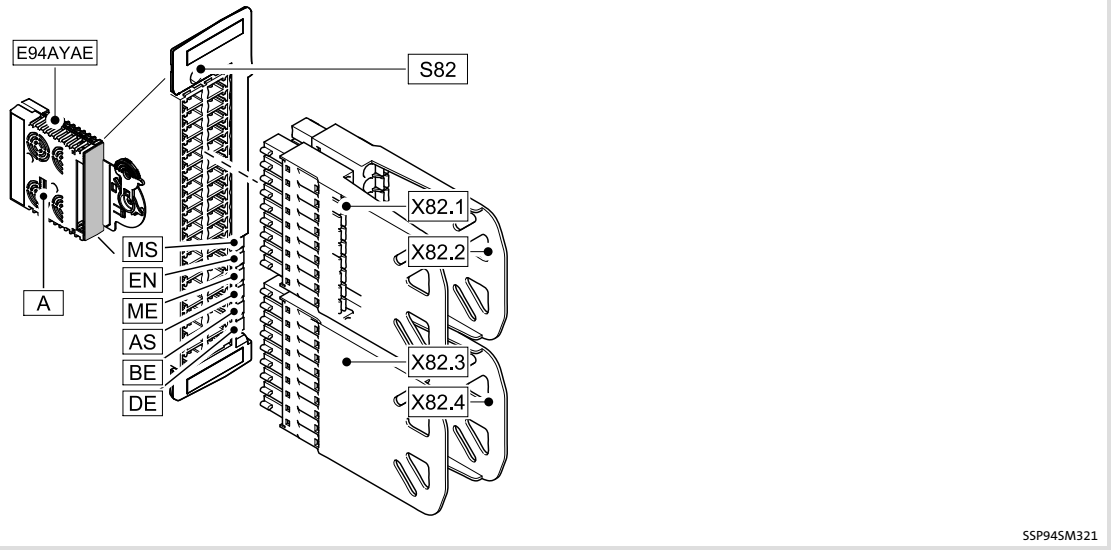
Terminal data				
	Conductor cross-section		Tightening torque	
	[mm²]	[AWG]	[Nm]	[lb-in]
Rigid	0.2 ... 2.5	24 ... 12	Spring terminal	
Wire end ferrule, insulated	0.2 ... 1.5	24 ... 16		
Twin wire end ferrule	0.5 ... 1.0	20 ... 18		

Stripping length / contact length: 10 mm

Information for the exchange of modules of different hardware versions		
up to HW: VB	from HW: VC	Comment
SI1	SIA	The exchange of the spring terminal is required!
GI	GI	
SI2	SIB	
GO	GO	
24O	24O	
DO1	DO1	

8.6.7 SM301

Elements



Pos.	Description
A	Safety address switch (in the left part of the housing)
S82	Module switch for parameter set adoption from the memory module
X82.1	Plug-in terminal strips for input and output signals
X82.2	
X82.3	
X82.4	

Displays

Pos.	Colour	State	Description
MS (Module State)	Green	On	Drive-based safety has initialised without a fault.
		Blinking	Drive-based safety has initialised without a fault. Internal communication to the standard device is not possible.
		Flashing	Drive-based safety is in service status. For exiting, parameterise the drive-based safety.
		Off	Drive-based safety is not initialised. Acknowledgement is not possible.
EN (Enable)	Yellow	On	Controller enabled
		Off	Non-safe display "STO"
ME (Module Error)	Red	On	System error
		Blinking	Trouble
		Flashing	Warning
		Off	Error-free operation
AS (Acknowledge Stop)	Yellow	On	Request of an acknowledgement for the restart or the parameter set adoption
		Blinking	SS1/STO active
		Flashing	SS2/SOS active
		Off	No stop function active
BE (Bus Error)	Red	On	Safety bus error: ● Communication is not possible. ● Acknowledgement is possible.
		Blinking	Safety bus error: no valid configuration.
		Off	Safety bus: error-free operation.
DE (Drive Error)	Red	On	Drive-based safety is not accepted by the standard device (see notes in the instructions for the standard device).
		Off	Drive-based safety is correctly recognised by the standard device.

Blinking: on/off every 0.5 s Flashing: on/off every 0.1/0.9 s

Application range

The use of this module is permissible with standard devices of the 9400 product series from nameplate designation

Type	HW	SW
E94xxHExxxx	VA	01.49
E94AxPExxxx	2A	02.xx

The use of this module is permissible with the PROFIBUS communication module from nameplate designation

Type	HW	SW
E94AYCPM	VB	01.10

Safety instructions

Danger!

When the request for the safety function is deactivated, the drive can restart automatically. The behaviour can be set via the parameter ”Restart behaviour” (C15300/1/2).

In the case of an automatic restart, you must provide external measures which ensure that the drive only restarts after an acknowledgement (EN 60204).

Danger!

Danger to life through improper installation

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

Possible consequences:

► Death or severe injuries

Protective measures:

Total cable length between X82 and its connected components (e.g. sensors, devices, ...) > 3 m:

► Up to HW version 1A, a shielded laying system must be used for the cable between X82 and its connected components:
  – The shield must at least cover the shield connection at the installation backplane.
  – The shield should also cover the connected component if possible.

► From HW version 1A onwards, unshielded wiring is permissible.

Total cable length between X82 and its connected components (e.g. sensors, devices, ...) < 3 m:

► Unshielded wiring is permissible.

Warnings!

► Secondary circuit shall supplied from an external isolating source.

► Maximum surrounding air temperature: 55 °C.

Avertissement !

- ► Prévoir un circuit auxiliaire alimenté par une source de tension avec isolation galvanique.
- ► Température ambiante maximale : 55 °C.

Technical data

If safety functions with SM301, which require reliable speed and position detection, are used, the cable length for motor and feedback must be restricted to 100 m. In addition, the maximum permissible cable lengths in relation to the drive controllers must be adhered to (c.f. respective chapter ”General data”).

The module and the safe output must be supplied with 24 V from safely separated power supply units. If electrical isolation is required, separate voltage supply lines must be used.

Detailed features of the 24-V supply					
Terminal	Specification	[Unit]	min.	typ.	max.
+, -	Supply voltage of the module via a safely separated power supply unit (SELV/PELV)	[V]	19,2	24	30
	Input current	[mA]			350
24O, GO	Supply voltage of the safe output via a safely separated power supply unit (SELV/PELV)	[V]	18	24	30
	Input current	[mA]			1100

If the voltage of the SELV/PELV power supply unit can exceed 30 V in the event of an error, provide for an external fuse (📖 8.7.3).

Functions from SM301 V1.0 onwards

- Safe torque off (STO)
  (formerly: safe standstill, protection against unexpected start-up)
- Safe stop 1 (SS1)
- Safe stop 2 (SS2) - see SOS
- Safe stop emergency (SSE)
- Safe operational stop (SOS) - in accordance with EN 61800-5-2: SOS is designed with speed monitoring
- Safe maximum speed (SMS)
- Safely limited speed 1 (SLS1)
- Safe operation mode selector (OMS)
- Safe enable switch (ES)
- Safe speed monitor (SSM)
- Safe monitor (output)
- Connection of safety sensors
- Safe parameterisation
- Safety bus connection (PROFIsafe V1)

Additional functions as of SM301 V1.1

- Safely limited speed 2 (SLS2)
- Safely limited speed 3 (SLS3)
- Safely limited speed 4 (SLS4)
- Safe cascading (CAS) via SD-In4/SD-Out1
- Safety bus connection (PROFIsafe V2)

Additional functions from SM301 V1.2

- Parameterisable response time of encoder monitoring

Additional functions from SM301 V1.3

- Safe operational stop (SOS) - compliant with EN 61800-5-2: SOS is designed with position monitoring
- Safe direction (SDI)
- Safe speed measurement and position detection with resolver using a motor encoder and an additional position encoder (two-encoder-concept)

Additional functions as of SM301 V1.4

- Safely limited increment (SLI)
- Safely monitored brake ramp for SS1/SS2
- Safe speed and position detection with resolver selected as the motor encoder

Addressing

The safety address serves to clearly assign the safety modules of the SM301 type in systems with several drives. The address ”0” is not permissible.

Address switch

The safety address can be set in the left part of the housing by means of the DIP switch Ⓐ. For setting the switch, use an appropriately small tool, e. g. a probe. The switch can only be set if the module is not connected to a standard device. Via the switch, addresses in the range of 0 ... 1023 can be set. Alterations by the switch with regard to the address are only activated when the 24-V supply is switched on. The address setting ”0” requires the setting by the address code.

DIP switch Ⓐ	Labelling									
	1	2	3	4	5	6	7	8	9	0
Value of the address bit	1	2	4	8	16	32	64	128	256	512

Note!

In the SM301 safety module as of version VA 1.xx, the address 0 is replaced as follows:

- ► With the address saved in the safety module in the parameter ”Safety address” (C15111).
- ► If the address 0 canot be replaced, the module reports an error.

Block diagram

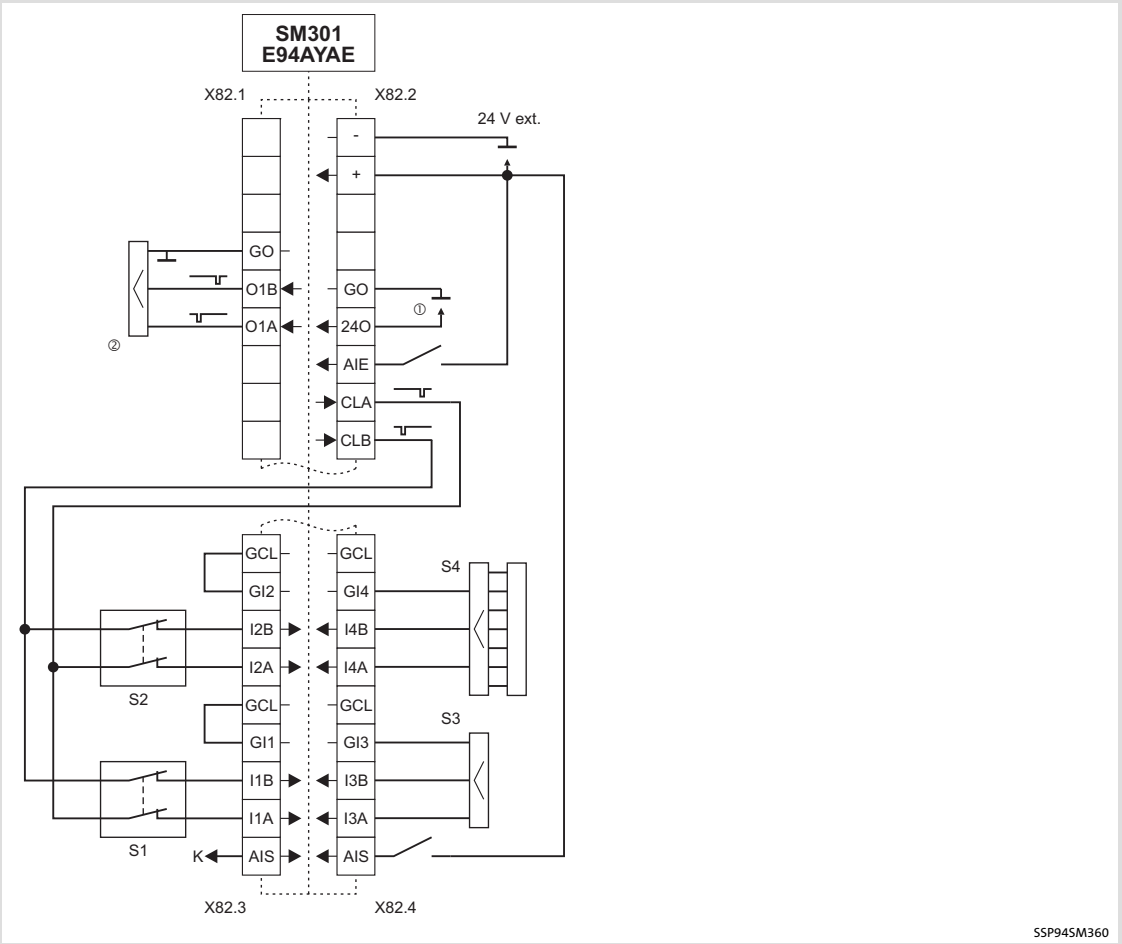


Fig. 8-3 Wiring example

E94AYAF	SM302 safety module
S1 S2	Passive sensor with channel A and B
S3	higher-level safety control (active sensor)
S4	lightgrid (active sensor)
24 V ext.	24-V voltage supply of the module (SELV/PELV)
①	24-V voltage supply of the output (SELV/PELV)
②	safe output to higher-level safety control
K	to AIS of the next module

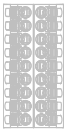
Connection data

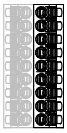
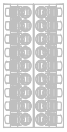
Note!

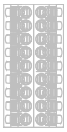
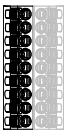
Provide for a sufficient strain relief, so that the terminals are not pulled from the plug connectors, in particular when you use rigid cables.

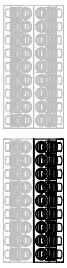
Cable cross-sections and tightening torques				
Type	**[mm²]**	**[Nm]**	**AWG**	**[lb-in]**
Wire end ferrule, insulated	0.25 ... 0.75	Spring terminal	24 ... 18	Spring terminal
Rigid	0.14 ... 1.5		26 ... 16	

Stripping length or contact length: 9 mm

X82.1	Labelling	Description
		This part of the terminal strip is not assigned.
	GO	GND SD-Out1
	O1B	Safe monitor SD-Out1, channel B
	O1A	Safe monitor SD-Out1, channel A
		This part of the terminal strip is not assigned.

X82.2	Labelling	Description
	-	GND external supply
	+	+24 V external supply via a safely separated power supply unit (SELV/PELV)
	GIR	This part of the terminal strip is reserved.
	RI1	
	GO	GND 24O
	24O	+24 V external supply for the safe monitor SD-Out1 (SELV/PELV)
	AIE	Error acknowledgement input (”Acknowledge In Error”)
	CLA	Clock output for passive sensors, channel A (Clock A)
	CLB	Clock output for passive sensors, channel B (Clock B)

X82.3	Labelling	Description
	GCL	GND clock output
	GI2	GND SD-In2
	I2B	Sensor input SD-In2, channel B
	I2A	Sensor input SD-In2, channel A
	GCL	GND clock output
	GI1	GND SD-In1
	I1B	Sensor input SD-In1, channel B
	I1A	Sensor input SD-In1, channel A
	AIS	Restart acknowledgement input (”Acknowledge In Stop”, 1-channel, bridged to X82.4/AIS)

X82.4	Labelling	Description
	GCL	GND clock output
	GI4	GND SD-In4
	I4B	Sensor input SD-In4, channel B
	I4A	Sensor input SD-In4, channel A
	GCL	GND clock output
	GI3	GND SD-In3
	I3B	Sensor input SD-In3, channel B
	I3A	Sensor input SD-In3, channel A
	AIS	Restart acknowledgement input (”Acknowledge In Stop”, 1-channel, bridged to X82.3/AIS)

8.6.8 SM302

Available for delivery soon with extended functions compared to SM301.

Warnings!

Secondary circuit shall supplied from an external isolating source.
Applicable if supplied by an external source.

► Maximum surrounding air temperature: 55 °C.
► External fuse for 24 Vdc supply voltage. Rated 4 A DC fuse UL248-14.

8.7 Motor holding brake control modules

8.7.1 Overview

The motor brake control modules differ in the following features:

- Rated voltage
- Device size assignment
- Mounting type

The table shows the module/controller assignments according to the features listed.

Single-axis controllers		Rated voltage of motor holding brake (control module)		
Type		24 V	205 V	180 V
E94xSxE0024 ... E94xSxE0244	GG1 ... GG3	E94AZHX0051 ① ③ E94AZHA0051 ① ④	E94AZHN0025 ④ ⑤	E94AZHN0026 ④ ⑤
E94xSxE0324 ... E94xSxE1044	GG6 ... GG7	E94AZHY0101 ② ③ E94AZHB0101 ② ④	E94AZHN0025 ④ ⑤ E94AZHY0025 ② ③	E94AZHN0026 ④ ⑤ E94AZHY0026 ② ③
E94xSxE1454 ... E94xSxE4604	GG81 ... GG91	E94AZHY0101 ② ③ E94AZHB0101 ② ④	E94AZHN0025 ④ ⑤ E94AZHY0025 ② ③	E94AZHN0026 ④ ⑤ E94AZHY0026 ② ③
Multi-axis controllers		Rated voltage of motor holding brake (control module)		
Type		24 V	205 V	180 V
E94xMxE0024 ... E94xMxE0324	GG1 ... GG3	E94AZHX0051 ① ③	E94AZHN0025 ④ ⑤	E94AZHN0026 ④ ⑤
E94xMxE0474 ... E94xMxE0594	GG6	E94AZHY0101 ② ③ E94AZHB0101 ② ④	E94AZHN0025 ④ ⑤ E94AZHY0025 ② ③	E94AZHN0026 ④ ⑤ E94AZHY0026 ② ③

Tab. 8-2 Motor holding brake/control module assignment

GGx	Device size
①	integrated in the installation backplane, already used or retrofittable
②	integrated in the device, already applied or retrofittable (recommended variant for the same rated voltage)
③	integrated control module (automatic brake operation can be activated)
④	external control (via digital output/digital input)
⑤	external mounting (DIN rail or mounting plate)

The information applicable to all modules is provided in advance.

The information applicable to the individual modules is provided afterwards:

- ► E94AZHX0051 - (📖 456)
- ► E94AZHA0051 - (📖 463)
- ► E94AZHY0101 - (📖 470)
- ► E94AZHB0101 - (📖 477)
- ► E94AZHY0025 - (📖 484)
- ► E94AZHN0025 - (📖 489)
- ► E94AZHY0026 - (📖 495)
- ► E94AZHN0026 - (📖 501)

Monitoring functions

Motor brake control module		
Brake status	**Module-internal monitoring**	**No monitoring**
Brake is not controlled (brake is applied)	● Supply voltage of brake – not available – not connected correctly	● Supply voltage – too high – too low – e.g. 18 V instead of 24 V ● Brake current – too high – too low ● Brake cable not connected correctly
Brake is controlled (brake is released)	● Short circuits – cable "+" or "-" – cable "BD1" or "BD2" ● Open circuit – cable "+" or "-" – cable "BD1" or "BD2"	

► Single Drive E94xS... devices: Monitoring active from $V_{DC\ bus}$ > 250 V

► Multi Drive E94xM... devices: Monitoring active independent of $V_{DC\ bus}$

$V_{DC\ bus}$ = DC-bus voltage

► Errors can be evaluated under code C02609/8.

The externally controllable E94AZHN002x modules can be monitored via the digital output (recommended).

Digital output DO	
Status	Description
HIGH	No faults
LOW	Fault ● Supply voltage for motor holding brake is missing ● Motor holding brake not connected to power supply ● Brake cable defective – Open circuit – Short circuit ● Supply voltage for motor brake control is missing

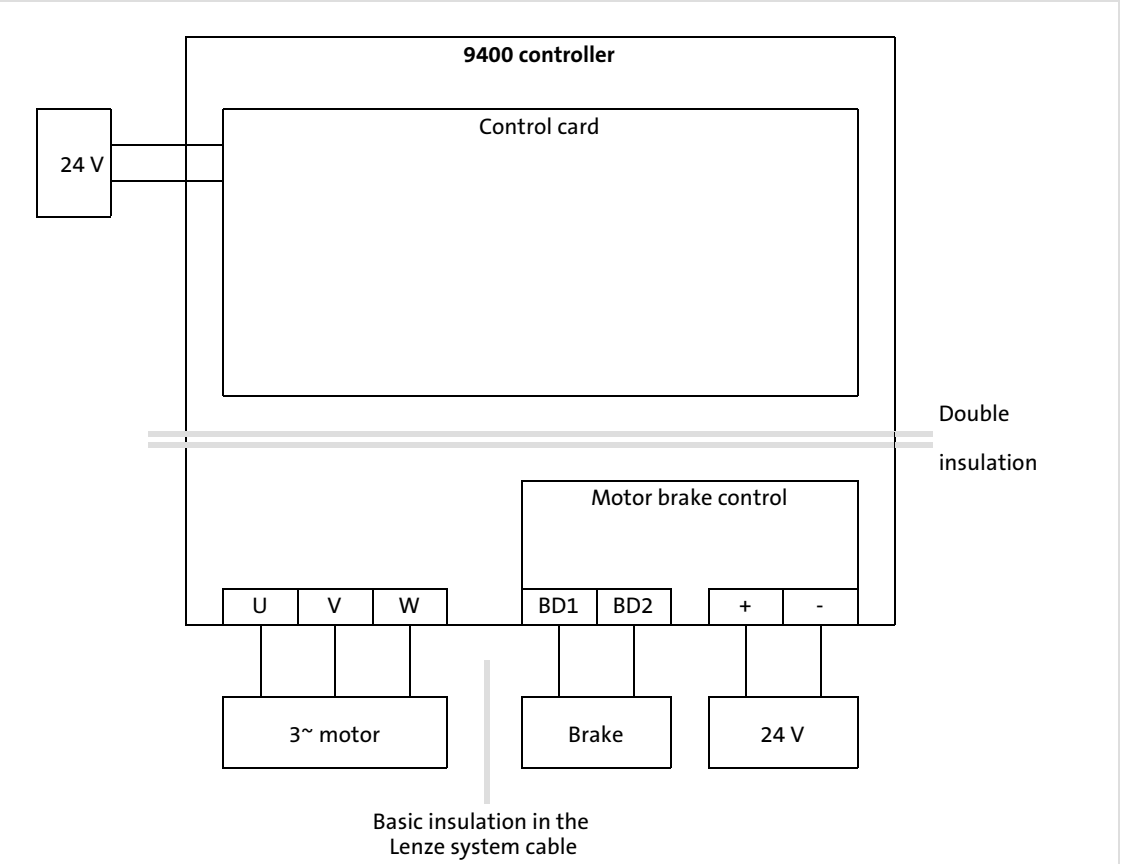
Note!

The supply status can be reported to the standard device via the error channel. For more information, please see the software manual or the online help (see description of C02609/8).

Operating conditions

The operating conditions correspond to the operating conditions for the standard device to which the DC-feeding point is connected.

Electrical isolation / protection against accidental contact



The principle of electrical isolation can be analogously transferred to the modules with other voltages for motor holding brakes.

8.7.2 Safety instructions

During installation the notes given in the documentation for the standard device must be observed!

Danger!

Dangerous electrical voltage!

Dangerous electrical voltages may be applied to the connections of the brake switch.

Possible consequences:

► Death or severe injuries when touching the terminals.

Protective measures:

► Disconnect the standard device and the brake switch from the mains before carrying out any operations.

► Check that all power terminals are deenergised.

Stop!

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

The motor brake control module may only be connected to holding brakes which correspond to the permissible data specified in the technical data.

If the permissible values specified in the technical data are not complied with:

► The motor brake control module can be destroyed.

► A safe operation of the motor holding brake cannot be guaranteed.

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

Stop!

Requirements on the brake cable (connection BD1/BD2):

► If the brake cable is part of the motor cable, it must be shielded.
  – An operation with unshielded brake cables can destroy the motor brake control module.
  – We recommend the use of Lenze system cables (motor cable with separately shielded additional cores).
  – Connect the shield to PE on both sides.

► 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.

8.7.3 Safety instructions for the installation according to UL/CSA

Original - English

E94AZHX0051, E94AZHA0051

Warnings!

- Only for use with series E94.
- Secondary circuit shall supplied from an external isolating source.
- Load at ”Brake Output” is provided for ”dc pilot duty”.
- The voltage rating of the fuses must at least be suitable for the input voltage of the device.
- Use 60/75 °C wire, except for control circuits.
- Maximum surrounding air temperature: 55 °C.
- These products are intended for use in a pollution degree 2 environment.

E94AZHY0101, E94AZHA0101, E94AZHY0025, E94AZHN0025, E94AZHY0026, E94AZHN0026

Warnings!

- Only for use with series E94.
- Secondary circuit shall supplied from an external isolating source.
- Load at ”Brake Output” is provided for ”dc pilot duty”.
- The voltage rating of the fuses must at least be suitable for the input voltage of the device.
- E94AZHx0101, E94AZHx0025:
  – Use 105 °C wire only (min. wire size 20 AWG), except for control circuits.
- E94AZHx0026:
  – Use 60/75 °C wire only (min. wire size 20 AWG), except for control circuits.
- Maximum surrounding air temperature: 55 °C.
- These products are intended for use in a pollution degree 2 environment.

	Branch circuit/short circuit protection with fuses in accordance with UL248
Type	Fuse [A]
E94AZHX0051	7.5
E94AZHA0051	7.5
E94AZHY0101	7.5
E94AZHB0101	7.5
E94AZHY0025	5
E94AZHN0025	5
E94AZHY0026	5
E94AZHN0026	5

Original - French

E94AZHX0051, E94AZHA0051

Avertissement !

- ► Equipement destiné uniquement à être utilisé avec la série E94.
- ► Prévoir un circuit auxiliaire alimenté par une source de tension avec isolation galvanique.
- ► Charge côté ”sortie du frein” fournie pour ”cycle pilote CC”.
- ► La tension des fusibles doit être adaptée à la tension d’entrée de l’équipement (exigence minimale).
- ► Utiliser exclusivement des conducteurs en cuivre 60/75 °C, sauf pour les circuits de commande.
- ► Température ambiante maximale : 55 °C.
- ► Ces produits sont destinés à un environnement caractérisé par le degré de pollution 2.

E94AZHY0101, E94AZHA0101, E94AZHY0025, E94AZHN0025, E94AZHY0026, E94AZHN0026

Avertissement !

- ► Equipement destiné uniquement à être utilisé avec la série E94.
- ► Prévoir un circuit auxiliaire alimenté par une source de tension avec isolation galvanique.
- ► Charge côté ”sortie du frein” fournie pour ”cycle pilote CC”.
- ► La tension des fusibles doit être adaptée à la tension d’entrée de l’équipement (exigence minimale).
- ► E94AZHx0101, E94AZHx0025:
  - – Utiliser exclusivement des conducteurs 105 °C (20 AWG minimum), sauf pour la partie commande.
- ► E94AZHx0026:
  - – Utiliser exclusivement des conducteurs 60/75 °C (20 AWG minimum), sauf pour la partie commande.
- ► Température ambiante maximale : 55 °C.
- ► Ces produits sont destinés à un environnement caractérisé par le degré de pollution 2.

	Branch circuit/short circuit protection with fuses in accordance with UL248
Type	Fuse [A]
E94AZHX0051	7.5
E94AZHA0051	7.5
E94AZHY0101	7.5
E94AZHB0101	7.5
E94AZHY0025	5
E94AZHN0025	5
E94AZHY0026	5
E94AZHN0026	5

8.7.4 Motor holding brake control module E94AZHX0051



Scope of supply

Pos.	Description
	Motor brake control E94AZHX0051
	Mounting Instructions

Elements of the motor brake control

Pos.	Description
A	Nameplate
B	Connection of the installation backplane
X107	Connection of supply and brake

Identification

Type code	①						
	E94	A	Z	H	x	005	1

Product series
Device generation
Accessories
Motor brake control type
Rated current
005 = 2.5 A
Voltage class
1 = 24 V

Standards

Conformity and approval			
Conformity			
CE	2014/35/EU	Low-Voltage Directive	
CE	2014/30/EU	EMC Directive	
UKCA	S.I. 2016/1101	The Electrical Equipment (Safety) Regulations 2016	
UKCA	S.I. 2016/1091	The Electromagnetic Compatibility Regulations 2016	
Approval			
$_{C}UL_{US}$	UL61800-5-1	Industrial Control Equipment (File No. E132659) for USA	
	CSA C22.2 No. 274-13	Industrial Control Equipment (File No. E132659) for Canada	

General electrical data

EMC			
Noise emission	EN 61800-3	Conducted, category C2.	
Noise immunity	EN 61800-3	Burst on control cable:	2 kV/5 kHz
		Surge on control cable:	1 kV (1.2 µs/50 µs; control cable - PE)

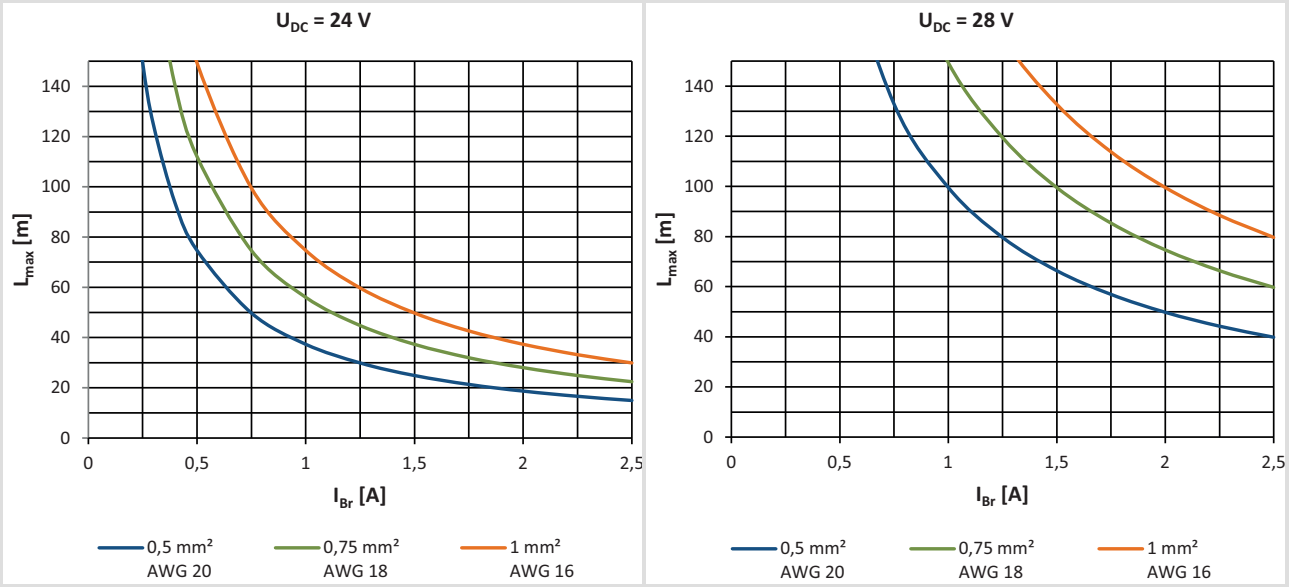
Rated data

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

Field	Values
Input voltage	DC 24 V (18 ... 30 V)
Output voltage	Corresponds to input voltage
Brake current	0.3 ... 2.5 A
Switching capacity	Max. 55 W
Breaking energy	Max. 5 Ws
Cable protection	Recommendation: 7.5 A, tripping characteristic ”B” or ”C”
Maximum cable length	In the chapter ”Electrical installation” the dependency of the cable length on the brake current and the cable cross-section is described.
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
Insulation [1)]	Double insulation (EN61800-5-1: V_{rated} = 300 V AC), Separation (UL: V_{rated} = 500 V AC)

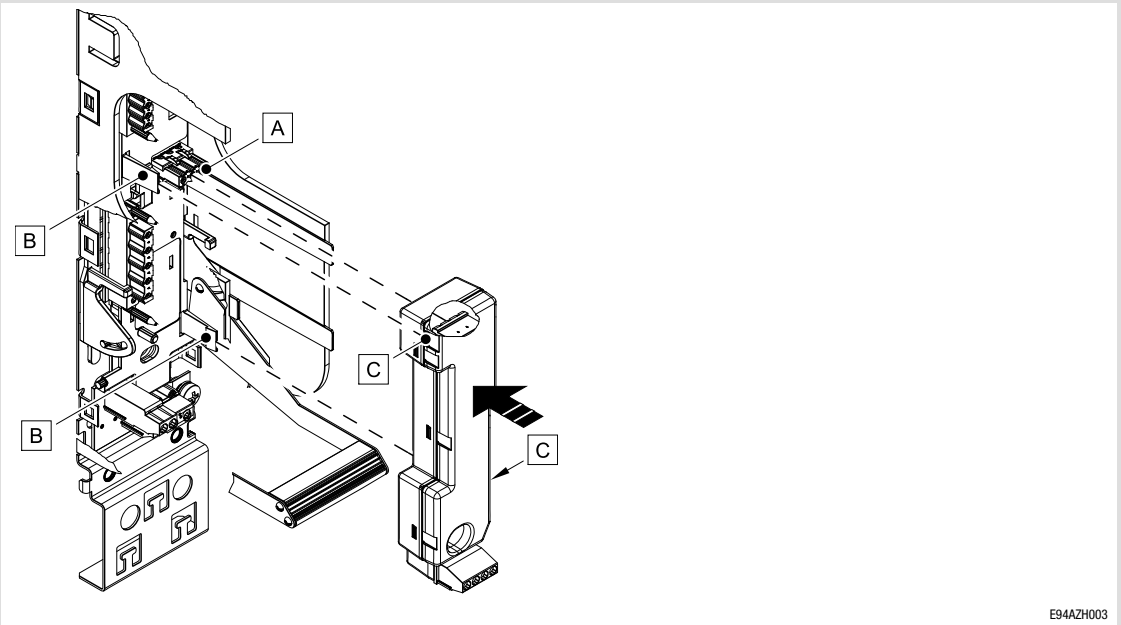
1) Brake connection against control card of the controller

Cable length



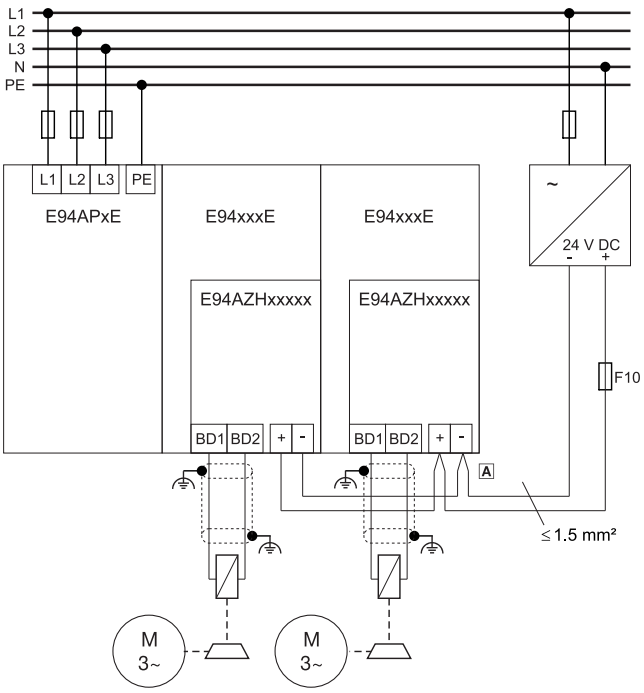
L_{max}	Maximum brake cable length in [m]
I_{BR}	Brake current in [A]
U_{DC}	Supply voltage of the motor brake control

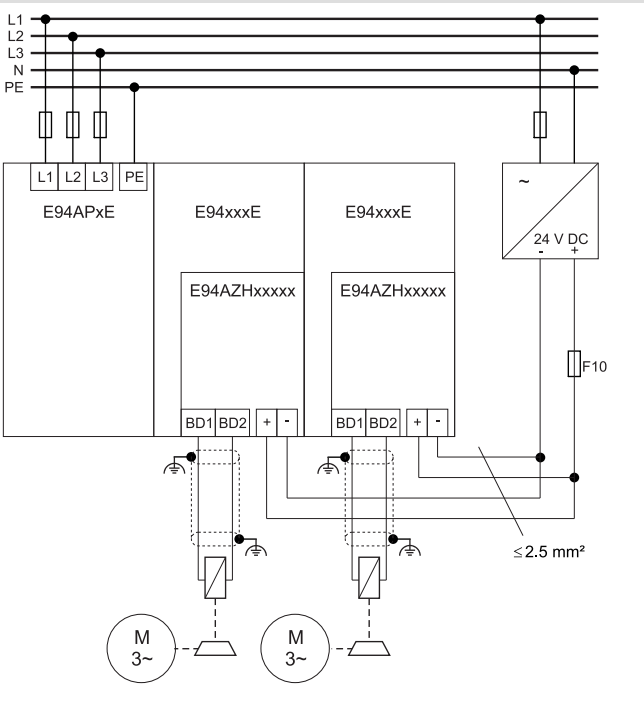
Installation steps



1. Plug the motor brake control onto the terminal A of the installation backplane.
2. Make sure that both clips B engage in the slots C of the motor brake control.

Connection plan



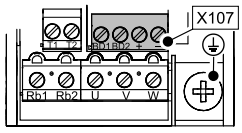


F10 Secondary cable protection. Observe the standards of the cable protection when selecting the fuse!

A Use twin wire end ferrules.

HF shield termination through large-surface PE connection

Terminal data

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!

Note!

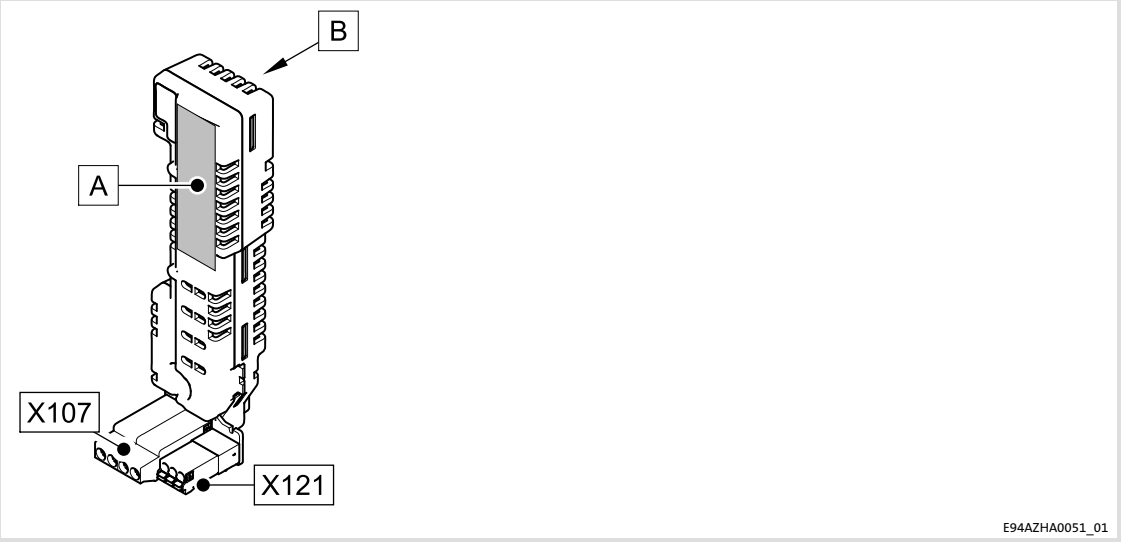
The supply terminals (+/-) are protected against polarity reversal.

The supply status can be reported to the basic device via the error channel. Further information can be obtained from the documentation of the basic device.

Terminal data	Conductor cross-section		Tightening torque	
	[mm²]	[AWG]	[Nm]	[lb-in]
Single core	0.25 ... 2.5	24 ... 12	0.5 ... 0.6	4.4 ... 5.3
2 conductors [1)]	0.25 ... 1.5	24 ... 16		

1) Two conductors of the same cross-section with a twin wire end ferrule

8.7.5 Motor holding brake control module E94AZHA0051



Scope of supply

Pos.	Description
	E94AZHA0051 motor brake control
	Mounting Instructions

Elements of the motor brake control

Pos.	Description
A	Nameplate
B	Terminal for the installation backplane
X107	Terminal for supply and brake
X121	Terminal for external control and feedback

Identification

Type code	①						
	E94	A	Z	H	A	005	1

- Product series
- Version
- Accessories
- Type of motor brake control
- Rated current
005 = 2.5 A
- Voltage class
1 = 24 V

Standards

Conformity and approval			
Conformity			
CE	2014/35/EU	Low-Voltage Directive	
CE	2014/30/EU	EMC Directive	
UKCA	S.I. 2016/1101	The Electrical Equipment (Safety) Regulations 2016	
UKCA	S.I. 2016/1091	The Electromagnetic Compatibility Regulations 2016	
Approval			
$_{C}UL_{US}$	UL61800-5-1	Industrial Control Equipment (File No. E132659) for USA	
	CSA C22.2 No. 274-13	Industrial Control Equipment (File No. E132659) for Canada	

General electrical data

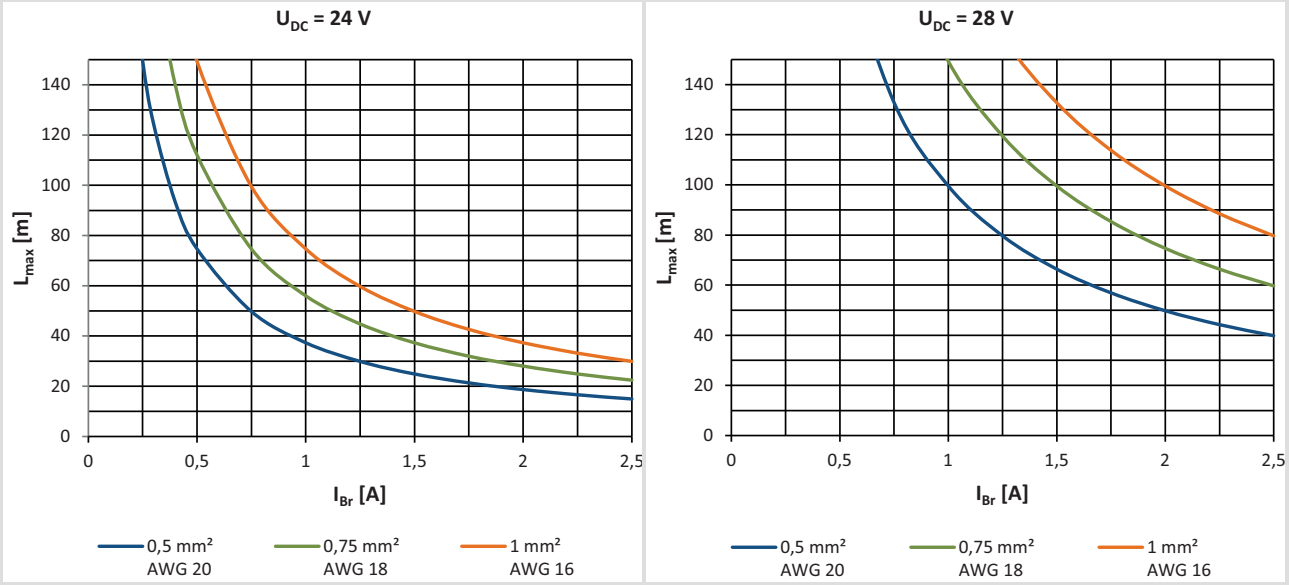
EMC			
Noise emission	EN 61800-3	Conducted, category C2.	
Noise immunity	EN 61800-3	Burst on control cable:	2 kV/5 kHz
		Surge on control cable:	1 kV (1.2 µs/50 µs; control cable - PE)

Rated data

Field	Values
Input voltage	DC 24 V (18 ... 30 V)
Output voltage	Corresponds to input voltage
Brake current	0.3 ... 2.5 A
Switching capacity	Max. 55 W
Breaking energy	Max. 5 Ws
Cable protection	Recommendation: 7.5 A, tripping characteristic ”B” or ”C”
Control input	
Input voltage	PLC input, IEC 61131-2, 24 V
Input current	Typically 15 mA
Control output	
Output voltage	PLC output, IEC 61131-2, 24 V
Output current	Typically 15 mA
Maximum cable length	In the chapter ”Electrical installation” the dependency of the cable length on the brake current and the cable cross-section is described.
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
Insulation [1)]	Double insulation (EN61800-5-1: V_{rated} = 300 V AC), Separation (UL: V_{rated} = 500 V AC)

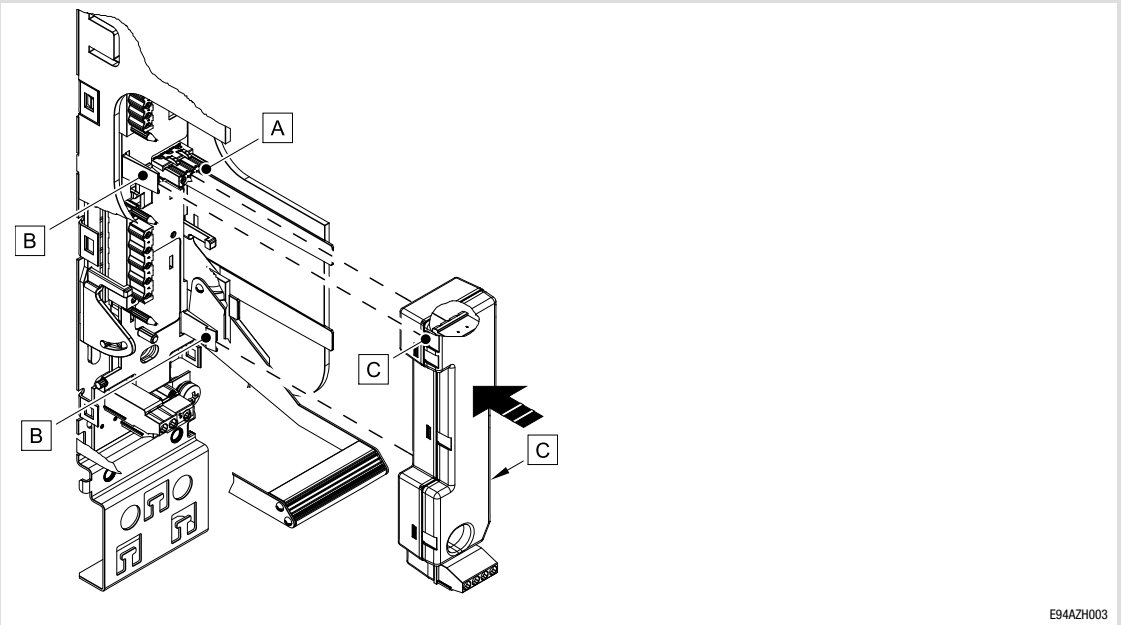
1) Brake connection against control card of the controller

Cable length



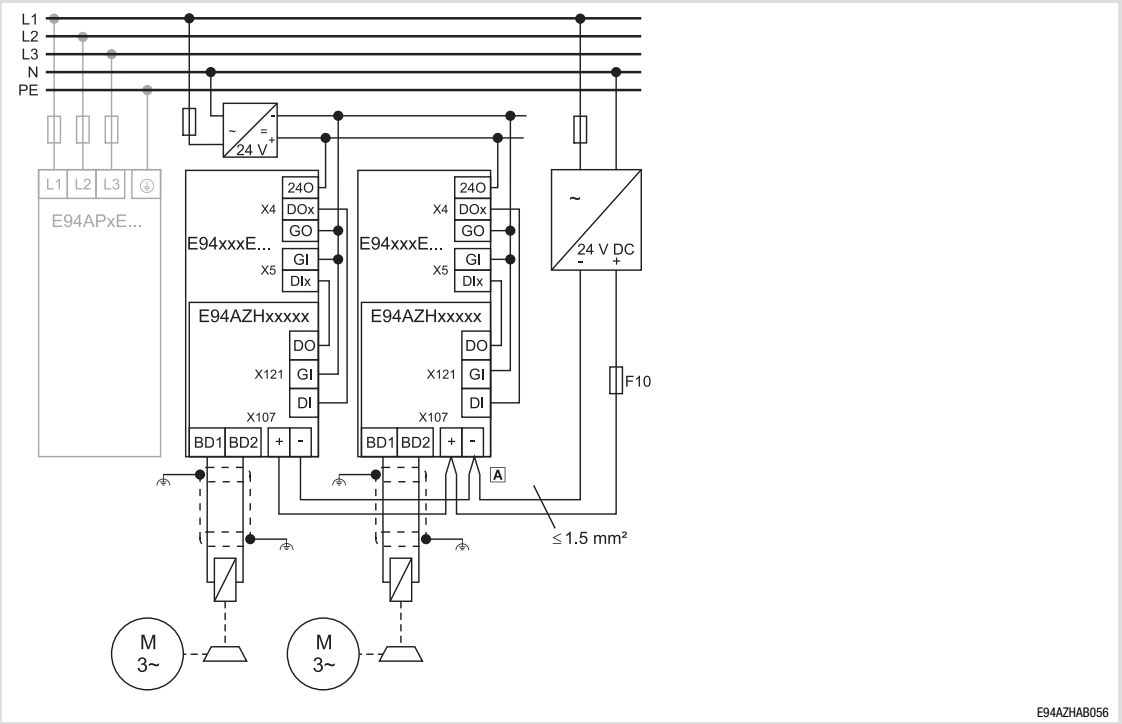
L_{max}	Maximum brake cable length in [m]
I_{BR}	Brake current in [A]
U_{DC}	Supply voltage of the motor brake control

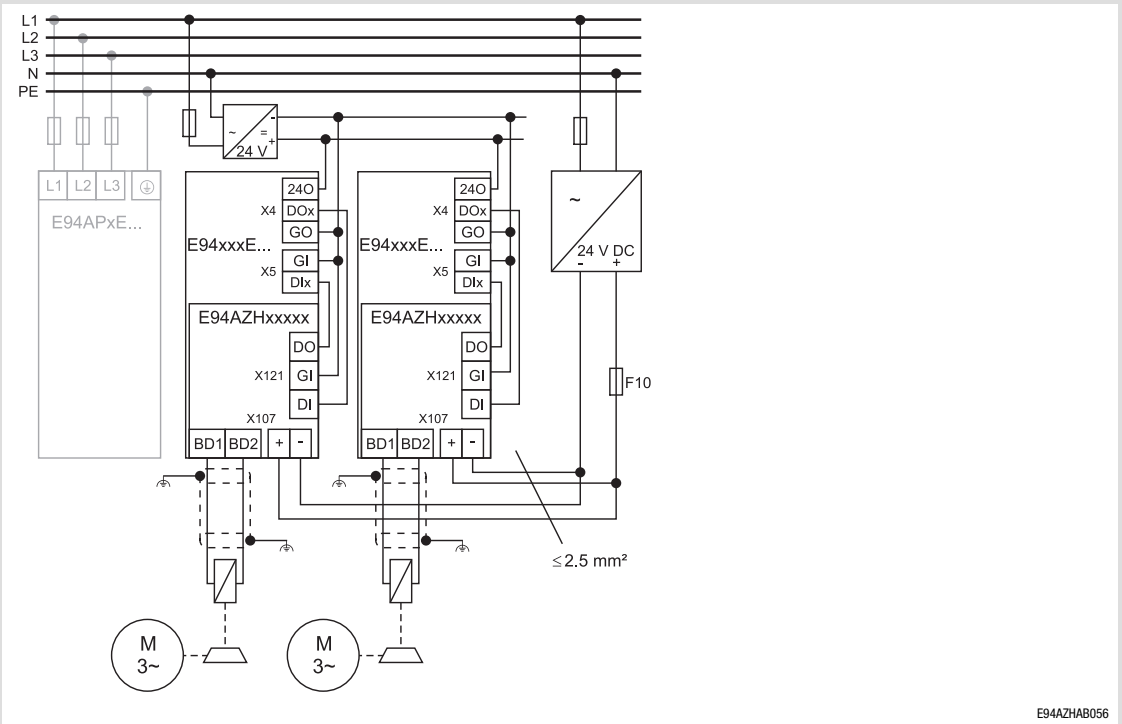
Installation steps



1. Plug the motor brake control onto the terminal A of the installation backplane.
2. Make sure that both clips B engage in the slots C of the motor brake control.

Connection plan



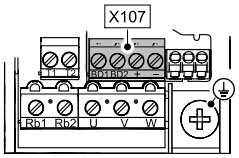


F10 Secondary cable protection. Observe the standards of the cable protection when selecting the fuse!

A Use twin wire end ferrules.

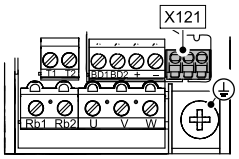
HF shield termination through large-surface PE connection

Terminal data

Terminal X107	Labelling	Description
 SSP940X107	BD1 BD2	Terminal for 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!

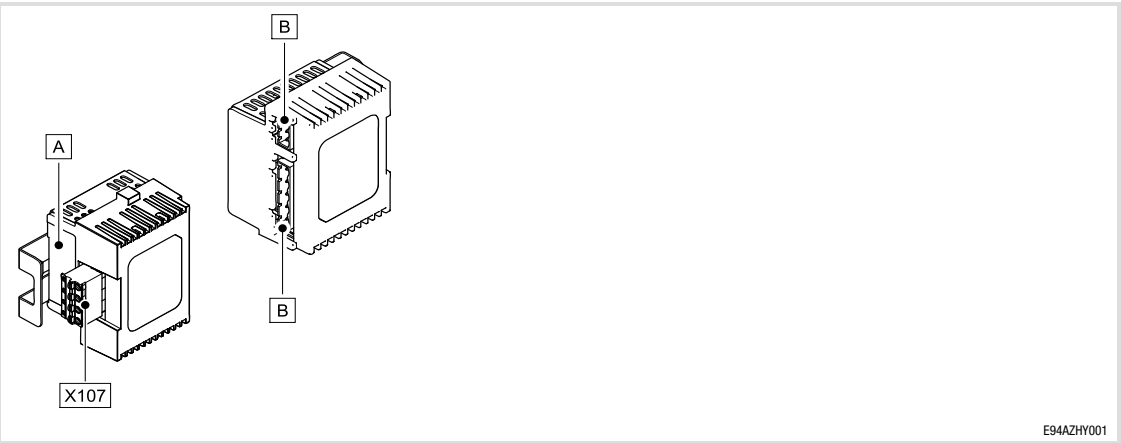
Terminal data	Conductor cross-section		Tightening torque	
	[mm²]	[AWG]	[Nm]	[lb-in]
Single core	0.25 ... 2.5	24 ... 12	0.5 ... 0.6	4.4 ... 5.3
2 conductors [1]	0.25 ... 1.5	24 ... 16		

[1] Two conductors of the same cross-section with a twin wire end ferrule

Terminal X121	Labelling	Description
 SSP940X107	DI	Terminal for external control in accordance with IEC 61131-2
	GI	Reference potential
	DO	Terminal for external feedback in accordance with IEC 61131-2

Terminal data	Conductor cross-section		Tightening torque	
	[mm²]	[AWG]	[Nm]	[lb-in]
Flexible	0.2 ... 1.5	24 ... 16	Spring terminal	
With wire end ferrule	0.25 ... 0.75	24 ... 18	Spring terminal	

8.7.6 Motor holding brake control module E94AZHY0101



Scope of supply

Pos.	Description
	Motor brake control E94AZHY0101
	Mounting Instructions

Elements of the motor brake control

Pos.	Description
A	Nameplate
B	Connection of standard device
X107	Connection of supply and brake

Identification

Type code	①						
	E94	A	Z	H	Y	xxx	x

Product series
Version
Accessories
Motor brake control type
Rated current
002 = 0.75 A
010 = 5.0 A
Voltage class
1 = 24 V DC
5 = 205 V DC
6 = 180 V DC

Standards

Conformity and approval			
Conformity			
CE	2014/35/EU	Low-Voltage Directive	
CE	2014/30/EU	EMC Directive	
UKCA	S.I. 2016/1101	The Electrical Equipment (Safety) Regulations 2016	
UKCA	S.I. 2016/1091	The Electromagnetic Compatibility Regulations 2016	
Approval			
$_{C}UR_{US}$	UL61800-5-1	Power Conversion Equipment (File No. E132659) for USA	
	CSA C22.2 No. 274-13	Power Conversion Equipment (File No. E132659) for Canada	

General electrical data

EMC			
Noise emission	EN 61800-3	Conducted, category C2.	
Noise immunity	EN 61800-3	Burst on mains cable:	2 kV/5 kHz
		Burst on control cable:	2 kV/5 kHz
		Surge on mains cable:	1 kV (1.2 µs/50 µs; phase - phase)
			2 kV (1.2 µs/50 µs; phase - PE)

Rated data

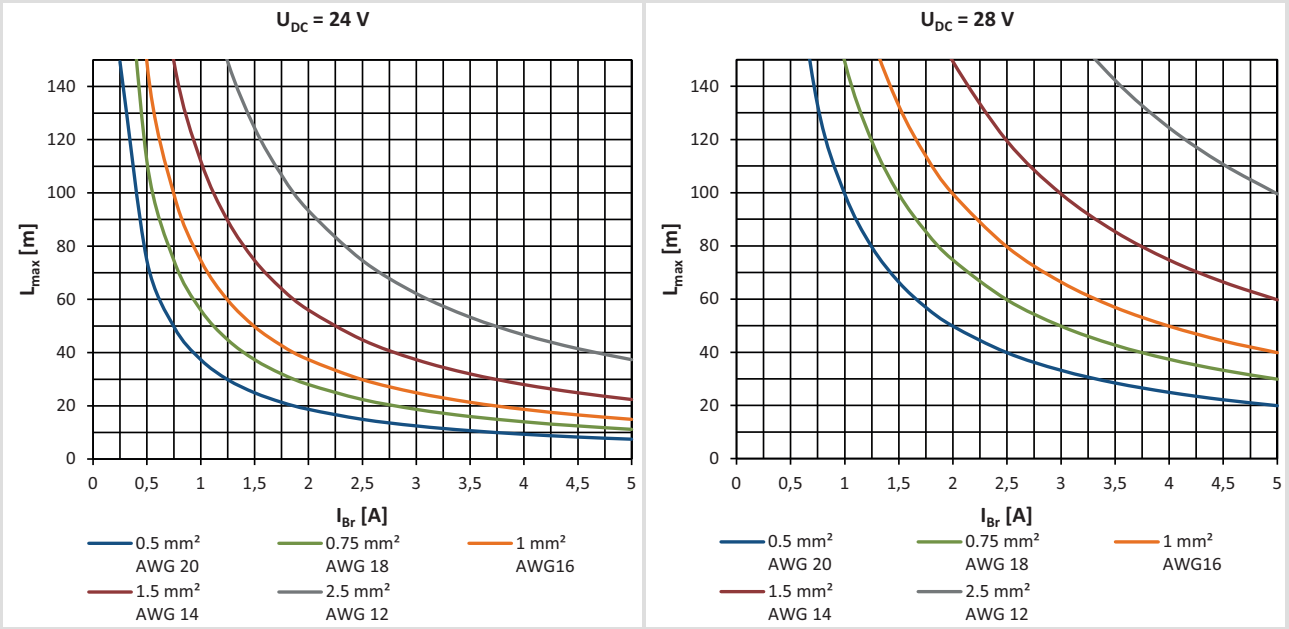
	Voltage	Frequency	Rated current [A]		Number of phases
	[V]	[Hz]	up to +45 °C ①	up to +55 °C ①	
E94AZHY0101	24	0 (DC)	0.3 ... 5	0.3 ... 5	2

① Temperature in the control cabinet

Area	Values
Input voltage	DC 24 V (18 ... 30 V)
Output voltage	Corresponds to input voltage
Brake current	0.3 ... 5 A
Switching capacity	Max. 110 W
Breaking energy	Max. 10 Ws
Cable protection	Recommendation: 7.5 A, tripping characteristic ”B” or ”C”
Control input	
Control voltage	Internal
Control current	
Protective function	
Maximum cable length	In the chapter ”Electrical installation” the dependency of the cable length on the brake current and the cable cross-section is described.
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
Insulation [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

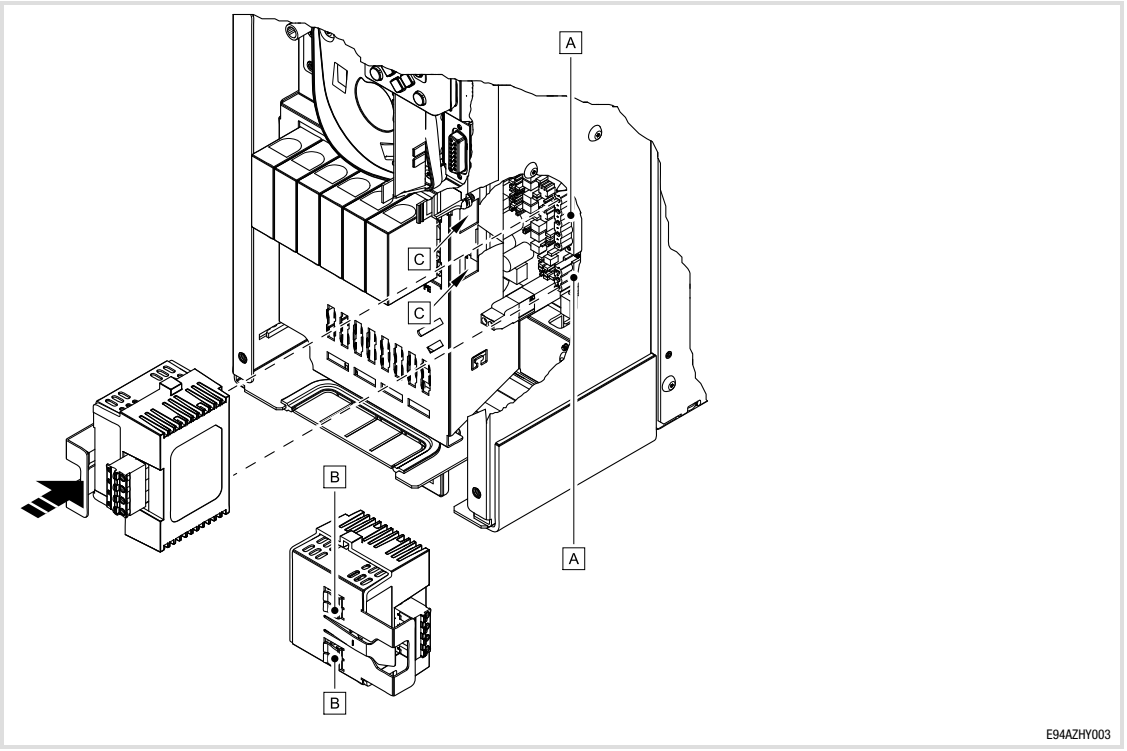
Cable length



E94AZHY007

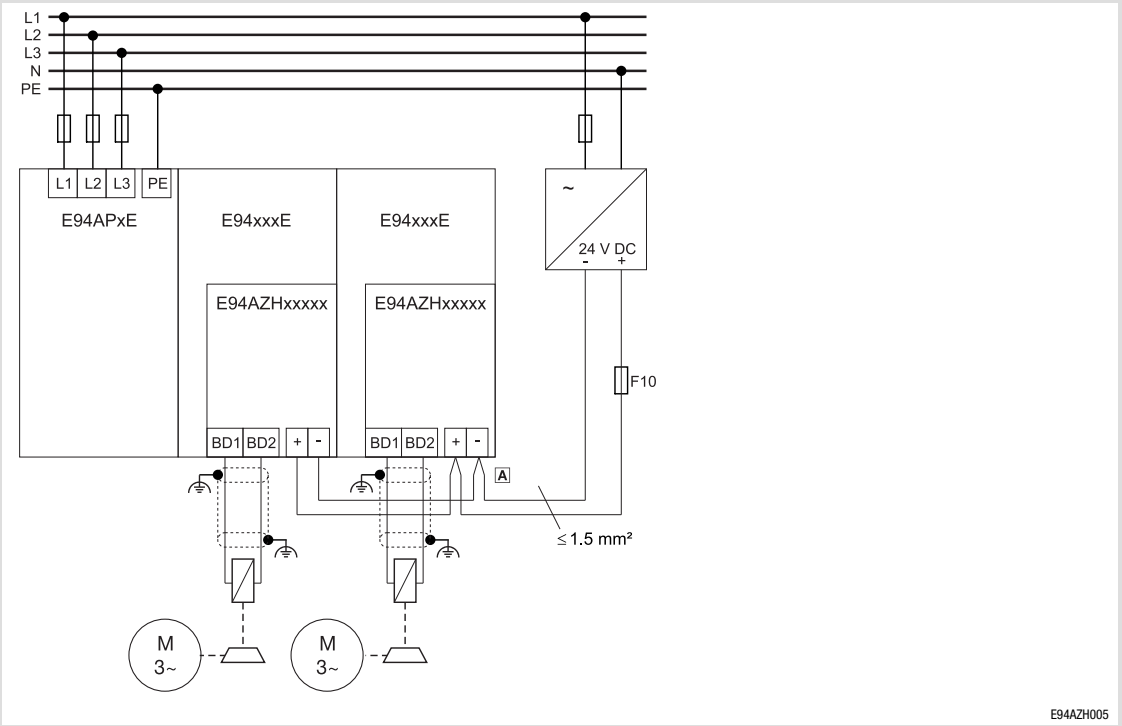
L_{max}	Maximum brake cable length in [m]
I_{BR}	Brake current in [A]
U_{DC}	Supply voltage of the motor brake control

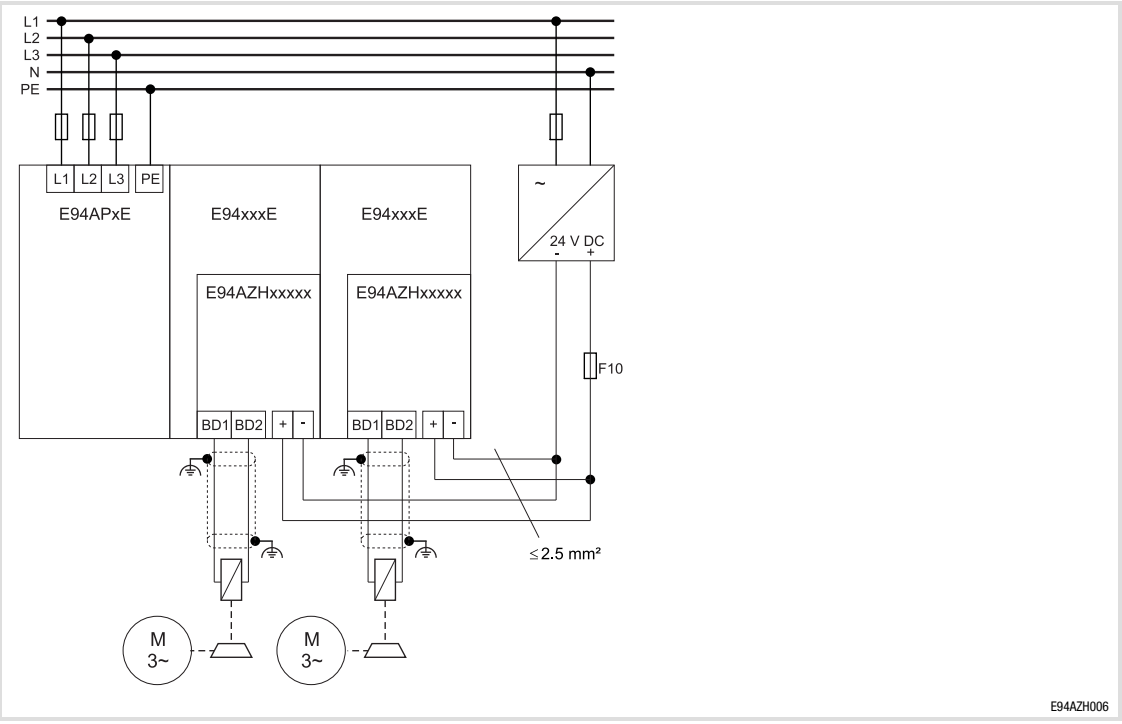
Installation steps



1. Plug the motor brake control module onto the terminals A of the standard device.
   – Ensure that both clips B snap into the slots C of the standard device!
2. Check that the motor brake control module is securely connected.

Connection plan



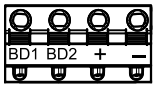


F10 Secondary cable protection. Observe the standards of the cable protection when selecting the fuse!

A Use twin wire end ferrules.

HF shield termination through large-surface PE connection

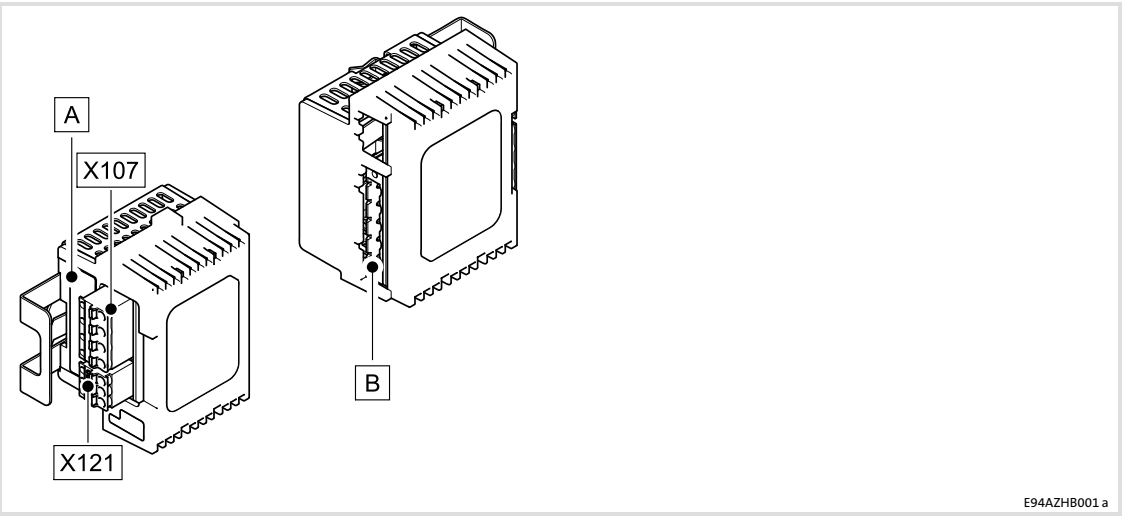
Terminal data

Terminal X107	Labelling	Description
 SSP94X6107	BD1 BD2	Connection of the motor holding brake + (Lenze: WH) - (Lenze: BN) E94AZHx0101: 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				
	Conductor cross-section		Tightening torque	
	[mm²]	[AWG]	[Nm]	[lb-in]
Flexible	0.5 ... 2.5	20 ... 12	Spring terminal	
With wire end ferrule				

Stripping length or contact length: 8 mm

8.7.7 Motor holding brake control module E94AZHB0101



Scope of supply

Pos.	Description
	E94AZHB0101 motor brake control
	Mounting Instructions

Elements of the motor brake control

Pos.	Description
A	Nameplate
B	Terminal for standard device
X107	Terminal for supply and brake
X121	Terminal for external control and feedback

Identification

Type code	①						
	E94	A	Z	H	B	xxx	x
Product series							
Version							
Accessories							
Type of motor brake control							
Rated current 010 = 5.0 A							
Voltage class 1 = 24 V DC							

Standards

Conformity and approval			
Conformity			
CE	2014/35/EU	Low-Voltage Directive	
CE	2014/30/EU	EMC Directive	
UKCA	S.I. 2016/1101	The Electrical Equipment (Safety) Regulations 2016	
UKCA	S.I. 2016/1091	The Electromagnetic Compatibility Regulations 2016	
Approval			
$_{C}UR_{US}$	UL61800-5-1	Power Conversion Equipment (File No. E132659) for USA	
	CSA C22.2 No. 274-13	Power Conversion Equipment (File No. E132659) for Canada	

General electrical data

EMC			
Noise emission	EN 61800-3	Conducted, category C2.	
Noise immunity	EN 61800-3	Burst on control cable:	2 kV/5 kHz
		Surge on control cable:	1 kV (1.2 µs/50 µs; control cable - PE)

Rated data

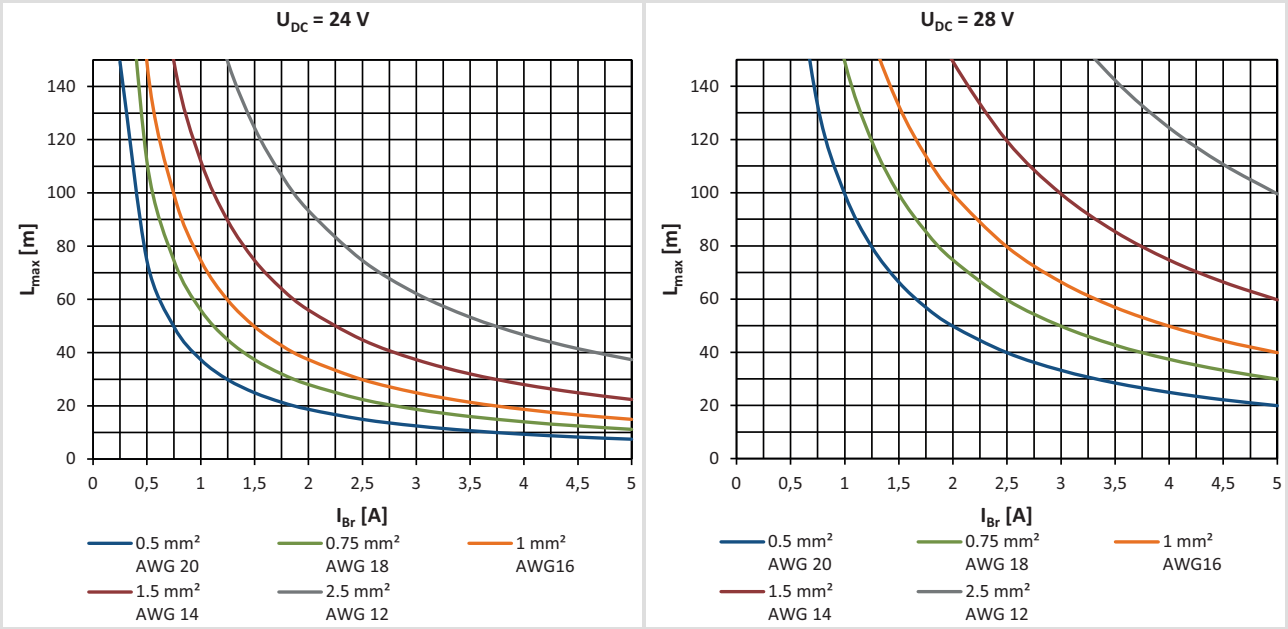
	Voltage	Frequency	Rated current [A]		Number of phases
	[V]	[Hz]	up to +45 °C ①	up to +55 °C ①	
E94AZHB0101	24	0 (DC)	0.3 ... 5	0.3 ... 5	2

① Temperature in the control cabinet

Area	Values
Input voltage	DC 24 V (18 ... 30 V)
Output voltage	Corresponds to input voltage
Brake current	0.3 ... 5 A
Switching capacity	Max. 110 W
Breaking energy	Max. 10 Ws
Cable protection	Recommendation: 7.5 A, tripping characteristic ”B” or ”C”
Maximum cable length	In the chapter ”Electrical installation” the dependency of the cable length on the brake current and the cable cross-section is described.
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
Insulation [1)]	Double insulation (EN61800-5-1: V_{rated} = 300 V AC), Separation (UL: V_{rated} = 500 V AC)

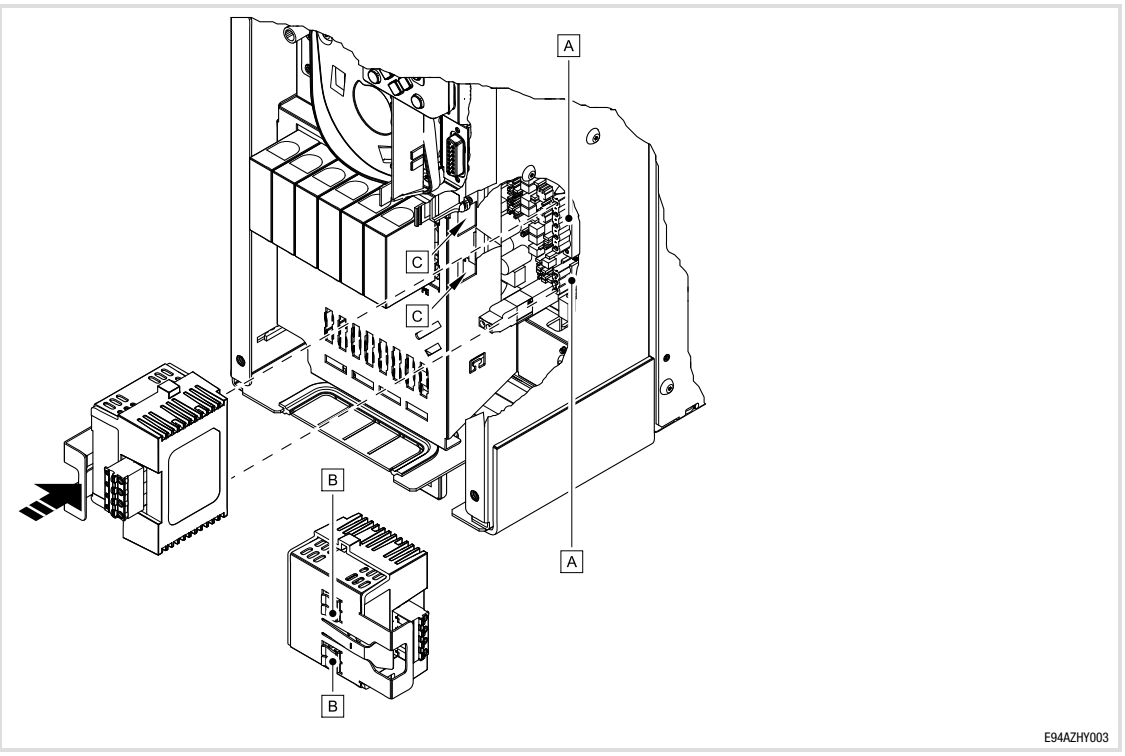
1) Brake connection against control card of the controller

Cable length



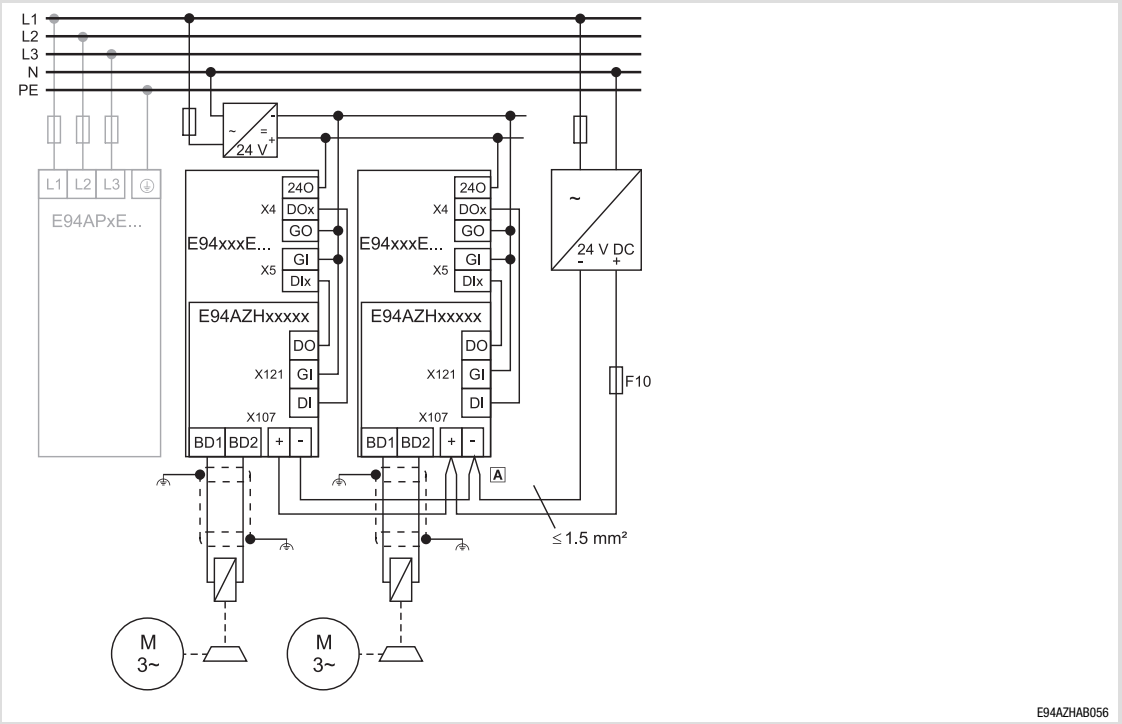
L_{max}	Maximum brake cable length in [m]
I_{BR}	Brake current in [A]
U_{DC}	Supply voltage of the motor brake control

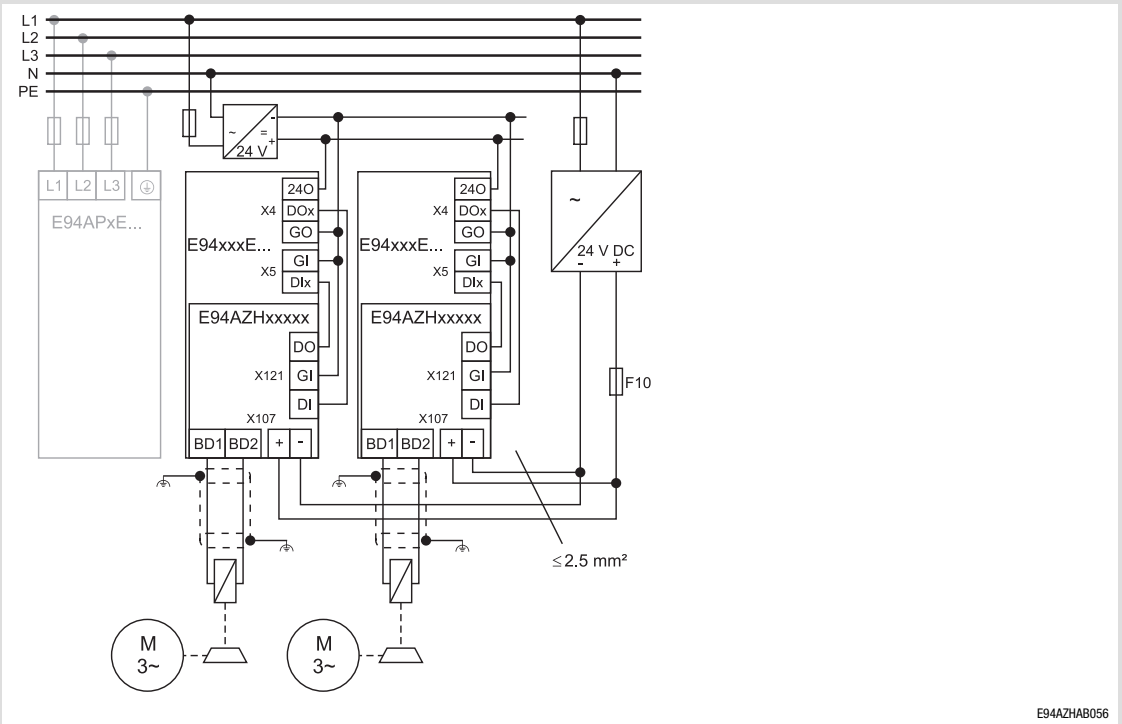
Installation steps



1. Plug the motor brake control module onto the terminals A of the standard device.
   – Ensure that both clips B snap into the slots C of the standard device!
2. Check that the motor brake control module is securely connected.

Connection plan



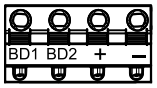


F10 Secondary cable protection. Observe the standards of the cable protection when selecting the fuse!

A Use twin wire end ferrules.

HF shield termination through large-surface PE connection

Terminal data

Terminal X107	Labelling	Description
 SSP94X6107	BD1 BD2	Connection of the motor holding brake + (Lenze: WH) - (Lenze: BN) E94AZHx0101: 24 V DC, max. 5.0 A Observe correct polarity!
	+ / -	Supply voltage for the motor holding brake (18 ... 30 V DC) Observe correct polarity!

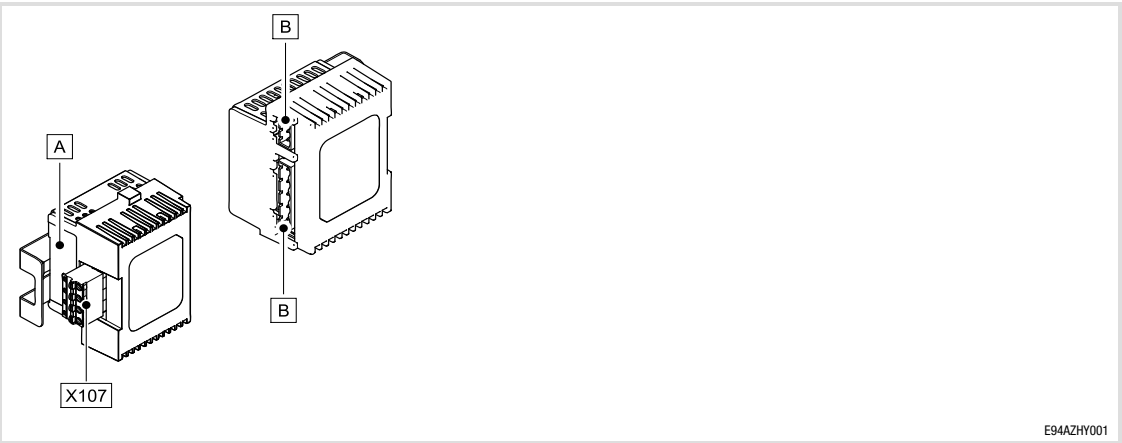
Terminal data				
	Conductor cross-section		Tightening torque	
	[mm²]	[AWG]	[Nm]	[lb-in]
Flexible	0.5 ... 2.5	20 ... 12	Spring terminal	
With wire end ferrule				

Stripping length or contact length: 8 mm

Terminal X121	Labelling	Description
 SSP940X121	DI	Connection for external control in accordance with IEC 61131-2
	GI	Reference potential
	DO	Connection for external feedback in accordance with IEC 61131-2

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				

8.7.8 Motor holding brake control module E94AZHY0025



Scope of supply

Pos.	Description
	Motor brake control E94AZHY0025
	Mounting Instructions

Elements of the motor brake control

Pos.	Description
A	Nameplate
B	Connection of standard device
X107	Connection of supply and brake

Identification

Type code	①						
	E94	A	Z	H	Y	xxx	x

Product series

Version

Accessories

Motor brake control type

Rated current
002 = 0.75 A
010 = 5.0 A

Voltage class
1 = 24 V DC
5 = 205 V DC
6 = 180 V DC

Standards

Conformity and approval			
Conformity			
CE	2014/35/EU	Low-Voltage Directive	
CE	2014/30/EU	EMC Directive	
UKCA	S.I. 2016/1101	The Electrical Equipment (Safety) Regulations 2016	
UKCA	S.I. 2016/1091	The Electromagnetic Compatibility Regulations 2016	
Approval			
$_{C}UR_{US}$	UL61800-5-1	Power Conversion Equipment (File No. E132659) for USA	
	CSA C22.2 No. 274-13	Power Conversion Equipment (File No. E132659) for Canada	

General electrical data

EMC			
Noise emission	EN 61800-3	Conducted, category C2.	
Noise immunity	EN 61800-3	Burst on mains cable:	2 kV/5 kHz
		Burst on control cable:	2 kV/5 kHz
		Surge on mains cable:	1 kV (1.2 µs/50 µs; phase - phase)
			2 kV (1.2 µs/50 µs; phase - PE)

Rated data

	Voltage	Frequency	Rated current [A]		Number of phases
	[V]	[Hz]	up to +45 °C ①	up to +55 °C ①	
E94AZHY0025	230/290	50/60	0.75/0.75	0.54/0.54	1
E94AZHY0025	205/260	0 (DC)	0.75/0.75	0.54/0.54	1

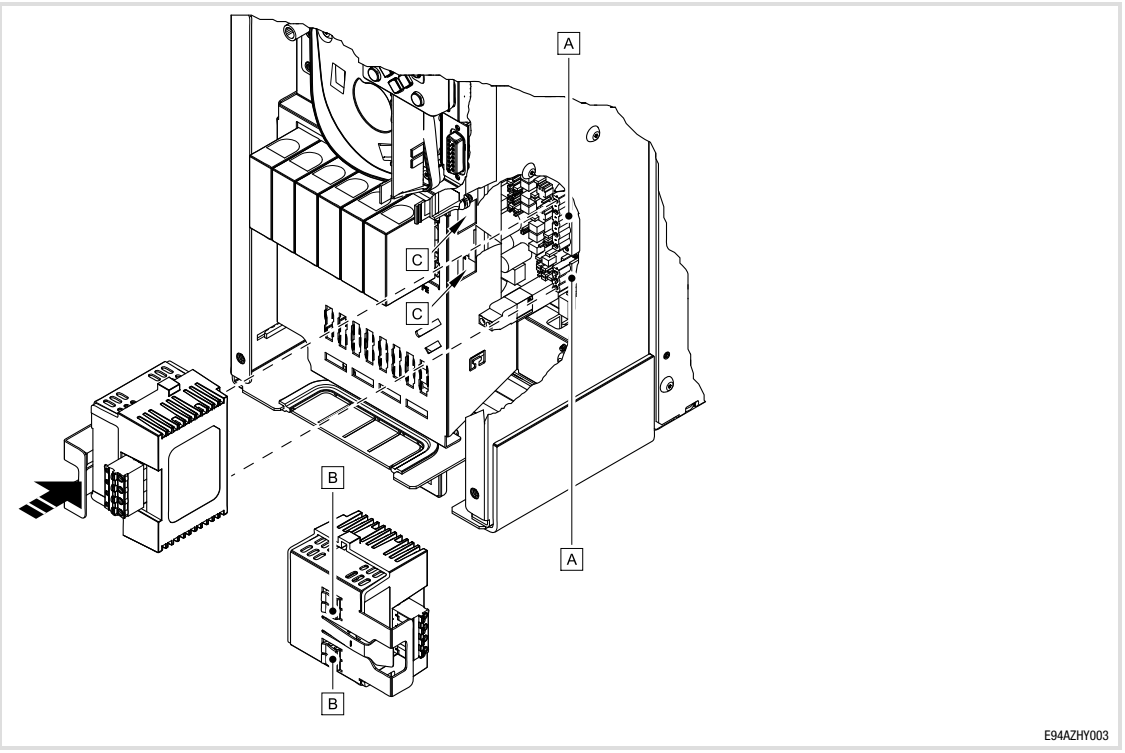
① Temperature in the control cabinet

Area	Values
Input voltage	AC 230 V (180 ... 317 V), 45 ... 65 Hz
Output voltage	DC 205 V With mains voltage of AC 230 V
Brake current	0.1 ... 0.75 A
Cable protection	Recommendation: 5 A, tripping characteristic "B" or "C"
Control input	
Control voltage	Internal
Control current	
Protective function	
Max. connectable cable cross-section	2.5 mm² AWG 12
Maximum cable length	150 m

Permissible operating frequencies

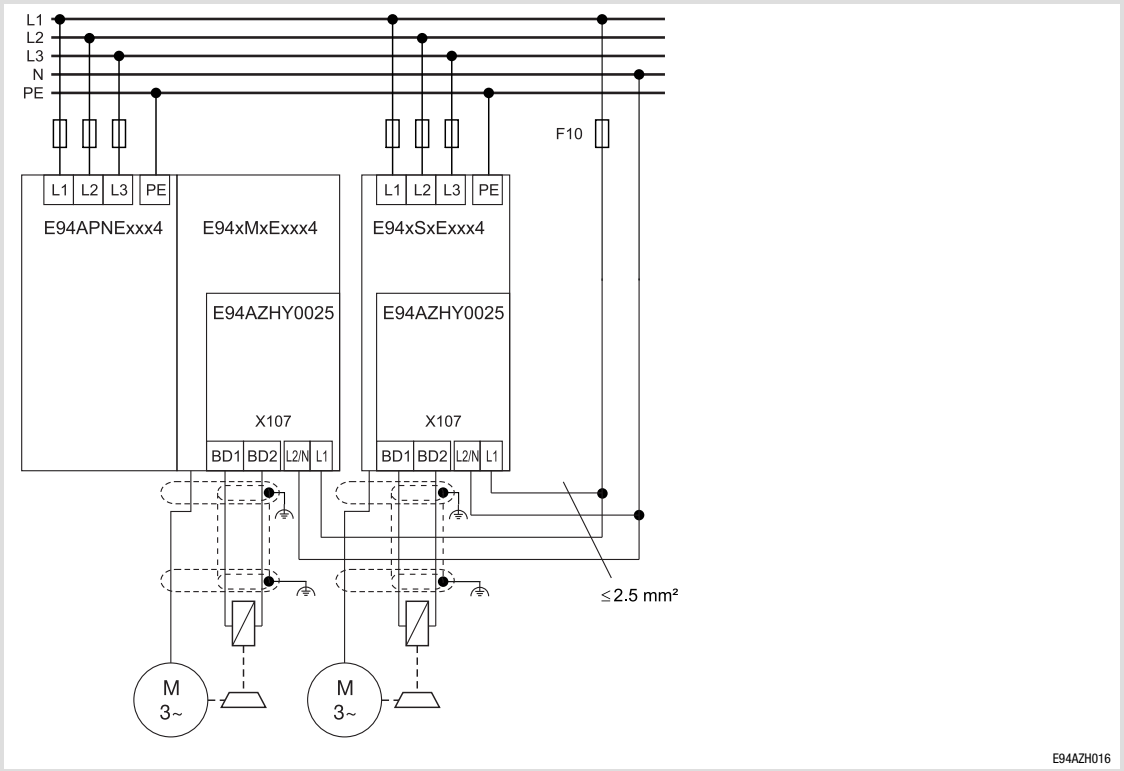
Recommended brake	Power	Coil: Voltage DC 205 V		Permissible operating frequency
Type	P [W]	L [H]	I [A] (20 °C)	[1/min]
BFK457-06E BFK458-06E	20	76	0.10	60
BFK457-08E BFK458-08E	25	66	0.12	60
BFK457-10E BFK458-10E	30	85	0.15	60
BFK457-12E BFK458-12E	40	107	0.20	40
BFK457-14E BFK458-14E	50	102	0.24	30
BFK457-16E BFK458-16E	55	127	0.27	20
BFK457-18E BFK458-18E	85	100	0.41	10
BFK457-20E BFK458-20E	100	115	0.49	8
BFK457-25E BFK458-25E	110	134	0.54	6

Installation steps



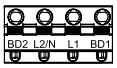
1. Plug the motor brake control module onto the terminals A of the standard device.
   – Ensure that both clips B snap into the slots C of the standard device!
2. Check that the motor brake control module is securely connected.

Connection plan



F10 Observe the cable protection standards for fuse dimensioning!
HF shield termination through large-surface PE connection

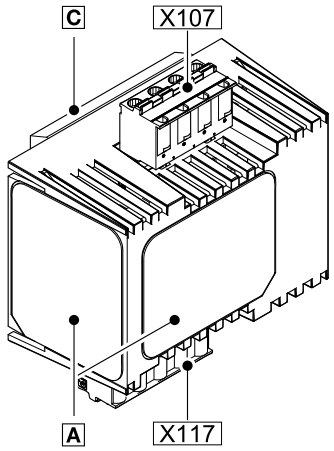
Terminal data

Terminal X107	Labelling	Description
 SSP94A6107	BD1 BD2	Connection of the motor holding brake: + (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	0.5 ... 2.5	20 ... 12	Spring terminal	
With wire end ferrule				

Stripping length or contact length: 8 mm

8.7.9 Motor holding brake control module E94AZHN0025



E94AZHN0025_003

Scope of supply

Pos.	Description
	Motor brake control E94AZHN0025
	Mounting Instructions
C	DIN rail adapter

Elements of the motor brake control

Pos.	Description
A	Nameplate
X117	Control connection
X107	Connection of supply and brake

Identification

Type code	①						
	E94	A	Z	H	N	xxx	x

Product series

Accessories

Motor brake control type

Rated current
002 = 0.75 A

Voltage class
5 = 205 V DC
6 = 180 V DC

Standards

Conformity and approval			
Conformity			
CE	2014/35/EU	Low-Voltage Directive	
CE	2014/30/EU	EMC Directive	
UKCA	S.I. 2016/1101	The Electrical Equipment (Safety) Regulations 2016	
UKCA	S.I. 2016/1091	The Electromagnetic Compatibility Regulations 2016	
Approval			
$_{C}UR_{US}$	UL61800-5-1	Power Conversion Equipment (File No. E132659) for USA	
	CSA C22.2 No. 274-13	Power Conversion Equipment (File No. E132659) for Canada	

General electrical data

EMC			
Noise emission	EN 61800-3	Conducted, category C2.	
Noise immunity	EN 61800-3	Burst on mains cable:	2 kV/5 kHz
		Burst on control cable:	2 kV/5 kHz
		Surge on mains cable:	1 kV (1.2 µs/50 µs; phase - phase)
			2 kV (1.2 µs/50 µs; phase - PE)

Rated data

	Voltage	Frequency	Rated current [A]		Number of phases
	[V]	[Hz]	up to +45 °C ①	up to +55 °C ①	
E94AZHN0025	230/290	50/60	0.75/0.75	0.54/0.54	1
E94AZHN0025	205/260	0 (DC)	0.75/0.75	0.54/0.54	1

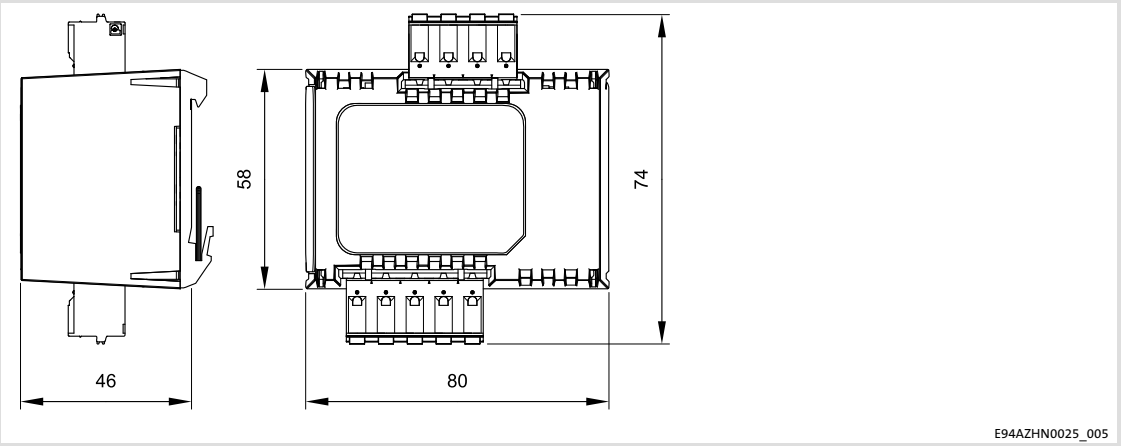
① Temperature in the control cabinet

Area	Values	
Input voltage	AC 230 V (180 ... 317 V), 45 ... 65 Hz	
Output voltage	DC 205 V	With mains voltage of AC 230 V
Brake current	0.1 ... 0.75 A	
Cable protection	Recommendation: 5 A, tripping characteristic "B" or "C"	
Control input DI **Signalling output DO**		
Control voltage	DC 24 V, PLC level	
	HIGH LOW	DC +15 ... 30 V DC 0 ... +3 V
Control current		
Input	5 ... 10 mA	
Output	5 ... 50 mA	
Protective function	Protected against polarity reversal up to DC 60 V	
Max. connectable cable cross-section	2.5 mm^2 AWG 12	
Maximum cable length	150 m	

Permissible operating frequencies

Recommended brake	Power	Coil: Voltage DC 205 V		Permissible operating frequency
Type	**P [W]**	**L [H]**	**I [A] (20 °C)**	**[1/min]**
BFK457-06E BFK458-06E	20	76	0.10	60
BFK457-08E BFK458-08E	25	66	0.12	60
BFK457-10E BFK458-10E	30	85	0.15	60
BFK457-12E BFK458-12E	40	107	0.20	40
BFK457-14E BFK458-14E	50	102	0.24	30
BFK457-16E BFK458-16E	55	127	0.27	20
BFK457-18E BFK458-18E	85	100	0.41	10
BFK457-20E BFK458-20E	100	115	0.49	8
BFK457-25E BFK458-25E	110	134	0.54	6

Dimensions

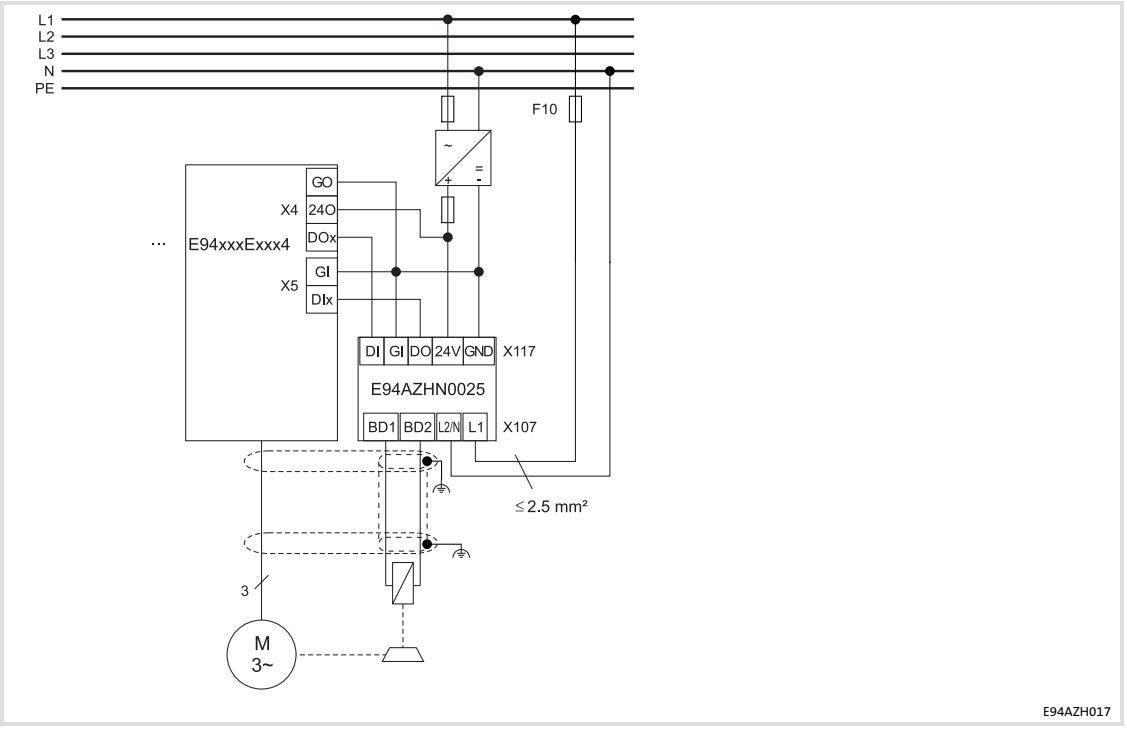


All dimensions in millimetres.

Installation steps

1. Attach the motor brake control with the DIN rail adapter [C] to the bottom of the DIN rail.
2. Engage the motor brake control against the spring pressure at the top of the DIN rail edge.
3. Check motor brake control for tight fit.

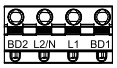
Connection plan



F10 Cable protection of the motor holding brake
Observe the cable protection standards for fuse dimensioning!
E94... Components of the 9400 series
⏚ HF shield termination through large-surface PE connection

Terminal data

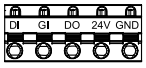
Motor holding brake connection

Terminal X107	Labelling	Description
 SSP94A6107	BD1 BD2	Connection of the motor holding brake: + (Lenze: WH) - (Lenze: BN) E94AZHN0025: 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

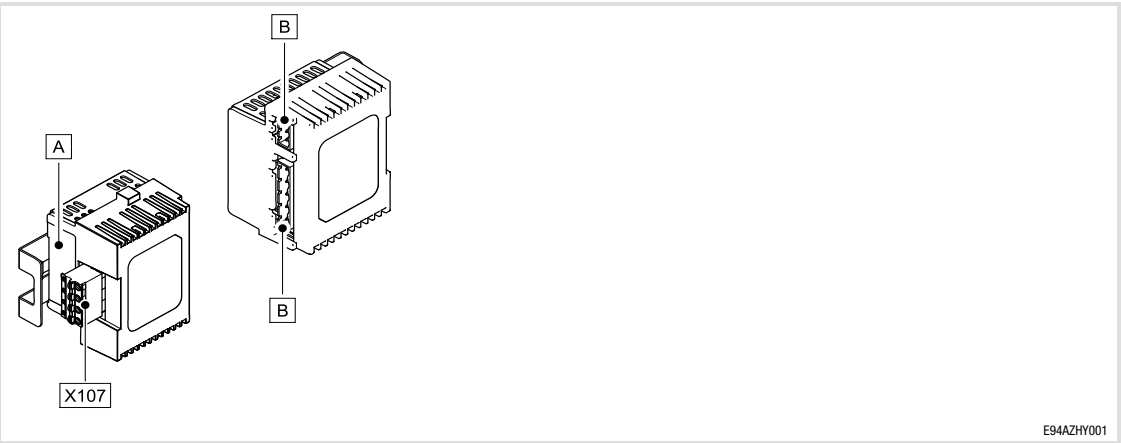
Control connection

Terminal X117	Labelling	Description
 SSP94A6117	DI	Digital input
	GI	GND digital in
	DO	Signalling output
	24V	24-V supply by safely separated power supply unit (SELV/PELV)
	GND	GND digital out

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

8.7.10 Motor holding brake control module E94AZHY0026



Scope of supply

Pos.	Description
	Motor brake control E94AZHY0026
	Mounting Instructions

Elements of the motor brake control

Pos.	Description
A	Nameplate
B	Connection of standard device
X107	Connection of supply and brake

Identification

Type code	①						
	E94	A	Z	H	Y	xxx	x

Product series
Version
Accessories
Motor brake control type
Rated current
002 = 0.75 A
010 = 5.0 A
Voltage class
1 = 24 V DC
5 = 205 V DC
6 = 180 V DC

Standards

Conformity and approval			
Conformity			
CE	2014/35/EU	Low-Voltage Directive	
CE	2014/30/EU	EMC Directive	
UKCA	S.I. 2016/1101	The Electrical Equipment (Safety) Regulations 2016	
UKCA	S.I. 2016/1091	The Electromagnetic Compatibility Regulations 2016	
Approval			
$_{C}UR_{US}$	UL61800-5-1	Power Conversion Equipment (File No. E132659) for USA	
	CSA C22.2 No. 274-13	Power Conversion Equipment (File No. E132659) for Canada	

General electrical data

EMC			
Noise emission	EN 61800-3	Conducted, category C2.	
Noise immunity	EN 61800-3	Burst on mains cable:	2 kV/5 kHz
		Burst on control cable:	2 kV/5 kHz
		Surge on mains cable:	1 kV (1.2 µs/50 µs; phase - phase)
			2 kV (1.2 µs/50 µs; phase - PE)

Rated data

	Voltage	Frequency	Rated current [A]		Number of phases
	[V]	[Hz]	up to +45 °C ①	up to +55 °C ①	
E94AZHY0026	400/480	50/60	0.61/0.61	0.61/0.61	1
E94AZHY0026	180/216	0 (DC)	0.61/0.61	0.61/0.61	1

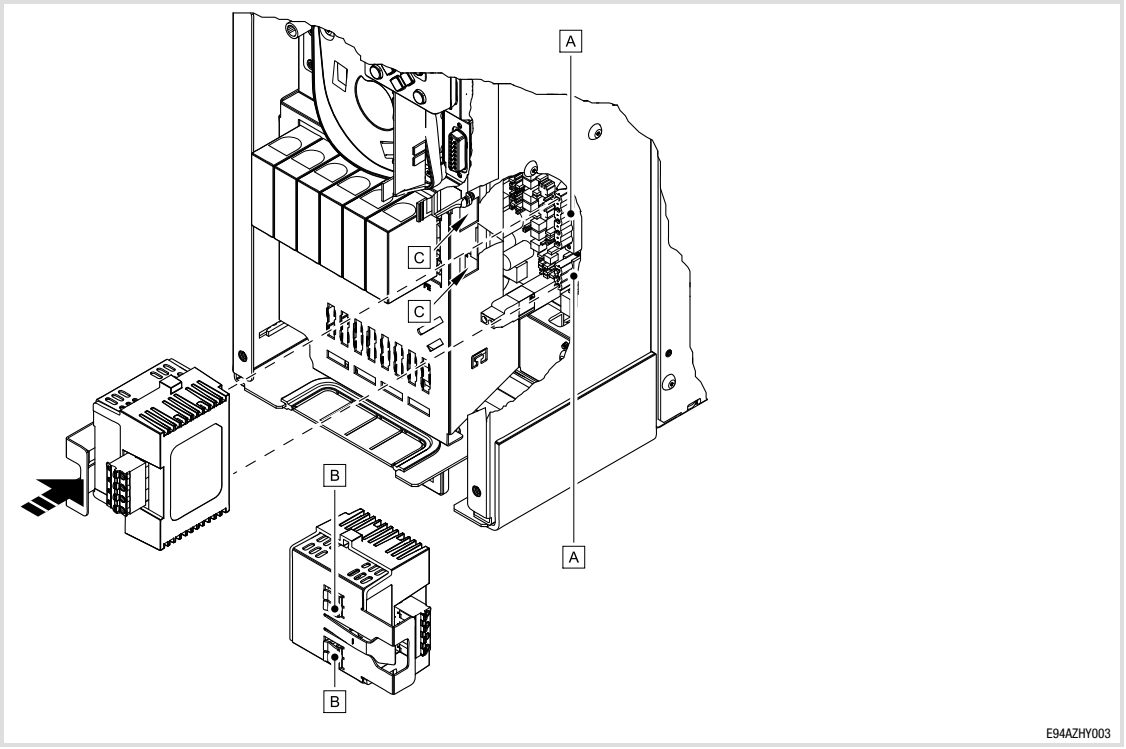
① Temperature in the control cabinet

Field	Values
Input voltage	AC 400 V (320 ... 528 V), 45 ... 65 Hz
Output voltage	DC 180 V at a mains voltage of AC 400 V
Brake current	0.1 ... 0.61 A
Cable protection	Recommendation: 5 A, tripping characteristic "B" or "C"
Control input	
Control voltage	Internal
Control current	
Protective function	
Max. connectable cable cross-section	2.5 mm^2 AWG 12
Maximum cable length	150 m

Permissible operating frequencies

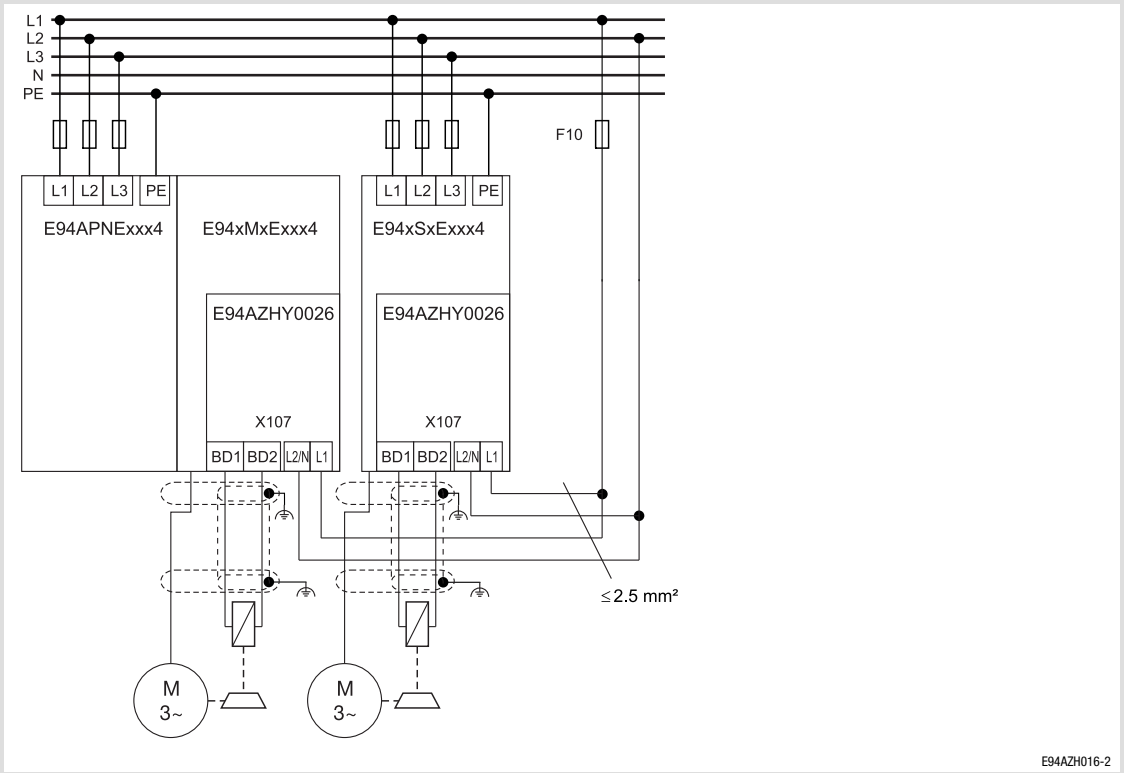
Recommended brake	Power	Coil: Voltage DC 180 V		Permissible operating frequency
Type	P [W]	L [H]	I [A] (20 °C)	[rpm]
BFK457-06E BFK458-06E	20	60	0.11	60
BFK457-08E BFK458-08E	25	50	0.14	60
BFK457-10E BFK458-10E	30	69	0.17	60
BFK457-12E BFK458-12E	40	81	0.22	40
BFK457-14E BFK458-14E	50	78	0.28	30
BFK457-16E BFK458-16E	55	102	0.31	20
BFK457-18E BFK458-18E	85	77	0.47	10
BFK457-20E BFK458-20E	100	92	0.56	8
BFK457-25E BFK458-25E	110	102	0.61	6

Installation steps



1. Plug the motor brake control module onto the terminals A of the standard device.
   – Ensure that both clips B snap into the slots C of the standard device!
2. Check that the motor brake control module is securely connected.

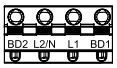
Connection plan



F10 Observe the cable protection standards for fuse dimensioning!

HF shield termination through large-surface PE connection

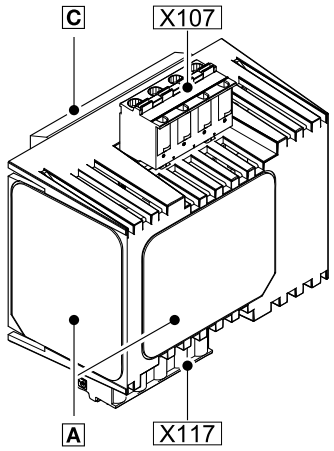
Terminal data

Terminal X107	Labelling	Description
 SSP94A6107	BD1 BD2	Connection of the motor holding brake: + (Lenze: WH) - (Lenze: BN) E94AZHY0026: 180 V DC, max. 0.61 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	0.5 ... 2.5	20 ... 12	Spring terminal	
With wire end ferrule				

Stripping length or contact length: 8 mm

8.7.11 Motor holding brake control module E94AZHN0026



E94AZHN0025_003

Scope of supply

Pos.	Description
	Motor brake control E94AZHN0026
	Mounting Instructions
C	DIN rail adapter

Elements of the motor brake control

Pos.	Description
A	Nameplate
X117	Control connection
X107	Connection of supply and brake

Identification

Type code	①						
	E94	A	Z	H	N	xxx	x

Product series

Accessories

Motor brake control type

Rated current
002 = 0.75 A

Voltage class
5 = 205 V DC
6 = 180 V DC

Standards

Conformity and approval			
Conformity			
CE	2014/35/EU	Low-Voltage Directive	
CE	2014/30/EU	EMC Directive	
UKCA	S.I. 2016/1101	The Electrical Equipment (Safety) Regulations 2016	
UKCA	S.I. 2016/1091	The Electromagnetic Compatibility Regulations 2016	
Approval			
$_{C}UR_{US}$	UL61800-5-1	Power Conversion Equipment (File No. E132659) for USA	
	CSA C22.2 No. 274-13	Power Conversion Equipment (File No. E132659) for Canada	

General electrical data

EMC			
Noise emission	EN 61800-3	Conducted, category C2.	
Noise immunity	EN 61800-3	Burst on mains cable:	2 kV/5 kHz
		Burst on control cable:	2 kV/5 kHz
		Surge on mains cable:	1 kV (1.2 µs/50 µs; phase - phase)
			2 kV (1.2 µs/50 µs; phase - PE)
Mounting conditions			
Mounting place		In the control cabinet	
Mounting position		Vertically	
Mounting clearances			
Above/below		≥ 25 mm	
To the sides		Side-by-side mounting without clearance	

Rated data

	Voltage	Frequency	Rated current [A]		Number of phases
	[V]	[Hz]	up to +45 °C ①	up to +55 °C ①	
E94AZHN0026	400/480	50/60	0.75/0.75	0.61/0.61	1
E94AZHN0026	180/216	0 (DC)	0.75/0.75	0.61/0.61	1

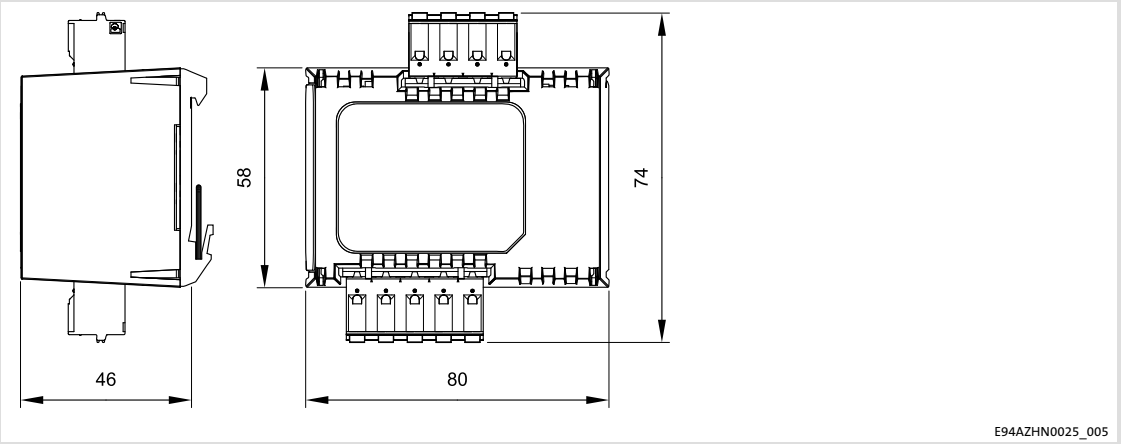
① Temperature in the control cabinet

Field	Values
Input voltage	AC 400 V (320 ... 528 V), 45 ... 65 Hz
Output voltage	DC 180 V at a mains voltage of AC 400 V
Brake current	0.1 ... 0.61 A
Cable protection	Recommendation: 5 A, tripping characteristic "B" or "C"
Control input DI **Signalling output DO**	
Control voltage	DC 24 V, PLC level
	HIGH DC +15 ... 30 V LOW DC 0 ... +3 V
Control current	
Input	5 ... 10 mA
Output	5 ... 50 mA
Protective function	Protected against polarity reversal up to DC 60 V
Max. connectable cable cross-section	2.5 mm^2 AWG 12
Maximum cable length	150 m

Permissible operating frequencies

Recommended brake	Power	Coil: Voltage DC 180 V		Permissible operating frequency
Type	P [W]	L [H]	I [A] (20 °C)	[rpm]
BFK457-06E BFK458-06E	20	60	0.11	60
BFK457-08E BFK458-08E	25	50	0.14	60
BFK457-10E BFK458-10E	30	69	0.17	60
BFK457-12E BFK458-12E	40	81	0.22	40
BFK457-14E BFK458-14E	50	78	0.28	30
BFK457-16E BFK458-16E	55	102	0.31	20
BFK457-18E BFK458-18E	85	77	0.47	10
BFK457-20E BFK458-20E	100	92	0.56	8
BFK457-25E BFK458-25E	110	102	0.61	6

Dimensions

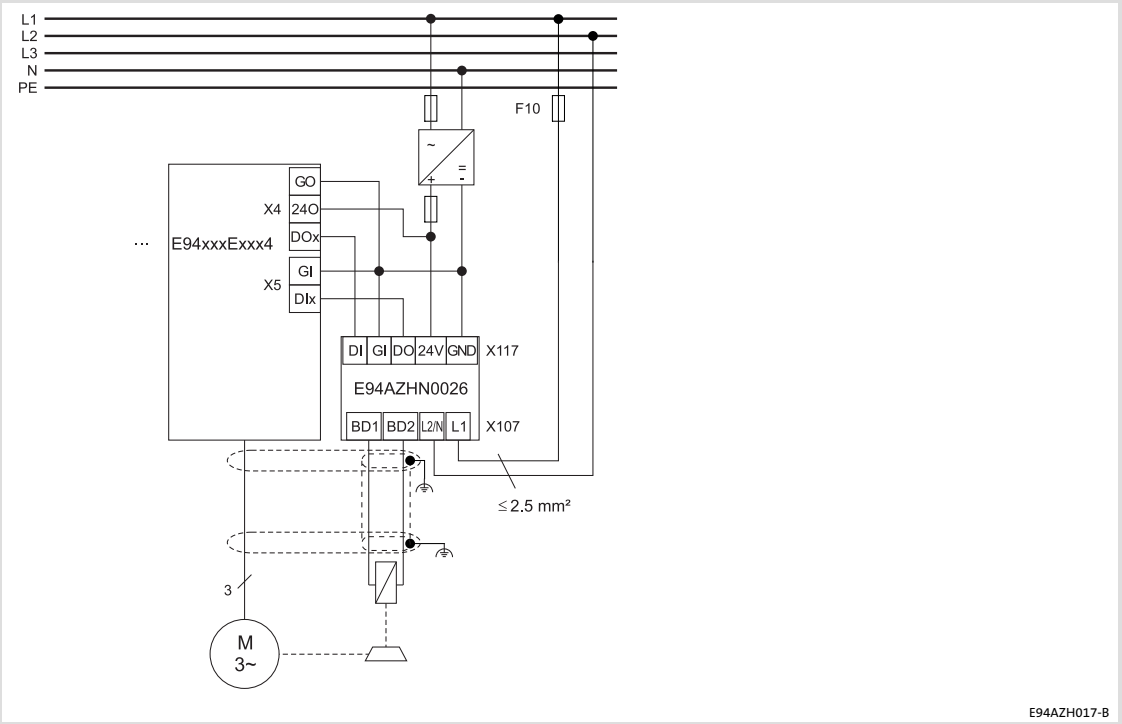


All dimensions in millimetres.

Installation steps

1. Attach the motor brake control with the DIN rail adapter Ⓒ to the bottom of the DIN rail.
2. Engage the motor brake control against the spring pressure at the top of the DIN rail edge.
3. Check motor brake control for tight fit.

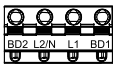
Connection plan



F10 Cable protection of the motor holding brake
Observe the cable protection standards for fuse dimensioning!
E94... Components of the 9400 series
⏚ HF shield termination through large-surface PE connection

Terminal data

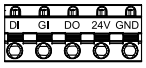
Connection of the motor holding brake

Terminal X107	Labelling	Description
 SSP94A6107	BD1 BD2	Connection of the motor holding brake: + (Lenze: WH) - (Lenze: BN) E94AZHN0026: 180 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

Control connection

Terminal X117	Labelling	Description
 SSP94A6117	DI	Digital input
	GI	GND digital in
	DO	Signalling output
	24V	24-V supply by safely separated power supply unit (SELV/PELV)
	GND	GND digital out

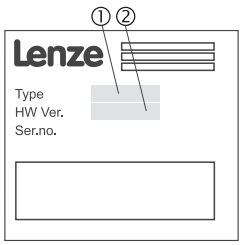
Terminal data				
	Conductor cross-section		Tightening torque	
	[mm²]	[AWG]	[Nm]	[lb-in]
Flexible With wire end ferrule	0.5 ... 2.5	20 ... 12	Spring terminal	

Stripping length or contact length: 8 mm

8.8 Accessories for diagnostics

8.8.1 USB diagnostic adapter

Identification

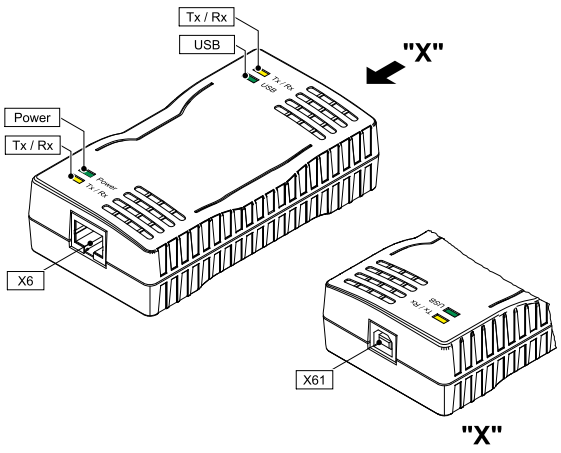


E94ZCUS003

	①					②
	E94	A	Z	C	US	VA

Product range
Version
Module identification: accessories
Module type: communication module
USB diagnostic adapter
Hardware version

Scope of supply



E894ZCUS001BA

Pos.	Description
	USB diagnostic adapter E94AZCUS
	USB cable
	Mounting Instructions

Connections

Pos.	Description
X61	USB connection
X6	Connection of the basic device (RJ69 socket)

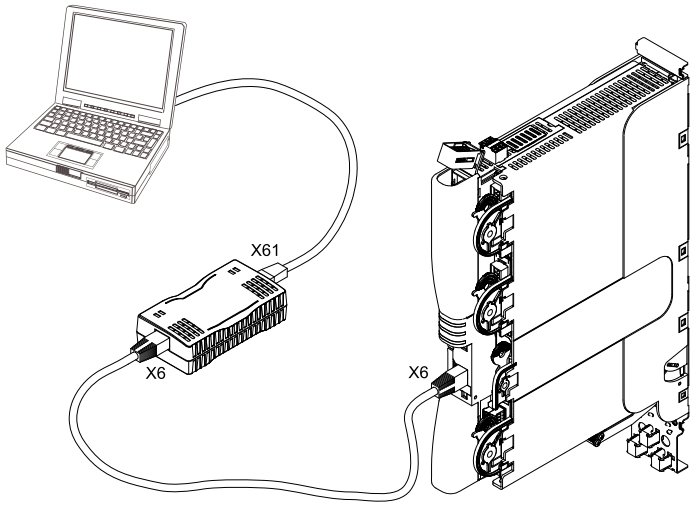
Displays

LED			
Pos.	Colour	Condition	Description
Power	Green	On	Diagnostic adapter is supplied with voltage by the basic device.
Tx / Rx	Yellow	Blinking	Basic device and PC communicate with each other via the diagnostic adapter.
USB	Green	On	Diagnostic adapter is connected to the PC and configured via USB.

Rated data

Field	Details
USB connection (X61)	Maximum current consumption: 100 mA

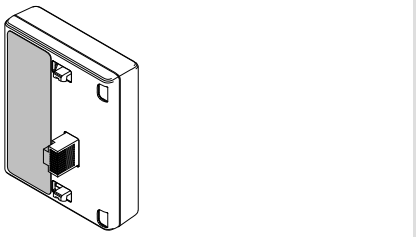
Installation steps

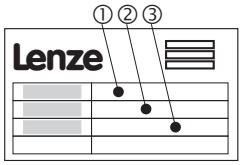


E94ZCUS002

8.8.2 Keypad

Identification


E94AZKAE036

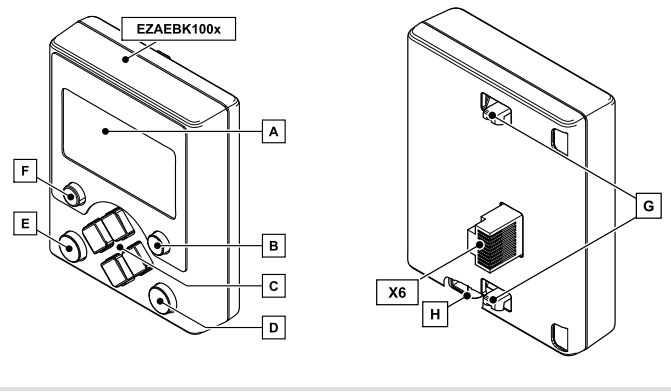


E94AZKAE100

	①					②	③
	EZ	AE	B	K	xxxx	xx	xx

- Product range: accessories
- Design
  AE = display unit
- Version
- Module type: keypad
- 100x = Keypad
  200x = Diagnosis terminal
- Hardware version
- Software version

Scope of supply



E94AZKAE025/035

Elements on the front

Pos.	Description
A	LCD display
B	Right function key
C	Navigation keys ↑↓←→
D	run key
E	stop key
F	Left function key

Elements on the back side

Pos.	Description
G	Lock hook
H	Release button
X6	RJ69 connector, connection on diagnostic interface (X6) on the basic device

Application range

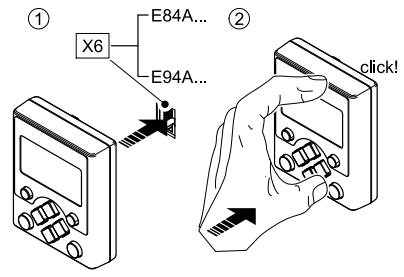
The use of this module is permissible with basic devices as of nameplate designation:

Inverter				Keypad X400		
	Type	HW	SW	Type	HW	SW
Servo Drives 9400	E94...	VB	01.10	EZAEBK1001	VA	02.00
Inverter Drives 8400	E84AV...	VA	00.07	EZAEBK1001	VA	02.00 1)
				EZAEBK1001	VA	04.xx

Rated data

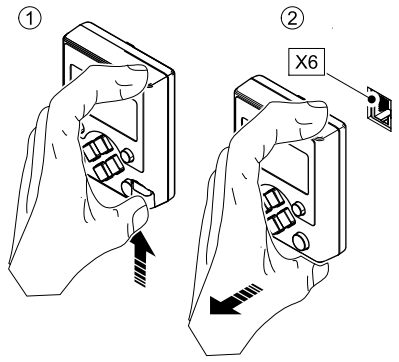
Field	Values	
Enclosure	IP20	IP65 (EZAEBK200x with EZAMSHHT)
Ambient temperature	In operation:	-10 °C ... +55 °C
	Transport:	-25 °C ... +70 °C
	Storage:	-25 °C ... +55 °C
Climatic conditions	Class 3K3 in accordance with EN 50178 (without condensation, average relative humidity 85 %)	
Degree of pollution	EN 61800-5-1, degree of pollution 2	

Mounting



E94AZKAE055

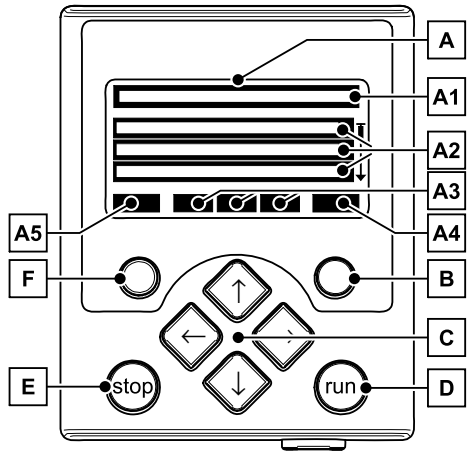
Dismounting



E94AZKAE060

Commissioning steps

Commissioning step		Comment
1.	Connect keypad to the diagnostic interface.	**You can also connect or remove the keypad during operation.**
2.	If the keypad is supplied with voltage, it carries out a short self test.	
3.	The keypad is ready for operation if it displays the main menu.	If you commission the keypad for the **first** time, you are requested to select the dialog language.
4.	You can now communicate with the basic device.	How to navigate through the menus and how to view and alter parameters can be learned here: 📖 514



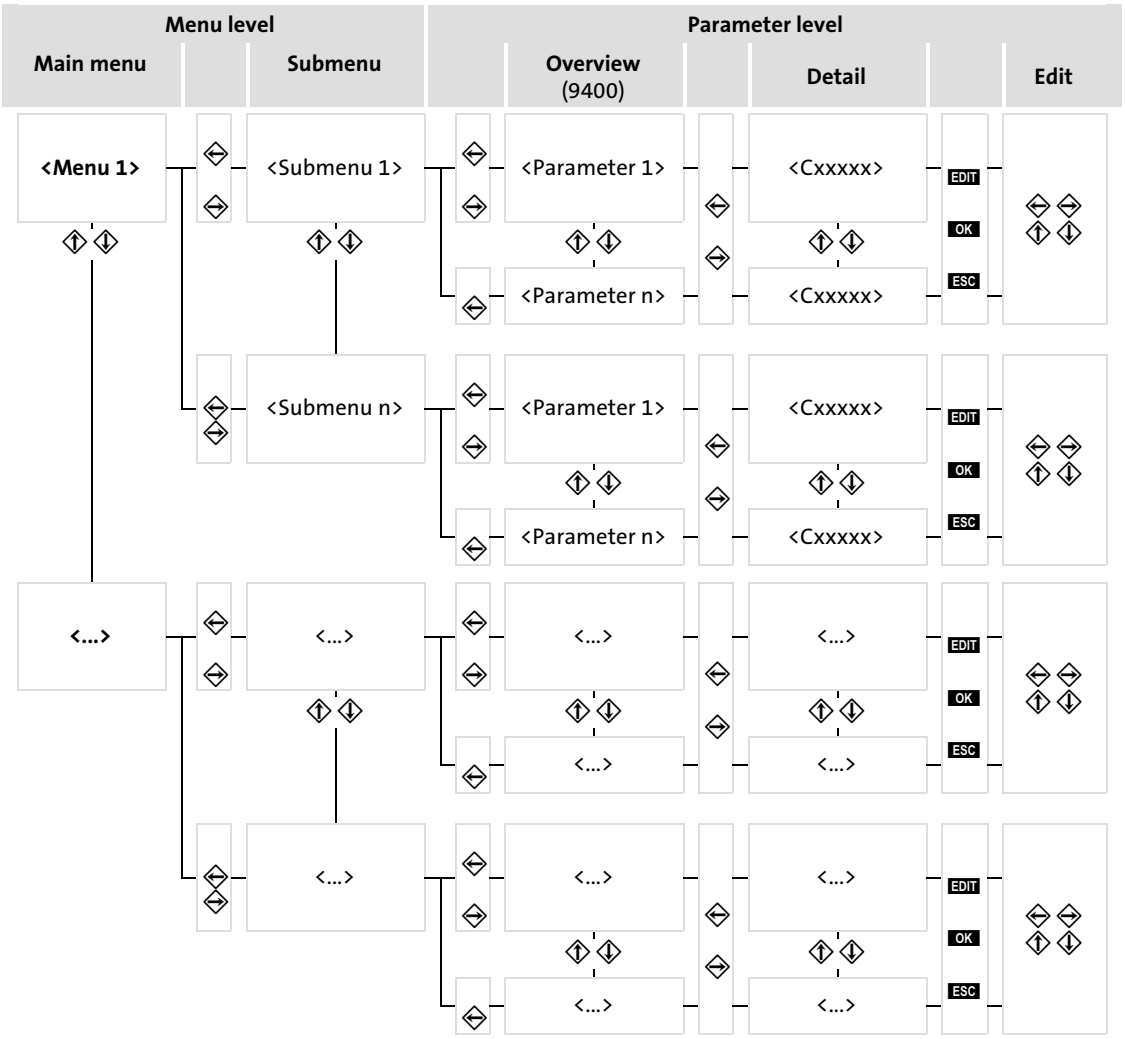
E94AZKAE003

Display		Meaning	Comment
A	**LCD display**		
A1	**Headline**		
	<MMM>	Meaning of the menu	In the menu level only
	<PPP>	Meaning of the parameter	In the parameter level only
A2	**Triple-spaced display**		
	<M1> <M2> <...>	List of the menus available	In the menu level only
	<P1> <P2> <...>	List of the parameters available	In the parameter level only
	<xxx>	Setting of the selected parameter	
A3	**Status of the basic device**		
	RDY	The basic device is ready for operation.	
	RUN	The basic device is enabled.	
	STP	Application in the basic device is stopped.	
	QSP	Quick stop active	
	CINH	The basic device is inhibited.	The power outputs are inhibited.
	OFF	The basic device is ready to start.	
	Mmax	Speed controller 1 in the limitation	The drive is torque-controlled.
	Imax	Set current limit exceeded in motor or generator mode	
	IMP	Pulse inhibit active	The power outputs are inhibited.
	!SYS	System error active	
	!FLT	Error active	
	!TRB	Fault active	
	!TQSP	Quick stop by trouble active	
	WRN	Warning active	
A4	**Current function of the right function key**		
	OK	Confirm and accept changes	
	HELP	Call up help	Is only displayed if a detailed help is available.
	NEXT	Browse to the next page.	
A5	**Current function of the left function key**		
		Back to the main menu	
	SAVE	Save parameter set in the drive non-volatilely.	
	EDIT	Alter parameter	
	ESC	Cancel action without accepting the change.	
	PREV	Browse to the previous page.	
	PLC!!	Parameter can only be altered if the application of the basic device is stopped.	
	CINH!!	Parameter can only be altered if the basic device is inhibited.	

Key		Function	Comment
B	○	Carry out the function indicated in the field A4.	
D	run	Deactivate the function of the stop key. The LED in the stop key goes out.	
E	stop	Carry out the function selected in C00469 in the "Keypad" menu. The LED in the key is on.	Lenze setting: activate quick stop.
F	○	Carry out the function indicated in the field A5.	

Key		Function				
		Menu level		Parameter level		
		Main menu	Submenu	Overview (9400)	Detail	Editing mode
C	⇧⇩	Select menu	Select submenu	Select parameter		Alter selected digit
	⇨	To the submenu	To the parameter level	To the detail view		Cursor to the right
	⇦		Back to the main menu	Back to the menu level	Back to the overview	Cursor to the left

Operation


Menu level
Parameter level
Main menu
Submenu
Overview (9400)
Detail
Edit
<Menu 1>
<Submenu 1>
<Parameter 1>
<Cxxxxx>
<Parameter n>
<Cxxxxx>
<Submenu n>
<Parameter 1>
<Cxxxxx>
<Parameter n>
<Cxxxxx>
<...>
<...>
<...>
<...>
<...>
<...>
<...>
<...>
EDIT
OK
ESC

In the main menu, you'll find the self-explanatory "Keypad" menu.

In the "Keypad" menu, you'll find parameters by means of which you can adapt the keypad to your needs:

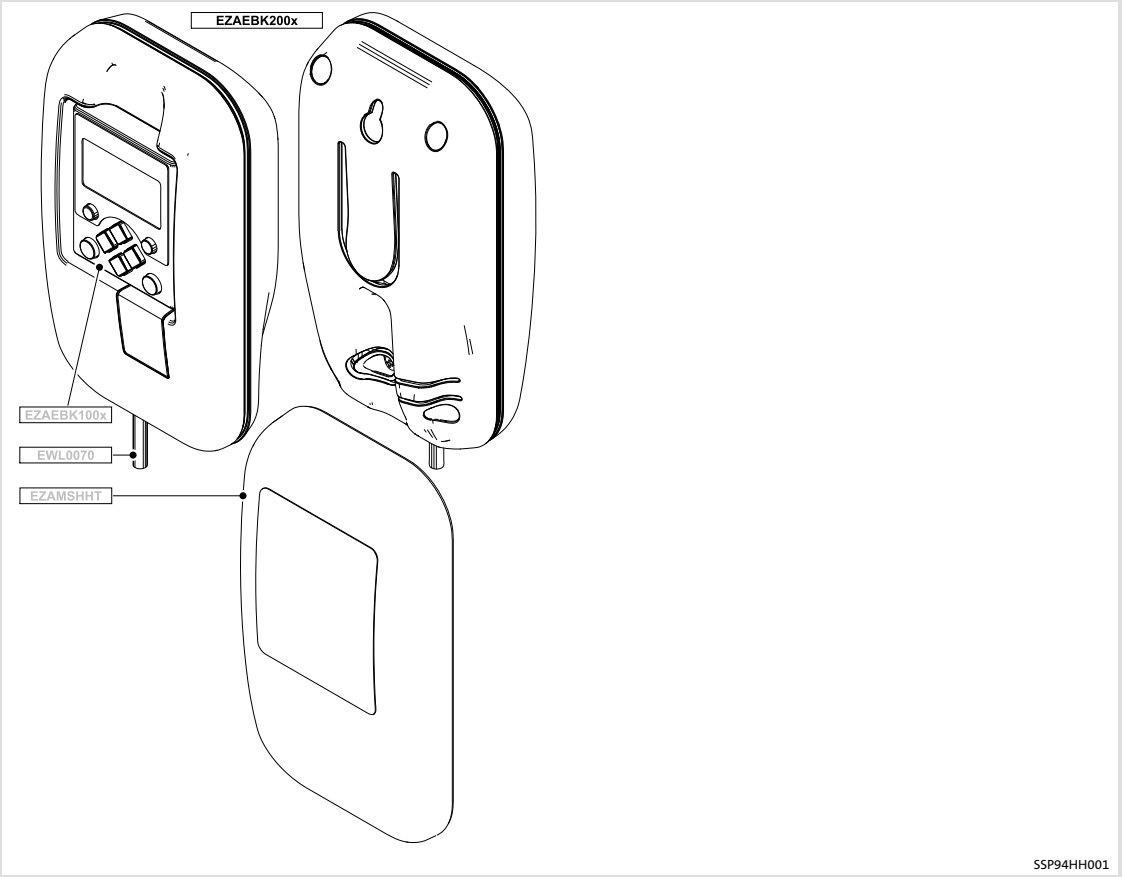
- Settings for the LCD display:
  - Duration and brightness of the background lighting
  - Contrast
- Starting values:
  - Display after the initialisation
  - Display of error messages
  - Representation of integers
- Function of the STOP key

In the "Keypad" menu, you can also call up status information on the keypad:

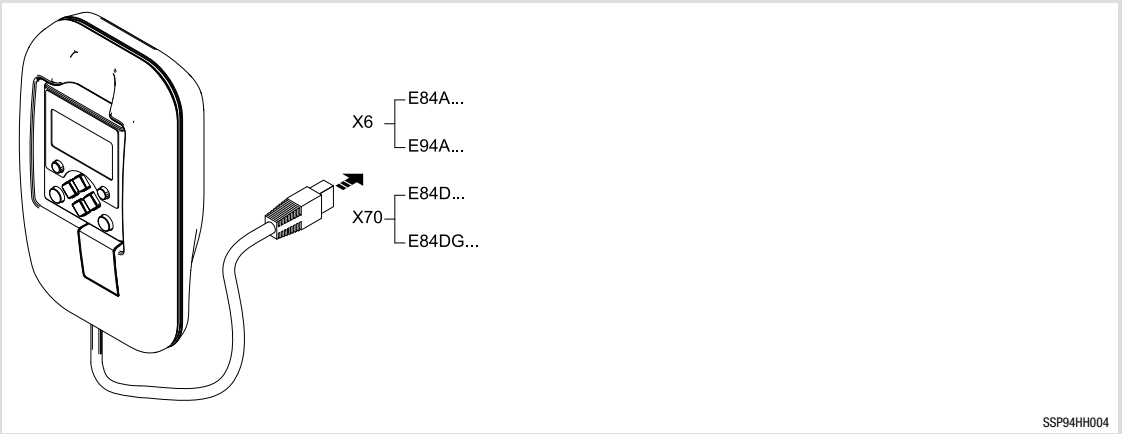
- Manufacturing data
- Hardware version and software version
- Serial number

8.8.3 Hand-held terminal

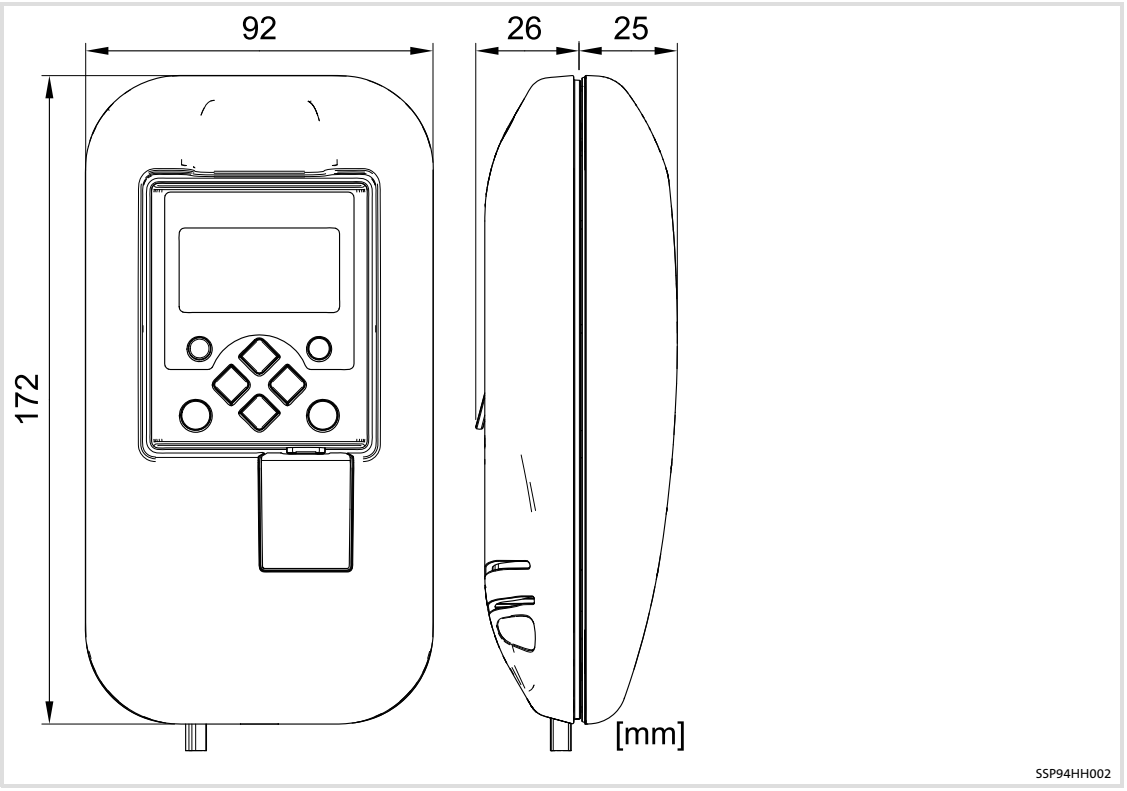
Scope of supply

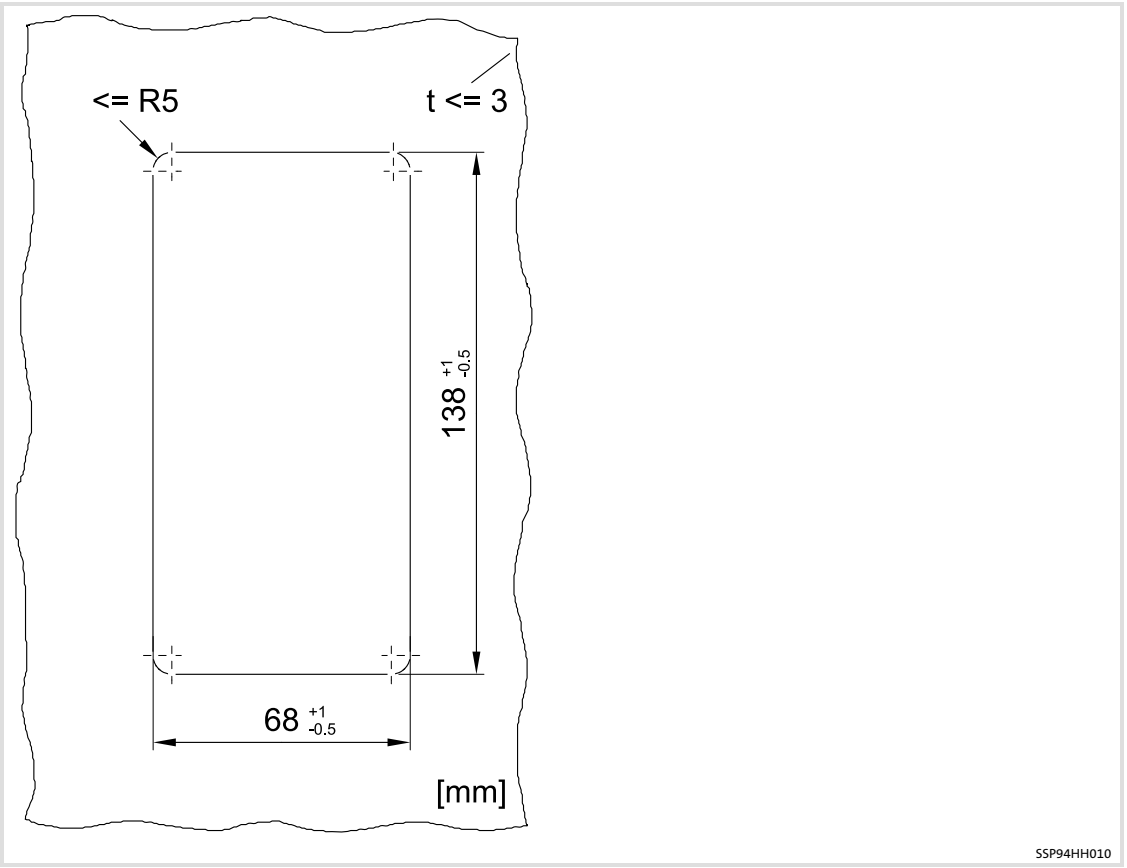


Connection

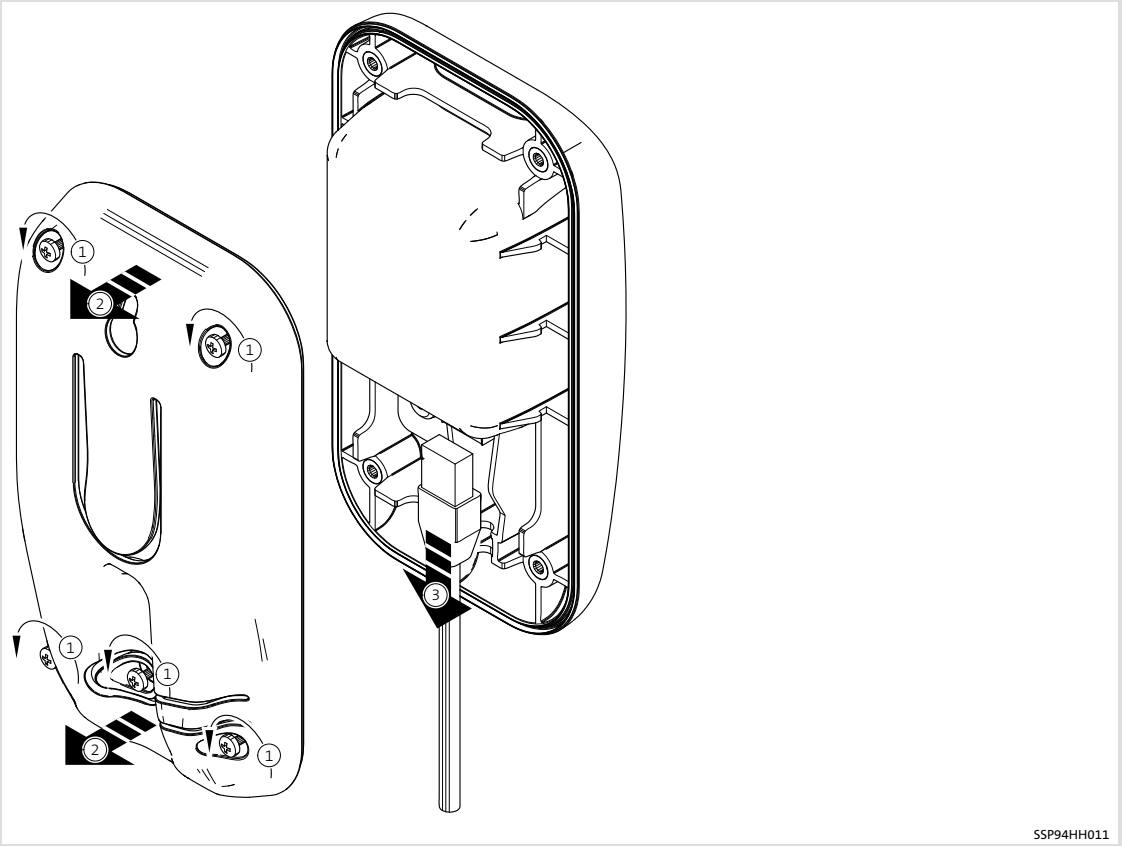


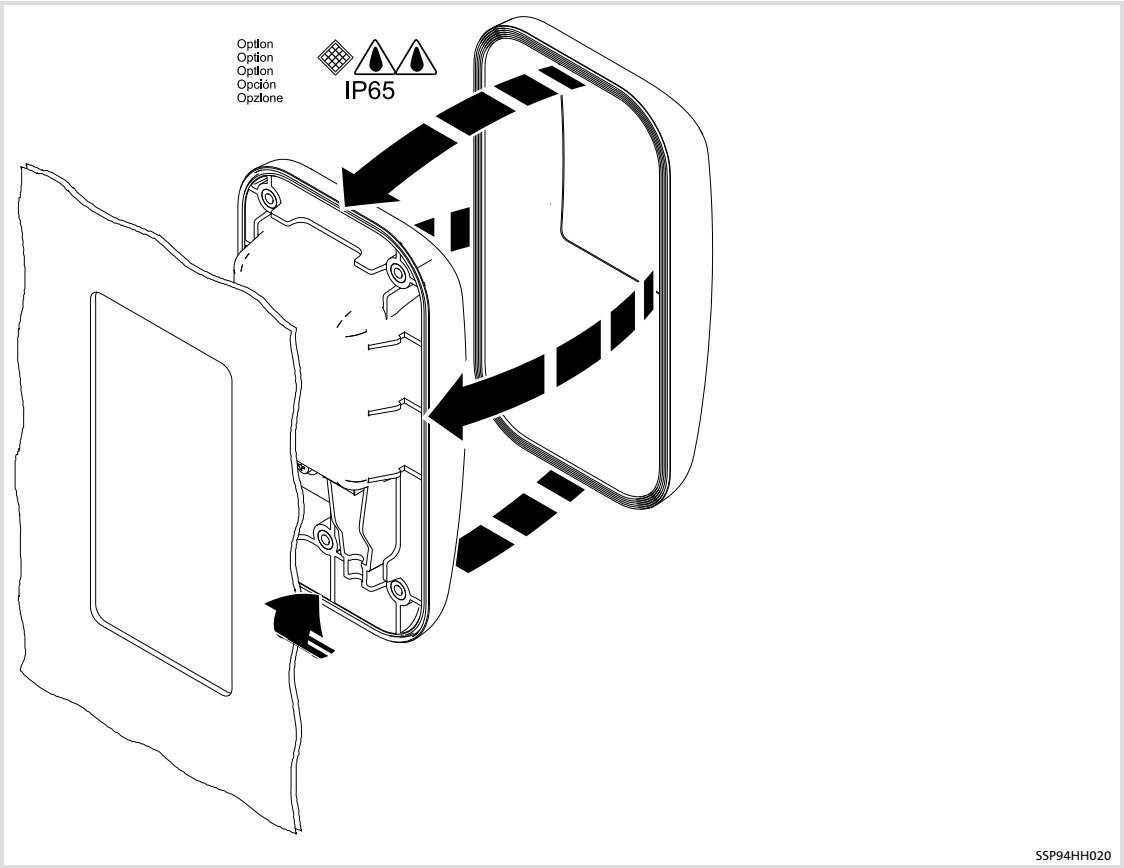
Dimensions

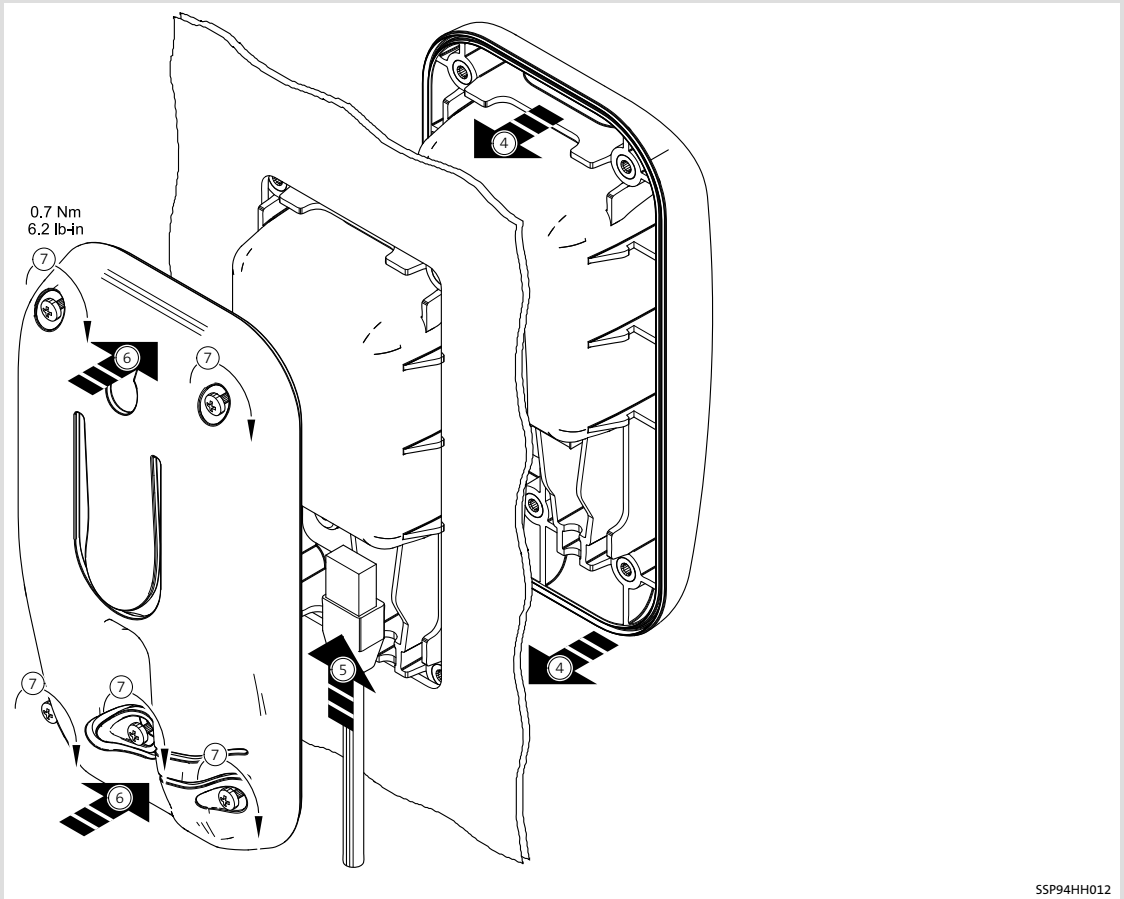




Installation steps



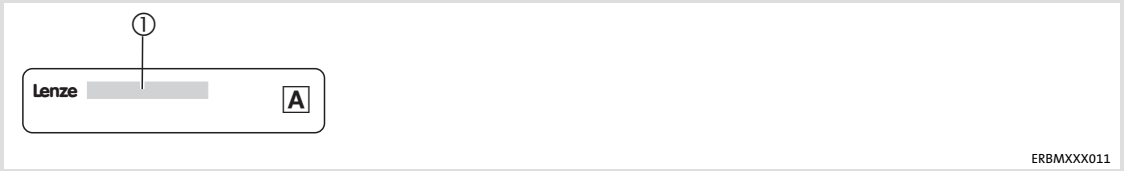

Option
Option
Option
Opción
Opzione
IP65
SSP94HH020


0.7 Nm
6.2 lb-in
4
4
5
6
6
7
7
7
7
7
SSP94HH012

8.9 Components for operation in the DC-bus connection

8.9.1 DC-feeding point

Identification



Type code	①					
	E94	A	Z	E	X	100

Product range

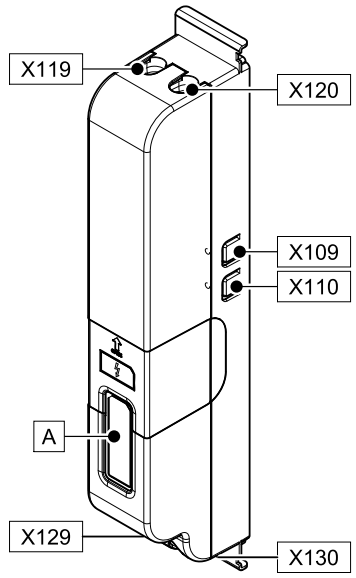
Device generation

Accessories

Type
E = input module

Rated current
100 = 100 A

Elements



Pos.	Description
A	Nameplate
X109	+UG busbar input
X110	-UG busbar input
X119	+UG cable input
X120	-UG cable input
X129	+UG cable output
X130	-UG cable output

Standards

Conformity and approval			
Conformity			
CE	2014/35/EU	Low-Voltage Directive	
CE	2014/30/EU	EMC Directive	
UKCA	S.I. 2016/1101	The Electrical Equipment (Safety) Regulations 2016	
UKCA	S.I. 2016/1091	The Electromagnetic Compatibility Regulations 2016	
Approval			
$_{C}UL_{US}$	UL61800-5-1	Power Conversion Equipment (File No. E132659) for USA	
	CSA C22.2 No. 274-13	Power Conversion Equipment (File No. E132659) for Canada	

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 from +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	Degree of pollution 2
Vibration resistance (9.81 m/s² = 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/s²
		200 ... 500 Hz: acceleration resistant up to 15 m/s²
Operation	Germanischer Lloyd	5 ... 13.2 Hz: Amplitude ±1 mm 13.2 ... 100 Hz: acceleration resistant up to 0.7 g
	IEC/EN 60068-2-6	10 ... 57 Hz: Amplitude 0.075 mm
		57 ... 150 Hz: Acceleration resistant up to 1 g

Protection		
Enclosure	EN 60529	IP 20
	NEMA 250	Protection against accidental contact acc. to type 1
Insulation resistance	EN 61800-5-1	Overvoltage category III Reduction from 2000 m: Overvoltage category II

Rated data

Mains	Voltage U_{DC} [V]	Voltage range U_{DC} [V]	Frequency range f [Hz]
2/PE DC	325	260 - 0 % ... 370 + 0 %	-
2/PE DC	565	455 - 0 % ... 620 + 0 %	-
2/PE DC	675	480 - 0 % ... 746 + 0 %	-

	Voltage [V]	Frequency [Hz]	Rated current [A] up to +45 °C ①	 up to +55 °C ①	Number of phases
E94AZEX100	325/565/675	0 (DC)	100/100/100	100/100/100	-

① Temperature in the control cabinet

Safety instructions



Danger!

Hazardous electrical voltage

All power connections carry a hazardous electrical voltage for a longer time after mains disconnection. Observe the information regarding the discharge time on the device.

Possible consequences:

► Death or severe injuries when touching the power terminals.

Protective measures:

► Before working on the power connections, wait at least until the discharge time has passed (depending on the device, this may be up to 20 minutes).

► Make sure that all power terminals are deenergised.

► Implement active discharge, e.g. by:
– Connection of a discharge resistor when the mains contactor drops.

Safety instructions for the installation according to UL/CSA

Original - English



Warnings!

► Maximum surrounding air temperature: 55 °C

► Use 60/75°C copper wire only, except for control circuits.

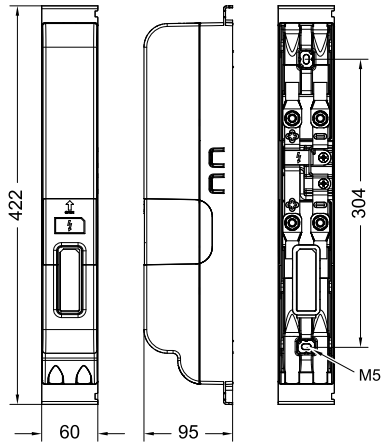
► Use appropriate listed (ZMVV) wire connectors and soldering lugs, suitable for current and voltage.

Original - French

Avertissement !

- ► Température ambiante maximale : 55 °C
- ► Utiliser exclusivement des conducteurs en cuivre 60/75 °C, sauf pour les circuits de commande.
- ► Utiliser les connecteurs de câble et les cosses à souder indiqués (ZMVV), à sélectionner en fonction du courant et de la tension d'alimentation.

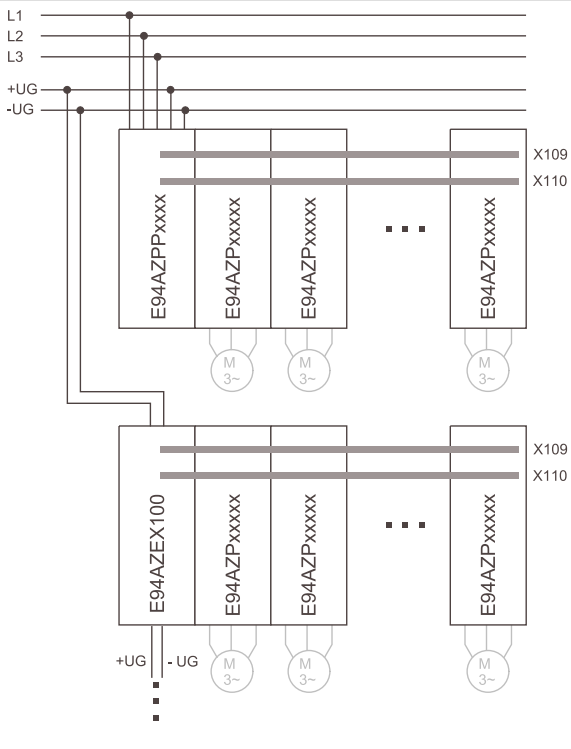
Dimensions



All dimensions in millimetres.

Type	Weight [kg]
E94AZEX100	0.9

Arrangement of the devices



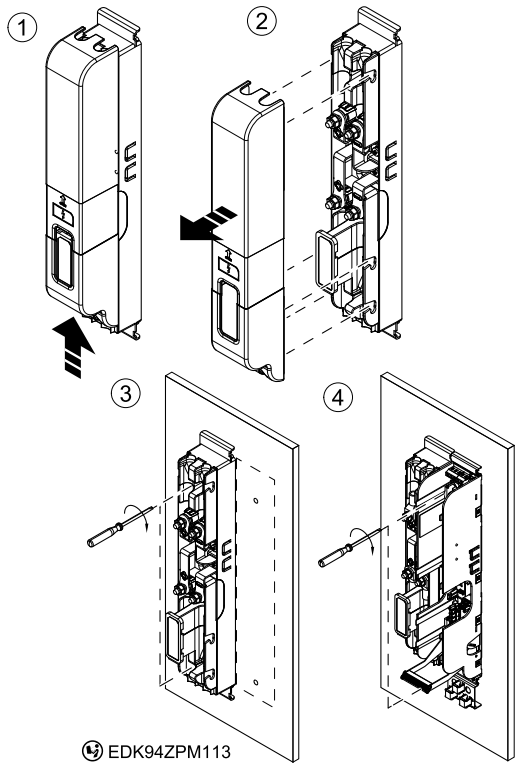
E94AZEX100	DC input module
E94AZPPxxxx	Installation backplane - 9400 DC power supply module
E94AZPxxxxx	Installation backplane - 9400 axis module

Installation steps

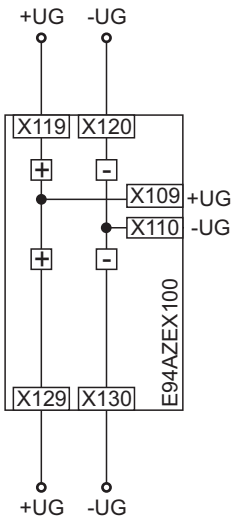
Note!

The place of installation and mounting material must ensure a permanent mechanical connection.

We recommend to keep to the hole patterns of the axis modules when fixing the DC input module. The hole spacing corresponds to device size I. For further information, please see the Mounting Instructions for the axis module installation backplane (EDK94ZPM113).

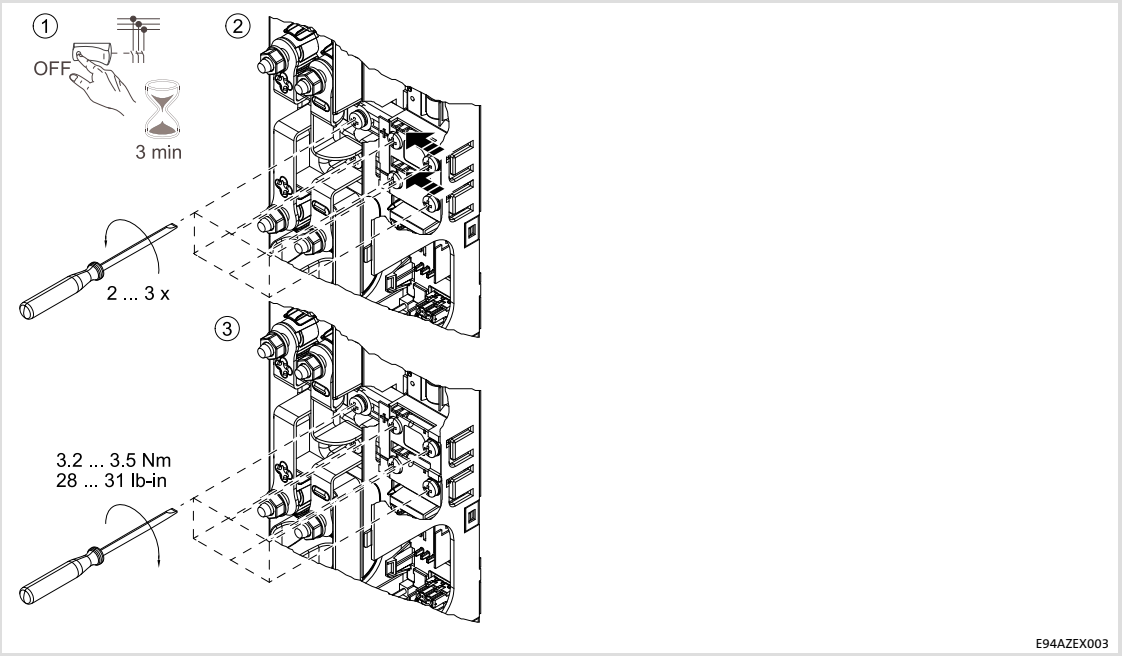


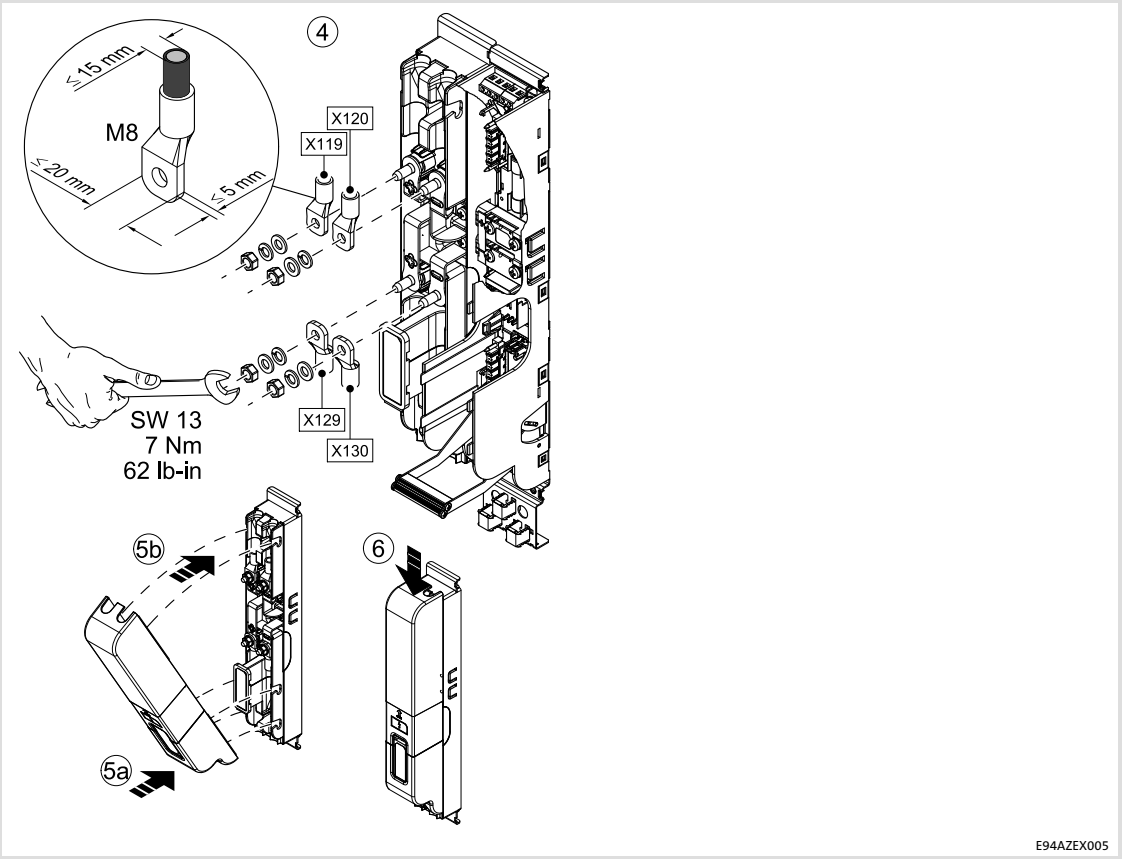
Connection plan



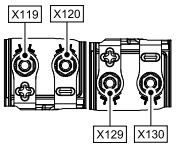
E94AZEX006

Electrical installation

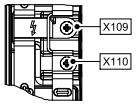




Terminal data

Terminal X119/X120/X129/X130	Labelling	Description
 E94AZEX007	*/-	Threaded bolt for connecting the input and output cables (+UG, -UG) with M8 ring cable lug

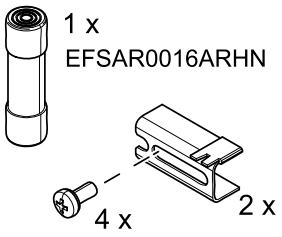
Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
E94AZEX100	50	1	7	62	SW13

Terminal X109/X110	Labelling	Description
 E94AZEX008	*/-	Busbar connection (+UG, -UG)

Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
E94AZEX100	–	–	3.2 ... 3.5	28 ... 31	PH2

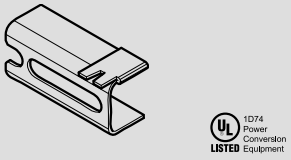
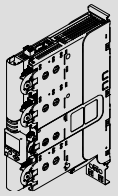
8.9.2 Busbar mounting set E94AZJA003

Elements



E94AZJA-001

Application range

	
E94AZJA003	E94xSxE002x E94xSxE003x

Safety instructions for the installation according to UL/CSA

Original - English

Warnings!

The busbar mounting set needs to be installed in accordance with the Mounting Instructions of Lenze Power Conversion Equipment, E94 servo system.

Risk of electrical shock - Disconnect power supply before you start working with the busbar mounting set.

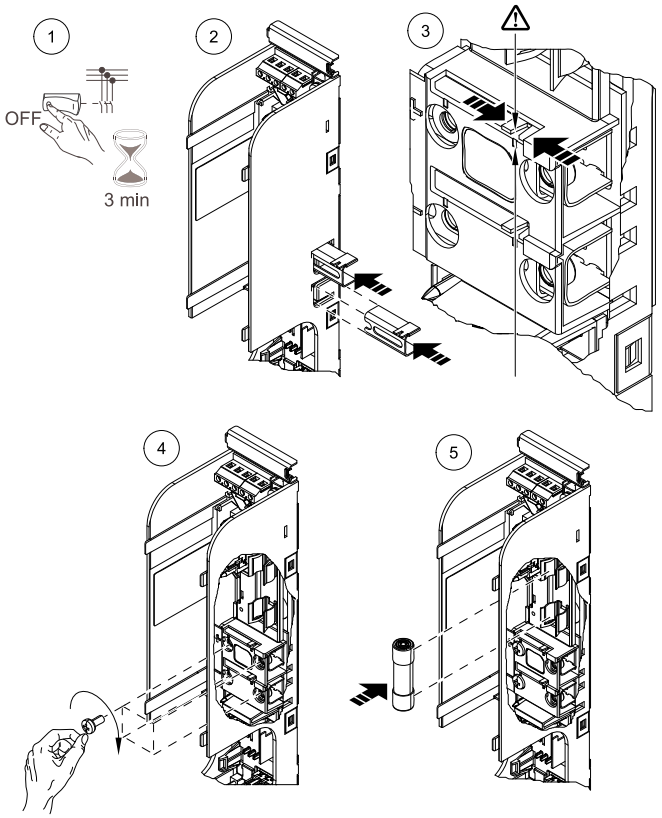
Original - French

Avertissement !

Le kit de montage de barres conductrices doit être utilisé conformément aux instructions de montage des convertisseurs de puissance Lenze, système servo E94.

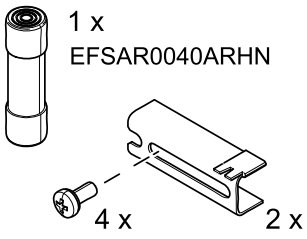
Risque d'électrocution - Débrancher l'alimentation avant le début des travaux de montage des barres conductrices.

Installation steps



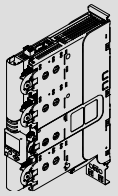
8.9.3 Busbar mounting set E94AZJA007

Elements



E94AZJA-011

Application range

	
E94AZJA007	E94xSxE004x E94xSxE007x

Safety instructions for the installation according to UL/CSA

Original - English

Warnings!

The busbar mounting set needs to be installed in accordance with the Mounting Instructions of Lenze Power Conversion Equipment, E94 servo system.

Risk of electrical shock - Disconnect power supply before you start working with the busbar mounting set.

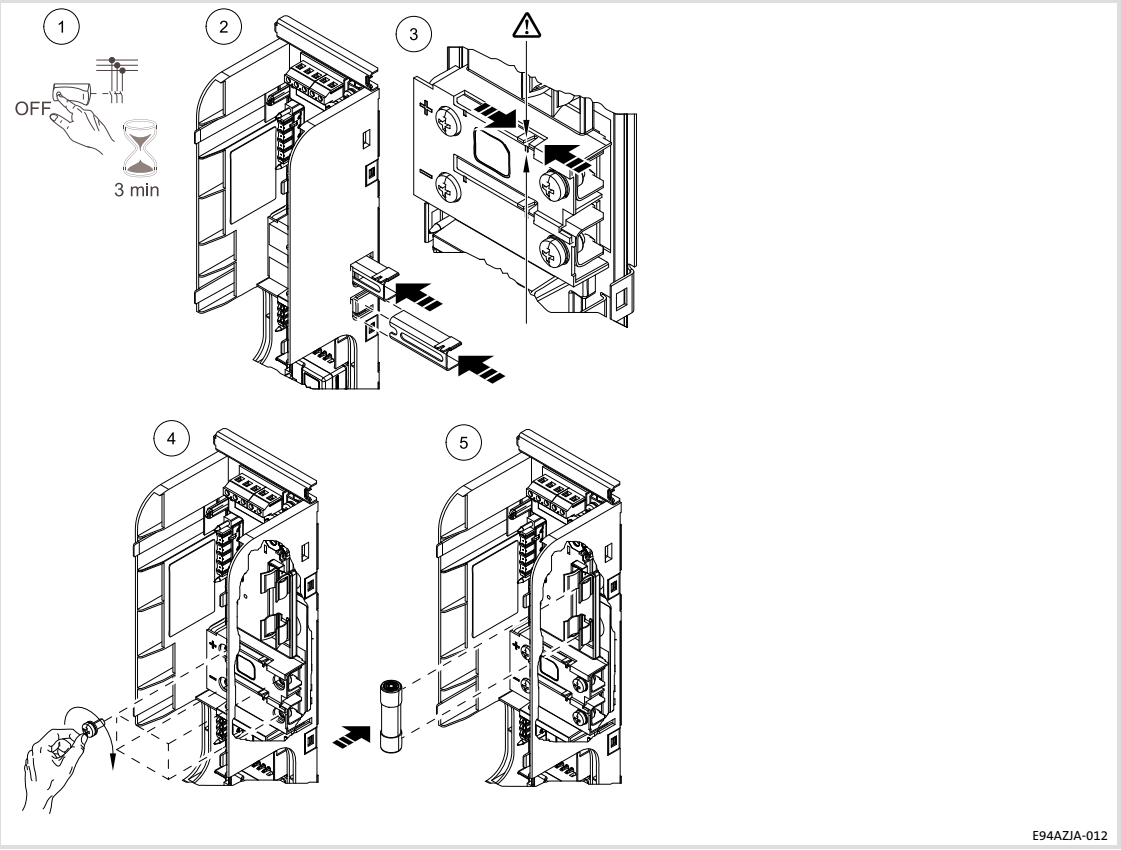
Original - French

Avertissement !

Le kit de montage de barres conductrices doit être utilisé conformément aux instructions de montage des convertisseurs de puissance Lenze, système servo E94.

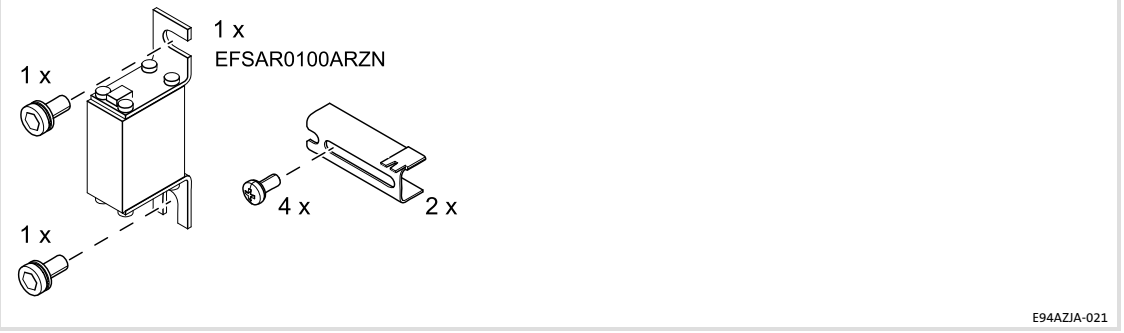
Risque d’électrocution - Débrancher l’alimentation avant le début des travaux de montage des barres conductrices.

Installation steps

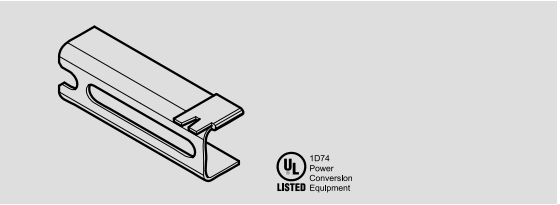
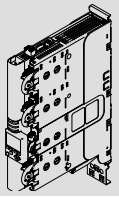


8.9.4 Busbar mounting set E94AZJA024

Elements



Application range

	
E94AZJA024	E94xSxE013x E94xSxE017x E94xSxE024x

Safety instructions for the installation according to UL/CSA

Original - English

Warnings!

The busbar mounting set needs to be installed in accordance with the Mounting Instructions of Lenze Power Conversion Equipment, E94 servo system.

Risk of electrical shock - Disconnect power supply before you start working with the busbar mounting set.

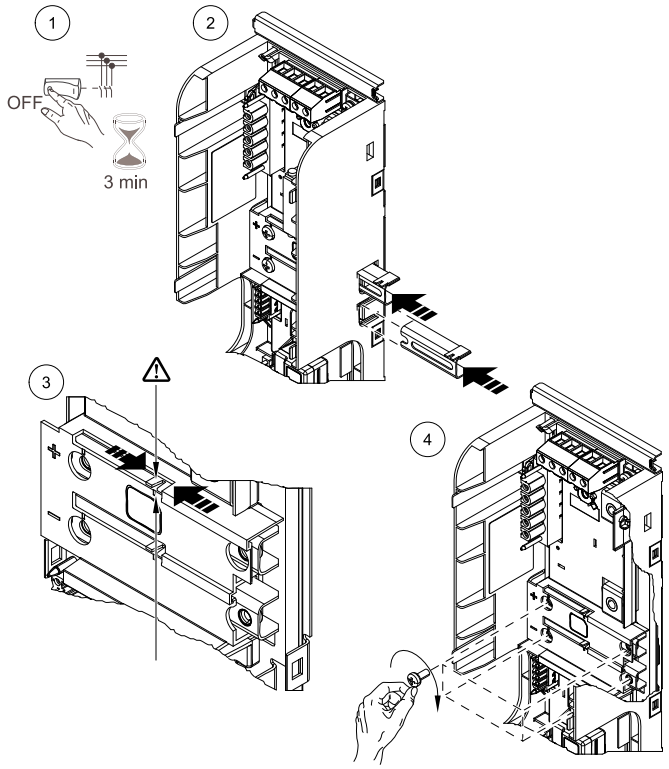
Original - French

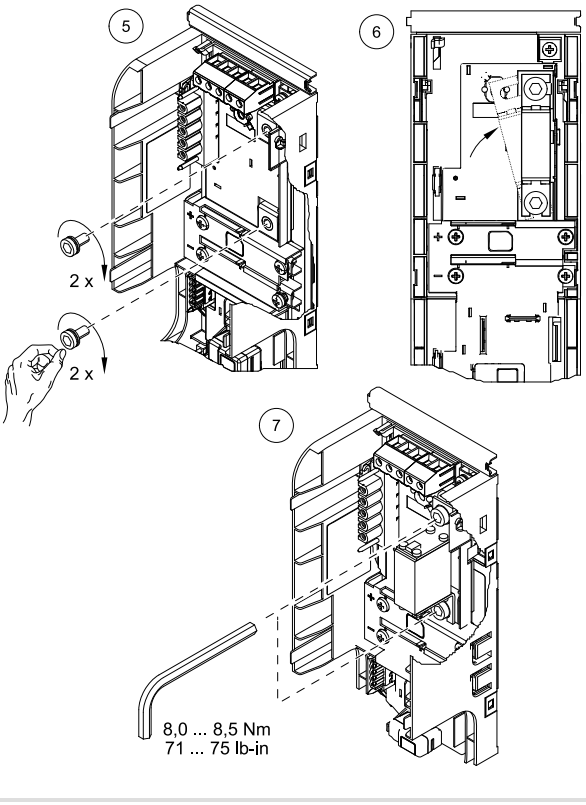
Avertissement !

Le kit de montage de barres conductrices doit être utilisé conformément aux instructions de montage des convertisseurs de puissance Lenze, système servo E94.

Risque d’électrocution - Débrancher l’alimentation avant le début des travaux de montage des barres conductrices.

Installation steps





8.10 Filters

Advantages by the use of filters:

- Compliance with EMC requirements
- Reduction of the current load
- Positive effects on the service life of the controllers possible
  – Strong reliability
  – Reduction of the failure rate
- Operation on 30 mA residual-current circuit breakers for device sizes 1 ... 3 (up to 24 A/11 kW) is enabled.

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.

A sinusoidal filter (LC filter) in the motor cable limits the rate of rise of voltage (du/dt < 500 V/µs) and the capacitive charge/discharge currents which occur during inverter operation. This enables considerably larger shielded motor cables and the service life of the motor is increased.

Accessories	Single Drive			Multi Drive		Power supply modules		VR modules	
Field	GG (device size)			GG		GG		GG	
Designation	1 ... 3	6 ... 7	81 ... 91	1 ... 3	6	1 & 3	4 & 5	1 & 3	Page
Filters									
Mains filter									
E94AZMSxxxx 3 ... 31 A	+	+	---	---	---	---	---	---	542
E94AZMSxxxx 180 ... 415 A (3F480-xxx.290EM)	---	---	+	---	---	---	---	---	585
E94AZMPxxxx 8 ... 29 A	---	---	---	---	---	+	+	---	549
E94AZMPxxxx 82 ... 200 A	---	---	---	---	---	+	+	---	556
E94AZMRxxxx 26 ... 47 A	---	---	---	---	---	---	---	+	564
RFI filter									
E94AZRSxxxx 4 ... 29 A	+	+	---	---	---	---	---	---	571
E94AZRSxxxx 54 ... 95 A	+	+	---	---	---	---	---	---	578
E94AZMSxxxx 180 ... 415 A (3F480-xxx.290EM)	---	---	+	---	---	---	---	---	585
E94AZRPxxxx 8 ... 29 A	---	---	---	---	---	+	+	---	589
E94AZRPxxxx 82 ... 200 A	---	---	---	---	---	+	+	---	596
Sine filter									
EZS3-xxxA200 4 ... 90 A	+	+	-	-	-	---	---	---	603
EZS3-xxxA200 115 ... 150 A	+	+	-	-	-	---	---	---	611
EZS3-xxxA200 180 ... 480 A	+	+	-	-	-	---	---	---	617

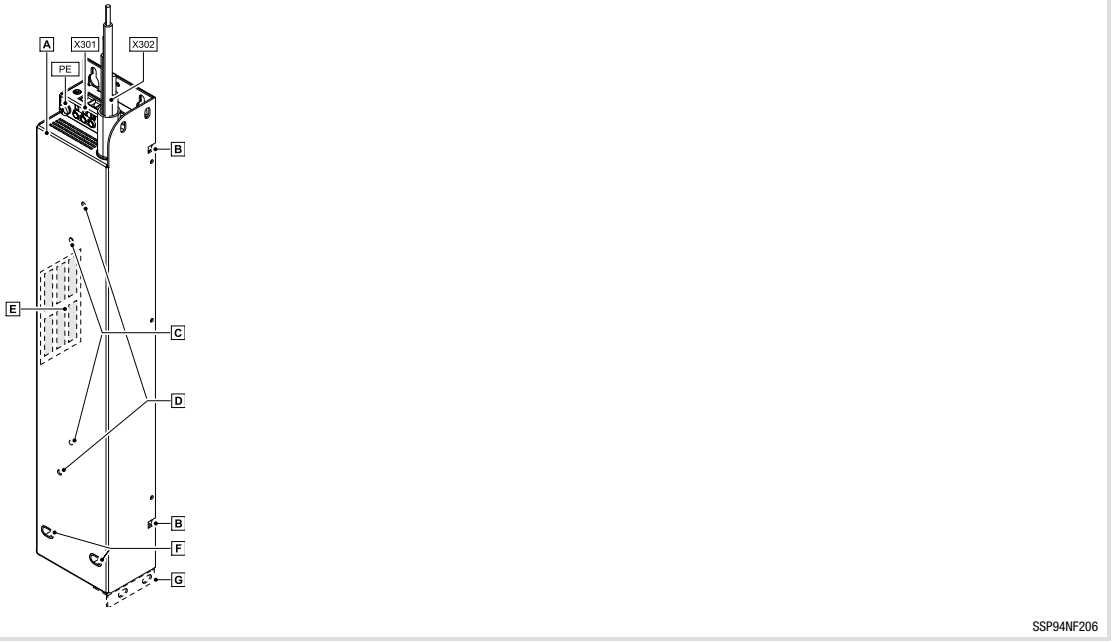
1)	Component from this range is absolutely necessary
+	Can be used without restrictions
o	Can be used with restrictions
-	Can be used, but check alternative
^	Already included
---	No use

8.10.1 Mains filters for single-axis controllers E94AZMSxxxx 3 ... 31 A

Assignment of filters to standard devices

Mains filter type	Single-axis controller type	Device size
E94AZMS0034	E94xSxE002x	1
	E94xSxE003x	
E94AZMS0094	E94xSxE004x	2
	E94xSxE007x	
E94AZMS0184	E94xSxE013x	3
	E94xSxE017x	
E94AZMS0314	E94xSxE024x	

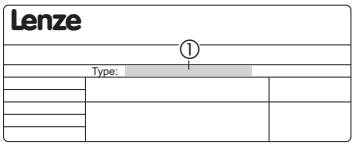
Elements on the filter



Pos.	Description
A	Mains filter E94AZMSxxxx
	Mounting Instructions

Pos.	Description
PE	PE connection (for M5 ring or fork-type cable lug)
X301	Mains terminal L1 ... L3
X302	Connection cable to controller, 4-core
B	Mounting aid for mounting base
C	Guide pins for mounting base
D	Mounting thread for mounting base
E	Nameplate
F	Fastening at the bottom
G	Angle bracket for "side-by-side" mounting variant, device sizes 2 and 3

Identification



SSP94NF002

	①						
Type code	**E94**	**A**	**Z**	**M**	**S**	**xxx**	**x**
Product range							
Version							
accessories							
Mains filter type							
for 9400 Single Drive							
Rated current [A]							
Voltage class 4 = 230 ... 400/480 V							

General data

Conformity and approval			
Conformity			
Approval			
$_{c}UR_{US}$	UL508 CSA C22.2 No.14	Industrial Control Equipment, Underwriter Laboratories (File-No. E219022) for USA and Canada	

Mains data		
Mains types		
With grounded neutral (TT/TN systems)	Operation permitted without restrictions	
Other mains types	Observe instructions for special measures in the documentation for the basic device!	

Protection of persons and equipment			
Enclosure	EN 60529	IP20	Not in the wire range of the terminals
	NEMA 250	Protection against contact to type 1	
Earth leakage current	IEC/EN 61800-5-1	> 3.5 mA AC > 10 mA DC	Observe regulations and safety instructions!
Insulation resistance	IEC/EN 61800-5-1	< 2000 m site altitude: overvoltage category III	
		> 2000 m site altitude: overvoltage category II	

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 from +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	Degree of pollution 2
Vibration resistance (9.81 m/s² = 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/s²
		200 ... 500 Hz: acceleration resistant up to 15 m/s²
Operation	Germanischer Lloyd	5 ... 13.2 Hz: Amplitude ±1 mm 13.2 ... 100 Hz: acceleration resistant up to 0.7 g
	IEC/EN 60068-2-6	10 ... 57 Hz: Amplitude 0.075 mm
		57 ... 150 Hz: Acceleration resistant up to 1 g

Mounting conditions		
Mounting place		In the control cabinet
Mounting position		Vertically
Free space		The required free space results from the mounting position and the specifications of the standard device.
Mounting position		
Standard		Footprint mounting; standard device is screwed on the filter
Variant		Side-by-side mounting; filter is directly screwed to the left of the standard device (📖Mechanical installation)

Rated data

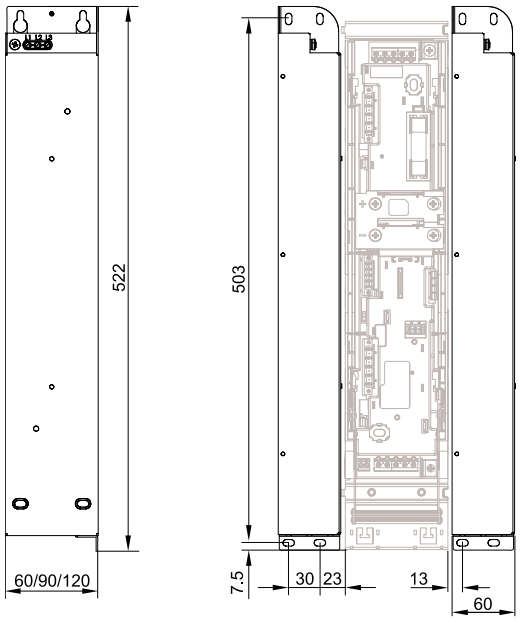
Mains	Voltage U_{Lrated} [V]	Voltage range U_{Lrated} [V]	Frequency range f [Hz]
3/PE AC	230	180 - 0 % ... 264 + 0 %	45 - 0 % ... 65 + 0 %
3/PE AC	400	320 - 0 % ... 440 + 0 %	45 - 0 % ... 65 + 0 %
3/PE AC	480	340 - 0 % ... 528 + 0 %	45 - 0 % ... 65 + 0 %

	Voltage [V]	Freq. [Hz]	Current [A] ① max. +45° C	Current [A] ① max. +55° C	Number of phases
E94AZMS0034	230/400/480	50/60	3.2/3.2/3.2	2.0/2.0/2.0	3
E94AZMS0094	230/400/480	50/60	9.0/9.0/9.0	5.6/5.6/5.6	3
E94AZMS0184	230/400/480	50/60	18/18/18	11/11/11	3
E94AZMS0314	230/400/480	50/60	31/31/31	19/19/19	3

① Temperature in the control cabinet

	Power loss P_{loss} [W]	Inductance L [mH]	Voltage drop ΔU [V]
E94AZMS0034	15	10	10
E94AZMS0094	23	3.5	10
E94AZMS0184	38	1.1	7.4
E94AZMS0314	48	0.75	7.3

Dimensions



All dimensions in millimetres.

	Mass [kg]
E94AZMS0034	3.2
E94AZMS0094	5.2
E94AZMS0184	8.4
E94AZMS0314	8.8

Mechanical installation

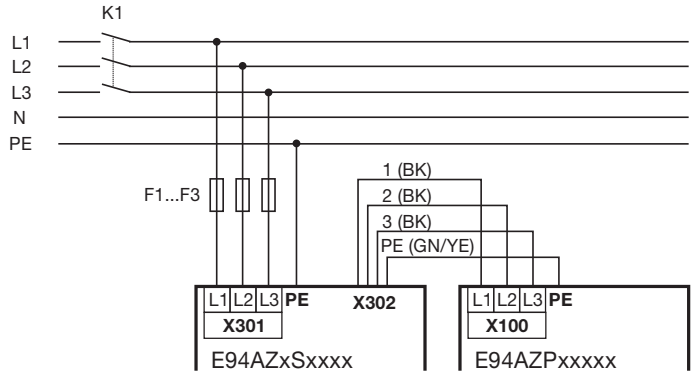
Note!

The filter can be mounted in two different variants. This results in differing mounting dimensions.

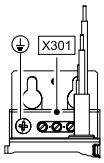
- ► Standard mounting
  - – The filter is mounted below the mounting base of the basic device. The grid hole pattern of the L-force 9400 device series can be used.
- ► Side-by-side mounting for small control cabinet depth
  - – Device size I: The filter is mounted left to the basic device. The grid hole pattern of the L-force 9400 device series can be used.
  - – Device sizes II and III: The filter is turned by 90° and mounted left to the basic device. The grid hole pattern of the L-force 9400 device series cannot be used.

For information on this topic, please see the corresponding mounting instructions.

Electrical installation



Mains

Terminal X301	Labelling	Description
 SSP94FF008	L1 L2 L3	Connection of the mains phases L1, L2, L3
	⏚	Connection for the supply-side PE conductor with M5 ring cable lug

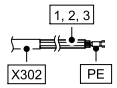
Terminal data

	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
E94AZMS0034	2.5	14	0.5 ... 0.6	4.4 ... 5.3	PH1
E94AZMS0094	4	12			
E94AZMS0184	10	8	1.2 ... 1.5	10.6 ... 13.3	
E94AZMS0314					

PE connection data

	∅	Starting torque		
	[mm]	[Nm]	[lb-in]	
E94AZMS0034	M5	3.0	26.5	SW 8
E94AZMS0094				
E94AZMS0184				
E94AZMS0314				

Standard device

Cable X302	Labelling	Description
 SSP94FF007	1 2 3	Filter output conductor (lead with wire end ferrule, colour BK)
	PE	Output-side PE conductor (lead with M5 fork-type cable lug, colour GN/YE)

Safety instructions for the installation according to UL/CSA

Original - English

Warnings!

Conditions of Acceptability:

- The products covered by this report are only intended for use with Power Conversion Equipment (inverters).
- Consideration shall be given to the field wiring leads. No strain relief test was performed on the leads.
- The devices in this report are only evaluated for factory wiring use.
- Temperature tests were performed with hook mounted drive.

Original - French

Avertissement !

Conditions d'acceptabilité :

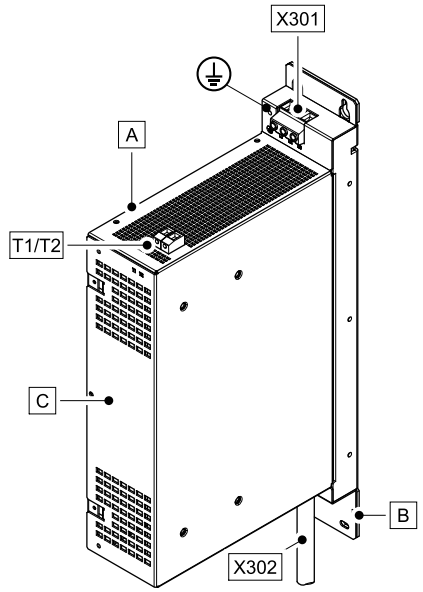
- Les produits concernés par ce rapport sont destinés exclusivement à être utilisés avec des convertisseurs de puissance (variateurs ou power conversion equipment).
- Une attention particulière doit être apportée aux tresses de câblage à pied d'oeuvre. Aucun test de décharge de traction n'a été réalisé sur ces éléments.
- Les équipements concernés par ce rapport sont évalués exclusivement pour un câblage en usine.
- Les tests de température ont été réalisés avec un entraînement à crochet.

8.10.2 Mains filters for power supply modules E94AZMPxxxx (8 ... 29 A)

Assignment of filters to standard devices

Mains filter		DC power supply module	
Type	Device size	Type	Device size
E94AZMP0084	2	E94APNE0104	1
E94AZMP0294	3	E94APNE0364	3
E94AZMP0294	3	E70ACPSx0304x	1

Elements on the filter

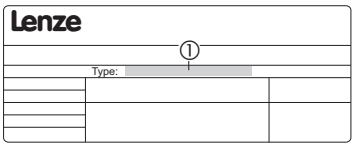


SSP94NF101

Pos.	Description
A	Mains filter E94AZMPxxxx
	Mounting Instructions

Pos.	Description
⏚	Connection of PE conductor
X301	Mains terminal L1 ... L3
X302	Connection cable to DC power supply module, four-core
T1/T2	Thermal contact terminal T1, T2
B	Mounting aid for installation backplane
C	Nameplate

Identification



SSP94NF002

	①						
Type code	**E94**	**A**	**Z**	**M**	**P**	**xxx**	**x**
Product range							
Version							
accessories							
Mains filter type							
for 9400 power supply							
Rated current [A]							
Voltage class 4 = 230 ... 400/480 V							

General data

Conformity and approval			
Conformity			
Approval			
$_{C}UR_{US}$	UL508 CSA C22.2 No.14	Industrial Control Equipment, Underwriter Laboratories (File-No. E219022) for USA and Canada	

Mains data		
Mains types		
With grounded neutral (TT/TN systems)	Operation permitted without restrictions	
Other mains types	Observe instructions for special measures in the documentation for the basic device!	

Protection of persons and equipment			
Enclosure	EN 60529	IP20	Not in the wire range of the terminals
	NEMA 250	Protection against contact to type 1	
Earth leakage current	IEC/EN 61800-5-1	> 3.5 mA AC > 10 mA DC	Observe regulations and safety instructions!
Insulation resistance	IEC/EN 61800-5-1	< 2000 m site altitude: overvoltage category III	
		> 2000 m site altitude: overvoltage category II	

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 from +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	Degree of pollution 2
Vibration resistance (9.81 m/s² = 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/s²
		200 ... 500 Hz: acceleration resistant up to 15 m/s²
Operation	Germanischer Lloyd	5 ... 13.2 Hz: Amplitude ±1 mm 13.2 ... 100 Hz: acceleration resistant up to 0.7 g
	IEC/EN 60068-2-6	10 ... 57 Hz: Amplitude 0.075 mm
		57 ... 150 Hz: Acceleration resistant up to 1 g

Mounting conditions		
Mounting place		In the control cabinet
Mounting position		Vertically
Free space		The required free space results from the mounting position and the specifications of the standard device.

Rated data

Mains	Voltage U_{Lrated} [V]	Voltage range U_{Lrated} [V]	Frequency range f [Hz]
3/PE AC	230	180 - 0 % ... 264 + 0 %	45 - 0 % ... 65 + 0 %
3/PE AC	400	320 - 0 % ... 440 + 0 %	45 - 0 % ... 65 + 0 %
3/PE AC	480	340 - 0 % ... 528 + 0 %	45 - 0 % ... 65 + 0 %

	Voltage [V]	Freq. [Hz]	Current [A] ① max. +45° C	Current [A] ① max. +55° C	Number of phases
E94AZMP0084	230/400/480	50/60	8/8/8	6/6/6	3
E94AZMP0294	230/400/480	50/60	29/29/29	21.8/21.8/21.8	3

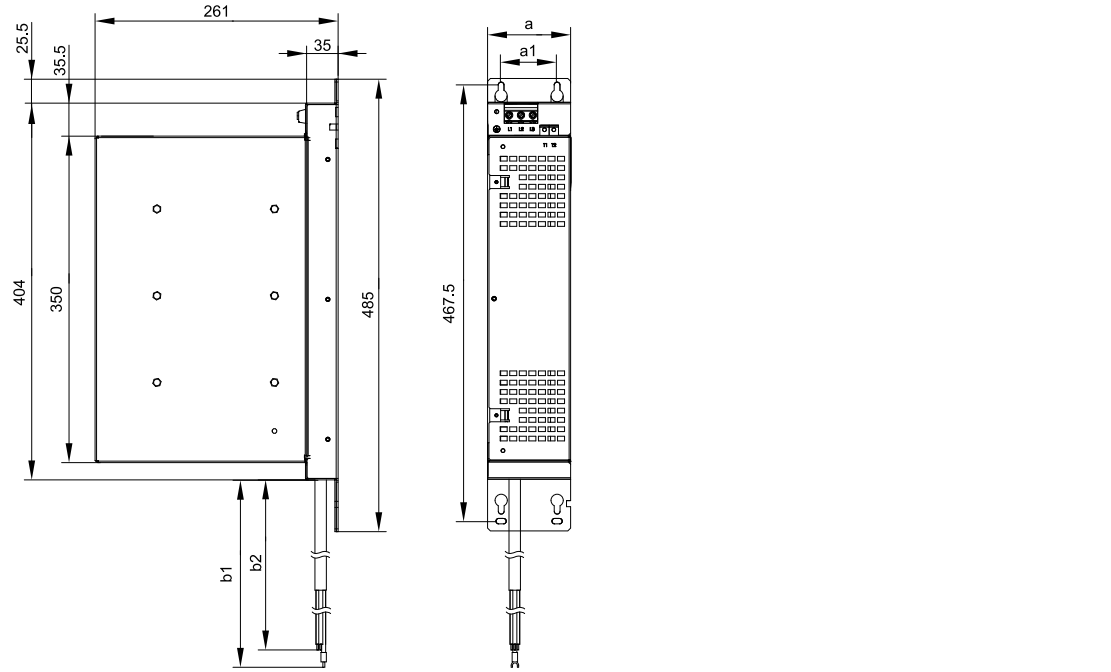
① Temperature in the control cabinet

	Power loss P_{loss} [W]	Inductance L [mH]	Voltage drop ΔU [V]
E94AZMP0084	50	3.9	9.8
E94AZMP0294	110	0.7	6.4

Thermal contact

	Design	max. switching voltage U_{Th} [V AC]	max. switching current I_{Th} [A]
E94AZMP0084	NC contact, 150 °C	250	2.5
E94AZMP0294			

Dimensions



All dimensions in millimetres.

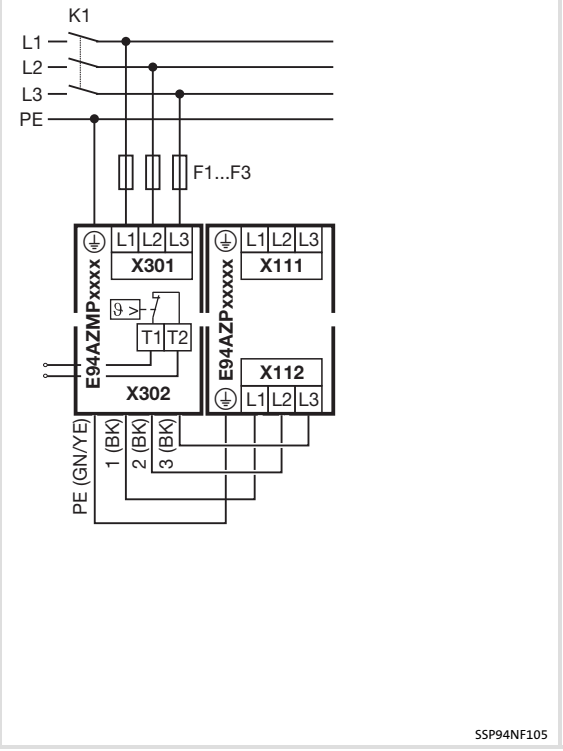
	a	a1	b1	b2	Mass
	[mm]				[kg]
E94AZMP0084	90	60	360 ±5	350 ±5	8.6
E94AZMP0294	120	90	430 ±5	420 ±5	16.0

Mechanical installation

For information on this topic, please see the corresponding mounting instructions.

Electrical installation

Standard mounting



Mounting variant

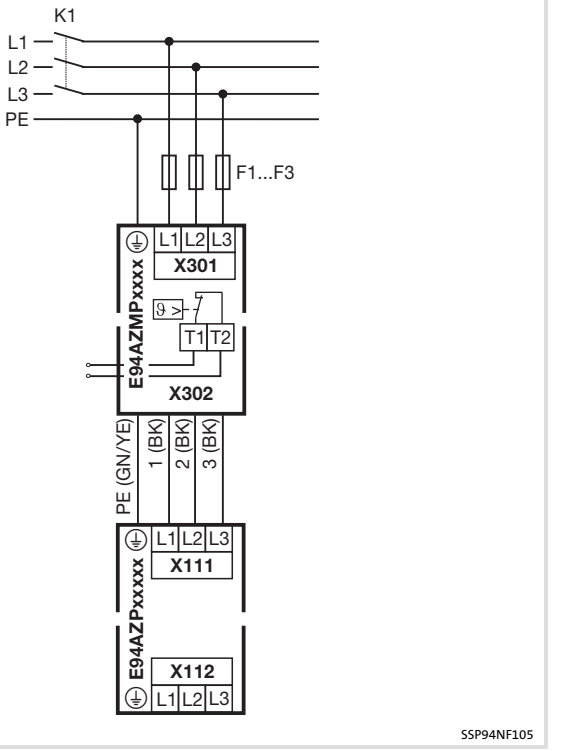
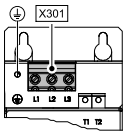


Fig. 8-4 Connection concept

E94AZMPxxxx	Mains filter
E94AZPxxxxx	Installation backplane for 9400 DC power supply module
F1 ... F3	Fuses
K1	Mains contactor

Mains

Terminal X301	Labelling	Description
 SSP94NF106	L1 L2 L3	Connection of the mains phases L1, L2, L3
	⏚	Connection for the supply-side PE conductor with M5 ring cable lug

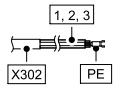
Terminal data

	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
E94AZxP0084	10	6	1.2 ... 1.5	10.6 ... 13.3	PH1
E94AZxP0294					

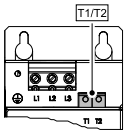
PE connection data

	∅	Starting torque		
	[mm]	[Nm]	[lb-in]	
E94AZxP0084	M5	3	26.5	SW 8
E94AZxP0294				

Standard device

Cable X302	Labelling	Description
 SSP94FF007	1 2 3	Filter output conductor (lead with wire end ferrule, colour BK)
	PE	Output-side PE conductor (lead with M5 fork-type cable lug, colour GN/YE)

Thermal contact

Terminal T1/T2	Labelling	Description
 SSP94NF108	T1 T2	Thermal contact connection

Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
E94AZMP0084	4	10	0.6 ... 0.8	5.3 ... 7.1	PZ1
E94AZMP0294					

Safety instructions for the installation according to UL/CSA

Original - English

Warnings!

Conditions of Acceptability:

- The products covered by this report are only intended for use with Power Conversion Equipment (inverters).
- Consideration shall be given to the field wiring leads. No strain relief test was performed on the leads.
- The devices in this report are only evaluated for factory wiring use.
- Temperature tests were performed with hook mounted drive.

Original - French

Avertissement !

Conditions d'acceptabilité :

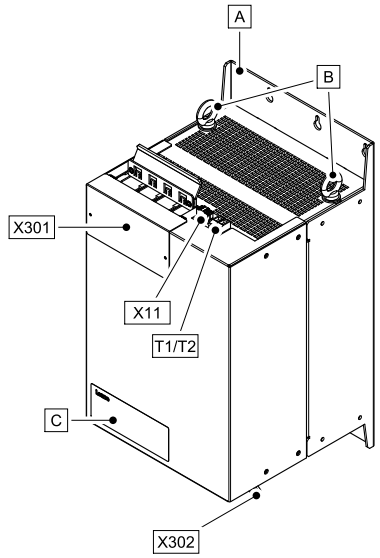
- Les produits concernés par ce rapport sont destinés exclusivement à être utilisés avec des convertisseurs de puissance (variateurs ou power conversion equipment).
- Une attention particulière doit être apportée aux tresses de câblage à pied d'oeuvre. Aucun test de décharge de traction n'a été réalisé sur ces éléments.
- Les équipements concernés par ce rapport sont évalués exclusivement pour un câblage en usine.
- Les tests de température ont été réalisés avec un entraînement à crochet.

8.10.3 Mains filters for power supply modules E94AZMPxxxx (82 ... 200 A)

Assignment of filters to standard devices

Mains filter		DC power supply module	
Type	Device size	Type	Device size
E94AZMP0824	4	E94APNE1004	4
E94AZMP2004	5	E94APNE2454	5
E94AZMP0824	4	E70ACPSx0604x	2

Elements on the filter

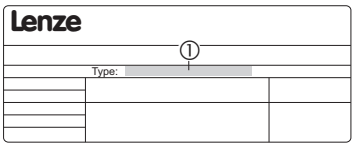


SSP94NF301

Pos.	Description
A	Mains filter E94AZMPxxxx
	Mounting Instructions

Pos.	Description
X301	Mains connection for L1 ... L3 and PE
X302	Connection cables to DC power supply module L1' ... L3' and PE
X11	Voltage supply for internal fan (24 V DC)
T1/T2	Thermal contact terminals T1, T2
B	Ring bolts
C	Nameplate

Identification



SSP94NF002

	①						
Type code	**E94**	**A**	**Z**	**M**	**P**	**xxx**	**x**
Product range							
Version							
accessories							
Mains filter type							
for 9400 power supply							
Rated current [A]							
Voltage class 4 = 230 ... 400/480 V							

General data

Conformity and approval			
Conformity			
Approval			
$_{C}UR_{US}$	UL508 CSA C22.2 No.14	Industrial Control Equipment, Underwriter Laboratories (File-No. E219022) for USA and Canada	

Mains data		
Mains types		
With grounded neutral (TT/TN systems)	Operation permitted without restrictions	
Other mains types	Observe instructions for special measures in the documentation for the basic device!	

Protection of persons and equipment			
Enclosure	EN 60529	IP20	Not in the wire range of the terminals
	NEMA 250	Protection against contact to type 1	
Earth leakage current	IEC/EN 61800-5-1	> 3.5 mA AC > 10 mA DC	Observe regulations and safety instructions!
Insulation resistance	IEC/EN 61800-5-1	< 2000 m site altitude: overvoltage category III	
		> 2000 m site altitude: overvoltage category II	

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 from +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	Degree of pollution 2
Vibration resistance (9.81 m/s² = 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/s²
		200 ... 500 Hz: acceleration resistant up to 15 m/s²
Operation	Germanischer Lloyd	5 ... 13.2 Hz: Amplitude ±1 mm 13.2 ... 100 Hz: acceleration resistant up to 0.7 g
	IEC/EN 60068-2-6	10 ... 57 Hz: Amplitude 0.075 mm
		57 ... 150 Hz: Acceleration resistant up to 1 g

Mounting conditions		
Mounting place		In the control cabinet
Mounting position		Vertically
Free space		The required free space results from the mounting position and the specifications of the standard device.

Rated data

Mains	Voltage U_{Lrated} [V]	Voltage range U_{Lrated} [V]	Frequency range f [Hz]
3/PE AC	230	180 - 0 % ... 264 + 0 %	45 - 0 % ... 65 + 0 %
3/PE AC	400	320 - 0 % ... 440 + 0 %	45 - 0 % ... 65 + 0 %
3/PE AC	480	340 - 0 % ... 528 + 0 %	45 - 0 % ... 65 + 0 %

	Voltage [V]	Freq. [Hz]	Current [A] ① max. +45° C	Current [A] ① max. +55° C	Number of phases
E94AZMP0824	230/400/480	50/60	82/82/82	61/61/61	3
E94AZMP2004	230/400/480	50/60	200/200/200	150/150/150	3

① Temperature in the control cabinet

	Power loss P_{loss} [W]	Inductance L [mH]	Voltage drop ΔU [V]
E94AZMP0824	200	0.25	6.4
E94AZMP2004	350	0.10	6.3

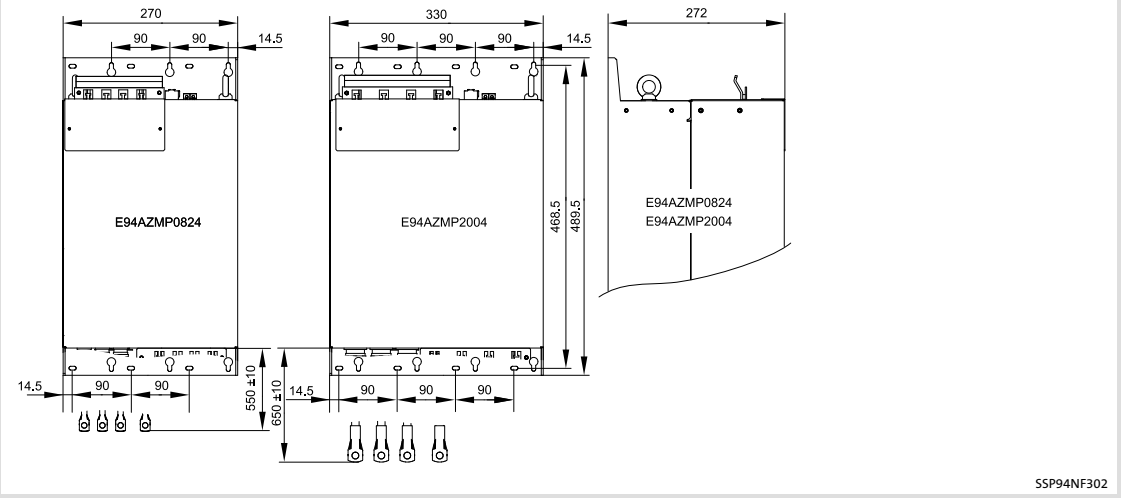
Thermal contact

	Design	max. switching voltage U_{Th} [V AC]	max. switching current I_{Th} [A]
E94AZMP0824	NC contact, 150 °C	250	2.5
E94AZMP2004			

Fan

	Voltage [V DC]	Current [A]
E94AZMP0824	24	0.3
E94AZMP2004		

Dimensions



All dimensions in millimetres.

	Mass [kg]
E94AZMP0824	29.0
E94AZMP2004	51.5

Mechanical installation

For information on this topic, please see the corresponding mounting instructions.

Electrical installation

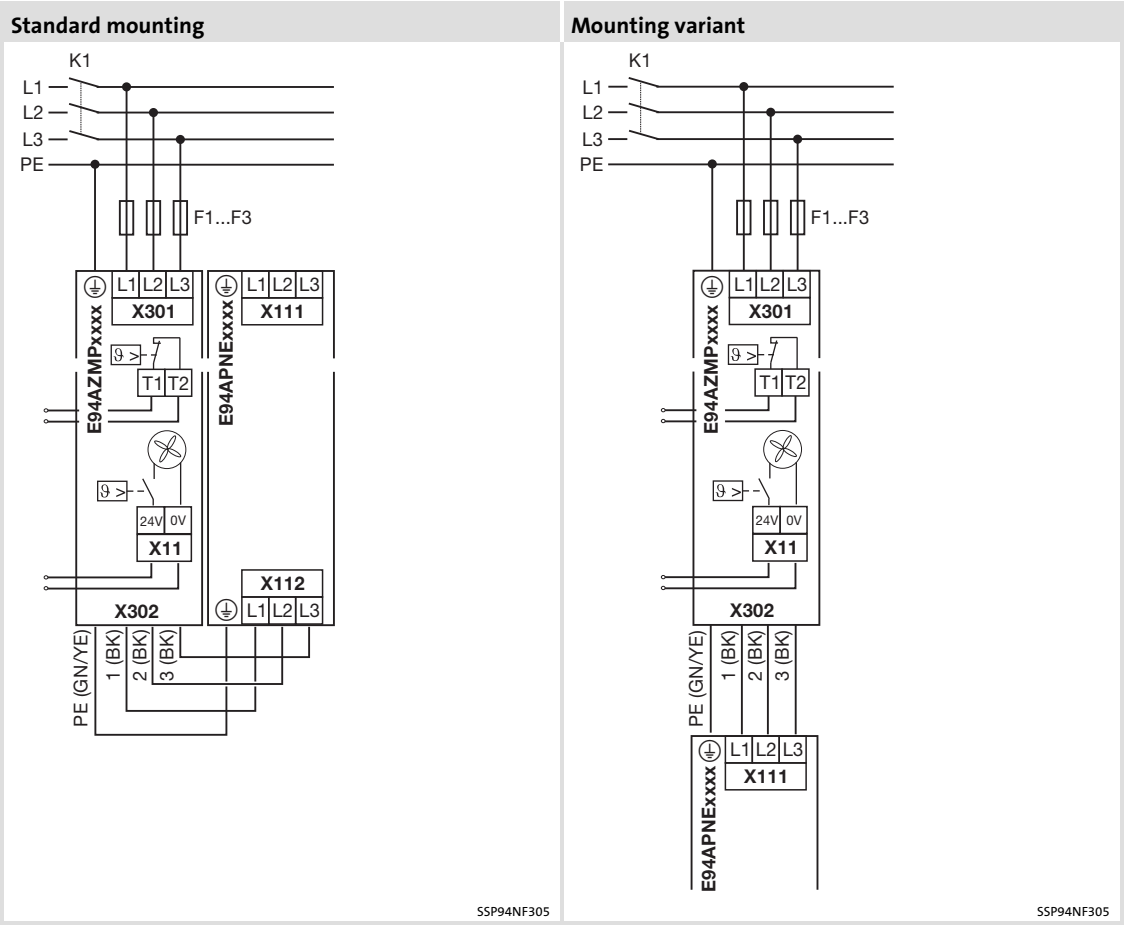
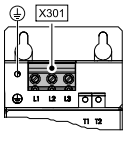


Fig. 8-5 Connection concept

E94AZMPxxxx	Mains filter
E94APNExxxx	9400 DC power supply module
F1 ... F3	Fuses
K1	Mains contactor

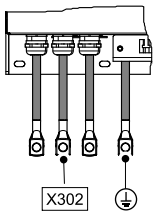
Mains

Terminal X301	Labelling	Description
 SSP94NF106	L1 L2 L3	Connection of the mains phases L1, L2, L3
	⏚	Connection for the supply-side PE conductor with M5 ring cable lug

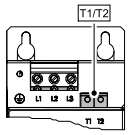
Terminal data

	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
E94AZxP0824 Connection with M8 ring cable lug	70 (2 x 70)	2/0	12	106	SW13
E94AZxP2004 Connection with M10 ring cable lug	150 (2 x 120)	250 mcm	20	177	SW15

Standard device

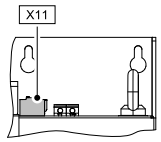
Cable X302	Labelling	Description
 SSP94NF307	L1' L2' L3'	Filter output conductor (lead with ring cable lug, colour BK)
		Output PE conductor (lead with ring cable lug, colour GN/YE)

Thermal contact

Terminal T1/T2	Labelling	Description
 SSP94NF108	T1 T2	Thermal contact connection

Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
E94AZxP0824	4.0	10	0.6 ... 0.8	5.3 ... 7.1	PZ1
E94AZxP2004					

Fan

Terminal X11	Labelling	Description
 SSP94NF309	GE	GND External supply
	24E	24 V External supply through safely separated power supply unit (SELV/PELV)

Terminal data				
	Conductor cross-section		Tightening torque	
	[mm²]	[AWG]	[Nm]	[lb-in]
E94AZMP0824	0.2 ... 2.5	24 ... 12	-	
E94AZMP2004				

Safety instructions for the installation according to UL/CSA

Original - English

Warnings!

Conditions of Acceptability:

- The products covered by this report are only intended for use with Power Conversion Equipment (inverters).
- Consideration shall be given to the field wiring leads. No strain relief test was performed on the leads.
- The devices in this report are only evaluated for factory wiring use.
- Temperature tests were performed with hook mounted drive.

Original - French

Avertissement !

Conditions d'acceptabilité :

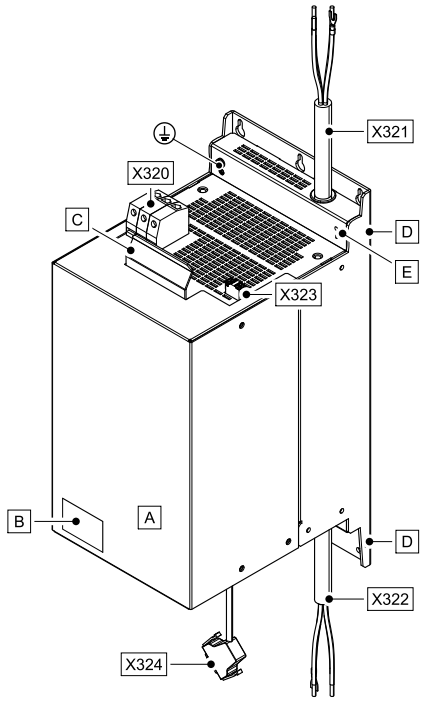
- Les produits concernés par ce rapport sont destinés exclusivement à être utilisés avec des convertisseurs de puissance (variateurs ou power conversion equipment).
- Une attention particulière doit être apportée aux tresses de câblage à pied d'oeuvre. Aucun test de décharge de traction n'a été réalisé sur ces éléments.
- Les équipements concernés par ce rapport sont évalués exclusivement pour un câblage en usine.
- Les tests de température ont été réalisés avec un entraînement à crochet.

8.10.4 Mains filters for regenerative power supply modules E94AZMRxxxx (26 ... 47 A)

Assignment of filters to standard devices

Mains filter	Regenerative power supply module		Device size
	Standard device	Installation backplane	
E94AZMR0264SDB E94AZMR0264LDB	E94ARNE0134	E94AZPP0364	GG3
E94AZMR0474SDB E94AZMR0474LDB	E94ARNE0244		

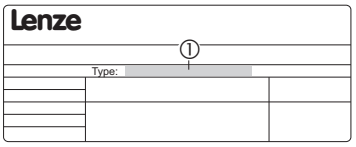
Elements on the filter



Pos.	Description
A	Mains filter
	Mounting Instructions

Pos.	Description
B	Nameplate
C	Lifting aid
D	Mounting aid for mounting base
E	Parking position of the IT screw
⏚	PE terminal
X320	Terminal L1 ... L3
X321	Connecting cable L1.1 ... L3.1
X322	Connecting cable L1.2 ... L3.2
X323	Terminal for 24-V supply voltage (use safely separated power supply unit (SELV/PELV), in accordance with IEC 61131-2)
X324	Mains filter control signal

Identification



SSP94NF002

Type code	①							
	E94	A	Z	MR	xxx	4	xx	B

Product range

Version

accessories

Type mains filter for regenerative power supply module

Rated current [A]

Voltage class
4 = 230 ... 400/480 V

Version
SD = short-distance motor cables
LD = long-distance motor cables

Operating mode
B = block mode

General data

Conformity and approval		
Conformity		
Approval		
$_{c}UR_{US}$	UL508 CSA C22.2 No.14	Industrial Control Equipment, Underwriter Laboratories (File-No. E219022) for USA and Canada

Mains data	
Mains types	
With grounded neutral (TT/TN systems)	Operation permitted without restrictions
IT systems	Request specific measures from Lenze

Protection of persons and equipment			
Enclosure	EN 60529	IP20	Not in the wire range of the terminals
	NEMA 250	Protection against contact to type 1	
Earth leakage current	IEC/EN 61800-5-1	> 3.5 mA AC > 10 mA DC	Observe regulations and safety instructions!
Insulation resistance	IEC/EN 61800-5-1	< 2000 m site altitude: overvoltage category III	
		> 2000 m site altitude: overvoltage category II	

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 from +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	Degree of pollution 2
Vibration resistance (9.81 m/s² = 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/s²
		200 ... 500 Hz: acceleration resistant up to 15 m/s²
Operation	Germanischer Lloyd	5 ... 13.2 Hz: Amplitude ±1 mm 13.2 ... 100 Hz: acceleration resistant up to 0.7 g
	IEC/EN 60068-2-6	10 ... 57 Hz: Amplitude 0.075 mm
		57 ... 150 Hz: Acceleration resistant up to 1 g

Mounting conditions		
Mounting place		In the control cabinet
Mounting position		Vertically
Free space		The required free space results from the mounting position and the specifications of the standard device.

Rated data

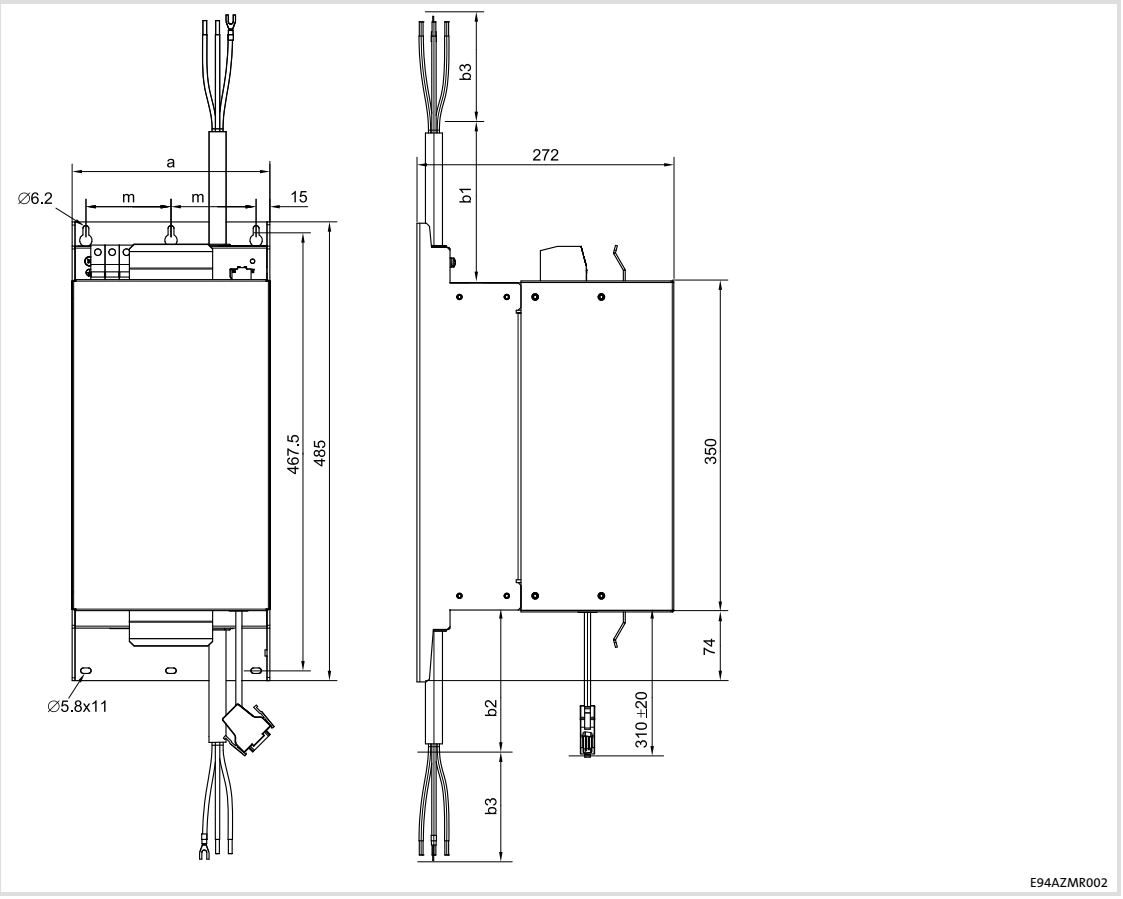
Mains	Voltage U_{Lrated} [V]	Voltage range U_{Lrated} [V]	Frequency range f [Hz]
3/PE AC	230	180 - 0 % ... 264 + 0 %	45 - 0 % ... 65 + 0 %
3/PE AC	400	320 - 0 % ... 440 + 0 %	45 - 0 % ... 65 + 0 %
3/PE AC	480	340 - 0 % ... 528 + 0 %	45 - 0 % ... 65 + 0 %

	Voltage [V]	Freq. [Hz]	Current [A] ① max. +45° C	Current [A] ① max. +55° C	Number of phases
E94AZMR0264xDB	230/400/480	50/60	26/26/26	19/19/19	3
E94AZMR0474xDB	230/400/480	50/60	47/47/47	35/35/35	3

① Temperature in the control cabinet

	Power loss	Inductance	Regenerative inductance	Voltage drop
	P_V [W]	L [mH]	L_{gen} [mH]	ΔU [V]
E94AZMR0264SDB	65	0.77 ±10 %	0.84 ±10 %	6.3
E94AZMR0264LDB	72			
E94AZMR0474SDB	85	0.42 ±10 %	1.54 ±10 %	6.2
E94AZMR0474LDB	101			

Dimensions



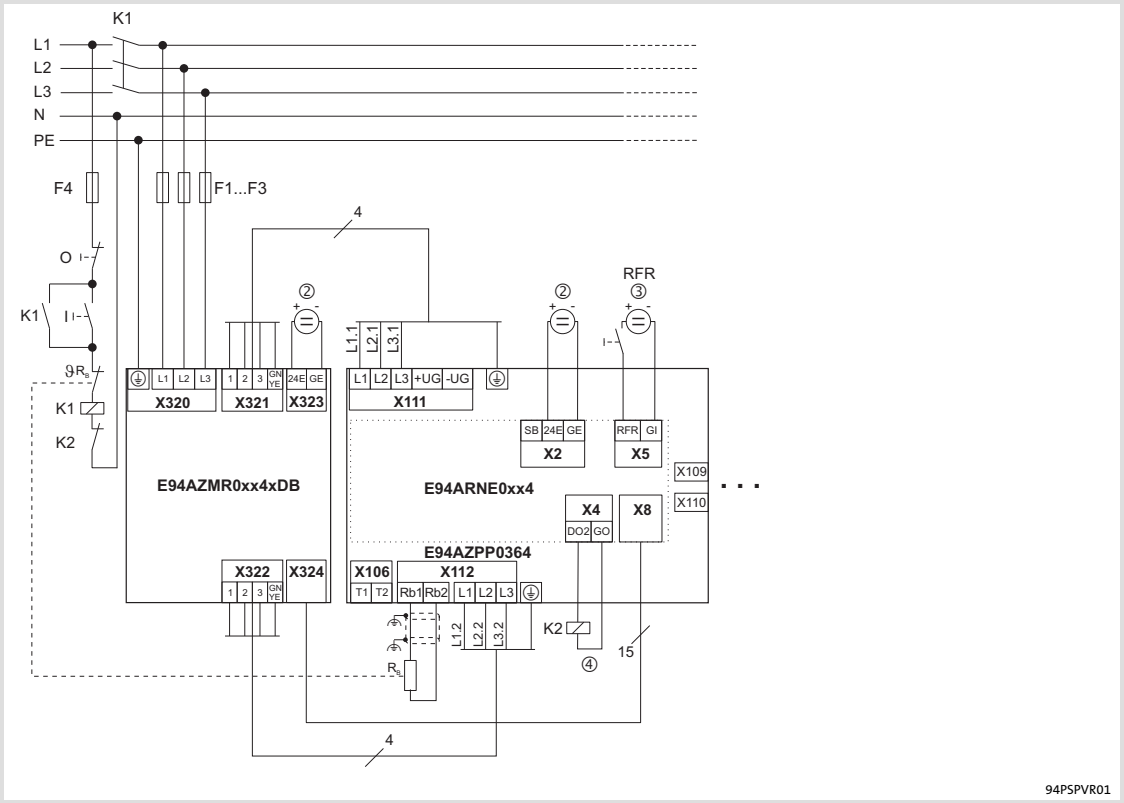
All dimensions in millimetres.

	a	m	b1	b2	b3	
	[mm]					[kg]
E94AZRM0264SDB	149	60	240 ±5	260 ±5	100 ±5	25
E94AZRM0264LDB						26
E94AZRM0474SDB	209	90	250 ±5	270 ±5	110 ±5	36
E94AZRM0474LDB						37

Mechanical installation

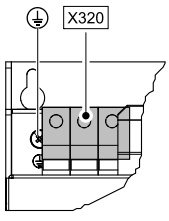
For information on this topic, please see the corresponding mounting instructions.

Electrical installation



E94ARNE0xx4	Regenerative power supply module
E94AZPP0364	Installation backplane for the regenerative power supply module
E94AZMR0...	Mains filter
F1 ... F4	Fuses
RFR	Controller enable (only for regenerative feedback)
K1	Mains contactor
RB	Brake resistor (Mounting instructions brake resistor)
②	24 V voltage source for the control electronics (safely separated power supply unit (SELV/PELV) according to IEC 61131-2)
③	24 V voltage source for the digital inputs according to IEC 61131-2
④	From FW 02.00: Overtemperature disconnection DO2 load: max. 50 mA

Mains

Terminal X320	Labelling	Description
 SSP94NF406	L1 L2 L3	Connection of the L1, L2, L3 mains phases
	⏚	Connection for the supply-side PE conductor with M5 ring cable lug

Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
E94AZMR0264xDB	10	6	1.2 ... 1.5	10.6 ... 13.3	1.0 x 4.0
E94AZMR0474xDB	25	2	2.5	22.1	1.0 x 6.5

PE connection data				
	∅	Starting torque		
	[mm]	[Nm]	[lb-in]	
E94AZMR0264xDB	M5	3	26.5	PH2
E94AZMR0474xDB				

24 V supply

Terminal X323	Labelling	Description
 SSP9400X11	GE	GND external supply
	24E	24 V external supply through safely separated power supply unit (SELV/PELV) IEC 61131-2, 22.8 ... 28.8 V, residual ripple max. ±5 % Current during operation: 450 mA Starting current: max. 4 A for 100 ms

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

Safety instructions for the installation according to UL/CSA

Original - English

Warnings!

Conditions of Acceptability:

- ► The products are only intended to be used for Lenze Drives E94ARNE0134 and E94ARNE0244.
  - – All test results are only valid for this Lenze Drives.
- ► The devices are only evaluated for factory wiring use.

Original - French

Avertissement !

Conditions d'acceptabilité :

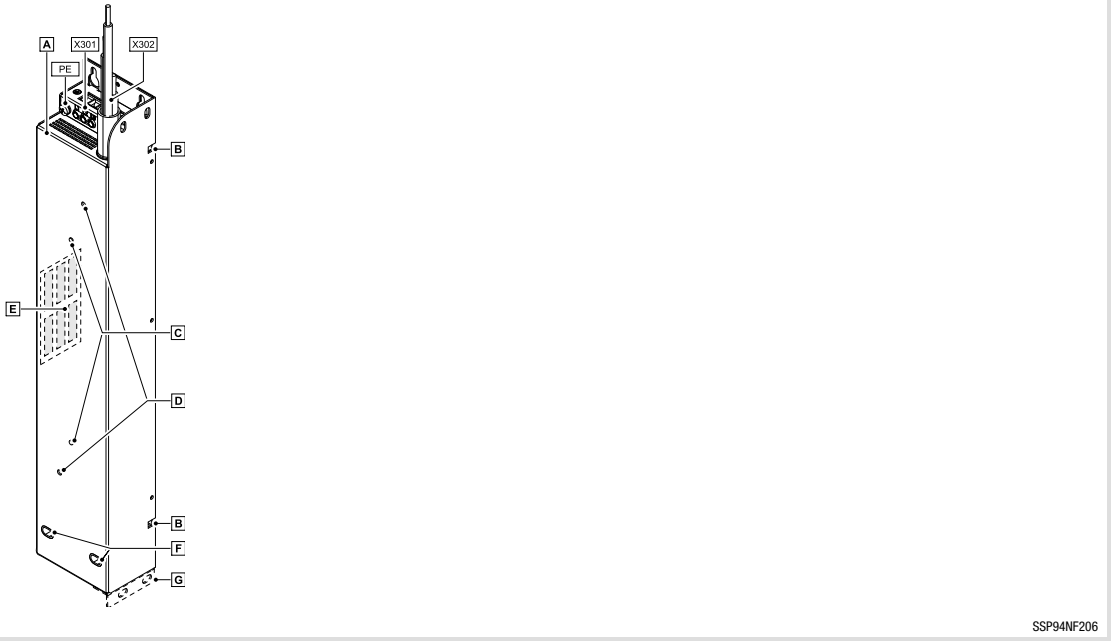
- ► Ces produits sont destinés exclusivement à être utilisés avec les systèmes d'entraînement Lenze E94ARNE0134 et E94ARNE0244.
  - – Tous les résultats des tests sont valables uniquement pour ces systèmes d'entraînement Lenze.
- ► Ces équipements sont évalués exclusivement pour un câblage en usine.

8.10.5 RFI filters for single-axis controllers E94AZRSxxxx (4 ... 29 A)

Assignment of filters to standard devices

RFI filter type	Single-axis controller type	Device size
E94AZRS0044	E94xSxE002x	1
	E94xSxE003x	
E94AZRS0104	E94xSxE004x	2
	E94xSxE007x	
E94AZRS0294	E94xSxE013x	3
	E94xSxE017x	
	E94xSxE024x	

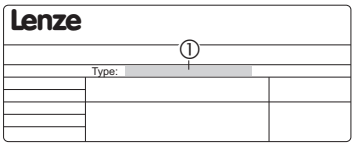
Elements on the filter



Pos.	Description
A	RFI filter E94AZRSxxxx
	Mounting Instructions

Pos.	Description
PE	PE connection (for M5 ring or fork-type cable lug)
X301	Mains terminal L1 ... L3
X302	Connection cable to controller, 4-core
B	Mounting aid for mounting base
C	Guide pins for mounting base
D	Mounting thread for mounting base
E	Nameplate
F	Fastening at the bottom
G	Angle bracket for ”side-by-side” mounting variant, device sizes 2 and 3

Identification



SSP94NF002

	①						
Type code	**E94**	**A**	**Z**	**R**	**S**	**xxx**	**x**
Product range							
Version							
accessories							
RFI filter type							
for 9400 Single Drive							
Rated current [A]							
Voltage class 4 = 230 ... 400/480 V							

General data

Conformity and approval		
Conformity		
Approval		
$_{C}UR_{US}$	UL508 CSA C22.2 No.14	Industrial Control Equipment, Underwriter Laboratories (File-No. E219022) for USA and Canada

Mains data	
Mains types	
With grounded neutral (TT/TN systems)	Operation permitted without restrictions
Other mains types	Observe instructions for special measures in the documentation for the basic device!

Protection of persons and equipment			
Enclosure	EN 60529	IP20	Not in the wire range of the terminals
	NEMA 250	Protection against contact to type 1	
Earth leakage current	IEC/EN 61800-5-1	> 3.5 mA AC > 10 mA DC	Observe regulations and safety instructions!
Insulation resistance	IEC/EN 61800-5-1	< 2000 m site altitude: overvoltage category III	
		> 2000 m site altitude: overvoltage category II	

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 from +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	Degree of pollution 2
Vibration resistance (9.81 m/s² = 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/s²
		200 ... 500 Hz: acceleration resistant up to 15 m/s²
Operation	Germanischer Lloyd	5 ... 13.2 Hz: Amplitude ±1 mm 13.2 ... 100 Hz: acceleration resistant up to 0.7 g
	IEC/EN 60068-2-6	10 ... 57 Hz: Amplitude 0.075 mm
		57 ... 150 Hz: Acceleration resistant up to 1 g

Mounting conditions		
Mounting place		In the control cabinet
Mounting position		Vertically
Free space		The required free space results from the mounting position and the specifications of the standard device.

Rated data

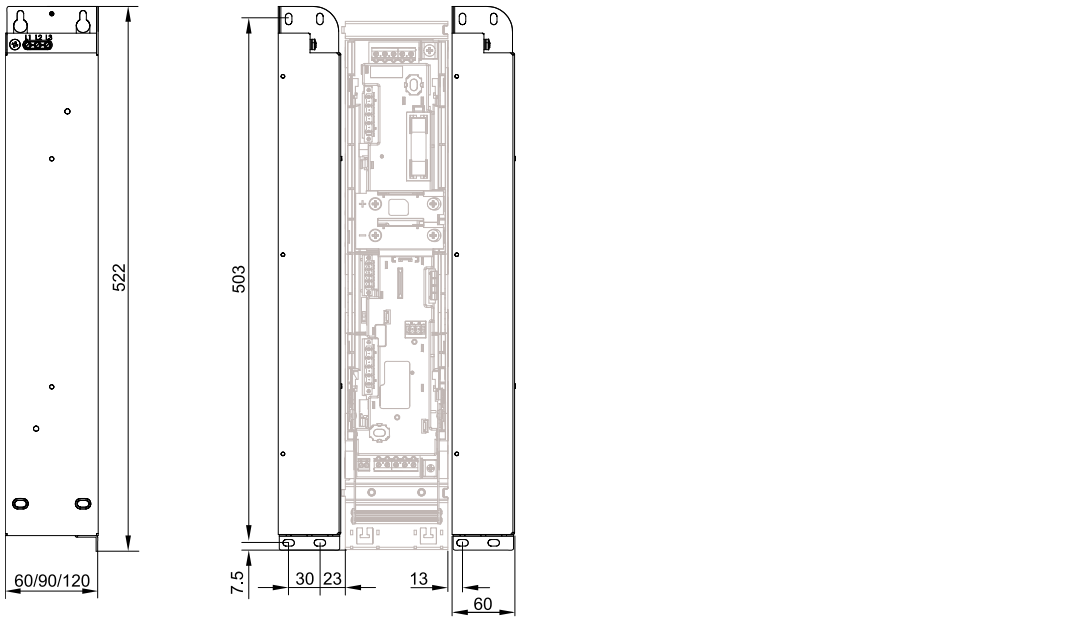
Mains	Voltage U_{Lrated} [V]	Voltage range U_{Lrated} [V]	Frequency range f [Hz]
3/PE AC	230	180 - 0 % ... 264 + 0 %	45 - 0 % ... 65 + 0 %
3/PE AC	400	320 - 0 % ... 440 + 0 %	45 - 0 % ... 65 + 0 %
3/PE AC	480	340 - 0 % ... 528 + 0 %	45 - 0 % ... 65 + 0 %

	Voltage	Frequency	Rated current [A]		Number of phases
	[V]	[Hz]	up to +45 °C ①	up to +55 °C ①	
E94AZRS0044	230/400/480	50/60	3.5/3.5/3.5	2.2/2.2/2.2	3
E94AZRS0104	230/400/480	50/60	10/10/10	6.2/6.2/6.2	3
E94AZRS0294	230/400/480	50/60	29/29/29	18/18/18	3

① Temperature in the control cabinet

	Power loss P_{loss} [W]	Inductance L [mH]	Voltage drop ΔU [V]
E94AZRS0044	4	-	-
E94AZRS0104	8	-	-
E94AZRS0294	22	-	-

Dimensions



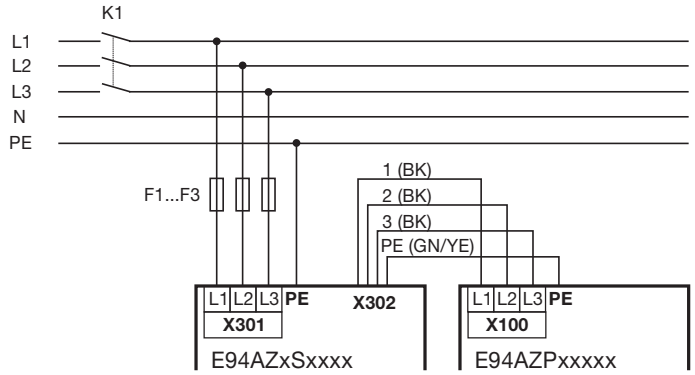
All dimensions in millimetres.

	Mass [kg]
E94AZRS0044	1.8
E94AZRS0104	2.3
E94AZRS0294	3.6

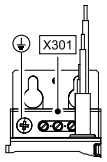
Mechanical installation

For information on this topic, please see the corresponding mounting instructions.

Electrical installation



Mains

Terminal X301	Labelling	Description
 SSP94FF008	L1 L2 L3	Connection of the mains phases L1, L2, L3
	⏚	Connection for the supply-side PE conductor with M5 ring cable lug

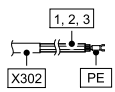
Terminal data

	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
E94AZRS0044	2.5	14	0.5 ... 0.6	4.4 ... 5.3	PH1
E94AZRS0104	4	12			
E94AZRS0294	10	8	1.2 ... 1.5	10.6 ... 13.3	

PE connection data

	∅	Starting torque		
	[mm]	[Nm]	[lb-in]	
E94AZRS0044	M5	3.0	26.5	SW 8
E94AZRS0104				
E94AZRS0294				

Standard device

Cable X302	Labelling	Description
 SSP94FF007	1 2 3	Filter output conductor (lead with wire end ferrule, colour BK)
	PE	Output-side PE conductor (lead with M5 fork-type cable lug, colour GN/YE)

Safety instructions for the installation according to UL/CSA

Original - English

Warnings!

Conditions of Acceptability:

- The products covered by this report are only intended for use with Power Conversion Equipment (inverters).
- Consideration shall be given to the field wiring leads. No strain relief test was performed on the leads.
- The devices in this report are only evaluated for factory wiring use.
- Temperature tests were performed with hook mounted drive.

Original - French

Avertissement !

Conditions d'acceptabilité :

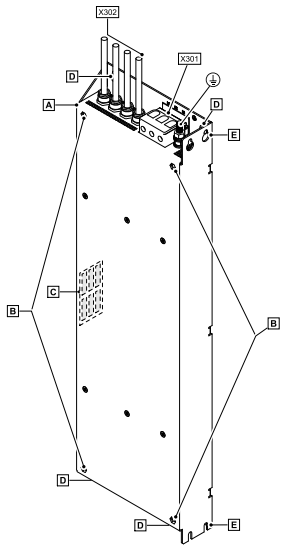
- Les produits concernés par ce rapport sont destinés exclusivement à être utilisés avec des convertisseurs de puissance (variateurs ou power conversion equipment).
- Une attention particulière doit être apportée aux tresses de câblage à pied d'oeuvre. Aucun test de décharge de traction n'a été réalisé sur ces éléments.
- Les équipements concernés par ce rapport sont évalués exclusivement pour un câblage en usine.
- Les tests de température ont été réalisés avec un entraînement à crochet.

8.10.6 RFI filters for single-axis controllers E94AZRSxxxx (54 ... 95 A)

Assignment of filters to standard devices

RFI filter		Single-axis controller	
Type	Device size	Type	Device size
E94AZRS0544	6	E94xSxE032x	6
		E94xSxE047x	
		E94xSxE059x	
E94AZRS0954	7	E94xSxE086x	7
		E94xSxE104x	

Elements on the filter

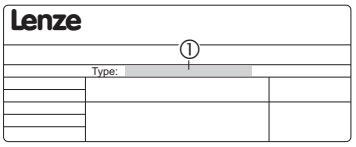


SSP94FF601

Pos.	Description
A	RFI filter E94AZRSxxxx
	Mounting Instructions

Pos.	Description
⏚	PE connection (for ring or fork-type cable lug M8)
X301	Mains terminal L1 ... L3
X302	Connection cable to controller, four-core
B	Fastening thread for standard device
C	Nameplate
D	Fixings for standard mounting (footprint mounting)
E	Fixings for mounting variant (side-by-side mounting)

Identification



SSP94NF002

	①						
Type code	**E94**	**A**	**Z**	**R**	**S**	**xxx**	**x**
Product range							
Version							
accessories							
RFI filter type							
for 9400 Single Drive							
Rated current [A]							
Voltage class 4 = 230 ... 400/480 V							

General data

Conformity and approval		
Conformity		
Approval		
$_{C}UR_{US}$	UL508 CSA C22.2 No.14	Industrial Control Equipment, Underwriter Laboratories (File-No. E219022) for USA and Canada

Mains data	
Mains types	
With grounded neutral (TT/TN systems)	Operation permitted without restrictions
Other mains types	Observe instructions for special measures in the documentation for the basic device!

Protection of persons and equipment			
Enclosure	EN 60529	IP20	Not in the wire range of the terminals
	NEMA 250	Protection against contact to type 1	
Earth leakage current	IEC/EN 61800-5-1	> 3.5 mA AC > 10 mA DC	Observe regulations and safety instructions!
Insulation resistance	IEC/EN 61800-5-1	< 2000 m site altitude: overvoltage category III	
		> 2000 m site altitude: overvoltage category II	

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 from +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	Degree of pollution 2
Vibration resistance (9.81 m/s² = 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/s²
		200 ... 500 Hz: acceleration resistant up to 15 m/s²
Operation	Germanischer Lloyd	5 ... 13.2 Hz: Amplitude ±1 mm 13.2 ... 100 Hz: acceleration resistant up to 0.7 g
	IEC/EN 60068-2-6	10 ... 57 Hz: Amplitude 0.075 mm
		57 ... 150 Hz: Acceleration resistant up to 1 g

Mounting conditions		
Mounting place		In the control cabinet
Mounting position		Vertically
Free space		The required free space results from the mounting position and the specifications of the standard device.

Rated data

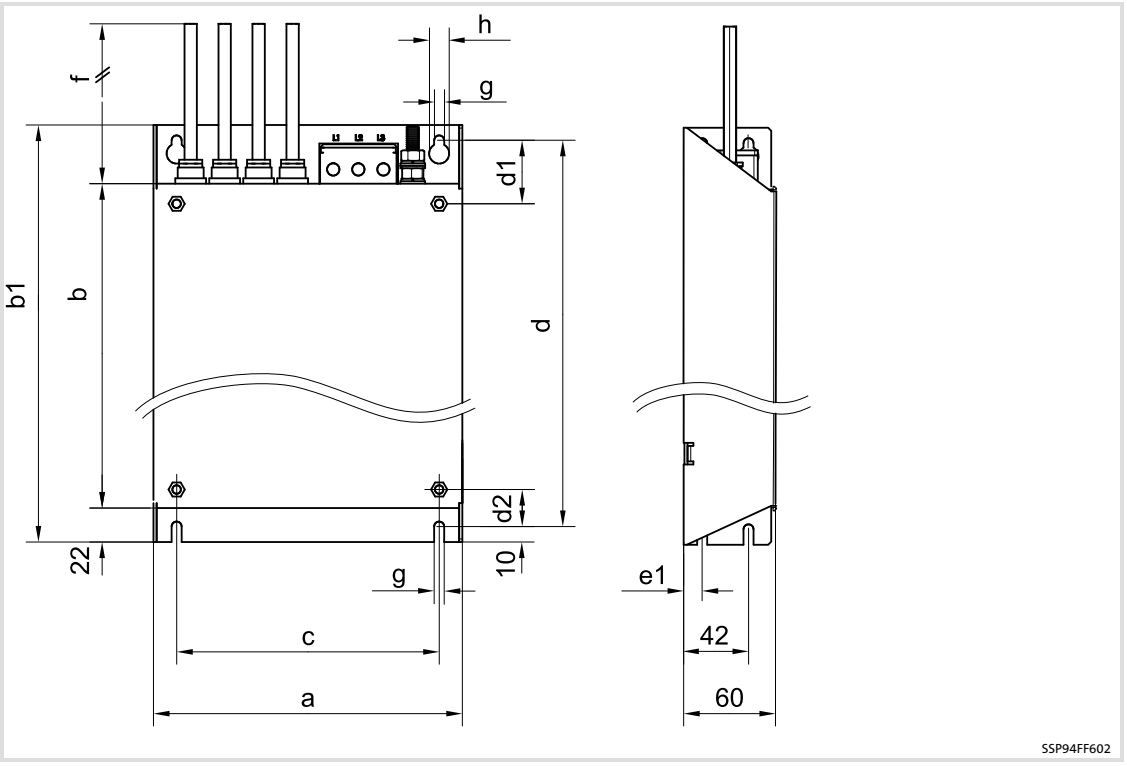
Mains	Voltage U_{Lrated} [V]	Voltage range U_{Lrated} [V]	Frequency range f [Hz]
3/PE AC	230	180 - 0 % ... 264 + 0 %	45 - 0 % ... 65 + 0 %
3/PE AC	400	320 - 0 % ... 440 + 0 %	45 - 0 % ... 65 + 0 %
3/PE AC	480	340 - 0 % ... 528 + 0 %	45 - 0 % ... 65 + 0 %

	Voltage [V]	Frequency [Hz]	Rated current [A]		Number of phases
			up to +45 °C ①	up to +55 °C ①	
E94AZRS0544	230/400/480	50/60	54.0/54.0/54.0	40.5/40.5/40.5	3
E94AZRS0954	230/400/480	50/60	95.0/95.0/95.0	71.0/71.0/71.0	3

① Temperature in the control cabinet

	Power loss P_{loss} [W]	Inductance L [mH]	Voltage drop ΔU [V]
E94AZRS0544	50	–	–
E94AZRS0954	70	–	–

Dimensions



All dimensions in millimetres.

E94AZxS	a	b	b1	c	d	d1	d2	e1	f	g	h	Mass
	[mm]											[kg]
...0544	201	610	670	170	650	41	24	12	500 ±10	6.5	13.0	9
...0954	261	713	790	230	760	48	27	17	550 ±10	9.0	16.5	13

E94AZxS	a	b	b1	c	d	d1	d2	e1	f	g	h	Mass
	[mm]											[kg]
...0544	201	610	670	170	650	41	24	12	500 ±10	6.5	13.0	9
...0954	261	713	790	230	760	48	27	17	550 ±10	9.0	16.5	13

	Mass
	[kg]
E94AZRS0044	1.8
E94AZRS0104	2.3
E94AZRS0294	3.6

Mechanical installation

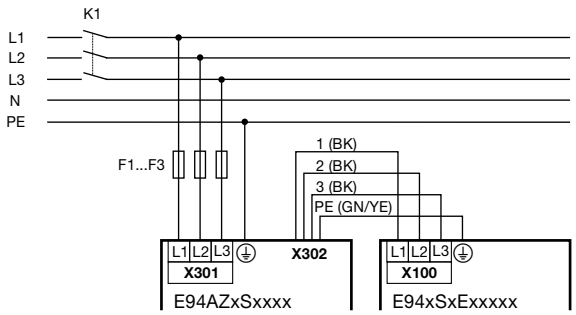
Note!

The filter can be mounted in two ways. From this result different mounting dimensions.

- ► Standard mounting: The filter is mounted underneath the standard device.
- ► Side-by-side mounting: In case of a low depth of the control cabinet, the filter is rotated by 90° and mounted to the left side of the standard device.

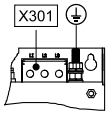
For information on this topic, please see the corresponding mounting instructions.

Electrical installation



SSP94FF610

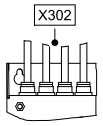
Mains

Terminal X301	Labelling	Description
 SSP94FF606	L1 L2 L3	Connection of the mains phases L1, L2, L3
	⏚	Connection for the supply-side PE conductor with ring cable lug M8

Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
E94AZxS0544	50	0	10	88.5	Hexagon socket 5
E94AZxS0954	95	000	14	124.0	

PE connection data				
	∅	Starting torque		
	[mm]	[Nm]	[lb-in]	
E94AZxS0544	M8	12	106	SW 13
E94AZxS0954				

Standard device

Cable X302	Labelling	Description
 SSP94FF607	1 2 3	Filter output conductor (lead with wire end ferrules, colour BK)
	PE	Output-side PE conductor (lead with wire end ferrule, colour GN/YE)

Safety instructions for the installation according to UL/CSA

Original - English

Warnings!

Conditions of Acceptability:

- The products covered by this report are only intended for use with Power Conversion Equipment (inverters).
- Consideration shall be given to the field wiring leads. No strain relief test was performed on the leads.
- The devices in this report are only evaluated for factory wiring use.
- Temperature tests were performed with hook mounted drive.
- Reactor model E94AZR0544 shall be installed with input wiring of 4 AWG minimum. Reactor model E94AZR0954 shall be installed with input wiring of 1/0 AWG minimum.

Original - French

Avertissement !

Conditions d'acceptabilité :

- Les produits concernés par ce rapport sont destinés exclusivement à être utilisés avec des convertisseurs de puissance (variateurs ou power conversion equipment).
- Une attention particulière doit être apportée au câblage à pied d'oeuvre. Aucun test de décharge de traction n'a été réalisé sur le câblage.
- Les équipements concernés par ce rapport sont évalués exclusivement pour un câblage en usine.
- Les tests de température ont été réalisés avec un entraînement à crochet.
- Il convient de prévoir un câblage d'entrée de 4 AWG minimum pour le modèle E94AZR0544 et de 1/0 AWG minimum pour le modèle E94AZR0954.

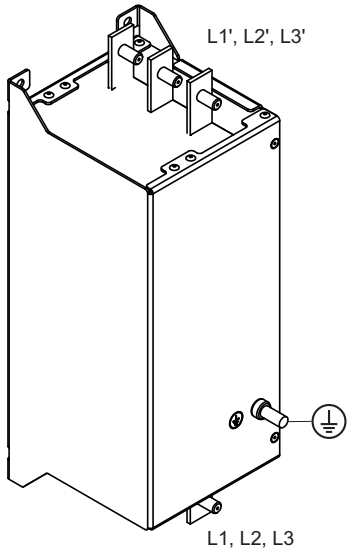
8.10.7 RFI filters for single-axis controllers E94AZRSxxxx (3F480-xxx.290EM) 180 ... 415 A

Assignment of filters to standard devices

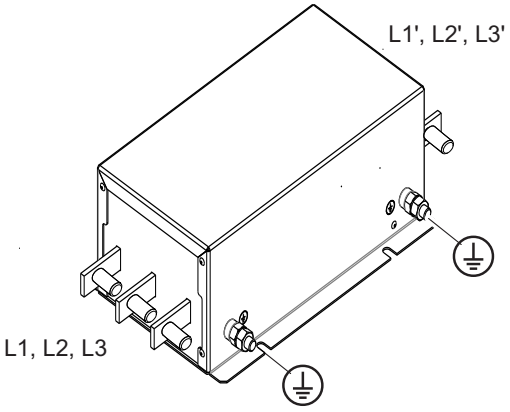
RFI filter		Single-axis controller	
Type (Lenze)	Type (see nameplate)	Type	Device size
E94AZRS1804	3F480-180.290EM	E94xSHE1454	81
E94AZRS1804	3F480-180.290EM	E94xSHE1724	82
E94AZRS3004	3F480-300.290EM	E94xSHE2024	82
E94AZRS3004	3F480-300.290EM	E94xSHE2454	82
E94AZRS3004	3F480-300.290EM	E94xSHE2924	83
E94AZRS4154	3F480-415.290EM	E94xSHE3664	91
E94AZRS4154	3F480-415.290EM	E94xSHE4604	91

Elements on the filter

E94AZRS1804



E94AZRS3004, E94AZRS4154



Pos.	Description
⏚	PE conductor connection
L1, L2, L3	Mains terminals
L1', L2', L3'	Device terminals

General data

Mains data	
Mains types	
With grounded neutral (TT/TN systems)	Operation permitted without restrictions
Other mains types	Observe instructions for special measures in the documentation for the basic device!

Protection of persons and equipment			
Enclosure	EN 60529	IP20	Not in the wire range of the terminals
	NEMA 250	Protection against contact to type 1	
Earth leakage current	IEC/EN 61800-5-1	> 3.5 mA AC > 10 mA DC	Observe regulations and safety instructions!
Insulation resistance	IEC/EN 61800-5-1	< 2000 m site altitude: overvoltage category III	
		> 2000 m site altitude: overvoltage category II	

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 from +45 ... +55 °C: 1 %/°C
Site altitude		0 ... 4000 m amsl 1000 ... 4000 m amsl: current derating of 5 %/1000 m
Pollution	EN 61800-5-1	Degree of pollution 2
Vibration resistance (9.81 m/s² = 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/s²
		200 ... 500 Hz: acceleration resistant up to 15 m/s²
Operation	Germanischer Lloyd	5 ... 13.2 Hz: Amplitude ±1 mm 13.2 ... 100 Hz: acceleration resistant up to 0.7 g
	IEC/EN 60068-2-6	10 ... 57 Hz: Amplitude 0.075 mm
		57 ... 150 Hz: Acceleration resistant up to 1 g

Mounting conditions		
Mounting place		Mount the filters in the control cabinet close to the standard device on the same mounting plate with a good electrical connection.
Mounting position		Vertically
Free space		The filters can be directly side-mounted. In case of heat sources that exceed the maximum ambient temperature of the filter, a minimum distance of 20 mm must be observed.

Rated data

Mains	Voltage U_{Lrated} [V]	Voltage range U_{Lrated} [V]	Frequency range f [Hz]
3/PE AC	400	320 - 0 % ... 440 + 0 %	45 - 0 % ... 65 + 0 %
3/PE AC	480	340 - 0 % ... 528 + 0 %	45 - 0 % ... 65 + 0 %

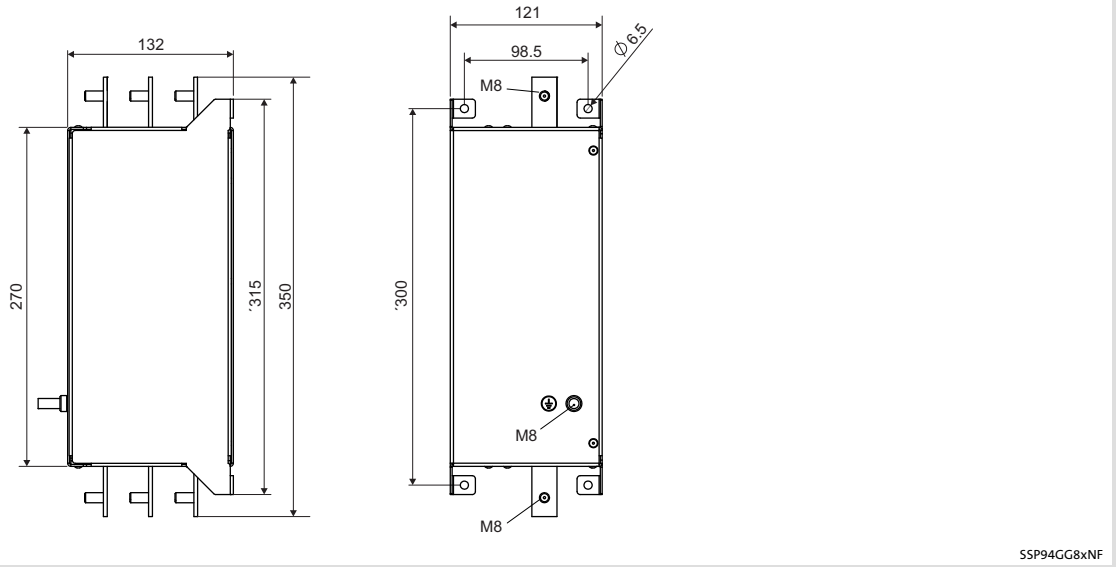
	Voltage [V]	Freq. [Hz]	Current [A] ① max. +45° C	Current [A] ① max. +55° C	Number of phases
E94AZRS1804	400/480	50/60	180/180	162/162	3
E94AZRS3004	400/480	50/60	300/300	270/270	3
E94AZRS4154	400/480	50/60	415/415	374/374	3

① Temperature in the control cabinet

	Power loss P_{loss} [W]	Inductance L [mH]	Voltage drop ΔU [V]
E94AZRS1804	14.2	-	-
E94AZRS3004	21.5	-	-
E94AZRS4154	27.0	-	-

Dimensions

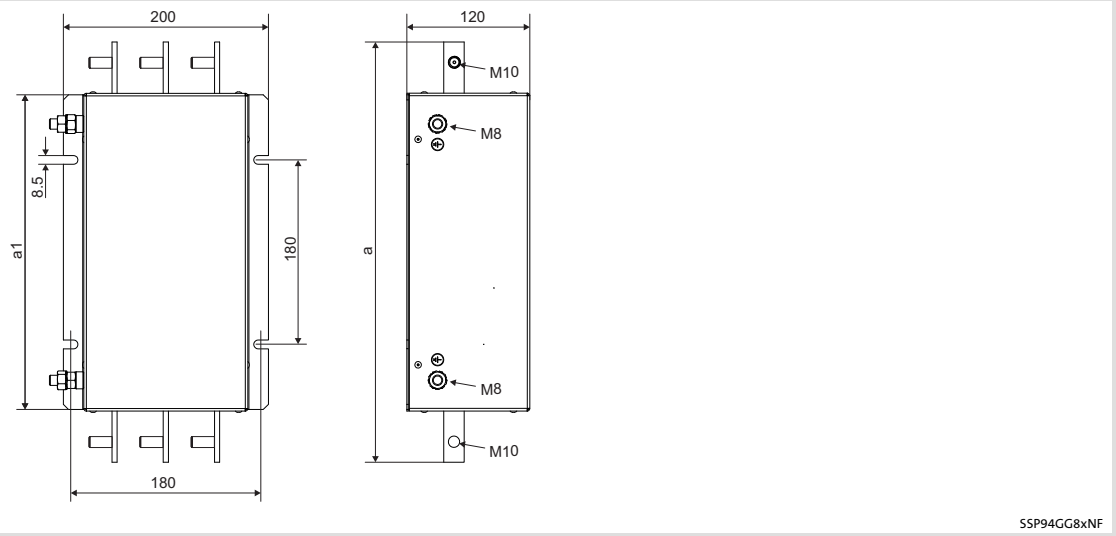
E94AZRS1804:



All dimensions in millimetres.

	Mass [kg]
E94AZRS1804	7.9

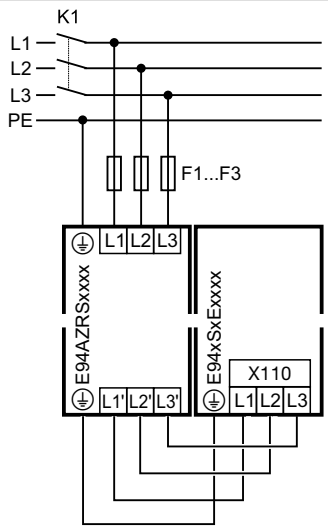
E94AZRS3004, E94AZRS4154:



All dimensions in millimetres.

	a [mm]	a1 mm]	Mass [kg]
E94AZRS3004	410	310	12
E94AZRS4154	450	350	13.5

Electrical installation



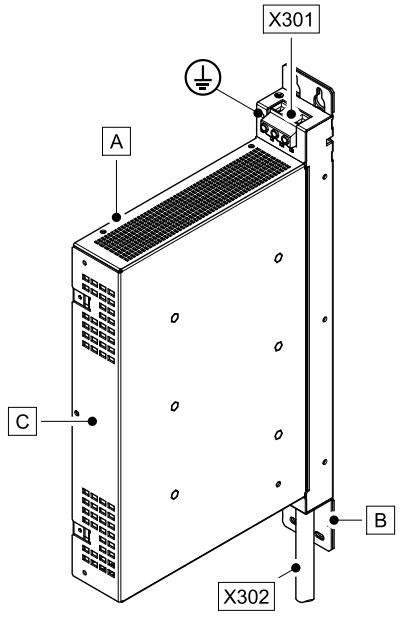
Terminal data L1/L2/L3, L1'/L2'/L3' and PE				
	∅ [mm]	Tightening torque [Nm]	 [lb-in]	
E94AZRS1804	M8	9	80	WAF 13
E94AZRS3004	M10	25 ... 30	221 ... 266	SW 17
E94AZRS4154				

8.10.8 RFI filters for power supply modules E94AZRPxxxx (8 ... 29 A)

Assignment of filters to standard devices

RFI filter		DC power supply module	
Type	Device size	Type	Device size
E94AZRP0084	1	E94APNE0104	1
E94AZRP0294	1	E94APNE0364	3
E94AZRP0294	1	E70ACPSx0304x	1

Elements on the filter

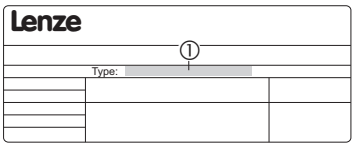


SSP94FF001

Pos.	Description
A	RFI filter E94AZRPxxxx
	Mounting Instructions

Pos.	Description
⏚	Connection of PE conductor
X301	Mains terminal L1 ... L3
X302	Connection cable to DC power supply module, four-core
B	Mounting aid for installation backplane
C	Nameplate

Identification



SSP94NF002

	①						
Type code	**E94**	**A**	**Z**	**R**	**P**	**xxx**	**x**
Product range							
Version							
accessories							
RFI filter type							
for 9400 power supply							
Rated current [A]							
Voltage class 4 = 230 ... 400/480 V							

General data

Conformity and approval			
Conformity			
Approval			
$_{c}UR_{US}$	UL508 CSA C22.2 No.14	Industrial Control Equipment, Underwriter Laboratories (File-No. E219022) for USA and Canada	

Mains data		
Mains types		
With grounded neutral (TT/TN systems)	Operation permitted without restrictions	
Other mains types	Observe instructions for special measures in the documentation for the basic device!	

Protection of persons and equipment			
Enclosure	EN 60529	IP20	Not in the wire range of the terminals
	NEMA 250	Protection against contact to type 1	
Earth leakage current	IEC/EN 61800-5-1	> 3.5 mA AC > 10 mA DC	Observe regulations and safety instructions!
Insulation resistance	IEC/EN 61800-5-1	< 2000 m site altitude: overvoltage category III	
		> 2000 m site altitude: overvoltage category II	

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 from +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	Degree of pollution 2
Vibration resistance (9.81 m/s² = 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/s²
		200 ... 500 Hz: acceleration resistant up to 15 m/s²
Operation	Germanischer Lloyd	5 ... 13.2 Hz: Amplitude ±1 mm 13.2 ... 100 Hz: acceleration resistant up to 0.7 g
	IEC/EN 60068-2-6	10 ... 57 Hz: Amplitude 0.075 mm
		57 ... 150 Hz: Acceleration resistant up to 1 g

Mounting conditions		
Mounting place		In the control cabinet
Mounting position		Vertically
Free space		The required free space results from the mounting position and the specifications of the standard device.

Rated data

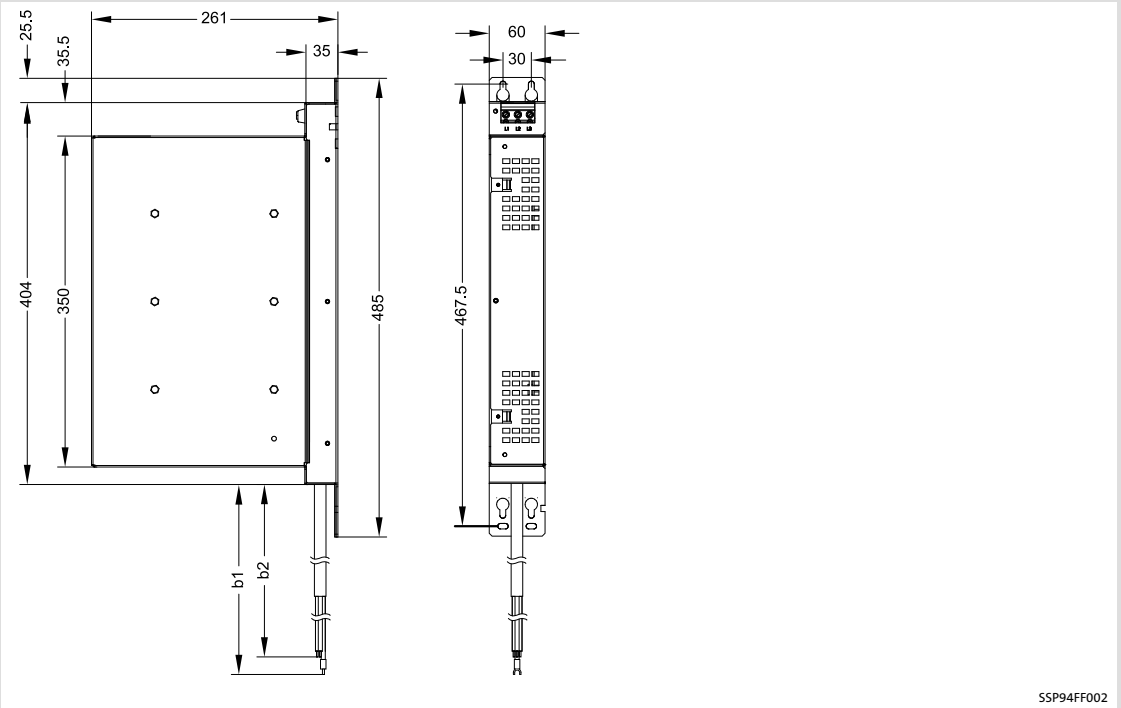
Mains	Voltage U_{Lrated} [V]	Voltage range U_{Lrated} [V]	Frequency range f [Hz]
3/PE AC	230	180 - 0 % ... 264 + 0 %	45 - 0 % ... 65 + 0 %
3/PE AC	400	320 - 0 % ... 440 + 0 %	45 - 0 % ... 65 + 0 %
3/PE AC	480	340 - 0 % ... 528 + 0 %	45 - 0 % ... 65 + 0 %

	Voltage [V]	Freq. [Hz]	Current [A] ① max. +45° C	Current [A] ① max. +55° C	Number of phases
E94AZRP0084	230/400/480	50/60	8/8/8	6/6/6	3
E94AZRP0294	230/400/480	50/60	29/29/29	21.8/21.8/21.8	3

① Temperature in the control cabinet

	Power loss P_{loss} [W]	Inductance L [mH]	Voltage drop ΔU [V]
E94AZRP0084	20	–	–
E94AZRP0294	50	–	–

Dimensions



All dimensions in millimetres.

	b1	b2	Mass
	[mm]		[kg]
E94AZRP0084	360 ±5	350 ±5	4.2
E94AZRP0294	430 ±5	420 ±5	4.5

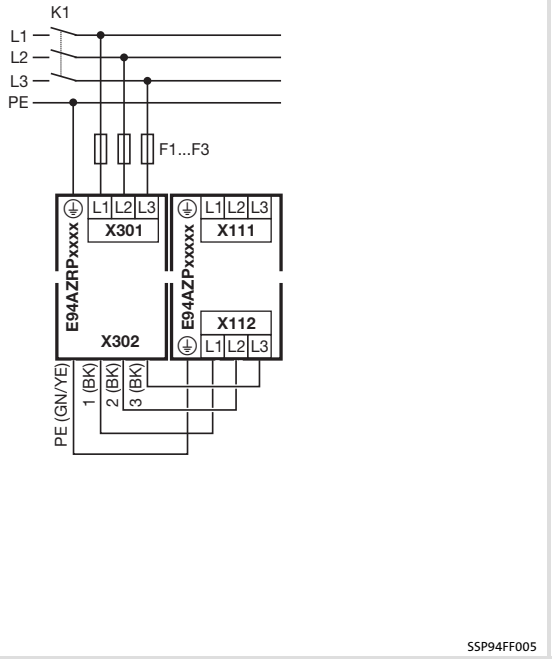
Mechanical installation

For information on this topic, please see the corresponding mounting instructions.

Electrical installation

Connection plan

Standard mounting



Mounting variant

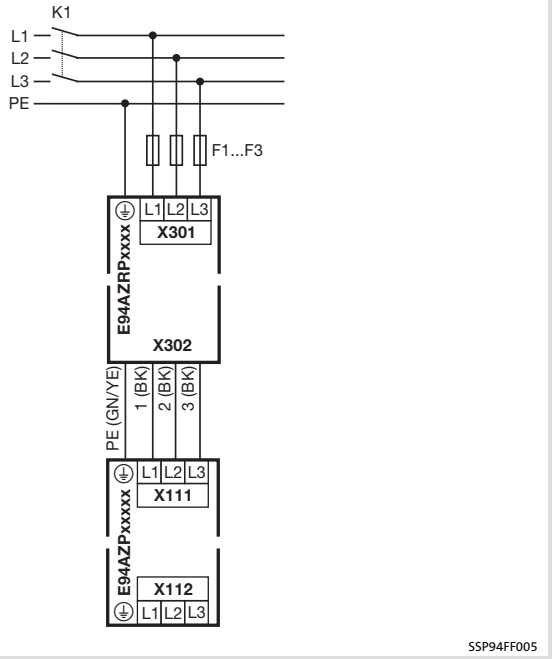
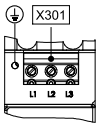


Fig. 8-6 Connection concept

E94AZRPxxxx	RFI filter
E94AZPxxxxx	Installation backplane for 9400 DC power supply module
F1 ... F3	Fuses
K1	Mains contactor

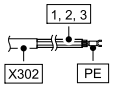
Mains

Terminal X301	Labelling	Description
 SSP94FF006	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		
	[mm²]	[AWG]	[Nm]	[lb-in]	
E94AZxP0084	10	6	1.2 ... 1.5	10.6 ... 13.3	PH1
E94AZxP0294					

PE connection data				
	∅	Starting torque		
	[mm]	[Nm]	[lb-in]	
E94AZxP0084	M5	3	26.5	SW 8
E94AZxP0294				

Standard device

Cable X302	Labelling	Description
 SSP94FF007	1 2 3	Filter output conductor (lead with wire end ferrule, colour BK)
	PE	Output-side PE conductor (lead with M5 fork-type cable lug, colour GN/YE)

Safety instructions for the installation according to UL/CSA

Original - English

Warnings!

Conditions of Acceptability:

- ► The products covered by this report are only intended for use with Power Conversion Equipment (inverters).
- ► Consideration shall be given to the field wiring leads. No strain relief test was performed on the leads.
- ► The devices in this report are only evaluated for factory wiring use.
- ► Temperature tests were performed with hook mounted drive.

Original - French

Avertissement !

Conditions d'acceptabilité :

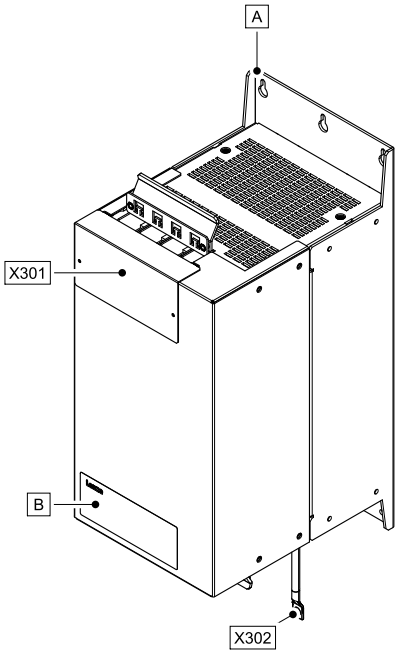
- Les produits concernés par ce rapport sont destinés exclusivement à être utilisés avec des convertisseurs de puissance (variateurs ou power conversion equipment).
- Une attention particulière doit être apportée aux tresses de câblage à pied d'oeuvre. Aucun test de décharge de traction n'a été réalisé sur ces éléments.
- Les équipements concernés par ce rapport sont évalués exclusivement pour un câblage en usine.
- Les tests de température ont été réalisés avec un entraînement à crochet.

8.10.9 RFI filters for power supply modules E94AZRPxxxx (82 ... 200 A)

Assignment of filters to standard devices

RFI filter		DC power supply module	
Type	Device size	Type	Device size
E94AZRP0824	4	E94APNE1004	4
E94AZRP2004	5	E94APNE2454	5
E94AZRP0824	4	E70ACPSx0604x	2

Elements on the filter

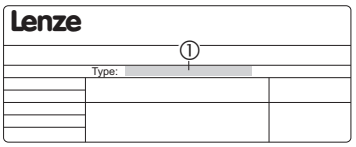


SSP94FF201

Pos.	Description
A	RFI filter E94AZRPxxxx
	Mounting Instructions

Pos.	Description
X301	Mains connection for L1 ... L3 and PE
X302	Connection cables to DC power supply module L1' ... L3' and PE
B	Nameplate

Identification



SSP94NF002

	①						
Type code	**E94**	**A**	**Z**	**R**	**P**	**xxx**	**x**
Product range							
Version							
accessories							
RFI filter type							
for 9400 power supply							
Rated current [A]							
Voltage class 4 = 230 ... 400/480 V							

General data

Conformity and approval			
Conformity			
Approval			
$_{c}UR_{US}$	UL508 CSA C22.2 No.14	Industrial Control Equipment, Underwriter Laboratories (File-No. E219022) for USA and Canada	

Mains data		
Mains types		
With grounded neutral (TT/TN systems)	Operation permitted without restrictions	
Other mains types	Observe instructions for special measures in the documentation for the basic device!	

Protection of persons and equipment			
Enclosure	EN 60529	IP20	Not in the wire range of the terminals
	NEMA 250	Protection against contact to type 1	
Earth leakage current	IEC/EN 61800-5-1	> 3.5 mA AC > 10 mA DC	Observe regulations and safety instructions!
Insulation resistance	IEC/EN 61800-5-1	< 2000 m site altitude: overvoltage category III	
		> 2000 m site altitude: overvoltage category II	

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 from +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	Degree of pollution 2
Vibration resistance (9.81 m/s² = 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/s²
		200 ... 500 Hz: acceleration resistant up to 15 m/s²
Operation	Germanischer Lloyd	5 ... 13.2 Hz: Amplitude ±1 mm 13.2 ... 100 Hz: acceleration resistant up to 0.7 g
	IEC/EN 60068-2-6	10 ... 57 Hz: Amplitude 0.075 mm
		57 ... 150 Hz: Acceleration resistant up to 1 g

Mounting conditions		
Mounting place		In the control cabinet
Mounting position		Vertically
Free space		The required free space results from the mounting position and the specifications of the standard device.

Rated data

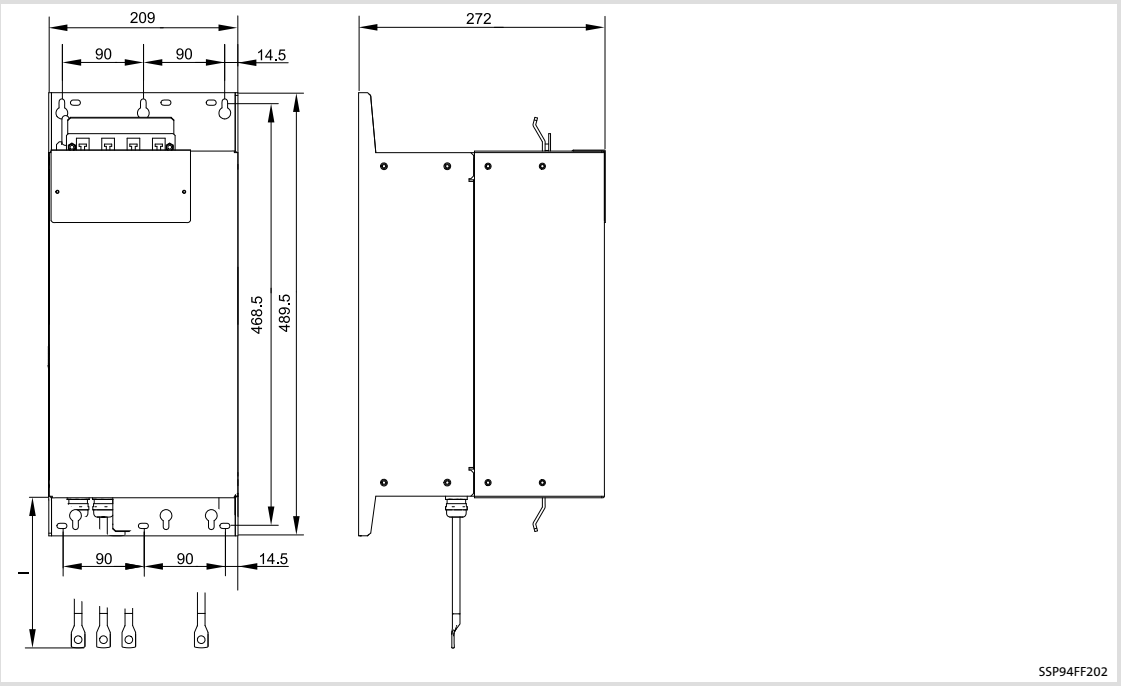
Mains	Voltage U_{Lrated} [V]	Voltage range U_{Lrated} [V]	Frequency range f [Hz]
3/PE AC	230	180 - 0 % ... 264 + 0 %	45 - 0 % ... 65 + 0 %
3/PE AC	400	320 - 0 % ... 440 + 0 %	45 - 0 % ... 65 + 0 %
3/PE AC	480	340 - 0 % ... 528 + 0 %	45 - 0 % ... 65 + 0 %

	Voltage [V]	Freq. [Hz]	Current [A] ① max. +45° C	Current [A] ① max. +55° C	Number of phases
E94AZRP0824	230/400/480	50/60	82/82/82	61/61/61	3
E94AZRP2004	230/400/480	50/60	200/200/200	150/150/150	3

① Temperature in the control cabinet

	Power loss P_{loss} [W]	Inductance L [mH]	Voltage drop ΔU [V]
E94AZRP0824	80	-	-
E94AZRP2004	150	-	-

Dimensions



All dimensions in millimetres.

	Dimension l [mm]	Mass [kg]
E94AZRP0824	500 ±10	18.5
E94AZRP2004	600 ±10	21.0

Mechanical installation

For information on this topic, please see the corresponding mounting instructions.

Electrical installation

Connection plan

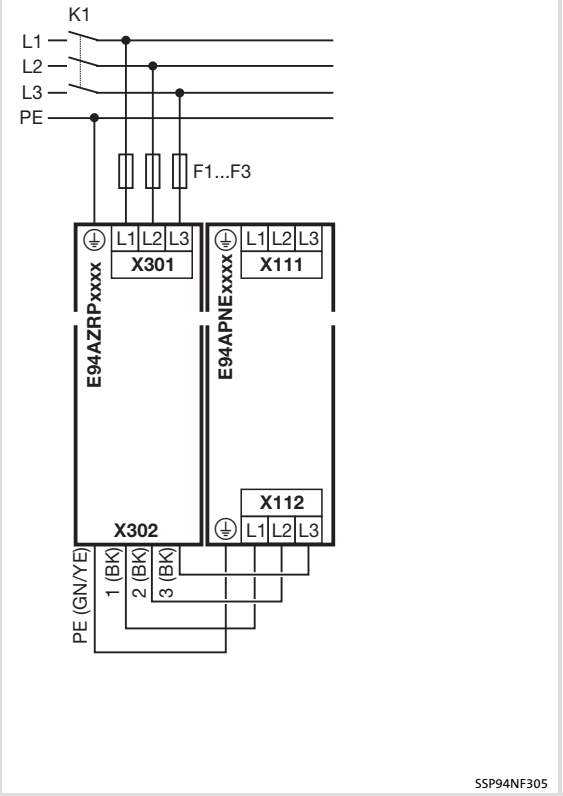
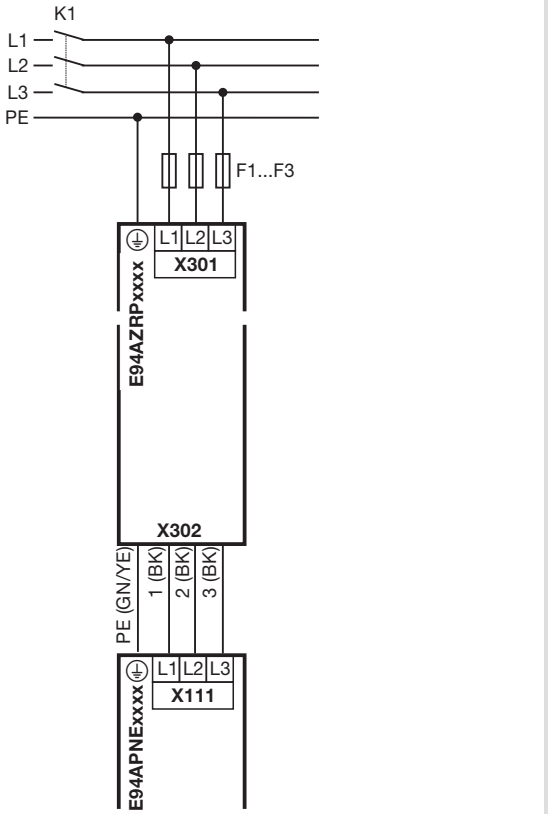
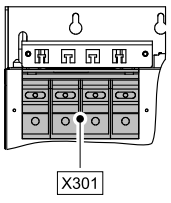
Standard mounting	Mounting variant
	

Fig. 8-7 Connection concept

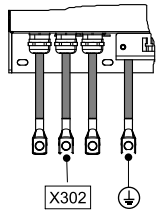
E94AZRPxxxx	RFI filter
E94APNExxxx	9400 DC power supply module
F1 ... F3	Fuses
K1	Mains contactor

Mains

Terminal X301	Labelling	Description
	L1 L2 L3 PE	Connection of mains phases L1, L2, L3 and PE conductor

Terminal data					
	Max. conductor cross-section		Tightening torque		
	[mm²]	[AWG]	[Nm]	[lb-in]	
E94AZxP0824 Connection with M8 ring cable lug	70 (2 x 70)	2/0	12	106	SW13
E94AZxP2004 Connection with M10 ring cable lug	150 (2 x 120)	250 mcm	20	177	SW15

Standard device

Cable X302	Labelling	Description
 SSP94NF307	L1' L2' L3'	Filter output conductor (lead with ring cable lug, colour BK)
		Output PE conductor (lead with ring cable lug, colour GN/YE)

Safety instructions for the installation according to UL/CSA

Original - English

Warnings!

Conditions of Acceptability:

- ► The products covered by this report are only intended for use with Power Conversion Equipment (inverters).
- ► Consideration shall be given to the field wiring leads. No strain relief test was performed on the leads.
- ► The devices in this report are only evaluated for factory wiring use.
- ► Temperature tests were performed with hook mounted drive.

Original - French

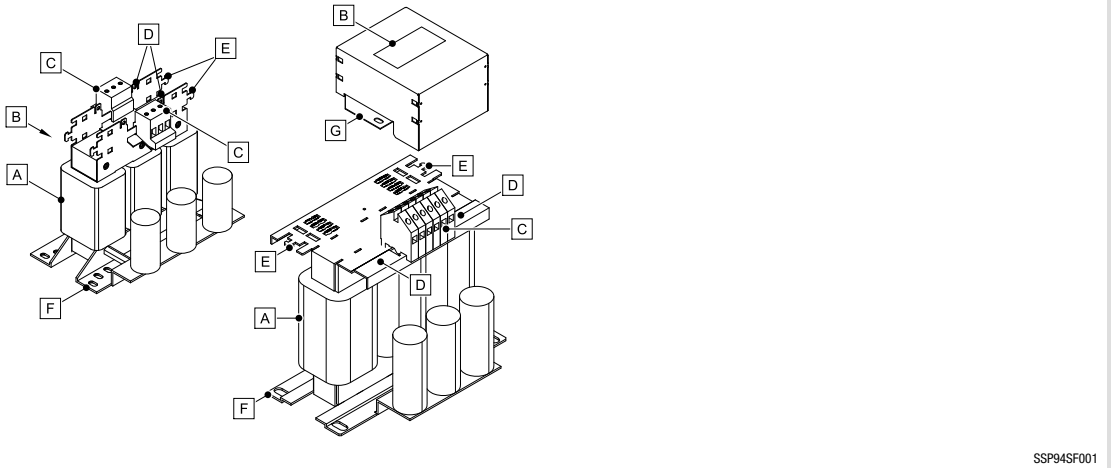
Avertissement !

Conditions d'acceptabilité :

- ► Les produits concernés par ce rapport sont destinés exclusivement à être utilisés avec des convertisseurs de puissance (variateurs ou power conversion equipment).
- ► Une attention particulière doit être apportée aux tresses de câblage à pied d'oeuvre. Aucun test de décharge de traction n'a été réalisé sur ces éléments.
- ► Les équipements concernés par ce rapport sont évalués exclusivement pour un câblage en usine.
- ► Les tests de température ont été réalisés avec un entraînement à crochet.

8.10.10 Sinusoidal filters EZS3-xxxA200 4 ... 90 A

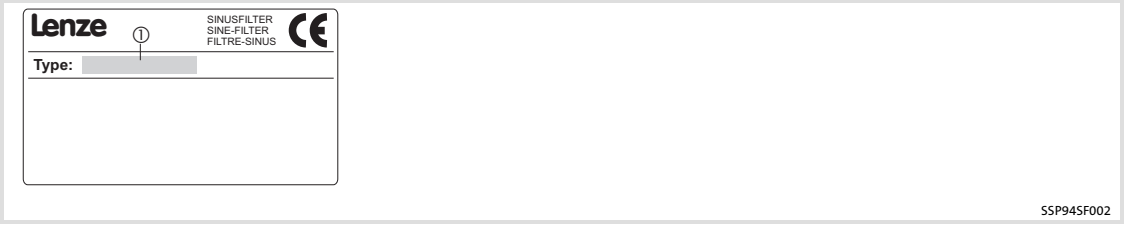
Elements on the filter



Pos.	Description
A	Sinusoidal filter EZS3-xxxA200
	Mounting Instructions

Pos.	Description
B	Nameplate
C	Terminals (input: 1U1, 1V1, 1W1 / output: 1U2, 1V2, 1W2)
D	PE connection
E	Shield connection
F	Fixing bracket
G	Terminal cover

Identification



	①						
Type code	**e**	**Z**	**S**	**3**	**-**	**xxxA**	**xxx**

Product series

Accessories

Filter type
S = sinusoidal filter

Phases
3 = 3 phases

Rated current [A] (rounded)

Variant

Operating conditions

A sinusoidal filter (LC filter) in the motor cable limits the rate of rise of voltage (du/dt < 500 V/µs) and the capacitive charge/discharge currents which occur during inverter operation. This enables considerably larger shielded motor cables and the service life of the motor is increased.

The following must be observed when using sinusoidal filters:

- ► Use sinusoidal filters only together with standard asynchronous machines 0 ... 550 V.
- ► The operation is only permissible using a V/f or V/f^2 characteristic control.
- ► The operation is only permissible using a switching frequency of 4 ... 8 kHz.
  - – The sinusoidal filter overheats when being operated with a switching frequency < 4 kHz.
  - – Ensure that the automatic switching frequency reduction is deactivated (see documentation of the basic device).
- ► Limit the output frequency to maximally 150 Hz.
- ► Please note, when dimensioning the controller, that the controller has an additional load of 10 ... 15 %.

General data

Conformity and approval			
CE	2014/35/EU	Low-Voltage Directive	
UKCA	S.I. 2016/1101	The Electrical Equipment (Safety) Regulations 2016	
Approval			
UR	UL508 CSA C22.2 No.14	Industrial Control Equipment, Underwriter Laboratories (File-No. E219022) for USA and Canada	

Protection of persons and equipment			
Enclosure	EN 60529	IP20	
	NEMA 250	Protection against contact to type 1	
Insulation resistance	IEC/EN 61800-5-1	< 2000 m site altitude: overvoltage category III	
		> 2000 m site altitude: overvoltage category II	

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 +40 ... +55 °C: 2.5 %/°C
Site altitude		0 ... 4000 m amsl 1000 ... 4000 m amsl: Current derating 5 %/1000 m
Pollution	EN 61800-5-1	Degree of pollution 2
Vibration resistance (9.81 m/s² = 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/s²
		200 ... 500 Hz: Acceleration resistant up to 15 m/s²
Operation	Germanischer Lloyd	5 ... 13.2 Hz: Amplitude ±1 mm 13.2 ... 100 Hz: Acceleration resistant up to 0.7 g
	IEC/EN 60068-2-6	10 ... 57 Hz: Amplitude 0.075 mm
		57 ... 150 Hz: Acceleration resistant up to 10 m/s²

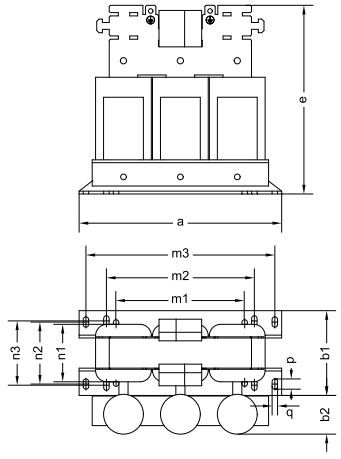
Mounting conditions		
Mounting place		In the control cabinet, as close as possible to the controller
Mounting position		Dependent on the payload of the control cabinet wall Lightweight filters: suspended, fixing bracket to the sides Heavy filters: vertical, fixing bracket below
Free space		100 mm to the side and above
Connecting cables		
Controller ↔ filter		As short as possible, shielded
Filter ↔ motor		Max. 200 m shielded or max. 300 m unshielded

Rated data

	Voltage	Output frequency	Switching frequency	Rate of rise of voltage
	U [V AC]	f [Hz]	f_{ch} [kHz]	du/dt [V/µs]
EZS3-xxxA200	0 ... 550	0 ... 150	4 ... 8	< 500

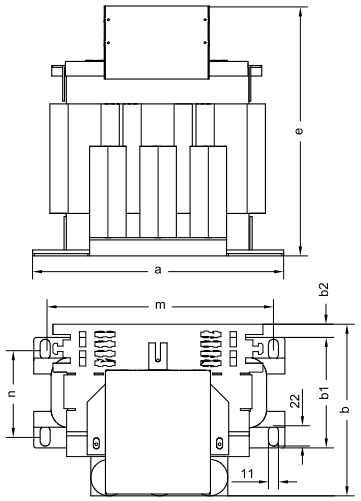
	Current	Power loss	Inductance
	I_r [A]	P_V [W]	L [mH]
EZS3-004A200	4.0	50	11.0
EZS3-010A200	10.0	80	5.1
EZS3-017A200	16.5	130	3.1
EZS3-024A200	23.5	160	2.5
EZS3-032A200	32.0	180	2.0
EZS3-037A200	37.0	190	1.7
EZS3-048A200	48.0	200	1.2
EZS3-061A200	61.0	230	1.0
EZS3-072A200	72.0	260	0.95
EZS3-090A200	90.0	300	0.8

Dimensions



SSP94SF003

Type	a	b1	b2	e	M1	M2	M3	n1	n2	n3	p	q	
	[mm]												[kg]
EZS3-004A200	178	75	36	171	113	130	166	50	55	57	9	5	4.0
EZS3-010A200	178	90	36	171	113	130	166	65	70	72	9	5	5.5
EZS3-017A200	219	111	51	198	136	170	201	67	68	81	13	7	8.5



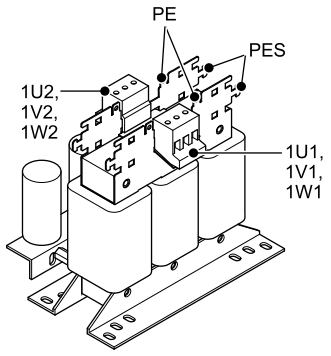
SSP94SF006

Type	a	b	b1	b2	e	m	n	
	[mm]							[kg]
EZS3-024A200	275	190	121	14	280	250	95	14.5
EZS3-032A200	275	200	131	14	280	250	105	19.0
EZS3-037A200	275	210	141	14	280	250	115	21.0
EZS3-048A200	275	245	151	14	290	250	125	25.5
EZS3-061A200	340	240	165	5	315	300	133	33.5
EZS3-072A200	340	265	176	5	325	300	145	37.0
EZS3-090A200	340	292	203	5	325	300	172	53.0

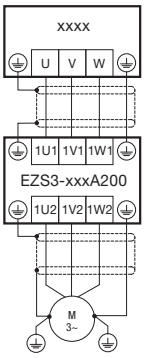
Mechanical installation

For information on this topic, please see the corresponding mounting instructions.

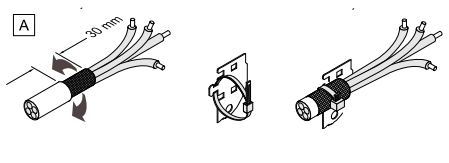
Electrical installation



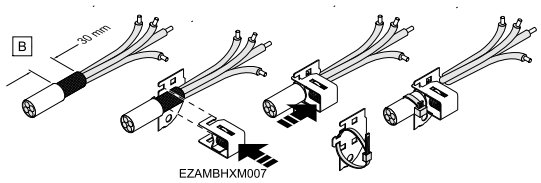
SSP94SF005



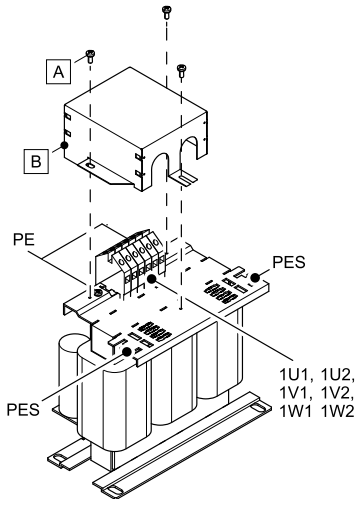
SSP94SF004



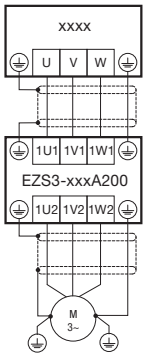
SSP94SF009



SSP94SF011



SSP94SF007



SSP94SF004

Terminal data

Sinusoidal filter	Terminal				PE screw		
	Connection cross-sections		Tightening torque		∅	Tightening torque	
	[mm²]	[AWG]	[Nm]	[lb-in]		[Nm]	[lb-in]
EZS3-004A200	0.2 ... 6	24 ... 10	0.6	5.3	M4	2	17.7
EZS3-010A200							
EZS3-017A200	0.5 ... 16	20 ... 6	1.5	13.3			
EZS3-024A200	2.5 ... 25	10 ... 6	2	17.7	M5	3	26.5
EZS3-032A200							
EZS3-037A200							
EZS3-048A200	2.5 ... 35	12 ... 2	3	26.5			
EZS3-061A200							
EZS3-072A200	16 ... 50	1/0 ... 6					
EZS3-090A200							

Safety instructions for the installation according to UL/CSA

Original - English

Warnings!

Conditions of Acceptability:

- The products covered by this report are only intended for use with Power Conversion Equipment (inverters).
- Appropriate cooling measures shall be taken based on the power loss data within the instructions available from the manufacturer.
- External wiring material for models with bus bar screw connectors - R/C (AVLV2), rated 105 °C min., suitable for applied voltage and current. If wiring material with a lower temperature rating is used, an additional temperature test at the wiring material has to be conducted in the end use.

Original - French

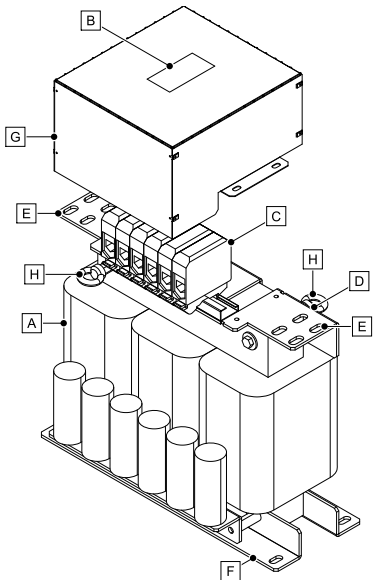
Avertissement !

Conditions d'acceptabilité :

- Les produits concernés par ce rapport sont destinés exclusivement à être utilisés avec des convertisseurs de puissance (variateurs ou power conversion equipment).
- Il convient de prendre des mesures de refroidissement appropriées en fonction de la puissance dissipée, conformément aux instructions fournies par le fabricant.
- Les éléments de câblage externes des modèles avec connecteurs à vis pour barres conductrices (R/C [AVLV2], mininum 105 °C) sont adaptés à la tension et au courant appliqués. En cas d'utilisation d'éléments de câblage conçus pour des températures inférieures, des essais de température supplémentaires doivent être menés sur ces éléments dans les conditions d'application.

8.10.11 Sinusoidal filters EZS3-xxxA200 115 ... 150 A

Elements on the filter

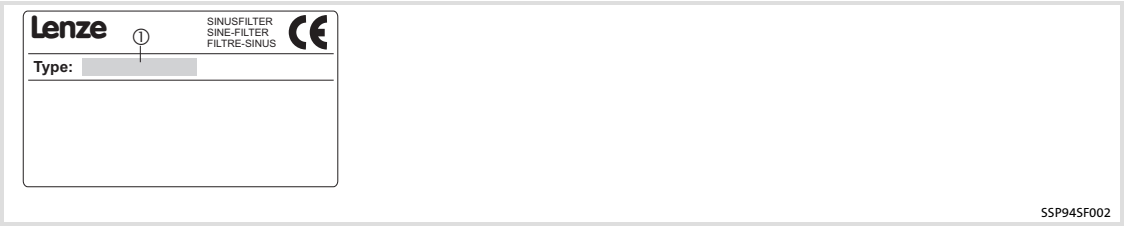


SSP94SF101

Pos.	Description
A	Sinusoidal filter EZS3-xxxA200
	Mounting Instructions

Pos.	Description
B	Nameplate
C	Terminals (input: 1U1, 1V1, 1W1 / output: 1U2, 1V2, 1W2)
D	PE connection
E	Shield connection
F	Fixing bracket
G	Terminal cover
H	Ring bolts

Identification



	①						
Type code	**e**	**Z**	**S**	**3**	**-**	**xxxA**	**xxx**

Product series

Accessories

Filter type
S = sinusoidal filter

Phases
3 = 3 phases

Rated current [A] (rounded)

Variant

Operating conditions

A sinusoidal filter (LC filter) in the motor cable limits the rate of rise of voltage (du/dt < 500 V/µs) and the capacitive charge/discharge currents which occur during inverter operation. This enables considerably larger shielded motor cables and the service life of the motor is increased.

The following must be observed when using sinusoidal filters:

- Use sinusoidal filters only together with standard asynchronous machines 0 ... 550 V.
- Operation is only permissible using a V/f or V/f^2 characteristic control.
- Operation is only permissible using a switching frequency of 2 ... 4 kHz.
  - Ensure that the automatic switching frequency reduction is deactivated (see documentation of the standard device).
- Limit the output frequency to maximally 150 Hz.
- Please note when dimensioning the controller that the controller has an additional load of 10 ... 15 %.

General data

Conformity and approval			
CE	2014/35/EU	Low-Voltage Directive	
UKCA	S.I. 2016/1101	The Electrical Equipment (Safety) Regulations 2016	
Approval			
UR	UL508 CSA C22.2 No.14	Industrial Control Equipment, Underwriter Laboratories (File-No. E219022) for USA and Canada	

Protection of persons and equipment			
Enclosure	EN 60529	IP20	
	NEMA 250	Protection against contact to type 1	
Insulation resistance	IEC/EN 61800-5-1	< 2000 m site altitude: overvoltage category III	
		> 2000 m site altitude: overvoltage category II	

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 +40 ... +55 °C: 2.5 %/°C
Site altitude		0 ... 4000 m amsl 1000 ... 4000 m amsl: Current derating 5 %/1000 m
Pollution	EN 61800-5-1	Degree of pollution 2
Vibration resistance (9.81 m/s² = 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/s²
		200 ... 500 Hz: Acceleration resistant up to 15 m/s²
Operation	Germanischer Lloyd	5 ... 13.2 Hz: Amplitude ±1 mm 13.2 ... 100 Hz: Acceleration resistant up to 0.7 g
	IEC/EN 60068-2-6	10 ... 57 Hz: Amplitude 0.075 mm
		57 ... 150 Hz: Acceleration resistant up to 10 m/s²

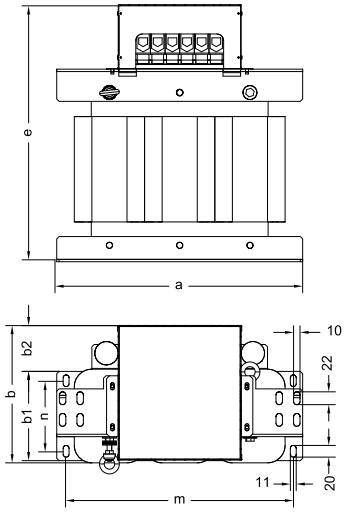
Mounting conditions		
Mounting place		In the control cabinet, as close as possible to the controller
Mounting position		Dependent on the payload of the control cabinet wall Lightweight filters: suspended, fixing bracket to the sides Heavy filters: vertical, fixing bracket below
Free space		100 mm to the side and above
Connecting cables		
Controller ↔ filter		As short as possible, shielded
Filter ↔ motor		Max. 200 m shielded or max. 300 m unshielded

Rated data

	Voltage	Output frequency	Switching frequency	Rate of rise of voltage
	U [V AC]	f [Hz]	f_{ch} [kHz]	du/dt [V/µs]
EZS3-xxxA200	0 ... 550	0 ... 150	2 ... 4	< 500

	Current	Power loss	Inductance
	I_N [A]	P_V [W]	L [mH]
EZS3-115A200	115	360	0.7
EZS3-150A200	150	400	0.5

Dimensions



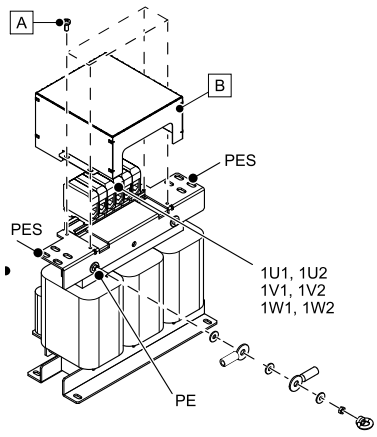
All dimensions in millimetres.

	a	b	b1	b2	e	m	n	
	[mm]						[mm]	[kg]
EZS3-115A200	420	235	153	78.5	444	388	121	66
EZS3-150A200	420	235	168	63.5	444	388	136	69

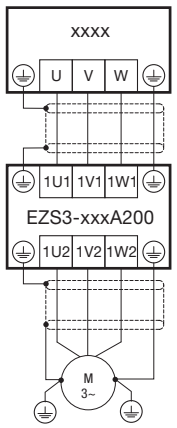
Mechanical installation

For information on this topic, please see the corresponding mounting instructions.

Electrical installation



SSP94SF107



SSP94SF004

Terminal data

Sinusoidal filter	Terminal				PE screw		
	Connection cross-sections		Tightening torque		∅	Tightening torque	
	[mm²]	[AWG]	[Nm]	[lb-in]		[Nm]	[lb-in]
EZS3-115A200	35 ... 95	4/0 ... 2	6	53.1	M8	18	159.3
EZS3-150A200							

Safety instructions for the installation according to UL/CSA

Original - English

Warnings!

Conditions of Acceptability:

- The products covered by this report are only intended for use with Power Conversion Equipment (inverters).
- Appropriate cooling measures shall be taken based on the power loss data within the instructions available from the manufacturer.
- External wiring material for models with bus bar screw connectors - R/C (AVLV2), rated 105 °C min., suitable for applied voltage and current. If wiring material with a lower temperature rating is used, an additional temperature test at the wiring material has to be conducted in the end use.

Original - French

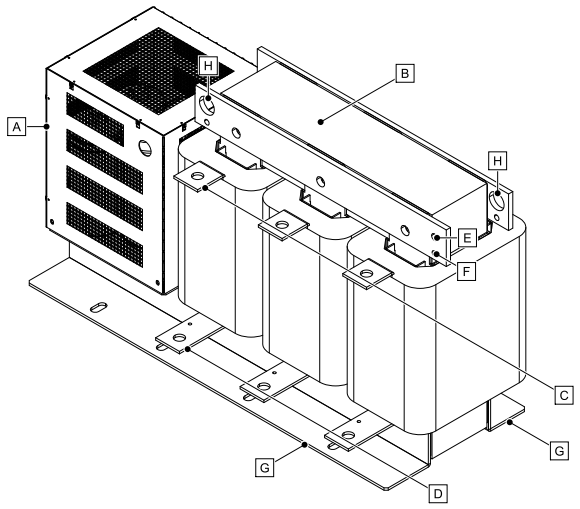
Avertissement !

Conditions d'acceptabilité :

- Les produits concernés par ce rapport sont destinés exclusivement à être utilisés avec des convertisseurs de puissance (variateurs ou power conversion equipment).
- Il convient de prendre des mesures de refroidissement appropriées en fonction de la puissance dissipée, conformément aux instructions fournies par le fabricant.
- Les éléments de câblage externes des modèles avec connecteurs à vis pour barres conductrices (R/C [AVLV2], mininum 105 °C) sont adaptés à la tension et au courant appliqués. En cas d'utilisation d'éléments de câblage conçus pour des températures inférieures, des essais de température supplémentaires doivent être menés sur ces éléments dans les conditions d'application.

8.10.12 Sinusoidal filters EZS3-xxxA200 180 ... 480 A

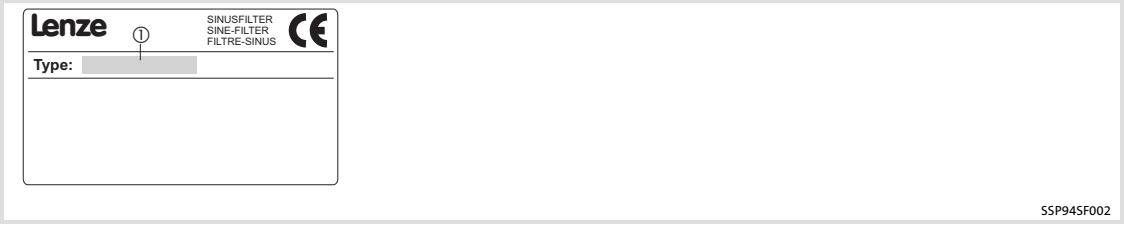
Elements on the filter



Pos.	Description
A	Sinusoidal filter EZS3-xxxA200
	Mounting Instructions

Pos.	Description
B	Nameplate
C	Connection 1U1, 1V1, 1W1 (inputs)
D	Connection 1U2, 1V2, 1W2 (outputs)
E	PE connection
F	Shield connection
G	Fixing bracket
H	Blocking point for lifting system

Identification



	①						
Type code	**e**	**Z**	**S**	**3**	**-**	**xxxA**	**xxx**

Product series

Accessories

Filter type
S = sinusoidal filter

Phases
3 = 3 phases

Rated current [A] (rounded)

Variant

Operating conditions

A sinusoidal filter (LC filter) in the motor cable limits the rate of rise of voltage (du/dt < 500 V/µs) and the capacitive charge/discharge currents which occur during inverter operation. This enables considerably larger shielded motor cables and the service life of the motor is increased.

The following must be observed when using sinusoidal filters:

- Use sinusoidal filters only together with standard asynchronous machines 0 ... 550 V.
- Operation is only permissible using a V/f or V/f^2 characteristic control.
- Operation is only permissible using a switching frequency of 2 ... 4 kHz.
  - Ensure that the automatic switching frequency reduction is deactivated (see documentation of the standard device).
- Limit the output frequency to maximally 90 Hz.
- Please note, when dimensioning the controller, that the controller has an additional load of 10 ... 15 %.

General data

Conformity and approval			
Conformity			
CE	2014/35/EU	Low-Voltage Directive	
UKCA	S.I. 2016/1101	The Electrical Equipment (Safety) Regulations 2016	

Protection of persons and equipment			
Degree of protection	EN 60529	IP00	
Earth leakage current	IEC/EN 61800-5-1	> 3.5 mA AC > 10 mA DC	Observe regulations and safety instructions!
Insulation resistance	IEC/EN 61800-5-1	< 2000 m site altitude: overvoltage category III	
		> 2000 m site altitude: overvoltage category II	

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 +40 ... +55 °C: 2.5 %/°C
Site altitude		0 ... 4000 m amsl 1000 ... 4000 m amsl: Current derating 5 %/1000 m
Pollution	EN 61800-5-1	Degree of pollution 2
Vibration resistance (9.81 m/s² = 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/s²
		200 ... 500 Hz: Acceleration resistant up to 15 m/s²
Operation	Germanischer Lloyd	5 ... 13.2 Hz: Amplitude ±1 mm 13.2 ... 100 Hz: Acceleration resistant up to 0.7 g
	IEC/EN 60068-2-6	10 ... 57 Hz: Amplitude 0.075 mm
		57 ... 150 Hz: Acceleration resistant up to 10 m/s²

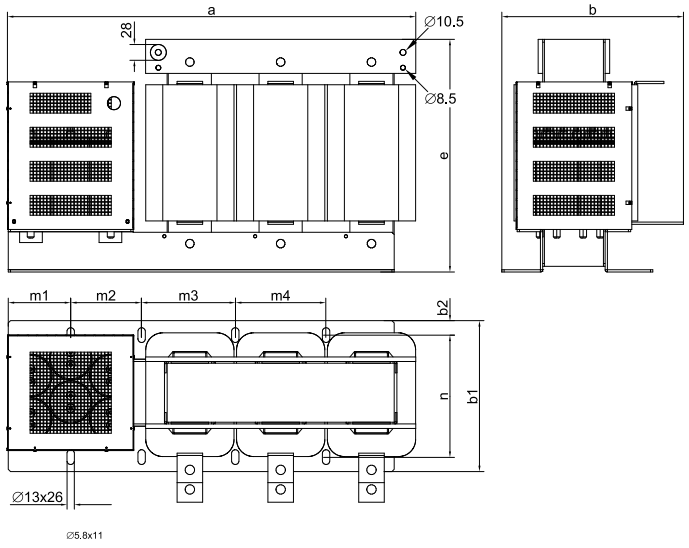
Mounting conditions		
Mounting place		In the control cabinet
Mounting position		Vertical, fixing bracket below
Free space		100 mm to the side and above
Connecting cables		
Controller ↔ filter		As short as possible, shielded
Filter ↔ motor		Max. 200 m shielded or max. 300 m unshielded

Rated data

	Voltage	Output frequency	Switching frequency	Rate of rise of voltage
	U [V AC]	f [Hz]	f_{ch} [kHz]	du/dt [V/µs]
EZS3-xxxA200	0 ... 550	0 ... 90	2 ... 4	< 500

	Current	Power loss	Inductance
	I_N [A]	P_V [W]	L [mH]
EZS3-180A200	180	580	0.40
EZS3-250A200	250	810	0.35
EZS3-350A200	350	1100	0.21
EZS3-480A200	480	1550	0.14

Dimensions

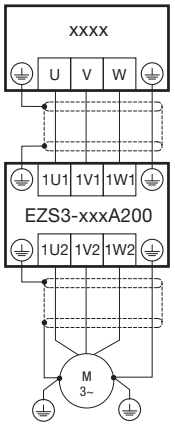


	a	b	b1	b2	e	m1	m2	m3	m4	n	
	[mm]										[kg]
EZS3-180A200	600	270	235	21	324	102.5	117.5	130	160	194.5	97
EZS3-250A200	665	330	290	23	373		122.5	145	140	238.5	152
EZS3-350A200	730	320	268	26	431	110	125	165	160	216.5	172
EZS3-480A200		370	318		426					266.5	244

Mechanical installation

For information on this topic, please see the corresponding mounting instructions.

Electrical installation



SSP94SF004

Terminal data

	1U1, 1V1, 1W1, 1U2, 1V2, 1W2 ∅	PE ∅	PES ∅
EZS3-180A200	M10	M10	M8
EZS3-250A200	M13		
EZS3-350A200	M16		
EZS3-480A200			

8.11 General accessories

For information about further accessories, please see the ”Servo Drives 9400” catalogue.

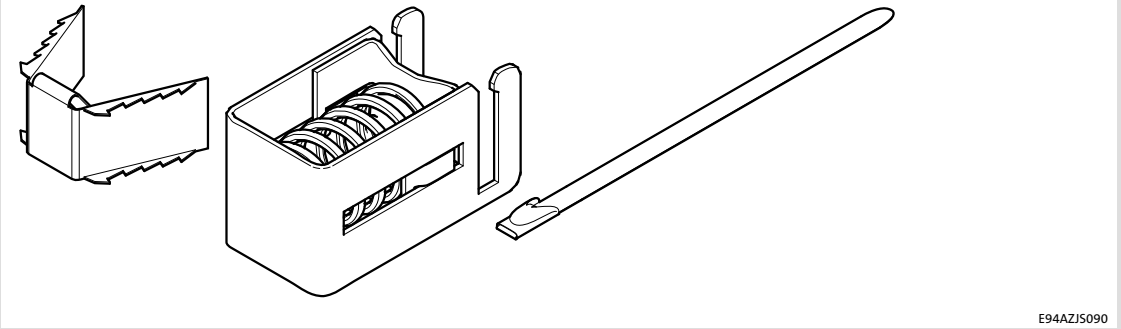
8.11.1 Shield mounting

Shield mounting kits facilitate the conductive connection of cable shields with a surface as large as possible. Good shield connections are an important part of wiring according to EMC guidelines. The shield connections on the devices are designed for different installations. If a recommended shield mounting cannot be implemented, e.g. because of thick cables, you can always choose an alternative. The alternative also ensures a good shield connection.

Always implement a strain relief in addition to the shield mounting, since strain relief is not possible with a shield mounting.

Possible installations of the shield connection:

- EMC clip (fixing clip)
  – preferred for control cables or thin motor cables
- EMC wire clamp
  – preferred for motor cables, device-dependent sizes
- Cable tie, metallic
  – preferred for thick motor cables or several cables



Shield mounting and cable cross-section

Shield mountings contained in the scope of supply of the Servo Drives 9400:

Type			EMC clip (fixing clip)	EMC wire clamp
Axis module	Installation backplane		EZA... (axis module/installation backplane)	(usability depends on installation backplane)
E94xSxE0024 E94xSxE0034	E94AZPS0034	GG1	2/3	-
E94xMxE0024 E94xMxE0034 E94xMxE0044	E94AZPM0044			
E94xSxE0044 E94xSxE0074	E94AZPS0074	GG2	2/2	1 x EZAMBHXM003
E94xMxE0074 E94xMxE0094	E94AZPM0094			
E94xSxE0134 E94xSxE0174 E94xSxE0244	E94AZPS0244	GG3	2/2	1 x EZAMBHXM004
E94xMxE0134 E94xMxE0174 E94xMxE0244	E94AZPM0244			
E94xMxE0324	E94AZPM0324			
E94xSxE0324 E94xSxE0474 E94xSxE0594	-	GG6	3/0	1 x EZAMBHXM003 1 x EZAMBHXM004
E94xMxE0474 E94xMxE0594				
E94xSxE0864 E94xSxE1044	-	GG7	3/0	1 x EZAMBHXM004 1 x EZAMBHXM005
E94xSxE0864 E94xSxE1044	-	GG7	3/0	1 x EZAMBHXM004 1 x EZAMBHXM005
E94xSxE1454	-	GG81	2/0	-
E94xSxE1724 E94xSxE2024 E94xSxB2454	-	GG82	2/0	2 x wire clamps, large (type of C-rail)
E94xSxE2924	-	GG83	2/0	
E94xSxB3664 E94xSxE4604	-	GG91	2/0	

Tab. 8-3 Shield mountings contained in the scope of supply

Shield mountings available as accessories:

Type	EMC clip	EMC wire clamp				Cable tie
Accessory set	EZAMBHXM007 (fixing clip)	EZAMBHXM006 (C02)	EZAMBHXM003 (C03)	EZAMBHXM004 (C04)	EZAMBHXM005 (C05)	EZAMBKBM (metallic)
EZAMBHXM007	20	-	-	-	-	-
EZAMBHXM006	-	10	-	-	-	-
EZAMBHXM003	-	-	10	-	-	-
EZAMBHXM004	-	-	-	10	-	-
EZAMBHXM005	-	-	-	-	10	-
EZAMBKBM	-	-	-	-	-	50

Tab. 8-4 Shield mountings in the accessories - Assignment and VPE

Permissible cable cross-sections (without cable sheath) of the shield mountings:

EMC clip	EMC wire clamp				Cable tie
EZAMBHXM007 (fixing clip)	EZAMBHXM006 (C02)	EZAMBHXM003 (C03)	EZAMBHXM004 (C04)	EZAMBHXM005 (C05)	EZAMBKBM (metallic)
[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
[*in*]	[*in*]	[*in*]	[*in*]	[*in*]	[*in*]
2 ... 11.6 *0.079 ... 0.456*	4 ... 15 *0.157 ... 0.59*	10 ... 20 *0.394 ... 0.787*	15 ... 28 *0.59 ... 1.1*	20 ... 37 *0.79 ... 1.46*	8 ... 30 *0.32 ... 1.18*

Tab. 8-5 Clamping range of shield mountings

Select the shield mounting according to the cable characteristics.

Lenze system cables		EMC clip	EMC wire clamp				Cable tie
A [mm²]	d [mm]	EZAMBHXM007 (fixing clip)	EZAMBHXM006 (C02)	EZAMBHXM003 (C03)	EZAMBHXM004 (C04)	EZAMBHXM005 (C04)	EZAMBKBM (metallic)
standard, shielded							
1.0	10.3	•	•	•	-	-	•
1.5	11.6	•	•	•	-	-	•
2.5	13.2	-	•	•	-	-	•
4.0	14.5	-	•	•	•	•	•
6.0	16.5	-	-	•	•	•	•
10	19.6	-	-	•	•	•	•
suitable for trailing							
1.0	11.2	•	•	•	-	-	•
1.5	12.3	-	•	•	-	-	•
2.5	14.2	-	•	•	-	-	•
4.0	14.8	-	•	•	•	•	•
6.0	17.5	-	-	•	•	•	•
10	20.5	-	-	-	•	•	•

Tab. 8-6 Cable characteristics of Lenze system cables

A Single-core cross-sections of a Lenze system cable (motor)
Standard design or trailing cable

d Cross-section of Lenze system cable/cable shield



Tip!

If a shield mounting cannot be used because of thicker cables, in many cases, an alternative is possible.

For the EMC shield clamp, the EZAMBHXM006 EMC wire clamp or the metal EZAMBKBM cable tie, for example, can be used.

8.11.2 Brake resistors

EMC-compliant wiring

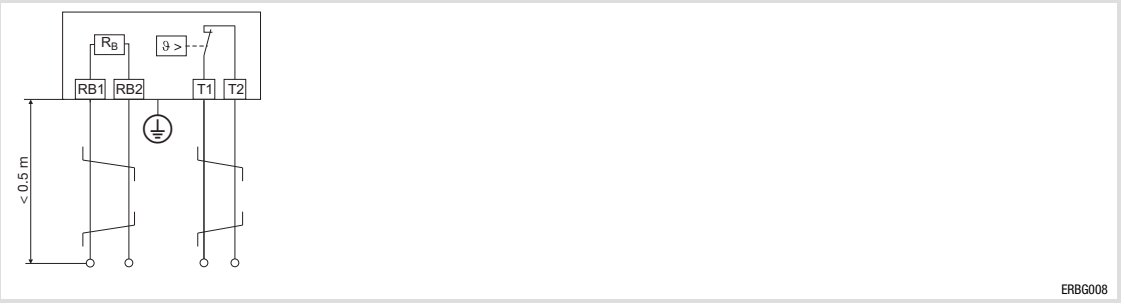
When brake resistors are being wired, the associated installation instructions are to be observed.

Generally applicable rules for wiring connecting cables:

- Keep cable length as short as possible.
- Use a twisted cable for cable lengths up to 0.5 m. A shielded cable is not necessary.
- Use a shield cable for cable lengths from 0.5 m to a maximum of 5 m.
- Always use a twisted cable for monitoring the brake resistor by means of a thermal contact.

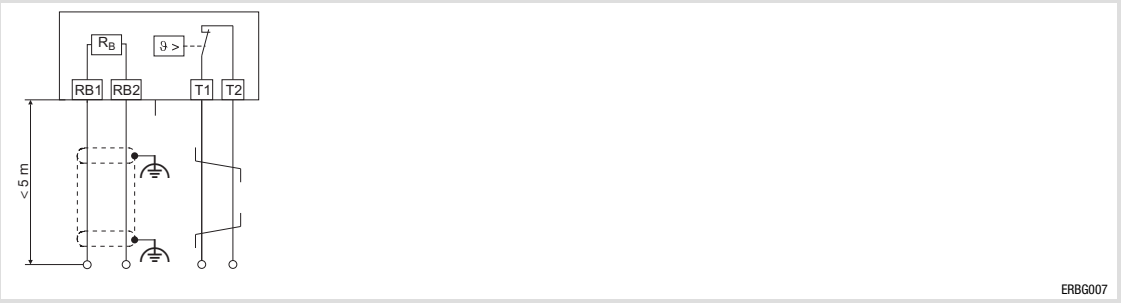
These rules should only be deviated from if such a deviation is expressly described for a brake resistor or other application.

Version 1 (short cables)



Twisted cables

Version 2 (long cables)



HF-shield termination by extensive PE connection

Twisted cables

Assignment of external brake resistors

Rated mains voltage: U_{Lr} = 400/480 V

For U_{Lr} = 230 V rated voltage, different assignments are applicable.

Note!

Max. permissible connecting cable length brake resistor ↔ device: ≤ 5 m

Single Drive axis module	Brake resistor	Resistance R [Ω]	Continuous power P [W]	Quantity of heat Q_B [kWs]
E94xSxE0024 E94xSxE0034	ERBP082R200W	82	200	30
E94xSxE0044 E94xSxE0074	ERBP047R200W	47	200	30
	ERBS047R400W		400	60
	ERBS047R800W		800	120
E94xSxE0134	ERBP027R200W	27	200	30
	ERBS027R600W		600	90
	ERBS027R01K2		1200	180
E94xSxE0174	ERBP018R300W	18	300	30
	ERBS018R800W		800	120
	ERBS018R02K8		2800	180
E94xSxE0244	ERBP018R300W	18	300	30
	ERBS018R01K2		1200	180
	ERBS018R02K8		2800	420
E94xSxE0324	ERBS018R800W	18	800	120
	ERBS018R01K4		1400	210
	ERBG018R04K3		4300	645
E94xSxE0474	ERBS015R800W	15	800	1500
	ERBS015R02K4		2400	495
	ERBG015R06K2		6200	930
E94xSxE0594	ERBS015R01K2	15	1200	180
	ERBG015R03K3		3300	495
	ERBG015R10K0		10000	1500
E94xSxE0864 E94xSxE1044	ERBG075D01K9	7.5	1900	285
E94xSxE1454	ERBG005R02K6	5	2600	390
E94xSxE1724	ERBG043D03K0	4.3	3000	450
E94xSxE2024	ERBG035D03K3	3.5	3300	495
E94xSxE2454	ERBG028D04K1	2.8	4100	615
E94xSxE2924	ERBG023D05K6	2.3	5600	840
E94xSxE3664	ERBG035D03K3 [2)]	2 * 3.5	3300	495
E94xSxE4604	ERBG028D04K1 [2)]	2 * 2.8	4100	615

2) Zwei Widerstände parallel schalten.

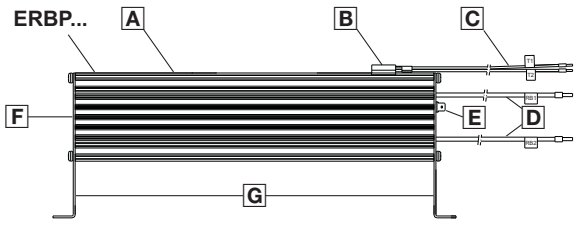
Power supply module	Brake resistor	Resistance R [Ω]	Continuous power P [W]	Quantity of heat QB [kWs]
E94APNE0104	ERBP027R200W	27	200	30
	ERBS027R600W		600	90
	ERBS027R01K2		1200	180
E94APNE0364	ERBG012R01K9	12	1900	285
	ERBG012R05K2		5200	780
E94APNE1004	ERBG005R02K6	5	2600	390
E94APNE2454	ERBG028D04K1	2.8	4100	615

Regenerative power supply module	Brake resistor	Resistance R [Ω]	Continuous power P [W]	Quantity of heat Q_B [kWs]
E94ARNE0134	ERBP027R200W	27	200	30
	ERBS027R600W		600	90
	ERBS027R01K2		1200	180
E94ARNE0244	ERBP018R300W	18	300	30
	ERBS018R01K2		1200	180
	ERBS018R02K8		2800	420

Operating conditions

Climatic conditions	Class 3K3 to EN 50178	Without condensation, average relative humidity 85 %
Ambient temperature	-10 °C ... +55 °C Above 45 °C the permanent power P_d is to be reduced by 2.5 %/°C	
Installation height	0 ... 4000 m amsl Above 1000 m the permanent power P_d is to be reduced by 5 %/1000 m	
Mounting location	● The mounting location must comply with the device features mentioned in the chapter "General data". ● Flammable materials or substances must not be placed in the vicinity of the brake resistor. ● The heat generated by the brake resistor must be dissipated freely.	
Mounting position		
Standard	Vertically suspended with connecting cables at the bottom.	
Variant	Horizontally standing with fixing bracket at the bottom. The permanent power P_d is to be reduced by 30 %!	
Free spaces		
Standard	at the top > 200 mm, to the sides > 25 mm, at the bottom > 100 mm	
Variant	at the top > 200 mm, to the sides > 45 mm, at the bottom > 45 mm	
Design and project planning	● Mean value of regenerative power < permanent power P_d of brake resistor. ● Regenerative power during braking time < heat quantity Q_B of brake resistor. ● Braking time < 10 % of cycle time (braking time + dead time). ● Always connect the thermal contact and integrate it in a way into the system monitoring that the mains supply will be switched off when the basic device is overheated.	

Scope of supply



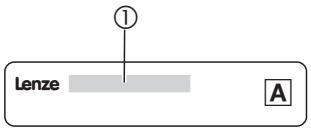
ERBP001

Pos.	Description
	Brake resistor
	Mounting Instructions

Brake resistor elements

Pos.	Description
A	Nameplate
B	Thermal contact
C	Connecting cable thermal contact
D	Connecting cable brake resistor
E	PE connection
F	Warning note
G	Fixing bracket

Identification



ERBMXXX011

	①		
Type code	**ERBx**	**xxxx**	**xxxx**
Product series			
Resistance R_B [Ω] e.g. 470R = 470 Ω 075D = 7.5 Ω			
Permanent power P_d [W] e.g. 120W = 120 W 01k2 = 1.2 kW			

General data

Conformity and approval		
Conformity		
CE	2014/35/EU	Low-Voltage Directive
UKCA	S.I. 2016/1101	The Electrical Equipment (Safety) Regulations 2016
Approval		
CURUS	UL508 CSA C22.2 No. 14	Industrial Control Equipment, Underwriter Laboratories (File-No. E232497) for USA and Canada

Protection of persons and equipment		
Enclosure	EN 60529	IP21
	NEMA 250	Protection against contact to type 1
Thermal contact		
Design		NC contact, 180 °C
Switching capacity		250 V AC / 4 A

Rated data

Electrical data

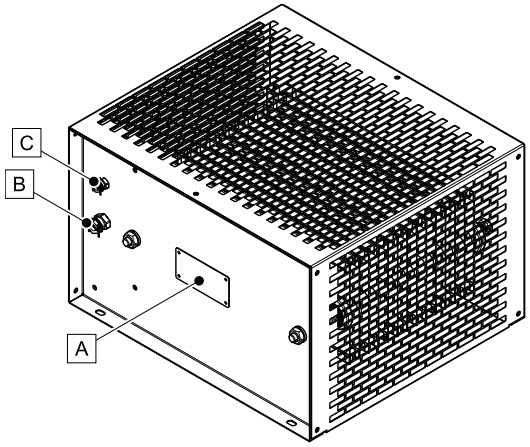
	R_B	P_d	Q_B	U_{max}
	[Ω]	[W]	[kWs]	[V_{DC}]
ERBP018R300W	18	300	30	800
ERBP027R200W	27	200	30	
ERBP033R200W	33	200	30	
ERBP033R300W		300	45	
ERBP047R200W	47	200	30	
ERBP082R200W	82	200	30	
ERBP180R200W	180	200	30	
ERBP180R300W		300	45	

R_B	Resistance
P_d	Permanent power
Q_B	Heat quantity
U_{max}	Max. operating voltage

Installation steps

For information on this topic, please see the corresponding mounting instructions.

Scope of supply



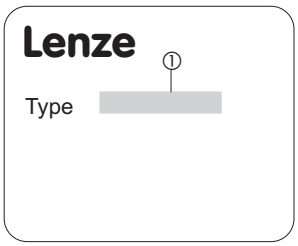
ERBG001

Pos.	Description
	Brake resistor
	Mounting Instructions

Brake resistor elements

Pos.	Description
A	Nameplate
B	Cable gland for brake resistor cable
C	Cable gland for thermal contact cable

Identification



ERBG002

	①		
Type code	**ERBx**	**xxxx**	**xxxx**
Product series			
Resistance R_B [Ω] e.g. 470R = 470 Ω 075D = 7.5 Ω			
Permanent power P_d [W] e.g. 120W = 120 W 01k2 = 1.2 kW			

General data

Conformity and approval			
Conformity			
CE	2014/35/EU	Low-Voltage Directive	
UKCA	S.I. 2016/1101	The Electrical Equipment (Safety) Regulations 2016	
Approval			
UR	UL508	Industrial Control Equipment, Underwriter Laboratories (File-No. E221095) for USA and Canada	
Enclosure	EN 60529	IP20	
	NEMA 250	Protection against contact to type 1	
Thermal contact			
Design		NC contact, 100 °C	
Switching capacity		250 V AC / 2.5 A 110 V AC / 1.6 A	

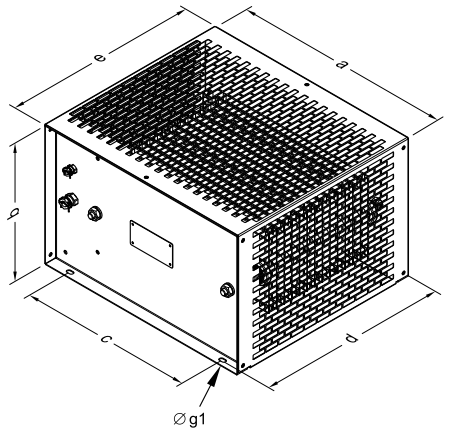
Rated data

Electrical data

	R_B	P_d	Q_B	U_{max}
	[Ω]	[W]	[kWs]	[V_{DC}]
ERBG023D05K6	2.3	5600	840	1000
ERBG028D04K1	2.8	4100	615	
ERBG035D03K3	3.5	3300	495	
ERBG043D03K0	4.3	3000	450	
ERBG005R02K6	5.0	2600	390	
ERBG075D01K9	7.5	1900	285	
ERBG012R01K9	12.0			
ERBG012R05K2		5200	780	
ERBG015R03K3	15.0	3300	495	
ERBG015R06K2		6200	930	
ERBG015R10K0		10000	1500	
ERBG018R04K3	18.0	4300	645	

R_B Resistance
P_d Permanent power
Q_B Heat quantity
U_{max} Max. operating voltage

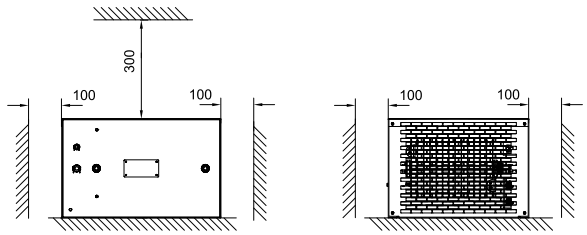
Dimensions



ERBG003

	a	b	c	d	e	g1	m
	[mm]						[kg]
ERBG023D05K6	486	302	380	400	426	6.3	15.9
ERBG028D04K1							12.8
ERBG035D03K3				300	326		12.6
ERBG043D03K0							11.8
ERBG005R02K6							11.0
ERBG075D01K9				210	236		9.5
ERBG012R01K9							
ERBG012R05K2				400	426		15.1
ERBG015R03K3				300	326		12.6
ERBG015R06K2				500	526		17.0
ERBG015R10K0				710	736		22.0
ERBG018R04K3				400	426		13.5

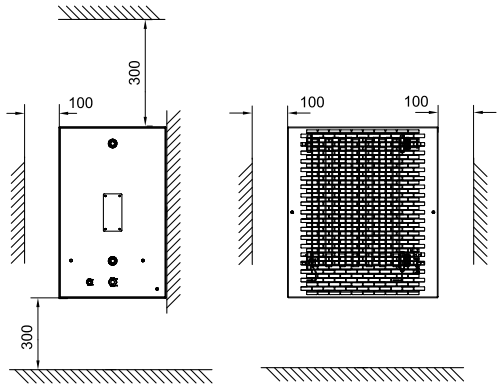
Free spaces for standard mounting



ERBG005

All dimensions in millimetres.

Free spaces for mounting variant



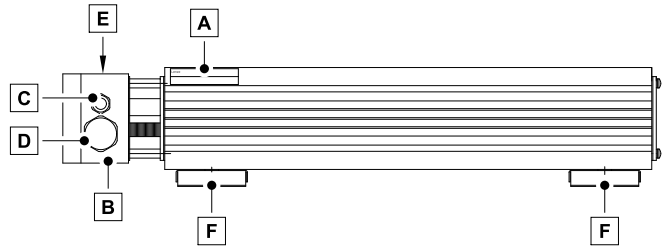
ERBG006

All dimensions in millimetres.

Installation steps

For information on this topic, please see the corresponding mounting instructions.

Scope of supply



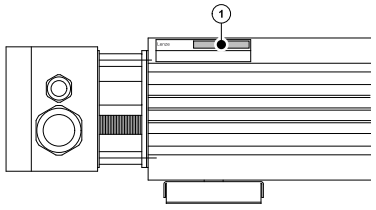
ERBS101

Pos.	Description
	Brake resistor
	Mounting Instructions

Brake resistor elements

Pos.	Description
A	Nameplate
B	Terminal box
C	Cable gland for thermal contact cable
D	Cable gland for brake resistor cable
E	Warning note
F	Fixing bracket

Identification



ERBS104

	①		
Type code	**ERBx**	**xxxx**	**xxxx**
Product series			
Resistance R_B [Ω] e.g. 470R = 470 Ω 075D = 7.5 Ω			
Permanent power P_d [W] e.g. 120W = 120 W 01k2 = 1.2 kW			

General data

Conformity and approval		
Conformity		
CE	2014/35/EU	Low-Voltage Directive
UKCA	S.I. 2016/1101	The Electrical Equipment (Safety) Regulations 2016
Approval		
CURUS	UL508 CSA C22.2 No. 14	Industrial Control Equipment, Underwriter Laboratories (File-No. E232497) for USA and Canada

Protection of persons and equipment		
Enclosure	EN 60529	IP65
	NEMA 250	Protection against contact to type 4
Thermal contact		
Design		NC contact, 230 °C
Switching capacity		250 V AC / 5 A

Rated data

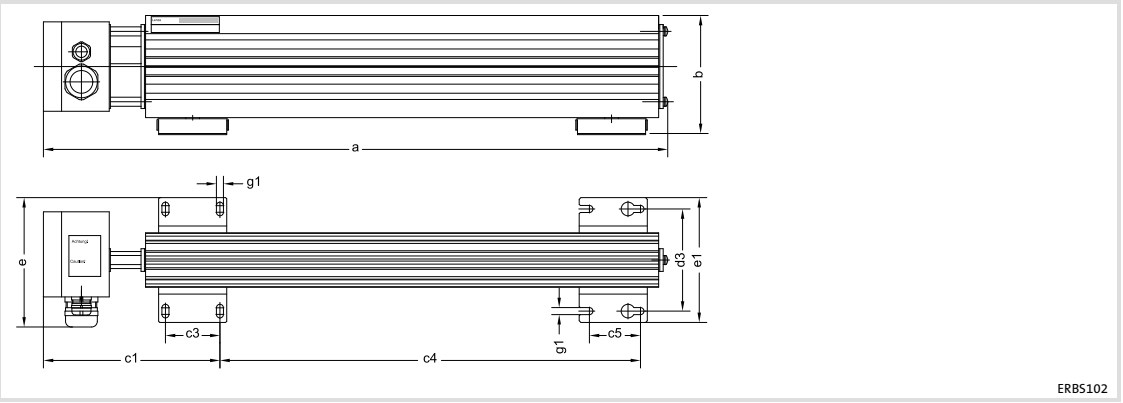
Electrical data

	R_B	P_d	Q_B	U_{max}
	[Ω]	[W]	[kWs]	[V_{DC}]
ERBS015R800W	15	800	120	800
ERBS015R01K2		1200	180	
ERBS015R02K4		2400	420	
ERBS018R800W	18	800	120	
ERBS018R01K2		1200	180	
ERBS018R01K4		1400	210	
ERBS018R01K9		1900	285	
ERBS018R02K8		2800	420	
ERBS027R600W	27	600	90	
ERBS027R01K2		1200	180	
ERBS027R01K4		1400	210	
ERBS047R400W	47	400	60	
ERBS047R800W		800	120	

R_B	Resistance
P_d	Permanent power
Q_B	Heat quantity
U_{max}	Max. operating voltage

Dimensions

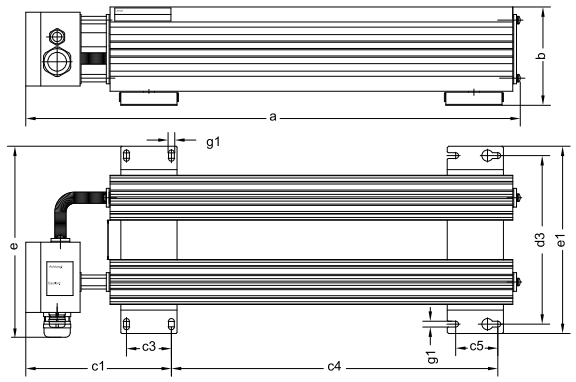
Design 1



All dimensions in millimetres.

	a	b	c1	c3	c4	c5	d3	e	e1	g1	
	[mm]										[kg]
ERBS015R800W	710	105	155.5	48	531	45	90	114	110	6.2	4.0
ERBS015R01K2	1020				841						5.6
ERBS018R800W	710				531						4.0
ERBS018R01K2	1020				841						5.6
ERBS018R01K4	1110				931						6.3
ERBS027R600W	550				371						3.1
ERBS027R01K2	1020				841						5.6
ERBS027R01K4	1110				931						6.3
ERBS047R400W	400				221						2.3
ERBS047R800W	710				531						4.0

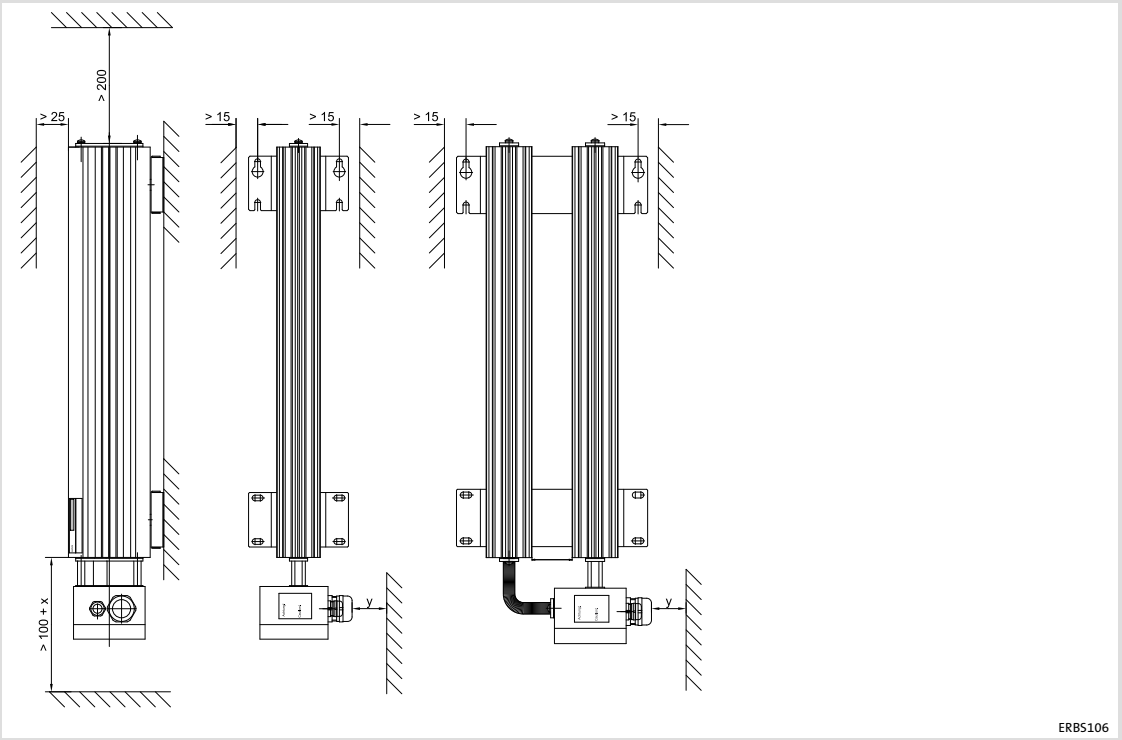
Design 2



All dimensions in millimetres.

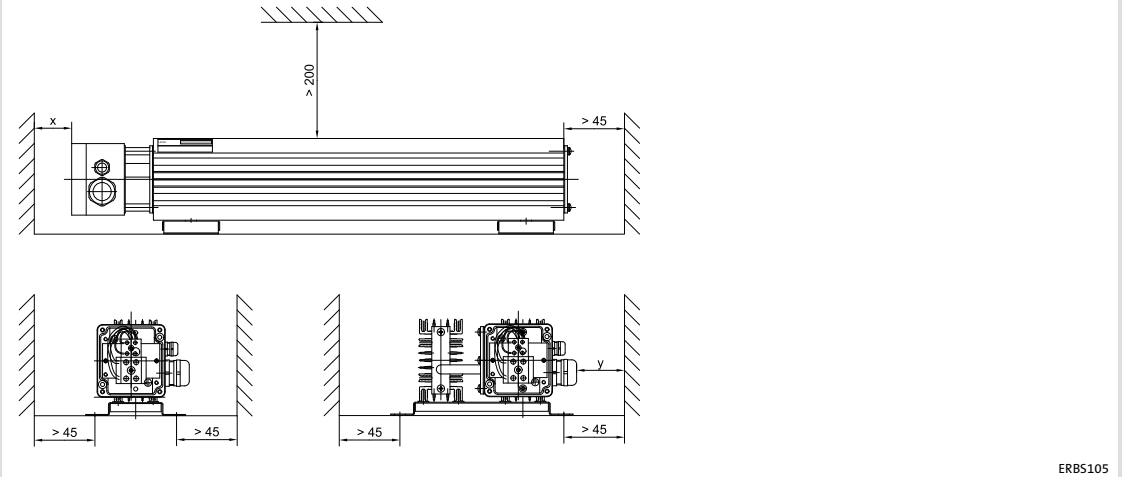
	a	b	c1	c3	c4	c5	d3	e	e1	g1	
	[mm]					[mm]					[kg]
ERBS015R02K4	1020	105	155.5	48	841	45	180	204	200	6.2	10.0
ERBS018R01K9	825				646						8.7
ERBS018R02K8	1110				931						12.0

Free spaces for standard mounting



x Wiring clearance
y Cable bending radius
All dimensions in millimetres

Free spaces for mounting variant

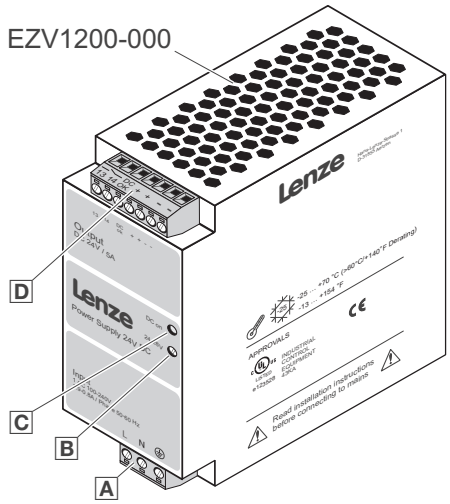


x Wiring clearance
y Cable bending radius
All dimensions in millimetres

Installation steps

For information on this topic, please see the corresponding mounting instructions.

8.11.3 Power supply unit



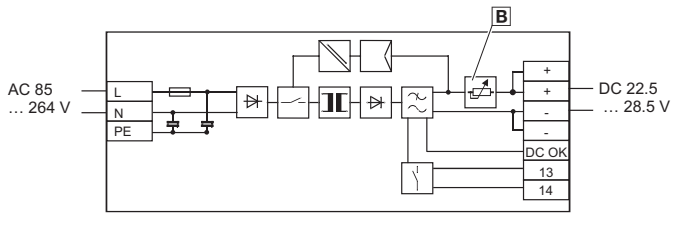
Elements

Pos.	Description
A	Input terminals (L, N, ⏚)
B	Potentiometer for setting the output voltage (24 ... 28 V)
C	LED for function monitoring (DC on)
D	Output terminals (+, -, DC o.k., 13, 14)

Overview

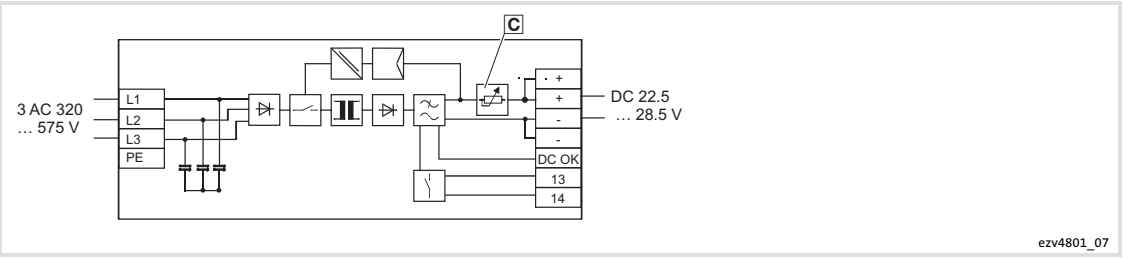
Power supply unit	Mains voltage V_{LN} [V]	Output voltage V_A [V]	Output current I_A [A]
EZV1200-000	1/N AC 230	DC 24	5
EZV1200-001	3 AC 400		
EZV2400-000	1/N AC 230		10
EZV2400-001	3 AC 400		
EZV4800-000	1/N AC 230		20
EZV4800-001	3 AC 400		

Connection plan



B Potentiometer

At DC OK: 24 V, max. 40 mA



C Potentiometer

At DC OK: 24 V, max. 40 mA

Terminal data

	Input terminals	Output terminals
Rigid terminal	0.2 … 2.5 mm² (AWG 24 … 12)	0.2 … 2.5 mm² (AWG 24 … 12)
Flexible terminal with wire end ferrule with plastic collar	0.2 … 2.5 mm² (AWG 24 … 12)	0.2 … 2.5 mm² (AWG 24 … 12)
Stripping length	7 mm	7 mm
Tightening torque	0.5 … 0.6 Nm (4.4 … 5.3 lb-in)	0.5 … 0.6 Nm (4.4 … 5.3 lb-in)

Function monitoring

The LED, the active ”DC OK” switching output and a potential-free contact provide the function monitoring.

LED	”DC OK” switching output	Potential-free contact	Output voltage	Info
AN	V = 24 V	closed	V_{output} > 0.9 U_{input}	Device is in operation, ● the output voltage V_{output} is higher than 90 % of the set voltage V_{input} ● the output current is in the permissible range
BLINKING	U = 0 V	open	V_{output} < 0.9 V_{input}	Device is in operation but ● error at the load ● current consumption is higher than I_{BOOST} ● output is short-circuited
OFF	U = 0 V	open	V_{output} = 0	Device is out of service because ● no mains voltage is applied ● the circuit-breaker is activated ● the device is defect

Note!

The device is defective and needs to be replaced if the mains voltage is applied, a short circuit can be excluded and an output voltage of V_{output} = 0 V is measured.

Standards

Conformity and approval			
Conformity			
CE	2014/35/EU	Low-Voltage Directive	
CE	2014/30/EU	EMC Directive	
UKCA	S.I. 2016/1101	The Electrical Equipment (Safety) Regulations 2016	
UKCA	S.I. 2016/1091	The Electromagnetic Compatibility Regulations 2016	
Approval			
$_{C}UL_{US}$	UL508	Power Conversion Equipment (File No. E132659) für USA	
	CSA C22.2 No. 14	Power Conversion Equipment (File No. E132659) für Canada	

General data/conditions of use		
Vibration resistance	up to 30 g	according tol IEC 68-2-27
Climatic conditions	Class 3K3	according to EN 60 721
Degree of pollution	2	according to EN 50 178
Permissible temperature ranges		
Storage	-40 °C ... +85 °C	
Operation	-25 °C ... +70 °C	Over +60 °C, reduce the output current by 2.5 %/°C
Humidity	< 95 %	At +25 °C, no condensation
Installation clearance	> 50 mm	above/below

General electrical data		
Degree of protection	IP 20	
Class of protection	I	with PE connection
Leakage current to PE	< 3.5 mA	
MTBF	> 500 000 h	to IEC 1709 (SN 29 500)

Input data	
Turn-on time	< 1 s after applying the mains voltage
Transient surge voltage protection	varistor

Output data		
Rated output voltage U_N	DC 24 V / ± 1 %	
Setting range of the output voltage	DC 22.5 ... 28.5 V	
Start of unlimited capacitive loads	yes	
Residual ripple / switching peaks (20 MHz)	< 100 mV_{SS}	with rated values
Can be connected in parallel	to increase redundancy and power	
Resistance to return supply	DC 35 V	

Dimensioning

The control level of the Servo Drives 9400 series is supplied with 24 V DC. To meet the requirements of typical applications, the 24-V supply has been implemented in a way allowing internal or external supply. For some components, external supply is absolutely necessary.

- The additional current requirements for extensions and components added to the modular structure must be considered.
- A separate 24-V supply is implemented via the connection of the basic device to operate the control section independently of the power section.
  - Communication modules are internally supplied.
  - Separate and external supply is absolutely necessary for: safety units.
- The control section of Single Drive controllers can supply itself from the power section. In this case, there is no external current required for the components and their modules.
  - E.g. for controllers for single drives without communication or without requirements on their availability (special case)
- Multi Drive controllers and power supply modules always require an external 24-V supply.

Typical current requirement of the 24-V supply for basic devices and modules or components (*with example*):

Current requirement of 24-V supply					
Type	GG	Connection	I_{24V} [mA]	Quantity	Total [mA]
Power supply modules					
E94APNE0104	1	X11	450	*1*	*450*
E94APNE0364	3		450		
E94APNE1004	4		1400		
E94APNE2454	5		1400		
Regenerative power supply modules					
E94ARNE0134	1	X11	620		
E94ARNE0244	3		620		
Multi Drive					
E94xMxE0024 E94xMxE0034 E94xMxE0044	1	X2	1120	*5*	*5600*
E94xMxE0074 E94xMxE0094	2	X2	1220		
E94xMxE0134 E94xMxE0174 E94xMxE0244 E94xMxE0324	3	X2	1470		
E94xMxE0474 E94xMxE0594	6	X2	660		
Single Drive					
E94xSxE0024 ... E94xSxE0244	1 ... 3	X2	620		
E94xSxE0324 ... E94xSxE1044	6 ... 7	X2	660		
E94xSxE1454 ... E94xSxE4604	81 ... 91	X2	660		

Current requirement of 24-V supply					
Type	**GG**	**Connection**	**[mA]**		**[mA]**
Connections					
Keypad EZAEBK...		X6	50	*5*	*250*
Digital outputs		X4	70	*6*	*420*
Analog outputs		X3	10		
Memory modules (MMI)					
MMxxx E94AYM...		-	20	*5*	*100*
Feedback					
Encoder		X8	110		
Resolvers		X7	20	*5*	*100*
Communication (MXI1/MXI2)					
CANopen® E94AYCCA		X	30		
DeviceNet™ E94AYCDN		X225	130		
Ethernet 2 port		-	60		
EtherNet/IP™		X232	130		
POWERLINK E94AYCEP POWERLINK CN E94AYCEC		X210/X250	140		
EtherCAT®		X245	130		
PROFIBUS E94AYCPM		X200	130	*5*	*650*
PROFINET E94AYCER		X240	140		
INTERBUS		X205	180		
Safety system (MSI)					
SM0 E94AYAA		-	0	*2*	*0*
SM100 E94AYAB		X80	200	*3*	*600*
- digital output			max. 700	*5 x 10 %*	*350*
SM301 E94AYAD		X80.2	350		
- clock output			50		
- safe digital output		X80.1	500		
				Example values in italics	
Result: current requirement of 24-V supply					
				Sum total [mA]:	*8520*
				Sum total [A]:	*8.5*

Notes:

- The current requirement refers to the nominal voltage of 24 V. With a lower voltage, the current requirement increases linearly.
- The values are maximum values. If the real currents are known, this can be considered accordingly in the table.
- The typical current consumption is approx. 10 ... 20 % lower.
- When selecting the power supply unit, observe that there will flow a substantially higher current for a short time when switching on the power supply unit. Select power supply units that can supply this overcurrent and do not switch off.
- The indicated current is a continuous current. If consumers are connected, more current is required in the starting phase (e.g. device fans). Power supply units therefore must have dynamic reserves.

Note!

When several devices are switched on, a very high initial charging current is required. Power supply units without current limitation can be overloaded (fault).

Lenze power supply units are equipped with an internal starting current limitation. When several devices are switched on, no faults will occur.

9 Anhang

9.1 Ecodesign Directive

REGULATION (EU) 2019/1781

9400 HighLine servo inverter

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

Power losses												
0; 25	f; l	%	8.7	5.2	3.0	2.7	1.9	1.6	1.3	1.3	0.6	0.7	0.7
0; 50	f; l	%	8.7	5.5	3.2	2.9	2.2	1.8	1.5	1.6	0.8	0.9	0.9
0; 100	f; l	%	9.0	5.9	3.7	3.4	2.8	2.4	2.1	2.3	1.2	1.4	1.4
50; 25	f; l	%	8.7	5.3	3.1	2.7	2.0	1.6	1.3	1.4	0.6	0.7	0.7
50; 50	f; l	%	8.7	5.5	3.3	3.0	2.2	1.8	1.6	1.7	0.8	1.0	1.0
50; 100	f; l	%	9.1	6.0	3.8	3.6	2.9	2.5	2.3	2.5	1.4	1.7	1.7
90; 50	f; l	%	8.8	5.5	3.3	3.1	2.3	1.9	1.7	1.7	0.9	1.1	1.1
90; 100	f; l	%	9.2	6.1	3.9	3.8	3.1	2.7	2.5	2.7	1.6	2.2	2.1
Standby losses		%	2.1	1.2	0.6	0.5	0.3	0.2	0.1	0.1	0.1	0.1	0.1
Efficiency level			IE2	IE2	IE2	IE2	IE2	IE2	IE2	IE2	IE2	IE2	IE2
Manufacturer			Lenze SE · Hans-Lenze-Str. 1 · 31855 Aerzen · GERMANY										
Commercial registration number			Hannover HRB 204803										
Product's model identifier			E94□S□E0024	E94□S□E0034	E94□S□E0044	E94□S□E0074	E94□S□E0134	E94□S□E0174	E94□S□E0244	E94□S□E0324	E94□S□E0474	E94□S□E0594	E94□S□E0864
Apparent output power		kVA	0.9	1.6	2.5	4.4	8.1	10.3	14.7	20	29.3	36.8	53.6
Indicative motor rated power output		kW	0.37	0.75	1.5	3	5.5	7.5	11	15	22	30	45
Rated output current		A	1.5	2.5	4	7	13	16.5	23.5	32	47	59	86
Maximum operating temperature		°C	45										
Rated supply frequency		Hz	50										
Rated supply voltage		V	400										
Switching frequency		kHz	8								4		
Rated apparent output power		kVA	0.977	1.71	3.3	4.44	9.95	14.4	19.5	23.9	38.2	38.2	56.2

Power losses										
0; 25	f; l	%	0.6	0.9	0.9	0.9	0.7	0.7	0.9	0.8
0; 50	f; l	%	0.8	1.1	1.1	1.1	0.9	0.9	1.2	0.9
0; 100	f; l	%	1.4	1.7	1.7	1.7	1.4	1.4	1.9	1.5
50; 25	f; l	%	0.7	1.0	1.0	0.9	0.6	0.8	1.0	0.8
50; 50	f; l	%	1.0	1.2	1.2	1.2	1.0	1.0	1.3	1.1
50; 100	f; l	%	1.8	2.0	2.0	2.0	1.7	1.6	2.2	1.8
90; 50	f; l	%	1.1	1.4	1.4	1.3	1.2	1.1	1.5	1.2
90; 100	f; l	%	2.3	2.3	2.2	2.4	2.1	2.0	2.6	2.2
Standby losses		%	0.1	0.1	0.1	0.0	0.1	0.1	0.0	0.0
Efficiency level			IE2	IE2	IE2	IE2	IE2	IE2	IE2	IE2
Manufacturer			Lenze SE · Hans-Lenze-Str. 1 · 31855 Aerzen · GERMANY							
Commercial registration number			Hannover HRB 204803							
Product's model identifier			E94□S□E1044	E94BS□E1454	E94BS□E1724	E94BS□E2024	E94BS□E2454	E94BS□E2924	E94BS□E3664	E94BS□E4604
Apparent output power		kVA	64.8	90	107	126	153	182	228	287
Indicative motor rated power output		kW	55	75	90	110	132	160	200	250
Rated output current		A	104	145	172	202	245	292	366	460
Maximum operating temperature		°C	45							
Rated supply frequency		Hz	50							
Rated supply voltage		V	400							
Switching frequency		kHz	4				2			
Rated apparent output power		kVA	68.4	92.8	111	135	162	196	242	302

□ Placeholder for product variants

Operating point (f; l) f = relative motor stator frequency; l = relative torque-producing current

Power losses Power losses at operating points (f; l) and in standby mode relate to the rated apparent output power.

For power losses for auxiliary equipment and options (e.g. for diagnostics) as well as for accessories (e.g. mains chokes) please refer to further documents for project planning on the product web page.

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EDS94SPP101 ▪ 13550980 ▪ EN ▪ 11.1 ▪ TD00

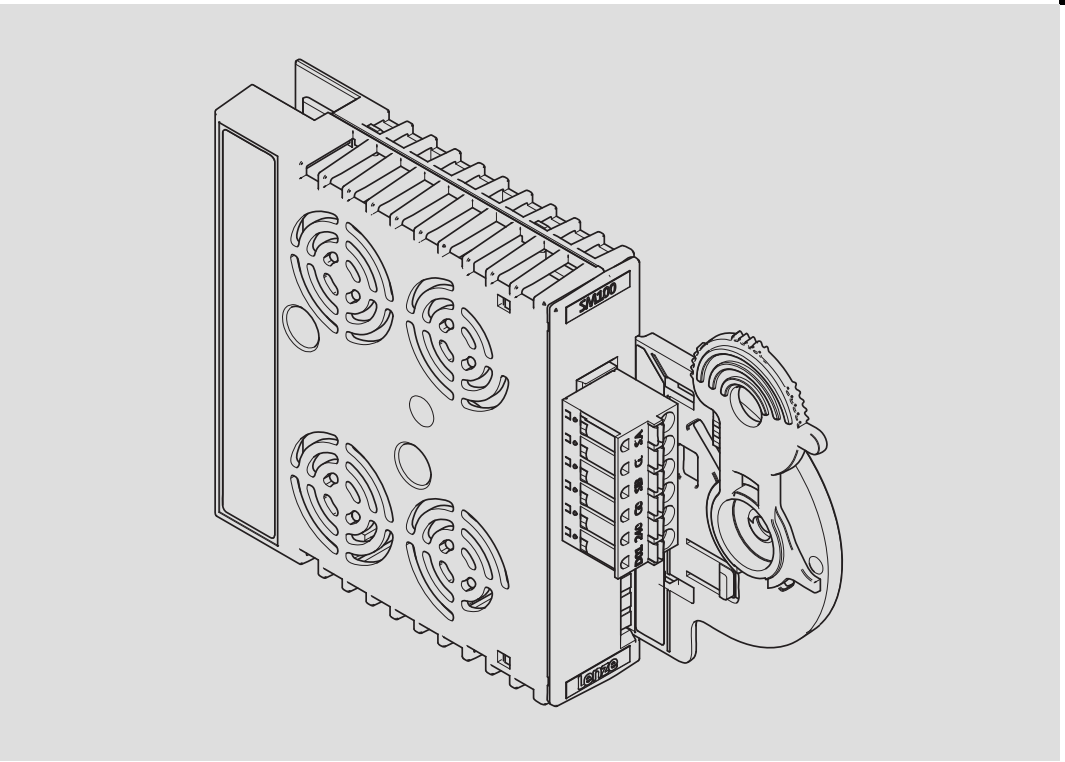
10 9 8 7 6 5 4 3 2 1

EDS94AYAB
13261738

L-force *Drives*

Translation of the original operating instructions

9400



E94AYAB - SM100

Safety module

Lenze



Please read these instructions and the documentation of the standard device before you start working!
Observe the safety instructions given therein!

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1 Safety engineering

1.1 Basics

1.1.1 Introduction

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

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

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

1.1.2 Drive-based safety with L-force | 9400

The controllers of the L-force|9400 range can be equipped with a safety module. The functional range of the safety module types varies in order to optimally implement different applications.

”Drive-based safety” stands for applied safety functions, which can be used for the protection of persons working on machines.

The motion functions are continued to be executed by the controller. The safety modules monitor the safe compliance with the limit values and provide the safe inputs and outputs. When the limit values are exceeded the safety modules start the control functions according to EN 60204-1 directly in the controller.

The safety functions are suitable for applications according to IEC 61508 to SIL 3 and meet, depending on the module, the requirements of Performance Level e (PL e) and control category 4 according to EN ISO 13849-1.

1.1.3 Terms and abbreviations of the safety engineering

Abbreviation	Meaning
9400	Lenze servo controller
Cat.	Category according to ISO 13849-1 (formerly EN 954-1)
OSSD	Output Signal Switching Device, tested signal output
PS	PROFIsafe
PWM	Pulse width modulation
SD-In	Safe input (Safe Digital Input)
SD-Out	Safe output (Safe Digital Output)
SIL	Safety Integrity Level according to IEC 61508
SM	Safety Module
Opto supply	Optocoupler supply for the driver control
PELV	Protective extra low voltage
SELV	Safety extra low voltage
OFF state	Signal state of the safety sensor technology when it is released or responding
ON state	Signal state of the safety sensor technology in normal operation
PM	P/N switching signal paths
PP	P/P switching signal paths
GSE	File containing device-specific data to establish PROFIBUS communication
GSDML	File containing device-specific data to establish PROFINET communication
S-Bus	Safety bus

Abbreviation	Safety function
SLS	Safely limited speed
SOS	Safe operating stop
SS1	Safe stop 1
SS2	Safe stop 2
SSM	Safe speed monitor
STO	Safe torque off Formerly: safe standstill

1.1.4 Important notes

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.

1.1.5 Safety instructions

Application as directed

The safety modules SMx (E94AYAx) may only be used together with Lenze drive controllers of the L-force | 9400 (E94A...) series.

Any other use shall be deemed inappropriate!

Installation/commissioning

Danger!

Danger to life through improper installation

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

Possible consequences:

► Death or severe injuries

Protective measures:

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

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

► It is essential to use insulated wire end ferrules for wiring.

► All safety relevant cables outside the control cabinet must be protected, e.g. by means of a cable duct:
  – Ensure that there are no short circuits.
  – For further measures see ISO 138492.

► If an external force acts upon the drive axes, additional brakes are required. Please observe that hanging loads are subject to the force of gravity!

Danger!

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

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

Danger!

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

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

During operation

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

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

Residual hazards

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

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

1.1.6 Hazard and risk analysis

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

Before putting a machine into circulation, the manufacturer of the machinemust carry out a hazard analysis according to 2006/42/EC: Machinery Directive [UKCA: S.I. 2008/1597 - The Supply of Machinery (Safety) Regulations 2008] to find out the hazards related to the application of the machine. To achieve a level of safety as high as possible the Machinery Directive contains three principles:

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

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

1.1.7 Standards

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

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

1.1.8 Overview of sensors

Passive sensors

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

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

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

Examples of passive sensors:

- Door contact switch
- Emergency-off control units

Active sensors

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

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

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

Examples of active sensors:

- Lightgrid
- Laser scanner
- Control

1.2 Safety notes for the installation according to U_L or U_R

Original - English

Warnings!

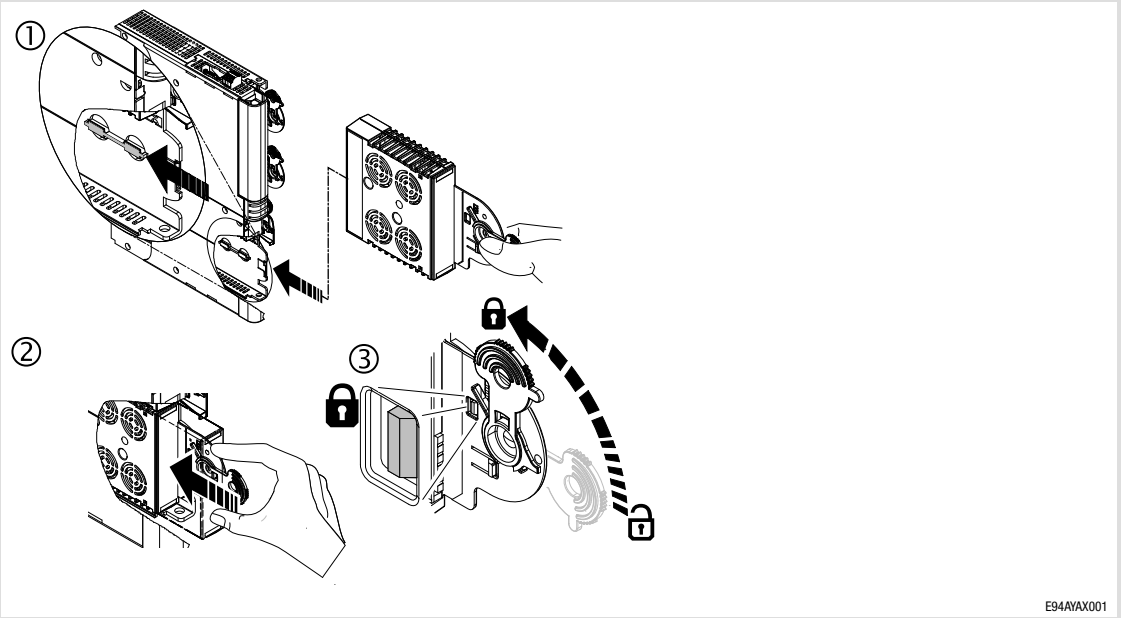
- ► Maximum surrounding air temperature: 55 °C.
- ► External fuse for 24 Vdc supply voltage. Rated 4 A DC fuse UL248-14.

1.3 Device modules

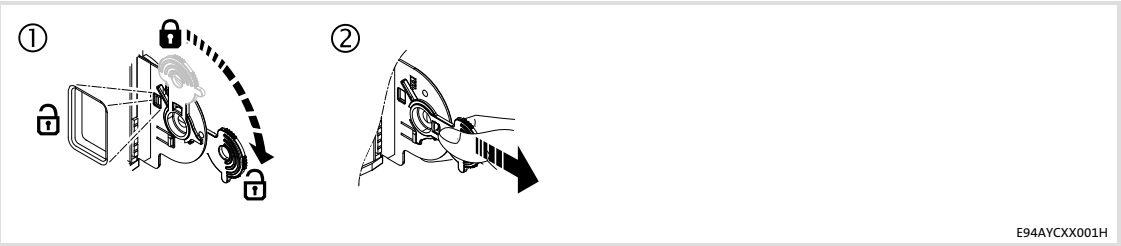
1.3.1 Slot

The slot for the safety modules is marked in the documentation with M4. It is the lowest slot in the controller (see overview in the documentation of the controller).

1.3.1.1 Mounting



1.3.1.2 Dismounting



1.3.1.3 Module exchange

Every module exchange is detected by the standard device and documented in a logbook.

When a module is replaced by the same type, no restrictions arise. Depending on the module type it may be necessary to take further measures (e.g. address setting, safe parameter setting, ...).

When the module is replaced by a different type, the drive is inhibited by the controller. The inhibit can only be deactivated when the parameter setting of the required safety module complies with the plugged safety module.

1.3.2 Function mode of the safety modules

C00214

The code C00214 must comply with the plug-in safety module type so that the controller is able to operate.

Disconnecting paths

The transmission of the pulse width modulation is safely (dis-)connected by the safety module. Hence the drivers do not create a rotating field. The motor is safely switched to torqueless operation (STO).

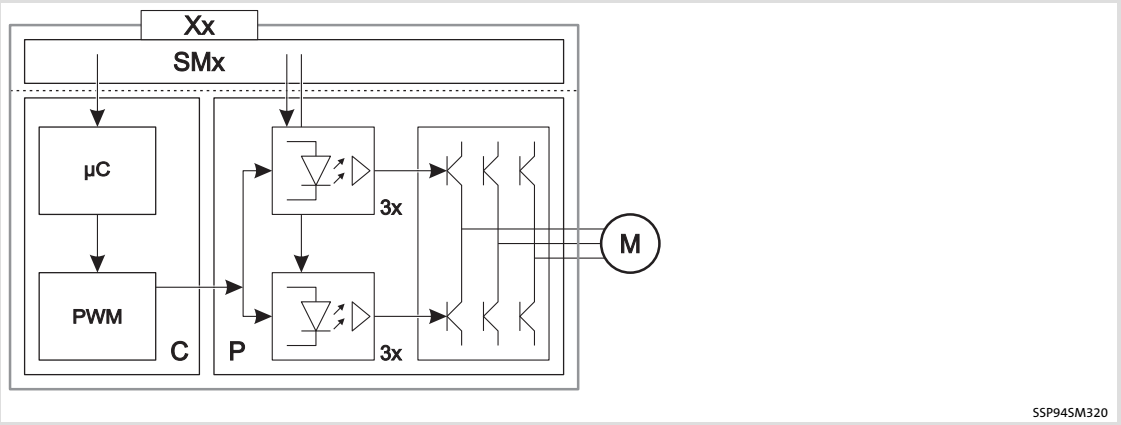


Fig. 1-1 Disconnecting paths of the safety modules

SMx	Safety module
xx	Input / output terminal
C	Control section
µC	Microcontroller
PWM	Pulse width modulation
P	Power section
M	Motor

Safety status

When the controller is switched off by the safety module, the controller switches to the ”Safe torque off”device state.

- ”Controller in STO state” is entered into the logbook (0x00750003).
- ”Safe torque off active” is displayed in C00183.

1.3.3 Safety module SM0

1.3.3.1 Overview

The type designation of the module is E94AYAA.

Function

- There are **no** safety functions available.
- This module is required to operate the controller without safetyfunctions.

Note!

If safety functions are required, replace the SM0 module by a module with safety functions (e.g. SM100, SM301).

Note!

After the module has been exchanged, the controller does not work if the module type plugged-in does not comply with the stored type (C00214).

1.3.4 Safety module SM100

1.3.4.1 Overview

The type designation of the safety module is E94AYAB.

Function

- Safe torque off
  (up to now: Safe standstill, protection against unexpected start-up)

Danger!

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

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

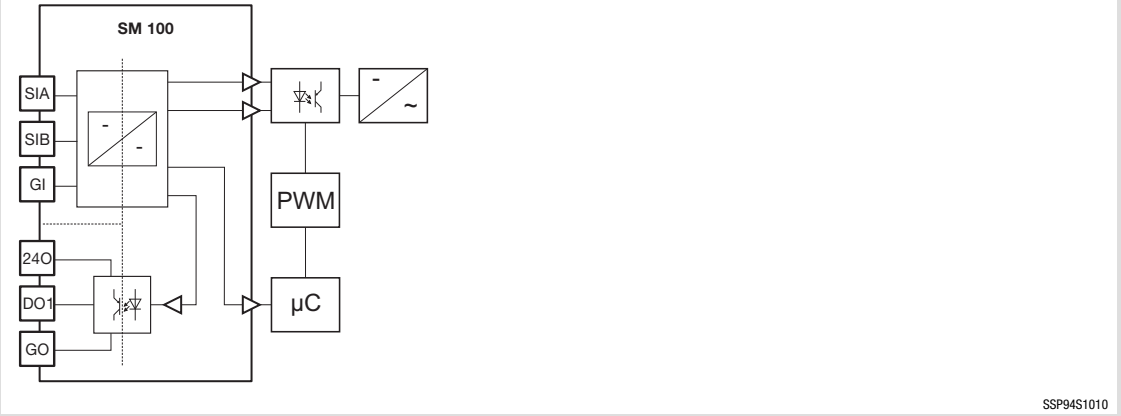


Fig. 1-2 Function overview SM100

SM100	Safety module
SIA, SIB, GI	Two-channel sensor signal connections, supply through safely separated power supply unit (SELV/PELV)
	(old labelling up to HW version VB: SI1, SI2, GI)
24O, DO1, GO	Non-safe feedback connections, supply through safely separated power supply unit (SELV/PELV)
µC	Microcontroller
PWM	Pulse width modulation

1.3.4.2 Safety category

The functions of the SM100 safety module for the Servo Drives 9400 controllers meet the requirements of the following standards:

- Category 4 and Performance Level e (PL e) according to ISO 13849-1 (formerly EN 954-1)
  - In order to comply with category 4/PL e, the external wiring and cable monitoring must also meet the requirements of category 4/PL e.
  - Ensure that short circuits cannot occur in the external wiring.
- SIL 3 according to IEC 61508
  - The SM100 safety module does not contribute to the probability of failure on demand (PFD) and probability of failure per hour (PFH) of IEC 61508.

1.3.4.3 Elements of the module

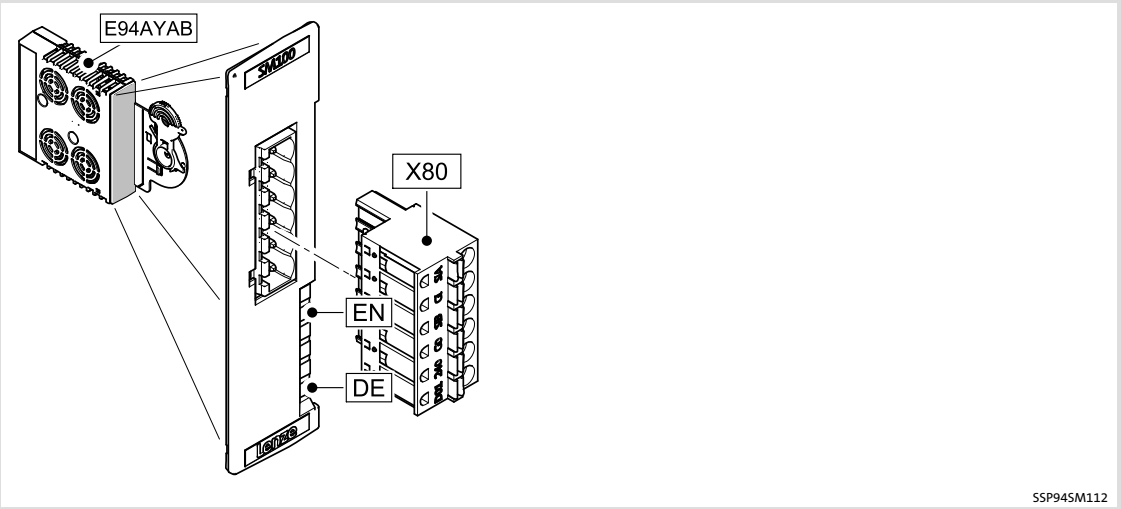


Fig. 1-3 Module view

Displays

Pos.	Colour	Condition	Description
EN	Yellow	On	Controller enabled
		Off	Non-safe display "Safe pulse inhibit"
DE	Red	On	The module is not accepted by the standard device (see notes given in the documentation for the standard device).

Tab. 1-1 LED display SM 100

1.3.4.4 Technical data

24 V

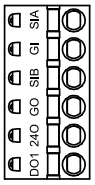
The inputs and outputs are isolated and designed for a low-voltage supply through a safely separated power supply unit (SELV/PELV) of 24 V DC. P/N switching input signals and test pulses ≤ 1 ms are permissible.

Output signals of active sensors are directly wired to the X80 terminal.

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

There is no monitoring for short circuits.

Signals

X80	Marking	Description	Electrical data
 SSP9400X80	SIA	Input first shutdown path	SIA: I_{typ} = 160 mA
	GI	GND potential for SIA/SIB	LOW: -3 ... 5 V, HIGH: 15 ... 30 V,
	SIB	Input second shutdown path	SIB: I_{typ} = 28 mA Supply through safely separated power supply unit (SELV/PELV)
	GO	GND potential feedback	24 V, max. 0.7 A, short-circuit-proof, LOW-active, Supply through safely separated power supply unit (SELV/PELV)
	24O	24 V supply feedback	
	DO1	Non-safe signalling output: "Safe pulse inhibit"	

Terminal data				
	Conductor cross-section		Tightening torque	
	[mm²]	[AWG]	[Nm]	[lb-in]
Rigid	0.2 ... 2.5	24 ... 12	Spring terminal	
Wire end ferrule, insulated	0.2 ... 1.5	24 ... 16		
Twin wire end ferrule	0.5 ... 1.0	20 ... 18		

Stripping length / contact length: 10 mm

Information for the exchange of modules of different hardware versions		
up to HW: VB	from HW: VC	Comment
SI1	SIA	The exchange of the spring terminal is required!
GI	GI	
SI2	SIB	
GO	GO	
24O	24O	
DO1	DO1	

Detail features of the inputs and outputs of the SM100					
Terminal	**Specification**	**[Unit]**	**min.**	**typ.**	**max.**
SIA, SIB	Low signal	V	-3	0	5
	High signal	V	15	24	30
	Input capacitance at switch-off	nF		4	
	Input delay (tolerated test pulse)	ms		1	
	Switch-off time (depending on the standard device)	ms	2.5	4	
	Running time	ms		3	
SIA	Input current	mA		160	170
	Input capacitance at switch-on, reduced	µF		20	
SIB	Input current	mA		28	35
	Input capacitance at switch-on, reduced	µF		5	
GI	Ground for SIA/SIB				
24O, GO	Supply voltage through safely separated power supply unit (SELV/PELV)	V	18	24	30
DO	Low signal	V		0	0.8
	High signal	V	17	24	29
24O, GO, DO	Output current	A			0.7

Truth table

Inputs		Outputs	Description	Enable
SIA	**SIB**	**DO1**		**through SM100**
0	0	1	”Safe torque off” is activated	0
0	1	0		0
1	0	0		0
1	1	0	Drive is active	1

Tab. 1-2 Truth table SM100

1.3.4.5 Commissioning

- ► Settings in or at the module are not required.
- ► Required settings in the basic device:
  – C00214, type of safety module
- ► During commissioning and after the replacement of a module it is vital to check the safety function.

1.4 Acceptance

1.4.1 Description

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

Inspector

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

Protocol

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

Note!

If parameters of the safety function are changed, the test must be repeated and recorded in the test report.

Scope

A complete test comprises the following:

- Documentation of the plant including the safety functions.
  - Plant description and overview map
  - Description of the safety devices
  - Safety functions used
- Functional test of the safety functions used
- Preparing the test report
  - Documenting the functional test
  - Controlling the parameters
  - Signing
- Preparing the appendix with test records
  - Protocols from the plant
  - External recording

1.4.2 Periodic inspections

The correct sequence of the safety-oriented functions must be checked in periodic inspections. The risk analysis or applicable regulations determine the time distances between the tests. The inspection interval should not exceed one year.

2 Appendix

2.1 Declarations of conformity

Lenze

2250519.04

EU-Konformitätserklärung — EU Declaration of Conformity

LENZE SE, Hans-Lenze-Strasse 1, 31855 Aerzen GERMANY

erklärt in alleiniger Verantwortung die Übereinstimmung der Produkte — declares under sole responsibility compliance of the products

E94xxxExxxxxxxxxxx (x=0-9/A-Z) &
SM100 - E94AYAB

mit der — with the

Maschinenrichtlinie
2006/42/EG Anhang VIII und IX

Machinery Directive
2006/42/EC Annex VIII and IX

Angewandte harmonisierte Normen: — **Applied harmonized standards:**

Sicherer Halt	Stopp Kategorie 0	EN 60204-1	:2018	Stop category 0	Safe torque off
	Kategorie 4 Performance Level (PL): PL e	EN ISO 13849-1	:2015	Category 4 Performance Level (PL): PL e	
		EN 61508 1-7	:2010		
Sicherheitsfunktionen siehe Betriebsanleitung.	SIL 3	EN 62061 +AC +A1 +A2	:2005 :2010 :2013 :2015	SIL 3	For safety functions see manual.
		EN 61800-5-2	:2017		
		EN 61800-5-1 +A1	:2007 :2017		

Konformitätsbewertung — **Conformity assessment**

CE 0035

Benannte Stelle		notified body	TÜV Rheinland Industrie Service GmbH Am Grauen Stein 51105 Köln / Germany
Zertifikate		Certificates	01/205/0669.02/19
Gültigkeit		Date of expiry	2024-12

EMV- Richtlinie
2014/30/EU

EMC Directive
2014/30/EU

Angewandte harmonisierte Normen: — **Applied harmonized standards:**

EN 61800-3:2004 + A1:2012
EN 61800-3:2018

RoHS- Richtline
2011/65/EU

RoHS Directive
2011/65/EU

Angewandte harmonisierte Normen: — **Applied harmonized standards:**

EN IEC 63000:2018

Die Sicherheitshinweise der Betriebanleitung sind zu beachten. — The safety instructions of the manual are to be considered.

Die Produkte sind bestimmt zum Einbau in Maschinen. Die Inbetriebnahme ist solange untersagt bis festgestellt wurde, dass die Maschine, in welche diese Produkte eingebaut werden sollen, den Bestimmungen der o.g. EU-Richtlinie entsprechen. — These products are intended for installation in machines. Operation is prohibited until it has been determined that the machines in which these products are to be installed, conforms to the above mentioned EU Directive.

Ort / Datum
Place / date

Aerzen 16.10.2020

Geschäftsführer
Managing Director

Dipl.-Ing. Frank Maier

Dokumentationsverantwortlicher
Responsible for documentation

i.V. T. Wedemeyer

Lenze

2462933.00

UK Declaration of Conformity

LENZE SE, Hans-Lenze-Strasse 1, 31855 Aerzen GERMANY

declares under sole responsibility compliance of the products

E94xxxExxxxxxxxxxx (x=0-9/A-Z) &
SM100 - E94AYAB

with the

The Supply of Machinery (Safety) Regulations 2008 — **S.I. 2008 No. 1597**

Applied designated standards:

Safe torque off	**EN 60204-1**	**:2018**		
	EN ISO 13849-1	**:2015**	Category 4 Performance Level: PL e	
For safety functions see manual.	**EN 61508 1-7**	**:2010**		
	**EN 62061** **+AC +A1 +A2**	**:2005** **:2010 :2013 :2015**	SIL 3	
	EN 61800-5-2	**:2007 + 2017**		
	EN 61800-5-1 + A1	**:2007 :2017**		

Conformity assessment

UK CA	**notified body**	TUV Rheinland UK Ltd 1011 Stratford Road Solihull, B90 4BN
	Certificates	01/205U/0669.00/22
	Date of expiry	2024-12

The Electromagnetic Compatibility Regulations 2016 — **S.I. 2016 No. 1091**

Applied designated standards:

EN 61800-3:2004 + A1:2012
EN IEC 61800-3:2018

The Ecodesign for Energy-Related Products and Energy Information Regulations 2021 — **S.I. 2021 No. 745**

Applied standards:

EN 61800-9-2:2017

The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012 — **S.I. 2012 No. 3032**

Applied designated standards:

EN IEC 63000:2018

Authorised representative
LENZE Ltd., 6, Abbey Court Fraser Road Priory, Business Park, MK44 3WH Bedford

The safety instructions of the manual are to be considered.
These products are intended for installation in machines. Operation is prohibited until it has been determined that the machines in which these products are to be installed, conforms to the above mentioned Regulations.

Place / date	Chief Technology Officer	Responsible for documentation
Aerzen 13.09.2022	*Dipl.-Ing. Frank Maier*	*i.V. Torsten Wedemeyer*

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EDS94AYAB ▪ 13261738 ▪ EN ▪ 2.2 ▪ TD00

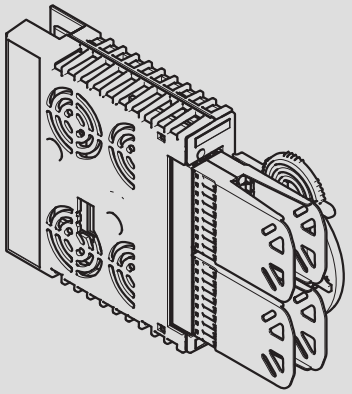
10 9 8 7 6 5 4 3 2 1

EDS94AYAE
13380800

L-force *Drives*

Translation of the original operating instructions

9400



E94AYAE - SM301

Safety module

Lenze



Please read these instructions and the documentation of the standard device before you start working!
Observe the safety instructions given therein!

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1 Safety engineering

1.1 Basics

1.1.1 Introduction

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

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

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

1.1.2 Drive-based safety with L-force | 9400

The controllers of the L-force|9400 range can be equipped with a safety module. The functional range of the safety module types varies in order to optimally implement different applications.

”Drive-based safety” stands for applied safety functions, which can be used for the protection of persons working on machines.

The motion functions are continued to be executed by the controller. The safety modules monitor the safe compliance with the limit values and provide the safe inputs and outputs. When the limit values are exceeded the safety modules start the control functions according to EN 60204-1 directly in the controller.

The safety functions are suitable for applications according to IEC 61508 to SIL 3 and meet, depending on the module, the requirements of Performance Level e (PL e) and control category 4 according to EN ISO 13849-1.

1.1.3 Terms and abbreviations of the safety engineering

Abbreviation	Meaning
9400	Lenze servo controller
Cat.	Category according to EN ISO 13849-1 (formerly EN 954-1)
OSSD	Output Signal Switching Device, tested signal output
PS	PROFIsafe
PWM	Pulse width modulation
SD-In	Safe input (Safe Digital Input)
SD-Out	Safe output (Safe Digital Output)
SIL	Safety Integrity Level according to IEC 61508
SM	Safety module
Optocoupler supply	Optocoupler supply for the driver control
PELV	Protective extra low voltage
SELV	Safety extra low voltage
OFF state	Signal status of the safety sensor technology when it is released or responding
ON state	Signal status of the safety sensor technology in normal operation
PM	PN-switched signal paths
PP	PP-switched signal paths
GSE	File containing device-specific data to establish PROFIBUS communication
GSDML	File containing device-specific data to establish PROFINET communication
S-Bus	Safety bus

Abbreviation	Safety function
SLS	Safely limited speed
SLI	Safely limited increment
SOS	Safe operating stop
SS1	Safe stop 1
SS2	Safe stop 2
SSM	Safe speed monitor
STO	Safe torque off Formerly: safe standstill
SMS	Safe maximum speed
SDI	Safe direction
SSE	Safe stop emergency
ES	Safe enable switch
OMS	Operation mode selector
AIE	Error acknowledgement (Acknowledge In Error)
AIS	Restart acknowledgement (Acknowledge In Stop)

1.1.4 Important notes

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

Pictograph and signal word	Meaning
 **Warnings!**	**Safety note or application note for the operation according to UL or CSA requirements.** The measures are required to meet the requirements according to UL or CSA.
 **Warnings!**	

1.1.5 Safety instructions

Application as directed

The safety modules SMx (E94AYAx) may only be used together with Lenze drive controllers of the L-force | 9400 (E94A...) series.

Any other use shall be deemed inappropriate!

Installation/commissioning

Danger!

Danger to life through improper installation

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

Possible consequences:

► Death or severe injuries

Protective measures:

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

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

► It is essential to use insulated wire end ferrules for wiring.

► All safety relevant cables outside the control cabinet must be protected, e.g. by means of a cable duct:
  – Ensure that no short circuits can occur.
  – For further measures see EN ISO 138492.

► If an external force acts upon the drive axes, additional brakes are required. Please observe that hanging loads are subject to the force of gravity!

Danger!

When the request for the safety function is deactivated, the drive can restart automatically. The behaviour can be set via the parameter ”Restart behaviour” (C15300/1/2).

In the case of an automatic restart, you must provide external measures which ensure that the drive only restarts after an acknowledgement (EN 60204).

Danger!

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

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

During operation

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

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

Residual hazards

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

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

1.1.6 Hazard and risk analysis

This documentation can only accentuate the need for hazard analysis. The user of the integrated safety system must read up on standards and the legal situation:

Before the launch of a machine, the manufacturer of the machine must conduct a hazard analysis according to 2006/42/EC: Machinery Directive [UKCA: S.I. 2008/1597 - The Supply of Machinery (Safety) Regulations 2008] to determine the hazards associated with the application of the machine. The Machinery Directive refers to three basic principles for the highest possible level of safety:

- Hazard elimination / minimisation by the construction itself.
- Required protective measures must be taken against hazards which cannot be eliminated.
- Existing residual hazards must be documented and the user must be informed of them.

Detailed information on the hazard analysis procedure is provided in the DIN EN ISO 12100:2013-08 - ""Safety of machinery - General principles for design, risk assessment and risk reduction". The results of the hazard analysis determine the category for safety-related control systems according to EN ISO 13849-1. Safety-oriented parts of the machine control must be compliant.

1.1.7 Standards

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

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

1.1.8 Overview of sensors

Passive sensors

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

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

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

Examples of passive sensors:

- Door contact switch
- Emergency stop control units

Active sensors

Active sensors are units with 2-channel semiconductor outputs (OSSD outputs). With the integrated safety system of this device series, test pulses < 1 ms for monitoring the outputs and cables are permissible. The maximally permissible connection capacity of the outputs is to be observed. Active sensors are wired directly to the terminals of the integrated safety system. Monitoring for cross or short circuits must be carried out by the active sensor.

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

The outputs must switch simultaneously (equivalently). Nevertheless, safety functions will be activated as soon as at least one channel is switched. Active triggering of only one channel indicates faulty sensors or impermissible wiring.

Examples of active sensors:

- Lightgrid
- Laser scanner
- Control systems

Sensor inputs

For unused sensor inputs, ”Input deactivated” must be parameterised.

Connected deactivated sensors can create the false impression of safety technology being provided. For this reason, a deactivation of sensors by parameter setting only is not permissible and not possible. It is monitored that no sensor signal is pending.

1.2 Safety instructions for the installation according to U_L or U_R

Original - English

Warnings!

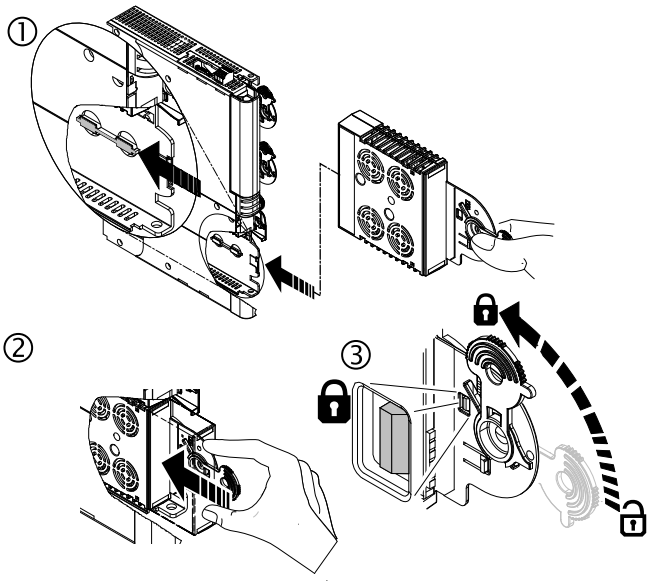
- ► Maximum surrounding air temperature: 55 °C.
- ► External fuse for 24 Vdc supply voltage. Rated 4 A DC fuse UL248-14.

1.3 Device modules

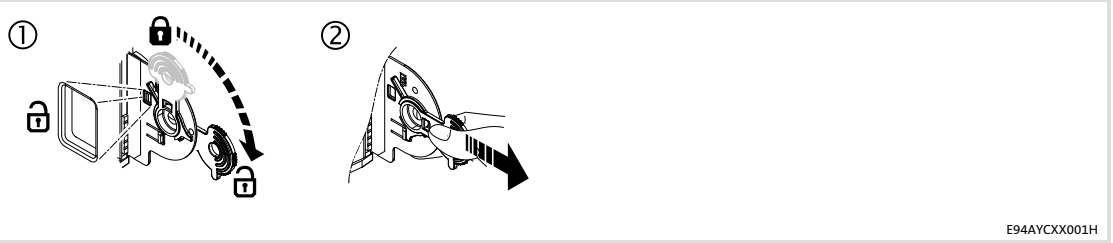
1.3.1 Slot

The slot for the safety modules is marked in the documentation with M4. It is the lowest slot in the controller (see overview in the documentation of the controller).

1.3.1.1 Mounting



1.3.1.2 Dismounting



1.3.1.3 Module exchange

Stop!

Before mounting/dismounting, switch off the supply voltage to prevent electronic modules from damage.

Every module exchange is detected by the standard device and documented in a logbook.

When a module is replaced by the same type, no restrictions arise. Depending on the module type it may be necessary to take further measures (e.g. address setting, safe parameter setting, ...).

When the module is replaced by a different type, the drive is inhibited by the controller. The inhibit can only be deactivated when the parameter setting of the required safety module complies with the plugged safety module.

Codes

Parameter:	Name:	Data type:	Index:
C00214	**Required safety module**	UNSIGNED_8	$24361_d = 5F29_h$

Setting of the expected safety module
- If a safety module deviating from this setting is detected, an error (fault) is caused. The error can only be removed by mains switching.

Selection list (Lenze setting bold)		**Information**
1	**SM0**	
2	SM100	
4	SM300	
5	SM301	

☑ Read access ☑ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer ☐ COM ☐ MOT

Note!

In case you exchange the module, the address switch Ⓐ must be set identically to the module to be replaced. Only then the corresponding safe parameter set can be transferred to the module.

1.3.2 Function mode of the safety modules

C00214

The setting in C00214 must comply with the plug-in safety module type so that the controller is able to operate.

Disconnecting paths

The transmission of the pulse width modulation is safely disconnected by the safety module. Hence the drivers do not create a rotating field. The motor is safely switched to torqueless operation (STO).

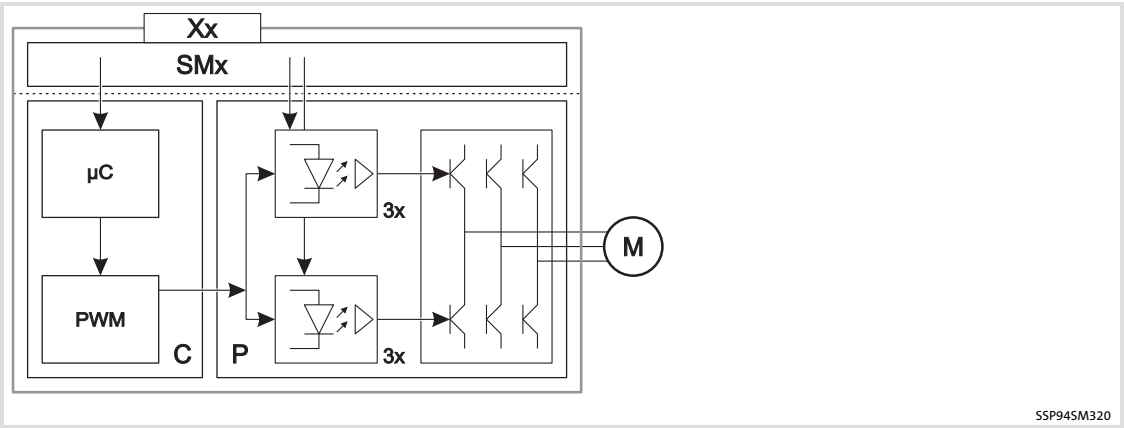


Fig. 1-1 Disconnecting paths of the safety modules

SMx	Safety module
xx	Input / output terminal
C	Control section
µC	Microcontroller
PWM	Pulse width modulation
P	Power section
M	Motor

Safety status

When the controller is switched off by the safety module, the controller switches to the ”Safe torque off”device state.

- ”Controller in STO state” is entered into the logbook (0x00750003).
- ”Safe torque off active” is displayed in C00183.

Fail-safe status

Note!

If internal errors of the safety modules are detected, the motor is safely switched to torque-free operation (fail-safe status).

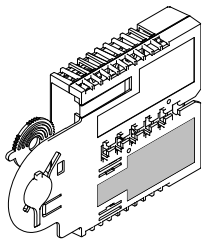
1.3.3 SM301 safety module

Validity information

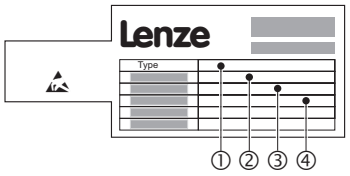
These instructions are valid for

SM301 safety module		
Type	**HW**	**SW**
E94AYAE	from VA	from 01.00

Identification



E94YCEI003C



E94AYXX001

①					②	③	④
E94	**A**	**Y**	**A**	**x**	**xx**	**xx**	**nn**

Product series

Version

Module identification: Device module

Module type: Safety module

Design
A = SM0
B = SM100
E = SM301

Hardware version

Software version (SM301 only)

Serial number

Application range

The use of this module is permissible with standard devices of the 9400 product series from nameplate designation

Type	HW	SW
E94AxHExxxx	VA	01.49
E94AxPExxxx	2A	02.xx

Safe position and speed detection with a resolver selected as the motor encoder and an additional position encoder is permissible with SM301 V1.3 and standard devices of the 9400 product series from nameplate designation

Type	HW	SW
E94AxHExxxx	xx	07.xx
E94AxPExxxx	2A	02.xx

Safe position and speed detection with a resolver selected as the motor encoder is permissible with SM301 V1.4 and standard devices of the 9400 product series from nameplate designation

Type	HW	SW
E94AxHExxxx	xx	08.xx
E94AxPExxxx	2A	02.xx

The use of this module is permissible with the PROFIBUS communication module from nameplate designation

Type	HW	SW
E94AYCPM	VB	01.10

This module as of SM301 V1.1 may be used in conjunction with the PROFINET communication module with the following nameplate data

Type	HW	SW
E94AYCER	VC	00.70

Note!

A safety bus system (PROFIsafe) can only be operated via the upper module slot (MXI1) of the Servo Drive 9400.

1.3.3.1 Overview

Functions from SM301 V1.0 onwards

- Safe torque off (STO)
  (formerly: safe standstill, protection against unexpected start-up)
- Safe stop 1 (SS1)
- Safe stop 2 (SS2) - see SOS
- Safe stop emergency (SSE)
- Safe operational stop (SOS) - in accordance with EN 61800-5-2: SOS is designed with speed monitoring
- Safe maximum speed (SMS)
- Safely limited speed 1 (SLS1)
- Safe operation mode selector (OMS)
- Safe enable switch (ES)
- Safe speed monitor (SSM)
- Safe monitor (output)
- Connection of safety sensors
- Safe parameterisation
- Safety bus connection (PROFIsafe V1)

Additional functions as of SM301 V1.1

- Safely limited speed 2 (SLS2)
- Safely limited speed 3 (SLS3)
- Safely limited speed 4 (SLS4)
- Safe cascading (CAS) via SD-In4/SD-Out1
- Safety bus connection (PROFIsafe V2)

Additional functions from SM301 V1.2

- Parameterisable response time of encoder monitoring

Additional functions from SM301 V1.3

- Safe operational stop (SOS) - compliant with EN 61800-5-2: SOS is designed with position monitoring
- Safe direction (SDI)
- Safe speed measurement and position detection with resolver using a motor encoder and an additional position encoder (two-encoder-concept)

Additional functions as of SM301 V1.4

- Safely limited increment (SLI)
- Safely monitored brake ramp for SS1/SS2
- Safe speed and position detection with resolver selected as the motor encoder

Motor-encoder combinations

Drive systems with Servo Drives 9400 and safety module SM301 provide speed-dependent safety functions for safe speed monitoring and/or safe relative-position monitoring. Observe permissible motor-encoder combinations during configuration.

- Possible speed-dependent safety functions with safety module SM301:
  - Safe stop 1 (SS1)
  - Safe operational stop (SOS)
  - Safely limited speed (SLS)
  - Safe maximum speed (SMS)
  - Safe direction (SDI)
  - Safe speed monitor (SSM)
  - Safely limited increment (SLI)
- Permissible motor-encoder combinations for these functions:

Synchronous servo motors	Encoder		Safe speed monitoring with SM301	
	Type	Product key		
MCS 06 ... 19 MDXKS 56 / 71	Sin/cos absolute value, single-turn	AS1024-8V-K2	Single-encoder concept	PL d / SIL 2
	Sin/cos absolute value, multi-turn	AM1024-8V-K2		
	Resolver	RV03		PL e / SIL 3
			Two-encoder concept	Up to PL e / SIL 3

Asynchronous servo motors	Encoder		Safe speed monitoring with SM301	
	Type	Product key		
MCA 10 ... 26 MQA 20 ... 26	Sin/cos incremental	IG1024-5V-V3	Single-encoder concept	PL e / SIL 3
	Resolver	RV03		
			Two-encoder concept	Up to PL e / SIL 3

Three-phase asynchronous motors	Encoder		Safe speed monitoring with SM301	
	Type	Product key		
MDxMA063-xx ... MDxMA225-xx MHxMA080-xx ... MHxMA225-xx	Sin/cos incremental	IG2048-5V-V3	Single-encoder concept	PL e / SIL 3
		IG2048-5V-V2		PL d / SIL 2
MFxMA063-xx ... MFxMA132-xx			Two-encoder concept	Up to PL e / SIL 3

A ”two-encoder concept” includes e.g. a resolver as motor encoder and, at the same time, an absolute value encoder (sin/cos), an incremental encoder (TTL), or digital encoder (SSI/bus) as position encoder on the machine.

In the case of the ”2-encoder concept”, the achievable risk mitigation (PL/SIL) depends on the suitability of the encoders used.



Note!

If feedback systems for safety functions are used, the manufacturer’s documentation must be observed!

Compatibility

Compatibility of SM301/SM300

The SM301 safety module is compatible with the SM300. The controller needs to be adapted since the safe parameter set is required. Observe the following:

- The GSE file can be used.
- The PROFIsafe bits that are not used with SM300 must be suppressed in the SM301, since unset bits would activate safety functions.
- Speed-dependent functions cannot be used.

Compatibility of different SM301 versions

Replacement of an SM301 by an SM301 with a higher firmware version (SW):

- Every SM301 can be used with a safe parameter set of an elder firmware version without any changes.
- The safe parameter set including CRC in the memory module of the drive is not changed when the parameter set from the memory module is accepted.
- The CE Declaration of Conformity remains valid.
- The replacement of the safety module by an equivalent module is ensured. Thus, there is no need for spare part stockage of SM301 safety modules with elder firmware versions.
- Safe parameter sets of the ”SM301 safety module” component can be loaded into an SM301 with a higher firmware version without any changes.
  – Extended functionalities of the newer firmware version cannot be selected and executed.

The safe parameter set of an SM301 with a newer firmware version cannot be loaded into an SM301 with an elder firmware version.

1.3.3.2 Safety category

The implemented safety functions meet the requirements of the standards:

- Control category 3 according to EN ISO 13849-1

  In order to comply with category 3, the external wiring and cable monitoring must also meet the requirements of category 3.
- Performance Level (PL) ”e” according to EN ISO 13849-1

1.3.3.3 Elements of the module

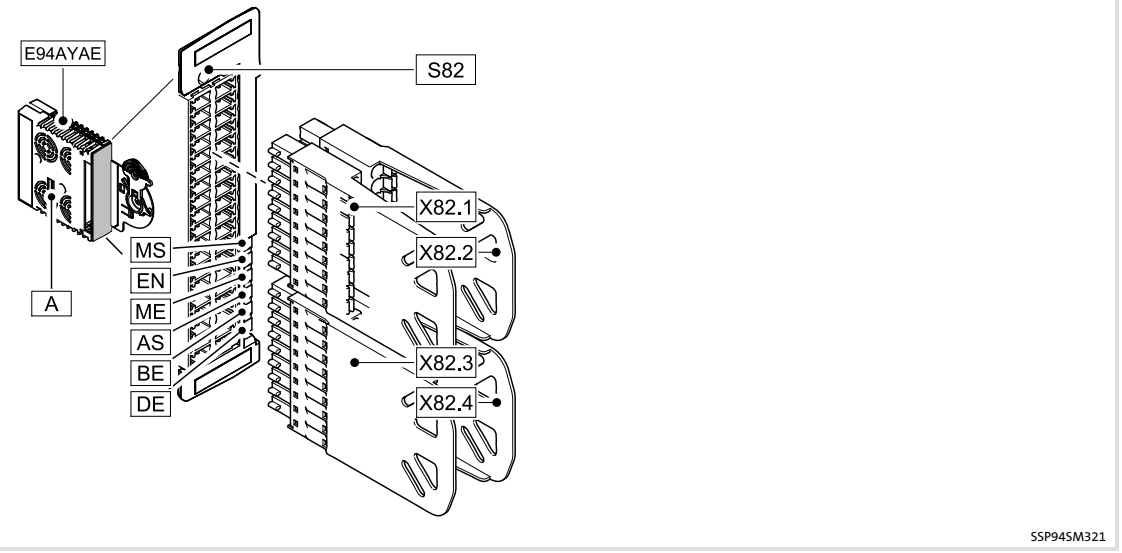


Fig. 1-2 Module view

Pos.	Description
A	Safety address switch (in the left part of the housing)
S82	Module switch for parameter set adoption from the memory module
X82.1	Plug-in terminal strips for input and output signals
X82.2	
X82.3	
X82.4	

Displays

Pos.	Colour	State	Description
MS (Module State)	Green	On	Drive-based safety has initialised without a fault.
		Blinking	Drive-based safety has initialised without a fault. Internal communication to the standard device is not possible.
		Flashing	Drive-based safety is in service status. For exiting, parameterise the drive-based safety.
		Off	Drive-based safety is not initialised. Acknowledgement is not possible.
EN (Enable)	Yellow	On	Controller enabled
		Off	Non-safe display ”STO”
ME (Module Error)	Red	On	System error
		Blinking	Trouble
		Flashing	Warning
		Off	Error-free operation
AS (Acknowledge Stop)	Yellow	On	Request of an acknowledgement for the restart or the parameter set adoption
		Blinking	SS1/STO active
		Flashing	SS2/SOS active
		Off	No stop function active
BE (Bus Error)	Red	On	Safety bus error: ● Communication is not possible. ● Acknowledgement is possible.
		Blinking	Safety bus error: no valid configuration.
		Off	Safety bus: error-free operation.
DE (Drive Error)	Red	On	Drive-based safety is not accepted by the standard device (see notes in the instructions for the standard device).
		Off	Drive-based safety is correctly recognised by the standard device.

Blinking: on/off every 0.5 s Flashing: on/off every 0.1/0.9 s

Terminal assignment

Danger!

Danger to life through improper installation

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

Possible consequences:

► Death or severe injuries

Protective measures:

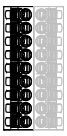
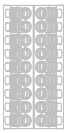
Total cable length between X82 and its connected components (e.g. sensors, devices, ...) > 3 m:

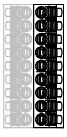
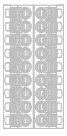
► Up to HW version 1A, a shielded laying system must be used for the cable between X82 and its connected components:
  – The shield must at least cover the shield connection at the installation backplane.
  – The shield should also cover the connected component if possible.

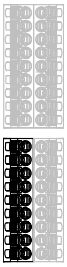
► From HW version 1A onwards, unshielded wiring is permissible.

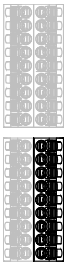
Total cable length between X82 and its connected components (e.g. sensors, devices, ...) < 3 m:

► Unshielded wiring is permissible.

X82.1	Labelling	Description
		This part of the terminal strip is not assigned.
	GO	GND SD-Out1
	O1B	Safe monitor SD-Out1, channel B
	O1A	Safe monitor SD-Out1, channel A
		This part of the terminal strip is not assigned.

X82.2	Labelling	Description
	-	GND external supply
	+	+24 V external supply via a safely separated power supply unit (SELV/PELV)
	GIR	This part of the terminal strip is reserved.
	RI1	
	GO	GND 24O
	24O	+24 V external supply for the safe monitor SD-Out1 (SELV/PELV)
	AIE	Error acknowledgement input (”Acknowledge In Error”)
	CLA	Clock output for passive sensors, channel A (Clock A)
	CLB	Clock output for passive sensors, channel B (Clock B)

X82.3	Labelling	Description
	GCL	GND clock output
	GI2	GND SD-In2
	I2B	Sensor input SD-In2, channel B
	I2A	Sensor input SD-In2, channel A
	GCL	GND clock output
	GI1	GND SD-In1
	I1B	Sensor input SD-In1, channel B
	I1A	Sensor input SD-In1, channel A
	AIS	Restart acknowledgement input (”Acknowledge In Stop”, 1-channel, bridged to X82.4/AIS)

X82.4	Labelling	Description
	GCL	GND clock output
	GI4	GND SD-In4
	I4B	Sensor input SD-In4, channel B
	I4A	Sensor input SD-In4, channel A
	GCL	GND clock output
	GI3	GND SD-In3
	I3B	Sensor input SD-In3, channel B
	I3A	Sensor input SD-In3, channel A
	AIS	Restart acknowledgement input (”Acknowledge In Stop”, 1-channel, bridged to X82.3/AIS)

Cable cross-sections and tightening torques				
Type	**[mm²]**	**[Nm]**	**AWG**	**[lb-in]**
Wire end ferrule, insulated	0.25 ... 0.75	Spring terminal	24 ... 18	Spring terminal
Rigid	0.14 ... 1.5		26 ... 16	

Stripping length or contact length: 9 mm

Insulated wire end ferrules according to DIN 46228, part 4, 0.5 mm² or 0.75 mm² - length L1 = 10 mm can be used.

Note!

Provide for a sufficient strain relief, so that the terminals are not pulled from the plug connectors, in particular when you use rigid cables.

1.3.3.4 Technical data

24 V supply

The module and the safe output must be supplied with 24 V from safely separated power supply units. If electrical isolation is required, separate voltage supply lines must be used.

Detailed features of the 24-V supply					
Terminal	Specification	[Unit]	min.	typ.	max.
+, -	Supply voltage of the module via a safely separated power supply unit (SELV/PELV)	[V]	19,2	24	30
	Input current	[mA]			350
24O, GO	Supply voltage of the safe output via a safely separated power supply unit (SELV/PELV)	[V]	18	24	30
	Input current	[mA]			1100

If the voltage of the SELV/PELV power supply unit can exceed 30 V in the event of an error, provide for an external fuse (📖 1.2).

Inputs and output

The inputs and the output are isolated and designed for a low-voltage supply of 24 V DC. The digital inputs are protected against polarity reversal.

Detailed features of the safe inputs and the safe output					
Terminal	Specification	[Unit]	min.	typ.	max.
I1A, I1B I2A, I2B I3A, I3B I4A, I4B AIE, AIS	PLC input, IEC-61131-2, 24 V, type 1				
	Low signal input voltage	V	-3	0	5
	Input current at low signal	mA			15
	High signal input voltage	V	15	24	30
	Input current at high signal	mA	2		15
	Input capacitance	nF			3.5
	Repetition rate of the test pulses	ms	50		
AIE, AIS	Input delay (operating time)	s	0.3		10
CLA, CLB	PLC output, IEC-61131-2, 24 V DC, 50 mA				
	Low signal output voltage	V		0	0.8
	High signal output voltage	V	17	24	30
	Output current	mA			60
	Cable capacity	nF			100
	Cable resistance of a passive sensor	Ω			200
O1A, O1B	PLC output, IEC-61131-2, 24 V DC				
	Low signal output voltage	V		0	0.8
	High signal output voltage	V	17	24	30
	Output current	mA			500
	Cable capacity	nF			100
	Cable resistance	Ω			200

Tab. 1-1 Technical data

The chapter ”Response times” must be observed as well (📖 1.9).

1.3.3.5 Example circuit

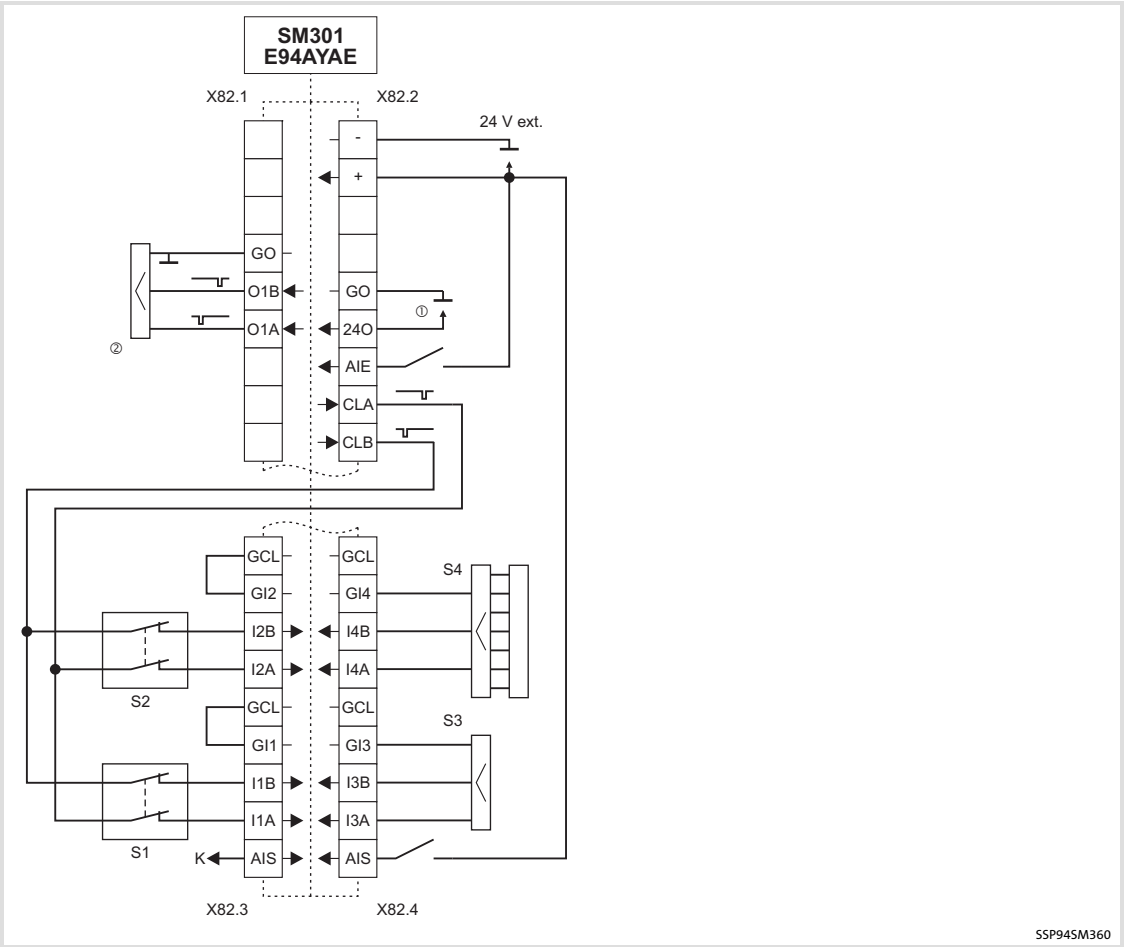


Fig. 1-3 Wiring example

E94AYAE	SM301 safety module
S1 S2	passive sensor with channel A and B
S3	higher-level safety control (active sensor)
S4	lightgrid (active sensor)
24 V ext.	24-V voltage supply of the module (SELV/PELV)
①	24-V voltage supply of the output (SELV/PELV)
②	safe output to higher-level safety control
K	to AIS of the next module

1.3.3.6 Commissioning

- For commissioning and safe parameter setting, the Lenze »Engineer« PC software from version 1.4 must be used.

  If you select the safety module in the *Project view*, various tabs are available in the *Operating range* via which the safety module can be parameterised. In all other program parts the parameters of the safety module can only be read. Thus, the write access of these parameters (codes) is marked with ⚠.

- Settings in or at the module:
  - Safety address
  - Safe parameter setting of the functions to be used

- Required settings in the standard device:
  - C00214, type of safety module
  - Implementation of the SM301 into the drive application by evaluating the control information and status information.

- During commissioning and after the replacement of a module it is vital to check the safety function. Additional information contains the ”Acceptance” chapter. (📖 108).

1.3.4 Safe inputs

1.3.4.1 General

The following applies to the sensors at the SM301 V1.0:

- Sensor type and sensor function can be parameterised in C15030, C15031 and C15032.
- A local evaluation is executed if corresponding parameters are set.
- If a safety bus is activated, the sensor signals are sent as status information to the higher-level control.
- Deactivated sensor inputs must not be connected. The status of a non-connected input is in the OFF state.
- If a signal is detected at deactivated sensor inputs during initialisation, the drive remains inhibited (STO).
- Faulty inputs are assessed as OFF state.

Additional conditions from SM301 V1.1 onwards:

- With active cascading in C15035 the SD-In4 input cannot be used freely anymore.

Codes

Parameter:	Name:	Data type:	Index:
C15030	**SD-In sensor type**	UNSIGNED_8	$9545_d = 2549_h$

Configuration of the sensor types which are connected to the safe inputs.

Selection list (Lenze setting bold)		**Information**
0	**Input deactivated**	
1	Passive sensor	
2	Active sensor	

Subcodes		**Information**
C15030/1		SD-In1 sensor type
C15030/2		SD-In2 sensor type
C15030/3		SD-In3 sensor type
C15030/4		SD-In4 sensor type

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15031	**SD-In sensor function**	UNSIGNED_8	$9544_d = 2548_h$

Function configuration of the safe inputs.
- The "operation mode selector" and "enable switch" functions may only be assigned to one of the four safe inputs.

Selection list (Lenze setting printed in bold)		**Information**
0	**Free assignment**	Safety function set in C15032
1	Emergency stop	Safe stop emergency function (SSE)
2	Operation mode selector	Safe operation mode selector (OMS)
3	Enable switch	Safe enable switch (ES)

Subcodes		**Information**
C15031/1		SD-In1 sensor function
C15031/2		SD-In2 sensor function
C15031/3		SD-In3 sensor function
C15031/4		SD-In4 sensor function

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

Parameter:	Name:	Data type:	Index:
C15032	**SD-In free assignment**	UNSIGNED_8	$9543_d = 2547_h$

Assignment of a safety function to a safe input.

- Only possible if the "free assignment" sensor function is set for the safe input in C15031.

Selection list (Lenze setting printed in bold)		**Information**
0	**STO**	Safe torque off
1	SS1	Safe stop 1
2	SS2	Safe stop 2
3	SLS1	Safely limited speed 1
4	SLS2	Safely limited speed 2 (from SM301 V1.1)
5	SLS3	Safely limited speed 3 (from SM301 V1.1)
6	SLS4	Safely limited speed 4 (from SM301 V1.1)
7	SDIpos	Safe positive direction (from SM301 V1.3)
8	SDIneg	Safe negative direction (from SM301 V1.3)
9	No function	No (local) safety function assigned. ● Functional test and monitoring of the discrepancy time are active. ● The input status is transferred to the control via the safety bus (if parameterised).

Subcodes		**Information**
C15032/1		Free assignment SD-In1
C15032/2		Free assignment SD-In2
C15032/3		Free assignment SD-In3
C15032/4		Free assignment SD-In4

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15205	**SSE: Safe stop emergency function**	UNSIGNED_8	$9370_d = 249A_h$

Selection of the stop function for emergency stop

Selection list (Lenze setting printed in bold)		**Information**
0	**STO**	Safe torque off
1	SS1	Safe stop 1

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

Specification	Sensor type	
	passive	active
Discrepancy time	parameterisable 0 ... 30000 ms (increment: 2 ms)	
Input delay	parameterisable 0 ... 100 ms (increment: 2 ms)	
Input filter time for test pulses	fixed 2 ms	
Repetition rate of the test pulses	is determined by the clock outputs CLA and CLB	> 50 ms
Error response	Sensor input is assessed as OFF state. Acknowledgement via safety bus or AIE input	

Tab. 1-2 Specification of sensor connections

Explanations

- Discrepancy time
  Maximum time in which both channels of a safe input may have non-equivalent states without the safety engineering causing an error response.
- Input delay
  Time between the recognition of the signal change and the effective evaluation of an input signal. As a result, multiple and short signal changes due to contact bounce of the components are not taken into account.
- Input filter time
  Time in which the interference pulses and test pulses are not detected by e.g. active sensors that are switched on.

The input delay time and the time of the input filters influence the response time. More information can be found in the "Response times" chapter (📖 105).

Codes

Parameter:	Name:	Data type:	Index:
C15033	**SD-In discrepancy time**	UNSIGNED_16	$9542_d = 2546_h$

Maximum time in which both channels of a safe input may have non-equivalent states without the safety engineering causing an error response.

Setting range (min. value | unit | max. value)			**Information**
0	MS	30000	Lenze: 10, increment: 2 ms
Subcodes			**Information**
C15033/1			SD-In1 discrepancy time
C15033/2			SD-In2 discrepancy time
C15033/3			SD-In3 discrepancy time
C15033/4			SD-In4 discrepancy time

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

Parameter:	Name:	Data type:	Index:
C15034	**SD-In input delay**	UNSIGNED_8	$9541_d = 2545_h$

Time between the recognition of the signal change and the effective evaluation of an input signal. As a result, multiple and short signal changes due to contact bounce of the components are not taken into account.

Setting range (min. value | unit | max. value)			**Information**
0	MS	100	Lenze: 0, increment: 2 ms
Subcodes			**Information**
C15034/1			Input delay SD-In1
C15034/2			Input delay SD-In2
C15034/3			Input delay SD-In3
C15034/4			Input delay SD-In4

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

Contact function test

Note!

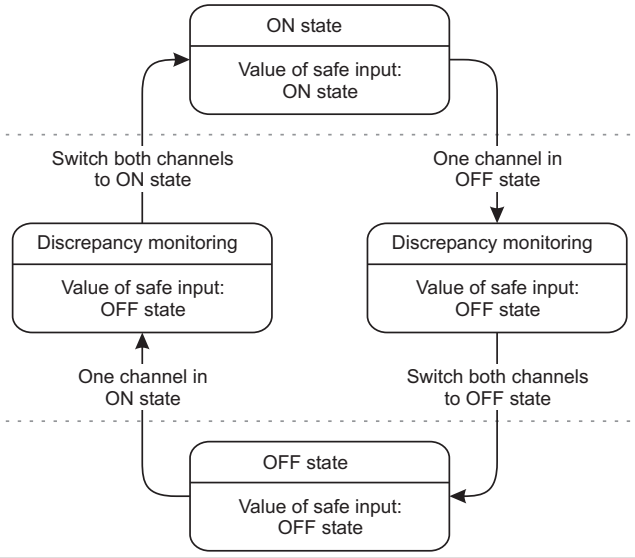
Make sure that an internal contact function test is carried out at the safe inputs:

Safe input in the ON state

- ► A LOW level at **one channel** puts the input in the OFF state. The discrepancy monitoring starts simultaneously.
- ► A LOW level must be detected at **both channels** within the discrepancy time, otherwise a discrepancy error will be reported.
- ► To be able to acknowledge the discrepancy error, a LOW level must be detected before at **both channels**.

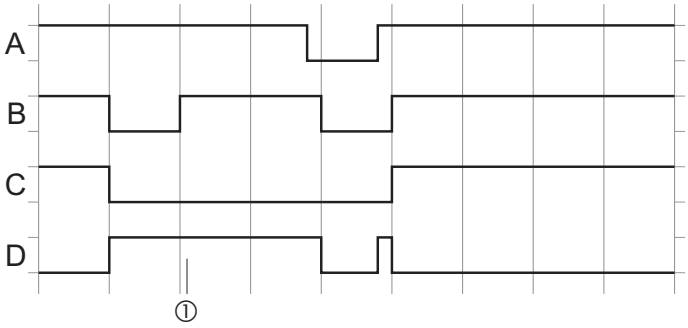
Safe input in the OFF state

- ► A HIGH level at **one channel** starts the discrepancy monitoring.
- ► A HIGH level must be detected at **both channels** within the discrepancy time, otherwise a discrepancy error will be reported.
- ► To be able to acknowledge the discrepancy error, a HIGH level must be detected before at **both channels**.



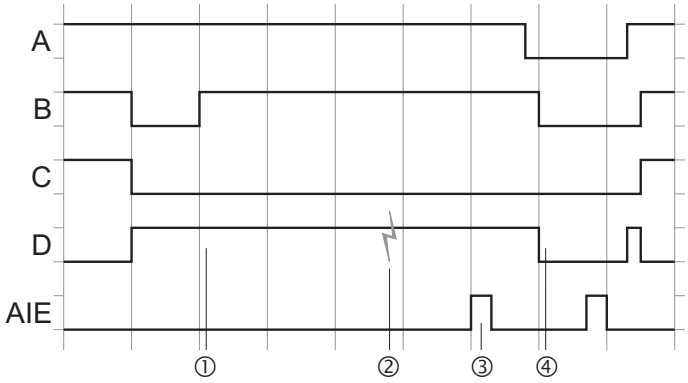
SSP94SM355

Fig. 1-4 Status behaviour - contact function test



SSP94SM358_1

Fig. 1-5 Contact function test - error-free input signals



SSP94SM358_2

Fig. 1-6 Contact function test - faulty input signals

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

1.3.4.2 Connection of passive sensors

The safe sensor inputs I1A ... I4B are suitable for **equivalently switching** passive sensors.

To monitor passive sensors according to EN ISO 13849-1, cat. 3, the clock outputs CLA and CLB must be wired. Please observe the following:

- The clock outputs are only suitable for monitoring the passive sensors.
- Always connect ...
  - ... CLA to IxA (channel A of the sensor input) via the sensor.
  - ... CLA to IxB (channel B of the sensor input) via the sensor.
  - ... GCL with GIx of the sensor input.
- The sensor inputs are tested cyclically through short LOW operation.
  - The A and B channels are tested at different times in cycles of approx. 2 s, with test pulses of < 1 ms.

These errors are detected:

- Short circuit to supply voltage.
- Short circuit between the input signals when different clock outputs are used.
- Non-equivalent input signals after the discrepancy time.

These errors are not detected:

- Short circuit between the input signals when the same clock outputs are used.

Avoid unrecognisable errors by the installation, e.g. by separated cable routing.

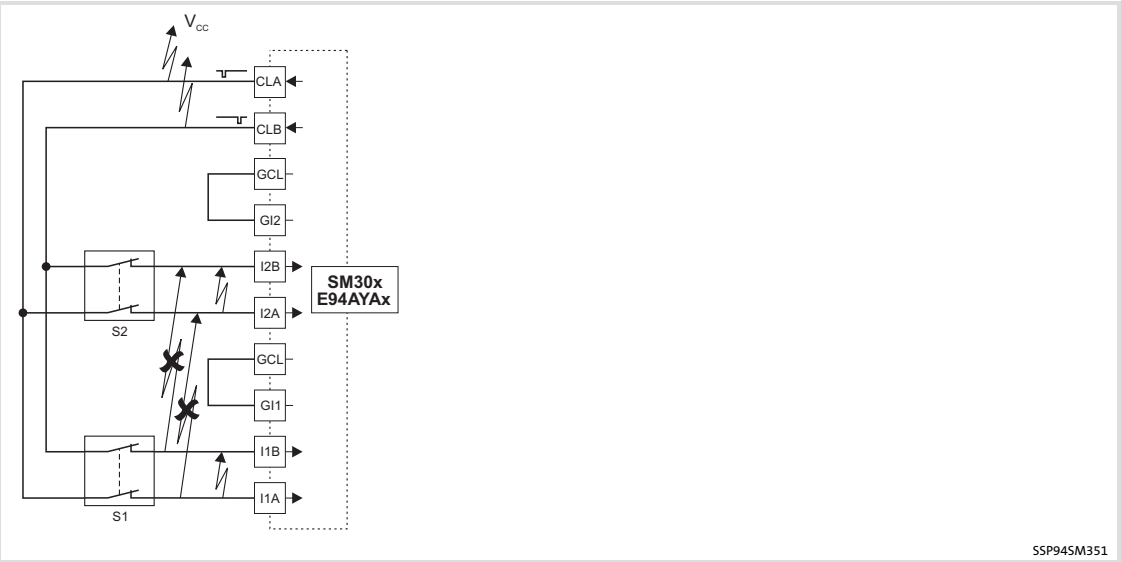


Fig. 1-7 Ways to detect errors

× Unrecognisable errors

1.3.4.3 Connection of active sensors

The safe sensor inputs I1A ... I4B are suitable for active sensors.

PN-switched input signals are permissible.

The line monitoring must comply with the requirements of the category 3. Drive-based safety does not provide for line monitoring.

These errors are detected:

- Non-equivalent input signals after the discrepancy time.

1.3.4.4 Example circuits

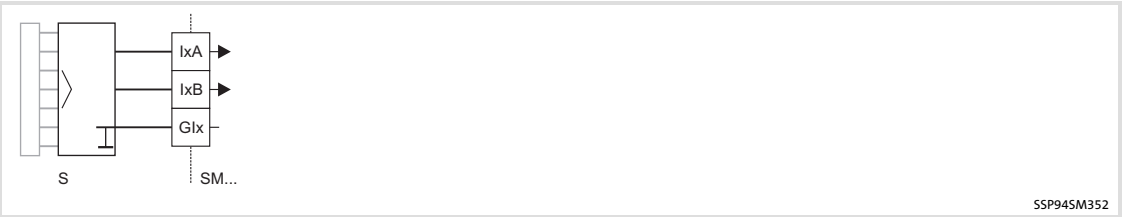


Fig. 1-8 Example circuit - active sensor

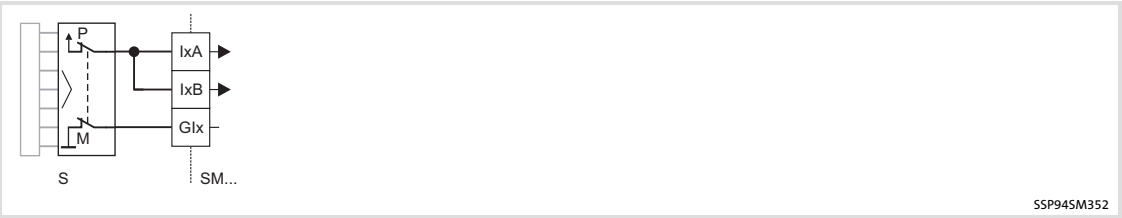


Fig. 1-9 Functional example of PN-switching sensor

S	Sensor
P	Positive path
M	Negative path

1.3.5 Safe output

1.3.5.1 General

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

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

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

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

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

These errors are not detected:

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

The output can be assigned multiple feedback information by parameter setting:

- Status of the safety function
- Information on error responses

The code C15060 contains information on the status of the feedback output.

Additional conditions for SM301 from version VB 1.1 onwards:

- With active cascading in C15035 the SD-Out1 output cannot be used freely anymore.

Codes

Parameter:	Name:	Data type:	Index:
C15051	**SD-Out condition**	BITFIELD_32	$9524_d = 2534_h$

Bit coded selection of the conditions for switching the safe output.

Value is bit coded:		**Information**
Bit 0	STO active	Safe torque off
Bit 1	STO active neg. logic	
Bit 2	SS1 active	Safe stop 1
Bit 3	SS1 active neg. logic	
Bit 4	SS2 active	Safe stop 2
Bit 5	SS2 active neg. logic	
Bit 6	SLS1 active	Safely limited speed 1
Bit 7	SLS1 active neg. logic	
Bit 8	SLS2 active	Safely limited speed 2 (From SM301 V1.1)
Bit 9	SLS2 active neg. logic	
Bit 10	SLS3 active	Safely limited speed 3 (From SM301 V1.1)
Bit 11	SLS3 active neg. logic	
Bit 12	SLS4 active	Safely limited speed 4 (as of SM301 V1.1)
Bit 13	SLS4 active neg. logic	
Bit 14	SDIpos is active	Safe direction, positive (From SM301 V1.3)
Bit 15	SDIpos active neg. logic	
Bit 16	SDIneg is active	Safe direction, negative (From SM301 V1.3)
Bit 17	SDIneg active neg. logic	
Bit 18	ES active	Safe enable switch
Bit 19	ES active neg. logic	
Bit 20	SLI is active	Safely limited increment (From SM301 V1.4)
Bit 21	SLI active neg. logic	
Bit 22	OMS	Safe operation mode selector
Bit 23	OMS neg. logic	
Bit 24	Reserved	
...		
Bit 31	Reserved	

Subcodes		**Information**
C15051/1		SD-Out1 switching condition

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

Parameter:	Name:	Data type:	Index:
C15052	**SD-Out condition**	BITFIELD_32	$9523_d = 2533_h$

Bit coded selection of the conditions for switching the safe output.

Value is bit coded:		**Information**
Bit 0	SOS monitored	Safe operational stop is monitored.
Bit 1	SOS monitors neg. logic	Safe operational stop is not monitored.
Bit 2	SLS1 monitored	Safely limited speed 1 is monitored.
Bit 3	SLS1 monitored neg. logic	Safely limited speed 1 is not monitored.
Bit 4	SLS2 monitored	Safely limited speed 2 is monitored. (from SM301 V1.1)
Bit 5	SLS2 monitors neg. logic	Safely limited speed 2 is not monitored. (from SM301 V1.1)
Bit 6	SLS3 monitored	Safely limited speed 3 is monitored. (from SM301 V1.1)
Bit 7	SLS3 monitors neg. logic	Safely limited speed 3 is not monitored. (from SM301 V1.1)
Bit 8	SLS4 monitored	Safely limited speed 4 is monitored. (from SM301 V1.1)
Bit 9	SLS4 monitors neg. logic	Safely limited speed 4 is not monitored. (from SM301 V1.1)
Bit 10	SDIpos monitored	Safe positive direction is monitored. (from SM301 V1.3)
Bit 11	SDIpos monitors neg. logic	Safe positive direction is not monitored. (from SM301 V1.3)
Bit 12	SDIneg monitored	Safe negative direction is monitored. (from SM301 V1.3)
Bit 13	SDIneg monitors neg. logic	Safe negative direction is not monitored. (from SM301 V1.3)
Bit 14	SSE active	Emergency stop function
Bit 15	SSE active neg. logic	
Bit 16	SD-In1 active	Safe inputs
Bit 17	SD-In1 active neg. logic	
Bit 18	SD-In2 active	
Bit 19	SD-In2 active neg. logic	
Bit 20	SD-In2 active	
Bit 21	SD-In2 active neg. logic	
Bit 22	SD-In4 active	
Bit 23	SD-In4 active neg. logic	
Bit 24	Reserved	
Bit 25	Reserved	
Bit 26	OMS active	Special operation is active (from SM301 V1.1)
Bit 27	OMS active neg. logic	Special operation is not active (from SM301 V1.1)
Bit 28	Reserved	
Bit 29	Reserved	
Bit 30	Error active	
Bit 31	Error active neg. logic	

Subcodes		**Information**
C15052/1		SD-Out1 switching condition

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15055	**SD-Out logic function**	UNSIGNED_8	$9520_d = 2530_h$

Selection of the logic operation for the switching conditions to be evaluated

Selection list (Lenze setting bold)		**Information**
0	**OR**	
1	AND	

Subcodes		**Information**
C15055/1		SD-Out1 logic function

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

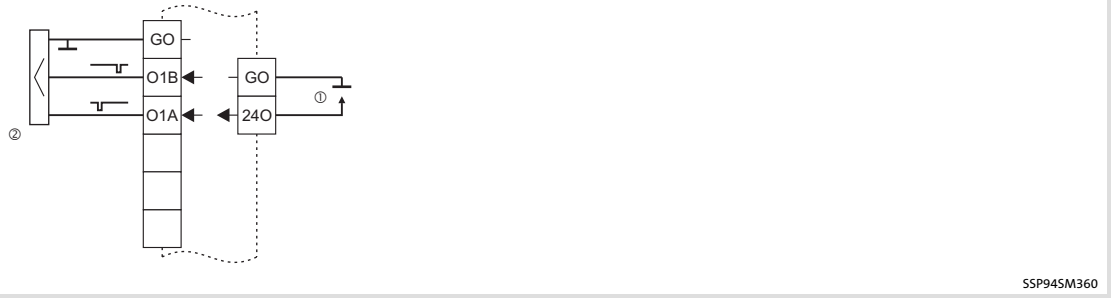
Parameter:	Name:	Data type:	Index:
C15060	**Output image**	BITFIELD_16	$9515_d = 252B_h$

Output image of the safety module feedback, shown in channels.

Value is bit coded:		Information
Bit 0	SD-Out1 channel A	Safe output 1
Bit 1	SD-Out1 channel B	
Bit 2	reserved	
...		
Bit 15	reserved	

☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

1.3.5.2 Example circuits



24O, GO	24-V voltage supply for the safe output
O1A, O1B, GO	Safe output SD-Out1, channel A and B with reference potential
①	24-V voltage supply - safe output (SELV/PELV) acc. to IEC 61131-2
②	Input of a higher-level unit (e.g. safety PLC)

1.3.6 Further inputs

AIS input

The restart (when setting "acknowledged restart", (📖 48)), after a stop function has been executed, requires an acknowledgement at AIS input:

► Positive signal pulse of 0.3 ... 10 s (terminal X82.3 or X82.4).
  – Evaluation of the negative edge.

Other equivalent option:

► Signal via the PROFIsafe bit PS_AIS
(if communication via safety bus is preferred)
  – Evaluation of the positive edge.

AIE input

Errors require an acknowledgement at AIE input:

► Positive signal pulse of 0.3 ... 10 s (terminal X82.2).
  – Evaluation of the negative edge.

Other equivalent option:

► Signal via the PROFIsafe bit PS_AIE
(if communication via safety bus is preferred)
  – Evaluation of the positive edge.

1.3.7 Safe speed measurement and position detection

For reliable speed and position detection, you must connect a safety-approved sin/cos encoder to terminal X8 (Sub-D).

Alternatively, you can connect a 2-encoder system, consisting of motor encoder and position encoder from SM301 V1.3. When selecting a 2-encoder system, you can also select a resolver as motor encoder.

From SM301 V1.4 onwards, the resolver can be selected as motor encoder without needing an additional position encoder. The response time of the encoder monitoring must be set to 50 ms or 100 ms.

Safe speed measurement				
Motor encoder system	Max. speed [rpm]	Synchronism [%]	Response time of encoder monitoring [ms]	Error response
Encoder	±16000	1.5	12 From SM301 V1.2: 12/50/100can be parameterised (📖 1.9.4)	Error stop STO
Resolver	±10000 / no. of resolver pole pairs	1	parameterisable SM301 V1.3: 12/50/100 From SM301 V1.4 onwards: 50/100 (📖 1.9.4)	

Tab. 1-3 Detailed features

Explanations on the data:

- Synchronism
  Variation of the speed determined in comparison with the current speed value.
- Response time of encoder monitoring
  Time required to detect faults due to continuous signal errors at the encoder interface.

Note!

If speed monitoring is active and the standard device detects the inverter error characteristic (C00002=71) or determines the motor parameters (C00002=72), the error message ”Safe speed invalid” is displayed. Both functions cannot be completed since the SM301 activates STO. These two states generally occur only once during commissioning.

Therefore, these functions should be carried out before the speed monitoring is activated in the SM301.

The speed determined by the standard device and the safety module is checked for plausibility. Up to SM301 V1.2, the maximum deviation (after a filtering of approx. 2 seconds) is set as a fixed limit value of 20 rpm. The filter time of approx. 2 s is part of the diagnostic function and is independent of the response time. From SM301 V1.3 onwards, this tolerancelimit can be parameterised (C15411).

Note!

As safe speed, the higher value which results from the comparison of the dual-channel speed information is used.

The value ”Tolerance - speed comparison” must be selected as low as possible. If a speed/position information fails during operation, this must be detected by the diagnostic function. It is thus required to exceed the value ”Tolerance - speed comparison” for at least more than two seconds during operation to ensure the dual-channel redundancy of the encoder information. A too low value can cause a restricted plant availability.

The speed-dependent and/or direction-of-rotation dependent functions require information from safe speed measurement. These are the functions:

- Safe stop 2 (SS2)
- Safe operational stop (SOS)
  - Following EN 61800-5-2: SOS is designed with speed monitoring (up to SM301 V1.2)
  - In compliance with EN 61800-5-2: SOS is designed with position monitoring (From SM301 V1.3)
- Safe maximum speed (SMS)
- Safely limited speed (SLS)
- Safe speed monitor (SSM)
- Safe direction (SDI) (From SM301 V1.3)
- Safely limited increment (SLI) (From SM301 V1.4)

The dependent functions must not be parameterised when ”No encoder system” is set. The plausibility check rejects such ambiguous settings until you have parameterised them correctly.

Tip!

The motor encoder position and, if required, position encoder position are 32-bit values in the safety module. The lower-order 16 bits contain the part of a motor revolution and the higher-order 16 bits contain the multiple of a motor revolution. Examples:

1/4 motor revolution	65536/4	16384	/	0x0000’4000
1/2 motor revolution	65536/2	32768	/	0x0000’8000
1 motor revolution	65536/1	65536	/	0x0001’0000
2 motor revolutions	2*65536	131072	/	0x0002’0000

Parameter setting of standard device 9400		→	Parameter setting of SM301	
Motor mounting direction	Position encoder mounting direction		Motor mounting direction	Position encoder mounting direction
C02527/0	C02529/0		C15409/0	C15502/0
CW	CW	→	CW	”Like motor encoder”
CW	CCW	→	CW	”Inverted ...”
CCW	CW	→	CCW	”Inverted ...”
CCW	CCW	→	CCW	”Like motor encoder”

Tab. 1-4 Overview of dependency of the parameterisation from the mounting direction



Stop!

Malfunctions due to slip, shaft fracture etc.

Slip, shaft fracture etc. between motor and encoder system disturb the safe speed measurement.

Possible consequences:

► The speed-dependent and/or direction-of-rotation dependent functions are executed incorrectly.

Protective measures:

► Prevent malfunctions by constructive measures.

► Use the motors and encoder systems with guaranteed features. Your Lenze contact partner helps you to find suitable systems.

► In the event of service, this must also be observed for the motor or the encoder system.

Single-encoder concepts with resolvers

Please observe during the configuration of such systems:

If only one feedback system is used in connection with these safety applications, the applicable safety standard, IEC 61800-5-2 (Adjustable speed electrical power drive systems, Part 5-2: Safety requirements - Functional), poses special requirements for the connection between feedback system and motor shaft. This is due to the fact that dual-channel safety systems are, as a matter of fact, mechanically designed as single-channel systems at this point. If this mechanical linkage is extremely overdimensioned, the standard allows for fault exclusion for the fault conditions ”Shaft breakage” and ”Shaft slippage”.

Hence, there are acceleration limit values for the individual drive solutions which must not be exceeded:

Synchronous servo motors	Encoder		Max. permissible angular acceleration	Min. time per 1000 r/min speed lift
	Type	Product key	[rad/s²]	[ms]
MCS 06	Resolver	RV03	56000	1.9
MCS 09 ... 19			19000	5.5
MDXKS 56 / 71			17000	6.2

Asynchronous servo motors	Encoder		Max. permissible angular acceleration	Min. time per 1000 r/min speed lift
	Type	Product key	[rad/s²]	[ms]
MCA 10 ... 19	Resolver	RV03	22000	4.8
MCA 20 ... 26			22000	4.8
MQA 20 ... 26			22000	4.8

Codes

Parameter:	Name:	Data type:	Index:
C15400	**Motor encoder system**	UNSIGNED_8	$9175_d = 23D7_h$

Selection of the encoder system connected

Selection list (Lenze setting printed in bold)		**Information**
0	No encoder system	
1	**Sin/cos encoder**	"Sin/cos encoder" is used instead of the entries "sine/cosine encoder" and "absolute value encoder (Hiperface)" of code C00422 of the 9400 standard device.
2	Resolver	

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15401	**Motor encoder status**	UNSIGNED_8	$9174_d = 23D6_h$

Status of the encoder evaluation

Selection list (read only)		**Information**
0	Valid	Encoder data is valid
1	Fault	Encoder data is invalid

☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15402	**Actual speed value n_safe**	INTEGER_16	$9173_d = 23D5_h$

Display of the current speed calculated from the safety module

Display area (min. value | unit | max. value)			**Information**
-16000	rpm	16000	With invalid encoder data (C15401 = 1) 32767 is displayed.

☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15405	**Internal actual speed value**	INTEGER_16	$9170_d = 23D2_h$

Internal actual speed values of SM301.

Display area (min. value | unit | max. value)			**Information**
-16000	rpm	16000	(As of SM301 V1.4) With invalid encoder data (C15401 = 1) 32767 is displayed.

Subcodes		**Information**
C15405/1	-	Internal actual speed value nSM detected from motor position.
C15405/2	-	Internal actual speed value nGG detected from position data of the standard device.

☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15409	**Motor mounting direction**	UNSIGNED_8	$9166_d = 23CE_h$

Setting of the motor mounting direction.

Selection list (Lenze setting bold)		**Information**
0	**Motor rotating clockwise**	(From SM301 V1.4)
1	Motor rotating counter-clockwise	

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15410	**Response time of encoder monitoring**	UNSIGNED_8	$9165_d = 23CD_h$

Max. internal time after which encoder errors lead to a system response

Selection list		**Information**
0	**12 ms**	(As of SM301 V1.2) (From SM301 V1.4: Resolver is sole encoder → 50 or 100 ms)
10	50 ms	
20	100 ms	

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

Parameter:	Name:		Data type:	Index:
C15411	**Tolerance of speed comparison**		UNSIGNED_16	$9164_d = 23CC_h$
Tolerance of the speed comparison in the safety module				
Display area (min. value | unit | max. value)			**Information**	
0	rpm	16000	(From SM301 V1.3)	
☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				
C15420	**Number of increments - sin/cos encoder**		UNSIGNED_16	$9155_d = 23C3_h$
Number of increments of the sin/cos encoder used				
Setting range (min. value | unit | max. value)			**Information**	
1		16384	Lenze: 1	
☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				
C15430	**Number of pole pairs of resolver**		UNSIGNED_8	$9145_d = 23B9_h$
Number of pole pairs of the used resolver				
Setting range (min. value | unit | max. value)			**Information**	
1		10	Lenze: 1 (From SM301 V1.3)	
☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				
C15500	**Position encoder system**		UNSIGNED_8	$9075_d = 2373_h$
Setting of the connected position encoder system				
Selection list (read only)			**Information**	
0	**No position encoder**		(From SM301 V1.3)	
1	Analog encoder (Sin-Cos/TTL)			
2	Digital encoder (SSI/BUS)			
☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				
C15501	**Position encoder - gearbox factor**		UNSIGNED_16	$9074_d = 2372_h$
Setting of the gearbox factor between motor and position encoder				
Display area (min. value | unit | max. value)			**Information**	
20	%	50000	Lenze: 100 (From SM301 V1.3) 100 ≡ i = 1.00 2543 ≡ i = 25.43	
☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				
C15502	**Position encoder - mounting direction**		UNSIGNED_8	$9073_d = 2371_h$
Setting of the mounting direction of the position encoder regarding the motor encoder				
Selection list (read only)			**Information**	
0	**Like motor encoder**		(From SM301 V1.3) If the mounting directions of the motor (C02527/0) and position encoder (C02529/0) in the standard device are set in different directions of rotation, this parameter must be set to ”inverted to the motor encoder”.	
1	Inverted to the motor encoder			
☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				

1.4 Safety functions

1.4.1 General information

1.4.1.1 Stop functions

The stop functions are distinguished according to the cause of release:

- Standard stop (simple stop)
  - Release by a safe input with the parameterised STO, SS1 or SS2 functions
  - Release by activating the bits STO, SS1 or SS2 bits via the safety bus.
  - In special operation the standard stop can be avoided by using the enable switch.
- Emergency stop
  - Release by a safe input with the parameterised ”Safe stop emergency” (SSE) function.
  - Release by activating the SSE bit via the safety bus.
  - STO or SS1 can be set as emergency stop function to be executed.
  - In special operation, the emergency stop **cannot** be avoided.
- Error stop
  - Release as response to an error.
  - In special operation, the error stop **cannot** be avoided.

Codes

Parameter:	Name:	Data type:	Index:
C15205	**SSE: Safe stop emergency function**	UNSIGNED_8	$9370_d = 249A_h$

Selection of the stop function for emergency stop

Selection list (Lenze setting printed in bold)		**Information**
0	**STO**	Safe torque off
1	SS1	Safe stop 1

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

1.4.1.2 Priorisation

Stop functions with priority influence the sequence of subordinated functions already started.

- STO

  The STO function has the highest priority over all other functions. Functions already started (e.g. SS1 or SS2) are aborted and the drive is switched off.

- SS1

  The SS1 function has priority over SS2. Considering the set stopping time for SS1 and SS2 (C15305) and the SS1 mode (C15306 as of SM301 V1.3), the drive is switched to torque-free operation.

- Monitoring functions

  The monitoring functions have equivalent priorities. They can be executed at the same time.

Codes

Parameter:	Name:	Data type:	Index:
C15305	**SS1, SS2: Stopping time**	UNSIGNED_16	$9270_d = 2436_h$

Stopping time for the SS1 and SS2 safety functions

Setting range (min. value | unit | max. value)			**Information**
0	MS	30000	Lenze: 0, increment: 2 ms

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15306	**SS1 mode**	UNSIGNED_8	$9269_d = 2435_h$

Selection list (Lenze setting bold)		**Information**
0	STO after stopping time	(From SM301 V1.3)
1	**STO at n = 0**	

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

1.4.1.3 Restart

The restart behaviour of the drive can be parameterised (C15300).

- The ”acknowledged restart” setting requires an acknowledgement to the safety module. The acknowledgement is made via:
  – Signal at the AIS input (with a signal time of 0.3 ... 10 s)
  – Signal via the ”PS_AIS” time (PROFIsafe)
- An error stop requires an acknowledgement (AIE), before the restart can be acknowledged.
- The ”Automatic restart” setting requires an acknowledgement at the master control.
- With active cascading (C15035 as of SM301 V1.1) an ”Automatic restart” after STO, SS1 is not possible.

Danger!

When the request for the safety function is deactivated, the drive can restart automatically. The behaviour can be set via the parameter ”Restart behaviour” (C15300/1/2).

In the case of an automatic restart, you must provide external measures which ensure that the drive only restarts after an acknowledgement (EN 60204).

Codes

Parameter:	Name:	Data type:	Index:
C15300	**Restart behaviour**	UNSIGNED_8	$9275_d = 243B_h$

Behaviour for restart after functions have been cancelled

Selection list (Lenze setting bold)		**Information**
0	**Acknowledged restart**	
1	Automatic restart	

Subcodes		**Information**
C15300/1		Restart - STO, SS1
C15300/2		Restart - SS2, SOS

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

1.4.2 Integration into the application of the controller

For the use of the functions, certain settings in the controller are required. Here, the Lenze PC software »Engineer« supports and guides you.

When a safety function is required, the safety technology activates the corresponding safe monitoring function. However, the standstill function is only directly executed with the ”safe torque off” (STO) function. Other safety functions in which a controller action is required will need to be safely monitored.

The action of the drive (e.g. braking, braking to standstill, keeping the standstill position) must be implemented by the user application in the standard device.

Currently the application can be parameterised and/or configured via function block editor of the Engineer depending on the runtime software licence. For this, the system block **LS_SafetyModuleInterface** must be integrated into the application.

The safety module is implemented in the 9400 ServoPLC via the control configuration (SMI_SafetyModuleInterface). The control and status data of the safety module can be evaluated via the free programming and connected to further interface signals.

The connection to a user application serves to achieve the following:

1. Activation of the safety function in the safety module, e.g. SS1.
   → The monitoring starts.
2. The safety module transmits the information to the basic device that the function has been activated using the corresponding bit in the control word *SMI_dwControl*.
3. The application evaluates the control word and starts the motion sequence, e.g. braking etc.

Internal communication

Safety module and standard device communicate via an internal interface.

1.4.2.1 Control information

The safety module transfers information via requested or active safety functions with the control word SMI_dwControl. The application in the standard device must evaluate the control word and execute the corresponding action.

The following table shows the bit coding of the control word.

Control word - SMI_dwControl		
Bit	Name	Meaning
1	SS1 active	Safe stop 1 requested
2	SS2 active	Safe stop 2 requested
3	SLS1 active	Safely limited speed 1 requested When the braking time Nlim1 parameterised has elapsed, bit 8 of the *SMI_dnState status signal (SLS1 monitored)* is set additionally.
4	SLS2 active	Safely limited speed 2 requested (as of SM301 V1.1) When the braking time Nlim2 parameterised has elapsed, bit 9 of the *SMI_dnState status signal (SLS2 monitored)* is set additionally.
5	SLS3 active	Safely limited speed 3 requested (as of SM301 V1.1) When the braking time Nlim3 parameterised has elapsed, bit 10 of the *SMI_dnState status signal (SLS3 monitored)* is set additionally.
6	SLS4 active	Safely limited speed 4 requested (as of SM301 V1.1) When the braking time Nlim4 parameterised has elapsed, bit 11 of the *SMI_dnState status signal (SLS4 monitored)* is set additionally.
7	SDIpos is active	The safe positive direction of movement (SDIpos) **function is active.**(As of SM301 V1.3) After the parameterised SDI deceleration time has expired, bit 12 of the status signal *SMI_dnState (SdIpos monitored)* is set in addition.
8	SDIneg is active	The safe negative direction of movement (SDIneg) **function is active.**(As of SM301 V1.3) After the parameterised SDI deceleration time has expired, bit 13 of the status signal *SMI_dnState (SdIneg monitored)* is set in addition.
9	ES active	Motion functions in special operation requested
10	SLI is active	Safely limited increment is active.(As of SM301 V1.4)
11	OMS	Operation mode selector (OMS) function for special operation has been requested. (0 = normal operation)
16	SOS is active	Safe operational stop maintained
23	SSE active	Emergency stop active (Safe Stop Emergency)
29	OMS active	Special operation active (Operation Mode Selector) (from SM301 V1.1)

1.4.2.2 Status information

The safety module transfers information via the status of safety functions with the SMI_dnState status word.

The SMI_dnIoState status word contains information on the status of the safe inputs and the safe output. The application in the standard device can evaluate and use the status words for additional tasks.

The following tables show the bit coding of the status words:

Status word SMI_dnState		
Bit	Name	Meaning
0	STO	Safe torque off is active.
3	EC_STO	Error stop category 0 is active (Safe Torque Off).
4	EC_SS1	Error stop category 1 is active (Safe Stop 1).
5	EC_SS2	Error stop category 2 is active (Safe Stop 2).
8	SLS1 monitored	Safely limited speed 1 is activated and maintained.
9	SLS2 monitored	Safely limited speed 2 is activated and maintained. (from SM301 V1.1)
10	SLS3 monitored	Safely limited speed 3 is activated and maintained. (from SM301 V1.1)
11	SLS4 monitored	Safely limited speed 4 is activated and maintained. (from SM301 V1.1)
12	SDIpos monitored	Safe positive direction (SDIpos) is activated and maintained. (from SM301 V1.3)
13	SDIneg monitored	Safe negative direction (SDIneg) is activated and maintained. (from SM301 V1.3)
14	Error active	SM301 safety module in error status (trouble or warning).

Unlisted bits are reserved for future extensions!

Status word SMI_dnIOState		
Bit	Name	Meaning
0	SD-In1	Sensor input 1 in ON state.
1	SD-In2	Sensor input 2 in ON state.
2	SD-In3	Sensor input 3 in ON state.
3	SD-In4	Sensor input 4 in ON state.
5	AIS	Restart acknowledgement via terminal in ON state.
6	AIE	Error acknowledgement via terminal ON state.
8	PS_AIS	Restart acknowledgement via safety bus.
9	PS_AIE	Error acknowledgement via safety bus.
12	SD-Out1	Safe output 1 (feedback output) in ON state.

Unlisted bits are reserved for future extensions!

If communication to the standard device is interrupted, e.g. by switching off the standard device, the safety module responds by means of the following actions:

- Error stop with STO is activated
- ”Warning” error message is transmitted
- The ”ME” LED is blinking

The required fault acknowledgement (AIE) is possible via terminal or safety bus. For further information read the ”Error management” chapter.

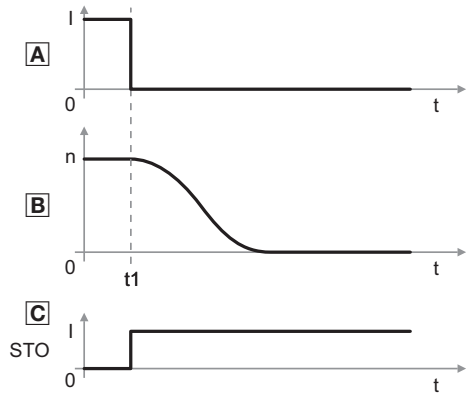
1.4.3 Safe torque off

1.4.3.1 Description

Safe **T**orque **O**ff/STO

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

When this function is used, the power supply of the motor is immediately (t1) safely interrupted. The motor cannot create a torque and thus no dangerous movements of the drive can occur. Additional measures, e.g. mechanical brakes are needed against movements caused by external force.



SM301DIA_STO

A Input signal of the request of a safety function
I ON state
O OFF state
B Speed characteristic n of the motor
t Time axis
tx Action instant
C Feedback(s)

The restart behaviour can be set (C15300/1). Function sequence and error response have no adjustable parameters.

Codes

Parameter:	Name:	Data type:	Index:
C15300	**Restart behaviour**	UNSIGNED_8	$9275_d = 243B_h$

Behaviour for restart after functions have been cancelled

Selection list (Lenze setting bold)		**Information**
0	**Acknowledged restart**	
1	Automatic restart	

Subcodes		**Information**
C15300/1		Restart - STO, SS1
C15300/2		Restart - SS2, SOS

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

1.4.3.2 Activation

How to activate the function:

- ”OFF state” at a safe input, the function of which has been assigned by parameter setting.
- Via a safety bus data telegram with corresponding content.
- As response to the error stop request.
- As response to the emergency stop request if the function has been parameterised as emergency stop function (C15205).

1.4.4 Safe stop 1

1.4.4.1 Description

Safe **S**top **1** / SS1

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

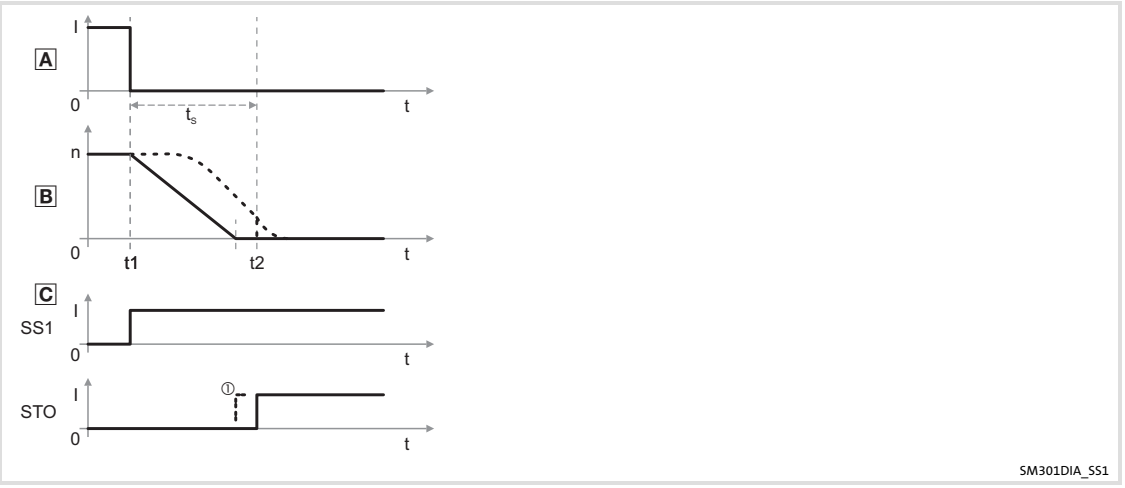
The function monitors the reaching of the speed n = 0 (C15310) within an adjustable stopping time (C15305). The speed is calculated from the encoder data (safe speed measurement). Without encoder the function evaluates the speed status n = 0 from the standard device. For this, the monitored stopping time parameterised in the safety module must be 0.5 s longer than the stopping time in the controller.

When the stopping time (t2) has expired, the motor power supply is safely interrupted (STO) immediately. The motor cannot create a torque and thus no dangerous movements of the drive. If standstill has not been achieved, an additional error message is triggered. Depending on the SS1 mode (C15306), the drive can also be switched off safely (STO) directly after the zero speed has been reached. This causes reduced cycle times. C15307 can be used to parameterise an additional deceleration time, e.g. for the application of a holding brake.

Additional measures, e.g. mechanical brakes are needed against movements caused by external force. The time for a brake to be applied must be considered when defining the stopping time.

Restart is only possible after the stopping time has completely elapsed (applies up to SM301 V1.2 and from SM301 V1.3 onwards if C15306 SS1 mode = ”STO after stopping time”). If the parameter SS1 mode is ”STO at n=0” (from SM301 V1.3 onwards), the restart can be executed immediately after the transition to the STO state.

From SM301 V1.4 onwards, deceleration ramp monitoring can be parameterised. Depending on the parameterised stopping time, a monitoring ramp is calculated. (🕮 62)



A Input signal of the request of a safety function
I ON state
0 OFF state
B Speed characteristic n of the motor
- Optional: Monitoring of the brake ramp as of SM301 V1.4

t Time axis
tx Action instant
t_S Monitored stopping time
— Normal operation
--- Incorrect operation
C Feedback(s)
① SS1 mode (C15306) influences the switching time and contains the "SS1:Deceleration STO after n=0" (C15307)

Codes

Parameter:	Name:		Data type:	Index:
C15300	**Restart behaviour**		UNSIGNED_8	$9275_d = 243B_h$
Behaviour for restart after functions have been cancelled				
Selection list (Lenze setting bold)			**Information**	
0	**Acknowledged restart**			
1	Automatic restart			
Subcodes			**Information**	
C15300/1			Restart - STO, SS1	
C15300/2			Restart - SS2, SOS	
☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				
C15305	**SS1, SS2: Stopping time**		UNSIGNED_16	$9270_d = 2436_h$
Stopping time for the SS1 and SS2 safety functions				
Setting range (min. value | unit | max. value)			**Information**	
0	MS	30000	Lenze: 0, increment: 2 ms	
☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				
C15306	**SS1 mode**		UNSIGNED_8	$9269_d = 2435_h$

Selection list (Lenze setting bold)		**Information**
0	STO after stopping time	(From SM301 V1.3)
1	**STO at n = 0**	
☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer		

C15307	**SS1: Deceleration STO after n=0**		UNSIGNED_16	$9268_d = 2434_h$
Display area (min. value | unit | max. value)			**Information**	
0	ms	30000	Lenze: 0, increment: 2 ms (From SM301 V1.3)	
☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				
C15310	**Tolerance window (n=0)**		INTEGER_16	$9265_d = 2431_h$
Safely monitored tolerance window for zero speed				
Setting range (min. value | unit | max. value)			**Information**	
0	rpm	16000	Lenze: 0	
☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				

1.4.4.2 Activation

How to activate the function:

- ”OFF state” at a safe input, the function of which has been assigned by parameter setting.
- Via a safety bus data telegram with corresponding content.
- As response to the error stop request.
- As response to the emergency stop request if the function has been parameterised as emergency stop function (C15205).

Note!

During the safe cascading of a drive system, the SS1 mode (C15306) (from V1.3) must be parameterised to ”STO after stopping time”. The first one of the drives which is at standstill changes to the STO status, thereby triggering STO for the entire drive system. Those drives which are not at standstill yet are coasting in an uncontrolled way. Therefore, a fixed stopping time for all drives makes sense here.

1.4.5 Safe stop 2

1.4.5.1 Description

Safe **S**top **2** / SS2

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

This function serves to monitor the reaching of speed n = 0 within an adjustable stopping time (C15305). The reached position must be kept active by the controller. The function SS2 changes to the safe operational stop (SOS) after the stopping time has expired. This function is implemented in the SM301 up to version 1.2 as a monitoring function of a speed band. Thus, the SOS function and accordingly the SS2 function is implemented deviating from the EN 61800-5-2 standard which demands the monitoring of a position windows in section 4.2.3.1. As of version 1.3, the function is implemented in compliance with the standard, i.e. the monitoring is executed through a parameterisable position window (C15311). Depending on the SS2 mode (C15308) the drive can also be switched directly to the safe operational stop (SOS) after zero speed has been reached. This causes reduced cycle times.

For speed n = 0, a tolerance window (C15310) can be parameterised. For the tolerance window Delta p=0 (C15311), a relative position is defined by which the drive may move in the SOS state.

From SM301 V1.3 onwards, the tolerance window for standstill detection (C15310) is used to control the transition to the SOS state subject to the ”SS2 mode” parameter (C15308). C15308 serves to determine whether the SOS state is reached after the stopping time has expired or after the reaching of n = 0. In the SOS state, the standstill monitoring based on the position takes place. The respective limit value is set via the parameter ”SOS: Tolerance window (Delta p=0)” C15311.

The speed and the position are calculated from the encoder data (safe speed measurement). Without an encoder, the function cannot be used.

If the monitored limits are exceeded, an error stop will be caused. The power supply of the motor is immediately safely interrupted (STO). The motor cannot create a torque and thus no dangerous movements of the drive can occur. Additional measures, e.g. mechanical brakes are needed against movements caused by external force.

A restart is only possible after the stopping time has expired completely (up to V1.2 and V1.3 with C15308 ”SS2-mode = SOS after stopping time”).
If the parameter SS2 mode = ”SOS at n=0” (from V1.3), the restart can be executed after the transition to the SOS state.
This does not apply to special operations.

From SM301 V1.3 onwards, the higher-prior stop function SS1/STO is executed when the SS2 stop request and SS1/STO occur at the same time. After the SS1/STO request has been cancelled and acknowledged accordingly (see restart behaviour), a direct STO transition to the SS2/STO state can be achieved without cancelling the SS2 request. Up to SM301 V1.2, the cancellation of all stop functions incl. SS2 before an acknowledgement was necessary in order to reach the SOS state via an SS2 request.

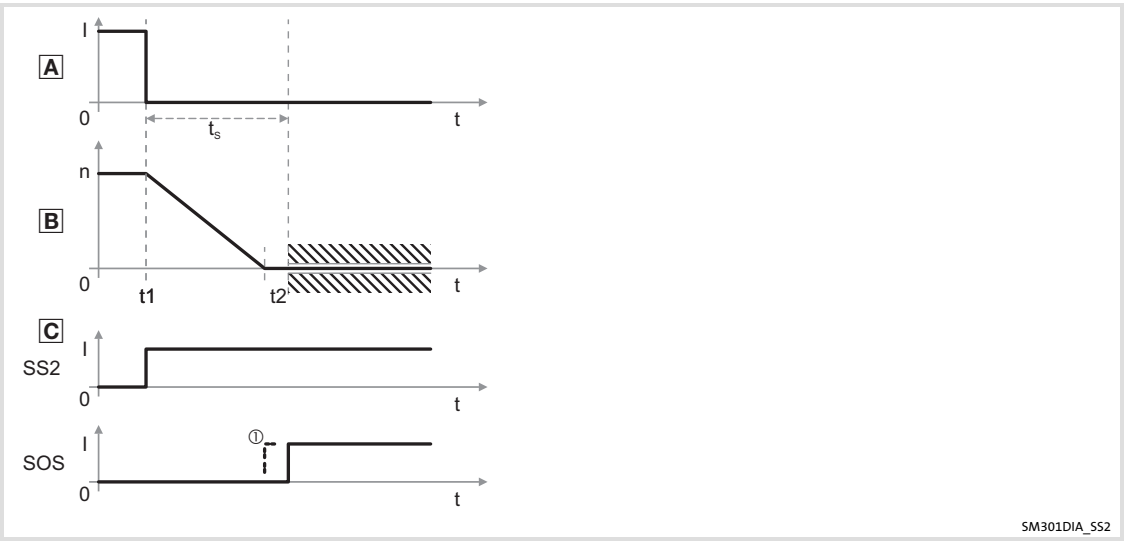
From SM301 V1.4 onwards, deceleration ramp monitoring can be parameterised. Depending on the parameterised stopping time, a monitoring ramp is calculated. (🕮 62)

Note!

The position of the motor is saved when the SOS state is entered. In the SOS state, relative position changes are added and compared to the permissible value in the parameter ”Tolerance window Delta p=0”. When the SOS state is quit, the maximum relative position change is displayed in code C15312. When the SOS state is requested again, the maximum value of the last position changes is reset to zero.

Example: The states ”SS2 active” and ”SOS active” are interrupted by a STO request. When the STO request is reset, an immediate transition to the SOS state takes place. This causes a reset of the current position deviation to p=0.

After the safe operational stop is interrupted by the STO, the motor may have a different position due to an external torque.



A Input signal of the request of a safety function
I ON state
0 OFF state
B Speed characteristic n of the motor
- Speed-monitored up to SM301 V1.2
- Position-monitored as of SM301 V1.3
- Optional: Monitoring of the brake ramp as of SM301 V1.4

t Time axis
tx Action instant
t_S Monitored stopping time
C Feedback(s)
① SS2 mode (C15308) influences the switching time

Tip!

Adapt the deceleration time for quick stop (C00105) of the standard device to the stopping time SS1, SS2 (C15305).

The drive must have reached standstill before the stopping time has elapsed.

Codes

Parameter:	Name:		Data type:	Index:
C15300	**Restart behaviour**		UNSIGNED_8	$9275_d = 243B_h$
Behaviour for restart after functions have been cancelled				
Selection list (Lenze setting bold)			**Information**	
0	**Acknowledged restart**			
1	Automatic restart			
Subcodes			**Information**	
C15300/1			Restart - STO, SS1	
C15300/2			Restart - SS2, SOS	
☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				
C15305	**SS1, SS2: Stopping time**		UNSIGNED_16	$9270_d = 2436_h$
Stopping time for the SS1 and SS2 safety functions				
Setting range (min. value | unit | max. value)			**Information**	
0	MS	30000	Lenze: 0, increment: 2 ms	
☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				
C15308	**SS2 mode**		UNSIGNED_8	$9267_d = 2433_h$
Selection whether SS2 is to be executed already after reaching n=0 SOS or only after reaching the parameterised stopping time.				
Selection list (Lenze setting bold)			**Information**	
0	**SOS after stopping time**		(As of SM301 V1.3)	
1	SOS at n = 0			
☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				
C15310	**Tolerance window (n=0)**		INTEGER_16	$9265_d = 2431_h$
Safely monitored tolerance window for zero speed				
Setting range (min. value | unit | max. value)			**Information**	
0	rpm	16000	Lenze: 0	
☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				
C15311	**SOS: Tolerance window (Delta p=0)**		UNSIGNED_32	$9264_d = 2430_h$
Safely monitored tolerance window for zero position change				
Display area (min. value | unit | max. value)			**Information**	
0	Incr.	327680	Lenze: 0 (From SM301 V1.3)	
☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				
C15312	**SOS: Maximum change in position**		UNSIGNED_32	$9263_d = 242F_h$
Amount of the maximum change in position while SOS was active				
Display area (min. value | unit | max. value)			**Information**	
0	Incr.	2147483647	(From SM301 V1.3)	
☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				

1.4.5.2 Activation

How to activate the function:

- ”OFF state” at a safe input, the function of which has been assigned by parameter setting.
- Via a safety bus data telegram with corresponding content.
- As response to the error stop request.

1.4.6 Ramp monitoring SS1/SS2

1.4.6.1 Description

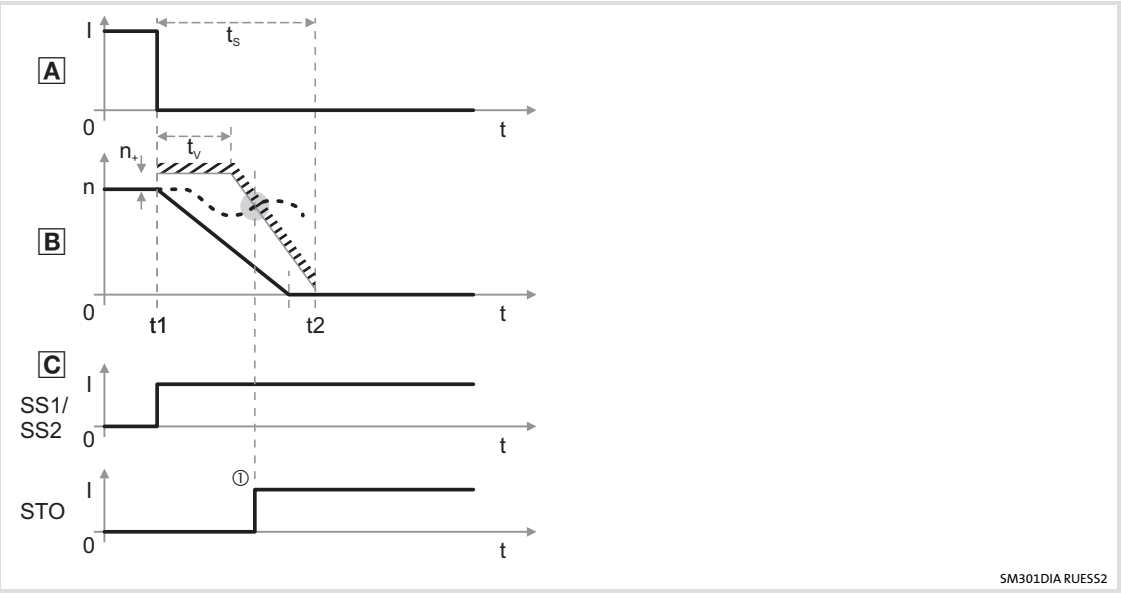
From SM301 V1.4 onwards, the deceleration ramp for the stop functions SS1 and SS2 can be parameterised and monitored. If the parameterised ramp is not exceeded, the state changes to the parameterised stop function STO or SOS.

The monitoring of the deceleration process serves to achieve a higher degree of safety. Ramp monitoring becomes most critical when delay times are caused by high moments of inertia

- Braking the drive to standstill and holding the position must still be executed by the application!
- A safe speed evaluation is the precondition for a safe ramp monitoring, i.e. an encoder system must be parameterised in the safety module.
- When ramp monitoring is activated, the starting value of the ramp and the S-ramp time must be defined in percent.
  - The starting value refers to the current speed value at the time of the SS1/SS2 request.
  - The starting time of the deceleration ramp is delayed via the S-ramp time in order to consider a possible S-ramp smoothing.

If the current speed exceeds the parameterised deceleration ramp within the stopping time or before reaching the tolerance window (n=0), an error message is caused and an error stop is initiated.

- The power supply of the motor is immediately safely interrupted (STO). The motor cannot create a torque and thus no dangerous movements of the drive can occur.



A Input signal of the request of a safety function
I ON state
0 OFF state
B Speed characteristic n of the motor
- Speed-monitored up to SM301 V1.2
- Position-monitored as of SM301 V1.3
- Optional: Monitoring of the brake ramp as of SM301 V1.4

n_+ Start offset ramp
t Time axis
tx Action instant
tS Monitored stopping time
tV S-ramp time
— Normal operation
--- Incorrect operation
C Feedback(s)
① If the speed exceeds the parameterised brake ramp, an error message is triggered and an error stop is initiated.

Codes

C15305	SS1, SS2: Stopping time		UNSIGNED_16	$9270_d = 2436_h$
Stopping time for the SS1 and SS2 safety functions				
Setting range (min. value | unit | max. value)			**Information**	
0	MS	30000	Lenze: 0, increment: 2 ms	
☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				

C15310	Tolerance window (n=0)		INTEGER_16	$9265_d = 2431_h$
Safely monitored tolerance window for zero speed				
Setting range (min. value | unit | max. value)			**Information**	
0	rpm	16000	Lenze: 0	
☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				

C15315	SS1, SS2: ramp monitoring	UNSIGNED_8	$9260_d = 242C_h$
Selection whether the brake ramp is to be monitored when SS1 and SS2 are executed.			
Selection list (Lenze setting bold)		**Information**	
0	No ramp monitoring	(From SM301 V1.4)	
1	**Ramp monitoring is activated**		
☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer			

C15316	SS1, SS2: S-ramp time		UNSIGNED_8	$9259_d = 242B_h$
S-ramp time of deceleration ramp for SS1 and SS2 if a linear ramp is not used.				
Setting range (min. value | unit | max. value)			**Information**	
0	%	100	0 (From SM301 V1.4)	
☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				

C15317	SS1, SS2: Start offset ramp		UNSIGNED_8	$9258_d = 242A_h$
Speed offset at the start of the ramp monitoring.				
Display area (min. value | unit | max. value)			**Information**	
0	%	30	0 (From SM301 V1.4)	
☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				

1.4.6.2 Activation

How to activate the function:

- ► The ramp monitoring must be activated via the C15315 parameter.
- ► When the stop functions SS1/SS2 are requested, a monitoring ramp is calculated and applied to the current speed characteristic.

Note!

- ► The parameterisation of the monitoring ramp in the safety module must consider the parameters of the deceleration ramp from within the application.
- ► Based on the actual speed, a parameterisable percentage (0 ... 30 %) is added to the actual speed as a start offset and used as a constant starting value.
  - – In the Lenze setting of the start offset (C15317), the tolerance window (n = 0) is considered as an offset.
- ► The monitoring ramp only starts after an internal deceleration time has expired which has been generated as a function of the parameters ”SS1, SS2: S-ramp time” and ”SS1, SS2: Stopping time”:
  - – The parameter ”SS1, SS2: S-ramp time” is scaled linearly from 10 ... 30 % of the stopping time:
    0 % S-ramp time ≡ 10 % deceleration
    100 % S-ramp time ≡ 30 % deceleration
  - – In the Lenze setting of the S-ramp time, the deceleration time is 10 % of the set stopping time.

1.4.7 Emergency stop

1.4.7.1 Description

Safe **S**top **E**mergency/SSE

The emergency stop function activates STO or SS1. The function to be executed can be set (C15205). There is no way to avoid emergency stopping during special operation.

With active cascading (C15035 from SM301 V1.1) only ”STO” is permissible as emergency stop.

Note!

Connect the emergency stop buttons which must not be overruled by a special operation to the emergency stop function. For this purpose, parameterise the safe input as ”emergency stop” (C15031).

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

The activation of the function is reported internally to the standard device and via the safety bus of the higher-level control.

Codes

Parameter:	Name:	Data type:	Index:
C15205	**SSE: Safe stop emergency function**	UNSIGNED_8	$9370_d = 249A_h$

Selection of the stop function for emergency stop

Selection list (Lenze setting printed in bold)		**Information**
0	**STO**	Safe torque off
1	SS1	Safe stop 1

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

1.4.7.2 Activation

How to activate the function:

- ”OFF state” at a safe input, the function of which has been assigned by parameter setting.
- Via a safety bus data telegram with corresponding content.

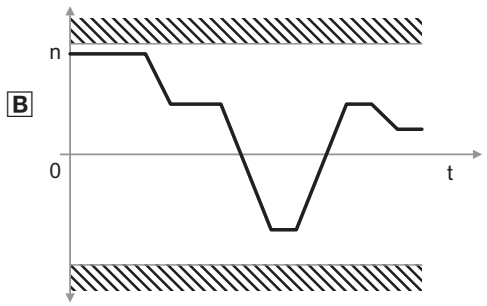
1.4.8 Safe maximum speed

1.4.8.1 Description

Safe **M**aximum **S**peed / SMS

This function monitors the maximum motor speed. If a value > 0 is indicated (C15320), the function is activated.

If the maximum speed is exceeded, a error stop is caused. STO, SS1 or SS2 (C15321) can be adjusted.



B Speed characteristic n of the motor
t Time axis

Codes

Parameter:	Name:		Data type:	Index:
C15320	**SMS: Max. speed Nmax**		INTEGER_16	$9255_d = 2427_h$
Selection of the maximum speed and activation of the SMS function				
Setting range (min. value | unit | max. value)			**Information**	
0	rpm	16000	Lenze: 1, deactivate: 0	
☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				
C15321	**SMS: Response (n>Nmax)**		UNSIGNED_8	$9254_d = 2426_h$
Response to the exceeding of the set maximum speed				
Selection list (Lenze setting bold)			**Information**	
0	STO		Safe torque off	
1	**SS1**		Safe stop 1	
2	SS2		Safe stop 2	
☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				
C15350	**SLS, SMS: Max. response time**		UNSIGNED_16	$9225_d = 2409_h$
Maximum time after an exceeded speed has been detected, after which the speed must be below the limit again.				
Setting range (min. value | unit | max. value)			**Information**	
0	MS	30000	Lenze: 0, increment: 2 ms	
☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				

1.4.8.2 Activation

The function is activated or deactivated via the parameter value. A value > 0 activates the function, a value = 0 deactivates the function.

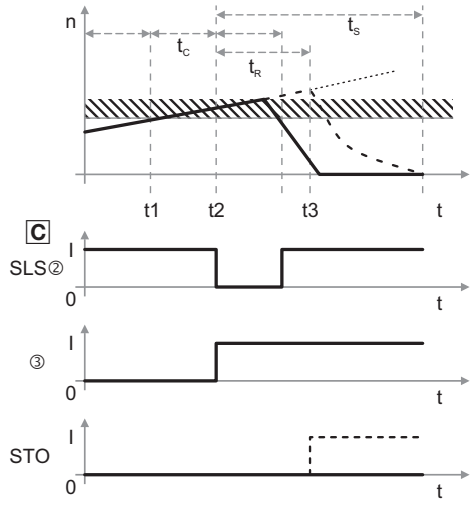
1.4.8.3 Fault analysis

This consideration applies to the SMS and SLS functions.

The evaluation and plausibility of the speed values is done in a cycle of 2 ms.

If the defined limit values are exceeded, the parameterised error response is activated within a time slot of maximally one evaluation cycle. With the error response SS1 or SS2 the response time of the stop function depends on the evaluation in the standard device. Moreover, the set stopping time must be added to the response time until the defined operating status is reached.

In order that the response can be checked for an error as quickly as possible, a maximum response time (C15350) can be parameterised. Before the maximum response time has elapsed, the detected speed must comply with the permissible (monitored) speed. If the permissible (monitored) speed is not complied with, STO is activated immediately.



T1	Occurrence of the error event
t_C	Cycle time 2 ms
T2	Determining the error event
t_R	Maximum permissible response time (parameterisable)
t3	Response instance to continuous exceedance
t_S	Stopping time
C	Feedback(s)
SLS②	SLS monitored
③	According to the error response set: SS2, SS1 or STO
STO	Response in case of an error after the max. response time has elapsed
———	Normal operation
------	Incorrect operation

Note!

If the STO function has been selected as the error response for SMS or SLS, the internal response time is not considered because the motor is already coasting after the speed threshold is exceeded for the first time.

Note!

In case of an error, the set limited speed will be exceeded.

To assess the risk for the plant, you have to calculate the height of the maximum exceedance. Consider the following:

- ► internal response time
- ► application-specific response time
- ► application-specific maximum acceleration

1.4.9 Safely limited speed

1.4.9.1 Description

Safely **L**imited **S**peed/SLS

Safe **S**peed **M**onitor/SSM

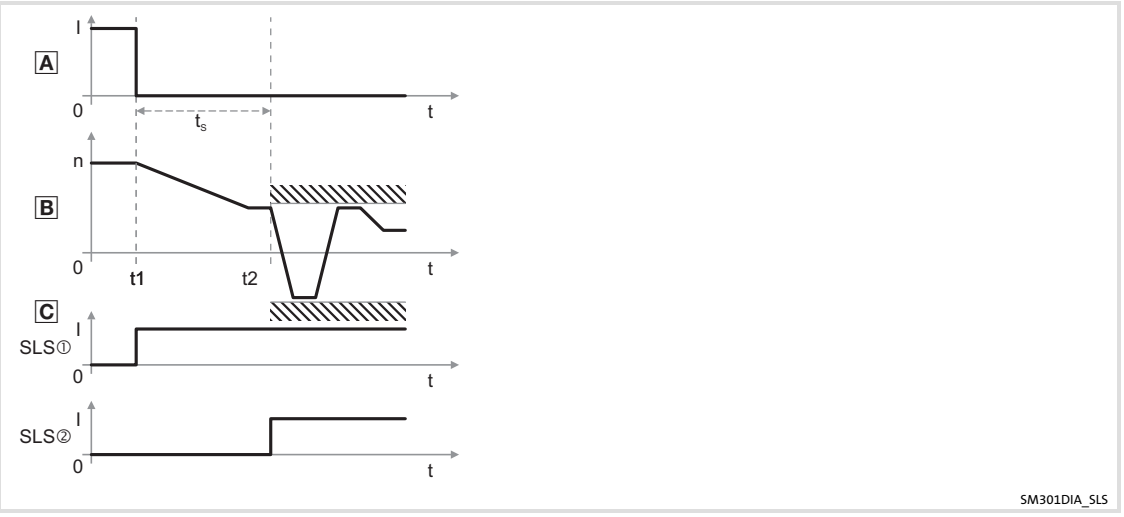
When the adjustable braking time (C15331/1 ... 4) has elapsed, the function monitors compliance with the limited speed N_{lim} (C15330/1 ... 4).

► From SM301 V1.,1 four different speeds can be monitored (SLS1 ... SLS4).

When operating within the limit values, the ”SLSx monitored” status is set (C15000). The status can be assigned to the safe output (C15052/1). The status can also be reported via the safety bus. From V1.3, feedback is returned as soon as the speed falls below its threshold. This results in reduced cycle times if the ”SLSx monitored” feedback is used.

When the monitored speed is exceeded, a stop error is caused. STO, SS1 or SS2 (C15332/1...4) can be adjusted. If the speed is not within the limit values even after the adjustable response time (C15350), the drive will be directly switched off (STO).

The monitoring of the limited speed can be combined with a monitoring of the direction of rotation. For this purpose, the permissible direction of rotation for the corresponding limited speed SLSx must be set in parameter SLS: Permissible direction of rotation (C15333). This setting triggers two monitoring functions at the same time via one request which is pending via SD-InX or the safety bus.



A	Input signal of the request of a safety function
I	ON state
0	OFF state
B	Speed characteristic n of the motor
t	Time axis
tx	Action instant
t_S	Monitored braking time
C	Feedback(s)
SLS①	SLS active
SLS②	SLS monitored

Codes

Parameter:	Name:		Data type:	Index:
C15330	**SLS: Limited speed Nlim**		UNSIGNED_16	$9245_d = 241D_h$
Setting of the limited speed				
Setting range (min. value | unit | max. value)			**Information**	
0	rpm	16000	Lenze: 0	
Subcodes			**Information**	
C15330/1			SLS1: Limited speed Nlim1	
C15330/2			SLS2: Limited speed Nlim2 (As of SM301 V1.1)	
C15330/3			SLS3: Limited speed Nlim3 (As of SM301 V1.1)	
C15330/4			SLS4: Limited speed Nlim4 (As of SM301 V1.1)	
☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				
C15331	**SLS: Braking time Nlim**		UNSIGNED_16	$9244_d = 241C_h$
Safely monitored time for braking the drive to the limited speed set in C15330.				
Setting range (min. value | unit | max. value)			**Information**	
0	MS	30000	Lenze: 0, increment: 2 ms	
Subcodes			**Information**	
C15331/1			SLS1: Braking time Nlim1	
C15331/2			SLS2: Braking time Nlim2 (as of SM301 V1.1)	
C15331/3			SLS3: Braking time Nlim3 (as of SM301 V1.1)	
C15331/4			SLS4: Braking time Nlim4 (as of SM301 V1.1)	
☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				
C15332	**SLS: Response (n>Nlim)**		UNSIGNED_8	$9243_d = 241B_h$
Response in the safety module to the exceeding of the limited speed				
Selection list (Lenze setting bold)			**Information**	
0	STO		Safe torque off	
1	**SS1**		Safe stop 1	
2	SS2		Safe stop 2	
Subcodes			**Information**	
C15332/1			SLS1: Response (n>Nlim1)	
C15332/2			SLS2: Response (n>Nlim2) (as of SM301 V1.1)	
C15332/3			SLS3: Response (n>Nlim3) (as of SM301 V1.1)	
C15332/4			SLS4: Response (n>Nlim4) (as of SM301 V1.1)	
☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				

Parameter:	Name:	Data type:	Index:
C15333	**SLS: Permissible direction of movement**	UNSIGNED_8	$9242_d = 241A_h$

Permissible direction of movement during SLS monitoring

Selection list (Lenze setting printed in bold)		**Information**
0	**Both directions enabled**	
1	Positive direction enabled	
2	Negative direction enabled	

Subcodes		**Information**
C15333/1		SLS1: Permissible direction of movement (from SM301 V1.3)
C15333/2		SLS2: Permissible direction of movement (from SM301 V1.3)
C15333/3		SLS3: Permissible direction of movement (from SM301 V1.3)
C15333/4		SLS4: Permissible direction of movement (from SM301 V1.3)

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15350	**SLS, SMS: Max. response time**	UNSIGNED_16	$9225_d = 2409_h$

Maximum time after an exceeded speed has been detected, after which the speed must be below the limit again.

Setting range (min. value | unit | max. value)			**Information**
0	MS	30000	Lenze: 0, increment: 2 ms

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

1.4.9.2 Activation

How to activate the function:

- ”OFF state” at a safe input, the function of which has been assigned by parameter setting.
- Via a safety bus data telegram with corresponding content.

1.4.9.3 Fault analysis

The fault analysis is described with the SMS function (📖 67).

1.4.10 Safe direction

1.4.10.1 Description

Safe **Di**rection / SDI

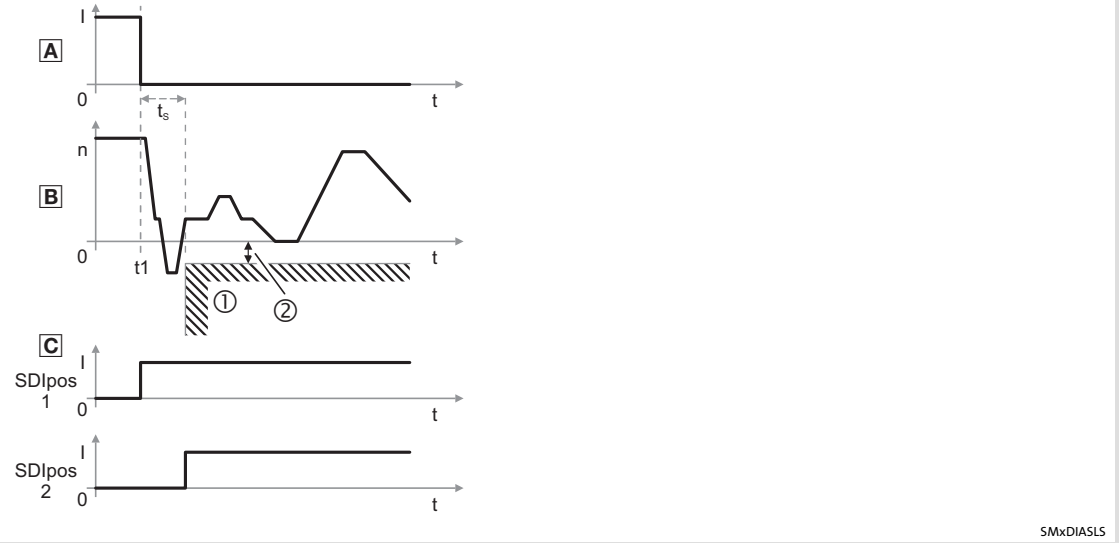
This function monitors safe compliance with an adjustable direction of movement. Monitoring also includes zero speed with a tolerance window.

If the valid direction of rotation is not complied with, optionally SS1, SS2, or STO can be activated.

After the adjustable delay time has expired (C15341), the function monitors the compliance with the positive/negative direction of movement.

When operating within the limit values (C15342), the ”SDIxxx monitored” status is set (C15000). The status can be assigned to the safe output (C15052/1). The status can also be reported via the safety bus.

If deviations from the permissible direction of movement occur, an error stop will be triggered. As an error response, STO, SS1, or SS2 can be set (C15343). In the event of an error the maximum change in position is displayed (C15344).



A	Input signal of the request of a safety function
’1’	Logic signal level ”1” / ”TRUE”
B	Direction of movemtn of the motor
tx	Action instant
t	Time axis
t_s	Delay time
C	Feedbacks
SDIpos1	SDIpos active
SDIpos2	SDIpos monitored
①	Error response - triggering motion range
②	Adjustable SDI tolerance threshold

Note!

If the SDI delay time (C15341) is parameterised greater than zero, either the ”SDIxxx monitored” feedback must be evaluated (safety bus or safe output) or the risk analysis must show that the delay is not hazardous. This fact must e.g. be considered in the calculation of the safety clearance.

Note!

If the monitoring of the direction of movement, SDIxxx, is combined with function SLSx, the delay times must be coordinated. Then, braking time Nlim will start at the same time as the SDI delay time.

Codes

Parameter:	Name:		Data type:	Index:
C15340	**SDI: Monitoring - normal operation**		UNSIGNED_8	$9235_d = 2413_h$
Setting of the monitoring of the direction of movement of the motor during normal operation				
Selection list (read only)			**Information**	
0	**Both directions enabled**		(From SM301 V1.3)	
1	Positive direction enabled			
2	Negative direction enabled			
☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				
C15341	**SDI: Deceleration time**		UNSIGNED_16	$9234_d = 2412_h$
Safely monitored time from activation to switching on the monitoring SDIpos/SDIneg				
Display area (min. value | unit | max. value)			**Information**	
0	ms	30000	(From SM301 V1.3)	
☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				
C15342	**SDI: Tolerance threshold**		UNSIGNED_32	$9233_d = 2411_h$
Setting of the tolerance threshold by how many increments the motor may move towards the direction inhibited through SDI				
Display area (min. value | unit | max. value)			**Information**	
0	Incr.	327680	(From SM301 V1.3)	
☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				
C15343	**SDI: Error response**		UNSIGNED_8	$9232_d = 2410_h$
Response to a violation of the permitted direction of movement of the motor				
Selection list (read only)			**Information**	
0	STO		(From SM301 V1.3)	
1	**SS1**			
2	SS2			
☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				
C15344	**SDI: Maximum change in position**		UNSIGNED_32	$9231_d = 240F_h$
Maximum change in position in inhibited direction if SDI is active				
Display area (min. value | unit | max. value)			**Information**	
0	Incr.	2147483647		
Subcodes			**Information**	
C15344/1			SDIpos: Maximum change in position (from SM301 V1.3)	
C15344/2			SDIneg: Maximum change in position (from SM301 V1.3)	
☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				

1.4.10.2 Activation

How to activate the ”Safe direction” function:

- ► Permanent monitoring of the direction of movement during normal operation (C15340).
- ► ”OFF state” at a safe input, the function of which has been assigned by parameter setting.
- ► In conjunction with safely limited speed SLSx (C15333).
- ► Via a safety bus data telegram with corresponding content.

1.4.10.3 Fault analysis

This consideration is applies to function SDI.

The position values are evaluated and checked at a cycle of 2 ms. If the defined tolerance window is exceeded, the parameterised error response is triggered immediately within a time slot of max. one evaluation cycle. If a SS1 or SS2 error response is triggered, the response time of the stop function depends on the evaluation in the standard device. Furthermore, the set stopping time must be added to the response time until the defined operating status is reached. In the Lenze setting, the error response is set to SS1.

1.4.11 Safe operation mode selector

1.4.11.1 Description

Operation **M**ode **S**elector / OMS

The function provides a special operation of the drive. In the special operation the drive is stopped (status 2). The drive can be traversed in the special operation via an enable switch (status 3).

For the stop status in the special operation, the STO, SS1 or SS2 functions can be parameterised.

For motion functions in the special operation, the SLS function (from V1.3 onwards combinable with SDI) or free movement (from V1.4 onwards combinable with SLI function) can be parameterised. The parameterised monitoring function will be automatically activated with the transition to the special operation.

The special operation enables an override of the simple STO, SS1, and SS2 stop functions by the enable switch.

Also in special operation, activated SMS, SDI and SLS monitoring functions are continued to be executed. An error detected in the monitoring functions, also in special operation, leads to the parameterised error stop function. Depending on the priority, the parameterised stop function of the monitoring function or the stop function of the special operation is executed without approval.

An active emergency stop function is also executed in special operation.

The special operation can also be selected via the safety bus by the F-PLC, unless a safe input is parameterised as operation mode selector.

The return to normal operation is only possible in the stop status. Since the drive is stopped in status 2, the AIS acknowledgement is required for restart. The parameters for the restart STO/SS1 or SS2 are used.

Note!

When returning to normal operation, the automatic restart is not permissible. If ”automatic restart” is parameterised, this can be prevented by special measures, e.g. programming in the higher-level control.

Note!

The ”safe enable switch” function serves to directly cancel/complete the stopping times assigned to the stop functions.

Note!

Monitoring of the safely limited increment (from SM301 V1.4 onwards) in special operation is active if a value > 0 has been selected for C15203.

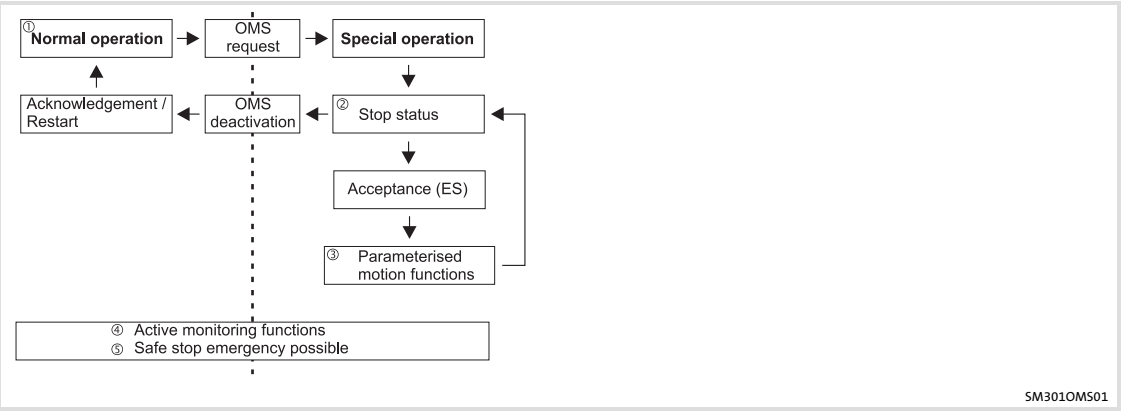
Note!

If an error (e.g. a discrepancy error) occurs at a safe input to which the OMS function has been assigned, normal operation will be selected. This corresponds to the OFF state. The ”ME” LED is blinking and STO is not activated. The special operation can only be selected again when the error has been eliminated and acknowledged.

From SM301 V1.3 onwards, the switching level at the digital input which determines special or normal operation can be set via the safe parameterisation.

Note!

When the OMS bit is received via the safety bus, the value 0 (normal operation) is assumed in case of passivation. In special applications (e.g. safety door, request of OMS, i.e. open safety door = special operation) this must not cause a dangerous state by automatic restart.



Operating mode	Normal	Special
Event	Impact	Impact
-	State ①	-
Request - OMS special operation via ...		
... safe input	Change ➞	State ② Stop function ... ● STO ● SS1 ● SS2 ... is executed Activated monitoring functions remain active.
... safety bus	same response - only possible as an alternative to the safe input	
Request - ES confirmation via ...		
... safe input	No function	State ③ ● Free movement ● SLS (as of V1.3 combinable with SDI) possible as restriction ● SLI (as of V1.4)
... via safety bus	same response - only possible as an alternative to the safe input	
Stop request	State ④ parameterised function ... ● STO ● SS1 ● SS2 ... is executed	is not executed
Emergency stop	State ⑤ parameterised function ... ● STO ● SS1 ... is executed	
Monitoring responds: SMS SLS SDI	dependent on priority: parameterised error function ... ● STO ● SS1 ● SS2 ... is executed or parameterised stopping function of special operation	

1.4.11.2 Conditions

A safe input must be parameterised and interconnected as an operation mode selector. Select the operating mode for the LOW level (C15202) depending on the application. Only one operation mode selector can be connected and parameterised. The OMS bit of the safety bus must be deactivated (C15113).

Special operation can also be selected via the safety bus (C15113) with the OMS bit if no safe input has been selected as an operation mode selector. In this case, at least one stop function must be parameterised via the safety bus to ensure that the drive system is safely switched-off if the bus should be interrupted. Furthermore, parameter C15202 must be set to ”Normal operation”.

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

Note!

The ”free traversing” setting for the special operation (C15201) motion function must be suitable for the application!

Danger!

Dangerous situations may occur during automatic or special operation

Depending on the application, automatic or special operation may bring about hazardous situations.

Possible consequences:

- ► Injury to persons
- ► Damage to material assets

Protective measures:

- ► Must be observed in particular when setting the operating mode for the LOW level at the SD-Inx.
- ► Observe the notes provided in the attached application examples.

Codes

Parameter:	Name:		Data type:	Index:
C15200	**OMS: Stop function**		UNSIGNED_8	$9375_d = 249F_h$
Selection of the stop function in special operation				
Selection list (Lenze setting bold)			**Information**	
0	**STO**		Safe torque off	
1	SS1		Safe stop 1	
2	SS2		Safe stop 2	
☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				
C15201	**OMS: motion function**		UNSIGNED_8	$9374_d = 249E_h$
Selection of the motion function in special operation				
Selection list (Lenze setting bold)			**Info**	
3	SLS1		Safely limited speed 1 (Lenze setting up to SM301 V1.3)	
4	SLS2		Safely limited speed 2 (From SM301 V1.1)	
5	SLS3		Safely limited speed 3 (From SM301 V1.1)	
6	SLS4		Safely limited speed 4 (as of SM301 V1.1)	
11	**Free traversing**		(Lenze setting from SM301 V1.4)	
☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				



Tip!

If SLSx has been parameterised as the motion function during special operation, a change to the acceptance operation is not possible until the reduced speed is monitored and maintained (SLSx monitored).

C15202	**OMS: Function at LOW level**		UNSIGNED_8	$9373_d = 249D_h$
Function that is executed in case of LOW level at the safe input with OMS function. Caution: According to the closed-circuit principle, the parameterisation must not cause any additional danger.				
Selection list (read only)			**Information**	
0	**Normal operation**		(From SM301 V1.3)	
1	Special operation			
☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				
C15203	**SLI: Safely lim. increment**		UNSIGNED_32	$9372_d = 249C_h$
Number of increments for safely limited increment				
Setting range (min. value | unit | max. value)			**Information**	
0	Incr.	2147483647	Lenze: 1, deactivate: 0 (From SM301 V1.4)	
☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				
C15204	**SLI: Amount of position change**		UNSIGNED_32	$9371_d = 249B_h$
Maximum position change while SLI is active.				
Display area (min. value | unit | max. value)			**Information**	
0	Incr.	2147483647	(From SM301 V1.4)	
☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				

1.4.11.3 Activation

How to activate the function:

- Via a safe input which has been assigned to the function by parameterisation. In addition, the requested operating mode depends on OMS: Function at LOW level (C15202).

  Example:

  Normal operation at LOW level

  Special operation is activated via a 2-pole key-operated switch. The ”Special operation with LOW level” function is not permissible for a key-operated switch which uses special operation for purposes of short-circuiting. An open circuit in the cable of the switch would activate special operation.

  Special operation at LOW level

  Special operation is active when the safe input detects the LOW level. This triggers execution of the stop function parameterised.

Only if no safe input is used, the function can only be activated via the safety bus:

- A data telegram with corresponding contents must be transmitted to the standard device.

1.4.12 Safe enable switch

1.4.12.1 Description

Enable **S**witch / ES

The drive can be traversed in special operation using an enable switch (see operation mode selector).

1.4.12.2 Conditions

A safe input must be parameterised and interconnected as enable switch. You can only connect and parameterise one enable switch. The ES bit of the safety bus must be deactivated (C15113).

The enable switch function can also be selected via the safety bus with the ES bit, unless a safe input is parameterised as enable switch.

The special operation must be activated.

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

Codes

Parameter:	Name:	Data type:	Index:
C15031	**SD-In sensor function**	UNSIGNED_8	$9544_d = 2548_h$

Function configuration of the safe inputs.
- The "operation mode selector" and "enable switch" functions may only be assigned to one of the four safe inputs.

Selection list (Lenze setting printed in bold)		**Information**
0	**Free assignment**	Safety function set in C15032
1	Emergency stop	Safe stop emergency function (SSE)
2	Operation mode selector	Safe operation mode selector (OMS)
3	Enable switch	Safe enable switch (ES)
Subcodes		**Information**
C15031/1		SD-In1 sensor function
C15031/2		SD-In2 sensor function
C15031/3		SD-In3 sensor function
C15031/4		SD-In4 sensor function

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

1.4.12.3 Activation

How to activate the function:

► Via a safe input which has been assigned to the function by parameterisation. With the edge change 0-1 of the ES signal, the status changes to "Acceptance (ES)".

Only if no safe input is used, the function can only be activated via the safety bus:

► A data telegram with corresponding contents must be transmitted to the standard device (edge change 0-1 of the ES signal).

1.4.13 Cascading

1.4.13.1 Description

Cascading / CAS

This function enables a synchronised shutdown of an entire drive system.

- The function can only be activated via parameter setting. For this purpose set the "CAS: cascading" parameter to "Cascading with SD-In4".
- With activated function:
  - The SD-In4 safe input is used as cascading input and cannot be used as universal input anymore.
  - The SD-Out1 safe output is used as cascading output and cannot be parameterised as universal feedback output anymore.
  - A stop function (emergency stop, SSE) released by cascading cannot be overruled in special operation through the enable switch.
- The cascade trips with every STO, irrespective of which safety module adopts the STO status and for which reason.
- All safety modules of the cascade can only be enabled if all cascading inputs (SD-In4) are in the OFF state (emergency stop has been enabled).
- For the restart of the drive system, the AIS restart acknowledgement must be executed simultaneously for all safety modules of the cascade.
- The restart is executed with a delay of 100 ms after the acknowledgement has been recognised.
- Cascading is designed for max. 100 drives.
- During special operation, the drives of the cascade can only change from the SS2/SOS stop function to acceptance. An STO or SS1 as stop function would trigger the entire drive system every time and thus impede acceptance.

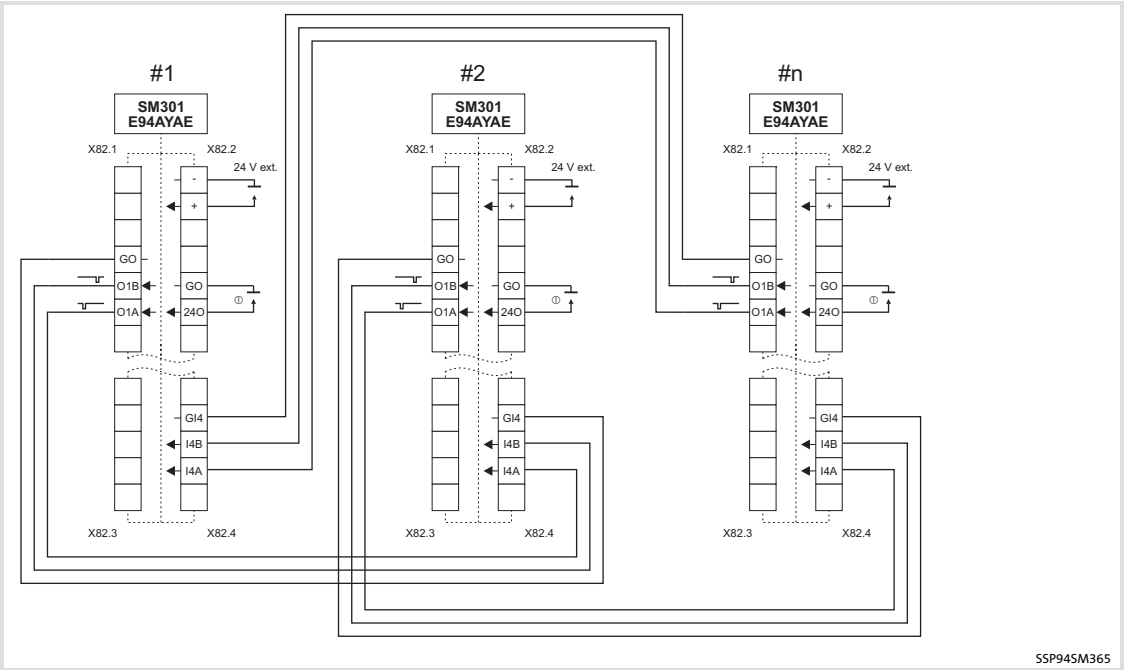


Fig. 1-10 Wiring example

E94AYAE	Safety module SM301 as of V1.1
#1, #2, #n	Number of the module
24 V ext. ②	24-V voltage supply of the module (SELV/PELV)
①	24-V voltage supply of the output (SELV/PELV)

1.4.13.2 Conditions

- This function is available from SM301 V1.1.
- The SD-In4 input must be parameterised as active input for the ”emergency stop” function and the input delay for SD-In4 must be ≤ 10 ms.
- The emergency stop function to be executed must be parameterised as STO via the ”SSE: emergency stop function” parameter.
- The restart behaviour of the drive after the STO/SS1 stop function has been executed must be parameterised to ”Acknowledged restart”.
- The control of the SD-Out1 output via a possibly parameterised safety bus must be inhibited.
- The SS1 mode (C15306) must be set to ”STO after stopping time”.
- The plausibility check rejects other settings until they are parameterised correctly.

Codes

Parameter:	Name:	Data type:	Index:
C15035	**CAS: Cascading**	UNSIGNED_8	$9540_d = 2544_h$

Safe cascading

Selection list (Lenze setting bold)		**Information**
0	**No cascading**	(As of SM301 V1.1)
4	Cascading with SD-In4	

☑ Read access ⚠ Write access ☐ CINH ☐ PLC-STOP ☐ No transfer

C15036	**CAS: Stop delay**	UNSIGNED_16	$9539_d = 2543_h$

Circulation time of safe cascading

Display area (min. value | unit | max. value)			**Information**
0	MS	65535	(As of SM301 V1.1) ● Display of the time that passes from switching the SD-Out1 output to OFF state to the detection of the OFF state at the SD-In4 input. This information may be helpful for system commissioning/maintenance. ● If ”0 ms” is displayed after a stop, another safety module has activated the stop via the cascade. ● The time is displayed until the next system acknowledgement.

☑ Read access ☐ Write access ☐ CINH ☐ PLC-STOP ☐ No transfer

1.4.13.3 Activation

The cascade trips with every STO, irrespective of which safety module adopts the STO status and for which reason.

1.5 Safety address

The safety address serves to clearly assign the safety modules of the SM301 type in systems with several drives. The address ”0” is not permissible.

Address switch

The safety address can be set in the left part of the housing by means of the DIP switch A. For setting the switch, use an appropriately small tool, e. g. a probe. The switch can only be set if the module is not connected to a standard device. Via the switch, addresses in the range of 0 ... 1023 can be set. Alterations by the switch with regard to the address are only activated when the 24-V supply is switched on. The address setting ”0” requires the setting by the address code.

DIP switch A	Labelling									
	1	2	3	4	5	6	7	8	9	0
Value of the address bit	1	2	4	8	16	32	64	128	256	512

Tab. 1-5 Address setting

Address code

The safety address can also be set with the ”Safety address” parameter (C15111) of the safety module. For this, the address setting via the DIP switch A must be set with the ”0” setting. Via parameter, addresses can be set in a range of 0 ... 65534.

Effective safety address

The effective safety address is the result from the address switch or address parameter. The effective safety address must comply with the module ID assigned in the safe parameter set.

The effective safety address must also be used as target address by a master control with safety bus (e.g. PROFIsafe/PROFIsafe target address).

Module ID

(As of SM301 V1.2) Before the safe parameter set is downloaded, the system checks if the module ID defined in the parameter set corresponds to the module ID saved in the safety module. If the values are not the same, a corresponding message is displayed. This shall ensure that the safety address is not changed by mistake during parameter setting. If the user confirms the new value after checking it, the changed module ID will be saved non-volatile in the SM301. Code C15017 contains the module ID saved during the last parameter set transfer in the SM301.

Note!

A general reset does not change the stored module ID.

Codes

Parameter:	Name:		Data type:	Index:
C15017	**Stored module ID**		UNSIGNED_16	$9558_d = 2556_h$
Module ID stored in the safety module				
Display area (min. value | unit | max. value)			**Information**	
0		65535	(As of SM301 V1.2) Default setting (invalid ID): 0 Stored ID defective: 65535	
☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				
C15101	**Display - DIP switch position**		UNSIGNED_16	$9474_d = 2502_h$
Display of the DIP switch position				
Display area (min. value | unit | max. value)			**Information**	
0		1023		
☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				
C15111	**Safety address**		UNSIGNED_16	$9464_d = 24F8_h$
Safety address parameterised in the safety module				
Setting range (min. value | unit | max. value)			**Information**	
0		65534	Lenze: 0	
☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				
C15112	**Effective safety address**		UNSIGNED_16	$9463_d = 24F7_h$
Address used in safety module				
Display area (min. value | unit | max. value)			**Information**	
1		65534		
☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				

1.6 Safe bus interfaces

In the safety module, parameterised interfaces are provided for standardised safety bus systems. With the selection of the bus system, the corresponding parameters are made available.

Currently supported communication types:

- Operation without safety bus system
- Operation with PROFIsafe protocol

Codes

Parameter:	Name:	Data type:	Index:
C15100	**S bus: Configuration**	UNSIGNED_8	$9475_d = 2503_h$

Configuration of the safety bus

Selection list (Lenze setting bold)		**Information**
0	**No safety bus**	
1	PROFIsafe / PROFIBUS	
2	PROFIsafe / PROFINET	(As of SM301 V1.1)

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

1.6.1 PROFIsafe connection

1.6.1.1 Conditions

The SM301 supports the transmission of safe information on the PROFIsafe protocol according to the ”PROFIsafe - Profile for Safety Technology” specification, version 1.30, of the PROFIBUS Nutzerorganisation (PNO). The SM301 V1.1 also supports the PROFIsafe protocol according to the ”PROFIsafe - Profile for Safety Technology” specification, version 2.x. The standard device transmits the PROFIsafe information to the safety module for safe evaluation.

PROFIsafe connection	Required communication module	Setting ”S BUS: Configuration” (C15100)
PROFIBUS	E94AYCPM (PROFIBUS-DP) as of software version V1.00	PROFIsafe / PROFIBUS
PROFINET (as of SM301 V1.1)	E94AYCER (PROFINET) as of software version V0.70	PROFIsafe / PROFINET

Note!

A safety bus system (PROFIsafe) can only be operated via the upper module slot (MXI1) of the Servo Drive 9400.

Note!

The operation with PROFIsafe via PROFINET is only permissible according to the ”PROFIsafe - Profile for Safety Technology” specification, version 2.x.

1.6.1.2 Description

Addressing

In order that a data telegram reaches the correct node, an unambiguous PROFIsafe target address is required. If PROFIsafe has been selected as safety bus, the safety address is simultaneously accepted as PROFIsafe target address. This address must comply with the corresponding configuration of the safety PLC.

PROFIsafe frame

The PROFIsafe message is sent in the first slot of a PROFIBUS data telegram or in the second slot of a PROFINET data telegram.

This must be observed for the hardware configuration of the safety PLC!

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

PROFINET data telegram (as of SM301 V1.1)			
Header	**PROFIsafe data**	**Data**	**Trailer**
	Slot 2	Slot 1	

PROFIsafe data

In the PROFIsafe data one bit each is used to control a certain safety function.

- The structure of the PROFIsafe message is described in the PROFIsafe profile.
- The length of the PROFIsafe message in the SM301 is eight bytes (fixed).

The PROFIsafe messages are structured according to the following system:

PROFIsafe message - V1 mode								
	Bit offset							
Byte offset	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	PROFIsafe process data PROFIsafe output data/PROFIsafe input data							
1								
2								
3								
4	Control byte or status byte							
5	Consecutive number							
6	CRC2 (Signature consists of PROFIsafe process data and PROFIsafe parameters)							
7								

PROFIsafe message - V2 mode (as of SM301 V1.1)								
	Bit offset							
Byte offset	7	6	5	4	3	2	1	0
0	PROFIsafe process data PROFIsafe output data/PROFIsafe input data							
1								
2								
3								
4	Control byte or status byte							
5	CRC2 (Signature consists of PROFIsafe process data and PROFIsafe parameters and the consecutive number)							
6								
7								

Tab. 1-6 Structure of the PROFIsafe data

The meaning of the PROFIsafe process data is separately described for PROFIsafe output data and PROFIsafe input data. All bits described are evaluated.

Unassigned bits are reserved for future functions and marked with ”-”. These bits must be transmitted with ”0”.

PROFIsafe output data

The PROFIsafe output data is transmitted from the control to the safety module.

Control word PROFIsafe output data (safe user data)			
Bit	Name	Value	Description
0	STO	0	The STO function is activated.
1	SS1	0	The SS1 function is activated.
2	SS2	0	The SS2 function is activated.
3	SLS1	0	The SLS1 function is activated.
4	SLS2	0	The SLS2 function is activated. (from SM301 V1.1)
5	SLS3	0	The SLS3 function is activated. (from SM301 V1.1)
6	SLS4	0	The SLS4 function is activated. (from SM301 V1.1)
7	SDIpos	0	The SDIpos function is activated. (from SM301 V1.3)
8	SDIneg	0	The SDIneg function is activated. (from SM301 V1.3)
9	ES	1	Acceptance active: In special operation -> motion functions are possible.
11	OMS	0	Normal operation
		1	Special operation
16	PS_AIS	0 → 1	Activation of restart acknowledgement The bit must be set for at least one PROFIsafe cycle.
17	PS_AIE	0 → 1	Activation of fault acknowledgement The bit must be set for at least one PROFIsafe cycle.
23	SSE	0	The SSE function is activated.
24	SD-Out1	0	The SD-Out1 output is set to the OFF state.
	-	0	Reserved for future extensions

Tab. 1-7 Detailed specification of the PROFIsafe output data

Control byte

For the PROFIsafe V1 mode only the indicated bits of the PROFIsafe control byte are supported:

Assignment	Bit							
Byte	7	6	5	4	3	2	1	0
4	-	-	-	activate_FV	-	-	-	-

Tab. 1-8 Structure of the PROFIsafe control byte in V1 mode

Bit coding - control byte			
Bit	Name	Value	Description
4	activate_FV	1	The PROFIsafe output data is passivated.
	-	0	Reserved for future extensions

Tab. 1-9 Detailed specification of the control byte in V1 mode

For the PROFIsafe V2 mode only the indicated bits of the PROFIsafe control byte are supported:

Assignment	Bit							
Byte	7	6	5	4	3	2	1	0
4	-	-	Toggle_h	activate_FV	-	R_cons_nr	-	-

Tab. 1-10 Structure of the PROFIsafe control byte in V2 mode

Bit coding - control byte			
Bit	Name	Value	Description
2	R_cons_nr	1	Reset of the consecutive number.
4	activate_FV	1	The PROFIsafe output data is passivated.
5	Toggle_h	1/0	Change increases the consecutive number.
	-	0	Reserved for future extensions

Tab. 1-11 Detailed specification of the control byte in V2 mode

Control data filter

Unused functions in the control data of the safety bus must be set to ”Inhibit” via the parameter ”S-bus: Control data filter” (C15113). After this, the functions can no longer be activated via the safety bus independently of the transferred control data. As of SM301 V1.2, the filtered control data is indicated in ”S-bus: Display of control data” (C15115).

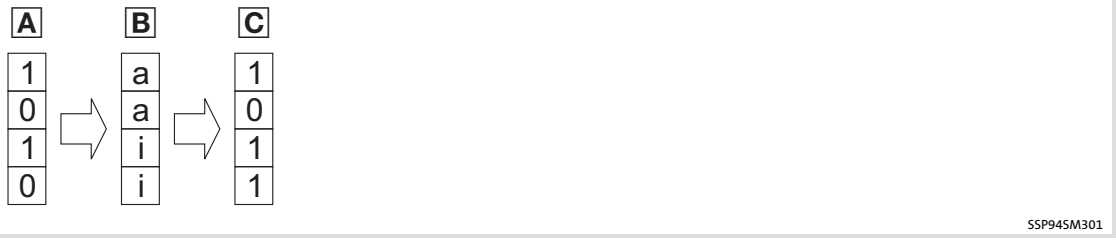


Fig. 1-11 Function example - filter

A Control data, incoming (0 = active, 1 = inactive)
B Control data filter
(Selection in the »Engineer«: a = ”pass through”, i = ”inhibit”)
C Effective control data (0 = active, 1 = inactive)

Codes

Parameter:	Name:	Data type:	Index:
C15113	**S-Bus: Filter control data**	BITFIELD_32	$9462_d = 24F6_h$

Bit coded selection of the active bit positions in the safety bus control data

Value is bit coded:		**Information**
Bit 0	STO	Safe torque off
Bit 1	SS1	Safe stop 1
Bit 2	SS2	Safe stop 2
Bit 3	SLS1	Safely limited speed 1
Bit 4	SLS2	Safely limited speed 2 (From SM301 V1.1)
Bit 5	SLS3	Safely limited speed 3 (From SM301 V1.1)
Bit 6	SLS4	Safely limited speed 4 (From SM301 V1.1)
Bit 7	SDIpos	Safe positive direction (From SM301 V1.3)
Bit 8	SDIneg	Safe negative direction (From SM301 V1.3)
Bit 9	ES	Safe enable switch
Bit 10	Reserved	
Bit 11	OMS	Safe operation mode selector
Bit 12	Reserved	
...		
Bit 15	Reserved	
Bit 16	PS_AIS	Restart acknowledgement via safety bus
Bit 17	PS_AIE	Fault acknowledgement via safety bus
Bit 18	Reserved	
...		
Bit 22	Reserved	
Bit 23	SSE	Emergency stop function
Bit 24	SD-Out1	Safe output
Bit 25	Reserved	
...		
Bit 31	Reserved	

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

Parameter:	Name:	Data type:	Index:
C15115	**S-bus: Control data display**	BITFIELD_32	$9460_d = 24F4_h$

Display of safety bus control data after filtering via C15113

Value is bit coded:		**Information** (From SM301 V1.2)
Bit 0	STO	Safe torque off
Bit 1	SS1	Safe stop 1
Bit 2	SS2	Safe stop 2
Bit 3	SLS1	Safely limited speed 1
Bit 4	SLS2	Safely limited speed 2
Bit 5	SLS3	Safely limited speed 3
Bit 6	SLS4	Safely limited speed 4
Bit 7	SDIpos	Safe positive direction (From SM301 V1.3)
Bit 8	SDIneg	Safe negative direction (From SM301 V1.3)
Bit 9	ES	Safe enable switch
Bit 10	Reserved	
Bit 11	OMS	Safe operation mode selector
Bit 12	Reserved	
...		
Bit 15	Reserved	
Bit 16	PS_AIS	Restart acknowledgement via safety bus
Bit 17	PS_AIE	Fault acknowledgement via safety bus
Bit 18	Reserved	
...		
Bit 22	Reserved	
Bit 23	SSE	Emergency stop function
Bit 24	SD-Out1	Safe output
Bit 25	Reserved	
...		
Bit 31	Reserved	

☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

PROFIsafe input data

The safety module transmits the PROFIsafe input data to the controller. This can be displayed via ”Safety function status” (C15000).

Bit coding of PROFIsafe input data		
Bit	Name	Description
0	STO active	The STO function is active and the drive is safely switched to torque-free operation. This bit is also set at the end of the stopping time by SS1.
1	SS1 active	The SS1 function is active. At the end of the function the STO bit is set.
2	SS2 active	The SS2 function is active. At the end of the function the SOS bit is set.
3	SLS1 active	The SLS1 function is active. When the braking time has elapsed, the SLS1_monitored bit is set additionally.
4	SLS2 active	The SLS2 function is active. When the braking time has elapsed, the SLS2_monitored bit is set additionally. (From SM301 V1.1 onwards)
5	SLS3 active	The SLS3 function is active. When the braking time has elapsed, the SLS3_monitored bit is set additionally. (From SM301 V1.1 onwards)
6	SLS4 active	The SLS4 function is active. When the braking time has elapsed, the SLS4_monitored bit is set additionally. (From SM301 V1.1 onwards)
7	SDIpos is active	The SDIpos function is active. After the deceleration time has expired, bit 21 (SDIpos monitored) is set in addition. (As of SM301 V1.3)
8	SDIneg is active	The SDIneg function is active. After the deceleration time has expired, bit 22 (SDIneg monitored) is set in addition. (As of SM301 V1.3)
9	ES active	1: ES function in special operation is active: Motion function 0: ES function in special operation is not active: Stop function
10	SLI is active	The safely limited increment (SLI) function is active. (As of SM301 V1.4)
11	OMS	1: special operation requested 0: normal operation
16	SOS monitored	The SOS function is monitored.
17	SLS1 monitored	The SLS1 function is monitored.
18	SLS2 monitored	The SLS2 function is monitored. (from SM301 V1.1)
19	SLS3 monitored	The SLS3 function is monitored. (from SM301 V1.1)
20	SLS4 monitored	The SLS4 function is monitored. (from SM301 V1.1)
21	SDIpos is monitored	The SDIpos function is active, the compliance with the direction of movement is monitored. (As of SM301 V1.3)
22	SDIneg is monitored	The SDIneg function is active, the compliance with the direction of movement is monitored. (As of SM301 V1.3)
23	SSE active	The SSE function is monitored. When the stopping time has elapsed, the STO or SS1 bit is set according to the emergency stop function parameterised.
24	SD-In1	Sensor at I1A and I1B Channels A and B are in the ON state
25	SD-In2	Sensor at I2A and I2B Channels A and B are in the ON state
26	SD-In3	Sensor at I3A and I3B Channels A and B are in the ON state
27	SD-In4	Sensor at I4A and I4B Channels A and B are in the ON state
29	OMS active	Special operation is not active. (from SM301 V1.1)
31	Error active	Error status (i.e trouble or warning) is active.

Tab. 1-12 Detailed specification of the PROFIsafe input data

Status byte

For the PROFIsafe V1 mode only the indicated bits of the PROFIsafe status byte are supported:

Assignment	Bit							
Byte	7	6	5	4	3	2	1	0
4	-	-	-	FV_activated	COM-Failure WD-Timeout	COM-Failure CRC	-	-

Tab. 1-13 Structure of the PROFIsafe status byte in V1 mode

Bit coding - status byte		
Bit	Name	Description
2	COM-Failure CRC	Status after communication error is active.
3	COM-Failure WD-Timeout	Status after time-out is active.
4	FV_activated	The PROFIsafe input data is deactivated.
	-	Reserved for future extensions

Tab. 1-14 Detailed specification of the status byte in V1 mode

For the PROFIsafe V2 mode only the indicated bits of the PROFIsafe status byte are supported:

Assignment	Bit							
Byte	7	6	5	4	3	2	1	0
4	-	cons_nr_R	Toggle_d	FV_activated	WD_timeout	CE_CRC	-	-

Tab. 1-15 Structure of the PROFIsafe status byte in V2 mode

Bit coding - status byte		
Bit	Name	Description
2	CE_CRC	Status after communication error is active.
3	WD_timeout	Status after time-out is active.
4	FV_activated	The PROFIsafe input data is deactivated.
5	Toggle_d	Change shows increase of the consecutive number.
6	cons_nr_R	Consecutive number has been reset.
	-	Reserved for future extensions

Tab. 1-16 Detailed specification of the status byte in V2 mode

PROFIsafe parameters

These PROFIsafe parameters and contents are supported:

PROFIsafe parameters		
Name	**Description**	**Valid contents**
F_Source_Add	PROFIsafe source address of the safety PLC	0x01 ... 0xFFFE
F_Dest_Add	PROFIsafe target address of the safety module	
	DIP switch:	0x01 ... 0x03FF
	Code:	0x01 ... 0xFFFE
F_WD_Time	PROFIsafe monitoring time of the safety module	110 ... 65535 ms
F_Check_SeqNo	Check sequence no. in CRC	
	V1 mode:	0
	V2 mode:	not relevant
F_Check_iPar	Check iparameters CRC3 in CRC	0
F_SIL	Supported SIL (Safety Integrity Level)	
	SIL1:	0
	SIL2:	1
	SIL3:	2
F_CRC_Length	Length of CRC	
	V1 mode/2-byte-CRC:	1
	V2 mode/3-byte-CRC:	0
F_Block_ID	Identification of the parameter type	0
F_Par_Version	Version of the safety layer	
	V1 mode:	0
	V2 mode:	1
F_Par_CRC	Cyclic CRC	Is calculated

Tab. 1-17 Supported PROFIsafe parameters

Diagnostic messages

Incorrect configurations of the PROFIsafe parameters are reported to the safety PLC by means of a diagnostic telegram (📖 PROFIBUS or PROFINET Communication Manual).

Diagnostic information

Error number	Description
64	The PROFIsafe target address set does not comply with the parameter F_Dest_Add.
65	The F_Dest_Add parameter has the invalid value 0x0000 or 0xFFFF.
66	The F_Source_Add parameter has the invalid value 0x0000 or 0xFFFF.
67	The F_WD_Time parameter has the invalid value 0 ms.
68	The F_SIL parameter does not have the valid value 0 ... 2.
69	The F_CRC_Length parameter does not have the valid value 1.
70	The version of the PROFIsafe parameter set is wrong.
71	CRC1 error

Tab. 1-18 Information contents of byte 11

More error messages are listed in the appendix.

GSE file

The GSE file contains all information on the configuration of the PROFIBUS system. This makes the integration easy and user-friendly.



Tip!

You will find the current GSE file for this Lenze product in the Internet in the ”Downloads” area under

http://www.Lenze.com

GSDML file

The GSDML file contains all information on the configuration of the PROFINET system (As of SM301 V1.1). This makes the integration easy and user-friendly.



Tip!

You will find the current GSDML file for this Lenze product on the Internet in the ”Downloads” area under

http://www.Lenze.com

1.7 Safe parameter setting

Note!

During online communication via bus system, multiple users can access the very same drive at the same time and edit the safe parameter set. After the safe parameter set has been transmitted, please check if the checksums (CRC) of the parameter set, memory module, and safety module in the ”Safe transfer” dialog are consistent.

The consistency of the safe parameters must be ensured by organisational measures because there are no technical means to avoid multiple users accessing parameter sets at the same time.

1.7.1 Parameter setting

Safety-relevant parameters can exclusively be transmitted to the safety module by safe parameter setting. The parameter set is saved in the memory module and safety module with a definite module ID which must comply with the effective safety address in the safety module.

A safe parameter setting requires the service status. The service status means the following:

- The standard stop is active and the drive is safely switched to torqueless operation (STO).
- The communication via the safety bus is active but passivated.

About the service status:

- It can be activated by the Lenze »Engineer« PC software.
- It can be quit by reinitialising the module, i.e. the communication via the safety module is interrupted.

Note!

The service status also occurs if the parameter set in the memory module does not comply with the parameter set in the safety module during initialisation.

Observe the information on compatibility of the SM301 firmware versions (📖 20).

1.7.1.1 Parameter setting with the Lenze »Engineer« PC software

Safe parameter setting is supported by the Lenze PC software »Engineer« as of version 1.4.

The parameter setting is described in the Software Manual for the SM301 safety module. Moreover, the software provides a comprehensive Online Help.

Password

For storing a safe parameter set, a password is required. The standard password is: ”Lenze SM301”. The password can be changed and must have at least six characters.

Use ”general reset” to delete the safe parameter set in the memory module and the safety module. The safety module must be reparameterised.
The password is reset to the standard ”Lenze SM301”.

1.7.1.2 Parameter set transfer from the memory module

The safe parameter set transfer is supported by a safe parameter set stored in the memory module, e.g. in case of a module exchange.

- A valid parameter set with a corresponding module ID must be stored.
- The safety module must be in the service status.

The transfer of the parameter set from the memory module must be acknowledged at the safety module.

- The ”MS” LED is flashing (safety module is in service status.)
- ”AS” LED is lit
- Press module switch S82 and keep it pressed
- ”AS” LED starts blinking
- When the ”AS” LED goes off, release the S82 module switch immediately
- The ”AS” LED is lit again after a short time
- Press again the S82 module switch and keep it pressed
- ”AS” LED starts blinking
- When the ”AS” LED goes off, release the S82 module switch immediately
- The parameter set transfer is completed successfully.

If system-related response times (approx. 2.5 s) cannot be complied with, the parameter transfer is cancelled. The process must be started again.

In case of success, the parameter transfer is recorded in the logbook of the standard device and the service status is quit by a software restart.

If the parameter set is invalid, an error is indicated and the ”ME” LED is blinking.



Fig. 1-12 Acknowledgement procedure

AS	AS light-emitting diode
S82	S82 module switch
t	Time axis
t_{max}	Maximum permissible response time

1.7.2 Parameter sets and axes

The individuality of an axis with safety functions in a drive system can be achieved by means of the safety address. In the safe parameter set a module ID is stored. This module ID is compared to the effective safety address (C15112) in the safety module.

When a safety module is initialised, i.e. when the parameter set is loaded, the compliance of the safety address will be checked. If no compliance exists, an initialisation error is reported.

Note!

- ► Clearly define the safety address in a drive system or plant.
- ► Document the address in circuit diagrams and labels.
- ► Ensure identical settings when replacing the module.

In drive systems with activated safety bus the safety address is also used as safety bus target address. The clear assignment of the safety address must be configured in the safety PLC.

In drive systems without activated safety bus, individuality and correct assignment of the safety address must be checked. For this, use the Lenze »Engineer« PC software or an E94AZK... keypad.

Codes

Parameter:	Name:		Data type:	Index:
C15112	**Effective safety address**		UNSIGNED_16	$9463_d = 24F7_h$
Address used in safety module				
Display area (min. value | unit | max. value)			**Information**	
1		65534		
☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				

1.8 Error management

1.8.1 Error states

Detected errors or maloperation of the drive are assigned to error statuses with definite reactions. The reaction can be co-ordinated with the complete drive via the error statuses.

Features	Error status		
	System error	Trouble	Warning
Event	Fatal internal error	Fault	Monitoring function
LED "ME"	On	Blinking	Flashing
Status of safety module	Lockout (CPU stopped)	Error status	Normal operation
The control category according to EN ISO 13849-1 ...	... has been abandoned	... has been abandoned	... has not been abandoned
Response	The motor immediately switches to torque-free operation via ● STO	The motor is stopped via ● STO or ● SS1	
Acknowledgement after deactivated event	● Connection and disconnection of the 24-V supply at the safety module	● Fault acknowledgement (AIE) via terminal X82.2 (positive signal pulse with a signal time of 0.3 ... 10 s) ● Fault acknowledgement (AIE) via the safety bus (Bit "PS_AIE") ● Connection and disconnection of the 24-V supply at the safety module	

Tab. 1-19 Overview of error statuses

More error messages are listed in the appendix.

Note!

If the system fault also occurs after switching the 24-V supply, please contact the service.

When using PROFIsafe as safety bus:

► If faults occur in the PROFIsafe communication, the data is passivated by the PROFIsafe driver.

► After the PROFIsafe communication is reinitialised, the drive is automatically enabled again if no standstill function is selected.

► Events which cause an error status are sent as diagnostic telegram via the safety bus.

1.8.2 Logbook function in the controller

Error states are saved in the logbook of the standard device. The following is entered:

- Type of response (e.g. trouble, warning, or information) to the event
- Date/time (in case of memory module with real-time clock)
- Value of the power-on time meter

The available logbook entries can be displayed in the »Engineer« when an online connection has been established.

The list of the error entries can be found in the appendix.

1.8.3 Logbook function in the SM301

For diagnostic purposes, a simple logbook with ten entries is implemented in the SM301 V1.4. Here, changes regarding the request of safety functions in the SM301 are logged. The basis for the logbook is the bit-coded log state generated in a 2-ms cycle. A logbook is generated every time the log state changes.

- The logbook function can be controlled via the ”Log function” (C15891).
  – The parameter can be written without using the safe parameter setting interface.
- A logbook entry consists of the two corresponding subcodes of the parameters ”Log time” (C15892) and ”Log state” (C15893).



Note!

Before the display parameters of the logbook are read for diagnostic purposes, the logbook function should be stopped in order to prevent inconsistency (C15891 = 1).

Codes

Parameter:	Name:		Data type:	Index:
C15890	**Current time**		UNSIGNED_32	$8685_d = 21ED_h$
Relative time for use in logbook.				
Display area (min. value | unit | max. value)			**Information**	
0	ms	4294967295	(From SM301 V1.4)	
☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				

C15891	Log function	UNSIGNED_8	$8684_d = 21EC_h$
Setting of the logging behaviour (trigger condition). (From SM301 V1.4)			

Selection list		Information
0	**Logging is active**	Logging is always active.
1	Logging is stopped	Logging is switched off.
2	Stop logging in case of error	Logging is stopped if an error occurs.
3	Stop logging in case of STO	Logging is stopped if STO occurs.
4	Stop logging in case of SS1	Logging is stopped if SS1 occurs.
5	Stop logging in case of SS2	Logging is stopped if SS2 occurs.

☑ Read access ☑ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

Parameter:	Name:		Data type:	Index:
C15892	**Log time**		UNSIGNED_32	$8683_d = 21EB_h$
Time of log entry.				
Display area (min. value | unit | max. value)			**Information**	
0	ms	4294967295	(From SM301 V1.4)	
Subcodes			**Information**	
C15892/1			Log time n	
C15892/2			Log time n-1	
...				
C15892/10			Log time n-9	
☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				

C15893	**Log state**		BITFIELD_64	$8682_d = 21EA_h$
Logged state				
Display area			**Information**	
-	-	-	(As of SM301 V1.4)	
Value is bit-coded			**Information**	
Bit 0	Bit-coded log states		Detailed information can be found in the appendix	
...				
Bit 63				
Subcodes			**Information**	
C15893/1			Log state n	
C15893/2			Log state n-1	
...				
C15893/10			Log state n-9	
☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				

1.9 Response times

In order to detect the response time to a safety function the entire system must be considered. The following is relevant:

- Response time of the connected sensors.
- Input delay of the safety inputs.
- Internal processing time.
- When using PROFIsafe as safety bus:
  – Monitoring time for the cyclic service in the PROFIBUS/PROFINET.
  – Monitoring time of the PROFIsafe in the safety PLC.
  – Processing time in the safety PLC.
- Delay times due to further components.

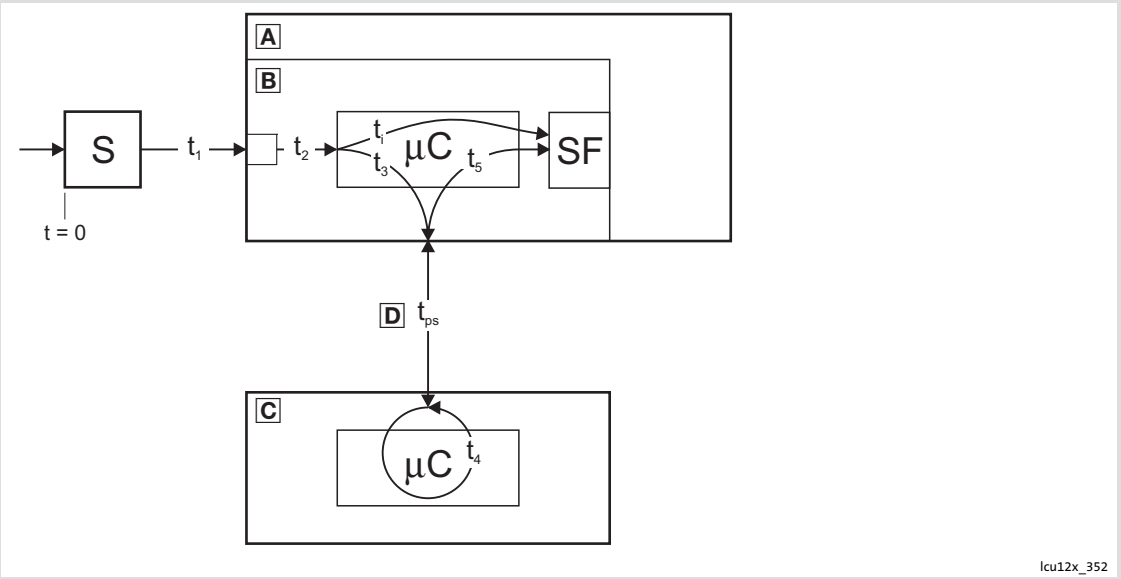


Fig. 1-13 Response times to the request of a safety function

A Standard device
B Safety module
C Safety PLC
D Safety bus
µC Microcontroller
S Safety sensor technology
SF Activated safety function

1.9.1 Response times of the inputs

Response time to an event in the sensors			
Time interval (Fig. 1-13)			[ms]
t_1	Response time of the sensors		according to manufacturer information
t_2	Input delay of the safe inputs		
		C15034:	**0** ... 100
		Input error:	2
t_i	Processing time in drive-based safety		4
	Safety function starts after ...		Σ

Tab. 1-20 Response time to an event in the sensors

1.9.2 Response time of the safe output

Response time of the safe output to a safety function		
		[ms]
	Safe output SD-Out1 switches to ...	4

Tab. 1-21 Response time - safe output

1.9.3 Response times of the safety bus

PROFIsafe

Response time to an event in the safety sensors (PROFIsafe input data)			
Time interval (Fig. 1-13)			[ms]
t_1	Response time of the sensors		according to manufacturer information
t_2	Input delay of the safe inputs		
		C15034:	**0** ... 100
		Input error:	2
t_3	Processing time in drive-based safety		24
	PROFIsafe input data ready for transmission to ...		Σ
t_{Ps}	PROFIsafe cycle time		according to manufacturer information
	PROFIsafe input data ready for processing in the safety PLC ...		Σ

Tab. 1-22 Response time to an event in the sensors

Response time to a PROFIsafe control word (PROFIsafe output data)		
Time interval (Fig. 1-13)		[ms]
t_4	Processing time in the safety PLC	must be calculated
t_{Ps}	PROFIsafe cycle time	according to manufacturer information
t_5	Processing time in drive-based safety	14
	Safety function starts after ...	Σ

Tab. 1-23 Response time in case of PROFIsafe request

Information on how to calculate the processing time and transmission time of the PROFIsafe can be found in the documentation of the safety PLC used.

Note!

When the PROFIsafe communication is disturbed, it is changed to the fail-safe state after the PROFIsafe monitoring time (F_WD_Time) has elapsed (📖 Tab. 1-17). The PROFIsafe communication is passivated.

Example

- After an event has occurred at a safe input, the message is fed back to drive-based safety via the safety PLC.
- Drive-based safety activates a safety function.
- Hence, the maximum response time to the event is calculated as follows:

  $t_{max\ response} = t_1 + t_2 + t_3 + \max\{t_{WD}; t_{PS} + t_4 + t_{Ps} + t_5\}$

When calculating the maximum response time, include the times of the safety functions, e.g. in case of SS1 the stopping time (C15305) until STO is active.

1.9.4 Response time of encoder monitoring

Response time of encoder monitoring			
			[ms]
	Time required to detect faults due to continuous signal errors at the encoder interface.		12
		(As of SM301 V1.2) can be parameterised under C15410	12/50/100

Note!

The minimum response time must be individually determined for each system.

A longer response time leads to an increased system availability, if, for instance, during machine set-up with safe operating stop process-related speed jumps occur for a short time.

1.10 Acceptance

1.10.1 Description

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

Inspector

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

Test report

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



Note!

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

Scope of test

A complete test comprises the following:

- Documenting the plant including the safety functions:
  - Creating an overview screen of the plant
  - Describing the plant
  - Describing the safety equipment
  - Documenting the safety functions used
- Checking the function of the safety functions used:
  - ”Safe torque off” function, STO
  - ”Safe stop 1” function, SS1
  - ”Safe stop 2” function, SS2
  - ”Safe operating stop” function, SOS
  - ”Safe maximum speed” function, SMS
  - ”Safely limited speed” function, SLS
  - ”Safe stop emergency” function, SSE
  - ”Safe direction” function, SDI
  - ”Safely limited increment” function, SLI
- Preparing the test report:
  - Documenting the functional test
  - Checking the parameters
  - Signing the test report
- Preparing the appendix with test records:
  - Protocols from the plant
  - External recording

1.10.2 Periodic inspections

The correct sequence of the safety-oriented functions must be checked in periodic inspections. The risk analysis or applicable regulations determine the time distances between the tests. The inspection interval should not exceed one year.

1.11 Module internal codes

This chapter contains all parameters of the SM301 safety module in numerically ascending order.

- Standard values are printed in bold type or with the ”Lenze:” addition.
- The write access is marked with ⚠ if the codes can only be set via the safe parameter setting.

Parameter:	Name:	Data type:	Index:
C15000	**Status of safety functions**	BITFIELD_32	9575_d = 2567h

Bit coded status word of the safety functions

Value is bit coded:		Information
Bit 0	STO active	Safe torque off
Bit 1	SS1 active	Safe stop 1
Bit 2	SS2 active	Safe stop 2
Bit 3	SLS1 active	Safely limited speed 1
Bit 4	SLS2 active	Safely limited speed 2 (From SM301 V1.1)
Bit 5	SLS3 active	Safely limited speed 3 (From SM301 V1.1)
Bit 6	SLS4 active	Safely limited speed 4 (From SM301 V1.1)
Bit 7	SDIpos is active	Safe direction, positive (From SM301 V1.3)
Bit 8	SDIneg is active	Safe direction, negative (From SM301 V1.3)
Bit 9	ES active	Safe enable switch
Bit 10	SLI is active	Safely limited increment (From SM301 V1.4)
Bit 11	OMS	Safe operation mode selector
Bit 12	Reserved	
...		
Bit 15	Reserved	
Bit 16	SOS monitored	Safe operational stop is monitored.
Bit 17	SLS1 monitored	Safely limited speed 1 is monitored.
Bit 18	SLS2 monitored	Safely limited speed 2 is monitored. (From SM301 V1.1)
Bit 19	SLS3 monitored	Safely limited speed 3 is monitored. (From SM301 V1.1)
Bit 20	SLS4 monitored	Safely limited speed 4 is monitored. (as of SM301 V1.1)
Bit 21	SDIpos is monitored	Safe positive direction is monitored. (From SM301 V1.3)
Bit 22	SDIneg is monitored	Safe negative direction is monitored. (From SM301 V1.3)
Bit 23	SSE active	Emergency stop function
Bit 24	SD-In1 active	Safe input
Bit 25	SD-In2 active	Safe input
Bit 26	SD-In3 active	Safe input
Bit 27	SD-In4 active	Safe input
Bit 28	Reserved	
Bit 29	OMS active	Special operation is active (as of SM301 V1.1)
Bit 30	Reserved	
Bit 31	Error active	

☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

Parameter:	Name:	Data type:	Index:
C15003	**Command status**	UNSIGNED_16	$9572_d = 2564_h$

Status of the current command.
- In high byte the command is repeated.
- In low byte the status is displayed:
  0x00: no command
  0x01: command executed
  0x02: password invalid
  0x03: command in process
  0x04: command unknown
  0x05: command error

Display area (min. value | unit | max. value)			**Information**
0		2309	

☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15010	**Parameter set status**	UNSIGNED_8	$9565_d = 255D_h$

Status of the parameter set

Selection list (read only)		**Information**
0	No parameter set	
1	Parameter set valid	
2	Read error - memory module	
3	Parameter set dissimilar	
4	CRC error	
5	Version error	
6	Format error	
7	Plausibility error	
8	Assignment error	
9	Local read error	
10	Communication error GG	

☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15011	**Parameter CRC**	UNSIGNED_32	$9564_d = 255C_h$

Parameter checksum (CRC = Cyclic Redundancy Code)

Display area (min. value | unit | max. value)			**Information**
0		4294967295	

Subcodes	**Information**
C15011/1	CRC safety module
C15011/2	CRC memory module

☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15013	**Time for parameter set creation**	UNSIGNED_64	$9562_d = 255A_h$

Time of parameter set creation

Display area (min. value | unit | max. value)			**Information**
0		1844674407370 96E+19	

☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15014	**Time - RTC parameter setting**	VISIBLE_STRING	$9561_d = 2559_h$

Time of parameter set transfer from the memory module as a value of the real-time clock (RTC).

☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15015	**Time sec. parameter setting**	UNSIGNED_32	$9560_d = 2558_h$

Time of parameter set transfer from the memory module as a value of the power-on time meter from the controller.

Display area (min. value | unit | max. value)			**Information**
0	S	4294967295	

☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

Parameter:	Name:	Data type:	Index:
C15016	**Parameter set version**	UNSIGNED_8	$9559_d = 2557_h$

Display of the parameter set version in the safety module.

Selection list (read only)		**Information**
0	No current parameter set	(From SM301 V1.1)
1	Parameter set V1.0	
2	Parameter set V1.1	
3	Parameter set V1.2	(From SM301 V1.2)
4	Parameter set V1.3	(From SM301 V1.3)
5	Parameter set V1.4	(From SM301 V1.4)

☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15017	**Stored module ID**	UNSIGNED_16	$9558_d = 2556_h$

Module ID stored in the safety module

Display area (min. value | unit | max. value)			**Information**
0		65535	(As of SM301 V1.2) Default setting (invalid ID): 0 Stored ID defective: 65535

☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15030	**SD-In sensor type**	UNSIGNED_8	$9545_d = 2549_h$

Configuration of the sensor types which are connected to the safe inputs.

Selection list (Lenze setting bold)		**Information**
0	**Input deactivated**	
1	Passive sensor	
2	Active sensor	

Subcodes		**Information**
C15030/1		SD-In1 sensor type
C15030/2		SD-In2 sensor type
C15030/3		SD-In3 sensor type
C15030/4		SD-In4 sensor type

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15031	**SD-In sensor function**	UNSIGNED_8	$9544_d = 2548_h$

Function configuration of the safe inputs.

- The ”operation mode selector” and ”enable switch” functions may only be assigned to one of the four safe inputs.

Selection list (Lenze setting printed in bold)		**Information**
0	**Free assignment**	Safety function set in C15032
1	Emergency stop	Safe stop emergency function (SSE)
2	Operation mode selector	Safe operation mode selector (OMS)
3	Enable switch	Safe enable switch (ES)

Subcodes		**Information**
C15031/1		SD-In1 sensor function
C15031/2		SD-In2 sensor function
C15031/3		SD-In3 sensor function
C15031/4		SD-In4 sensor function

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

Parameter:	Name:	Data type:	Index:
C15032	**SD-In free assignment**	UNSIGNED_8	$9543_d = 2547_h$

Assignment of a safety function to a safe input.
- Only possible if the "free assignment" sensor function is set for the safe input in C15031.

Selection list (Lenze setting printed in bold)		**Information**
0	**STO**	Safe torque off
1	SS1	Safe stop 1
2	SS2	Safe stop 2
3	SLS1	Safely limited speed 1
4	SLS2	Safely limited speed 2 (from SM301 V1.1)
5	SLS3	Safely limited speed 3 (from SM301 V1.1)
6	SLS4	Safely limited speed 4 (from SM301 V1.1)
7	SDIpos	Safe positive direction (from SM301 V1.3)
8	SDIneg	Safe negative direction (from SM301 V1.3)
9	No function	No (local) safety function assigned. ● Functional test and monitoring of the discrepancy time are active. ● The input status is transferred to the control via the safety bus (if parameterised).

Subcodes	**Information**
C15032/1	Free assignment SD-In1
C15032/2	Free assignment SD-In2
C15032/3	Free assignment SD-In3
C15032/4	Free assignment SD-In4

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15033	**SD-In discrepancy time**	UNSIGNED_16	$9542_d = 2546_h$

Maximum time in which both channels of a safe input may have non-equivalent states without the safety engineering causing an error response.

Setting range (min. value | unit | max. value)			**Information**
0	MS	30000	Lenze: 10, increment: 2 ms

Subcodes	**Information**
C15033/1	SD-In1 discrepancy time
C15033/2	SD-In2 discrepancy time
C15033/3	SD-In3 discrepancy time
C15033/4	SD-In4 discrepancy time

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15034	**SD-In input delay**	UNSIGNED_8	$9541_d = 2545_h$

Time between the recognition of the signal change and the effective evaluation of an input signal. As a result, multiple and short signal changes due to contact bounce of the components are not taken into account.

Setting range (min. value | unit | max. value)			**Information**
0	MS	100	Lenze: 0, increment: 2 ms

Subcodes	**Information**
C15034/1	Input delay SD-In1
C15034/2	Input delay SD-In2
C15034/3	Input delay SD-In3
C15034/4	Input delay SD-In4

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

Parameter:	Name:	Data type:	Index:
C15035	**CAS: Cascading**	UNSIGNED_8	$9540_d = 2544_h$

Safe cascading

Selection list (Lenze setting bold)		**Information**
0	**No cascading**	(As of SM301 V1.1)
4	Cascading with SD-In4	

☑ Read access ⚠ Write access ☐ CINH ☐ PLC-STOP ☐ No transfer

C15036	**CAS: Stop delay**	UNSIGNED_16	$9539_d = 2543_h$

Circulation time of safe cascading

Display area (min. value | unit | max. value)			**Information**
0	MS	65535	(As of SM301 V1.1) ● Display of the time that passes from switching the SD-Out1 output to OFF state to the detection of the OFF state at the SD-In4 input. This information may be helpful for system commissioning/maintenance. ● If ”0 ms” is displayed after a stop, another safety module has activated the stop via the cascade. ● The time is displayed until the next system acknowledgement.

☑ Read access ☐ Write access ☐ CINH ☐ PLC-STOP ☐ No transfer

C15040	**Input image**	BITFIELD_32	$9535_d = 253F_h$

Input image of the external module inputs of the safety module, shown in channels.

Value is bit coded:		**Information**
Bit 0	SD-In1 channel A	Safe input 1
Bit 1	SD-In1 channel B	
Bit 2	SD-In2 channel A	Safe input 2
Bit 3	SD-In2 channel B	
Bit 4	SD-In3 channel A	Safe input 3
Bit 5	SD-In3 channel B	
Bit 6	SD-In4 channel A	Safe input 4
Bit 7	SD-In4 channel B	
Bit 8	reserved	
...		
Bit 15	reserved	
Bit 16	AIE	AIE input (fault acknowledgement)
Bit 17	AIS	AIS input (restart acknowledgement)
Bit 18	Module switch	
Bit 19	reserved	
...		
Bit 31	reserved	

☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

Parameter:	Name:	Data type:	Index:
C15051	**SD-Out condition**	BITFIELD_32	$9524_d = 2534_h$

Bit coded selection of the conditions for switching the safe output.

Value is bit coded:		**Information**
Bit 0	STO active	Safe torque off
Bit 1	STO active neg. logic	
Bit 2	SS1 active	Safe stop 1
Bit 3	SS1 active neg. logic	
Bit 4	SS2 active	Safe stop 2
Bit 5	SS2 active neg. logic	
Bit 6	SLS1 active	Safely limited speed 1
Bit 7	SLS1 active neg. logic	
Bit 8	SLS2 active	Safely limited speed 2 (From SM301 V1.1)
Bit 9	SLS2 active neg. logic	
Bit 10	SLS3 active	Safely limited speed 3 (From SM301 V1.1)
Bit 11	SLS3 active neg. logic	
Bit 12	SLS4 active	Safely limited speed 4 (as of SM301 V1.1)
Bit 13	SLS4 active neg. logic	
Bit 14	SDIpos is active	Safe direction, positive (From SM301 V1.3)
Bit 15	SDIpos active neg. logic	
Bit 16	SDIneg is active	Safe direction, negative (From SM301 V1.3)
Bit 17	SDIneg active neg. logic	
Bit 18	ES active	Safe enable switch
Bit 19	ES active neg. logic	
Bit 20	SLI is active	Safely limited increment (From SM301 V1.4)
Bit 21	SLI active neg. logic	
Bit 22	OMS	Safe operation mode selector
Bit 23	OMS neg. logic	
Bit 24	Reserved	
...		
Bit 31	Reserved	

Subcodes		**Information**
C15051/1		SD-Out1 switching condition

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

Parameter:	Name:	Data type:	Index:
C15052	**SD-Out condition**	BITFIELD_32	$9523_d = 2533_h$

Bit coded selection of the conditions for switching the safe output.

Value is bit coded:		**Information**
Bit 0	SOS monitored	Safe operational stop is monitored.
Bit 1	SOS monitors neg. logic	Safe operational stop is not monitored.
Bit 2	SLS1 monitored	Safely limited speed 1 is monitored.
Bit 3	SLS1 monitored neg. logic	Safely limited speed 1 is not monitored.
Bit 4	SLS2 monitored	Safely limited speed 2 is monitored. (from SM301 V1.1)
Bit 5	SLS2 monitors neg. logic	Safely limited speed 2 is not monitored. (from SM301 V1.1)
Bit 6	SLS3 monitored	Safely limited speed 3 is monitored. (from SM301 V1.1)
Bit 7	SLS3 monitors neg. logic	Safely limited speed 3 is not monitored. (from SM301 V1.1)
Bit 8	SLS4 monitored	Safely limited speed 4 is monitored. (from SM301 V1.1)
Bit 9	SLS4 monitors neg. logic	Safely limited speed 4 is not monitored. (from SM301 V1.1)
Bit 10	SDIpos monitored	Safe positive direction is monitored. (from SM301 V1.3)
Bit 11	SDIpos monitors neg. logic	Safe positive direction is not monitored. (from SM301 V1.3)
Bit 12	SDIneg monitored	Safe negative direction is monitored. (from SM301 V1.3)
Bit 13	SDIneg monitors neg. logic	Safe negative direction is not monitored. (from SM301 V1.3)
Bit 14	SSE active	Emergency stop function
Bit 15	SSE active neg. logic	
Bit 16	SD-In1 active	Safe inputs
Bit 17	SD-In1 active neg. logic	
Bit 18	SD-In2 active	
Bit 19	SD-In2 active neg. logic	
Bit 20	SD-In2 active	
Bit 21	SD-In2 active neg. logic	
Bit 22	SD-In4 active	
Bit 23	SD-In4 active neg. logic	
Bit 24	Reserved	
Bit 25	Reserved	
Bit 26	OMS active	Special operation is active (from SM301 V1.1)
Bit 27	OMS active neg. logic	Special operation is not active (from SM301 V1.1)
Bit 28	Reserved	
Bit 29	Reserved	
Bit 30	Error active	
Bit 31	Error active neg. logic	

Subcodes		**Information**
C15052/1		SD-Out1 switching condition

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15055	**SD-Out logic function**	UNSIGNED_8	$9520_d = 2530_h$

Selection of the logic operation for the switching conditions to be evaluated

Selection list (Lenze setting bold)		**Information**
0	**OR**	
1	AND	

Subcodes		**Information**
C15055/1		SD-Out1 logic function

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

Parameter:	Name:	Data type:	Index:
C15060	**Output image**	BITFIELD_16	$9515_d = 252B_h$

Output image of the safety module feedback, shown in channels.

Value is bit coded:		**Information**
Bit 0	SD-Out1 channel A	Safe output 1
Bit 1	SD-Out1 channel B	
Bit 2	reserved	
...		
Bit 15	reserved	

☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15100	**S bus: Configuration**	UNSIGNED_8	$9475_d = 2503_h$

Configuration of the safety bus

Selection list (Lenze setting bold)		**Information**
0	**No safety bus**	
1	PROFIsafe / PROFIBUS	
2	PROFIsafe / PROFINET	(As of SM301 V1.1)

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15101	**Display - DIP switch position**	UNSIGNED_16	$9474_d = 2502_h$

Display of the DIP switch position

Display area (min. value | unit | max. value)			**Information**
0		1023	

☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15111	**Safety address**	UNSIGNED_16	$9464_d = 24F8_h$

Safety address parameterised in the safety module

Setting range (min. value | unit | max. value)			**Information**
0		65534	Lenze: 0

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15112	**Effective safety address**	UNSIGNED_16	$9463_d = 24F7_h$

Address used in safety module

Display area (min. value | unit | max. value)			**Information**
1		65534	

☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

Parameter:	Name:	Data type:	Index:
C15113	**S-Bus: Filter control data**	BITFIELD_32	$9462_d = 24F6_h$

Bit coded selection of the active bit positions in the safety bus control data

Value is bit coded:		**Information**
Bit 0	STO	Safe torque off
Bit 1	SS1	Safe stop 1
Bit 2	SS2	Safe stop 2
Bit 3	SLS1	Safely limited speed 1
Bit 4	SLS2	Safely limited speed 2 (From SM301 V1.1)
Bit 5	SLS3	Safely limited speed 3 (From SM301 V1.1)
Bit 6	SLS4	Safely limited speed 4 (From SM301 V1.1)
Bit 7	SDIpos	Safe positive direction (From SM301 V1.3)
Bit 8	SDIneg	Safe negative direction (From SM301 V1.3)
Bit 9	ES	Safe enable switch
Bit 10	Reserved	
Bit 11	OMS	Safe operation mode selector
Bit 12	Reserved	
...		
Bit 15	Reserved	
Bit 16	PS_AIS	Restart acknowledgement via safety bus
Bit 17	PS_AIE	Fault acknowledgement via safety bus
Bit 18	Reserved	
...		
Bit 22	Reserved	
Bit 23	SSE	Emergency stop function
Bit 24	SD-Out1	Safe output
Bit 25	Reserved	
...		
Bit 31	Reserved	

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

Parameter:	Name:	Data type:	Index:
C15115	**S-bus: Control data display**	BITFIELD_32	$9460_d = 24F4_h$

Display of safety bus control data after filtering via C15113

Value is bit coded:		**Information** (From SM301 V1.2)
Bit 0	STO	Safe torque off
Bit 1	SS1	Safe stop 1
Bit 2	SS2	Safe stop 2
Bit 3	SLS1	Safely limited speed 1
Bit 4	SLS2	Safely limited speed 2
Bit 5	SLS3	Safely limited speed 3
Bit 6	SLS4	Safely limited speed 4
Bit 7	SDIpos	Safe positive direction (From SM301 V1.3)
Bit 8	SDIneg	Safe negative direction (From SM301 V1.3)
Bit 9	ES	Safe enable switch
Bit 10	Reserved	
Bit 11	OMS	Safe operation mode selector
Bit 12	Reserved	
...		
Bit 15	Reserved	
Bit 16	PS_AIS	Restart acknowledgement via safety bus
Bit 17	PS_AIE	Fault acknowledgement via safety bus
Bit 18	Reserved	
...		
Bit 22	Reserved	
Bit 23	SSE	Emergency stop function
Bit 24	SD-Out1	Safe output
Bit 25	Reserved	
...		
Bit 31	Reserved	

☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15200	**OMS: Stop function**	UNSIGNED_8	$9375_d = 249F_h$

Selection of the stop function in special operation

Selection list (Lenze setting bold)		**Information**
0	**STO**	Safe torque off
1	SS1	Safe stop 1
2	SS2	Safe stop 2

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15201	**OMS: motion function**	UNSIGNED_8	$9374_d = 249E_h$

Selection of the motion function in special operation

Selection list (Lenze setting bold)		**Info**
3	SLS1	Safely limited speed 1 (Lenze setting up to SM301 V1.3)
4	SLS2	Safely limited speed 2 (From SM301 V1.1)
5	SLS3	Safely limited speed 3 (From SM301 V1.1)
6	SLS4	Safely limited speed 4 (as of SM301 V1.1)
11	**Free traversing**	(Lenze setting from SM301 V1.4)

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

Parameter:	Name:	Data type:	Index:
C15202	**OMS: Function at LOW level**	UNSIGNED_8	$9373_d = 249D_h$

Function that is executed in case of LOW level at the safe input with OMS function.
Caution: According to the closed-circuit principle, the parameterisation must not cause any additional danger.

Selection list (read only)		**Information**
0	**Normal operation**	(From SM301 V1.3)
1	Special operation	

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15203	**SLI: Safely lim. increment**	UNSIGNED_32	$9372_d = 249C_h$

Number of increments for safely limited increment

Setting range (min. value | unit | max. value)			**Information**
0	Incr.	2147483647	Lenze: 1, deactivate: 0 (From SM301 V1.4)

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15204	**SLI: Amount of position change**	UNSIGNED_32	$9371_d = 249B_h$

Maximum position change while SLI is active.

Display area (min. value | unit | max. value)			**Information**
0	Incr.	2147483647	(From SM301 V1.4)

☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15205	**SSE: Safe stop emergency function**	UNSIGNED_8	$9370_d = 249A_h$

Selection of the stop function for emergency stop

Selection list (Lenze setting printed in bold)		**Information**
0	**STO**	Safe torque off
1	SS1	Safe stop 1

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15300	**Restart behaviour**	UNSIGNED_8	$9275_d = 243B_h$

Behaviour for restart after functions have been cancelled

Selection list (Lenze setting bold)		**Information**
0	**Acknowledged restart**	
1	Automatic restart	

Subcodes		**Information**
C15300/1		Restart - STO, SS1
C15300/2		Restart - SS2, SOS

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15305	**SS1, SS2: Stopping time**	UNSIGNED_16	$9270_d = 2436_h$

Stopping time for the SS1 and SS2 safety functions

Setting range (min. value | unit | max. value)			**Information**
0	MS	30000	Lenze: 0, increment: 2 ms

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15306	**SS1 mode**	UNSIGNED_8	$9269_d = 2435_h$

Selection list (Lenze setting bold)		**Information**
0	STO after stopping time	(From SM301 V1.3)
1	**STO at n = 0**	

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15307	**SS1: Deceleration STO after n=0**	UNSIGNED_16	$9268_d = 2434_h$

Display area (min. value | unit | max. value)			**Information**
0	ms	30000	Lenze: 0, increment: 2 ms (From SM301 V1.3)

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

Parameter:	Name:	Data type:	Index:
C15308	**SS2 mode**	UNSIGNED_8	$9267_d = 2433_h$

Selection whether SS2 is to be executed already after reaching n=0 SOS or only after reaching the parameterised stopping time.

Selection list (Lenze setting bold)		**Information**
0	**SOS after stopping time**	(As of SM301 V1.3)
1	SOS at n = 0	

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15310	**Tolerance window (n=0)**	INTEGER_16	$9265_d = 2431_h$

Safely monitored tolerance window for zero speed

Setting range (min. value | unit | max. value)			**Information**
0	rpm	16000	Lenze: 0

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15311	**SOS: Tolerance window (Delta p=0)**	UNSIGNED_32	$9264_d = 2430_h$

Safely monitored tolerance window for zero position change

Display area (min. value | unit | max. value)			**Information**
0	Incr.	327680	Lenze: 0 (From SM301 V1.3)

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15312	**SOS: Maximum change in position**	UNSIGNED_32	$9263_d = 242F_h$

Amount of the maximum change in position while SOS was active

Display area (min. value | unit | max. value)			**Information**
0	Incr.	2147483647	(From SM301 V1.3)

☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15315	**SS1, SS2: ramp monitoring**	UNSIGNED_8	$9260_d = 242C_h$

Selection whether the brake ramp is to be monitored when SS1 and SS2 are executed.

Selection list (Lenze setting bold)		**Information**
0	No ramp monitoring	(From SM301 V1.4)
1	**Ramp monitoring is activated**	

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15316	**SS1, SS2: S-ramp time**	UNSIGNED_8	$9259_d = 242B_h$

S-ramp time of deceleration ramp for SS1 and SS2 if a linear ramp is not used.

Setting range (min. value | unit | max. value)			**Information**
0	%	100	0 (From SM301 V1.4)

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15317	**SS1, SS2: Start offset ramp**	UNSIGNED_8	$9258_d = 242A_h$

Speed offset at the start of the ramp monitoring.

Display area (min. value | unit | max. value)			**Information**
0	%	30	0 (From SM301 V1.4)

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15320	**SMS: Max. speed Nmax**	INTEGER_16	$9255_d = 2427_h$

Selection of the maximum speed and activation of the SMS function

Setting range (min. value | unit | max. value)			**Information**
0	rpm	16000	Lenze: 1, deactivate: 0

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

Parameter:	Name:	Data type:	Index:
C15321	**SMS: Response (n>Nmax)**	UNSIGNED_8	$9254_d = 2426_h$

Response to the exceeding of the set maximum speed

Selection list (Lenze setting bold)		**Information**
0	STO	Safe torque off
1	**SS1**	Safe stop 1
2	SS2	Safe stop 2

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15330	**SLS: Limited speed Nlim**	UNSIGNED_16	$9245_d = 241D_h$

Setting of the limited speed

Setting range (min. value | unit | max. value)			**Information**
0	rpm	16000	Lenze: 0

Subcodes	**Information**
C15330/1	SLS1: Limited speed Nlim1
C15330/2	SLS2: Limited speed Nlim2 (As of SM301 V1.1)
C15330/3	SLS3: Limited speed Nlim3 (As of SM301 V1.1)
C15330/4	SLS4: Limited speed Nlim4 (As of SM301 V1.1)

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15331	**SLS: Braking time Nlim**	UNSIGNED_16	$9244_d = 241C_h$

Safely monitored time for braking the drive to the limited speed set in C15330.

Setting range (min. value | unit | max. value)			**Information**
0	MS	30000	Lenze: 0, increment: 2 ms

Subcodes	**Information**
C15331/1	SLS1: Braking time Nlim1
C15331/2	SLS2: Braking time Nlim2 (as of SM301 V1.1)
C15331/3	SLS3: Braking time Nlim3 (as of SM301 V1.1)
C15331/4	SLS4: Braking time Nlim4 (as of SM301 V1.1)

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15332	**SLS: Response (n>Nlim)**	UNSIGNED_8	$9243_d = 241B_h$

Response in the safety module to the exceeding of the limited speed

Selection list (Lenze setting bold)		**Information**
0	STO	Safe torque off
1	**SS1**	Safe stop 1
2	SS2	Safe stop 2

Subcodes	**Information**
C15332/1	SLS1: Response (n>Nlim1)
C15332/2	SLS2: Response (n>Nlim2) (as of SM301 V1.1)
C15332/3	SLS3: Response (n>Nlim3) (as of SM301 V1.1)
C15332/4	SLS4: Response (n>Nlim4) (as of SM301 V1.1)

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

Parameter:	Name:	Data type:	Index:
C15333	**SLS: Permissible direction of movement**	UNSIGNED_8	$9242_d = 241A_h$

Permissible direction of movement during SLS monitoring

Selection list (Lenze setting printed in bold)		**Information**
0	**Both directions enabled**	
1	Positive direction enabled	
2	Negative direction enabled	

Subcodes	**Information**
C15333/1	SLS1: Permissible direction of movement (from SM301 V1.3)
C15333/2	SLS2: Permissible direction of movement (from SM301 V1.3)
C15333/3	SLS3: Permissible direction of movement (from SM301 V1.3)
C15333/4	SLS4: Permissible direction of movement (from SM301 V1.3)

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15340	**SDI: Monitoring - normal operation**	UNSIGNED_8	$9235_d = 2413_h$

Setting of the monitoring of the direction of movement of the motor during normal operation

Selection list (read only)		**Information**
0	**Both directions enabled**	(From SM301 V1.3)
1	Positive direction enabled	
2	Negative direction enabled	

☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15341	**SDI: Deceleration time**	UNSIGNED_16	$9234_d = 2412_h$

Safely monitored time from activation to switching on the monitoring SDIpos/SDIneg

Display area (min. value | unit | max. value)			**Information**
0	ms	30000	(From SM301 V1.3)

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15342	**SDI: Tolerance threshold**	UNSIGNED_32	$9233_d = 2411_h$

Setting of the tolerance threshold by how many increments the motor may move towards the direction inhibited through SDI

Display area (min. value | unit | max. value)			**Information**
0	Incr.	327680	(From SM301 V1.3)

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15343	**SDI: Error response**	UNSIGNED_8	$9232_d = 2410_h$

Response to a violation of the permitted direction of movement of the motor

Selection list (read only)		**Information**
0	STO	(From SM301 V1.3)
1	**SS1**	
2	SS2	

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15344	**SDI: Maximum change in position**	UNSIGNED_32	$9231_d = 240F_h$

Maximum change in position in inhibited direction if SDI is active

Display area (min. value | unit | max. value)			**Information**
0	Incr.	2147483647	

Subcodes	**Information**
C15344/1	SDIpos: Maximum change in position (from SM301 V1.3)
C15344/2	SDIneg: Maximum change in position (from SM301 V1.3)

☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

Parameter:	Name:	Data type:	Index:
C15350	**SLS, SMS: Max. response time**	UNSIGNED_16	$9225_d = 2409_h$

Maximum time after an exceeded speed has been detected, after which the speed must be below the limit again.

Setting range (min. value | unit | max. value)			**Information**
0	MS	30000	Lenze: 0, increment: 2 ms

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15400	**Motor encoder system**	UNSIGNED_8	$9175_d = 23D7_h$

Selection of the encoder system connected

Selection list (Lenze setting printed in bold)		**Information**
0	No encoder system	
1	**Sin/cos encoder**	"Sin/cos encoder" is used instead of the entries "sine/cosine encoder" and "absolute value encoder (Hiperface)" of code C00422 of the 9400 standard device.
2	Resolver	

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15401	**Motor encoder status**	UNSIGNED_8	$9174_d = 23D6_h$

Status of the encoder evaluation

Selection list (read only)		**Information**
0	Valid	Encoder data is valid
1	Fault	Encoder data is invalid

☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15402	**Actual speed value n_safe**	INTEGER_16	$9173_d = 23D5_h$

Display of the current speed calculated from the safety module

Display area (min. value | unit | max. value)			**Information**
-16000	rpm	16000	With invalid encoder data (C15401 = 1) 32767 is displayed.

☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15405	**Internal actual speed value**	INTEGER_16	$9170_d = 23D2_h$

Internal actual speed values of SM301.

Display area (min. value | unit | max. value)			**Information**
-16000	rpm	16000	(As of SM301 V1.4) With invalid encoder data (C15401 = 1) 32767 is displayed.

Subcodes		**Information**
C15405/1	-	Internal actual speed value nSM detected from motor position.
C15405/2	-	Internal actual speed value nGG detected from position data of the standard device.

☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15409	**Motor mounting direction**	UNSIGNED_8	$9166_d = 23CE_h$

Setting of the motor mounting direction.

Selection list (Lenze setting bold)		**Information**
0	**Motor rotating clockwise**	(From SM301 V1.4)
1	Motor rotating counter-clockwise	

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

Parameter:	Name:	Data type:	Index:
C15410	**Response time of encoder monitoring**	UNSIGNED_8	$9165_d = 23CD_h$

Max. internal time after which encoder errors lead to a system response

Selection list		Information
0	**12 ms**	(As of SM301 V1.2) (From SM301 V1.4: Resolver is sole encoder ➞ 50 or 100 ms)
10	50 ms	
20	100 ms	

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15411	Tolerance of speed comparison	UNSIGNED_16	$9164_d = 23CC_h$

Tolerance of the speed comparison in the safety module

Display area (min. value | unit | max. value)			Information
0	rpm	16000	(From SM301 V1.3)

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15420	Number of increments - sin/cos encoder	UNSIGNED_16	$9155_d = 23C3_h$

Number of increments of the sin/cos encoder used

Setting range (min. value | unit | max. value)			Information
1		16384	Lenze: 1

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15430	Number of pole pairs of resolver	UNSIGNED_8	$9145_d = 23B9_h$

Number of pole pairs of the used resolver

Setting range (min. value | unit | max. value)			Information
1		10	Lenze: 1 (From SM301 V1.3)

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15500	Position encoder system	UNSIGNED_8	$9075_d = 2373_h$

Setting of the connected position encoder system

Selection list (read only)		Information
0	**No position encoder**	(From SM301 V1.3)
1	Analog encoder (Sin-Cos/TTL)	
2	Digital encoder (SSI/BUS)	

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15501	Position encoder - gearbox factor	UNSIGNED_16	$9074_d = 2372_h$

Setting of the gearbox factor between motor and position encoder

Display area (min. value | unit | max. value)			Information
20	%	50000	Lenze: 100 (From SM301 V1.3) 100 ≡ i = 1.00 2543 ≡ i = 25.43

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15502	Position encoder - mounting direction	UNSIGNED_8	$9073_d = 2371_h$

Setting of the mounting direction of the position encoder regarding the motor encoder

Selection list (read only)		Information
0	**Like motor encoder**	(From SM301 V1.3) If the mounting directions of the motor (C02527/0) and position encoder (C02529/0) in the standard device are set in different directions of rotation, this parameter must be set to "inverted to the motor encoder".
1	Inverted to the motor encoder	

☑ Read access ⚠ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

Parameter:	Name:	Data type:	Index:
C15800	**Current error type**	UNSIGNED_8	$8775_d = 2247_h$

Type of the currently pending error

Selection list (read only)		**Information**
0	No error	
1	Warning	
2	Trouble	

☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15801	**Error history**	UNSIGNED_16	$8774_d = 2246_h$

for Lenze service

Selection list (read only)			**Information**
-	-	-	(As of SM301 V1.2)

Subcodes		**Information**
C15801/1	-	Error history 1
...		
C15801/8	-	Error history 8

☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15805	**Service code**	UNSIGNED_32	$8770_d = 2242_h$

for Lenze service

Selection list (read only)			**Information**
-	-	-	(From SM301 V1.2)

Subcodes		**Information**
C15805/1	-	-
C15805/2	-	-
C15805/3	-	-

☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15810	**Service code**	UNSIGNED_32	$8765_d = 223D_h$

for Lenze service

Selection list (read only)			**Information**
-	-	-	(From SM301 V1.2)

Subcodes		**Information**
C15810/1	-	-
...		
C15810/11	-	-

☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15815	**Service code**	UNSIGNED_16	$8760_d = 2238_h$

for Lenze service

Selection list (read only)			**Information**
-	-	-	(From SM301 V1.3)

☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15820	**Internal actual position value**	INTEGER_32	$8755_d = 2233_h$

for Lenze service

Selection list (read only)			**Information**
-	-	-	(From SM301 V1.3)

Subcodes		**Information**
C15820/1	-	Internal actual position value pSM
C15820/2	-	Internal actual position value pGG

☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

Parameter:	Name:		Data type:	Index:
C15821	**Service code**		INTEGER_16	$8754_d = 2232_h$

for Lenze service: Currently monitored speed value of ramp monitoring.

Display area (min. value | unit | max. value)			**Information**
-16000	rpm	16000	Displayed value is only valid if SS1 or SS2 are active with ramp monitoring. (From SM301 V1.4)

☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15822	**Service code**		INTEGER_16	$8753_d = 2231_h$

for Lenze service: Minimum differences between actual speed value and monitored ramp.

Display area (min. value | unit | max. value)			**Information**
-16000	rpm	16000	The value is kept until the ramp monitoring is restarted. (From SM301 V1.4)

☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15890	**Current time**		UNSIGNED_32	$8685_d = 21ED_h$

Relative time for use in logbook.

Display area (min. value | unit | max. value)			**Information**
0	ms	4294967295	(From SM301 V1.4)

☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15891	**Log function**	UNSIGNED_8	$8684_d = 21EC_h$

Setting of the logging behaviour (trigger condition). (From SM301 V1.4)

Selection list		**Information**
0	**Logging is active**	Logging is always active.
1	Logging is stopped	Logging is switched off.
2	Stop logging in case of error	Logging is stopped if an error occurs.
3	Stop logging in case of STO	Logging is stopped if STO occurs.
4	Stop logging in case of SS1	Logging is stopped if SS1 occurs.
5	Stop logging in case of SS2	Logging is stopped if SS2 occurs.

☑ Read access ☑ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15892	**Log time**	UNSIGNED_32	$8683_d = 21EB_h$

Time of log entry.

Display area (min. value | unit | max. value)			**Information**
0	ms	4294967295	(From SM301 V1.4)

Subcodes	**Information**
C15892/1	Log time n
C15892/2	Log time n-1
...	
C15892/10	Log time n-9

☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer

C15893	**Log state**	BITFIELD_64	$8682_d = 21EA_h$

Logged state

Display area			**Information**
-	-	-	(From SM301 V1.4)

Value is bit-coded		**Information**
Bit 0	STO via SD-In	STO was triggered via a safe input.
Bit 1	STO via S-bus	STO was triggered via the safety bus.
Bit 2	STO through error	STO was triggered through an error.
Bit 3	Reserved	-

Parameter:	Name:		Data type:	Index:
C15893	**Log state**		BITFIELD_64	$8682_d = 21EA_h$
Bit 4	SS1 via SD-In	SS1 was triggered via a safe input.		
Bit 5	SS1 via S-bus	SS1 was triggered via the safety bus.		
Bit 6	SS1 through error	SS1 was triggered through an error.		
Bit 7	Reserved	-		
Bit 8	SS2 via SD-In	SS2 was triggered via a safe input.		
Bit 9	SS2 via S-bus	SS2 was triggered via the safety bus.		
Bit 10	SS2 through error	SS2 was triggered through an error.		
Bit 11	Reserved	-		
Bit 12	SLS1 via SD-In	SLS1 was triggered via a safe input.		
Bit 13	SLS1 via S-bus	SLS1 was triggered via the safety bus.		
Bit 14	SLS1 via OMS	SLS1 was triggered via the operating mode changeover.		
Bit 15	Reserved	-		
Bit 16	SLS2 via SD-In	SLS2 was triggered via a safe input.		
Bit 17	SLS2 via S-bus	SLS2 was triggered via the safety bus.		
Bit 18	SLS2 via OMS	SLS2 was triggered via the operating mode changeover.		
Bit 19	Reserved	-		
Bit 20	SLS3 via SD-In	SLS3 was triggered via a safe input.		
Bit 21	SLS3 via S-bus	SLS3 was triggered via the safety bus.		
Bit 22	SLS3 via OMS	SLS3 was triggered via the operating mode changeover.		
Bit 23	Reserved	-		
Bit 24	SLS4 via SD-In	SLS4 was triggered via a safe input.		
Bit 25	SLS4 via S-bus	SLS4 was triggered via the safety bus.		
Bit 26	SLS4 via OMS	SLS5 was triggered via the operating mode changeover.		
Bit 27	Reserved	-		
Bit 28	SDIpos via SD-In	SDIpos was triggered via a safe input.		
Bit 29	SDIpos via S-bus	SDIpos was triggered via the safety bus.		
Bit 30	SDIpos via SLS	SDIpos was triggered in combination with SLS.		
Bit 31	SDIpos in normal operation	SDIpos was triggered in normal operation.		
Bit 32	SDIneg via SD-In	SDIneg was triggered via a safe input.		
Bit 33	SDIneg via S-bus	SDIneg was triggered via the safety bus.		
Bit 34	SDIneg via SLS	SDIneg was triggered in combination with SLS.		
Bit 35	SDIneg in normal operation	SDIneg was triggered in normal operation.		
Bit 36	SLI is active	SLI was triggered in special operation.		
Bit 37	Reserved	-		
Bit 38	Reserved	-		
Bit 39	Reserved	-		
Bit 40	Special operation via SD-In	Special operation was triggered vi a safe input.		
Bit 41	Special operation via S-bus	Special operation was triggered via the safety bus.		
Bit 42	Reserved	-		
Bit 43	Reserved	-		
Bit 44	ES via SD-In	ES was triggered via a safe input.		
Bit 45	ES via S-bus	ES was triggered via the safety bus.		
Bit 46	Reserved	-		
Bit 47	Reserved	-		

Parameter:	Name:		Data type:	Index:
C15893	**Log state**		BITFIELD_64	$8682_d = 21EA_h$
Bit 48	FailSafeValues via control word	Safe replacement values on the safety bus were activated via the control word.		
Bit 49	FailSafeValues through error	Safe replacement values on the safety bus were activated through an error.		
Bit 50	Reserved	-		
Bit 51	Reserved	-		
Bit 52	SD-In1 active	The safe input SD-In1 has been switched on.		
Bit 53	SD-In2 active	The safe input SD-In2 has been switched on.		
Bit 54	SD-In3 active	The safe input SD-In3 has been switched on.		
Bit 55	SD-In4 active	The safe input SD-In4 has been switched on.		
Bit 56	Reserved	-		
...				
Bit 63	Reserved	-		
Subcodes		**Information**		
C15893/1		Log state n		
C15893/2		Log state n-1		
...				
C15893/10		Log state n-9		
☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				
C15900	**Firmware - product type**		VISIBLE_STRING	$8675_d = 21E3_h$
Display of the product type (E94AFAE)				
☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				
C15901	**Firmware - compilation date**		VISIBLE_STRING	$8674_d = 21E2_h$
Display of the compilation date				
☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				
C15902	**Firmware version**		VISIBLE_STRING	$8673_d = 21E1_h$
Software version of the firmware, e.g.: ”V1.0”				
☑ Read access ☐ Write access ☐ Controller inhibit ☐ PLC-STOP ☐ No transfer				

1.12 Module error messages

The Parameterisation & Configuration Software Manual provides information on diagnostics & fault analysis and describes the structure of the operating system's error messages in the logbook.

Entries

Field Error number		Description	Error type/response/ Note
Internal			
1	0x01	Internal error, STO is active	Replace safety module. Consultation with Lenze is required.
2	0x02	Internal error, SS1 is active	
3	0x03	Internal error, SS2 is active	
Communication - standard device			
16	0x10	Communication error - standard device (communication between standard device and SM301 cancelled)	Warning/STO
17	0x11	Synchronisation error - standard device	No error status Logbook entry/info
PROFIsafe			
33	0x21	Safety address is invalid (0 or 0xFFFF)	
34	0x22	PROFIsafe communication error	PROFIsafe passivated/- No error status No diagnostic telegram via PROFIBUS
35	0x23	F_WD_Time exceeded (PROFIsafe monitoring time activated)	
36	0x24	PROFIsafe deactivated	
37	0x25	PROFIsafe has quit Data Exchange	
38	0x26	PROFIsafe invalid data	
39	0x27	Error - F parameter (Wrong parameter setting of the F PLC)	PROFIsafe parameter setting/STO No error status
40	0x28	Communication error in parameter phase	
Inputs			
49	0x31	Error - discrepancy or functional test SD-In1	Trouble/- OFF state for the affected input
50	0x32	Error - discrepancy or functional test SD-In2	
51	0x33	Error - discrepancy or functional test SD-In3	
52	0x34	Error - discrepancy or functional test SD-In4	
53	0x35	Internal error AIS	
54	0x36	Internal error AIE	
55	0x37	Internal error - module switch	
57	0x39	Deactivated SD-In1 = high (Initialisation error, input in ON state)	Trouble/STO
58	0x3A	Deactivated SD-In2 = high	
59	0x3B	Deactivated SD-In3 = high	
60	0x3C	Deactivated SD-In4 = high	

Field		Description	Error type/response/ Note
Error number			
PROFIsafe			
64	0x40	F_Dest_Add does not equal F address	PROFIsafe parameter setting/STO No error status
65	0x41	F_Dest_Add = 0 or FFFFhex	
66	0x42	F_Source_Add = 0 or FFFFhex	
67	0x43	F_WD_Time is 0 msec	
68	0x44	F_SIL exceeds technical SIL	
69	0x45	F_CRC_Length error	
70	0x46	F parameter version incorrect	
71	0x47	PROFIsafe CRC1 error	
72	0x48	reserved (PROFIsafe standard)	-
73	0x49	reserved (PROFIsafe standard)	-
74	0x4A	reserved (PROFIsafe standard)	-
Test functions			
81	0x51	Error SD-Inx/CLx (internal short circuit in one of the inputs)	Trouble/- OFF state for all SD-In
82	0x52	Error SD-Inx/CLx (internal short circuit in one of the inputs)	
89	0x59	Short circuit SD-Out	
93	0x5D	Error - internal disconnecting path (internal error of the safe switch-off logic)	Trouble/STO OFF state for all SD-In and SD-Out
94	0x5E	Test pulse error - internal switch-off path (internal error of the safe switch-off logic)	Trouble/STO

Field		Description	Error type/response/ Note
Error number			
Safety functions			
97	0x61	SS1/SS2: Stopping time exceeded (The drive has not reached zero speed within the stopping time.)	Warning/STO
98	0x62	SLS1: Nlim1 exceeded (The drive has exceeded the limited speed.)	Warning/response can be set
99	0x63	SLS2: Nlim2 exceeded (The drive has exceeded the limited speed.)	Warning/response can be set
100	0x64	SLS3: Nlim3 exceeded (The drive has exceeded the limited speed.)	Warning/response can be set
101	0x65	SLS4: Nlim4 exceeded (The drive has exceeded the limited speed.)	Warning/response can be set
102	0x66	SLS/SMS: Error stop not executed (The drive has exceeded the limited speed or maximum speed and has not stopped the drive safely. Following error to no. 0x62 or 0x69)	Warning/STO
103	0x67	SDIpos: Wrong direction of movement	Warning/response can be set
104	0x68	SDIneg: Wrong direction of movement	
105	0x69	SMS: Nmax exceeded (The drive has exceeded the monitored maximum speed.)	Warning/response can be set
106	0x6A	SOS: Tolerance limit exceeded (The drive has exceeded a tolerance limit.)	Warning/STO
107	0x6B	No encoder system parameterised (SMS, SLS1 or SS2 are tried to be executed without an encoder being parameterised.)	Warning/STO
108	0x6C	CAS: Circulation time exceeded Maximum time between release and feedback of the cascading function has been exceeded.	Warning/STO
109	0x6D	CAS: Hardware or discrepancy error The cascading output has not been switched off quickly enough by the hardware or there is a discrepancy at the cascading input.	Warning/STO
110	0x6E	SS1/SS2: Speed ramp exceeded Monitoring of the speed ramp is activated. When the stop function SS1/SS2 is executed, the deceleration of the speed ramp is monitored. When the monitoring limits are exceeded, an error is reported.	Warning/STO
111	0x6F	SLI: Safely limited increment exceeded The safely limited increment is monitored in the special operation mode. The parameterised increment has been exceeded.	Warning/STO
Test functions - output			
128	0x80	Stuck at High SD-Out1, channel A (Short circuit (High))	Trouble/- SD-Out1: OFF state
129	0x81	Stuck at Low SD-Out1, channel A (Short circuit (Low))	
130	0x82	Stuck at High SD-Out1, channel B	
131	0x83	Stuck at Low SD-Out1, channel B	

Field		Description	Error type/response/ Note
Error number			
Test functions - inputs			
144	0x90	Stuck at High SD-In1, channel A (Short circuit (High)	Trouble/- SD-In1: OFF state
145	0x91	Stuck at High SD-In1, channel B	
146	0x92	Stuck at High SD-In2, channel A	Trouble/- SD-In2: OFF state
147	0x93	Stuck at High SD-In2, channel B	
148	0x94	Stuck at High SD-In3, channel A	Trouble/- SD-In3: OFF state
149	0x95	Stuck at High SD-In3, channel B	
150	0x96	Stuck at High SD-In4, channel A	Trouble/- SD-In4: OFF state
151	0x97	Stuck at High SD-In4, channel B	
154	0x9A	CLA/CLB short circuit Short circuit between the CLA and CLB clock outputs	Trouble/- SD-In: OFF state
Safe parameterisation			
160	0xA0	New parameter set deleted (by the safe parameter setting in the Engineer)	-/- Logbook entry: Info
161	0xA1	New safe parameter set loaded (by the safe parameter setting in the Engineer or the procedure with the module switch)	
162	0xA2	Memory module parameter set - access error (Error while accessing the parameter set of the memory module.)	Trouble/STO OFF state for all SD-In and SD-Out
163	0xA3	Different parameter sets (in the memory module and SM301)	
164	0xA4	No safe parameter set in the safety module (SM301 has no parameter set.)	
165	0xA5	Defective parameter set (SM301 parameter set is defective.)	
166	0xA6	Parameter set in memory module - format error (Format error in parameter set of memory module)	
167	0xA7	Parameter set - plausibility error	
168	0xA8	Parameter set - communication error (Communication error when loading the parameter set)	
169	0xA9	Module ID does not equal effective safety address (Module ID in the parameter set does not equal the effective safety address)	Warning/STO OFF state for all SD-In and SD-Out
Test functions - internal module			
192	0xC0	Reference voltage error	Trouble/STO OFF state for all SD-In and SD-Out
193	0xC1	6 V voltage error	
194	0xC2	5 V voltage error	
195	0xC3	2.6 V voltage error	
208	0xD0	Safe speed is invalid	Trouble/STO
209	0xD1	SSM: Encoder error	Trouble/STO
210	0xD2	SSM: Resolver error	Trouble/STO
211	0xD3	SSM: Standard device data error	Trouble/STO
212	0xD4	SSM: Speed comparison error	
213	0xD5	SSM: Synchronisation error	
214	0xD6	SSM: Wrong PDO version	Trouble/STO

Tab. 1-24 Description of the numerical entries

2 Appendix

2.1 Declarations of conformity

Lenze

2251756.03

EU-Konformitätserklärung — EU Declaration of Conformity

LENZE SE, Hans-Lenze-Strasse 1, 31855 Aerzen GERMANY

erklärt in alleiniger Verantwortung die Übereinstimmung der Produkte — declares under sole responsibility compliance of the products

E94xxxExxxxxxxxxxx (x=0-9/A-Z) &
SM301 - E94AYAE

mit der — with the

Maschinenrichtlinie
2006/42/EG Anhang VIII und IX
Angewandte harmonisierte Normen:

Machinery Directive
2006/42/EC Annex VIII and IX
Applied harmonized standards:

		EN 60204-1	**:2018**		
	Kategorie 3			Category 3	
	Performance Level (PL): PL e	**EN ISO 13849-1**	**:2015**	Performance Level (PL): PL e	
		EN 61508 1-7	**:2010**		
Sicherheitsfunktionen siehe Betriebsanleitung.	SIL 3	**EN 62061**	**:2005**	SIL 3	For safety functions see manual.
		+AC +A1 +A2	**:2010 :2013 :2015**		
		EN 61800-5-2	**:2017**		
		EN 61800-5-1 +A1	**:2007 :2017**		

Konformitätsbewertung

CE 0035

Benannte Stelle
Zertifikate
Gültigkeit

Conformity assessment
notified body TÜV Rheinland Industrie Service GmbH, Am Grauen Stein, 51105 Köln / Germany
Certificates 01/205/0718.02/20
Date of expiry 2025-01

EMV- Richtlinie
2014/30/EU
Angewandte harmonisierte Normen:

EMC Directive
2014/30/EU
Applied harmonized standards:

EN 61800-3:2004 + A1:2012
EN 61800-3:2018

RoHS- Richtlinie
2011/65/EU
Angewandte harmonisierte Normen:

RoHS Directive
2011/65/EU
Applied harmonized standards:

EN IEC 63000:2018

Die Sicherheitshinweise der Betriebanleitung sind zu beachten.

The safety instructions of the manual are to be considered.

Die Produkte sind bestimmt zum Einbau in Maschinen. Die Inbetriebnahme ist solange untersagt bis festgestellt wurde, dass die Maschine, in welche diese Produkte eingebaut werden sollen, den Bestimmungen der o.g. EU-Richtlinie entsprechen.

These products are intended for installation in machines. Operation is prohibited until it has been determined that the machines in which these products are to be installed, conforms to the above mentioned EU Directive.

Ort / Datum
Place / date

Aerzen 16.10.2020

Geschäftsführer
Managing Director

Dipl.-Ing. Frank Maier

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Lenze

2462938.00

UK Declaration of Conformity

LENZE SE, Hans-Lenze-Strasse 1, 31855 Aerzen GERMANY

declares under sole responsibility compliance of the products

E94xxxExxxxxxxxxx (x=0-9/A-Z) &
SM301 - E94AYAE

with the

The Supply of Machinery (Safety) Regulations 2008 — **S.I. 2008 No. 1597**

Applied designated standards:

Safe torque off	**EN 60204-1**	**:2018**		
	EN ISO 13849-1	**:2015**	Category 3 Performance Level: PL e	
For safety functions see manual.	**EN 61508 1-7**	**:2010**		
	EN 62061 +AC +A1 +A2	**:2005 :2010 :2013 :2015**	SIL 3	
	EN 61800-5-2	**:2007 + 2017**		
	EN 61800-5-1 + A1	**:2007 :2017**		

Conformity assessment

UK CA

notified body	TUV Rheinland UK Ltd 1011 Stratford Road Solihull, B90 4BN
Certificates	01/205U/0718.00/22
Date of expiry	2025-01

The Electromagnetic Compatibility Regulations 2016 — **S.I. 2016 No. 1091**

Applied designated standards:

EN 61800-3:2004 + A1:2012
EN IEC 61800-3:2018

The Ecodesign for Energy-Related Products and Energy Information Regulations 2021 — **S.I. 2021 No. 745**

Applied standards:

EN 61800-9-2:2017

The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012 — **S.I. 2012 No. 3032**

Applied designated standards:

EN IEC 63000:2018

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The safety instructions of the manual are to be considered.
These products are intended for installation in machines. Operation is prohibited until it has been determined that the machines in which these products are to be installed, conforms to the above mentioned Regulations.

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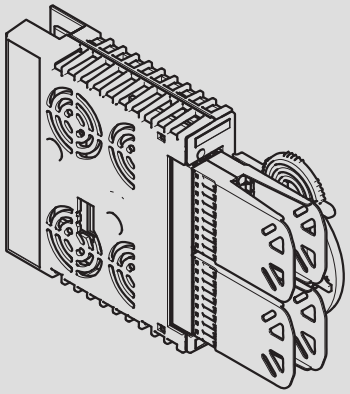
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EDS94AYAF
13523378

L-force *Drives*

Translation of the original operating instructions

9400



E94AYAF - SM302

Safety module

Lenze



Please read these instructions and the documentation of the standard device before you start working!
Observe the safety instructions given therein!

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1 Safety engineering

1.1 Basics

1.1.1 Introduction

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

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

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

1.1.2 Drive-based safety with L-force | 9400

The controllers of the L-force|9400 range can be equipped with a safety module. The functional range of the safety module types varies in order to optimally implement different applications.

”Drive-based safety” stands for applied safety functions, which can be used for the protection of persons working on machines.

The motion functions are continued to be executed by the controller. The safety modules monitor the safe compliance with the limit values and provide the safe inputs and outputs. When the limit values are exceeded the safety modules start the control functions according to EN 60204-1 directly in the controller.

The safety functions are suitable for applications according to IEC 61508 to SIL 3 or 4 and meet, depending on the module, the requirements of Performance Level e (PL e) and control category 4 according to EN ISO 13849-1.

1.1.3 Terms and abbreviations of the safety engineering

Abbreviation	Meaning
9400	Lenze servo controller
Cat.	Category according to EN ISO 13849-1 (formerly EN 954-1)
OSSD	Output Signal Switching Device, tested signal output
PS	PROFIsafe
PWM	Pulse width modulation
SD-In	Safe input (Safe Digital Input)
SD-Out	Safe output (Safe Digital Output)
SIL	Safety Integrity Level according to IEC 61508
SM	Safety module
Optocoupler supply	Optocoupler supply for the driver control
PELV	Protective extra low voltage
SELV	Safety extra low voltage
OFF state	Signal status of the safety sensor technology when it is released or responding
ON state	Signal status of the safety sensor technology in normal operation
PM	PN-switched signal paths
PP	PP-switched signal paths
GSE	File containing device-specific data to establish PROFIBUS communication
GSDML	File containing device-specific data to establish PROFINET communication
S-Bus	Safety bus

Abbreviation	Safety function
SLS	Safely limited speed
SLI	Safely limited increment
SOS	Safe operating stop
SS1	Safe stop 1
SS2	Safe stop 2
STO	Safe torque off Formerly: safe standstill
SMS	Safe maximum speed
SDI	Safe direction
SSE	Safe stop emergency
ES	Safe enable switch
OMS	Operation mode selector
AIE	Error acknowledgement (Acknowledge In Error)
AIS	Restart acknowledgement (Acknowledge In Stop)
SLP	Safely Limited Position
SCA	Safe Cam
PDSS	Position-dependent Safe Speed
FSoE	Fail Safe over EtherCAT
RMS	Repair Mode Select

1.1.4 Registered trademarks

Term / logo	Information
 	PROFINET® (Process Field Network) is a real-time capable fieldbus system based on Ethernet. PROFINET® is a registered trademark and patented technology, licensed by the PROFIBUS & PROFINET International (PI) user organisation. The certified safety protocol for transmitting safety-oriented data via PROFINET®.
 	EtherCAT® (Ethernet for Controller and Automation Technology) is an Ethernet-based fieldbus system meeting the application profile for industrial realtime systems. EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany. Safety over EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

1.1.5 Important notes

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

Pictograph and signal word	Meaning
 **Warnings!**	**Safety note or application note for the operation according to UL or CSA requirements.** The measures are required to meet the requirements according to UL or CSA.
 **Warnings!**	

1.1.6 Safety instructions

Application as directed

The safety modules SMx (E94AYAx) may only be used together with Lenze drive controllers of the L-force | 9400 (E94A... / E94B...) series.

Any other use shall be deemed inappropriate!

Installation/commissioning

Danger!

Danger to life through improper installation

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

Possible consequences:

► Death or severe injuries

Protective measures:

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

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

► It is essential to use insulated wire end ferrules for wiring.

► All safety relevant cables outside the control cabinet must be protected, e.g. by means of a cable duct:
  – Ensure that no short circuits can occur.
  – For further measures see EN ISO 138492.

► If an external force acts upon the drive axes, additional brakes are required. Please observe that hanging loads are subject to the force of gravity!

Danger!

When the request for the safety function is deactivated, the drive can restart automatically. The behaviour can be set via the parameter ”Restart behaviour” (C15300/1/2).

In the case of an automatic restart, you must provide external measures which ensure that the drive only restarts after an acknowledgement (EN 60204).

Danger!

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

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

During operation

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

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

Residual hazards

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

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

1.1.7 Hazard and risk analysis

This documentation can only accentuate the need for hazard analysis. The user of the integrated safety system must read up on standards and the legal situation:

Before the launch of a machine, the manufacturer of the machine must conduct a hazard analysis according to 2006/42/EC: Machinery Directive [UKCA: S.I. 2008/1597 - The Supply of Machinery (Safety) Regulations 2008] to determine the hazards associated with the application of the machine. The Machinery Directive refers to three basic principles for the highest possible level of safety:

- Hazard elimination / minimisation by the construction itself.
- Required protective measures must be taken against hazards which cannot be eliminated.
- Existing residual hazards must be documented and the user must be informed of them.

Detailed information on the hazard analysis procedure is provided in the DIN EN ISO 12100:2013-08 - ""Safety of machinery - General principles for design, risk assessment and risk reduction". The results of the hazard analysis determine the category for safety-related control systems according to EN ISO 13849-1. Safety-oriented parts of the machine control must be compliant.

1.1.8 Standards

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

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

1.1.9 Overview of sensors

Passive sensors

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

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

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

Examples of passive sensors:

- Door contact switch
- Emergency stop control units

Active sensors

Active sensors are units with 2-channel semiconductor outputs (OSSD outputs). With the integrated safety system of this device series, test pulses < 1 ms for monitoring the outputs and cables are permissible. The maximally permissible connection capacity of the outputs is to be observed. Active sensors are wired directly to the terminals of the integrated safety system. Monitoring for cross or short circuits must be carried out by the active sensor.

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

The outputs must switch simultaneously (equivalently). Nevertheless, safety functions will be activated as soon as at least one channel is switched. Active triggering of only one channel indicates faulty sensors or impermissible wiring.

Examples of active sensors:

- Lightgrid
- Laser scanner
- Control systems

Sensor inputs

For unused sensor inputs, ”Input deactivated” must be parameterised.

Connected deactivated sensors can create the false impression of safety technology being provided. For this reason, a deactivation of sensors by parameter setting only is not permissible and not possible. It is monitored that no sensor signal is pending.

1.2 Safety instructions for the installation according to UL/CSA

Original - English

Warnings!

- ► Secondary circuit shall supplied from an external isolating source.
- ► Maximum surrounding air temperature: 55 °C.

Original - French

Avertissement !

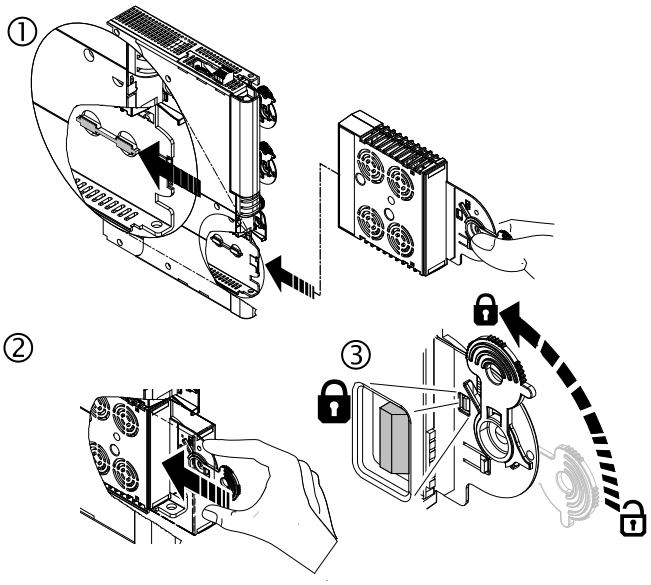
- ► Prévoir un circuit auxiliaire alimenté par une source de tension avec isolation galvanique.
- ► Température ambiante maximale : 55 °C.

1.3 Device modules

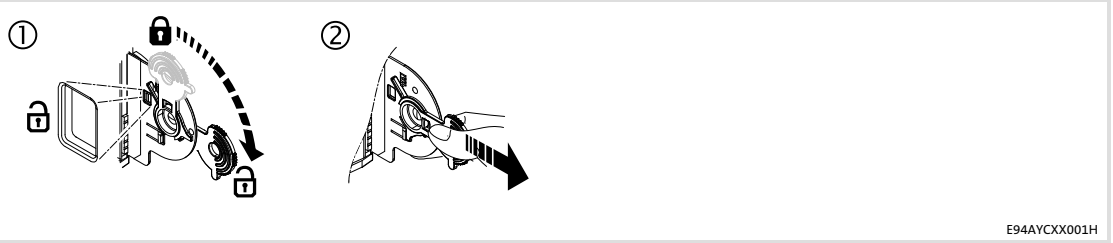
1.3.1 Slot

The slot for the safety modules is marked in the documentation with M4. It is the lowest slot in the controller (see overview in the documentation of the controller).

1.3.1.1 Mounting



1.3.1.2 Dismounting



1.3.1.3 Module exchange

Stop!

Before mounting/dismounting, switch off the supply voltage to prevent electronic modules from damage.

Every module exchange is detected by the standard device and documented in a logbook.

When a module is replaced by the same type, no restrictions arise. Depending on the module type it may be necessary to take further measures (e.g. address setting, safe parameter setting, ...).

When the module is replaced by a different type, the drive is inhibited by the controller. The inhibit can only be deactivated when the parameter setting of the required safety module complies with the plugged safety module.

Note!

In case you exchange the module, the address switch Ⓐ must be set identically to the module to be replaced. Only then the corresponding safe parameter set can be transferred to the module.

1.3.2 Function mode of the safety modules

Disconnecting paths

The transmission of the pulse width modulation is safely disconnected by the safety module. Hence the drivers do not create a rotating field. The motor is safely switched to torqueless operation (STO).

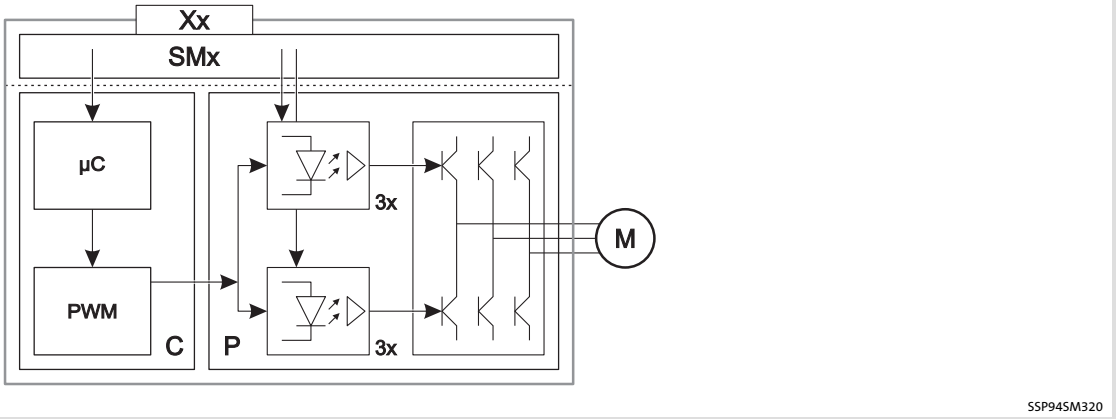


Fig. 1-1 Disconnecting paths of the safety modules

SMx	Safety module
xx	Input / output terminal
C	Control section
µC	Microcontroller
PWM	Pulse width modulation
P	Power section
M	Motor

Safety status

When the controller is switched off by the safety module, the controller switches to the ”Safe torque off”device state.

► ”Controller in STO state” is entered into the logbook (0x00750003).

► ”Safe torque off active” is displayed in C00183.

Fail-safe status

Note!

If internal errors of the safety modules are detected, the motor is safely switched to torque-free operation (fail-safe status).

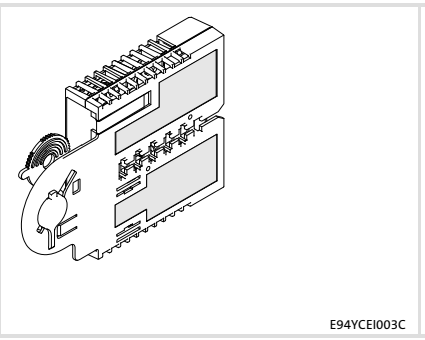
1.3.3 SM302 safety module

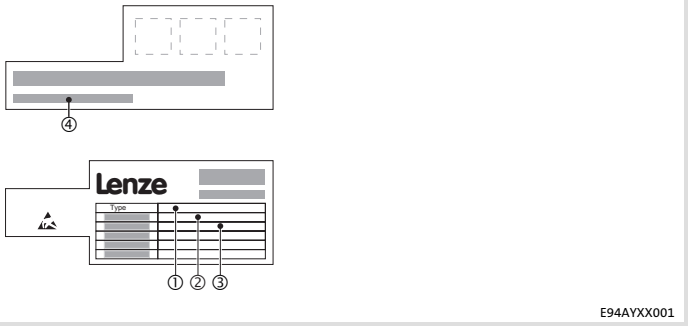
Validity information

This documentation is valid for:

SM302 safety module		
Type	**HW**	**SW**
E94AYAF	from VA	As of 1.0

Identification





	①					②	③	④
	E94	**A**	**Y**	**A**	**x**	**xx**	**xx**	**nn**
Product series								
Version								
Module identification: Device module								
Module type: Safety module								
Design A = SM0 B = SM100 E = SM301 F = SM302								
Hardware version								
Software version (SM30x only)								
Serial number								

Application range

The use of this module is permissible with standard devices of the 9400 product series from nameplate designation

Type	HW	SW
E94AxHExxxx	2A	13.xx
E94BSHExxxx	PA	-
E94AxPExxxx	2A	07.xx
E94BSPExxxx	PA	-

The use of this module is permissible with the PROFINET® communication module from nameplate designation

Type	HW	SW
E94AYCER	VF	03.xx

The use of this module is permissible with the EtherCAT® communication module from the nameplate designation

Type	HW	SW
E94AYCET	VF	04.xx

Note!

A safety bus system can only be operated via the upper module slot (MXI1) of the Servo Drive 9400.

1.3.3.1 Overview

Functions from SM302 V1.0 onwards

- Safe torque off (STO)
  (formerly: safe standstill, protection against unexpected start-up)
- Safe stop 1 (SS1)
- Safe stop 2 (SS2) - see SOS
- Safe stop emergency (SSE)
- Safe operational stop (SOS)
- Safe maximum speed (SMS)
- Safely limited speed 1 ... 4 (SLS1 ... SLS4)
- Safe direction (SDI)
- Safely limited increment (SLI)
- Safely limited position (SLP)
- Safe cam (SCA)
- Safe referencing (SREF)
- Safe speed and position monitoring
  – with resolver and encoder as motor encoder
  – or optionally with additional position encoder (2-encoder concept)
- Position-dependent safe speed (PDSS)
- Safe cascading (CAS) via SD-In4/SD-Out1
- Safety bus connection (PROFIsafe V2)
- Fail Safe over EtherCAT - Slave (FSoE))
- Safe operation mode selector (OMS)
- Repair mode select (RMS)
- Safe enable switch (ES)
- Safe monitor (safe output)
- Connection of safety sensors (safe inputs)
- Safe parameter setting
- Parameterisable response time of encoder monitoring

Compatibility

Compatibility of different SM302 versions

Replacement of an SM302 by an SM302 with a higher firmware version (SW):

- Every SM302 can be used with a safe parameter set of an elder firmware version without any changes.
- The safe parameter set including CRC in the memory module of the drive is not changed by the SM302 when the parameter set from the memory module is accepted.
- The CE Declaration of Conformity remains valid.
- Safe parameter sets of the ”SM302 safety module” component can be loaded into an SM302 with a higher firmware version without any changes.
  – Extended functionalities of the newer firmware version cannot be selected and executed.

The safe parameter set of an SM302 with a newer firmware version cannot be loaded into an SM302 with an elder firmware version.

1.3.3.2 Elements of the module

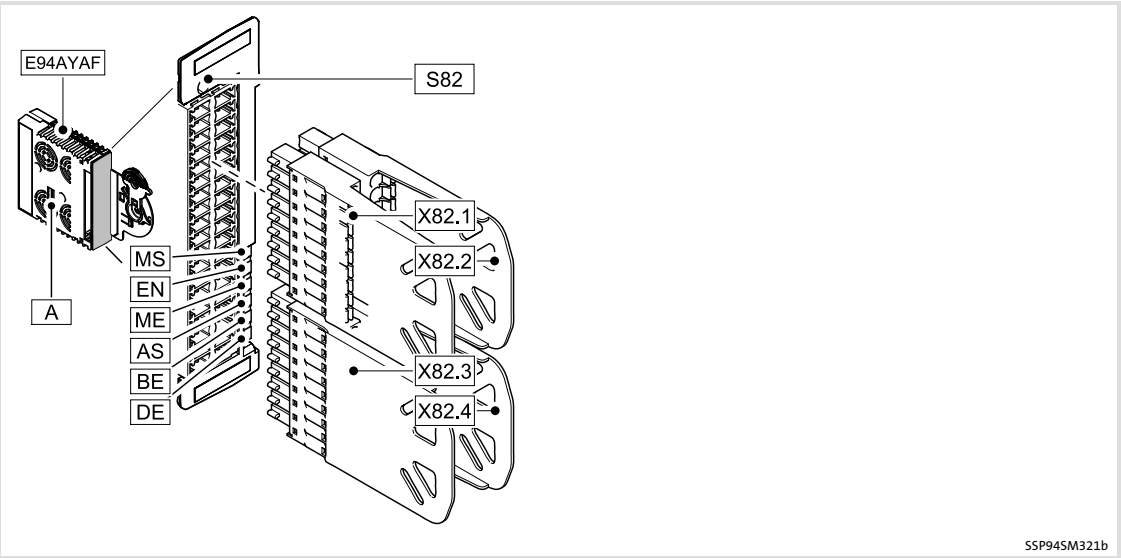


Fig. 1-2 Module view

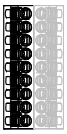
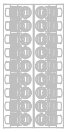
Pos.	Description
A	Safety address switch (in the left part of the housing)
S82	Module switch for parameter set adoption from the memory module
X82.1	Plug-in terminal strips for input and output signals
X82.2	
X82.3	
X82.4	

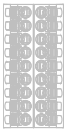
Displays

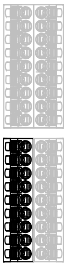
Pos.	Colour	State	Description
MS (Module State)	Green	On	Drive-based safety has initialised without a fault.
		Blinking	Drive-based safety has initialised without a fault. Internal communication to the standard device is not possible.
		Flashing	Drive-based safety is in service status. For exiting, parameterise the drive-based safety.
		Off	Drive-based safety is not initialised. Acknowledgement is not possible.
EN (Enable)	Yellow	On	Controller enabled
		Off	Non-safe display "STO"
ME (Module Error)	Red	On	System error
		Blinking	Trouble
		Flashing	Warning
		Off	Error-free operation
AS (Acknowledge Stop)	Yellow	On	Request of an acknowledgement for the restart or the parameter set adoption
		Blinking	SS1/STO active
		Flashing	SS2/SOS active
		Off	No stop function active
BE (Bus Error)	Red	On	Safety bus error: ● Communication is not possible. ● Acknowledgement is possible.
		Blinking	Safety bus error: no valid configuration.
		Off	Safety bus: error-free operation.
DE (Drive Error)	Red	On	Drive-based safety is not accepted by the standard device (see notes in the instructions for the standard device).
		Off	Drive-based safety is correctly recognised by the standard device.

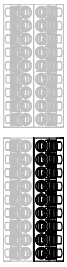
Blinking: on/off every 0.5 s Flashing: on/off every 0.1/0.9 s

Terminal assignment

X82.1	Labelling	Description
		This part of the terminal strip is not assigned.
	GO	GND SD-Out1
	O1B	Safe monitor SD-Out1, channel B
	O1A	Safe monitor SD-Out1, channel A
		This part of the terminal strip is not assigned.

X82.2	Labelling	Description
	-	GND external supply
	+	+24 V external supply via a safely separated power supply unit (SELV/PELV)
	GIR	This part of the terminal strip is reserved.
	RI1	
	GO	GND 24O
	24O	+24 V external supply for the safe monitor SD-Out1 (SELV/PELV)
	AIE	Error acknowledgement input (”Acknowledge In Error”)
	CLA	Clock output for passive sensors, channel A (Clock A)
	CLB	Clock output for passive sensors, channel B (Clock B)

X82.3	Labelling	Description
	GCL	GND clock output
	GI2	GND SD-In2
	I2B	Sensor input SD-In2, channel B
	I2A	Sensor input SD-In2, channel A
	GCL	GND clock output
	GI1	GND SD-In1
	I1B	Sensor input SD-In1, channel B
	I1A	Sensor input SD-In1, channel A
	AIS	Restart acknowledgement input (”Acknowledge In Stop”, 1-channel, bridged to X82.4/AIS)

X82.4	Labelling	Description
	GCL	GND clock output
	GI4	GND SD-In4
	I4B	Sensor input SD-In4, channel B
	I4A	Sensor input SD-In4, channel A
	GCL	GND clock output
	GI3	GND SD-In3
	I3B	Sensor input SD-In3, channel B
	I3A	Sensor input SD-In3, channel A
	AIS	Restart acknowledgement input (”Acknowledge In Stop”, 1-channel, bridged to X82.3/AIS)

Cable cross-sections and tightening torques				
Type	**[mm²]**	**[Nm]**	**AWG**	**[lb-in]**
Wire end ferrule, insulated	0.25 ... 0.75	Spring terminal	24 ... 18	Spring terminal
Rigid	0.14 ... 1.5		26 ... 16	

Stripping length or contact length: 9 mm

Insulated wire end ferrules according to DIN 46228, part 4, 0.5 mm² or 0.75 mm² - length L1 = 10 mm can be used.

Note!

Provide for a sufficient strain relief, so that the terminals are not pulled from the plug connectors, in particular when you use rigid cables.

1.3.3.3 Technical data

24 V supply

The module and the safe output must be supplied with 24 V from safely separated power supply units. If electrical isolation is required, separate voltage supplies must be used.

Detailed features of the 24-V supply					
Terminal	Specification	[Unit]	min.	typ.	max.
+, -	Supply voltage of the module via a safely separated power supply unit (SELV/PELV)	[V]	19.2	24	30
	Input current	[mA]			350
24O, GO	Supply voltage of the safe output via a safely separated power supply unit (SELV/PELV)	[V]	18	24	30
	Input current	[mA]			1100

Inputs and output

The inputs and the output are isolated and designed for a low-voltage supply of 24 V DC. The digital inputs are protected against polarity reversal.

Detailed features of the safe inputs and the safe output					
Terminal	Specification	[Unit]	min.	typ.	max.
I1A, I1B I2A, I2B I3A, I3B I4A, I4B AIE, AIS	PLC input, IEC-61131-2, 24 V, type 1				
	Low signal input voltage	V	-3	0	5
	Input current at low signal	mA			15
	High signal input voltage	V	15	24	30
	Input current at high signal	mA	2		15
	Input capacitance	nF			3.5
	Repetition rate of the test pulses	ms	50		
AIE, AIS	Input delay (operating time)	s	0.3		10
CLA, CLB	PLC output, IEC-61131-2, 24 V DC, 50 mA				
	Low signal output voltage	V		0	0.8
	High signal output voltage	V	17	24	30
	Output current	mA			60
	Cable capacity	nF			100
	Cable resistance of a passive sensor	Ω			200
O1A, O1B	PLC output, IEC-61131-2, 24 V DC				
	Low signal output voltage	V		0	0.8
	High signal output voltage	V	17	24	30
	Output current	mA			500
	Cable capacity	nF			100
	Cable resistance	Ω			200

Tab. 1-1 Technical data

The chapter ”Response times” must be observed as well (📖 1.9).

1.3.3.4 Safety-related characteristics

Safety-related characteristics		SM302	
		Value	Comment
Control category according to EN ISO 13849-1	Cat.	4	Category
Risk reduction according to EN ISO 13849-1	PL	E	Performance Level
Risk reduction according to EN 61508 and EN 62061	SIL	3	Safety Integrity Level
Probability of dangerous failure per hour	PFH	< E-9 1/h	< 1 % of SIL 3 Probability of dangerous Failure per Hour
Probability of dangerous failure via the test interval	PFD	< E-4	< 10 % of SIL 3 Probability of dangerous Failure on Demand
Safe failure fraction	SFF	99 %	Safe Failure Fraction
Proof test interval/mission time	t	20 years	Proof Test Interval/Mission Time
Mean operating time to failure	$MTTF_d$	High	250 years Mean Time To Failure dangerous
Average diagnostic coverage	DC_{av}	High	~ 95 % Diagnostic Coverage

► In order to comply with control category 4 according to EN ISO 13849-1, external wiring and cable monitoring must meet the requirements of category 4 (see chapter 1.3.5 and 1.3.6).

1.3.4 Mission time

The *mission time*) of the used component must be observed and complied with.
The given mission time is counted from the manufacturing date. The manufacturing dates can be read out using the Lenze »Engineer« PC software. These can be found in the parameter list within the ”Identification” column.

Note!

After the mission time of a component has elapsed, the component must be taken out of service or replaced. Any further operation is not permissible!

1.3.4.1 Example circuit

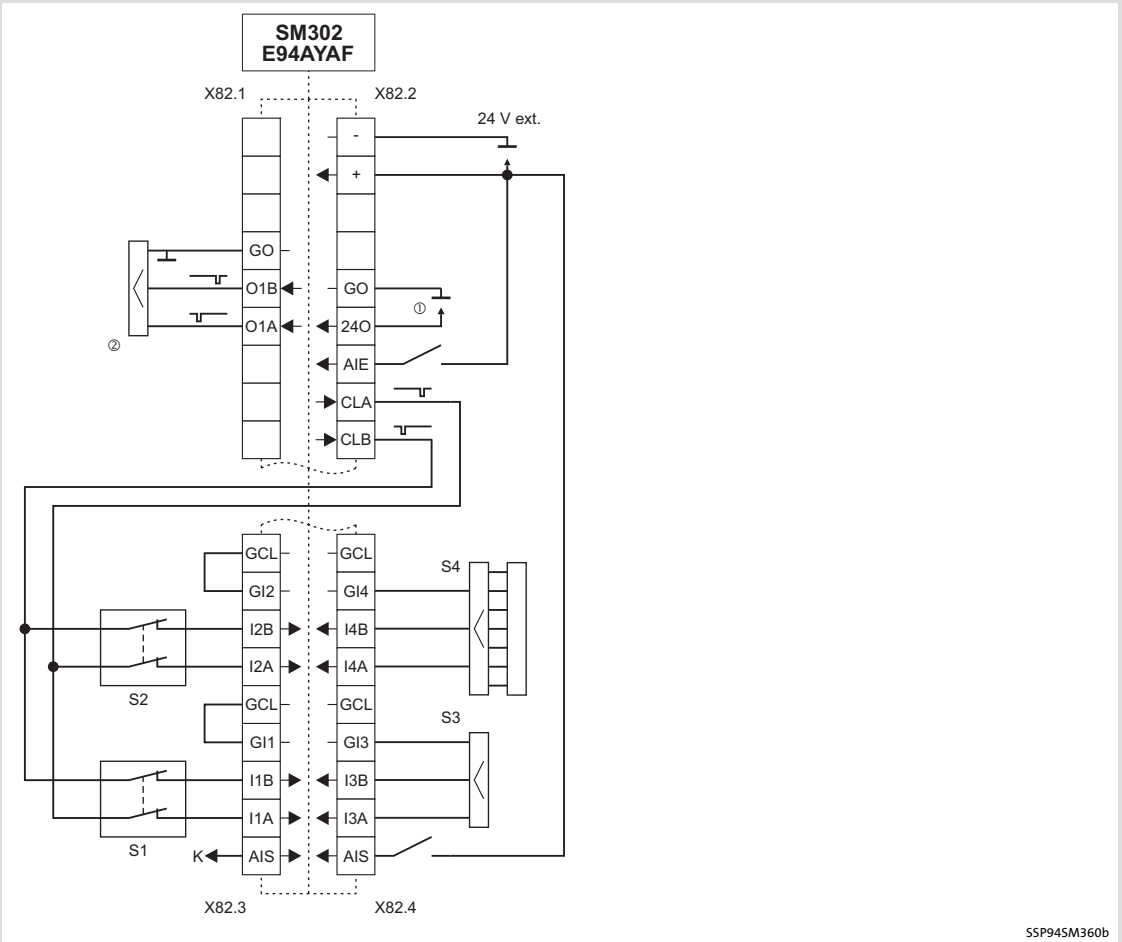


Fig. 1-3 Wiring example

E94AYAF	SM302 safety module
S1 S2	Passive sensor with channel A and B
S3	higher-level safety control (active sensor)
S4	lightgrid (active sensor)
24 V ext.	24-V voltage supply of the module (SELV/PELV)
①	24-V voltage supply of the output (SELV/PELV)
②	safe output to higher-level safety control
K	to AIS of the next module

1.3.4.2 Commissioning

- For commissioning and safe parameter setting, the Lenze »Engineer« PC software from version 02.23 must be used.

  If you select the safety module in the *Project view*, various tabs are available in the *Operating range*via which the safety module can be parameterised. In all other program parts the parameters of the safety module can only be read. Thus, the write access of these parameters (codes) is marked with ⚠.

- Settings in or at the module:
  - Safety address
  - Safe parameter setting of the functions to be used

- Required settings in the basic device:
  - C00214, type of safety module
  - Implementation of the SM302 into the drive application by evaluating the control information and status information.

- During commissioning and after the replacement of a module it is vital to check the safety function. Additional information contains the ”Acceptance” chapter. (📖 79).

1.3.5 Safe inputs

1.3.5.1 General

The following applies to the sensors on the SM302:

- The sensor type and function can be parameterised.
- A local evaluation is executed if corresponding parameters are set.
- If a safety bus is activated, the sensor signals are sent as status information to the higher-level control.
- Deactivated sensor inputs must not be connected. The status of a non-connected input is OFF.
- If a signal is detected at deactivated sensor inputs during initialisation, the drive remains inhibited (STO).
- Faulty inputs are assessed as OFF state.

Specification	Sensor type	
	passive	active
Discrepancy time	parameterisable 0 ... 30000 ms (increment: 2 ms)	
Input delay	parameterisable 0 ... 100 ms (increment: 2 ms)	
Input filter time for test pulses	fixed 2 ms	
Repetition rate of the test pulses	is determined by the clock outputs CLA and CLB	> 50 ms
Error response	Sensor input is assessed as OFF state. Acknowledgement via safety bus or AIE input	

Tab. 1-2 Specification of sensor connections

Explanations

- Discrepancy time
  Maximum time in which both channels of a safe input may have non-equivalent states without the safety engineering causing an error response.
- Input delay
  Time between the recognition of the signal change and the effective evaluation of an input signal. As a result, multiple and short signal changes due to contact bounce of the components are not taken into account.
- Input filter time
  Time in which the interference pulses and test pulses are not detected by e.g. active sensors that are switched on.

The input delay time and the time of the input filters influence the response time. More information can be found in the "Response times" chapter (📖 76).

Contact function test

Note!

Make sure that an internal contact function test is carried out at the safe inputs:

Safe input in the ON state

- A LOW level at **one channel** puts the input in the OFF state. The discrepancy monitoring starts simultaneously.
- A LOW level must be detected at **both channels** within the discrepancy time, otherwise a discrepancy error will be reported.
- To be able to acknowledge the discrepancy error, a LOW level must be detected before at **both channels**.

Safe input in the OFF state

- A HIGH level at **one channel** starts the discrepancy monitoring.
- A HIGH level must be detected at **both channels** within the discrepancy time, otherwise a discrepancy error will be reported.
- To be able to acknowledge the discrepancy error, a HIGH level must be detected before at **both channels**.

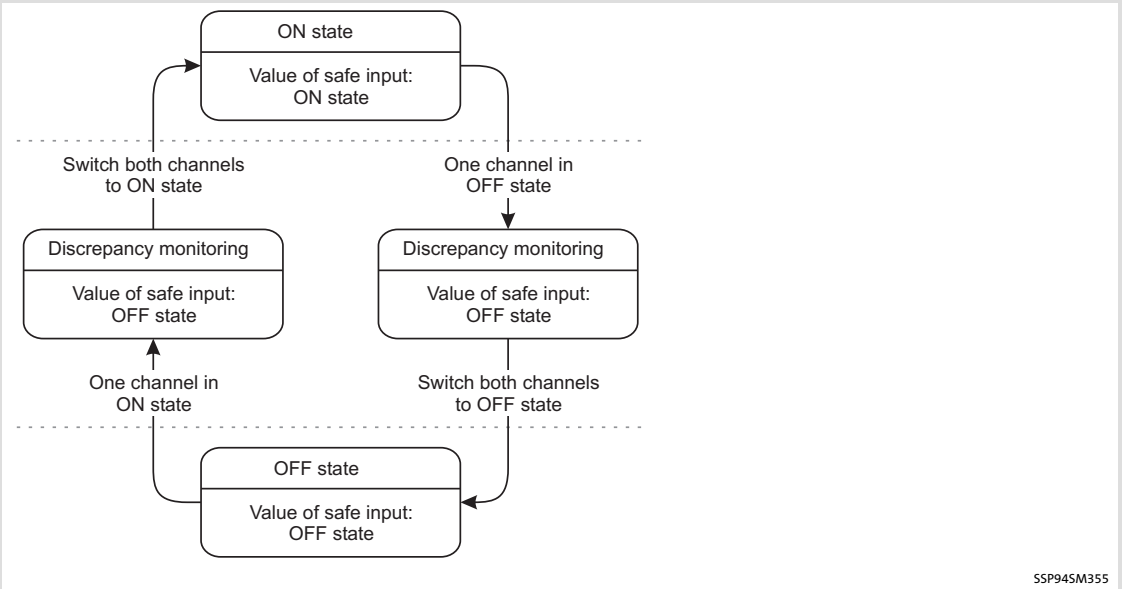


Fig. 1-4 Status behaviour - contact function test

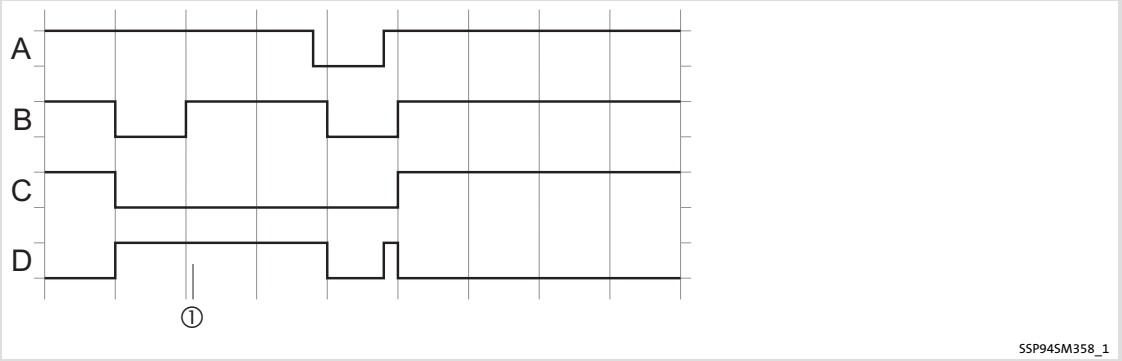


Fig. 1-5 Contact function test - error-free input signals

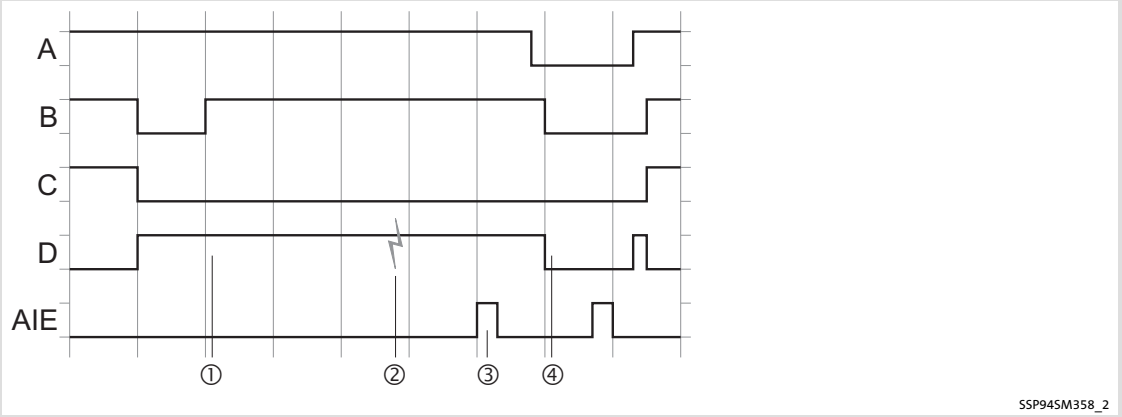


Fig. 1-6 Contact function test - faulty input signals

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

1.3.5.2 Connection of passive sensors

The safe sensor inputs I1A ... I4B are suitable for **equivalently switching** passive sensors.

To monitor passive sensors according to EN ISO 13849-1, cat. 3 or cat. 4, the clock outputs CLA and CLB must be wired. Please observe the following:

- The clock outputs are only suitable for monitoring the passive sensors.
- Always connect ...
  - ... CLA to IxA (channel A of the sensor input) via the sensor.
  - ... CLA to IxB (channel B of the sensor input) via the sensor.
  - ... GCL with GIx of the sensor input.
- The sensor inputs are tested cyclically through short LOW operation.
  - The A and B channels are tested at different times in cycles of approx. 2 s, with test pulses of < 1 ms.

These errors are detected:

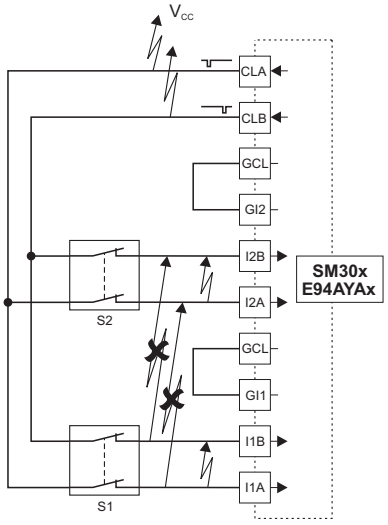
- Short circuit to supply voltage.
- Short circuit between the input signals when different clock outputs are used.
- Non-equivalent input signals after the discrepancy time.

These errors are not detected:

- Short circuit between the input signals when the same clock outputs are used.

Note!

Avoid unrecognisable errors by the installation, e.g. by separated cable routing.



SSP94SM351

Fig. 1-7 Ways to detect errors

× Unrecognisable errors

1.3.5.3 Connection of active sensors

The safe sensor inputs I1A ... I4B are suitable for active sensors.

PN-switched input signals are permissible.

The line monitoring must comply with the requirements of the category 3 or category 4. Drive-based safety does not provide for line monitoring.

These errors are detected:

- Non-equivalent input signals after the discrepancy time.

1.3.5.4 Example circuits

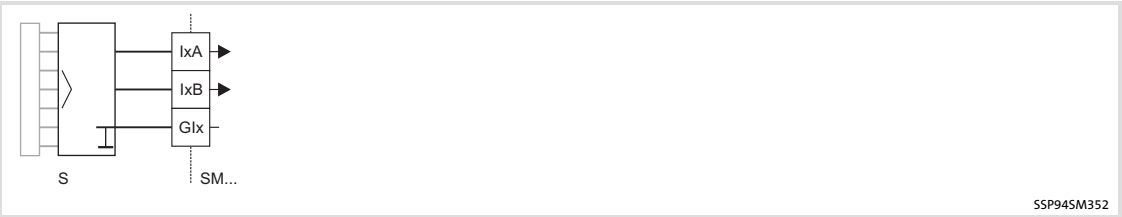


Fig. 1-8 Example circuit - active sensor

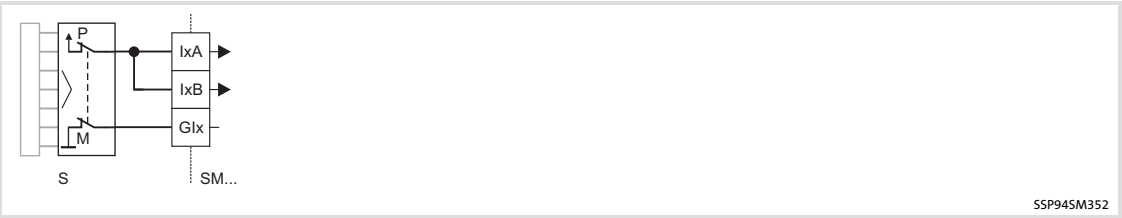


Fig. 1-9 Functional example of PN-switching sensor

S	Sensor
P	Positive path
M	Negative path

1.3.6 Safe output

1.3.6.1 General

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

Note!

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

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

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

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

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

These errors are not detected:

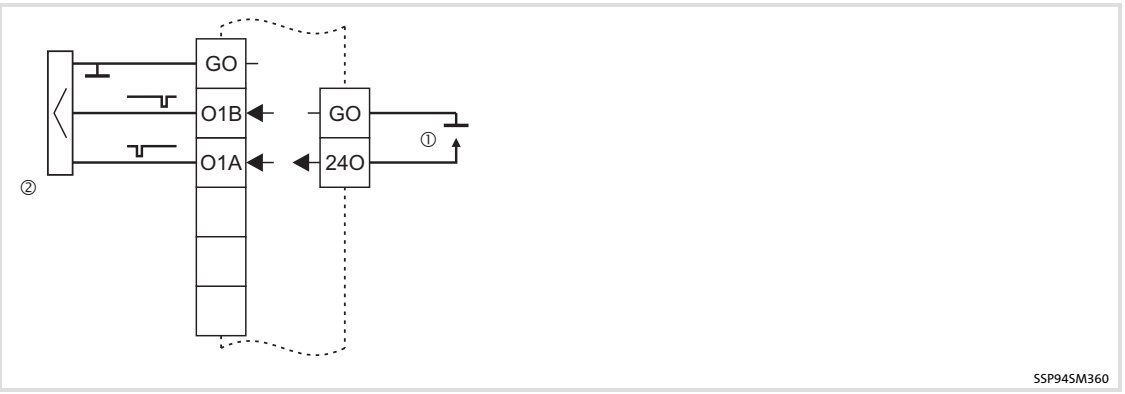
- In the OFF state: short circuit between the output signals.

The output can be assigned multiple feedback information by parameter setting:

- Status of the safety function
- Information on error responses

The code C15060 contains information on the status of the feedback output.

1.3.6.2 Example circuits



24O, GO	24-V voltage supply for the safe output
O1A, O1B, GO	Safe output SD-Out1, channel A and B with reference potential
①	24-V voltage supply - safe output (SELV/PELV) acc. to IEC 61131-2
②	Input of a higher-level unit (e.g. safety PLC)

1.3.7 Further inputs

AIS input

The restart (when setting ”acknowledged restart”, (📖 41)), after a stop function has been executed, requires an acknowledgement at AIS input:

► Positive signal pulse of 0.3 ... 10 s (terminal X82.3 or X82.4).
  – Evaluation of the negative edge.

Other equivalent option:

► ”PS_AIS” signal via a safety bus
(if communication via safety bus is preferred)
  – Evaluation of the positive edge.

AIE input

Errors require an acknowledgement at AIE input:

► Positive signal pulse of 0.3 ... 10 s (terminal X82.2).
  – Evaluation of the negative edge.

Other equivalent option:

► ”PS_AIE” signal via a safety bus bit
(if communication via safety bus is preferred)
  – Evaluation of the positive edge.

1.3.8 Safe speed measurement and position detection

For a safe speed and position detection, you must connect a safety-approved sin/cos encoder to terminal X8 or a resolver to X7.

You can alternatively connect a two-encoder system consisting of a motor and a position encoder.

Safe speed measurement				
Motor encoder system	Max. speed [rpm]	Synchronism [%]	Response time of encoder monitoring [ms]	Error response
Encoder	±16000	1.5	12	Error stop STO
			12/50/100can be parameterised (📖 1.9.4)	
Resolver	±10000 / no. of resolver pole pairs	1	parameterisable 50/100 (📖 1.9.4)	

Tab. 1-3 Detailed features

Explanations on the data:

- Synchronism
  Variation of the speed determined in comparison with the current speed value.
- Response time of encoder monitoring
  Time required to detect faults caused by continuous signal errors at the encoder interface.

Note!

If speed monitoring is active and the standard device detects the inverter error characteristic (C00002=71) or determines the motor parameters (C00002=72), the error message ”Safe speed invalid” is displayed. Both functions cannot be completed since the SM302 activates STO. These two states generally occur only once during commissioning.

Therefore, these functions should be carried out before the speed monitoring is activated in the SM302.

The functions depending on speed, direction of rotation or position must not be parameterised if ”No encoder” is set. The plausibility check rejects such implausible settings until they have been parameterised correctly.

Tip!

The motor encoder position and, if required, position encoder position are 32-bit values in the safety module. The lower-order 16 bits contain the part of a motor revolution and the higher-order 16 bits contain the multiple of a motor revolution. Examples:

1/4 motor revolution	65536/4	16384	/ 0x0000’4000
1/2 motor revolution	65536/2	32768	/ 0x0000’8000
1 motor revolution	65536/1	65536	/ 0x0001’0000
2 motor revolutions	2*65536	131072	/ 0x0002’0000

Parameter setting of standard device 9400		→	Parameter setting of M302	
Motor mounting direction	Position encoder mounting direction		Motor mounting direction	Position encoder mounting direction
C02527/0	C02529/0		C15409/0	C15502/0
CW	CW	→	CW	”Like motor encoder”
CW	CCW	→	CW	”Inverted ...”
CCW	CW	→	CCW	”Inverted ...”
CCW	CCW	→	CCW	”Like motor encoder”

Tab. 1-4 Overview of dependency of the parameterisation from the mounting direction



Stop!

Malfunctions due to slip, shaft fracture etc.

Slip, shaft fracture etc. between motor and encoder system disturb the safe speed measurement.

Possible consequences:

► The speed-dependent and/or direction-of-rotation dependent functions are executed incorrectly.

Protective measures:

► Prevent malfunctions by constructive measures.

► Use the motors and encoder systems with guaranteed features. Your Lenze contact partner helps you to find suitable systems.

► In the event of service, this must also be observed for the motor or the encoder system.

Motor-encoder combinations

Drive systems with Servo Drives 9400 and safety module SM302 provide speed-dependent safety functions for safe speed monitoring and/or safe position monitoring. Observe permissible motor-encoder combinations during configuration.

► Permissible motor-encoder combinations for these functions:

Synchronous servo motors	Encoder		Safe speed monitoring with SM30x	
	Type	Product key		
MCS 06 ... 19 MDXKS 56 / 71	Sin/cos absolute value, single-turn	AS1024-8V-K2	Single-encoder concept	PL d / SIL 2
	Sin/cos absolute value, multi-turn	AM1024-8V-K2		
	Resolver	RV03		PL e / SIL 3
			Two-encoder concept	Up to PL e / SIL 3

Asynchronous servo motors	Encoder		Safe speed monitoring with SM30x	
	Type	Product key		
MCA 10 ... 26 MQA 20 ... 26	Sin/cos incremental	IG1024-5V-V3	Single-encoder concept	PL e / SIL 3
	Resolver	RV03		
			Two-encoder concept	Up to PL e / SIL 3

Three-phase asynchronous motors	Encoder		Safe speed monitoring with SM30x	
	Type	Product key		
MDxMA063-xx ... MDxMA225-xx MHxMA080-xx ... MHxMA225-xx	Sin/cos incremental	IG2048-5V-V3	Single-encoder concept	PL e / SIL 3
		IG2048-5V-V2		PL d / SIL 2
MFxMA063-xx ... MFxMA132-xx			Two-encoder concept	Up to PL e / SIL 3

A ”two-encoder concept” includes e.g. a resolver as motor encoder and, at the same time, an absolute value encoder (sin/cos), an incremental encoder (TTL), or digital encoder (SSI/bus) as position encoder on the machine.

In the case of the ”2-encoder concept”, the achievable risk mitigation (PL/SIL) depends on the suitability of the encoders used.

Note!

If feedback systems for safety functions are used, the manufacturer’s documentation must be observed!

Single-encoder concepts with resolvers

Please observe during the configuration of such systems:

If only one feedback system is used in connection with these safety applications, the applicable safety standard, IEC 61800-5-2 (Adjustable speed electrical power drive systems, Part 5-2: Safety requirements - Functional), poses special requirements for the connection between feedback system and motor shaft. This is due to the fact that dual-channel safety systems are, as a matter of fact, mechanically designed as single-channel systems at this point. If this mechanical linkage is overdimensioned as specified in EN 61800-5-2, the standard allows for fault exclusion for the fault conditions ”Shaft breakage” and ”Shaft slippage”.

Hence, there are acceleration limit values for the drive solutions with resolvers which must not be exceeded:

Synchronous servo motors	Encoder		Max. permissible angular acceleration	Min. time per 1000 r/min speed lift
	Type	Product key	[rad/s²]	[ms]
MCS 06	Resolver	RV03	56000	1.9
MCS 09 ... 19			19000	5.5
MDXKS 56 / 71			17000	6.2

Asynchronous servo motors	Encoder		Max. permissible angular acceleration	Min. time per 1000 r/min speed lift
	Type	Product key	[rad/s²]	[ms]
MCA 10 ... 19	Resolver	RV03	22000	4.8
MCA 20 ... 26			22000	4.8
MQA 20 ... 26			22000	4.8

1.4 Safety functions

Detailed information on the safety functions and parameterisation can be found in the software manual and online help for the safety module.

The following information is intended for a basic orientation.

1.4.1 General information

1.4.1.1 Stop functions

The stop functions are distinguished according to the cause of release:

- Standard stop (simple stop)
  - Release by a safe input with the parameterised STO, SS1 or SS2 functions
  - Release by activating the bits STO, SS1 or SS2 bits via the safety bus.
  - In special operation the standard stop can be avoided by using the enable switch.
- Emergency stop
  - Release by a safe input with the parameterised "Safe stop emergency" (SSE) function.
  - Release by activating the SSE bit via the safety bus.
  - STO or SS1 can be set as emergency stop function to be executed.
  - In special operation, the emergency stop **cannot** be avoided.
- Error stop
  - Release as response to an error.
  - In special operation, the error stop **cannot** be avoided.

1.4.1.2 Priorisation

Stop functions with priority influence the sequence of subordinated functions already started.

- STO

  The STO function has the highest priority over all other functions. Functions already started (e.g. SS1 or SS2) are aborted and the drive is switched off.

- SS1

  The SS1 function has priority over SS2. Considering the set stopping time for SS1 and SS2 (C15305) and the SS1 mode (C15306), the drive is switched to torque-free operation.

- Monitoring functions

  The monitoring functions have equivalent priorities. They can be executed at the same time.

1.4.1.3 Restart

The restart behaviour of the drive can be parameterised (C15300).

- The ”acknowledged restart” setting requires an acknowledgement to the safety module. The acknowledgement is made via:
  – Signal at the AIS input (with a signal time of 0.3 ... 10 s)
  – Signal via the ”PS_AIS” bit via the safety bus.
- An error stop requires an acknowledgement (AIE), before the restart can be acknowledged.
- The ”Automatic restart” setting requires an acknowledgement at the master control.
- With active cascading (C15035), an ”automatic restart” after STO, SS1 is not possible.

Danger!

When the request for the safety function is deactivated, the drive can restart automatically. The behaviour can be set via the parameter ”Restart behaviour” (C15300/1/2).

In the case of an automatic restart, you must provide external measures which ensure that the drive only restarts after an acknowledgement (EN 60204).

1.4.2 Integration into the application of the controller

For the use of the functions, certain settings in the controller are required. Here, the Lenze PC software »Engineer« supports and guides you.

When a safety function is required, the safety technology activates the corresponding safe monitoring function. However, the standstill function is only directly executed with the ”safe torque off” (STO) function. Other safety functions in which a controller action is required will need to be safely monitored.

The action of the drive (e.g. braking, braking to standstill, keeping the standstill position) must be implemented by the user application in the standard device.

Currently the application can be parameterised and/or configured via function block editor of the Engineer depending on the runtime software licence. For this, the system block **LS_SafetyModuleInterface** must be integrated into the application.

The safety module is implemented in the 9400 ServoPLC via the control configuration (SMI_SafetyModuleInterface). The control and status data of the safety module can be evaluated via the free programming and connected to further interface signals.

The connection to a user application serves to achieve the following:

1. Activation of the safety function in the safety module, e.g. SS1.
   → The monitoring starts.
2. The safety module transmits the information to the basic device that the function has been activated using the corresponding bit in the control word *SMI_dwControl*.
3. The application evaluates the control word and starts the motion sequence, e.g. braking etc.

Internal communication

Safety module and standard device communicate via an internal interface.

If communication to the standard device is interrupted, e.g. by switching off the standard device, the safety module responds by means of the following actions:

- Error stop with STO is activated
- ”Warning” error message is transmitted
- The ”ME” LED is blinking

The required fault acknowledgement (AIE) is possible via terminal or safety bus. For further information read the ”Error management” chapter.

1.4.2.1 Control information

The safety module transfers information via requested or active safety functions with the control word SMI_dwControl. The application in the standard device must evaluate the control word and execute the corresponding action.

1.4.2.2 Status information

The safety module transfers information via the status of safety functions with the SMI_dnState status word.

The SMI_dnIoState status word contains information on the status of the safe inputs and the safe output. The application in the standard device can evaluate and use the status words for additional tasks.

1.4.3 Safe torque off

Safe **T**orque **O**ff/STO

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

When this function is used, the power supply of the motor is immediately safely interrupted. The motor cannot create a torque and thus no dangerous movements of the drive can occur. Additional measures, e.g. mechanical brakes are needed against movements caused by external force.

The restart behaviour can be set. Function sequence and error response have no adjustable parameters.

1.4.4 Safe stop 1

Safe **S**top **1** / SS1

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

The function monitors the reaching of the speed n = 0 within an adjustable stopping time. The speed is calculated from the encoder data (safe speed measurement). Without encoder the function evaluates the speed status n = 0 from the standard device. For this, the monitored stopping time parameterised in the safety module must be 0.5 s longer than the stopping time in the controller.

When the stopping time has elapsed, the power supply of the motor is immediately safely interrupted (STO). The motor cannot create a torque and thus no dangerous movements of the drive can occur.

Additional measures, e.g. mechanical brakes are needed against movements caused by external force. The time for a brake to be applied must be considered when defining the stopping time.

A restart is only possible after the stopping time has completely elapsed with ”SS1 mode = STO after stopping time”. If the SS1 mode parameter is set to ”STO at n=0”, a restart can be directly carried out after the transition to the STO status.

Deceleration ramp monitoring can be parameterised. Depending on the parameterised stopping time, a monitoring ramp is calculated. (📖 47)

1.4.5 Safe stop 2

Safe **S**top **2** / SS2

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

This function serves to monitor the reaching of speed n = 0 within an adjustable stopping time (C15305). The reached position must be kept active by the controller.

For speed n = 0, a tolerance window (C15310) can be parameterised. For the tolerance window Delta p=0 (C15311), a relative position is defined by which the drive may move in the SOS state.

If the monitored limits are exceeded, an error stop will be caused. The power supply of the motor is immediately safely interrupted (STO). The motor cannot create a torque and thus no dangerous movements of the drive can occur. Additional measures, e.g. mechanical brakes are needed against movements caused by external force.

The higher-prior stop function SS1/STO is executed when the SS2 stop request and SS1/STO occur at the same time. After the SS1/STO request has been cancelled and acknowledged accordingly (see restart behaviour), a direct STO transition to the SS2/STO state can be achieved without cancelling the SS2 request.

Deceleration ramp monitoring can be parameterised. Depending on the parameterised stopping time, a monitoring ramp is calculated. (📖 47)

Note!

The position of the motor is saved when the SOS state is entered. In the SOS state, relative position changes are added and compared to the permissible value in the parameter ”Tolerance window Delta p=0”. When the SOS state is quit, the maximum relative position change is displayed in code C15312. When the SOS state is requested again, the maximum value of the last position changes is reset to zero.

Example: The states ”SS2 active” and ”SOS active” are interrupted by a STO request. When the STO request is reset, an immediate transition to the SOS state takes place. This causes a reset of the current position deviation to p=0.

After the safe operational stop is interrupted by the STO, the motor may have a different position due to an external torque.

1.4.6 Ramp monitoring SS1/SS2

The deceleration ramp can be additionally parameterised and monitored for the stop functions SS1 and SS2 . If the parameterised ramp is not exceeded, the state changes to the parameterised stop function STO or SOS.

The monitoring of the deceleration process serves to achieve a higher degree of safety. Ramp monitoring becomes most critical when delay times are caused by high moments of inertia

- The application must ensure that the drive is braked to a standstill and the position is maintained!
- A safe speed evaluation is the precondition for a safe ramp monitoring, i.e. an encoder system must be parameterised in the safety module.
- When ramp monitoring is activated, the starting value of the ramp and the S-ramp time must be defined in percent.
  - The starting value refers to the current speed value at the time of the SS1/SS2 request.
  - The starting time of the deceleration ramp is delayed via the S-ramp time in order to consider a possible S-ramp smoothing.

If the current speed exceeds the parameterised deceleration ramp within the stopping time or before reaching the tolerance window (n=0), an error message is caused and an error stop is initiated.

- The power supply of the motor is immediately safely interrupted (STO). The motor cannot create a torque and thus no dangerous movements of the drive can occur.

1.4.7 Emergency stop

Safe **S**top **E**mergency/SSE

The emergency stop function activates STO or SS1. The function to be executed can be set (C15205). There is no way to avoid emergency stopping during special operation and in repair mode select (RMS).

With active cascading (C15035), only ”STO” is permissible as emergency stop.

Note!

Connect the emergency stop buttons, which must not be overruled by special operation or repair mode select, to the emergency stop function. For this purpose, parameterise the safe input as ”emergency stop” (C15031).

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

The activation of the function is reported internally to the standard device and via the safety bus of the higher-level control.

1.4.8 Safe maximum speed

1.4.8.1 Description

Safe **M**aximum **S**peed / SMS

This function monitors the maximum motor speed. If a value > 0 is indicated (C15320), the function is activated.

If the maximum speed is exceeded, a error stop is caused. STO, SS1 or SS2 (C15321) can be adjusted.

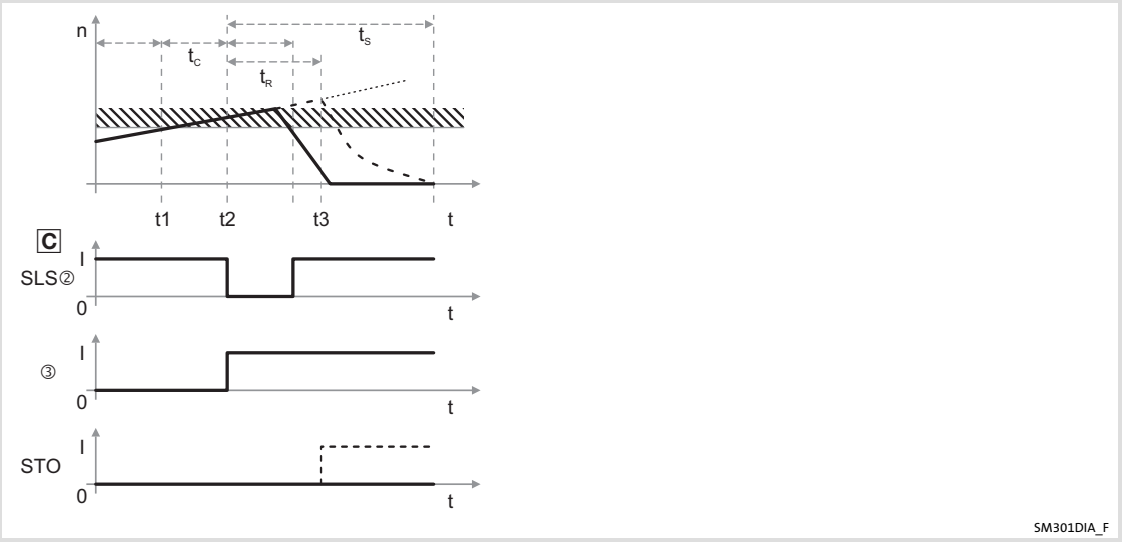
1.4.8.2 Fault analysis

This consideration applies to the SMS and SLS functions.

The evaluation and plausibility of the speed values is done in a cycle of 2 ms.

If the defined limit values are exceeded, the parameterised error response is activated within a time slot of maximally one evaluation cycle. With the error response SS1 or SS2 the response time of the stop function depends on the evaluation in the standard device. Moreover, the set stopping time must be added to the response time until the defined operating status is reached.

In order that the response can be checked for an error as quickly as possible, a maximum response time (C15350) can be parameterised. Before the maximum response time has elapsed, the detected speed must comply with the permissible (monitored) speed. If the permissible (monitored) speed is not complied with, STO is activated immediately.



T1	Occurrence of the error event
t_C	Cycle time 2 ms
T2	Determining the error event
t_R	Maximum permissible response time (parameterisable)
t3	Response instance to continuous exceedance
t_S	Stopping time
C	Feedback(s)
SLS②	SLS monitored
③	According to the error response set: SS2, SS1 or STO
STO	Response in case of an error after the max. response time has elapsed
———	Normal operation
------	Incorrect operation

Note!

If the STO function has been selected as the error response for SMS or SLS, the internal response time is not considered because the motor is already coasting after the speed threshold is exceeded for the first time.

Note!

In case of an error, the set limited speed will be exceeded.

To assess the risk for the plant, you have to calculate the height of the maximum exceedance. Consider the following:

- ► internal response time
- ► application-specific response time
- ► application-specific maximum acceleration

1.4.9 Safely limited speed

1.4.9.1 Description

Safely **L**imited **S**peed/SLS

Safe **M**aximum **S**peed / SMS

After the speed has fallen below the threshold or the adjustable braking time has elapsed, the function monitors the compliance with the limited speed N_{lim}.

► Four different speeds can be monitored (SLS1 ... SLS4).

When operating within the limit values, the ”SLSx monitored” status is set. The status can be assigned to the safe output. The status can also be reported via the safety bus. A feedback takes place as soon as it has been detected that the speed has fallen below the threshold.

When the monitored speed is exceeded, a stop error is caused. STO, SS1 or SS2 (C15332/1...4) can be adjusted. If the speed is not within the limit values even after the adjustable response time, the drive will be directly switched off (STO).

1.4.9.2 Fault analysis

The fault analysis is described with the SMS function (📖 50).

1.4.10 Safe direction

1.4.10.1 Description

Safe **Di**rection / SDI

This function monitors safe compliance with an adjustable direction of movement. Monitoring also includes zero speed with a tolerance window.

If the valid direction of rotation is not complied with, optionally SS1, SS2, or STO can be activated.

After the adjustable delay time has expired (C15341), the function monitors the compliance with the positive/negative direction of movement.

When operating within the limit values (C15342), the ”SDIxxx monitored” status is set (C15000). The status can be assigned to the safe output (C15052/1). The status can also be reported via the safety bus.

If deviations from the permissible direction of movement occur, an error stop will be triggered. As an error response, STO, SS1, or SS2 can be set (C15343). In the event of an error the maximum change in position is displayed (C15344).

Note!

If the SDI delay time (C15341) is parameterised greater than zero, either the ”SDIxxx monitored” feedback must be evaluated (safety bus or safe output) or the risk analysis must show that the delay is not hazardous. This fact must e.g. be considered in the calculation of the safety clearance.

Note!

If the monitoring of the direction of movement, SDIxxx, is combined with function SLSx, the delay times must be coordinated. Then, braking time Nlim will start at the same time as the SDI delay time.

1.4.10.2 Fault analysis

This consideration is applies to function SDI.

The position values are evaluated and checked at a cycle of 2 ms. If the defined tolerance window is exceeded, the parameterised error response is triggered immediately within a time slot of max. one evaluation cycle. If a SS1 or SS2 error response is triggered, the response time of the stop function depends on the evaluation in the standard device. Furthermore, the set stopping time must be added to the response time until the defined operating status is reached. In the Lenze setting, the error response is set to SS1.

1.4.11 Safely limited position

1.4.11.1 Description

Safely **L**imited **P**osition / SLP

The safety module monitors the lower and upper position limit.

If the drives violates the upper or lower limit value in the course of limit value monitoring, an error response is activated, providing the possibility that the position value monitored is exceeded by the coast-down of the torqueless motor.

For monitoring an absolute position range, an upper and a lower position value must be set via a safe parameter. Up to four absolute position limit value pairs can be parameterised and monitored at the same time.

In order to execute this function, a home position assessed from a safety-related point of view must be available in the system which is approached before the function is executed.

Otherwise the parameterised safe speed limitation (SLS1 - SLS4) is triggered when the SLP function is activated, which can be executed during normal operation and special operation.

The SLP function can be executed during normal operation and special operation (OMS). If a safe reference is available, monitoring of the parameterised upper and lower position limit values is carried out at the time of request.

This state is shown by the ”SLPx monitored” status bit.

1.4.12 Position-dependent safe speed

1.4.12.1 Description

Position-**D**ependent **S**afe **S**peed / PDSS

The ”position-dependent safe speed” ...

- monitors the speed of a drive as a function of the absolute position along a motion range.
- enables the use of a physically limited motion range without the use of mechanical buffers and limit switches.
- It is possible to parameterise a creep speed at the travel way ends in order to optimally use the entire travel way.
- Depending on the direction of rotation, the monitoring envelope curve switches to make it possible that the travel way end can be left with maximum speed.

The PDSS function can be executed during normal operation and special operation.

In order to execute this function, a home position assessed from a safety-related point of view must be available in the system which is approached before the function is executed.

1.4.13 Safe cam

1.4.13.1 Description

Safe **CA**m / SCA

When this function is executed, the current absolute position is compared to the parameterised position limits. This binary state is displayed via status bits which can be provided via the safe output or the safety bus. The function is activated by entering a parameter value (> 0). The status is transmitted to the safety and standard application.

Up to four pairs of position values can be parameterised and monitored. The four position areas can be activated and monitored in parallel.

In order to execute this function, a home position assessed from a safety-related point of view must be available in the system which is approached before the function is executed.

1.4.14 Safe referencing

1.4.14.1 Description

Safety **Ref**erencing / SREF

For an absolute position calculation and monitoring, the safety module requires an absolute reference point. This function is required since the encoder systems described for position evaluation do not provide any safe absolute position.

If absolute position-dependent functions are parameterised, the drive can only be moved with a safely limited speed until homing is successfully completed. The SLS1-SLS4 assignment can be parameterised. When the home position is overtravelled, the parameterised ”Home Position” value is accepted as the current position value. A faulty homing, e.g. by a missing signal edge or violation of the timing request triggers STO.

Parameterisation serves to set whether the switch-off of the voltage supply shall cause a non-volatile storage of the current position. If the restart conditions after switching on the voltage supply and a minimum motion (minimum homing) are complied with, a restart can be made without a renewed homing.



Danger!

The components for detecting the home position must be mechanically mounted in such a way that the home position cannot change, e.g. by external influences.

An unnoticed local change of the home position causes faulty values of the absolute position.

1.4.15 Repair mode select

1.4.15.1 Description

Repair **M**ode **S**elect / RMS

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

In the safety concept, this state is accounted for as a special case for actuating an axis connected, the encoders connected being evaluated in a non-safety-rated fashion.

Note!

In repair mode, the safety functions are solely restricted to the parameterisable stop functions STO and SS1 (without ramp monitoring) and the effectiveness of the enable switch.

Danger!

Uncontrolled motor rotation possible

The RMS operating mode may lead to unexpected motions with unexpected speed.

Possible consequences:

► The RMS operating mode may lead to a violation of the permissible motion limits of the axis.

Protective measures:

► The RMS function can only be used to free an axis from a ”deadlock”. If possible, use the OMS function!

► In the RMS operating mode, only the enable switch is effective. Use additional safety measures to ensure that no person is endangered.

1.4.16 Safe operation mode selector

1.4.16.1 Description

Operation **M**ode **S**elector / OMS

The function provides a special operation of the drive. In the special operation the drive is stopped (status 2). The drive can be traversed in the special operation via an enable switch (status 3).

For the stop status in the special operation, the STO, SS1 or SS2 functions can be parameterised.

For motion functions in the special operation, the SLS function (combinable with SDI) or free movement (combinable with SLI function) can be parameterised. The parameterised monitoring function will be automatically activated with the transition to the special operation.

The special operation enables an override of the simple STO, SS1, and SS2 stop functions by the enable switch.

Also in special operation, activated monitoring functions are continued to be executed. An error detected in the monitoring functions, also in special operation, leads to the parameterised error stop function. Depending on the priority, the parameterised stop function of the monitoring function or the stop function of the special operation is executed without approval.

An active emergency stop function is also executed in special operation.

The special operation can also be selected via the safety bus by the F-PLC, unless a safe input is parameterised as operation mode selector.

The return to normal operation is only possible in the stop status. Since the drive is stopped in status 2, the AIS acknowledgement is required for restart. The parameters for the restart STO/SS1 or SS2 are used.

Note!

When returning to normal operation, the automatic restart is not permissible. If ”automatic restart” is parameterised, this can be prevented by special measures, e.g. programming in the higher-level control.

Note!

The ”safe enable switch” function serves to directly cancel/complete the stopping times assigned to the stop functions.

Note!

Monitoring of the safely limited increment during special operation is active if a value > 0 has been selected for C15203.

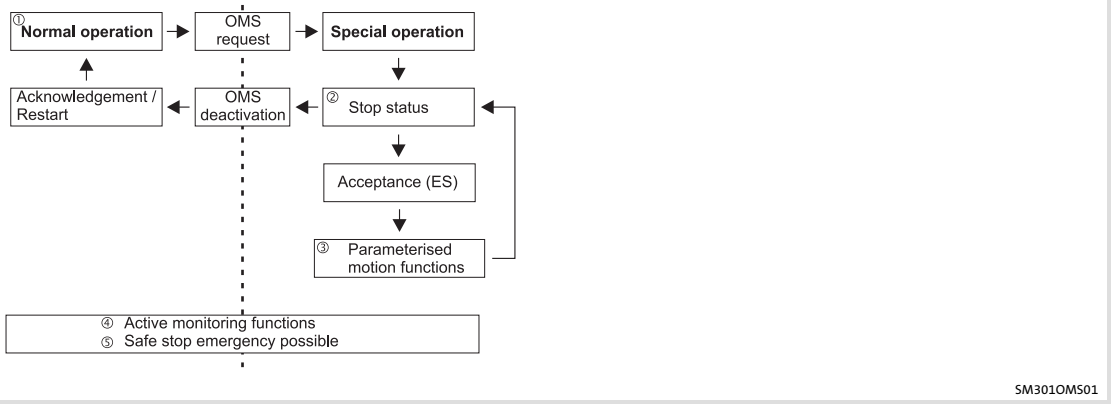
Note!

If an error (e.g. a discrepancy error) occurs at a safe input to which the OMS function has been assigned, normal operation will be selected. This corresponds to the OFF state. The ”ME” LED is blinking and STO is not activated. The special operation can only be selected again when the error has been eliminated and acknowledged.

The switching level at the digital input which determines special or normal operation can be set via the safe parameterisation.

Note!

When the OMS bit is received via the safety bus, the value 0 (normal operation) is assumed in case of passivation. In special applications (e.g. safety door, request of OMS, i.e. open safety door = special operation) this must not cause a dangerous state by automatic restart.



Operating mode	Normal	Special
Event	Impact	Impact
-	State ①	-
Request - OMS special operation via ...		
... safe input	Change ➞	State ② Stop function ... ● STO ● SS1 ● SS2 ... is executed Activated monitoring functions remain active.
... safety bus	same response - only possible as an alternative to the safe input	
Request - ES confirmation via ...		
... safe input	No function	State ③ ● Free movement ● SLS (as of V1.3 combinable with SDI) possible as restriction ● SLI (as of V1.4)
... via safety bus	same response - only possible as an alternative to the safe input	
Stop request	State ④ parameterised function ... ● STO ● SS1 ● SS2 ... is executed	is not executed
Emergency stop	State ⑤ parameterised function ... ● STO ● SS1 ... is executed	
Monitoring responds: SMS SLS SDI	dependent on priority: parameterised error function ... ● STO ● SS1 ● SS2 ... is executed or parameterised stopping function of special operation	

1.4.16.2 Conditions

A safe input must be parameterised and interconnected as an operation mode selector. Select the operating mode for the LOW level (C15202) depending on the application. Only one operation mode selector can be connected and parameterised. The OMS bit of the safety bus must be deactivated (C15113).

Special operation can also be selected via the safety bus (C15113) with the OMS bit if no safe input has been selected as an operation mode selector. In this case, at least one stop function must be parameterised via the safety bus to ensure that the drive system is safely switched-off if the bus should be interrupted. Furthermore, parameter C15202 must be set to ”Normal operation”.

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

Note!

The ”free traversing” setting for the special operation (C15201) motion function must be suitable for the application!

Danger!

Dangerous situations may occur during automatic or special operation

Depending on the application, automatic or special operation may bring about hazardous situations.

Possible consequences:

- ► Injury to persons
- ► Damage to material assets

Protective measures:

- ► Must be observed in particular when setting the operating mode for the LOW level at the SD-Inx.
- ► Observe the notes provided in the attached application examples.

Tip!

If SLSx has been parameterised as the motion function during special operation, a change to the acceptance operation is not possible until the reduced speed is monitored and maintained (SLSx monitored).

1.4.17 Safe enable switch

1.4.17.1 Description

Enable **S**witch / ES

The drive can be traversed in special operation using an enable switch (see operation mode selector).

1.4.17.2 Conditions

A safe input must be parameterised and interconnected as enable switch. You can only connect and parameterise one enable switch. The ES bit of the safety bus must be deactivated (C15113).

The enable switch function can also be selected via the safety bus with the ES bit, unless a safe input is parameterised as enable switch.

The special operation must be activated.

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

1.4.18 Cascading

1.4.18.1 Description

Cascading / CAS

This function enables a synchronised shutdown of an entire drive system.

- The function can only be activated via parameter setting. For this purpose set the "CAS: cascading" parameter to "Cascading with SD-In4".
- With activated function:
  - The SD-In4 safe input is used as cascading input and cannot be used as universal input anymore.
  - The SD-Out1 safe output is used as cascading output and cannot be parameterised as universal feedback output anymore.
  - A stop function (emergency stop, SSE) released by cascading cannot be overruled in special operation through the enable switch.
- The cascade trips with every STO, irrespective of which safety module adopts the STO status and for which reason.
- All safety modules of the cascade can only be enabled if all cascading inputs (SD-In4) are in the OFF state (emergency stop has been enabled).
- For the restart of the drive system, the AIS restart acknowledgement must be executed simultaneously for all safety modules of the cascade.
- The restart is executed with a delay of 100 ms after the acknowledgement has been recognised.
- Cascading is designed for max. 100 drives.
- During special operation, the drives of the cascade can only change from the SS2/SOS stop function to acceptance. An STO or SS1 as stop function would trigger the entire drive system every time and thus impede acceptance.

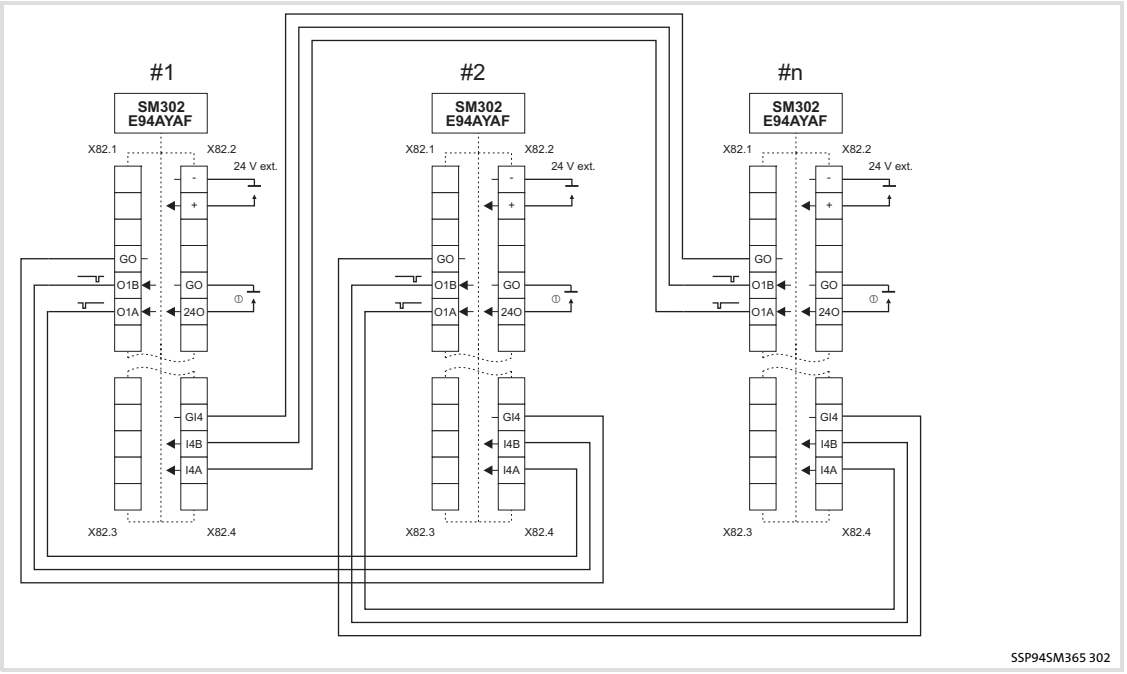


Fig. 1-10 Wiring example

E94AYAF	SM302 safety module
#1, #2, #n	Number of the module
24 V ext. ②	24-V voltage supply of the module (SELV/PELV)
①	24-V voltage supply of the output (SELV/PELV)

1.4.18.2 Conditions

- The SD-In4 input must be parameterised as active input for the ”emergency stop” function and the input delay for SD-In4 must be ≤ 10 ms.
- The emergency stop function to be executed must be parameterised as STO via the ”SSE: emergency stop function” parameter.
- The restart behaviour of the drive after the STO/SS1 stop function has been executed must be parameterised to ”Acknowledged restart”.
- The control of the SD-Out1 output via a possibly parameterised safety bus must be inhibited.
- The SS1 mode (C15306) must be set to ”STO after stopping time”.
- The plausibility check rejects other settings until they are parameterised correctly.

1.5 Safety address

The safety address serves to the clear assignment of the safety modules of the SM302 type in systems with several drives. The address ”0” is not permissible.

Address switch

The safety address can be set in the left part of the housing by means of the DIP switch A. For setting the switch, use an appropriately small tool, e.g. a probe. The switch can only be set if the module is not connected to a standard device. The switch serves to set addresses in the range of 0 ... 1023. Alterations by the switch with regard to the address are only activated when the 24-V supply is switched on.

- ► The address setting ”0” requires the setting by the address code.
- ► The address settings 1 ... 1023 are used with priority. The setting by the address code is not possible.

DIP switch A	Labelling									
	1	2	3	4	5	6	7	8	9	0
Value of the address bit	1	2	4	8	16	32	64	128	256	512

Tab. 1-5 Address setting

Address code

The safety address can also be set with the ”Safety address” parameter (C15111) of the safety module. For this, the address setting via the DIP switch A must be set with the ”0” setting. Via parameter, addresses can be set in a range of 0 ... 65534.

Effective safety address

The effective safety address is the result from the address switch or address parameter. The effective safety address must comply with the module ID assigned in the safe parameter set.

The effective safety address must also be used as target address by a master control with safety bus (e.g. PROFIsafe/PROFIsafe target address).

Module ID

Before the safe parameter set is downloaded, the system checks if the module ID defined in the parameter set corresponds to the module ID saved in the safety module. If the values are not the same, a corresponding message is displayed. This shall ensure that the safety address is not changed by mistake during parameter setting. If the user confirms the new value after checking it, the changed module ID will be saved non-volatile in the SM302. Code C15017 contains the module ID saved during the last parameter set transfer in the SM302.

Note!

A general reset does not change the stored module ID.

1.6 Safe bus interfaces

In the safety module, parameterised interfaces are provided for standardised safety bus systems. With the selection of the bus system, the corresponding parameters are made available.

Currently supported communication types:

- Operation without safety bus system
- Operation with PROFIsafe protocol
- Operation with FSoE via EtherCAT

1.6.1 PROFIsafe connection

1.6.1.1 Conditions

The SM302 supports the transmission of safe information on the PROFIsafe protocol according to the specification "PROFIsafe - Profile for Safety Technology" from version 2.x onwards of the PROFIBUS Nutzerorganisation (PNO). The basic device transmits the PROFIsafe information to the safety module for safe evaluation.

Note!

A safety bus system can only be operated via the upper module slot (MXI1) of the Servo Drive 9400.

Note!

The operation with PROFIsafe via PROFINET is only permissible according to the "PROFIsafe - Profile for Safety Technology" specification, version 2.x.

1.6.1.2 Description

Addressing

In order that a data telegram reaches the correct node, an unambiguous PROFIsafe target address is required. If PROFIsafe has been selected as safety bus, the safety address is simultaneously accepted as PROFIsafe target address. This address must comply with the corresponding configuration of the safety PLC.

PROFIsafe frame

The PROFIsafe message is sent in the first slot of a PROFIBUS data telegram or in the second slot of a PROFINET data telegram.

This must be observed for the hardware configuration of the safety PLC!

PROFINET data telegram			
header	**PROFIsafe message**	**Data**	**Trailer**
	Slot 2	Slot 1	

GSDML file

The GSDML file contains all information on the configuration of the PROFINET system. This makes the integration easy and user-friendly.



Tip!

You will find the current GSDML file for this Lenze product on the Internet in the ”Downloads” area under

http://www.Lenze.com

1.6.2 FSoE connection

Fail **S**afe **o**ver **E**therCAT / FSoE

1.6.2.1 Conditions

The SM302 supports the transmission of safe information via FSoE protocol in compliance with the ”ETG.5100 S” specification, version 1.2.0, of the EtherCAT user organisation (ETG). The standard device forwards the FSoE information to the safety module for safe evaluation.

Note!

A safety bus system can only be operated via the upper module slot (MXI1) of the Servo Drive 9400.

1.6.2.2 Description

Safe transmission via EtherCAT (”Fail-Safe-over-EtherCAT”).

Addressing

In order that a data frame reaches the correct node, a unique FSoE target address is required. If ”FSoE” has been selected as safety bus, the safety address is at the same time accepted as the FSoE target address. This address must match the corresponding configuration of the safety PLC.

FSoE frame

The FSoE data are sent in the first slot of an EtherCAT data frame.

This must be observed for the hardware configuration of the safety PLC!

Range	Values
Process data	1 ... 32 process data words for each direction (max. 64 bytes, 16 bits)
Parameter data (Mailbox size for CoE transfer)	max. 128 bytes
FSoE data for the use of the SM302 safety module (from SW version 04.00)	Safety outputs: 11 bytes
	Safety inputs: 19 bytes

ESI file

The ESI file contains all information on the configuration of the EtherCAT system. This makes the integration easy and user-friendly.

Tip!

You will find the current ESI file for this Lenze product on the Internet in the ”Downloads” area under

http://www.Lenze.com

1.7 Safe parameter setting

Note!

During online communication via bus system, multiple users can access the very same drive at the same time and edit the safe parameter set. After the safe parameter set has been transmitted, please check if the checksums (CRC) of the parameter set, memory module, and safety module in the ”Safe transfer” dialog are consistent.

The consistency of the safe parameters must be ensured by organisational measures because there are no technical means to avoid multiple users accessing parameter sets at the same time.

1.7.1 Parameter setting

Safety-relevant parameters can exclusively be transmitted to the safety module by safe parameter setting. The parameter set is saved in the memory module and safety module with a definite module ID which must comply with the effective safety address in the safety module.

A safe parameter setting requires the service status. The service status means the following:

- The standard stop is active and the drive is safely switched to torqueless operation (STO).
- The communication via the safety bus is active but passivated.

About the service status:

- It can be activated by the Lenze »Engineer« PC software.
- It can be quit by reinitialising the module, i.e. the communication via the safety module is interrupted.

Note!

The service status is also active if the parameter set in the memory module does not correspond to the parameter set in the safety module during the initialisation.

Observe the information on compatibility of the SM302 firmware versions (📖 20).

1.7.1.1 Parameter setting with the Lenze »Engineer« PC software

Safe parameter setting is supported by the Lenze PC software »Engineer« as of version 02.23.

The parameter setting is described in the Software Manual for the SM302 safety module. Moreover, the software provides a comprehensive Online Help.

Password

For storing a safe parameter set, a password is required. The standard password is: ”Lenze SM302”. The password can be changed and must have at least six characters.

Use ”general reset” to delete the safe parameter set in the memory module and the safety module. The safety module must be reparameterised.
The password is reset to the standard ”Lenze SM302”.

1.7.1.2 Parameter set transfer from the memory module

The safe parameter set transfer is supported by a safe parameter set stored in the memory module, e.g. in case of a module exchange.

- ► A valid parameter set with a corresponding module ID must be stored.
- ► The safety module must be in the service status.

The transfer of the parameter set from the memory module must be acknowledged at the safety module.

- ► The ”MS” LED is flashing (safety module is in service status.)
- ► ”AS” LED is lit
- ► Press module switch S82 and keep it pressed
- ► ”AS” LED starts blinking
- ► When the ”AS” LED goes off, release the S82 module switch immediately
- ► The ”AS” LED is lit again after a short time
- ► Press again the S82 module switch and keep it pressed
- ► ”AS” LED starts blinking
- ► When the ”AS” LED goes off, release the S82 module switch immediately
- ► The parameter set transfer is completed successfully.

If system-related response times (approx. 2.5 s) cannot be complied with, the parameter transfer is cancelled. The process must be started again.

In case of success, the parameter transfer is recorded in the logbook of the standard device and the service status is quit by a software restart.

If the parameter set is invalid, an error is indicated and the ”ME” LED is blinking.



Fig. 1-11 Acknowledgement procedure

AS	AS light-emitting diode
S82	S82 module switch
t	Time axis
t_{max}	Maximum permissible response time

1.7.2 Parameter sets and axes

The individuality of an axis with safety functions in a drive system can be achieved by means of the safety address. In the safe parameter set a module ID is stored. This module ID is compared to the effective safety address (C15112) in the safety module.

When a safety module is initialised, i.e. when the parameter set is loaded, the compliance of the safety address will be checked. If no compliance exists, an initialisation error is reported.

Note!

- ► Clearly define the safety address in a drive system or plant.
- ► Document the address in circuit diagrams and labels.
- ► Ensure identical settings when replacing the module.

In drive systems with activated safety bus the safety address is also used as safety bus target address. The clear assignment of the safety address must be configured in the safety PLC.

In drive systems without activated safety bus, individuality and correct assignment of the safety address must be checked. For this, use the Lenze »Engineer« PC software or an E94AZK... keypad.

1.8 Error management

1.8.1 Error states

Detected errors or maloperation of the drive are assigned to error statuses with definite reactions. The reaction can be co-ordinated with the complete drive via the error statuses.

Features	Error status		
	System error	Trouble	Warning
Event	Fatal internal error	Fault	Monitoring function
LED "ME"	On	Blinking	Flashing
Status of safety module	Lockout (CPU stopped)	Error status	Normal operation
The control category according to EN ISO 13849-1 ...	... has been abandoned	... has been abandoned	... has not been abandoned
Response	The motor immediately switches to torque-free operation via ● STO	The motor is stopped via ● STO or ● SS1	
Acknowledgement after deactivated event	● Connection and disconnection of the 24-V supply at the safety module	● Fault acknowledgement (AIE) via terminal X82.2 (positive signal pulse with a signal time of 0.3 ... 10 s) ● Fault acknowledgement (AIE) via the safety bus (Bit "PS_AIE") ● Connection and disconnection of the 24-V supply at the safety module	

Tab. 1-6 Overview of error statuses

More error messages are listed in the appendix.

Note!

If the system fault also occurs after switching the 24-V supply, please contact the service.

When a safety bus is used:

► If errors occur in the safe communication, the data is passivated by the safe communication driver.

► After the safe communication is reinitialised, the drive is automatically enabled again if no standstill function is selected.

► Events which cause an error status are sent as diagnostic telegram via the safety bus.

1.8.2 Logbook function in the controller

Error states are saved in the logbook of the standard device. The following is entered:

- Type of response (e.g. trouble, warning, or information) to the event
- Date/time (in case of memory module with real-time clock)
- Value of the power-on time meter

The available logbook entries can be displayed in the »Engineer« when an online connection has been established.

The list of the error entries can be found in the appendix.

1.8.3 Logbook function in the SM302

For purposes of diagnostics, a simple logbook with ten entries is implemented in the SM302. Changes with regard to the request of safety functions in the SM302 are logged. The bit coded log status created in a 2-ms cycle serves as a basis for the logbook. A logbook entry is generated when the log status has changed.

- The logbook function can be controlled via the ”Log function” (C15891).
  – The parameter can be written without using the safe parameter setting interface.
- A logbook entry consists of the two corresponding subcodes of the parameters ”Log time” (C15892) and ”Log state” (C15893).



Note!

Before the display parameters of the logbook are read for diagnostic purposes, the logbook function should be stopped in order to prevent inconsistency (C15891 = 1).

1.9 Response times

In order to detect the response time to a safety function the entire system must be considered. The following is relevant:

- Response time of the connected sensors.
- Input delay of the safety inputs.
- Internal processing time.
- When a safety bus is used:
  – Monitoring time for cyclic services.
  – Monitoring time in the safety PLC.
  – Processing time in the safety PLC.
- Delay times due to further components.

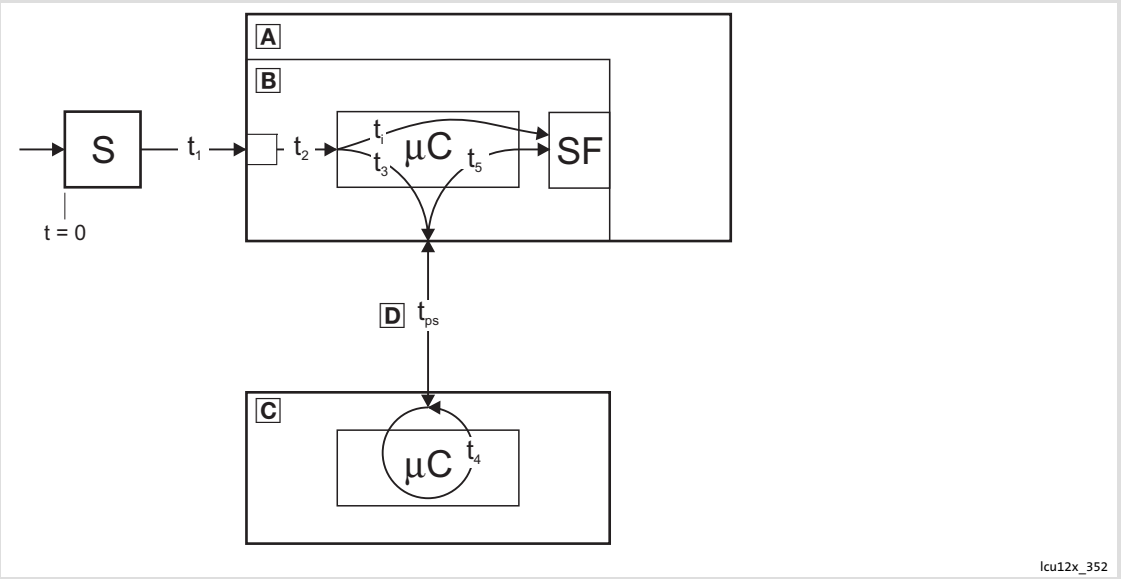


Fig. 1-12 Response times to the request of a safety function

A Standard device
B Safety module
C Safety PLC
D Safety bus
µC Microcontroller
S Safety sensor technology
SF Activated safety function

1.9.1 Response times of the inputs

Response time to an event in the sensors			
Time interval (Fig. 1-12)			[ms]
t_1	Response time of the sensors		according to manufacturer information
t_2	Input delay of the safe inputs		
		C15034:	**0** ... 100
		Input error:	2
t_i	Processing time in drive-based safety		4
	Safety function starts after ...		Σ

Tab. 1-7 Response time to an event in the sensors

1.9.2 Response time of the safe output

Response time of the safe output to a safety function		
		[ms]
	Safe output SD-Out1 switches to ...	4

Tab. 1-8 Response time - safe output

1.9.3 Response times of the safety bus

Response time to an event in the sensors (input data)			
Time interval (Fig. 1-12)			[ms]
t_1	Response time of the sensors		according to manufacturer information
t_2	Input delay of the safe inputs		
		C15034:	**0** ... 100
		Input error:	2
t_3	Processing time in drive-based safety		24
	Input data ready for transmission after ...		Σ
t_{Ps}	Cycle time		according to manufacturer information
	Input data ready for processing in the safety PLC ...		Σ

Tab. 1-9 Response time to an event in the sensors

Response time to a control word (output data)		
Time interval (Fig. 1-12)		[ms]
t_4	Processing time in the safety PLC	must be calculated
t_{Ps}	Cycle time	according to manufacturer information
t_5	Processing time in drive-based safety	14
	Safety function starts after ...	Σ

Tab. 1-10 Response time in case of a safety bus request

Information on how to calculate the processing time and transmission time of the safety bus can be found in the documentation of the safety PLC used.

Note!

When the safety bus communication is disturbed, it is changed to the fail-safe state after the safety bus monitoring time (F_WD_Time) has elapsed. The safety bus communication is passivated.

Example

- After an event has occurred at a safe input, the message is fed back to drive-based safety via the safety PLC.
- Drive-based safety activates a safety function.
- Hence, the maximum response time to the event is calculated as follows:

  $t_{max\ response} = t_1 + t_2 + t_3 + \max\{t_{WD}; t_{PS} + t_4 + t_{Ps} + t_5\}$

When calculating the maximum response time, include the times of the safety functions, e.g. in case of SS1 the stopping time (C15305) until STO is active.

1.9.4 Response time of encoder monitoring

Response time of encoder monitoring			
			[ms]
	Time required to detect faults caused by continuous signal errors at the encoder interface.		12
		can be parameterised under C15410	12/50/100

Note!

The minimum response time must be individually determined for each system.

A longer response time leads to an increased system availability, if, for instance, during machine set-up with safe operating stop process-related speed jumps occur for a short time.

1.10 Acceptance

1.10.1 Description

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

Inspector

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

Test report

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



Note!

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

Scope of test

A complete test comprises the following:

- Documenting the plant including the safety functions:
  - Creating an overview screen of the plant
  - Describing the plant
  - Describing the safety equipment
  - Documenting the safety functions used
- Checking the function of the safety functions used:
  - "Safe torque off" function, STO
  - "Safe stop 1" function, SS1
  - "Safe stop 2" function, SS2
  - "Safe operational stop" function, SOS
  - "Safe maximum speed" function, SMS
  - "Safely limited speed" function, SLS
  - "Safe stop emergency" function, SSE
  - "Safe direction" function, SDI
  - "Safely limited increment" function, SLI
  - "Safely limited absolute position" function, SLP
  - "Position-dependent safe speed", PDSS
  - "Safe cam" function, SCA
  - "Safe referencing" function, SREF
  - "Repair mode select", RMS
- Preparing the test report:
  - Documenting the functional test
  - Checking the parameters
  - Signing the test report
- Preparing the appendix with test records:
  - Protocols from the plant
  - External recording

1.10.2 Periodic inspections

The correct sequence of the safety-oriented functions must be checked in periodic inspections. The risk analysis or applicable regulations determine the time distances between the tests. The inspection interval should not exceed one year.

1.11 Module error messages

The Parameterisation & Configuration Software Manual provides information on diagnostics & fault analysis and describes the structure of the operating system's error messages in the logbook.

2 Appendix

2.1 Declarations of conformity

Lenze

2354660.03

EU-Konformitätserklärung	EU Declaration of Conformity

LENZE SE, Hans-Lenze-Strasse 1, 31855 Aerzen GERMANY

erklärt in alleiniger Verantwortung die Übereinstimmung der Produkte	declares under sole responsibility compliance of the products

E94xxxExxxxxxxxxxx (x=0-9/A-Z) &
SM302 - E94AYAF

mit der	with the

Maschinenrichtlinie 2006/42/EG Anhang VIII und IX	**Machinery Directive** 2006/42/EC Annex VIII and IX
Angewandte harmonisierte Normen:	**Applied harmonized standards:**

		EN 60204-1	:2018		
	Kategorie 4			Category 4	
	Performance Level (PL): PL e	EN ISO 13849-1	:2015	Performance Level (PL): PL e	
		EN 61508 1-7	:2010		
Sicherheitsfunktionen siehe Betriebsanleitung.	SIL 3	EN 62061 +AC +A1 +A2	:2005 :2010 :2013 :2015	SIL 3	For safety functions see manual.
		EN 61800-5-2	:2017		
		EN 61800-5-1 +A1	:2007 :2017		

Konformitätsbewertung		**Conformity assessment**	
CE 0035	**Benannte Stelle**	**notified body**	TÜV Rheinland Industrie Service GmbH Am Grauen Stein 51105 Köln / Germany
	Zertifikate	Certificates	01/205/5529.01/21
	Gültigkeit	Date of expiry	2026-12

EMV- Richtlinie 2014/30/EU	**EMC Directive** 2014/30/EU
Angewandte harmonisierte Normen:	**Applied harmonized standards:**

EN 61800-3:2004 + A1:2012
EN IEC 61800-3:2018

RoHS- Richtline 2011/65/EU	**RoHS Directive** 2011/65/EU
Angewandte harmonisierte Normen:	**Applied harmonized standards:**

EN IEC 63000:2018

Die Sicherheitshinweise der Betriebanleitung sind zu beachten.	The safety instructions of the manual are to be considered.
Die Produkte sind bestimmt zum Einbau in Maschinen. Die Inbetriebnahme ist solange untersagt bis festgestellt wurde, dass die Maschine, in welche diese Produkte eingebaut werden sollen, den Bestimmungen der o.g. EU-Richtlinie entsprechen.	These products are intended for installation in machines. Operation is prohibited until it has been determined that the machines in which these products are to be installed, conforms to the above mentioned EU Directive.

Ort / Datum Place / date	**Geschäftsführer** Managing Director	**Dokumentationsverantwortlicher** Responsible for documentation
Aerzen 15.12.2021	*Dipl.-Ing. Frank Maier*	*i.V. T. Wedemeyer*

Lenze

2462939.00

UK Declaration of Conformity

LENZE SE, Hans-Lenze-Strasse 1, 31855 Aerzen GERMANY

declares under sole responsibility compliance of the products

E94xxxExxxxxxxxxx (x=0-9/A-Z) &
SM302 - E94AYAF

with the

The Supply of Machinery (Safety) Regulations 2008 — S.I. 2008 No. 1597

Applied designated standards:

Safe torque off	EN 60204-1	:2018	
	EN ISO 13849-1	:2015	Category 4 Performance Level: PL e
For safety functions see manual.	EN 61508 1-7	:2010	
	EN 62061 +AC +A1 +A2	:2005 :2010 :2013 :2015	SIL 3
	EN 61800-5-2	:2007 + 2017	
	EN 61800-5-1 + A1	:2007 :2017	

Conformity assessment

UK CA

notified body	TUV Rheinland UK Ltd 1011 Stratford Road Solihull, B90 4BN
Certificates	01/205U/5529.00/22
Date of expiry	2026-12

The Electromagnetic Compatibility Regulations 2016 — S.I. 2016 No. 1091

Applied designated standards:

EN 61800-3:2004 + A1:2012
EN IEC 61800-3:2018

The Ecodesign for Energy-Related Products and Energy Information Regulations 2021 — S.I. 2021 No. 745

Applied standards:

EN 61800-9-2:2017

The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012 — S.I. 2012 No. 3032

Applied designated standards:

EN IEC 63000:2018

Authorised representative

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The safety instructions of the manual are to be considered.
These products are intended for installation in machines. Operation is prohibited until it has been determined that the machines in which these products are to be installed, conforms to the above mentioned Regulations.

Place / date	Chief Technology Officer	Responsible for documentation
Aerzen 13.09.2022	Dipl.-Ing. Frank Maier	i.V. Torsten Wedemeyer

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