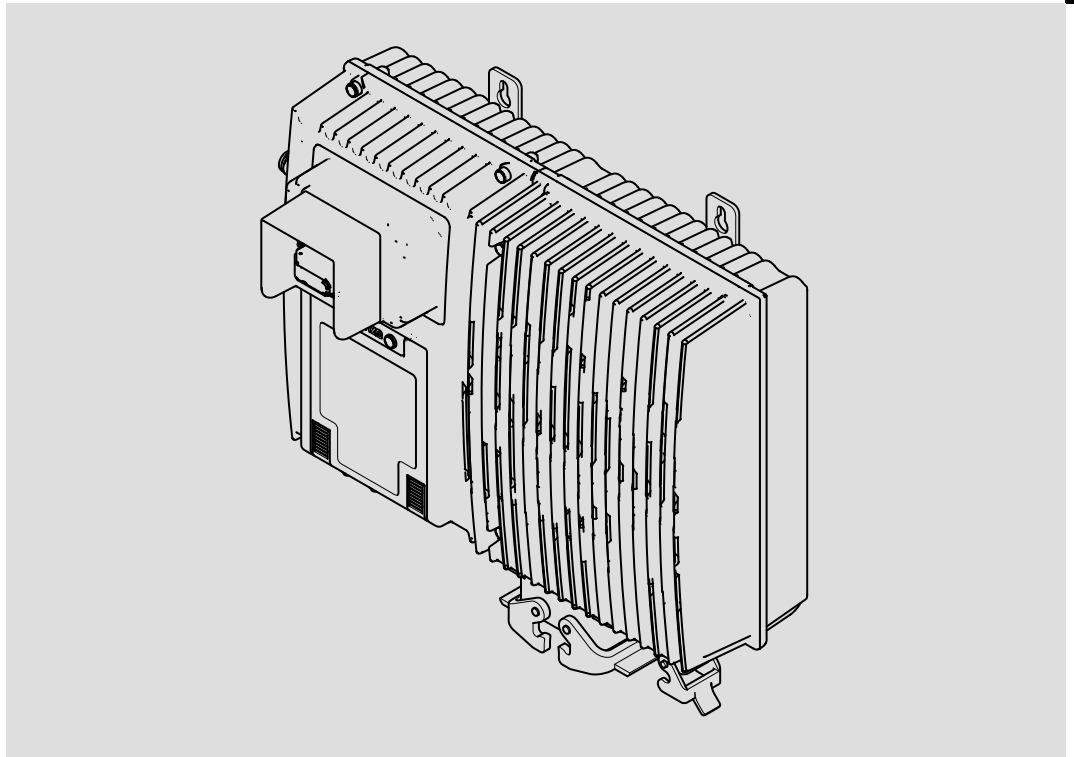


8400 protec 0.75 ... 7.5 kW



E84Dxxxxxxx HighLine/StateLine/EMS

Decentralised frequency inverter

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1 About this documentation

Contents

The hardware manual contains the complete information on the intended use of the 8400 protec controllers in the StateLine and HighLine versions.

Validity

These instructions apply to decentralised 8400 protec frequency inverters with the following type designation:

Type designation	From HW	From SW
E84DSxxx... (StateLine)	VA	01.01
E84DHxxx... (HighLine)	VA	02.02
E84DDxxx... (EMS)	VA	01.00
E84DExxx... (EMS)	VA	01.00
E84DFxxx... (EMS)	VA	01.00
E84DLxxx... (EMS)	VA	01.00
E84DPxxx... (EMS)	VA	01.00

Further information on the type code can be obtained from the "Product description" chapter.

Target group

This hardware manual is intended for all persons who design, install, commission, and set 8400 protec controllers.



Tip!

Information and auxiliary devices related to the Lenze products can be found in the download area at
<http://www.Lenze.com>

1.1 Document history

Material number	Version			Description
13446171	5.0	10/2013	TD15	Additions by UL
13428102	4.1	04/2013	TD15	Expansion up to 7.5 kW and corrections
13398992	3.0	05/2012	TD15	Additions and corrections
13384749	2.0	06/2011	TD15	Extended by EMS version
13368848	1.1	05/2011	TD15	General revision
13337296	1.0	04/2010	TD15	First edition

1 About this documentation

Conventions used

1.2 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

1.3 Terms and abbreviations used

Axis, drive	Lenze controller combined with a motor or geared motor and other Lenze drive components
Basic insulation	Insulation providing basic protection against hazardous shock currents
Controller	Any frequency inverter, servo inverter, or DC speed controller
Device size	Used as generic term for a group of devices which have the same dimensions (depth, height and width) but different power ratings.
Double insulation	Basic insulation and additional insulation
Functional insulation	Insulation ensuring perfect operation
Holding brake	See motor holding brake
Motor holding brake	The motor holding brake serves to statically hold e.g. a position during the downtimes of a robot, travelling, synchronous, or hoist drive.
Reinforced insulation	Uniform insulation system, same protection as double insulation
Spring-applied brake	Design type of a (motor) holding brake (electromechanically released, spring-applied operation)
Standard device	Used as generic term when actions and features are described which are very similar or the same for different versions or device sizes, e.g. • mechanical installation or • power terminals
EMS	Electrified M onorail S ystem, e.g. monorail overhead conveyors, automated guided vehicle systems
Half wave (coded)	Process for transmitting control signals via contact conductor Control bar and message bar, also with coding
Power wave	Process for transmitting control signals with mains voltage
DECA BUS	Process for transmitting control signals via rail bus
PLC	Programmable logic controller, compatible with IEC 61131
IrRC	Infrared remote control
IrDA	Infrared data interface
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)

AC	AC current or AC voltage
DC	DC current or DC voltage
V_{LR} [V]	Rated mains voltage
U_{DC} [V]	DC voltage
U_M [V]	Output voltage / voltage at the motor terminals
I_{LR} [A]	Rated mains current
I_{aR} [A]	Rated output current
I_{aM} [A]	Maximum output current
I_{PE} [mA]	Discharge current
P_R [kW]	Rated motor power
P_V [W]	Inverter power loss
P_{DC} [kW]	Power at the DC voltage end
S_R [kVA]	Apparent output power of the controller
M_R [Nm]	Rated torque
f_{max} [Hz]	Maximum frequency
L [mH]	Inductance
R [Ω]	Resistor
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 Européenne
UL	Underwriters Laboratories

Terms and abbreviations of the safety system

Abbreviation	Meaning
24O	24 V voltage supply for non-safe monitoring
Cat.	Category according to EN 954-1 (valid until 30 November 2009)
DO	Non-safe feedback output
F-PLC	Safety PLC
GSDML	File containing device-specific data to establish PROFINET communication
GSE	File containing device-specific data to establish PROFIBUS communication
OFF state	Signal status of the safety sensors when they are activated or respond
ON state	Signal status of the safety sensors during normal operation
Opto supply	Optocoupler supply for controlling the drivers
OSSD	Output Signal Switching Device, tested signal output
PELV	Protective Extra Low Voltage
PL	Performance Level according to EN ISO 13849-1
PM	P/N switching signal paths
PP	P/P switching signal paths
PS	PROFIsafe
PWM	Pulse Width Modulation
S-Bus	Safety bus
SD-In	Safe input (Safe Digital Input)
SD-Out	Safe output (Safe Digital Output)
SELV	Safety Extra Low Voltage
SIA, SIB	Safe Input, channel A or B, respectively
SIL	Safety Integrity Level according to IEC 61508
SO	Integrated safety option

Abbreviation	Safety function
AIE	Error acknowledgement (Acknowledge In Error)
AIS	Restart acknowledgement (Acknowledge In Stop)
ES	Safe enable switch
OMS	Operation Mode Selector
SS1	Safe Stop 1
SSE	Safe Stop Emergency
STO	Safe Torque Off Formerly: Safe standstill

1.4

Notes used

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

Safety instructions

Structure of safety instructions:

**Danger!**

(characterises the type and severity of danger)

Note

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

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

Application notes

Pictograph and signal word	Meaning
Note!	Important note to ensure troublefree operation
Tip!	Useful tip for simple handling
Reference to another documentation	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.
Warnings!	The measures are required to meet the requirements according to UL or CSA.

2 Safety instructions

2.1 General safety and application notes for Lenze controllers

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

For your personal safety

Disregarding the following safety measures can lead to severe injury to persons and damage to material 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.
 - Observe IEC 364 and CENELEC HD 384 or DIN VDE 0100 and IEC report 664 or DIN VDE 0110 and all national regulations for the prevention of accidents.
 - According to this basic safety information, qualified, skilled personnel are persons who are familiar with the assembly, installation, commissioning, and operation of the product and who have the qualifications necessary for their occupation.
- ▶ Observe all specifications in this documentation.
 - This is the condition for safe and trouble-free operation and the achievement of the specified product features.
 - The procedural notes and circuit details described in this documentation are only proposals. It's up to the user to check whether they can be transferred to the particular applications. Lenze Drives GmbH does not accept any liability for the suitability of the procedures and circuit proposals described.
- ▶ Depending on their degree of protection, some parts of the Lenze controllers (frequency inverters, servo inverters, DC speed controllers) and their accessory components can be live, moving and rotating during operation. Surfaces can be hot.
 - Non-authorised removal of the required cover, inappropriate use, incorrect installation or operation, creates the risk of severe injury to persons or damage to material assets.
 - For more information, please see the documentation.
- ▶ High amounts of energy are produced in the controller. Therefore it is required to wear personal protective equipment (body protection, headgear, eye protection, ear protection, hand guard).

Application as directed

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

When controllers are installed into machines, commissioning (i.e. starting of the operation as directed) is prohibited until it is proven that the machine complies with the regulations of the EC Directive 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 (2004/108/EC).

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

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

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

Transport, storage

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

Observe the climatic conditions according to the technical data.

Installation

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

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

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

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

Electrical connection

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

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

The documentation provides notes on EMC-compliant installation (shielding, earthing, filter arrangement, and laying of cables). Please also observe these notes when installing CE-labelled controllers. The manufacturer of the machine or plant is responsible for the compliance with the required limit values associated with EMC legislation.

Lenze controllers may cause a DC current in the PE conductor. If a residual current device is used as a protective means in the case of direct or indirect contact with a three-phase controller, a residual current device of type B must be used on the current supply side of the controller. If the controller has a single-phase supply, it is also permissible to use a residual current device of type A. Apart from the use of a residual current device, other protective measures can also be taken, such as isolation from the environment by double or reinforced insulation, or separation from the supply system by means of a transformer.

Operation

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

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

All protection covers and doors must be shut during operation.

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

Safety functions

Certain controller versions support safety functions (e.g. "Safe torque off", formerly "Safe standstill") according to the requirements of the EC Directive "Machinery" 2006/42/EC. The notes provided in the documentation on drive-based safety must be strictly observed.

Maintenance and servicing

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

Disposal

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

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

2.2 General safety and application instructions for Lenze motors

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

General

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

Synchronous machines induce voltages at open terminals during operation.

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

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

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

Application as directed

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

Low-voltage machines are components for installation into machines as defined in the Machinery Directive 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)

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

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

Transport, storage

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

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

Installation

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

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

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

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

Electrical connection

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

Check safe isolation from supply!

If the tolerances specified in EN 60034-1; IEC 34 (VDE 0530-1) - voltage $\pm 5\%$, frequency $\pm 2\%$, 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 connector must be bolted tightly (to stop).

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

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

Commissioning and operation

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

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

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

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

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

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

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

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

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

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

2.3 Residual hazards

Protection of persons

- ▶ Before working on the controller, check if no voltage is applied to the power terminals.
- ▶ The operating temperature of the heatsink at the controller is very high. Skin contact with the heatsink causes burns. If required, provide for protective covers.
- ▶ Before working on the controller, check if no voltage is applied to the power terminals because
 - depending on the device - the power terminals U, V, W, Rb1, and Rb2 remain live for at least 3 ... 20 minutes after disconnecting the mains.
 - the power terminals L1, L2, L3; U, V, W, Rb1, and Rb2 remain live when the motor is stopped.

Device protection

- ▶ Frequent switching on of the mains voltage (e.g. inching mode via mains contactor) may overload or destroy the controller.

Motor protection

- ▶ Frequent switching on may overheat the connected motor.
- ▶ Use PTC thermistors or thermostats with PTC characteristics to monitor the motor.
- ▶ 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

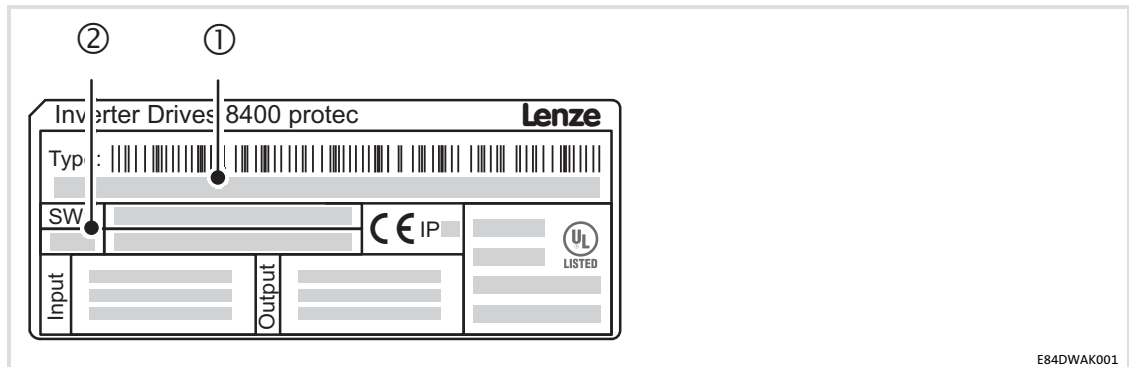
- ▶ Drives can reach dangerous overspeeds (e.g. setting of high output frequencies in connection with motors and machines unsuitable for such conditions):
 - The controllers do not offer any protection against such operating conditions. Use additional components for this purpose.
- ▶ Switch **contactors in the motor cable** only if the controller is inhibited.
When switching contactors in the motor cable while the controller is enabled, you can activate monitoring functions of the controller. If no monitoring function is activated, switching is permissible.
- ▶ All unused connectors must be closed with protection covers or blanking plugs.

Product description

Device features

Decentralised 8400 protec frequency inverter	Version		
Features	HighLine	StateLine	EMS
Power range	0.75 ... 7.5 kW	0.75 ... 4 kW	0.75 ... 7.5 kW
Mounting type	Wall-mounted device		
Brake management	Control of a mechanical motor holding brake		
24 V supply			
Internal (depending on mains voltage)	✓	✓	✓
24 V buffer voltage possible (for maintaining the control functionality in the case of mains failure)	✓	✓	-
Interfaces			
Digital inputs,	6	6	14
can be configured as outputs	2	2	2 or 4
Analog inputs	1	1	1
or optionally synchronous serial interface (SSI)		-	
Optional: RS485 or/and RS422	-	-	2 x RS485 2 x RS422 1 x RS485 / RS422 each
Remote control, infrared (IrRC)	✓ (from SW V12)	-	✓
Data interface, infrared (IrDA)	-	-	✓
Optional:			
Drive-based safety	Safety option (SO) 10, 20 or 30		-
Operation in generator mode	Internal or external brake resistor		
Control element	Various service switches		Rocker switch
Operation			
200 % overload current for 3 s	✓	✓	✓
S ramps for jerk-free acceleration and deceleration	✓	✓	✓
Protection against restart for cyclic mains switching	✓	✓	✓
Technology applications			
Speed actuating drive	✓	✓	✓
Switch-off positioning	✓	✓	✓
Absolute positioning	✓	-	✓
Table positioning	✓	-	✓
EMS-specific communication			
Half wave	-	-	✓
Half wave coded	-	-	✓
Power wave	-	-	✓
DECA BUS	-	-	✓
Inductive energy transmission	-	-	✓
PLC functionality	-	-	✓

3.2 Identification



E84DWAK001

- ① Type designation
② Version

Note

The type designation serves to identify detailed device properties with the following type code. The listing of the type code, features, and device properties does not consider any limitations of possible combinations.

In the HighLine and StateLine versions, certain combinations are not possible:

Possible ...			
either		or	
Safety option 30	< >	CAN on board	
Analog input	< >	SSI	

Impossible ...			
		with/in	
PROFIBUS	< >	Push-pull	
CANopen	< >	Push-pull	
SSI	< >	StateLine	
EtherNet/IP	< >	Safety option 20 or 30	

3.3

Type code

StateLine, HighLine

	E84D	x	x	x	x	① xxx	x	x	x	x	x	x	x
Product range Inverter Drives 8400 protec													
Version S = Stateline H = HighLine													
Connection system for mains and 24 V supply M = 2 hybrid plugs, type Q4/2 P = 1 hybrid plug, type Q4/2 H = circular connector Molex (Brad Mini-Change)													
Motor holding brake control (with connection system for motor) "Fast switch": B = plug type Modular Integrated half-wave brake rectifier: F = plug type Q8/0 "Cold brake": C = plug type Q8/0													
Series C = 24 V internal													
Power, e.g. 152 = 15 x 10 ² W = 1.5 kW													
Voltage class 4 = 400/500 V, 3/PE AC													
Communication (fieldbus) C = CANopen P = PROFIBUS® R = PROFINET® G = EtherNet/IP™													
Configuration of input and output range see table "Possible combinations", 27													
Extension module S = None													
Drive-based safety N = none J = safety option 10 K = safety option 20 L = safety option 30													
Control element N = none C = service switch with protective function W = service switch with operating unit													
Brake resistor N = none R = internal E = external connection option													

EMS version

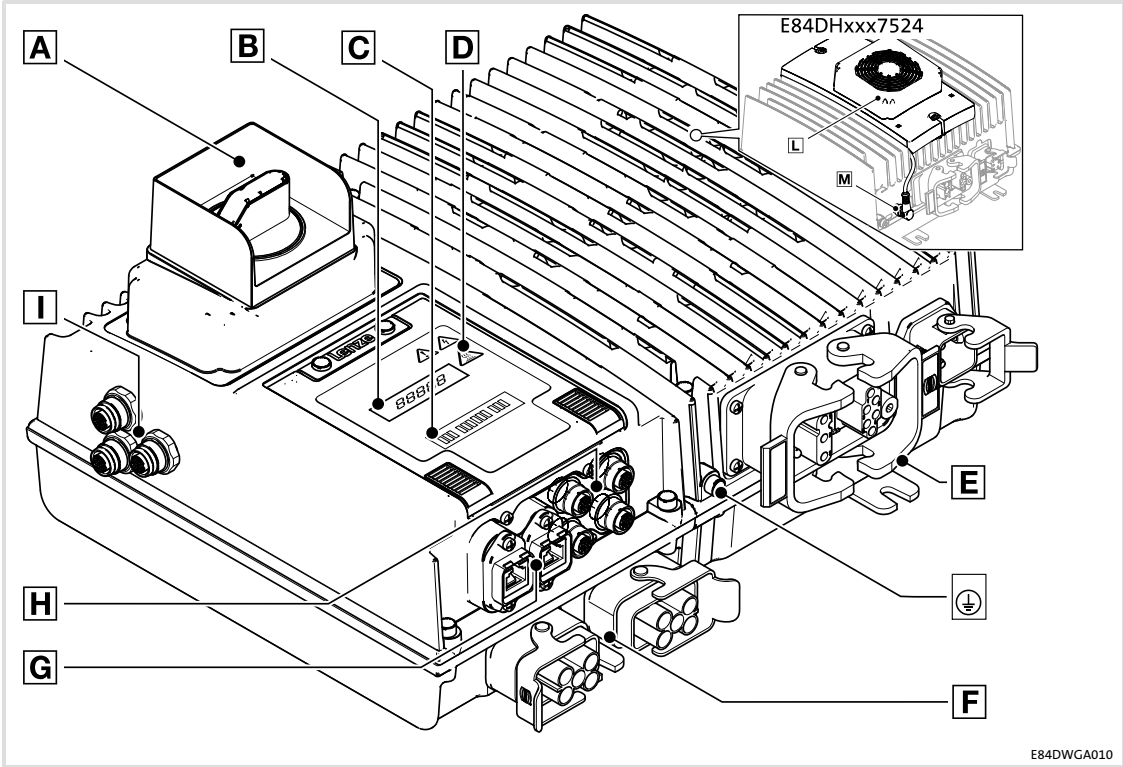
	E84D	x	x	x	x	① xxx	x	x	x	x	x	x	x
Product range Inverter Drives 8400 protec EMS													
Special communication version for monorail overhead conveyor applications E = half wave L = coded half wave P = power wave D = DECA bus F = inductive system													
Connection system for mains and 24-V supply of the brake control in case of inductive systems M = 2 hybrid plugs, type Q4/2 P = 1 hybrid plug, type Q4/2													
Motor holding brake control (with connection system for motor) "Fast switch": B = plug type Modular Integrated half-wave brake rectifier: K = plug type Q8/0 H = plug type Han 10E 24 V DC: V = plug type Q8/0 (for version F only)													
Series for half wave version: D = half wave 400 V AC / reference phase L1 // 24 V DC internal E = half wave 400 V AC / reference phase L3 // 24 V DC internal for coded half wave version: F = half wave 230 V AC / reference phase L1 // 24V DC internal G = half wave 230 V AC / reference phase L3 // 24V DC internal for power wave version or DECA bus: E = half wave 400 V AC / reference phase L3 // 24 V DC internal for inductive system version: C = 24 V DC internal													
Power, e.g. 152 = $15 \times 10^2 \text{ W} = 1.5 \text{ kW}$													
Voltage class 4 = 400/500 V, 3/PE AC													
Communication (fieldbus) C = CANopen													
Configuration of input and output range 1 = CANopen and analog input via M12 plug 5 = CANopen and SSI via M12 plug													
Extension module B = digital I/O, CAN, 2 x RS485 C = digital I/O, CAN, RS485, RS422 D = digital I/O, CAN, 2 x RS422													
Drive-based safety N = none													

	E84D	x	x	x	x	xxx	x	x	x	x	x	x	x
Control element N = none C = service switch with protective function R = rocker switch for EMS (without mains disconnection)													
Brake resistor N = none R = internal E = external connection option													

3.4

Overview of standard devices

StateLine, HighLine

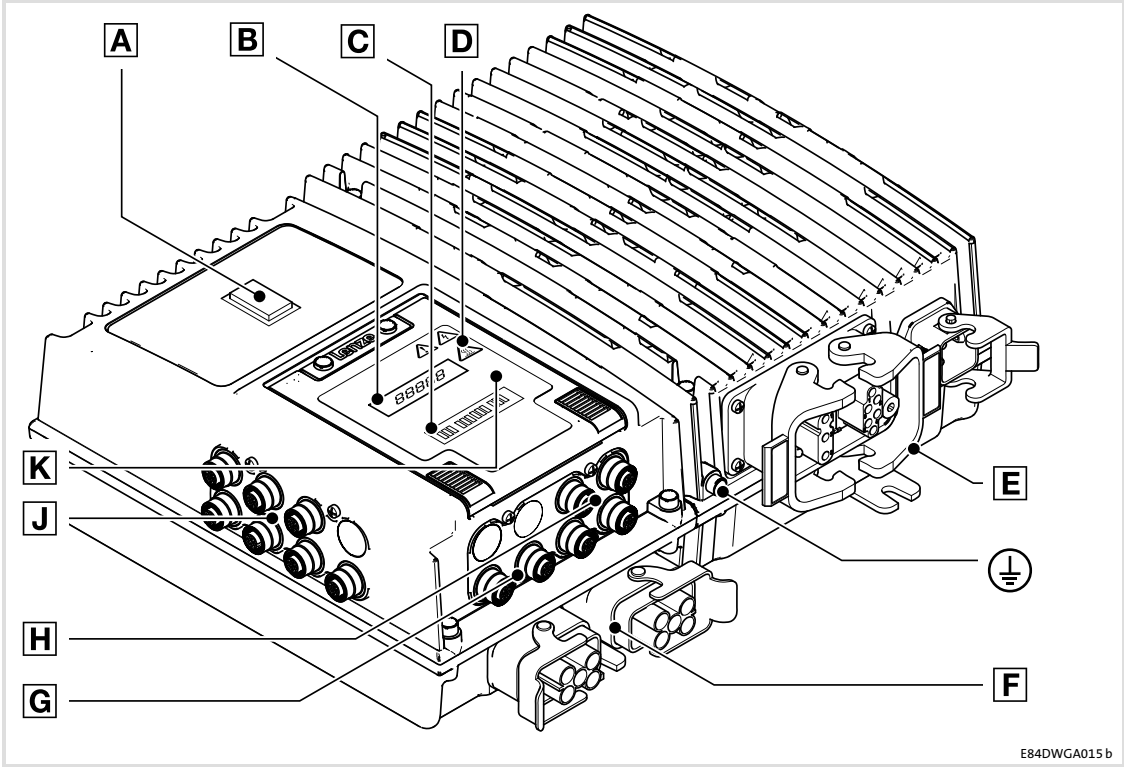


Control elements and overview of connections

Pos.	Description/function	Page(s)
A	Control element, various versions, optional	22
B	Display for values and messages, 5 characters	165
C	LED status display	159
D	Warning symbols	See below
E	Motor and brake resistor connections	From 87
F	Connections for mains and 24 V supply voltage	
G	Fieldbus connections	From 64
H	Input and output connections	
I	Connections for safety system and/or CAN on board	
⊕	PE connections, M6 thread	-
L	only E84DHxx7524: External fan	-
M	Operating voltage for the external fan	

Pos.	Icon	Description
D		Long discharge time: All power terminals remain live for up to 3 minutes after mains disconnection!
		High discharge current: Carry out fixed installation and PE connection according to EN 61800-5-1!
		Electrostatic sensitive devices: Before working on the device, the personnel must be free of electrostatic charge!
		Hot surface: Risk of burns! Hot surfaces should not be touched without wearing protective gloves.

EMS version



E84DWGA015 b

Control elements and connection overview of the EMS version		
Pos.	Description/function	Page(s)
A	Control element, various versions, optional	23
B	Display for values and messages, 5 characters	165
C	LED status display	159
D	Warning symbols	See below
E	Motor and brake resistor connections	From 87
F	Mains connections and EMS-specific communication	
G	Fieldbus connections	From 64
H	Input and output connections	
J	EMS extension connection	22
K	Infrared receiver/transmitter	165
⊕	PE connections, M6 thread	-

Pos.	Icon	Description
D		Long discharge time: All power terminals remain live for up to 3 minutes after mains disconnection!
		High discharge current: Carry out fixed installation and PE connection according to EN 61800-5-1!
		Electrostatic sensitive devices: Before working on the device, the personnel must be free of electrostatic charge!
		Hot surface: Risk of burns! Hot surfaces should not be touched without wearing protective gloves.

3.5 Communication

The available combinations of communication and connection system can be seen from the table.

Type code characteristics		Connection system version				
Communication (fieldbus)	Input / output area configuration	Fieldbus		SSI 3)	Analog input	CAN on board
		Push-pull	M12	M12	M12	M12
CANopen 1)						
C	1	-	☑	-	☑	-
	5	-	☑	☑	-	-
PROFIBUS						
P	1	-	☑	-	☑	-
	3	-	☑	-	☑	☑ 2)
	5	-	☑	☑	-	-
	7	-	☑	☑	-	☑ 2)
PROFINET / EtherNet/IP 1)						
R / G	1	-	☑	-	☑	-
	2	☑	-	-	☑	-
	3	-	☑	-	☑	☑ 2)
	4	☑	-	-	☑	☑ 2)
	5	-	☑	☑	-	-
	6	☑	-	☑	-	-
	7	-	☑	☑	-	☑ 2)
	8	☑	-	☑	-	☑ 2)

☑ designed

¹⁾ cannot be combined with safety options 20 and 30

²⁾ cannot be combined with safety option 30

³⁾ not in StateLine version

- impossible

3.5.1 CAN port

Detailed information on CAN can be found in the software manual.

CAN on board

"CAN on board" is only suited for short point-to-point connections between two controllers, e.g. for synchronisation. Pay attention to notes on EMC-compliant wiring and short cable lengths as there is no isolation towards the control electronics of the controller.

Node address and baud rate must be parameterised using the »Engineer«.

CANopen

CANopen is executed as isolated fieldbus and suited for multiple-node networks.

In case of fieldbuses, node address and baud rate can be set using the DIP switch under the service hatch or parameterised using the »Engineer«.

3.5.2 Infrared remote control receiver

For remote control, the devices are equipped with an infrared receiver (IrRC) (supported from SW version 12 onwards).

The actions enabled by the infrared remote control (LDEZIRRC) are freely programmable. For more information see the software manual and the online help for the LS_IRInterface system block.



Note!

A trouble-free operation of the optical interface requires:

- ▶ Clear line of sight between transmitter and receiver
 - Maximum distance IrRC: ~ 5 m
 - Maximum distance IrDA: ~ 1 m
 - Angle of incidence: ~ 30 °
 - Avoid direct solar radiation
 - Environment without interfering transmitter (e.g. from adjacent stations)
- ▶ Clean and scratch-free service hatch

3.5.3 Extensions in EMS version

For EMS device versions, additional interfaces are implemented for control :

- ▶ Additional digital inputs and outputs
- ▶ Infrared data interface (IrDA)
- ▶ RS485 and/or RS422 serial interface

The type designation indicates which extensions are implemented in a device (📖 23).

Overview of EMS extensions

Indicator in the type code	Connection			
	Digital I/O	RS485	RS422	CANopen master PLC
	X45, X46, X47, X48 M12, 5-pole, A-coded	X81, X82 M12, 8-pole, A-coded		X34 M12, 5-pole, A-coded
B	6 x DI 2 x DI/O (X46 configurable)	2 x	-	☑
C		1 x	1 x	☑
D		-	2 x	☑

- ☑ designed
- impossible

3.5.4 Infrared interface

The EMS versions come with an implemented infrared interface for data transfer (IrDA). The actions enabled via the interface or the reading of parameter data (codes) are freely programmable in the PLC program.



Note!

A trouble-free operation of the optical interface requires:

- ▶ Clear line of sight between transmitter and receiver
 - Maximum distance IrRC: ~ 5 m
 - Maximum distance IrDA: ~ 1 m
 - Angle of incidence: ~ 30 °
 - Avoid direct solar radiation
 - Environment without interfering transmitter (e.g. from adjacent stations)
- ▶ Clean and scratch-free service hatch

3.6 Concepts for the mains connection

8400 protec controllers support the implementation of various concepts for the mains connection. Here, a distinction is drawn between wiring using a:

- ▶ Standard cable - commercially available cable
- ▶ Hybrid cable - special cable for mains voltage and buffer/control voltage, including shielding if required

The following must be observed when selecting the wiring:

- ▶ Permissible back-up fuse: max. 32 A
- ▶ Permissible current for plug contacts 24 V supply: max. 10 A
- ▶ Select the cable cross-sections in compliance with applicable standards and directives.
 - Mains/PE: max. 6 mm²
 - 24 V supply: max. 2.5 mm²

3.6.1 Concepts for the connection of individual axes

The following versions are possible according to device version (see type code for mains connection system):

Standard cable ①

The mains voltage is connected to the controller by means of a standard cable (plug X10).

The 24 V supply of the controller is generated inside the device (mains-operated supply). After the mains voltage has been switched off, all device functions including the control electronics are deactivated. The switch function of Ethernet fieldbuses is also inactive.

Hybrid cable with external 24 V buffer voltage ②

The mains voltage and an external 24 V buffer voltage are fed using a hybrid cable (plug X10). Depending on the state of the external 24 V supply, it is possible for the control electronics to remain active even if the mains is switched off.

Standard cable with external 24 V buffer voltage ③

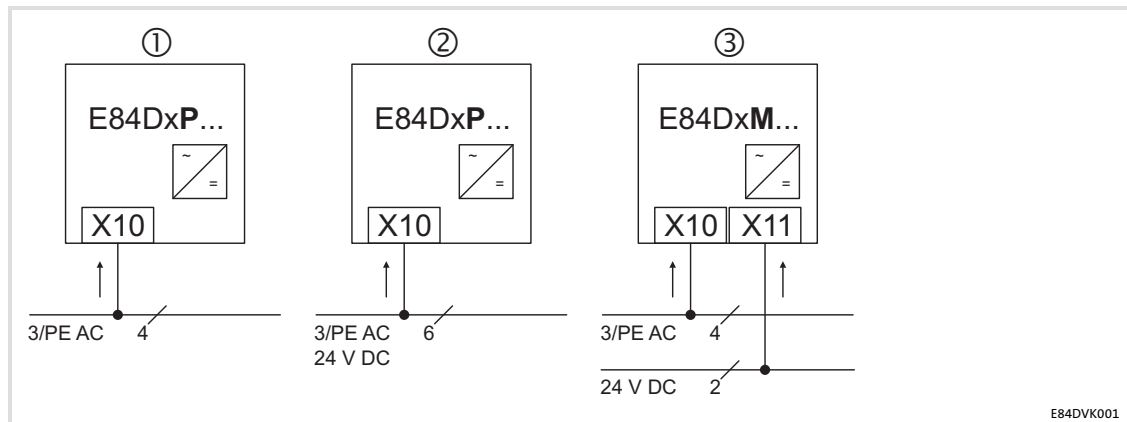
Since the connector housings only allow for one cable access per Q4/2 connector, the E84DxM... device version (loop-through technique) can be used to implement this concept for connection.

Here, the mains voltage is connected to the controller by means of a standard cable (plug X10). The external 24 V buffer voltage is connected by means of a standard cable (plug X11). Depending on the state of the external 24 V supply, it is possible for the control electronics to remain active even if the mains is switched off.

**Note!**

This concept for connection implies that the mains voltage at plug X10 is also applied at plug X11 at the same time.

Wiring principle



- | | |
|-----|---|
| ① | 8400 protec in version E84DxP... |
| X10 | Mains connection 3/PE AC with standard cable |
| ② | 8400 protec in version E84DxP... |
| X10 | Mains connection 3/PE AC with 24 V DC buffer voltage and hybrid cable |
| ③ | 8400 protec in version E84DxM... |
| X10 | Mains connection 3/PE AC with standard cable |
| X11 | 24 V DC buffer voltage with standard cable |

3.6.2 Concepts for the connection of the power bus

Spacious plants are often organised in lines. A clearly structured cable routing leads to a typical line topology. Two connection types are used:

- ▶ Loop-through technique from device to device
 - Here, the mains voltage and the 24 V buffer voltage are applied at X10 and X11 at the same time.
- ▶ Branch of power distributors

Depending on the type of cables and the 24 V supply, the following implementations are possible.

Possible loop-through arrangements:

Standard cable ①

The mains voltage is distributed among the devices by means of a standard cable (plugs X10 and X11). The 24 V supply of the controller is generated inside the device (mains-operated supply). After the mains voltage has been switched off, all device functions including the control electronics are deactivated. The switch function of Ethernet fieldbuses is also inactive.

Hybrid cable with external 24 V buffer voltage ②

The mains voltage and an external 24 V buffer voltage (self-contained) are distributed among the devices using a cable (plugs X10 and X11). Depending on the state of the external 24 V supply, it is possible for the control electronics to remain active even if the mains is switched off.

Arrangements including power distributors:

Standard cable including power distributors ③

The mains voltage is carried in a cable and distributed to the device by power distributors (plug X10). The 24 V supply of the controller is generated inside the device (mains-operated supply). After the mains voltage has been switched off, all device functions including the control electronics are deactivated. The switch function of Ethernet fieldbuses is also inactive.

Hybrid cable with power distributors and external 24 V buffer voltage ④

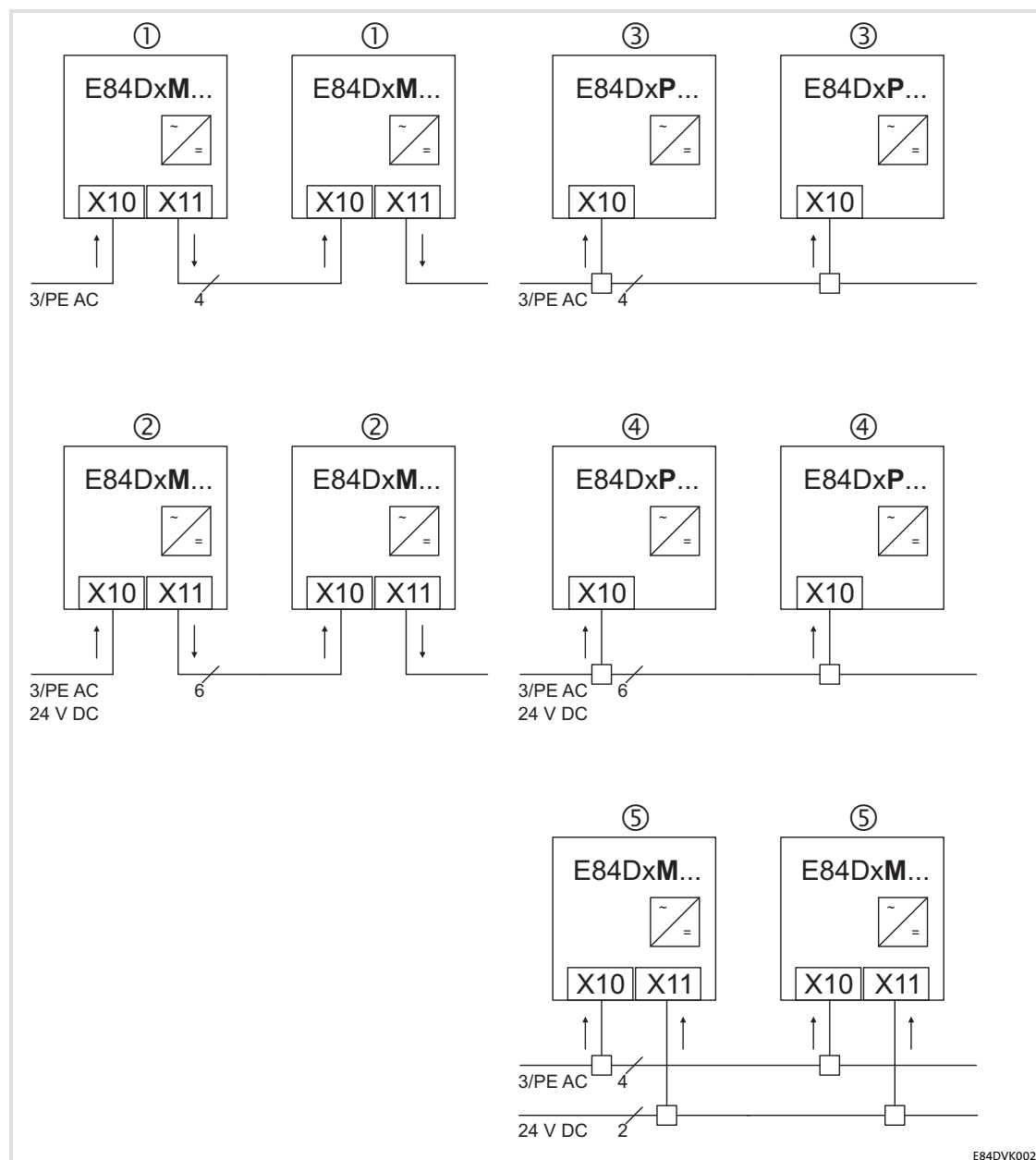
The mains voltage and the 24 V buffer voltage are carried in a cable and distributed to the device by power distributors (plug X10). Depending on the state of the external 24 V supply, it is possible for the control electronics to remain active even if the mains is switched off.

Standard cable with power distributors and external 24 V buffer voltage ⑤

Isolated cable routing for mains voltage and 24 V buffer voltage.

Here, the mains voltage is connected to the controller by means of a standard cable (plug X10). The external 24 V buffer voltage (self-contained) is connected by means of a standard cable (plug X11). Depending on the state of the external 24 V supply, it is possible for the control electronics to remain active even if the mains is switched off.

Wiring principle



E84DVK002

- | | |
|-----------------|---|
| ①
X10, X11 | Loop-through technique with 8400 protec in version E84DxM...
Mains connection 3/PE AC with standard cable |
| ②
X10, X11 | Loop-through technique with 8400 protec in version E84DxM...
Mains connection 3/PE AC with 24 V DC supply voltage and hybrid cable |
| ③
X10 | Power distributor with 8400 protec in version E84DxP...
Mains connection 3/PE AC with standard cable |
| ④
X10 | Power distributor with 8400 protec in version E84DxP...
Mains connection 3/PE AC with 24 V DC supply voltage and hybrid cable |
| ⑤
X10
X11 | Power distributor with 8400 protec in version E84DxM...
Mains connection 3/PE AC with standard cable
24 V DC buffer voltage with standard cable |

3.7 EMS mains connection concepts

The mains connection concepts can also be realised with 8400 protec EMS, e.g.

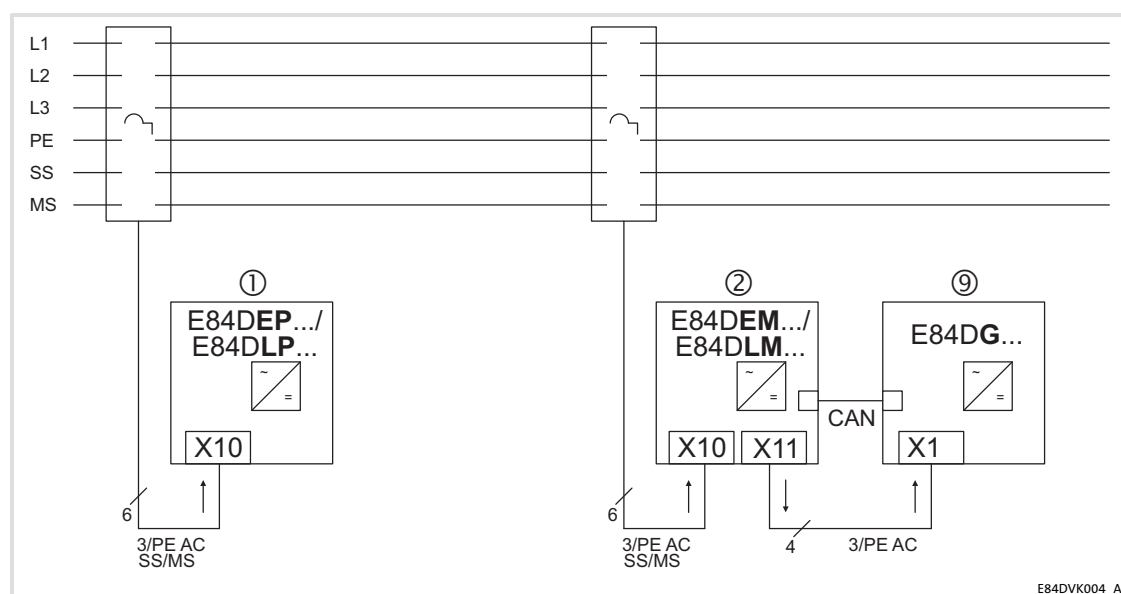
- Loop-through technique from device to device for multi-axis applications

Moreover, 8400 protec EMS controllers support the following (depending on the device version):

- Contact conductor connection for mains, control bar and message bar (half wave and coded half wave)
- Control signals via mains voltage (power wave)
- Control signals via rail bus
- Inductive transmission of energy and signals

For establishing a drive system, more adjusted components are required.

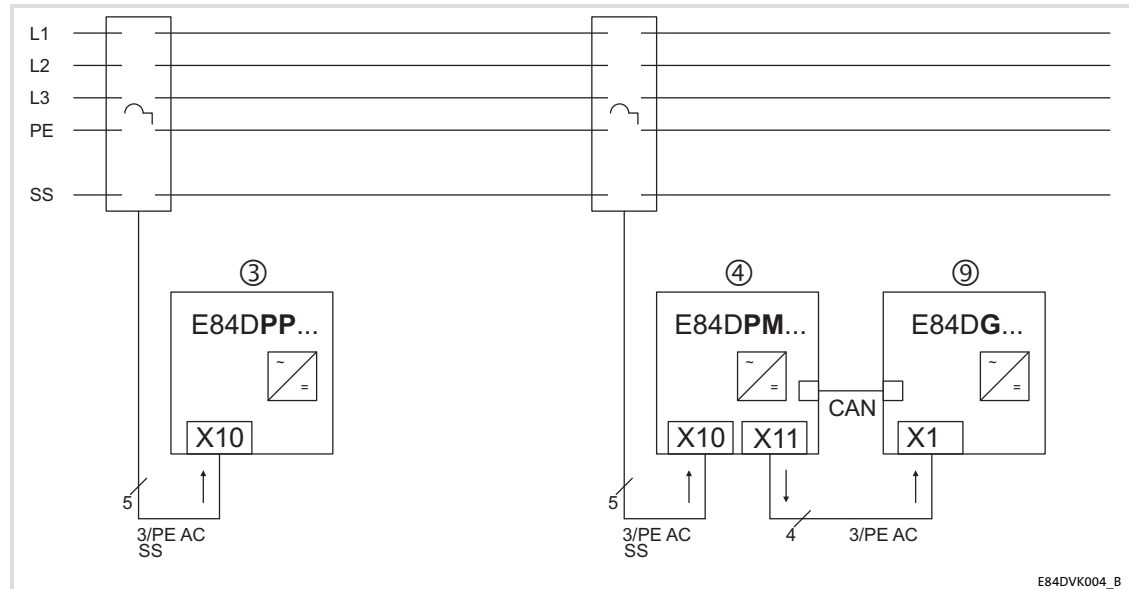
3.7.1 Half wave (coded)



L1 ... L3, PE	Sliding bar conductors for mains and PE conductor
SS	Control bar SS1, SS2
ms	Message bar MS1
①	8400 protec EMS controller for single-axis drive
②	8400 protec EMS controller for multi-axis drive
X10	Mains
X11	Mains loop-through technique
CAN	CANopen communication
③	Controller, e.g. 8400 motec, as auxiliary drive
X1	Mains (with accessory plug-in module E84DZEVb...: X10)

3.7.2

Power wave



L1 ... L3, PE

SS

③

④

X10

X11

CAN

⑨

X1

Sliding bar conductors for mains and PE conductor

Control bar Data±, SS1

8400 protec EMS controller for single-axis drive

8400 protec EMS controller for multi-axis drive

Mains

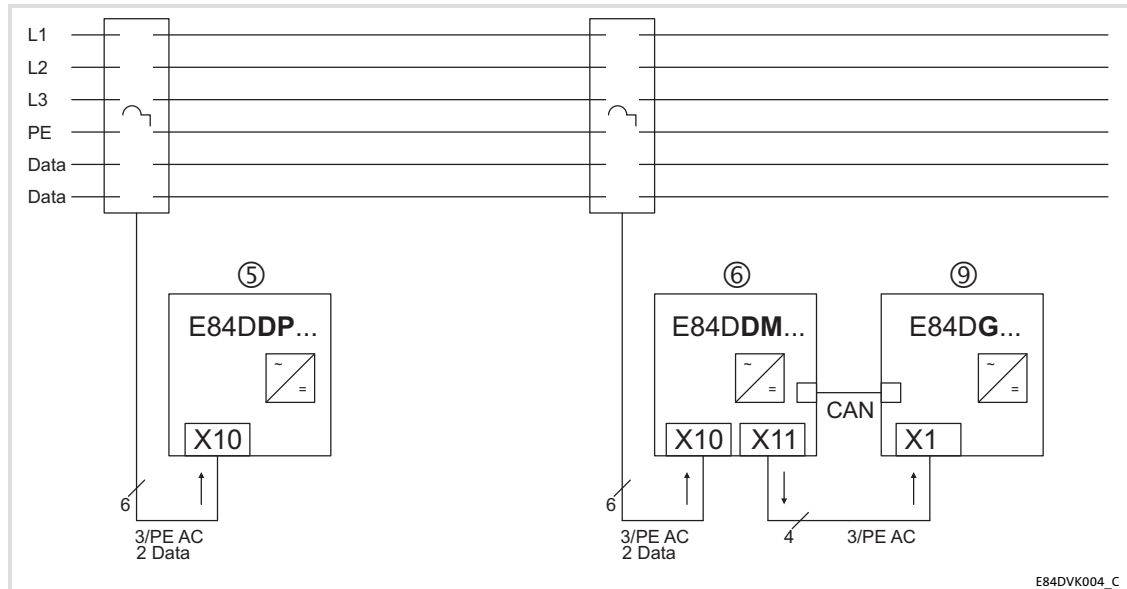
Mains loop-through technique

Communication of CANopen master PLC

Controller, e.g. 8400 motec, as auxiliary drive

Mains (with accessory plug-in module E84DZEVb...: X10)

3.7.3 DECA bus



L1 ... L3, PE
 Data

⑤

⑥

X10

X11

CAN

⑨

X1

Sliding bar conductors for mains and PE conductor

Signal rails Data±, SS1

8400 protec EMS controller for single-axis drive

8400 protec EMS controller for multi-axis drive

Mains

Mains loop-through technique

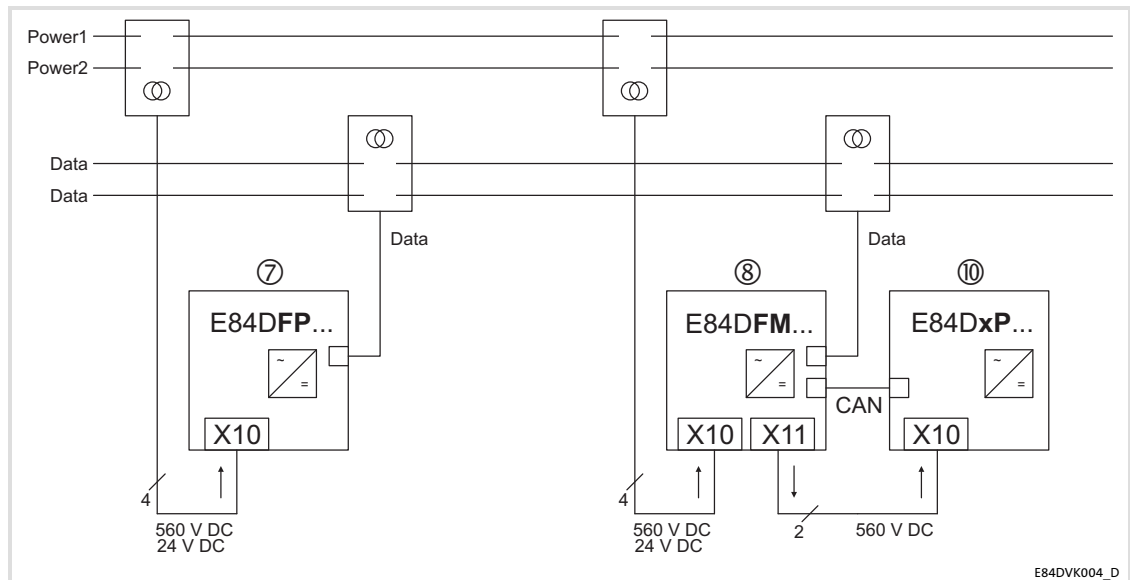
Communication of CANopen master PLC

Controller, e.g. 8400 motec, as auxiliary drive

Mains (with accessory plug-in module E84DZEVb...: X10)

3.7.4

Inductive



Power1/2

Inductive energy transmission
(24 V DC for controlling a motor holding brake)

Data

Inductive data transfer

⑦

8400 protec EMS controller for single-axis drive

⑧

8400 protec EMS controller for multi-axis drive

X10

Mains

X11

Mains loop-through technique

CAN

Communication of CANopen master PLC

⑩

Controller, e.g. 8400 protec, as auxiliary drive

X10

DC mains voltage

4 Technical data

4.1 General data and operating conditions

General data

Conformity and approval

Conformity

CE	2006/95/EC	Low-Voltage Directive	 13.1
----	------------	-----------------------	--

Approval

cULUS	UL 508C CSA 22.2 No. 14	Power Conversion Equipment, File No. 132659
	-	No UL approval for control element W

Protection of persons and equipment			
Enclosure	EN 60529	IP65	All unused connectors must be closed with protection covers or blanking plugs.
		Deviating enclosure by options:	
		IP64 with control element C	
		IP54 with control element W	
		IP55 with external fan for 7.5 kW devices	
	NEMA	Type 4X, indoor only	
(Earth) leakage current	EN 61800-5-1	> 3.5 mA AC, > 10 mA DC	Observe the regulations and safety instructions!
Total fault current		< 100 mA Earth-leakage circuit breakers of type B can be used.	
additional equipotential bonding		M6 thread outside at the housing for connecting a 16mm ² PE cable	
Protective insulation of control circuits	EN 61800-5-1	Safe isolation from mains by double (reinforced) insulation	
Insulation resistance	EN 61800-5-1	< 2000 m site altitude: Overvoltage category III > 2000 m site altitude: Overvoltage category II	
Short-circuit strength	EN 61800-5-1	Motor connection: Limited, controller is inhibited, error acknowledgement required	
		Phase/phase not earth-fault-proof	Max. short-circuit current to be expected: 10 kA
		Motor holding brake connection: no	
		Brake resistor connection: no	
		PTC connection: not earth-fault-proof	
		Control terminals: full	
Protective measures for		- Short circuit on the motor side at switchon and during operation - Earth fault at switchon - Motor stalling - Motor overtemperature - Input for PTC or thermal contact - I²t monitoring	
Cyclic mains switching		3 switching/minute - maximally 20 switching/hour A circuit that can be reset automatically protects the device against destruction.	
Installation	EN 60204-1	Cable protection on the supply side is max. 32 A with - cable cross-section (L1, L2, L3): 6 mm² - laying system B2 max. short-circuit current: < 10 kA	

Operating conditions

Ambient conditions

Climatic

Storage	EN 60721-3-1	1K3 (-25 ... +60 °C)	< 6 months
		1K3 (-25 ... +60 °C)	> 6 months > 2 years: Anodise DC bus capacitors
Transport	EN 60721-3-2	2K3 (-25 ... +75 °C)	
Operation	EN 60721-3-3	3K3 (-25 ... +55 °C)	"K" or "L" safety system included: -25 ... +45 °C
		Operation at 2/4 kHz: > +45 °C: Reduce the rated output current by 2.5 %/°C. Operation at 8/16 kHz: > +40 °C: Reduce the rated output current by 2.5 %/°C.	
Site altitude		0 ... 4000 m amsl Above 1000 ... 4000 m amsl: Reduce the rated output current by 5 %/ 1000 m.	
Pollution	EN 61800-5-1	Degree of pollution 2	

Mechanical

Vibration resistance ($9.81 \text{ m/s}^2 = 1 \text{ g}$)

Transport	EN 60721-3-2	2M2
	EN 61800-2	2 ... 9 Hz: Amplitude 3.5 mm
		10 ... 200 Hz: Acceleration resistant up to 10 m/s^2 200 ... 500 Hz: Acceleration resistant up to 15 m/s^2
Operation	Germanischer Lloyd	General conditions: Acceleration resistant up to 2 g
	EN 60721-3-3	3M4
	EN 61800-5-1	10 ... 57 Hz: Amplitude 0.075 mm 57 ... 150 Hz: Acceleration resistant up to 1 g

Supply conditions

Mains connection

Power system

TT, TN (with earthed neutral)		Operation is permitted without any restrictions.
IT		Only permitted with devices of voltage class "E" (see type code).

Motor connection

Motors	EN 60034	Only use motors suitable for inverter operation. Insulation resistance: min. $\hat{u} \geq 1.5 \text{ kV}$, min. $du/dt \geq 5 \text{ kV}/\mu\text{s}$
Length of the motor cable		< 20 m (Lenze system cable, shielded)

Mounting conditions

Mounting place		Wall Ensure convection cooling in the niches.)
Mounting position		
Standard mounting		Display to the front Vertically suspended, -30 ... +30 ° In case of greater angles of tilt: Operation at 2/4 kHz: > +40 °C: Reduce the rated output current by 2.5 %/°C. Operation at 8/16 kHz: > +35 °C: Reduce the rated output current by 2.5 %/°C.
Free space		 72

Requirements on the motor cable

Capacitance per unit length

$\leq 1.5 \text{ mm}^2/\text{AWG 16}$	$C_{\text{Core/core}}/C_{\text{Core/shield}} \leq 75/150 \text{ pF/m}$
$\geq 2.5 \text{ mm}^2/\text{AWG 12}$	$C_{\text{core/core}}/C_{\text{Core/shield}} \leq 100/\leq 150 \text{ pF/m}$

Electric strength

VDE 0250-1	$U_0/U = 0.6/1.0 \text{ kV}$	(U_0 = r.m.s. value external - conductor/PE, U = r.m.s. value - external conductor/external conductor)
UL	$U \geq 600 \text{ V}$	(U = r.m.s. value external conductor/external conductor)

EMC		
Noise emission		
Cable-guided	EN 61800-3	Up to 20 m shielded motor cable (Lenze system cable): category C2
Radiation		Category C2
Noise immunity (according to requirements of EN 61800-3)		
Electrostatic discharge (ESD)	EN 61000-4-2	8 kV with air discharge, 4 kV with contact discharge against housing
Radio frequency		
Cable-guided	EN 61000-4-6	150 kHz ... 80 MHz, 10 V/m 80 % AM (1kHz)
Interference (housing)	EN 61000-4-3	80 MHz ... 1000 MHz, 10 V/m 80 % AM (1kHz)
Burst		
Power terminals and interfaces	EN 61000-4-4	2 kV/5 kHz
Signal interfaces	EN 61000-4-4	1 kV/5 kHz
Control terminals	EN 61000-4-4	2 kV/5 kHz
Surge		
Power terminals	EN 61000-4-5	1.2/50 µs, 1 kV phase/phase, 2 kV phase/PE
Control terminals	EN 61000-4-5	1.2/50 µs, 1 kV
Operation on public supply systems	EN 61000-3-2 EN 61000-3-12	The devices are intended for use in an industrial environment. When being used on public network, additional measures must be taken to limit the expected radio interference. The compliance with the requirements for the machine/plant is the responsibility of the manufacturer of the machine or system!
	EN 61000-3-2	< 0.5 kW: with mains choke
		0.5 ... 1 kW: with active filter
		> 1 kW at mains current ≤ 16 A: No limit values for harmonic currents
	EN 61000-3-12	Mains current > 16 A: further measures are required for compliance with the standard

Open and closed loop control**Open and closed loop control processes**

	VFCplus: • V loop (linear or square-law) • V/f closed loop SLVC: • Sensorless vector control (torque/speed)
Only for HighLine device version	SC: • Servo control (torque/speed)
from SW version 12	VFCplus eco: • Energy-efficient V/f characteristic SL PSM: • Sensorless synchronous control (torque/speed)

Switching frequency

	2 kHz, 4 kHz, 8 kHz, 16 kHz, Optionally noise optimised or power-loss optimised
--	--

Torque behaviour

Setting range	1 : 10	In a setting range of 3 ... 50 Hz
---------------	--------	-----------------------------------

Sensorless vector control (speed)

Minimum output frequency	0.5 Hz (0 ... M_{rated})	
Setting range	1 : 10	Based on 50 Hz and M_{rated}
Accuracy	± 0.5 %	In a setting range of 3 ... 50 Hz
Smooth running	± 0.1 Hz	

Output frequency

Range	-1000 Hz ... +1000 Hz	
Absolute resolution	0.2 Hz	
Standardised resolution	Parameter data: 0.01 %, process data: 0.006 % (= 2^{14})	

Digital setpoint selection

Accuracy	± 0.01 %	
----------	--------------	--

Analog setpoint selection

Accuracy	± 1 %	Based on the final value
----------	-----------	--------------------------

EMS version

Half-wave system		
E84DE..., E84DL...		
Control bar		
Z system		No
Number		2
Signal level		Full wave
		Positive half wave
		Negative half wave
		Coded half wave
Reference voltage or switched voltage		L3 L1 possible with different hardware configuration
Rated voltage		400-480 V AC, 50-60 Hz
		Coded half wave: 230 V AC, 50-60 Hz
Switching threshold		50 Hz: 270 V AC (243 ... 297 V AC) 60 Hz: 330 V AC (297 ... 363 V AC)
Power input		1.5 W (400 V AC) for 1 x half wave
Signalling bar		
Number		1
Signal level		Full wave
		Positive half wave
		Negative half wave
Reference voltage or switched voltage		L3 L1 possible with different hardware configuration
Short circuit protection		PTC protection (500 Ω connected in series)
Reference voltage		400 ... 480 V
Switching current		max. 28 mA AC

4 Technical data

Rated data

Overview

4.2 Rated data

4.2.1 Overview

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

Output switching frequency $f = 4 \text{ kHz}$

Input data

	Voltage [V]	Frequency [Hz]	Rated current [A]		Number of phases
			up to +45 °C ①	up to +55 °C ①	
E84Dxxxx7514	400/500	50/60	4.1/3.2	3.0/2.4	3
E84Dxxxx1524	400/500	50/60	5.5/4.4	3.5/3.1	3
E84Dxxxx3024	400/500	50/60	9.7/7.9	7.3/6.0	3
E84Dxxxx4024	400/500	50/60	12.9/11.0	9.5/8.1	3
E84DHxxx7524	400/500	50/60	20.8/16.6	15.6/12.5	3

① Ambient temperature during operation

Rated data of the 24-V buffer voltage (preserves the control functionality in the event of a mains failure):

Typ	Supply voltage for control electronics of the controller (safely separated power supply unit SELV/PELV)		
	Voltage range U_{DC} [V DC]	Current consumption at + 24 V DC [A]	
		Min. ¹⁾	Max. ²⁾
E84Dxxxx7514	$+ 24$ (+19.2 - 0 % ... +28.8 + 0 %)	0.2 ... 0.6	2
E84Dxxxx1524			
E84Dxxxx3024			
E84Dxxxx4024			
E84DHxxx7524			

¹⁾ according to optional equipment, digital inputs and outputs are not wired

²⁾ digital inputs and outputs are completely wired



Note!

The maximum total current of the 24 V voltage supply for external actuators and encoders is 1 A, e.g. ports

- Digital inputs/outputs at X4x,
- Analog input at X50 or SSI at X80, and
- Serial interfaces RS485/RS422 at X81/X82.

Output data

	Voltage [V]	Frequency [Hz]	Rated current [A]		Number of phases
			up to +45 °C ①	up to +55 °C ①	
E84Dxxxx7514	0 ... 400/500	0 ... 1000	2.4/1.9	1.8/1.4	3
E84Dxxxx1524	0 ... 400/500	0 ... 1000	3.9/3.1	2.9/2.3	3
E84Dxxxx3024	0 ... 400/500	0 ... 1000	7.3/5.8	5.5/4.4	3
E84Dxxxx4024	0 ... 400/500	0 ... 1000	9.5/7.6	7.1/5.7	3
E84DHxxx7524	0 ... 400/500	0 ... 1000	16.0/12.8	12.0/9.6	3

① Ambient temperature during operation

Power losses

Type	Power loss P_V [W]	
	when operating with rated output current I_{arated}	when controller is inhibited
E84Dxxxx7514	66	27
E84Dxxxx1524	84	
E84Dxxxx3024	127	
E84Dxxxx4024	155	
E84DHxxx7524	232	

4.2.2

Operation at rated mains voltage 400 V

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

Type	Mains current at I_{Rated} I_{Rated} [A]	Output power U, V, W S_{Rated} [kVA]	Motor power 4 pol. ASM P_{Rated} [kW]
E84Dxxxx7514	4.1	1.5	0.75
E84Dxxxx1524	5.5	2.4	1.5
E84Dxxxx3024	9.7	4.6	3.0
E84Dxxxx4024	12.9	5.9	4.0
E84DHxxx7524	20.8	10.0	7.5

Type	Output currents [A] at switching frequency							
	2 kHz		4 kHz		8 kHz		16 kHz	
	$I_{\text{Rated}2}$	$I_{\text{aM}2}$	$I_{\text{Rated}4}$	$I_{\text{aM}4}$	$I_{\text{Rated}8}$	$I_{\text{aM}8}$	$I_{\text{Rated}16}$	$I_{\text{aM}16}$
E84Dxxxx7514	2.4	4.8	2.4	4.8	2.4	4.8	1.6	4.0
E84Dxxxx1524	3.9	7.8	3.9	7.8	3.9	7.8	2.3	6.4
E84Dxxxx3024	7.3	14.6	7.3	14.6	7.3	14.6	4.9	9.5
E84Dxxxx4024	9.5	19.0	9.5	19.0	9.5	17.0	6.3	9.5
E84DHxxx7524	16.0	32.0	16.0	32.0	16.0	30.0	10.7	21.3

I_{aNx}
 I_{aMx}

Rated value of continuous output current

Maximum output current (overload current)

- Periodic load change of 3 s with I_{aMx} and recovery time of 12 s according to the tables under chapter 4.4
- Can be obtained in the setting "x kHz fixed/..." in C00018

Switching
frequency

If the maximum heatsink temperature is reached, the switching frequency is reduced to 4 kHz.

In the setting "x kHz var./..." in C00018 the switching frequency is reduced depending on the output current.

Depending on the switching frequency and e.g. the ambient temperature, it may be required to reduce the output current (chapter 4.1, operating conditions).

Rated data for internal brake chopper

Switching threshold V_{BRmax} : 725 V, adjustable

Type	R _{Bmin} [Ω]	I _{BRmax} [A]	P _{BRmax} [kW]	I _{BRd} [A]	P _{Bd} [kW]	t _z [s]	t _{on} [s]	t _{fp} [s]
Internal brake resistor								
E84Dxxx7514 E84Dxxx1524	220	3.3	2.4	0.5	0.05 ¹⁾	-	-	-
E84Dxxx3024 E84Dxxx4024 E84Dxxx7524	-	-	-	-	-	-	-	-
External brake resistor								
E84Dxxx7514	150	4.8	3.5	1.4	0.9	300	60	-
E84Dxxx1524	150	4.8	3.5	2.9	2.0	300	60	-
E84Dxxx3024	47	15.4	11.2	5.7	3.9	300	60	-
E84Dxxx4024	47	15.4	11.2	7.5	5.2	300	60	-
E84Dxxx7524	47	15.4	11.2	14.1	9.8	300	60	-

R_{Bmin}	Minimum brake resistance, nominal value $\pm 10\%$
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
¹⁾	Max. heat Q_B: 3 kW Max. power loss in the internal brake resistor P_{Bdav} : see table

	f _{ch} [kHz]	I _a [A]	P _{Bdav} [W]			
			T _{amb}	20 °C	30 °C	40 °C
E84Dxxx7514	4	2.4	50	47	-	27
		1.4	50	41	-	21
	8	2.4	48	34	21	-
		1.4	36	23	10	-
E84Dxxx1524	4	3.9	42	28	-	8
		2.34	50	47	-	27
	8	3.9	22	9	0	-
		2.34	48	34	21	-

f_{ch}	Output switching frequency
I_a	Motor current
P_{Bdav}	Permissible power loss in the internal brake resistor, averaged over 60 s and dependent on T_{amb} (Linear interpolation/extrapolation via T_{amb} is permissible. Here, the application must limit the power loss in the brake resistor to $P_{Bdav} \leq P_{Bd}$.)
T_{amb}	Ambient temperature

Fuses and cable cross-sections

Operation without external mains choke/mains filter								
Type	Installation according to EN 60204-1 ¹⁾					Installation according to UL ²⁾		FI ³⁾
	①	②	L1, L2, L3 - Laying system			③	L1, L2, L3	
			B2	C	F			
			[A]	[A]	[mm ²]			
E84Dxxxx7514	32	32	6	-	-	30	8	≥ 300
E84Dxxxx1524	32	32	6	-	-	30	8	≥ 300
E84Dxxxx3024	32	32	6	-	-	30	8	≥ 300
E84Dxxxx4024	32	32	6	-	-	30	8	≥ 300
E84DHxxx7524	32	32	6	-	-	30	8	≥ 300

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

2) Use UL-approved cables, fuses and fuse holders only.

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

3) Universal-current sensitive earth-leakage circuit breaker, short-time delay

If cables are longer than 50 m, the protective circuit-breaker may respond, depending on the cable type and switching frequency.

① Circuit breaker

② Fuse of gG/gL utilisation category or semiconductor fuses of gRL utilisation category

③ Fuse

Observe national and regional regulations

4.2.3 Operation at a rated mains voltage of 500 V

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

Type	Mains current at I_{Rated} I_{Rated} [A]	Output power U, V, W S_{Rated} [kVA]	Motor power 4 pol. ASM P_{Rated} [kW]
E84Dxxx7514	3.2	1.5	0.75
E84Dxxx1524	4.4	2.4	1.5
E84Dxxx3024	7.9	4.6	3.0
E84Dxxx4024	11.0	5.9	4.0
E84DHxxx7524	16.6	10.0	7.5

Type	Output currents [A] at switching frequency							
	2 kHz		4 kHz		8 kHz		16 kHz	
	$I_{\text{Rated}2}$	$I_{\text{aM}2}$	$I_{\text{Rated}4}$	$I_{\text{aM}4}$	$I_{\text{Rated}8}$	$I_{\text{aM}8}$	$I_{\text{Rated}16}$	$I_{\text{aM}16}$
E84Dxxx7514	1.9	4.8	1.9	4.4	1.9	4.4	1.3	3.1
E84Dxxx1524	3.1	7.8	3.1	7.2	3.1	7.2	1.7	3.4
E84Dxxx3024	5.8	14.6	5.8	13.5	5.8	13.5	3.9	7.4
E84Dxxx4024	7.6	19.0	7.6	17.6	7.6	13.4	5.1	7.3
E84DHxxx7524	12.8	25.6	12.8	25.6	12.8	24.0	8.5	17.1

I_{aNx}

I_{aMx}

Switching
frequency

Rated value of continuous output current

Maximum output current (overload current)

- Periodic load change of 3 s with I_{aMx} and recovery time of 12 s according to the tables under chapter 4.4
- Can be obtained in the setting "x kHz fixed/..." in C00018

If the maximum heatsink temperature is reached, the switching frequency is reduced to 4 kHz.

In the setting "x kHz var./..." in C00018 the switching frequency is reduced depending on the output current.

Depending on the switching frequency and e.g. the ambient temperature, it may be required to reduce the output current (chapter 4.1, operating conditions).

Rated data for internal brake chopper

Switching threshold V_{BRmax} : 790 V, adjustable

Type	R_{Bmin} [Ω]	I_{BRmax} [A]	P_{BRmax} [kW]	I_{BRd} [A]	P_{Bd} [kW]	t_z [s]	t_{on} [s]	t_{fp} [s]
Internal brake resistor								
E84Dxxx7514	220	3.6	2.8	0.5	0.05 ¹⁾	-	-	-
E84Dxxx1524								
E84Dxxx3024	-	-	-	-	-	-	-	-
E84Dxxx4024								
E84Dxxx7524								
External brake resistor								
E84Dxxx7514	150	5.3	4.2	1.4	1.2	300	60	-
E84Dxxx1524	150	5.3	4.2	2.9	2.5	300	60	-
E84Dxxx3024	47	16.8	13.3	5.7	4.9	300	60	-
E84Dxxx4024	47	16.8	13.3	14.1	12.2	300	60	-

R_{Bmin}	Minimum brake resistance, nominal value $\pm 10\%$
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
¹⁾	Max. heat Q_B: 3 kW Max. power loss in the internal brake resistor P_{Bdav} : see table

	f _{ch} [kHz]	I _a [A]	P _{Bdav} [W]				
			T _{amb}	20 °C	30 °C	40 °C	45 °C
E84Dxxx7514	4	1.9	50	47	-	27	
		1.14	50	41	-	21	
	8	1.9	48	34	21	-	
		1.14	36	23	10	-	
E84Dxxx1524	4	3.1	42	28	-	8	
		1.86	50	47	-	27	
	8	3.1	22	9	0	-	
		1.86	48	34	21	-	

f_{ch}	Output switching frequency
I_a	Motor current
P_{Bdav}	Permissible power loss in the internal brake resistor, averaged over 60 s and dependent on T_{amb} (Linear interpolation/extrapolation via T_{amb} is permissible. Here, the application must limit the power loss in the brake resistor to $P_{Bdav} \leq P_{Bd}$.)
T_{amb}	Ambient temperature

Fuses and cable cross-sections

Operation without external mains choke/mains filter								
Type	Installation according to EN 60204-1 1)					Installation according to UL 2)		FI 3)
	①	②	L1, L2, L3 - Laying system			③	L1, L2, L3	
			B2	C	F			
	[A]	[A]	[mm²]	[mm²]	[mm²]	[A]	[AWG]	[mA]
E84Dxxxx7514	32	32	6	-	-	30	8	≥ 300
E84Dxxxx1524	32	32	6	-	-	30	8	≥ 300
E84Dxxxx3024	32	32	6	-	-	30	8	≥ 300
E84Dxxxx4024	32	32	6	-	-	30	8	≥ 300
E84DHxxx7524	32	32	6	-	-	30	8	≥ 300

- 1) These values are recommendations only. Other dimensioning values/laying systems are possible (e.g. according to VDE 0298-4). The cable cross-sections apply under the following conditions: Use of PVC-insulated copper cables, conductor temperature < 70 °C, ambient temperature < 45 °C, no bundling of cables or cores, three loaded cores.
- 2) Use UL-approved cables, fuses and fuse holders only.
UL fuse: voltage ≥ 500 V, tripping characteristic for example "H", "K5" or "CC". The cable cross-sections apply under the following conditions: conductor temperature < 75 °C, ambient temperature < 45 °C.
- 3) Universal-current sensitive earth-leakage circuit breaker, short-time delay
If cables are longer than 50 m, the protective circuit-breaker may respond, depending on the cable type and switching frequency.
- ① Circuit breaker
② Fuse of gG/gL utilisation category or semiconductor fuses of gRL utilisation category
③ Fuse
- Observe national and regional regulations

4.3 Current characteristics

The controller limits its maximally possible motor current under the following operating conditions ("current derating"):

- ▶ If the maximum heatsink temperature is exceeded
 - In this case, the controller switches independently from switching frequency mode of 16 kHz to 8 kHz and from 8 kHz to 4 kHz (but not from 4 kHz to 2 kHz). This function can be deactivated via C00144.
 - When the heatsink temperature continues to rise, the inverter output will be inhibited and the error message "Trip" occurs. This also occurs when the switching frequency reduction is deactivated.
- ▶ In case of output frequencies $f_{out} < |5 \text{ Hz}|$
- ▶ As a function of the switching frequency modes "fixed" or "variable"

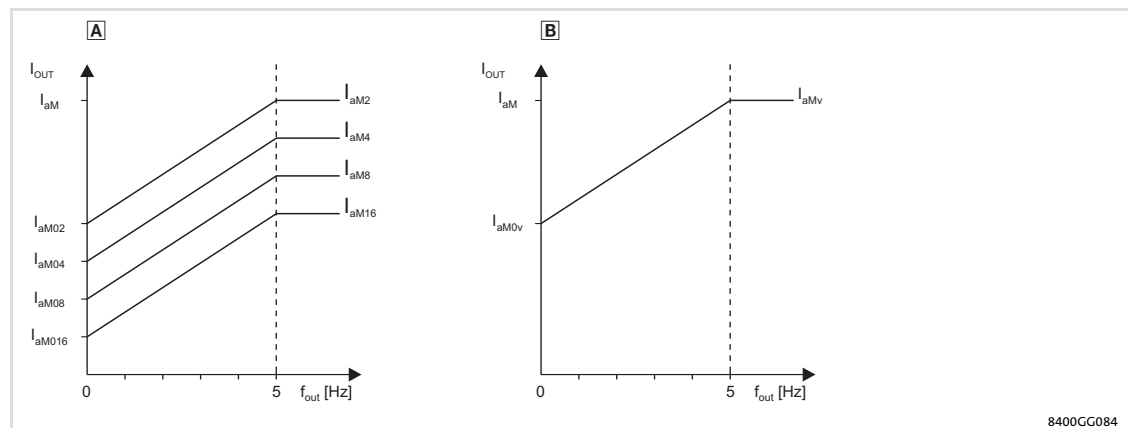


Fig. 4-1 Current derating characteristics

- A** Derating curve depending on the fixed switching frequency
- B** Derating curve depending on the variable switching frequency

I_{out}	Output current
I_{aM}	Maximum output current (overload current)
I_{aMx}	Maximum output current (overload current) at different switching frequencies: 2kHz, 4kHz, 8kHz and 16kHz
I_{aM0x}	Maximum output current (overload current) at $f_{out} = 0 \text{ Hz}$ and different switching frequencies: 2kHz, 4kHz, 8kHz, 16kHz
I_{aMv}	Maximum output current (overload current) at a variable switching frequency
I_{aM0v}	Maximum output current (overload current) at $f_{out} = 0 \text{ Hz}$ and a variable switching frequency
f_{out}	Field frequency at the output U, V, W

Type	Maximum output currents [A] ¹⁾ at a fixed switching frequency and $U_{LN} = 400V$							
	2 kHz		4 kHz		8 kHz		16 kHz	
	I_{aM02}	I_{aM2}	I_{aM04}	I_{aM4}	I_{aM08}	I_{aM8}	I_{aM016}	I_{aM16}
E84Dxxxx7514	4.8	4.8	4.8	4.8	2.8	4.8	1.8	4.0
E84Dxxxx1524	5.9	7.8	5.9	7.8	4.1	7.8	2.5	6.4
E84Dxxxx3024	11.0	14.6	11.0	14.6	9.5	14.6	5.5	9.5
E84Dxxxx4024	14.3	19.0	13.8	19.0	9.5	17.1	5.7	9.5
E84DHxxx7524	16.0	32.0	16.0	32.0	17.0	30.0	10.7	21.3

Type	Maximum output currents [A] ¹⁾ at a fixed switching frequency and $U_{LN} = 500V$							
	2 kHz		4 kHz		8 kHz		16 kHz	
	I_{aM02}	I_{aM2}	I_{aM04}	I_{aM4}	I_{aM08}	I_{aM8}	I_{aM016}	I_{aM16}
E84Dxxxx7514	4.8	4.8	4.4	4.4	2.1	4.4	1.4	3.1
E84Dxxxx1524	5.9	7.8	5.9	7.2	3.2	7.2	1.9	3.4
E84Dxxxx3024	11.0	14.6	10.6	13.5	7.4	13.5	4.2	7.4
E84Dxxxx4024	14.3	19.0	10.7	17.6	7.3	13.4	4.3	7.3
E84DHxxx7524	16.0	25.6	12.8	25.6	13.6	24.0	8.5	17.1

- ¹⁾ The shown values apply to the operation with ambient temperatures of up to +45°C for 2/4kHz and up to +40°C for 8/16kHz. For ambient temperatures between +40/45°C and +55°C, a derating from 2.5 %/K to the given values must be observed.

4.4 Overcurrent operation

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

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

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

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

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

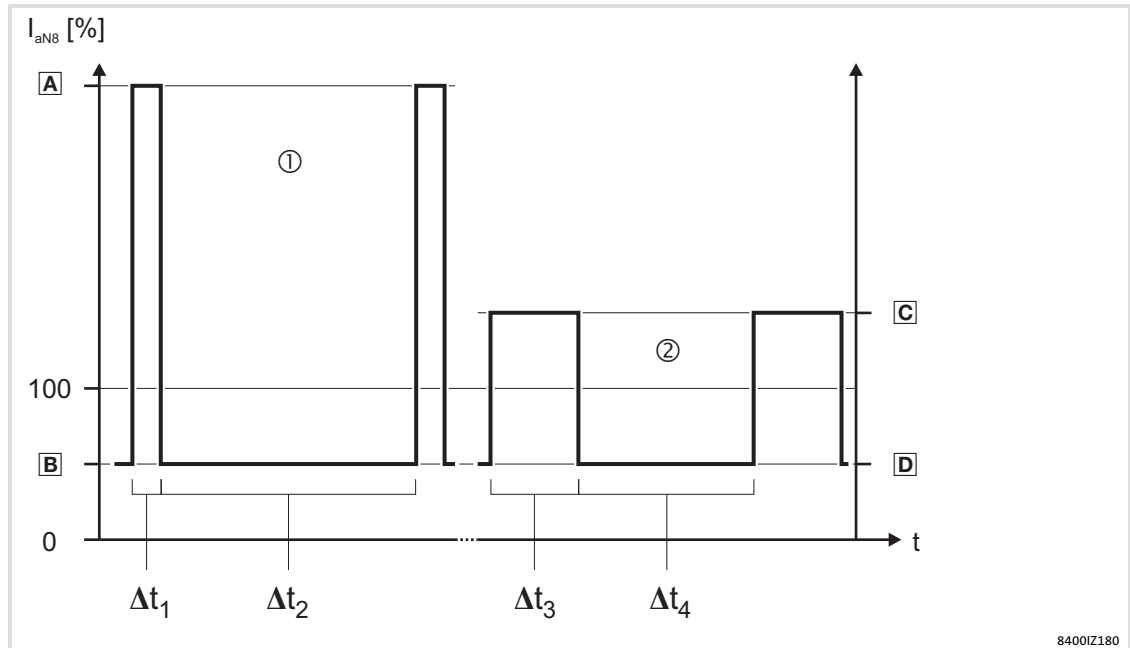


Fig. 4-2

Overcurrent capacity at 45° C

① Pulse load (15 s cycle)

A Peak current

B Unloading current

Δt₁ Peak current period

Δt₂ Unloading current period

Calculation equation:

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

② Permanent load (180 s cycle)

C Peak current

D Unloading current

Δt₃ Peak current period

Δt₄ Unloading current period

I_{arx} Rated value of continuous output current

Calculation equation:

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

Type	I_{amax}/I_{aR8} [%] in 15-s cycle ①							
	f = 2 kHz		f = 4 kHz		f = 8 kHz		f = 16 kHz	
	A	B	A	B	A	B	A	B
E84Dxxx7514	200	75	200	75	200	75	133	50
E84Dxxx1524							120	45
E84Dxxx3024							133	50
E84Dxxx4024								
E84Dxxx7524								

Type	I_{amax}/I_{aR8} [%] in 180-s cycle ②							
	f = 2 kHz		f = 4 kHz		f = 8 kHz		f = 16 kHz	
	C	D	C	D	C	D	C	D
E84Dxxx7514	150	75	150	75	150	75	100	50
E84Dxxx1524							90	45
E84Dxxx3024							100	50
E84Dxxx4024								
E84Dxxx7524								



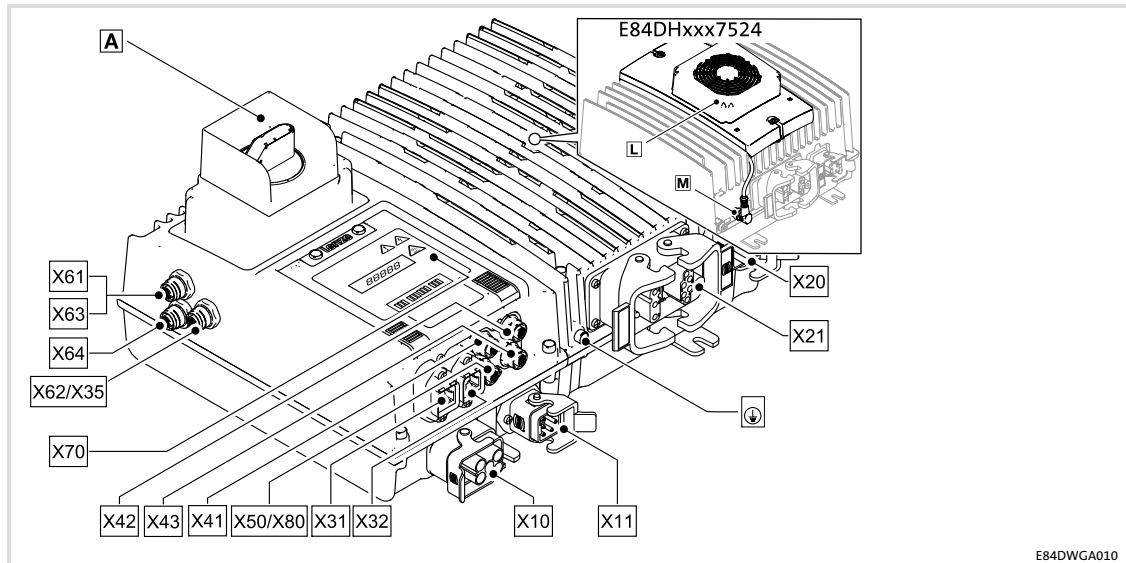
Tip!

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

4.5 Terminal description

Overview

StateLine, HighLine

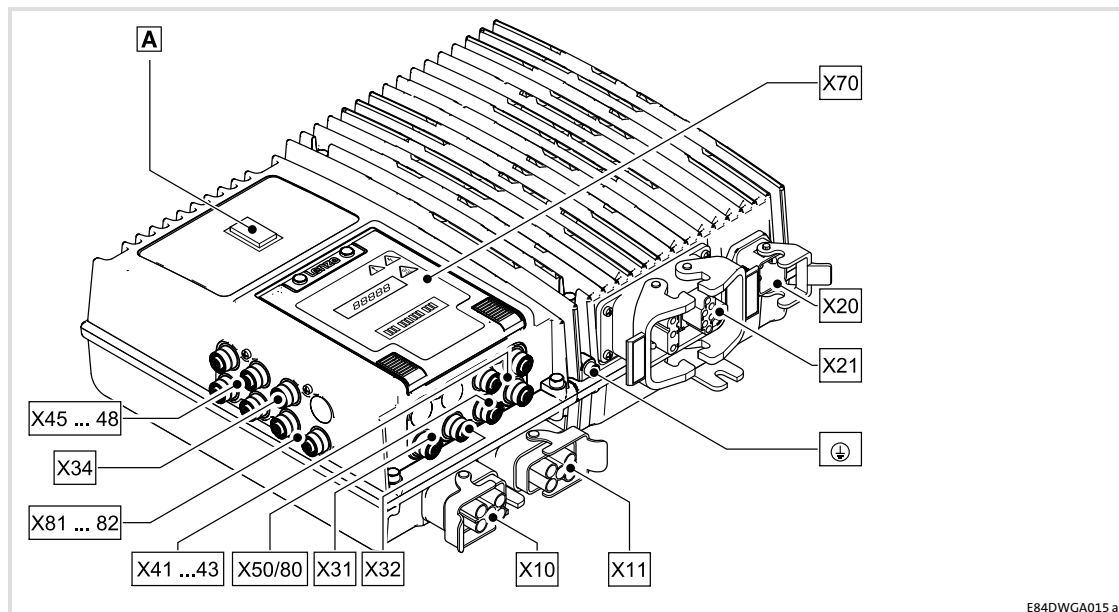


E84DWGA010

Operational controls and connections

Pos.	Function	Description
A	Control element	Optional
⏚	PE connection	for M6 ring cable lug
X10	Mains and 24-V buffer voltage	DESINA Q4/2, pins Optional: Molex (87)
X11	Optional: Loop-through technique - mains and 24-V buffer voltage	DESINA Q4/2, sockets (optional) Optional: Molex
X20	Optional: For external brake resistor	Q5/0, sockets (optional) Optional: Molex
X21	Motor, temperature monitoring and motor holding brake	Q8/0, Modular or 10E, sockets
X31	Fieldbus input	Socket RJ45 or M12, A-coded, male
X32	Fieldbus output	Socket RJ45 or M12, A-coded, female
X35	CAN on board	M12, 5-pole sockets, A-coded
X41	Digital inputs DI1 and DI2	M12, 5-pole sockets, A-coded
X42	Digital inputs DI3 and DI4, also configurable as digital outputs DO1 and DO2	
X43	Digital inputs DI5 and DI6	
X50	Analog input AI, AU	M12, 5-pole sockets, A-coded
X61	Safety system, option 10	M12, 5-pole pins, A-coded
X62		M12, 5-pole sockets, A-coded
X63	Safety system, option 30	
X64		M12, 8-pole sockets, A-coded
X70	Diagnostics	Socket RJ69
X80	Synchronous serial interface (SSI)	M12, 8-pole sockets, A-coded
L	only E84DHxxx7524: External fan	
M	Operating voltage for the external fan	-

EMS version



Operational controls and connections		
Pos.	Function	Description
A	Control element	Optional
⊕	PE connection	for M6 ring cable lug
X10	Mains and 24-V buffer voltage	DESINA Q4/2, pins
X11	Optional: Loop-through technique - mains and 24-V buffer voltage	DESINA Q4/2, sockets (optional) Optional: Molex
X20	Optional: For external brake resistor	Q5/0, sockets (optional) Optional: Molex
X21	Motor, temperature monitoring and motor holding brake	Q8/0, Modular or 10E, sockets
X31	Fieldbus input	M12, A-coded, pins
X32	Fieldbus output	M12, A-coded, sockets
X34	CANopen master PLC	M12, 5-pole, A-coded, sockets
X41	Digital inputs DI1 and DI2	M12, 5-pole sockets, A-coded
X42	Digital inputs DI3 and DI4, also configurable as digital outputs DO1 and DO2	
X43	Digital inputs DI5 and DI6	
X45	Digital inputs DI7 and DI8	
X46	Digital inputs DI9 and DI10, also configurable as digital outputs DO3 and DO4	
X47	Digital inputs DI11 and DI12	M12, 5-pole, A-coded, sockets
X48	Digital inputs DI13 and DI14	
X50	Analog input AI, AU	M12, 5-pole sockets, A-coded
X70	Diagnostics	Socket RJ69
X80	Synchronous serial interface (SSI)	M12, 8-pole sockets, A-coded
X81 X82	RS485/RS422	M12, 8-pole, A-coded, sockets

4.6 Supply concept of control voltage

8400 protec controllers generate the 24 V supply voltage of the control electronics from the mains voltage by means of an integrated power supply unit (mains-operated supply).

An external 24 V buffer voltage from a safely separated power supply unit (SELV/PELV) must be connected in order to implement a self-contained supply of the control electronics.

The 24 V supply voltage is required for the control electronics and other components such as fieldbus communication and/or drive-based safety.

In addition, the supply voltage is available at the terminals, irrespective of the fact whether it is fed internally or externally. Information on the supply voltage at the digital and analog terminals is provided under:

- ▶ Digital inputs(📖 64)
- ▶ Digital outputs(📖 65)
- ▶ Analog inputs(📖 66)
- ▶ Synchronous serial interface (SSI) (📖 66)

The supply voltage is preferentially used for:

- ▶ Connecting potential-free contacts to digital inputs
- ▶ Supplying external sensors

At an external 24 V supply voltage, the rated values may deviate according to the voltage source.

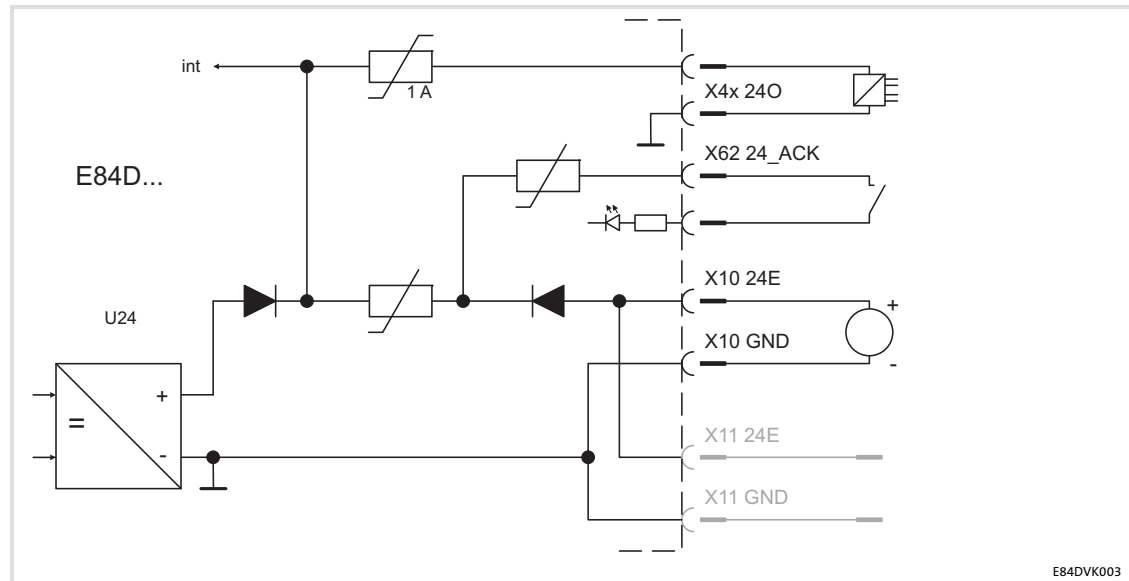
4.6.1 Internal 24 V supply voltage

At an internal 24 V supply voltage, the maximally permissible total current of terminals X4x, X50/X8x is 1 A.

4.6.2 External supply voltage 24 V

Detailed information on the X10 and X11 pin assignment with the external 24 V supply is provided on page 87.

Example circuit



E84DVK003

X10 ...	External 24 V buffer voltage at the mains connection
X11 ...	External 24 V supply at the mains connection in loop-through technique (for devices of the E84DxM... version)
X4x ...	24 V supply of the digital sensors
X62 ...	24 V supply of the safety system
U24	Internal 24 V supply
int	Voltage supply of the control electronics

An external 24 V supply voltage must comply with the following rated values to ensure trouble-free operation of the controller.

X10		
Pin / Name	Feature	Rated value
11 / 24E 12 / GND	Connection for external 24 V supply voltage by a safely separated power supply unit (required for feeding the control electronics and the communication module independent of the mains supply)	24 V in accordance with IEC 61131-2 19.2 ... 28.8 V Max. residual ripple $\pm 5\%$ SELV/PELV
	Suppression of voltage pulses	Suppressor diode 36 V, bidirectional
	Electric strength of external voltage	+30 V
	Excess current release	Automatically resettable
	Polarity reversal protection	When polarity is reversed: No function and no destruction
	Current consumption	Approx. 0.6 A during operation if inputs/outputs are not configured Max. 2.0 A during operation with typical input/output configuration Max. 1.5 A starting current for 100 ms
	Capacity to be charged	2000 μF
	Max. load for plug contacts	10 A

X11		
Pin / Name	Feature	Rated value
11 / 24E 12 / GND	Connection for an external 24 V supply voltage (loop-through arrangement)	24 V according to IEC 61131-2 (cp. X10)
	Number of devices included in the loop-through arrangement	is limited by the voltage drop due to max. current= 10 A and max. cable cross-section = 2.5 mm ²
	Max. load for plug contacts	10 A

X4x, X50/X8x		
Pin / Name	Feature	Rated value
1 / 24O 3 / GIO	24 V supply of the external sensors or potential-free contacts	External supply at 24E: voltage drop < 2.5 V Internal supply: DC 18 ... 28 V
	Max. output current	200 mA per output
	Total current for X4x, X50/X8x	1 A
	Electric strength of external voltage	+30 V
	Excess current release	Automatically resettable

4.7 Control terminals

4.7.1 Digital inputs

X41 ... X43		
Pin / Name	Features	Rated value
4 / DI1 2 / DI2	Digital input 1/2 at X41	according to IEC 61131-2, type 1 or two-track frequency input for HTL encoder 0 ... 100 kHz
4 / DI3 2 / DI4	Digital input 3/4 at X42	according to IEC 61131-2, type 1 DI4 - typical delay time: • 5 µs at rising edge • 25 µs at falling edge
4 / DI5 2 / DI6	Digital input 5/6 at X43	according to IEC 61131-2, type 1 or Single-channel frequency input, 0 ... 10 kHz DI5/DI6 - typical delay time:µ • 5 µs at rising edge • 25 µs at falling edge
1 / 24O 3 / GIO	24 V supply of the external sensors or potential-free contacts	External supply at 24E: Voltage drop < 2.5 V
	Total current for X4x, X50/X8x	1 A

Extensions in the EMS version

X45 ... X48		
Pin / Name	Features	Rated value
4 / DI7 2 / DI8	Digital input 7/8 at X45	according to IEC 61131-2, type 1
4 / DI9 2 / DI10	Digital input 9/10 at X46 (configurable with DO3/DO4)	
4 / DI11 2 / DI12	Digital input 11/12 at X47	
4 / DI13 2 / DI14	Digital input 13/14 at X48	
5 / n. c.	not assigned	-
1 / 24O 3 / GIO	24 V supply of the external sensors or potential-free contacts	External supply at 24E: Voltage drop < 2.5 V
	Total current for X41 ... X48	1 A

4.7.2 Digital outputs

X42 - configured		
Labelling	Features	Rated value
4 / DO1 2 / DO2 3 / GIO	Digital output	According to IEC61131-2, type 1
	External-voltage protected	up to +30 V Integrated polarity reversal protection diode for switching inductive loads
	Isolation	 76
	Level	LOW < +5 V High > +15 V
	Time-dependent behaviour	LOW - HIGH / HIGH - LOW max. 250 µs
	Behaviour during overload	Reduced voltage or periodic switch-off/on
	Behaviour in case of reset and during switch-on	Outputs are switched-off (LOW)
	Cycle time	1 ms
	Max. output current	200 mA per output
1 / 24O 3 / GIO	24 V supply of the external sensors or potential-free contacts	External supply at 24E: Voltage drop < 2.5 V
	Total current for X4x, X50/X8x	1 A

Extensions in the EMS version

X46 - configured		
Labelling	Features	Rated value
4 / DO3 2 / DO4 3 / GIO	Digital output	According to IEC61131-2, type 1
	External-voltage protected	up to +30 V Integrated polarity reversal protection diode for switching inductive loads
	Isolation	 76
	Level	LOW < +5 V High > +15 V
	Time-dependent behaviour	LOW - HIGH / HIGH - LOW max. 250 µs
	Behaviour during overload	Reduced voltage or periodic switch-off/on
	Behaviour in case of reset and during switch-on	Outputs are switched-off (LOW)
	Cycle time	1 ms
	Max. output current	200 mA per output
1 / 24O 3 / GIO	24 V supply of the external sensors or potential-free contacts	External supply at 24E: Voltage drop < 2.5 V
	Total current for X4x, X50/X8x	1 A

4.7.3

Analog inputs

X50		
Pin / Name	Feature	Rated value
4 / AU 3 / GA	Voltage input	0.3 ... 10 V ($V < 0.3 \text{ V} \triangleq "0"$)
	Input resistance	$> 80 \text{ k}\Omega$
	Sampling frequency	1 kHz (1 ms)
	Accuracy	$\pm 0.1 \text{ V}$
	Electric strength of external voltage	$\pm 15 \text{ V}$
	A/D converter	Resolution 10 bits + sign Error: 1 digit $\equiv 0.1 \%$, based on the final value
2 / AI 3 / GA	Current input, parameterisable	0.6 ... +20 mA ($I < 0.6 \text{ mA} \triangleq "0"$) 4 ... +20 mA, fail-safe
	Input resistance	220Ω
	Input current in case of open circuit	Display "0" ($I < 0.6 \text{ mA}$)
	Sampling frequency	1 kHz (1 ms)
	Accuracy	$\pm 0.2 \text{ mA}$
	Electric strength of external voltage	$\pm 15 \text{ V}$
1 / 24O 3 / GIO	24 V supply of the external sensors or potential-free contacts	External supply at 24E: Voltage drop $< 2.5 \text{ V}$
	Total current for X4x, X50/X8x	1 A

4.7.4

Synchronous serial interface (SSI)

X80		
Pin / Name	Feature	Rated value
1 / CLK+	Pos. clock signal	Bit rate: 100 ... 1000 kbits Data word width: 1 ... 32 bits (effective) Code: Gray an binary
2 / CLK-	Neg. clock signal	
3 / Data+	Pos. data line	
4 / Data-	Neg. data line	
5 / n. c.	Not assigned	
6 / n. c.	Not assigned	
8 / 24O	24 V supply of the external SSI encoders	External supply at 24E: Voltage drop $< 2.5 \text{ V}$
7 / GIO	Total current for X4x, X50/X8x	1 A

4.7.5

Remote control (IrRC)

IrRC (Infrared Remote Control)		
Pin / Name	Features	Rated value
-	Reach	$\sim 5 \text{ m}$
	Angle of incidence	$\sim 30^\circ$

4.7.6 Interfaces of the EMS version

CANopen Master PLC

X34		
Pin / Name	Features	Rated value
1 / 	Shielding (functional earth)	-
2 / n. c.	not assigned	-
3 / CAN_GND	CAN GND	Bit rate: adjustable up to 1 Mbit Isolation: Function separation
4 / CANH	CAN HIGH	
5 / CANL	CAN LOW	

RS485/422 PLC

X81/X82		
Pin / Name	Features	
	RS485	RS422
The assignment depends on the device version (133).	24 V supply	
	RS485A'	Reception + (Data+)
	RS485B'	Reception (Data-)
	RS485A	Transmission+ (CLK+)
	RS485B	Transmission- (CLK-)
		according to IEC 61131-2, type 1 - according to: – ANSI/TIA/EIA-485-A-98 – ANSI/TIA/EIA-422 - Bit rate: Adjustable up to 115.2 kbit - Isolation: Function separation - At RS422, PLC supports evaluation of SSI encoders (max. 150 kHz).

Infrared interface (IrDA)

IrDA (Infrared Data Association)		
Pin / Name	Features	Rated value
-	Reach	~1 m
	Angle of incidence	~30 °

4.7.7

Motor holding brake connection

Version according to type code: B (AC voltage: fast switch)

X21		
Pin / Name	Feature	Rated value
	Connection of a motor holding brake to the external brake rectifier in the motor terminal box	
	Max. switching capacity	55 W
	Internal switching time	< 10 ms
	Isolation	Basic insulation (76)
	Time-dependent behaviour	See software manual, chapter holding brake control / parameterisation
	Behaviour in case of reset and during switch-on	Outputs are switched-off / open
	Operating frequency	Max. 60/min
	Short-circuit strength	no
c2 / ~	Switched mains voltage (L1/L2) for a brake rectifier	
c3 / ~	Switching voltage	AC 400/480 V according to IEC 61131-2
c4 / S1	Potential-free contact for switching the brake rectifier on the DC side	
c5 / S2	Switching voltage	DC 250 V

Version according to type code: F (DC voltage: integrated brake rectifier)

X21		
Pin / Name	Feature	Rated value
6 / BD1	Connection of a motor holding brake	
4 / BD2	Integrated brake rectifier	Half-wave rectification with increased ripple
	Output voltage	AC 400 V DC 180 V
	(dependent on mains voltage)	AC 500 V DC 225 V
	Max. output power	55 W
	Internal switching time	< 1 ms
	Time-dependent behaviour	See software manual, chapter holding brake control / parameterisation
	Short-circuit strength	no
	Behaviour in case of reset and during switch-on	Outputs are switched off
	Operating frequency	Max. 60/min

Version according to type code: V (24 V DC Voltage)

X21		
Pin / Name	Feature	Rated value
6 / BD1	Connection of a motor holding brake	
4 / BD2	Output voltage	DC 24 V
	(dependent on input voltage)	
	Max. output power	48 W
	Internal switching time	< 1 ms
	Time-dependent behaviour	See software manual, chapter holding brake control / parameterisation
	Short-circuit strength	Yes
	Behaviour in case of reset and during switch-on	Outputs are switched off
	Operating frequency	Max. 60/min

Version according to type code: C (DC voltage: cold brake)

X21		
Pin / Name	Feature	Rated value
6 / BD1	Connection of a motor holding brake	
4 / BD2	Voltage boost for 0.3 s	130 %
	Voltage reduction (cold brake) after 0.3 s	65 %
		Half-wave rectification with increased ripple
	Output voltage AC 400 V	DC 180 V
	(dependent on mains voltage) AC 500 V	DC 225 V
	Max. output power	55 W
	Internal switching time	< 1 ms
	Time-dependent behaviour	See software manual, chapter holding brake control / parameterisation
	Short-circuit strength	no
	Behaviour in case of reset and during switch-on	Outputs are switched off
	Operating frequency	Max. 60/min



Stop!

Damage of the devices

A defective motor holding brake or a short circuit on the X21 connection (motor and built-on accessories) causes internal damage to the device.

Possible consequences:

- If a defective motor holding brake is connected, the replacement device is also damaged immediately.

Protective measures:

- When devices are replaced due to malfunction of the brake control, ensure that defect-free motor holding brakes are connected.
- Check whether the motor holding brake and the connecting cable are free from defects.
- Replace or repair defective components.

5**Mechanical installation****5.1****Important notes**

- ▶ If the cooling air is polluted (fluff, (conductive) dust, soot, aggressive gases), take adequate countermeasures, as e.g.:
 - Cleaning of the cooling ribs on the controller in regular intervals
 - Separate air guide
- ▶ Possible mounting position:
 - Vertically suspended
- ▶ Maintain the specified free spaces above and below the controller to other installations!
- ▶ Ensure untroubled cooling and exhaust air flow.
- ▶ In case of continuous vibrations or shocks use vibration dampers.

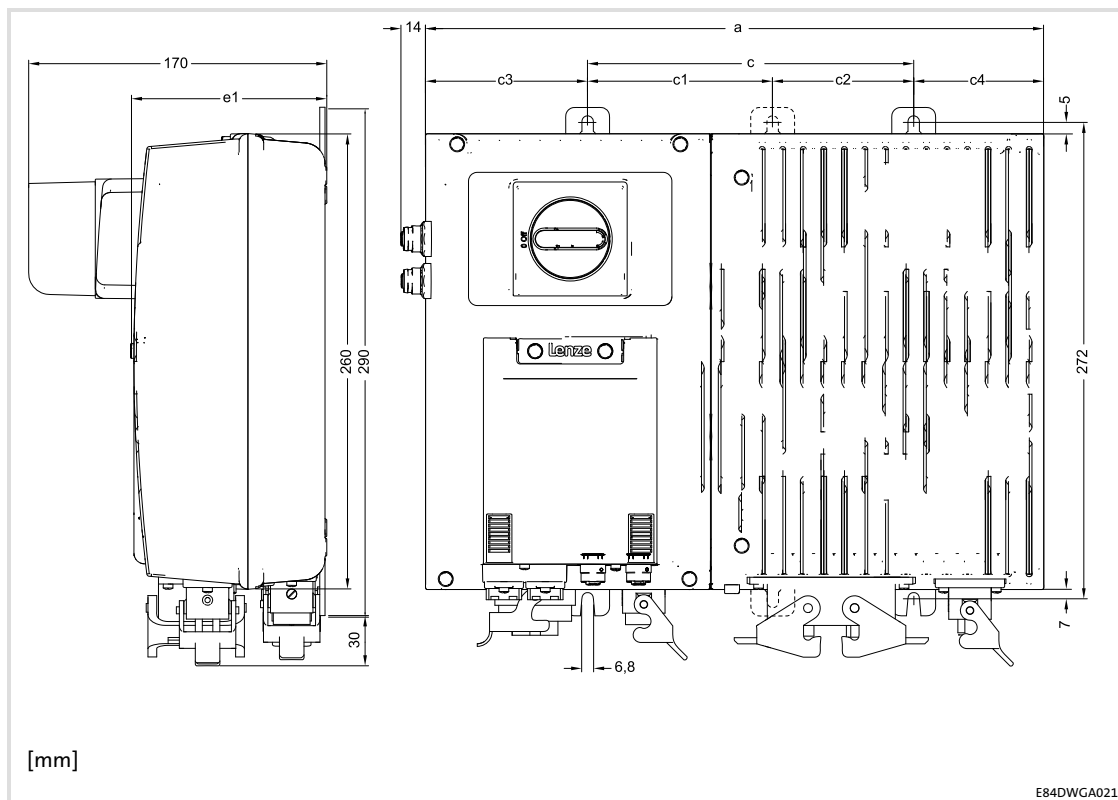
Depending on the size, four or six screws M6 x >10 mm are required for the mounting. The mounting location and material must ensure a durable mechanical connection.

For fastening the devices, we recommend:

- ▶ M6 cheese head screw, hexagon socket, according to DIN 912/ISO 4762
- ▶ M6 cheese head screw, torx, according to ISO 14579

5.2

Dimensions

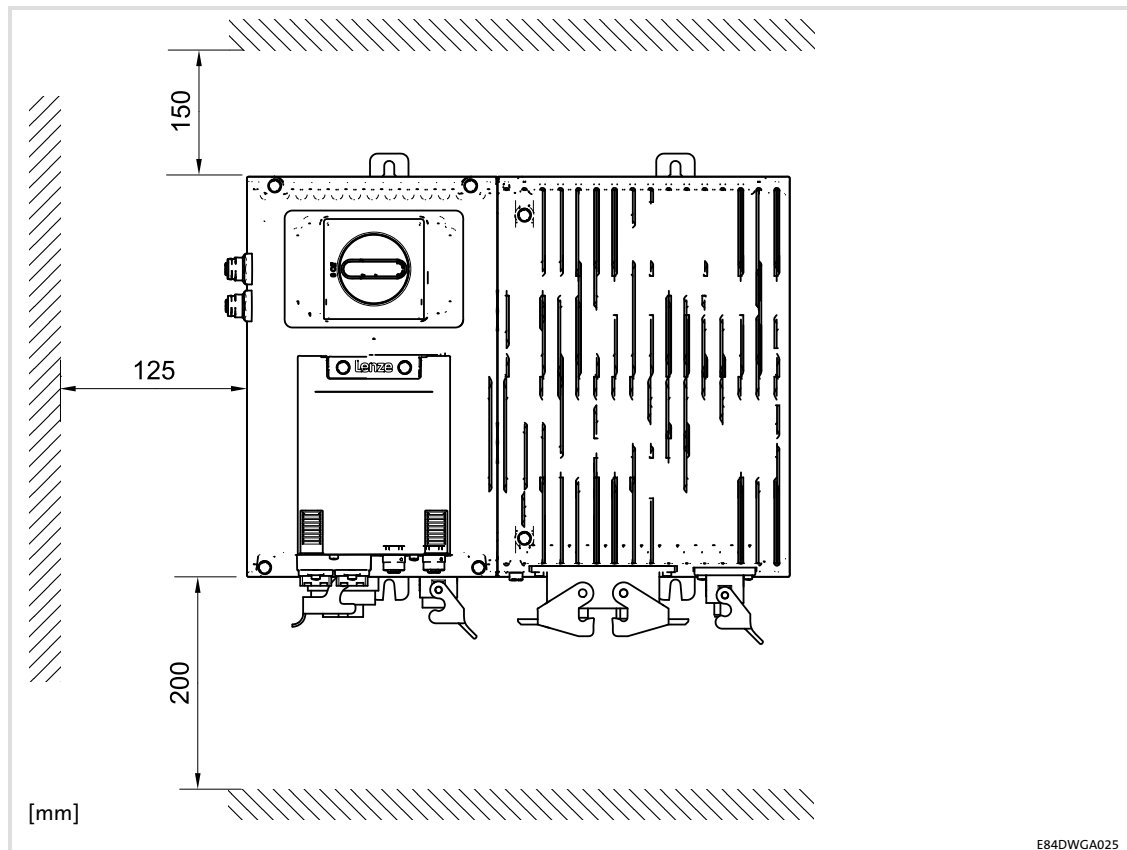


	[mm]						 [kg]
	a	c	c1 = c2	c3	c4	e1	
E84Dxxx7514	353	186	-	92	75	110	7.0 ... 7.5
E84Dxxx1524							
E84Dxxx3024	434	290	145	92	52	148	8.9 ... 9.4
E84Dxxx4024							
E84DHxxx7524	434	290	145	92	52	195	9.1 ... 9.6

5.3

Mounting clearance**Note!**

The actual free space is determined by the connectors used and the cable bending radii.



6 Electrical installation - HighLine/StateLine version

6.1 Important notes



Danger!

Dangerous electrical voltage

All power terminals remain live for up to three minutes after mains disconnection.

Possible consequences:

- ▶ Death or severe injuries when touching the power terminals.

Protective measures:

- ▶ Switch off the power supply and wait for at least three minutes before working on the power terminals.
- ▶ Make sure that all power terminals are deenergised.



Danger!

- ▶ The contacts of the power connectors **X10, X11, X20 and X21** may carry dangerous voltage if the frequency inverter is connected to the mains. Thus, deenergise the frequency inverter before working on it.
- ▶ Earth the device by means of X10 and by connecting it to functional earth (earthing bolt) in order to prevent injury to persons and malfunctioning.



Danger!

Dangerous voltage

The leakage current to earth (PE) is $> 3.5 \text{ mA AC}$ or $> 10 \text{ mA DC}$.

Possible consequences:

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

Protective measures:

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

**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!****Pluggable terminal strips or plug connections**

Plugging or removing the terminal strips or plug connections during operation may cause high voltages and arcing.

Possible consequences:

- ▶ Damage of the devices

Protective measures:

- ▶ Switch off device.
- ▶ Only plug or remove the terminal strips or plug connections in deenergised status.

**Note!**

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

Please observe the following:

- ▶ When switching with the controller is enabled, you can activate monitoring functions of the controller. If no monitoring function is activated, switching is permissible.
- ▶ The switching elements at the motor end must be rated for DC voltages $V_{DCmax} = 800 \text{ V}$.



Note!

Only with the **control element**

- ▶ **C** = service switch with protective function
the device can be disconnected from the mains voltage.



Note!

The counter plugs of the power terminals must be equipped with connector housings with a vertical outgoing cable.



Note!

- ▶ **It is absolutely necessary to keep the plastic caps on the connectors for the control terminals and interfaces!**
- ▶ During transport, storage, and operation, ports not used must be sealed using the plastic caps, in order to maintain the product features in accordance with the technical data.
- ▶ Only if this note is observed, the product features certified are ensured for devices with a safety system.

EMC-compliant wiring



Note!

- ▶ Establish a good conductive connection to protective earth by means of a copper-braid cable (e.g. mounting surface, machine earth or building earth).
- ▶ Lay control cables and data lines separately from the motor cables.
- ▶ Connect the shields of the control cables and data lines **at both ends**.

6.1.1 Electrical isolation

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

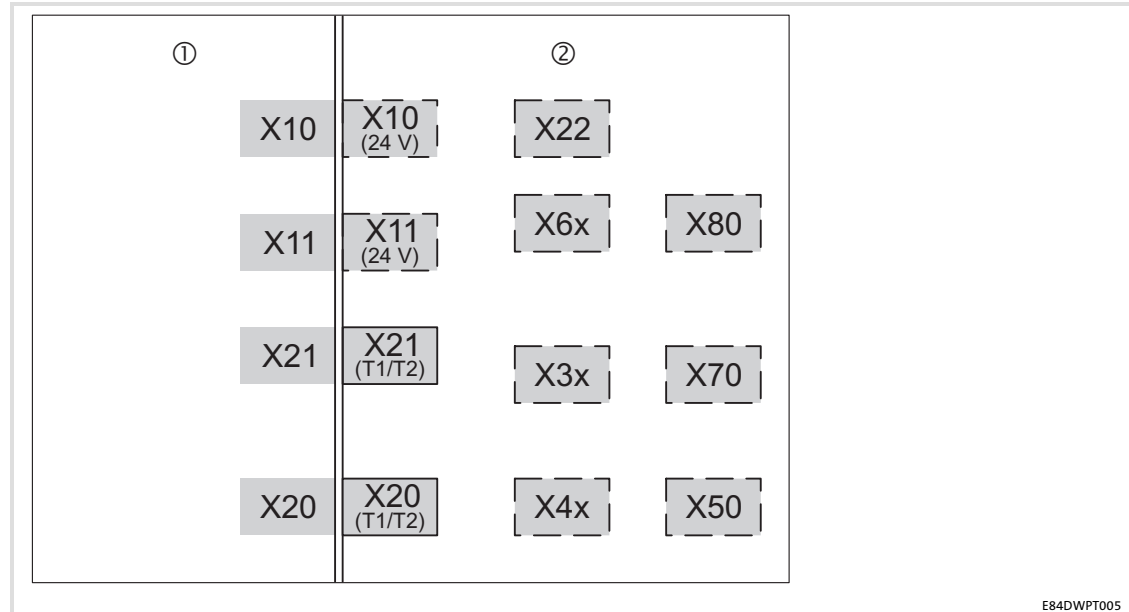


Fig. 6-1 Electrical isolation between power terminals, control terminals and housing

⋮	Isolation by functional insulation
	Isolation by basic insulation
	Safe isolation by double or reinforced insulation Protection against accidental contact is guaranteed without any further measures.
①	Power connections
X10, X11	Mains
X21	Motor
X20	Brake resistor
②	Control terminals
X10 (24 V)	24 V supply voltage
X11 (24 V)	
X20 (T1/T2)	brake resistor temperature monitoring
X21 (T1/T2)	Motor temperature monitoring
X22	Voltage supply of external fan - only for 7.5 kW devices
X3x	Fieldbus communication
X4x	Digital inputs/outputs
X50	Analog input
X6x	Safety system
X70	Diagnostics
X80	SSI

6.1.2 Device protection

- ▶ In case of condensation, do not connect the controller to the mains voltage before the moisture has evaporated completely.
- ▶ The controller must be protected by external fuses.
- ▶ Unused control inputs and outputs must be closed according to the intended type of protection.

6.1.3 Maximum motor cable length

- ▶ Keep the motor cable as short as possible since this has a positive effect on the drive behaviour.
- ▶ The maximally permissible motor cable length is: 20 m, shielded
 - at rated mains voltage
 - at a switching frequency of 8 kHz

**Note!**

If the conditions for electromagnetic compatibility must be observed, the permissible cable lengths may vary.

6.1.4 Motor protection

- ▶ Extensive protection against overload:
 - By overcurrent relays or temperature monitoring.
 - We recommend the use of PTC thermistors or thermostats to monitor the motor temperature.
 - PTC thermistors or thermostats can be connected to the controller.
 - For monitoring the motor, we recommend the use of the I²xt monitoring.
- ▶ Only use motors with an insulation suitable for the inverter operation:
 - Insulation resistance: min. $\hat{u} = 1.5 \text{ kV}$, min. $du/dt = 5 \text{ kV}/\mu\text{s}$
 - When using motors with an unknown insulation resistance, please contact your motor supplier.

6.2

Safety instructions for the installation according to U_L or U_R

Original - English

**Warnings!**

- ▶ Branch circuit protection:
Suitable for use on a circuit capable of delivering not more than 200 000 rms symmetrical amperes, 500 V maximum.
– When Protected by CC, T, or J Class Fuses.
- ▶ Integral solid state protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electrical Code and any additional local codes.
- ▶ Overload Protection = 125 % of rated FLA.
- ▶ Use 75 °C copper wire only, except for control circuits.
- ▶ Use Class 1 wire only.
- ▶ Enclosed Device, suitable for use in a UL Type 4X (Indoor) Environment.
- ▶ Suitable for use in a surrounding air temperature of 45 °C, and
– additionally 55 °C when de-rating rules are followed.
- ▶ Suitable for use in a compartment handling conditioned air.
- ▶ The device is provided with internal overload protection. For information on the protection level of the internal overload protection for a motor load, see the corresponding Software Manual or Online Help under the topic "Motor load monitoring (I^2xt)". This function has to be activated; i. e. the reaction must be changed from "Warning" (factory setting) to "Fault".
- ▶ For information on rating and proper connection of the thermal protector (only for connection to motors having integral thermal protection), see the corresponding Manual or Online Help.

**Warnings!**

The opening of branch-circuit protective device may be an indication that a fault has been interrupted.

To reduce the risk of fire or electric shock, current-carrying parts and other components of the controller should be examined and replaced if damaged or equivalent.

6.3

Safety instructions for the installation according to U_L or U_R

Original - French



Avertissement !

- ▶ Protection par disjoncteur :
Convient aux circuits non susceptibles de délivrer plus de 200 000 ampères symétriques eff., maximum 500 V.
– Protection par des fusibles CC de calibre T ou J.
- ▶ 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 et aux autres dispositions applicables au niveau local.
- ▶ Protection contre les surcharges = 125 % de l'intensité assignée à pleine charge.
- ▶ Utiliser exclusivement des conducteurs en cuivre 75 °C, sauf pour la partie commande.
- ▶ Utiliser impérativement un câble de classe 1.
- ▶ Equipement monté dans un coffret de protection adapté à une utilisation en environnement UL de type 4X (intérieur).
- ▶ Convient à une utilisation à une température ambiante maximale de 45 °C ainsi que
– 55 °C en cas d'application des règles de réduction de puissance.
- ▶ Convient pour une utilisation dans un espace à air conditionné.
- ▶ L'équipement est doté d'un dispositif de protection intégré contre les surcharges. Pour obtenir des informations sur le niveau de protection offert par la protection intégrée contre les surcharges du moteur, se reporter au manuel du logiciel ou à l'aide en ligne correspondante, rubrique "Surveillance de la charge du moteur (I²xt)". Cette fonction doit être activée. En d'autres termes, la réaction doit être modifiée de "Avertissement" (réglage usine) à "Défaut".
- ▶ Pour obtenir des informations sur les caractéristiques assignées et sur le raccordement correct du dispositif de protection thermique (uniquement pour raccordement à des moteurs dotés d'une protection thermique intégrée), se reporter au manuel correspondant ou à l'aide en ligne.



Avertissement !

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 et les remplacer s'ils sont endommagés.

6.4 Installation according to EMC (installation of a CE-typical drive system)**Design of the cables**

- ▶ It is imperative to comply with the regulations concerning minimum cross-sections of PE conductors. The cross-section of the PE conductor must be at least as large as the cross-section of the power connections.
- ▶ The cables used must comply with the approvals required for the location (e.g. UL).

6.4.1 Shielding**Requirements**

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

Use system cables or shielded cables for these connections:

- ▶ Motor
- ▶ External brake resistor (⚠ Mounting Instructions of the brake resistor)
- ▶ Motor holding brake (shielding is required when being integrated into the motor cable; connection to optional motor brake control)
- ▶ Motor temperature monitoring
- ▶ Analog signals (inputs and outputs; single-sided shield connection to the controller)
- ▶ Fieldbus communication (e.g. CANopen ,PROFIBUS, PROFINET, ...)
- ▶ Safety system
- ▶ CAN on board

The following connections need not be shielded:

- ▶ Mains
- ▶ 24-V supply
- ▶ Digital signals (inputs and outputs).
 - We recommend to use shielded cables for a cable length from approximately 5 m on or in environments with strong interferences.

Connection system

- ▶ Directly apply the shielding in the plug.
 - Extensively apply the shielding and ensure electrical conductivity.
 - If required, additionally connect the shield to the cable clamp rail.

6.4.2 Motor cable

- ▶ Only use shielded motor cables with braids made of tinned or nickel-plated copper. Shields made of steel braids are not suitable.
 - The overlap rate of the braid must be at least 70 % with an overlap angle of 90 °.
- ▶ The cables used must correspond to the requirements at the location (e.g. EN 60204-1).
- ▶ Use Lenze system cables.
- ▶ Extensively apply the shielding in the plug and attach it in a way which ensures electrical conductivity.
- ▶ The motor cable is optimally installed if
 - it is separated from mains cables and control cables,
 - it only crosses mains cables and control cables at right angles,
 - it is not interrupted.
- ▶ If the motor cable must be opened all the same (e.g. due to chokes, contactors, or terminals):
 - The unshielded cable ends may not be longer than 100 mm (depending on the cable cross-section).
 - Install chokes, contactors, terminals etc. spatially separated from other components (with a min. distance of 100 mm).
 - Install the shield of the motor cable directly before and behind the point of separation to the mounting plate with a large surface.
- ▶ Connect the shield with a large surface to PE in the terminal box of the motor at the motor housing.
 - Metal EMC cable glands at the motor terminal box ensure a large surface connection of the shield with the motor housing.

6.4.3**Control cables**

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

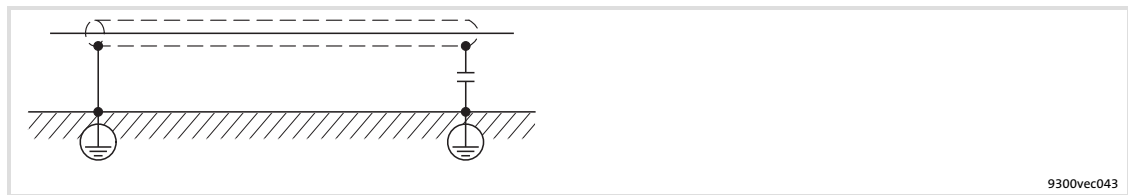


Fig. 6-2 Shielding of long, analog control cables

9300vec043

6.4.4 Wiring

Notes on the laying of cables:

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

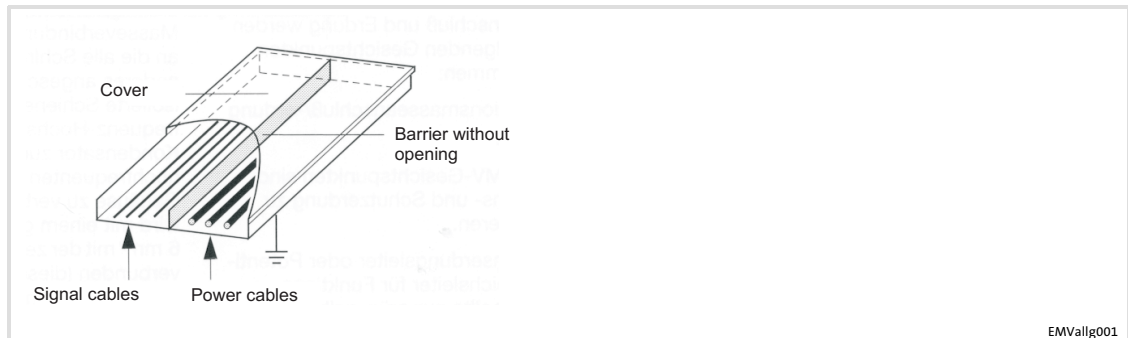


Fig. 6-3 Cable routing in the cable duct with barrier

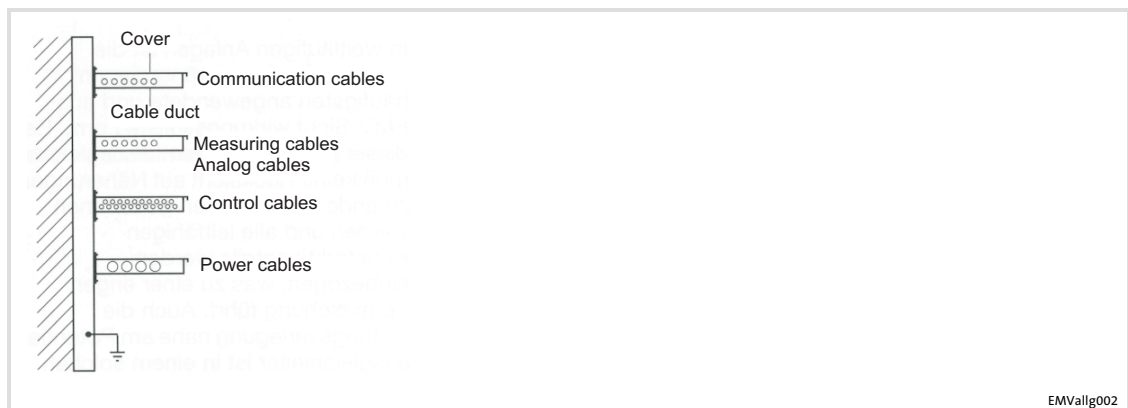


Fig. 6-4 Cable routing in separated cable ducts

Wiring on the mains side

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

Wiring on the motor side**Stop!**

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

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

Special conditions allow you to integrate the supply cable for temperature monitoring of the motor into the motor cable: (📖 81)

**Danger!****Uncontrolled motor movements can occur**

If the motor cable is damaged, a short circuit between the brake control cables and the motor cables can cause motor movements with low torque.

Possible consequences:

- ▶ Personnel in the vicinity of the motor can be injured.

Protective measures:

- ▶ Install motor cable in a protected way (e.g. in a cable duct).

6.4.5 Detecting and eliminating EMC interferences

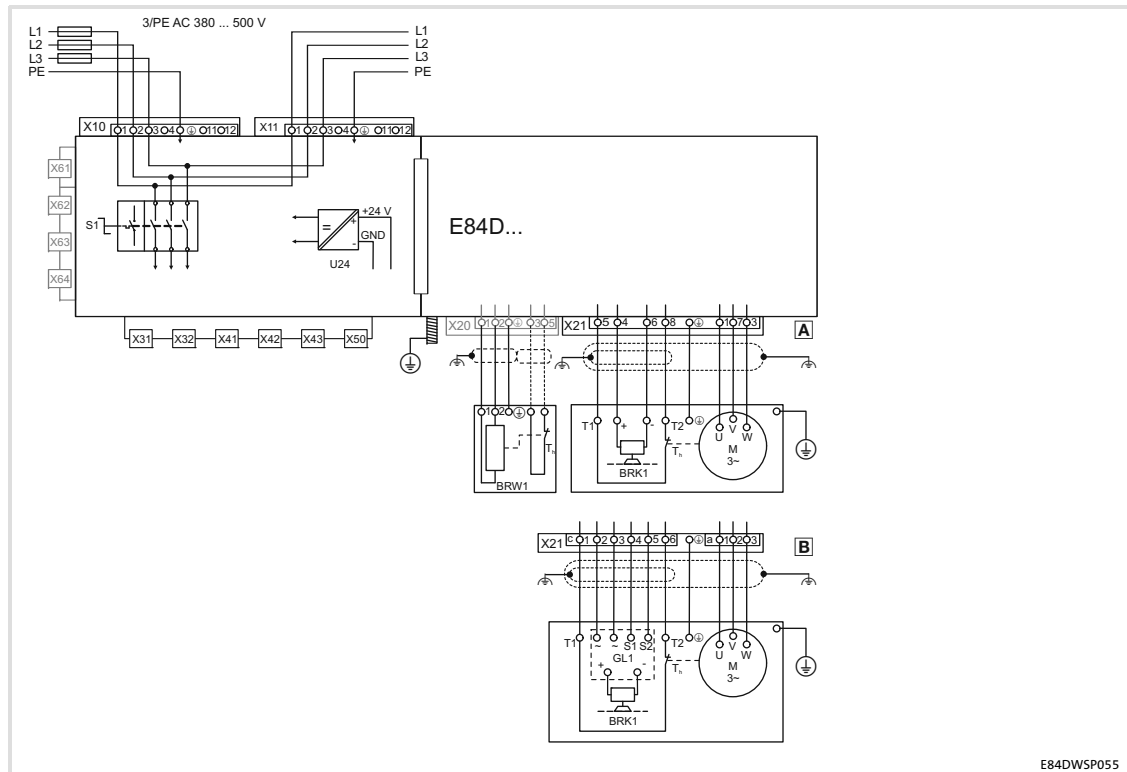
Fault	Cause	Remedy
Interferences of analog setpoints of your own or other devices and measuring systems	Unshielded motor cable	Use shielded motor cable
	Shield contact is not extensive enough	Carry out optimal shielding as specified
	Shield of the motor cable is interrupted by terminal strips, switched, etc.	• Separate components from other component part with a minimum distance of 100 mm • Use motor choke/motor filter
	Install additional unshielded cables inside the motor cable (e.g. for motor temperature monitoring)	Install and shield additional cables separately
	Too long and unshielded cable ends of the motor cable	Shorten unshielded cable ends to maximally 40 mm

6.5

Devices in a power range of 0.75 ... 7.5 kW (3/PE AC 400 V)

6.5.1

Example circuits



E84D...

S1

U24

BRK1

GL1

BRW1

T_h

M

[A]

[B]

X31 ... X50

X61 ... X64

8400 protec controller

Service switch control element (optional)

Supply voltage 24 V internal

Spring-applied brake

Spring-applied brake control

External brake resistor at optional terminal X20

- for E84DHxx7524: Direct connection of the thermal contact

PTC thermistor (PTC) or thermal contact (NC contact)

Motor

Motor connection system: Plug type Q8/0

Motor connection system: Plug type Modular

Communication, inputs and outputs

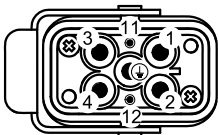
Optional: Drive-based safety

E84DWS055

6.5.2 Terminal assignment of the power connections

Mains connection

X10 - port for mains

Pin	Connection	Description	Data
 84DWTX0100		DESINA type Q4/2, pins	
1	L1	Mains phase L1	Max. 6 mm ²
2	L2	Mains phase L2	
3	L3	Mains phase L3	
⊕	PE	PE conductor	
11	24E	External 24-V power supply	Max. 2.5 mm ²
12	GND	External reference potential	

X10 - mains connection - device version E84DxH...

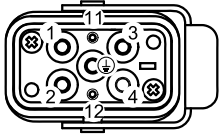
Pin	Connection	Description	Data
 E84DWTXXMO 1		Type Molex, Brad Mini-Change, pins	
1	L1	Mains phase L1	max. 14 AWG
2	L2	Mains phase L2	
3	L3	Mains phase L3	
4	PE ⊕	PE conductor	

Electrical installation - HighLine/StateLine version

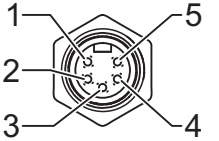
Devices in a power range of 0.75 ... 7.5 kW (3/PE AC 400 V)

Terminal assignment of the power connections

X11 - mains loop-through technique (optional)

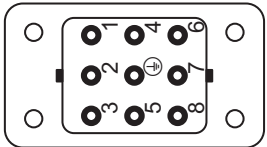
Pin	Connection	Description	Data
 84DWTX0110		DESINA type Q4/2, sockets	
1	L1	Phase L1	Max. 6 mm ²
2	L2	Phase L2	
3	L3	Phase L3	
⊕	PE	PE conductor	
11	24E	External 24-V power supply	Max. 2.5 mm ²
12	GND	External reference potential	

X11 - mains connection - device version E84DxH...

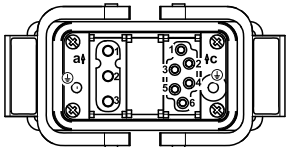
Pin	Connection	Description	Data
 E84DWTXXMO 2		Type Molex, Brad Mini-Change, pins	
4	24E	External 24 V voltage supply	max. 16 AWG
2	GND	External reference potential 24 V	
3	PE ⊕	PE conductor	
1, 5	n. c.	not assigned	

Motor connection

X21 - motor connection - device version E84DxxC...

Pin	Connection	Description	Data
 84DWTX0210			
2	n. c.	Grooved pin as a protection against mix-up with power bus	
1	U	Motor phase U	Max. 4 mm ²
3	W	Motor phase W	Max. output voltage: mains voltage
7	V	Motor phase V	Max. permanent output current: type-dependent
4	BD2	Motor holding brake (reference conductor)	Max. 4 mm ²
6	BD1	Motor holding brake	
5	+PTC	Motor temperature monitoring	Max. 4 mm ²
8	-PTC		PTC thermistor (PTC) or thermal contact (NC contact)
⊕	PE	PE conductor	Max. 4 mm ²

X21 - motor connection - device version E84DxxB...

Pin	Connection	Description	Data
 84DWTX0211			
a1	U	Motor phase U	Max. 6 mm ²
a2	V	Motor phase V	Max. output voltage: mains voltage
a3	W	Motor phase W	Max. permanent output current: type-dependent
c1	+PTC	Motor temperature monitoring	Max. 4 mm ²
c6	-PTC		PTC thermistor (PTC) or thermal contact (NC contact)
c2	~	Supply voltage of brake rectifier	Max. 4 mm ²
c3	~		V _{rated} = mains voltage-dependent
c4	S1	Switch for separation on the DC side	The brake rectifier is mounted in the terminal box of the motor.
c5	S2		
⊕	PE	PE conductor	Max. 6 mm ²

**Stop!****Damage of the devices**

A defective motor holding brake or a short circuit on the X21 connection (motor and built-on accessories) causes internal damage to the device.

Possible consequences:

- ▶ If a defective motor holding brake is connected, the replacement device is also damaged immediately.

Protective measures:

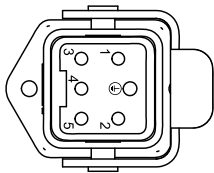
- ▶ When devices are replaced due to malfunction of the brake control, ensure that defect-free motor holding brakes are connected.
- ▶ Check whether the motor holding brake and the connecting cable are free from defects.
- ▶ Replace or repair defective components.

**Note!**

In the Lenze setting, the temperature monitoring of the motor is activated! To start motors without thermal detectors, the response of the motor temperature monitoring must be deactivated (C00585). Alternatively, a wire jumper between +PTC and -PTC can be used to simulate a normal temperature.

Connection of external brake resistor

X20 - connection of external brake resistor (optional)

Pin	Connection	Description	Data
 E84DWX0202		Type Q5, sockets	
1	RB2	Brake resistor	max. 2.5 mm ²
2	RB1		
3	T1	only E84DHxxx7524: brake resistor temperature monitoring	
5	T2		
4	n. c.	not assigned	
⊕	PE	PE conductor	

X20 - connection of external brake resistor (optional, - device version E84DxH...)

Pin	Connection	Description	Data
 E84DWTXXMO 3		Type Molex, Brad Mini-Change, sockets	
1	RB1	Brake resistor	max. 16 AWG
5	RB2		
3	PE ⊕	PE conductor	
2, 4, 6	n. c.	not assigned	

6.6 Control terminals

6.6.1 Diagnostics

The following can be optionally connected to the X70 diagnostic interface:

► USB diagnostic adapter E94AZCUS

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

► EZAEBK2001diagnosis terminal

The diagnosis terminal comprises the keypad including housing and a connecting cable.

The diagnosis terminal can be used to control or change individual settings. In a quick commissioning menu, the basic settings of the controller can be parameterised using the diagnosis terminal.

The X70 plug is located behind the service hatch. Apply a little pressure to open the service hatch and push the two plastic bars down. Tools are not required.

After using the diagnostic interface, remove the connecting cable at X70 and completely close the service hatch.

X70 - diagnostic interface			
Pin	Signal	Description	Data
 8400HLC009		Type RJ69, 10-pole, socket	
1 ... 10	internal	Terminal for diagnosis terminal or diagnostic adapter	

6.6.2 Analog input

The analog input can be used either as voltage input or as current input.

X50- analog inputs AI, AU

Pin	Signal	Description	Data
 84DPSO05_5			
Type M12, 5-pole sockets			
1	24O	24 V supply of the external sensors	
2	AI	Current input	0 ... +20 mA 4 ... +20 mA
3	GA	Reference potential	
4	AU	Voltage input	0 ... 10 V
5	Controller	10 V reference voltage (output)	+ 10 V, max. 10 mA

Example circuit

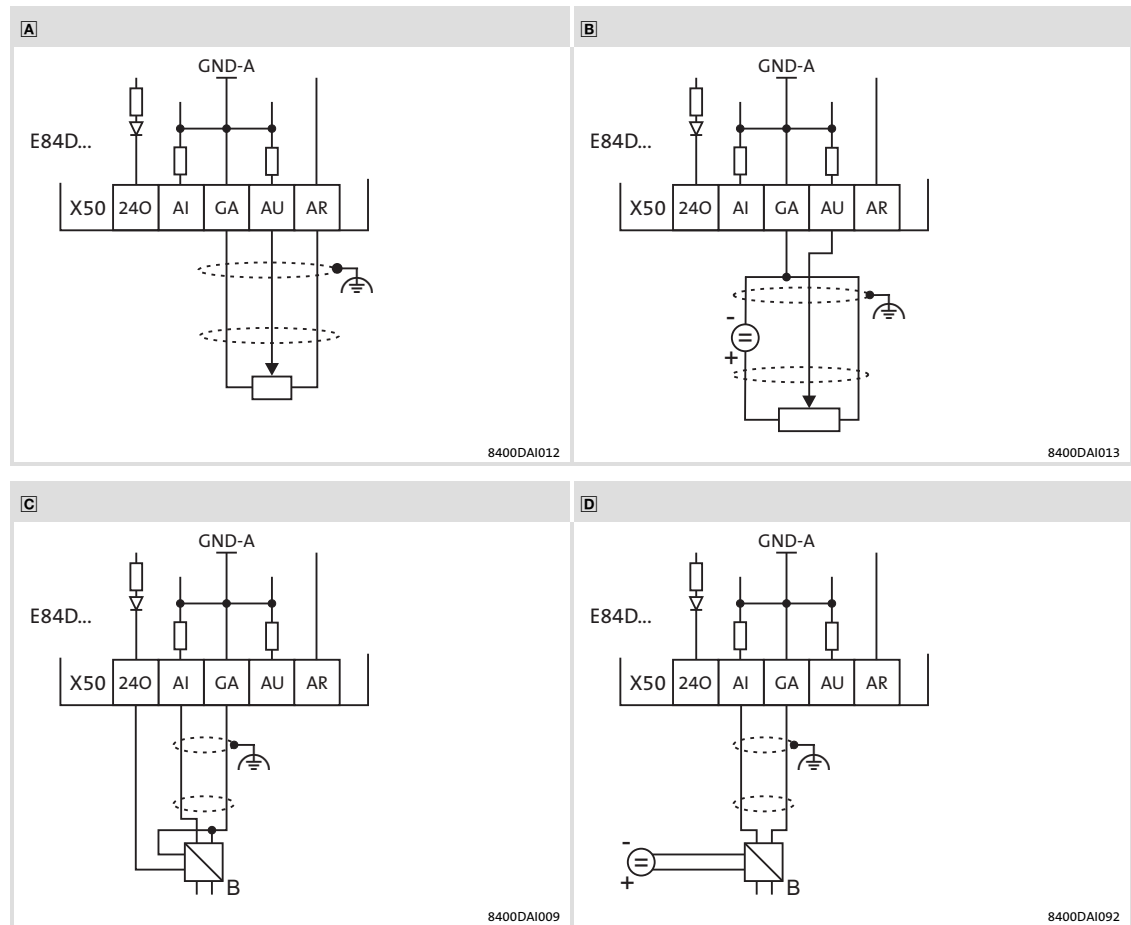


Fig. 6-5 Wiring examples of the analog input

- A** Potentiometer with internal reference voltage AR
 - B** Potentiometer with external reference voltage
 - C** External master current selection based on a sensor signal 0 - 20 mA.
 - D** External master current selection based on a sensor signal 0 - 20 mA. External sensor supply.
- X50 Connection for analog input
- GA GND-A Ground reference potential for the analog inputs and outputs
- ⏏ EMC shield connection
- U Measuring device
- B Measuring transducer

6.6.3 Digital inputs and outputs

**Note!**

The maximum total current of the 24 V voltage supply for external actuators and encoders is 1 A, e.g. ports

- Digital inputs/outputs at X4x,
- Analog input at X50 or SSI at X80, and
- Serial interfaces RS485/RS422 at X81/X82.

Digital inputs**X41 - digital inputs DI1, DI2**

Pin	Signal	Description	Data
 84DPSO05_5			
1	24O	24 V supply of the external sensors	
2	DI2	Digital input 2	According to IEC61131-2, type 1 or Two-track frequency input for HTL encoder 0 ... 100 kHz
3	GIO	Reference potential	HIGH +15 ... +30 V DC LOW 0 ... +5 V
4	DI1	Digital input 1	8 mA at 24 V DC
5	n. c.	Not assigned	

X42 - digital inputs DI3, DI4

Pin	Signal	Description	Data
 84DPSO05_5			
1	24O	24 V supply of the external sensors	
2	DI4 (DO2)	Digital input 4 (also available as digital output)	HIGH +15 ... +30 V DC
3	GIO	Reference potential	LOW 0 ... +5 V
4	DI3 (DO1)	Digital input 3 (also available as digital output)	8 mA at 24 V DC
5	n. c.	Not assigned	

X43 - digital inputs DI5, DI6

Pin	Signal	Description	Data
 84DPSO05_5			
1	24O	24 V supply of the external sensors	
2	DI6	Digital input 6	According to IEC61131-2, type 1 or Single-channel frequency input, 0 ... 10 kHz
3	GIO	Reference potential	HIGH +15 ... +30 V DC LOW 0 ... +5 V
4	DI5	Digital input 5	8 mA at 24 V DC
5	n. c.	Not assigned	

Example circuit

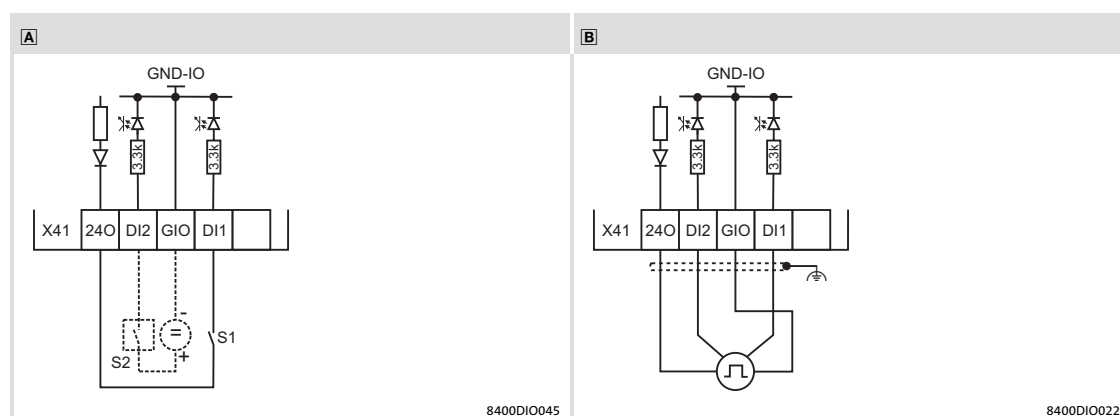


Fig. 6-6 Wiring examples of the digital inputs

- A** Wiring of digital inputs, examples:
 S1 Potential-free contact, at internal 24 V supply
 S2 Signal source, e.g. PLC or with external 24 V supply
- B** Connection of an HTL incremental encoder with a maximum input frequency of 100 kHz
 DI1 track A
 DI2 track B
- X41 Plugs for digital inputs X41 ... X43
 GIO Ground reference potential for the digital inputs and outputs (GND-IO)

Digital outputs

**Note!**

If inductive loads are being connected, it is essential to use a spark suppressor at the digital output.

X42 - digital outputs DO1, DO2 (configured digital input!)

Pin	Signal	Description	Data
 84DPSO05_5		Type M12, 5-pole sockets	
1	24O	24 V supply of the external sensors	
2	DO2	digital output 2 (configured)	HIGH +24 V or V_{DC} at X10
3	GIO	Reference potential	LOW 0 ... +5 V
4	DO1	digital output 1 (configured)	max. 200 mA per output
5	n. c.	Not assigned	

Example circuit

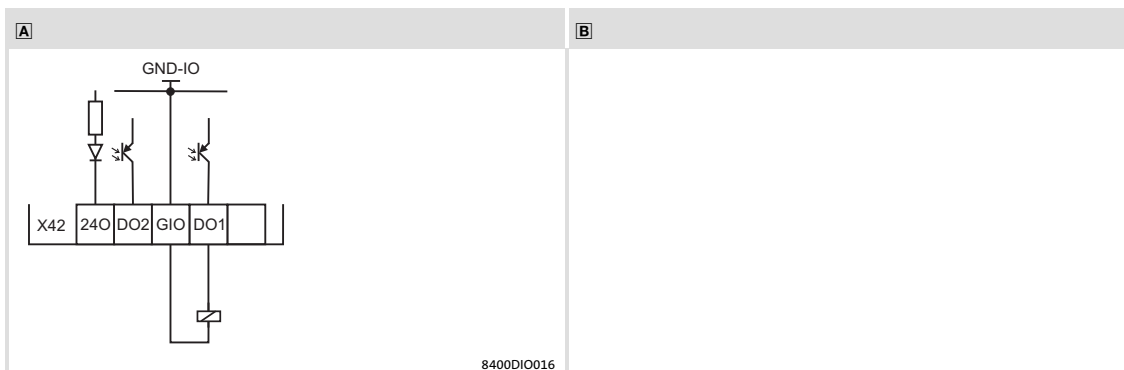


Fig. 6-7

Wiring examples of the digital inputs and outputs

- A** Digital control (relay, valve, ...) with internal 24 V supply
B -
X42 Plug for the digital outputs (configured)
GIO Ground reference potential for the digital inputs and outputs (GND-IO)

6.6.4

Synchronous serial interface (SSI)

X80 - SSI			
Pin	Signal	Description	Data
 84DPS005_8			
		M12 type, 8-pole sockets	
1	CLK+	Pos. clock signal	
2	CLK-	Neg. clock signal	
3	Data+	Pos. data line	
4	Data-	Neg. data line	
5	n. c.	Not assigned	-
6	n. c.	Not assigned	-
7	GIO	Reference potential	External supply at 24E: Voltage drop < 2.5 V
8	24O	24 V supply of the external SSI encoders	Total current for X4x, X50/X8x: 1 A

6.7 Communication

Carry out the installation in accordance with the mounting directives of the fieldbus systems in order to prevent a faulty communication. Please observe the notes on the additional equipotential bonding.



Stop!

High compensation currents

High compensation currents can flow via the shield of the fieldbus cable.

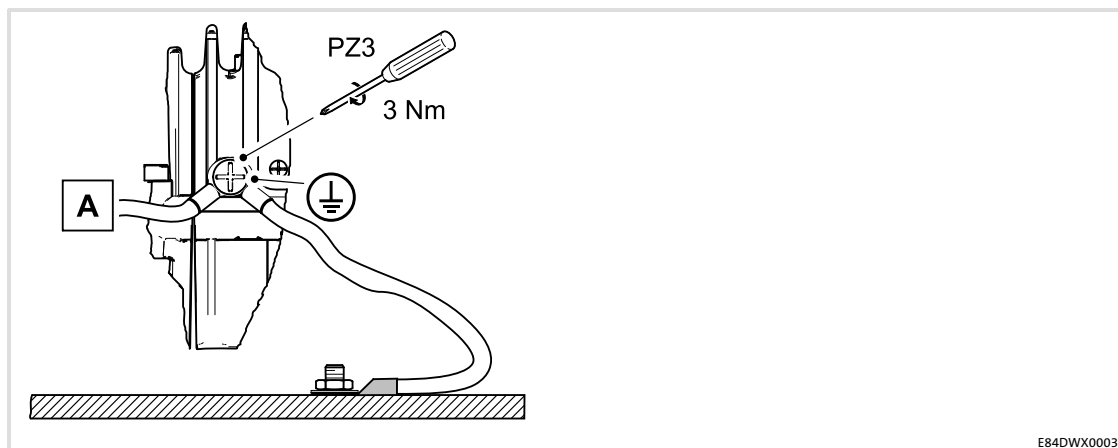
Possible consequences:

Damage to material assets or failures

Protective measures:

Prevent compensation currents via the shield of the fieldbus cable as follows:

- ▶ Connect all fieldbus nodes with a 16 mm² cable via the earthing studs.
- ▶ Lay this cable in parallel to the bus cable.
- ▶ Ensure a highly conductive connection of all earthing studs with a copper braid cable to the mounting surface.



E84DWX0003

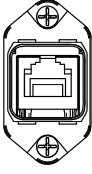
- ⊕ Earthing for compliance with EMC conditions, prevents compensation currents via the shield of the fieldbus cable
- A 16 mm² equalizing conductor with ring cable lug M6

The communication cables of the available fieldbus systems can be installed using different plug versions. The type code provides information on the design of one device.

6.7.1

PROFINET® / EtherNet/IP™

Push-pull plug

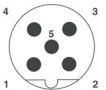
X31 - fieldbus input, X32 fieldbus output			
Pin	Signal	Description	Data
 84DWTX0311		AIDA standard, type RJ45, socket, 8-pole	
1	Tx+	Transmit path + (transmit)	
2	Tx-	Transmit path - (transmit)	
3	Rx+	Receive path + (receive)	
4	res.	-	
5	res.	-	
6	Rx-	Receive path - (receive)	
7	res.	-	
8	res.	-	

M12 plug, 4-pole

X3x - communication			
Pin	Signal	Description	Data
 84DPSO05_5		Type M12, 4-pole, D-coded X31 -> sockets X32 -> sockets	
1	Tx+	Transmit path +	
2	Rx+	Receive path +	
3	Tx-	Transmit path -	
4	Rx-	Receive path -	

6.7.2

PROFIBUS®

X3x - communication			
Pin	Signal	Description	Data
 84DPSO05_5		Type M12, 5-pole, B-coded X31 -> input -> pins X32 -> output -> sockets	
1	P5V2	● Only assigned at the output	5 V DC / 30 mA (bus termination)
2	RxD/TxD-N	Data line A (received/transmitted data, minus)	
3	M5V2	Data ground (ground to 5 V)	
4	RxD/TxD-P	Data line B (received/transmitted data, plus)	
5	n. c.	- (shield connection above the housing)	

The station address can be set via DIP switches 1 ... 64 behind the service hatch.

6.7.3

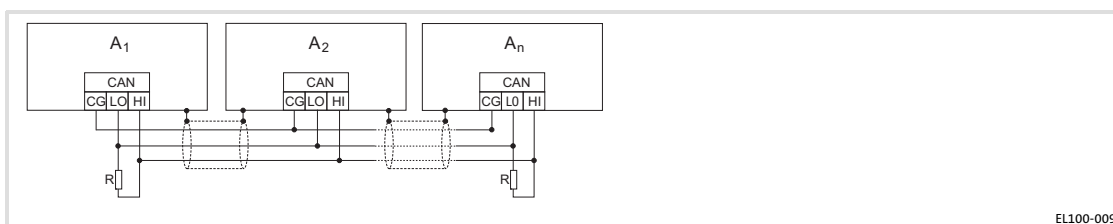
CANopen®

X3x - communication

Pin	Signal	Description	Data
 84DPSO05_5			
1	n. c.	Not assigned	CAN specification
2	n. c.	Not assigned	
3	CG	CAN-Ground	
4	CH	CAN-HIGH	
5	CL	CAN-LOW	

Example circuit

Wiring example



Terminating resistors of 120 Ω are not integrated and must be wired externally.

6.7.4

CAN on board

X35 - communication

Pin	Signal	Description	Data
 84DPSO05_5			
1	n. c.	Not assigned	CAN specification
2	n. c.	Not assigned	
3	CG	CAN-Ground	From HW version VD onwards, the 120 Ω terminating resistor is integrated. HW version: see C00210/10
4	CH	CAN-HIGH	
5	CL	CAN-LOW	



Software manual for the standard device / »Engineer« online help

Here, detailed information is provided about ...

- CAN communication;
- Parameter setting and configuration;
- System bus (CAN) diagnostics.

6.8

Safety engineering

Please observe the following safety instructions and application notes to preserve the certified safety engineering features and to ensure trouble-free and safe operation.

**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 cabinet must comply with the requirements of ISO 138491 and ISO 13849-2. This includes i.a.:
 - Switches, relays with at least IP54 enclosure.
 - Control cabinet with at least IP54 enclosure.
 - Please refer to ISO 138491 and ISO 13849-2 for all further requirements.
- ▶ Wiring must be shielded.
- ▶ 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 13849-2.
- ▶ If an external force acts upon the drive axes, additional brakes are required. Please observe that hanging loads are subject to the force of gravity!

**Danger!****Danger to life by improper installation**

Improper installation of the safety equipment may cause an uncontrolled start of the drives.

Possible consequences:

- ▶ Death or severe injury

Protective measures:

Shield the cables between the plugs for the safety equipment and the connected components (e.g. sensors, devices, ...).

**Note!**

Please observe during transport, storage and operation:

- ▶ Cover unused connectors for control connections and interfaces with the plastic covers provided to preserve the certified safety technology features.

X61 - connection of safety system "Safety Option 10"

Pin	Connection	Description	Data
 84DPSO05_5			
1	SIA	Safe input, channel A	$I_{typ} = 45 \text{ mA}$ LOW: -3 ... 5 V HIGH: 18 ... 30 V Supply through safely separated power supply unit (SELV/PELV).
2	SIB	Safe input, channel, B	
5	GI	1. GND potential for SIA/SIB 2. GND potential for the non-safe signalling output	
4	24O	24-V voltage supply for the non-safe signalling output	24 V, max. 0.2 A short-circuit-proof Supply through safely separated power supply unit (SELV/PELV).
3	DO1	Non-safe signalling output: "SafeTorqueOff" with 2-channel request by SIA and SIB	
			High active

X62 - connection of safety engineering system "Safety Option 30"

Pin	Connection	Description	Data
 84DPS005_5		M12, 5-pole sockets, A-coded	
1	AIE	Error acknowledgement	
2	24_ACK	24-V supply voltage for reset button	max. 300 mA
3	AIS	Restart acknowledgement	
4	GND_SM	GND potential	
5	GND_SM		

X63 - connection of the "Safety Option 30" safety engineering system

Pin	Connection	Description	Data
 84DSO05_8		M12, sockets 8-pole, A-coded	
1	CLA	Clock output, channel A	
2	CLB	Clock output, channel B	
3	GND_CLK	GND potential - clock output, channel A	
4	I1A	Safe input 1, channel A	
5	GND_I1	GND potential - input 1, channel A	
6	I1B	Safe input 1, channel B	
7	GND_CLK	GND potential - clock output, channel B	
8	GND_I1	GND potential - input 1, channel B	

X64 - connection of the "Safety Option 30" safety engineering system

Pin	Connection	Description	Data
 84DSO05_8		M12, sockets 8-pole, A-coded	
1	CLA	Clock output, channel A	
2	CLB	Clock output, channel B	
3	GND_CLK	GND potential - clock output, channel A	
4	I2A	Safe input 2, channel A	
5	GND_I2	GND potential - input 2, channel A	
6	I2B	Safe input 2, channel B	
7	GND_CLK	GND potential - clock output, channel B	
8	GND_I2	GND potential - input 2, channel B	

7 Electrical installation - EMS version

7.1 Important notes



Danger!

Dangerous electrical voltage

All power terminals remain live for up to three minutes after mains disconnection.

Possible consequences:

- ▶ Death or severe injuries when touching the power terminals.

Protective measures:

- ▶ Switch off the power supply and wait for at least three minutes before working on the power terminals.
- ▶ Make sure that all power terminals are deenergised.



Danger!

- ▶ The contacts of the power connectors **X10, X11, X20 and X21** may carry dangerous voltage if the frequency inverter is connected to the mains. Thus, deenergise the frequency inverter before working on it.
- ▶ Earth the device by means of X10 and by connecting it to functional earth (earthing bolt) in order to prevent injury to persons and malfunctioning.



Danger!

Dangerous voltage

The leakage current to earth (PE) is $> 3.5 \text{ mA AC}$ or $> 10 \text{ mA DC}$.

Possible consequences:

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

Protective measures:

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

**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!****Pluggable terminal strips or plug connections**

Plugging or removing the terminal strips or plug connections during operation may cause high voltages and arcing.

Possible consequences:

- ▶ Damage of the devices

Protective measures:

- ▶ Switch off device.
- ▶ Only plug or remove the terminal strips or plug connections in deenergised status.

**Note!**

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

Please observe the following:

- ▶ When switching with the controller is enabled, you can activate monitoring functions of the controller. If no monitoring function is activated, switching is permissible.
- ▶ The switching elements at the motor end must be rated for DC voltages $V_{DCmax} = 800 \text{ V}$.



Note!

Only with the **control element**

- ▶ **C** = service switch with protective function
the device can be disconnected from the mains voltage.



Note!

The counter plugs of the power terminals must be equipped with connector housings with a vertical outgoing cable.



Note!

- ▶ **It is absolutely necessary to keep the plastic caps on the connectors for the control terminals and interfaces!**
- ▶ During transport, storage, and operation, ports not used must be sealed using the plastic caps, in order to maintain the product features in accordance with the technical data.
- ▶ Only if this note is observed, the product features certified are ensured for devices with a safety system.

EMC-compliant wiring



Note!

- ▶ Establish a good conductive connection to protective earth by means of a copper-braid cable (e.g. mounting surface, machine earth or building earth).
- ▶ Lay control cables and data lines separately from the motor cables.
- ▶ Connect the shields of the control cables and data lines **at both ends**.

7.1.1

Electrical isolation

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

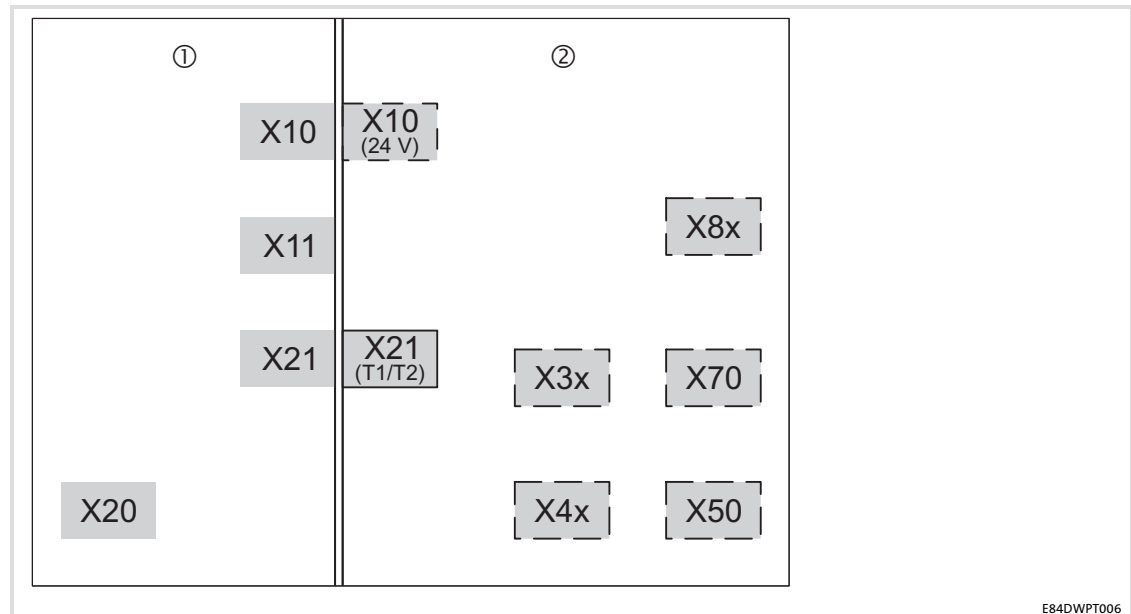


Fig. 7-1 Electrical isolation between power terminals, control terminals and housing

⋮	Isolation by functional insulation
	Isolation by basic insulation
	Safe isolation by double or reinforced insulation Protection against accidental contact is guaranteed without any further measures.
①	Power terminals
X10, X11	Mains
X21	Motor
X20	Brake resistor
②	Control terminals
X10 (24 V)	24 V supply voltage for the motor holding brake
X21 (T1/T2)	Motor temperature monitoring
X3x	Fieldbus communication, CANopen Master PLC
X4x	Digital inputs/outputs
X50	Analog input
X70	Diagnostics
X8x	SSI, RS485/422

7.1.2

Device protection

- In case of condensation, do not connect the controller to the mains voltage before the moisture has evaporated completely.
- The controller must be protected by external fuses.
- Unused control inputs and outputs must be closed according to the intended type of protection.

7.1.3 Maximum motor cable length

- ▶ Keep the motor cable as short as possible since this has a positive effect on the drive behaviour.
- ▶ The maximally permissible motor cable length is: 20 m, shielded
 - at rated mains voltage
 - at a switching frequency of 8 kHz

**Note!**

If the conditions for electromagnetic compatibility must be observed, the permissible cable lengths may vary.

7.1.4 Motor protection

- ▶ Extensive protection against overload:
 - By overcurrent relays or temperature monitoring.
 - We recommend the use of PTC thermistors or thermostats to monitor the motor temperature.
 - PTC thermistors or thermostats can be connected to the controller.
 - For monitoring the motor, we recommend the use of the I²t monitoring.
- ▶ Only use motors with an insulation suitable for the inverter operation:
 - Insulation resistance: min. $\hat{u} = 1.5 \text{ kV}$, min. $du/dt = 5 \text{ kV}/\mu\text{s}$
 - When using motors with an unknown insulation resistance, please contact your motor supplier.

7.2

Safety instructions for the installation according to U_L or U_R

Original - English

**Warnings!**

- ▶ Branch circuit protection:
Suitable for use on a circuit capable of delivering not more than 200 000 rms symmetrical amperes, 500 V maximum.
– When Protected by CC, T, or J Class Fuses.
- ▶ Integral solid state protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electrical Code and any additional local codes.
- ▶ Overload Protection = 125 % of rated FLA.
- ▶ Use 75 °C copper wire only, except for control circuits.
- ▶ Use Class 1 wire only.
- ▶ Enclosed Device, suitable for use in a UL Type 4X (Indoor) Environment.
- ▶ Suitable for use in a surrounding air temperature of 45 °C, and
– additionally 55 °C when de-rating rules are followed.
- ▶ Suitable for use in a compartment handling conditioned air.
- ▶ The device is provided with internal overload protection. For information on the protection level of the internal overload protection for a motor load, see the corresponding Software Manual or Online Help under the topic "Motor load monitoring (I^2xt)". This function has to be activated; i. e. the reaction must be changed from "Warning" (factory setting) to "Fault".
- ▶ For information on rating and proper connection of the thermal protector (only for connection to motors having integral thermal protection), see the corresponding Manual or Online Help.

**Warnings!**

The opening of branch-circuit protective device may be an indication that a fault has been interrupted.

To reduce the risk of fire or electric shock, current-carrying parts and other components of the controller should be examined and replaced if damaged or equivalent.

7.3

Safety instructions for the installation according to U_L or U_R

Original - French



Avertissement !

- ▶ Protection par disjoncteur :
Convient aux circuits non susceptibles de délivrer plus de 200 000 ampères symétriques eff., maximum 500 V.
– Protection par des fusibles CC de calibre T ou J.
- ▶ 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 et aux autres dispositions applicables au niveau local.
- ▶ Protection contre les surcharges = 125 % de l'intensité assignée à pleine charge.
- ▶ Utiliser exclusivement des conducteurs en cuivre 75 °C, sauf pour la partie commande.
- ▶ Utiliser impérativement un câble de classe 1.
- ▶ Equipement monté dans un coffret de protection adapté à une utilisation en environnement UL de type 4X (intérieur).
- ▶ Convient à une utilisation à une température ambiante maximale de 45 °C ainsi que
– 55 °C en cas d'application des règles de réduction de puissance.
- ▶ Convient pour une utilisation dans un espace à air conditionné.
- ▶ L'équipement est doté d'un dispositif de protection intégré contre les surcharges. Pour obtenir des informations sur le niveau de protection offert par la protection intégrée contre les surcharges du moteur, se reporter au manuel du logiciel ou à l'aide en ligne correspondante, rubrique "Surveillance de la charge du moteur (I²xt)". Cette fonction doit être activée. En d'autres termes, la réaction doit être modifiée de "Avertissement" (réglage usine) à "Défaut".
- ▶ Pour obtenir des informations sur les caractéristiques assignées et sur le raccordement correct du dispositif de protection thermique (uniquement pour raccordement à des moteurs dotés d'une protection thermique intégrée), se reporter au manuel correspondant ou à l'aide en ligne.



Avertissement !

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 et les remplacer s'ils sont endommagés.

7.4 Installation according to EMC (installation of a CE-typical drive system)**Design of the cables**

- ▶ It is imperative to comply with the regulations concerning minimum cross-sections of PE conductors. The cross-section of the PE conductor must be at least as large as the cross-section of the power connections.
- ▶ The cables used must comply with the approvals required for the location (e.g. UL).

7.4.1 Shielding**Requirements**

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

Use system cables or shielded cables for these connections:

- ▶ Motor
- ▶ External brake resistor (⚠ Mounting Instructions of the brake resistor)
- ▶ Motor holding brake (shielding is required when being integrated into the motor cable; connection to optional motor brake control)
- ▶ Motor temperature monitoring
- ▶ Fieldbus communication (e.g. CANopen)
- ▶ Serial interfaces (e.g. SSI, RS485/422)

The following connections need not be shielded:

- ▶ Mains
- ▶ 24 V supply for motor holding brakes
- ▶ Digital signals (inputs and outputs). From a cable length of approx. 5 m onwards, we recommend to use shielded cables.

Connection system

- ▶ Directly apply the shielding in the plug.
 - Extensively apply the shielding and ensure electrical conductivity.
 - If required, additionally connect the shield to the cable clamp rail.

7.4.2**Motor cable**

- ▶ Only use shielded motor cables with braids made of tinned or nickel-plated copper. Shields made of steel braids are not suitable.
 - The overlap rate of the braid must be at least 70 % with an overlap angle of 90 °.
- ▶ The cables used must correspond to the requirements at the location (e.g. EN 60204-1).
- ▶ Use Lenze system cables.
- ▶ Extensively apply the shielding in the plug and attach it in a way which ensures electrical conductivity.
- ▶ The motor cable is optimally installed if
 - it is separated from mains cables and control cables,
 - it only crosses mains cables and control cables at right angles,
 - it is not interrupted.
- ▶ If the motor cable must be opened all the same (e.g. due to chokes, contactors, or terminals):
 - The unshielded cable ends may not be longer than 100 mm (depending on the cable cross-section).
 - Install chokes, contactors, terminals etc. spatially separated from other components (with a min. distance of 100 mm).
 - Install the shield of the motor cable directly before and behind the point of separation to the mounting plate with a large surface.
- ▶ Connect the shield with a large surface to PE in the terminal box of the motor at the motor housing.
 - Metal EMC cable glands at the motor terminal box ensure a large surface connection of the shield with the motor housing.

7.4.3**Control cables**

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

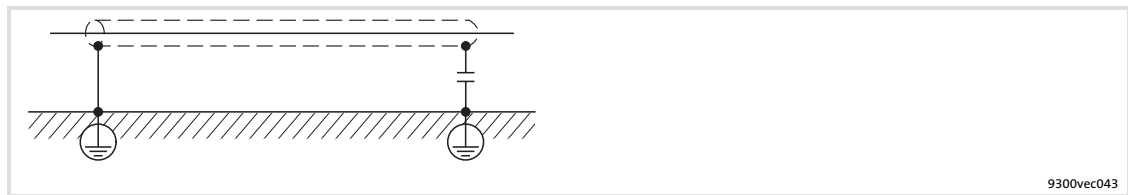


Fig. 7-2 Shielding of long, analog control cables

9300vec043

7.4.4 Wiring

Notes on the laying of cables:

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

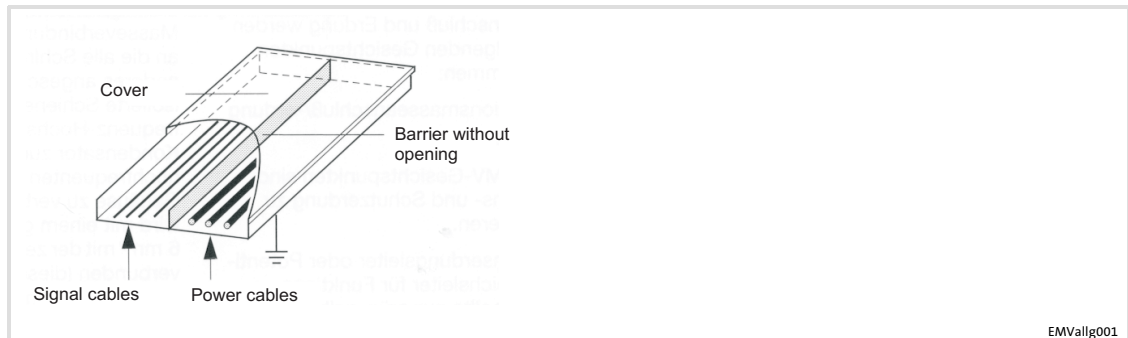


Fig. 7-3 Cable routing in the cable duct with barrier

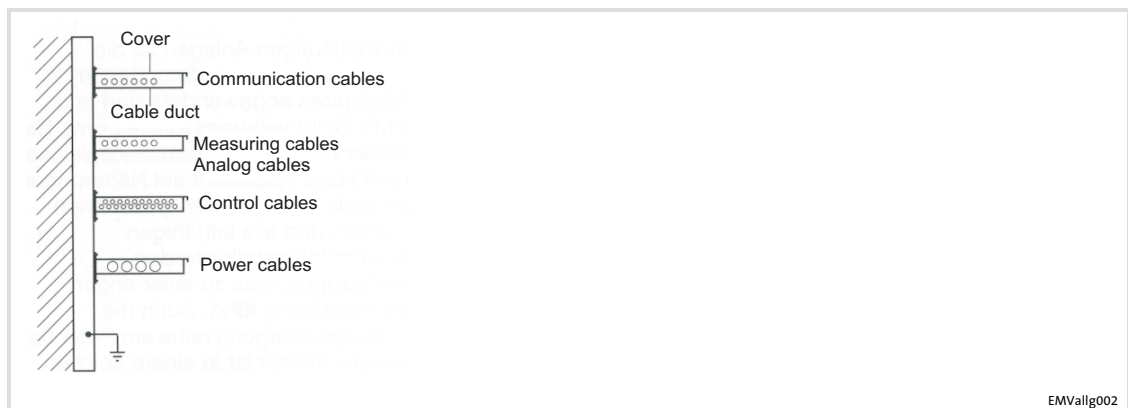


Fig. 7-4 Cable routing in separated cable ducts

Wiring on the mains side

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

Wiring on the motor side**Stop!**

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

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

Special conditions allow you to integrate the supply cable for temperature monitoring of the motor into the motor cable: (📖 113)

**Danger!****Uncontrolled motor movements can occur**

If the motor cable is damaged, a short circuit between the brake control cables and the motor cables can cause motor movements with low torque.

Possible consequences:

- ▶ Personnel in the vicinity of the motor can be injured.

Protective measures:

- ▶ Install motor cable in a protected way (e.g. in a cable duct).

7.4.5 Detecting and eliminating EMC interferences

Fault	Cause	Remedy
Interferences of analog setpoints of your own or other devices and measuring systems	Unshielded motor cable	Use shielded motor cable
	Shield contact is not extensive enough	Carry out optimal shielding as specified
	Shield of the motor cable is interrupted by terminal strips, switched, etc.	• Separate components from other component part with a minimum distance of 100 mm • Use motor choke/motor filter
	Install additional unshielded cables inside the motor cable (e.g. for motor temperature monitoring)	Install and shield additional cables separately
	Too long and unshielded cable ends of the motor cable	Shorten unshielded cable ends to maximally 40 mm

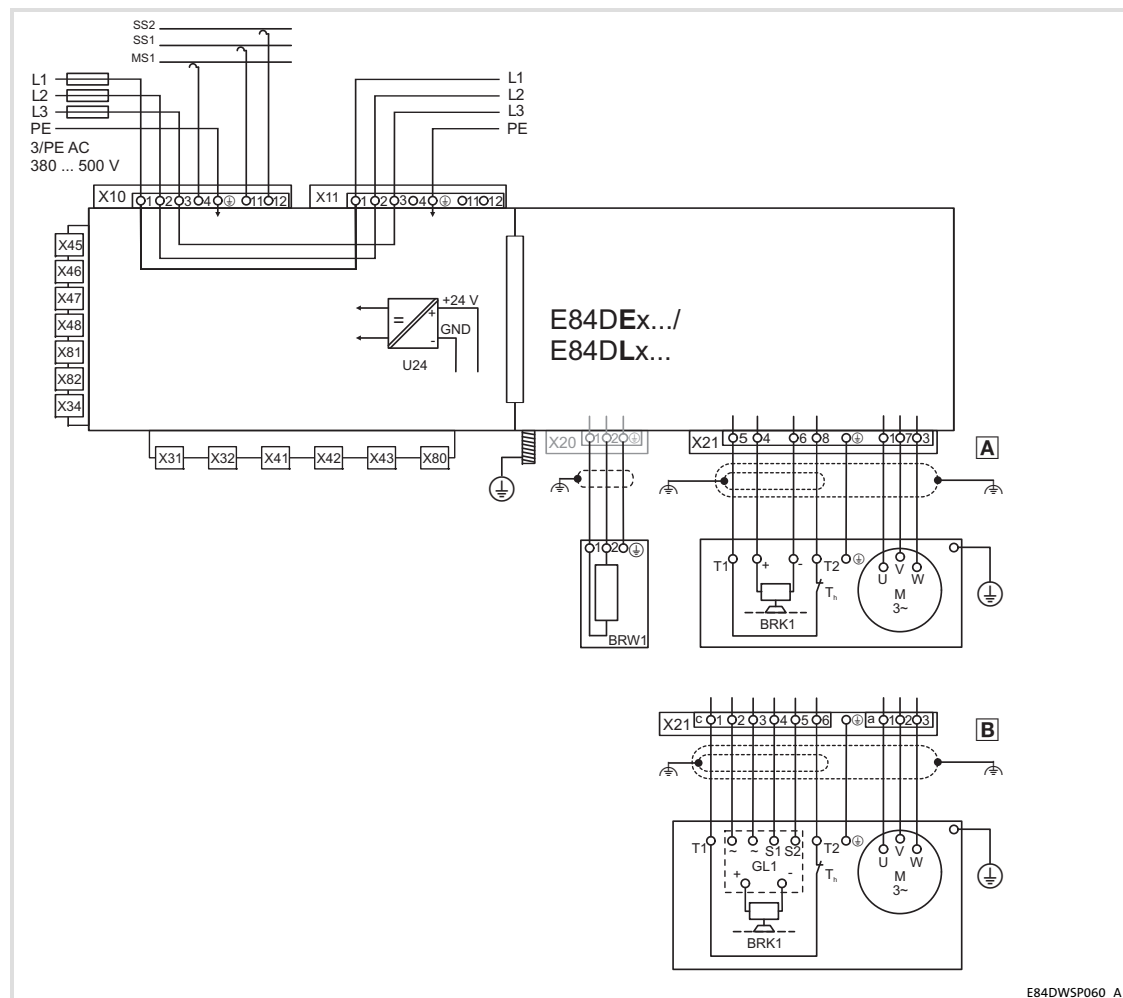
7.5

Devices in a power range of 0.75 ... 4 kW (3/PE AC 400 V)

7.5.1

Example circuits

Half wave / half wave coded



E84DWSP060_A

E84DEx... / E84DLx...

X10: L1, L2, L3, PE

X10: SS1, SS2, MS1

X11

X31 ... X32

X34

X41 ... X43

X45 ... X48

X80

X81/X82

M

A

B

T_h

BRK1

GL1

BRW1

U24

8400 protec EMS controller, half wave / half wave coded

Mains voltage

EMS: control bars, signalling bars

Mains voltage loop-through technique (optional)

Fieldbus communication

CANopen master PLC

DIO

EMS: Further DIO

SSI

EMS: RS485/422

Motor

Motor connection system: Plug type Q8/0

Motor connection system: Plug type Modular

PTC thermistor (PTC) or thermal contact (NC contact)

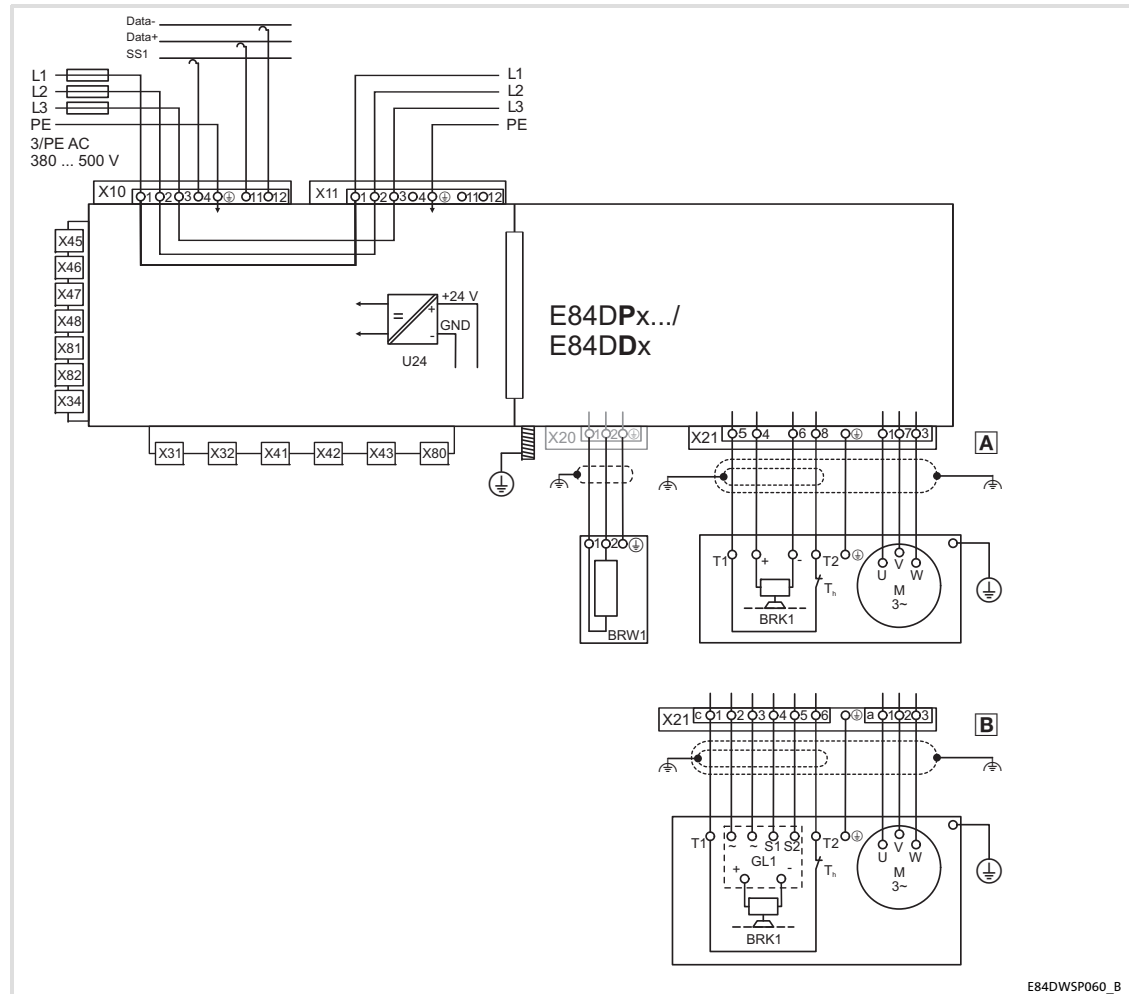
Spring-applied brake

Spring-applied brake control

External brake resistor at the optional terminal X20

Supply voltage 24 V internal

Power wave / DECA bus



E84DWS060_B

E84DPx... / E84DDx...

X10: L1, L2, L3, PE

X11: data±, SS1

X11

X31 ... X32

X34

X41 ... X43

X45 ... X48

X80

X81/X82

M

A

B

T_h

BRK1

GL1

BRW1

U24

8400 protec EMS controller, power wave / DECA bus

Mains voltage

EMS: Signalling bars, control bars

Mains voltage loop-through technique (optional)

Fieldbus communication

CANopen master PLC

DIO

EMS: Further DIO

SSI

EMS: RS485/422

Motor

Motor connection system: Plug type Q8/0

Motor connection system: Plug type Modular

PTC thermistor (PTC) or thermal contact (NC contact)

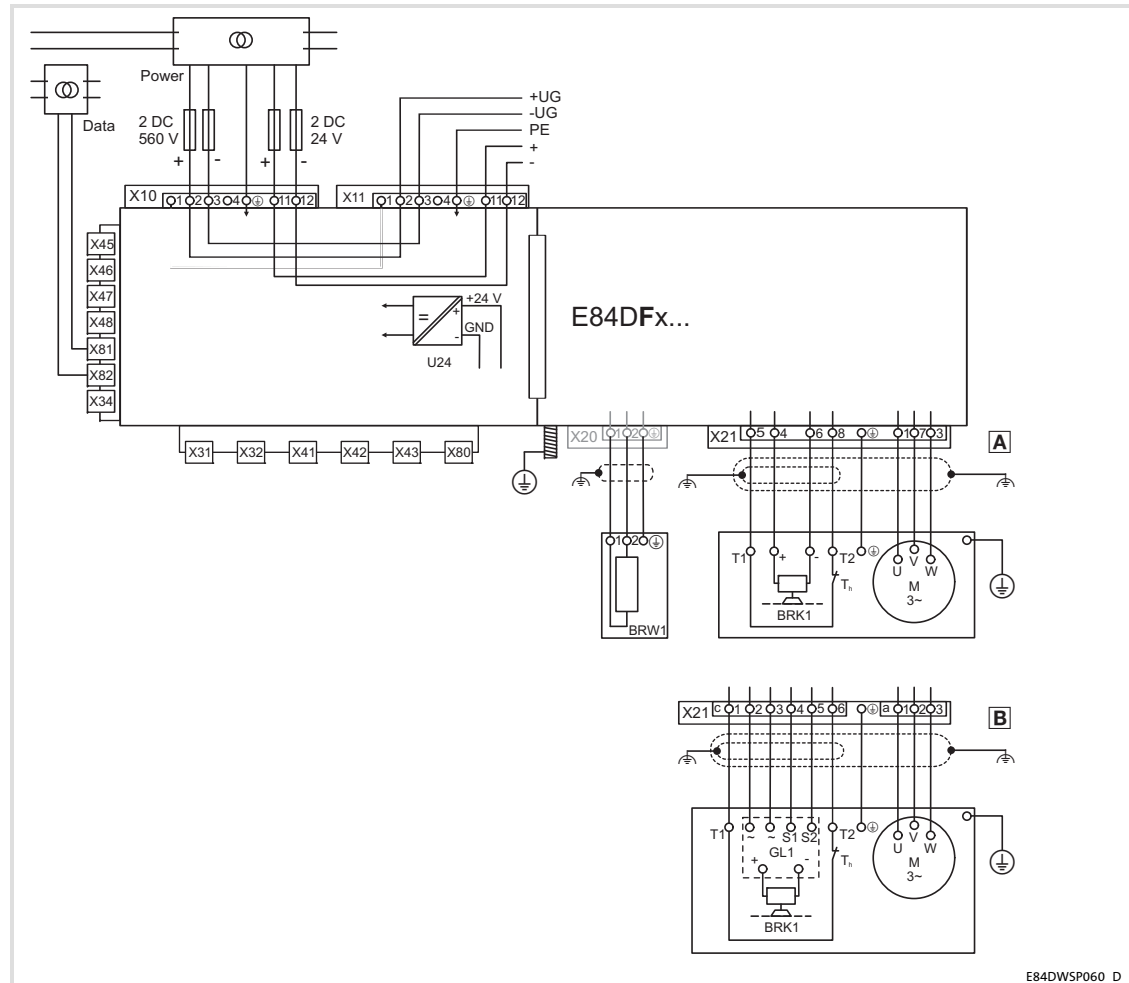
Spring-applied brake

Spring-applied brake control

External brake resistor at the optional terminal X20

Supply voltage 24 V internal

Inductive



E84DWSP060_D

E84DFx...

X10: +UG, -UG, PE

X10: +, -

X11

X31 ... X32

X34

X41 ... X43

X45 ... X48

X80

X81/X82

M

A

B

T_h

BRK1

GL1

BRW1

U24

8400 protec EMS controller, inductive system

560 V DC (mains voltage)

24 V DC (motor holding brake)

Mains voltage loop-through technique (optional)

Fieldbus communication

CANopen master PLC

DIO

EMS: Further DIO

SSI

EMS: RS485/422

Motor

Motor connection system: Plug type Q8/0

Motor connection system: Plug type Modular

PTC thermistor (PTC) or thermal contact (NC contact)

Spring-applied brake

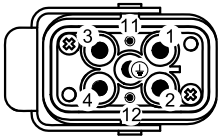
Spring-applied brake control

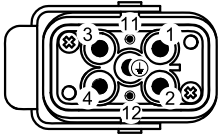
External brake resistor at the optional terminal X20

Supply voltage 24 V internal

7.5.2 Terminal assignment of the power connections

Mains connection

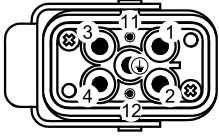
X10 - port for mains, signalling bar, and control bar			
Pin	Connection	Description	Data
 84DWTX0100		DESINA type Q4/2, pins	Version: 8400 protec EMS Type designation: • E84DEx... (half wave) • E84DLx... (half wave coded)
1	L1	Mains phase L1	Max. 6 mm ²
2	L2	Mains phase L2	
3	L3	Mains phase L3	
4	MS1	Signalling bar 1	
⊕	PE	PE conductor	Max. 2.5 mm ²
11	SS1	Control bar 1 (Half wave/half wave coded)	
12	SS2	Control bar 2 (half wave optional)	

X10 - port for mains, power wave / DECA and control bar			
Pin	Connection	Description	Data
 84DWTX0100		DESINA type Q4/2, pins	Version: 8400 protec EMS Type designation: • E84DPx... (power wave) • E84DDx... (DECA bus)
1	L1	Mains phase L1	Max. 6 mm ²
2	L2	Mains phase L2	
3	L3	Mains phase L3	
4	SS1	Control bar 1	
⊕	PE	PE conductor	Max. 2.5 mm ²
11	Data+	PW+ / DECA+	
12	Data-	/ DECA-	

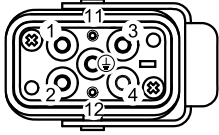
Electrical installation - EMS version

Devices in a power range of 0.75 ... 4 kW (3/PE AC 400 V)

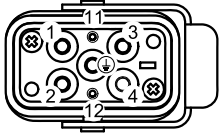
Terminal assignment of the power connections

X10 - port for DC supply			
Pin	Connection	Description	Data
 84DWTX0100		DESINA type Q4/2, pins	Version: 8400 protec EMS Type designation: ● E84DFx... (inductive)
1	n. c.	Not assigned	Max. 6 mm ²
2	+UG	DC-bus voltage +	
3	-UG	DC-bus voltage -	
4	n. c.	Not assigned	
⊕	PE	PE conductor	Max. 2.5 mm ²
11	+	External supply voltage for motor holding brake 24 V DC	
12	-	External reference potential 24 V DC	

X11 - port for mains loop-through technique (optional)

Pin	Connection	Description	Data
 84DWTX0110		DESINA type Q4/2, sockets	Version: 8400 protec EMS Type designation: • E84DEM... (half wave) • E84DLM... (half wave coded) • E84DPM... (power wave) • E84DDM... (DECA bus)
1	L1	Mains phase L1	Max. 6 mm ²
2	L2	Mains phase L2	
3	L3	Mains phase L3	
4	n. c.	Not assigned	
⊕	PE	PE conductor	
11	n. c.	Not assigned	Max. 2.5 mm ²
12	n. c.	Not assigned	

X11 - port for loop-through technique DC supply (optional)

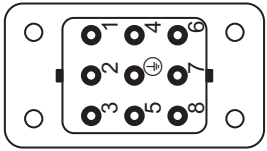
Pin	Connection	Description	Data
 84DWTX0110		DESINA type Q4/2, sockets	Version: 8400 protec EMS Type designation: • E84DFM... (inductive)
1	n. c.	Not assigned	Max. 6 mm ²
2	+UG	DC-bus voltage +	
3	-UG	DC-bus voltage -	
4	n. c.	Not assigned	
⊕	PE	PE conductor	
11	+	External supply voltage for motor holding brake 24 V DC	Max. 2.5 mm ²
12	-	External reference potential 24 V DC	

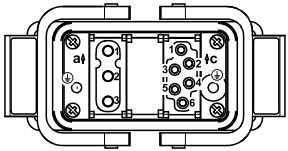
Electrical installation - EMS version

Devices in a power range of 0.75 ... 4 kW (3/PE AC 400 V)

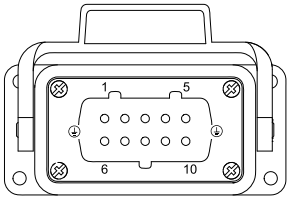
Terminal assignment of the power connections

Motor connection

X21 - motor connection - device version E84DxxC...			
Pin	Connection	Description	Data
 84DWTX0210		Type Q8/0, sockets Use Lenze system cable: EYP0037xxxxxxxxQ10, 8-core, 1.5 mm ² EYP0038xxxxxxxxQ11, 8 core, 2.5 mm ²	
2	n. c.	Grooved pin as a protection against mix-up with power bus	
1	U	Motor phase U	Max. 4 mm ²
3	W	Motor phase W	Max. output voltage: mains voltage
7	V	Motor phase V	Max. permanent output current: type-dependent
4	BD2	Motor holding brake (reference conductor)	Max. 4 mm ²
6	BD1	Motor holding brake	Max. 4 mm ² PTC thermistor (PTC) or thermal contact (NC contact)
5	+PTC	Motor temperature monitoring	
8	-PTC		
⊕	PE	PE conductor	Max. 4 mm ²

X21 - motor connection - device version E84DxxB...			
Pin	Connection	Description	Data
 84DWTX0211		Type Modular, sockets Use Lenze system cable: EYP0039xxxxxxxxQ08, 10-core, 1.5 mm ² EYP0040xxxxxxxxQ09, 10-core, 2.5 mm ²	
a1	U	Motor phase U	Max. 6 mm ²
a2	V	Motor phase V	Max. output voltage: mains voltage
a3	W	Motor phase W	Max. permanent output current: type-dependent
c1	+PTC	Motor temperature monitoring	Max. 4 mm ²
c6	-PTC		PTC thermistor (PTC) or thermal contact (NC contact)
c2	~	Supply voltage of brake rectifier	Max. 4 mm ²
c3	~		V _{rated} = mains voltage-dependent
c4	S1	Switch for separation on the DC side	The brake rectifier is mounted in the terminal box of the motor.
c5	S2		
⊕	PE	PE conductor	Max. 6 mm ²

X21 - motor connection - device version E84DxH...

Pin	Connection	Description	Data
 84DWTX0212		Type Han 10E, sockets	
1	U	Motor phase U	Max. 4 mm ²
2	V	Motor phase W	Max. output voltage: mains voltage
3	W	Motor phase V	Max. permanent output current: type-dependent
4	BD1	Motor holding brake	Max. 4 mm ²
9	BD2	Motor holding brake (reference conductor)	
5	+PTC	Motor temperature monitoring	Max. 4 mm ²
10	-PTC		PTC thermistor (PTC) or thermal contact (NC contact)
6, 7, 8	n. c.	-	-
⊕	PE	PE conductor	Max. 4 mm ² , above housing



Stop!

Damage of the devices

A defective motor holding brake or a short circuit on the X21 connection (motor and built-on accessories) causes internal damage to the device.

Possible consequences:

- If a defective motor holding brake is connected, the replacement device is also damaged immediately.

Protective measures:

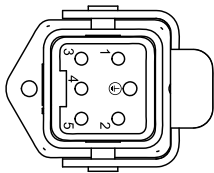
- When devices are replaced due to malfunction of the brake control, ensure that defect-free motor holding brakes are connected.
- Check whether the motor holding brake and the connecting cable are free from defects.
- Replace or repair defective components.



Note!

In the Lenze setting, the temperature monitoring of the motor is activated! To start motors without thermal detectors, the response of the motor temperature monitoring must be deactivated (C00585). Alternatively, a wire jumper between +PTC and -PTC can be used to simulate a normal temperature.

Connection of external brake resistor

X20 - connection of external brake resistor (optional)			
Pin	Connection	Description	Data
 E84DWX0202		Type Q5, sockets	
1	RB2	Brake resistor	max. 2.5 mm ²
2	RB1		
3	T1	In preparation	
5	T2	Brake resistor temperature monitoring	
4	n. c.	Not assigned	
⊕	PE	PE conductor	

7.6 Control terminals

7.6.1 Diagnostics

The following can be optionally connected to the X70 diagnostic interface:

► USB diagnostic adapter E94AZCUS

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

► EZAEBK2001diagnosis terminal

The diagnosis terminal comprises the keypad including housing and a connecting cable.

The diagnosis terminal can be used to control or change individual settings. In a quick commissioning menu, the basic settings of the controller can be parameterised using the diagnosis terminal.

The X70 plug is located behind the service hatch. Apply a little pressure to open the service hatch and push the two plastic bars down. Tools are not required.

After using the diagnostic interface, remove the connecting cable at X70 and completely close the service hatch.

X70 - diagnostic interface			
Pin	Signal	Description	Data
		Type RJ69, 10-pole, socket	
		8400HLC009	
1 ... 10	internal	Terminal for diagnosis terminal or diagnostic adapter	

7.6.2

Digital inputs and outputs

**Note!**

The maximum total current of the 24 V voltage supply for external actuators and encoders is 1 A, e.g. ports

- Digital inputs/outputs at X4x,
- Analog input at X50 or SSI at X80, and
- Serial interfaces RS485/RS422 at X81/X82.

Digital inputs**X41 - digital inputs DI1, DI2**

Pin	Signal	Description	Data
 84DPSO05_5			
1	24O	24 V supply of the external sensors	
2	DI2	Digital input 2	According to IEC61131-2, type 1 or Two-track frequency input for HTL encoder 0 ... 100 kHz
3	GIO	Reference potential	HIGH +15 ... +30 V DC LOW 0 ... +5 V
4	DI1	Digital input 1	8 mA at 24 V DC
5	n. c.	Not assigned	

X42 - digital inputs DI3, DI4

Pin	Signal	Description	Data
 84DPSO05_5			
1	24O	24 V supply of the external sensors	
2	DI4 (DO2)	Digital input 4 (also available as digital output)	HIGH +15 ... +30 V DC
3	GIO	Reference potential	LOW 0 ... +5 V
4	DI3 (DO1)	Digital input 3 (also available as digital output)	8 mA at 24 V DC
5	n. c.	Not assigned	

X43 - digital inputs DI5, DI6

Pin	Signal	Description	Data
 84DPSO05_5			
Type M12, 5-pole sockets			
1	240	24 V supply of the external sensors	
2	DI6	Digital input 6	According to IEC61131-2, type 1 or Single-channel frequency input, 0 ... 10 kHz
3	GIO	Reference potential	HIGH +15 ... +30 V DC LOW 0 ... +5 V
4	DI5	Digital input 5	8 mA at 24 V DC
5	n. c.	Not assigned	

X45 - digital inputs DI7, DI8

Pin	Signal	Description	Data
 84DPSO05_5			
Type M12, 5-pole sockets			
1	240	24 V supply of the external sensors	
2	DI8	Digital input 8	HIGH +15 ... +30 V DC
3	GIO	Reference potential	LOW 0 ... +5 V
4	DI7	Digital input 7	8 mA at 24 V DC
5	n. c.	Not assigned	

X46 - digital inputs DI9, DI10

Pin	Signal	Description	Data
 84DPSO05_5			
Type M12, 5-pole sockets			
1	240	24 V supply of the external sensors	
2	DI10 (DO4)	Digital input 10 (also available as digital output)	HIGH +15 ... +30 V DC
3	GIO	Reference potential	LOW 0 ... +5 V
4	DI9 (DO3)	Digital input 9 (also available as digital output)	8 mA at 24 V DC
5	n. c.	Not assigned	

X47 - digital inputs DI11, DI12

Pin	Signal	Description	Data
 84DPSO05_5			
Type M12, 5-pole sockets			
1	240	24 V supply of the external sensors	
2	DI12	Digital input 12	HIGH +15 ... +30 V DC
3	GIO	Reference potential	LOW 0 ... +5 V
4	DI11	Digital input 11	8 mA at 24 V DC
5	n. c.	Not assigned	

X48 - digital inputs DI13, DI14

Pin	Signal	Description	Data
 84DPS005_5		Type M12, 5-pole sockets	
1	24O	24 V supply of the external sensors	
2	DI14	Digital input 14	HIGH +15 ... +30 V DC
3	GIO	Reference potential	LOW 0 ... +5 V
4	DI13	Digital input 13	8 mA at 24 V DC
5	n. c.	Not assigned	

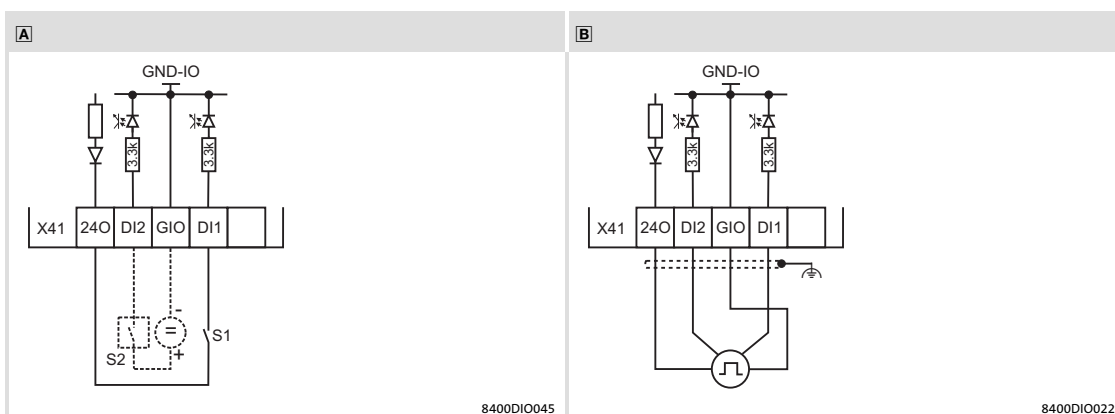
Example circuit

Fig. 7-5 Wiring examples of the digital inputs

- A** Wiring of digital inputs, examples:
- S1 Potential-free contact, at internal 24 V supply
- S2 Signal source, e.g. PLC or with external 24 V supply
- B** Connection of an HTL incremental encoder with a maximum input frequency of 100 kHz
- DI1 track A
- DI2 track B
- X41 Plugs for digital inputs X41 ... X43
- GIO Ground reference potential for the digital inputs and outputs (GND-IO)

Digital outputs



Note!

If inductive loads are being connected, it is essential to use a spark suppressor at the digital output.

X42 - digital outputs DO1, DO2 (configured digital input!)				
Pin	Signal	Description	Data	
 84DPSO05_5		Type M12, 5-pole sockets		
1	24O	24 V supply of the external sensors		
2	DO2	digital output 2 (configured)	HIGH	+24 V or V _{DC} at X10
3	GIO	Reference potential	LOW	0 ... +5 V
4	DO1	digital output 1 (configured)	max. 200 mA per output	
5	n. c.	Not assigned		

X46 - digital outputs DO3, DO4 (configured digital inputs)				
Pin	Signal	Description	Data	
 84DPSO05_5		M12 type, 5-pole sockets, A-coded		
1	24O	24 V supply of the external sensors		
2	DO4	Digital output 4	HIGH	+24 V or V _{DC} at X10
3	GIO	Reference potential	LOW	0 ... +5 V
4	DO3	Digital output 3	Max. 200 mA per output	
5	n. c.	Not assigned		

Example circuit

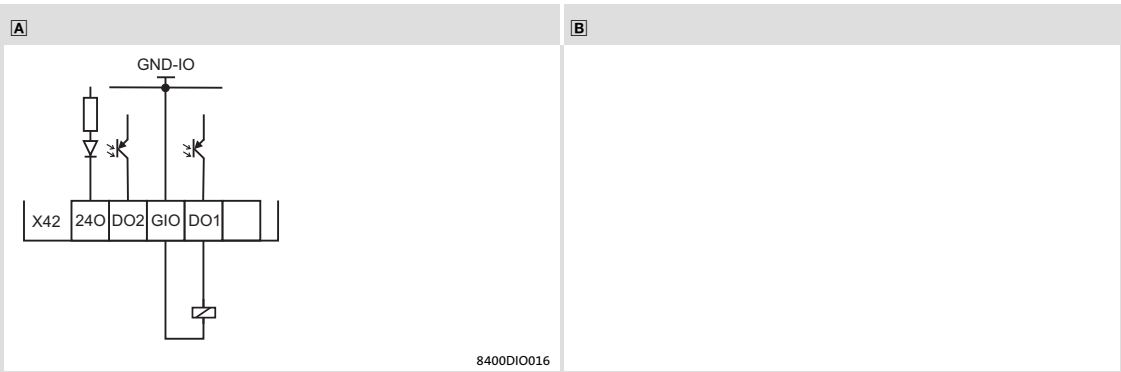


Fig. 7-6

A

Digital control (relay, valve, ...) with internal 24 V supply

B

-

X42

Plug for the digital outputs (configured)

GIO

Ground reference potential for the digital inputs and outputs (GND-IO)

7.6.3

Synchronous serial interface (SSI)

X80 - SSI			
Pin	Signal	Description	Data
 84DPSO05_8			
		M12 type, 8-pole sockets	
1	CLK+	Pos. clock signal	
2	CLK-	Neg. clock signal	
3	Data+	Pos. data line	
4	Data-	Neg. data line	
5	n. c.	Not assigned	-
6	n. c.	Not assigned	-
7	GIO	Reference potential	External supply at 24E: Voltage drop < 2.5 V
8	24O	24 V supply of the external SSI encoders	Total current for X4x, X50/X8x: 1 A

7.6.4 Interfaces RS485/422 PLC

These connections are available with device versions:

- E84DDxxxxxxx**C1C**xxx
- E84DExxxxxxx**C1C**xxx
- E84DFxxxxxxx**C1C**xxx
- E84DLxxxxxxx**C1C**xxx
- E84DPxxxxxxx**C1C**xxx

X81 - RS485 PLC

Pin	Signal	Description	Data
 84DPS005_8			
M12 type, 8-pole sockets, A-coded			
1	+24V	24 V supply	In accordance with IEC 61131-2, type 1
3	GND-EXT	Reference potential	
2	RxD+	RS485A'	In accordance with ANSI/TIA/EIA-485-A-98
4	RxD-	RS485B'	
5	TxD+	RS485A	
6	TxD-	RS485B	
7	n. c.	Not assigned	-
8	n. c.		

X82 - RS422 PLC

Pin	Signal	Description	Data
 84DPS005_8			
M12 type, 8-pole sockets, A-coded			
1	+24V	24 V supply	In accordance with IEC 61131-2, type 1
3	GND-EXT	Reference potential	
2	RxD+	Reception+	In accordance with ANSI/TIA/EIA-422
4	RxD-	Reception-	
5	TxD+	Transmission+	
6	TxD-	Transmission-	
7	n. c.	Not assigned	-
8	n. c.		

Please observe that the direct coupling of two 8400 protec EMS devices require an external connection with terminating resistors.

7.6.5

Interfaces RS485 PLC

These connections are available with device versions:

- E84DDxxxxxxxCxBxxx
- E84DExxxxxxxCxBxxx
- E84DFxxxxxxxCxBxxx
- E84DLxxxxxxxCxBxxx
- E84DPxxxxxxxCxBxxx

X81/X82 - RS485 PLC			
Pin	Signal	Description	Data
 84DPS005_8		M12 type, 8-pole sockets, A-coded	
1	TxD+	RS485A	In accordance with ANSI/TIA/EIA-485-A-98
2	TxD-	RS485B	
3	RxD+	RS485A'	
4	RxD-	RS485B'	
5	n. c.	Not assigned	-
6	n. c.		
7	GND-EXT	Reference potential	In accordance with IEC 61131-2, type 1
8	+24V	24 V supply	

7.6.6 Interfaces RS422 PLC

These connections are available with device versions:

- ▶ E84DDxxxxxxxCxDxxx
- ▶ E84DExxxxxxxCxDxxx
- ▶ E84DFxxxxxxxCxDxxx
- ▶ E84DLxxxxxxxCxDxxx
- ▶ E84DPxxxxxxxCxDxxx

Because of the integrated PLC also SSI encoders can be evaluated at RS422 interfaces (max. 150 kHz).

X81/X82 - RS422 PLC			
Pin	Signal	Description	Data
 84DPS005_8		M12 type, 8-pole sockets, A-coded	
1	TxD+ (CLK+)	Transmission+	• In accordance with ANSI/TIA/EIA-422 • At RS422, PLC supports evaluation of SSI encoders (max. 150 kHz).
2	TxD- (CLK-)	Transmission-	
3	RxD+ (Data+)	Reception+	
4	RxD- (Data-)	Reception-	
5	n. c.	Not assigned	-
6	n. c.		
7	GND-EXT	Reference potential	In accordance with IEC 61131-2, type 1
8	+24V	24 V supply	

Please observe that the direct coupling of two 8400 protec EMS devices require an external connection with terminating resistors.

7.7

Communication

Carry out the installation in accordance with the mounting directives of the fieldbus systems in order to prevent a faulty communication. Please observe the notes on the additional equipotential bonding.

**Stop!****High compensation currents**

High compensation currents can flow via the shield of the fieldbus cable.

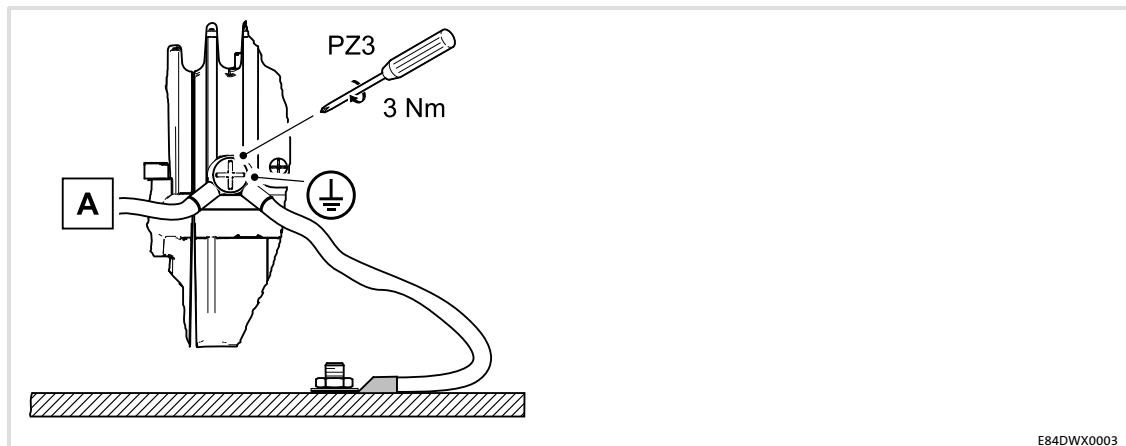
Possible consequences:

Damage to material assets or failures

Protective measures:

Prevent compensation currents via the shield of the fieldbus cable as follows:

- ▶ Connect all fieldbus nodes with a 16 mm² cable via the earthing studs.
- ▶ Lay this cable in parallel to the bus cable.
- ▶ Ensure a highly conductive connection of all earthing studs with a copper braid cable to the mounting surface.



Earthing for compliance with EMC conditions, prevents compensation currents via the shield of the fieldbus cable



16 mm² equalizing conductor with ring cable lug M6

The communication cables of the available fieldbus systems can be installed using different plug versions. The type code provides information on the design of one device.

7.7.1 CANopen

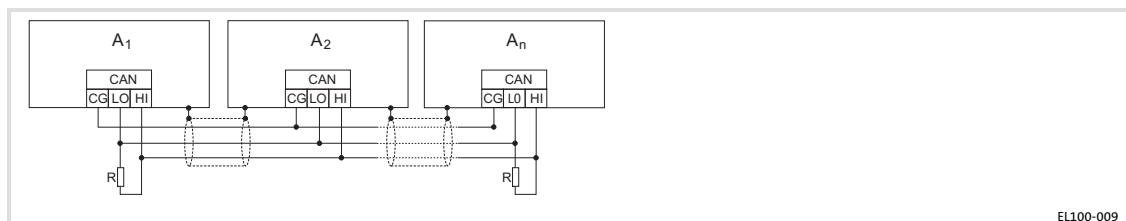
X3x - communication			
Pin	Signal	Description	Data
 84DPS005_5		Type: M12, 5-pole, A-coded X31 -> pins X32 -> sockets	
1	n. c.	Not assigned	CAN specification
2	n. c.	Not assigned	
3	CG	CAN-Ground	
4	CH	CAN-HIGH	
5	CL	CAN-LOW	

7.7.2 CANopen master PLC

X34 - CANopen master PLC			
Pin	Signal	Description	Data
 84DPS005_5		M12 type, 5-pole sockets, A-coded	
1		Shielding (functional earth)	-
2	n. c.	Not assigned	-
3	CAN_GND	CAN GND	In accordance with CAN specification
4	CANH	CAN HIGH	
5	CANL	CAN LOW	

Example circuit

Wiring example



Terminating resistors of 120 Ω are not integrated and must be wired externally.



Software manual for the standard device / »Engineer« online help

Here, detailed information is provided about ...

- ▶ CAN communication;
- ▶ Parameter setting and configuration;
- ▶ System bus (CAN) diagnostics.

**Note!**

- ▶ Please observe the general safety instructions (📖 13).
- ▶ Please observe the notes regarding residual hazards (📖 19).

**Danger!****Uncontrolled motor movements may occur**

Under certain conditions, the motor may rotate after mains connection.

Possible consequences:

- ▶ Near the machine or plant, situations may arise that are hazardous to persons.
- ▶ The machine or plant may be damaged by an unexpected start.

Protective measures:

- ▶ Commissioning with external 24 V supply and without mains voltage
- ▶ Remove motor connector X21. An active motor temperature monitoring prevents a motor voltage from being output. If the monitoring is deactivated, a voltage may be applied at the plug.
- ▶ Ensure that no setpoint is applied.

8.1

Before switching on



Note!

Please observe during transport, storage and operation:

- ▶ Cover unused connectors for control connections and interfaces with the plastic covers provided to preserve the certified safety technology features.

Check that all connectors are properly locked in order to ensure trouble-free operation.



Note!

- ▶ Comply with the respective switch-on sequence.
- ▶ In case of trouble during commissioning, the following supports you:
 - The "Diagnostics" chapter
 - The online help in the »Engineer«
 - The software manual of the prevailing device version

In order to avoid injury to persons or damage to material assets, check ...

... before switching on the mains voltage:

- ▶ Check the wiring for completeness, short-circuit and earth fault
- ▶ The "emergency switching off" function of the entire plant
- ▶ The motor circuit configuration (star/delta) must be adapted to the output voltage of the controller
- ▶ The in-phase connection of the motor
- ▶ The direction of rotation of the incremental encoder (if available)

...the setting of the most important drive parameters before controller enable to ensure the following:

- ▶ The V/f rated frequency is adapted to the motor circuit configuration!
- ▶ The drive parameters relevant for your application are set correctly!
- ▶ The configuration of the analog and digital inputs and outputs are adapted to the wiring!



Tip!

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

8.2 Preparing the commissioning procedure

You need the following for commissioning:

- ▶ Computer with a Windows® operating system (XP, 7 or 2000)
- ▶ Lenze »Engineer« PC software
- ▶ Connection to the controller via an interface, e.g.
 - diagnostic interface X70 with diagnostic USB adapter
 - Fieldbus
- ▶ Software manual for the technology application used
- ▶ Hardware manual (GHB)
- ▶ Manual for the drive-based safety
- ▶ Communication manual for the network of the automation platform
- ▶ 24 V voltage supply for the control electronics of the controller
 - by switching on the mains voltage
 - alternatively by a 24-V buffer voltage

Follow the instructions of the software and/or read the documentation.

Selection of the appropriate commissioning tool

There are two ways to commission the 8400 frequency inverter:

- ▶ Commissioning using the keypad (or diagnosis terminal)
 - For simple drive tasks such as quick commissioning of the 'Speed closed-loop control' standard application
- ▶ Commissioning using the »Engineer«
 - For rather demanding drive tasks such as 'Table positioning' of the HighLine version
 - Supported by online help and accompanying software documentation (software manual)

**Note!**

The following can be used at the diagnostic interface X70:

- ▶ Diagnosis terminal X401 (EZAEBK2003)
 - The described settings with the keypad X401 can also be carried out with the diagnosis terminal X401.
- ▶ USB diagnostic adapter (E94AZCUS)

Notes on commissioning in the case of an external 24 V supply

The following sequence must be observed when commissioning devices with an external 24 V supply:

- ▶ Switch-on
 - Connection of the external 24 V supply
The control electronics and fieldbus communication are started and the display shows the "LU" message (undervoltage in the DC bus)
 - Connection of the 400 V mains voltage
The message in the display goes off / changes over to .
- ▶ Switch-off
 - Switch-off of the 400 V mains voltage
 - Switch-off of the 24 V supply

**Note!**

The functions of the control electronics become inactive when the 24 V supply is switched off. The switch function of Ethernet-based fieldbuses is also inactive.

Switching the 24 V supply when the mains voltage is applied may lead to an error status in higher-level controls.

Notes for the commissioning of EMS versions

For EMS version devices, in addition the following has to be observed:

- ▶ Devices with a rocker switch control element
 - To enable the controller, the rocker switch has to be operated.
 - Operating the rocker switch again inhibits the controller.
- ▶ Device without a rocker switch control element
The controller has to be enabled using the available communication options.

Notes for motor operation**Danger!**

- ▶ For thermal reasons, continuous operation of self-ventilated motors at low field frequency and rated motor current is not permissible. If required, activate a motor temperature monitoring with C00585
 - motor temperature monitoring with I^2_{xt} (see software manual)
 - motor temperature monitoring with motor PTC (see software manual).
- ▶ Select 87-Hz operation under code C00015 if an asynchronous motor in delta connection (nameplate data: 400 V ∇ /230 V Δ) is to be operated on a frequency inverter for a supply voltage of 400 V.

**Tip!**

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

Recommendations for the following application cases

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

8.3 Quick commissioning

Target

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

Keypad or setpoint potentiometer

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

- ▶ Keypad control (📖 144), i.e. the X400 keypad is used as setpoint source
- ▶ Terminal control (📖 146), i.e. a setpoint potentiometer connected to the controller terminals is used as setpoint source

Diagnostics

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

- ▶ Two LEDs indicate the device status (DRIVE READY and DRIVE ERROR)
- ▶ Two LEDs indicate the bus status (CAN-RUN and CAN-ERROR)

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



Tip!

The handling of the keypad X401 or the diagnosis terminal X401 is described in the operating instructions. The instructions are supplied with the keypad and are also included in electronic form on the product CD "L-force Inverter Drives 8400".

8.3.1 Keypad control

Commissioning steps

1. Wiring of power terminals

The "Electrical installation" chapter and the mounting instructions provide information on the correct wiring of the power terminals according to the requirements of your device.

2. Wiring of control terminals.

3. Load Lenze setting to controller



Note!

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

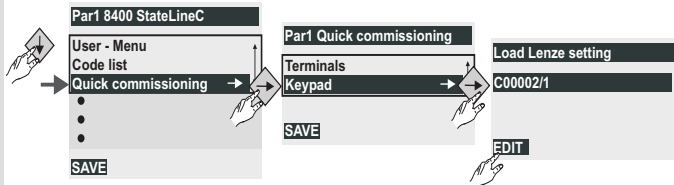


MCTRL: Act. speed val.
C00051
0 rpm

After attaching the keypad or switching on the controller with keypad attached, the connection between keypad and controller is established.

The connection has been established when the code C00051 appears in the display.

- Then press the left function key.



- Starting from "User menu" scroll down with button to "Quick commissioning" menu
- Click right button.
- Select "Keypad" menu.
- Click right button.
- Code 00002/1:
 - Parameterise with left "Edit" function key
 - Select value "1" -> On/Start and confirm with right "OK" function key.

MCTRL: Act. speed val.
C00051
0 rpm



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

4. Set keypad control

Continue as in commissioning step ► 3. Load Lenze setting to controller:

- "Quick commissioning" menu
- Keypad
- Load Lenze setting

Use the "down" navigation key to go to code C00007 for selecting the control mode:

- Select parameter code 00007 and parameterise with "Edit"
- Select value "20" -> keypad and confirm with "OK".

5. Enable controller:

- 8400 protec controllers are automatically enabled after mains connection. They can also be enabled or inhibited via code C00002/16.

6. Vary the motor speed using the keypad or by defining different fixed setpoints:

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

► Please observe:

- The actual speed value: C00051

7. Save the settings with **SAVE** in the keypad.

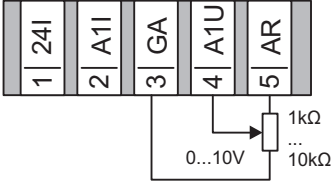
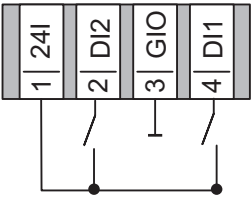
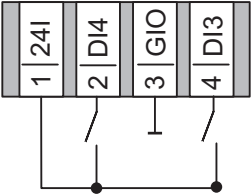
8.3.2 Terminal control

Commissioning steps

1. Wiring of power terminals

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

2. Wiring of control terminals.

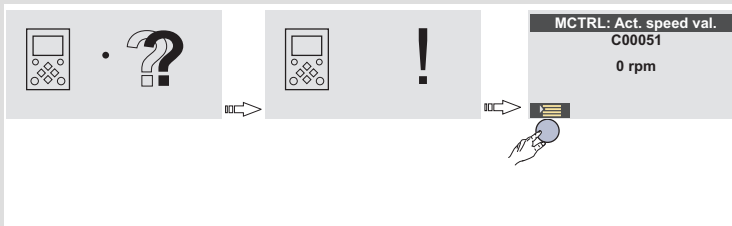
Analog inputs at X50	Assignment	Terminal control
X50 	A1U	Setpoint selection 10 V (=100 %): 1500 min ⁻¹ (with 4-pole motor)
Wiring of the digital outputs at X41	Assignment	Terminal control
X41  DI1 ... DI2: active = HIGH	DI1	Fixed frequency 1 ... fixed frequency 3, see table below
	DI2	
Wiring of the digital outputs at X42	Assignment	Terminal control
X42  DI3 ... DI4: active = HIGH	DI3	DCB
	DI4	Direction of rotation left/right (CCW/CW)

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



Note!

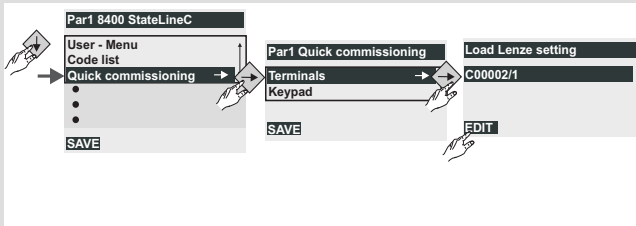
The application "actuating drive speed" is implemented with the Lenze setting.



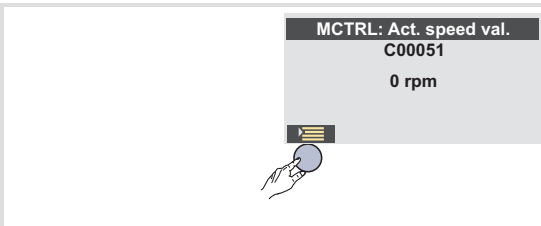
After attaching the keypad or switching on the controller with keypad attached, the connection between keypad and controller is established.

The connection has been established when the code C00051 appears in the display.

- Then press the left function key.



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



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

4. Enable controller:

- 8400 protec controllers are automatically enabled after mains connection. The motor rotates according to the default value at the analog input or the defined fixed setpoints.

5. Vary the motor speed with the potentiometer or by defining different fixed setpoints:

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

► Please observe

- the actual speed value: C00051
- the front LEDs (159)

6. Save the settings with **SAVE** in the keypad.

Braking operation

When electric motors are braked, the kinetic energy of the drive train is fed back to the DC bus in generator mode. This energy results in an increased DC-bus voltage. Various strategies are available to avoid an overvoltage in the DC bus:

► **Braking operation without additional measures**

This includes functions integrated in the controller which do not require external brake resistors and can be parameterised using the »Engineer«:

- DC injection brake DCB
- Stopping of the ramp function generator
- "Inverter motor brake" function (from software version 01.01)

The braking operation without external brake resistor is suitable for simple applications which do not require strict compliance with the deceleration ramp. Hence, this is a cost-saving procedure since a brake resistor is not required. A combination of all above-mentioned braking procedures is also possible, e.g. to perform emergency braking in the event of a brake resistor failure.

- **Braking operation with external brake resistor**
- **Braking operation with spring-applied brake**

**Stop!**

- The two braking procedures "Stopping of the ramp function generator" and "Inverter motor brake" are only active in speed-controlled applications if the position controller does not interfere!
- Do not additionally adapt the motor load (I_{2xt}) if the inverter motor brake is used!
In this case, the motor may thermally overload or the motor overload monitoring (I_{2xt}) may be working incorrectly!

9.1**Braking operation without additional measures****DC injection brake DCB**

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

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

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

Stopping of the ramp function generator

The "Stopping of the ramp function generator" response is set in C00175. If the brake chopper threshold in the DC-bus connection which results from C00173 and C00174 is exceeded, the ramp function generator is stopped.

This function is suitable for braking operations with reduced dynamics and torque oscillations.

Inverter motor brake

During this alternative braking procedure which can be selected in C00175, the energy conversion of the regenerative energy of the motor is achieved by dynamic acceleration/deceleration while the ramp function generator is ramped down.

The ramp function generator is stopped during acceleration. Using a hysteresis controller, the speed set in C00987 is added to the speed setpoint. The sign of the current actual speed is considered in the process. The ramp function generator is also stopped if an overvoltage occurs.

If the DC-bus voltage falls below a defined DC-bus voltage potential of the hysteresis controller, the connected additive speed is removed and the ramp function generator is enabled again.

The energy which results from the alternating acceleration and braking procedure due to this switching operation is converted into heat in the motor.

In general, the following applies to the "Inverter motor brake" function:

- ▶ The regenerative energy converted in the motor can be increased and the braking procedure can be accelerated if the additive speed setpoint is decelerated and the corresponding filter time constant is reduced.
- ▶ There may be procedure-related torque oscillations. Mechanical vibrations can be reduced by reducing the additive speed setpoint (C00987) or by increasing the filter time constant.

The illustration below provides a schematic overview of the function modes of the various braking procedures:

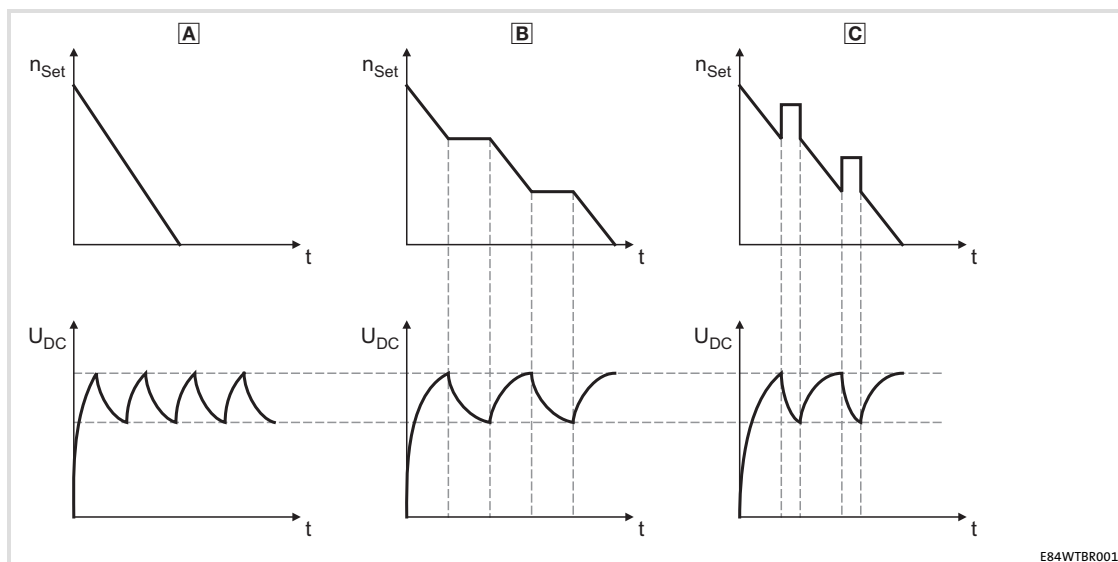


Fig. 9-1 Behaviour of the effective speed setpoint and the DC-bus voltage during the braking process



Further information on the parameterisation of all mentioned braking procedures for the respective device version is provided in the chapter "Motor control (MCTR)".

9.2 Braking operation with external brake resistor

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

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

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

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

The rated data for the brake chopper are provided in the chapters 4.2.2 and 4.2.3.

9.2.1**Selection of the brake resistors**

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

The brake resistors recommended in the accessories chapter are designed to tolerate a regenerative power of approx. 1.5 times the normal value. The cycle time of the brake resistors is 150 s and includes a braking time of max. 15 s and a recovery time (pause) of min. 135 s.

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

**Note!**

The 8400 protec devices do not allow for the thermostats of brake resistors to be monitored via a specific terminal.

Exception: E84DHxxx7524

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

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

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

9.2.2

Wiring of brake resistor

**Danger!****Hazardous electrical voltage**

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

Possible consequences:

- ▶ Death or severe injuries when touching the terminals.

Protective measures:

- ▶ Disconnect the standard device from the mains before working on the brake resistor.
- ▶ Check all power terminals for isolation from supply.
- ▶ Select the mounting location so that the operating conditions mentioned in the mounting instructions for the brake resistor are permanently guaranteed.

**Danger!****Hot surface**

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

Possible consequences:

- ▶ Severe burns when touching the brake resistor.
- ▶ Fire or smouldering fire if flammable material is placed near the brake resistor or may get to it.

Protective measures:

- ▶ Before working on the brake resistor, check its surface temperature.
- ▶ Select the mounting location so that the operating conditions mentioned in the mounting instructions for the brake resistor are permanently guaranteed.
- ▶ Protect the mounting location through fire prevention.

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

- ▶ Establish an external safety shutdown using the thermostat of the brake resistor to disconnect the controller from the mains.
- ▶ Exception for devices with special connection for the thermostat of the brake resistor: Use the device-internal safety shutdown.

Connecting cable version

- ▶ up to 0.5 m: twisted and unshielded
- ▶ from 0.5 to 5 m: shielded
 - Use shielded cables to meet the EMC requirements.

Braking operation

Braking operation with external brake resistor

Wiring of brake resistor

Wiring principle

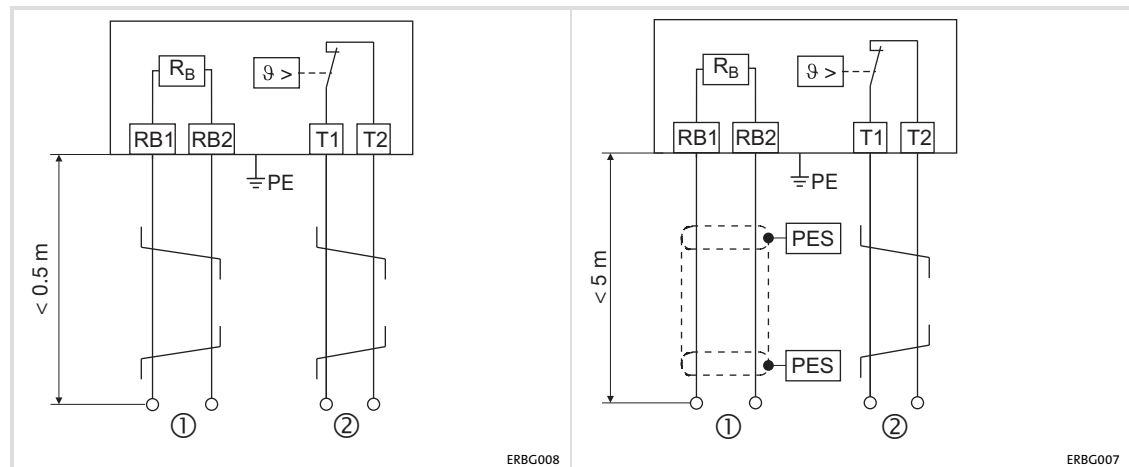


Fig. 9-2 Wiring of a brake resistor to the controller

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

The brake resistor is thermally stressed due to converted braking power and may be thermally destroyed as a consequence of excessive braking power.

To avoid thermal overload of the brake resistor:

- set additional parameters in the »Engineer«

or

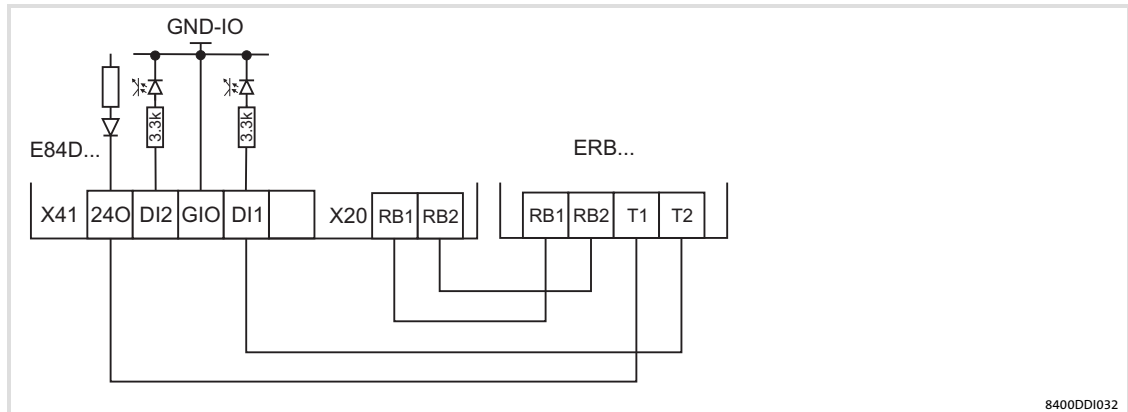
- implement external wiring using a temperature contact on the brake resistor (e.g. interrupted supply and activation of the mechanical brakes).

To protect the brake resistor:

- use the monitoring of the I^2t utilisation of the controller which is proportional to the converted braking power.

Evaluation of the thermal contact via digital input

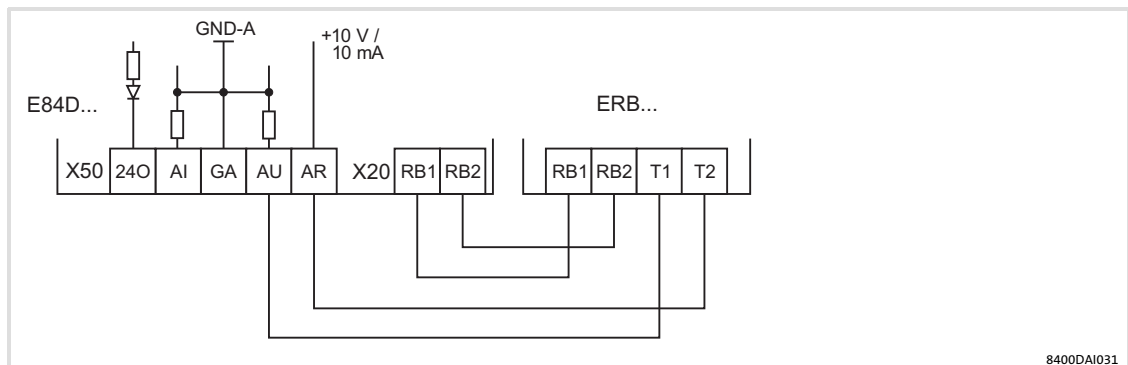
As an alternative to the integration of the thermal contact via a mains contactor, the brake resistor can also be monitored via a digital input. Please use a Lenze system cable. The response to the input signal must be parameterised in the FB Editor using the »Engineer«.



E84D...	8400 protec
X41	Digital input
X20	Brake resistor connection
ERB...	Brake resistor

Evaluation of the thermal contact via analog input

As an alternative to the integration of the thermal contact via a mains contactor, the brake resistor can also be monitored via an analog input. Please use a Lenze system cable. The response to the input signal must be parameterised in the FB Editor using the »Engineer«.



E84D...	8400 protec
X50	Analog input
X20	Brake resistor connection
ERB...	Brake resistor



Further information on brake resistor monitoring is provided in:

- the 8400 protec software manual, chapter "Motor control" → "Monitorings"

9.3 Operation with spring-applied brake**9.3.1 Introduction****Stop!**

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

Only motor holding brakes which comply with the permissible data mentioned in the Technical Data may be connected to the integrated brake control. (If necessary, the holding brake must be controlled without a brake control via a digital output and a coupling relay.)

If the permissible values mentioned in the Technical Data are not observed:

- ▶ the brake control may be destroyed.
- ▶ a safe operation of the motor holding brake is not ensured.

Lenze three-phase AC motors and G-motion geared motors can be equipped with spring-applied brakes (motor holding brakes). 8400 protec controllers have an integrated motor brake control.

Switching the brake

Switching of the brake can be controlled:

► Fast switch design

An external motor brake control module is required for the switching operations and the DC supply of the spring-applied brake. The suitable motor brake control module must be selected according to the rated data of the spring-applied brake.

The fast switch option also offers the possibility of a quick switch-off. Here, a relay contact is controlled in the supply circuit of the coil via the controller.

Wiring: See motor connection for type Modular

► "Integrated brake rectifier" version

The voltage required for controlling the motor brake is generated in the controller, dependent on the mains voltage value. The following motor brakes can be connected:

– to the 400-V mains: Coil voltage 180 V DC, max. 50 W

– to the 500-V mains: Coil voltage 225 V DC, max. 50 W

The rated coil voltage is neither increased nor reduced.

Wiring: See motor connection for type Q8/0

► "24 V DC" version

The voltage required for controlling the motor brake is supplied to the controller by an external voltage source. The following motor brakes can be connected:

– Coil voltage 24 V DC

Wiring: See motor connection for type Q8/0

► Cold brake design

The voltage required for controlling the motor brake is generated in the controller proportionally to the mains voltage value. The following motor brakes can be connected:

– to the 400 V mains: coil voltage 180 V DC

– to the 500 V mains: coil voltage 225 V DC

To ensure a safe release of the brake, 130 % of the rated coil voltage is connected to the coil for 0.3 s. Then, this voltage is reduced to 65 % of the rated coil voltage.

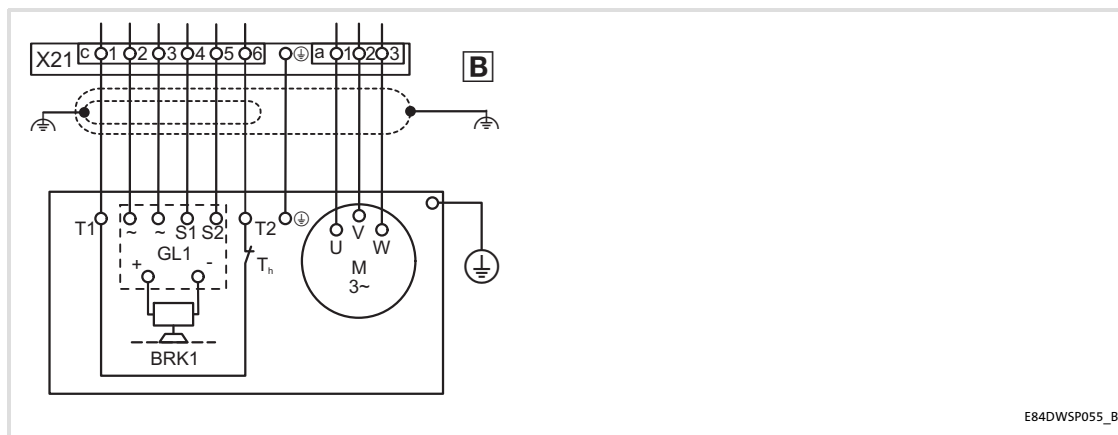
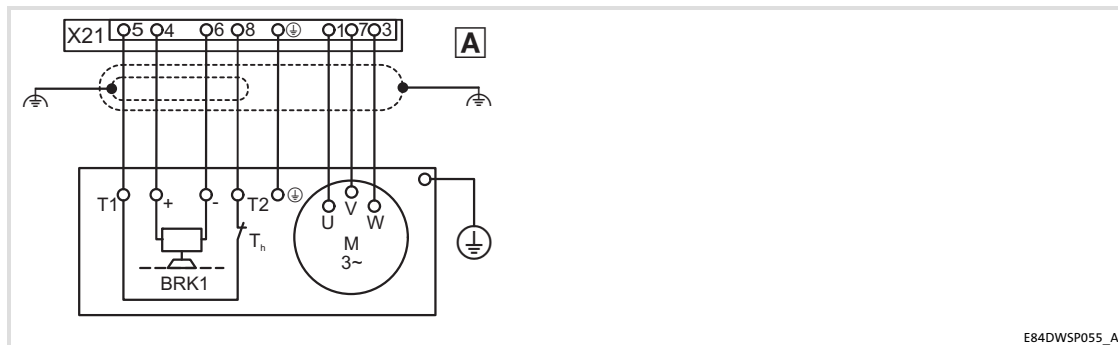
Wiring: See motor connection for type Q8/0

Optionally, the switching of the brake can be controlled in addition:

► Via an external control contact (e.g. PLC)

► Via a brake switch which is connected to one of the digital outputs of the controller.
The digital output must be parameterised accordingly.

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

9.3.2**Wiring**

- | | |
|---|---|
| <p>A</p> <p>B</p> <p>X21</p> <p>BRK1</p> <p>GL1</p> <p>T_h</p> <p>M</p> <p>⏏</p> <p>⏏</p> | <p>"Cold brake" or "Integrated brake rectifier" wiring "24 V DC"</p> <p>Connection system of plug type Q8/0</p> <p>"Fast switch" wiring, connection system plug type Modular</p> <p>Motor connection</p> <p>Spring-applied brake</p> <p>Spring-applied brake control</p> <p>PTC thermistor (PTC) or thermal contact (NC contact)</p> <p>Motor</p> <p>HF-shield termination by large surface connection to PE.</p> <p>Earthing</p> |
|---|---|

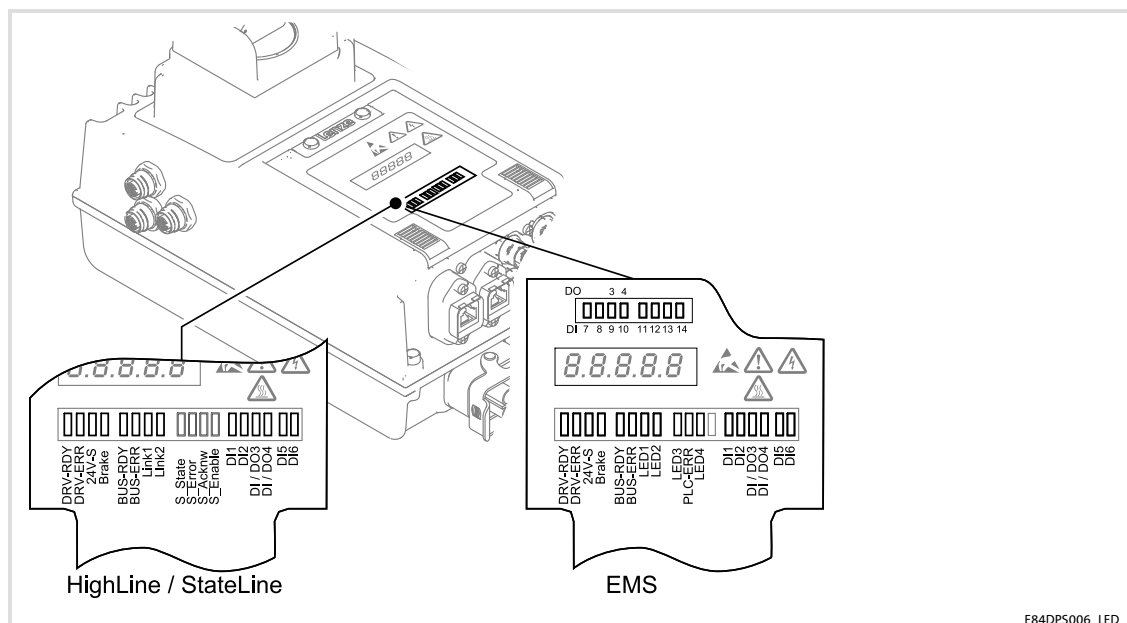
10 Diagnostics

10.1 Display of operating data, diagnostics

- ▶ LEDs on the controller provide information on the operating status.
- ▶ Basic diagnostics is performed directly on the controller.
- ▶ Use the keypad to perform easy and quick diagnostics.
 - The keypad can only be used in the diagnosis terminal version (= keypad including holder and connecting cable) for 8400 protec controllers. Please always substitute the term 'keypad' for 'diagnosis terminal' in the following.
- ▶ Perform comprehensive diagnostics and settings via your PC using the »Engineer« software.

10.1.1 Status display via controller LEDs

Depending on the version, during operation the operating status of the controller is displayed with LEDs. They are located on the front of the device.



E84DPS006_LED

Status display: device

Pos.	Colour	State	Description
DRV-RDY	green	on	Controller is ready
		blinking	Controller is enabled
ERR	red	on	System error
		blinking	Fault is active
		off	No fault
24V-S	green	on	24 V voltage is ready
		off	24-V voltage is not ready
Brake	yellow	on	Motor holding brake is controlled (released)
		off	Motor holding brake is not controlled (applied)

Status display: fieldbus interface

Pos.	Colour	State	Description
BUS-RDY	green	blinking	Communication has been established
		on	Communication has been stopped
		off	Communication has not been initialised
BUS-ERR	red	fast blinking	Communication error for PROFINET: Node not recognised
		blinking	for PROFINET: Node recognition
		on	Communication error
Link-1	yellow	fast blinking	only for PROFINET: Communication is active, telegrams are transmitted
Link-2		blinking	Initialisation
		off	Communication is not active

Status display: Digital signals

Pos.	Colour	State	Description
DI1	yellow	on	DI1 = HIGH
		off	DI1 = LOW
DI2	yellow	on	DI2 = HIGH
		off	DI2 = LOW
DI3/DO1	yellow	on	DI3/DO1 = HIGH
		off	DI3/DO1 = LOW
DI4/DO2	yellow	on	DI4/DO2 = HIGH
		off	DI4/DO2 = LOW
DI5	yellow	on	DI5 = HIGH
		off	DI5 = LOW
DI6	yellow	on	DI6 = HIGH
		off	DI6 = LOW

10.1.2 Extensions in EMS version

Pos.	Colour	Status	Description		
BUS-RDY	green	blinking	Communication has been established		
		on	Communication has been stopped		
		off	Communication is not initialised		
BUS-ERR	red	blinking fast	Communication error For PROFINET: Node not recognised		
		blinking	For PROFINET: Node recognition		
		on	Communication error		
LED1	yellow	-	Signalling controlled by the PLC program with adjustable blinking speed		
LED2					
LED3 (PLC-RDY)	green	flashes	PLC program is not available		
		blinking fast	PLC program is loaded/saved or parameters are saved		
		blinking	PLC program is started		
		on	PLC program is stopped		
		off	PLC status is undefined / device is switched off		
PLC-ERR	red	flashes 3x	Internal system error		
		flashes 2x	Parameter version or checksum invalid		
		flashes	Retain memory error		
		blinking fast	PLC program is stopped by watchdog monitoring		
		blinking	Error		
		off	No error / device switched off		
LED4 (PLC-Com)	yellow		Half wave	Half wave coded	DECA
		flashes 3x	Control bar: full wave	-	-
		flashes 2x	Control bar: negative half wave	-	Pre operational
		flashes	Control bar: positive half wave	-	Silent mode
		blinking fast	-	Command received	Operational
		blinking	Error	Error	Error
		on	-	-	Warning
		off	Control bar: no half wave		Not activated

Pos.	Colour	State	Description
DI7	yellow	on	DI7 = HIGH
		off	DI7 = LOW
DI8	yellow	on	DI8 = HIGH
		off	DI8 = LOW
DI9/DO3	yellow	on	DI9/DO3 = HIGH
		off	DI9/DO3 = LOW
DI10/DO4	yellow	on	DI10/DO4 = HIGH
		off	DI10/DO4 = LOW
DI11	yellow	on	DI11 = HIGH
		off	DI11 = LOW
DI12	yellow	on	DI12 = HIGH
		off	DI12 = LOW
DI13	yellow	on	DI13 = HIGH
		off	DI13 = LOW
DI14	yellow	on	DI14 = HIGH
		off	DI14 = LOW

10.1.3**Status display of the safety system via LEDs at the controller****Status display: drive-based safety**

Pos.	Colour	State	Description
S-State	green	on	Communication between standard device and safety system is running
		blinking	Drive-based safety is in service status
		off	Communication between standard device and safety system is not possible
S-Error	red	on	Fault, trouble or warning
		blinking	Drive-based safety is not accepted by the standard device
		off	Error-free operation
S-Acknw	yellow	on	A parameter set acceptance must be acknowledged
S-Enable	yellow	on	Controller is enabled
		blinking	Safety function is active (non-safe display)

The status of safety option 10 is solely shown via the "S-Enable" display. All other displays have no function.

**Danger!****Danger to life due to wrong interpretation of the status display**

A wrong interpretation of the status display of the drive-based safety may result in dangerous operating statuses.

Possible consequences:

- Death or severe injuries

Protective measures:

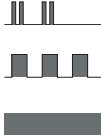
- The status display of the drive-based safety must not be used for safety-related purposes. The displays shown are unsafe.

Legend

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

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

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

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

10.1.4 Drive diagnostics via the integrated display

The controllers have an integrated 7-segment display which, depending on the device version, comprises either 4 or 5 characters.

The display has three different modes:

- ▶ Automatic display - the parameter saved under status value 1 is displayed when the controller is switched on.
- ▶ Manual operation display - when the controller is activated during manual operation.
- ▶ Message display - for errors or warnings. This display has the highest priority and overrides the other two modes.

Operation is carried out via keys T1 and T2.

- ▶ T1 - operator button to display the status of lower-level devices (in preparation).
- ▶ T2 - operator button used for browsing if several status messages or error messages have occurred at the same time.

In the case of a device replacement, both keys must be operated to transfer the safe parameters from the memory module to the safety module. Further information on this topic is provided in the corresponding documentation.

Automatic display

This mode serves to display five preset parameters in a row. Use key T2 to browse the parameters in ascending order. Using the »Engineer«, the user can define which status values are shown in the display. The following status values (Lenze setting) are displayed:

- ▶ Status value 1: Motor output frequency in [Hz]
The output frequency is displayed based on the direction of rotation, i.e. CCW rotation is displayed with a minus sign. The display area ranges from - 999 to 999 Hz and has a resolution of 1 Hz.
- ▶ Status value 2: Actual current value in [A], resolution 0.1 A
- ▶ Status value 3: Device utilisation in [%]
- ▶ Status value 4: Motor voltage in [V]
- ▶ Status value 5: DC-bus voltage in [V]

Manual operation display (in preparation)

- ▶ If the operator button is used to switch the controller over to the manual operation mode, "rc" is displayed.
- ▶ If an error is pending during manual operation, the display changes from "rc" to the error code every 0.5 s. If several errors are pending, they are displayed alternately.
- ▶ If the operator button is used to switch over between CCW and CW rotation, the motor output frequency is displayed without sign for CW rotation and with a minus sign for CCW rotation.

Message display

If warnings or errors are pending, their displays are blinking.

Overview of the error messages of the operating system

The table below lists all error messages of the controller operating system in alphabetically ascending order of the abbreviated designation with the preset error response as well as the parameter for setting the error response, if available.

Error							
Group	ID	Number	Abbr.	Text	Reaction	CAN code	Setting
106							
	1	0x0601	PL01	PLC internal	No reaction	-	C00596/1
	2	0x0602	PL02	PLC watchdog	No reaction	-	C00596/2
	3	0x0603	PL03	PLC parameter error	No Reaction	-	C00596/3
	4	0x0604	PL04	PLC retain data error	No reaction	-	C00596/4
	21	0x0615	PL21	PLC program generic error 1	No reaction	-	C00596/9
	22	0x0616	PL22	PLC program generic error 2	No reaction	-	C00596/10
	23	0x0617	PL23	PLC program generic error 3	No reaction	-	C00596/11
	24	0x0618	PL24	PLC program generic error 4	No reaction	-	C00596/12
	25	0x0619	PL25	PLC program generic error 5	No reaction	-	C00596/13
	26	0x061a	PL26	PLC program generic error 6	No reaction	-	C00596/14
	27	0x061b	PL27	PLC program generic error 7	No reaction	-	C00596/15
	28	0x061c	PL28	PLC program generic error 8	No reaction	-	C00596/16
111							
	2	0x0b02	Su02	One mains phase is missing	Warning	0x3000	C00565
	3	0x0b03	Su03	Too frequent mains switching	Fault	0x3000	-
	4	0x0b04	Su04	CU supplied insufficiently	Fault	0x3000	-
	5	0x0b05	Su05	IO supply overload	Warning	0x3000	C00598/4
119							
	50	0x1332	OC5	Ixt overload	Fault	0x2000	-
	1	0x1301	OH1	Heatsink overtemperature	Fault	0x4000	-
	15	0x130f	OH3	Motor temperature (X21) triggered	Fault	0x4000	C00585
	0	0x1300	OH4	Heatsink temp. > shutdown temp. -5°C	No reaction	0x4000	C00582

Group		Error						
ID	Number	Abbr.	Text			Reaction	CAN code	Setting
123								
99	0x1763	FC1	Limitation of field controller			No reaction	0xF000	C00570/4
94	0x175e	FCH1	Switching frequency reduction			No reaction	0x2000	C00590
95	0x175f	FCH2	Maximum speed for Fchop			No reaction	0xF000	C00588
57	0x1739	ID1	Error: Motor data identification			WarningLocked	0xF000	-
58	0x173a	ID3	CINH motor data identification			WarningLocked	0xF000	-
59	0x173b	ID4	Error in resistor identification			Warning	0xF000	-
145	0x1791	LP1	Motor phase failure			No reaction	0x3000	C00597
15	0x170f	LU	DC bus undervoltage			Trouble	0x3100	C00600/1
16	0x1710	OC1	Power section short circuit			Fault	0x2000	-
17	0x1711	OC2	Power section earth fault			Fault	0x2000	-
105	0x1769	OC6	I ² xt overload - motor			Warning	0x2000	C00606
7	0x1707	OC7	Motor overcurrent			Fault	0x2000	-
30	0x171e	OC10	Maximum current reached			Fault	0x2000	-
71	0x1747	OC11	Clamp operation active			Warning	0xF000	-
65	0x1741	OC12	I ² xt overload - brake resistor			Fault	0xF000	-
90	0x175a	OC13	Exceedance of maximum current for Fch			Fault	0xF000	-
96	0x1760	OC14	Limitation of direct-axis current controller			No reaction	0xF000	C00570/1
97	0x1761	OC15	Limitation of cross current controller			No reaction	0xF000	C00570/2
98	0x1762	OC16	Limitation of torque controller			No reaction	0xF000	C00570/3
31	0x171f	OC17	Clamp sets pulse inhibit			No reaction	0xF000	C00569/1
32	0x1720	OS1	Maximum speed limit reached			No reaction	0x8400	C00579
1	0x1701	OT1	Maximum torque reached			No reaction	0x8300	C00608
93	0x175d	OT2	Speed controller output limited			No reaction	0xF000	C00567
14	0x170e	OU	DC bus overvoltage			Trouble	0x3100	-
205	0x17cd	SD3	Open circuit - feedback system			Fault	0x7300	C00586
200	0x17c8	SD10	Speed limit - feedback system 12			Fault	0x7300	C00607
201	0x17c9	SD11	Speed limit - feedback system 67			Fault	0x7300	C00607
125								
1	0x1901	An01	AIN1_I < 4 mA			TroubleQuickStop	0xF000	C00598/1
11	0x190b	Io11	DigOut level			Warning	0xF000	C00598/3
127								
2	0x1b02	CE04	MCI communication error			No reaction	0x7000	C01501/1
15	0x1b0f	CE0F	MCI control word			Fault	0xF000	C00594/2
128								
5	0x1c05	EDB1	EMS half wave error			No reaction	-	C00596/5
6	0x1c06	EHV1	EMS PowerwaveFail			No reaction	-	C00596/6
7	0x1907	EPV2	EMS DeCaBus error			No reaction	-	C00596/7

Group		Error						
		ID	Number	Abbr.	Text	Reaction	CAN code	Setting
131								
	6	0x1f06	CA06	CAN CRC error	No reaction	0x8000	C00592/1	
	7	0x1f07	CA07	CAN bus warn	No reaction	0x8000	C00592/3	
	8	0x1f08	CA08	CAN bus stopped	No reaction	0x8000	C00592/4	
	11	0x1f0b	CA0b	CAN HeartBeatEvent	No reaction	0x8130	C00592/5	
	15	0x1f0f	CA0F	CAN control word	Fault	0xF000	C00594/2	
	0	0x1f00	CE4	CAN bus off	No reaction	0x8000	C00592/2	
135								
	1	0x2301	CE1	CAN RPDO1	No reaction	0x8100	C00593/1	
	2	0x2302	CE2	CAN RPDO2	No reaction	0x8100	C00593/2	
	3	0x2303	CE3	CAN RPDO3	No reaction	0x8100	C00593/3	
	4	0x2304	CP04	CAN RPDO4	No reaction	0x8100	C00593/4	
140								
	13	0x280d	MCI1	Module missing / incompatible	No reaction	0x7000	C01501/2	
144								
	1	0x2c01	PS01	No memory module	Warning	0x6300	-	
	2	0x2c02	PS02	Par.set invalid	Fault	0x6300	-	
	3	0x2c03	PS03	Device par.set invalid	Fault	0x6300	-	
	4	0x2c04	PS04	MCI par.set invalid	Fault	0x6300	-	
	7	0x2c07	PS07	Memory module par. invalid	Fault	0x6300	-	
	8	0x2c08	PS08	Device par. invalid	Fault	0x6300	-	
	9	0x2c09	PS09	Par. format invalid	Fault	0x6300	-	
	10	0x2c0a	PS10	Memory module binding invalid	Fault	-	-	
145								
	35	0x2d23	dF10	AutoTrip reset	Fault	0xF000	C00189/0	
	14	0x2d0e	dF14	SW-HW invalid	Fault	0x6100	-	
	24	0x2d18	dF18	BU RCOM error	Fault	0x6100	-	
	33	0x2d21	dF21	BU watchdog	Fault	0x6100	-	
	34	0x2d22	dF22	CU watchdog	Fault	0x6100	-	
	25	0x2d19	dF25	CU RCOM error	Fault	-	-	
	50	0x2d32	dF50	Retain error	Fault	0x6100	-	
	51	0x2d33	dF51	CuCcr error	Fault	0x6100	-	
	52	0x2d34	dF52	BuCcr error	Fault	0x6100	-	

Display of operating data, diagnostics Drive diagnostics via the integrated display

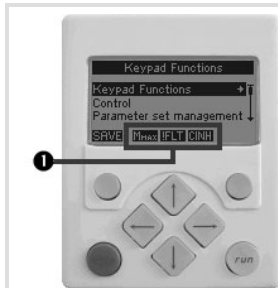
Error						
Group	ID	Number	Abbr.	Text	Reaction	CAN code
Setting						
184						
	1	0x5401	Ck01	Pos. HW limit switch	TroubleQuickStop	0x8600
	2	0x5402	Ck02	Neg. HW limit switch	TroubleQuickStop	0x8600
	7	0x5407	Ck03	Pos. SW limit position	TroubleQuickStop	0x8600
	8	0x5408	Ck04	Neg. SW limit position	TroubleQuickStop	0x8600
	153	0x5499	Ck05	Following error 1	Warning	0x8611
	154	0x549a	Ck06	Following error 2	Warning	0x8611
	155	0x549b	Ck07	Travel range limit exceeded	TroubleQuickStop	0x8612
	156	0x549c	Ck08	Home position unknown	WarningLocked	0x8612
	8005	0x54cd	Ck09	Positioning mode invalid	WarningLocked	0x8600
	8007	0x54cf	Ck10	Profile data implausible	WarningLocked	0x8600
	8009	0x54d1	Ck11	Operating mode invalid	Warning	0x8600
	8014	0x54d6	Ck12	Profile number invalid	WarningLocked	0x8600
	8015	0x54d7	Ck13	Error FB MCKCtrlInterface	Warning	0x8600
	15	0x540f	Ck14	Target position beyond SW limit position	WarningLocked	0x8600
	5	0x5405	Ck15	Error - brake message signal	Fault	0x8600
	64	0x5440	Ck16	Time overflow - manual operation	Fault	-
400						
	9	0x1a09	dH09	EEPROM power section	Fault	0x5530
	16	0x1a10	dH10	Fan failure	Warning	0x5000
	104	0x1a68	dH68	Adjustment data error CU	Fault	0x5530
	105	0x1a69	dH69	Adjustment data error BU	Fault	0x5530
98x						
0	1	-	US01	User error 1	No reaction	0x6200
1	2	-	US02	User error 2	No reaction	0x6200
2	3	-	US03	User error 3	No reaction	0x6200
3	4	-	US04	User error 4	No reaction	0x6200
4	1	-	US05	User error 5	No reaction	0x6200
5	2	-	US06	User error 6	No reaction	0x6200
6	3	-	US07	User error 7	No reaction	0x6200
7	4	-	US08	User error 8	No reaction	0x6200

Group	32 bit error number
ID	
Number	16 bit hex error number
Abbr.	first part of error message - is also indicated in the device display
Text	Full text - visible in the keypad or Engineer
Reaction	Lenze setting of the response to the error / event
CAN code	CAN emergency error code
Setting	Code for setting the response
SO	Group error - safety option
CI	Group error - fieldbus communication

10.1.5 Drive diagnostics

The controller measures relevant operating parameters which can be displayed using the diagnosis terminal or the PC.

Display of the controller status on the keypad



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

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

Display parameters

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

- In the »Engineer« parameter list and in the keypad, these parameters are classified in the **Diagnostics** category.
- A detailed description of these parameters can be found in the software manual of the prevailing device version.

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

Identification data

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

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

11 Safety engineering

11.1 Introduction

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

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

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

Drive-based safety with L-force | 8400 protec

Unlike control cabinet devices, decentralised drives are frequency inverters which are not locally mounted but directly attached to the application on site. Due to this product-specific property, they must meet demanding requirements for robustness and class of protection.

8400 protec controllers are optionally available with drive-based safety.

"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 drive-based safety monitors the safe compliance with the limit values and provides the safe inputs and outputs. When the limit values are exceeded, the drive-based safety starts 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 achieve a performance level (PL) e and the control category 3 or 4 depending on the safety option according to EN ISO 13849-1.

11.2 Important notes

Application as directed

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



Danger!

Danger to life through improper installation

Improper installation of 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 138491 and ISO 13849-2. This includes i.a.:
 - Switches, relays with at least IP54 enclosure.
 - Control cabinet with at least IP54 enclosure.
 - Please refer to ISO 138491 and ISO 13849-2 for all further requirements.
- ▶ Wiring must be shielded.
- ▶ 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 13849-2.
- ▶ If an external force acts upon the drive axes, additional brakes are required. Please observe that hanging loads are subject to the force of gravity!



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!

11.3 Overview of safety options

Depending on the device version, the following safety functions are available:

Safety option 10

Due to safety option 10, the following safety functions can be used:

- ▶ Safe torque off (STO),
formerly: safe standstill

If requested, the safe disconnection of the drive is achieved through:

- ▶ Directly connected active sensors
- ▶ Passive sensors connected to a safety switching device

The safety functions are suitable for applications according to IEC 61508 to SIL 3 and achieve a performance level (PL) e and the control category 4 according to EN ISO 13849-1.

Safety option 20

Due to safety option 20, the following safety functions can be used:

- ▶ Safe torque off (STO),
formerly: safe standstill
- ▶ Safe stop 1 (SS1)
- ▶ Safe stop emergency (SSE)
- ▶ Safe operation mode selector (OMS)
- ▶ Safe enable switch (ES)

The safe disconnection of the drive is achieved through:

- ▶ a higher-level safety PLC via PROFIsafe/PROFINET
- ▶ a higher-level safety PLC via PROFIsafe/PROFIBUS

The functions of the safety option must be parameterised via the »Engineer«.

The motion functions are continued to be executed by the controller. The drive-based safety monitors the safe compliance with the limit values. When the limit values are exceeded, the drive-based safety starts 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 achieve a performance level (PL) e and the control category 3 according to EN ISO 13849-1.

Safety option 30

Due to safety option 30, the following safety functions can be used:

- ▶ Safe torque off (STO),
formerly: safe standstill
- ▶ Safe stop 1 (SS1)
- ▶ Safe stop emergency (SSE)
- ▶ Safe operation mode selector (OMS)
- ▶ Safe enable switch (ES)

The safe disconnection of the drive is achieved through:

- ▶ a higher-level safety PLC via PROFIsafe/PROFINET
- ▶ connected active or passive sensors

The functions of the safety option must be parameterised via the »Engineer«.

The motion functions are continued to be executed by the controller. The drive-based safety monitors the safe compliance with the limit values. When the limit values are exceeded, the drive-based safety starts 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 achieve a performance level (PL) e and the control category 3 according to EN ISO 13849-1.



Further information on functional safety is provided in:

- ▶ the 8400 protec manual on drive-based safety
- ▶ the 8400 protec software manual on drive-based safety: Parameter setting & configuration

12 **Accessories (overview)**



Note!

You can find additional information on the accessories in the catalogue to this product series.

12.1 **Overview**

Coordinated accessories for L-force Inverter Drives 8400 protec:

- ▶ Lenze system cables
 - Motor connection
 - Brake resistor connection
 - Incremental HTL encoder
- ▶ Memory module
- ▶ USB-diagnostic adapter E94AZCUS
 - Connecting cables EWL007x
- ▶ PC system bus adapter EMF2173IBxxx/EMF2177IB
- ▶ Diagnosis terminal EZAEBK2001
- ▶ Brake resistors ERBMxxxRxxxW/ERBPxxxRxxxW/ERBSxxxRxxxW
- ▶ 24-V power supply units EZVxx00-00x
- ▶ EMS accessories

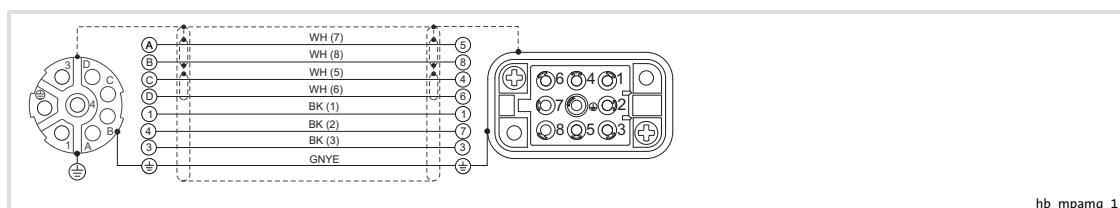
12.2 System cables

A wide variety of system cables is available for Lenze motors and controllers. Detailed information is provided in the "System cables and system connectors" manual.

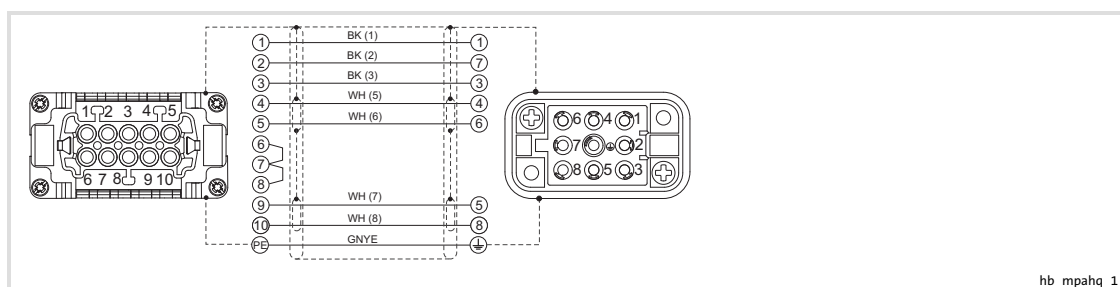
The available system cables for 8400 protec controllers are listed below.

12.2.1 Motor cable

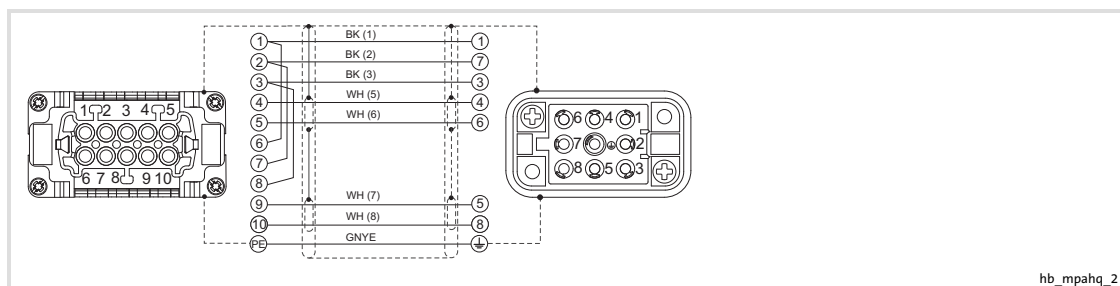
**EYPxxxxAxxxxM07Q10, EYPxxxxAxxxxM07Q11,
EYPxxxxAxxxxM08Q10, EYPxxxxAxxxxM08Q11**



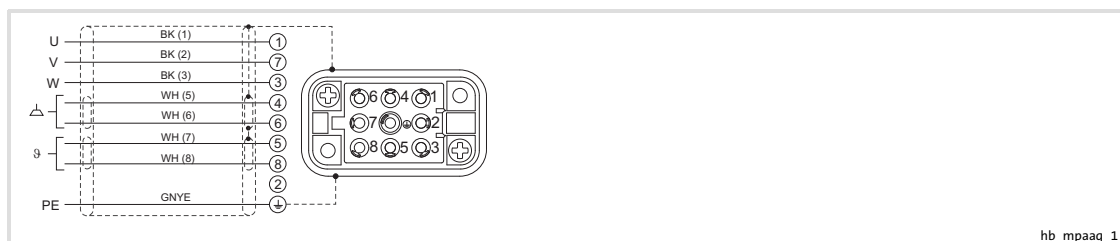
EYPxxxxAxxxxH10Q10, EYPxxxxAxxxxH11Q11

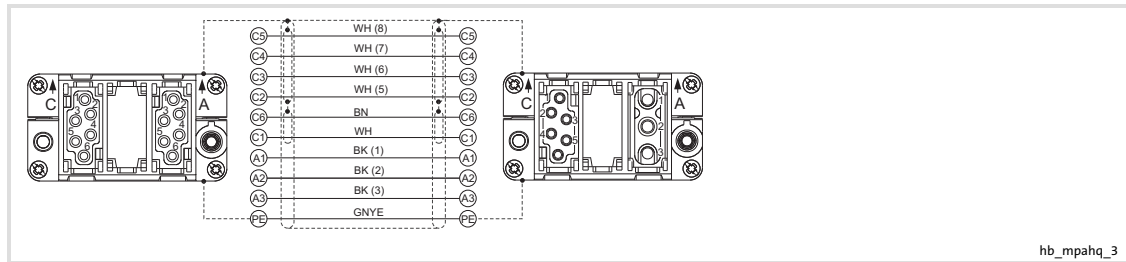
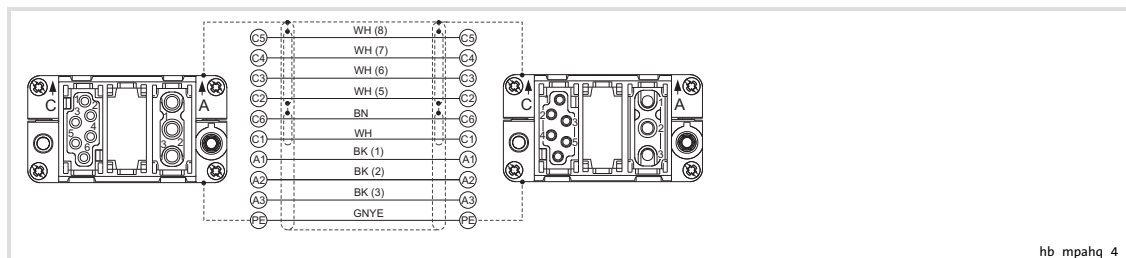
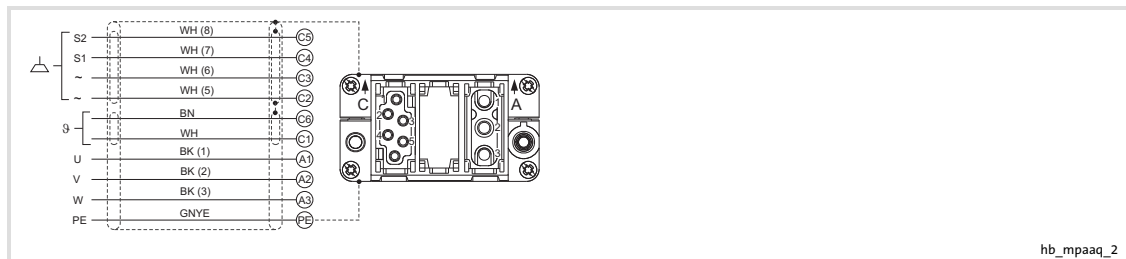


EYPxxxxAxxxxH12Q10, EYPxxxxAxxxxH13Q11



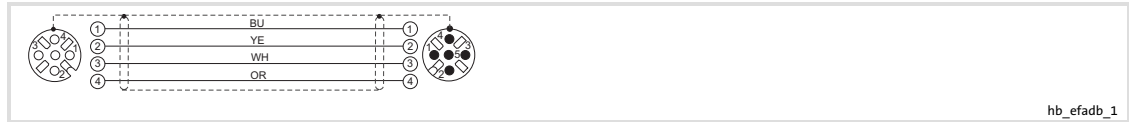
EYPxxxxAxxxxA00Q10, EYPxxxxAxxxxA00Q11



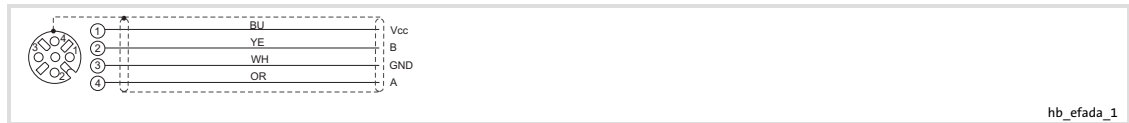
EYPxxxxAxxxxH07Q08, EYPxxxxAxxxxH08Q09**EYPxxxxAxxxxH09Q09****EYPxxxxAxxxxA00Q08, EYPxxxxAxxxxA00Q09**

12.2.2 Incremental HTL encoder

EYF0048AxxxxD01B02

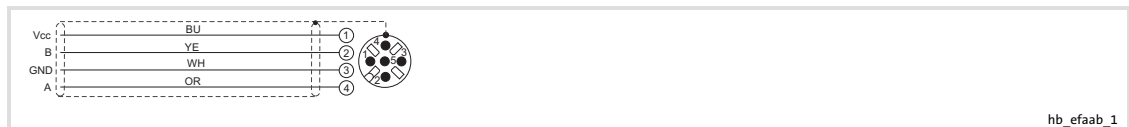


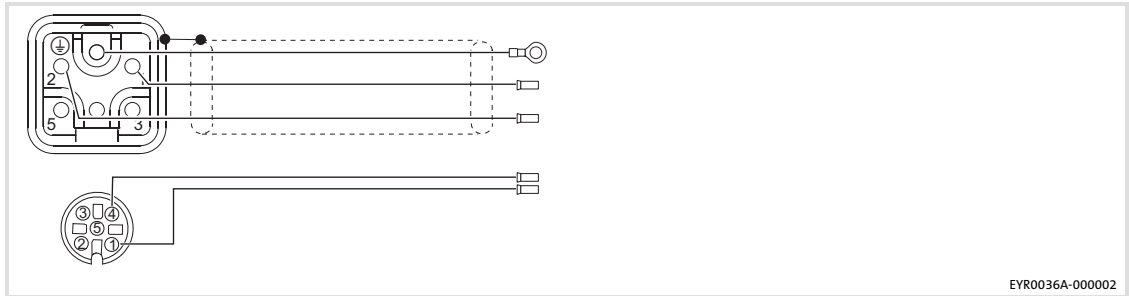
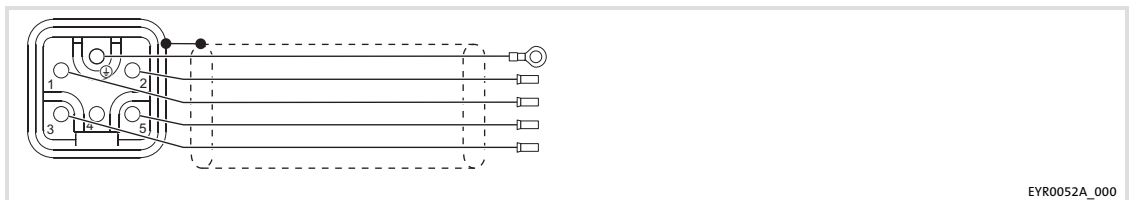
EYF0048AxxxxD01A00



EYF0048AxxxxA00B02

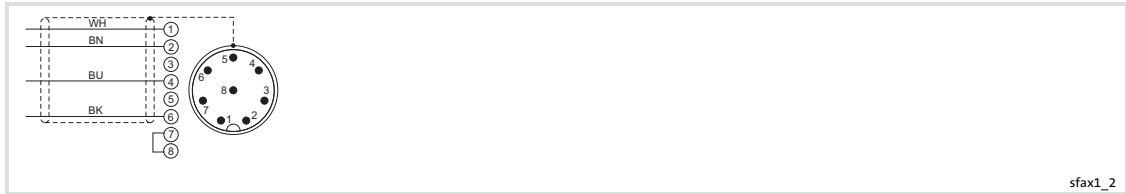
EYF0048AxxxxD01A00, EYF0048AxxxxA00B02, EYF0048AxxxxD01B02



12.2.3**Connection of external brake resistor****EYR0036AxxxxxB01A03****EYR0052AxxxxxH18A03**

12.2.4 Connection of safety sensors and actuators

EYF0041Axxxxxxxxxx

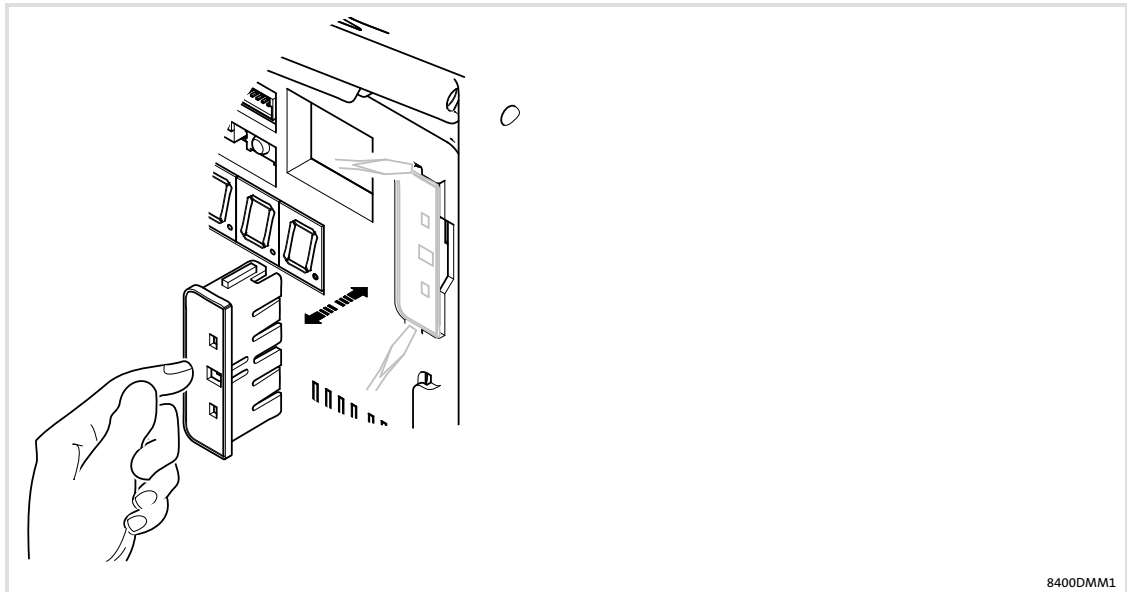


12.3 Memory module

**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.



12.3.1 E84AYM10S

Name: Memory module (for StateLine/HighLine version)

Type designation: E84AYM10S (/M = 5 pcs/VPE)

Slot: MMI

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

The pluggable memory module enables a quick parameter set transfer to an identical controller. Possible reasons for a parameter set transfer are:

- ▶ Duplication of similar applications in a series of identical drives.
- ▶ Restorage of an application after device replacement.

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

In order to remove the memory module, use a suitable screwdriver to lever the module out at the upper and lower groove. In order to plug in the module, insert it into the slot and push it with light pressure until end position is reached.

12.3.2 E84AYM30S

Name: Memory module (for EMS version)

Type designation: E84AYM30S (/M = 5 pcs/VPE)

Slot: MMI

The parameters of the controller are stored in the memory module. Moreover, this module has further memory capacity for PLC programs and retain variables.

The pluggable memory module enables a quick parameter set transfer to an identical controller. Possible reasons for a parameter set transfer are:

- ▶ Duplication of similar applications in a series of identical drives.
- ▶ Restorage of an application after device replacement.

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

In order to remove the memory module, use a suitable screwdriver to lever the module out at the upper and lower groove. In order to plug in the module, insert it into the slot and push it with light pressure until end position is reached.

12.4 Diagnosis terminal

The X400 diagnosis terminal is a simple means for parameter setting and diagnostics on site. Clearly structured menus and a plain text menu grant quick data access. The diagnosis terminal is connected to the X70 diagnostic interface (behind the service hatch). The diagnosis terminal is based on the X400 keypad, extended by a holder and a connecting cable.

Name: Diagnosis terminal X400

Type designation: EZAEBK200x

Slot: X70

Features

- ▶ In a robust housing
- ▶ Suitable for installation into the control cabinet door
- ▶ 2.5 m connecting cable, exchangeable
- ▶ Enclosure IP65 is possible for installation into the control cabinet
- ▶ Menu-driven diagnostics and parameter setting
- ▶ Backlighting graphic display for representing information
- ▶ 4 navigation keys, 2 context-sensitive keys
- ▶ Adjustable RUN/STOP function
- ▶ Hot-plug capable
- ▶ Enclosure IP20

12.5 Infrared remote control (IrRC)

The infrared remote control LDEZIRRC serves to execute up to 18 functions. The system-specific functions (key assignment) are described in the documentation of the system.

Change-over from automatic operation to manual infrared operation

- ▶ Press [ON] key
 - Display: $\epsilon---$
- ▶ enter the desired vehicle number (e.g. 020) within 8 s, using the number keys [0 ... 9]
 - Display: $\epsilon 020$



Note!

If no vehicle number is entered, the control remains in automatic operation and continues to travel, if required!

The vehicle number ensures that the remote control only addresses the control of the desired vehicle.

In manual infrared operation, the automatic distance control is switched off. Moreover, control is even possible with active error (except for internal errors).

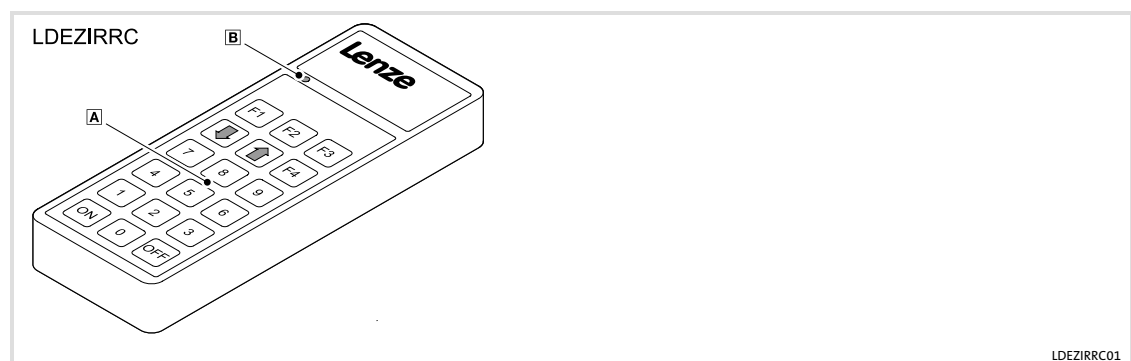
Change-over from manual infrared operation to automatic operation

Press [OFF] key



Note!

The manual infrared operation is not reset by switching the mains.



- A** Key field
- B** Control LED "Transmit"

12.6**External brake resistors****Assignment of controller - brake resistor**

Controller	External brake resistor	
	400 V	500 V
E84Dxxxx7514	ERBS240R300W	ERBS180R350W
E84Dxxxx1524	ERBS180R350W	
E84Dxxxx3024	ERBS047R400W	ERBS047R400W
E84Dxxxx4024		
E84DHxxx7524		

12.7 Power supply units

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

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

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

12.8 EMS accessories

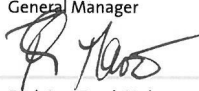
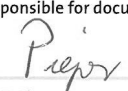
- ▶ **LDEZHMTX - half wave transmission module**
Interface module for the half-wave command selection (transmission module) via a control bar between the mobile control at the vehicle and the stationary system. The connection of up to 8 channels is possible.
- ▶ **LDEZHMRX - half wave reception module**
Interface module for the half-wave feedback (reception module) via a signalling bar between the mobile control at the vehicle and the stationary system. The connection of up to 8 channels is possible.
- ▶ **LDEZPW10238Kxx - Power wave**
Communication module with up to 1023 commands for data exchange between the stationary system centre and the mobile control at the vehicle. For communicating with the central PLC, PROFIBUS-DP, DeviceNet or INTERBUS CU are available.
- ▶ **LDEZLDC1Kxx - rail bus local data concentrator**
Communication module (master) for data exchange between the system PLC and the bus transfer unit on the rail bus or inductive data transfer. Depending on the communication medium, an LDEZLMDC (contact conductor rail bus) or an LDEZLMIDAT (inductive data transfer) interface can be connected.
- ▶ **LDEZLMDC - rail bus CAN bus driver module**
Interface module - CAN bus driver for the rail bus, (implementation TTL -> 50 V DC) for plugging onto the data concentrator (master - bus transfer unit) LDEZLDC1KPB, LDC1KDN, for bidirectional data exchange with mobile control.
- ▶ **LDEZIRDS - infrared station with fieldbus link**
The infrared station is used for bidirectional data exchange between the stationary system PLC and the mobile control at the vehicle.
Vehicle-specific process data and maintenance data can be transmitted. Communication is possible with central PLC via PROFINET I/O, (PROFIBUS DP, EtherNet /IP and DeviceNet on request).
- ▶ **LDEZEXIRD - external infrared module (remote control receiver with LED display)**
The external infrared module serves to be connected to a Lenze control system CCU/ICU series with LDEZDrive PLCC and is an external display as well as an infrared remote control receiver. The connection to the LDEZDPLCC is made via the system bus (CAN) which provides the option to mount it to any position of the vehicle.

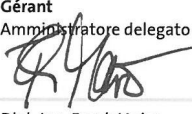
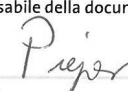
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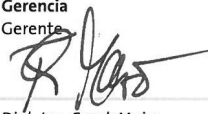
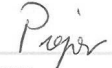
Appendix

13.1

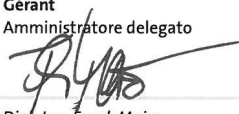
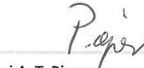
Declarations and certificates

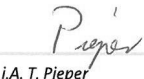
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