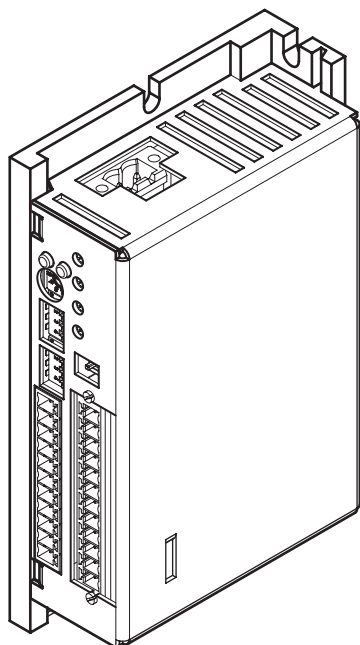


SD3150

Drive for stepper motors

Product manual

V2.00, 03.2011



Important information

This manual is part of the product.

Carefully read this manual and observe all instructions.

Keep this manual for future reference.

Hand this manual and all other pertinent product documentation over to all users of the product.

Carefully read and observe all safety instructions and the chapter "Before you begin - safety information".

Some products are not available in all countries.

For information on the availability of products, please consult the catalog.

Subject to technical modifications without notice.

All details provided are technical data which do not constitute warranted qualities.

Most of the product designations are registered trademarks of their respective owners, even if this is not explicitly indicated.

Table of contents

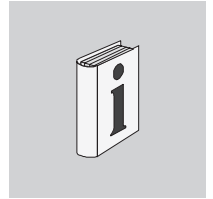


Important information	2
Table of contents	3
About this manual	7
Further reading	8
1 Introduction	9
1.1 Device overview	9
1.2 Scope of supply	10
1.3 Components and interfaces	11
1.4 Type code	12
2 Before you begin - safety information	13
2.1 Qualification of personnel	13
2.2 Intended use	13
2.3 Hazard categories	14
2.4 Basic information	15
2.5 Standards and terminology	16
3 Technical Data	17
3.1 Ambient conditions	17
3.2 Mechanical data	19
3.2.1 Dimensions	19
3.3 Electrical Data	20
3.3.1 Connection overview	20
3.3.2 Supply voltage VDC at CN1	21
3.3.3 Signal interface at CN2	22
3.3.4 Motor connection at CN3	22
3.3.5 Signal interface CN4	23
3.4 Technical data accessories	24
3.4.1 Cables	24
3.4.2 Connectors	25
3.4.3 Other accessories	25
3.5 Conditions for UL 508C	26
3.6 Certifications	26
3.7 Declaration of conformity	27

4	Installation	29
4.1	Electromagnetic compatibility, EMC	30
4.2	Mechanical installation	34
4.2.1	Mounting the device	34
4.3	Electrical installation	36
4.3.1	Overview of procedure	36
4.3.2	Connection overview	37
4.3.3	Connecting the power stage supply (CN1)	38
4.3.4	Connecting the signal interface (CN2)	41
4.3.5	Connecting the motor phases (CN3)	44
4.3.6	Connecting the signal interface (CN4)	47
4.4	Checking installation	50
5	Commissioning	51
5.1	Overview	52
5.2	Commissioning procedure	53
5.2.1	Overview of parameter switches	53
5.2.2	Setting the nominal current	54
5.2.3	Setting the current reduction	55
5.2.4	Setting the Softstep function	56
5.2.5	Setting the number of steps	57
5.2.6	Setting the type of Enable	58
5.2.7	Setting the source for the oscillator	58
5.2.8	Test run of the drive	59
6	Operation	61
6.1	Overview	61
6.2	Enabling motor movements	62
6.2.1	Enabling the power stage	62
6.2.2	Block P/D signals	62
6.3	Performing motor movements	63
6.3.1	Reference values via the digital signal inputs	63
6.3.2	Reference values via the analog signal input	64
6.3.3	Reference values via external P/D signals	65
6.4	Signal outputs	66
6.4.1	Readiness	66
6.4.2	Pulse signal and direction of movement	66
6.5	Monitoring functions	67
7	Examples	69
7.1	Wiring examples	69
8	Diagnostics and troubleshooting	71
8.1	Status indication via LEDs	71
8.2	Troubleshooting	72

9	Accessories and spare parts	73
9.1	Optional accessories	73
10	Service, maintenance and disposal	75
10.1	Service address	75
10.2	Maintenance	75
10.3	Replacing devices	76
10.4	Shipping, storage, disposal	76
11	Extract	77
11.1	Extract for installation	77
11.2	Extract for commissioning	81
11.2.1	Setting the nominal current	81
11.2.2	Setting the current reduction	82
11.2.3	Setting the Softstep function	83
11.2.4	Setting the number of steps	84
11.2.5	Setting the type of Enable	85
11.2.6	Setting the source for the oscillator	85
12	Glossary	87
12.1	Units and conversion tables	87
12.1.1	Length	87
12.1.2	Mass	87
12.1.3	Force	87
12.1.4	Power	87
12.1.5	Rotation	88
12.1.6	Torque	88
12.1.7	Moment of inertia	88
12.1.8	Temperature	88
12.1.9	Conductor cross section	88
12.2	Terms and Abbreviations	89
13	Index	91

About this manual



This manual is valid for SD3150 standard products. Chapter 1 "Introduction" lists the type code for this product. The type code allows you to identify whether your product is a standard product or a customized version.

The following manuals belong to this product:

- **Product manual**, describes the technical data, installation, commissioning and the operating modes and functions.
- **Motor manual**, describes the technical characteristics of the motors, including correct installation and commissioning.

Source manuals The latest versions of the manuals can be downloaded from the Internet at:

<http://www.schneider-electric.com>

Source EPLAN Macros For easier engineering, macro files and product master data are available for download from the Internet at:

<http://www.schneider-electric.com>

Corrections and suggestions We always try to further optimize our manuals. We welcome your suggestions and corrections.

Please get in touch with us by e-mail:

techcomm@schneider-electric.com.

Work steps If work steps must be performed consecutively, this sequence of steps is represented as follows:

- Special prerequisites for the following work steps
- ▶ Step 1
- ◁ Specific response to this work step
- ▶ Step 2

If a response to a work step is indicated, this allows you to verify that the work step has been performed correctly.

Unless otherwise stated, the individual steps must be performed in the specified sequence.

Making work easier Information on making work easier is highlighted by this symbol:



Sections highlighted this way provide supplementary information on making work easier.

SI units

SI units are the original values. Converted units are shown in brackets behind the original value; they may be rounded.

Example:

Minimum conductor cross section: 1.5 mm² (AWG 14)

- Glossary* Explanations of special technical terms and abbreviations.
Index List of keywords with references to the corresponding page numbers.

Further reading

Recommended literature for further reading:

1 Introduction

1

1.1 Device overview

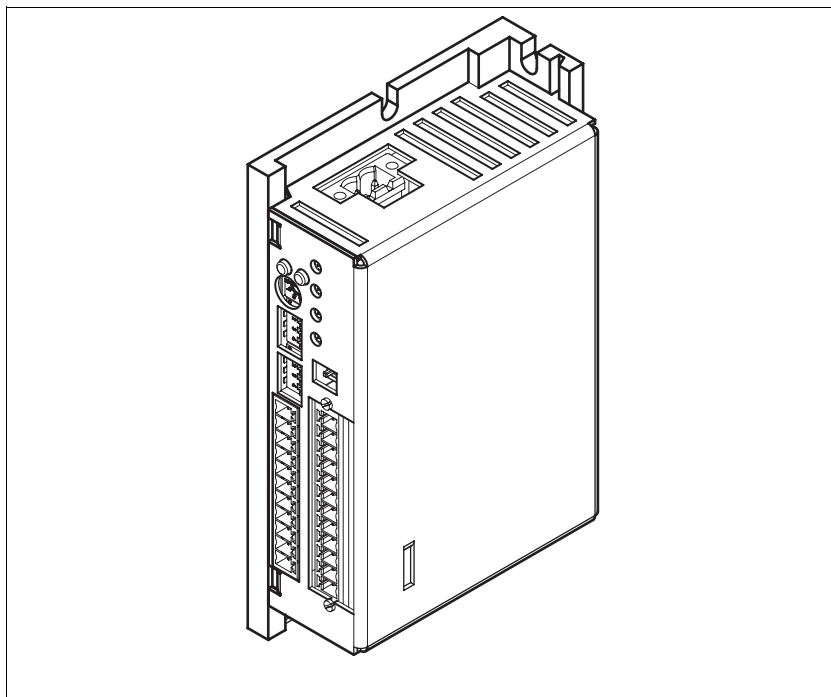


Figure 1.1 Device overview

This drive is used to control a 3-phase stepper motor.

Drive The drive moves the motor as per the supplied external reference values.

There are several ways of supplying the reference values:

- Reference values via the digital signal inputs
The movement is started and terminated via a digital signal input. It is possible to switch between 2 velocities via a further digital signal input.
- Reference values via the analog signal input
The movement is started and terminated via a digital signal input. The velocity is set via the analog signal input.
- Reference values via external P/D signals
A master controller generates reference values which are supplied as P/D signals (PULSE/DIR).

1.2 Scope of supply

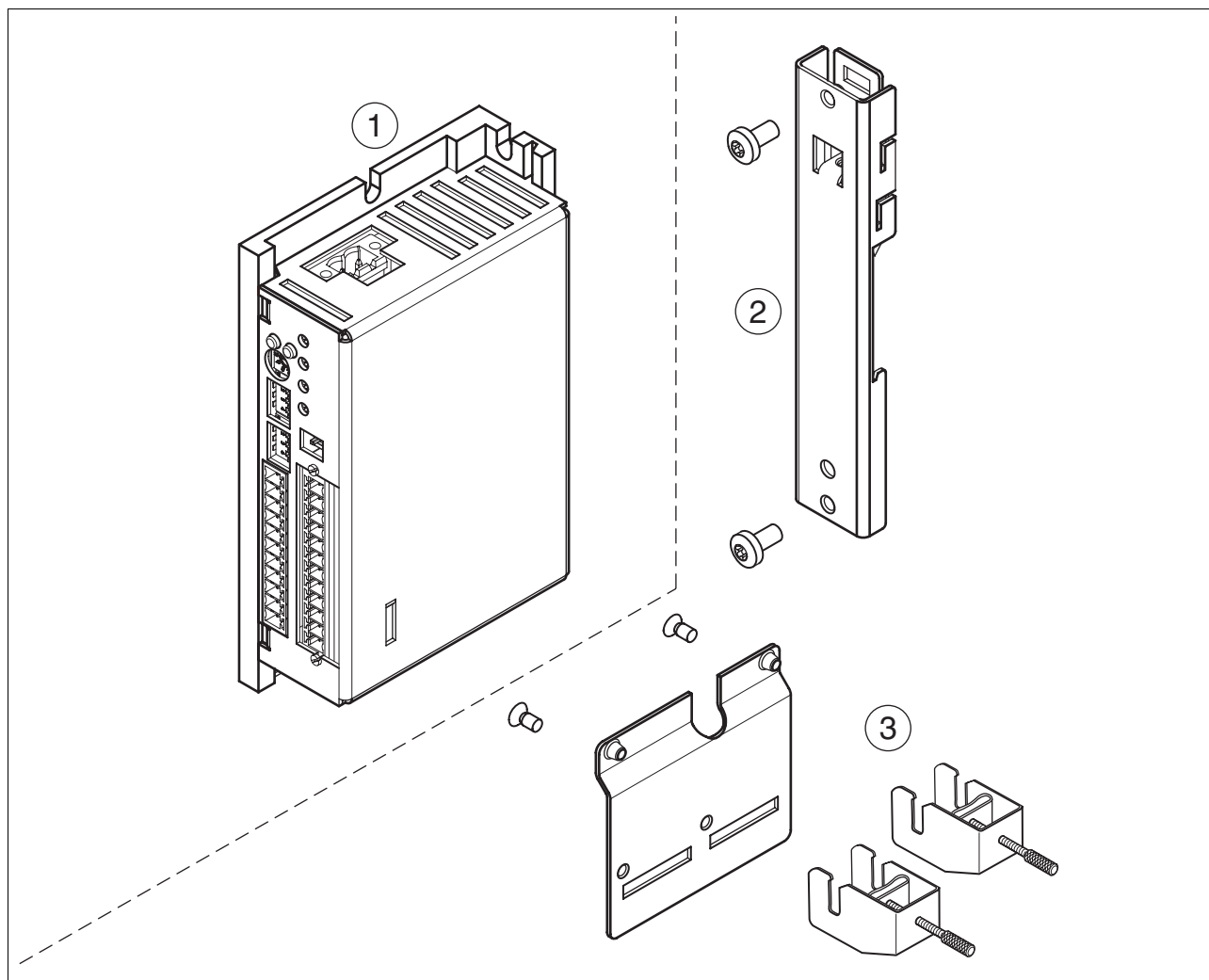


Figure 1.2 Scope of supply

- (1) SD3150
- (2) DIN rail adapter with mounting screws (accessories)
- (3) EMC kit (accessories)

1.3 Components and interfaces

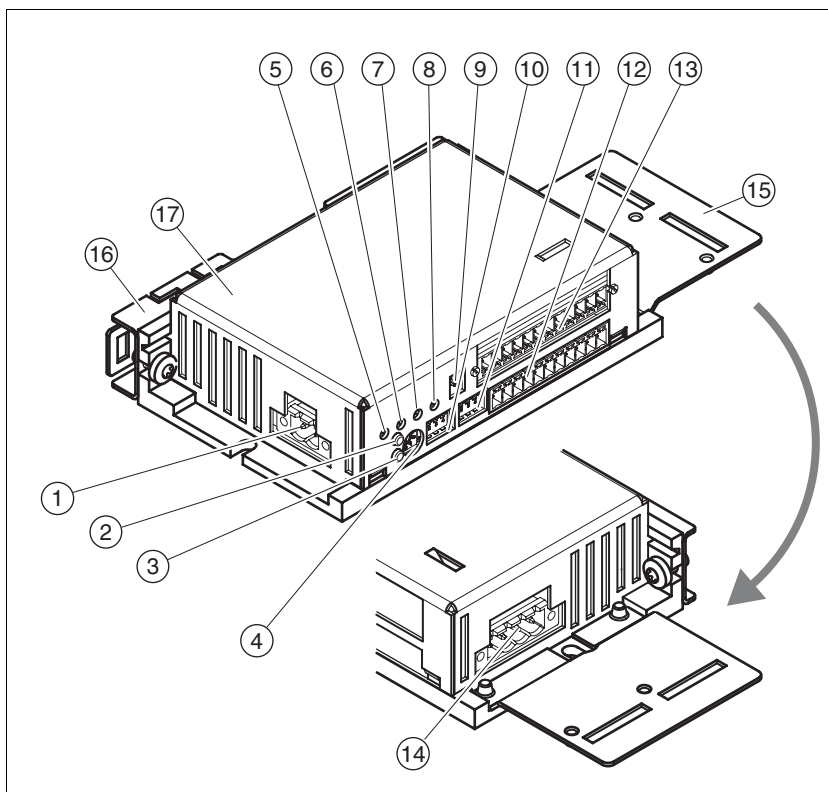


Figure 1.3 Components and interfaces

- (1) Connection CN1 power stage supply
- (2) LED ERR (red)
- (3) LED OK (green)
- (4) Parameter switch S1 motor phase current
- (5) Potentiometer R1: f_high
- (6) Potentiometer R2: f_low
- (7) Potentiometer R3: ACC
- (8) Potentiometer R4: DEC
- (9) Parameter switch S4 "Source for oscillator."
- (10) Parameter switch S2 "Current Reduction" and "Softstep"
- (11) Parameter switch S3 number of steps and type of release
- (12) Connection CN2 signal interface
- (13) Connection CN4 signal interface oscillator
- (14) Connection CN3 motor
- (15) EMC mounting plate (accessories)
- (16) DIN rail adapter (accessories)
- (17) Nameplate

1.4 Type code

	SD3	15	•	N10	B4	••
Product designation SD3 = Stepper motor drive 3-phase						
Product design 15 = Stepper motor drive module						
Interface D = P/D signals O = P/D signals with oscillator						
Max. motor phase current N10 = 10 A						
Power stage supply B4 = 24 ... 48 V _{dc}						
Further options 00 = Standard xx = Customized version						

If you have questions concerning the type code, contact your Schneider Electric sales office. Contact your machine vendor if you have questions concerning customized versions.

2 Before you begin - safety information

2

2.1 Qualification of personnel

Only appropriately trained persons who are familiar with and understand the contents of this manual and all other pertinent product documentation are authorized to work on and with this product. In addition, these persons must have received safety training to recognize and avoid hazards involved. These persons must have sufficient technical training, knowledge and experience and be able to foresee and detect potential hazards that may be caused by using the product, by changing the settings and by the mechanical, electrical and electronic equipment of the entire system in which the product is used.

All persons working on and with the product must be fully familiar with all applicable standards, directives, and accident prevention regulations when performing such work.

2.2 Intended use

This product is a drive for 3-phase stepper motors and intended for industrial use according to these instructions.

The product may only be used in compliance with all applicable safety regulations and directives, the specified requirements and the technical data.

Prior to using the product, you must perform a risk assessment in view of the planned application. Based on the results, the appropriate safety measures must be implemented.

Since the product is used as a component in an entire system, you must ensure the safety of persons by means of the design of this entire system (for example, machine design).

Operate the product only with the specified cables and accessories. Use only genuine accessories and spare parts.

The product must NEVER be operated in explosive atmospheres (hazardous locations, Ex areas).

Any use other than the use explicitly permitted is prohibited and can result in hazards.

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel.

2.3 Hazard categories

Safety instructions to the user are highlighted by safety alert symbols in the manual. In addition, labels with symbols and/or instructions are attached to the product that alert you to potential hazards.

Depending on the seriousness of the hazard, the safety instructions are divided into 4 hazard categories.

DANGER

DANGER indicates an imminently hazardous situation, which, if not avoided, **will result** in death or serious injury.

WARNING

WARNING indicates a potentially hazardous situation, which, if not avoided, **can result** in death, serious injury, or equipment damage.

CAUTION

CAUTION indicates a potentially hazardous situation, which, if not avoided, **can result** in injury or equipment damage.

CAUTION

CAUTION used without the safety alert symbol, is used to address practices not related to personal injury (e.g. **can result** in equipment damage).

2.4 Basic information

▲ WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are emergency stop, overtravel stop, power outage and restart.
- Separate or redundant control paths must be provided for critical functions.
- System control paths may include communication links. Consideration must be given to the implication of unanticipated transmission delays or failures of the link.
- Observe all accident prevention regulations and local safety guidelines. ¹⁾
- Each implementation of the product must be individually and thoroughly tested for proper operation before being placed into service.

Failure to follow these instructions can result in death or serious injury.

1) For USA: Additional information, refer to NEMA ICS 1.1 (latest edition), "Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control" and to NEMA ICS 7.1 (latest edition), "Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems".

▲ WARNING

UNEXPECTED BEHAVIOR AND DESTRUCTION OF SYSTEM COMPONENTS

When you work on the wiring and when you unplug or plug in connectors, this may cause unexpected behavior and destruction of system components.

- Switch the power supply off before working on the wiring.

Failure to follow these instructions can result in death, serious injury or equipment damage.

2.5 Standards and terminology

Technical terms, terminology and the corresponding descriptions in this manual are intended to use the terms or definitions of the pertinent standards.

In the area of drive systems, this includes, but is not limited to, terms such as "safety function", "safe state", "fault", "fault reset", "failure", "error", "error message", "warning", "warning message", etc.

Among others, these standards include:

- IEC 61800 series: "Adjustable speed electrical power drive systems"
- IEC 61158 series: "Industrial communication networks - Fieldbus specifications"
- IEC 61784 series: "Industrial communication networks - Profiles"
- IEC 61508 series: "Functional safety of electrical/electronic/programmable electronic safety-related systems"

Also see the glossary at the end of this manual.

3 Technical Data

3

This chapter contains information on the ambient conditions and on the mechanical and electrical properties of the product family and the accessories.

3.1 Ambient conditions

Ambient conditions transportation and storage

The environment during transport and storage must be dry and free from dust. The maximum vibration and shock load must be within the specified limits.

Temperature	[°C]	-25 ... 70
-------------	------	------------

Climatic environmental conditions operation

The maximum permissible ambient temperature during operation depends on the mounting distances between the devices and on the required power. Observe the pertinent instructions in the chapter 4 "Installation".

Ambient temperature (no icing, non-condensing)	[°C]	0 ... 50
--	------	----------

The following relative humidity is permissible during operation:

Relative humidity (non-condensing)	[%]	5 ... 85 As per IEC 60721-3-3, class 3K3
------------------------------------	-----	---

The installation altitude is defined as altitude above mean sea level.

Installation altitude without derating	[m]	<1000
Installation altitude if the following condition is met: • Reduction of the motor phase current by 1% per 100 m above 1000 m	[m]	1000 ... 2000

Pollution degree and degree of protection

Pollution degree		2
Degree of protection		IP 20

Vibration and shock

Vibration, sinusoidal		Type test with 10 runs as per IEC 60068-2-6 1.5 mm (from 3 Hz ... 13 Hz) 10 m/s ² (from 13 Hz ... 150 Hz)
Shock, semi-sinusoidal		Type test with 3 shocks in each direction as per IEC 60068-2-27 150 m/s ² (for 11 ms)

EMC

Emission with shielded cables		IEC 61800-3: Category C2 IEC 61000-6-4 EN 55022: Class A
Emission with unshielded cables		IEC 61800-3: Category C3 IEC 61000-6-4 EN 55022: Class A
Immunity		IEC 61800-3: second environment

3.2 Mechanical data

3.2.1 Dimensions

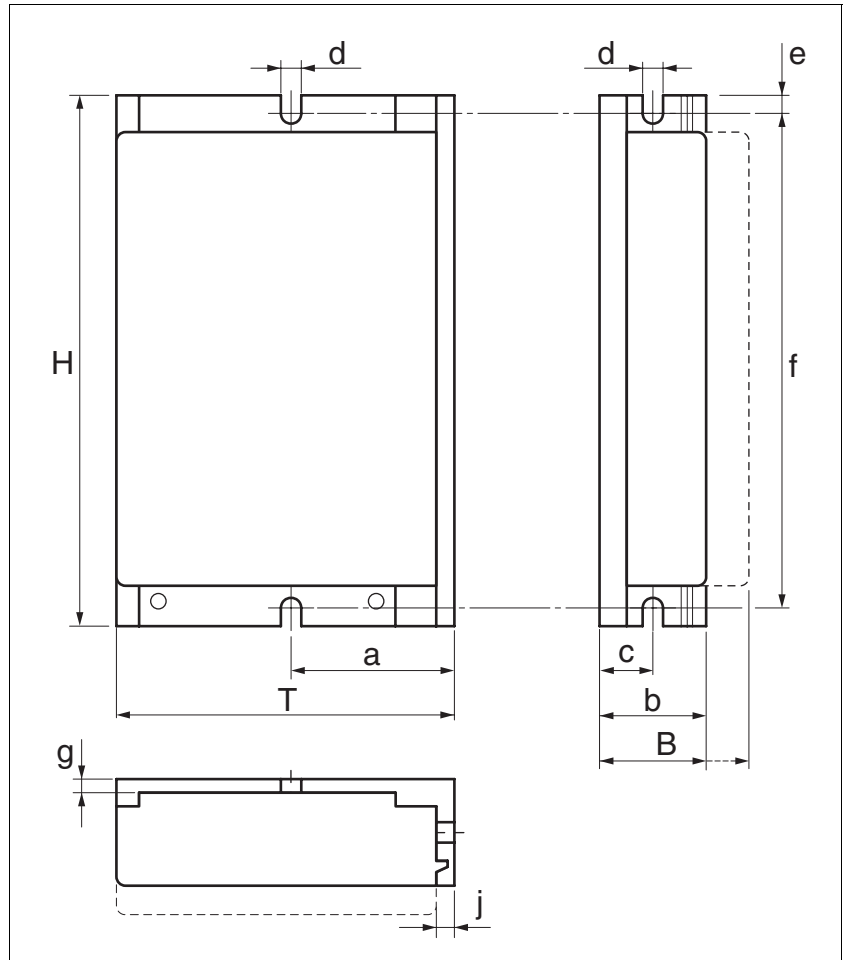


Figure 3.1 Dimensions

H	[mm]	117
B	[mm]	33
T	[mm]	74.5
a	[mm]	36
b	[mm]	23.5
c	[mm]	11.75
d	[mm]	4.5
e	[mm]	4.25
f	[mm]	108.5
g	[mm]	3
j	[mm]	4
Type of cooling		Free convection
Mass	[kg]	0.30

3.3 Electrical Data

3.3.1 Connection overview

The illustration below shows an overview of the connections:

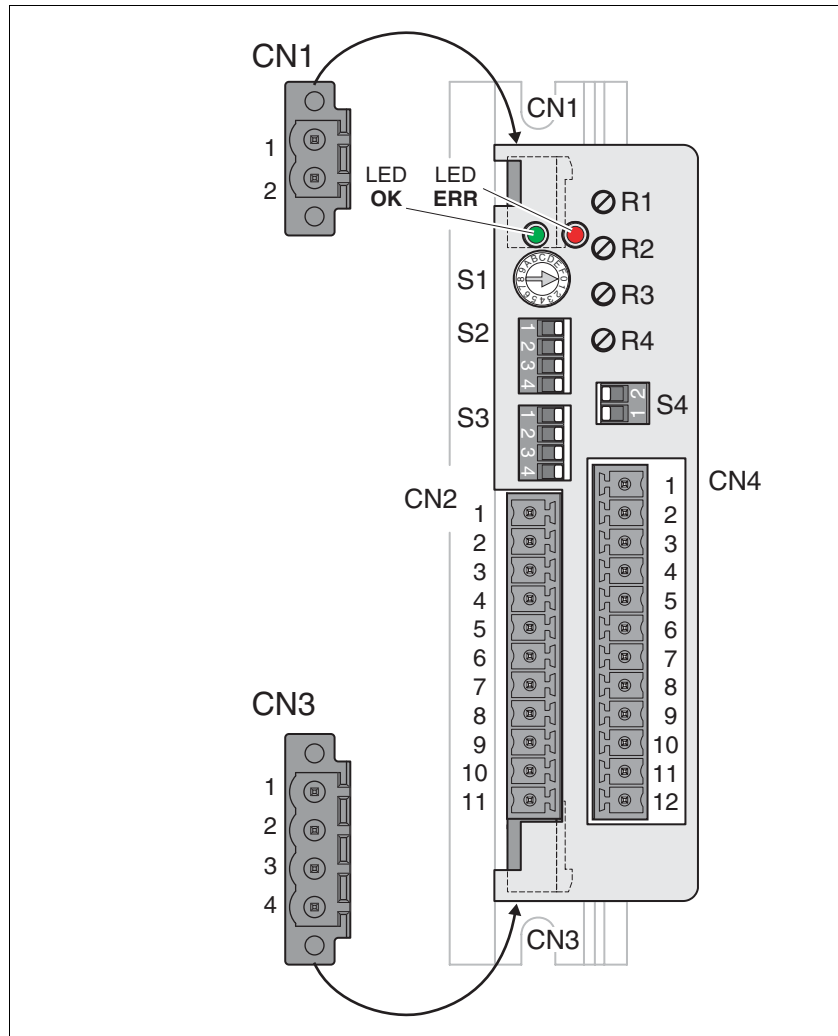


Figure 3.2 Overview of signal connections

Connection	Assignment
CN1	Power stage supply
CN2	Signal interface
CN3	Motor
CN4	Signal interface oscillator

3.3.2 Supply voltage V_{DC} at CN1

The power stage supply V_{DC} is also the controller supply voltage.

Electrical data

Nominal voltage V_{DC}	[V _{dc}]	24 ... 48
Limit values V_{DC}	[V _{dc}]	19.2 ... 60
Residual ripple	[%]	<5
Input current	[A]	≤7.5
Power dissipation	[W]	≤7
Internal capacitors	[μF]	1100
Fuse to be connected upstream	[A]	≤10

Fuse to be connected upstream

The input current may increase greatly for a short periods in the case of dynamic processes such as fast acceleration or brief load torque peaks.

Circuit breakers with thermal tripping are recommended.

For example type multi9 C60N by Schneider Electric, Cat.No.60110, rated current 10 A, trip characteristic C.

Alternatively, circuit breakers with electronic tripping can be used.

For example type ESS20 by E-T-A.

Select the nominal current of the circuit breaker depending on the wiring and the input current.

3.3.3 Signal interface at CN2

5V inputs The inputs are optocoupler inputs.

1 level (U_{high})	V	2.5 ... 5.25
0 level (U_{low})	V	≤ 0.4
Input current	[mA]	≤ 25
Input frequency	[kHz]	≤ 200

24V inputs The inputs are optocoupler inputs.

1 level (U_{high})	V	15 ... 30
0 level (U_{low})	V	≤ 5
Input current	[mA]	≤ 7
Input frequency	[kHz]	≤ 200

Output ACTIVE_OUT The output is an electronic relay (bidirectional Mosfet). The output is not short-circuit protected.

Switching voltage	[V]	≤ 30
Switching current	[mA]	≤ 200
Voltage drop at 50 mA load	[V]	≤ 1

3.3.4 Motor connection at CN3

Maximum motor phase current	[A _{pk}]	14
	[A _{rms}]	10
Maximum motor phase current without the function "Current Reduction"	[A _{rms}]	7.5
Number of phases		3

Approved motors You can use motors from the motor series BRS36•F, BRS36•H, BRS39•F and BRS39•H.

3.3.5 Signal interface CN4

5V inputs The inputs are optocoupler inputs.

1 level (U_{high})	V	2.5 ... 5.25
0 level (U_{low})	V	≤ 0.4
Input current	[mA]	≤ 25

24V inputs The inputs are optocoupler inputs.

1 level (U_{high})	V	15 ... 30
0 level (U_{low})	V	≤ 5
Input current	[mA]	≤ 7

Outputs PULS_OUT_NO and DIR_OUT_NO

Outputs with polarity. The reference potential is 0V_EXT. The outputs are not short-circuit protected.

Switching voltage	[V]	≤ 30
Maximum switching current	[mA]	50
Recommended switching current	[mA]	≥ 10
Voltage drop at 50 mA load	[V]	≤ 0.5

Analog input ANA1

A voltage value for the velocity can be supplied via the input ANA1.

Measuring range	[V _{dc}]	0 ... 10
Zero voltage window	[mV]	50
Input voltage	[V _{dc}]	≤ 30
Input resistance	[k Ω]	≥ 10
Resolution	[Bit]	10

Output 10V_OUT (for potentiometer)

A voltage for an external potentiometer is available via the output 10V_OUT. The reference potential is ANA_0V.

Voltage	[V _{dc}]	10
Output current	[mA]	≤ 20
Resistance potentiometer	[k Ω]	10

3.4 Technical data accessories

3.4.1 Cables

Cable specifications CN1

Shield:	Depends on EMC limit values, see chapter 3.1 "Ambient conditions".
Twisted Pair:	Not required
PELV:	Required
Minimum conductor cross section:	Use a conductor with a sufficient cross section according to the upstream fuse and the cable length.
Maximum cable length:	-

Cable specifications CN2

Shield:	Required
Twisted Pair:	Required
PELV:	Required
Minimum conductor cross section:	0.2 mm ² (AWG 24)
Maximum cable length:	-

Cable specifications CN3

Shield:	Depends on EMC limit values, see chapter 3.1 "Ambient conditions".
Twisted Pair:	Not required
PELV:	Required
Minimum conductor cross section:	0.75 mm ² . Use a conductor with a sufficient cross section according to the upstream fuse and the cable length.
Maximum cable length:	50 m

Cable specifications CN4

Shield:	Required
Twisted Pair:	Required
PELV:	Required
Minimum conductor cross section:	0.2 mm ² (AWG 24)
Maximum cable length:	-

3.4.2 Connectors

The connectors are available as a connector kit. See chapter 9 "Accessories and spare parts".

Properties of connector CN1

Designation		Female header 2 pins 5.08, gold contact, black
Type		BLZF 5.08/02/180F AU BK (Weidmüller)
Maximum connection cross section	[mm ²]	2.5 (AWG 14)
Stripping length	[mm]	10

Properties of connector CN2

Designation		Spring force connector, 11 pins
Type		FK-MCP 1,5/11-ST-3,81 (Phoenix Combicon)
Maximum connection cross section with wire ferrule without plastic collar	[mm ²]	1.5 (AWG 16)
Maximum connection cross section with wire ferrule with plastic collar	[mm ²]	0.5 (AWG 22)
Stripping length	[mm]	9

Properties of connector CN3

Designation		Female header 4 pins 5.08, gold contact, black
Type		BLZF 5.08/04/180F AU BK (Weidmüller)
Maximum connection cross section	[mm ²]	2.5 (AWG 14)
Stripping length	[mm]	10

Properties of connector CN4

Designation		Spring force connector, 12 pins
Type		FK-MCP 1,5/12-ST-3,81 (Phoenix Combicon)
Maximum connection cross section with wire ferrule without plastic collar	[mm ²]	1.5 (AWG 16)
Maximum connection cross section with wire ferrule with plastic collar	[mm ²]	0.5 (AWG 22)
Stripping length	[mm]	9

3.4.3 Other accessories

DIN rail adapter

The 35 mm DIN rail adapter is provided for a standard TH35 rail as per IEC 60715. 2 fastening screws are included with this accessory.

EMC kit

The EMC kit improves the EMC characteristics. Shielded cables must be used with the EMC kit. The scope of supply of the EMC kit includes two fastening screws and two shield clamps.

3.5 Conditions for UL 508C

If the product is used to comply with UL 508C, the following conditions must also be met:

PELV power supply Use only power supply units that are approved for overvoltage category III.



Wiring Use at least 60/75 °C copper conductors.

3.6 Certifications

Product certifications:

Certified by	Assigned number
UL	File E 153659

3.7 Declaration of conformity

 <p>SCHNEIDER ELECTRIC MOTION DEUTSCHLAND GmbH Breslauer Str. 7 D-77933 Lahr</p> <p style="text-align: center;"><u>EC DECLARATION OF CONFORMITY</u> <u>YEAR 2011</u></p> <p> <input type="checkbox"/> according to EC Directive on Machinery 2006/42/EC <input checked="" type="checkbox"/> according to EC Directive EMC 2004/108/EC <input type="checkbox"/> according to EC Directive Low Voltage 2006/95/EC </p> <p>We hereby declare that the products listed below meet the requirements of the EC Directives indicated with respect to design, construction and version distributed by us. This declaration becomes invalid in the case of any modification to the products not authorized by us.</p>	
Designation:	Drive
Type:	SD315D, SD315O
Applied harmonized standards, especially:	EN 61800-3:2004, second environment
Applied national standards and technical specifications, especially:	UL 508C Product documentation
Company stamp:	Schneider Electric Motion Deutschland GmbH Postfach 11 80 • D-77901 Lahr Breslauer Str. 7 • D-77933 Lahr
Date/Signature:	25 January 2011 
Name/Department:	Björn Hagemann/R & D

4 Installation

4

▲ WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are emergency stop, overtravel stop, power outage and restart.
- Separate or redundant control paths must be provided for critical functions.
- System control paths may include communication links. Consideration must be given to the implication of unanticipated transmission delays or failures of the link.
- Observe all accident prevention regulations and local safety guidelines.¹⁾
- Each implementation of the product must be individually and thoroughly tested for proper operation before being placed into service.

Failure to follow these instructions can result in death or serious injury.

1) For USA: Additional information, refer to NEMA ICS 1.1 (latest edition), "Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control" and to NEMA ICS 7.1 (latest edition), "Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems".

4.1 Electromagnetic compatibility, EMC

▲ WARNING

SIGNAL AND DEVICE INTERFERENCE

Signal interference can cause unexpected responses of device.

- Install the wiring in accordance with the EMC requirements.
- Verify compliance with the EMC requirements.

Failure to follow these instructions can result in death, serious injury or equipment damage.

Limit values This product meets the EMC requirements according to the standard IEC 61800-3 if the measures described in this manual are implemented during installation.

If the selected composition is not designed for category C1, note the following:

▲ WARNING

HIGH-FREQUENCY INTERFERENCE

In a residential environment this product may cause high-frequency interference that requires interference suppression.

Failure to follow these instructions can result in death or serious injury.

An EMC-compliant design is required to meet the specified limit values. Note the following requirements:

Control cabinet design

EMC measures	Objective
Use galvanised or chrome-plated mounting plates, make large contact surface connections for metal parts, remove paint from contact surfaces	Good conductivity due to two-dimensional contacts
Ground the control cabinet, the control cabinet door and the mounting plate with ground straps or ground wires. The conductor cross section must be at least 10 mm ² (AWG 6).	Reduces emissions.
Fit switching devices such as power contactors, relays or solenoid valves with interference suppression units or arc suppressors (for example, diodes, varistors, RC circuits).	Reduces mutual interference
Install power components and control components separately.	Reduces mutual interference

Shielded cables

EMC measures	Objective
Connect large surface areas of cable shields, use cable clamps and ground straps.	Reduces emissions.
Use cable clamps to connect a large surface area of the shields of all shielded cables to the mounting plate at the control cabinet entry.	Reduces emissions.
Ground shields of digital signal wires at both ends by connecting them to a large surface or via conductive connector housings.	Reduces interference affecting the signal wires, reduces emissions
Ground the shields of analog signal wires directly at the device (signal input); insulate the shield at the other cable end or ground it via a capacitor (for example, 10 nF).	Reduces ground loops due to low-frequency interference.
Use only shielded motor cables with copper braid and a coverage of at least 85%, ground a large surface area of the shield at both ends.	Diverts interference currents in a controlled way, reduces emissions.

Cable installation

EMC measures	Objective
Do not route fieldbus cables and signal wires in a single cable duct together with lines with DC and AC voltages of more than 60 V. (Fieldbus cables, signal lines and analog lines may be in the same cable duct) Recommendation: Use separate cable ducts at least 20 cm apart.	Reduces mutual interference
Keep cables as short as possible. Do not install unnecessary cable loops, use short cables from the central grounding point in the control cabinet to the external ground connection.	Reduces capacitive and inductive interference.
Use equipotential bonding conductors in the following cases: wide-area installations, different voltage supplies and installation across several buildings.	Reduces current in the cable shield, reduces emissions.
Use equipotential bonding conductors with fine wires	Diverts high-frequency interference currents.
If motor and machine are not conductively connected, for example by an insulated flange or a connection without surface contact, you must ground the motor with a ground strap or a ground wire. The conductor cross section must be at least 10 mm ² (AWG 6).	Reduces emissions, increases immunity.
Use twisted pair for the DC supply.	Reduces interference affecting the signal cables, reduces emissions.

Power supply

EMC measures	Objective
Surge arrester if there is a risk of overvoltage.	Reduces the risk of damage caused by overvoltage.

Additional measures for EMC improvement

An EMC-compliant design is required to meet the specified limit values. Depending on the application, better results can be achieved with the following measures:

EMC measures	Objective
Additional EMC measures design, for example mounting in an closed control cabinet with 15 dB shielding attenuation of radiated interference	Improves the EMC limit values.

Motor cables

In terms of EMC, motor cables are especially critical. Use only pre-assembled cables (see chapter 9 "Accessories and spare parts") or cables that comply with the specifications and implement the EMC measures described below.

EMC measures	Objective
Do not install switching elements in motor cables.	Reduces interference.
Route the motor cable at a distance of at least 20 cm from the signal cable or use shielding plates between the motor cable and signal cable.	Reduces mutual interference
For long lines, use equipotential bonding conductors.	Reduces current in the cable shield.
Route the motor cable without cutting it. ¹⁾	Reduces emission.

1) If a cable has to be cut for the installation, it has to be connected with shield connections and a metal housing at the point of the cut.

Equipotential bonding conductors

Potential differences can result in excessive currents on the cable shields. Use equipotential bonding conductors to reduce currents on the cable shields.

The equipotential bonding conductor must be rated for the maximum current flowing. Practical experience has shown that the following conductor cross sections can be used:

- 16 mm² (AWG 4) for equipotential bonding conductors up to a length of 200 m
- 20 mm² (AWG 4) for equipotential bonding conductors with a length of more than 200 m

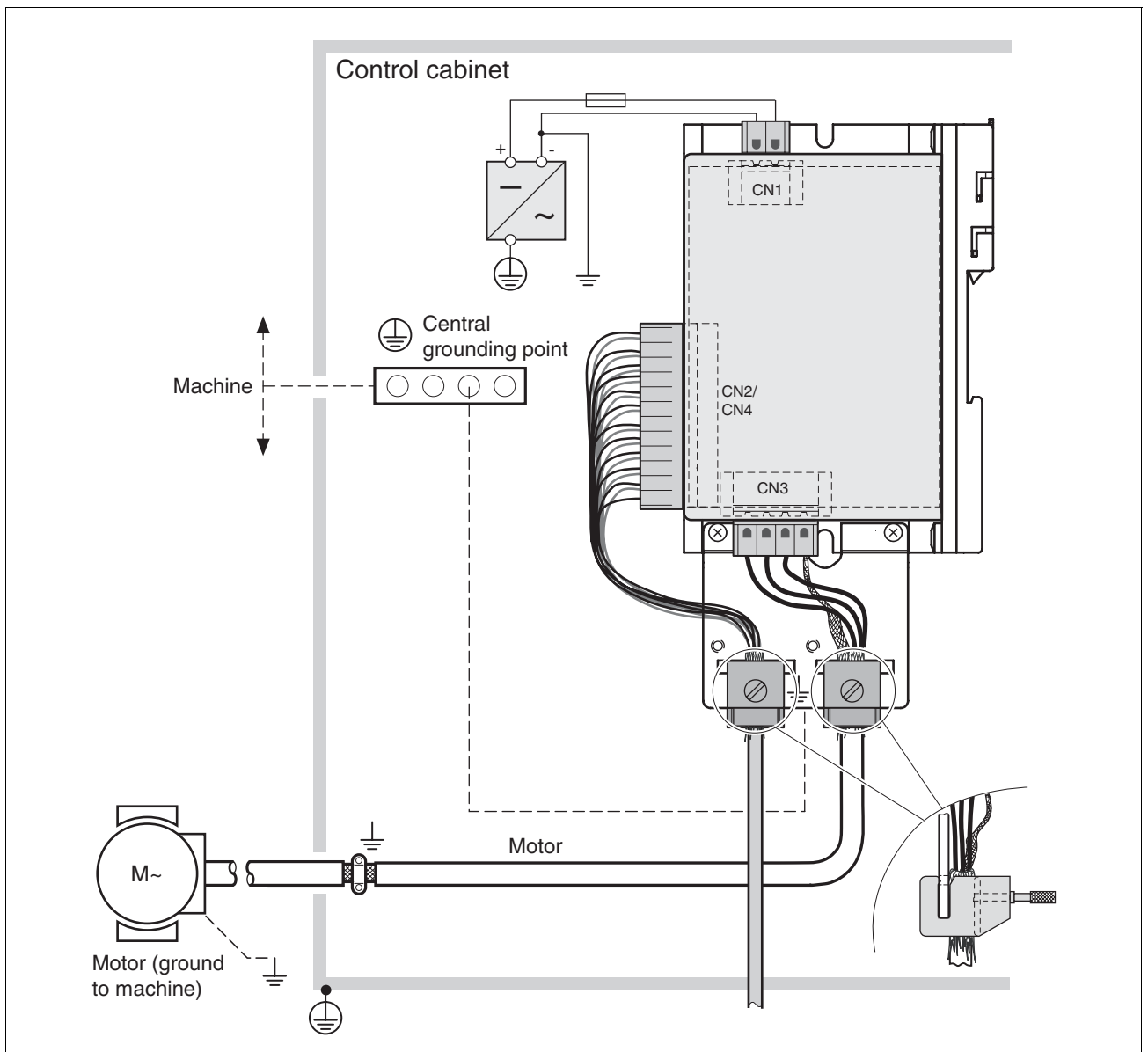


Figure 4.1 EMC measures

4.2 Mechanical installation

▲ WARNING

HOT SURFACES

The heat sink at the product may heat up to over 100°C (212°F) during operation.

- Avoid contact with the hot heat sink.
- Do not allow flammable or heat-sensitive parts in the immediate vicinity.
- Consider the measures for heat dissipation described.

Failure to follow these instructions can result in death or serious injury.

4.2.1 Mounting the device

Control cabinet The control cabinet must have a sufficient size so that the devices and components can be permanently installed and wired in compliance with the EMC requirements.

Sufficient ventilation of the control cabinet must be provided to remove the heat generated by all devices and components operated in the control cabinet.

Mounting distances, ventilation When selecting the position of the device in the control cabinet, note the following:

- Mount the device in a vertical position ($\pm 10^\circ$). This is required for cooling the device.
- Adhere to the minimum installation distances for required cooling. Avoid heat accumulations.
- Do not mount the device close to heat sources.
- Do not mount the device on flammable materials.
- The heated airflow from other devices and components must not heat up the air used for cooling the device.
- If the thermal limits are exceeded during operation, the drive switches off (overtemperature).

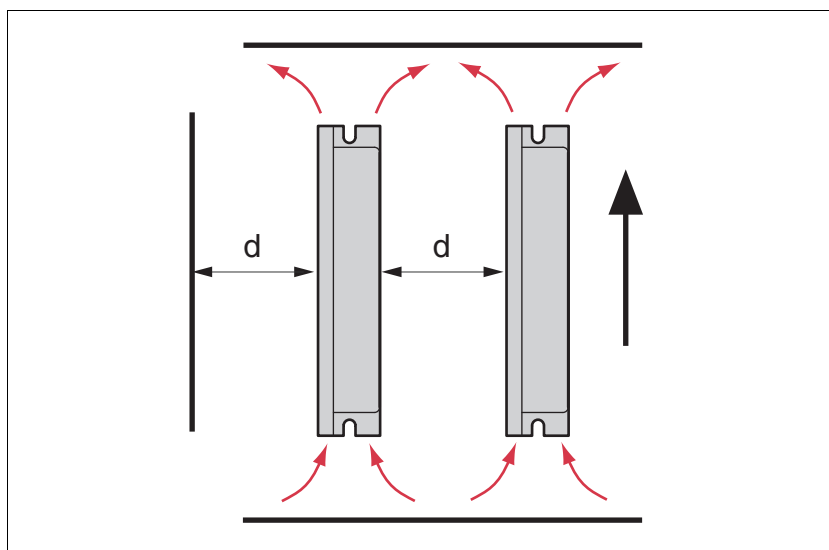


Figure 4.2 Mounting distances and air circulation

The specified continuous current is applicable if the following distances are maintained and the device is installed vertically.

- At least 10 mm of free space is required in front of the device.
- At least 50 mm of free space is required above the device.
- At least 30 mm of free space is required for "d".
- At least 200 mm of free space is required below the device to allow for cable installation without bends.

If other parts are mounted in the areas mentioned, the possible continuous current is reduced.

Mounting the device

The product can be mounted directly via the narrow or wide mounting surface with two M4 screws. The product can optionally be snapped onto a standard TH35 rail (accessories) as per IEC 60715 (DIN rail 35 mm). See chapter 3.2.1 "Dimensions", for the dimensions of the mounting holes.

- ▶ Mount the device in a vertical position ($\pm 10^\circ$).
- ▶ Use connection elements (busbars, shield clamps or similar) to route the cable and connect the shield.

NOTE: Painted surfaces have an insulating effect. Before mounting the device to a painted mounting plate, remove all paint across a large area of the mounting points until the metal is completely bare.

4.3 Electrical installation

▲ WARNING

UNEXPECTED BEHAVIOR DUE TO EXTERNAL OBJECTS

External objects, deposits or humidity can cause unexpected behavior.

- Do not use damaged products.
- Prevent external objects such as chips, screws or wire clippings from entering the product.
- Do not use products that contain external objects.

Failure to follow these instructions can result in death, serious injury or equipment damage.

Suitability of the cables Cables must not be twisted, stretched, crushed or bent. Use only cables that comply with the cable specification. Consider the following in determining suitability of the cables:

- Suitable for drag chain applications
- Temperature range
- Chemical resistance
- Outdoor installation
- Underground installation

4.3.1 Overview of procedure

- ▶ Connect the housing to the central ground point of the system.
- ▶ Verify compliance with the EMC requirements, see page 30.
- ▶ Finally, verify proper installation.

Chapter	Page
4.3.3 "Connecting the power stage supply (CN1)"	38
4.3.4 "Connecting the signal interface (CN2)"	41
4.3.5 "Connecting the motor phases (CN3)"	44
4.3.6 "Connecting the signal interface (CN4)"	47

4.3.2 Connection overview

The illustration below shows an overview of the connections:

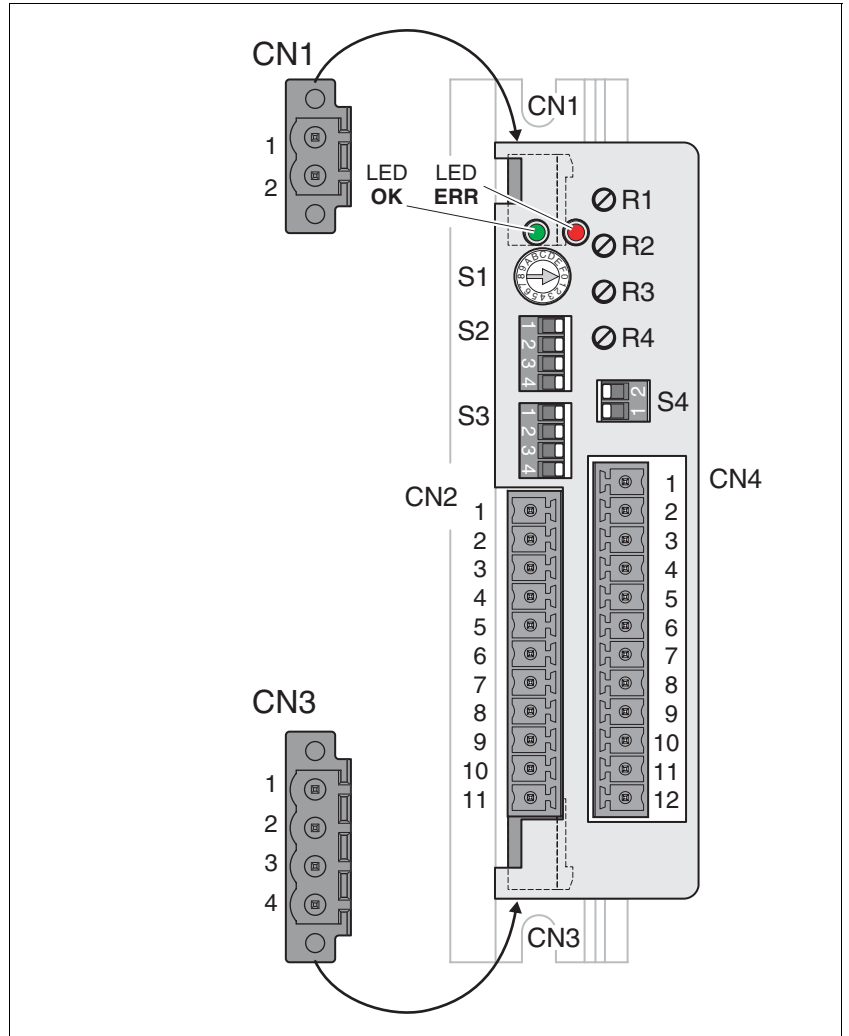


Figure 4.3 Overview of signal connections

Connection	Assignment
CN1	Power stage supply
CN2	Signal interface
CN3	Motor
CN4	Signal interface oscillator

4.3.3 Connecting the power stage supply (CN1)

⚠ DANGER**ELECTRIC SHOCK CAUSED BY INCORRECT POWER SUPPLY UNIT**

The VDC supply voltage is connected with many exposed signal connections in the drive system.

- Use a power supply unit that meets the PELV (Protective Extra Low Voltage) requirements.
- Connect the negative output of the power supply unit to PE (ground).

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING**LOSS OF CONTROL DUE TO REGENERATION CONDITION**

Regeneration conditions resulting from braking or external driving forces may increase the VDC supply voltage to an unexpected level. Components not rated for this voltage may be destroyed or cause misoperation.

- Verify that all VDC consumers are rated for the voltage occurring during regeneration conditions (for example limit switches).
- Use only power supply units that will not be damaged by regeneration conditions.
- If necessary, use a braking resistor controller.

Failure to follow these instructions can result in death, serious injury or equipment damage.

CAUTION**DAMAGE TO CONTACTS**

The connection for the controller supply voltage at the product does not have an inrush current limitation. If the voltage is switched on by means of switching of contacts, damage to the contacts or contact welding may result.

- Use a power supply unit that limits the peak value of the output current to a value permissible for the contact.
- Switch the power input of the power supply unit instead of the output voltage.

Failure to follow these instructions can result in equipment damage.

Wiring diagram CN1

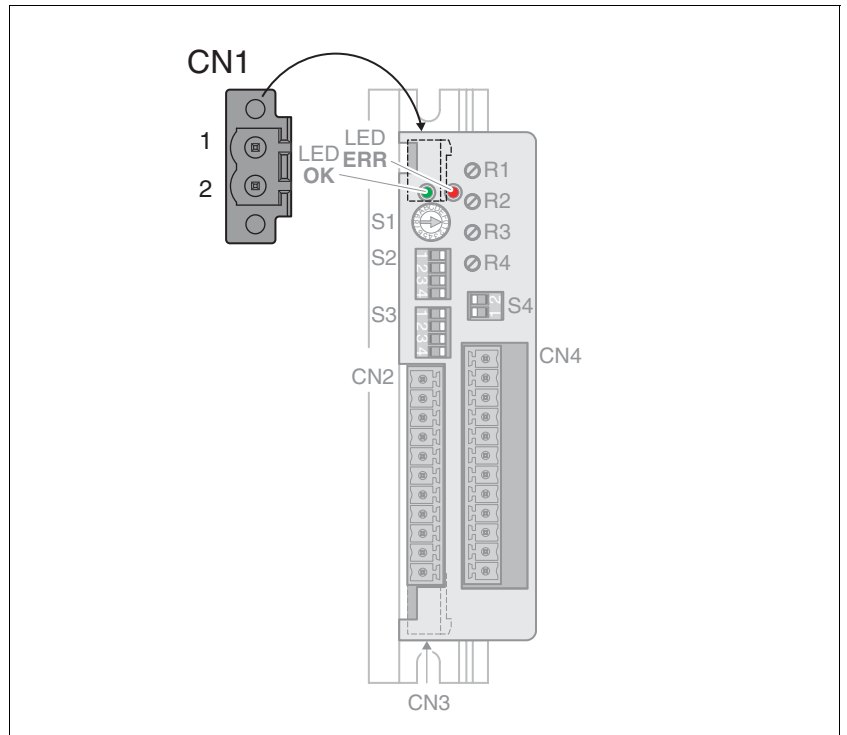


Figure 4.4 Connector CN1

Pin	Signal	Meaning
1	VDC	Power stage supply
2	0VDC	Reference potential to VDC

Reverse polarity protection
Fuse to be connected upstream

The connection CN1 is not protected against reverse polarity.
 See chapter 3.3.2 "Supply voltage VDC at CN1" for information on the fuse to be connected upstream.

Cable specifications

Shield:	Depends on EMC limit values, see chapter 3.1 "Ambient conditions".
Twisted Pair:	Not required
PELV:	Required
Minimum conductor cross section:	Use a conductor with a sufficient cross section according to the upstream fuse and the cable length.
Maximum cable length:	-

Properties of the connector The connector is available as a part of a connector kit. See chapter 9 "Accessories and spare parts".

Designation		Female header 2 pins 5.08, gold contact, black
Type		BLZF 5.08/02/180F AU BK (Weidmüller)
Maximum connection cross section	[mm ²]	2.5 (AWG 14)
Stripping length	[mm]	10

The terminals are approved for fine wire conductors and rigid conductors. Observe the maximum permissible connection cross section. Take into account the fact that wire ferrules increase the conductor cross section.

4.3.4 Connecting the signal interface (CN2)

⚠ WARNING

UNEXPECTED MOVEMENT

Incorrect or interfered signals as reference values can cause unexpected movements.

- Use shielded twisted-pair cables.
- If possible, operate the interface with push-pull signals.
- Do not use signals without push-pull in critical applications or in environments subject to interference.
- Do not use signals without push-pull in the case of cable lengths of more than 3 m and limit the frequency to 50 kHz

Failure to follow these instructions can result in death, serious injury or equipment damage.

Schematic circuit diagram inputs

The following illustration provides a schematic overview of the opto-isolated inputs, using the example of the signal input PULSE.

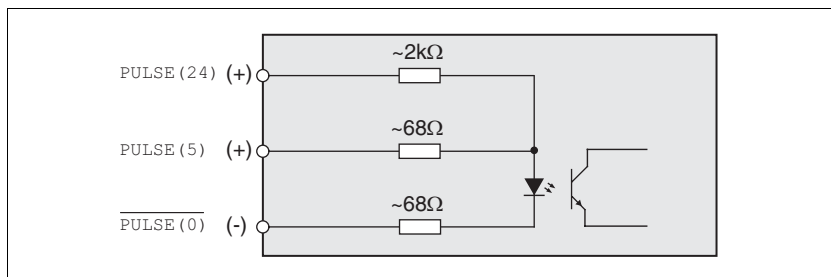


Figure 4.5 Schematic circuit diagram inputs

Schematic circuit diagram output

The following illustration provides a schematic overview of the output ACTIVE_OUT.

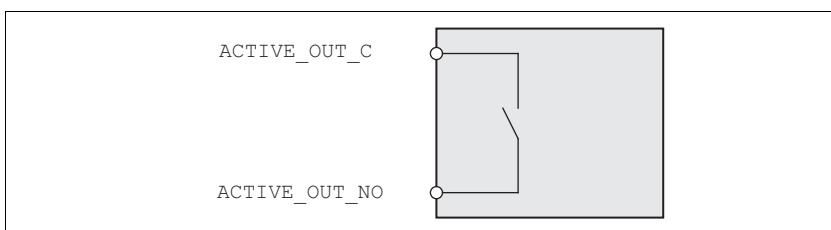


Figure 4.6 Schematic circuit diagram output

Wiring diagram CN2

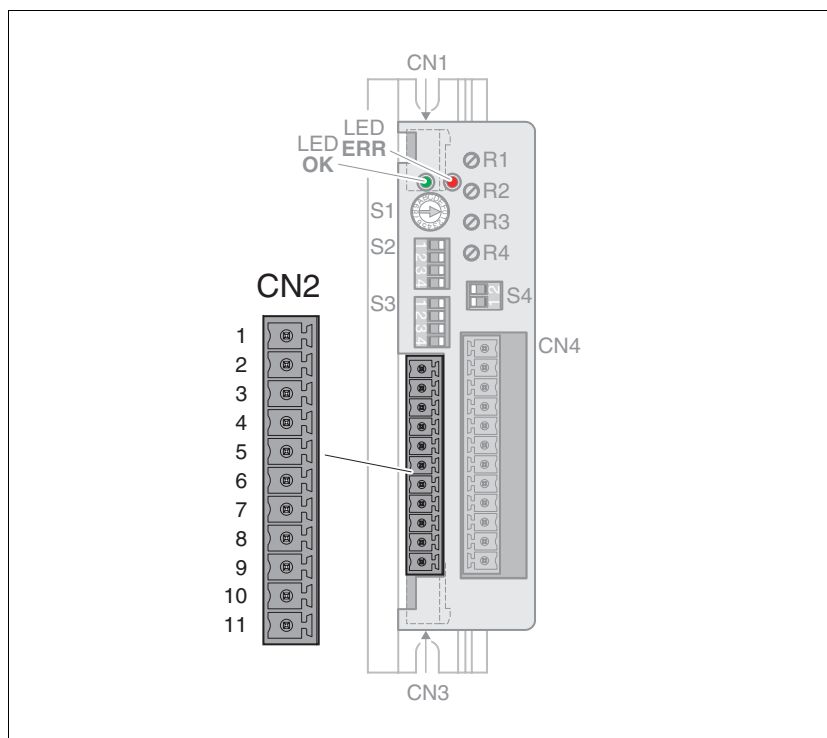


Figure 4.7 Wiring diagram signal interface CN2

Pin	Signal	Meaning	5V/24V	I/O
1	PULSE (24)	Motor step	24V	I
2	PULSE (5)	Motor step	5V	I
3	$\overline{\text{PULSE}} (0)$	Reference potential to PULSE (24) and PULSE (5)		
4	DIR (24)	Direction of movement	24V	I
5	DIR (5)	Direction of movement	5V	I
6	$\overline{\text{DIR}} (0)$	Reference potential to DIR (24) and DIR (5)		
7	ENABLE (24) or GATE (24)	Enabling the power stage or Block P/D signals	24V	I
8	ENABLE (5) or GATE (5)	Enabling the power stage or Block P/D signals	5V	I
9	$\overline{\text{ENABLE}} (0)$ or $\overline{\text{GATE}} (0)$	Reference potential to ENABLE (24) and ENABLE (5) or to GATE (24) and GATE (5)		
10	ACTIVE_OUT_C	Readiness		O
11	ACTIVE_OUT_NO	Readiness		O

The 24 V input and 5 V input per signal, for example, PULSE (24) and PULSE (5), must not be connected simultaneously.

Connecting the signal interface

- ▶ Verify that wiring and cables meet the PELV requirements.
- ▶ Connect the connector to CN2.

NOTE: The 5 V signal inputs must not be connected to 24 V_{dc}.

Cable specifications

Shield:	Required
Twisted Pair:	Required
PELV:	Required
Minimum conductor cross section:	0.2 mm ² (AWG 24)
Maximum cable length:	-

Properties of the connector

The connector is available as a part of a connector kit. See chapter 9 "Accessories and spare parts".

Designation		Spring force connector, 11 pins
Type		FK-MCP 1,5/11-ST-3,81 (Phoenix Combicon)
Maximum connection cross section with wire ferrule without plastic collar	[mm ²]	1.5 (AWG 16)
Maximum connection cross section with wire ferrule with plastic collar	[mm ²]	0.5 (AWG 22)
Stripping length	[mm]	9

The terminals are approved for fine wire conductors and rigid conductors. Observe the maximum permissible connection cross section. Take into account the fact that wire ferrules increase the conductor cross section.

4.3.5 Connecting the motor phases (CN3)

⚠ DANGER

ELECTRIC SHOCK

High voltages at the motor connection may occur unexpectedly.

- The motor generates voltage when the shaft is rotated. Prior to performing any type of work on the drive system, block the motor shaft to prevent rotation.
- AC voltage can couple voltage to unused conductors in the motor cable. Insulate both ends of unused conductors in the motor cable.
- The system integrator is responsible for compliance with all local and national electrical code requirements as well as all other applicable regulations with respect to grounding of all equipment. Supplement the motor cable grounding conductor with an additional protective ground conductor to the motor housing.

Failure to follow these instructions will result in death or serious injury.

Monitoring The motor phases are monitored for short circuits between the phases. Short circuits between a motor phase and VDC as well as short circuits between a motor phase and 0VDC are not detected.

Wiring diagram CN3

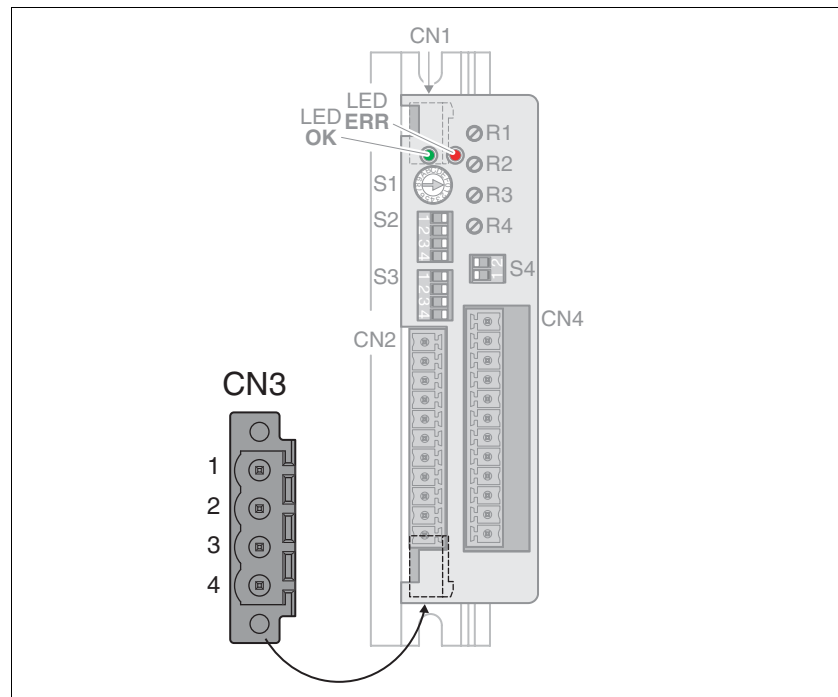


Figure 4.8 Wiring diagram motor

Connection	Meaning
1	Motor phase U
2	Motor phase V
3	Motor phase W
4	Ground

Assembling cables

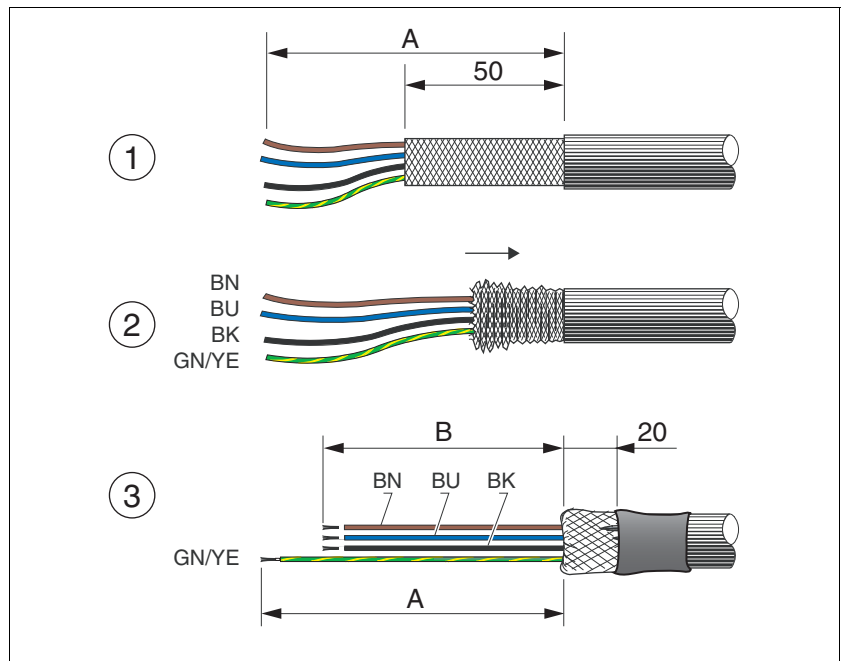


Figure 4.9 Assembling motor cables

(A) 70 mm

(B) 60 mm

Connection	Meaning	Color ¹⁾
U	Motor phase	Brown (BN)
V	Motor phase	Blue (BU)
W	Motor phase	Black (BK)
Ground	Ground	Green/yellow (GN/YE)

1) Color information relates to the cables available as accessories.

Cable specifications

Shield:	Depends on EMC limit values, see chapter 3.1 "Ambient conditions".
Twisted Pair:	Not required
PELV:	Required
Minimum conductor cross section:	0.75 mm ² . Use a conductor with a sufficient cross section according to the upstream fuse and the cable length.
Maximum cable length:	50 m

Properties of the connector The connector is available as a part of a connector kit. See chapter 9 "Accessories and spare parts".

Designation		Female header 4 pins 5.08, gold contact, black
Type		BLZF 5.08/04/180F AU BK (Weidmüller)
Maximum connection cross section	[mm ²]	2.5 (AWG 14)
Stripping length	[mm]	10

The terminals are approved for fine wire conductors and rigid conductors. Observe the maximum permissible connection cross section. Take into account the fact that wire ferrules increase the conductor cross section.

4.3.6 Connecting the signal interface (CN4)

▲ WARNING

UNEXPECTED MOVEMENT

Incorrect or interfered signals as reference values can cause unexpected movements.

- Use shielded twisted-pair cables.
- If possible, operate the interface with push-pull signals.
- Do not use signals without push-pull in critical applications or in environments subject to interference.
- Do not use signals without push-pull in the case of cable lengths of more than 3 m and limit the frequency to 50 kHz

Failure to follow these instructions can result in death, serious injury or equipment damage.

▲ WARNING

UNEXPECTED MOVEMENT

The product has inputs which act without edge changes. Depending on the wiring, the product may restart unexpectedly when the supply voltage is applied or after a power outage.

- Plan and verify the behavior of the system when the power stage supply is switched on.
- Verify that there are no hazards to persons when the system restarts after a power outage.

Failure to follow these instructions can result in death or serious injury.

Wiring diagram CN4

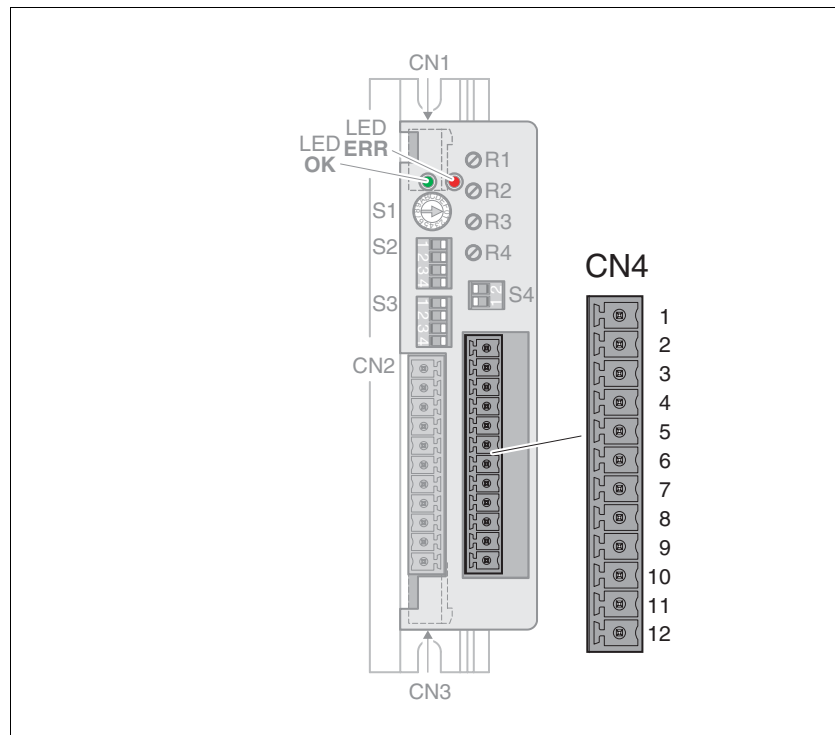


Figure 4.10 Wiring diagram signal interface CN4

Pin	Signal	Meaning	5V/24V	I/O
1	START (24)	Activates the oscillator	24V	I
2	START (5)	Activates the oscillator	5V	I
3	$\overline{\text{START}} (0)$	Reference potential to START (24) and START (5)		
4	F_HIGH (24)	Fast/slow movement	24V	I
5	F_HIGH (5)	Fast/slow movement	5V	I
6	$\overline{\text{F_HIGH}} (0)$	Reference potential to F_HIGH (24) and F_HIGH (5)		
7	PULS_OUT_NO	Output of the pulse signals		O
8	DIR_OUT_NO	Output of the direction signals		O
9	10V_OUT	10V _{dc} supply for external potentiometer		O
10	ANA_0V	Reference potential to 10V_OUT		
11	ANA1	Analog input		I
12	0V_EXT	Reference potential to PULS_OUT_NO and DIR_OUT_NO		

The 24 V input and 5 V input per signal, for example, PULSE (24) and PULSE (5), must not be connected simultaneously.

Schematic circuit diagram inputs The following illustration provides a schematic overview of the opto-isolated inputs, using the example of the signal input *START*.

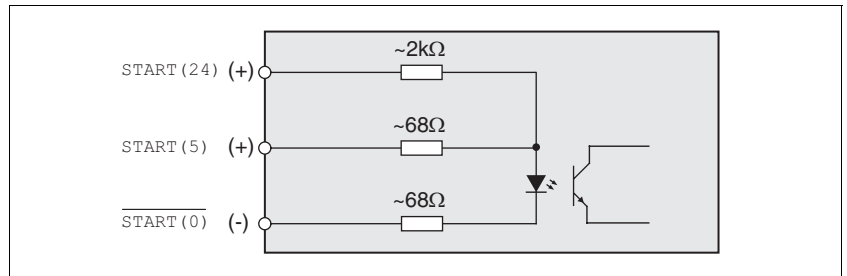


Figure 4.11 Schematic circuit diagram inputs

Schematic circuit diagram output The following illustration provides a schematic overview of the outputs *PULS_OUT_NO* and *DIR_OUT_NO*.

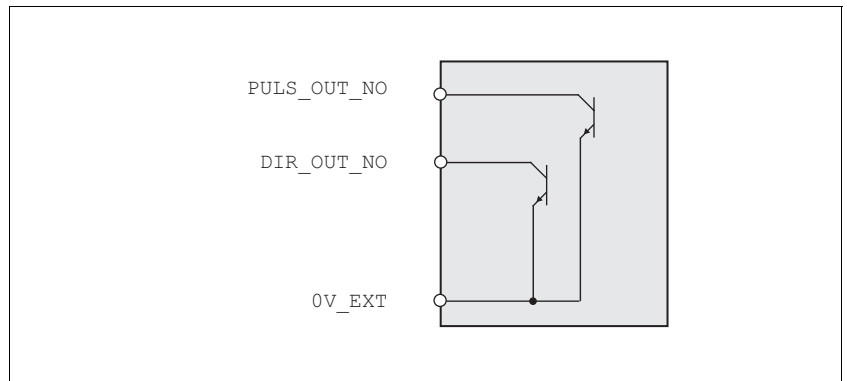


Figure 4.12 Schematic circuit diagram output

- Connecting the signal interface*
- ▶ Verify that wiring and cables meet the PELV requirements.
 - ▶ Connect the connector to CN4.

NOTE: The 5 V signal inputs must not be connected to 24 V_{dc}.

Cable specifications

Shield:	Required
Twisted Pair:	Required
PELV:	Required
Minimum conductor cross section:	0.2 mm ² (AWG 24)
Maximum cable length:	-

Properties of the connector The connector is available as a part of a connector kit. See chapter 9 "Accessories and spare parts".

Designation		Spring force connector, 12 pins
Type		FK-MCP 1,5/12-ST-3,81 (Phoenix Combicon)
Maximum connection cross section with wire ferrule without plastic collar	[mm ²]	1.5 (AWG 16)
Maximum connection cross section with wire ferrule with plastic collar	[mm ²]	0.5 (AWG 22)
Stripping length	[mm]	9

The terminals are approved for fine wire conductors and rigid conductors. Observe the maximum permissible connection cross section. Take into account the fact that wire ferrules increase the conductor cross section.

4.4 Checking installation

Verify proper installation:

- ▶ Did you properly install and connect all cables and connectors?
- ▶ Are there any live, exposed cables?
- ▶ Did you properly connect the signal wires?
- ▶ Are all fuses correct?

5 Commissioning

5

▲ WARNING

UNEXPECTED MOVEMENT

When the drive is operated for the first time, there is a risk of unexpected movements caused by possible wiring errors or unsuitable parameters.

- Run initial tests without coupled loads.
- Verify that a functioning button for emergency stop is within reach.
- Anticipate movements in the incorrect direction or oscillation of the motor.
- Only start the system if there are no persons or obstructions in the hazardous area.

Failure to follow these instructions can result in death, serious injury or equipment damage.

▲ WARNING

MOTOR WITHOUT BRAKING EFFECT

If power outage, functions or errors cause the power stage to be switched off, the motor is no longer decelerated in a controlled way and may cause damage.

- Verify the mechanical situation.
- If necessary, use a cushioned mechanical stop or a suitable holding brake.

Failure to follow these instructions can result in death, serious injury or equipment damage.

⚠ WARNING**UNINTENDED BEHAVIOR**

Unsuitable settings or unsuitable data may trigger unexpected movements, trigger signals, damage parts and disable monitoring functions.

- Do not operate the drive system with unknown settings or data.
- Verify that the stored data and settings are correct.
- When commissioning, carefully run tests for all operating states and potential error situations.
- Verify the functions after replacing the product and also after making changes to the settings or data.
- Only start the system if there are no persons or obstructions in the hazardous area.

Failure to follow these instructions can result in death, serious injury or equipment damage.

⚠ WARNING**HOT SURFACES**

The heat sink at the product may heat up to over 100°C (212°F) during operation.

- Avoid contact with the hot heat sink.
- Do not allow flammable or heat-sensitive parts in the immediate vicinity.
- Consider the measures for heat dissipation described.

Failure to follow these instructions can result in death or serious injury.

5.1 Overview



To be done

You must also re-commission an already configured product if you want to use it under changed operating conditions.

Chapter	Page
4.4 "Checking installation"	50
5.2.2 "Setting the nominal current"	54
5.2.3 "Setting the current reduction"	55
5.2.4 "Setting the Softstep function"	56
5.2.5 "Setting the number of steps"	57
5.2.6 "Setting the type of Enable"	58
5.2.7 "Setting the source for the oscillator"	58
5.2.8 "Test run of the drive"	59

5.2 Commissioning procedure

5.2.1 Overview of parameter switches

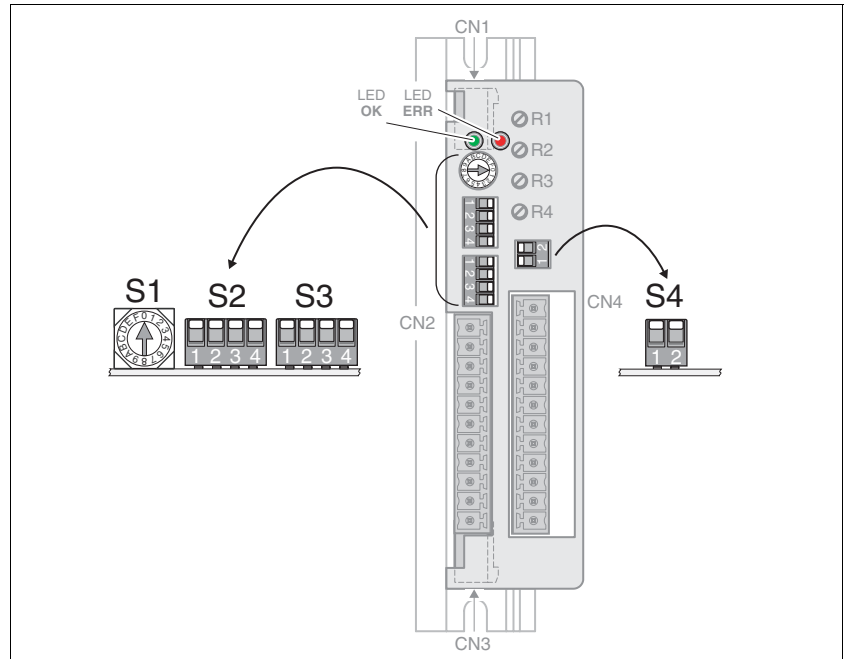


Figure 5.1 Overview of parameter switches

The settings of the parameter switches S1, S2 and S3 only become active when the power stage is enabled. Changing the settings while the power stage is enabled has no effect.

Changed settings of the parameter switch S4 become effective even while the power stage is enabled.

5.2.2 Setting the nominal current

NOTE: Setting a nominal current higher than the nominal current of the motor may damage or destroy the motor.

Parameter switch S1 allows you to set the nominal current.

- ▶ Set the nominal current of the motor by means of parameter switch S1.

NOTE: If the nominal current of the motor is >7.5 A, you must set a value of $\leq 67\%$ for the current reduction.

Switch setting S1		Nominal current of motor
0 (factory setting)	[A]	3
1	[A]	3.7
2	[A]	4.4
3	[A]	4.8
4	[A]	5.2
5	[A]	5.5
6	[A]	5.8
7	[A]	6.2
8	[A]	6.6
9	[A]	7
A	[A]	7.5
B	[A]	8
C	[A]	8.5
D	[A]	9
E	[A]	9.5
F	[A]	10

5.2.3 Setting the current reduction

If the full holding torque is not required at standstill, the "Current Reduction" function can be used to reduce the holding torque.

⚠ WARNING

FALLING LOAD AT STANDSTILL

If the current reduction is enabled, the motor torque at standstill is reduced; if external forces act on the drive (vertical axes), this may cause the load to fall.

- Verify that the load conditions allow for operation with current reduction.
- If necessary, deactivate the current reduction.

Failure to follow these instructions can result in death, serious injury or equipment damage.

Current reduction saves energy and reduces the temperature of the drive and the motor.

The motor phase current is reduced to the set value 100 ms after the last pulse edge. The set value relates to the set nominal current of the motor.

- ▶ Switch off all supply voltages. Verify that no voltages are present (safety instructions).
- ▶ Use parameter switches S2.1 to S2.3 to set the current reduction.

NOTE: If the nominal current of the motor is >7.5 A, you must set a value of $\leq 67\%$ for the current reduction.

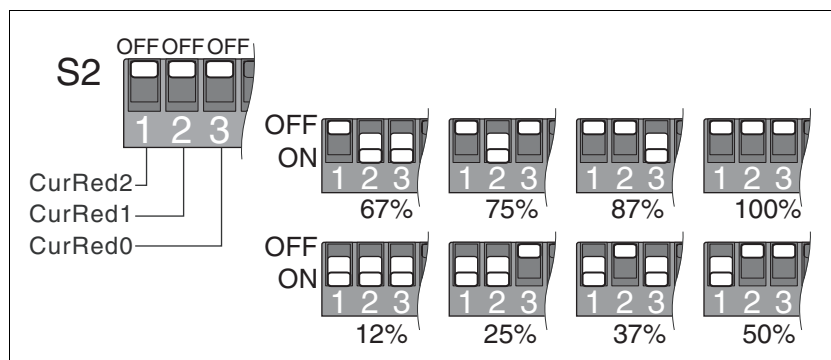


Figure 5.2 Current reduction to the set value

5.2.4 Setting the Softstep function

Parameter switch S2.4 allows you to set the "Softstep" function.

If the function is active, the signals at the P/D signals are internally smoothed. This results in smoother motor movements.

This results in a temporary position deviation during a motor movement. The magnitude of the position deviation depends on the velocity. The position deviation increases in line with the velocity and may amount to as much as one motor revolution.

You can calculate the position deviation using the following formula:

- Position deviation in degrees:
Velocity in min^{-1} / 8
- Position deviation in number of rotations:
Velocity in min^{-1} / 2880

Once the motor is at a standstill, the position deviation no longer exists.

- ▶ Switch off all supply voltages. Verify that no voltages are present (safety instructions).
- ▶ Use parameter switch S2.4 to activate or deactivate the "Softstep" function.

Switch setting S2.4	Meaning
OFF (factory setting)	Function "Softstep" deactivated
ON	"Softstep" function activated

5.2.5 Setting the number of steps

The resolution of the drive can be adjusted via the number of steps per revolution.

- ▶ Switch off all supply voltages. Verify that no voltages are present (safety instructions).
- ▶ Use parameter switches S3.1 to S3.3 to set the number of steps.

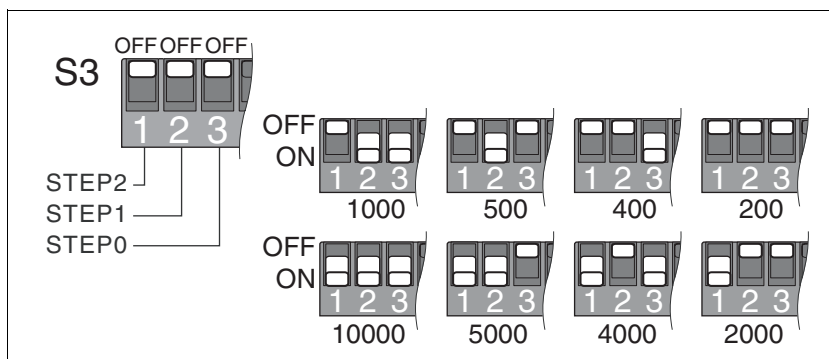


Figure 5.3 Number of steps per revolution

Examples: P/D signals

At a number of steps of 1000, the motor revolves once every 1000 P/D signals. At a frequency of 1 kHz, this corresponds to a speed of rotation of 60 min^{-1} .

The table below shows examples of various frequencies:

Number of steps	Frequency of 1 kHz	Frequency of 5 kHz	Frequency of 10 kHz
200	300 min^{-1}	150 min^{-1}	3000 min^{-1}
400	150 min^{-1}	750 min^{-1}	1500 min^{-1}
500	120 min^{-1}	600 min^{-1}	1200 min^{-1}
1000 ¹⁾	60 min^{-1}	300 min^{-1}	600 min^{-1}
2000	30 min^{-1}	150 min^{-1}	300 min^{-1}
4000	15 min^{-1}	75 min^{-1}	150 min^{-1}
5000	12 min^{-1}	60 min^{-1}	120 min^{-1}
10000	6 min^{-1}	30 min^{-1}	60 min^{-1}

1) Factory setting

5.2.6 Setting the type of Enable

Parameter switch S3.4 allows you to set the type of Enable.

See chapter 6.2 "Enabling motor movements" for a description of the function.

- ▶ Switch off all supply voltages. Verify that no voltages are present (safety instructions).
- ▶ Use parameter switch S3.4 to set the function to "ENABLE" or "GATE".

Switch setting S3.4	Meaning
OFF (factory setting)	Function "ENABLE" Enabling and disabling the power stage
ON	Function "GATE" Blocking and enabling P/D signals

5.2.7 Setting the source for the oscillator

Parameter switch S4.1 allows you to set the source for the oscillator.

See chapter 6 "Operation" for a description of the function.

- ▶ Switch off all supply voltages. Verify that no voltages are present (safety instructions).
- ▶ Use parameter switch S4.1 to set the source for the oscillator.

Switch setting S4.1	Meaning
OFF (factory setting)	Velocity, acceleration ramp and deceleration ramp are set via the integrated potentiometers. See chapter 6.3.1 "Reference values via the digital signal inputs".
ON	Velocity, acceleration ramp and deceleration ramp are set via the voltage value at the analog signal input. See chapter 6.3.2 "Reference values via the analog signal input".

5.2.8 Test run of the drive

Function test

- The type of Enable must be set to "ENABLE".
No signal may yet be available at the input `ENABLE`.
- ▶ Switch on the supply voltages.
- ▶ Check the status indication, see chapter 8.1 "Status indication via LEDs".
 - ◁ LED OK (green) flashes: Device is in the state "Disable".
 - ▶ Enable the power stage via the input `ENABLE`.
 - ◁ LED OK (green) is steady on.
Output `ACTIVE_OUT` signals readiness.
- ▶ Start the first test with a low frequency of the P/D signals. If the signal `DIR` has 0 level, the motor must perform a movement in positive direction.
- ▶ Also perform movements with reversed direction of movement. A reversal of the active edge at the signal input `PULSE` can cause displacement of the position when the direction is reversed.

The motor must follow the reference values correctly.

Temperature test

The maximum temperature of the motor must not be exceeded. The temperature of the motor is not monitored by the drive.

- ▶ Perform a test of the motor under realistic conditions.
- ▶ Check the temperature of the motor.

6 Operation

6

The chapter "Operation" describes the basic functions of the device.

6.1 Overview

⚠ WARNING

UNEXPECTED MOVEMENT

The product has inputs which act without edge changes. Depending on the wiring, the product may restart unexpectedly when the supply voltage is applied or after a power outage.

- Plan and verify the behavior of the system when the power stage supply is switched on.
- Verify that there are no hazards to persons when the system restarts after a power outage.

Failure to follow these instructions can result in death or serious injury.

Drive The drive moves the motor as per the supplied external reference values.

There are several ways of supplying the reference values:

- Reference values via the digital signal inputs
The movement is started and terminated via a digital signal input. It is possible to switch between 2 velocities via a further digital signal input.
- Reference values via the analog signal input
The movement is started and terminated via a digital signal input. The velocity is set via the analog signal input.
- Reference values via external P/D signals
A master controller generates reference values which are supplied as P/D signals (PULSE/DIR).

6.2 Enabling motor movements

The motor movement can be enabled in 2 different ways.

- Enabling the power stage
- Block P/D signals

The setting for the input `ENABLE` is specified during commissioning, see chapter 5.2.6 "Setting the type of Enable".

6.2.1 Enabling the power stage

The power stage is enabled and disabled via the input `ENABLE`.

An error message is also reset when the power stage is disabled.

signal state	Meaning
0 level	Disable power stage and reset error message
1 level	Enabling the power stage

If there is no error, the output `ACTIVE_OUT` signals ready for operation approximately 500 ms after the power stage is enabled.

6.2.2 Block P/D signals

P/D signals are enabled and blocked via the input `GATE`. Individual axes can be selected this way in a multi-axis system.

signal state	Meaning
0 level	Enable P/D signals
1 level	Block P/D signals

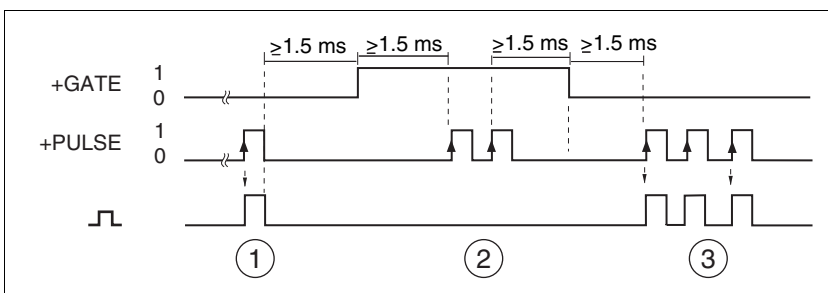


Figure 6.1 Signal sequences in case of activation via `GATE`

- (1) Motor step
- (2) No motor steps
- (3) Motor steps

No pulse may be applied for a period of 1.5 ms before and after the `GATE` signal changes so that the drive can correctly process the pulse.

6.3 Performing motor movements

6.3.1 Reference values via the digital signal inputs

The movement is started and terminated via the digital signal input START.

signal state	Meaning
0 level	Terminate movement
1 level	Starting a movement

The digital signal input F_HIGH allows you to switch between the two adjustable velocities.

signal state	Meaning
0 level	Slow velocity
1 level	Fast velocity

NOTE: If the reference value is supplied via the analog signal input, reference values may neither be supplied via the digital signal inputs nor as external reference values.

Setting velocities

The potentiometer f_high allows you to set the value for the fast velocity. The potentiometer f_low allows you to set the value for the slow velocity.

The adjustable velocity depends on the number of steps.

Number of steps		Adjustable velocity
200	[min ⁻¹]	0 ... 60000
400	[min ⁻¹]	0 ... 30000
500	[min ⁻¹]	0 ... 24000
1000 ¹⁾	[min ⁻¹]	0 ... 12000
2000	[min ⁻¹]	0 ... 6000
4000	[min ⁻¹]	0 ... 3000
5000	[min ⁻¹]	0 ... 2400
10000	[min ⁻¹]	0 ... 1200

1) Factory setting

NOTE: The velocity range is a theoretical value. The actually possible velocity depends on the motor used.

Setting acceleration and deceleration

The potentiometer ACC allows you to set the value for the acceleration ramp. The potentiometer DEC allows you to set the value for the deceleration ramp.

Direction of rotation of the potentiometer	Meaning
Clockwise	Higher value
Counter-clockwise	Lower value

6.3.2 Reference values via the analog signal input

The movement is started and terminated via the digital signal input *START*.

Signal state	Meaning
0 level	Terminate movement
1 level	Starting a movement

The use of the analog signal input is determined during commissioning, see chapter 5.2.7 "Setting the source for the oscillator".

NOTE: If the reference values are supplied via the analog signal input, reference values may neither be supplied via the digital signal inputs nor as external reference values.

Velocity The velocity is set via the voltage value at the analog signal input.

The velocity for the voltage range from 0 ... 10 V depends on the number of steps:

Number of steps		Velocity
200	[min ⁻¹]	0 ... 60000
400	[min ⁻¹]	0 ... 30000
500	[min ⁻¹]	0 ... 24000
1000 ¹⁾	[min ⁻¹]	0 ... 12000
2000	[min ⁻¹]	0 ... 6000
4000	[min ⁻¹]	0 ... 3000
5000	[min ⁻¹]	0 ... 2400
10000	[min ⁻¹]	0 ... 1200

1) Factory setting

NOTE: The velocity range is a theoretical value. The actually possible velocity depends on the motor used.

Signal output 10V_OUT The signal output *10V_OUT* provides a voltage so that you can, for example, use an external potentiometer without an additional voltage source.

6.3.3 Reference values via external P/D signals

The motor performs a motor step when the edge of the signal `PULSE` rises. The direction of movement is controlled with the `DIR` signal.

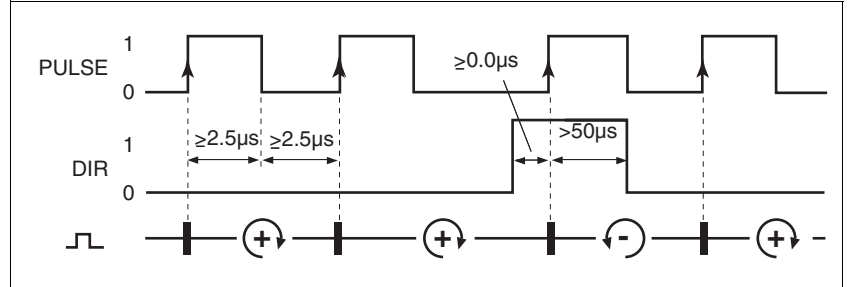


Figure 6.2 P/D signals

Signal	signal state	Meaning
PULSE	Rising edge	Motor step
DIR	0 level 1 level	Positive direction of movement Negative direction of movement

The maximum frequency is 200 kHz.

NOTE: If the reference values are supplied as external P/D signals, no reference values may be supplied via the digital signal inputs or the analog signal input.

6.4 Signal outputs

6.4.1 Readiness

The output `ACTIVE_OUT` signals operational readiness.

signal state	Meaning
Open	Power stage disabled, motor without current
Closed	Power stage enabled, current is applied to the motor

6.4.2 Pulse signal and direction of movement

The outputs `PULS_OUT_NO` and `DIR_OUT_NO` output the externally supplied P/D signals or the P/D signals generated internally.

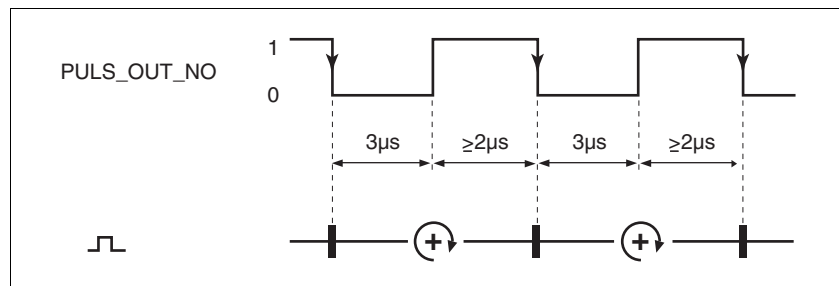


Figure 6.3 Pulse signal

Signal	signal state	Meaning
<code>PULS_OUT_NO</code>	Falling edge	Motor step
<code>DIR_OUT_NO</code>	1 level	Positive direction of movement
	0 level	Negative direction of movement

6.5 Monitoring functions

The monitoring functions in the product can help to guard the system and reduce the risks involved in a system misoperation. These monitoring functions may not be used to protect persons.

The following monitoring functions are available:

Overtemperature If the maximum permissible temperature ($>90^{\circ}\text{C}$) of the power stage is exceeded, the power stage is disabled. The error is signaled by the LED ERR (red).

After you have fixed the cause of the error, reset the error message with a 0 level at the signal input *ENABLE*.

The motor temperature is not monitored.

Overvoltage If an upper voltage limit (60 V_{dc}) is exceeded, the power stage is disabled. The error is signaled by the LED ERR (red).

After you have fixed the cause of the error, reset the error message with a falling edge at the signal input *ENABLE*.

Undervoltage If the voltage drops below a lower voltage limit ($<18\text{ V}_{\text{dc}}$), the power stage is disabled. The error is signaled by the LED ERR (red) if sufficient voltage is still available.

After you have fixed the cause of the error, reset the error message with a falling edge at the signal input *ENABLE*.

Short circuit When the power stage is enabled, the device monitors the motor phases for short circuit between the motor phases. In the case of a short circuit, the power stage is disabled and the motor coasts down in an uncontrolled way. The error is signaled by the LED ERR (red).

After you have fixed the cause of the error, reset the error message with a falling edge at the signal input *ENABLE*.

Ground faults are not detected.

7 Examples



7.1 Wiring examples

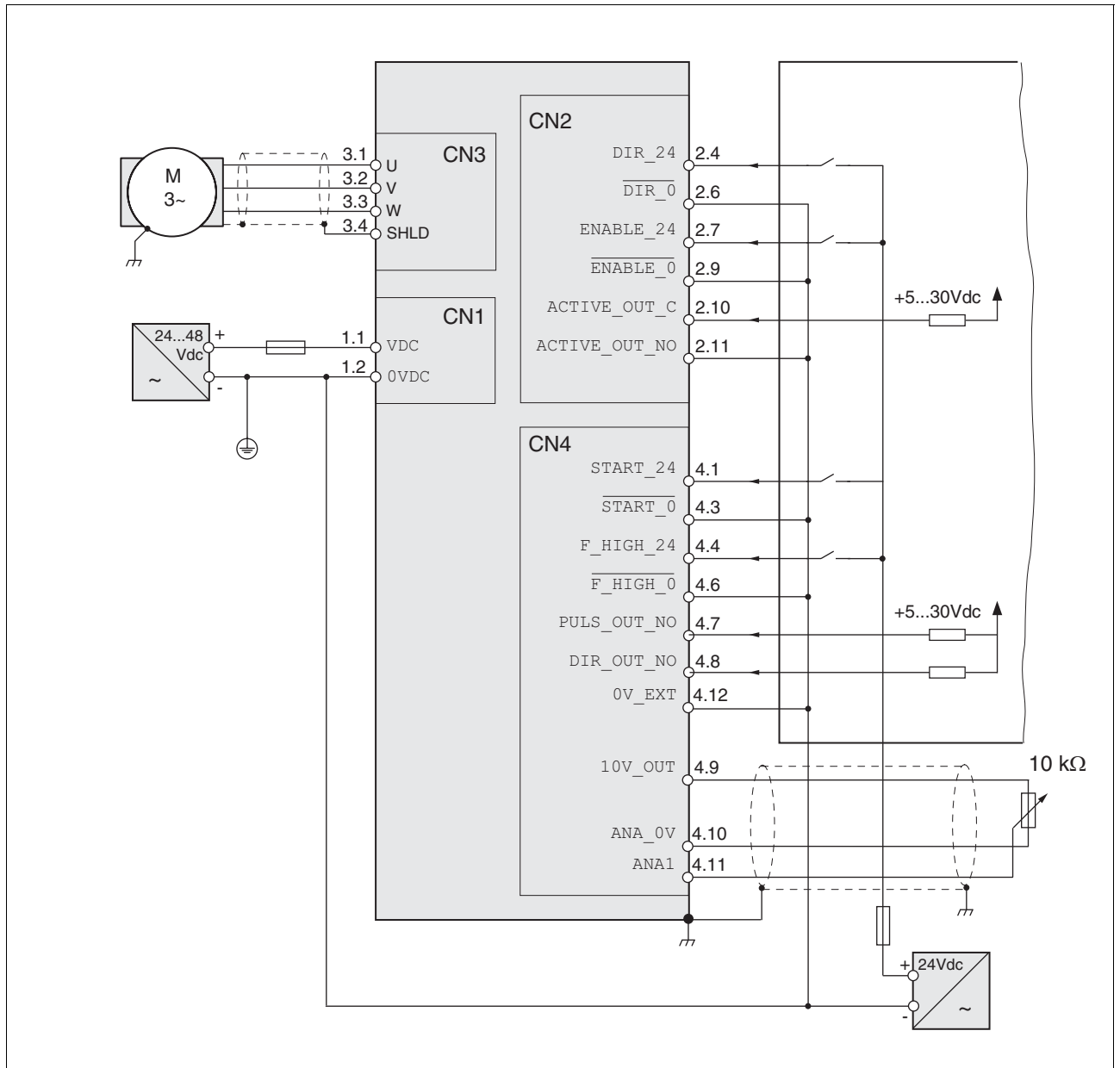


Figure 7.1 Wiring example with 24 V signal inputs

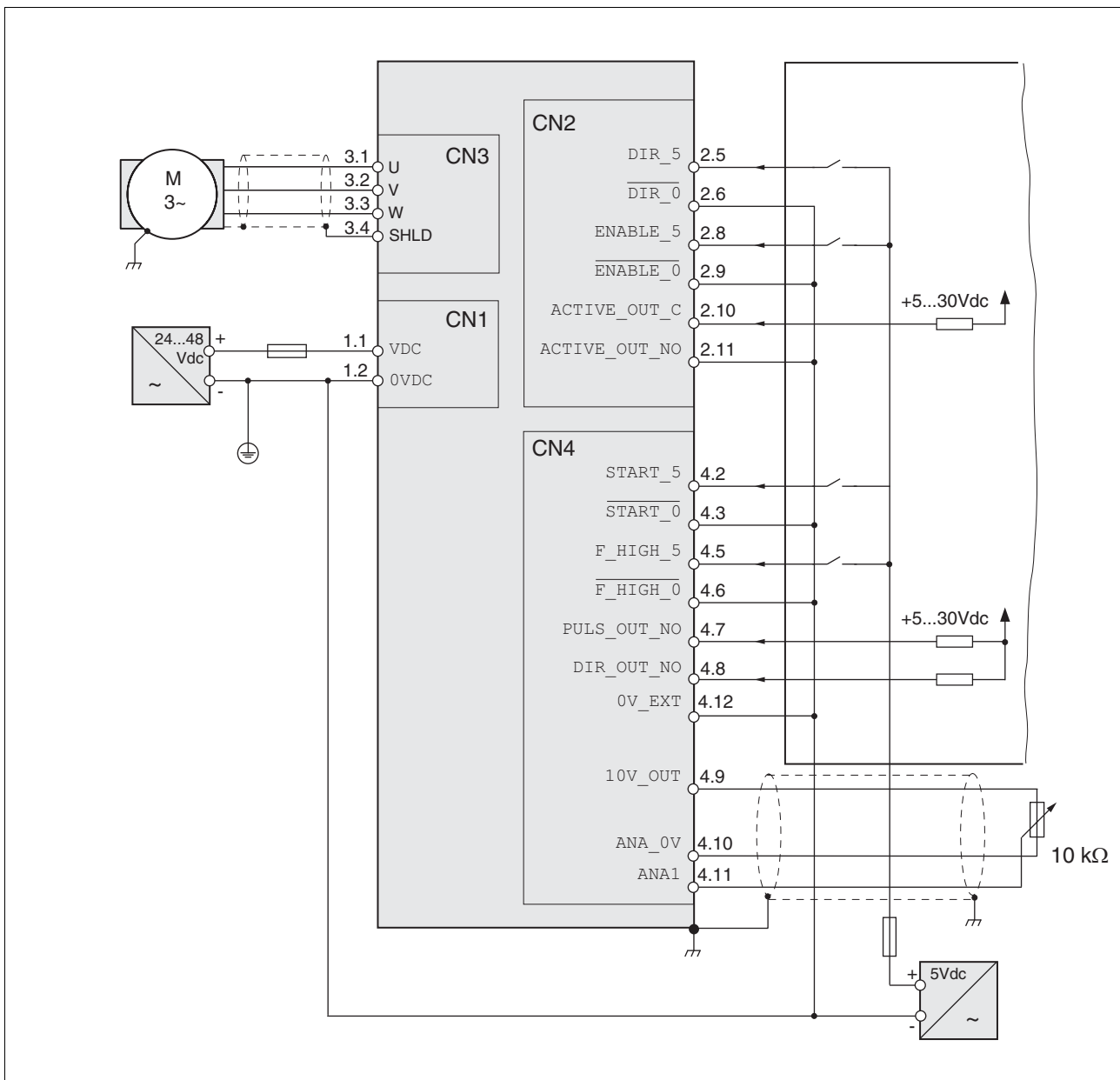


Figure 7.2 Wiring example with 5 V signal inputs

8 Diagnostics and troubleshooting

8

8.1 Status indication via LEDs

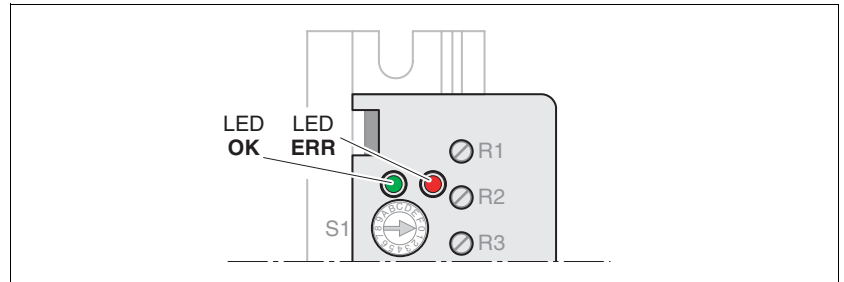


Figure 8.1 Status indication via LEDs

The current operating state is indicated by means of the two LEDs.

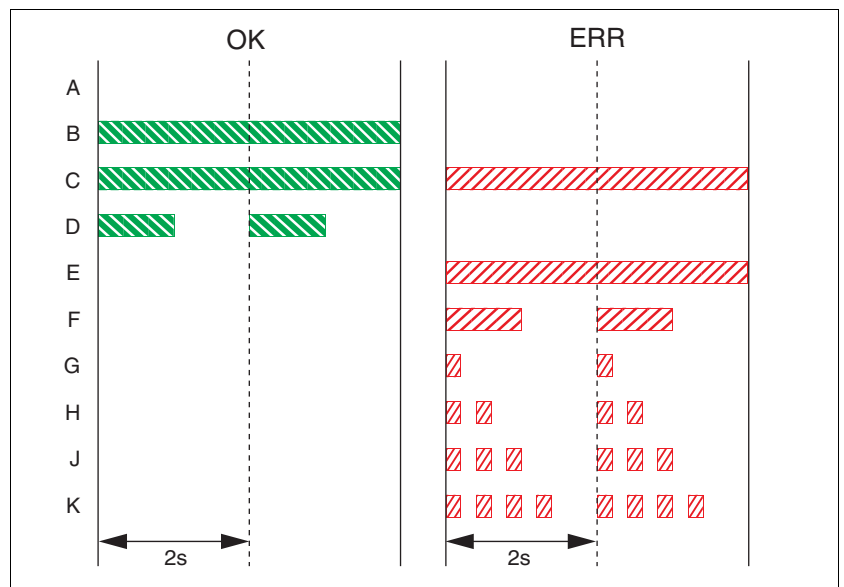


Figure 8.2 Flash codes of LED OK (green) and LED ERR (red)

- (A) No power stage supply
- (B) Power stage is enabled
- (C) Reserved
- (D) Power stage is disabled
- (E) Reserved
- (F) Power stage overtemperature
- (G) Overvoltage, also in case of regeneration conditions
- (H) Undervoltage
- (J) Frequency of the external reference values too high
- (K) Short circuit between two motor phases

8.2 Troubleshooting

Error	Cause	Troubleshooting
Motor does not rotate and has no holding torque.	Motor phase interrupted	Check motor cable and connection. One or more motor phases are not connected.
	Signal input <code>ENABLE</code> is inactive.	Enable the power stage
Motor does not rotate, but has holding torque	Motor mechanically blocked.	Check coupled components.
	Holding brake applied.	Check the holding brake controller
Motor rotates irregularly.	Overload.	Reduce load.
	Motor damaged.	Replace motor.
Motor rotates in the wrong direction.	Motor phases are inverted.	Check motor phases.
	Signal input <code>DIR</code> has incorrect level.	Check signal input.
LED flash code A	No power stage supply.	Check power stage supply.
LED flash code E	Reserved.	Reserved.
LED flash code F	Power stage overtemperature ($>90\text{ }^{\circ}\text{C}$).	Check the temperature in the control cabinet. Check the motor phase current.
LED flash code G	Overvoltage ($>60\text{ V}_{\text{dc}}$), also in case of regeneration conditions.	If necessary, use a braking resistor controller (such as UBC60). Error message must be reset.
LED flash code E	Undervoltage ($<18\text{ V}_{\text{dc}}$).	Check power supply. Error message must be reset.
LED flash code J	Frequency of the external reference values too high.	Check the frequency.
LED flash code A	Short circuit between two motor phases	Check connections. Error message must be reset.

Resetting an error message After you have fixed the cause of the error, reset the error message with a falling edge at the signal input `ENABLE`.

9 Accessories and spare parts

9

9.1 Optional accessories

Description	Order no.
Adapter for DIN rail mounting	MNA3MFDINR1
EMC kit	MNA3CS013
Connector kit 2-pin, 4-pin, 11-pin, 12-pin spring terminals	MNA3CS009
Motor cable for stepper motor 4 x 1.5 shielded, motor end with 6-pin circular connector; other cable end open; length 3 m	VW3S5101R30
Motor cable for stepper motor 4 x 1.5 shielded, motor end with 6-pin circular connector; other cable end open; length 5 m	VW3S5101R50
Motor cable for stepper motor 4 x 1.5 shielded, motor end with 6-pin circular connector; other cable end open; length 10 m	VW3S5101R100
Motor cable for stepper motor 4 x 1.5 shielded, motor end with 6-pin circular connector; other cable end open; length 15 m	VW3S5101R150
Motor cable for stepper motor 4 x 1.5 shielded, motor end with 6-pin circular connector; other cable end open; length 20 m	VW3S5101R200
Motor cable for stepper motor 4 x 1.5 shielded, both cable ends open; length 3 m	VW3S5102R30
Motor cable for stepper motor 4 x 1.5 shielded, both cable ends open; length 5 m	VW3S5102R50
Motor cable for stepper motor 4 x 1.5 shielded, both cable ends open; length 10 m	VW3S5102R100
Motor cable for stepper motor 4 x 1.5 shielded, both cable ends open; length 15 m	VW3S5102R150
Motor cable for stepper motor 4 x 1.5 shielded, both cable ends open; length 20 m	VW3S5102R200
Holding brake controller HBC	VW3M3103

Connector kit The connectors listed can be purchased as connector kits.

	Designation	Type
Power stage supply (CN1)	Female header 2 pins 5.08, gold contact, black	BLZF 5.08/02/180F AU BK (Weidmüller)
Signal interface (CN2)	Spring force connector, 11-pin	FK-MCP 1,5/11-ST-3,81 (Phoenix Combicon)
Motor (CN3)	Female header 4 pins 5.08, gold contact, black	BLZF 5.08/04/180F AU BK (Weidmüller)
Signal interface (CN4)	Spring force connector, 12-pin	FK-MCP 1,5/12-ST-3,81 (Phoenix Combicon)

10 Service, maintenance and disposal

10



The product may only be repaired by a Schneider Electric customer service center. No warranty or liability is accepted for repairs made by unauthorized persons.

10.1 Service address

If you cannot resolve an error yourself please contact your sales office. Have the following details available:

- Nameplate (type, identification number, serial number, DOM, ...)
- Type of error (with LED flash code or error number)
- Previous and concomitant circumstances
- Your own assumptions concerning the cause of the error

Also include this information if you return the product for inspection or repair.



If you have any questions please contact your sales office. Your sales office staff will be happy to give you the name of a customer service office in your area.

<http://www.schneider-electric.com>

10.2 Maintenance

Check the product for pollution or damage at regular intervals.

10.3 Replacing devices

▲ WARNING
<p>UNINTENDED BEHAVIOR</p> <p>Unsuitable settings or unsuitable data may trigger unexpected movements, trigger signals, damage parts and disable monitoring functions.</p> <ul style="list-style-type: none"> • Do not operate the drive system with unknown settings or data. • Verify that the stored data and settings are correct. • When commissioning, carefully run tests for all operating states and potential error situations. • Verify the functions after replacing the product and also after making changes to the settings or data. • Only start the system if there are no persons or obstructions in the hazardous area. <p>Failure to follow these instructions can result in death, serious injury or equipment damage.</p>

- ▶ Switch off all supply voltages. Verify that no voltages are present (safety instructions).
- ▶ Label all connections and uninstall the product.
- ▶ Note the identification number and the serial number shown on the product nameplate for later identification.
- ▶ Install the new product as per chapter 4 "Installation".
- ▶ Commission the product as per chapter 5 "Commissioning".

10.4 Shipping, storage, disposal

Note the ambient conditions in chapter 3.1 "Ambient conditions".

- Shipping* The product must be protected against shocks during transportation. If possible, use the original packaging for shipping.
- Storage* The product may only be stored in spaces where the specified permissible ambient conditions are met.
Protect the product from dust and dirt.
- Disposal* The product consists of various materials that can be recycled. Dispose of the product in accordance with local regulations.

11 Extract



⚠ DANGER

UNEXPECTED HAZARDS

This chapter Extract does not replace the product manual. Unexpected hazards occur during installation, commissioning and maintenance.

- You may only perform install, commission and maintain the product if you are a qualified and trained technician.
- Carefully read and understand the entire product manual.

Failure to follow these instructions will result in death or serious injury.

11.1 Extract for installation

Wiring diagram CN1

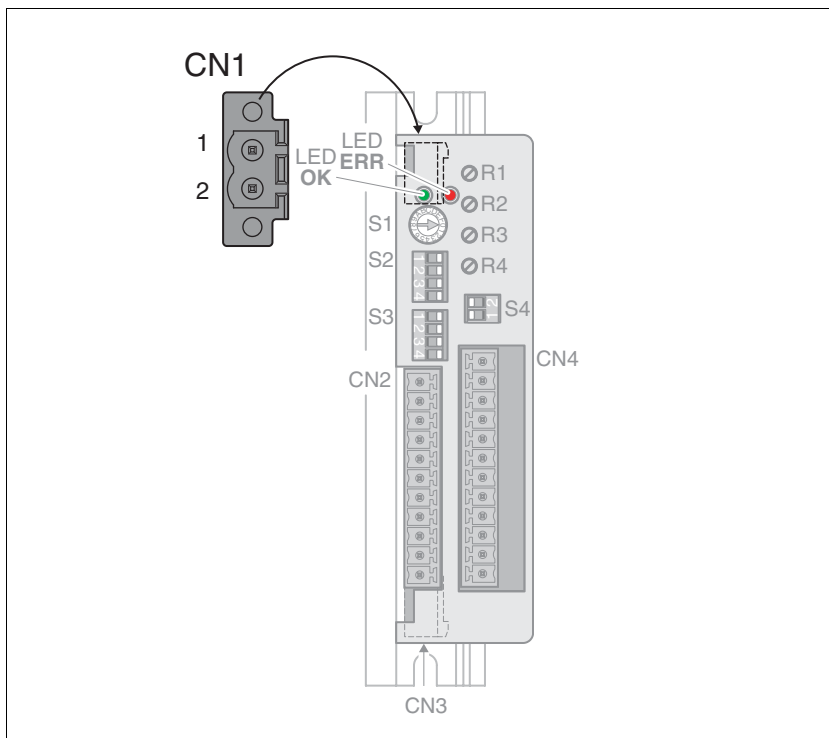


Figure 11.1 Connector CN1

Pin	Signal	Meaning
1	VDC	Power stage supply
2	0VDC	Reference potential to VDC

Wiring diagram CN2

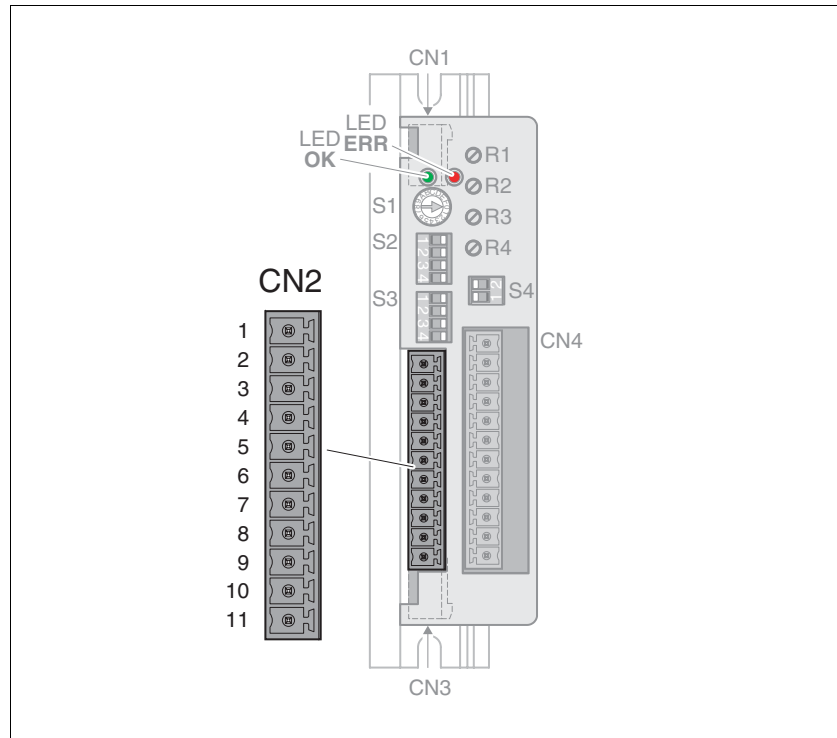


Figure 11.2 Wiring diagram signal interface CN2

Pin	Signal	Meaning	5V/24V	I/O
1	PULSE (24)	Motor step	24V	I
2	PULSE (5)	Motor step	5V	I
3	$\overline{\text{PULSE}} (0)$	Reference potential to PULSE (24) and PULSE (5)		
4	DIR (24)	Direction of movement	24V	I
5	DIR (5)	Direction of movement	5V	I
6	$\overline{\text{DIR}} (0)$	Reference potential to DIR (24) and DIR (5)		
7	ENABLE (24) or GATE (24)	Enabling the power stage or Block P/D signals	24V	I
8	ENABLE (5) or GATE (5)	Enabling the power stage or Block P/D signals	5V	I
9	$\overline{\text{ENABLE}} (0)$ or $\overline{\text{GATE}} (0)$	Reference potential to ENABLE (24) and ENABLE (5) or to GATE (24) and GATE (5)		
10	ACTIVE_OUT_C	Readiness		O
11	ACTIVE_OUT_NO	Readiness		O

The 24 V input and 5 V input per signal, for example, PULSE (24) and PULSE (5) , must not be connected simultaneously.

Wiring diagram CN3

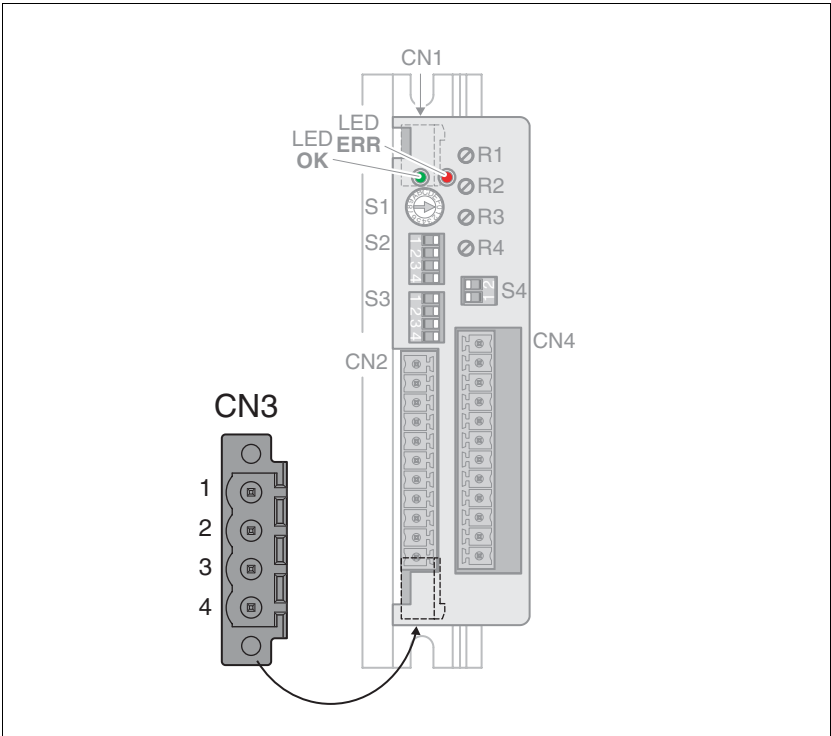


Figure 11.3 Wiring diagram motor

Connection	Meaning
1	Motor phase U
2	Motor phase V
3	Motor phase W
4	Ground

Wiring diagram CN4

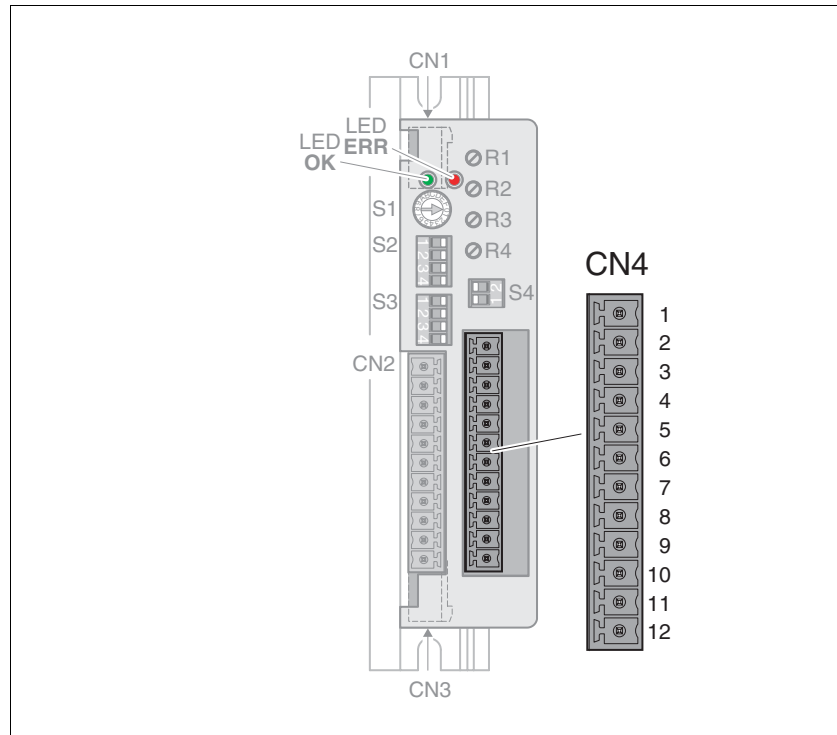


Figure 11.4 Wiring diagram signal interface CN4

Pin	Signal	Meaning	5V/24V	I/O
1	START (24)	Activates the oscillator	24V	I
2	START (5)	Activates the oscillator	5V	I
3	$\overline{\text{START}} (0)$	Reference potential to START (24) and START (5)		
4	F_HIGH (24)	Fast/slow movement	24V	I
5	F_HIGH (5)	Fast/slow movement	5V	I
6	$\overline{\text{F_HIGH}} (0)$	Reference potential to F_HIGH (24) and F_HIGH (5)		
7	PULS_OUT_NO	Output of the pulse signals		O
8	DIR_OUT_NO	Output of the direction signals		O
9	10V_OUT	10V _{dc} supply for external potentiometer		O
10	ANA_0V	Reference potential to 10V_OUT		
11	ANA1	Analog input		I
12	0V_EXT	Reference potential to PULS_OUT_NO and DIR_OUT_NO		

The 24 V input and 5 V input per signal, for example, PULSE (24) and PULSE (5), must not be connected simultaneously.

11.2 Extract for commissioning

11.2.1 Setting the nominal current

NOTE: Setting a nominal current higher than the nominal current of the motor may damage or destroy the motor.

Parameter switch S1 allows you to set the nominal current.

- ▶ Set the nominal current of the motor by means of parameter switch S1.

NOTE: If the nominal current of the motor is >7.5 A, you must set a value of $\leq 67\%$ for the current reduction.

Switch setting S1		Nominal current of motor
0 (factory setting)	[A]	3
1	[A]	3.7
2	[A]	4.4
3	[A]	4.8
4	[A]	5.2
5	[A]	5.5
6	[A]	5.8
7	[A]	6.2
8	[A]	6.6
9	[A]	7
A	[A]	7.5
B	[A]	8
C	[A]	8.5
D	[A]	9
E	[A]	9.5
F	[A]	10

11.2.2 Setting the current reduction

If the full holding torque is not required at standstill, the "Current Reduction" function can be used to reduce the holding torque.

▲ WARNING

FALLING LOAD AT STANDSTILL

If the current reduction is enabled, the motor torque at standstill is reduced; if external forces act on the drive (vertical axes), this may cause the load to fall.

- Verify that the load conditions allow for operation with current reduction.
- If necessary, deactivate the current reduction.

Failure to follow these instructions can result in death, serious injury or equipment damage.

Current reduction saves energy and reduces the temperature of the drive and the motor.

The motor phase current is reduced to the set value 100 ms after the last pulse edge. The set value relates to the set nominal current of the motor.

- ▶ Switch off all supply voltages. Verify that no voltages are present (safety instructions).
- ▶ Use parameters switches S2.1 to S2.3 to set the current reduction.

NOTE: If the nominal current of the motor is >7.5 A, you must set a value of ≤67 % for the current reduction.

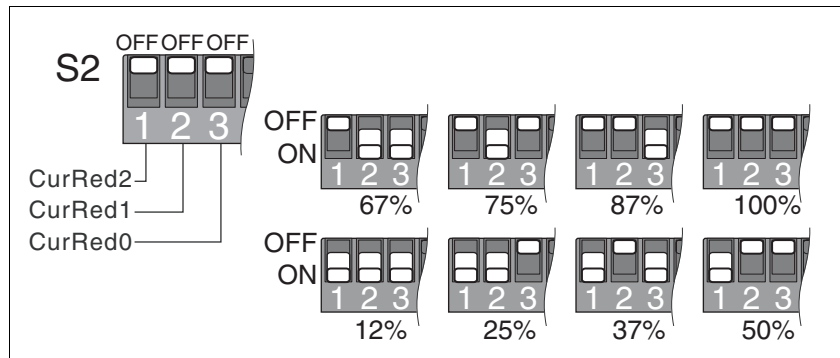


Figure 11.5 Current reduction to the set value

11.2.3 Setting the Softstep function

Parameter switch S2.4 allows you to set the "Softstep" function.

If the function is active, the signals at the P/D signals are internally smoothed. This results in smoother motor movements.

This results in a temporary position deviation during a motor movement. The magnitude of the position deviation depends on the velocity. The position deviation increases in line with the velocity and may amount to as much as one motor revolution.

You can calculate the position deviation using the following formula:

- Position deviation in degrees:
Velocity in min^{-1} / 8
- Position deviation in number of rotations:
Velocity in min^{-1} / 2880

Once the motor is at a standstill, the position deviation no longer exists.

- ▶ Switch off all supply voltages. Verify that no voltages are present (safety instructions).
- ▶ Use parameter switch S2.4 to activate or deactivate the "Softstep" function.

Switch setting S2.4	Meaning
OFF (factory setting)	Function "Softstep" deactivated
ON	"Softstep" function activated

11.2.4 Setting the number of steps

The resolution of the drive can be adjusted via the number of steps per revolution.

- ▶ Switch off all supply voltages. Verify that no voltages are present (safety instructions).
- ▶ Use parameter switches S3.1 to S3.3 to set the number of steps.

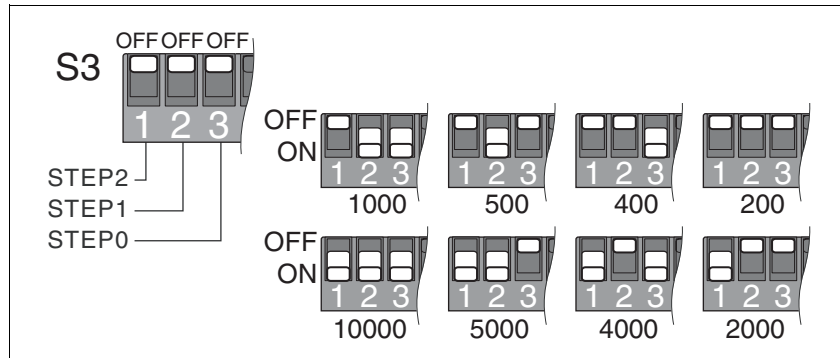


Figure 11.6 Number of steps per revolution

Examples: P/D signals

At a number of steps of 1000, the motor revolves once every 1000 P/D signals. At a frequency of 1 kHz, this corresponds to a speed of rotation of 60 min⁻¹.

The table below shows examples of various frequencies:

Number of steps	Frequency of 1 kHz	Frequency of 5 kHz	Frequency of 10 kHz
200	300 min ⁻¹	150 min ⁻¹	3000 min ⁻¹
400	150 min ⁻¹	750 min ⁻¹	1500 min ⁻¹
500	120 min ⁻¹	600 min ⁻¹	1200 min ⁻¹
1000 ¹⁾	60 min ⁻¹	300 min ⁻¹	600 min ⁻¹
2000	30 min ⁻¹	150 min ⁻¹	300 min ⁻¹
4000	15 min ⁻¹	75 min ⁻¹	150 min ⁻¹
5000	12 min ⁻¹	60 min ⁻¹	120 min ⁻¹
10000	6 min ⁻¹	30 min ⁻¹	60 min ⁻¹

1) Factory setting

11.2.5 Setting the type of Enable

Parameter switch S3.4 allows you to set the type of Enable.

See chapter 6.2 "Enabling motor movements" for a description of the function.

- ▶ Switch off all supply voltages. Verify that no voltages are present (safety instructions).
- ▶ Use parameter switch S3.4 to set the function to "ENABLE" or "GATE".

Switch setting S3.4	Meaning
OFF (factory setting)	Function "ENABLE" Enabling and disabling the power stage
ON	Function "GATE" Blocking and enabling P/D signals

11.2.6 Setting the source for the oscillator

Parameter switch S4.1 allows you to set the source for the oscillator.

See chapter 6 "Operation" for a description of the function.

- ▶ Switch off all supply voltages. Verify that no voltages are present (safety instructions).
- ▶ Use parameter switch S4.1 to set the source for the oscillator.

Switch setting S4.1	Meaning
OFF (factory setting)	Velocity, acceleration ramp and deceleration ramp are set via the integrated potentiometers. See chapter 6.3.1 "Reference values via the digital signal inputs".
ON	Velocity, acceleration ramp and deceleration ramp are set via the voltage value at the analog signal input. See chapter 6.3.2 "Reference values via the analog signal input".

12 Glossary

12

12.1 Units and conversion tables

The value in the specified unit (left column) is calculated for the desired unit (top row) with the formula (in the field).

Example: conversion of 5 meters [m] to yards [yd]
 $5 \text{ m} / 0.9144 = 5.468 \text{ yd}$

12.1.1 Length

	in	ft	yd	m	cm	mm
in	-	/ 12	/ 36	* 0.0254	* 2.54	* 25.4
ft	* 12	-	/ 3	* 0.30479	* 30.479	* 304.79
yd	* 36	* 3	-	* 0.9144	* 91.44	* 914.4
m	/ 0.0254	/ 0.30479	/ 0.9144	-	* 100	* 1000
cm	/ 2.54	/ 30.479	/ 91.44	/ 100	-	* 10
mm	/ 25.4	/ 304.79	/ 914.4	/ 1000	/ 10	-

12.1.2 Mass

	lb	oz	slug	kg	g
lb	-	* 16	* 0.03108095	* 0.4535924	* 453.5924
oz	/ 16	-	* $1.942559 \cdot 10^{-3}$	* 0.02834952	* 28.34952
slug	/ 0.03108095	/ $1.942559 \cdot 10^{-3}$	-	* 14.5939	* 14593.9
kg	/ 0.45359237	/ 0.02834952	/ 14.5939	-	* 1000
g	/ 453.59237	/ 28.34952	/ 14593.9	/ 1000	-

12.1.3 Force

	lb	oz	p	dyne	N
lb	-	* 16	* 453.55358	* 444822.2	* 4.448222
oz	/ 16	-	* 28.349524	* 27801	* 0.27801
p	/ 453.55358	/ 28.349524	-	* 980.7	* $9.807 \cdot 10^{-3}$
dyne	/ 444822.2	/ 27801	/ 980.7	-	/ $100 \cdot 10^3$
N	/ 4.448222	/ 0.27801	/ $9.807 \cdot 10^{-3}$	* $100 \cdot 10^3$	-

12.1.4 Power

	HP	W
HP	-	* 746
W	/ 746	-

12.1.5 Rotation

	min ⁻¹ (RPM)	rad/s	deg./s
min ⁻¹ (RPM)	-	* $\pi / 30$	* 6
rad/s	* $30 / \pi$	-	* 57.295
deg./s	/ 6	/ 57.295	-

12.1.6 Torque

	lb-in	lb-ft	oz-in	Nm	kp-m	kp-cm	dyne-cm
lb-in	-	/ 12	* 16	* 0.112985	* 0.011521	* 1.1521	* 1.129×10^6
lb-ft	* 12	-	* 192	* 1.355822	* 0.138255	* 13.8255	* 13.558×10^6
oz-in	/ 16	/ 192	-	* 7.0616×10^{-3}	* 720.07×10^{-6}	* 72.007×10^{-3}	* 70615.5
Nm	/ 0.112985	/ 1.355822	/ 7.0616×10^{-3}	-	* 0.101972	* 10.1972	* 10×10^6
kp-m	/ 0.011521	/ 0.138255	/ 720.07×10^{-6}	/ 0.101972	-	* 100	* 98.066×10^6
kp-cm	/ 1.1521	/ 13.8255	/ 72.007×10^{-3}	/ 10.1972	/ 100	-	* 0.9806×10^6
dyne-cm	/ 1.129×10^6	/ 13.558×10^6	/ 70615.5	/ 10×10^6	/ 98.066×10^6	/ 0.9806×10^6	-

12.1.7 Moment of inertia

	lb-in ²	lb-ft ²	kg-m ²	kg-cm ²	kp-cm-s ²	oz-in ²
lb-in ²	-	/ 144	/ 3417.16	/ 0.341716	/ 335.109	* 16
lb-ft ²	* 144	-	* 0.04214	* 421.4	* 0.429711	* 2304
kg-m ²	* 3417.16	/ 0.04214	-	* 10×10^3	* 10.1972	* 54674
kg-cm ²	* 0.341716	/ 421.4	/ 10×10^3	-	/ 980.665	* 5.46
kp-cm-s ²	* 335.109	/ 0.429711	/ 10.1972	* 980.665	-	* 5361.74
oz-in ²	/ 16	/ 2304	/ 54674	/ 5.46	/ 5361.74	-

12.1.8 Temperature

	°F	°C	K
°F	-	(°F - 32) * 5/9	(°F - 32) * 5/9 + 273.15
°C	°C * 9/5 + 32	-	°C + 273.15
K	(K - 273.15) * 9/5 + 32	K - 273.15	-

12.1.9 Conductor cross section

AWG	1	2	3	4	5	6	7	8	9	10	11	12	13
mm ²	42.4	33.6	26.7	21.2	16.8	13.3	10.5	8.4	6.6	5.3	4.2	3.3	2.6

AWG	14	15	16	17	18	19	20	21	22	23	24	25	26
mm ²	2.1	1.7	1.3	1.0	0.82	0.65	0.52	0.41	0.33	0.26	0.20	0.16	0.13

009844113480, V2.00, 03.2011

12.2 Terms and Abbreviations

See chapter 2.5 "Standards and terminology" for information on the pertinent standards on which many terms are based. Some terms and abbreviations may have specific meanings with regard to the standards.

<i>AC</i>	Alternating current
<i>DC</i>	Direct current
<i>DOM</i>	Date of manufacturing: The nameplate of the product shows the date of manufacture in the format DD.MM.YY or in the format DD.MM.YYYY. Example: 31.12.09 corresponds to December 31, 2009 31.12.2009 corresponds to December 31, 2009
<i>Degree of protection</i>	The degree of protection is a standardized specification for electrical equipment that describes the protection against the ingress of foreign objects and water (for example: IP 20).
<i>Drive system</i>	System consisting of controller, drive and motor.
<i>EMC</i>	Electromagnetic compatibility
<i>ESD</i>	(electrostatic discharge) is the electrostatic discharge and describes processes and effects occurring during the discharge of electric charges.
<i>Error</i>	Discrepancy between a detected (computed, measured or signaled) value or condition and the specified or theoretically correct value or condition.
<i>LED</i>	Light Emitting Diode
<i>PELV</i>	Protective Extra Low Voltage, low voltage with isolation. For more information: IEC 60364-4-41
<i>PK</i>	Peak value of a voltage (V_{pk}) or a current (A_{pk}); abbreviation for "Peak".
<i>PLC</i>	Programmable logic controller
<i>Parameter switch</i>	The parameter switches are small switches adjacent to each other that allow you to make settings.
<i>Power stage</i>	The power stage controls the motor. The power stage generates current for controlling the motor on the basis of the positioning signals from the controller.
<i>rms</i>	"Root Mean Square" value of a voltage (V_{rms}) or a current (A_{rms})

13 Index**13****A**

- Abbreviations 89
- Accessories and spare parts 73
- Ambient conditions 17
- Assembling cables
 - Motor phases 45

B

- Before you begin
 - Safety information 13

C

- Cable installation - EMC requirements 31
- Cables 24
- Certifications 26
- Commissioning 51
 - steps 53
- Components and interfaces 11
- Connection
 - Motor phases 44
 - Power stage supply 38
 - Signal interface (CN2) 41
 - Signal interface (CN4) 47
- Connection overview 20, 37
- Control cabinet 34
- Control cabinet design 30

D

- Declaration of conformity 27
- Degree of protection 17
- Device
 - Mounting 34, 35
- Device overview 9
- Diagnostics 71
- dimensional drawing, see dimensions
- Dimensions 19
- Disposal 75, 76

E

- Electrical installation 36
- EMC 30
 - Cable installation 31
 - Improvement 32
 - Power supply 31
 - Shielded cables 31
- Energy efficiency 55
- EPLAN Macros 7

Equipotential bonding conductors 32
Examples 69

F

Functions
 monitoring functions 67
Further reading 8

G

Glossary 87

H

Hazard categories 14

I

Improvement of EMC 32
Installation
 electrical 36
 mechanical 34
Intended use 13
Introduction 9
IP degree of protection 17

M

Macros EPLAN 7
Maintenance 75
Manuals
 Source 7
Mechanical installation 34
Monitoring
 Motor phases 44
 Parameters 67
Monitoring functions 67
Mounting distances 34
Mounting, mechanical 34

O

Operation 61
Overview 52
 Connections 20, 37
 Procedure for electrical installation 36
Overvoltage 67

P

PELV power supply UL 26
Pollution degree 17

Q

Qualification of personnel 13

S

Service 75
Service address 75
Shield - EMC requirements 31

Shipping 76
Short circuit 67
Signal interface
 Connection 42, 49
Source
 EPLAN Macros 7
 Manuals 7
Status indication via LEDs 71
Storage 76

T

Technical data 17
Terms 89
Troubleshooting 71, 72
Type code 12

U

UL, conditions for
 PELV power supply 26
 Wiring 26
Undervoltage 67
Units and conversion tables 87

V

Ventilation 34

W

Wiring UL 26

