SD326

Stepper motor drive
Product manual

V2.03, 07.2010

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Schneider Electric

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.

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Writing conventions and symbols

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.

Bulleted lists

The items in bulleted lists are sorted alphanumerically or by priority. Bulleted lists are structured as follows:

- Item 1 of bulleted list
- Item 2 of bulleted list
  - Subitem for 2
  - Subitem for 2
- Item 3 of bulleted list

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 mm^2 (AWG 14)

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1 Introduction

1.1 About this manual

This manual is valid for all SD326 standard products. This chapter lists the type code for this product. The type code can be used to identify whether your product is a standard product or a customized model.

1.2 Device overview

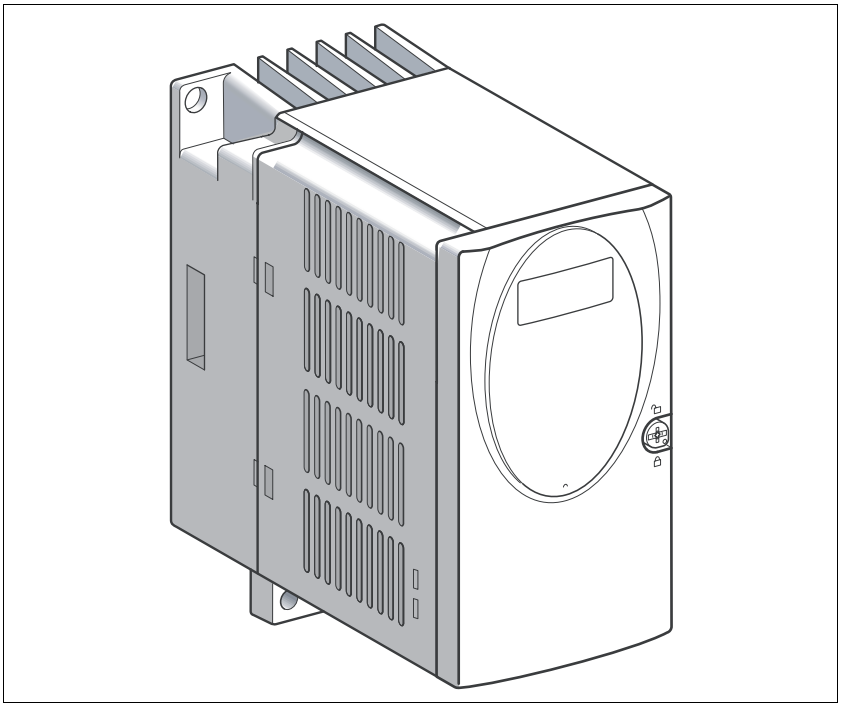

Figure 1.1 Device overview

Drive system

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

Reference values are normally supplied and monitored by a master PLC or a motion controller, e.g. LMC.

An HMI (HMI, **H**uman-**M**achine-**I**nterface) with display and keys is located at the front of the device.

Signal interface

The reference value is provided incrementally as a pulse signal via the signal interface. In addition, control signals for enabling the power stage and for changing the step resolution as well as the reference value for the reference current are provided are available.

An output signal signals operating readiness.

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Rotation monitoring / motor monitoring

If a stepper motor with integrated encoder is connected, the following functions can be activated:

- Rotation monitoring:
  The calculated reference position and the actual position of the motor are compared. If a defined deviation is exceeded, a rotation monitoring error is signaled.
- Cable monitoring:
  The encoder cable is monitored. If the encoder supply is interrupted, it is signaled that the encoder is not ready.
- Motor temperature monitoring:
  The device shuts off if the motor temperature is too high.

Rotation monitoring is an optional feature of the device. The controller supply voltage (+24VDC) must be connected if rotation monitoring is used.

Holding brake output

The device is equipped with an output for direct connection of a holding brake.

The controller supply voltage (+24VDC) must be connected if a holding brake is used.

1.3 Scope of supply

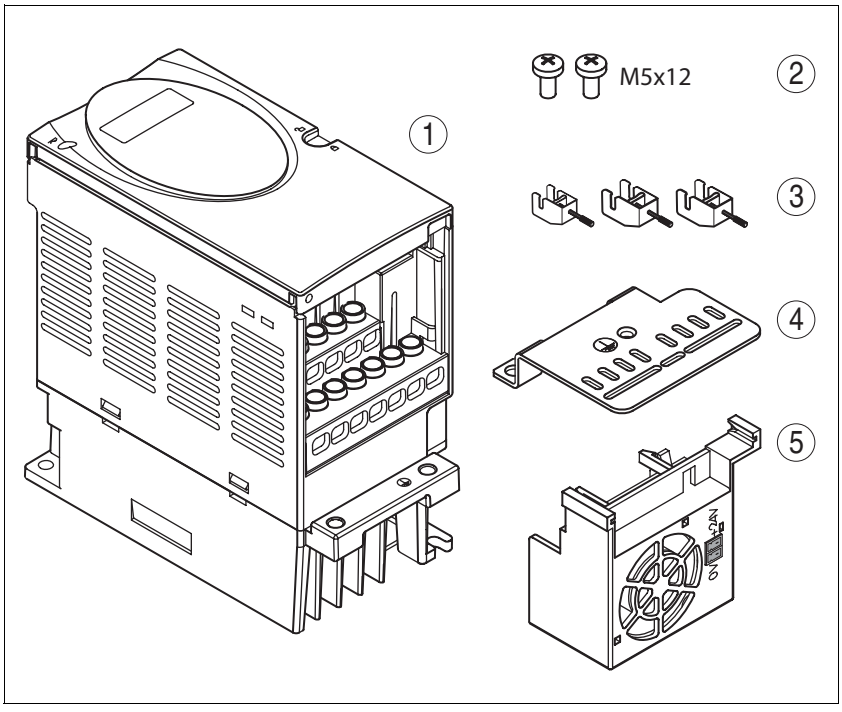

Figure 1.2 Scope of supply

(1) SD32••
(2) Mounting screws
(3) Shield terminal
(4) EMC mounting plate
(5) Fan (SD32••U68 only)

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1.4 Components and interfaces

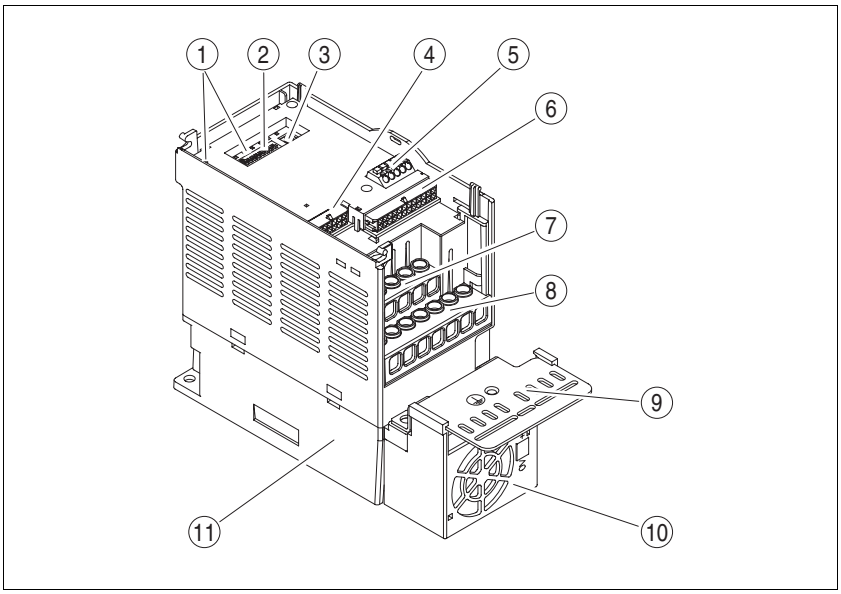

Figure 1.3 Components and interfaces

(1) LEDs for status indication
(2) Parameter switches for configuration of the device
(3) Rotary switch for setting the motor current
(4) CN2 rotation monitoring (12-pin female connector and LED, optional)
(5) 24V interface CN3 (spring terminals, optional)
- 24V controller supply voltage
- 24V outputs

(6) Signal interface CN1 (24-pin female connector)
- 5V inputs opto-isolated
- 24V inputs opto-isolated
- Output "Readiness"

(7) Screw terminals for connection of the mains supply
(8) Screw terminals for connecting the motor
(9) EMC mounting plate
(10) Fan (SD326•U68 only)
(11) Heat sink

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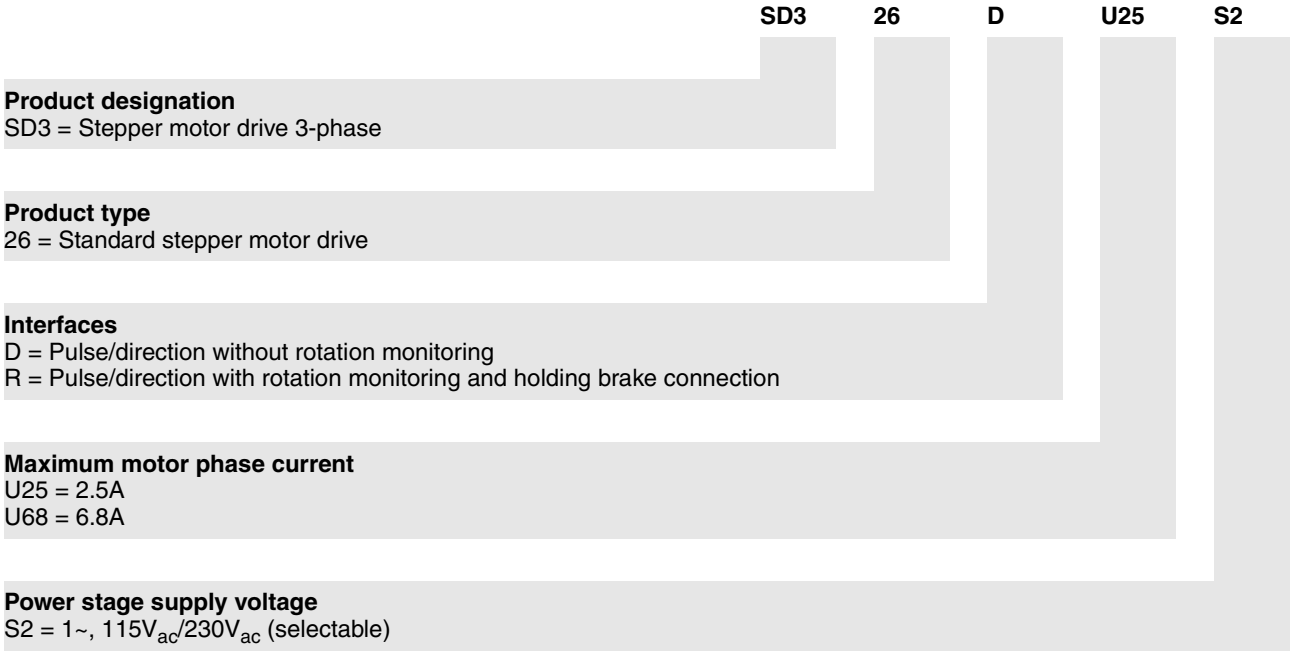
1.5 Type code



The device type is shown on the nameplate and on the inside of the front plate.

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1.6 Documentation and literature references

The following manuals belong to this product:

- **Product manual**, describes the technical data, installation, commissioning and all 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

Further reading

Recommended literature for further reading

- No recommendation for literature available.

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1.7 Declaration of conformity

SCHNEIDER ELECTRIC MOTION DEUTSCHLAND GmbH & Co. KG
Breslauer Str. 7 D-77933 Lahr

EC DECLARATION OF CONFORMITY
YEAR 2008

☐ according to EC Directive Machinery 98/37/EC
☒ according to EC Directive EMC 2004/108/EC
☒ according to EC Directive Low Voltage 2006/95/EC

We declare that the products listed below meet the requirements of the mentioned EC Directives with respect to design, construction and version distributed by us. This declaration becomes invalid with any modification on the products not authorized by us.

Designation:	Stepper motor drive
Type:	SD326xUxxS2
Product number:	0063711110x0x
Applied harmonized standards, especially:	EN 61800-3:2004, second environment EN 61800-5-1:2007
Applied national standards and technical specifications, especially:	UL 508C Product documentation
Company stamp:	Schneider Electric Motion Deutschland GmbH & Co. KG Postfach 11 80 • D-77901 Lahr Breslauer Str. 7 • D-77933 Lahr
Date/ Signature:	10 July 2008
Name/ Department:	Wolfgang Brandstätter/Development

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2 Before you begin - safety information

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 with a permanently installed connection in the control cabinet.

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.

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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).

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2.4 Basic information

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Only appropriately trained persons who are familiar with and understand the contents of this manual and all other pertinent product documentation and who have received safety training to recognize and avoid hazards involved are authorized to work on and with this drive system. Installation, adjustment, repair and maintenance must be performed by qualified personnel.
- 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.
- Many components of the product, including the printed circuit board, operate with mains voltage. Do not touch. Only use electrically insulated tools.
- Do not touch unshielded components or terminals with voltage present.
- 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.
- Do not short across the DC bus terminals or the DC bus capacitors.
- Before performing work on the drive system:
  - Disconnect all power, including external control power that may be present.
  - Place a "DO NOT TURN ON" label on all power switches.
  - Lock all power switches in the open position.
  - **Wait 15 minutes** to allow the DC bus capacitors to discharge. Measure the voltage on the DC bus as per chapter "DC bus voltage measurement" and verify the voltage is < 42 V_{dc}. The DC bus LED is not an indicator of the absence of DC bus voltage.
- Install and close all covers before applying voltage.

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

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⚠ WARNING

MOTOR WITHOUT BRAKING EFFECT

If power outage and faults cause the power stage to be switched off, the motor is no longer stopped by the brake and may increase its speed even more until it reaches a mechanical stop.

- 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

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 the 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 for Construction and Operation of Adjustable-Speed Drive Systems.

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2.5 DC bus voltage measurement

Disconnect all power prior to starting work on the product.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Only appropriately trained persons who are familiar with and understand the safety instructions in the chapter "Before you begin - safety information" may perform the measurement.

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

The DC bus voltage can exceed 800 Vdc. Use a properly rated voltage-sensing device for measuring. Procedure:

- ▶ Disconnect all power.
- ▶ Wait 15 minutes to allow the DC bus capacitors to discharge.
- ▶ Measure the DC bus voltage between the DC bus terminals to verify that the voltage is < 42 V_{dc}.
- ▶ If the DC bus capacitors do not discharge properly, contact your local Schneider Electric representative. Do not repair or operate the product.

The DC bus LED is not an indicator of the absence of DC bus voltage.

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2.6 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 61800-7 series: "Adjustable speed electrical power drive systems - Part 7-1: Generic interface and use of profiles for power drive systems - Interface definition"
- 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.

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3 Technical Data

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

3.1 Certifications

Product certifications:

Certified by	Assigned number	Validity
UL	File E153659	

3.2 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

Ambient temperature during operation

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

Operating temperature [1) 2)]	[°C]	0 ... +50

1) No icing
2) If the product is to be used in compliance with UL 508C, note the information provided in chapter 3.6 "Conditions for UL 508C".

Pollution degree

Pollution degree	2

Relative humidity

The following relative humidity is permissible during operation:

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

Installation altitude

The installation altitude is defined as height above sea level.

Installation altitude	[m]	≤1000
Installation altitude at a max. ambient temperature of 40°C, without cover film, with a free space at the sides > 50 mm	[m]	≤2000

Vibration and shock

Vibration, sinusoidal	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	As per IEC 60068-2-27 150 m/s^2 (for 11 ms)

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3.2.1 Degree of protection

The product has degree of protection IP20.

The top of the housing has degree of protection IP40 if the cover film covering the top of the housing is not removed. It may be necessary to remove the cover film for reasons of ambient temperature or mounting distances, see chapter 4.2.1 "Mounting the device", page 35.

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3.3 Mechanical data

3.3.1 Dimensions

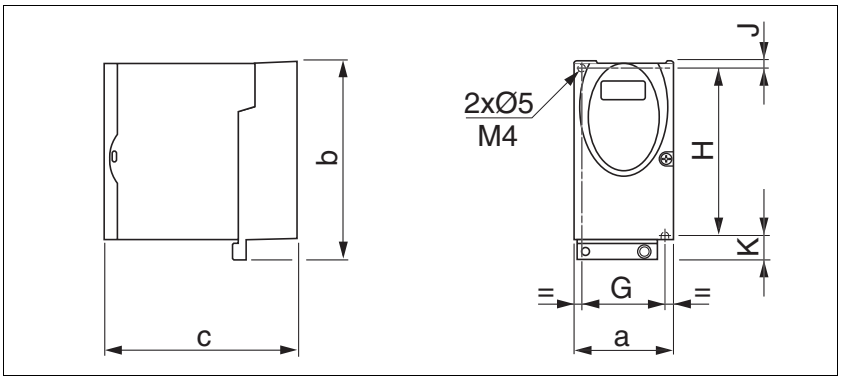

Figure 3.1 Dimensions

SD32••...		U25S2	U68S2
a	[mm]	72	72
b	[mm]	145	145
c	[mm]	140	140
G	[mm]	60	60
H	[mm]	121.5	121.5
J	[mm]	5	5
K	[mm]	18.5	18.5
Mass	[kg]	1.1	1.2
Type of cooling		Convection [1)]	Fan
DIN rail mounting	[mm]	77.5 [2)]	77.5 [2)]

1) >1 m/s
2) Width of adapter plate

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3.4 Electrical Data

The products are intended for industrial use and may only be operated with a permanently installed connection.

3.4.1 Power stage

Electrical data

SD32••...		U25S2	U68S2
Nominal voltage (switchable)	[V]	115/230 (1~)	115/230 (1~)
Input current (115V/230V)	[A]	4/3	7/5
Maximum motor phase current	[A]	2.5	6.8
Maximum speed of rotation of motor	[min^{-1}]	3000	3000
Nominal power (115V/230V) (power output of device)	[W]	180/270	280/420
Maximum voltage to ground	[V_{ac}]	300	300
Maximum permissible short circuit current of the supply mains	[kA]	0.5	0.5
Power loss	[W]	≤26	≤65
Fuse to be connected upstream [1)]	[A]	10	10

1) Fuses: Class CC or J as per UL 248-4, alternatively circuit breakers with C characteristic.

Mains voltage: Range and tolerance

Mains voltage 115 V	[V_{AC}]	100-15 % ... 120+10 %
Mains voltage 230 V	[V_{AC}]	200-15% ... 240+10 %
frequency	[Hz]	50-5 % ... 60+5 %

transient overvoltages	overvoltage category III

Inrush current and leakage current

Inrush current	[A]	<60
Leakage current at a motor cable length of <10 m and a design as per "IEC 60990 figure number 3"	[mA]	<30 [1)]

1) Measured on mains with grounded neutral point, without external mains filter. If residual current devices are used, note that a 30 mA residual current device can trigger at values as low as 15 mA. In addition, there is a high-frequency leakage current which is not considered in the measurement. Residual current device respond differently to this.

Input current and impedance of mains supply

The input current depends on the impedance of the supply mains. This is indicated by a possible short-circuit current. If the mains supply has a higher short-circuit current, use upstream mains reactors. Suitable mains reactors can be found in chapter 9 "Accessories and spare parts".

Approved motors

Approved motor families: BRS3, ExRDM, VRDM3
Approved motor voltage: $230V_{ac}$ / $325V_{dc}$
Further information on approved motors can be found in the product catalog.

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3.4.2 Interface CN1

5V inputs The inputs are optocoupler inputs.

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

24V inputs The inputs are optocoupler inputs.

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

Output "Readiness" The output "Readiness" is an electronic relay (bidirectional Mosfet).

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

3.4.3 Interface CN2 (optional)

Rotation monitoring

Output ENC+5V_OUT		
Supply voltage	[V]	4.75 ... 5.25
Maximum output current	[mA]	100
Sense-controlled, short-circuit protected, overload-protected		

Inputs ENC_A / ENC_B		
Signal voltage		As per RS422
Input frequency	[kHz]	≤400

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3.4.4 Interface CN3 (optional)

Spring terminals

The spring terminals have the following properties

Minimum conductor cross section	[mm^2]	0.14 (AWG 24)
Maximum connection cross section without wire ferrule	[mm^2]	1.5 (AWG 16)
Maximum connection cross section with wire ferrule	[mm^2]	0.75 (AWG 20)
Stripping length 1)	[mm]	8.5 ... 9.5
Maximum current load	[A]	2

1) Mechanical conditions must be considered.

24V controller supply voltage

The 24V controller supply voltage must meet the requirements of IEC 61131-2 (PELV standard power supply unit):

Input voltage	[V]	24 (-15 % / +20 %)
Input current 1)	[A]	≤0.2
Residual ripple	[%]	<5

1) Without load on outputs

The controller supply voltage (+24VDC) only needs to be connected if a holding brake or rotation monitoring are used.

24V output signals

Output voltage	[V]	≤30
Maximum switching current RM-FAULT_OUT	[mA]	50
Maximum switching current +BRAKE_OUT 1)	[A]	1.5

1) No voltage reduction

3.4.5 Fan

Only device type SD32••U68 comes with a fan.

Fan

Input voltage	[V_{dc}]	24
Input current	[mA]	130

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3.4.6 Mains filter

Basics The EMC standards distinguish various use cases:

EN 61800-3:2001-02; IEC 61800-3, Ed.2	Description
First environment, category C1	Operation in residential areas
First environment, category C2	Operation in residential areas
Second environment, category C3	Operation in industrial power distribution networks

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 may require interference suppression.

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

Better values can be achieved depending on the device and the application and as well as the design, for example, in the case of installation in an enclosed control cabinet with at least 15db attenuation.

The following limit values for conducted interference are met by EMC-compliant designs:

Devices without external mains filter	C3 up to a motor cable length of 10 m
Devices with external mains filter	C2 up to a motor cable length of 20 m, C3 up to a motor cable length of 50 m

The system integrator and/or machine owner/operator is responsible for complying with the EMC directives. See chapter 9 "Accessories and spare parts" for order data on external mains filters.

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3.5 Technical data accessories

3.5.1 Cables

Overview of required cables

	Max. cable length [m]	in. conductor cross section [mm²]	As per PELV	Shielded, both ends grounded	Twisted pair
Motor cables (see chapter 9.2 "Motor cables")	10/50 [1)]	4*1.5 (AWG 14)		X	
Mains supply	–	0.75 (AWG 18)			
Signal interface	100	8*2*0.14 (AWG 24)	X	X	X
Encoder cables (see chapter 9.3 "Encoder cables")	100	10*0.25 and 2*0.5 (AWG 22 and 18)	X	X	X
Controller supply voltage	–	0.75 (AWG 18)	X		

1) Length depends on the required limit values for conducted interference, see chapter 3.4.6 "Mains filter".

Motor cable and encoder cable

The motor cables and encoder cables are suitable for drag chain applications; they are available in various lengths. See page 81 for the versions available as accessories.

Motor cables		Style 20234
Encoder cable		Style 20963
Permissible voltage motor cable	[V_{ac}]	600 (UL and CSA)
Temperature range	[°C]	-40 ... +90 (permanently installed) -20 ... +80 (moving)
Minimum bending radius		4 x diameter (permanently installed) 7.5 x diameter (moving)
Cable jacket		Oil-resistant PUR
Shielding		Shield braiding
Coverage of shielding	[%]	≥85

Table 3.1 Data of the motor cable and encoder cable available as accessories

3.6 Conditions for UL 508C

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

Ambient temperature during operation

Surrounding air temperature	[°C]	0 ... +40

Wiring

Use at least 60/75 °C copper conductors.

PELV power supply

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

Short-circuit current rating

Short-circuit current rating	[kA]	5

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4 Installation

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 may require interference suppression.

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

EMC scope of supply and accessories

The device is shipped with SK shield clamps and an EMC plate. The number of shield clamps depends on the device type. The shield clamps are not designed to be used as a strain relief.

See page 81 for information pre-assembled cables.

Control cabinet design

EMC measures	Objective
Use EMC plate or galvanized or chrome-plated mounting plates, connect large surface areas of metal parts, remove paint from contact surfaces.	Improves conductivity due to surface contact.
Ground the control cabinet, door and EMC plate with ground straps or cables with a cross section greater than 10 mm^2 (AWG 6).	Reduces emissions.
Fit switching devices such as contactors, relays or solenoid valves with interference suppression assemblies or arc suppressors (for example, diodes, varistors, RC circuits).	Reduces mutual interference
Install power and control components separately.	Reduces mutual interference

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Shielding

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 systems with - wide-area installations - different voltage supplies - networking 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, ground the motor with a ground wire (> 10 mm^2) or a ground strap.	Reduces emissions, increases immunity.
Use twisted pair for 24 V_{dc} signals.	Reduces interference affecting the signal cables, reduces emissions.

Power supply

EMC measures	Objective
Operate product on mains with grounded neutral point (mains filter is not effective in IT mains).	Enables effectiveness of mains filter.
Protective circuit if there is a risk of overvoltage.	Reduces the risk of damage caused by overvoltage.

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Motor and encoder cables

Motor and encoder cables are especially critical in terms of EMC. Use only pre-assembled cables 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 or encoder 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 and encoder cable without cutting them. [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.

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
Upstream mains reactors	Reduces mains harmonics, prolongs product service life.
Upstream external mains filters	Improves the EMC limit values.
Particularly EMC-compliant design, e.g. in a closed control cabinet with 15 dB damping of radiated interference	Improves the EMC limit values.

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 mm^2 (AWG 4) for equipotential bonding conductors up to a length of 200 m
- 20 mm^2 (AWG 4) for equipotential bonding conductors with a length of more than 200 m

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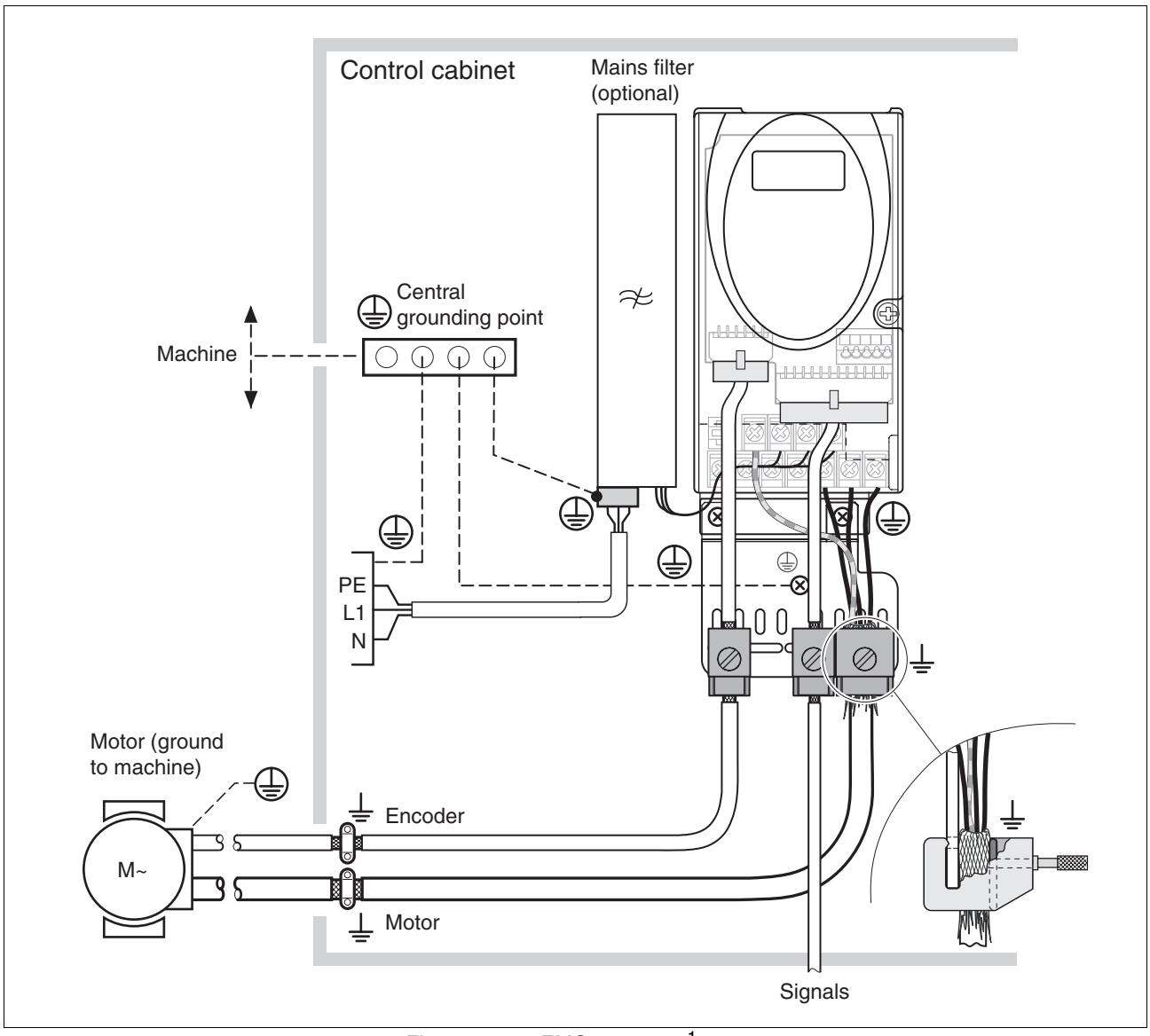

Figure 4.1 EMC measures[1]

1. Number of shield clamps depends on the device type.

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4.1.1 Operation in an IT mains

An IT mains has a neutral conductor that is isolated or grounded via high impedance. If you use permanent isolation monitoring, it must be suitable for non-linear loads (e.g. Merlin Gerin type XM200). If, in spite of correct wiring, an error is signaled, you can, in the case of products with integrated mains filters, disconnect the ground connection of the Y capacitors (deactivate the Y capacitors).

In the case of all other mains except for IT mains, the ground connection via the Y capacitors must remain effective!

If the ground connections of the Y capacitors are disconnected, the specifications for radiated interference are no longer met (specified categories, see chapter 3.4.6 "Mains filter", page 27)! You must take all the measures required for compliance with all applicable directives, regulations and standards.

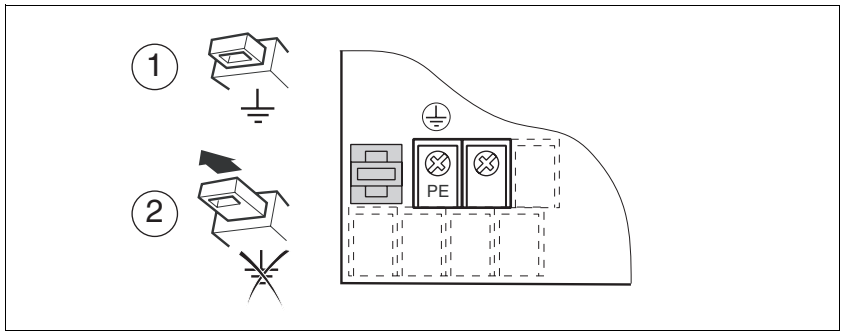

Figure 4.2 Operation in an IT mains

(1) Y capacitors of the internal filter operative (standard)
(2) Y-capacitors of the internal filter deactivated (IT mains)

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4.2 Mechanical installation

⚠ DANGER

ELECTRIC SHOCK CAUSED BY FOREIGN OBJECTS OR DAMAGE

Conductive foreign objects in the product or serious damage may cause parasitic voltage.

- Do not use damaged products.
- Keep foreign objects such as chips, screws or wire clippings from getting into the product.
- Do not use products that contain foreign objects.

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

⚠ CAUTION

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 injury or equipment damage.

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4.2.1 Mounting the device

Control cabinet

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

The ventilation of the control cabinet must be sufficient 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 (±10°). 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).
- When planning installation distances, consider the dimensions of a mains filter, see also notes on page 38

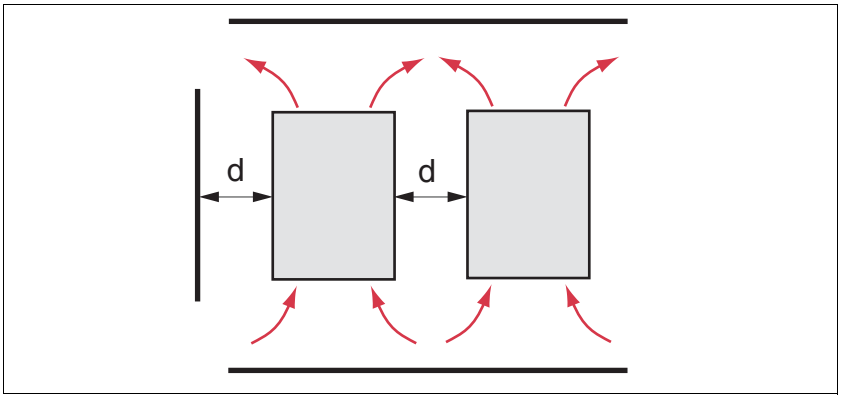

Figure 4.3 Mounting distances and air circulation

Temperature [1]	Distance [2]	Measures without cover film [3]	Measures with cover film
0°C to +40°C (32°F to 104°F)	d > 50mm (d > 1.97 in.)	None	None
	d < 50mm (d < 1.97 in.)	None	d > 10mm (d > 0.39 in.)
+40°C to +50°C (104°F to 122°F)	d > 50mm (d > 1.97 in.)	None	Reduce nominal current and continuous current [4]
	d < 50mm (d < 1.97 in.)	Reduce nominal current and continuous current [4]	Operation impossible

1) Maximum operating temperature for use as per UL: max. +40°C (104°F)

2) Distance in front of the device: 10mm (0.39 in.), above: 50mm (1.97 in.), below: 200mm (7.87 in.)
3) Recommendation: Remove cover film after installation
4) By 2.2 % per °C above 40 °C (by 1.22 % per °F above 104 °F)

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At least 10mm of free space is required in front of the device.
At least 50mm of free space is required above the device.
The connecting cables are routed out of the housing at the bottom. At least 200mm of free space is required below the device to allow for cable installation without bends.

Mounting the device

For the dimensions of the mounting holes, see chapter 3.3.1 "Dimensions", page 23.

- ▶ Mount the device in a vertical position (±10°). This is required for cooling the device.
- ▶ Mount the EMC plate at the bottom of the device, see also Figure 4.1, or use alternative connection elements (busbars, shield clamps or similar).

Attaching a label with safety instructions

- ▶ Select the label suitable for the target country.
  Observe the safety regulations in the target country.
- ▶ Attach the label to the front of the device so that it is clearly visible.

Instead of mounting the device directly to the control cabinet mounting plate, you can use adapter plates for DIN rail mounting which are available as accessories, see chapter 3.3.1 "Dimensions".

In this case mains filters cannot be mounted directly next to or behind the device.

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.

Mounting the fan

Device type SD32••U68 comes with a fan. The fan must be mounted and connected.

- ▶ Mount the fan as shown in the illustration below.
- ▶ Mount the fan before carrying out the electrical installation of the product.

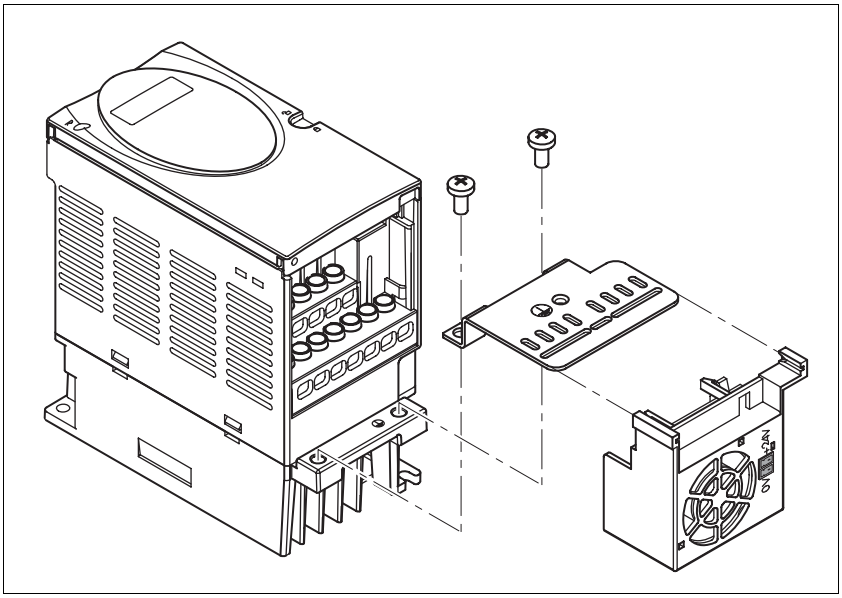

Figure 4.4 Mounting the fan

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Removing the cover film

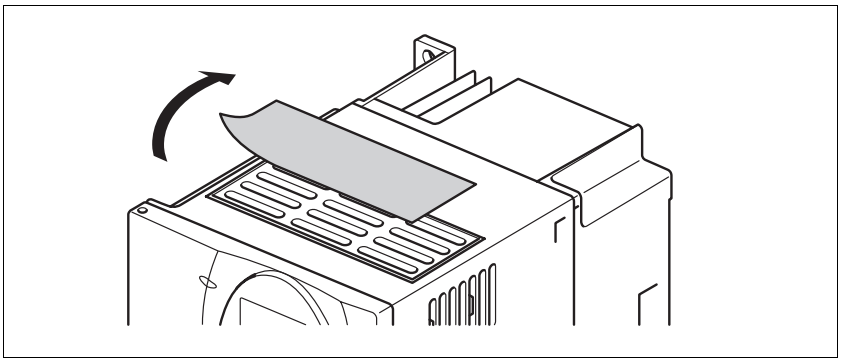

Figure 4.5 Removing the cover film

▶ Remove the cover film only after completion of all installation work. The cover film must be removed if required by the thermal conditions.

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4.2.2 Mounting a mains filter

For technical data of external mains filters, see page 27.
Information on the electrical installation can be found in chapter 4.3.5 "Mains supply connection", page 46.

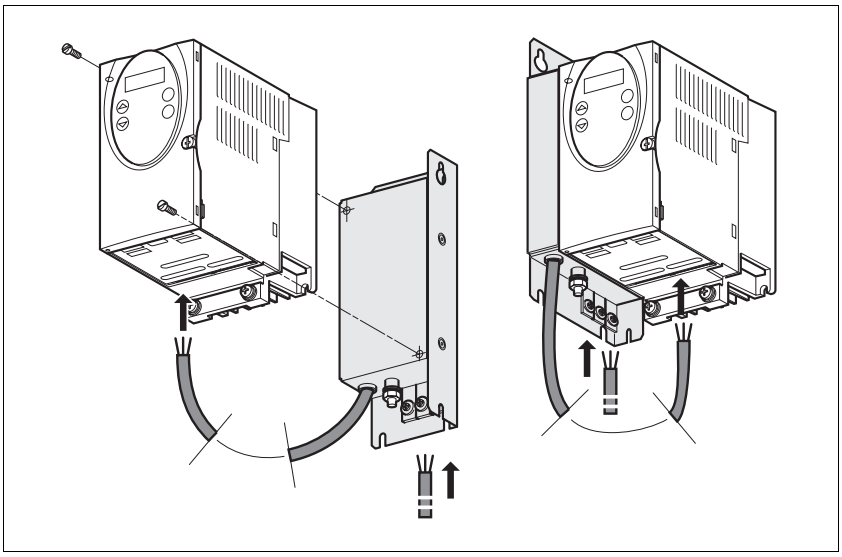

Figure 4.6 Mounting a mains filter

▶ Mount the mains filter at the rear or the left side of the device.

If the mains filter is mounted behind the device, the mains filter connections are no longer accessible after installation of the EMC plate.

If you use DIN rail mounting plates, the mains filter cannot be mounted directly next to or behind the device.

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4.3 Electrical installation

⚠ DANGER

ELECTRIC SHOCK CAUSED BY FOREIGN OBJECTS OR DAMAGE

Conductive foreign objects in the product or serious damage may cause parasitic voltage.

- Do not use damaged products.
- Keep foreign objects such as chips, screws or wire clippings from getting into the product.
- Do not use products that contain foreign objects.

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

⚠ DANGER

ELECTRIC SHOCK CAUSED BY INSUFFICIENT GROUNDING

Insufficient grounding causes the hazard of electric shocks.

- Ground the drive system before applying voltage.
- Do not use conduits as protective ground conductors; use a protective ground conductor inside the conduit.
- The cross section of the protective ground conductor must comply with the applicable standards.
- Ground the cable shields at both ends; however, the shields are not protective ground conductors.

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

⚠ WARNING

THIS PRODUCT MAY CAUSE DIRECT CURRENT IN THE PROTECTIVE GROUND CONDUCTOR

If a residual current device (RCD) is used, conditions must be observed.

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

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Conditions for use of residual current device

Where the installation regulations require upstream protection against direct or indirect contact by means of a residual current device (RCD) or a residual current monitor (RCM), a residual current device of "type A" can be used for a single-phase drive with connection between N and L. In all other cases, a "type B" RCD must be used.

Note the following:

- Filtering of high-frequency currents.
- Delayed triggering to avoid triggering as a result of capacitance which may be present when the unit is switched on. 30 mA residual current devices rarely have a delay. Use residual current devices which are not sensitive to unintentional triggering, for example residual current devices with increased immunity.

Use residual current devices that meet the following conditions:

- For single-phase devices, type A: Residual current devices of series s.i (super-immunized, Schneider Electric).
- For three-phase devices, type B: sensitive to all current types with approval for frequency inverters

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

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4.3.1 Overview of procedure

- ▶ Unlock the front plate of the device and open the front plate.
- ▶ Connect the ground connection of the device or the EMC plate to the central grounding point of the system.
- ▶ Make all required connections according to the sequence as shown in the table below. If you do not make the connections in the sequence described, the connection terminals may be covered by other cables.

  Verify compliance with the EMC requirements, see page 29.
- ▶ Finally, lock the front plate.

Chapter	Page
4.3.3 "Connection of motor phases"	43
4.3.4 "DC bus connection"	45
4.3.5 "Mains supply connection"	46
4.3.6 "Connecting the signal interface (CN1)"	49
4.3.7 "Connection of rotation monitoring (CN2)"	53
4.3.8 "Connection of outputs and controller supply voltage (CN3)"	56
4.3.9 "Connecting the fan"	58

The connections CN2 and CN3 are only available on device type SD326R.

The controller supply voltage (+24VDC) only needs to be connected if a holding brake or rotation monitoring are used.

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4.3.2 Overview of all connections

Power connections

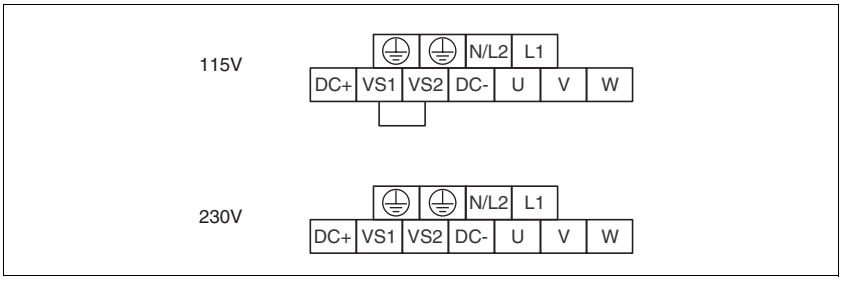

Figure 4.7 Power connections

Power connections	Meaning
PE	Ground connection
L1, N/L2	Mains connection
DC+, DC-	DC bus
VS1, VS2	Setting the voltage range
U, V, W	Motor phases

Signal connections

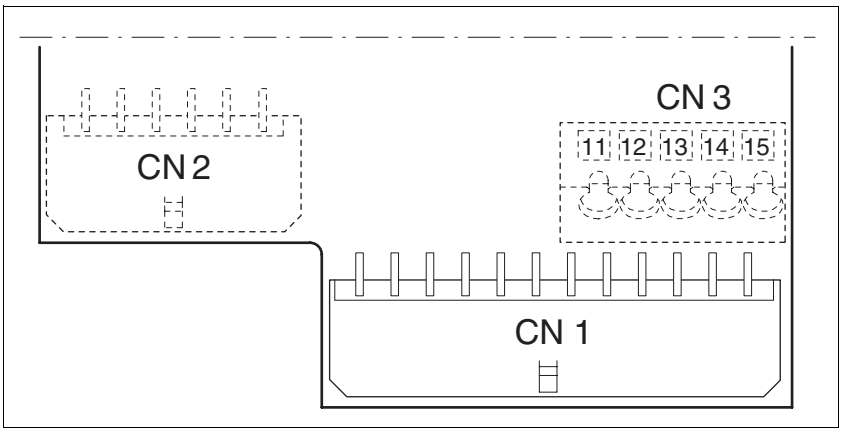

Figure 4.8 Overview of signal connections

Connection	Assignment
CN1	Signal interface
CN2 (optional)	Rotation monitoring
CN3 (optional)	24V outputs, pins 11-13 24V controller supply voltage, pins 14-15

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4.3.3 Connection of motor phases

⚠ 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.

Cable specifications and terminal

- Shielded cable
- Shield grounded at both ends

Maximum cable length [1)]	[m]	10/50
Minimum conductor cross section	[mm^2]	1.5
Maximum connection cross section	[mm^2]	1.5
Tightening torque	[Nm] (lb·in)	0.5 ... 0.6 (4.4 ... 5.3)

1) Depends on the required limit values for conducted interference, see chapter 3.4.6 "Mains filter".

- See chapter 3.5.1 "Cables" for additional information.

▶ Use pre-assembled cables (page 81) to reduce the risk of wiring errors.

▶ Use only the cables available as accessories, the use of other cables may destroy the product.

Approved motors

Approved motor families: BRS3, ExRDM, VRDM3
Approved motor voltage: $230V_{ac}$ / $325V_{dc}$
Further information on approved motors can be found in the product catalog.

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Assembling cables

Note the dimensions specified when assembling cables. The specified dimensions refer to a cable arrangement as shown in the figure "EMC measures", page 31.

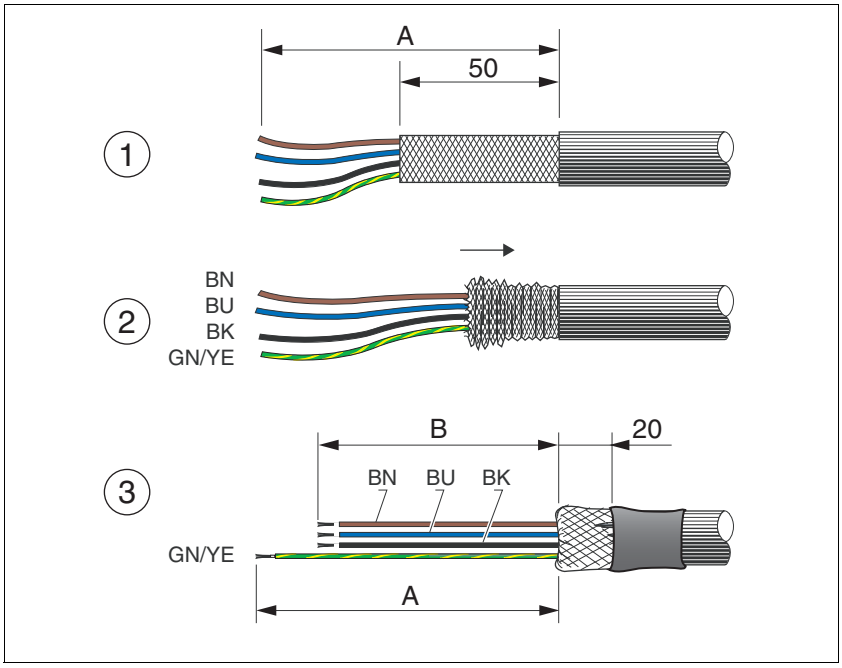

Figure 4.9 Steps (1-3) for assembling the motor cable

(A) 130 mm
(B) 75 mm

- ▶ (1) Strip the cable jacket (length A) and shorten the shield braiding to approx. 50mm.
- ▶ (2) Slide the shield braiding back over the cable jacket and fasten it with heat shrink tubing, tape or by other means. Note that approx. 20 mm of the shield braiding must not be insulated for the required large-surface connection of the shield braiding to the EMC plate.
- ▶ (3) Shorten the three motor phase wires (U, V, W) to length B. The protective ground conductor has length A.

Use fork-type cable lugs or wire ferrules. Insert the conductor in such a way that it fully fills the entire length of the ferrule for maximum current capacity and vibration resistance.

Monitoring

The motor phases are monitored for:

- Short circuit between the motor phases
- Short circuit to ground

Connecting the motor cable

- ▶ Note the EMC requirements for the motor cables, see page 31.
- ▶ Connect the motor phases and the protective ground conductor to terminals U, V, W and PE (ground). The connection assignments at the motor and device ends must match.
- ▶ Connect a large area of the cable shield to the EMC plate.

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Wiring diagram

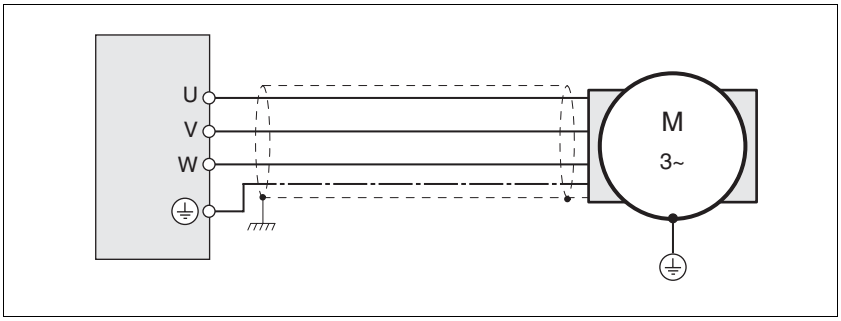

Figure 4.10 Wiring diagram motor

Connection	Meaning	Color [1)]
U	Motor phase	Brown (BN)
V	Motor phase	Blue (BU)
W	Motor phase	Black (BK)
PE	Protective ground conductor	Green/yellow (GN/YE)

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

4.3.4 DC bus connection

CAUTION

NON-APPROVED PARALLEL CONNECTION

Operation with parallel connection via the DC bus may destroy the drives immediately or after a delay.

- Do not connect the DC bus of several drives.

Failure to follow these instructions can result in equipment damage.

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4.3.5 Mains supply connection

⚠ DANGER

ELECTRIC SHOCK CAUSED BY INSUFFICIENT GROUNDING

This drive system has an increased leakage current > 3.5 mA.

- Use a protective ground conductor at with least 10 mm^2 (AWG 6) or two protective ground conductors with the cross section of the conductors supplying the power terminals. Verify compliance with all local and national electrical code requirements as well as all other applicable regulations with respect to grounding of all equipment.

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

⚠ WARNING

INSUFFICIENT PROTECTION AGAINST OVERCURRENTS

- Use the external fuses specified in "Technical data".
- Do not connect the product to a power supply in which the short-circuit capacity exceeds the maximum short-circuit current approved in "Technical data".

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

CAUTION

DESTRUCTION DUE TO INCORRECT MAINS VOLTAGE

Incorrect mains voltage may destroy the product.

- Before switching on and configuring the product, verify that it is approved for the mains voltage.

Failure to follow these instructions can result in equipment damage.

The products are intended for industrial use and may only be operated with a permanently installed connection.

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Cable specifications and terminal

Minimum conductor cross section	[mm^2]	0.75 (AWG 18)
Maximum connection cross section	[mm^2]	1.5 (AWG 16)
Tightening torque	[Nm] (lb·in)	0.5 ... 0.6 (4.4 ... 5.3)

- See chapter 3.5.1 "Cables", page 28 for additional information.

The wires must have a sufficiently large cross section so that the fuse at the mains connection can trip if required.

Note the information in chapter 4.1.1 "Operation in an IT mains" when connecting the device to an IT mains.

Verify the suitability of the cables, see page 40, and the EMC-compliant connection, see page 30.

Assembling cables

Use fork-type cable lugs or wire ferrules. Insert the conductor in such a way that it fully fills the entire length of the ferrule for maximum current capacity and vibration resistance.

Wiring diagram

The figure below shows the mains supply connection. The figure also shows the wiring of an optional external mains filter.

NOTE: In three-phase systems, the neutral conductor N must be used instead of L2 in the majority of cases.

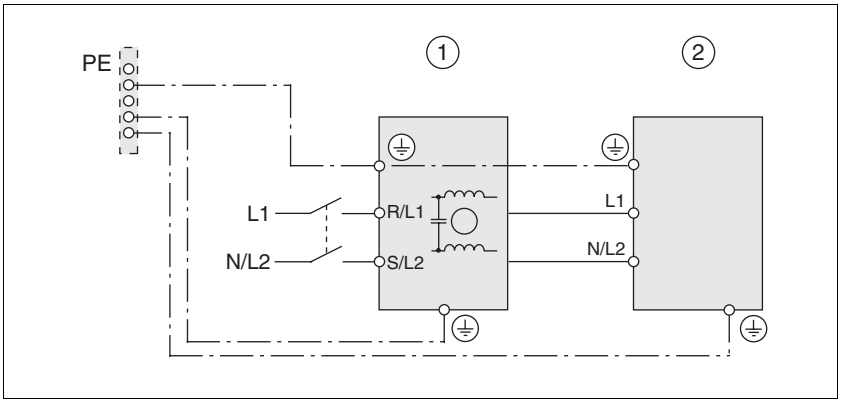

Figure 4.11 Wiring diagram mains supply for single-phase device

(1) Mains filter (optional)
(2) Product

If neutral conductor N is used instead of L2, a fuse is only required with L1.

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Setting the voltage range

▶ Set the device to the correct voltage range.

VS1 bridged to VS2: 115 V
VS1 not bridged to VS2: 230 V (factory setting)

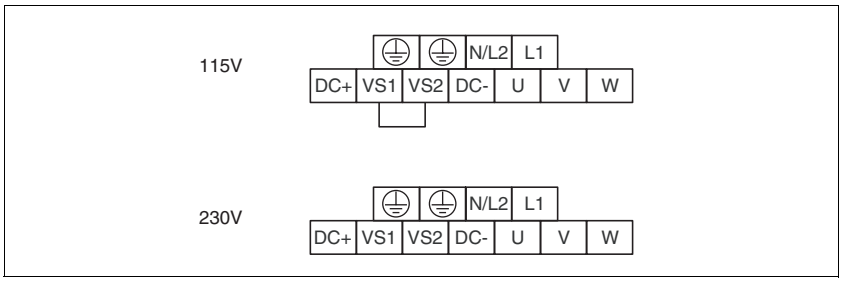

Figure 4.12 Setting the voltage range

Connecting mains supply

Note the following information:

- The device must be set to the correct voltage range.
- If you use an external mains filter, the mains cable must be shielded and grounded at both ends if the length between the external mains filter and the device exceeds 200 mm.
- Observe the EMC requirements. If necessary, use surge arresters, mains filters and mains reactors, see page 38.
- See page 28 for a UL-compliant design.

▶ Connect the mains wires. Note the terminal assignment of your device, see chapter 4.3.2 "Overview of all connections".

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4.3.6 Connecting the signal interface (CN1)

⚠ 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 circuit of the opto-isolated inputs, using the example of the PULSE signal input.

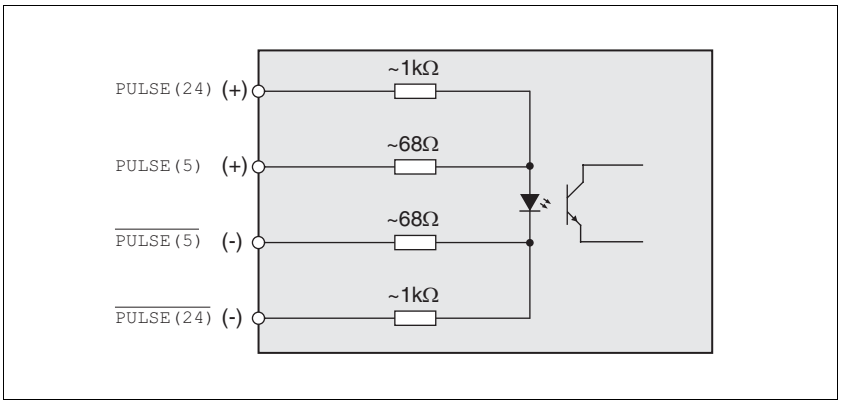

Figure 4.13 Schematic circuit diagram inputs

Schematic circuit diagram output

The following illustration provides a schematic overview of output "Readiness".

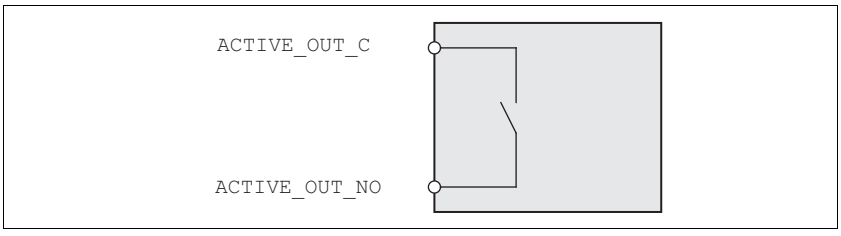

Figure 4.14 Schematic circuit diagram output

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Wiring diagram

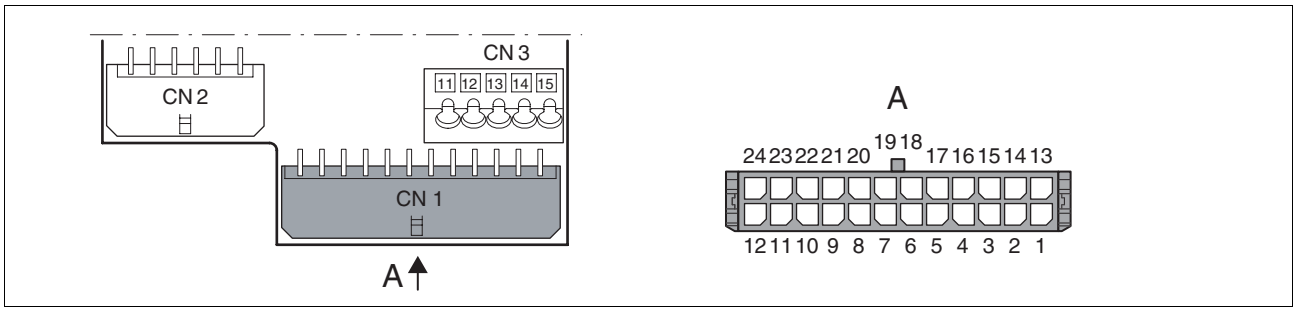

Figure 4.15 Wiring diagram signal interface

Pin	Signal	Color [1)]	Pair	Meaning	5V/24V	I/O
13	PULSE(5) CW(5)	White	1	Motor step (+) Motor step positive direction of rotation (+)	5V	I
1	$\overline{\text{PULSE(5)}}$ $\overline{\text{CW(5)}}$	Brown	1	Motor step, inverted (-) Motor step positive direction of rotation, inverted (-)	5V	I
14	DIR(5) CCW(5)	Green	2	Direction of rotation (+) Motor step negative direction of rotation (+)	5V	I
2	$\overline{\text{DIR(5)}}$ $\overline{\text{CCW(5)}}$	Yellow	2	Direction of rotation, inverted (-) Motor step negative direction of rotation, inverted (-)	5V	I
15	GATE(5) ENABLE(5)	Gray	3	Reference values locked (+) Power stage enable (+)	5V	I
3	$\overline{\text{GATE(5)}}$ $\overline{\text{ENABLE(5)}}$	Pink	3	Reference values locked, inverted (-) Power stage enable, inverted (-)	5V	I
16	STEP2_INV(5)	Black	4	Switching angular resolution (+)	5V	I
4	$\overline{\text{STEP2\_INV(5)}}$	Violet	4	Switching angular resolution, inverted (-)	5V	I
17	PWM(5)	Blue	5	Control of motor phase current (+)	5V	I
5	$\overline{\text{PWM(5)}}$	Red	5	Control of motor phase current, inverted (-)	5V	I
19	ACTIVE_OUT_C	Gray/pink	6	Readiness		O
7	ACTIVE_OUT_NO	Red/blue	6	Readiness		O
20	PULSE(24) CW(24)	White	1	Motor step (+) Motor step positive direction of rotation (+)	24V	I
8	$\overline{\text{PULSE(24)}}$ $\overline{\text{CW(24)}}$	Brown	1	Motor step, inverted (-) Motor step positive direction of rotation, inverted (-)	24V	I
21	DIR(24) CCW(24)	Green	2	Direction of rotation (+) Motor step negative direction of rotation (+)	24V	I
9	$\overline{\text{DIR(24)}}$ $\overline{\text{CCW(24)}}$	Yellow	2	Direction of rotation, inverted (-) Motor step negative direction of rotation, inverted (-)	24V	I
22	GATE(24) ENABLE(24)	Gray	3	Reference values locked (+) Power stage enable (+)	24V	I
10	$\overline{\text{GATE(24)}}$ $\overline{\text{ENABLE(24)}}$	Pink	3	Reference values locked, inverted (-) Power stage enable, inverted (-)	24V	I
23	STEP2_INV(24)	Black	4	Switching angular resolution (+)	24V	I
11	$\overline{\text{STEP2\_INV(24)}}$	Violet	4	Switching angular resolution, inverted (-)	24V	I
24	PWM(24)	Blue	5	Control of motor phase current (+)	24V	I

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Pin	Signal	Color [1)]	Pair	Meaning	5V/24V	I/O
12	$\overline{\text{PWM(24)}}$	Red	5	Control of motor phase current, inverted (-)	24V	I
6.18				Not assigned		

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

Cable specifications

- Twisted pair
- Shielded cable
- Shield grounded at both ends

Maximum cable length	[m]	100
Minimum conductor cross section	[mm^2]	8*2*0.14 (AWG 24)

- See chapter 3.5.1 "Cables", page 28 for additional information.

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Assembling cables

- ▶ Use pre-assembled cables to reduce the risk of wiring errors. Step 5 in the illustration below must be carried out even with pre-assembled cables. The dimensions for connecting the shield to the housing are applicable when the included EMC plate is used.
- ▶ If you do not use a pre-assembled cable, follow the procedure below.

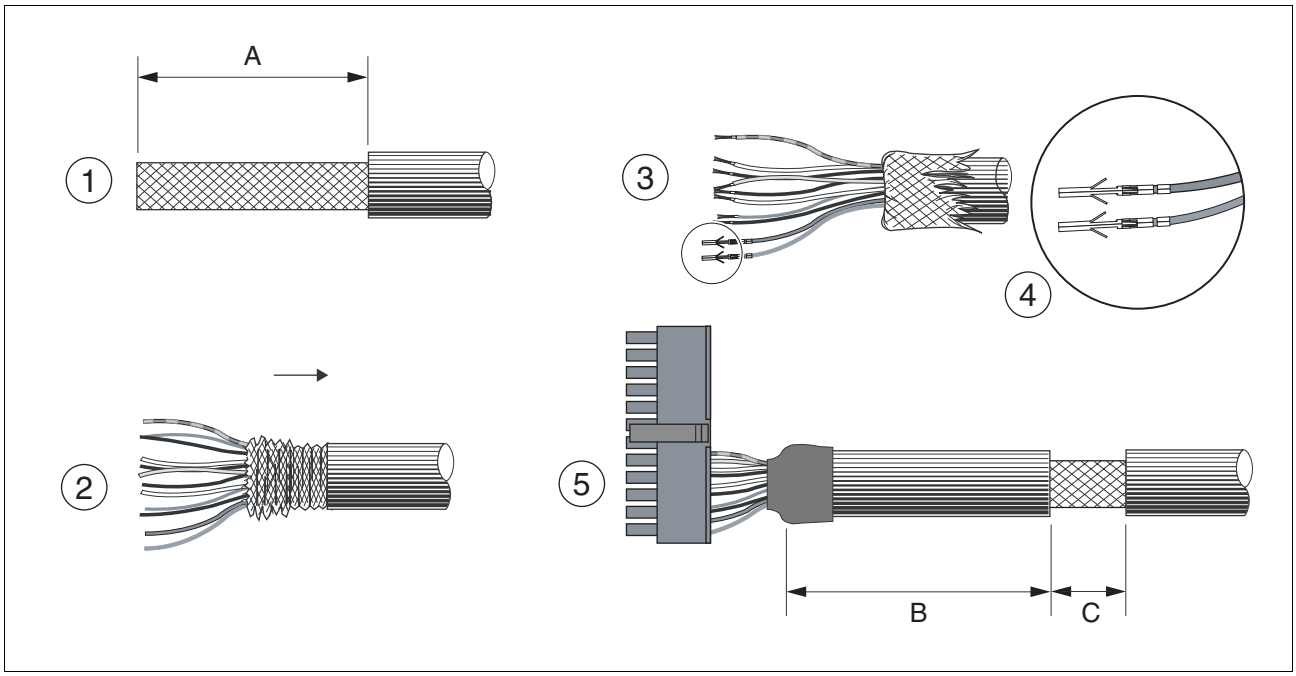

Figure 4.16 Assembling the cable for the signal interface

(A) 25 mm
(B) 80 mm
(C) 15 mm

Stripping length [mm]	Manufacturer's crimp contact no.	Crimping tool	Connector manufacturer	Connector type
2.5 ..3.0	43030-0007	69008-0982	Molex	Micro-Fit 43025-2400

- ▶ (1) Strip the cable jacket, length A.
- ▶ (2) Slide the shield braiding back over the cable jacket.
- ▶ (3+4) Crimp the contacts to the wires. Insulate the shield braiding with heat shrink tube. Plug the crimp contacts into the connector housing; see Figure 4.15 for the pin assignment.
- ▶ (5) Strip the cable jacket to length C at the position shown; at this point, the cable is fastened to the EMC plate with a clamp (shield to ground connection).

Connecting the signal interface

- ▶ Verify that wiring and cables meet the PELV requirements.
- ▶ Connect the connector to CN1.
- ▶ Fasten the cable to the EMC plate and verify that the cable shield is connected to a large surface area.

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4.3.7 Connection of rotation monitoring (CN2)

Only device type SD326R has this connection.

Encoder

The motor encoder is an incremental encoder integrated into the motor. It signals changes of the position of the motor shaft in the form of A/B signals.

Cable specifications

- Twisted pair
- Shielded cable
- Shield grounded at both ends

Maximum cable length	[m]	100
Minimum conductor cross section	[mm^2]	10*0.25 + 2*0.5 (AWG 22)

- See chapter 3.5.1 "Cables", page 28 for additional information.

Assembling cables

▶ Use pre-assembled cables to reduce the risk of wiring errors. Step 5 in the illustration below must be carried out even with pre-assembled cables. The dimensions for connecting the shield to the housing are applicable when the included EMC plate is used.

▶ If you do not use a pre-assembled cable, follow the procedure below.

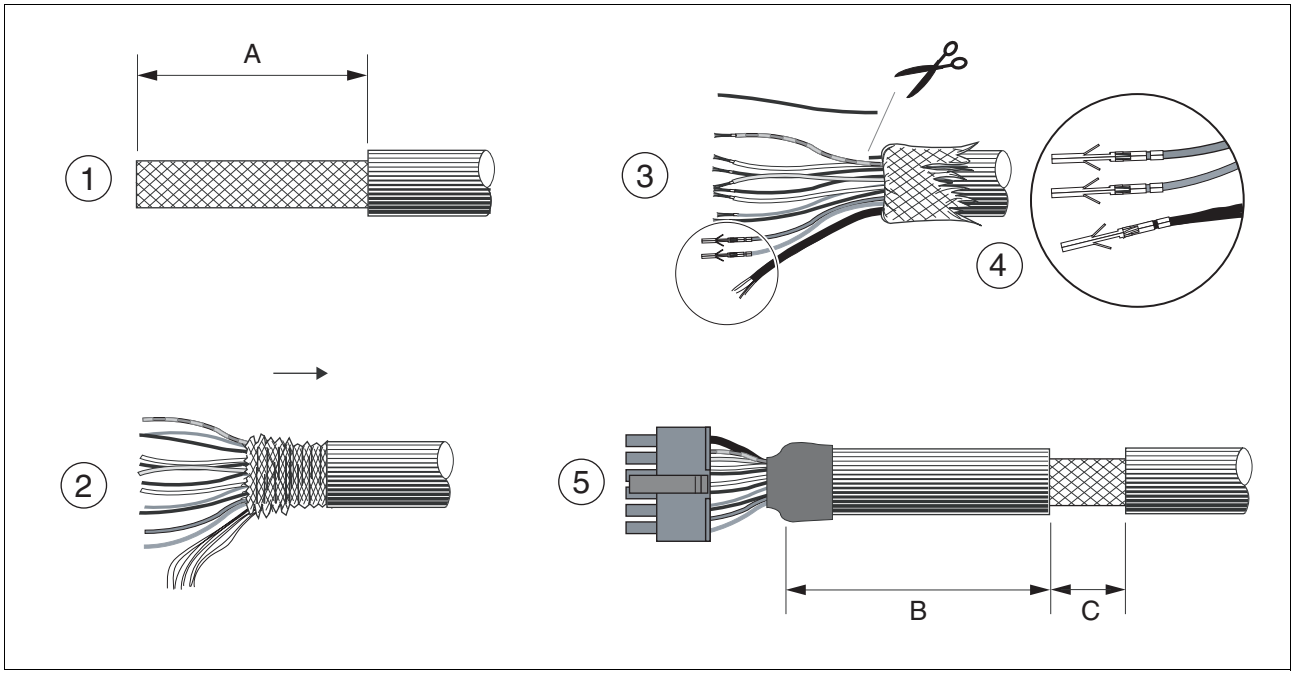

Figure 4.17 Steps (1-5) for assembling the encoder cable

(A) 25 mm
(B) 90 mm
(C) 15 mm

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Stripping length [mm]	Manufacturer's crimp contact no.	Crimping tool	Connector manufacturer	Connector type
2.5 ..3.0	43030-0007	69008-0982	Molex	Micro-Fit 43025-1200

- ▶ (1) Strip the cable jacket, length A.
- ▶ (2) Slide the shield braiding back over the cable jacket. The shield drain wire is required as connection.
- ▶ (3) The wire with the color blue/red is not required and may be cut. Insulate the shield drain wire with heat shrink tube.
- ▶ (4) Crimp the contacts to the remaining wires and to the insulated shield drain wire. Insulate the shield braiding with heat shrink tube. Plug the crimp contacts into the connector housing; see Figure 4.18 for the pin assignment.
- ▶ (5) Strip the cable jacket to length C at the position shown; at this point, the cable is fastened to the EMC plate with a clamp (shield to ground connection).

Connecting the motor encoder

- ▶ Verify that wiring, cables and connected interfaces meet the PELV requirements.
- ▶ Note the EMC requirements for the encoder cable, page 31; use equipotential bonding conductors for equipotential bonding.
- ▶ Connect the connector to CN2.
- ▶ Fasten the cable to the EMC plate and verify that the cable shield is connected to a large surface area.

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Wiring diagram

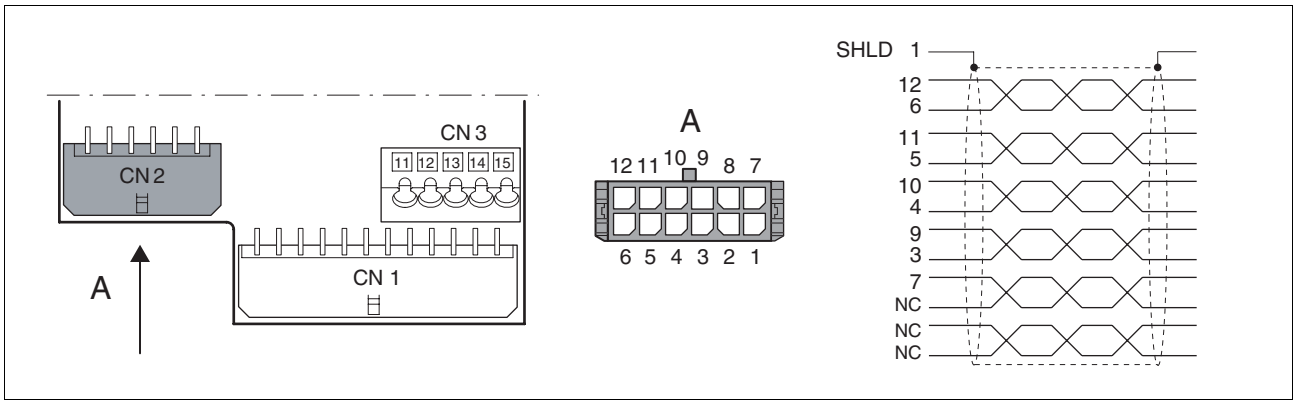

Figure 4.18 Wiring diagram rotation monitoring

Pin	Signal	Motor, pin	Color [1]	Pair	Meaning	I/O
12	ENC_A	1	White	1	Encoder signal channel A	I
6	$\overline{\text{ENC\_A}}$	2	Brown	1	Encoder signal channel A, inverted	I
11	ENC_B	3	Green	2	Encoder signal channel B	I
5	$\overline{\text{ENC\_B}}$	4	Yellow	2	Encoder signal channel B, inverted	I
10	ENC_0V_OUT	7	Blue	3	Reference potential to ENC+5V_OUT [2]	O
4	ENC+5V_OUT	8	Red	3	$5V_{DC}$ supply for encoder, max. 100 mA [2]	O
9	ENC_0V_SENSE	9	Black	4	Reference potential to ENC+5V_SENSE [2]	I
3	ENC+5V_SENSE	10	Violet	4	SENSE line to ENC+5V_OUT [2]	I
8					Not assigned	
2					Not assigned	
7	$\overline{\text{T\_MOT}}$	11	Gray/pink		Temperature sensor PTC	I
1	SHLD				Shield drain wire	

1) Color information relates to the cables available as accessories.
2) At the end of the motor cable (motor end), the signal wire ENC+5V_OUT must be connected to ENC+5V_SENSE and the signal wire ENC_0V_OUT must be connected to ENC_0V_SENSE. The LED "ENDCODER lights up when the encoder supply is on."

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4.3.8 Connection of outputs and controller supply voltage (CN3)

Only device type SD326R has this connection.

The controller supply voltage (+24VDC) only needs to be connected if a holding brake or rotation monitoring are used.

⚠ DANGER

ELECTRIC SHOCK CAUSED BY INCORRECT POWER SUPPLY UNIT

The +24VDC 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.

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.

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Wiring diagram

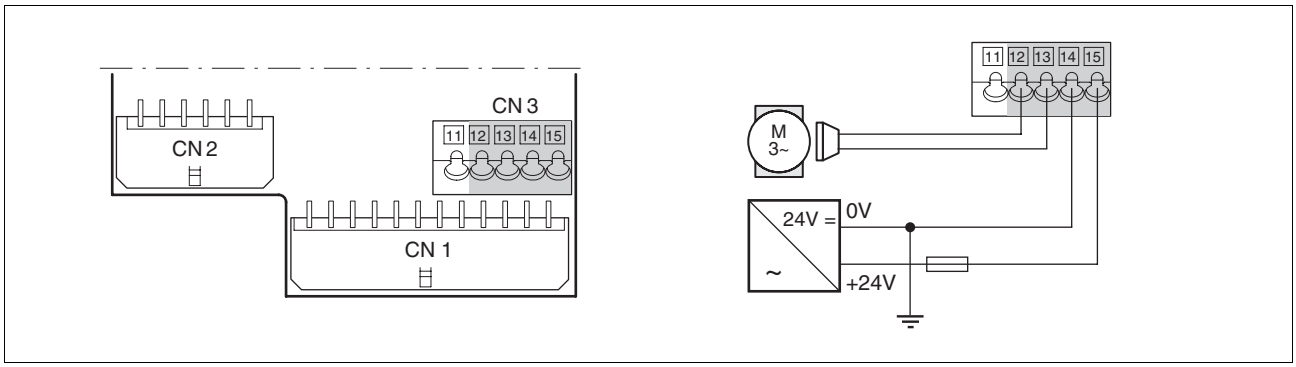

Figure 4.19 Wiring diagram CN3

Pin	Signal	Meaning	I/O
11	RM-FAULT_OUT	Error message rotation monitoring	O
12	+BRAKE_OUT	Holding brake connection	O
13	-BRAKE_OUT	Reference potential to +BRAKE_OUT [1]	O
14	0VDC	Reference potential to +24VDC	
15	+24VDC	Controller supply voltage	

1) Internally connected to pin 14

Cable specifications

Minimum conductor cross section		
Controller supply voltage	[mm²]	0.75 (AWG 18)
Holding brake connection	[mm²]	0.75 (AWG 18)
Error message rotation monitoring	[mm²]	0.25 (AWG 22)

Connecting the controller supply voltage

- ▶ Verify that wiring, cables and connected interfaces meet the PELV requirements.
- ▶ Route the controller supply voltage from a power supply unit (PELV) to the device.
- ▶ Ground the negative output at the power supply unit.
- ▶ Note the maximum permissible terminal current when connecting several devices.
- ▶ Verify that the connector locks snap in properly at the housing.

Connecting the outputs

- ▶ Connect the outputs to be used in accordance with the pin assignment.

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4.3.9 Connecting the fan

The connection is only required in the case of device type SD32••U68.

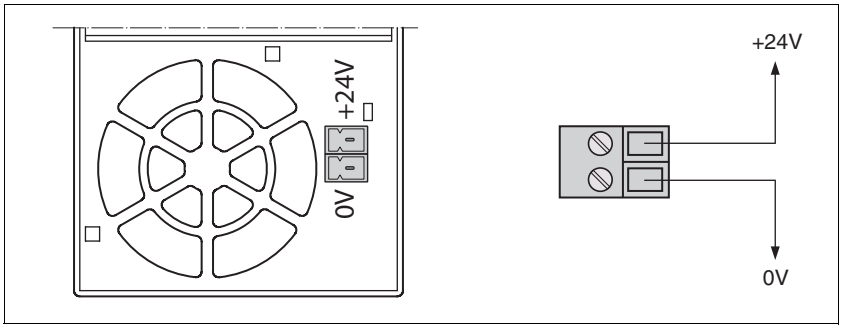

Figure 4.20 Wiring diagram fan

Connecting the supply

- ▶ Verify that wiring and cables meet the PELV requirements.
- ▶ Route the power supply cable from a power supply unit (PELV) to the fan connection.

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4.4 Checking installation

Verify proper installation:

▶ Check the mechanical installation of the entire drive system:

- Does the installation meet the specified distance requirements?
- Did you tighten all fastening screws with the specified torque?

▶ Check the electrical connections and the cabling:

- Did you connect all protective ground conductors?
- Do all fuses have the correct rating; are the fuses of the specified type?
- Did you connect both ends of all live cables or insulate them (no exposed cable ends)?
- Did you properly connect and install all cables and connectors?
- Are the mechanical locks of the connectors correct and effective?
- Did you properly connect the signal wires?
- Are the required shield connections EMC-compliant?
- Did you take all measures for EMC compliance?

▶ Verify that all covers and seals of the control cabinet are properly installed to meet the required degree of protection.

▶ If necessary, remove the cover film
(see chapter 4.2.1 "Mounting the device").

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5 Commissioning

⚠ DANGER

UNINTENDED CONSEQUENCES OF EQUIPMENT OPERATION

When the system is started, the drives are usually out of the operator's view and cannot be visually monitored.

- Only start the system if there are no persons in the hazardous area.

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

⚠ WARNING

UNINTENDED BEHAVIOR

The behavior of the drive system is governed by numerous stored data or settings. Unsuitable settings or data may trigger unexpected movements or responses to signals 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 fault 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

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.

- Perform the first test run without coupled loads.
- Verify that a functioning button for EMERGENCY STOP is within reach.
- Anticipate movements in the incorrect direction or oscillation of the drive.
- 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.

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⚠ CAUTION

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 injury or equipment damage.

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5.1 Overview

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

To be done

Chapter	Page
4.4 "Checking installation"	59
5.2.2 "Setting parameter switch S1"	64
5.2.3 "Setting parameter switch S2"	68
5.2.4 "Test operation of the motor"	69

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5.2 Commissioning procedure

5.2.1 Overview of parameter switches

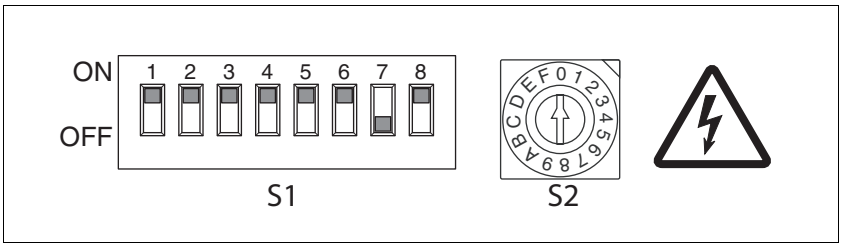

Figure 5.1 Overview of parameter switches

The parameter switches are at mains potential. Settings may only be made with suitable, insulated tools and if no voltage is present and the DC bus is discharged.

5.2.2 Setting parameter switch S1

⚠ DANGER

ELECTRIC SHOCK

The parameter switches are at mains potential.

- Only operate the switches if there is no voltage present.
- Only use appropriately insulated tools.

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

Setting the number of steps

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

Example: At a number of steps of 1000, the drive executes exactly one complete motor revolution at 1000 pulses.

At a pulse frequency of 1 kHz this corresponds to a speed of rotation 60 min^{-1}.

▶ Switch off all supply voltages. Verify that no voltages are present (safety instructions).

▶ Use parameter switches S1.1 to S1.3 to set the number of steps.

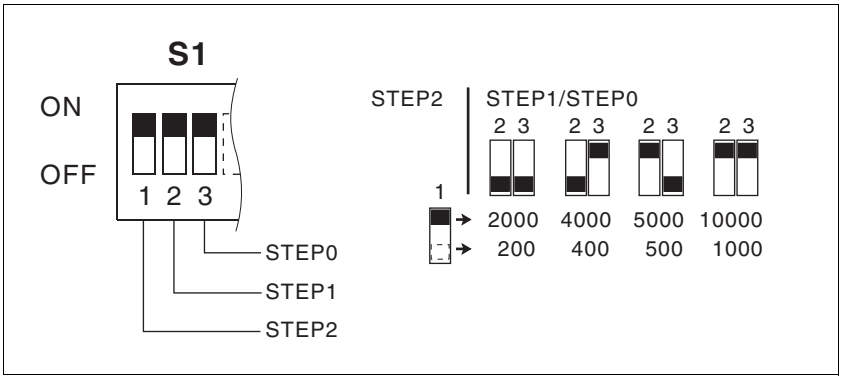

Figure 5.2 Setting the number of steps

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The "STEP2" setting can be inverted with the STEP2_INV input signal.

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, switch on the current reduction.

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

Motor and electrics heat up less and the efficiency is improved.

100 ms after the rising edge at PULSE, the motor phase current is reduced to approximately 60 % of the set motor phase current.

▶ Switch off all supply voltages. Verify that no voltages are present (safety instructions).

▶ Activate or deactivate current reduction with parameter switch S1.4.

Switch setting S1.4	Meaning
ON (factory setting)	Function "Current reduction" activated
OFF	Function "Current Reduction" deactivated

Setting the type of Enable

Parameter switch S1.5 allows you to set the type of Enable.

For a description of the function, see chapter 6.1 "Functions".

▶ Switch off all supply voltages. Verify that no voltages are present (safety instructions).

▶ Use parameter switch S1.5 to set the function to "GATE" or "ENABLE".

Switch setting S1.5	Meaning
ON (factory setting)	Function "GATE" Block or release reference values
OFF	Function "ENABLE" Enable/disable power stage

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Setting the interface mode

Parameter switch S1.6 allows you to set the interface mode.

For a description of the function, see chapter 6.1 "Functions".

- ▶ Switch off all supply voltages. Verify that no voltages are present (safety instructions).
- ▶ Use parameter switch S1.6 to set the type of reference value supply to "PULSE/DIR" or "CW/CCW".

Switch setting S1.6	Meaning
ON (factory setting)	Interface mode "PULSE/DIR"
OFF	Interface mode "CW/CCW"

Setting the "Softstep"

Parameter switch S1.7 allows you to set the "Softstep" function.

If the function is active, the signals at the reference value interface are internally smoothed. As a result, the motor operation is significantly smoother, particularly at low speeds or if the reference values change.

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

You can calculate the position deviation using the following formula:

- Position deviation in degrees = speed of rotation in min^{-1} / 8
- Position deviation in revolutions = speed of rotation 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 S1.7 to activate or deactivate the Softstep function.

Switch setting S1.7	Meaning
ON	"Softstep" function activated
OFF (factory setting)	"Softstep" function deactivated

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Setting rotation monitoring

This parameter switch has no function in the case of devices without rotation monitoring.

In the case of devices with rotation monitoring, parameter switch S1.8 allows you to deactivate rotation monitoring.

- ▶ Switch off all supply voltages. Verify that no voltages are present (safety instructions).
- ▶ Use parameter switch S1.8 to activate or deactivate rotation monitoring.

Switch setting S1.8	Meaning
ON (factory setting)	Rotation monitoring activated
OFF	Rotation monitoring deactivated

If rotation monitoring is activated and the encoder cable is connected correctly, the "ENCODER" LED lights up when the device is switched on.

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5.2.3 Setting parameter switch S2

⚠ DANGER

ELECTRIC SHOCK

The parameter switches are at mains potential.

- Only operate the switches if there is no voltage present.
- Only use appropriately insulated tools.

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

Parameter switch S2 allows you to set the nominal motor current.

▶ Switch off all supply voltages. Verify that no voltages are present (safety instructions).

▶ Use parameter switch S2 to set the nominal motor current.

Switch setting S2		SD326•U25	SD326•U68
0 (factory setting)	[A]	0.6	1.7
1	[A]	0.8	2.0
2	[A]	0.9	2.4
3	[A]	1.0	2.7
4	[A]	1.1	3.1
5	[A]	1.3	3.4
6	[A]	1.4	3.7
7	[A]	1.5	4.1
8	[A]	1.6	4.4
9	[A]	1.8	4.8
A	[A]	1.9	5.1
B	[A]	2.0	5.4
C	[A]	2.1	5.8
D	[A]	2.3	6.1
E	[A]	2.4	6.5
F	[A]	2.5	6.8

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5.2.4 Test operation of the motor

Direction of rotation

Rotation of the motor shaft in a positive or negative direction of rotation. Positive direction of rotation is when the motor shaft rotates clockwise as you look at the end of the protruding motor shaft.

Function test

- The type of Enable must be set to "ENABLE".

▶ Switch on the supply voltages.

▶ Check the status indication, see chapter 8.2 "Status indication via LEDs".

▶ Enable the power stage via the ENABLE input.

◁ If there is no error, the "Readiness" output signals ready for operation approx. 500 ms after the power stage is enabled. If rotation monitoring is used, this time is 1.5 s. The motor performs a minor movement (approx. 1.2 °) to adjust rotation monitoring.

▶ Start the first test with a low pulse frequency. If the signal DIR has 0 level, the motor must rotate with positive direction of rotation.

▶ Also perform positioning tests with reversed direction of rotation. A reversal of the active edge at the PULSE signal can cause displacement of the position when the direction is reversed.

If the motor follows the reference values, the motor is correctly controlled.

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6 Operation

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

6.1 Functions

6.1.1 Input PULSE/DIR

Interface mode "PULSE/DIR"

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

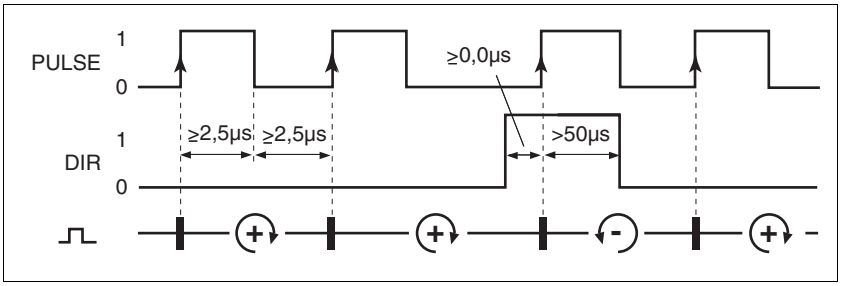

Figure 6.1 Interface mode "PULSE/DIR"

Signal	Signal value	Meaning
PULSE	0 -> 1	Motor movement
DIR	0 / open 1	Positive direction Negative direction of rotation

The maximum frequency is 200 kHz.

6.1.2 Input CW/CCW

Interface mode "CW/CCW"

The motor performs a motor step in positive direction when the edge of the signal CW rises. The motor performs a motor step in negative direction when the edge of the signal CCW falls.

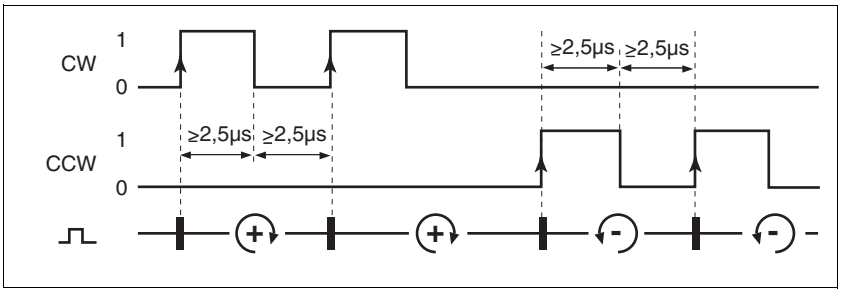

Figure 6.2 Interface mode "CW/CCW"

Signal	Signal value	Meaning
CW	0 -> 1	Motor movement in positive direction
CCW	0 -> 1	Motor movement in negative direction

The maximum frequency is 200 kHz.

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6.1.3 Input ENABLE

Function The input ENABLE enables the power stage.

In the case of a falling edge, an error message is reset.

Signal value	Meaning
1	Enable power stage
0 / open	Disable power stage
Falling edge	Reset error message

If there is no error, the "Readiness" output signals ready for operation approx. 500 ms after the power stage is enabled. If rotation monitoring is used, this time is 1.5 s. The motor performs a minor movement (approx. 1.2 °) to adjust rotation monitoring.

When the signal ENABLE is removed, the power stage remains enabled for about another 100 ms. The allows the holding brake to be completely applied before the motor current is removed. The power stage of motors without holding brake is disabled immediately.

6.1.4 Input GATE

Function The input GATE blocks the signals at the signal interface without disabling the operating readiness. In a multi-axis system, individual axes can be selected with GATE.

Signal value	Meaning
Rising edge	Block signals
Falling edge	Release signals

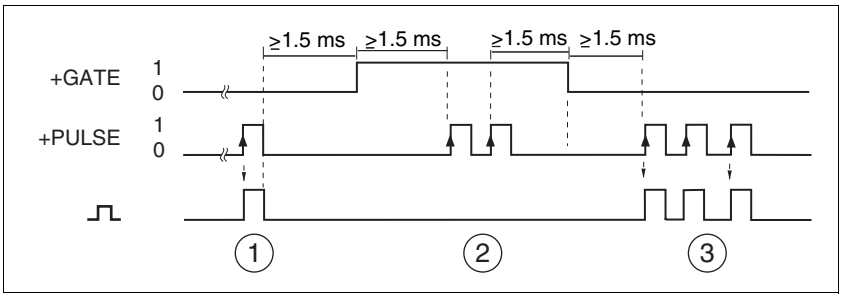

Figure 6.3 Signal sequences in case of activation via GATE

(1) Motor movement
(2) no motor steps
(3) motor steps

No pulse may be applied for 1.5 ms before and after the GATE signal changes so that the drive can follow the pulse step by step.

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6.1.5 Input PWM

The input PWM (**p**ulse **w**idth **m**odulation) allows you to control the motor phase current (and, by implication, the torque). The nominal motor current can be controlled between 0% and 100%.

1 level No motor phase current flows at constant 1 level (current set to zero).

0 level The motor operates with the adjusted nominal motor phase current a constant 0 level.

Square-wave signal The motor phase current can be controlled with a square-wave signal. The pulse-pause ratio determines the value between 0% and 100%. The frequency of the square-wave signal must be between 6 kHz and 25 kHz.

6.1.6 Input STEP2_INV

The STEP2INV input can be used if a high positioning accuracy is required but the output frequency of the master is limited.

The number of steps can be increased or reduced by a factor of 10 with the signal input.

The STEP2_INV input inverts the setting of switch S1.1.

The table below shows an example:

Signal value	S1.1	S1.2	S1.3	Number of motor steps	Explanation
0 / open	0	0	1	400	Number of motor steps as set with switches S1.1 .. S1.3
1	0	0	1	4000	Setting of switch S1.1 is inverted

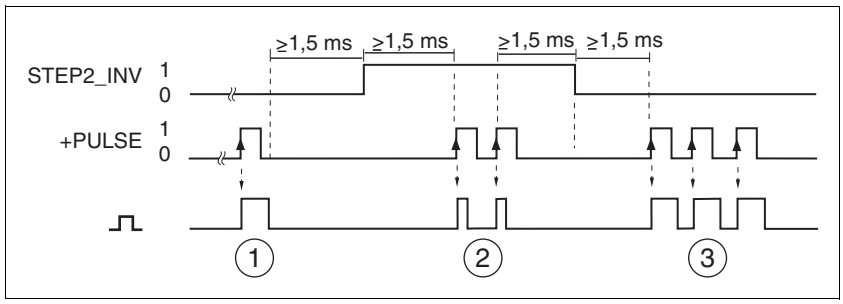

Figure 6.4 Signal sequences when the signal STEP2_INV changes

(1) Large motor step
(2) Motor steps which are smaller by a factor of 10
(3) Large motor steps

No pulse may be applied for 1.5 ms before and after the STEP2_INV signal changes so that the drive can follow the pulse step by step.

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6.1.7 Output "Readiness"

The output ACTIVE_OUT_C / ACTIVE_OUT_NO signals operating readiness.

Signal value	Meaning
Open	Power stage enabled, motor without current
Closed	Power stage disabled, motor has current

6.1.8 Output "Holding Brake" (optional)

The output +BRAKE_OUT controls the holding brake of the motor.

Signal value	Meaning
1	Holding brake released
0	Holding brake applied

6.1.9 Output "Error Message Rotation Monitoring" (optional)

The $\overline{\text{RM-FAULT\_OUT}}$ output provides a rotation monitoring error message signal.

Signal value	Meaning
1	No error
0	Error message signaled by rotation monitoring

If rotation monitoring is activated and the encoder cable is connected correctly, the "ENCODER" LED lights up when the device is switched on.

6.1.10 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:

Monitoring	Task
Overvoltage and undervoltage	Monitors for overvoltage and undervoltage of the supply voltage
Overtemperature	Monitors the device for overtemperature
Rotation monitoring (optional)	Monitors the motor movement and the motor temperature
Short circuit / ground fault	Monitors for short circuit between motor phase and motor phase and between motor phase and ground

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7 Examples

7.1 Wiring example

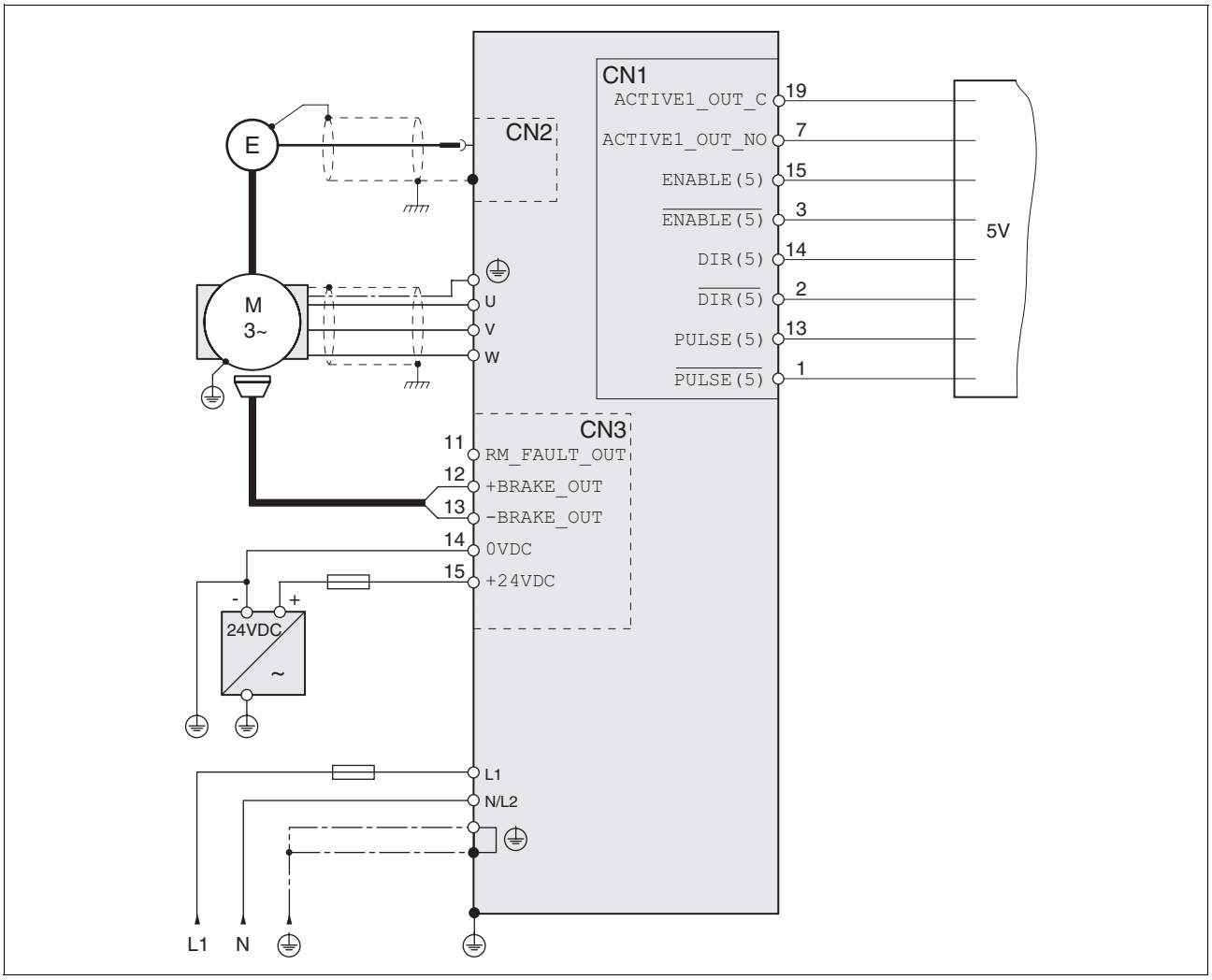

Figure 7.1 Wiring example

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8 Diagnostics and troubleshooting

8.1 Service

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 (such as 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.

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8.2 Status indication via LEDs

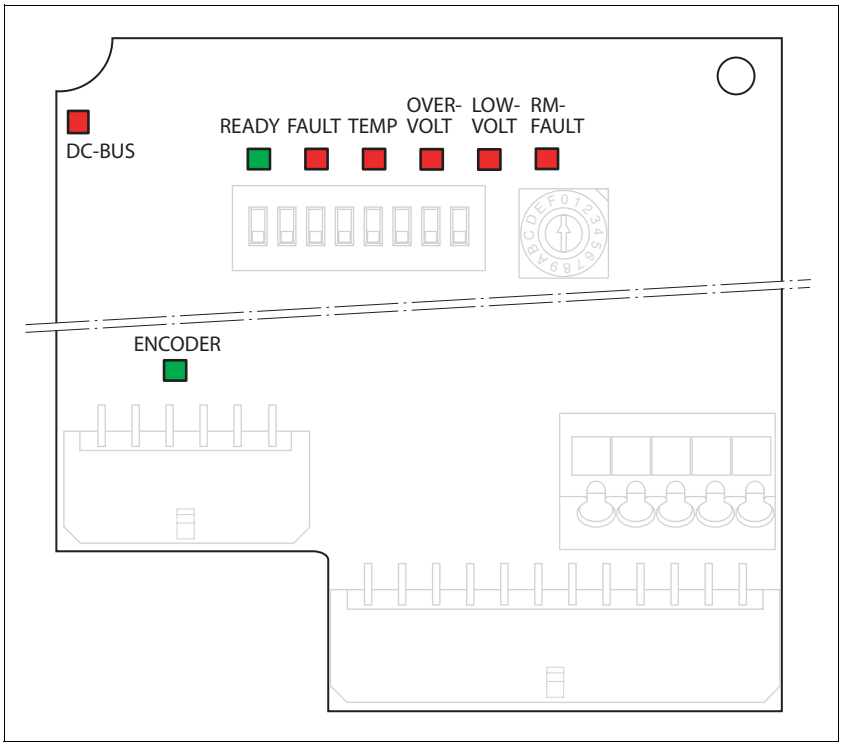

Figure 8.1 Status indication via LEDs

The current operating state is indicated by means of LEDs.

LED	Meaning
DC BUS	DC bus under voltage
READY	Ready, power stage enabled, motor has current
FAULT	Short circuit between 2 motor phases or between motor phase and ground
TEMP (steady) TEMP (flashing [1)])	Power stage overtemperature Motor overtemperature
OVER-VOLT	Overvoltage (DC bus >420V_{DC})
LOW-VOLT	Undervoltage (DC bus <180V_{DC})
RM-FAULT [1)]	Error message signaled by rotation monitoring
OVER-VOLT, LOW-VOLT	Power stage disabled, motor without current
FAULT, TEMP, OVER-VOLT, LOW-VOLT	Frequency at signal interface too high
ENCODER [1)]	Encoder connected and ready

1) SD326R only

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8.3 Troubleshooting

8.3.1 Troubleshooting problems

Problem	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 PWM has level 1	Check input signal.
	Signal input ENABLE has level 0	Enable power stage.
Motor does not rotate and has no holding torque	Motor blocked by holding brake	Release holding brake, check wiring.
	Motor mechanically blocked	Check coupled components.
	Signal input GATE has level 1	Check input signal.
Motor rotates unevenly	Overload	Reduce load.
	Motor problem	Replace motor.
Motor rotates in the wrong direction	Motor phases reversed	Check motor phases.
	Signal input DIR has incorrect level	Check input signal.
LED FAULT	Short circuit between 2 motor phases or between motor phase and ground	Checking wiring.
LED TEMP (steady)	Power stage overtemperature	Check temperature in control cabinet, use current reduction.
LED TEMP (flashing)	Motor overtemperature	Allow motor to cool down, use motor with greater nominal power, use current reduction for power reduction.
	Interruption of signal $\overline{\text{T\_MOT}}$, encoder cable not plugged in	Check encoder cable.
	24V controller supply voltage not connected or switched off	Check 24 V controller supply voltage.
LED OVER-VOLT	Overvoltage caused by regeneration condition during deceleration	Use less steep deceleration ramp. Error message must be reset.
LED LOW-VOLT	Undervoltage	Check mains voltage and connections.

Reset error message

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

If the "Gate" function is used, the input ENABLE is not available. The error message can only be reset by disconnecting the mains supply.

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9 Accessories and spare parts

9.1 Optional accessories

Designation	Order no.
Fan kit 24 VDC	VW3S3101

9.2 Motor cables

Designation	Order no.
Motor cable for stepper motor 4x1.5, shielded, 6-pin circular plug at the motor end; other cable end = open; length= 3m	VW3S5101R30
Motor cable for stepper motor 4x1.5, shielded, 6-pin circular plug at the motor end; other cable end = open; length= 5m	VW3S5101R50
Motor cable for stepper motor 4x1.5, shielded, 6-pin circular plug at the motor end; other cable end = open; length= 10m	VW3S5101R100
Motor cable for stepper motor 4x1.5, shielded, 6-pin circular plug at the motor end; other cable end = open; length= 15m	VW3S5101R150
Motor cable for stepper motor 4x1.5, shielded, 6-pin circular plug at the motor end; other cable end = open; length= 20m	VW3S5101R200
Motor cable for stepper motor 4x1.5 shielded, both cable ends = open; length= 3m	VW3S5102R30
Motor cable for stepper motor 4x1.5 shielded, both cable ends = open; length= 5m	VW3S5102R50
Motor cable for stepper motor 4x1.5 shielded, both cable ends = open; length= 10m	VW3S5102R100
Motor cable for stepper motor 4x1.5 shielded, both cable ends = open; length= 15m	VW3S5102R150
Motor cable for stepper motor 4x1.5 shielded, both cable ends = open; length= 20m	VW3S5102R200

9.3 Encoder cables

Designation	Order no.
Encoder cable for stepper motor, shielded, motor end with 12 pole round connector; other cable end 12-pin Molex connector; Length = 3m	VW3S8101R30
Encoder cable for stepper motor; shielded; motor end with 12 pole round connector; other cable end 12-pin Molex connector; Length = 5m	VW3S8101R50
Encoder cable for stepper motor; shielded; motor end with 12 pole round connector; other cable end 12-pin Molex connector; Length = 10m	VW3S8101R100
Encoder cable for stepper motor; shielded; motor end with 12 pole round connector; other cable end 12-pin Molex connector; Length = 15m	VW3S8101R150
Encoder cable for stepper motor; shielded; motor end with 12 pole round connector; other cable end 12-pin Molex connector; Length = 20m	VW3S8101R200
Connector set, Molex connector 12 pole, with crimp contacts, 5 pieces	VW3M8213

9.4 Signal cables

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Designation	Order no.
Pulse/dir., 5V, shielded, the cable has a 24-pin Molex connector at the device end; other cable end = open; length 0.5m	VW3S8201R05
Pulse/dir., 5V, shielded, the cable has a 24-pin Molex connector at the device end; other cable end = open; length 1.5m	VW3S8201R15
Pulse/dir., 5V, shielded, the cable has a 24-pin Molex connector at the device end; other cable end = open; length 3.0m	VW3S8201R30
Pulse/dir., 5V, shielded, the cable has a 24-pin Molex connector at the device end; other cable end = open; length 5.0m	VW3S8201R50
Pulse/dir., 24V, shielded, the cable has a 24-pin Molex connector at the device end; other cable end = open; length 0.5m	VW3S8202R05
Pulse/dir., 24V, shielded, the cable has a 24-pin Molex connector at the device end; other cable end = open; length 1.5m	VW3S8202R15
Pulse/dir., 24V, shielded, the cable has a 24-pin Molex connector at the device end; other cable end = open; length 3.0m	VW3S8202R30
Pulse/dir., 24V, shielded, the cable has a 24-pin Molex connector at the device end; other cable end = open; length 5.0m	VW3S8202R50
Pulse/dir. to =S= Premium CFY connection cable; the cable has a 24-pin Molex connector at the drive end, CFY end with 15-pin SubD connector; length 1.5m	VW3S8204R15
Pulse/dir. to =S= Premium CFY connection cable; the cable has a 24-pin Molex connector at the drive end, CFY end with 15-pin SubD connector; length 3m	VW3S8204R30
Pulse/dir. to Siemens S7-300 FM353 connection cable; the cable has a 24-pin Molex connector at the drive end, FM353 end with 15-pin SubD15 socket; length 1.5m	VW3S8206R15
Pulse/dir. to Siemens S7-300 FM353 connection cable; the cable has a 24-pin Molex connector at the drive end, FM353 end with 15-pin SubD15 socket; length 3m	VW3S8206R30
P/R, to TLM2 or WP/WPM 311 connection cable; the cable has a 24-pin Molex connector at the drive end, other end with SubD15 socket; length 0.5m	VW3S8208R05
P/R, to TLM2 or WP/WPM 311 connection cable; the cable has a 24-pin Molex connector at the drive end, other end with SubD15 socket; length 1.5m	VW3S8208R15
P/R, to TLM2 or WP/WPM 311 connection cable; the cable has a 24-pin Molex connector at the drive end, other end with SubD15 socket; length 3.0m	VW3S8208R30
P/R, to TLM2 or WP/WPM 311 connection cable; the cable has a 24-pin Molex connector at the drive end, other end with SubD15 socket; length 5.0m	VW3S8208R50
Connector kit with 5 Molex connectors 24-pin with crimp contacts	VW3S8212

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9.5 Mains filter

Designation	Order no.
Mains filter 1~; 9A; 115/230V_{ac}	VW3A31401

9.6 Mains reactors

Designation	Order no.
Mains reactor 1~; 50-60Hz; 7A; 5mH; IP00	VZ1L007UM50
Mains reactor 1~; 50-60Hz; 18A; 2mH; IP00	VZ1L018UM20

9.7 Mounting material

Designation	Order no.
Adapter plate for DIN rail mounting, width 77.5mm	VW3A11851

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10 Service, maintenance and disposal

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 (such as 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.

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10.3 Replacing devices

⚠ WARNING

UNINTENDED BEHAVIOR

The behavior of the drive system is governed by numerous stored data or settings. Unsuitable settings or data may trigger unexpected movements or responses to signals 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 fault 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.

Observe the following procedure when replacing devices.

▶ 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 Changing the motor

▶ 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".

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10.5 Shipping, storage, disposal

Note the ambient conditions on page 21.

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 for room temperature and humidity are met. Protect the product from dust and dirt.

Disposal The product consists of various materials that can be recycled and must be disposed of separately. Dispose of the product in accordance with local regulations.

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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 complete product manual.

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

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11.1 Extract for installation and commissioning

11.1.1 Overview

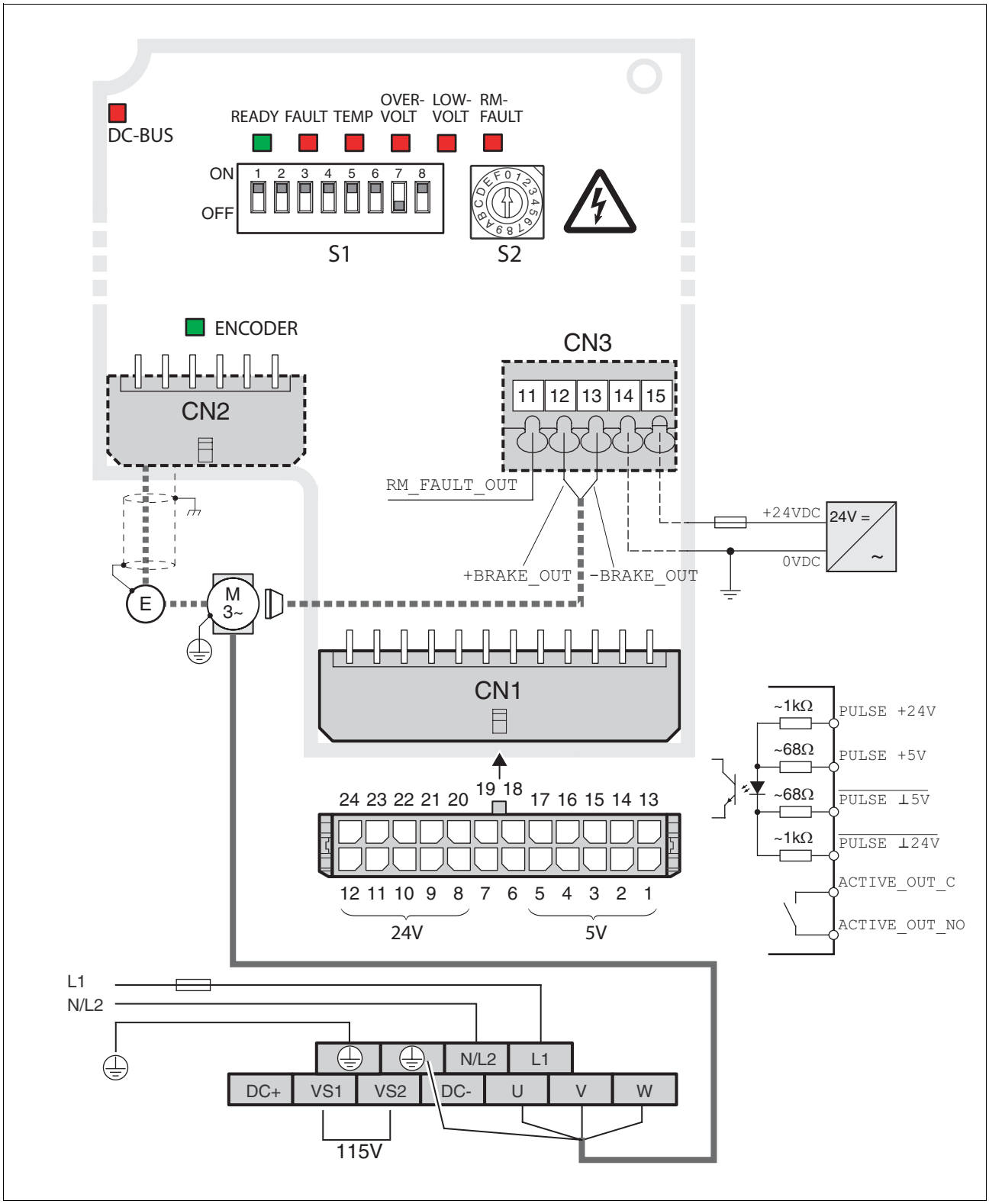

Figure 11.1 Wiring overview

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11.1.2 Settings for parameter switches S1 and S2

The parameter switches are at mains potential. Settings may only be made with suitable, insulated tools and if no voltage is present and the DC bus is discharged.

- ▶ Switch all supply voltages off before making any settings to S1 or S2. Verify that no voltages are present.

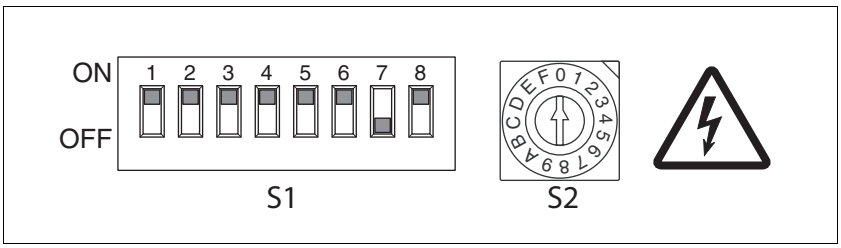

Figure 11.2 Overview of parameter switches

For more information, see chapter "Commissioning".

11.1.2.1 Settings for parameter switch S1

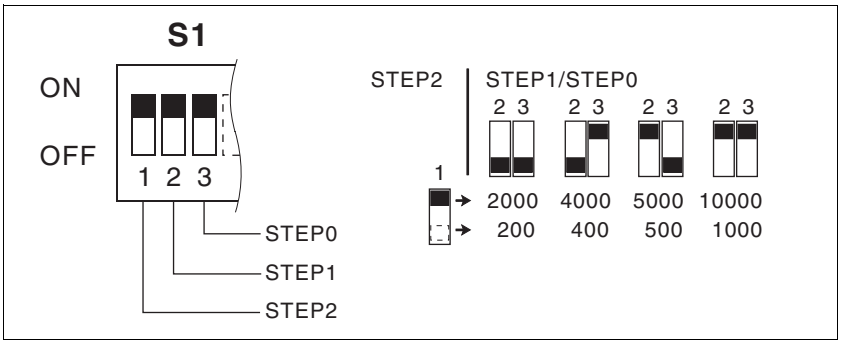

Figure 11.3 Setting the number of steps with S1.1..S1.3

The "STEP2" setting can be inverted with the STEP2_INV input signal.

	Meaning	On	Off
S1.4	Current reduction [1]	Function "Current reduction" activated [2]	Function "Current Reduction" deactivated
S1.5	Type of enable	Function "GATE" Block or release reference values [2]	Function "ENABLE" Enable/disable power stage
S1.6	Interface mode	Interface mode "PULSE/DIR" [2]	Interface mode "CW/CCW"
S1.7	Softstep	"Softstep" function activated	Function "Softstep" deactivated [2]
S1.8	Rotation monitoring	Rotation monitoring activated [2]	Rotation monitoring deactivated

1) Activated current reduction reduces the motor torque at standstill. Axes subject to external forces may move!
2) Factory setting

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11.1.2.2 Settings for parameter switch S2

Parameter switch S2 allows you to set the nominal motor current.

Switch setting S2		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
SD326•U25	[A]	0.6	0.8	0.9	1.0	1.1	1.3	1.4	1.5	1.6	1.8	1.9	2.0	2.1	2.3	2.4	2.5
SD326•U68	[A]	1.7	2.0	2.4	2.7	3.1	3.4	3.7	4.1	4.4	4.8	5.1	5.4	5.8	6.1	6.5	6.8

11.1.3 Signal interface CN1

Connection assignment CN1: 5V or 24V signals

Either 5V **or** 24V Signale may be connected!

Pin 5V	Pin 24V	Signal	Color [1)]	Pair	Meaning	I/O
13	20	PULSE CW	White	1	Motor step (+) Motor step positive direction of rotation (+)	I
1	8	$\overline{\text{PULSE}}$ $\overline{\text{CW}}$	Brown	1	Motor step, inverted (-) Motor step positive direction of rotation, inverted (-)	I
14	21	DIR CCW	Green	2	Direction of rotation (+) Motor step negative direction of rotation (+)	I
2	9	$\overline{\text{DIR}}$ $\overline{\text{CCW}}$	Yellow	2	Direction of rotation, inverted (-) Motor step negative direction of rotation, inverted (-)	I
15	22	GATE ENABLE	Gray	3	Reference values locked (+) Power stage enable (+)	I
3	10	$\overline{\text{GATE}}$ $\overline{\text{ENABLE}}$	Pink	3	Reference values locked, inverted (-) Power stage enable, inverted (-)	I
16	23	STEP2_INV	Black	4	Switching angular resolution (+)	I
4	11	$\overline{\text{STEP2\_INV}}$	Violet	4	Switching angular resolution, inverted (-)	I
17	24	PWM	Blue	5	Control of motor phase current (+)	I
5	12	$\overline{\text{PWM}}$	Red	5	Control of motor phase current, inverted (-)	I
19	19	ACTIVE_OUT_C	Gray/pink	6	Readiness	O
7	7	ACTIVE_OUT_NO	Red/blue	6	Readiness	O
6.18	6.18				Not assigned	

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

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11.1.4 Test operation of the motor

Direction of rotation

Rotation of the motor shaft in a positive or negative direction of rotation. Positive direction of rotation is when the motor shaft rotates clockwise as you look at the end of the protruding motor shaft.

Function test

- The type of Enable must be set to "ENABLE".
- ▶ Switch on the supply voltages.
- ▶ Check the status indication, see chapter 8.2 "Status indication via LEDs".
- ▶ Enable the power stage via the ENABLE input.
- ◁ If there is no error, the "Readiness" output signals ready for operation approx. 500ms after the power stage is enabled. If rotation monitoring is used, this time is 1.5 s. The motor performs a minor movement (approx. 1.2°) to adjust rotation monitoring.
- ▶ Start the first test with a low pulse frequency. If the signal DIR has 0 level, the motor must rotate with positive direction of rotation.
- ▶ Also perform positioning tests with reversed direction of rotation. A reversal of the active edge at the PULSE signal can cause displacement of the position when the direction is reversed.

If the motor follows the reference values, the motor is correctly controlled.

11.1.5 Operating state via LED

The current operating state is indicated by means of LEDs.

LED	Meaning
DC BUS	DC bus under voltage
READY	Ready, power stage enabled, motor has current
FAULT	Short circuit between 2 motor phases or between motor phase and ground
TEMP (steady) TEMP (flashing [1)])	Power stage overtemperature Motor overtemperature
OVER-VOLT	Overvoltage (DC bus >420V_{DC})
LOW-VOLT	Undervoltage (DC bus <180V_{DC})
RM-FAULT [1)]	Error message signaled by rotation monitoring
OVER-VOLT, LOW-VOLT	Power stage disabled, motor without current
FAULT, TEMP, OVER-VOLT, LOW-VOLT	Frequency at signal interface too high
ENCODER [1)]	Encoder connected and ready

1) SD326R only

For more information, see chapters "Commissioning" and "Diagnostics".

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12 Glossary

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 m / 0.9144 = 5.468 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	-	* $1.942559*10^{-3}$	* 0.02834952	* 28.34952
slug	/ 0.03108095	/ $1.942559*10^{-3}$	-	* 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	* $9.807*10^{-3}$
dyne	/ 444822.2	/ 27801	/ 980.7	-	/ $100*10^{3}$
N	/ 4.448222	/ 0.27801	/ $9.807*10^{-3}$	* $100*10^{3}$	-

12.1.4 Power

	HP	W
HP	-	* 746
W	/ 746	-

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12.1.5 Rotation

	min^{-1} (RPM)	rad/s	deg./s
min^{-1} (RPM)	-	* π / 30	* 6
rad/s	* 30 / π	-	* 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

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12.2 Terms and Abbreviations

See chapter 2.6 "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.

AC Alternating current

DC Direct current

Default value Factory setting.

Degree of protection 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).

Direction of rotation Rotation of the motor shaft in a positive or negative direction of rotation. Positive direction of rotation is when the motor shaft rotates clockwise as you look at the end of the protruding motor shaft.

Drive system System consisting of controller, power stage and motor.

DOM The **D**ate **o**f **m**anufacturing on the nameplate of the device is shown in the format DD.MM.YY,
for example 31.12.06 (December 31, 2006).

EMC Electromagnetic compatibility

Error Discrepancy between a computed, observed or measured value or condition and the specified or theoretically correct value or condition.

Error class Classification of errors into groups. The different error classes allow for specific responses to faults, for example by severity.

Fatal error In the case of fatal error, the product is no longer able to control the motor so that the power stage must be immediately disabled.

Fault Operating state of the drive caused as a result of a discrepancy between a detected (computed, measured or signaled) value or condition and the specified or theoretically correct value or condition.

Fault reset A function used to restore the drive to an operational state after a detected error is cleared by removing the cause of the error so that the error is no longer active (transition from operating state "Fault" to state "Operation Enable").

Holding brake The motor holding brake has the task of blocking the motor shaft when no current is supplied to the motor (for example, in the case of a vertical axis). The holding brake is not a safety function.

Inc Increments

IT mains Mains in which all active components are isolated from ground or are grounded by a high impedance. IT: isolé terre (French), isolated ground. Opposite: Grounded mains, see TT/TN mains

Parameter switch The parameter switches are small switches adjacent to each other that allow you to make settings.

PELV Protective Extra Low Voltage, low voltage with isolation. For more information: IEC 60364-4-41

PLC Programmable logic controller

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Power stage	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.
PTC	Resistor with positive temperature coefficient. Resistance value increases as the temperature rises.
Pulse/direction signals	Digital signals with variable pulse frequencies which signal changes in position and direction of rotation via separate signal wires.
RCD	Residual Current Device
rms	Root Mean Square value of a voltage (V_{rms}) or a current (A_{rms})
TT mains, TN mains	Grounded mains, differ in terms of the ground connection (PE conductor connection). Opposite: Ungrounded mains, see IT mains.
Warning	If the term is used outside the context of safety instructions, a warning alerts to a potential problem that was detected by a monitoring function. A warning is not an error and does not cause a transition of the operating state.

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