

# SD326

Stepper motor drive

Product manual

V2.00, 09.2008



## Important information

This manual is part of the product.

Carefully read this manual and observe all instructions.

Keep this manual for future reference.

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

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

Some products are not available in all countries.

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

Subject to technical modifications without notice.

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

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

## Table of Contents

<b>Important information</b> .....	<b>2</b>
<b>Table of Contents</b> .....	<b>3</b>
<b>Writing conventions and symbols</b> .....	<b>7</b>
<b>1 Introduction</b> .....	<b>9</b>
1.1 About this manual .....	9
1.2 Unit overview .....	9
1.3 Scope of supply .....	10
1.4 Components and interfaces .....	11
1.5 Type code .....	12
1.6 Documentation and literature references .....	13
1.7 Declaration of conformity .....	14
<b>2 Before you begin - safety information</b> .....	<b>15</b>
2.1 Qualification of personnel .....	15
2.2 Intended use .....	15
2.3 Hazard categories .....	16
2.4 Basic information .....	17
2.5 Standards and terminology .....	18
<b>3 Technical Data</b> .....	<b>19</b>
3.1 Certifications .....	19
3.2 Ambient conditions .....	19
3.2.1 Degree of protection .....	20
3.3 Mechanical data .....	20
3.3.1 Dimensions .....	20
3.4 Electrical Data .....	21
3.4.1 Performance data for power amplifier .....	21
3.4.2 Interface CN1 .....	22
3.4.3 CN2 interface (optional) .....	22
3.4.4 CN3 interface (optional) .....	23
3.4.5 Fan .....	23
3.4.6 Mains filter .....	24
3.5 Technical Data accessories .....	25
3.5.1 Cable .....	25
3.6 Conditions for UL 508C .....	25
<b>4 Installation</b> .....	<b>27</b>

4.1	Electromagnetic compatibility, EMC	28
4.1.1	Operation in an IT mains	32
4.2	Mechanical installation	33
4.2.1	Mounting the device	34
4.2.2	Mounting mains filters	37
4.3	Electrical installation	38
4.3.1	Overview of procedure	40
4.3.2	Overview of all connections	41
4.3.3	Connection of motor phases	42
4.3.4	Connection of DC bus	45
4.3.5	Connection:Mains supply	46
4.3.6	Connection of signal interface (CN1)	48
4.3.7	Connection of rotation monitoring (CN2)	52
4.3.8	Connection of outputs and controller supply voltage (CN3)	55
4.3.9	Fan connection	57
4.4	Checking installation	58
<b>5</b>	<b>Commissioning</b>	<b>59</b>
5.1	Overview	61
5.2	Commissioning procedure	62
5.2.1	Overview of parameter switches	62
5.2.2	Setting parameter switch S1	62
5.2.3	Setting parameter switch S2	65
5.2.4	Test operation of the motor	66
<b>6</b>	<b>Operation</b>	<b>67</b>
6.1	Functions	67
6.1.1	Input PULSEDIR	67
6.1.2	Input CWCCW	67
6.1.3	Input ENABLE	68
6.1.4	Input GATE	68
6.1.5	Input PWM	69
6.1.6	Input STEP2_INV	69
6.1.7	"Ready" output	70
6.1.8	"Holding brake" output (optional)	70
6.1.9	"Rotation monitoring error message" output (optional)	70
<b>7</b>	<b>Examples</b>	<b>71</b>
7.1	Wiring example	71
<b>8</b>	<b>Diagnostics and troubleshooting</b>	<b>73</b>
8.1	Service	73
8.2	Status display via LEDs	74
8.3	Troubleshooting	75
8.3.1	Troubleshooting	75

<b>9</b>	<b>Accessories and spare parts</b>	<b>77</b>
9.1	Optional accessories	77
9.2	Motor cables	77
9.3	Encoder cable	77
9.4	Signal cable	78
9.5	Mains filter	78
9.6	Installation material	78
<b>10</b>	<b>Service, maintenance and disposal</b>	<b>79</b>
10.1	Service address	80
10.2	Maintenance	80
10.3	Replacing units	81
10.4	Changing the motor	81
10.5	Shipping, storage, disposal	82
<b>11</b>	<b>Extract</b>	<b>83</b>
11.1	Extract for installation and commissioning	83
11.1.1	Overview	84
11.1.2	Settings for parameter switches S1 and S2	85
11.1.3	Signal interface CN1	86
11.1.4	Test operation of the motor	87
11.1.5	Operating state via LED	87
<b>12</b>	<b>Glossary</b>	<b>89</b>
12.1	Units and conversion tables	89
12.1.1	Length	89
12.1.2	Mass	89
12.1.3	Force	89
12.1.4	Power	89
12.1.5	Rotation	90
12.1.6	Torque	90
12.1.7	Moment of inertia	90
12.1.8	Temperature	90
12.1.9	Conductor cross section	90
12.2	Terms and Abbreviations	91
<b>13</b>	<b>Index</b>	<b>93</b>



## 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<sup>2</sup> (AWG 14)



# 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 Unit overview

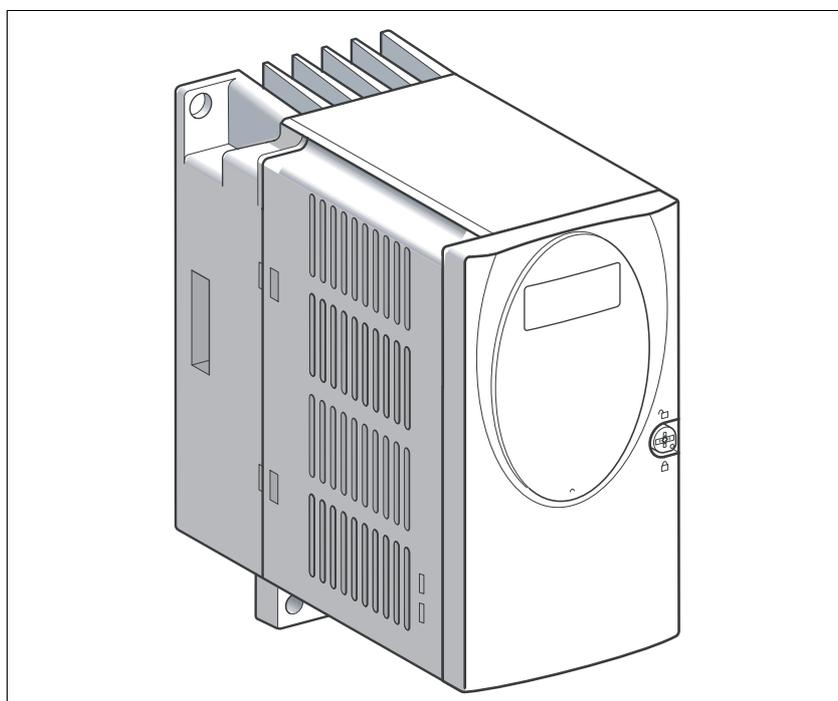


Figure 1.1 Device overview

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

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

An input panel (HMI, **H**uman-**M**achine-**I**nterface) with display and keypad is installed in the front panel for easy parameterization.

*Signal interface* The reference value is preset incrementally as a pulse signal via the signal interface. Control signals are also sent to enable the power stage and to change the step resolution and the current reference value.

An output signal signals operating readiness.

*Rotation monitoring / motor monitoring*

If a stepper motor is connected to an integrated encoder, the following functions can be enabled:

- **Rotation monitoring:**  
The calculated reference position and the actual position of the motor are compared. If a permanently defined variation is exceeded a rotation monitoring error is reported.
- **Line monitoring:**  
The encoder cable is monitored. If the encoder supply is interrupted, no readiness will be signaled for the encoder.
- **Motor temperature monitoring:**  
The device shuts off if the motor temperature is too high.

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

*Holding brake output*

The device has an output for direct connection of a holding brake.

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

1.3 Scope of supply

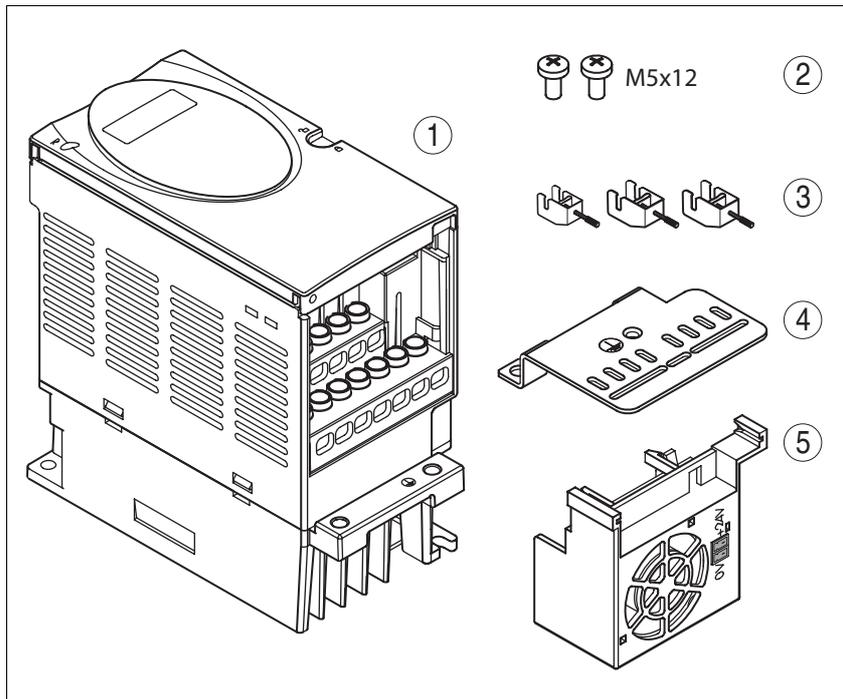


Figure 1.2 Scope of supply

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

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## 1.4 Components and interfaces

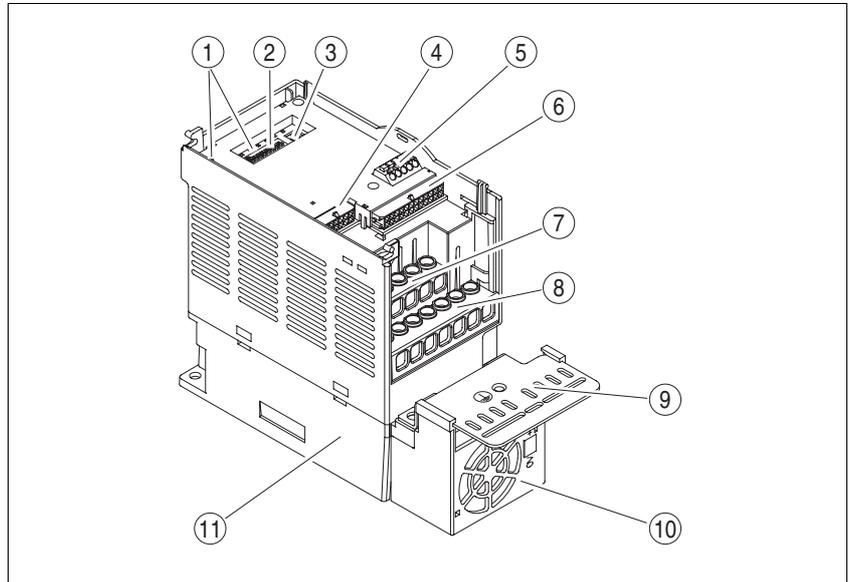


Figure 1.3 Components and interfaces

- (1) LEDs for status indication
- (2) Parameter switch for configuration of the device
- (3) Rotary switch for adjustment of the motor current
- (4) CN2 rotation monitoring (12 pole female connector and LED, optional)
- (5) 24V CN3 interface (spring clamp terminals, optional)
  - 24V controller supply voltage
  - 24V outputs
- (6) CN1 signal interface (24 pole female connector)
  - Inputs 5V opto-isolated
  - Inputs 24V opto-isolated
  - "Readiness" output
- (7) Screw terminals for connecting the mains supply
- (8) Screw terminals for connecting the motor
- (9) EMC mounting plate
- (10) Fan (SD326•U68 only)
- (11) Heat sink

## 1.5 Type code

	SD3	26	D	U25	S2
<b>Product designation</b> SD3 = stepper drive 3-phase					
<b>Product type</b> 26 = standard stepper motor drive					
<b>Interfaces</b> D = pulse-direction without rotation monitoring R = pulse-direction with rotation monitoring and holding brake connection					
<b>Maximum motor phase current</b> U25 = 2.5A U68 = 6.8A					
<b>Power stage supply voltage</b> S2 = 1~, 115V <sub>ac</sub> /230V <sub>ac</sub> (selectable)					

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

## 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 product manuals* The current product manuals are available for download from the Internet.

<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>

*Additional literature* We recommend the following literature for more in-depth knowledge:

- No recommendation for literature available.

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

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Type: SD326xUxxS2

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Product number: 0063711110x0x

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Applied harmonized standards, especially: EN 61800-3:2004, second environment  
EN 61800-5-1:2007

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Applied national standards and technical specifications, especially: UL 508C  
Product documentation

---

Schneider Electric Motion Deutschland  
GmbH & Co. KG

Company stamp: 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 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 (e.g. machine design).

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

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

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

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

## 2.3 Hazard categories

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

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

### DANGER

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

### WARNING

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

### CAUTION

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

### CAUTION

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

## 2.4 Basic information

### **⚠ DANGER**

#### **ELECTRIC SHOCK, FIRE, 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.
- The system manufacturer is responsible for compliance with all applicable regulations pertaining to grounding the drive system.
- Many components, including the printed circuit board, operate with mains voltage. **Do not touch.** Do **not** touch unprotected parts or screws of the terminals when they are under voltage.
- Install all covers and close the housing doors before applying voltage.
- The motor generates voltage when the shaft is rotated. Lock the motor shaft to prevent rotation caused by external forces before starting work on the drive system.
- Before working on the drive system:
  - Disconnect the voltage supply to all connections.
  - Place a label "DO NOT SWITCH ON" on the switch and secure the switch against being switched on.
  - **Wait for 6 minutes** (discharge DC bus capacitors). Do **not** short-circuit DC bus!
  - Measure the voltage on DC bus and verify that it is <42V. (The DC bus LED is not a reliable indicator for the absence of DC bus voltage).

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

### **⚠ 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****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.<sup>1)</sup>
- 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.

## 2.5 Standards and terminology

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

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

### 3 Technical Data

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

#### 3.1 Certifications

Product certifications:

Certified by	Assigned number	Validity
UL	File E153659	

#### 3.2 Ambient conditions

*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 <sup>1) 2)</sup>	[°C]	0 ... +50
--	------	-----------

1) no icing

2) With use according to UL 508C, the notes in chapter 3.6 "Conditions for UL 508C" must be adhered to.

*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
-------------	------	-------------

*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 height with max ambient temperature 40°C, without protective film and with a side distance >50 mm	[m]	≤2000
--	-----	-------

*Vibration and shock*

Vibration, sinusoidal	As per IEC/EN 60068-2-6 1.5 mm (from 3 Hz ... 13 Hz) 10 m/s <sup>2</sup> (from 13 Hz ... 150 Hz)
-----------------------	--

Shock, semi-sinusoidal	As per IEC/EN 60068-2-27 150 m/s <sup>2</sup> (11 ms)
------------------------	--

### 3.2.1 Degree of protection

The devices have the degree of protection IP20. The degree of protection IP40 is met for the top of the housing if the protective film on top of the device has not been removed. The protective film may need to be removed because of the ambient temperature or the device clearances, see chapter 4.2.1 "Mounting the device" page 34.

## 3.3 Mechanical data

### 3.3.1 Dimensions

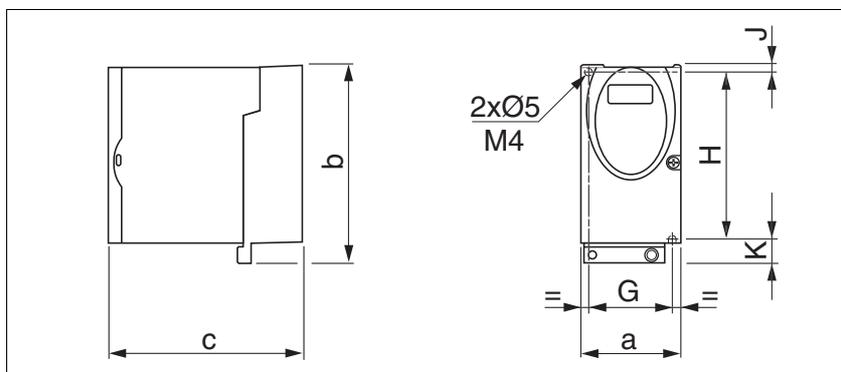


Figure 3.1 Dimensions

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 <sup>1)</sup>	Fan
DIN rail installation	[mm]	77.5 <sup>2)</sup>	77.5 <sup>2)</sup>

1) >1 m/s

2) Width of adapter plate

### 3.4 Electrical Data

#### 3.4.1 Performance data for power amplifier

##### Performance data

SD32••...		U25S2	U68S2
Nominal voltage (switching)	[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 <sup>-1</sup> ]	3000	3000
Nominal power (115V/230V) (Device power output)	[W]	180/270	280/420
Max. allowable short circuit current of mains	[kA]	0.5	0.5
power loss	[W]	≤26	≤65
Fuse to be connected upstream <sup>1)</sup>	[A]	10	10

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

##### Mains voltage: Range and tolerance

Mains voltage 115 V	[V <sub>AC</sub> ]	100-15 % ... 120+10 %
Mains voltage 230 V	[V <sub>AC</sub> ]	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 - motor cable length <10 m - as per IEC 60990, Figure 3	[mA]	<30 <sup>1)</sup>

1) measured on mains with grounded neutral point, with no external mains filter. When using residual-current devices be aware that a 30 mA residual-current device can trigger at 15 mA. A high-frequency leakage current also flows, which is not considered in the measurement. Residual current devices respond differently to this.

##### Input current and impedance of the mains supply

The specified input current refers to a mains with the specified reference voltage and the assumed short-circuit impedance at nominal power output. The input current depends to a large degree on the impedance of the supply mains. This is expressed by a possible short-circuit current. If the actual mains deviates from this, mains reactors must be installed upstream.

##### Voltage against ground

The isolation of the devices is designed for a rated voltage corresponding to the value of the nominal voltage. The voltage to ground must not exceed these values.

##### Approved motors

Approved motor families: BRS3, ExRDM, VRDM3  
Approved motor voltage: 230V<sub>ac</sub> / 325V<sub>dc</sub>  
The product catalog contains an overview of approved motors.

## 3.4.2 Interface CN1

*5V inputs* The inputs are optocoupler inputs.

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

*24V inputs* The inputs are optocoupler inputs.

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

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

max. switching voltage	[V]	$\leq 30$
max. switching current	[mA]	$\leq 200$
Voltage drop at 50 mA load	[V]	$\leq 1$

## 3.4.3 CN2 interface (optional)

*Rotation monitoring*

<b>Output, ENC+5V_OUT</b>		
Supply voltage	[V]	4.75 ... 5.25
Maximum output current	[mA]	100
SENSE-controlled, short-circuit protected and overload protected		
<b>Inputs, ENC_A / ENC_B</b>		
Signal voltage		Conforming to RS422
Input frequency	[kHz]	$\leq 400$

### 3.4.4 CN3 interface (optional)

*Spring clamp terminals* The spring clamp terminals have the following properties:

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

1) Mechanical conditions must be accounted for

*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 %)
Current consumption <sup>1)</sup>	[A]	≤0.2
Residual ripple	[%]	<5

1) without load on outputs



*The connection to the controller supply voltage +24VDC) is only required when using a holding brake or rotation monitoring.*

*24V output signals*

Output voltage	[V]	≤30
Max. switching current $\overline{\text{RM-FAULT\_OUT}}$	[mA]	50
Maximum switching current $\overline{\text{+BRAKE\_OUT}}$ <sup>1)</sup>	[A]	1.5

1) no voltage reduction

### 3.4.5 Fan

The fan is only installed on device type SD32●●U68.

*Fan*

Input voltage	[V <sub>dc</sub> ]	24
Input current	[mA]	130

### 3.4.6 Mains filter

*Basics* The EMC standards differentiate between various application cases:

EN 61800-3:2001-02; IEC 61800-3, Ed.2	Description
first environment, general availability; category C1	operation in living areas, e.g. sale by hardware supplier
first environment, restricted availability; category C2	operation in living areas, sale through dealers only
second environment; category C3	operation in industrial mains

*Limit values* This drive system meets the EMC requirements according to the standard IEC 61800-3, if the described measures are implemented during installation. If it is operated outside this scope, note the following:

#### **⚠ WARNING**

##### **HIGH-FREQUENCY INTERFERENCE**

In a domestic environment this product may cause high-frequency interference that may require action to suppress interference.

Better values can be achieved depending on the device and the application and also the structure, e.g. on mounting in an enclosed control cabinet.

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

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

The operator must ensure that the EMC guidelines are observed. For ordering data for external mains filters see Chapter 9 "Accessories and spare parts".

### 3.5 Technical Data accessories

#### 3.5.1 Cable

*Overview of cables required*

	max. cable length [m]	min. conductor cross section [mm <sup>2</sup> ]	as per PELV	shielded, both ends grounded	twisted pair
Motor cable (see chapter 9.2 "Motor cables")	10/50Length depends on required limit val- ues for line interfer- ence, see chapter 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
Sensor cable (see chapter 9.3 "Encoder cable")	100	10*0.25 and 2*0.5 (AWG 22 and 18)	X	X	X
Controller supply voltage	–	0.75 (AWG 18)	X		

1) 3.4.6 "Mains filter".

#### *Motor and encoder cable*

The motor cable and encoder cable are suitable for trailing and are available in various lengths. Accessories offered are listed beginning from Page 77.

Permissible voltage	[V <sub>AC</sub> ]	600 (UL and CSA)
Temperature range	[°C]	-40 ... +90 (fixed installation) -20 ... +80 (in motion)
Minimum bending radius		4 x diameter (fixed) 7.5 x diameter (in motion)
Sheath		Oil-resistant PUR
Shielding		Shield braiding
Overlapping of shielding	[%]	≥85

### 3.6 Conditions for UL 508C

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

#### *Ambient temperature during operation*

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

#### *Pollution degree*

Use in an environment with pollution degree 2.

#### *Wiring*

Use only 60/75 °C copper conductors.



## 4 Installation

### **▲ 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.<sup>1)</sup>
- 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.

### 4.1 Electromagnetic compatibility, EMC

<b>▲ WARNING</b>
<p><b>SIGNAL AND DEVICE INTERFERENCE</b></p> <p>Signal interference can cause unexpected responses of device.</p> <ul style="list-style-type: none"> <li>• Install the wiring in accordance with the EMC requirements.</li> <li>• Verify compliance with the EMC requirements.</li> </ul> <p><b>Failure to follow these instructions can result in death, serious injury or equipment damage.</b></p>

*Limit values* This drive system complies with the EMC requirements for the second environment in accordance with IEC 61800-3 when used with the original accessories and if the measures described for installation have been implemented. When operating outside this application area note the following:

<b>▲ WARNING</b>
<p><b>HIGH-FREQUENCY INTERFERENCE</b></p> <p>In a domestic environment this product may cause high-frequency interference that may require action to suppress interference.</p>

*EMC scope of supply and accessories* The scope of supply includes SK shielding terminals and an EMC plate. The number of shielding terminals depends on the device type. The shielding terminals are not strain reliefs.

For information on the pre-assembled cables, see page 77.

*Switching cabinet*

EMC measures	Objective
Use EMC plate or galvanized or chrome-plated mounting plates, make large contact surface connections for metal parts, remove paint from contact surfaces	Improving conductivity with surface contact.
Ground the control cabinet, door and EMC plate with ground straps or cables with a cross section area greater than 10 mm <sup>2</sup> (AWG 6).	Reduces emissions.
Fit switching devices such as contactors, relays or solenoids with interference suppressors or spark suppressors (e.g. diodes, varistors, RC elements)	Reduction of mutual interference
Install power and control components separately.	Reduction of mutual interference

*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 shield of all shielded cables to the mounting plate at the control cabinet entry.	Reduction of 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 shield on analog signal wires directly at the device (signal input), and insulate the shield at the other end of the cable or ground via a capacitor if interference occurs, e.g. 10 nF.	Reducing ripple loops due to low-frequency interference.
Use only shielded motor cables with copper braiding and at least 85% covering, ground a large surface area of the shield at each end.	Controlled discharge of interference currents, reduction of emissions

*Cable installation*

EMC measures	Objective
Fieldbus lines and signal lines must not be laid in one conduit with lines for DC and AC voltage over 60V. (Fieldbus cables can be laid in one conduit with signal and analog lines)	Reduction of mutual interference
Recommendation: use separate cable ducts at least 20 cm apart.	
Keep cables as short as possible. Do not install unnecessary cable loops, use short cables from the star point in the control cabinet to the external ground connection.	Reduces capacitive and inductive interference.
Use equipotential bonding conductors in systems with <ul style="list-style-type: none"> <li>- wide-area installations</li> <li>- different voltage supplies</li> <li>- networking across several buildings</li> </ul>	Reduces current on cable shield, reduces emissions.
Use fine-core bonding conductors	Deflect even high-frequency interference currents
If motor and machine are not conductively connected, e.g. by an insulated flange or a non-flat connection, earth the motor with an earth wire >10 mm <sup>2</sup> (>6 AWG) or ground strap.	Reduction of emissions, increase in resistance to interference
Lay connections of the 24 V <sub>DC</sub> supply voltage as twisted pair.	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 the IT mains).	Enabling the the effectiveness of the mains filter.
Circuit breaker if there is danger of overvoltage.	Reduce risk of damage by overvoltage.

*Motor and encoder cable* Motor leads and encoder cables are especially critical signal circuits. Use the recommended cables.

EMC measures	Objective
Do not install switching elements in motor cables or encoder cables.	Reduction of interference.
Install motor cable at a distance of at least 20 cm to the signal cable or insert shields between motor cables and signal cables.	Reduction of mutual interference
Insert equipotential bonding conductors for long lines.	Reduce current on cable shield.
Install the motor cable and encoder cable without separation point. <sup>1)</sup>	Reduce perturbing radiation.

1) If a cable must be cut for installation, the cut points of the cables must be connected with shield connections and metal housing

*Other measures for the improvement of the EMC* 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	Improvement of EMC limit values
External upstream mains filter	Improvement of EMC limit values
Particularly EMC-compliant design, e.g. in a closed control cabinet with 15dB damping of radiated interference	Improvement of 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<sup>2</sup> (AWG 4) for equipotential bonding conductors up to a length of 200 m
- 20 mm<sup>2</sup> (AWG 4) for equipotential bonding conductors with a length of more than 200 m

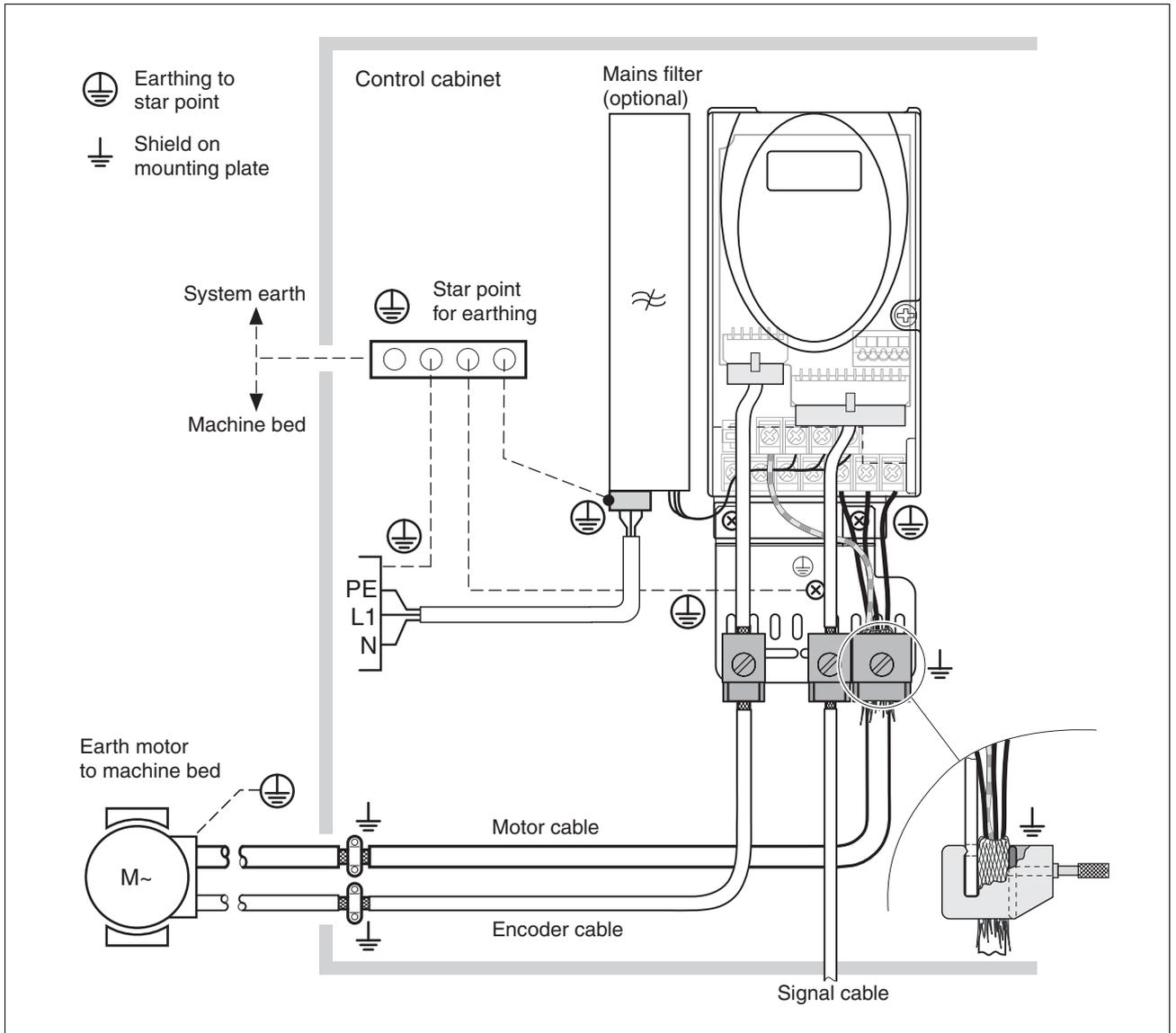


Figure 4.1 EMC measures<sup>1</sup>

1. Number of shielding terminals depending on device type.

### 4.1.1 Operation in an IT mains

An IT mains is characterised by a neutral conductor that is insulated or earthed through a high impedance. If you use a permanent insulation monitor, it must be suited for non-linear loads (e.g. Type XM200 from Merlin Gerin). If, despite perfect wiring, a fault is indicated, you can, in the case of products with integrated mains filters, disconnect the earth connection to the Y-capacitors (deactivate the Y-capacitors).

With all other networks except for IT mains the earth connection via the Y-capacitors must be maintained.

If the earth connection to the Y-capacitors is removed, the specifications for the transmission of electromagnetic interference will no longer be maintained (specific categories see chapter 3.4.6 "Mains filter" page 24)! Separate measures are required to comply with national regulations and standards.

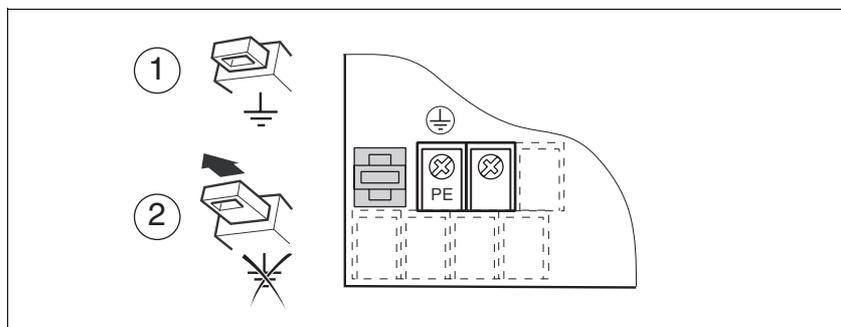


Figure 4.2 Operation in an IT mains

#### Isolation monitoring error

- (1) Y-capacitors of the internal filter effective (standard)
- (2) Y-capacitors of the internal filter disabled (IT mains)

## 4.2 Mechanical installation

### **⚠ DANGER**

#### **ELECTRIC SHOCK FROM FOREIGN BODIES OR DAMAGE**

Conductive foreign objects in the product or serious damage can 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 atn the product may heat up to over 100 °C (212 °F) depending on the operating mode.

- 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.**

4.2.1 Mounting the device

*Control cabinet* The control cabinet must be dimensioned so all devices and accessories can be fixed in place and wired to meet EMC standards.

The control cabinet ventilation must be capable of extracting the heat generated by all devices and components installed in the control cabinet.

*Installation spacing, ventilation* When selecting the position of the device in the control cabinet, note the following:

- Install the device in a vertical position ( $\pm 10^\circ$ ). This is important for cooling the device
- Adhere to the minimum installation distances for required cooling. Avoid heat accumulations.
- Do not install the device close to heat sources.
- Do not mount the device on flammable materials.
- Make sure that the heated airflow from other devices and components does not heat the air used for cooling the device.
- The device will switch off as a result of overtemperature when operated above the thermal limits.
- When planning installation clearances the dimensions of a mains filter must also be considered, see also notes on page 37

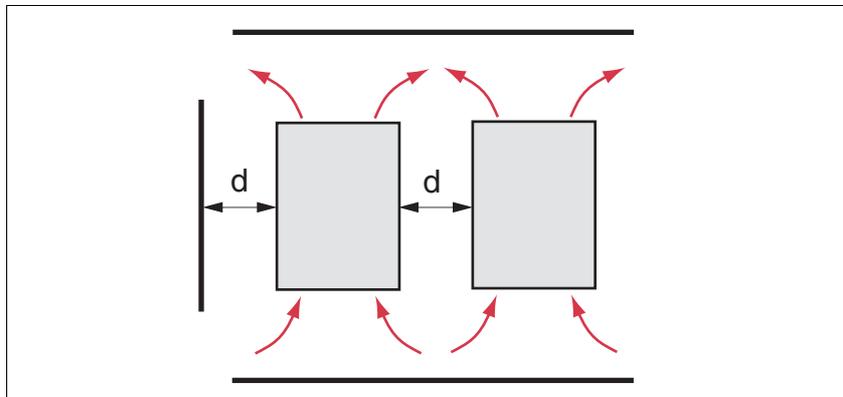


Figure 4.3 Installation spacing and air circulation

Temperature <sup>1)</sup>	Distance <sup>2)</sup>	Implementation without protective film <sup>3)</sup>	Implementation with protective 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 <sup>4)</sup>
	d < 50mm (d < 1.97 in.)	Reduce nominal current and continuous current <sup>4)</sup>	Operation not possible

1) maximum operating temperature when used in accordance with 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 protective film on completion of the installation  
 4) by 2.2 % per °C above 40 °C (by 1.22 % per °F above 104 °F)

At least 10 mm of free space is required in front of the device.  
 At least 50 mm of free space is required above the device.  
 The connecting cables are routed out of the housing at the bottom. At least 200mm free space under the device is required so that wiring can be installed without bending.

*Mounting the device* For the dimensions of the fastening holes see Chapter 3.3.1 "Dimensions" from page 20.

- ▶ Install the device in a vertical position ( $\pm 10^\circ$ ). This is particularly important for cooling the device.
- ▶ Attach the EMC plate at the bottom of the device, see also Figure 4.1, or use alternative attaching elements (comb bars, shield clamps, bus bars).

*Attach plate with safety instructions* ▶ Attach the plate with safety instructions included with the device in a visible position on the front panel as specified by the national regulations.

An alternative to fastening the unit directly to the control cabinet mounting plate consists of adapter plates for DIN rail mounting, see chapter 3.3.1 "Dimensions".

In this case mains filters cannot be attached directly beside or behind the device.



*Painted surfaces have an insulating effect. Remove the paint from the attachment points over a wide area (bright metal) before attaching the device to a painted mounting plate.*

*Mounting fans* A fan is included with device type SD32••U68. The fan must be mounted and connected.

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

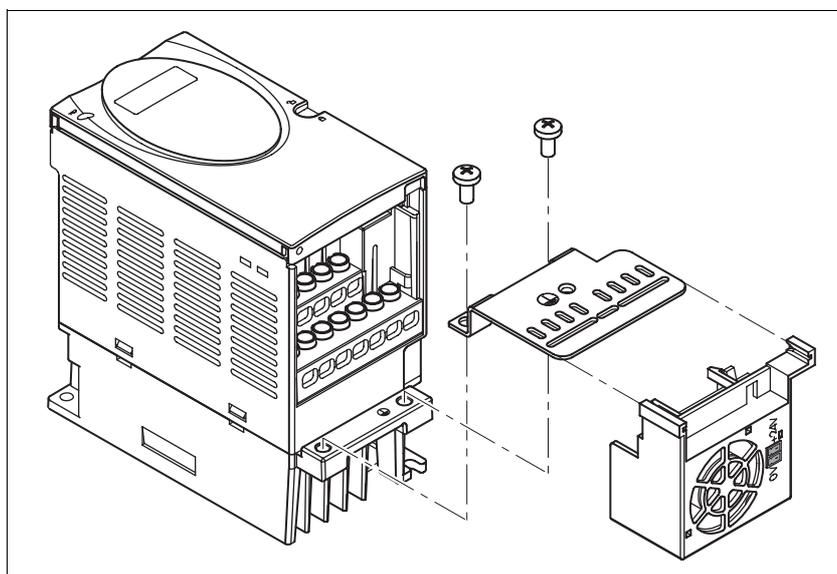


Figure 4.4 Mounting fans

*Remove the protective film*

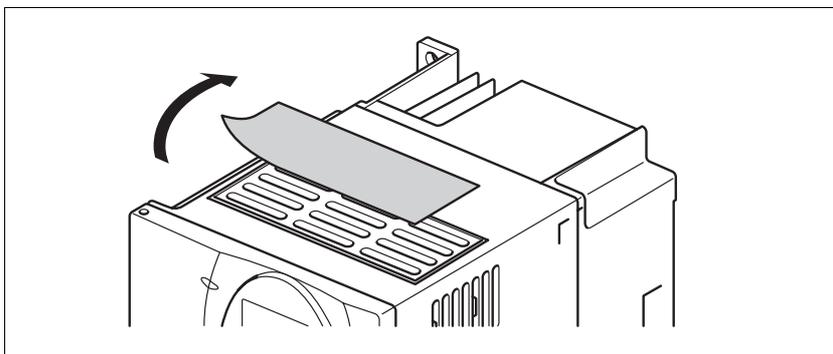


Figure 4.5 Removing protective film

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

## 4.2.2 Mounting mains filters

For specifications of external mains filters see page 24.

For notes on electrical installation see mains supply from page 46.

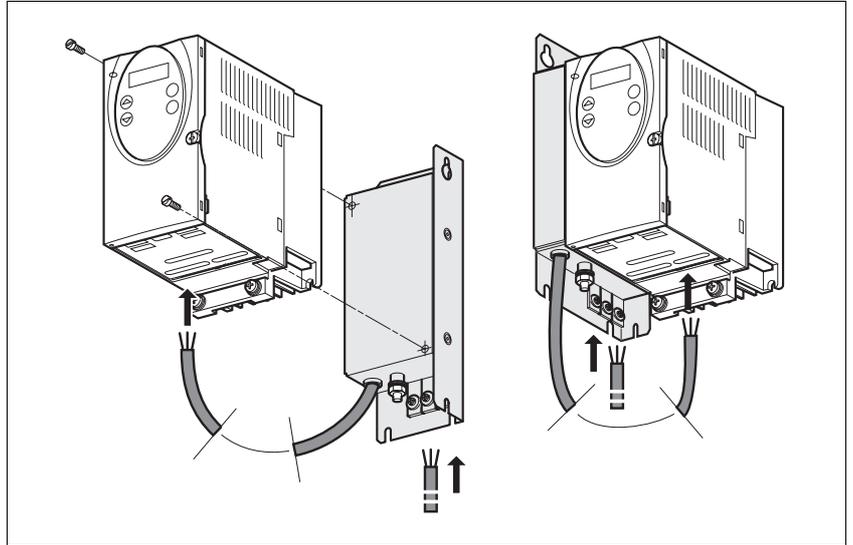


Figure 4.6 Mounting of mains filters

- 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 will not be accessible after installation of the EMC plate.*

*If you are using the DIN rail mounting plates, the mains filter cannot be mounted directly beside or behind the device.*

### 4.3 Electrical installation

#### **⚠ DANGER**

##### **ELECTRIC SHOCK, FIRE, 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.
- The system manufacturer is responsible for compliance with all applicable regulations pertaining to grounding the drive system.
- Many components, including the printed circuit board, operate with mains voltage. **Do not touch.** Do **not** touch unprotected parts or screws of the terminals when they are under voltage.
- Install all covers and close the housing doors before applying voltage.
- The motor generates voltage when the shaft is rotated. Lock the motor shaft to prevent rotation caused by external forces before starting work on the drive system.
- Before working on the drive system:
  - Disconnect the voltage supply to all connections.
  - Place a label "DO NOT SWITCH ON" on the switch and secure the switch against being switched on.
  - **Wait for 6 minutes** (discharge DC bus capacitors). Do **not** short-circuit DC bus!
  - Measure the voltage on DC bus and verify that it is <42V. (The DC bus LED is not a reliable indicator for the absence of DC bus voltage).

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

#### **⚠ DANGER**

##### **ELECTRIC SHOCK FROM FOREIGN BODIES OR DAMAGE**

Conductive foreign objects in the product or serious damage can 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 BECAUSE OF INSUFFICIENT GROUNDING**

With insufficient grounding there is a danger of electric shock.

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

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

**⚠ WARNING****THIS PRODUCT MAY CAUSE DIRECT CURRENT IN THE PROTECTIVE CONDUCTOR**

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

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

*Conditions for use of a residual current device*

Where the installation regulations require upstream protection by means of a residual current device (residual current device, RCD), a residual current device of "Type A" can be used on a single-phase drive with connection between N and L. In all other cases, "Type B" must be used.

The following characteristics must be taken into consideration here:

- Filtering of high-frequency currents.
- Delay against triggering as a result of interference capacitance which may be present when the unit is switched on. This delay is not possible with 30-mA residual current devices. In this case, use residual current devices which are not sensitive to unintended triggering, for example a series s.i (super-immunized) residual current device with increased noise immunity (brand Merlin Gerin).

If the system consists of several drives, it is necessary to use a residual current device for each drive.

*Suitability of wiring*

Cables must not be twisted, stretched, crushed or kinked. Use only cables that comply with the cable specification. For example, make sure that it is suitable for:

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

### 4.3.1 Overview of procedure

- ▶ Unlock the front panel of the device and open it.
- ▶ Connect the earth terminal of the device or the EMC plate to the earthing star point of the system.
- ▶ Connect the required terminal corresponding to the sequence of the following table. If a different connection sequence is followed, terminals may be covered by other lines.

Follow the EMC requirements, see page 28.

- ▶ Then lock the front panel.

Chapter	from page
4.3.3 "Connection of motor phases"	42
4.3.4 "Connection of DC bus"	45
4.3.5 "Connection:Mains supply"	46
4.3.6 "Connection of signal interface (CN1)"	48
4.3.7 "Connection of rotation monitoring (CN2)"	52
4.3.8 "Connection of outputs and controller supply voltage (CN3)"	55
4.3.9 "Fan connection"	57

The CN2 and CN3 connections are only included with device type SD326R.



*The connection to the controller supply voltage +24VDC) is only required when using a holding brake or rotation monitoring.*

### 4.3.2 Overview of all connections

#### Power connections

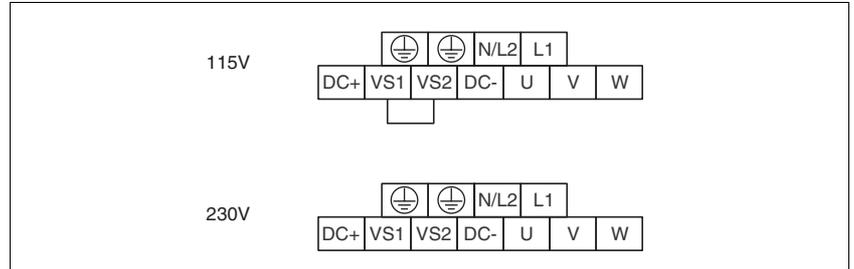


Figure 4.7 Power connections

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

#### Signal connections

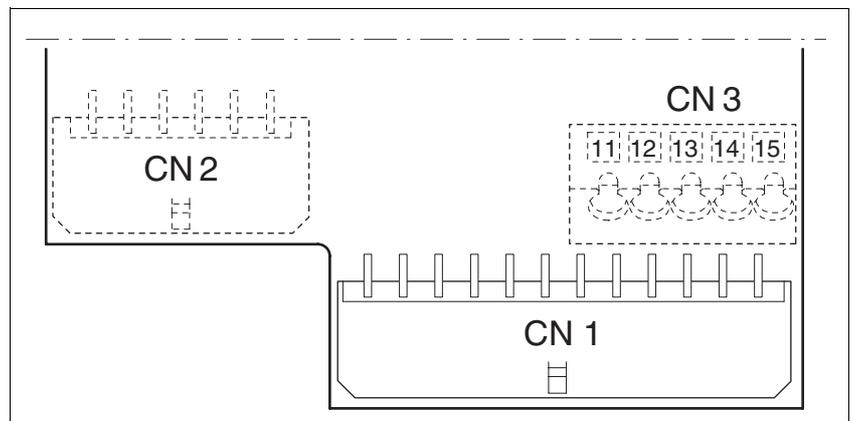


Figure 4.8 Overview of signal connections

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

### 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. Lock the motor shaft to prevent rotation before starting work on the drive system.
- AC voltages may jump over unused wires in the motor cable. Isolate unused wires at both ends of the motor cable.
- It is the system manufacturer's responsibility to ensure compliance with all applicable regulations on grounding the drive system. Extend the ground through the motor cable with an additional ground at the motor housing.

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

#### *Cable specifications and terminal*

- Shielded cable
- Grounding of the shield at both ends

Maximum cable length <sup>1)</sup>	[m]	10/50
Minimum conductor cross section	[mm <sup>2</sup> ]	1.5 (AWG 14)
Maximum connection cross section	[mm <sup>2</sup> ]	1.5 (AWG 16)
Tightening torque	[mm <sup>2</sup> ]	0.5 ... 0.6 (0.36 ... 0.44 lb-ft)

1) Length depends on the required limit values for line related malfunctions, see chapter 3.4.6 "Mains filter"

- For more information see chapter 3.5.1 "Cable".
- ▶ Use pre-assembled cables to reduce the risk of wiring errors (page 77).
- ▶ 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<sub>ac</sub> / 325V<sub>dc</sub>  
 The product catalog contains an overview of approved motors.

*Assembling cables* Note the dimensions specified when assembling cables. The specified dimensions refer to a cable arrangement as shown in the figure "EMC measures" on page 30.

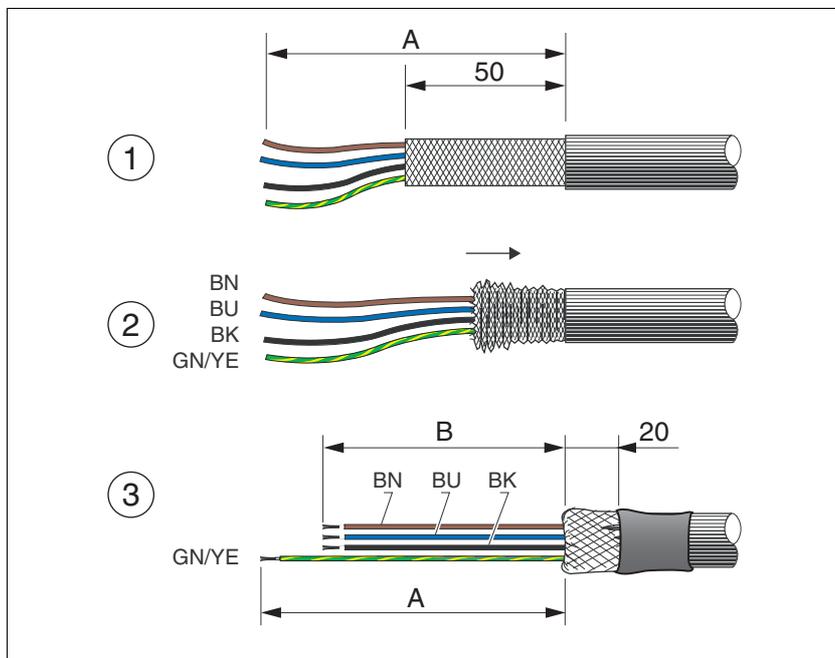


Figure 4.9 Steps (1-3) for assembling the motor cable

(A) 130 mm

(B) 75 mm

- ▶ (1) Sheath the cable to length A and reduce the shield braiding to approx. 50mm.
- ▶ (2) Slide the shield braiding back over the cable sheath and fix the shield braiding, e.g. with shrink wrap. Note that approx. 20 mm of the shield braiding must not be isolated for the required wide-area attachment of the shield braiding on the EMC plate.
- ▶ (3) Shorten the three wires (U, V, W) of the motor line to length B. The protective conductor has length A.

Use fork-type cable lugs or wire end ferrules. The lead must fill the sleeve for its entire length to ensure maximum current carrying capacity and vibration resistance.

*Monitoring* The motor lines are monitored for:

- short circuit between the motor phases
- short circuit against ground

*Connecting the motor cable*

- ▶ Follow the EMC requirements for motor cables, see page 30.
- ▶ Connect the motor wires and protective conductor to terminals U, V, W and PE. The cable assignment at the motor and device sides must match.
- ▶ Fix the cable shielding flat on the EMC plate.

## Wiring diagram

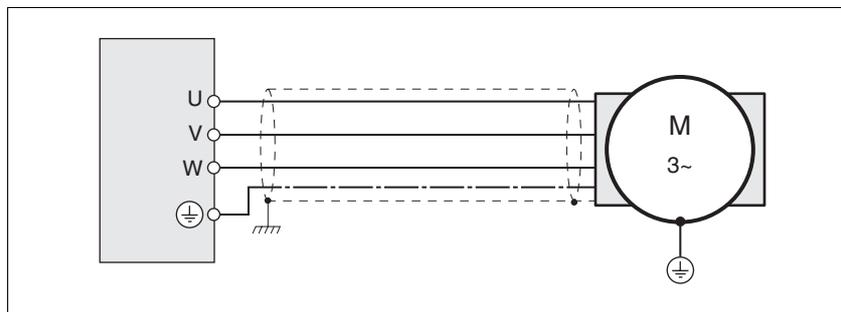


Figure 4.10 Wiring diagram motor

Connection	Meaning	Color <sup>1)</sup>
U	Motor lead	brown (BN)
V	Motor lead	blue (BU)
W	Motor lead	black (BK)
PE	Protective conductor	green/yellow (GN/YE)

1) Color specifications refer to the cables available as accessories

#### 4.3.4 Connection of DC bus

### CAUTION

#### NON-APPROVED PARALLEL CONNECTION

Operation with a parallel connection of the DC bus may destroy the drive systems immediately or after a delay.

- Never connect the DC bus to multiple drive systems.

**Failure to follow these instructions can result in equipment damage.**

#### *External capacitors*

The device can save excess braking energy temporarily in an external electrolytic capacitor via the DC bus. This can be used to reduce the DC bus voltage during frequent braking.

Only use capacitors with the following specifications:

SD32••...	.	...U25	...U68
Dielectric strength	[V]	≥450	≥450
external capacity	[μF]	<500	<1000

#### *Cable specifications and terminal*

- Shielded cable
- Grounding of the shield at both ends

Maximum cable length	[m]	3
Minimum conductor cross section	[mm <sup>2</sup> ]	1.5 (AWG 14)
Maximum connection cross section	[mm <sup>2</sup> ]	1.5 (AWG 16)
Tightening torque	[mm <sup>2</sup> ]	0.5 ... 0.6 (0.36 ... 0.44 lb·ft)

#### *Connection*

- ▶ Connect the cable from the DC bus to the connections of the capacitor.  
Make sure the polarity is correct:  
DC+ to "+" and DC- to "-".  
Otherwise the device and capacitor may be destroyed.

4.3.5 Connection:Mains supply

**⚠ DANGER**

**ELECTRIC SHOCK BECAUSE OF INSUFFICIENT GROUNDING**

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

- Use a protective conductor at least 10 mm<sup>2</sup> (AWG 6) or two protective conductors with the cross section of the conductor for the power supply of the power terminals. Observe the local regulations for grounding.

**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 BY INCORRECT MAINS VOLTAGE**

The 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.**

*Cable specifications and terminal*

Minimum conductor cross section	[mm <sup>2</sup> ]	0.75 (AWG 18)
Maximum connection cross section	[mm <sup>2</sup> ]	1.5 (AWG 16)
Tightening torque	[Nm]	0.5 ... 0.6 (0.36 ... 0.44 lb-ft)

- For more information see chapter 3.5.1 "Cable" on page 25.

The wiring must have a sufficiently large cross section so that the fuse at the mains connection can be tripped in the event of a fault.

When connecting the device in an IT mains follow the directions in 4.1.1 "Operation in an IT mains".

In addition, note the suitability of the wiring, see page 39 and the EMC-compliant connection, see page 29.

*Assembling cables*

Use fork-type cable lugs or wire end ferrules. The lead must fill the sleeve for its entire length to ensure maximum current carrying capacity and vibration resistance.

*Wiring diagram* The figure below shows the mains power supply connection. The diagram also shows the wiring of the optional external mains filter.

**NOTE:** In three-phase systems the neutral conductor N must generally be used instead of L2.

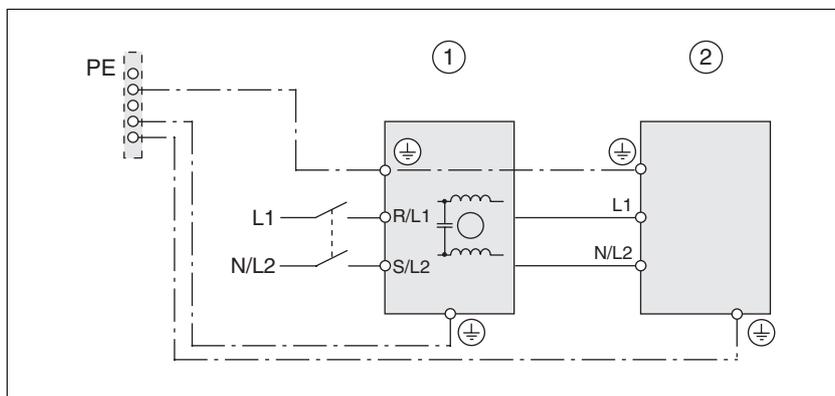


Figure 4.11 Wiring diagram of mains supply for single phase device.

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

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

*Setting the voltage range* ► Set the device to the correct voltage range.

VS1 bridged to VS2: 115V

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

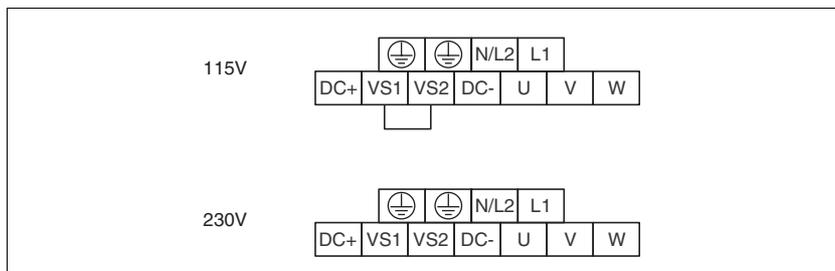


Figure 4.12 Setting the voltage range

*Connecting mains supply* Observe the following notes:

- The device must be set to the correct voltage range.
- For devices with external mains filter the mains power cable must be shielded from 200mm length between the external mains filter and the device and grounded at both ends.
- Observe the EMC requirements. If necessary, use surge protectors and mains filters, see page 37.
- Follow the requirements for design of corresponding UL, see page 25.
- Connect the power cables. Note the exact terminal assignment of your device, see chapter 4.3.2 "Overview of all connections".

4.3.6 Connection of signal interface (CN1)

**⚠ WARNING**

**UNEXPECTED MOVEMENT**

Incorrect or faulty signals as reference position can trigger unexpected movements.

- Use shielded cables with twisted-pair.
- Operate the interface with push-pull signals.
- Do not use signals without push-pull in critical applications or in an environment subject to interference.
- Do not use signals without push-pull with cable lengths over 3 m and limit the frequency to 50 kHz

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

*Input circuit diagram* The following diagram shows the general design of the opto-isolated inputs based on the PULSE signal input.

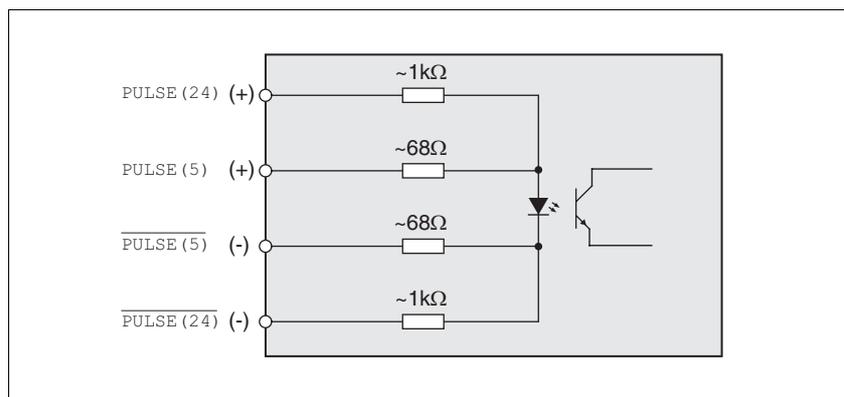


Figure 4.13 Input circuit diagram

*Output circuit diagram* The following diagram shows the general design of the "Readiness" output.

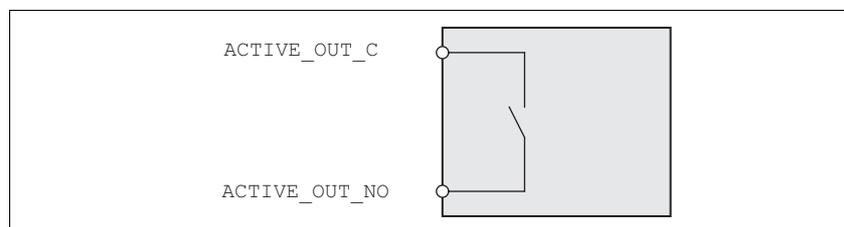


Figure 4.14 Output circuit diagram

Wiring diagram

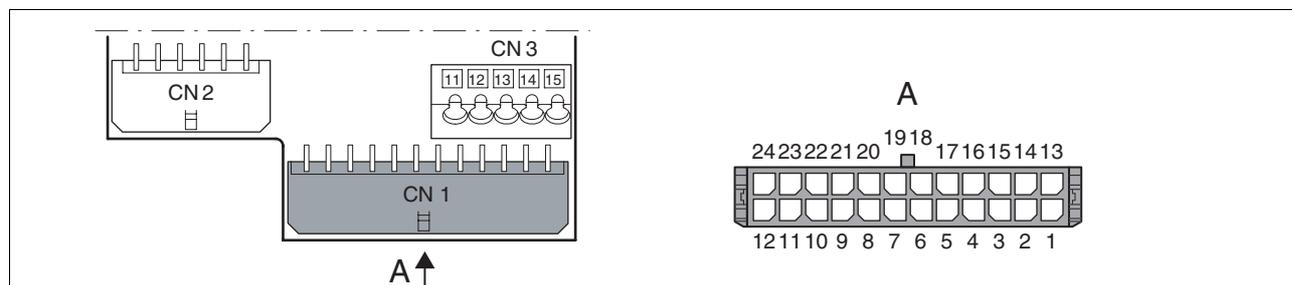


Figure 4.15 Wiring diagram signal interface

Pin	Signal	Color <sup>1)</sup>	Pair	Meaning	5V/24V	I/O
13	PULSE ( 5 ) CW ( 5 )	White	1	Motor step (+) Motor step clockwise direction of rotation (+)	5V	I
1	$\overline{\text{PULSE}} ( 5 )$ $\overline{\text{CW}} ( 5 )$	Brown	1	Motor step, inverted (-) Motor step in clockwise direction of rotation, inverted (-)	5V	I
14	DIR ( 5 ) CCW ( 5 )	Green	2	Direction of rotation (+) Motor step in counterclockwise direction of rotation (+)	5V	I
2	$\overline{\text{DIR}} ( 5 )$ $\overline{\text{CCW}} ( 5 )$	Yellow	2	Direction of rotation, inverted (-) Motor step in counterclockwise direction of rotation, inv.(-)	5V	I
15	GATE ( 5 ) ENABLE ( 5 )	Gray	3	Disable reference values (+) Release power stage (+)	5V	I
3	$\overline{\text{GATE}} ( 5 )$ $\overline{\text{ENABLE}} ( 5 )$	Pink	3	Disable reference values, inverted (-) Release power stage, 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	Ready		O
7	ACTIVE_OUT_NO	Red/blue	6	Ready		O
20	PULSE ( 24 ) CW ( 24 )	White	1	Motor step (+) Motor step clockwise direction of rotation (+)	24V	I
8	$\overline{\text{PULSE}} ( 24 )$ $\overline{\text{CW}} ( 24 )$	Brown	1	Motor step, inverted (-) Motor step in clockwise direction of rotation, inverted (-)	24V	I
21	DIR ( 24 ) CCW ( 24 )	Green	2	Direction of rotation (+) Motor step in counterclockwise direction of rotation (+)	24V	I
9	$\overline{\text{DIR}} ( 24 )$ $\overline{\text{CCW}} ( 24 )$	Yellow	2	Direction of rotation, inverted (-) Motor step in counterclockwise direction of rotation, inv.(-)	24V	I
22	GATE ( 24 ) ENABLE ( 24 )	Gray	3	Disable reference values (+) Release power stage (+)	24V	I
10	$\overline{\text{GATE}} ( 24 )$ $\overline{\text{ENABLE}} ( 24 )$	Pink	3	Disable reference values, inverted (-) Release power stage, 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
12	$\overline{\text{PWM}} ( 24 )$	Red	5	Control of motor phase current, inverted (-)	24V	I
6,18				Not assigned		

1) Color specifications refer to the cables available as accessories

- Cable specifications*
- Twisted pair lines
  - Shielded cable
  - Grounding of the shield at both ends

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

- For more information see chapter 3.5.1 "Cable" on page 25.

*Preparing cables*

- ▶ Use prefabricated cables to minimise the risk of a wiring error. Step 5 in the diagram below must be carried out even with prefabricated cable. The dimensions for positioning the shield on the housing are applicable when the included EMC plate is used.
- ▶ If you are not using prefabricated wiring, follow the procedure below.

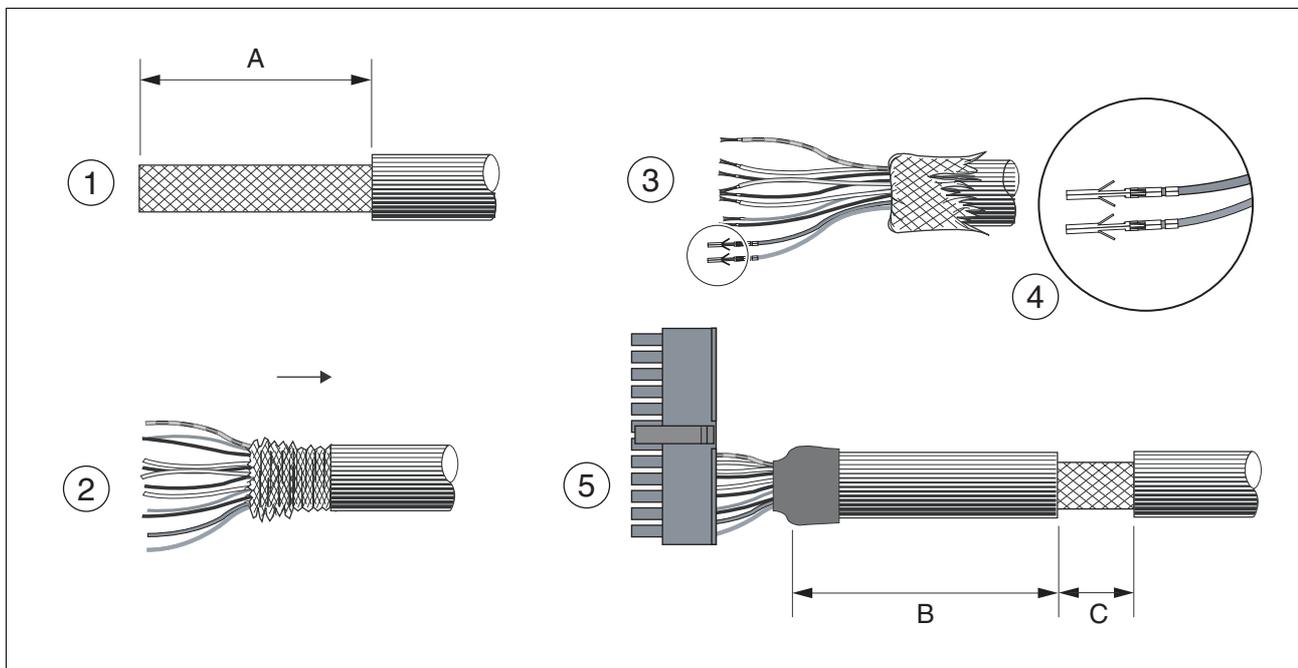


Figure 4.16 Assembling the cable for the signal interface

- (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) Remove the cable sheath to length A.
- ▶ (2) Slide the shield braiding back over the cable sheath.
- ▶ (3+4) Crimp the plug contacts to the braided wires. Isolate the shield braiding with shrink wrap. Plug the crimp contacts into the connector shell; for the pin assignment see Figure 4.15.
- ▶ (5) Sheath the cable to length C on the position shown, the cable is fastened there at the EMC plate with a clamp (shield-ground connection).

*Connecting 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.

### 4.3.7 Connection of rotation monitoring (CN2)

The connection is only included with the device type SD326R.

*Function and type of encoder* The motor encoder is an incremental encoder integrated into the motor. It sends changes in the position of the motor shaft as A/B/I signals.

- Cable specifications*
- Twisted pair lines
  - Shielded cable
  - Grounding of the shield at both ends

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

- For more information see chapter 3.5.1 "Cable" on page 25.

- Preparing cables*
- ▶ Use prefabricated cables to minimise the risk of a wiring error. Step 5 in the diagram below must be carried out even with prefabricated cable. The dimensions for positioning the shield on the housing are applicable when the included EMC plate is used.
  - ▶ If you are not using prefabricated wiring, follow the procedure below.

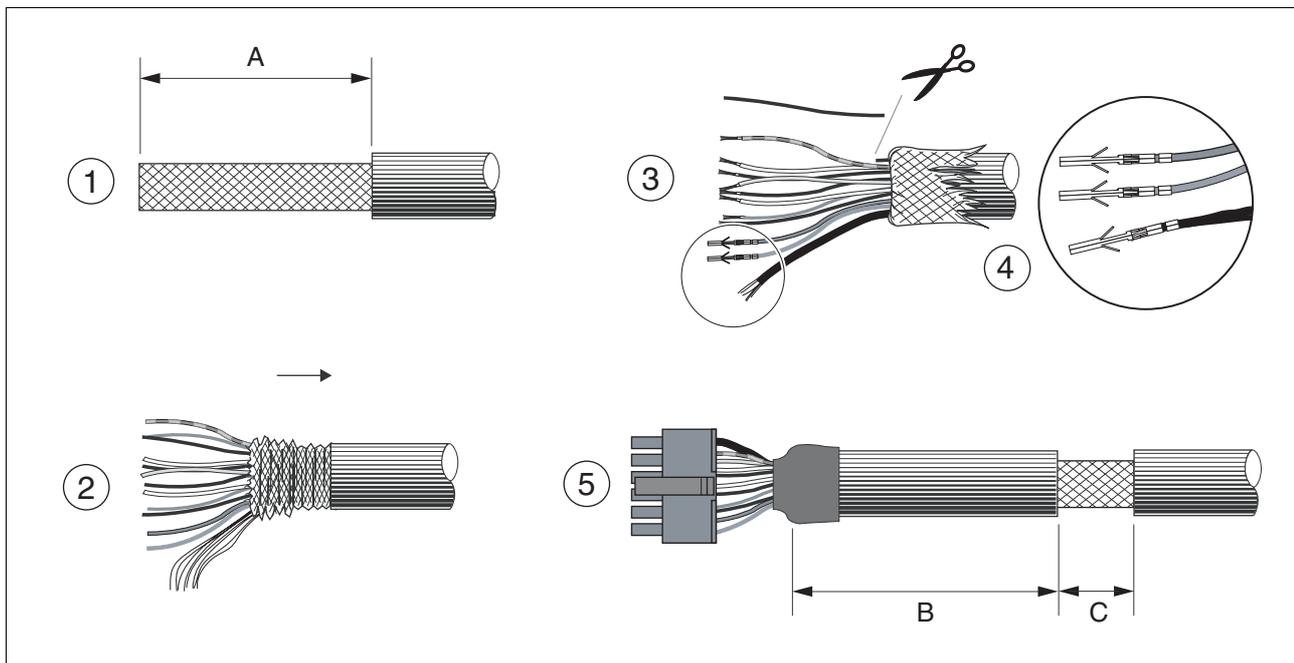


Figure 4.17 Steps (1-5) for assembly of the encoder cable

- (A) 25 mm  
 (B) 90 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 43025-1200

- ▶ (1) Remove the cable sheath to length A.
- ▶ (2) Slide the shield braiding back over the cable sheath. The shield braided filler wire is required as the connection.
- ▶ (3) The blue and red braided wires are not required and can be cut off. Isolate the shield braided wire with shrink wrap.
- ▶ (4) Crimp the plug contacts on the remaining braided wires and on the insulated shield braided wire. Insulate the shield braiding with shrink wrap. Plug the crimp contacts into the connector shell; for the pin assignment see Figure 4.18.
- ▶ (5) Sheath the cable to length C on the position shown, the cable is fastened there at the EMC plate with a clamp (shield-ground connection).

*Connecting the motor encoder*

- ▶ Verify that wiring, cables and connected interfaces meet the PELV requirements.
- ▶ Note the EMC specification for motor encoder cables starting at page 30, and 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.

Wiring diagram

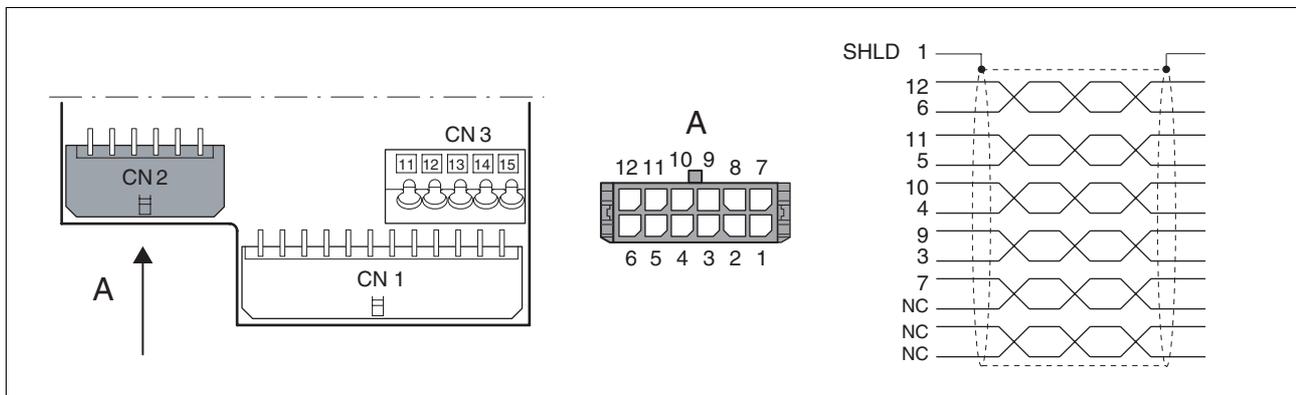


Figure 4.18 Wiring diagram of rotation monitoring

Pin	Signal	Motor, pin	Color <sup>1)</sup>	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 <sup>2)</sup>	O
4	ENC+5V_OUT	8	Red	3	5 V <sub>DC</sub> power supply for encoder, max. 100mA <sup>2)</sup>	O
9	ENC_0V_SENSE	9	Black	4	Reference potential to ENC+5V_SENSE <sup>2)</sup>	I
3	ENC+5V_SENSE	10	Violet	4	SENSE line to ENC+5V_OUT <sup>2)</sup>	I
8					Not assigned	
2					Not assigned	
7	$\overline{\text{T\_MOT}}$	11	Gray/pink		temperature sensor PTC	I
1	SHLD				Shielding braid	

1) Color specifications refer to the cables available as accessories

2) At the end of the motor encoder cable (motor side), the signal line ENC+5V\_OUT must be connected to ENC+5V\_SENSE and ENC\_0V\_OUT to ENC\_0V\_SENSE. The "ENCODER LED lights up when the encoder power supply is switched on."

### 4.3.8 Connection of outputs and controller supply voltage (CN3)



The connection is only included with the device type SD326R.

*The connection to the controller supply voltage +24VDC) is only required when using a holding brake or rotation monitoring.*

#### **⚠ DANGER**

##### **ELECTRIC SHOCK CAUSED BY INCORRECT POWER SUPPLY UNIT**

The +24VDC supply voltage is connected with many accessible signals 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.**

Wiring diagram

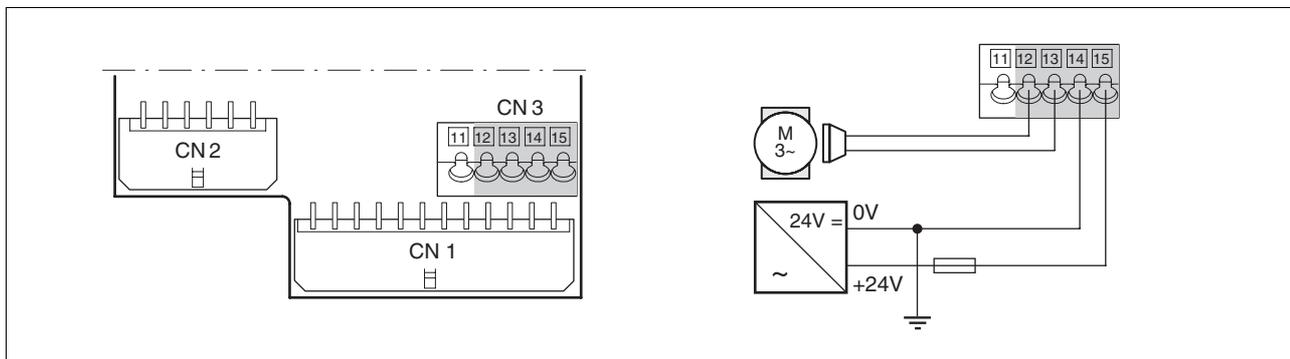


Figure 4.19 Wiring diagram CN3

Pin	Signal	Meaning	I/O
11	$\overline{\text{RM-FAULT\_OUT}}$	Rotation monitoring error message	O
12	+BRAKE_OUT	Holding brake connection	O
13	-BRAKE_OUT	Reference potential to +BRAKE_OUT <sup>1)</sup>	O
14	0VDC	Reference potential to +24VDC	
15	+24VDC	Controller supply voltage	

1) internally connected with Pin 14

Cable specifications

Minimum conductor cross section	
Controller supply voltage	[mm <sup>2</sup> ] 0.75 (AWG 18)
Holding brake connection	[mm <sup>2</sup> ] 0.75 (AWG 18)
Rotation monitoring error message	[mm <sup>2</sup> ] 0.25 (AWG 22)

Connecting the controller supply voltage

- ▶ Make sure that the cables, the wiring and the connected interfaces meet the requirements for PELV.
- ▶ Feed the controller supply voltage from a power supply unit (PELV) to the device.
- ▶ Earth the negative output at the power supply

Connecting outputs

- ▶ Connect the required outputs in accordance with the pin assignment.

### 4.3.9 Fan connection

The connection is only required with device type SD32●●U68.

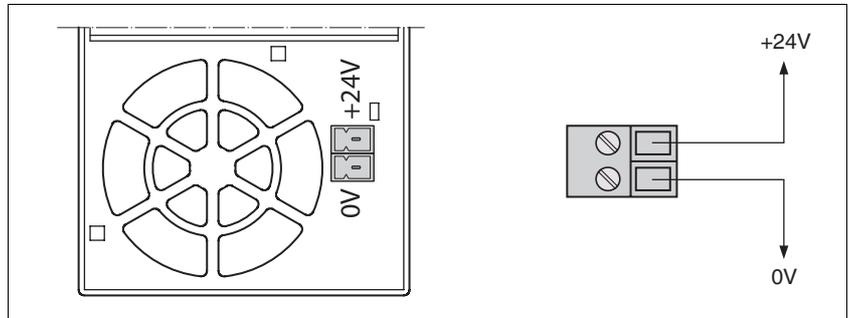


Figure 4.20 Fan wiring diagram

#### *Connecting power supply*

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

## 4.4 Checking installation

Check the following:

- ▶ Make sure the drive system is correctly installed and wired up. Check especially the basic connections such as the power stage supply voltage and controller supply voltage.
- ▶ Check in detail:
  - Are all protective conductors connected?
  - Are all fuses correct?
  - Are any live cable ends exposed?
  - Did you properly install and connect all cables and connectors?
  - Did you properly connect the signal wires?
  - 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.
- ▶ Remove the protective film if required (see chapter 4.2.1 "Mounting the device").

## 5 Commissioning

### ⚠ DANGER

#### ELECTRIC SHOCK, FIRE, 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.
- The system manufacturer is responsible for compliance with all applicable regulations pertaining to grounding the drive system.
- Many components, including the printed circuit board, operate with mains voltage. **Do not touch.** Do **not** touch unprotected parts or screws of the terminals when they are under voltage.
- Install all covers and close the housing doors before applying voltage.
- The motor generates voltage when the shaft is rotated. Lock the motor shaft to prevent rotation caused by external forces before starting work on the drive system.
- Before working on the drive system:
  - Disconnect the voltage supply to all connections.
  - Place a label "DO NOT SWITCH ON" on the switch and secure the switch against being switched on.
  - **Wait for 6 minutes** (discharge DC bus capacitors). Do **not** short-circuit DC bus!
  - Measure the voltage on DC bus and verify that it is <42V. (The DC bus LED is not a reliable indicator for the absence of DC bus voltage).

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

### ⚠ 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****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 brake.

**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.**

**▲ CAUTION****HOT SURFACES**

The heat sink atn the product may heat up to over 100 °C (212 °F) depending on the operating mode.

- 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.**

## 5.1 Overview



*The following commissioning steps are also required if you want to use a configured device under changed operating conditions.*

*What must be done*

<b>Chapter</b>	<b>from page</b>
4.4 "Checking installation"	58
5.2.2 "Setting parameter switch S1"	62
5.2.3 "Setting parameter switch S2"	65
5.2.4 "Test operation of the motor"	66

## 5.2 Commissioning procedure

### 5.2.1 Overview of parameter switches

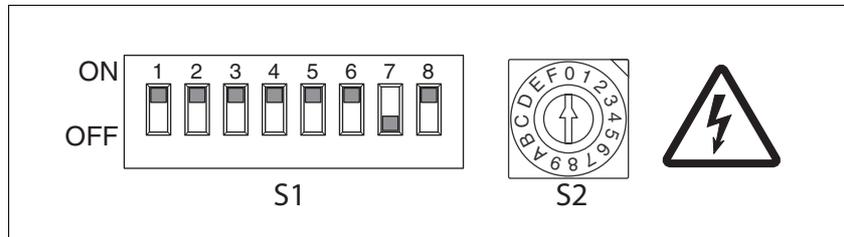


Figure 5.1 Overview of parameter switches

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

### 5.2.2 Setting parameter switch S1

*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 of 60 1/min.

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

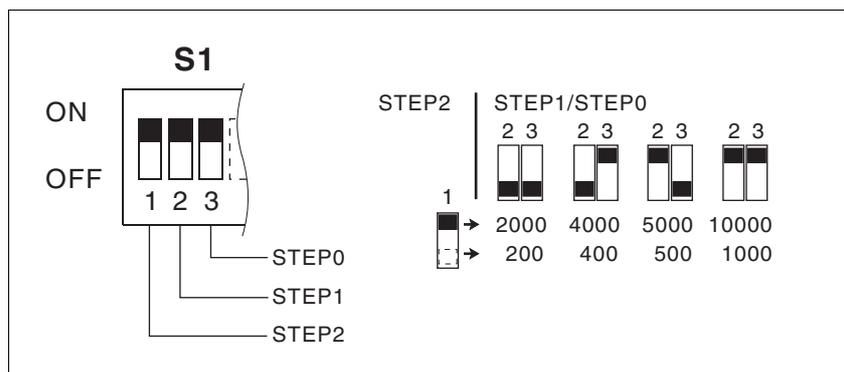


Figure 5.2 Setting the number of steps

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 of a 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 release type* The release type can be set with parameter switch S1.5.

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 of the release to "GATE" or "ENABLE".

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

- Setting the interface mode* The interface mode can be set with parameter switch S1.6.  
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 default 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"* The "Softstep" function can be set with parameter switch S1.7  
When the function is active, the signals at the reference value interface are internally equalised. As a result, the motor operation is significantly smoother, particularly at low speeds or with a rough preset reference value.

A temporary position deviation then occurs temporarily during a motor movement. The size of the position deviation depends on the speed. The position deviation increases in line with the speed and may measure as much as a motor revolution.

You can calculate the position deviation using the following formula:

- Position deviation in degrees = speed in [1/min] / 8
- Position deviation in revolutions = speed in [1/min] / 2880

Once the motor is at a standstill, the position deviation is adjusted.

- ▶ Switch off all supply voltages. Verify that no voltages are present (safety instructions).
- ▶ Use parameter switch S1.7 to set the Softstep function to active or inactive.

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

*Setting rotation monitoring* This parameter switch has no function on devices without rotation monitoring.

On devices with rotation monitoring the parameter switch S1.8 can be used to disable the rotation monitoring.

- ▶ Switch off all supply voltages. Verify that no voltages are present (safety instructions).
- ▶ Set the rotation monitoring to active or inactive with parameter switch S1.8.

Switch setting S1.8	Meaning
ON (factory setting)	Rotation monitoring enabled
OFF	Rotation monitoring disabled

When the rotation monitoring is activated and the device is switched on, the "ENCODER" LED lights up.

### 5.2.3 Setting parameter switch S2

The nominal motor current is set with parameter switch S2.

- ▶ Switch off all supply voltages. Verify that no voltages are present (safety instructions).
- ▶ Set the nominal motor current with parameter switch S2.

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

### 5.2.4 Test operation of the motor

*Direction of rotation* Rotation of the motor shaft in a clockwise or counterclockwise direction of rotation. Clockwise rotation is when the motor shaft rotates clockwise as you look at the end of the protruding motor shaft.

- Function test*
- The release type must be set to "ENABLE".
  - ▶ Switch on the supply voltage.
  - ▶ Check the status indication, see chapter 8.2 "Status display via LEDs".
  - ▶ Enable the power stage via the `ENABLE` input.
  - ◁ If there is no error condition, the "Readiness" output signals ready for operation approx. 500 ms after the power stage is enabled. When you use rotation monitoring, this time is 1.5 s. The motor executes a small movement (approx. 1.2°) to verify proper operation of the rotation monitoring unit.
  - ▶ Start the first test with a low pulse frequency. If the signal `DIR` has 0-level, the motor must rotate clockwise.
  - ▶ Conduct positioning movements with direction reversals during the test. A reversal of the active edge at the `PULSE` signal can cause displacement of the position when reversing the direction.

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

## 6 Operation

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

### 6.1 Functions

#### 6.1.1 Input PULSEDIR

*Interface mode "PULSE/DIR"*

The motor executes a motor step with the rising edge of the PULSE signal. The direction of rotation is controlled by the DIR signal.

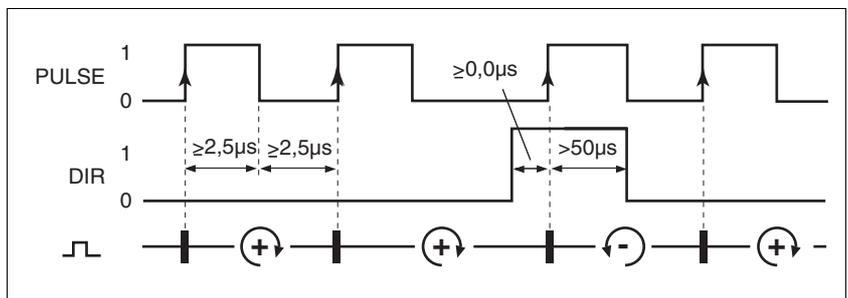


Figure 6.1 "PULSE/DIR" interface mode

Signal	Signal value	Meaning
PULSE	0 -> 1	Motor step
DIR	0 / open	Clockwise direction of rotation
	1	Counterclockwise direction of rotation

The maximum frequency is 200 Hz.

#### 6.1.2 Input CWCCW

*Interface mode "CW/CCW"*

The motor executes a clockwise motor step with the rising edge of the CW signal. The motor executes an anticlockwise motor step with the rising edge of the CCW signal.

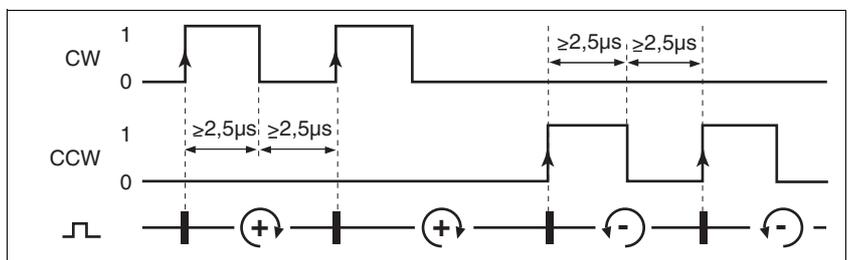


Figure 6.2 Interface mode CW/CCW

Signal	Signal value	Meaning
CW	0 -> 1	clockwise motor step
CCW	0 -> 1	anticlockwise motor step

The maximum frequency is 200 Hz.

### 6.1.3 Input ENABLE

*Function* The ENABLE input activates the power stage.

An error message is acknowledged with a falling edge.

Signal value	Meaning
1	Enable power stage
0 / open	Disable power stage
Falling edge	Resetting error messages

If there is no error condition, the "Readiness" output signals ready for operation approx. 500 ms after the power stage is enabled. When you use rotation monitoring, this time is 1.5 s. The motor executes a small movement (approx. 1.2°) to adjust the function of the rotation monitoring.

When the signal ENABLE is removed, the power stage remains enabled for about another 100 ms. This allows for the holding brake to be applied before the motor loses torque. The power stage is disabled immediately on drives without a holding brake.

### 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 you can select individual axes with GATE.

Signal value	Description
rising edge	blocking signals
falling edge	releasing signals

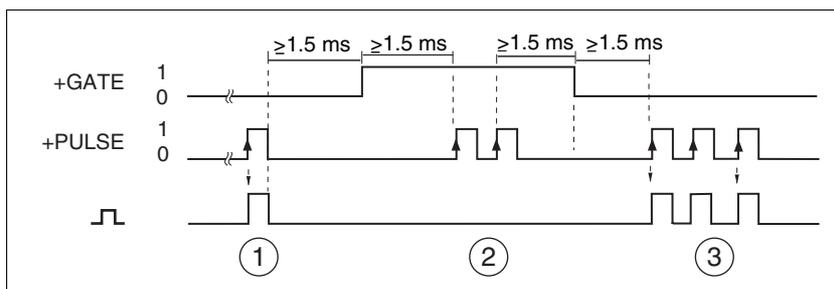


Figure 6.3 Signal sequences during switch-on via GATE

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

There must be no pulse pending for 1.5 ms before and after switching the signal GATE to ensure that the drive can follow the pulse preset step by step.

### 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 precision is required but the output frequency of the master controller 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	Motor increment count	Explanation
0 / open	0	0	1	400	Number of motor steps set as with switches S1.1 .. S1.3
1	0	0	1	4000	Setting of switch S1.1 is inverted

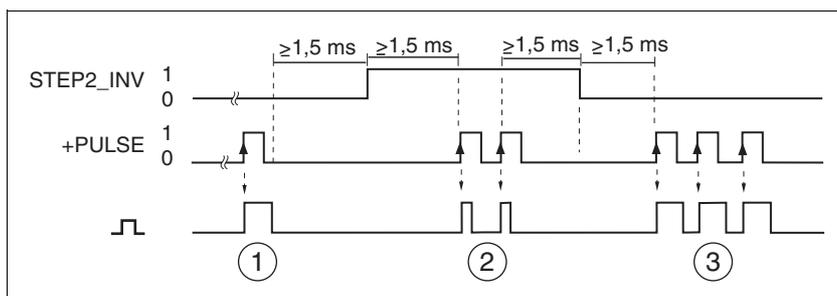


Figure 6.4 Signal sequences when switching the **STEP2\_INV** signal

- (1) Large motor step
- (2) Motor steps lower 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.

### 6.1.7 "Ready" output

The ACTIVE\_OUT\_C / ACTIVE\_OUT\_NO output displays the operating readiness.

Signal value	Meaning
open	Power stage blocked, motor without current
closed	Power stage enabled, motor has current

### 6.1.8 "Holding brake" output (optional)

The output +BRAKE\_OUT controls the motor holding brake.

Signal value	Meaning
1	Brake released
0	Brake applied

### 6.1.9 "Rotation monitoring error message" output (optional)

The  $\overline{\text{RM-FAULT\_OUT}}$  output displays an error message via the rotation monitoring.

Signal value	Meaning
1	no error
0	Error message by rotation monitoring

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

## 7 Examples

### 7.1 Wiring example

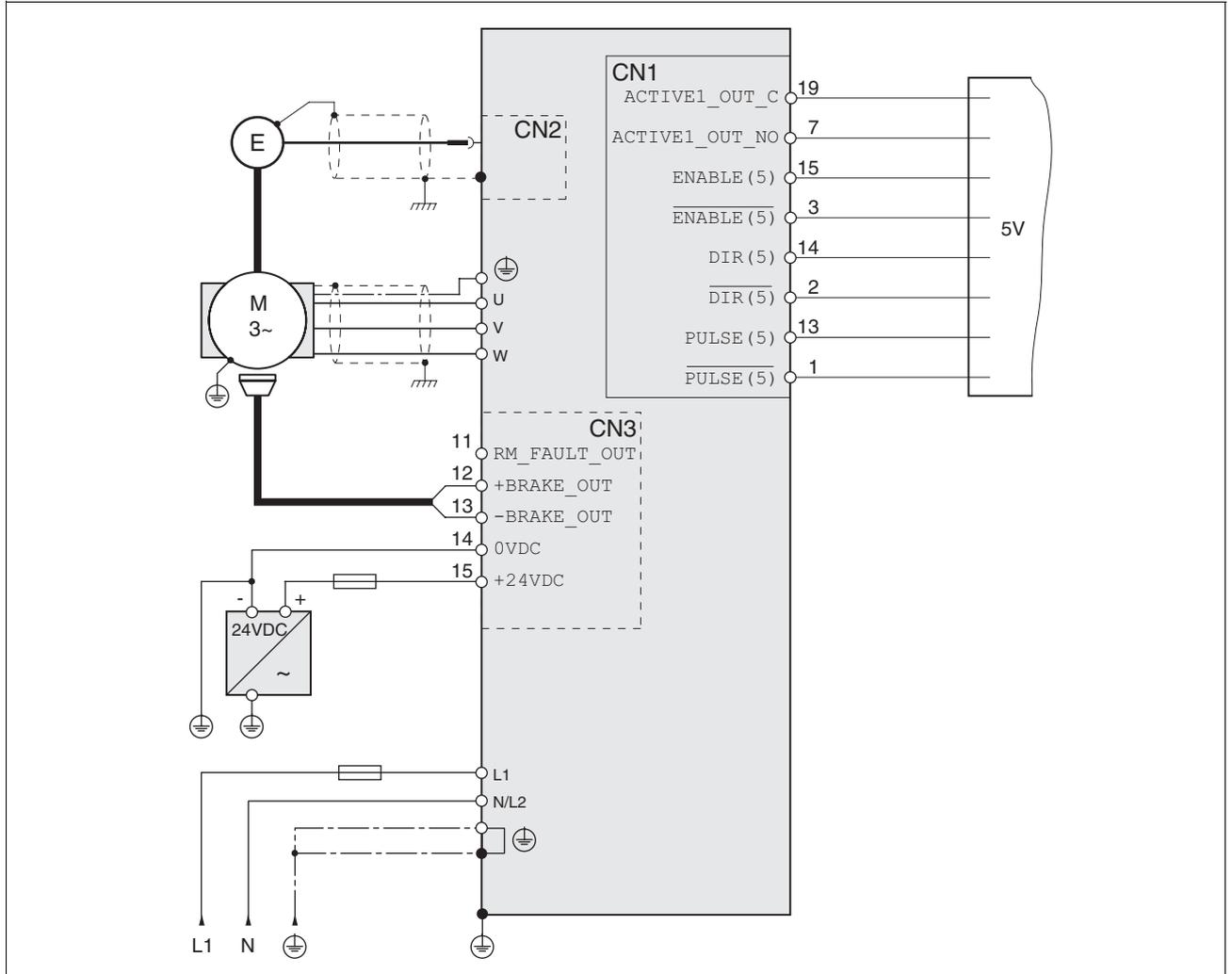


Figure 7.1 Wiring example



## 8 Diagnostics and troubleshooting

### ⚠ DANGER

#### ELECTRIC SHOCK, FIRE, 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.
- The system manufacturer is responsible for compliance with all applicable regulations pertaining to grounding the drive system.
- Many components, including the printed circuit board, operate with mains voltage. **Do not touch.** Do **not** touch unprotected parts or screws of the terminals when they are under voltage.
- Install all covers and close the housing doors before applying voltage.
- The motor generates voltage when the shaft is rotated. Lock the motor shaft to prevent rotation caused by external forces before starting work on the drive system.
- Before working on the drive system:
  - Disconnect the voltage supply to all connections.
  - Place a label "DO NOT SWITCH ON" on the switch and secure the switch against being switched on.
  - **Wait for 6 minutes** (discharge DC bus capacitors). Do **not** short-circuit DC bus!
  - Measure the voltage on DC bus and verify that it is <42V. (The DC bus LED is not a reliable indicator for the absence of DC bus voltage).

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

### 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.

## 8.2 Status display via LEDs

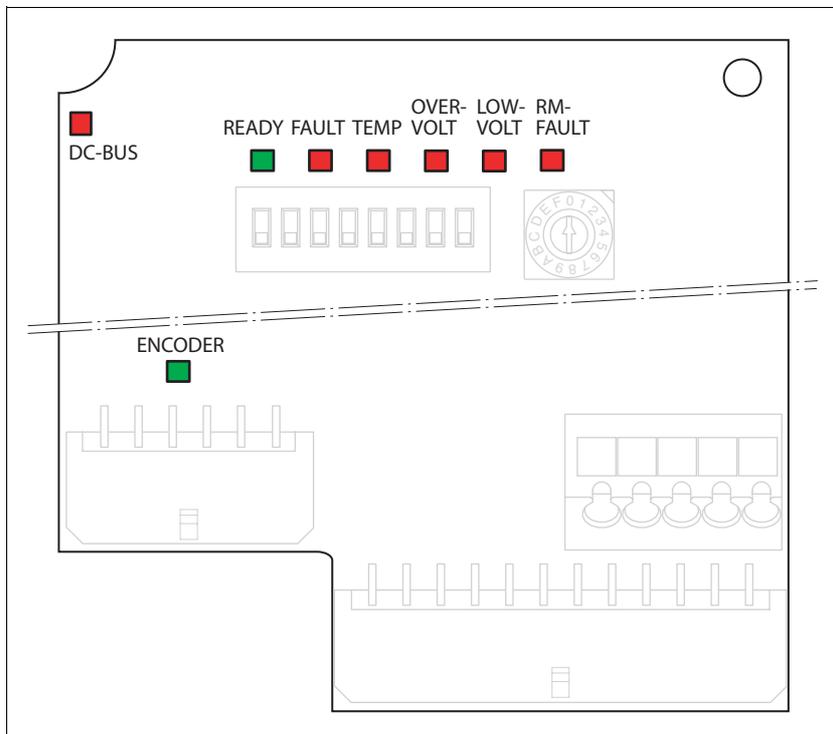


Figure 8.1 Status display via LEDs

The LEDs indicate the current operating state.

LED	Meaning
DC bus	DC bus under voltage
READY	ready, power stage released, motor with current
FAULT	Short circuit between 2 motor phases or between motor phase against ground
TEMP (static)	Power stage excess temperature
TEMP (flashing <sup>1)</sup> )	Motor overtemperature
OVER-VOLT	Overvoltage (DC bus $>420V_{DC}$ )
LOW-VOLT	Undervoltage (DC bus $<180V_{DC}$ )
RM-FAULT <sup>1)</sup>	Error message by rotation monitoring
OVER-VOLT, LOW-VOLT	Power stage blocked, motor without current
FAULT, TEMP, OVER-VOLT, LOW-VOLT	Frequency at signal interface too high
ENCODER <sup>1)</sup>	Encoder connected and ready

1) only with SD326R

## 8.3 Troubleshooting

### 8.3.1 Troubleshooting

Problem	Cause	Correction
Motor does not rotate and has no holding torque	Break in the motor cable	Check motor cable and connection. One or more motor phases are not connected.
	Signal input <code>PWM</code> has 1-level	Checking signal input.
	Signal input <code>ENABLE</code> has 0-level	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 ancillary devices
	Signal input <code>GATE</code> has 1-level	Checking signal input.
Motor rotates unevenly	Overload	Reduce load
	Motor defective	Replace motor
Motor rotates in the wrong direction.	Motor phases reversed	Check motor phases
	Signal input <code>DIR</code> has incorrect level	Checking signal input.
LED FAULT	Short circuit between 2 motor phases or between motor phase against ground	Checking wiring
LED TEMP (static)	Power stage excess temperature	Check temperature in control cabinet, reduce current for power 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 <code>T_MOT</code> , encoder cable not plugged in	Check encoder cable
	24V controller supply voltage not connected or switched off	Check 24V controller supply voltage
LED OVER-VOLT	Overvoltage by energy recovery during deceleration	Use external capacitor. Error message must be reset.
LED LOW-VOLT	Undervoltage	Check mains voltage and connections

*Resetting error messages* When the malfunction is corrected, the error message can be reset by cancelling the `ENABLE` signal.

When using the "Gate" function, the input `ENABLE` is not available. The error message can only be reset by isolation of the mains supply.



## 9 Accessories and spare parts

### 9.1 Optional accessories

Designation	Order no.
Fan set 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 cable

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 cable

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

## 9.5 Mains filter

Designation	Order no.
Mains filter 1~; 9A; 115/230V <sub>ac</sub>	VW3A31401

## 9.6 Installation material

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

## 10 Service, maintenance and disposal

### **⚠ DANGER**

#### **ELECTRIC SHOCK, FIRE, 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.
- The system manufacturer is responsible for compliance with all applicable regulations pertaining to grounding the drive system.
- Many components, including the printed circuit board, operate with mains voltage. **Do not touch.** Do **not** touch unprotected parts or screws of the terminals when they are under voltage.
- Install all covers and close the housing doors before applying voltage.
- The motor generates voltage when the shaft is rotated. Lock the motor shaft to prevent rotation caused by external forces before starting work on the drive system.
- Before working on the drive system:
  - Disconnect the voltage supply to all connections.
  - Place a label "DO NOT SWITCH ON" on the switch and secure the switch against being switched on.
  - **Wait for 6 minutes** (discharge DC bus capacitors). Do **not** short-circuit DC bus!
  - Measure the voltage on DC bus and verify that it is <42V. (The DC bus LED is not a reliable indicator for the absence of DC bus voltage).

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



*The product may only be repaired by a certified 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, depending on the way you use it.

### 10.3 Replacing units

#### **⚠ 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 specified in chapter 4 "Installation".
- ▶ Commission the product as per chapter 5 "Commissioning".

## 10.5 Shipping, storage, disposal

Note the ambient conditions on page 19!

- 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.

## 11 Extract

This extract does not replace the product manual. The chapter provides keywords for installation and commissioning.

- ▶ Read the entire product manual before you begin.

### 11.1 Extract for installation and commissioning

#### **▲ 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.**

11.1.1 Overview

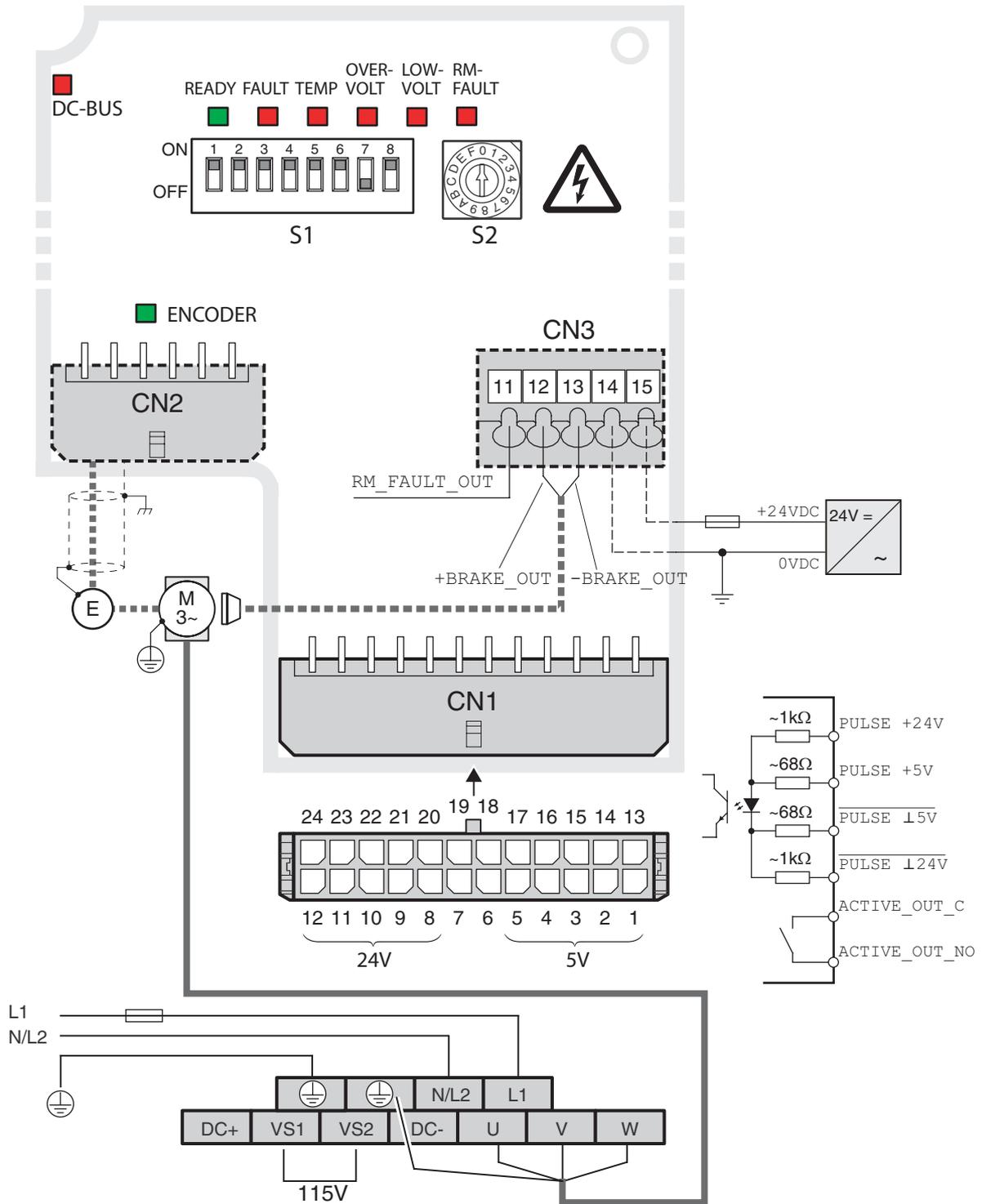


Figure 11.1 Wiring overview

0198441113694, V2.00, 09.2008

### 11.1.2 Settings for parameter switches S1 and S2

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

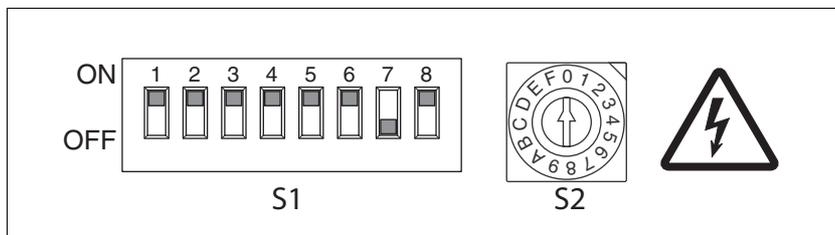


Figure 11.2 Overview of parameter switches

For more information see "Commissioning".

#### 11.1.2.1 Settings for parameter switch S1

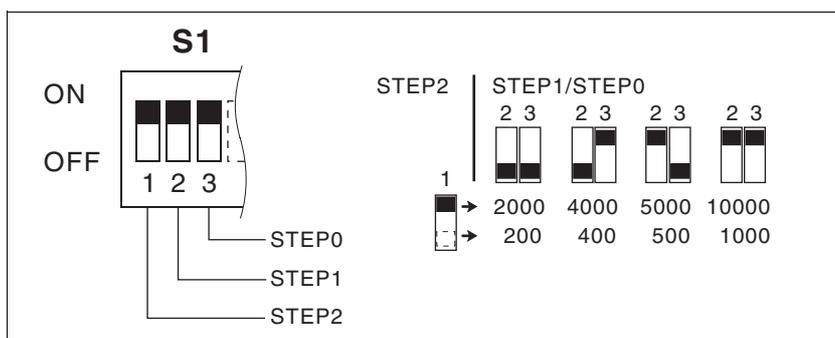


Figure 11.3 Set step number with S1.1..S1.3

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

Meaning	ON	OFF
S1.4 Current reduction <sup>1)</sup>	"Current reduction" function activated <sup>2)</sup>	Function "Current reduction" deactivated
S1.5 Type of release	Function "GATE" Block or release reference values <sup>2)</sup>	Function "ENABLE" Enable/block power stage
S1.6 Interface mode	Interface mode "PULSE/DIR" <sup>2)</sup>	Interface mode "CW/CCW"
S1.7 Softstep	"softstep" function is activated	"softstep" function is deactivated <sup>2)</sup>
S1.8 Encoder monitoring	Rotation monitoring enabled <sup>2)</sup>	Rotation monitoring disabled

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

#### 11.1.2.2 Settings for parameter switch S2

The nominal motor current is set with parameter switch S2.

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

*CN1 connection assignment: 5V or 24V signals* Either 5V or 24V signals can be connected!

Pin 5V	Pin 24V	Signal	Color <sup>1)</sup>	Pair	Meaning	I/O
13	20	PULSE CW	White	1	Motor step (+) Motor step clockwise direction of rotation (+)	I
1	8	$\overline{\text{PULSE}}$ $\overline{\text{CW}}$	Brown	1	Motor step, inverted (-) Motor step in clockwise direction of rotation, inverted (-)	I
14	21	DIR CCW	Green	2	Direction of rotation (+) Motor step in counterclockwise direction of rotation (+)	I
2	9	$\overline{\text{DIR}}$ $\overline{\text{CCW}}$	Yellow	2	Direction of rotation, inverted (-) Motor step in counterclockwise direction of rotation, inverted (-)	I
15	22	GATE ENABLE	Gray	3	Disable reference values (+) Release power stage (+)	I
3	10	$\overline{\text{GATE}}$ $\overline{\text{ENABLE}}$	Pink	3	Disable reference values, inverted (-) Release power stage, 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	Ready	O
7	7	ACTIVE_OUT_NO	Red/blue	6	Ready	O
6.18	6.18				Not assigned	

1) Color specifications refer to the cables available as accessories

### 11.1.4 Test operation of the motor

*Direction of rotation* Rotation of the motor shaft in a clockwise or counterclockwise direction of rotation. Clockwise rotation is when the motor shaft rotates clockwise as you look at the end of the protruding motor shaft.

- Function test*
- The release type must be set to "ENABLE".
  - ▶ Switch on the supply voltage.
  - ▶ Check the status indication, see chapter 8.2 "Status display via LEDs".
  - ▶ Enable the power stage via the `ENABLE` input.
  - ◁ If there is no error condition, the "Readiness" output signals ready for operation approx. 500 ms after the power stage is enabled. When you use rotation monitoring, this time is 1.5 s. The motor executes a small movement (approx.  $1.2^\circ$ ) to adjust the function of the rotation monitoring.
  - ▶ Start the first test with a low pulse frequency. If the signal `DIR` has 0-level, the motor must rotate clockwise.
  - ▶ Conduct positioning movements with direction reversals during the test. A reversal of the active edge at the `PULSE` signal can cause displacement of the position when reversing the direction.

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

### 11.1.5 Operating state via LED

The LEDs display the current operating state.

LED	Meaning
DC bus	DC bus under voltage
READY	ready, power stage released, motor with current
FAULT	Short circuit between 2 motor phases or between motor phase against ground
TEMP (static) TEMP (flashing <sup>1)</sup> )	Power stage excess temperature Motor overtemperature
OVER-VOLT	Overvoltage (DC bus $>420V_{DC}$ )
LOW-VOLT	Undervoltage (DC bus $<180V_{DC}$ )
RM-FAULT <sup>1)</sup>	Error message by rotation monitoring
OVER-VOLT, LOW-VOLT	Power stage blocked, motor without current
FAULT, TEMP, OVER-VOLT, LOW-VOLT	Frequency at signal interface too high
ENCODER <sup>1)</sup>	Encoder connected and ready

1) only with SD326R

For more information see "Commissioning" or "Diagnostics".



## 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]  
 $5 \text{ m} / 0.9144 = 5.468 \text{ yd}$

#### 12.1.1 Length

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

#### 12.1.2 Mass

	<b>lb</b>	<b>oz</b>	<b>slug</b>	<b>kg</b>	<b>g</b>
<b>lb</b>	-	* 16	* 0.03108095	* 0.4535924	* 453.5924
<b>oz</b>	/ 16	-	* $1.942559 \cdot 10^{-3}$	* 0.02834952	* 28.34952
<b>slug</b>	/ 0.03108095	/ $1.942559 \cdot 10^{-3}$	-	* 14.5939	* 14593.9
<b>kg</b>	/ 0.453592370	/ 0.02834952	/ 14.5939	-	* 1000
<b>g</b>	/ 453.592370	/ 28.34952	/ 14593.9	/ 1000	-

#### 12.1.3 Force

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

#### 12.1.4 Power

	<b>HP</b>	<b>W</b>
<b>HP</b>	-	* 745.72218
<b>W</b>	/ 745.72218	-

12.1.5 Rotation

	min <sup>-1</sup> (RPM)	rad/s	deg./s
min <sup>-1</sup> (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 <sup>6</sup>
lb-ft	* 12	-	* 192	* 1.355822	* 0.138255	* 13.8255	* 13.558*10 <sup>6</sup>
oz-in	/ 16	/ 192	-	* 7.0616*10 <sup>-3</sup>	* 720.07*10 <sup>-6</sup>	* 72.007*10 <sup>-3</sup>	* 70615.5
Nm	/ 0.112985	/ 1.355822	/ 7.0616*10 <sup>-3</sup>	-	* 0.101972	* 10.1972	* 10*10 <sup>6</sup>
kp-m	/ 0.011521	/ 0.138255	/ 720.07*10 <sup>-6</sup>	/ 0.101972	-	* 100	* 98.066*10 <sup>6</sup>
kp-cm	/ 1.1521	/ 13.8255	/ 72.007*10 <sup>-3</sup>	/ 10.1972	/ 100	-	* 0.9806*10 <sup>6</sup>
dyne-cm	/ 1.129*10 <sup>6</sup>	/ 13.558*10 <sup>6</sup>	/ 70615.5	/ 10*10 <sup>6</sup>	/ 98.066*10 <sup>6</sup>	/ 0.9806*10 <sup>6</sup>	-

12.1.7 Moment of inertia

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

<b>AWG</b>	1	2	3	4	5	6	7	8	9	10	11	12	13
<b>mm<sup>2</sup></b>	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
<b>AWG</b>	14	15	16	17	18	19	20	21	22	23	24	25	26
<b>mm<sup>2</sup></b>	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

## 12.2 Terms and Abbreviations

<i>AC</i>	Alternating current
<i>DC</i>	Direct current
<i>Degree of protection</i>	The degree of protection is a standardized specification for electrical equipment that describes the protection against the ingress of foreign objects and water (for example: IP 20).
<i>Default value</i>	Factory setting.
<i>Direction of rotation</i>	Rotation of the motor shaft in a clockwise or counterclockwise direction of rotation. Clockwise rotation is when the motor shaft rotates clockwise as you look at the end of the protruding motor shaft.
<i>Drive system</i>	System consisting of controller, power stage and motor.
<i>EMC</i>	Electromagnetic compatibility
<i>Error class</i>	Classification of errors into groups. The different error classes allow for specific responses to faults, e.g. by severity.
<i>Fatal error</i>	In the case of fatal error, the drive is not longer able to control the motor, so that an immediate switch-off of the drive is necessary.
<i>Fault</i>	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.
<i>Fault reset</i>	A function used to restore the drive to an operational state after a detected fault is cleared by removing the cause of the fault so that the fault is no longer active (transition from state "Fault" to state "Operation Enable").
<i>Holding brake</i>	The holding brake in the motor is used to block the motor when it is not under current (e.g. with a vertical axis). The holding brake must not be used as a service brake for braking motion.
<i>Inc</i>	Increments
<i>IT mains</i>	Mains in which all active components are isolated from ground or are grounded by a high impedance. IT: isol�e terre (French), isolated ground. Opposite: Grounded mains, see TT/TN mains
<i>Parameter switches</i>	Small, side-by-side switches. Must be set during installation.
<i>PELV</i>	Protective Extra Low Voltage, low voltage with isolation. For more information: IEC 60364-4-41
<i>PLC</i>	Programmable logic controller
<i>Power stage</i>	The power stage controls the motor. The power stage generates currents for controlling the motor on the basis of the positioning signals from the controller.
<i>PTC</i>	Resistor with positive temperature coefficient. Resistance value increases as the temperature rises.
<i>Pulse/direction signals</i>	Digital signals with variable pulse frequencies which signal changes in position and direction of rotation via separate signal wires.
<i>RCD</i>	Residual Current Device
<i>rms</i>	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 not used within the context of safety instructions, a warning alerts to a potential problem detected by a monitoring function. A warning is not a fault and does not cause a transition of the operating state. Warnings belong to error class 0.

## 13 Index

### A

- Abbreviations 91
- Accessories and spare parts 77
- Air humidity 19
- Ambient conditions 19
  - Air humidity operation 19
  - Operation 19
  - Relative air humidity operation 19
  - Transportation and storage 19
- Approved motors 21, 42
- Assembling cables
  - Mains supply 46
  - Motor phases 43

### B

- Before you begin
  - Safety information 15

### C

- Cable 25
- Cable specifications and terminal
  - Motor phase connections 42
- Certifications 19
- Changing the motor 81
- Commissioning 59
  - steps 62
- Components and interfaces 11
- Connect controller supply voltage 56
- Connection
  - DC bus 45
  - Mains supply 46
  - motor phases 42
  - outputs and controller supply voltage (CN3) 55
  - rotation monitoring (CN2) 52
  - Signal interface (CN1) 48
- Control cabinet 28, 34

### D

- Declaration of conformity 14
- Device
  - installation 35
- device
  - installation 34
- Diagnostics 73
- dimensional drawing, see dimensions
- Dimensions 20
- Disposal 79, 82
- Documentation and literature references 13

### E

- Electrical installation 38

- EMC 28
  - Cable installation 29
  - Measures for improvement 30
  - Motor cable and encoder cable 30
  - power supply 29
  - scope of supply and accessories 28
  - Shielding 29
- Encoder (motor)
  - connectMotor encoder
    - connect 53
- encoder cable
  - EMC specifications 30
- EPLAN Macros 13
- Equipotential bonding conductors 30
- Examples 71

## F

- Functions 67

## G

- Glossary 89

## H

- Hazard categories 16
- Humidity 19

## I

- Installation
  - electrical 38
  - mechanical 33
- Installation spacing 34
- Installation, mechanical 34
- Intended use 15
- Introduction 9
- IT mains, operation in 32

## M

- Macros EPLAN 13
- Mains filter
  - mounting 37
- Mains supply
  - connecting 47
- Maintenance 79
- manuals 13
- Max. humidity operation 19
- Measures for improvement of the EMC 30
- Mechanical installation 33
- Misoperation 75
- Monitoring
  - motor phases 43
- motor cable
  - EMC specifications 30
- Motor cables
  - connecting 43

Motor encoder  
Encoder type 52  
Function 52

## O

Operation 67  
Operation ambient temperature 19  
Overview 61  
all connections 41  
procedure for electrical installation 40

## P

Power connections  
overview 41  
product manuals 13

## Q

Qualification of personnel 15

## R

Relative air humidity 19  
Remove protective foil 36

## S

Scope of supply 10  
Service 79  
Service address 80  
Shielding - EMC specifications 29  
Shipping 82  
Signal connections  
overview 41  
Signal interface  
connecting 51  
Source  
EPLAN Macros 13  
product manuals 13  
Status display via LEDs 74  
Storage 82

## T

Technical data 19  
Temperature during operation 19  
Terms 91  
Troubleshooting 73, 75  
Misoperation 75  
Type code 12

## U

Unit overview 9  
Units and conversion tables 89

**V**

ventilation 34

**W**

Wiring diagram

24V power supply 56

motor encoder 54

Motor phases 44

power stage supply voltage 47

signal interface 49