

## Technical Documentation

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Product manual

Drive for EC motors

### **BLV 14**

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## Important information

The drive systems described here are products for general use that conform to the state of the art in technology and are designed to prevent any dangers. However, drives and drive controllers that are not specifically designed for safety functions are not approved for applications where the functioning of the drive could endanger persons. The possibility of unexpected or unbraked movements can never be totally excluded without additional safety equipment. For this reason personnel must never be in the danger zone of the drives unless additional suitable safety equipment prevents any personal danger. This applies to operation of the machine during production and also to all service and maintenance work on drives and the machine. The machine design must ensure personal safety. Suitable measures for prevention of property damage are also required.

See safety section for additional critical instructions.

### **Not all product variants are available in all countries.**

Please consult the current catalogue for information on the availability of product variants.

We reserve the right to make changes during the course of technical developments.

All details provided are technical data and not promised characteristics.

In general, product names must be considered to be trademarks of the respective owners, even if not specifically identified as such.

## 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>	
1.1 About this manual	1-1
1.2 Unit overview	1-1
1.3 Scope of supply	1-2
1.4 Components and interfaces	1-3
1.5 Type code	1-4
1.6 Documentation and literature references	1-4
1.7 Directives and standards	1-5
<b>2 Safety</b>	
2.1 Qualification of personnel	2-1
2.2 Intended use	2-1
2.3 General safety instructions	2-2
2.4 Monitoring functions	2-3
<b>3 Technical Data</b>	
3.1 Environmental conditions	3-1
3.1.1 Degree of protection	3-2
3.1.2 Service life	3-2
3.2 Mechanical data	3-3
3.2.1 Dimensions	3-3
3.3 Electrical Data	3-4
3.3.1 Power supply	3-4
3.3.2 Signal interface	3-5
3.3.3 Motor connection	3-6
3.3.4 Interface for Hall-sensors	3-7
3.4 Technical Data accessories	3-8
3.4.1 Cable	3-8
3.4.2 Connector	3-8
3.4.3 Other accessories	3-9

**4 Installation**

4.1	Electromagnetic compatibility, EMC . . . . .	4-1
4.2	Mechanical installation . . . . .	4-5
4.2.1	Installing the device . . . . .	4-6
4.3	Electrical installation . . . . .	4-7
4.3.1	Overview of procedure . . . . .	4-9
4.3.2	Circuit diagrams of digital outputs . . . . .	4-9
4.3.3	Overview of all connections . . . . .	4-10
4.3.4	Connection of power supply (CN1) . . . . .	4-11
4.3.5	Connection of signal interface (CN2) . . . . .	4-13
4.3.6	Connection of motor phases (CN3) . . . . .	4-14
4.3.7	Hall sensors connection (CN4) . . . . .	4-16
4.4	Checking installation . . . . .	4-17

**5 Commissioning**

5.1	General safety instructions . . . . .	5-1
5.2	Overview . . . . .	5-2
5.3	Commissioning procedure . . . . .	5-3
5.3.1	Setting parameter switch S1 . . . . .	5-3
5.3.2	Setting parameter switch S2 . . . . .	5-4
5.3.3	Setting potentiometer S3 . . . . .	5-6
5.3.4	Test operation of the drive . . . . .	5-6

**6 Operation**

6.1	Speed control operating mode (closed loop) . . . . .	6-1
6.2	Required motor voltage (open loop) operating mode . . . . .	6-1
6.3	Functions . . . . .	6-2
6.3.1	Input ENABLE . . . . .	6-2
6.3.2	Input DIR . . . . .	6-3
6.3.3	Input BRAKE . . . . .	6-3
6.3.4	ACTIVE_OUT output (readiness) . . . . .	6-3
6.3.5	N_OUT output (speed signal) . . . . .	6-3
6.3.6	Setting maximum motor phase current . . . . .	6-4
6.3.7	Setting ramp steepness . . . . .	6-4
6.3.8	Monitoring functions . . . . .	6-5

**7 Examples**

7.1	Wiring example of BLV14H . . . . .	7-1
7.2	Wiring example of BLV14L . . . . .	7-2
7.3	Calculation of current consumption . . . . .	7-3

**8 Diagnostics and troubleshooting**

8.1	Service .....	8-1
8.2	Status display via LEDs .....	8-2
8.3	Troubleshooting .....	8-3
8.3.1	Resolution of malfunctions .....	8-3

**9 Accessories and spare parts**

9.1	Optional accessories .....	9-1
-----	----------------------------	-----

**10 Service, maintenance and disposal**

10.1	Service address .....	10-1
10.2	Maintenance .....	10-1
10.3	Replacing units .....	10-1
10.4	Changing the motor .....	10-2
10.5	Shipping, storage, disposal .....	10-2

**11 Glossary**

11.1	Units and conversion tables .....	11-1
11.1.1	Length .....	11-1
11.1.2	Mass .....	11-1
11.1.3	Force .....	11-1
11.1.4	Power .....	11-1
11.1.5	Rotation .....	11-2
11.1.6	Torque .....	11-2
11.1.7	Moment of inertia .....	11-2
11.1.8	Temperature .....	11-2
11.1.9	Conductor cross section .....	11-2
11.2	Terms and Abbreviations .....	11-3

**12 Index**



## Writing conventions and symbols

*Work steps* If work steps must be carried out in sequence, they are shown as follows:

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

If a response to a work step is specified, this will inform you that the step has been carried out correctly.

Unless otherwise stated, the individual instruction steps must be carried in the given sequence.

*Lists* Lists can be sorted alphanumerically or by priority. Lists are structured as follows:

- Point 1
- Point 2
  - Subpoint to 2
  - Subpoint to 2
- Point 3

*Making work easier* Information on making work easier can be found at this symbol:



*This offers supplementary information on making work easier.  
See the chapter on safety for an explanation of the safety instructions.*





# 1 Introduction

## 1.1 About this manual

This manual is applicable for all BLV14 standard models. This chapter lists the type code for this product. The type code can be used to identify whether your product is a standard model or a customised model. If your product is a customised model, please contact your dealer for an appropriate manual.

## 1.2 Unit overview

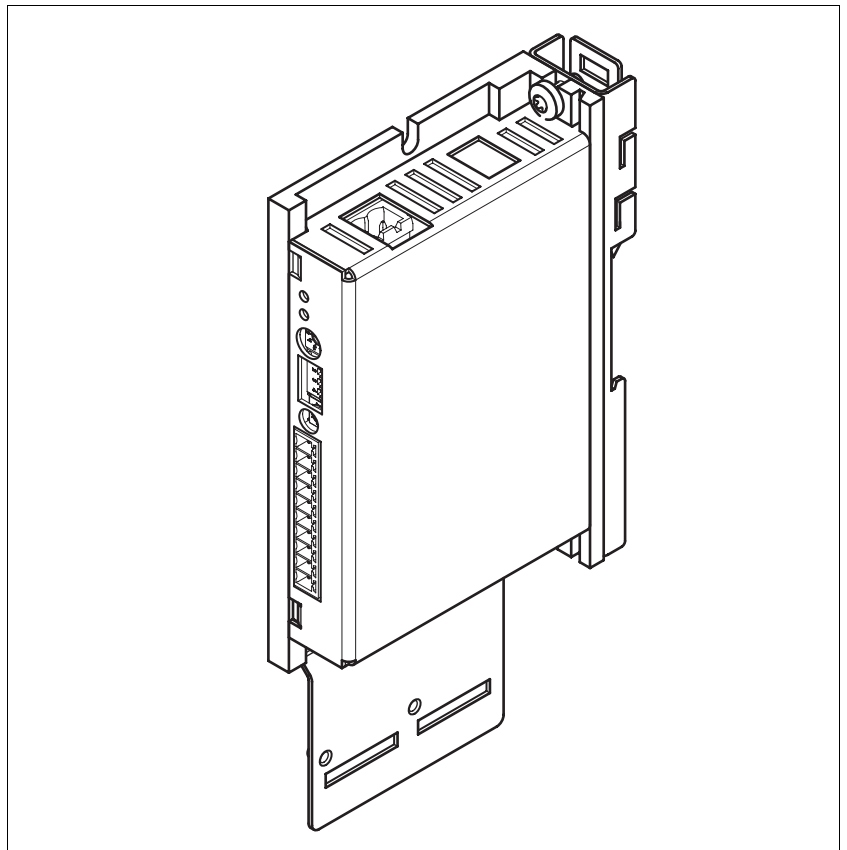


Figure 1.1 BLV with accessories

*Drive system* The BLV drive is used to actuate EC motors.

Reference values are analogue preset via an internal potentiometer or an external voltage signal.

It offers a very compact and powerful drive system in combination with selected brushless DC motors by Berger Lahr.

*Signal interface* The reference value must be set as an analogue signal over the signal interface. Digital control signals are also connected for activation of the power amplifier, the direction of rotation and for the short-circuit brakes.

One output supplies the voltage for external potentiometers.

One output signal reports the operating readiness, another output sends a pulse signal proportionate to the speed of rotation.

### 1.3 Scope of supply

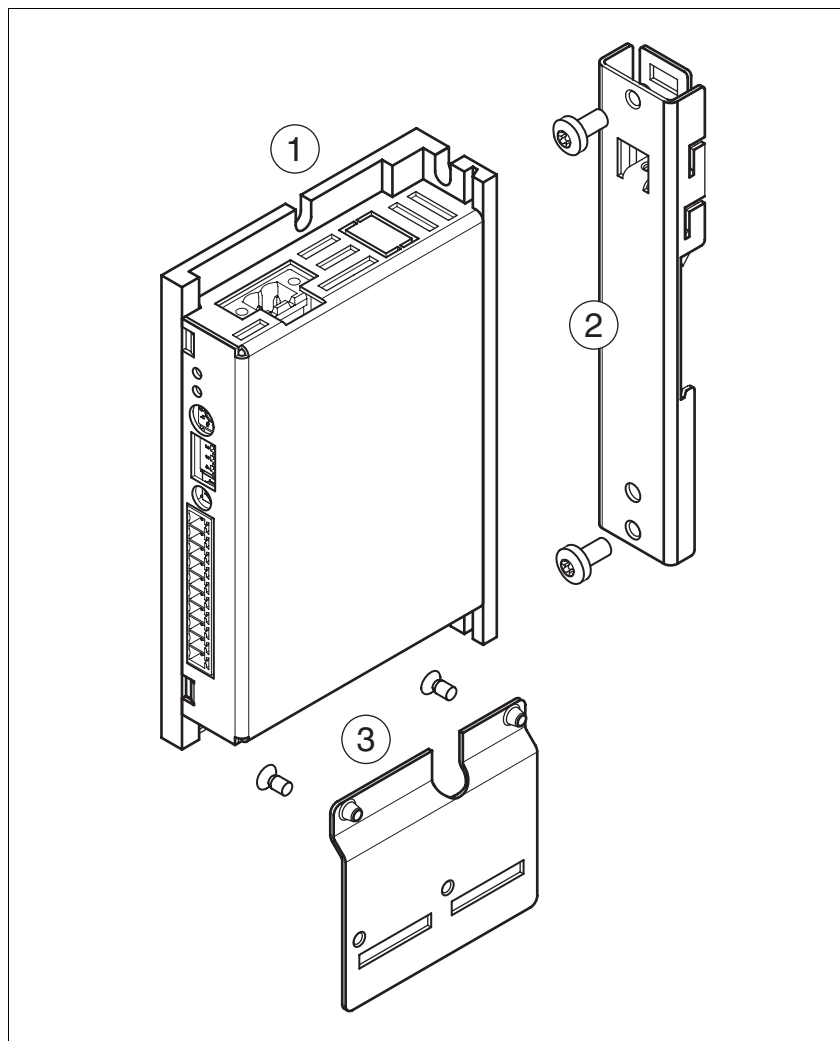


Figure 1.2 Scope of supply

- (1) BLV14●●
- (2) Top-hat rail adapter with mounting screws (accessories)
- (3) EMC kit with mounting screws (accessories)

## 1.4 Components and interfaces

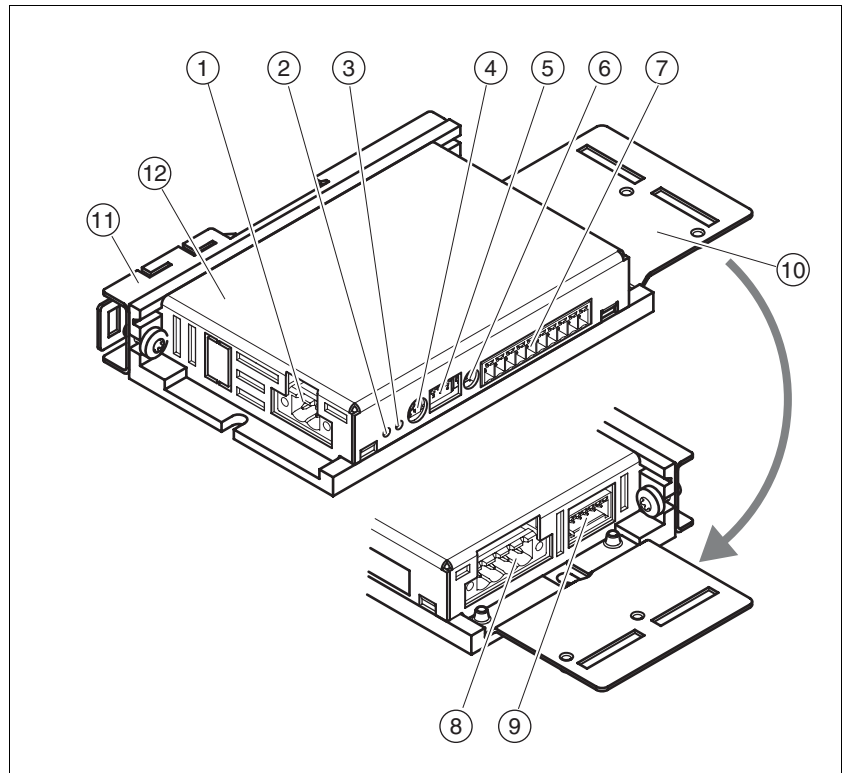


Figure 1.3 Components and interfaces

- (1) Supply voltage connection CN1
- (2) LED1 (green)
- (3) LED2 (red)
- (4) Rotary switch for adjustment of the motor current S1
- (5) Parameter switch S2
- (6) Internal potentiometer S3
- (7) Power connection for signal interface CN2
  - Analogue inputs
  - Digital inputs
  - outputs
- (8) Connection of motor CN3
- (9) Connection of Hall sensors CN4
- (10) EMC mounting plate (accessories)
- (11) Top-hat rail adapter (accessories)
- (12) Nameplate with simplified manual

## 1.5 Type code

	BLV1	•	•	D16	B4	••
<b>Product designation</b> Drive for brushless DC motors (Brushless Velocity)						
<b>Product design</b> 1 = design for soldering 2 = open design 4 = closed design						
<b>Interface</b> H = analogue inputs 0 ... 10 V <sub>DC</sub> ; digital signals 24 V <sub>DC</sub> L = analogue inputs 0 ... 5 V <sub>DC</sub> ; digital signals 5 V <sub>DC</sub>						
<b>Peak current</b> D 16 = 16 A <sub>RMS</sub>						
<b>Power supply</b> B 4 = 24 ... 48 V <sub>DC</sub>						
<b>Other options</b> 00 = standard xx = customised model <sup>1)</sup>						

1) This documentation is for the standard model only, not customised models.

## 1.6 Documentation and literature references

The following User's manuals are supplied with this drive system:

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

The user's manuals can also be found in the Internet at

<http://www.berger-lahr.com/download>.

### *Additional literature*

We recommend the following literature for more in-depth information:

- Vogel, Johannes: Elektrische Antriebstechnik. ISBN: 3-7785-2649-9, Hüthig Verlag Heidelberg
- Riefenstahl, Ulrich: Elektrische Antriebstechnik - Leitfaden der Elektrotechnik. ISBN: 3-519-06429-4, B.G. Teubner Stuttgart, Leipzig

## 1.7 Directives and standards

<i>CE mark</i>	With the declaration of conformity and the CE mark on the product the manufacturer certifies that the product complies with the requirements of all relevant EC directives.
<i>EC Machine Directive</i>	<p>The drive systems described here are not machines as defined by the EC Machine Directive (98/37/EEC) but components for installation in machines. They do not have moving parts designed for specific purposes. However, they can be components of a machine or system.</p> <p>The manufacturer must certify that the complete system conforms to the machine directive with the CE mark.</p>
<i>EC EMC Directive</i>	<p>The EC Electromagnetic Compatibility Directives (89/336/EEC) applies to products that cause electromagnetic interference or whose operation may be adversely affected by electromagnetic interference.</p> <p>Conformity with the EMC Directive can only be expected of drive systems after correct installation in the machine. The information on ensuring electromagnetic compatibility given in the chapter on "Installation" must be followed to ensure that the drive system in the machine or system is EMC-compatible and that the product can legally be operated.</p>
<i>EC Low-Voltage Directive</i>	<p>The EC Low-Voltage Directive (73/23/EEC) lays down safety requirements for "electrical apparatus" as protection against the risks that can originate in such devices and can be created in response to external influences.</p> <p>The drive systems described here comply with the EN 50178 Standard as per the Low-Voltage Directive.</p>
<i>Declaration of conformity</i>	The declaration of conformity certifies that the drive system complies with the specific EC directive.
<i>Standards for safe operation</i>	<p>IEC 60204-1: Electrical equipment of machines, General requirements</p> <p>IEC 60529: IP degrees of protection</p>
<i>Standards for compliance with EMC limit values</i>	IEC 61800-3: Variable-speed electrical drives



## 2 Safety

### 2.1 Qualification of personnel

Only technicians who are familiar with and understand the contents of this manual and the other relevant manuals are authorised to work on and with this drive system. The technicians must be able to detect potential dangers that may be caused by setting parameters, changing parameter values and generally by the mechanical, electrical and electronic equipment.

The technicians must have sufficient technical training, knowledge and experience to recognise and avoid dangers.

The technicians must be familiar with the relevant standards, regulations and safety regulations that must be observed when working on the drive system.

### 2.2 Intended use

The drive systems described here are products for general use that conform to the state of the art in technology and are designed to prevent any dangers. However, drives and drive controllers that are not specifically designed for safety functions are not approved for applications where the functioning of the drive could endanger persons. The possibility of unexpected or unbraked movements can never be totally excluded without additional safety equipment. For this reason personnel must never be in the danger zone of the drives unless additional suitable safety equipment prevents any personal danger. This applies to operation of the machine during production and also to all service and maintenance work on drives and the machine. The machine design must ensure personal safety. Suitable measures for prevention of property damage are also required.

In the system configuration described the drive systems must be used in industrial applications only and must have a fixed connection only.

In all cases the applicable safety regulations and the specified operating conditions, such as environmental conditions and specified technical data, must be observed.

The drive system must not be commissioned and operated until completion of installation in accordance with the EMC regulations and the specifications in this manual.

To prevent personal injury and damage to property damaged drive systems must not be installed or operated.

Changes and modifications of the drive systems are not permitted and if made all no warranty and liability will be accepted.

The drive system must be operated only with the specified wiring and approved accessories. In general, use only original accessories and spare parts.

The drive systems must not be operated in an environment subject to explosion hazard (ex area).

## 2.3 General safety instructions

### DANGER

#### **Motor out of view**

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

- Only start the system if there are no persons in the operating zone of the moving components and the system can be operated safely.

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

### WARNING

#### **Loss of control over controller**

- Observe the accident prevention regulations. (For USA see also NEMA ICS1.1 and NEMA ICS7.1)
- The system manufacturer must take the potential error possibilities of the signals and the critical functions into account to ensure a safe status during and after errors. Some examples are: emergency stop, final position limitation, power failure and restart.
- The assessment of error possibilities must also include unexpected delays and the failure of signals or functions.
- Suitable redundant control paths must be in place for dangerous functions.
- Check that measures taken are effective.

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



## 2.4 Monitoring functions

The monitoring functions in the product protect the system and reduce the risks involved in a system malfunction. These monitoring functions are not sufficient for personal protection.

The following errors and limit values can be monitored:

Monitoring	Task	Protective function
Overvoltage and undervoltage	Monitoring for overvoltage and undervoltage of the power supply	Functional safety and device protection
Overtemperature	Monitoring device for overtemperature	Device protection
Motor output short circuit	A brief short-circuit at the motor output will not destroy the power amplifier. In the event of a short-circuit current >45 A between the motor phases the motor is stopped as an error response.	Device protection
Commutation Monitoring	If an invalid signal, e.g. 0-0-0 or 1-1-1, is detected at the hall sensors input, the power amplifier is disabled.	Operational safety and device protection

*Motor protection* A current limit value that corresponds to the nominal current of the motor can protect the motor from overload in case of error (e.g. by a defective Hall sensor). See 5.3.1 "Setting parameter switch S1".



### 3 Technical Data

This chapter contains information on the required environmental conditions and on the mechanical and electrical properties of the unit family and the accessories.

#### 3.1 Environmental conditions

##### *ambient operating temperature*

When considering the ambient temperature a distinction is made between the permissible temperatures during operation and the permissible storage and transport temperature.

The maximum permissible ambient air temperature during operation depends on the clearance between the units and the required output. The relevant requirements in the chapter on installation are also very important.

Operating temperature <sup>1)</sup>	[°C]	0 ... +50
-------------------------------------	------	-----------

1) no icing

##### *Ambient climate for transport and storage*

The environment during transport and storage must be dry and dust-free. The maximum oscillation and shock stress must be within the specified limits. The bearing and transport temperature must remain within the specified range.

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

##### *Pollution degree*

Pollution degree	2
------------------	---

##### *Relative humidity*

The relative humidity is allowed as follows:

rel. air humidity	corresponding to IEC60721-3-3, class 3K3, 5% - 85%, no condensation permissible
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##### *Installation height*

Installation height above mean sea level for 100% power	[m]	< 2000
---	-----	--------

##### *Vibration and shock loading*

The strength during oscillation stress on the units corresponds to EN 50178 Section 9.4.3.2 and IEC 61131-2 Section 6.3.5.1.

Oscillation and vibration	As per IEC/EN 60068-2-6: 1.5 mm peaks of 3 ... 13Hz, 1 g from 13 ... 150Hz
---------------------------	--

Shock loading	15 g for 11 ms in accordance with IEC/EN 60068-2-27
---------------	---

*EMC limiting values*      Shielded or unshielded cables can be used. The limit values for category C3 are maintained as per EN 61800-3 even with unshielded cables for a typical structure in the case of field-borne emissions (emittance) in the range from 30 MHz to 1 GHz.

The limit values for the second environment are maintained even with unshielded cables for noise immunity. This corresponds to EN 61800-3 for a typical structure.

Shielded cables should be used if the requirements for EMC resistance or emittance are higher.

### 3.1.1 Degree of protection

*IP degree of protection*

Degree of protection as per DIN EN 60529	IP20
--	------

### 3.1.2 Service life

The service life of an electronic product is largely determined by the electrolyte capacitors in use. The service life depends on the alternating current (ripple current) in the capacitors.

Service life at 100% Duty Cycle	5000 h at maximum continuous output current and 50°C ambient temperature
---------------------------------	--

## 3.2 Mechanical data

### 3.2.1 Dimensions

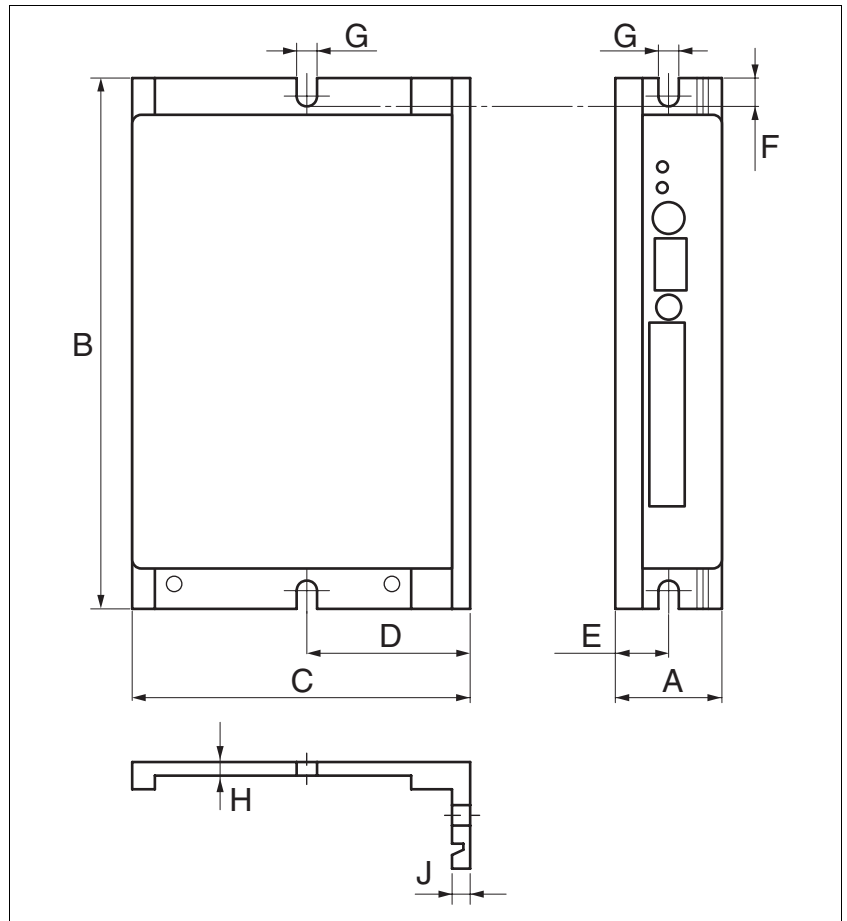


Figure 3.1 Dimensions

BLV14..		
A	[mm]	23.5
B	[mm]	117
C	[mm]	74.5
D	[mm]	36
I	[mm]	11.75
F	[mm]	6.25
G	[mm]	4.5
H	[mm]	3
J	[mm]	4
Type of cooling	Free convection	
Weight	[kg]	0.25

### 3.3 Electrical Data

#### 3.3.1 Power supply

#### CAUTION

##### Destruction of contacts

The connection for the controller power supply at the drive system does not have a make current limit. If the voltage is switched on by switching contacts, the contacts may be destroyed or welded shut.

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

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

The V<sub>DC</sub> power supply is simultaneously the controller supply voltage.

##### Power data

BLV14••		
Nominal voltage V <sub>DC</sub>	[V <sub>DC</sub> ]	24 ... 48
Limit values V <sub>DC</sub>	[V <sub>DC</sub> ]	19.2 ... 60
Residual ripple	[%]	< 5
Current consumption	[A]	6.5
Nominal power at 24 V <sub>DC</sub>	[W]	150
Nominal power at 48 V <sub>DC</sub>	[W]	300
power loss	[W]	≤7
Fuse, external	[A]	≤10

##### Fuses

The current consumption may increase greatly for a short period with dynamic processes such as fast acceleration or brief load torque peaks. The high load current may also trip a fuse. Circuit-breakers with thermal tripping only are therefore recommended.

e.g. model 2-5700 from E-T-A ([www.e-t-a.com](http://www.e-t-a.com)).

Electronic circuit-breakers can also be used – e.g. model ESS20, also from E-T-A.

The nominal current of these circuit-breakers must be selected depending on the wiring and the current consumption of the BLV.

The BLV capacitors have a capacitance value of 1100μF.

### 3.3.2 Signal interface

*Analogue inputs* Two analogue inputs ANA1 and ANA2 are available. They are electrically connected to 0VDC.

		BLV14H●●	BLV14L●●
Measuring range	[V <sub>DC</sub> ]	0 ... 10	0 ... 5
Zero voltage window	[mV]	50	50
Max. input voltage	[V <sub>DC</sub> ]	30	10
Input resistance	[kΩ]	≥10	≥10
Resolution	[Bit]	10	10

*Digital inputs* The digital inputs are electrically connected to 0VDC.

		BLV14H●● <sup>1)</sup>	BLV14L●●
inactive	[V <sub>DC</sub> ]	≤5	open / 4 ... 6
active	[V <sub>DC</sub> ]	+15 ... +30	0VDC / <0.8
Input current	[mA]	≤7	-
internal pull-up resistance	[kΩ]	-	10
Debouncing time	[ms]	1...2	1...2
max. breaking energy on inductive load	[mJ]	2	2

1) The levels correspond to EN 61131-2 Type 1.

*Output for potentiometer* The 10V<sub>OUT</sub> (BLV14H) or 5V<sub>OUT</sub> signal outputs (BLV14L) are the power supplies for the external potentiometer.

		BLV14H●●	BLV14L●●
Voltage	[V <sub>DC</sub> ]	10	5
Max. allowable current	[mA]	≤20	≤10
Potentiometer resistance	[kΩ]	1	1

*Digital outputs* The digital outputs are electrically connected to 0VDC and are high resistance in inactive status.

		BLV14H●●	BLV14L●●
max. switching voltage	[V <sub>DC</sub> ]	≤30	≤30
max. switching current	[mA]	≤50	≤50
voltage drop at 50 mA load	[V <sub>DC</sub> ]	≤0.5	≤0.5
Short-circuit-resistant and overload-proof		yes	yes
Signal power supply <sup>1)</sup> 24VDC / 0VDC	[V <sub>DC</sub> ]	24	0VDC / <0.8

1) Supplies power to the ACTIVE<sub>OUT</sub> and N<sub>OUT</sub> outputs. Must not be bridged with VDC power supply, otherwise danger of feedback.

*Power connection for signal interface*

Phoenix Combicon, 10-pin, without threaded flange.

### 3.3.3 Motor connection

Max. motor phase current	[A <sub>pk</sub> ]	22
Max. motor phase current	[A <sub>rms</sub> ]	16
Continuous output current	[A <sub>rms</sub> ]	8
Number of phases		3

*Approved motors* All motors in the RECM 34x and RECM 37x series may be used, and also motors with the following technical data:

Inductance	[μH]	>100
Number of phases		3
Hall component electrically offset by:	[degrees]	120
Short-circuit current	[A <sub>rms</sub> ]	<40

*external moment of inertia* The product is designed for an external moment of inertia corresponding to three times the rotor inertia.

*Connection* Phoenix Combicon, 4-pin, with threaded flange.



### 3.3.4 Interface for Hall-sensors

Voltage	[V <sub>DC</sub> ]	5
Max. allowable current	[mA]	10
BLV internal pull-up resistance	[kΩ]	1
maximum cable length	[m]	10

The 5 V power supply for the Hall sensors is output from the product. The pull-up resistances are integrated in the product. The maximum commutation frequency is 3000 Hz.

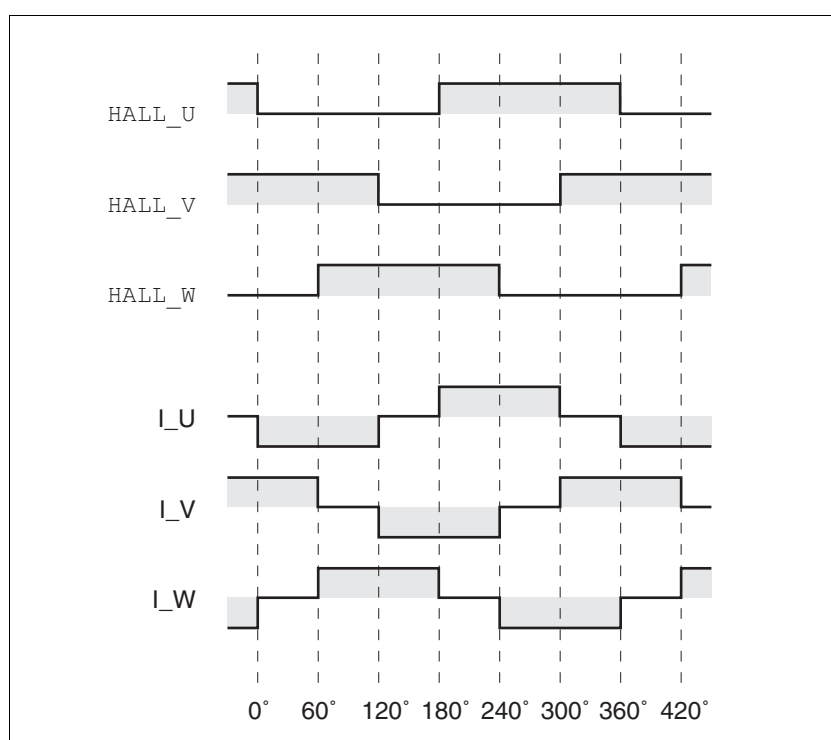


Figure 3.2 Switching performance of the Hall sensors

**Hall sensors** The rotor position is detected by three Hall sensors integrated in the motor. They are offset 120° and send six different switching combinations per electrical revolution. Current is sent to the three windings corresponding to the signals. The switching position of every electronic commutation is offset 30° to the corresponding torque vertex.

- Check the function as described in 5.3.4 "Test operation of the drive".

**Connection** Phoenix Micro Combicon, 6-pin, without threaded flange.

The layout of the Hall components as shown in Figure 3.2 is the prerequisite for trouble-free operation. If motors that are not manufactured by Berger Lahr are used, the layout may be different.

### 3.4 Technical Data accessories

#### 3.4.1 Cable

Shielded or unshielded cables can be used. The limit values for category C3 are maintained as per EN 61800-3 even with unshielded cables for a typical structure in the case of field-borne emissions (emittance) in the range from 30 MHz to 1 GHz.

The limit values for the second environment are maintained even with unshielded cables for noise immunity. This corresponds to EN 61800-3 for a typical structure.

Shielded cables should be used if the requirements for EMC resistance or emittance are higher.

Max. cable length of Hall sensor cable and motor cable: 10m

##### *Overview of cables required*

	max. length [m]	Stripped length [mm]	Cross section rigid or flexible [mm <sup>2</sup> ]	Cross section flexible with wire end ferrule [mm <sup>2</sup> ]
Power supply	-	10	0.2 ... 2.5	0.25 ... 2.5
Signal interface	-	9	0.14 ... 1.5	0.14 ... 0.5 <sup>1)</sup> 0.25 ... 1.5 <sup>2)</sup>
Motor cables	10	10	0.2 ... 2.5	0.25 ... 2.5
Hall sensors	10	8	0.14 ... 0.5	0.25 ... 0.5

1) with plastic ferrule

2) without plastic ferrule

#### 3.4.2 Connector

##### *Overview of required connectors*

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

	Designation	Type (Phoenix Combicon)
Power supply	Spring force of connector section, 2-pin	FKC 2.5/ 2-STF-5.08
Signal connector	Spring force of connector section, 10-pin	FK-MCP 1.5/10-ST-3.81
Motor plug	Spring force of connector section, 4-pin	FKC 2.5/ 4-STF-5.08
Hall sensors	Spring force of connector section, 6-pin	FK-MC 0.5/6-ST-2.5

### 3.4.3 Other accessories

- Top-hat rail adapter* The 35 mm top-hat rail adapter is for a standard TH35 rack as per EN 60715. Two retaining screws are included with this accessory.
- EMC kit* The optional EMC kit improves the EMC characteristics. Shielded cable must be used with this plate. The Figure 4.1 "EMC measures" shows an example of the installation of this plate. Two retaining screws and two SK terminals are included with this accessory.



## 4 Installation

### WARNING

#### Loss of control over controller

- Observe the accident prevention regulations. (For USA see also NEMA ICS1.1 and NEMA ICS7.1)
- The system manufacturer must take the potential error possibilities of the signals and the critical functions into account to ensure a safe status during and after errors. Some examples are: emergency stop, final position limitation, power failure and restart.
- The assessment of error possibilities must also include unexpected delays and the failure of signals or functions.
- Suitable redundant control paths must be in place for dangerous functions.
- Check that measures taken are effective.

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

### 4.1 Electromagnetic compatibility, EMC

### WARNING

#### Interference with signals and devices

Distorted signals can cause unpredictable device responses.

- Install the wiring in accordance with the EMC requirements.
- Check compliance with the EMC requirements, particularly in an environment subject to strong interference.

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

#### *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:

### WARNING

#### High-frequency interference

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

An EMC-compliant design is required to maintain the specified limit values. Depending in the case better results can be achieved with the following measures:

- Particularly EMC-compliant design, e.g. in an enclosed control cabinet with 15 dB damping of radiated interference

#### Switching cabinet setup

EMC measures	Effect
Use EMC plate or galvanised or chrome-plated mounting plates, make large contact surface connections for metal parts, remove paint from contact surfaces	Good conductivity due to two-dimensional contacts
Earth the control cabinet, door and EMC plate with metal tapes or cables with a cross section area greater than 10 mm <sup>2</sup> .	Reduction of 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

#### Cabling

EMC measures	Effect
Keep wiring as short as possible. Do not install "safety loops", short cables from the star point in the switch cabinet to outlying earth connection.	Avoidance of capacitive and inductive interference injection
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.
Fieldbus lines and signal lines must not be laid in the same conduit with lines for DC and AC voltage over 60 V. (Fieldbus lines can be laid in the same conduit with signal and analogue lines)	Prevention of mutual interference
Recommendation: lay in separate conduits at least 20 cm apart.	
Connect large surface areas of cable shields, use cable clamps and tapes	Reduction of emissions.
Earth shields on digital signal lines over a wide area at both ends or via conductive plug housing.	Preventing interference on control cables, reduction of emissions
Earth shield on analogue signal lines directly at the device (signal input), and insulate the shield at the other end of the cable or earth via a capacitor if interference occurs, e.g. 10 nF.	Preventing 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
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 supply voltage as "twisted pair".	Preventing interference on control cables, reduction of emissions

*Power supply*

EMC measures	Effect
Connect the negative output of the PELV power supply unit to PE.	Reduction of EMC emissions, safety
Circuit breaker if there is danger of overvoltage or lightning strike	Protection against damage by overvoltage

*EMC requirement: motor and motor encoder cables*

Motor leads and motor sensor cables are especially critical signal lines. Use the cables recommended by your local representative. They must be tested for EMC safety and must be suitable for trailing cables.

The motor cable and the motor encoder cable on the drive solution must be laid out over a wide area with low resistance on the device, the switch cabinet output and on the motor.

- Lay out motor and motor encoder cables without interruption (do not install switch components) from the motor and encoder to the device.  
If a line has to be interrupted, shielded connections and metal casing must be used to prevent interference.

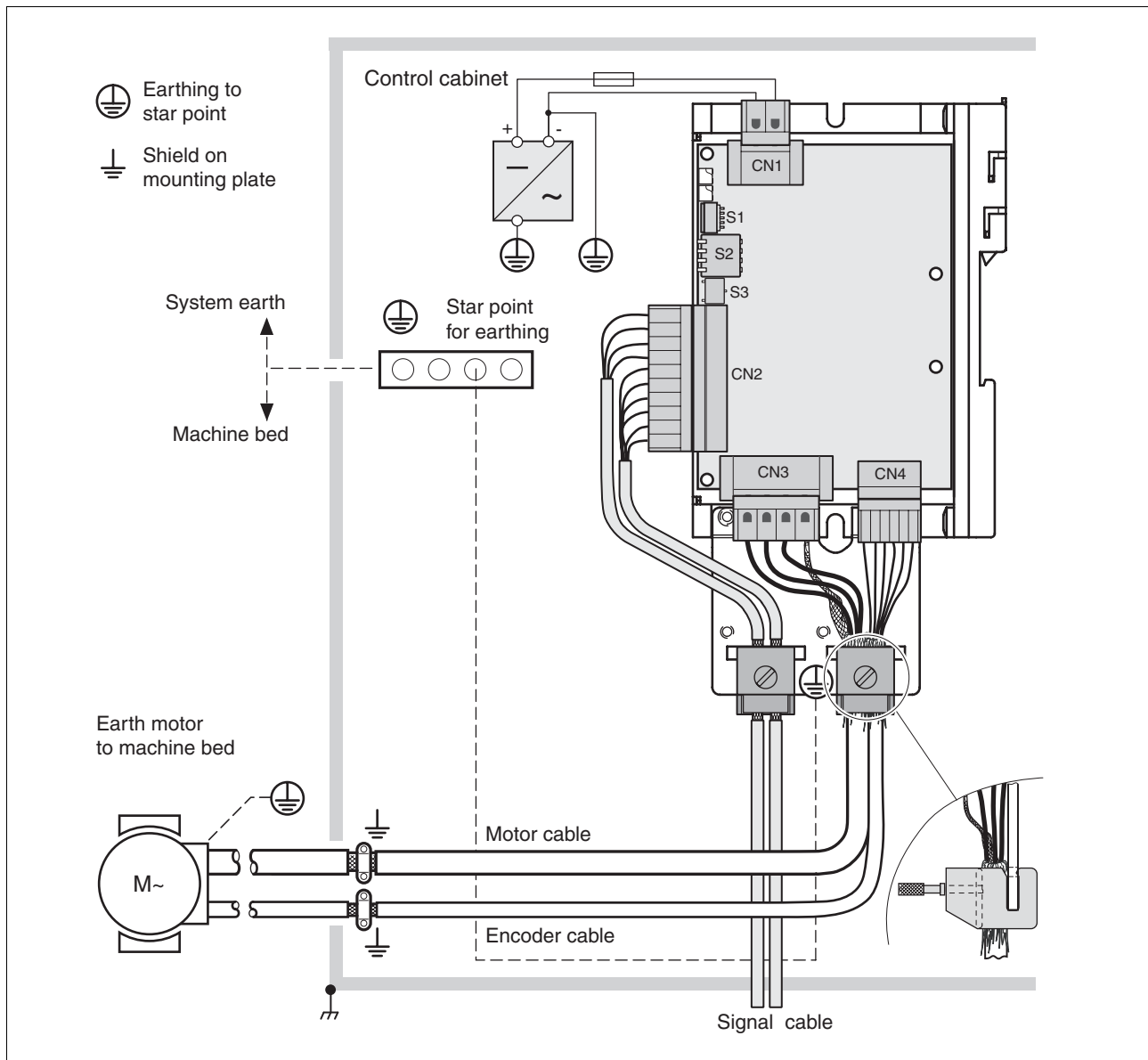


Figure 4.1 EMC measures



## 4.2 Mechanical installation

### **DANGER**

#### **Electric shock from foreign bodies or damage.**

Conductive foreign bodies in the product or serious damage can cause voltage spread.

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

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

### **CAUTION**

#### **Hot surfaces**

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

- Prevent contact with the hot heat sink.
- Do not install flammable or heat-sensitive components in the immediate vicinity.
- Follow the actions described for heat dissipation.

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

### 4.2.1 Installing 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 switching cabinet, note the following instructions:

- Adequate cooling of the device must be ensured by complying with the minimum installation distances. Prevent heat accumulation.
- The device must not be installed close to heat sources or mounted on flammable materials.
- The warm airflow from other devices and components must not heat the air used for cooling the device.
- The drive will switch off as a result of overtemperature when operated above the thermal limits.

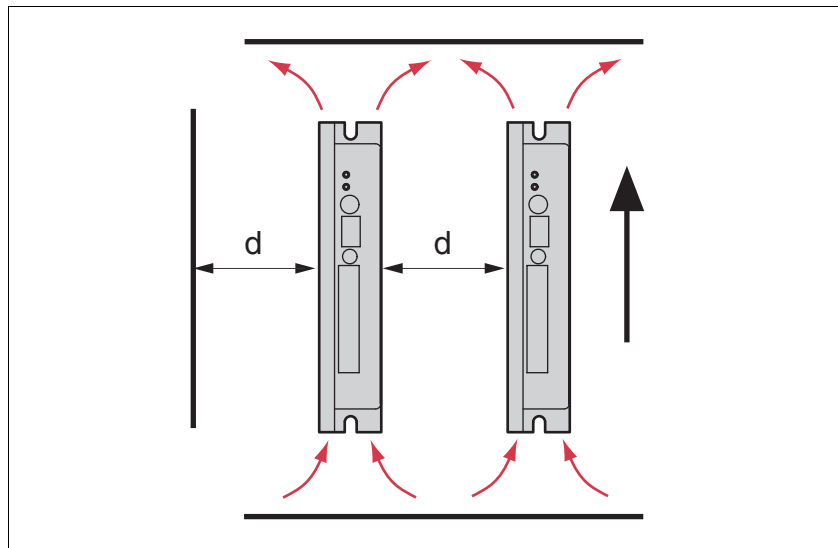


Figure 4.2 Installation spacing and air circulation

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

- At least 10mm of free space is required in front of the device.
- At least 50 mm of free space is required above the device.
- For "d" ist mindestens 30mm Freiraum einzuhalten.
- At least 200mm free space under the device is required to ensure that wiring can be installed without excessive bending.

If other components are installed in these areas, the possible continuous current is reduced. The integrated temperature shutoff protects the BLV.

*Installing the device*

The product can be mounted directly on the narrow or wide mounting surface with two M4 screws. The product can optionally be snapped on to a standard TH35 rack (EN 60715) with a top-hat rail adapter (optional accessory) (top-hat rail 35 mm). For the dimensions of the fastening holes see 3.2.1 "Dimensions" from page 3-3.

- ▶ Install the device in a vertical position ( $\pm 10^\circ$ ). This is particularly important for cooling the device.
- ▶ Use attaching elements (comb bars, shield clamps, busbars) for the cable layout and connecting the shielding.



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

## 4.3 Electrical installation

### DANGER

#### Motor out of view

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

- Only start the system if there are no persons in the operating zone of the moving components and the system can be operated safely.

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

### 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.
- The system manufacturer is responsible for compliance with all applicable regulations relevant to earthing the drive system. Extend the earth through the motor cable with an additional earth at the motor housing.

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

**⚠ WARNING****Unexpected behaviour due to foreign bodies**

Foreign bodies, deposits or humidity can cause unexpected behaviour.

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

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

*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:

- Use as a trailing cable
- Temperature range
- Chemical resistance
- Layout outdoors
- Layout underground

### 4.3.1 Overview of procedure

- ▶ Connect the housing to the earthed neutral point of the system.
- ▶ Follow the EMC requirements, see page 4-1.
- ▶ At the end check the installation.

Chapter	from page
4.3.4 "Connection of power supply (CN1)"	4-11
4.3.5 "Connection of signal interface (CN2)"	4-13
4.3.6 "Connection of motor phases (CN3)"	4-14
4.3.7 "Hall sensors connection (CN4)"	4-16

### 4.3.2 Circuit diagrams of digital outputs

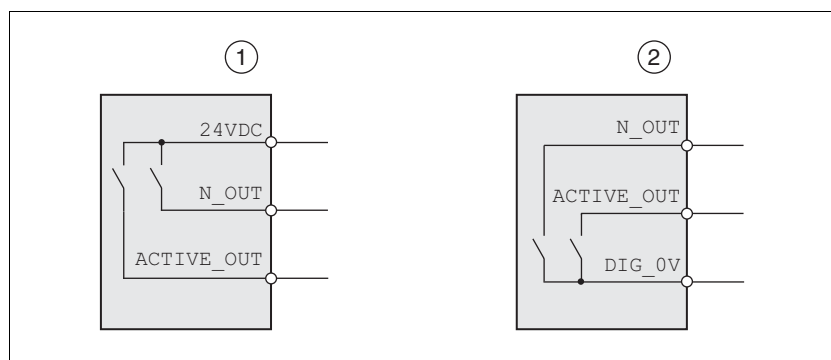


Figure 4.3 Circuit diagrams of digital outputs

- (1) BLV14H
- (2) BLV14L

### 4.3.3 Overview of all connections

#### *Signal connections*

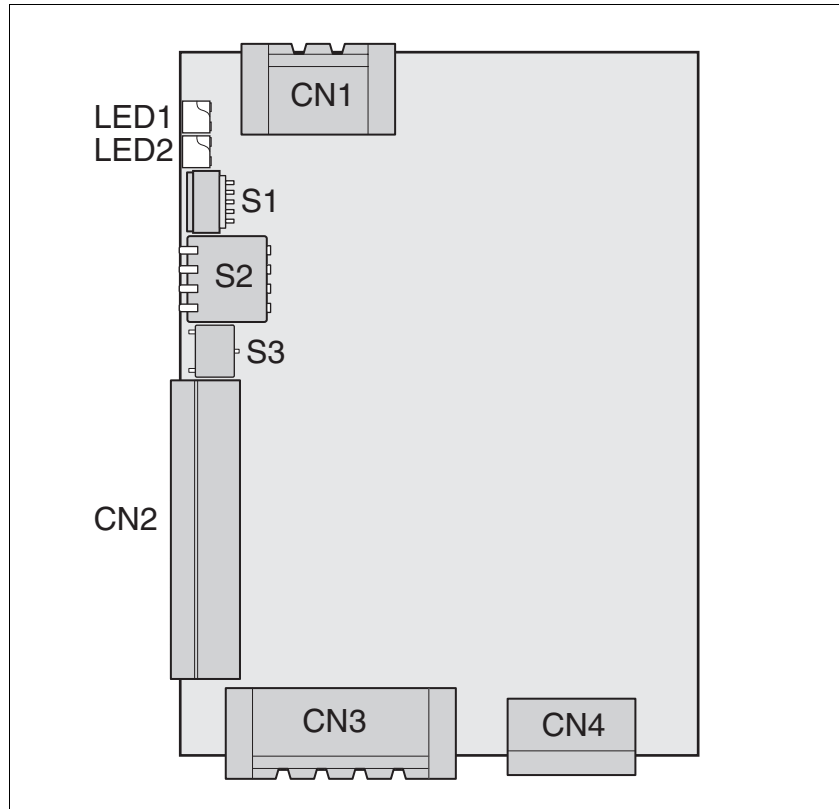


Figure 4.4 Overview of signal connections

Connection	Assignments
CN1	Power supply
CN2	Signal interface
CN3	Motor
CN4	Hall sensors

#### 4.3.4 Connection of power supply (CN1)

##### **⚠ CAUTION**

###### **Loss of control by high feedback!**

Feedback resulting from braking or external drive may increase the VDC supply voltage unexpectedly. Components not designed for this voltage may be destroyed or they may malfunction.

- Check that all consumers on VDC are designed for the voltage occurring during feedback (for example limit switches).
- Use only power supply units that will not be damaged by energy recovery.
- Use a braking resistor actuator if necessary.

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

##### **CAUTION**

###### **Destruction of contacts**

The connection for the controller power supply at the drive system does not have a make current limit. If the voltage is switched on by switching contacts, the contacts may be destroyed or welded shut.

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

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

##### **⚠ DANGER**

###### **Electric shock from incorrect power supply unit**

The +24VDC and VDC supply voltages are connected with many exposed signals in the drive system.

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

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

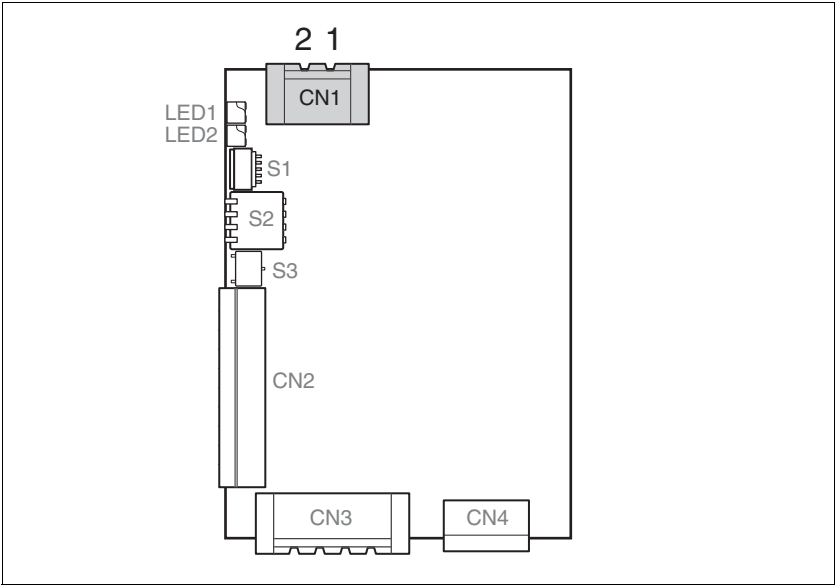


Figure 4.5 Connector CN1

Pin	Signal	Description
1	VDC	Power supply
2	0VDC	Reference potential to VDC

*Reverse polarity* The CN1 connection has short-term protection against polarity reversal. A very high current may flow in case of reverse polarity. If this status is sustained for an extended period, the power amplifier will be thermally destroyed.

*Fuses* Notes on fuses are listed at 3.3.1 "Power supply".

*Required connectors* The connector is available as a component of a connector set. See chapter 9 "Accessories and spare parts".

Designation	Type (Phoenix Combicon)
Spring force of connector section, 2-pin	FKC 2.5/ 2-STF-5.08

*Preparing cables* Note the dimensions specified when fabricating cables.

	max. length [m]	Stripped length [mm]	Cross section rigid or flexible [mm <sup>2</sup> ]	Cross section flexible with wire end ferrule [mm <sup>2</sup> ]
Power supply cable	-	10	0.2 ... 2.5	0.25 ... 2.5



### 4.3.5 Connection of signal interface (CN2)

Wiring diagram

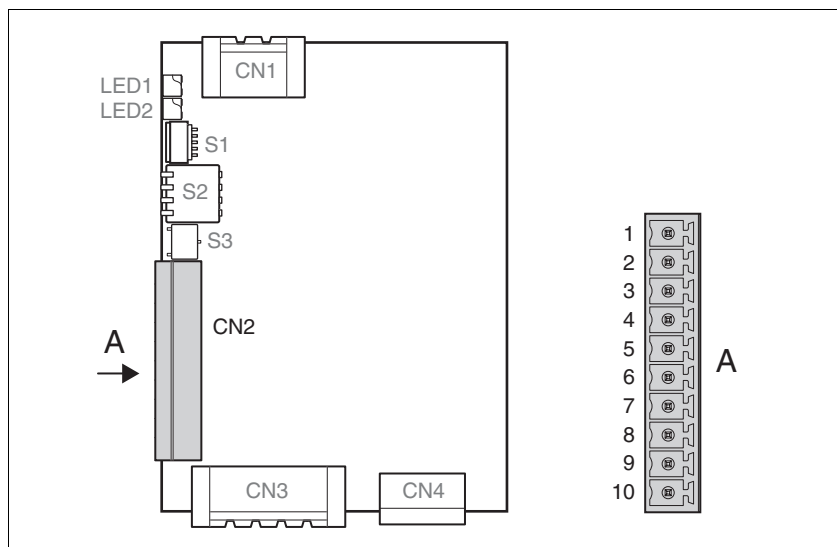


Figure 4.6 Wiring diagram of signal interface

Pin	Signal	Description	I/O
1 <sup>2)</sup>	10V_OUT	Output 10 V, supply voltage at connection of potentiometer	O
1 <sup>4)</sup>	5V_OUT	Output 5 V, supply voltage at connection of potentiometer	O
2	ANA1	Analogue input 1	I
3	ANA2	Analogue input 2	I
4	ANA_OV/DIG_0V	Reference potential of analogue inputs <sup>1)</sup>	O
5	ENABLE	Digital input 1 (enable)	I
6	DIR	Digital input 2 (direction of rotation)	I
7	BRAKE	Digital input 3 (brake)	I
8 <sup>2)</sup>	24VDC <sup>3)</sup>	Signal power supply +24 VDC for outputs (PIN9 and PIN10)	I
8 <sup>4)</sup>	DIG_OV	Reference potential	
9 <sup>5)</sup>	N_OUT	Output speed of rotation signal	O
10 <sup>5)</sup>	ACTIVE_OUT	Output Readiness	O

1) Note connection information!

2) Only in the BLV14H model, see 7.1 "Wiring example of BLV14H".

3) 24VDC must not be bridged with VDC, because at VDC voltage increases may occur (feedback).

4) Only in the BLV14L model, see 7.2 "Wiring example of BLV14L".

5) The voltage for the output signals must be no greater than max. 30 V.

#### Connection information

All inputs and outputs are electrically connected to the power supply. ANA\_OV/DIG\_0V must not be connected to 0VDC outside the device.

*Required connectors* The connector is available as a component of a connector set. See chapter 9 "Accessories and spare parts".

	Designation	Type (Phoenix Combicon)
Signal connector	Spring force of connector section, 10-pin	FK-MCP 1.5/10-ST-3.81

*Preparing cables* Note the dimensions specified when fabricating cables.

	max. length [m]	Stripped length [mm]	Cross section rigid or flexible [mm <sup>2</sup> ]	Cross section flexible with wire end ferrule [mm <sup>2</sup> ]
Signal interface	-	9	0.14 ... 1.5	0.14 ... 0.5 <sup>1)</sup> 0.25 ... 1.5 <sup>2)</sup>

1) with plastic ferrule

2) without plastic ferrule

- Connecting signal interface*
- Make sure that the wiring and the cables meet the requirements for PELV.
  - Attach the connector to CN2.

#### 4.3.6 Connection of motor phases (CN3)

### 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.
- The system manufacturer is responsible for compliance with all applicable regulations relevant to earthing the drive system. Extend the earth through the motor cable with an additional earth at the motor housing.

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

*Monitoring* The motor lines are monitored for:

- short circuit between the motor phases

A short circuit between the motor phases and VDC is not detected.

Wiring diagram

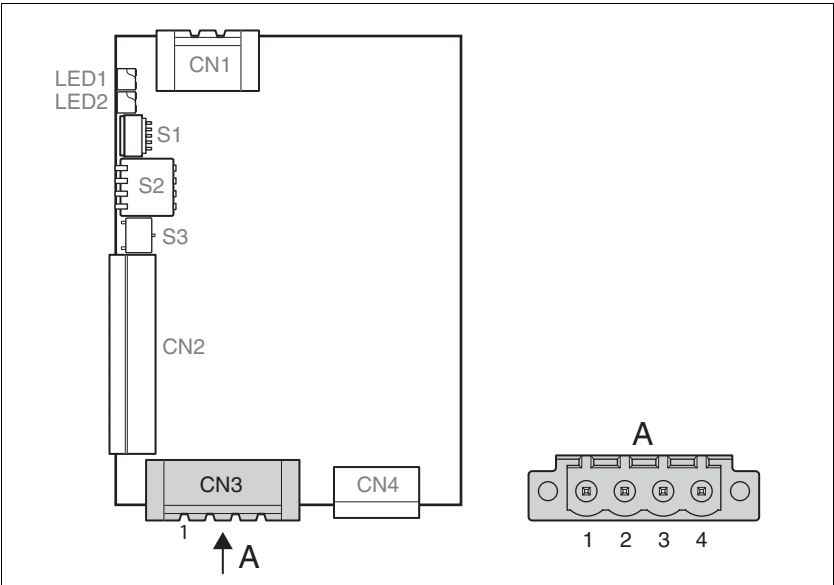


Figure 4.7 Motor wiring diagram

Connection	Description
1	Motor line U
2	Motor line V
3	Motor line W
4	Shield connection

Required connectors

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

	Designation	Type (Phoenix Combicon)
Motor plug	Spring force of connector section, 4-pin	FKC 2.5/ 4-STF-5.08

Preparing cables

Note the dimensions specified when fabricating cables.

	max. length [m]	Stripped length [mm]	Cross section rigid or flexible [mm <sup>2</sup> ]	Cross section flexible with wire end ferrule [mm <sup>2</sup> ]
Motor cables	10	10	0.2 ... 2.5	0.25 ... 2.5

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4.3.7 Hall sensors connection (CN4)

Wiring diagram

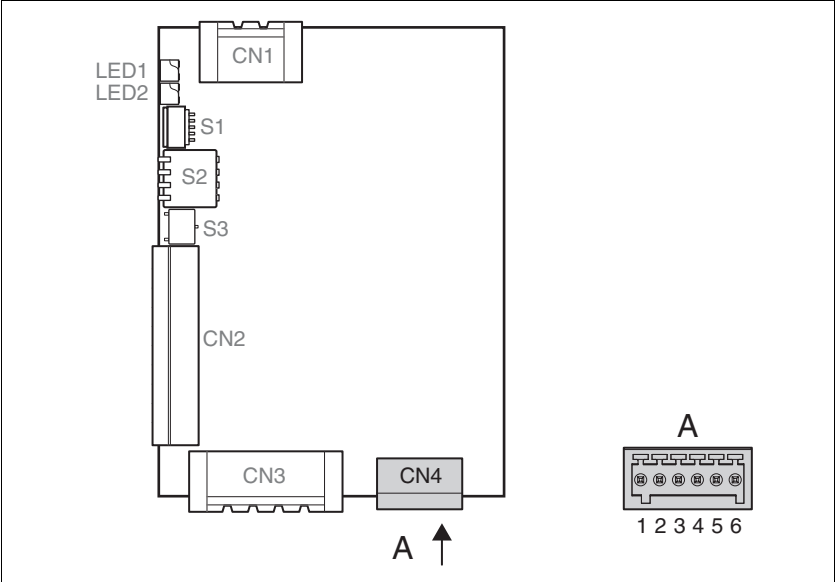


Figure 4.8 Wiring diagram of Hall sensors

Pin	Signal	Description	I/O
1	HALL_5VOUT	5V <sub>DC</sub> power supply for Hall sensors	O
2	HALL_0V	Reference potential to HALL_5VOUT	O
3	HALL_U	Encoder signal phase U	I
4	HALL_V	Encoder signal phase V	I
5	HALL_W	Encoder signal phase W	I
6	SHLD	Shield connection	

Required connectors

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

Designation	Type (Phoenix Combicon)
Hall sensors plug	Spring force of connector section, 6-pin

Preparing cables

Note the dimensions specified when fabricating cables.

	max. length [m]	Stripped length [mm]	Cross section rigid or flexible [mm <sup>2</sup> ]	Cross section flexible with wire end ferrule [mm <sup>2</sup> ]
Hall sensors cable	10	8	0.14 ... 0.5	0.25 ... 0.5

## 4.4 Checking installation

Check the following items:

- ▶ Are all cables and connectors safely installed and connected?
- ▶ Are any live cables exposed?
- ▶ Are the control lines connected correctly?
- ▶ Are all fuses correct?



## 5 Commissioning

### 5.1 General safety instructions

#### DANGER

##### **Motor out of view**

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

- Only start the system if there are no persons in the operating zone of the moving components and the system can be operated safely.

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

#### WARNING

##### **Unexpected movement**

When the drive is operated for the first time there is a high risk of unexpected movement because of possible wiring errors or unsuitable parameters.

- If possible, run the first test movement without coupled loads.
- Make sure that a functioning button for EMERGENCY STOP is within reach.
- Also anticipate a movement in the incorrect direction or oscillation of the drive.
- Make sure that the system is free and ready for the movement before starting the function.

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

#### WARNING

##### **Unbraked motor**

In the case of power failure and faults which cause the power amplifier to be switched off, the motor is no longer controlled by the brake and increases its speed even more until it comes to a mechanical stop.

- Check 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 behaviour**

The behaviour of the drive system is governed by numerous stored data or settings. Unsuitable settings or data may trigger unexpected movements or reactions to signals and disable monitoring functions.

- Do not operate a drive system with unknown settings or data.
- Check the stored data or settings.
- When commissioning carefully run tests for all operating statuses and fault cases.
- Check 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 materials in the danger zone and the system can be operated safely.

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

**⚠ CAUTION****Hot surfaces**

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

- Prevent contact with the hot heat sink.
- Do not install flammable or heat-sensitive components in the immediate vicinity.
- Follow the actions described for heat dissipation.

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

## 5.2 Overview



*The following commissioning steps are also required if you are using a configured unit under changed operating conditions.*

*What must be done*

Chapter	from page
4.4 "Checking installation"	4-17
5.3.1 "Setting parameter switch S1"	5-3
5.3.2 "Setting parameter switch S2"	5-4
5.3.3 "Setting potentiometer S3"	5-6
5.3.4 "Test operation of the drive"	5-6



## 5.3 Commissioning procedure

### 5.3.1 Setting parameter switch S1

The peak current of the motor can be limited with the parameter switch S1.

A current limit value that corresponds to the nominal current of the motor can protect the motor from overload in case of error (e.g. by defective Hall sensors).



*The maximum peak current of the motor (and thus the torque) is set via the analogue input ANA2 or the parameter switch S1. The value of ANA2 or S1 that is higher is used. This means that the unused setting option must always be set to the lowest value.*

- Set the desired current limit value with parameter switch S1.

Switch setting S1		Current limit value (reference value) <sup>1)</sup>
0 (factory setting)	[A <sub>pk</sub> ]	0.1
1	[A <sub>pk</sub> ]	1.3
2	[A <sub>pk</sub> ]	2.7
3	[A <sub>pk</sub> ]	4.0
4	[A <sub>pk</sub> ]	5.3
5	[A <sub>pk</sub> ]	6.7
6	[A <sub>pk</sub> ]	8.0
7	[A <sub>pk</sub> ]	9.3
8	[A <sub>pk</sub> ]	11.0
9	[A <sub>pk</sub> ]	12.3
A	[A <sub>pk</sub> ]	13.7
B	[A <sub>pk</sub> ]	15.0
C	[A <sub>pk</sub> ]	16.3
D	[A <sub>pk</sub> ]	17.7
I	[A <sub>pk</sub> ]	19.0
F	[A <sub>pk</sub> ]	20.3

<sup>1)</sup> Depending on the motor type the actual peak current may deviate from the specified current limit value. This is particularly obvious at a current limit value below the nominal current of the motor.

When the motor accelerates a very high current may be drawn from the power supply. If the power supply unit is weak this may result in an undervoltage. This can be prevented by suitable parameterisation of the current limit value.

5.3.2 Setting parameter switch S2

The switch is only queried when the power amplifier is activated.

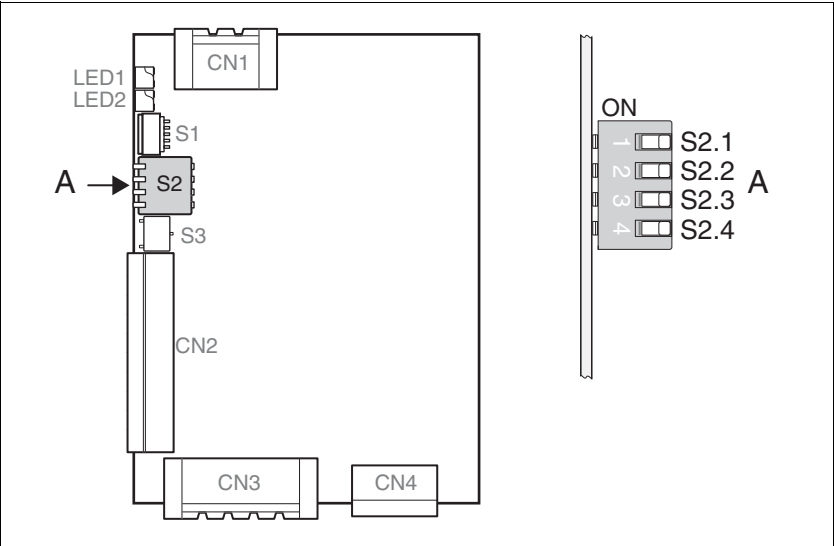


Figure 5.1 Parameter switch S2

*S 2.1: speed control (closed loop) / required motor voltage (open loop)*

Speed control or required motor voltage.

- With speed control the speed of rotation depends on the setting of S2.2 via the ANA1 analogue input or the potentiometer S3. The speed of rotation is monitored by a Hall sensors at CN4 and regulated in accordance with the requirement
- In the operating mode required motor voltage the motor acts as a conventional, permanent-field motor.
- Switch the device to the "Disable" status or switch off the supply voltages.
- Set the speed control or required motor voltage with the parameter switch S2.1.

Switch setting S2.1	Description
OFF (factory setting)	Speed control (closed loop)
ON	Required motor voltage (open loop)

*S2.2: set function of potentiometer S3 / ANA1*

The potentiometer S3 is effective depending on the switch setting of S2.2.

The default for the speed control and required motor voltage can be set via an external analogue signal ANA1 or the internal potentiometer S3. If the default is set via ANA1 (S2.2 OFF), the internal potentiometer S3 is used to set the ramp steepness. If the speed of rotation is set via the internal potentiometer S3 (S2.2 ON), an average ramp steepness is set internally with a fixed value.

- Switch the device to the "Disable" status or switch off the supply voltages.
- Set as desired with parameter switch S2.2

Switch setting S2.2	Description
OFF (factory setting)	ANA1 sets the speed for the speed control and required motor voltage, S3 sets the ramp steepness.
ON	ANA1 is inactive. S3 is used to set the speed for the speed control and required motor voltage. The ramp steepness is set at an average value.

*S2.3: set the speed control (closed loop) depending on the external load*

The speed control (closed loop) can be set depending on the external load with the parameter switch S2.3.

- Switch the device to the "Disable" status or switch off the supply voltages.
- Set the control depending on the external load with the parameter switch S2.3.

Switch setting S2.3	Description
OFF (factory setting)	Speed control with moment of inertia of load $\leq$ rotor inertia
ON	Speed control with moment of inertia of load $>$ rotor inertia

*S2.3: with required motor voltage (open loop)*

Function reserved.

*S2.4: set speed range with speed control (closed loop)*

With speed control (closed loop) the speed range can be set via the parameter switch S2.4.

- Switch the device to the "Disable" status or switch off the supply voltages.
- Set the speed range as desired with the parameter switch S2.4.

Switch setting S2.4	Description
OFF (factory setting)	2 pairs of poles 0...6000 1/min 3 pairs of poles 0...4000 1/min 4 pairs of poles 0...3000 1/min 6 pairs of poles 0...2000 1/min
ON	2 pairs of poles 0...12000 1/min 3 pairs of poles 0...8000 1/min 4 pairs of poles 0...6000 1/min 6 pairs of poles 0...4000 1/min

*S2.4: with required motor voltage (open loop)*

Function reserved.

### 5.3.3 Setting potentiometer S3

The function of the potentiometer S3 is determined by the switch setting of S2.2.

**S2.2 OFF** If S2.2 is set to "OFF" (factory setting), S3 is used to set the acceleration and deceleration ramp between two speed reference values.

Direction of rotation	Description
clockwise	steeper ramp
counterclockwise	flatter ramp

**Example** From the maximum speed of rotation to standstill or vice versa the steepest ramp has a duration of 65.47 milliseconds [ms]. The flattest ramp has a duration of 10.91 seconds [sec].

**S2.2 ON** If S2.2 is set to "ON", S3 is used to set the speed of rotation of the motor. The ramp steepness is preset internally to an average value.

- Use the potentiometer S3 to set the speed of rotation and the ramp steepness of the motor depending on your application.

### 5.3.4 Test operation of the drive

**Direction of rotation** Rotation of the motor shaft in a positive or negative direction of rotation. A positive direction of rotation is defined as the motor shaft rotating clockwise as the observer faces the end of the protruding shaft.

- Function test**
- Set a maximum current that is below the nominal current of the motor at parameter switch S1. See 5.3.1 "Setting parameter switch S1".
  - Switch on the supply voltage.
  - Check the status display, see Chapter 8.2 "Status display via LEDs".
  - ◁ Green LED1 is flashing: device is in Disable status.
  - Activate the power amplifier via the `ENABLE` input.
  - ◁ Green LED1 steady  
`ACTIVE_OUT` output switches to active.
  - Start the first test with a low analogue value. If the signal `DIR` is inactive, the motor must rotate clockwise.
  - Test both directions of rotation.
  - Observe the behaviour of the motor. Note whether it accelerates uncontrolled (e.g. by incorrectly connected Hall sensors).

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

## 6 Operation

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

### 6.1 Speed control operating mode (closed loop)

**Description** In the speed control (closed loop) operating mode the reference value of the motor speed of rotation is set via the **ANA1** analogue input or the internal potentiometer. The speed of rotation is controlled with Hall sensors. The current consumption increases in proportion to the required torque.

The maximum peak current of the motor (and thus the torque) is set via the analogue input **ANA2** or the parameter switch **S1**. The value of **ANA2** or **S1** that is higher is used. This means that the unused setting option must always be set to the lowest value.

The following overview shows the effectivity of the parameters which can be set for this operating mode.

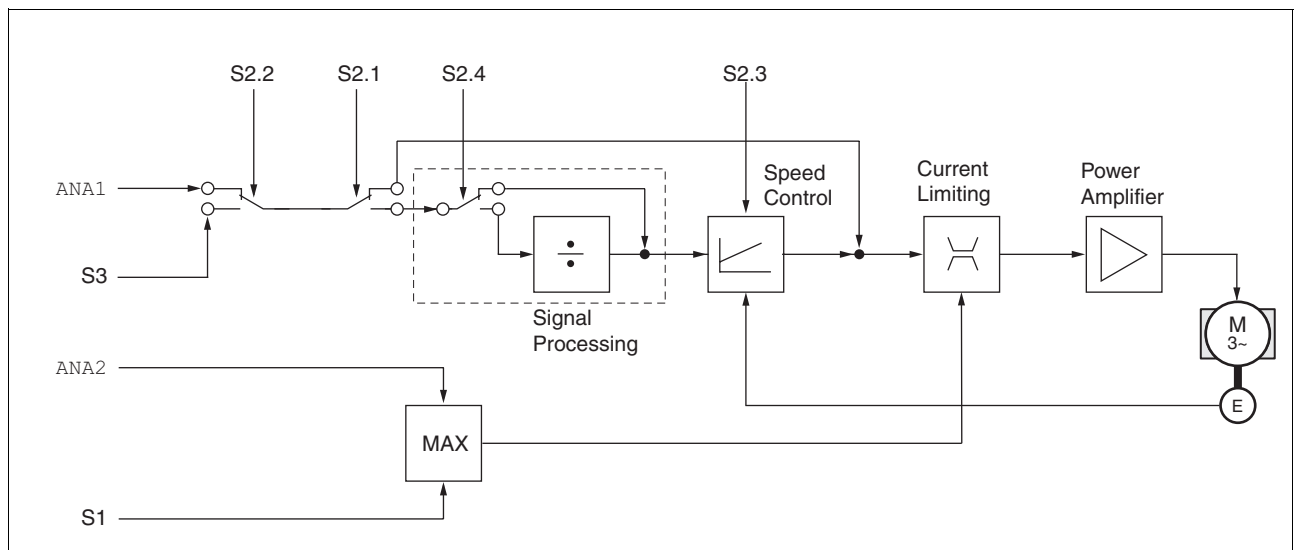


Figure 6.1 Effect of adjustable parameters

### 6.2 Required motor voltage (open loop) operating mode

**Description** In the required motor voltage (open loop) operating mode the reference value for the voltage of the motor is set via the **ANA1** analogue input or the internal potentiometer **S3**. There is no feedback via the actual speed of rotation of the motor.

The maximum peak current of the motor (and thus the torque) is set via the analogue input **ANA2** or the parameter switch **S1**. The value of **ANA2** or **S1** that is higher is used. This means that the unused setting option must always be set to the lowest value.

## 6.3 Functions

*active/inactive* The products BLV14H●● and BLV14L●● have different signal levels.

Signal value	BLV14H●●	BLV14L●●
inactive	$[V_{DC}] \leq 5$	open / 4 ... 6
active	$[V_{DC}] +15 \dots +30$	0VDC / <0.8
Switch from inactive to active	rising edge	switch from open to 0VDC

### 6.3.1 Input ENABLE

#### DANGER

##### Unexpected movement

With suitable parameterisation the product can start movements automatically after application of the VDC power supply. An unexpected restart may occur after a power failure.

- Check the behaviour of the system during application of the power supply.
- Make sure that no persons can be endangered by a restart of the system after a power failure.
- Make sure that there are no persons in the range of action of the moving system components.

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

*Function* If the ENABLE input is active, the power amplifier is activated. If no error message is pending, the power amplifier is activated by a static signal applied at the ENABLE input. A change from inactive to active is not required. After a power failure this may cause an unexpected restart of the motor.

An error message is reset on a change from inactive to active.

Signal value	BLV14H●●	BLV14L●●	Description
inactive	$[V_{DC}] \leq 5$	open / 4 ... 6	Deactivate power amplifier
active	$[V_{DC}] +15 \dots +30$	0VDC / <0.8	Activating power amplifier
Switch from inactive to active	rising edge	switch from open to 0VDC	Reset error message

If there is no breakdown, the output ACTIVE\_OUT displays ready for operation after activation of the power amplifier (green LED1 steady).

When the ENABLE signal is inactive, the power amplifier is deactivated, the motor runs down unbraked.

### 6.3.2 Input DIR

The direction of rotation is controlled by the DIR signal.

Signal value	BLV14H●●	BLV14L●●	Description
inactive	[V <sub>DC</sub> ] ≤5	open / 4 ... 6	Clockwise rotation
active	[V <sub>DC</sub> ] +15 ...+30	0VDC / <0.8	Counterclockwise rotation

### 6.3.3 Input BRAKE

*Function* A motor braking procedure can be triggered via the BRAKE input. The input must be activated for normal operation mode. If the input is inactive with the motor rotating, the motor will decelerate to standstill via a fast ramp. At standstill the motor windings are short-circuited. This results in a slight braking torque. LED1 and LED2 remain steady to signal the closed brake. If the BRAKE input is activated, the motor is accelerated at an average acceleration (S2.2 ON) or at a specified ramp corresponding to S3 (S2.2 OFF).

Signal value	BLV14H●●	BLV14L●●	Description
inactive	[V <sub>DC</sub> ] ≤5	open / 4 ... 6	A braking sequence is triggered
active	[V <sub>DC</sub> ] +15 ...+30	0VDC / <0.8	Normal operating mode

### 6.3.4 ACTIVE\_OUT output (readiness)

The ACTIVE\_OUT output shows that the drive is ready for operation. In the BLV14H model the output requires the 24VDC signal power supply at CN3 PIN8. This must not be bridged with VDC (danger from feedback).

Signal value	BLV14H●●	BLV14L●●	Description
inactive	[V <sub>DC</sub> ] ≤5	open / 4 ... 6	Power amplifier deactivated
active	[V <sub>DC</sub> ] +15 ...+30	0VDC / <0.8	Power amplifier activated

### 6.3.5 N\_OUT output (speed signal)

The N\_OUT output initiates a change of edge at every commutation. In the case of motors with, for example, 6 pairs of poles 36 signals per revolution are output. The output requires a 24VDC or DIG\_0V signal power supply. This must not be bridged with VDC power supply (danger from feedback).

The following number of changes of edge result based on one revolution:

Number of pole pairs	Number of changes of edge
2	12
3	18
4	24
6	36

### 6.3.6 Setting maximum motor phase current

The maximum peak current of the motor (and thus the torque) is set via the analogue input *ANA2* or the parameter switch *S1*. The value of *ANA2* or *S1* that is higher is used. This means that the unused setting option must always be set to the lowest value.

### 6.3.7 Setting ramp steepness

If *S2.2* is set to "OFF" (factory setting), *S3* is used to set the acceleration and deceleration ramp between two speed reference values.

Direction of rotation	Description
clockwise	steeper ramp
counterclockwise	flatter ramp

*Example* From the maximum speed of rotation to standstill or vice versa the steepest ramp has a duration of 65.47 milliseconds [ms]. The flattest ramp has a duration of 10.91 seconds [sec].

- Set the ramp steepness of the motor with the potentiometer *S3*.



## 6.3.8 Monitoring functions

### 6.3.8.1 Monitoring internal signals

Multiple monitoring systems protect the product from destruction.

<i>Overtemperature</i>	<p>If the maximum allowable temperature (<math>&gt;90\text{ °C}</math>) of the power amplifier is exceeded, the product is shut down. The error is signalled by the red LED2.</p> <p>When the malfunction has been repaired, the error message can be reset by a switch from inactive to active at the <code>ENABLE</code> signal input.</p>
<i>Overvoltage</i>	<p>If a top voltage limit (<math>65V_{DC}</math>) is exceeded, the power amplifier is deactivated. The error is signalled by the red LED2.</p> <p>When the malfunction has been repaired, the error message can be reset by a switch from inactive to active at the <code>ENABLE</code> signal input.</p>
<i>Undervoltage</i>	<p>If a low voltage limit (<math>&lt;18V_{DC}</math>) is not met, the power amplifier is deactivated. The error is signalled by the red LED2 if sufficient voltage is available.</p> <p>When the malfunction has been repaired, the error message can be reset by a switch from inactive to active at the <code>ENABLE</code> signal input.</p>
<i>Short circuit</i>	<p>With the power amplifier active the device continuously checks the motor phases for short circuits. In case of short-circuit the power amplifier becomes inactive and the motor runs down without braking. The red LED2 signals an overcurrent as an error message.</p> <p>When the malfunction has been repaired, the error message can be reset by a switch from inactive to active at the <code>ENABLE</code> signal input.</p> <p>An earth fault is not detected.</p>



## 7 Examples

### 7.1 Wiring example of BLV14H

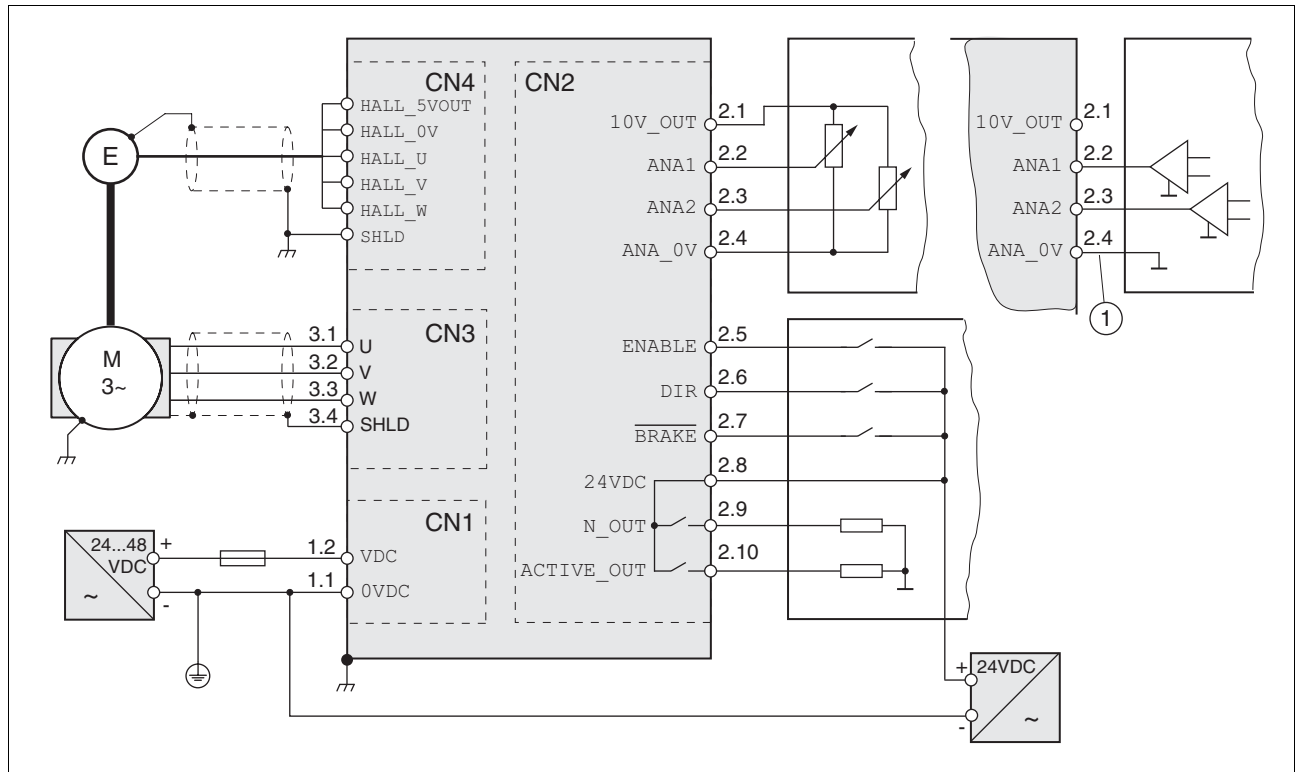


Figure 7.1 Wiring example of BLV14H

- (1) ANA\_0V must only be connected if there is no other connection to 0VDC.

Figure 7.2 Wiring example of BLV14L

- (1) ANA\_0V must only be connected if there is no other connection to 0VDC.
- (2) When the electrical connection is disconnected with 0VDC, the dashed connection of 2.8 must be connected.

### 7.3 Calculation of current consumption

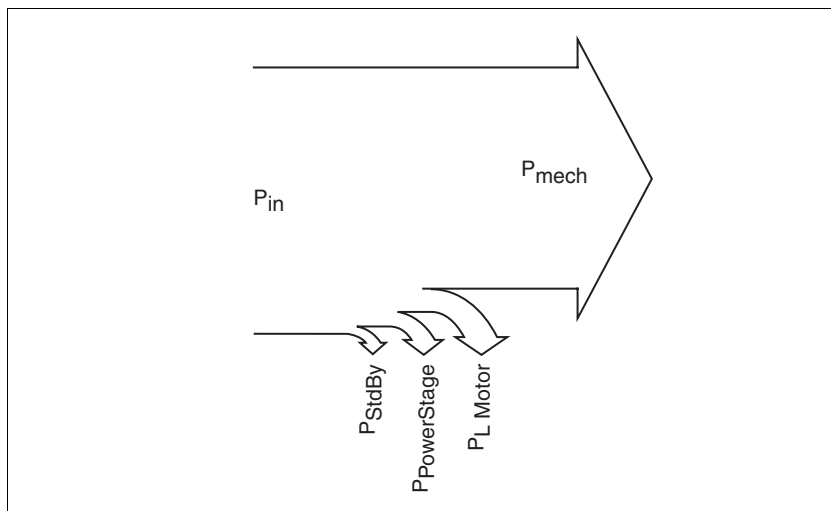


Figure 7.3 Typical power distribution of the BLV

The current consumption of the BLV depends on the  $P_{in}$  power consumption. The power consumption is derived from the sum of the mechanical power output of the motor  $P_{mech}$ , the power loss of the motor  $P_{LMotor}$ , the power loss of the power amplifier  $P_{PowerStage}$  and the power loss of the internal auxiliary voltages of the BLV  $P_{StdBy}$

$$P_{in} = P_{mech} + P_{LMotor} + P_{PowerStage} + P_{StdBy}$$

$$P_{vMotor} = P_{mech} * 10\%$$

$$P_{PowerStage} = I_{Motor} / I_{Nenn} * 6,5 \text{ W}$$

$$P_{StdBy} = \text{approx. } 0.5 \text{ W}$$

Example of calculation for  $P_{mech}$ :

*Assumed:* required torque  $M$ :  $1 \text{ Nm} = 1 \text{ kg} * \text{m}^2/\text{s}^2$   
 speed of rotation  $n$ :  $1000 \text{ 1/min} = 16.66 \text{ 1/s}$   
 supply voltage  $V_{DC}$ :  $48$   
 $P_{PowerStage} = 6,5 \text{ W}$   
 $P_{StdBy} = \text{approx. } 0.5 \text{ W}$

$$\begin{aligned} P_{mech} &= M * 2 * \pi * n \\ P_{mech} &= 1 \text{ kg} * \text{m}^2 * \text{s}^2 * 2 * \pi * 16.66 \text{ 1/s} \\ P_{mech} &= 104.72 * 1 \text{ kg} * \text{m}^2 * \text{s}^2 * \text{1/s}^3 \\ 1 \text{ kg} * \text{m}^2 * \text{1/s}^3 &= \text{W} \\ P_{mech} &= 104.72 \text{ W} \end{aligned}$$

$$P_{vMotor} = P_{mech} * 10\% = 10.47 \text{ W}$$

$$\begin{aligned} P_{in} &= P_{mech} + P_{LMotor} + P_{PowerStage} + P_{StdBy} \\ P_{in} &= 122,19 \text{ W} \end{aligned}$$

$$\begin{aligned} I_{in} &\approx \text{approx. } P_{in} / V_{DC} \\ I_{in} &= 122.19 \text{ W} / 48 \text{ V} = 2.55 \text{ A} \end{aligned}$$



## 8      **Diagnostics and troubleshooting**

### 8.1    **Service**

If you cannot resolve the fault yourself please contact your sales representative. Have the following details available:

- Type, identification number and DOM of product (nameplate)
- Type of fault (possibly flash code)
- Previous and concurrent conditions
- Your own ideas regarding the cause of the fault

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

## 8.2 Status display via LEDs

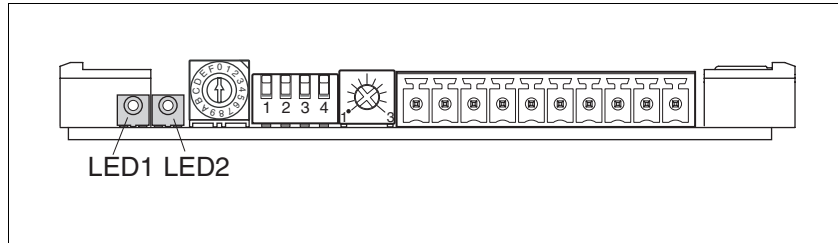


Figure 8.1 Status display via LEDs

The two LEDs display the current operating status.

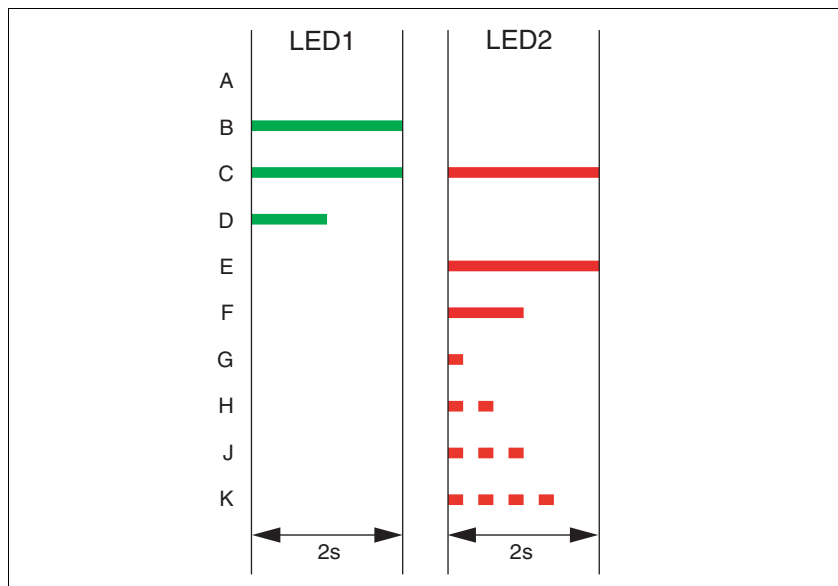


Figure 8.2 Flash code of LED1 and LED2

- (A) No power supply.
- (B) Power amplifier is activated.
- (C) Short-circuit brakes activated.
- (D) Power amplifier is deactivated.
- (E) System error.
- (F) Power amplifier overtemperature.
- (G) Overvoltage, including with feedback.
- (H) Undervoltage.
- (J) Commutation error.
- (K) Short circuit between two motor phases.



## 8.3 Troubleshooting

### 8.3.1 Resolution of malfunctions

Malfunction	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>ENABLE</code> is inactive.	Enable power amplifier.
Motor does not rotate and has no holding torque.	Motor mechanically blocked.	Check ancillary devices.
	Analogue input without signal/0V.	Checking signal input.
	Hall sensors incorrectly connected.	Checking signal input.
Motor rotates irregularly.	Overload.	Reduce load.
	Motor faulty.	Replace motor.
	Hall sensors incorrectly connected.	Checking signal input.
Motor rotates in the wrong direction.	Motor phases reversed.	Check motor phases.
	Signal input <code>DIR</code> has incorrect level.	Checking signal input.
Motor accelerates uncontrolled.	Hall sensors incorrectly connected.	Checking signal input.
LED flash code A <sup>1)</sup>	No power supply.	Connect power supply.
LED flash code C	Short-circuit brakes activated.	Activate <code>BRAKE</code> signal input.
LED flash code D <sup>1)</sup>	Device is in "DISABLE" status.	Enable power amplifier.
LED flash code E <sup>1)</sup>	System error (shutdown and startup).	Check wiring.
LED flash code F <sup>1)</sup>	Overtemperature of power amplifier (>90 °C).	Check temperature in control cabinet, apply current reduction for power reduction.
LED flash code G <sup>1)</sup>	Overvoltage (>65V <sub>DC</sub> ), including with feedback	Also use a brake resistor actuator if applicable (e.g. UBC60).
		Error message must be reset.
LED flash code H <sup>1)</sup>	Undervoltage (<18V <sub>DC</sub> ).	Check power supply.
		Error message must be reset.
LED flash code J <sup>1)</sup>	Commutation error.	Check Hall sensors connection.
	maximum commutation frequency exceeded.	Error message must be reset. The speed of rotation can be reduced in the required motor voltage operating mode.
LED flash code K <sup>1)</sup>	Short circuit between two motor phases.	Check connections.
		Error message must be reset.

1) see 8.2 "Status display via LEDs"

#### Reset error message

When the malfunction has been repaired, the error message can be reset by a switch from inactive to active (see 6.3.1 "Input ENABLE").



## 9 Accessories and spare parts

### 9.1 Optional accessories

Description	Order number
Adapter plate for mounting on top-hat rail	MNA3MFDINR1
EMC kit	MNA3CS013
Braking Resistor Controller UBC60	ACC3EA001
Connector set as listed below; spring-tension terminals connector set; 2-,4-,6-,10-pin	MNA3CS007
Connector cable for Hall sensors for RECM 34x; 0.3 m length	139103112
Connector cable for motor for RECM 34x; 0.3 m length	139103111
Connector cable for Hall sensors for RECM 34x; 3.0 m length	139103278
Connector cable for motor for RECM 34x; 3.0 m length	139103279
HBC Holding brake controller	VW3M3103

#### Overview of required connectors

The listed connectors can be procured as a connector set.

	Designation	Type (Phoenix Combicon)
Power supply	Spring force of connector section, 2-pin	FKC 2.5/ 2-STF-5.08
Signal connector	Spring force of connector section, 10-pin	FK-MCP 1.5/10-ST-3.81
Motor plug	Spring force of connector section, 4-pin	FKC 2.5/ 4-STF-5.08
Hall connector	Spring force of connector section, 6-pin	FK-MC 0.5/6-ST-2.5



## 10 Service, maintenance and disposal



*You cannot carry out repairs yourself. The repair should only be carried out by a certified customer service organisation. No warranty or liability is accepted for repairs made by the customer.*

### 10.1 Service address

If you cannot resolve the fault yourself please contact your sales representative. Have the following details available:

- Type, identification number and DOM of product (nameplate)
- Type of fault (possibly flash code)
- Previous and concurrent conditions
- Your own ideas regarding the cause of the fault

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



*If you have any questions please contact your local dealer. Your dealer will be happy to give you the name of a customer service outlet in your area.*

<http://www.berger-lahr.com>

### 10.2 Maintenance

The product is maintenance free.

### 10.3 Replacing units

#### **⚠ WARNING**

##### **Unexpected behaviour**

The behaviour of the drive system is governed by numerous stored data or settings. Unsuitable settings or data may trigger unexpected movements or reactions to signals and disable monitoring functions.

- Do not operate a drive system with unknown settings or data.
- Check the stored data or settings.
- When commissioning carefully run tests for all operating statuses and fault cases.
- Check 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 materials in the danger zone and the system can be operated safely.

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

## 10.4 Changing the motor

- ▶ Switch off all supply voltages. Make sure that power is no longer connected (safety instructions).
- ▶ Label all connections and remove the product.
- ▶ Note the identification number and the serial number from the product nameplate for later identification.
- ▶ Install the new product as specified in 4 "Installation"
- ▶ Carry out commissioning in accordance with chapter 5 "Commissioning".

## 10.5 Shipping, storage, disposal

Note the ambient conditions in the chapter 3.1 "Environmental conditions"!

<i>Shipping</i>	The product must be protected against shocks during transport. Use the original packaging for this purpose.
<i>Storage</i>	Store the product only under the specified, approved environmental conditions for room temperature and humidity. Protect the product against dust and dirt.
<i>Disposal</i>	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 Glossary

### 11.1 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 metres [m] to yards [yd]

5 m / 0.9144 = 5.468 yd

#### 11.1.1 Length

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

#### 11.1.2 Mass

	lb	oz	slug	kg	g
lb	-	* 16	* 0.03108095	* 0.4535924	* 453.5924
oz	/ 16	-	* 1.942559*10 <sup>-3</sup>	* 0.02834952	* 28.34952
slug	/ 0.03108095	/ 1.942559*10 <sup>-3</sup>	-	* 14.5939	* 14593.9
kg	/ 0.453592370	/ 0.02834952	/ 14.5939	-	* 1000
g	/ 453.592370	/ 28.34952	/ 14593.9	/ 1000	-

#### 11.1.3 Force

	lb	oz	p	dyne	N
lb	-	* 16	* 453.55358	* 444822.2	* 4.448222
oz	/ 16	-	* 28.349524	* 27801	* 0.27801
p	/ 453.55358	/ 28.349524	-	* 980.7	* 9.807*10 <sup>-3</sup>
dyne	/ 444822.2	/ 27801	/ 980.7	-	/ 100*10 <sup>3</sup>
N	/ 4.448222	/ 0.27801	/ 9.807*10 <sup>-3</sup>	* 100*10 <sup>3</sup>	-

#### 11.1.4 Power

	HP	W
HP	-	* 745.72218
W	/ 745.72218	-

## 11.1.5 Rotation

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

## 11.1.6 Torque

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

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

## 11.1.8 Temperature

	°F	°C	K
°F	-	$(^{\circ}\text{F} - 32) \ast 5/9$	$(^{\circ}\text{F} - 32) \ast 5/9 + 273.15$
°C	$^{\circ}\text{C} \ast 9/5 + 32$	-	$^{\circ}\text{C} + 273,15$
K	$(\text{K} - 273.15) \ast 9/5 + 32$	$\text{K} - 273.15$	-

## 11.1.9 Conductor cross section

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

AWG	14	15	16	17	18	19	20	21	22	23	24	25	26
mm <sup>2</sup>	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



## 11.2 Terms and Abbreviations

<i>AC</i>	Alternating Current
<i>Drive system</i>	The drive system consists of the controller, power amplifier and motor.
<i>DC</i>	Direct current
<i>DOM</i>	(Date of manufacturing), the nameplate of the device shows the date of manufacture in the format DD.MM.YY, e.g. 31.12.06 (31. December 2006).
<i>Direction of rotation</i>	Rotation of the motor shaft in a positive or negative direction of rotation. A positive direction of rotation is defined as the motor shaft rotating clockwise as the observer faces the end of the protruding shaft.
<i>EC motor</i>	Electronically commutated motor.
<i>EMC</i>	Electromagnetic compatibility.
<i>Power amplifier</i>	A device that generates current for controlling the motor in accordance with the positioning signals from the controller.
<i>Short-circuit brakes</i>	A speed-dependent braking torque is generated by short-circuiting the motor.
<i>Short-circuit current</i>	The short-circuit current is the current that can be measured with short-circuited motor windings and outside-driven motors.
<i>Parameter switches</i>	Small, side-by-side switches. Must be set during installation.
<i>PELV</i>	Protective Extra Low Voltage, functional low voltage with safe isolation.
<i>PK</i>	Peak value of a voltage ( $V_{pk}$ ) or a current ( $A_{pk}$ ); abbreviation for "Peak".
<i>PTC</i>	resistance with positive temperature coefficient. Resistance value is increased as the temperature rises.
<i>rms</i>	RMS value of a voltage ( $V_{rms}$ ) or a current ( $A_{rms}$ ); abbreviation of "Root Mean Square".
<i>Protection class</i>	The protection class is a standardised specification for electrical equipment that describes the protection against the ingress of foreign bodies and water (for example, IP20).
<i>PLC</i>	Programmable Logic Controller



## 12 Index

### A

Abbreviations 11-3  
Accessories and spare parts 9-1

### C

Cable 3-8  
CE mark 1-5  
Changing the motor 10-2  
Commissioning 5-1  
    steps 5-3  
Components and interfaces 1-3  
Connection  
    Hall sensors 4-16  
    motor phases 4-14  
    power amplifier supply voltage 4-11  
    signal interface (CN1) 4-13  
Control cabinet 4-6

### D

device  
    installation 4-7  
    Mounting 4-6  
Diagnostics 8-1  
dimensional drawing, see dimensions  
Dimensions 3-3  
Directives and standards 1-5  
Disposal 10-1, 10-2  
Documentation and literature references 1-4

### E

Electrical installation 4-7  
EMC 4-1  
    cabling 4-2  
    motor cables and encoder cables 4-3  
    power supply 4-3  
Environment  
    Installation height 3-1  
Environmental conditions 3-1  
Examples 7-1

### F

Fabricating cables  
    motor phases 4-12, 4-14, 4-15, 4-16  
Function  
    set motor phase current 6-4  
Functions 6-2  
    monitoring functions 6-5

### G

Glossary 11-1

**I**

Installation  
    electrical 4-7  
    mechanical 4-5  
Installation spacing 4-6  
Intended use 2-1  
Introduction 1-1

**M**

Maintenance 10-1  
malfunctions 8-3  
Mechanical installation 4-5  
Monitoring  
    motor phases 4-14  
    parameters 6-5  
Monitoring functions 2-3, 6-5  
Mounting, mechanical 4-6

**O**

Operating mode  
    speed control 6-1  
Operation 6-1  
Overview 5-2  
    all connections 4-10  
    procedure for electrical installation 4-9  
Overvoltage 6-5

**Q**

Qualifications, personnel 2-1

**S**

Second environment 4-2  
Service 10-1  
Service address 10-1  
Set motor phase current percentage 6-4  
Shipping 10-2  
Signal connections  
    overview 4-10  
Signal interface  
    connecting 4-14  
Speed control 6-1  
Status display via LEDs 8-2  
Storage 10-2  
Switching cabinet setup 4-2

**T**

Technical data 3-1  
Terms 11-3  
Troubleshooting 8-1, 8-3  
troubleshooting  
    malfunctions 8-3  
Type code 1-4

**U**

Undervoltage 6-5  
Unit overview 1-1  
Units and conversion tables 11-1

**V**

ventilation 4-6

**W**

Wiring diagram  
    motor encoder 4-16  
    motor phases 4-15  
    signal interface 4-13

