BRS3
3-phase stepper motor
Motor manual
V2.01, 11.2008
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

- **Important information** ........................................... 2
- **Table of Contents** .................................................. 3
- **Writing conventions and symbols** ................................. 7

## 1 Introduction ..................................................... 9
  1.1 About this manual ............................................... 9
  1.2 Overview .......................................................... 9
  1.3 Options, accessories and cables .................................. 10
  1.4 Nameplate .......................................................... 11
  1.5 Type code BRS 36 .................................................. 12
  1.6 Type code BRS 39 .................................................. 13
  1.7 Type code BRS 3A .................................................. 15
  1.8 Declaration of conformity ......................................... 16

## 2 Before you begin - safety information .......................... 17
  2.1 Qualification of personnel ....................................... 17
  2.2 Intended use ........................................................ 17
  2.3 Hazard categories ................................................ 18
  2.4 Basic information ................................................ 19
  2.5 Standards and terminology ...................................... 20

## 3 Technical Data .................................................. 21
  3.1 General features .................................................. 21
  3.2 Ambient conditions .............................................. 22
  3.3 Service life ....................................................... 23
  3.4 IP degree of protection .......................................... 24
  3.5 Motor-specific data ............................................... 26
  3.6 Characteristic curves ............................................ 27
    3.6.1 Characteristic curves BRS368 ................................ 27
    3.6.2 Characteristic curves BRS397 ................................ 28
    3.6.3 Characteristic curves BRS39A ................................ 29
    3.6.4 Characteristic curves BRS39B ................................ 30
    3.6.5 Characteristic curves BRS3AC ................................ 31
    3.6.6 Characteristic curves BRS3AD ................................ 32

---

3-phase stepper motor
# Table of Contents

3.7 Dimensions ............................................. 33
3.7.1 Dimensional drawing BRS 36 ...................... 33
3.7.2 Dimensional drawing BRS 39 ...................... 35
3.7.3 Dimensional drawing BRS 3A ....................... 37
3.8 Shaft-specific data ....................................... 39
3.8.1 Press-on force ....................................... 39
3.8.2 Shaft load ........................................... 40
3.9 Motor versions .......................................... 41
3.10 Options .................................................. 42
3.10.1 Holding brake ........................................ 42
3.10.2 Position capture (encoder) ....................... 44

4 Installation ................................................ 45
4.1 Before installation................................. 46
4.1.1 Calculation of installation space ............... 47
4.2 Electromagnetic compatibility, EMC ............... 48
4.3 Mechanical installation .............................. 50
4.4 Electrical installation ............................... 52
4.4.1 Motor connection .................................. 53
4.4.2 Encoder connection ................................ 55
4.4.3 Holding brake connection ....................... 56

5 Commissioning ............................................ 57
5.1 Preparing for commissioning ..................... 57
5.2 Performing commissioning ........................... 58

6 Diagnostics and troubleshooting ..................... 61
6.1 Mechanical problems ............................... 61
6.2 Electrical problems .................................. 61

7 Accessories and spare parts ............................ 63
7.1 Accessories ............................................ 63
7.2 Motor cable ............................................ 63

8 Service, maintenance and disposal ................. 65
8.1 Service address ....................................... 66
8.2 Maintenance ............................................ 66
# Table of Contents

9 Glossary

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.1 Units and conversion tables</td>
<td>69</td>
</tr>
<tr>
<td>9.1.1 Length</td>
<td>69</td>
</tr>
<tr>
<td>9.1.2 Mass</td>
<td>69</td>
</tr>
<tr>
<td>9.1.3 Force</td>
<td>69</td>
</tr>
<tr>
<td>9.1.4 Power</td>
<td>69</td>
</tr>
<tr>
<td>9.1.5 Rotation</td>
<td>70</td>
</tr>
<tr>
<td>9.1.6 Torque</td>
<td>70</td>
</tr>
<tr>
<td>9.1.7 Moment of inertia</td>
<td>70</td>
</tr>
<tr>
<td>9.1.8 Temperature</td>
<td>70</td>
</tr>
<tr>
<td>9.1.9 Conductor cross section</td>
<td>70</td>
</tr>
<tr>
<td>9.2 Terms and Abbreviations</td>
<td>71</td>
</tr>
</tbody>
</table>

10 Index

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>73</td>
</tr>
</tbody>
</table>
Table of Contents

3-phase stepper motor
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 mm² (AWG 14)
1 Introduction

1.1 About this manual

This manual is valid for all BRS 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 Overview

The 3-phase stepper motors are extremely robust, maintenance-free drives. They carry out step-by-step movements which are controlled by a positioning controller.

The 3-phase stepper motors can be operated at very high resolutions with appropriate control electronics.

Options such as rotation monitoring and holding brake with robust, low-play planetary gear extend the application options.

Features

- **Powerful**, the optimized internal geometry of the motor offers a high power density; i.e. up to 50% greater torque as compared to conventional stepper motors of comparable size.

- **Silent**, the sine commutation of the drive and the special mechanical design result in a very quiet and virtually resonance-free stepper motor.

- **Versatile**, with a flexible modular system and modern variant management, a wide variety of motor types can be manufactured and delivered in a very short time.
1.3 Options, accessories and cables

The motors are optionally available with:

- Encoder
- Holding brake
- Angled and rotatable connectors
- Various degrees of protection

For the options see the technical data in the various motor descriptions.

The following accessories are available:

- Controller for holding brake
- Cable
- Gearboxes

Pre-assembled motor and encoder cables designed for the drive systems provide for excellent connection of motor and power stage.
1.4 Nameplate

The nameplate contains the following data:

1. Motor type, see type code
2. Order no.
3. Maximum supply voltage
4. Phase current at standstill
5. Voltage constant
6. Nominal torque at standstill
7. Temperature class
8. Degree of protection
9. Nominal voltage of the holding brake
10. Date of manufacture
11. Serial number
12. Variable torque
13. Country of manufacture, site
14. Barcode
### Type code BRS 36

<table>
<thead>
<tr>
<th>Position</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Motor size</td>
</tr>
<tr>
<td>8</td>
<td>Length</td>
</tr>
<tr>
<td>W</td>
<td>Winding</td>
</tr>
<tr>
<td>1</td>
<td>Mechanical interface - shaft and degree of protection</td>
</tr>
<tr>
<td>3</td>
<td>Mechanical interface - centering collar</td>
</tr>
<tr>
<td>0</td>
<td>Position capture</td>
</tr>
<tr>
<td>1</td>
<td>Holding brake</td>
</tr>
<tr>
<td>B</td>
<td>Connection version</td>
</tr>
<tr>
<td>A</td>
<td>Second shaft end</td>
</tr>
</tbody>
</table>

**Product family**
- 3-phase stepper motors

**Motor size**
- 6 = 57.2 mm flange

**Length**
- 8 = 79 mm

**Winding**
- W = 325 V$_{dc}$

**Mechanical interface - shaft and degree of protection**
- 0 = Smooth shaft 6.35 mm; degree of protection: shaft bushing IP 41, housing IP 56
- 1 = Smooth shaft 8 mm; degree of protection: shaft bushing IP 41, housing IP 56

**Mechanical interface - centering collar**
- 3 = 38 mm

**Position capture**
- 0 = Without encoder
- 1 = Incremental encoder (1000 pulses/revolution)

**Holding brake**
- A = Without holding brake
- F = With holding brake

**Connection version**
- B = Terminal box
- C = Connector

**Second shaft end**
- A = Without second shaft end
- B = With second shaft end

1) Only available for motors without a holding brake.

*Customized product*  In the case of a customized product, position 8 is an "S".
### 1.6 Type code BRS 39

**Product family**
- 3-phase stepper motors

**Motor size**
- 9 = 85 mm flange

**Length**
- 7 = 68 mm
- A = 98 mm
- B = 128 mm

**Winding**
- W = 325 V<sub>dc</sub>

**Mechanical interface - shaft and degree of protection**
- 2 = Smooth shaft 9.5 mm; degree of protection: shaft bushing IP 41, housing IP 56<sup>1)</sup>
- 3 = Smooth shaft 12 mm; type of protection: shaft bushing IP 41, housing IP 56<sup>1)</sup>
- 4 = Smooth shaft 14 mm; degree of protection: shaft bushing IP 41, housing IP 56<sup>2)</sup>
- 5 = Woodruff key 9.5 mm; degree of protection: shaft bushing IP 41, housing IP 56<sup>1)</sup>
- 6 = Woodruff key 12 mm; degree of protection: shaft bushing IP 41, housing IP 56<sup>1)</sup>
- 7 = Woodruff key 14 mm; degree of protection: shaft bushing IP 41, housing IP 56<sup>2)</sup>

**Mechanical interface - centering collar**
- 6 = 60 mm
- 7 = 73 mm

**Position capture**
- 0 = Without encoder
- 1 = Incremental encoder (1000 pulses/revolution)

**Holding brake**
- A = Without holding brake
- F = With holding brake

**Connection version**
- B = Terminal box
- C = Connector

**Second shaft end**
- A = Without second shaft end
- B = With second shaft end<sup>3)</sup>

1) Only available for lengths 7 and A.
2) Only available for length B.
3) Only available for motors without a holding brake.
Customized product  In the case of a customized product, position 8 is an "S".
### 1.7 Type code BRS 3A

<table>
<thead>
<tr>
<th>BRS3</th>
<th>A</th>
<th>W</th>
<th>8</th>
<th>5</th>
<th>0</th>
<th>A</th>
<th>B</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3</td>
<td>A</td>
<td>W</td>
<td>8</td>
<td>5</td>
<td>0</td>
<td>A</td>
<td>B</td>
</tr>
</tbody>
</table>

**Product family**
3-phase stepper motors

**Motor size**
A = 110 mm flange

**Length**
C = 180 mm
D = 230 mm

**Winding**
W = 325 V<sub>dc</sub>

**Mechanical interface - shaft and degree of protection**
8 = Parallel key 19 mm; degree of protection: shaft bushing IP 41, housing IP 56

**Mechanical interface - centering collar**
5 = 56 mm

**Position capture**
0 = Without encoder
1 = Incremental encoder (1000 pulses/revolution)

**Holding brake**
A = Without holding brake
F = With holding brake

**Connection version**
B = Terminal box
C = Connector

**Second shaft end**
A = Without second shaft end
B = With second shaft end

---

1) Only available for motors without a holding brake.

**Customized product**
In the case of a customized product, position 8 is an "S".
1.8 Declaration of conformity

EC DECLARATION OF CONFORMITY

YEAR 2008

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: 3 phase stepping motor

Type: BRS3xx

Product number: 0x5xx2xxxxxxx

Applied harmonized standards, especially:

- EN 60034-1:2005 Thermal class 155
- EN 60034-5:2001 Degree of protection according product documentation
- EN 60800-5-1:2007

Applied national standards and technical specifications, especially:

- UL 1004 Product documentation

Company stamp: Schneider Electric Motion Deutschland GmbH & Co. KG

Date/ Signature: 29 July 2008

Name/ Department: Wolfgang Brandstätter/Development
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 motor and intended for industrial use according to this manual.

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

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

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

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

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

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

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

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

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

<table>
<thead>
<tr>
<th>△ DANGER</th>
</tr>
</thead>
<tbody>
<tr>
<td>DANGER indicates an imminently hazardous situation, which, if not avoided, will result in death or serious injury.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>△ WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>WARNING indicates a potentially hazardous situation, which, if not avoided, can result in death, serious injury, or equipment damage.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>△ CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAUTION indicates a potentially hazardous situation, which, if not avoided, can result in injury or equipment damage.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAUTION used without the safety alert symbol, is used to address practices not related to personal injury (e.g. can result in equipment damage).</td>
</tr>
</tbody>
</table>
2.4 Basic information

⚠️ DANGER

**ELECTRIC SHOCK, EXPLOSION OR ARC FLASH**

- Only appropriately trained persons who are familiar with and understand the contents of this manual and all other pertinent product documentation and who have received safety training to recognize and avoid hazards involved are authorized to work on and with this drive system. Installation, adjustment, repair and maintenance must be performed by qualified personnel.

- The system integrator is responsible for compliance with all local and national electrical code requirements as well as all other applicable regulations with respect to grounding of all equipment. Supplement the motor cable grounding conductor with an additional protective ground conductor to the motor housing.

- Do not touch unshielded components or terminals with voltage present.

- The motor generates voltage when the shaft is rotated. Prior to performing any type of work on the drive system, block the motor shaft to prevent rotation.

- AC voltage can couple voltage to unused conductors in the motor cable. Insulate both ends of unused conductors in the motor cable.

- Do not short across the DC bus terminals or the DC bus capacitors.

- Before performing work on the drive system:
  - Disconnect all power, including external control power that may be present.
  - Place a "DO NOT TURN ON" label on all power switches.
  - Lock all power switches in the open position.
  - Wait for the DC bus capacitors to discharge (see the product manual for the power stage). Then measure the DC bus voltage and verify it is less than \(< 42\,\text{V}_\text{dc}\) (see the product manual for the power stage).

- Install and close all covers before applying voltage.

**Failure to follow these instructions will result in death or serious injury.**
2.5 Standards and terminology

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

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

Among others, these standards include:

- IEC 61800 series: "Adjustable speed electrical power drive systems"
- IEC 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 product family and the accessories.

3.1 General features

The series BRS3 motors are 3-phase stepper motors. They excel with:

- High power density
- Integrated thermal winding monitoring as per EN 61800-5-1 "safe isolation"
- Test voltage as per IEC 60034-1
- Thermal class 155 (F) as per IEC 60034-1
- Vibration grade A as per IEC 60034-14
- Shaft wobble and perpendicularity as per IEC 60072-1 (EN 50347)
- Color: black RAL 9005
### 3.2 Ambient conditions

#### Ambient temperature during operation

<table>
<thead>
<tr>
<th>Ambient temperature</th>
<th>°C</th>
<th>-25 ... +40</th>
</tr>
</thead>
</table>

1) Limit values with flanged motor (e.g. steel plate 300x300x10 mm)

#### 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.

The storage time is primarily determined by the service life of the bearing lubricants; do not store the product for more than 36 months. It is recommended to periodically operate the motor to maintain its operability.

<table>
<thead>
<tr>
<th>Storage and transportation temperature</th>
<th>°C</th>
<th>-25 ... +70</th>
</tr>
</thead>
</table>

#### Relative humidity

The following relative humidity is permissible during operation:

<table>
<thead>
<tr>
<th>Relative humidity</th>
<th>%</th>
<th>75 (annual mean) 95 (on 30 days)</th>
</tr>
</thead>
</table>

#### Installation altitude

<table>
<thead>
<tr>
<th>Installation altitude above seal level without derating</th>
<th>m</th>
<th>&lt; 1000</th>
</tr>
</thead>
</table>

#### Vibration and shock

<table>
<thead>
<tr>
<th>Vibration, sinusoidal</th>
<th>As per IEC/EN 60068-2-6: 0.15 mm (from 10 Hz ... 60 Hz) 20 m/s² (from 10 Hz ... 500 Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shock, semi-sinusoidal</td>
<td>As per IEC/EN 60068-2-27: 150 m/s² (11 ms)</td>
</tr>
</tbody>
</table>

#### Ambient conditions

<table>
<thead>
<tr>
<th>Maximum rotary acceleration</th>
<th>[rad/s²]</th>
<th>200000</th>
</tr>
</thead>
</table>
3.3 Service life

The service life of the motors when operated correctly is limited primarily by the bearing service life.

The following operating conditions can significantly reduce the service life:

- Installation altitude more than 1000 m above m.s.l.
- Continuous operating temperatures greater than 80 °C
- Angular travel less than 100 °
- Operation with very high rotary accelerations
- Operation under vibration load greater than 20 m/s²
- High cycle frequencies
- Allowing sealing rings to run dry
- Wetting of the drive with aggressive media
- Condensation and icing of functional parts
- Exceeding the permissible shaft load
3.4 IP degree of protection

The motors have the following IP degrees of protection as per EN 60034-5:

![Figure 3.1 IP degree of protection](image)

<table>
<thead>
<tr>
<th>Item</th>
<th>Degree of protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Shaft bushing without shaft sealing ring</td>
</tr>
<tr>
<td></td>
<td>Shaft bushing with shaft sealing ring</td>
</tr>
<tr>
<td></td>
<td>Shaft bushing with GBX gearbox</td>
</tr>
<tr>
<td>2</td>
<td>Motor connection</td>
</tr>
<tr>
<td>3</td>
<td>Shaft bushing second shaft end</td>
</tr>
<tr>
<td></td>
<td>Rear side of motor with holding brake or encoder</td>
</tr>
</tbody>
</table>

1) Optional in case of BRS39

The total degree of protection is determined by the component with the lowest degree of protection.

**Shaft sealing ring**

The motors can be optionally equipped with a shaft sealing ring and thus achieve degree of protection IP56. However, this limits the maximum speed to 3000 min⁻¹.

Note the following:

- The shaft sealing ring is initially lubricated at the factory.
- Allowing the seals to run dry increases friction and greatly reduces the service life of the sealing rings.
- Mounting position IM V3 (drive shaft vertical, shaft end upward) only achieves degree of protection IP 41.
### Overview of IP degrees of protection

<table>
<thead>
<tr>
<th>First digit</th>
<th>Second digit</th>
<th>Protection against intrusion of objects</th>
<th>Protection against intrusion of water</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>No protection</td>
<td>No protection</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>External objects &gt;50 mm</td>
<td>Vertically falling dripping water</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>External objects &gt;12 mm</td>
<td>Dripping water falling at an angle (75° ... 90°)</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>External objects &gt;2.5 mm</td>
<td>Spraying water</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>External objects &gt;1 mm</td>
<td>Splashing water</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>Dust-protected</td>
<td>Water jets</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>Dust-tight</td>
<td>Heavy sea</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td></td>
<td>Immersion</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td></td>
<td>Submersion</td>
</tr>
</tbody>
</table>
### 3.5 Motor-specific data

<table>
<thead>
<tr>
<th>Motor type BRS3*</th>
<th>368</th>
<th>397</th>
<th>39A</th>
<th>39B</th>
<th>3AC</th>
<th>3AD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Winding</strong></td>
<td>W</td>
<td>W</td>
<td>W</td>
<td>W</td>
<td>W</td>
<td>W</td>
</tr>
<tr>
<td>Maximum supply voltage (U_{\text{max}}) [VAC]</td>
<td>230</td>
<td>230</td>
<td>230</td>
<td>230</td>
<td>230</td>
<td>230</td>
</tr>
<tr>
<td>Maximum voltage to ground ([V_{\text{AC}}])</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td>Nominal voltage DC bus (U_{N}) [Vdc]</td>
<td>325</td>
<td>325</td>
<td>325</td>
<td>325</td>
<td>325</td>
<td>325</td>
</tr>
<tr>
<td>Motor phase current (I_N) [A_{\text{rms}}]</td>
<td>0.9</td>
<td>1.75</td>
<td>2</td>
<td>2.25</td>
<td>4.1</td>
<td>4.75</td>
</tr>
<tr>
<td>Nominal torque (M_N) [Nm]</td>
<td>1.50</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>12</td>
<td>16.5</td>
</tr>
<tr>
<td>Holding torque (M_H) [Nm]</td>
<td>1.70</td>
<td>2.26</td>
<td>4.52</td>
<td>6.78</td>
<td>13.5</td>
<td>19.7</td>
</tr>
<tr>
<td>Rotor inertia (J_R) [kgcm²]</td>
<td>0.38</td>
<td>1.1</td>
<td>2.2</td>
<td>3.3</td>
<td>10.5</td>
<td>16</td>
</tr>
<tr>
<td>Steps per revolution 1)</td>
<td>200 / 400 / 500 / 1000 / 2000 / 4000 / 5000 / 10000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step angle 1) (\alpha) [°]</td>
<td>1.8 / 0.9 / 0.72 / 0.36 / 0.18 / 0.09 / 0.072 / 0.036</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systematic angle tolerance 2) (\Delta\alpha_s) ['']</td>
<td>±6</td>
<td>±6</td>
<td>±6</td>
<td>±6</td>
<td>±6</td>
<td>±6</td>
</tr>
<tr>
<td>Max. starting frequency (f_{\text{Aom}}) [kHz]</td>
<td>8.5</td>
<td>5.3</td>
<td>5.3</td>
<td>5.3</td>
<td>4.7</td>
<td>4.7</td>
</tr>
<tr>
<td>Winding resistance (R_W) [Ω]</td>
<td>25</td>
<td>6.5</td>
<td>5.8</td>
<td>6.5</td>
<td>1.8</td>
<td>1.9</td>
</tr>
<tr>
<td>Current rise time constant (\tau) [ms]</td>
<td>4.6</td>
<td>~7</td>
<td>~9</td>
<td>~10</td>
<td>~22</td>
<td>~22</td>
</tr>
<tr>
<td>Mass 3) (m) [kg]</td>
<td>2.0</td>
<td>2.1</td>
<td>3.2</td>
<td>4.3</td>
<td>8.2</td>
<td>11.2</td>
</tr>
</tbody>
</table>

1) Depends on control
2) Measured at 1000 steps/revolution, unit: minute of arc
3) Mass of motor type with cable gland or connector
3.6 Characteristic curves

3.6.1 Characteristic curves BRS368

Measurement of characteristic curves with 1000 steps/revolution, nominal voltage $U_N$ and phase current $I_N$

1. Pull-out torque
2. Pull-in torque
3. Maximum load inertia
3.6.2 Characteristic curves BRS397

Measurement of characteristic curves with 1000 steps/revolution, nominal voltage $U_N$ and phase current $I_N$

(1) Pull-out torque
(2) Pull-in torque
(3) Maximum load inertia
3.6.3 Characteristic curves BRS39A

Measurement of characteristic curves with 1000 steps/revolution, nominal voltage $U_N$ and phase current $I_N$

- (1) Pull-out torque
- (2) Pull-in torque
- (3) Maximum load inertia
3.6.4 Characteristic curves BRS39B

Measurement of characteristic curves with 1000 steps/revolution, nominal voltage $U_N$ and phase current $I_N$

(1) Pull-out torque
(2) Pull-in torque
(3) Maximum load inertia
3.6.5 Characteristic curves BRS3AC

Measurement of characteristic curves with 1000 steps/revolution, nominal voltage $U_N$ and phase current $I_N$

(1) Pull-out torque  
(2) Pull-in torque  
(3) Maximum load inertia
3.6.6 Characteristic curves BRS3AD

Measurement of characteristic curves with 1000 steps/revolution, nominal voltage $U_N$ and phase current $I_N$

(1) Pull-out torque
(2) Pull-in torque
(3) Maximum load inertia
3.7 Dimensions

3.7.1 Dimensional drawing BRS 36

The following applies for the dimensional drawings:

(1) motor with holding brake

<table>
<thead>
<tr>
<th>BRS ••</th>
<th>•• 368</th>
</tr>
</thead>
<tbody>
<tr>
<td>L [mm]</td>
<td>79</td>
</tr>
<tr>
<td>D [mm]</td>
<td>8</td>
</tr>
</tbody>
</table>

Figure 3.2 Dimensional drawing terminal version
Figure 3.3  Dimensional drawing connector version without encoder

Figure 3.4  Dimensional drawing connector version with encoder
### 3.7.2 Dimensional drawing BRS 39

The following applies for the dimensional drawings:

1. **motor with holding brake**

<table>
<thead>
<tr>
<th>BRS  ••</th>
<th>397</th>
<th>39A</th>
<th>39B</th>
</tr>
</thead>
<tbody>
<tr>
<td>L [mm]</td>
<td>67.5</td>
<td>97.5</td>
<td>127.5</td>
</tr>
<tr>
<td>D [mm]</td>
<td>9.5 / 12</td>
<td>9.5 / 12</td>
<td>14</td>
</tr>
<tr>
<td>N [mm]</td>
<td>60 / 73</td>
<td>60 / 73</td>
<td>60 / 73</td>
</tr>
</tbody>
</table>

![Dimensional drawing terminal version](image-url)

**Figure 3.5** Dimensional drawing terminal version
Figure 3.6  Dimensional drawing connector version without encoder

Figure 3.7  Dimensional drawing connector version with encoder
3.7.3 Dimensional drawing BRS 3A

The following applies for the dimensional drawings:

(1) motor with holding brake

<table>
<thead>
<tr>
<th>BRS ••</th>
<th>•• 3AC</th>
<th>•• 3AD</th>
</tr>
</thead>
<tbody>
<tr>
<td>L [mm]</td>
<td>180</td>
<td>228</td>
</tr>
</tbody>
</table>

Figure 3.8  Dimensional drawing terminal version
Figure 3.9  Dimensional drawing connector version without encoder

Figure 3.10  Dimensional drawing connector version with encoder
3.8 Shaft-specific data

3.8.1 Press-on force

⚠️ WARNING

UNINTENDED BEHAVIOR CAUSED BY MECHANICAL DAMAGE TO THE MOTOR

If the maximum permissible forces at the shaft are exceeded, this will result in premature wear of the bearing, shaft breakage or damage to the encoder.

- Do not exceed the maximum permissible axial and radial forces.
- Protect the shaft from impact.
- Do not exceed the maximum permissible axial force when pressing on components.

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

Maximum press-on force

The maximum press-on force is limited by the maximum permissible axial force that may act on the rolling bearing. Using assembly paste (such as Klüberpaste 46 MR 401) on the shaft and the component to be mounted reduces friction and mechanical impact on the surfaces.

If the shaft has a thread, it is recommended to use it to press on the component to be mounted. This way there is no axial force acting on the rolling bearing.

It is also possible to shrink-fit, clamp or glue the component to be mounted.
3.8.2 Shaft load

The following conditions apply:

- Speed \( n = 600 \text{ m}^{-1} \)
- Ambient temperature = 40°C (approx. 80°C storage temperature)
- 100% Duty Cycle at nominal torque

When these conditions are met the maximum forces shown in the table below may act on the shaft, but not simultaneously:

<table>
<thead>
<tr>
<th>BRS **</th>
<th>368</th>
<th>397</th>
<th>39A</th>
<th>39B</th>
<th>3AC</th>
<th>3AD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. radial force 1st shaft end ( F_{R1} ) (1) ) [N]</td>
<td>50</td>
<td>100</td>
<td>100</td>
<td>110</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>Max. radial force 2nd shaft end (optional) ( F_{R2} ) (1) ) [N]</td>
<td>25</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>Max. axial force tension ( F_{A1} ) [N]</td>
<td>100</td>
<td>175</td>
<td>175</td>
<td>175</td>
<td>330</td>
<td>330</td>
</tr>
<tr>
<td>Max. axial force pressure ( F_{A2} ) [N]</td>
<td>8.4</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Nominal bearing service life ( L_{10h} ) (2) ) [h]</td>
<td>20000</td>
<td>20000</td>
<td>20000</td>
<td>20000</td>
<td>20000</td>
<td>20000</td>
</tr>
</tbody>
</table>

1) Point of application of radial force: \( X = Y = 10 \text{ mm} \) distance from flange
2) Operating hours at a probability of failure of 10%
## 3.9 Motor versions

![Motor versions diagram](image)

<table>
<thead>
<tr>
<th>Item</th>
<th>BRS ••</th>
<th>•• 36</th>
<th>•• 39</th>
<th>•• 3A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 GBX gearbox (accessory)</td>
<td>See catalog</td>
<td>See catalog</td>
<td>See catalog</td>
<td></td>
</tr>
<tr>
<td>2 Shaft diameter</td>
<td>6.35 mm</td>
<td>9.5 mm</td>
<td>19 mm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8 mm</td>
<td>12 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>14 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Centering collar</td>
<td>38.1 mm</td>
<td>60 mm</td>
<td>56 mm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>73 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Size</td>
<td>57.2 mm</td>
<td>85 mm</td>
<td>110 mm</td>
<td></td>
</tr>
<tr>
<td>4 Length</td>
<td>79 mm</td>
<td>68 mm</td>
<td>180 mm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>98 mm</td>
<td>230 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>128 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Motor connection</td>
<td>Terminal box 1)</td>
<td>Terminal box</td>
<td>Terminal box</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Connector</td>
<td>Connector</td>
<td>Connector</td>
<td></td>
</tr>
<tr>
<td>6 Options</td>
<td>2nd shaft end 2)</td>
<td>2nd shaft end</td>
<td>2nd shaft end</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Holding brake</td>
<td>Holding brake</td>
<td>Holding brake</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Encoder 3)</td>
<td>Encoder</td>
<td>Encoder</td>
<td></td>
</tr>
</tbody>
</table>

1) Terminal strip inside motor; sealed with a cable gland
2) Only one feature selectable; either 2nd shaft end or holding brake
3) Only in case of motor with connector version (in addition, 2nd shaft end or holding brake possible)
3 Technical Data

3.10 Options

3.10.1 Holding brake

The holding brake is an electromagnetic spring force brake. It holds the motor shaft after the motor current is switched off, including after power outage and EMERGENCY STOP. A holding brake is required particularly in the case of torque loads caused by weight, such as those that occur with vertical axes.

For a description of the controller, see chapter 4.4.3 "Holding brake connection".

The connections are safely isolated from the motor winding.

<table>
<thead>
<tr>
<th>Technical data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holding brake for motor type BRS ••</td>
</tr>
<tr>
<td>Nominal voltage [V]</td>
</tr>
<tr>
<td>Holding torque [Nm]</td>
</tr>
<tr>
<td>Electrical pull-in power [W]</td>
</tr>
<tr>
<td>Moment of inertia [kgcm²]</td>
</tr>
<tr>
<td>Permissible friction per deceleration Q 1) [J]</td>
</tr>
<tr>
<td>Holding brake release time [ms]</td>
</tr>
<tr>
<td>Holding brake application time [ms]</td>
</tr>
<tr>
<td>Radial backlash [Degrees]</td>
</tr>
<tr>
<td>Mass approx. [kg]</td>
</tr>
</tbody>
</table>

1) The values apply to 1 ... 10 brake applications per hour.

⚠️ WARNING

LOAD FALLS DURING SWITCHING ON

When the brake of stepping motor drives is released and external forces are applied (vertical axes), the load may fall if the friction is low.

- In such applications, limit the load to a maximum of 25% of the static holding torque.

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

The drive rating at permissible braking power is calculated with the formula:

\[
Q = \frac{J \cdot n^2}{182.4} \cdot \frac{M_2}{M_{\text{dec}}}
\]

Where:
- \(Q\) = Permissible friction per deceleration [J],
- \(J\) = Mass moment of inertia [kg\(\text{cm}^2\)],
- \(n\) = Speed of rotation,
- \(M_2\) = Nominal torque of holding brake,
- \(M_{\text{dec}}\) = Deceleration torque.

The holding brake is a product of "Chr. Mayr GmbH + Co.KG". The holding brakes of the "ROBA-Stop" and "ROBA-Stop-M" series are used. Manuals can be found on the Internet at [http://www.mayr.de](http://www.mayr.de).

**Brake application and release times**

The application and release times are based on the following circuit:
3.10.2 Position capture (encoder)

3-phase stepper motors can be fitted with an optional encoder. This measuring system signals the actual position if the drive is fitted with rotation monitoring electronics. A temperature sensor is integrated. The connections are isolated from the motor winding.

Rotation monitoring compares the reference position and the actual position of the motor and signals an error if the difference exceeds a specified limit (position deviation -> tracking error). For example, this enables detection of mechanical overload of the motor.

*An encoder can only be used with motors with connector. A second shaft end or a holding brake can also be used.*

---

### Technical data

<table>
<thead>
<tr>
<th>Resolution</th>
<th>[Pulses/rev.]</th>
<th>1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Index pulse</td>
<td>[Pulses/rev.]</td>
<td>1</td>
</tr>
<tr>
<td>Output</td>
<td></td>
<td>RS 422</td>
</tr>
<tr>
<td>Accuracy</td>
<td>[°]</td>
<td>±1</td>
</tr>
<tr>
<td>Signals</td>
<td></td>
<td>A; B; I</td>
</tr>
<tr>
<td>Pulse shape</td>
<td></td>
<td>Rectangular</td>
</tr>
<tr>
<td>Supply voltage</td>
<td>[V]</td>
<td>5 ± 5 %</td>
</tr>
<tr>
<td>Max. input current</td>
<td>[A]</td>
<td>0.125 (BRS 36)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.15 (BRS 39 and 3A)</td>
</tr>
<tr>
<td>Temperature sensor</td>
<td>[°C]</td>
<td>100 to 105 (BRS 39 and 3A)</td>
</tr>
</tbody>
</table>

---

**Pulse diagram**

![Pulse diagram](image)

*Figure 3.12 Signal curve with clockwise direction of rotation of the motor*

---

**Temperature monitoring**

![Temperature monitoring](image)

*Figure 3.13 Temperature monitoring*
4 Installation

⚠️ WARNING

UNEXPECTED BEHAVIOR CAUSED BY DAMAGE OR FOREIGN OBJECTS
Damage to the product as well as foreign objects, deposits or humidity can cause unexpected behavior.
- Do not use damaged products.
- Keep foreign objects from getting into the product.
- Verify correct seat of seals and cable entries.
Failure to follow these instructions can result in death, serious injury or equipment damage.

⚠️ WARNING

STRONG ELECTROMAGNETIC FIELDS
Motors can generate strong local electrical and magnetic fields. This can cause interference in sensitive devices.
- Keep persons with implants such as pacemakers away from the motor.
- Do not place any sensitive devices close to the motor.
Failure to follow these instructions can result in death, serious injury or equipment damage.

⚠️ WARNING

MOVEMENT 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.
Overload or faults can cause danger due to the failure of the holding brake.
Incorrect use of the holding brake results in premature wear and failure.
- Do not use the internal brake as a service brake.
- If necessary, use a damped mechanical stop or a service brake.
- Verify the function of the brake.
- In addition, secure the hazardous area so it cannot be accessed.
- The brake function must be checked again after frequent EMERGENCY STOP braking operations.
Failure to follow these instructions can result in death, serious injury or equipment damage.
4.1 Before installation...

- Read this manual carefully, particularly the chapter on safety, and follow all safety instructions. Also familiarize yourself with the drive manual.

- Prior to mounting, obtain all required tools, measurement and testing instruments and all other equipment.

- Check the nameplate to verify that the motor is really intended for the intended application.

- Verify that all ambient conditions are met during operation.

**Checking for damage**
Prior to mounting, check the drive system for visible damage. Damaged drive systems must neither be installed nor operated.

**Cleaning the shaft**
The shaft ends are factory-treated with an anti-corrosive. The anti-corrosive must be removed with a standard industrial cleaner and a soft cloth.

Avoid direct contact of the skin and the sealing material with the anticorrosive or the industrial cleaner.

**Mounting surface for flange**
The mounting surface must be stable, clean and low-vibration.

Verify that the system side meets all requirements in terms of dimensions and tolerances.
4.1.1 Calculation of installation space

**Principle diagram**

![Diagram showing connector installation space](image)

**Connector data**

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Motor connector</th>
<th>Encoder connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>D [mm]</td>
<td>28</td>
<td>26</td>
</tr>
<tr>
<td>LS [mm]</td>
<td>79</td>
<td>54</td>
</tr>
<tr>
<td>LR [mm]</td>
<td>115</td>
<td>80</td>
</tr>
<tr>
<td>LC [mm]</td>
<td>95</td>
<td>65</td>
</tr>
<tr>
<td>LM [mm]</td>
<td>34</td>
<td>24</td>
</tr>
</tbody>
</table>

**Cable specifications**

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Motor cable</th>
<th>Encoder cable</th>
</tr>
</thead>
<tbody>
<tr>
<td>d [mm]</td>
<td>10.5 (± 0.2)</td>
<td>8.8 (± 0.2)</td>
</tr>
</tbody>
</table>

**Calculation**

The following is a rule of thumb for calculating the connector installation space $R_{\text{min}}$:

- Stationary wiring: $R = 7.5 \times d$
- Drag chains (moving): $R = 7.5 \times d$

For the permissible temperatures, a distinction is made between stationary and moving:

- Stationary wiring: -40°C ... +85°C
- Drag chains (moving): -20°C ... +85°C
4.2 Electromagnetic compatibility, EMC

**WARNING**

**SIGNAL AND DEVICE INTERFERENCE**
Signal interference can cause unexpected responses of device.
- Install the wiring in accordance with the EMC requirements.
- Verify compliance with the EMC requirements.

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

---

**Pre-assembled motor and encoder system connections in many different lengths are available for the drive solutions. Contact your local sales office.**

**EMC requirement: Route motor cable separately**
When planning the wiring, take into account the fact that the motor cable must be routed separately. The motor cable must be separate from the mains cable or the signal wires.

**Motor and encoder cables**
Motor and encoder cables are especially critical in terms of EMC. Use only pre-assembled cables or cables that comply with the specifications and implement the EMC measures described below.

<table>
<thead>
<tr>
<th>EMC measures</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do not install switching elements in motor cables or encoder cables.</td>
<td>Reduces interference.</td>
</tr>
<tr>
<td>Route the motor cable at a distance of at least 20 cm from the signal cable or use shielding plates between the motor cable and signal cable.</td>
<td>Reduces mutual interference.</td>
</tr>
<tr>
<td>For long lines, use equipotential bonding conductors.</td>
<td>Reduce current in the cable shield.</td>
</tr>
<tr>
<td>Route the motor cable and encoder cable without cutting them. 1)</td>
<td>Reduces emission.</td>
</tr>
</tbody>
</table>

---

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

**EMC requirement: Mains and motor connection**
Great care is required when connecting the mains power and the motor to the drive because the risk of uncontrolled coupling is greatest here.
- Route mains and motor cable well apart (> 25 cm).
- Keep the motor cable as short as possible.
- Keep unshielded wires of the motor cable (for example, U,V,W) as short as possible at the device and at the motor.

**EMC requirement: Ground strap**
Connect the motor with a ground strap >10 mm² (AWG 8) with ground potential to avoid interference.
Equipotential bonding conductors

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

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

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

Protective ground conductor connection

For safety reasons, a redundant protective ground conductor connection is required. Directly connect the motor housing to ground (PE).

Pre-assembled connector cable as accessories

We recommend using only the fully assembled connection cables that we supply to connect the motor and the encoder system. They are properly tuned to these drive solutions.

Place the female connector of the motor cable onto the male connector and tighten the union nut. Proceed in the same manner with the connection cable of the encoder system. Connect the motor and the encoder system cables to the drive according to the wiring diagram of the drive.
4.3 Mechanical installation

⚠️ WARNING

UNINTENDED BEHAVIOR CAUSED BY MECHANICAL DAMAGE TO THE MOTOR

If the maximum permissible forces at the shaft are exceeded, this will result in premature wear of the bearing, shaft breakage or damage to the encoder.

- Do not exceed the maximum permissible axial and radial forces.
- Protect the shaft from impact.
- Do not exceed the maximum permissible axial force when pressing on components.

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

⚠️ CAUTION

DESTRUCTION OF THE GEARBOX DUE TO OVERLOAD

Exceeding the permissible torques causes premature wear, breakage of the shaft or blocking.

- Do not exceed the peak torque of the gearbox in any operating state.
- Limit the motor torque if there is a danger of destruction of the gearbox by peak torques.
- Limit the torque for short-term operation (e.g. for an EMERGENCY STOP situation) to twice the continuous gear output torque $M_{d2}$

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

Mounting position

The following mounting positions are defined and approved as per EN 60034-7:

- IM B5 drive shaft horizontal
- IM V1 drive shaft vertical, shaft end down
- IM V3 drive shaft vertical, shaft end up
## 4 Installation

### Mounting

When the motor is mounted to the mounting flange, it must be accurately aligned axially and radially and evenly contact the surface. There must be no tension. The flange area of the machine must be sufficiently rigid and able to withstand the dynamic reaction by the drive. The same applies to coupling components or loads that are mounted to the shaft.

### Mounting output components

If output components are not properly mounted, the encoder for position capture may be damaged. Output components such as pulleys, couplings must be mounted with suitable equipment and tools. The maximum axial and radial forces acting on the shaft must not exceed the maximum shaft load values specified.

Observe the mounting instructions provided by the manufacturer of the output component. Motor and output component must be accurately aligned both axially and radially. Failure to follow the instructions will cause runout, damage to the shaft bearings and premature wear.

### WARNING

**UNEXPECTED MOVEMENT**

If the approved ambient conditions are exceeded, external substances from the environment may penetrate and cause unexpected movement or equipment damage.

- Verify that the ambient conditions are met.
- Do not allow seals to run dry.
- Keep liquids from getting to the shaft end (for example in mounting position IM V3).
- Do not expose the shaft sealing rings and cable entries to the direct spray of a pressure cleaner.

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

NOTE: In the case of motors with terminal boxes, the cover may only be opened to connect the terminals!

The motors are not designed for direct connection to mains power; they may only be operated with a suitable power stage.

⚠️ CAUTION

FIRE HAZARD DUE TO POOR CONTACT
The motor connector may overheat and contacts may be destroyed by arcing if the connector is not properly connected and the union nut is not tightly screwed in place.

- Verify that the connector is properly plugged in and the union nut of the connector is tight.

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

⚠️ WARNING

UNEXPECTED BEHAVIOR CAUSED BY FOREIGN OBJECTS
Foreign objects, deposits or humidity can cause unexpected behavior.

- Keep foreign objects from getting into the product.
- Verify correct seat of seals and cable entries.

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

- Protective ground conductor and shield must be connected to the motor and the device.
- To connect the cables in the terminal box, only unscrew the four screws of the terminal box. See Figure 4.2.
- Motors with flying leads must be connected to ground (PE) via the front flange.
- Two connections (for example, U and V) can be reversed to change the direction of rotation of the motor shaft.
Do not reverse the motor phases of motors with encoders.

![Figure 4.2 Opening the terminal box](image)

**Cable specifications**

- Shielded cable
- Grounding of the shield at both ends

<table>
<thead>
<tr>
<th>Cable specifications</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Conductor cross section</td>
<td>[mm²]</td>
<td>4*1.5</td>
</tr>
<tr>
<td>Rated voltage</td>
<td>[V]</td>
<td>800</td>
</tr>
</tbody>
</table>

Table 4.1 Cable specifications for motor connection
Wiring diagram of motor with terminal box (symbolic)

![Wiring diagram of motor with terminal box (symbolic)](image)

**Figure 4.3** Wiring diagram of motor with terminal box (symbolic)

<table>
<thead>
<tr>
<th>Pin</th>
<th>Connection</th>
<th>Meaning</th>
<th>Wire color (IEC 757)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>U</td>
<td>Motor lead</td>
<td>Brown (BN)</td>
</tr>
<tr>
<td>2</td>
<td>V</td>
<td>Motor lead</td>
<td>Blue (BU)</td>
</tr>
<tr>
<td>3</td>
<td>W</td>
<td>Motor lead</td>
<td>Black (BK)</td>
</tr>
<tr>
<td></td>
<td>PE</td>
<td>Protective ground conductor</td>
<td>Green/yellow (GN/YE)</td>
</tr>
<tr>
<td></td>
<td>SHLD</td>
<td>Shield</td>
<td></td>
</tr>
</tbody>
</table>

Tightening torque of motor terminals $[\text{Nm}]$ (lb·ft) 0.6 (0.4)

Tightening torque of housing screws $[\text{Nm}]$ (lb·ft) 0.6 (0.4)

Wiring diagram for motor with connector

![Wiring diagram for motor with connector](image)

**Figure 4.4** Connector, view of motor side to the contact pins

<table>
<thead>
<tr>
<th>Pin</th>
<th>Terminal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>U</td>
<td>Motor lead</td>
</tr>
<tr>
<td>2</td>
<td>V</td>
<td>Motor lead</td>
</tr>
<tr>
<td>3</td>
<td>W</td>
<td>Motor lead</td>
</tr>
<tr>
<td>4</td>
<td>PE</td>
<td>Protective conductor</td>
</tr>
</tbody>
</table>
4.4.2 Encoder connection

The shield must be connected to the motor and the device.

*Shielded encoder cable with 5 (2*0.25 mm²) and 1 (2*0.5 mm²) twisted pair wires.*

*Wiring diagram encoder*

![Wiring diagram encoder](image)

<table>
<thead>
<tr>
<th>Pin</th>
<th>Designation</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ENC_A</td>
<td>Encoder signal channel A</td>
</tr>
<tr>
<td>2</td>
<td>ENC_A</td>
<td>Encoder signal channel A, inverted</td>
</tr>
<tr>
<td>3</td>
<td>ENC_B</td>
<td>Encoder signal channel B</td>
</tr>
<tr>
<td>4</td>
<td>ENC_B</td>
<td>Encoder signal channel B, inverted</td>
</tr>
<tr>
<td>5</td>
<td>ENC_I</td>
<td>Encoder signal channel I</td>
</tr>
<tr>
<td>6</td>
<td>ENC_T</td>
<td>Encoder signal channel I, inverted</td>
</tr>
<tr>
<td>7</td>
<td>ENC_0V</td>
<td>Reference potential to ENC+5V</td>
</tr>
<tr>
<td>8</td>
<td>ENC+5V</td>
<td>5Vdc power supply for encoder</td>
</tr>
<tr>
<td>9</td>
<td>ENC_0V_SENSE</td>
<td>Reference potential to ENC+5V_SENSE</td>
</tr>
<tr>
<td>10</td>
<td>ENC+5V_SENSE</td>
<td>SENSE line to ENC+5V</td>
</tr>
<tr>
<td>11</td>
<td>T_MOT</td>
<td>Temperature sensor</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>Not assigned</td>
</tr>
</tbody>
</table>
4 Installation

4.4.3 Holding brake connection

⚠️ WARNING

LOSS OF BRAKING FORCE DUE TO WEAR OR HIGH TEMPERATURE

Applying the holding brake while the motor is running will cause excessive wear and loss of the braking force. Heat decreases the braking force.

- Do not use the brake as a service brake.
- Note that "EMERGENCY STOPS" may also cause wear
- At operating temperatures of more than 80°C (176°F), do not exceed a maximum of 50% of the specified holding torque when using the brake.

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

Control logic

A suitable control logic is required for a motor with holding brake. The control logic releases and applies the holding brake.

Holding brake controller

When the holding brake heats up 80°C, the holding torque may be reduced by 50% of the nominal value. If the heat build-up is excessive, a holding brake controller with voltage reduction is recommended. This allows for a voltage reduction by a maximum of 50% after approx. 100 ms. When a holding brake controller is used, the holding brake must be connected with a shielded cable.

Wiring diagram of holding brake

![Wiring diagram of holding brake](image)

Figure 4.6 Wiring diagram of holding brake

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
<th>Meaning</th>
<th>I/O</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 2</td>
<td>24 VDC</td>
<td>Power supply of holding brake (non-polarized)</td>
<td>I</td>
</tr>
</tbody>
</table>

The connector is a part of the scope of supply.
Connector designation: Hirschmann type G4 A 5M
5 Commissioning

5.1 Preparing for commissioning

Commissioning procedure:

► Check the mechanical installation. In particular, verify proper mounting of the screws at the flange and tension-free alignment of the motor.

► Verify proper isolation of unused wires. Unused wires must be properly individually isolated at both ends because induction currents may also flow in unused wires in drive systems.

► Check the electrical installation. In particular, verify proper connection of the protective ground conductors. Check wiring and connection of all cables and system components. Verify that all cable glands are properly tightened.

► Check the ambient conditions are met. Verify that all ambient conditions specified are met.

► Check the output elements. Verify that any output components already installed are balanced and accurately aligned.

► Check the parallel key at the shaft end of the motor. If you have a motor with a parallel key groove and parallel key, the parallel key must not be inserted during commissioning without output component or it must be appropriately secured.

► Ensure contact protection. Appropriate contact guards must be installed to avoid contact with electrical and moving parts.
5.2 Performing commissioning

⚠️ WARNING

ROTATING PARTS
Rotating parts may cause injuries and may catch clothing or hair. Loose parts or parts that are unbalanced may be flung.
- Verify correct mounting and installation of all rotating parts.
- Use a cover to help protect against rotating parts.
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.

⚠️ WARNING

FALLING PARTS
The motor may move, tip and crash down as a result of the reaction torque.
- Mount the motor securely so it will not break loose during strong acceleration.
Failure to follow these instructions can result in death, serious injury or equipment damage.
**WARNING**

**MOVEMENT 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. Overload or faults can cause danger due to the failure of the holding brake. Incorrect use of the holding brake results in premature wear and failure.

- Do not use the internal brake as a service brake.
- If necessary, use a damped mechanical stop or a service brake.
- Verify the function of the brake.
- In addition, secure the hazardous area so it cannot be accessed.
- The brake function must be checked again after frequent EMERGENCY STOP braking operations.

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

---

**CAUTION**

**HOT SURFACES**

Depending on the operation, the surface may heat up to more than 100°C (212°F).

- Do not allow contact with the hot surfaces.
- Do not allow flammable or heat-sensitive parts in the immediate vicinity.
- Consider the measures for heat dissipation described.
- Check the temperature during test runs.

**Failure to follow these instructions can result in injury or equipment damage.**
6 Diagnostics and troubleshooting

6.1 Mechanical problems

<table>
<thead>
<tr>
<th>Error</th>
<th>Cause</th>
<th>Troubleshooting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excessive heat</td>
<td>Overload</td>
<td>Reduce load</td>
</tr>
<tr>
<td></td>
<td>Holding brake not released</td>
<td>Check the holding brake controller</td>
</tr>
<tr>
<td></td>
<td>Heavy pollution</td>
<td>Clean the motor</td>
</tr>
<tr>
<td>Whistling or knocking noise</td>
<td>Bearing or gearbox</td>
<td>Contact service</td>
</tr>
<tr>
<td>Grinding noise</td>
<td>Rotating output component grinds</td>
<td>Align output component</td>
</tr>
<tr>
<td>Radial oscillation</td>
<td>Poor alignment of output component</td>
<td>Align output component</td>
</tr>
<tr>
<td></td>
<td>Output component out of balance</td>
<td>Balance output component</td>
</tr>
<tr>
<td></td>
<td>Shaft bent</td>
<td>Contact service</td>
</tr>
<tr>
<td></td>
<td>Resonance with coupling elements</td>
<td>Use a different coupling type</td>
</tr>
<tr>
<td></td>
<td>Resonance with mounting elements</td>
<td>Check the stiffness of the motor mounting</td>
</tr>
<tr>
<td>Axial oscillation</td>
<td>Poor alignment of output component</td>
<td>Align output component</td>
</tr>
<tr>
<td></td>
<td>Shocks of the output component</td>
<td>Check output component</td>
</tr>
<tr>
<td></td>
<td>Resonance with mounting elements</td>
<td>Check the stiffness of the motor mounting</td>
</tr>
<tr>
<td>Encoder does not operate or only operates sporadically</td>
<td>Encoder damaged due to axial movement of the motor shaft (max. axial load exceeded)</td>
<td>Verify that the axial load is not exceeded or the shaft is returned to the original axial position</td>
</tr>
</tbody>
</table>

6.2 Electrical problems

<table>
<thead>
<tr>
<th>Error</th>
<th>Cause</th>
<th>Troubleshooting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor does not start or starts with problems</td>
<td>Overload</td>
<td>Reduce load</td>
</tr>
<tr>
<td></td>
<td>Drive error</td>
<td>Check drive</td>
</tr>
<tr>
<td></td>
<td>Connection cables, phases / winding short circuit</td>
<td>Check connection cable and connections</td>
</tr>
<tr>
<td>Excessive heat</td>
<td>Overcurrent</td>
<td>Check motor phase current, use current reduction</td>
</tr>
<tr>
<td>Heat at connection terminals</td>
<td>Connector loose or not tightened</td>
<td>Tighten connector</td>
</tr>
</tbody>
</table>
## 7 Accessories and spare parts

### 7.1 Accessories

<table>
<thead>
<tr>
<th>Designation</th>
<th>Order no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holding brake controller HBC</td>
<td>VW3M3103</td>
</tr>
</tbody>
</table>

### 7.2 Motor cable

<table>
<thead>
<tr>
<th>Designation</th>
<th>Order no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor cable for stepper motor 4x1.5, shielded, 6-pin circular plug at the motor end; other cable end = open; length= 3m</td>
<td>VW3S5101R30</td>
</tr>
<tr>
<td>Motor cable for stepper motor 4x1.5, shielded, 6-pin circular plug at the motor end; other cable end = open; length= 5m</td>
<td>VW3S5101R50</td>
</tr>
<tr>
<td>Motor cable for stepper motor 4x1.5, shielded, 6-pin circular plug at the motor end; other cable end = open; length= 10m</td>
<td>VW3S5101R100</td>
</tr>
<tr>
<td>Motor cable for stepper motor 4x1.5, shielded, 6-pin circular plug at the motor end; other cable end = open; length= 15m</td>
<td>VW3S5101R150</td>
</tr>
<tr>
<td>Motor cable for stepper motor 4x1.5, shielded, 6-pin circular plug at the motor end; other cable end = open; length= 20m</td>
<td>VW3S5101R200</td>
</tr>
<tr>
<td>Motor cable for stepper motor 4x1.5, shielded, both cable ends = open; length= 3m</td>
<td>VW3S5102R30</td>
</tr>
<tr>
<td>Motor cable for stepper motor 4x1.5, shielded, both cable ends = open; length= 5m</td>
<td>VW3S5102R50</td>
</tr>
<tr>
<td>Motor cable for stepper motor 4x1.5, shielded, both cable ends = open; length= 10m</td>
<td>VW3S5102R100</td>
</tr>
<tr>
<td>Motor cable for stepper motor 4x1.5, shielded, both cable ends = open; length= 15m</td>
<td>VW3S5102R150</td>
</tr>
<tr>
<td>Motor cable for stepper motor 4x1.5, shielded, both cable ends = open; length= 20m</td>
<td>VW3S5102R200</td>
</tr>
</tbody>
</table>
8  Service, maintenance and disposal

⚠️ DANGER

ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Only appropriately trained persons who are familiar with and understand the contents of this manual and all other pertinent product documentation and who have received safety training to recognize and avoid hazards involved are authorized to work on and with this drive system. Installation, adjustment, repair and maintenance must be performed by qualified personnel.

- The system integrator is responsible for compliance with all local and national electrical code requirements as well as all other applicable regulations with respect to grounding of all equipment. Supplement the motor cable grounding conductor with an additional protective ground conductor to the motor housing.

- Do not touch unshielded components or terminals with voltage present.

- The motor generates voltage when the shaft is rotated. Prior to performing any type of work on the drive system, block the motor shaft to prevent rotation.

- AC voltage can couple voltage to unused conductors in the motor cable. Insulate both ends of unused conductors in the motor cable.

- Do not short across the DC bus terminals or the DC bus capacitors.

- Before performing work on the drive system:
  - Disconnect all power, including external control power that may be present.
  - Place a "DO NOT TURN ON" label on all power switches.
  - Lock all power switches in the open position.
  - Wait for the DC bus capacitors to discharge (see the product manual for the power stage). Then measure the DC bus voltage and verify it is less than < 42 V_{dc} (see the product manual for the power stage).

- Install and close all covers before applying voltage.

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

The motor may not be opened by the customer because this procedure partially demagnetizes the motor and it loses power.

The product may only be repaired by a certified customer service center. No warranty or liability is accepted for repairs made by unauthorized persons.
8.1 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

8.2 Maintenance

Prior to any type of work on the drive system, consult the chapters on Installation and Commissioning for information on the precautions and processes to be observed.

The motor is maintenance-free. However, we recommend the following maintenance work at regular intervals:

Lubricating shaft sealing ring

In the case of motors with shaft sealing rings, lubricant must be applied between the sealing lip of the shaft sealing ring and the shaft with a suitable non-metallic tool. If the shaft sealing rings are allowed to run dry, the service life of the sealing rings will be significantly reduced.

Connections and fastening

- Check all connection cables and connectors regularly for damage. Replace damaged cables immediately.
- Check that all output elements are firmly seated.
- Tighten all mechanical and electrical threaded connections to the specified torque. Check the union nuts at the connection cables.
Cleaning

⚠️ WARNING

UNEXPECTED MOVEMENT
If the approved ambient conditions are exceeded, external substances from the environment may penetrate and cause unexpected movement or equipment damage.

- Verify that the ambient conditions are met.
- Do not allow seals to run dry.
- Keep liquids from getting to the shaft end (for example in mounting position IM V3).
- Do not expose the shaft sealing rings and cable entries to the direct spray of a pressure cleaner.

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

Clean dust and dirt off the motor at regular intervals. Insufficient heat dissipation to the ambient air may excessively increase the temperature.

Motors are not suitable for cleaning with a high-pressure cleaner. The high pressure may force water into the motor.

When using solvents or cleaning agents, verify that the motor and encoder cables, cable entry seals, O rings and motor paint are not damaged.

Replacing the shaft bearing
The customer must not replace the shaft bearing. The motor will be partially demagnetized by this procedure and lose power.
9 Glossary

9.1 Units and conversion tables

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

Example: conversion of 5 meters [m] to yards [yd]
5 m / 0.9144 = 5.468 yd

9.1.1 Length

<table>
<thead>
<tr>
<th></th>
<th>in</th>
<th>ft</th>
<th>yd</th>
<th>m</th>
<th>cm</th>
<th>mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>in</td>
<td>-</td>
<td></td>
<td></td>
<td>* 0.0254</td>
<td>* 2.54</td>
<td>* 25.4</td>
</tr>
<tr>
<td>ft</td>
<td>* 12</td>
<td>-</td>
<td></td>
<td>* 0.30479</td>
<td>* 30.479</td>
<td>* 304.79</td>
</tr>
<tr>
<td>yd</td>
<td>* 36</td>
<td>* 3</td>
<td>-</td>
<td>* 0.9144</td>
<td>* 91.44</td>
<td>* 914.4</td>
</tr>
<tr>
<td>m</td>
<td>/ 0.0254</td>
<td>/ 0.30479</td>
<td>/ 0.9144</td>
<td>-</td>
<td>* 100</td>
<td>* 1000</td>
</tr>
<tr>
<td>cm</td>
<td>/ 2.54</td>
<td>/ 30.479</td>
<td>/ 91.44</td>
<td>/ 100</td>
<td>-</td>
<td>* 10</td>
</tr>
<tr>
<td>mm</td>
<td>/ 25.4</td>
<td>/ 304.79</td>
<td>/ 914.4</td>
<td>/ 1000</td>
<td>/ 10</td>
<td>-</td>
</tr>
</tbody>
</table>

9.1.2 Mass

<table>
<thead>
<tr>
<th></th>
<th>lb</th>
<th>oz</th>
<th>slug</th>
<th>kg</th>
<th>g</th>
</tr>
</thead>
<tbody>
<tr>
<td>lb</td>
<td>-</td>
<td>* 16</td>
<td>* 0.03108095</td>
<td>* 0.4535924</td>
<td>* 453.5924</td>
</tr>
<tr>
<td>oz</td>
<td>/ 16</td>
<td>-</td>
<td>* 1.942559*10^{-3}</td>
<td>* 0.02834952</td>
<td>* 28.34952</td>
</tr>
<tr>
<td>slug</td>
<td>/ 0.03108095</td>
<td>/ 1.942559*10^{-3}</td>
<td>-</td>
<td>* 14.5939</td>
<td>* 14593.9</td>
</tr>
<tr>
<td>kg</td>
<td>/ 0.45359237</td>
<td>/ 0.02834952</td>
<td>/ 14.5939</td>
<td>-</td>
<td>* 1000</td>
</tr>
<tr>
<td>g</td>
<td>/ 453.59237</td>
<td>/ 28.34952</td>
<td>/ 14593.9</td>
<td>/ 1000</td>
<td>-</td>
</tr>
</tbody>
</table>

9.1.3 Force

<table>
<thead>
<tr>
<th></th>
<th>lb</th>
<th>oz</th>
<th>p</th>
<th>dyne</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>lb</td>
<td>-</td>
<td>* 16</td>
<td>* 453.55358</td>
<td>* 444822.2</td>
<td>* 4.448222</td>
</tr>
<tr>
<td>oz</td>
<td>/ 16</td>
<td>-</td>
<td>* 28.349524</td>
<td>* 27801</td>
<td>* 0.27801</td>
</tr>
<tr>
<td>p</td>
<td>/ 453.55358</td>
<td>/ 28.349524</td>
<td>-</td>
<td>* 980.7</td>
<td>* 9.807*10^{-3}</td>
</tr>
<tr>
<td>dyne</td>
<td>/ 444822.2</td>
<td>/ 27801</td>
<td>/ 980.7</td>
<td>-</td>
<td>/ 100*10^3</td>
</tr>
<tr>
<td>N</td>
<td>/ 4.448222</td>
<td>/ 0.27801</td>
<td>/ 9.807*10^{-3}</td>
<td>* 100*10^3</td>
<td>-</td>
</tr>
</tbody>
</table>

9.1.4 Power

<table>
<thead>
<tr>
<th></th>
<th>HP</th>
<th>W</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP</td>
<td>-</td>
<td>* 746</td>
</tr>
<tr>
<td>W</td>
<td>/ 746</td>
<td>-</td>
</tr>
</tbody>
</table>

3-phase stepper motor
9.1.5 Rotation

<table>
<thead>
<tr>
<th>rad/s</th>
<th>deg/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \min^{-1} ) (RPM)</td>
<td>( \pi / 30 )</td>
</tr>
<tr>
<td>rad/s</td>
<td>( 30 / \pi )</td>
</tr>
<tr>
<td>deg/s</td>
<td>( 6 )</td>
</tr>
</tbody>
</table>

9.1.6 Torque

<table>
<thead>
<tr>
<th>lb-in</th>
<th>lb-ft</th>
<th>oz-in</th>
<th>Nm</th>
<th>kp-m</th>
<th>kp-cm</th>
<th>dyne-cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>lb-in</td>
<td>-</td>
<td>* 16</td>
<td>* 0.112985</td>
<td>* 0.011521</td>
<td>* 1.1521</td>
<td>* 1.129*10^6</td>
</tr>
<tr>
<td>lb-ft</td>
<td>* 12</td>
<td>-</td>
<td>* 1.355822</td>
<td>* 0.138255</td>
<td>* 13.8255</td>
<td>* 13.558*10^6</td>
</tr>
<tr>
<td>oz-in</td>
<td>/ 16</td>
<td>/ 192</td>
<td>* 7.0616*10^{-3}</td>
<td>* 720.07*10^{-6}</td>
<td>* 72.007*10^{-3}</td>
<td>* 70615.5</td>
</tr>
<tr>
<td>Nm</td>
<td>/ 0.112985</td>
<td>/ 1.355822</td>
<td>/ 7.0616*10^{-3}</td>
<td>-</td>
<td>* 0.101972</td>
<td>* 10.1972</td>
</tr>
<tr>
<td>kp-m</td>
<td>/ 0.011521</td>
<td>/ 0.138255</td>
<td>/ 720.07*10^{-6}</td>
<td>/ 0.101972</td>
<td>-</td>
<td>* 100</td>
</tr>
<tr>
<td>kp-cm</td>
<td>/ 1.1521</td>
<td>/ 13.8255</td>
<td>/ 72.007*10^{-3}</td>
<td>/ 10.1972</td>
<td>/ 100</td>
<td>-</td>
</tr>
<tr>
<td>dyne-cm</td>
<td>/ 1.129*10^6</td>
<td>/ 13.558*10^6</td>
<td>/ 70615.5</td>
<td>/ 10^6</td>
<td>/ 98.066*10^6</td>
<td>/ 0.9806*10^6</td>
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9.1.7 Moment of inertia

<table>
<thead>
<tr>
<th>lb-in²</th>
<th>lb-ft²</th>
<th>kg-m²</th>
<th>kg-cm²</th>
<th>kp-cm-s²</th>
<th>oz-in²</th>
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<tr>
<td>lb-in²</td>
<td>-</td>
<td>/ 144</td>
<td>/ 3417.16</td>
<td>/ 0.341716</td>
<td>/ 335.109</td>
</tr>
<tr>
<td>lb-ft²</td>
<td>* 144</td>
<td>-</td>
<td>* 0.04214</td>
<td>* 421.4</td>
<td>* 0.429711</td>
</tr>
<tr>
<td>kg-m²</td>
<td>* 3417.16</td>
<td>/ 0.04214</td>
<td>-</td>
<td>* 10*10^3</td>
<td>* 10.1972</td>
</tr>
<tr>
<td>kg-cm²</td>
<td>* 0.341716</td>
<td>/ 421.4</td>
<td>/ 10*10^3</td>
<td>-</td>
<td>/ 980.665</td>
</tr>
<tr>
<td>kp-cm-s²</td>
<td>* 335.109</td>
<td>/ 0.429711</td>
<td>/ 10.1972</td>
<td>* 980.665</td>
<td>-</td>
</tr>
<tr>
<td>oz-in²</td>
<td>/ 16</td>
<td>/ 2304</td>
<td>/ 54674</td>
<td>/ 5.46</td>
<td>/ 5361.74</td>
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</table>

9.1.8 Temperature

<table>
<thead>
<tr>
<th>°F</th>
<th>°C</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>°F</td>
<td>(°F - 32) * 5/9</td>
<td>(°F - 32) * 5/9 + 273.15</td>
</tr>
<tr>
<td>°C</td>
<td>°C * 9/5 + 32</td>
<td>-</td>
</tr>
<tr>
<td>K</td>
<td>(K - 273.15) * 9/5 + 32</td>
<td>K - 273.15</td>
</tr>
</tbody>
</table>

9.1.9 Conductor cross section

<table>
<thead>
<tr>
<th>AWG</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
</tr>
</thead>
<tbody>
<tr>
<td>mm²</td>
<td>42.4</td>
<td>33.6</td>
<td>26.7</td>
<td>21.2</td>
<td>16.8</td>
<td>13.3</td>
<td>10.5</td>
<td>8.4</td>
<td>6.6</td>
<td>5.3</td>
<td>4.2</td>
<td>3.3</td>
<td>2.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AWG</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
<th>19</th>
<th>20</th>
<th>21</th>
<th>22</th>
<th>23</th>
<th>24</th>
<th>25</th>
<th>26</th>
</tr>
</thead>
<tbody>
<tr>
<td>mm²</td>
<td>2.1</td>
<td>1.7</td>
<td>1.3</td>
<td>1.0</td>
<td>0.82</td>
<td>0.65</td>
<td>0.52</td>
<td>0.41</td>
<td>0.33</td>
<td>0.26</td>
<td>0.20</td>
<td>0.16</td>
<td>0.13</td>
</tr>
</tbody>
</table>
9.2 Terms and Abbreviations

**Axial forces**  Tension or compression forces acting longitudinally on the shaft

**Centering collar**  Centering device at the motor flange that allows for accurate motor mounting.

**Degree of protection**  The degree of protection is a standardized specification for electrical equipment that describes the protection against the ingress of foreign objects and water (for example: IP 20).

**Emc**  Electromagnetic compatibility

**Encoder**  Sensor for detection of the angular position of a rotating component. Installed in a motor, the encoder shows the angular position of the rotor.

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

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

**Fatal error**  In the case of fatal error, the product is not longer able to control the motor, so that an immediate deactivation of the power stage is necessary.

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

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

**Holding brake**  The motor holding brake has the task of blocking the motor shaft when no current is supplied to the motor (e.g. in the case of a vertical axis). The holding brake must not be used as a service brake.

**Length**  Length of motor without optional equipment (such as holding brake or gearbox)

**PtC**  Resistor with positive temperature coefficient. Resistance value increases as the temperature rises.

**Radial forces**  Forces that act radially on the shaft

**Shaft sealing ring**  A sealing ring with a fixed seat in the motor flange. The sealing lip runs on the surface of the rotating shaft, which increases the degree of protection of the shaft bushing. Regular lubrication of the shaft sealing ring is essential and the allowable maximum speed of the motor shaft must not be exceeded.

**Size**  Defined by the flange size in the type code
**Warning**  
If the term is used outside the context of safety instructions, a warning alerts to a potential problem that was detected by a monitoring function. A warning is not an error and does not cause a transition of the operating state.
10 Index

A
Abbreviations 71
Accessories 63
Accessories and spare parts 63
Air humidity 22
Ambient conditions 22
   Air humidity operation 22
   Operation 22
   Relative air humidity operation 22
   Transportation and storage 22

B
Before installation... 46
Before you begin
   Safety information 17

C
Cable specifications
   Encoder connection 55
   Motor connection 53
Characteristic curves 27
Commissioning 57
   preparation 57
   running 58
Connector installation space 47

D
Diagnostics 61
dimensional drawing, see dimensions
Dimensions 33
Disposal 65

E
EMC 48
   Motor cable and encoder cable 48
EMC requirement
   Ground strap 48
   Mains and motor connection 48
   Route motor cable separately 48
Encoder
   Pulse diagram 44
   Technical data 42, 44
   Temperature monitoring 44
   Wiring diagram 55
Encoder cable
   EMC requirements 48
Encoder connection
   Cable specifications 55
   Equipotential bonding conductors 49
R
Radial shaft sealing ring 24
Relative air humidity 22

S
Service 65
Service address 66
Service life 23
Shaft-specific data 39

T
Technical data 21
  Encoder 42, 44
Temperature during operation 22
Temperature monitoring (encoder) 44
Terms 71
Troubleshooting 61
Type code
  VRDM 3x overview 12, 13, 15

U
Units and conversion tables 69

W
Wiring diagram
  Encoder 55
  Holding brake 56
  motor with connector 54
  Motor with terminal box 54