

# **3-PHASE STEPPING MOTOR**

## **VRDM 39x**



Document: 100000116  
Edition: c244, 12.02

## Features common to all motor types

- Test voltage to DIN EN 60034 part 1
- Insulation class F
- Run-out and perpendicularity to DIN 42955 N
- Paint: black RAL 9005

## Security

Please observe before installation, set-up, maintenance and repairs of the motors our security tips.

Should you not know these sheets, please ask for the data sheet "Security tips of the motors"

## Motor specification

The listed data in this table are motor-specified data.

A breakdown of the individual motors is given under the type code on page 10.

Motor type			VRDM 397			VRDM 3910			VRDM 3913		
Winding			H	N	W	H	N	W	H	N	W
Max. voltage	U <sub>max</sub>	V <sub>AC</sub> <sup>4)</sup>	25	92	230	25	92	230	25	92	230
		V <sub>DC</sub> <sup>5)</sup>	35	130	325	35	130	325	35	130	325
Rated torque	M <sub>N</sub>	Nm	1.7	2	2	3.7	4	4	5	6	6
Holding torque	M <sub>H</sub>	Nm	1.92	2.26	2.26	4.18	4.52	4.52	5.65	6.78	6.78
Rotor inertia	J <sub>R</sub>	kgm <sup>2</sup>	0.11 • 10 <sup>-3</sup>			0.22 • 10 <sup>-3</sup>			0.33 • 10 <sup>-3</sup>		
Number of steps <sup>1)</sup>	z		200 / 400 / 500 / 1000 / 2000 / 4000 / 5000 / 10000								
Step angle <sup>1)</sup>	α	°	1.8 / 0.9 / 0.72 / 0.36 / 0.18 / 0.09 / 0.072 / 0.036								
Systematic angle tolerance per step <sup>2)</sup>	Δα <sub>s</sub>	‘	±6								
Max. starting frequency <sup>1)</sup>	f <sub>Aom</sub>	kHz	5	5.3	5.3	4.8	5.3	5.3	4.5	5.3	5.3
Rated current	I <sub>N</sub>	A <sub>rms</sub>	5.8	4.4	1.75	5.8	5	2	5.8	5	2.25
Resistance / winding	R <sub>W</sub>	Ω	0.35	1	6.5	0.55	1.2	5.8	0.63	1.3	6.5
Current rise constant	τ	ms	~ 7			~ 9			~ 10		
Weight <sup>3)</sup>	m	kg	1.65			2.7			3.8		

Terms and symbols taken from DIN 42021 part 2

<sup>1)</sup> With suitable power drive

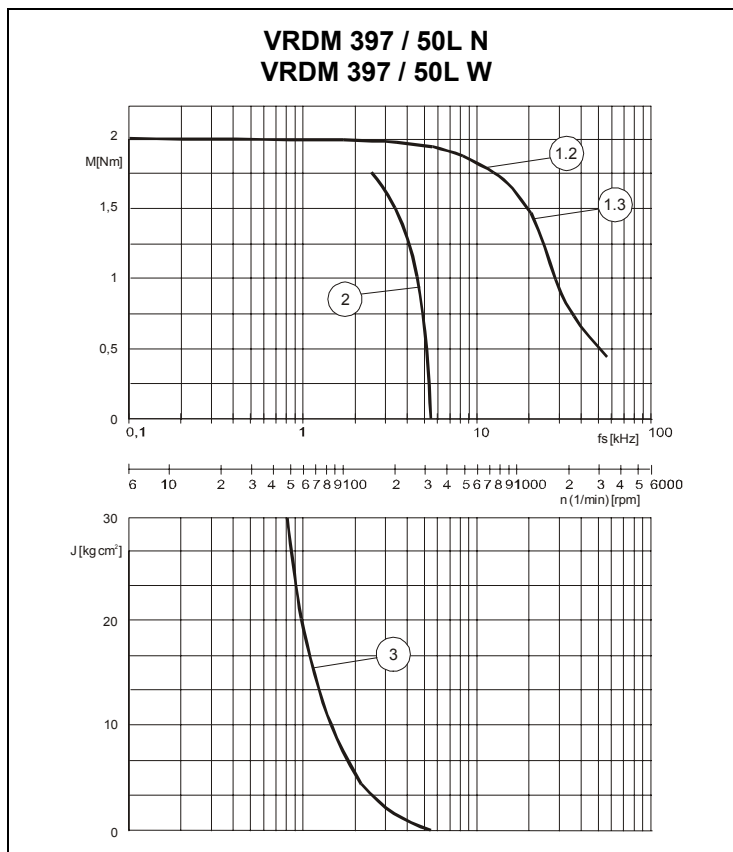
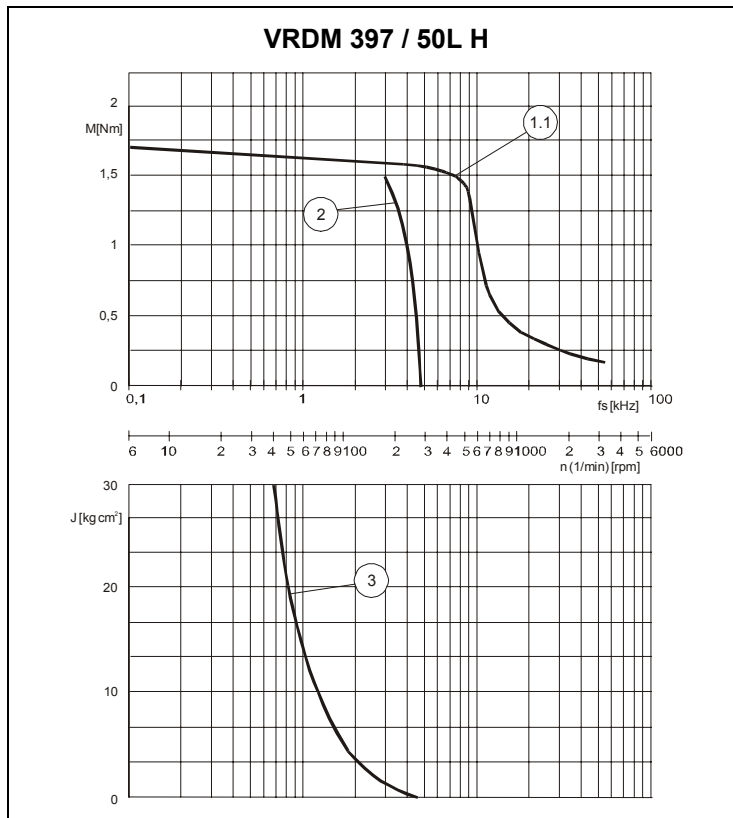
<sup>2)</sup> Measured at 1000 steps / revolution, units in minutes

<sup>3)</sup> Weight of the motor with stranded wires

<sup>4)</sup> maximal possible rms value

<sup>5)</sup> DC bus voltage

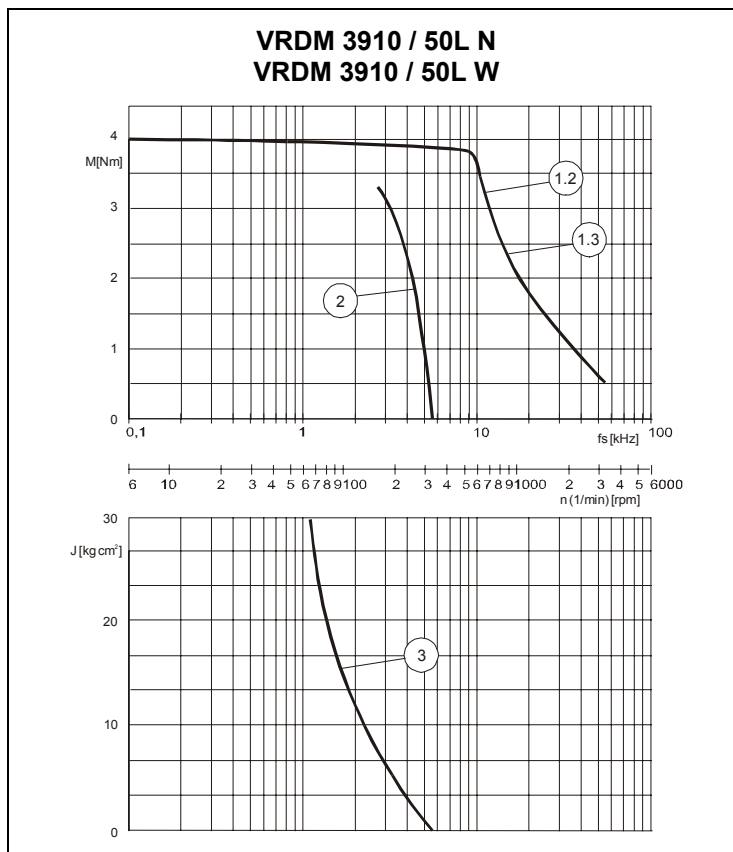
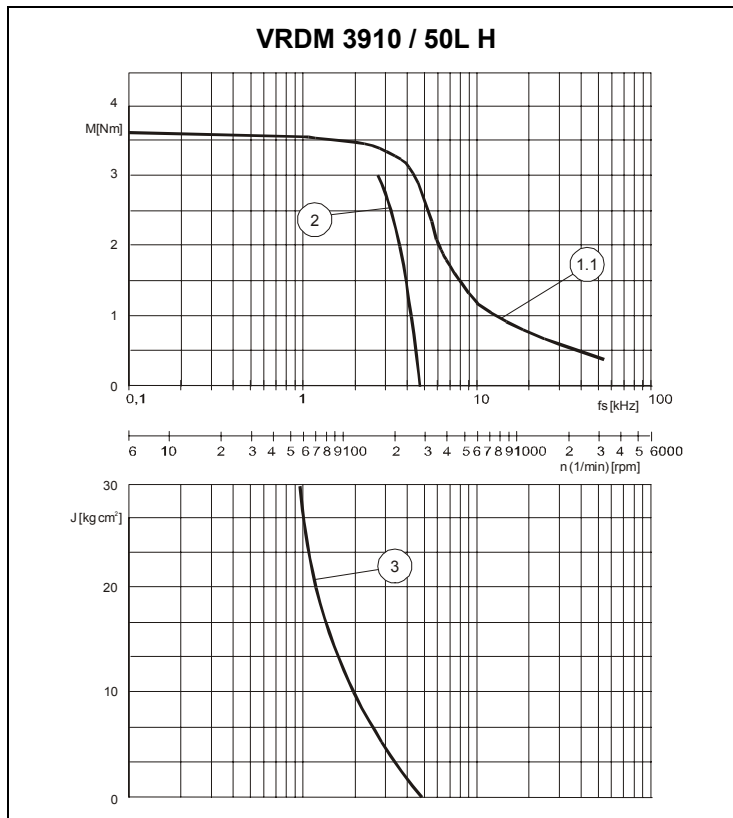
## Characteristic curves VRDM 397



- 1.1** Pull-out torque  
Drive = D 920  
 $U_N = 35 V_{DC}$   
 $I_W = 5,8 A$
- 1.2** Pull-out torque  
Drive = D 900  
 $U_N = 130 V_{DC}$   
 $I_W = 4,4 A$
- 1.3** Pull-out torque  
Drive = WDx3-xx4, TLxx11  
 $U_N = 325 V_{DC}$   
 $I_W = 1,75 A$
- 2** Pull-in torque
- 3** Maximum load inertia

Measuring of characteristic curves with 1000 steps / revolution

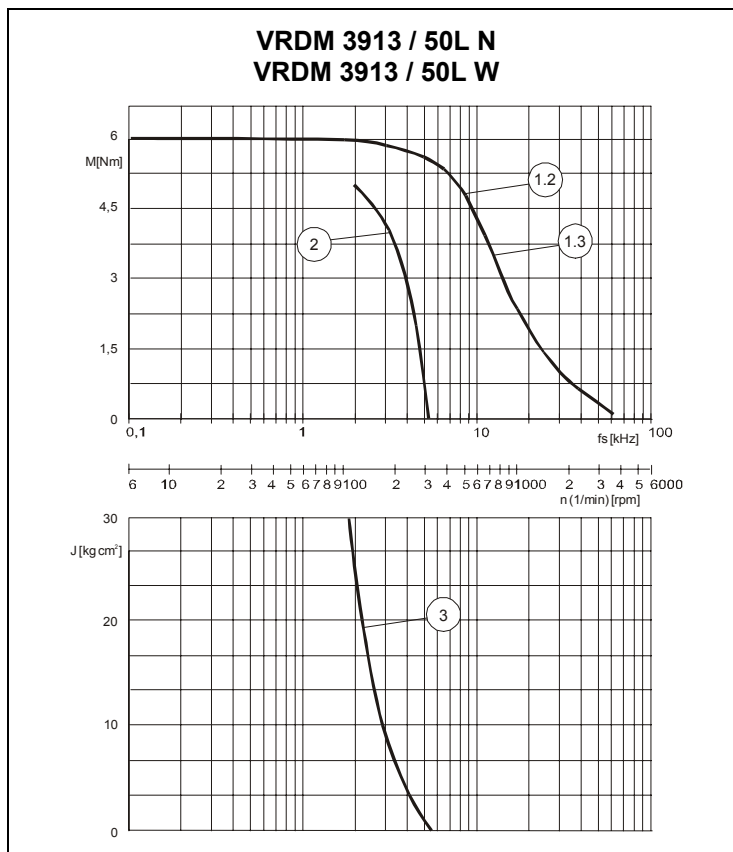
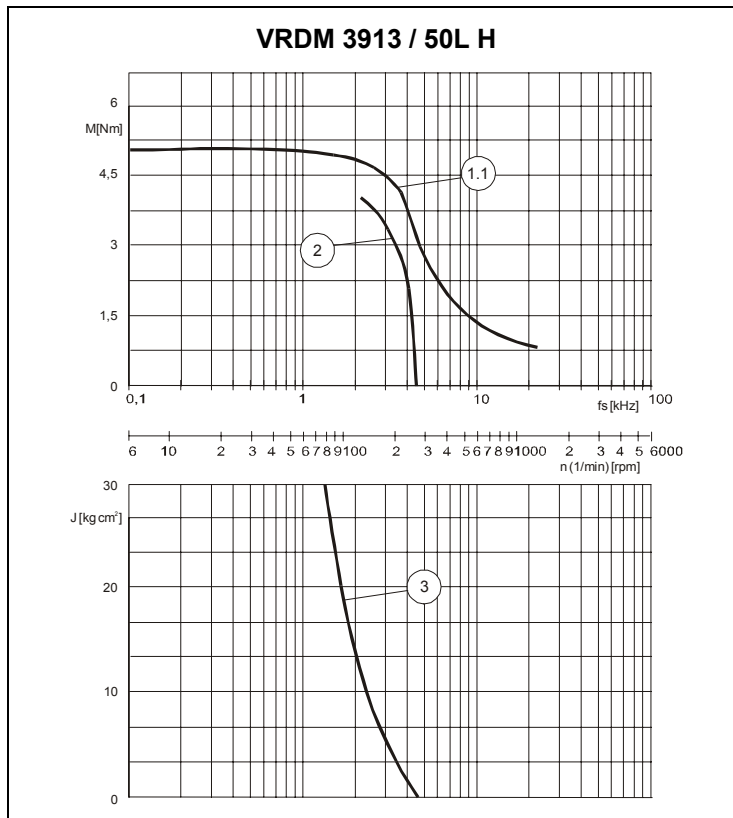
## Characteristic curves VRDM 3910



- 1.1** Pull-out torque  
Drive = D 920  
 $U_N = 35 V_{DC}$   
 $I_W = 5,8 A$
- 1.2** Pull-out torque  
Drive = D 900  
 $U_N = 130 V_{DC}$   
 $I_W = 5 A$
- 1.3** Pull-out torque  
Drive = WDx3-xx4, TLxx11  
 $U_N = 325 V_{DC}$   
 $I_W = 2 A$
- 2** Pull-in torque
- 3** Maximum load inertia

Measuring of characteristic curves with 1000 steps / revolution

## Characteristic curves VRDM 3913



- 1.1** Pull-out torque  
Drive = D 920  
 $U_N = 35 \text{ V}_{\text{DC}}$   
 $I_W = 5,8 \text{ A}$
- 1.2** Pull-out torque  
Drive = D 900  
 $U_N = 130 \text{ V}_{\text{DC}}$   
 $I_W = 5 \text{ A}$
- 1.3** Pull-out torque  
Drive = WDx3-xx4, TLxx11  
 $U_N = 325 \text{ V}_{\text{DC}}$   
 $I_W = 2,25 \text{ A}$
- 2** Pull-in torque
- 3** Maximum load inertia

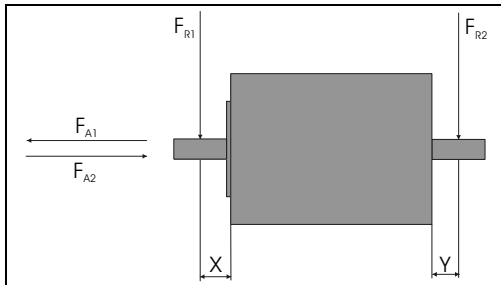
Measuring of characteristic curves with 1000 steps / revolution

## Shaft load

The Motor must not be opened by the customer. If it is opened it will be partially demagnetized with a consequent loss of power.

In the case of motors with terminal box, the cover can be opened to connect the terminals!

Please always observe our safety information!



Conditions:

- Nominal bearing life <sup>1)</sup>  $L_{10h} = 20.000 \text{ hours}$
- Speed  $n = 600 \text{ min}^{-1}$
- Ambient temperature  $= 40^\circ\text{C}$   
( $\approx 80^\circ\text{C}$  bearing temperature)
- Rated torque  $= 100 \% \text{ c.d.f.}$
- Point of application of forces  $X = 15 \text{ mm}$   
 $Y = 15 \text{ mm}$

Motor		VRDM 397	VRDM 3910	VRDM 3913
<b>Max. radial force</b> Front $F_{R1}$	100 % c.d.f.	100 N		110 N
<b>Max. radial force</b> 2nd shaft end $F_{R2}$	100 % c.d.f.	50 N <sup>2)</sup>		
		75 N <sup>3)</sup>		
<b>Max. axial force</b> Pull $F_{A1}$	100 % c.d.f.	170 N		
<b>Max. axial force</b> Push $F_{A2}$	100 % c.d.f.	30 N		

<sup>1)</sup> In operation hours with a 10% probability of failure

<sup>2)</sup> Motors with terminal box, receptacle or encoder

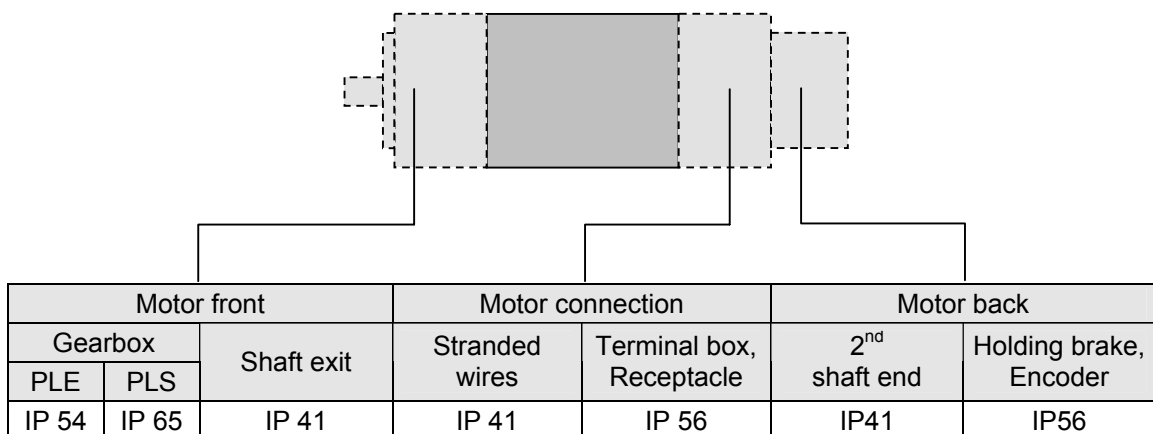
<sup>3)</sup> Motors with stranded wires



- Axial and radial loading must not occur simultaneously.
- The shaft must be supported if components are pressed onto the shaft ends.

## Degree of protection

The degree of protection of your motor version is shown in the following diagramm.



## Ambient conditions

### Climate:

(with reference to DIN 50019-R14)

Temperature (t): -25°C to +40°C

Atmospheric humidity (U): ≤ 75 % RH annual average / 95 % RH on 30 days / without condensation

### Storage and transportation temperature:

-25°C to +70°C

### Motor service life

Where motors are operated under technically correct conditions, the service life is largely depend on the service life of the bearing.

The following operating conditions may significantly reduce the service life of the motor:

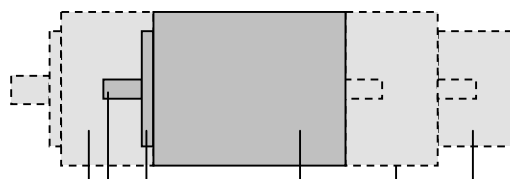
- Installation at altitudes over 1000 m above mean sea level
- Continuous operating temperatures greater than 80°C
- Angular travel less than 100°
- Operation with very high rotation accelerations
- Operation und vibration loads greater than 20 m/s<sup>2</sup>
- High cyclic frequencies
- Running with dry sealing rings
- Wetting seals with aggressive media

## Motor versions

Our flexible modular system and the latest version management techniques enable us to supply the following versions. The dimensions and a detailed information are shown in the variants section on page 11.

Pease also see thy type code on page 10.

### Schematic representation



Gearbox	Shaft version		Centring collar	Motor type VRDM 3xx			Motor connection	Options
				Size	Length	Winding		
3:1	Surface-finished	Ø 9,5 <sup>1)</sup>	Ø 60 mm Ø 73 mm	90	7	H N W	Stranded wires	2 <sup>nd</sup> shaft end <sup>3)</sup>
5:1	Cross-drilled hole	Ø 12 <sup>1)</sup>			10		Terminal box <sup>2)</sup>	Holding brake <sup>3)</sup>
8:1	Woodruff-key	Ø 14 <sup>1)</sup>			13		Receptacle	Encoder <sup>4)</sup>

<sup>1)</sup> Ø 9.5 mm and Ø 12 mm for VRDM 397 and Ø 14mm for VRDM 3913

<sup>2)</sup> Terminal strip inside the motor, sealed with a cable gland, EMC-tested

<sup>3)</sup> Choice between 2nd shaft end or holding brake. Both cannot be fitted simultaneously

<sup>4)</sup> Motors with receptacle only (2nd shaft end or a holding brake is also possible)

## Encoder

3-phase stepping motors can optionally be fitted with an encoder. This system of measurement returns the actual position if the power drive is equipped with a rotation monitoring circuit. The rotation monitoring circuit compares the setpoint and actual positions of the motor and signals an error if the difference between the two exceeds a certain limit (contouring error limit). This will detect overloading of the motor, for example.



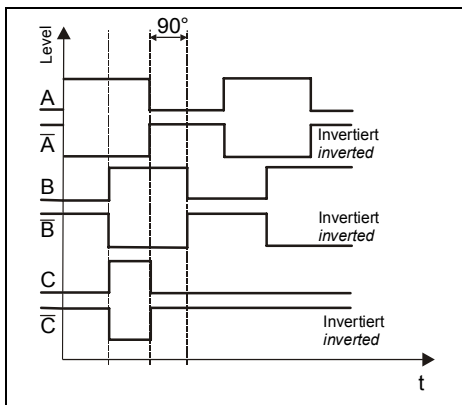
An Encoder can only be fitted on motors equipped with a receptacle. A second shaft end or a holding brake can also be used.

## Technical data

Resolution	1000 increments / revolution
Index pulse	1 increment / revolution
Output	RS 422
Signals	A; B; I
Pulse waveshape	Square-wave
Supply voltage	5V $\pm$ 5%
Current	up to 0.15 A



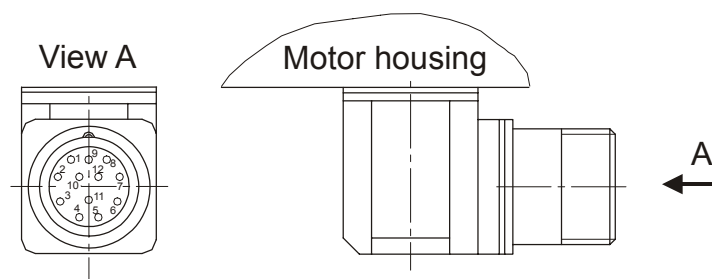
## Timing diagram



## Notes:

- A Temperature sensor is integrated.
- The shield must be connected to both the motor and the device.

## Connection



## PIN Designation

1	A
2	A (-)
3	B
4	B (-)
5	C, I
6	C (-), I (-)
7	5 V <sub>GND</sub>
8	+ 5
9	- SENSE
10	+ SENSE
11	Temperature sensor
12	Not assigned



Any strands that are not used must be separately insulated (to prevent the risk of short-circuits)



## Holding brake

The holding brake is an electromagnetic spring-pressure brake which holds the motor shaft in position when there is no current to the motor (e.g. in the event of a power failure or emergency stop). This holding function is needed for applications in which weight on the shaft can cause excessive torque, e.g. the Z axes of handling equipment.

### Technical data

Rated voltage	24 V
Holding torque	6 Nm
Power consumption	24 W
Moment of inertia	0.2 kgcm <sup>2</sup>
ON time (disengage brake)	40 ms
OFF time (engage brake)	20 ms
Weight	Approx. 1.5 kg



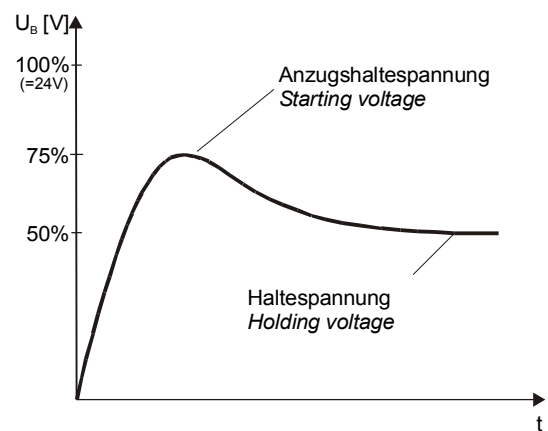
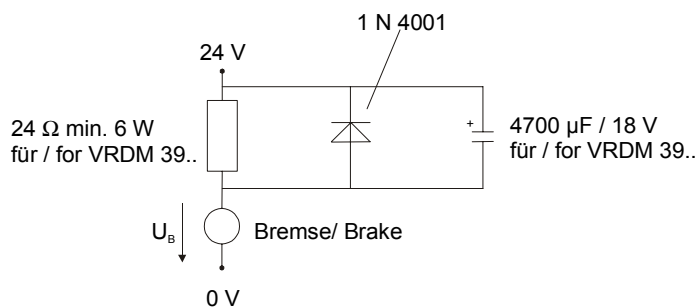
VRDM 397 with encoder and brake



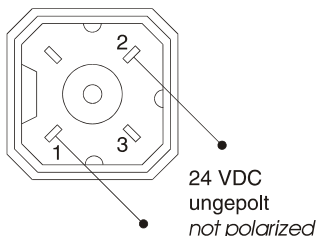
For the brake to work reliably on Z axes with a holding brake the static load torque must not exceed 25% of the motor's holding torque.

### Drive circuit

The drive circuit must be electrically excited in order to disengage the brake. To prevent overheating, the excitation current should be reduced as soon as the brake is disengaged. The recommended circuit arrangement is shown in the following diagram.



### Connection



The plug is supplied with the motor.

Plug designation: Hirschmann type G4 A 5M



The holding torque of the brake is reduced by approximately 50% at an operating temperature of 120°C.

## Gearbox options

The following tables show available combinations of motor and gearbox.

Refer to gearbox datasheet for further information.

## Gearbox type PLE

Economic precision planetary gearbox (Single-stage gearbox)

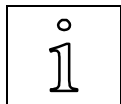
### Configuration options

Grey highlighted	recommended types
<b>Bold highlighted</b>	Limiter of torque by gear box or motor
x	gearbox over or under-sized or uneconomic

M <sub>d0</sub> [Nm]	Motor	Gearbox	3:1		5:1		8:1	
			M <sub>dG</sub> <sup>1)</sup> [Nm]	M <sub>maxG</sub> <sup>2)</sup> [Nm]	M <sub>dG</sub> <sup>1)</sup> [Nm]	M <sub>maxG</sub> <sup>2)</sup> [Nm]	M <sub>dG</sub> <sup>1)</sup> [Nm]	M <sub>maxG</sub> <sup>2)</sup> [Nm]
2	<b>VRDM 397</b>	with <b>PLE 80</b>	40	<b>6</b>	50	<b>10</b>	50	<b>16</b>
4	<b>VRDM 3910</b>		40	<b>12</b>	50	<b>20</b>	50	<b>32</b>
6	<b>VRDM 3913</b>		40	<b>18</b>	50	<b>30</b>	50	<b>48</b>

Index G (M<sub>xxG</sub>) -> in relation to gearbox output shaft

- 1) M<sub>dG</sub> continuous gearbox output torque  
 2) M<sub>maxG</sub> max. output torque with this motor  
 (theoretical value calculated from: max. motor torque M<sub>max</sub> x gear ratio)



*The continuous gearbox output torque M<sub>dG</sub> may not be continuously exceeded.  
 For a short period, e.g. in an emergency shutdown situation, twice this torque is permitted.*

## Gearbox type PLS

High-quality, low-backlash, planetary gearbox (Single-stage gearbox)

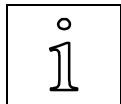
### Configuration options

Grey highlighted	recommended types
<b>Bold highlighted</b>	Limiter of torque by gear box or motor
x	gearbox over or under-sized or uneconomic

$M_{dG}$ [Nm]	Motor	Gearbox	3:1		5:1		8:1	
			$M_{dG}^{1)}$ [Nm]	$M_{maxG}^{2)}$ [Nm]	$M_{dG}^{1)}$ [Nm]	$M_{maxG}^{2)}$ [Nm]	$M_{dG}^{1)}$ [Nm]	$M_{maxG}^{2)}$ [Nm]
2	<b>VRDM 397</b>	with <b>PLS 90</b>	75	<b>6</b>	110	<b>10</b>	62	<b>16</b>
4	<b>VRDM 3910</b>		75	<b>12</b>	110	<b>20</b>	62	<b>32</b>
6	<b>VRDM 3913</b>		75	<b>18</b>	110	<b>30</b>	62	<b>48</b>

Index G ( $M_{xxG}$ ) -> in relation to gearbox output shaft

- 1)  $M_{dG}$  gearbox output torque (continuous)  
 2)  $M_{maxG}$  max. output torque with this motor  
 (theoretical value calculated from: max. motor torque  $M_{max}$  x gear ratio)



*The continuous gearbox output torque  $M_{dG}$  may not be continuously exceeded.  
 For a short period, e.g. in an emergency shutdown situation, twice this torque is permitted.*

## Type code

Example:

VRDM 3 9 13 / 50 L N C E B IP 41

VRDM	X	X	X	/	50	L	X	X	X	X	IP	X
------	---	---	---	---	----	---	---	---	---	---	----	---

Number of phases

3

Size (flange)

9 (approx. 85 mm)

Length

7 overall approx. 70 mm  
 10 overall approx. 100 mm  
 13 overall approx. 130 mm

The motor is approximately  
 37 mm longer with a terminal  
 box or a receptacle.

Number of pairs of poles

50

Laminated rotor

L

Winding identification

H 25 V<sub>AC</sub> (35 V<sub>DC</sub>)  
 N 92 V<sub>AC</sub> (130 V<sub>DC</sub>)  
 W 230 V<sub>AC</sub> (325 V<sub>DC</sub>)  
 S spezial modell

Motor connection

A stranded wires  
 B terminal box  
 C receptacle, straight connector  
 T receptacle, right-angled

System of measurement

E with encoder (1000 increments / revolution)  
 O without encoder

Holding brake

B with holding brake  
 O without holding brake

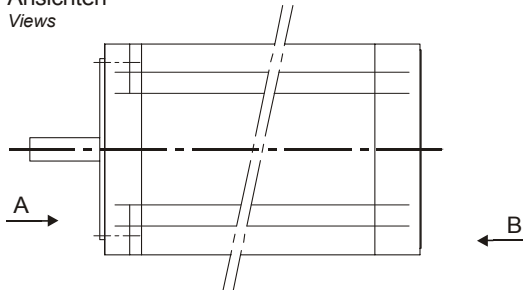
Degree of protection



## Variants

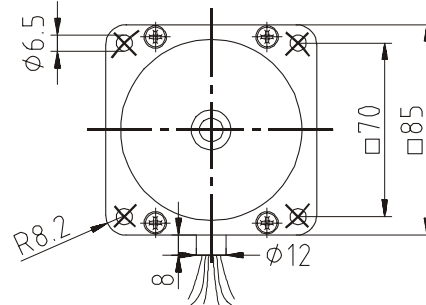
Vorder- und Rückansichten  
der Motorvarianten  
*Views from the motor versions*

Ansichten  
*Views*



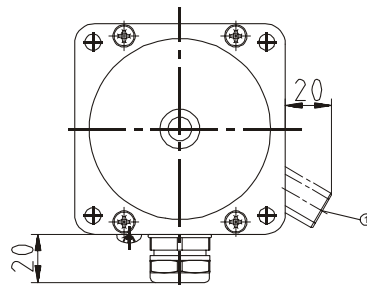
Motor mit Litzen  
*Motor with stranded wires*

Ansicht A  
*View A*



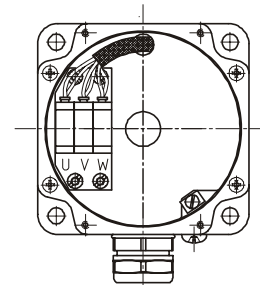
Motor mit Klemmkasten  
*Motor with terminal box*

Ansicht A  
*View A*



Ansicht B

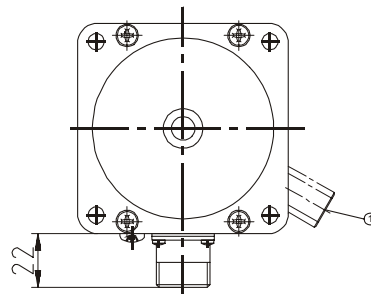
ohne Haltebremse  
*View A, without holding brake*



Motor mit Einbaudose  
*Motor with receptacle*

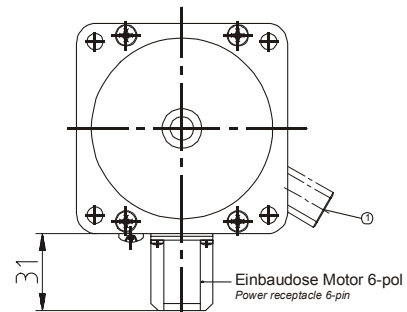
Ansicht A

Einbaudose, gerader Abgang  
*View A*  
*Receptacle, straight connector*



Ansicht A

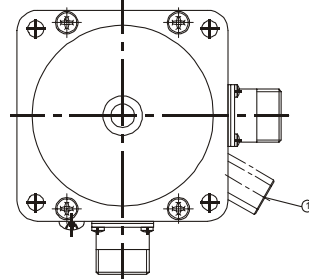
Einbaudose, 90° abgewinkelt  
*View A*  
*Receptacle, right-angled*



Motor mit Encoder  
*Motor with encoder*

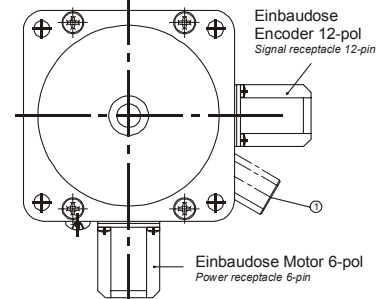
Ansicht A

Einbaudose, gerader Abgang  
*View A*  
*Receptacle, straight connector*



Ansicht A


Einbaudose, 90° abgewinkelt  
*View A*  
*Receptacle, right-angled*

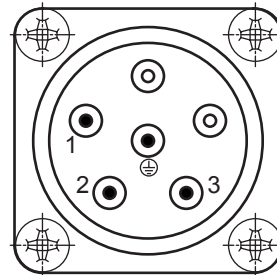


① Steckerposition der Haltebremse (wenn vorhanden)  
*brake plug position*

## Motor connection

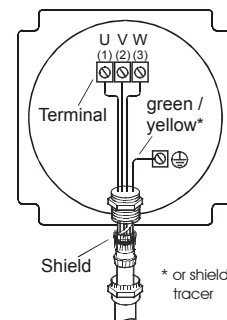
### Motor with receptacle

Pin	Designation
1	U
2	V
3	W
	PE



### Motor with terminal box (symbolic)

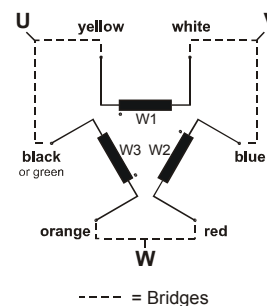
Cable colours	Designation
brown	U
blue	V
black	W
green / yellow	PE



### Motor with stranded wires

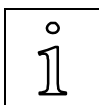
The wires shown in the figure must be bridged.

Cable colours	Designation
black and yellow	U
white and blue	V
orange and red	W



### Notes:

- The protective earth (or shield tracer) must be connected to both the motor and the device
- If the cables are connected in a terminal box, simply unscrew the four Phillips screws on the box. Do not remove the brake!
- Outer terminal is the EMC terminal
- Motors with stranded wires must be connected via the front flange with PE potential.



The direction of rotation of the motor shaft can be inverted by swapping over two terminals (e.g. U, V or V, W).