

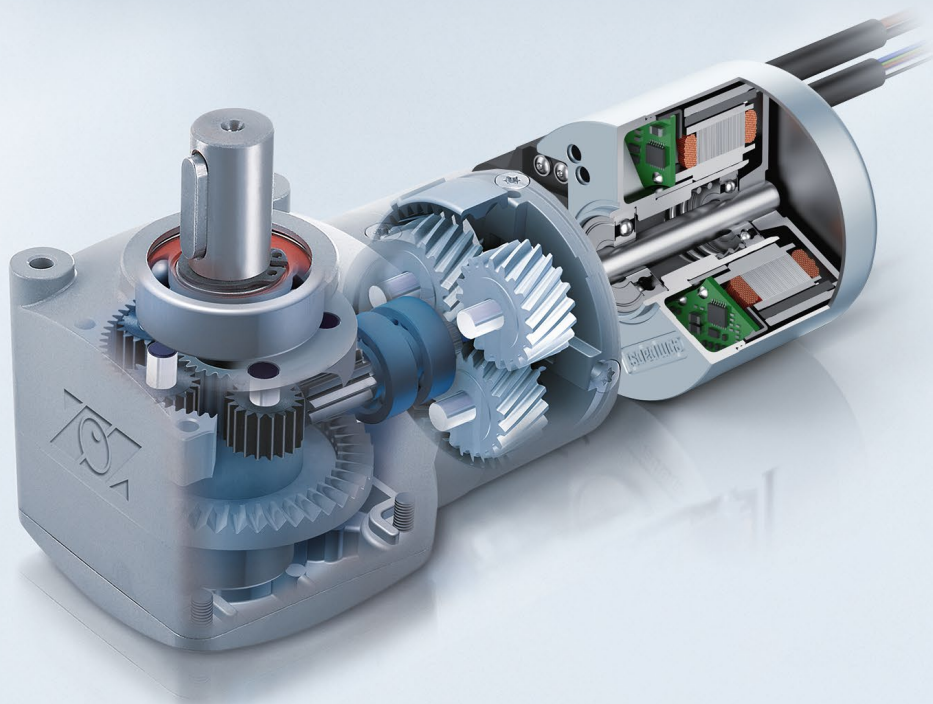
Brushless external rotor motor VD/VDC series

Drive solutions | Industrial drive engineering 2017-05

ebmpapst

The engineer's choice





Modular drive systems.
Motors with integrated logic and power
electronics – optional gearhead.

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About ebm-papst.

As technological leader for ventilation and drive engineering, ebm-papst is in demand as an engineering partner in many industries. With over 15,000 different products, we provide the right solution for just about any challenge. Our fans and drives are reliable, quiet and energy-efficient.

Six reasons that make us the ideal partner:

Our systems expertise.

You want the best solution for every project. The interrelationships between ventilation and drive engineering must thus be considered as a whole. And that's what we do – with **motor technology** that sets standards, sophisticated **electronics** and **aerodynamic designs** – all from a single source and perfectly matched. These system solutions release unique synergies worldwide. And in particular – they relieve you of a lot of work, so that you can concentrate on your core competency.

The ebm-papst spirit of invention.

In addition to our wide range of products, we are always able to develop customized solutions for you. A diversified team of 600 engineers and technicians works at our three locations in Germany: Mulfingen, Landshut and St. Georgen. Contact us to discuss your next project.

Our lead in technology.

As pioneer and trail-blazer for developing highly efficient EC technology, we are way ahead of other motor manufacturers. Almost all our products are also available with GreenTech EC technology. The list of benefits is long: higher efficiency, maintenance-free, longer service life, sound reduction, intelligent control characteristics and unrivalled energy efficiency with savings of up to 80 % compared to conventional AC technology. Let our technology be your competitive advantage as you lead in your industry.

Closeness to our customers.

ebm-papst has 25 production locations worldwide (including facilities in Germany, China and the USA), together with 49 sales offices, each of which has a dense network of sales representatives. You will always have a local contact, someone who speaks your language and knows your market.

Our standard of quality.

Of course you can rely on the highest standards of quality with our products. Our quality management is uncompromising, at every step in every process. This is underscored by our certification according to international standards including DIN EN ISO 9001, TS declaration of conformity and DIN EN ISO 14001.

Our sustainable approach.

Assuming responsibility for the environment, for our employees and for society is an integral part of our corporate philosophy. We develop products with an eye to maximum environmental compatibility, in particular resource-preserving production methods. We promote environmental awareness among our young staff and are actively involved in sports, culture and education. That's what makes us a leading company – and an ideal partner for you.

Our success story to becoming market leader and technological innovator.

- 1963** Elektrobau Mulfingen **GmbH & Co. KG founded by** Gerhard Sturm and Heinz Ziehl.
- 1965** Development of the first compact fan in the field of EC-/DC-technology.
- 1966** The ebm-papst success story started to take off with the release of the new 68 motor.
- 1972** The first foreign subsidiary was founded in Sweden.
- 1988** Gerhard Sturm receives the German Cross of Merit.
- 1990** The sixty millionth external rotor fan was produced.
- 1992** Acquisition of **PAPST Motoren GmbH** in St. Georgen.
- 1997** Purchase of the **Landshut** plant (mvl).
- 2003** Change of name to **ebm-papst**.
- 2007** Introduction of the gearhead "**EtaCrown®**".
- 2010** **GreenTech** – our symbol for energy-efficiency and resource conservation.
- 2012** Introduction of a new generation control electronics (**K4**) for BLDC motors.
- 2013** ebm-papst acquires the gear specialist, **Zeitlauf**, and wins the **German Sustainability Award**.
- 2014** Launch of the BLDC internal rotor motor, **ECI 80**.
- 2015** Introduction of the overload-capable planetary gear "**Optimax 63**".
- 2016** Expansion of the electronic production plant, St. Georgen Hagenmoos.





Overview of VD/VDC motors.

Brushless external rotor motors VD/VDC		VD-25.07 (p. 14)	VD-35.06 (p. 16)	VD-45.10 (p. 18)	VD-54.14 (p. 20)	VD-49.15 (p. 22)	VDC-43.10 (p. 24)	VDC-54.14 (p. 26)	VDC-49.15 (p. 28)	VDC-49.15 (p. 30)	VDC-49.15 (p. 30)
U _N	V DC	24	24	24	24	24	24	24	24	24	48
M _N	mNm	8	20	54	150	235	45	130	150	235	300
P	W	5	8	21	57	110	19	47.6	63	100	125
n _N	rpm	6 000	3 700	3 700	3 700	4 500	4 000	3 500	4 000	4 000	4 000
l	mm	23.6	29.3	40.8	43.3	52	40	42	52	52	52
d	mm	32	44	52.8	68.4	63	52.8	68.3	63	63	63
Control electronics (integrated) (from page 10)											
K1 (Hall sensor system)		•	•	•	•	•					
K3 (speed)							•	•	•		
K4 (position)										○	○
Control electronics (external) (from page 34)											
VTD-XX.XX-K3		•	•	•	•	•					
VTD-XX.XX-K4S					•	•					
VTD-60.13-K5 SB				•	•	•					
Gearheads (from page 42)											
NoiselessPlus 63 (planetary gearhead) (p. 44)						•					
Performax® 63 (planetary gearhead) (p. 46)						•				•	•
Performax®Plus 63 (planetary gearhead) (p. 48)						•					
EtaCrown® 75 (crown gearhead) (p. 50)						•				•	•
EtaCrown®Plus 63 (crown gearhead) (p. 52)						•				•	•
Compactline 90 (spur gearhead) (p. 54)					•			•			
Compactline 91 (spur gearhead) (p. 56)				•	•	•	•	•	•	•	•
Compactline 92 (spur gearhead) (p. 58)					•			•			
Flatline 85 (spur gearhead) (p. 60)					•	•		•	•	•	•
Subject to alterations		• Standard type ○ Preferred type: ready to ship in 48 hours									

With our **preferred type** products, we offer a selection of motors and gear motors which are available and ready to ship within 48 hours. Preferred type products can be ordered with a maximum order quantity of 20 products per order.

With **standard type** products, we refer to a wide range of motors and gear motors which can be ordered using the stated order numbers with standard delivery times.

Further products for your project requirements are available **on request**. These products are generally available but cannot be ordered by means of an allocated material number. We reserve the right to make changes to the necessary order numbers after technical and economic evaluation of the requirement.

VD/VDC motors.



VD-25.07-K1	14
VD-35.06-K1	16
VD-43.10-K1	18
VD-54.14-K1	20
VD-49.15-K1	22
VDC-43.10-K3	24
VDC-54.14-K3	26
VDC-49.15-K3	28
VDC-49.15-K4	30

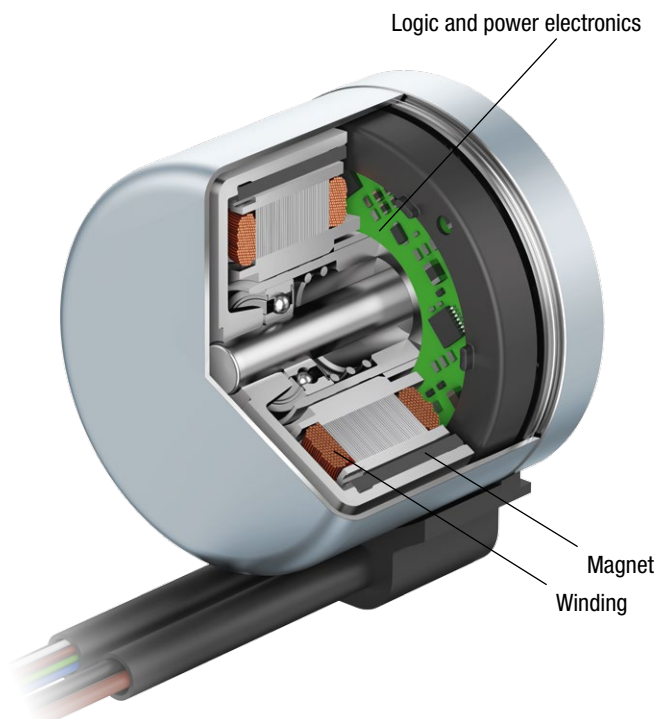
Information for VD/VDC motors.

Key figures

- 3-phase, electronically commutated external rotor motor
 - Output range between 5 and 125 watts
 - High power density realized in a compact design
 - Very quiet operation across the entire speed range
 - High overload capacity
 - Very high power density
 - Rigid speed / torque curve
 - Extremely wide speed control range
 - Robust housing and bearings
 - Protection class IP 54 as per EN 60 034-5: up to IP 65
-
- Various motor types which can be combined with planetary, crown and spur gearheads

Approvals

- Support with the accreditation of products in different economic areas and markets
- As an experienced and competent partner we would be happy to support you
- Possible approvals include CE, CCC, UL, CSA, EAC
- Additional approvals on request



The data in this catalog contain product specifications, but are not a guarantee of particular properties.

All information is based on the measuring conditions mentioned below. Operation of motors using reference electronics at an **ambient temperature of max. 40°C** when attached (thermally conductive) to a free-standing steel plate of the following size:
Steel plate 105 x 105 x 10 mm

The **nominal operating point** is the basis for the electromagnetic design of the motor from the point of view of the maximum possible continuous output of the motor and is specified by the nominal values described here.

The values mentioned are typical values for the design in question and are also subject to the tolerances included in the specifications or drawings. Unless otherwise stated, the supplements and safety notes contained in the relevant operating and assembly instructions must be kept at all times. Subject to availability and technical alterations.

Nominal output power P_N [W]

The output power which the motor can produce continuously; it is calculated from nominal torque and nominal speed. For the electromagnetic design of the motor the determination of the nominal operating point is based on the fact that the nominal output power is close the maximum output power of the motor.

Nominal voltage U_{BN} , U_N , U_B [V DC]

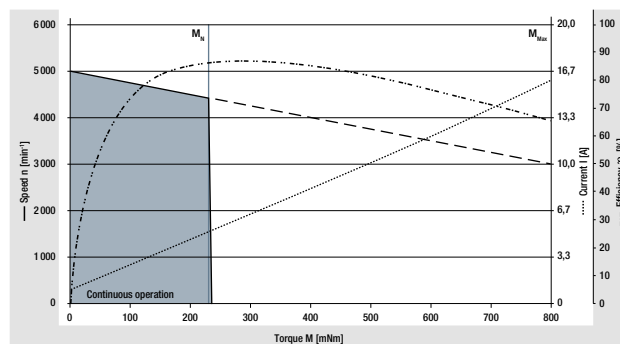
The DC voltage (i.e. DC voltage range) that is applied to the commutation electronics as a system supply voltage. All nominal values listed in the technical tables of the individual motors refer to this voltage. Motor applications are, however, not restricted to this voltage.

Nominal speed n_N [rpm]

The speed at which the motor may be operated continuously while delivering nominal torque at an ambient temperature of 40°C and nominal output torque. It is an operating point on the max. motor curve based on an ideal electronics with negligible losses.

Nominal torque M_N [mNm]

The torque that the motor can deliver continuously at an ambient temperature of 40°C and nominal speed.



The illustrated curves are idealized representations based on the figures in the tables.

Nominal current I_{BN}

The current that is drawn from the system supply when the motor delivers nominal torque at nominal speed.

Speed at no-load operation n_L [rpm]

The speed that takes effect at the nominal voltage and with unloaded motor. The theoretical possible speed at no-load operation can, in some cases, be limited by the mechanical ceiling speed.

No-load current I_{BL} [A]

Is established with nominal voltage and unloaded motor; is largely influenced by the bearing friction. For drive systems that have a separate supply for power and logic, the no-load current is called I_L . This no-load current is the sum of the power supply (I_{zk}) and the low-power logic supply (I_b).

Permanent stall torque M_{Bn0} [mNm]

Is the maximum permissible torque with which the motor may be permanently loaded when the rotor is locked.

Permissible eff. continuous stall current I_{noeff} [A]

Is the maximum permissible current which at a stalled motor is allowed to flow into the motor lead as an effective value.

Definitions for VD/VDC motors.

Continuous stall power P_{Bn0} [W]

Is an approximate value for the voltage-independent maximum permitted output ($P=U \times I$) that can be taken from the DC voltage source in holding status.

Permissible peak torque short-term M_{max} [mNm]

Is the torque which the motor can usually deliver in a short time.

Permissible peak current, motor lead I_{max} [A]

Is the current that must flow in to the motor lead as a peak value to achieve the short-time peak torque.

Induced voltage U_{max} [V/1 000 rpm]

Maximum value of the induced voltage between two motor leads at 1 000 rpm. It is a dimension for the electromagnetic utilization of the motor.

Connection resistance R_v [Ohm]

The winding resistance that is measured at 20°C between any two of three winding terminations.

Connection inductance L_v [mH]

The average inductance that is measured at 20°C between any two of three winding terminations using a sinusoidal wave measuring frequency of 1 kHz.

Rotor moment of inertia J_r [kgm²x10⁻⁶]

The mass moment of inertia of the rotor and necessary dimension for the dynamic characteristics of the motor.

Protection class

Information on the protection class; it describes protection against foreign particles (Point 1) and water (Point 2).

Permissible ambient temperature range T_v [°C]

Defines the minimum and maximum permissible ambient temperature to which the mentioned performance values apply when the motor is in operation. The permissible winding temperature in the motor (115°C for insulation Class E, as per EN 60 034-1) </1125 should not be exceeded.

Weight [kg]

Weight of the delivered unit without additional units or packaging.

Max. shaft load F_{radial}/F_{axial} [N]

The permissible forces are divided into radial and axial load values. They are based on the maximum permissible values for the motor bearing during operation at normal rating and a defined service life expectancy L_{10} .

Service life L_{10}

The values for the L_{10} service life specified in conjunction with the permitted bearing loads have been calculated to DIN ISO 281. In addition to the specified values, this calculation is based on operation of the motor at nominal conditions (nominal torque, nominal speed) and an ambient temperature of max. 40°C. Therefore, the service life information is explicitly not a guarantee of service life, but strictly a theoretical quality figure.

Max. reverse voltage [V DC]

When the braking function is activated and when the set value step change is negative, the motor operates in controlled braking mode. In this operating state, the large part of the braking energy is fed back to the intermediate circuit until the max. reverse voltage is reached and the electronics prevent a further increase beyond this value by chopped braking. This behavior should be given special consideration when selecting the system supply.

Set value input

Speed setting via an analogue interface for DC voltage.

Depending on the drive design, the set speed can be configured in a range from 0 ... n_{max} , where the minimum possible speed value (with limited control quality) is about 0 rpm (sine commutation)

or approx. 50 to 100 rpm (block commutation). (Relevant only for drives with integrated operating electronics).

Recommended speed range [rpm]

Speed control range within which the speed control accuracy stipulated in the system specification is complied with.

Starting torque [mNm]

Is the torque that can be delivered over a short time when the motor is started based on the electromagnetic motor characteristics and the set current limitation.

Effective torque M_{eff} [mNm]

For cycle operation (e.g. "S5" operating mode – intermittent duty with the effect of the startup losses and the losses due to electrical braking on the heating), the effective torque corresponding to continuous operation ("S1" operating mode) is determined according to the following formula:

$$M_{\text{eff}} = \sqrt{\frac{M_A^2 \cdot t_A + M_L^2 \cdot t_b + M_{Br}^2 \cdot t_{Br}}{t_A + t_b + t_{Br} + t_{St}}}$$

M_A	Starting torque	M_{Br}	Braking
t_A	Acceleration time	t_{Br}	Braking time
M_L	Load torque	t_{St}	Standstill time
t_b	Load period		

At an ambient temperature of 40°C this effective torque must not be greater than the nominal torque M_N listed in the catalog for the selected motor. For intermittent operation (operating mode S3 with t_r = relative on period) the following permissible load moment applies:

$$M_L = M_N \cdot \sqrt{\frac{100}{t_r}}$$

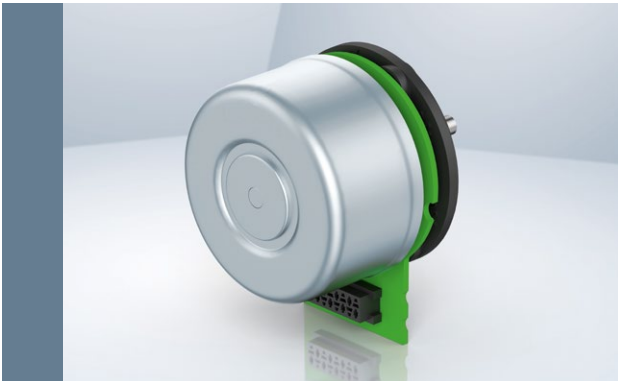
System selection

When selecting a motor and operating for a drive system, consideration should be given to the fact that the values permitted for the motor should not be exceeded by the electronics. Likewise, the relationship shown in the commutation sequences between the sequence of Hall signals and the corresponding switching times and switching states of the output stage at the phase supply lines must be observed in order to attain optimum operation of the motor.

Please contact the manufacturer if the products are operated or stored under non standard environmental conditions.

VD motor.

VD-25.07-K1



- 3-phase external rotor motor with EC technology
- Basic motor with electronic module K1 for operation on external control electronics
- Very good synchronization characteristics
- Long lifetime by using precision ball bearings
- Insulation class E
- Electrical connection via socket directly on the circuit board
- Alternative windings / motor part sets on request

Nominal data

Type		VD-25.07-K1-B01
Nominal voltage (U_N)	V DC	24
Nominal speed (n_N)*	rpm	6 000
Nominal torque (M_N)*	mNm	8.00
Nominal current (I_N)*	A	0.40
Nominal output power (P_N)*	W	5.00
Starting torque (M_{max})	mNm	40.0
Permissible peak current (I_{max})**	A	1.80
Speed at no-load operation (n_L)	rpm	8 500
No-load current (I_L)	A	0.095
Recommended speed control range	rpm	300 ... 8 500
Rotor moment of inertia (J_R)	kgm ² x10 ⁻⁶	4.30
Motor constant (K_E)	mVs/rad	26.6
Connection resistance (R_V)	Ω	14.8
Connection inductance (L_V)	mH	8.00
Overload protection		To be implemented via the control electronics
Permissible ambient temperature range (T_U)	$^{\circ}\text{C}$	0 ... +40
Weight	kg	0.055
Order no.	IP 00	937 2507 000

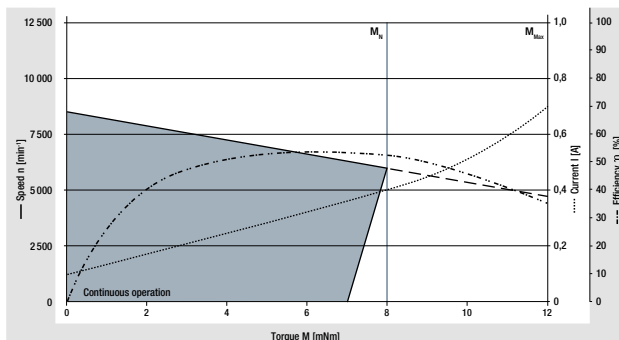
Subject to alterations

* At T_U max. 40 $^{\circ}\text{C}$

** Permissible time for peak current: max. 1 sec. – to be repeated only after complete cool down

Characteristic curve

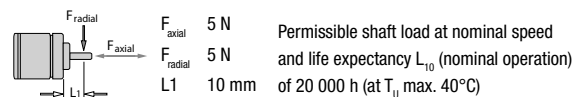
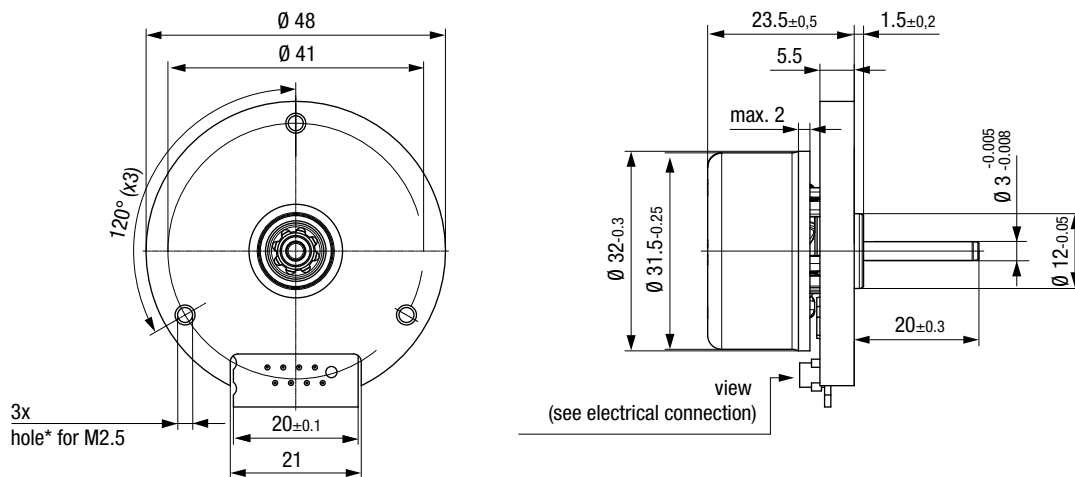
VD-25.07-K1-B01 (at 25 $^{\circ}\text{C}$)



¹⁾ Nominal data, see table

Technical drawing

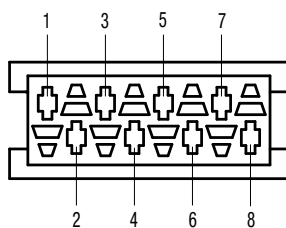
All dimensions in mm



* For thread-rolling screws according to DIN 7500

Electrical connection

Supply wire	
No.	Function
6	Phase U
7	Phase V
8	Phase W

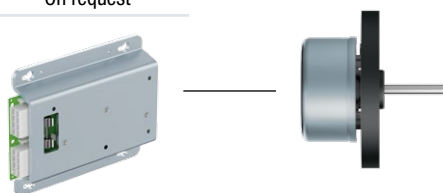


Signal wire	
No.	Function
1	GND
2	Hall C
3	+ U_B
4	Hall B
5	Hall A

Modular construction kit

Recommended external control electronics	
VTD-XX.XX-K3	On request

Basic motor



For motor-gearbox combinations, depending on the choice of the single components, the maximum allowable torque (gearbox) can be exceeded or respectively not reached.

VD motor.

VD-35.06-K1



- 3-phase external rotor motor with EC technology
- Basic motor with electronic module K1 for operation on external control electronics
- Very good synchronization characteristics
- Long lifetime by using precision ball bearings
- Insulation class E
- Electrical connection via the circuit board edge plug
- Alternative windings / motor part sets on request

Nominal data

Type		VD-35.06-K1-B01	VD-35.06-K1-B00
Nominal voltage (U_N)	V DC	24	
Nominal speed (n_N)*	rpm	7 500	3 700
Nominal torque (M_N)*	mNm	20.0	20.0
Nominal current (I_N)*	A	1.25	0.80
Nominal output power (P_N)*	W	16.0	8.00
Starting torque (M_{max})	mNm	69.0	
Permissible peak current (I_{max})**	A	4.00	2.50
Speed at no-load operation (n_L)	rpm	11 000	7 100
No-load current (I_L)	A	0.25	0.16
Recommended speed control range	rpm	300 ... 11 000	300 ... 7 100
Rotor moment of inertia (J_R)	kgm ² x10 ⁻⁶	16.0	
Motor constant (K_E)	mVs/rad	20.9	33.6
Connection resistance (R_V)	Ω	3.70	9.40
Connection inductance (L_V)	mH	2.50	6.40
Overload protection		To be implemented via the control electronics	
Permissible ambient temperature range (T_U)	$^{\circ}\text{C}$	0 ... +40	
Weight	kg	0.12	
Order no.	IP 00	937 3506 000	937 3506 010

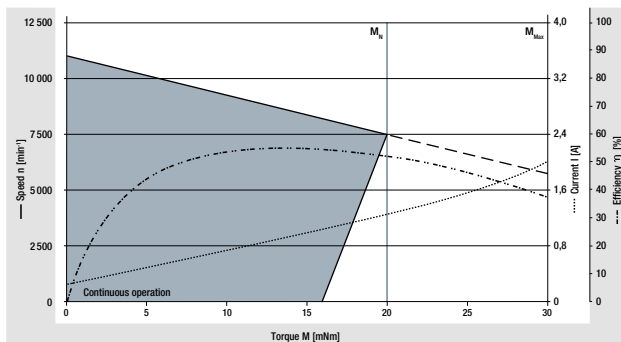
Subject to alterations

* At T_U max. 40°C

** Permissible time for peak current: max. 1 sec. – to be repeated only after complete cool down

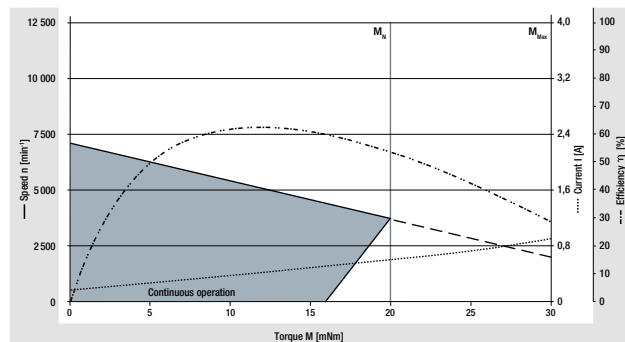
Characteristic curve

VD-35.06-K1-B01 (at 25°C)



¹⁾ Nominal data, see table

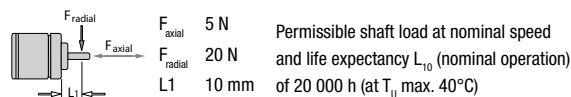
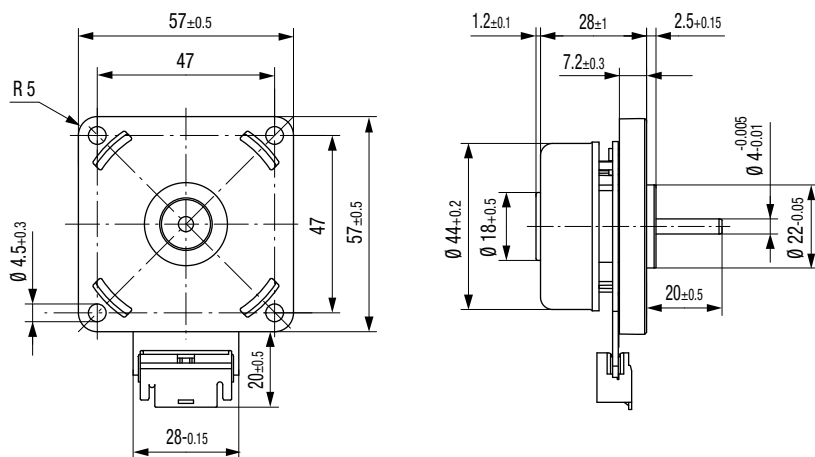
VD-35.06-K1-B00 (at 25°C)



¹⁾ Nominal data, see table

Technical drawing

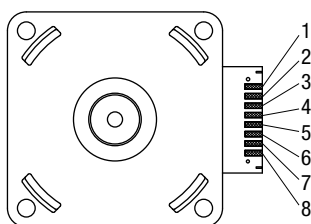
All dimensions in mm



Electrical connection

Supply wire

No.	Function
6	Phase W
7	Phase V
8	Phase U



Signal wire

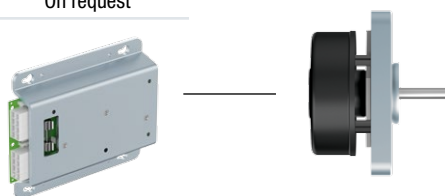
No.	Function
1	+ U_B
2	GND
3	Hall C
4	Hall B
5	Hall A

Modular construction kit

Recommended external control electronics

VTD-XX.XX-K3	On request
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Basic motor



Accessories

Rotor protection cap	(page 66)
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VD motor.

VD-43.10-K1



- 3-phase external rotor motor with EC technology
- Basic motor with electronic module K1 for operation on external control electronics
- Very good synchronization characteristics
- Long lifetime by using precision ball bearings
- Insulation class E
- Electrical connection via the circuit board edge plug
- Alternative windings / motor part sets on request

Nominal data

Type		VD-43.10-K1-B01	VD-43.10-K1-B00
Nominal voltage (U_N)	V DC	24	
Nominal speed (n_N)*	rpm	7 900	3 700
Nominal torque (M_N)*	mNm	53.0	54.0
Nominal current (I_N)*	A	2.70	1.60
Nominal output power (P_N)*	W	44.0	21.0
Starting torque (M_{max})	mNm	110	
Permissible peak current (I_{max})**	A	6.50	4.20
Speed at no-load operation (n_L)	rpm	10 200	8 000
No-load current (I_L)	A	0.27	0.18
Recommended speed control range	rpm	300 ... 10 200	300 ... 8 000
Rotor moment of inertia (J_R)	kgm ² x10 ⁻⁶	40.0	
Motor constant (K_E)	mVs/rad	19.4	29.3
Connection resistance (R_V)	Ω	0.96	2.30
Connection inductance (L_V)	mH	1.55	3.50
Overload protection		To be implemented via the control electronics	
Permissible ambient temperature range (T_U)	°C	0 ... +40	
Weight	kg	0.24	
Order no.	IP 00	937 4310 000	937 4310 010

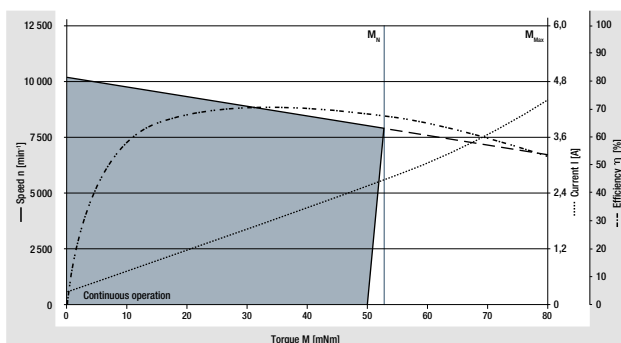
Subject to alterations

* At T_U max. 40°C

** Permissible time for peak current: max. 1 sec. – to be repeated only after complete cool down

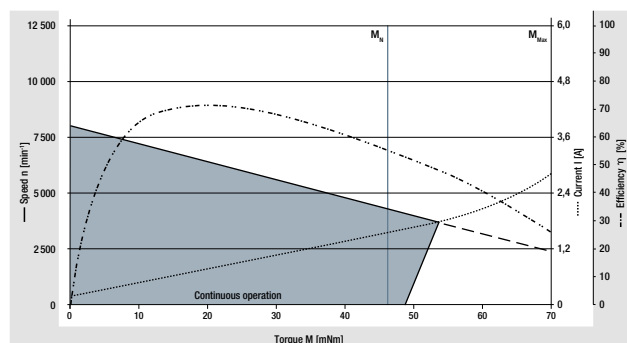
Characteristic curve

VD-43.10-K1-B01 (at 25°C)



¹⁾ Nominal data, see table

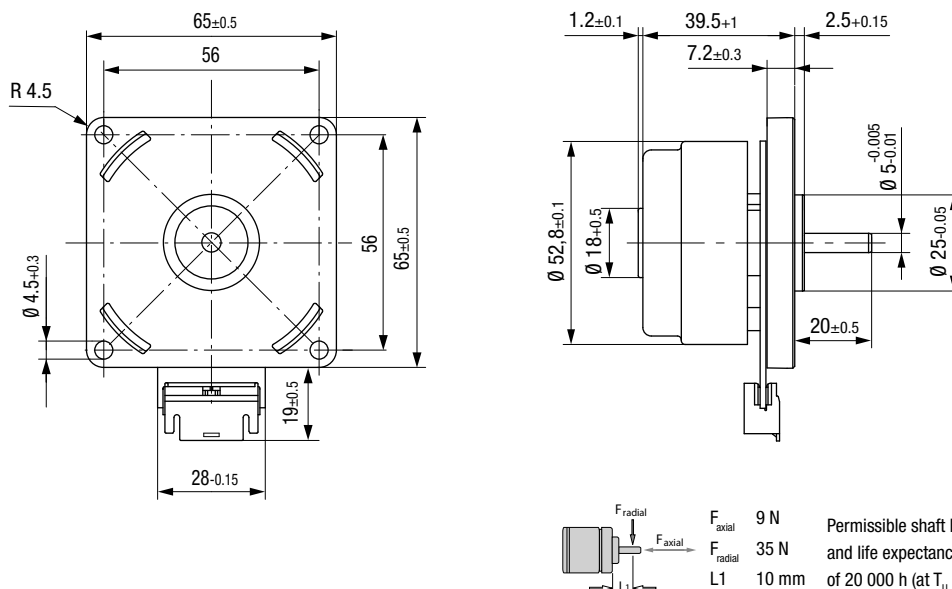
VD-43.10-K1-B00 (at 25°C)



¹⁾ Nominal data, see table

Technical drawing

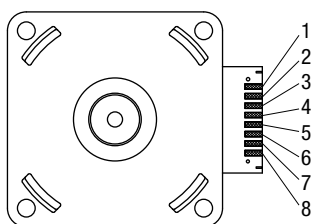
All dimensions in mm



Electrical connection

Supply wire

No.	Function
6	Phase W
7	Phase V
8	Phase U



Signal wire

No.	Function
1	+ U_B
2	GND
3	Hall C
4	Hall B
5	Hall A

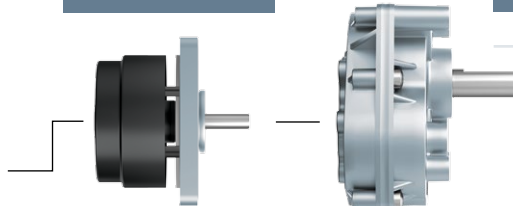
Modular construction kit

Recommended external control electronics

VTD-XX.XX-K3	On request
VTD-60.13-K5SB	On request



Basic motor



Spur gearheads

Compactline 91 (page 56)

Accessories

rotor protection cap	(page 66)
Connection cables	(page 67)

VD motor.

VD-54.14-K1



- 3-phase external rotor motor with EC technology
- Basic motor with electronic module K1 for operation on external control electronics
- Very good synchronization characteristics
- Long lifetime by using precision ball bearings
- Insulation class E
- Electrical connection via the circuit board edge plug

Nominal data

Type		VD-54.14-K1-B01	VD-54.14-K1-B00
Nominal voltage (U_N)	V DC	24	
Nominal speed (n_N)*	rpm	5 600	3 700
Nominal torque (M_N)*	mNm	150	
Nominal current (I_N)*	A	5.10	3.60
Nominal output power (P_N)*	W	88.0	57.0
Starting torque (M_{max})	mNm	400	
Permissible peak current (I_{max} **)	A	15.0	10.0
Speed at no-load operation (n_L)	rpm	7 100	5 200
No-load current (I_L)	A	0.41	0.26
Recommended speed control range	rpm	300 ... 7 100	300 ... 5 200
Rotor moment of inertia (J_R)	kgm ² x10 ⁻⁶	145	
Motor constant (K_E)	mVs/rad	29.2	41.8
Connection resistance (R_V)	Ω	0.49	0.96
Connection inductance (L_V)	mH	1.00	2.00
Overload protection		To be implemented via the control electronics	
Permissible ambient temperature range (T_U)	$^{\circ}$ C	0 ... +40	
Weight	kg	0.52	
Order no.	IP 00	937 5414 000	937 5414 010

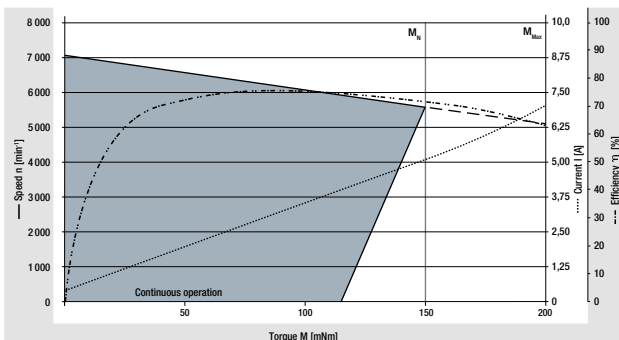
Subject to alterations

* At T_U max. 40 $^{\circ}$ C

** Permissible time for peak current: max. 1 sec. – to be repeated only after complete cool down

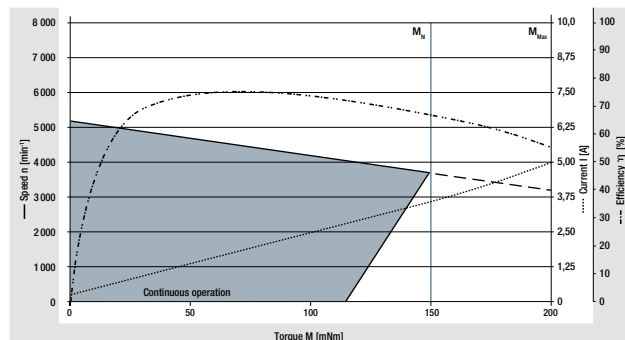
Characteristic curve

VD-54.14-K1-B01 (at 25 $^{\circ}$ C)



¹⁾ Nominal data, see table

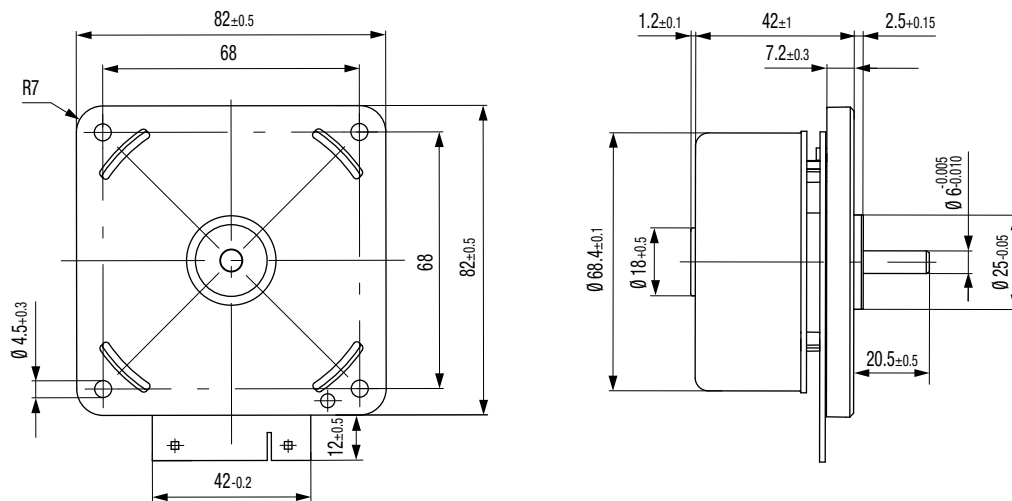
VD-54.14-K1-B00 (at 25 $^{\circ}$ C)



¹⁾ Nominal data, see table

Technical drawing

All dimensions in mm

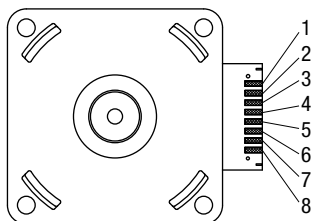


	F_{axial} 9 N	Permissible shaft load at nominal speed and life expectancy L_{10} (nominal operation) of 20 000 h (at T_u max. 40°C)
	F_{radial} 60 N	
	L1 10 mm	

Electrical connection

Supply wire

No.	Function
6	Phase W
7	Phase V
8	Phase U



Signal wire

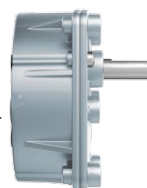
No.	Function
1	+ U_B
2	GND
3	Hall C
4	Hall B
5	Hall A

Modular construction kit

Recommended external control electronics

VTD-XX.XX-K3	Speed (page 34)
VTD-XX.XX-K4S	Position (page 36)
VTD-60.13-K5SB	Position (page 38)

Basic motor



Spur gearheads

- Compactline 90 (page 54)
- Compactline 91 (page 56)
- Compactline 92 (page 58)

Spur gearheads

- Flatline 85 (page 60)

Accessories

Rotor protection cap	(page 66)
Connection cables	(page 67)

VD motor.

VD-49.15-K1



- 3-phase external rotor motor with EC technology
- High poled motor structure for optimum power density
- Basic motor with electronic module K1 for operation on external control electronics
- Very good synchronization characteristics
- Robust mechanical design in IP 54 for industrial applications
- Long lifetime by using precision ball bearings
- Insulation class E
- Electrical connection via cable

Nominal data

Type		VD-49.15-K1-B00	VD-49.15-K1-D00
Nominal voltage (U_N)	V DC	24	48
Nominal speed (n_N)*	rpm	4 500	5 300
Nominal torque (M_N)*	mNm	235	245
Nominal current (I_N)*	A	6.10	3.40
Nominal output power (P_N)*	W	110	135
Starting torque (M_{max})	mNm	1 150	1 300
Permissible peak current (I_{max})**	A	30.0	18.5
Speed at no-load operation (n_L)	rpm	6 000	
No-load current (I_L)	A	0.47	0.36
Recommended speed control range	rpm	0 ... 6 000	
Rotor moment of inertia (J_R)	kgm ² x10 ⁻⁶	108	
Motor constant (K_E)	mVs/rad	41.0	80.7
Connection resistance (R_V)	Ω	0.23	0.62
Connection inductance (L_V)	mH	0.17	0.62
Overload protection		To be implemented via the control electronics	
Permissible ambient temperature range (T_U)	$^{\circ}\text{C}$	0 ... +40	
Weight	kg	0.59	
Order no. (cable type)***	IP 54	937 4915 000	937 4915 001

Subject to alterations

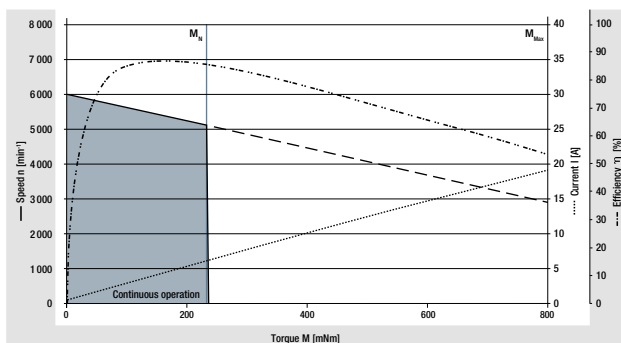
* At T_U max. 40 $^{\circ}\text{C}$

** Permissible time for peak current: max. 1 sec. – to be repeated only after complete cool down

*** Classification of protection class refers to installed state with sealing on the flange side

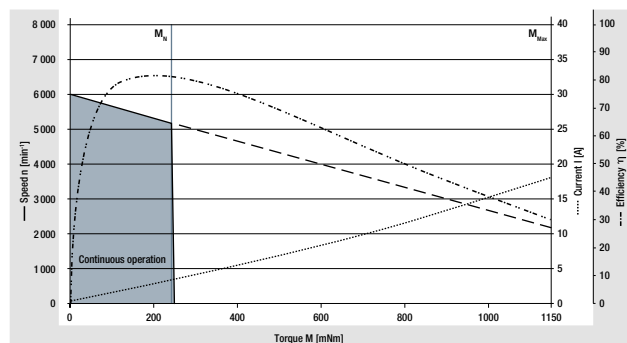
Characteristic curve

VD-49.15-K1-B00 (at 25 $^{\circ}\text{C}$)



¹⁾ Nominal data, see table

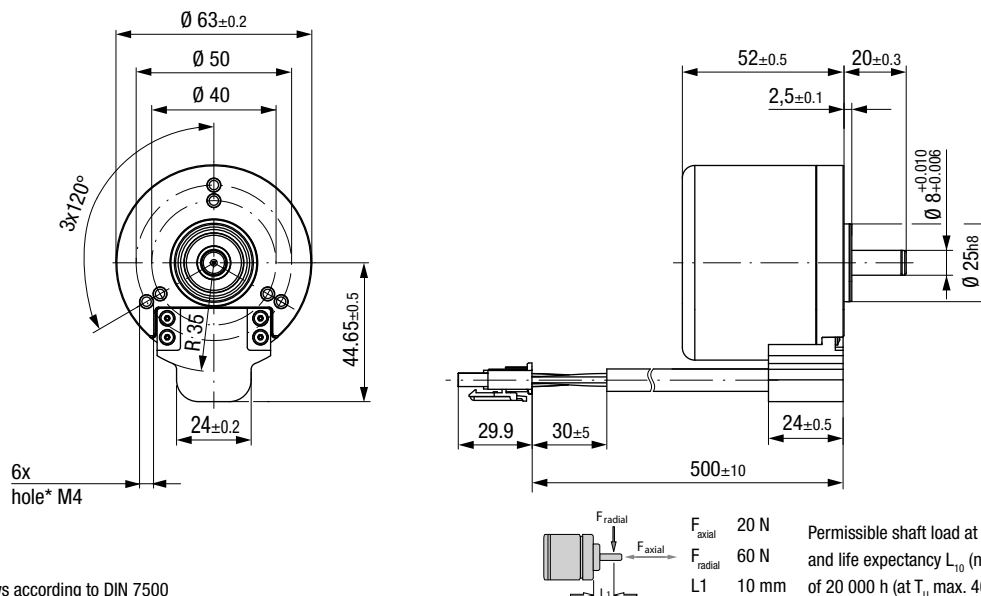
VD-49.15-K1-D00 (at 25 $^{\circ}\text{C}$)



¹⁾ Nominal data, see table

Technical drawing

All dimensions in mm

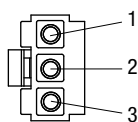


* For thread-rolling screws according to DIN 7500

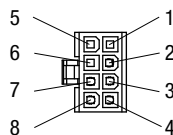
Electrical connection

Supply wire

No.	Color	Function
1	yellow	Phase W
2	violet	Phase V
3	brown	Phase U



Molex plug
no. 39-03-6035



Molex plug
no. 39-01-2085

Signal wire

No.	Color	Function
1	–	–
2	red	+12 V
3	white	Hall B
4	green	Hall A
5	–	–
6	–	–
7	black	GND
8	gray	Hall C

Modular construction kit

Recommended external control electronics

VTD-XX.XX-K3	Speed (page 34)
VTD-XX.XX-K4S	Position (page 36)
VTD-60.13-K5SB	Position (page 38)

Basic motor



Planetary gearheads

- NoiselessPlus 63 (page 44)
- Performax® 63 (page 46)
- Performax®Plus 63 (page 48)

Crown gearheads

- EtaCrown® 75 (page 50)
- EtaCrown®Plus 63 (page 52)

Spur gearheads

- Compactline 91 (page 56)
- Flatline 85 (page 60)

VDC motor.

VDC-43.10-K3



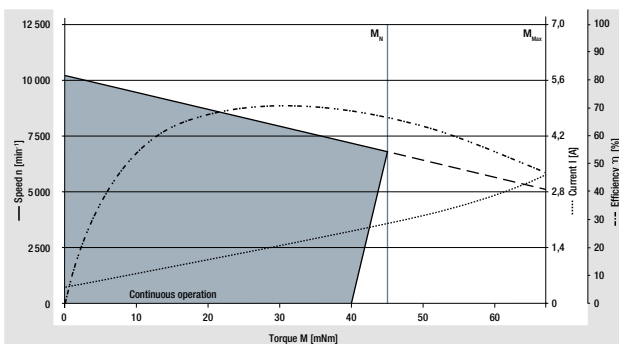
- 3-phase external rotor motor with EC technology
- Drive with completely integrated K3 operation and control electronics
- Integrated speed control function
- Interface with analog and digital control inputs
- Very good synchronization characteristics
- Long lifetime by using precision ball bearings
- Electrical connection via the circuit board edge plug

Nominal data

Type		VDC-43.10-K3-B01	VDC-43.10-K3-B00
Nominal voltage (U_N)	V DC	24	
Nominal speed (n_N)*	min ⁻¹	6 800	4 000
Nominal torque (M_N)*	mNm	45	
Nominal current (I_N)*	A	2.00	1.25
Nominal output power (P_N)*	W	32.0	18.8
Starting torque (M_{max})	mNm	67	
Speed at no-load operation (n_l)	min ⁻¹	10 200	4 100
No-load current (I_l)	A	0.40	0.14
Recommended speed control range	min ⁻¹	300 ... 10 000	300 ... 4 000
Rotor moment of inertia (J_R)	kgm ² x10 ⁻⁶	40	
Overload protection		integrated	
Permissible ambient temperature range (T_U)	°C	0 ... +40	
Weight	kg	0.24	
Order no.	IP 00	937 4310 600	937 4310 610
Subject to alterations	* At T_U max. 40°C		

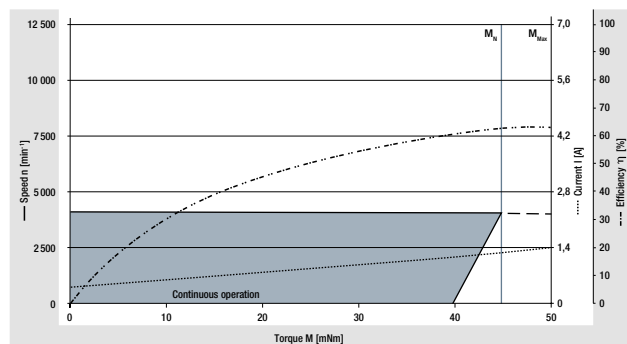
Characteristic curve

VDC-43.10-K3-B01 (at 25°C)



¹⁾ Nominal data, see table

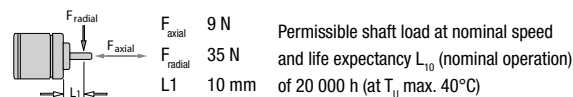
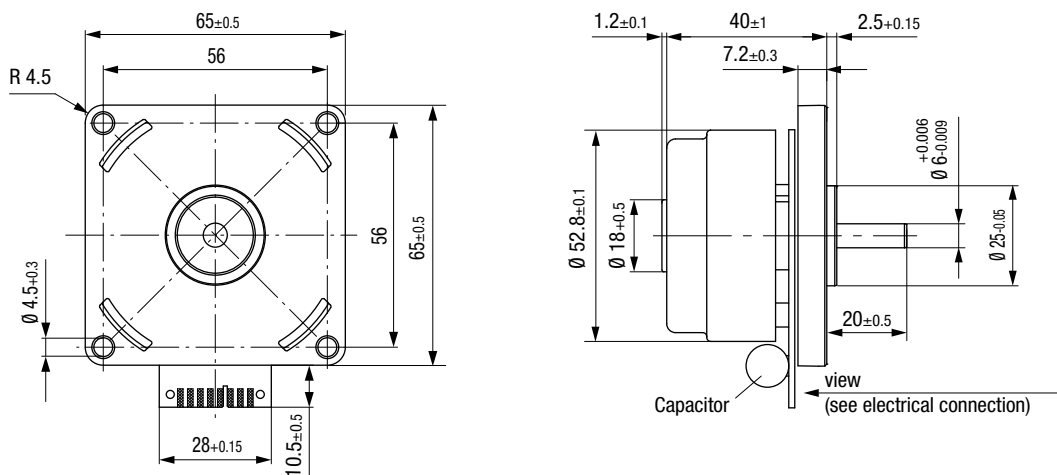
VDC-43.10-K3-B00 (at 25°C)



¹⁾ Nominal data, see table

Technical drawing

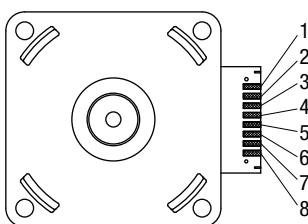
All dimensions in mm



Electrical connection

Supply wire

No.	Configuration
7	GND
8	U _B



Signal wire

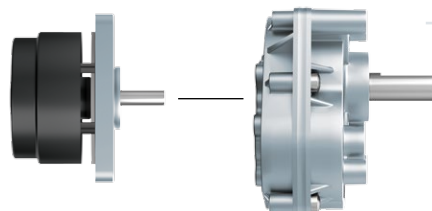
Nr.	Configuration	Function
1	OUT	Pulse output (speed)
2	D-IN-A	Input
3	D-IN-B	Input
4	C	-
5	A-IN	0 ... 10V (differential)
6	A-GND	GND for analog IN for differential

Modular construction kit

Accessories

Connection cables (page 67)

Basic motor



Spur gearheads

Compactline 91 (page 56)

VDC motor.

VDC-54.14-K3



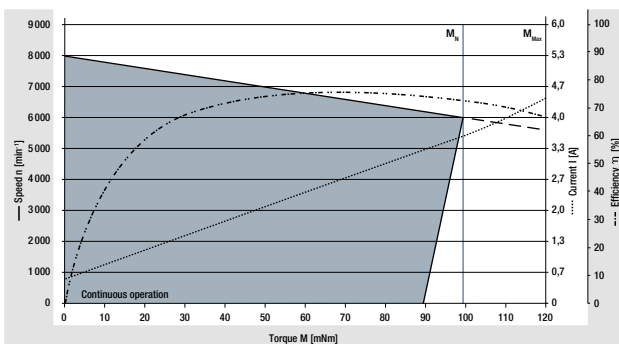
- 3-phase external rotor motor with EC technology
- Drive with completely integrated K3 operation and control electronics
- Integrated speed control function
- Interface with analog and digital control inputs
- Very good synchronization characteristics
- Long lifetime by using precision ball bearings
- Electrical connection via the circuit board edge plug

Nominal data

Type		VDC-54.14-K3-B01	VDC-54.14-K3-B00
Nominal voltage (U_N)	V DC	24	
Nominal speed (n_N) [*]	min ⁻¹	6 000	3 500
Nominal torque (M_N) [*]	mNm	100	150
Nominal current (I_N) [*]	A	3.60	2.80
Nominal output power (P_N) [*]	W	62.8	47.6
Starting torque (M_{max})	mNm	120	
Speed at no-load operation (n_0)	min ⁻¹	8 000	4 000
No-load current (I_0)	A	0.51	0.21
Recommended speed control range	min ⁻¹	300 ... 8 000	300 ... 4 000
Rotor moment of inertia (J_R)	kgm ² x10 ⁻⁶	145	
Overload protection		integrated	
Permissible ambient temperature range (T_U)	°C	0 ... +40	
Weight	kg	0.52	
Order no.	IP 00	937 5414 622	937 5414 620
Subject to alterations	* At T_U max. 40°C		

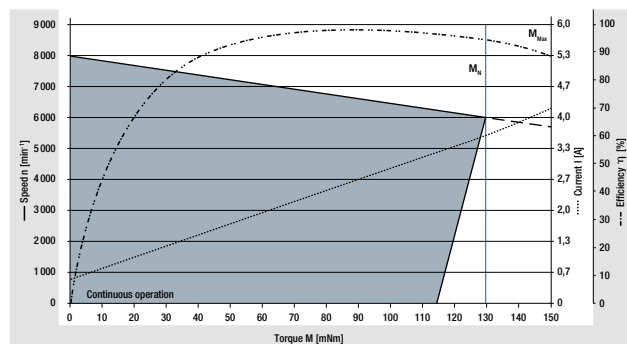
Characteristic curve

VDC-54.14-K3-B01 (at 25°C)



¹⁾ Nominal data, see table

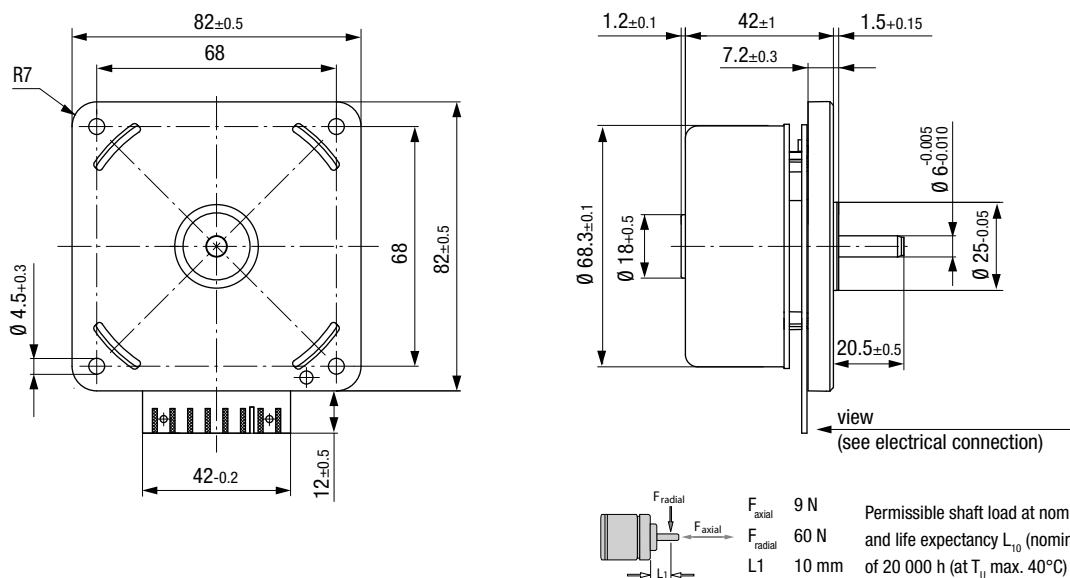
VDC-54.14-K3-B00 (at 25°C)



¹⁾ Nominal data, see table

Technical drawing

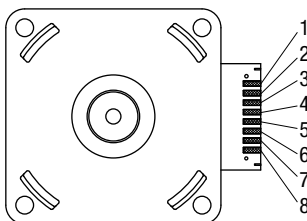
All dimensions in mm



Electrical connection

Supply wire

No.	Configuration
7	GND
8	U _B



Signal wire

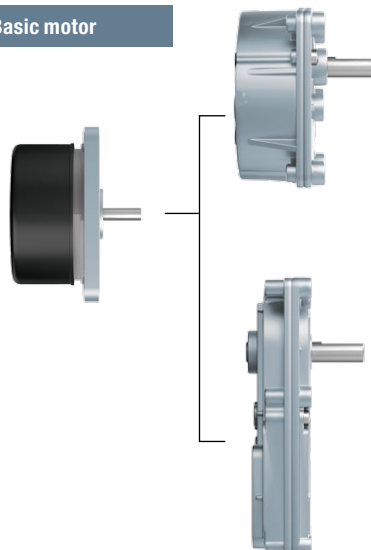
Nr.	Configuration	Function
1	OUT	Pulse output (speed)
2	D-IN-A	Input
3	D-IN-B	Input
4	C	-
5	A-IN	0 ... 10V (differential)
6	A-GND	GND for analog IN for differential

Modular construction kit

Accessories

Rotor protection cap	(page 66)
Connection cables	(page 67)

Basic motor



Spur gearheads

- Compactline 90 (page 54)
- Compactline 91 (page 56)
- Compactline 92 (page 58)

Spur gearheads

- Flatline 85 (page 60)

VDC motor.

VDC-49.15-K3



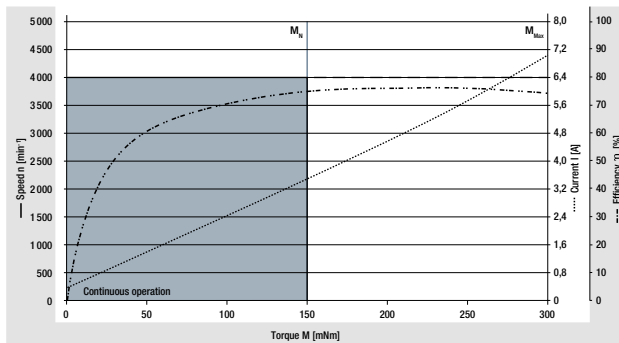
- 3-phase external rotor motor with EC technology
- High-poled motor structure for optimum power density.
- Drive with completely integrated K3 operation and control electronics
- Integrated speed control function
- Interface with analog and digital control inputs
- Very good synchronization characteristics
- Robust mechanical design in IP 54 for industrial applications
- Long lifetime by using precision ball bearings
- Electrical connection via cable with free wire ends

Nominal data

Type		VDC-49.15-K3-B00	VDC-49.15-K3-D00
Nominal voltage (U_N)	V DC	24	48
Nominal speed (n_N)*	min ⁻¹	4 000	
Nominal torque (M_N)*	mNm	150	250
Nominal current (I_N)*	A	3.50	2.75
Nominal output power (P_N)*	W	63.0	105
Starting torque (M_{max})	mNm	300	506
Speed at no-load operation (n_0)	min ⁻¹	4 000	
No-load current (I_0)	A	0.40	0.25
Recommended speed control range	min ⁻¹	0 ... 4 000	
Rotor moment of inertia (J_R)	kgm ² x10 ⁻⁶	108	
Overload protection		integrated	
Permissible ambient temperature range (T_U)	°C	0 ... +40	
Weight	kg	0.59	
Order no. (cable type)**	IP 54	937 4915 600	937 4915 607
Subject to alterations	* At T_U max. 40°C ** Classification of protection class refers to installed state with sealing on the flange side		

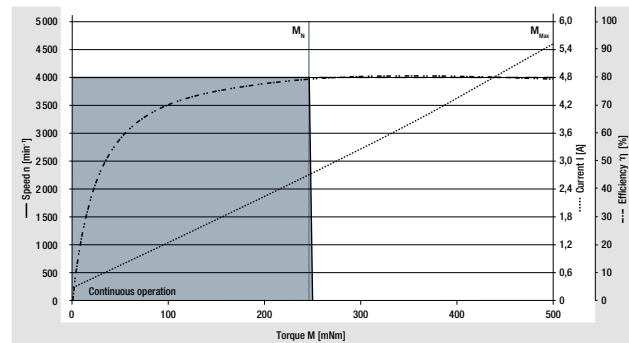
Characteristic curve

VDC-49.15-K3-B00 (at 25°C)

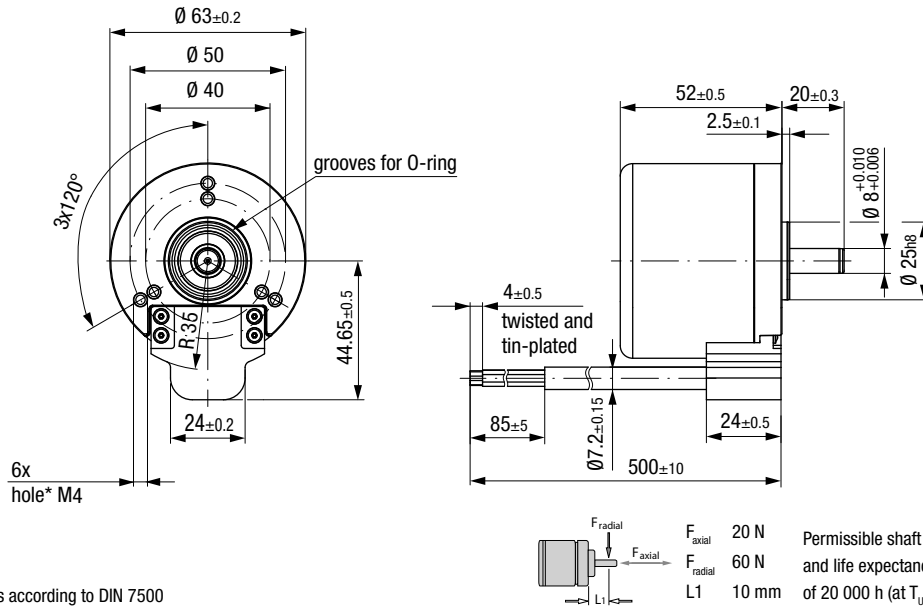


¹⁾ Nominal data, see table

VDC-49.15-K3-D00 (at 25°C)



¹⁾ Nominal data, see table



* For thread-rolling screws according to DIN 7500

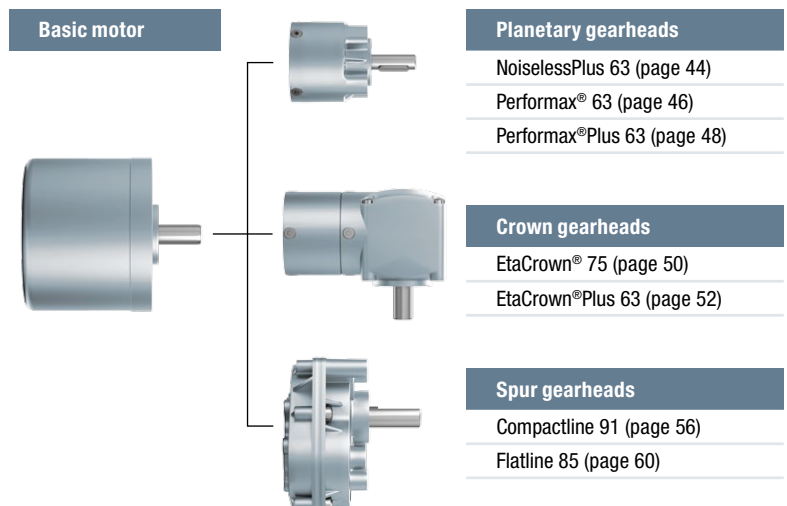
Permissible shaft load at nominal speed and life expectancy L_{10} (nominal operation) of 20 000 h (at T_u max. 40°C)

F_{axial}	20 N
F_{radial}	60 N
$L1$	10 mm

Electrical connection / cable with open wires

	Wire color	Configuration	Function	Recommended AWG
Signal	Blue	GND	Logic power/signal GND	24
	Pink	S1	0 to 10 V – speed set Point	
	Green	TXD	Communication / programming interface	
	White	RXD	Communication / programming interface	
	Grey-Pink	A	Control input A, TTL level	
	Violet	B	Control input B, TTL level	
	Grey	IST	Actual value 1	
	Red-Blue	F+	Frequency specification for speed setpoint	
	Brown	S2	0 to +5 V current limitation (torque)	
	Black	C	Control input C – hardware enable	
	Red	E	Actual value 2	
Yellow	D	Drive status		
Power	Blue	GND	Power supply GND	16
	Brown	+ U_B	Logic power supply	
	Black	U_{2K}	Power supply	

Modular construction kit



VDC motor.

VDC-49.15-K4



- 3-phase external rotor motor with EC technology
- High-poled motor structure for optimum power density.
- Drive with completely integrated K4 operation and control electronics
- Integrated speed, torque and position control
- Selection of operating modes and parameter setting via RS485
- Interface with analog and digital control inputs
- Integrated brake chopper
- Robust mechanical design in IP 54 for industrial applications
- Electrical connection via cable with free wire ends

Nominal data

Type		VDC-49.15-K4-B00	VDC-49.15-K4-D00
Nominal voltage (U_N)	V DC	24	48
Nominal speed (n_N)*	min ⁻¹	4 000	
Nominal torque (M_N)*	mNm	235	300
Nominal current (I_N)*	A	5.20	3.20
Nominal output power (P_N)*	W	99	126
Starting torque (M_{max})	mNm	705	900
Permissible peak current (I_{max})**	A	15.6	9.60
Speed at no-load operation (n_l)	min ⁻¹	5 000	
No-load current (I_l)	A	0.40	0.25
Recommended speed control range	min ⁻¹	0 ... 4 000	
Rotor moment of inertia (J_R)	kgm ² x10 ⁻⁶	108	
Overload protection		integrated	
Permissible ambient temperature range (T_U)	°C	0 ... +40	
Weight	kg	0.59	
Order no. (cable type)***	IP 54	937 4915 400	937 4915 402

Subject to alterations

* At T_U max. 40°C

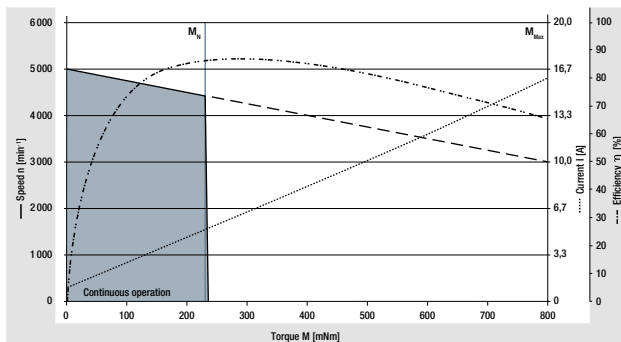
** Permissible time for peak current: max. 1 sec. – to be repeated only after complete cool down

*** Classification of protection class refers to installed state with sealing on the flange side

Preferred type: ready to ship in 48 hours

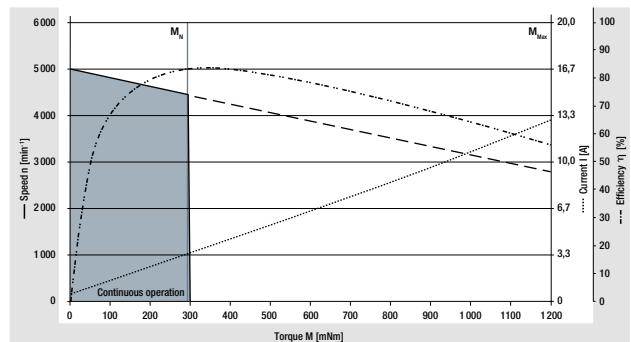
Characteristic curve

VDC-49.15-K4-B00 (at 25°C)

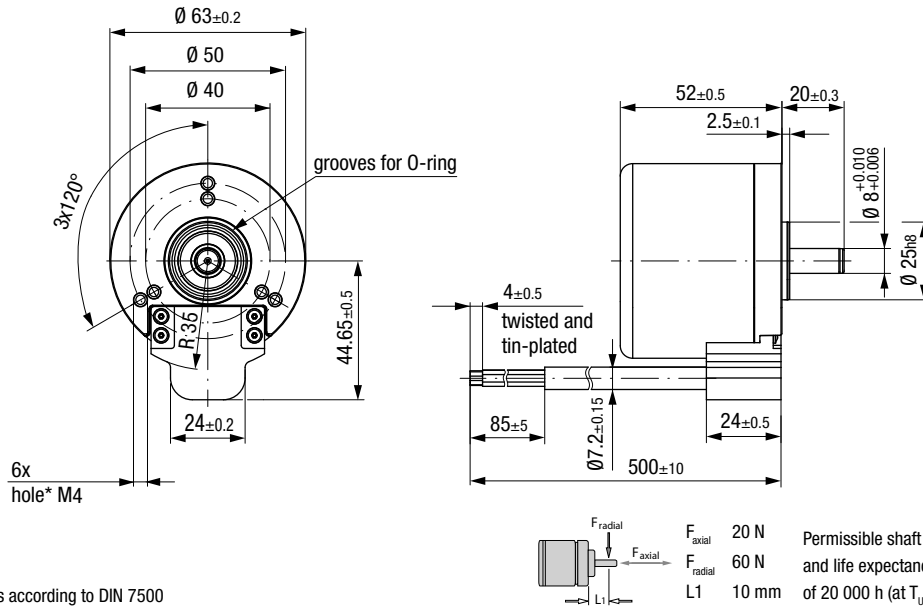


¹⁾ Nominal data, see table

VDC-49.15-K4-D00 (at 25°C)



¹⁾ Nominal data, see table



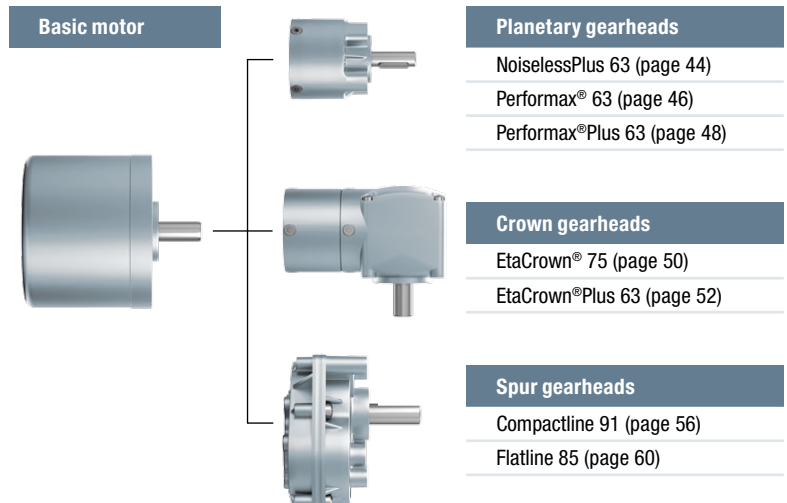
* For thread-rolling screws according to DIN 7500

F_{axial} 20 N
 F_{radial} 60 N
 $L1$ 10 mm
 Permissible shaft load at nominal speed and life expectancy L_{10} (nominal operation) of 20 000 h (at T_u max. 40°C)

Electrical connection / cable with open wires

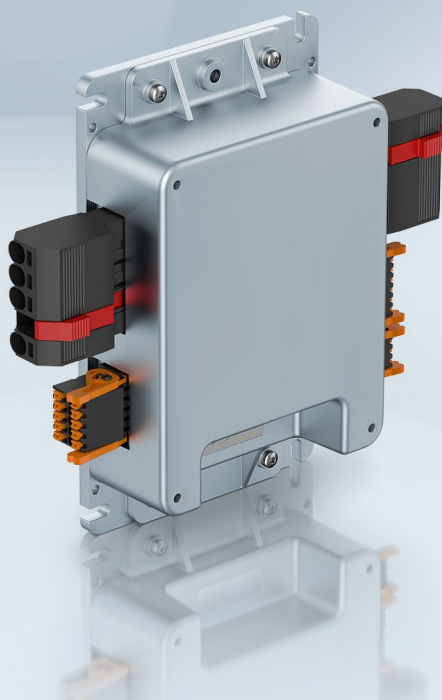
	Wire color	Configuration	Function	Recommended AWG
Signal	white	D-IN-A	NPN 24 V	24
	brown	D-IN-B	NPN 24 V	
	green	D-IN-1	NPN 24 V	
	yellow	D-IN-2	NPN 24 V / analog 0 ... 10 V / brake	
	gray	D-OUT-1	PNP 24 V	
	pink	D-OUT-2	PNP 24 V	
	blue	–	Must not be used	
	red	A-IN-1	0 ... 10 V (differential)	
	black	A-GND	GND for analog IN 1 (differential)	
	violet	RS485 A (+)	Progr. bus	
	gray / pink	RS485 B (-)	Progr. bus	
	red / blue	U_{Logic}	Logic power supply (24 V)	
Power	gray	Ballast	Ballast resistor	16
	brown	U_{ZK}	Power supply	
	black	GND	Power / signal GND	

Modular construction kit





Control electronics.



VTD-XX.XX-K3 (speed)	34
VTD-XX.XX-K4S (position)	36
VTD-60.13-K5SB (CANopen)	38

Control electronics.

VTD-XX.XX-K3



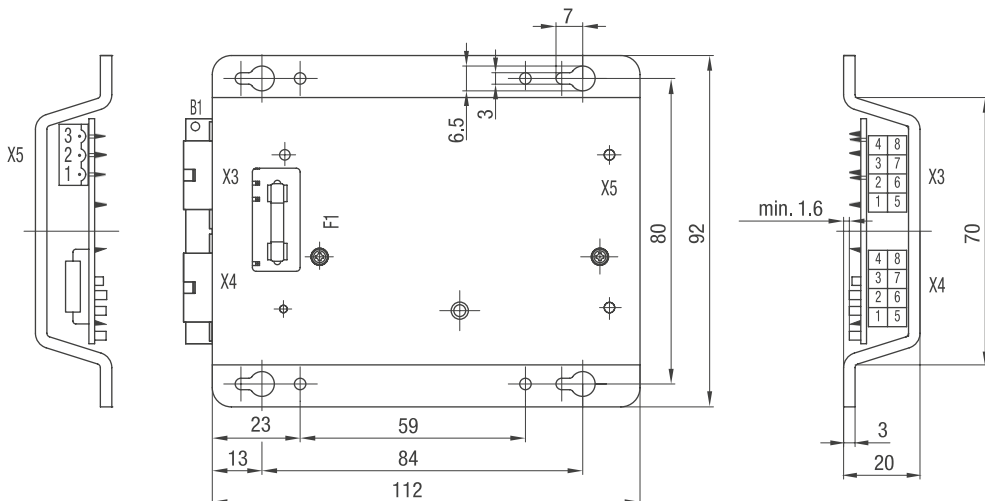
Operating electronics for driving 3-phase BLDC motors from the VD-43.10 / VD-54.14 and VD-49.15 series. Design in digital technology for use as OEM electronics in series applications

- Motor commutation and speed control via microcontroller
- Control parameters are each specifically designed for the motor
- Four-quadrant controller
- Speed setting via analog nominal value 0 ... 10 V DC
- Speed actual value processing and output
- Setting of the operating mode via 2 control inputs
- Monitoring function for output current and voltage

Nominal data			
Type		VTD-24.XX-K3	VTD-48.XX-K3
Nominal voltage (power supply U_N)	V DC	24	48
Permissible supply voltage range (U)	V DC	18 ... 30	30 ... 52
Permissible continuous output current*	A	3-12 depending on model	3-6 depending on model
Maximum commutation frequency	kHz		2
Switching frequency	kHz		20
Minimum connection inductance	mH		0.1
Digital inputs	Number		2
Digital outputs	Number		1
Analog inputs	Number		1
Efficiency (in optimum working range)	%		95
Permissible ambient temperature range (T_U)	°C		0 ... +40
Permissible ambient humidity**	%		5 ... 93
Protection class			IP 00
Weight	kg		0.2
Order number		On request	On request
Subject to alterations	Commutation: block commutation (by means of 3 digital Hall sensors) * Applicable at rated temperature $T_U = 40^\circ\text{C}$ ** Condensation not permitted		

Technical drawing

All dimensions in mm



Electrical connection

Pin	Control plug X3		Motor plug X4		Capacitor plug X5	
1	A	Operating mode	L3	Motor phase	U+	Capacitor connector
2	+U _B	Operating voltage	+U-Hall	Hall sensor supply	U-	Capacitor connector
3	n.c.	Not allocated	RLG2	Hall signal 2	BR	Braking resistor
4	S+	Set value input	RLG1	Hall signal 1		
5	B	Operating mode	L2	Motor phase 2		
6	Actual	Actual speed value	L1	Motor phase 1		
7	GND	Ground	GND Hall	Ground Hall sensor supply		
8	S-	Ground set value input	RLG3	Hall signal 3		

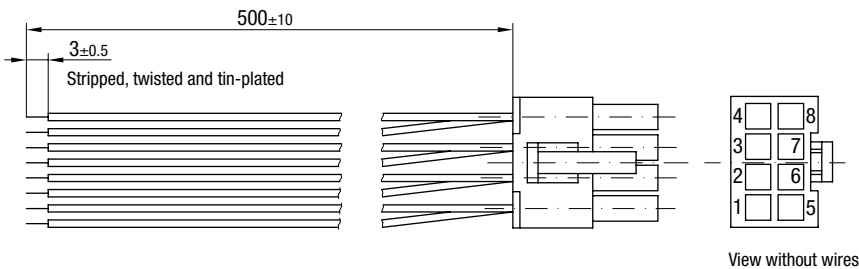
Accessories

Connection cables X3

Type	Order no.
X3 Control plug	194 0017 000

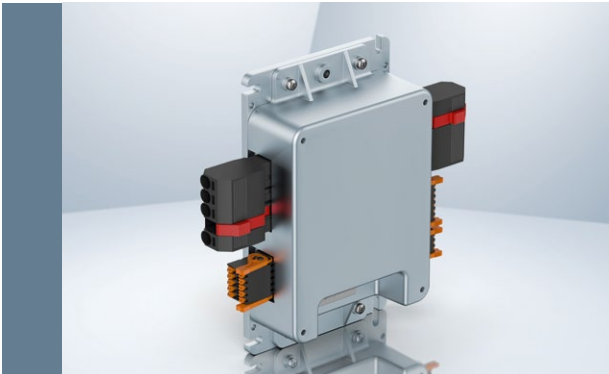
Color assignment

No.	Color	Function
1	white (AWG 20)	A
2	red (AWG 18)	+U _B
3	violet (AWG 20)	n.c.
4	green (AWG 20)	S+
5	gray (AWG 20)	B
6	yellow (AWG 20)	Actual
7	black (AWG 18)	GND
8	brown (AWG 20)	S-



Control electronics.

VTD-XX.XX-K4S

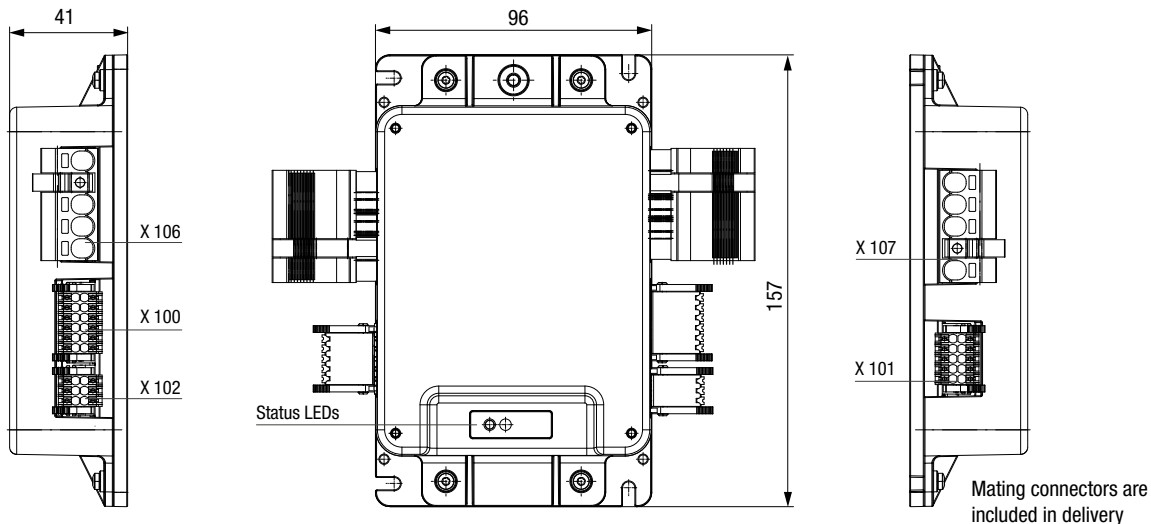


- Operating electronics for driving 3-phase BLDC motors up to 1 000 watt output power
- Four-quadrant controller
- Speed, torque and positioning mode
- Selection of operating modes and parameter setting via RS 485
- User-friendly parameter setting with “Kickstart” PC software
- Integrated brake ballast-control
- Device status notification by 2 LEDs

Nominal data			
Type		VTD-24.40-K4S	VTD-48.20-K4S
Nominal voltage (power supply U_N)	V DC	24	48
Permissible supply voltage range (U)	V DC	18 ... 30	18 ... 53
Maximum output current (max. 5 sec)*	A	100	
Permissible continuous output current*	A	40 ± 10%	20 ± 10%
Nominal voltage (Logic supply U_L)	V DC	24	
Logic current draw** (at 24 V DC)	mA	< 100	
Maximum commutation frequency	kHz	2	
Switching frequency	kHz	20	
Minimum connection inductance	mH	0.10	
Digital inputs	Number	4	
Digital outputs	Number	3	
Analog inputs	Number	1	
Parameterization interface		RS 485	
Efficiency (in optimum working range)	%	> 95	
Permissible ambient temperature range (T_U)	°C	-30 ... +40	
Permissible ambient humidity***	%	5 ... 85	
Protection class		IP 20	
Weight	kg	approx. 0.50	
Order number (IP 20)		994 2440 000	994 4820 000
Subject to alterations	* Applicable at rated temperature $T_U = 25^\circ\text{C}$, Derating at deviating (higher) temperatures		
	** Current draw without current requirement of digital outputs		
Series planned for 2nd q/2017	*** Condensation not permitted		

Technical drawing

All dimensions in mm



Electrical connection

Pin	X100 Signals Logic supply	X101 Hall sensors	X102 Parameterization interface	X106 Power supply, controller	X107 Power supply, motor
1	D-OUT-1	+U Hall (5V)	FE	Ballast	U
2	D-OUT-2	GND	RS485 B (-)	P-GND	V
3	D-OUT-3	Hall A	RS485 A (+)	U _{ZK}	W
4	U _{Logic}	Hall B		FE	FE
5	GND	Hall C			
6	FE (Functional earth)	+U _{sin/cos} (5V)			
7	D-IN-A	GND			
8	D-IN-B	SIN			
9	D-IN-1	COS			
10	D-IN-2	FE			
11	A-IN-1				
12	A-IN-GND				

Accessories

Commissioning tool

“Kickstart” (page 64)

“Kickstart” PC software for commissioning/ parametrization of the drive controller

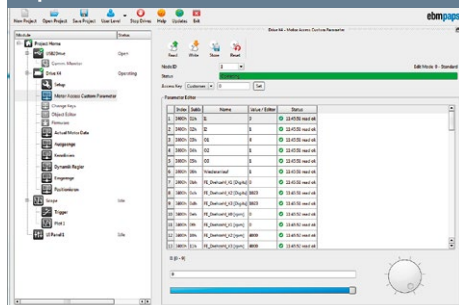
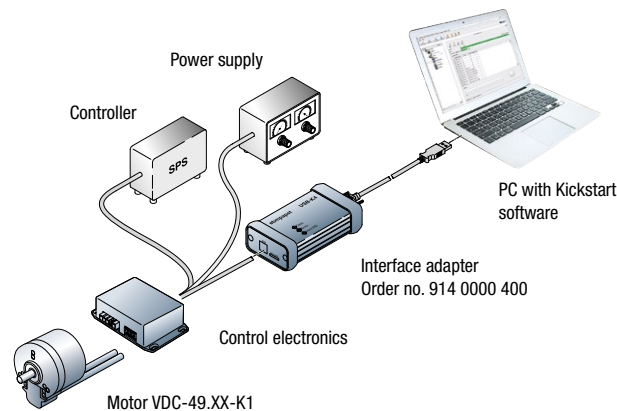


Image of “Kickstart” PC software



Commissioning setup

Control electronics.

VTD-60.13-K5SB

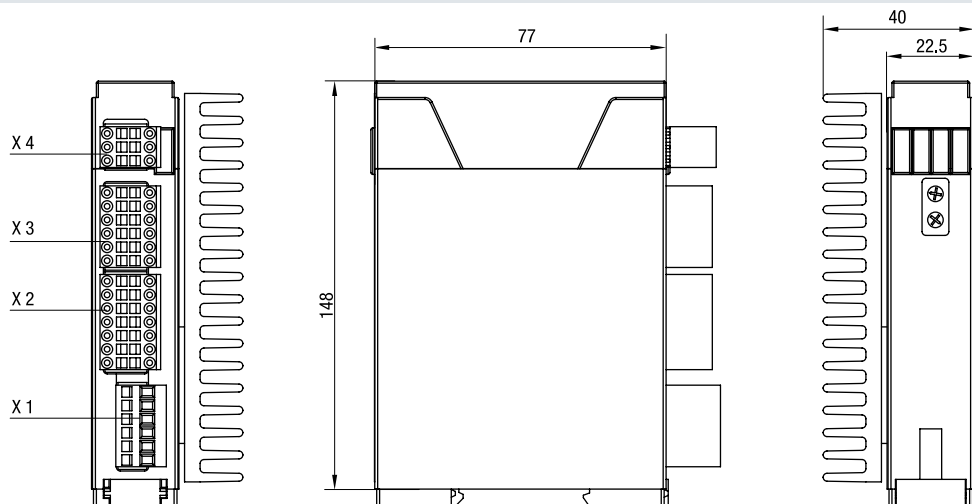


- Compact four-quadrant controller for BLDC motors
- CANopen interface (Protocol DS301, Device profile DS402)
- Integrated digital inputs
- Integrated digital outputs
- Integrated analog inputs
- Overvoltage, undervoltage and overtemperature monitoring
- Device status notification by 3 LEDs (Power, Status, Error)
- Hex switch for setting the device node ID
- Freely programmable due to built in MPU (Motion Process Unit)

Nominal data			
Type		VTD-60.13-K5SB	
Nominal voltage (Power supply U_N)	V DC	24	48
Permissible supply voltage range (U)	V DC	9 ... 60	
Maximum output current*	A	50	
Permissible continuous output current*	A	12.5 (at 24 V)	12.5 (at 24 V)
Nominal voltage (Logic supply U_L)	V DC	9 ... 30	
Logic current draw** (at 24 V DC)	mA	60	
Maximum commutation frequency	kHz	2	
Switching frequency	kHz	32	
Minimum connection inductance	mH	0.20	
Digital inputs	Number	8	
Digital outputs	Number	2	
Analog inputs	Number	2	
Parameterization interface		CANopen	
Efficiency (in optimum working range)	%	95	
Permissible ambient temperature range (T_U)	°C	0 ... +70	
Permissible ambient humidity***	%	5 ... 85	
Protection class		IP 20	
Weight	kg	0.31	
Order number (IP 20)		994 6013 000	
Subject to alterations	Commutation: block commutation (by means of 3 digital Hall sensors)		
	* Applicable at rated temperature $T_U = 25^\circ\text{C}$, Derating at deviating (higher) temperatures		
	** Current draw without current requirement of digital outputs		
	*** Condensation not permitted		

Technical drawing

All dimensions in mm



Mating connectors are included in delivery

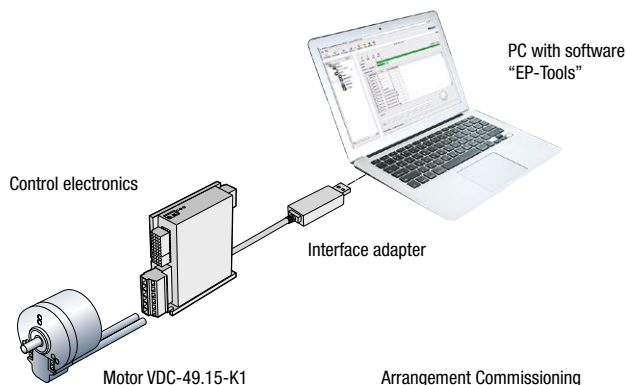
Electrical connection

Pin	X1	Motor	X2	Hall sensors and encoder	X3	I/O's and CAN	X4	I/O's
1	FE	Functional earth	H1	Hall sensor signal 1	U _{Logic}	Power supply Electronics	A-IN-1	Analog input 1
2	+Up	Power supply Power	H2	Hall sensor signal 2	A-IN-0 +	Analog input 0, plus	D-IN-4	Digital input 4
3	GND	Ground for power supply voltage	H3	Hall sensor signal 3	D-IN-0	Digital input 0	D-IN-5	Digital input 5
4	Ma	Motor phase A	A	Incremental encoder – A channel	D-IN-1	Digital input 1	D-IN-6	Digital input 6
5	Mb	Motor phase B	B	Incremental encoder – B channel	D-IN-2	Digital input 2	D-OUT-1	Digital output 1
6	Mc	Motor phase C	Inx	Incremental encoder – index channel	D-IN-3	Digital input 3	D-IN-7	Digital input 7
7			+U _{sv}	5V auxiliary voltage (Hall and encoder)	GND	Ground for electronic supply voltage		
8			/H1	Hall sensor signal 1 inverted	A-IN-0 -	Analog input 0, minus		
9			/H2	Hall sensor signal 2 inverted	D-OUT-0	Digital output 0		
10			/H3	Hall sensor signal 3 inverted	CAN Hi	CAN High		
11			/A	Incremental encoder – A channel inverted	CAN Lo	CAN Low		
12			/B	Incremental encoder – B channel inverted	CAN GND	CAN Ground		
13			/Inx	Incremental encoder – index channel inverted				
14			GND	Ground for auxiliary voltage				

Accessories

Commissioning tool

“EP-Tools” (page 65)





Gearheads.



NoiselessPlus 63 (planetary gearhead)	44
Performax® 63 (planetary gearhead)	46
Performax®Plus 63 (planetary gearhead)	48
EtaCrown® 75 (crown gearhead)	50
EtaCrown®Plus 63 (crown gearhead)	52
Compactline 90 (spur gearhead)	54
Compactline 91 (spur gearhead)	56
Compactline 92 (spur gearhead)	58
Flatline 85 (spur gearhead)	60
Information on operating factor, lifetime, efficiency	70

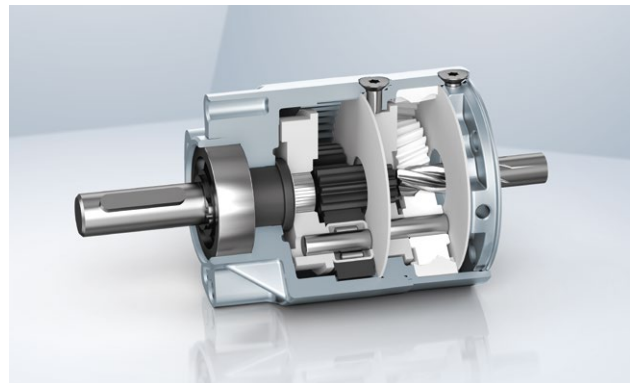
Information for gearheads.

In the gearbox product range, we offer three types of transmission technologies. These include planetary gearing, crown gearhead units and spur gears, all individually adapted to the requirements of the customer according to the modular principle. Deciding which of these technologies will render the best results for the respective application, ultimately depends on the application itself.

Characteristics of the individual transmission technologies:

Planetary gearheads

- Higher reduction ratios within first and second stage
- Very quiet operation
- Extremely high performance
- Compact design
- No offset axle
- Comprehensive range of products with three model types
 - Noiseless Plus – unique quiet operation
 - Performax® – extreme performance
 - Optimax – robust and long lifetime



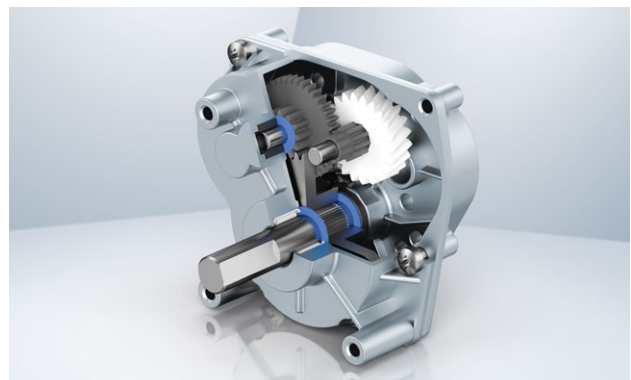
Crown gearheads

- Outstanding efficiency
- Large reduction ratio range
- No self-locking
- Highest power density
- No offset axle
- Two different model ranges
 - EtaCrown®
 - EtaCrown® Plus



Spur gearheads

- Highest power density
- Flat, compact design
- Large reduction ratio range
- High radial loads permitted
- Good price/performance ratio
- Two different model ranges
 - Flat-line
 - Compact-line



The comprehensive range of **planetary gearbox** products is used when the application does not allow axle misalignment. When it comes to achieving high efficiency with minimal noise, the **NoiselessPlus** is the impressive obvious choice. Exemplary smooth running is achieved thanks to extremely sturdy, low-wear plastic planetary wheels in an aluminium housing with bevelled teeth. Double ball bearing output shafts efficiently absorb the forces acting on the shaft at high radial loads. The output shafts of the NoiselessPlus gearheads are made of hardened and ground case-hardened steel and are thus particularly durable.

Performax® is an innovative, patent-pending concept of high-performance **planetary gearheads**.

With its pioneering design, Performax® gearheads are popular for their outstanding power density, ultimate smoothness and unique reduction ranges. Transmissions of up to 17:1 in one stage allow the use of single-stage gearheads, whereas competitors' products already require a two-stage design. The design features of the series include helical plastic gear wheels in the first stage and in the second stage, straight toothing in the zinc diecast casting with case-hardened planetary wheels. Another special standard feature of Performax® gearheads is the planetary wheels of the second stage.

These have needle bearings, which really sets the series apart from the regular planetary gearheads available on the market.

EtaCrown® is the name of the innovative **angular gear** with crown gearhead technology.

Our vision of making crown gearheads smaller, more powerful and more efficient, and above all to manufacture them more economically, is now a reality. EtaCrown® significantly improves energy efficiency and cost-effectiveness of drive solutions. The modular design can be flexibly adapted for any drive task. Characteristic is its very compact design and space-saving geometry with a symmetrical structure and maximum performance density. Transmissions of 4:1 to 113:1 are available as standard. Also standard is jolt-free start-up due to rolling tooth gripping. Smooth running due to intelligent gear-tooth technology and gearhead design, while maximum radial load thanks to double-sided support of the drive shaft are also part of its features. A special feature among angular drives is the self-locking capacity, which does not exist in the technology. In contrast to other gearbox technologies, this offers optimal protection against vandalism.

The range of gearboxes is rounded off by the **spur gearhead systems** of the **Flatline** and **Compactline** series.

In the first transmission stage, these have helically toothed plastic wheels, thus achieving optimum noise reduction. The following gear stages are optimally configured in terms of running noise and torque to be transferred. Ground and hardened output shafts and hardened gearwheels are standard in all Flatline series gearheads. Die-cast zinc is used as a housing material. Gearheads of the Flatline design are particularly suitable for use in applications with limited installation lengths. In drives of the Compactline series, where the wheel widths were dimensioned in order to minimise noise particularly in the first stage, due attention was paid to having the greatest possible wheel width and therefore to a good contact ratio between the motor shaft and the combing gearwheel.

Planetary gearheads.

NoiselessPlus 63



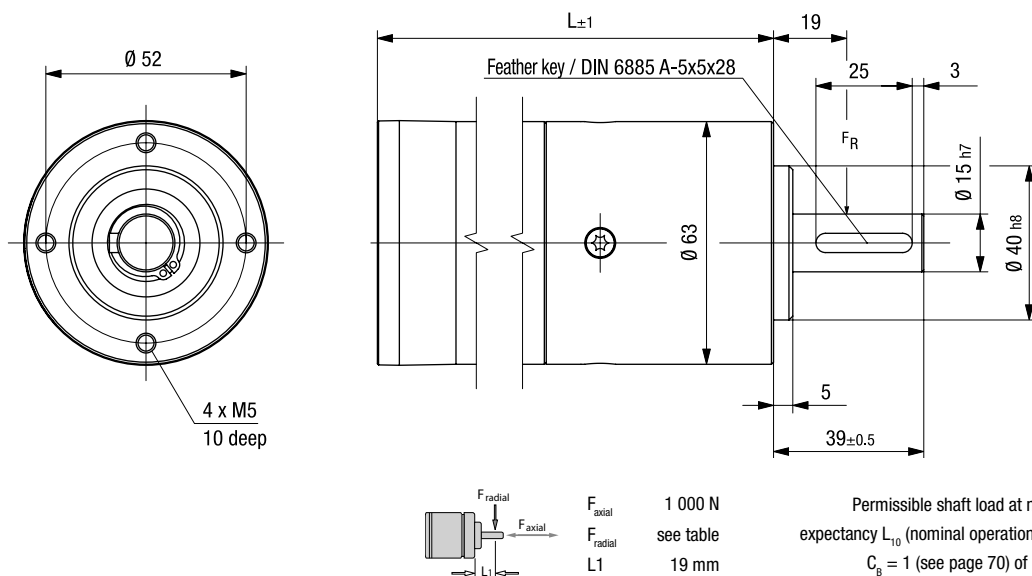
Image of 1-stage gearhead

- Very quiet operation due to helical-tooth gear stages
- Toothed parts made of plastic with optimized sliding properties ensure smooth operation
- Higher reduction ratios within first and second gear stage
- High radial loads due to double ball bearing in the output shaft
- Flexible connection to customer applications (shaft variants, centering and fastening)

Nominal data									
Gearheads		NoiselessPlus 63.1				NoiselessPlus 63.2			
Reduction ratio		4.30	6.00	11.0	21.0	26.0	47.0	66.0	121
No. of stages		1				2			
Efficiency		0.90				0.81			
Max. input speed (n_i)	rpm	6 000				6 000			
Rated output torque (M_{ab})	Nm	8.99	7.13	3.98	1.32	12.6	14.7	17.5	10.6
Short-term torque (M_{max})	Nm	22.5	17.8	9.95	3.30	31.5	36.8	43.8	26.5
Gear play	°	0.2 ... 0.5				0.2 ... 0.5			
Permissible operating temperature (T_{p})	°C	-20 ... +80				-20 ... +80			
Operating mode		S1				S1			
Protection class		IP 50				IP 50			
Weight	kg	0.56				0.80			
Shaft load radial / axial	N	50 / 1 000	50 / 1 000	50 / 1 000	100 / 1 000	780 / 1 000	1 000 / 1 000	1 100 / 1 000	1 550 / 1 000
Service life	h	10 000				10 000			
Lubrication		Maintenance-free grease lubrication for life							
Installation position		any							
Subject to alterations									
Preferred type: ready to ship in 48 hours		on request							

Technical drawing

Image of 1-stage gearhead / All dimensions in mm



Length of the possible motor / gearhead combinations

Motor / gearhead		L - 1-stage	L - 2-stage
VD-49.15-K1-NP63	mm	120	152
VDC-49.15-K3-NP63	mm	120	152
VDC-49.15-K4-NP63	mm	120	152

Subject to alterations

Planetary gearheads.

Performax® 63



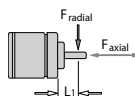
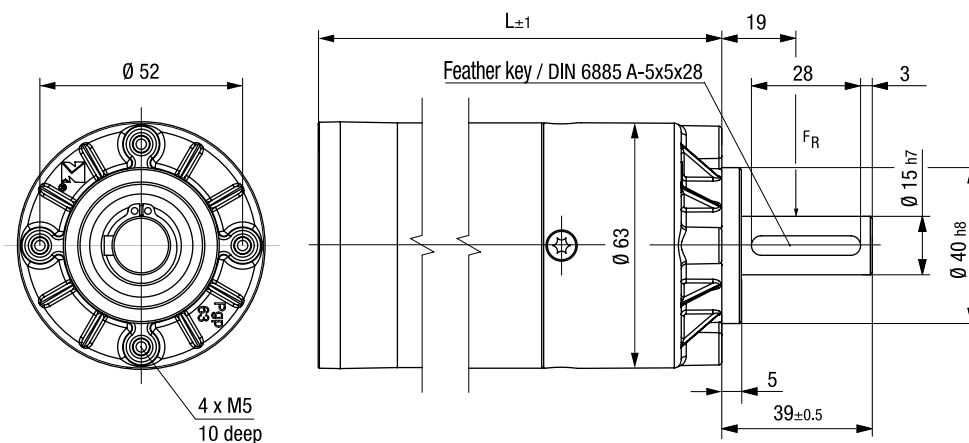
- High power density from compact dimensions
- Very quiet operation due to helical teeth in the first gear stage
- Planetary wheels made of plastic with optimized sliding properties in the first stage ensure smooth operation
- Large effective diameter thanks to radial screw connection
- Economical setup due to use of many individual parts which are readily available on the market

Image of 1-stage gearhead

Nominal data											
Gearheads		Performax® 63.1				Performax® 63.2					
Reduction ratio		5.00	9.00	17.0	21.25	30.0	38.25	54.0	72.3	102	204
No. of stages		1				2					
Efficiency		0.90				0.81					
Max. input speed (n_i)	rpm	6 000				6 000					
Rated output torque (M_{ab})	Nm	6.91	2.20	1.50	12.0	37.3	8.30	11.8	5.90	8.30	16.5
Short-term torque (M_{max})	Nm	17.3	5.50	3.75	30.0	42.5	20.8	29.5	14.8	20.8	41.3
Gear play	°	0.7 ... 1.2				0.7 ... 1.2					
Permissible operating temperature (T_{ν})	°C	-20 ... +80				-20 ... +80					
Operating mode		S1				S1					
Protection class		IP 50				IP 50					
Weight	kg	0.40				0.60					
Shaft load radial / axial	N	350 / 500				350 / 500					
Service life	h	5 000				5 000					
Lubrication		Maintenance-free grease lubrication for life									
Installation position		any									
Subject to alterations											
Preferred type: ready to ship in 48 hours		on request									

Technical drawing

Image of 1-stage gearhead / 2-stage design completely cylindrical / All dimensions in mm



F_{axial} 500 N
 F_{radial} 350 N
 $L1$ 19 mm

Permissible shaft load at nominal speed and life expectancy L_{10} (nominal operation) and operating factor $C_g = 1$ (see page 70) of 5 000 h (at T_u 40°C).

Length of the possible motor / gearhead combinations

Motor / gearhead		L - 1-stage	L - 2-stage
VDC-49.15-K3-P63	mm	107	128
VDC-49.15-K4-P63	mm	107	128

Subject to alterations

Planetary gearheads.

Performax®Plus 63



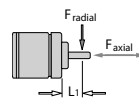
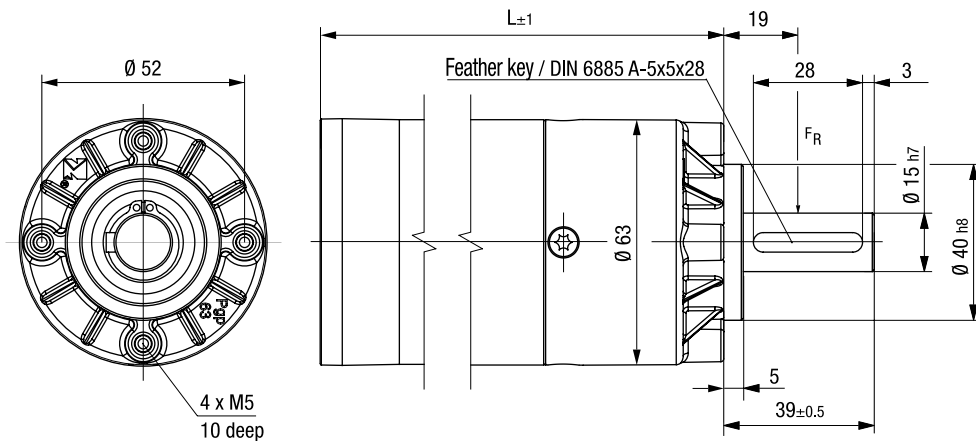
- High torques thanks to large gearing width in the first gear stage
- Good shock resistance due to housing made of case-hardened steel with linear tooth profile in the output stage
- Very quiet operation due to helical teeth in the first gear stage
- Planetary wheels made of plastic with optimized sliding properties in the first stage ensure smooth operation
- Large effective diameter thanks to radial screw connection

Image of 2-stage gearhead

Nominal data												
Gearheads		Performax®Plus 63.1					Performax®Plus 63.2					
Reduction ratio		3.20	5.00	9.00	17.0	21.3	30.0	38.3	54.0	72.3	102	204
No. of stages		1					2					
Efficiency		0.90					0.81					
Max. input speed (n_i)	rpm	6 000					6 000					
Rated output torque (M_{ab})	Nm	6.50	11.9	7.60	4.40	45.2	64.0	28.9	41.0	16.9	23.9	27.4
Short-term torque (M_{max})	Nm	16.3	29.8	19.0	11.0	113	160	72.3	102.5	42.3	59.8	68.5
Gear play	°	0.7 ... 1.2					0.7 ... 1.2					
Permissible operating temperature (T_{ν})	°C	-20 ... +80					-20 ... +80					
Operating mode		S1					S1					
Protection class		IP 50					IP 50					
Weight	kg	0.66					1.20					
Shaft load radial / axial	N	350 / 500					350 / 500					
Service life	h	5 000					5 000					
Lubrication		Maintenance-free grease lubrication for life										
Installation position		any										
Subject to alterations												
Preferred type: ready to ship in 48 hours		on request										

Technical drawing

Image of 1-stage gearhead / 2-stage design completely cylindrical / All dimensions in mm



F_{axial} 500 N
 F_{radial} 350 N
 L_1 19 mm

Permissible shaft load at nominal speed and life expectancy L_{10} (nominal operation) and operating factor $C_g = 1$ (see page 70) of 5 000 h (at T_u 40°C).

Length of the possible motor / gearhead combinations

Motor / gearhead		L - 1-stage	L - 2-stage
VDC-49.15-K3-PP63	mm	119	140
VDC-49.15-K4-PP63	mm	119	140

Subject to alterations

Crown gearheads.

EtaCrown® 75



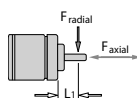
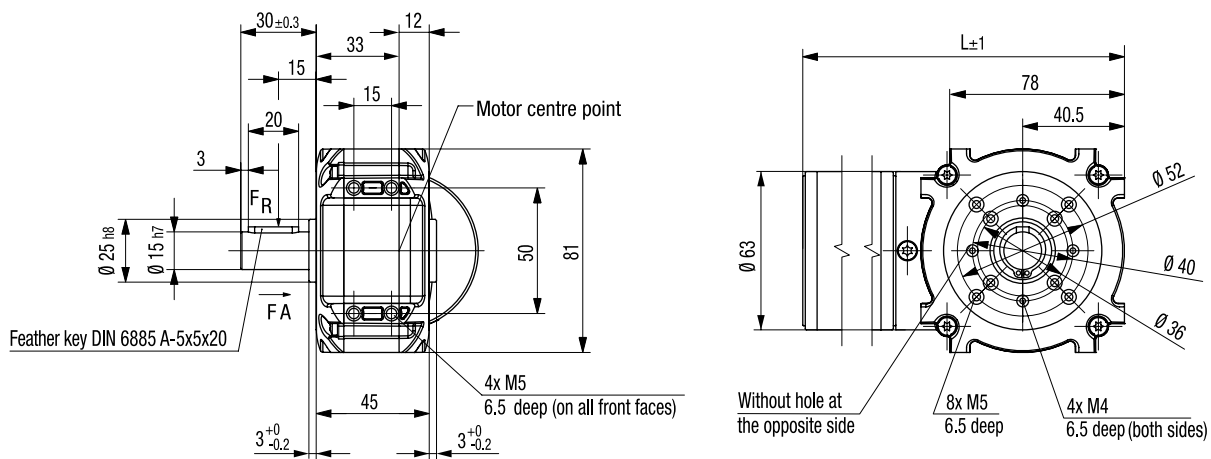
Image of 2-stage gearhead

- Maximum safety in design and operation, as well as optimal vandalism protection; no automatic lock due to high efficiency of the crown wheel technology
- Space-saving installation due to zero offset axle and symmetrical structure
- Flexible application possibilities with various optional shaft outlets and available shaft geometries
- Wide reduction range by means of upstream / downstream planetary stage
- High radial loads due to double ball bearing in the output shaft

Nominal data								
Gearheads		EtaCrown® 75.1				EtaCrown® 75.2		
Reduction ratio		4.10	6.70	10.1	20.3	33.3	60.0	113
No. of stages		1				2		
Efficiency		0.90				0.81		
Max. input speed (n_i)	rpm	6 000				6 000		
Rated output torque (M_{ab})	Nm	6.00	5.00	2.43	10.0	10.0	10.0	10.0
Short-term torque (M_{max})	Nm	15.0	12.5	6.08	25.0	25.0	25.0	25.0
Gear play	°	0.55 ... 1.10				0.55 ... 1.10		
Permissible operating temperature (T_{ν})	°C	-20 ... +80				-20 ... +80		
Operating mode		S1				S1		
Protection class		IP 50				IP 50		
Weight	kg	0.90				1.30		
Shaft load radial / axial	N	150 / 500	250 / 500	400 / 500	550 / 500	800 / 500	1 100 / 500	1 300 / 500
Service life	h	5 000				5 000		
Lubrication		Maintenance-free grease lubrication for life						
Installation position		any						
Subject to alterations								
Preferred type: ready to ship in 48 hours		on request						

Technical drawing

Image of 1-stage gearhead with right shaft end (W05) / All dimensions in mm



F_{axial} 500 N
 F_{radial} see table
 $L1$ 15 mm

Permissible shaft load at nominal speed and life expectancy L_{10} (nominal operation) and operating factor $C_g = 1$ (see page 70) of 5 000 h (at T_u 40°C).

Shaft end, right (W05) (standard)	Shaft end, left (W06)	Shaft end, both sides (W07)	Hollow shaft (W08)
			 Hollow shaft \varnothing 10 mm

Length of the possible motor / gearhead combinations

Motor / gearhead	L - 1-stage		L - 2-stage
VDC-49.15-K4-E75	mm	152	188
Subject to alterations			

Crown gearheads.

EtaCrown®Plus 63

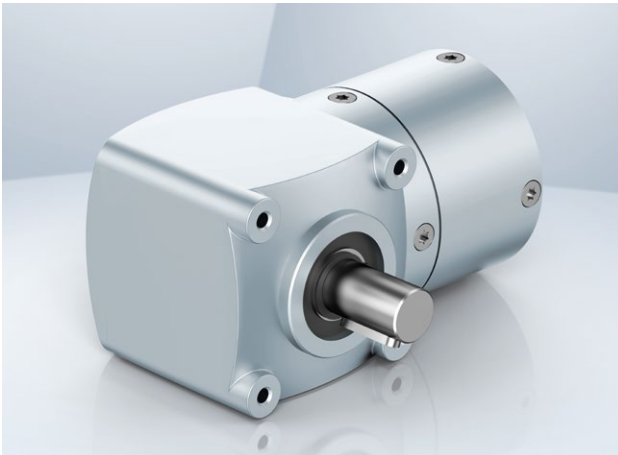


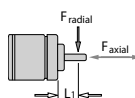
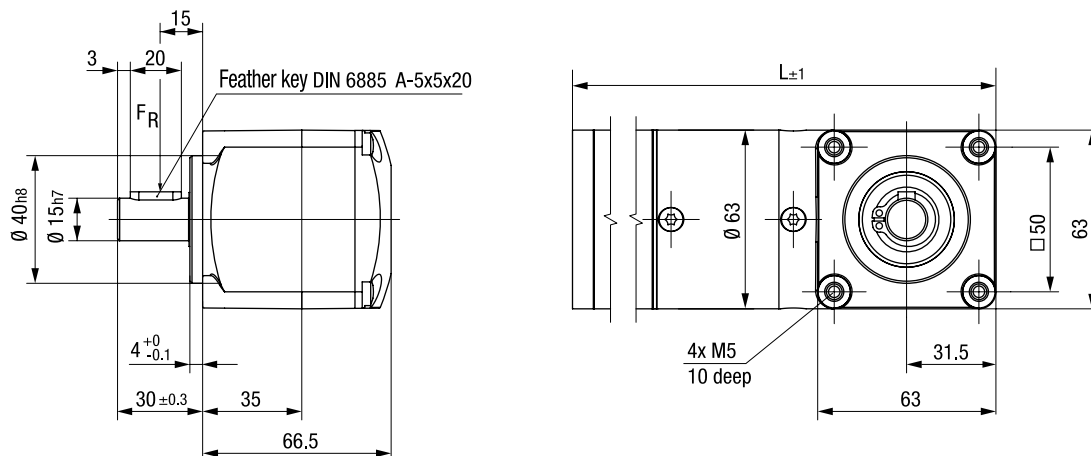
Image of 3-stage gearhead

- Compact design due to combination of the crown wheel and planetary stage in one housing
- No automatic lock due to high efficiency of the crown wheel technology
- High torques by using 5 straight toothed planetary gears made of case-hardened sintered steel in the integrated planetary gear stage
- Wide reduction range thanks to possibility of an upstream planetary stage
- Improved quiet operation thanks to the optimized design of the crown wheel stage when using an upstream helical planetary gear stage made of plastic with optimized sliding properties

Nominal data		EtaCrown®Plus 63.3			
Gearheads					
Reduction ratio		54.0	84.8	153	289
No. of stages		3			
Efficiency		0.73			
Max. input speed (n_i)	rpm	6 000			
Rated output torque (M_{ab})	Nm	40.0	40.0	30.1	29.1
Short-term torque (M_{max})	Nm	100	100	75.3	72.8
Gear play	°	0.7 ... 1.2			
Permissible operating temperature (T_{op})	°C	-20 ... +80			
Operating mode		S1			
Protection class		IP 50			
Weight	kg	1.00			
Shaft load radial / axial	N	600 / 300			
Service life	h	5 000			
Lubrication		Maintenance-free grease lubrication for life			
Installation position		any			
Subject to alterations					
Preferred type: ready to ship in 48 hours		on request			

Technical drawing

Image of 3-stage gearhead / All dimensions in mm



F_{axial}	300 N
F_{radial}	600 N
L_1	15 mm

Permissible shaft load at nominal speed and life expectancy L_{10} (nominal operation) and operating factor $C_g = 1$ (see page 70) of 5 000 h (at T_u 40°C).

Length of the possible motor / gearhead combinations

Motor / gearhead	L - 3-stage	
VDC-49.15-K4-EP63	mm	177
Subject to alterations		

Spur gearheads.

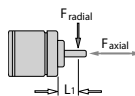
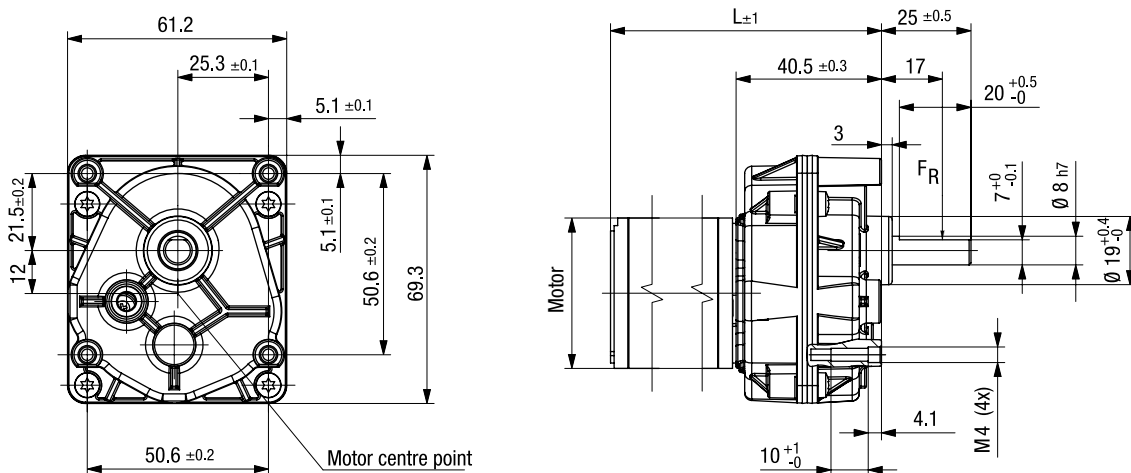
Compactline 90



- Minimum space requirement due to compact design
- High power density
- High torques from the smallest possible dimensions
- Very quiet operation thanks to optimized gear geometries and materials
- Maintenance-free over entire service life

Nominal data		Compactline 90.2		Compactline 90.3			Compactline 90.4	
Gearheads								
Reduction ratio		16.0	32.0	57.8	79.1	121.6	189.3	368
No. of stages		2		3			4	
Efficiency		0.81		0.73			0.66	
Max. input speed (n_1)	rpm	4 000		4 000			4 000	
Rated output torque (M_{ab})	Nm	1.90	3.80	6.20	7.00	7.00	9.00	9.00
Short-term torque (M_{max})	Nm	4.75	9.50	15.50	17.5	17.5	22.5	22.5
Gear play	°	0.70 ... 1.60		0.70 ... 1.60			0.70 ... 1.60	
Permissible operating temperature (T_{ij})	°C	-20 ... +80		-20 ... +80			-20 ... +80	
Operating mode		S1		S1			S1	
Protection class*		IP 50		IP 50			IP 50	
Weight	kg	0.30		0.35			0.40	
Shaft load radial / axial	N	120 / 40		120 / 40			120 / 40	
Service life	h	5 000		5 000			5 000	
Lubrication		Maintenance-free grease lubrication for life						
Installation position		any						
Subject to alterations on request		* Classification of protection class refers to installed state with sealing on the flange side						

Technical drawing All dimensions in mm



F_{axial} 40 N
 F_{radial} 120 N
 $L1$ 17 mm

Permissible shaft load at nominal speed and a life expectancy L_{10} (nominal operation) and operating factor $C_0 = 1$ (see page 70) of 5 000 h (at T_u 40°C).

Length of the possible motor / gearhead combinations		
Motor / gearhead	L	
VD-43.10-K1-C90	mm	81
VDC-43.10-K3-C90	mm	82
VD-54.14-K1-C90	mm	84
VDC-54.14-K3-C90	mm	84
Subject to alterations		

Spur gearheads.

Compactline 91

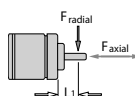
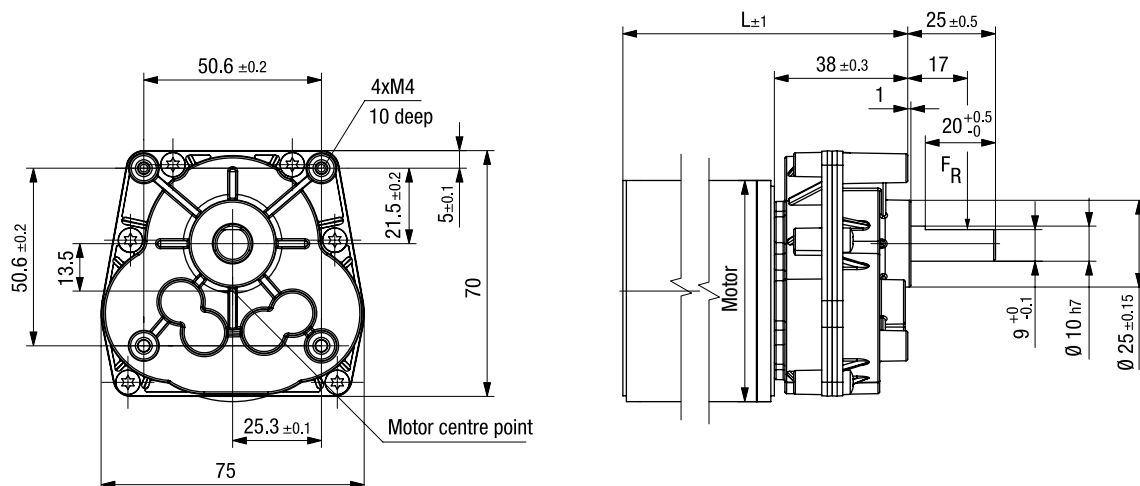


- Minimum space requirement due to compact design
- High power density
- High torques from the smallest possible dimensions
- Very quiet operation thanks to optimized gear geometries and materials
- Maintenance-free over entire service life

Nominal data		Compactline 91.2					Compactline 91.3		
Gearheads									
Reduction ratio (for motor 43.10 / 54.14)					11.3	26.4	38.6	117.1	165.8
No. of stages (for motor 49.15)		9.20	18.4	27.6					
No. of stages		2			3				
Efficiency		0.81			0.73				
Max. input speed (n_i)	rpm	4 000			4 000				
Rated output torque (M_{ab})	Nm	7.00			9.00				
Short-term torque (M_{max})	Nm	17.5			22.5				
Gear play	°	0.70 ... 1.20			0.70 ... 1.20				
Permissible operating temperature (T_{ij})	°C	-20 ... +80			-20 ... +80				
Operating mode		S1			S1				
Protection class*		IP 50			IP 50				
Weight	kg	0.30			0.30				
Shaft load radial / axial	N	150 / 50			150 / 50				
Service life	h	5 000			5 000				
Lubrication		Maintenance-free grease lubrication for life							
Installation position		any							
Subject to alterations		* Classification of protection class refers to installed state with sealing on the flange side							
Preferred type: ready to ship in 48 hours		on request							

Technical drawing

All dimensions in mm



F_{axial} 50 N
 F_{radial} 150 N
 $L1$ 17 mm

Permissible shaft load at nominal speed and a life expectancy L_{10} (nominal operation) and operating factor $C_b = 1$ (see page 70) of 5 000 h (at T_u 40°C).

Length of the possible motor / gearhead combinations

Motor / gearhead		L
VD-43.10-K1-C91	mm	79
VDC-43.10-K3-C91	mm	79
VD-54.14-K1-C91	mm	81
VDC-54.14-K3-C91	mm	81
VDC-49.15-K3-C91	mm	99
VDC-49.15-K4-C91	mm	99

Subject to alterations

Spur gearheads.

Compactline 92

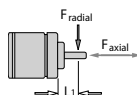
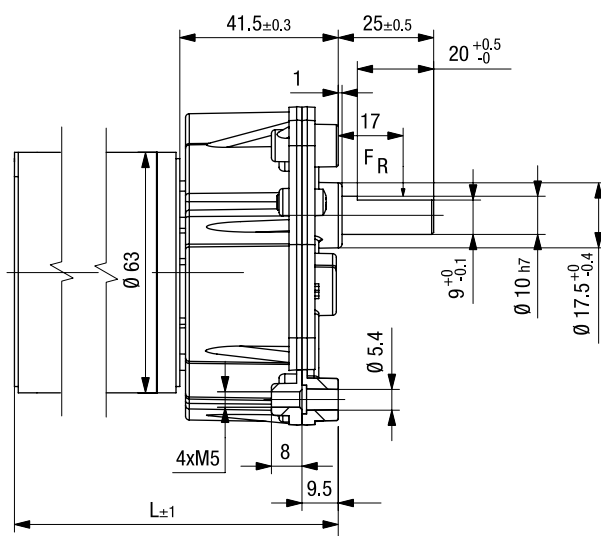
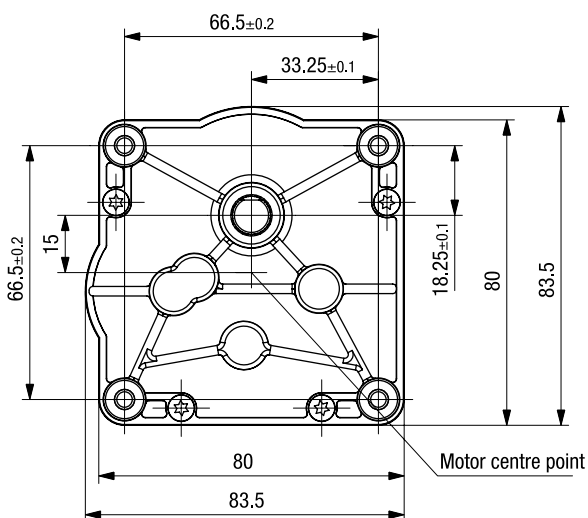


- Minimum space requirement due to compact design
- High power density
- High torques from the smallest possible dimensions
- Very quiet operation thanks to optimized gear geometries and materials
- Maintenance-free over entire service life

Nominal data					
Gearheads		Compactline 92.2		Compactline 92.3	
Reduction ratio		22.2	32.4	75.6	163
No. of stages		2		3	
Efficiency		0.81		0.73	
Max. input speed (n_i)	rpm	4 000		4 000	
Rated output torque (M_{ab})	Nm	4.30	6.30	13.20	15.0
Short-term torque (M_{max})	Nm	10.8	15.75	33.0	37.5
Gear play	°	0.70 ... 1.20		0.70 ... 1.20	
Permissible operating temperature (T_{ly})	°C	-20 ... +80		-20 ... +80	
Operating mode		S1		S1	
Protection class*		IP 50		IP 50	
Weight	kg	0.40		0.50	
Shaft load radial / axial	N	150 / 50		150 / 50	
Service life	h	5 000		5 000	
Lubrication		Maintenance-free grease lubrication for life			
Installation position		any			
Subject to alterations		* Classification of protection class refers to installed state with sealing on the flange side			
Preferred type: ready to ship in 48 hours		on request			

Technical drawing

All dimensions in mm



F_{axial} 50 N
 F_{radial} 150 N
 $L1$ 17 mm

Permissible shaft load at nominal speed and a life expectancy L_{10} (nominal operation) and operating factor $C_g = 1$ (see page 70) of 5 000 h (at T_u 40°C).

Length of the possible motor / gearhead combinations

Motor / gearhead	L	
VD-54.14-K1-C92	mm	85
VDC-54.14-K3-C92	mm	85
Subject to alterations		

Spur gearheads.

Flatline 85

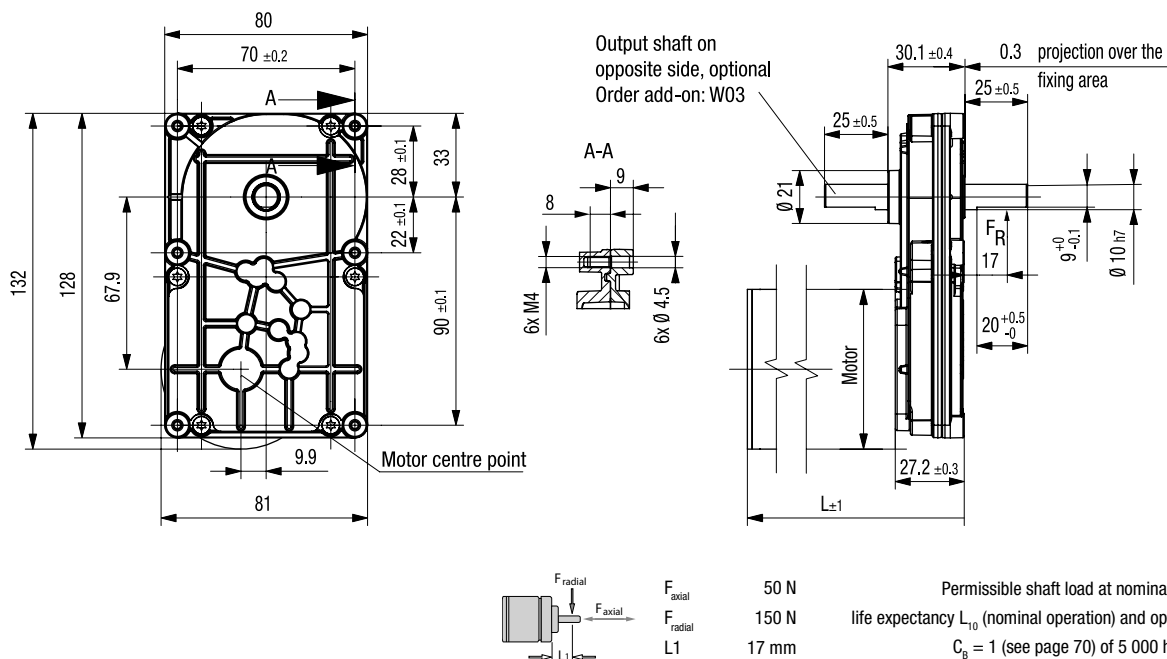


- Optimized installation length due to flat gear design
- Large reduction range
- Flexible connection to customer applications due to different available output shafts
- Use of alternative toothing materials as standard
- Maintenance-free over entire service life

Nominal data											
Gearheads		Flatline 85.3								Flatline 85.4	
Reduction ratio		8.20	12.3	27.6	40.3	64.0	101.8	136.5	189	454	1 030
No. of stages		3								4	
Efficiency		0.73								0.66	
Max. input speed (n_i)	rpm	4 000								4 000	
Rated output torque (M_{ab})	Nm	1.90	2.80	6.30	9.20	14.6	23.2	25.0	25.0	30.0	30.0
Short-term torque (M_{max})	Nm	4.80	7.00	15.8	23.0	36.0	58.0	62.0	62.0	75.0	75.0
Gear play	°	0.80 ... 1.60								0.80 ... 1.60	
Permissible operating temperature (T_U)	°C	-20 ... +80								-20 ... +80	
Operating mode		S1								S1	
Protection class*		IP 50								IP 50	
Weight	kg	0.50								0.50	
Shaft load radial / axial	N	150 / 50								150 / 50	
Service life	h	5 000								5 000	
Lubrication		Maintenance-free grease lubrication for life									
Installation position		any									
Subject to alterations		* Classification of protection class refers to installed state with sealing on the flange side									
Preferred type: ready to ship in 48 hours		on request									

Technical drawing

All dimensions in mm



Length of the possible motor / gearhead combinations

Motor / gearhead		L
VDC-49.15-K3-F85	mm	88
VDC-49.15-K4-F85	mm	88
VDC-54.14-K3-F85	mm	70
Subject to alterations		

Order add-on for motor mounting position

Gearhead	VDC-49.15				VDC-54.14			
	C02 (Standard)	C02-K02	C02-K03	C02-K04	K01 (Standard)	K02	K03	K04



Accessories.

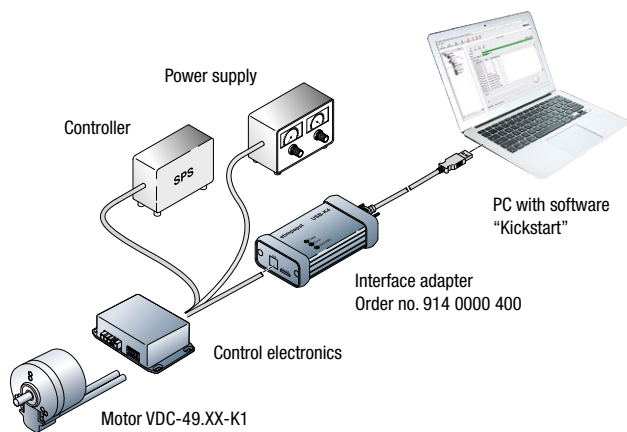


Commissioning tools	64
Accessories	66

Commissioning tools.

K4

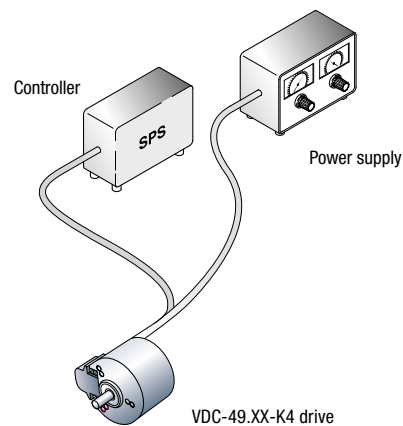
Parameterization and commissioning



Commissioning setup

Automatic operation

Automatic operation with stored parameters and integrated control



The RS485 interface serves as an interface for parameterization and diagnosis. It can be operated using the freely available “Kickstart” PC software. This requires a PC and the ebm-papst USB-CAN-RS485 adapter. Load your detailed operating manual and the PC software “Kickstart” under www.ebmpapst.com.



Interface adapter for “Kickstart” PC software	Order number
USB-CAN-RS485 adapter	914 0000 400

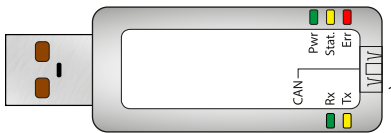
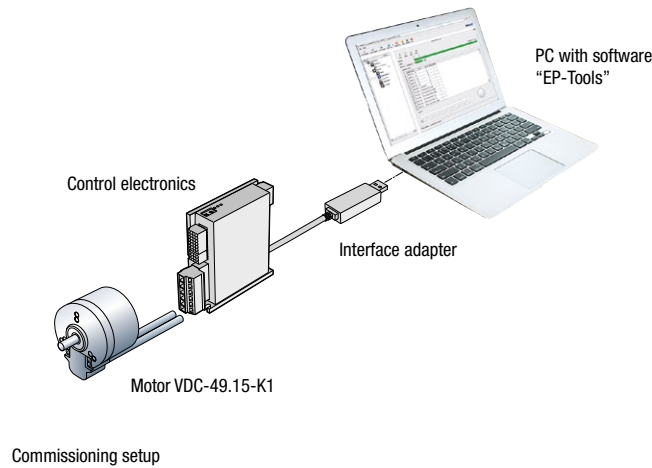
Functional description of the LED displays

LED name	Color	Function assignment
Data	red	No assignment.
	green	Active data transfer via the USB-CAN-RS485 adapter.
Error	red	No response following request to K4. Receipt of a faulty data package.
	green	Received data is OK.
microSD	red	No assignment.
	green	Access to the memory card.

Commissioning tools.

K5

Parameterization and commissioning



Commissioning tool for
"EP-Tools" PC software

Order number

USB to CANstick

914 0000 401

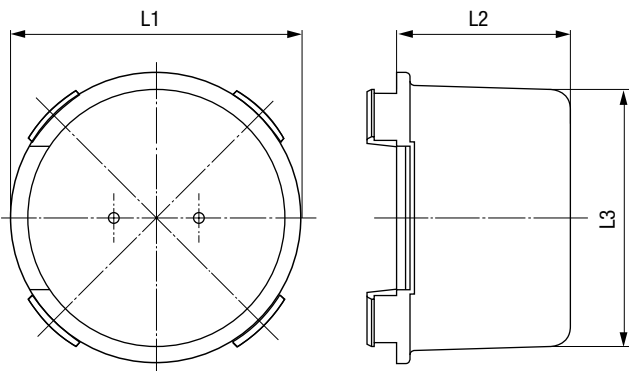
Functional description of the LED displays

LED name	Color	Display	Function assignment
LED0 "Power"	green	lights up	Normal operation
		does not light up	No power supply
		flashes	Bootloader mode (no firmware)
LED1 "State"	yellow	does not light up	Normal operation
		flashes	Bootloader mode (flashes with incoming message)
LED2 "Error"	red	lights up	Error
		does not light up	No error (normal operation)
LED3 "Rx"	green	flashes	Flashes with incoming message
		does not light up	No incoming message
LED4 "Tx"	yellow	flashes	Flashes with outgoing message
		does not light up	No outgoing message

Accessories.

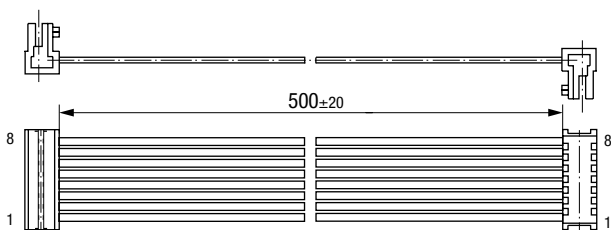
Rotor protection cap

All dimensions in mm



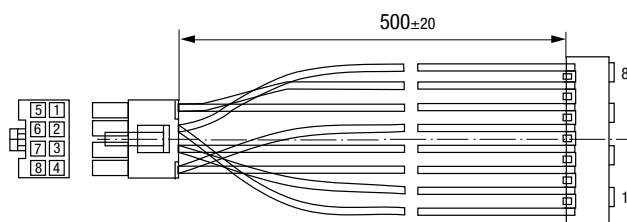
Protection cap				
For type	L1	L2	L3	Order no.
VD-35.0X	57	27.4	49.5	194 3506 000
VD-43.10	65	38.8	57.4	194 4310 000
VD-54.14	82	42.0	74.4	194 5414 000

Technical drawing connection cables K1 All dimensions in mm



8 single wires / AWG 22

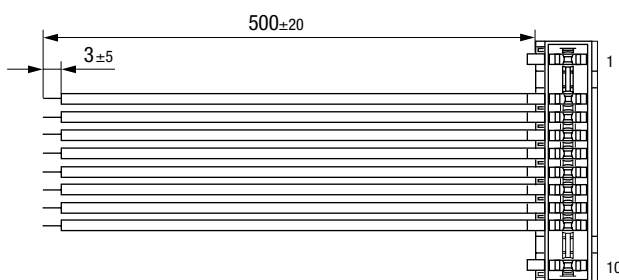
Connection cables	
For type	Order no.
VD-35.06-K1	194 0010 000
VD-43.10-K1	



8 single wires / AWG 20

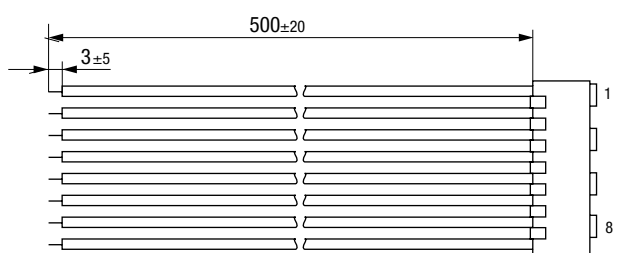
Connection cables	
For type	Order no.
VD-54.14-K1	194 0012 000

Technical drawing connection cables K3 All dimensions in mm



8 single wires / AWG 22

Connection cables	
For type	Order no.
VDC-43.10-K3	194 0009 000



8 single wires / AWG 20

Connection cables	
For type	Order no.
VDC-54.14-K3	194 0014 000

Standards and guidelines.

Basic information on standards and guidelines for electrical small-power motors and drive systems operated with a DC voltage of max. 75 V DC (nominal voltage):

The VD/VDC series described in this catalog are direct current motors in an electronically commutated design, which are designed and specified for a nominal voltage of max. 75 V DC. Thus the supply voltage of these drives is within the range of safety extra-low voltage (SELV). On this basis, ebm-papst would like to provide some information intended to help you understand the classification of the motors from the relevant EC Directives and the resulting consequences.

The CE label

In order to ensure a uniform safety level in the European internal market, the European commission has implemented a new approach for technical harmonization. This has been welcomed by all relevant parties and is visible in many products as a CE label giving proof of agreement with the harmonized provisions.



What does CE actually mean? Why don't all products bear the CE label?

CE is the abbreviation for "Communauté Européenne". The harmonized statutory provisions are a framework directive and belong to the so-called New Approach. This framework directive defines the basic requirements, putting in circulation and operation as well as the applicable conformity assessment process. The manufacturer of a product must now decide which framework directive applies to which product. For electrical small-powered motors the following framework directive can be applied:

- 1) Machinery Directive 2006/42/EC
- 2) Low Voltage Directive 2014/35/EU
- 3) EMC Directive 2014/30/EU

Based on these directives, ebm-papst St. Georgen GmbH & Co. KG does not mark the electric motors and drive systems described with the "CE" mark and does not issue an EC Declaration of Conformity. The reason for this is consideration of the relevant EC Directives and the definitions of the terms used, "Electric motor" and "Drive system", by ebm-papst St. Georgen GmbH & Co. KG.

Definition of the electric motor

An electric motor is a motor without electronics or a motor with integrated electronics of low complexity, such as commutation sensors, simple commutation electronics or commutation electronics with simple speed control with a voltage range of <75 V DC (nominal voltage) for use by customers who incorporate them into end devices.

According to this definition, electric motors include, for example, the VD/VDC-XX.XX-K1 series.

Definition of drive systems

Drive systems are motors with built-in electronic control systems that have a certain degree of complexity. These include electronic control systems which, in addition to a speed control, offer other functions such as current control or position control. This also includes electronic control systems which, for example, have a CANopen interface or that can be operated via programmable sequential controls. For these drive systems, the voltage range of <75 V DC (nominal voltage) and the intended use by customers who will use the systems in end devices also apply. Drive systems include the VDC-XX.XX-K3 and VDC-XX.XX-K4 series, for example.

Reasons according to the Machinery Directive 2006/42/EC

Electric motors are expressly exempt in Art. 1, Par. (2), lit. k) and thus are NOT given the CE mark.

According to the definition of the term in Art. 2, lit. g), a drive system is an "incomplete machine" and thus does not receive a CE mark, but falls under the process for incomplete machines according to Art. 13. Installation instructions to Annex IV and a Declaration of Incorporation to Annex II, Part 1, Section B are available for each drive system.

The specific technical documents to Art. 13, Par. (1), lit. a) have been created in-house and are archived for the government agencies of the individual countries.

Based on this directive, the machine manufacturer is responsible for verifying and ensuring compliance with the basic requirements of the Machinery Directive.

Reasons according to the Low Voltage Directive 2014/35/EU

Due to the voltage ranges (nominal voltage), the specified electric motors and drive systems do not fall under the application area of the low voltage directive according to Art. 1.

Reasons according to the EMC Directive 2014/30/EU

Because they are sold exclusively to customers who incorporate them into end devices and not to the end user, the specified electric motors and drive systems do not fall under the application area of the EMC directive according to the definition of the term in Art. 3, Par. (2), 1: As the small motors are supplied to companies who incorporate them into end devices and not to the end user, ebm-papst has no control over further use of the pre-fabricated components in devices, machines or installations. Therefore, ebm-papst provides express notice that the system manufacturer must provide a suitable EMC circuit when selecting the power supply and must provide for EMC-compliant installation and use in the devices. For more information about EMC-compliant installation and EMC safety measures, refer to resources such as the IEC 61000-5-x series (Installation and Mitigation Guidelines).

Proper use

All drives in this catalog are determined for installation in permanently connected, stationary end devices and machines in the industrial area and must be operated on electricity only when in installed condition! Operation is prohibited until it has been ascertained that this product, along with the machine into which this product is to be installed, complies with the protective requirements of the Machinery Directive. If, when using our drives, market or application-specific product standards apply, compliance with these must be verified and ensured by the device manufacturer. This product is not intended for the end consumer.

RoHS **European Directive EC No. 2011/65/EU (RoHS)** **Legally regulated substances**

As an innovative company and trendsetter in the world of air technology and drive engineering, ebm-papst feels a special obligation towards the environment. Accordingly, under the GreenTech logo, we have implemented a comprehensive concept that extends from the origin to the use of our products. This includes, of course, protecting our environment and using natural resources in a way that conserves them. This applies equally to our manufacturing processes and to our products.

When developing our products, we already take into consideration any possible negative consequences they may have for the environment.

Our goal is to prevent such environmental impact-even beyond the extent mandated by law-or to reduce it to a minimum, and thus to ensure sustainable development of our products. Thus we ensure that our products are free of materials and substances that are prohibited by law.

Of course, all current products have been designed for conformity with European Directive 2011/65/EU (RoHS). All older products that do not yet conform to these directives or parts thereof will be consistently redesigned. Our suppliers are required to provide us only with goods that conform to the directives. Thus we can confirm that basically, all of our products listed in this catalog conform to the above-mentioned directive. We are also available to help with any other questions you may have on both these topics.

REACH Directive (EC No. 1907/2006)

The EU legal regulation for Registration, Evaluation, Authorization and Restriction of Chemical substances (REACH) entered into force on 1 June 2007. This is a chemicals law intended to provide maximum protection to health and the environment. As defined by the REACH directive, ebm-papst is a downstream user. The units you purchase from us are products as defined by REACH and thus do not require registration. However, in our own interest and to ensure a high degree of product safety, we track the implementation of REACH and the resulting requirements as part of our duty to provide information. To comply with the requirements of REACH, we are in contact with all suppliers from whom we obtain chemicals (substances), preparations and components that we use as part of our production process. Within this framework, ebm-papst fulfills the obligations set forth in the REACH regulation. If you have any other questions about the implementation of the REACH directive in our company, please do not hesitate to contact us.

Operating factor, lifetime, efficiency.

Operating factor c_b

To achieve a uniform lifetime for the gearheads and motors, the necessary torques M must be increased by the respective operating factor c_b under the various operating loads so as not to exceed the maximum permissible gearhead torque $M_{2,max}$ (see table below).

Operating modes									
	Load			Operating period in h/days					
	even	gradual	sudden	3 h	8 h	24 h	3 h	8 h	24 h
				up to 10 switching ops./h			over 10 switching ops./h		
One rotation direction	•			1.00	1.00	1.20	1.00	1.20	1.52
Rotation direction change	•			1.00	1.30	1.59	1.20	1.59	1.92
One rotation direction		•		1.11	1.30	1.59	1.30	1.52	1.82
Rotation direction change		•		1.41	1.72	2.00	1.59	1.89	2.33
One rotation direction			•	1.20	1.52	1.82	1.52	1.82	2.22
Rotation direction change			•	1.59	2.00	2.33	2.00	2.33	2.86

Operating mode

It is necessary to define the operating mode under which a gear motor can be operated with certain nominal values in order to avoid overloading the motor and/or the gearhead. The values stated in this catalog refer to S1 operation (continuous operation). This means that the gear motor can be constantly operated with the stated values, but can also have a higher load placed on it for a short time. Please contact us if you require more information about this.

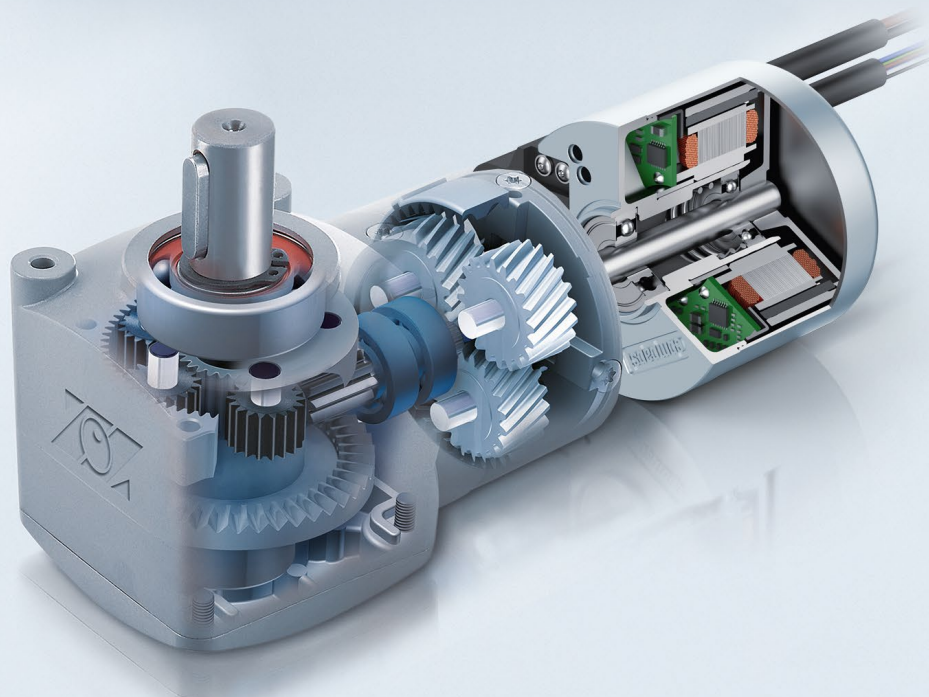
Lifetime

Lifetime is limited by the various components in the drive. If frequently overloaded, the gearhead components are subjected to more wear than under nominal load. Extreme ambient and operating conditions cause a reduction in the lifetime guaranteed for operation under operating ratio $c_b = 1$.

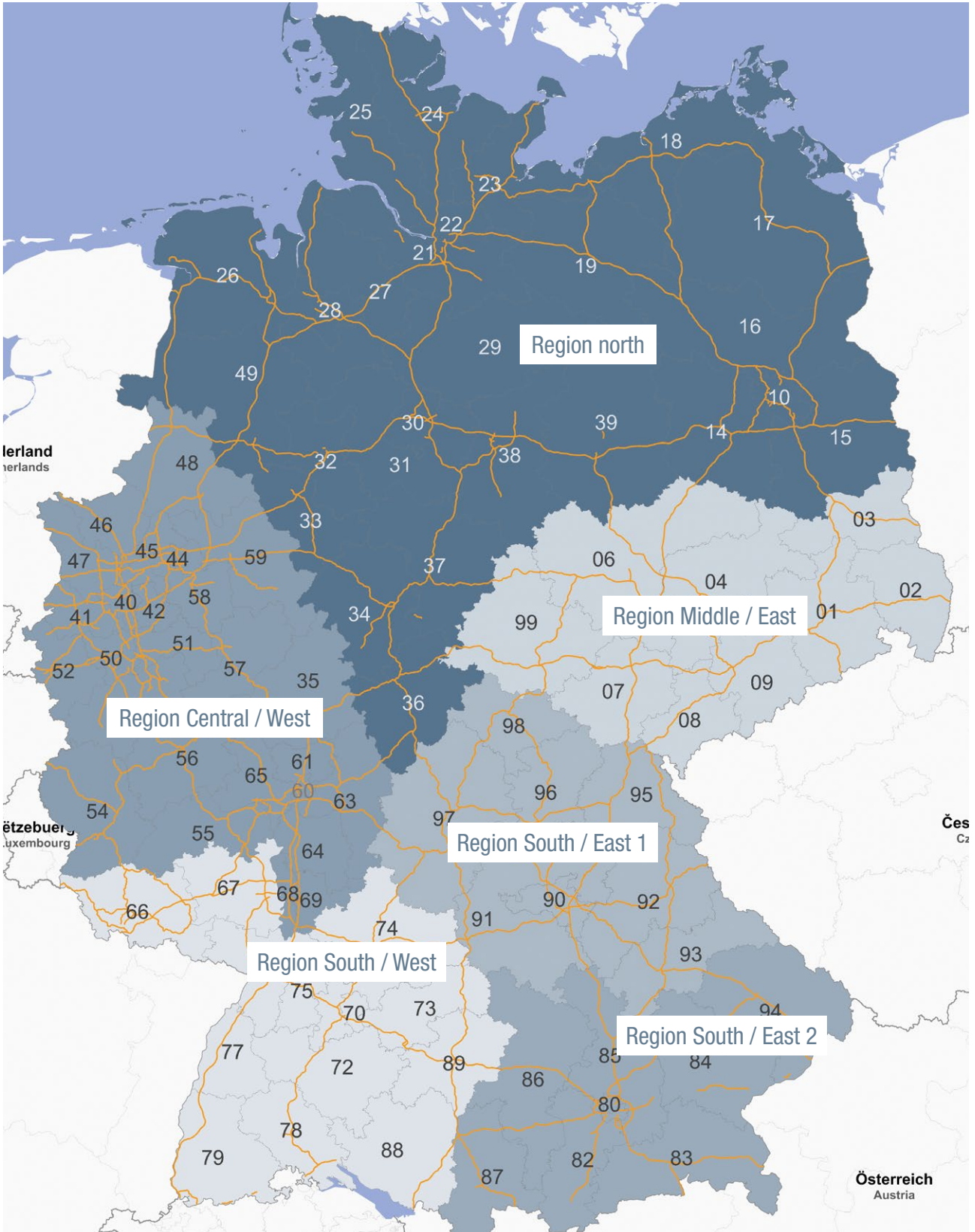
Efficiency η (eta)

The efficiency per gear stage is at least 90%. Depending on the tooth configuration and on the manufacturing quality, far better levels of efficiency can also be achieved. The following overall efficiencies were obtained for multi-stage gearheads:

Overall efficiency	
for 1-stage gearhead	$\eta = 0.9$
for 2-stage gearhead	$\eta = 0.9^2 = 0.81$
for 3-stage gearhead	$\eta = 0.9^3 = 0.73$
for 4-stage gearhead	$\eta = 0.9^4 = 0.66$
for 5-stage gearhead	$\eta = 0.9^5 = 0.59$



Region in Germany.



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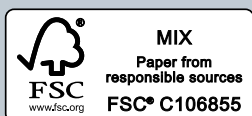
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