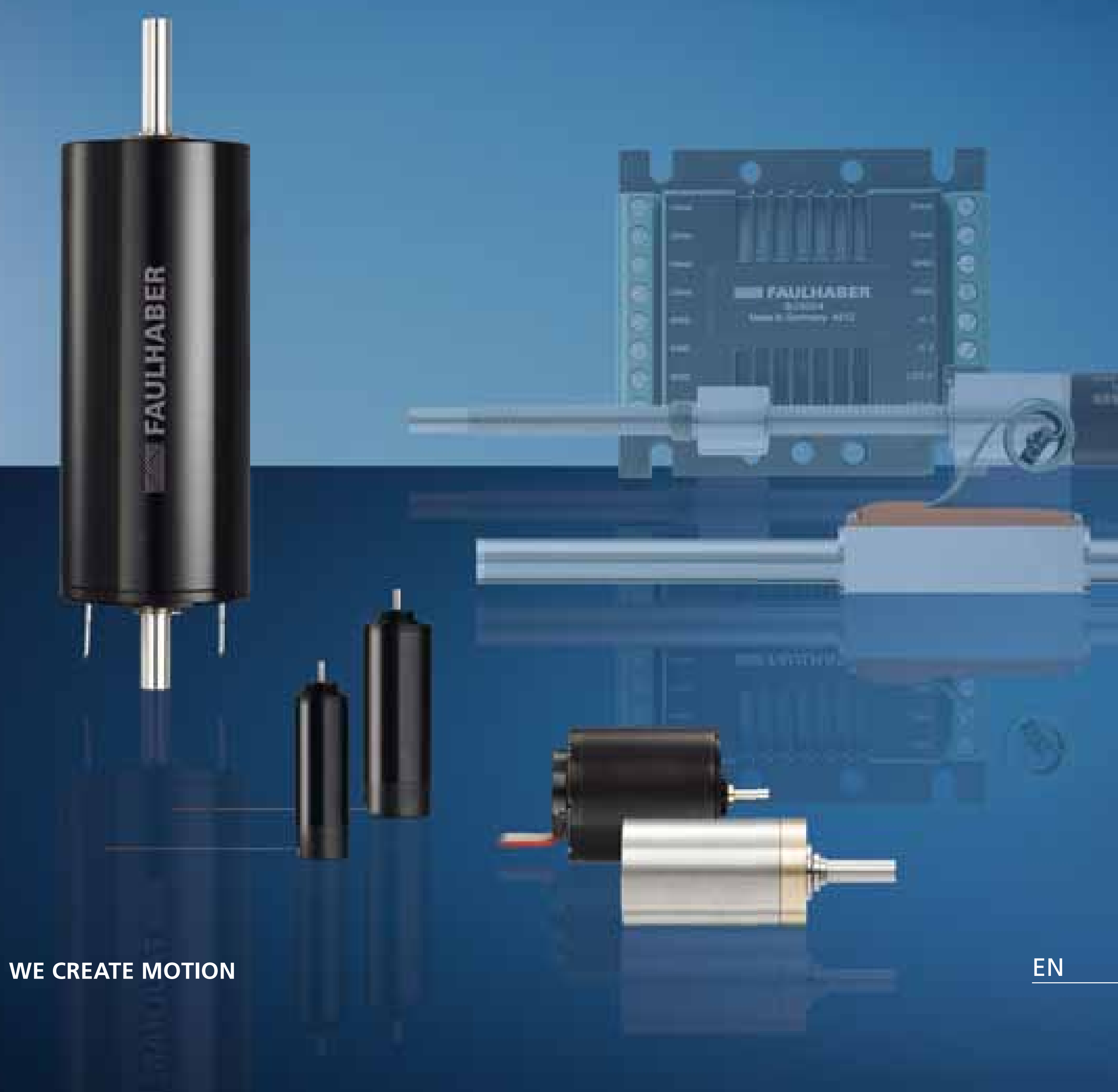
FAULHABER

Miniature Drive Systems



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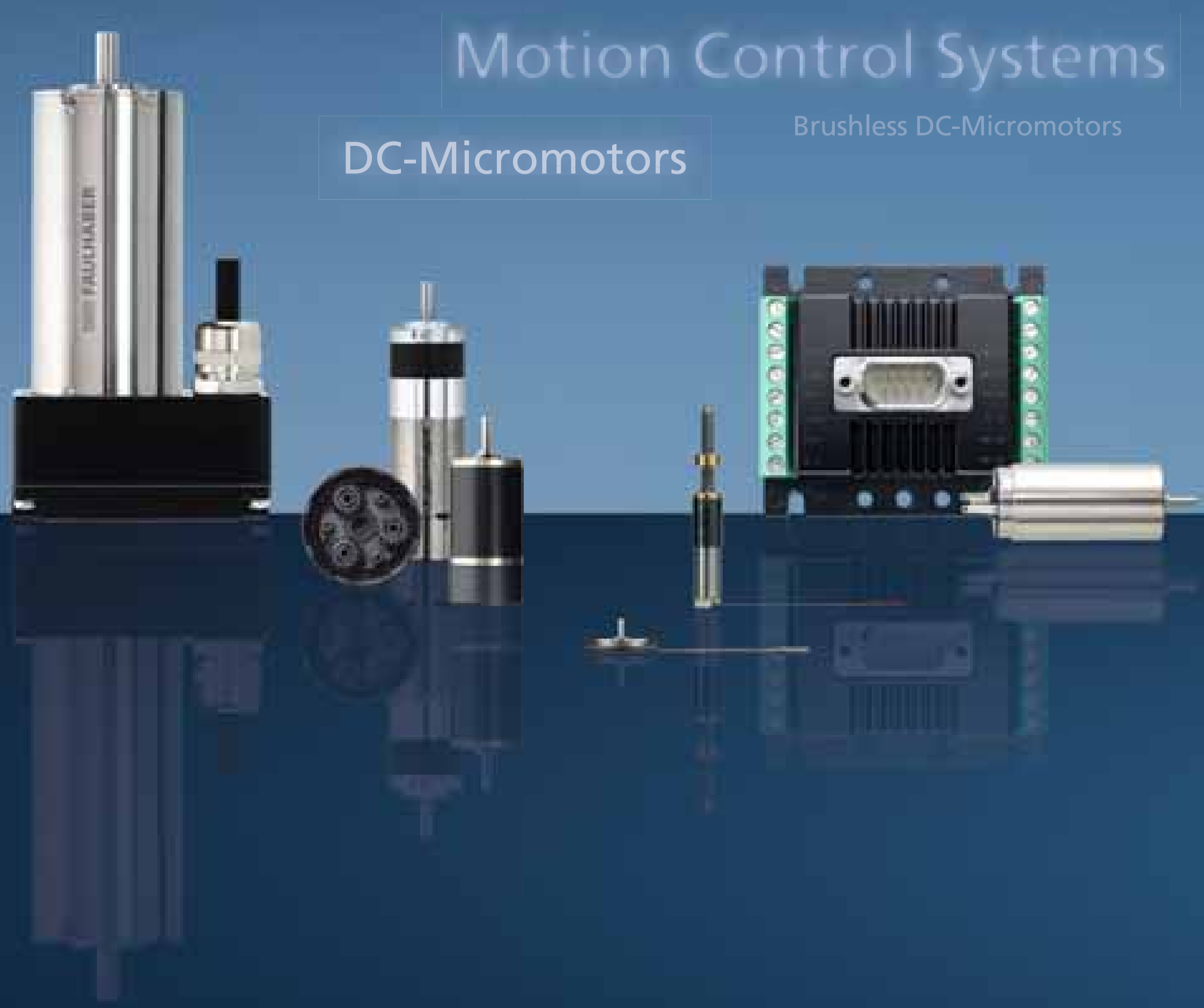

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FAULHABER

Encoders

Brushless DC-Motors

Planetary Gearheads

Drive Electronics

Stepper Motors

Linear DC-Servomotors

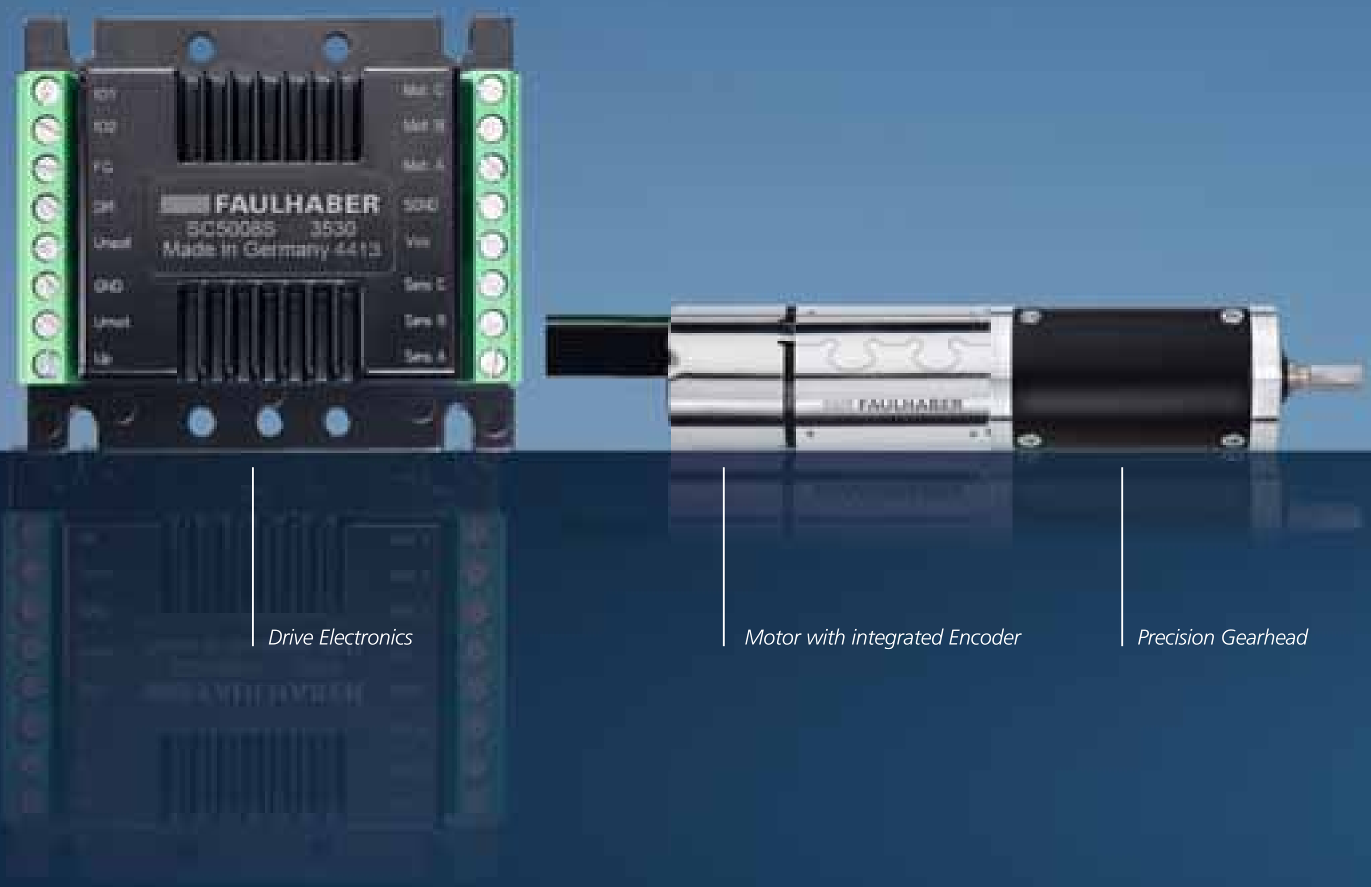
Flat DC-Micromotors

The success story of the „FAULHABER" brand began over 60 years ago with the development of the self-supporting, skew-wound ironless rotor coil by Dr. Fritz Faulhaber. As a symbol of quality the brand is the cornerstone of FAULHABER's pioneering platform of innovative, high precision drive technologies which have unlocked new opportunities for a host of cutting edge applications.

Some of Dr. Faulhaber sen. first models of the self-supporting skew–wound ironless rotor coil

Today, the tradition of ironless coil technology leadership is carried on using state of the art development and production technologies

Seamless Partnership



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The optimal whole is the sum of unique parts

FAULHABER offers the largest consolidated portfolio of miniature and micro drive technologies available in the world today. This unique basis provides almost limitless possibilities for innovation.

Based on decades of application experience in a myriad of high-tech areas of application, FAULHABER developes new drive systems tailormade to the ever more challenging needs of our customers. These drive systems find application in industries where high precision, reliability, and miniaturization are essential elements for success.

Commitment and experience define our mutual success

The prerequisite for success is the dialog with our customers. Only through a focused exchange of information and ideas can the customer's needs be fully understood and the most efficient solution provided. Our staff is committed to providing their experience and know-how to understand our customer's needs and to help guide them to the best solution for their individual miniature drive system requirements.

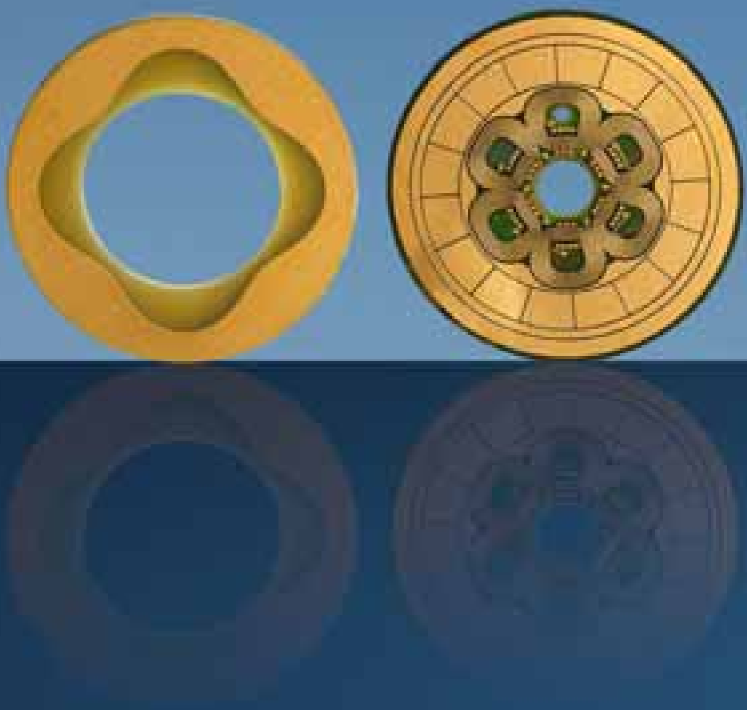
CONSULTING AND CONCEPT

We create Motion

Moving in new directions
for continuous innovation

In each of its dedicated research and development departments FAULHABER is hard at work on the future of miniature and micro drive system technologies.

From the idea, to the prototype, and through to the innovative new products that we bring to the market year after year, FAULHABER utilizes state-of-the-art tools and methods to support and enhance its research and development capabilities. Computer aided 3D design, advanced simulation tools, and preventative methods like matix FMEA's, are par for the course not to mention our uncompromising focus on quality and providing the customer with the most efficient production and logistical solution available.



Our philosophy is market driven technology leadership

For over 60 years the name FAULHABER has been synonymous with inventions and innovations that have written countless chapters in the history of miniature and micro drive technology. The pioneering spirit of Dr. Fritz Faulhaber sen. that drove him to continuously set new standards in the market lives on today in the hearts and minds of our highly motivated and creative engineering team.

Multiple awards for innovative development and implementation of detailed technical solutions

The Standard is High-tech

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FAULHABER

The highest power in the most compact dimensions

FAULHABER miniature and micro drive systems are electromechanical masterpieces. In today's high-tech market, miniaturization and an ever increasing need to integrate intelligent features into our systems are common challenges.

Through decades of research and development experience FAULHABER has aquired the high degree of know-how in the various specialized processes, manufacturing, and logistical techniques that are necessary to efficiently produce complex miniature and micro drive systems.

Our globalized network of state-of-the-art production facilities with 1,300 qualified employees provide an integrated, highly competitive, efficient production platform focused on on-time delivery and uncompromising quality.

Efficient and effective processes from manual production to highly automated production and testing

A Vision of Innovation

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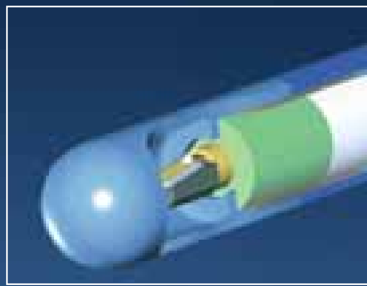
Unique applications demand unique solutions

Decades of drive systems applications know-how and experienced engineers combined with the widest portfolio of high precision drive technologies in the industry, make FAULHABER the ideal partner for a multitude of custom drive system solutions.

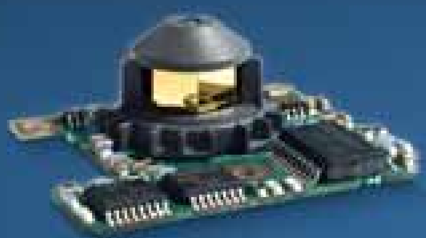
We provide a strong basis for your success

FAULHABER's service portfolio ranges from custom design of drive components to the design of complete drive systems based on strategic partnerships with our innovative customers which includes coordinated development and production support.

This close partnership in the creation of custom drive solutions provides our visionary customers the opportunity to focus on their core capabilities in order to assure the future market success of their product.



The areas of application of FAULHABER custom solutions are as diverse as they are challenging; anything from critical medical care to high end automation



FAULHABER completes the drive system with custom designed electronics, software and sensor components

Applications driving the Future

Medical & Laboratory Equipment

- Analysis & dialysis equipment
- Arthroscopic tools
- Artificial limbs
- Blood extraction pumps
- Chemotherapy pumps
- Dental equipment
- EGG & EEG recorders
- Hearing aids
- Mammographs
- Opthalmic tools
- Orthopaedic equipment
- Peristaltic pumps
- Respiratory aids
- Safety equipment
- Syringe drivers
- X-Ray equipment

Instrumentation

- Balances, scales
- Densitometers
- Display boards
- Fibre optics splicers
- Geotechnical measurements
- Laser levelling devices
- Laser measuring equipment
- Measuring equipment
- Micrometers
- Valves
- Potentiometers
- Plotters
- Scanners
- Solar displays
- Photo spectrometers
- Surface roughness meters
- Thermoprinters

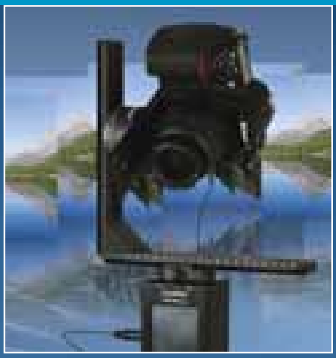
Factory Automation & Robotics

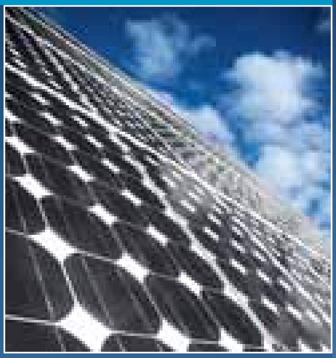
- Handling equipment
- Screwdrivers
- Remote inspection devices
- PCB automated handling
- Robots, educational robots
- SMD, SMT

Industrial Machinery & Equipment

- Automatic weighting systems
- CD production machines
- Industrial sawing machines
- Laser cutting systems
- Laser marker machines
- Paper industry
- Positioning devices
- Battery operated devices
- Power nailers
- Printing industry
- Surface roughness scanners
- Textile machines
- Tool changers
- Welding equipment
- Winding machines

FAULHABER





Office, Security & Communications

- Access systems
- Card readers
- Copiers & Printers
- Data processing equipment
- Data storage equipment
- Voice recorders
- Labelling & franking machines
- Personal emergency senders
- Locking systems
- Paper cutters
- Pagers
- Payphones
- Ticket printers & dispensers
- Vending devices

Aerospace & Aviation

- Aircraft instrumentation
- Flap controls
- Flight recorders
- Flight simulators
- Gyros
- High altitude cameras
- Infrared pyrometers
- Radar
- Range finders
- Thermal imagers

Optical, Audio & Video

- Camera lens adjustments
- CCTV
- Concert lighting
- Film winders
- Microfilm readers
- Microscopes
- Movie & photo cameras
- Photographic aerial applications
- TV studio equipment
- Video recorders

Environmental & Safety

- Air sampling monitors
- Emissions supervision devices
- Forced air gasmasks

Total Quality Commitment

We believe that the commitment to total quality is the responsibility of each and every employee

For FAULHABER, quality assurance is not just a technical certification but also an employee philosophy. An atmosphere of solution oriented cooperation and dialog contribute to the total quality consciousness that is embodied by each and every employee in our Group.

A clearly defined quality system supports our employees from the first contact with a customer through to delivery and after sales service and contributes to the uncompromising quality and high performance of our products and services.

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Periodical ISO audits guarantee that we ful- fill the accepted international standards and we profit from an external view of our management processes and procedures. The will for continuous improvement and the implementation of state-of-the-art test procedures enhances the value of our products and services for our customers.

ISO 13485

ISO 9001

FAULHABER drive systems are considered components according to the EG rules for CE compliance. They are intended for use by our customers, who are considered experts in their individual fields of application, as an integrated part of an application and thereby do not require the CE mark

Naturally efficient

The basis for a responsible use of resources

The reduction of CO_2 emissions and the responsible use of energy play a key roll in protecting our environment in all its natural beauty for future generations.

FAULHABER is doing its part through the conscientious development of highly energy and resource efficient drive systems which help to lower overall energy use in a myriad of high-tech applications.

FAULHABER maintains a high standard of environmental consciousness in each aspect of its organization. This transparent commitment to a responsible relationship to the environment is confirmed by our certification according to the ISO 14001 standard.

TÜV ISO 14001

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In practice for FAULHABER this means energy efficient production, disciplined recycling, and a commitment to energy efficient infrastructure and facilities worldwide.

The most recent addition to the FAULHABER facility in Schönaich, Germany, was constructed with a conscious focus on energy and resource efficiency

Product Index

DC-Motors

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DC-Micromotors

Flat DC-Micromotors and DC-Gearmotors

General information

The FAULHABER Winding:
Originally invented by Dr. Fritz Faulhaber Sr. and patented in 1958, the System FAULHABER© coreless (or ironless) progressive, self-supporting, skew-wound rotor winding is at the heart of every System FAULHABER DC Motor. This revolutionary technology changed the industry and created new possibilities for customer application of DC Motors where the highest power, best dynamic performance, in the smallest possible size and weight are required. The main benefits of this technology include:

- No cogging torque resulting in smooth positioning and speed control and higher overall efficiency than other DC motor types
- Extremely high torque and power in relation to motor size and weight
- Absolute linear relationship between load to speed, current to torque, and voltage to speed
- Very low rotor inertia which results in superior dynamic characteristics for starting and stopping
- Extremely low torque ripple and EMI

DC Motor Types:
FAULHABER DC Motors are built with two different types of commutation systems: precious metal commutation and graphite commutation.

The term precious metal commutation refers to the materials used in the brushes and commutator which consist of high performance precious metal alloys. This type of commutation system is used mainly because of its very small size, very low contact resistance and the very precise commutation signal. This commutation system is particularly well suited for low current applications such as battery operated devices.

In general, precious metal commutated motors exhibit the best overall performance at continuous duty with a load at or around the point of maximum nominal efficiency.

The term graphite commutation refers to the brush material used in combination with a copper alloy commutator. This type of commutation system is very robust and is better suited to dynamic high power applications with rapid start / stops or periodic overload conditions.

Magnets:
FAULHABER DC Motors are designed with a variety of different types of magnets to suit the particular performance of the given motor type. These materials include AlNiCo magnets and high performance rare earth types such as SmCo and NdFeB.

Operational Lifetime:
The lifetime of a FAULHABER DC motor depends mainly on the operational duty point and the ambient conditions during operation. The total hours of operation can therefore vary greatly from some hundreds of hours under extreme conditions to over 25.000 hours under optimal conditions. Under typical load conditions a FAULHABER DC motor will have an operational lifetime anywhere between 1000 to 5000 hours.

In general the operational lifetime of a FAULHABER DC motor is limited by the effects of electrical and mechanical wear on the commutator and brushes. The electrical wear (sparking) depends heavily on the electrical load and the motor speed. As the electrical load and speed increase, the typical motor operational lifetime will normally decrease. The effects of electrical wear are more significant for motors with precious metal commutation and vary depending on the nominal voltage of the winding. Where necessary FAULHABER DC motors are therefore fitted with integrated spark suppression to minimize the negative effects of sparking on the operational lifetime.

The mechanical wear of the commutation system is dependent on the motor speed and will increase with higher speeds. In general, for applications with higher than specified speeds and loads, a longer operational lifetime can be achieved by graphite commutated motors. It is also important not to exceed the load characteristics for the motor bearings given in the data sheet for continuous duty operation. Doing so will also limit the achievable motor lifetime.

Other effects limiting motor lifetime include ambient conditions like excessive humidity and temperature, excessive vibration and shock, and an incorrect or suboptimal mounting configuration of the motor in the application.

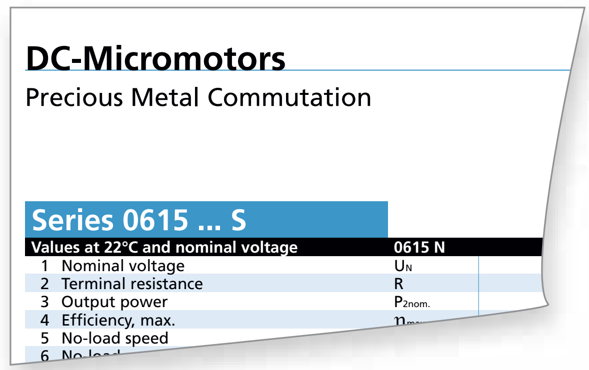
It is also important to note that the method of driving and controlling the motor will have a large effect on the operational lifetime of the motor. For example, for control using a PWM signal, FAULHABER recommends a minimum frequency of 20kHz.

Modifications:
FAULHABER specializes in the configuration of its standard products to fit the customer application. Available modifications for FAULHABER DC Motors include:

- Many other nominal voltage types
- Motor leads (PTFE and PVC) and connectors
- Configurable shaft lengths and second shaft ends
- Modified shaft dimensions and pinion configurations such as flats, gears, pulley and eccenters
- Modifications for extreme high and low temperature operation
- Modifications for operation in a vacuum (ex. 10^{-7} Torr)
- Modifications for high speed and / or high load applications
- Modifications for motors with tighter than standard electrical or mechanical tolerances

Product Combinations
FAULHABER offers the industry's largest selection of complementary products tailor made for all of its DC motors including:

- Precision Gearheads (planetary, spur, and low backlash spur)
- High resolution Encoders (Incremental and Absolute)
- High Performance Drive Electronics (Speed controllers, Motion Controllers)



Notes on technical datasheet

The following values are measured or calculated at nominal voltage with an ambient temperature of 22°C.

Nominal voltage U_N [Volt]
The nominal voltage at which all other characteristics indicated are measured and rated.

Terminal resistance R [Ω] ±12%
The resistance measured across the motor terminals.
The value will vary according to the winding temperature. (temperature coefficient: α_{22} = 0,004 K^{-1}).
This type of measurement is not possible for the graphite commutated motors due to the transition resistance of the brushes.

Output power $P_{2\,nom.}$ [W]
The maximum mechanical power achieved at the nominal voltage.

$$P_{2\,nom.} = \frac{R}{4} \cdot \left(\frac{U_N}{R} - I_o\right)^2$$

Efficiency $\eta_{max.}$ [%]
The maximum ratio between the absorbed electrical power and the obtained mechanical power of the motor.

$$\eta_{max.} = \left(1 - \sqrt{\frac{I_o \cdot R}{U_N}}\right)^2 \cdot 100$$

No-load speed n_o [rpm] ±12%
Describes the motor speed under no-load conditions at steady state and 22 °C ambient temperature. If not otherwise defined the tolerance for the no-load speed is assumed to be ±12%.

$$n_o = (U_N - I_o \cdot R) \cdot k_n$$

No-load current (typical) I_o [A]
Describes the typical current consumption of the motor without load at an ambient temperature of 22°C after reaching a steady state condition.

DC-Micromotors

Technical Information

The no-load current is speed and temperature dependent. Changes in ambient temperature or cooling conditions will influence the value. In addition, modifications to the shaft, bearing, lubrication, and commutation system or combinations with other components such as gearheads or encoders will all result in a change to the no-load current of the motor.

Stall torque M_H [mNm]
The torque developed by the motor at zero speed (locked rotor) and nominal voltage. This value may vary due to the magnet type and temperature and the temperature of the winding.

$$M_H = k_M \cdot \left(\frac{U_N}{R} - I_o\right)$$

Friction torque M_R [mNm]
Torque losses caused by the friction of brushes, commutator and bearings. This value varies due to temperature.

$$M_R = k_M \cdot I_o$$

Speed constant k_n [rpm/V]
The speed variation per Volt applied to the motor terminals at constant load.

$$k_n = \frac{n_o}{U_N - I_o \cdot R} = \frac{1\,000}{k_E}$$

Back-EMF constant k_E [mV/rpm]
The constant corresponding to the relationship between the induced voltage in the rotor and the speed of rotation.

$$k_E = \frac{2\pi \cdot k_M}{60}$$

Torque constant k_M [mNm/A]
The constant corresponding to the relationship between the torque developed by the motor and the current drawn.

Current constant k_I [A/mNm]
Describes the relation of the current in the motor winding and the torque developed at the output shaft.

$$k_I = \frac{1}{k_M}$$

Slope of n-M curve $\Delta n/\Delta M$ [rpm/mNm]
The ratio of the speed variation to the torque variation. The smaller the value, the more powerful the motor.

$$\frac{n}{M} = \frac{30\,000}{\pi} \cdot \frac{R}{k_M^2}$$

Rotor inductance L [μH]
The inductance measured on the motor terminals at 1 kHz.

Mechanical time constant τ_m [ms]
The time required for the motor to reach a speed of 63% of its final no-load speed, from standstill.

$$\tau_m = \frac{100 \cdot R \cdot J}{k_M^2}$$

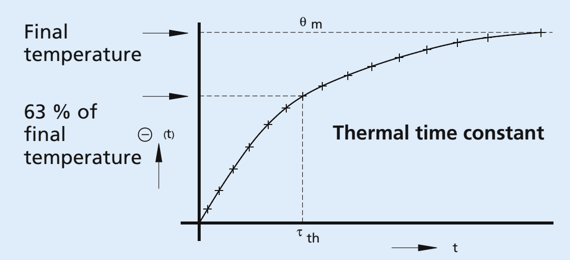
Rotor inertia J [gcm²]
The dynamic moment of inertia of the rotor.

Angular acceleration $\alpha_{max.}$ [$\cdot 10^3$ rad/s²]
The acceleration obtained from standstill under no-load-conditions and at nominal voltage.

$$\alpha_{max.} = \frac{M_H \cdot 10}{J}$$

Thermal resistance R_{th1}/R_{th2} [K/W]
R_{th1} corresponds to the value between the rotor and housing. R_{th2} corresponds to the value between the housing and the ambient air.
R_{th2} can be reduced by enabling exchange of heat between the motor and the ambient air (for example, a thermally coupled mounting configuration, using a heat sink, and / or forced air cooling).

Thermal time constant τ_{w1} / τ_{w2} [s]
The thermal time constant specifies the time needed for the rotor (τ_{w1}) and housing (τ_{w2}) to reach a temperature equal to 63% of final steady state value.



Operating temperature range [°C]
Indicates the minimum and maximum standard motor operating temperature, as well as the maximum allowable temperature of the standard motor winding.

Shaft bearings
The bearings used for the DC-Micromotors.

Shaft load max. [N]
The output shaft load at a specified shaft diameter for the primary output shaft. For motors with ball bearings the load and lifetime are in accordance with the values given by the bearing manufacturers. This value does not apply to second, or rear shaft ends.

Shaft play [mm]
The play between the shaft and bearings, including the additional bearing play in the case of ball bearings.

Housing material
The housing material and the surface protection.

Mass [g]
The typical mass of the motor in its standard configuration.

Direction of rotation
The direction of rotation as viewed from the front face. Positive voltage applied to the (+) terminal gives clockwise rotation of the motor shaft. All motors are designed for clockwise (CW) and counter-clockwise (CCW) operation; the direction of rotation is reversible.

Motor shaft
All mechanical dimensions related to the motor shaft are measured with an axial preload of the shaft toward the motor.

Unspecified mechanical tolerances:
Tolerances in accordance with ISO 2768.

≤	6	= ± 0,1 mm
≤	30	= ± 0,2 mm
≤	120	= ± 0,3 mm

The tolerances of values not specified are given on request.

Speed up to [rpm]
The maximum recommended motor speed for continuous operation. This value is based on the recommended operating range for the standard motor bearings, winding, and commutation system. All values in excess of this value will negatively affect the maximum achievable operational lifetime of the motor.

Rated Values for Continuous Duty Operation

The following values are measured or calculated at nominal voltage with an ambient temperature of 22°C.

Rated Torque M_N [mNm]

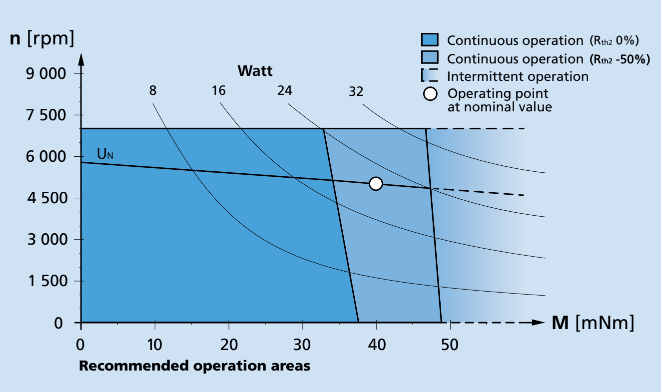
For DC motors with precious metal commutation:
The maximum continuous duty torque at nominal voltage resulting in steady state current and speed not exceeding the capacity of the brush and commutation system. The motor is rated without a reduction to the R_{th2} value (without external cooling). This value can be safely exceeded if the motor is operated intermittently, for example, in S2 operation and/or if more cooling is applied. For the purposes of the rating, certain motors are limited by the resulting rated speed (< 2500 rpm) at nominal voltage.

Please note, when choosing a precious metal commutated motor that they exhibit the best overall continuous duty performance at or around the point of highest efficiency. For continuous duty operating conditions that require the motor to operate close to its thermal limits, a DC motor with graphite commutation is recommended.

For DC motors with graphite commutation:
The maximum continuous duty torque (S1 operation) at nominal voltage resulting in a steady state temperature not exceeding the maximum winding temperature and / or operating temperature range of the motor. The motor is rated with a reduction of the R_{th2} value of 25% which approximates the amount of cooling available from a typical mounting configuration of the motor. This value can be safely exceeded if the motor is operated intermittently, for example, in S2 operation and/or if more cooling is applied.

Rated Current (thermal limit) I [A]
The typical maximum continuous current at steady state resulting from the rated continuous duty torque. This value includes the effects of a loss of K_m (torque constant) as it relates to the temperature coefficient of the winding as well as the thermal characteristics of the given magnet material. This value can be safely exceeded if the motor is operated intermittently, during start / stop, in the ramp up phases of the operating cycle and/or if more cooling is applied. For certain series and lower voltage types this current is limited by the capacity of the brush and commutation system.

Rated Speed n_N [rpm]
The typical speed at steady state resulting from the application of the given rated torque. This value includes the effects of motor heating on the slope of the n/M curve. Higher speeds can be achieved by increasing the input voltage to the motor, however the rated current (thermal limit) remains the same.



Example: Power diagram for rated values at continuous operation

DC-Micromotors

Technical Information

How to select a DC-Micromotor

This section provides a very basic step-by-step procedure of how to select a DC-Micromotor for an application that requires continuous duty operation under constant load and ambient conditions. The example describes the calculations necessary to create a basic motor characteristic curve to describe the behaviour of the motor in the application. To simplify the calculation, in this example continuous operation and optimum life performance are assumed and the influence of temperature and tolerances has been omitted.

Application data:

The basic data required for any given application are:

Required torque	M	[mNm]
Required speed	n	[rpm]
Duty cycle	δ	[%]
Available supply voltage, max.	U	[V DC]
Available current source, max.	I	[A]
Available space, max.	diameter/length	[mm]
Shaft load	radial/axial	[N]
Ambient temperature		[°C]

The assumed application data for the selected example are:

Output torque	M	= 3	mNm
Speed	n	= 5 500	rpm
Duty cycle	δ	= 100	%
Supply voltage	U	= 20	V DC
Current source, max.	I	= 0,5	A
Space max.	diameter	= 25	mm
	length	= 50	mm
Shaft load	radial	= 1,0	N
	axial	= 0,2	N
Ambient temperature		= 22 °C	constant

Preselection

The first step is to calculate the power the motor is expected to deliver:

$$P_2 = M \cdot n \, \frac{\pi}{30 \cdot 1\,000} \qquad [W]$$

$$P_2 = 3 \cdot 5\,500 \, \frac{\pi}{30 \cdot 1\,000} \qquad = 1{,}73 \quad W$$

A motor is then selected from the catalogue which will give at least 1,5 to 2 times the output power [$P_{2\,nom.}$] than the one obtained by calculation, and where the nominal voltage is equal to or higher than the one required in the application data.

The physical dimensions (diameter and length) of the motor selected from the data sheets should not exceed the available space in the application.

$$P_{2\,nom.} \geq P_2 \qquad U_N \geq U$$

The motor selected from the catalogue for this particular application, is **series 2233 T 024 S** with the following characteristics:

Nominal voltage		U_N	= 24	V DC
Output power, max.		$P_{2\,nom.}$	= 2,47	W
Frame size:	diameter	Ø	= 22	mm
	length	L	= 33	mm
Shaft load, max.:		radial	= 1,2	N
		axial	= 0,2	N
No-load current		I_o	= 0,005	A
No-load speed		n_o	= 8 800	rpm
Stall torque		M_H	= 10,70	mNm

Caution:

Should the available supply voltage be lower than the nominal voltage of the selected DC-Micromotor, it will be necessary to calculate [$P_{2\,nom.}$] with the following equation:

$$P_{2\,nom.} = \frac{R}{4} \cdot \left(\frac{U_N}{R} - I_o\right)^2 \qquad [W]$$

$$P_{2\,nom.}(20\ V) = \frac{57}{4} \cdot \left(\frac{20}{57} - 0{,}005\right)^2 \qquad = 1{,}70 \quad W$$

Optimizing the preselection

To optimize the motor's operation and life performance, the required speed [n] has to be higher than half the no-load speed [n_o] at nominal voltage, and the load torque [M] has to be less than half the stall torque [M_H].

$$n \geq \frac{n_o}{2} \qquad M \leq \frac{M_H}{2}$$

From the data sheet for the DC-Micromotor, **2233 T 024 S** the parameters meet the above requirements.

$$n\ (5\,500\ rpm) \geq \frac{n_o}{2} \ \text{is higher than} \ \frac{8\,800}{2} = 4\,400 \quad rpm$$

$$M\ (3\ mNm) \leq \frac{M_H}{2} \ \text{is less than} \ \frac{10{,}70}{2} = 5{,}35 \quad mNm$$

This DC-Micromotor will be a good first choice to test in this application. Should the required speed [n] be less than half the no-load speed [n_o], and the load torque [M] be less than half the stall torque [M_H], try the next voltage motor up.

Should the required torque [M] be compliant but the required speed [n] be less than half the no-load speed [n_o], try a lower supply voltage or another smaller frame size motor.

Should the required speed be well below half the no-load speed and or the load torque [M] be more than half the stall torque [M_H], a gearhead or a larger frame size motor has to be selected.

Performance characteristics at nominal voltage (24 V DC)
A graphic presentation of the motor's characteristics can be obtained by calculating the stall current [I] and the torque [M] at its point of max. efficiency [$M_{opt.}$]. All other parameters are taken directly from the data sheet of the selected motor.

Stall current

$$I = \frac{U_N}{R} \qquad [A]$$

$$I = \frac{24}{57} \qquad = 0{,}421 \quad A$$

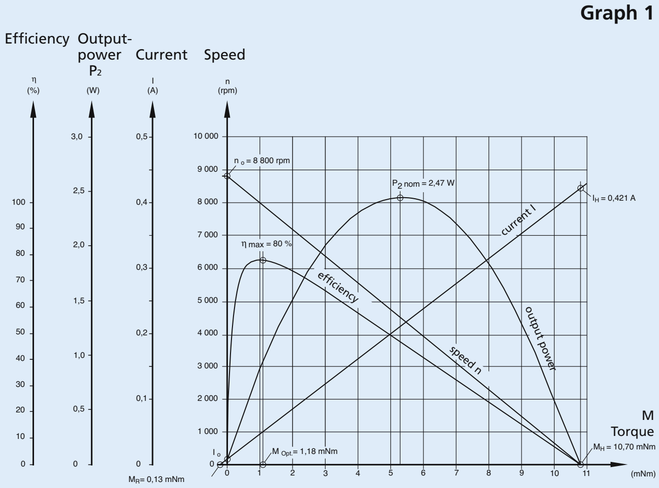
Torque at max. efficiency

$$M_{opt.} = \sqrt{M_H \cdot M_R} \qquad [mNm]$$

$$M_{opt.} = \sqrt{10{,}70 \cdot 0{,}13} \qquad = 1{,}18 \quad mNm$$

It is now possible to make a graphic presentation and draw the motor diagram (see graph 1).

Graph 1



Calculation of the main parameters
In this application the available supply voltage is lower than the nominal voltage of the selected motor.
The calculation under load therefore is made at 20 V DC.

No-load speed n_o at 20 V DC

$$n_o = \frac{U - (I_o \cdot R)}{k_E} \cdot 1\,000 \qquad [rpm]$$

inserting the values

Supply voltage	U	=	20	V DC
Terminal resistance	R	=	57	
No-load current	I_o	=	0,005	A
Back-EMF constant	k_E	=	2,690	mV/rpm

$$n_o = \frac{20 - (0{,}005 \cdot 57)}{2{,}690} \cdot 1\,000 \qquad = 7\,329 \quad rpm$$

Stall current I_H

$$I_H = \frac{U}{R} \qquad [A]$$

$$I_H = \frac{20}{57} \qquad = 0{,}351 \quad A$$

Stall torque M_H

$$M_H = k_M (I_H - I_o) \qquad [mNm]$$

inserting the value

Torque constant	k_M	=	25,70	mNm/A

$$M_H = 25{,}70\,(0{,}351 - 0{,}005) \qquad = 8{,}89 \quad mNm$$

Output power, max. $P_{2\,nom.}$

$$P_{2\,nom.} = \frac{R}{4} \cdot \left(\frac{U_N}{R} - I_o\right)^2 \qquad [W]$$

$$P_{2\,nom.}(20\,V) = \frac{57}{4} \cdot \left(\frac{20}{57} - 0{,}005\right)^2 \qquad = 1{,}70 \quad W$$

Efficiency, max. $\eta_{max.}$

$$\eta_{max.} = \left(1 - \sqrt{\frac{I_o}{I_H}}\right)^2 \cdot 100 \qquad [\%]$$

$$\eta_{max.} = \left(1 - \sqrt{\frac{0{,}005}{0{,}351}}\right)^2 \cdot 100 \qquad = 77{,}6 \quad \%$$

At the point of max. efficiency, the torque delivered is:

$$M_{opt.} = \sqrt{M_H \cdot M_R} \qquad [mNm]$$

inserting the values

Friction torque	M_R	=	0,13 mNm
and			
Stall torque at 20 V DC	M_H	=	8,89 mNm

$$M_{opt.} = \sqrt{8{,}89 \cdot 0{,}13} \qquad = 1{,}08 \quad \text{mNm}$$

Calculation of the operating point at 20 V DC
When the torque (M = 3 mNm) at the working point is taken into consideration I, n, P_2 and η can be calculated:

Current at the operating point

$$I = \frac{M + M_R}{k_M} \qquad [A]$$

$$I = \frac{3 + 0{,}13}{25{,}70} \qquad = 0{,}122 \quad A$$

Speed at the operating point

$$n = \frac{U - R \cdot I}{k_E} \cdot 1\,000 \qquad [\text{rpm}]$$

$$n = \frac{20 - 57 \cdot 0{,}122}{2{,}690} \cdot 1\,000 \qquad = 4\,841 \quad \text{rpm}$$

Output power at the operating point

$$P_2 = M \cdot n \cdot \frac{\pi}{30 \cdot 1\,000} \qquad [W]$$

$$P_2 = 3 \cdot 4\,841 \cdot \frac{\pi}{30 \cdot 1\,000} \qquad = 1{,}52 \quad W$$

Efficiency at the operating point

$$\eta = \frac{P_2}{U \cdot I} \cdot 100 \qquad [\%]$$

$$\eta = \frac{1{,}52}{20 \cdot 0{,}122} \cdot 100 \qquad = 62{,}3 \quad \%$$

In this example the calculated speed at the working point is different to the required speed, therefore the supply voltage has to be changed and the calculation repeated.

Supply voltage at the operating point
The exact supply voltage at the operating point can now be obtained with the following equation:

$$U = R \cdot I + k_E \cdot n \cdot 10^{-3}$$

$$U = 57 \cdot 0{,}122 + 2{,}695 \cdot 5\,500 \cdot 10^{-3} \quad = 21{,}78 \text{ V DC}$$

In this calculated example, the parameters at the operating point are summarized as follows:

Supply voltage	U	=	21,78	V DC
Speed	n	=	5 500	rpm
Output torque	M_N	=	3	mNm
Current	I	=	0,12	A
Output power	P_2	=	1,72	W
Efficiency	η	=	66	%

Estimating the temperature of the motor winding in operation:
In order to confirm that the motor is operating in an allowable temperature range it is useful to estimate the temperature of the winding under load.

First, calculate the approximate motor losses due to heating using the following formula:

$$P_{loss} = I_{load}^2 \cdot R$$

inserting the values

Current	I_{load}	=	0,12 A
Resistance	R	=	57 Ω

$$P_{loss} = (0{,}12)^2 \cdot 57 \qquad = 0{,}82 \text{ W}$$

Then multiply the value for the power losses by the combined thermal resistances of the motor to estimate the change in the temperature of the motor due to the load.

$$\Delta T = P_{loss} \cdot (R_{th1} + R_{th2})$$

inserting the values

Thermal Resistance 1	R_{th1}	=	4 K/W
Thermal Resistance 2	R_{th2}	=	27 K/W

$$\Delta T = 0{,}82 \cdot (4+27) \qquad = 25{,}4 \text{ °K}$$

Add the resulting change in temperature ΔT to the ambient temperature to estimate the motor winding temperature under load.

$$T_{winding} = \Delta T + T_{amb}$$

$$T_{winding} = 25{,}4 + 22 \qquad = 47{,}4 \text{ °C}$$

This calculation confirms that the temperature is well within the specified standard operating temperature range as well as the maximum winding temperature.

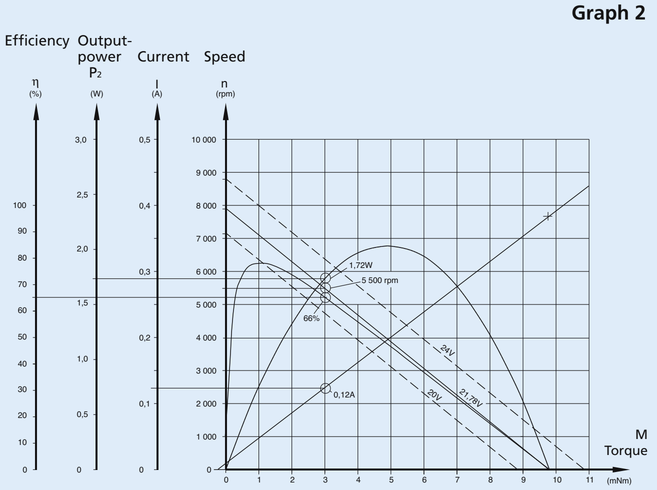
The calculation given above is for the purposes of a quick estimation only. The non-linear effects of temperature on the resistance of the winding and the resulting torque constant (K_m) of the motor due to the temperature coefficient of the magnet material used have not been taken into account and can have a large effect on motor performance at higher temperatures. A more detailed calculation should be performed before operating the motor close to its thermal limits.

Motor characteristic curves

For a specific torque, the various parameters can be read on graph 2.

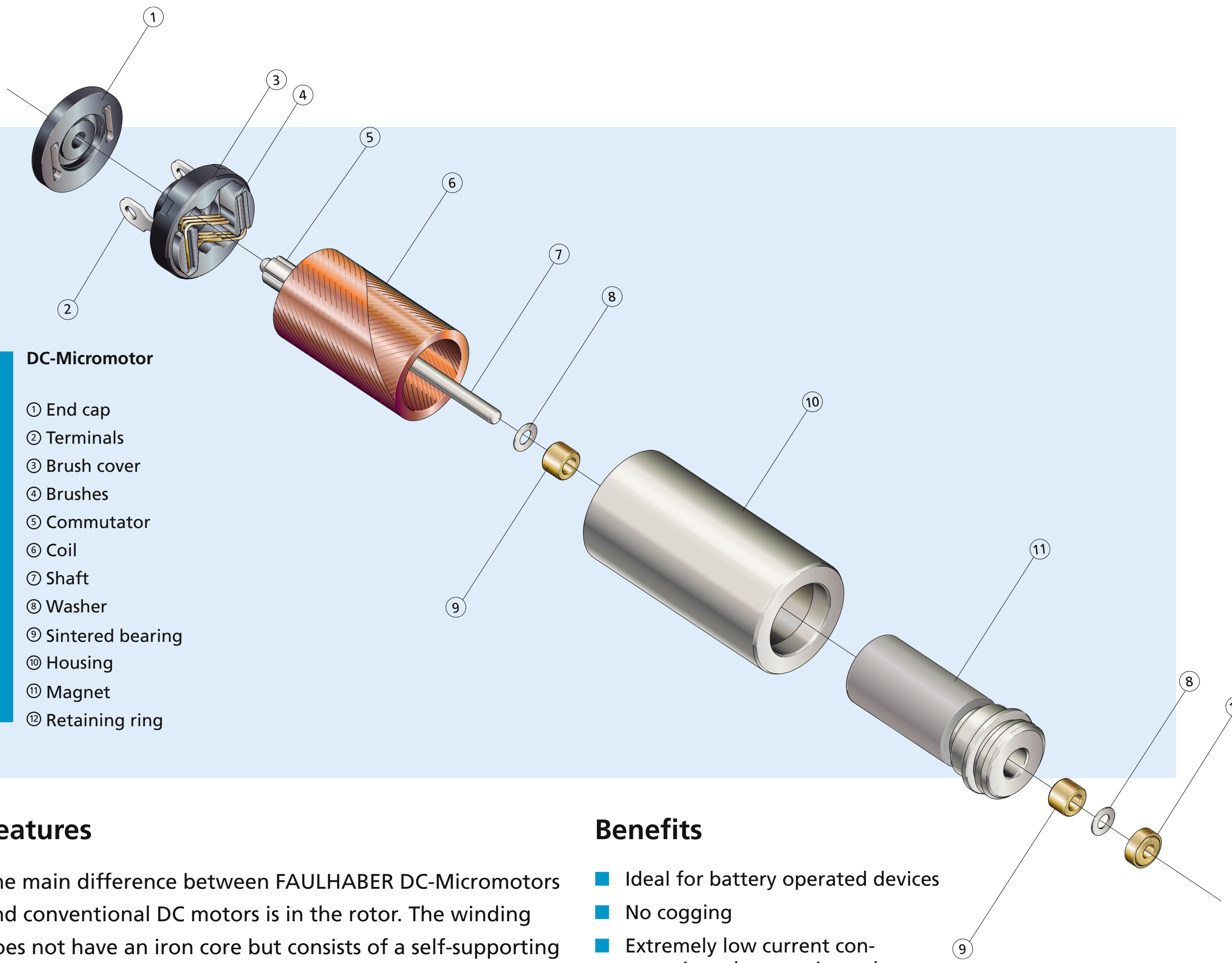
To simplify the calculation, the influence of temperature and tolerances has deliberately been omitted.

Graph 2



DC-Micromotors

Precious Metal Commutation



DC-Micromotor

① End cap
② Terminals
③ Brush cover
④ Brushes
⑤ Commutator
⑥ Coil
⑦ Shaft
⑧ Washer
⑨ Sintered bearing
⑩ Housing
⑪ Magnet
⑫ Retaining ring

Features

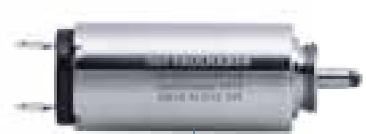
The main difference between FAULHABER DC-Micromotors and conventional DC motors is in the rotor. The winding does not have an iron core but consists of a self-supporting skew-wound copper coil. This featherweight rotor has an extremely low moment of inertia, and it rotates without cogging. The result is the outstanding dynamics of FAULHABER motors. For low power motors, commutation systems using precious metals are the optimum solution because of their low contact resistance.

FAULHABER precious metal commutated motors range in size from just 6 mm to 22 mm in diameter. FAULHABER completes the drive system by providing a variety of additional hightech standard components including high resolution encoders, precision gearheads, and drive electronics. FAULHABER specializes in the modification of their drive systems to fit the customer's particular application requirements. Common modifications include vaccuum compatibility, extreme temperature compatibility, modified shaft geometry, additional voltage types, custom motor leads and connectors, and much more.

Benefits

- Ideal for battery operated devices
- No cogging
- Extremely low current consumption – low starting voltage
- Highly dynamic performance due to a low inertia, low inductance coil
- Light and compact
- Precise speed control
- Simple to control due to the linear performance characteristics

Product Code

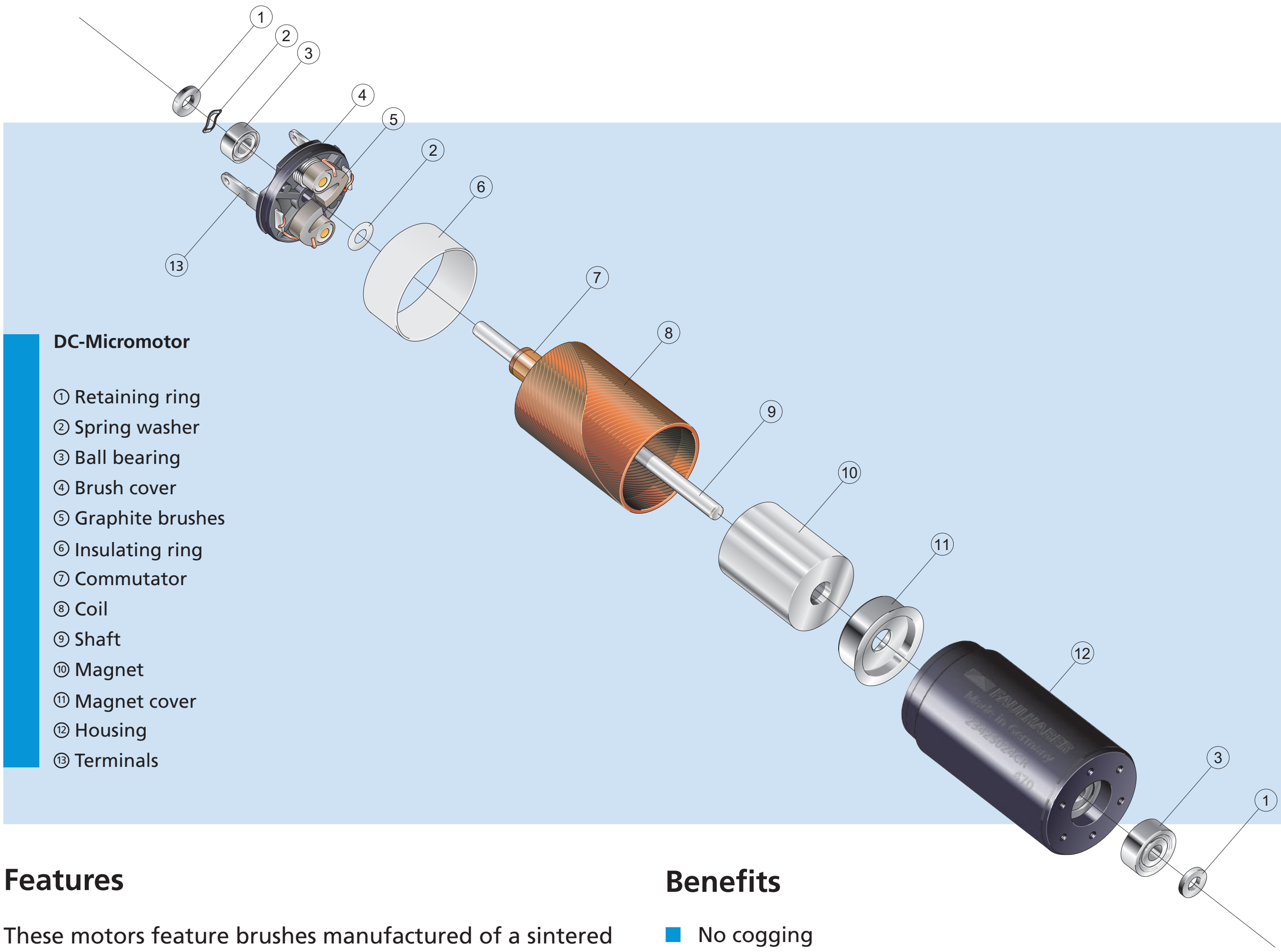


0816 N 012 S R

08	Motor diameter
16	Motor length [mm]
N	Shaft type
012	Nominal voltage [V]
S	Type of commutation (precious metal)
R	Version (rare earth magnet)

DC-Micromotors

Graphite Commutation



Features

These motors feature brushes manufactured of a sintered metal graphite material and a copper commutator.
This ensures that the commutation system can withstand more power and still deliver exceptionally long operational lifetimes.

A multitude of adaptations for customer specific requirements and special executions are available.

FAULHABER motors with graphite brushes range in size from just 13 mm to 38 mm in diameter.
FAULHABER completes the drive system by providing a variety of additional high-tech standard components including high resolution encoders, precision gearheads, drive electronics, brakes and other servo componets.
FAULHABER specializes in the modification of their drive systems to fit the customer's particular application requirements. Common modifications include vaccuum compatibility, extreme temperature compatibility, modified shaft geometry, additional voltage types, custom motor leads and connectors, and much more.

Benefits

- No cogging
- High power density
- Highly dynamic performance due to a low inertia, low inductance coil
- Light and compact
- Precise speed control
- Simple to control due to the linear performance characteristics

Product Code

2342 S 024 CR

23	Motor diameter [mm]
42	Motor length [mm]
S	Shaft type
024	Nominal voltage [V]
C	Type of commutation (Graphite)
R	Version (rare earth magnet)

DC-Micromotors

0,17 mNm

Precious Metal Commutation

For combination with
Gearheads:
06/1
Encoders:
HXM3-64, PA2-50

Series 0615 ... S

Values at 22°C and nominal voltage	0615 N		1,5 S	003 S	4,5 S	
1 Nominal voltage	U_N		1,5	3	4,5	V
2 Terminal resistance	R		3,9	16,2	37,7	Ω
3 Output power	$P_{2nom.}$		0,12	0,12	0,11	W
4 Efficiency, max.	$\eta_{max.}$		52	50	48	%
5 No-load speed	n_0		19 100	20 200	20 000	rpm
6 No-load current, typ. (with shaft ø 0,8 mm)	I_0		0,03	0,016	0,012	A
7 Stall torque	M_H		0,24	0,22	0,21	mNm
8 Friction torque	M_R		0,02	0,02	0,02	mNm
9 Speed constant	k_n		13 840	7 346	4 872	rpm/V
10 Back-EMF constant	k_E		0,072	0,136	0,205	mV/rpm
11 Torque constant	k_M		0,69	1,3	1,96	mNm/A
12 Current constant	k_I		1,449	0,769	0,51	A/mNm
13 Slope of n-M curve	$\Delta n/\Delta M$		78 224	91 538	93 713	rpm/mNm
14 Rotor inductance	L		12	39	95	µH
15 Mechanical time constant	τ_m		8	10	10	ms
16 Rotor inertia	J		0,01	0,01	0,01	gcm²
17 Angular acceleration	$\alpha_{max.}$		244	221	213	·10³rad/s²
18 Thermal resistance	R_{th1} / R_{th2}	35 / 76				K/W
19 Thermal time constant	τ_{w1} / τ_{w2}	2,6 / 110				s
20 Operating temperature range:						
– motor		-30 ... +85 (optional version -30 ... +125)				°C
– winding, max. permissible		+85 (optional version +125)				°C
21 Shaft bearings		sintered bearings				
22 Shaft load max.:						
– with shaft diameter		0,8				mm
– radial at 3 000 rpm (1,5 mm from bearing)		0,5				N
– axial at 3 000 rpm		0,1				N
– axial at standstill		20				N
23 Shaft play						
– radial	≤	0,03				mm
– axial	≤	0,15				mm
24 Housing material		steel, black coated				
25 Mass		2				g
26 Direction of rotation		clockwise, viewed from the front face				
27 Speed up to	$n_{max.}$	24 000				rpm
28 Number of pole pairs		1				
29 Magnet material		NdFeB				

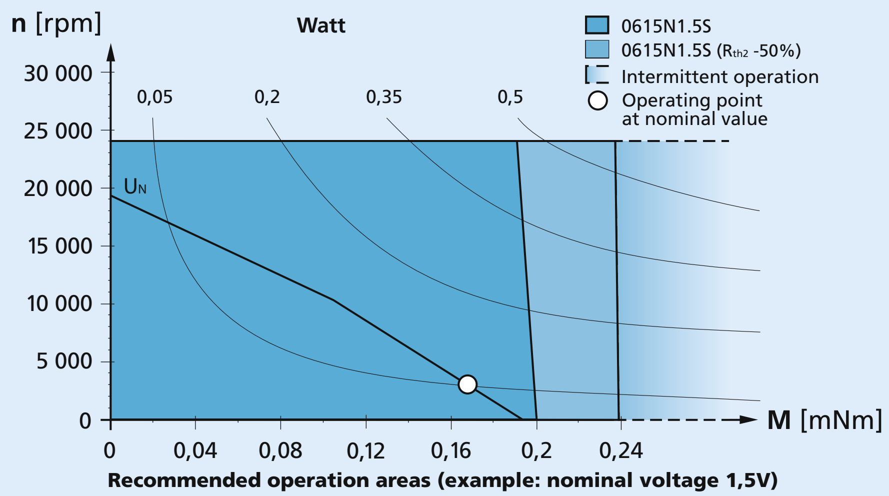
Rated values for continuous operation						
30 Rated torque	M_N		0,17	0,16	0,15	mNm
31 Rated current (thermal limit)	I_N		0,29	0,14	0,092	A
32 Rated speed	n_N		2 500	2 500	2 500	rpm

Note: Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The R_{th2} value has been reduced by 0%.

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

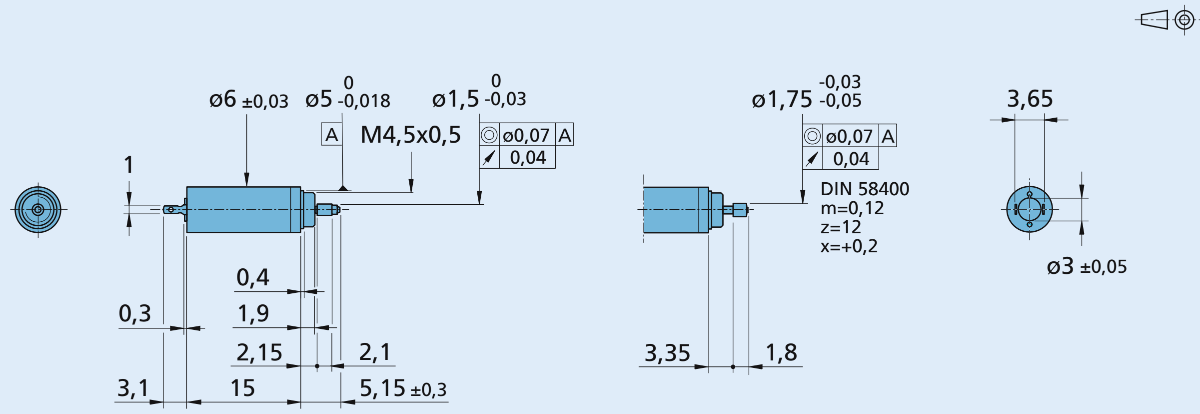
The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 50% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended operation areas (example: nominal voltage 1,5V)

Dimensional drawing



0615 N ... S

0615 C ... S
for Gearhead 06/1

NEW

FAULHABER

DC-Micromotors

Precious Metal Commutation

0,7 mNm

For combination with
Gearheads:
08/1, 08/2, 08/3, 10/1
Encoders:
HEM3-256-W, PA2-50

Series 0816 ... SR

	Values at 22°C and nominal voltage	0816 K		003 SR	006 SR	009 SR	012 SR	
1	Nominal voltage	U_N		3	6	9	12	V
2	Terminal resistance	R		5,4	21,2	47	101,8	Ω
3	Output power	$P_{2nom.}$		0,4	0,4	0,41	0,33	W
4	Efficiency, max.	$\eta_{max.}$		69	69	69	67	%
5	No-load speed	n_0		13 250	13 500	13 500	12 600	rpm
6	No-load current, typ. (with shaft ø 1 mm)	I_0		0,016	0,0083	0,0057	0,0039	A
7	Stall torque	M_H		1,15	1,13	1,15	1	mNm
8	Friction torque	M_R		0,034	0,034	0,035	0,034	mNm
9	Speed constant	k_n		4 526	2 318	1 543	1 085	rpm/V
10	Back-EMF constant	k_E		0,221	0,431	0,648	0,922	mV/rpm
11	Torque constant	k_M		2,11	4,12	6,19	8,8	mNm/A
12	Current constant	k_I		0,474	0,243	0,162	0,114	A/mNm
13	Slope of n-M curve	$\Delta n/\Delta M$		11 475	11 904	11 714	12 553	rpm/mNm
14	Rotor inductance	L		53	217	507	1 033	µH
15	Mechanical time constant	τ_m		6,1	6,5	6,2	6,5	ms
16	Rotor inertia	J		0,051	0,052	0,051	0,049	gcm²
17	Angular acceleration	$\alpha_{max.}$		229	219	227	203	·10³rad/s²
18	Thermal resistance	R_{th1} / R_{th2}	20 / 48					K/W
19	Thermal time constant	τ_{w1} / τ_{w2}	4,2 / 242					s
20	Operating temperature range:							
	– motor		-30 ... +85					°C
	– winding, max. permissible		+85					°C
21	Shaft bearings		sintered bearings					
22	Shaft load max.:							
	– with shaft diameter		1					mm
	– radial at 3 000 rpm (1,5 mm from bearing)		0,7					N
	– axial at 3 000 rpm		0,1					N
	– axial at standstill		20					N
23	Shaft play							
	– radial	≤	0,02					mm
	– axial	≤	0,2					mm
24	Housing material		steel, nickel plated					
25	Mass		4,5					g
26	Direction of rotation		clockwise, viewed from the front face					
27	Speed up to	$n_{max.}$	16 000					rpm
28	Number of pole pairs		1					
29	Magnet material		NdFeB					

	Rated values for continuous operation							
30	Rated torque	M_N		0,7	0,69	0,69	0,61	mNm
31	Rated current (thermal limit)	I_N		0,37	0,19	0,13	0,077	A
32	Rated speed	n_N		2 540	2 660	2 790	2 500	rpm

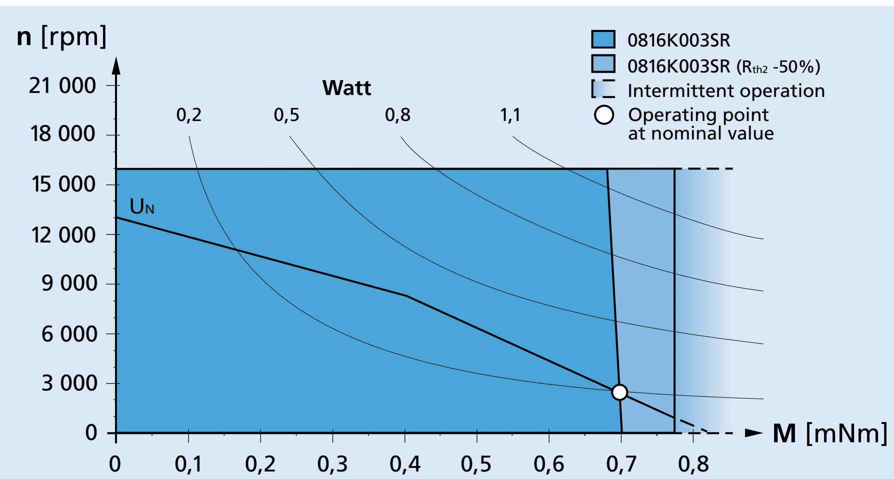
Note: Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The Rth2 value has been reduced by 0%.

Note:

The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

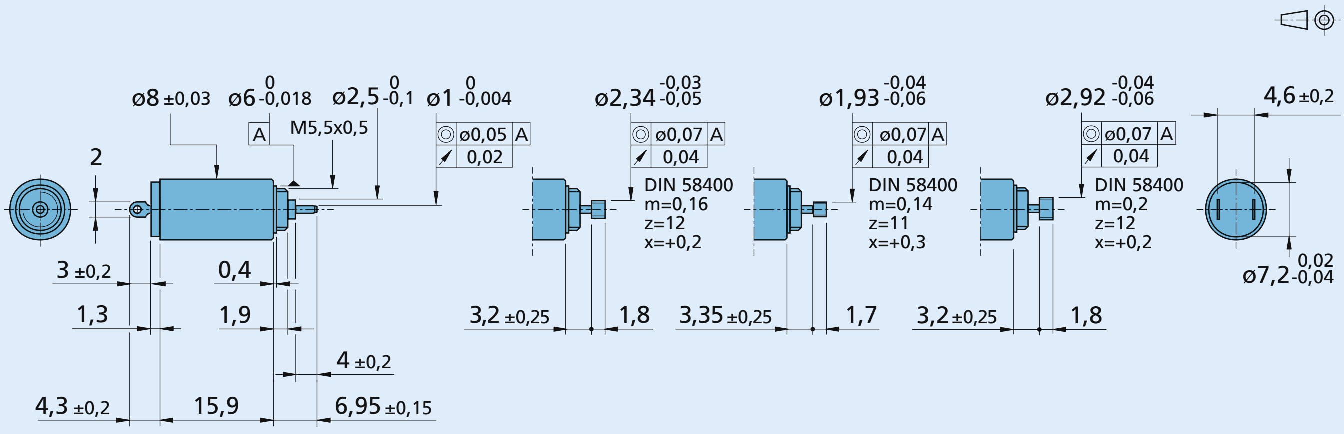
The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 50% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended operation areas (example: nominal voltage 3V)

Dimensional drawing



0816 K ... SR

0816 P ... SR
for Gearhead 08/1

0816 D ... SR
for Gearheads 08/2, 08/3

0816 M ... SR
for Gearhead 10/1

DC-Micromotors

Precious Metal Commutation

0,5 mNm

For combination with
Gearheads:
10/1, 12/3
Encoders:
HEM3-256-W, PA2-100

Series 1016 ... G

Values at 22°C and nominal voltage	1016 N		003 G	006 G	012 G	
1 Nominal voltage	U_N		3	6	12	V
2 Terminal resistance	R		8,7	19,3	95	Ω
3 Output power	$P_{2nom.}$		0,24	0,44	0,36	W
4 Efficiency, max.	$\eta_{max.}$		63	68	68	%
5 No-load speed	n_0		14 200	18 400	16 500	rpm
6 No-load current, typ. (with shaft ø 0,8 mm)	I_0		0,015	0,01	0,004	A
7 Stall torque	M_H		0,64	0,9	0,82	mNm
8 Friction torque	M_R		0,03	0,03	0,03	mNm
9 Speed constant	k_n		4 948	3 173	1 419	rpm/V
10 Back-EMF constant	k_E		0,202	0,315	0,705	mV/rpm
11 Torque constant	k_M		1,93	3,01	6,73	mNm/A
12 Current constant	k_I		0,518	0,332	0,149	A/mNm
13 Slope of n-M curve	$\Delta n/\Delta M$		22 304	20 342	20 029	rpm/mNm
14 Rotor inductance	L		28	60	310	µH
15 Mechanical time constant	τ_m		9	12,8	10	ms
16 Rotor inertia	J		0,04	0,06	0,05	gcm²
17 Angular acceleration	$\alpha_{max.}$		159	151	165	·10³rad/s²
18 Thermal resistance	R_{th1} / R_{th2}	26 / 56				K/W
19 Thermal time constant	τ_{w1} / τ_{w2}	3,1 / 260				s
20 Operating temperature range:						
– motor		-30 ... +85 (optional version -30 ... +125)				°C
– winding, max. permissible		+85 (optional version +125)				°C
21 Shaft bearings		sintered bearings	ball bearings			
22 Shaft load max.:		(standard)	(optional version)			
– with shaft diameter		0,8	1			mm
– radial at 3 000 rpm (1,5 mm from bearing)		0,5	5			N
– axial at 3 000 rpm		0,1	0,5			N
– axial at standstill		20	5			N
23 Shaft play						
– radial	≤	0,03	0,02			mm
– axial	≤	0,2	0,2			mm
24 Housing material		steel, nickel plated				
25 Mass		6,5				g
26 Direction of rotation		clockwise, viewed from the front face				
27 Speed up to	$n_{max.}$	22 000				rpm
28 Number of pole pairs		1				
29 Magnet material		SmCo				

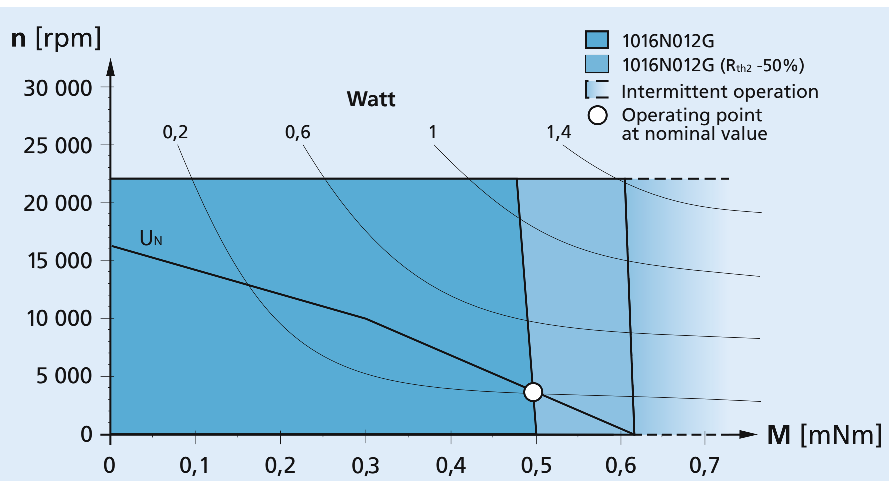
Rated values for continuous operation			003 G	006 G	012 G	
30 Rated torque	M_N		0,43	0,48	0,5	mNm
31 Rated current (thermal limit)	I_N		0,24	0,17	0,08	A
32 Rated speed	n_N		2 500	5 730	3 750	rpm

Note: Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The R_{th2} value has been reduced by 0%.

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

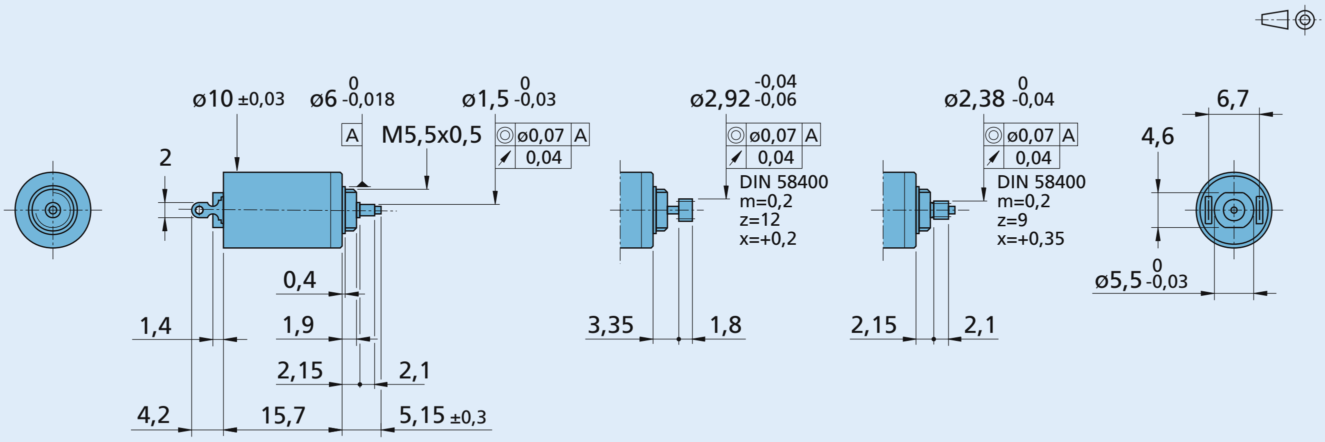
The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 50% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended operation areas (example: nominal voltage 12V)

Dimensional drawing



1016 N ... G

1016 M ... G
for Gearhead 10/1

1016 E ... G
for Gearhead 12/3

DC-Micromotors

1,3 mNm

Precious Metal Commutation

For combination with
Gearheads:
10/1, 12/3, 12/4, 12/5
Encoders:
HEM3-256-W, PA2-100

Series 1024 ... S

	Values at 22°C and nominal voltage	1024 N		003 S	006 S	012 S	
1	Nominal voltage	U_N		3	6	12	V
2	Terminal resistance	R		2,3	10,8	31,6	Ω
3	Output power	$P_{2nom.}$		0,97	0,81	1,11	W
4	Efficiency, max.	$\eta_{max.}$		79	78	79	%
5	No-load speed	n_0		13 800	13 200	14 700	rpm
6	No-load current, typ. (with shaft ø 1 mm)	I_0		0,016	0,008	0,004	A
7	Stall torque	M_H		2,69	2,34	2,89	mNm
8	Friction torque	M_R		0,03	0,03	0,03	mNm
9	Speed constant	k_n		4 658	2 231	1 240	rpm/V
10	Back-EMF constant	k_E		0,215	0,448	0,806	mV/rpm
11	Torque constant	k_M		2,05	4,28	7,7	mNm/A
12	Current constant	k_I		0,488	0,234	0,13	A/mNm
13	Slope of n-M curve	$\Delta n/\Delta M$		5 135	5 630	5 090	rpm/mNm
14	Rotor inductance	L		26	100	344	µH
15	Mechanical time constant	τ_m		6	7	6	ms
16	Rotor inertia	J		0,12	0,12	0,12	gcm²
17	Angular acceleration	$\alpha_{max.}$		224	195	241	·10³rad/s²
18	Thermal resistance	R_{th1} / R_{th2}	14 / 41				K/W
19	Thermal time constant	τ_{w1} / τ_{w2}	5 / 289				s
20	Operating temperature range:						
	– motor		-30 ... +85 (optional version -30 ... +125)				°C
	– winding, max. permissible		+85 (optional version +125)				°C
21	Shaft bearings		sintered bearings				
22	Shaft load max.:						
	– with shaft diameter		1				mm
	– radial at 3 000 rpm (1,5 mm from bearing)		0,5				N
	– axial at 3 000 rpm		0,1				N
	– axial at standstill		20				N
23	Shaft play						
	– radial	≤	0,03				mm
	– axial	≤	0,2				mm
24	Housing material		steel, black coated				
25	Mass		8,8				g
26	Direction of rotation		clockwise, viewed from the front face				
27	Speed up to	$n_{max.}$	17 000				rpm
28	Number of pole pairs		1				
29	Magnet material		NdFeB				

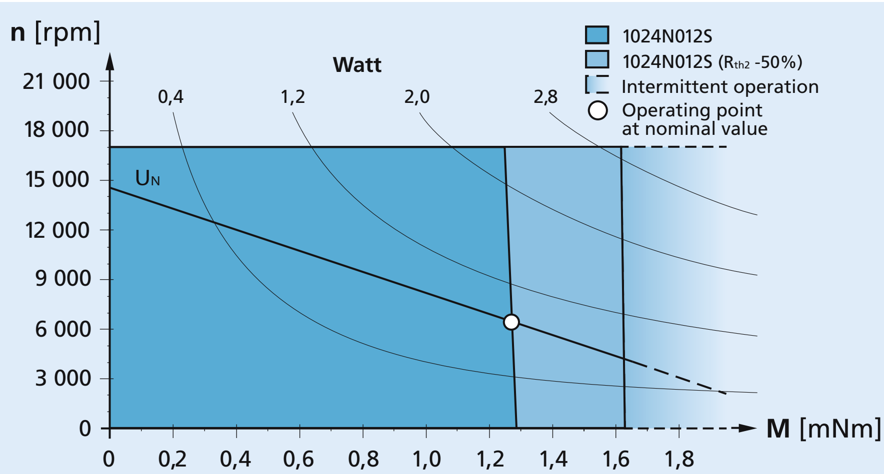
	Rated values for continuous operation						
30	Rated torque	M_N		0,79	1,2	1,3	mNm
31	Rated current (thermal limit)	I_N		0,4	0,29	0,17	A
32	Rated speed	n_N		9 300	4 660	6 650	rpm

Note: Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The R_{th2} value has been reduced by 0%.

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

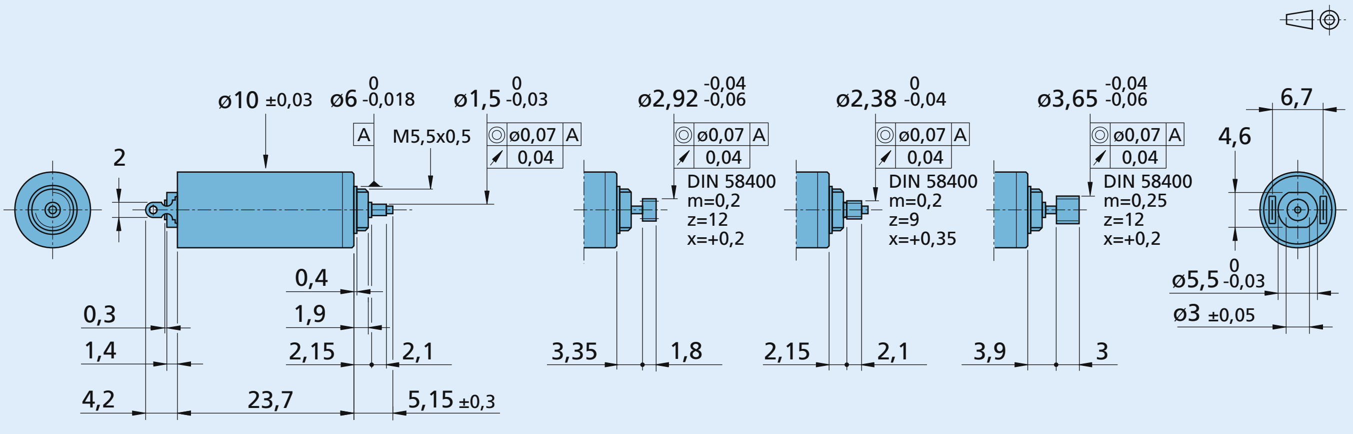
The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 50% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended operation areas (example: nominal voltage 12V)

Dimensional drawing



1024 N ... S

1024 M ... S
for Gearhead 10/1

1024 E ... S
for Gearheads 12/3, 12/5

1024 A ... S
for Gearhead 12/4

DC-Micromotors

Precious Metal Commutation

0,72 mNm

For combination with
Gearheads:
10/1, 12/3

Series 1219 ... G

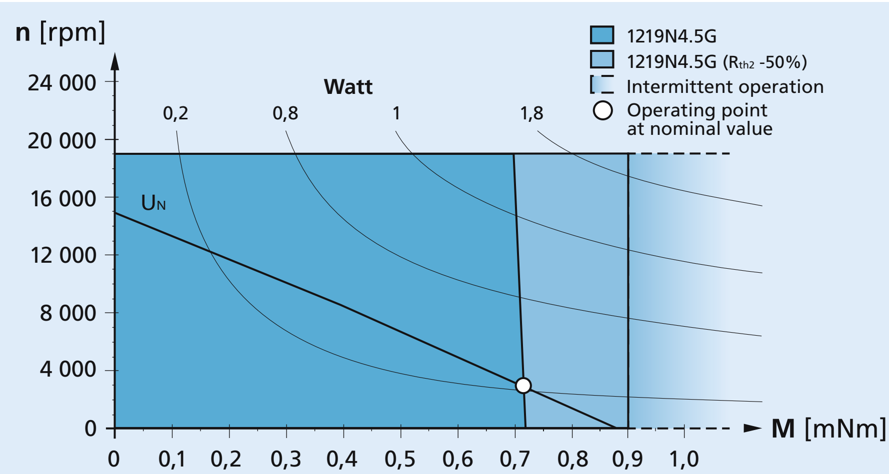
	Values at 22°C and nominal voltage	1219 N		4,5 G	006 G	012 G	015 G	
1	Nominal voltage	U_N		4,5	6	12	15	V
2	Terminal resistance	R		10,7	17,6	69	131	Ω
3	Output power	$P_{2nom.}$		0,46	0,49	0,5	0,41	W
4	Efficiency, max.	$\eta_{max.}$		74	73	72	70	%
5	No-load speed	n_0		15 300	16 000	16 000	16 200	rpm
6	No-load current, typ. (with shaft ø 0,8 mm)	I_0		0,008	0,007	0,004	0,003	A
7	Stall torque	M_H		1,14	1,17	1,19	0,96	mNm
8	Friction torque	M_R		0,02	0,02	0,03	0,03	mNm
9	Speed constant	k_n		3 460	2 721	1 364	1 109	rpm/V
10	Back-EMF constant	k_E		0,289	0,368	0,733	0,902	mV/rpm
11	Torque constant	k_M		2,76	3,51	7	8,61	mNm/A
12	Current constant	k_I		0,362	0,285	0,143	0,116	A/mNm
13	Slope of n-M curve	$\Delta n/\Delta M$		13 413	13 642	13 447	16 875	rpm/mNm
14	Rotor inductance	L		150	300	1 200	1 600	µH
15	Mechanical time constant	τ_m		20	20	18	19	ms
16	Rotor inertia	J		0,14	0,14	0,13	0,11	gcm²
17	Angular acceleration	$\alpha_{max.}$		81	84	92	87	$\cdot 10^3$rad/s²
18	Thermal resistance	R_{th1} / R_{th2}	17 / 48					K/W
19	Thermal time constant	τ_{w1} / τ_{w2}	3,5 / 386					s
20	Operating temperature range:							
	– motor		-30 ... +85 (optional version -30 ... +125)					°C
	– winding, max. permissible		+85 (optional version +125)					°C
21	Shaft bearings		sintered bearings	ball bearings				
22	Shaft load max.:		(standard)	(optional version)				
	– with shaft diameter		0,8	1				mm
	– radial at 3 000 rpm (1,5 mm from bearing)		0,5	5				N
	– axial at 3 000 rpm		0,1	0,5				N
	– axial at standstill		20	5				N
23	Shaft play							
	– radial	≤	0,03	0,02				mm
	– axial	≤	0,2	0,2				mm
24	Housing material		steel, nickel plated					
25	Mass		11					g
26	Direction of rotation		clockwise, viewed from the front face					
27	Speed up to	$n_{max.}$	19 000					rpm
28	Number of pole pairs		1					
29	Magnet material		AlNiCo					
	Rated values for continuous operation							
30	Rated torque	M_N		0,72	0,71	0,7	0,62	mNm
31	Rated current (thermal limit)	I_N		0,27	0,21	0,11	0,077	A
32	Rated speed	n_N		3 120	3 870	4 040	2 770	rpm

Note: Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The R_{th2} value has been reduced by 0%.

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

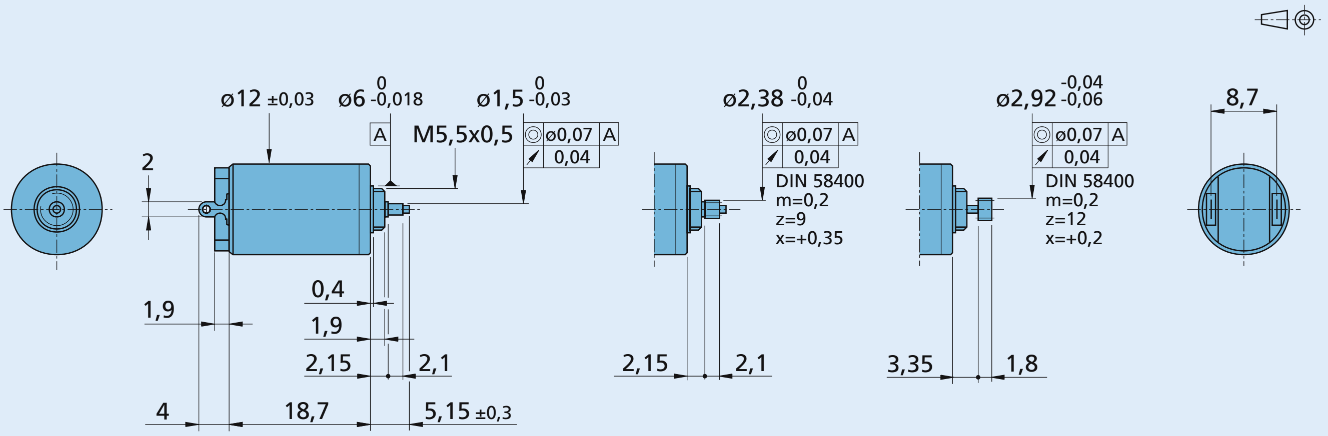
The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 50% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended operation areas (example: nominal voltage 4,5V)

Dimensional drawing



1219 N ... G

1219 E ... G
for Gearhead 12/3

1219 M ... G
for Gearhead 10/1

DC-Micromotors

Precious Metal Commutation

1,7 mNm

For combination with
Gearheads:
10/1, 12/3, 12/4, 12/5
Encoders:
HEM3-256-W, PA2-100

Series 1224 ... SR

	Values at 22°C and nominal voltage	1224 N	006 SR	012 SR	015 SR	
1	Nominal voltage	U_N	6	12	15	V
2	Terminal resistance	R	4,6	18,2	29,4	Ω
3	Output power	$P_{2nom.}$	1,92	1,95	1,88	W
4	Efficiency, max.	$\eta_{max.}$	82	83	83	%
5	No-load speed	n_0	13 800	13 700	13 400	rpm
6	No-load current, typ. (with shaft ø 1 mm)	I_0	0,011	0,005	0,004	A
7	Stall torque	M_H	5,31	5,43	5,36	mNm
8	Friction torque	M_R	0,05	0,05	0,05	mNm
9	Speed constant	k_n	2 323	1 151	901	rpm/V
10	Back-EMF constant	k_E	0,43	0,869	1,11	mV/rpm
11	Torque constant	k_M	4,11	8,3	10,6	mNm/A
12	Current constant	k_I	0,243	0,12	0,094	A/mNm
13	Slope of n-M curve	$\Delta n/\Delta M$	2 600	2 523	2 499	rpm/mNm
14	Rotor inductance	L	55	220	350	µH
15	Mechanical time constant	τ_m	5	5	5	ms
16	Rotor inertia	J	0,18	0,18	0,18	gcm²
17	Angular acceleration	$\alpha_{max.}$	295	302	298	·10³rad/s²
18	Thermal resistance	R_{th1} / R_{th2}	17 / 37			K/W
19	Thermal time constant	τ_{w1} / τ_{w2}	6,5 / 371			s
20	Operating temperature range:					
	– motor		-30 ... +85 (optional version -30 ... +125)			°C
	– winding, max. permissible		+85 (optional version +125)			°C
21	Shaft bearings		sintered bearings			
22	Shaft load max.:					
	– with shaft diameter		1			mm
	– radial at 3 000 rpm (1,5 mm from bearing)		0,5			N
	– axial at 3 000 rpm		0,1			N
	– axial at standstill		20			N
23	Shaft play					
	– radial	≤	0,03			mm
	– axial	≤	0,2			mm
24	Housing material		steel, black coated			
25	Mass		13,5			g
26	Direction of rotation		clockwise, viewed from the front face			
27	Speed up to	$n_{max.}$	16 000			rpm
28	Number of pole pairs		1			
29	Magnet material		NdFeB			

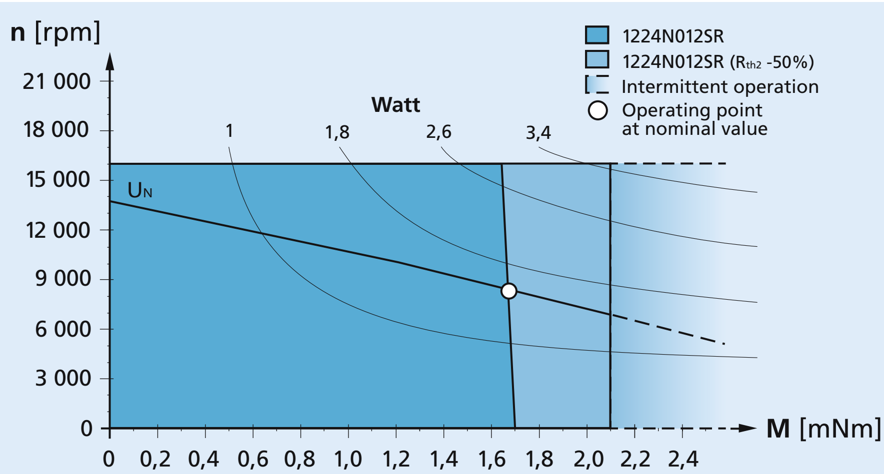
	Rated values for continuous operation					
30	Rated torque	M_N	1,5	1,7	1,7	mNm
31	Rated current (thermal limit)	I_N	0,4	0,22	0,18	A
32	Rated speed	n_N	9 680	8 580	8 270	rpm

Note: Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The R_{th2} value has been reduced by 0%.

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

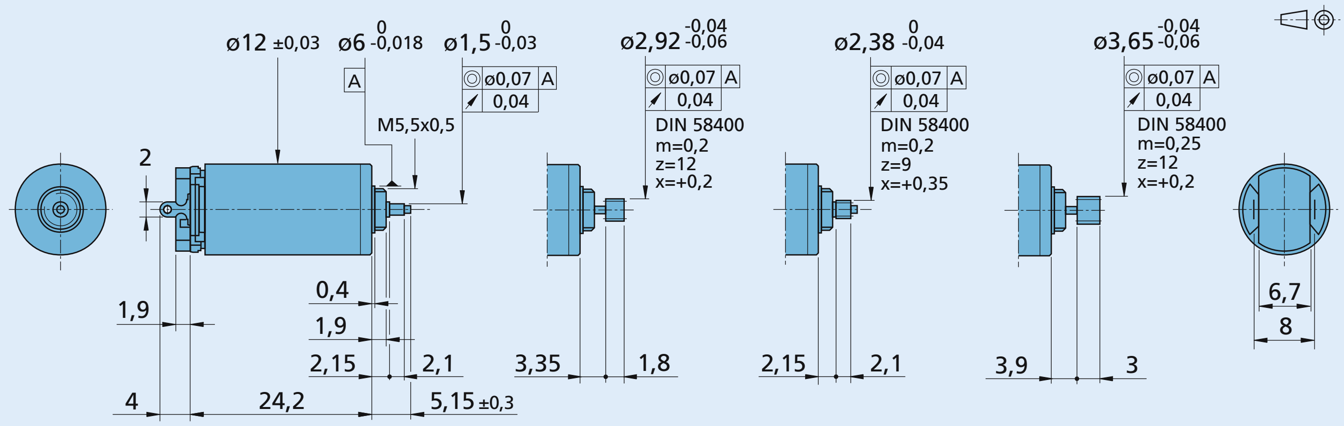
The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 50% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended operation areas (example: nominal voltage 12V)

Dimensional drawing



1224 N ... SR

1224 M ... SR
for Gearhead 10/1

1224 E ... SR
for Gearheads 12/3, 12/5

1224 A ... SR
for Gearhead 12/4

DC-Micromotors

Precious Metal Commutation

1,4 mNm

For combination with
Gearheads:
13A, 14/1, 15/5, 15/5 S
Encoders:
IE2-400

Series 1319 ... SR

Values at 22°C and nominal voltage		1319 T		006 SR	012 SR	024 SR	
1	Nominal voltage	U_N		6	12	24	V
2	Terminal resistance	R		8,26	34,6	119	Ω
3	Output power	$P_{2nom.}$		1	0,95	1,1	W
4	Efficiency, max.	$\eta_{max.}$		66	65	66	%
5	No-load speed	n_0		13 100	12 800	14 600	rpm
6	No-load current, typ. (with shaft ø 1,5 mm)	I_0		0,031	0,015	0,009	A
7	Stall torque	M_H		2,91	2,84	2,89	mNm
8	Friction torque	M_R		0,13	0,13	0,13	mNm
9	Speed constant	k_n		2 280	1 110	637	rpm/V
10	Back-EMF constant	k_E		0,438	0,897	1,57	mV/rpm
11	Torque constant	k_M		4,19	8,57	15	mNm/A
12	Current constant	k_I		0,239	0,117	0,067	A/mNm
13	Slope of n-M curve	$\Delta n/\Delta M$		4 500	4 510	5 050	rpm/mNm
14	Rotor inductance	L		130	530	1 600	µH
15	Mechanical time constant	τ_m		19	19	19	ms
16	Rotor inertia	J		0,4	0,4	0,36	gcm²
17	Angular acceleration	$\alpha_{max.}$		72	71	80	·10³rad/s²
18	Thermal resistance	R_{th1} / R_{th2}	8 / 35				K/W
19	Thermal time constant	τ_{w1} / τ_{w2}	3,8 / 175				s
20	Operating temperature range:						
	– motor		-30 ... +85 (optional version -55 ... +125)				°C
	– winding, max. permissible		+125				°C
21	Shaft bearings		sintered bearings				
22	Shaft load max.:						
	– with shaft diameter		1,5				mm
	– radial at 3 000 rpm (3 mm from bearing)		1,2				N
	– axial at 3 000 rpm		0,2				N
	– axial at standstill		20				N
23	Shaft play						
	– radial	≤	0,03				mm
	– axial	≤	0,2				mm
24	Housing material		steel, black coated				
25	Mass		12				g
26	Direction of rotation		clockwise, viewed from the front face				
27	Speed up to	$n_{max.}$	17 000				rpm
28	Number of pole pairs		1				
29	Magnet material		NdFeB				
Rated values for continuous operation							
30	Rated torque	M_N		1,4	1,4	1,3	mNm
31	Rated current (thermal limit)	I_N		0,4	0,2	0,11	A
32	Rated speed	n_N		4 140	3 790	5 400	rpm

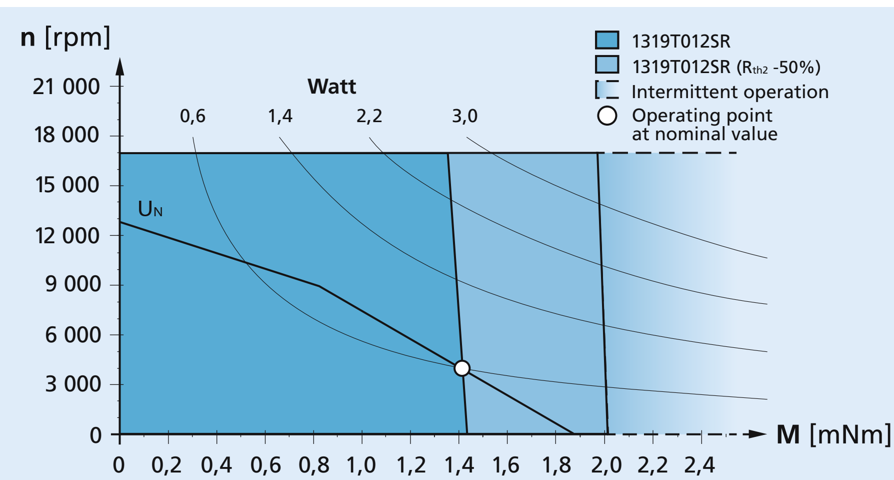
Note: Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The R_{th2} value has been reduced by 0%.

Note:

The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

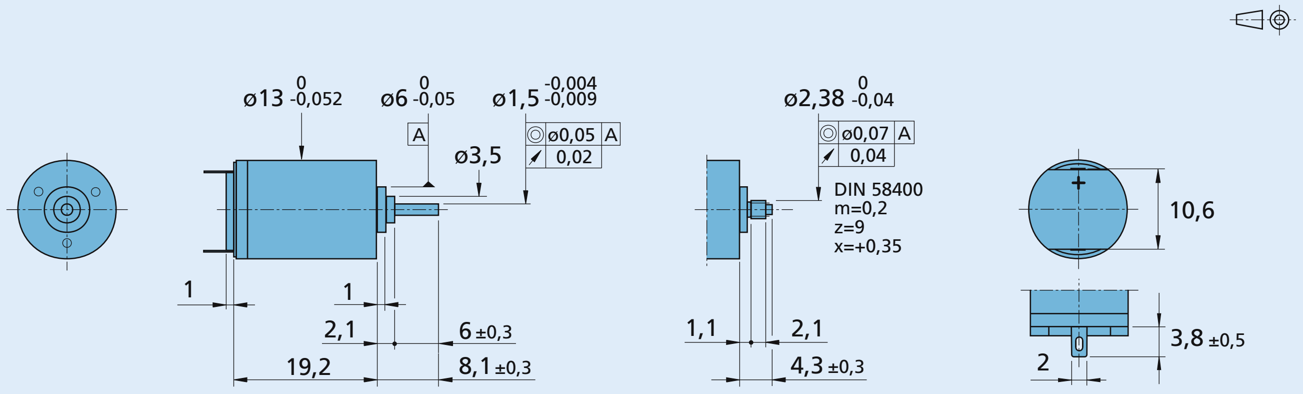
The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 50% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended operation areas (example: nominal voltage 12V)

Dimensional drawing



1319 T ... SR

1319 E ... SR

DC-Micromotors

Precious Metal Commutation

3,8 mNm

For combination with
Gearheads:
13A, 14/1, 15/5, 15/5 S
Encoders:
IE2-400

Series 1331 ... SR

Values at 22°C and nominal voltage	1331 T		006 SR	012 SR	024 SR	
1 Nominal voltage	U_N		6	12	24	V
2 Terminal resistance	R		2,83	13,7	52,9	Ω
3 Output power	$P_{2nom.}$		3,11	2,57	2,66	W
4 Efficiency, max.	$\eta_{max.}$		81	80	80	%
5 No-load speed	n_0		10 600	9 900	10 400	rpm
6 No-load current, typ. (with shaft ø 1,5 mm)	I_0		0,022	0,0105	0,0055	A
7 Stall torque	M_H		11,2	9,9	9,76	mNm
8 Friction torque	M_R		0,12	0,12	0,12	mNm
9 Speed constant	k_n		1 790	835	439	rpm/V
10 Back-EMF constant	k_E		0,56	1,2	2,28	mV/rpm
11 Torque constant	k_M		5,35	11,4	21,8	mNm/A
12 Current constant	k_I		0,187	0,087	0,046	A/mNm
13 Slope of n-M curve	$\Delta n/\Delta M$		946	1 000	1 070	rpm/mNm
14 Rotor inductance	L		70	310	1 100	µH
15 Mechanical time constant	τ_m		7	7	7	ms
16 Rotor inertia	J		0,71	0,67	0,63	gcm²
17 Angular acceleration	$\alpha_{max.}$		160	150	160	$\cdot 10^3$rad/s²
18 Thermal resistance	R_{th1} / R_{th2}	6 / 25				K/W
19 Thermal time constant	τ_{w1} / τ_{w2}	5 / 190				s
20 Operating temperature range:						
– motor		-30 ... +85 (optional version -55 ... +125)				°C
– winding, max. permissible		+125				°C
21 Shaft bearings		sintered bearings				
22 Shaft load max.:						
– with shaft diameter		1,5				mm
– radial at 3 000 rpm (3 mm from bearing)		1,2				N
– axial at 3 000 rpm		0,2				N
– axial at standstill		20				N
23 Shaft play						
– radial	≤	0,03				mm
– axial	≤	0,2				mm
24 Housing material		steel, black coated				
25 Mass		19				g
26 Direction of rotation		clockwise, viewed from the front face				
27 Speed up to	$n_{max.}$	12 000				rpm
28 Number of pole pairs		1				
29 Magnet material		NdFeB				

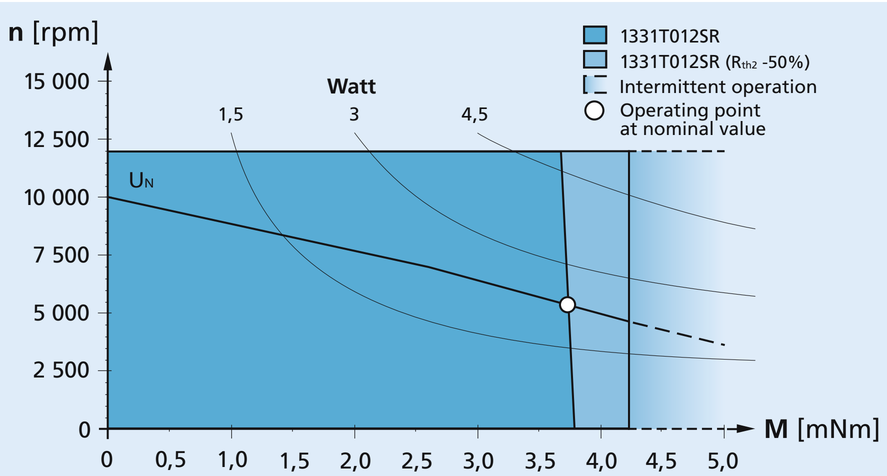
Rated values for continuous operation						
30 Rated torque	M_N		2	3,8	3,7	mNm
31 Rated current (thermal limit)	I_N		0,4	0,37	0,19	A
32 Rated speed	n_N		8 710	4 900	5 260	rpm

Note: Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The R_{th2} value has been reduced by 0%.

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

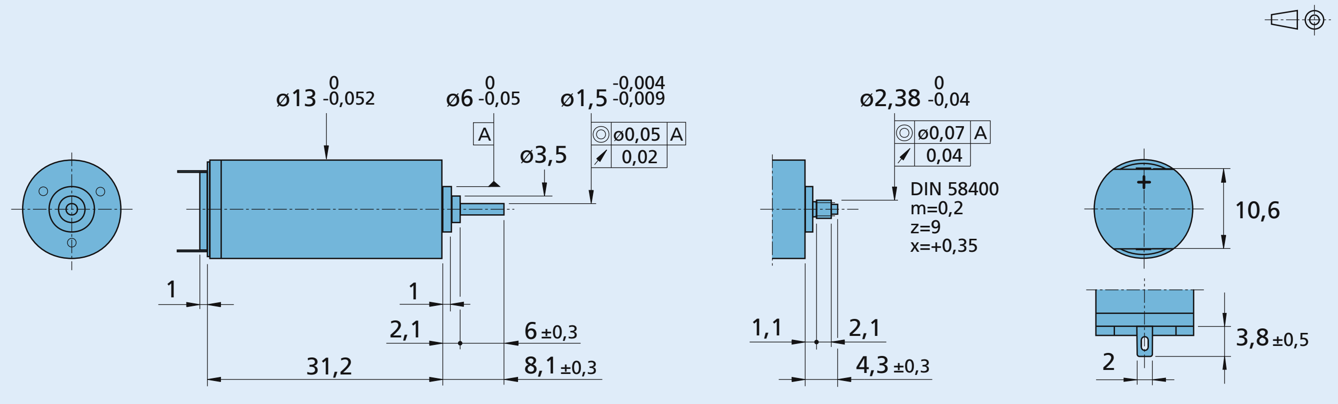
The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 50% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended operation areas (example: nominal voltage 12V)

Dimensional drawing



1331 T ... SR

1331 E ... SR

DC-Micromotors

Graphite Commutation

3,6 mNm

For combination with
Gearheads:
13A, 14/1
Encoders:
IE2-1024, IE2-16

Series 1336 ... CXR

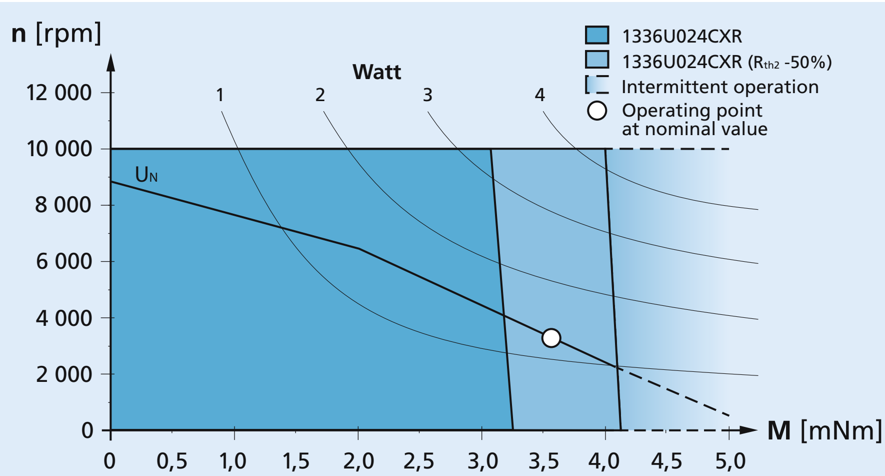
Values at 22°C and nominal voltage	1336 U		006 CXR	012 CXR	024 CXR	
1 Nominal voltage	U_N		6	12	24	V
2 Terminal resistance	R		3,98	15,6	63,7	Ω
3 Output power	$P_{2nom.}$		1,75	1,96	2	W
4 Efficiency, max.	$\eta_{max.}$		58	62	64	%
5 No-load speed	n_0		8 300	8 700	8 900	rpm
6 No-load current, typ. (with shaft ø 2 mm)	I_0		0,058	0,029	0,014	A
7 Stall torque	M_H		8,1	8,6	8,6	mNm
8 Friction torque	M_R		0,35	0,35	0,35	mNm
9 Speed constant	k_n		1 568	783	392	rpm/V
10 Back-EMF constant	k_E		0,638	1,277	2,552	mV/rpm
11 Torque constant	k_M		6,09	12,19	24,37	mNm/A
12 Current constant	k_I		0,164	0,082	0,041	A/mNm
13 Slope of n-M curve	$\Delta n/\Delta M$		1 025	1 003	1 024	rpm/mNm
14 Rotor inductance	L		70	280	1 100	µH
15 Mechanical time constant	τ_m		5,9	6	6	ms
16 Rotor inertia	J		0,55	0,57	0,56	gcm²
17 Angular acceleration	$\alpha_{max.}$		147	152	154	·10³rad/s²
18 Thermal resistance	R_{th1} / R_{th2}	13 / 28				K/W
19 Thermal time constant	τ_{w1} / τ_{w2}	11 / 245				s
20 Operating temperature range:						
– motor		-30 ... +100				°C
– winding, max. permissible		+125				°C
21 Shaft bearings		ball bearings, preloaded				
22 Shaft load max.:						
– with shaft diameter		2				mm
– radial at 3 000 rpm (3 mm from bearing)		8				N
– axial at 3 000 rpm		0,8				N
– axial at standstill		10				N
23 Shaft play						
– radial	≤	0,015				mm
– axial	=	0				mm
24 Housing material		steel, nickel plated				
25 Mass		21				g
26 Direction of rotation		clockwise, viewed from the front face				
27 Speed up to	$n_{max.}$	10 000				rpm
28 Number of pole pairs		1				
29 Magnet material		NdFeB				
Rated values for continuous operation						
30 Rated torque	M_N		3,5	3,6	3,6	mNm
31 Rated current (thermal limit)	I_N		0,7	0,36	0,18	A
32 Rated speed	n_N		2 780	3 170	3 250	rpm

Note: Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The R_{th2} value has been reduced by 25%.

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

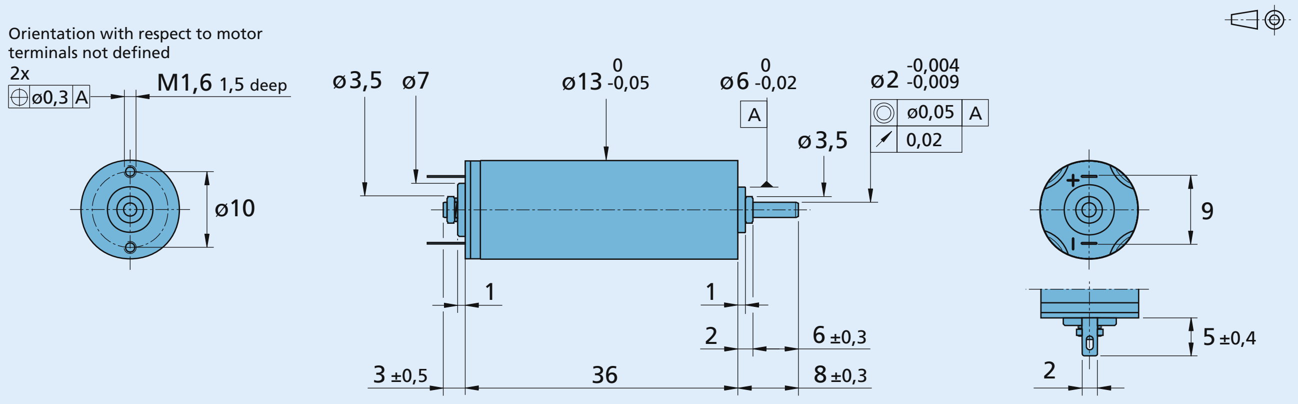
The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 50% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended operation areas (example: nominal voltage 24V)

Dimensional drawing



1336 U ... CXR

FAULHABER

DC-Micromotors

Precious Metal Commutation

0,59 mNm

For combination with
Gearheads:
15/5, 15/5 S, 16A

DC-Micromotors

Series 1516 ... S

Values at 22°C and nominal voltage	1516 T		1,5 S	002 S	4,5 S	006 S	012 S	
1 Nominal voltage	U_N		1,5	2	4,5	6	12	V
2 Terminal resistance	R		1,11	3,25	14,7	31,2	115	Ω
3 Output power	$P_{2nom.}$		0,45	0,25	0,29	0,23	0,25	W
4 Efficiency, max.	$\eta_{max.}$		59	48	50	45	47	%
5 No-load speed	n_0		14 400	14 200	15 000	15 000	15 600	rpm
6 No-load current, typ. (with shaft ø 1,5 mm)	I_0		0,075	0,057	0,027	0,021	0,011	A
7 Stall torque	M_H		1,2	0,68	0,73	0,59	0,62	mNm
8 Friction torque	M_R		0,07	0,07	0,07	0,07	0,07	mNm
9 Speed constant	k_n		10 159	7 827	3 659	2 800	1 445	rpm/V
10 Back-EMF constant	k_E		0,098	0,128	0,273	0,357	0,692	mV/rpm
11 Torque constant	k_M		0,94	1,22	2,61	3,41	6,61	mNm/A
12 Current constant	k_I		1,064	0,82	0,383	0,293	0,151	A/mNm
13 Slope of n-M curve	$\Delta n/\Delta M$		12 000	20 800	20 600	25 600	25 100	rpm/mNm
14 Rotor inductance	L		16	27	140	240	900	µH
15 Mechanical time constant	τ_m		39	45	56	56	60	ms
16 Rotor inertia	J		0,31	0,21	0,26	0,21	0,23	gcm²
17 Angular acceleration	$\alpha_{max.}$		39	32	28	28	27	·10³rad/s²
18 Thermal resistance	R_{th1} / R_{th2}	8 / 45						K/W
19 Thermal time constant	τ_{w1} / τ_{w2}	2 / 200						s
20 Operating temperature range:								
– motor		-30 ... +65 (optional version -55 ... +125)						°C
– winding, max. permissible		+65 (optional version +125)						°C
21 Shaft bearings		sintered bearings		ball bearings		ball bearings, preloaded		
22 Shaft load max.:		(standard)		(optional version)		(optional version)		
– with shaft diameter		1,5		1,5		1,5		mm
– radial at 3 000 rpm (3 mm from bearing)		1,2		5		5		N
– axial at 3 000 rpm		0,2		0,5		0,5		N
– axial at standstill		20		10		10		N
23 Shaft play								
– radial	≤	0,03		0,015		0,015		mm
– axial	≤	0,2		0,2		0		mm
24 Housing material		steel, zinc galvanized and passivated						
25 Mass		10						g
26 Direction of rotation		clockwise, viewed from the front face						
27 Speed up to	$n_{max.}$	18 000						rpm
28 Number of pole pairs		1						
29 Magnet material		AlNiCo						
Rated values for continuous operation								
30 Rated torque	M_N		0,59	0,47	0,49	0,41	0,43	mNm
31 Rated current (thermal limit)	I_N		0,7	0,45	0,21	0,14	0,077	A
32 Rated speed	n_N		6 290	2 500	2 980	2 500	2 500	rpm

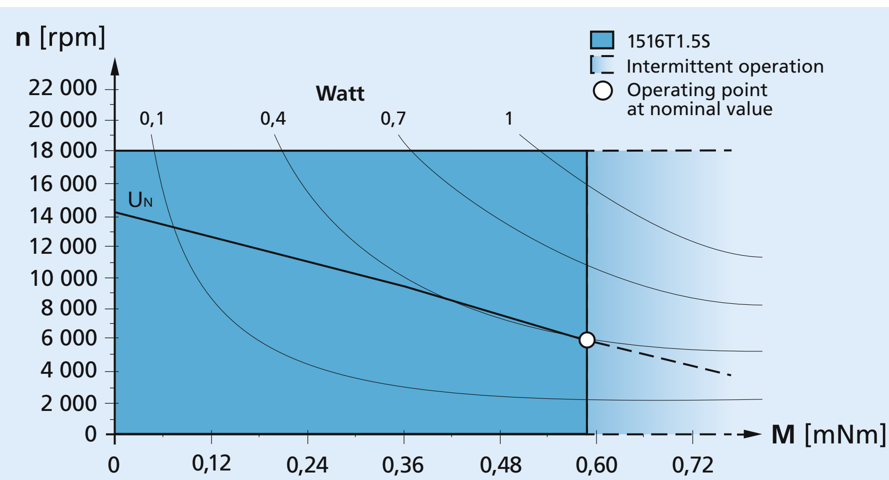
Note: Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The R_{th2} value has been reduced by 0%.

Note:

The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

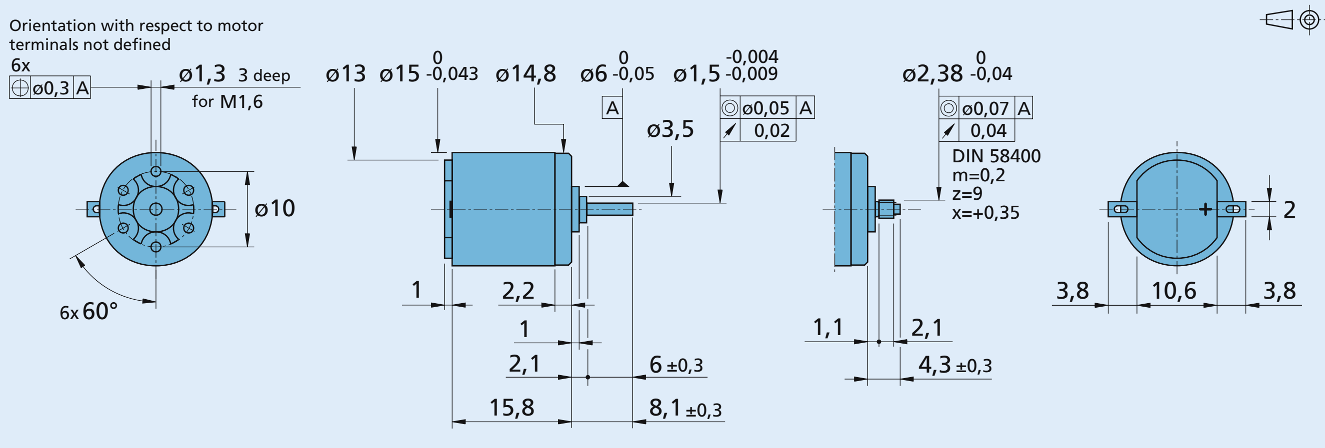
The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 50% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended operation areas (example: nominal voltage 1.5V)

Dimensional drawing



1516 T ... S **1516 E ... S**

FAULHABER

DC-Micromotors

Precious Metal Commutation

0,97 mNm

For combination with
Gearheads:
15/10, 15/5, 15/5 S, 15/8, 15A, 16/7, 16A
Encoders:
IE2-1024, IE2-16, IEH2-4096

Series 1516 ... SR

	Values at 22°C and nominal voltage	1516 T	006 SR	009 SR	012 SR	
1	Nominal voltage	U_N	6	9	12	V
2	Terminal resistance	R	15,2	32,5	60	Ω
3	Output power	$P_{2nom.}$	0,51	0,54	0,52	W
4	Efficiency, max.	$\eta_{max.}$	57	58	58	%
5	No-load speed	n_0	12 800	12 800	12 900	rpm
6	No-load current, typ. (with shaft ø 1,5 mm)	I_0	0,029	0,019	0,014	A
7	Stall torque	M_H	1,52	1,61	1,53	mNm
8	Friction torque	M_R	0,12	0,12	0,12	mNm
9	Speed constant	k_n	2 300	1 530	1 160	rpm/V
10	Back-EMF constant	k_E	0,434	0,655	0,865	mV/rpm
11	Torque constant	k_M	4,15	6,25	8,26	mNm/A
12	Current constant	k_I	0,241	0,16	0,121	A/mNm
13	Slope of n-M curve	$\Delta n/\Delta M$	8 420	7 950	8 430	rpm/mNm
14	Rotor inductance	L	100	230	400	µH
15	Mechanical time constant	τ_m	35	35	35	ms
16	Rotor inertia	J	0,4	0,42	0,4	gcm²
17	Angular acceleration	$\alpha_{max.}$	38	38	39	·10³rad/s²

18	Thermal resistance	R_{th1} / R_{th2}	10 / 33			K/W
19	Thermal time constant	τ_{w1} / τ_{w2}	2,9 / 190			s
20	Operating temperature range:					
	– motor		-30 ... +85 (optional version -55 ... +125)			°C
	– winding, max. permissible		+125			°C
21	Shaft bearings		sintered bearings	ball bearings	ball bearings, preloaded	
22	Shaft load max.:		(standard)	(optional version)	(optional version)	
	– with shaft diameter		1,5	1,5	1,5	mm
	– radial at 3 000 rpm (3 mm from bearing)		1,2	5	5	N
	– axial at 3 000 rpm		0,2	0,5	0,5	N
	– axial at standstill		20	10	10	N
23	Shaft play					
	– radial	≤	0,03	0,015	0,015	mm
	– axial	≤	0,2	0,2	0	mm
24	Housing material		steel, black coated			
25	Mass		13			g
26	Direction of rotation		clockwise, viewed from the front face			
27	Speed up to	$n_{max.}$	15 000			rpm
28	Number of pole pairs		1			
29	Magnet material		NdFeB			

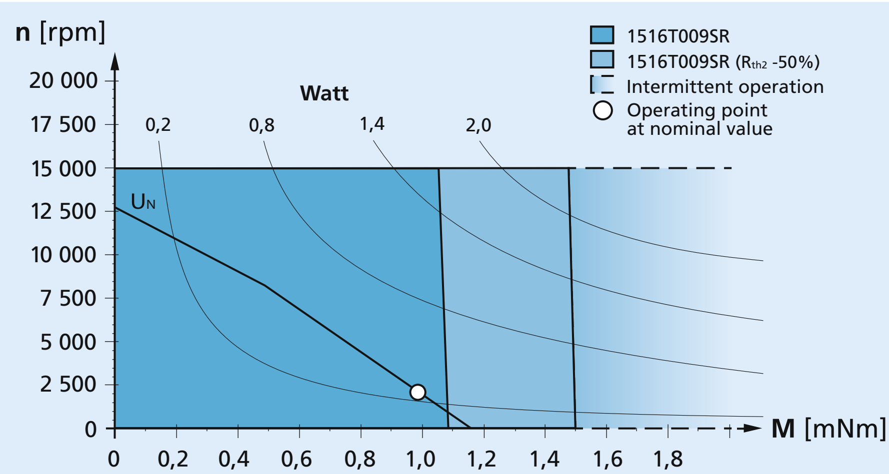
	Rated values for continuous operation		006 SR	009 SR	012 SR	
30	Rated torque	M_N	0,92	0,97	0,93	mNm
31	Rated current (thermal limit)	I_N	0,27	0,19	0,14	A
32	Rated speed	n_N	2 500	2 500	2 500	rpm

Note: Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The R_{th2} value has been reduced by 0%.

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

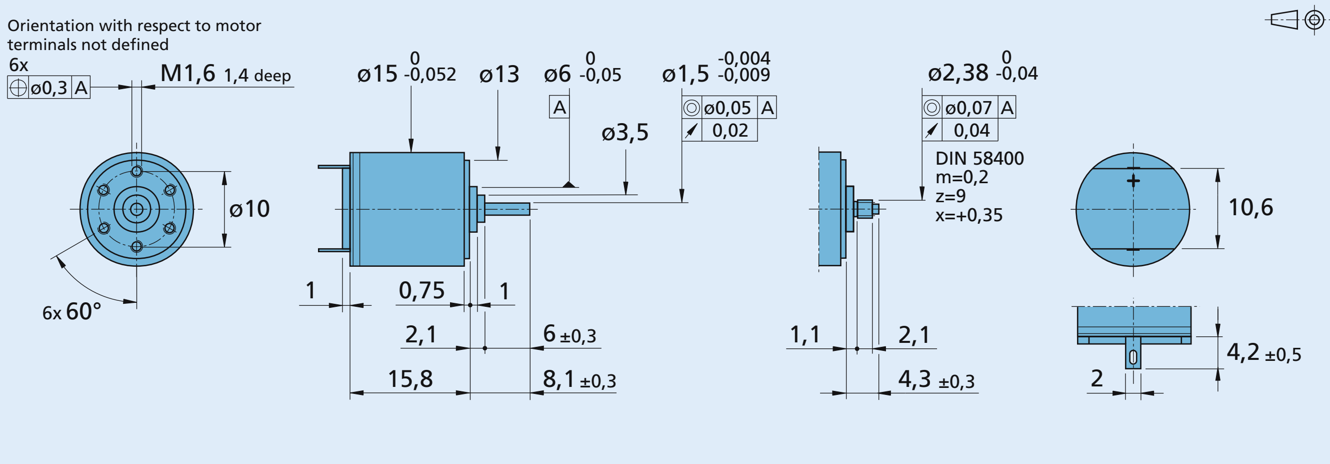
The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 50% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended operation areas (example: nominal voltage 9V)

Dimensional drawing



1516 T ... SR

1516 E ... SR

FAULHABER

DC-Micromotors

Precious Metal Commutation

2,8 mNm

For combination with
Gearheads:
15/10, 15/5, 15/5 S, 15/8, 15A, 16/7, 16A
Encoders:
IE2-1024, IE2-16, IEH2-4096

Series 1524 ... SR

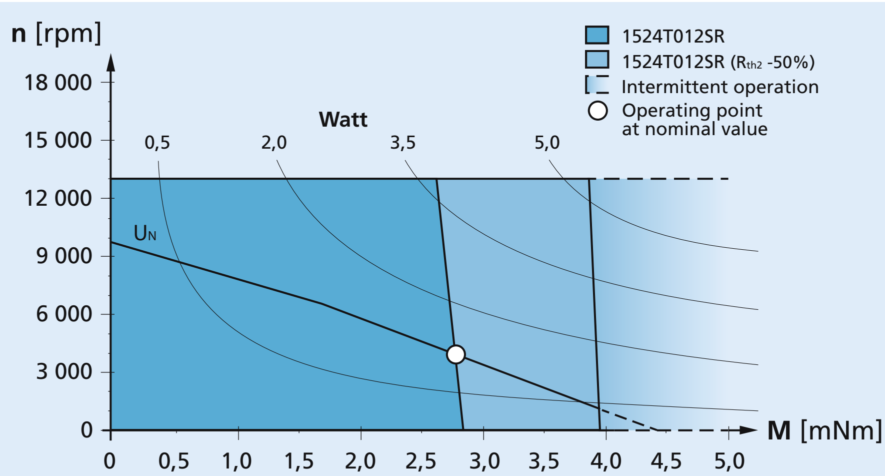
	Values at 22°C and nominal voltage	1524 T	003 SR	006 SR	009 SR	012 SR	018 SR	024 SR	
1	Nominal voltage	U_N	3	6	9	12	18	24	V
2	Terminal resistance	R	1,1	5,1	10,4	19,8	44	79,6	Ω
3	Output power	$P_{2nom.}$	1,92	1,7	1,88	1,75	1,78	1,75	W
4	Efficiency, max.	$\eta_{max.}$	77	77	77	76	77	78	%
5	No-load speed	n_0	10 800	9 700	10 100	9 900	9 900	9 900	rpm
6	No-load current, typ. (with shaft ø 1,5 mm)	I_0	0,047	0,021	0,014	0,011	0,007	0,005	A
7	Stall torque	M_H	6,8	6,68	7,12	6,76	6,86	6,75	mNm
8	Friction torque	M_R	0,12	0,12	0,12	0,13	0,12	0,11	mNm
9	Speed constant	k_n	3 660	1 650	1 140	840	560	419	rpm/V
10	Back-EMF constant	k_E	0,273	0,607	0,877	1,19	1,79	2,38	mV/rpm
11	Torque constant	k_M	2,61	5,8	8,37	11,4	17,1	22,8	mNm/A
12	Current constant	k_I	0,384	0,172	0,119	0,088	0,059	0,044	A/mNm
13	Slope of n-M curve	$\Delta n/\Delta M$	1 590	1 450	1 420	1 460	1 440	1 470	rpm/mNm
14	Rotor inductance	L	17	70	150	250	560	1 000	µH
15	Mechanical time constant	τ_m	10	10	10	10	10	10	ms
16	Rotor inertia	J	0,6	0,66	0,67	0,65	0,66	0,65	gcm²
17	Angular acceleration	$\alpha_{max.}$	110	100	110	100	100	100	$\cdot 10^3$rad/s²
18	Thermal resistance	R_{th1} / R_{th2}	4,5 / 31						K/W
19	Thermal time constant	τ_{w1} / τ_{w2}	2,4 / 300						s
20	Operating temperature range:								
	– motor		-30 ... +85 (optional version -55 ... +125)						°C
	– winding, max. permissible		+125						°C
21	Shaft bearings		sintered bearings		ball bearings		ball bearings, preloaded		
22	Shaft load max.:		(standard)		(optional version)		(optional version)		
	– with shaft diameter		1,5		1,5		1,5		mm
	– radial at 3 000 rpm (3 mm from bearing)		1,2		5		5		N
	– axial at 3 000 rpm		0,2		0,5		0,5		N
	– axial at standstill		20		10		10		N
23	Shaft play								
	– radial	≤	0,03		0,015		0,015		mm
	– axial	≤	0,2		0,2		0		mm
24	Housing material		steel, black coated						
25	Mass		21						g
26	Direction of rotation		clockwise, viewed from the front face						
27	Speed up to	$n_{max.}$	13 000						rpm
28	Number of pole pairs		1						
29	Magnet material		NdFeB						
	Rated values for continuous operation								
30	Rated torque	M_N	1,7	2,8	2,8	2,8	2,8	2,8	mNm
31	Rated current (thermal limit)	I_N	0,7	0,55	0,38	0,28	0,19	0,14	A
32	Rated speed	n_N	8 100	4 300	4 800	4 510	4 510	4 450	rpm

Note: Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The R_{th2} value has been reduced by 0%.

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

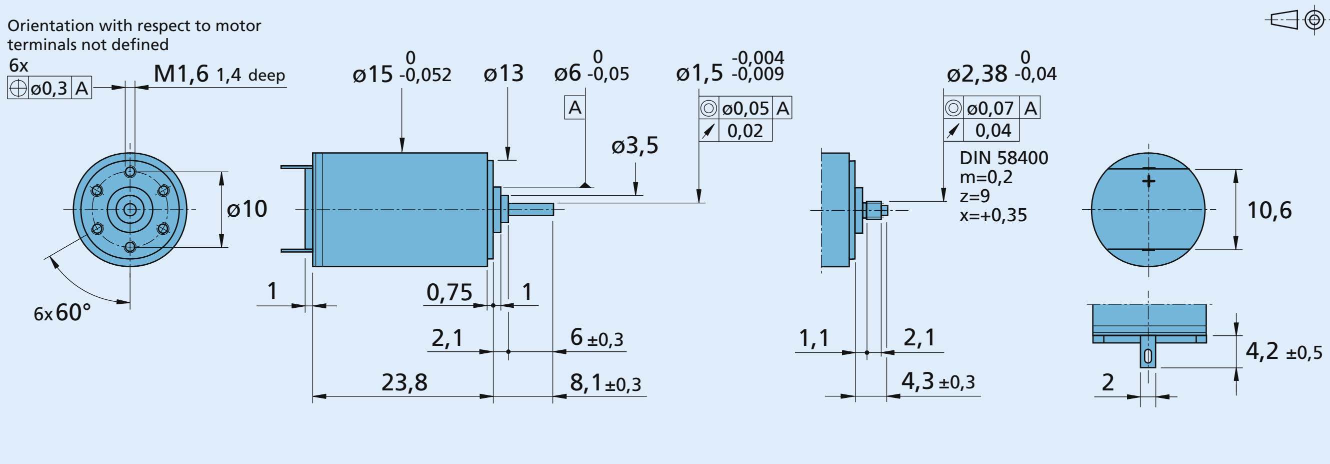
The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 50% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended operation areas (example: nominal voltage 12V)

Dimensional drawing



1524 T ... SR

1524 E ... SR

DC-Micromotors

Precious Metal Commutation

2 mNm

For combination with
Gearheads:
15/10, 15A, 16/5, 16/5 S, 16/7, 16/8, 16A, 17/1

Series 1624 ... S

	Values at 22°C and nominal voltage	1624 T	003 S	006 S	009 S	012 S	018 S	024 S	
1	Nominal voltage	U_N	3	6	9	12	18	24	V
2	Terminal resistance	R	1,6	9,1	14,5	24	42	75	Ω
3	Output power	$P_{2nom.}$	1,36	0,93	1,34	1,44	1,87	1,85	W
4	Efficiency, max.	$\eta_{max.}$	78	71	75	75	77	76	%
5	No-load speed	n_0	12 000	10 500	11 500	13 000	13 800	14 400	rpm
6	No-load current, typ. (with shaft ø 1,5 mm)	I_0	0,03	0,019	0,012	0,01	0,007	0,006	A
7	Stall torque	M_H	4,33	3,39	4,46	4,23	5,16	4,91	mNm
8	Friction torque	M_R	0,07	0,1	0,09	0,09	0,09	0,09	mNm
9	Speed constant	k_n	4 070	1 800	1 300	1 110	779	611	rpm/V
10	Back-EMF constant	k_E	0,246	0,555	0,767	0,905	1,28	1,64	mV/rpm
11	Torque constant	k_M	2,35	5,3	7,33	8,64	12,3	15,6	mNm/A
12	Current constant	k_I	0,426	0,189	0,136	0,116	0,082	0,064	A/mNm
13	Slope of n-M curve	$\Delta n/\Delta M$	2 770	3 100	2 580	3 070	2 670	2 930	rpm/mNm
14	Rotor inductance	L	85	200	400	750	1 200	3 000	µH
15	Mechanical time constant	τ_m	19	22	19	19	19	24	ms
16	Rotor inertia	J	0,65	0,68	0,7	0,59	0,68	0,78	gcm²
17	Angular acceleration	$\alpha_{max.}$	66	50	63	72	76	63	$\cdot 10^3$rad/s²
18	Thermal resistance	R_{th1} / R_{th2}	8 / 39						K/W
19	Thermal time constant	τ_{w1} / τ_{w2}	4 / 335						s
20	Operating temperature range:								
	– motor		-30 ... +85 (optional version -55 ... +125)						°C
	– winding, max. permissible		+125						°C
21	Shaft bearings		sintered bearings		ball bearings		ball bearings, preloaded		
22	Shaft load max.:		(standard)		(optional version)		(optional version)		
	– with shaft diameter		1,5		1,5		1,5		mm
	– radial at 3 000 rpm (3 mm from bearing)		1,2		5		5		N
	– axial at 3 000 rpm		0,2		0,5		0,5		N
	– axial at standstill		20		10		10		N
23	Shaft play								
	– radial	≤	0,03		0,015		0,015		mm
	– axial	≤	0,2		0,2		0		mm
24	Housing material		steel, zinc galvanized and passivated						
25	Mass		21						g
26	Direction of rotation		clockwise, viewed from the front face						
27	Speed up to	$n_{max.}$	17 000						rpm
28	Number of pole pairs		1						
29	Magnet material		AlNiCo						
	Rated values for continuous operation								
30	Rated torque	M_N	1,6	1,8	2	1,8	2	1,9	mNm
31	Rated current (thermal limit)	I_N	0,7	0,37	0,29	0,22	0,17	0,13	A
32	Rated speed	n_N	6 860	3 050	4 680	5 620	6 890	7 240	rpm

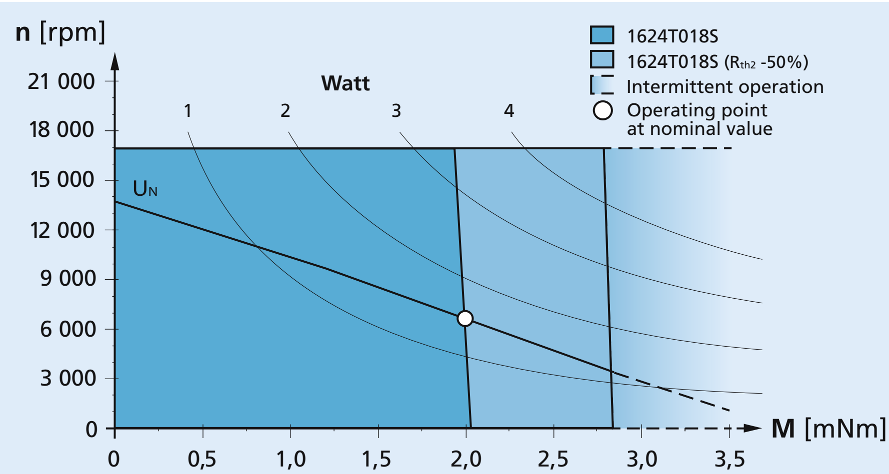
Note: Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The R_{th2} value has been reduced by 0%.

Note:

The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

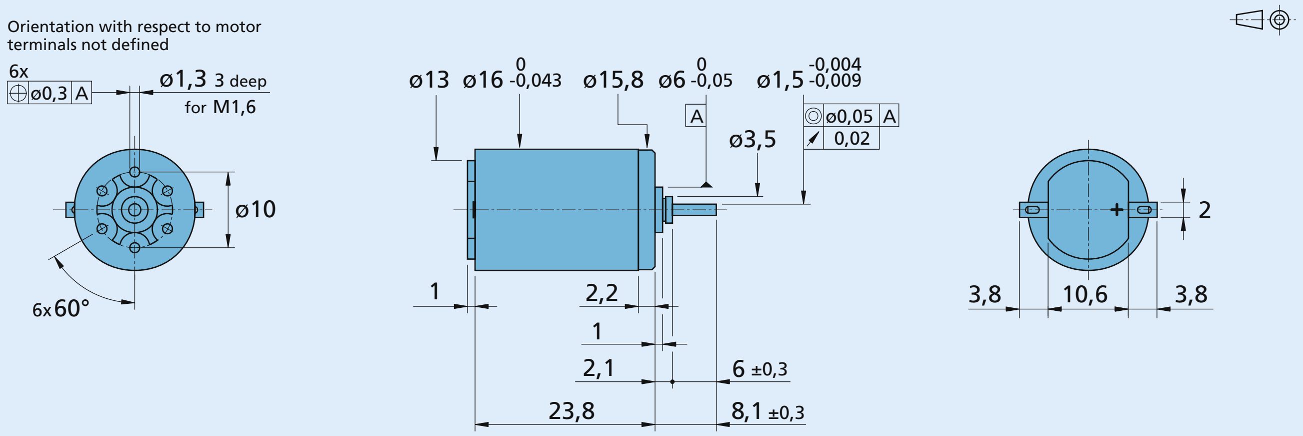
The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 50% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended operation areas (example: nominal voltage 18V)

Dimensional drawing



1624 T ... S

DC-Micromotors

Precious Metal Commutation

2,2 mNm

For combination with
Gearheads:
15/10, 15A, 16/7, 16A, 17/1
Encoders:
IE2-1024, IE2-16, IEH2-4096

Series 1717 ... SR

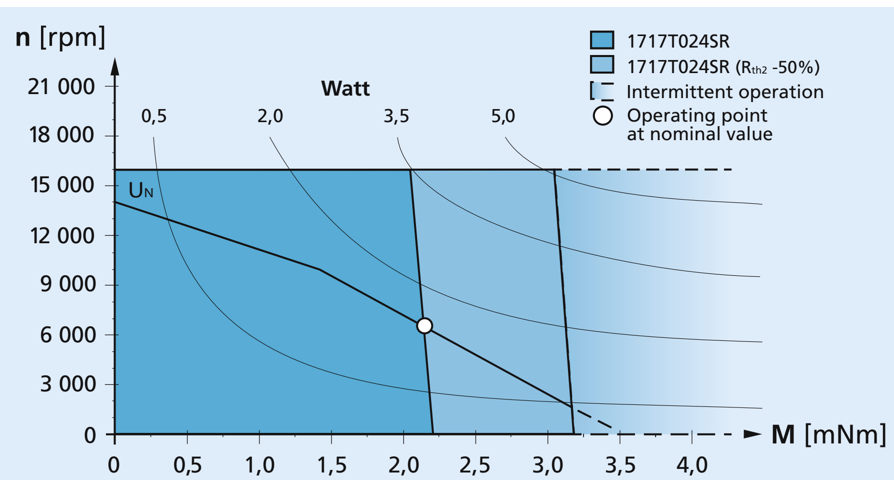
	Values at 22°C and nominal voltage	1717 T		003 SR	006 SR	012 SR	018 SR	024 SR	
1	Nominal voltage	U_N		3	6	12	18	24	V
2	Terminal resistance	R		1,07	4,3	17,1	50,1	68,8	Ω
3	Output power	$P_{2nom.}$		1,97	1,96	1,97	1,5	1,96	W
4	Efficiency, max.	$\eta_{max.}$		69	69	70	68	70	%
5	No-load speed	n_0		14 000	14 000	14 000	12 300	14 000	rpm
6	No-load current, typ. (with shaft ø 1,5 mm)	I_0		0,091	0,046	0,023	0,013	0,011	A
7	Stall torque	M_H		5,37	5,34	5,38	4,66	5,36	mNm
8	Friction torque	M_R		0,18	0,18	0,18	0,18	0,17	mNm
9	Speed constant	k_n		4 820	2 410	1 210	709	602	rpm/V
10	Back-EMF constant	k_E		0,207	0,414	0,829	1,41	1,66	mV/rpm
11	Torque constant	k_M		1,98	3,96	7,92	13,5	15,9	mNm/A
12	Current constant	k_I		0,505	0,253	0,126	0,074	0,063	A/mNm
13	Slope of n-M curve	$\Delta n/\Delta M$		2 610	2 620	2 600	2 640	2 610	rpm/mNm
14	Rotor inductance	L		17	65	260	760	1 040	µH
15	Mechanical time constant	τ_m		16	16	16	16	16	ms
16	Rotor inertia	J		0,59	0,58	0,59	0,58	0,59	gcm²
17	Angular acceleration	$\alpha_{max.}$		92	92	92	80	92	·10³rad/s²
18	Thermal resistance	R_{th1} / R_{th2}	4,5 / 27						K/W
19	Thermal time constant	τ_{w1} / τ_{w2}	2 / 210						s
20	Operating temperature range:								
	– motor		-30 ... +85 (optional version -55 ... +125)						°C
	– winding, max. permissible		+125						°C
21	Shaft bearings		sintered bearings		ball bearings		ball bearings, preloaded		
22	Shaft load max.:		(standard)		(optional version)		(optional version)		
	– with shaft diameter		1,5		1,5		1,5		mm
	– radial at 3 000 rpm (3 mm from bearing)		1,2		5		5		N
	– axial at 3 000 rpm		0,2		0,5		0,5		N
	– axial at standstill		20		10		10		N
23	Shaft play								
	– radial	≤	0,03		0,015		0,015		mm
	– axial	≤	0,2		0,2		0		mm
24	Housing material		steel, black coated						
25	Mass		18						g
26	Direction of rotation		clockwise, viewed from the front face						
27	Speed up to	$n_{max.}$	16 000						rpm
28	Number of pole pairs		1						
29	Magnet material		NdFeB						
	Rated values for continuous operation								
30	Rated torque	M_N		1,2	2,1	2,1	2,1	2,2	mNm
31	Rated current (thermal limit)	I_N		0,7	0,63	0,32	0,19	0,16	A
32	Rated speed	n_N		10 790	6 540	6 570	4 570	6 540	rpm

Note: Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The R_{th2} value has been reduced by 0%.

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

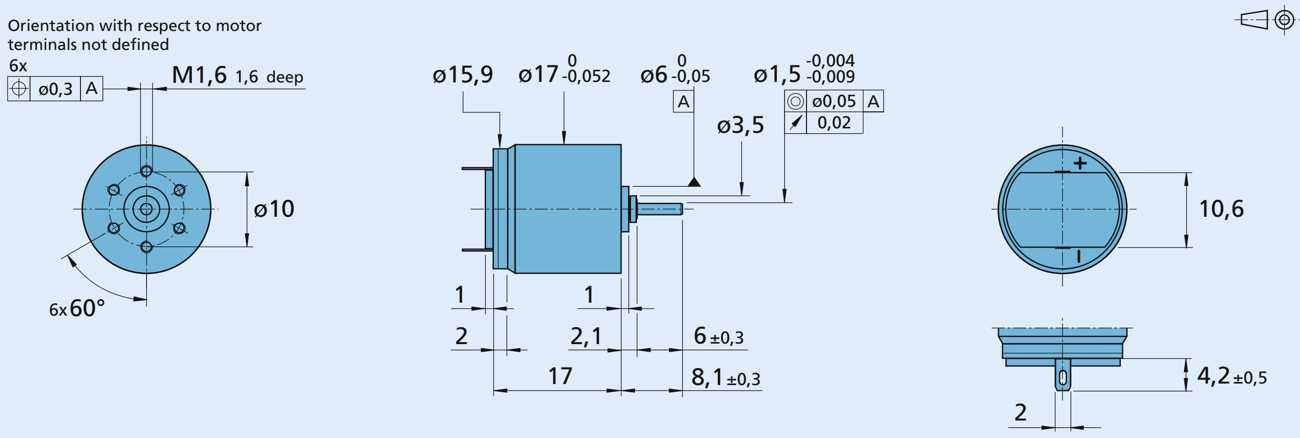
The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 50% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended operation areas (example: nominal voltage 24V)

Dimensional drawing



1717 T ... SR

FAULHABER

DC-Micromotors

Precious Metal Commutation

4,5 mNm

For combination with
Gearheads:
15/10, 15A, 16/7, 16A, 17/1
Encoders:
IE2-1024, IE2-16, IEH2-4096

DC-Micromotors

Series 1724 ... SR

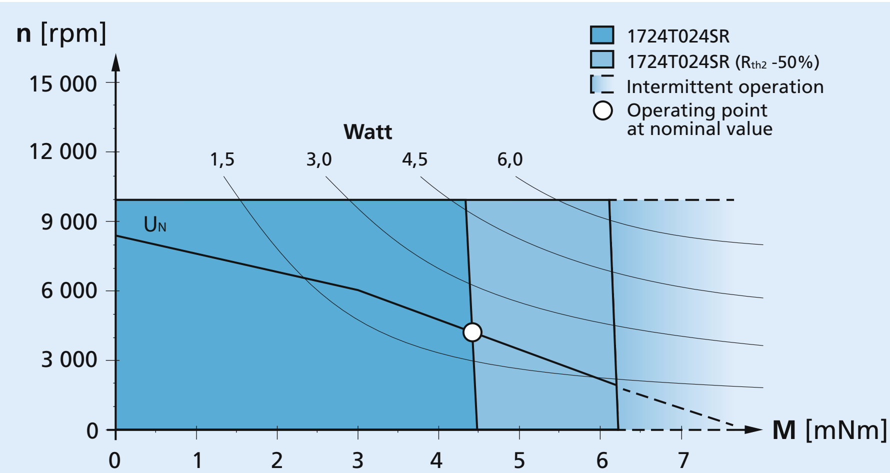
	Values at 22°C and nominal voltage	1724 T		003 SR	006 SR	012 SR	018 SR	024 SR	
1	Nominal voltage	U_N		3	6	12	18	24	V
2	Terminal resistance	R		0,78	3,41	16,2	32,1	54,6	Ω
3	Output power	$P_{2nom.}$		2,83	2,58	2,17	2,47	2,58	W
4	Efficiency, max.	$\eta_{max.}$		82	81	80	81	81	%
5	No-load speed	n_0		8 200	8 600	7 900	8 400	8 600	rpm
6	No-load current, typ. (with shaft ø 1,5 mm)	I_0		0,038	0,02	0,009	0,006	0,005	A
7	Stall torque	M_H		13,2	11,5	10,5	11,2	11,5	mNm
8	Friction torque	M_R		0,13	0,13	0,13	0,12	0,13	mNm
9	Speed constant	k_n		2 760	1 450	666	472	362	rpm/V
10	Back-EMF constant	k_E		0,362	0,69	1,5	2,12	2,76	mV/rpm
11	Torque constant	k_M		3,46	6,59	14,3	20,2	26,3	mNm/A
12	Current constant	k_I		0,289	0,152	0,07	0,049	0,038	A/mNm
13	Slope of n-M curve	$\Delta n/\Delta M$		621	748	752	750	748	rpm/mNm
14	Rotor inductance	L		21	75	360	710	1 200	µH
15	Mechanical time constant	τ_m		8	8	8	8	8	ms
16	Rotor inertia	J		1,2	1	1	1	1	gcm²
17	Angular acceleration	$\alpha_{max.}$		110	110	100	100	100	·10³rad/s²
18	Thermal resistance	R_{th1} / R_{th2}	4 / 24,5						K/W
19	Thermal time constant	τ_{w1} / τ_{w2}	2,6 / 270						s
20	Operating temperature range:								
	– motor		-30 ... +85 (optional version -55 ... +125)						°C
	– winding, max. permissible		+125						°C
21	Shaft bearings		sintered bearings		ball bearings		ball bearings, preloaded		
22	Shaft load max.:		(standard)		(optional version)		(optional version)		
	– with shaft diameter		1,5		1,5		1,5		mm
	– radial at 3 000 rpm (3 mm from bearing)		1,2		5		5		N
	– axial at 3 000 rpm		0,2		0,5		0,5		N
	– axial at standstill		20		10		10		N
23	Shaft play								
	– radial	≤	0,03		0,015		0,015		mm
	– axial	≤	0,2		0,2		0		mm
24	Housing material		steel, black coated						
25	Mass		27						g
26	Direction of rotation		clockwise, viewed from the front face						
27	Speed up to	$n_{max.}$	10 000						rpm
28	Number of pole pairs		1						
29	Magnet material		NdFeB						
	Rated values for continuous operation								
30	Rated torque	M_N		2,3	4,2	4,5	4,5	4,5	mNm
31	Rated current (thermal limit)	I_N		0,7	0,7	0,35	0,25	0,19	A
32	Rated speed	n_N		6 790	4 720	3 430	3 990	4 220	rpm

Note: Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The R_{th2} value has been reduced by 0%.

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

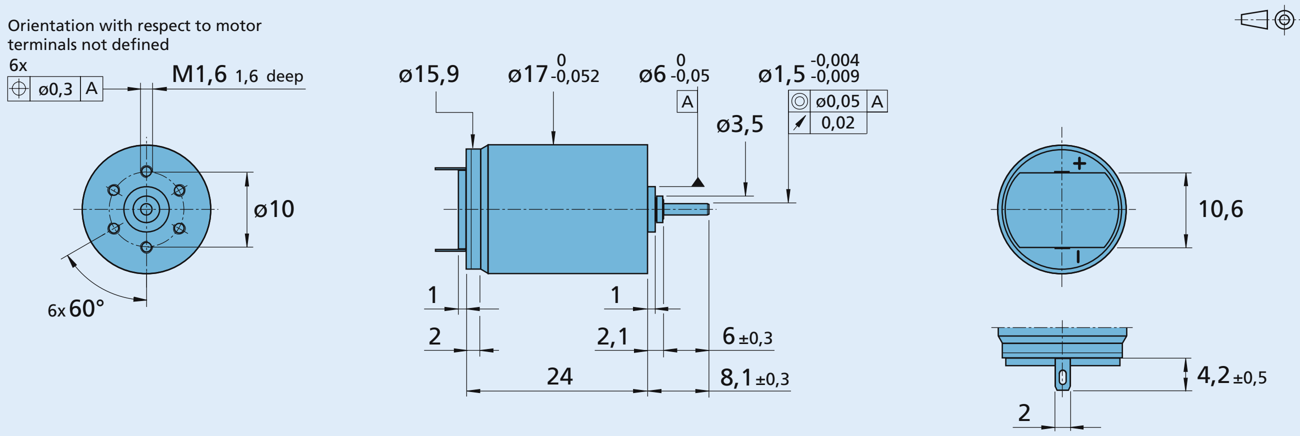
The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 50% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended operation areas (example: nominal voltage 24V)

Dimensional drawing



1724 T ... SR

DC-Micromotors

Graphite Commutation

5,1 mNm

For combination with
Gearheads:
15/10, 16/7, 17/1, 20/1
Encoders:
IE2-1024, IE2-16

Series 1727 ... C

Values at 22°C and nominal voltage	1727 U		006 C	012 C	024 C	
1 Nominal voltage	U_N		6	12	24	V
2 Terminal resistance	R		3	13,8	57,6	Ω
3 Output power	$P_{2nom.}$		2,37	2,25	2,25	W
4 Efficiency, max.	$\eta_{max.}$		70	70	70	%
5 No-load speed	n_0		7 800	7 800	7 800	rpm
6 No-load current, typ. (with shaft ø 2 mm)	I_0		0,055	0,026	0,013	A
7 Stall torque	M_H		11,6	11	11	mNm
8 Friction torque	M_R		0,36	0,35	0,36	mNm
9 Speed constant	k_n		1 460	700	343	rpm/V
10 Back-EMF constant	k_E		0,684	1,43	2,92	mV/rpm
11 Torque constant	k_M		6,53	13,6	27,9	mNm/A
12 Current constant	k_I		0,153	0,073	0,036	A/mNm
13 Slope of n-M curve	$\Delta n/\Delta M$		672	709	709	rpm/mNm
14 Rotor inductance	L		80	320	1 440	µH
15 Mechanical time constant	τ_m		9	9	9	ms
16 Rotor inertia	J		1,3	1,2	1,2	gcm²
17 Angular acceleration	$\alpha_{max.}$		91	91	91	$\cdot 10^3$rad/s²
18 Thermal resistance	R_{th1} / R_{th2}	5 / 24				K/W
19 Thermal time constant	τ_{w1} / τ_{w2}	4,2 / 254				s
20 Operating temperature range:						
– motor		-30 ... +100				°C
– winding, max. permissible		+125				°C
21 Shaft bearings		ball bearings, preloaded				
22 Shaft load max.:						
– with shaft diameter		2				mm
– radial at 3 000 rpm (3 mm from bearing)		8				N
– axial at 3 000 rpm		0,8				N
– axial at standstill		10				N
23 Shaft play						
– radial	≤	0,015				mm
– axial	=	0				mm
24 Housing material		steel, black coated				
25 Mass		28				g
26 Direction of rotation		clockwise, viewed from the front face				
27 Speed up to	$n_{max.}$	9 000				rpm
28 Number of pole pairs		1				
29 Magnet material		NdFeB				
Rated values for continuous operation						
30 Rated torque	M_N		5,1	5	5	mNm
31 Rated current (thermal limit)	I_N		0,95	0,45	0,22	A
32 Rated speed	n_N		2 600	2 500	2 500	rpm

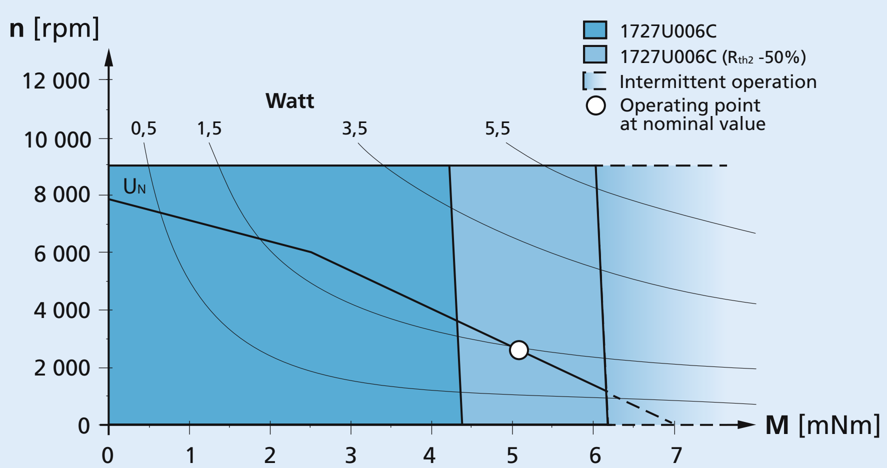
Note: Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The R_{th2} value has been reduced by 25%.

Note:

The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

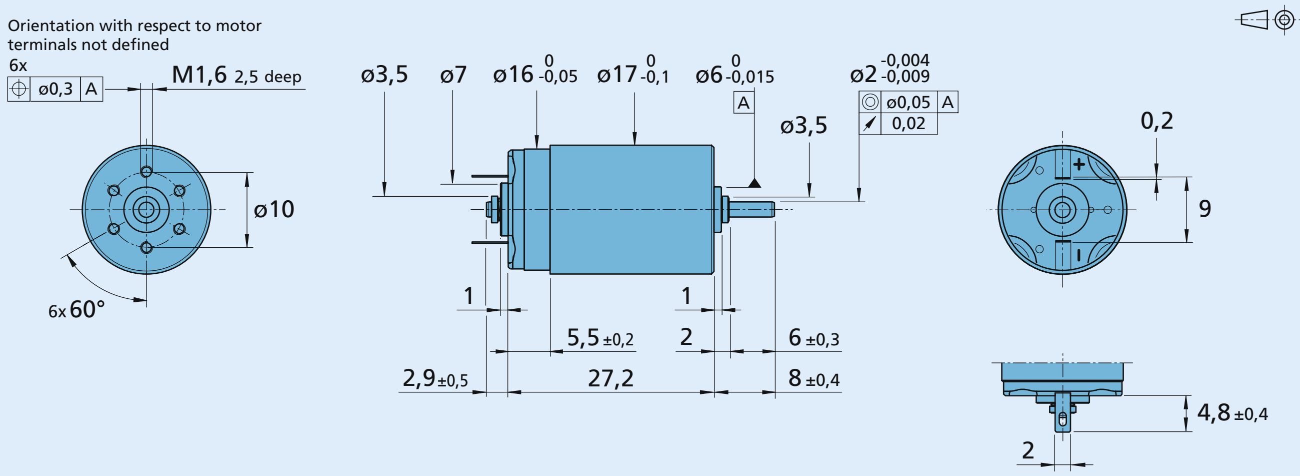
The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 50% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended operation areas (example: nominal voltage 6V)

Dimensional drawing



1727 U ... C

FAULHABER

DC-Micromotors

Graphite Commutation

8,8 mNm

For combination with
Gearheads:
15/10, 16/7, 17/1, 20/1
Encoders:
IE2-1024, IE2-16

Series 1741 ... CXR

	Values at 22°C and nominal voltage	1741 U		006 CXR	012 CXR	018 CXR	024 CXR	
1	Nominal voltage	U_N		6	12	18	24	V
2	Terminal resistance	R		1,3	5,8	15	26,9	Ω
3	Output power	$P_{2nom.}$		5,67	5,54	4,95	4,8	W
4	Efficiency, max.	$\eta_{max.}$		72	74	75	75	%
5	No-load speed	n_0		7 100	7 600	7 300	7 300	rpm
6	No-load current, typ. (with shaft ø 2 mm)	I_0		0,055	0,028	0,017	0,013	A
7	Stall torque	M_H		30,6	27,9	26,1	26,2	mNm
8	Friction torque	M_R		0,4	0,4	0,4	0,4	mNm
9	Speed constant	k_n		1 303	668	420	314	rpm/V
10	Back-EMF constant	k_E		0,768	1,496	2,378	3,185	mV/rpm
11	Torque constant	k_M		7,33	14,29	22,71	30,41	mNm/A
12	Current constant	k_I		0,136	0,07	0,044	0,033	A/mNm
13	Slope of n-M curve	$\Delta n/\Delta M$		231	271	278	278	rpm/mNm
14	Rotor inductance	L		35	135	340	600	µH
15	Mechanical time constant	τ_m		4,3	4,5	4,4	4,4	ms
16	Rotor inertia	J		1,8	1,6	1,5	1,5	gcm²
17	Angular acceleration	$\alpha_{max.}$		170	175	174	174	$\cdot 10^3$rad/s²
18	Thermal resistance	R_{th1} / R_{th2}	7 / 23					K/W
19	Thermal time constant	τ_{w1} / τ_{w2}	8 / 440					s
20	Operating temperature range:							
	– motor		-30 ... +100					°C
	– winding, max. permissible		+125					°C
21	Shaft bearings		ball bearings, preloaded					
22	Shaft load max.:							
	– with shaft diameter		2					mm
	– radial at 3 000 rpm (3 mm from bearing)		8					N
	– axial at 3 000 rpm		0,8					N
	– axial at standstill		10					N
23	Shaft play							
	– radial	≤	0,015					mm
	– axial	=	0					mm
24	Housing material		steel, zinc galvanized and passivated					
25	Mass		45					g
26	Direction of rotation		clockwise, viewed from the front face					
27	Speed up to	$n_{max.}$	9 000					rpm
28	Number of pole pairs		1					
29	Magnet material		NdFeB					
	Rated values for continuous operation							
30	Rated torque	M_N		8,8	8,4	8,4	8,4	mNm
31	Rated current (thermal limit)	I_N		1,4	0,69	0,43	0,33	A
32	Rated speed	n_N		4 280	4 410	3 940	3 940	rpm

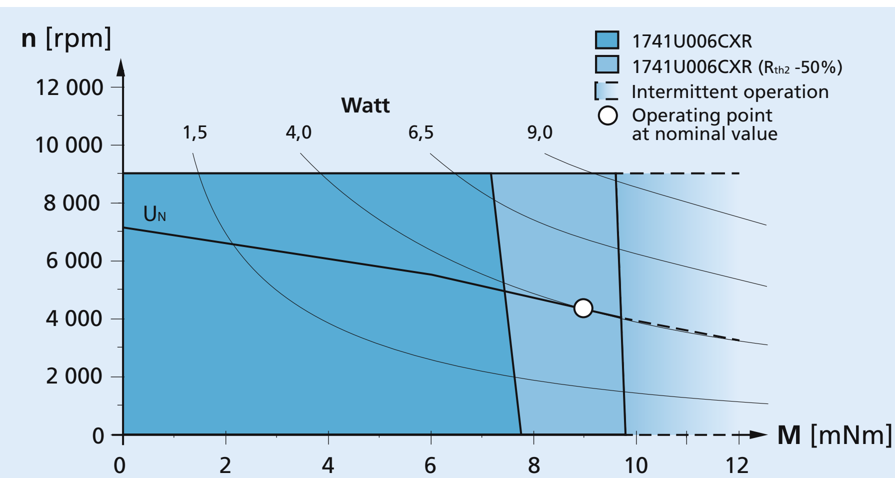
Note: Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The R_{th2} value has been reduced by 25%.

Note:

The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

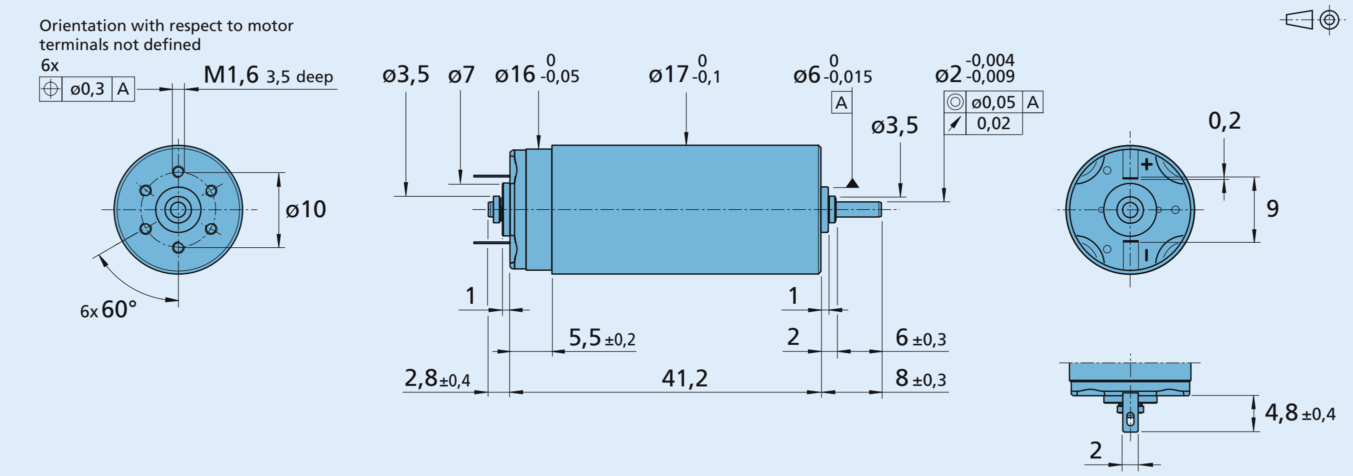
The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 50% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended operation areas (example: nominal voltage 6V)

Dimensional drawing



1741 U ... CXR

DC-Micromotors

Precious Metal Commutation

6,8 mNm

For combination with
Gearheads:
20/1, 22/2, 22/5, 22/7, 22E, 22EKV, 22F, 23/1
Encoders:
IE2-1024, IE2-16, IEH2-4096

Series 2224 ... SR

	Values at 22°C and nominal voltage	2224 U	003 SR	006 SR	012 SR	018 SR	024 SR	036 SR	
1	Nominal voltage	U_N	3	6	12	18	24	36	V
2	Terminal resistance	R	0,56	1,94	8,71	17,5	36,3	91,4	Ω
3	Output power	$P_{2nom.}$	3,92	4,55	4,05	4,54	3,88	3,46	W
4	Efficiency, max.	$\eta_{max.}$	80	82	82	82	81	80	%
5	No-load speed	n_0	8 100	8 200	7 800	8 100	7 800	7 800	rpm
6	No-load current, typ. (with shaft ø 2 mm)	I_0	0,066	0,029	0,014	0,01	0,007	0,005	A
7	Stall torque	M_H	18,5	21,2	19,8	21,4	19	16,9	mNm
8	Friction torque	M_R	0,23	0,2	0,2	0,21	0,2	0,22	mNm
9	Speed constant	k_n	2 730	1 380	657	454	328	219	rpm/V
10	Back-EMF constant	k_E	0,366	0,725	1,52	2,2	3,04	4,56	mV/rpm
11	Torque constant	k_M	3,49	6,92	14,5	21	29,1	43,5	mNm/A
12	Current constant	k_I	0,286	0,144	0,069	0,048	0,034	0,023	A/mNm
13	Slope of n-M curve	$\Delta n/\Delta M$	438	387	394	379	411	462	rpm/mNm
14	Rotor inductance	L	11	45	200	450	800	1 800	µH
15	Mechanical time constant	τ_m	11	11	11	11	11	11	ms
16	Rotor inertia	J	2,4	2,7	2,7	2,8	2,6	2,3	gcm²
17	Angular acceleration	$\alpha_{max.}$	77	78	74	77	74	74	$\cdot 10^3$rad/s²
18	Thermal resistance	R_{th1} / R_{th2}	5 / 20						K/W
19	Thermal time constant	τ_{w1} / τ_{w2}	6,8 / 440						s
20	Operating temperature range:								
	– motor		-30 ... +85 (optional version -55 ... +125)						°C
	– winding, max. permissible		+125						°C
21	Shaft bearings		sintered bearings		ball bearings		ball bearings, preloaded		
22	Shaft load max.:		(standard)		(optional version)		(optional version)		
	– with shaft diameter		2		2		2		mm
	– radial at 3 000 rpm (3 mm from bearing)		1,5		8		8		N
	– axial at 3 000 rpm		0,2		0,8		0,8		N
	– axial at standstill		20		10		10		N
23	Shaft play								
	– radial	≤	0,03		0,015		0,015		mm
	– axial	≤	0,2		0,2		0		mm
24	Housing material		steel, black coated						
25	Mass		46						g
26	Direction of rotation		clockwise, viewed from the front face						
27	Speed up to	$n_{max.}$	9 000						rpm
28	Number of pole pairs		1						
29	Magnet material		NdFeB						

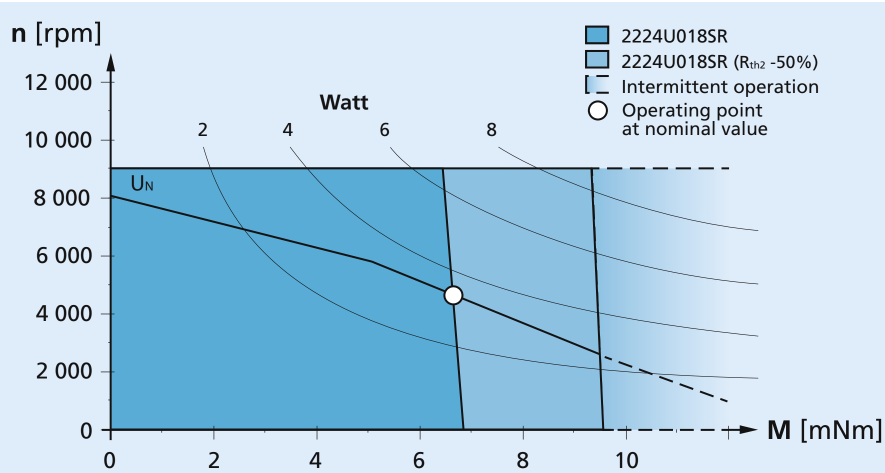
	Rated values for continuous operation								
30	Rated torque	M_N	2,2	4,5	6,7	6,8	6,6	6,1	mNm
31	Rated current (thermal limit)	I_N	0,7	0,7	0,52	0,37	0,25	0,16	A
32	Rated speed	n_N	7 170	6 390	4 390	4 800	4 300	4 060	rpm

Note: Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The R_{th2} value has been reduced by 0%.

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

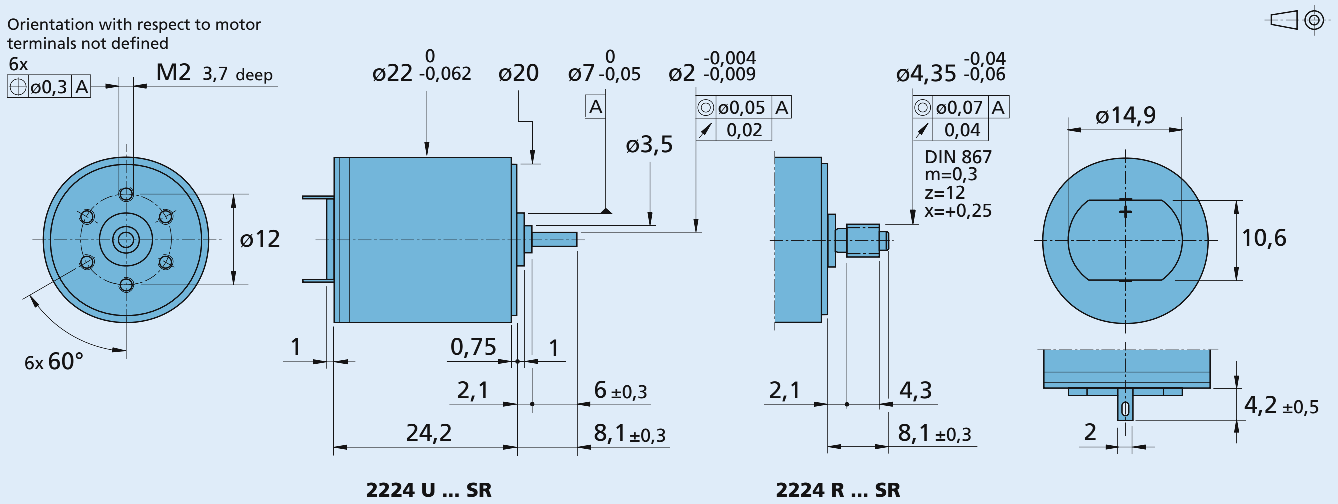
The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 50% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended operation areas (example: nominal voltage 18V)

Dimensional drawing



DC-Micromotors

Precious Metal Commutation

4,7 mNm

For combination with
Gearheads:
20/1, 22/2, 22/5, 22/7, 22E, 22EKV, 23/1
Encoders:
HEDL 5540, HEDM 5500, HEDS 5500, HEDS 5540

Series 2230 ... S

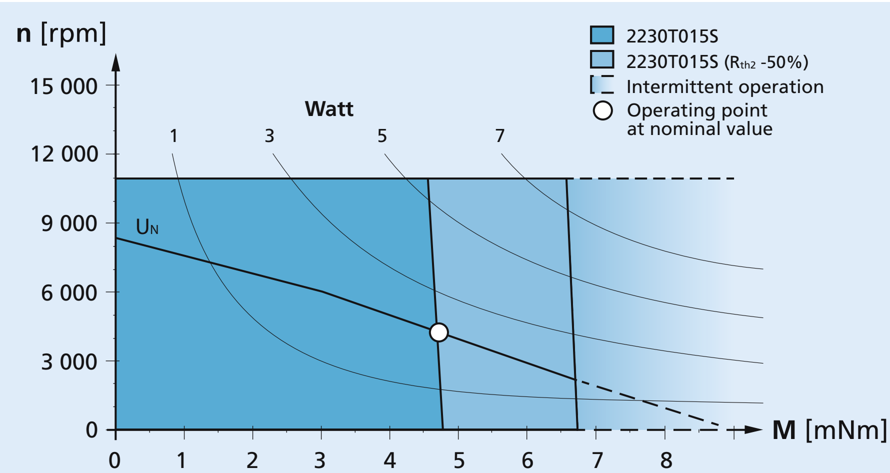
Values at 22°C and nominal voltage	2230 T	003 S	006 S	012 S	015 S	024 S	040 S	
1 Nominal voltage	U_N	3	6	12	15	24	40	V
2 Terminal resistance	R	0,6	3	10,8	21	50	193	Ω
3 Output power	$P_{2nom.}$	3,69	2,94	3,27	2,63	2,82	2,01	W
4 Efficiency, max.	$\eta_{max.}$	83	82	83	82	81	78	%
5 No-load speed	n_0	9 600	9 300	9 500	8 400	9 000	8 200	rpm
6 No-load current, typ. (with shaft ø 1,5 mm)	I_0	0,04	0,019	0,01	0,007	0,005	0,003	A
7 Stall torque	M_H	14,7	12,1	13,2	11,9	12	9,37	mNm
8 Friction torque	M_R	0,12	0,12	0,12	0,12	0,13	0,14	mNm
9 Speed constant	k_n	3 230	1 560	799	566	379	208	rpm/V
10 Back-EMF constant	k_E	0,31	0,639	1,25	1,77	2,64	4,81	mV/rpm
11 Torque constant	k_M	2,96	6,1	12	16,9	25,2	45,9	mNm/A
12 Current constant	k_I	0,338	0,164	0,084	0,059	0,04	0,022	A/mNm
13 Slope of n-M curve	$\Delta n/\Delta M$	653	769	720	706	750	875	rpm/mNm
14 Rotor inductance	L	35	150	420	900	2 200	8 000	µH
15 Mechanical time constant	τ_m	25	20	20	20	19	22	ms
16 Rotor inertia	J	3,7	2,5	2,7	2,7	2,4	2,4	gcm²
17 Angular acceleration	$\alpha_{max.}$	40	49	50	44	50	39	·10³rad/s²
18 Thermal resistance	R_{th1} / R_{th2}	4 / 28						K/W
19 Thermal time constant	τ_{w1} / τ_{w2}	4,5 / 602						s
20 Operating temperature range:								
– motor		-30 ... +85 (optional version -55 ... +125)						°C
– winding, max. permissible		+125						°C
21 Shaft bearings		sintered bearings		ball bearings		ball bearings, preloaded		
22 Shaft load max.:		(standard)		(optional version)		(optional version)		
– with shaft diameter		1,5		2		2		mm
– radial at 3 000 rpm (3 mm from bearing)		1,2		8		8		N
– axial at 3 000 rpm		0,2		0,8		0,8		N
– axial at standstill		20		10		10		N
23 Shaft play								
– radial	≤	0,03		0,015		0,015		mm
– axial	≤	0,2		0,2		0		mm
24 Housing material		steel, zinc galvanized and passivated						
25 Mass		50						g
26 Direction of rotation		clockwise, viewed from the front face						
27 Speed up to	$n_{max.}$	11 000						rpm
28 Number of pole pairs		1						
29 Magnet material		AlNiCo						
Rated values for continuous operation								
30 Rated torque	M_N	2	4,1	4,6	4,7	4,5	4,2	mNm
31 Rated current (thermal limit)	I_N	0,7	0,7	0,4	0,29	0,18	0,094	A
32 Rated speed	n_N	8 260	5 370	5 210	4 160	4 650	3 490	rpm

Note: Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The R_{th2} value has been reduced by 0%.

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

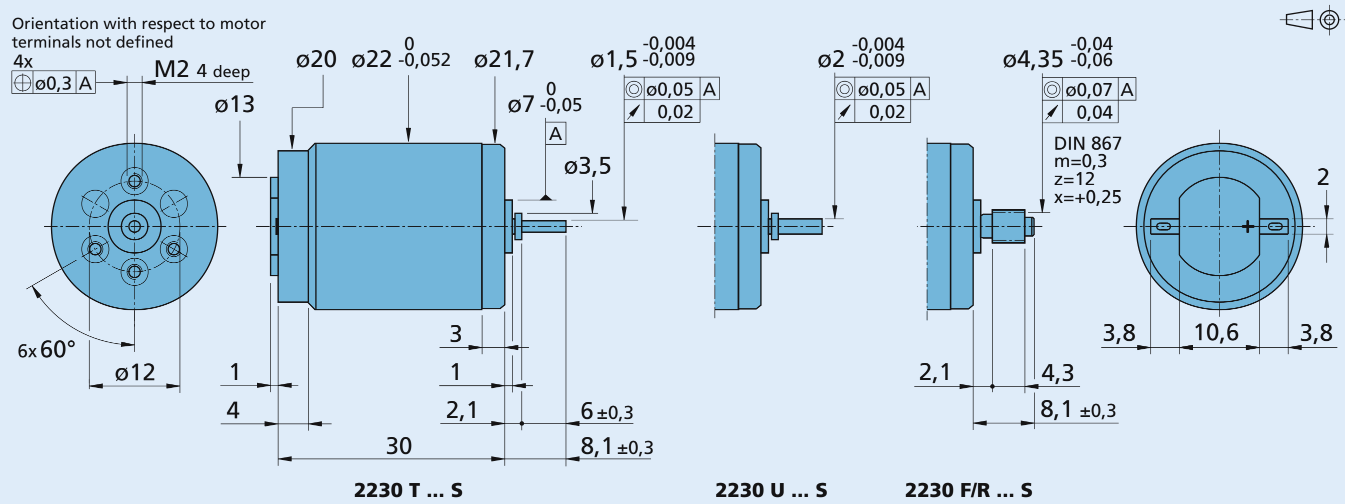
The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 50% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended operation areas (example: nominal voltage 15V)

Dimensional drawing



DC-Micromotors

Precious Metal Commutation

10 mNm

For combination with
Gearheads:
20/1, 22/2, 22/5, 22/7, 22E, 22EKV, 22F, 23/1, 26A
Encoders:
IE2-1024, IE2-16, IEH2-4096

Series 2232 ... SR

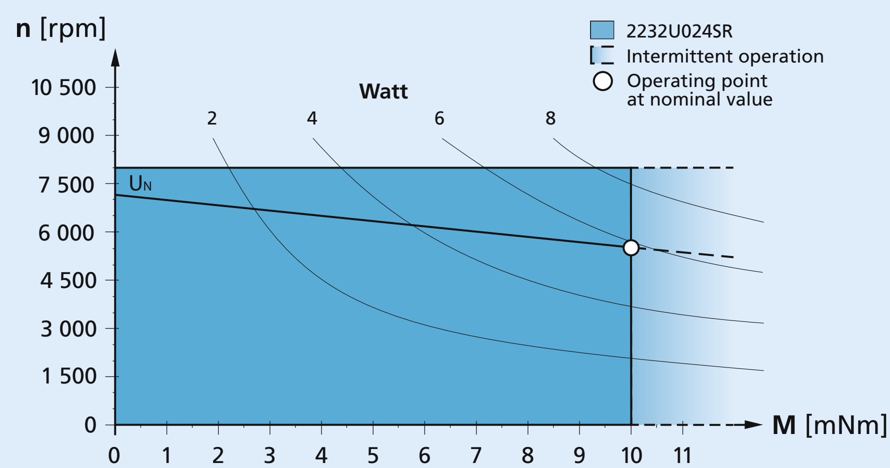
Values at 22°C and nominal voltage	2232 U	006 SR	009 SR	012 SR	015 SR	018 SR	024 SR	
1 Nominal voltage	U_N	6	9	12	15	18	24	V
2 Terminal resistance	R	0,81	2,14	4,09	6,61	9,04	16,4	Ω
3 Output power	$P_{2nom.}$	11	9,35	8,7	8,41	8,86	8,68	W
4 Efficiency, max.	$\eta_{max.}$	87	86	86	85	86	86	%
5 No-load speed	n_0	7 100	7 400	7 100	7 100	7 100	7 100	rpm
6 No-load current, typ. (with shaft ø 2 mm)	I_0	0,035	0,0241	0,0175	0,0139	0,0116	0,0087	A
7 Stall torque	M_H	59,2	48,3	46,8	45,2	47,6	46,7	mNm
8 Friction torque	M_R	0,28	0,28	0,28	0,28	0,28	0,28	mNm
9 Speed constant	k_n	1 190	827	595	476	397	298	rpm/V
10 Back-EMF constant	k_E	0,84	1,21	1,68	2,1	2,52	3,36	mV/rpm
11 Torque constant	k_M	8,03	11,5	16	20,1	24,1	32,1	mNm/A
12 Current constant	k_I	0,125	0,087	0,062	0,05	0,042	0,031	A/mNm
13 Slope of n-M curve	$\Delta n/\Delta M$	120	153	152	157	149	152	rpm/mNm
14 Rotor inductance	L	45	90	180	280	400	710	µH
15 Mechanical time constant	τ_m	6	6	6	6	6	6	ms
16 Rotor inertia	J	4,8	3,8	3,8	3,8	3,8	3,8	gcm²
17 Angular acceleration	$\alpha_{max.}$	120	120	120	120	120	120	·10³rad/s²
18 Thermal resistance	R_{th1} / R_{th2}	4 / 13						K/W
19 Thermal time constant	τ_{w1} / τ_{w2}	7 / 340						s
20 Operating temperature range:								
– motor		-30 ... +85 (optional version -55 ... +125)						°C
– winding, max. permissible		+125						°C
21 Shaft bearings		sintered bearings		ball bearings		ball bearings, preloaded		
22 Shaft load max.:		(standard)		(optional version)		(optional version)		
– with shaft diameter		2		2		2		mm
– radial at 3 000 rpm (3 mm from bearing)		1,5		8		8		N
– axial at 3 000 rpm		0,2		0,8		0,8		N
– axial at standstill		20		10		10		N
23 Shaft play								
– radial	≤	0,03		0,015		0,015		mm
– axial	≤	0,2		0,2		0		mm
24 Housing material		steel, black coated						
25 Mass		62						g
26 Direction of rotation		clockwise, viewed from the front face						
27 Speed up to	$n_{max.}$	8 000						rpm
28 Number of pole pairs		1						
29 Magnet material		NdFeB						
Rated values for continuous operation								
30 Rated torque	M_N	10	10	10	10	10	10	mNm
31 Rated current (thermal limit)	I_N	1,3	0,93	0,67	0,53	0,44	0,33	A
32 Rated speed	n_N	5 900	5 810	5 510	5 420	5 530	5 490	rpm

Note: Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The R_{th2} value has been reduced by 0%.

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

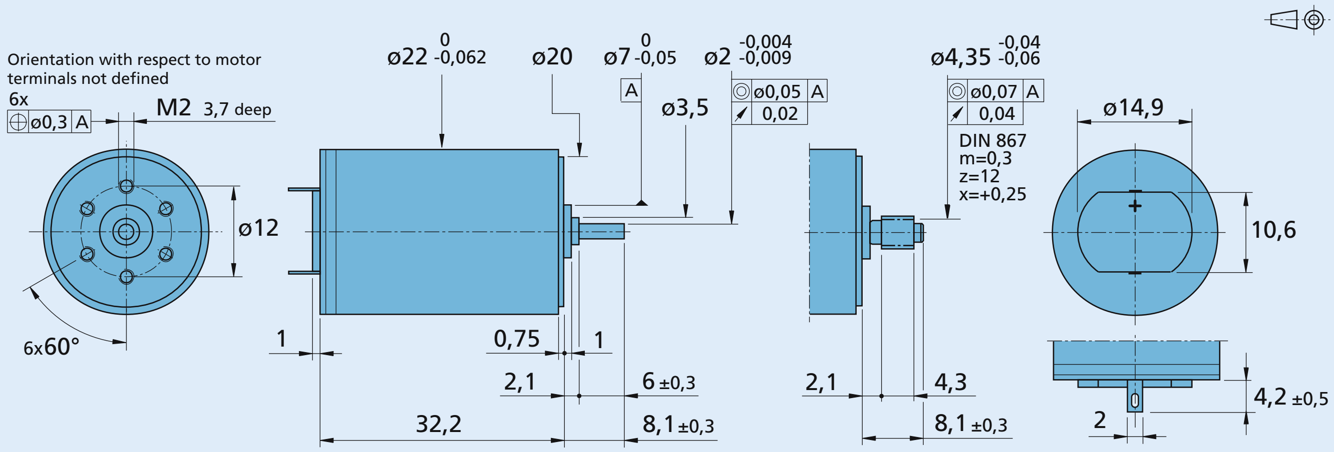
The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 50% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended operation areas (example: nominal voltage 24V)

Dimensional drawing



2232 U ... SR

2232 R ... SR

DC-Micromotors

Precious Metal Commutation

5,9 mNm

For combination with
Gearheads:
20/1, 22/2, 22/5, 22/7, 22E, 22EKV, 23/1
Encoders:
HEDL 5540, HEDM 5500, HEDS 5500, HEDS 5540

Series 2233 ... S

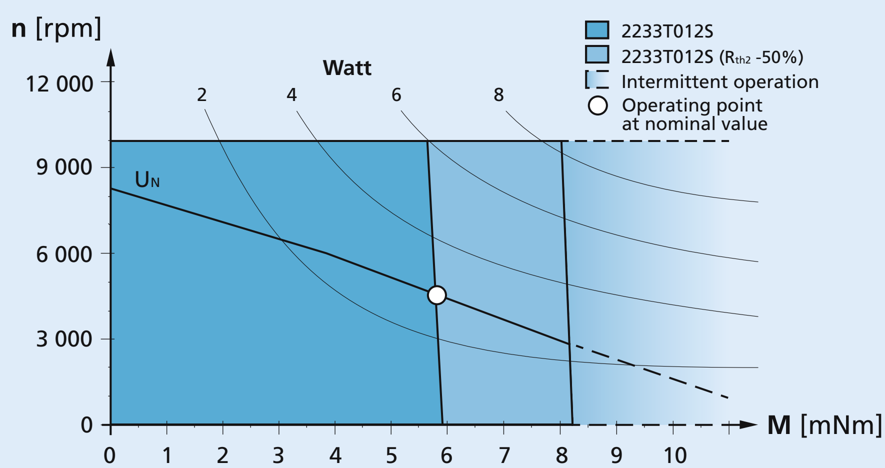
Values at 22°C and nominal voltage	2233 T	4,5 S	006 S	012 S	018 S	024 S	030 S	
1 Nominal voltage	U_N	4,5	6	12	18	24	30	V
2 Terminal resistance	R	1,2	2,7	9,6	25	52	97	Ω
3 Output power	$P_{2nom.}$	4,48	3,23	3,69	3,19	2,75	2,26	W
4 Efficiency, max.	$\eta_{max.}$	86	85	85	83	83	81	%
5 No-load speed	n_0	8 500	7 700	8 200	9 000	8 400	8 700	rpm
6 No-load current, typ. (with shaft ø 1,5 mm)	I_0	0,02	0,014	0,007	0,005	0,004	0,003	A
7 Stall torque	M_H	20,2	16	17,3	13,4	12,4	9,9	mNm
8 Friction torque	M_R	0,1	0,1	0,1	0,1	0,1	0,1	mNm
9 Speed constant	k_n	1 895	1 296	684	508	354	293	rpm/V
10 Back-EMF constant	k_E	0,528	0,772	1,46	1,97	2,82	3,41	mV/rpm
11 Torque constant	k_M	5,04	7,37	14	18,8	27	32,6	mNm/A
12 Current constant	k_I	0,198	0,136	0,072	0,053	0,037	0,031	A/mNm
13 Slope of n-M curve	$\Delta n/\Delta M$	421	483	472	676	678	877	rpm/mNm
14 Rotor inductance	L	60	120	440	800	1 600	2 400	µH
15 Mechanical time constant	τ_m	11,5	10	11	17	11	12,9	ms
16 Rotor inertia	J	2,6	2	2,2	2,5	1,6	1,4	gcm²
17 Angular acceleration	$\alpha_{max.}$	77	80	78	54	78	71	$\cdot 10^3$rad/s²
18 Thermal resistance	R_{th1} / R_{th2}	4 / 27						K/W
19 Thermal time constant	τ_{w1} / τ_{w2}	4 / 660						s
20 Operating temperature range:								
– motor		-30 ... +85 (optional version -55 ... +125)						°C
– winding, max. permissible		+125						°C
21 Shaft bearings		sintered bearings		ball bearings		ball bearings, preloaded		
22 Shaft load max.:		(standard)		(optional version)		(optional version)		
– with shaft diameter		1,5		2		2		mm
– radial at 3 000 rpm (3 mm from bearing)		1,2		8		8		N
– axial at 3 000 rpm		0,2		0,8		0,8		N
– axial at standstill		20		10		10		N
23 Shaft play								
– radial	≤	0,03		0,015		0,015		mm
– axial	≤	0,2		0,2		0		mm
24 Housing material		steel, zinc galvanized and passivated						
25 Mass		61						g
26 Direction of rotation		clockwise, viewed from the front face						
27 Speed up to	$n_{max.}$	10 000						rpm
28 Number of pole pairs		1						
29 Magnet material		AlNiCo						
Rated values for continuous operation								
30 Rated torque	M_N	3,4	5	5,9	4,9	4,9	4,3	mNm
31 Rated current (thermal limit)	I_N	0,7	0,7	0,43	0,27	0,19	0,14	A
32 Rated speed	n_N	6 930	4 800	4 600	4 830	4 170	3 860	rpm

Note: Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The R_{th2} value has been reduced by 0%.

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

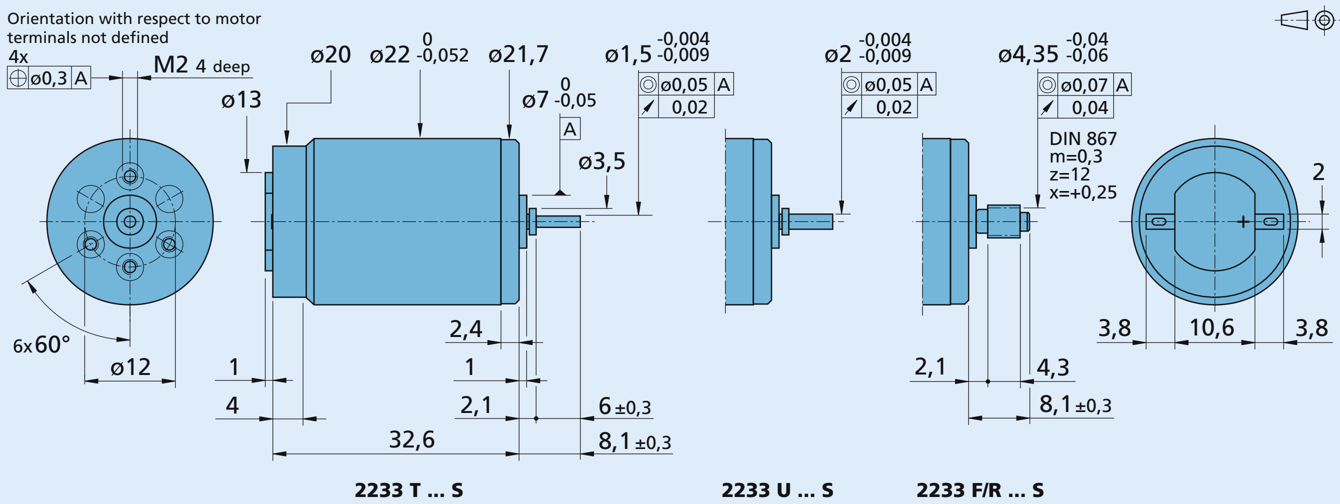
The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 50% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended operation areas (example: nominal voltage 12V)

Dimensional drawing



DC-Micromotors

Graphite Commutation

12 mNm

For combination with
Gearheads:
22/7, 22F, 23/1, 26A
Encoders:
IE3-1024, IE3-1024 L

Series 2237 ... CXR

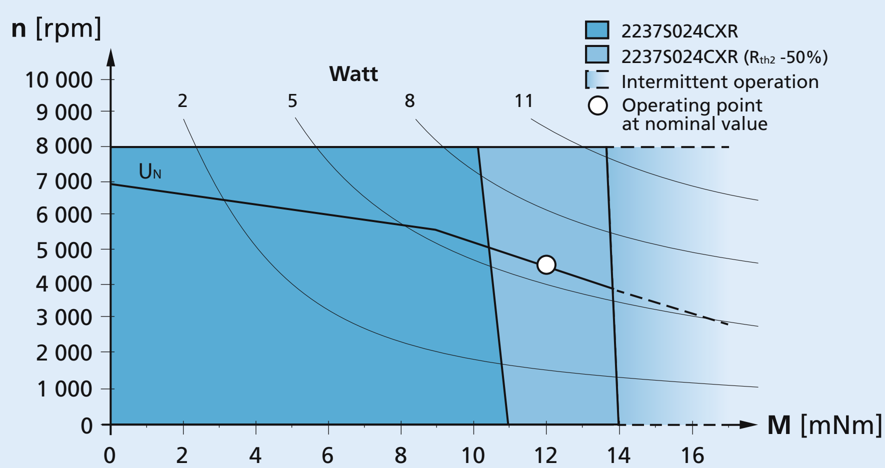
Values at 22°C and nominal voltage	2237 S	006 CXR	012 CXR	018 CXR	024 CXR	036 CXR	048 CXR	
1 Nominal voltage	U_N	6	12	18	24	36	48	V
2 Terminal resistance	R	0,85	3,92	8,5	15,7	33	62,8	Ω
3 Output power	$P_{2nom.}$	8,6	8,1	8,7	8,5	9,2	8,6	W
4 Efficiency, max.	$\eta_{max.}$	68,1	70,8	72,2	72,6	73,6	73,5	%
5 No-load speed	n_0	6 900	6 800	7 000	6 900	7 200	7 000	rpm
6 No-load current, typ. (with shaft ø 3 mm)	I_0	0,124	0,058	0,039	0,029	0,02	0,015	A
7 Stall torque	M_H	47,2	45,7	47,1	46,6	48,7	47,1	mNm
8 Friction torque	M_R	0,92	0,92	0,92	0,92	0,92	0,92	mNm
9 Speed constant	k_n	1 283	601	409	301	207	150	rpm/V
10 Back-EMF constant	k_E	0,78	1,66	2,44	3,33	4,83	6,65	mV/rpm
11 Torque constant	k_M	7,44	15,9	23,3	31,8	46,2	63,5	mNm/A
12 Current constant	k_I	0,134	0,063	0,043	0,032	0,022	0,016	A/mNm
13 Slope of n-M curve	$\Delta n/\Delta M$	146	148	149	149	148	149	rpm/mNm
14 Rotor inductance	L	35	150	320	590	1 240	2 340	µH
15 Mechanical time constant	τ_m	5	5	5	5	5	5	ms
16 Rotor inertia	J	3,1	3,1	3,1	3,1	3,1	3,1	gcm²
17 Angular acceleration	$\alpha_{max.}$	152	147	152	150	157	152	·10³rad/s²
18 Thermal resistance	R_{th1} / R_{th2}	8 / 17						K/W
19 Thermal time constant	τ_{w1} / τ_{w2}	13 / 500						s
20 Operating temperature range:								
– motor		-30 ... +100						°C
– winding, max. permissible		+125						°C
21 Shaft bearings		sintered bearings		ball bearings, preloaded				
22 Shaft load max.:		(standard)		(optional version)				
– with shaft diameter		3		3				mm
– radial at 3 000 rpm (3 mm from bearing)		2,5		15				N
– axial at 3 000 rpm		0,3		2				N
– axial at standstill		20		20				N
23 Shaft play								
– radial	≤	0,03		0,015				mm
– axial	≤	0,15		0				mm
24 Housing material		steel, zinc galvanized and passivated						
25 Mass		68						g
26 Direction of rotation		clockwise, viewed from the front face						
27 Speed up to	$n_{max.}$	8 000						rpm
28 Number of pole pairs		1						
29 Magnet material		NdFeB						
Rated values for continuous operation								
30 Rated torque	M_N	11	12	12	12	12	12	mNm
31 Rated current (thermal limit)	I_N	1,9	0,9	0,61	0,46	0,31	0,23	A
32 Rated speed	n_N	4 750	4 450	4 700	4 560	4 880	4 630	rpm

Note: Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The R_{th2} value has been reduced by 25%.

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

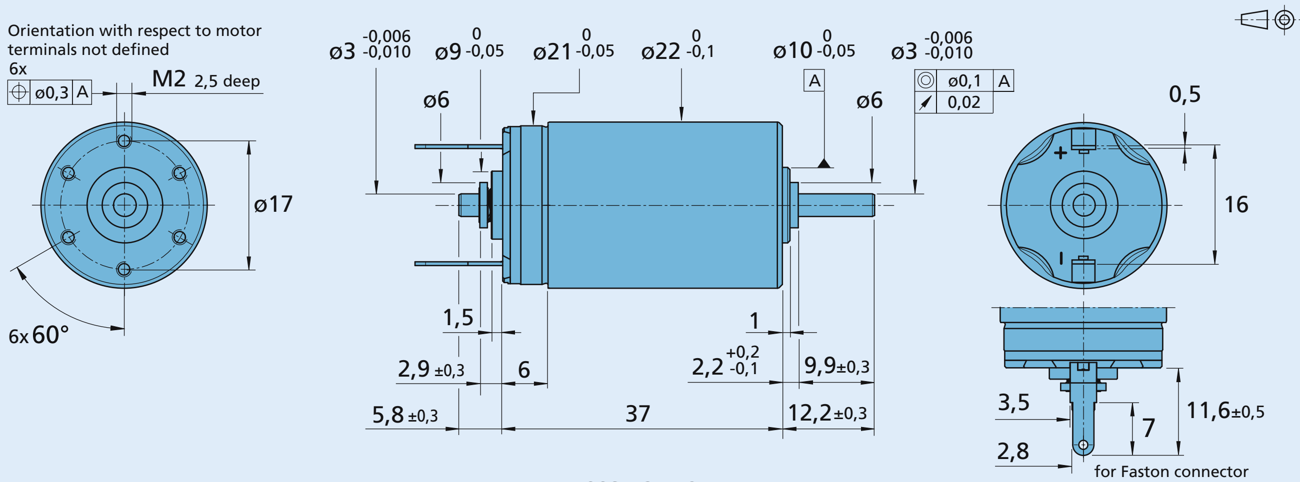
The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 50% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended operation areas (example: nominal voltage 24V)

Dimensional drawing



2237 S ... CXR

DC-Micromotors

Graphite Commutation

19 mNm

For combination with
Gearheads:
22/7, 22F, 23/1, 26/1, 26/1 S, 26A, 30/1, 30/1 S
Encoders:
HEDL 5540, HEDM 5500, HEDS 5500, HEDS 5540, IE3-1024, IE3-1024 L

Series 2342 ... CR

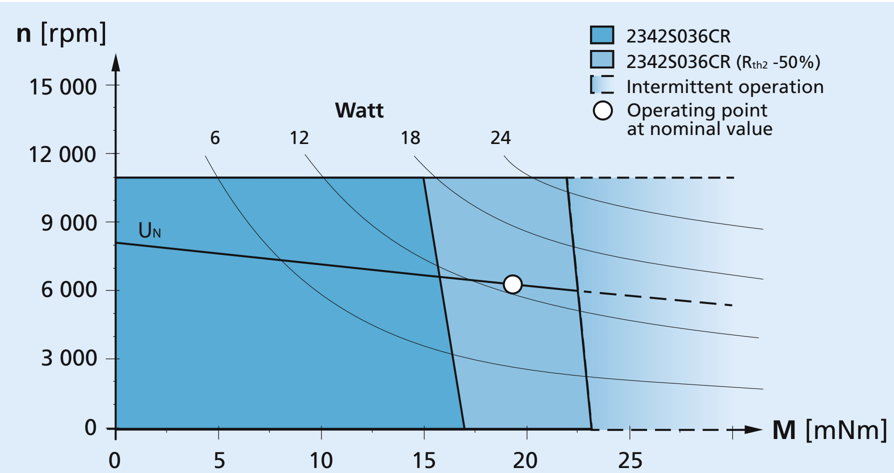
Values at 22°C and nominal voltage	2342 S	006 CR	012 CR	018 CR	024 CR	036 CR	048 CR	
1 Nominal voltage	U_N	6	12	18	24	36	48	V
2 Terminal resistance	R	0,4	1,9	4,1	7,1	15,9	31,2	Ω
3 Output power	$P_{2nom.}$	20,5	17	18,1	19	19,4	17,7	W
4 Efficiency, max.	$\eta_{max.}$	81	80	81	81	81	81	%
5 No-load speed	n_0	9 000	8 100	8 000	8 500	8 100	8 000	rpm
6 No-load current, typ. (with shaft ø 3 mm)	I_0	0,17	0,075	0,048	0,038	0,024	0,017	A
7 Stall torque	M_H	87,2	80	86,5	85,4	91,4	84,4	mNm
8 Friction torque	M_R	0,98	1	0,99	0,99	0,99	0,95	mNm
9 Speed constant	k_n	1 650	713	462	366	231	170	rpm/V
10 Back-EMF constant	k_E	0,604	1,4	2,16	2,73	4,34	5,87	mV/rpm
11 Torque constant	k_M	5,77	13,4	20,7	26,1	41,4	56,1	mNm/A
12 Current constant	k_I	0,173	0,075	0,048	0,038	0,024	0,018	A/mNm
13 Slope of n-M curve	$\Delta n/\Delta M$	103	101	92,5	99,5	88,6	94,8	rpm/mNm
14 Rotor inductance	L	13,5	65	150	265	590	1 050	µH
15 Mechanical time constant	τ_m	6	6	6	6	6	6	ms
16 Rotor inertia	J	5,6	5,7	6,2	5,8	6,5	6	gcm²
17 Angular acceleration	$\alpha_{max.}$	160	140	140	150	140	140	·10³rad/s²
18 Thermal resistance	R_{th1} / R_{th2}	3 / 15						K/W
19 Thermal time constant	τ_{w1} / τ_{w2}	6,5 / 490						s
20 Operating temperature range:								
– motor		-30 ... +100						°C
– winding, max. permissible		+125						°C
21 Shaft bearings		ball bearings, preloaded						
22 Shaft load max.:								
– with shaft diameter		3						mm
– radial at 3 000 rpm (3 mm from bearing)		20						N
– axial at 3 000 rpm		2						N
– axial at standstill		20						N
23 Shaft play								
– radial	≤	0,015						mm
– axial	=	0						mm
24 Housing material		steel, black coated						
25 Mass		88						g
26 Direction of rotation		clockwise, viewed from the front face						
27 Speed up to	$n_{max.}$	11 000						rpm
28 Number of pole pairs		1						
29 Magnet material		NdFeB						
Rated values for continuous operation								
30 Rated torque	M_N	14	17	18	17	19	18	mNm
31 Rated current (thermal limit)	I_N	2,9	1,5	1	0,78	0,53	0,38	A
32 Rated speed	n_N	7 140	6 090	6 040	6 470	6 160	5 910	rpm

Note: Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The R_{th2} value has been reduced by 25%.

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

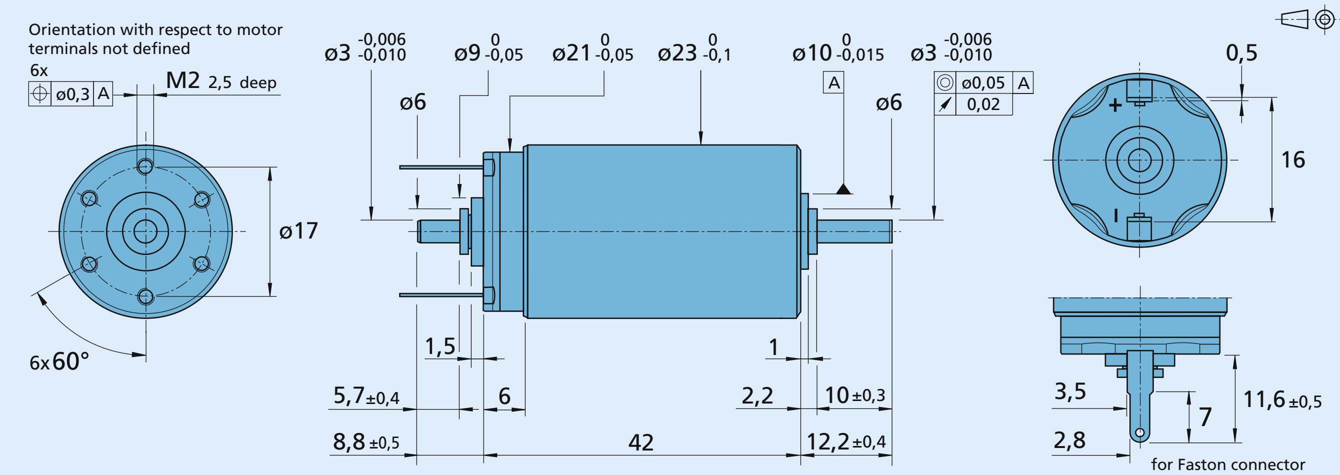
The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 50% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended operation areas (example: nominal voltage 36V)

Dimensional drawing



2342 S ... CR

DC-Micromotors

Graphite Commutation

26 mNm

For combination with
Gearheads:
26/1, 26/1 S, 26A, 30/1, 30/1 S, 32A
Encoders:
HEDL 5540, HEDM 5500, HEDS 5500, HEDS 5540, IE3-1024, IE3-1024 L

Series 2642 ... CXR

	Values at 22°C and nominal voltage	2642 W			012 CXR	024 CXR	048 CXR	
1	Nominal voltage	U_N			12	24	48	V
2	Terminal resistance	R			1,46	5,84	24,06	Ω
3	Output power	$P_{2nom.}$			22,1	23,1	22,9	W
4	Efficiency, max.	$\eta_{max.}$			76	78	79	%
5	No-load speed	n_0			5 800	5 900	5 900	rpm
6	No-load current, typ. (with shaft ø 4 mm)	I_0			0,092	0,045	0,022	A
7	Stall torque	M_H			144,6	150,5	149	mNm
8	Friction torque	M_R			1,7	1,7	1,7	mNm
9	Speed constant	k_n			514	252	125	rpm/V
10	Back-EMF constant	k_E			1,945	3,962	7,994	mV/rpm
11	Torque constant	k_M			18,57	37,83	76,34	mNm/A
12	Current constant	k_I			0,054	0,026	0,013	A/mNm
13	Slope of n-M curve	$\Delta n/\Delta M$			40,4	39	39,4	rpm/mNm
14	Rotor inductance	L			135	560	2 280	µH
15	Mechanical time constant	τ_m			5,1	4,9	5	ms
16	Rotor inertia	J			12	12	12	gcm²
17	Angular acceleration	$\alpha_{max.}$			121	125	124	$\cdot 10^3$rad/s²
18	Thermal resistance	R_{th1} / R_{th2}	4,7 / 15,2					K/W
19	Thermal time constant	τ_{w1} / τ_{w2}	20 / 720					s
20	Operating temperature range:							
	– motor		-30 ... +100					°C
	– winding, max. permissible		+125					°C
21	Shaft bearings		sintered bearings	ball bearings, preloaded				
22	Shaft load max.:		(standard)	(optional version)				
	– with shaft diameter		4	4				mm
	– radial at 3 000 rpm (3 mm from bearing)		10	20				N
	– axial at 3 000 rpm		2	2				N
	– axial at standstill		50	20				N
23	Shaft play							
	– radial	≤	0,03	0,015				mm
	– axial	≤	0,2	0				mm
24	Housing material		steel, zinc galvanized and passivated					
25	Mass		114					g
26	Direction of rotation		clockwise, viewed from the front face					
27	Speed up to	$n_{max.}$	7 000					rpm
28	Number of pole pairs		1					
29	Magnet material		NdFeB					
	Rated values for continuous operation							
30	Rated torque	M_N			25	26	26	mNm
31	Rated current (thermal limit)	I_N			1,6	0,82	0,41	A
32	Rated speed	n_N			4 770	4 770	4 750	rpm

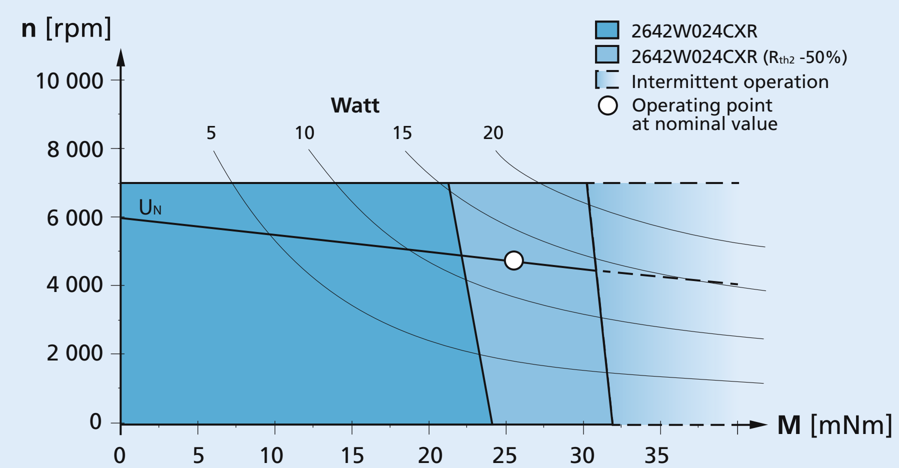
Note: Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The R_{th2} value has been reduced by 25%.

Note:

The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

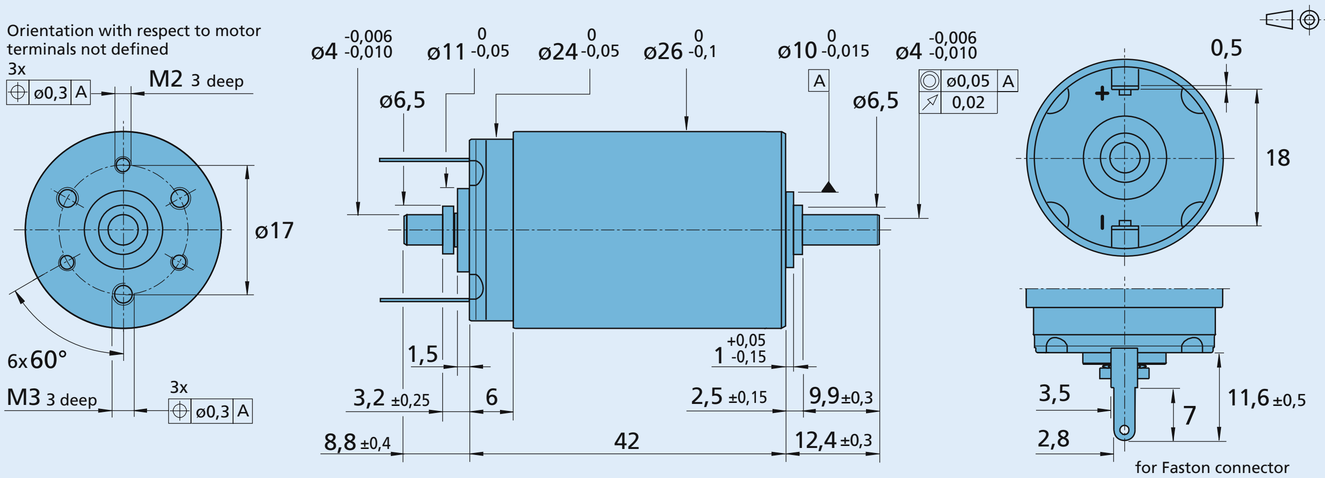
The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 50% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended operation areas (example: nominal voltage 24V)

Dimensional drawing



2642 W ... CXR

DC-Micromotors

Graphite Commutation

32 mNm

For combination with
Gearheads:
26/1, 26/1 S, 26A, 30/1, 30/1 S, 32A, 32ALN
Encoders:
HEDL 5540, HEDM 5500, HEDS 5500, HEDS 5540, IE3-1024, IE3-1024 L

Series 2642 ... CR

Values at 22°C and nominal voltage	2642 W		012 CR	024 CR	048 CR	
1 Nominal voltage	U_N		12	24	48	V
2 Terminal resistance	R		1,45	5,78	23,8	Ω
3 Output power	$P_{2nom.}$		22,1	23,2	23	W
4 Efficiency, max.	$\eta_{max.}$		78	79	79	%
5 No-load speed	n_0		6 400	6 400	6 400	rpm
6 No-load current, typ. (with shaft ø 4 mm)	I_0		0,118	0,058	0,029	A
7 Stall torque	M_H		132	139	137	mNm
8 Friction torque	M_R		2	2	2	mNm
9 Speed constant	k_n		565	276	137	rpm/V
10 Back-EMF constant	k_E		1,77	3,62	7,31	mV/rpm
11 Torque constant	k_M		16,9	34,6	69,8	mNm/A
12 Current constant	k_I		0,059	0,029	0,014	A/mNm
13 Slope of n-M curve	$\Delta n/\Delta M$		48,5	46	46,7	rpm/mNm
14 Rotor inductance	L		130	550	2 200	µH
15 Mechanical time constant	τ_m		5,4	5,4	5,4	ms
16 Rotor inertia	J		11	11	11	gcm²
17 Angular acceleration	$\alpha_{max.}$		120	120	120	·10³rad/s²
18 Thermal resistance	R_{th1} / R_{th2}	2,1 / 11				K/W
19 Thermal time constant	τ_{w1} / τ_{w2}	10 / 510				s
20 Operating temperature range:						
– motor		-30 ... +125				°C
– winding, max. permissible		+155				°C
21 Shaft bearings		ball bearings, preloaded				
22 Shaft load max.:						
– with shaft diameter		4				mm
– radial at 3 000 rpm (3 mm from bearing)		20				N
– axial at 3 000 rpm		2				N
– axial at standstill		20				N
23 Shaft play						
– radial	≤	0,015				mm
– axial	=	0				mm
24 Housing material		steel, black coated				
25 Mass		114				g
26 Direction of rotation		clockwise, viewed from the front face				
27 Speed up to	$n_{max.}$	7 000				rpm
28 Number of pole pairs		1				
29 Magnet material		NdFeB				
Rated values for continuous operation						
30 Rated torque	M_N		30	32	32	mNm
31 Rated current (thermal limit)	I_N		2,2	1,1	0,56	A
32 Rated speed	n_N		4 390	4 370	4 330	rpm

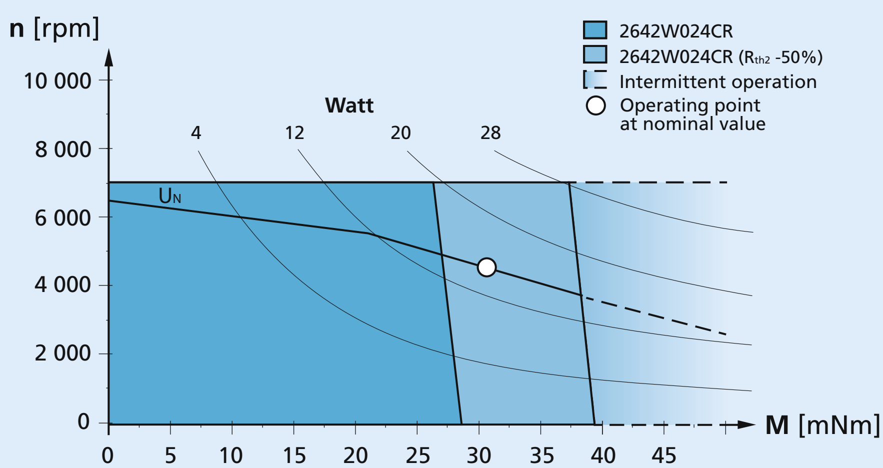
Note: Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The R_{th2} value has been reduced by 25%.

Note:

The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

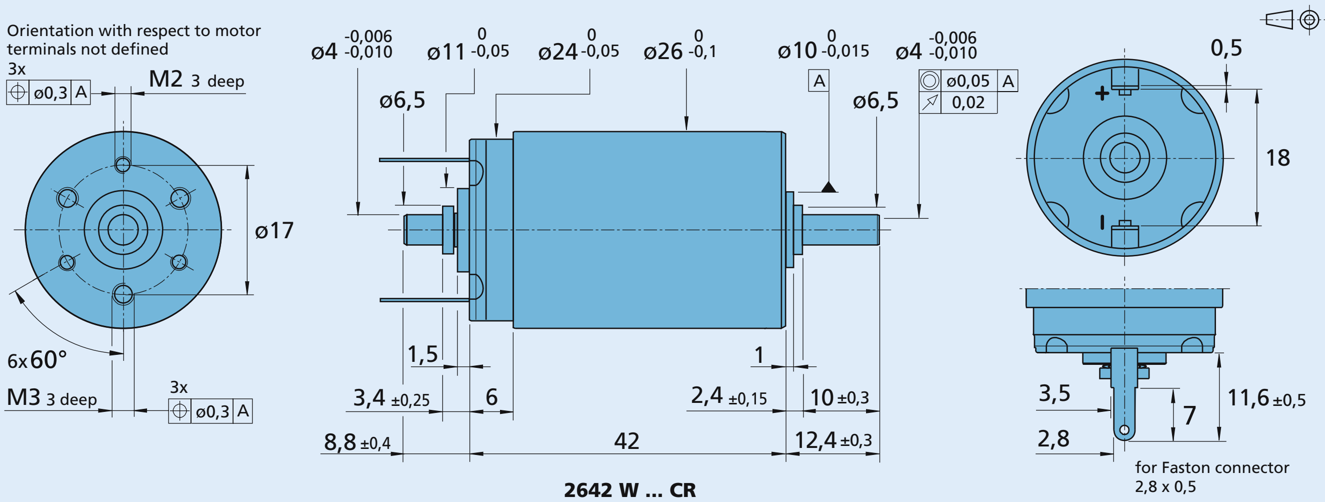
The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 50% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended operation areas (example: nominal voltage 24V)

Dimensional drawing



2642 W ... CR

FAULHABER

DC-Micromotors

Graphite Commutation

40 mNm

For combination with
Gearheads:
26/1, 26/1 S, 26A, 30/1, 30/1 S, 32A
Encoders:
HEDL 5540, HEDM 5500, HEDS 5500, HEDS 5540, IE3-1024, IE3-1024 L

Series 2657 ... CXR

	Values at 22°C and nominal voltage	2657 W			012 CXR	024 CXR	048 CXR	
1	Nominal voltage	U_N			12	24	48	V
2	Terminal resistance	R			0,72	2,98	12,61	Ω
3	Output power	$P_{2nom.}$			45,3	45,7	44,1	W
4	Efficiency, max.	$\eta_{max.}$			81	83	83	%
5	No-load speed	n_0			5 600	5 800	5 800	rpm
6	No-load current, typ. (with shaft ø 4 mm)	I_0			0,104	0,052	0,026	A
7	Stall torque	M_H			306,7	302,9	283,1	mNm
8	Friction torque	M_R			2	2	2	mNm
9	Speed constant	k_n			494	247	122	rpm/V
10	Back-EMF constant	k_E			2,024	4,05	8,205	mV/rpm
11	Torque constant	k_M			19,33	38,67	78,35	mNm/A
12	Current constant	k_I			0,052	0,026	0,013	A/mNm
13	Slope of n-M curve	$\Delta n/\Delta M$			18,4	19	19,6	rpm/mNm
14	Rotor inductance	L			90	365	1 500	µH
15	Mechanical time constant	τ_m			3,3	3,4	3,5	ms
16	Rotor inertia	J			17	17	17	gcm^2
17	Angular acceleration	$\alpha_{max.}$			180	178	172	$\cdot 10^3$rad/s^2
18	Thermal resistance	R_{th1} / R_{th2}	4,4 / 12,6					K/W
19	Thermal time constant	τ_{w1} / τ_{w2}	28 / 810					s
20	Operating temperature range:							
	– motor		-30 ... +100					°C
	– winding, max. permissible		+125					°C
21	Shaft bearings		sintered bearings	ball bearings, preloaded				
22	Shaft load max.:		(standard)	(optional version)				
	– with shaft diameter		4	4				mm
	– radial at 3 000 rpm (3 mm from bearing)		10	20				N
	– axial at 3 000 rpm		2	2				N
	– axial at standstill		50	20				N
23	Shaft play							
	– radial	≤	0,03	0,015				mm
	– axial	≤	0,2	0				mm
24	Housing material		steel, zinc galvanized and passivated					
25	Mass		156					g
26	Direction of rotation		clockwise, viewed from the front face					
27	Speed up to	$n_{max.}$	7 000					rpm
28	Number of pole pairs		1					
29	Magnet material		NdFeB					
	Rated values for continuous operation							
30	Rated torque	M_N			39	40	40	mNm
31	Rated current (thermal limit)	I_N			2,4	1,2	0,61	A
32	Rated speed	n_N			5 040	5 110	5 050	rpm

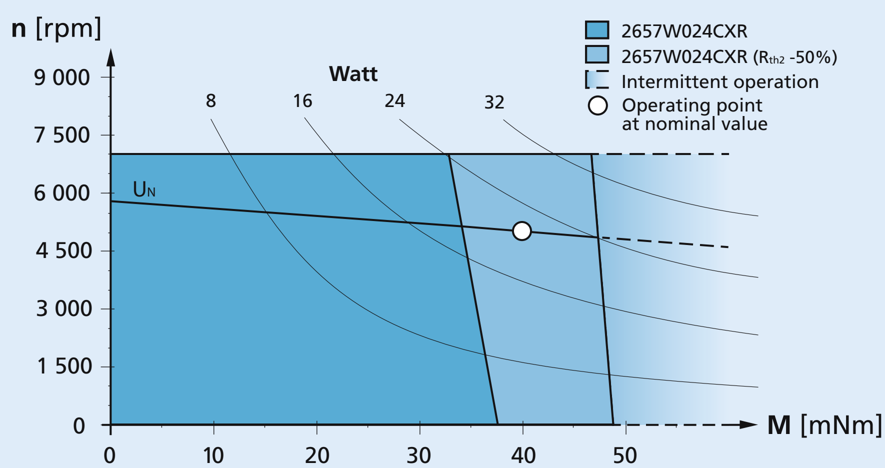
Note: Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The R_{th2} value has been reduced by 25%.

Note:

The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

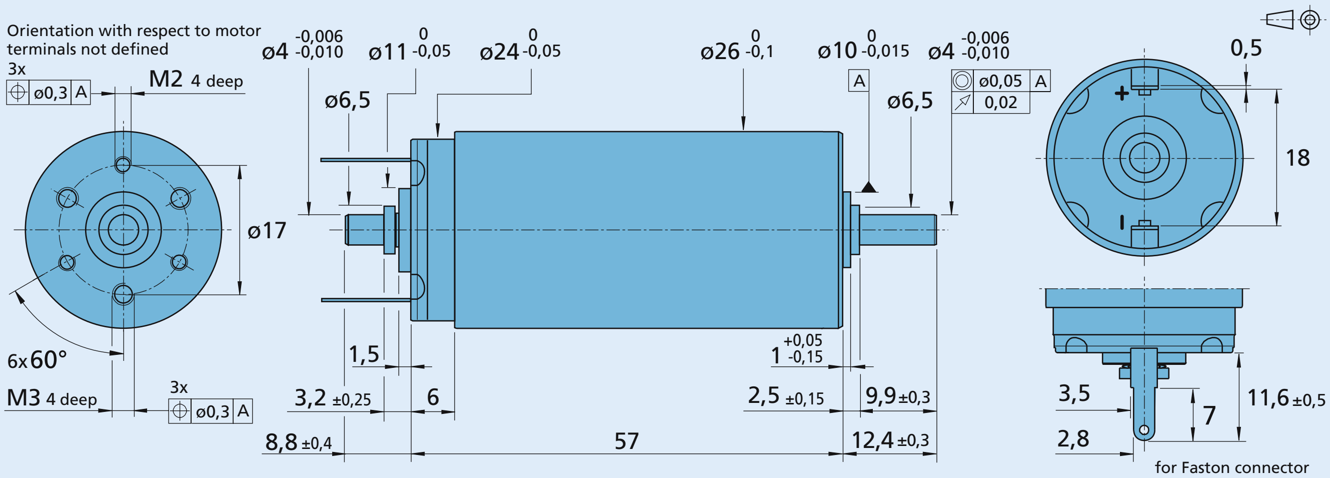
The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 50% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended operation areas (example: nominal voltage 24V)

Dimensional drawing



2657 W ... CXR

DC-Micromotors

Graphite Commutation

51 mNm

For combination with
Gearheads:
26/1, 26/1 S, 26A, 30/1, 30/1 S, 32A, 32ALN
Encoders:
HEDL 5540, HEDM 5500, HEDS 5500, HEDS 5540, IE3-1024, IE3-1024 L

Series 2657 ... CR

	Values at 22°C and nominal voltage	2657 W		012 CR	024 CR	048 CR	
1	Nominal voltage	U_N		12	24	48	V
2	Terminal resistance	R		0,71	2,84	12,5	Ω
3	Output power	$P_{2nom.}$		45,9	47,9	44,5	W
4	Efficiency, max.	$\eta_{max.}$		84	85	84	%
5	No-load speed	n_0		6 300	6 400	6 400	rpm
6	No-load current, typ. (with shaft ø 4 mm)	I_0		0,115	0,058	0,028	A
7	Stall torque	M_H		278	286	265	mNm
8	Friction torque	M_R		2	2	2	mNm
9	Speed constant	k_n		552	274	136	rpm/V
10	Back-EMF constant	k_E		1,81	3,65	7,37	mV/rpm
11	Torque constant	k_M		17,3	34,8	70,4	mNm/A
12	Current constant	k_I		0,058	0,029	0,014	A/mNm
13	Slope of n-M curve	$\Delta n/\Delta M$		22,7	22,4	24,2	rpm/mNm
14	Rotor inductance	L		95	380	1 550	µH
15	Mechanical time constant	τ_m		3,9	3,9	3,9	ms
16	Rotor inertia	J		16	17	15	gcm²
17	Angular acceleration	$\alpha_{max.}$		170	170	170	$\cdot 10^3$rad/s²
18	Thermal resistance	R_{th1} / R_{th2}	1,9 / 9				K/W
19	Thermal time constant	τ_{w1} / τ_{w2}	10 / 580				s
20	Operating temperature range:						
	– motor		-30 ... +125				°C
	– winding, max. permissible		+155				°C
21	Shaft bearings		ball bearings, preloaded				
22	Shaft load max.:						
	– with shaft diameter		4				mm
	– radial at 3 000 rpm (3 mm from bearing)		20				N
	– axial at 3 000 rpm		2				N
	– axial at standstill		20				N
23	Shaft play						
	– radial	≤	0,015				mm
	– axial	=	0				mm
24	Housing material		steel, black coated				
25	Mass		156				g
26	Direction of rotation		clockwise, viewed from the front face				
27	Speed up to	$n_{max.}$	7 000				rpm
28	Number of pole pairs		1				
29	Magnet material		NdFeB				

	Rated values for continuous operation						
30	Rated torque	M_N		45	51	50	mNm
31	Rated current (thermal limit)	I_N		3	1,8	0,86	A
32	Rated speed	n_N		5 250	5 060	4 920	rpm

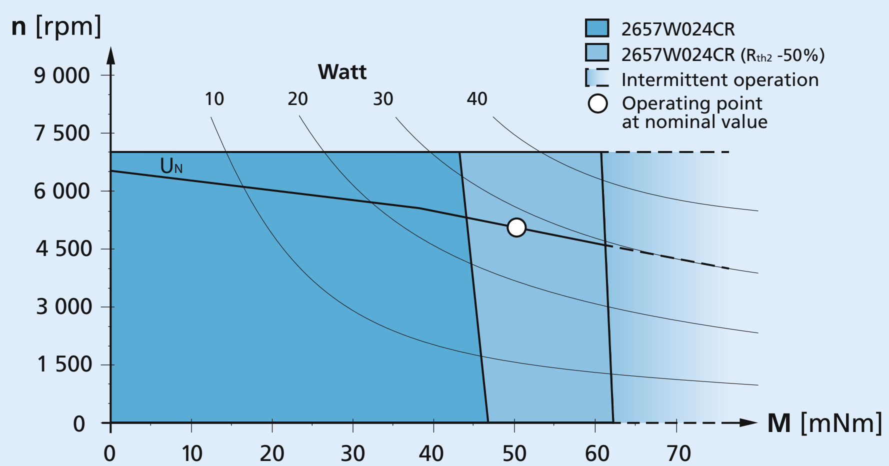
Note: Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The R_{th2} value has been reduced by 25%.

Note:

The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

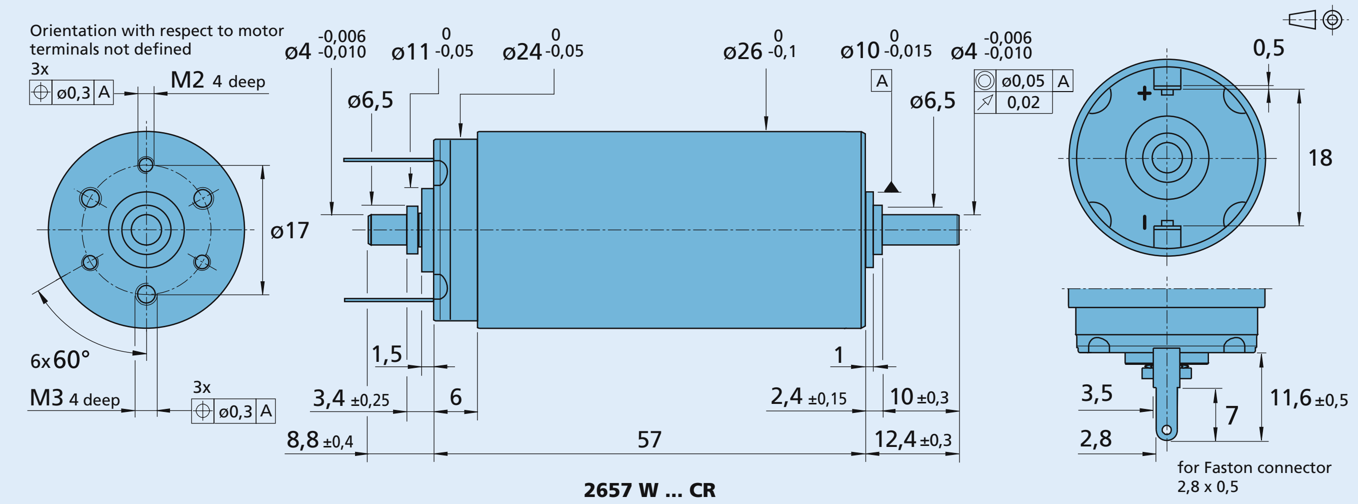
The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 50% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended operation areas (example: nominal voltage 24V)

Dimensional drawing



2657 W ... CR

DC-Micromotors

Graphite Commutation

41 mNm

For combination with
Gearheads:
32/3, 32/3 S, 32A, 32ALN, 38/1, 38/1 S, 38/2, 38/2 S, 38A
Encoders:
HEDL 5540, HEDM 5500, HEDS 5500, HEDS 5540, IE3-1024, IE3-1024 L

Series 3242 ... CR

	Values at 22°C and nominal voltage	3242 G		012 CR	024 CR	048 CR	
1	Nominal voltage	U_N		12	24	48	V
2	Terminal resistance	R		1,27	5	19,7	Ω
3	Output power	$P_{2nom.}$		24,7	26,3	27,3	W
4	Efficiency, max.	$\eta_{max.}$		72	73	73	%
5	No-load speed	n_0		5 200	5 300	5 400	rpm
6	No-load current, typ. (with shaft ø 5 mm)	I_0		0,234	0,117	0,058	A
7	Stall torque	M_H		181	189	193	mNm
8	Friction torque	M_R		4,8	4,8	4,8	mNm
9	Speed constant	k_n		464	231	116	rpm/V
10	Back-EMF constant	k_E		2,15	4,33	8,58	mV/rpm
11	Torque constant	k_M		20,6	41,3	82	mNm/A
12	Current constant	k_I		0,049	0,024	0,012	A/mNm
13	Slope of n-M curve	$\Delta n/\Delta M$		28,7	28	28	rpm/mNm
14	Rotor inductance	L		135	540	2 200	µH
15	Mechanical time constant	τ_m		7,5	7,5	7,5	ms
16	Rotor inertia	J		25	26	26	gcm²
17	Angular acceleration	$\alpha_{max.}$		73	74	75	$\cdot 10^3$rad/s²
18	Thermal resistance	R_{th1} / R_{th2}	2,5 / 9				K/W
19	Thermal time constant	τ_{w1} / τ_{w2}	17 / 660				s
20	Operating temperature range:						
	– motor		-30 ... +125				°C
	– winding, max. permissible		+155				°C
21	Shaft bearings		ball bearings, preloaded				
22	Shaft load max.:						
	– with shaft diameter		5				mm
	– radial at 3 000 rpm (3 mm from bearing)		50				N
	– axial at 3 000 rpm		5				N
	– axial at standstill		50				N
23	Shaft play						
	– radial	≤	0,015				mm
	– axial	=	0				mm
24	Housing material		steel, black coated				
25	Mass		175				g
26	Direction of rotation		clockwise, viewed from the front face				
27	Speed up to	$n_{max.}$	6 000				rpm
28	Number of pole pairs		1				
29	Magnet material		NdFeB				
	Rated values for continuous operation						
30	Rated torque	M_N		40	41	41	mNm
31	Rated current (thermal limit)	I_N		2,5	1,3	0,65	A
32	Rated speed	n_N		3 580	3 690	3 780	rpm

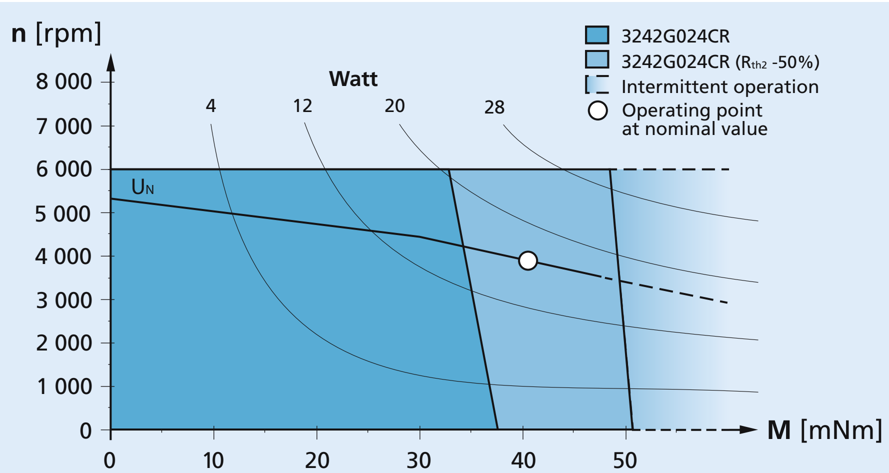
Note: Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The R_{th2} value has been reduced by 25%.

Note:

The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

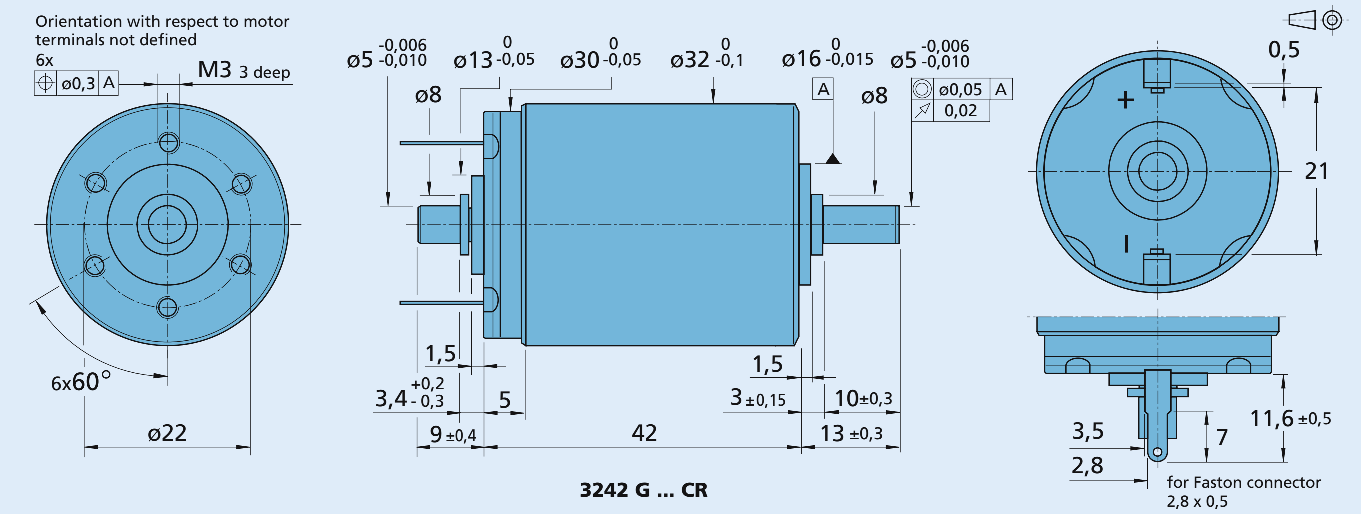
The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 50% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended operation areas (example: nominal voltage 24V)

Dimensional drawing



3242 G ... CR

FAULHABER

DC-Micromotors

Graphite Commutation

73 mNm

For combination with
Gearheads:
32/3, 32/3 S, 32A, 32ALN, 38/1, 38/1 S, 38/2, 38/2 S, 38A
Encoders:
HEDL 5540, HEDM 5500, HEDS 5500, HEDS 5540, IE3-1024, IE3-1024 L

Series 3257 ... CR

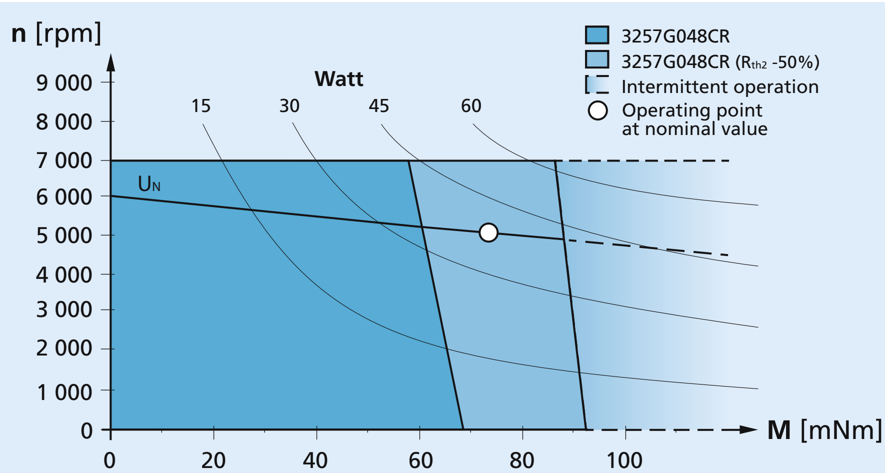
Values at 22°C and nominal voltage	3257 G		012 CR	024 CR	048 CR	
1 Nominal voltage	U_N		12	24	48	V
2 Terminal resistance	R		0,41	1,63	6,56	Ω
3 Output power	$P_{2nom.}$		79,2	83,2	84,5	W
4 Efficiency, max.	$\eta_{max.}$		83	83	83	%
5 No-load speed	n_0		5 700	5 900	5 900	rpm
6 No-load current, typ. (with shaft ø 5 mm)	I_0		0,258	0,129	0,064	A
7 Stall torque	M_H		531	539	547	mNm
8 Friction torque	M_R		4,9	4,9	4,9	mNm
9 Speed constant	k_n		500	253	125	rpm/V
10 Back-EMF constant	k_E		2	3,95	7,98	mV/rpm
11 Torque constant	k_M		19,1	37,7	76,2	mNm/A
12 Current constant	k_I		0,052	0,027	0,013	A/mNm
13 Slope of n-M curve	$\Delta n/\Delta M$		10,7	10,9	10,8	rpm/mNm
14 Rotor inductance	L		70	270	1 100	µH
15 Mechanical time constant	τ_m		4,7	4,7	4,7	ms
16 Rotor inertia	J		42	41	42	gcm²
17 Angular acceleration	$\alpha_{max.}$		130	130	130	·10³rad/s²
18 Thermal resistance	R_{th1} / R_{th2}	2 / 8				K/W
19 Thermal time constant	τ_{w1} / τ_{w2}	17 / 810				s
20 Operating temperature range:						
– motor		-30 ... +125				°C
– winding, max. permissible		+155				°C
21 Shaft bearings		ball bearings, preloaded				
22 Shaft load max.:						
– with shaft diameter		5				mm
– radial at 3 000 rpm (3 mm from bearing)		50				N
– axial at 3 000 rpm		5				N
– axial at standstill		50				N
23 Shaft play						
– radial	≤	0,015				mm
– axial	=	0				mm
24 Housing material		steel, black coated				
25 Mass		242				g
26 Direction of rotation		clockwise, viewed from the front face				
27 Speed up to	$n_{max.}$	7 000				rpm
28 Number of pole pairs		1				
29 Magnet material		NdFeB				
Rated values for continuous operation						
30 Rated torque	M_N		63	71	73	mNm
31 Rated current (thermal limit)	I_N		4	2,3	1,2	A
32 Rated speed	n_N		5 150	5 210	5 190	rpm

Note: Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The R_{th2} value has been reduced by 25%.

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

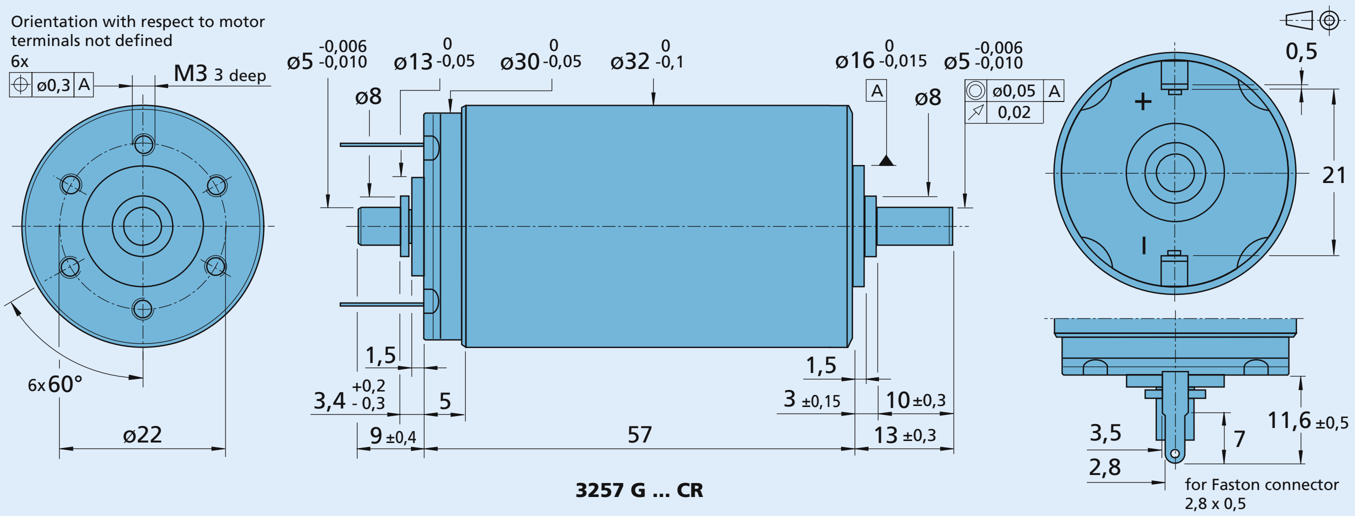
The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 50% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended operation areas (example: nominal voltage 48V)

Dimensional drawing



3257 G ... CR

DC-Micromotors

Graphite Commutation

120 mNm

For combination with
Gearheads:
30/1, 30/1 S, 32/3, 32/3 S, 32A, 32ALN, 38/1, 38/1 S, 38/2, 38/2 S, 38A
Encoders:
HEDL 5540, HEDM 5500, HEDS 5500, HEDS 5540, IE3-1024, IE3-1024 L

Series 3272 ... CR

Values at 22°C and nominal voltage	3272 G		012 CR	024 CR	048 CR	
1 Nominal voltage	U_N		12	24	48	V
2 Terminal resistance	R		0,2	0,82	3,35	Ω
3 Output power	$P_{2nom.}$		164	167	167	W
4 Efficiency, max.	$\eta_{max.}$		85	87	88	%
5 No-load speed	n_0		5 400	5 500	5 500	rpm
6 No-load current, typ. (with shaft ø 5 mm)	I_0		0,191	0,095	0,048	A
7 Stall torque	M_H		1 192	1 188	1 177	mNm
8 Friction torque	M_R		3,9	3,9	3,9	mNm
9 Speed constant	k_n		459	230	115	rpm/V
10 Back-EMF constant	k_E		2,18	4,35	8,7	mV/rpm
11 Torque constant	k_M		20,8	41,6	83,3	mNm/A
12 Current constant	k_I		0,048	0,024	0,012	A/mNm
13 Slope of n-M curve	$\Delta n/\Delta M$		4,4	4,5	4,6	rpm/mNm
14 Rotor inductance	L		45	185	740	µH
15 Mechanical time constant	τ_m		3,1	3	2,9	ms
16 Rotor inertia	J		67	63	60	gcm²
17 Angular acceleration	$\alpha_{max.}$		178	189	196	$\cdot 10^3$rad/s²
18 Thermal resistance	R_{th1} / R_{th2}	2,3 / 7				K/W
19 Thermal time constant	τ_{w1} / τ_{w2}	40 / 850				s
20 Operating temperature range:						
– motor		-30 ... +125				°C
– winding, max. permissible		+155				°C
21 Shaft bearings		ball bearings, preloaded				
22 Shaft load max.:						
– with shaft diameter		5				mm
– radial at 3 000 rpm (3 mm from bearing)		50				N
– axial at 3 000 rpm		5				N
– axial at standstill		50				N
23 Shaft play						
– radial	≤	0,015				mm
– axial	=	0				mm
24 Housing material		steel, black coated				
25 Mass		312				g
26 Direction of rotation		clockwise, viewed from the front face				
27 Speed up to	$n_{max.}$	6 000				rpm
28 Number of pole pairs		1				
29 Magnet material		NdFeB				

Rated values for continuous operation						
30 Rated torque	M_N		75	119	120	mNm
31 Rated current (thermal limit)	I_N		4	3,5	1,7	A
32 Rated speed	n_N		5 110	5 150	5 180	rpm

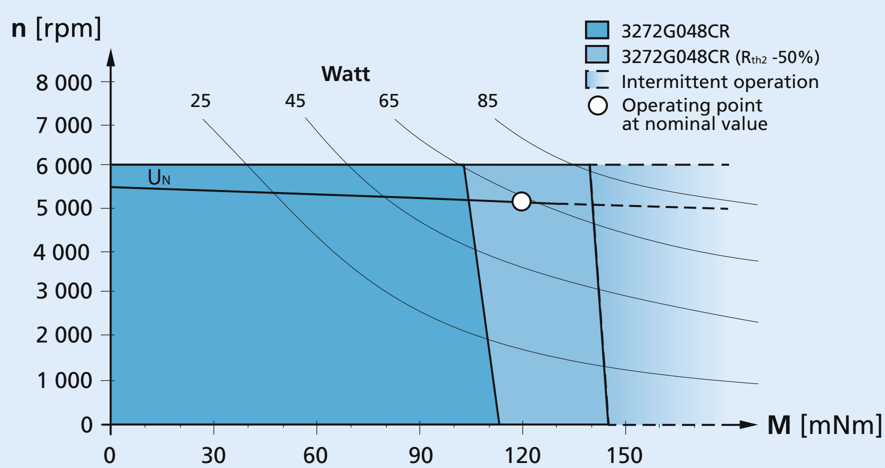
Note: Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The R_{th2} value has been reduced by 25%.

Note:

The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 50% reduced).

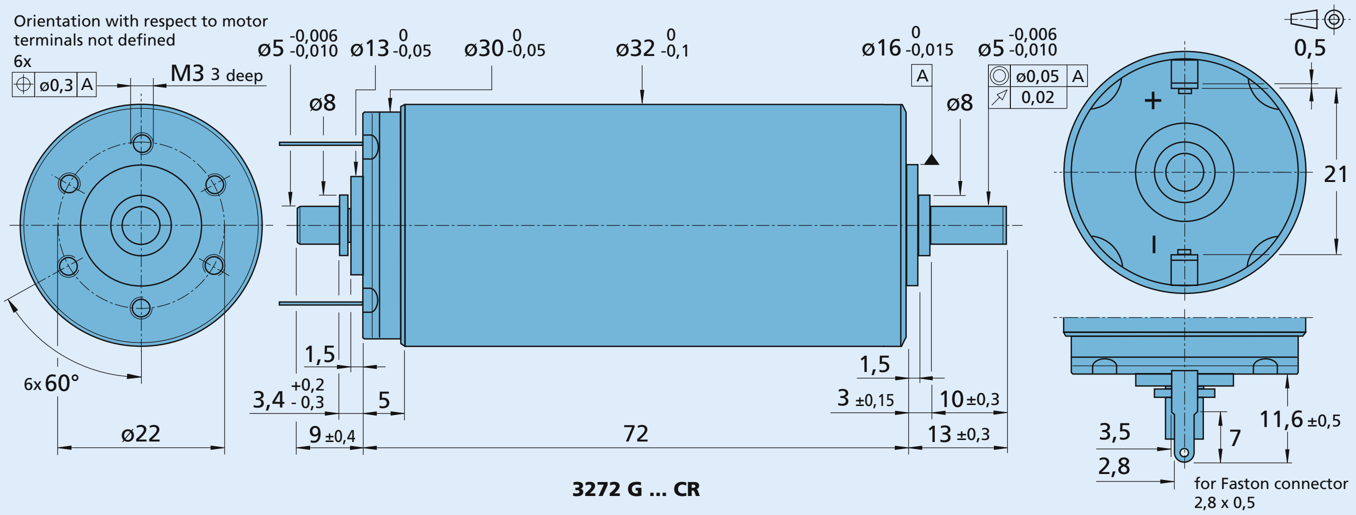
The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended operation areas (example: nominal voltage 48V)

DC-Micromotors

Dimensional drawing



3272 G ... CR

DC-Micromotors

Graphite Commutation

131 mNm

For combination with
Gearheads:
38/1, 38/1 S, 38/2, 38/2 S, 38A, 44/1
Encoders:
HEDL 5540, HEDM 5500, HEDS 5500, HEDS 5540, IE3-1024, IE3-1024 L

Series 3863 ... CR

	Values at 22°C and nominal voltage	3863 H		012 CR	018 CR	024 CR	036 CR	048 CR	
1	Nominal voltage	U_N		12	18	24	36	48	V
2	Terminal resistance	R		0,16	0,36	0,64	1,55	2,58	Ω
3	Output power	$P_{2nom.}$		205	211	214	201	217	W
4	Efficiency, max.	$\eta_{max.}$		83	84	85	86	86	%
5	No-load speed	n_0		5 600	5 900	5 800	5 800	5 800	rpm
6	No-load current, typ. (with shaft ø 6 mm)	I_0		0,335	0,232	0,168	0,112	0,084	A
7	Stall torque	M_H		1 424	1 394	1 455	1 363	1 461	mNm
8	Friction torque	M_R		6,5	6,5	6,5	6,5	6,5	mNm
9	Speed constant	k_n		480	332	240	160	120	rpm/V
10	Back-EMF constant	k_E		2,08	3,01	4,17	6,25	8,33	mV/rpm
11	Torque constant	k_M		19,9	28,8	39,8	59,8	79,7	mNm/A
12	Current constant	k_I		0,05	0,035	0,025	0,017	0,013	A/mNm
13	Slope of n-M curve	$\Delta n/\Delta M$		3,9	4,1	3,9	4,1	3,9	rpm/mNm
14	Rotor inductance	L		45	90	180	400	700	µH
15	Mechanical time constant	τ_m		4,8	4,8	4,8	4,8	4,7	ms
16	Rotor inertia	J		120	110	120	110	115	gcm²
17	Angular acceleration	$\alpha_{max.}$		119	127	121	124	127	·10³rad/s²
18	Thermal resistance	R_{th1} / R_{th2}	2,5 / 6						K/W
19	Thermal time constant	τ_{w1} / τ_{w2}	50 / 900						s
20	Operating temperature range:								
	– motor		-30 ... +125						°C
	– winding, max. permissible		+155						°C
21	Shaft bearings		ball bearings, preloaded						
22	Shaft load max.:								
	– with shaft diameter		6						mm
	– radial at 3 000 rpm (3 mm from bearing)		60						N
	– axial at 3 000 rpm		6						N
	– axial at standstill		50						N
23	Shaft play								
	– radial	≤	0,015						mm
	– axial	=	0						mm
24	Housing material		steel, black coated						
25	Mass		390						g
26	Direction of rotation		clockwise, viewed from the front face						
27	Speed up to	$n_{max.}$	7 000						rpm
28	Number of pole pairs		1						
29	Magnet material		NdFeB						
	Rated values for continuous operation								
30	Rated torque	M_N		69	99	129	126	131	mNm
31	Rated current (thermal limit)	I_N		4	4	4	2,6	2	A
32	Rated speed	n_N		5 430	5 660	5 510	5 500	5 550	rpm

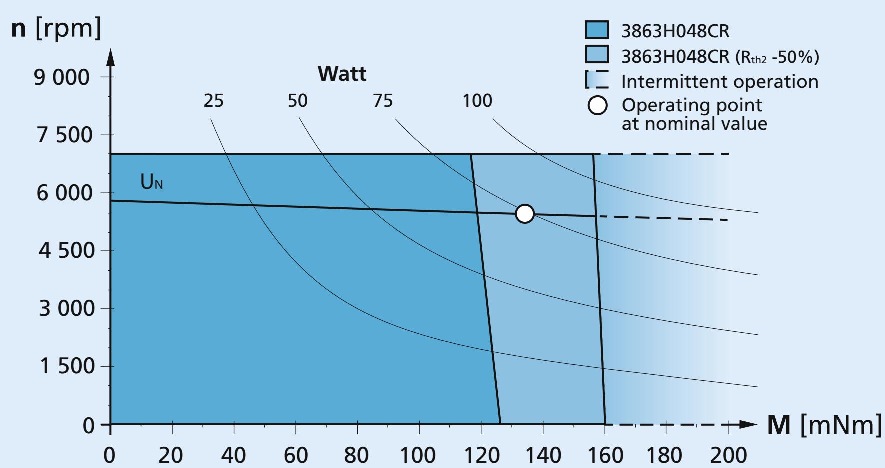
Note: Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The R_{th2} value has been reduced by 25%.

Note:

The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 50% reduced).

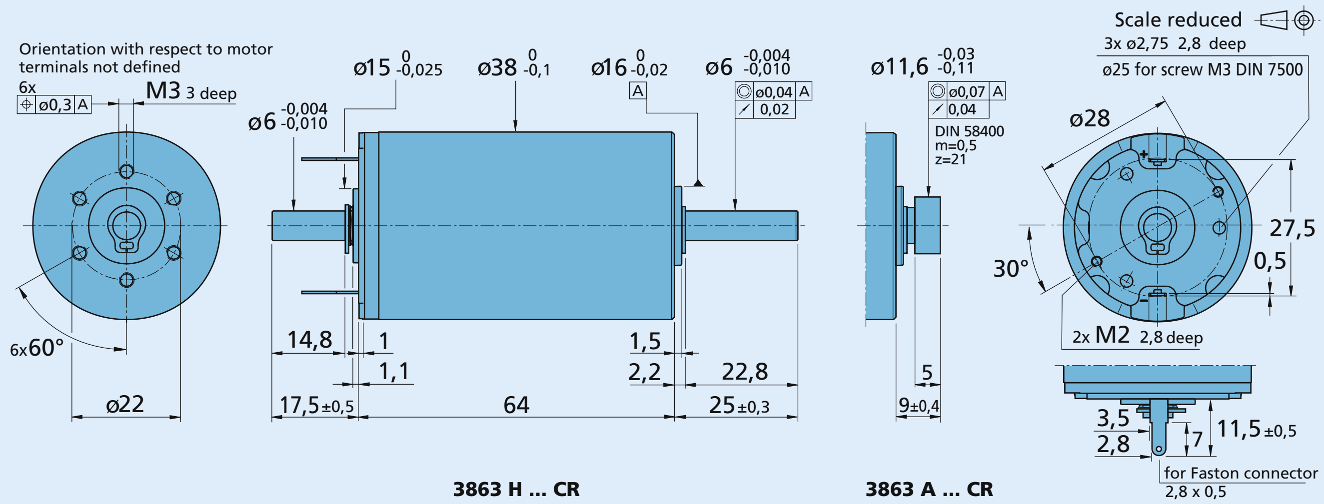
The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended operation areas (example: nominal voltage 48V)

DC-Micromotors

Dimensional drawing



3863 H ... CR

3863 A ... CR

NEW

FAULHABER

DC-Micromotors

Graphite Commutation

224 mNm

For combination with
Gearheads:
38/1, 38/1 S, 38/2, 38/2 S, 38A, 44/1
Encoders:
HEDL 5540, HEDM 5500, HEDS 5500, HEDS 5540, IE3-1024, IE3-1024 L

Series 3890 ... CR

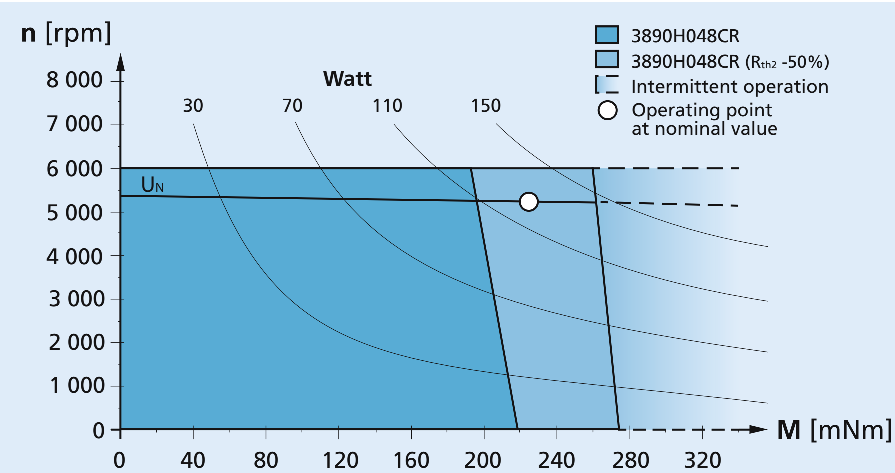
	Values at 22°C and nominal voltage	3890 H		018 CR	024 CR	036 CR	048 CR	
1	Nominal voltage	U_N		18	24	36	48	V
2	Terminal resistance	R		0,21	0,36	0,78	1,38	Ω
3	Output power	$P_{2nom.}$		362	381	401	406	W
4	Efficiency, max.	$\eta_{max.}$		86	87	87	88	%
5	No-load speed	n_0		5 400	5 400	5 400	5 500	rpm
6	No-load current, typ. (with shaft ø 6 mm)	I_0		0,323	0,242	0,161	0,121	A
7	Stall torque	M_H		2 642	2 760	2 887	2 911	mNm
8	Friction torque	M_R		10	10	10	10	mNm
9	Speed constant	k_n		300	225	150	112	rpm/V
10	Back-EMF constant	k_E		3,332	4,443	6,665	8,887	mV/rpm
11	Torque constant	k_M		31,82	42,43	63,65	84,86	mNm/A
12	Current constant	k_I		0,031	0,024	0,016	0,012	A/mNm
13	Slope of n-M curve	$\Delta n/\Delta M$		2	1,9	1,8	1,8	rpm/mNm
14	Rotor inductance	L		60	110	240	430	µH
15	Mechanical time constant	τ_m		3,4	3,3	3,3	3,3	ms
16	Rotor inertia	J		164	164	171	171	gcm²
17	Angular acceleration	$\alpha_{max.}$		161	168	169	170	$\cdot 10^3$rad/s²
18	Thermal resistance	R_{th1} / R_{th2}	1,9 / 4,2					K/W
19	Thermal time constant	τ_{w1} / τ_{w2}	58 / 910					s
20	Operating temperature range:							
	– motor		-30 ... +125					°C
	– winding, max. permissible		+155					°C
21	Shaft bearings		ball bearings, preloaded					
22	Shaft load max.:							
	– with shaft diameter		6					mm
	– radial at 3 000 rpm (3 mm from bearing)		60					N
	– axial at 3 000 rpm		6					N
	– axial at standstill		50					N
23	Shaft play							
	– radial	≤	0,015					mm
	– axial	=	0					mm
24	Housing material		steel, black coated					
25	Mass		550					g
26	Direction of rotation		clockwise, viewed from the front face					
27	Speed up to	$n_{max.}$	6 000					rpm
28	Number of pole pairs		1					
29	Magnet material		NdFeB					
	Rated values for continuous operation							
30	Rated torque	M_N		139	182	222	224	mNm
31	Rated current (thermal limit)	I_N		5	5	4,3	3,2	A
32	Rated speed	n_N		5 190	5 240	5 350	5 360	rpm

Note: Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The R_{th2} value has been reduced by 25%.

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

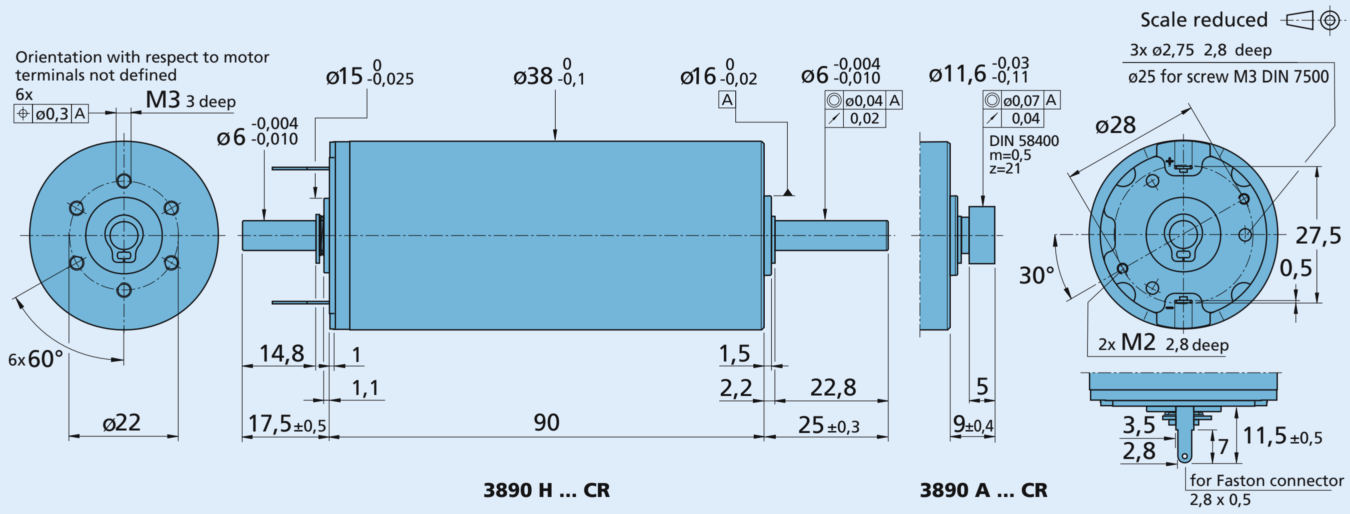
The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 50% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended operation areas (example: nominal voltage 48V)

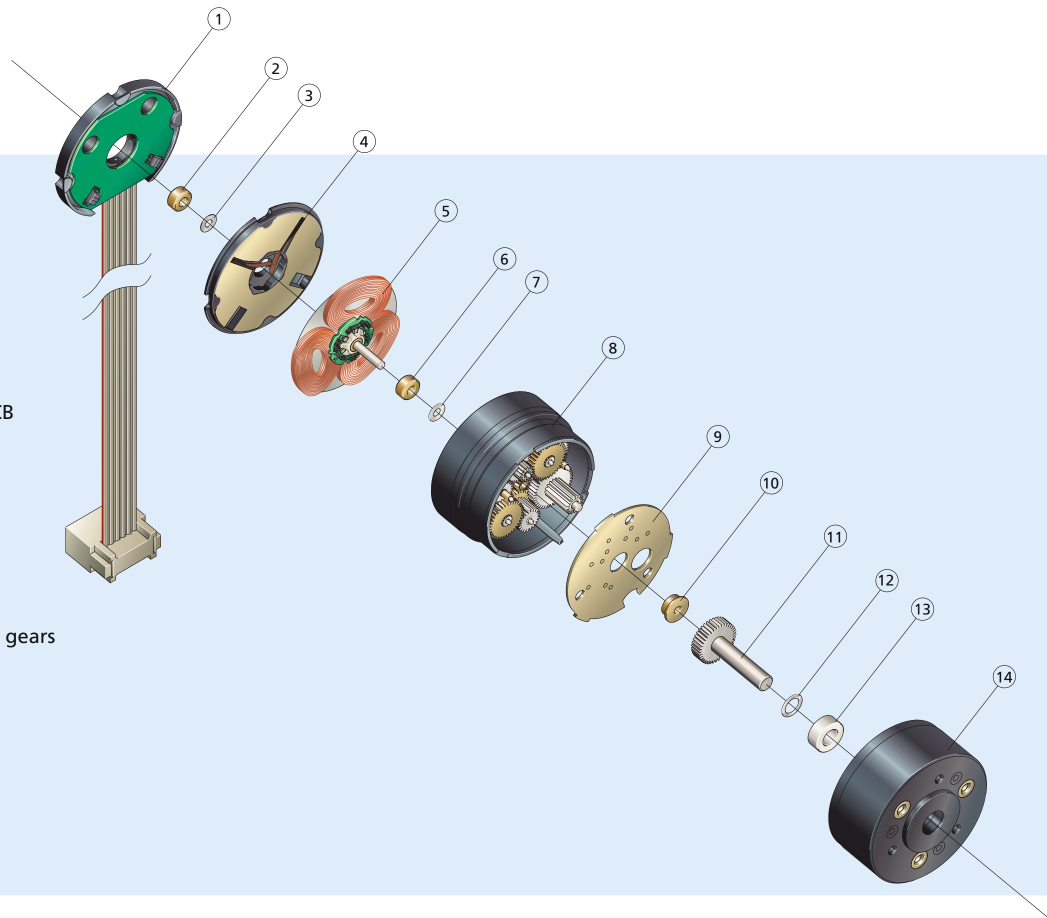
Dimensional drawing



Notes

Flat DC-Micromotors

Precious Metal Commutation



DC-Gearmotor with integrated encoder

① End cap with encoder PCB
② Sintered bearing
③ Washer
④ Brush cover
⑤ Coils and collector
⑥ Sintered bearing
⑦ Washer
⑧ Housing with integrated gears
⑨ Intermediate plate
⑩ Sintered bearing
⑪ Output shaft
⑫ Washer
⑬ Sleeve bearing
⑭ Front cover

Features

The heart of these Flat DC-Micromotors is the ironless rotor made up of three flat self supporting coils.
The rotor coil has exceptionally low inertia and inductance and rotates in an axial magnetic field.

Motor torque can be increased by the addition of an integrated reduction gearhead. This also reduces the speed to fit the specifications in the application.

FAULHABER specializes in the modification of their drive systems to fit the customer's particular application requirements. Common modifications include vaccuum compatibility, extreme temperature compatability, modified shaft geometry, additional voltage types, custom motor leads and connectors, and much more.

Benefits

- No cogging
- Extremely low current consumption – low starting voltage
- Highly dynamic performance due to a low inertia, low inductance coil
- Light and compact
- Precise speed control
- Simple to control due to the linear performance characteristics

Product Code

2619 S 012 SR

26	Motor diameter [mm]
19	Motor length [mm]
S	Shaft type
012	Nominal voltage [V]
S	Type of commutation (precious metal)
R	Version (rare earth magnet)

Flat DC-Micromotors

0,45 mNm

Precious Metal Commutation

Series 1506 ... SR

	Values at 22°C and nominal voltage	1506 N		003 SR	006 SR	012 SR	
1	Nominal voltage	U_N		3	6	12	V
2	Terminal resistance	R		13,5	54,7	155	Ω
3	Output power	$P_{2nom.}$		0,15	0,15	0,22	W
4	Efficiency, max.	$\eta_{max.}$		62	63	67	%
5	No-load speed	n_0		11 100	11 800	12 800	rpm
6	No-load current, typ. (with shaft ø 0,8 mm)	I_0		0,01	0,005	0,003	A
7	Stall torque	M_H		0,52	0,49	0,64	mNm
8	Friction torque	M_R		0,02	0,02	0,02	mNm
9	Speed constant	k_n		3 884	2 053	1 107	rpm/V
10	Back-EMF constant	k_E		0,257	0,487	0,903	mV/rpm
11	Torque constant	k_M		2,46	4,65	8,63	mNm/A
12	Current constant	k_I		0,407	0,215	0,116	A/mNm
13	Slope of n-M curve	$\Delta n/\Delta M$		21 333	24 135	19 947	rpm/mNm
14	Rotor inductance	L		275	1 157	3 550	µH
15	Mechanical time constant	τ_m		17	19	16	ms
16	Rotor inertia	J		0,08	0,08	0,08	gcm²
17	Angular acceleration	$\alpha_{max.}$		68	63	83	·10³rad/s²
18	Thermal resistance	R_{th1} / R_{th2}	25 / 35				K/W
19	Thermal time constant	τ_{w1} / τ_{w2}	4,5 / 48,4				s
20	Operating temperature range:						
	– motor		-25 ... +80				°C
	– winding, max. permissible		+85				°C
21	Shaft bearings		sintered bearings				
22	Shaft load max.:						
	– with shaft diameter		0,8				mm
	– radial at 3 000 rpm (3 mm from bearing)		0,5				N
	– axial at 3 000 rpm		0,1				N
	– axial at standstill		10				N
23	Shaft play						
	– radial	≤	0,03				mm
	– axial	≤	0,2				mm
24	Housing material		plastic				
25	Mass		4,3				g
26	Direction of rotation		clockwise, viewed from the front face				
27	Speed up to	$n_{max.}$	16 000				rpm
28	Number of pole pairs		2				
29	Magnet material		NdFeB				
	Rated values for continuous operation						
30	Rated torque	M_N		0,37	0,35	0,45	mNm
31	Rated current (thermal limit)	I_N		0,16	0,081	0,056	A
32	Rated speed	n_N		2 500	2 500	2 500	rpm

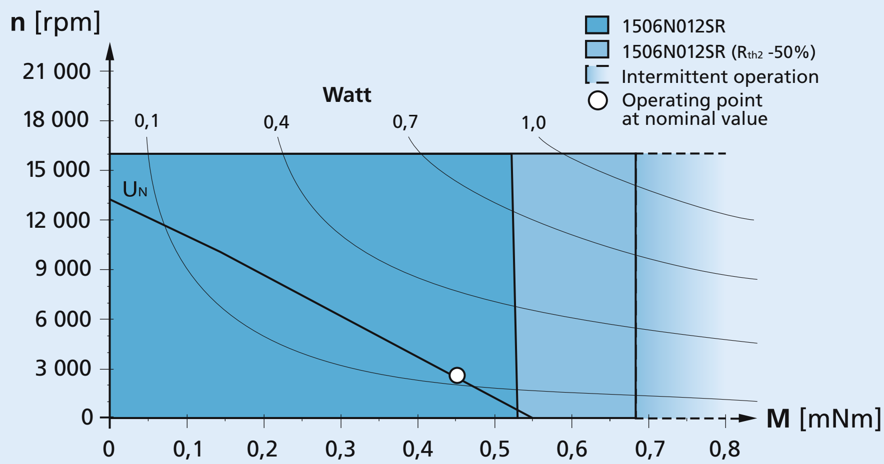
Note: Brush plate is loose and is only held in place by magnetic force.
Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The R_{th2} value has been reduced by 0%.

Note:

The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

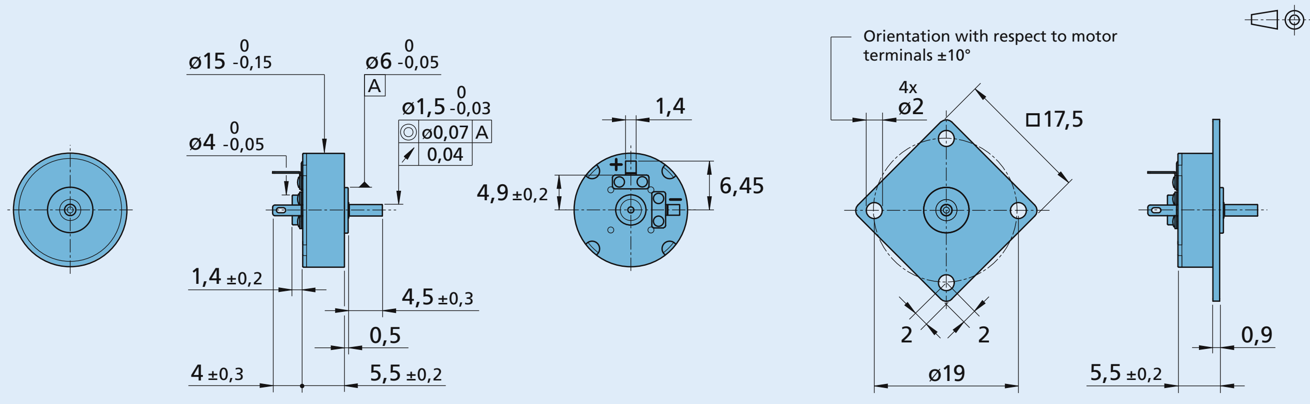
The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 50% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended operation areas (example: nominal voltage 12V)

Dimensional drawing



1506 N ... SR

1506 N ... SR X3697

Flat DC-Micromotors 0,4 mNm

Precious Metal Commutation with integrated Encoder

Series 1506 ... SR IE2-8

Values at 22°C and nominal voltage		1506 N		003 SR	006 SR	012 SR	IE2-8
1	Nominal voltage	U_N		3	6	12	V
2	Terminal resistance	R		10,4	50,5	130	Ω
3	Output power	$P_{2nom.}$		0,19	0,17	0,26	W
4	Efficiency, max.	$\eta_{max.}$		68	66	70	%
5	No-load speed	n_0		13 400	14 300	15 500	rpm
6	No-load current, typ. (with shaft ø 0,8 mm)	I_0		0,01	0,005	0,003	A
7	Stall torque	M_H		0,54	0,46	0,64	mNm
8	Friction torque	M_R		0,02	0,02	0,02	mNm
9	Speed constant	k_n		4 640	2 480	1 340	rpm/V
10	Back-EMF constant	k_E		0,216	0,403	0,749	mV/rpm
11	Torque constant	k_M		2,06	3,84	7,15	mNm/A
12	Current constant	k_I		0,486	0,26	0,14	A/mNm
13	Slope of n-M curve	$\Delta n/\Delta M$		24 700	31 400	24 200	rpm/mNm
14	Rotor inductance	L		175	720	2 100	µH
15	Mechanical time constant	τ_m		24	30	23	ms
16	Rotor inertia	J		0,09	0,09	0,09	gcm²
17	Angular acceleration	$\alpha_{max.}$		58	50	71	$\cdot 10^3$rad/s²
18	Thermal resistance	R_{th1} / R_{th2}	36 / 61				K/W
19	Thermal time constant	τ_{w1} / τ_{w2}	5,4 / 190				s
20	Operating temperature range:						
	– motor		+0 ... +70				°C
	– winding, max. permissible		+70				°C
21	Shaft bearings		sintered bearings				
22	Shaft load max.:						
	– with shaft diameter		0,8				mm
	– radial at 3 000 rpm (3 mm from bearing)		0,5				N
	– axial at 3 000 rpm		0,1				N
	– axial at standstill		10				N
23	Shaft play						
	– radial	≤	0,03				mm
	– axial	≤	0,2				mm
24	Housing material		plastic				
25	Mass		7,1				g
26	Direction of rotation		clockwise, viewed from the front face				
27	Speed up to	$n_{max.}$	16 000				rpm
28	Number of pole pairs		2				
29	Magnet material		NdFeB				
Rated values for continuous operation							
30	Rated torque	M_N		0,37	0,29	0,4	mNm
31	Rated current (thermal limit)	I_N		0,2	0,086	0,063	A
32	Rated speed	n_N		2 500	2 500	2 530	rpm

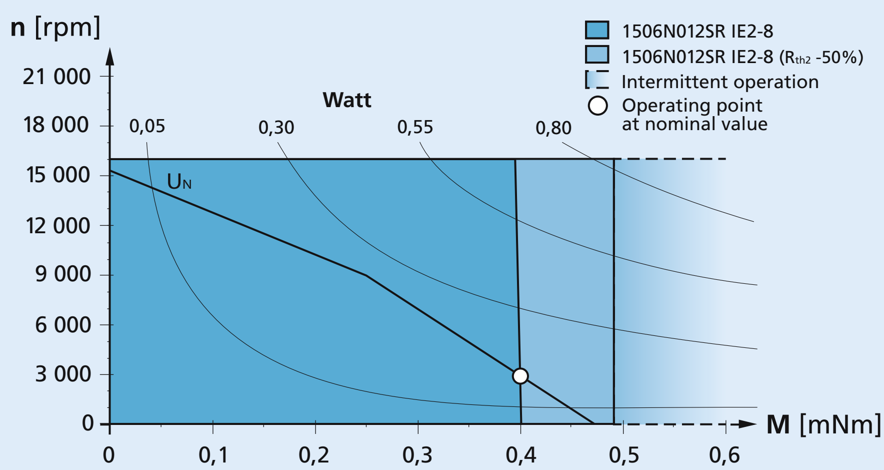
Note: Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The R_{th2} value has been reduced by 0%.

Note:

The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

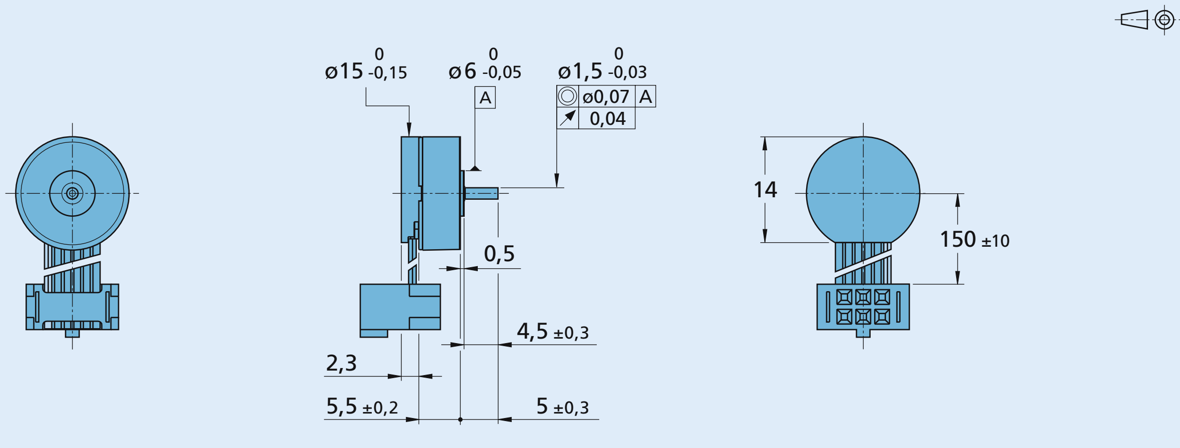
The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 50% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended operation areas (example: nominal voltage 12V)

Dimensional drawing



1506 N ... SR IE2-8

Integrated optical Encoder

Lines per revolution	N	8	
Signal output, square wave		2	Channel
Supply voltage	U_{DD}	3,2 ... 5,5	V DC
Current consumption, typical (U_{DD} = 5 V DC)	I_{DD}	typ. 8, max. 15	mA
Output current, max. allowable (at U_{out} < 1,5V)	I_{OUT}	5	mA
Pulse width [1]	P	180 ± 45	°e
Phase shift, channal A to B [1]	Φ	90 ± 45	°e
Signal rise/fall time, max. (C_{LOAD} = 50 pF)	tr/tf	2,5/0,3	µs
Frequency range [2], up to	f	4,5	kHz

[1] Ambient temperature 22°C (tested at 1kHz)
[2] Velocity (rpm) = f (Hz) x 60/N

Features

In this version, the DC-Micromotors have an optical encoder with two output channels. A code wheel on the shaft is optically captured and further processed. At the encoder outputs, two 90° phase-shifted rectangular signals are available with 8 impulses per motor revolution.

The encoder is suitable for the monitoring and regulation of the speed and direction of rotation and for positioning the drive shaft.

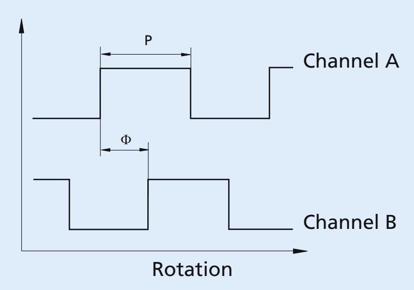
The supply voltage for the encoder and the DC-Micromotor as well as the two channel output signals are interfaced through a ribbon cable with connector.

Full product description
- Examples:

1506N003SR IE2-8
1506N012SR IE2-8

Output signals / Circuit diagram / Connector information

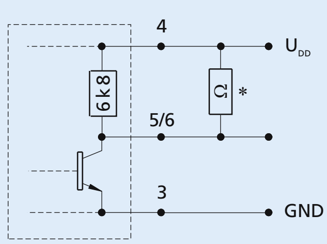
Output signals
with clockwise rotation as seen from the shaft end



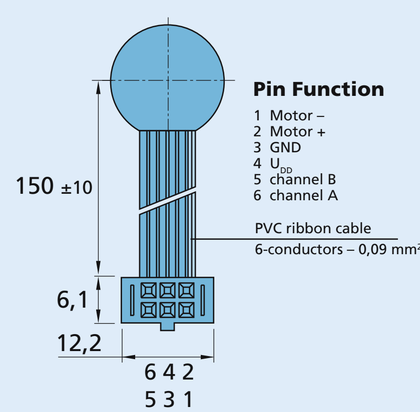
Admissible deviation of phase shift:

$$\Delta\Phi = \left| 90° - \frac{\Phi}{P} * 180° \right| \leq 45°$$

Output circuit



* An additional external pull-up resistor can be added to improve the rise time.
Caution: I_{OUT} max. 5 mA must not be exceeded!



Pin Function
1 Motor –
2 Motor +
3 GND
4 U_{DD}
5 channel B
6 channel A

PVC ribbon cable
6-conductors – 0,09 mm²

DC-Gearmotors

30 mNm

Precious Metal Commutation

Series 1512 ... SR

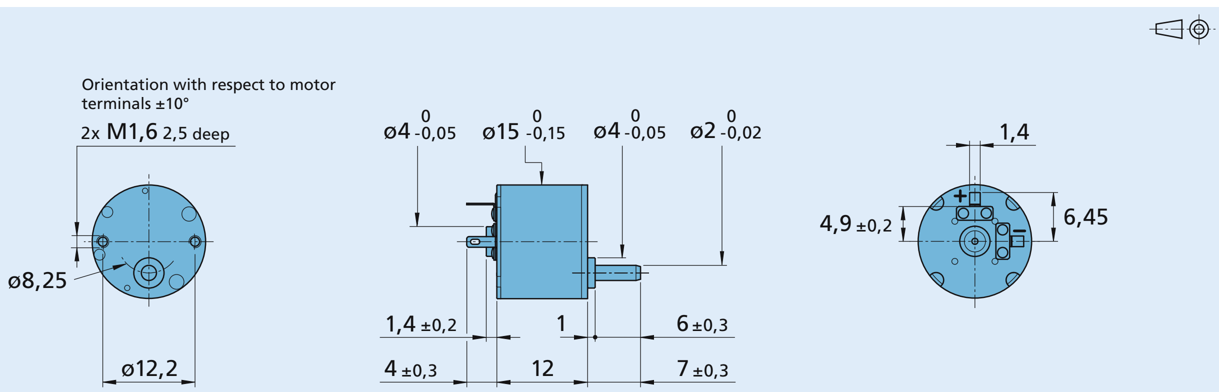
	1512 U		003 SR	006 SR	012 SR	
Nominal voltage	U_N		3	6	12	Volt
Terminal resistance	R		13,6	60,5	156	Ω
Output power	$P_{2\ max.}$		0,15	0,15	0,22	W
No-load speed (motor)	n_o		11 100	11 980	12 800	rpm
Speed constant	k_n		3 884	2 053	1 107	rpm/V
Back-EMF constant	k_E		0,257	0,487	0,903	mV/rpm
Torque constant	k_M		2,46	4,65	8,63	mNm/A
Current constant	k_I		0,407	0,215	0,116	A/mNm
Slope of n-M curve	Δn/ΔM		21 330	24 135	19 947	rpm/mNm
Rotor inductance	L		275	1 157	3 550	µH
Rotor inertia	J		0,08	0,08	0,08	gcm^2

Housing material		plastic	
Geartrain material		metal	
Backlash, at no-load	≤	4	°
Bearings on output shaft		plastic / brass bearing	
Shaft load max.:			
– radial (5 mm from mounting face)	≤	1,4	N
– axial	≤	1	N
Shaft press fit force, max.	≤	15	N
Shaft play:			
– radial (5 mm from mounting face)	≤	0,08	mm
– axial	≤	0,25	mm
Operating temperature range		– 25 ... + 80	°C

Specifications

reduction ratio (rounded)	output speed up to n_{max} rpm	weight with motor g	output torque continuous operation M_{max} mNm	output torque intermittent operation M_{max} mNm	direction of rotation (reversible)	efficiency %
6 : 1	779	6,9	1,4	3	=	81
13 : 1	372	7,0	2,8	5	≠	73
39 : 1	129	7,2	7,0	10	=	60
112 : 1	45	7,4	19,8	30	≠	59
324 : 1	15	7,7	30,0	50	=	53

Note: output speed at 5000 rpm input speed. Based on motor 1506 ... SR.



1512 U ... SR

Notes

FAULHABER

DC-Gearmotors

Precious Metal Commutation with integrated Encoder

30 mNm

For combination with
Drive Electronics:
Speed Controller

Series 1512 ... SR ... IE2-8

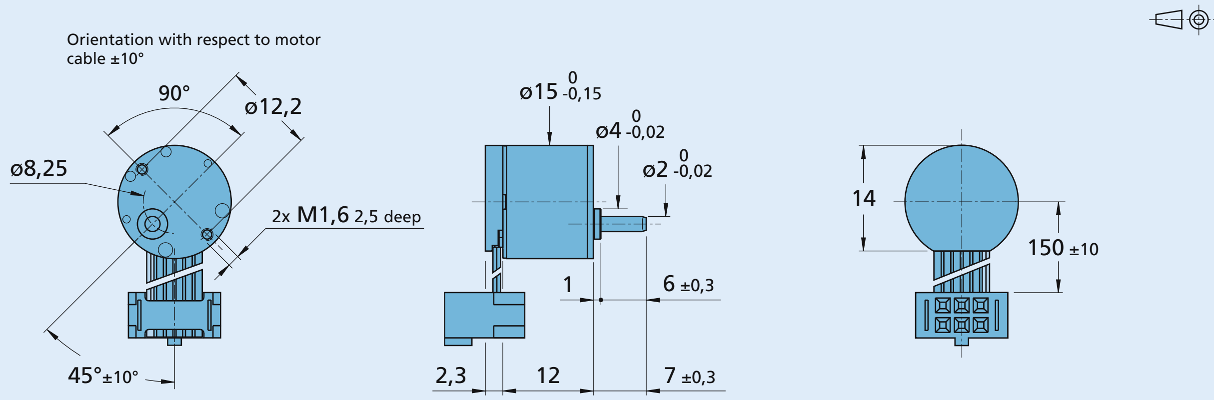
	1512 U		003 SR	006 SR	012 SR	IE2-8
Nominal voltage	U_N		3	6	12	Volt
Terminal resistance	R		10,4	50,5	130	Ω
Output power	$P_{2\ max.}$		0,19	0,17	0,26	W
No-load speed (motor)	n_o		13 400	14 300	15 500	rpm
Speed constant	k_n		4 640	2 480	1 340	rpm/V
Back-EMF constant	k_E		0,216	0,403	0,749	mV/rpm
Torque constant	k_M		2,06	3,84	7,15	mNm/A
Current constant	k_I		0,486	0,260	0,140	A/mNm
Slope of n-M curve	$\Delta n/\Delta M$		24 700	31 400	24 200	rpm/mNm
Rotor inductance	L		175	720	2 100	µH
Rotor inertia	J		0,09	0,09	0,09	gcm^2

Housing material		plastic	
Geartrain material		metal	
Backlash, at no-load	≤	4	°
Bearings on output shaft		plastic / brass bearing	
Shaft load max.:			
– radial (5 mm from mounting face)	≤	1,4	N
– axial	≤	1	N
Shaft press fit force, max.	≤	15	N
Shaft play:			
– radial (5 mm from mounting face)	≤	0,08	mm
– axial	≤	0,25	mm
Operating temperature range		0 ... + 70	°C

Specifications

reduction ratio (rounded)	output speed up to n_{max} rpm	weight with motor g	output torque continuous operation M_{max} mNm	output torque intermittent operation M_{max} mNm	direction of rotation (reversible)	efficiency %
6 : 1	779	6,9	1,4	3	=	81
13 : 1	372	7,0	2,8	5	≠	73
39 : 1	129	7,2	7,0	10	=	60
112 : 1	45	7,4	19,8	30	≠	59
324 : 1	15	7,7	30,0	50	=	53

Note: output speed at 5000 rpm input speed. Based on motor 1506 ... SR.



1512 U ... SR ... IE2-8

Integrated optical Encoder		IE2-8	
Lines per revolution	N	8	
Signal output, square wave		2	channels
Supply voltage	U_{DD}	3,2 ... 5,5	V DC
Current consumption, typical (U_{DD} = 5 V DC)	I_{DD}	typ. 8, max. 15	mA
Output current, max. allowable (at U_{out} < 1,5V)	I_{OUT}	5	mA
Pulse width [1]	P	180 ± 45	°e
Phase shift, channal A to B [1]	Φ	90 ± 45	°e
Signal rise/fall time, max. (C_{LOAD} = 50 pF)	tr/tf	2,5/0,3	µs
Frequency range [2], up to	f	4,5	kHz

[1] Ambient temperature 22°C (tested at 1kHz)
[2] Velocity (rpm) = f (Hz) x 60/N

Features

In this version, the DC-Micromotors have an optical encoder with two output channels. A code wheel on the shaft is optically captured and further processed. At the encoder outputs, two 90° phase-shifted rectangular signals are available with 8 impulses per motor revolution.

The encoder is suitable for the monitoring and regulation of the speed and direction of rotation and for positioning the drive shaft.

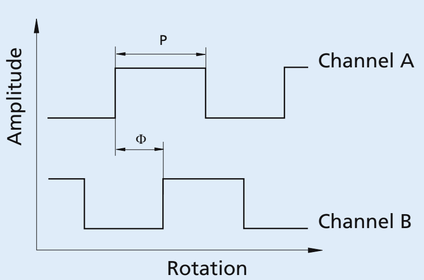
The supply voltage for the encoder and the DC-Micromotor as well as the two channel output signals are interfaced through a ribbon cable with connector.

Full product description

- Examples:
  1512U003SR 6:1 IE2-8
  1512U012SR 324:1 IE2-8

Output signals / Circuit diagram / Connector information

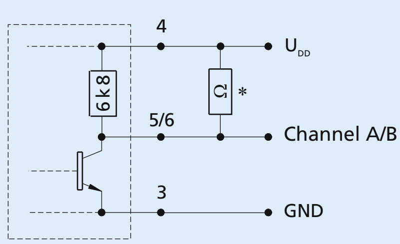
Output signals



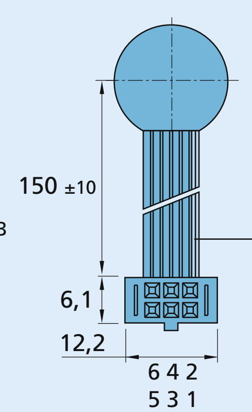
Admissible deviation of phase shift:

$$\Delta\Phi = \left| 90° - \frac{\Phi}{P} * 180° \right| \leq 45°$$

Output circuit



* An additional external pull-up resistor can be added to improve the rise time. Caution: I_{OUT} max. 5 mA must not be exceeded!



Pin Function

1 Motor –
2 Motor +
3 GND
4 U_{DD}
5 channel B
6 channel A

PVC ribbon cable
6-conductors – 0,09 mm²

Connector
DIN-41651
grid 2,54 mm

Flat DC-Micromotors

3,4 mNm

Precious Metal Commutation

Series 2607 ... SR

	Values at 22°C and nominal voltage	2607 T			006 SR	012 SR	024 SR	
1	Nominal voltage	U_N			6	12	24	V
2	Terminal resistance	R			8,2	36,5	128	Ω
3	Output power	$P_{2nom.}$			1,08	0,97	1,1	W
4	Efficiency, max.	$\eta_{max.}$			81	80	81	%
5	No-load speed	n_0			6 600	5 900	6 200	rpm
6	No-load current, typ. (with shaft ø 1,5 mm)	I_0			0,007	0,004	0,002	A
7	Stall torque	M_H			6,26	6,21	6,77	mNm
8	Friction torque	M_R			0,06	0,07	0,07	mNm
9	Speed constant	k_n			1 111	500	261	rpm/V
10	Back-EMF constant	k_E			0,9	2	3,83	mV/rpm
11	Torque constant	k_M			8,59	19,09	36,54	mNm/A
12	Current constant	k_I			0,116	0,052	0,027	A/mNm
13	Slope of n-M curve	$\Delta n/\Delta M$			1 055	957	917	rpm/mNm
14	Rotor inductance	L			465	2 200	8 400	µH
15	Mechanical time constant	τ_m			7,5	6,8	6,5	ms
16	Rotor inertia	J			0,68	0,68	0,68	gcm^2
17	Angular acceleration	$\alpha_{max.}$			92	92	100	$\cdot 10^3 rad/s^2$
18	Thermal resistance	R_{th1} / R_{th2}	2,7 / 24,45					K/W
19	Thermal time constant	τ_{w1} / τ_{w2}	1,8 / 163					s
20	Operating temperature range:							
	– motor		-25 ... +80					°C
	– winding, max. permissible		+100					°C
21	Shaft bearings		sintered bearings	ball bearings, preloaded				
22	Shaft load max.:		(standard)	(optional version)				
	– with shaft diameter		1,5	1,5				mm
	– radial at 3 000 rpm (3 mm from bearing)		1,2	5				N
	– axial at 3 000 rpm		0,2	0,5				N
	– axial at standstill		20	10				N
23	Shaft play							
	– radial	≤	0,03	0,015				mm
	– axial	≤	0,2	0				mm
24	Housing material		plastic					
25	Mass		16,1					g
26	Direction of rotation		clockwise, viewed from the front face					
27	Speed up to	$n_{max.}$	8 000					rpm
28	Number of pole pairs		2					
29	Magnet material		NdFeB					
	Rated values for continuous operation							
30	Rated torque	M_N			3,2	3,1	3,4	mNm
31	Rated current (thermal limit)	I_N			0,4	0,17	0,1	A
32	Rated speed	n_N			2 500	2 500	2 500	rpm

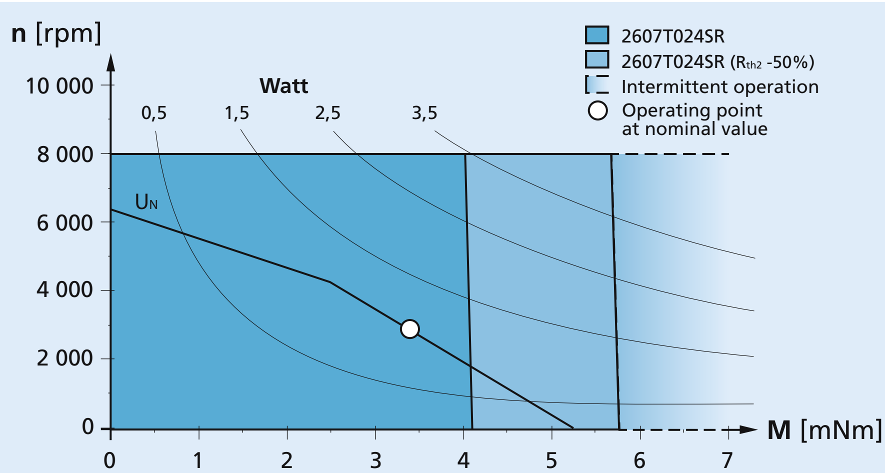
Note: Brush plate is loose and is only held in place by magnetic force.
Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The R_{th2} value has been reduced by 0%.

Note:

The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

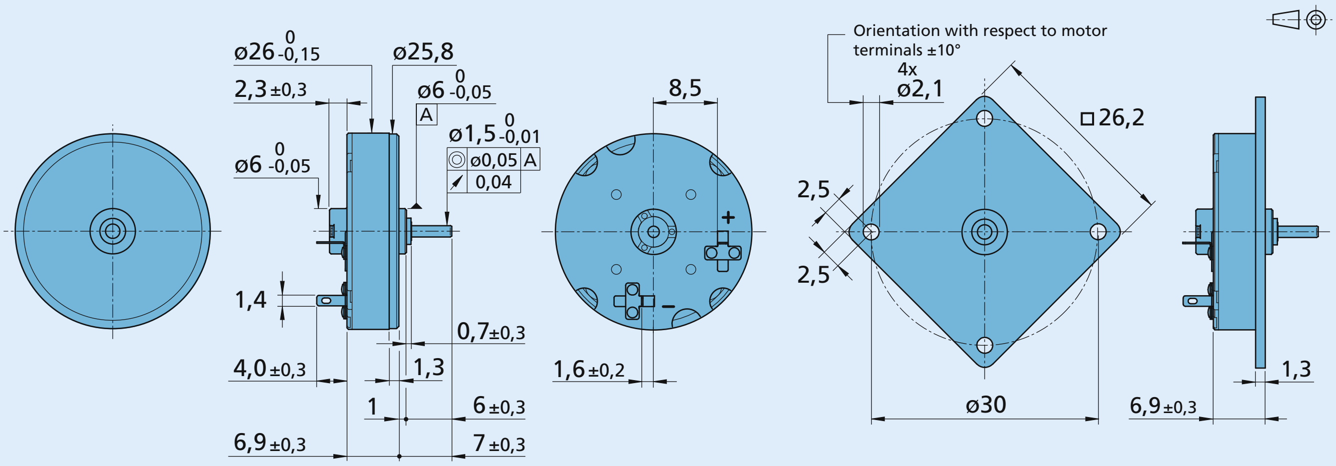
The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 50% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended operation areas (example: nominal voltage 24V)

Dimensional drawing



2607 T ... SR

2607 T ... SR 3697

Flat DC-Micromotors

2,9 mNm

Precious Metal Commutation with integrated Encoder

Series 2607 ... SR IE2-16

Values at 22°C and nominal voltage		2607 T	006 SR	012 SR	024 SR	IE2-16
1 Nominal voltage	U_N		6	12	24	V
2 Terminal resistance	R		8	31,2	118,6	Ω
3 Output power	$P_{2nom.}$		1,11	1,14	1,22	W
4 Efficiency, max.	$\eta_{max.}$		80	80	80	%
5 No-load speed	n_0		6 700	6 900	7 200	rpm
6 No-load current, typ. (with shaft ø 1,5 mm)	I_0		0,01	0,005	0,0025	A
7 Stall torque	M_H		6,33	6,31	6,48	mNm
8 Friction torque	M_R		0,08	0,08	0,08	mNm
9 Speed constant	k_n		1 130	582	304	rpm/V
10 Back-EMF constant	k_E		0,884	1,72	3,29	mV/rpm
11 Torque constant	k_M		8,44	16,4	31,4	mNm/A
12 Current constant	k_I		0,118	0,061	0,032	A/mNm
13 Slope of n-M curve	$\Delta n/\Delta M$		1 060	1 090	1 110	rpm/mNm
14 Rotor inductance	L		420	1 600	5 800	µH
15 Mechanical time constant	τ_m		7,5	7,8	7,9	ms
16 Rotor inertia	J		0,68	0,68	0,68	gcm²
17 Angular acceleration	$\alpha_{max.}$		94	93	95	$\cdot 10^3 rad/s^2$
18 Thermal resistance	R_{th1} / R_{th2}	10 / 32				K/W
19 Thermal time constant	τ_{w1} / τ_{w2}	6 / 250				s
20 Operating temperature range:						
– motor		+0 ... +70				°C
– winding, max. permissible		+70				°C
21 Shaft bearings		sintered bearings	ball bearings, preloaded			
22 Shaft load max.:		(standard)	(optional version)			
– with shaft diameter		1,5	1,5			mm
– radial at 3 000 rpm (3 mm from bearing)		1,2	5			N
– axial at 3 000 rpm		0,2	0,5			N
– axial at standstill		20	10			N
23 Shaft play						
– radial	≤	0,03	0,015			mm
– axial	≤	0,2	0			mm
24 Housing material		plastic				
25 Mass		18,6				g
26 Direction of rotation		clockwise, viewed from the front face				
27 Speed up to	$n_{max.}$	8 000				rpm
28 Number of pole pairs		2				
29 Magnet material		NdFeB				

Rated values for continuous operation						
30 Rated torque	M_N		3	2,9	2,9	mNm
31 Rated current (thermal limit)	I_N		0,39	0,2	0,1	A
32 Rated speed	n_N		2 620	2 760	3 010	rpm

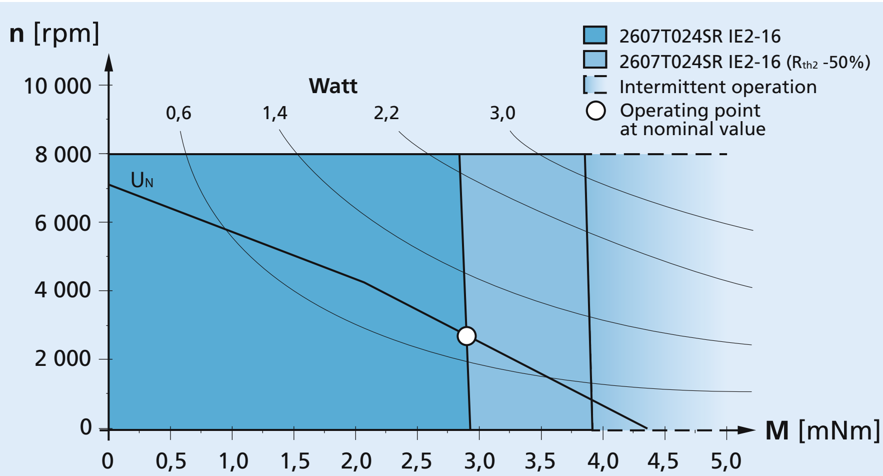
Note: Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The R_{th2} value has been reduced by 0%.

Note:

The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

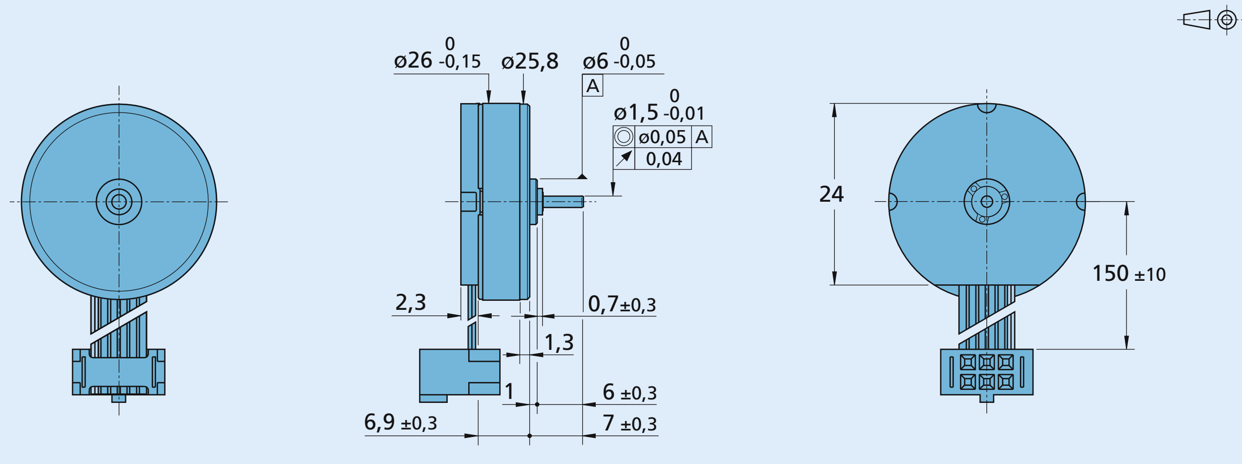
The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 50% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended operation areas (example: nominal voltage 24V)

Dimensional drawing



2607 T ... SR IE2-16

Integrated optical Encoder

Lines per revolution	N	16	
Signal output, square wave		2	Channel
Supply voltage	U_{DD}	3,2 ... 5,5	V DC
Current consumption, typical (U_{DD} = 5 V DC)	I_{DD}	typ. 8, max. 15	mA
Output current, max. allowable (at U_{out} < 1,5V)	I_{OUT}	5	mA
Pulse width [1]	P	180 ± 45	°e
Phase shift, channal A to B [1]	Φ	90 ± 45	°e
Signal rise/fall time, max. (C_{LOAD} = 50 pF)	tr/tf	2,5 / 0,3	µs
Frequency range [2], up to	f	4,5	kHz

[1] Ambient temperature 22°C (tested at 1kHz)
[2] Velocity (rpm) = f (Hz) x 60/N

Features

In this version, the DC-Micromotors have an optical encoder with two output channels. A code wheel on the shaft is optically captured and further processed. At the encoder outputs, two 90° phase-shifted rectangular signals are available with 8 impulses per motor revolution.

The encoder is suitable for the monitoring and regulation of the speed and direction of rotation and for positioning the drive shaft.

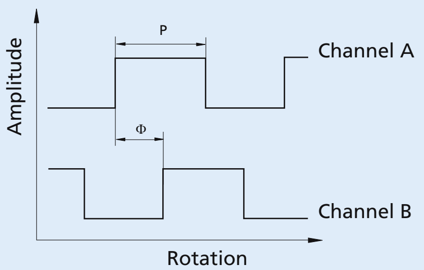
The supply voltage for the encoder and the DC-Micromotor as well as the two channel output signals are interfaced through a ribbon cable with connector.

Full product description
Examples:

2607T006SR IE2-16
2607T024SR IE2-16

Output signals / Circuit diagram / Connector information

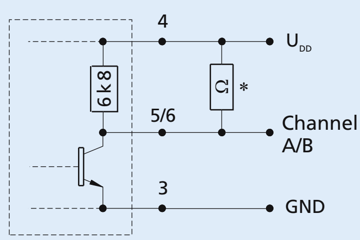
Output signals
with clockwise rotation as seen from the shaft end



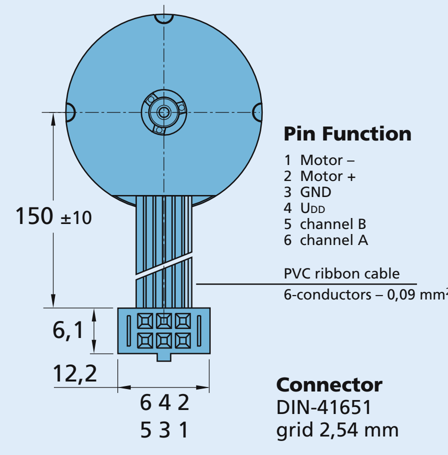
Admissible deviation of phase shift:

$$\Delta\Phi = \left| 90° - \frac{\Phi}{P} * 180° \right| \leq 45°$$

Output circuit



* An additional external pull-up resistor can be added to improve the rise time. Caution: I_{OUT} max. 5 mA must not be exceeded!



Pin Function
1 Motor –
2 Motor +
3 GND
4 U_{DD}
5 channel B
6 channel A

Connector
DIN-41651
grid 2,54 mm

DC-Gearmotors
100 mNm
Precious Metal Commutation

Series 2619 ... SR

	2619 S	006 SR	012 SR	024 SR	
Nominal voltage	U_N	6	12	24	Volt
Terminal resistance	R	8,2	36,5	128	Ω
Output power	$P_{2\ max.}$	1,08	0,97	1,1	W
No-load speed (motor)	n_o	6 600	5 900	6 200	rpm
Speed constant	k_n	1 111	500	261	rpm/V
Back-EMF constant	k_E	0,9	2	3,83	mV/rpm
Torque constant	k_M	8,59	19,09	36,54	mNm/A
Current constant	k_I	0,116	0,052	0,027	A/mNm
Slope of n-M curve	$\Delta n/\Delta M$	1 055	957	917	rpm/mNm
Rotor inductance	L	465	2 200	8 400	µH
Rotor inertia	J	0,68	0,68	0,68	gcm^2

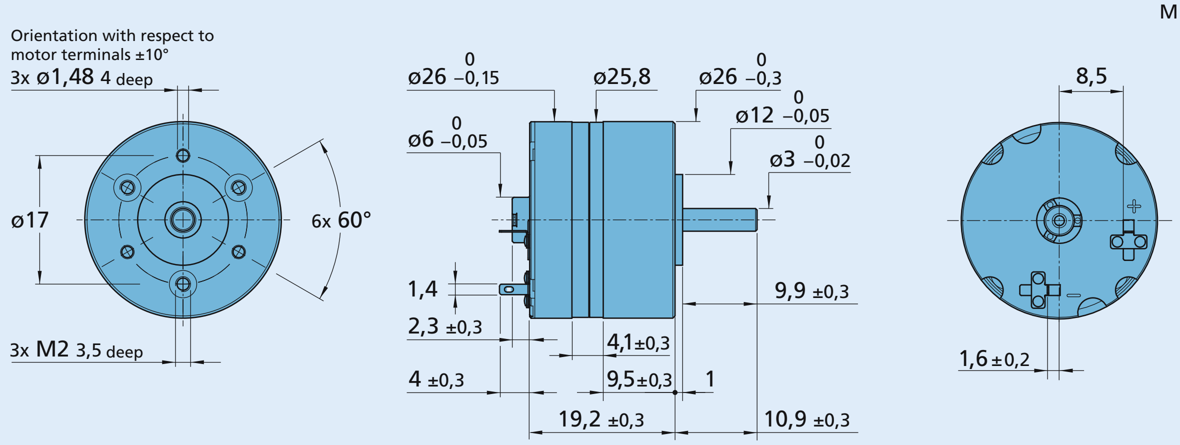
Housing material		plastic		
Geartrain material		metal		
Backlash, at no-load	≤	4		°
Bearings on output shaft		brass / ceramic bearings	ball bearings, preloaded	
Shaft load max.:		(standard)	(optional)	
– radial (5 mm from mounting face)	≤	3,5	10,5	N
– axial	≤	2	5	N
Shaft press fit force, max.	≤	10	10	N
Shaft play:				
– radial (5 mm from mounting face)	≤	0,07	0,03	mm
– axial	≤	0,25	0	mm
Operating temperature range		– 25 ... + 80		°C

Specifications

reduction ratio (rounded)	output speed up to n_{max} rpm	weight with motor g	output torque continuous operation M_{max} mNm	output torque intermittent operation M_{max} mNm	direction of rotation (reversible)	efficiency %
8 : 1	635	25	9	30	=	81
22 : 1	223	26	23	75	≠	73
33 : 1	151	26	30	100	=	66
112 : 1	44	27	93	180	≠	59
207 : 1	24	27	100	180	=	53
361 : 1	14	27	100	180	=	53
814 : 1	6	28	100	180	=	43
1 257 : 1	4	29	100	180	=	43

Note: output speed at 5000 rpm input speed. Based on motor 2607 ... SR.

M 1:1



2619 S

Notes

DC-Gearmotors

Precious Metal Commutation with integrated Encoder

100 mNm

For combination with
Drive Electronics:
Speed Controller

Series 2619 ... SR ... IE2-16

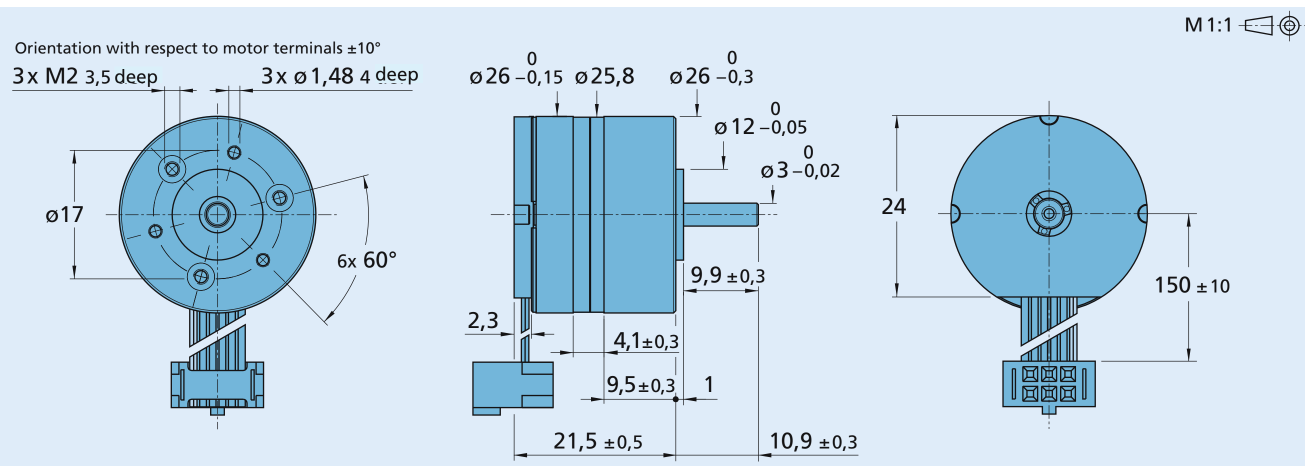
	2619 S	006 SR	012 SR	024 SR	IE2-16
Nominal voltage	U_N	6	12	24	Volt
Terminal resistance	R	8	31,2	118,6	Ω
Output power	$P_{2\,max.}$	1,11	1,14	1,22	W
No-load speed (motor)	n_o	6 700	6 900	7 200	rpm
Speed constant	k_n	1 130	582	304	rpm/V
Back-EMF constant	k_E	0,884	1,72	3,29	mV/rpm
Torque constant	k_M	8,44	16,4	31,4	mNm/A
Current constant	k_I	0,118	0,061	0,032	A/mNm
Slope of n-M curve	$\Delta n/\Delta M$	1 060	1 090	1 110	rpm/mNm
Rotor inductance	L	420	1 600	5 800	µH
Rotor inertia	J	0,68	0,68	0,68	gcm^2

Housing material		plastic		
Geartrain material		metal		
Backlash, at no-load	≤	4		°
Bearings on output shaft		brass / ceramic bearings (standard)	ball bearings, preloaded (optional)	
Shaft load max.:				
– radial (5 mm from mounting face)	≤	3,5	10,5	N
– axial	≤	2	5	N
Shaft press fit force, max.	≤	10	10	N
Shaft play:				
– radial (5 mm from mounting face)	≤	0,07	0,03	mm
– axial	≤	0,25	0	mm
Operating temperature range		0 ... + 70		°C

Specifications

reduction ratio (rounded)	output speed up to n_{max} rpm	weight with motor g	output torque continuous operation M_{max} mNm	output torque intermittent operation M_{max} mNm	direction of rotation (reversible)	efficiency %
8 : 1	635	25	9	30	=	81
22 : 1	223	26	23	75	≠	73
33 : 1	151	26	30	100	=	66
112 : 1	44	27	93	180	≠	59
207 : 1	24	27	100	180	=	53
361 : 1	14	27	100	180	=	53
814 : 1	6	28	100	180	=	43
1 257 : 1	4	29	100	180	=	43

Note: output speed at 5000 rpm input speed. Based on motor 2607 ... SR.



2619S ... SR ... IE2-16

Integrated optical Encoder		IE2-16	
Lines per revolution	N	16	
Signal output, square wave		2	channels
Supply voltage	U_{DD}	3,2 ... 5,5	V DC
Current consumption, typical (U_{DD} = 5 V DC)	I_{DD}	typ. 8, max. 15	mA
Output current, max. allowable (at U_{out} < 1,5V)	I_{OUT}	5	mA
Pulse width [1]	P	180 ± 45	°e
Phase shift, channal A to B [1]	Φ	90 ± 45	°e
Signal rise/fall time, max. (C_{LOAD} = 50 pF)	tr/tf	2,5/0,3	µs
Frequency range [2], up to	f	4,5	kHz

[1] Ambient temperature 22°C (tested at 1kHz)
[2] Velocity (rpm) = f (Hz) x 60/N

Features

In this version, the DC-Micromotors have an optical encoder with two output channels. A code wheel on the shaft is optically captured and further processed. At the encoder outputs, two 90° phase-shifted rectangular signals are available with 16 impulses per motor revolution.

The encoder is suitable for the monitoring and regulation of the speed and direction of rotation and for positioning the drive shaft.

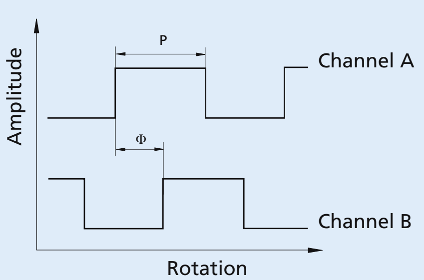
The supply voltage for the encoder and the DC-Micromotor as well as the two channel output signals are interfaced through a ribbon cable with connector.

Full product description

- Examples:
  2619S006SR 8:1 IE2-16
  2619S024SR 1257:1 IE2-16

Output signals / Circuit diagram / Connector information

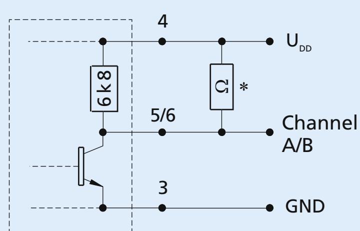
Output signals



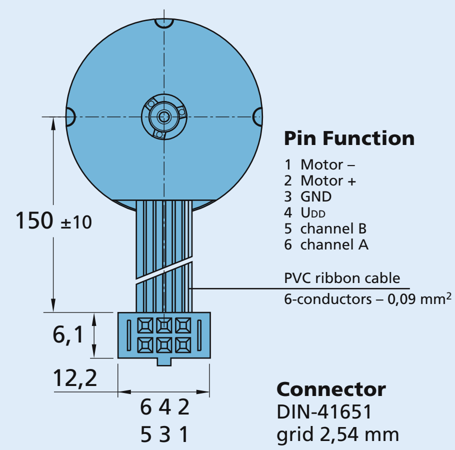
Admissible deviation of phase shift:

$$\Delta\Phi = \left| 90° - \frac{\Phi}{P} * 180° \right| \leq 45°$$

Output circuit



* An additional external pull-up resistor can be added to improve the rise time.
Caution: I_{OUT} max. 5 mA must not be exceeded!



Pin Function

1 Motor –
2 Motor +
3 GND
4 U_{DD}
5 channel B
6 channel A

Connector
DIN-41651
grid 2,54 mm

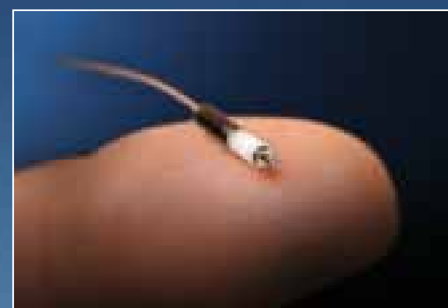
Brushless DC-Motors

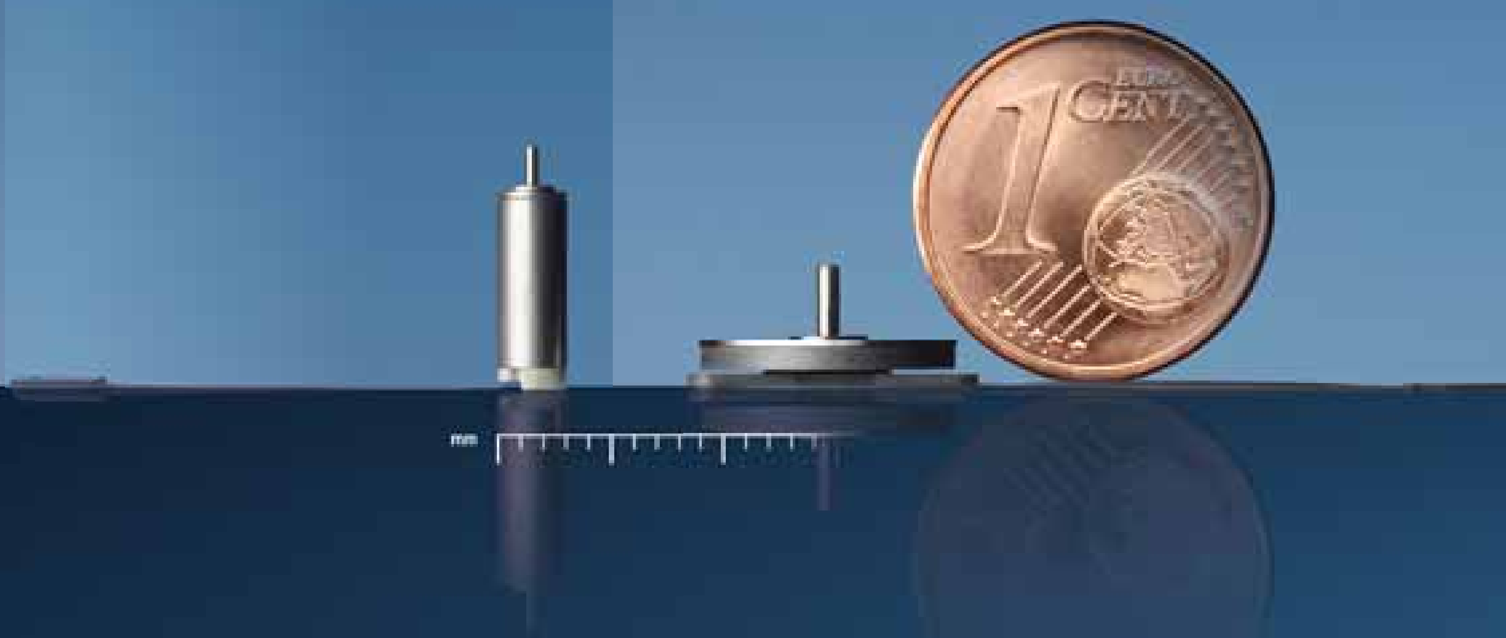
WE CREATE MOTION

Micro Drive Systems

The outer diameter of the world's smallest brushless planetary gearmotor measures just 1.9 mm.

FAULHABER offers the most extensive portfolio of truly "micro" drive technology products in the industry today. Whether micro in diameter or ultra flat FAULHABER provides micro drive systems for innovative applications in the field of microtechnology ranging from highly reliable medical devices to precision optical assemblies.

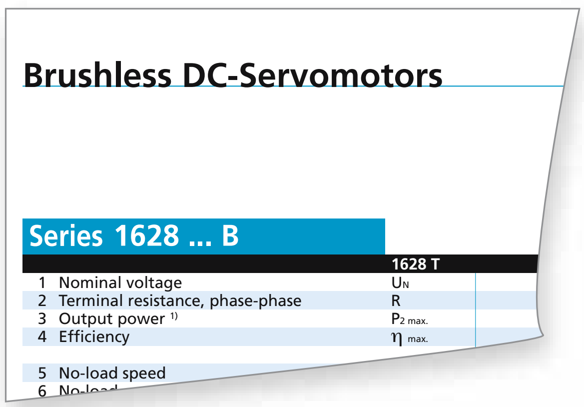




WE CREATE MOTION

Brushless DC-Servomotors

Technical Information



Notes on technical data

The perfomance lifetime of Brushless DC-Servomotors is mainly influenced by the ball bearings service life and the electronic components used. On average, the lifetime may exceed 10 000 hours if the motors are operated within the recommended values indicated on the data sheet.

All values at 22 °C.
All values at nominal voltage, motor only, without load.

Nominal voltage U_N [Volt]
The direct voltage applied on the motor phases correspond to a bipolar supply with a 120° square-wave commutation logic. Definition of motor parameters η, n_o and I_o are directly related to it. A higher or lower voltage may be applied according to the application requirement.

Terminal resistance, phase to phase R [Ω] ±12 %
The resistance measured between two motor phases. The value is directly affected by the coil temperature (temperature coefficient: $\alpha_{22} = 0{,}004\ K^{-1}$).

Output power $P_{2\,max.}$ [W]
The maximum obtainable mechanical power achieved by the motor at continuous operation and at the thermal limit. This power can only be obtained at high speeds.

$$P_{2\,max.} = \frac{\pi}{30\,000} \cdot n \cdot (k_m \cdot I_{e\,max.} - C_o - C_v \cdot n)$$

Efficiency $\eta_{max.}$ [%]
The max. ratio between the absorbed electrical power and the obtained mechanical power of the motor. It does not always correspond to the optimum working point of the motor.

No-load speed n_o [rpm] ±12 %
The maximum speed the motor attains under no-load conditions at the nominal voltage. This value varies according to the voltage applied to the motor.

$$n_o = (U_n - I_o \cdot R) \cdot \frac{1\,000}{k_E}$$

No-load current I_o [A] ± 50 %
The current consumption of the motor at nominal voltage and under no-load conditions. This value varies proportionally to speed and is influenced by temperature.

$$I_o = \frac{C_o + C_v \cdot n_o}{k_M}$$

Stall torque M_H [mNm]
The torque developed by the motor at zero speed and nominal voltage.

$$M_H = k_M \cdot \frac{U_N}{R} - C_o$$

Friction torque C_o [mNm]
The sum of torque losses not depending from speed. This torque is caused by static mechanical friction of the ball bearings and magnetic hysteresis of the stator.

Viscous damping factor C_v [$\cdot 10^{-5}$ mNm/rpm]
The multiplier factor defining the torque losses proportional to speed. This torque is due to the viscous friction of the ball bearings as well as to the Foucault currents in the stator, originated by the rotating magnetic field of the magnet.

Speed constant k_n [rpm/V]
The speed variation per Volt applied to the motor phases at constant load.

$$k_n = \frac{n_o}{U_N - I_o \cdot R} = \frac{1\,000}{k_E}$$

Back-EMF constant k_E [mV/rpm]
The constant corresponding to the relationship between the induced voltage in the motor phases and the rotation speed.

$$k_E = \frac{2\pi \cdot k_M}{60}$$

Torque constant k_M [mNm/A]
The constant corresponding to the relationship between the torque developed and the current drawn.

Current constant k_I [A/mNm]
The constant corresponding to the relationship between the current drawn and torque developed.

$$k_I = \frac{1}{k_M}$$

Slope of n-M curve $\Delta n/\Delta M$ [rpm/mNm]
The ratio of the speed to torque variations. The smaller this value, the more powerful the motor.

$$\frac{n}{M} = \frac{30\,000}{\pi} \cdot \frac{R}{k_M^2}$$

Terminal inductance, phase to phase L [µH]
The inductance measured between two phases at 1 kHz.

Mechanical time constant τ_m [ms]
The time required by the motor to reach a speed of 63% of its final no-load speed, from standstill.

$$\tau_m = \frac{100 \cdot R \cdot J}{k_M^2}$$

Rotor intertia J [gcm²]
Rotor's mass. dynamic inertia moment.

Angular acceleration $\alpha_{max.}$ [$\cdot 10^3$ rad/s²]
No-load rotor acceleration, from standstill and at nominal voltage.

$$\alpha_{max.} = \frac{(U_N/R) \cdot k_M - C_o}{J} \cdot 10$$

Thermal resistance $R_{th\,1}$ / $R_{th\,2}$ [K/W]
$R_{th\,1}$ corresponds to the value between the coil and housing. $R_{th\,2}$ corresponds to the value between the housing and the ambient air.

$R_{th\,2}$ can be reduced by enabling exchange of heat between the motor and the ambient air (for example using a heat sink or forced air cooling).
All parameters calculated at thermal limit are given with a $R_{th\,2}$ value reduced by 55%.

Thermal time constant τ_{w1} / τ_{w2} [s]
The thermal time constant specifies the time needed for the rotor and housing to reach a temperature equal to 63% of final value.

Operating temperature range [°C]
The min. and max. permissible operating temperature of the motor.

Shaft bearings
The standard bearings used for the Brushless DC-Servomotor.

Shaft load max. [N]
The max. load values allow a motor lifetime of 20 000 hours. This is in accordance with the values given by the bearing manufacturer. The radial load is defined for a force applied at the center of the standard shaft length. This value is speed dependent.

Shaft play [mm]
The shaft play on the bearings, measured at the bearing exit.

Housing material
The housing material and the surface protection.

Weight [g]
The average weight of the basic motor type.

Direction of rotation
The direction of rotation is given by the external servo amplifier. All motors are designed for clockwise (CW) and counter-clockwise (CCW) operation; the direction of rotation is reversible.

Recommended values

The maximum recommended values for continuous operation to obtain optimum life performance are listed below.

These values are independent each other.

The recommended torque ($M_{e\,max.}$) and current ($I_{e\,max.}$) are given with the $R_{th\,2}$ value reduced by 55%.

Speed $n_{e\,max.}$ [rpm]
The max. operation speed limited by Foucault currents is generated by the rotation of the magnet and the magnetic field in the stator. The values are calculated at 2/3 of the max. permissible motor temperature, rounded off.

$$n_{e\,max.} = \sqrt{\frac{C_o^2}{4 \cdot C_v^2} + \frac{30\,000 \cdot (T_{83} - T_{22})}{\pi \cdot 0{,}45 \cdot R_{th\,2} \cdot C_v}} - \frac{C_o}{2 \cdot C_v}$$

Torque $M_{e\,max.}$ [mNm]
The calculated torque for a motor at the thermal limit.

$$M_{e\,max.} = k_M \cdot I_{e\,max.} - C_o - C_v \cdot n$$

Current $I_{e\,max.}$ [A]
The calculated current for a motor at the thermal limit.

$$I_{e\,max.} = \sqrt{\frac{T_{125} - T_{22} - \frac{\pi}{30\,000} \cdot n \cdot 0{,}45 \cdot R_{th\,2} \cdot (C_o + C_v \cdot n)}{R \cdot (1 + \alpha_{22} \cdot (T_{125} - T_{22})) \cdot (R_{th\,1} + 0{,}45 \cdot R_{th\,2})}}$$

Brushless DC-Micromotors

0,023 mNm

sensorless
smoovy® Technology

For combination with
Gearheads:
03A
Linear Actuators:
03A S3
Drive Electronics:
Speed controller

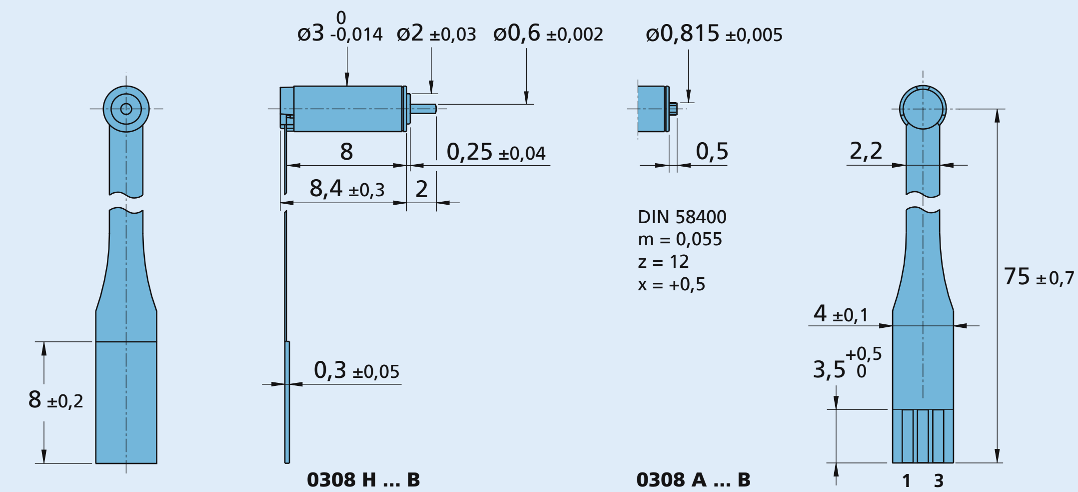
Series 0308 ... B

		0308 H	003 B	
1	Nominal voltage	U_N	3	Volt
2	Terminal resistance, phase-phase	R	33,5	Ω
3	Output power [1]	$P_{2\ max.}$	0,04	W
4	Efficiency	$\eta_{max.}$	16,94	%
5	No-load speed	n_o	60 500	rpm
6	No-load current (with shaft ø 0,6 mm)	I_o	0,029	A
7	Stall torque	M_H	0,024	mNm
8	Friction torque, static	C_o	$1,77 \cdot 10^{-3}$	mNm
9	Friction torque, dynamic	C_v	$1,09 \cdot 10^{-7}$	mNm/rpm
10	Speed constant	k_n	33 043	rpm/V
11	Back-EMF constant	k_E	0,03	mV/rpm
12	Torque constant	k_M	0,289	mNm/A
13	Current constant	k_I	3,46	A/mNm
14	Slope of n-M curve	$\Delta n/\Delta M$	$3,8 \cdot 10^{6}$	rpm/mNm
15	Terminal inductance, phase-phase	L	60	µH
16	Mechanical time constant	τ_m	8	ms
17	Rotor inertia	J	$2 \cdot 10^{-4}$	gcm^2
18	Angular acceleration	$\alpha_{max.}$	1 200	$\cdot 10^3 rad/s^2$
19	Thermal resistance	$R_{th\ 1}$ / $R_{th\ 2}$	29 / 188	K/W
20	Thermal time constant	τ_{w1} / τ_{w2}	0,4 / 8	s
21	Operating temperature range		– 30 ... + 60	°C
22	Shaft bearings		jewel bearings	
23	Shaft load max.:			
	– radial at 3 000 (1 mm from mounting flange)		0,2	N
	– axial at 3 000 rpm (push-on only)		0,2	N
	– axial at standstill (push-on only)		2	N
24	Shaft play:			
	– radial	≤	0,03	mm
	– axial	≤	0,15	mm
25	Housing material		Nickel alloy	
26	Weight		0,31	g
27	Direction of rotation		electronically reversible	

Recommended values - mathematically independent of each other				
28	Speed up to [2]	$n_{e\ max.}$	84 000	rpm
29	Torque up to [1] [2]	$M_{e\ max.}$	0,023	mNm
30	Current up to (thermal limits) [1] [2]	$I_{e\ max.}$	0,1	A

[1] at 15 000 rpm
[2] thermal resistance $R_{th\ 2}$ not reduced

Scale enlarged



Connection

No.	Function
1	Phase A
2	Phase B
3	Phase C

Flex Print connector
3-pole, 1 mm pitch, e.g.:
Molex: 52207-0390

Micro Planetary Gearheads

smoovy® Technology

0,88 mNm

For combination with
Brushless DC-Motors

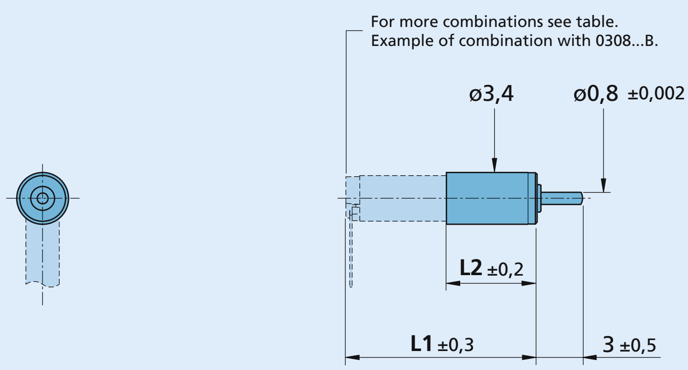
Series 03A

	03A
Housing material	plastic
Geartrain material	steel
Recommended max. input speed for:	
– continuous operation	15 000 rpm
Backlash, at no-load	≤ 4 °
Bearings on output shaft	bronze
Shaft load, max.:	
– radial (2 mm from mounting face)	≤ 0,1 N
– axial	≤ 0,2 N
Shaft press fit force, max.	≤ 1 N
Shaft play	
– radial (2 mm from mounting face)	≤ 0,07 mm
– axial	≤ 0,15 mm
Operating temperature range	- 20 ... + 60 °C

Specifications			
Number of gear stages		**2**	**3**
Continuous torque	mNm	0,28	0,88
Intermittent torque	mNm	0,42	1,32
Mass without motor, ca.	g	0,2	0,18
Efficiency, max.		-	-
Direction of rotation, drive to output		=	=
Reduction ratio (exact)		**25:1**	**125:1**
L2 [mm] = length without motor		6,0	6,0
L1 [mm] = length with motor 0308A...B		12,6	12,6

Note: These gearheads are available only with motors mounted.

Scale enlarged



03A

Linear Actuators

smoovy® Technology

2,8 N

For combination with
Brushless DC-Motors

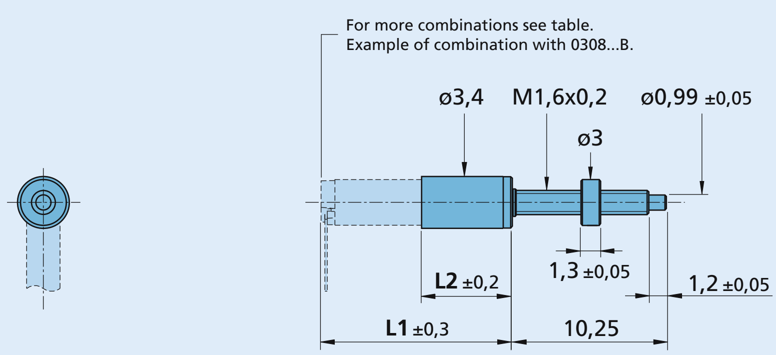
Series 03A S3

	03A S3
Housing material	plastic
Geartrain material	steel
Screw material	steel
Nut material	bronze
Recommended max. input speed for:	
– continuous operation	15 000 rpm
Max. linear travel	7 mm
Bearings on output shaft	bronze
Shaft play (2 mm from mounting face):	
– radial	≤ 0,07 mm
– axial	≤ 0,15 mm
Operating temperature range	- 20 ... + 60 °C

Specifications			
Number of gear stages		**2**	**3**
Push force, continuous	N	0,47	2,8
Push force, intermittent	N	0,7	4,2
Weight without motor, ca.	g	0,36	0,34
Max. speed	mm/min	120	24
Direction of rotation, drive to output		=	=
Reduction ratio (exact)		**25:1**	**125:1**
L2 [mm] = length without motor		6,0	6,0
L1 [mm] = length with motor 0308A...B		12,6	12,6

Note: These gearheads are available only with motors mounted.
Capability of pushing/pulling the nut requires a bearing at the end of the shaft.

Scale enlarged



03A S3

Brushless DC-Micromotors

0,2 mNm

sensorless
smoovy® Technology

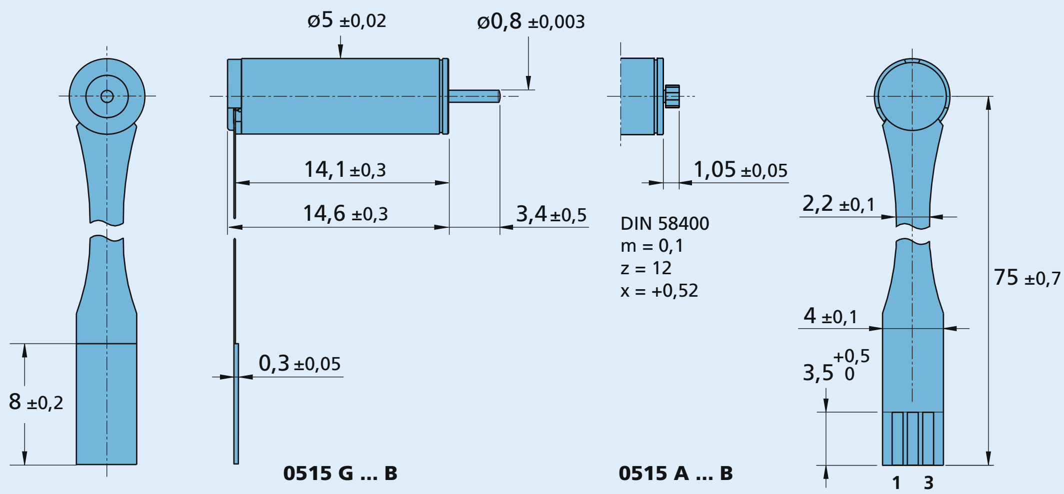
For combination with
Gearheads:
06A
Linear Actuators:
06A S2
Drive Electronics:
Speed Controller

Series 0515 ... B

No.			0515 G 006 B	
1	Nominal voltage	U_N	6	Volt
2	Terminal resistance, phase-phase	R	15,8	Ω
3	Output power [1]	$P_{2\,max.}$	0,43	W
4	Efficiency	$\eta_{max.}$	34,7	%
5	No-load speed	n_o	37 800	rpm
6	No-load current (with shaft ø 0,8 mm)	I_o	0,062	A
7	Stall torque	M_H	0,43	mNm
8	Friction torque, static	C_o	0,030	mNm
9	Friction torque, dynamic	C_v	$1,2 \cdot 10^{-6}$	mNm/rpm
10	Speed constant	k_n	7 847	rpm/V
11	Back-EMF constant	k_E	0,127	mV/rpm
12	Torque constant	k_M	1,217	mNm/A
13	Current constant	k_I	0,822	A/mNm
14	Slope of n-M curve	$\Delta n/\Delta M$	102 000	rpm/mNm
15	Terminal inductance, phase-phase	L	120	µH
16	Mechanical time constant	τ_m	2,2	ms
17	Rotor inertia	J	0,002	gcm^2
18	Angular acceleration	$\alpha_{max.}$	2 000	$\cdot 10^3 rad/s^2$
19	Thermal resistance	$R_{th\,1} / R_{th\,2}$	15 / 110	K/W
20	Thermal time constant	τ_{w1} / τ_{w2}	1,4 / 75	s
21	Operating temperature range		– 30 ... + 80	°C
22	Shaft bearings		sintered bronze sleeves	
23	Shaft load max.:			
	– radial at 3 000 (1 mm from mounting flange)		0,2	N
	– axial at 3 000 rpm (push-on only)		0,2	N
	– axial at standstill (push-on only)		2	N
24	Shaft play:			
	– radial	≤	0,03	mm
	– axial	≤	0,15	mm
25	Housing material		Nickel alloy	
26	Weight		1,5	g
27	Direction of rotation		electronically reversible	
	Recommended values - mathematically independent of each other			
28	Speed up to [2]	$n_{e\,max.}$	15 000	rpm
29	Torque up to [1] [2]	$M_{e\,max.}$	0,2	mNm
30	Current up to (thermal limits) [1] [2]	$I_{e\,max.}$	0,23	A

[1] at 15 000 rpm
[2] thermal resistance $R_{th\,2}$ by 55% reduced

Scale enlarged



Connection

No.	Function
1	Phase A
2	Phase B
3	Phase C

Flex Print connector
3-pole, 1 mm pitch, e.g.:
Molex: 52207-0390

Micro Planetary Gearheads

smoovy® Technology

25 mNm

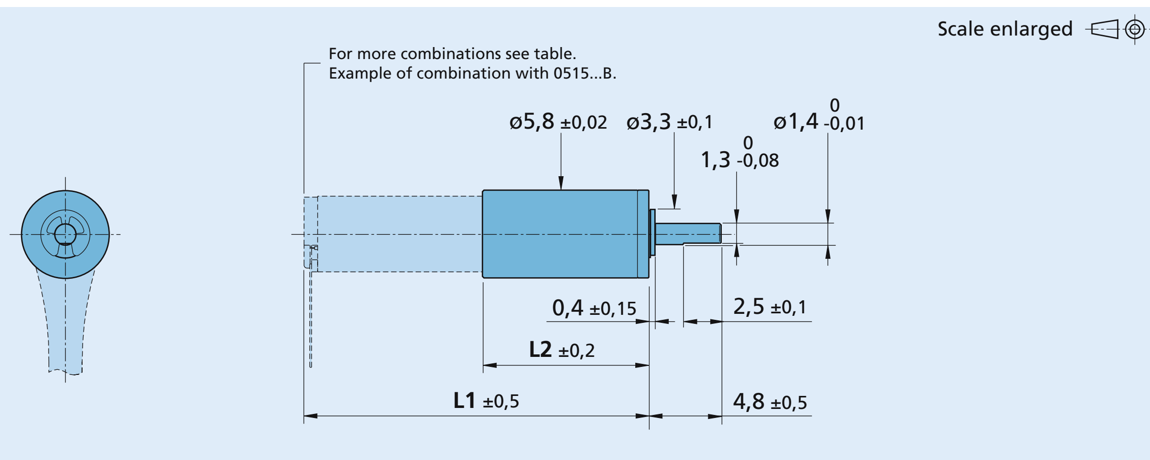
For combination with
Brushless DC-Motors

Series 06A

	06A
Housing material	plastic
Geartrain material	bronze
Recommended max. input speed for:	
– continuous operation	15 000 rpm
Backlash, at no-load	≤ 4 °
Bearings on output shaft	bronze
Shaft load, max.:	
– radial (3 mm from mounting face)	≤ 0,3 N
– axial	≤ 0,5 N
Shaft press fit force, max.	≤ 2 N
Shaft play	
– radial (3 mm from mounting face)	≤ 0,05 mm
– axial	≤ 0,1 mm
Operating temperature range	- 20 ... + 60 °C

Specifications				
Number of gear stages		**2**	**3**	**3**
Continuous torque	mNm	1,2	6	25
Intermittent torque	mNm	1,8	9	37,5
Mass without motor, ca.	g	1,24	1,32	1,4
Efficiency, max.		-	-	-
Direction of rotation, drive to output		=	=	=
Reduction ratio (exact)		**25:1**	**125:1**	**625:1**
L2 [mm] = length without motor		11,0	11,0	12,7
L1 [mm] = length with motor 0515A...B		22,8	22,8	24,5

Note: These gearheads are available only with motors mounted.



06A

Linear Actuators

smoovy® Technology

41 N

For combination with
Brushless DC-Motors

Series 06A S2

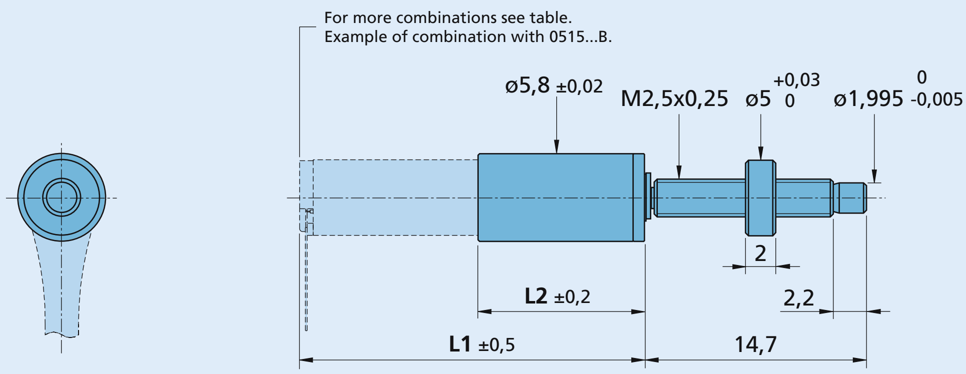
	06A S2
Housing material	plastic
Geartrain material	bronze
Screw material	steel
Nut material	bronze
Recommended max. input speed for:	
– continuous operation	15 000 rpm
Max. linear travel	12 mm
Bearings on output shaft	bronze
Shaft play (3 mm from mounting face):	
– radial	≤ 0,05 mm
– axial	≤ 0,1 mm
Operating temperature range	- 20 ... + 60 °C

Specifications

Number of gear stages		**2**	**3**	**4**
Push force, continuous	N	1,6	15,7	41,2
Push force, intermittent	N	2,4	23,6	61,8
Weight without motor, ca.	g	1,79	1,92	2,05
Max. speed	mm/min	150	30	6
Direction of rotation, drive to output		=	=	=
Reduction ratio (exact)		**25:1**	**125:1**	**625:1**
L2 [mm] = length without motor		11,0	11,0	12,7
L1 [mm] = length with motor 0515A...B		22,8	22,8	24,5

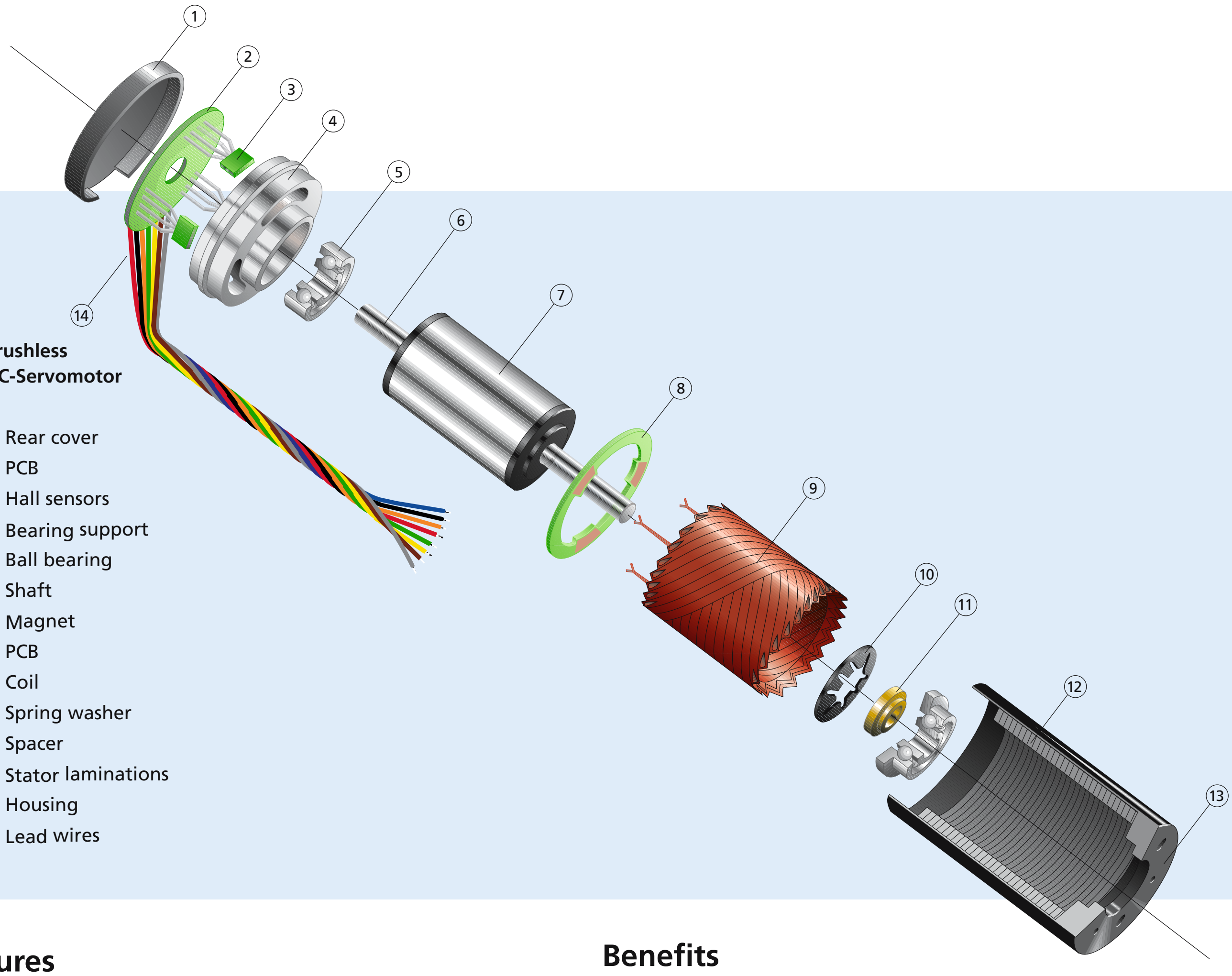
Note: These gearheads are available only with motors mounted.
Capability of pushing/pulling the nut requires a bearing at the end of the shaft.

Scale enlarged



06A S2

Brushless DC-Servomotors



Brushless DC-Servomotor

① Rear cover
② PCB
③ Hall sensors
④ Bearing support
⑤ Ball bearing
⑥ Shaft
⑦ Magnet
⑧ PCB
⑨ Coil
⑩ Spring washer
⑪ Spacer
⑫ Stator laminations
⑬ Housing
⑭ Lead wires

Features

The FAULHABER Brushless DC-Servomotors are built for extreme operating conditions. They are precise, have extreme long lifetimes and are highly reliable. Exceptional qualities such as smooth running and especially low noise level are of particular note. The rare-earth magnet as rotor, and FAULHABER skew winding technology ensure that these motors deliver top performance dynamics within minimum overall dimensions.

This series is also available in an autoclavable version and is ideally suited for application in laboratory and medical equipment.

Sterilizing conditions

- Temperature 134 °C ± 2 °C
- Water vapour pressure 2,1 bar
- Relative humidity 100 %
- Duration of cycle 20 min.
- Rated for a minimum of 100 cycles

Benefits

- System FAULHABER®, ironless stator coil
- High reliability and operational lifetime
- Wide range of linear torque / speed performance
- No sparking
- No cogging
- Dynamically balanced rotor
- Simple design
- Standard with digital hall sensors with optional analog hall sensors

Product Code

2444 S 024 B

24	Motor diameter [mm]
44	Motor length [mm]
S	Shaft type
024	Nominal voltage [V]
B	Type of commutation (brushless)

Brushless DC-Servomotors

0,36 mNm

For combination with
Gearheads:
06/1
Encoder:
PA2-50, HXM3-64
Drive Electronics:
Speed Controller, Motion Controller

Series 0620 ... B

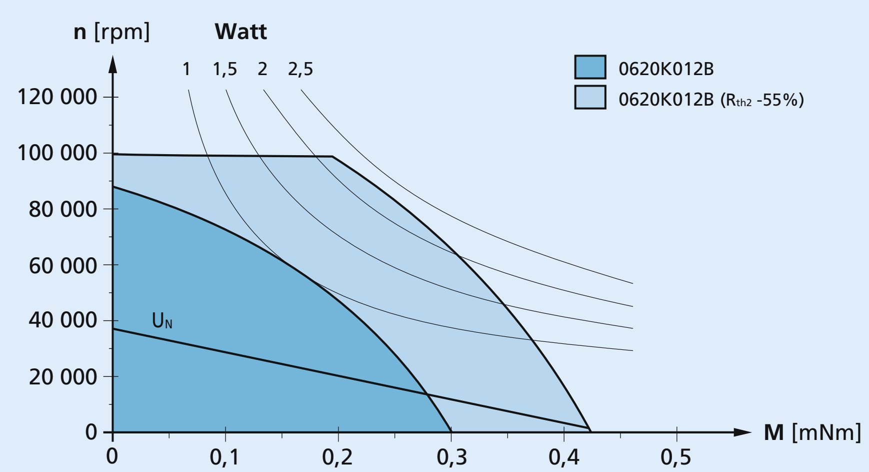
		0620 K		006 B	012 B	
1	Nominal voltage	U_N		6	12	Volt
2	Terminal resistance, phase-phase	R		9,1	59,0	Ω
3	Output power [1]	$P_{2\ max.}$		1,47	1,49	W
4	Efficiency	η max.		52	50	%
5	No-load speed	n_0		46 500	35 600	rpm
6	No-load current (with shaft ø 1,0 mm)	I_0		0,062	0,020	A
7	Stall torque	M_H		0,73	0,57	mNm
8	Friction torque, static	C_0		0,023	0,023	mNm
9	Friction torque, dynamic	C_v		$1,0 \cdot 10^{-6}$	$1,0 \cdot 10^{-6}$	mNm/rpm
10	Speed constant	k_n		8 451	3 282	rpm/V
11	Back-EMF constant	k_E		0,118	0,305	mV/rpm
12	Torque constant	k_M		1,13	2,91	mNm/A
13	Current constant	k_I		0,885	0,344	A/mNm
14	Slope of n-M curve	$\Delta n/\Delta M$		68 054	66 533	rpm/mNm
15	Terminal inductance, phase-phase	L		26	187	µH
16	Mechanical time constant	τ_m		6	6	ms
17	Rotor inertia	J		0,0095	0,0095	gcm^2
18	Angular acceleration	α max.		768	601	$\cdot 10^3 rad/s^2$
19	Thermal resistance	R_{th1} / R_{th2}	14 / 88,0			K/W
20	Thermal time constant	τ_{w1} / τ_{w2}	1 / 149			s
21	Operating temperature range:					
	– motor		– 20 ... +100			°C
	– coil, max. permissible		+125			°C
22	Shaft bearings		ball bearings, preloaded			
23	Shaft load max.:					
	– radial at 10 000/50 000 rpm (3,7 mm from mounting flange)		2,0 / 1,5			N
	– axial at 10 000/50 000 rpm (push-on only)		0,6 / 0,2			N
	– axial at standstill (push-on only)		10			N
24	Shaft play:					
	– radial	≤	0,012			mm
	– axial	=	0			mm
25	Housing material		aluminium, black anodized			
26	Weight		2,5			g
27	Direction of rotation		electronically reversible			
	Recommended values - mathematically independent of each other					
28	Speed up to [2]	$n_{e\ max.}$		100 000	100 000	rpm
29	Torque up to [1] [2]	$M_{e\ max.}$		0,351	0,356	mNm
30	Current up to [1] [2]	$I_{e\ max.}$		0,367	0,144	A

[1] at 40 000 rpm
[2] thermal resistance R_{th2} by 55% reduced

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 55% reduced).

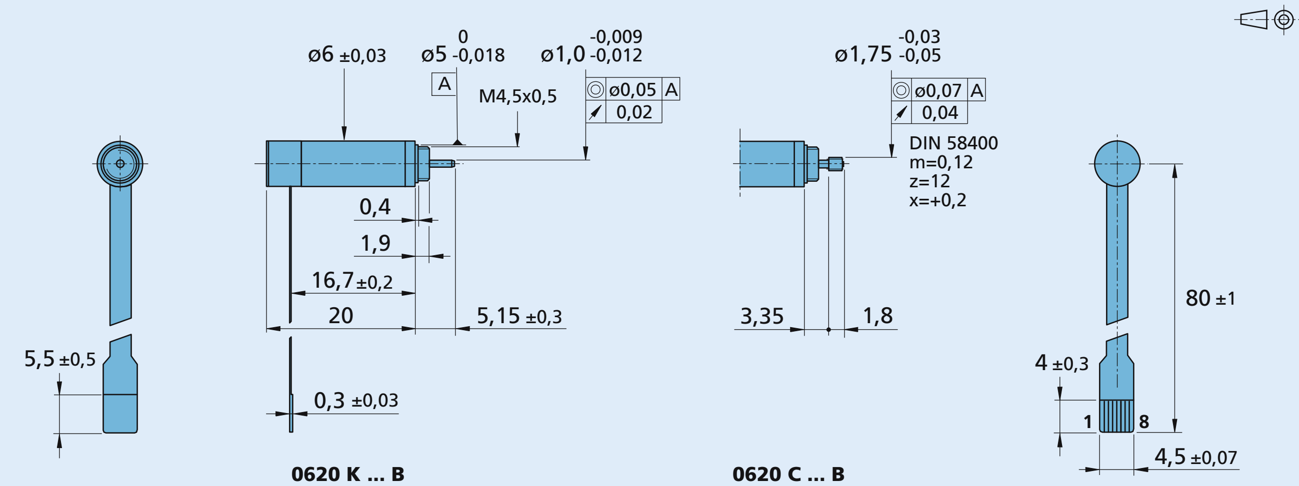
The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended areas for continuous operation

For notes on technical data and lifetime performance refer to „Technical Information".
Edition 2014

0620 ... B

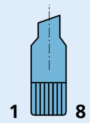


0620 K ... B

0620 C ... B
for Gearheads 06/1

Options

- Motors with analog Hall sensors for operation with Motion Controllers. (Option no. K1855) For this option is necessary the adapter 6501.0083.

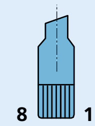


Connection

No.	Function
1	Phase C
2	Phase B
3	Hall sensor C
4	+5V
5	GND
6	Hall sensor A
7	Hall sensor B
8	Phase A

- Flexboard variant for digital Hall sensors and combination with Speed Controller (Option no. K2279)

- Flexboard variant for analog Hall sensors and combination with Motion Controller (Option no. K2280)



Connection

No.	Function
1	Phase C
2	Phase B
3	Phase A
4	GND
5	+5V
6	Hall sensor C
7	Hall sensor B
8	Hall sensor A

Full product description

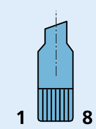
- Examples:

0620K006 B

0620K012 B-K2279

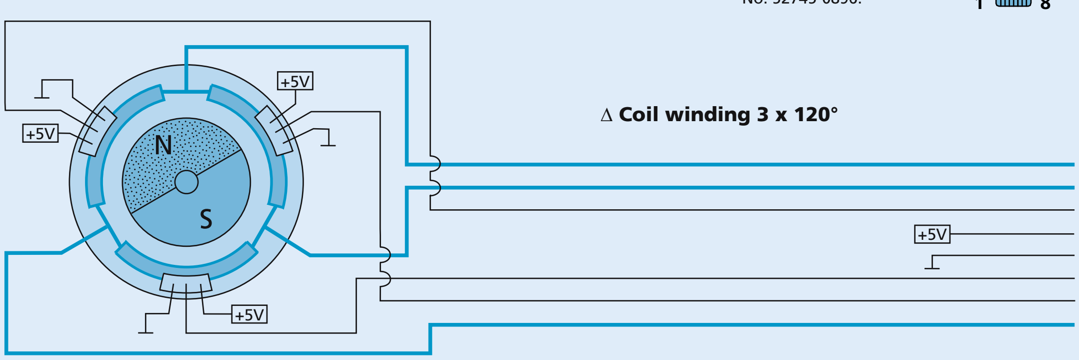
Cable and connection information

Recommended connector
Molex - ZIF Connector,
No. 52745-0896.



Flexboard
8 circuits; 0,5mm pitch,
Top Contact Style.

Note
Hallsensors digital
Number of pole pairs = 1



∆ Coil winding 3 x 120°

Connection

No.	Function
1	Phase C
2	Phase B
3	Hall sensor C
4	+5V
5	GND
6	Hall sensor A
7	Hall sensor B
8	Phase A

NEW

Brushless DC-Servomotors

1,1 mNm

For combination with
Gearheads:
08/1, 08/2, 08/3, 10/1
Encoder:
IEM3 – 1024, AESM – 4096
Drive Electronics:
Speed Controller, Motion Controller

Series 0824 ... B

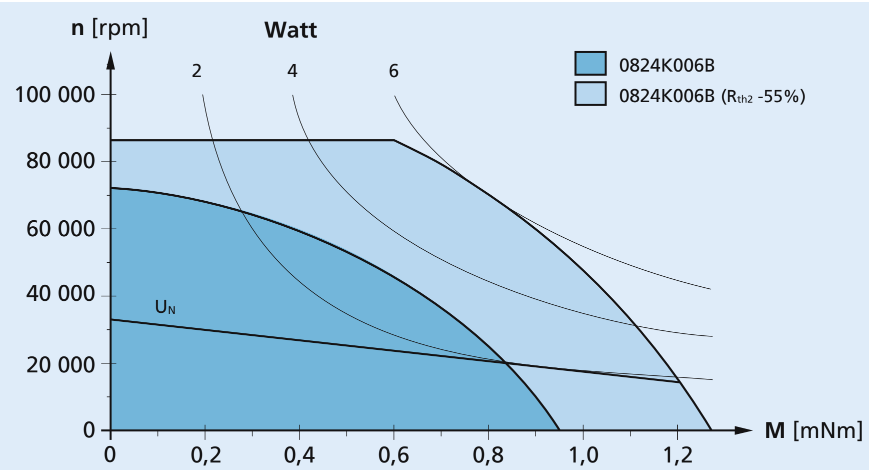
		0824 K		006 B	012 B	
1	Nominal voltage	U_N		6	12	Volt
2	Terminal resistance, phase-phase	R		3,10	10,80	Ω
3	Output power 1)	$P_{2\ max.}$		4,56	4,34	W
4	Efficiency	$\eta_{max.}$		67	66,6	%
5	No-load speed	n_o		33 200	37 200	rpm
6	No-load current (with shaft ø 1,0 mm)	I_o		0,070	0,043	A
7	Stall torque	M_H		3,2	3,3	mNm
8	Friction torque, static	C_o		0,031	0,031	mNm
9	Friction torque, dynamic	C_v		$2,59 \cdot 10^{-6}$	$2,59 \cdot 10^{-6}$	mNm/rpm
10	Speed constant	k_n		5 753	3 215	rpm/V
11	Back-EMF constant	k_E		0,174	0,311	mV/rpm
12	Torque constant	k_M		1,66	2,97	mNm/A
13	Current constant	k_I		0,602	0,337	A/mNm
14	Slope of n-M curve	$\Delta n/\Delta M$		10 743	11 692	rpm/mNm
15	Terminal inductance, phase-phase	L		30	104	µH
16	Mechanical time constant	τ_m		2	2	ms
17	Rotor inertia	J		0,0210	0,0210	gcm^2
18	Angular acceleration	$\alpha_{max.}$		1 513	1 561	$\cdot 10^3 rad/s^2$
19	Thermal resistance	$R_{th\,1}$ / $R_{th\,2}$	10 / 60			K/W
20	Thermal time constant	τ_{w1} / τ_{w2}	3,2 / 201			s
21	Operating temperature range:					
	– motor		– 20 ... +100			°C
	– coil, max. permissible		+125			°C
22	Shaft bearings		ball bearings, preloaded			
23	Shaft load max.:					
	– radial at 10 000/50 000 rpm (3,7 mm from mounting flange)		1,5 / 1,0			N
	– axial at 10 000/50 000 rpm (push-on only)		0,4 / 0,2			N
	– axial at standstill (push-on only)		10			N
24	Shaft play:					
	– radial	≤	0,012			mm
	– axial	=	0			mm
25	Housing material		aluminium, black anodized			
26	Weight		5,2			g
27	Direction of rotation		electronically reversible			
	Recommended values - mathematically independent of each other					
28	Speed up to 2)	$n_{e\ max.}$		85 000	85 000	rpm
29	Torque up to 1) 2)	$M_{e\ max.}$		1,09	1,04	mNm
30	Current up to 1) 2)	$I_{e\ max.}$		0,74	0,39	A

1) at 40 000 rpm
2) thermal resistance $R_{th\,2}$ by 55% reduced

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

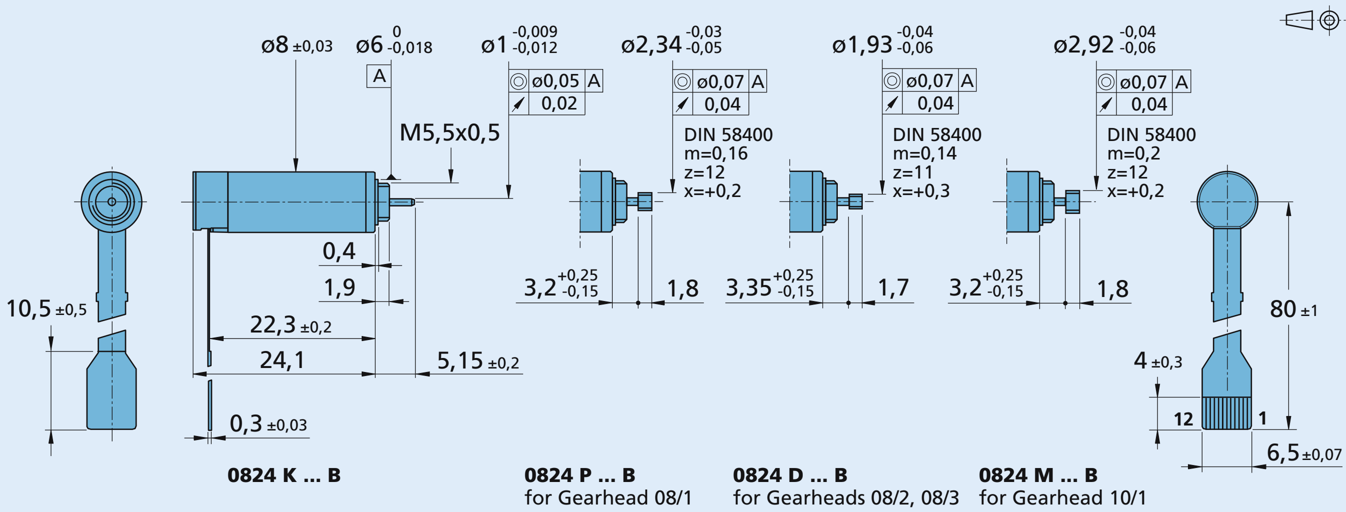
The diagram shows the motor in a completely insulated as well as thermally coupled condition ($R_{th\,2}$ 55% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



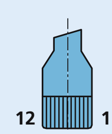
Recommended areas for continuous operation

0824 ... B



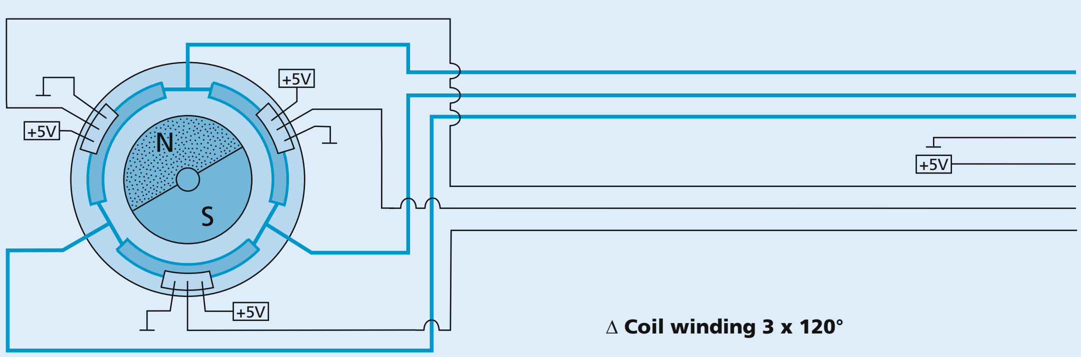
Cable and connection information

Recommended connector
Top contact style
12 circuits, 0,5 mm pitch, e.g.:
Molex: 52745-1296/1297



Flexboard
12 circuits, 0,5 mm pitch

Note
Hallsensors digital
Number of pole pairs = 1



∆ **Coil winding 3 x 120°**

Connection

No.	Function
1	Phase C
2	Phase B
3	Phase A
4	GND
5	+5V
6	Hall sensor C
7	Hall sensor B
8	Hall sensor A
9	Hall sensor $\overline{B}$
10	Hall sensor $\overline{A}$
11	Hall sensor $\overline{C}$
12	Reserved

NEW

Brushless DC-Servomotors

2,1 mNm

For combination with
Gearheads:
10/1, 12/3, 12/4, 12/5
Encoder:
IEM3 – 1024, AESM – 4096
Drive Electronics:
Speed Controller, Motion Controller

Series 1028 ... B

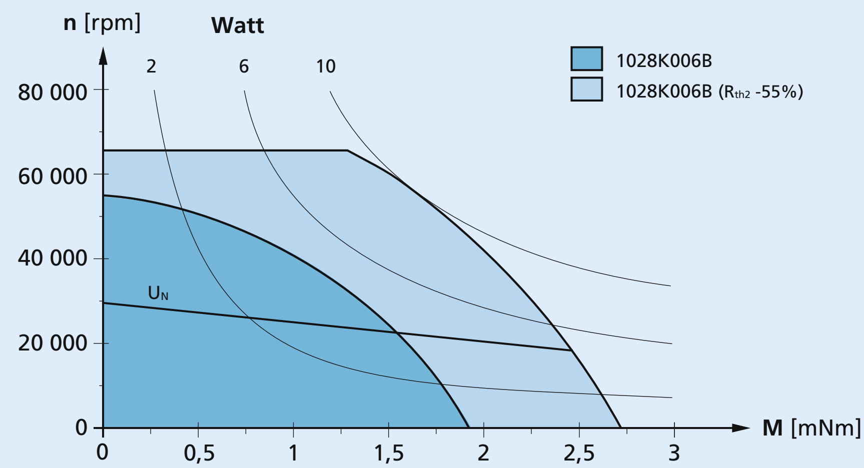
		1028 S		006 B	012 B	
1	Nominal voltage	U_N		6	12	Volt
2	Terminal resistance, phase-phase	R		1,35	4,64	Ω
3	Output power 1)	$P_{2\,max.}$		8,8	8,5	W
4	Efficiency	$\eta_{max.}$		68	68	%
5	No-load speed	n_o		30 200	33 500	rpm
6	No-load current (with shaft ø 1,2 mm)	I_o		0,148	0,089	A
7	Stall torque	M_H		8,2	8,4	mNm
8	Friction torque, static	C_o		0,104	0,104	mNm
9	Friction torque, dynamic	C_v		$5,65 \cdot 10^{-6}$	$5,65 \cdot 10^{-6}$	mNm/rpm
10	Speed constant	k_n		5 159	2 890	rpm/V
11	Back-EMF constant	k_E		0,194	0,346	mV/rpm
12	Torque constant	k_M		1,85	3,30	mNm/A
13	Current constant	k_I		0,540	0,303	A/mNm
14	Slope of n-M curve	$\Delta n/\Delta M$		3 763	4 060	rpm/mNm
15	Terminal inductance, phase-phase	L		24,3	86,7	µH
16	Mechanical time constant	τ_m		2	2	ms
17	Rotor inertia	J		0,0539	0,0539	gcm^2
18	Angular acceleration	$\alpha_{max.}$		1 521	1 566	$\cdot 10^3 rad/s^2$
19	Thermal resistance	R_{th1} / R_{th2}	5 / 41			K/W
20	Thermal time constant	τ_{w1} / τ_{w2}	3,4 / 247			s
21	Operating temperature range:					
	– motor		– 20 ... +100			°C
	– coil, max. permissible		+125			°C
22	Shaft bearings		ball bearings, preloaded			
23	Shaft load max.:					
	– radial at 10 000/30 000 rpm (3.7 mm from mounting flange)		2,5 / 2,0			N
	– axial at 10 000/30 000 rpm (push-on only)		1,3 / 0,8			N
	– axial at standstill (push-on only)		11			N
24	Shaft play:					
	– radial	≤	0,012			mm
	– axial	=	0			mm
25	Housing material		aluminium, black anodized			
26	Weight		9,1			g
27	Direction of rotation		electronically reversible			
	Recommended values - mathematically independent of each other					
28	Speed up to 2)	$n_{e\,max.}$		66 000	66 000	rpm
29	Torque up to 1) 2)	$M_{e\,max.}$		2,1	2,0	mNm
30	Current up to 1) 2)	$I_{e\,max.}$		1,32	0,71	A

1) at 40 000 rpm
2) thermal resistance $R_{th\,2}$ by 55% reduced

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

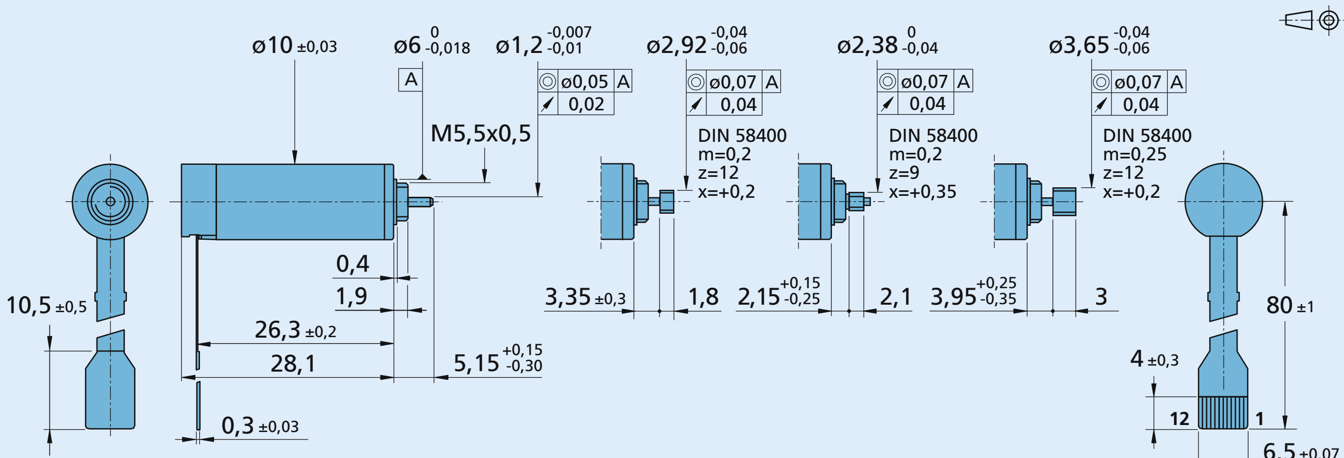
The diagram shows the motor in a completely insulated as well as thermally coupled condition ($R_{th\,2}$ 55% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended areas for continuous operation

1028 ... B



1028 S ... B

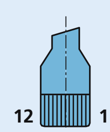
1028 M ... B
for Gearhead 10/1

1028 E ... B
for Gearheads 12/3, 12/5

1028 A ... B
for Gearhead 12/4

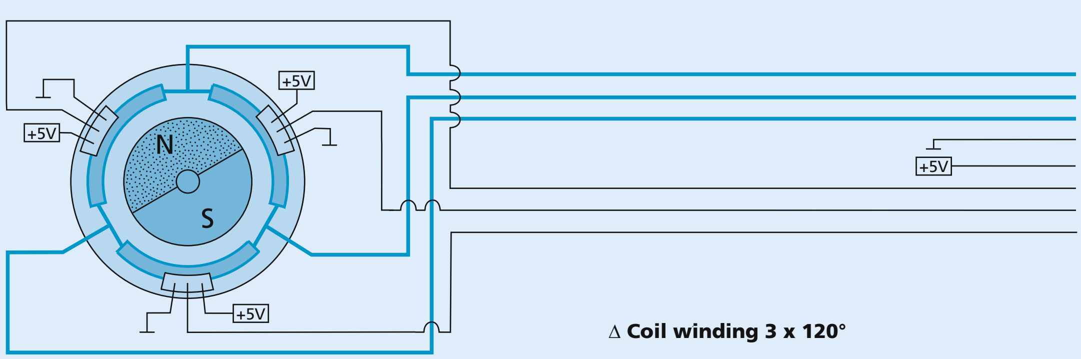
Cable and connection information

Recommended connector
Top contact style
12 circuits, 0,5 mm pitch, e.g.:
Molex: 52745-1296/1297



Flexboard
12 circuits, 0,5 mm pitch

Note
Hallsensors digital
Number of pole pairs = 1



∆ **Coil winding 3 x 120°**

Connection

No.	Function
1	Phase C
2	Phase B
3	Phase A
4	GND
5	+5V
6	Hall sensor C
7	Hall sensor B
8	Hall sensor A
9	Hall sensor $\overline{B}$
10	Hall sensor $\overline{A}$
11	Hall sensor $\overline{C}$
12	Reserved

NEW

Brushless DC-Servomotors

FAULHABER

1,02 mNm

For combination with
Gearheads:
10/1, 12/3, 12/4, 12/5
Drive electronics:
Speed Controller, Motion Controller

Brushless DC-Motors

Series 1218 ... B

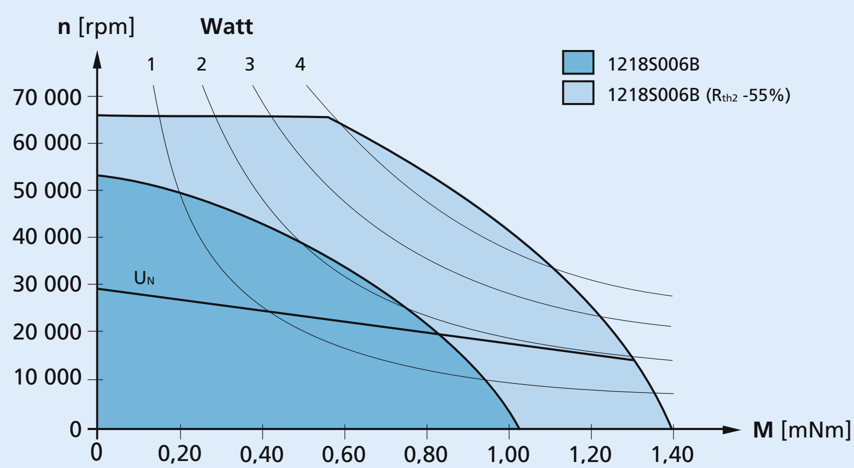
	1218 S		006 B	012 B	
1 Nominal voltage	U_N		6	12	Volt
2 Terminal resistance, phase-phase	R		3,14	12,0	Ω
3 Output power [1]	$P_{2\,max.}$		4,3	4,2	W
4 Efficiency	$\eta_{max.}$		57,4	57,0	%
5 No-load speed	n_o		29 200	30 400	rpm
6 No-load current (with shaft ø 1,2 mm)	I_o		0,126	0,067	A
7 Stall torque	M_H		3,4	3,4	mNm
8 Friction torque, static	C_o		0,107	0,107	mNm
9 Friction torque, dynamic	C_v		$4,24 \cdot 10^{-6}$	$4,24 \cdot 10^{-6}$	mNm/rpm
10 Speed constant	k_n		5 207	2 713	rpm/V
11 Back-EMF constant	k_E		0,192	0,369	mV/rpm
12 Torque constant	k_M		1,83	3,52	mNm/A
13 Current constant	k_I		0,545	0,284	A/mNm
14 Slope of n-M curve	$\Delta n/\Delta M$		8 914	9 249	rpm/mNm
15 Terminal inductance, phase-phase	L		34	130	µH
16 Mechanical time constant	τ_m		7	7	ms
17 Rotor inertia	J		0,080	0,080	gcm^2
18 Angular acceleration	$\alpha_{max.}$		423	425	$\cdot 10^3 rad/s^2$
19 Thermal resistance	R_{th1} / R_{th2}	13 / 49,0			K/W
20 Thermal time constant	τ_{w1} / τ_{w2}	4 / 265			s
21 Operating temperature range:					
– motor		– 20 ... +100			°C
– coil, max. permissible		+125			°C
22 Shaft bearings		ball bearings, preloaded			
23 Shaft load max.:					
– radial at 10 000/30 000 rpm (3,7 mm from mounting flange)		3,5 / 2,8			N
– axial at 10 000/30 000 rpm (push-on only)		2,0 / 1,0			N
– axial at standstill (push-on only)		11			N
24 Shaft play:					
– radial	≤	0,012			mm
– axial	=	0			mm
25 Housing material		aluminium, black anodized			
26 Weight		8,3			g
27 Direction of rotation		electronically reversible			
Recommended values - mathematically independent of each other					
28 Speed up to [2]	$n_{e\,max.}$		67 000	67 000	rpm
29 Torque up to [1,2]	$M_{e\,max.}$		1,02	0,99	mNm
30 Current up to [1,2]	$I_{e\,max.}$		0,71	0,36	A

[1] at 40 000 rpm
[2] thermal resistance R_{th2} by 55% reduced

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 55% reduced).

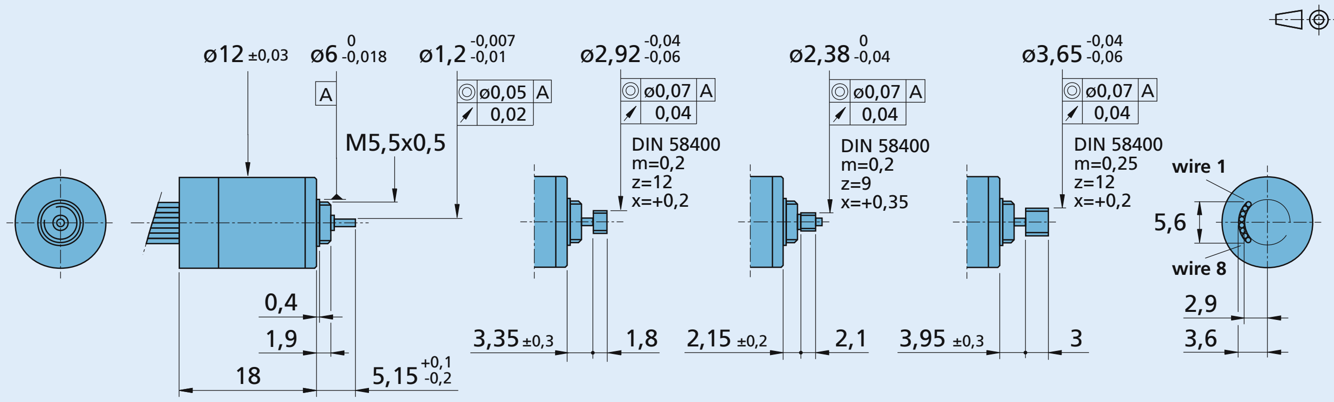
The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended areas for continuous operation

Options
K1855:
Motors with analog Hall sensors
for operation with Motion Controllers

1218 ... B



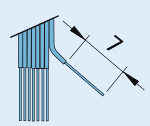
1218 S ... B

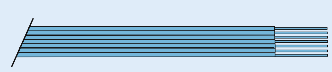
1218 M ... B
for Gearhead 10/1

1218 E ... B
for Gearheads 12/3, 12/5

1218 A ... B
for Gearhead 12/4

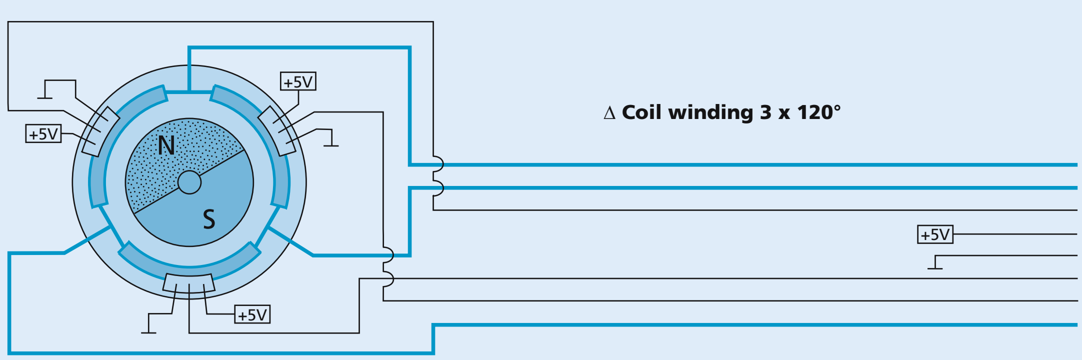
Cable and connection information





Cable
Single wires, material PTFE
Length 80 mm ± 3 mm
8 conductors, AWG 30

Note
Hallsensors digital
Number of pole pairs = 1



Connection

No.	Function	Colour
1	Phase C	yellow
2	Phase B	orange
3	Hall sensor C	grey
4	Logical supply +5V	red
5	Logical GND	black
6	Hall sensor A	green
7	Hall sensor B	blue
8	Phase A	brown

FAULHABER

Brushless DC-Servomotors

2,2 mNm

For combination with
Gearheads:
10/1, 12/3, 12/4, 12/5
Drive electronics:
Speed Controller, Motion Controller

Series 1226 ... B

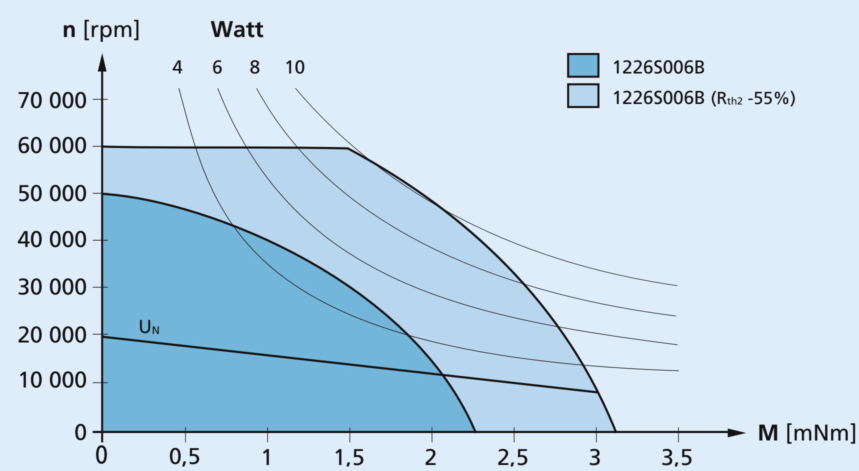
	1226 S			006 B	012 B	
1	Nominal voltage	U_N		6	12	Volt
2	Terminal resistance, phase-phase	R		2,30	5,30	Ω
3	Output power [1]	$P_{2\ max.}$		9,6	9,3	W
4	Efficiency	$\eta_{\ max.}$		68	69	%
5	No-load speed	n_o		20 100	27 200	rpm
6	No-load current (with shaft ø 1,2 mm)	I_o		0,088	0,074	A
7	Stall torque	M_H		7,19	9,21	mNm
8	Friction torque, static	C_o		0,079	0,079	mNm
9	Friction torque, dynamic	C_v		$8{,}2 \cdot 10^{-6}$	$8{,}2 \cdot 10^{-6}$	mNm/rpm
10	Speed constant	k_n		3 447	2 335	rpm/V
11	Back-EMF constant	k_E		0,290	0,428	mV/rpm
12	Torque constant	k_M		2,77	4,09	mNm/A
13	Current constant	k_I		0,361	0,244	A/mNm
14	Slope of n-M curve	$\Delta n/\Delta M$		2 862	3 026	rpm/mNm
15	Terminal inductance, phase-phase	L		35	80	µH
16	Mechanical time constant	τ_m		4	4	ms
17	Rotor inertia	J		0,145	0,145	gcm^2
18	Angular acceleration	$\alpha_{\ max.}$		496	635	$\cdot 10^3 rad/s^2$
19	Thermal resistance	$R_{th\ 1}$ / $R_{th\ 2}$	7 / 38,0			K/W
20	Thermal time constant	τ_{w1} / τ_{w2}	3 / 186			s
21	Operating temperature range:					
	– motor		– 20 ... +100			°C
	– coil, max. permissible		+125			°C
22	Shaft bearings		ball bearings, preloaded			
23	Shaft load max.:					
	– radial at 10 000/30 000 rpm (3,7 mm from mounting flange)		4,9 / 4,0			N
	– axial at 10 000/30 000 rpm (push-on only)		2,6 / 1,1			N
	– axial at standstill (push-on only)		11			N
24	Shaft play:					
	– radial	≤	0,012			mm
	– axial	=	0			mm
25	Housing material		aluminium, black anodized			
26	Weight		13			g
27	Direction of rotation		electronically reversible			
	Recommended values - mathematically independent of each other					
28	Speed up to [2]	$n_{e\ max.}$		60 000	60 000	rpm
29	Torque up to [1,2]	$M_{e\ max.}$		2,28	2,21	mNm
30	Current up to [1,2]	$I_{e\ max.}$		0,97	0,64	A

[1] at 40 000 rpm
[2] thermal resistance $R_{th\ 2}$ by 55% reduced

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

The diagram shows the motor in a completely insulated as well as thermally coupled condition ($R_{th\ 2}$ 55% reduced).

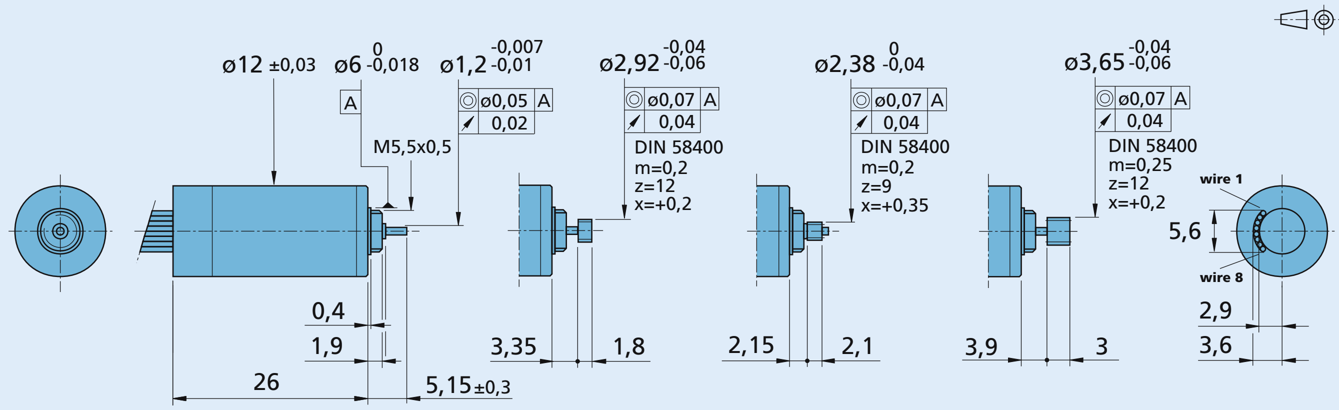
The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended areas for continuous operation

Options
K1855:
Motors with analog Hall sensors
for operation with Motion Controllers

1226 ... B



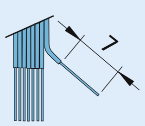
1226 S ... B

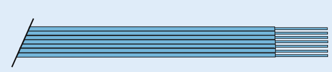
1226 M ... B
for Gearheads 10/1

1226 E ... B
for Gearheads 12/3, 12/5

1226 A ... B
for Gearheads 12/4

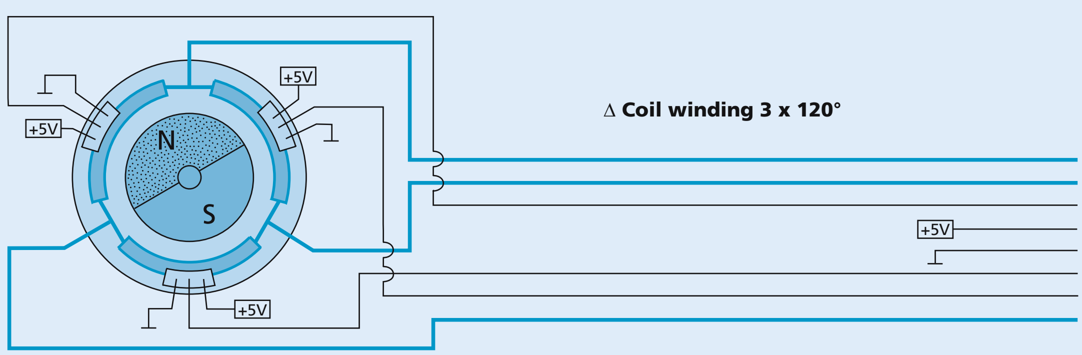
Cable and connection information





Cable
Single wires, material PTFE
Length 80 mm ± 3 mm
8 conductors, AWG 30

Note
Hallsensors digital
Number of pole pairs = 1



Connection

No.	Function	Colour
1	Phase C	yellow
2	Phase B	orange
3	Hall sensor C	grey
4	Logical supply +5V	red
5	Logical GND	black
6	Hall sensor A	green
7	Hall sensor B	blue
8	Phase A	brown

Brushless DC-Servomotors

sensorless, with optional Hall Sensors

2,1 mNm

For combination with
Gearheads:
15/5, 15/5 S, 15/8, 16/7
Drive Electronics:
Speed Controller, Motion Controller

Series 1524 ... BSL

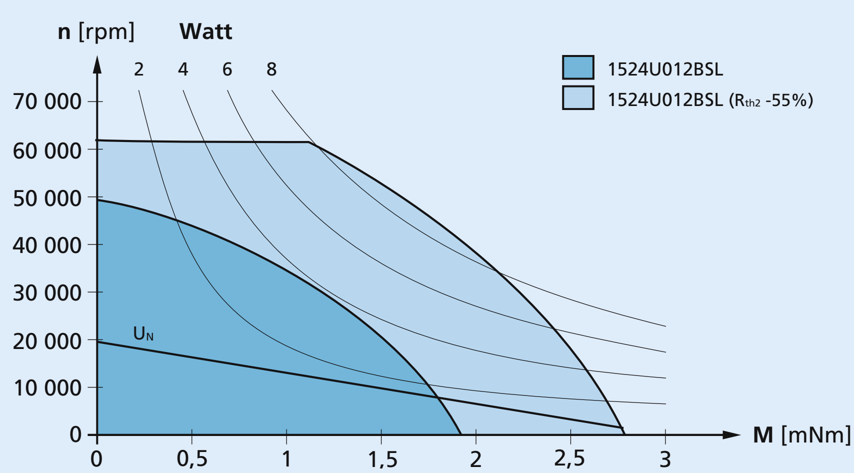
	1524 U		006 BSL	009 BSL	012 BSL	
1	Nominal voltage	U_N	6	9	12	Volt
2	Terminal resistance, phase-phase	R	4,30	9,7	15,3	Ω
3	Output power [1]	$P_{2\ max.}$	8	8	8	W
4	Efficiency	$\eta_{max.}$	54	53	54	%
5	No-load speed	n_o	18 500	19 200	19 900	rpm
6	No-load current (with shaft ø 2,0 mm)	I_o	0,110	0,078	0,062	A
7	Stall torque	M_H	4	4	4	mNm
8	Friction torque, static	C_o	0,140	0,140	0,140	mNm
9	Friction torque, dynamic	C_v	$9,5 \cdot 10^{-6}$	$9,5 \cdot 10^{-6}$	$9,5 \cdot 10^{-6}$	mNm/rpm
10	Speed constant	k_n	3 339	2 318	1 805	rpm/V
11	Back-EMF constant	k_E	0,299	0,431	0,554	mV/rpm
12	Torque constant	k_M	2,86	4,12	5,29	mNm/A
13	Current constant	k_I	0,350	0,243	0,189	A/mNm
14	Slope of n-M curve	$\Delta n/\Delta M$	5 020	5 457	5 221	rpm/mNm
15	Terminal inductance, phase-phase	L	82	169	273	µH
16	Mechanical time constant	τ_m	15	16	16	ms
17	Rotor inertia	J	0,30	0,30	0,30	gcm²
18	Angular acceleration	$\alpha_{max.}$	129	123	133	$\cdot 10^3$rad/s²
19	Thermal resistance	R_{th1} / R_{th2}	2,6 / 29,0			K/W
20	Thermal time constant	τ_{w1} / τ_{w2}	1 / 326			s
21	Operating temperature range		– 30 ... +125			°C
22	Shaft bearings		ball bearings, preloaded			
23	Shaft load max.:					
	– radial at 3 000/20 000 rpm (4,5 mm from mounting flange)		5 / 4 for series 1524 U ... B ..			N
	– radial at 3 000/20 000 rpm (2,0 mm from mounting flange)		5,5 / 4,5 for series 1524 E ... B ..			N
	– axial at 3 000/20 000 rpm (push-on only)		4 / 3,5			N
	– axial at standstill (push-on only)		17			N
24	Shaft play:					
	– radial	≤	0,015			mm
	– axial	=	0			mm
25	Housing material		mounting face in aluminium, housing in plastic			
26	Weight		20			g
27	Direction of rotation		electronically reversible			
Recommended values - mathematically independent of each other						
28	Speed up to [2]	$n_{e\ max.}$	62 000	62 000	62 000	rpm
29	Torque up to [1] [2]	$M_{e\ max.}$	2,1	2,0	2,1	mNm
30	Current up to [1] [2]	$I_{e\ max.}$	0,91	0,61	0,48	A

[1] at 36 000 rpm
[2] thermal resistance $R_{th\,2}$ by 55% reduced

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

The diagram shows the motor in a completely insulated as well as thermally coupled condition ($R_{th\,2}$ 55% reduced).

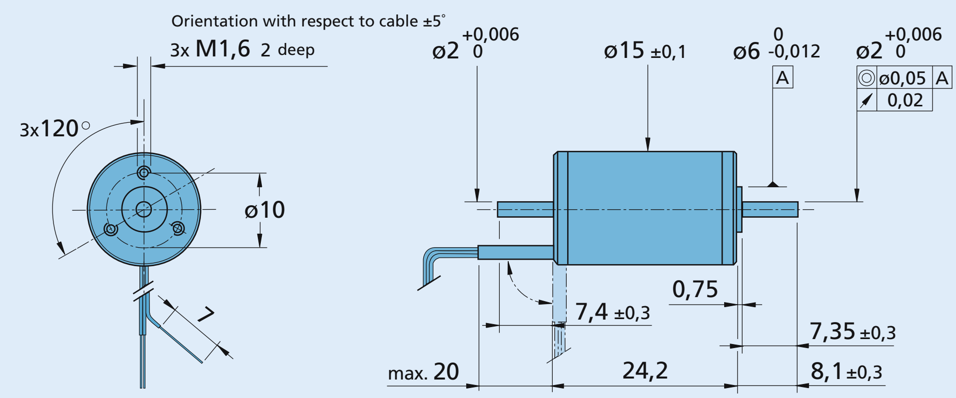
The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.

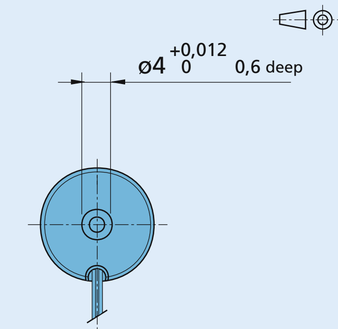


Recommended areas for continuous operation

Options
Motors with digital sensors:
1524 U ... BDS, 1524 E ... BDS
Motors with analog sensors:
1524 U ... BAS, 1524 E ... BAS

1524 U ... BSL sensorless





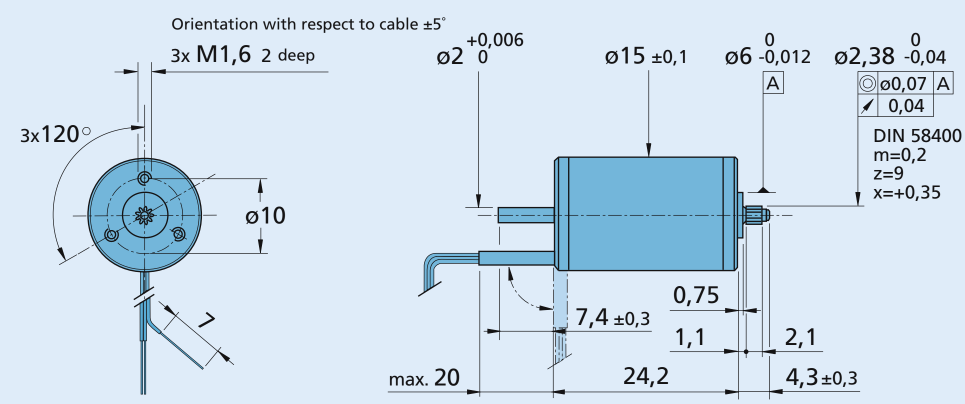
Cable
Single wires, material PTFE
Length 300 mm ± 15 mm
3 conductors, AWG 26

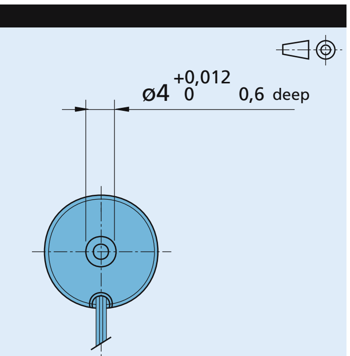
1524 U ... BSL
for combination with:
Gearheads 16/7
Drive Electronics Speed Controller

Connection

Function	Colour
Phase A	brown
Phase B	orange
Phase C	yellow

1524 E ... BSL sensorless





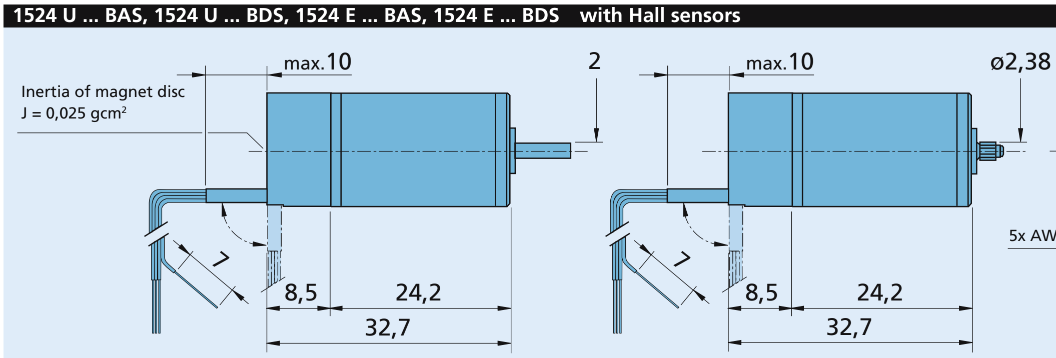
Cable
Single wires, material PTFE
Length 300 mm ± 15 mm
3 conductors, AWG 26

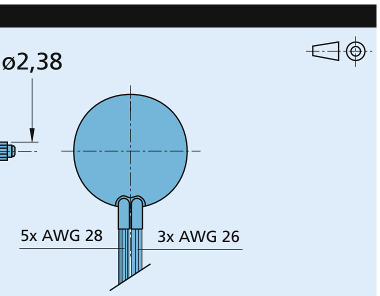
1524 E ... BSL
for combination with:
Getriebe 15/5(S), 15/8
Drive Electronics Speed Controller

Connection

Function	Colour
Phase A	brown
Phase B	orange
Phase C	yellow

1524 U ... BAS, 1524 U ... BDS, 1524 E ... BAS, 1524 E ... BDS with Hall sensors





1524 U ... BDS
for combination with:
Drive Electronics Speed Controller

1524 U ... BAS
for combination with:
Drive Electronics Motion Controllers

1524 E ... BDS
for combination with:
Drive Electronics Speed Controller

1524 E ... BAS
for combination with:
Drive Electronics Motion Controllers

Cable
Single wires, material PTFE
Length 300 mm ± 15 mm
3 conductors, AWG 26
5 conductors, AWG 28

Connection

Function	Colour
Phase A	brown
Phase B	orange
Phase C	yellow
Hall sensor A	green
Hall sensor B	blue
Hall sensor C	grey
+5V	red
GND	black

Brushless DC-Servomotors

sensorless, with optional Hall Sensors

5,7 mNm

For combination with
Gearheads:
15/5, 15/5 S, 15/8, 16/7
Drive Electronics:
Speed Controller, Motion Controller

Brushless DC-Motors

Series 1536 ... BSL

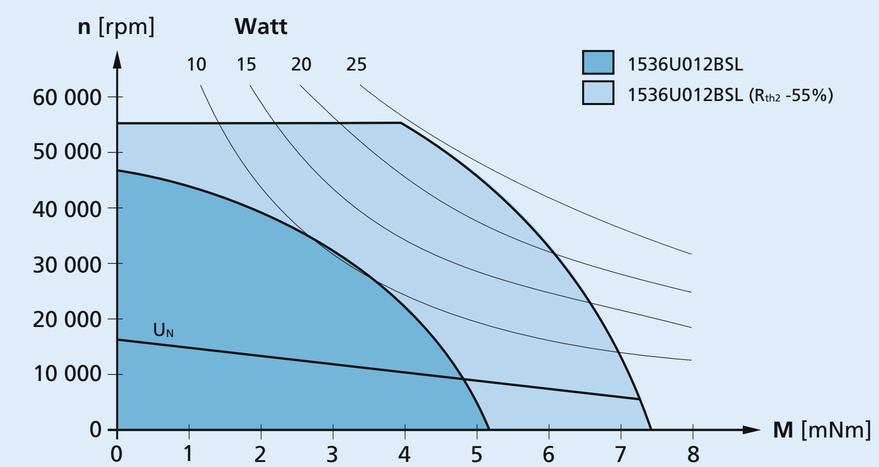
	1536 U			009 BSL	012 BSL	024 BSL	
1	Nominal voltage	U_N		9	12	24	Volt
2	Terminal resistance, phase-phase	R		3,28	5,48	21,42	Ω
3	Output power [1]	$P_{2\ max.}$		22	21	21	W
4	Efficiency	$\eta_{max.}$		69	69	69	%
5	No-load speed	n_o		15 100	15 900	16 200	rpm
6	No-load current (with shaft ø 2,0 mm)	I_o		0,086	0,069	0,036	A
7	Stall torque	M_H		15	15	15	mNm
8	Friction torque, static	C_o		0,230	0,230	0,230	mNm
9	Friction torque, dynamic	C_v		$1,61 \cdot 10^{-5}$	$1,61 \cdot 10^{-5}$	$1,61 \cdot 10^{-5}$	mNm/rpm
10	Speed constant	k_n		1 739	1 364	698	rpm/V
11	Back-EMF constant	k_E		0,575	0,733	1,433	mV/rpm
12	Torque constant	k_M		5,49	7,00	13,68	mNm/A
13	Current constant	k_I		0,182	0,143	0,073	A/mNm
14	Slope of n-M curve	$\Delta n/\Delta M$		1 039	1 068	1 093	rpm/mNm
15	Terminal inductance, phase-phase	L		102	170	654	µH
16	Mechanical time constant	τ_m		6	6	6	ms
17	Rotor inertia	J		0,55	0,55	0,55	gcm^2
18	Angular acceleration	$\alpha_{max.}$		269	275	274	$\cdot 10^3 rad/s^2$
19	Thermal resistance	$R_{th\,1}$ / $R_{th\,2}$	1,9 / 20,9				K/W
20	Thermal time constant	τ_{w1} / τ_{w2}	2 / 430				s
21	Operating temperature range		– 30 ... +125				°C
22	Shaft bearings		ball bearings, preloaded				
23	Shaft load max.:						
	– radial at 3 000/20 000 rpm (4,5 mm from mounting flange)		5,5 / 4,5 for series 1536 U ... B ..				N
	– radial at 3 000/20 000 rpm (2,0 mm from mounting flange)		6 / 5 for series 1536 E ... B ..				N
	– axial at 3 000/20 000 rpm (push-on only)		4 / 3,5				N
	– axial at standstill (push-on only)		17				N
24	Shaft play:						
	– radial	≤	0,015				mm
	– axial	=	0				mm
25	Housing material		mounting face in aluminium, housing in plastic				
26	Weight		33				g
27	Direction of rotation		electronically reversible				
Recommended values - mathematically independent of each other							
28	Speed up to [2]	$n_{e\ max.}$		55 000	55 000	55 000	rpm
29	Torque up to [1) 2)]	$M_{e\ max.}$		5,7	5,6	5,6	mNm
30	Current up to [1) 2)]	$I_{e\ max.}$		1,19	0,92	0,47	A

[1] at 36 000 rpm
[2] thermal resistance $R_{th\,2}$ by 55% reduced

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

The diagram shows the motor in a completely insulated as well as thermally coupled condition ($R_{th\,2}$ 55% reduced).

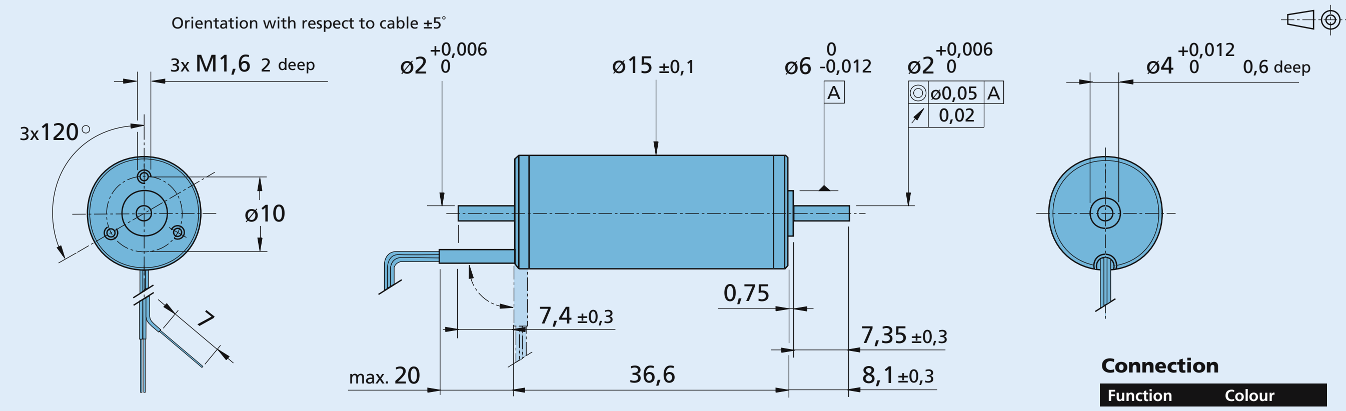
The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended areas for continuous operation

Options
Motors with digital sensors:
1536 U ... BDS, 1536 E ... BDS
Motors with analog sensors:
1536 U ... BAS, 1536 E ... BAS

1536 U ... BSL sensorless



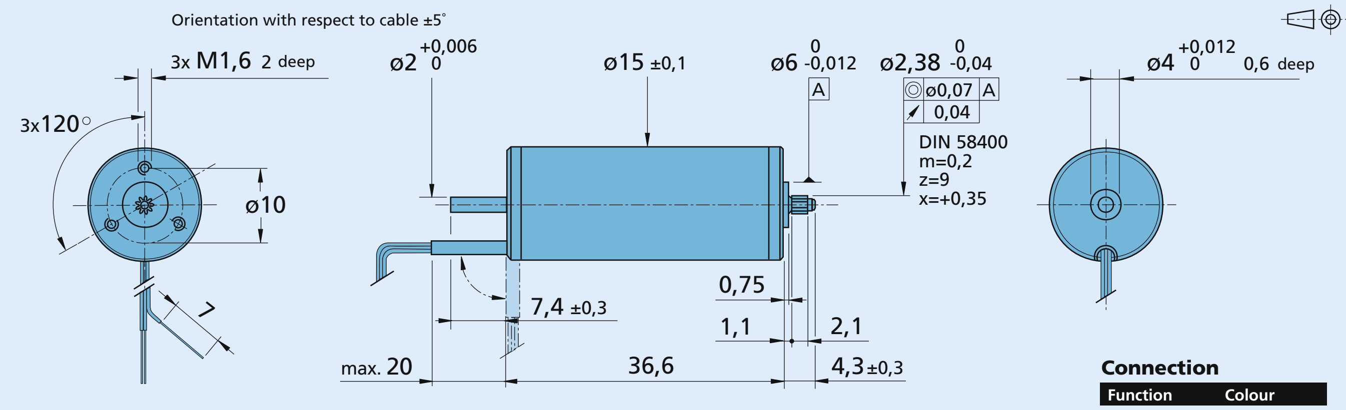
Cable
Single wires, material PTFE
Length 300 mm ± 15 mm
3 conductors, AWG 26

1536 U ... BSL
for combination with:
Gearheads 16/7
Drive Electronics Speed Controller

Connection

Function	Colour
Phase A	brown
Phase B	orange
Phase C	yellow

1536 E ... BSL sensorless



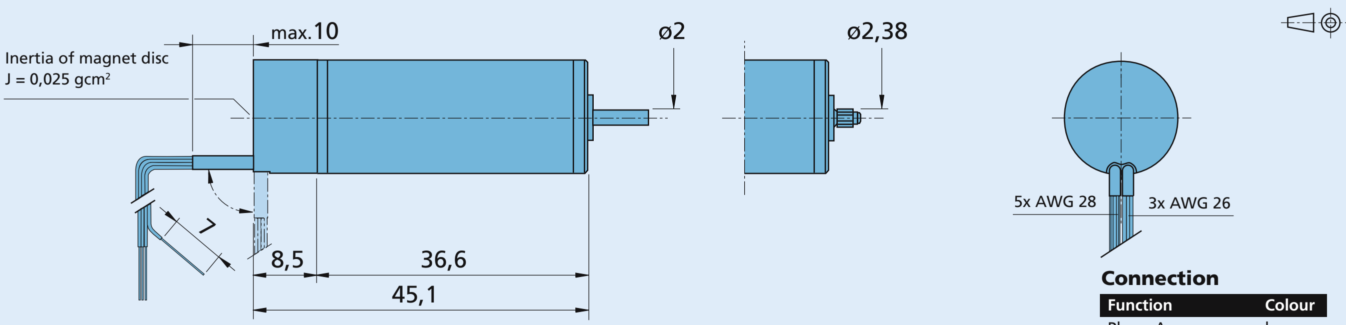
Cable
Single wires, material PTFE
Length 300 mm ± 15 mm
3 conductors, AWG 26

1536 E ... BSL
for combination with:
Getriebe 15/5(S), 15/8
Drive Electronics Speed Controller

Connection

Function	Colour
Phase A	brown
Phase B	orange
Phase C	yellow

1536 U ... BAS, 1536 U ... BDS, 1536 E ... BAS, 1536 E ... BDS with Hall sensors



Cable
Single wires, material PTFE
Length 300 mm ± 15 mm
3 conductors, AWG 26
5 conductors, AWG 28

1536 U ... BDS
for combination with:
Drive Electronics Speed Controller

1536 U ... BAS
for combination with:
Drive Electronics Motion Controllers

1536 E ... BDS
for combination with:
Drive Electronics Speed Controller

1536 E ... BAS
for combination with:
Drive Electronics Motion Controllers

Connection

Function	Colour
Phase A	brown
Phase B	orange
Phase C	yellow
Hall sensor A	green
Hall sensor B	blue
Hall sensor C	grey
+5V	red
GND	black

Brushless DC-Servomotors

2,6 mNm

For combination with
Gearheads:
15/10, 16/7, 17/1
Encoders:
IE2-1024
Drive Electronics:
Speed Controller, Motion Controller

Series 1628 ... B

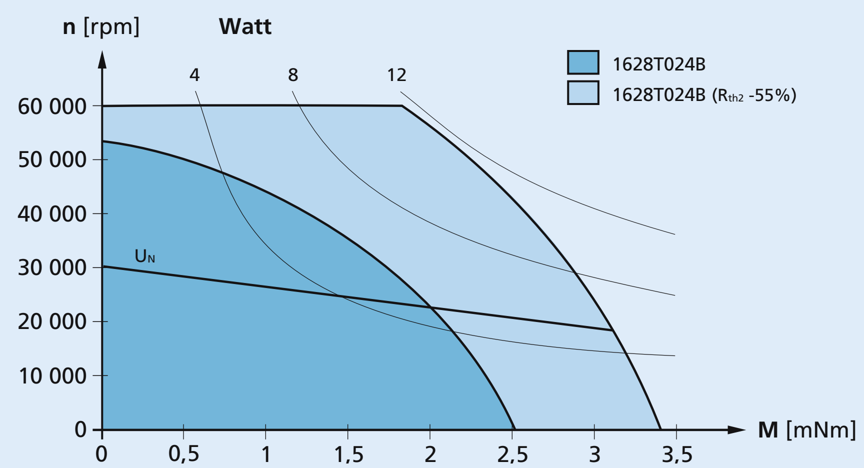
	1628 T			012 B	024 B	
1	Nominal voltage	U_N		12	24	Volt
2	Terminal resistance, phase-phase	R		4,3	15,1	Ω
3	Output power [1]	$P_{2\,max.}$		10	11	W
4	Efficiency	$\eta_{max.}$		68	68	%
5	No-load speed	n_o		28 650	29 900	rpm
6	No-load current (with shaft ø 1,5 mm)	I_o		0,098	0,052	A
7	Stall torque	M_H		11	12	mNm
8	Friction torque, static	C_o		0,15	0,15	mNm
9	Friction torque, dynamic	C_v		$8{,}0 \cdot 10^{-6}$	$8{,}0 \cdot 10^{-6}$	mNm/rpm
10	Speed constant	k_n		2 474	1 287	rpm/V
11	Back-EMF constant	k_E		0,404	0,777	mV/rpm
12	Torque constant	k_M		3,86	7,42	mNm/A
13	Current constant	k_I		0,259	0,135	A/mNm
14	Slope of n-M curve	$\Delta n/\Delta M$		2 737	2 610	rpm/mNm
15	Terminal inductance, phase-phase	L		141	525	µH
16	Mechanical time constant	τ_m		15	14	ms
17	Rotor inertia	J		0,54	0,54	gcm²
18	Angular acceleration	$\alpha_{max.}$		198	217	$\cdot 10^3$rad/s²
19	Thermal resistance	R_{th1} / R_{th2}	7,8 / 30,1			K/W
20	Thermal time constant	τ_{w1} / τ_{w2}	8 / 379			s
21	Operating temperature range		– 30 ... +125			°C
22	Shaft bearings		ball bearings, preloaded			
23	Shaft load max.:					
	– radial at 3 000/20 000 rpm (4,5 mm from mounting flange)		17 / 10			N
	– axial at 3 000/20 000 rpm (push-on only)		10 / 6			N
	– axial at standstill (push-on only)		20			N
24	Shaft play:					
	– radial	≤	0,015			mm
	– axial	=	0			mm
25	Housing material		aluminium, black anodized			
26	Weight		31			g
27	Direction of rotation		electronically reversible			
	Recommended values - mathematically independent of each other					
28	Speed up to [2]	$n_{e\,max.}$		60 000	60 000	rpm
29	Torque up to [1] [2]	$M_{e\,max.}$		2,5	2,6	mNm
30	Current up to [1] [2]	$I_{e\,max.}$		0,77	0,41	A

[1] at 40 000 rpm
[2] thermal resistance R_{th2} by 55% reduced

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 55% reduced).

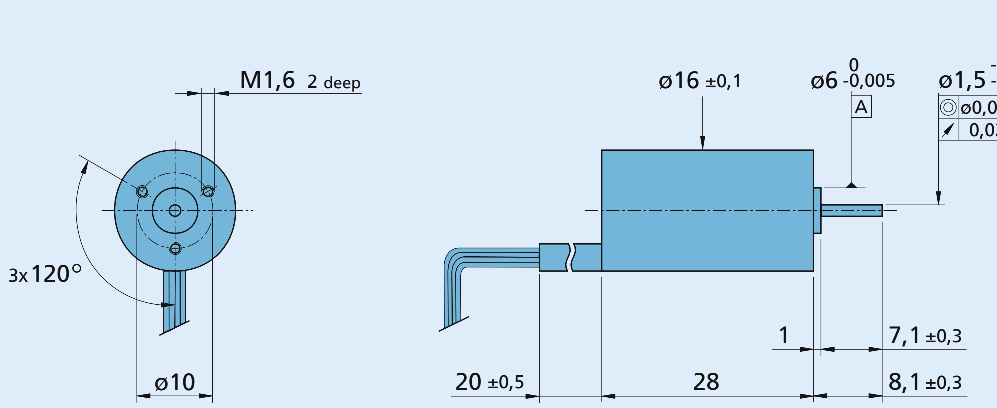
The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended areas for continuous operation

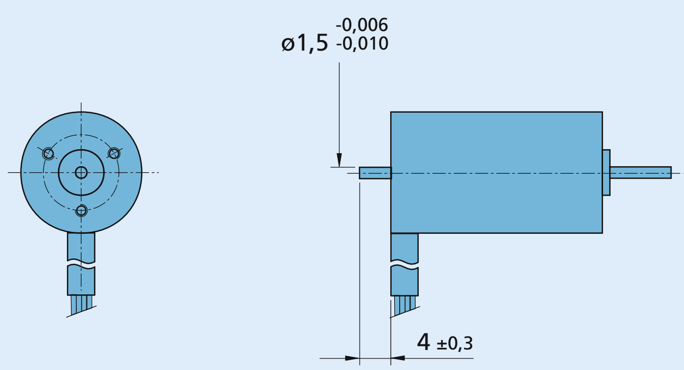
Options
K1000:
Motors in autoclavable version.
K1155:
Motors with analog Hall sensors
for operation with Motion Controllers

1628 T ... B



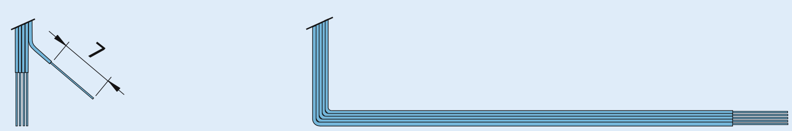
1628 T ... B

1628 T ... B - K312 with rear end shaft



1628 T ... B - K312

Cable and connection information

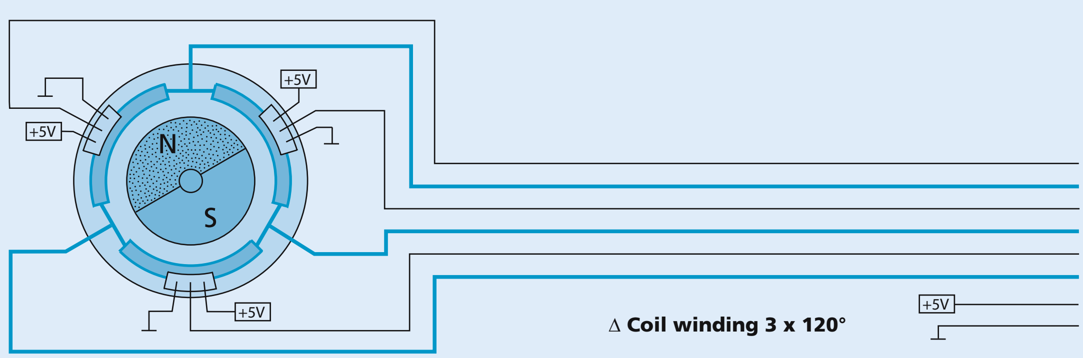


Cable
Single wires, material PTFE
Length 300 mm ± 15 mm
8 conductors, AWG 26

Note
Hallsensors digital
Number of pole pairs = 1

Connection

	Function	Colour
A	Hall sensor	green
A	Phase	brown
B	Hall sensor	blue
B	Phase	orange
C	Hall sensor	grey
C	Phase	yellow
+5V		red
GND		black



∆ Coil winding 3 x 120°

Brushless DC-Servomotors

5,2 mNm

For combination with
Gearheads:
20/1
Encoders:
IE2-1024, 5500, 5540
Drive Electronics:
Speed Controller, Motion Controller

Series 2036 ... B

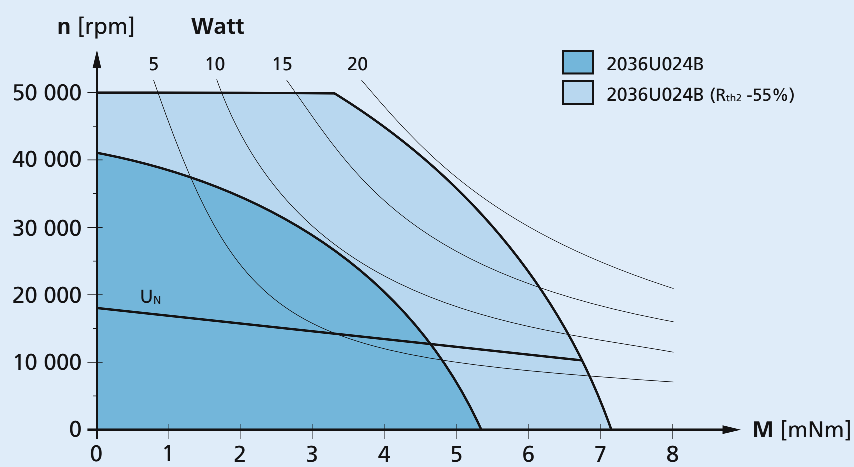
		2036 U		012 B	024 B	036 B	048 B	
1	Nominal voltage	U_N		12	24	36	48	Volt
2	Terminal resistance, phase-phase	R		3,4	14,0	27,9	62,2	Ω
3	Output power [1]	$P_{2\ max.}$		20	19	18	18	W
4	Efficiency	$\eta_{max.}$		70	69	69	69	%
5	No-load speed	n_o		17 600	18 000	19 500	17 400	rpm
6	No-load current (with shaft ø 2,0 mm)	I_o		0,102	0,053	0,040	0,025	A
7	Stall torque	M_H		22	21	22	20	mNm
8	Friction torque, static	C_o		0,27	0,27	0,27	0,27	mNm
9	Friction torque, dynamic	C_v		$2{,}14 \cdot 10^{-5}$	$2{,}14 \cdot 10^{-5}$	$2{,}14 \cdot 10^{-5}$	$2{,}14 \cdot 10^{-5}$	mNm/rpm
10	Speed constant	k_n		1 506	773	557	374	rpm/V
11	Back-EMF constant	k_E		0,664	1,294	1,796	2,677	mV/rpm
12	Torque constant	k_M		6,34	12,36	17,15	25,56	mNm/A
13	Current constant	k_I		0,158	0,081	0,058	0,039	A/mNm
14	Slope of n-M curve	$\Delta n/\Delta M$		808	875	906	909	rpm/mNm
15	Terminal inductance, phase-phase	L		148	600	1 160	2 500	µH
16	Mechanical time constant	τ_m		16	18	18	18	ms
17	Rotor inertia	J		1,95	1,95	1,95	1,95	gcm²
18	Angular acceleration	$\alpha_{max.}$		114	107	113	100	$\cdot 10^3$rad/s²
19	Thermal resistance	$R_{th\,1}$ / $R_{th\,2}$	5,7 / 19,9					K/W
20	Thermal time constant	τ_{w1} / τ_{w2}	9 / 577					s
21	Operating temperature range		– 30 ... +125					°C
22	Shaft bearings		ball bearings, preloaded					
23	Shaft load max.:							
	– radial at 3 000/20 000 rpm (4,5 mm from mounting flange)		14 / 7					N
	– axial at 3 000/20 000 rpm (push-on only)		8 / 4					N
	– axial at standstill (push-on only)		30					N
24	Shaft play:							
	– radial	≤	0,015					mm
	– axial	=	0					mm
25	Housing material		aluminium, black anodized					
26	Weight		50					g
27	Direction of rotation		electronically reversible					
	Recommended values - mathematically independent of each other							
28	Speed up to [2]	$n_{e\ max.}$		50 000	50 000	50 000	50 000	rpm
29	Torque up to [1] [2]	$M_{e\ max.}$		5,2	4,9	4,8	4,8	mNm
30	Current up to [1] [2]	$I_{e\ max.}$		0,98	0,48	0,34	0,23	A

[1] at 36 000 rpm
[2] thermal resistance $R_{th\,2}$ by 55% reduced

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

The diagram shows the motor in a completely insulated as well as thermally coupled condition ($R_{th\,2}$ 55% reduced).

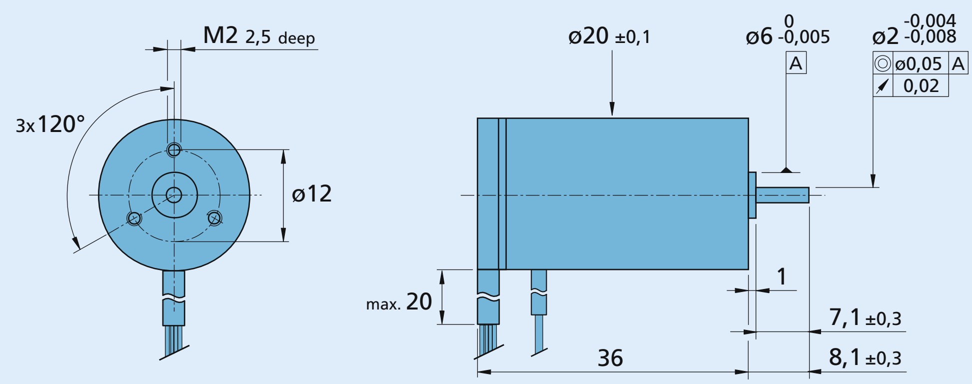
The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended areas for continuous operation

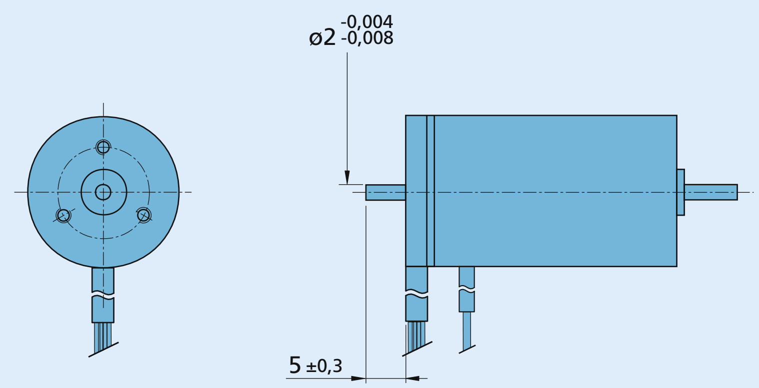
Options
K1000:
Motors in autoclavable version.
K1155:
Motors with analog Hall sensors
for operation with Motion Controllers

2036 U ... B



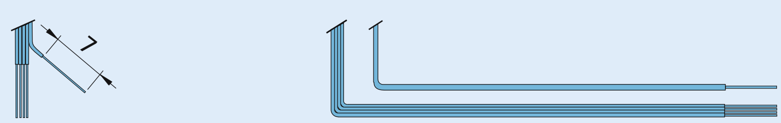
2036 U ... B

2036 U ... B - K312 with rear end shaft



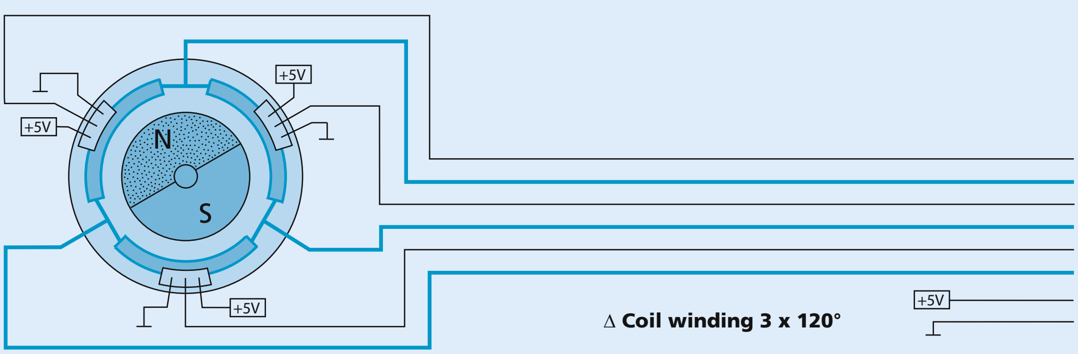
2036 U ... B - K312

Cable and connection information



Cable
Single wires, material PTFE
Length 300 mm ± 15 mm
3 conductors, AWG 24
5 conductors, AWG 26

Note
Hallsensors digital
Number of pole pairs = 1



Connection

	Function	Colour
A	Hall sensor	green
A	Phase	brown
B	Hall sensor	blue
B	Phase	orange
C	Hall sensor	grey
C	Phase	yellow
+5V		red
GND		black

Brushless DC-Servomotors

16,5 mNm

For combination with
Gearheads:
20/1, 23/1
Encoders:
IE2-1024, 5500, 5540
Drive Electronics:
Speed Controller, Motion Controller

Series 2057 ... B

		2057 S		012 B	024 B	
1	Nominal voltage	U_N		12	24	Volt
2	Terminal resistance, phase-phase	R		0,55	1,42	Ω
3	Output power [1]	$P_{2\,max.}$		61	62	W
4	Efficiency	$\eta_{max.}$		82	83	%
5	No-load speed	n_o		21 900	26 500	rpm
6	No-load current (with shaft ø 3,0 mm)	I_o		0,210	0,147	A
7	Stall torque	M_H		113	144	mNm
8	Friction torque, static	C_o		0,28	0,28	mNm
9	Friction torque, dynamic	C_v		$3{,}70 \cdot 10^{-5}$	$3{,}70 \cdot 10^{-5}$	mNm/rpm
10	Speed constant	k_n		1 840	1 116	rpm/V
11	Back-EMF constant	k_E		0,543	0,896	mV/rpm
12	Torque constant	k_M		5,19	8,56	mNm/A
13	Current constant	k_I		0,193	0,117	A/mNm
14	Slope of n-M curve	$\Delta n/\Delta M$		195	185	rpm/mNm
15	Terminal inductance, phase-phase	L		68	117	µH
16	Mechanical time constant	τ_m		8	8	ms
17	Rotor inertia	J		3,95	3,95	gcm^2
18	Angular acceleration	$\alpha_{max.}$		286	365	$\cdot 10^3 rad/s^2$
19	Thermal resistance	$R_{th\,1}$ / $R_{th\,2}$	2,8 / 11,5			K/W
20	Thermal time constant	τ_{w1} / τ_{w2}	10 / 590			s
21	Operating temperature range		– 30 ... +125			°C
22	Shaft bearings		ball bearings, preloaded			
23	Shaft load max.:					
	– radial at 3 000/20 000 rpm (4,5 mm from mounting flange)		28 / 14			N
	– axial at 3 000/20 000 rpm (push-on only)		17 / 11			N
	– axial at standstill (push-on only)		75			N
24	Shaft play:					
	– radial	≤	0,015			mm
	– axial	=	0			mm
25	Housing material		aluminium, black anodized			
26	Weight		95			g
27	Direction of rotation		electronically reversible			

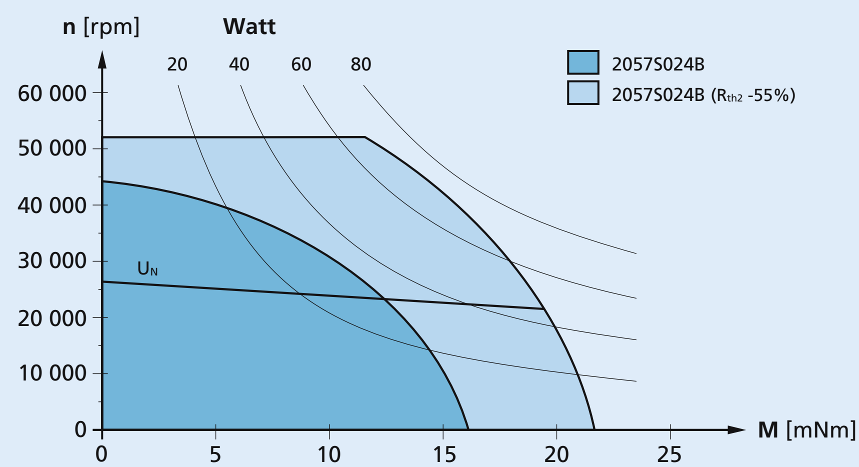
	Recommended values - mathematically independent of each other					
28	Speed up to [2]	$n_{e\,max.}$		52 000	52 000	rpm
29	Torque up to [1] [2]	$M_{e\,max.}$		16,1	16,5	mNm
30	Current up to [1] [2]	$I_{e\,max.}$		3,41	2,12	A

[1] at 36 000 rpm
[2] thermal resistance $R_{th\,2}$ by 55% reduced

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

The diagram shows the motor in a completely insulated as well as thermally coupled condition ($R_{th\,2}$ 55% reduced).

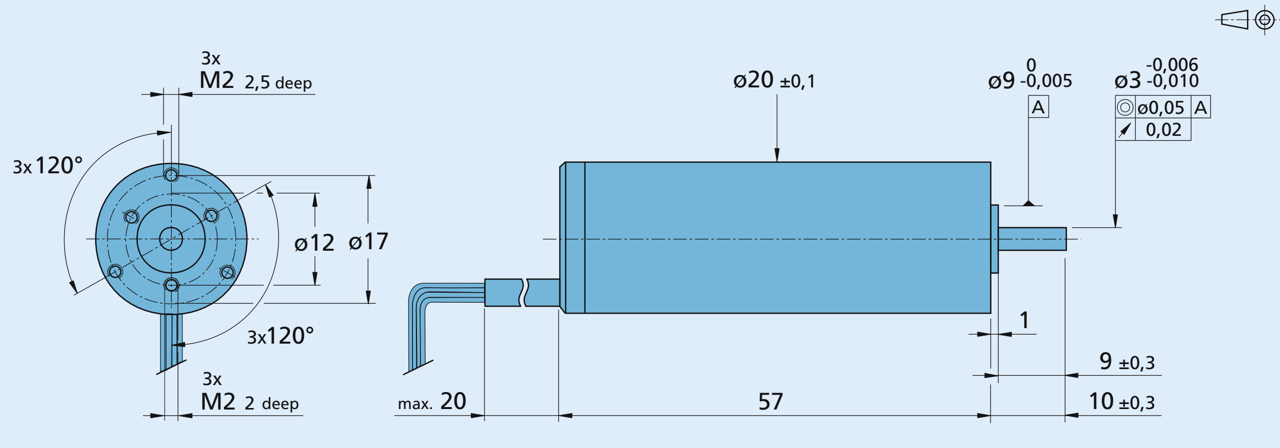
The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended areas for continuous operation

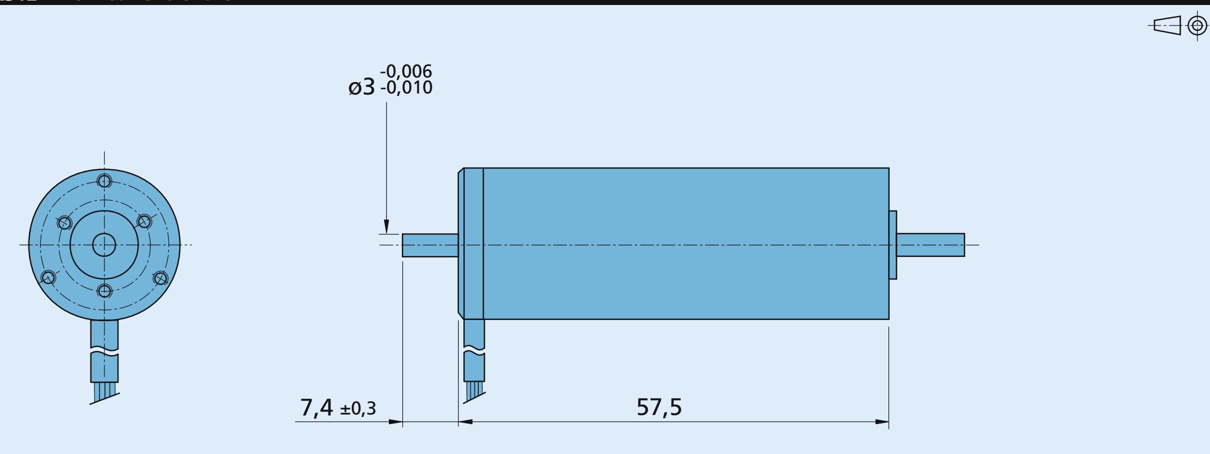
Options
K1000:
Motors in autoclavable version.
K1155:
Motors with analog Hall sensors
for operation with Motion Controllers

2057 S ... B



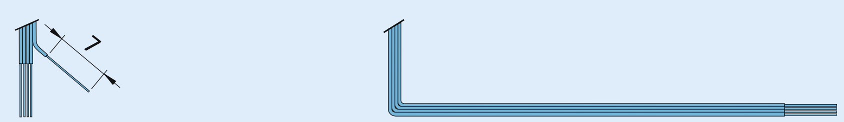
2057 S ... B

2057 S ... B - K312 with rear end shaft



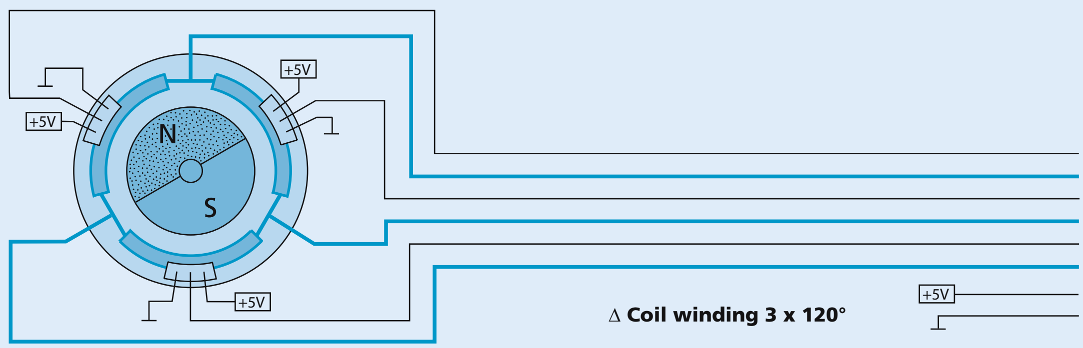
2057 S ... B - K312

Cable and connection information



Cable
Single wires, material PTFE
Length 300 mm ± 15 mm
5 conductors, AWG 26
3 conductors, AWG 24

Note
Hallsensors digital
Number of pole pairs = 1



Connection

	Function	Colour
A	Hall sensor	green
A	Phase	brown
B	Hall sensor	blue
B	Phase	orange
C	Hall sensor	grey
C	Phase	yellow
	+5V	red
	GND	black

Brushless DC-Servomotors

11,8 mNm

For combination with
Gearheads:
23/1, 26/1, 26/1S, 30/1, 30/1S
Encoders:
5500, 5540, IE3-1024, IE3-1024 L
Drive Electronics:
Speed Controller, Motion Controller

Series 2444 ... B

		2444 S		024 B	048 B	
1	Nominal voltage	U_N		24	48	Volt
2	Terminal resistance, phase-phase	R		2,1	8,4	Ω
3	Output power 1)	$P_{2\ max.}$		36	37	W
4	Efficiency	$\eta_{\ max.}$		77	77	%
5	No-load speed	n_o		23 000	22 500	rpm
6	No-load current (with shaft ø 3,0 mm)	I_o		0,184	0,088	A
7	Stall torque	M_H		111	115	mNm
8	Friction torque, static	C_o		1,00	1,00	mNm
9	Friction torque, dynamic	C_v		$3,5 \cdot 10^{-5}$	$3,5 \cdot 10^{-5}$	mNm/rpm
10	Speed constant	k_n		974	473	rpm/V
11	Back-EMF constant	k_E		1,026	2,115	mV/rpm
12	Torque constant	k_M		9,8	20,2	mNm/A
13	Current constant	k_I		0,102	0,050	A/mNm
14	Slope of n-M curve	$\Delta n/\Delta M$		209	197	rpm/mNm
15	Terminal inductance, phase-phase	L		180	760	µH
16	Mechanical time constant	τ_m		14	13	ms
17	Rotor inertia	J		6,5	6,5	gcm^2
18	Angular acceleration	$\alpha_{\ max.}$		171	177	$\cdot 10^3 rad/s^2$
19	Thermal resistance	$R_{th\ 1}$ / $R_{th\ 2}$	4,1 / 14,8			K/W
20	Thermal time constant	τ_{w1} / τ_{w2}	16 / 680			s
21	Operating temperature range		– 30 ... +125			°C
22	Shaft bearings		ball bearings, preloaded			
23	Shaft load max.:					
	– radial at 3 000/20 000 rpm (6 mm from mounting flange)		30 / 17			N
	– axial at 3 000/20 000 rpm (push-on only)		16 / 10			N
	– axial at standstill (push-on only)		57			N
24	Shaft play:					
	– radial	≤	0,015			mm
	– axial	=	0			mm
25	Housing material		aluminium, black anodized			
26	Weight		100			g
27	Direction of rotation		electronically reversible			

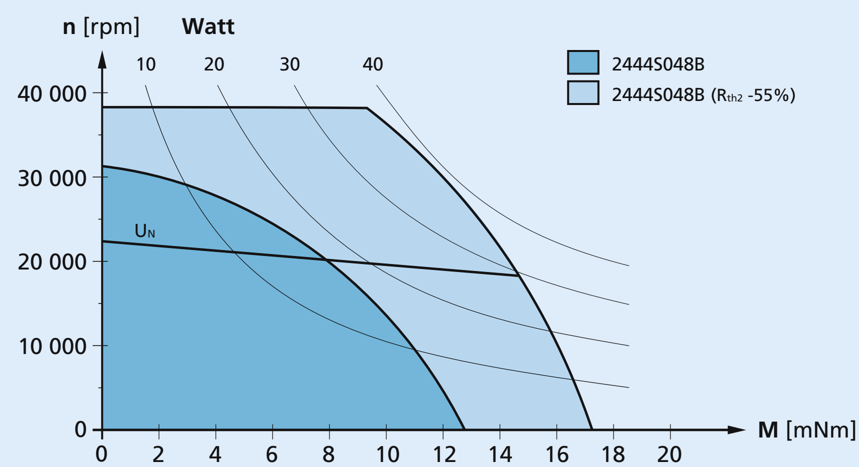
Recommended values - mathematically independent of each other						
28	Speed up to 2)	$n_{e\ max.}$		38 000	38 000	rpm
29	Torque up to 1) 2)	$M_{e\ max.}$		11,4	11,8	mNm
30	Current up to 1) 2)	$I_{e\ max.}$		1,37	0,69	A

1) at 30 000 rpm
2) thermal resistance $R_{th\ 2}$ by 55% reduced

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

The diagram shows the motor in a completely insulated as well as thermally coupled condition ($R_{th\ 2}$ 55% reduced).

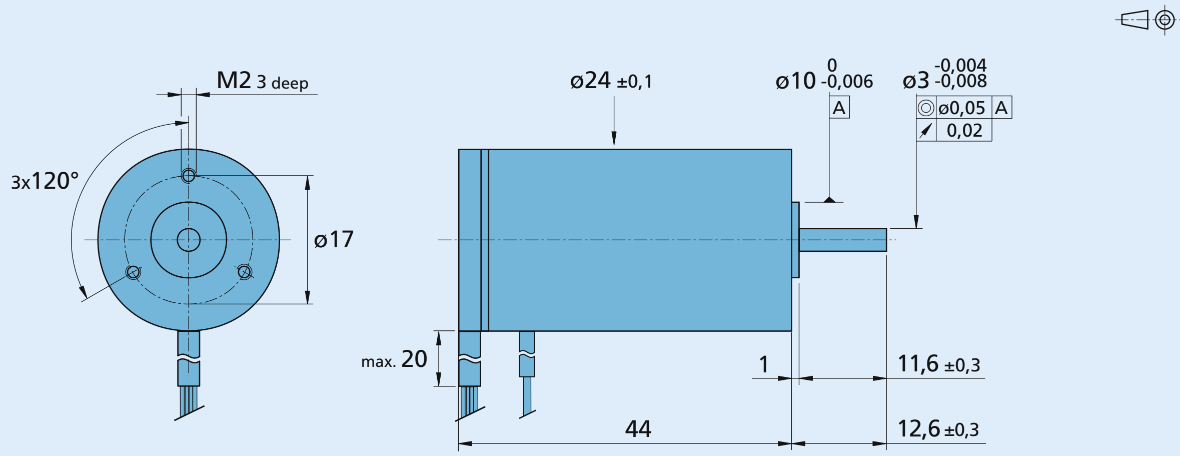
The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended areas for continuous operation

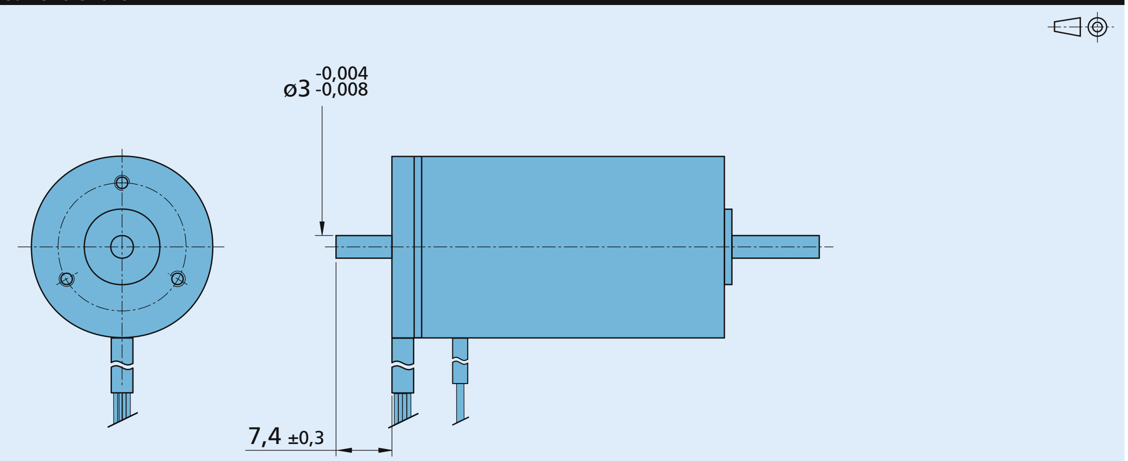
Options
K1000:
Motors in autoclavable version.
K1155:
Motors with analog Hall sensors
for operation with Motion Controllers

2444 S ... B



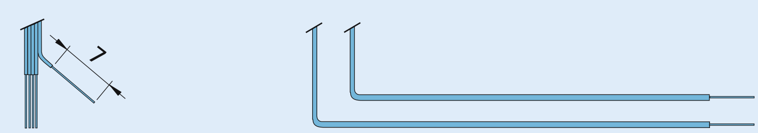
2444 S ... B

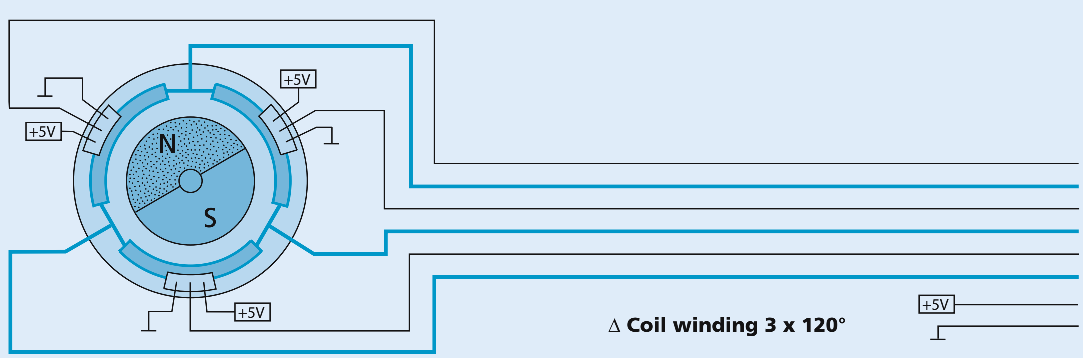
2444 S ... B - K312 with rear end shaft



2444 S ... B - K312

Cable and connection information





Cable
Single wires, material PTFE
Length 300 mm ± 15 mm
3 conductors, AWG 24
5 conductors, AWG 26

Note
Hallsensors digital
Number of pole pairs = 1

Connection

	Function	Colour
A	Hall sensor	green
A	Phase	brown
B	Hall sensor	blue
B	Phase	orange
C	Hall sensor	grey
C	Phase	yellow
+5V		red
GND		black

Brushless DC-Servomotors

22,1 mNm

For combination with
Gearheads:
30/1, 30/1 S, 38/1, 38/1 S, 38/2, 38/2 S
Encoders:
5500, 5540, IE3-1024, IE3-1024 L
Drive Electronics:
Speed Controller, Motion Controller

Series 3056 ... B

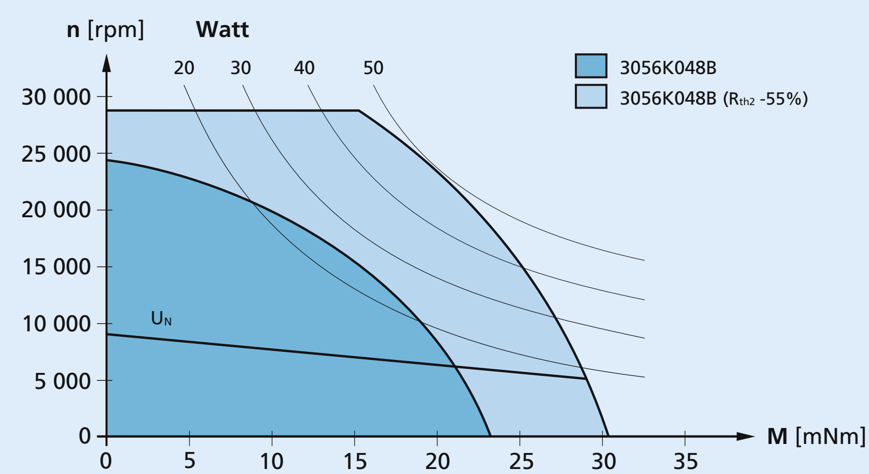
	3056 K			012 B	024 B	036 B	048 B	
1	Nominal voltage	U_N		12	24	36	48	Volt
2	Terminal resistance, phase-phase	R		1,6	6,6	13,7	26,5	Ω
3	Output power [1]	$P_{2\,max.}$		48	51	49	49	W
4	Efficiency	$\eta_{max.}$		73	74	74	74	%
5	No-load speed	n_o		8 790	8 200	8 840	8 740	rpm
6	No-load current (with shaft ø 4,0 mm)	I_o		0,168	0,075	0,056	0,042	A
7	Stall torque	M_H		95	98	99	100	mNm
8	Friction torque, static	C_o		0,91	0,91	0,91	0,91	mNm
9	Friction torque, dynamic	C_v		$1,4 \cdot 10^{-4}$	$1,4 \cdot 10^{-4}$	$1,4 \cdot 10^{-4}$	$1,4 \cdot 10^{-4}$	mNm/rpm
10	Speed constant	k_n		750	350	251	186	rpm/V
11	Back-EMF constant	k_E		1,334	2,861	3,981	5,374	mV/rpm
12	Torque constant	k_M		12,74	27,32	38,02	51,32	mNm/A
13	Current constant	k_I		0,078	0,037	0,026	0,019	A/mNm
14	Slope of n-M curve	$\Delta n/\Delta M$		94	84	91	89	rpm/mNm
15	Terminal inductance, phase-phase	L		160	720	1 400	2 520	µH
16	Mechanical time constant	τ_m		13	12	13	12	ms
17	Rotor inertia	J		13,6	13,6	13,6	13,6	gcm^2
18	Angular acceleration	$\alpha_{max.}$		70	72	73	73	$\cdot 10^3 rad/s^2$
19	Thermal resistance	$R_{th\,1} / R_{th\,2}$	3,3 / 9,4					K/W
20	Thermal time constant	τ_{w1} / τ_{w2}	19 / 1 034					s
21	Operating temperature range		– 30 ... +125					°C
22	Shaft bearings		ball bearings, preloaded					
23	Shaft load max.:							
	– radial at 3 000/20 000 rpm (7,4 mm from mounting flange)		72 / 51					N
	– axial at 3 000/20 000 rpm (axial push-on only)		18 / 12					N
	– axial at standstill (axial push-on only)		62					N
24	Shaft play:							
	– radial	≤	0,015					mm
	– axial	=	0					mm
25	Housing material		aluminium, black anodized					
26	Weight		190					g
27	Direction of rotation		electronically reversible					
	Recommended values - mathematically independent of each other							
28	Speed up to [2]	$n_{e\,max.}$		28 000	28 000	28 000	28 000	rpm
29	Torque up to [1) 2)]	$M_{e\,max.}$		20,7	22,1	21,2	21,5	mNm
30	Current up to [1) 2)]	$I_{e\,max.}$		1,94	0,96	0,66	0,50	A

[1] at 22 000 rpm
[2] thermal resistance $R_{th\,2}$ by 55% reduced

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

The diagram shows the motor in a completely insulated as well as thermally coupled condition ($R_{th\,2}$ 55% reduced).

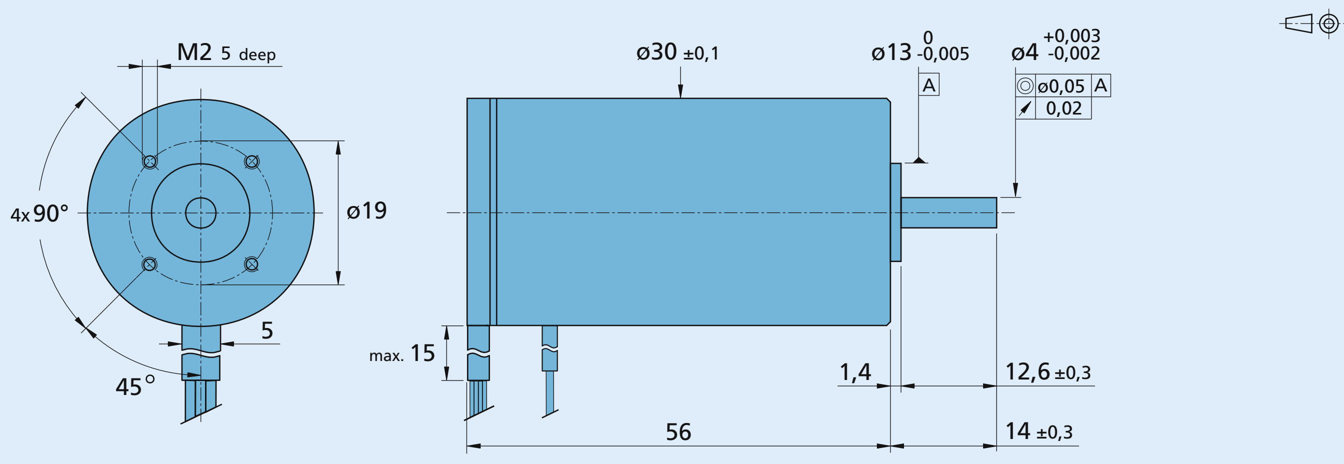
The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended areas for continuous operation

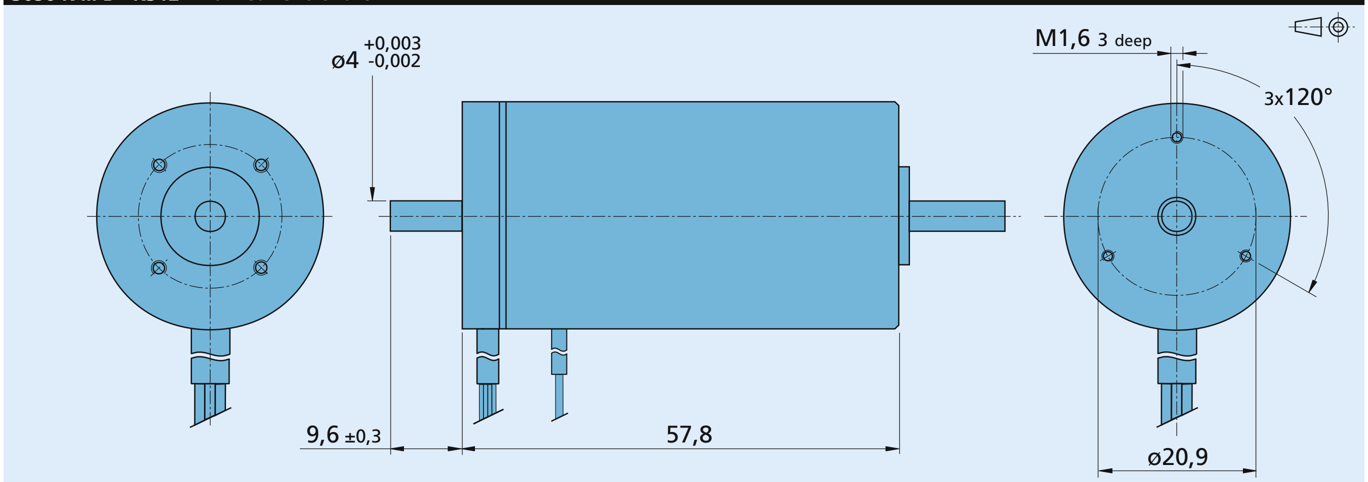
Options
K1000:
Motors in autoclavable version.
K1155:
Motors with analog Hall sensors
for operation with Motion Controllers

3056 K ... B



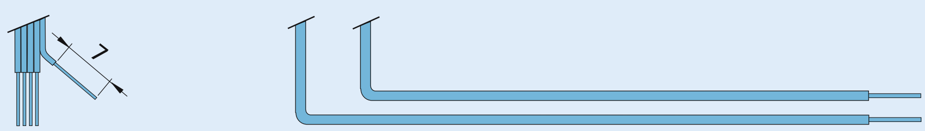
3056 K ... B

3056 K ... B - K312 with rear end shaft



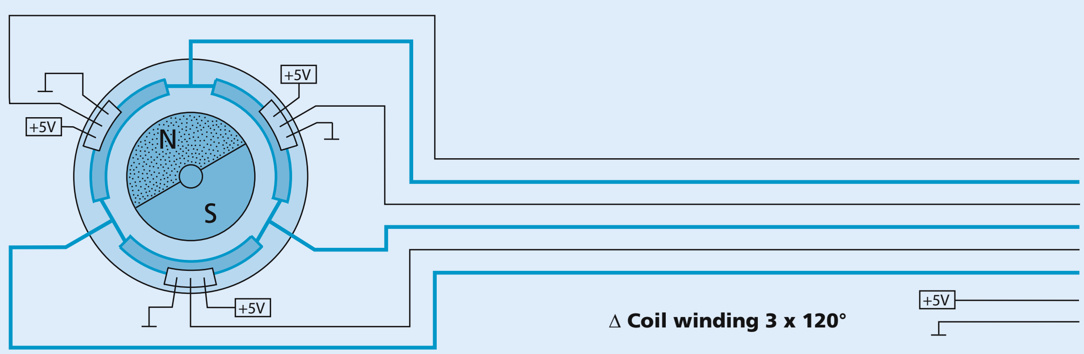
3056 K ... B - K312

Cable and connection information



Cable
Single wires, material PTFE
Length 300 mm ± 15 mm
3 conductors, AWG 20
5 conductors, AWG 26

Note
Hallsensors digital
Number of pole pairs = 1



∆ **Coil winding 3 x 120°**

Connection

	Function	Colour
A	Hall sensor	green
A	Phase	brown
B	Hall sensor	blue
B	Phase	orange
C	Hall sensor	grey
C	Phase	yellow
+5V		red
GND		black

Brushless DC-Servomotors

47,1 mNm

For combination with
Gearheads:
30/1, 30/1 S, 32/3, 32/3 S, 38 A, 38/1, 38/1 S, 38/2, 38/2 S
Encoders:
5500, 5540, IE3-1024, IE3-1024 L
Drive Electronics:
Speed Controller, Motion Controller

Series 3564 ... B

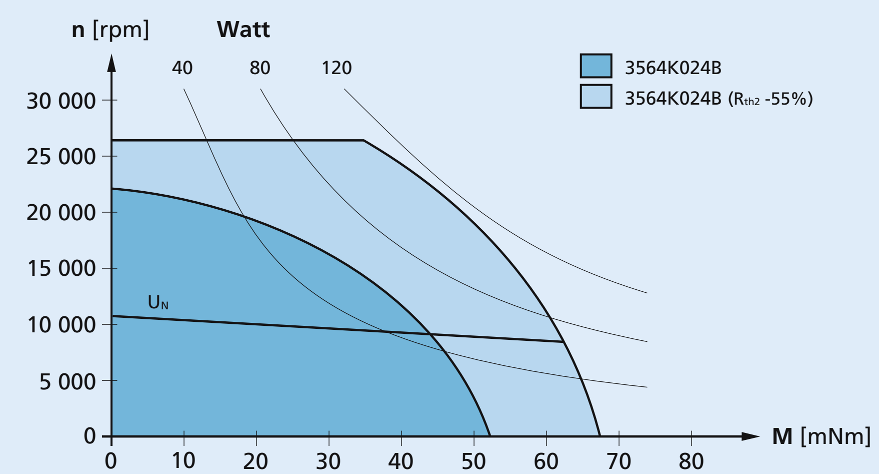
		3564 K		012 B	024 B	036 B	048 B	
1	Nominal voltage	U_N		12	24	36	48	Volt
2	Terminal resistance, phase-phase	R		0,6	1,16	2,8	4,4	Ω
3	Output power [1]	$P_{2\,max.}$		109	101	101	101	W
4	Efficiency	$\eta_{max.}$		81	81	81	82	%
5	No-load speed	n_o		7 850	11 300	11 550	12 200	rpm
6	No-load current (with shaft ø 4,0 mm)	I_o		0,206	0,189	0,131	0,109	A
7	Stall torque	M_H		291	371	379	401	mNm
8	Friction torque, static	C_o		1,10	1,10	1,10	1,10	mNm
9	Friction torque, dynamic	C_v		$2,4 \cdot 10^{-4}$	$2,4 \cdot 10^{-4}$	$2,4 \cdot 10^{-4}$	$2,4 \cdot 10^{-4}$	mNm/rpm
10	Speed constant	k_n		658	475	324	258	rpm/V
11	Back-EMF constant	k_E		1,521	2,107	3,089	3,877	mV/rpm
12	Torque constant	k_M		14,52	20,12	29,50	37,02	mNm/A
13	Current constant	k_I		0,069	0,050	0,034	0,027	A/mNm
14	Slope of n-M curve	$\Delta n/\Delta M$		27	31	31	31	rpm/mNm
15	Terminal inductance, phase-phase	L		96	194	427	678	µH
16	Mechanical time constant	τ_m		10	11	11	11	ms
17	Rotor inertia	J		34	34	34	34	gcm^2
18	Angular acceleration	$\alpha_{max.}$		86	109	111	118	$\cdot 10^3 rad/s^2$
19	Thermal resistance	$R_{th\,1}$ / $R_{th\,2}$	2,5 / 6,3					K/W
20	Thermal time constant	τ_{w1} / τ_{w2}	23 / 1 175					s
21	Operating temperature range		– 30 ... +125					°C
22	Shaft bearings		ball bearings, preloaded					
23	Shaft load max.:							
	– radial at 3 000/20 000 rpm (7,4 mm from mounting flange)		108 / 73					N
	– axial at 3 000/20 000 rpm (push-on only)		50 / 30					N
	– axial at standstill (push-on only)		131					N
24	Shaft play:							
	– radial	≤	0,015					mm
	– axial	=	0					mm
25	Housing material		aluminium, black anodized					
26	Weight		310					g
27	Direction of rotation		electronically reversible					
	Recommended values - mathematically independent of each other							
28	Speed up to [2]	$n_{e\,max.}$		27 000	27 000	27 000	27 000	rpm
29	Torque up to [1,2]	$M_{e\,max.}$		47,1	44,0	43,9	44,0	mNm
30	Current up to [1,2]	$I_{e\,max.}$		3,68	2,50	1,71	1,36	A

[1] at 22 000 rpm
[2] thermal resistance $R_{th\,2}$ by 55% reduced

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

The diagram shows the motor in a completely insulated as well as thermally coupled condition ($R_{th\,2}$ 55% reduced).

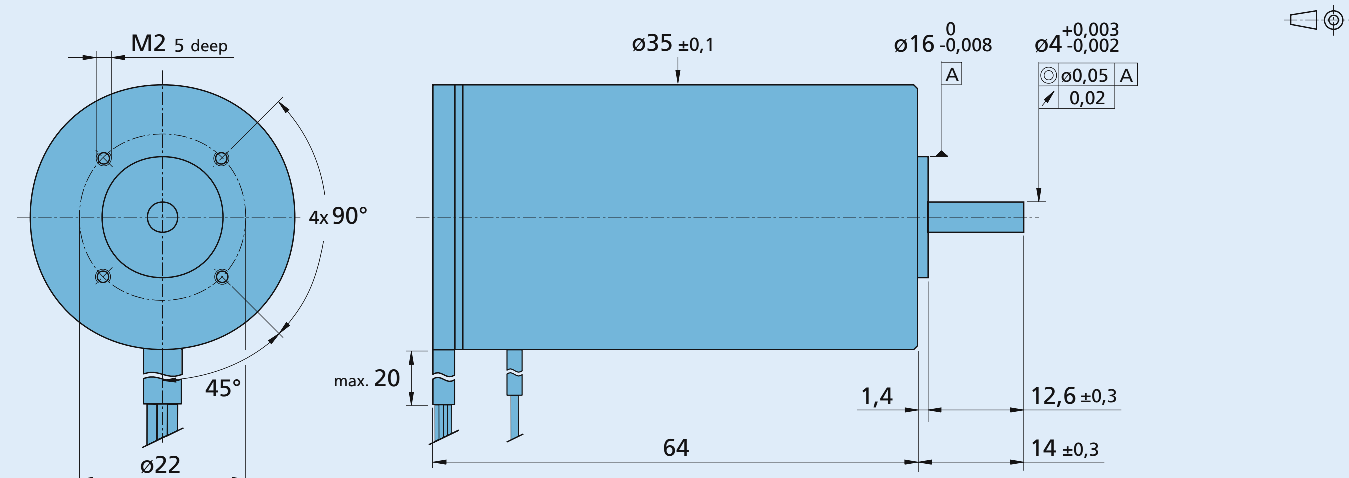
The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended areas for continuous operation

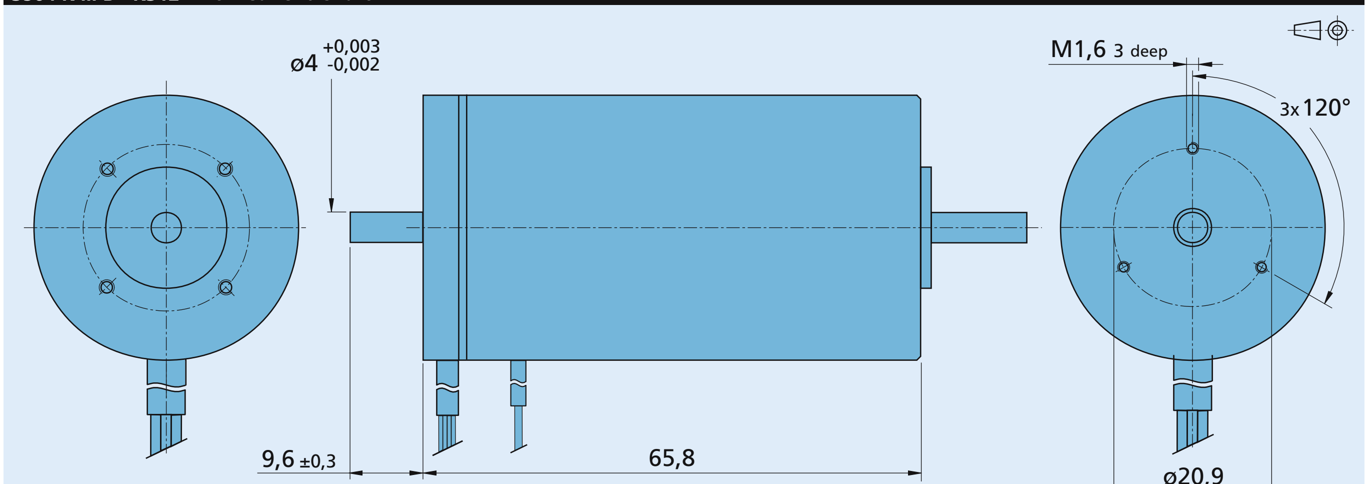
Options
K1000:
Motors in autoclavable version.
K1155:
Motors with analog Hall sensors
for operation with Motion Controllers

3564 K ... B



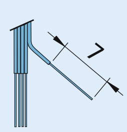
3564 K ... B

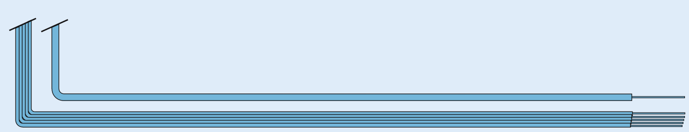
3564 K ... B - K312 with rear end shaft



3564 K ... B - K312

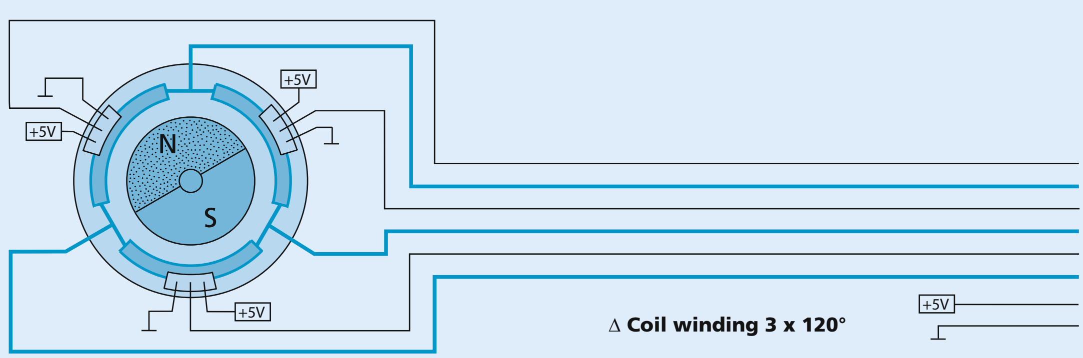
Cable and connection information





Cable
Single wires, material PTFE
Length 300 mm ± 15 mm
3 conductors, AWG 20
5 conductors, AWG 26

Note
Hallsensors digital
Number of pole pairs = 1



Δ Coil winding 3 x 120°

Connection

	Function	Colour
A	Hall sensor	green
A	Phase	brown
B	Hall sensor	blue
B	Phase	orange
C	Hall sensor	grey
C	Phase	yellow
+5V		red
GND		black

Brushless DC-Servomotors

191 mNm

For combination with
Gearheads:
38A, 44/1
Encoders:
IE3-1024, IE3-1024 L, 40B
Drive Electronics:
Speed Controller, Motion Controller

Series 4490 ... B

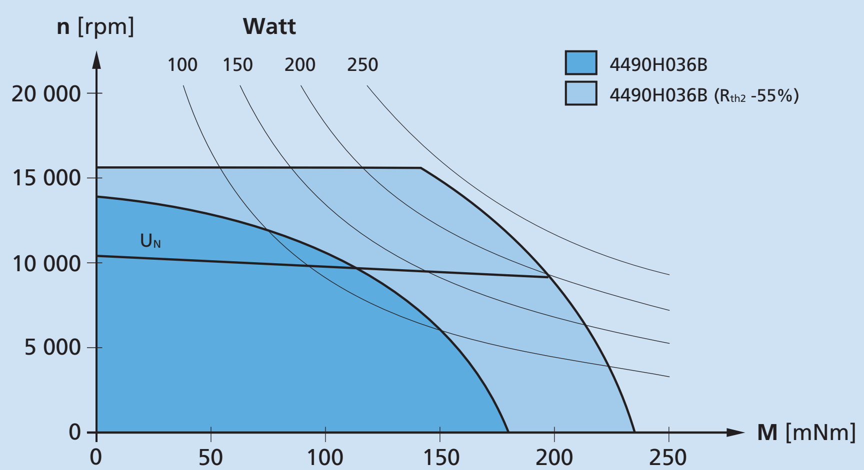
		4490 H		024 B	036 B	048 B	
1	Nominal voltage	U_N		24	36	48	Volt
2	Terminal resistance, phase-phase	R		0,237	0,445	0,720	Ω
3	Output power [1]	$P_{2\ max.}$		201	201	200	W
4	Efficiency	$\eta_{max.}$		86	86	86	%
5	No-load speed	n_o		9 550	10 450	11 000	rpm
6	No-load current (with shaft ø 6,0 mm)	I_o		0,554	0,432	0,354	A
7	Stall torque	M_H		2 406	2 637	2 758	mNm
8	Friction torque, static	C_o		3,65	3,65	3,65	mNm
9	Friction torque, dynamic	C_v		$1,0 \cdot 10^{-3}$	$1,0 \cdot 10^{-3}$	$1,0 \cdot 10^{-3}$	mNm/rpm
10	Speed constant	k_n		401	292	231	rpm/V
11	Back-EMF constant	k_E		2,495	3,422	4,335	mV/rpm
12	Torque constant	k_M		23,83	32,68	41,40	mNm/A
13	Current constant	k_I		0,042	0,031	0,024	A/mNm
14	Slope of n-M curve	$\Delta n/\Delta M$		4,0	4,0	4,0	rpm/mNm
15	Terminal inductance, phase-phase	L		76	143	236	µH
16	Mechanical time constant	τ_m		5	5	5	ms
17	Rotor inertia	J		130	130	130	gcm²
18	Angular acceleration	$\alpha_{max.}$		185	203	212	$\cdot 10^3 rad/s^2$
19	Thermal resistance	R_{th1} / R_{th2}	1,35 / 3,94				K/W
20	Thermal time constant	τ_{w1} / τ_{w2}	29 / 1 756				s
21	Operating temperature range		– 30 ... +125				°C
22	Shaft bearings		ball bearings, preloaded				
23	Shaft load max.:						
	– radial at 3 000/10 000 rpm (13,5 mm from mounting flange)		103 / 66				N
	– axial at 3 000/10 000 rpm (push-on only)		45 / 30				N
	– axial at standstill (push-on only)		135				N
24	Shaft play:						
	– radial	≤	0,015				mm
	– axial	=	0				mm
25	Housing material		aluminium, black anodized				
26	Weight		750				g
27	Direction of rotation		electronically reversible				
	Coil connection		Δ Delta-circuit				
Recommended values - mathematically independent of each other							
28	Speed up to [2]	$n_{e\ max.}$		16 000	16 000	16 000	rpm
29	Torque up to [1] [2]	$M_{e\ max.}$		191,8	191,9	191,1	mNm
30	Current up to [1] [2]	$I_{e\ max.}$		8,62	6,29	4,95	A

[1] at 10 000 rpm
[2] thermal resistance R_{th2} by 55% reduced

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

The diagram shows the motor in a completely insulated as well as thermally coupled condition (R_{th2} 55% reduced).

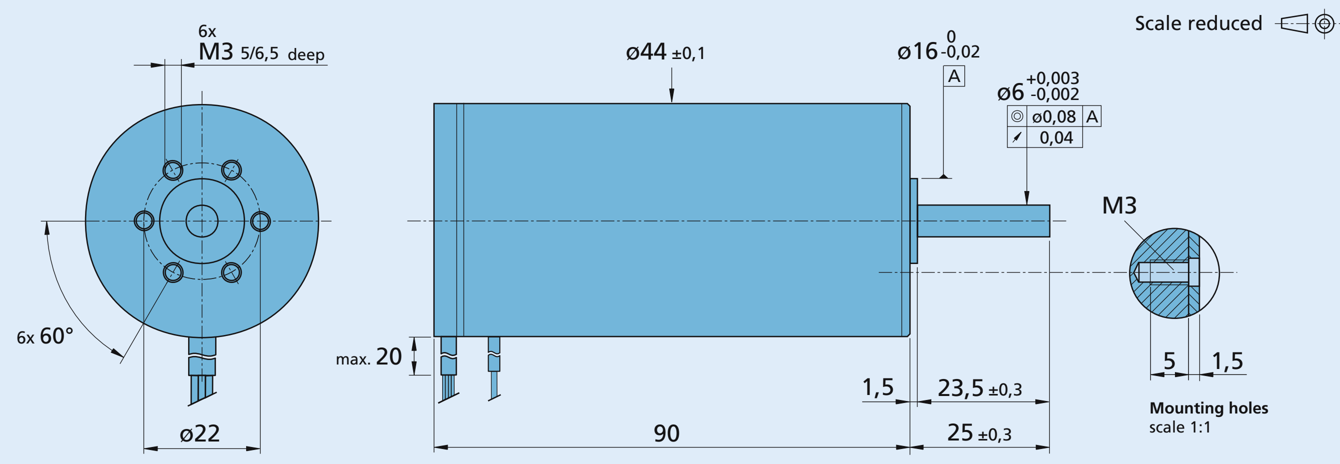
The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended areas for continuous operation

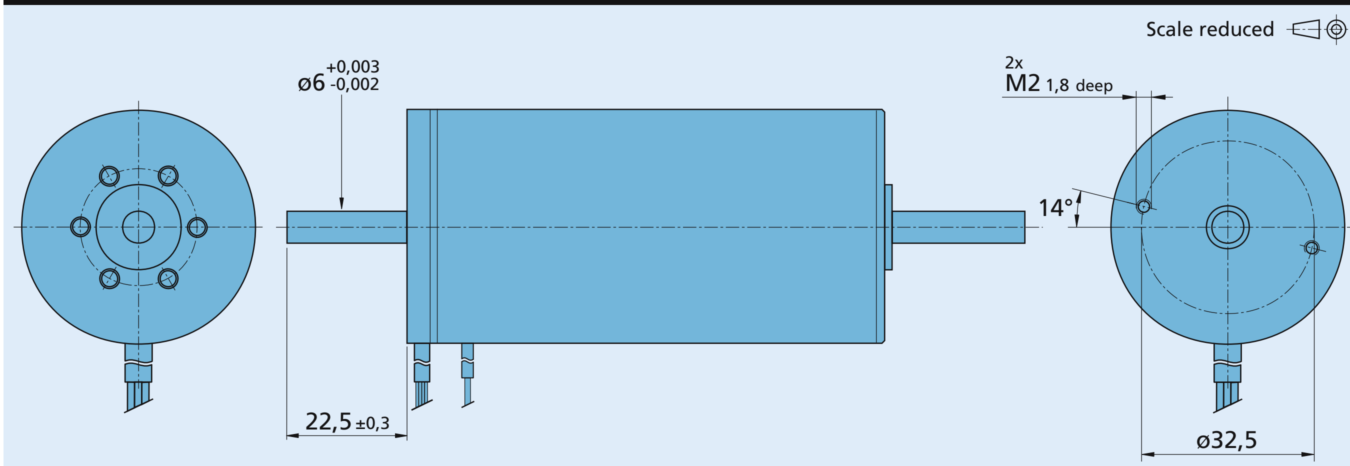
Options
K1155:
Motors with analog Hall sensors
for operation with Motion Controllers

4490 H ... B



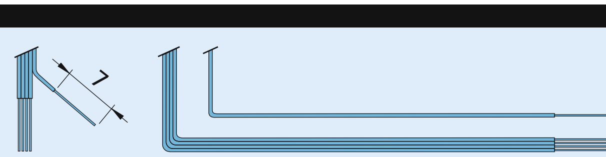
4490 H ... B

4490 H ... B - K312 with rear end shaft



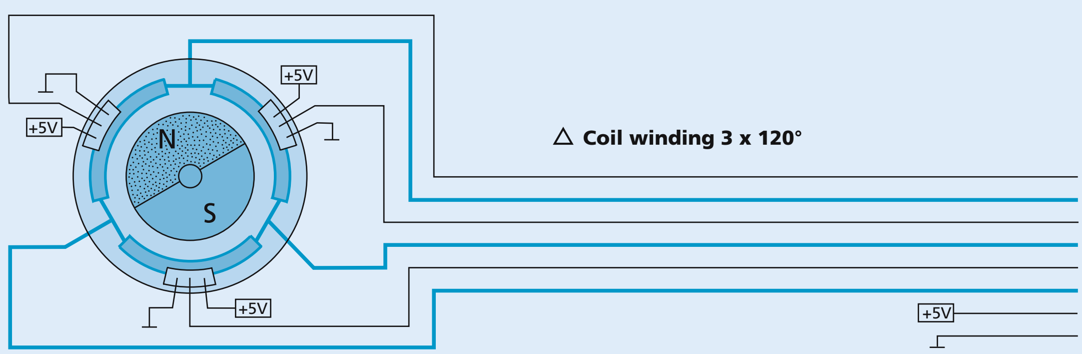
4490 H ... B - K312

Cable and connection information



Cable
Single wires, material PTFE
Length 300 mm ± 15 mm
3 conductors, AWG 16
5 conductors, AWG 26

Note
Hallsensors digital
Number of pole pairs = 1



Connection

	Function	Colour
A	Hall sensor	green
A	Phase	brown
B	Hall sensor	blue
B	Phase	orange
C	Hall sensor	grey
C	Phase	yellow
+5V		red
GND		black

Brushless DC-Servomotors

202 mNm

For combination with
Gearheads:
38A, 44/1
Encoders:
IE3-1024, IE3-1024 L, 40B
Drive Electronics:
Speed Controller, Motion Controller

Series 4490 ... BS

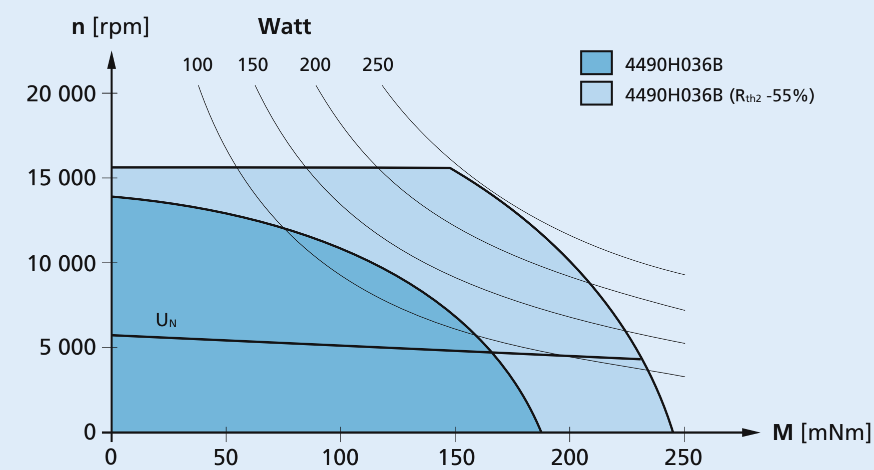
		4490 H		024 BS	036 BS	048 BS	
1	Nominal voltage	U_N		24	36	48	Volt
2	Terminal resistance, phase-phase	R		0,690	1,340	2,130	Ω
3	Output power [1]	$P_{2\ max.}$		207	210	212	W
4	Efficiency	$\eta_{max.}$		85	85	86	%
5	No-load speed	n_o		5 450	5 790	6 060	rpm
6	No-load current (with shaft ø 6,0 mm)	I_o		0,217	0,160	0,129	A
7	Stall torque	M_H		1 455	1 584	1 689	mNm
8	Friction torque, static	C_o		3,65	3,65	3,65	mNm
9	Friction torque, dynamic	C_v		$1{,}0 \cdot 10^{-3}$	$1{,}0 \cdot 10^{-3}$	$1{,}0 \cdot 10^{-3}$	mNm/rpm
10	Speed constant	k_n		228	162	127	rpm/V
11	Back-EMF constant	k_E		4,384	6,185	7,871	mV/rpm
12	Torque constant	k_M		41,86	59,06	75,16	mNm/A
13	Current constant	k_I		0,024	0,017	0,013	A/mNm
14	Slope of n-M curve	$\Delta n/\Delta M$		3,8	3,7	3,6	rpm/mNm
15	Terminal inductance, phase-phase	L		220	435	720	µH
16	Mechanical time constant	τ_m		5	5	5	ms
17	Rotor inertia	J		130	130	130	gcm^2
18	Angular acceleration	$\alpha_{max.}$		112	122	130	$\cdot 10^3 rad/s^2$
19	Thermal resistance	$R_{th\ 1} / R_{th\ 2}$	1,35 / 3,94				K/W
20	Thermal time constant	τ_{w1} / τ_{w2}	29 / 1 756				s
21	Operating temperature range		– 30 ... +125				°C
22	Shaft bearings		ball bearings, preloaded				
23	Shaft load max.:						
	– radial at 3 000/10 000 rpm (13,5 mm from mounting flange)		103 / 66				N
	– axial at 3 000/10 000 rpm (push-on only)		45 / 30				N
	– axial at standstill (push-on only)		135				N
24	Shaft play:						
	– radial	≤	0,015				mm
	– axial	=	0				mm
25	Housing material		aluminium, black anodized				
26	Weight		750				g
27	Direction of rotation		electronically reversible				
	Coil connection		Y Star-circuit				
Recommended values - mathematically independent of each other							
28	Speed up to [2]	$n_{e\ max.}$		16 000	16 000	16 000	rpm
29	Torque up to [1] [2]	$M_{e\ max.}$		197,8	200,4	202,4	mNm
30	Current up to [1] [2]	$I_{e\ max.}$		5,05	3,63	2,88	A

[1] at 10 000 rpm
[2] thermal resistance $R_{th\ 2}$ by 55% reduced

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

The diagram shows the motor in a completely insulated as well as thermally coupled condition ($R_{th\ 2}$ 55% reduced).

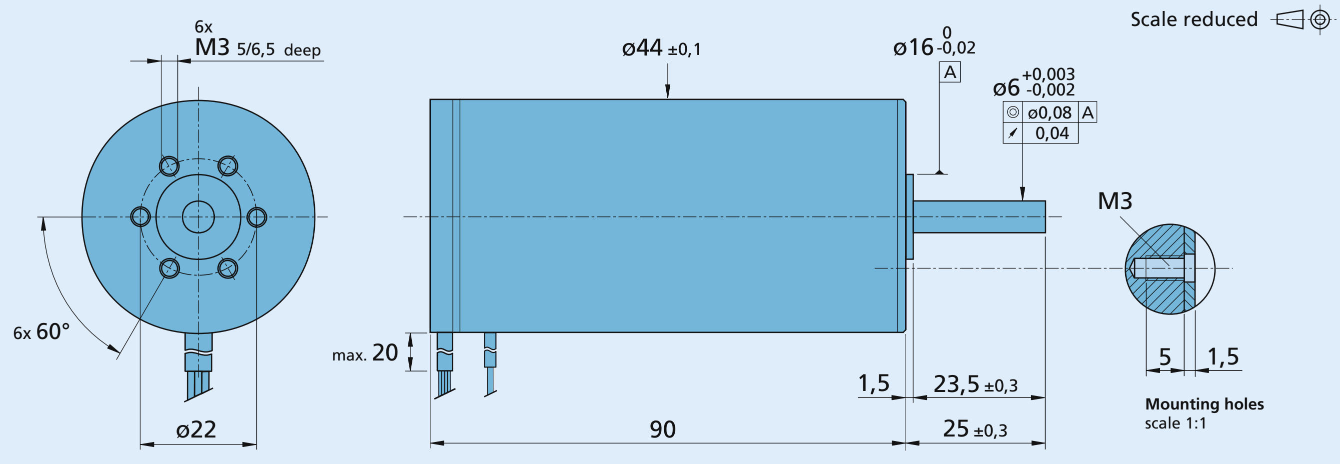
The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended areas for continuous operation

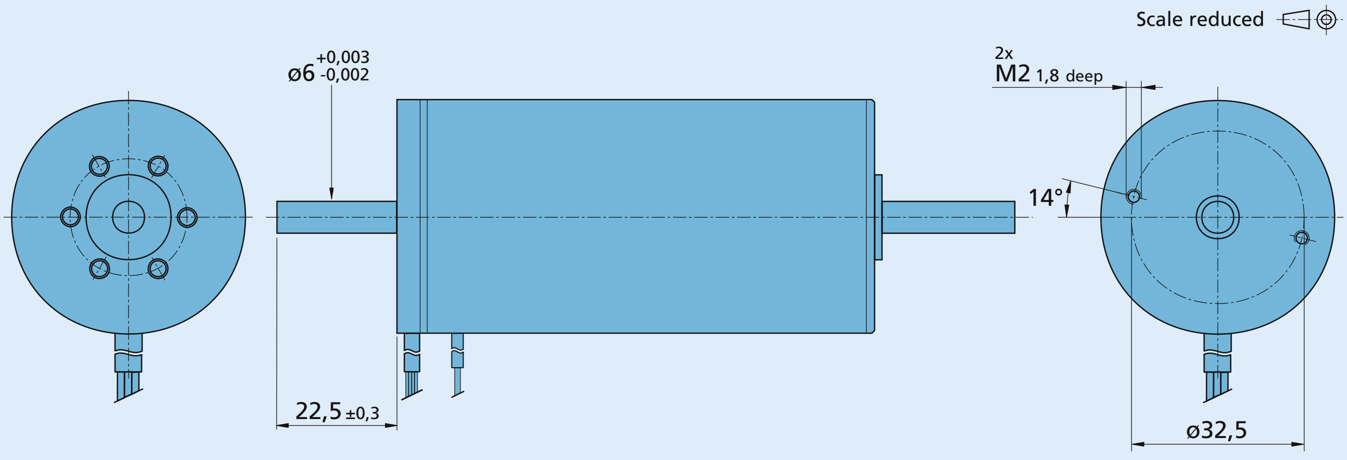
Options
K1155:
Motors with analog Hall sensors
for operation with Motion Controllers

4490 H ... BS



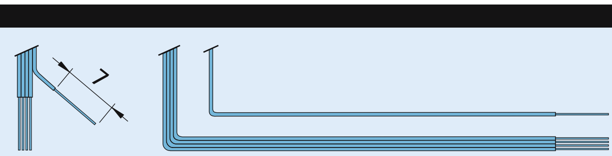
4490 H ... BS

4490 H ... BS - K312 with rear end shaft



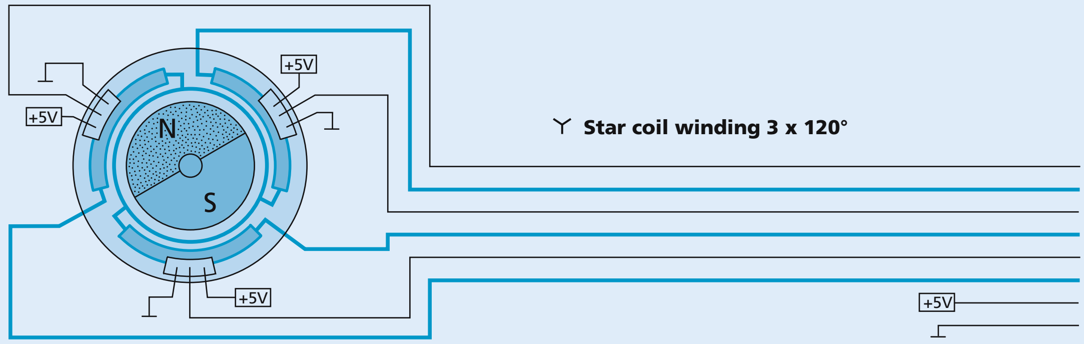
4490 H ... BS - K312

Cable and connection information



Cable
Single wires, material PTFE
Length 300 mm ± 15 mm
3 conductors, AWG 16
5 conductors, AWG 26

Note
Hallsensors digital
Number of pole pairs = 1



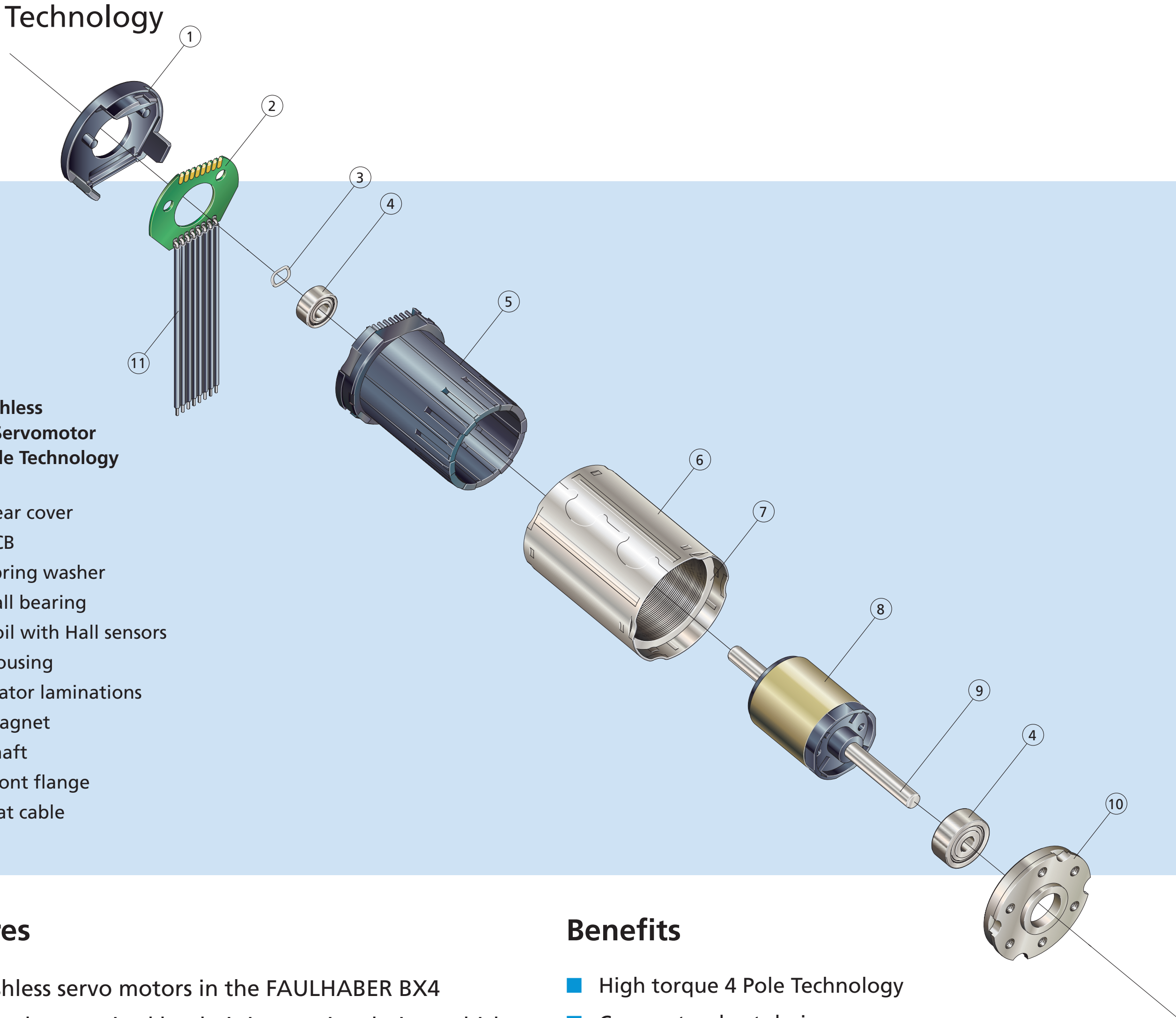
Connection

	Function	Colour
A	Hall sensor	green
A	Phase	brown
B	Hall sensor	blue
B	Phase	orange
C	Hall sensor	grey
C	Phase	yellow
+5V		red
GND		black

FAULHABER

Brushless DC-Servomotors

4 Pole Technology



Brushless DC-Servomotor 4 Pole Technology

① Rear cover
② PCB
③ Spring washer
④ Ball bearing
⑤ Coil with Hall sensors
⑥ Housing
⑦ Stator laminations
⑧ Magnet
⑨ Shaft
⑩ Front flange
⑪ Flat cable

Features

The brushless servo motors in the FAULHABER BX4 series are characterised by their innovative design, which comprises just a few individual components.

Despite their compact dimensions, the 4 pole magnet technology gives these drives a high continuous torque with smooth running characteristics and a particularly low noise level. The modular rotor system makes it possible to tune the performance of the motor to the higher torque or higher speed needs of the application.

Thanks to the electronic commutation of the drives, the lifetime is much longer in comparison with mechanically commutated motors. Alongside the basic version in which the commutation is provided by an external control. The motors come standard with digital Hall sensors.

Due to the optional use of analog Hall sensors, stable regulation of low rotational speeds is also possible without the need for an additional encoder. The flexible motor concept of the BX4 series also includes versions with an integrated encoder, Speed Controller or Motion Controller.

Benefits

- High torque 4 Pole Technology
- Compact, robust design
- Modular design
- Also available as a diameter-compliant version with an integrated encoder, Speed Controller or Motion Controller
- High reliability and operational lifetime
- No sparking
- No cogging
- Dynamically balanced rotor

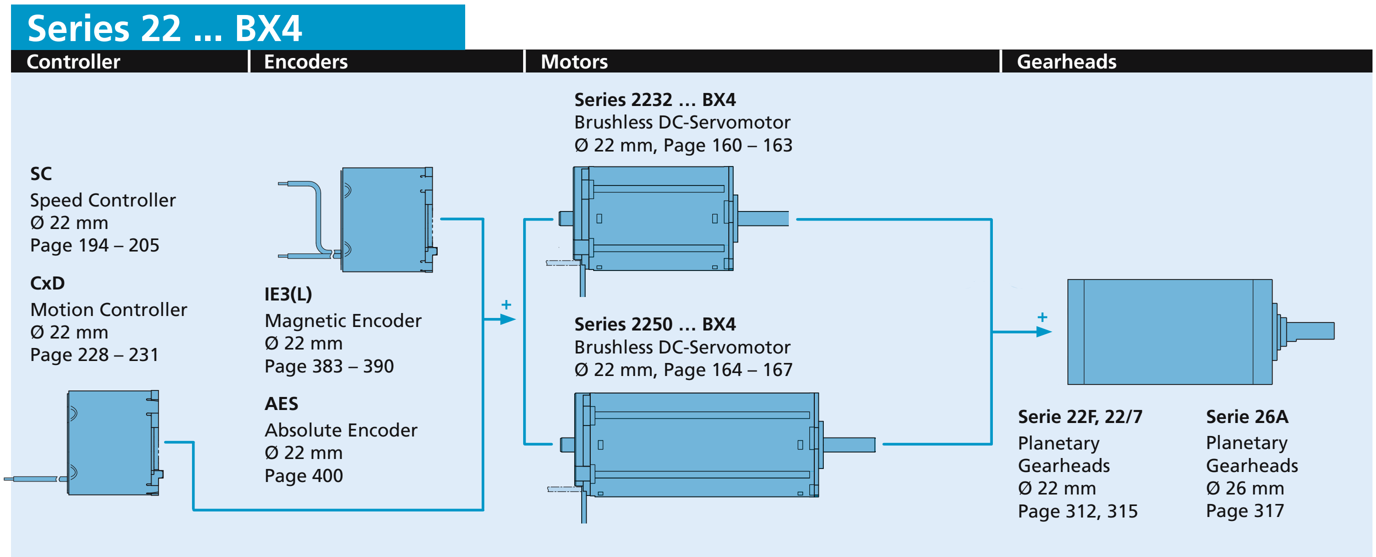
Product Code

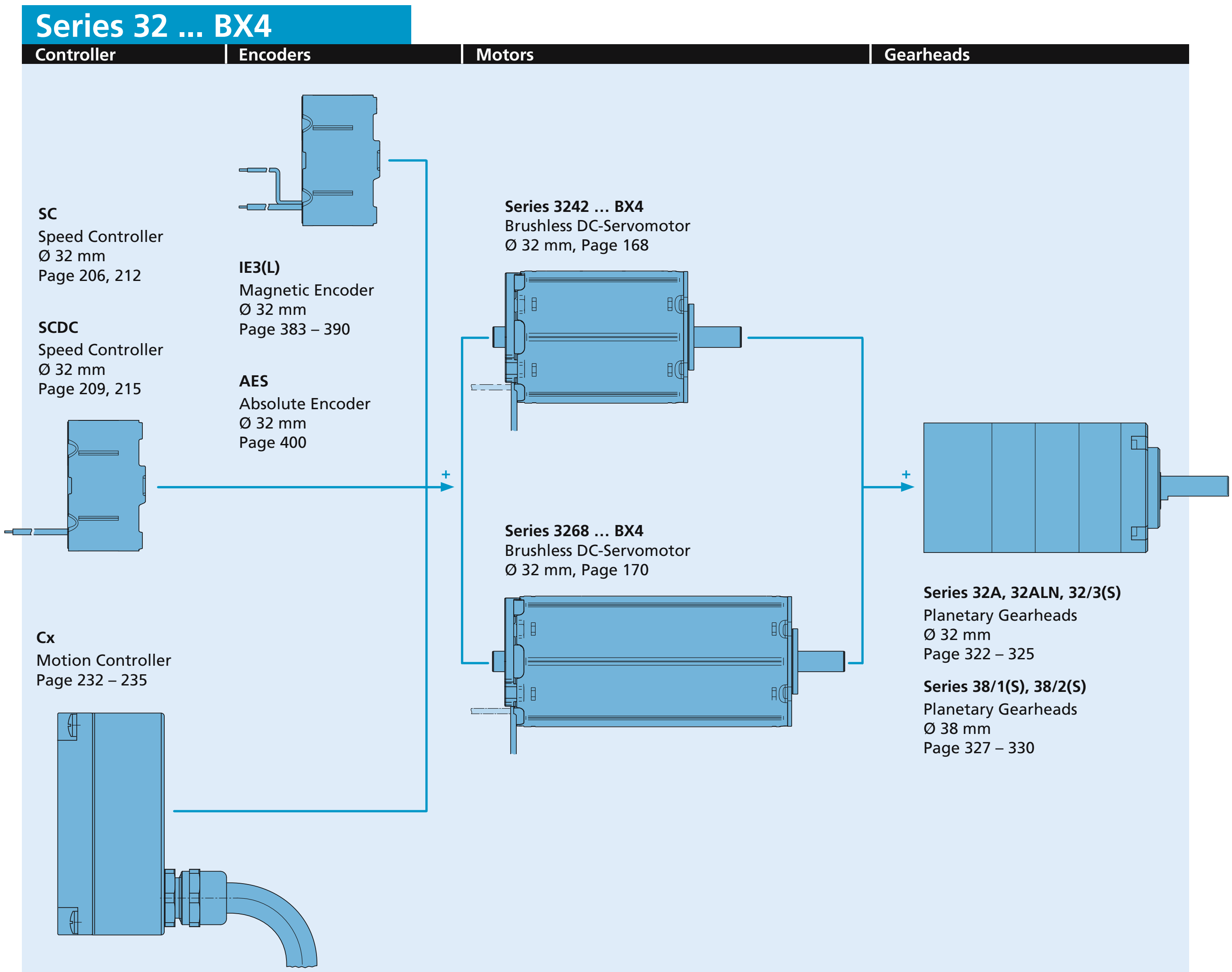
2232 S 012 BX4

22	Motor diameter [mm]
32	Motor length [mm]
S	Shaft type
012	Nominal voltage [V]
BX4	Type of commutation (brushless), 4 Pole Technology

Brushless DC-Servomotors

4 Pole Technology
overview of combinations





Brushless DC-Servomotors

4 Pole Technology

10 mNm

For combination with
Gearheads:
22F, 22/7, 26A
Encoders:
IE3-1024, IE3-1024 L, AES-4096
Drive Electronics:
Speed Controller, Motion Controller

Series 2232 ... BX4 S

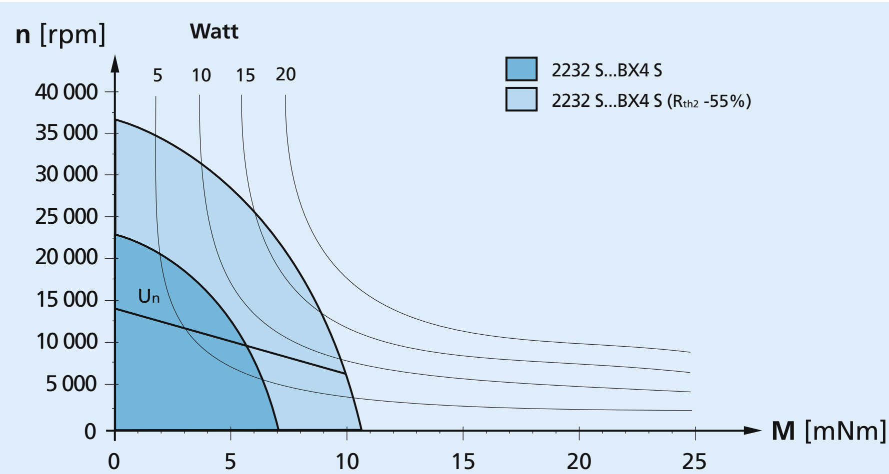
	2232 S			012 BX4 S	024 BX4 S	
1	Nominal voltage	U_N		12	24	Volt
2	Terminal resistance, phase-phase	R		3,5	12,4	Ω
3	Output power 1)	$P_{2\ max.}$		3,8	3,9	W
4	Efficiency	$\eta_{max.}$		60,9	61,7	%
5	No-load speed	n_o		13 200	14 000	rpm
6	No-load current (with shaft ø 3,0 mm)	I_o		0,163	0,088	A
7	Stall torque	M_H		27,3	29,4	mNm
8	Friction torque, static	C_o		0,6	0,6	mNm
9	Friction torque, dynamic	C_v		$5{,}5 \cdot 10^{-5}$	$5{,}5 \cdot 10^{-5}$	mNm/rpm
10	Speed constant	k_n		1 173	616	rpm/V
11	Back-EMF constant	k_E		0,852	1,623	mV/rpm
12	Torque constant	k_M		8,14	15,50	mNm/A
13	Current constant	k_I		0,123	0,065	A/mNm
14	Slope of n-M curve	$\Delta n/\Delta M$		504	493	rpm/mNm
15	Terminal inductance, phase-phase	L		130	470	µH
16	Mechanical time constant	τ_m		22	22	ms
17	Rotor inertia	J		4,2	4,2	gcm^2
18	Angular acceleration	$\alpha_{max.}$		65	70	$\cdot 10^3 rad/s^2$
19	Thermal resistance	$R_{th\ 1}$ / $R_{th\ 2}$	2 / 17			K/W
20	Thermal time constant	τ_{w1} / τ_{w2}	4,1 / 360			s
21	Operating temperature range		– 40 ... + 100			°C
22	Shaft bearings		ball bearings, preloaded			
23	Shaft load max.:					
	– radial at 3 000 rpm (4 mm from mounting flange)		20			N
	– axial at 3 000 rpm		2			N
	– axial at standstill		20			N
24	Shaft play:					
	– radial	≤	0,015			mm
	– axial	=	0			mm
25	Housing material		stainless steel			
26	Weight		70			g
27	Direction of rotation		electronically reversible			
28	Number of pole pairs		2			
Recommended values - mathematically independent of each other						
29	Speed up to	$n_{e\ max.}$		34 000	34 000	rpm
30	Torque up to 1) 2)	$M_{e\ max.}$		6 / 10	6 / 10	mNm
31	Current up to 1) 2)	$I_{e\ max.}$		0,94 / 1,42	0,50 / 0,75	A

1) at 5 000 rpm
2) thermal resistance $R_{th\ 2}$ not reduced / thermal resistance $R_{th\ 2}$ by 55% reduced

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

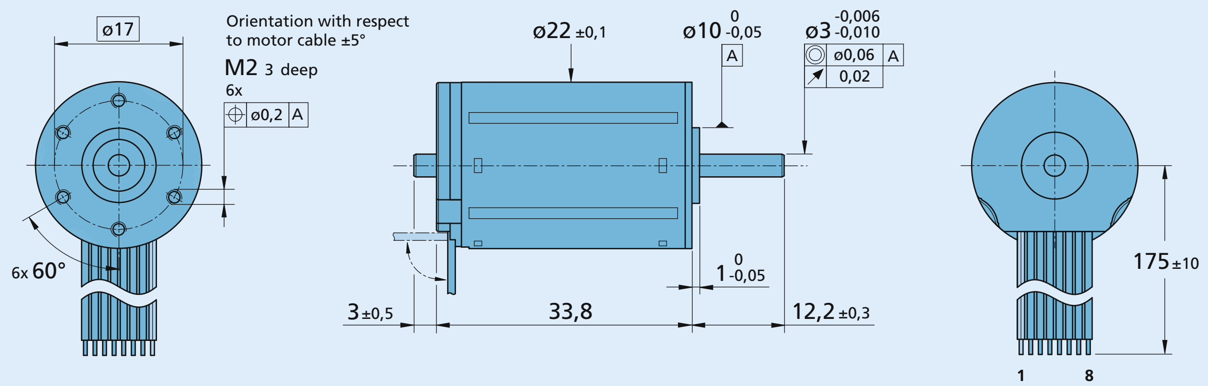
The diagram shows the motor in a completely insulated as well as thermally coupled condition ($R_{th\ 2}$ 55% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended areas for continuous operation

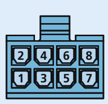
Dimensional drawing



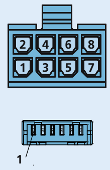
2232 S ... BX4 S

Options

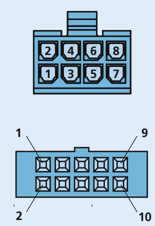
- Analog Hall sensors (Option no. 3692)
- Connector variant (Option no. 3830)
  Motor and motor with encoder AES:
  AWG 26 / PVC ribbon cable
  with connector Micro-Fit



- Connector variant (Option no. 3592)
  Motor:
  AWG 26 / PVC ribbon cable
  with connector Micro-Fit
  Encoder IE3:
  AWG 28 / PVC ribbon cable
  with connector PicoBlade (pitch 1,25 mm)



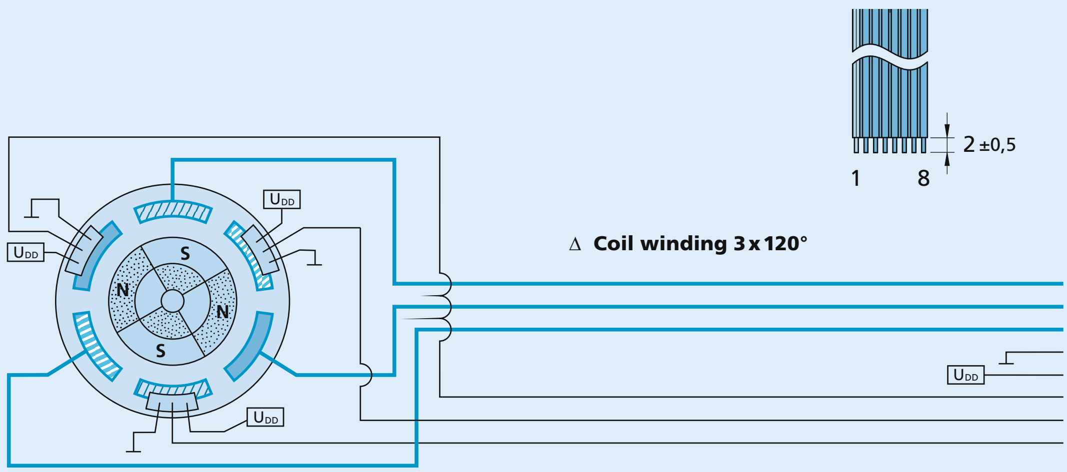
- Connector variant (Option no.: 3589)
  Motor:
  AWG 26 / PVC ribbon cable
  with connector Micro-Fit
  Encoder IE3L:
  AWG 28 / PVC ribbon cable
  with connector DIN-41651 (pitch 2,54 mm)



Full product description

- Examples:
  2232S012BX4S

Cable and connection information



Cable
Jacket Material: PVC
8 conductors, AWG 26
grid 1,27 mm
wires tinned

Note:
Hall sensors digital

Connection

No.	Function
1	Phase C
2	Phase B
3	Phase A
4	GND
5	U_{DD} (4,5 ... 5,5V DC)
6	Hall sensor C
7	Hall sensor B
8	Hall sensor A

Brushless DC-Servomotors

4 Pole Technology

19 mNm

For combination with
Gearheads:
22F, 22/7, 26A
Encoders:
IE3-1024, IE3-1024 L, AES-4096
Drive Electronics:
Speed Controller, Motion Controller

Series 2232 ... BX4

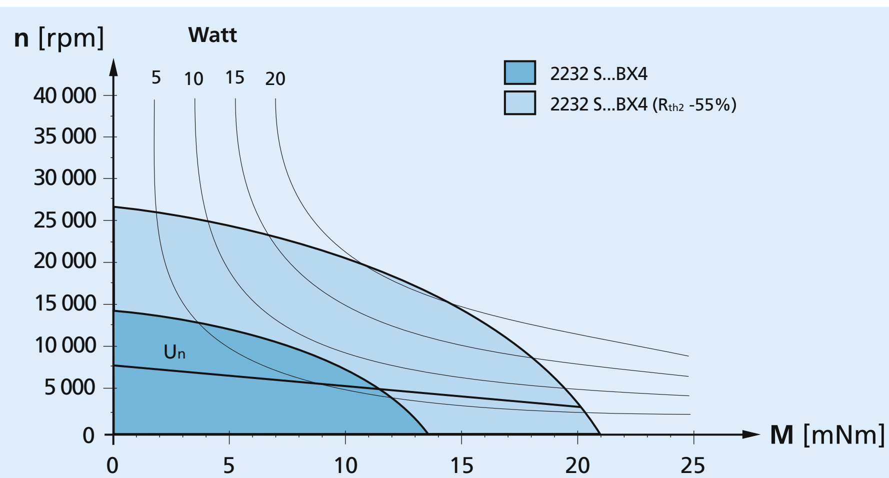
	2232 S		012 BX4	024 BX4	
1	Nominal voltage	U_N	12	24	Volt
2	Terminal resistance, phase-phase	R	3,5	12,4	Ω
3	Output power 1)	$P_{2\,max.}$	7,6	7,7	W
4	Efficiency	$\eta_{max.}$	66,9	67,6	%
5	No-load speed	n_o	6 600	7 000	rpm
6	No-load current (with shaft ø 3,0 mm)	I_o	0,112	0,061	A
7	Stall torque	M_H	55,7	59,9	mNm
8	Friction torque, static	C_o	0,85	0,85	mNm
9	Friction torque, dynamic	C_v	$1,5 \cdot 10^{-4}$	$1,5 \cdot 10^{-4}$	mNm/rpm
10	Speed constant	k_n	579	304	rpm/V
11	Back-EMF constant	k_E	1,728	3,288	mV/rpm
12	Torque constant	k_M	16,50	31,40	mNm/A
13	Current constant	k_I	0,061	0,032	A/mNm
14	Slope of n-M curve	$\Delta n/\Delta M$	123	120	rpm/mNm
15	Terminal inductance, phase-phase	L	120	440	µH
16	Mechanical time constant	τ_m	6,7	6,5	ms
17	Rotor inertia	J	5,2	5,2	gcm^2
18	Angular acceleration	$\alpha_{max.}$	107	115	$\cdot 10^3 rad/s^2$
19	Thermal resistance	R_{th1} / R_{th2}	2 / 17		K/W
20	Thermal time constant	τ_{w1} / τ_{w2}	4,1 / 370		s
21	Operating temperature range		– 40 ... + 100		°C
22	Shaft bearings		ball bearings, preloaded		
23	Shaft load max.:				
	– radial at 3 000 rpm (4 mm from mounting flange)		20		N
	– axial at 3 000 rpm		2		N
	– axial at standstill		20		N
24	Shaft play:				
	– radial	≤	0,015		mm
	– axial	=	0		mm
25	Housing material		stainless steel		
26	Weight		70		g
27	Direction of rotation		electronically reversible		
28	Number of pole pairs		2		
	Recommended values - mathematically independent of each other				
29	Speed up to	$n_{e\,max.}$	22 000	22 000	rpm
30	Torque up to 1) 2)	$M_{e\,max.}$	12 / 19	12 / 19	mNm
31	Current up to 1) 2)	$I_{e\,max.}$	0,90 / 1,40	0,48 / 0,74	A

1) at 5 000 rpm
2) thermal resistance $R_{th\,2}$ not reduced / thermal resistance $R_{th\,2}$ by 55% reduced

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

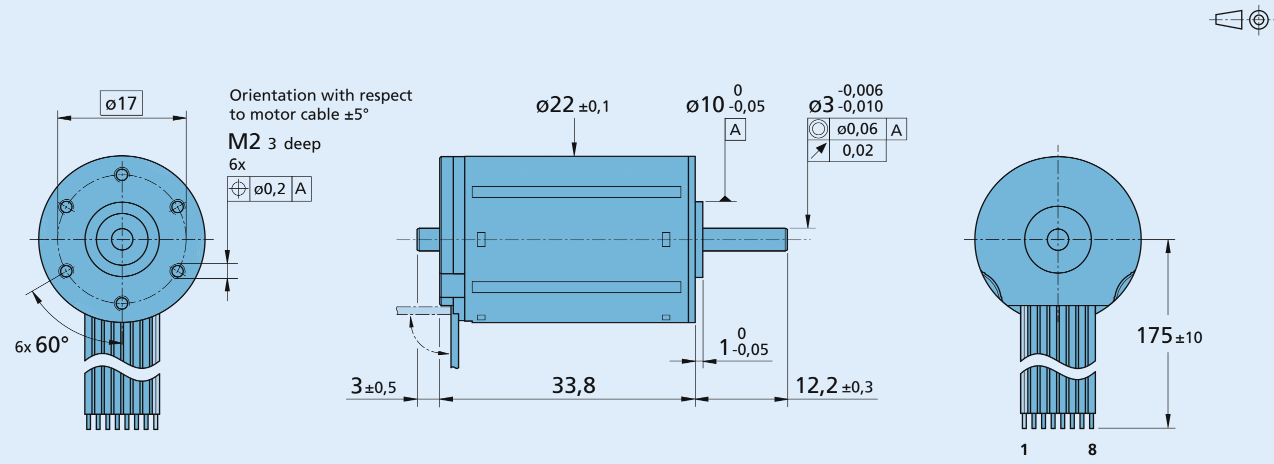
The diagram shows the motor in a completely insulated as well as thermally coupled condition ($R_{th\,2}$ 55% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended areas for continuous operation

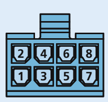
Dimensional drawing



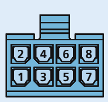
2232 S ... BX4

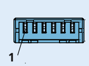
Options

- Analog Hall sensors (Option no. 3692)
- Connector variant (Option no. 3830)
  Motor and motor with encoder AES:
  AWG 26 / PVC ribbon cable
  with connector Micro-Fit

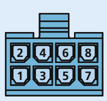


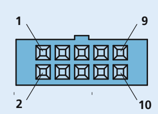
- Connector variant (Option no. 3592)
  Motor:
  AWG 26 / PVC ribbon cable
  with connector Micro-Fit
  Encoder IE3:
  AWG 28 / PVC ribbon cable
  with connector PicoBlade (pitch 1,25 mm)





- Connector variant (Option no.: 3589)
  Motor:
  AWG 26 / PVC ribbon cable
  with connector Micro-Fit
  Encoder IE3L:
  AWG 28 / PVC ribbon cable
  with connector DIN-41651 (pitch 2,54 mm)

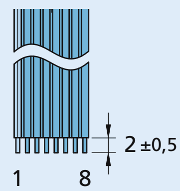




Full product description

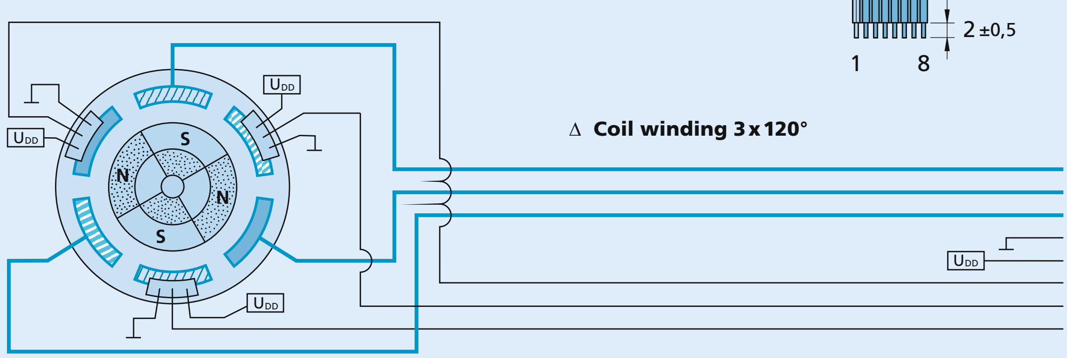
- Examples:
  2232S024BX4

Cable and connection information



Cable
Jacket Material: PVC
8 conductors, AWG 26
grid 1,27 mm
wires tinned

Note:
Hall sensors digital



Connection

No.	Function
1	Phase C
2	Phase B
3	Phase A
4	GND
5	U_{DD} (4,5 ... 5,5V DC)
6	Hall sensor C
7	Hall sensor B
8	Hall sensor A

Brushless DC-Servomotors

4 Pole Technology

22 mNm

For combination with
Gearheads:
22F, 22/7, 26A
Encoders:
IE3-1024, IE3-1024 L, AES-4096
Drive Electronics:
Speed Controller

Series 2250 ... BX4 S

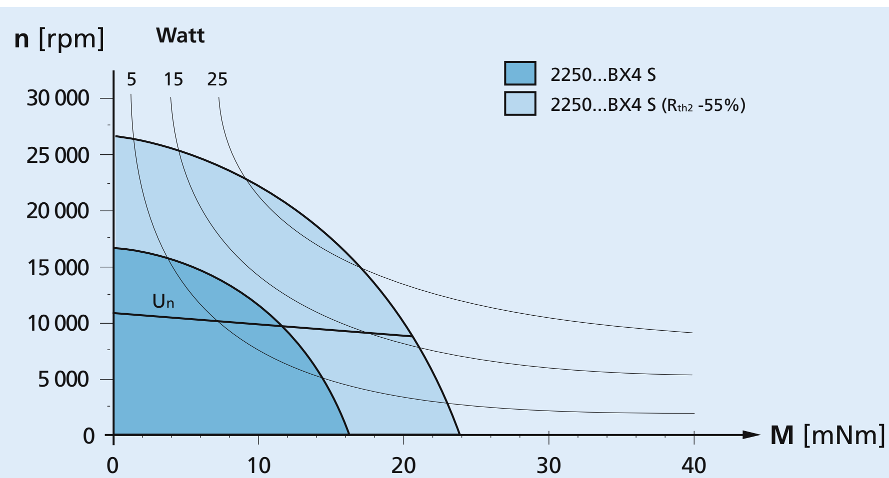
		2250 S		024 BX4 S	
1	Nominal voltage	U_N		24	Volt
2	Terminal resistance, phase-phase	R		5,9	Ω
3	Output power [1]	$P_{2\,max.}$		8,8	W
4	Efficiency	$\eta_{max.}$		70,4	%
5	No-load speed	n_o		10 500	rpm
6	No-load current (with shaft ø 3,0 mm)	I_o		0,105	A
7	Stall torque	M_H		84,7	mNm
8	Friction torque, static	C_o		0,75	mNm
9	Friction torque, dynamic	C_v		$1,4 \cdot 10^{-4}$	mNm/rpm
10	Speed constant	k_n		451	rpm/V
11	Back-EMF constant	k_E		2,218	mV/rpm
12	Torque constant	k_M		21,1	mNm/A
13	Current constant	k_I		0,047	A/mNm
14	Slope of n-M curve	$\Delta n/\Delta M$		125,6	rpm/mNm
15	Terminal inductance, phase-phase	L		250	µH
16	Mechanical time constant	τ_m		6,97	ms
17	Rotor inertia	J		5,3	gcm^2
18	Angular acceleration	$\alpha_{max.}$		160	$\cdot 10^3 rad/s^2$
19	Thermal resistance	R_{th1} / R_{th2}	1,2 / 14		K/W
20	Thermal time constant	τ_{w1} / τ_{w2}	4,2 / 443		s
21	Operating temperature range		– 40 ... + 100		°C
22	Shaft bearings		ball bearings, preloaded		
23	Shaft load max.:				
	– radial at 3 000 rpm (4 mm from mounting flange)		20		N
	– axial at 3 000 rpm		2		N
	– axial at standstill		20		N
24	Shaft play:				
	– radial	≤	0,015		mm
	– axial	=	0		mm
25	Housing material		stainless steel		
26	Weight		90		g
27	Direction of rotation		electronically reversible		
28	Number of pole pairs		2		
	Recommended values - mathematically independent of each other				
29	Speed up to	$n_{e\,max.}$		25 000	rpm
30	Torque up to [1,2]	$M_{e\,max.}$		14 / 22	mNm
31	Current up to [1,2]	$I_{e\,max.}$		0,79 / 1,20	A

[1] at 5 000 rpm
[2] thermal resistance $R_{th\,2}$ not reduced / thermal resistance $R_{th\,2}$ by 55% reduced

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

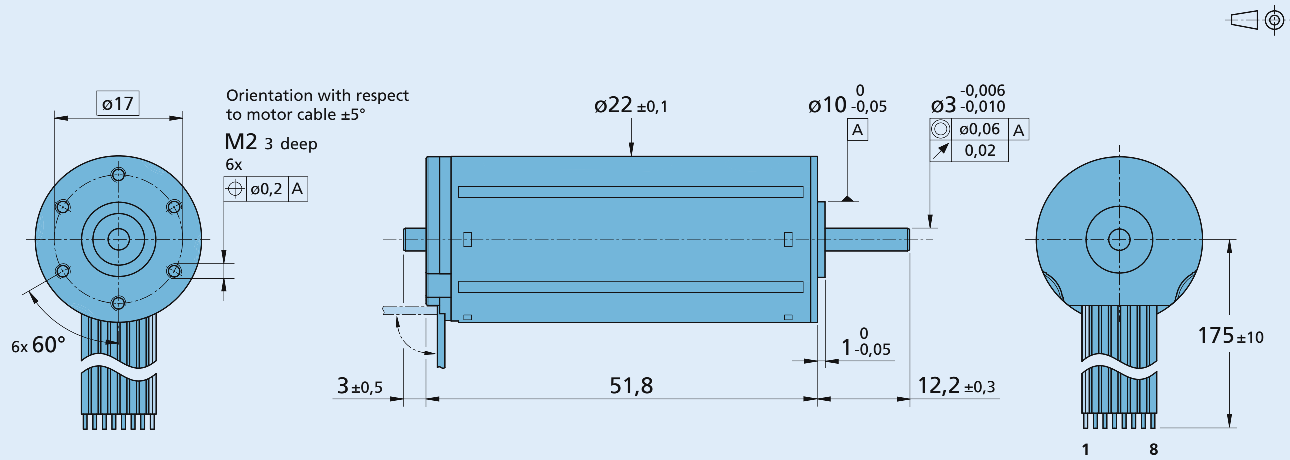
The diagram shows the motor in a completely insulated as well as thermally coupled condition ($R_{th\,2}$ 55% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended areas for continuous operation

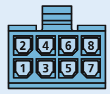
Dimensional drawing



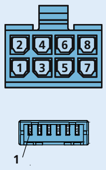
2250 S ... BX4 S

Options

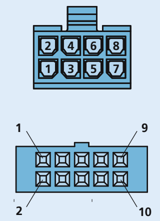
- Connector variant (Option no. 3830)
  Motor and motor with encoder AES:
  AWG 26 / PVC ribbon cable
  with connector Micro-Fit



- Connector variant (Option no. 3592)
  Motor:
  AWG 26 / PVC ribbon cable
  with connector Micro-Fit
  Encoder IE3:
  AWG 28 / PVC ribbon cable
  with connector PicoBlade (pitch 1,25 mm)



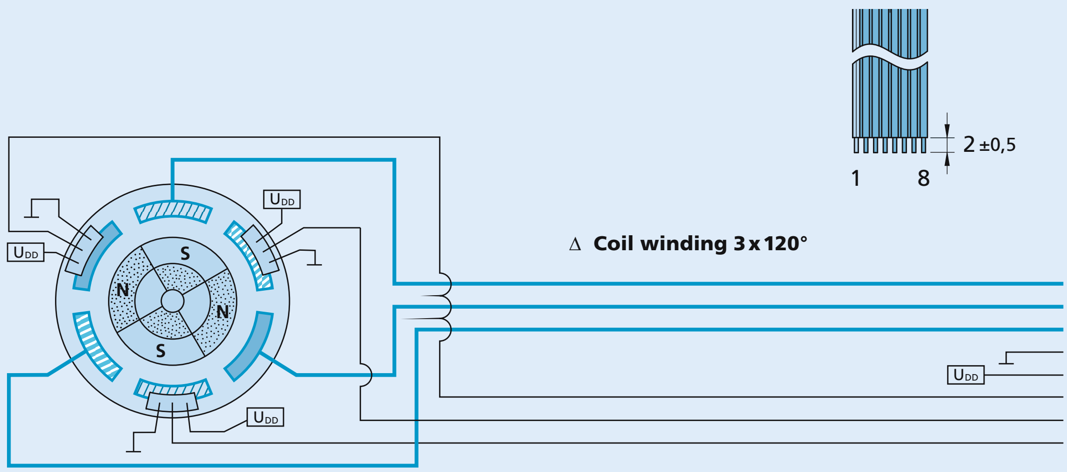
- Connector variant (Option no.: 3589)
  Motor:
  AWG 26 / PVC ribbon cable
  with connector Micro-Fit
  Encoder IE3L:
  AWG 28 / PVC ribbon cable
  with connector DIN-41651 (pitch 2,54 mm)



Full product description

- Examples:
  2250S024 BX4S

Cable and connection information



Cable
Jacket Material: PVC
8 conductors, AWG 26
grid 1,27 mm
wires tinned

Note:
Hall sensors digital

Connection

No.	Function
1	Phase C
2	Phase B
3	Phase A
4	GND
5	UDD (4,5 ... 5,5V DC)
6	Hall sensor C
7	Hall sensor B
8	Hall sensor A

Brushless DC-Servomotors

4 Pole Technology

37 mNm

For combination with
Gearheads:
22F, 22/7, 26A
Encoders:
IE3-1024, IE3-1024 L, AES-4096
Drive Electronics:
Speed Controller, Motion Controller

Series 2250 ... BX4

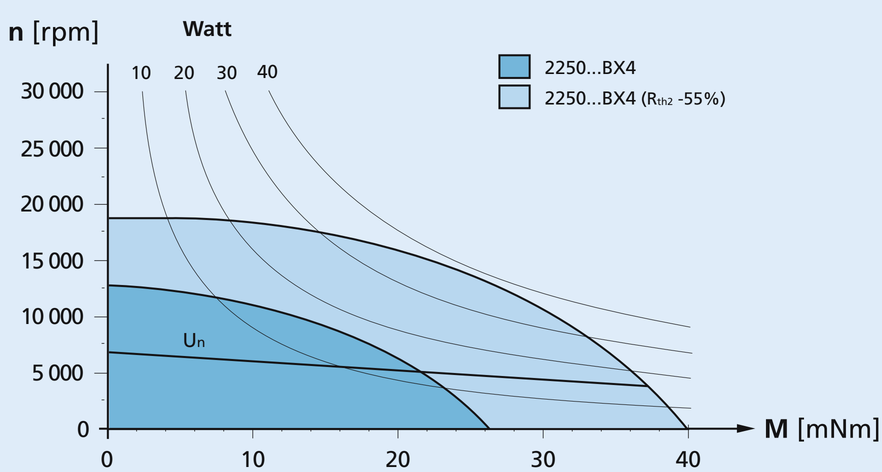
		2250 S	024 BX4	
1	Nominal voltage	U_N	24	Volt
2	Terminal resistance, phase-phase	R	5,9	Ω
3	Output power 1)	$P_{2\,max.}$	14,6	W
4	Efficiency	$\eta_{max.}$	75,0	%
5	No-load speed	n_o	6 000	rpm
6	No-load current (with shaft ø 3,0 mm)	I_o	0,072	A
7	Stall torque	M_H	149,0	mNm
8	Friction torque, static	C_o	1,20	mNm
9	Friction torque, dynamic	C_v	$2{,}4 \cdot 10^{-4}$	mNm/rpm
10	Speed constant	k_n	259	rpm/V
11	Back-EMF constant	k_E	3,860	mV/rpm
12	Torque constant	k_M	36,9	mNm/A
13	Current constant	k_I	0,027	A/mNm
14	Slope of n-M curve	$\Delta n/\Delta M$	41,4	rpm/mNm
15	Terminal inductance, phase-phase	L	240	µH
16	Mechanical time constant	τ_m	4,30	ms
17	Rotor inertia	J	10,0	gcm^2
18	Angular acceleration	$\alpha_{max.}$	149	$\cdot 10^3 rad/s^2$
19	Thermal resistance	$R_{th\,1}$ / $R_{th\,2}$	1,2 / 14	K/W
20	Thermal time constant	τ_{w1} / τ_{w2}	4,2 / 566	s
21	Operating temperature range		– 40 ... + 100	°C
22	Shaft bearings		ball bearings, preloaded	
23	Shaft load max.:			
	– radial at 3 000 rpm (4 mm from mounting flange)		20	N
	– axial at 3 000 rpm		2	N
	– axial at standstill		20	N
24	Shaft play:			
	– radial	≤	0,015	mm
	– axial	=	0	mm
25	Housing material		stainless steel	
26	Weight		106	g
27	Direction of rotation		electronically reversible	
28	Number of pole pairs		2	
	Recommended values - mathematically independent of each other			
29	Speed up to	$n_{e\,max.}$	18 000	rpm
30	Torque up to 1) 2)	$M_{e\,max.}$	23 / 37	mNm
31	Current up to 1) 2)	$I_{e\,max.}$	0,74 / 1,18	A

1) at 5 000 rpm
2) thermal resistance $R_{th\,2}$ not reduced / thermal resistance $R_{th\,2}$ by 55% reduced

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

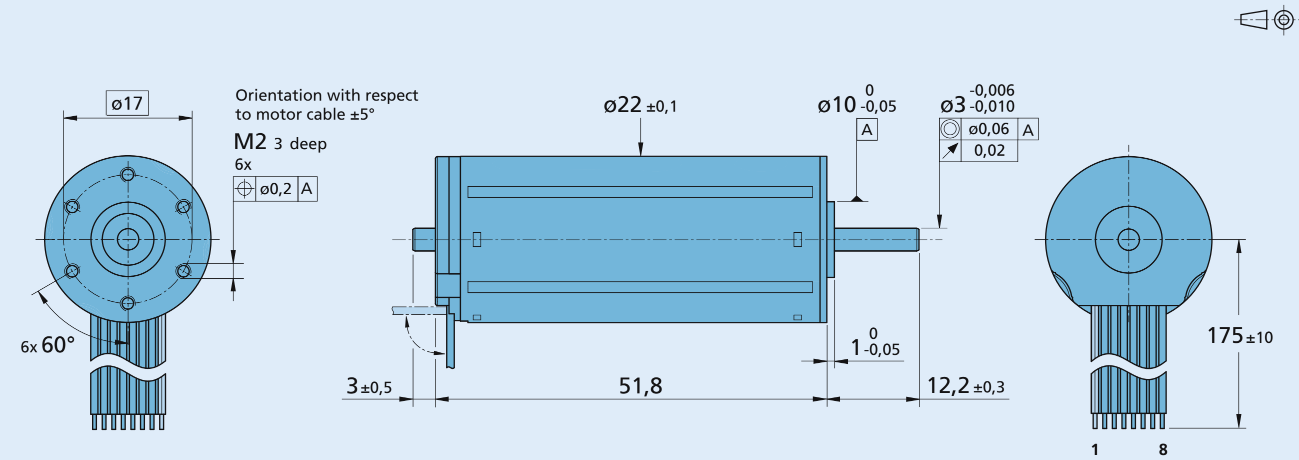
The diagram shows the motor in a completely insulated as well as thermally coupled condition ($R_{th\,2}$ 55% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended areas for continuous operation

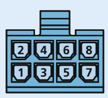
Dimensional drawing



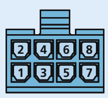
2250 S ... BX4

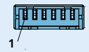
Options

- Analog Hall sensors (Option no. 3692)
- Connector variant (Option no. 3830)
  Motor and motor with encoder AES:
  AWG 26 / PVC ribbon cable
  with connector Micro-Fit

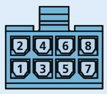


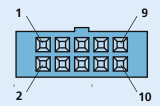
- Connector variant (Option no. 3592)
  Motor:
  AWG 26 / PVC ribbon cable
  with connector Micro-Fit
  Encoder IE3:
  AWG 28 / PVC ribbon cable
  with connector PicoBlade (pitch 1,25 mm)





- Connector variant (Option no.: 3589)
  Motor:
  AWG 26 / PVC ribbon cable
  with connector Micro-Fit
  Encoder IE3L:
  AWG 28 / PVC ribbon cable
  with connector DIN-41651 (pitch 2,54 mm)

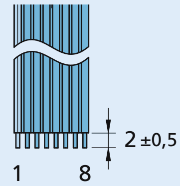




Full product description

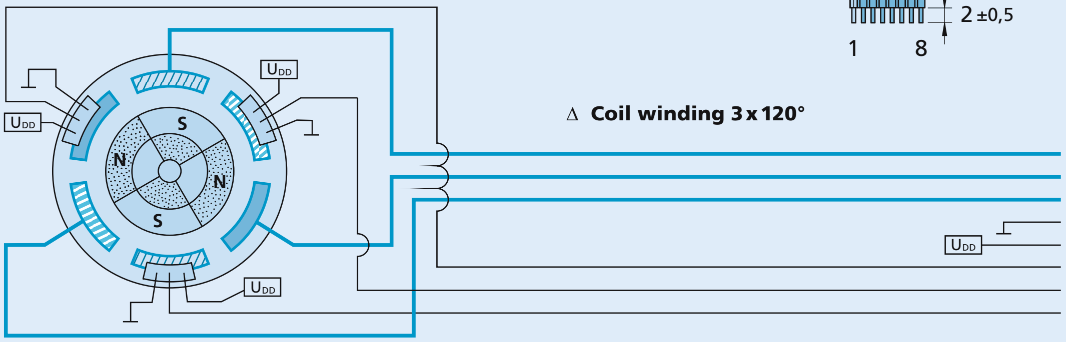
- Examples:
  2250S024 BX4

Cable and connection information



Cable
Jacket Material: PVC
8 conductors, AWG 26
grid 1,27 mm
wires tinned

Note:
Hall sensors digital



Connection

No.	Function
1	Phase C
2	Phase B
3	Phase A
4	GND
5	U_{DD} (4,5 ... 5,5V DC)
6	Hall sensor C
7	Hall sensor B
8	Hall sensor A

Brushless DC-Servomotors

4 Pole Technology

56 mNm

For combination with
Gearheads:
32A, 32ALN, 32/3, 32/3 S, 38/1, 38/1 S, 38/2, 38/2 S
Encoders:
IE3-1024, IE3-1024 L, AES-4096
Drive Electronics:
Speed Controller, Motion Controller

Series 3242 ... BX4

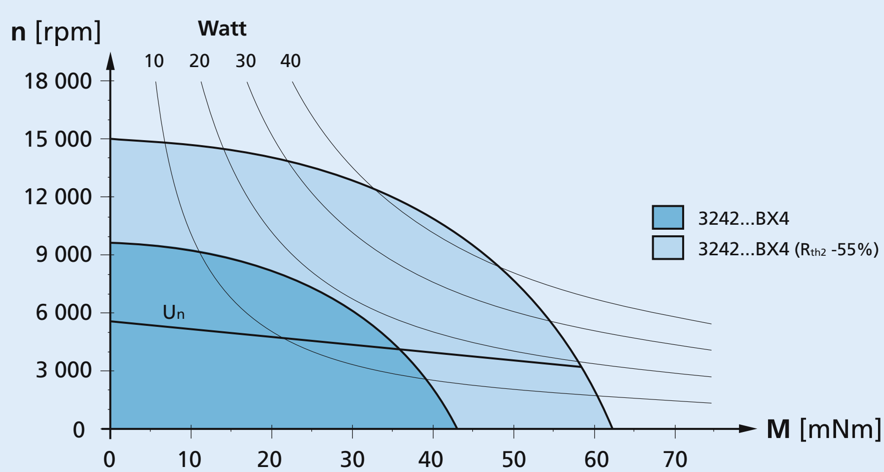
	3242 G			012 BX4	024 BX4	
1	Nominal voltage	U_N		12	24	Volt
2	Terminal resistance, phase-phase	R		0,89	3,6	Ω
3	Output power [1]	$P_{2\ max.}$		21,7	21,7	W
4	Efficiency	$\eta_{max.}$		77,4	77,3	%
5	No-load speed	n_o		5 500	5 500	rpm
6	No-load current	I_o		0,206	0,103	A
7	Stall torque	M_H		282	279	mNm
8	Friction torque, static	C_o		1,3	1,3	mNm
9	Friction torque, dynamic	C_v		$5{,}2 \cdot 10^{-4}$	$5{,}2 \cdot 10^{-4}$	mNm/rpm
10	Speed constant	k_n		455	227	rpm/V
11	Back-EMF constant	k_E		2,199	4,409	mV/rpm
12	Torque constant	k_M		21,0	42,1	mNm/A
13	Current constant	k_I		0,0476	0,0238	A/mNm
14	Slope of n-M curve	$\Delta n/\Delta M$		19,3	19,4	rpm/mNm
15	Terminal inductance, phase-phase	L		60	240	µH
16	Mechanical time constant	τ_m		6,1	6,1	ms
17	Rotor inertia	J		30	30	gcm^2
18	Angular acceleration	$\alpha_{max.}$		94	93	$\cdot 10^3 rad/s^2$
19	Thermal resistance	$R_{th\ 1} / R_{th\ 2}$	1,6 / 11,9			K/W
20	Thermal time constant	τ_{w1} / τ_{w2}	9 / 780			s
21	Operating temperature range		– 40 ... + 100			°C
22	Shaft bearings		ball bearings, preloaded			
23	Shaft load max.:					
	– radial at 3 000 rpm (4,5 mm from mounting flange)		50			N
	– axial at 3 000 rpm		5			N
	– axial at standstill		50			N
24	Shaft play:					
	– radial	≤	0,015			mm
	– axial	=	0			mm
25	Housing material		stainless steel			
26	Weight		177			g
27	Direction of rotation		electronically reversible			
28	Number of pole pairs		2			
	Recommended values - mathematically independent of each other					
29	Speed up to	$n_{e\ max.}$		14 500	14 500	rpm
30	Torque up to [1] [2]	$M_{e\ max.}$		33 / 56	33 / 56	mNm
31	Current up to [1] [2]	$I_{e\ max.}$		1,95 / 3,19	0,97 / 1,59	A

[1] at 5 000 rpm
[2] thermal resistance $R_{th\ 2}$ not reduced / thermal resistance $R_{th\ 2}$ by 55% reduced

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

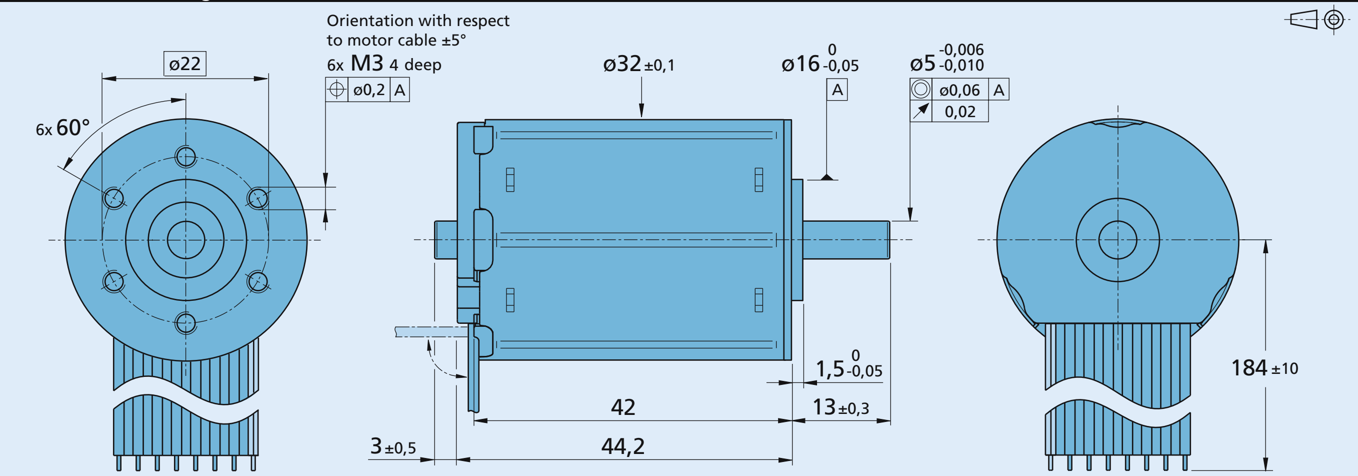
The diagram shows the motor in a completely insulated as well as thermally coupled condition ($R_{th\ 2}$ 55% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended areas for continuous operation

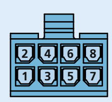
Dimensional drawing



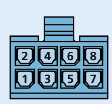
3242 G ... BX4

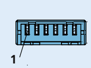
Options

- Analog Hall sensors (Option no. 3692)
- Connector variant (Option no. 3830)
  Motor and motor with encoder AES:
  AWG 24 / PVC ribbon cable
  with connector Micro-Fit

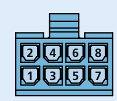


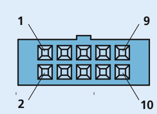
- Connector variant (Option no. 3592)
  Motor:
  AWG 24 / PVC ribbon cable
  with connector Micro-Fit
  Encoder IE3:
  AWG 28 / PVC ribbon cable
  with connector PicoBlade (pitch 1,25 mm)





- Connector variant (Option no.: 3589)
  Motor:
  AWG 24 / PVC ribbon cable
  with connector Micro-Fit
  Encoder IE3L:
  AWG 28 / PVC ribbon cable
  with connector DIN-41651 (pitch 2,54 mm)

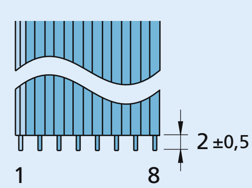




Full product description

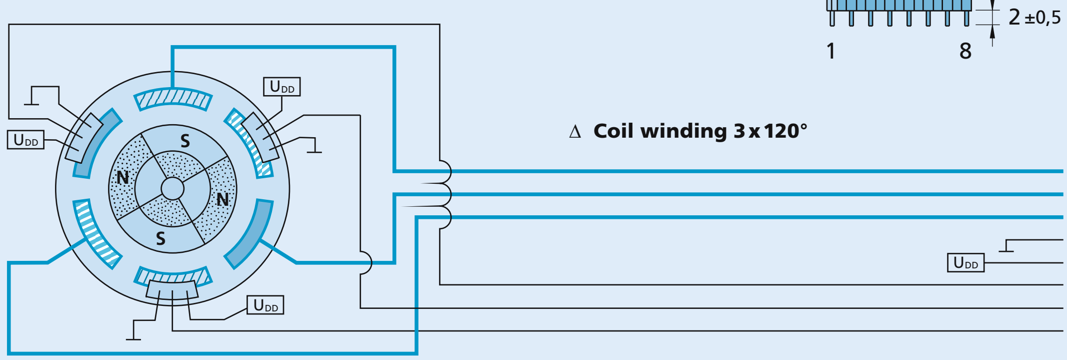
- Examples:
  3242G012BX4
  3242G024BX4

Cable and connection information



Cable
Insulation: PVC
8 conductors, AWG 24
pitch 2,54 mm
wires tinned

Note:
Hall sensors digital



Connection

No.	Function
1	Phase C
2	Phase B
3	Phase A
4	GND
5	U_{DD} (4,5 ... 5,5V DC)
6	Hall sensor C
7	Hall sensor B
8	Hall sensor A

Brushless DC-Servomotors

4 Pole Technology

97 mNm

For combination with
Gearheads:
32A, 32ALN, 32/3, 32/3 S, 38/1, 38/1 S, 38/2, 38/2 S
Encoders:
IE3-1024, IE3-1024 L, AES-4096
Drive Electronics:
Speed Controller, Motion Controller

Series 3268 ... BX4

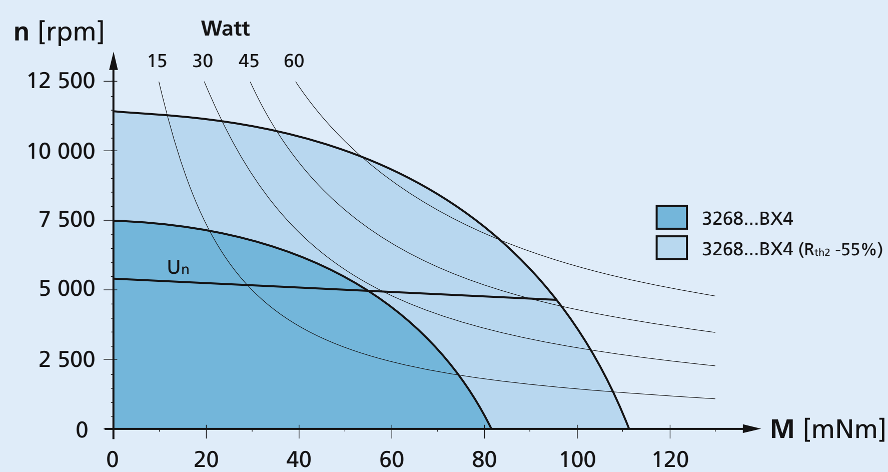
		3268 G		024 BX4	
1	Nominal voltage	U_N		24	Volt
2	Terminal resistance, phase-phase	R		1,45	Ω
3	Output power [1]	$P_{2\ max.}$		35,8	W
4	Efficiency	$\eta_{\ max.}$		79,5	%
5	No-load speed	n_o		5 500	rpm
6	No-load current	I_o		0,212	A
7	Stall torque	M_H		718	mNm
8	Friction torque, static	C_o		1,7	mNm
9	Friction torque, dynamic	C_v		$1,3 \cdot 10^{-3}$	mNm/rpm
10	Speed constant	k_n		220	rpm/V
11	Back-EMF constant	k_E		4,555	mV/rpm
12	Torque constant	k_M		43,5	mNm/A
13	Current constant	k_I		0,0230	A/mNm
14	Slope of n-M curve	$\Delta n/\Delta M$		7,3	rpm/mNm
15	Terminal inductance, phase-phase	L		110	µH
16	Mechanical time constant	$\tau_{\ m}$		4,6	ms
17	Rotor inertia	J		60	gcm^2
18	Angular acceleration	$\alpha_{\ max.}$		120	$\cdot 10^3 rad/s^2$
19	Thermal resistance	$R_{th\ 1}$ / $R_{th\ 2}$	1,9 / 8,6		K/W
20	Thermal time constant	$\tau_{\ w1}$ / $\tau_{\ w2}$	17 / 950		s
21	Operating temperature range		– 40 ... + 100		°C
22	Shaft bearings		ball bearings, preloaded		
23	Shaft load max.:				
	– radial at 3 000 rpm (4,5 mm from mounting flange)		50		N
	– axial at 3 000 rpm		5		N
	– axial at standstill		50		N
24	Shaft play:				
	– radial	≤	0,015		mm
	– axial	=	0		mm
25	Housing material		stainless steel		
26	Weight		290		g
27	Direction of rotation		electronically reversible		
28	Number of pole pairs		2		
	Recommended values - mathematically independent of each other				
29	Speed up to	$n_{e\ max.}$		12 000	rpm
30	Torque up to [1) 2)]	$M_{e\ max.}$		54 / 97	mNm
31	Current up to [1) 2)]	$I_{e\ max.}$		1,57 / 2,72	A

[1)] at 5 000 rpm
[2)] thermal resistance $R_{th\ 2}$ not reduced / thermal resistance $R_{th\ 2}$ by 55% reduced

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

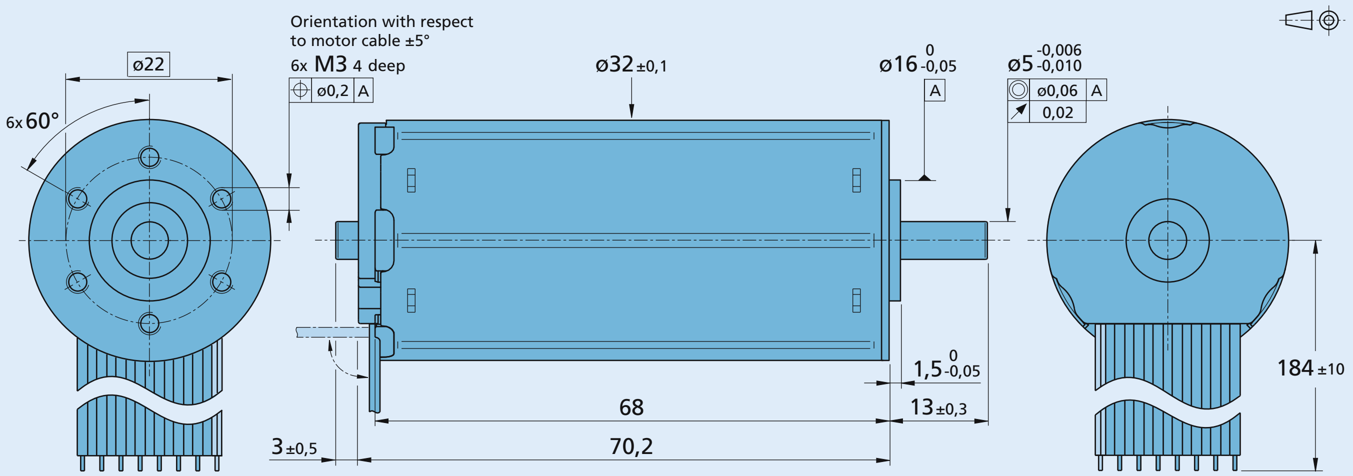
The diagram shows the motor in a completely insulated as well as thermally coupled condition ($R_{th\ 2}$ 55% reduced).

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended areas for continuous operation

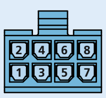
Dimensional drawing



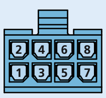
3268 G ... BX4

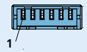
Options

- Analog Hall sensors (Option no. 3692)
- Connector variant (Option no. 3830)
  Motor and motor with encoder AES:
  AWG 24 / PVC ribbon cable
  with connector Micro-Fit

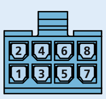


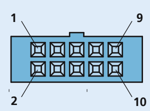
- Connector variant (Option no. 3592)
  Motor:
  AWG 24 / PVC ribbon cable
  with connector Micro-Fit
  Encoder IE3:
  AWG 28 / PVC ribbon cable
  with connector PicoBlade (pitch 1,25 mm)





- Connector variant (Option no.: 3589)
  Motor:
  AWG 24 / PVC ribbon cable
  with connector Micro-Fit
  Encoder IE3L:
  AWG 28 / PVC ribbon cable
  with connector DIN-41651 (pitch 2,54 mm)

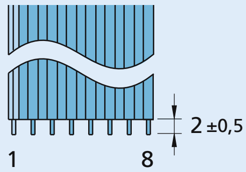




Full product description

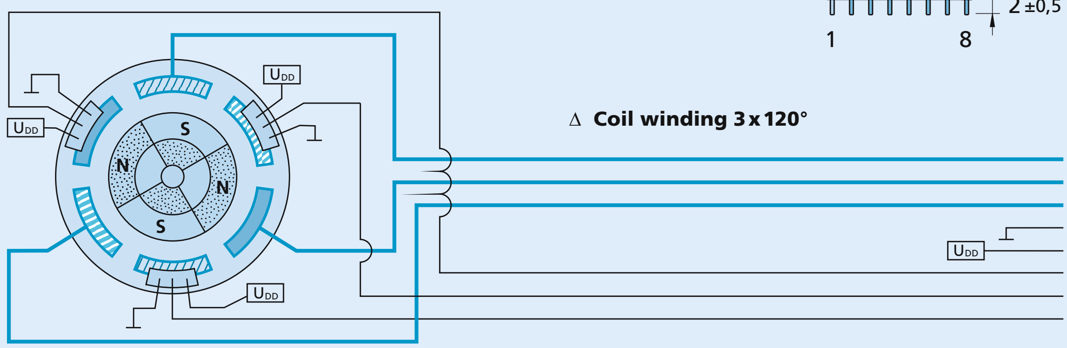
- Examples:
  3268G024BX4

Cable and connection information



Cable
Insulation: PVC
8 conductors, AWG 24
pitch 2,54 mm
wires tinned

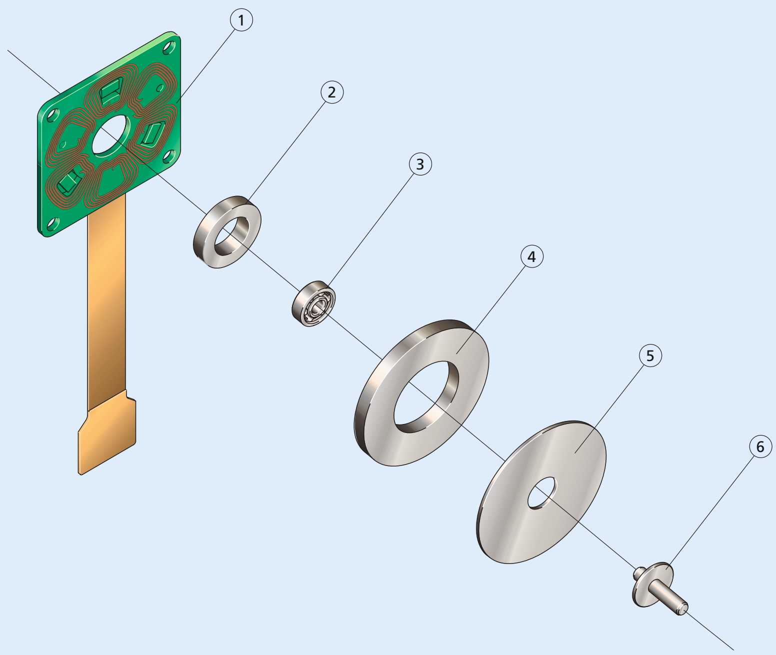
Note:
Hall sensors digital



Connection

No.	Function
1	Phase C
2	Phase B
3	Phase A
4	GND
5	U_{DD} (4,5 ... 5,5V DC)
6	Hall sensor C
7	Hall sensor B
8	Hall sensor A

Brushless Flat DC-Micromotors



Brushless Flat DC-Micromotor

① PCB with coil
② Bearing support
③ Ball bearing
④ Magnet
⑤ Rotor disc
⑥ Shaft

Features

The extremely flat design of the brushless penny-motor® is made possible by innovative coil design. Instead of being mechanically wound, it is fabricated by means of photo-lithographic processes. High power neodymium magnets (NdFeB) and a precise bearing system complete the motors for exceptional torque and smooth performance despite their extremely flat dimensions.

Motors with integrated spur gears are available with coaxial or eccentric shafts for higher torque in a compact form. The motors are electronically commutated for extremely long operational lifetime. They are particularly suited for applications where precise speed control and continuous duty operation are a must; for example in high precision optical filters, choppers or scanning devices.

Benefits

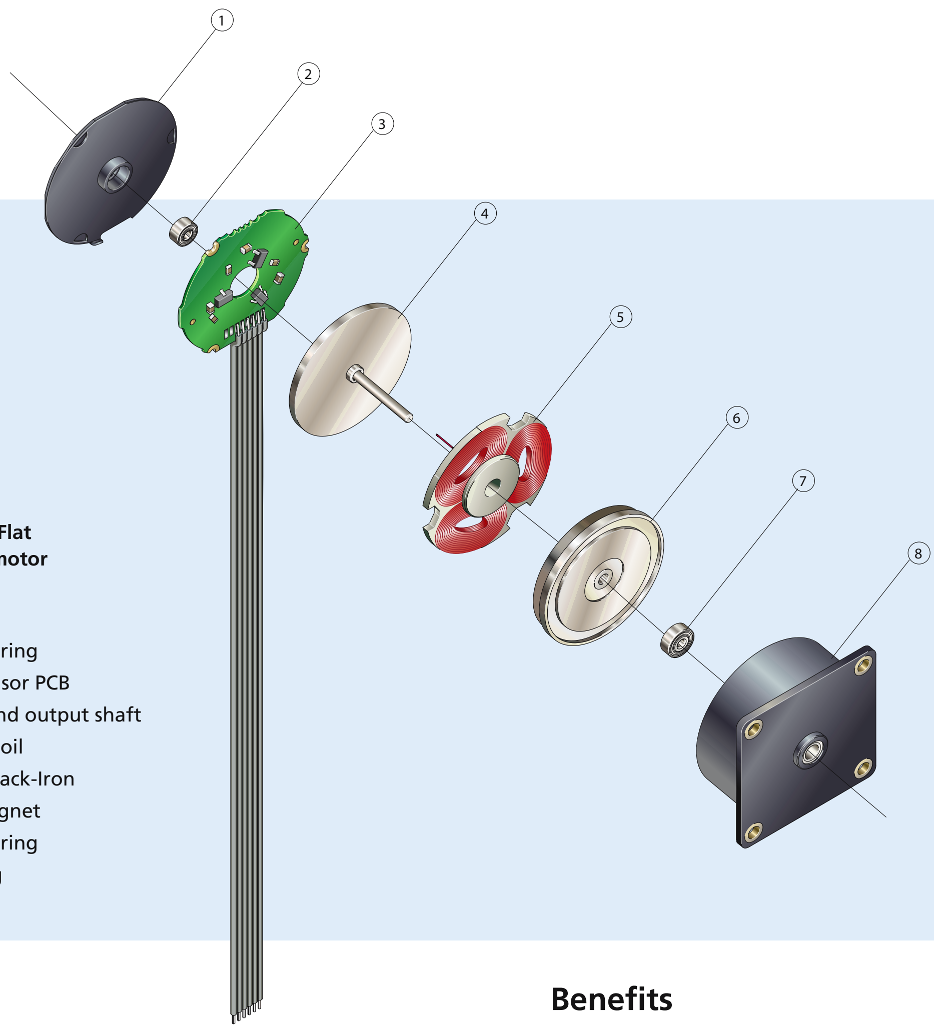
- Ultra flat design
- No cogging and precise speed control
- Exceptional power to volume ratio
- Very low current consumption
- High operational lifetime

Product Code

1202 H 004 BH

12	Motor diameter [mm]
02	Motor height [mm]
H	Shaft type
004	Nominal voltage [V]
B	Type of commutation (brushless)
H	Hall sensors

Brushless Flat DC-Micromotors



Brushless Flat DC-Micromotor

① End cap
② Ball bearing
③ Hall Sensor PCB
④ Rotor and output shaft
⑤ Stator Coil
⑥ Rotor, Back-Iron and Magnet
⑦ Ball bearing
⑧ Housing

Features

The heart of each brushless flat DC motor consists of the flat stator coils. The rotor is constructed of a high power rare earth magnet and two rotating discs which provide the back iron for an optimal use of the magnetic flux. The rotating back iron also serves to eliminate any cogging, or so-called detent torque which improves the inherent speed control properties of the motor drastically.

Thanks to the brushless commutation the motors can reach much higher operational lifetimes than conventional mechanically commutated DC motors.

Motor torque can be increased and motor speed reduced by the addition of an integrated reduction gearhead. The revolutionary integrated design provides for a wide variety of reduction ratios while maintaining a very flat profile.

Benefits

- No cogging torque
- Electronic commutation using three digital hall sensors
- Precise speed control
- Flat, light, and very compact

Product Code

26 10 T 012 B

26	Motor diameter [mm]
10	Motor length [mm]
T	Shaft type
012	Nominal voltage [V]
B	Type of commutation (electronic)

Brushless Flat DC-Micromotors

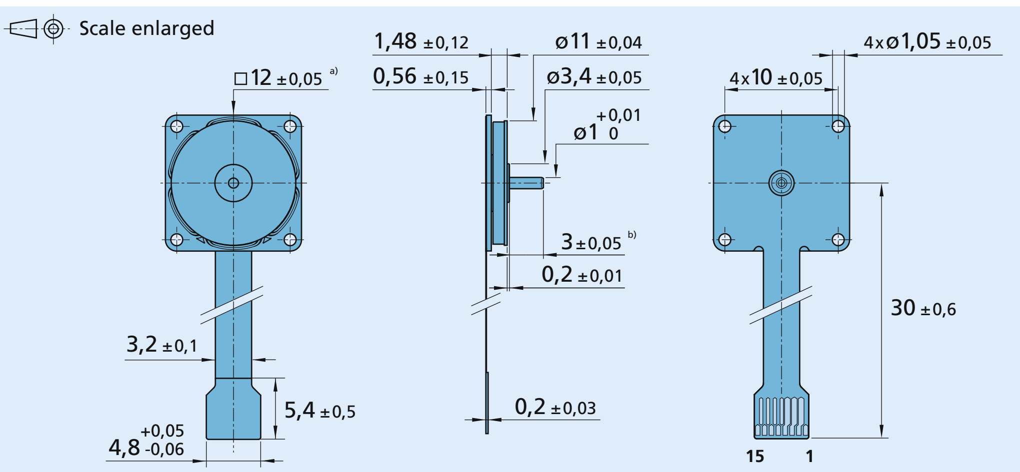
0,16 mNm

For combination with
Drive Electronics:
Speed controller with adapter board

Series 1202 ... BH

1202 H		004 BH	006 BH	
Nominal voltage	U_N	4	6	V
Terminal resistance, phase-phase	R	16	70	Ω
Output power [1]	$P_{2\ max.}$	0,652	0,492	W
Efficiency	$\eta_{max.}$	51	42	%
No-load speed	n_o	41 740	37 600	rpm
No-load current	I_o	0,028	0,015	A
Stall torque	M_H	0,222	0,124	mNm
Friction torque, static	C_o	0,003	0,003	mNm
Friction torque, dynamic	C_v	$0{,}52 \cdot 10^{-6}$	$0{,}52 \cdot 10^{-6}$	mNm/rpm
Speed constant	k_n	10 587	6 431	rpm/V
Back-EMF constant	k_E	0,094	0,156	mV/rpm
Torque constant	k_M	0,902	1,485	mNm/A
Current constant	k_I	1,109	0,673	A/mNm
Slope of n-M curve	$\Delta n/\Delta M$	187 793	303 121	rpm/mNm
Terminal inductance, phase-phase	L	26	58	µH
Mechanical time constant	τ_m	246	397	ms
Rotor inertia	J	0,125	0,125	gcm^2
Angular acceleration	$\alpha_{max.}$	$18 \cdot 10^3$	$10 \cdot 10^3$	rad/s^2
Thermal resistance	$R_{th\ 1}$ / $R_{th\ 2}$	0 / 94		K/W
Operating temperature range		-30 ... +85		°C
Shaft bearing		ball bearing		
Shaft load max.:				
– radial at 10 000 rpm (at shaft step ø3,4 mm)		0,6		N
– axial at 10 000 rpm (axial push-on only)		1		N
– axial at standstill (axial push-on only)		1		N
Shaft play:				
– radial	≤	0,011		mm
– axial	≤	0,060		mm
Number of pole pairs		4		
Weight		1,1		g
Direction of rotation		electronically reversible		
Recommended values - mathematically independent of each other				
Speed up to	$n_{e\ max.}$	40 000	40 000	rpm
Torque up to [2] [3]	$M_{e\ max.}$	0,16	0,12	mNm
Thermal current up to [3] [4]	$I_{e\ max.}$	0,199	0,095	A

[1] at 40 000 rpm [2] at 10 000 rpm [3] thermal resistance $R_{th\ 2}$ not reduced [4] at standstill



a) also available with round stator ø12 ± 0,05
b) also available with 1 mm output shaft length

1202 H ... BH

Connection

No.	Function
1	Star point
2	Phase A
3	Phase A
4	Phase B
5	Phase B
6	Phase C
7	Phase C
8	Hall sensor In +
9	Hall sensor In -
10	analog Hall A Out +
11	analog Hall A Out -
12	analog Hall B Out +
13	analog Hall B Out -
14	analog Hall C Out +
15	analog Hall C Out -

Connectors
15-pole; 0,3 mm pitch; e.g.:
Hirose: FH23-15S-0.3SHAW (05)

Brushless DC-Gearmotors

5 mNm

For combination with
Drive Electronics:
Speed controller with adapter board

Series 1307 ... BH

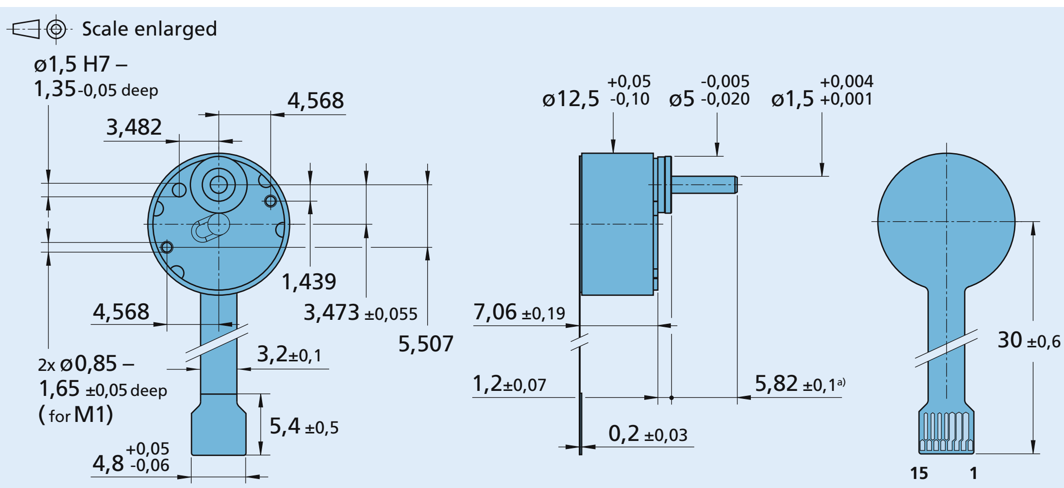
Integrated Motor	**1307 C**	**004 BH**	**006 BH**	
Nominal voltage	U_N	4	6	V
Terminal resistance, phase-phase	R	16	70	Ω
Output power [1]	$P_{2\ max.}$	0,206	0,157	W
Efficiency	$\eta_{max.}$	52	43	%
No-load speed	n_o	37 630	34 770	rpm
No-load current	I_o	0,026	0,015	A
Stall torque	M_H	0,249	0,136	mNm
Speed constant	k_n	9 502	5 902	rpm/V
Back-EMF constant	k_E	0,105	0,169	mV/rpm
Torque constant	k_M	1,005	1,618	mNm/A
Current constant	k_I	0,995	0,618	A/mNm
Slope of n-M curve	$\Delta n/\Delta M$	151 272	255 336	rpm/mNm
Rotor inertia	J	0,16	0,16	gcm^2

Drive system			
Housing material / Geartrain material		plastic / metal	
Shaft bearing		combination ball bearings + sleeve bearings	
Shaft load max.:			
– radial at 10 000 rpm (1,5 mm from bearing)	≤	0,5	N
– axial at 10 000 rpm	≤	0,1	N
– axial at standstill	≤	5	N
Shaft play:			
– radial (3 mm from bearing face)	≤	0,12	mm
– axial	≤	0,2	mm
Operating temperature range		0 ... + 85	°C

Recommended values - mathematically independent of each other				
Speed up to	$n_{e\ max}$	10 000	10 000	min^{-1}
Current up to (thermal limits) [2] [3]	$I_{e\ max}$	0,205	0,098	A

[1] at 10 000 min^{-1} [2] thermal resistance R_{th2} not reduced [3] at standstill

Integrated Gearhead			**004 BH**		**006 BH**			
			output torque		output torque			
reduction ratio (rounded)	output speed up to n_{max} rpm	weight with motor g	continuous operation $M_{max.}$ mNm	intermittent operation $M_{max.}$ mNm	continuous operation $M_{max.}$ mNm	intermittent operation $M_{max.}$ mNm	direction of rotation (reversible)	efficiency %
6 : 1	1 639	2,1	1,0	1,9	0,8	1,5	=	88
11 : 1	893	2,2	1,6	3,3	1,3	2,6	≠	82
32 : 1	310	2,3	4,4	8,9	3,5	7,1	=	77
93 : 1	107	2,4	5,0	15,0	5,0	15,0	≠	72
270 : 1	37	2,5	5,0	15,0	5,0	15,0	=	68
659 : 1	15	3,5	5,0	15,0	5,0	15,0	≠	64



a) also available with 2,82 mm output shaft length

1307 C ... BH

Connection

No.	Function
1	Star point
2	Phase A
3	Phase A
4	Phase B
5	Phase B
6	Phase C
7	Phase C
8	Hall sensor In +
9	Hall sensor In -
10	analog Hall A Out +
11	analog Hall A Out -
12	analog Hall B Out +
13	analog Hall B Out -
14	analog Hall C Out +
15	analog Hall C Out -

Connectors
15-pole; 0,3 mm pitch; e.g.:
Hirose: FH23-15S-0.3SHAW (05)

Brushless DC-Gearmotors

5 mNm

For combination with
Drive Electronics:
Speed controller with adapter board

Series 1309 ... BH

Integrated Motor	1309 C		004 BH	006 BH	
Nominal voltage	U_N		4	6	V
Terminal resistance, phase-phase	R		16	70	Ω
Output power [1]	$P_{2\ max.}$		0,206	0,157	W
Efficiency	$\eta_{max.}$		52	43	%
No-load speed	n_o		37 630	34 770	rpm
No-load current	I_o		0,026	0,015	A
Stall torque	M_H		0,249	0,136	mNm
Speed constant	k_n		9 502	5 902	rpm/V
Back-EMF constant	k_E		0,105	0,169	mV/rpm
Torque constant	k_M		1,005	1,618	mNm/A
Current constant	k_I		0,995	0,618	A/mNm
Slope of n-M curve	$\Delta n/\Delta M$		151 272	255 336	rpm/mNm
Rotor inertia	J		0,16	0,16	gcm^2

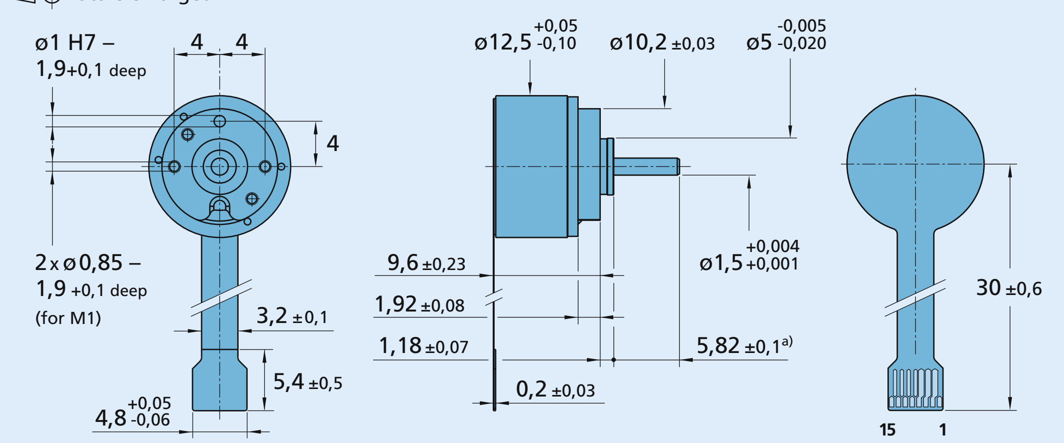
Drive system			
Housing material / Geartrain material		plastic / metal	
Shaft bearing		combination ball bearings + sleeve bearings	
Shaft load max.:			
– radial at 10 000 rpm (1,5 mm from bearing)	≤	0,5	N
– axial at 10 000 rpm	≤	0,1	N
– axial at standstill	≤	5	N
Shaft play:			
– radial (3 mm from bearing face)	≤	0,12	mm
– axial	≤	0,2	mm
Operating temperature range		0 ... + 85	°C

Recommended values - mathematically independent of each other					
Speed up to	$n_{e\ max}$		10 000	10 000	min^{-1}
Current up to (thermal limits) [2] [3]	$I_{e\ max}$		0,205	0,098	A

[1] at 10 000 min^{-1} [2] thermal resistance R_{th2} not reduced [3] at standstill

Integrated Gearhead			004 BH		006 BH			
reduction ratio (rounded)	output speed up to n_{max} rpm	weight with motor g	output torque continuous operation $M_{max.}$ mNm	output torque intermittent operation $M_{max.}$ mNm	output torque continuous operation $M_{max.}$ mNm	output torque intermittent operation $M_{max.}$ mNm	direction of rotation (reversible)	efficiency %
17 : 1	592	2,6	2,5	5,0	2,0	3,9	≠	82
31 : 1	323	2,7	4,3	8,5	3,4	6,8	=	77
90 : 1	111	2,8	5,0	15,0	5,0	15,0	≠	72
259 : 1	39	2,9	5,0	15,0	5,0	15,0	=	68
749 : 1	13	2,9	5,0	15,0	5,0	15,0	≠	64
1 830 : 1	5	3,0	5,0	15,0	5,0	15,0	=	60

Scale enlarged



a) also available with 2,82 mm output shaft length

1309 C ... BH

Connection

No.	Function
1	Star point
2	Phase A
3	Phase A
4	Phase B
5	Phase B
6	Phase C
7	Phase C
8	Hall sensor In +
9	Hall sensor In -
10	analog Hall A Out +
11	analog Hall A Out -
12	analog Hall B Out +
13	analog Hall B Out -
14	analog Hall C Out +
15	analog Hall C Out -

Connectors
15-pole; 0,3 mm pitch; e.g.:
Hirose: FH23-15S-0.3SHAW (05)

Notes

Brushless Flat DC-Micromotors

0,6 mNm

For combination with
Drive Electronics:
Speed Controller

Series 1509 ... B

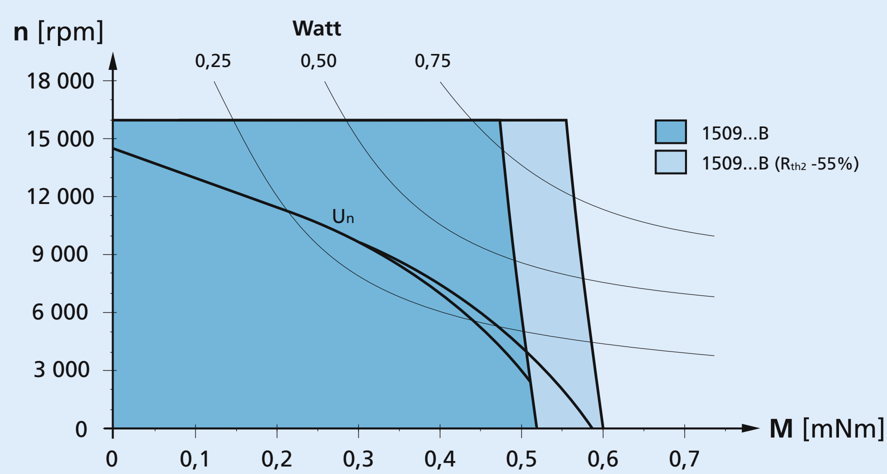
No.		1509 T		006 B	012 B	
1	Nominal voltage	U_N		6	12	Volt
2	Terminal resistance, phase-phase	R		22,0	92,8	Ω
3	Output power [1]	$P_{2\,max.}$		0,31	0,30	W
4	Efficiency	$\eta_{max.}$		56	55	%
5	No-load speed	n_o		14 700	14 700	rpm
6	No-load current	I_o		0,0174	0,0087	A
7	Stall torque	M_H		0,97	0,92	mNm
8	Friction torque, static	C_o		0,025	0,025	mNm
9	Friction torque, dynamic	C_v		$2,6 \cdot 10^{-6}$	$2,6 \cdot 10^{-6}$	mNm/rpm
10	Speed constant	k_n		2 623	1 312	rpm/V
11	Back-EMF constant	k_E		0,381	0,762	mV/rpm
12	Torque constant	k_M		3,64	7,28	mNm/A
13	Current constant	k_I		0,275	0,137	A/mNm
14	Slope of n-M curve	$\Delta n/\Delta M$		15 856	16 721	rpm/mNm
15	Terminal inductance, phase-phase	L		590	2 350	µH
16	Mechanical time constant	τ_m		115	121	ms
17	Rotor inertia	J		0,69	0,69	gcm^2
18	Angular acceleration	$\alpha_{max.}$		14	13	$\cdot 10^3 rad/s^2$
19	Thermal resistance	$R_{th\,1} / R_{th\,2}$	65 / 45			K/W
20	Thermal time constant	τ_{w1} / τ_{w2}	10 / 130			s
21	Operating temperature range		-25 ... +80			°C
22	Shaft bearings		ball bearing, preloaded			
23	Shaft load max.:					
	– radial at 3 000/16 000 rpm (3 mm from mounting flange)		2,0 / 0,5			N
	– axial at 3 000/16 000 rpm (push-on only)		2,0 / 1,7			N
	– axial at standstill (push-on only)		15			N
24	Shaft play:					
	– radial	≤	0,015			mm
	– axial	=	0			mm
25	Housing material		plastic			
26	Weight		6,9			g
27	Direction of rotation		electronically reversible			
28	Number of pole pairs		2			
Recommended values - mathematically independent of each other						
29	Speed up to	$n_{e\,max.}$		16 000	16 000	rpm
30	Torque up to [1] [2]	$M_{e\,max.}$		0,52 / 0,60	0,51 / 0,58	mNm
31	Current up to [1] [2]	$I_{e\,max.}$		0,17 / 0,20	0,09 / 0,10	A

[1] at 5 000 rpm
[2] thermal resistance $R_{th\,2}$ not reduced / thermal resistance $R_{th\,2}$ by 55% reduced

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

The diagram shows the motor in a completely insulated as well as thermally coupled condition ($R_{th\,2}$ 55% reduced).

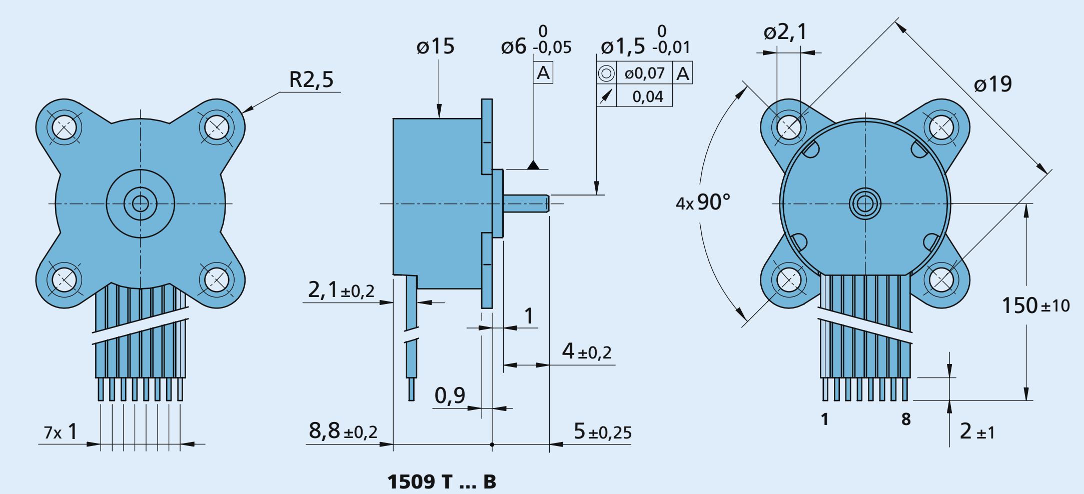
The nominal voltage curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended areas for continuous operation

For notes on technical data and lifetime performance refer to „Technical Information“.
Edition 2014

1509 T ... B



Cable
Jacket Material: PVC
8 conductors, AWG 28
grid 1,0 mm
wires tinned

Note:
Hallsensors digital

Connection

No.	Function
1	Phase C
2	Phase B
3	Phase A
4	GND
5	+ 5V
6	Hall sensor C
7	Hall sensor B
8	Hall sensor A

Brushless DC-Gearmotors

30 mNm

For combination with
Drive Electronics:
Speed Controller

Series 1515 ... B

	1515 U		006 B	012 B	
1 Nominal voltage	U_N		6	12	Volt
2 Terminal resistance, phase-phase	R		22,0	92,8	Ω
3 Output power	$P_{2\ max.}$		0,31	0,30	W
4 Efficiency	$\eta_{max.}$		56	55	%
5 No-load speed	n_o		14 700	14 700	rpm
6 No-load current	I_o		0,0174	0,0087	A
7 Stall torque	M_H		0,97	0,92	mNm
8 Friction torque, static	C_o		0,025	0,025	mNm
9 Friction torque, dynamic	C_v		$2,6 \cdot 10^{-6}$	$2,6 \cdot 10^{-6}$	mNm/rpm
10 Speed constant	k_n		2 623	1 312	rpm/V
11 Back-EMF constant	k_E		0,381	0,762	mV/rpm
12 Torque constant	k_M		3,64	7,28	mNm/A
13 Current constant	k_I		0,275	0,137	A/mNm
14 Slope of n-M curve	$\Delta n/\Delta M$		15 856	16 721	rpm/mNm
15 Terminal inductance, phase-phase	L		590	2 350	µH
16 Mechanical time constant	τ_m		115	121	ms
17 Rotor inertia	J		0,69	0,69	gcm^2
18 Angular acceleration	$\alpha_{max.}$		14	13	$\cdot 10^3 rad/s^2$
19 Thermal resistance	R_{th1} / R_{th2}	65 / 45			K/W
20 Thermal time constant	τ_{w1} / τ_{w2}	10 / 130			s

Integrated Gearhead			
Housing material		plastic	
Geartrain material		metal	
Backlash, at no-load	≤	4	°
Bearings on output shaft		plastic / brass bearing	
Shaft load max.:			
– radial (5 mm from mounting face)	≤	1,4	N
– axial	≤	0,3	N
Shaft press fit force, max.	≤	5	N
Shaft play:			
– radial (5 mm from mounting face)	≤	0,08	mm
– axial	≤	0,25	mm
Operating temperature range		– 25 ... + 80	°C

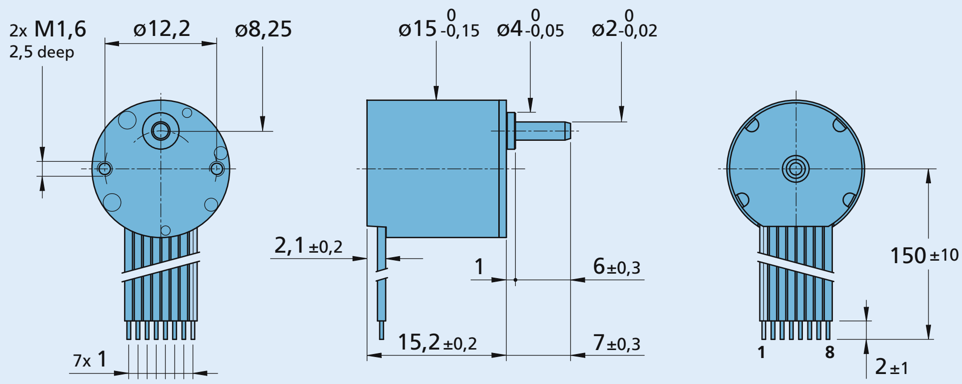
Specifications

reduction ratio (rounded)	output speed up to n_{max} rpm	weight with motor g	output torque continuous operation M_{max} mNm	output torque intermittent operation M_{max} mNm	direction of rotation (reversible)	efficiency %
6 : 1	779	6,9	1,4	3	=	81
13 : 1	372	7,0	2,8	5	≠	73
39 : 1	129	7,2	7,0	10	=	60
112 : 1	45	7,4	19,8	30	≠	59
324 : 1	15	7,7	30,0	50	=	53

Note: output speed at 5000 rpm input speed. Based on motor 1509 ... B.

1515 U ... B

Scale enlarged



1515 U ... B

Cable
Jacket Material: PVC
8 conductors, AWG 28
grid 1,0 mm
wires tinned

Note:
Hallsensors digital

Connection

No.	Function
1	Phase C
2	Phase B
3	Phase A
4	GND
5	+ 5V
6	Hall sensor C
6	Hall sensor B
6	Hall sensor A

Brushless Flat DC-Micromotors

0,2 mNm

For combination with
Gearheads:
16A
Drive Electronics:
Speed controller

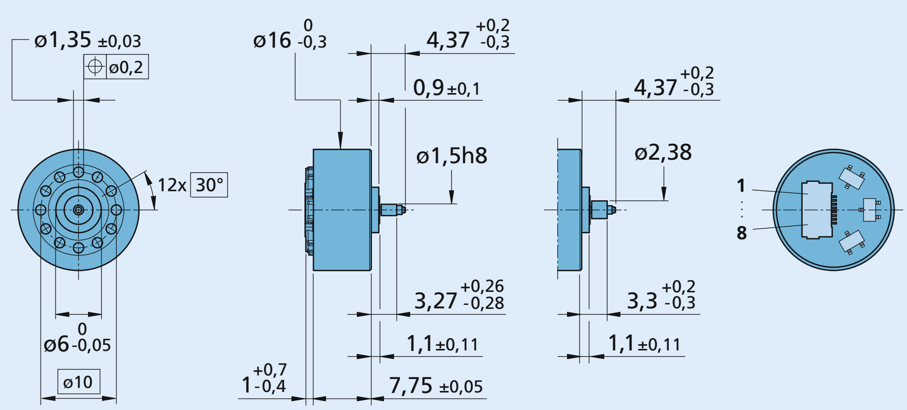
Brushless DC-Motors

Series 1608 ... BH

	1608 N		003 BH	
Nominal voltage	U_N		3	V
Terminal resistance, phase-phase	R		18,6	Ω
Output power [1]	$P_{2\,max.}$		0,116	W
Efficiency	$\eta_{max.}$		38	%
No-load speed	n_o		17 872	rpm
No-load current	I_o		0,032	A
Stall torque	M_H		0,203	mNm
Friction torque, static	C_o		0,005	mNm
Friction torque, dynamic	C_v		$2 \cdot 10^{-6}$	mNm/rpm
Speed constant	k_n		7 407	rpm/V
Back-EMF constant	k_E		0,135	mV/rpm
Torque constant	k_M		1,289	mNm/A
Current constant	k_I		0,776	A/mNm
Slope of n-M curve	$\Delta n/\Delta M$		106 746	rpm/mNm
Terminal inductance, phase-phase	L		21	µH
Mechanical time constant	τ_m		702	ms
Rotor inertia	J		0,628	gcm^2
Angular acceleration	$\alpha_{max.}$		$3 \cdot 10^3$	rad/s^2
Thermal resistance	R_{th1} / R_{th2}	0 / 80		K/W
Operating temperature range		-30 ... +85		°C
Shaft bearing		sintered sleeve bearings		
Shaft load max.:				
– radial at 10 000 rpm (at shaft step ø 3,4 mm)		0,5		N
– axial at 10 000 rpm (axial push-on only)		0,1		N
– axial at standstill (axial push-on only)		20		N
Shaft play:				
– radial	≤	0,05		mm
– axial	≤	0,12		mm
Number of pole pairs		4		
Weight		4,1		g
Direction of rotation		electronically reversible		

Recommended values - mathematically independent of each other				
Speed up to	$n_{e\,max.}$		12 000	rpm
Torque up to [1) 2)]	$M_{e\,max.}$		0,205	mNm
Thermal current up to [1) 2)]	$I_{e\,max.}$		0,184	A

[1)] at 5000 rpm [2)] thermal resistance $R_{th\,2}$ not reduced



1608 N ... BH 1608 E ... BH

Connection

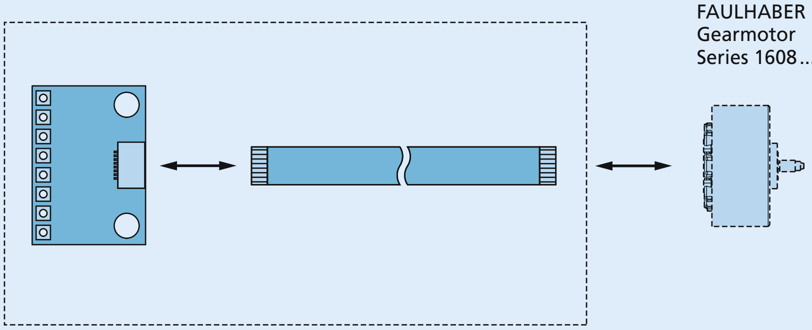
No.	Function
1	Hall sensor A
2	Hall sensor B
3	Hall sensor C
4	U_{DD} (2.2 ... 18V DC)
5	GND
6	Phase A
7	Phase B
8	Phase C

Connectors
8-pole; 0,5 mm pitch;
thickness 0,3 mm

Accessory - optional

Adapter board with ribbon cable
Part number: 6611.00017

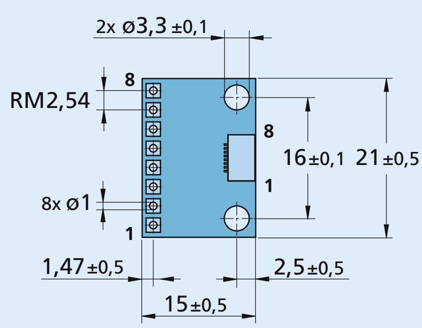
FAULHABER Brushless
Gearmotor
Series 1608 ... BH



Note: The conector on the adapter board has contacts on both sides. The pin out of the adapter board depends on the orientation of the ribbon cable and motor conector.

Accessory - Dimensional drawing

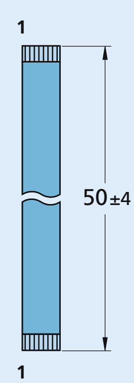
M 1:1



Adapter board

Connector Information

FFC/FPC Connector; 8-pole;
0,5 mm pitch; thickness: 0,3 mm
Connector has contacts on both sides



Ribbon cable

Brushless Flat DC-Micromotors

3,8 mNm

For combination with
Drive Electronics:
Speed Controller

Series 2610 ... B

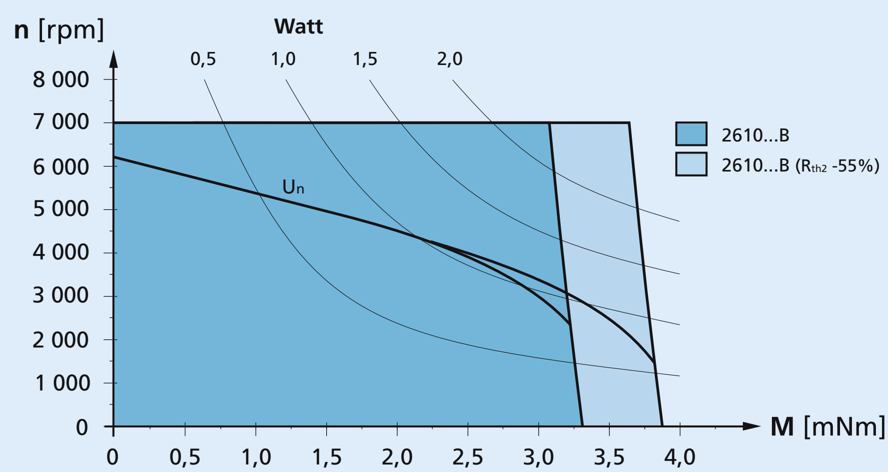
	2610 T			006 B	012 B	
1	Nominal voltage	U_N		6	12	Volt
2	Terminal resistance, phase-phase	R		7,0	28,2	Ω
3	Output power [1]	$P_{2\,max.}$		1,92	1,91	W
4	Efficiency	$\eta_{max.}$		78	78	%
5	No-load speed	n_o		6 200	6 200	rpm
6	No-load current	I_o		0,012	0,006	A
7	Stall torque	M_H		7,73	7,68	mNm
8	Friction torque, static	C_o		0,025	0,025	mNm
9	Friction torque, dynamic	C_v		$1,35 \cdot 10^{-5}$	$1,35 \cdot 10^{-5}$	mNm/rpm
10	Speed constant	k_n		1 055	528	rpm/V
11	Back-EMF constant	k_E		0,948	1,895	mV/rpm
12	Torque constant	k_M		9,05	18,1	mNm/A
13	Current constant	k_I		0,111	0,055	A/mNm
14	Slope of n-M curve	$\Delta n/\Delta M$		816	822	rpm/mNm
15	Terminal inductance, phase-phase	L		480	1 940	µH
16	Mechanical time constant	τ_m		69	70	ms
17	Rotor inertia	J		8,1	8,1	gcm^2
18	Angular acceleration	$\alpha_{max.}$		9,5	9,5	$\cdot 10^3 rad/s^2$
19	Thermal resistance	R_{th1} / R_{th2}	33 / 27			K/W
20	Thermal time constant	τ_{w1} / τ_{w2}	20 / 230			s
21	Operating temperature range		-25 ... +80			°C
22	Shaft bearings		ball bearing, preloaded			
23	Shaft load max.:					
	– radial at 3 000/7 000 rpm (3 mm from mounting flange)		4,0 / 3,5			N
	– axial at 3 000/7 000 rpm (push-on only)		3,5 / 3,4			N
	– axial at standstill (push-on only)		17,5			N
24	Shaft play:					
	– radial	≤	0,015			mm
	– axial	=	0			mm
25	Housing material		plastic			
26	Weight		20,1			g
27	Direction of rotation		electronically reversible			
28	Number of pole pairs		2			
Recommended values - mathematically independent of each other						
29	Speed up to	$n_{e\,max.}$		7 000	7 000	rpm
30	Torque up to [1] [2]	$M_{e\,max.}$		3,24 / 3,77	3,23 / 3,75	mNm
31	Current up to [1] [2]	$I_{e\,max.}$		0,42 / 0,48	0,21 / 0,24	A

[1] at 5 000 rpm
[2] thermal resistance $R_{th\,2}$ not reduced / thermal resistance $R_{th\,2}$ by 55% reduced

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

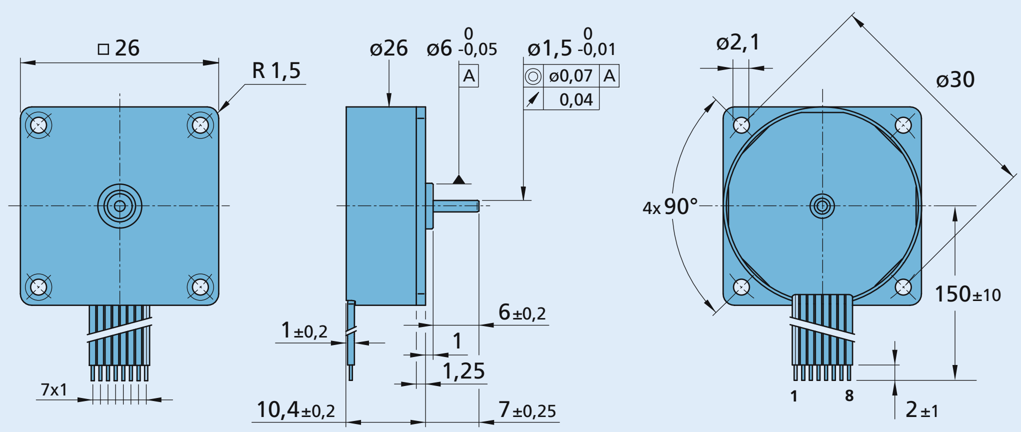
The diagram shows the motor in a completely insulated as well as thermally coupled condition ($R_{th\,2}$ 55% reduced).

The nominal voltage curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended areas for continuous operation

2610 T ... B



2610 T ... B

Cable
Jacket Material: PVC
8 conductors, AWG 28
grid 1,0 mm
wires tinned

Note:
Hallsensors digital

Connection

No.	Function
1	Phase C
2	Phase B
3	Phase A
4	GND
5	+ 5V
6	Hall sensor C
6	Hall sensor B
6	Hall sensor A

Brushless DC-Gearmotors

100 mNm

For combination with
Drive Electronics:
Speed Controller

Series 2622 ... B

	2622 S		006 B	012 B	
1 Nominal voltage	U_N		6	12	Volt
2 Terminal resistance, phase-phase	R		7,0	28,2	Ω
3 Output power	$P_{2\ max.}$		1,92	1,91	W
4 Efficiency	$\eta_{\ max.}$		78	78	%
5 No-load speed	n_o		6 200	6 200	rpm
6 No-load current	I_o		0,012	0,006	A
7 Stall torque	M_H		7,73	7,68	mNm
8 Friction torque, static	C_o		0,025	0,025	mNm
9 Friction torque, dynamic	C_v		$1,35 \cdot 10^{-5}$	$1,35 \cdot 10^{-5}$	mNm/rpm
10 Speed constant	k_n		1 055	528	rpm/V
11 Back-EMF constant	k_E		0,948	1,895	mV/rpm
12 Torque constant	k_M		9,05	18,1	mNm/A
13 Current constant	k_I		0,111	0,055	A/mNm
14 Slope of n-M curve	$\Delta n/\Delta M$		816	822	rpm/mNm
15 Terminal inductance, phase-phase	L		480	1 940	µH
16 Mechanical time constant	$\tau_{\ m}$		69	70	ms
17 Rotor inertia	J		8,1	8,1	gcm^2
18 Angular acceleration	$\alpha_{\ max.}$		9,5	9,5	$\cdot 10^3 rad/s^2$
19 Thermal resistance	$R_{th\ 1}$ / $R_{th\ 2}$	33 / 27			K/W
20 Thermal time constant	$\tau_{\ w1}$ / $\tau_{\ w2}$	20 / 230			s

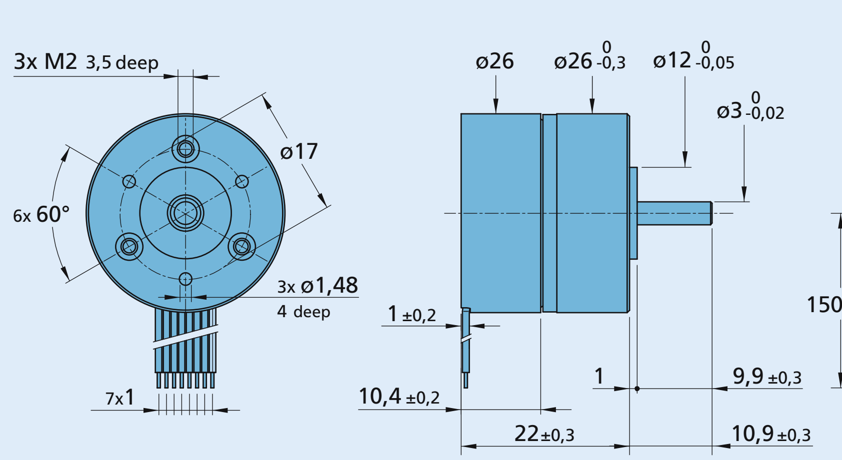
Integrated Gearhead			
Housing material		plastic	
Geartrain material		metal	
Backlash, at no-load	≤	4	°
Bearings on output shaft		ball bearing	
Shaft load max.:			
– radial (5 mm from mounting face)	≤	15	N
– axial	≤	5	N
Shaft press fit force, max.	≤	10	N
Shaft play:			
– radial (5 mm from mounting face)	≤	0,03	mm
– axial	≤	0,25	mm
Operating temperature range		– 25 ... + 80	°C

Specifications

reduction ratio (rounded)	output speed up to n_{max} rpm	weight with motor g	output torque continuous operation M_{max} mNm	output torque intermittent operation M_{max} mNm	direction of rotation (reversible)	efficiency %
8 : 1	635	25	9	30	=	81
22 : 1	223	26	23	75	≠	73
33 : 1	151	26	30	100	=	60
112 : 1	44	27	93	180	≠	59
207 : 1	24	27	100	180	=	53
361 : 1	14	27	100	180	=	53
814 : 1	6	28	100	180	=	43
1 257 : 1	4	29	100	180	=	43

Note: output speed at 5000 rpm input speed. Based on motor 2610 ... B.

2622 S ... B



2622 S ... B

Cable
Jacket Material: PVC
8 conductors, AWG 28
grid 1,0 mm
wires tinned

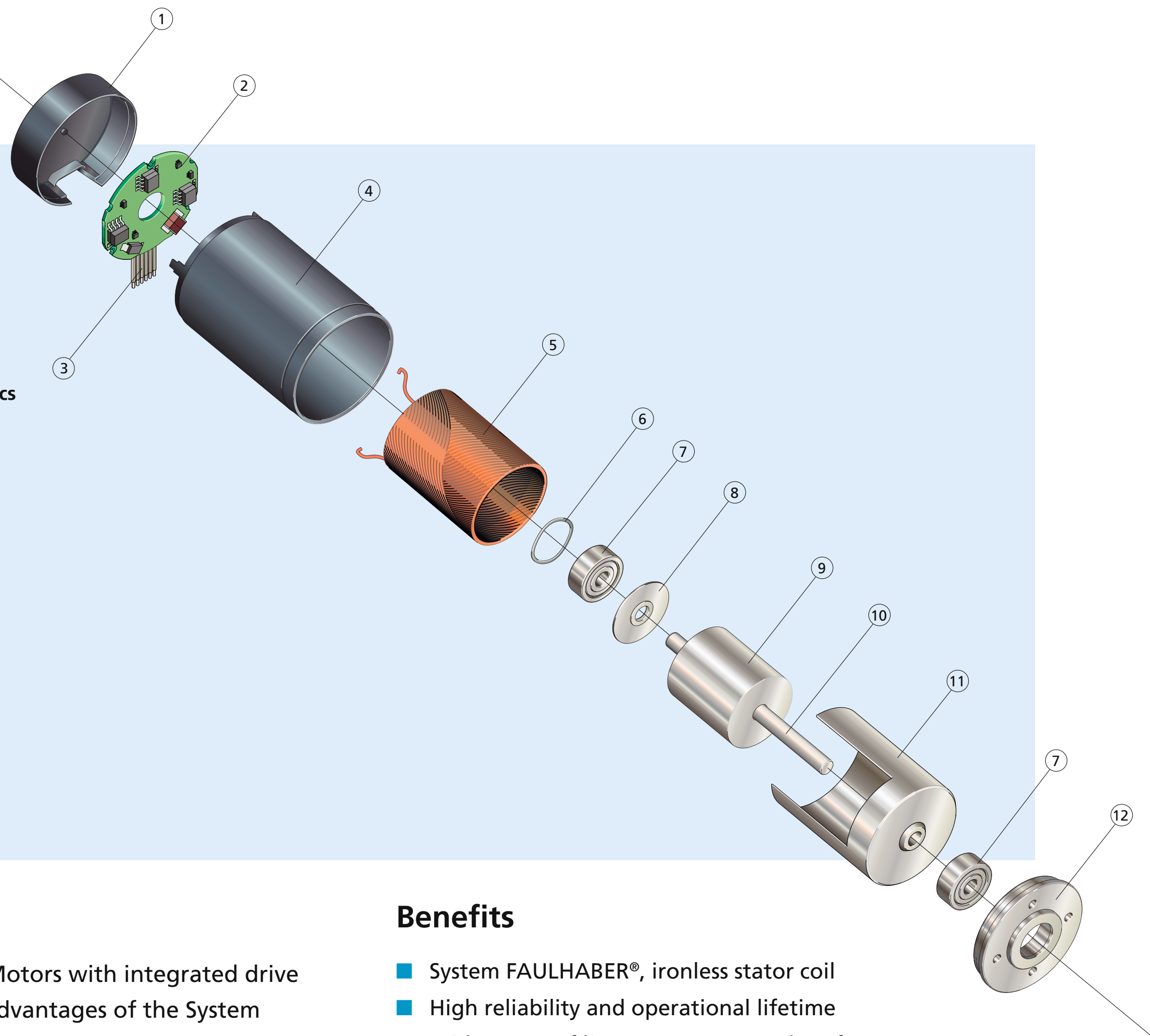
Note:
Hallsensors digital

Connection

No.	Function
1	Phase C
2	Phase B
3	Phase A
4	GND
5	+ 5V
6	Hall sensor C
6	Hall sensor B
6	Hall sensor A

Brushless DC-Motors

with integrated Electronics



Brushless DC-Motor with integrated Electronics

① Rear cover
② Drive Electronics
③ Flat cable
④ Housing
⑤ Coil
⑥ Spring washer
⑦ Ball bearing
⑧ Washer
⑨ Magnet
⑩ Shaft
⑪ Rotor back-iron
⑫ Front flange

Features

These new brushless DC-Motors with integrated drive electronics combine the advantages of the System FAULHABER® skew wound coil technology with the lifetime benefits of electronic commutation. The motors are based on a three-phase ironless coil, a bipolar rare-earth permanent magnet and sensorless electronic commutation.

To define the position of the rotor in relation to the rotating field of the coil, the back-EMF is measured and processed. The position detection of the rotor is sensorless. The design features the basic linear characteristics over a wide speed range and the absence of cogging torque just like the traditional brush commutated DC-Motors in the FAULHABER program. The rotating magnet and iron flux path avoid iron losses and results in higher efficiency.

Benefits

- System FAULHABER®, ironless stator coil
- High reliability and operational lifetime
- Wide range of linear torque / speed performance
- Programmable motor characteristics
- No sparking
- No cogging
- Dynamically balanced rotor
- Integrated electronics
- Simple design

Product Code

3153 K 012 BRC

31	Motor diameter [mm]
53	Motor length [mm]
K	Shaft type
012	Nominal voltage [V]
BRC	Type of commutation (brushless), with integrated electronics

Brushless DC-Motors

with integrated Drive Electronics

1,8 mNm

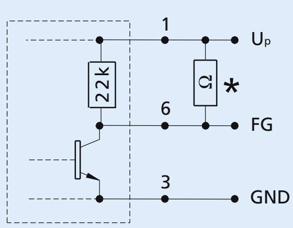
Series 1525 ... BRC

1525 U			009 BRC	012 BRC	015 BRC	
Nominal voltage	U_N		9	12	15	Volt
No-load speed	n_0		16 300	15 800	15 500	rpm
No-load current (with shaft ø 2,0 mm)	I_0		0,047	0,037	0,033	A
Starting torque	M_A		3,9	4,1	4,1	mNm
Torque constant	k_M		5,12	7,06	8,95	mNm/A
Slope of n-M curve	$\Delta n/\Delta M$		2 540	2 260	2 270	rpm/mNm
Rotor inertia	J		2,2	2,2	2,2	gcm²
Operating temperature range		– 25 ... + 85				°C
Shaft bearings		ball bearings, preloaded				
Shaft load max.:						
– shaft diameter		2,0				mm
– radial at 3 000 rpm (3 mm from mounting face)		8				N
– axial at 3 000 rpm		0,8				N
– axial at standstill		10				N
Shaft play:						
– radial	≤	0,015				mm
– axial	=	0				mm
Housing material		mounting face in aluminium, housing in plastic				
Weight		16				g
Direction of rotation		reversible				

Recommended values - mathematically independent of each other						
Speed range	n_e		1 000 – 16 000			rpm
Torque up to [1]	$M_{e\,max.}$		1,7	1,8	1,8	mNm
Current up to (thermal limits) [1]	$I_{e\,max.}$		0,40	0,31	0,25	A

[1] Specification applies to U_{nsoll} = 10 V

Electronic			
Supply voltage	U_p	min. 4 ... max. 18	V DC
Current	$I_{max.}$	15	mA

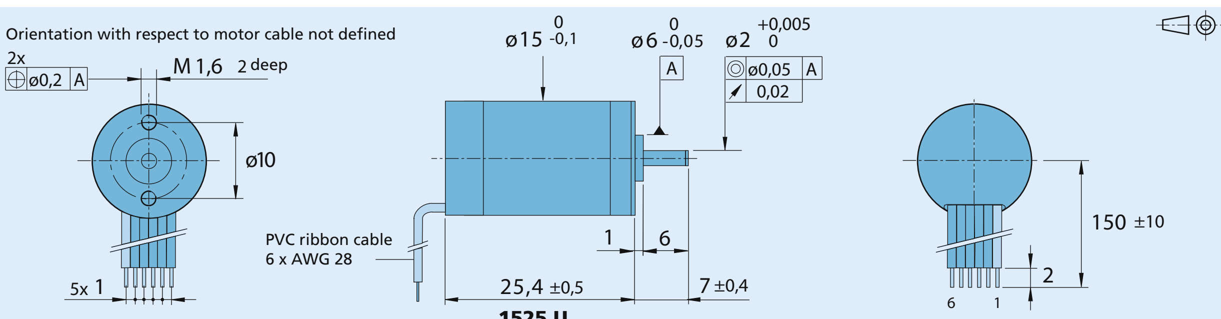


Circuit diagram

* An additional external pull-up resistor can be added to improve the rise time.

Caution:

I_{OUT} max. 15 mA must not be exceeded!



Cable connection

No.	Function		
1 (red)	U_p	: electronic supply	4 V DC - 18 V DC
2	U_{mot}	: coil supply	1,7 V DC - 18 V DC
3	GND	: ground	
4	U_{nsoll}	: Speed command	0 - 10 V DC | > 10 V DC - max. U_P not defined
5	DIR	: direction of rotation	on ground or U < 0,5 V = CCW, U > 3 V = CW
6	FG	: frequency output	(max. U_p, $I_{max.}$ 15 mA) 3 lines per revolution

Caution:
Incorrect lead connection will damage the motor electronics!

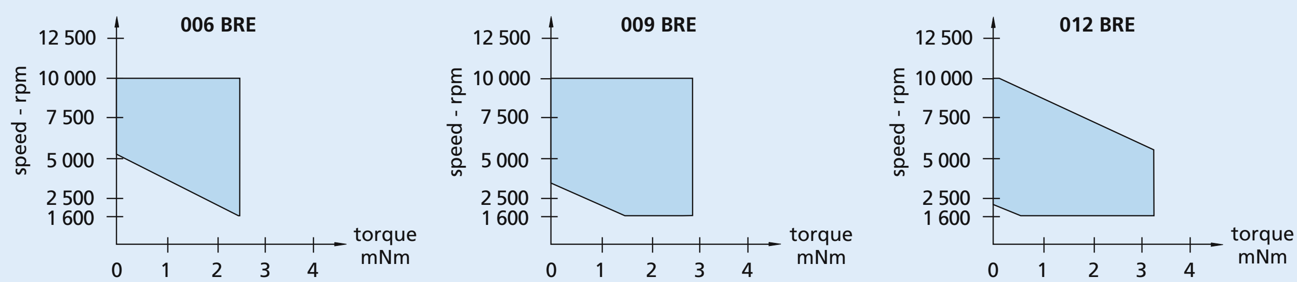
Brushless DC-Motors

3,2 mNm

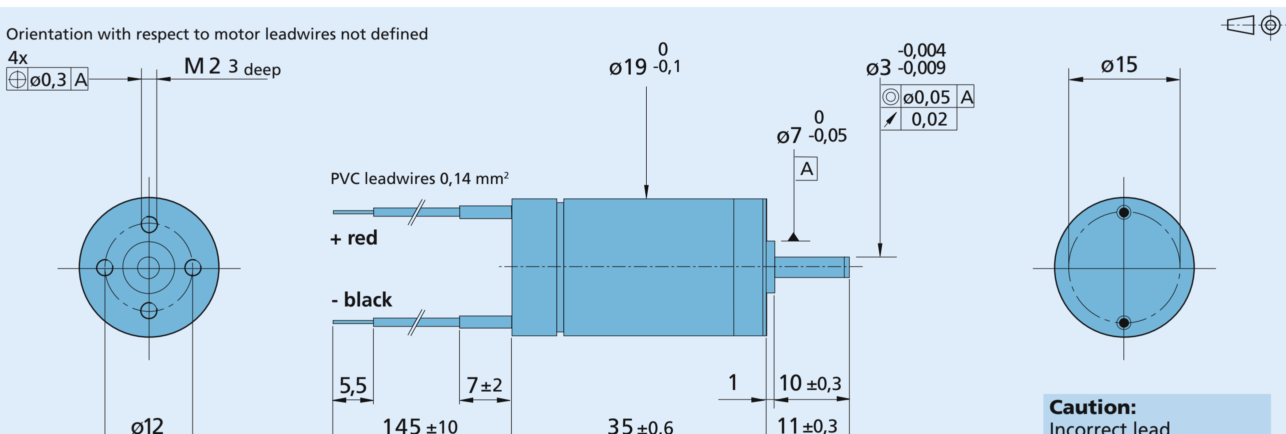
with integrated Drive Electronics

Series 1935 ... BRE

	1935 S		006 BRE	009 BRE	012 BRE	
Nominal voltage [1]	U_N		6	9	12	Volt
No-load speed	n_o		7 400	7 650	7 400	rpm
No-load current (with shaft ø 3,0 mm)	I_o		0,050	0,035	0,027	A
Starting torque	M_A		2,9	4,0	4,4	mNm
Torque constant	k_M		6,32	9,74	13,70	mNm/A
Slope of n-M curve	$\Delta n/\Delta M$		1 470	1 140	1 110	rpm/mNm
Rotor inertia	J		8,1	8,1	8,1	gcm²
Operating temperature range		0 ... + 70				°C
Shaft bearings		ball bearings, preloaded				
Shaft load max.:						
– shaft diameter		3				mm
– radial at 3 000 rpm (3 mm from mounting face)		10				N
– axial at 3 000 rpm		1				N
– axial at standstill		150				N
Shaft play:						
– radial	≤	0,015				mm
– axial	=	0				mm
Housing material		mounting face in aluminium, housing in plastic				
Weight		33				g
Direction of rotation		not reversible - clockwise rotation, viewed from the front face				
[1] The supply voltage range for the integrated electronics is:		min. 4,5 ... max. 16				V DC
Recommended values - mathematically independent of each other						
Speed range	n_e			1 600 – 10 000		rpm
Torque up to	$M_{e\ max.}$		2,4	2,9	3,2	mNm
Current up to (thermal limits)	$I_{e\ max.}$		0,50	0,40	0,33	A



Recommended speed - torque range



Caution:
Incorrect lead connection will damage the motor electronics!

1935 S

Brushless DC-Motors

28 mNm

with integrated Drive Electronics

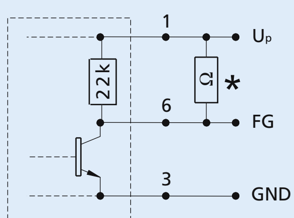
Series 3153 ... BRC

	3153 K		009 BRC	012 BRC	024 BRC	
Nominal voltage	U_N		9	12	24	Volt
No-load speed	n_0		5 200	5 200	5 200	rpm
No-load current (with shaft ø 4,0 mm)	I_0		0,142	0,107	0,057	A
Starting torque	M_A		42	50	50	mNm
Torque constant	k_M		16,22	21,80	43,59	mNm/A
Slope of n-M curve	$\Delta n/\Delta M$		45,8	42,9	41,4	rpm/mNm
Rotor inertia	J		118	118	118	gcm²
Operating temperature range		– 25 ... + 85				°C
Shaft bearings		ball bearings, preloaded				
Shaft load max.:						
– shaft diameter		4,0				mm
– radial at 3 000 rpm (3 mm from mounting face)		30				N
– axial at 3 000 rpm		5				N
– axial at standstill		50				N
Shaft play:						
– radial	≤	0,015				mm
– axial	=	0				mm
Housing material		mounting face in aluminium, housing in plastic				
Weight		155				g
Direction of rotation		reversible				

Recommended values - mathematically independent of each other						
Speed range	n_e			1 000 – 6 500		rpm
Torque up to [1]	$M_{e\,max.}$		27	28	28	mNm
Current up to (thermal limits) [1]	$I_{e\,max.}$		1,90	1,46	0,75	A

[1] Specification applies to U_{nsoll} = 10 V

Electronic			
Supply voltage	U_p	min. 5 ... max. 30	V DC
Current	$I_{max.}$	25	mA

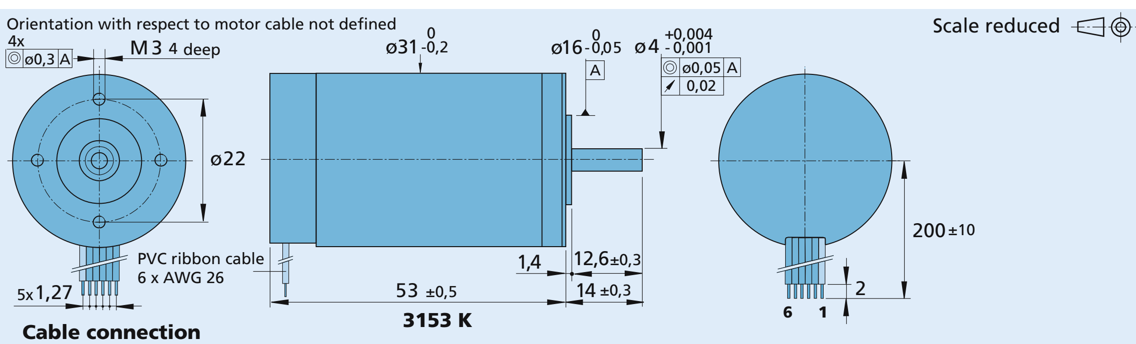


Circuit diagram

* An additional external pull-up resistor can be added to improve the rise time.

Caution:

I_{OUT} max. 15 mA must not be exceeded!



3153 K

Cable connection

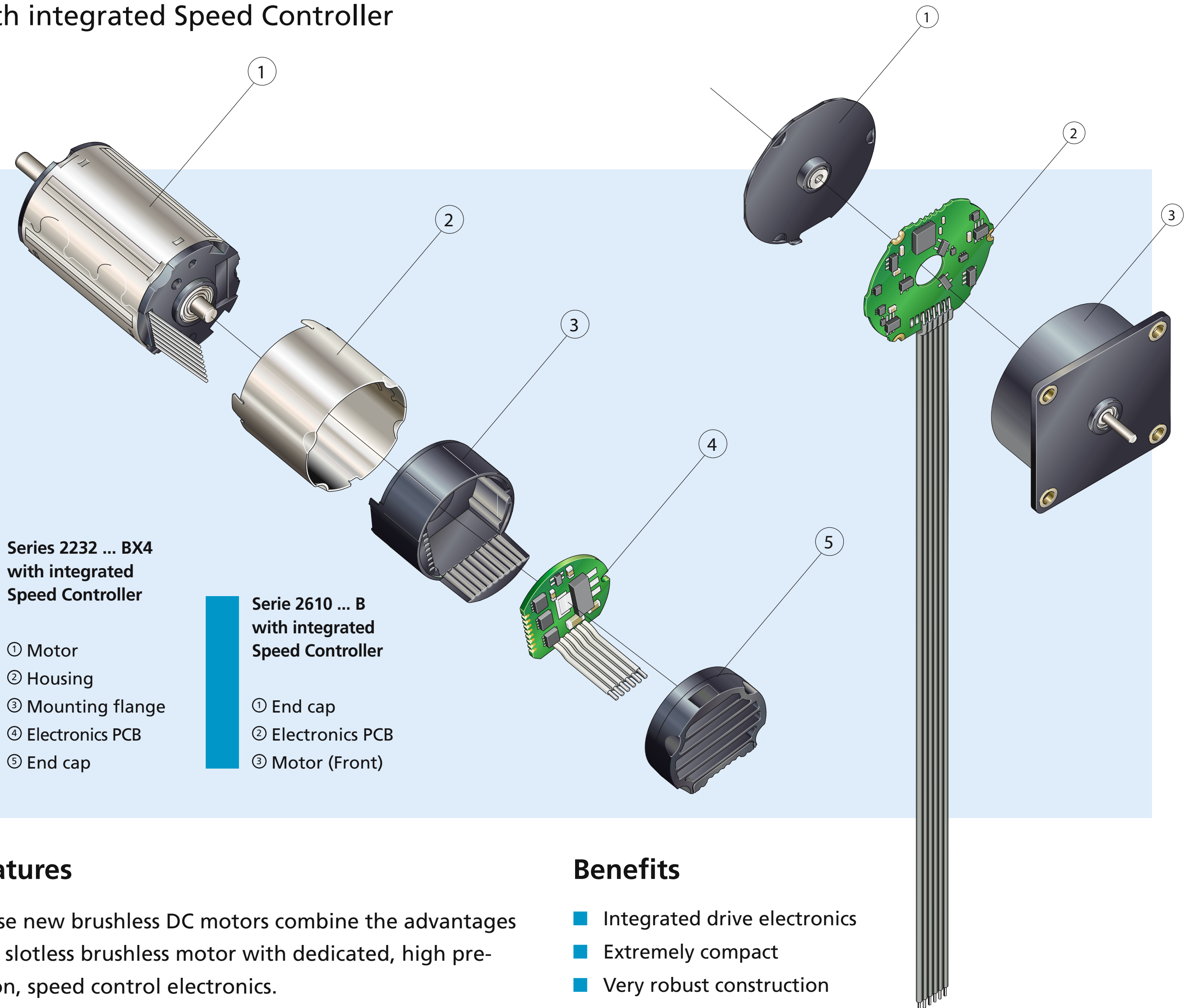
No.	Function			
1 (red)	U_p	: electronic supply	5 V DC - 30 V DC
2	U_{mot}	: coil supply	0 V DC up to 2 · U_N (max. 30 V DC)
3	GND	: ground	
4	U_{nsoll}	: Speed command	0 - 10 V DC | > 10 V DC - max. U_P not defined
5	DIR	: direction of rotation	on ground or U < 0,5 V = CCW, U > 3 V = CW
6	FG	: frequency output	(max. U_p, $I_{max.}$ 15 mA) 3 lines per revolution

Caution:
Incorrect lead connection will damage the motor electronics!

Notes

Brushless DC-Motors

with integrated Speed Controller



Series 2232 ... BX4 with integrated Speed Controller

① Motor
② Housing
③ Mounting flange
④ Electronics PCB
⑤ End cap

Serie 2610 ... B with integrated Speed Controller

① End cap
② Electronics PCB
③ Motor (Front)

Features

These new brushless DC motors combine the advantages of a slotless brushless motor with dedicated, high precision, speed control electronics.

Speed control is achieved using the on board PI controller with an external command voltage. The drives are protected from overload with the integrated current limiting.

The control parameters of the drive electronics can be modified to fit the application using our optional programming adapter and the easy to use FAULHABER Motion Manager software.

Many drives are also available in a simple 2 wire configuration for ease of integration or replacement of standard DC motors in some applications.

Benefits

- Integrated drive electronics
- Extremely compact
- Very robust construction
- Easy to use
- Integrated current limiting
- Control parameters can be tuned to the application

Product Code

32 68 G 024 BX4 SC

32	Motor diameter [mm]
68	Motor length [mm]
G	Shaft type
024	Nominal Voltage [V]
BX4	Type of commutation (electronic)
SC	Integrated Speed Controller

Brushless DC-Servomotors

with integrated Speed Controller
4 Pole Technology

10 mNm

For combination with
Gearheads:
22F, 22/7, 26A

Series 2232 ... BX4 S SC

	2232 S			012 BX4 S	024 BX4 S	SC
1	Nominal voltage	U_N		12	24	Volt
2	Terminal resistance, phase-phase	R		3,5	12,4	Ω
3	Output power [1]	$P_{2\ max.}$		4,4	4,5	W
4	Efficiency	$\eta_{max.}$		60,9	61,7	%
5	No-load speed	n_o		13 200	14 000	rpm
6	No-load current (with shaft ø 3,0 mm)	I_o		0,163	0,088	A
7	Stall torque	M_H		27,3	29,4	mNm
8	Friction torque, static	C_o		0,6	0,6	mNm
9	Friction torque, dynamic	C_v		$5,5 \cdot 10^{-5}$	$5,5 \cdot 10^{-5}$	mNm/rpm
10	Speed constant	k_n		1 173	616	rpm/V
11	Back-EMF constant	k_E		0,852	1,623	mV/rpm
12	Torque constant	k_M		8,14	15,50	mNm/A
13	Current constant	k_I		0,123	0,065	A/mNm
14	Slope of n-M curve	$\Delta n/\Delta M$		504	493	rpm/mNm
15	Terminal inductance, phase-phase	L		130	470	µH
16	Mechanical time constant	τ_m		22	22	ms
17	Rotor inertia	J		4,2	4,2	gcm^2
18	Angular acceleration	$\alpha_{max.}$		65	70	$\cdot 10^3 rad/s^2$
19	Thermal resistance	$R_{th\ 1} / R_{th\ 2}$	2 / 13			K/W
20	Thermal time constant	τ_{w1} / τ_{w2}	4,1 / 274			s
21	Operating temperature range		– 40 ... + 85			°C
22	Shaft bearings		ball bearings, preloaded			
23	Shaft load max.:					
	– radial at 3 000 rpm (4 mm from mounting flange)		20			N
	– axial at 3 000 rpm		2			N
	– axial at standstill		20			N
24	Shaft play:					
	– radial	≤	0,015			mm
	– axial	=	0			mm
25	Housing material		stainless steel			
26	Weight		77			g
27	Direction of rotation		electronically reversible			
28	Number of pole pairs		2			
Recommended values - mathematically independent of each other						
29	Speed up to	$n_{e\ max.}$		22 500	17 000	rpm
30	Torque up to [1) 2)]	$M_{e\ max.}$		6 / 8	7 / 10	mNm
31	Current up to [1) 2)]	$I_{e\ max.}$		1 / 1,4	0,5 / 0,8	A

1) at 5 000 rpm
2) thermal resistance $R_{th\ 2}$ not reduced / thermal resistance $R_{th\ 2}$ by 55% reduced

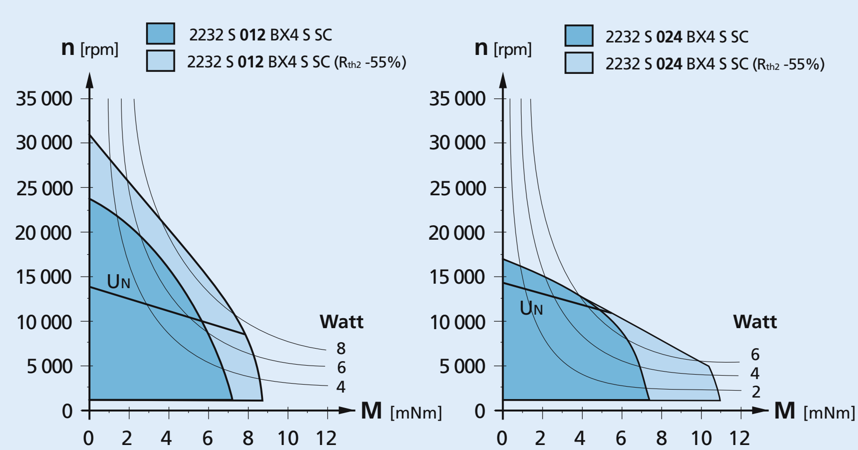
Note:

The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

The diagram shows the motor in a completely insulated as well as thermally coupled condition ($R_{th\ 2}$ 55% reduced).

The motor is factory pre-configured to a continuous current for the thermally insulated condition. The controller must be reconfigured with the easy to use Motion Manager Software for use with other parameter settings.

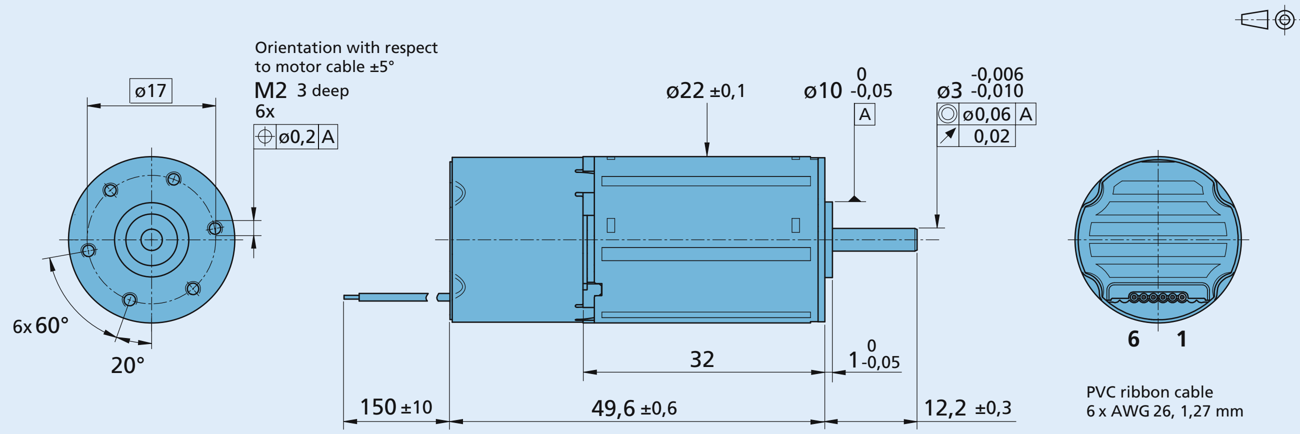
The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended areas for continuous operation

Brushless DC-Motors

Dimensional drawing



2232 S ... BX4 S SC

Speed Controller			012 BX4 S	024 BX4 S	SC
Power supply electronic	U_p	5 ... 28			V DC
Power supply motor	U_{mot}	6 ... 28			V DC
PWM switching frequency	f_{PWM}	96			kHz
Efficiency	η	95			%
Max. continuous output current [1]	I_{dauer}		1,4	0,8	A
Max. peak output current [1]	I_{max}		2,8	1,6	A
Total standby current at U_N	I_{el}	0,020			A
Speed range:					
– standard » Hall sensors (digital)		400 ... 50 000 [2]			rpm
– optional » Hall sensors (analog)		50 ... 50 000 [2]			rpm
Scanning range		500			µs

[1] at 22°C ambient temperature and max. 60°C motor temperature at the nominal voltage of motor and electronics
[2] speed depend on motor operating voltage

Connection information

Connection 1 "U_P":	power supply electronic	U_P
Connection 2 "U_{mot}":	power supply electronic coil	U_{mot}
Connection 3 "GND":	ground	ground
Connection 4 "U_{nsoll}":		
– analog input	input voltage	U_{in} = 0 ... 10 V | > 10 V ... U_P » set speed value not defined
	input resistance	$R_{in} \geq 5\,k\Omega$
	set speed value	per 1 V, 2 000 rpm
		U_{in} < 0,15 V » motor stops
		U_{in} > 0,3 V » motor starts
Connection 5 "DIR":		
– digital input	direction of rotation	to ground or level < 0,5 V » counterclockwise
		open or level > 3 V » clockwise
	input resistance	$R_{in} \geq 10\,k\Omega$
Connection 6 "FG":		max. U_P; I_{max} = 15 mA; open collector with 22 kΩ pull-up resistor
– digital output	frequency output	6 lines per revolution

Features

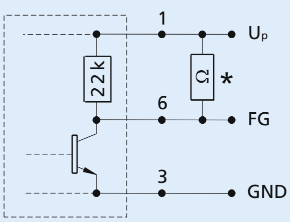
In this variant, the brushless DC servomotors have an integrated Speed Controller. The motor is commutated using Hall sensors integrated into the motor. Speed control is via a PI regulator.

The Speed Controller has a current limiting device which limits the maximum motor current if the thermal load is too high. Twice the continuous current is possible over a short time.

Using the **"FAULHABER Motion Manager"** software, the customer can modify the Speed Controller to special conditions of use. The following parameters can be changed: current limit and regulator parameters.

Circuit diagram / Connection information

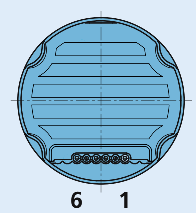
Output circuit



* An additional external pull-up resistor can be added to improve the rise time.

Caution: I_{OUT} max. 15 mA must not be exceeded!

Cable connection

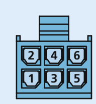


Connection

No.	Function
1	U_P
2	U_{mot}
3	GND
4	U_{nsoll}
5	DIR
6	FG

Caution:
Incorrect lead connection will damage the motor electronics!

Options



- Connector variant (Option no.: 3809)
  AWG 26 / PVC ribbon cable
  with connector Micro-Fit
- Analog Hall sensors (Option no.: 3692)

Accessories

- Programming board (Part No.: 6501.00088)

Full product description

- Example:
  2232S024BX4S SC

Brushless DC-Servomotors

with integrated Speed Controller
4 Pole Technology

16 mNm

For combination with
Gearheads:
22F, 22/7, 26A

Series 2232 ... BX4 SC

	2232 S			012 BX4	024 BX4	SC
1	Nominal voltage	U_N		12	24	Volt
2	Terminal resistance, phase-phase	R		3,5	12,4	Ω
3	Output power [1]	$P_{2\ max.}$		8,8	8,9	W
4	Efficiency	$\eta_{\ max.}$		66,9	67,6	%
5	No-load speed	n_o		6 600	7 000	rpm
6	No-load current (with shaft ø 3,0 mm)	I_o		0,112	0,061	A
7	Stall torque	M_H		55,7	59,9	mNm
8	Friction torque, static	C_o		0,85	0,85	mNm
9	Friction torque, dynamic	C_v		$1,5 \cdot 10^{-4}$	$1,5 \cdot 10^{-4}$	mNm/rpm
10	Speed constant	k_n		579	304	rpm/V
11	Back-EMF constant	k_E		1,728	3,288	mV/rpm
12	Torque constant	k_M		16,50	31,40	mNm/A
13	Current constant	k_I		0,061	0,032	A/mNm
14	Slope of n-M curve	$\Delta n/\Delta M$		123	120	rpm/mNm
15	Terminal inductance, phase-phase	L		120	440	µH
16	Mechanical time constant	τ_m		6,7	6,5	ms
17	Rotor inertia	J		5,2	5,2	gcm^2
18	Angular acceleration	$\alpha_{\ max.}$		107	115	$\cdot 10^3 rad/s^2$
19	Thermal resistance	$R_{th\ 1}$ / $R_{th\ 2}$	2 / 13			K/W
20	Thermal time constant	τ_{w1} / τ_{w2}	4,1 / 283			s
21	Operating temperature range		– 40 ... +85			°C
22	Shaft bearings		ball bearings, preloaded			
23	Shaft load max.:					
	– radial at 3 000 rpm (4 mm from mounting flange)		20			N
	– axial at 3 000 rpm		2			N
	– axial at standstill		20			N
24	Shaft play:					
	– radial	≤	0,015			mm
	– axial	=	0			mm
25	Housing material		stainless steel			
26	Weight		77			g
27	Direction of rotation		electronically reversible			
28	Number of pole pairs		2			
Recommended values - mathematically independent of each other						
29	Speed up to	$n_{e\ max.}$		14 500	8 500	rpm
30	Torque up to [1] [2]	$M_{e\ max.}$		13 / 16	12 / 13	mNm
31	Current up to [1] [2]	$I_{e\ max.}$		1 / 1,4	0,5 / 0,8	A

[1] at 5 000 rpm
[2] thermal resistance $R_{th\ 2}$ not reduced / thermal resistance $R_{th\ 2}$ by 55% reduced

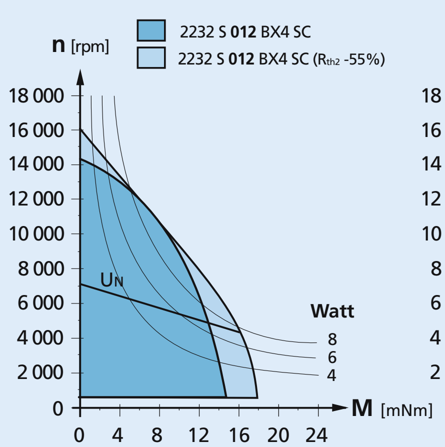
Note:

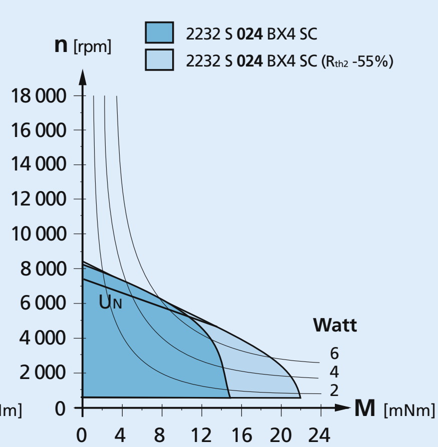
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

The diagram shows the motor in a completely insulated as well as thermally coupled condition ($R_{th\ 2}$ 55% reduced).

The motor is factory pre-configured to a continuous current for the thermally insulated condition. The controller must be reconfigured with the easy to use Motion Manager Software for use with other parameter settings.

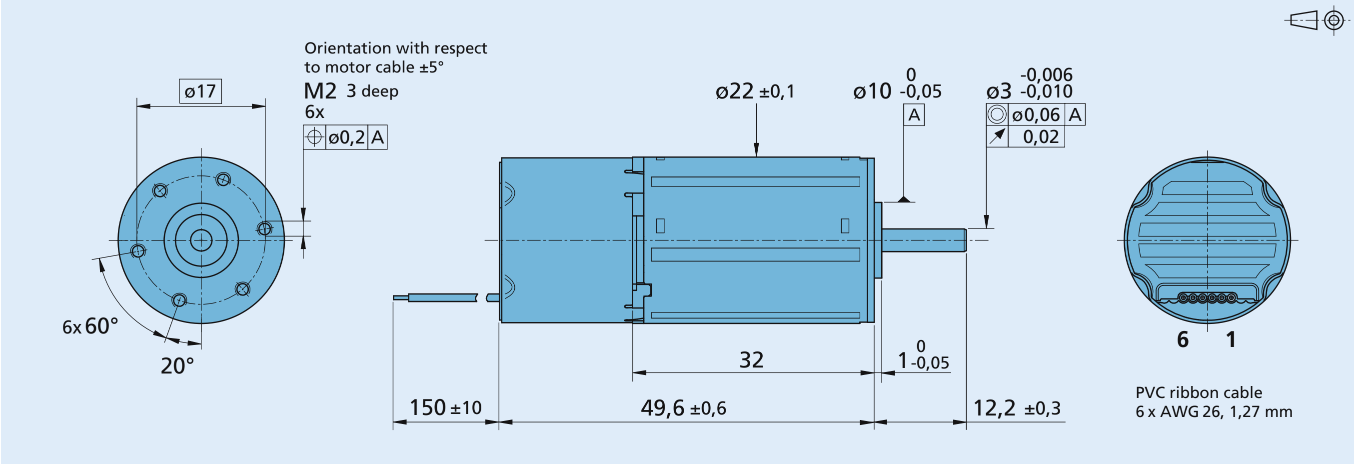
The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.





Recommended areas for continuous operation

Dimensional drawing



2232 S ... BX4 SC

Speed Controller			012 BX4	024 BX4	SC
Power supply electronic	U_p	5 ... 28			V DC
Power supply motor	U_{mot}	6 ... 28			V DC
PWM switching frequency	f_{PWM}	96			kHz
Efficiency	η	95			%
Max. continuous output current [1]	I_{dauer}		1,4	0,8	A
Max. peak output current [1]	I_{max}		2,8	1,6	A
Total standby current at U_N	I_{el}	0,020			A
Speed range:					
– standard » Hall sensors (digital)		400 ... 50 000 [2]			rpm
– optional » Hall sensors (analog)		50 ... 50 000 [2]			rpm
Scanning range		500			µs

[1] at 22°C ambient temperature and max. 60°C motor temperature at the nominal voltage of motor and electronics
[2] speed depend on motor operating voltage

Connection information		
Connection 1 “U_P”:	power supply electronic	U_P
Connection 2 “U_{mot}”:	power supply electronic coil	U_{mot}
Connection 3 “GND”:	ground	ground
Connection 4 “U_{nsoll}”:		
– analog input	input voltage	U_{in} = 0 ... 10 V | > 10 V ... U_P » set speed value not defined
	input resistance	R_{in} ≥ 5 kΩ
	set speed value	per 1 V, 1 000 rpm
		U_{in} < 0,15 V » motor stops
		U_{in} > 0,3 V » motor starts
Connection 5 “DIR”:		
– digital input	direction of rotation	to ground or level < 0,5 V » counterclockwise
		open or level > 3 V » clockwise
	input resistance	R_{in} ≥ 10 kΩ
Connection 6 “FG”:		max. U_P; I_{max} = 15 mA; open collector with 22 kΩ pull-up resistor
– digital output	frequency output	6 lines per revolution

Features

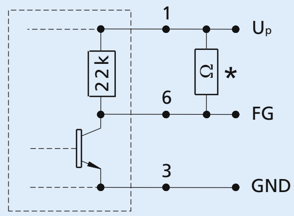
In this variant, the brushless DC servomotors have an integrated Speed Controller. The motor is commutated using Hall sensors integrated into the motor. Speed control is via a PI regulator.

The Speed Controller has a current limiting device which limits the maximum motor current if the thermal load is too high. Twice the continuous current is possible over a short time.

Using the **“FAULHABER Motion Manager”** software, the customer can modify the Speed Controller to special conditions of use. The following parameters can be changed: current limit and regulator parameters.

Circuit diagram / Connection information

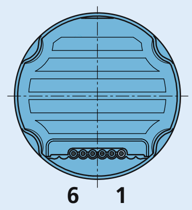
Output circuit



* An additional external pull-up resistor can be added to improve the rise time.

Caution: I_{OUT} max. 15 mA must not be exceeded!

Cable connection



Connection

No.	Function
1	U_P
2	U_{mot}
3	GND
4	U_{nsoll}
5	DIR
6	FG

Caution:
Incorrect lead connection will damage the motor electronics!

Options

- Connector variant (Option no.: 3809)
  AWG 26 / PVC ribbon cable
  with connector Micro-Fit
- Analog Hall sensors (Option no.: 3692)

Accessories
- Programming board (Part No.: 6501.00088)

Full product description
- Example:
  2232S024BX4 SC

Brushless DC-Servomotors

with integrated Speed Controller
4 Pole Technology

20 mNm

For combination with
Gearheads:
22F, 22/7, 26A

Series 2250 ... BX4 S SC

		2250 S		024 BX4 S	SC
1	Nominal voltage	U_N		24	Volt
2	Terminal resistance, phase-phase	R		5,9	Ω
3	Output power [1]	$P_{2\,max.}$		10,3	W
4	Efficiency	$\eta_{max.}$		70,4	%
5	No-load speed	n_o		10 500	rpm
6	No-load current (with shaft ø 3,0 mm)	I_o		0,105	A
7	Stall torque	M_H		84,7	mNm
8	Friction torque, static	C_o		0,75	mNm
9	Friction torque, dynamic	C_v		$1,4 \cdot 10^{-4}$	mNm/rpm
10	Speed constant	k_n		451	rpm/V
11	Back-EMF constant	k_E		2,218	mV/rpm
12	Torque constant	k_M		21,1	mNm/A
13	Current constant	k_I		0,047	A/mNm
14	Slope of n-M curve	$\Delta n/\Delta M$		125,6	rpm/mNm
15	Terminal inductance, phase-phase	L		250	µH
16	Mechanical time constant	τ_m		6,97	ms
17	Rotor inertia	J		5,3	gcm^2
18	Angular acceleration	$\alpha_{max.}$		160	$\cdot 10^3 rad/s^2$
19	Thermal resistance	$R_{th\,1}$ / $R_{th\,2}$	1,2 / 10,5		K/W
20	Thermal time constant	τ_{w1} / τ_{w2}	4,2 / 332		s
21	Operating temperature range		– 40 ... +85		°C
22	Shaft bearings		ball bearings, preloaded		
23	Shaft load max.:				
	– radial at 3 000 rpm (4 mm from mounting flange)		20		N
	– axial at 3 000 rpm		2		N
	– axial at standstill		20		N
24	Shaft play:				
	– radial	≤	0,015		mm
	– axial	=	0		mm
25	Housing material		stainless steel		
26	Weight		97		g
27	Direction of rotation		electronically reversible		
28	Number of pole pairs		2		
Recommended values - mathematically independent of each other					
29	Speed up to	$n_{e\,max.}$		12 500	rpm
30	Torque up to [1) 2)]	$M_{e\,max.}$		15 / 20	mNm
31	Current up to [1) 2)]	$I_{e\,max.}$		0,8 / 1,2	A

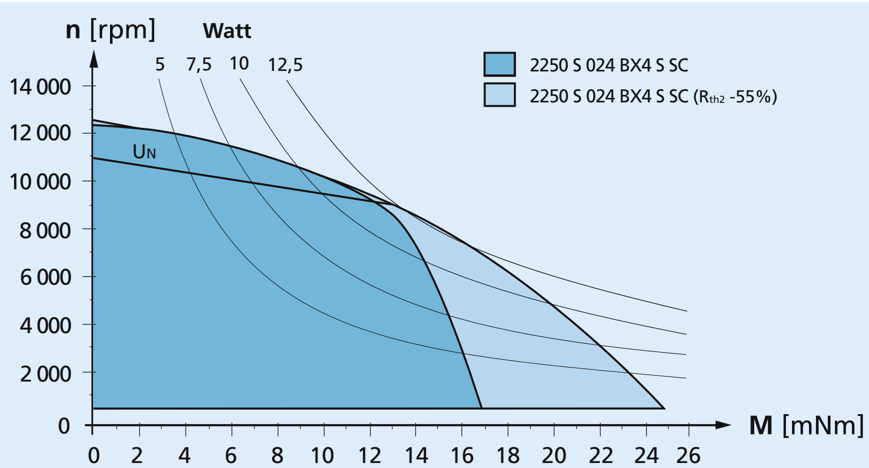
1) at 5 000 rpm
2) thermal resistance $R_{th\,2}$ not reduced / thermal resistance $R_{th\,2}$ by 55% reduced

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

The diagram shows the motor in a completely insulated as well as thermally coupled condition ($R_{th\,2}$ 55% reduced).

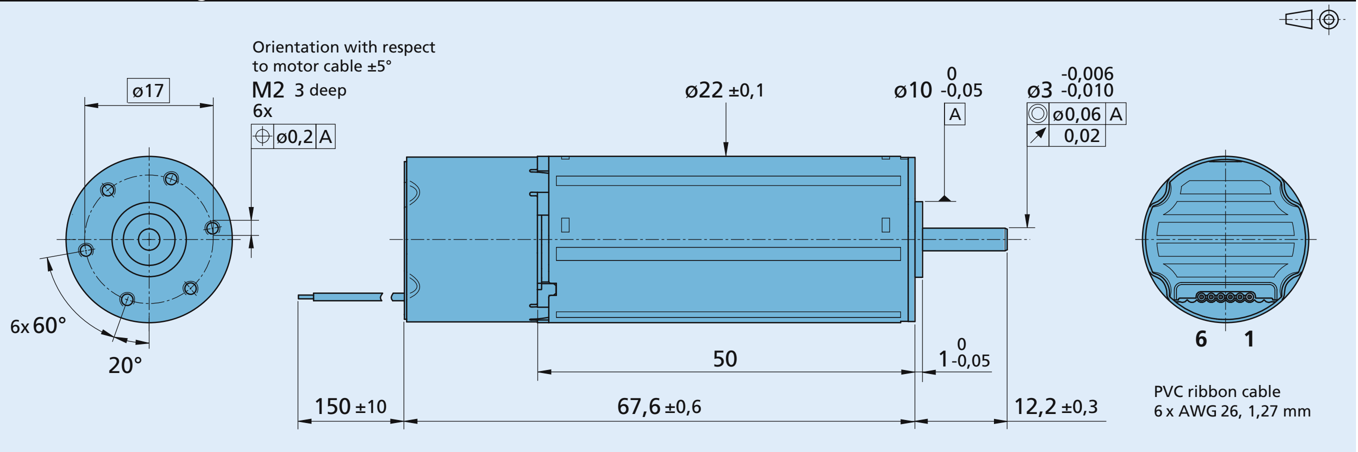
The motor is factory pre-configured to a continuous current for the thermally insulated condition. The controller must be reconfigured with the easy to use Motion Manager Software for use with other parameter settings.

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended areas for continuous operation

Dimensional drawing



2250 S ... BX4 S SC

Speed Controller		024 BX4 S	SC
Power supply electronic	U_p	5 ... 28	V DC
Power supply motor	U_{mot}	6 ... 28	V DC
PWM switching frequency	f_{PWM}	96	kHz
Efficiency	η	95	%
Max. continuous output current [1]	I_{dauer}	0,8	A
Max. peak output current [1]	I_{max}	1,6	A
Total standby current at U_N	I_{el}	0,020	A
Speed range:			
– standard » Hall sensors (digital)		400 ... 50 000 [2]	rpm
Scanning range		500	µs

[1] at 22°C ambient temperature and max. 60°C motor temperature at the nominal voltage of motor and electronics
[2] speed depend on motor operating voltage

Connection information

Connection 1 "U_P":	power supply electronic	U_P
Connection 2 "U_{mot}":	power supply electronic coil	U_{mot}
Connection 3 "GND":	ground	ground
Connection 4 "U_{nsoll}":		
– analog input	input voltage	U_{in} = 0 ... 10 V | > 10 V ... U_P » set speed value not defined
	input resistance	R_{in} ≥ 5 kΩ
	set speed value	per 1 V, 2 000 rpm
		U_{in} < 0,15 V » motor stops
		U_{in} > 0,3 V » motor starts
Connection 5 "DIR":		
– digital input	direction of rotation	to ground or level < 0,5 V » counterclockwise
		open or level > 3 V » clockwise
	input resistance	R_{in} ≥ 10 kΩ
Connection 6 "FG":		max. U_P; Imax = 15 mA; open collector with 22 kΩ pull-up resistor
– digital output	frequency output	6 lines per revolution

Features

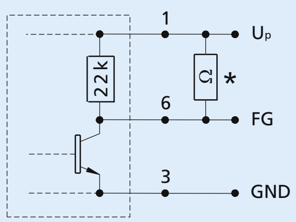
In this variant, the brushless DC servomotors have an integrated Speed Controller. The motor is commutated using Hall sensors integrated into the motor. Speed control is via a PI regulator.

The Speed Controller has a current limiting device which limits the maximum motor current if the thermal load is too high. Twice the continuous current is possible over a short time.

Using the **"FAULHABER Motion Manager"** software, the customer can modify the Speed Controller to special conditions of use. The following parameters can be changed: current limit and regulator parameters.

Circuit diagram / Connection information

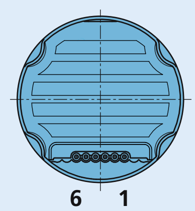
Output circuit



* An additional external pull-up resistor can be added to improve the rise time.

Caution: I_{OUT} max. 15 mA must not be exceeded!

Cable connection



Connection

No.	Function
1	U_P
2	U_{mot}
3	GND
4	U_{nsoll}
5	DIR
6	FG

Caution:
Incorrect lead connection will damage the motor electronics!

Options

- Connector variant (Option no.: 3809)
  AWG 26 / PVC ribbon cable
  with connector Micro-Fit

Accessories

- Programming board (Part No.: 6501.00088)

Full product description

- Example:
  2250S024BX4S SC

Brushless DC-Servomotors

with integrated Speed Controller
4 Pole Technology

25 mNm

For combination with
Gearheads:
22F, 22/7, 26A

Series 2250 ... BX4 SC

		2250 S		024 BX4	SC
1	Nominal voltage	U_N		24	Volt
2	Terminal resistance, phase-phase	R		5,9	Ω
3	Output power [1]	$P_{2\ max.}$		17,3	W
4	Efficiency	$\eta_{\ max.}$		75,0	%
5	No-load speed	n_o		6 000	rpm
6	No-load current (with shaft ø 3,0 mm)	I_o		0,072	A
7	Stall torque	M_H		149,0	mNm
8	Friction torque, static	C_o		1,2	mNm
9	Friction torque, dynamic	C_v		$2,4 \cdot 10^{-4}$	mNm/rpm
10	Speed constant	k_n		259	rpm/V
11	Back-EMF constant	k_E		3,860	mV/rpm
12	Torque constant	k_M		36,9	mNm/A
13	Current constant	k_I		0,027	A/mNm
14	Slope of n-M curve	$\Delta n/\Delta M$		41,4	rpm/mNm
15	Terminal inductance, phase-phase	L		240	µH
16	Mechanical time constant	τ_m		4,30	ms
17	Rotor inertia	J		10	gcm^2
18	Angular acceleration	$\alpha_{\ max.}$		149	$\cdot 10^3 rad/s^2$
19	Thermal resistance	$R_{th\ 1}$ / $R_{th\ 2}$	1,2 / 10,5		K/W
20	Thermal time constant	τ_{w1} / τ_{w2}	4,2 / 424		s
21	Operating temperature range		– 40 ... +85		°C
22	Shaft bearings		ball bearings, preloaded		
23	Shaft load max.:				
	– radial at 3 000 rpm (4 mm from mounting flange)		20		N
	– axial at 3 000 rpm		2		N
	– axial at standstill		20		N
24	Shaft play:				
	– radial	≤	0,015		mm
	– axial	=	0		mm
25	Housing material		stainless steel		
26	Weight		117		g
27	Direction of rotation		electronically reversible		
28	Number of pole pairs		2		
Recommended values - mathematically independent of each other					
29	Speed up to	$n_{e\ max.}$		7 200	rpm
30	Torque up to [1) 2)]	$M_{e\ max.}$		23 / 25	mNm
31	Current up to [1) 2)]	$I_{e\ max.}$		0,8 / 1,2	A

[1)] at 5 000 rpm
[2)] thermal resistance $R_{th\ 2}$ not reduced / thermal resistance $R_{th\ 2}$ by 55% reduced

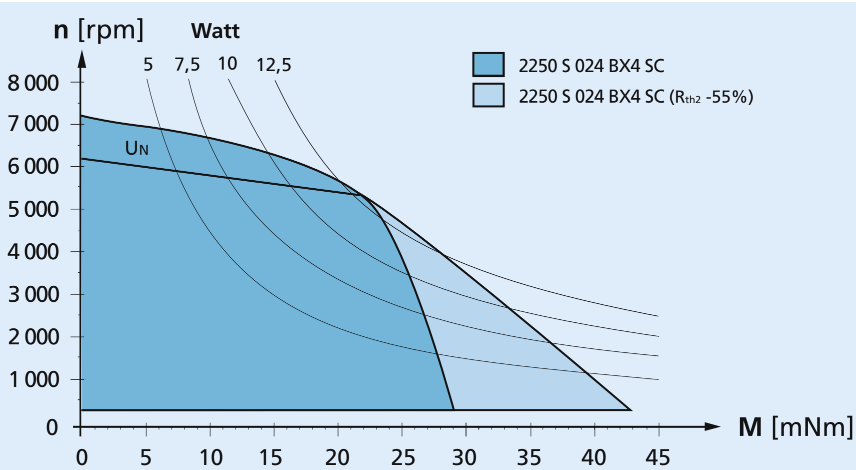
Note:

The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

The diagram shows the motor in a completely insulated as well as thermally coupled condition ($R_{th\ 2}$ 55% reduced).

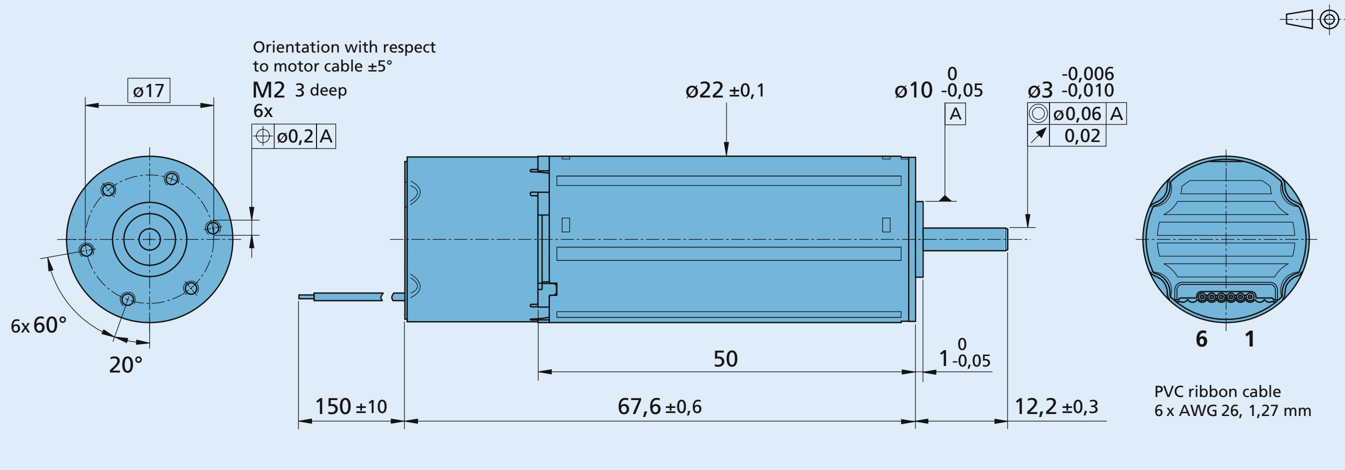
The motor is factory pre-configured to a continuous current for the thermally insulated condition. The controller must be reconfigured with the easy to use Motion Manager Software for use with other parameter settings.

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended areas for continuous operation

Dimensional drawing



2250 S ... BX4 SC

Speed Controller		024 BX4	SC
Power supply electronic	U_p	5 ... 28	V DC
Power supply motor	U_{mot}	6 ... 28	V DC
PWM switching frequency	f_{PWM}	96	kHz
Efficiency	η	95	%
Max. continuous output current 1)	I_{dauer}	0,8	A
Max. peak output current 1)	I_{max}	1,6	A
Total standby current at U_N	I_{el}	0,020	A
Speed range:			
– standard » Hall sensors (digital)		400 ... 50 000 2)	rpm
– optional » Hall sensors (analog)		50 ... 50 000 2)	rpm
Scanning range		500	µs

1) at 22°C ambient temperature and max. 60°C motor temperature at the nominal voltage of motor and electronics
2) speed depend on motor operating voltage

Connection information		
Connection 1 "U_P":	power supply electronic	U_P
Connection 2 "U_{mot}":	power supply electronic coil	U_{mot}
Connection 3 "GND":	ground	ground
Connection 4 "U_{nsoll}":		
– analog input	input voltage	U_{in} = 0 ... 10 V | > 10 V ... U_P » set speed value not defined
	input resistance	R_{in} ≥ 5 kΩ
	set speed value	per 1 V, 1 000 rpm
		U_{in} < 0,15 V » motor stops
		U_{in} > 0,3 V » motor starts
Connection 5 "DIR":		
– digital input	direction of rotation	to ground or level < 0,5 V » counterclockwise
		open or level > 3 V » clockwise
	input resistance	R_{in} ≥ 10 kΩ
Connection 6 "FG":		max. U_P; Imax = 15 mA; open collector with 22 kΩ pull-up resistor
– digital output	frequency output	6 lines per revolution

Features

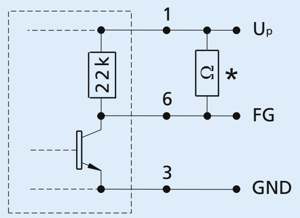
In this variant, the brushless DC servomotors have an integrated Speed Controller. The motor is commutated using Hall sensors integrated into the motor. Speed control is via a PI regulator.

The Speed Controller has a current limiting device which limits the maximum motor current if the thermal load is too high. Twice the continuous current is possible over a short time.

Using the **"FAULHABER Motion Manager"** software, the customer can modify the Speed Controller to special conditions of use. The following parameters can be changed: current limit and regulator parameters.

Circuit diagram / Connection information

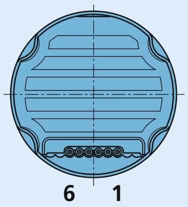
Output circuit



* An additional external pull-up resistor can be added to improve the rise time.

Caution: I_{OUT} max. 15 mA must not be exceeded!

Cable connection



Connection

No.	Function
1	U_P
2	U_{mot}
3	GND
4	U_{nsoll}
5	DIR
6	FG

Caution:
Incorrect lead connection will damage the motor electronics!

Options

- Connector variant (Option no.: 3809)
  AWG 26 / PVC ribbon cable
  with connector Micro-Fit
- Analog Hall sensors (Option no.: 3692)

Accessories

- Programming board (Part No.: 6501.00088)

Full product description

- Example:
  2250S024BX4 SC

Brushless DC-Servomotors

with integrated Speed Controller
4 Pole Technology

54 mNm

For combination with
Gearheads:
32A, 32ALN, 32/3, 32/3 S, 38/1, 38/1S, 38/2, 38/2 S

Series 3242 ... BX4 SC

		3242 G		012 BX4	024 BX4	SC
1	Nominal voltage	U_N		12	24	Volt
2	Terminal resistance, phase-phase	R		0,89	3,6	Ω
3	Output power [1]	$P_{2\,max.}$		21,2	21,1	W
4	Efficiency	$\eta_{max.}$		77,4	77,3	%
5	No-load speed	n_o		5 500	5 500	rpm
6	No-load current	I_o		0,206	0,103	A
7	Stall torque	M_H		83	83	mNm
8	Friction torque, static	C_o		1,3	1,3	mNm
9	Friction torque, dynamic	C_v		$5{,}2 \cdot 10^{-4}$	$5{,}2 \cdot 10^{-4}$	mNm/rpm
10	Speed constant	k_n		455	227	rpm/V
11	Back-EMF constant	k_E		2,199	4,409	mV/rpm
12	Torque constant	k_M		21,0	42,1	mNm/A
13	Current constant	k_I		0,0476	0,0238	A/mNm
14	Slope of n-M curve	$\Delta n/\Delta M$		19,3	19,4	rpm/mNm
15	Terminal inductance, phase-phase	L		60	240	µH
16	Mechanical time constant	τ_m		6,1	6,1	ms
17	Rotor inertia	J		30	30	gcm^2
18	Angular acceleration	$\alpha_{max.}$		28	28	$\cdot 10^3 rad/s^2$
19	Thermal resistance	$R_{th\,1}$ / $R_{th\,2}$	1,6 / 12,4			K/W
20	Thermal time constant	τ_{w1} / τ_{w2}	9 / 810			s
21	Operating temperature range		– 40 ... + 100			°C
22	Shaft bearings		ball bearings, preloaded			
23	Shaft load max.:					
	– radial at 3 000 rpm (4,5 mm from mounting flange)		50			N
	– axial at 3 000 rpm		5			N
	– axial at standstill		50			N
24	Shaft play:					
	– radial	≤	0,015			mm
	– axial	=	0			mm
25	Housing material		stainless steel			
26	Weight		192			g
27	Direction of rotation		electronically reversible			
28	Number of pole pairs		2			
Recommended values - mathematically independent of each other						
29	Speed up to	$n_{e\,max.}$		14 000	6 000	rpm
30	Torque up to [1] [2]	$M_{e\,max.}$		32 / 36	32 / 54	mNm
31	Current up to [1] [2]	$I_{e\,max.}$		1,90 / 2,00	0,95 / 1,55	A

[1] at 5 000 rpm
[2] thermal resistance $R_{th\,2}$ not reduced / thermal resistance $R_{th\,2}$ by 55% reduced

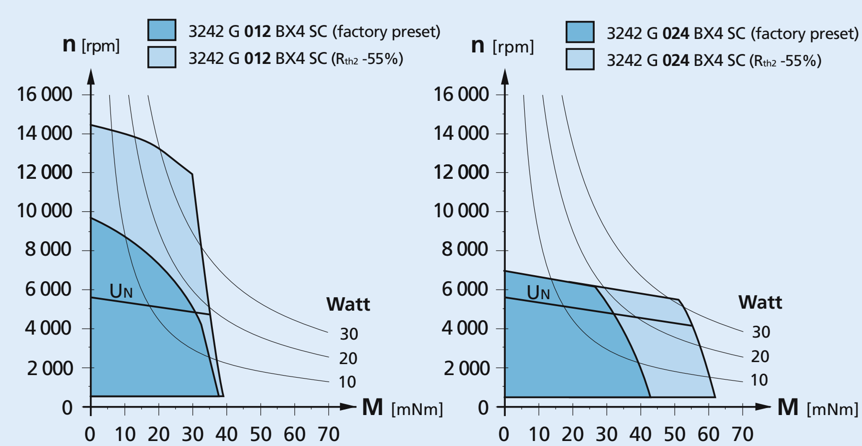
Note:

The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

The diagram shows the motor in a completely insulated as well as thermally coupled condition ($R_{th\,2}$ 55% reduced).

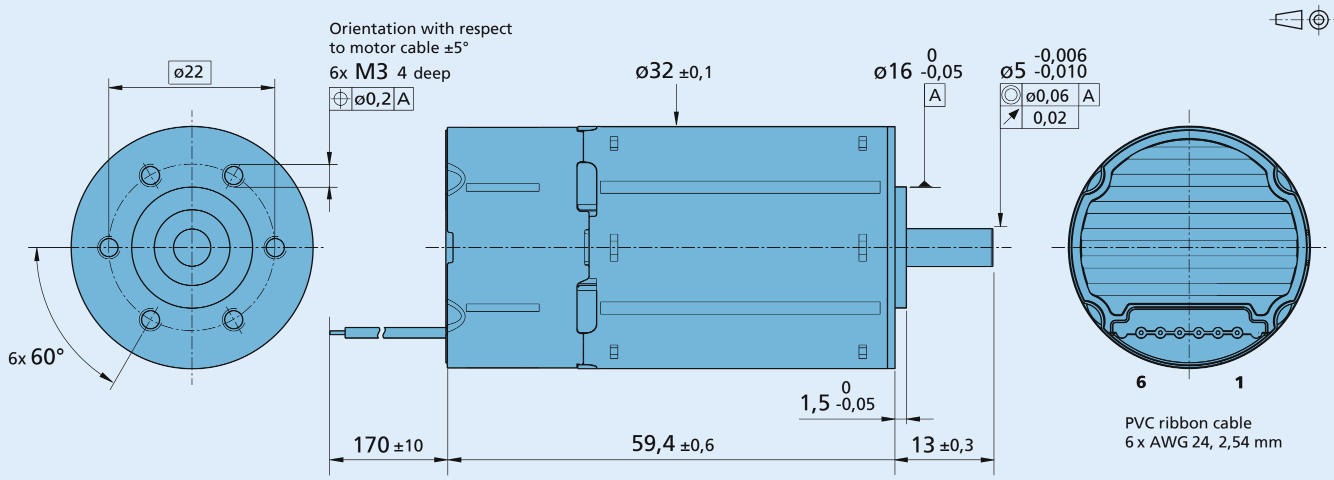
The motor is factory pre-configured to a continuous current for the thermally insulated condition. The controller must be reconfigured with the easy to use Motion Manager Software for use at higher continuous current.

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended areas for continuous operation

Dimensional drawing



3242 G ... BX4 SC

Speed Controller		012 BX4	024 BX4	SC
Power supply electronic	U_P	6,5 ... 30		V DC
Power supply motor	U_{mot}	6,5 ... 30		V DC
PWM switching frequency	f_{PWM}	96		kHz
Efficiency	η	95		%
Max. continuous output current [1]	I_{dauer}	2		A
Max. peak output current	I_{max}	4		A
Total standby current at U_N	I_{el}	17	10	mA
Speed range:				
– standard » Hall sensors (digital)		400 ... 50 000 [2]		rpm
– optional » Hall sensors (analog)		50 ... 50 000 [2]		rpm
Scanning range		500		µs

[1] at 22°C ambient temperature and max. 60°C motor temperature at the nominal voltage of motor and electronics
[2] speed is dependent on the motor operating voltage

Connection information			
Connection 1 "U_P":	power supply electronic	U_P	
Connection 2 "U_{mot}":	power supply electronic coil	U_{mot}	
Connection 3 "GND":	ground	ground	
Connection 4 "U_{nsoll}":			
– analog input	input voltage	U_{in} = 0 ... 10 V | > 10 V ... U_P » set speed value not defined	
	input resistance	$R_{in} \geq 8{,}9\,k\Omega$	
	set speed value	per 1 V, 1 000	rpm
		U_{in} < 0,15 V » motor stops	
		U_{in} > 0,3 V » motor starts	
Connection 5 "DIR":			
– digital input	direction of rotation	to ground or level < 0,5 V » counterclockwise	
		open or level > 3 V » clockwise	
	input resistance	$R_{in} \geq 10\,k\Omega$	
Connection 6 "FG":		max. U_P; I_{max} = 15 mA; open collector with 22 kΩ pull-up resistor	
– digital output	frequency output	6 lines per revolution	

Features

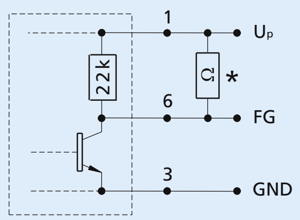
In this variant, the brushless DC servomotors have an integrated Speed Controller. The motor is commutated using Hall sensors integrated into the motor. Speed control is via a PI regulator.

The Speed Controller has a current limiting device which limits the maximum motor current if the thermal load is too high. Twice the continuous current is possible over a short time.

Using the **"FAULHABER Motion Manager"** software, the customer can modify the Speed Controller to special conditions of use. The following parameters can be changed: current limit and regulator parameters.

Circuit diagram / Connection information

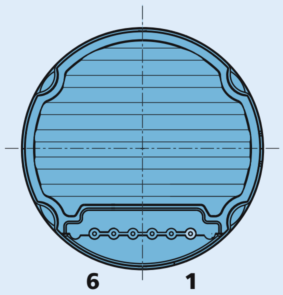
Output circuit



* An additional external pull-up resistor can be added to improve the rise time.

Caution: I_{OUT} max. 15 mA must not be exceeded!

Cable connection



Connection

No.	Function
1	U_P
2	U_{mot}
3	GND
4	U_{nsoll}
5	DIR
6	FG

Caution:
Incorrect lead connection will damage the motor electronics!

Options

- Connector variant (Option no.: 3809)
  AWG 24 / PVC ribbon cable with connector Micro-Fit
- Analog Hall sensors (Option no.: 3692)

Accessories

- Programming board (Part No.: 6501.00088)

Full product description

- Examples:
  3242G012BX4 SC
  3242G024BX4 SC

Brushless DC-Servomotors

with integrated Speed Controller
4 Pole Technology

50 mNm

For combination with
Gearheads:
32A, 32ALN, 32/3, 32/3 S, 38/1, 38/1S, 38/2, 38/2 S

Series 3242 ... BX4 SCDC

		3242 G		012 BX4	024 BX4	SCDC
1	Nominal voltage	U_N		12	24	Volt
2	Terminal resistance, phase-phase	R		0,89	3,6	Ω
3	Output power [1]	$P_{2\ max.}$		21,2	21,1	W
4	Efficiency	$\eta_{max.}$		77,4	77,3	%
5	No-load speed	n_o		5 300	5 400	rpm
6	No-load current	I_o		0,199	0,101	A
7	Stall torque	M_H		83	83	mNm
8	Friction torque, static	C_o		1,3	1,3	mNm
9	Friction torque, dynamic	C_v		$5,2 \cdot 10^{-4}$	$5,2 \cdot 10^{-4}$	mNm/rpm
10	Speed constant	k_n		455	227	rpm/V
11	Back-EMF constant	k_E		2,199	4,409	mV/rpm
12	Torque constant	k_M		21,0	42,1	mNm/A
13	Current constant	k_I		0,0476	0,0238	A/mNm
14	Slope of n-M curve	$\Delta n/\Delta M$		19,3	19,4	rpm/mNm
15	Terminal inductance, phase-phase	L		60	240	µH
16	Mechanical time constant	τ_m		6,1	6,1	ms
17	Rotor inertia	J		30	30	gcm^2
18	Angular acceleration	$\alpha_{max.}$		28	28	$\cdot 10^3 rad/s^2$
19	Thermal resistance	$R_{th\ 1}$ / $R_{th\ 2}$	1,6 / 12,4			K/W
20	Thermal time constant	τ_{w1} / τ_{w2}	9 / 810			s
21	Operating temperature range		– 40 ... +85			°C
22	Shaft bearings		ball bearings, preloaded			
23	Shaft load max.:					
	– radial at 3 000 rpm (4,5 mm from mounting flange)		50			N
	– axial at 3 000 rpm		5			N
	– axial at standstill		50			N
24	Shaft play:					
	– radial	≤	0,015			mm
	– axial	=	0			mm
25	Housing material		stainless steel			
26	Weight		189			g
27	Direction of rotation		electronically reversible			
28	Number of pole pairs		2			
	Recommended values - mathematically independent of each other					
29	Speed up to	$n_{e\ max.}$		12 000	6 000	rpm
30	Torque up to [1] [2]	$M_{e\ max.}$		27 / 29	28 / 50	mNm
31	Current up to [1] [2]	$I_{e\ max.}$		1,60 / 1,60	0,82 / 1,40	A

[1] at 5000 rpm
[2] thermal resistance $R_{th\ 2}$ not reduced / thermal resistance $R_{th\ 2}$ by 55% reduced

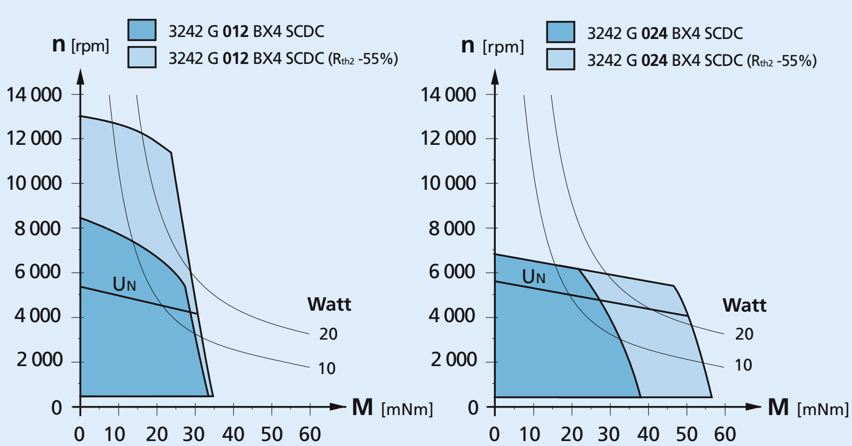
Note:

The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

The diagram shows the motor in a completely insulated as well as thermally coupled condition ($R_{th\ 2}$ 55% reduced).

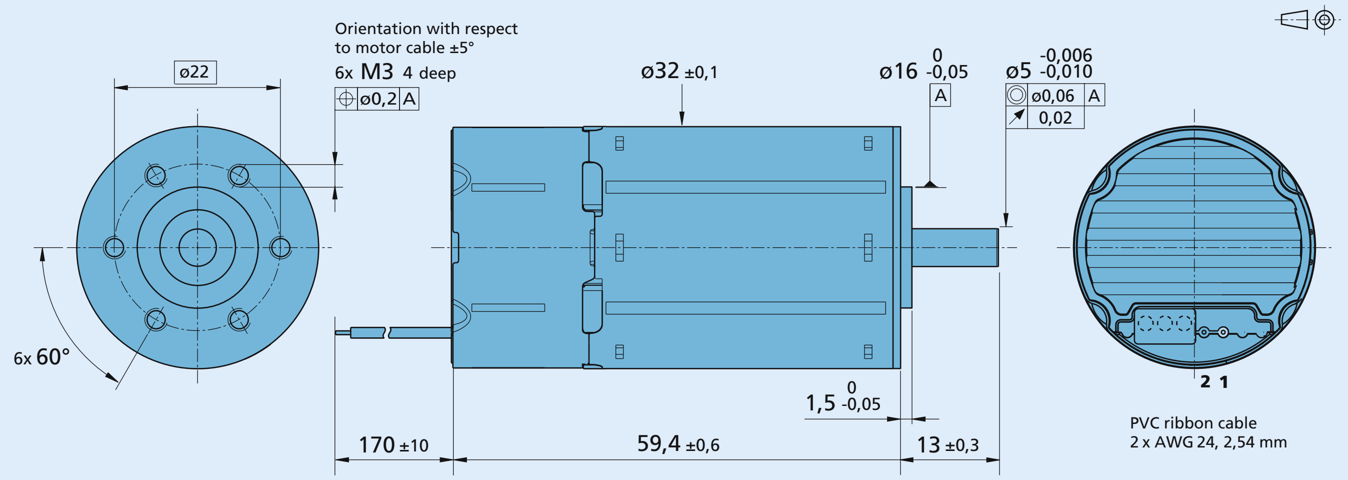
The motor is factory pre-configured to perform at the recommended continuous current. Non-standard configurations are only possible upon request from the manufacturer.

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended areas for continuous operation

Dimensional drawing



3242 G ... BX4 SCDC

Speed Controller		012 BX4	024 BX4	SCDC
Power supply electronic	U_p	6,5 ... 30		V DC
Power supply motor	U_{mot}	6,5 ... 30		V DC
PWM switching frequency	f_{PWM}	96		kHz
Efficiency	η	95		%
Max. continuous output current [1]	I_{dauer}	1,6		A
Max. peak output current	I_{max}	4		A
Total standby current at U_N	I_{el}	17	10	mA
Speed range, electronics		400 ... 50 000 [2]		rpm
Scanning rate		500		µs

[1] at 22°C ambient temperature and max. 60°C motor temperature at the nominal voltage of motor and electronics
[2] speed is dependent on the motor operating voltage

Connection information

Connection 1 “Mot +”: positive power supply

Connection 2 “Mot –”: negative power supply

Features

In this version, the brushless DC servomotors have an integrated Speed Controller. The motor is commutated using the integrated digital hall sensors. Speed control is via a PI regulator.

The Speed Controller has a current limiting device which limits the maximum motor current if the thermal load is too high.
Twice the continuous current is possible over a short time.

The direction of rotation is dependent on the polarity of the voltage.

Full product description

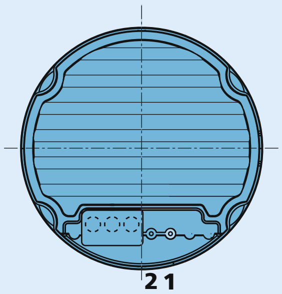
- Examples:
  3242G012BX4 SCDC
  3242G024BX4 SCDC

Connection information

Options

- Connector variants (Option no. 4140)
  AWG 24 / PVC ribbon cable
  with connector Micro-Fit
  connector pin assignment:

Cable connection



Connection

No.	Function
1	Mot +
2	Mot –

Brushless DC-Servomotors

with integrated Speed Controller
4 Pole Technology

73 mNm

For combination with
Gearheads:
32A, 32ALN, 32/3, 32/3 S, 38/1, 38/1S, 38/2, 38/2 S

Series 3268 ... BX4 SC

	3268 G		024 BX4	SC
1 Nominal voltage	U_N		24	Volt
2 Terminal resistance, phase-phase	R		1,45	Ω
3 Output power 1)	$P_{2\ max.}$		32,7	W
4 Efficiency	$\eta_{max.}$		79,5	%
5 No-load speed	n_o		5 500	rpm
6 No-load current	I_o		0,215	A
7 Stall torque	M_H		137	mNm
8 Friction torque, static	C_o		1,7	mNm
9 Friction torque, dynamic	C_v		$1,3 \cdot 10^{-3}$	mNm/rpm
10 Speed constant	k_n		220	rpm/V
11 Back-EMF constant	k_E		4,555	mV/rpm
12 Torque constant	k_M		43,5	mNm/A
13 Current constant	k_I		0,0230	A/mNm
14 Slope of n-M curve	$\Delta n/\Delta M$		7,3	rpm/mNm
15 Terminal inductance, phase-phase	L		110	µH
16 Mechanical time constant	τ_m		4,6	ms
17 Rotor inertia	J		60	gcm^2
18 Angular acceleration	$\alpha_{max.}$		23	$\cdot 10^3 rad/s^2$
19 Thermal resistance	R_{th1} / R_{th2}	1,9 / 9,6		K/W
20 Thermal time constant	τ_{w1} / τ_{w2}	17 / 1 060		s
21 Operating temperature range		– 40 ... + 100		°C
22 Shaft bearings		ball bearings, preloaded		
23 Shaft load max.:				
– radial at 3 000 rpm (4,5 mm from mounting flange)		50		N
– axial at 3 000 rpm		5		N
– axial at standstill		50		N
24 Shaft play:				
– radial	≤	0,015		mm
– axial	=	0		mm
25 Housing material		stainless steel		
26 Weight		305		g
27 Direction of rotation		electronically reversible		
28 Number of pole pairs		2		
Recommended values - mathematically independent of each other				
29 Speed up to	$n_{e\ max.}$		7 000	rpm
30 Torque up to 1) 2)	$M_{e\ max.}$		47 / 73	mNm
31 Current up to 1) 2)	$I_{e\ max.}$		1,41 / 2,00	A

1) at U_{soll} = 10V
2) thermal resistance $R_{th\ 2}$ not reduced / thermal resistance $R_{th\ 2}$ by 55% reduced

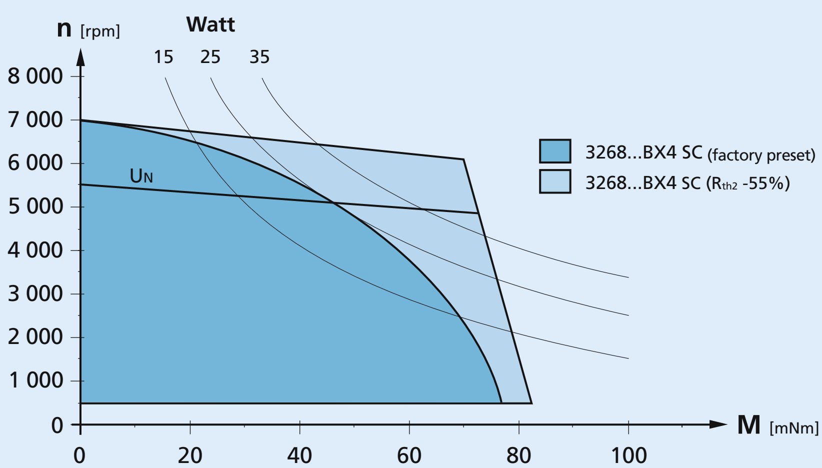
Note:

The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

The diagram shows the motor in a completely insulated as well as thermally coupled condition ($R_{th\ 2}$ 55% reduced).

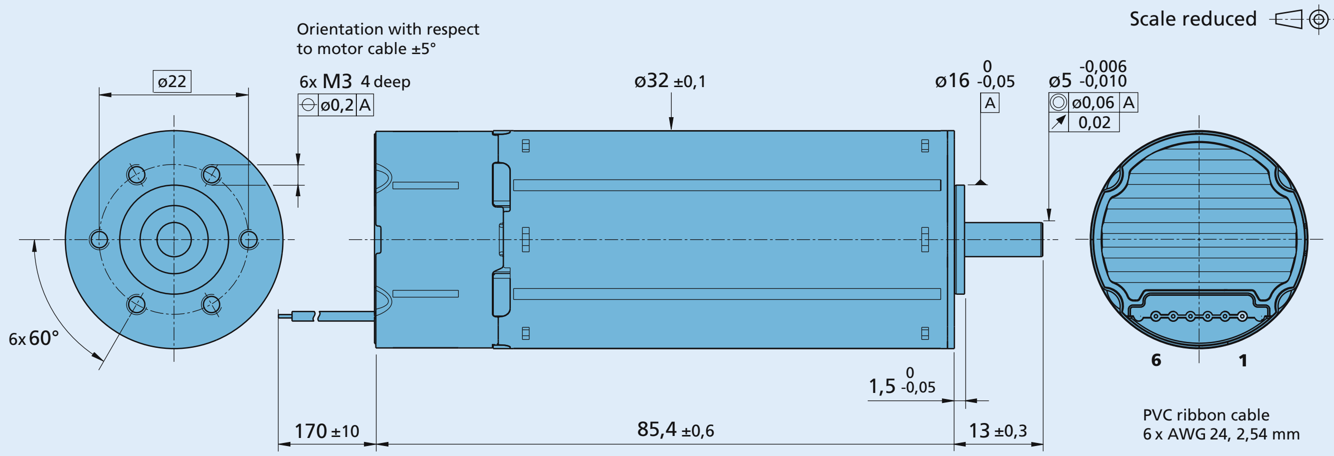
The motor is factory pre-configured to a continuous current for the thermally insulated condition. The controller must be reconfigured with the easy to use Motion Manager Software for use at higher continuous current.

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended areas for continuous operation

Dimensional drawing



3268 G ... BX4 SC

Speed Controller		024 BX4	SC
Power supply electronic	U_P	6,5 ... 30	V DC
Power supply motor	U_{mot}	6,5 ... 30	V DC
PWM switching frequency	f_{PWM}	96	kHz
Efficiency	η	95	%
Max. continuous output current [1]	I_{dauer}	2	A
Max. peak output current	I_{max}	4	A
Total standby current at U_N	I_{el}	10	mA
Speed range:			
– standard » Hall sensors (digital)		400 ... 50 000 [2]	rpm
– optional » Hall sensors (analog)		50 ... 50 00 [2]	rpm
Scanning range		500	µs

[1] at 22°C ambient temperature and max. 60°C motor temperature at the nominal voltage of motor and electronics
[2] speed is dependent on the motor operating voltage

Connection 1 "U_P":	power supply electronic	U_P	
Connection 2 "U_{mot}":	power supply electronic coil	U_{mot}	
Connection 3 "GND":	ground	ground	
Connection 4 "U_{nsoll}":			
– analog input	input voltage	U_{in} = 0 ... 10 V | > 10 V ... U_P » set speed value not defined	
	input resistance	$R_{in} \geq 8{,}9\,k\Omega$	
	set speed value	per 1 V, 1 000	rpm
		U_{in} < 0,15 V » motor stops	
		U_{in} > 0,3 V » motor starts	
Connection 5 "DIR":			
– digital input	direction of rotation	to ground or level < 0,5 V » counterclockwise	
		open or level > 3 V » clockwise	
	input resistance	$R_{in} \geq 10\,k\Omega$	
Connection 6 "FG":		max. U_P; I_{max} = 15 mA; open collector with 22 kΩ pull-up resistor	
– digital output	frequency output	6 lines per revolution	

Features

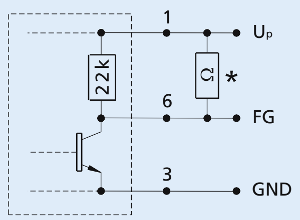
In this variant, the brushless DC servomotors have an integrated Speed Controller. The motor is commutated using Hall sensors integrated into the motor. Speed control is via a PI regulator.

The Speed Controller has a current limiting device which limits the maximum motor current if the thermal load is too high. Twice the continuous current is possible over a short time.

Using the **"FAULHABER Motion Manager"** software, the customer can modify the Speed Controller to special conditions of use. The following parameters can be changed: current limit and regulator parameters.

Circuit diagram / Connection information

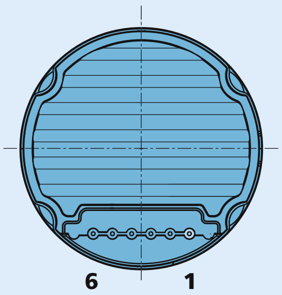
Output circuit



* An additional external pull-up resistor can be added to improve the rise time.

Caution: I_{OUT} max. 15 mA must not be exceeded!

Cable connection



Connection

No.	Function
1	U_P
2	U_{mot}
3	GND
4	U_{nsoll}
5	DIR
6	FG

Caution:
Incorrect lead connection will damage the motor electronics!

Options

- Connector variant (Option no.: 3809)
  AWG 24 / PVC ribbon cable
  with connector Micro-Fit

- Analog Hall sensors (Option no.: 3692)

Accessories

- Programming board (Part No.: 6501.00088)

Full product description

- Example:
  3268G024BX4 SC

Brushless DC-Servomotors

with integrated Speed Controller
4 Pole Technology

58 mNm

For combination with
Gearheads:
32A, 32ALN, 32/3, 32/3 S, 38/1, 38/1S, 38/2, 38/2 S

Series 3268 ... BX4 SCDC

No.		3268 G		024 BX4	SCDC
1	Nominal voltage	U_N		24	Volt
2	Terminal resistance, phase-phase	R		1,45	Ω
3	Output power 1)	$P_{2\ max.}$		32,7	W
4	Efficiency	$\eta_{\ max.}$		79,5	%
5	No-load speed	n_o		5 300	rpm
6	No-load current	I_o		0,210	A
7	Stall torque	M_H		137	mNm
8	Friction torque, static	C_o		1,7	mNm
9	Friction torque, dynamic	C_v		$1,3 \cdot 10^{-3}$	mNm/rpm
10	Speed constant	k_n		220	rpm/V
11	Back-EMF constant	k_E		4,555	mV/rpm
12	Torque constant	k_M		43,5	mNm/A
13	Current constant	k_I		0,0230	A/mNm
14	Slope of n-M curve	$\Delta n/\Delta M$		7,3	rpm/mNm
15	Terminal inductance, phase-phase	L		110	µH
16	Mechanical time constant	τ_m		4,6	ms
17	Rotor inertia	J		60	gcm^2
18	Angular acceleration	$\alpha_{\ max.}$		23	$\cdot 10^3 rad/s^2$
19	Thermal resistance	$R_{th\ 1}$ / $R_{th\ 2}$	1,9 / 9,6		K/W
20	Thermal time constant	τ_{w1} / τ_{w2}	17 / 1 060		s
21	Operating temperature range		– 40 ... +85		°C
22	Shaft bearings		ball bearings, preloaded		
23	Shaft load max.:				
	– radial at 3 000 rpm (4,5 mm from mounting flange)		50		N
	– axial at 3 000 rpm		5		N
	– axial at standstill		50		N
24	Shaft play:				
	– radial	≤	0,015		mm
	– axial	=	0		mm
25	Housing material		stainless steel		
26	Weight		305		g
27	Direction of rotation		electronically reversible		
28	Number of pole pairs		2		
Recommended values - mathematically independent of each other					
29	Speed up to	$n_{e\ max.}$		6 500	rpm
30	Torque up to 1) 2)	$M_{e\ max.}$		37 / 58	mNm
31	Current up to 1) 2)	$I_{e\ max.}$		1,11 / 1,60	A

1) at 5000 rpm
2) thermal resistance $R_{th\ 2}$ not reduced / thermal resistance $R_{th\ 2}$ by 55% reduced

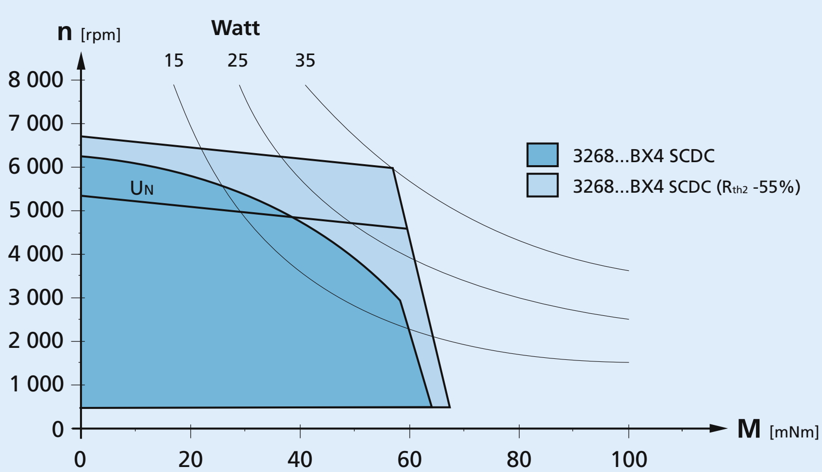
Note:

The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

The diagram shows the motor in a completely insulated as well as thermally coupled condition ($R_{th\ 2}$ 55% reduced).

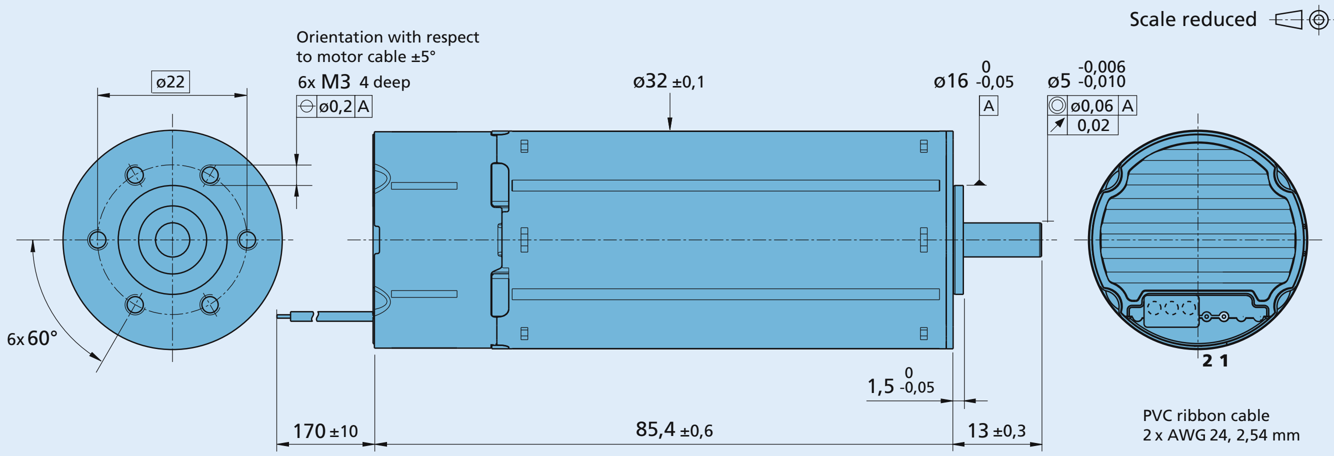
The motor is factory pre-configured to perform at the recommended continuous current. Non-standard configurations are only possible upon request from the manufacturer.

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended areas for continuous operation

Dimensional drawing



3268 G ... BX4 SCDC

Speed Controller		024 BX4	SCDC
Power supply electronic	U_p	6,5 ... 30	V DC
Power supply motor	U_{mot}	6,5 ... 30	V DC
PWM switching frequency	f_{PWM}	96	kHz
Efficiency	η	95	%
Max. continuous output current [1]	I_{dauer}	1,6	A
Max. peak output current	I_{max}	4	A
Total standby current at U_N	I_{el}	10	mA
Speed range, electronics		400 ... 50 000 [2]	rpm
Scanning rate		500	µs

[1] at 22°C ambient temperature and max. 60°C motor temperature at the nominal voltage of motor and electronics
[2] speed is dependent on the motor operating voltage

Connection information

Connection 1 "Mot +": positive power supply

Connection 2 "Mot –": negative power supply

Features

In this version, the brushless DC servomotors have an integrated Speed Controller. The motor is commutated using the integrated digital hall sensors. Speed control is via a PI regulator.

The Speed Controller has a current limiting device which limits the maximum motor current if the thermal load is too high.
Twice the continuous current is possible over a short time.

The direction of rotation is dependent on the polarity of the voltage.

Full product description

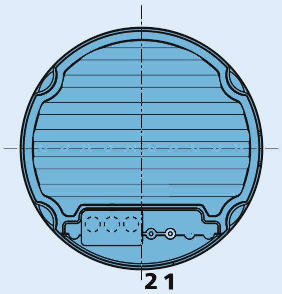
- Examples:
  3268G024BX4 SCDC

Connection information

Options

- Connector variants (Option no. 4140)
  AWG 24 / PVC ribbon cable
  with connector Micro-Fit
  connector pin assignment:

Cable connection



Connection

No.	Function
1	Mot +
2	Mot –

Brushless Flat DC-Micromotors
with integrated Speed Controller

3,7 mNm

Series 2610 ... B SC

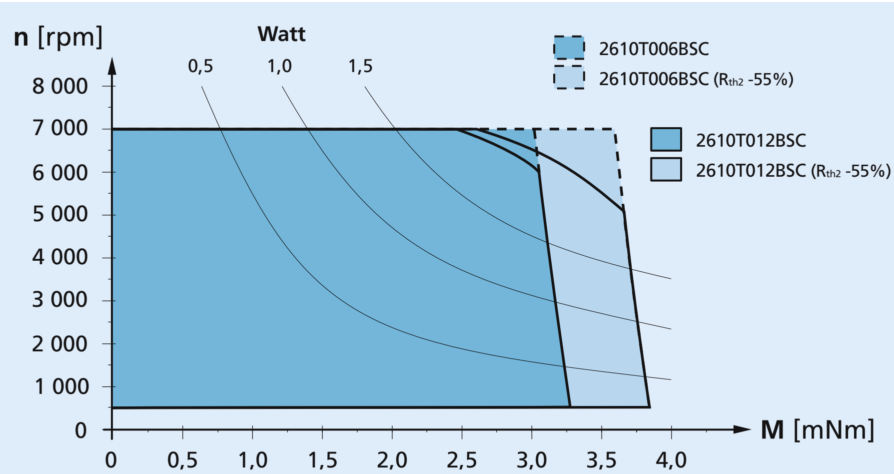
		2610 T		006 B	012 B	SC
1	Nominal voltage	U_N		6	12	Volt
2	Terminal resistance, phase-phase	R		7,0	28,2	Ω
3	Output power [1]	$P_{2\ max.}$		1,92	1,91	W
4	Efficiency	$\eta_{\ max.}$		78	78	%
5	No-load speed	n_o		6 200	6 200	rpm
6	No-load current	I_o		0,012	0,006	A
7	Stall torque	M_H		7,73	7,68	mNm
8	Friction torque, static	C_o		0,025	0,025	mNm
9	Friction torque, dynamic	C_v		$1,35 \cdot 10^{-5}$	$1,35 \cdot 10^{-5}$	mNm/rpm
10	Speed constant	k_n		1 055	528	rpm/V
11	Back-EMF constant	k_E		0,948	1,895	mV/rpm
12	Torque constant	k_M		9,05	18,1	mNm/A
13	Current constant	k_I		0,111	0,055	A/mNm
14	Slope of n-M curve	$\Delta n/\Delta M$		816	822	rpm/mNm
15	Terminal inductance, phase-phase	L		480	1 940	µH
16	Mechanical time constant	τ_m		69	70	ms
17	Rotor inertia	J		8,1	8,1	gcm^2
18	Angular acceleration	$\alpha_{\ max.}$		9,5	9,5	$\cdot 10^3 rad/s^2$
19	Thermal resistance	$R_{th\ 1}$ / $R_{th\ 2}$	33 / 27			K/W
20	Thermal time constant	τ_{w1} / τ_{w2}	20 / 230			s
21	Operating temperature range		-25 ... +80			°C
22	Shaft bearings		ball bearing, preloaded			
23	Shaft load max.:					
	– radial at 3 000/7 000 rpm (3 mm from mounting flange)		4,0 / 3,5			N
	– axial at 3 000/7 000 rpm (push-on only)		3,5 / 3,4			N
	– axial at standstill (push-on only)		17,5			N
24	Shaft play:					
	– radial	≤	0,015			mm
	– axial	=	0			mm
25	Housing material		plastic			
26	Weight		20,1			g
27	Direction of rotation		electronically reversible			
28	Number of pole pairs		2			
	Recommended values - mathematically independent of each other					
29	Speed up to	$n_{e\ max.}$		7 000	7 000	rpm
30	Torque up to [1] [2]	$M_{e\ max.}$		3,14 / 3,72	3,13 / 3,70	mNm
31	Current up to [1] [2]	$I_{e\ max.}$		0,40 / 0,47	0,20 / 0,24	A

[1] at 5 000 rpm
[2] thermal resistance $R_{th\ 2}$ not reduced / thermal resistance $R_{th\ 2}$ by 55% reduced

Note:
The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

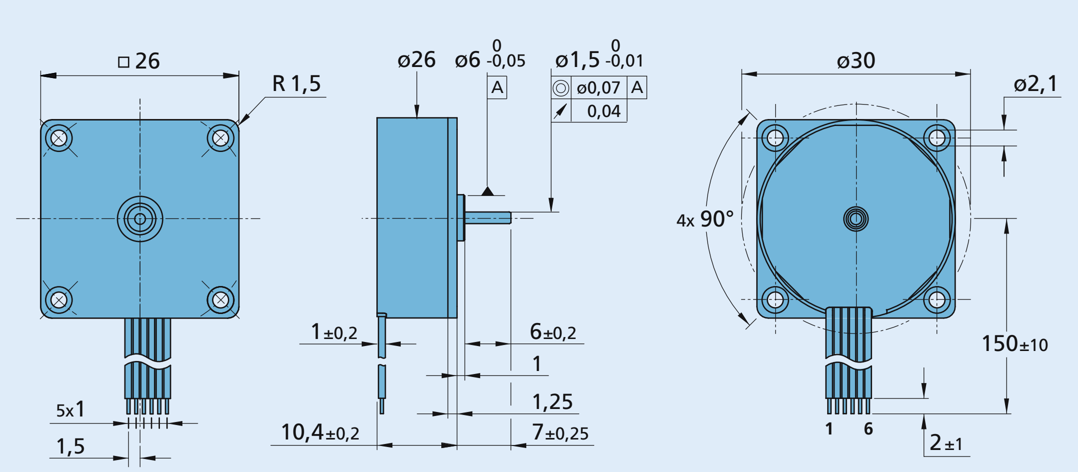
The diagram shows the motor in a completely insulated as well as thermally coupled condition ($R_{th\ 2}$ 55% reduced).

The area of the curve is defined by the maximum allowable supply voltage of the integrated speed controller as well as the control performance characteristics.



Recommended areas for continuous operation

2610 T ... B SC



2610 B SC

Cable
Jacket Material: PVC
8 conductors, AWG 28
grid 1,0 mm
wires tinned

Note:
Hallsensors digital

Connection

No.	Function
1	U_P
2	U_{mot}
3	GND
4	U_{nsoll}
5	DIR
6	FG

Speed Controller

PWM switching frequency	96	kHz
Efficiency	95	%
Max. continuous output current 1)	0,8	A
Max. peak output current	1,6	A
Total standby current	0,020	A
Speed range:		
– standard » Hall sensors (digital)	500 ... 60 000 2)	rpm
Scanning range	500	µs

1) at 22°C ambient temperature and max. 60°C motor temperature respectively
2) speed depend on motor operating voltage

Connection information

Connection 1 "U_P":	power supply electronic	U_P = 4 ... 18 V
Connection 2 "U_{mot}":	power supply electronic coil	U_{mot} = 1,7 ... 18 V
Connection 3 "GND":	ground	ground
Connection 4 "U_{nsoll}":		
– analog input	input voltage	U_{in} = 0 ... 10 V (max. Up)
	input resistance	$R_{in} \geq 8\,k\Omega$
	set speed value	per 1 V » 1 000 rpm
		U_{in} < 0,15 V » motor stops
		U_{in} > 0,3 V » motor starts
Connection 5 "DIR":		
– digital input	direction of rotation	to ground or level < 0,5 V » counterclockwise
		open or level > 3 V » clockwise (max. Up)
	input resistance	$R_{in} \geq 10\,k\Omega$
Connection 6 "FG":		with max. U_P » I_{max} = 15 mA; open collector with 22 kΩ pull-up resistor
– digital output	frequency output	6 lines per revolution

Features

In this variant, the brushless DC-Micromotors have an integrated Speed Controller. The motor is commutated using Hall sensors integrated into the motor. Speed control is via a PI regulator. The Speed Controller has a current limiting device which limits the maximum motor current if the thermal load is too high. Twice the continuous current is possible over a short time.

Using the **"FAULHABER Motion Manager"** software, the customer can modify the Speed Controller to special conditions of use.

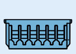
The following parameters can be changed: current limit and regulator parameters.

Full product description

- Examples:
  2610T006B SC
  2610T012B SC

Option

- connector variants (Option no. 4257) AWG 28 / PVC ribbon cable with connector Picoblade



Brushless DC-Gearmotors

with integrated Speed Controller

100 mNm

Series 2622 ... B SC

	2622 S		006 B	012 B	SC
1 Nominal voltage	U_N		6	12	Volt
2 Terminal resistance, phase-phase	R		7,0	28,2	Ω
3 Output power	$P_{2\ max.}$		1,92	1,91	W
4 Efficiency	$\eta_{max.}$		78	78	%
5 No-load speed	n_o		6 200	6 200	rpm
6 No-load current	I_o		0,012	0,006	A
7 Stall torque	M_H		7,73	7,68	mNm
8 Friction torque, static	C_o		0,025	0,025	mNm
9 Friction torque, dynamic	C_v		$1,35 \cdot 10^{-5}$	$1,35 \cdot 10^{-5}$	mNm/rpm
10 Speed constant	k_n		1 055	528	rpm/V
11 Back-EMF constant	k_E		0,948	1,895	mV/rpm
12 Torque constant	k_M		9,05	18,1	mNm/A
13 Current constant	k_I		0,111	0,055	A/mNm
14 Slope of n-M curve	$\Delta n/\Delta M$		816	822	rpm/mNm
15 Terminal inductance, phase-phase	L		480	1 940	µH
16 Mechanical time constant	τ_m		69	70	ms
17 Rotor inertia	J		8,1	8,1	gcm^2
18 Angular acceleration	$\alpha_{max.}$		9,5	9,5	$\cdot 10^3 rad/s^2$
19 Thermal resistance	R_{th1} / R_{th2}	33 / 27			K/W
20 Thermal time constant	τ_{w1} / τ_{w2}	20 / 230			s
21 Number of pole pairs		2			

Integrated Gearhead

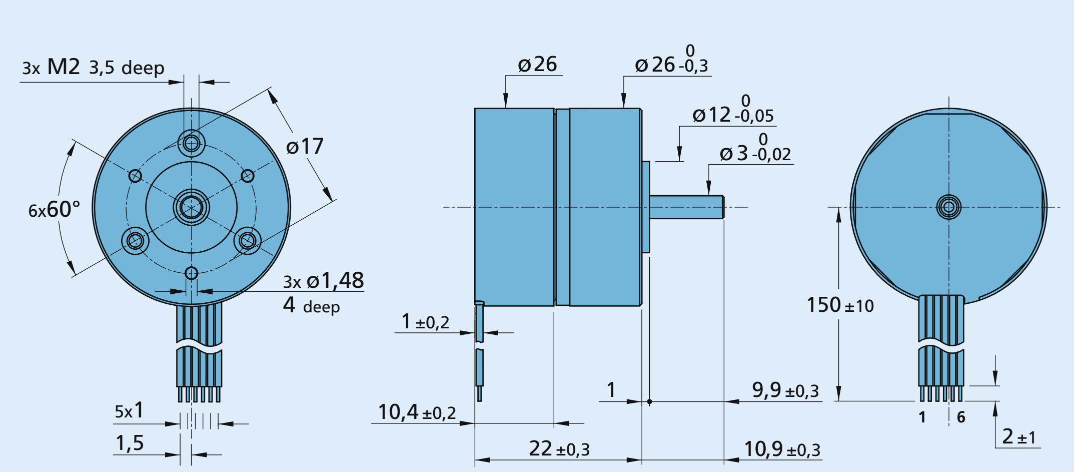
Housing material		plastic	
Geartrain material		metal	
Backlash, at no-load	≤	4	°
Bearings on output shaft		ball bearing	
Shaft load max.:			
– radial (5 mm from mounting face)	≤	15	N
– axial	≤	5	N
Shaft press fit force, max.	≤	10	N
Shaft play:			
– radial (5 mm from mounting face)	≤	0,03	mm
– axial	≤	0,25	mm
Operating temperature range		– 25 ... + 80	°C

Specifications

reduction ratio (rounded)	output speed up to n_{max} rpm	weight with motor g	output torque continuous operation M_{max} mNm	output torque intermittent operation M_{max} mNm	direction of rotation (reversible)	efficiency %
8 : 1	635	25	9	30	=	81
22 : 1	223	26	23	75	≠	73
33 : 1	151	26	30	100	=	60
112 : 1	44	27	93	180	≠	59
207 : 1	24	27	100	180	=	53
361 : 1	14	27	100	180	=	53
814 : 1	6	28	100	180	=	43
1 257 : 1	4	29	100	180	=	43

Note: output speed at 5000 rpm input speed. Based on motor 2610 ... B.

2622 S ... B SC



2622 B SC

Cable
Jacket Material: PVC
8 conductors, AWG 28
grid 1,0 mm
wires tinned

Note:
Hallsensors digital

Connection

No.	Function
1	U_P
2	U_{mot}
3	GND
4	U_{nsoll}
5	DIR
6	FG

Speed Controller

PWM switching frequency	96	kHz
Efficiency	95	%
Max. continuous output current [1]	0,8	A
Max. peak output current	1,6	A
Total standby current	0,020	A
Speed range:		
– standard » Hall sensors (digital)	500 ... 60 000 [2]	rpm
Scanning range	500	µs

[1] at 22°C ambient temperature and max. 60°C motor temperature at the nominal voltage of motor and electronics
[2] speed depend on motor operating voltage

Connection information

Connection 1 “U_P”:	power supply electronic	U_P = 4 ... 18 V
Connection 2 “U_{mot}”:	power supply electronic coil	U_{mot} = 1,7 ... 18 V
Connection 3 “GND”:	ground	ground
Connection 4 “U_{nsoll}”:		
– analog input	input voltage	U_{in} = 0 ... 10 V (max. Up)
	input resistance	R_{in} ≥ 8 kΩ
	set speed value	per 1 V » 1 000 rpm
		U_{in} < 0,15 V » motor stops
		U_{in} > 0,3 V » motor starts
Connection 5 “DIR”:		
– digital input	direction of rotation	to ground or level < 0,5 V » counterclockwise
		open or level > 3 V » clockwise (max. Up)
	input resistance	R_{in} ≥ 10 kΩ
Connection 6 “FG”:		with max. U_P » I_{max} = 15 mA; open collector with 22 kΩ pull-up resistor
– digital output	frequency output	6 lines per revolution

Features

In this variant, the brushless DC-Micromotors have an integrated Speed Controller. The motor is commutated using Hall sensors integrated into the motor. Speed control is via a PI regulator. The Speed Controller has a current limiting device which limits the maximum motor current if the thermal load is too high. Twice the continuous current is possible over a short time.

Using the **“FAULHABER Motion Manager”** software, the customer can modify the Speed Controller to special conditions of use.

The following parameters can be changed: current limit and regulator parameters.

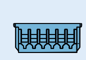
Full product description

- Examples:

2622S006B SC 22:1

2622S012B SC 33:1

Option



- connector variants (Option no. 4257) AWG 28 / PVC ribbon cable with connector Picoblade

Motion Control Systems

WE CREATE MOTION

FAULHABER

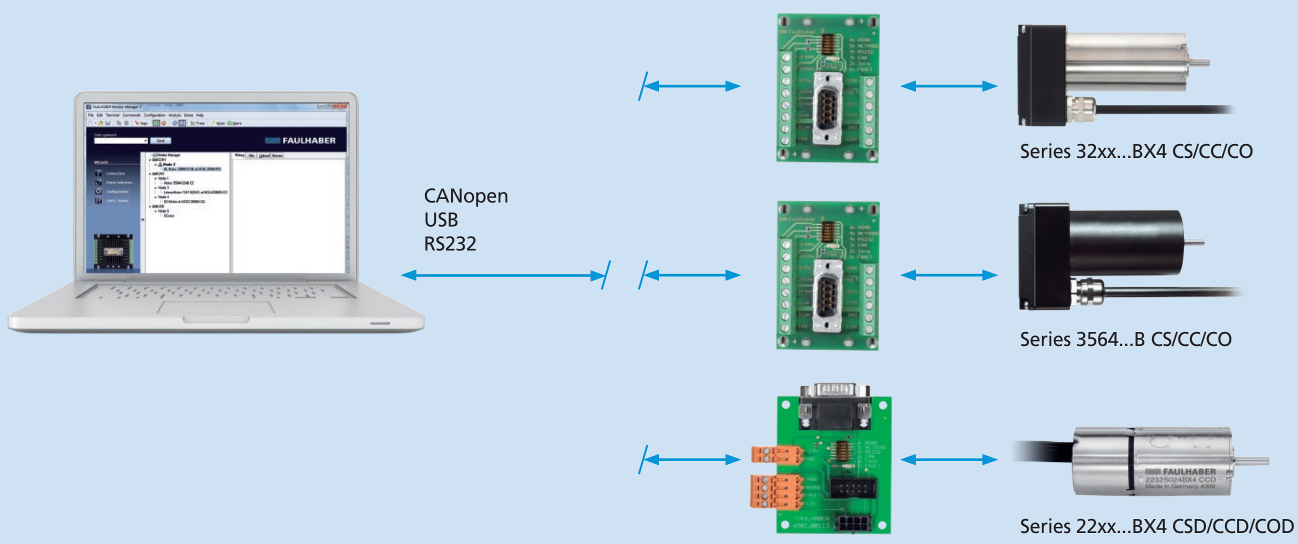
Brushless DC-Servomotors with integrated Motion Controller

Motion Control Systems

Technical Information

Terminal Variations

Brushless DC-Servomotors with integrated Motion Controller and RS232 or CAN interface



Features

FAULHABER Motion Controllers are highly dynamic positioning systems tailored specifically to the requirements of micromotor operations.

In addition to being deployed as a positioning system, they can also operate as speed or current controllers.

The drives can be supplied with an RS232 interface or with a CAN interface and CANopen protocol.

Using this technology, up to 127 drives can be interconnected and controlled with maximum efficiency.

Motion Control Systems – highly dynamic, low-maintenance BLDC servomotors with integrated motion control functionality – deliver the ultimate in slimline design. The integrated systems require less space, as well as making installation much simpler thanks to their reduced wiring.

Benefits

- Compact construction
- Modular design, various performance ratings
- Minimal wiring
- Parametrization via „FAULHABER Motion Manager“ software
- Extensive accessories
- Adapter for connection to USB interface

Product Code

3268	motor series
G	shaft type
024	nominal voltage
BX4	electronic commutation brushless
CS	Serial interface RS232

Motion Control Systems

Configuration, Networking, Interfaces

Operating Modes

Speed control
PI speed controls, even for demanding synchronization requirements.

Positioning
For moving to defined positions with a high level of resolution. Using a PD Controller, the dynamic response can be adjusted to suit the application. Reference and limit switches are evaluated by means of various homing modes.

Speed profiles
Acceleration ramps, deceleration ramps and maximum velocity can also be defined for each section. As a result, even complex profiles can be implemented quickly and effectively.

Current control
Protects the drive by limiting the motor current to the set peak current. The current is limited to the continuous current by means of integrated I^2t monitoring if required.

Protective features

- Protection against ESD
- Overload protection for electronics and motor
- Self-protection from overheating
- Overvoltage protection in generator mode

Extended operating modes

- Stepper motor mode
- Gearing mode
- Position control to analog set point
- Operation as servo amplifier in voltage adjuster mode
- Torque/force controller using variable set current input

Options

Separate supply of power to the motor and electronic actuator is optional (important for safety-critical applications). No third input is required in such cases. Depending on the drive, additional programming adapters and connection aids are available. The modes and parameters can be specially pre-configured on request.

Interfaces - Discrete I/O

Setpoint input
Depending on the operating mode, setpoints can be input via the command interface, via an analog voltage value, a PWM signal or a quadrature signal.

Error output (Open Collector)
Configured as error output (factory setting). Also usable as digital input, free switch output, for speed control or signaling an achieved position.

Additional digital input
For evaluating reference switches.

Networking

FAULHABER Motion Controllers are available with three different interfaces.

RS: This indicates a system with an RS232 interface. It is ideal for applications that do not use a higher level controller. Operation is made simple through the use of a plain text command set which can be used to generate scripts and programs that can run automously on the controller itself.

CF: This indicates a system with a FAULHABER CAN interface. This version contains the CiA 402 commands and includes the RS232 interface commands which are translated into simple to use CAN commands. This version is intended as a user friendly, simple to use bridge into to the complex use of CAN communications. A CAN master is always required when using this version.

CO: This indicates a system with a CANopen interface. This version is ideal when integrating a FAULHABER motion controller into a system with a PLC, either directly or through the use of a gateway. All parameter settings are made via the object directory. Configuration is possible through the use of the FAULHABER Motion Manager 5.0 or better, or standard CAN configuration tools.

Motion Control Systems

Configuration, Networking, Interfaces

Interfaces – Bus Connection

Version with RS232

For coupling to a PC with a transfer rate of up to 115 kbaud. Multiple drives can be connected to a single controller using the RS232 interface. As regards the control computer, no special arrangements are necessary. The interface also offers the possibility of retrieving online operational data and values.

A comprehensive ASCII command set is available for programming and operation. This can be preset from the PC using the „FAULHABER Motion Manager" software or from another control computer.

Additionally, there is the possibility of creating complex processes from these commands and storing them on the drive. Once programmed as a speed or positioning controller via the analog input, as step motor or electronic gear unit, the drive can operate independently of the RS232 interface.

Versions with CAN CF or CO

Two controller versions with a CANopen interface are available for optimal integration within a wide range of applications. CANopen is the perfect choice for networking miniature drives because the interface can also be integrated into small electronics. Due to their compact size and efficient communication methods, they are the ideal solution for complex fields of application such as industrial automation.

CF version: CANopen with FAULHABER channel

The CF version supports not only CiA 402 standard operating modes but also a special FAULHABER Mode. Via PDO2, operator control is thus analogous to that of the RS232 version. Extended operating modes such as operation with analog setpoint input or the stepper or gearing mode are also supported. The CF version is therefore particularly suitable for users who are already familiar with the RS232 version and wish to exploit the benefits of CAN in networking.

CO version: pure CANopen

The CO version provides the CiA 402 standard operating modes. All the parameters are directly stored in the object directory. Configuration can therefore be performed with the help of the FAULHABER Motion Manager or by applying available standardized configuratons tools common to the automation market. The CO version is particularly suitable for users who already use various CANopen devices or operate the Motion Controllers on a PLC. With dynamic PDO mapping it is possible to achieve highly efficient networking on the CAN.

CF / CO comparison

	CF	CO
NMT with node guarding	•	•
Baud rate	1 Mbit max., LSS	1 Mbit max, LSS
EMCY object	•	•
SYNCH Objekt	•	•
Server SDO	1x	1x
PDOs	3 x Rx 3 x Tx each with static mapping	4 x Rx 4 x Tx each with dynamic mapping
PDO ID	fixed	adjustable
Configuration	Motion Manager	Motion Manager from V5
Trace	PDO3 (fixed)	Any PDO
Standard operating modes - Profile Position Mode - Profile Velocity Mode - Homing	•	•
Ext. operating modes	FAULHABER channel	-

Both versions support the CANopen communication profile to CiA 301 V4.02. The transfer rate and node number are set via the network in accordance with the LSS protocol conforming to CiA 305 V1.11.

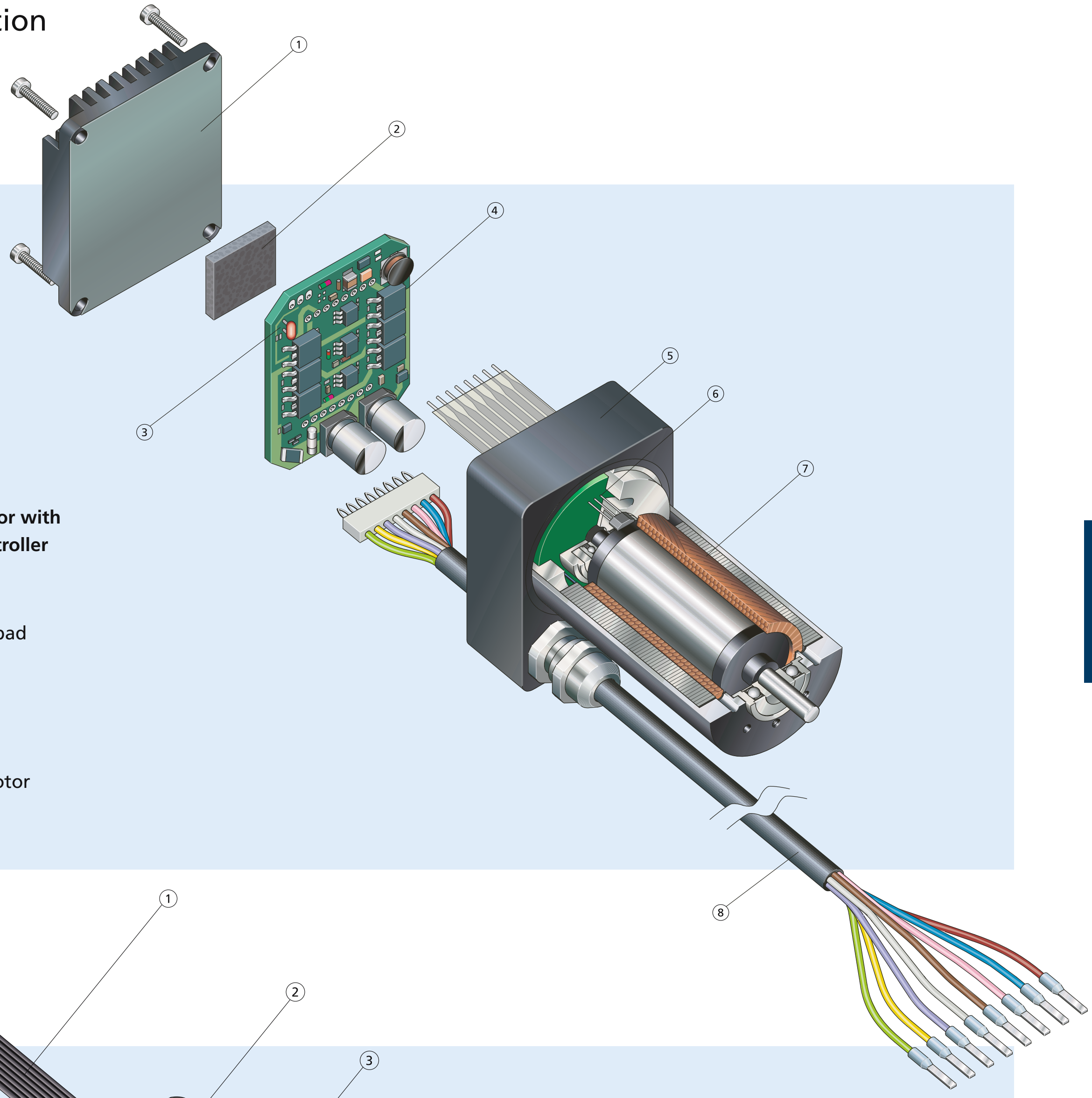
For this purpose, we recommend using the latest version of the FAULHABER Motion Manager.

Notes

Device manuals for installation and start up, communication and function manuals, and the „FAULHABER Motion Manager" software are available on request and on the Internet at www.faulhaber.com.

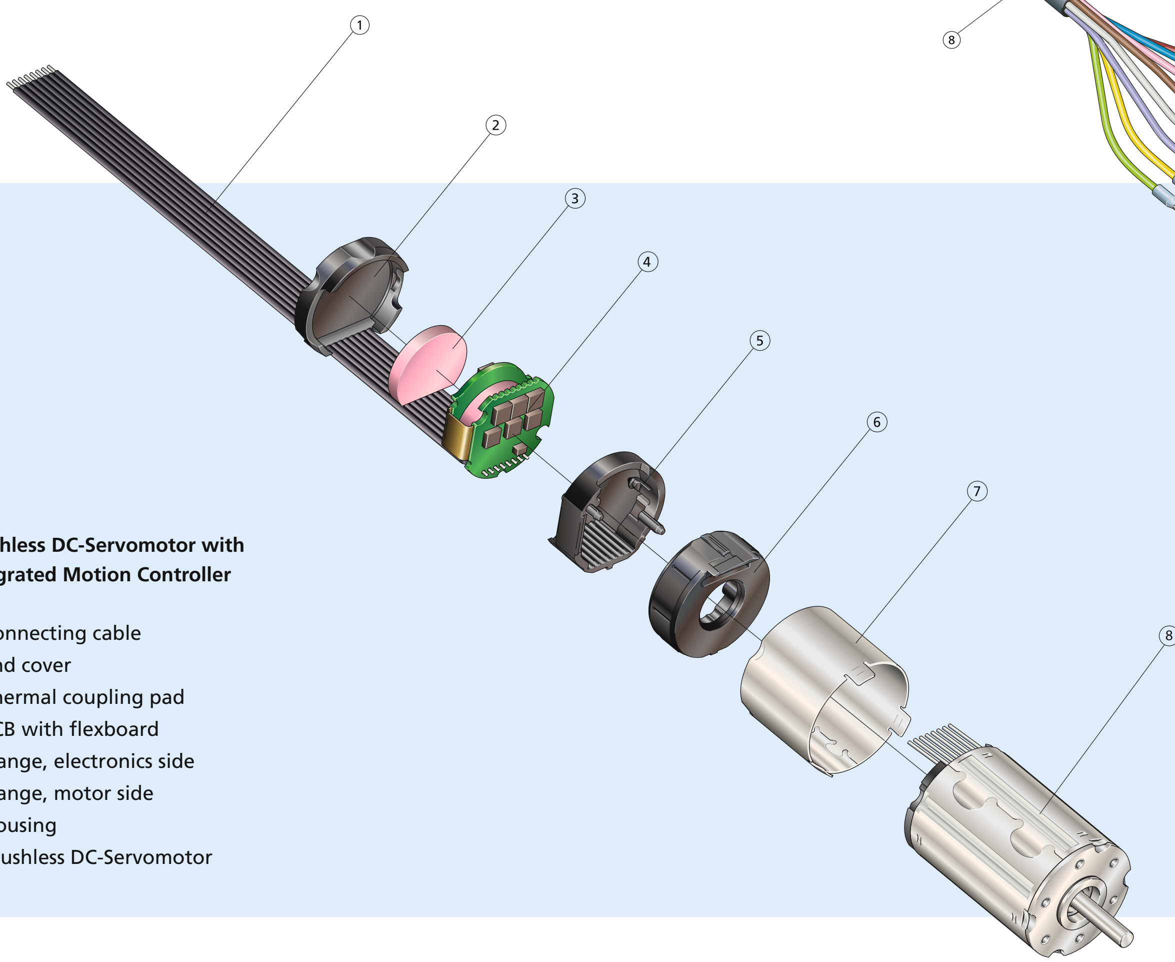
Motion Control Systems

Technical Information



Brushless DC-Servomotor with integrated Motion Controller

① Heat sink/cover
② Thermal conduction pad
③ Thermal protection
④ Motion Controller
⑤ Housing
⑥ Analog Hall sensors
⑦ Brushless DC-Servomotor
⑧ Interface cable



Brushless DC-Servomotor with integrated Motion Controller

① Connecting cable
② End cover
③ Thermal coupling pad
④ PCB with flexboard
⑤ Flange, electronics side
⑥ Flange, motor side
⑦ Housing
⑧ Brushless DC-Servomotor

FAULHABER

Brushless DC-Servomotors

with integrated Motion Controller
and RS232 or CAN interface

18 mNm

For combination with
Gearheads:
22F, 22/7, 26A

2232 ... BX4 CxD

		2232 S		024 BX4 CSD/CCD/COD	
1	Nominal voltage	U_N		24	Volt
2	Terminal resistance, phase-phase	R		12,4	Ω
3	Output power [1]	$P_{2\,max.}$		6,4	W
4	Efficiency	$\eta_{max.}$		67,7	%
5	No-load speed	n_o		6 800	rpm
6	No-load current [3]	I_o		0,061	A
7	Stall torque at 1,8A	M_H		57	mNm
8	Friction torque, static	C_o		0,85	mNm
9	Friction torque, dynamic	C_v		$1,5 \cdot 10^{-4}$	mNm/rpm
10	Speed constant	k_n		304	rpm/V
11	Back-EMF constant	k_E		3,288	mV/rpm
12	Torque constant	k_M		31,40	mNm/A
13	Current constant	k_I		0,031	A/mNm
14	Slope of n-M curve	$\Delta n/\Delta M$		120	rpm/mNm
15	Terminal inductance, phase-phase	L		440	µH
16	Mechanical time constant	τ_m		6,5	ms
17	Rotor inertia	J		5,2	gcm²
18	Angular acceleration	$\alpha_{max.}$		109	$\cdot 10^3$rad/s²
19	Thermal resistance	$R_{th\,1}$ / $R_{th\,2}$	2 / 17		K/W
20	Thermal time constant	τ_{w1} / τ_{w2}	4,1 / 360		s
21	Operating temperature range		– 25 ... + 85		°C
22	Shaft bearings		ball bearings, preloaded		
23	Shaft load max.:				
	– radial at 3 000 rpm (4 mm from mounting flange)		20		N
	– axial at 3 000 rpm		2		N
	– axial at standstill		20		N
24	Shaft play:				
	– radial	≤	0,015		mm
	– axial	=	0		mm
25	Housing material		stainless steel		
26	Weight		77		g
27	Direction of rotation		electronically reversible		
Recommended values - mathematically independent of each other					
28	Speed up to	$n_{e\,max.}$		5 - 8 000	rpm
29	Torque up to [1) 2)]	$M_{e\,max.}$		11 / 18	mNm
30	Current up to [1) 2) 3)]	$I_{e\,max.}$		0,44 / 0,69	A

1) at 4 000 rpm 2) thermal resistance $R_{th\,2}$ not reduced / thermal resistance $R_{th\,2}$ by 55% reduced
3) total standby current 0,04 A at U_B = 24V

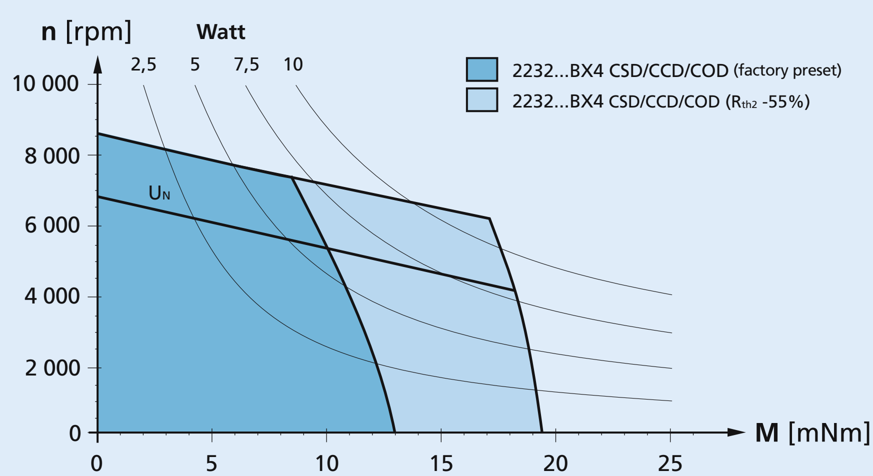
Note:

The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

The diagram shows the motor in a completely insulated as well as thermally coupled condition ($R_{th\,2}$ 55% reduced).

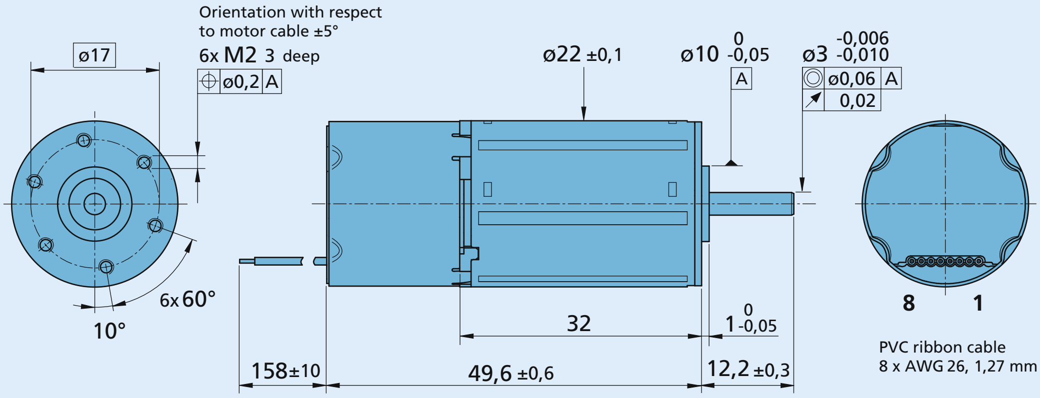
The motor is factory pre-configured to a continuous current for the thermally insulated condition. The controller must be reconfigured with the easy to use Motion Manager Software for use at higher continuous current.

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended areas for continuous operation

Dimensional drawing



2232 ... BX4 CSD/CCD/COD

Connection

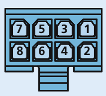
No.	Function
1	3.input
2	+24V
3	GND
4	Analog input
5	Analog GND
6	Fault output
7	RS232 RXD / CAN_L
8	RS232 TXD / CAN_H

Caution:
Incorrect lead connection will damage the motor electronics!

Options

Options

- Connector variant (Option no. 3830)
  AWG 26 / PVC ribbon cable
  with connector Micro-Fit



Accessories

- Adapter board BX4 CxD (Part No.: 6501.00113)

Full product description

- Example:
  2232S024 BX4 CSD

Motion Controller

Supply voltage [1]	U_B		5 ... 30	V DC
Peak current [2]	$I_{max.}$		3	A
Connection "Analog input":				
– Speed command analog input		voltage range	±10	V
– Speed command PWM input		frequency range	100 ... 2 000	Hz
		pulse duty factor 50%	0	rpm
– Digital input		input resistance (at 24V)	5	kΩ
– External encoder	$f_{max.}$		400	kHz
– Step frequency input	$f_{max.}$		400	kHz
Connection "Fault output":				
– Fault output		no error	switched to GND	
– Digital output		open collector	max. U_B / 30 mA	
– Digital input		input resistance	100	kΩ
Connection "3.input":				
– Digital input		input resistance	22	kΩ
– Electronic supply voltage [1]	U_B		5 ... 30	V DC
Encoder:				
– Scanning rate			200	µs
– Resolution internal encoder			3 000	Inc./turn

The signal level of the digital inputs can be set using the above commands:
Standard (PLC): Low 0...4,5V / High 12,5V...U_B, TTL: Low 0...0,5V / High 2,5V...U_B

[1] Separate supply of motor and control electronics for safetyrelevant applications is optionally available (Option no. 2993). In this case the 3rd input is not available for digital signals.
[2] Preset value. Can be changed over the interface.

Brushless DC-Servomotors

with integrated Motion Controller
and RS232 or CAN interface

35 mNm

For combination with
Gearheads:
22F, 22/7, 26A

2250 ... BX4 CxD

		2250 S		024 BX4 CSD/CCD/COD	
1	Nominal voltage	U_N		24	Volt
2	Terminal resistance, phase-phase	R		5,9	Ω
3	Output power 1)	$P_{2\ max.}$		12,2	W
4	Efficiency	$\eta_{\ max.}$		75,1	%
5	No-load speed	n_o		5 900	rpm
6	No-load current 3)	I_o		0,072	A
7	Stall torque at 3A	M_H		110	mNm
8	Friction torque, static	C_o		1,20	mNm
9	Friction torque, dynamic	C_v		$2,4 \cdot 10^{-4}$	mNm/rpm
10	Speed constant	k_n		259	rpm/V
11	Back-EMF constant	k_E		3,864	mV/rpm
12	Torque constant	k_M		36,90	mNm/A
13	Current constant	k_I		0,027	A/mNm
14	Slope of n-M curve	$\Delta n/\Delta M$		41,4	rpm/mNm
15	Terminal inductance, phase-phase	L		240	µH
16	Mechanical time constant	τ_m		4,3	ms
17	Rotor inertia	J		10	gcm^2
18	Angular acceleration	$\alpha_{max.}$		110	$\cdot 10^3 rad/s^2$
19	Thermal resistance	R_{th1} / R_{th2}	1,2 / 14		K/W
20	Thermal time constant	τ_{w1} / τ_{w2}	4,2 / 566		s
21	Operating temperature range		– 25 ... + 85		°C
22	Shaft bearings		ball bearings, preloaded		
23	Shaft load max.:				
	– radial at 3 000 rpm (4 mm from mounting flange)		20		N
	– axial at 3 000 rpm		2		N
	– axial at standstill		20		N
24	Shaft play:				
	– radial	≤	0,015		mm
	– axial	=	0		mm
25	Housing material		stainless steel		
26	Weight		117		g
27	Direction of rotation		electronically reversible		
Recommended values - mathematically independent of each other					
28	Speed up to	$n_{e\ max.}$		5 - 7 000	rpm
29	Torque up to 1) 2)	$M_{e\ max.}$		22 / 35	mNm
30	Current up to 1) 2) 3)	$I_{e\ max.}$		0,7 / 1,1	A

1) at 4 000 rpm 2) thermal resistance $R_{th\,2}$ not reduced / thermal resistance $R_{th\,2}$ by 55% reduced
3) total standby current 0,04 A at U_B = 24V

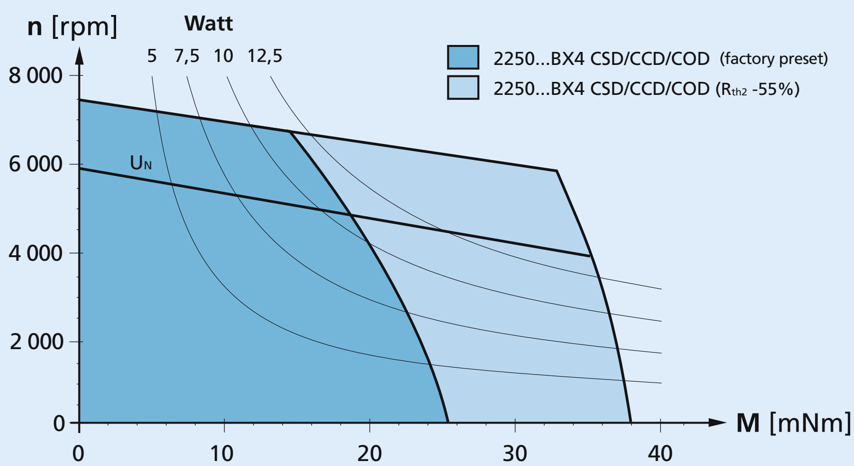
Note:

The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

The diagram shows the motor in a completely insulated as well as thermally coupled condition ($R_{th\,2}$ 55% reduced).

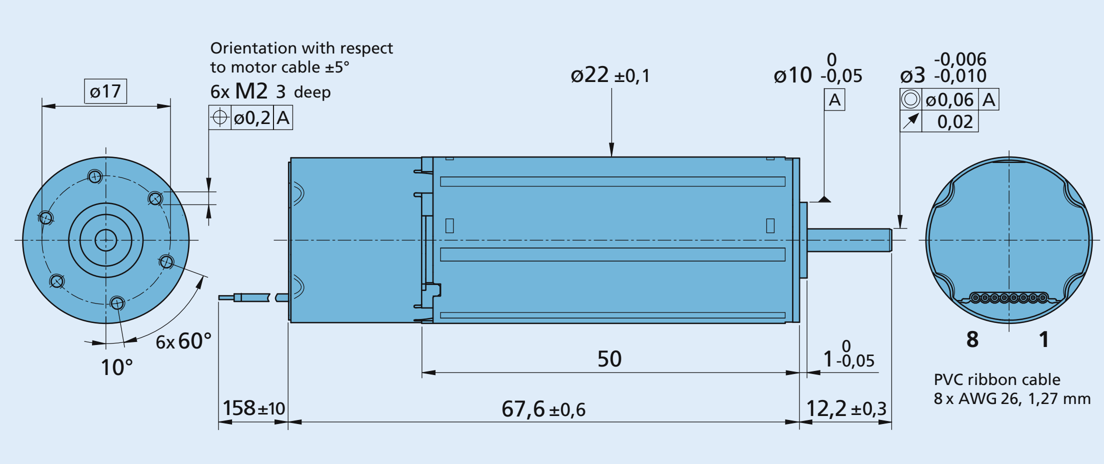
The motor is factory pre-configured to a continuous current for the thermally insulated condition. The controller must be reconfigured with the easy to use Motion Manager Software for use at higher continuous current.

The nominal voltage (U_N) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



Recommended areas for continuous operation

Dimensional drawing



2250 ... BX4 CSD/CCD/COD

Connection

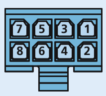
No.	Function
1	3.input
2	+24V
3	GND
4	Analog input
5	Analog GND
6	Fault output
7	RS232 RXD / CAN_L
8	RS232 TXD / CAN_H

Caution:
Incorrect lead connection will damage the motor electronics!

Options

Options

- Connector variant (Option no. 3830)
  AWG 26 / PVC ribbon cable
  with connector Micro-Fit



Accessories

- Adapter board BX4 CxD (Part No.: 6501.00113)

Full product description

- Example:
  2250S024 BX4 CSD

Motion Controller

Supply voltage [1]	U_B		5 ... 30	V DC
Peak current [2]	$I_{max.}$		3	A
Connection "Analog input":				
– Speed command analog input		voltage range	±10	V
– Speed command PWM input		frequency range	100 ... 2 000	Hz
		pulse duty factor 50%	0	rpm
– Digital input		input resistance (at 24V)	5	kΩ
– External encoder	$f_{max.}$		400	kHz
– Step frequency input	$f_{max.}$		400	kHz
Connection "Fault output":				
– Fault output		no error	switched to GND	
– Digital output		open collector	max. U_B / 30 mA	
– Digital input		input resistance	100	kΩ
Connection "3.input":				
– Digital input		input resistance	22	kΩ
– Electronic supply voltage [1]	U_B		5 ... 30	V DC
Encoder:				
– Scanning rate			200	µs
– Resolution internal encoder			3 000	Inc./turn

The signal level of the digital inputs can be set using the above commands:
Standard (PLC): Low 0...4,5V / High 12,5V...U_B, TTL: Low 0...0,5V / High 2,5V...U_B

[1] Separate supply of motor and control electronics for safetyrelevant applications is optionally available (Option no. 2993).
In this case the 3rd input is not available for digital signals.
[2] Preset value. Can be changed over the interface.

Brushless DC-Servomotors

with integrated Motion Controller
and RS232 or CAN interface

56 mNm

For combination with
Gearheads:
32A, 32ALN, 32/3, 32/3 S, 38/1, 38/1 S, 38/2, 38/2 S

3242 ... BX4 Cx

		3242 G		024 BX4 CS/CC/CO	
1	Nominal voltage	U_N		24	Volt
2	Terminal resistance, phase-phase	R		3,6	Ω
3	Output power [1]	$P_{2\,max.}$		18,2	W
4	Efficiency	$\eta_{max.}$		77,3	%
5	No-load speed	n_o		5 200	rpm
6	No-load current [3]	I_o		0,098	A
7	Stall torque at 5A	M_H		209	mNm
8	Friction torque, static	C_o		1,3	mNm
9	Friction torque, dynamic	C_v		$5,2 \cdot 10^{-4}$	mNm/rpm
10	Speed constant	k_n		227	rpm/V
11	Back-EMF constant	k_E		4,409	mV/rpm
12	Torque constant	k_M		42,1	mNm/A
13	Current constant	k_I		0,0238	A/mNm
14	Slope of n-M curve	$\Delta n/\Delta M$		19,4	rpm/mNm
15	Terminal inductance, phase-phase	L		240	µH
16	Mechanical time constant	τ_m		6,1	ms
17	Rotor inertia	J		30	gcm^2
18	Angular acceleration	$\alpha_{max.}$		66	$\cdot 10^3 rad/s^2$
19	Thermal resistance	R_{th1} / R_{th2}	1,6 / 12,4		K/W
20	Thermal time constant	τ_{w1} / τ_{w2}	9 / 810		s
21	Operating temperature range		– 40 ... +85		°C
22	Shaft bearings		ball bearings, preloaded		
23	Shaft load max.:				
	– radial at 3 000 rpm (4,5 mm from mounting flange)		50		N
	– axial at 3 000 rpm		5		N
	– axial at standstill		50		N
24	Shaft play:				
	– radial	≤	0,015		mm
	– axial	=	0		mm
25	Housing material		motor: stainless steel; controller housing: zinc, black anodized		
26	Weight		370		g
27	Direction of rotation		electronically reversible		
	Recommended values - mathematically independent of each other				
28	Speed up to	$n_{e\,max.}$		5 - 6 500	rpm
29	Torque up to [1) 2)]	$M_{e\,max.}$		35 / 56	mNm
30	Current up to [1) 2) 3)]	$I_{e\,max.}$		1,00 / 1,58	A

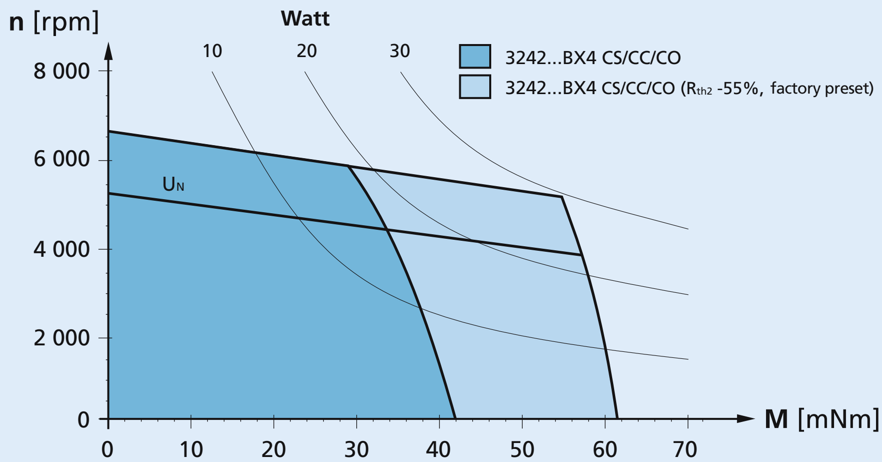
1) at 4 000 rpm 2) thermal resistance $R_{th\,2}$ not reduced / thermal resistance $R_{th\,2}$ by 55% reduced
3) total standby current 0,055 A at U_B = 24V

Note:
The diagram indicates the maximum speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

The motor can provide more power with adequate cooling (for ex. R_{th2} reduction of –55%).

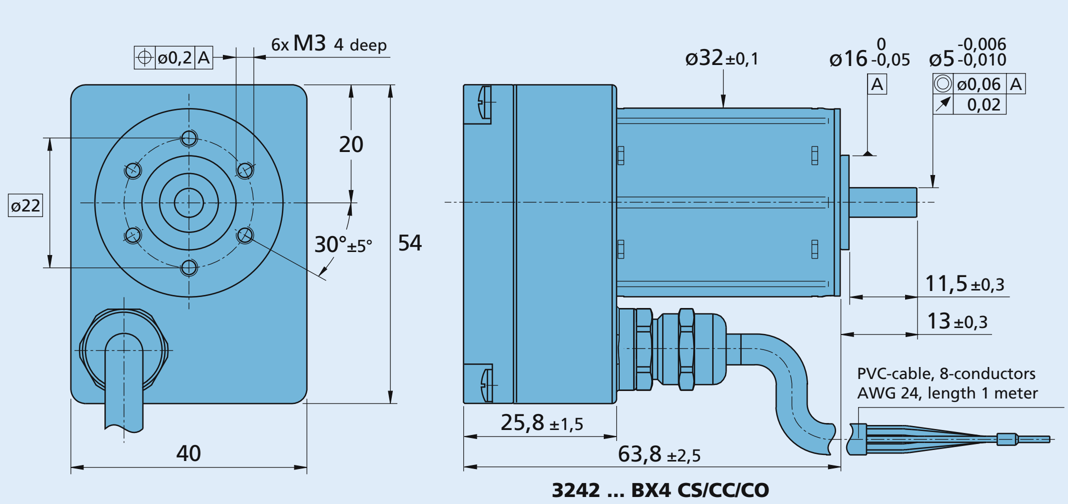
The maximum available torque and speed will be reduced if the ambient temperature is higher than 22°C and/or the motor is thermally insulated to the ambient environment.

The characteristics of the curve diagram is determined by U_B and the control characteristics of the integrated Motion Controller.



Recommended areas for continuous operation

Dimensional drawing



Connection

Wires	Function
blue	GND
pink	U_B
brown	Analog input
white	Fault output
grey	Analog GND
yellow	RS232 RXD / CAN_L
green	RS232 TXD / CAN_H
red	Connection No. 3

Caution:
Connect motor supply terminals to the correct polarity. Electronics are protected against polarity reversal by an internal fuse. In case of damage, this internal fuse can only be replaced at the factory.

Motion Control Systems

Options

Accessories

- Adapter board (Part No.: 6501.00065)

Full product description

- Example:
  3242G024 BX4 CS (RS232 interface)
  3242G024 BX4 CC (CANopen with FAULHABER CAN)
  3242G024 BX4 CO (CANopen CiA)

Motion Controller

Supply voltage [1]	U_B		12 ... 30	V DC
Peak current [2]	$I_{max.}$		5	A
Input/output			3	
Connection "Analog input":				
– Speed command analog input		voltage range	±10	V
– Speed command PWM input		frequency range	100 ... 2 000	Hz
		pulse duty factor 50%	0	rpm
– Digital input		input resistance (at 24V)	5	kΩ
– External encoder	$f_{max.}$		400	kHz
– Step frequency input	$f_{max.}$		400	kHz
Connection "Fault output":				
– Fault output		no error	switched to GND	
– Digital output		open collector	max. U_B / 30 mA	
– Digital input		input resistance	100	kΩ
Connection "3.input":				
– Digital input		input resistance	22	kΩ
– Electronic supply voltage [1]	U_{EL}		12 ... 30	V DC
Encoder:				
– Scanning rate			200	µs
– Resolution internal encoder			3 000	Inc./turn

The signal level of the digital inputs can be set using the above commands:
Standard (PLC): Low 0...7,0V / High 12,5V...U_B, TTL: Low 0...0,5V / High 3,5V...U_B

[1] Separate supply of motor and control electronics for safetyrelevant applications is optionally available (Option no. 2993). In this case the 3rd input is not available for digital signals; connection 3.
[2] Preset value. Can be changed over the interface.

Brushless DC-Servomotors

with integrated Motion Controller
and RS232 or CAN interface

96 mNm

For combination with
Gearheads:
32A, 32ALN, 32/3, 32/3 S, 38/1, 38/1 S, 38/2, 38/2 S

3268 ... BX4 Cx

		3268 G		024 BX4 CS/CC/CO	
1	Nominal voltage	U_N		24	Volt
2	Terminal resistance, phase-phase	R		1,45	Ω
3	Output power [1]	$P_{2\ max.}$		29,8	W
4	Efficiency	$\eta_{\ max.}$		77,3	%
5	No-load speed	n_o		5 200	rpm
6	No-load current [3]	I_o		0,203	A
7	Stall torque at 8A	M_H		346	mNm
8	Friction torque, static	C_o		1,7	mNm
9	Friction torque, dynamic	C_v		$1,3 \cdot 10^{-3}$	mNm/rpm
10	Speed constant	k_n		220	rpm/V
11	Back-EMF constant	k_E		4,555	mV/rpm
12	Torque constant	k_M		43,5	mNm/A
13	Current constant	k_I		0,0230	A/mNm
14	Slope of n-M curve	$\Delta n/\Delta M$		7,3	rpm/mNm
15	Terminal inductance, phase-phase	L		110	µH
16	Mechanical time constant	τ_m		4,6	ms
17	Rotor inertia	J		60	gcm²
18	Angular acceleration	$\alpha_{max.}$		58	$\cdot 10^3 rad/s^2$
19	Thermal resistance	R_{th1} / R_{th2}	1,9 / 9,6		K/W
20	Thermal time constant	τ_{w1} / τ_{w2}	17 / 1 060		s
21	Operating temperature range		– 40 ... +85		°C
22	Shaft bearings		ball bearings, preloaded		
23	Shaft load max.:				
	– radial at 3 000 rpm (4,5 mm from mounting flange)		50		N
	– axial at 3 000 rpm		5		N
	– axial at standstill		50		N
24	Shaft play:				
	– radial	≤	0,015		mm
	– axial	=	0		mm
25	Housing material		motor: stainless steel; controller housing: zinc, black anodized		
26	Weight		460		g
27	Direction of rotation		electronically reversible		

Recommended values - mathematically independent of each other

28	Speed up to	$n_{e\ max.}$		5 - 6 500	rpm
29	Torque up to [1] [2]	$M_{e\ max.}$		58 / 96	mNm
30	Current up to [1] [2] [3]	$I_{e\ max.}$		1,60 / 2,65	A

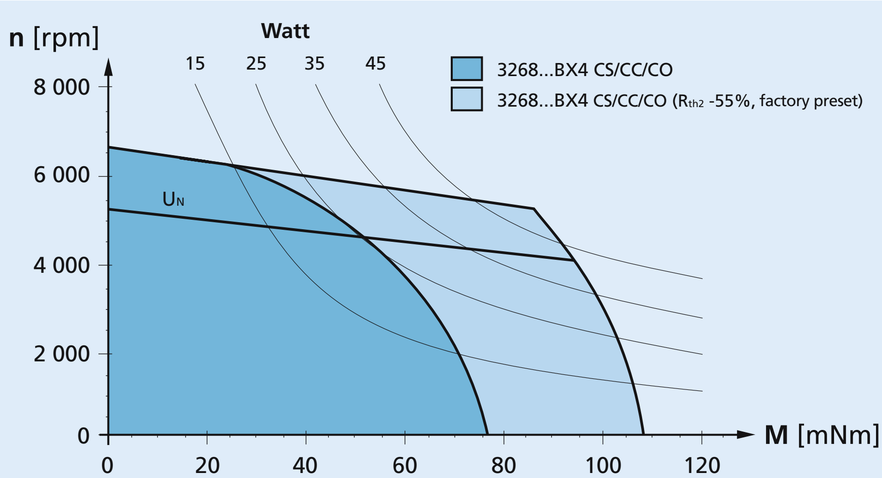
[1] at 4 000 rpm [2] thermal resistance $R_{th\,2}$ not reduced / thermal resistance $R_{th\,2}$ by 55% reduced
[3] total standby current 0,055 A at U_B = 24V

Note:
The diagram indicates the maximum speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

The motor can provide more power with adequate cooling (for ex. R_{th2} reduction of –55%).

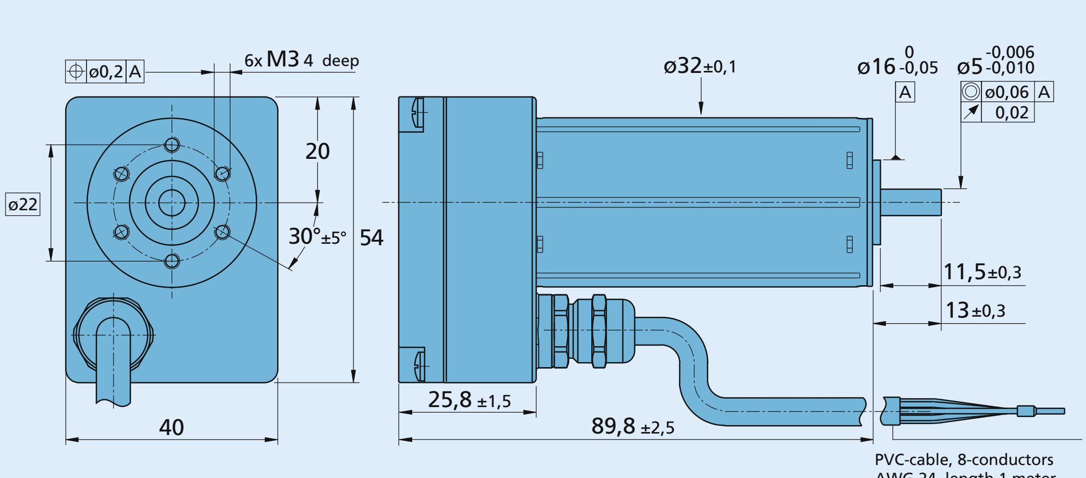
The maximum available torque and speed will be reduced if the ambient temperature is higher than 22°C and/or the motor is thermally insulated to the ambient environment.

The characteristics of the curve diagram is determined by U_b and the control characteristics of the integrated Motion Controller.



Recommended areas for continuous operation

Dimensional drawing



3268 ... BX4 CS/CC/CO

Connection

Wires	Function
blue	GND
pink	U_B
brown	Analog input
white	Fault output
grey	Analog GND
yellow	RS232 RXD / CAN_L
green	RS232 TXD / CAN_H
red	Connection No. 3

Caution:
Connect motor supply terminals to the correct polarity. Electronics are protected against polarity reversal by an internal fuse. In case of damage, this internal fuse can only be replaced at the factory.

Options

Accessories

- Adapter board (Part No.: 6501.00065)

Full product description

- Example:
  3268G024 BX4 CS (RS232 interface)
  3268G024 BX4 CC (CANopen with FAULHABER CAN)
  3268G024 BX4 CO (CANopen CiA)

Motion Controller

Supply voltage [1]	U_B		12 ... 30	V DC
Peak current [2]	$I_{max.}$		8	A
Input/output			3	
Connection "Analog input":				
– Speed command analog input		voltage range	±10	V
– Speed command PWM input		frequency range	100 ... 2 000	Hz
		pulse duty factor 50%	0	rpm
– Digital input		input resistance (at 24V)	5	kΩ
– External encoder	$f_{max.}$		400	kHz
– Step frequency input	$f_{max.}$		400	kHz
Connection "Fault output":				
– Fault output		no error	switched to GND	
– Digital output		open collector	max. U_B / 30 mA	
– Digital input		input resistance	100	kΩ
Connection "3.input":				
– Digital input		input resistance	22	kΩ
– Electronic supply voltage [1]	U_{EL}		12 ... 30	V DC
Encoder:				
– Scanning rate			200	µs
– Resolution internal encoder			3 000	Inc./turn

The signal level of the digital inputs can be set using the above commands:
Standard (PLC): Low 0...7,0V / High 12,5V...U_B, TTL: Low 0...0,5V / High 3,5V...U_B

[1] Separate supply of motor and control electronics for safetyrelevant applications is optionally available (Option no. 2993).
In this case the 3rd input is not available for digital signals; connection 3.
[2] Preset value. Can be changed over the interface.

Motion Control Systems

Brushless DC-Servomotors

with integrated Motion Controller and RS232 or CAN interface

53 mNm

For combination with
Gearheads:
30/1, 30/1 S, 32A, 32ALN, 32/3, 32/3 S, 38/1, 38/1 S, 38/2, 38/2 S

Motion Control Systems

3564 ... B Cx

	3564 K		024 B CS/CC/CO	
1 Nominal voltage	U_N		24	Volt
2 Terminal resistance, phase-phase	R		1,12	Ω
3 Output power [1]	$P_{2\ max.}$		51	W
4 Efficiency	$\eta_{max.}$		82	%
5 No-load speed	n_o		10 500	rpm
6 No-load current [3]	I_o		0,225	A
7 Stall torque at 8A	M_H		160	mNm
8 Friction torque, static	C_o		1,10	mNm
9 Friction torque, dynamic	C_v		$2,4 \cdot 10^{-4}$	mNm/rpm
10 Speed constant	k_n		473	rpm/V
11 Back-EMF constant	k_E		2,114	mV/rpm
12 Torque constant	k_M		20,2	mNm/A
13 Current constant	k_I		0,05	A/mNm
14 Slope of n-M curve	$\Delta n/\Delta M$		26,2	rpm/mNm
15 Terminal inductance, phase-phase	L		194	µH
16 Mechanical time constant	τ_m		9,3	ms
17 Rotor inertia	J		34	gcm^2
18 Angular acceleration	$\alpha_{max.}$		47	$\cdot 10^3 rad/s^2$
19 Thermal resistance	$R_{th\ 1}$ / $R_{th\ 2}$	2,5 / 6,3		K/W
20 Thermal time constant	τ_{w1} / τ_{w2}	23 / 1 175		s
21 Operating temperature range		– 30 ... +85		°C
22 Shaft bearings		ball bearings, preloaded		
23 Shaft load max.:				
– radial at 3 000 rpm (4,5 mm from mounting flange)		108		N
– axial at 3 000 rpm		50		N
– axial at standstill		131		N
24 Shaft play:				
– radial	≤	0,015		mm
– axial	=	0		mm
25 Housing material		motor: aluminium, black anodized; controller housing: zinc		
26 Weight		510		g
27 Direction of rotation		electronically reversible		
Recommended values - mathematically independent of each other				
28 Speed up to	$n_{e\ max.}$		5 - 12 000	rpm
29 Torque up to [1) 2)]	$M_{e\ max.}$		39 / 53	mNm
30 Current up to [1) 2) 3)]	$I_{e\ max.}$		2,1 / 2,8	A

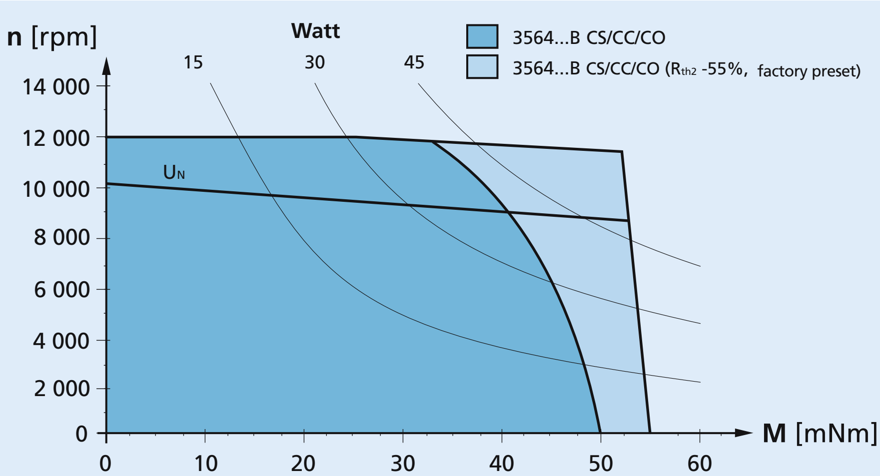
[1)] at 8 400 rpm [2)] thermal resistance $R_{th\ 2}$ not reduced / thermal resistance $R_{th\ 2}$ by 55% reduced
[3)] current for electronic plus 0,055 A at U_B = 24V

Note:
The diagram indicates the maximum speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

The motor can provide more power with adequate cooling (for ex. R_{th2} reduction of –55%).

The maximum available torque and speed will be reduced if the ambient temperature is higher than 22°C and/or the motor is thermally insulated to the ambient environment.

The characteristics of the curve diagram is determined by U_B and the control characteristics of the integrated Motion Controller.

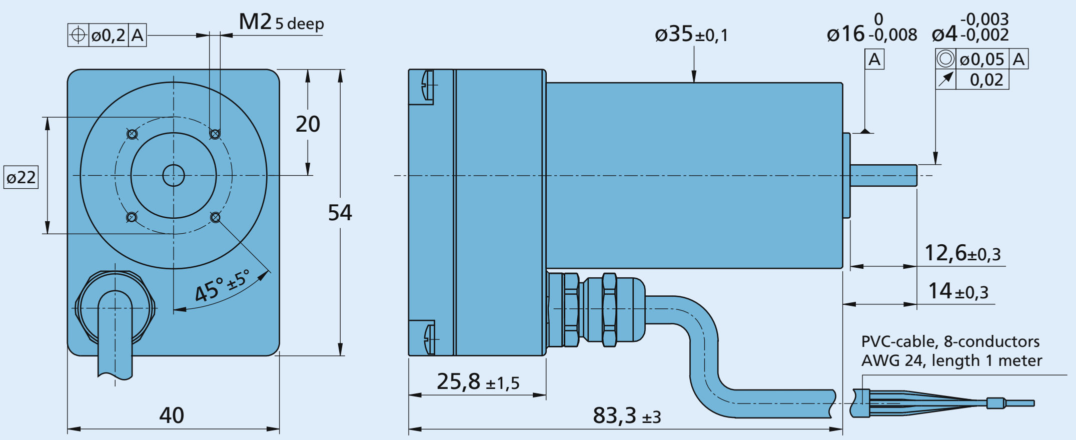


Recommended areas for continuous operation

For notes on technical data and lifetime performance refer to „Technical Information“.
Edition 2014

Dimensional drawing

Scale reduced



3564 ... B CS/CC/CO

Connection

Wires	Function
blue	GND
pink	UB
brown	Analog input
white	Fault output
grey	Analog GND
yellow	RS232 RXD / CAN_L
green	RS232 TXD / CAN_H
red	Connection No. 3

Caution:
Connect motor supply terminals to the correct polarity. Electronics are protected against polarity reversal by an internal fuse. In case of damage, this internal fuse can only be replaced at the factory.

Options

Accessories

- Adapter board (Part No.: 6501.00065)

Full product description

- Example:

  3564K024B CS (RS232 interface)
  3564K024B CC (CANopen with FAULHABER CAN)
  3564K024B CO (CANopen CiA)

Motion Controller

Supply voltage [1]	U_B		12 ... 30	V DC
Peak current [2]	$I_{max.}$		8	A
Input/output			3	
Connection "Analog input":				
– Speed command analog input		voltage range	±10	V
– Speed command PWM input		frequency range	100 ... 2 000	Hz
		pulse duty factor 50%	0	rpm
– Digital input		input resistance (at 24V)	5	kΩ
– External encoder	$f_{max.}$		400	kHz
– Step frequency input	$f_{max.}$		400	kHz
Connection "Fault output":				
– Fault output		no error	switched to GND	
– Digital output		open collector	max. U_B / 30 mA	
– Digital input		input resistance	100	kΩ
Connection "3.input":				
– Digital input		input resistance	22	kΩ
– Electronic supply voltage [1]	U_{EL}		12 ... 30	V DC
Encoder:				
– Scanning rate			100	µs
– Resolution internal encoder			3 000	Inc./turn

The signal level of the digital inputs can be set using the above commands:
Standard (PLC): Low 0...7,0V / High 12,5V...U_B, TTL: Low 0...0,5V / High 3,5V...U_B

[1] Separate supply of motor and control electronics for safetyrelevant applications is optionally available (Option no. 2993). In this case the 3rd input is not available for digital signals; connection 3.
[2] Preset value. Can be changed over the interface.

Stepper Motors

WE CREATE MOTION

FAULHABER

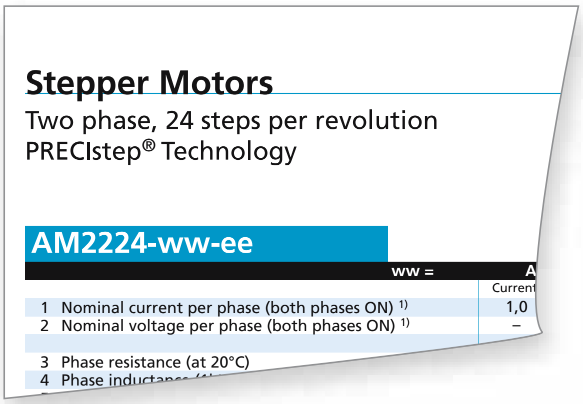
Stepper Motors – PRECIstep® Technology

FAULHABER

WE CREATE MOTION

Stepper Motors

Technical Information



Stepper Motors

Two phase, 24 steps per revolution

PRECIstep® Technology

AM2224-ww-ee

	ww =	A
		Current
1	Nominal current per phase (both phases ON) 1)	1,0
2	Nominal voltage per phase (both phases ON) 1)	–
3	Phase resistance (at 20°C)	
4	Phase inductance ...	

Notes on technical data

Nominal current per phase [A]
The current supplied to both phases windings at an ambient temperature of 20°C that will not exceed the thermal limits of the motor. The resulting torque corresponds to the holding torque (at nominal current in both phases) specification.

Nominal voltage per phase [Volts]
The voltage necessary to reach the nominal current per phase, measured at an ambient temperature of 20°C. The resulting torque corresponds to the holding torque (at nominal current in both phases) specification.

Phase resistance [1)] [Ω]
The winding resistance per phase measured at an ambient temperature of 20°C. Tolerance +/- 12%.

Phase inductance [mH]
The winding inductance per phase measured at 1kHz.

Back-EMF amplitude [1)] [V/k step/s]
The amplitude of the back-EMF measured at 1000 steps/s. In part due to this factor motor torque will decrease at higher speeds.

Holding torque (at nominal current in both phases) [mNm]
Is the torque of the motor at nominal current with two phases on.

Holding torque (at twice the nominal current) [mNm]
Is the torque of the motor at 2 x nominal current with two phases on. The magnetic circuit of the motor will not be affected by this boost current, however, to avoid thermal overload the motor should only be boosted intermittently.

Step angle (full step) [degree]
Number of angular degrees the motor moves per full-step.

Angular accuracy [% of full step]
The percentage position error per full step, at no load, with identical phase current in both phases. This error is not cumulative between steps.

Residual torque, max.[1)] [mNm]
The maximum torque applied to the shaft to rotate the shaft without current to the motor.

Residual torque is useful to hold a position without any current to save battery life or to reduce heat.

Rotor inertia [kgm²]
This value represents the inertia of the complete rotor.

Resonance frequency (at no load) [Hz]
The step rate at which the motor at no load will demonstrate resonance. The resonance frequency is load dependent. For the best results the motor should be driven at a higher frequency or in half-step or microstepping mode outside of the given frequency.

Electrical time constant [ms]
Is the time needed to establish 67% of the max. possible phase current under a given operation point. In part due to this factor motor torque will decrease at higher speeds.

Ambient temperature range [°C]
Temperatures at which the motor can operate.

Winding temperature tolerated max. [°C]
Maximum temperature supported by the winding and the magnets.

Thermal resistance winding-ambient air [°C/W]
The gradient at which the motor winding temperature increases per Watt of power losses generated in the motor. This value can be reduced by cooling.

Thermal time constant [s]
Time needed to reach 67% of the final winding temperature. Adding cooling surfaces reduces the thermal resistance but will increase the thermal time constant.

Shaft bearings
Self lubricating sintered sleeve bearings or preloaded ball bearings are available.

Shaft load, max. radial [N]
The maximum recommended radial shaft load for all bearing types.

Shaft load, max. axial [N]
The maximum recommended axial shaft load for all bearing types. For ball bearings this value corresponds to the axial preload. If this value is exceeded, irreversible displacement of the shaft may occur. The allowable axial travel of the shaft without damage to the motor is approximately 0,2mm.

Shaft play max., radial [µm]
The maximum clearance between shaft and bearing tested with the indicated force to move the shaft.

Shaft play max., axial [µm]
Represents the maximum axial play tested with the indicated force.

Isolation test voltage [1)] [VDC]
Is the test voltage for isolation test between housing and phase windings.

Weight [g]
Is the motor weight in grams.

[1)] these parameters are measured during final inspection on 100 % of the products delivered.

Stepper Motor Selection

The selection of a stepper motor requires the use of published torque speed curves based on the load parameters.

It is not possible to verify the motor selection mathematically without the use of the curves.

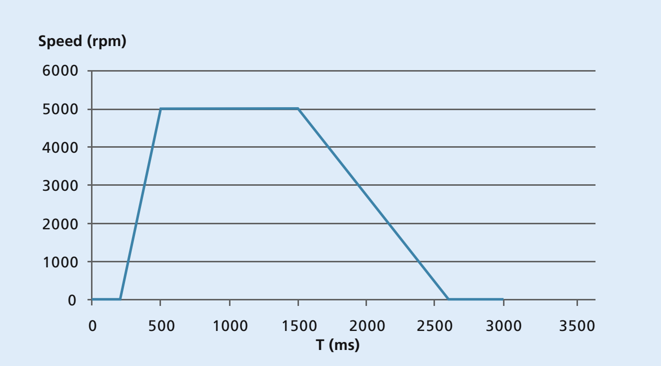
To select a motor the following parameters must be known:

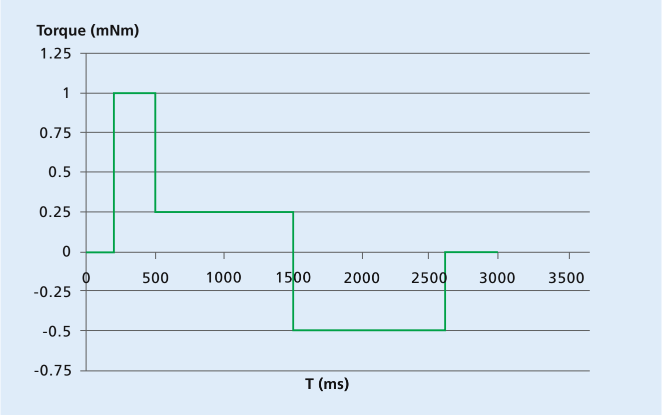
- Motion profile
- Load friction and inertia
- Required resolution
- Available space
- Available power supply voltage

1. Definition of the load parameters at the motor shaft
The target of this step is to determine a motion profile needed to move the motion angle in the given time frame and to calculate the motor torque over the entire cycle using the application load parameters such as friction and load inertia.

The motion and torque profiles of the movement used in this example are shown below:
Depending on the motor size suitable for the application it is required to recompute the torque parameters with the motor inertia as well.

In the present case it is assumed that a motor with an outside diameter of maximum 15 mm is suitable and the data has been computed with the inertia of the AM1524.





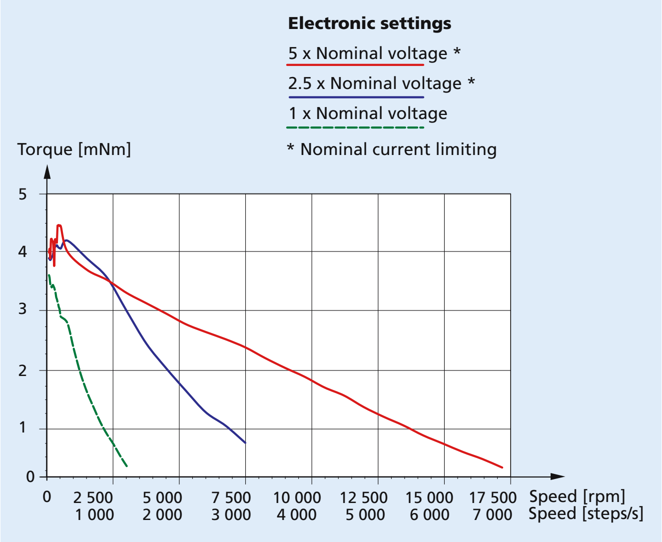
2. Verification of the motor operation.
The highest torque/speed point for this application is found at the end of the acceleration phase. The top speed is then n = 5000 rpm, the torque is M = 1 mNm.

Using these parameters you can transfer the point into the torque speed curves of the motor as shown here with the AM1524 curves.

To ensure the proper operation of the motor in the application, it is highly recommended to use a safety factor of 30% during the torque calculation. The shown example assures that the motor will correctly fulfil the requested application conditions.

The use of a higher supply voltage (typically 3 to 5 x higher than the nominal voltage) provides a higher torque at higher speed (please refer to graph).

In case that no solution is found, it is possible to adapt the load parameters seen by the motor by the use of a reduction gearhead.



3. Verification of the resolution

It is assumed that the application requires a 9° angular resolution.

The motor selected, the AM1524, has a full step angle of 15° which is not suitable in full step mode. It can be operated either in half-step, which reduces the step angle to 7,5°, or in micro stepping. With micro stepping, the resolution can be increased even higher whereas the precision is reduced because the error angle without load of the motor (expressed in % of a full-step) remains the same independently from the number of micro-steps the motor is operated.

For that reason the most common solution for adapting the motor resolution to the application requirements is the use of a gearhead or a lead-screw where linear motion is required.

4. Operation at low speed

All stepper motors exhibit a resonance frequency. These are typically below 200Hz. When operating at this frequency stepper motors will exhibit uncontrolled perturbations in speed, direction of rotation and a reduced torque. Thus, if the application requires a speed lower or equal to the resonance frequency, it is recommended to drive the motor in microstepping mode where the higher the microstepping rate, the better performance can be achieved. This will greatly decrease the affects of the resonant frequency and result in smoother speed control.

General application notes

In principle each stepper motor can be operated in three modes: full step (one or two phases on), half step or microstep.

Holding torque is the same for each mode as long as dissipated power (I^2R losses) is the same. The theory is best presented on a basic motor model with two phases and one pair of poles where mechanical and electrical angle are equal.

- In full step mode (1 phase on) the phases are successively energised in the following way:
  1. A+ 2. B+ 3. A– 4. B–.
- Half step mode is obtained by alternating between 1-phase-on and 2-phases-on, resulting in 8 half steps per electrical cycle: 1. A+ 2. A+B+ 3. B+ 4. A–B+ 5. A– 6. A–B– 7. B– 8. A+B–.
- If every half step should generate the same holding torque, the current per phase is multiplied by $\sqrt{2}$ each time only 1 phase is energised.

The two major advantages provided by microstep operation are lower running noise and higher resolution, both depending on the number of microsteps per full step which can in fact be any number but is limited by the system cost.

As explained above, one electrical cycle or revolution of the field vector (4 full steps) requires the driver to provide a number of distinct current values proportional to the number of microsteps per full step.

For example, 8 microsteps require 8 different values which in phase A would drop from full current to zero following the cosine function from 0° to 90°, and in phase B would rise from zero to full following the sine function.

These values are stored and called up by the program controlling the chopper driver. The rotor target position is determined by the vector sum of the torques generated in phase A and B:

$$M_A = k \cdot I_A = k \cdot I_o \cdot \cos \varphi$$

$$M_B = k \cdot I_B = k \cdot I_o \cdot \sin \varphi$$

where M is the motor torque, k is the torque constant and I_o the nominal phase current.

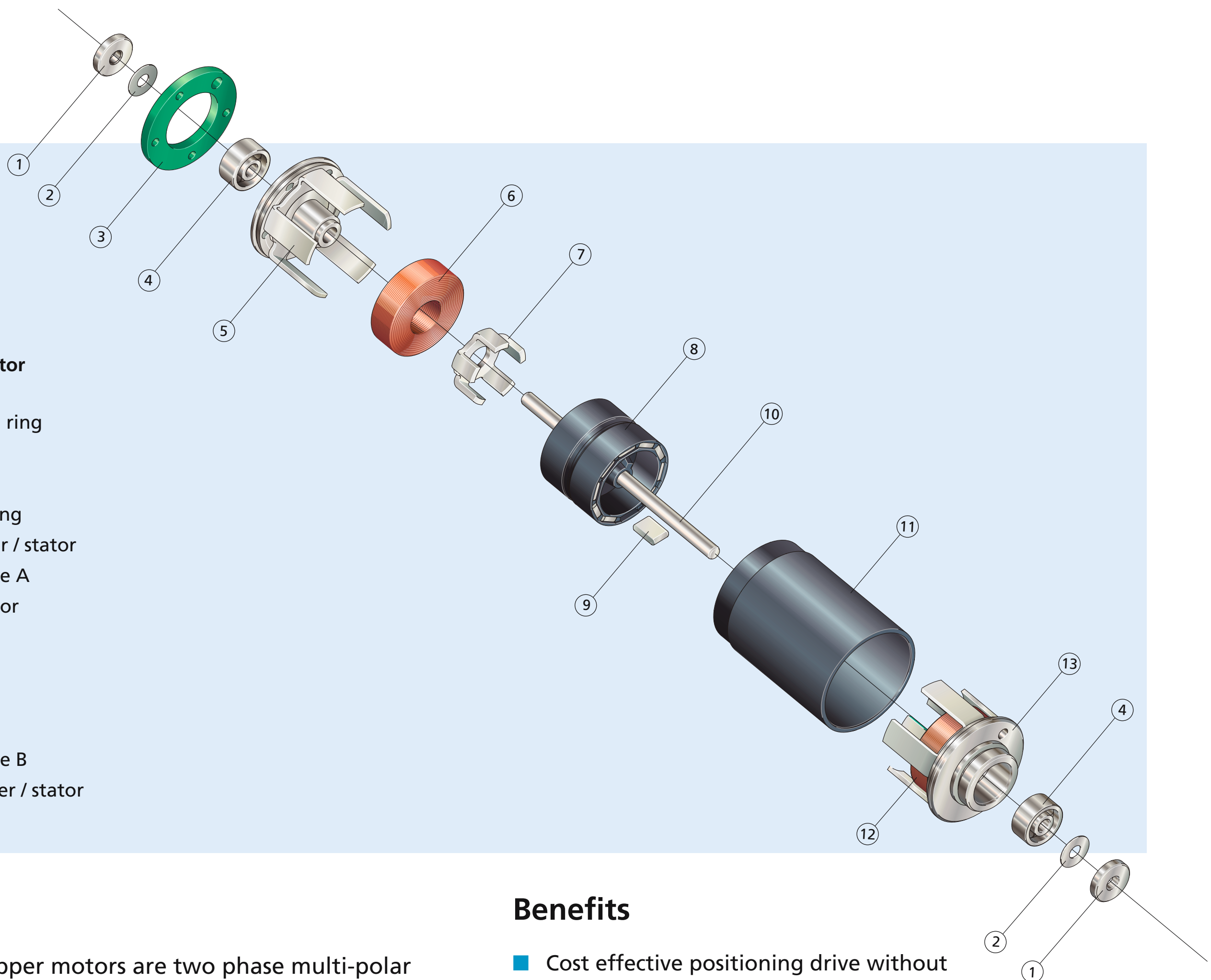
For the motor without load the position error is the same in full, half or microstep mode and depends on distortions of the sinusoidal motor torque function due to detent torque, saturation or construction details (hence on the actual rotor position), as well as on the accuracy of the phase current values.

4. Verification in the application

Any layout based on such considerations has to be verified in the final application under real conditions.
Please make sure that all load parameters are taken into account during this test.

Stepper Motors

Two phase



Stepper Motor

① Retaining ring
② Washer
③ PCB
④ Ball bearing
⑤ Rear cover / stator
⑥ Coil, Phase A
⑦ Inner stator
⑧ Rotor
⑨ Magnets
⑩ Shaft
⑪ Housing
⑫ Coil, Phase B
⑬ Front cover / stator

Features

PRECIstep® stepper motors are two phase multi-polar motors with permanent magnets. The use of rare-earth magnets provides an exceptionally high power to volume ratio. Precise, open-loop, speed control can be achieved with the application of full step, half step, or micro-stepping electronics.

The rotor consists of an injection moulded plastic support and magnets which are assembled in a 10 or 12 pole configuration depending on the motor type. The large magnet volume helps to achieve a very high torque density. The use of high power rare-earth magnets also enhances the available temperature range of the motors from extremely low temperatures up to 180 °C as a special configuration. The stator consists of two discrete phase coils which are positioned on either side of the rotor. The inner and outer stator assemblies provide the necessary radial magnetic field.

Benefits

- Cost effective positioning drive without an encoder
- High power density
- Long operational lifetimes
- Wide operational temperature range
- Speed range up to 16 000 rpm using a current mode chopper driver
- Possibility of full step, half step and microstep operation

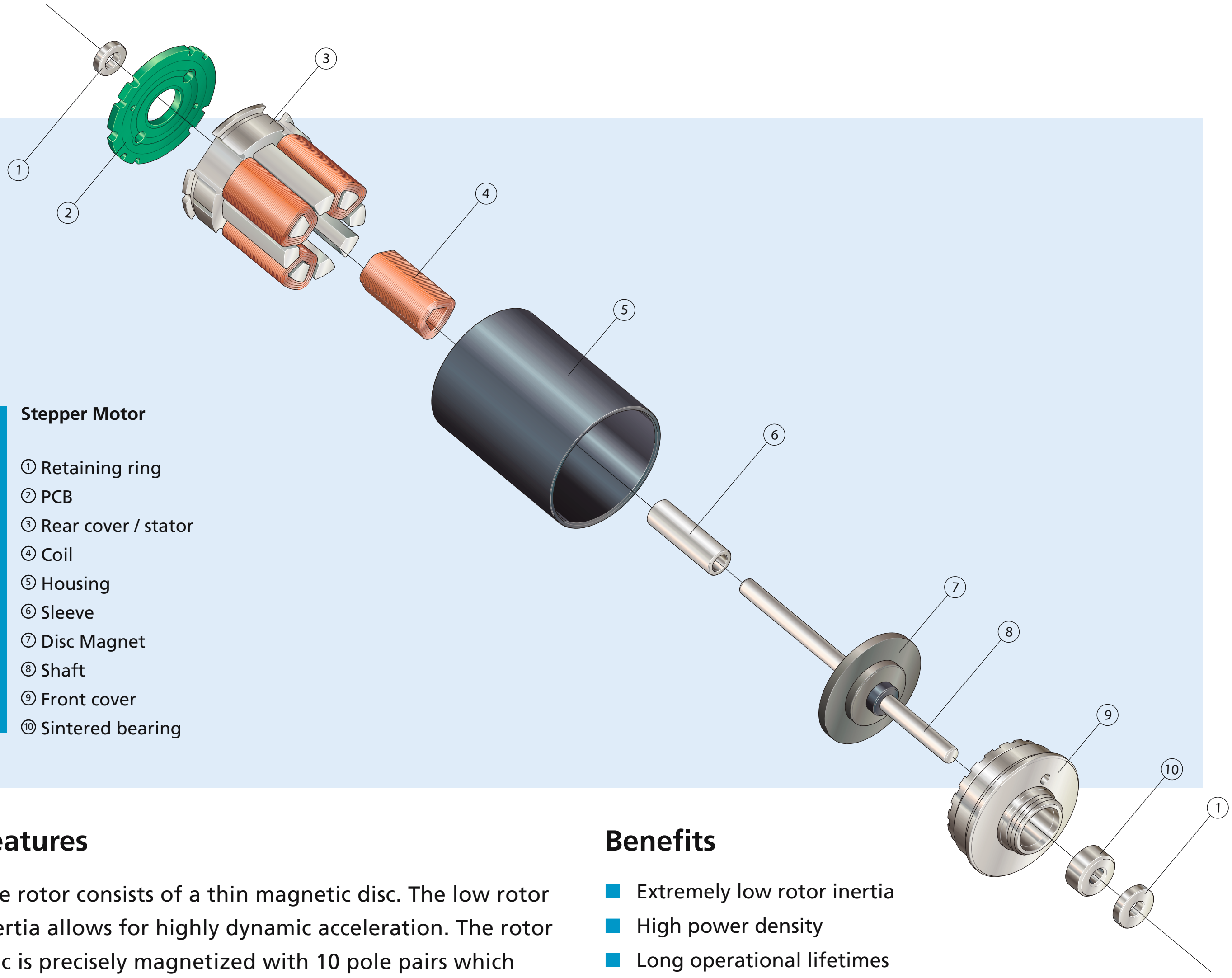
Product Code

AM1524	Motor series
2R	Bearing type
V-12-150	Coil type
57	Motor version

AM1524-2R-V-12-150-57

Stepper Motors

Two phase with Disc Magnet



Stepper Motor

① Retaining ring
② PCB
③ Rear cover / stator
④ Coil
⑤ Housing
⑥ Sleeve
⑦ Disc Magnet
⑧ Shaft
⑨ Front cover
⑩ Sintered bearing

Features

The rotor consists of a thin magnetic disc. The low rotor inertia allows for highly dynamic acceleration. The rotor disc is precisely magnetized with 10 pole pairs which helps the motor achieve a very high angular accuracy. The stator consists of four coils, two per phase, which are located on one side of the rotor disc and provide the axial magnetic field.

Special executions with additional rotating back-iron are available for exceptionally precise micro-stepping performance.

Benefits

- Extremely low rotor inertia
- High power density
- Long operational lifetimes
- Wide operational temperature range
- Ideally suited for micro-stepping applications

Product Code

ADM1220S	Motor series
2R	Bearing type
V2	Coil type
51	Motor version

ADM1220S-2R-V2-51

Stepper Motors

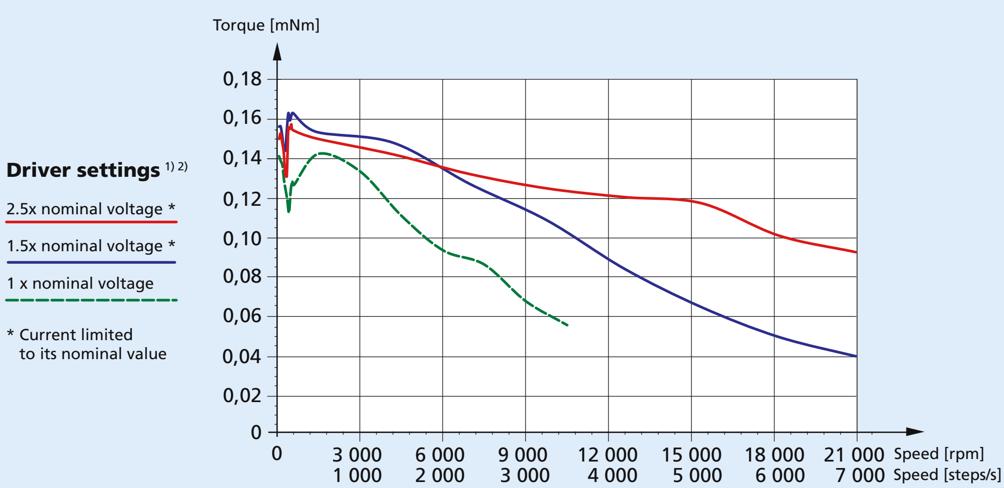
0,2 mNm

Two phase, 20 steps per revolution
PRECIstep® Technology

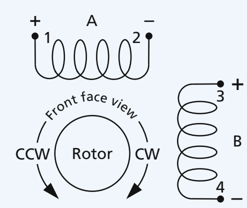
ADM0620-2R-ww-ee

ww =		V2		V3		
		Current	Voltage	Current	Voltage	Drive mode
1 Nominal current per phase (both phases ON) [1]		0,13	–	0,075	–	A
2 Nominal voltage per phase (both phases ON) [1]		–	2	–	3	V DC
3 Phase resistance (at 20°C)		12,4		30,6		Ω
4 Phase inductance (1kHz)		1,2		3,0		mH
5 Back-EMF amplitude		0,33		0,6		V/k step/s
6 Holding torque (at nominal current in both phases)	0,2					mNm
7 Holding torque (at twice the nominal current)	0,28					mNm
8 Step angle (full step)	18					degree
9 Angular accuracy [1]	± 5					% of full step
10 Residual torque, max.	0,06					mNm
11 Rotor inertia	0,7					$\cdot 10^{-9}$ kgm²
12 Resonance frequency (at no load)	170					Hz
13 Electrical time constant	0,09					ms
14 Ambient temperature range	–35 ... +70					°C
15 Winding temperature tolerated, max.	130					°C
16 Thermal resistance winding-ambient air	165					°C/W
17 Thermal time constant	120					s
18 Shaft bearings	ball bearings, preloaded (standard)					
19 Shaft load, max.:						
– radial (3 mm from bearing)	0,3					N
– axial	0,5					N
20 Shaft play, max.:						
– radial (0,2N)	20					µm
– axial (0,2N)	50					µm
21 Isolation test voltage	200					V DC
22 Weight	1,4					g

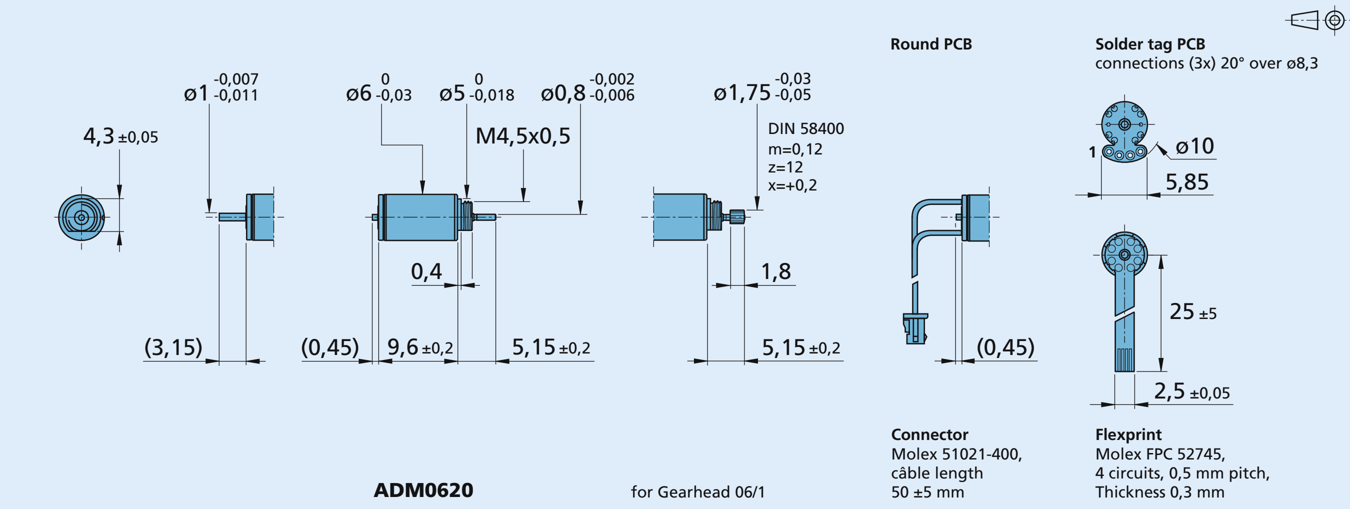
[1] Relevant for 2 phases ON only. On PWM drivers with chopper (current mode), the current is set to the nominal value and the supply voltage is typically 3 to 5x higher than the nominal voltage.
[2] Curves measured with a load inertia of 3 $\cdot 10^{-9}$ kgm², in half-step mode for the "1 x nominal voltage" curve, in 1/4 micro-stepping mode for the other curves.



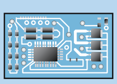
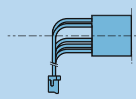
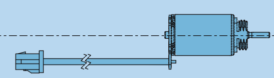
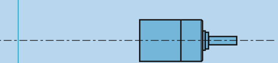
	CW / CCW			
	1	2	3	4
Phase A	+	–	–	+
Phase B	+	+	–	–



Dimensional drawing



Combinations

Drive Electronics	Encoders	Cables	Gearheads / Lead screws
			
Available on request		List available on request	**06/1**
			Lead screws **M1,2 - M1,6**

Ordering information

Example: **ADM0620-2R-V2-01**

Motor type ADM = Motor design 06 = Motor diameter (mm) 20 = Steps per revolution	**Bearings** (rr) Special lubricant options available	**Winding** (ww)	**Motor execution** (ee) Only front output shaft	With double output shaft	Front output shaft
ADM0620	**-2R** (2 ball bearings)	**-V2**	**-11** (Solder tag PCB)	**-10** (Solder tag PCB)	Plain shaft
		-V3	**-15** (Solder tag PCB)	**-16** (Solder tag PCB)	Pinion 06/1
			-26 (Solder tag PCB)	**-25** (Solder tag PCB)	Shaft for lead screw M1,2
			-28 (Solder tag PCB)	**-27** (Solder tag PCB)	Shaft for lead screw M1,6
			-43 (Flexprint)	**-42** (Flexprint)	Plain Shaft
			-47 (Flexprint)	**-48** (Flexprint)	Pinion 06/1
			-67 (Flexprint)	**-66** (Flexprint)	Shaft for lead screw M1,2
			-69 (Flexprint)	**-68** (Flexprint)	Shaft for lead screw M1,6
			-01 (Round PCB & cable)		Plain Shaft
			-05 (Round PCB & cable)		Pinion 06/1
			-21 (Round PCB & cable)		Shaft for lead screw M1,2
			-23 (Round PCB & cable)		Shaft for lead screw M1,6

Stepper Motors

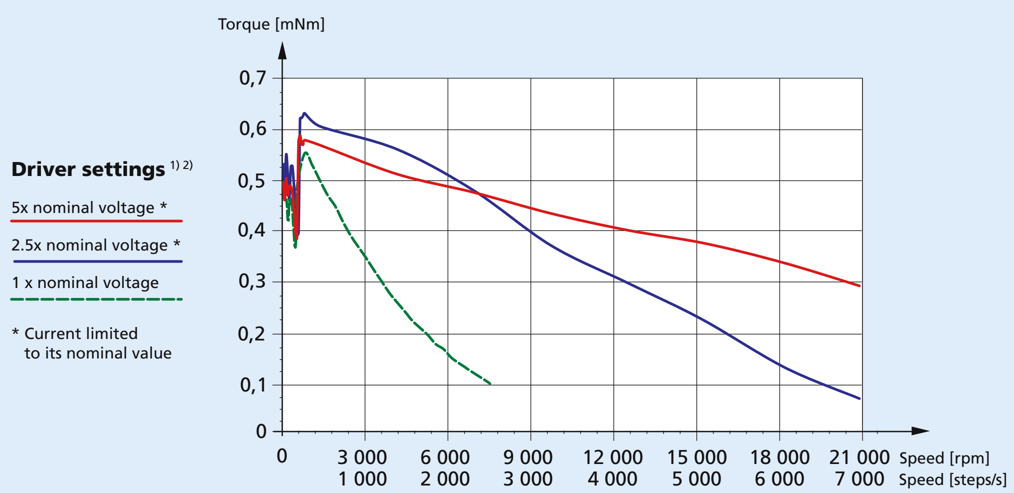
0,65 mNm

Two phase, 20 steps per revolution
PRECIstep® Technology

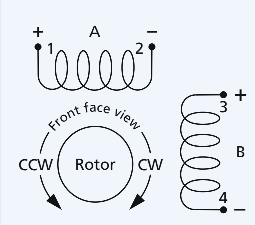
AM0820-ww-ee

	ww =		A-0,225-7		V-3-18		V-5-56		
			Current	Voltage	Current	Voltage	Current	Voltage	Drive mode
1	Nominal current per phase (both phases ON) [1]		0,225	–	0,15	–	0,08	–	A
2	Nominal voltage per phase (both phases ON) [1]		–	2	–	3	–	5	V DC
3	Phase resistance (at 20°C)		7,3		18		56		Ω
4	Phase inductance (1kHz)		1,4		3,9		12,6		mH
5	Back-EMF amplitude		0,8		1,3		2,4		V/k step/s
6	Holding torque (at nominal current in both phases)	0,65							mNm
7	Holding torque (at twice the nominal current)	1							mNm
8	Step angle (full step)	18							degree
9	Angular accuracy [1]	± 10							% of full step
10	Residual torque, max.	0,17							mNm
11	Rotor inertia	2,75							$\cdot 10^{-9}$ kgm²
12	Resonance frequency (at no load)	170							Hz
13	Electrical time constant	0,21							ms
14	Ambient temperature range	–30 ... +70							°C
15	Winding temperature tolerated, max.	130							°C
16	Thermal resistance winding-ambient air	76							°C/W
17	Thermal time constant	180							s
18	Shaft bearings	sintered bronze sleeves (standard)			ball bearings, preloaded (optional)				
19	Shaft load, max.:								
	– radial (3 mm from bearing)	0,3			3,0				N
	– axial	0,2			1,5				N
20	Shaft play, max.:								
	– radial (0,2N)	15			12				µm
	– axial (0,2N)	140			~0				µm
21	Isolation test voltage	200							V DC
22	Weight	3,3							g

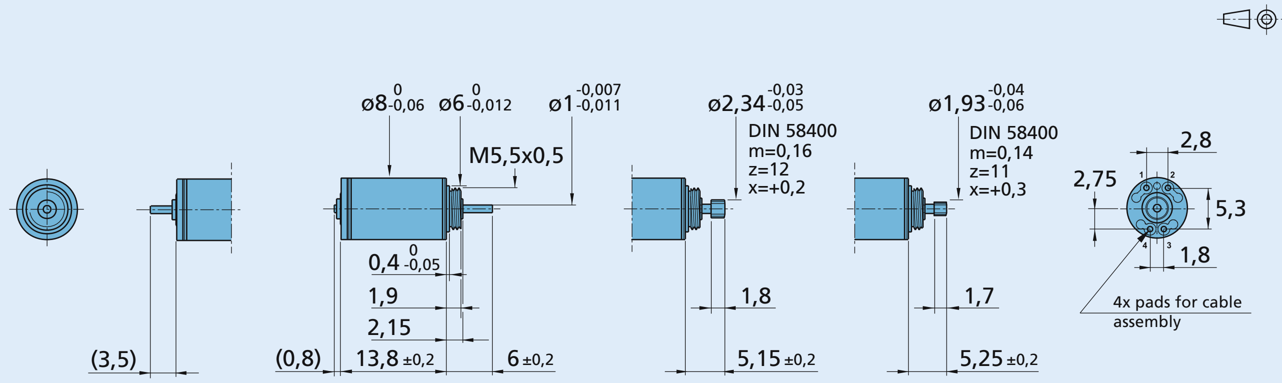
[1] Relevant for 2 phases ON only. On PWM drivers with chopper (current mode), the current is set to the nominal value and the supply voltage is typically 3 to 5x higher than the nominal voltage.
[2] Curves measured with a load inertia of $6 \cdot 10^{-9}$ kgm², in half-step mode for the "1 x nominal voltage" curve, in 1/4 micro-stepping mode for the other curves.



	1	2	3	4
← CW / CCW →				
Phase A	+	–	–	+
Phase B	+	+	–	–



Dimensional drawing

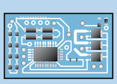
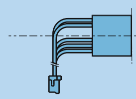
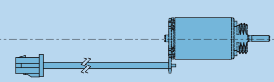
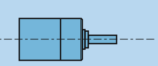


AM0820

for Gearhead 08/1

for Gearhead 08/2, 08/3

Combinations

Drive Electronics	Encoders	Cables	Gearheads / Lead screws
			
Available on request	Available on request	List available on request	**08/1**
			08/2
			08/3*
			10/1
			Lead screws **M1,2 - M1,6**
			Lead screws **M2 - M2,5 - M3**

* Zero Backlash Gearheads

Ordering information

Example: **AM0820-2R-V-3-18-08**

Motor type	**Bearings** (rr)	**Winding** (ww)	**Motor execution** (ee)		
AM = Motor design 08 = Motor diameter (mm) 20 = Steps per revolution	Special lubricant options available		Only front output shaft	With double output shaft	Front output shaft
AM0820	**-** (sleeve bearings)	**-V-3-18**	**-01**	**-00**	Plain shaft
	-2R (2 ball bearings)	**-V-5-56**	**-08**	**-09**	Pinion 08/1
		-A-0,225-7	**-10**	**-11**	Pinion 10/1
			-12	**-13**	Pinion 08/2, 08/3
			-21	**-20**	Shaft for lead screw M1,2
			-23	**-22**	Shaft for lead screw M2 - M2,5 - M3
			-25	**-24**	Shaft for lead screw M1,6

Stepper Motors

1,6 mNm

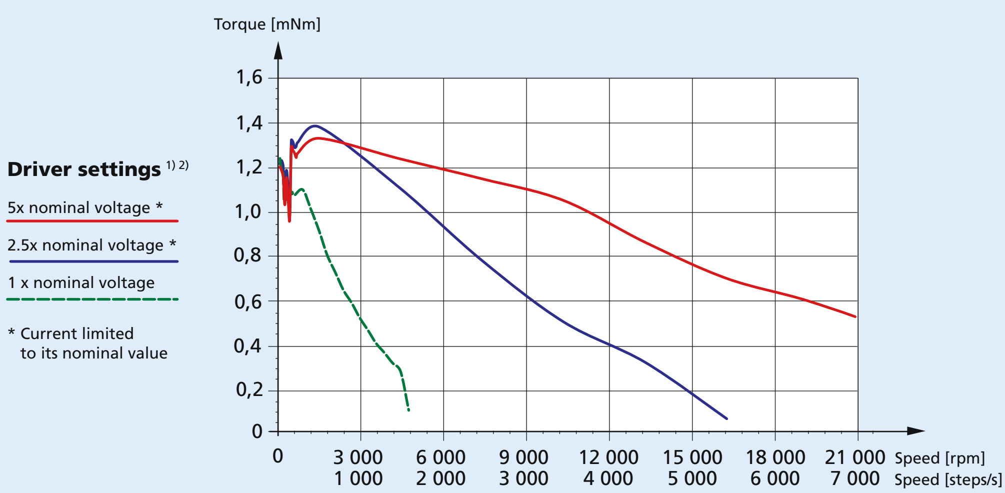
Two phase, 20 steps per revolution
PRECIstep® Technology

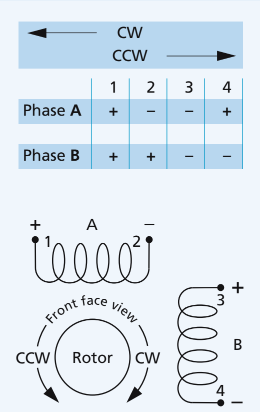
AM1020-ww-ee

	ww =	A-0,25-8		V-3-16		V-6-65		V-12-250		
		Current	Voltage	Current	Voltage	Current	Voltage	Current	Voltage	Drive mode
1	Nominal current per phase (both phases ON) 1)	0,25	–	0,18	–	0,09	–	0,045	–	A
2	Nominal voltage per phase (both phases ON) 1)	–	2	–	3	–	6	–	12	V DC
3	Phase resistance (at 20°C)	8		16		65		250		Ω
4	Phase inductance (1kHz)	2,4		5,2		21,4		80,1		mH
5	Back-EMF amplitude	1,8		2,6		5,3		10,5		V/k step/s
6	Holding torque (at nominal current in both phases)	1,6								mNm
7	Holding torque (at twice the nominal current)	2,4								mNm
8	Step angle (full step)	18								degree
9	Angular accuracy 1)	± 10								% of full step
10	Residual torque, max.	0,20								mNm
11	Rotor inertia	9								$\cdot 10^{-9}$ kgm²
12	Resonance frequency (at no load)	140								Hz
13	Electrical time constant	0,32								ms
14	Ambient temperature range	–35 ... +70								°C
15	Winding temperature tolerated, max.	130								°C
16	Thermal resistance winding-ambient air	73								°C/W
17	Thermal time constant	90								s
18	Shaft bearings	sintered sleeve bearings (standard)				ball bearings, preloaded (optional)				
19	Shaft load, max.:									
	– radial (3 mm from bearing)	0,3				4,0				N
	– axial	0,3				3,0				N
20	Shaft play, max.:									
	– radial (0,2N)	15				12				µm
	– axial (0,2N)	150				~0				µm
21	Isolation test voltage	200								V DC
22	Weight	5,5								g

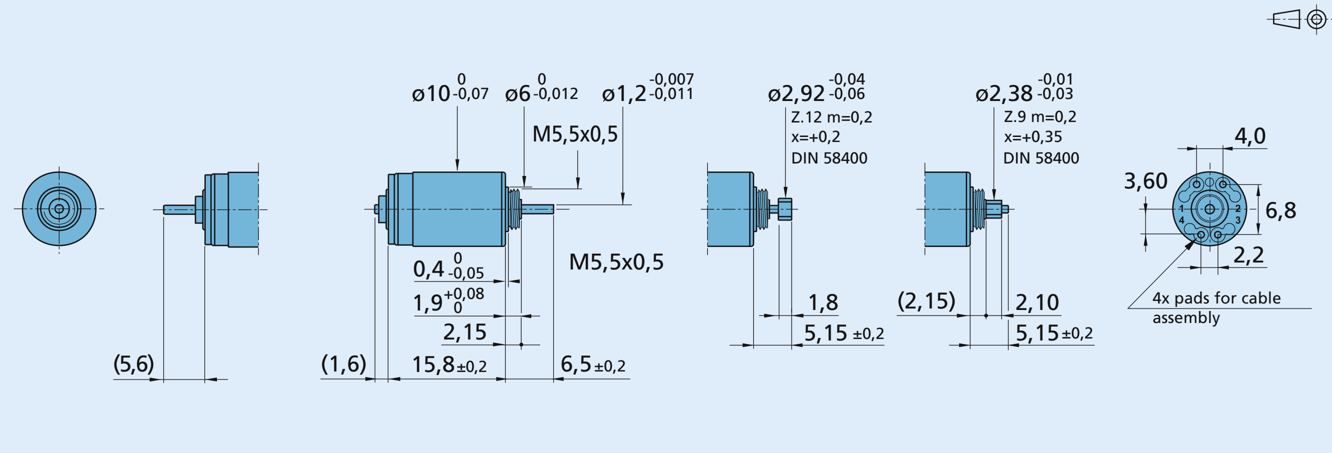
1) Relevant for 2 phases ON only. On PWM drivers with chopper (current mode), the current is set to the nominal value and the supply voltage is typically 3 to 5x higher than the nominal voltage.

2) Curves measured with a load inertia of 6 $\cdot 10^{-9}$ kgm², in half-step mode for the "1 x nominal voltage" curve, in 1/4 micro-stepping mode for the other curves.



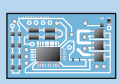
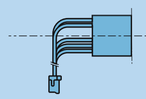
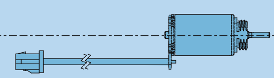
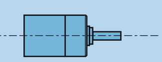


Dimensional drawing



AM1020 | for Gearhead 10/1 | for Gearhead 12/3, 12/5

Combinations

Drive Electronics	Encoders	Cables	Gearheads / Lead screws
			
Available on request	Available on request	List available on request	**10/1**
			12/3
			12/5*
			Lead screws **M1,2 M1,6**
			Lead screws **M2 - M2,5 - M3**

* Zero Backlash Gearheads

Ordering information

Example: **AM1020-2R-V-3-16-08**

Motor type	**Bearings** (rr)	**Winding** (ww)	**Motor execution** (ee)		
AM = Motor design 10 = Motor diameter (mm) 20 = Steps per revolution	Special lubricant options available		Only front output shaft	With double output shaft	Front output shaft
AM1020	**-** (sleeve bearings)	**-V-3-16**	**-01**	**-00**	Plain shaft
	-2R (2 ball bearings)	**-V-6-65**	**-08**	**-09**	Pinion 10/1
		-V-12-250	**-10**	**-11**	Pinion 12/5
		-A-0,25-8		**-12**	Plain shaft, Rear = 3,7mm for encoder
				-13	Pinion 10/1, Rear = 3,7mm for encoder
				-14	Pinion 12/5, Rear = 3,7mm for encoder
			-21	**-20**	Plain shaft for lead screw M1,2
			-23	**-22**	Plain shaft for lead screw M2 - M2,5 - M3
			-25	**-24**	Plain shaft for lead screw M1,6

Stepper Motors

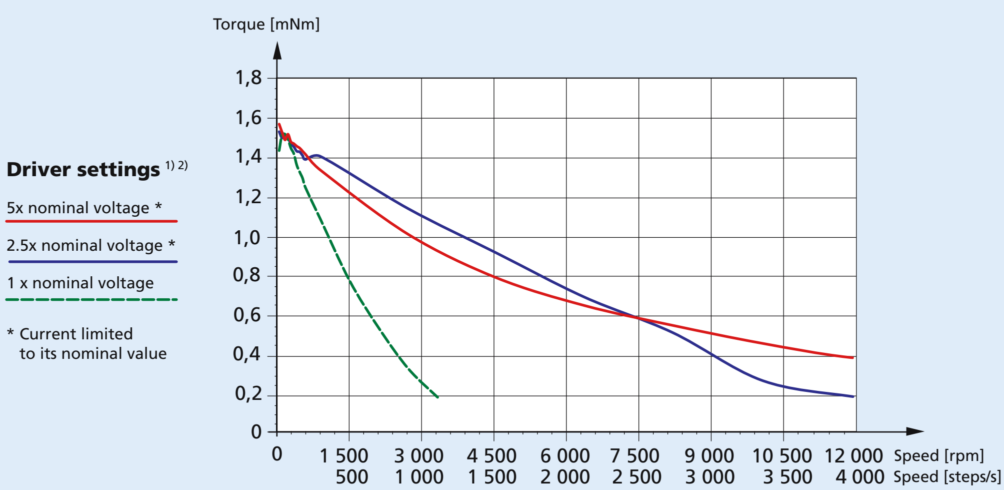
Stepper Motors 2,4 mNm

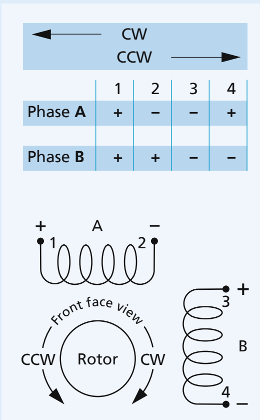
Two phase, 20 steps per revolution
microstepping motor (low residual torque), PRECIstep® Technology

ADM1220S-ww-ee

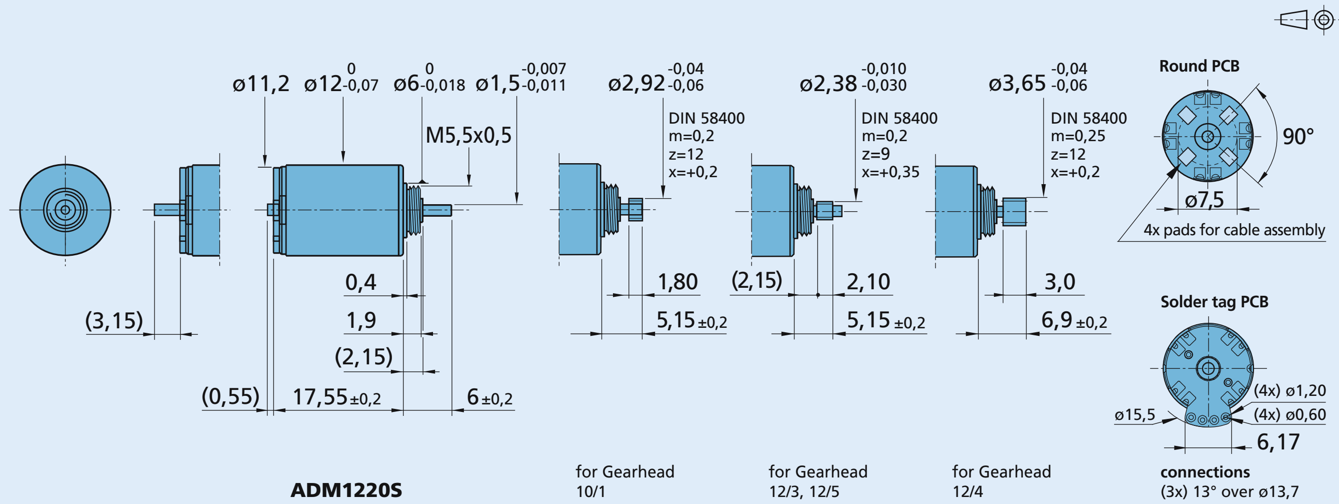
	ww =	V2		V3		V6		V12		
		Current	Voltage	Current	Voltage	Current	Voltage	Current	Voltage	Drive mode
1	Nominal current per phase (both phases ON) 1)	0,3	–	0,2	–	0,1	–	0,055	–	A
2	Nominal voltage per phase (both phases ON) 1)	–	2	–	3	–	6	–	12	V DC
3	Phase resistance (at 20°C)	5,4		13		48		164		Ω
4	Phase inductance (1kHz)	1,3		3,5		13		57		mH
5	Back-EMF amplitude	1,7		2,6		5,0		10,0		V/k step/s
6	Holding torque (at nominal current in both phases)	2,4								mNm
7	Holding torque (at twice the nominal current)	4,1								mNm
8	Step angle (full step)	18								degree
9	Angular accuracy 1)	± 3								% of full step
10	Residual torque, max.	0,15								mNm
11	Rotor inertia	18,5								$\cdot 10^{-9}$ kgm²
12	Resonance frequency (at no load)	128								Hz
13	Electrical time constant	0,28								ms
14	Ambient temperature range	–35 ... +70								°C
15	Winding temperature tolerated, max.	130								°C
16	Thermal resistance winding-ambient air	62								°C/W
17	Thermal time constant	205								s
18	Shaft bearings	sintered bronze sleeves (standard)				ball bearings, preloaded (optional)				
19	Shaft load, max.:									
	– radial (3 mm from bearing)	0,5				6,0				N
	– axial	3,0				3,0				N
20	Shaft play, max.:									
	– radial (0,2N)	15				12				µm
	– axial (0,2N)	~0				~0				µm
21	Isolation test voltage	200								V DC
22	Weight	9								g

1) Relevant for 2 phases ON only. On PWM drivers with chopper (current mode), the current is set to the nominal value and the supply voltage is typically 3 to 5x higher than the nominal voltage.
2) Curves measured with a load inertia of 20 $\cdot 10^{-9}$ kgm², in half-step mode for the "1 x nominal voltage" curve, in 1/4 micro-stepping mode for the other curves.

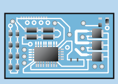
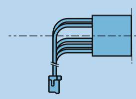
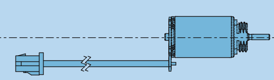
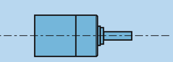




Dimensional drawing



Combinations

Drive Electronics	Encoders	Cables	Gearheads / Lead screws
			
Available on request		List available on request	**10/1**
			12/3
			12/4
			12/5*
			Lead screws **M2 - M2,5 - M3**

* Zero Backlash Gearheads

Ordering information

Example: **ADM1220S-2R-V2-51**

Motor type	**Bearings** (rr)	**Winding** (ww)	**Motor execution** (ee)		
ADM = Motor design 12 = Motor diameter (mm) 20 = Steps per revolution	Special lubricant options available		Only front output shaft	With double output shaft	Front output shaft
ADM1220S	**-** (sleeve bearings)	**-V2**	**-51** (Round PCB)	**-50** (Round PCB)	Plain shaft, plain shaft for lead screw M3
	-2R (2 ball bearings)	**-V3**	**-55** (Round PCB)	**-56** (Round PCB)	Pinion 10/1
		-V6	**-57** (Round PCB)	**-58** (Round PCB)	Pinion 12/3, 12/5
		-V12	**-59** (Round PCB)	**-60** (Round PCB)	Pinion 12/4
			-83 (Round PCB)	**-82** (Round PCB)	Plain shaft for lead screw M2 - M2,5
			-31 (Solder tag PCB)	**-30** (Solder tag PCB)	Plain shaft, plain shaft for lead screw M3
			-35 (Solder tag PCB)	**-34** (Solder tag PCB)	Pinion 10/1
			-37 (Solder tag PCB)	**-36** (Solder tag PCB)	Pinion 12/3, 12/5
			-39 (Solder tag PCB)	**-38** (Solder tag PCB)	Pinion 12/4
			-53 (Solder tag PCB)	**-52** (Solder tag PCB)	Plain shaft for lead screw M2 - M2,5

Stepper Motors

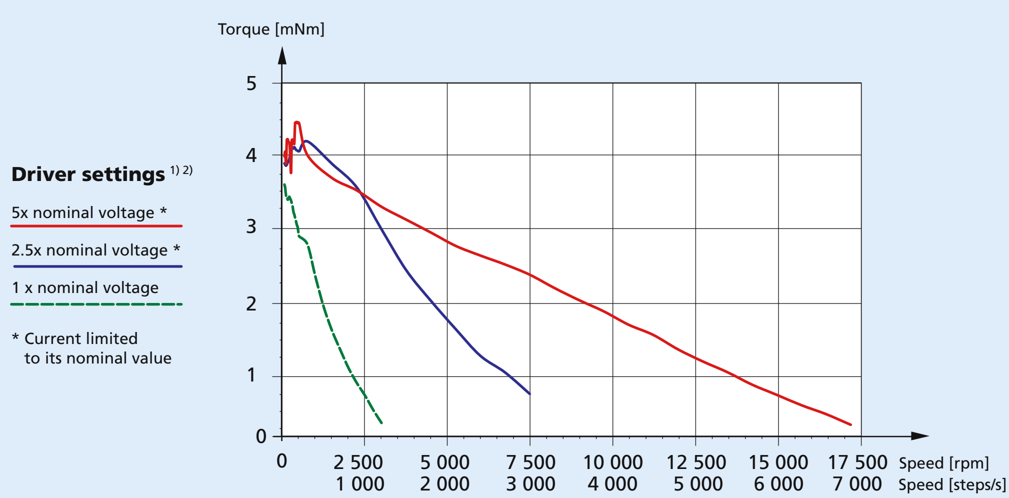
6,0 mNm

Two phase, 24 steps per revolution
PRECIstep® Technology

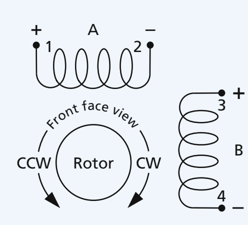
AM1524-ww-ee

	ww =	A-0,45-3,6		A-0,25-12,5		V-6-35		V-12-150		
		Current	Voltage	Current	Voltage	Current	Voltage	Current	Voltage	Drive mode
1	Nominal current per phase (both phases ON) [1]	0,45	–	0,25	–	0,15	–	0,075	–	A
2	Nominal voltage per phase (both phases ON) [1]	–	2	–	3,5	–	6	–	12	V DC
3	Phase resistance (at 20°C)	3,6		12,5		35		138		Ω
4	Phase inductance (1kHz)	1,9		6,3		16,5		70,6		mH
5	Back-EMF amplitude	2,4		4,4		7,2		14,7		V/k step/s
6	Holding torque (at nominal current in both phases)	6,0								mNm
7	Holding torque (at twice the nominal current)	10								mNm
8	Step angle (full step)	15								degree
9	Angular accuracy [1]	± 10								% of full step
10	Residual torque, max.	0,9								mNm
11	Rotor inertia	45								$\cdot 10^{-9}$ kgm²
12	Resonance frequency (at no load)	120								Hz
13	Electrical time constant	0,5								ms
14	Ambient temperature range	–35 ... +70								°C
15	Winding temperature tolerated, max.	130								°C
16	Thermal resistance winding-ambient air	37								°C/W
17	Thermal time constant	220								s
18	Shaft bearings	sintered bronze sleeves (standard)				ball bearings, preloaded (optional)				
19	Shaft load, max.:									
	– radial (3 mm from bearing)	0,5				6,0				N
	– axial	0,5				2,0				N
20	Shaft play, max.:									
	– radial (0,2N)	15				12				µm
	– axial (0,2N)	150				~0				µm
21	Isolation test voltage	200								V DC
22	Weight	12								g

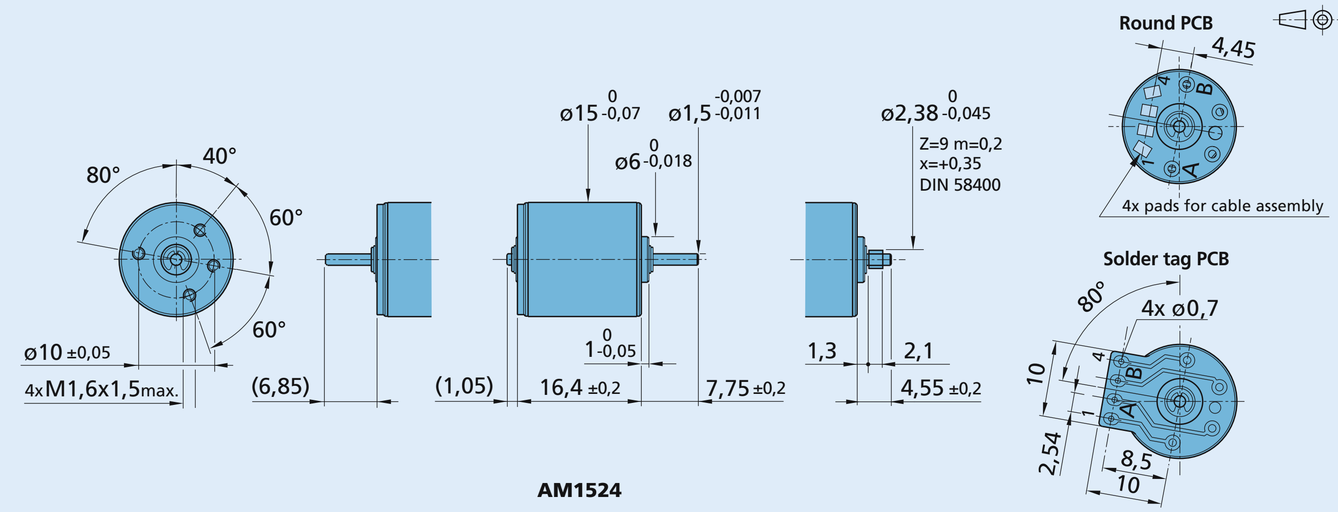
[1] Relevant for 2 phases ON only. On PWM drivers with chopper (current mode), the current is set to the nominal value and the supply voltage is typically 3 to 5x higher than the nominal voltage.
[2] Curves measured with a load inertia of 50 $\cdot 10^{-9}$ kgm², in half-step mode for the "1 x nominal voltage" curve, in 1/4 micro-stepping mode for the other curves.



CW → / ← CCW	1	2	3	4
Phase A	+	–	–	+
Phase B	+	+	–	–

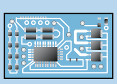
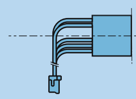
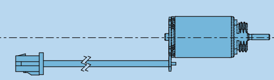
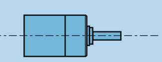


Dimensional drawing



AM1524

Combinations

Drive Electronics	Encoders	Cables	Gearheads / Lead screws
			
Available on request	Available on request	List available on request	**15A**
			15/5(S)
			15/8*
			15/10
			16/7
			17/1
			Lead screws **M2 - M2,5 - M3**

* Zero Backlash Gearheads

Ordering information

Example: **AM1524-2R-V-6-35-57**

Motor type	**Bearings** (rr)	**Winding** (ww)	**Motor execution** (ee)		
AM = Motor design 15 = Motor diameter (mm) 24 = Steps per revolution	Special lubricant options available		Only front output shaft	With double output shaft	Front output shaft
AM1524	**-** (sleeve bearings)	**-V-6-35**	**-55** (Round PCB)	**-54** (Round PCB)	Plain shaft, L=7,75 mm for 15/10,16/7, 17/1, M3
	-2R (2 ball bearings)	**-V-12-150**	**-57** (Round PCB)	**-56** (Round PCB)	Pinion 15/5(S), 15/8
		-A-0,25-12,5	**-70** (Round PCB)	**-71** (Round PCB)	Plain shaft, L=4,5 mm for gearhead 15A
		-A-0,45-3,6	**-83** (Round PCB)	**-82** (Round PCB)	Plain shaft for lead screw M2 - M2,5
			-05 (Solder tag PCB)	**-04** (Solder tag PCB)	Plain shaft, L=7,75 mm for 15/10,16/7, 17/1, M3
			-07 (Solder tag PCB)	**-06** (Solder tag PCB)	Pinion 15/5(S), 15/8
			-72 (Solder tag PCB)	**-73** (Solder tag PCB)	Plain shaft, L=4,5 mm for gearhead 15A
			-23 (Solder tag PCB)	**-22** (Solder tag PCB)	Plain shaft for lead screw M2 - M2,5
				-04-0904	Idem -04 & for encoder
				-06-0904	Idem -06 & for encoder
				-73-0904	Idem -73 & for encoder

Stepper Motors

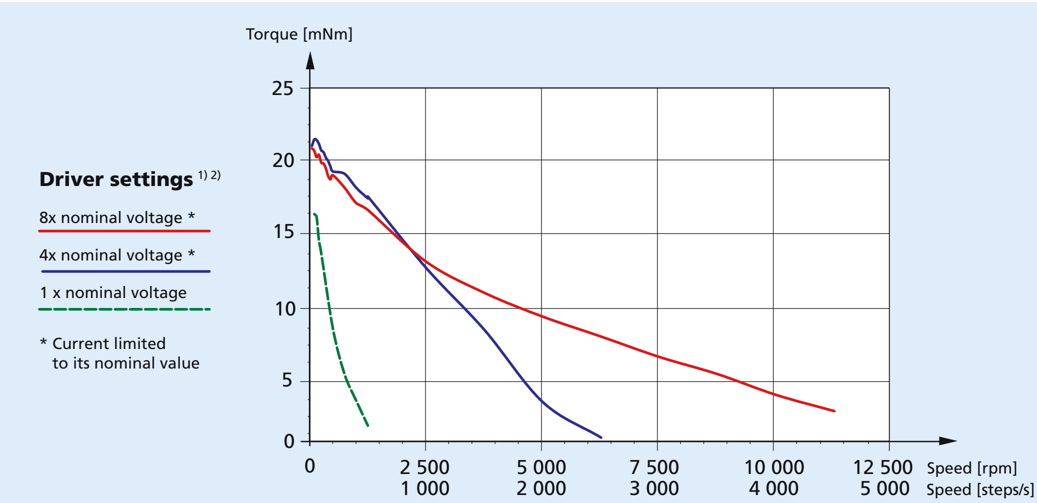
22 mNm

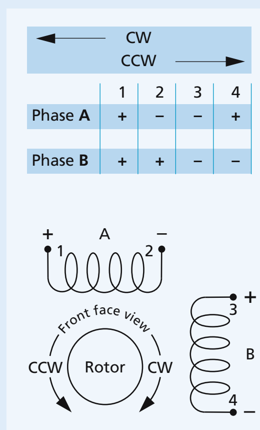
Two phase, 24 steps per revolution
PRECIstep® Technology

AM2224-ww-ee

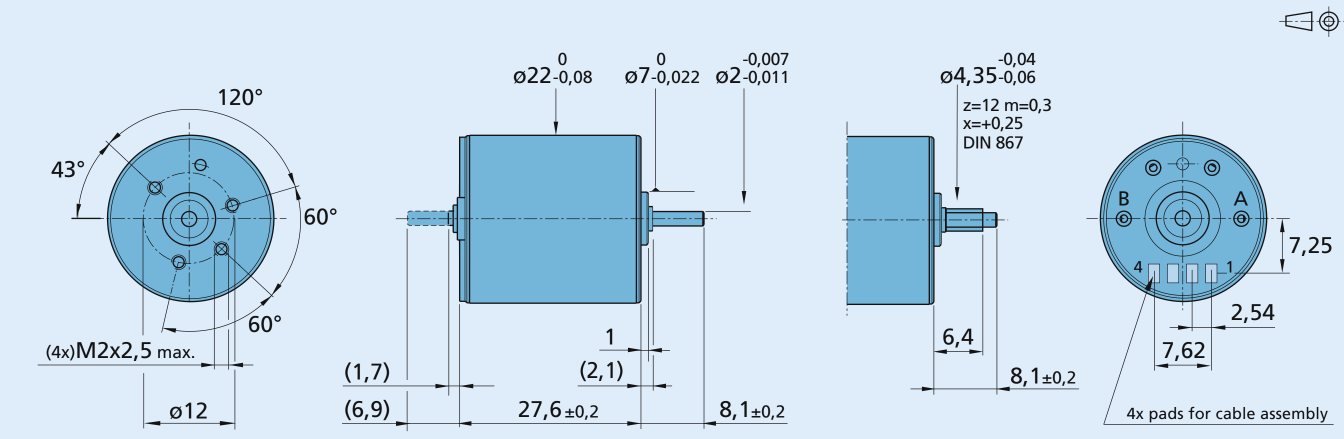
	ww =	AV-0,9		AV-4,8		AV-18		V-12-75		
		Current	Voltage	Current	Voltage	Current	Voltage	Current	Voltage	Drive mode
1	Nominal current per phase (both phases ON) 1)	1,0	–	0,5	–	0,25	–	0,125	–	A
2	Nominal voltage per phase (both phases ON) 1)	–	1,4	–	3	–	6	–	12	V DC
3	Phase resistance (at 20°C)	0,9		4,8		18		75		Ω
4	Phase inductance (1kHz)	0,9		4,3		16,3		65,6		mH
5	Back-EMF amplitude	3,8		8,3		16,3		32,7		V/k step/s
6	Holding torque (at nominal current in both phases)	22								mNm
7	Holding torque (at twice the nominal current)	37								mNm
8	Step angle (full step)	15								degree
9	Angular accuracy 1)	± 10								% of full step
10	Residual torque, max.	2								mNm
11	Rotor inertia	253								$\cdot 10^{-9}$ kgm²
12	Resonance frequency (at no load)	100								Hz
13	Electrical time constant	1,7								ms
14	Ambient temperature range	–35 ... +70								°C
15	Winding temperature tolerated, max.	130								°C
16	Thermal resistance winding-ambient air	28								°C/W
17	Thermal time constant	600								s
18	Shaft bearings	sintered bronze sleeves (standard with 2 mm shaft)				ball bearings, preloaded (optional)				
19	Shaft load, max.:									
	– radial (3 mm from bearing)	1,5				8,0				N
	– axial	0,5				4,0				N
20	Shaft play, max.:									
	– radial (0,2N)	30				15				µm
	– axial (0,2N)	200				~0				µm
21	Isolation test voltage	200								V DC
22	Weight	43								g

1) Relevant for 2 phases ON only. On PWM drivers with chopper (current mode), the current is set to the nominal value and the supply voltage is typically 3 to 5x higher than the nominal voltage.
2) Curves measured with a load inertia of 600 $\cdot 10^{-9}$ kgm², in half-step mode for the "1 x nominal voltage" curve, in 1/4 micro-stepping mode for the other curves.





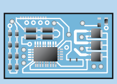
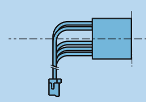
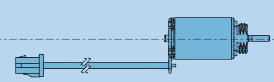
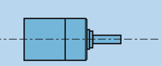
Dimensional drawing



AM2224

for Gearheads
22/2, 22/5

Combinations

Drive Electronics	Encoders	Cables	Gearheads / Lead screws
			
Available on request	**PE 22-120**	List available on request	**22E**
			22EKV
			22/2
			22/5*
			22/7
			23/1

* Zero Backlash Gearheads

Ordering information

Example: **AM2224-2R-AV-18-10**

Motor type	Bearings (rr)	Winding (ww)	Motor execution (ee)		
AM = Motor design 22 = Motor diameter (mm) 24 = Steps per revolution	Special lubricant options available		Only front output shaft	With double output shaft	Front output shaft
AM2224	**-** (sleeve bearings)	**-AV-0,9**	**-10**	**-11**	Plain shaft, L=8,1 mm ø2 mm for 22/7, 23/1
	-2R (2 ball bearings)	**-AV-4,8**	**-12**	**-13**	Plain shaft, L=6,6 mm ø1,5 for 22E, 22EKV
		-AV-18	**-14**	**-15**	Pinion 22/2, 22/5
		-V-12-75		**-16**	Plain shaft for 22/7, 23/1, encoder PE22-120
				-17	Plain shaft for 22E, encoder PE22-120
				-18	Pinion 22/2, 22/5, encoder PE22-120

Stepper Motors

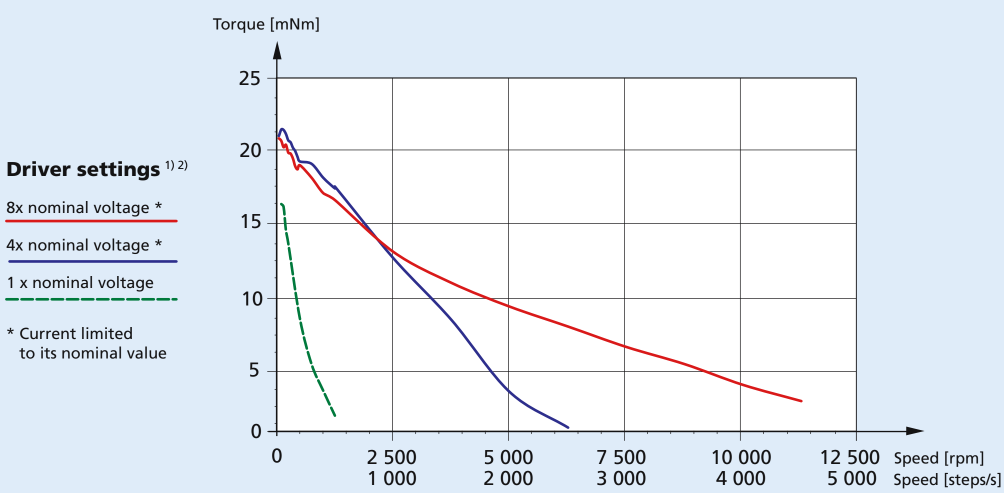
22 mNm

Two phase, 24 steps per revolution
PRECIstep® Technology

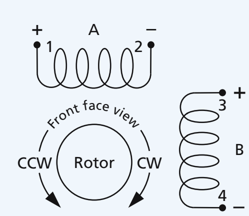
AM2224-R3-ww-ee

ww =	AV-0,9		AV-4,8		AV-18		V-12-75		
	Current	Voltage	Current	Voltage	Current	Voltage	Current	Voltage	Drive mode
1 Nominal current per phase (both phases ON) 1)	1,0	–	0,5	–	0,25	–	0,125	–	A
2 Nominal voltage per phase (both phases ON) 1)	–	1,4	–	3	–	6	–	12	V DC
3 Phase resistance (at 20°C)	0,9		4,8		18		75		Ω
4 Phase inductance (1kHz)	0,9		4,3		16,3		65,6		mH
5 Back-EMF amplitude	3,8		8,3		16,3		32,7		V/k step/s
6 Holding torque (at nominal current in both phases)	22								mNm
7 Holding torque (at twice the nominal current)	37								mNm
8 Step angle (full step)	15								degree
9 Angular accuracy 1)	± 10								% of full step
10 Residual torque, max.	2								mNm
11 Rotor inertia	253								$\cdot 10^{-9}$ kgm²
12 Resonance frequency (at no load)	100								Hz
13 Electrical time constant	0,92								ms
14 Ambient temperature range	–35 ... +70								°C
15 Winding temperature tolerated, max.	130								°C
16 Thermal resistance winding-ambient air	28								°C/W
17 Thermal time constant	600								s
18 Shaft bearings	ball bearings, preloaded (standard with 3 mm shaft)								
19 Shaft load, max.:									
– radial (3 mm from bearing)	20,0								N
– axial	4,0								N
20 Shaft play, max.:									
– radial (0,2N)	15								µm
– axial (0,2N)	~0								µm
21 Isolation test voltage	200								V DC
22 Weight	50,5								g

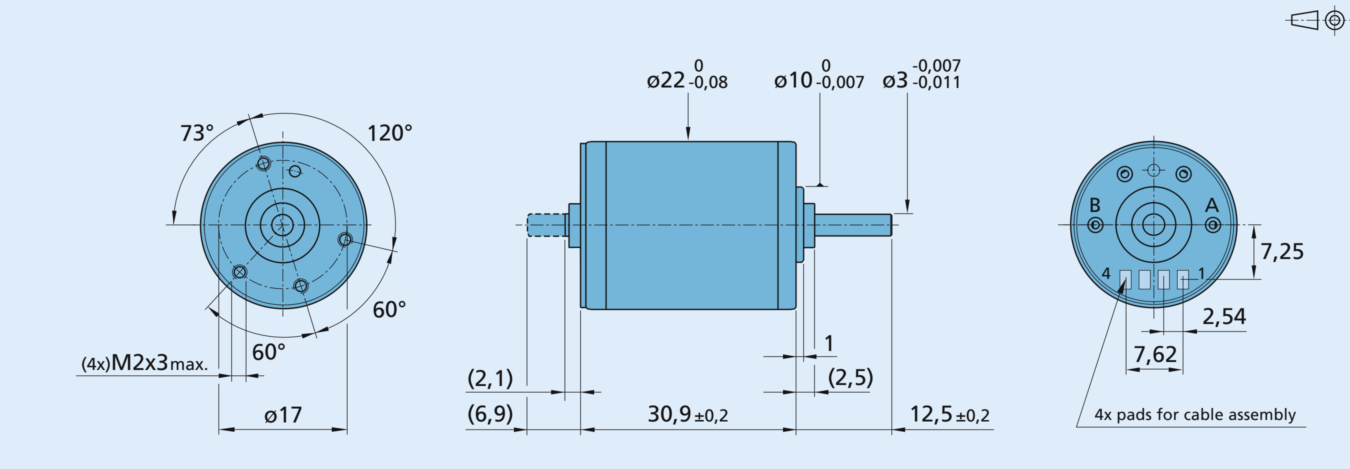
1) Relevant for 2 phases ON only. On PWM drivers with chopper (current mode), the current is set to the nominal value and the supply voltage is typically 3 to 5x higher than the nominal voltage.
2) Curves measured with a load inertia of 600 $\cdot 10^{-9}$ kgm², in half-step mode for the "1 x nominal voltage" curve, in 1/4 micro-stepping mode for the other curves.



		1	2	3	4
← CW / CCW →					
Phase A		+	–	–	+
Phase B		+	+	–	–

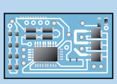
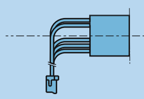
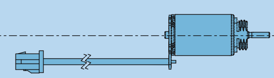
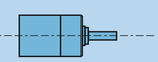


Dimensional drawing



AM2224-R3

Combinations

Drive Electronics	Encoders	Kabel	Gearheads / Lead screws
			
Available on request	**PE22-120**	List available on request	Lead screws **M3**

Ordering information

Example: **AM2224-R3-AV-18-31**

Motor type	**Bearings** (rr)	**Winding** (ww)	**Motor execution** (ee)		
AM = Motor design 22 = Motor diameter (mm) 24 = Steps per revolution	Special lubricant options available		Only front output shaft	With double output shaft	Front output shaft
AM2224	**-R3** (2 ball bearings)	**-AV-0,9**	**-30**	**-31**	Plain shaft
		-AV-4,8	**-85**	**-84**	Plain shaft for lead screw M3
		-AV-18		**-36**	Plain shaft for encoder PE22-120
		-V-12-75		**-86**	Plain shaft for lead screw M3, PE22-120

Notes

Linear DC-Servomotors

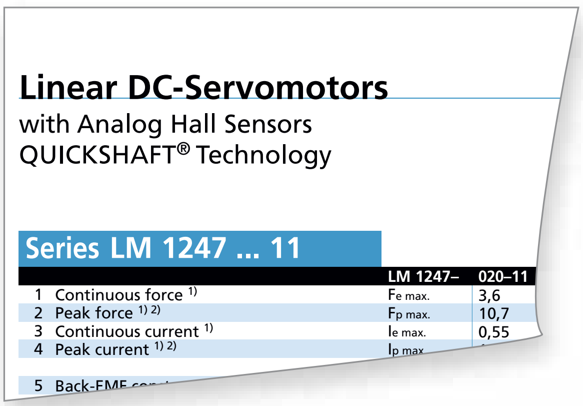
WE CREATE MOTION

FAULHABER

FAULHABER

Linear
DC-Servomotors

WE CREATE MOTION



Linear DC-Servomotors
with Analog Hall Sensors
QUICKSHAFT® Technology

Series LM 1247 ... 11

		LM 1247–	020–11
1	Continuous force [1]	$F_{e\,max.}$	3,6
2	Peak force [1) 2)]	$F_{p\,max.}$	10,7
3	Continuous current [1]	$I_{e\,max.}$	0,55
4	Peak current [1) 2)]	$I_{p\,max}$	
5	Back-EMF con...		

Notes on technical data

All values at 22 °C.

Continuous force $F_{e\,max.}$ [N]
The maximum force delivered by the motor at the thermal limit in continuous duty operation.

$$F_{e\,max.} = k_F \cdot I_{e\,max.}$$

Peak force $F_{p\,max.}$ [N]
The maximum force delivered by the motor at the thermal limit in intermittent duty operation (max. 1 s, 10% duty cycle).

$$F_{p\,max.} = k_F \cdot I_{p\,max.}$$

Continuous current $I_{e\,max.}$ [A]
The maximum motor current consumption at the thermal limit in continuous duty operation.

$$I_{e\,max.} = \sqrt{\frac{T_{125} - T_{22}}{R \cdot (1 + \alpha_{22} \cdot (T_{125} - T_{22})) \cdot (R_{th\,1} + 0{,}45 \cdot R_{th\,2})}} \cdot \frac{\sqrt{2}}{\sqrt{3}}$$

Peak current $I_{p\,max.}$ [A]
The maximum motor current consumption at the thermal limit in intermittent duty operation (max. 1 s, 10% duty cycle).

Back-EMF constant k_E [V/m/s]
The constant corresponding to the relationship between the induced voltage in the motor phases and the linear motion speed.

$$k_E = \frac{2 \cdot k_F}{\sqrt{6}}$$

Force constant k_F [N/A]
The constant corresponding to the relationship between the motor force delivered and current consumption.

Terminal resistance, phase-phase R [Ω] ±12%
The resistance measured between two motor phases. This value is directly influenced by the coil temperature (temperature coefficient: $\alpha_{22} = 0{,}004\ K^{-1}$).

Terminal inductance, phase-phase L [µH]
The inductance measured between two phases at 1 kHz.

Stroke length $s_{max.}$ [mm]
The maximum stroke length of the moving cylinder rod.

Repeatability [µm]
The maximum measured difference when repeating several times the same movement under the same conditions.

Precision [µm]
The maximum positioning error. This value corresponds to the maximum difference between the set position and the exact measured position of the system.

Acceleration $a_{e\,max.}$ [m/s²]
The maximum no-load acceleration from standstill.

$$a_{e\,max.} = \frac{F_{e\,max.}}{m_m}$$

Speed $v_{e\,max.}$ [m/s]
The maximum no-load speed from standstill, considering a triangular speed profile and maximum stroke length.

$$v_{e\,max.} = \sqrt{a_{e\,max.} \cdot s_{max.}}$$

Thermal resistance $R_{th\,1}$ / $R_{th\,2}$ [K/W]
R_{th1} corresponds to the value between coil and housing. R_{th2} corresponds to the value between housing and ambient air.
The listed values refer to a motor totally surrounded by air. R_{th2} can be reduced with a heat sink and/or forced air cooling.

Thermal time constant τ_{w1} / τ_{w2} [s]
The thermal time constant of the coil and housing, respectively.

Operating temperature range [°C]
The minimum and maximum permissible operating temperature values of the motors.

Rod weight m_m [g]
The weight of the rod (cylinder with magnets).

Total weight m_t [g]
The total weight of the linear DC-Servomotor.

Linear DC-Servomotors

Technical Information

Magnetic pitch τ_m [mm]
The distance between two equal poles.

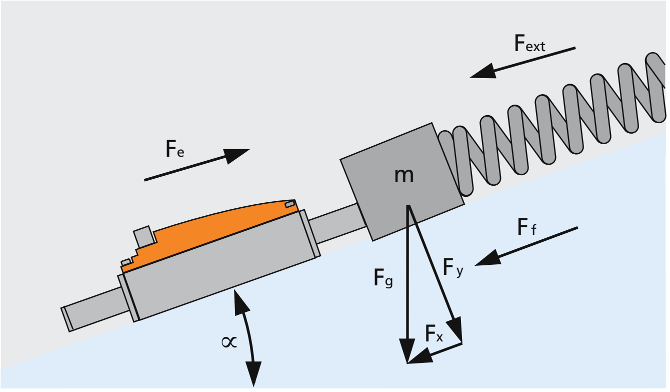
Rod bearings
The material and type of bearings.

Housing material
The material of the motor housing.

Direction of movement
The direction of movement is reversible, determined by the control electronics.

Force calculation

To move a mass on a slope, the motor needs to deliver a force to accelerate the load and overcome all forces opposing the movement.



The sum of forces shown in above figure has to be equal to:

$$\sum F = m \cdot a \qquad [N]$$

Entering the various forces in this equation it follows that:

$$F_e - F_{ext} - F_f - F_x = m \cdot a \qquad [N]$$

where:

F_e :	Continuous force delivered by motor	[N]
F_{ext} :	External force	[N]
F_f :	Friction force $F_f = m \cdot g \cdot \mu \cdot \cos(\propto)$	[N]
F_x :	Parallel force $F_x = m \cdot g \cdot \sin(\propto)$	[N]
m :	Total mass	[kg]
g :	Gravity acceleration	[m/s²]
a :	Acceleration	[m/s²]

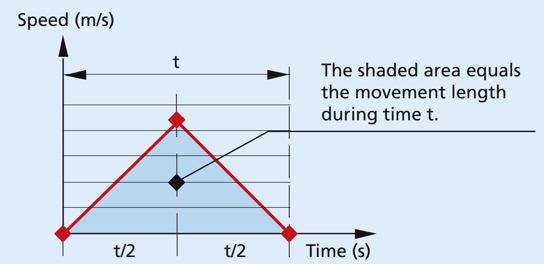
Speed profiles

Shifting any load from point A to point B is subject to the laws of kinematics.

Equations of a uniform straight-line movement and uniformly accelerated movement allow definition of the various speed vs. time profiles.

Prior to calculating the continuous duty force delivered by the motor, a speed profile representing the various load movements needs to be defined.

Triangular speed profile
The triangular speed profile simply consists of an acceleration and a deceleration time.



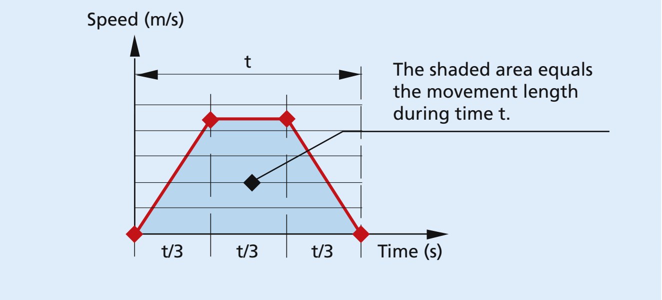
Displacement: $$s = \frac{1}{2} \cdot v \cdot t = \frac{1}{4} \cdot a \cdot t^2 = \frac{v^2}{a} \qquad [m]$$

Speed: $$v = 2 \cdot \frac{s}{t} = \frac{a \cdot t}{2} = \sqrt{a \cdot s} \qquad [m/s]$$

Acceleration: $$a = 4 \cdot \frac{s}{t^2} = 2 \cdot \frac{v}{t} = \frac{v^2}{s} \qquad [m/s^2]$$

Trapezoidal speed profile

The trapezoidal speed profile, acceleration, speed and deceleration, allow simple calculation and represent typical real application cases.



Displacement:	$s = \frac{2}{3}\cdot v\cdot t = \frac{1}{4,5}\cdot a\cdot t^2 = 2\cdot\frac{v^2}{a}$	[m]
Speed:	$v = 1,5\cdot\frac{s}{t} = \frac{a\cdot t}{3} = \sqrt{\frac{a\cdot s}{2}}$	[m/s]
Acceleration:	$a = 4,5\cdot\frac{s}{t^2} = 3\cdot\frac{v}{t} = 2\cdot\frac{v^2}{s}$	[m/s²]

How to select a linear DC-Servomotor

This section describes a step-by-step procedure to select a linear DC-Servomotor.

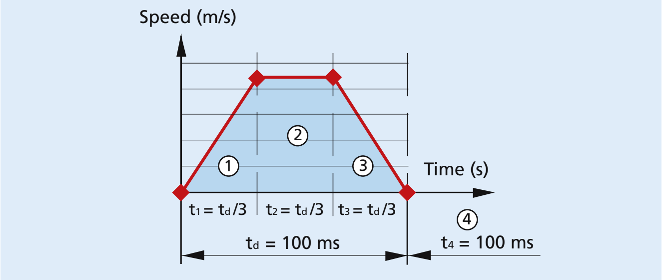
Speed profile definition

To start, it is necessary to define the speed profile of the load movements.

Movement characteristics are the first issues to be considered. Which is the maximum speed? How fast should the mass be accelerated? Which is the length of movement the mass needs to achieve? How long is the rest time?

Should the movement parameters not be clearly defined, it is recommended to use a triangular or trapezoidal profile.

Lets assume a load of 500 g that needs to be moved 20 mm in 100 ms on a slope having a rising angle of 20° considering a trapezoidal speed profile.



	Unit	①	②	③	④
s (displacement)	m	0,005	0,01	0,005	0
v (speed)	m/s	0 ... 0,3	0,3	0,3 ... 0	0
a (acceleration)	m/s²	9,0	0	–9,0	0
t (time)	s	0,033	0,033	0,033	0,100

Calculation example

Speed and acceleration of part ①

$$v_{max.} = 1,5\cdot\frac{s}{t} = 1,5\cdot\frac{20\cdot10^{-3}}{100\cdot10^{-3}} = 0,3\ \text{m/s}$$

$$a = 4,5\cdot\frac{s}{t^2} = 4,5\cdot\frac{20\cdot10^{-3}}{(100\cdot10^{-3})^2} = 9\ \text{m/s}^2$$

Force definition

Assuming a load of 500 g and a friction coefficient of 0,2, the following forces result:

Force	Unit	Symbol	Forward ①	②	③	④	Backward ①	②	③	④
Friction	N	F_f	0,94	0,94	0,94	-0,94	0,94	0,94	0,94	0,94
Parallel	N	F_x	1,71	1,71	1,71	1,71	-1,71	-1,71	-1,71	-1,71
Acceleration	N	F_a	4,5	0	-4,5	0	4,5	0	-4,5	0
Total	N	F_t	7,15	2,65	-1,85	0,77	3,73	-0,77	-5,27	-0,77

Calculation example

Friction and acceleration forces of part ①

$$F_f = m\cdot g\cdot\ \cdot\cos(\propto) = 0,5\cdot10\cdot0,2\cdot\cos(20^\circ) = 0,94\ \text{N}$$

$$F_a = m\cdot a = 0,5\cdot9 = 4,5\ \text{N} \qquad = 4,5\ \text{N}$$

Motor selection

Now that the forces of the three parts of the profile are known, requested peak and continuous forces can be calculated in function of the time of each part.

The peak force is the highest one achieved during the motion cycle.

$$F_p = \max.(|\mathbf{7,15}|, |2,65|, |-1,85|, |0,77|, |3,73|, |-0,77|, |-5,27|, |-0,77|) = 7,15\ \text{N}$$

The continuous force is represented by the expression:

$$F_e = \sqrt{\frac{\Sigma\,(t \cdot F_t^2)}{2 \cdot \Sigma t}} = \ldots$$

$$F_e = \sqrt{\frac{0{,}033 \cdot 7{,}15^2 + 0{,}033 \cdot 2{,}65^2 + 0{,}033 \cdot (-1{,}85)^2 + 0{,}1 \cdot 0{,}77^2 + 0{,}033 \cdot 3{,}73^2 + 0{,}033 \cdot (-0{,}77)^2 + 0{,}033 \cdot (-5{,}27)^2 + 0{,}1 \cdot (-0{,}77)^2}{2 \cdot (0{,}033 + 0{,}033 + 0{,}033 + 0{,}1)}} = 2{,}98 \text{ N}$$

With these two values it is now possible to select the suitable motor for the application.

Linearer DC-Servomotor **LM 1247–020–11**

$s_{max.} = 20$ mm ; $F_{e\,max} = 3{,}6$ N ; $F_{p\,max.} = 10{,}7$ N

Coil winding temperature calculation

To obtain the coil winding temperature, the continuous motor current needs to be calculated.
For this example, considering a force constant k_F equal to 6,43 N/A, gives the result:

$$I_e = \frac{F_e}{k_f} = \frac{2{,}98}{6{,}43} = 0{,}46 \text{ A}$$

With an electrical resistance of 13,17 Ω, a total thermal resistance of 26,2 °C/W ($R_{th1} + R_{th2}$) and a reduced thermal resistance Rth2 by 55% ($0{,}45 \cdot R_{th2}$), the resulting coil temperature is:

$$T_c(I) = \frac{R \cdot (R_{th1} + 0{,}45 \cdot R_{th2}) \cdot (I_e \cdot \frac{\sqrt{3}}{\sqrt{2}})^2 \cdot (1 - \alpha_{22} \cdot T_{22}) + T_{22}}{1 - \alpha_{22} \cdot R \cdot (R_{th1} + 0{,}45 \cdot R_{th2}) \cdot (I_e \cdot \frac{\sqrt{3}}{\sqrt{2}})^2} = \ldots$$

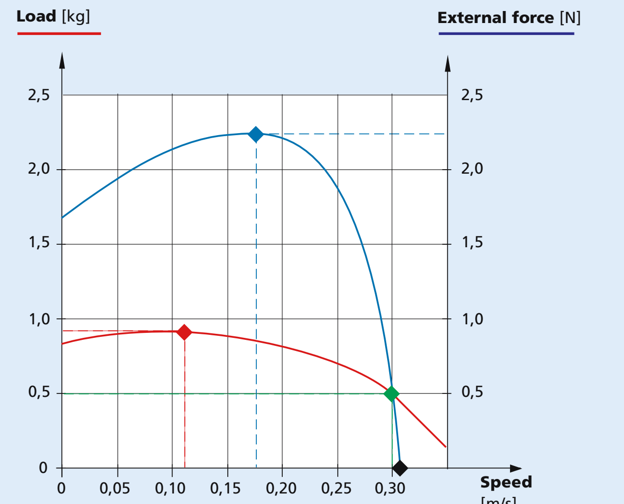
$$T_c(I) = \frac{13{,}17 \cdot (8{,}1 + 0{,}45 \cdot 18{,}1) \cdot (0{,}46 \cdot \frac{\sqrt{3}}{\sqrt{2}})^2 \cdot (1 - 0{,}0038 \cdot 22) + 22}{1 - 0{,}0038 \cdot 13{,}17\,(8{,}1 + 0{,}45 \cdot 18{,}1) \cdot (0{,}46 \cdot \frac{\sqrt{3}}{\sqrt{2}})^2} = 113{,}5 \text{ °C}$$

Motor characteristic curves

Motion profile:
Trapezoidal (t1 = t2 = t3), back and forth

Motor characteristic curves of the linear DC-Servomotor with the following parameters:

Displacement distance:	20 mm
Friction coefficient:	0,2
Slope angle:	20°
Rest time:	0,1 s



LM 1247–020–11

Load curve

Allows knowing the maximum applicable load for a given speed with 0 N external force.

The graph shows that a maximum load (◆) of 0,87 kg can be applied at a speed of 0,11 m/s.

External force curve

Allows knowing the maximum applicable external force for a given speed with a load of 0,5 kg.

The graph shows that the max. achievable speed (◆) without external forces, but with a load of 0,5 kg is 0,31 m/s.

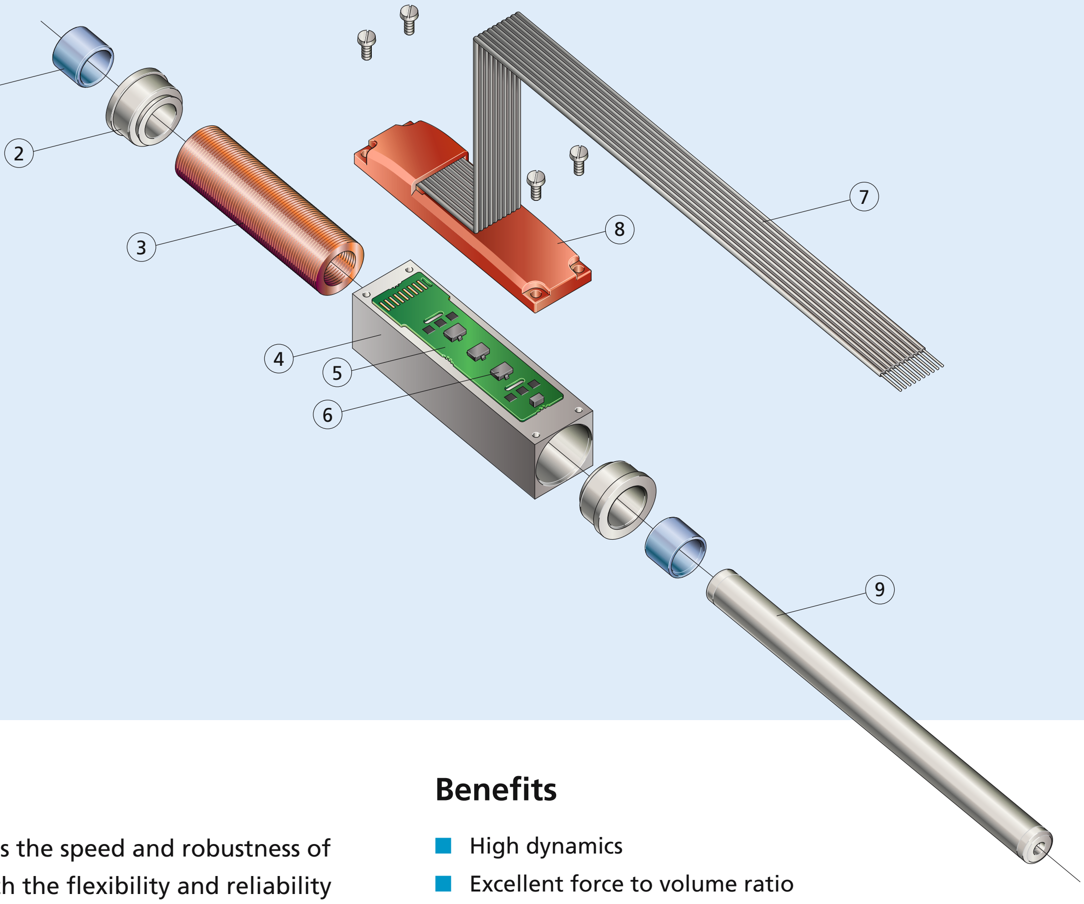
Therefore, the maximum applicable external force (◆) at a speed of 0,3 m/s is 0,5 N.

The external peak force (◆) is achieved at a speed of 0,17 m/s, corresponding to a maximum applicable external force of 2,27 N.

FAULHABER

Linear DC-Servomotors

QUICKSHAFT® Technology



Linear DC-Servomotor

① Sleeve bearings
② Bearing support
③ Coil
④ Housing
⑤ PCB
⑥ Hall sensors
⑦ Cable
⑧ Cover
⑨ Forcer rod

Features

QUICKSHAFT® combines the speed and robustness of a pneumatic system with the flexibility and reliability features of an electro-mechanical linear motor.
The innovative design with a 3-phase self-supporting coil and non-magnetic steel housing offers outstanding performance.

The absence of residual static force and the excellent relationship between the linear force and current make these motors ideal for use in micro-positioning applications. Position control of the QUICKSHAFT® Linear DC-Servomotor is made possible by the built-in Hall sensors.

Performance lifetime of the QUICKSHAFT® Linear DC-Servomotors is mainly influenced by the wear of the sleeve bearings, which depends on operating speed and applied load of the cylinder rod.

Benefits

- High dynamics
- Excellent force to volume ratio
- No residual force present
- Non-magnetic steel housing
- Compact and robust construction
- No lubrication required
- Simple installation and configuration

Product Code

LM1247–020–11

LM	Linear Motor
12	Motor width □ [mm]
47	Motor length [mm]
020	Stroke length [mm]
11	Sensors type: linear

Linear DC-Servomotors

with Analog Hall Sensors
QUICKSHAFT® Technology

1,03 N

For combination with
Drive Electronics:
Motion Controller

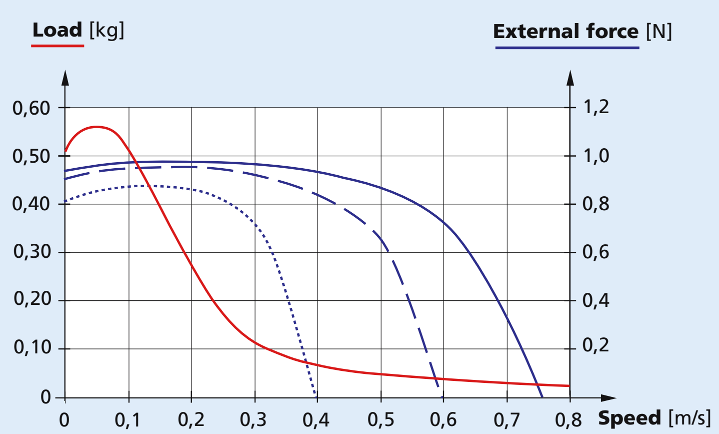
Series LM 0830 ... 01

		LM 0830–		015–01	040–01	
1	Continuous force [1]	$F_{e\ max.}$	1,03			N
2	Peak force [1) 2)]	$F_{p\ max.}$	2,74			N
3	Continuous current [1]	$I_{e\ max.}$	0,53			A
4	Peak current [1) 2)]	$I_{p\ max.}$	1,41			A
5	Back-EMF constant	k_E	1,58			V/m/s
6	Force constant [3]	k_F	1,94			N/A
7	Terminal resistance, phase-phase	R	7,37			Ω
8	Terminal inductance, phase-phase	L	117			µH
9	Stroke length	$s_{max.}$		15	40	mm
10	Repeatability [4]			40	40	µm
11	Precision [4]			120	140	µm
12	Acceleration [5]	$a_{e\ max.}$		206,9	147,8	m/s²
13	Speed [5) 6)]	$v_{e\ max.}$		1,8	2,4	m/s
14	Thermal resistance	$R_{th\ 1}$ / $R_{th\ 2}$	6,6 / 37,4			K/W
15	Thermal time constant	τ_{w1} / τ_{w2}	4 / 291			s
16	Operating temperature range		– 20 ... +125			°C
17	Rod weight [7]	m_m		5	7	g
18	Total weight [7]	m_t		15	17	g
19	Magnetic pitch	τ_m	12			mm
20	Rod bearings		polymer sleeves			
21	Housing material		metal, non-magnetic			
22	Direction of movement		electronically reversible			

1) thermal resistance $R_{th\ 2}$ by 55% reduced
2) for max. 1 second with a duty cycle of 10%
3) with sine wave commutation
4) typical values with integrated linear Hall sensors and Motion Controller. The values depend on conditions of use
5) theorical value, referring only to the motor
6) with a triangular speed profile and the max. stroke
7) rounded value, for reference only

Notes: These motors are for operation with DC-voltage < 50 V DC.
The given values are for free standing motors.
The mounting with magnetic conductive metal can influence the characteristics of the motor.

Caution: Presence of strong magnetic fields. Static sensitive device.



LM 0830–015–01

Trapezoidal motion profile (t1 = t2 = t3)

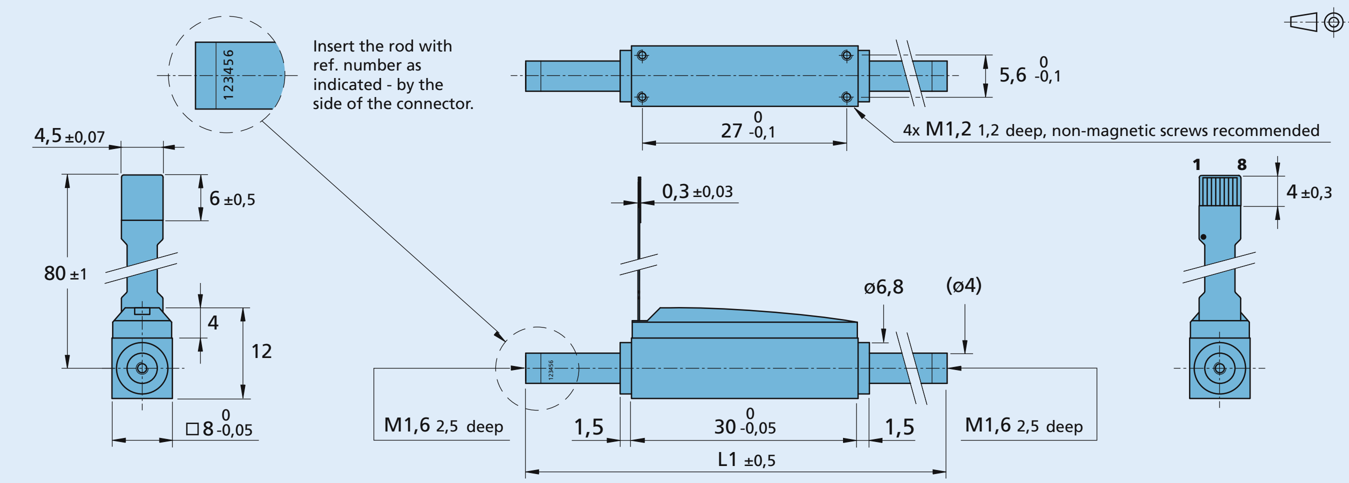
Displacement distance:	15 mm
Friction coefficient:	0,2
Slope angle:	0°
Rest time:	0,1 s

Load: The max. permissible load at a given speed with an external force of 0 N

External force: The max. permissible external force at a given speed with a load of:
- 0,035 Kg
- 0,05 Kg
- 0,1 Kg

For notes on technical data and lifetime performance refer to „Technical Information“.
Edition 2014

Linear DC-Servomotor LM 0830



LM 0830 ... 01

Ordering information

Linear DC-Servomotors Series	**Stroke** mm	**Rod length** L1 ±0,5 mm
LM 0830–015–01	–7,5 … 0 … +7,5	58
LM 0830–040–01	–20 … 0 … +20	82

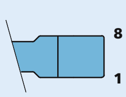
Note: Single rod available on request.

Options

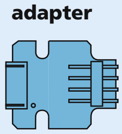
- Flexboard adapter (part no. L08.90.02), size 18 x 23 x 6 mm
- Cable with connector (part no. L12.09.01), 200 mm length ± 10 mm, 8 conductors

Cable and connection information

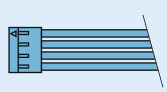
Motor flexboard



Flexboard adapter

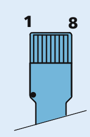


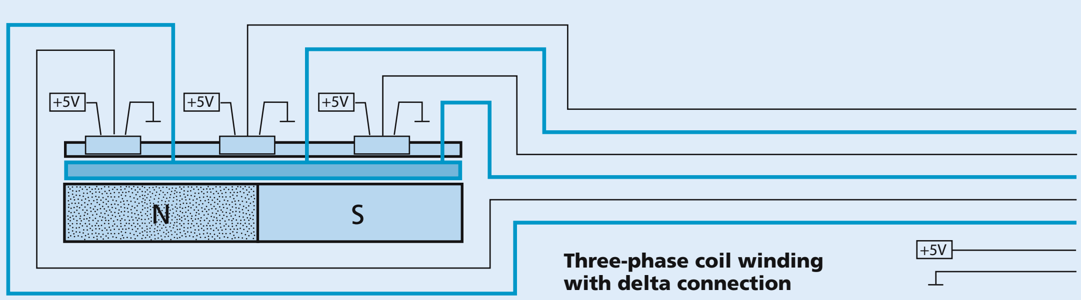
Cable for connection with Motion Controller



Recommended connector
Molex - ZIF connector,
Nr. 52746

Flexboard
8 circuits; 0,5mm pitch





Connection

No.	Function
6	Hall sensor C
1	Phase C
7	Hall sensor B
2	Phase B
8	Hall sensor A
3	Phase A
5	+5V
4	GND

Linear DC-Servomotors

with Analog Hall Sensors
QUICKSHAFT® Technology

3,6 N

For combination with
Drive Electronics:
Motion Controller

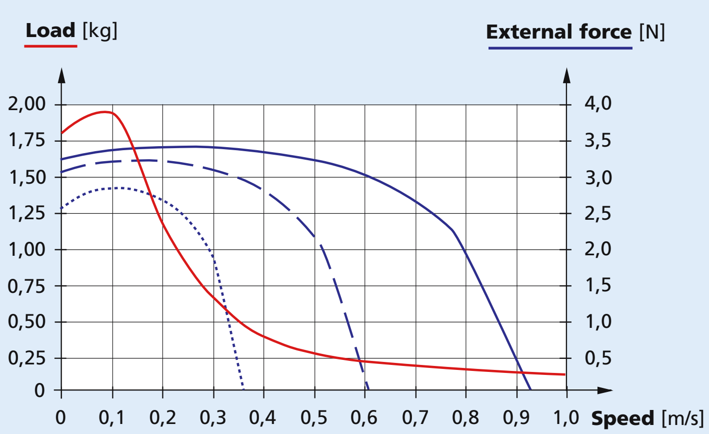
Series LM 1247 ... 11

		LM 1247–	020–11	040–11	060–11	080–11	100–11	120–11	
1	Continuous force [1]	$F_{e\ max.}$	3,6						N
2	Peak force [1,2]	$F_{p\ max.}$	10,7						N
3	Continuous current [1]	$I_{e\ max.}$	0,55						A
4	Peak current [1,2]	$I_{p\ max.}$	1,66						A
5	Back-EMF constant	k_E	5,25						V/m/s
6	Force constant [3]	k_F	6,43						N/A
7	Terminal resistance, phase-phase	R	13,17						Ω
8	Terminal inductance, phase-phase	L	820						µH
9	Stroke length	$s_{max.}$	20	40	60	80	100	120	mm
10	Repeatability [4]		40	40	40	40	40	40	µm
11	Precision [4]		120	140	160	180	200	220	µm
12	Acceleration [5]	$a_{e\ max.}$	198,0	148,5	127,3	101,8	91,4	82,9	m/s²
13	Speed [5,6]	$v_{e\ max.}$	2,0	2,4	2,8	2,9	3,0	3,2	m/s
14	Thermal resistance	$R_{th\,1}$ / $R_{th\,2}$	3,2 / 20,0						K/W
15	Thermal time constant	τ_{w1} / τ_{w2}	11 / 624						s
16	Operating temperature range		– 20 ... +125						°C
17	Rod weight [7]	m_m	18	24	28	35	39	43	g
18	Total weight [7]	m_t	57	63	67	74	78	82	g
19	Magnetic pitch	τ_m	18						mm
20	Rod bearings		polymer sleeves						
21	Housing material		metal, non-magnetic						
22	Direction of movement		electronically reversible						

1) thermal resistance $R_{th\,2}$ by 55% reduced
2) for max. 1 second with a duty cycle of 10%
3) with sine wave commutation
4) typical values with integrated linear Hall sensors and Motion Controller. The values depend on conditions of use
5) theorical value, referring only to the motor
6) with a triangular speed profile and the max. stroke
7) rounded value, for reference only

Notes: These motors are for operation with DC-voltage < 75 V DC.
The given values are for free standing motors.
The mounting with magnetic conductive metal can influence the characteristics of the motor.

Caution: Presence of strong magnetic fields. Static sensitive device.



LM 1247–020–11

Trapezoidal motion profile (t1 = t2 = t3)

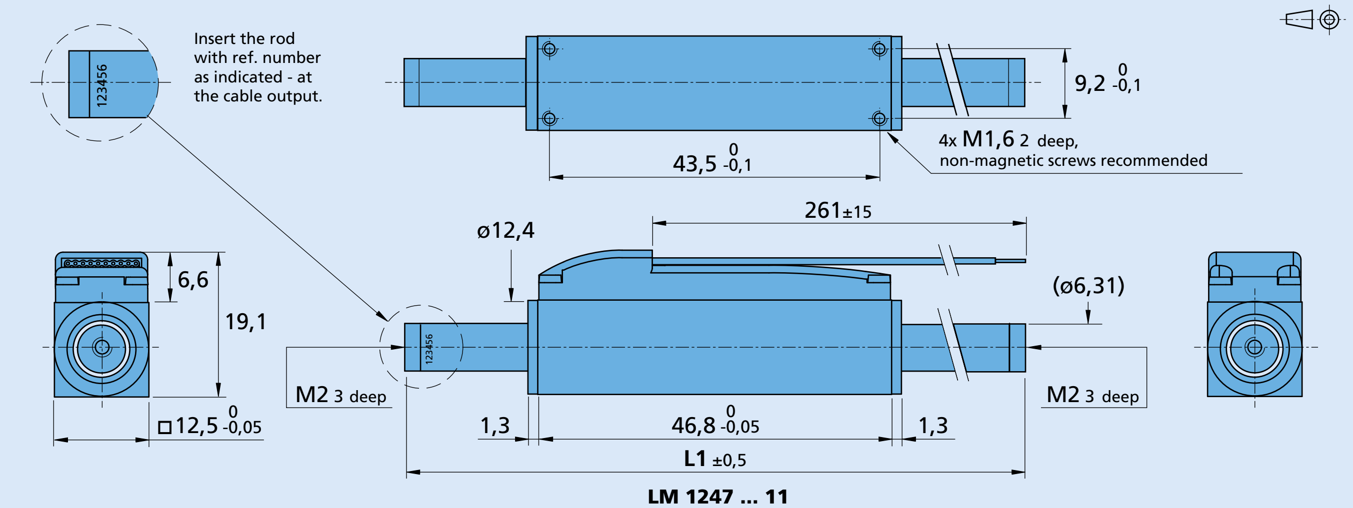
Displacement distance:	20 mm
Friction coefficient:	0,2
Slope angle:	0°
Rest time:	0,1 s

Load: The max. permissible load at a given speed with an external force of 0 N

External force: The max. permissible external force at a given speed with a load of:

- 0,1 Kg
- 0,2 Kg
- 0,5 Kg

Linear DC-Servomotor LM 1247 ... 11 with axial connection



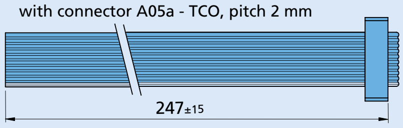
Ordering information

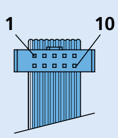
Linear DC-Servomotors Series	Stroke mm		Rod length L1 ±0,5 mm
LM 1247–020–11	– 10	+10	82
LM 1247–040–11	– 20	+20	109
LM 1247–060–11	– 30	+30	127
LM 1247–080–11	– 40	+40	154
LM 1247–100–11	– 50	+50	172
LM 1247–120–11	– 60	+60	190

Note: Single rod available on request.

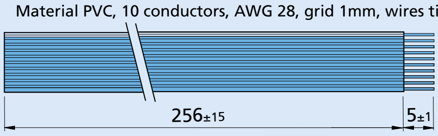
Cable and connection information

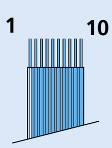
Cable for LM 1247–...–11C
Material PVC, 10 conductors, AWG 28
with connector A05a - TCO, pitch 2 mm



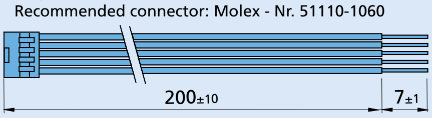


Cable for LM 1247–...–11
Material PVC, 10 conductors, AWG 28, grid 1mm, wires tinned

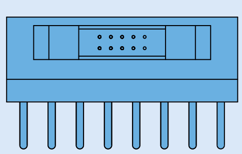




Cable for LM 1247–...–01
Single wires, material PVC, 10 conductors, AWG 28.
Recommended connector: Molex - Nr. 51110-1060



* The color reference refers only to the **LM 1247-...-01** version.



Adapter for LM 1247–...–11C
for connection with
Motion Controllers
MCLM 3006 S RS/CF
(part no. L12.90.02).

Connection

LM 1247–...–01

PIN	Function	Color*
1	Phase C	yellow
7	Phase B	orange
8	Phase A	brown
4	GND	black
3	+5V	red
6	Hall sensor C	grey
5	Hall sensor B	blue
2	Hall sensor A	green
9	N.C.	white
10	N.C.	purple

LM 1247–...–11 / 11C

PIN	Function
1	Phase C
2	Phase B
3	Phase A
4	GND
5	+5V
6	Hall sensor C
7	Hall sensor B
8	Hall sensor A
9	N.C.
10	N.C.

Linear DC-Servomotors

3,6 N

for sin/cos control
QUICKSHAFT® Technology

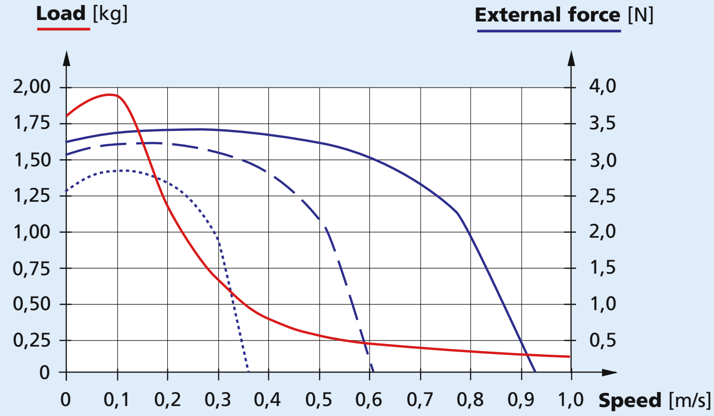
Series LM 1247 ... 12

		LM 1247–	020–12	040–12	060–12	080–12	100–12	120–12	
1	Continuous force [1]	$F_{e\ max.}$	3,6						N
2	Peak force [1] [2]	$F_{p\ max.}$	10,7						N
3	Continuous current [1]	$I_{e\ max.}$	0,55						A
4	Peak current [1] [2]	$I_{p\ max.}$	1,66						A
5	Back-EMF constant	k_E	5,25						V/m/s
6	Force constant [3]	k_F	6,43						N/A
7	Terminal resistance, phase-phase	R	13,17						Ω
8	Terminal inductance, phase-phase	L	820						µH
9	Stroke length	$s_{max.}$	20	40	60	80	100	120	mm
10	Repeatability [4]		80	80	80	80	80	80	µm
11	Precision [4]		200	220	240	260	280	300	µm
12	Acceleration [5]	$a_{e\ max.}$	198,0	148,5	127,3	101,8	91,4	82,9	m/s²
13	Speed [5] [6]	$v_{e\ max.}$	2,0	2,4	2,8	2,9	3,0	3,2	m/s
14	Thermal resistance	$R_{th\ 1}$ / $R_{th\ 2}$	3,2 / 20,0						K/W
15	Thermal time constant	τ_{w1} / τ_{w2}	11 / 624						s
16	Operating temperature range		– 20 ... +125						°C
17	Rod weight [7]	m_m	18	24	28	35	39	43	g
18	Total weight [7]	m_t	57	63	67	74	78	82	g
19	Magnetic pitch	τ_m	18						mm
20	Rod bearings		polymer sleeves						
21	Housing material		metal, non-magnetic						
22	Direction of movement		electronically reversible						

[1] thermal resistance $R_{th\ 2}$ by 55% reduced
[2] for max. 1 second with a duty cycle of 10%
[3] with sine wave commutation
[4] typical values with integrated linear Hall sensors (sin/cos) and Motion Controller Elmo "Whistle" SOL-WHI2.5/60I01.
The values depend on conditions of use
[5] theorical value, referring only to the motor
[6] with a triangular speed profile and the max. stroke
[7] rounded value, for reference only

Notes: These motors are for operation with DC-voltage < 75 V DC.
The given values are for free standing motors.
The mounting with magnetic conductive metal can influence the characteristics of the motor.
For more information about drive electronics, please contact your local sales representative.

Caution: Presence of strong magnetic fields. Static sensitive device.



LM 1247–020–12

Trapezoidal motion profile (t1 = t2 = t3)

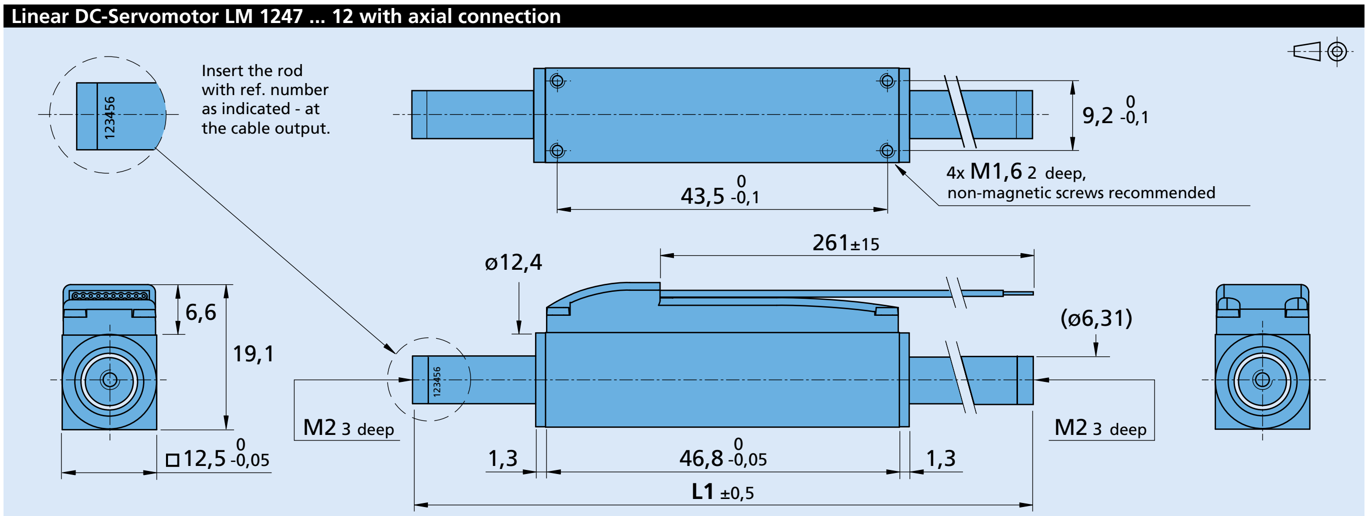
Displacement distance:	20 mm
Friction coefficient:	0,2
Slope angle:	0°
Rest time:	0,1 s

Load: The max. permissible load at a given speed with an external force of 0 N

External force: The max. permissible external force at a given speed with a load of:

- 0,1 Kg
- 0,2 Kg
- 0,5 Kg

Linear DC-Servomotor LM 1247 ... 12 with axial connection



LM 1247 ... 12

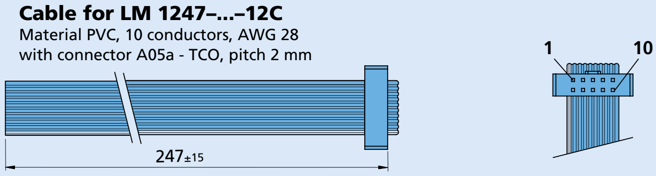
Ordering information

Linear DC-Servomotors Series	**Stroke** mm	**Rod length** L1 ±0,5 mm
LM 1247–020–12	– 10 … +10	82
LM 1247–040–12	– 20 … +20	109
LM 1247–060–12	– 30 … +30	127
LM 1247–080–12	– 40 … +40	154
LM 1247–100–12	– 50 … +50	172
LM 1247–120–12	– 60 … +60	190

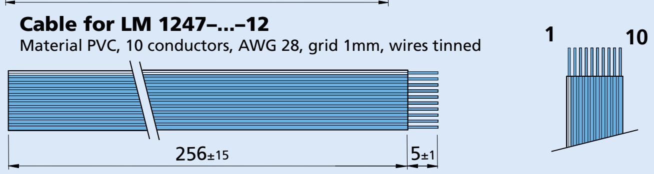
Note: Single rod available on request.

Cable and connection information

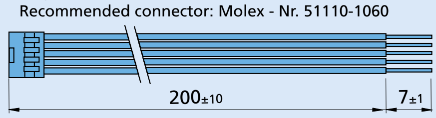
Cable for LM 1247–...–12C
Material PVC, 10 conductors, AWG 28
with connector A05a - TCO, pitch 2 mm



Cable for LM 1247–...–12
Material PVC, 10 conductors, AWG 28, grid 1mm, wires tinned



Cable for LM 1247–...–02
Single wires, material PVC, 10 conductors, AWG 28.
Recommended connector: Molex - Nr. 51110-1060



* The color reference refers only to the **LM 1247-...-02** version.

Connection

LM 1247–...–02

PIN	Function	Color*
1	Phase C	yellow
7	Phase B	orange
8	Phase A	brown
4	GND	black
3	+5V	red
2	Sin +	green
5	Sin -	blue
6	Cos +	grey
9	Cos -	white
10	N.C.	purple

LM 1247–...–12 / 12C

PIN	Function
1	Phase C
2	Phase B
3	Phase A
4	GND
5	+5V
6	Sin +
7	Sin -
8	Cos +
9	Cos -
10	N.C.

FAULHABER

Linear DC-Servomotors

with Analog Hall Sensors
QUICKSHAFT® Technology

9,2 N

For combination with
Drive Electronics:
Motion Controller

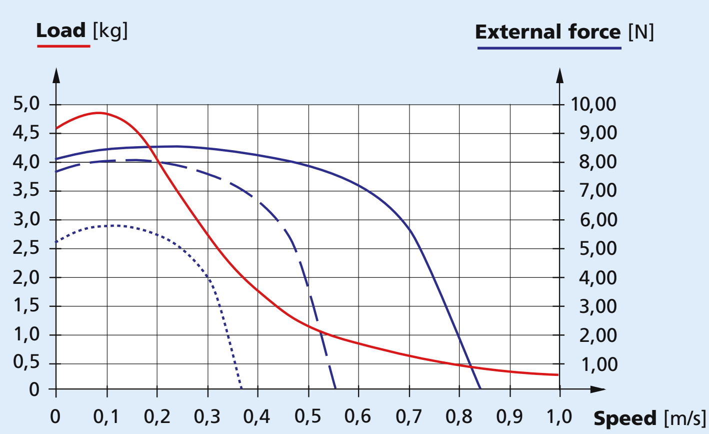
Series LM 2070 ... 11

		LM 2070–	040–11	080–11	120–11	160–11	220–11	
1	Continuous force 1)	$F_{e\ max.}$	9,2					N
2	Peak force 1) 2)	$F_{p\ max.}$	27,6					N
3	Continuous current 1)	$I_{e\ max.}$	0,79					A
4	Peak current 1) 2)	$I_{p\ max.}$	2,37					A
5	Back-EMF constant	k_E	9,5					V/m/s
6	Force constant 3)	k_F	11,64					N/A
7	Terminal resistance, phase-phase	R	10,83					Ω
8	Terminal inductance, phase-phase	L	1 125					µH
9	Stroke length	$s_{max.}$	40	80	120	160	220	mm
10	Repeatability 4)		60	60	60	60	80	µm
11	Precision 4)		200	300	400	500	600	µm
12	Acceleration 5)	$a_{e\ max.}$	93,9	65,7	54,8	46,0	36,8	m/s²
13	Speed 5) 6)	$v_{e\ max.}$	1,9	2,3	2,6	2,7	2,8	m/s
14	Thermal resistance	$R_{th\ 1}$ / $R_{th\ 2}$	3,1 / 9,3					K/W
15	Thermal time constant	τ_{w1} / τ_{w2}	30 / 1 200					s
16	Operating temperature range		– 20 ... +125					°C
17	Rod weight 7)	m_m	98	140	168	200	250	g
18	Total weight 7)	m_t	236	278	306	338	388	g
19	Magnetic pitch	τ_m	24					mm
20	Rod bearings		polymer sleeves					
21	Housing material		metal, non-magnetic					
22	Direction of movement		electronically reversible					

1) thermal resistance $R_{th\ 2}$ by 55% reduced
2) for max. 1 second with a duty cycle of 10%
3) with sine wave commutation
4) typical values with integrated linear Hall sensors and Motion Controller. The values depend on conditions of use
5) theorical value, referring only to the motor
6) with a triangular speed profile and the max. stroke
7) rounded value, for reference only

Notes: These motors are for operation with DC-voltage < 75 V DC.
The given values are for free standing motors.
The mounting with magnetic conductive metal can influence the characteristics of the motor.

Caution: Presence of strong magnetic fields. Static sensitive device.



LM 2070–040–11

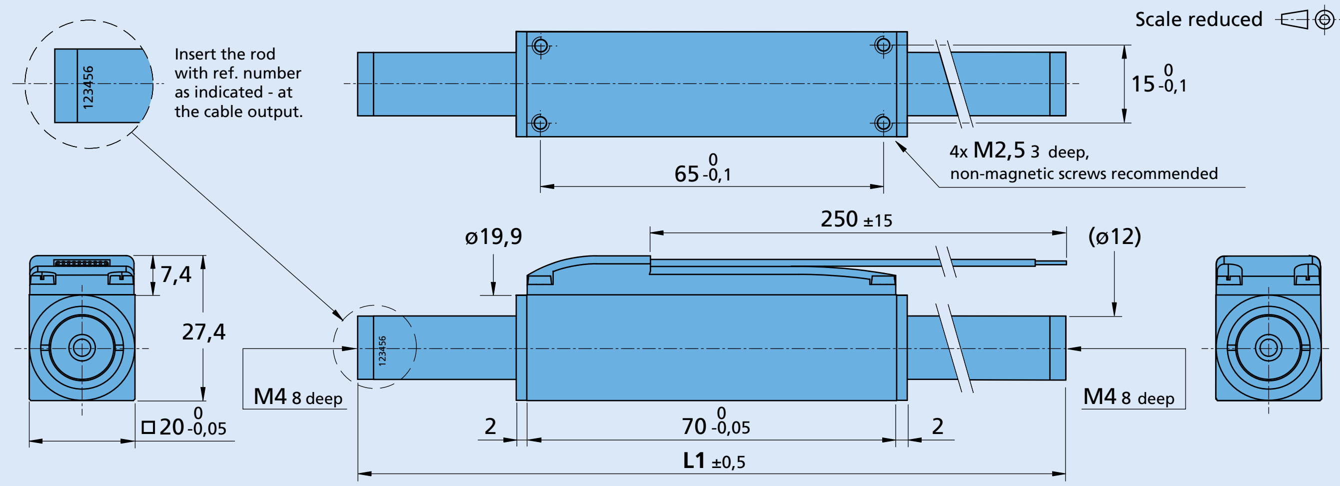
Trapezoidal motion profile (t1 = t2 = t3)

Displacement distance:	40 mm
Friction coefficient:	0,2
Slope angle:	0°
Rest time:	0,1 s

Load: The max. permissible load at a given speed with an external force of 0 N

External force: The max. permissible external force at a given speed with a load of:
- 0,5 Kg
- 1,0 Kg
- 2,0 Kg

Linear DC-Servomotor LM 2070 ... 11 with axial connection



LM 2070 ... 11

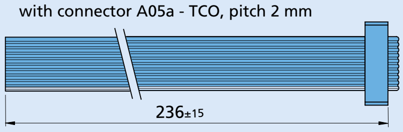
Ordering information

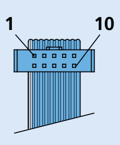
Linear DC-Servomotors Series	Stroke mm	Rod length L1 ±0,5 mm
LM 2070-040-11	- 20 … + 20	134
LM 2070-080-11	- 40 … + 40	182
LM 2070-120-11	- 60 … + 60	218
LM 2070-160-11	- 80 … + 80	254
LM 2070-220-11	- 110 … + 110	314

Note: Single rod available on request.

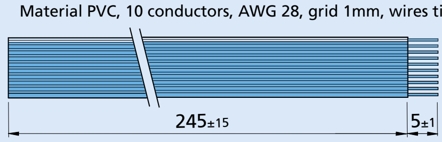
Cable and connection information

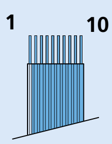
Cable for LM 2070–...–11C
Material PVC, 10 conductors, AWG 28
with connector A05a - TCO, pitch 2 mm



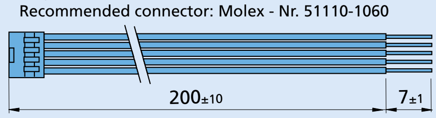


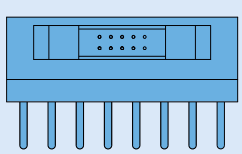
Cable for LM 2070–...–11
Material PVC, 10 conductors, AWG 28, grid 1mm, wires tinned





Cable for LM 2070–...–01
Single wires, material PVC, 10 conductors, AWG 28.
Recommended connector: Molex - Nr. 51110-1060





Adapter for LM 2070–...–11C
for connection with
Motion Controllers
MCLM 3006 S RS/CF
(part no. L12.90.02).

Connection
LM 2070–...–01

PIN	Function	Color*
1	Phase C	yellow
7	Phase B	orange
8	Phase A	brown
4	GND	black
3	+5V	red
6	Hall sensor C	grey
5	Hall sensor B	blue
2	Hall sensor A	green
9	N.C.	white
10	N.C.	purple

LM 2070–...–11 / 11C

PIN	Function
1	Phase C
2	Phase B
3	Phase A
4	GND
5	+5V
6	Hall sensor C
7	Hall sensor B
8	Hall sensor A
9	N.C.
10	N.C.

* The color reference refers only to the **LM 2070-...-01** version.

Linear DC-Servomotors

9,2 N

for sin/cos control
QUICKSHAFT® Technology

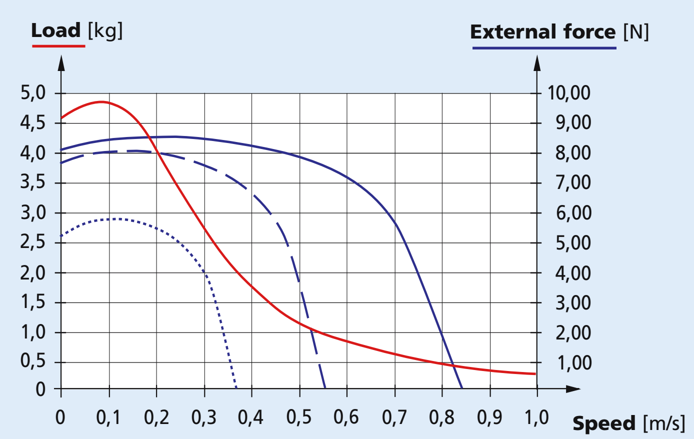
Series LM 2070 ... 12

		LM 2070–	040–12	080–12	120–12	160–12	220–12	
1	Continuous force [1]	$F_{e\,max.}$	9,2					N
2	Peak force [1) 2)]	$F_{p\,max.}$	27,6					N
3	Continuous current [1]	$I_{e\,max.}$	0,79					A
4	Peak current [1) 2)]	$I_{p\,max.}$	2,37					A
5	Back-EMF constant	k_E	9,5					V/m/s
6	Force constant [3]	k_F	11,64					N/A
7	Terminal resistance, phase-phase	R	10,83					Ω
8	Terminal inductance, phase-phase	L	1 125					µH
9	Stroke length	$s_{max.}$	40	80	120	160	220	mm
10	Repeatability [4]		100	100	100	100	120	µm
11	Precision [4]		500	600	700	800	900	µm
12	Acceleration [5]	$a_{e\,max.}$	93,9	65,7	54,8	46,0	36,8	m/s^2
13	Speed [5) 6)]	$v_{e\,max.}$	1,9	2,3	2,6	2,7	2,8	m/s
14	Thermal resistance	$R_{th\,1}$ / $R_{th\,2}$	3,1 / 9,3					K/W
15	Thermal time constant	τ_{w1} / τ_{w2}	30 / 1 200					s
16	Operating temperature range		– 20 ... +125					°C
17	Rod weight [7]	m_m	98	140	168	200	250	g
18	Total weight [7]	m_t	236	278	306	338	388	g
19	Magnetic pitch	τ_m	24					mm
20	Rod bearings		polymer sleeves					
21	Housing material		metal, non-magnetic					
22	Direction of movement		electronically reversible					

1) thermal resistance $R_{th\,2}$ by 55% reduced
2) for max. 1 second with a duty cycle of 10%
3) with sine wave commutation
4) typical values with integrated linear Hall sensors (sin/cos) and Motion Controller Elmo "Whistle" SOL-WHI2.5/60I01. The values depend on conditions of use
5) theorical value, referring only to the motor
6) with a triangular speed profile and the max. stroke
7) rounded value, for reference only

Notes: These motors are for operation with DC-voltage < 75 V DC.
The given values are for free standing motors.
The mounting with magnetic conductive metal can influence the characteristics of the motor.
For more information about drive electronics, please contact your local sales representative.

Caution: Presence of strong magnetic fields. Static sensitive device.



LM 2070–040–12

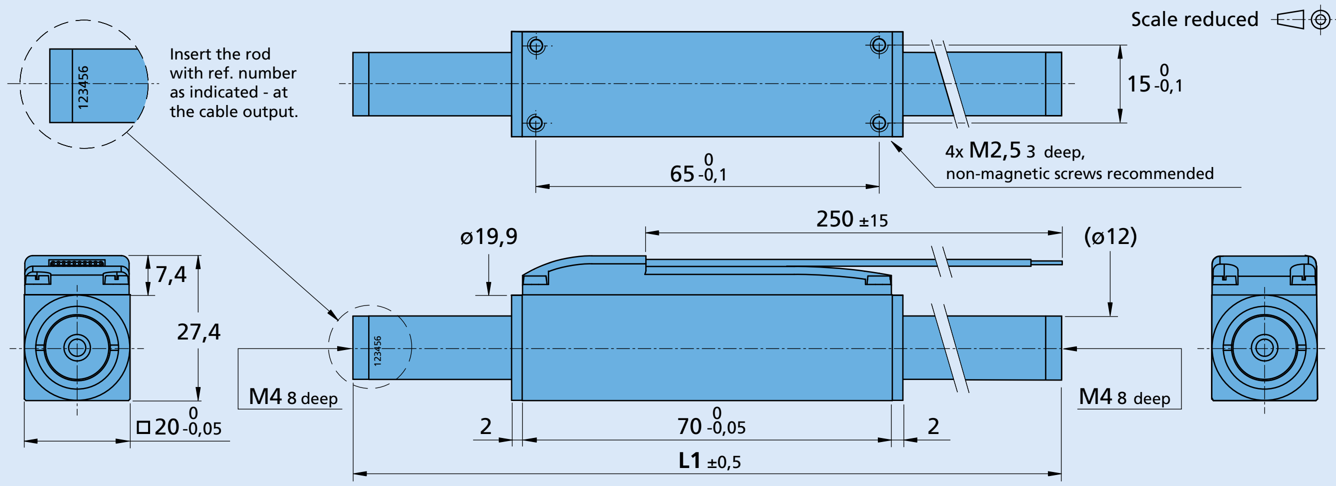
Trapezoidal motion profile (t1 = t2 = t3)

Displacement distance:	40 mm
Friction coefficient:	0,2
Slope angle:	0°
Rest time:	0,1 s

Load: The max. permissible load at a given speed with an external force of 0 N

External force: The max. permissible external force at a given speed with a load of:
- 0,5 Kg
- 1,0 Kg
- 2,0 Kg

Linear DC-Servomotor LM 2070 ... 12 with axial connection



LM 2070 ... 12

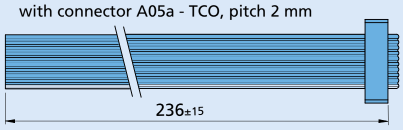
Ordering information

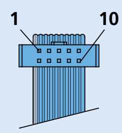
Linear DC-Servomotors Series	Stroke mm	Rod length L1 ±0,5 mm
LM 2070-040-12	- 20 … + 20	134
LM 2070-080-12	- 40 … + 40	182
LM 2070-120-12	- 60 … + 60	218
LM 2070-160-12	- 80 … + 80	254
LM 2070-220-12	- 110 … + 110	314

Note: Single rod available on request.

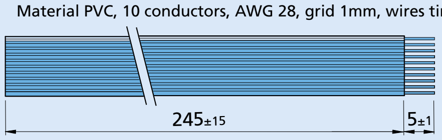
Cable and connection information

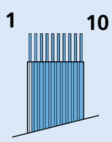
Cable for LM 2070–...–12C
Material PVC, 10 conductors, AWG 28
with connector A05a - TCO, pitch 2 mm



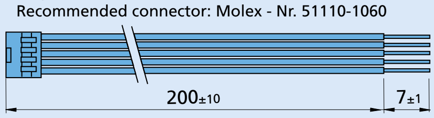


Cable for LM 2070–...–12
Material PVC, 10 conductors, AWG 28, grid 1mm, wires tinned





Cable for LM 2070–...–02
Single wires, material PVC, 10 conductors, AWG 28.
Recommended connector: Molex - Nr. 51110-1060



* The color reference refers only to the **LM 2070-...-02** version.

Connection

LM 2070–...–02

PIN	Function	Color*
1	Phase C	yellow
7	Phase B	orange
8	Phase A	brown
4	GND	black
3	+5V	red
2	Sin +	green
5	Sin -	blue
6	Cos +	grey
9	Cos -	white
10	N.C.	purple

LM 2070–...–12 / 12C

PIN	Function
1	Phase C
2	Phase B
3	Phase A
4	GND
5	+5V
6	Sin +
7	Sin -
8	Cos +
9	Cos -
10	N.C.

Precision Gearheads

WE CREATE MOTION

FAULHABER

Precision Gearheads

FAULHABER

WE CREATE MOTION

Precision Gearheads

Technical Information

General information

Life performance

The operational lifetime of a reduction gearhead and motor combination is determined by:

- Input speed
- Output torque
- Operating conditions
- Environment and Integration into other systems

Since a multitude of parameters prevail in any application, it is nearly impossible to state the actual lifetime that can be expected from a specific type of gearhead or motor-gearhead combination. A number of options to the standard reduction gearheads are available to increase life performance: ball bearings, all metal gears, reinforced lubrication etc.

Bearings – Lubrication

Gearheads are available with a range of bearings to meet various shaft loading requirements: sintered sleeve bearings, ball bearings and ceramic bearings. Where indicated, ball bearings are preloaded with spring washers of limited force to avoid excessive current consumption.

A higher axial shaft load or shaft pressfit force than specified in the data sheets will neutralise the preload on the ball bearings.

The satellite gears in the 38/1-2 Series Planetary Gearheads are individually supported on sintered sleeve bearings.
In the 44/1 Series, the satellite gears are individually supported on needle or ball bearings.

All bearings are lubricated for life. Relubrication is not necessary and not recommended. The use of non-approved lubricants on or around the gearheads or motors can negatively influence the function and life expectancy.

The standard lubrication of the reduction gears is such as to provide optimum life performance at minimum current consumption at no-load conditions. For extended life performance, all metal gears and heavy duty lubrication are available. Specially lubricated gearheads are available for operation at extended temperature environments and under vacuum.

Notes on technical data

Unspecified tolerances

Tolerances in accordance with ISO 2768 medium.

$\leq$ 6	=	± 0,1 mm
$\leq$ 30	=	± 0,2 mm
$\leq$ 120	=	± 0,3 mm

Input speed

The recommended maximum input speed for continuous operation serves as a guideline. It is possible to operate the gearhead at higher speeds. However, to obtain optimum life performance in applications that require continuous operation and long life, the recommended speed should be considered.

Ball bearings

Ratings on load and lifetime, if not stated, are according to the information from the ball bearing manufacturers.

Operating temperature range

Standard range as listed on the data sheets.
Special executions for extended temperature range available on request.

Reduction ratio

The listed ratios are nominal values only, the exact ratio for each reduction gearhead can be calculated by means of the stage ratio applicable for each type.

Output torque

Continuous operation.
The continuous torque provides the maximum load possible applied to the output shaft; exceeding this value will reduce the service life.

Intermittent operation.
The intermittent torque value may be applied for a short period. It should be for short intervals only and not exceed 5% of the continuous duty cycle.

Direction of rotation, reversible

All gearheads are designed for clockwise and counterclockwise rotation. The indication refers to the direction of rotation as seen from the shaft end, with the motor running in a clockwise direction.

Backlash

Backlash is defined by the amount by which the width of a tooth space exceeds the width of the engaging tooth on the pitch circle. Backlash is not to be confused with elasticity or torsional stiffness of the system.
The general purpose of backlash is to prevent gears from jamming when making contact on both sides of their teeth simultaneously. A small amount of backlash is desirable to provide for lubricant space and differential expansion between gear components. The backlash is measured on the output shaft, at the last geartrain stage.

Precision Gearheads

Technical Information

Zero Backlash Gearheads

The spur gearheads, series 08/3, 12/5, 15/8, 16/8 and 22/5, with dual pass geartrains feature zero backlash when preloaded with a FAULHABER DC-Micromotor.

Preloaded gearheads result in a slight reduction in overall efficiency and load capability.

Due to manufacturing tolerances, the preloaded gearheads could present higher and irregular internal friction torque resulting in higher and variable current consumption in the motor.

However, the unusual design of the FAULHABER zero backlash gearheads offers, with some compromise, an excellent and unique product for many low torque, high precision postioning applications.

The preloading, especially with a small reduction ratios, is very sensitive. This operation is achieved after a defined burn-in in both directions of rotation. For this reason, gearheads with pre-loaded zero backlash are only available when factory assembled to the motor.

The true zero backlash properties are maintained with new gearheads only. Depending on the application, a slight backlash could appear with usage when the gears start wearing. If the wearing is not excessive, a new preload could be considered to return to the original zero backlash properties.

Assembly instructions

It is strongly recommended to have the motors and gearheads factory assembled and tested. This will assure perfect matching and lowest current consumption.

The assembly of spur and hybrid gearheads with motors requires running the motor at very low speed to ensure the correct engagement of the gears without damage.

The planetary gearheads must not be assembled with the motor running. The motor pinion must be matched with the planetary input-stage gears to avoid misalignment before the motor is secured to the gearhead.

When face mounting any gearhead, care must be taken not to exceed the specified screw depth. Driving screws beyond this point will damage the gearhead. Gearheads with metal housing can be mounted using a radial set screw.

How to select a reduction gearhead

This section gives an example of a step-by-step procedure on how to select a reduction gearhead.

Application data

The basic data required for any given application are:

Required torque	M	[mNm]
Required speed	n	[rpm]
Duty cycle	δ	[%]
Available space, max.	diameter/length	[mm]
Shaft load	radial/axial	[N]

The assumed application data for the selected example are:

Output torque	M	=	120 mNm
Speed	n	=	30 rpm
Duty cycle	δ	=	100%
Space dimensions, max.	diameter	=	18 mm
	length	=	60 mm
Shaft load	radial	=	20 N
	axial	=	4 N

To simplify the calculation in this example, the duty cycle is assumed to be continuous operation.

Preselection

A reduction gearhead which has a continuous output torque larger than the one required in the application is selected from the catalogue.
If the required torque load is for intermittent use, the selection is based on the output torque for intermittent operation.
The shaft load, frame size and overall length with the motor must also meet the minimum requirements.
The product selected for this application is the planetary gearhead, type 16/7.

Output torque, continuous operation	$M_{max.}$	= 300 mNm
Recommended max. input speed for		
– Continuous operation	n	$\leq$ 5 000 rpm
– Shaft load, max.	radial	$\leq$ 30 N
	axial	$\leq$ 5 N

Calculation of the reduction ratio

To calculate the theoretical reduction ratio, the recommended input speed for continuous operation is divided by the required output speed.

$$i_N = \frac{\text{Recommended max. input speed}}{\text{required output speed}}$$

From the gearhead data sheet, a reduction ratio is selected which is equal to or less than the calculated one.

For this example, the reduction ratio selected is 159 : 1.

Calculation of the input speed n_{input}

$n_{input} = n \cdot i$	[rpm]
$n_{input} = 30 \cdot 159 = 4\,770$	rpm

Calculation of the input torque M_{input}

$$M_{input} = \frac{M \cdot 100}{i \cdot \eta} \quad [\text{mNm}]$$

The efficiency of this gearhead is 60%, consequently:

$$M_{input} = \frac{120 \cdot 100}{159 \cdot 60} = 1{,}26 \quad \text{mNm}$$

The values of

Input speed	n_{input}	= 4 770	rpm
and			
Input torque	M_{input}	= 1,26	mNm

are related to the motor calculation.

The motor suitable for the gearhead selected must be capable of producing at least two times the input torque needed.

For this example, the DC-Micromotor type 1624 E 024 S supplied with 14 V DC will produce the required speed and torque.

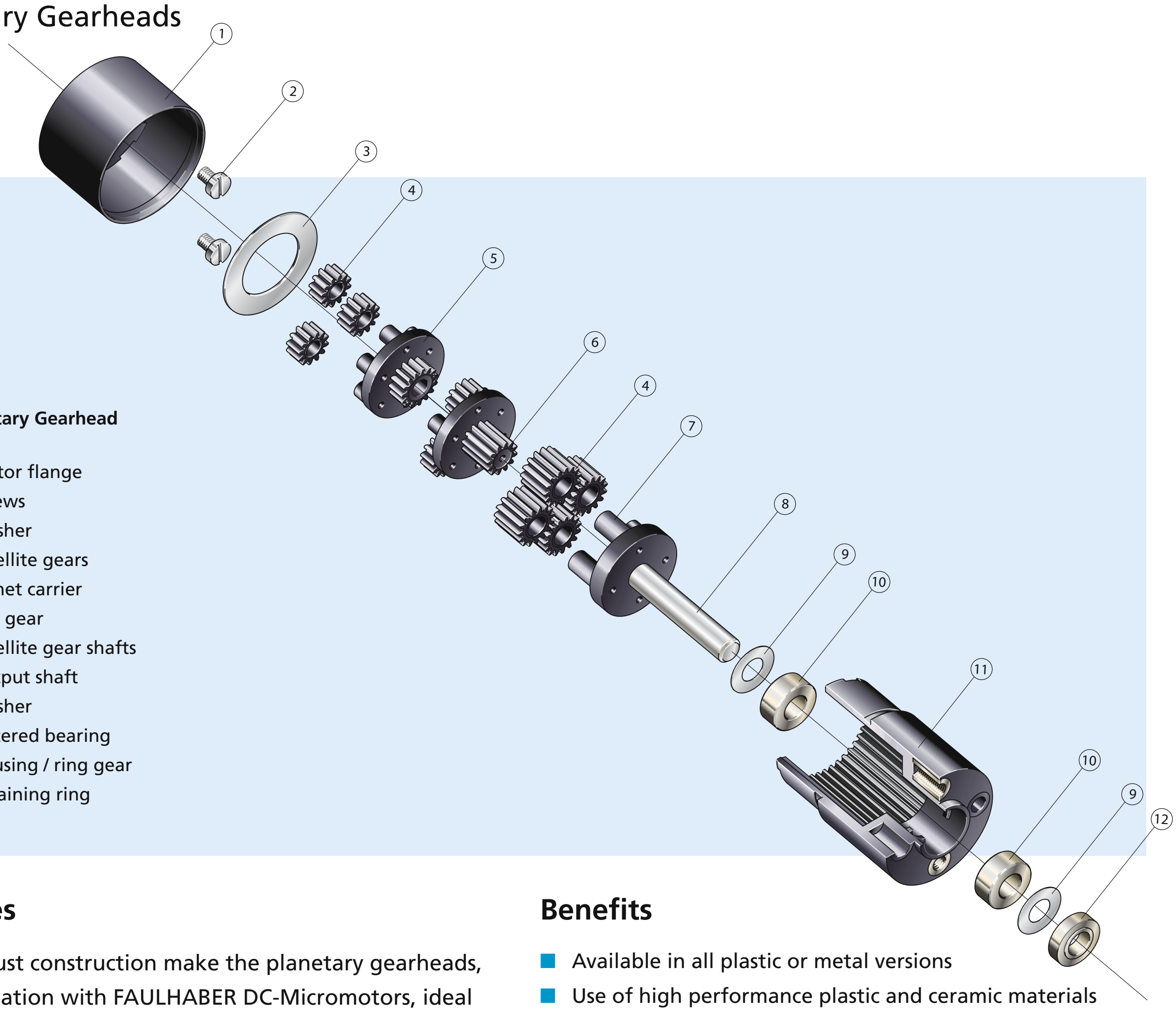
For practical applications, the calculation of the ideal motor-gearhead drive is not always possible.
Detailed values on torque and speed are usually not clearly defined.

It is recommended to select suitable components based on a first estimation, and then test the units in the application by varying the supply voltage until the required speed and torque are obtained.
Recording the applied voltage and current at the point of operation, along with the type numbers of the test assembly, we can help you to select the ideal motor-gearhead.

The success of your product will depend on the best possible selection being made!
For confirmation of your selection and peace of mind, please contact our sales engineers.

Precision Gearheads

Planetary Gearheads



Planetary Gearhead

① Motor flange
② Screws
③ Washer
④ Satellite gears
⑤ Planet carrier
⑥ Sun gear
⑦ Satellite gear shafts
⑧ Output shaft
⑨ Washer
⑩ Sintered bearing
⑪ Housing / ring gear
⑫ Retaining ring

Features

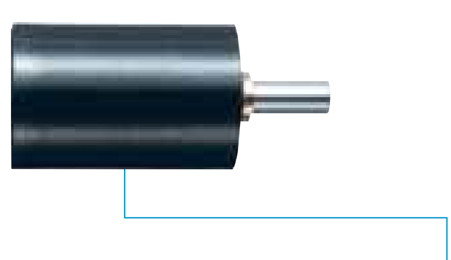
Their robust construction make the planetary gearheads, in combination with FAULHABER DC-Micromotors, ideal for high torque, high performance applications.
In most cases, the geartrain of the input stage is made of plastic to keep noise levels as low as possible at higher RPM's. All steel input gears as well as a modified lubrication are available for applications requiring very high torque, vacuum, or higher temperature compatability.

For applications requiring medium to high torque FAULHABER offers planetary gearheads constructed of high performance plastics. They are ideal solutions for applications where low weight and high torque density play a decisive role. The gearhead is mounted to the motor with a threaded flange to ensure a solid fit.

Benefits

- Available in all plastic or metal versions
- Use of high performance plastic and ceramic materials
- Available with a variety of shaft bearings including sintered, ceramic, and ball bearings
- Modified versions for extended temperature and special environmental conditions are available
- Custom modifications available

Product Code



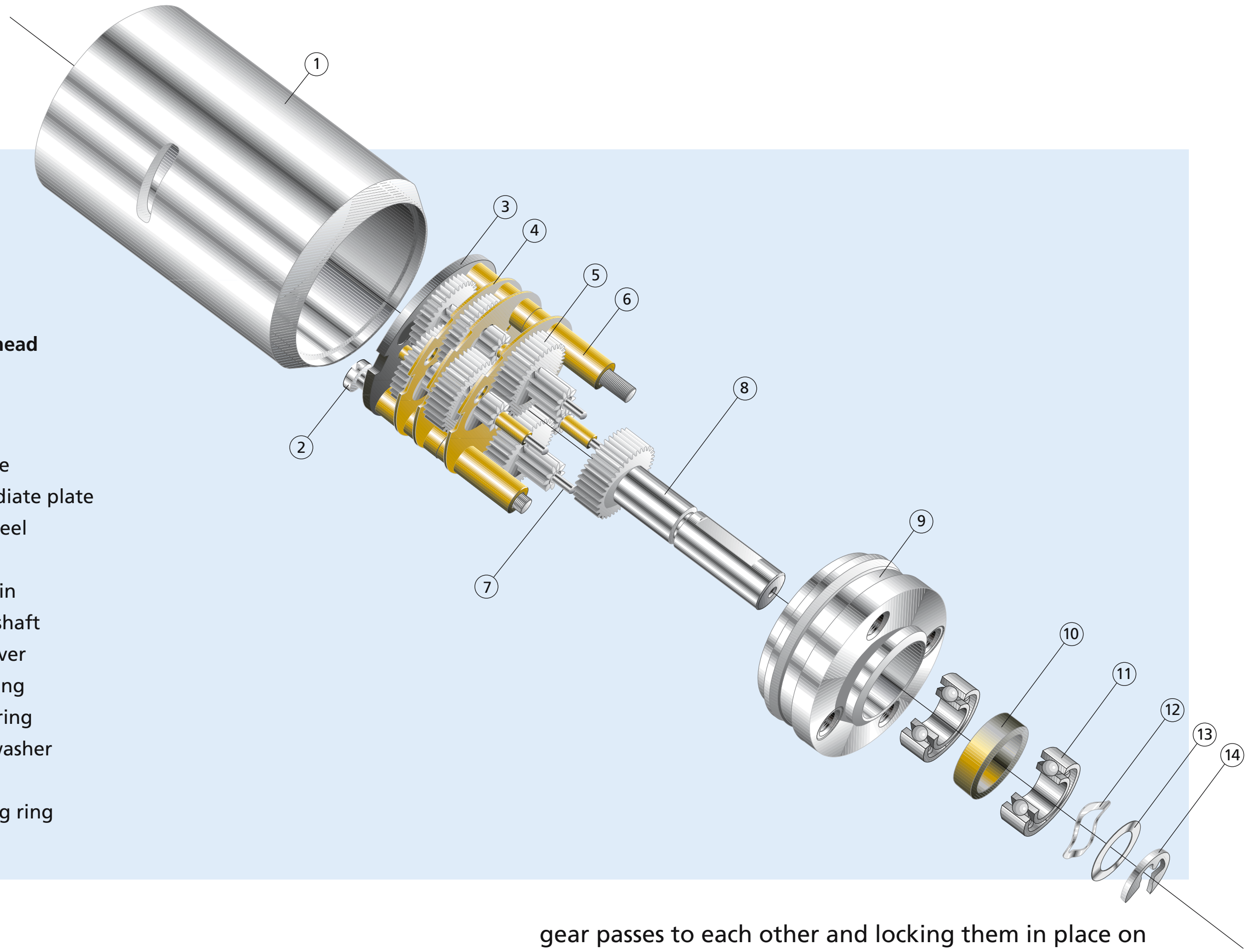
26	Outer diameter [mm]
A	Version
64:1	Reduction ratio

26A 64:1

All metal planetary gearhead series 12/4

Precision Gearheads

Spur Gearheads

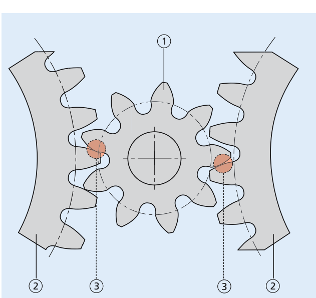


Spur Gearhead

① Housing
② Screws
③ End plate
④ Intermediate plate
⑤ Gear wheel
⑥ Sleeve
⑦ Dowel pin
⑧ Output shaft
⑨ Front cover
⑩ Spacer ring
⑪ Ball bearing
⑫ Spring washer
⑬ Washer
⑭ Retaining ring

Features

A wide range of high quality spur gearheads are available to compliment FAULHABER DC-Micromotors.
The all metal or plastic input-stage geartrain assures extremely quiet running. The precise construction of the gearhead causes very low current consumption in the motor, giving greater efficiency. The gearhead is sleeve mounted on the motor, providing a seamless in-line fit.
The FAULHABER Spur Gearheads are ideal for high precision, low torque and low noise applications.



Zero Backlash Spur Gearhead

① Motor pinion
② Dual-pass geartrain input stage
③ Zero backlash preloaded engagement

FAULHABER offers a special version of a spur gearhead with zero backlash. These gearheads consist of a dual pass spur geartrain with all metal gears. The backlash is reduced to a minimum by counter-rotating the two individual gear passes to each other and locking them in place on the motor pinion gear. They are ideal for positioning applications with a very high resolution and moderate torque. Zero backlash gearheads can only be delivered preloaded from the factory.

Benefits

- Available in a wide variety of reduction ratios including very high ratios
- Zero backlash versions are available
- Available with a variety of shaft bearings including sintered, ceramic, and ball bearings

Product Code

22	Outer diameter [mm]
/5	Version
377:1	Reduction ratio

22/5 377:1

Planetary Gearheads

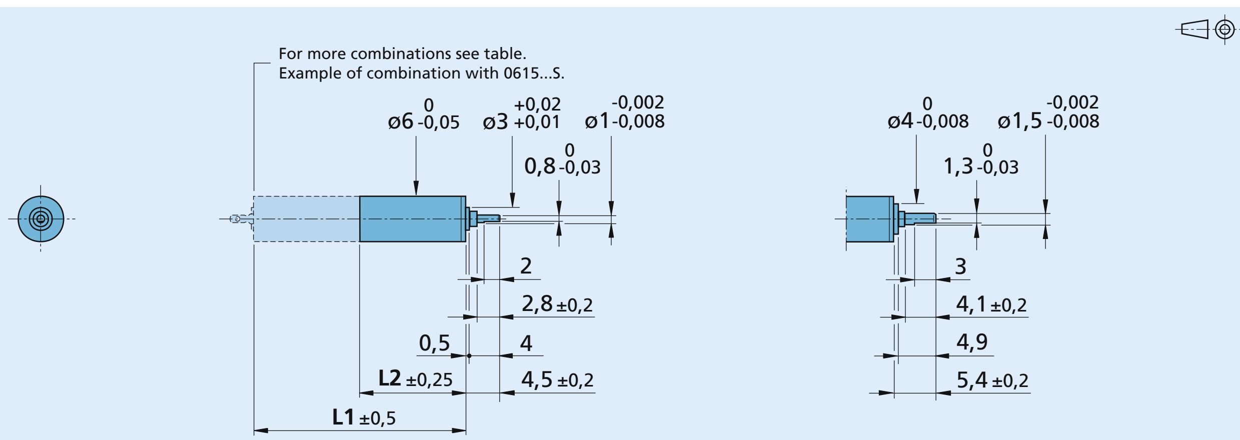
25 mNm

For combination with
DC-Micromotors
Brushless DC-Motors
Stepper Motors

Series 06/1

	06/1	06/1K
Housing material	steel	steel
Geartrain material	steel	steel
Recommended max. input speed for:		
– continuous operation	8 000 rpm	8 000 rpm
Backlash, at no-load	≤ 3 °	≤ 3 °
Bearings on output shaft	sintered bearings	ball bearings
Shaft load, max.:		
– radial (3,5 mm from mounting face)	≤ 0,5 N	≤ 5 N
– axial	≤ 0,5 N	≤ 3 N
Shaft press fit force, max.	≤ 3,5 N	≤ 5 N
Shaft play		
– radial (3,5 mm from mounting face)	≤ 0,06 mm	≤ 0,06 mm
– axial	≤ 0,1 mm	≤ 0,05 mm
Operating temperature range	- 30 ... + 100 °C	- 30 ... + 100 °C

Specifications							
Number of gear stages		**1**	**2**	**3**	**4**	**5**	**6**
Continuous torque	mNm	25	25	25	25	25	25
Intermittent torque	mNm	35	35	35	35	35	35
Mass without motor, ca.	g	2	2,8	3,4	4	4,4	5
Efficiency, max.	%	90	80	70	60	55	48
Direction of rotation, drive to output		=	=	=	=	=	=
Reduction ratio (exact)		**4:1**	**16:1**	**64:1**	**256:1**	**1 024:1**	**4 096:1**
L2 [mm] = length without motor		9,2	11,9	14,6	17,3	20,0	22,7
L1 [mm] = length with motor	0615C...S	24,2	26,9	29,6	32,3	35,0	37,7
	0620C...B	29,2	31,9	34,6	37,3	40,0	42,7
	ADM0620...-05	18,8	21,5	24,2	26,9	29,6	32,3



06/1

06/1 K (L1, L2 = +1)

Planetary Gearheads

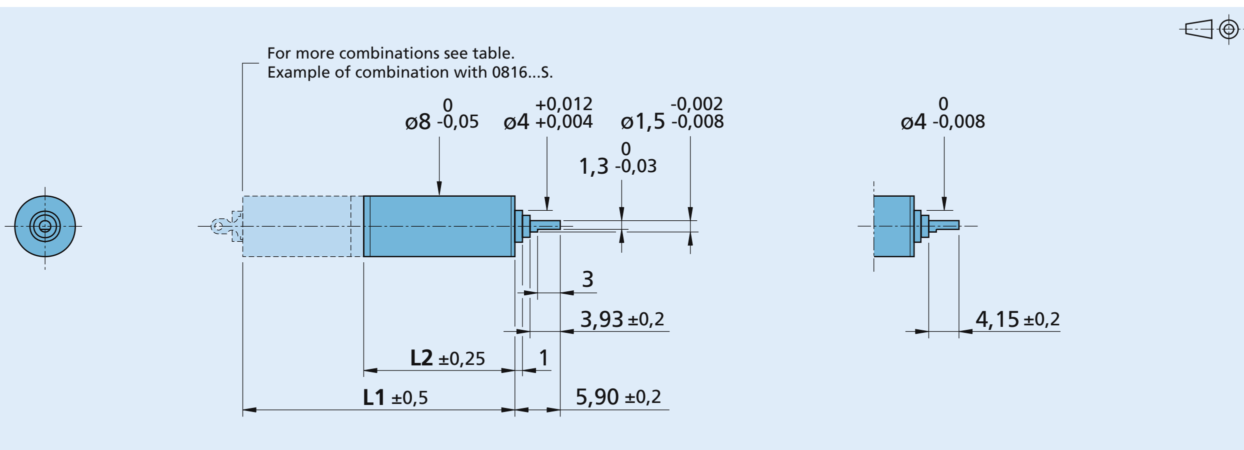
60 mNm

For combination with
DC-Micromotors
Brushless DC-Motors
Stepper Motors

Series 08/1

	08/1	08/1K
Housing material	metal	metal
Geartrain material	steel	steel
Recommended max. input speed for:		
– continuous operation	8 000 rpm	8 000 rpm
Backlash, at no-load	≤ 3 °	≤ 3 °
Bearings on output shaft	sintered bearings	ball bearings
Shaft load, max.:		
– radial (4,5 mm from mounting face)	≤ 0,8 N	≤ 5 N
– axial	≤ 1 N	≤ 3 N
Shaft press fit force, max.	≤ 5 N	≤ 5 N
Shaft play		
– radial (4,5 mm from mounting face)	≤ 0,06 mm	≤ 0,06 mm
– axial	≤ 0,1 mm	≤ 0,05 mm
Operating temperature range	- 30 ... + 100 °C	- 30 ... + 100 °C

Specifications							
Number of gear stages		1	2	3	4	5	6
Continuous torque	mNm	60	60	60	60	60	60
Intermittent torque	mNm	120	120	120	120	120	120
Mass without motor, ca.	g	2,9	3,8	4,6	5,4	6,3	7,1
Efficiency, max.	%	90	80	70	60	55	48
Direction of rotation, drive to output		=	=	=	=	=	=
Reduction ratio (exact)		**4:1**	**16:1**	**64:1**	**256:1**	**1 024:1**	**4 096:1**
L2 [mm] = length without motor		9,6	12,3	15,0	17,7	20,4	23,1
L1 [mm] = length with motor	0816P...SR	25,5	28,2	30,9	33,6	36,3	39,0
	0824P...B	33,7	36,4	39,1	41,8	44,5	47,2
	AM0820...-08	23,4	26,1	28,8	31,5	34,2	36,9



08/1 **08/1 K**

Spur Gearheads

15 mNm

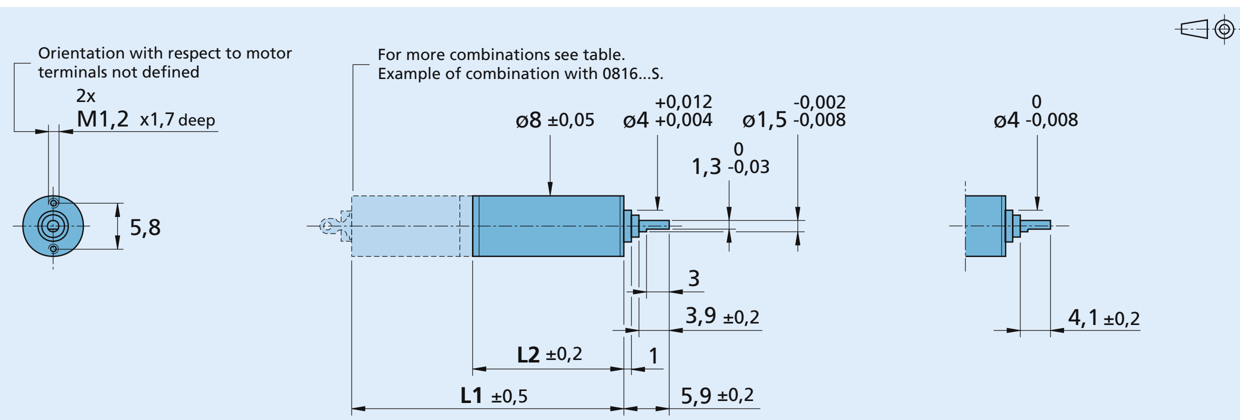
For combination with
DC-Micromotors
Brushless DC-Motors
Stepper Motors

Series 08/2

	08/2	08/2K
Housing material	metal	metal
Geartrain material	metal	metal
Recommended max. input speed for:		
– continuous operation	8 000 rpm	8 000 rpm
Backlash, at no-load	≤ 5 °	≤ 5 °
Bearings on output shaft	sintered bearings	ball bearings
Shaft load, max.:		
– radial (4,5 mm from mounting face)	≤ 0,8 N	≤ 5 N
– axial	≤ 1 N	≤ 3 N
Shaft press fit force, max.	≤ 5 N	≤ 5 N
Shaft play		
– radial (4,5 mm from mounting face)	≤ 0,06 mm	≤ 0,06 mm
– axial	≤ 0,1 mm	≤ 0,05 mm
Operating temperature range	- 30 ... + 100 °C	- 30 ... + 100 °C

Specifications										
Number of gear stages			**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Continuous torque		mNm	15	15	15	15	15	15	15	15
Intermittent torque		mNm	25	25	25	25	25	25	25	25
Mass without motor, ca.		g	3,2	3,4	3,6	3,8	4	4,2	4,4	4,6
Efficiency, max.		%	94	90	86	81	77	74	70	66
Direction of rotation, drive to output			=	≠	=	≠	=	≠	=	≠
Reduction ratio [1] (rounded)			**4:1**	**9,4:1**	**21,9:1**	**51,2:1**	**120:1**	**279:1**	**650:1**	**1 518:1**
L2 [mm] = length without motor			12,0	13,4	15,2	17,0	18,8	20,6	22,4	24,2
L1 [mm] = length with motor	0816D...SR		27,9	29,3	31,1	32,9	34,7	36,5	38,3	40,1
	0824D...B		36,1	37,5	39,3	41,1	42,9	44,7	46,5	48,3
	AM0820...-12		25,8	27,2	29,0	30,8	32,6	34,4	36,2	38,0

[1] The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.



08/2 **08/2 K**

FAULHABER

Spur Gearheads

Zero Backlash

15 mNm

For combination with
DC-Micromotors
Brushless DC-Motors
Stepper Motors

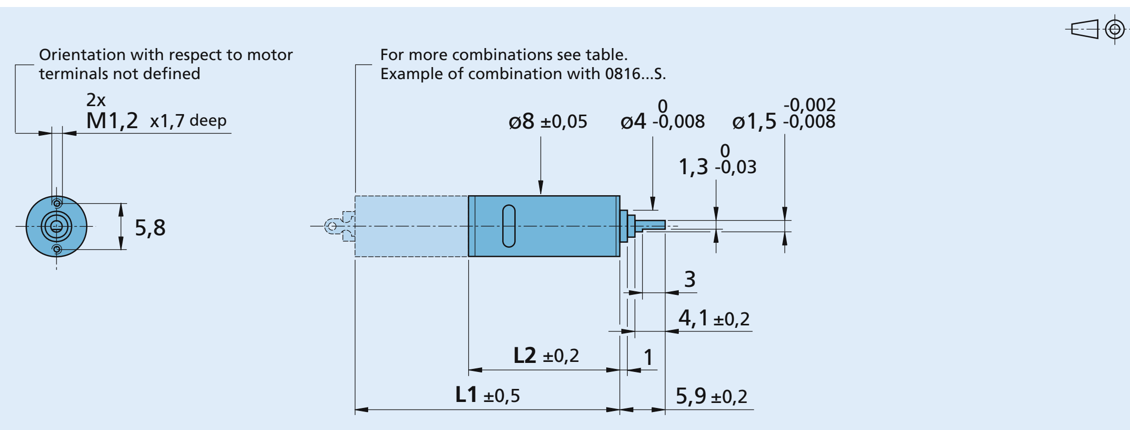
Series 08/3

	08/3
Housing material	metal
Geartrain material	metal
Recommended max. input speed for:	
– continuous operation	8 000 rpm
Backlash, at no-load	0 °
Bearings on output shaft	ball bearings
Shaft load, max.:	
– radial (4,5 mm from mounting face)	≤ 5 N
– axial	≤ 3 N
Shaft press fit force, max.	≤ 5 N
Shaft play	
– radial (4,5 mm from mounting face)	≤ 0,06 mm
– axial	≤ 0,05 mm
Operating temperature range	- 30 ... + 100 °C

Specifications						
Number of gear stages			**6**	**7**	**8**	**9**
Continuous torque		mNm	15	15	15	15
Intermittent torque		mNm	25	25	25	25
Mass without motor, ca.		g	4,5	4,9	5,3	5,7
Efficiency, max.			-	-	-	-
Direction of rotation, drive to output			=	≠	=	≠
Reduction ratio [1] (rounded)			**120:1**	**279:1**	**650:1**	**1 518:1**
L2 [mm] = length without motor			18,8	20,6	22,4	24,2
L1 [mm] = length with motor	0816D...SR		34,7	36,5	38,3	40,1
	0824D...B		42,9	44,7	46,5	48,3
	AM0820...-12		32,6	34,4	36,2	38,0

[1] The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.

Note: These gearheads are available only with motors mounted.



08/3

Planetary Gearheads

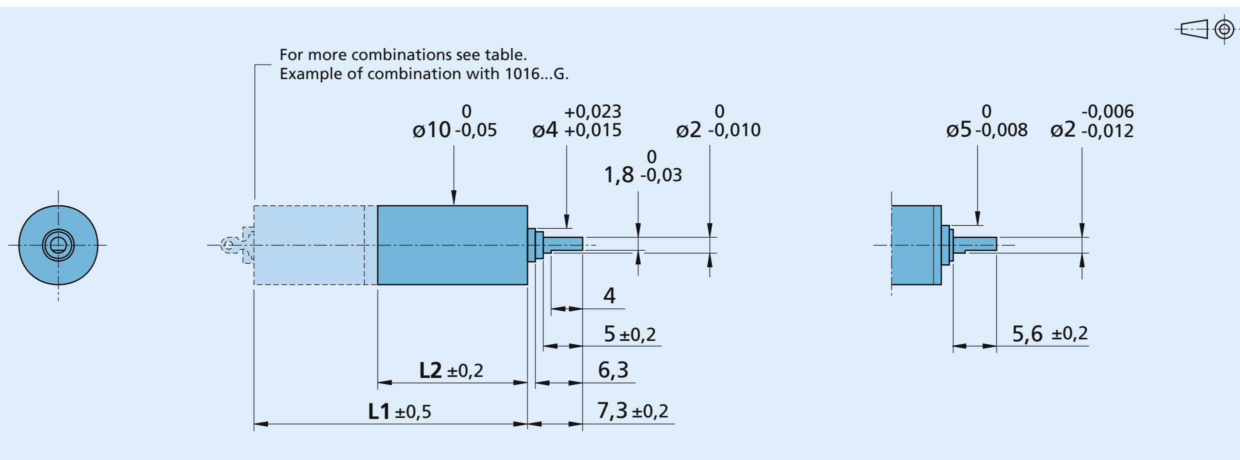
0,1 Nm

For combination with
DC-Micromotors
Brushless DC-Motors
Stepper Motors

Series 10/1

	10/1	10/1K
Housing material	metal	metal
Geartrain material	steel	steel
Recommended max. input speed for:		
– continuous operation	5 000 rpm	5 000 rpm
Backlash, at no-load	≤ 3 °	≤ 3 °
Bearings on output shaft	sintered bearings	ball bearings, preloaded
Shaft load, max.:		
– radial (5 mm from mounting face)	≤ 1 N	≤ 7 N
– axial	≤ 2 N	≤ 5 N
Shaft press fit force, max.	≤ 10 N	≤ 5 N
Shaft play		
– radial (5 mm from mounting face)	≤ 0,06 mm	≤ 0,04 mm
– axial	≤ 0,1 mm	= 0 mm
Operating temperature range	- 30 ... + 100 °C	- 30 ... + 100 °C

Specifications							
Number of gear stages		1	2	3	4	5	6
Continuous torque	mNm	5	15	54	100	100	100
Intermittent torque	mNm	200	200	200	200	200	200
Mass without motor, ca.	g	6	7	8	10	11	13
Efficiency, max.	%	90	80	70	60	55	48
Direction of rotation, drive to output		=	=	=	=	=	=
Reduction ratio (exact)		4:1	16:1	64:1	256:1	1 024:1	4 096:1
L2 [mm] = length without motor		9,7	12,8	15,9	19,0	22,1	25,2
L1 [mm] = length with motor	0816M...SR	25,6	28,7	31,8	34,9	38,0	41,1
	1016M...G	25,4	28,5	31,6	34,7	37,8	40,9
	1024M...S	33,4	36,5	39,6	42,7	45,8	48,9
	1219M...G	28,4	31,5	34,6	37,7	40,8	43,9
	1224M...SR	33,9	37,0	40,1	43,2	46,3	49,4
	0824M...B	33,8	36,9	40,0	43,1	46,2	49,3
	1028M...B	37,8	40,9	44,0	47,1	50,2	53,3
	1218M...B	27,7	30,8	33,9	37,0	40,1	43,2
	1226M...B	35,7	38,8	41,9	45,0	48,1	51,2
	ADM1220S...-55	27,1	30,2	33,3	36,4	39,5	42,6
	AM0820...-10	23,5	26,6	29,7	32,8	35,9	39,0
	AM1020...-08	25,6	28,7	31,8	34,9	38,0	41,1



10/1

10/1 K (L1, L2 = +1)

For notes on technical data and lifetime performance refer to „Technical Information“.
Edition 2014

Spur Gearheads

0,03 Nm

For combination with
DC-Micromotors
Brushless DC-Motors
Stepper Motors

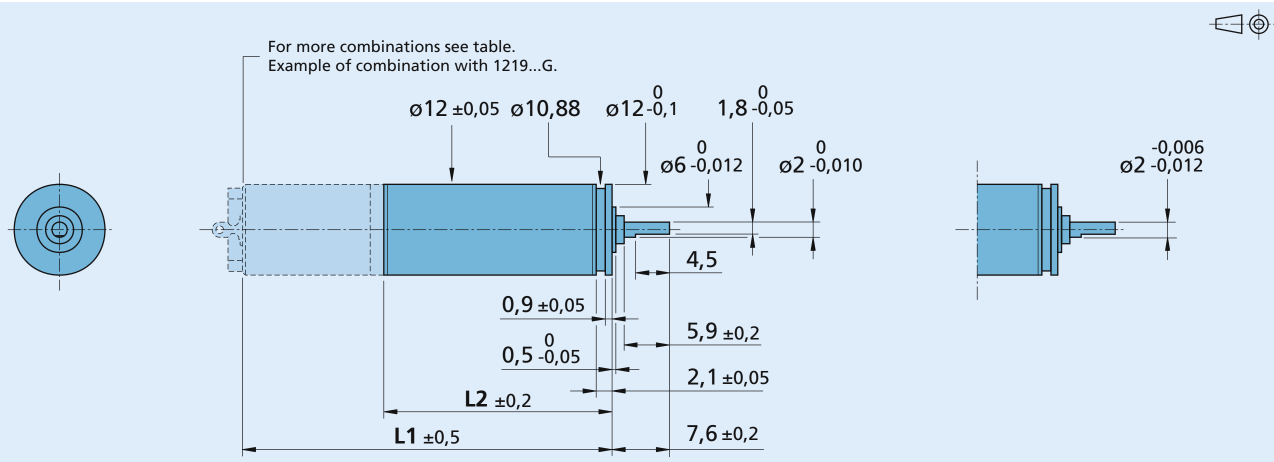
Series 12/3

	12/3	12/3K
Housing material	metal	metal
Geartrain material	metal	metal
Recommended max. input speed for:		
– continuous operation	5 000 rpm	5 000 rpm
Backlash, at no-load	≤ 3 °	≤ 3 °
Bearings on output shaft	sintered bearings	ball bearings
Shaft load, max.:		
– radial (4,5 mm from mounting face)	≤ 3 N	≤ 5 N
– axial	≤ 2 N	≤ 10 N
Shaft press fit force, max.	≤ 10 N	≤ 10 N
Shaft play		
– radial (4,5 mm from mounting face)	≤ 0,06 mm	≤ 0,08 mm
– axial	≤ 0,1 mm	≤ 0,05 mm
Operating temperature range	- 30 ... + 100 °C	- 30 ... + 100 °C

Specifications											
Number of gear stages		**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Continuous torque	mNm	6	8	10	20	30	30	30	30	30
Intermittent torque	mNm	100	100	100	100	100	100	100	100	100
Mass without motor, ca.	g	9	10	11	12	13	14	15	16	17
Efficiency, max.	%	90	86	81	77	74	70	66	63	60
Direction of rotation, drive to output		≠	=	≠	=	≠	=	≠	=	≠
Reduction ratio [1] (rounded)		**9,17:1**	**20,6:1**	**46,4:1**	**104,4:1**	**235:1**	**529:1**	**1 190:1**	**2 677:1**	**6 023:1**
L2 [mm] = length without motor		15,4	17,5	19,6	21,7	23,8	25,9	28,0	30,1	32,2
L1 [mm] = length with motor	1016E...G	31,1	33,2	35,3	37,4	39,5	41,6	43,7	45,8	47,9
	1024E...S	39,1	41,2	43,3	45,4	47,5	49,6	51,7	53,8	55,9
	1219E...G	34,1	36,2	38,3	40,4	42,5	44,6	46,7	48,8	50,9
	1224E...SR	39,6	41,7	43,8	45,9	48,0	50,1	52,2	54,3	56,4
	1028E...B	43,5	45,6	47,7	49,8	51,9	54,0	56,1	58,2	60,3
	1218E...B	33,4	35,5	37,6	39,7	41,8	43,9	46,0	48,1	50,2
	1226E...B	41,4	43,5	45,6	47,7	49,8	51,9	54,0	56,1	58,2
	ADM1220S...-57	32,8	34,9	37,0	39,1	41,2	43,3	45,4	47,5	49,6

[1] The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.

Note: Reduction ratios from 13 552:1 to 154 368:1 are available on request.



12/3 **12/3 K** (L1, L2 = +1)

Precision Gearheads

Planetary Gearheads

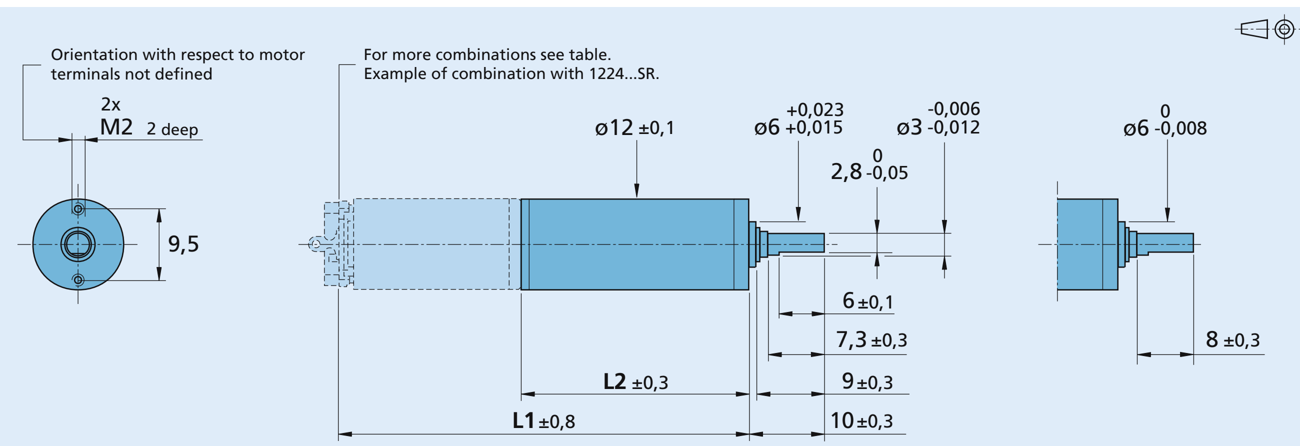
0,3 Nm

For combination with
DC-Micromotors
Brushless DC-Motors
Stepper Motors

Series 12/4

	12/4	12/4K
Housing material	metal	metal
Geartrain material	metal	metal
Recommended max. input speed for:		
– continuous operation	5 000 rpm	5 000 rpm
Backlash, at no-load	≤ 3 °	≤ 3 °
Bearings on output shaft	sintered bearings	ball bearings, preloaded
Shaft load, max.:		
– radial (6 mm from mounting face)	≤ 4 N	≤ 20 N
– axial	≤ 3 N	≤ 5 N
Shaft press fit force, max.	≤ 15 N	≤ 5 N
Shaft play		
– radial (6 mm from mounting face)	≤ 0,05 mm	≤ 0,04 mm
– axial	≤ 0,1 mm	= 0 mm
Operating temperature range	- 30 ... + 100 °C	- 30 ... + 100 °C

Specifications						
Number of gear stages		**1**	**2**	**3**	**4**	**5**
Continuous torque	mNm	300	300	300	300	300
Intermittent torque	mNm	450	450	450	450	450
Mass without motor, ca.	g	12	15	18	21	24
Efficiency, max.	%	90	80	70	60	55
Direction of rotation, drive to output		=	=	=	=	=
Reduction ratio (exact)		**4:1**	**16:1**	**64:1**	**256:1**	**1 024:1**
L2 [mm] = length without motor		15,1	19,7	24,3	28,9	33,5
L1 [mm] = length with motor	1024A...S	38,8	43,4	48,0	52,6	57,2
	1224A...SR	39,3	43,9	48,5	53,1	57,7
	1028A...B	43,2	47,8	52,4	57,0	61,6
	1218A...B	33,1	37,7	42,3	46,9	51,5
	1226A...B	41,1	45,7	50,3	54,9	59,5
	ADM1220S...-59	32,5	37,1	41,7	46,3	50,9



12/4 **12/4 K**

Spur Gearheads

Zero Backlash

0,03 Nm

For combination with
DC-Micromotors
Brushless DC-Motors
Stepper Motors

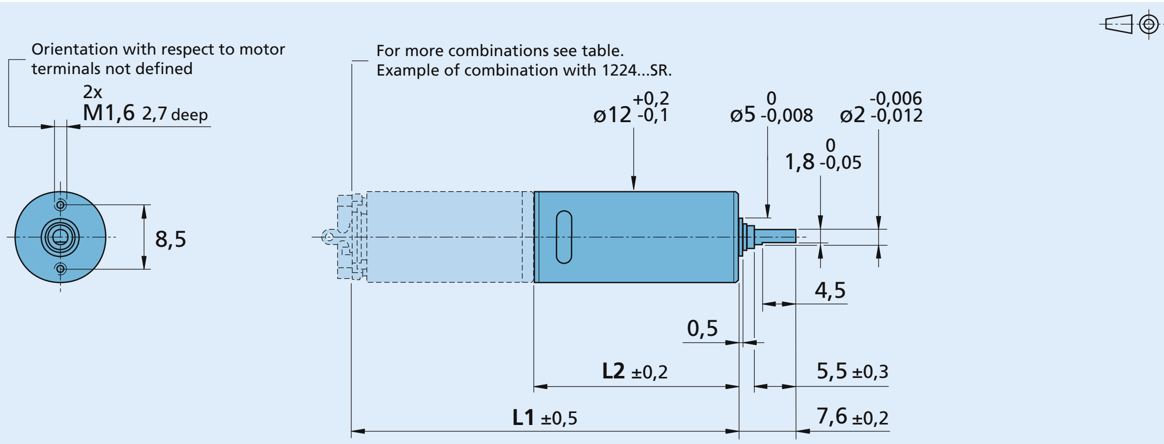
Series 12/5

	12/5
Housing material	metal
Geartrain material	metal
Recommended max. input speed for:	
– continuous operation	5 000 rpm
Backlash, at no-load	0 °
Bearings on output shaft	ball bearings, preloaded
Shaft load, max.:	
– radial (4,5 mm from mounting face)	≤ 5 N
– axial	≤ 5 N
Shaft press fit force, max.	≤ 10 N
Shaft play	
– radial (4,5 mm from mounting face)	≤ 0,04 mm
– axial	= 0 mm
Operating temperature range	- 30 ... + 100 °C

Specifications						
Number of gear stages		**5**	**6**	**7**	**8**	**9**
Continuous torque	mNm	30	30	30	30	30
Intermittent torque	mNm	100	100	100	100	100
Mass without motor, ca.	g	11	12	13	14	15
Efficiency, max.		-	-	-	-	-
Direction of rotation, drive to output		≠	=	≠	=	≠
Reduction ratio [1] (rounded)		**69,2:1**	**161:1**	**377:1**	**879:1**	**2 050:1**
L2 [mm] = length without motor		18,7	20,8	22,9	25,0	27,1
L1 [mm] = length with motor	1024E...S	42,4	44,5	46,6	48,7	50,8
	1224E...SR	42,9	45,0	47,1	49,2	51,3
	1028E...B	46,8	48,9	51,0	53,1	55,2
	1218E...B	36,7	38,8	40,9	43,0	45,1
	1226E...B	44,7	46,8	48,9	51,0	53,1
	ADM1220S...-57	36,1	38,2	40,3	42,4	44,5
	AM1020...-10	34,6	36,7	38,8	40,9	43,0

[1] The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.

Note: These gearheads are available only with motors mounted.



12/5

Planetary Gearheads

0,18 Nm

For combination with
DC-Micromotors

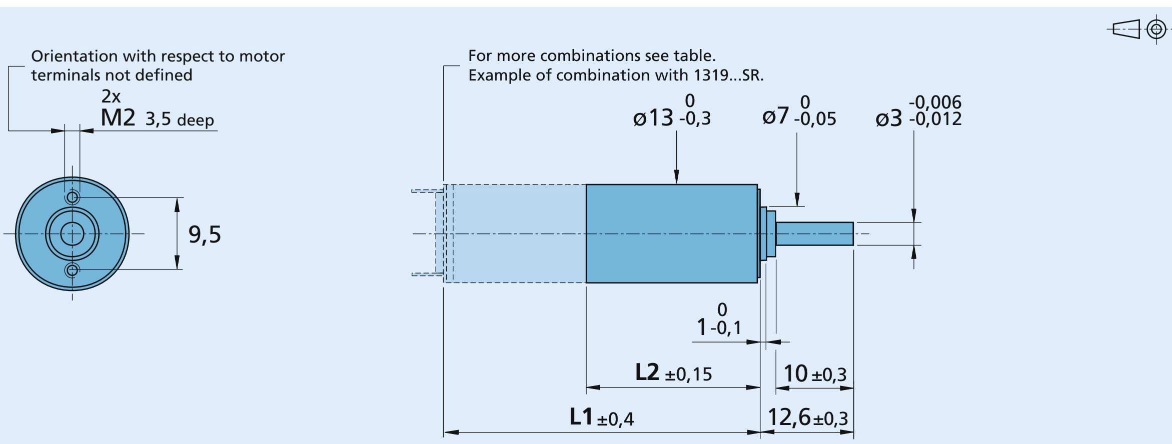
Series 13A

	13A	13AC	13AK
Housing material	plastic/aluminium	plastic/aluminium	plastic/aluminium
Geartrain material	plastic	plastic	plastic
Recommended max. input speed for:			
– continuous operation	5 000 rpm	5 000 rpm	5 000 rpm
Backlash, at no-load	≤ 4 °	≤ 4 °	≤ 4 °
Bearings on output shaft	sintered bearings	ceramic bearings	ball bearings
Shaft load, max.:			
– radial (5 mm from mounting face)	≤ 3 N	≤ 10 N	≤ 15 N
– axial	≤ 1 N	≤ 2 N	≤ 5 N
Shaft press fit force, max.	≤ 10 N	≤ 10 N	≤ 10 N
Shaft play			
– radial (5 mm from mounting face)	≤ 0,06 mm	≤ 0,08 mm	≤ 0,09 mm
– axial	≤ 0,25 mm	≤ 0,25 mm	≤ 0,25 mm
Operating temperature range	- 30 ... + 65 °C	- 20 ... + 85 °C	- 30 ... + 85 °C

Specifications					
Number of gear stages		**2**	**3**	**4**	**5**
Continuous torque	mNm	100	100	150	180
Intermittent torque	mNm	150	150	180	220
Mass without motor, ca.	g	5	5	5	6
Efficiency, max.	%	80	72	64	55
Direction of rotation, drive to output		=	=	=	=
Reduction ratio [1] (rounded)		**16:1**	**50:1** **64:1**	**158:1** **201:1** **256:1**	**497:1** **632:1** **805:1** **1 024:1**
L2 [mm] = length without motor		18,8	22,0	25,2	28,4
L1 [mm] = length with motor	1319C...SR	38,0	41,2	44,4	47,6
	1331C...SR	50,0	53,2	56,4	59,6
	1336C...CXR	53,8	57,0	60,2	63,4

[1] The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.

Note: These gearheads are available only with motors mounted.
Vibrational load of up to 5 g at frequencies up to 500 Hz will not limit the function of the motor-gearhead combinations.



13A, 13AC, 13AK

FAUHABER

Planetary Gearheads

0,3 Nm

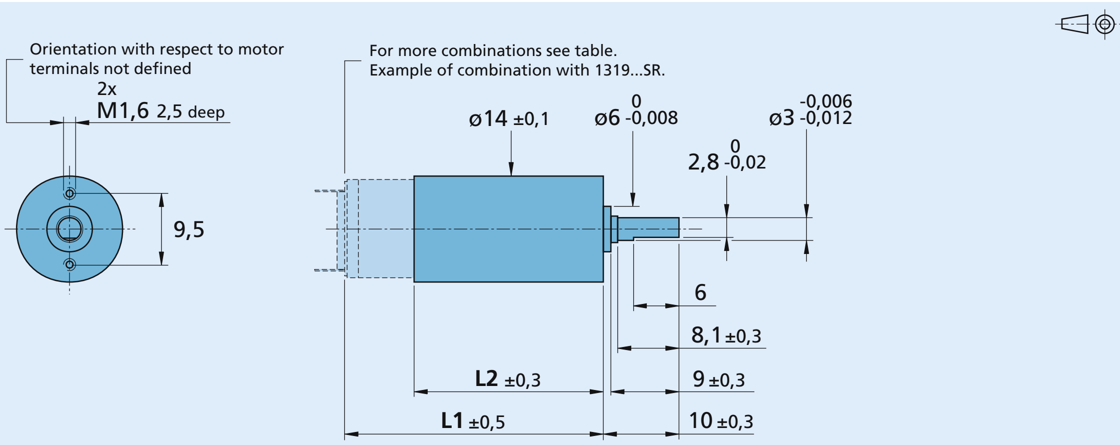
For combination with
DC-Micromotors

Series 14/1

	14/1
Housing material	metal
Geartrain material	steel
Recommended max. input speed for:	
– continuous operation	5 000 rpm
Backlash, at no-load	≤ 1 °
Bearings on output shaft	ball bearings, preloaded
Shaft load, max.:	
– radial (6,5 mm from mounting face)	≤ 20 N
– axial	≤ 5 N
Shaft press fit force, max.	≤ 15 N
Shaft play	
– radial (6,5 mm from mounting face)	≤ 0,04 mm
– axial	= 0 mm
Operating temperature range	- 30 ... + 100 °C

Specifications							
Number of gear stages		1	2	3	4	5	6
Continuous torque	mNm	200	300	300	300	300	300
Intermittent torque	mNm	300	450	450	450	450	450
Mass without motor, ca.	g	17	20	24	27	30	34
Efficiency, max.	%	90	80	70	60	55	50
Direction of rotation, drive to output		=	=	=	=	=	=
Reduction ratio [1] (rounded)		**3,71:1**	**9,7:1 14:1**	**43:1 66:1**	**94:1 112:1 134:1 159:1 190:1 246:1**	**415:1 592:1 989:1 1 526:1**	**2 608:1 4 365:1 5 647:1**
L2 [mm] = length without motor		20,9	25,0	29,2	33,3	37,4	41,5
L1 [mm] = length with motor	1319T...SR	34,1	38,2	42,4	46,5	50,6	54,7
	1331T...SR	46,1	50,2	54,4	58,5	62,6	66,7
	1336U...CXR	50,9	55,0	59,2	63,3	67,4	71,5

[1] The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.



14/1

Precision Gearheads

Planetary Gearheads

0,25 Nm

For combination with
DC-Micromotors
Stepper Motors

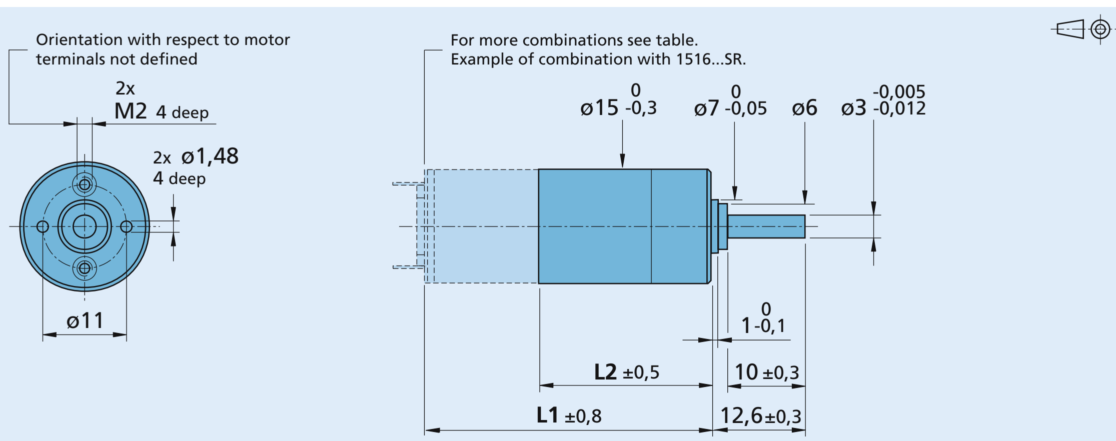
Series 15A

	15A	15AC	15AK
Housing material	plastic	plastic	plastic
Geartrain material	plastic	plastic	plastic
Recommended max. input speed for:			
– continuous operation	5 000 rpm	5 000 rpm	5 000 rpm
Backlash, at no-load	≤ 4 °	≤ 4 °	≤ 4 °
Bearings on output shaft	sintered bearings	ceramic bearings	ball bearings
Shaft load, max.:			
– radial (5 mm from mounting face)	≤ 3 N	≤ 10 N	≤ 15 N
– axial	≤ 1 N	≤ 2 N	≤ 5 N
Shaft press fit force, max.	≤ 10 N	≤ 10 N	≤ 10 N
Shaft play			
– radial (5 mm from mounting face)	≤ 0,06 mm	≤ 0,08 mm	≤ 0,09 mm
– axial	≤ 0,25 mm	≤ 0,25 mm	≤ 0,25 mm
Operating temperature range	- 30 ... + 65 °C	- 20 ... + 85 °C	- 30 ... + 85 °C

Specifications										
Number of gear stages			**1**	**2**	**3**	**3**	**4**	**5**	**5**	**6**
Continuous torque		mNm	50	100	100	150	200	200	250	250
Intermittent torque		mNm	100	200	200	300	400	400	400	400
Mass without motor, ca.		g	4	5	5	5	6	6	6	7
Efficiency, max.		%	87	78	68	67	62	55	52	49
Direction of rotation, drive to output			=	=	=	=	=	=	=	=
Reduction ratio [1] (rounded)	Code B [2]			**14:1** **19:1**	**52:1** **69:1**		**249:1**	**896:1**		**3 225:1**
	Code A [2]		**5,33:1**	**28:1**	**102:1**	**152:1**	**369:1** **546:1** **809:1**	**1 327:1** **1 966:1**	**2 913:1** **4 315:1**	**4 778:1** **7 078:1** **10 486:1** **15 534:1** **23 014:1**
L2 [mm] = length without motor [3]			14,1	17,7	21,3	21,3	24,9	28,5	28,5	32,1
L1 [mm] = length with motor	1516A/B...SR		29,9	33,5	37,1	37,1	40,7	44,3	44,3	47,9
	1524A/B...SR		37,9	41,5	45,1	45,1	48,7	52,3	52,3	55,9
	1624A/B...S		37,9	41,5	45,1	45,1	48,7	52,3	52,3	55,9
	1717A/B...SR		31,1	34,7	38,3	38,3	41,9	45,5	45,5	49,1
	1724A/B...SR		38,1	41,7	45,3	45,3	48,9	52,5	52,5	56,1
	AM1524...-70		30,5	34,1	37,7	37,7	41,3	44,9	44,9	48,5

[1] The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.
[2] Example of ordering information: 1516 **B** 012 SR + 15A 19:1, not for AM1524.
[3] L2 + 0,7 mm, in combination with 1516A/B...SR and 1524A/B...SR.

Note: These gearheads are available only with motors mounted.



15A, 15AC, 15AK

Spur Gearheads

0,1 Nm

For combination with
DC-Micromotors
Brushless DC-Motors
Stepper Motors

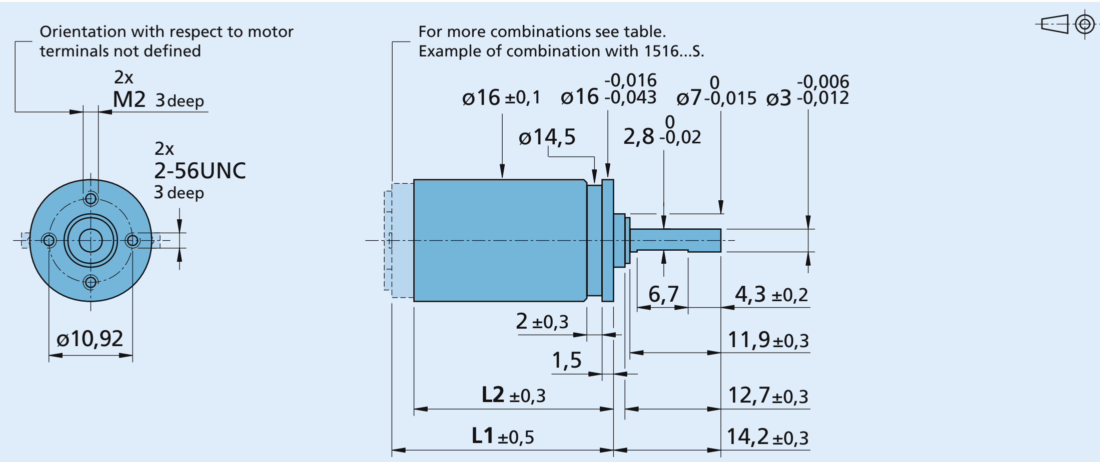
Series 15/5

	15/5
Housing material	metal
Geartrain material [1]	plastic/steel
Recommended max. input speed for:	
– continuous operation	5 000 rpm
Backlash, at no-load	≤ 3 °
Bearings on output shaft	ball bearings, preloaded
Shaft load, max.:	
– radial (6,5 mm from mounting face)	≤ 25 N
– axial	≤ 5 N
Shaft press fit force, max.	≤ 5 N
Shaft play	
– radial (6,5 mm from mounting face)	≤ 0,03 mm
– axial	= 0 mm
Operating temperature range	- 30 ... + 100 °C

Specifications										
Number of gear stages		**2**	**3**	**4**	**4**	**5**	**5**	**6**	**6**	**7**
Continuous torque	mNm	60	60	100	100	100	100	100	100	100
Intermittent torque	mNm	150	150	300	150	300	150	300	150	300
Mass without motor, ca.	g	17	19	21	21	22	22	24	24	25
Efficiency, max.	%	81	73	66	66	59	59	53	53	48
Direction of rotation, drive to output		=	≠	=	=	≠	≠	=	=	≠
Reduction ratio [2] (rounded)		**6,3:1** **11,8:1**	**22:1** **41:1**	**76:1**	**141:1**	**262:1**	**485:1**	**900:1**	**1 670:1**	**3 101:1**
L2 [mm] = length without motor		26,2	29,9	32,0	32,0	34,1	34,1	36,2	36,2	38,3
L1 [mm] = length with motor	1319E...SR	32,5	36,2	38,3	38,3	40,4	40,4	42,5	42,5	44,6
	1331E...SR	44,5	48,2	50,3	50,3	52,4	52,4	54,5	54,5	56,6
	1516E...S	29,1	32,8	34,9	34,9	37,0	37,0	39,1	39,1	41,2
	1516E...SR	29,1	32,8	34,9	34,9	37,0	37,0	39,1	39,1	41,2
	1524E...SR	37,1	40,8	42,9	42,9	45,0	45,0	47,1	47,1	49,2
	1524E...BSL	37,5	41,2	43,3	43,3	45,4	45,4	47,5	47,5	49,6
	1536E...BSL	49,9	53,6	55,7	55,7	57,8	57,8	59,9	59,9	62,0
	AM1524...-57	30,0	33,7	35,8	35,8	37,9	37,9	40,0	40,0	42,1

[1] Gearheads with ratios < 3 101:1 have all steel gears.
[2] The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.

Note: Reduction ratios from 5 752:1 to 235 067:1 are available on request.



15/5

Spur Gearheads

0,1 Nm

For combination with
DC-Micromotors
Brushless DC-Motors
Stepper Motors

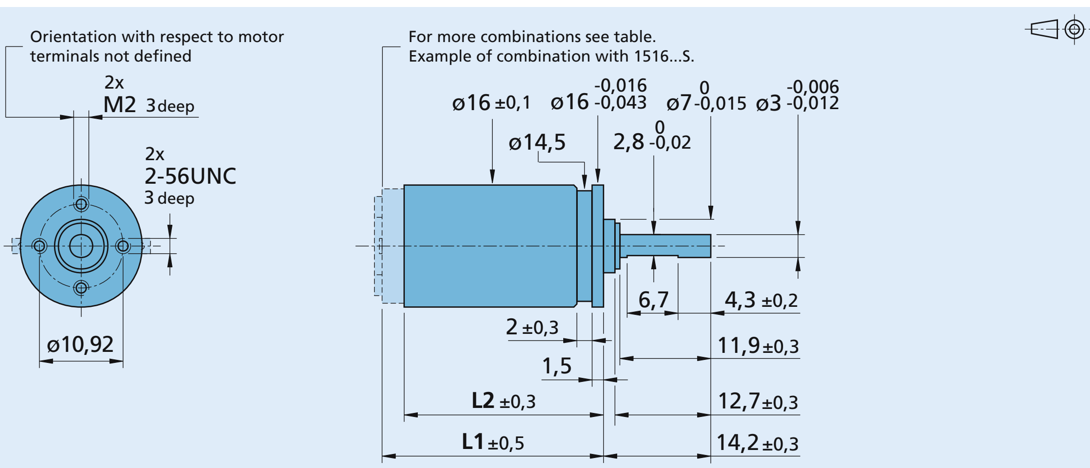
Series 15/5 S

	15/5 S
Housing material	metal
Geartrain material	steel
Recommended max. input speed for:	
– continuous operation	5 000 rpm
Backlash, at no-load	≤ 3 °
Bearings on output shaft	ball bearings, preloaded
Shaft load, max.:	
– radial (6,5 mm from mounting face)	≤ 25 N
– axial	≤ 5 N
Shaft press fit force, max.	≤ 5 N
Shaft play	
– radial (6,5 mm from mounting face)	≤ 0,03 mm
– axial	= 0 mm
Operating temperature range	- 30 ... + 100 °C

Specifications											
Number of gear stages			2	3	4	4	5	5	6	6	7
Continuous torque		mNm	60	60	100	100	100	100	100	100	100
Intermittent torque		mNm	150	150	300	150	300	150	300	150	300
Mass without motor, ca.		g	17	19	21	21	22	22	24	24	25
Efficiency, max.		%	81	73	66	66	59	59	53	53	48
Direction of rotation, drive to output			=	≠	=	=	≠	≠	=	=	≠
Reduction ratio [1] (rounded)			**6,3:1** **11,8:1**	**22:1** **41:1**	**76:1**	**141:1**	**262:1**	**485:1**	**900:1**	**1 670:1**	**3 101:1**
L2 [mm] = length without motor			26,2	29,9	32,0	32,0	34,1	34,1	36,2	36,2	38,3
L1 [mm] = length with motor	1319E...SR		32,5	36,2	38,3	38,3	40,4	40,4	42,5	42,5	44,6
	1331E...SR		44,5	48,2	50,3	50,3	52,4	52,4	54,5	54,5	56,6
	1516E...S		29,1	32,8	34,9	34,9	37,0	37,0	39,1	39,1	41,2
	1516E...SR		29,1	32,8	34,9	34,9	37,0	37,0	39,1	39,1	41,2
	1524E...SR		37,1	40,8	42,9	42,9	45,0	45,0	47,1	47,1	49,2
	1524E...BSL		37,5	41,2	43,3	43,3	45,4	45,4	47,5	47,5	49,6
	1536E...BSL		49,9	53,6	55,7	55,7	57,8	57,8	59,9	59,9	62,0
	AM1524...-57		30,0	33,7	35,8	35,8	37,9	37,9	40,0	40,0	42,1

[1] The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.

Note: Reduction ratios from 5 752:1 to 235 067:1 are available on request.
The gearheads as S-type have all steel gears and heavy duty lubricant for extended lifetime performance.



15/5 S

Spur Gearheads

Zero Backlash

0,1 Nm

For combination with
DC-Micromotors
Brushless DC-Motors
Stepper Motors

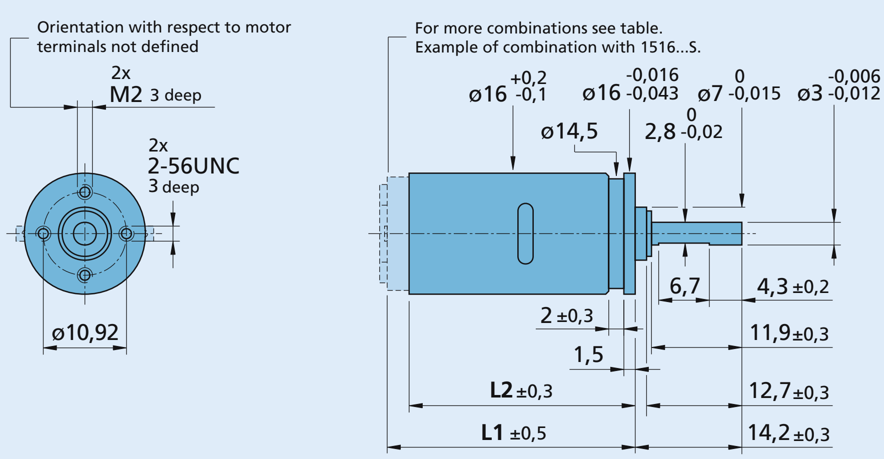
Series 15/8

	15/8
Housing material	metal
Geartrain material	steel
Recommended max. input speed for:	
– continuous operation	5 000 rpm
Backlash, at no-load	0 °
Bearings on output shaft	ball bearings, preloaded
Shaft load, max.:	
– radial (6,5 mm from mounting face)	≤ 25 N
– axial	≤ 5 N
Shaft press fit force, max.	≤ 5 N
Shaft play	
– radial (6,5 mm from mounting face)	≤ 0,03 mm
– axial	= 0 mm
Operating temperature range	- 30 ... + 100 °C

Specifications								
Number of gear stages			4	4	5	5	6	6
Continuous torque		mNm	100	100	100	100	100	100
Intermittent torque		mNm	300	150	300	150	300	150
Mass without motor, ca.		g	24	24	26	26	28	28
Efficiency, max.			-	-	-	-	-	-
Direction of rotation, drive to output			=	=	≠	≠	=	=
Reduction ratio [1] (rounded)			**76:1**	**141:1**	**262:1**	**485:1**	**900:1**	**1 670:1**
L2 [mm] = length without motor			32,0	32,0	34,1	34,1	36,2	36,2
L1 [mm] = length with motor	1516E...SR		34,9	34,9	37,0	37,0	39,1	39,1
	1524E...SR		42,9	42,9	45,0	45,0	47,1	47,1
	1524E...BSL		43,3	43,3	45,4	45,4	47,5	47,5
	1536E...BSL		55,7	55,7	57,8	57,8	59,9	59,9
	AM1524...-57		35,8	35,8	37,9	37,9	40,0	40,0

[1] The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.

Note: These gearheads are available only with motors mounted.



15/8

Precision Gearheads

NEW

Planetary Gearheads

0,35 Nm

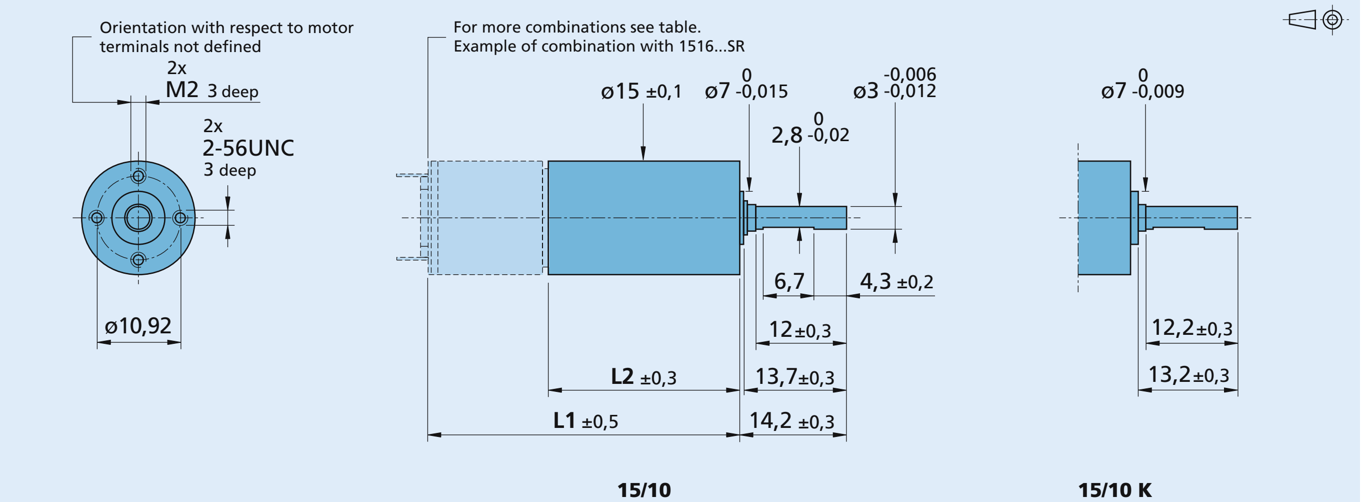
For combination with
DC-Micromotors
Brushless DC-Motors
Stepper Motors

Series 15/10

	15/10	15/10K
Housing material	stainless steel	stainless steel
Geartrain material	steel	steel
Recommended max. input speed for:		
– continuous operation	6 000 rpm	6 000 rpm
Backlash, at no-load	≤ 1,5 °	≤ 1,5 °
Bearings on output shaft	sintered bearings	ball bearings, preloaded
Shaft load, max.:		
– radial (6,5 mm from mounting face)	≤ 4 N	≤ 30 N
– axial	≤ 3 N	≤ 5 N
Shaft press fit force, max.	≤ 100 N	≤ 25 N
Shaft play		
– radial (6,5 mm from mounting face)	≤ 0,03 mm	≤ 0,03 mm
– axial	≤ 0,1 mm	= 0 mm
Operating temperature range	- 30 ... + 100 °C	- 30 ... + 100 °C

Specifications						
Number of gear stages		1	2	3	4	5
Continuous torque	mNm	350	350	350	350	350
Intermittent torque	mNm	500	500	500	500	500
Mass without motor, ca.	g	19	23	27	31	35
Efficiency, max.	%	90	80	70	60	50
Direction of rotation, drive to output		=	=	=	=	=
Reduction ratio [1]		**3,33:1**	**11:1**	**37:1**	**123:1**	**412:1**
(rounded)		**4,5:1**	**15:1**	**44:1**	**148:1**	**494:1**
			20:1	**50:1**	**167:1**	**593:1**
				68:1	**178:1**	**667:1**
				81:1	**200:1**	**750:1**
				91:1	**240:1**	**800:1**
					270:1	**900:1**
					304:1	**1 013:1**
					365:1	**1 367:1**
L2 [mm] = length without motor		17,1	21,3	25,4	29,5	33,6
L1 [mm] = length with motor	1516T...SR	32,9	37,1	41,2	45,3	49,4
	1524T...SR	40,9	45,1	49,2	53,3	57,4
	1624T...S	40,9	45,1	49,2	53,3	57,4
	1717T...SR	34,1	38,3	42,4	46,5	50,6
	1724T...SR	41,1	45,3	49,4	53,5	57,6
	1727U...C	44,3	48,5	52,6	56,7	60,8
	1741U...CXR	58,3	62,5	66,6	70,7	74,8
	1524U...BSL	41,3	45,5	49,6	53,7	57,8
	1536U...BSL	53,7	57,9	62,0	66,1	70,2
	1628T...B	45,1	49,3	53,4	57,5	61,6
	AM1524...-55	33,5	37,7	41,8	45,9	50,0

[1] The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.



Spur Gearheads

0,03 Nm

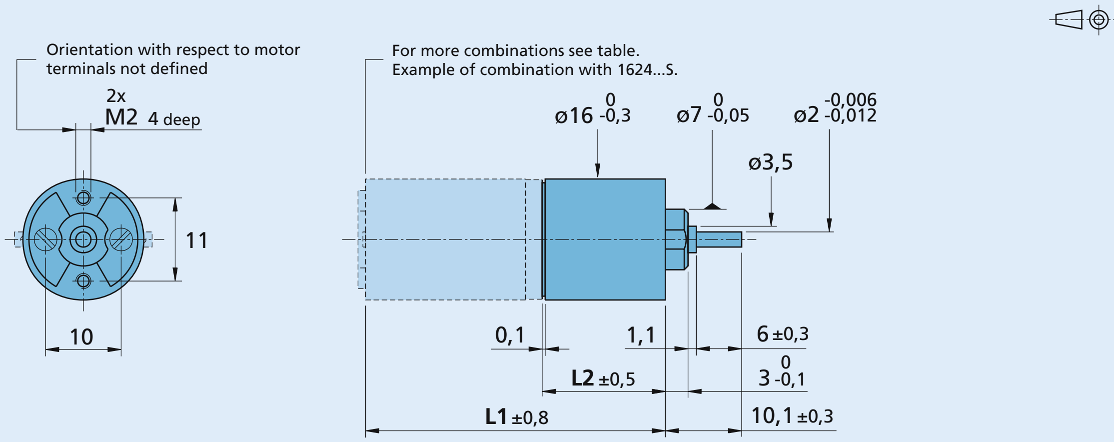
For combination with
DC-Micromotors

Series 16A

	16A	16AC	16AK
Housing material	plastic	plastic	plastic
Geartrain material	metal	metal	metal
Recommended max. input speed for:			
– continuous operation	5 000 rpm	5 000 rpm	5 000 rpm
Backlash, at no-load	≤ 4 °	≤ 4 °	≤ 4 °
Bearings on output shaft	sintered bearings	ceramic bearings	ball bearings
Shaft load, max.:			
– radial (5 mm from mounting face)	≤ 2 N	≤ 6 N	≤ 10 N
– axial	≤ 1 N	≤ 2 N	≤ 5 N
Shaft press fit force, max.	≤ 10 N	≤ 10 N	≤ 10 N
Shaft play			
– radial (5 mm from mounting face)	≤ 0,05 mm	≤ 0,06 mm	≤ 0,06 mm
– axial	≤ 0,25 mm	≤ 0,25 mm	≤ 0,25 mm
Operating temperature range	- 30 ... + 65 °C	- 20 ... + 65 °C	- 30 ... + 65 °C

Specifications									
Number of gear stages		**2**	**3**	**3**	**4**	**4**	**5**	**6**	**7**
Continuous torque	mNm	10	10	20	20	30	30	30	30
Intermittent torque	mNm	100	100	100	100	100	100	100	100
Mass without motor, ca.	g	3	4	4	4	4	5	5	6
Efficiency, max.	%	81	73	73	66	66	59	53	48
Direction of rotation, drive to output		=	≠	≠	=	=	≠	=	≠
Reduction ratio [1] (rounded)		**11,9:1**	**22:1**	**41:1**	**76:1**	**141:1**	**262:1** **485:1**	**900:1** **1 670:1**	**3 101:1** **5 752:1**
L2 [mm] = length without motor		9,2	11,0	11,0	12,8	12,8	14,5	16,3	18,0
L1 [mm] = length with motor	1516E...S	25,0	26,8	26,8	28,6	28,6	30,3	32,1	33,8
	1516E...SR	25,0	26,8	26,8	28,6	28,6	30,3	32,1	33,8
	1524E...SR	33,0	34,8	34,8	36,6	36,6	38,3	40,1	41,8
	1624E...S	33,0	34,8	34,8	36,6	36,6	38,3	40,1	41,8
	1717E...SR	26,2	28,0	28,0	29,8	29,8	31,5	33,3	35,0
	1724E...SR	33,0	34,8	34,8	36,6	36,6	38,3	40,1	41,8

[1] The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.



16A, 16AC, 16AK

Precision Gearheads

Spur Gearheads

0,1 Nm

For combination with
DC-Micromotors

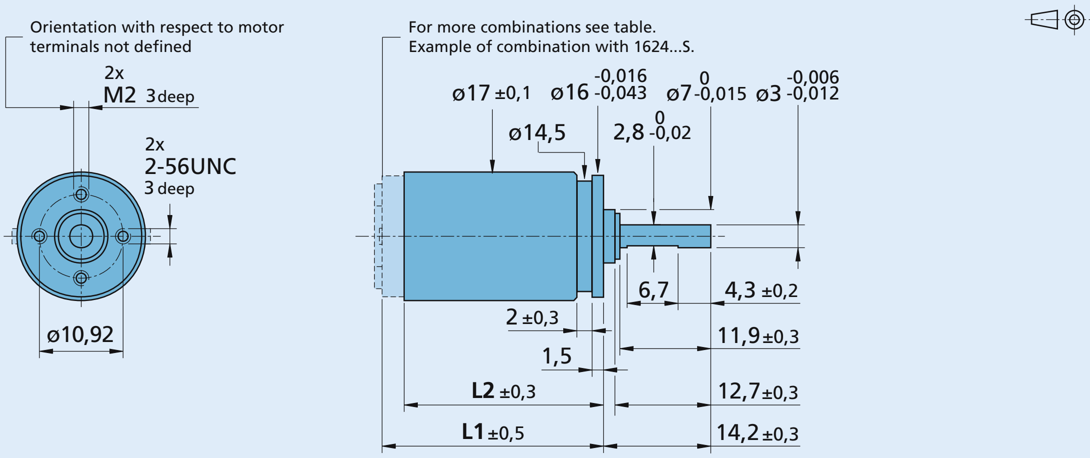
Series 16/5

	16/5
Housing material	metal
Geartrain material 1)	plastic/steel
Recommended max. input speed for:	
– continuous operation	5 000 rpm
Backlash, at no-load	≤ 3 °
Bearings on output shaft	ball bearings, preloaded
Shaft load, max.:	
– radial (6,5 mm from mounting face)	≤ 25 N
– axial	≤ 5 N
Shaft press fit force, max.	≤ 5 N
Shaft play	
– radial (6,5 mm from mounting face)	≤ 0,03 mm
– axial	= 0 mm
Operating temperature range	- 30 ... + 100 °C

Specifications										
Number of gear stages		**2**	**3**	**4**	**4**	**5**	**5**	**6**	**6**	**7**
Continuous torque	mNm	60	60	100	100	100	100	100	100	100
Intermittent torque	mNm	150	150	300	150	300	150	300	150	300
Mass without motor, ca.	g	17	19	21	21	22	22	24	24	25
Efficiency, max.	%	81	73	66	66	59	59	53	53	48
Direction of rotation, drive to output		=	≠	=	=	≠	≠	=	=	≠
Reduction ratio 2) (rounded)		**6,3:1** **11,8:1**	**22:1** **41:1**	**76:1**	**141:1**	**262:1**	**485:1**	**900:1**	**1 670:1**	**3 101:1**
L2 [mm] = length without motor		26,2	29,9	32,0	32,0	34,1	34,1	36,2	36,2	38,3
L1 [mm] = length with motor 1624E...S		37,1	40,8	42,9	42,9	45,0	45,0	47,1	47,1	49,2

1) Gearheads with ratios < 3 101:1 have all steel gears.
2) The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.

Note: Reduction ratios from 5 752:1 to 235 067:1 are available on request.



16/5

Spur Gearheads

0,1 Nm

For combination with
DC-Micromotors

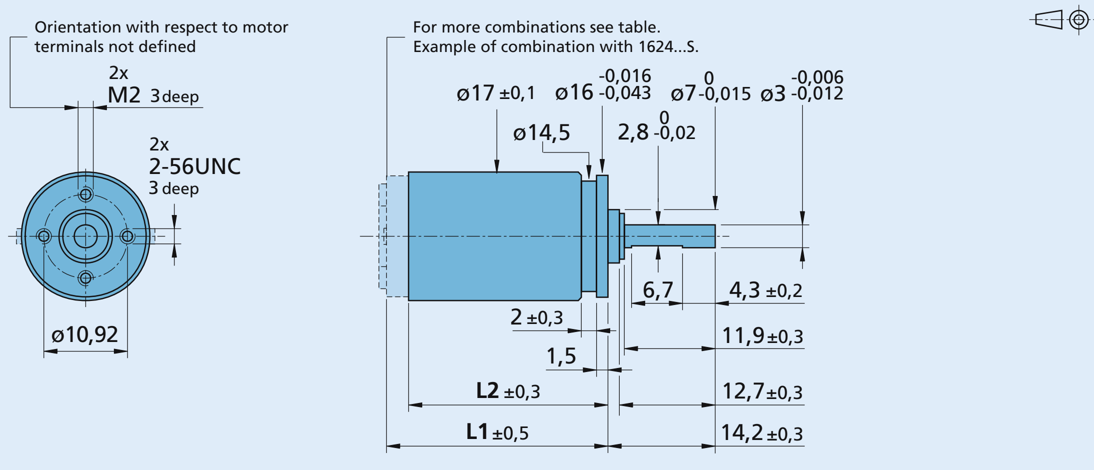
Series 16/5 S

	16/5 S
Housing material	metal
Geartrain material	steel
Recommended max. input speed for:	
– continuous operation	5 000 rpm
Backlash, at no-load	≤ 3 °
Bearings on output shaft	ball bearings, preloaded
Shaft load, max.:	
– radial (6,5 mm from mounting face)	≤ 25 N
– axial	≤ 5 N
Shaft press fit force, max.	≤ 5 N
Shaft play	
– radial (6,5 mm from mounting face)	≤ 0,03 mm
– axial	= 0 mm
Operating temperature range	- 30 ... + 100 °C

Specifications										
Number of gear stages		**2**	**3**	**4**	**4**	**5**	**5**	**6**	**6**	**7**
Continuous torque	mNm	60	60	100	100	100	100	100	100	100
Intermittent torque	mNm	150	150	300	150	300	150	300	150	300
Mass without motor, ca.	g	17	19	21	21	22	22	24	24	25
Efficiency, max.	%	81	73	66	66	59	59	53	53	48
Direction of rotation, drive to output		=	≠	=	=	≠	≠	=	=	≠
Reduction ratio [1] (rounded)		**6,3:1** **11,8:1**	**22:1** **41:1**	**76:1**	**141:1**	**262:1**	**485:1**	**900:1**	**1 670:1**	**3 101:1**
L2 [mm] = length without motor		26,2	29,9	32,0	32,0	34,1	34,1	36,2	36,2	38,3
L1 [mm] = length with motor	1624E...S	37,1	40,8	42,9	42,9	45,0	45,0	47,1	47,1	49,2

[1] The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.

Note: Reduction ratios from 5 752:1 to 235 067:1 are available on request.
The gearheads as S-type have all steel gears and heavy duty lubricant for extended lifetime performance.



16/5 S

Planetary Gearheads

0,3 Nm

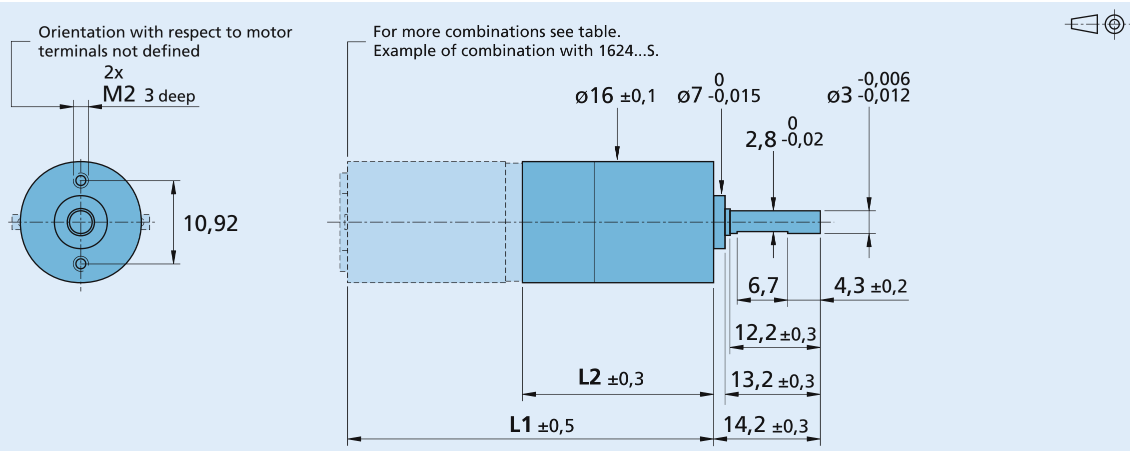
For combination with
DC-Micromotors
Brushless DC-Motors
Stepper Motors

Series 16/7

	16/7
Housing material	metal
Geartrain material	steel
Recommended max. input speed for:	
– continuous operation	5 000 rpm
Backlash, at no-load	≤ 1 °
Bearings on output shaft	ball bearings, preloaded
Shaft load, max.:	
– radial (6,5 mm from mounting face)	≤ 30 N
– axial	≤ 5 N
Shaft press fit force, max.	≤ 25 N
Shaft play	
– radial (6,5 mm from mounting face)	≤ 0,03 mm
– axial	= 0 mm
Operating temperature range	- 30 ... + 100 °C

Specifications							
Number of gear stages		**1**	**2**	**3**	**4**	**5**	**6**
Continuous torque	mNm	200	300	300	300	300	300
Intermittent torque	mNm	300	450	450	450	450	450
Mass without motor, ca.	g	18	23	28	33	38	43
Efficiency, max.	%	90	80	70	60	55	50
Direction of rotation, drive to output		=	=	=	=	=	=
Reduction ratio [1] (rounded)		**3,71:1**	**9,7:1** **14:1**	**43:1** **66:1**	**94:1** **112:1** **134:1** **159:1** **190:1** **246:1**	**415:1** **592:1** **989:1** **1 526:1**	**2 608:1** **4 365:1** **5 647:1**
L2 [mm] = length without motor		17,0	21,2	25,3	29,4	33,5	37,6
L1 [mm] = length with motor	1516T...SR	32,8	37,0	41,1	45,2	49,3	53,4
	1524T...SR	40,8	45,0	49,1	53,2	57,3	61,4
	1624T...S	40,8	45,0	49,1	53,2	57,3	61,4
	1717T...SR	34,0	38,2	42,3	46,4	50,5	54,6
	1724T...SR	41,0	45,2	49,3	53,4	57,5	61,6
	1727U...C	44,2	48,4	52,5	56,6	60,7	64,8
	1741U...CXR	58,2	62,4	66,5	70,6	74,7	78,8
	1524U...BSL	41,2	45,4	49,5	53,6	57,7	61,8
	1536U...BSL	53,6	57,8	61,9	66,0	70,1	74,2
	1628T...B	45,0	49,2	53,3	57,4	61,5	65,6
	AM1524...-55	33,4	37,6	41,7	45,8	49,9	54,0

[1] The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.



16/7

Spur Gearheads

Zero Backlash

0,1 Nm

For combination with
DC-Micromotors

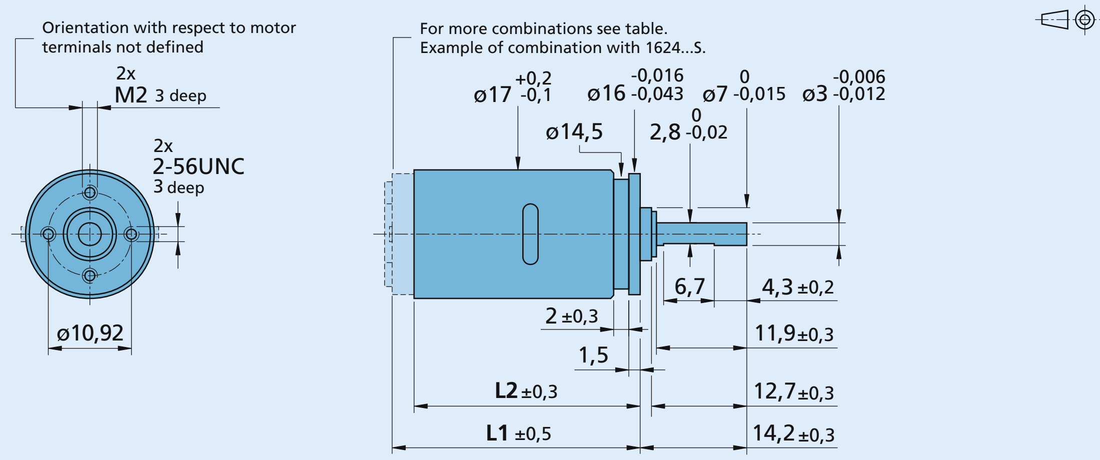
Series 16/8

	16/8
Housing material	metal
Geartrain material	steel
Recommended max. input speed for:	
– continuous operation	5 000 rpm
Backlash, at no-load	0 °
Bearings on output shaft	ball bearings, preloaded
Shaft load, max.:	
– radial (6,5 mm from mounting face)	≤ 25 N
– axial	≤ 5 N
Shaft press fit force, max.	≤ 5 N
Shaft play	
– radial (6,5 mm from mounting face)	≤ 0,03 mm
– axial	= 0 mm
Operating temperature range	- 30 ... + 100 °C

Specifications							
Number of gear stages		4	4	5	5	6	6
Continuous torque	mNm	100	100	100	100	100	100
Intermittent torque	mNm	300	150	300	150	300	150
Mass without motor, ca.	g	24	24	26	26	28	28
Efficiency, max.		-	-	-	-	-	-
Direction of rotation, drive to output		=	=	≠	≠	=	=
Reduction ratio [1] (rounded)		**76:1**	**141:1**	**262:1**	**485:1**	**900:1**	**1 670:1**
L2 [mm] = length without motor		32,0	32,0	34,1	34,1	36,2	36,2
L1 [mm] = length with motor 1624E...S		42,9	42,9	45,0	45,0	47,1	47,1

[1] The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.

Note: These gearheads are available only with motors mounted.



16/8

Precision Gearheads

NEW

Planetary Gearheads

0,55 Nm

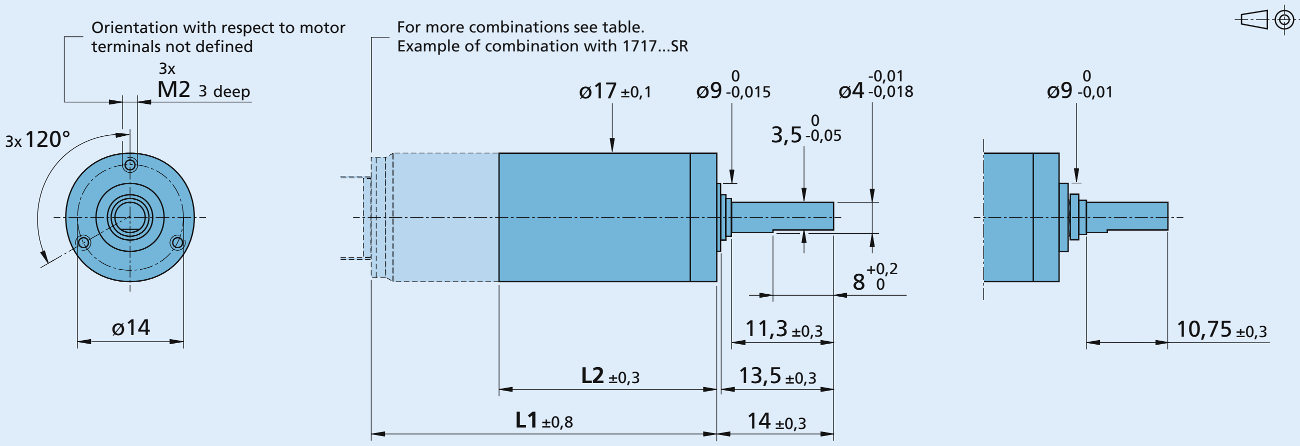
For combination with
DC-Micromotors
Brushless DC-Motors
Stepper Motors

Series 17/1

	17/1	17/1 K
Housing material	stainless steel	stainless steel
Geartrain material	steel	steel
Recommended max. input speed for:		
– continuous operation	8 000 rpm	8 000 rpm
Backlash, at no-load	≤ 2 °	≤ 2 °
Bearings on output shaft	sintered bearings	ball bearings, preloaded
Shaft load, max.:		
– radial (6,5 mm from mounting face)	≤ 5 N	≤ 75 N
– axial	≤ 3 N	≤ 12 N
Shaft press fit force, max.	≤ 100 N	≤ 35 N
Shaft play		
– radial (6,5 mm from mounting face)	≤ 0,03 mm	≤ 0,03 mm
– axial	≤ 0,1 mm	= 0 mm
Operating temperature range	- 30 ... + 100 °C	- 30 ... + 100 °C

Specifications						
Number of gear stages		**1**	**2**	**3**	**4**	**5**
Continuous torque	mNm	550	550	550	550	550
Intermittent torque	mNm	800	800	800	800	800
Mass without motor, ca.	g	28	35	42	49	56
Efficiency, max.	%	90	80	70	60	50
Direction of rotation, drive to output		=	=	=	=	=
Reduction ratio [1]		**3,33:1**	**11:1**	**37:1**	**123:1**	**412:1**
(rounded)		**4,5:1**	**15:1**	**44:1**	**148:1**	**494:1**
			20:1	**50:1**	**167:1**	**593:1**
				68:1	**178:1**	**667:1**
				81:1	**200:1**	**750:1**
				91:1	**240:1**	**800:1**
					270:1	**900:1**
					304:1	**1 013:1**
					365:1	**1 367:1**
L2 [mm] = length without motor		18,6	23,7	28,8	33,9	39,1
L1 [mm] = length with motor	1624T...S	42,4	47,5	52,6	57,7	62,9
	1717T...SR	35,6	40,7	45,8	50,9	56,1
	1724T...SR	42,6	47,7	52,8	57,9	63,1
	1727U...C	45,8	50,9	56,0	61,1	66,3
	1741U...CXR	59,8	64,9	70,0	75,1	80,3
	1628T...B	46,6	51,7	56,8	61,9	67,1
	AM1524...-55	35,0	40,1	45,2	50,3	55,5

[1] The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.



17/1 **17/1 K**

Planetary Gearheads

0,5 Nm

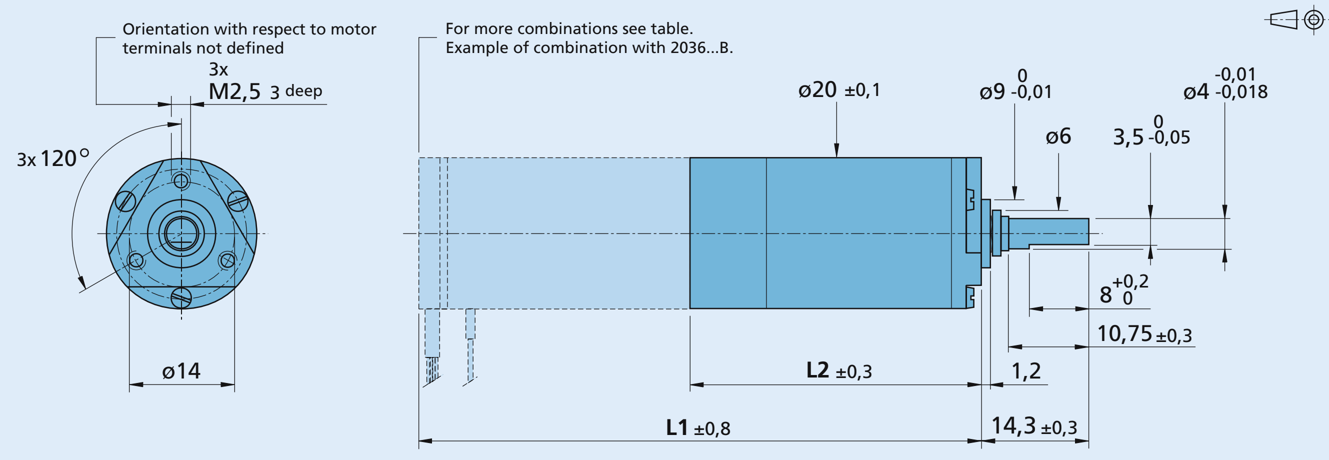
For combination with
DC-Micromotors
Brushless DC-Motors

Series 20/1

	20/1
Housing material	steel
Geartrain material	metal
Recommended max. input speed for:	
– continuous operation	5 000 rpm
Backlash, at no-load	≤ 1 °
Bearings on output shaft	ball bearings, preloaded
Shaft load, max.:	
– radial (8,5 mm from mounting face)	≤ 75 N
– axial	≤ 20 N
Shaft press fit force, max.	≤ 35 N
Shaft play	
– radial (8,5 mm from mounting face)	≤ 0,03 mm
– axial	= 0 mm
Operating temperature range	- 30 ... + 100 °C

Specifications								
Number of gear stages		1	2	2	3	3	4	5
Continuous torque	mNm	500	500	500	500	500	500	500
Intermittent torque	mNm	700	700	700	700	700	700	700
Mass without motor, ca.	g	28	38	38	48	48	58	68
Efficiency, max.	%	88	80	80	70	70	60	55
Direction of rotation, drive to output		=	=	=	=	=	=	=
Reduction ratio [1]		**3,71:1**	**9,7:1**	**23:1**	**43:1**	**86:1**	**112:1**	**415:1**
(rounded)			**14:1**		**66:1**		**134:1**	**592:1**
							159:1	**989:1**
							190:1	**1 526:1**
							246:1	
L2 [mm] = length without motor [2]		18,4	23,5	23,5	28,6	28,6	33,7	38,8
L1 [mm] = length with motor	1727U...C	45,6	50,7	50,7	55,8	55,8	60,9	66,0
	1741U...CXR	59,6	64,7	64,7	69,8	69,8	74,9	80,0
	2224U...SR	42,6	47,7	47,7	52,8	52,8	57,9	63,0
	2230U...S	48,4	53,5	53,5	58,6	58,6	63,7	68,8
	2232U...SR	50,6	55,7	55,7	60,8	60,8	65,9	71,0
	2233U...S	51,0	56,1	56,1	61,2	61,2	66,3	71,4
	2036U...B	54,4	59,5	59,5	64,6	64,6	69,7	74,8
	2057S...B	77,3	82,4	87,9	87,5	93,0	92,6	97,7

[1] The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.
[2] L2 + 1,9 mm or 7,4 mm, in combination with 2057S...B.



20/1

Planetary Gearheads

0,6 Nm

For combination with
DC-Micromotors
Stepper Motors

Series 22E

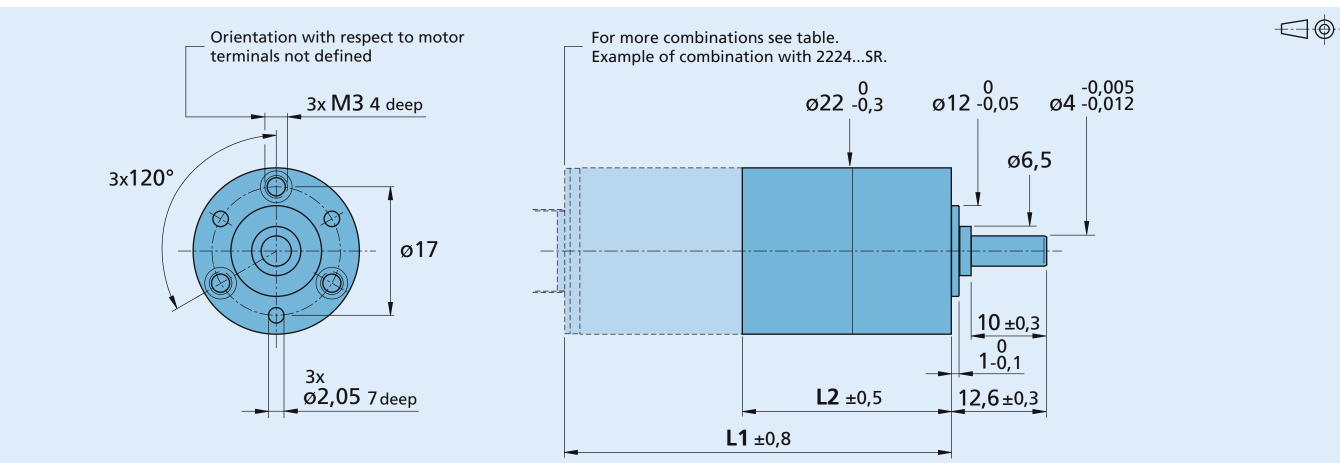
	22E	22EC	22EK
Housing material	plastic	plastic	plastic
Geartrain material	plastic	plastic	plastic
Recommended max. input speed for:			
– continuous operation	5 000 rpm	5 000 rpm	5 000 rpm
Backlash, at no-load	≤ 3 °	≤ 3 °	≤ 3 °
Bearings on output shaft	sintered bearings	ceramic bearings	ball bearings
Shaft load, max.:			
– radial (5 mm from mounting face)	≤ 3 N	≤ 15 N	≤ 50 N
– axial	≤ 3 N	≤ 2 N	≤ 5 N
Shaft press fit force, max.	≤ 15 N	≤ 15 N	≤ 15 N
Shaft play			
– radial (5 mm from mounting face)	≤ 0,05 mm	≤ 0,06 mm	≤ 0,07 mm
– axial	≤ 0,25 mm	≤ 0,25 mm	≤ 0,25 mm
Operating temperature range	- 30 ... + 65 °C	- 20 ... + 85 °C	- 30 ... + 85 °C

Specifications

Number of gear stages			**2**	**3**	**3**	**4**	**4**	**4**	**5**	**6**
Continuous torque		mNm	200	300	400	400	500	600	600	600
Intermittent torque		mNm	400	600	800	800	1 000	1 000	1 000	1 000
Mass without motor, ca.		g	17	19	19	20	20	20	22	24
Efficiency, max.		%	78	69	67	62	61	60	55	49
Direction of rotation, drive to output			=	=	=	=	=	=	=	=
Reduction ratio [1] (rounded)	Code B [2]		**19:1**	**69:1**		**249:1**			**896:1**	**3 225:1**
	Code A [2]		**28:1**	**102:1**	**152:1**		**369:1**	**546:1** **809:1**	**1 327:1** **1 966:1** **2 913:1** **4 315:1**	**4 778:1** **7 078:1** **10 486:1** **15 534:1** **23 014:1**
L2 [mm] = length without motor [3]			27,1	32,1	32,1	37,1	37,1	37,1	42,1	47,1
L1 [mm] = length with motor	2224A/B...SR		51,3	56,3	56,3	61,3	61,3	61,3	66,3	71,3
	2230A/B...S		57,1	62,1	62,1	67,1	67,1	67,1	72,1	77,1
	2232A/B...SR		59,3	64,3	64,3	69,3	69,3	69,3	74,3	79,3
	2233A/B...S		59,7	64,7	64,7	69,7	69,7	69,7	74,7	79,7
	AM2224...-12		54,8	59,8	59,8	64,8	64,8	64,8	69,8	74,8

[1] The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.
[2] Example of ordering information: 2224 **B** 012 SR + 22E 19:1, not for AM2224.
[3] L2 + 0,7 mm, in combination with 2224A/B...SR and 2232A/B...SR.

Note: These gearheads are available only with motors mounted.



22E, 22EC, 22EK

Planetary Gearheads

1,2 Nm

For combination with
DC-Micromotors
Stepper Motors

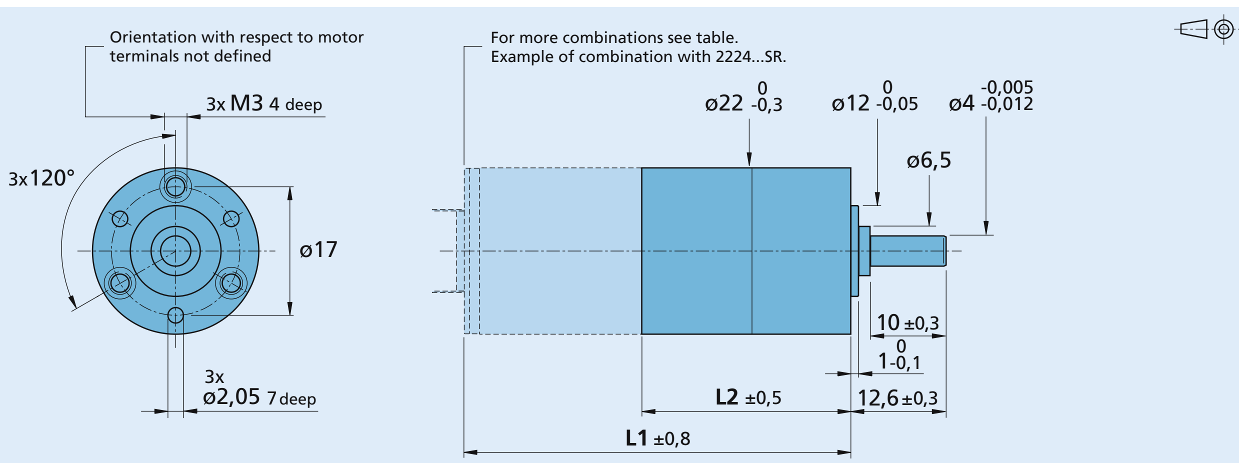
Series 22EKV

	22EKV
Housing material	plastic
Geartrain material	plastic/steel/ceramic
Recommended max. input speed for:	
– continuous operation	5 000 rpm
Backlash, at no-load	≤ 3 °
Bearings on output shaft	ball bearings
Shaft load, max.:	
– radial (5 mm from mounting face)	≤ 50 N
– axial	≤ 5 N
Shaft press fit force, max.	≤ 15 N
Shaft play	
– radial (5 mm from mounting face)	≤ 0,07 mm
– axial	≤ 0,25 mm
Operating temperature range	- 30 ... + 85 °C

Specifications										
Number of gear stages			2	3	3	4	4	4	5	6
Continuous torque		Nm	0,4	0,6	0,8	0,8	1	1,2	1,2	1,2
Intermittent torque		Nm	0,8	1,2	1,6	1,6	2	2	2	2
Mass without motor, ca.		g	27	29	29	30	30	30	32	34
Efficiency, max.		%	77	68	68	61	61	61	53	47
Direction of rotation, drive to output			=	=	=	=	=	=	=	=
Reduction ratio [1] (rounded)	Code B [2]		**19:1**	**69:1**		**249:1**			**896:1**	**3 225:1**
	Code A [2]		**28:1**	**102:1**	**152:1**		**369:1**	**546:1**	**1 327:1**	**4 778:1**
								809:1	**1 966:1**	**7 078:1**
									2 913:1	**10 486:1**
									4 315:1	**15 534:1**
										23 014:1
L2 [mm] = length without motor [3]			27,1	32,1	32,1	37,1	37,1	37,1	42,1	47,1
L1 [mm] = length with motor	2224A/B...SR		51,3	56,3	56,3	61,3	61,3	61,3	66,3	71,3
	2230A/B...S		57,1	62,1	62,1	67,1	67,1	67,1	72,1	77,1
	2232A/B...SR		59,3	64,3	64,3	69,3	69,3	69,3	74,3	79,3
	2233A/B...S		59,7	64,7	64,7	69,7	69,7	69,7	74,7	79,7
	AM2224...-12		54,8	59,8	59,8	64,8	64,8	64,8	69,8	74,8

[1] The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.
[2] Example of ordering information: 2224 **B** 012SR + 22EKV 19:1, not for AM2224.
[3] L2 + 0,7 mm, in combination with 2224A/B...SR and 2232A/B...SR.

Note: These gearheads are available only with motors mounted.



22EKV

Planetary Gearheads

1 Nm

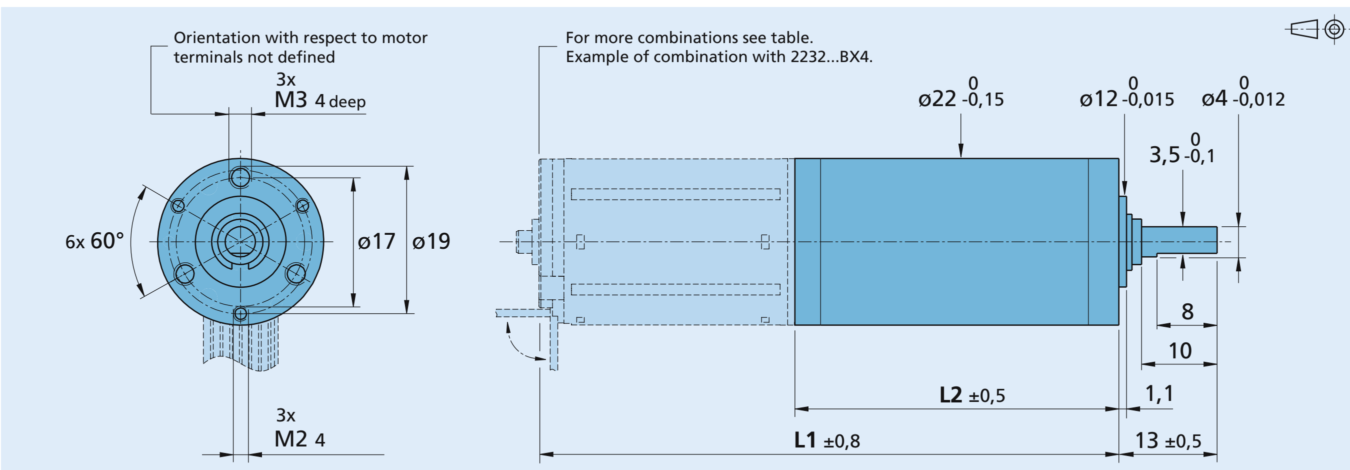
For combination with
DC-Micromotors
Brushless DC-Motors

Series 22F

	22F
Housing material	steel
Geartrain material	metal
Recommended max. input speed for:	
– continuous operation	6 000 rpm
Backlash, at no-load	≤ 3,5 °
Bearings on output shaft	ball bearings
Shaft load, max.:	
– radial (10 mm from mounting face)	≤ 70 N
– axial	≤ 100 N
Shaft press fit force, max.	≤ 100 N
Shaft play	
– radial (10 mm from mounting face)	≤ 0,06 mm
– axial	≤ 0,2 mm
Operating temperature range	- 30 ... + 100 °C

Specifications					
Number of gear stages		1	2	3	4
Continuous torque	mNm	400	600	900	1 000
Intermittent torque	mNm	600	900	1 350	1 500
Mass without motor, ca.	g	41	57	75	90
Efficiency, max.	%	80	75	70	60
Direction of rotation, drive to output		=	=	=	=
Reduction ratio [1]		**4:1**	**14:1**	**51:1**	**189:1**
(rounded)			**16:1**	**59:1**	**218:1**
			19:1	**68:1**	**252:1**
			25:1	**71:1**	**264:1**
				93:1	**292:1**
				100:1	**305:1**
				107:1	**344:1**
				130:1	
				169:1	
L2 [mm] = length without motor		26,6	34,8	42,9	51,1
L1 [mm] = length with motor	2224U...SR	50,8	59,0	67,1	75,3
	2232U...SR	58,8	67,0	75,1	83,3
	2237S...CXR	63,6	71,8	79,9	88,1
	2342S...CR	68,6	76,8	84,9	93,1
	2232S...BX4(S)	60,4	68,6	76,7	84,9
	2250S...BX4(S)	78,4	86,6	94,7	102,9

[1] The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.



22F

Precision Gearheads

Spur Gearheads

0,1 Nm

For combination with
DC-Micromotors
Stepper Motors

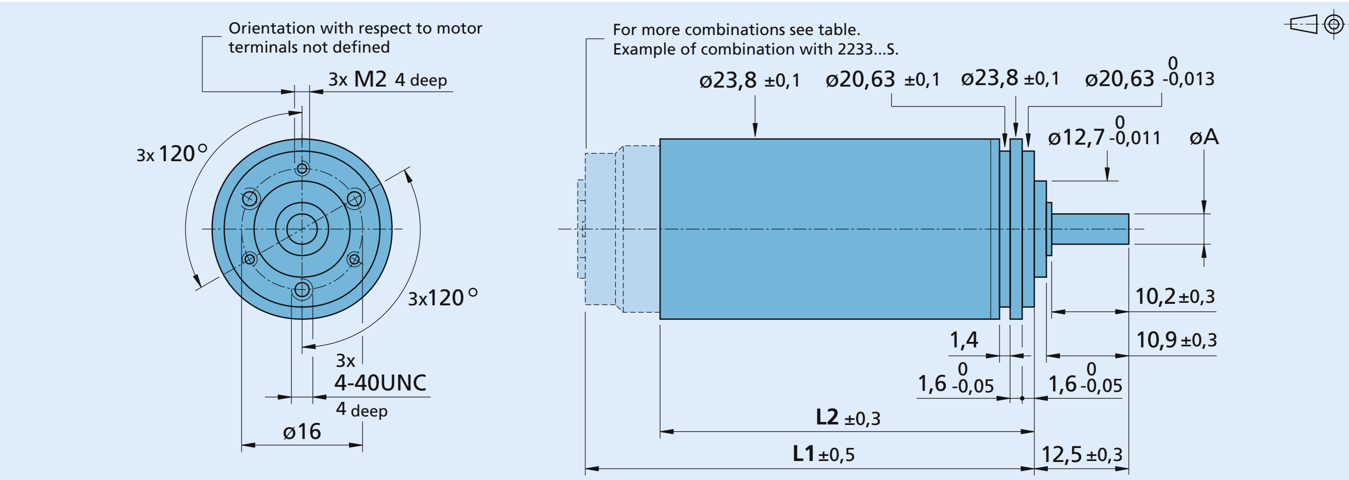
Series 22/2

	22/2	22/2K
Housing material	metal	metal
Geartrain material	metal	metal
Recommended max. input speed for:		
– continuous operation	4 000 rpm	4 000 rpm
Backlash, at no-load	≤ 3 °	≤ 3 °
Bearings on output shaft	sintered bearings	ball bearings, preloaded
Shaft load, max.:		
– radial (6 mm from mounting face)	≤ 3 N	≤ 100 N
– axial	≤ 5 N	≤ 5 N
Shaft press fit force, max.	≤ 50 N	≤ 5 N
Shaft play		
– radial (6 mm from mounting face)	≤ 0,05 mm	≤ 0,03 mm
– axial	≤ 0,2 mm	= 0 mm
Operating temperature range	- 30 ... + 100 °C	- 30 ... + 100 °C

Specifications										
Number of gear stages		**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Continuous torque	mNm	100	100	100	100	100	100	100	100	100
Intermittent torque	mNm	400	400	400	400	400	400	400	400	400
Mass without motor, ca.	g	58	68	72	77	82	88	93	98	103
Efficiency, max.	%	90	86	81	73	66	59	53	48	43
Direction of rotation, drive to output		=	≠	=	≠	=	≠	=	≠	=
Reduction ratio [1] (rounded)		**3,1:1** **5,4:1**	**9,7:1**	**17,2:1** **30,7:1**	**54,6:1** **97,3:1**	**173:1** **308:1**	**548:1** **975:1**	**1 734:1** **3 088:1**	**5 490:1** **9 780:1**	**17 386:1** **30 969:1**
L2 [mm] = length without motor		40,8	46,6	49,5	52,4	55,3	58,2	61,1	64,0	66,9
L1 [mm] = length with motor	2224R...SR	45,4	50,0	53,6	56,5	59,4	62,3	65,2	68,1	71,0
	2230F/R...S	51,2	55,8	59,4	62,3	65,2	68,1	71,0	73,9	76,8
	2232R...SR	53,4	58,0	61,6	64,5	67,4	70,3	73,2	76,1	79,0
	2233F/R...S	54,0	58,6	62,2	65,1	68,0	70,9	73,8	76,7	79,6
	AM2224...-14	48,9	53,5	57,1	60,0	62,9	65,8	68,7	71,6	74,5

[1] The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.

Note: Reduction ratios from 55 057:1 to 983 447:1 are available on request.



22/2 ø A = 4 -0,008 **22/2K** ø A = 4 -0,010 / -0,018 (L1, L2 = + 2,1)

Spur Gearheads

Zero Backlash

0,1 Nm

For combination with
DC-Micromotors
Stepper Motors

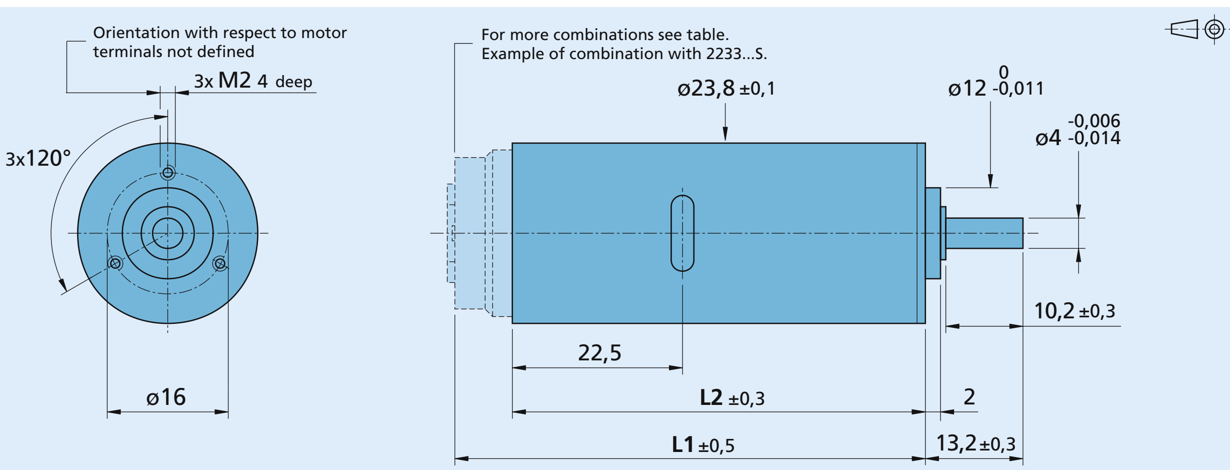
Series 22/5

	22/5
Housing material	metal
Geartrain material	metal
Recommended max. input speed for:	
– continuous operation	4 000 rpm
Backlash, at no-load	0 °
Bearings on output shaft	ball bearings, preloaded
Shaft load, max.:	
– radial (6 mm from mounting face)	≤ 100 N
– axial	≤ 5 N
Shaft press fit force, max.	≤ 5 N
Shaft play	
– radial (6 mm from mounting face)	≤ 0,03 mm
– axial	= 0 mm
Operating temperature range	- 30 ... + 100 °C

Specifications							
Number of gear stages			5	6	7	8	9
Continuous torque		mNm	100	100	100	100	100
Intermittent torque		mNm	400	400	400	400	400
Mass without motor, ca.		g	80	85	90	95	105
Efficiency, max.			-	-	-	-	-
Direction of rotation, drive to output			≠	=	≠	=	≠
Reduction ratio [1] (rounded)			**69,2:1**	**161:1**	**377:1**	**879:1**	**2 050:1**
L2 [mm] = length without motor			50,9	54,6	59,5	63,2	68,1
L1 [mm] = length with motor	2224R...SR		57,8	61,6	66,5	70,3	75,2
	2230F/R...S		63,6	67,4	72,3	76,1	81,0
	2232R...SR		65,8	69,6	74,5	78,3	83,2
	2233F/R...S		66,2	70,0	74,9	78,7	83,6
	AM2224...-14		61,4	65,2	70,1	73,9	78,8

[1] The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.

Note: These gearheads are available only with motors mounted.



22/5

Planetary Gearheads

0,7 Nm

For combination with
DC-Micromotors
Brushless DC-Motors
Stepper Motors

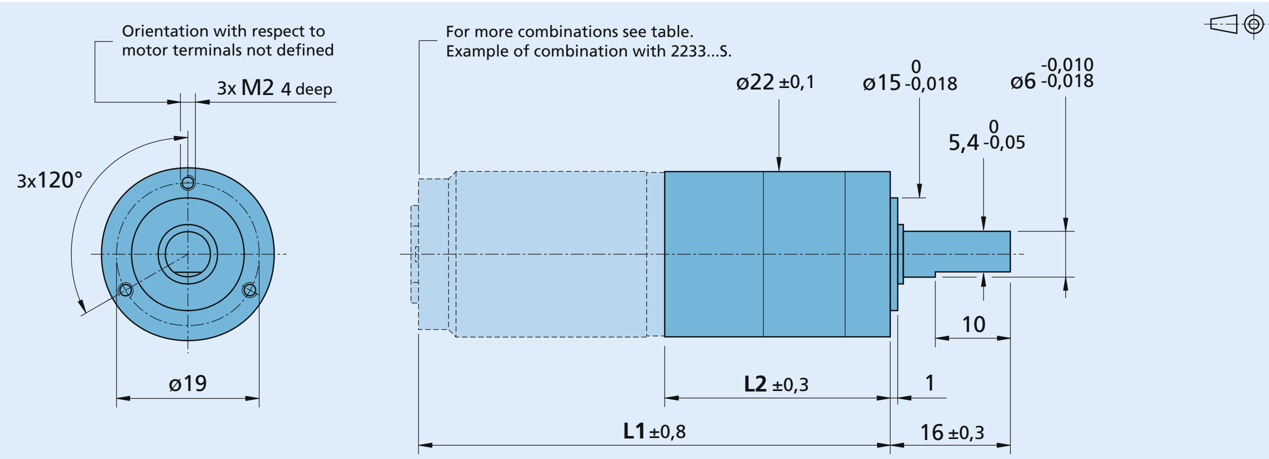
Series 22/7

	22/7
Housing material	metal
Geartrain material	steel
Recommended max. input speed for:	
– continuous operation	4 000 rpm
Backlash, at no-load	≤ 1 °
Bearings on output shaft	ball bearings, preloaded
Shaft load, max.:	
– radial (10 mm from mounting face)	≤ 170 N
– axial	≤ 150 N
Shaft press fit force, max.	≤ 150 N
Shaft play	
– radial (10 mm from mounting face)	≤ 0,03 mm
– axial	≤ 0,1 mm
Operating temperature range	- 30 ... + 100 °C

Specifications						
Number of gear stages		1	2	3	4	5
Continuous torque	mNm	200	300	700	700	700
Intermittent torque	mNm	400	600	1 000	1 000	1 000
Mass without motor, ca.	g	68	63	76	88	102
Efficiency, max.	%	88	80	70	60	55
Direction of rotation, drive to output		=	=	=	=	=
Reduction ratio [1]		**3,71:1**	**9,7:1**	**43:1**	**94:1**	**415:1**
(rounded)			**14:1**	**66:1**	**112:1**	**592:1**
					134:1	**989:1**
					159:1	**1 526:1**
					190:1	
					246:1	
L2 [mm] = length without motor [2]		27,9	34,1	40,3	46,4	52,6
L1 [mm] = length with motor	2224U...SR	48,2	54,4	60,6	66,7	72,9
	2230U...S	54,0	60,2	66,4	72,5	78,7
	2232U...SR	56,2	62,4	68,6	74,7	80,9
	2233U...S	56,6	62,8	69,0	75,1	81,3
	2237S...CXR	64,9	71,1	77,3	83,4	89,6
	2342S...CR	69,9	76,1	82,3	88,4	94,6
	2232S...BX4(S)	61,7	67,9	74,1	80,2	86,4
	2250S...BX4(S)	79,7	85,9	92,1	98,2	104,4
	2444S...B	71,9	78,1	84,3	90,4	96,6
	AM2224...-10	55,6	61,8	68,0	74,1	80,3

[1] The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.
[2] L2 - 3,9 mm, in combination with 2224U...SR, 2230U...S, 2232U...SR, 2233U...S and AM2224.

Note: Reduction ratio 3,71:1 with motor types 2224U...SR, 2230U...S, 2232U...SR, 2233U...S and AM2224 shall be ordered as 22/7 3,71:1 - K288.



22/7

Planetary Gearheads

0,7 Nm

For combination with
DC-Micromotors
Brushless DC-Motors
Stepper Motors

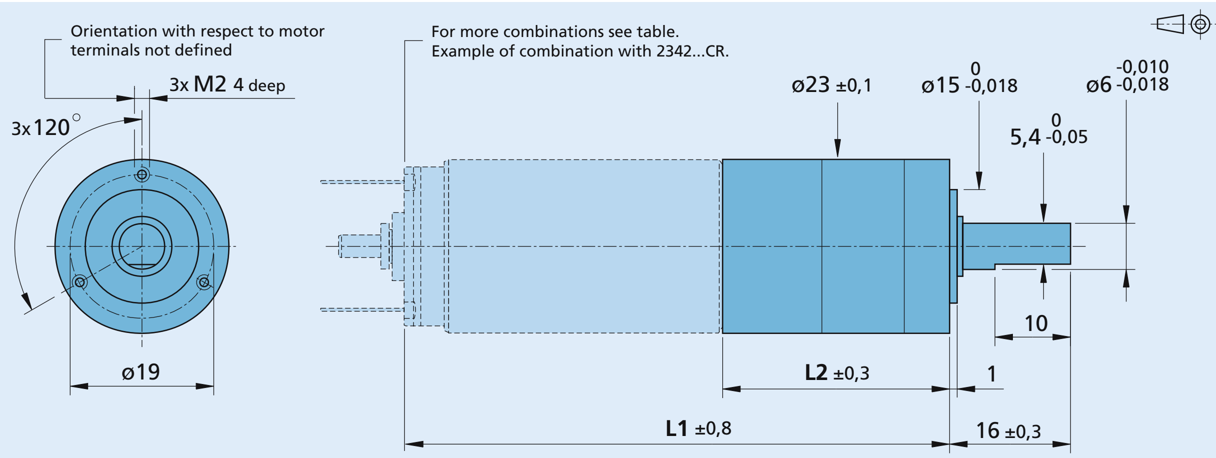
Series 23/1

	23/1
Housing material	metal
Geartrain material	steel
Recommended max. input speed for:	
– continuous operation	4 000 rpm
Backlash, at no-load	≤ 1 °
Bearings on output shaft	ball bearings, preloaded
Shaft load, max.:	
– radial (10 mm from mounting face)	≤ 170 N
– axial	≤ 150 N
Shaft press fit force, max.	≤ 150 N
Shaft play	
– radial (10 mm from mounting face)	≤ 0,03 mm
– axial	≤ 0,1 mm
Operating temperature range	- 30 ... + 100 °C

Specifications						
Number of gear stages		1	2	3	4	5
Continuous torque	mNm	200	300	700	700	700
Intermittent torque	mNm	400	600	1 000	1 000	1 000
Mass without motor, ca.	g	60	70	90	100	110
Efficiency, max.	%	88	80	70	60	55
Direction of rotation, drive to output		=	=	=	=	=
Reduction ratio [1] (rounded)		**3,71:1**	**9,7:1** **14:1**	**43:1** **66:1**	**94:1** **112:1** **134:1** **159:1** **190:1** **246:1**	**415:1** **592:1** **989:1** **1 526:1**
L2 [mm] = length without motor [2]		27,9	34,1	40,3	46,4	52,6
L1 [mm] = length with motor	2224U...SR	48,2	54,4	60,6	66,7	72,9
	2230U...S	54,0	60,2	66,4	72,5	78,7
	2232U...SR	56,2	62,4	68,6	74,7	80,9
	2233U...S	56,6	62,8	69,0	75,1	81,3
	2237S...CXR	64,9	71,1	77,3	83,4	89,6
	2342S...CR	69,9	76,1	82,3	88,4	94,6
	2057S...B	84,9	91,1	97,3	103,4	109,6
	2444S...B	71,9	78,1	84,3	90,4	96,6
	AM2224...-10	55,6	61,8	68,0	74,1	80,3

[1] The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.
[2] L2 - 3,9 mm, in combination with 2224U...SR, 2230U...S, 2232U...SR, 2233U...S and AM2224.

Note: Reduction ratio 3,71:1 with motor types 2224U...SR, 2230U...S, 2232U...SR, 2233U...S and AM2224 shall be ordered as 23/1 3,71:1 - K288.



23/1

Precision Gearheads

Planetary Gearheads

1 Nm

For combination with
DC-Micromotors
Brushless DC-Motors

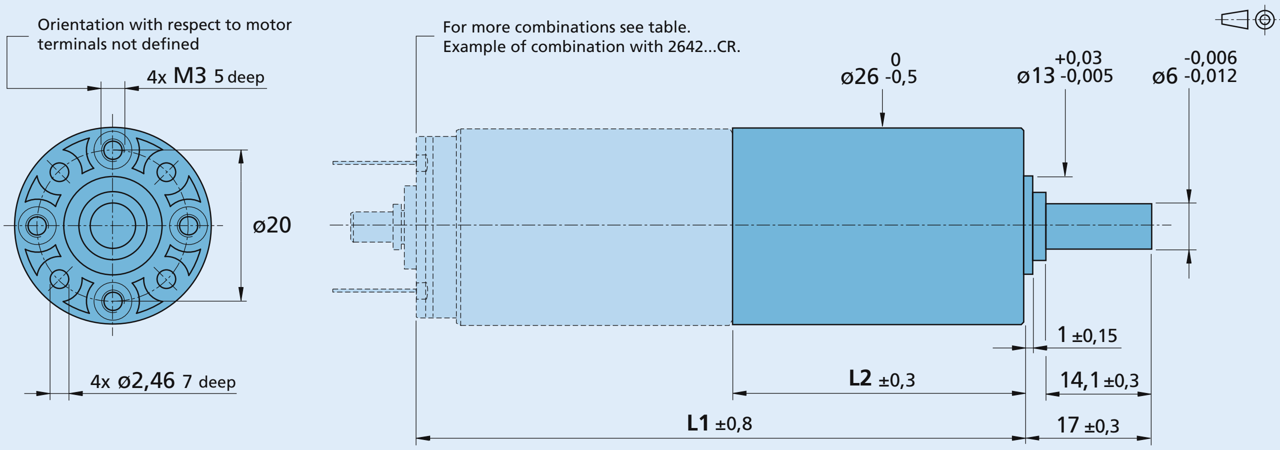
Series 26A

	26A	26AK
Housing material	plastic	plastic
Geartrain material	plastic	plastic
Recommended max. input speed for:		
– continuous operation	5 000 rpm	5 000 rpm
Backlash, at no-load	≤ 3 °	≤ 3 °
Bearings on output shaft	sintered bearings	ball bearings
Shaft load, max.:		
– radial (10 mm from mounting face)	≤ 4 N	≤ 60 N
– axial	≤ 4 N	≤ 15 N
Shaft press fit force, max.	≤ 20 N	≤ 20 N
Shaft play		
– radial (10 mm from mounting face)	≤ 0,08 mm	≤ 0,1 mm
– axial	≤ 0,25 mm	≤ 0,25 mm
Operating temperature range	- 30 ... + 65 °C	- 30 ... + 85 °C

Specifications							
Number of gear stages		2	2	3	3	4	4
Continuous torque	mNm	300	300	750	800	900	1 000
Intermittent torque	mNm	500	600	1 100	1 200	1 400	1 500
Mass without motor, ca.	g	21	21	23	23	25	25
Efficiency, max.	%	81	81	73	73	64	64
Direction of rotation, drive to output		=	=	=	=	=	=
Reduction ratio [1] (rounded)		13:1	16:1	40:1	50:1 64:1	124:1	158:1 201:1 256:1
L2 [mm] = length without motor		32,7	32,7	38,5	38,5	44,3	44,3
L1 [mm] = length with motor	2232U...SR	67,4	67,4	73,2	73,2	79,0	79,0
	2237S...CXR	69,7	69,7	75,5	75,5	81,3	81,3
	2342S...CR	74,7	74,7	80,5	80,5	86,3	86,3
	2642W...CR	74,7	74,7	80,5	80,5	86,3	86,3
	2642W...CXR	74,7	74,7	80,5	80,5	86,3	86,3
	2657W...CR	89,7	89,7	95,5	95,5	101,3	101,3
	2657W...CXR	89,7	89,7	95,5	95,5	101,3	101,3
	2232S...BX4(S)	66,5	66,5	72,3	72,3	78,1	78,1
	2250S...BX4(S)	84,5	84,5	90,3	90,3	96,1	96,1

[1] The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.

Note: These gearheads are available only with motors mounted.



26A, 26AK

Planetary Gearheads

3,5 Nm

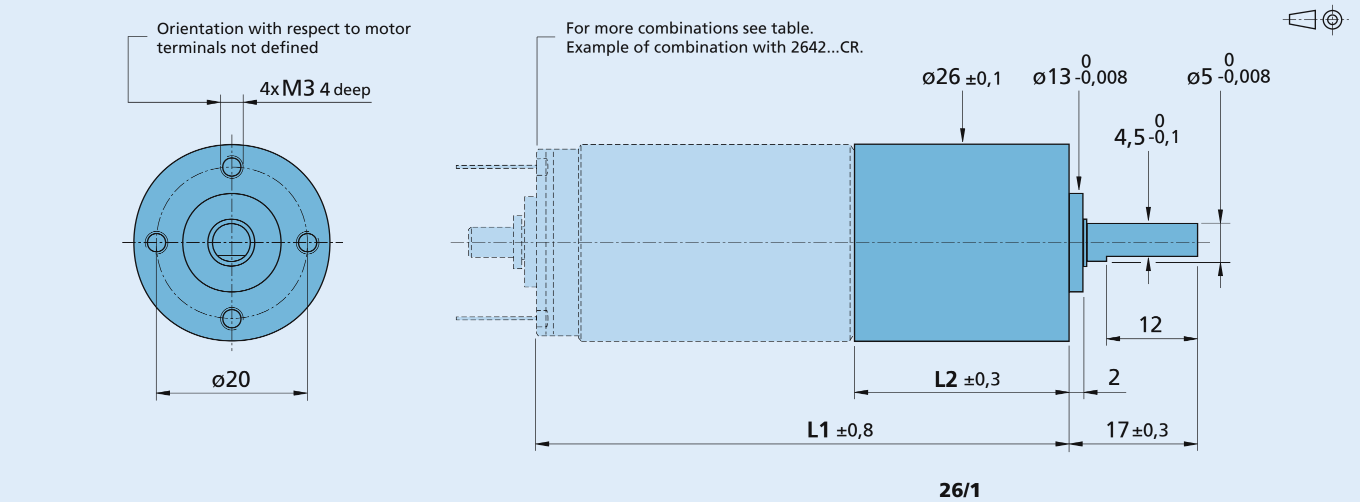
For combination with
DC-Micromotors
Brushless DC-Motors

Series 26/1

	26/1
Housing material	steel
Geartrain material [1]	plastic/steel
Recommended max. input speed for:	
– continuous operation	4 000 rpm
Backlash, at no-load	≤ 1 °
Bearings on output shaft	ball bearings, preloaded
Shaft load, max.:	
– radial (10 mm from mounting face)	≤ 150 N
– axial	≤ 100 N
Shaft press fit force, max.	≤ 150 N
Shaft play	
– radial (10 mm from mounting face)	≤ 0,03 mm
– axial	≤ 0,1 mm
Operating temperature range	- 30 ... + 100 °C

Specifications								
Number of gear stages		1	2	3	3	4	4	5
Continuous torque	Nm	1,1	0,3	1	1,5	2,5	3,5	3,5
Intermittent torque	Nm	2,3	0,4	1,2	1,8	3,5	4,5	4,5
Mass without motor, ca.	g	93	116	139	139	162	162	185
Efficiency, max.	%	88	80	70	70	60	60	55
Direction of rotation, drive to output		=	=	=	=	=	=	=
Reduction ratio [2] (rounded)		**3,71:1**	**14:1**	**43:1**	**66:1**	**134:1**	**159:1** **246:1**	**415:1** **592:1** **989:1** **1 526:1**
L2 [mm] = length without motor		28,4	36,4	44,4	44,4	52,4	52,4	60,5
L1 [mm] = length with motor	2342S...CR	70,4	78,4	86,4	86,4	94,4	94,4	102,5
	2642W...CR	70,4	78,4	86,4	86,4	94,4	94,4	102,5
	2642W...CXR	70,4	78,4	86,4	86,4	94,4	94,4	102,5
	2657W...CR	85,4	93,4	101,4	101,4	109,4	109,4	117,5
	2657W...CXR	85,4	93,4	101,4	101,4	109,4	109,4	117,5
	2444S...B	72,4	80,4	88,4	88,4	96,4	96,4	104,5

[1] Gearheads with ratios < 14:1 have all steel gears.
[2] The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.



Planetary Gearheads

3,5 Nm

For combination with
DC-Micromotors
Brushless DC-Motors

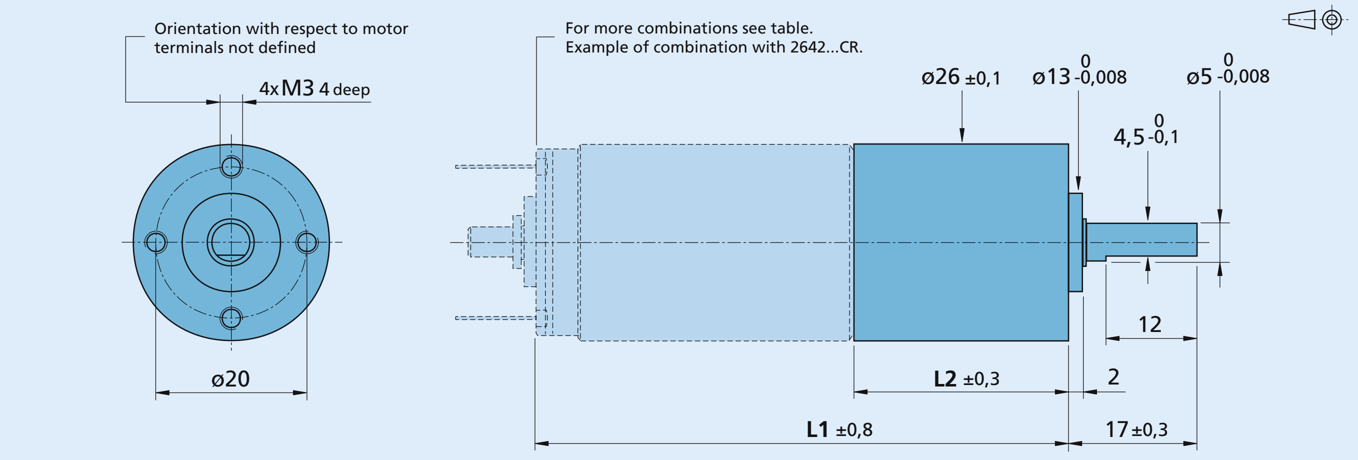
Series 26/1 S

	26/1 S
Housing material	steel
Geartrain material	steel
Recommended max. input speed for:	
– continuous operation	4 000 rpm
Backlash, at no-load	≤ 1 °
Bearings on output shaft	ball bearings, preloaded
Shaft load, max.:	
– radial (10 mm from mounting face)	≤ 150 N
– axial	≤ 100 N
Shaft press fit force, max.	≤ 150 N
Shaft play	
– radial (10 mm from mounting face)	≤ 0,03 mm
– axial	≤ 0,1 mm
Operating temperature range	- 30 ... + 100 °C

Specifications						
Number of gear stages			2	3	4	5
Continuous torque		Nm	3,5	3,5	3,5	3,5
Intermittent torque		Nm	4,5	4,5	4,5	4,5
Mass without motor, ca.		g	116	139	162	185
Efficiency, max.		%	80	70	60	55
Direction of rotation, drive to output			=	=	=	=
Reduction ratio [1]			**9,7:1**	**43:1**	**134:1**	**415:1**
(rounded)			**14:1**	**66:1**	**159:1**	**592:1**
			23:1	**86:1**	**246:1**	**989:1**
						1 526:1
L2 [mm] = length without motor			36,4	44,4	52,4	60,5
L1 [mm] = length with motor	2342S...CR		78,4	86,4	94,4	102,5
	2642W...CR		78,4	86,4	94,4	102,5
	2642W...CXR		78,4	86,4	94,4	102,5
	2657W...CR		93,4	101,4	109,4	117,5
	2657W...CXR		93,4	101,4	109,4	117,5
	2444S...B		80,4	88,4	96,4	104,5

[1] The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.

Note: The gearheads as S-type have all steel gears and heavy duty lubricant for extended lifetime performance.



26/1 S

Planetary Gearheads

4,5 Nm

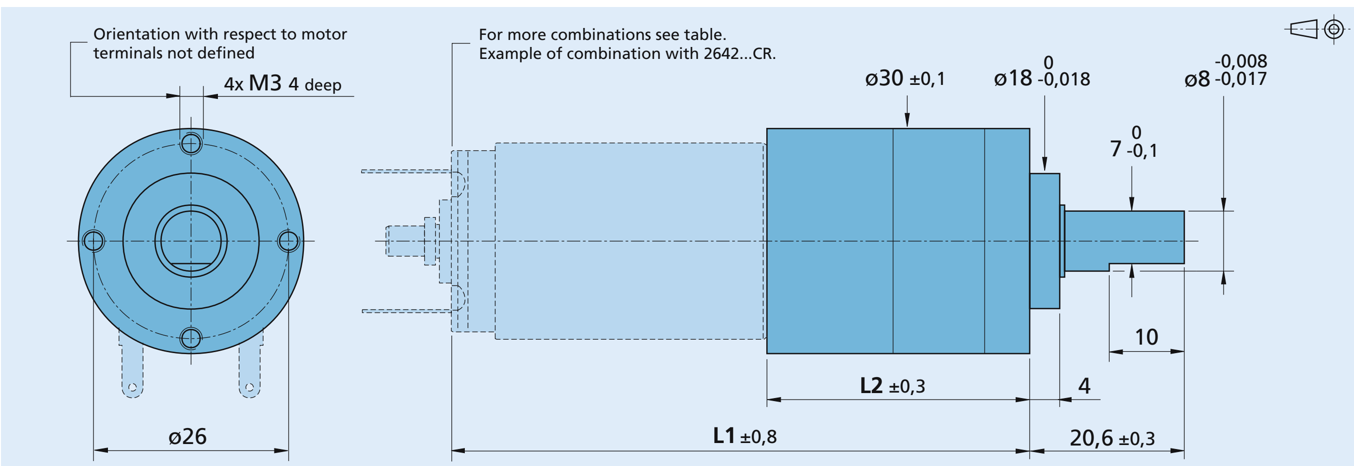
For combination with
DC-Micromotors
Brushless DC-Motors

Series 30/1

	30/1
Housing material	metal
Geartrain material 1)	plastic/steel
Recommended max. input speed for:	
– continuous operation	4 000 rpm
Backlash, at no-load	≤ 1 °
Bearings on output shaft	ball bearings, preloaded
Shaft load, max.:	
– radial (15 mm from mounting face)	≤ 150 N
– axial	≤ 150 N
Shaft press fit force, max.	≤ 200 N
Shaft play	
– radial (15 mm from mounting face)	≤ 0,03 mm
– axial	≤ 0,15 mm
Operating temperature range	- 30 ... + 100 °C

Specifications								
Number of gear stages		**1**	**2**	**3**	**3**	**4**	**4**	**5**
Continuous torque	Nm	1,5	0,35	1,2	1,8	3,5	4,5	4,5
Intermittent torque	Nm	3	0,5	1,6	2,4	4,5	6	6
Mass without motor, ca.	g	107	139	171	171	203	203	235
Efficiency, max.	%	88	80	70	70	60	60	55
Direction of rotation, drive to output		=	=	=	=	=	=	=
Reduction ratio 2) (rounded)		**3,71:1**	**14:1**	**43:1**	**66:1**	**134:1**	**159:1**	**415:1**
							246:1	**592:1**
								989:1
								1 526:1
L2 [mm] = length without motor 3)		27,1	35,1	43,1	43,1	51,2	51,2	59,2
L1 [mm] = length with motor	2342S...CR	69,1	77,1	85,1	85,1	93,2	93,2	101,2
	2642W...CR	69,1	77,1	85,1	85,1	93,2	93,2	101,2
	2642W...CXR	69,1	77,1	85,1	85,1	93,2	93,2	101,2
	2657W...CR	84,1	92,1	100,1	100,1	108,2	108,2	116,2
	2657W...CXR	84,1	92,1	100,1	100,1	108,2	108,2	116,2
	3272G...CR	99,1	107,1	115,1	115,1	123,2	123,2	131,2
	2444S...B	71,1	79,1	87,1	87,1	95,2	95,2	103,2
	3056K...B	84,5	92,5	100,5	100,5	108,6	108,6	116,6
	3564K...B	92,5	100,5	108,5	108,5	116,6	116,6	124,6

1) Gearheads with ratios < 14:1 have all steel gears.
2) The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.
3) L2 + 1,4 mm, in combination with 3056K...B and 3564K...B.



30/1

FAULHABER

Planetary Gearheads

4,5 Nm

For combination with
DC-Micromotors
Brushless DC-Motors

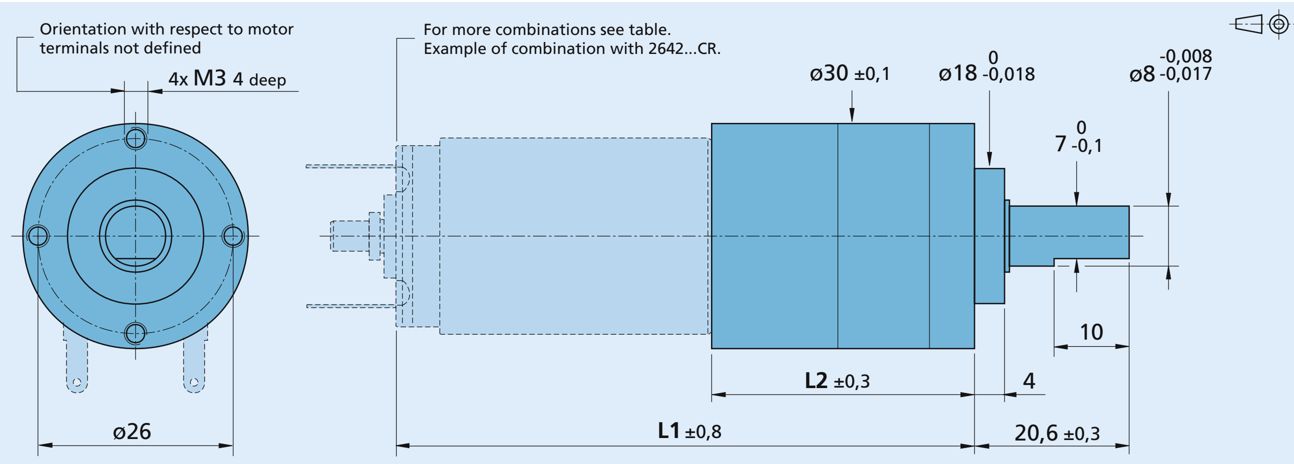
Series 30/1 S

	30/1 S
Housing material	metal
Geartrain material	steel
Recommended max. input speed for:	
– continuous operation	4 000 rpm
Backlash, at no-load	≤ 1 °
Bearings on output shaft	ball bearings, preloaded
Shaft load, max.:	
– radial (15 mm from mounting face)	≤ 150 N
– axial	≤ 150 N
Shaft press fit force, max.	≤ 200 N
Shaft play	
– radial (15 mm from mounting face)	≤ 0,03 mm
– axial	≤ 0,15 mm
Operating temperature range	- 30 ... + 100 °C

Specifications						
Number of gear stages			2	3	4	5
Continuous torque		Nm	4,5	4,5	4,5	4,5
Intermittent torque		Nm	6	6	6	6
Mass without motor, ca.		g	139	171	203	235
Efficiency, max.		%	80	70	60	55
Direction of rotation, drive to output			=	=	=	=
Reduction ratio [1]			**9,7:1**	**43:1**	**134:1**	**415:1**
(rounded)			**14:1**	**66:1**	**159:1**	**592:1**
			23:1	**86:1**	**246:1**	**989:1**
						1 526:1
L2 [mm] = length without motor [2]			35,1	43,1	51,2	59,2
L1 [mm] = length with motor	2342S...CR		77,1	85,1	93,2	101,2
	2642W...CR		77,1	85,1	93,2	101,2
	2642W...CXR		77,1	85,1	93,2	101,2
	2657W...CR		92,1	100,1	108,2	116,2
	2657W...CXR		92,1	100,1	108,2	116,2
	3272G...CR		107,1	115,1	123,2	131,2
	2444S...B		79,1	87,1	95,2	103,2
	3056K...B		92,5	100,5	108,6	116,6
	3564K...B		100,5	108,5	116,6	124,6

[1] The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.
[2] L2 + 1,4 mm, in combination with 3056K...B and 3564K...B.

Note: The gearheads as S-type have all steel gears and heavy duty lubricant for extended lifetime performance.



30/1 S

Precision Gearheads

Planetary Gearheads

4,5 Nm

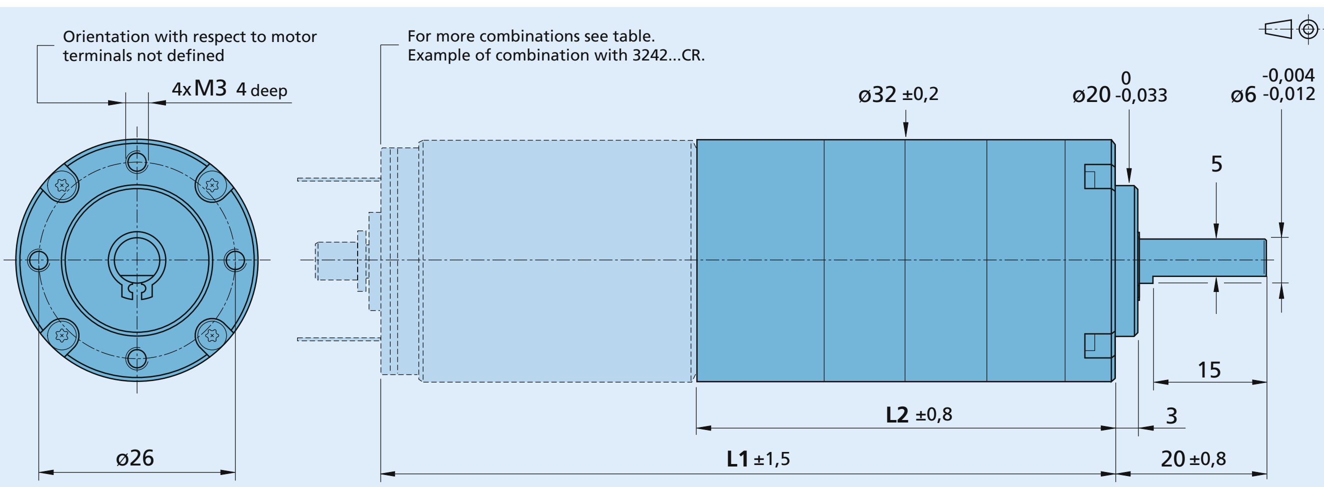
For combination with
DC-Micromotors
Brushless DC-Motors

Series 32A

	32A
Housing material	metal
Geartrain material	steel
Recommended max. input speed for:	
– continuous operation	3 000 rpm
Backlash, at no-load	≤ 2 °
Bearings on output shaft	ball bearings
Shaft load, max.:	
– radial (10 mm from mounting face)	≤ 100 N
– axial	≤ 30 N
Shaft press fit force, max.	≤ 120 N
Shaft play	
– radial (10 mm from mounting face)	≤ 0,1 mm
– axial	≤ 0,3 mm
Operating temperature range	- 25 ... + 80 °C

Specifications						
Number of gear stages			1	2	3	4
Continuous torque		Nm	0,75	2,25	4,5	4,5
Intermittent torque		Nm	1	3	6	6
Mass without motor, ca.		g	150	195	240	290
Efficiency, max.		%	88	85	75	65
Direction of rotation, drive to output			=	=	=	=
Reduction ratio [1]			**4:1**	**14:1**	**68:1**	**344:1**
(rounded)			**7:1**	**19:1**	**93:1**	**626:1**
				25:1	**124:1**	**1 140:1**
				29:1	**169:1**	**2 076:1**
				46:1	**236:1**	
					308:1	
L2 [mm] = length without motor			37,8	47,3	56,8	66,4
L1 [mm] = length with motor	2642W...CR		79,8	89,3	98,8	108,4
	2642W...CXR		79,8	89,3	98,8	108,4
	2657W...CR		94,8	104,3	113,8	123,4
	2657W...CXR		94,8	104,3	113,8	123,4
	3242G...CR		79,8	89,3	98,8	108,4
	3257G...CR		94,8	104,3	113,8	123,4
	3272G...CR		109,8	119,3	128,8	138,4
	3242G...BX4		82,0	91,5	101,0	110,6
	3268G...BX4		108,0	117,5	127,0	136,6

[1] The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.



32A

Planetary Gearheads

Low noise

4,5 Nm

For combination with
DC-Micromotors
Brushless DC-Motors

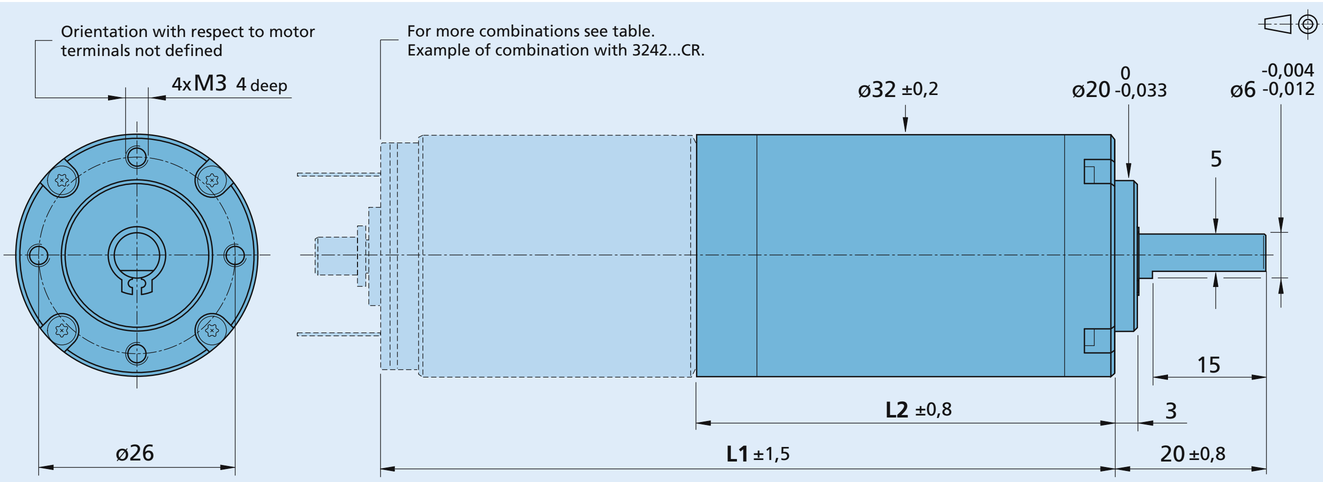
Series 32ALN

	32ALN
Housing material	metal
Geartrain material	plastic/steel
Recommended max. input speed for:	
– continuous operation	3 000 rpm
Backlash, at no-load	≤ 2 °
Bearings on output shaft	ball bearings
Shaft load, max.:	
– radial (10 mm from mounting face)	≤ 100 N
– axial	≤ 30 N
Shaft press fit force, max.	≤ 120 N
Shaft play	
– radial (10 mm from mounting face)	≤ 0,1 mm
– axial	≤ 0,3 mm
Operating temperature range	- 15 ... + 65 °C

Specifications					
Number of gear stages		**1**	**2**	**3**	**4**
Continuous torque	Nm	0,75	2,25	4,5	4,5
Intermittent torque	Nm	1	3	6	6
Mass without motor, ca.	g	125	195	240	290
Efficiency, max.	%	88	85	75	65
Direction of rotation, drive to output		=	=	=	=
Reduction ratio [1]		**4:1**	**14:1**	**68:1**	**344:1**
(rounded)		**7:1**	**19:1**	**93:1**	**626:1**
			25:1	**124:1**	**1 140:1**
			29:1	**169:1**	**2 076:1**
			46:1	**236:1**	
				308:1	
L2 [mm] = length without motor		37,8	47,3	56,8	66,4
L1 [mm] = length with motor	2642W...CR	79,8	89,3	98,8	108,4
	2657W...CR	94,8	104,3	113,8	123,4
	3242G...CR	79,8	89,3	98,8	108,4
	3257G...CR	94,8	104,3	113,8	123,4
	3272G...CR	109,8	119,3	128,8	138,4
	3242G...BX4	82,0	91,5	101,0	110,6
	3268G...BX4	108,0	117,5	127,0	136,6

[1] The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.

Note: Motor option - 3888 is required for combination with 2642W...CR, 2657W...CR, 3242G...CR and 3257G...CR.



32ALN

Precision Gearheads

Planetary Gearheads

7 Nm

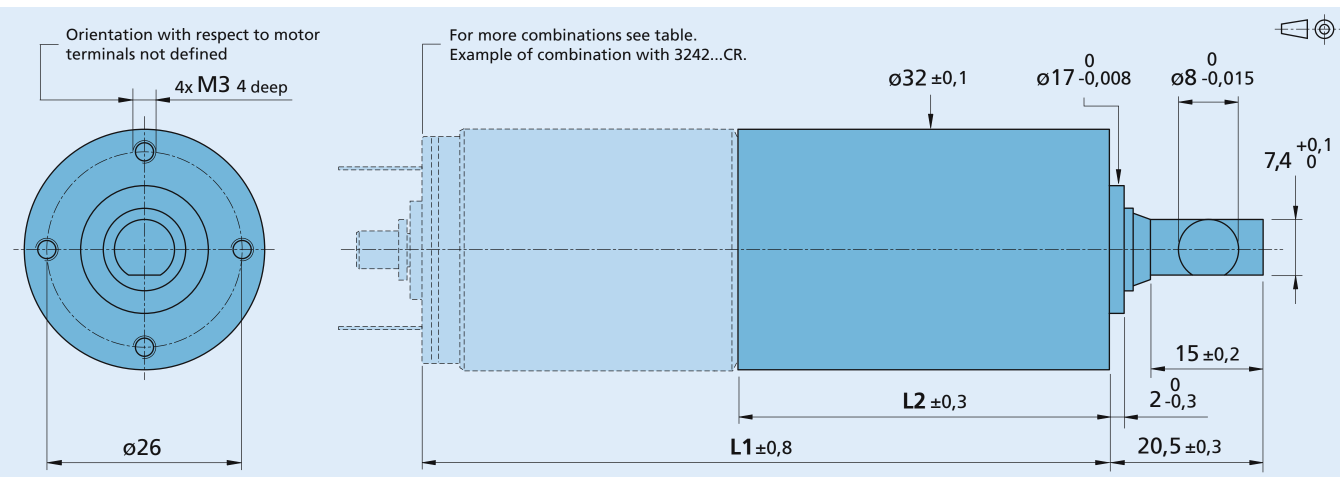
For combination with
DC-Micromotors
Brushless DC-Motors

Series 32/3

	32/3
Housing material	metal
Geartrain material 1)	plastic/steel
Recommended max. input speed for:	
– continuous operation	4 000 rpm
Backlash, at no-load	≤ 1 °
Bearings on output shaft	ball bearings, preloaded
Shaft load, max.:	
– radial (10 mm from mounting face)	≤ 200 N
– axial	≤ 200 N
Shaft press fit force, max.	≤ 250 N
Shaft play	
– radial (10 mm from mounting face)	≤ 0,03 mm
– axial	≤ 0,15 mm
Operating temperature range	- 20 ... + 125 °C

Specifications										
Number of gear stages		**1**	**2**	**3**	**3**	**4**	**4**	**4**	**5**	**5**
Continuous torque	Nm	4,2	0,4	1,4	2	4	4,9	5,8	7	7
Intermittent torque	Nm	5,3	0,6	1,9	2,6	5,2	6,5	8	10	10
Mass without motor, ca.	g	160	190	230	230	260	260	260	290	300
Efficiency, max.	%	88	80	70	70	60	60	60	55	55
Direction of rotation, drive to output		=	=	=	=	=	=	=	=	=
Reduction ratio 2) (rounded)		**3,71:1**	**14:1**	**43:1**	**66:1**	**134:1**	**159:1**	**246:1**	**415:1** **592:1** **989:1**	**1 526:1**
L2 [mm] = length without motor		33,9	41,6	49,4	49,4	57,2	57,2	57,2	65,0	65,0
L1 [mm] = length with motor	3242G...CR	75,9	83,6	91,4	91,4	99,2	99,2	99,2	107,0	107,0
	3257G...CR	90,9	98,6	106,4	106,4	114,2	114,2	114,2	122,0	122,0
	3272G...CR	105,9	113,6	121,4	121,4	129,2	129,2	129,2	137,0	137,0
	3242G...BX4	78,1	85,8	93,6	93,6	101,4	101,4	101,4	109,2	109,2
	3268G...BX4	104,1	111,8	119,6	119,6	127,4	127,4	127,4	135,2	135,2
	3564K...B	97,9	105,6	113,4	113,4	121,2	121,2	121,2	129,0	129,0

1) Gearheads with ratios < 14:1 have all steel gears.
2) The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.



32/3

Planetary Gearheads

7 Nm

For combination with
DC-Micromotors
Brushless DC-Motors

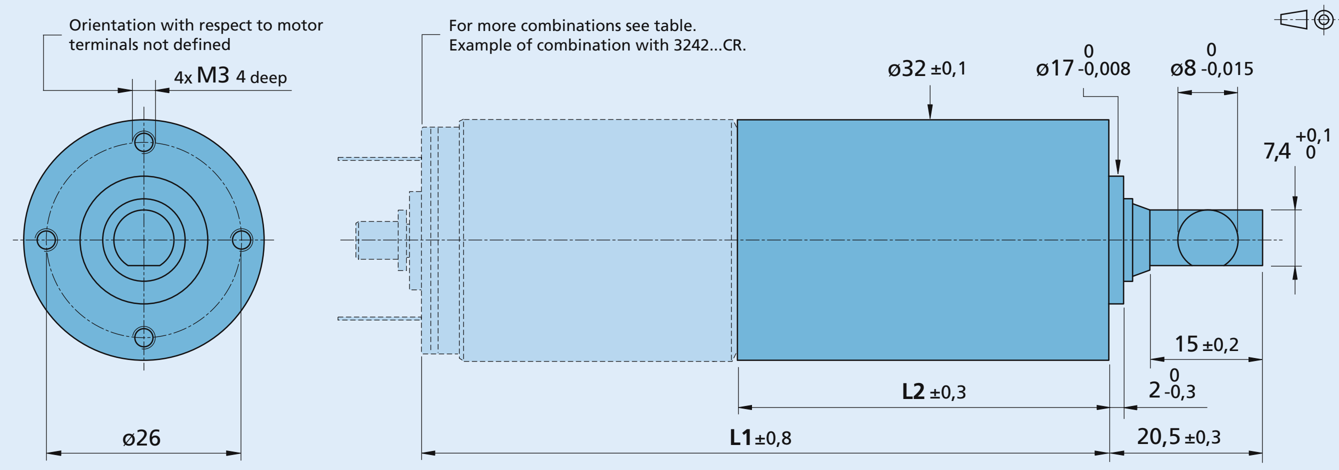
Series 32/3 S

	32/3 S
Housing material	metal
Geartrain material	steel
Recommended max. input speed for:	
– continuous operation	4 000 rpm
Backlash, at no-load	≤ 1 °
Bearings on output shaft	ball bearings, preloaded
Shaft load, max.:	
– radial (10 mm from mounting face)	≤ 200 N
– axial	≤ 200 N
Shaft press fit force, max.	≤ 250 N
Shaft play	
– radial (10 mm from mounting face)	≤ 0,03 mm
– axial	≤ 0,15 mm
Operating temperature range	- 20 ... + 125 °C

Specifications							
Number of gear stages			**2**	**3**	**4**	**5**	**5**
Continuous torque		Nm	7	7	7	7	7
Intermittent torque		Nm	10	10	10	10	10
Mass without motor, ca.		g	190	230	260	290	300
Efficiency, max.		%	80	70	60	55	55
Direction of rotation, drive to output			=	=	=	=	=
Reduction ratio [1]			**14:1**	**43:1**	**134:1**	**415:1**	**1 526:1**
(rounded)			**23:1**	**66:1**	**159:1**	**592:1**	
				86:1	**246:1**	**989:1**	
L2 [mm] = length without motor			41,6	49,4	57,2	65,0	65,0
L1 [mm] = length with motor	3242G...CR		83,6	91,4	99,2	107,0	107,0
	3257G...CR		98,6	106,4	114,2	122,0	122,0
	3272G...CR		113,6	121,4	129,2	137,0	137,0
	3242G...BX4		85,8	93,6	101,4	109,2	109,2
	3268G...BX4		111,8	119,6	127,4	135,2	135,2
	3564K...B		105,6	113,4	121,2	129,0	129,0

[1] The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.

Note: The gearheads as S-type have all steel gears and heavy duty lubricant for extended lifetime performance.



32/3 S

Planetary Gearheads

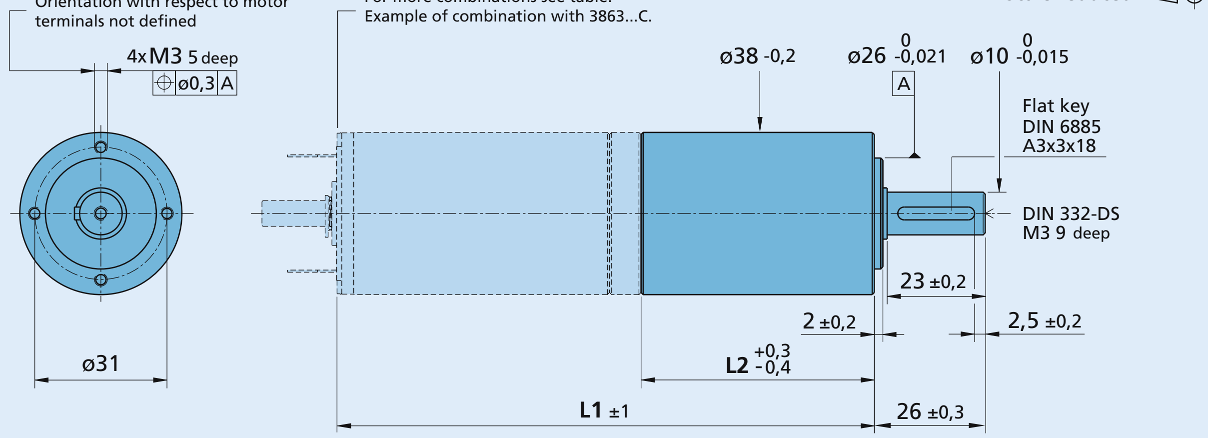
20 Nm

For combination with
DC-Micromotors
Brushless DC-Motors

Series 38A

	38A
Housing material	steel
Geartrain material	steel
Recommended max. input speed for:	
– continuous operation	4 500 rpm
Backlash, at no-load	≤ 0,6 °
Bearings on output shaft	ball bearings
Shaft load, max.:	
– radial (14,5 mm from mounting face)	≤ 200 N
– axial	≤ 200 N
Shaft press fit force, max.	≤ 490 N
Shaft play	
– radial (14,5 mm from mounting face)	≤ 0,02 mm
– axial	≤ 0,3 mm
Operating temperature range	- 25 ... + 90 °C

Specifications								
Number of gear stages		1	2	2	3	3	4	4
Continuous torque	Nm	6	20	18	20	18	20	18
Intermittent torque	Nm	9,6	32	29	32	29	32	29
Mass without motor, ca.	g	190	260	260	330	330	410	410
Efficiency, max.	%	96	94	94	90	90	80	80
Direction of rotation, drive to output		=	=	=	=	=	=	=
Reduction ratio (exact)		**4:1** **5:1**	**12:1** **16:1** **20:1**	**25:1**	**36:1** **45:1** **60:1** **80:1** **100:1** **120:1** **160:1**	**200:1**	**240:1** **360:1** **480:1** **800:1**	**1 600:1**
L2 [mm] = length without motor		42,2	55,0	55,0	67,6	67,6	80,2	80,2
L1 [mm] = length with motor	3242G...CR	78,8	91,6	91,6	104,2	104,2	116,8	116,8
	3257G...CR	93,8	106,6	106,6	119,2	119,2	131,8	131,8
	3272G...CR	108,8	121,6	121,6	134,2	134,2	146,8	146,8
	3863H...CR	113,6	126,4	126,4	139,0	139,0	151,6	151,6
	3890H...CR	132,2	145,0	145,0	157,6	157,6	170,2	170,2
	3564K...B	106,2	119,0	119,0	131,6	131,6	144,2	144,2
	4490H...B	139,6	152,4	152,4	165,0	165,0	177,6	177,6
	4490H...BS	139,6	152,4	152,4	165,0	165,0	177,6	177,6



38A

Planetary Gearheads

10 Nm

For combination with
DC-Micromotors
Brushless DC-Motors

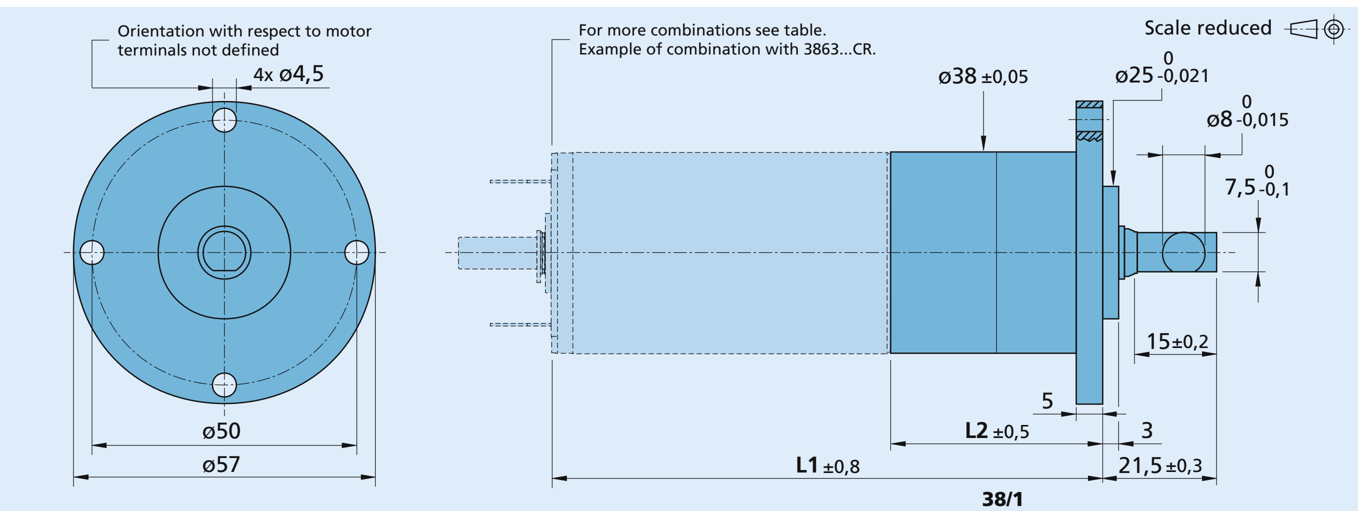
Series 38/1

	38/1
Housing material	metal
Geartrain material [1]	plastic/steel
Recommended max. input speed for:	
– continuous operation	4 000 rpm
Backlash, at no-load	≤ 1 °
Bearings on output shaft	ball bearings, preloaded
Shaft load, max.:	
– radial (10 mm from mounting face)	≤ 300 N
– axial	≤ 300 N
Shaft press fit force, max.	≤ 350 N
Shaft play	
– radial (10 mm from mounting face)	≤ 0,03 mm
– axial	≤ 0,15 mm
Operating temperature range	- 20 ... + 125 °C

Specifications

Number of gear stages		**1**	**2**	**3**	**3**	**4**	**4**	**4**	**5**
Continuous torque	Nm	6	0,4	1,4	2,2	4,5	5,3	8,2	10
Intermittent torque	Nm	8	0,6	1,9	2,9	6	7	11	15
Mass without motor, ca.	g	166	215	268	268	320	320	320	375
Efficiency, max.	%	88	80	70	70	60	60	60	55
Direction of rotation, drive to output		=	=	=	=	=	=	=	=
Reduction ratio [2] (rounded)		**3,71:1**	**14:1**	**43:1**	**66:1**	**134:1**	**159:1**	**246:1**	**415:1** **592:1** **989:1** **1 526:1**
L2 [mm] = length without motor [3]		32,3	40,1	47,9	47,9	55,7	55,7	55,7	63,5
L1 [mm] = length with motor	3242G...CR	73,5	81,3	89,1	89,1	96,9	96,9	96,9	104,7
	3257G...CR	88,5	96,3	104,1	104,1	111,9	111,9	111,9	119,7
	3272G...CR	103,5	111,3	119,1	119,1	126,9	126,9	126,9	134,7
	3863A...CR	91,3	99,1	106,9	106,9	114,7	114,7	114,7	122,5
	3890A...CR	122,3	130,1	137,9	137,9	145,7	145,7	145,7	153,5
	3056K...B	88,3	96,1	103,9	103,9	111,7	111,7	111,7	119,5
	3242G...BX4	75,7	83,5	91,3	91,3	99,1	99,1	99,1	106,9
	3268G...BX4	101,7	109,5	117,3	117,3	125,1	125,1	125,1	132,9
	3564K...B	96,3	104,1	111,9	111,9	119,7	119,7	119,7	127,5

[1] Gearheads with ratios < 14:1 have all steel gears.
[2] The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.
[3] L2 - 0,8 mm, in combination with 3242G...CR, 3257G...CR, 3272G...CR, 3242G...BX4 and 3268G...BX4.
L2 - 5 mm, in combination with 3863A...CR and 3890A...CR.



Precision Gearheads

Planetary Gearheads

10 Nm

For combination with
DC-Micromotors
Brushless DC-Motors

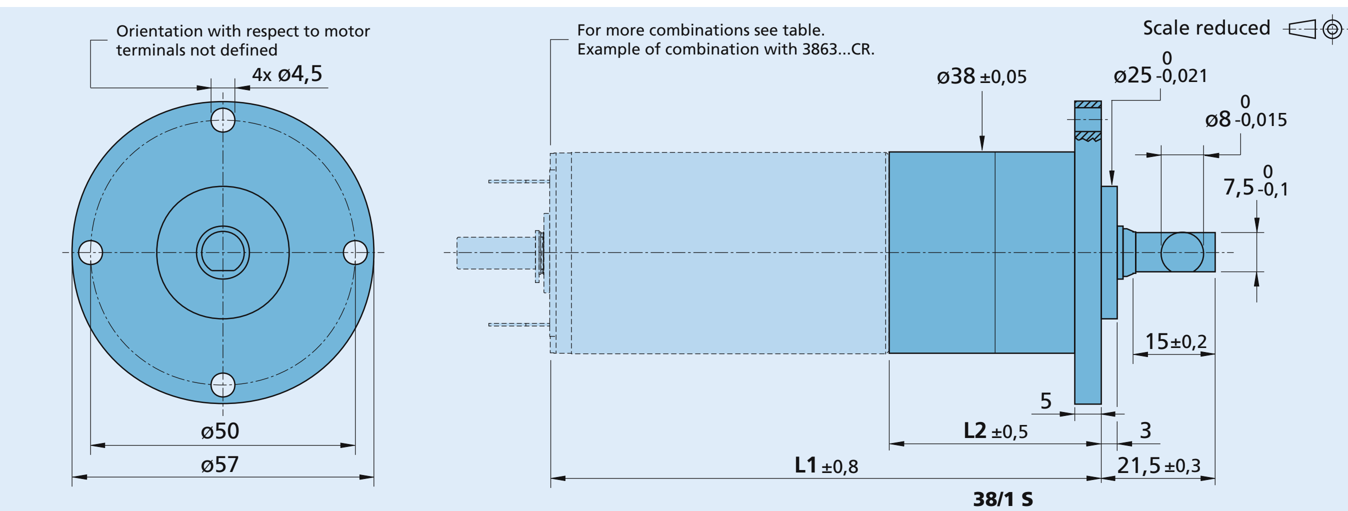
Series 38/1 S

	38/1 S
Housing material	metal
Geartrain material	steel
Recommended max. input speed for:	
– continuous operation	4 000 rpm
Backlash, at no-load	≤ 1 °
Bearings on output shaft	ball bearings, preloaded
Shaft load, max.:	
– radial (10 mm from mounting face)	≤ 300 N
– axial	≤ 300 N
Shaft press fit force, max.	≤ 350 N
Shaft play	
– radial (10 mm from mounting face)	≤ 0,03 mm
– axial	≤ 0,15 mm
Operating temperature range	- 20 ... + 125 °C

Specifications						
Number of gear stages			**2**	**3**	**4**	**5**
Continuous torque		Nm	10	10	10	10
Intermittent torque		Nm	15	15	15	15
Mass without motor, ca.		g	215	268	320	375
Efficiency, max.		%	80	70	60	55
Direction of rotation, drive to output			=	=	=	=
Reduction ratio [1] (rounded)			**14:1**	**43:1**	**134:1**	**415:1**
				66:1	**159:1**	**592:1**
					246:1	**989:1**
						1 526:1
L2 [mm] = length without motor [2]			40,1	47,9	55,7	63,5
L1 [mm] = length with motor	3242G...CR		81,3	89,1	96,9	104,7
	3257G...CR		96,3	104,1	111,9	119,7
	3272G...CR		111,3	119,1	126,9	134,7
	3863A...CR		99,1	106,9	114,7	122,5
	3890A...CR		130,1	137,9	145,7	153,5
	3056K...B		96,1	103,9	111,7	119,5
	3242G...BX4		83,5	91,3	99,1	106,9
	3268G...BX4		109,5	117,3	125,1	132,9
	3564K...B		104,1	111,9	119,7	127,5

[1] The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.
[2] L2 - 0,8 mm, in combination with 3242G...CR, 3257G...CR, 3272G...CR, 3242G...BX4 and 3268G...BX4.
L2 - 5 mm, in combination with 3863A...CR and 3890A...CR.

Note: The gearheads as S-type have all steel gears and heavy duty lubricant for extended lifetime performance.



Planetary Gearheads

10 Nm

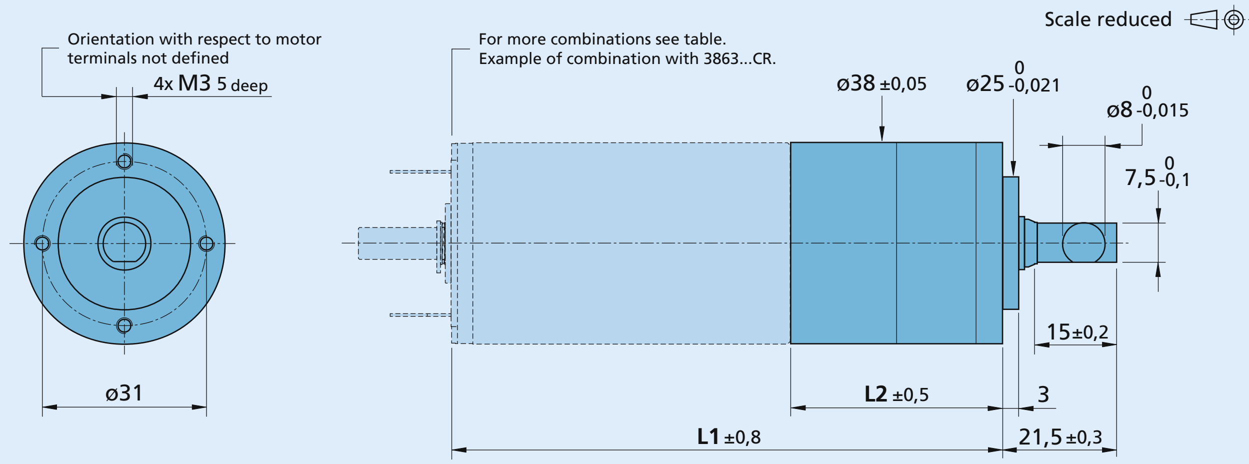
For combination with
DC-Micromotors
Brushless DC-Motors

Series 38/2

	38/2
Housing material	metal
Geartrain material 1)	plastic/steel
Recommended max. input speed for:	
– continuous operation	4 000 rpm
Backlash, at no-load	≤ 1 °
Bearings on output shaft	ball bearings, preloaded
Shaft load, max.:	
– radial (10 mm from mounting face)	≤ 300 N
– axial	≤ 300 N
Shaft press fit force, max.	≤ 350 N
Shaft play	
– radial (10 mm from mounting face)	≤ 0,03 mm
– axial	≤ 0,15 mm
Operating temperature range	- 20 ... + 125 °C

Specifications										
Number of gear stages		1	2	3	3	4	4	4	5	
Continuous torque	Nm	6	0,4	1,4	2,2	4,5	5,3	8,2	10	
Intermittent torque	Nm	8	0,6	1,9	2,9	6	7	11	15	
Mass without motor, ca.	g	145	195	245	245	296	296	296	348	
Efficiency, max.	%	88	80	70	70	60	60	60	55	
Direction of rotation, drive to output		=	=	=	=	=	=	=	=	
Reduction ratio 2) (rounded)		**3,71:1**	**14:1**	**43:1**	**66:1**	**134:1**	**159:1**	**246:1**	**415:1** **592:1** **989:1** **1 526:1**	
L2 [mm] = length without motor 3)		32,3	40,1	47,9	47,9	55,7	55,7	55,7	63,5	
L1 [mm] = length with motor	3242G...CR	73,5	81,3	89,1	89,1	96,9	96,9	96,9	104,7	
	3257G...CR	88,5	96,3	104,1	104,1	111,9	111,9	111,9	119,7	
	3272G...CR	103,5	111,3	119,1	119,1	126,9	126,9	126,9	134,7	
	3863A...CR	91,3	99,1	106,9	106,9	114,7	114,7	114,7	122,5	
	3890A...CR	122,3	130,1	137,9	137,9	145,7	145,7	145,7	153,5	
	3056K...B	88,3	96,1	103,9	103,9	111,7	111,7	111,7	119,5	
	3242G...BX4	75,7	83,5	91,3	91,3	99,1	99,1	99,1	106,9	
	3268G...BX4	101,7	109,5	117,3	117,3	125,1	125,1	125,1	132,9	
	3564K...B	96,3	104,1	111,9	111,9	119,7	119,7	119,7	127,5	

1) Gearheads with ratios < 14:1 have all steel gears.
2) The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.
3) L2 - 0,8 mm, in combination with 3242G...CR, 3257G...CR, 3272G...CR, 3242G...BX4 and 3268G...BX4.
L2 - 5 mm, in combination with 3863A...CR and 3890A...CR.



38/2

Precision Gearheads

Planetary Gearheads

10 Nm

For combination with
DC-Micromotors
Brushless DC-Motors

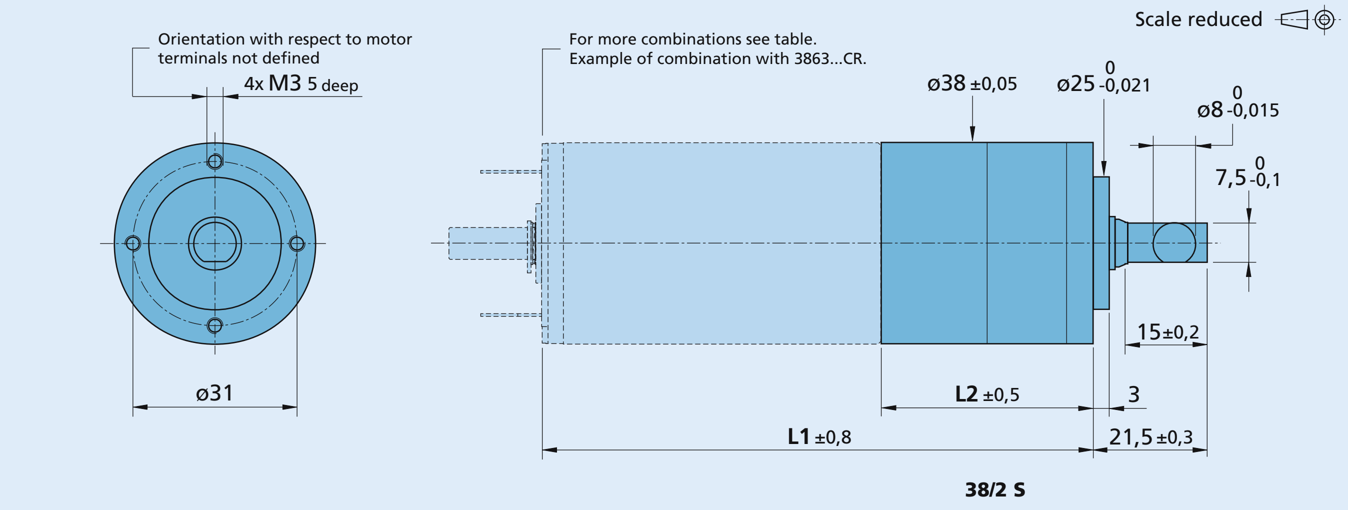
Series 38/2 S

	38/2 S
Housing material	metal
Geartrain material	steel
Recommended max. input speed for:	
– continuous operation	4 000 rpm
Backlash, at no-load	≤ 1 °
Bearings on output shaft	ball bearings, preloaded
Shaft load, max.:	
– radial (10 mm from mounting face)	≤ 300 N
– axial	≤ 300 N
Shaft press fit force, max.	≤ 350 N
Shaft play	
– radial (10 mm from mounting face)	≤ 0,03 mm
– axial	≤ 0,15 mm
Operating temperature range	- 20 ... + 125 °C

Specifications						
Number of gear stages			**2**	**3**	**4**	**5**
Continuous torque		Nm	10	10	10	10
Intermittent torque		Nm	15	15	15	15
Mass without motor, ca.		g	195	245	296	348
Efficiency, max.		%	80	70	60	55
Direction of rotation, drive to output			=	=	=	=
Reduction ratio [1]			**14:1**	**43:1**	**134:1**	**415:1**
(rounded)				**66:1**	**159:1**	**592:1**
					246:1	**989:1**
						1 526:1
L2 [mm] = length without motor [2]			40,1	47,9	55,7	63,5
L1 [mm] = length with motor	3242G...CR		81,3	89,1	96,9	104,7
	3257G...CR		96,3	104,1	111,9	119,7
	3272G...CR		111,3	119,1	126,9	134,7
	3863A...CR		99,1	106,9	114,7	122,5
	3890A...CR		130,1	137,9	145,7	153,5
	3056K...B		96,1	103,9	111,7	119,5
	3242G...BX4		83,5	91,3	99,1	106,9
	3268G...BX4		109,5	117,3	125,1	132,9
	3564K...B		104,1	111,9	119,7	127,5

[1] The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.
[2] L2 - 0,8 mm, in combination with 3242G...CR, 3257G...CR, 3272G...CR, 3242G...BX4 and 3268G...BX4.
L2 - 5 mm, in combination with 3863A...CR and 3890A...CR.

Note: The gearheads as S-type have all steel gears and heavy duty lubricant for extended lifetime performance.



Planetary Gearheads

16 Nm

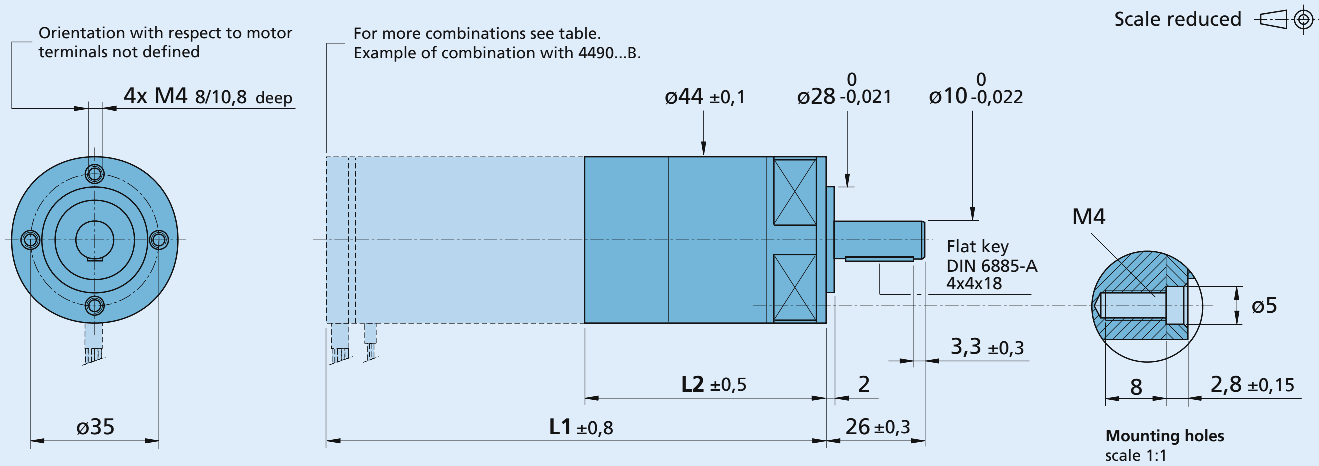
For combination with
DC-Micromotors
Brushless DC-Motors

Series 44/1

	44/1
Housing material	metal
Geartrain material	metal
Recommended max. input speed for:	
– continuous operation	3 500 rpm
Backlash, at no-load	≤ 1 °
Bearings on output shaft	ball bearings, preloaded
Shaft load, max.:	
– radial (12 mm from mounting face)	≤ 400 N
– axial	≤ 350 N
Shaft press fit force, max.	≤ 500 N
Shaft play	
– radial (12 mm from mounting face)	≤ 0,03 mm
– axial	= 0 mm
Operating temperature range	- 30 ... + 125 °C

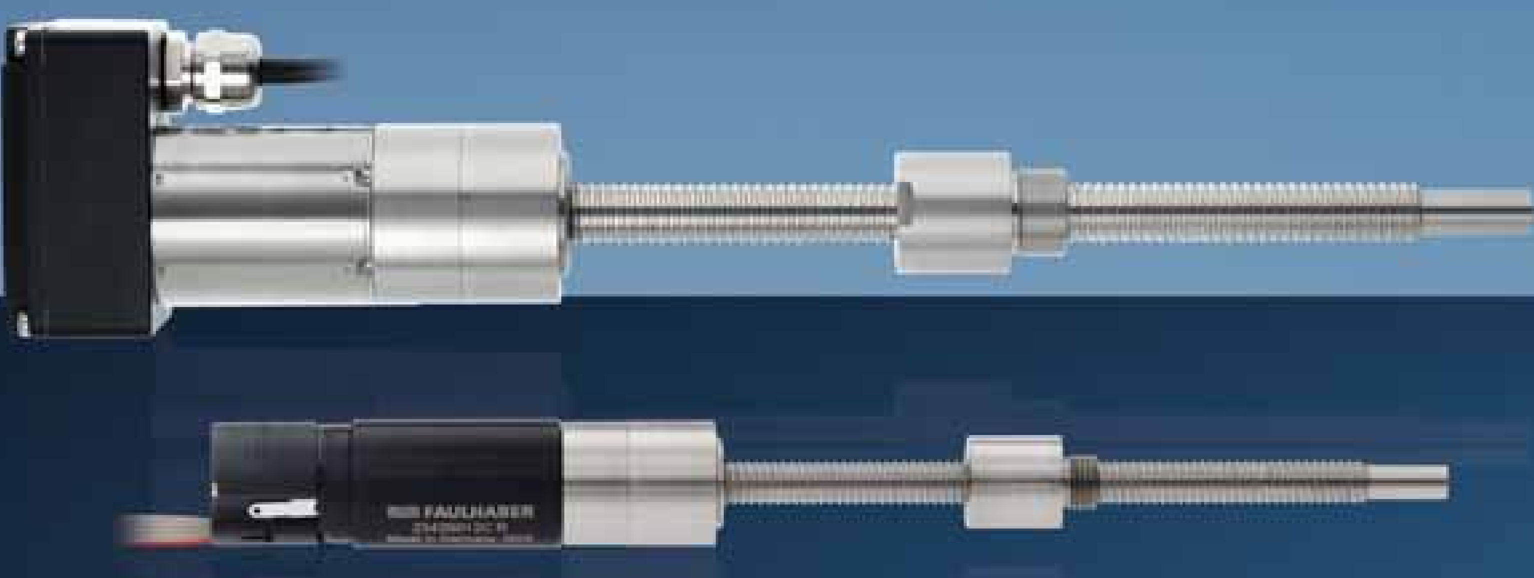
Specifications						
Number of gear stages		**1**	**2**	**3**	**4**	**5**
Continuous torque	Nm	16	16	16	16	16
Intermittent torque	Nm	20	20	20	20	20
Mass without motor, ca.	g	480	600	720	840	960
Efficiency, max.	%	90	80	70	65	60
Direction of rotation, drive to output		=	=	=	=	=
Reduction ratio [1] (rounded)		**4,8:1**	**23:1**	**111:1**	**531:1**	**2 548:1**
L2 [mm] = length without motor		62,2	77,8	93,2	108,6	124,0
L1 [mm] = length with motor	3863H...CR	126,2	141,8	157,2	172,6	188,0
	3890H...CR	152,2	167,8	183,2	198,6	214,0
	4490H...B	152,2	167,8	183,2	198,6	214,0
	4490H...BS	152,2	167,8	183,2	198,6	214,0

[1] The reduction ratios are rounded, the exact values are available on request or at www.faulhaber.com.



44/1

Linear Components



WE CREATE MOTION

FAULHABER

Ball Screw

Technical information

General information

Function:
Ball screws convert rotational movements into an axial movement. Ball screws, which are designed as a recirculating ball screw, have a very high level of efficiency in comparison with planetary screw drives (such as trapezoidal screws or metric screws) due to the lower rolling friction that occurs. In addition, the superior manufacturing precision enables a very low axial play, accompanied by a very high positioning accuracy.

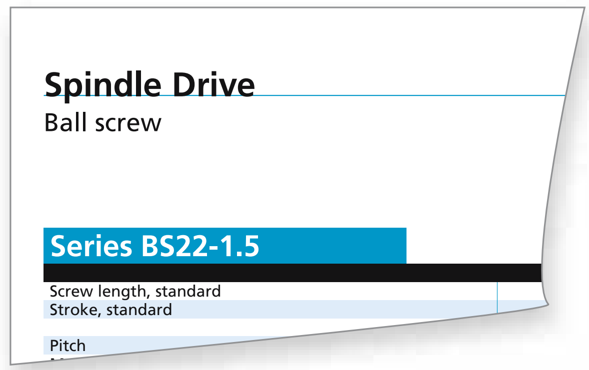
In addition to the ball screw, the BS product series also includes both the bearing and the coupling to the motor. The duplex bearing used in this case – a pair of angular ball bearings with backlash-free mounting – enables the absorption of axial tensile and compressive forces. The high-precision pin coupling transmits the motor torque to the screw virtually backlash-free.

Mounting
A number of threaded holes are provided on the front of the housing for the purpose of attaching the motor-screw combination.

Because of the high-precision raceways and the low-backlash or backlash-free adjustment, the ball screw nut cannot compensate for radial deviations between screw axis and any additional guides of an attachment to the nut. A radial decoupling element must be provided here if necessary. This relates to deviations of the radial distance (misalignment) and angular deviations (tipping) of the guides.

In order to reduce radial forces on the bearing, it is recommended that the screw is supported by an additional bearing.

Handling
The ball raceways on the ball screws are exposed. For this reason, the screw drives have to be protected against dirt and contamination. The ball screw nut must never, either in operation or during mounting, be moved out beyond the raceway area of the ball screw.



Explanations regarding the data sheets

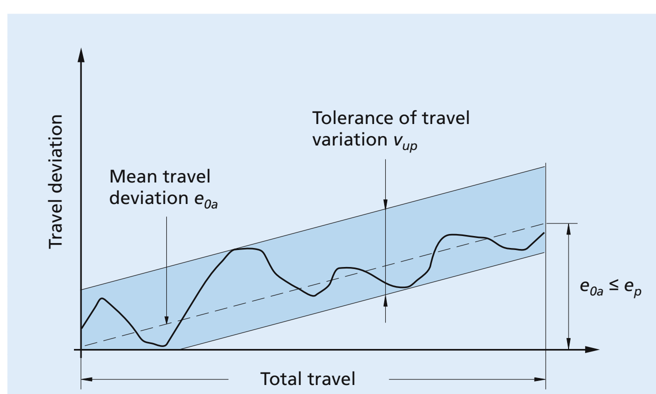
Ball screw length, standard [mm]
Designates the length of the ball screw between the front of the housing and the end of the ball screw.

Stroke [mm]
Maximum path which the ball screw nut may axially travel. The metric fastening thread of the ball screw nut can protrude beyond the raceway area of the ball screw.

Pitch P_h [mm]
Axial displacement when rotating the ball screw by 360° relative to the ball screw nut.

Average actual travel deviation, max. permissible e_p [µm]
The averaged deviation of the actual travel from the ideal nominal travel is called the average actual travel deviation e_{0a}. This is limited by the value e_p over the entire travel ($e_{0a} \leq e_p$).

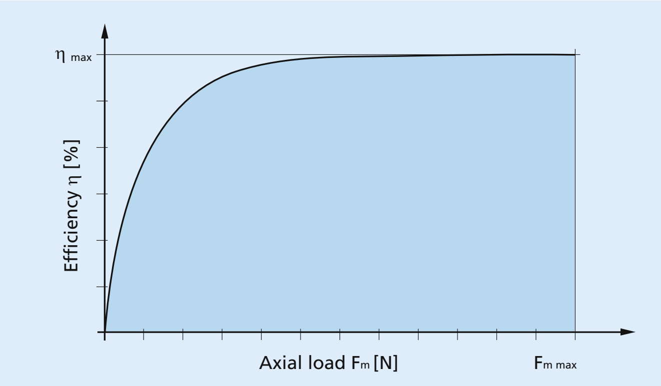
Tolerance of travel variation V_{up} [µm]
In parallel with the average actual travel deviation, short-wave travel variations can occur. The bandwidth, represented as a blue band in the following, is limited by the value of the tolerance of travel variation v_{up}.



Ball Screw

Technical information

Efficiency $\eta_{max.}$ [%]
Describes the ratio between the power input and power output of the ball screw at axial load $F_{m\ max.}$



Please observe the dependence of the efficiency on the axial load, especially for small axial loads.

Operating temperature range [C°]
Designates the maximum and minimum permissible operating temperature of the ball screw.

Axial load capacity, dynamic C_{am} [N]
Parameter for calculating the theoretical service life. This corresponds to a constant axial load in a constant direction, at which a theoretical service life of 10^6 revolutions is achieved. This is based on a life expectancy of 90%.

Axial load capacity, static C_{oa} [N]
Maximum permissible axial loading of the ball screw nut. Unless specified otherwise, this is also the maximum permissible axial loading of the ball screw. To prevent exceeding of the permissible loading, the motor current must be limited if necessary.

Max. permissible shaft loading, radial $F_{rs\ max}$ [N]
Maximum permissible radial loading of the ball screw. This is dependent on the acting lever arm.

Screw nut, axial play [µm]
Maximum axial displacement of the ball screw nut in relation to the ball screw, if these are not twisted towards each other. This is determined using an axial test force of 3.5 N.

Max. permissible nut loading, radial $F_{rn\ max}$ [N]
Maximum permissible radial loading of the ball screw nut.

Direction of rotation
Direction of rotation of the ball screw, observed from the direction of the ball screw. With a right-hand thread the clockwise direction of rotation of the drive shaft (= rotating clockwise) results in an increase in the distance between drive and ball screw nut.

Recommended values

The maximum permissible values for continuous operation in order to obtain an optimal service life are listed below. The values are mathematically independent of each other.

Continuous axial load $F_{m\ max.}$ [N]
Designates the maximum recommended axial load during continuous operation.

Intermittent axial load $F_{p\ max.}$ [N]
Designates the maximum permissible axial load. The motor current must be limited if necessary in order to prevent exceeding of the permissible loading.

Rotational speed, max. [rpm]
Designates the maximum permissible rotational speed.

Linear speed, max. [mm/s]
Designates the maximum permissible linear speed. This results from the product of the maximum permissible rotational speed and the pitch P_h.

Calculations

Calculation of the motor drive torque
The minimum required motor drive torque can be derived as follows

$$M_{mot} = \frac{F_m \cdot P_h \cdot 100}{2\pi \cdot \eta}$$

Required motor torque	M_{mot}	[mNm]
Continuous axial load	F_m	[N]
Pitch	P_h	[mm]
Efficiency	η	[%]

Calculation of the motor drive speed

$$n_{mot} = \frac{v \cdot 60}{P_h}$$

Required motor speed	n_{mot}	[rpm]
Linear speed	v	[mm/s]
Pitch	P_h	[mm]

Calculation of the theoretical lifetime
The service life depends on the following factors:

- Axial load
- Linear speed
- Operating conditions
- Environment and installation in other systems

As a very large number of parameters come into play in any application, a precise service life definition is not possible.

As a non-binding reference value a theoretical service life can be calculated on the basis of standard ISO 3408:

The theoretical service life is generally defined by the number of revolutions. Alternatively, it can also be specified in hours or as travel. It is based on a life expectancy of 90%.

The theoretical service life is calculated as follows:

$$L_{rev} = \left(\frac{C_{am}}{F_m}\right)^3 \cdot 10^6$$

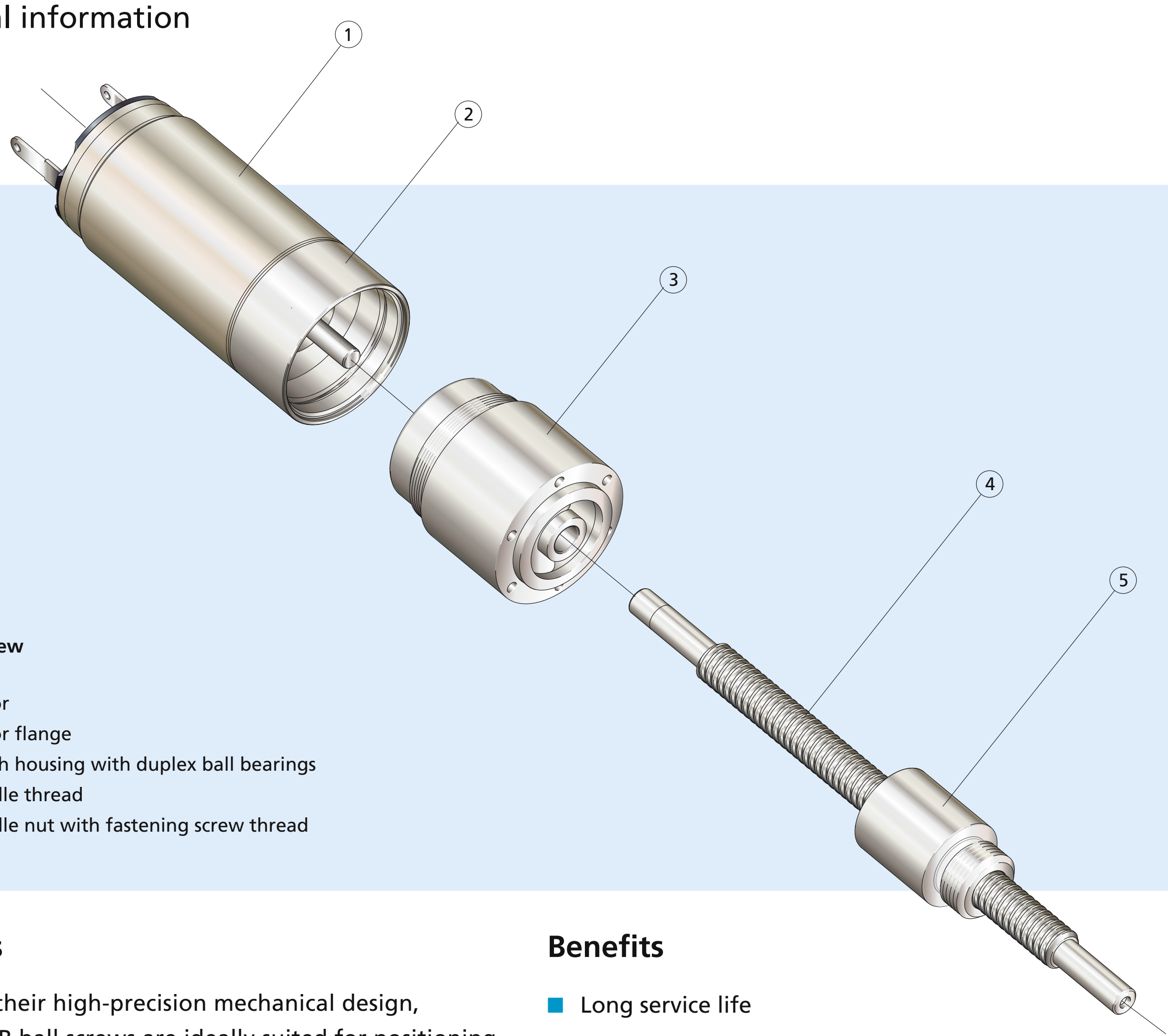
$$L_h = \frac{L_{rev}}{n_m \cdot 60}$$

$$L_s = P_h \cdot \left(\frac{C_{am}}{F_m}\right)^3 \cdot 10^3$$

Service life in revolutions	L_{rev}	[rev]
Service life in hours	L_h	[h]
Service life in meters	L_s	[m]
Dynamic axial load capacity	C_{am}	[N]
Continuous axial load	F_m	[N]
Average motor speed	n_m	[min^{-1}]
Pitch	P_h	[mm]

Ball Screw

Technical information



Ball Screw

① Motor
② Motor flange
③ Clutch housing with duplex ball bearings
④ Spindle thread
⑤ Spindle nut with fastening screw thread

Features

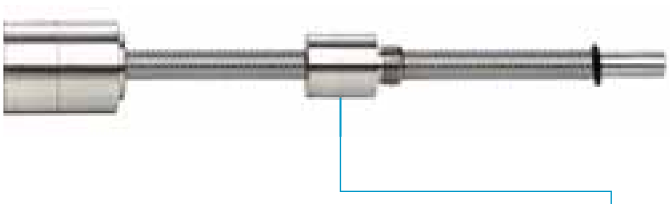
Thanks to their high-precision mechanical design, FAULHABER ball screws are ideally suited for positioning tasks requiring a high degree of accuracy. Combinations with DC-Micromotors with high-resolution encoders, integrated Motion Controllers or Stepper Motors represent a superior system solution for the most demanding applications in optical systems, special machine construction, automation or medical technology.

Compact design in conjunction with numerous modification options translates into the perfect drive solution for a wide range of applications.

Benefits

- Long service life
- High efficiency
- Variable length
- Customized versions with special lubrication for extended application areas
- High positioning accuracy thanks to considerably reduced play

Product Code



BS 22-1.5

BS	Ball screw
22	Coupling diameter [mm]
1.5	Pitch [mm]

FAULHABER

Spindle Drive

Ball screw

105 N

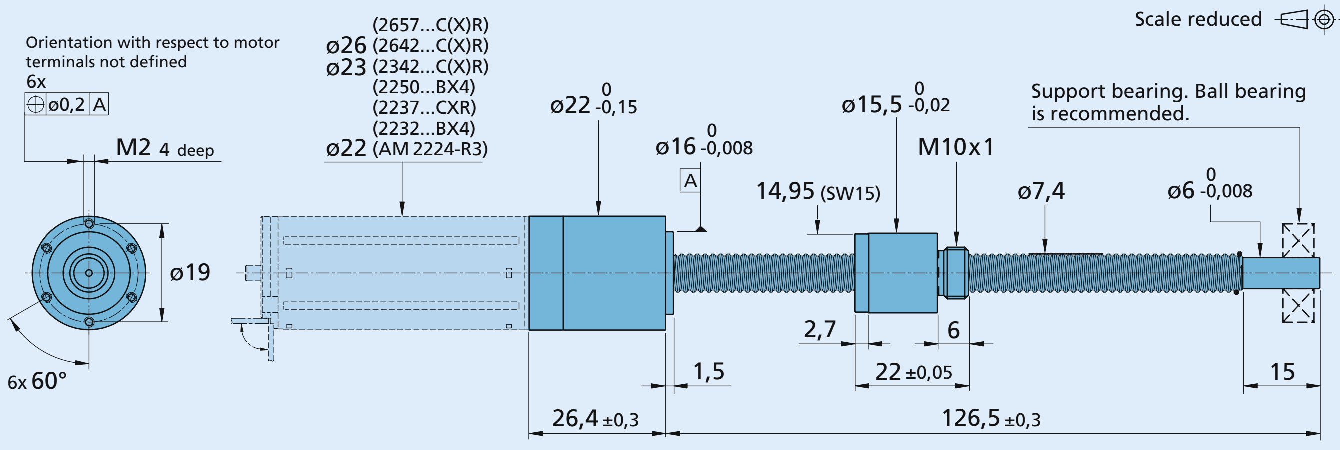
For combination with
DC-Micromotors
Brushless DC-Servomotors
Stepper Motors

Series BS22-1.5

			BS22-1.5	
Screw length, standard			126,5	mm
Stroke, standard			94	mm
Pitch	P_h		1,5	mm
Mean actual travel deviation e_{0a}:				
– maximum permissible	e_p		5 (According to accuracy class 1)	µm
Tolerance of travel variation	v_{up}		5 (According to accuracy class 1)	µm
Efficiency, max.	$\eta_{max.}$		89	%
Operating temperature range		–35 ... +100		°C
Bearing		ball bearings, preloaded		
Axial load capacity:				
– dynamic	C_{am}	≤ 519		N
– static	C_{oa}	≤ 475		N
Shaft load, max.:				
– radial (50 mm from mounting face)	$F_{rs\ max}$	≤ 43		N
Screw nut:				
– axial play		≤ 5		µm
Screw nut load, max.:				
– radial	$F_{rn\ max}$	≤ 23		N
Material				
– screw		stainless steel		
– nut		stainless steel		
– balls		stainless steel		
Direction of rotation		right hand thread		

Recommended values - mathematically independent of each other				
Continous axial load, max.	$F_{m\ max.}$		105	N
Intermittent axial load, max.	$F_{p\ max.}$		475	N
Rotational speed, max.			5 000	rpm
Linear speed, max.			125	mm/s

Note: Specifications are valid over the whole entire travel according to ISO 3408.
A clean and contamination/dust free operating environment is required for performance as specified in the datasheet.
Do not remove the nut from the screw! No relubrication allowed.



BS22-1.5

Spindle Drive

Ball screw

176 N

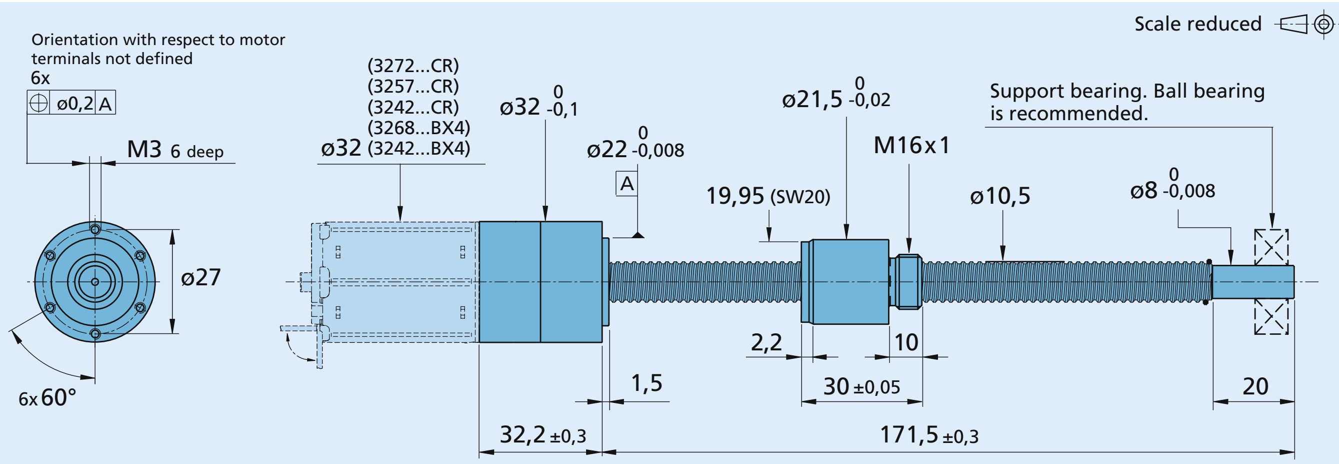
For combination with
DC-Micromotors
Brushless DC-Servomotors

Series BS32-2.0

			BS32-2.0	
Screw length, standard			171,5	mm
Stroke, standard			130	mm
Pitch	P_h		2,0	mm
Mean actual travel deviation e_{0a}:				
– maximum permissible	e_p		5 (According to accuracy class 1)	µm
Tolerance of travel variation	v_{up}		5 (According to accuracy class 1)	µm
Efficiency, max.	$\eta_{max.}$		91	%
Operating temperature range		–35 ... +100		°C
Bearing		ball bearings, preloaded		
Axial load capacity:				
– dynamic	C_{am}	≤ 890		N
– static	C_{oa}	≤ 887		N
Shaft load, max.:				
– radial (50 mm from mounting face)	$F_{rs\ max}$	≤ 100		N
Screw nut:				
– axial play		≤ 5		µm
Screw nut load, max.:				
– radial	$F_{rn\ max}$	≤ 44		N
Material				
– screw		stainless steel		
– nut		stainless steel		
– balls		stainless steel		
Direction of rotation		right hand thread		

Recommended values - mathematically independent of each other				
Continous axial load, max.	$F_{m\ max.}$		176	N
Intermittent axial load, max.	$F_{p\ max.}$		887	N
Rotational speed, max.			5 000	rpm
Linear speed, max.			166	mm/s

Note: Specifications are valid over the whole entire travel according to ISO 3408.
A clean and contamination/dust free operating environment is required for performance as specified in the datasheet.
Do not remove the nut from the screw! No relubrication allowed.



BS32-2.0

Lead Screws and Options

Technical Information

Lead Screws Parameters

Resolution (travel/step)
A lead screw combined with a PRECIstep® stepper motor can achieve a positioning with a resolution of 10µm.

The resolution of the position depends on the pitch and number of steps per revolution:

$$P = \frac{P_h}{n}$$

With P_h the pitch of the screw and n the number of steps per revolution of the motor.

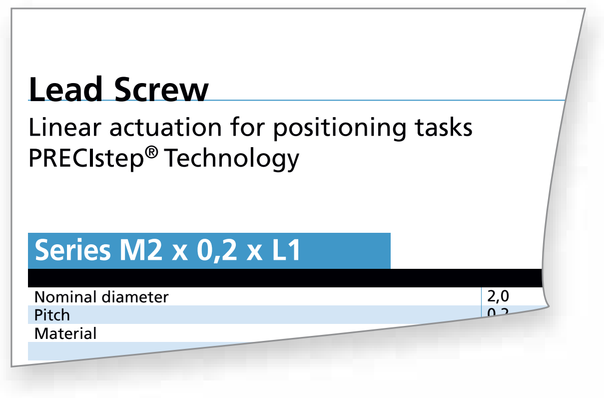
Driving the motor with half-stepping or microstepping will improve the resolution up to a certain extent.
The resolution must be balanced with another parameter: the precision.

Precision
The motor step angle accuracy is one parameter, together with the axial play between the nut and the lead screw, influencing the precision of the linear displacement. It varies between ±3 and ±10% of a full step angle depending on the motor model (see line 9 on motor datasheet) and remains the same with microstepping. It is however not cumulative.

Axial play
An axial play up to 30µm is measured with optional nuts offered in this catalogue. However, it is possible to negate the axial play by implementing a preloading system in the design of the application (for instance with a spring mechanism).

The "zero" axial play between the lead screw and motor housing is ensured thanks to a preload of the motor ball bearings (in standard configuration: spring washer on rear ball bearing). An axial play up to 0.2 mm will occur if the axial load on the lead screw exceeds the ball bearing preload.

This does not cause any damage to the motor and is reversible. This limit is translated into a flat portion on the force vs speed curves of lead screws datasheet. This occurs only while pulling on the shaft. On request, customization can overcome this limitation.


Lead Screw
Linear actuation for positioning tasks
PRECIstep® Technology
Series M2 x 0,2 x L1

Nominal diameter	2,0
Pitch	0,2
Material	

Backdriving
Backdriving the motors while applying an axial load on the lead screws is impossible. The pitch vs. diameter ratio does not allow it.

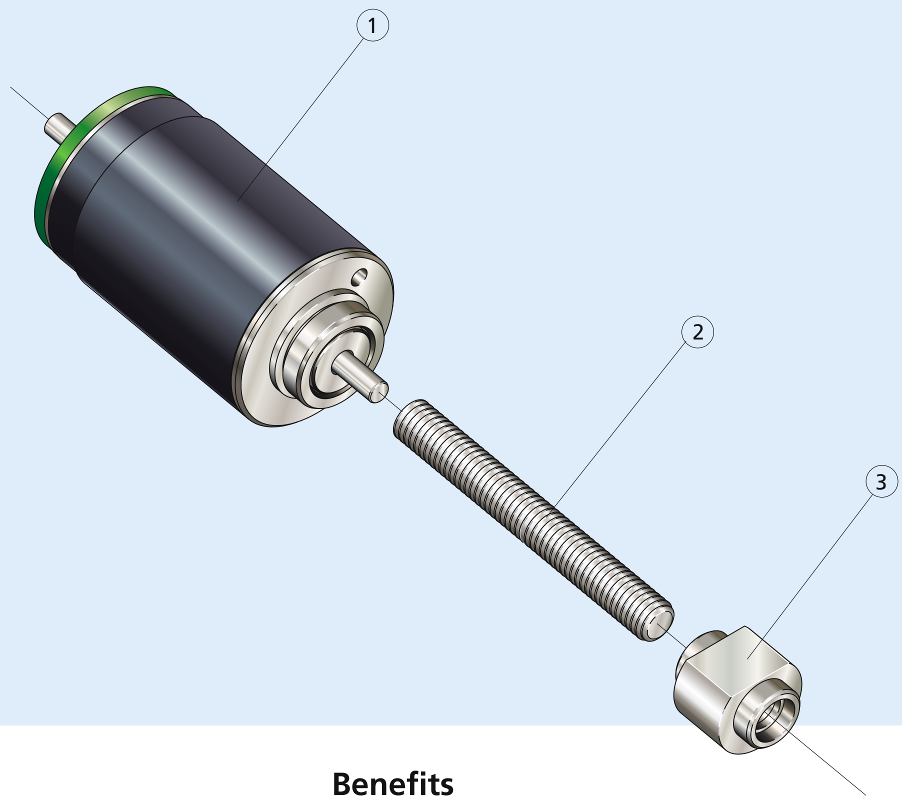
Force vs speed curves
The force that a linear system can provide depends on the type of screw and stepper motor selected. Torque vs speed curves for each solution are provided in this catalogue. Those curves do already consider a 40% safety factor on the motor torque as well as the lead screw efficiency in the calculation.

Tip for bearings
Ideally, the application should handle radial loads and the lead screw only axial loads. If it is not the case, it is possible to get lead screws with a tip suitable for bearing at its front end in order to handle radial loads. With this configuration, a special care to the alignment of the motor and bearing must be paid to not deteriorate the thrust force achievable. Optional mating ball bearings are available in the dedicated datasheet for options.

Nut
Optional nuts offered in this catalogue are made of aluminum bronze alloy and are shaped with a flat in order to prevent its rotations in the application. Alternatively, tapped holes on the application are a convenient solution since metric taps are readily available.

Lead Screws and Options

Technical Information



Lead Screws

① Stepper motor
② Lead screw
③ Nut

Features

Stepper motors can be used for more than just a rotation. When combined with lead screws, they provide a high accuracy linear positioning system that provides the benefits of a stepper (open loop control, long life, high torque density, etc.).

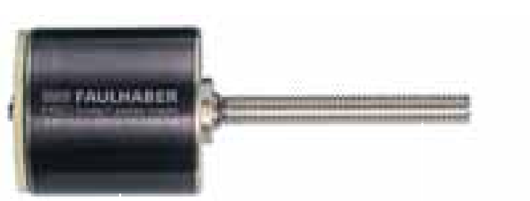
The lead screws available on stepper motors are all based on metric dimensions (M1.2 up to M3) and specifically designed to be assembled with PRECIstep® stepper motors. The rolling technique used to produce the thread ensures a very high precision and consistency of quality. A large choice of standard lengths is available from stock and customization is possible on request.

Such a combination is ideal for any application such as requiring accurate linear movement or lens adjustment (zoom, focus), microscope stages or medical syringes.

Benefits

- Cost effective positioning drive without encoder
- High accuracy
- Wide range of lead screws available
- Short lead time for standard length
- Flexibility offered by optional nuts and ball bearings
- Custom length on request

Product Code



AM1524-2R-V-12-150-55

AM1524	Motor series
2R	Bearing type
V-12-150	Coil type
55	Motor version

M3 x 0,5 x 15

M3	Screw type
0.5	Pitch (mm)
15	Length (mm)

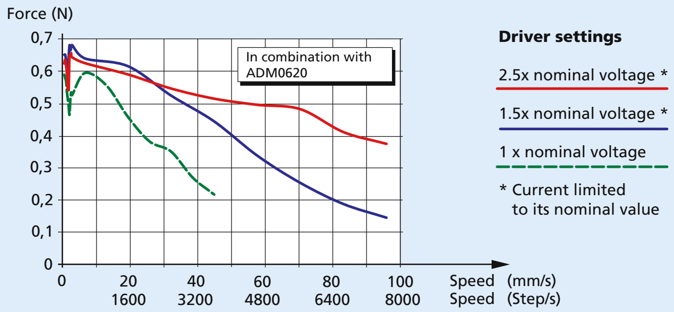
Lead Screw

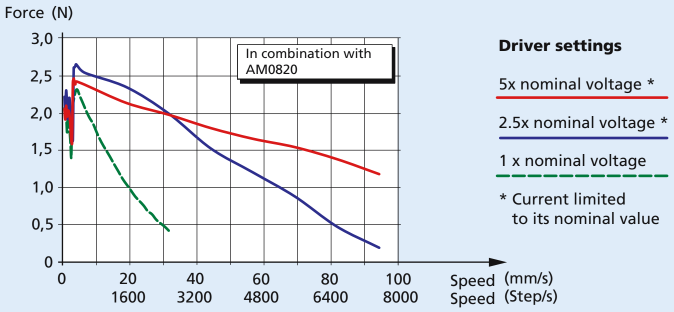
Linear actuation for positioning tasks
PRECIstep® Technology

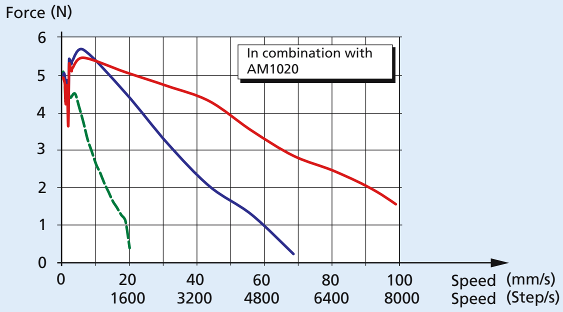
For combination with
Stepper Motors: ADM0620, AM0820, AM1020

Series M1,2 x 0,25 x L1

Nominal diameter	1,2	mm
Pitch	0,25	mm
Material	Stainless steel	



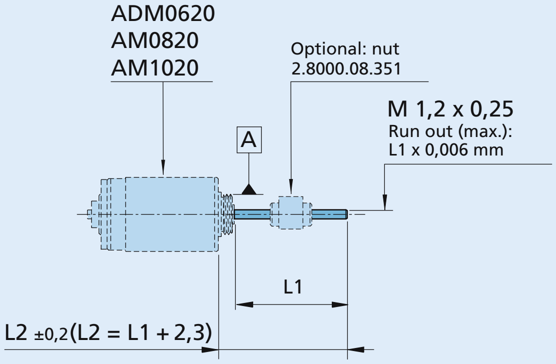




Important notes: The thrust curves include already a safety factor for the use of the stepper motor. Please read the "Technical information" for a better understanding of the curves.

Ordering information	L1 (mm) =	7,5	15	Custom
Order code (no bearing tip)		M1,2x0,25x7,5	M1,2x0,25x15	M1,2x0,25xL1*
Order code (with bearing tip)		–	–	–

* For custom length, please inquire with your point of sales



M1,2 x 0,25 x L1

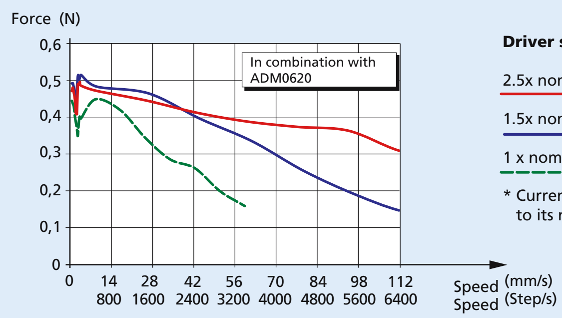
Lead Screw

Linear actuation for positioning tasks
PRECIstep® Technology

For combination with
Stepper Motors: ADM0620, AM0820, AM1020

Series M1,6 x 0,35 x L1

Nominal diameter	1,6	mm
Pitch	0,35	mm
Material	Stainless steel	



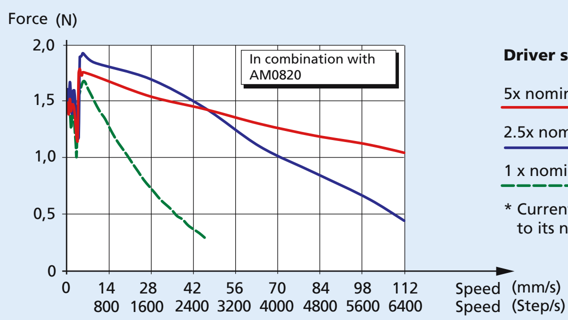
Driver settings

2.5x nominal voltage *

1.5x nominal voltage *

1 x nominal voltage

* Current limited
to its nominal value



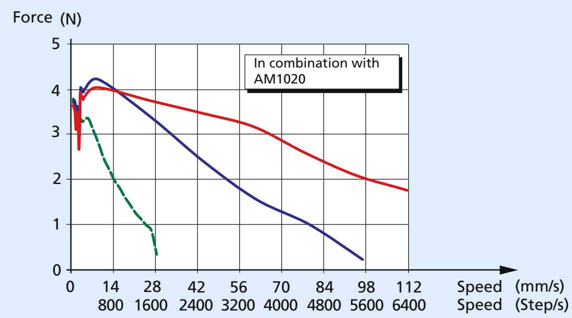
Driver settings

5x nominal voltage *

2.5x nominal voltage *

1 x nominal voltage

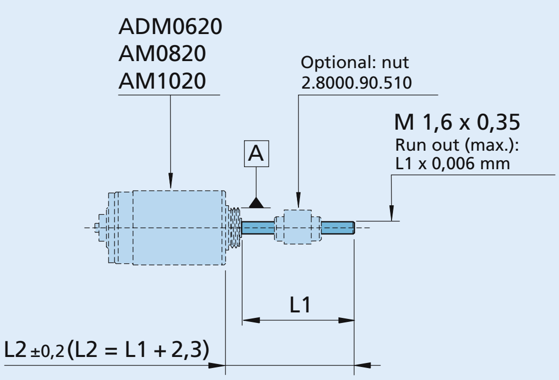
* Current limited
to its nominal value



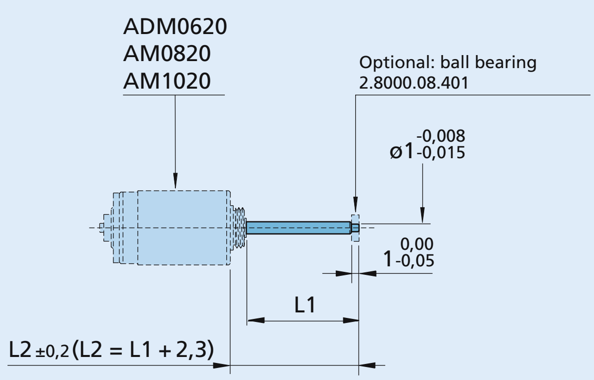
Important notes: The thrust curves include already a safety factor for the use of the stepper motor.
Please read the "Technical information" for a better understanding of the curves.

Ordering information	L1 (mm) = 7,5	15	25	Custom
Order code (no bearing tip)	M1,6x0,35x7,5	M1,6x0,35x15	–	M1,6x0,35xL1*
Order code (with bearing tip)	–	M1,6x0,35x15T	M1,6x0,35x25T	M1,6x0,35xL1*T

* For custom length, please inquire with your point of sales



M1,6 x 0,35 x L1



Version with bearing tip
M1,6 x 0,35 x L1 T

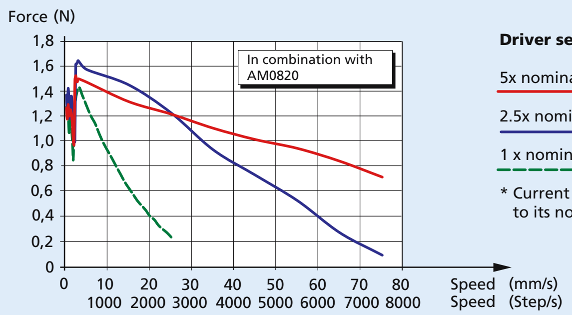
Lead Screw

Linear actuation for positioning tasks
PRECIstep® Technology

For combination with
Stepper Motors: AM0820, AM1020, ADM1220S, AM1524

Series M2 x 0,2 x L1

Nominal diameter	2,0	mm
Pitch	0,2	mm
Material	Stainless steel	



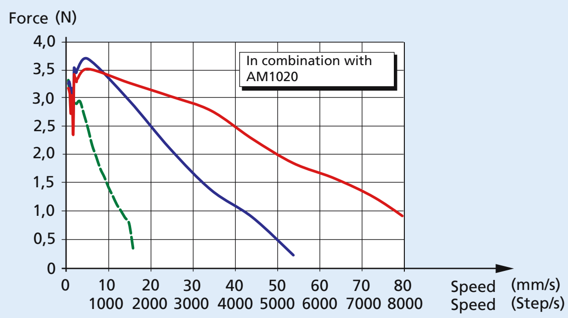
Driver settings

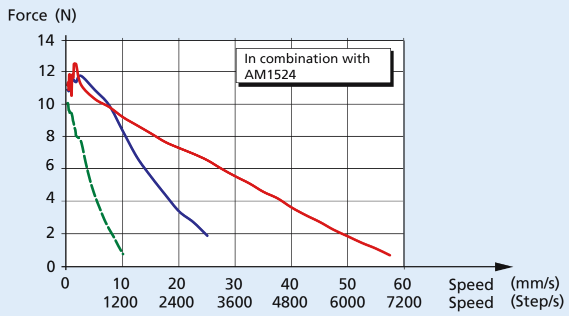
5x nominal voltage *

2.5x nominal voltage *

1 x nominal voltage

* Current limited to its nominal value

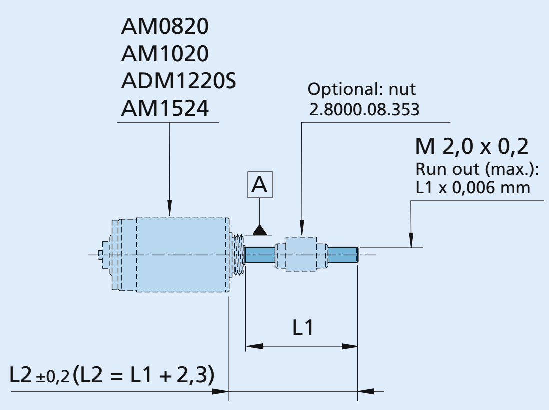




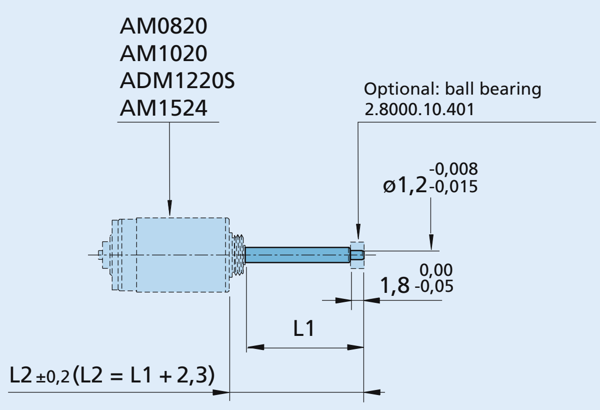
Important notes: The thrust curves include already a safety factor for the use of the stepper motor. Please read the "Technical information" for a better understanding of the curves.

Ordering information L1 (mm) =	15	25	28/30	Custom
Order code (no bearing tip)	M2x0,2x15	M2x0,2x25	M2x0,2x30	M2x0,2xL1*
Order code (with bearing tip)	M2x0,2x15T	M2x0,2x25T	M2x0,2x28T	M2x0,2xL1*T

* For custom length, please inquire with your point of sales



M2,0 x 0,2 x L1



Version with bearing tip
M2,0 x 0,2 x L1 T

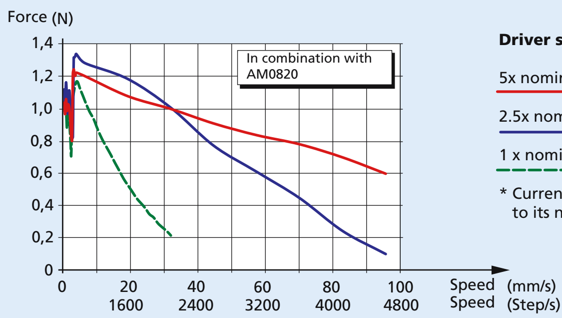
Lead Screw

Linear actuation for positioning tasks
PRECIstep® Technology

For combination with
Stepper Motors: AM0820, AM1020, ADM1220S, AM1524

Series M2,5 x 0,25 x L1

Nominal diameter	2,5	mm
Pitch	0,25	mm
Material	Stainless steel	



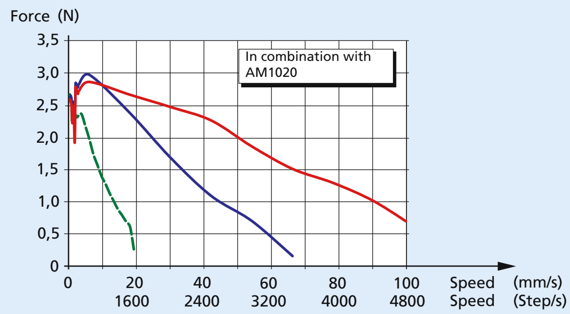
Driver settings

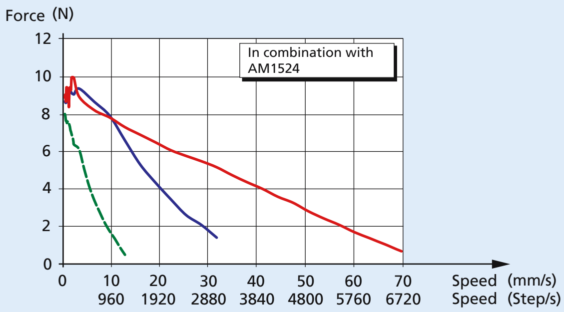
5x nominal voltage *

2.5x nominal voltage *

1 x nominal voltage

* Current limited to its nominal value

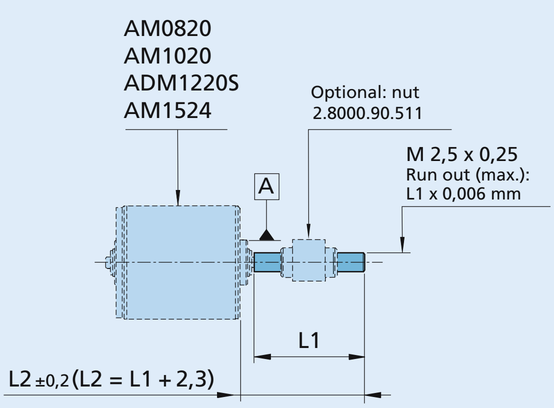




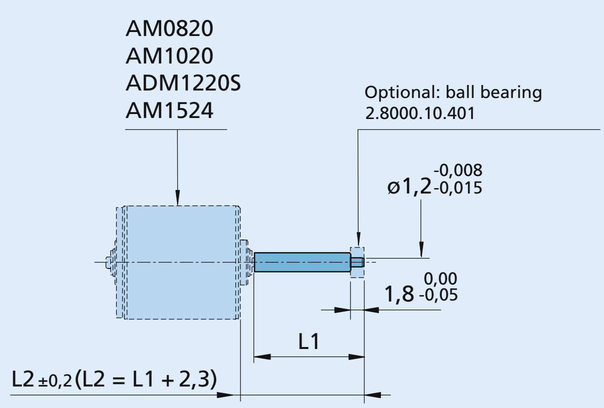
Important notes: The thrust curves include already a safety factor for the use of the stepper motor. Please read the "Technical information" for a better understanding of the curves.

Ordering information	L1 (mm) =	15	25	Custom
Order code (no bearing tip)		M2,5x0,25x15	M2,5x0,25x25	M2,5x0,25xL1*
Order code (with bearing tip)		M2,5x0,25x15T	M2,5x0,25x25T	M2,5x0,25xL1*T

* For custom length, please inquire with your point of sales



M2,5 x 0,25 x L1



Version with bearing tip
M2,5 x 0,25 x L1 T

FAULHABER

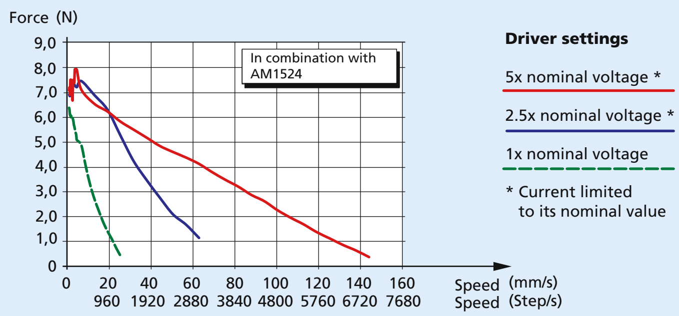
Lead Screw

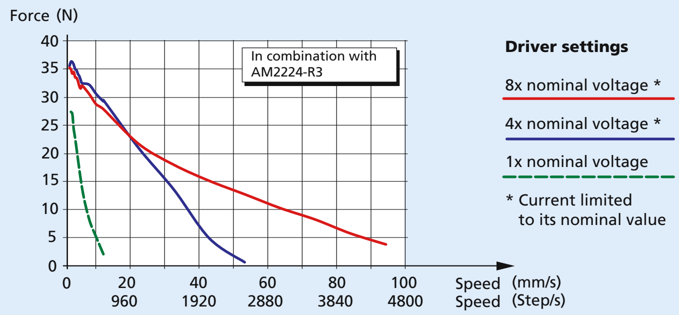
Linear actuation for positioning tasks
PRECIstep® Technology

For combination with
Stepper Motors: AM0820, AM1020, ADM1220S, AM1524, AM2224-R3

Series M3 x 0,5 x L1

Nominal diameter	3,0	mm
Pitch	0,5	mm
Material	Stainless steel	

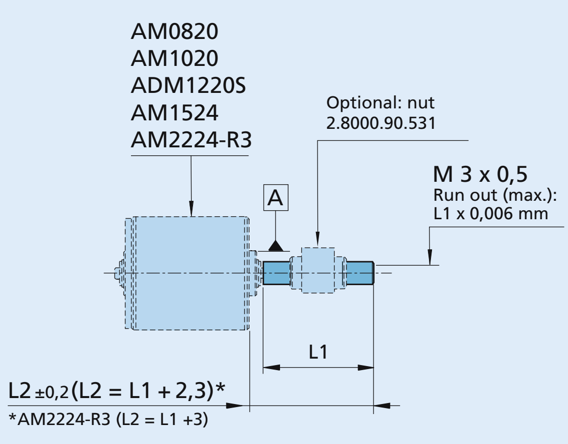




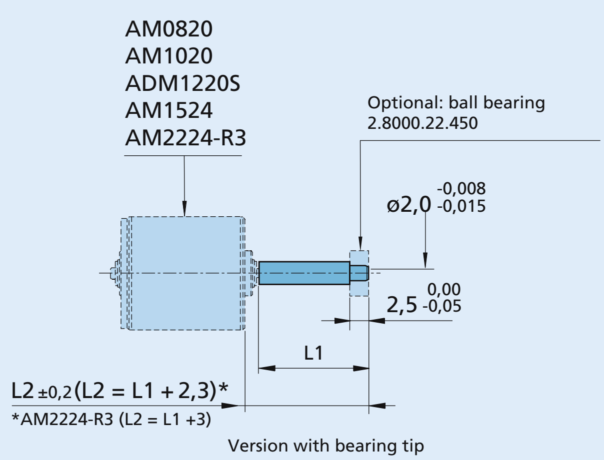
Important notes: The thrust curves include already a safety factor for the use of the stepper motor.
Please read the "Technical information" for a better understanding of the curves.

Ordering information	L1 (mm) =	15	25	Custom
Order code (no bearing tip)		M3x0,5x15	M3x0,5x25	M3x0,5xL1*
Order code (with bearing tip)		M3x0,5x15T	M3x0,5x25T	M3x0,5xL1*T

* For custom length, please inquire with your point of sales



M3,0 x 0,5 x L1



Version with bearing tip
M3,0 x 0,5 x L1 T

Linear Components

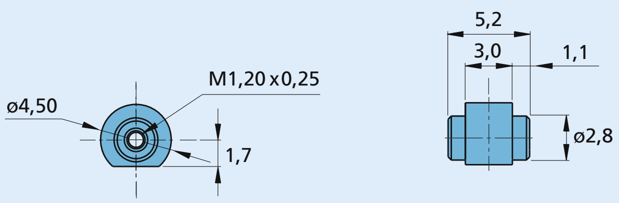
Lead Screw

Optional nuts and bearings
PRECIstep® Technology

Options

For M1,2 x 0,25 Lead screws

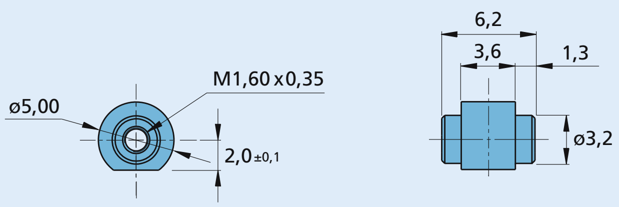
Scale 2:1

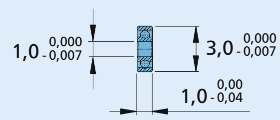


Nut Part No. 2.8000.08.351, Material CuAl10Ni5Fe4

For M1,6 x 0,35 Lead screws

Scale 2:1



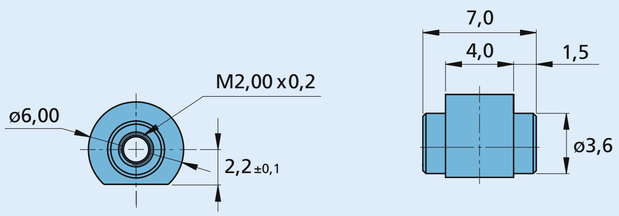


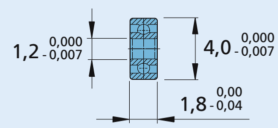
Nut Part No. 2.8000.90.510, Material CuAl10Ni5Fe4

Bearing for leadscrew tip Part No. 2.8000.08.401

For M2,0 x 0,2 Lead screws

Scale 2:1



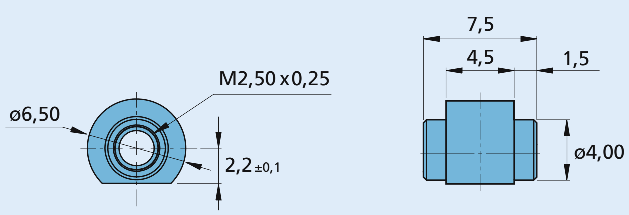


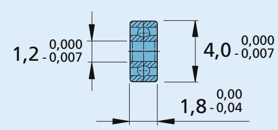
Nut Part No. 2.8000.08.353, Material CuAl10Ni5Fe4

Bearing for leadscrew tip Part No. 2.8000.10.401

For M2,5 x 0,25 Lead screws

Scale 2:1



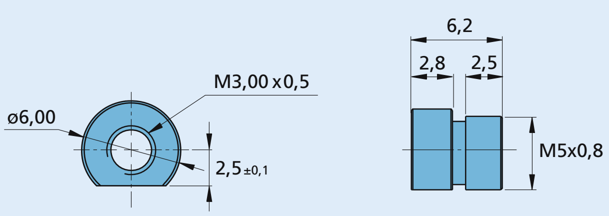


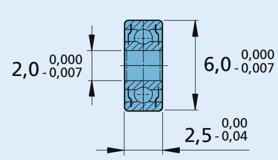
Nut Part No. 2.8000.90.511, Material CuAl10Ni5Fe4

Bearing for leadscrew tip Part No. 2.8000.10.401

For M3,0 x 0,5 Lead screws

Scale 2:1





Nut Part No. 2.8000.90.531, Self-lubricating synthetics material

Bearing for leadscrew tip Part No. 2.8000.22.450

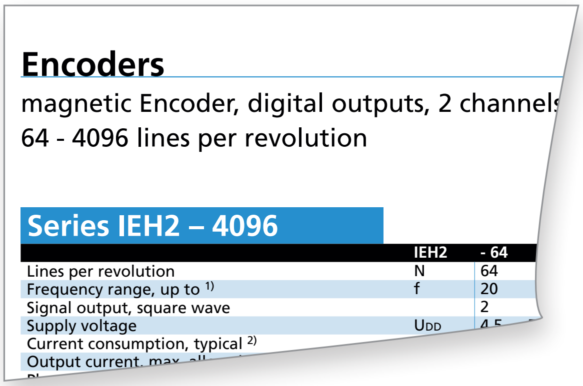
Encoders

WE CREATE MOTION

FAULHABER

Encoders

Technical Information



Encoders

magnetic Encoder, digital outputs, 2 channels
64 - 4096 lines per revolution

Series IEH2 – 4096

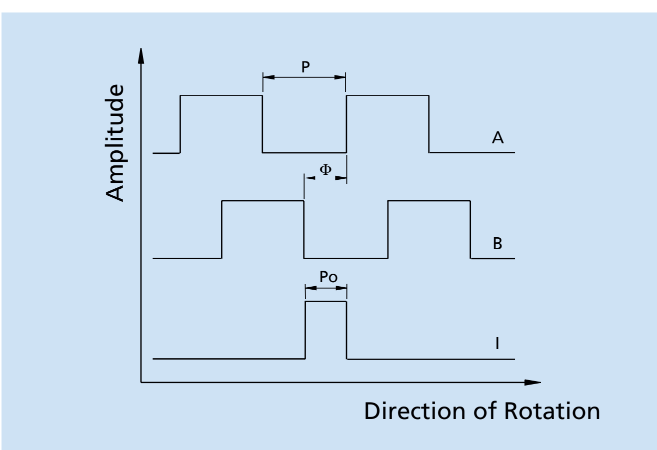
		IEH2 - 64
Lines per revolution	N	64
Frequency range, up to [1]	f	20
Signal output, square wave		2
Supply voltage	U_{DD}	4.5 ...
Current consumption, typical [2]		
Output current, max. ...		

Notes on technical data

Lines per revolution (N)
The number of incremental encoder pulses per revolution per channel.

The output signal is a quadrature signal which means that both the leading and following edge, or flank, can be evaluated. For example, an encoder with two channels and 256 lines per revolution has 1024 edges, or flanks per revolution.

Output signal
The number of output channels. For example, the IE3 encoders offer 2 channels, A and B, plus 1 additional index channel.



Supply Voltage (U_{DD})
Defines the range of supply voltage necessary for the encoder to function properly.

Current consumption, typical (I_{DD})
Indicates the typical current consumption of the encoder at the given supply voltage.

Output current, max. (I_{OUT})
Indicates the maximum allowable load current at the signal outputs.

Puls width (P)
Width of the output signal in electrical degrees (°e) of the channels A and B. The value corresponds to one full period, or 360°e at channel A or B.

Index pulse width (P_0)
Indicates the width of the index pulse signal in electrical degrees.

Tolerance ΔP_0:

$$\Delta P_0 = \left| 90° - \frac{P_0}{P} * 180° \right|$$

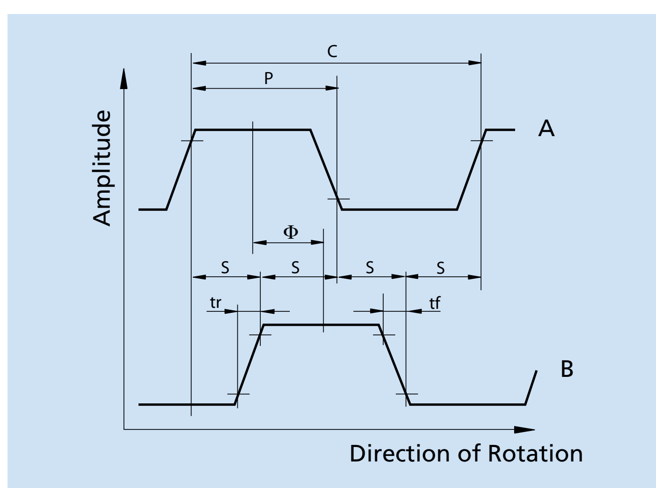
Phase shift, channel A to B (Φ)
The phase shift in electrical degrees between the following edge of output channel A and the leading edge of output channel B.

Phase shift tolerance ($\Delta\Phi$)
Indicates the allowable position error, in electrical degrees, between the following edge of channel A to the leading edge of channel B.

$$\Delta\Phi = \left| 90° - \frac{\Phi}{P} * 180° \right|$$

Signal period (C)
The total period, measured in electrical degrees of one pulse on channel A or B.

Typically one period is 360 °e.



Logic state width (S)
The distance measured in electrical degrees (°e) between two neighbouring signal edges, for example the leading edge of signal A to the leading edge of signal B.

Typically this has a value of 90 °e.

Signal rise/fall time, typical (tr/tf)
Corresponds to the slope of the rising and falling signal edges.

Frequency range (f)
Indicates the maximum encoder frequency. The maximum achievable motor speed can be derived using the following formula.

$$n = \frac{60 \cdot f}{N}$$

Inertia of the code disc (J)
Indicates the additional inertial load due on the motor due to the code wheel.

Operating temperature range
Indicates the minimum and maximum allowable temperature range for encoder operation.

Test speed
The speed at which the encoder specifications were measured.

Line Driver
This is an integrated signal amplifier in the encoder that makes it possible to send the encoder signals through much longer connection cables. It is a differential signal with complementary signals to all channels which eliminates sensitivity to ambient electrical noise.

Synchronous serial interface
The synchronous serial interface (SSI) is an interface for absolute encoders with which absolute position information is supplied via serial data transfer. Position value transfer is synchronized with a clock rate defined by a control.

Steps per revolution
Steps per revolution indicates the number of position values per motor revolution.

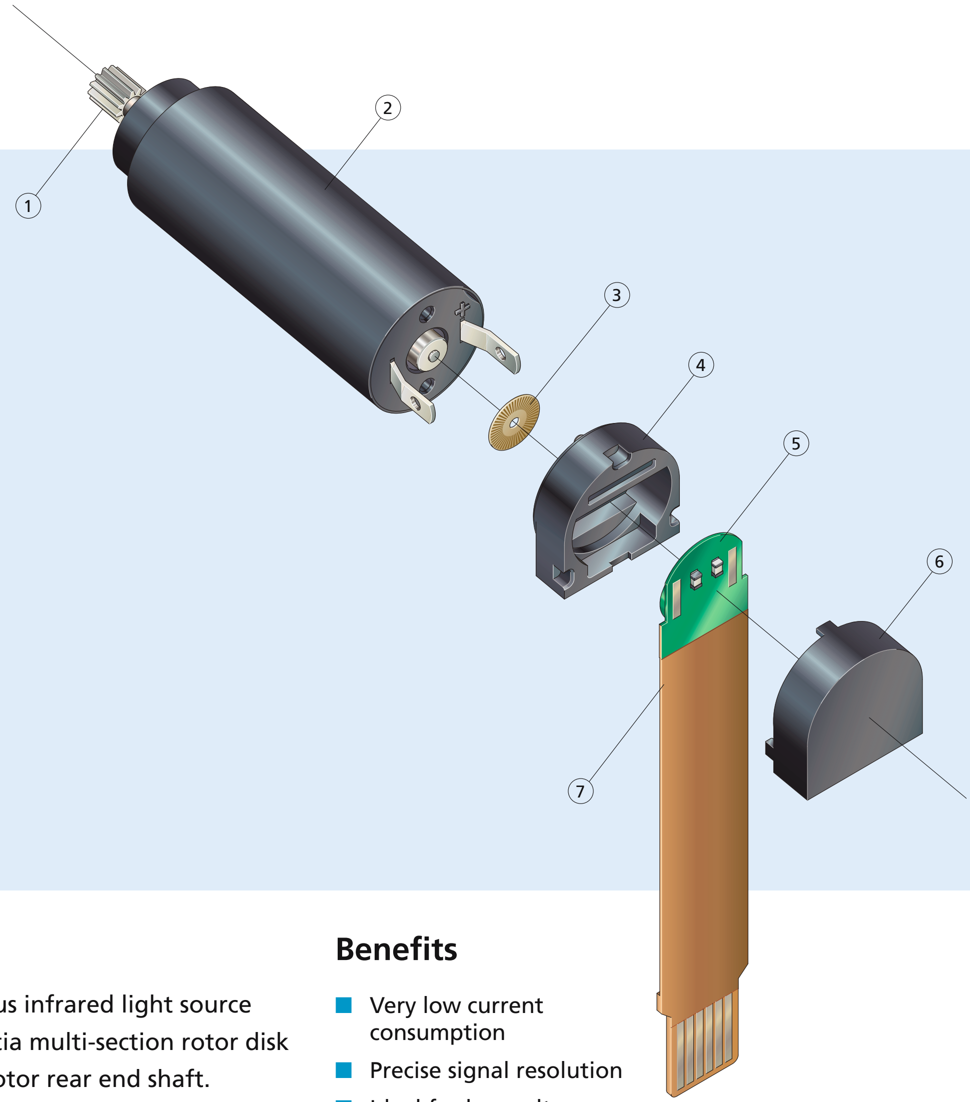
Set-up time after power on
Maximum time to availability of the output signals, as of when supply voltage is applied.

Clock frequency max.
Maximal permissible clock frequency for reading the extended synchronous serial interface.

Timeout
Refers to the time after which communication is terminated by the encoder, when the master is no longer transmitting a clock rate.

Optical Encoders

Technical Information



Optical Encoder

① Output shaft
② Motor
③ Code wheel
④ Adapter flange
⑤ Encoder PCB
⑥ End cap
⑦ Flex cable

Features

Optical encoders use a continuous infrared light source transmitting through a low-inertia multi-section rotor disk which is fitted directly on the motor rear end shaft. The unit thus generates two output signals with a 90° phase shift.

In optoreflective encoders, the light source is sent and reflected back or alternately absorbed to create the necessary phase shifted pulse.

Benefits

- Very low current consumption
- Precise signal resolution
- Ideal for low voltage battery operation
- Insensitive to magnetic interference
- Extremely light and compact

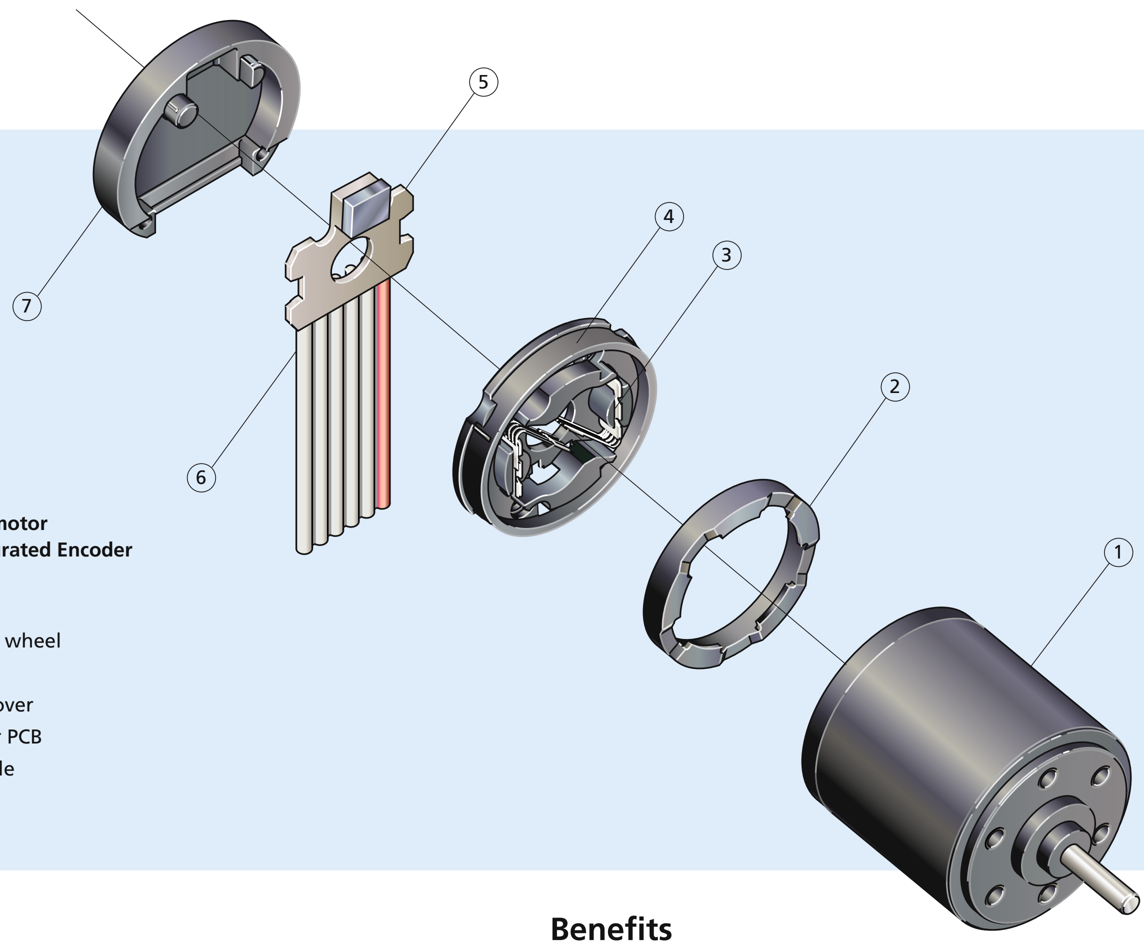
Product Code

PA2 - 50

PA	Encoder series
2	Number of Channels
50	Resolution

Integrated Encoders

Technical Information



DC-Micromotor with integrated Encoder

① Motor
② Magnet wheel
③ Brushes
④ Brush cover
⑤ Encoder PCB
⑥ Flat cable
⑦ End cap

Features

The encoders of the IEH2 series consist of a multi-part magnetic ring, which is attached to the rotor, and a single-chip angle sensor. The angle sensor comprises all necessary functions, such as hall sensors, an interpolator and driver stages. Analogue signals of the sensor magnets are detected by the hall sensors and, after suitable amplification, passed along to the interpolator.
By means of a special processing algorithm, the interpolator generates the high-resolution encoder signal. With this, two square wave signals that are phase-shifted by 90°, with up to 4,096 pulses per rotation, are available at the outputs. The encoder is integrated in the motors of the SR series and lengthens these by just 1.4 mm.

Benefits

- Extremely compact
- High resolution of up to 16,384 steps per rotation (corresponds to a 0.02° angle resolution)
- No pull-up resistors are necessary at the outputs because there are no open collector outputs
- Symmetric switching edges, CMOS and TTL-compatible
- Different resolutions, from 64 to 4,096 pulses, are available for standard delivery
- Installation space-compatible with IE2-1024

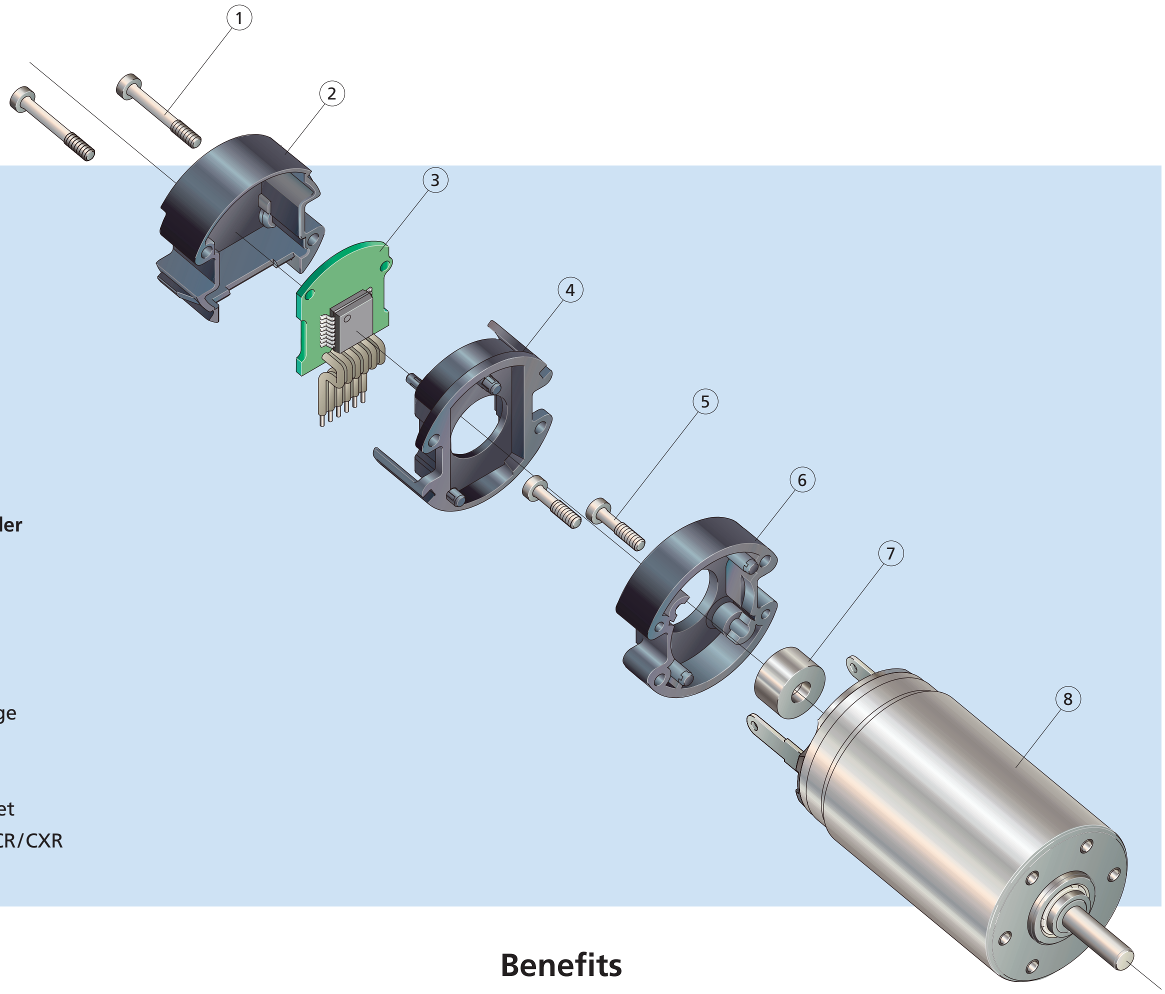
Product Code

IEH2 – 4096

IEH	Incremental Encoder
2	Number of Channels
4096	Resolution

Magnetic Encoders

Single Chip



Magnetic Encoder
Single Chip

① Screws
② Rear cover
③ Encoder PCB
④ Encoder flange
⑤ Screws
⑥ Motor flange
⑦ Sensor magnet
⑧ Motor Serie CR/CXR

Features

FAULHABER IE3 encoders are designed with a diametrically magnetized code wheel which is pressed onto the motor shaft and provides the axial magnetic field to the encoder electronics. The electronics contain all the necessary functions of an encoder including Hall sensors, interpolation, and driver. The Hall sensors sensed the rotational position of the sensor magnet and the signal is interpolated to provide a high resolution position signal.

The encoder signal is a two channel quadrature output with a 90 °e phase shift between channels.
A third channel provides a single index pulse per revolution. These encoders are available as attachable kits or preassembled to FAULHABER DC-Motors with graphite commutation, or as integrated assemblies for many FAULHABER Brushless DC-Servomotors.

Benefits

- Compact modular system
- A wide range of resolutions are available
- Index channel
- Line Drivers are available
- Standardized encoder outputs
- Ideal for combination with FAULHABER Motion Controllers and Speed Controllers
- Custom modifications including custom resolution, index position and index pulse width are possible

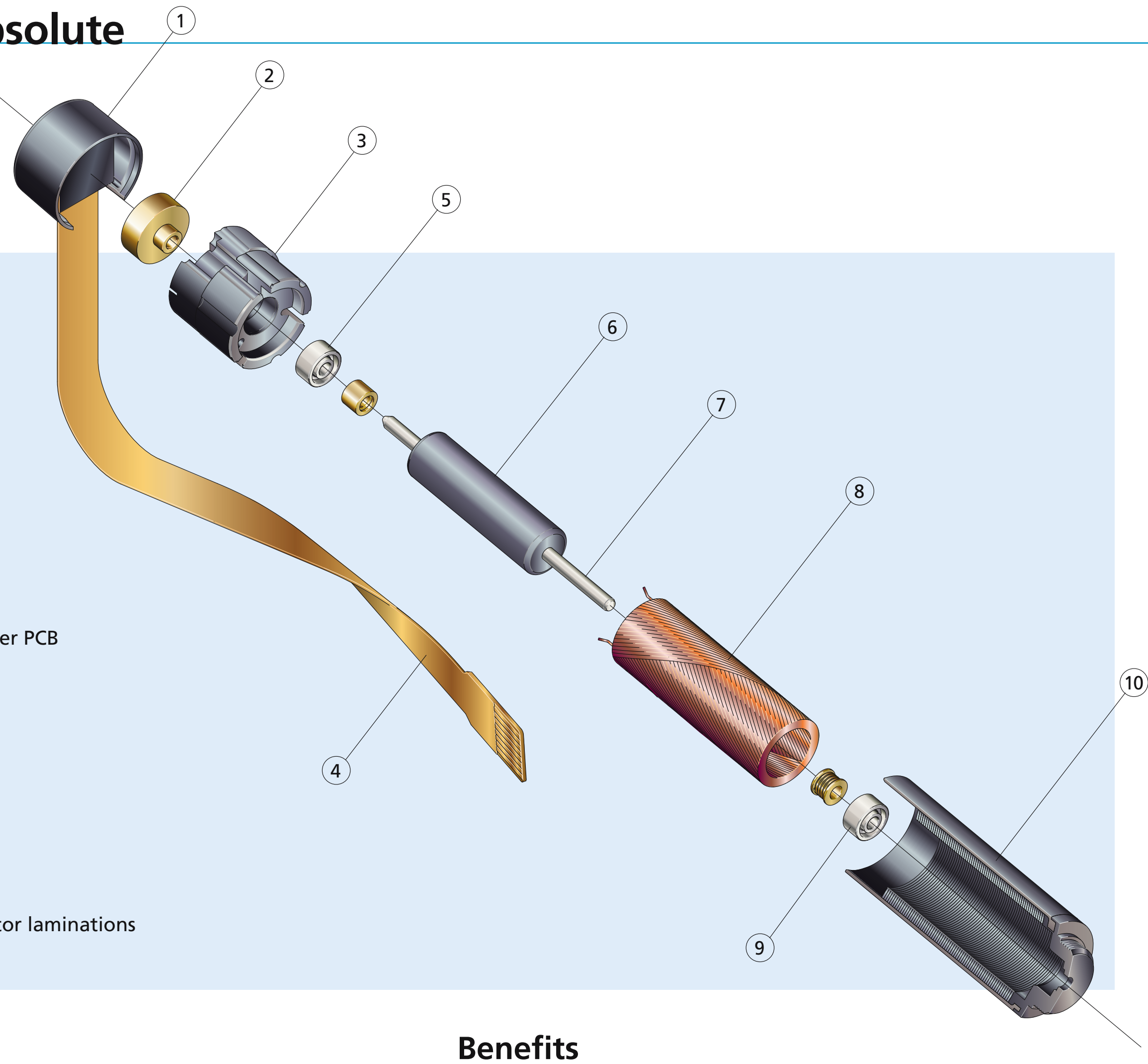
Product Code

IE3 – 1024 L

IE	Incremental Encoder
3	Number of Channels
1024	Resolution
L	with integrated Line Driver

Encoders Absolute

Single Chip



Encoders - Absolute

① Cover with encoder PCB
② Sensor magnet
③ Encoder flange
④ Flex cable
⑤ Ball bearing
⑥ Magnet
⑦ Shaft
⑧ Coil
⑨ Ball bearing
⑩ Housing with stator laminations

Features

Encoders in the AES series consist of a diametrically magnetized 2-pole sensor magnet mounted on the motor shaft. A special single-chip angle sensor for detecting the drive shaft position is positioned in an axial direction in relation to the sensor magnet. The angle sensor contains all the necessary functions such as Hall sensors, interpolator and driver stages. The analog signal of the sensor magnet detected by the Hall sensors is processed, after appropriate amplification, by a special algorithm to produce a high-resolution encoder signal. At the output there is absolute angle information available with a resolution of 4096 steps per revolution. This data can be scanned by an extended serial interface (SSI). The absolute encoder is ideal for commutation, rotational speed control and position control.

Benefits

- Minimal wiring
- Absolute angle information directly after power-on
- No referencing necessary
- Enhanced control characteristics even at low rotational speeds
- Ideal for combination with FAULHABER Motion Controllers and FAULHABER Speed Controllers
- Flexible customization of resolution and direction of rotation is possible

Product Code

AESM – 4096

AESM	Encoder Series
4096	Steps per revolution

Encoders

optical Encoder, digital outputs
2 channels, 50 lines per revolution

For combination with
DC-Micromotors
Brushless DC-Motors

Series PA2 – 50

		PA2 – 50	
Lines per revolution	N	50	
Frequency range [1]	f	up to 35	kHz
Signal output, square wave		2	channels
Supply voltage (ripple < 100 $mV_{p.p}$)	U_{DD}	2,7 ... 3,3	V DC
Current consumption, typical (U_{DD} = 3 V DC)	I_{DD}	8,5	mA
Output current, per channel	I_{OUT}	– 1 ... 8	mA
Pulse width	P_0	180 ± 50	°e
Phase shift, channel A to B	Φ	90 ± 45	°e
Logic state width	S	90 ± 50	°e
Cycle	C	360 ± 36	°e
Signal rise/fall time, max. (C_{LOAD} = 25 pF)	tr/tf	0,3 / 0,1	µs
Inertia of code disc	J	0,02	gcm^2
Operating temperature range		– 30 ... + 85	°C

[1] speed (rpm) = f (Hz) x 60/N

For combination with motor			
Dimensional drawing A	**L1** [mm]		
0615...S - K1655	19,2		
Dimensional drawing B	**L1** [mm]		
0620...B - K1719	24,0		
Dimensional drawing C	**L1** [mm]		
0816...SR - K2565	24,0		

Features

These incremental shaft encoders in combination with the DC-Micromotors and Brushless DC-Servomotors are designed for both indication and control of both shaft velocity and direction of rotation as well as for positioning.

An all-in-one emitter and detector chip transmits and receives LED light reflected off a low inertia reflective disc providing two channels with 90° phase shift.

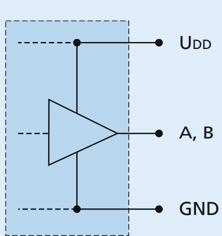
The supply voltage for the encoder and the Micromotor as well as the output signals are interfaced with a flexible printed circuit (FPC).

Details for the DC-Micromotors and Brushless DC-Servomotors and suitable reduction gearheads are on separate catalog pages.

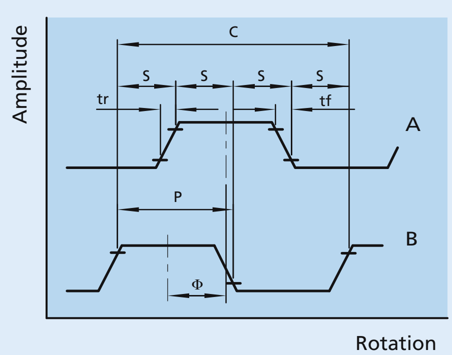
An optional interface board with suitable connector is also available on request.

Circuit diagram / Output signals

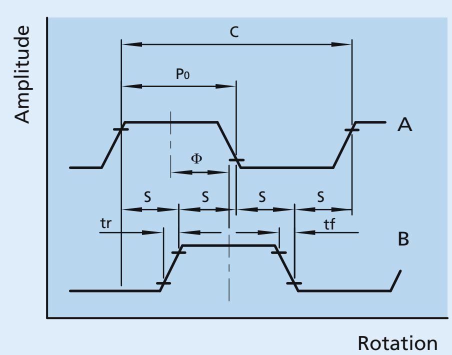
Output circuit



Output signals
with clockwise rotation as seen from the shaft end



0615 ... S / 0620 ... B
Channel B Leads channel A



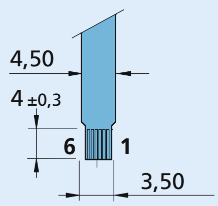
0816 ... S

Connector information / Variants

No.	Function
1	Motor + *
2	U_{DD}
3	Channel A
4	Channel B
5	GND
6	Motor – *

* **Note:** Brushless motors have separate motor leads.

Connection Encoder

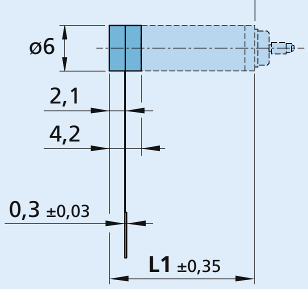


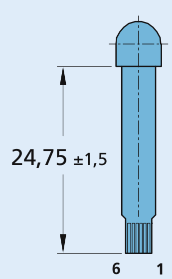
Recommended connector
Molex 52745
grid 0,5 mm
FPC / FFC, 6-conductors

Full product description
- Examples:
  0615N003S-K1655 PA2-50
  0620K012B-K1719 PA2-50

Dimensional drawing A

Example of combination with 0615...S

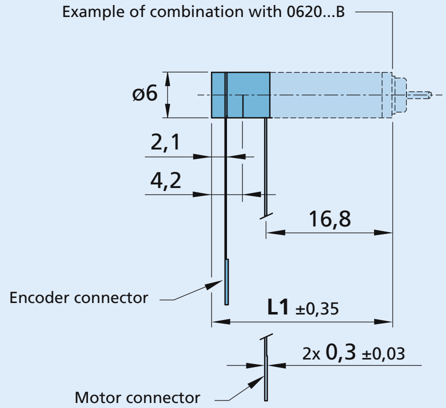


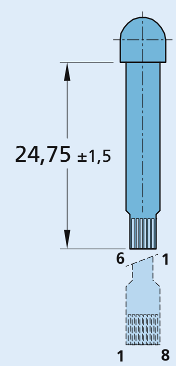


PA2 – 50

Dimensional drawing B

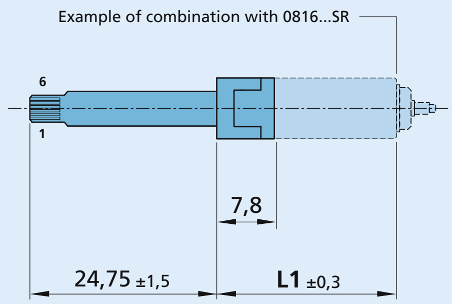
Example of combination with 0620...B

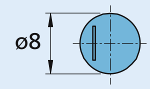




PA2 – 50

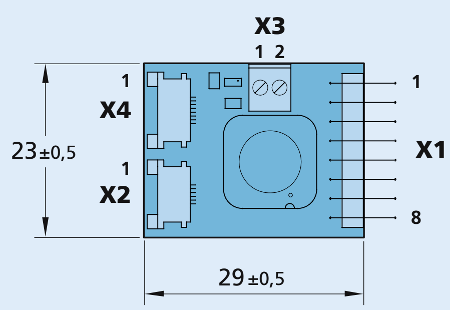
Dimensional drawing C





PA2 – 50

Interface board MCDC 3002 S



Interface Board PA2-50 / PA2-100
Part. No.: 6501.00144

Connection

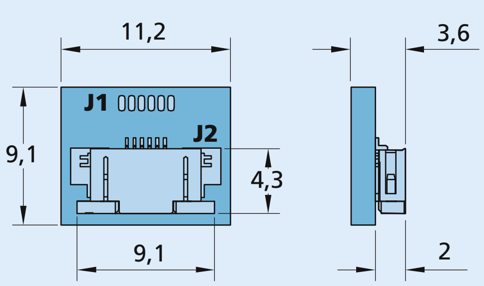
Pin	Connection X1
1	4. In
2	Channel A
3	Channel B
4	U_{DD} = 5V
5	SGND
6	Motor +
7	Motor -
8	5 .In

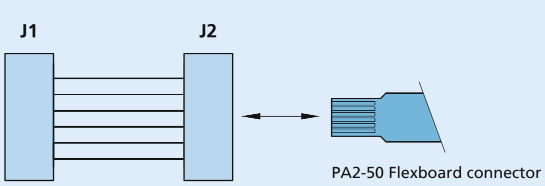
Pin	Connection X2
1	Motor +
2	U_{DD} = 3,3V
3	Channel A
4	Channel B
5	SGND
6	Motor -

Pin	Connection X3
1	5. In
2	4. In

Pin	Connection X4
1	Motor +
2	Motor +
3	U_{DD} = 3,3V
4	Channel A
5	Channel B
6	SGND
7	Motor -
8	Motor -

Optional interface board





Interface board PA2-50
Part No.: D100315100

Connector
J1 - Solder Pads
J2 - Molex 52475-0690

Encoders

optical Encoder, digital outputs
2 channels, 100 lines per revolution

For combination with
DC-Micromotors
Brushless DC-Motors

Series PA2 – 100

		PA2 – 100	
Lines per revolution	N	100	
Frequency range [1]	f	up to 35	kHz
Signal output, square wave		2	channels
Supply voltage	U_{DD}	2,7 … 3,3	V DC
Current consumption, typical (U_{DD} = 3 V DC)	I_{DD}	8	mA
Pulse width	P_0	180 ± 45	°e
Phase shift, channel A to B	Φ	90 ± 45	°e
Logic state width	S	90 ± 45	°e
Cycle	C	360 ± 30	°e
Signal rise/fall time, max. (C_{LOAD} = 50 pF)	tr/tf	0,1 / 0,1	µs
Inertia of code disc	J	0,02	gcm^2
Operating temperature range		– 25 … + 85	°C

[1] speed (rpm) = f (Hz) x 60/N

For combination with motor

Dimensional drawing A	L1 [mm]		
1016...G - K1752	23,5		
1024...S - K1752	31,5		
Dimensional drawing B	**L1** [mm]		
1224...SR - K1752	31,05		

Features

These incremental shaft encoders in combination with the DC-Micromotors are designed for both indication and control of both shaft velocity and direction of rotation as well as for positioning.

An all-in-one emitter and detector chip transmits and receives LED light reflected off a low inertia reflective disc providing two channels with 90° phase shift.

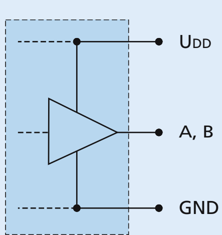
The supply voltage for the encoder and the Micromotor as well as the output signals are interfaced with a flexible printed circuit (FPC).

Details for the DC-Micromotors and suitable reduction gearheads are on separate catalog pages.

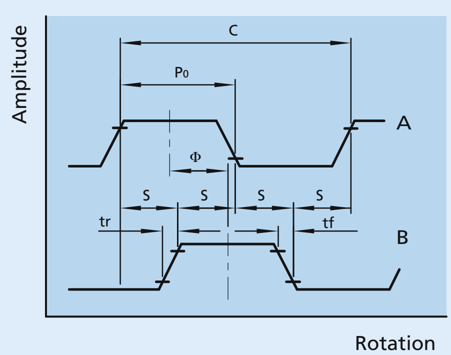
An optional interface board with suitable connector is also available on request.

Circuit diagram / Output signals

Output circuit



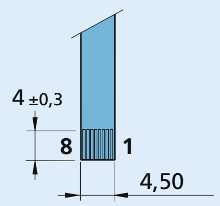
Output signals
with clockwise rotation as seen from the shaft end



Connector information / Variants

No.	Function
1	Motor +
2	Motor +
3	UDD
4	Channel A
5	Channel B
6	GND
7	Motor –
8	Motor –

Connection Encoder

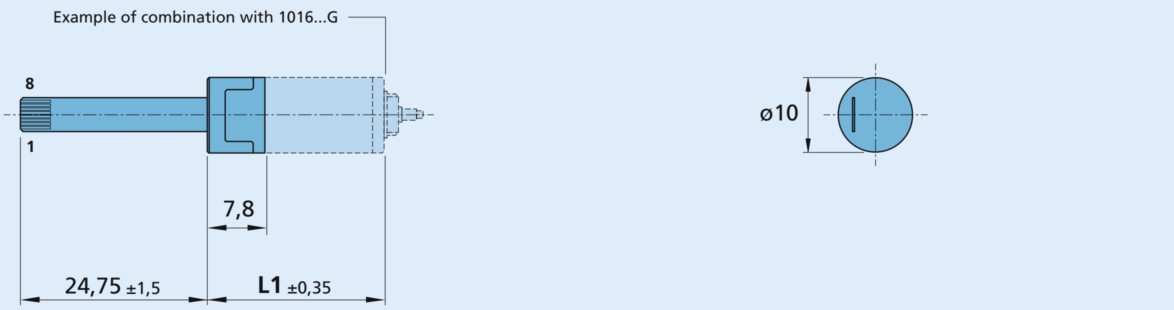


Recommended connector
Molex 52745
grid 0,5 mm
FPC / FFC, 8-conductors

Full product description

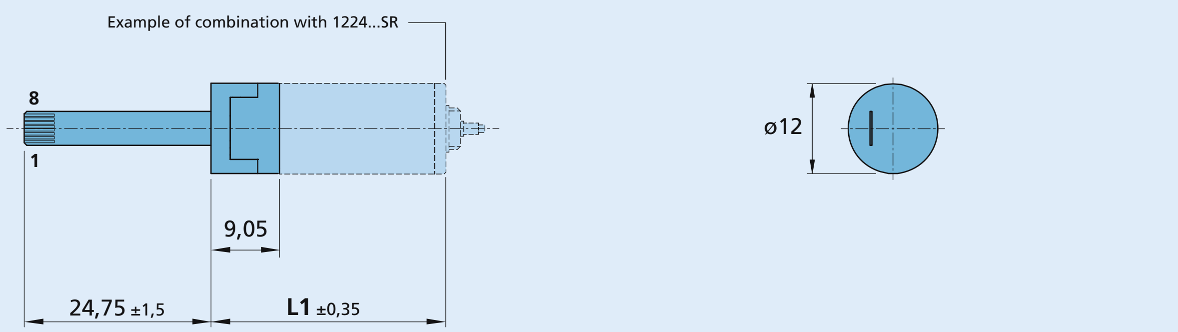
- Examples:
  1016N006G-K1752 PA2-100
  1224N012SR-K1752 PA2-100

Dimensional drawing A



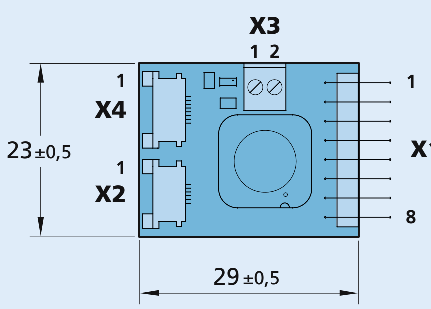
PA2 – 100

Dimensional drawing B



PA2 – 100

Interface board MCDC 3002 S



Interface Board PA2-50 / PA2-100
Part. No.: 6501.00144

Connection

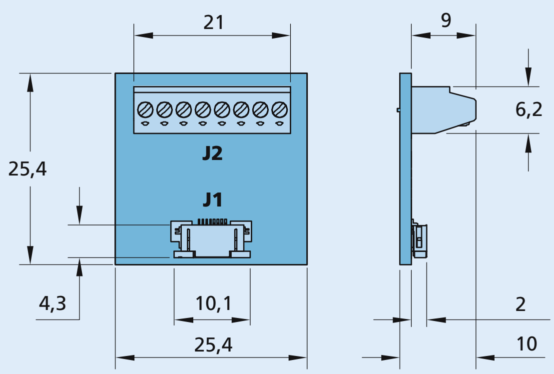
Pin	Connection X1
1	4. In
2	Channel A
3	Channel B
4	U_{DD} = 5V
5	SGND
6	Motor +
7	Motor -
8	5 .In

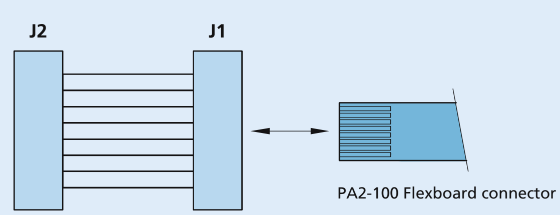
Pin	Connection X2
1	Motor +
2	U_{DD} = 3,3V
3	Channel A
4	Channel B
5	SGND
6	Motor -

Pin	Connection X3
1	5. In
2	4. In

Pin	Connection X4
1	Motor +
2	Motor +
3	U_{DD} = 3,3V
4	Channel A
5	Channel B
6	SGND
7	Motor -
8	Motor -

Optional interface board





Interface board PA2-100
Part No.: D100308900

Connector
J1 - Molex 52745-0896
J2 - Phoenix 1725711

Encoders

magnetic Encoder, digital outputs, 2 channels,
16 lines per revolution

For combination with
DC-Micromotors

Series IE2 – 16

		IE2 – 16	
Lines per revolution	N	16	
Frequency range, up to [1]	f	7	kHz
Signal output, square wave		2	channels
Supply voltage	U_{DD}	4 … 18	V DC
Current consumption, typical [2]	I_{DD}	typ. 6, max. 12	mA
Output current, max. allowable	I_{OUT}	15	mA
Phase shift, channel A to B [3]	Φ	90 ± 45	°e
Signal rise/fall time, max. (C_{LOAD} = 100 pF)	tr/tf	2,5 / 0,3	µs
Inertia of code disc	J	0,11	gcm²
Operating temperature range		– 25 ... + 85	°C

[1] speed (rpm) = f (Hz) x 60/N
[2] $U_{DD\ Enc}$ = 12 V: with unloaded outputs
[3] Tested at 2 kHz

For combination with motor

Dimensional drawing A	<L1 [mm]	Dimensional drawing C	<L1 [mm]
1336...CXR-123	47,5	1727...C-123	38,2
		1741...CXR-123	49,4
Dimensional drawing B	**<L1** [mm]		
1516...SR	18,2		
1524...SR	26,2		
1717...SR	19,4		
1724...SR	26,4		
2224...SR	26,6		
2232...SR	34,6		

Features

These incremental shaft encoders in combination with the FAULHABER DC-Micromotors are used for the indication and control of both shaft velocity and direction of rotation as well as for positioning.

The encoder is integrated in the DC-Micromotors SR-Series and extends the overall length by only 1,4 mm!

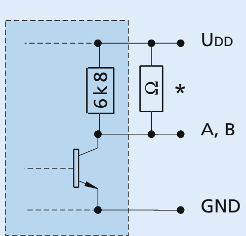
Solid state Hall sensors and a low inertia magnetic disc provide two channels with 90° phase shift.

The supply voltage for the encoder and the DC-Micromotor as well as the two channel output signals are interfaced through a ribbon cable with connector.

Details for the DC-Micromotors and suitable reduction gearheads are on separate catalogue pages.

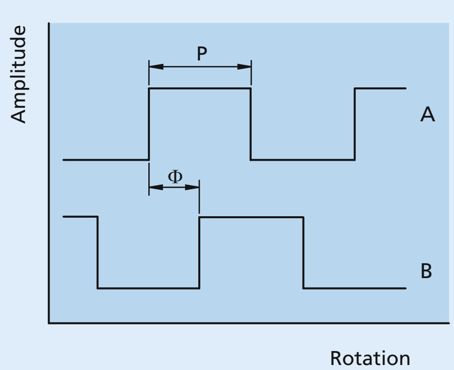
Output signals / Circuit diagram

Output circuit



* An additional external pull-up resistor can be added to improve the rise time.
Caution: I_{OUT} max. 15 mA must not be exceeded!

Output signals
with clockwise rotation as seen from the shaft end



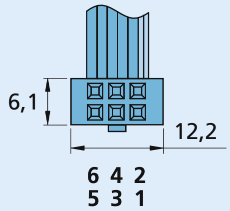
Admissible deviation of phase shift:

$$\Delta\Phi = \left| 90° - \frac{\Phi}{P} * 180° \right| \le 45°$$

Connector information / Variants

No.	Function
1	Motor –
2	Motor +
3	GND
4	UDD
5	Channel B
6	Channel A

Connection Encoder



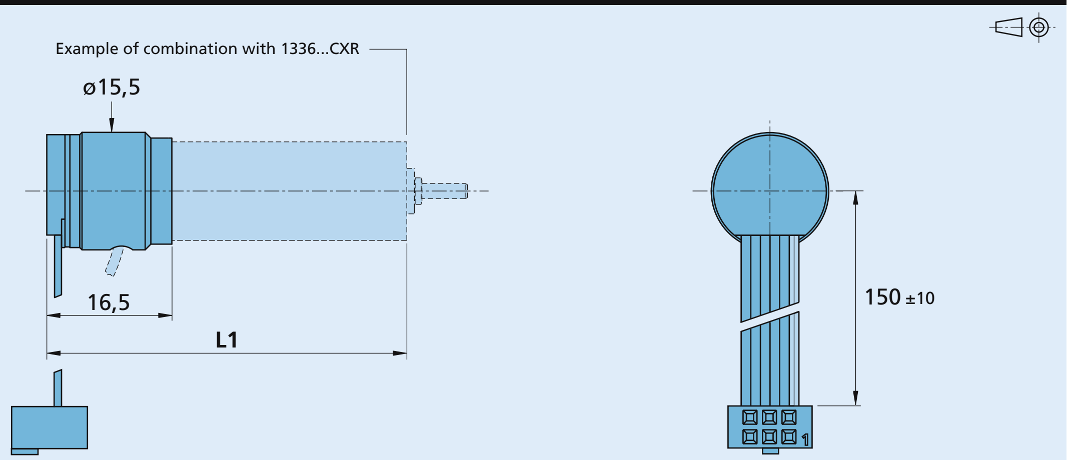
Cable
PVC-ribbon cable
6-conductors, 0,09 mm²

Connector
DIN-41651
grid 2,54 mm

Full product description

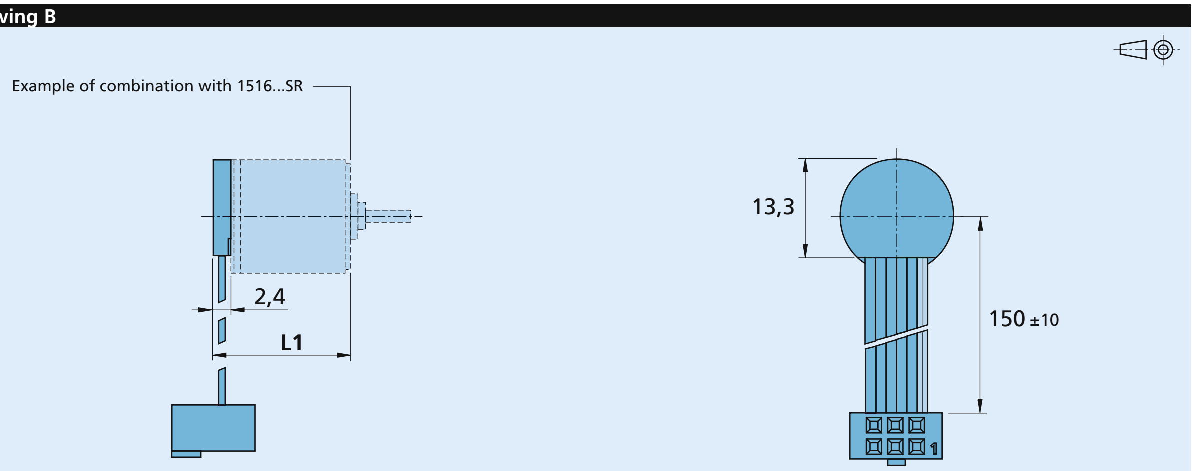
- Example:
  1336U012C-123 IE2-16
  1516T006SR IE2-16

Dimensional drawing A



IE2 – 16

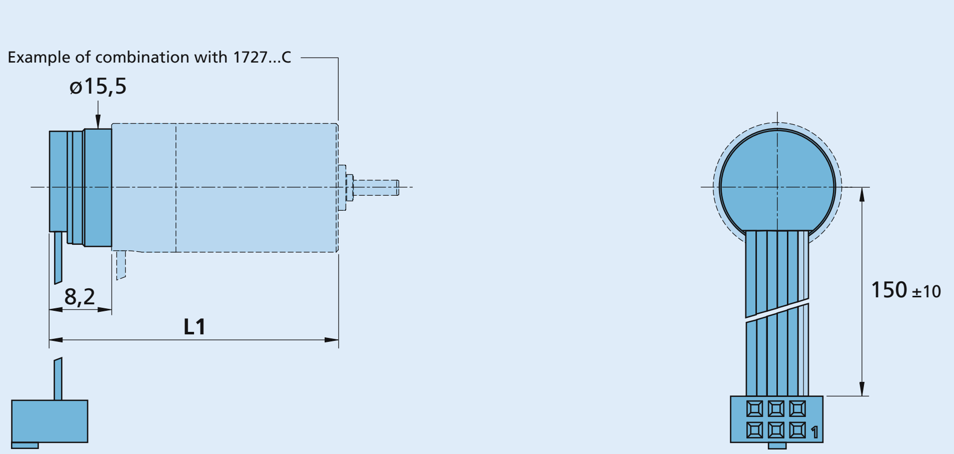
Dimensional drawing B



IE2 – 16

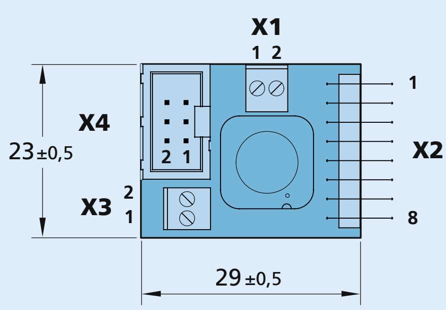
Encoders

Dimensional drawing C



IE2 – 16

Interface board for MCDC 3002 S



Interface Board IE2
Part. No.: 6501.00143

Connection

Pin	Connection X1
1	5. In
2	4. In

Pin	Connection X3
1	Motor -
2	Motor +

Pin	Connection X2
1	4. In
2	Channel A
3	Channel B
4	U_{DD}
5	SGND
6	Motor +
7	Motor -
8	5. In

Pin	Connection X4
1	Motor -
2	Motor +
3	SGND
4	U_{DD}
5	Channel B
6	Channel A

Encoders

magnetic Encoder, digital outputs, 2 channels,
50 - 400 lines per revolution

For combination with
DC-Micromotors

Series IE2 – 400

		IE2 – 50	IE2 – 100	IE2 – 200	IE2 – 400	
Lines per revolution	N	50	100	200	400	
Frequency range, up to [1]	f	20	40	80	160	kHz
Signal output, square wave		2				channels
Supply voltage	U_{DD}	4,5 … 5,5				V DC
Current consumption, typical [2]	I_{DD}	typ. 8,5, max. 12				mA
Output current, max. allowable [3]	I_{OUT}	5				mA
Phase shift, channel A to B	Φ	90 ± 45				°e
Signal rise/fall time, max. (C_{LOAD} = 50 pF)	tr/tf	0,1 / 0,1				µs
Inertia of code disc	J	0,05				gcm²
Operating temperature range		– 25 … + 85				°C

[1] speed (rpm) = f (Hz) x 60/N
[2] U_{DD} = 5 V: with unloaded outputs
[3] U_{DD} = 5 V: low logic level < 0,5 V, high logic level > 4,5 V: CMOS- and TTL compatible

For combination with motor

Dimensional drawing A	<L1 [mm]
1319T...SR	21,9
1331T...SR	33,9

Features

These incremental shaft encoders in combination with the FAULHABER DC-Micromotors are used for the indication and control of both shaft velocity and direction of rotation as well as for positioning.

The encoder is integrated in the DC-Micromotors SR-Series and extends the overall length by only 1,7 mm!

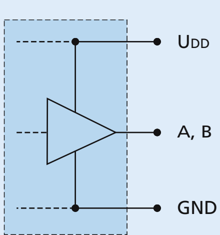
Hybrid circuits with sensors and a low inertia magnetic disc provide two channels with 90° phase shift.

The supply voltage for the encoder and the DC-Micromotor as well as the two channel output signals are interfaced through a ribbon cable with connector.

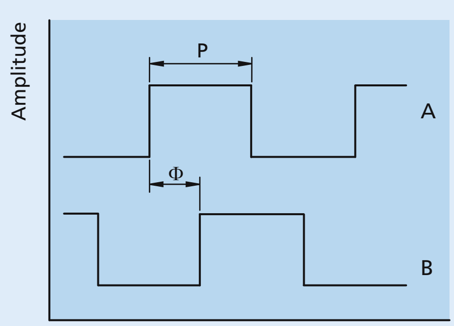
Details for the DC-Micromotors and suitable reduction gearheads are on separate catalogue pages.

Output signals / Circuit diagram

Output circuit



Output signals
with clockwise rotation as seen from the shaft end



Admissible deviation of phase shift:

$$\Delta\Phi = \left| 90° - \frac{\Phi}{P} * 180° \right| \leq 45°$$

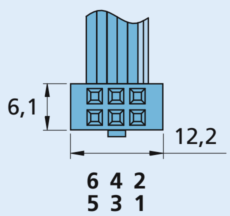
Encoders

Connector information / Variants

No.	Function
1	Motor – *
2	Motor + *
3	GND
4	U_{DD}
5	Channel B
6	Channel A

***Note:** The terminal resistance of all motors with precious metal commutation is increased by approx. 0.4 Ω, and the max. allowable motor current in combination is 1A, depending on the motor can also be lower.

Connection Encoder



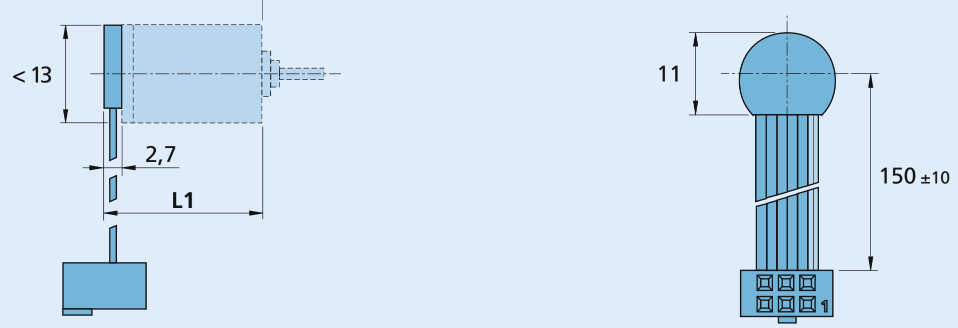
Cable
PVC-ribbon cable
6-conductors, 0,09 mm²

Connector
DIN-41651
grid 2,54 mm

Full product description

- Example:
  1319T012SR IE2-50
  1331T012SR IE2-400

Dimensional drawing A



IE2 – 50 ... 400

FAULHABER

Encoders

magnetic Encoder, digital outputs, 2 channels, 64 - 1024 lines per revolution

For combination with
DC-Micromotors
Brushless DC-Servomotors

Series IE2 – 1024

		IE2 – 64	IE2 – 128	IE2 – 256	IE2 – 512	IE – 1024	
Lines per revolution	N	64	128	256	512	1024	
Frequency range, up to [1]	f	20	40	80	160	300	kHz
Signal output, square wave		2					channels
Supply voltage	U_{DD}	4,5 … 5,5					V DC
Current consumption, typical [2]	I_{DD}	typ. 8,5, max. 12					mA
Output current, max. allowable [3]	I_{OUT}	5					mA
Phase shift, channel A to B	Φ	90 ± 45					°e
Signal rise/fall time, max. (C_{LOAD} = 50 pF)	tr/tf	0,1 / 0,1					µs
Inertia of code disc [4]	J	0,09					gcm²
Operating temperature range		– 25 … + 85					°C

[1] speed (rpm) = f (Hz) x 60/N
[2] $U_{DD\,Enc}$ = 5 V: with unloaded outputs
[3] $U_{DD\,Enc}$ = 5 V: low logic level < 0,5 V, high logic level > 4,5 V: CMOS- and TTL compatible
[4] For the brushless DC-Servomotors the inertia of code disc is J = 0,14 gcm²

For combination with motor

Dimensional drawing A	**<L1** [mm]	**Dimensional drawing C**	**<L1** [mm]
1336...CXR-123	47,5	1727...C-123	38,2
		1741...CXR-123	49,4
Dimensional drawing B	**<L1** [mm]		
1516...SR	18,2	**Dimensional drawing D**	**<L1** [mm]
1524...SR	26,2	1628...B-K313	38,8
1717...SR	19,4	2036...B-K313	46,8
1724...SR	26,4	2057...B-K313	68,3
2224...SR	26,6		
2232...SR	34,6		

Features

These incremental shaft encoders in combination with the FAULHABER DC-Micromotors and Brushless DC-Servomotors are used for the indication and control of both shaft velocity and direction of rotation as well as for positioning.

The encoder is integrated in the DC-Micromotors SR-Series and extends the overall length by only 1,4 mm. Built-on option for DC-Micromotors and Brushless DC-Servomotors.

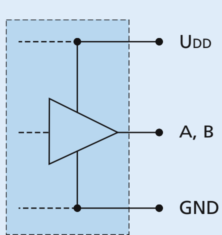
Hybrid circuits with sensors and a low inertia magnetic disc provide two channels with 90° phase shift.

The supply voltage for the encoder and the DC-Micromotor as well as the two channel output signals are interfaced through a ribbon cable with connector.

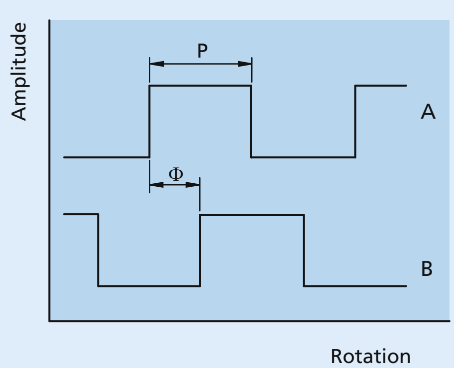
Details for the DC-Micromotors and suitable reduction gearheads are on separate catalogue pages.

Output signals / Circuit diagram

Output circuit



Output signals
with clockwise rotation as seen from the shaft end



Admissible deviation of phase shift:

$$\Delta\Phi = \left| 90° - \frac{\Phi}{P} * 180° \right| \leq 45°$$

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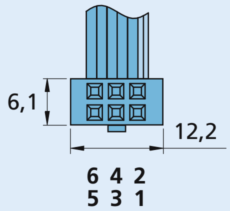
Connector information / Variants

No.	Function
1	Motor – *
2	Motor + *
3	GND
4	U_{DD}
5	Channel B
6	Channel A

***Note:** The terminal resistance of all motors with precious metal commutation is increased by approx. 0.4 Ω, and the max. allowable motor current in combination is 1A, depending on the motor can also be lower. Motors with graphite commutation have separate motor leads and higher motor current is allowed.

Connection Encoder



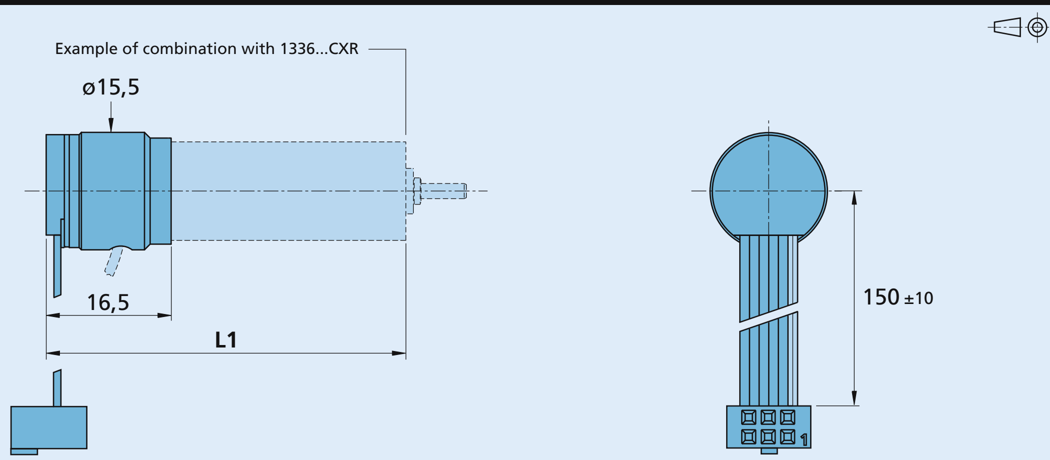
Cable
PVC-ribbon cable
6-conductors, 0,09 mm²

Connector
DIN-41651
grid 2,54 mm

Full product description

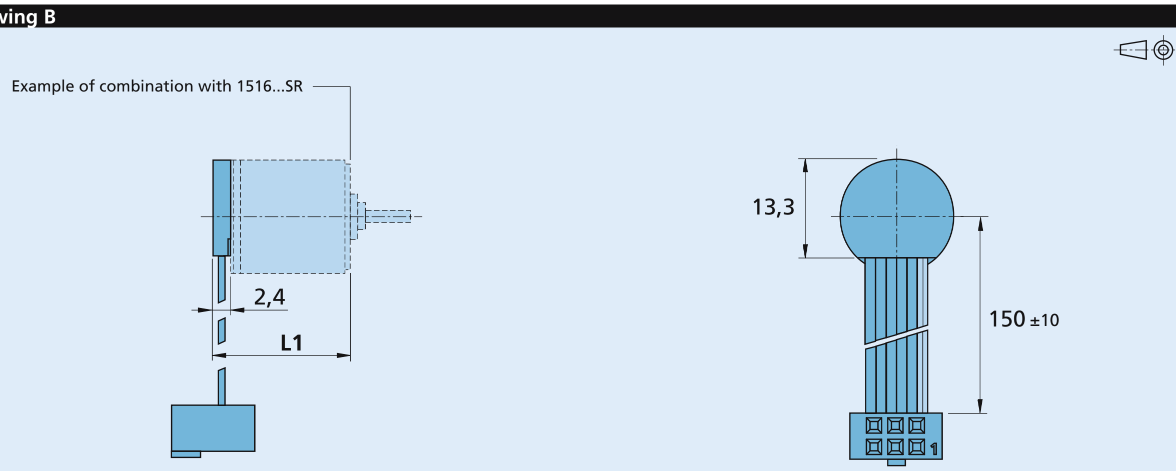
- Example:
  1336U012C-123 IE2-1024
  1516T006SR IE2-256

Dimensional drawing A



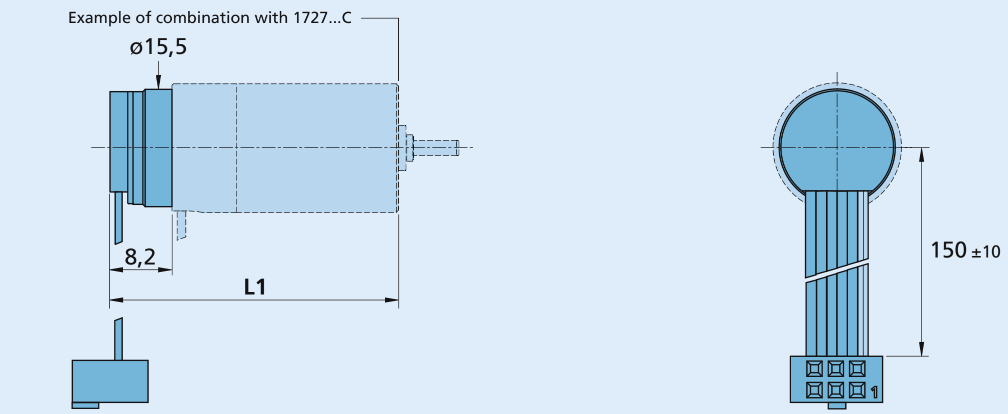
IE2 – 64 ... 1024

Dimensional drawing B



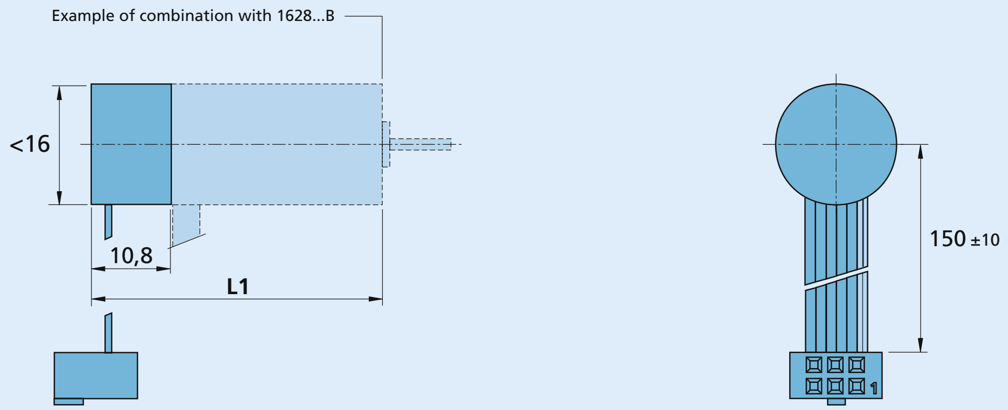
IE2 – 64 ... 1024

Dimensional drawing C



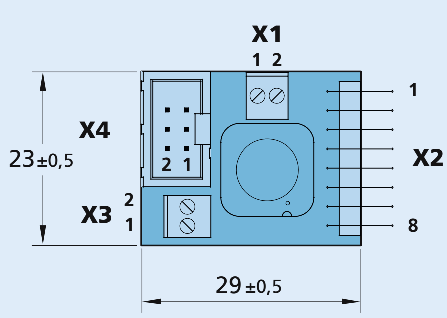
IE2 – 64 ... 1024

Dimensional drawing D



IE2 – 64 ... 1024

Interface board for MCDC 3002 S



Interface Board IE2
Part. No.: 6501.00143

Connection

Pin	Connection X1
1	5. In
2	4. In

Pin	Connection X3
1	Motor -
2	Motor +

Pin	Connection X2
1	4. In
2	Channel A
3	Channel B
4	U_{DD}
5	SGND
6	Motor +
7	Motor -
8	5. In

Pin	Connection X4
1	Motor -
2	Motor +
3	SGND
4	U_{DD}
5	Channel B
6	Channel A

NEW

Encoders

magnetic Encoder, digital outputs, 2 channels, 64 - 4096 lines per revolution

For combination with
DC-Micromotors

Series IEH2 – 4096

	IEH2	- 64	- 128	- 256	- 512	- 1024	- 2048	- 4096	
Lines per revolution	N	64	128	256	512	1024	2048	4096	
Frequency range, up to [1]	f	20	40	80	160	320	640	875	kHz
Signal output, square wave		2							channels
Supply voltage	U_{DD}	4,5 … 5,5							V DC
Current consumption, typical [2]	I_{DD}	typ. 15, max. 25							mA
Output current, max. allowable [3]	I_{OUT}	2,5							mA
Phase shift, channel A to B [4]	Φ	90 ±45				90 ±65	90 ±75		°e
Signal rise/fall time, max. (C_{LOAD} = 50 pF)	tr/tf	0,05 / 0,05							µs
Inertia of code disc	J	0,09							gcm^2
Operating temperature range		– 40 ... +100							°C

[1] speed (rpm) = f (Hz) x 60/N
[2] U_{DD} = 5 V: with unloaded outputs
[3] U_{DD} = 5 V: low logic level < 0,4 V, high logic level > 4,6 V: CMOS- and TTL compatible
[4] at 5000 rpm

For combination with motor

Dimensional drawing A	<L1 [mm]
1516...SR	18,2
1524...SR	26,2
1717...SR	19,4
1724...SR	26,4
2224...SR	26,6
2232...SR	34,6

Features

These incremental shaft encoders in combination with the FAULHABER DC-Micromotors are used for the indication and control of both shaft velocity and direction of rotation as well as for positioning.

The encoder is integrated in the DC-Micromotors SR-Series and extends the overall length by only 1,4 mm.

A segmented magnetic disc provides a magnetic field which is detected and further processed by a single chip angle sensor. The output signals of both channels consist of a square wave signal with 90° phase shift and up to 4096 impulses per motor revolution.

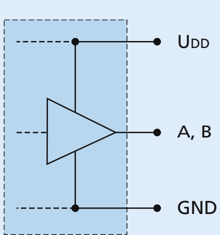
The encoder is available with different standard resolutions.

The supply voltage for the encoder and the DC-Micromotor as well as the two channel output signals are interfaced through a ribbon cable with connector.

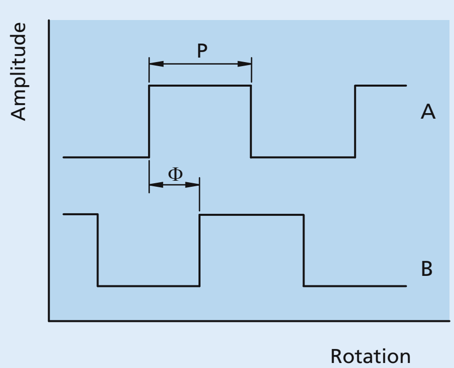
Details for the DC-Micromotors and suitable reduction gearheads are on separate catalogue pages.

Output signals / Circuit diagram

Output circuit



Output signals
with clockwise rotation as seen from the shaft end



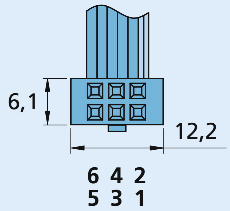
Admissible deviation of phase shift:

$$\Delta\Phi = \left| 90° - \frac{\Phi}{P} * 180° \right| \leq \text{see above}$$

Connector information / Variants

No.	Function
1	Motor –
2	Motor +
3	GND
4	UDD
5	Channel B
6	Channel A

Connection Encoder



Cable
PVC-ribbon cable
6-conductors, 0,09 mm²

Connector
DIN-41651
grid 2,54 mm

Full product description

- Example:
  1516T006SR IEH2-256

Dimensional drawing A

IEH2 – 64 ... 4096

Encoders

optical Encoder, digital outputs
2 channels, 120 lines per revolution

For combination with
Stepper Motors

Series PE22 – 120

		PE22 – 120	
Lines per revolution	N	120	
Frequency range [1]	f	up to 30	kHz
Signal output, square wave		2	channels
Supply voltage	U_{DD}	4,5 … 5,5	V DC
Current consumption, typical [2]	I_{DD}	20	mA
Pulse width	P_0	180 ± 45	°e
Phase shift, channel A to B	Φ	90 ± 45	°e
Logic state width	S	90 ± 45	°e
Cycle	C	360 ± 30	°e
Signal rise/fall time, typical	tr/tf	0,5 / 0,1	µs
Inertia of code disc	J	0,24	gcm^2
Operating temperature range		– 20 … + 85	°C

1) speed (rpm) = f (Hz) x 60/N
2) U_{DD} = 5 V: with unloaded outputs

For combination with motor

Dimensional drawing A	<L1 [mm]
AM2224	37,80
AM2224-R3	41,00

Features

These incremental shaft encoders in combination with two phases stepper motors are designed for indication and control of both, shaft velocity and direction of rotation as well as for position verification.

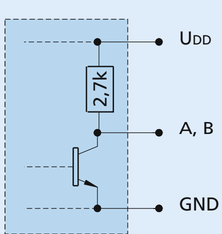
The encoder is integrated in the Stepper Motors and extends the overall length by only 11 mm.

The supply voltage for the encoder and the stepper motors as well as the two channel output signals are interfaced through a ribbon cable with connector.

Details for the stepper motors and suitable reduction gearheads are on the corresponding data sheets.

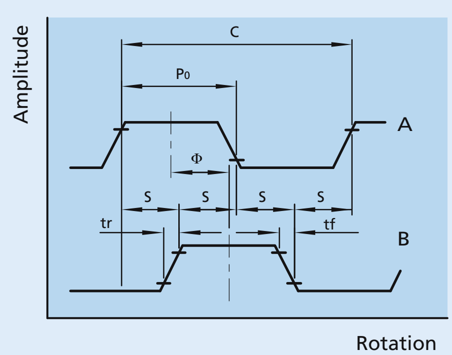
Circuit diagram / Output signals

Output circuit



Recommendation:
Please use a latch to capture the outputs.

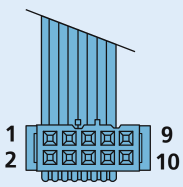
Output signals
with clockwise rotation as seen from the shaft end



Connector information / Variants

No.	Function
1	Motor Phase A +
2	Motor Phase A –
3	Motor Phase B +
4	Motor Phase B –
5	UDD ENC
6	GND
7	Channel A
8	Channel B
9	N.C.
10	N.C.

Connection Encoder and Motor

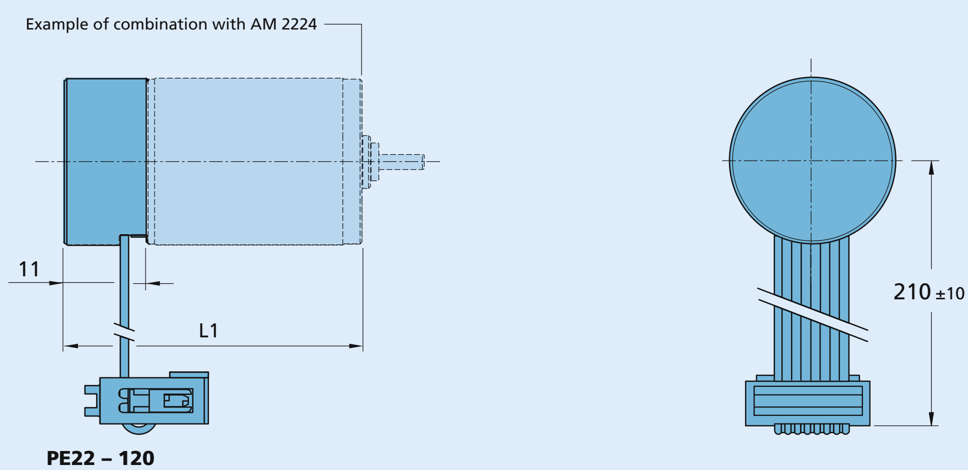


Connector
Serie 71600-010LF
PVC-ribbon cable

Full product description

- Example:
  AM2224-AV-18-16 PE22-120
  AM2224-R3-V-12-75-86 PE22-120

Dimensional drawing A



Encoders

magnetic Encoder, digital outputs, 3 channels,
16 - 64 lines per revolution

For combination with
DC-Micromotors
Brushless DC-Servomotors

Series HXM3 – 64

		HXM3 – 16	HXM3 – 32	HXM3 – 64	
Lines per revolution	N	16	32	64	
Signal output, square wave		3			channels
Supply voltage	U_{DD}	4,5 ... 5,5			V DC
Current consumption, typical [1]	I_{DD}	9			mA
Pulse width	P	180 ± 45			°e
Phase shift, channel A to B	Φ	90 ± 45			°e
Logic state width	S	90 ± 45			°e
Cycle	C	360 ± 45			°e
Signal rise/fall time, max. (C_{LOAD} = 50 pF)	tr/tf	60 / 60			µs
Rotational speed up to	$n_{max.}$	30 000			rpm
Inertia of code disc [2]	J	0,02			gcm^2
Operating temperature range		– 25 ... + 85			°C

[1] U_{DD} = 5 V: with unloaded outputs
[2] No additional inertia for series 0620...B

For combination with motor			
Dimensional drawing A	**L1** [mm]		
0615...S - K1707	19,4		
Dimensional drawing B	**L1** [mm]		
0620...B - K1674	21,5		

Features

These incremental shaft encoders in combination with the FAULHABER DC-Micromotors and Brushless DC-Servomotors are designed for indication and control of both shaft velocity and direction of rotation as well as for positioning.

Solid state sensors and a low inertia magnetic disc provide two channels with 90° phase shift and one index channel.

The supply voltage for the encoder and the DC-Micromotor as well as the output signals are interfaced with a flexible printed circuit (FPC) to a 8-pin ZIF connector.

Encoder is programmable by user to 16, 32, and 64 lines per revolution by setting the CFG2 pin to high, open, or ground respectively. The input power must be cycled off and on to change the settings.

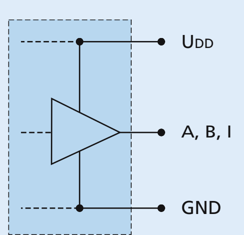
Please note: Velocity (rpm) = f (Hz) x 60/N

Details for the DC-Micromotors and suitable reduction gearheads are on separate catalog pages.

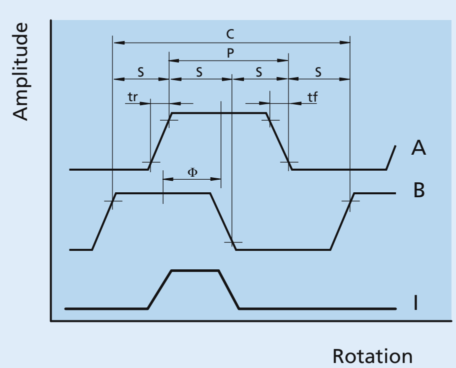
An optional interface board with suitable connector is also available on request.

Output signals / Circuit diagram

Output circuit



Output signals
with clockwise rotation as seen from the shaft end

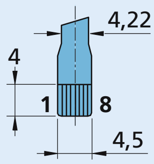


Connector information / Variants

No.	Function
1	Motor +*
2	UDD
3	Channel I
4	Channel A
5	Channel B
6	Cfg2
7	GND
8	Motor –*

* **Note:** Brushless motors have separate motor leads.

Connection Encoder and Motor



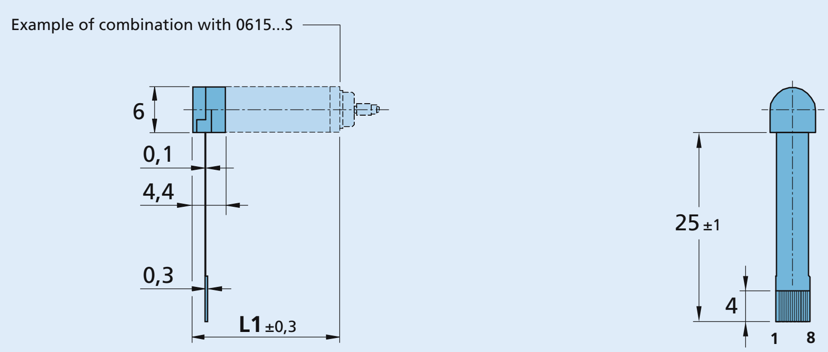
Flexboard
8 circuits, 0,5 mm pitch

Recommended connector
Top contact style
8 circuits, 0,5 mm pitch, e.g.:
Molex: 52745

Full product description

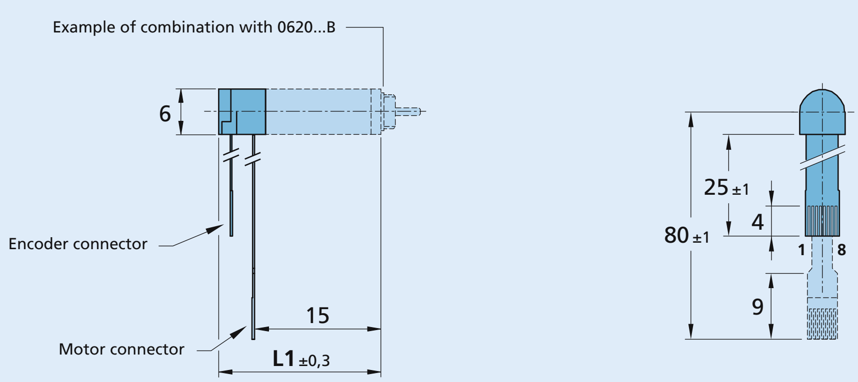
- Examples:
  0615N003SK1707 HXM3-64
  0620K012BK1674 HXM3-64

Dimensional drawing A



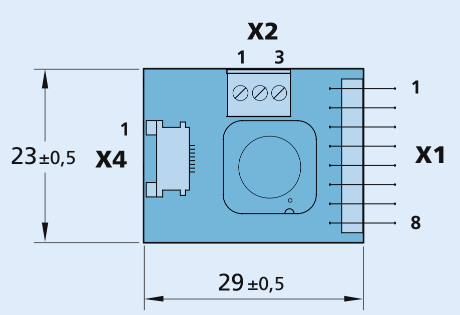
HXM3 – 64

Dimensional drawing B



HXM3 – 64

Interface board MCDC 3002 S



Interface Board HXM3 – 64
Part. No.: 6501.00145

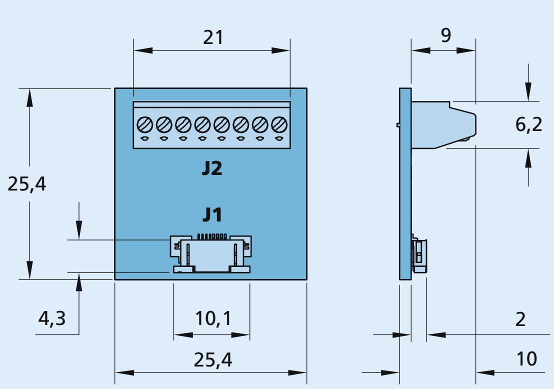
Connection

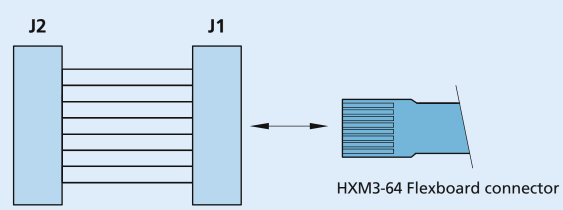
Pin	Connection X1
1	4. In
2	Channel A
3	Channel B
4	U_{DD} = 5V
5	SGND
6	Motor +
7	Motor -
8	5 .In

Pin	Connection X4
1	Motor +
2	U_{DD} = 5V
3	Kanal Z
4	Channel A
5	Channel B
6	N.C.
7	SGND
8	Motor -

Pin	Connection X2
1	Channel Z
2	5. In
3	4. In

Optional interface board





Interface board HXM3-64
Part No.: D100308900

Connector
J1 - Molex 52745-0896
J2 - Phoenix 1725711

Encoders

magnetic Encoder, digital outputs, 3 channels,
32 - 256 lines per revolution

For combination with
DC-Micromotors

Series HEM3 – 256 – W

		HEM3 – 32 – W	HEM3 – 64 – W	HEM3 – 128 – W	HEM3 – 256 – W	
Lines per revolution	N	32	64	128	256	
Signal output, square wave		3				channels
Supply voltage [1]	U_{DD}	3 … 3,6				V DC
Supply voltage [2]	U_{DD}	4,5 … 5,5				V DC
Current consumption, typical [3]	I_{DD}	16				mA
Output current, max. [4]	I_{OUT}	2 / 4				mA
Pulse width	P	180 ± 45				°e
Phase shift, channel A to B	Φ	90 ± 45				°e
Logic state width	S	90 ± 45				°e
Signal rise/fall time, max. (C_{LOAD} = 50 pF)	tr/tf	0,1 / 0,1				µs
Rotational speed up to	$n_{max.}$	30 000				rpm
Inertia of code disc	J	0,02				gcm^2
Operating temperature range		– 30 … + 85				°C

1) U_{DD} = 3,3 V DC: Connect pins 3 and 4 to 3,3 V DC
2) U_{DD} = 5 V DC: Connect pin 3 to 5 V DC, pin 4 open
3) U_{DD} = 3,3 or 5 V, with unloaded outputs
4) U_{DD} = 5 V DC: Low logic level < 0,5 V, high logic level > 4,5 V: CMOS and TTL compatible

For combination with motor

Dimensional drawing A	L1 [mm]
0816...SR - K2566	23,5
Dimensional drawing B	L1 [mm]
1016...G - K1707	24,2
1024...S - K1707	32,2
Dimensional drawing C	L1 [mm]
1224...SR - K1707	31,1

Features

These incremental shaft encoders in combination with the FAULHABER DC-Micromotors are designed for indication and control of both shaft velocity and direction of rotation as well as for positioning.

Solid state sensors and a low inertia magnetic disc provide two channels with 90° phase shift and one index channel.

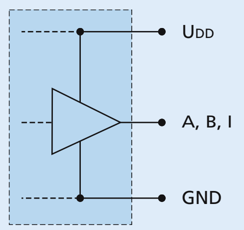
The nominal supply voltage for the encoder is selectable and either 3,3 VDC or 5,0 VDC.

The supply voltage for the encoder and the DC-Micromotor as well as the output signals are interfaced with discrete wires and an 8-pin Molex crimp style connector.

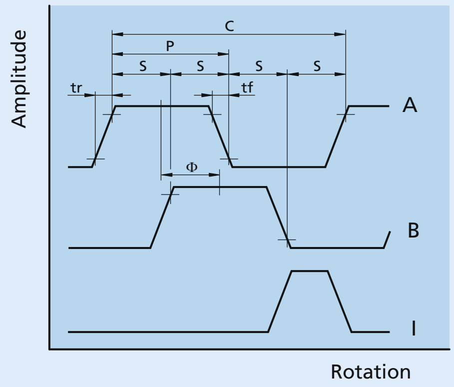
Details for the DC-Micromotors and suitable reduction gearheads are on separate catalog pages.

Output signals / Circuit diagram

Output circuit



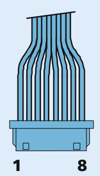
Output signals
with clockwise rotation as seen from the shaft end



Connector information / Variants

No.	Function
1	Motor –
2	GND
3	$U_{DD\ 5V}$
4	$U_{DD\ 3,3V}$
5	Channel A
6	Channel B
7	Channel I (Index)
8	Motor +

Connection Encoder and Motor



Cable
Wire: Tefzel MIL-W-22759/32, 30AWG

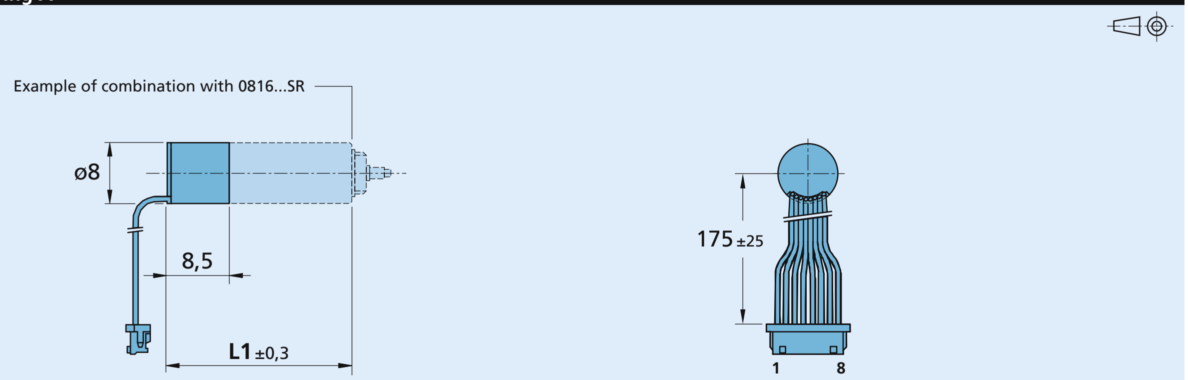
Recommended connector
8 circuits, 1,25 mm pitch, e.g.:
Molex: 51021-0800

Full product description

- Examples:

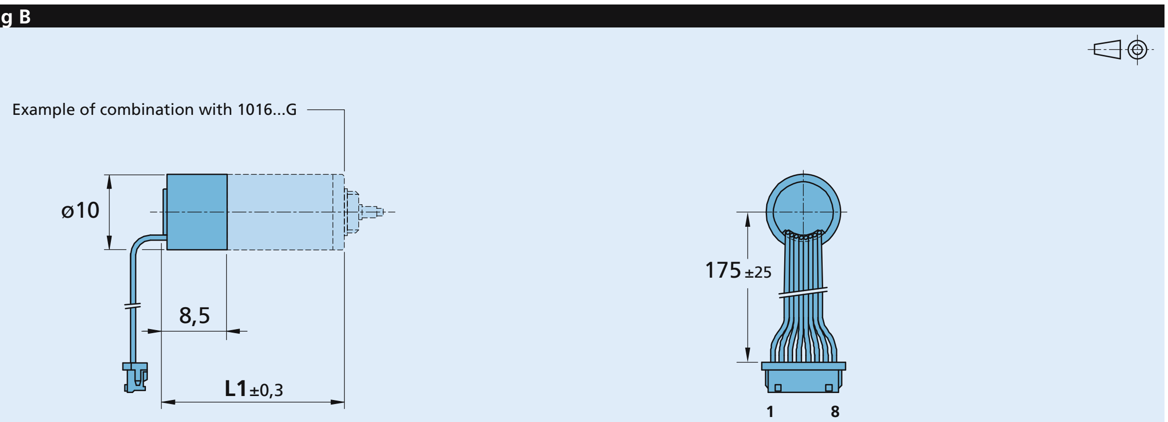
1016N012G HEM3-32
1224N012SR HEM3-256

Dimensional drawing A



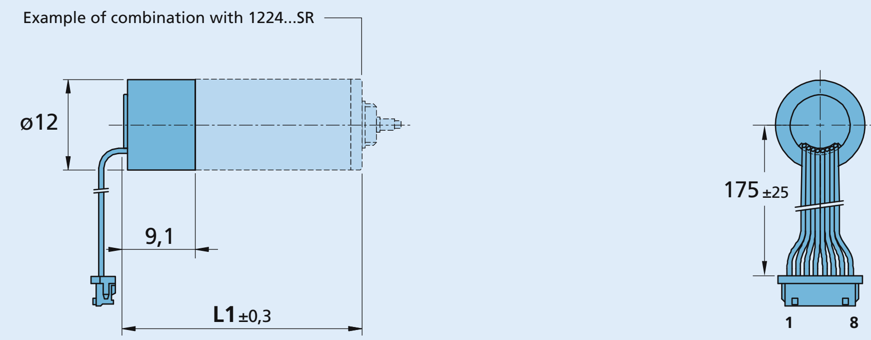
HEM3 – 256 – W

Dimensional drawing B



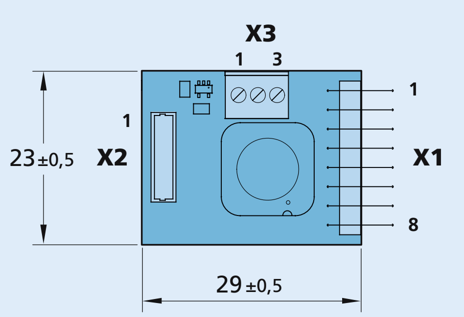
HEM3 – 256 – W

Dimensional drawing C



HEM3 – 256 – W

Interface board for MCDC 3002 S



Interface Board HEM3 – 256 – W
Part. No.: 6501.00146

Connection

Pin	Connection X1
1	4. In
2	Channel A
3	Channel B
4	U_{DD} = 5V
5	SGND
6	Motor +
7	Motor -
8	5 .In

Pin	Connection X2
1	Motor -
2	SGND
3	U_{DD} = 5V
4	N.C.
5	Channel A
6	Channel B
7	Index
8	Motor +

Pin	Connection X3
1	Index
2	5. In
3	4. In

Note:
U_{DD} = 3,3V available on request

Encoders

NEW

Encoders

magnetic Encoder, digital outputs
3 channels, 32 - 1024 lines per revolution

For combination with
Brushless DC-Servomotors

Series IEM3 – 1024

		IEM3 – 32	IEM3 – 64	IEM3 – 128	IEM3 – 256	IEM3 – 512	IEM3 – 1024	
Lines per revolution	N	32	64	128	256	512	1024	
Frequency range, up to 1)	f	64	128	256	500	500	500	kHz
Signal output, square wave		2+1 Index						channels
Supply voltage	U_{DD}	4,5 ... 5,5						V DC
Current consumption, typical 2)	I_{DD}	typ. 16, max. 23						mA
Output current, max. allowable 3)	I_{OUT}	4						mA
Index Pulse width 4)	P_0	90 ± 45			90 ± 75			°e
Phase shift, channel A to B 4)	Φ	90 ± 45			90 ± 75			°e
Signal rise/fall time, max. (C_{LOAD} = 50 pF)	tr/tf	0,1 / 0,1						µs
Operating temperature range		– 20 ... + 100						°C

1) speed (rpm) = f (Hz) x 60/N
2) U_{DD} = 5 V: with unloaded outputs
3) U_{DD} = 5 V: low logic level < 0,4 V, high logic level > 4,5 V: CMOS- and TTL compatible
4) at 5 000 rpm

For combination with motor	
Dimensional drawing A	**<L1** [mm]
0824...B	24,1
Dimensional drawing B	**<L1** [mm]
1028...B	28,1

Features

These incremental encoders in combination with the FAULHABER motors are used for the indication and control of both velocity and direction of rotation as well as for positioning.

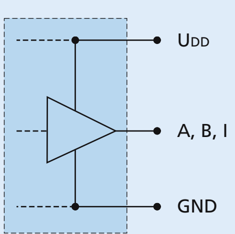
A permanent magnet on the shaft creates a moving magnetic field which is captured using a single-chip angular sensor and further processed. At the encoder outputs, two 90° phase-shifted rectangular signals are available with up to 1024 impulses and an index impulse per motor revolution.

The encoder is available in a variety of different resolutions and is suitable for speed control and positioning applications.

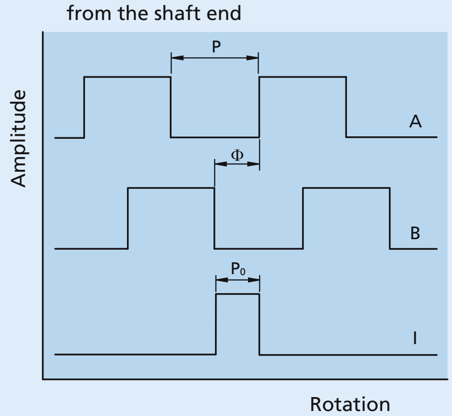
Motor and encoder are connected via a common flexboard.

Circuit diagram / Output signals

Output circuit



Output signals
with clockwise rotation as seen from the shaft end



Admissible deviation of phase shift:

$$\Delta\Phi = \left| 90° - \frac{\Phi}{P} * 180° \right|$$

Admissible deviation of Index pulse:

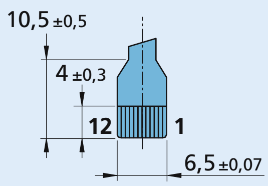
$$\Delta P_0 = \left| 90° - \frac{P_0}{P} * 180° \right|$$

Connector information / Variants

No.	Function
1	Phase C
2	Phase B
3	Phase A
4	GND
5	U_{DD}
6	Hall sensor C
7	Hall sensor B
8	Hall sensor A
9	Channel B
10	Channel A
11	Channel I
12	Reserved

Caution:
Incorrect lead connection will damage the motor electronics!

Connection Encoder and Motor



Flexboard
12 circuits, 0,5 mm pitch

Recommended connector
Top contact style
12 circuits, 0,5 mm pitch, e.g.:
Molex: 52745-1296/1297

Options

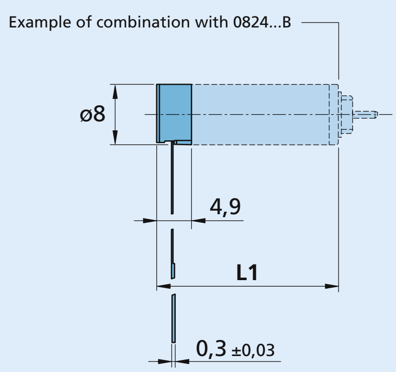
- Resolutions from 1 - 127 lines per revolution are available on request.

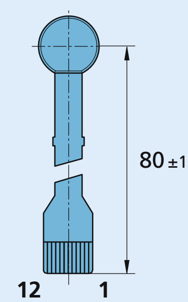
Full product description

- Examples:

0824K006B IEM3-1024
1028S012B IEM3-1024

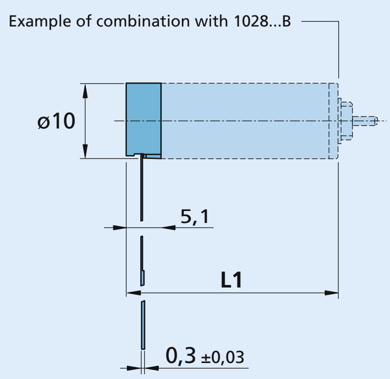
Dimensional drawing A

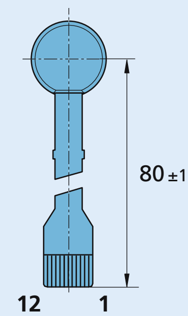




IEM3 – 1024

Dimensional drawing B

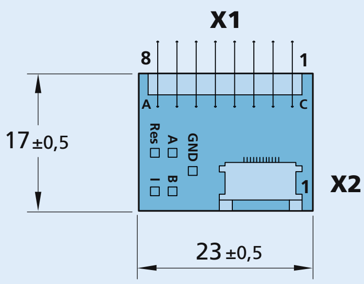




IEM3 – 1024

Encoders

Interface board for SC 1801 S



Interface Board IEM3 – 1024
Part. No.: 6501.00163

Connection

Pin	Connection X1
1	Phase C
2	Phase B
3	Phase A
4	GND
5	U_{DD}
6	Hall Sensor C
7	Hall Sensor B
8	Hall Sensor A

Pin	Connection X2
1	Phase C
2	Phase B
3	Phase A
4	GND
5	U_{DD}
6	Hall Sensor C
7	Hall Sensor B
8	Hall Sensor A
9	Channel B
10	Channel A
11	Channel I
12	Res.

Encoders

magnetic Encoder, digital outputs
3 channels, 32 - 1024 lines per revolution

For combination with
DC-Micromotors
Brushless DC-Motors

Series IE3 – 1024

		IE3 – 32	IE3 – 64	IE3 – 128	IE3 – 256	IE3 – 512	IE3 – 1024	
Lines per revolution	N	32	64	128	256	512	1024	
Frequency range, up to [1]	f	15	30	60	120	240	430	kHz
Signal output, square wave		2+1 Index						channels
Supply voltage	U_{DD}	4,5 … 5,5						V DC
Current consumption, typical [2]	I_{DD}	typ. 16, max. 23						mA
Output current, max. allowable [3]	I_{OUT}	4						mA
Index Pulse width [4]	P_0	90 ± 45				90 ± 75		°e
Phase shift, channel A to B [4]	Φ	90 ± 45				90 ± 75		°e
Signal rise/fall time, max. (C_{LOAD} = 50 pF)	tr/tf	0,1 / 0,1						µs
Inertia of code disc	J	0,08						gcm²
Operating temperature range		– 40 ... + 100						°C

[1] speed (rpm) = f (Hz) x 60/N
[2] U_{DD} = 5 V: with unloaded outputs
[3] U_{DD} = 5 V: low logic level < 0,4 V, high logic level > 4,5 V: CMOS- and TTL compatible
[4] at 5 000 rpm

For combination with motor

Dimensional drawing A	**<L1** [mm]
2237...CXR	52,5

Dimensional drawing B	**<L1** [mm]
2342...CR	60,5
2642...CR	60,5
2642...CXR	60,5
2657...CR	75,5
2657...CXR	75,5
3242...CR	60,5
3257...CR	75,5
3272...CR	90,5

Dimensional drawing C	**<L1** [mm]
2444...B - K1838	55,3
3056...B - K1838	67,3
3564...B -K1838	75,3
4490...B - K1838	100,3
4490...BS - K1838	100,3

Dimensional drawing D	**<L1** [mm]
2232...BX4	50,2
2232...BX4S	50,2
2250...BX4	68,2
2250...BX4S	68,2

Dimensional drawing E	**<L1** [mm]
3242...BX4	60,0
3268...BX4	86,0

Dimensional drawing F	**<L1** [mm]
3863...CR - 2016	82,6
3890...CR - 2016	108,6

Features

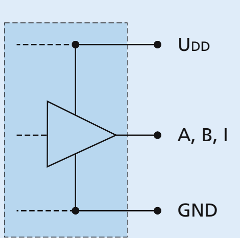
These incremental encoders have 3 output channels, in combination with the FAULHABER Motors are used for the indication and control of both shaft velocity and direction of rotation as well as for positioning.

A permanent magnet on the shaft creates a moving magnetic field which is captured using a single-chip angular sensor and further processed. At the encoder outputs, two 90° phase-shifted rectangular signals are available with up to 1024 impulses and an index impulse per motor revolution.

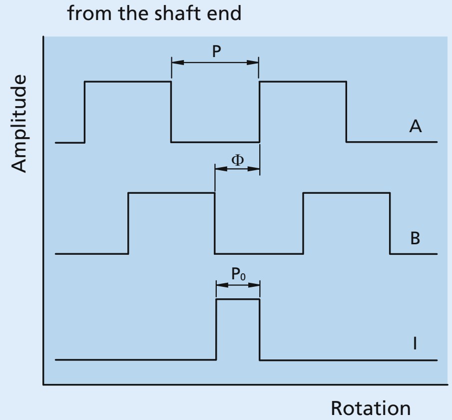
The encoder is available in a variety of different resolutions. Motor and encoder are connected via a common flexboard.

Circuit diagram / Output signals

Output circuit



Output signals
with clockwise rotation as seen from the shaft end



Admissible deviation of phase shift:

$$\Delta\Phi = \left| 90° - \frac{\Phi}{P} * 180° \right| \leq 75°$$

Admissible deviation of Index pulse:

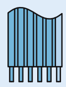
$$\Delta P_0 = \left| 90° - \frac{P_0}{P} * 180° \right| \leq 75°$$

Connector information / Variants

No.	Function
1	n.c.
2	Channel I (Index)
3	GND
4	UDD
5	Channel B
6	Channel A

Caution:
Incorrect lead connection will damage the motor electronics!

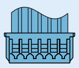
Connection Encoder



Cable
PVC-ribbon cable
6-AWG 28, 1,27 mm

Option

- Connector variants (Option no.: 3807)
  AWG 28 / PVC ribbon cable (6-conductors), with connector PicoBlade (pitch 1,25 mm)

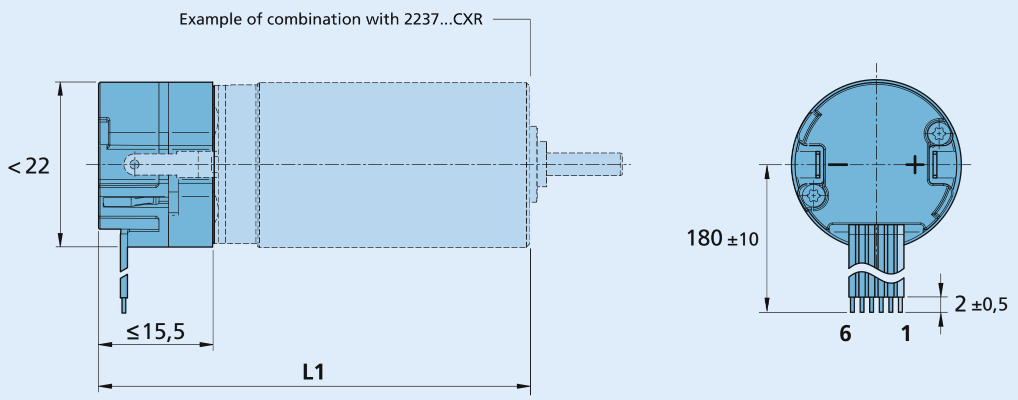


- Resolutions from 1 - 127 lines per revolution are available by request.

Full product description

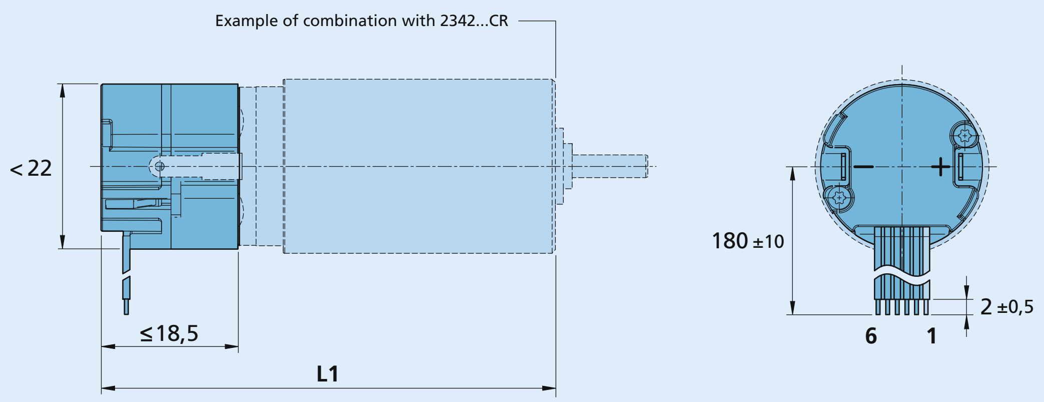
- Example:
  2444S024B K1838 IE3-1024
  2232S024BX4 IE3-256

Dimensional drawing A



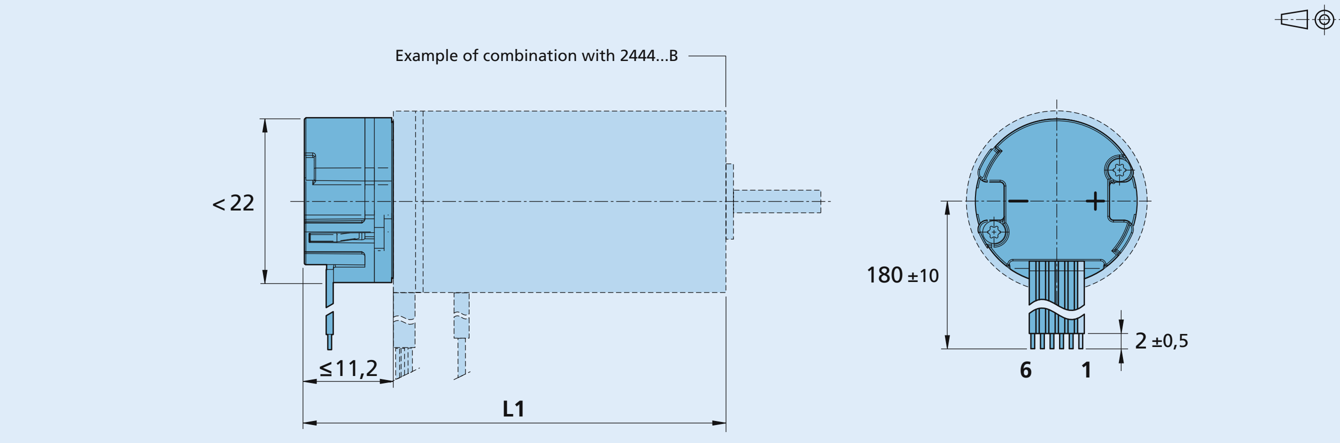
IE3 – 32 ... 1024

Dimensional drawing B



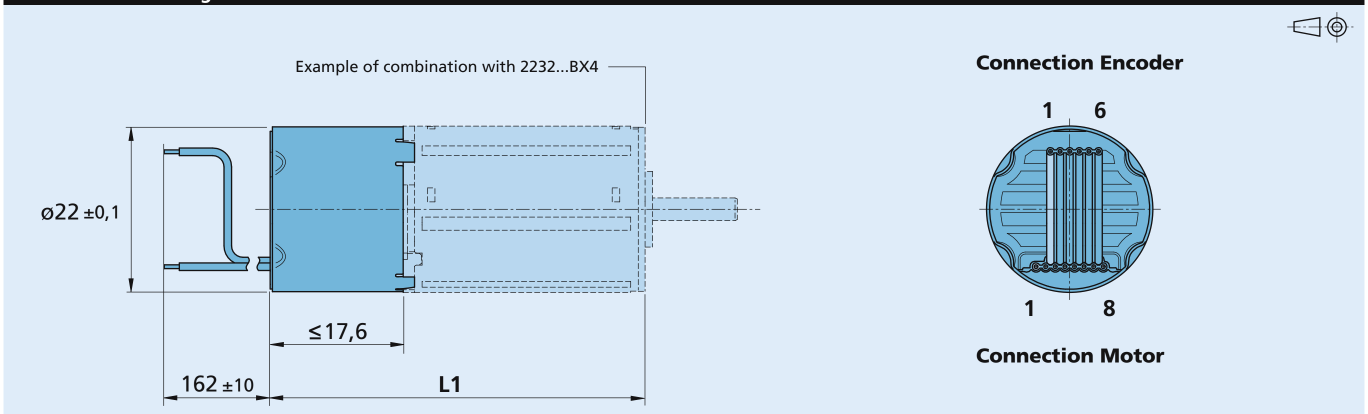
IE3 – 32 ... 1024

Dimensional drawing C



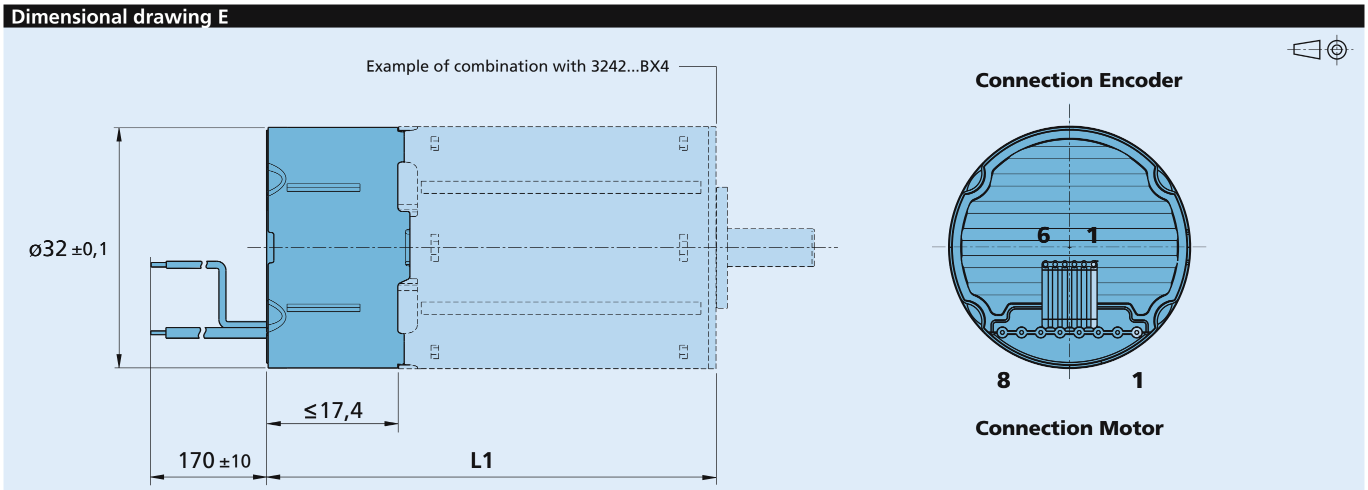
IE3 – 32 ... 1024

Dimensional drawing D



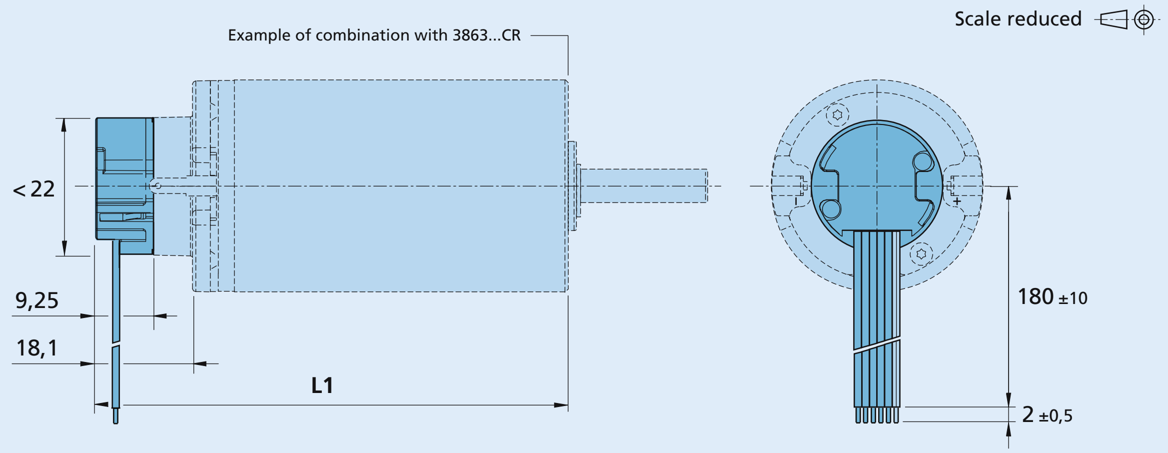
IE3 – 32 ... 1024

Dimensional drawing E



IE3 – 32 ... 1024

Dimensional drawing F



IE3 – 32 ... 1024

Encoders

magnetic Encoder, digital outputs, 3 channels,
32 - 1024 lines per revolution, Line Driver

For combination with
DC-Micromotors
Brushless DC-Motors

Series IE3 – 1024 L

		IE3 – 32 L	IE3 – 64 L	IE3 – 128 L	IE3 – 256 L	IE3 – 512 L	IE3 – 1024 L	
Lines per revolution	N	32	64	128	256	512	1024	
Frequency range, up to [1]	f	15	30	60	120	240	430	kHz
Signal output, square wave		2+1 index and complementary outputs						channels
Supply voltage	U_{DD}	4,5 ... 5,5						V DC
Current consumption, typical [2]	I_{DD}	typ. 17, max. 25						mA
Index Pulse width [3]	P_0	90 ± 45				90 ± 75		°e
Phase shift, channel A to B [3]	Φ	90 ± 45				90 ± 75		°e
Inertia of code disc	J	0,08						gcm^2
Operating temperature range		– 40 ... + 85				– 40 ... 100		°C

[1] speed (rpm) = f (Hz) x 60/N
[2] U_{DD} = 5 V: with unloaded outputs
[3] at 5 000 rpm

Notes: The output signals are TIA-422 compatible.
Examples of Line driver Receivers: ST26C32ABD (STM), ST26C32IP16 (EXAR), DS26C32AT (NSC).

For combination with motor

Dimensional drawing A	**<L1** [mm]	**Dimensional drawing C**	**<L1** [mm]	**Dimensional drawing E**	**<L1** [mm]
2237...CXR	52,5	2444...B - K1838	55,3	3242...BX4	60,0
		3056...B - K1838	67,3	3268...BX4	86,0
Dimensional drawing B	**<L1** [mm]	3564...B -K1838	75,3		
2342...CR	60,5	4490...B - K1838	100,3	**Dimensional drawing F**	**<L1** [mm]
2642...CR	60,5	4490...BS - K1838	100,3	3863...CR - 2016	82,6
2642...CXR	60,5			3890...CR - 2016	108,6
2657...CR	75,5	**Dimensional drawing D**	**<L1** [mm]		
2657...CXR	75,5	2232...BX4	50,2		
3242...CR	60,5	2232...BX4S	50,2		
3257...CR	75,5	2250...BX4	68,2		
3272...CR	90,5	2250...BX4S	68,2		

Features

These incremental encoders have 3 output channels, in combination with the FAULHABER DC-Micromotors are used for the indication and control of both shaft velocity and direction of rotation as well as for positioning.

A permanent magnet on the shaft creates a moving magnetic field which is captured using a single-chip angular sensor and further processed. At the encoder outputs, two 90° phase-shifted rectangular signals are available with up to 1 024 impulses and an index impulse per motor revolution.

The Line Driver version has differential signal outputs (TIA-422). Differential signals reduce ambient interference and are suitable for applications with high ambient interference.

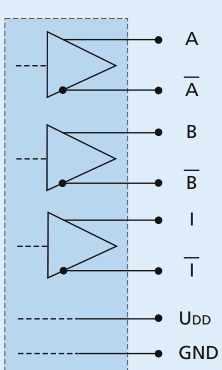
The line driver amplifies the encoder signal which means that long cables can be used without signal degradation.

Differential signal outputs must be decoded by the appropriate receiver module.

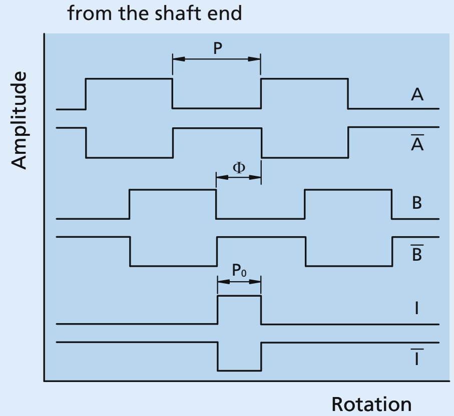
The encoder is available in a variety of different resolutions.
The motor and encoder are connected via separate ribbon cables.

Circuit diagram / Output signals

Output circuit



Output signals
with clockwise rotation as seen from the shaft end



Admissible deviation of phase shift:

$$\Delta\Phi = \left| 90° - \frac{\Phi}{P} * 180° \right| \le 75°$$

Admissible deviation of Index pulse:

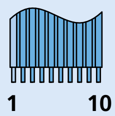
$$\Delta P_0 = \left| 90° - \frac{P_0}{P} * 180° \right| \le 75°$$

Connector information / Variants

No.	Function
1	n.c.
2	U_{DD}
3	GND
4	n.c.
5	Channel $\overline{A}$
6	Channel A
7	Channel $\overline{B}$
8	Channel B
9	Channel $\overline{I}$ (Index)
10	Channel I (Index)

Caution:
Incorrect lead connection will damage the motor electronics!

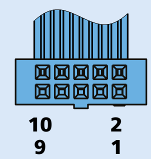
Connection Encoder



Cable
PVC-ribbon cable
10-AWG 28, 1,27 mm

Option

- Connector variants (Option no.: 3806)
  AWG 28 / PVC ribbon cable (10-conductors),
  with connector DIN-41651 (pitch 2,54 mm)

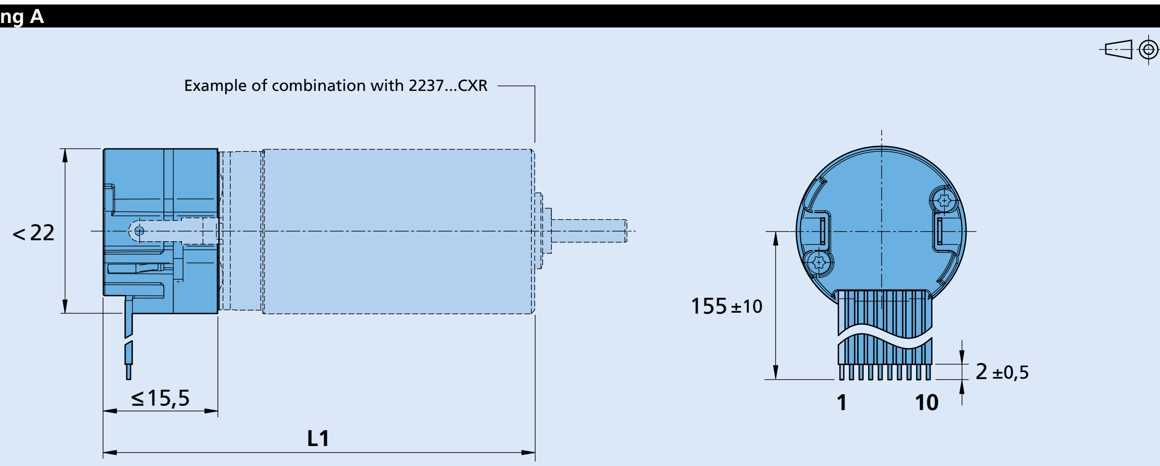


- Resolutions from 1 - 127 lines per revolution
  are available by request.

Full product description

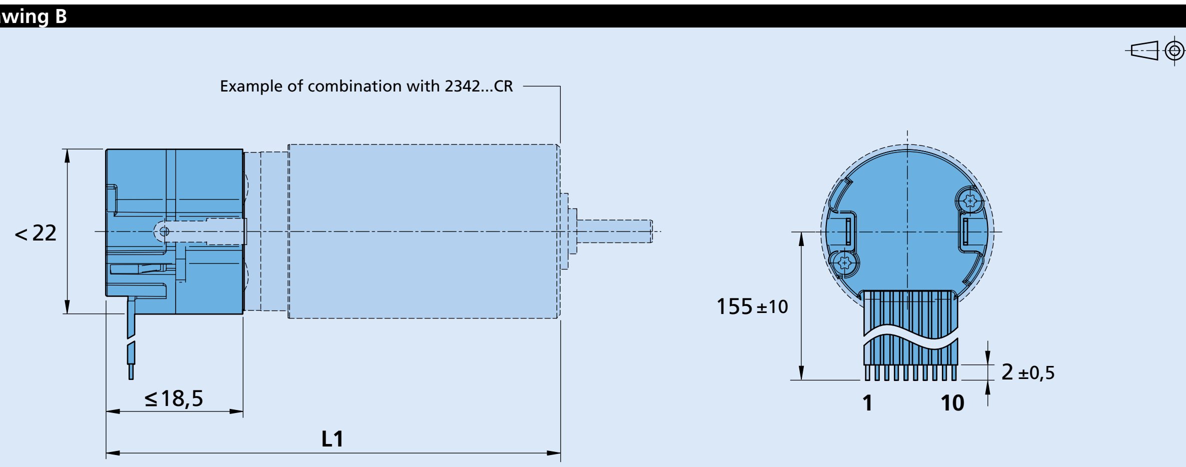
- Example:
  2444S024B K1838 IE3-1024L
  2232S024BX4 IE3-256L

Dimensional drawing A



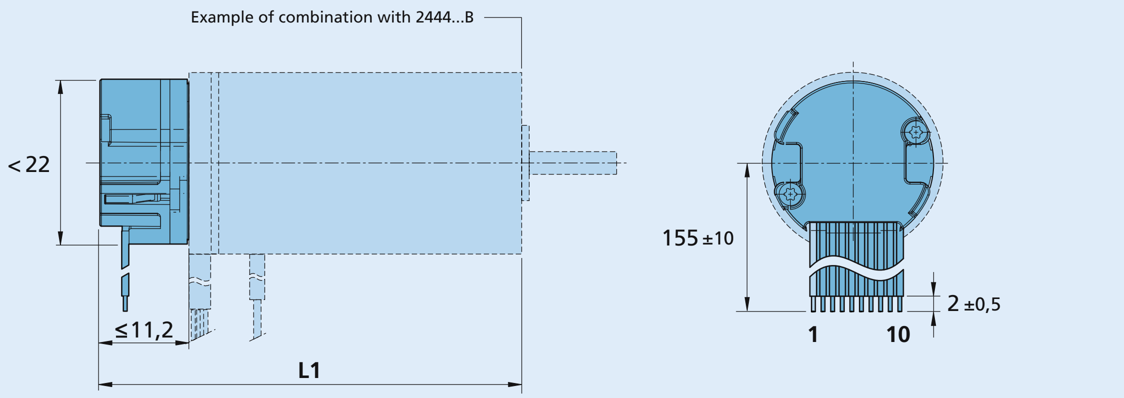
IE3 – 32 ... 1024 L

Dimensional drawing B



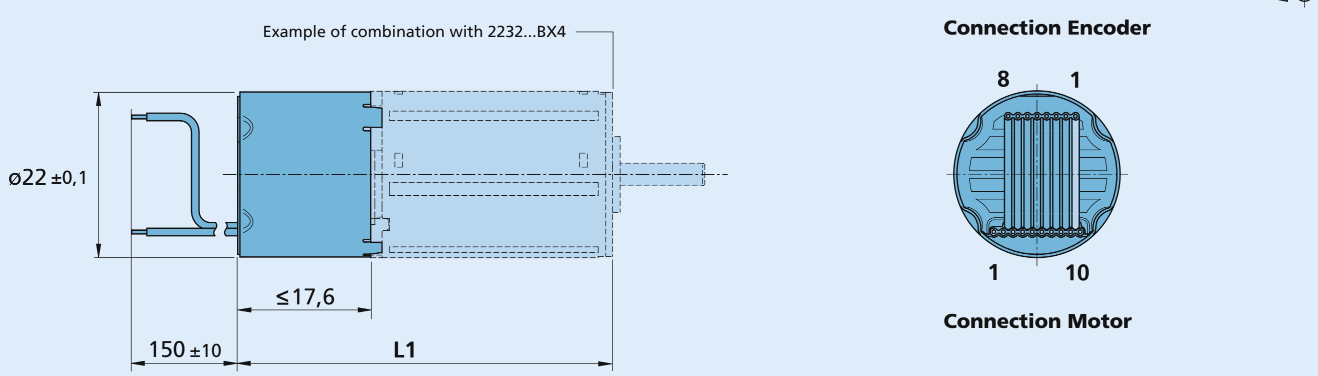
IE3 – 32 ... 1024 L

Dimensional drawing C



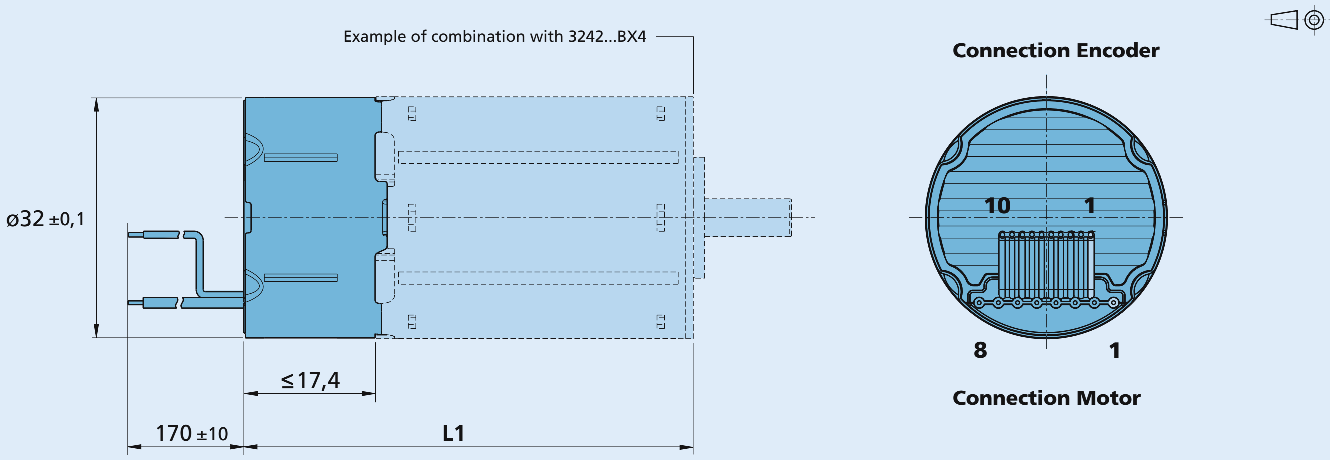
IE3 – 32 ... 1024 L

Dimensional drawing D



IE3 – 32 ... 1024 L

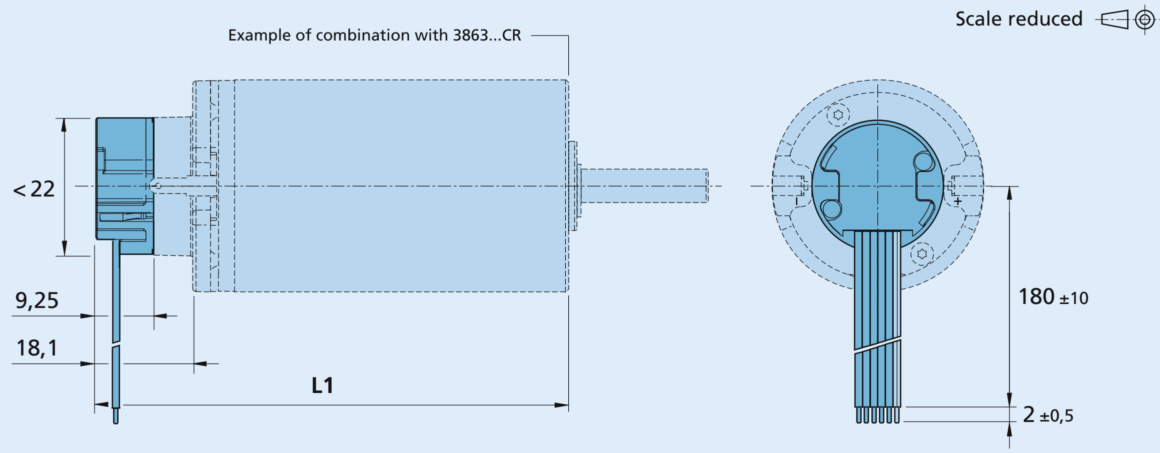
Dimensional drawing E



IE3 – 32 ... 1024 L

Dimensional drawing F

Scale reduced



IE3 – 32 ... 1024 L

Notes

Encoders

optical Encoder, digital outputs, 2 - 3 channels,
100 - 1024 lines per revolution

For combination with
DC-Micromotors
Brushless DC-Servomotors

Series 5500, 5540

		HEDS 5500	HEDS 5540	HEDM 5500	
Lines per revolution	N	100 - 500	100 - 500	1000 - 1024	
Frequency range [1]	f	up to 100	up to 100 [2]	up to 100	kHz
Signal output, square wave		2	2+1 Index	2	channels
Supply voltage	U_{DD}	4,5 … 5,5	4,5 … 5,5	4,5 … 5,5	V DC
Current consumption, typical [3]	I_{DD}	17	57	57	mA
Pulse width	P	180 ± 45	180 ± 35	180 ± 45	°e
Phase shift, channel A to B	Φ	90 ± 20	90 ± 15	90 ± 15	°e
Logic state width	S	90 ± 45	90 ± 35	90 ± 45	°e
Cycle	C	360 ± 5,5	360 ± 5,5	360 ± 7,5	°e
Signal rise/fall time, typical	tr/tf	0,25 / 0,25	0,25 / 0,25	0,25 / 0,25	µs
Inertia of code disc	J	0,6	0,6	0,6	gcm^2
Operating temperature range		– 40 ... + 100	– 40 ... + 100	– 40 ... + 70	°C

[1] Velocity (rpm) = f (Hz) x 60/N
[2] HEDS 5540 requires pull-up resistors of 2,7 kΩ between pins 2, 3, 5 and 4 (V_{CC})
[3] U_{DD} = 5 V: with unloaded outputs

For combination with motor

Dimensional drawing A	**<L1** [mm]	3890...CR	112,1
2230...S	52,8		
2233...S	55,6	**Dimensional drawing B**	**<L1** [mm]
2342...CR	63,8	2036...B - K312	56,8
2642...CXR	64,8	2057...B - K312	75,8
2642...CR	64,8	2444...B - K312	64,9
2657...CXR	79,8	3056...B - K312	76,1
2657...CR	79,8	3564...B - K312	84,1
3242...CR	65,3		
3257...CR	80,3		
3272...CR	95,3		
3863...CR	86,1		

Features

These incremental shaft encoders in combination with the DC-Micromotors and brushless DC-Servomotors are designed for the indication and control of both shaft velocity and direction of rotation as well as for positioning.

A LED source and lens system transmits collimated light through a low inertia metal disc to give two channels with 90° phase shift.

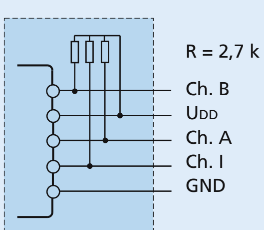
The single 5 volt supply and the two or three channel digital output signals are interfaced with a 5-pin connector.

Motors with ball bearings are recommended for continuous operation at low and high speeds and for elevated radial shaft load.

Details for the Motors and suitable reduction gearheads are on separate catalogue pages.

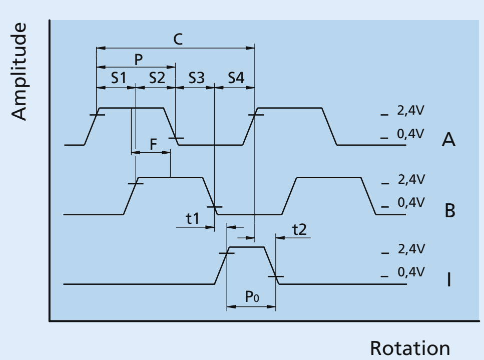
Output signals / Circuit diagram

Output circuit



Note:
HEDS 5540 requires pull-up resistors

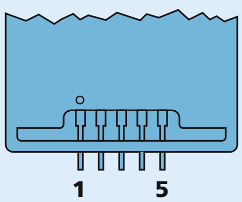
Output signals
with clockwise rotation as seen from the shaft end



Connector information / Variants

No.	Function
1	GND
2	Channel I (Index)
3	Channel A
4	UDD
5	Channel B

Connection Encoder



Recommended connector
AMP 103686-4/640442-5,
Molex 2695/2759
FCI 65039-032 / 4825x-000

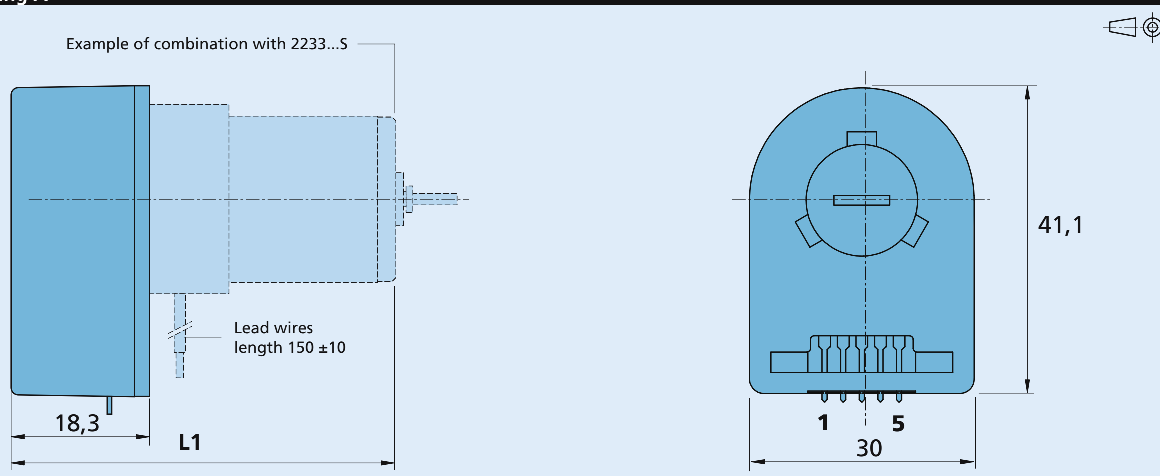
Option

- **HEDS 5500, HEDM 5500** Interlocking connector, extension cables 300 mm length (Part No.: K798)
- **HEDS 5540** Interlocking connector, extension cables 300 mm length (Part No.: K799)

Full product description

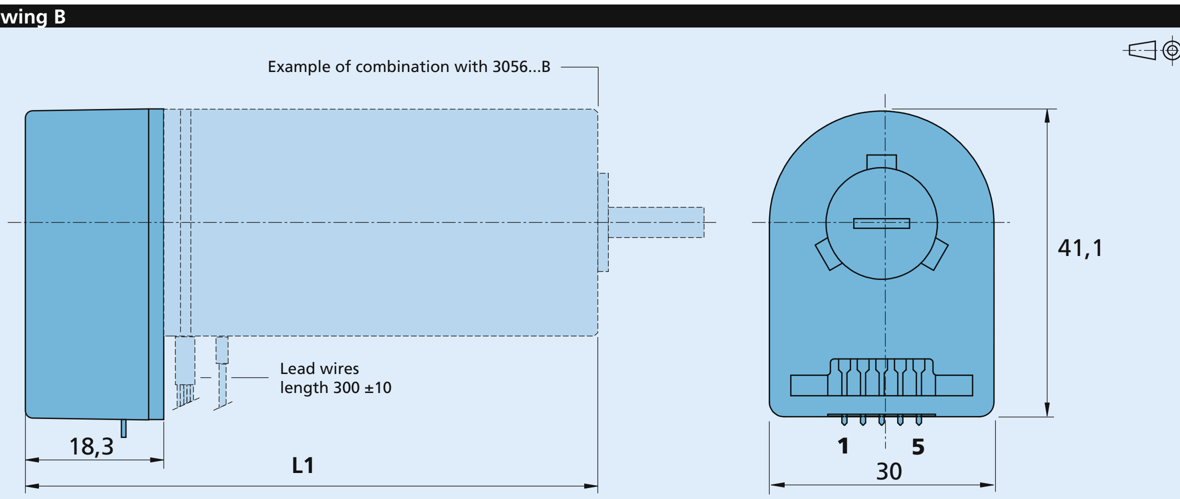
- Example:
  2444S024B K312 HEDM5500J
  3863H048CR HEDM5540C

Dimensional drawing A



5500, 5540

Dimensional drawing B



5500, 5540

Encoders

Encoders

optical Encoder, digital outputs, 3 channels, 500 lines per revolution, Line Driver

For combination with
DC-Micromotors
Brushless DC-Servomotors

Series 5540

		HEDL 5540	
Lines per revolution	N	500	
Frequency range [1]	f	up to 100	kHz
Signal output, square wave		2+1 index and complementary outputs	channels
Supply voltage	U_{DD}	4,5 ... 5,5	V DC
Current consumption, typical [2]	I_{DD}	57	mA
Pulse width	P	180 ± 35	°e
Index pulse width	P_0	90 ± 35	°e
Phase shift, channel A to B	Φ	90 ± 15	°e
Logic state width	S	90 ± 35	°e
Cycle	C	360 ± 5,5	°e
Signal rise/fall time, typical	tr/tf	0,25 / 0,25	µs
Inertia of code disc	J	0,6	gcm^2
Operating temperature range		– 40 ... + 100	°C

[1] Velocity (rpm) = f (Hz) x 60/N
[2] U_{DD} = 5 V: with unloaded outputs

For combination with motor

Dimensional drawing A	<L1 [mm]		
2230...S	52,8	3890...CR	112,1
2233...S	55,6		
2342...CR	63,8	**Dimensional drawing B**	**<L1** [mm]
2642...CXR	64,8	2036...B - K312	56,8
2642...CR	64,8	2057...B - K312	75,8
2657...CXR	79,8	2444...B - K312	64,9
2657...CR	79,8	3056...B - K312	76,1
3242...CR	65,3	3564...B - K312	84,1
3257...CR	80,3		
3272...CR	95,3		
3863...CR	86,1		

Features

These incremental shaft encoders in combination with the DC-Micromotors and Brushless DC-Servomotors are designed for the indication and control of both shaft velocity and direction of rotation as well as for positioning.

A LED source and lens system transmits collimated light through a low inertia metal disc to give two channels with 90° phase shift.

The index pulse is synchronized with the channel $\overline{B}$.
Each encoder channel provides complementary output signals.

The single 5 volt supply and the digital output signals are interfaced with a connector.

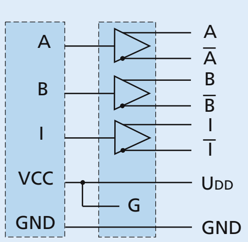
The line driver offers enhanced performance when the encoder is used in noisy environments, or when it is required to drive long distances.

Motor with ball bearings are recommended for continuous operation at low and high speeds and for elevated radial shaft load.

Details for the motors and suitable reduction gearheads are on separate catalogue pages.

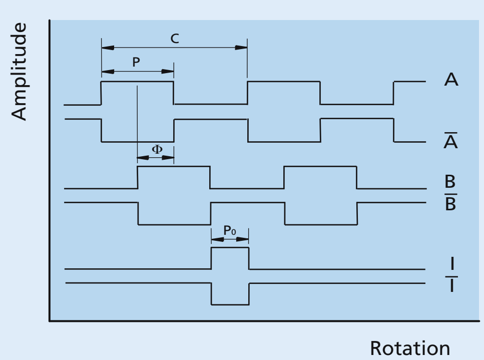
Output signals / Circuit diagram

Output circuit



Recommendation:
Suggested Line Receivers:
AM26LS32, SN75175, MC3486

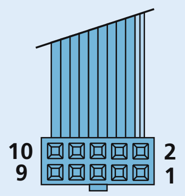
Output signals
with clockwise rotation as seen from the shaft end



Connector information / Variants

No.	Function
1	n.c.
2	U_{DD} (+5V)
3	GND
4	n.c.
5	Channel $\overline{A}$
6	Channel A
7	Channel $\overline{B}$
8	Channel B
9	Channel $\overline{I}$ (Index)
10	Channel I (Index)

Connection Encoder



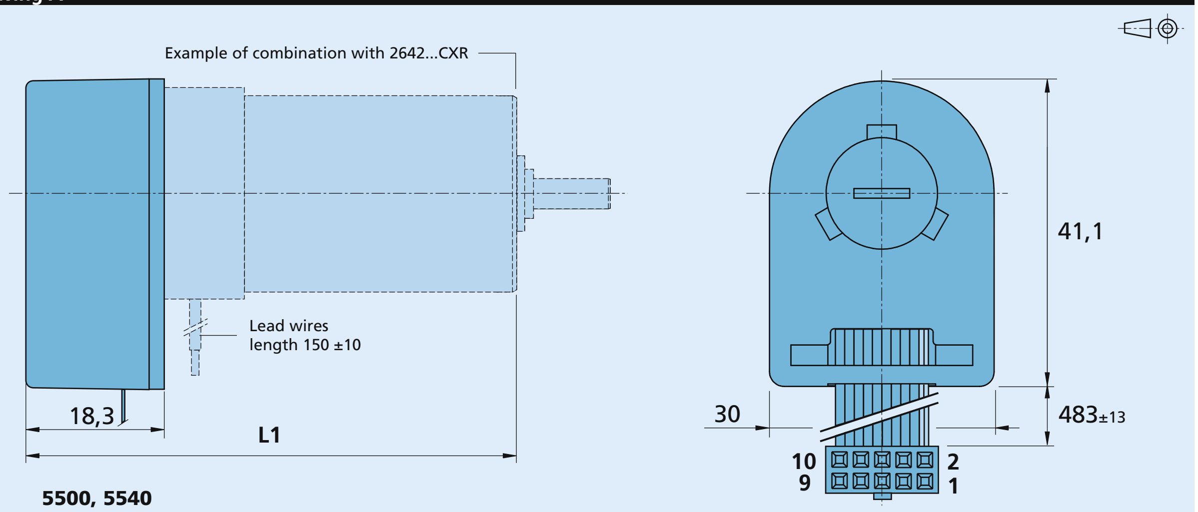
Cable
PVC-ribbon cable
10-conductors, 0,09 mm²

Connector
DIN-41651
grid 2,54 mm

Full product description

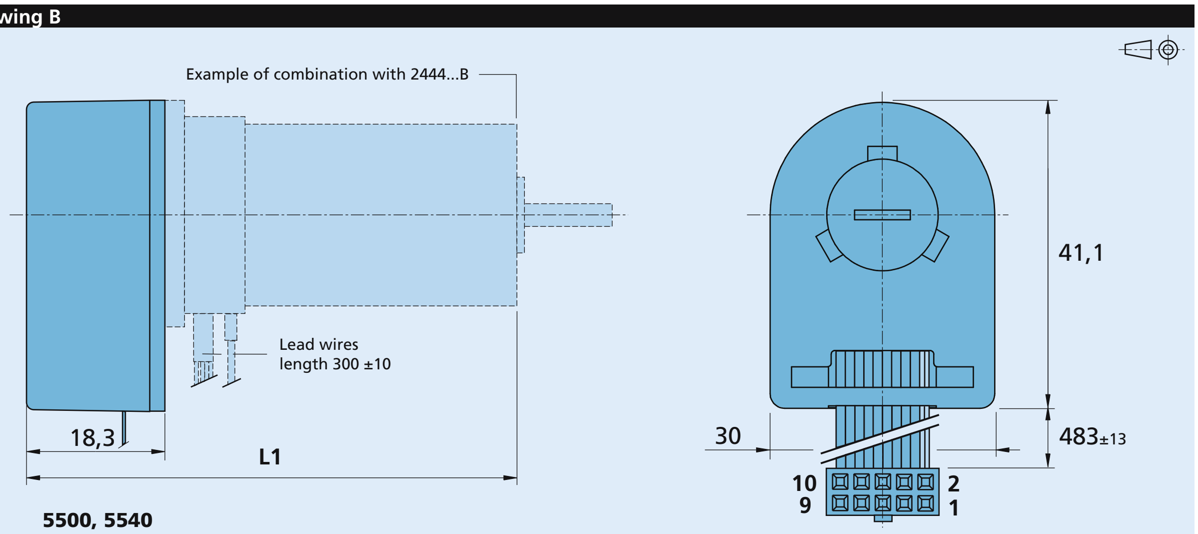
- Example:
  2444S024B K312 HEDL5540A
  3863H048CR HEDL5540A

Dimensional drawing A



5500, 5540

Dimensional drawing B



5500, 5540

Encoders

Encoders

optical Encoder, digital outputs,
1000 lines per revolution, 3 channels, Line Driver

For combination with
Brushless DC-Motors

Series 40B

		40B	
Lines per revolution	N	1000	
Frequency range [1]	f	up to 200	kHz
Signal output, square wave		2 + 1 index and complementary signals	channels
Supply voltage	U_{DD}	4,5 … 5,5	V DC
Current consumption, max. [2]	I_{DD}	100	mA
Pulse width	P	180 ± 18	°e
Index pulse width	P_0	180 ± 36	°e
Phase shift, channel A to B	Φ	90 ± 18	°e
Signal rise/fall time, typical	tr/tf	0,25 / 0,25	µs
Inertia of code disc	J	4,7	gcm^2
Operating temperature range		– 40 ... + 120	°C
EMC radiated emission		EN 50081-2	
Protection classification		IP54	

[1] speed (rpm) = f (Hz) x 60/N
[2] U_{DD} = 5 V: with unloaded outputs

For combination with motor

Dimensional drawing A	<L1 [mm]
4490...B - K1300	120,8
4490...BS - K1300	120,8

Features

Designed for industrial environments, this high-performance incremental shaft encoder in combination with the Brushless DC-Servomotors is for the indication and control of both shaft velocity and direction of rotation as well as for positioning.

A LED source and lens system transmits collimated light through a low inertia disc to give two channels with 90° phase shift.

The index pulse is synchronized with the channel B.
Each encoder channel provides complementary output signals.

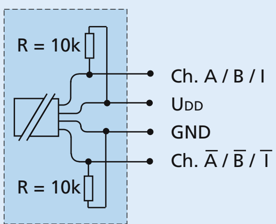
The single 5 volt supply and the digital output signals are interfaced with a shielded cable.

The line driver offers enhanced performance when the encoder is used in noisy environment, or when it is required to operate over long cables.

Details for the Brushless DC-Servomotors and suitable reduction gear-heads are on separate catalogue pages.

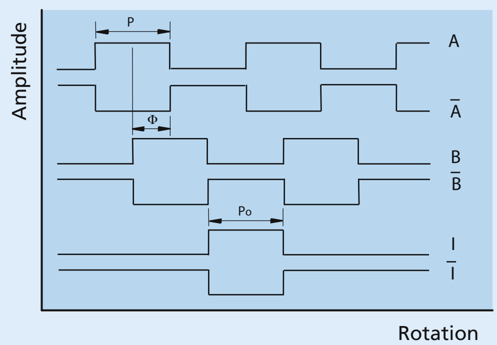
Circuit diagram / Output signals

Output circuit



Recommendation:
Please use a latch to capture the outputs.

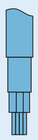
Output signals
with clockwise rotation as seen from the shaft end



Connector information / Variants

Motor logic
5 conductors, AWG 26

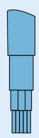
1



Function	Colour
Hall sensor A	green
Hall sensor B	blue
Hall sensor C	grey
Logical supply +5V	red
GND Logical	black

Encoder signals
8 conductors, AWG 28

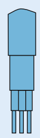
2



Function	Colour
Vcc	red
GND	black
A	green
$\overline{A}$	red / black
B	orange
$\overline{B}$	white / black
I	white
$\overline{I}$	blue

Motor power
3 conductors, AWG 16

3



Function	Colour
Phase A	brown
Phase B	orange
Phase C	yellow

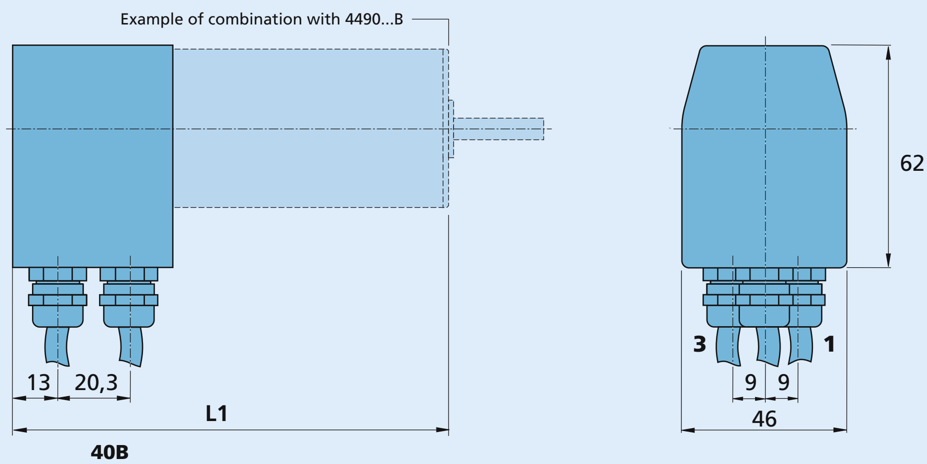
Cable
Shielded cables, PVC insulation, black
Length 300 mm ± 15mm

Full product description

- Example:
  4490H024B-K1300 40B

Dimensional drawing A

Scale reduced



NEW

Encoders

magnetic absolute Encoder, advanced SSI Interface, 4096 lines per revolution

For combination with
Brushless DC-Servomotors

Series AESM – 4096

		AESM – 4096	
Lines per revolution	N	4096	
Resolution		12 Bit	
Signal output		Advanced Synchronous Serial Interface (SSI)	
Supply voltage	U_{DD}	4,5 ... 5,5	V DC
Current consumption, typical [1]	I_{DD}	typ. 16, max. 23	mA
Output current, max. (DATA) [2]		4	mA
Clock Frequency, max. (CLK)		2	MHz
Input low level (CLK)		0 ... 0,8	V
Input high level (CLK)		2 ... U_{DD}	V
Setup time after power on, max.	t_{setup}	4	ms
Timeout	$t_{timeout}$	16	µs
Operating temperature range		– 20 ... + 100	°C

[1] U_{DD} = 5 V: with unloaded outputs
[2] U_{DD} = 5 V: low logic level ≤ 0,4 V, high logic level ≥ 4,6 V

For combination with motor			
Dimensional drawing A	**<L1** [mm]		
0824...B	24,1		
Dimensional drawing B	**<L1** [mm]		
1028...B	28,1		

Features

The absolute encoder in combination with the Faulhaber motors is ideal for commutation, speed and position control. It can also be used to create a sinusoidal commutation signal.

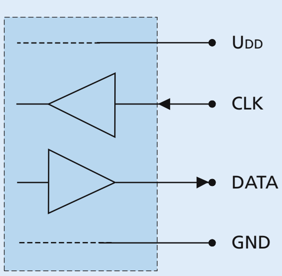
In the AESM version (absolute encoder), absolute position information is provided with a resolution of up to 4096 steps per revolution at the signal outputs and communicated via a serial (SSI) interface. Absolute means, that each shaft position is assigned to a unique angular value within one revolution. This value is already available directly after power-on.

The advantages are a reduced torque ripple, a higher efficiency, and reduced electrical noise generation. When using sinusoidal commutation. It is also especially suitable for slow speed regulation.

Motor and encoder are connected via a common flexboard.

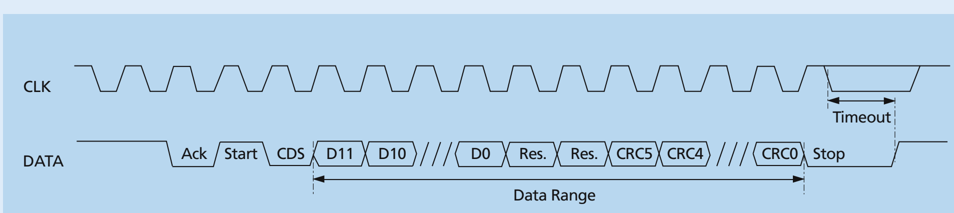
Circuit diagram / Output signals

Output circuit



Interface signals (SSI)

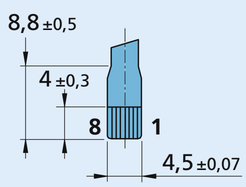
Angle position values are ascending for clockwise rotation.
Clockwise rotation as seen from the shaft end.



Connector information / Variants

No.	Function
1	Phase C
2	Phase B
3	Phase A
4	GND
5	U_{DD}
6	CLK
7	Reserved
8	DATA

Connection Encoder and Motor



Flexboard
8 circuits, 0,5 mm pitch

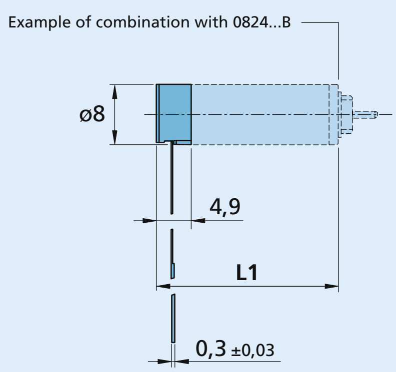
Recommended connector
Top contact style
8 circuits, 0,5 mm pitch, e.g.:
Molex: 52745-0896/0897

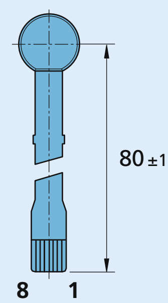
Caution:
Incorrect lead connection will damage the motor electronics!

Full product description

- Examples:
  0824K006B AESM-4096
  1028S012B AESM-4096

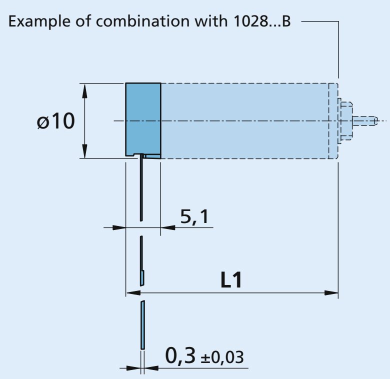
Dimensional drawing A

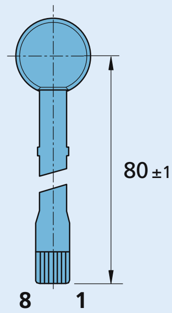




AESM – 4096

Dimensional drawing B





AESM – 4096

Encoders

Encoders

magnetic absolute Encoder, SSI Interface, 4096 lines per revolution

For combination with
Brushless DC-Motors

Series AES – 4096

		AES – 4096	
Lines per revolution	N	4096	
Resolution		12 Bit	
Signal output		Synchronous Serial Interface (SSI)	
Supply voltage	U_{DD}	4,5 ... 5,5	V DC
Current consumption, typical [1]	I_{DD}	typ. 16, max. 23	mA
Output current, max. (DATA) [2]		4	mA
Clock Frequency, max. (CLK)		2	MHz
Input low level (CLK)		0 ... 0,8	V
Input high level (CLK)		2 ... U_{DD}	V
Setup time after power on, max.	t_{setup}	4	ms
Timeout	$t_{timeout}$	16	µs
Operating temperature range		– 40 ... + 100	°C

[1] U_{DD} = 5 V: with unloaded outputs
[2] U_{DD} = 5 V: low logic level ≤ 0,4 V, high logic level ≥ 4,6 V

For combination with motor

Dimensional drawing A	<L1 [mm]		
2232...BX4	50,2		
2232...BX4S	50,2		
2250...BX4	68,2		
2250...BX4S	68,2		
Dimensional drawing B	**<L1** [mm]		
3242...BX4	60,0		
3268...BX4	86,0		

Features

The absolute encoder in combination with the Faulhaber motors is ideal for commutation, speed and position control. It can also be used to create a sinusoidal commutation signal.

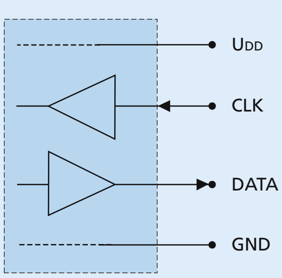
In the AES version (absolute encoder), absolute position information is provided with a resolution of up to 4096 steps per revolution at the signal outputs and communicated via a serial (SSI) interface. Absolute means, that each shaft position is assigned to a unique angular value within one revolution. This value is already available directly after power-on.

The advantages are a reduced torque ripple, a higher efficiency, and reduced electrical noise generation. When using sinusodial commutation.

Motor and encoder are connected via a common flexboard.

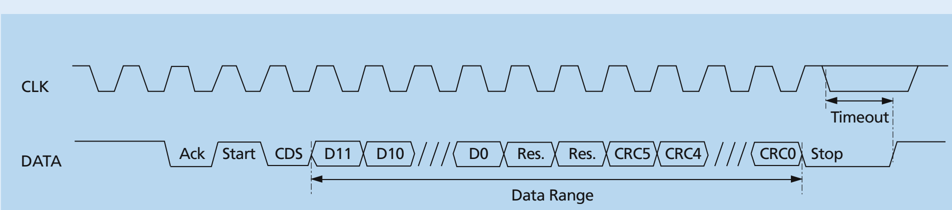
Circuit diagram / Output signals

Output circuit



Interface signals (SSI)

Angle position values are ascending for clockwise rotation.
Clockwise rotation as seen from the shaft end.

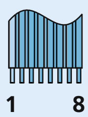


Connector information / Variants

No.	Function
1	Phase C
2	Phase B
3	Phase A
4	GND
5	U_{DD}
6	CLK
7	Reserved
8	DATA

Caution:
Incorrect lead connection will damage the motor electronics!

Connection Encoder and Motor



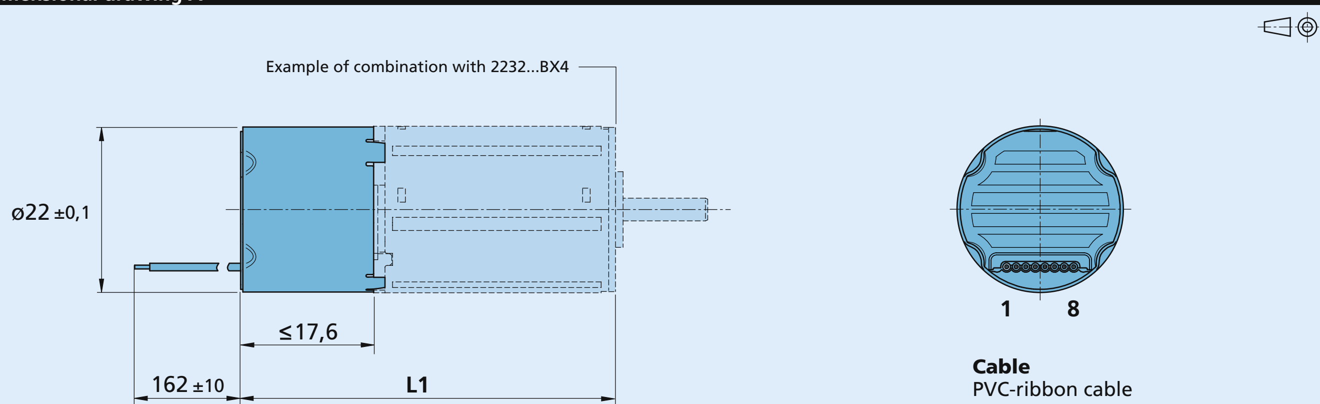
Option

- Connector variants (Option no.: 3807) with connector Micro-Fit

Full product description

- Example:
  2232S012BX4 AES-4096
  3242G024BX4 AES-4096

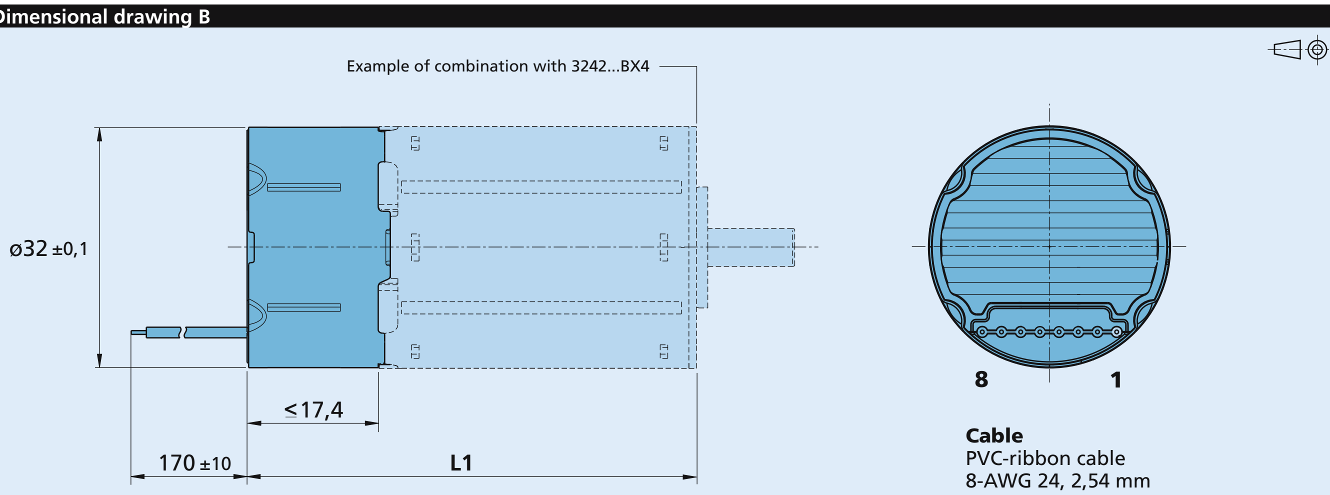
Dimensional drawing A



Cable
PVC-ribbon cable
8-AWG 26, 1,27 mm

AES – 4096

Dimensional drawing B



Cable
PVC-ribbon cable
8-AWG 24, 2,54 mm

AES – 4096

Drive Electronics

WE CREATE MOTION

FAULHABER

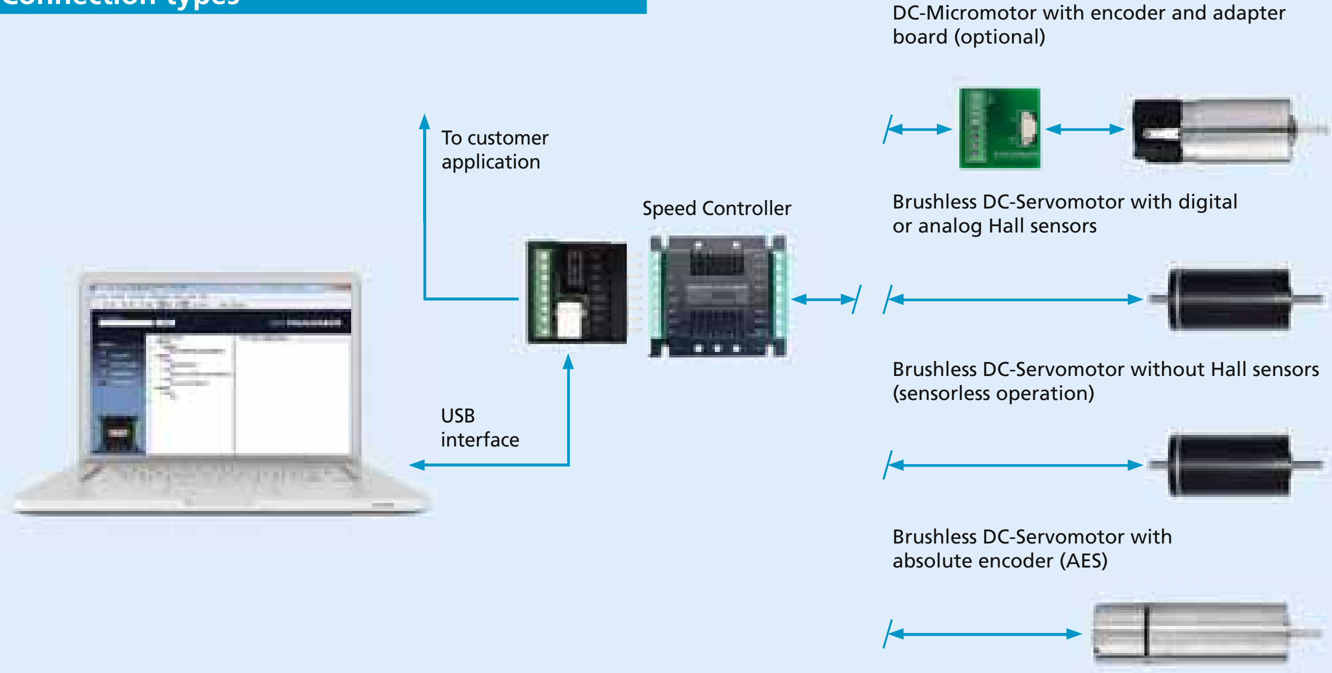
Speed Controller

Motion Controller

Speed Controller

Technical Information

Connection types



Function

FAULHABER Speed Controllers are highly dynamic speed governors that are optimized for the operation of micro-motors.

The Speed Controllers are available as separate controllers for

- DC-Micromotors
- Brushless DC-Servomotors.

The minimal wiring requirement and compact design of the Speed Controllers allow them to be used in a wide range of applications. The flexible interfacing options make them suitable for a variety of uses in all areas, e.g. in distributed automation systems, handling and tooling devices or pumps.

Benefits

- Compact design
- Flexible reconfiguration capacity
- Minimal wiring required
- Parameter setting using FAULHABER Motion Manager software and USB interface adapter
- Wide range of accessories

Product code

SC 28 04 S 3530

SC	Speed Controller
28	Max. supply voltage (28V)
04	Max. continuous output current (4A)
S	Housing with screw terminal
3530	Operating mode (brushless motor with digital Hall sensors)

Speed Controller

Description & Operating Modes

Description

Covering almost the entire range of FAULHABER GROUP motors, Faulhaber Speed Controllers are suitable for both Brushless DC-Servomotors (BL motors) and DC-Micromotors (DC motors).

- The Speed Controllers are extremely versatile and can be configured as required using a programming adapter and FAULHABER Motion Manager software.
- Depending on configuration, either a BL motor or DC motor can be run with the appropriate sensors for rotational speed measurement.
- The Speed Controllers are designed as velocity regulators. Control is via a PI controller.
- Sensorless operation, in which the rotational speed is determined by evaluating the counter-EMF (also known as back electromotive force), is also available.
- All Speed Controllers have a current limiter that limits the maximum motor current in the event of excessive thermal loads. In the standard configuration this current limiter is set to the maximum admissible value for the respective Speed Controller.

Standard models

To allow fast setup without programming adapter and software, the Speed Controllers come in various standard models. The variants specified for each type of controller can be reconfigured as required.

Operating modes

Depending on the type of controller, the Speed Controllers can be reconfigured to some or all of the following operating modes (cf. „Note“ below) using a programming adapter and FAULHABER Motion Manager software.

BL motors with digital or analog Hall sensors
In this configuration, the motors are operated with speed control, using the signals from the Hall sensors to commutate and determine the actual speed.

BL motors without Hall sensors (sensorless operation)
Instead of applying Hall sensors, this configuration uses the counter-EMF of the motor for commutation and speed control.

BL motors with absolute encoder
This mode can only be used in conjunction with the relevant hardware. In this configuration the encoder provides absolute position data, which is used for commutation and speed control. Thanks to the encoder signal's high resolution, low rotational speeds can be achieved in this operating mode.

BL motors with digital Hall sensors and brake/enable input
In this configuration the motors are operated with speed control. Thanks to the additional brake/enable inputs, it is easier to connect the controller – e.g. to a PLC or fail-safe circuits.

BL motors with digital Hall sensors and encoder
In this configuration the Hall sensors provide the information for the commutation. The speed is adjusted to the signal from the incremental encoder. This is why a high resolution encoder is able to achieve very low speeds.

DC motors with encoder
In this configuration the motors are operated with speed control. An incremental encoder is necessary to transmit the actual rpm value.

DC motors without encoder
In the sensorless DC motor configuration the motors are operated with speed control using either the counter-electromotive force or an IxR compensation to register the actual rotational speed, depending on load. This operating mode has to be matched to the motor type.

In addition, other parameters can be modified using the **FAULHABER Motion Manager software**:

- Controller parameters
- Output current limitation
- Fixed rotational speed
- Encoder resolution
- Rpm setpoint via analog or PWM signal
- Maximum rotational speed or speed range

Note

Device manuals for installation and putting into operation and the „FAULHABER Motion Manager“ software are available on request and on the Internet at www.faulhaber.com. Please note that not all Speed Controllers are suitable for all operating modes. Detailed information on the various operating modes is provided in the respective data sheets.

Speed Controller

2-Quadrant PWM
configurable via PC

For combination with:
DC-Micromotors and
Brushless DC-Servomotors

Series SC 1801

		SC 1801 P	SC 1801 F	SC 1801 S	
Power supply for electronic	U_P	4,0 ... 18	4,0 ... 18	4,0 ... 18	V DC
Power supply for motor	U_{mot}	1,8 ... 18	1,8 ... 18	1,8 ... 18	V DC
Max. continuous output current [1]	I_{dauer}	1	1	1	A
Max. peak output current	I_{max}	2	2	2	A
Total standby current	$I_{el\ max}$	0,018	0,018	0,018	A
Input/output (partially free configurable)		3	3	3	
Tightening torque, terminal strip		-	0,12 ... 0,15	0,12 ... 0,15	Nm
Weight		4	10	12	g
PWM switching frequency [2]	f_{PWM}	96			kHz
Efficiency	η	95			%
Speed range:					
– BL motors with Hall sensors (digital)		500 ... 100 000			rpm
– BL motors with Hall sensors (analog)		50 ... 60 000			rpm
– DC motors with encoder		100 ... 30 000			rpm
Scanning rate		500			µs
Resolution of encoder with DC motors		≤ 65 535			inc./rev.
Operating temperature range		– 25 ... + 60			°C
Storage temperature		– 25 ... + 85			°C

[1] at 22°C ambient temperature
[2] for brushless DC-Motors without Hall sensors: f_{PWM} 24 kHz

Versions

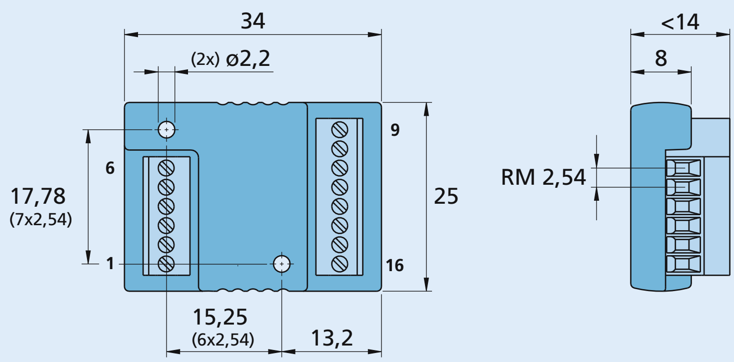
Speed Controller	Option	Motor Type	Sensor Type	Set speed value specification [1]	Speed at U_{nsoll} =10 V	Part No.	Conformity
SC 1801 S	**3530**	BL	Hall sensors (digital) [3]	0 ... 10 V	30 000 rpm	**6500.01377**	**CE**
SC 1801 S	**3531**	DC	Incremental encoder [2]	0 ... 10 V	10 000 rpm	**6500.01393**	**CE**
SC 1801 F	**3533**	BL	sensorless (high speed)	0 ... 10 V	40 000 rpm	**6500.01378**	**CE**
SC 1801 P	**3530**	BL	Hall sensors (digital) [3]	0 ... 10 V	30 000 rpm	**6500.01379**	
SC 1801 P	**3531**	DC	Incremental encoder [2]	0 ... 10 V	10 000 rpm	**6500.01394**	
SC 1801 S	**4763**	BL	Absolute encoder 2 pole	0 ... 10 V	30 000 rpm	**6500.01592**	
SC 1801 P	**4763**	BL	Absolute encoder 2 pole	0 ... 10 V	30 000 rpm	**6500.01593**	
SC 1801 F	**4763**	BL	Absolute encoder 2 pole	0 ... 10 V	30 000 rpm	**6500.01594**	
SC 1801 S	**4289**	BL	Hall sensors (analog) 2 pole	0 ... 10 V	40 000 rpm	**6500.01475**	
SC 1801 P	**4289**	BL	Hall sensors (analog) 2 pole	0 ... 10 V	40 000 rpm	**6500.01476**	
SC 1801 F	**4289**	BL	Hall sensors (analog) 2 pole	0 ... 10 V	40 000 rpm	**6500.01477**	
SC 1801 S	**3980**	BL	Absolute encoder 4 pole	0 ... 10 V	30 000 rpm	**6500.01435**	
SC 1801 P	**3980**	BL	Absolute encoder 4 pole	0 ... 10 V	30 000 rpm	**6500.01440**	
SC 1801 F	**3980**	BL	Absolute encoder 4 pole	0 ... 10 V	50 000 rpm	**6500.01441**	
SC 1801 S	**4764**	BL	Hall sensors (analog) 4 pole	0 ... 10 V	10 000 rpm	**6500.01595**	
SC 1801 P	**4764**	BL	Hall sensors (analog) 4 pole	0 ... 10 V	10 000 rpm	**6500.01596**	
SC 1801 F	**4764**	BL	Hall sensors (analog) 4 pole	0 ... 10 V	10 000 rpm	**6500.01597**	

[1] The velocity range can be configured by software. Versions with PWM and other configurations are available on request.
[2] preset value is 512 lines
[3] Factory pre-configured for 2 pole motors. For operation with 4 pole motors the speed controller must be reconfigured with the software "Faulhaber Motion Manager".

Accessories

		Motor Type	for SC 1801 S Part No.
Programming adapter	**Starterkit**		**6501.00088**
Programming adapter			**6501.00097**
Motor connector adapter	**0620 ... B**	BL	**6501.00083**
	penny-motor	BL	**6501.00090**
	BX4	BL	**6501.00085**
Encoder adapter	**IE2**	DC	**6501.00084**
	HEDS	DC	**6501.00001**

Dimensional drawing and connection information SC 1801 S

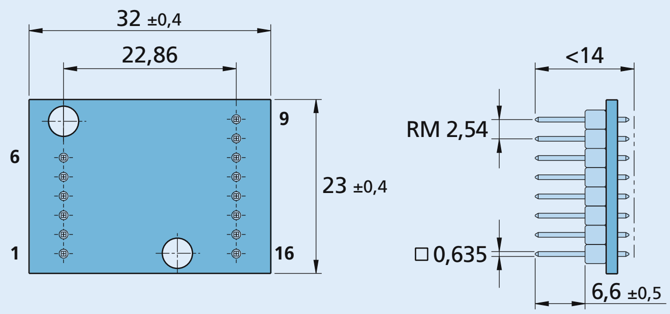


SC 1801 S

Connection

No.	Function
1	U_P
2	U_{mot}
3	GND
4	U_{nsoll}
5	DIR
6	FG
9	Mot C
10	Mot B
11	Mot A
12	SGND
13	V_{CC}
14	Sens C
15	Sens B
16	Sens A

Dimensional drawing and connection information SC 1801 P

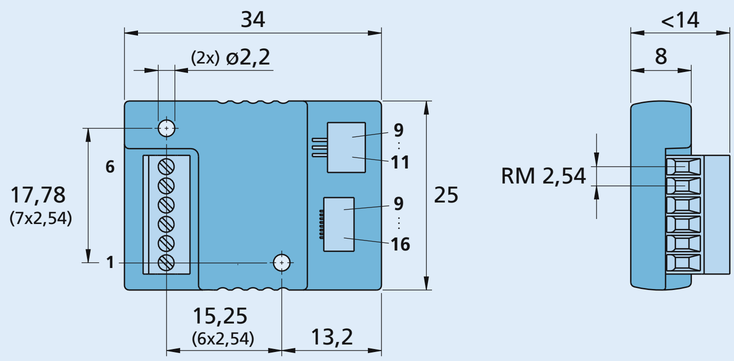


SC 1801 P

Connection

No.	Function
1	U_P
2	U_{mot}
3	GND
4	U_{nsoll}
5	DIR
6	FG
9	Mot C
10	Mot B
11	Mot A
12	SGND
13	V_{CC}
14	Sens C
15	Sens B
16	Sens A

Dimensional drawing and connection information SC 1801 F



SC 1801 F

Connector Information
LIF-Connector
3-pole and 8-pole

Connection

No.	Function
1	U_P
2	U_{mot}
3	GND
4	U_{nsoll}
5	DIR
6	FG
9	Mot C
10	Mot B
11	Mot A
12	SGND
13	V_{CC}
14	Sens C
15	Sens B
16	Sens A

FAULHABER

Speed Controller

2-Quadrant PWM
configurable via PC

For combination with:
DC-Micromotors and
Brushless DC-Servomotors

Series SC 2402

		SC 2402 P	
Power supply for electronic	U_P	5 ... 24	V DC
Power supply for motor	U_{mot}	0 ... 24	V DC
Max. continuous output current 1)	I_{dauer}	2	A
Max. peak output current	I_{max}	4	A
Total standby current	$I_{el\ max}$	0,03	A
Input/output (partially free configurable)		5	
Weight		14	g
PWM switching frequency 2)	f_{PWM}	96	kHz
Efficiency	η	95	%
Speed range:			
– BL motors with Hall sensors (digital)		500 ... 100 000	rpm
– BL motors with Hall sensors (analog)		50 ... 60 000	rpm
– BL motors with digital Hall + encoder		50 ... 30 000	rpm
– DC motors with encoder		100 ... 30 000	rpm
Scanning rate		500	µs
Resolution of encoder with DC motors		≤ 65 535	inc./rev.
Operating temperature range		– 25 ... + 60	°C
Storage temperature		– 25 ... + 85	°C

1) at 22°C ambient temperature
2) for brushless DC-Motors without Hall sensors: f_{PWM} 24 kHz

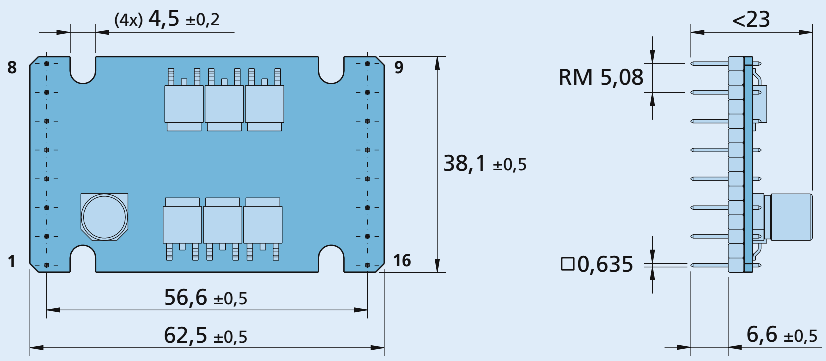
Versions

Speed Controller	Option	Version Motor Type	Sensor Type	Set speed value specification 1)	Speed at U_{nsoll} =10 V	Part No.
SC 2402 P	**3530**	BL	Hall sensors (digital) 3)	0 ... 10 V	20 000 rpm	**6500.01381**
SC 2402 P	**3531**	DC	Incremental encoder 2)	0 ... 10 V	10 000 rpm	**6500.01392**
SC 2402 P	**4763**	BL	Absolute encoder 2 pole	0 ... 10 V	30 000 rpm	**6500.01599**
SC 2402 P	**4289**	BL	Hall sensors (analog) 2 pole	0 ... 10 V	20 000 rpm	**6500.01474**
SC 2402 P	**3980**	BL	Absolute encoder 4 pole	0 ... 10 V	20 000 rpm	**6500.01439**
SC 2402 P	**4764**	BL	Hall sensors (analog) 4 pole	0 ... 10 V	10 000 rpm	**6500.01601**
SC 2402 P	**4475**	BL	Digital Hall + encoder 3)	0 ... 10 V	20 000 rpm	**6500.01520**
SC 2402 P	**4476**	BL	Digital Hall + brake/enable 3)	0 ... 10 V	20 000 rpm	**6500.01522**

1) The velocity range can be configured by software. Versions with PWM and other configurations are available on request.
2) preset value is 512 lines
3) Factory pre-configured for 2 pole motors. For operation with 4 pole motors the speed controller must be reconfigured with the software “Faulhaber Motion Manager”.

Dimensional drawing and connection information SC 2402 P

Scale reduced



SC 2402 P

Connection

No.	Function
1	U_P
2	U_{mot}
3	GND
4	U_{nsoll}
5	DIR
6	FG
7	IO 2
8	IO 1
9	Mot C
10	Mot B
11	Mot A
12	SGND
13	V_{CC}
14	Sens C
15	Sens B
16	Sens A

FAULHABER

Speed Controller

2-Quadrant PWM
configurable via PC

For combination with:
DC-Micromotors and
Brushless DC-Servomotors

Series SC 2804

		SC 2804 S	
Power supply for electronic	U_P	5 ... 28	V DC
Power supply for motor	U_{mot}	0 ... 28	V DC
Max. continuous output current [1]	I_{dauer}	4	A
Max. peak output current	I_{max}	8	A
Total standby current	$I_{el\ max}$	0,03	A
Input/output (partially free configurable)		5	
Tightening torque, terminal strip		0,5 ... 0,6	Nm
Weight		160	g
PWM switching frequency [2]	f_{PWM}	96	kHz
Efficiency	η	95	%
Speed range:			
– BL motors with Hall sensors (digital)		500 ... 100 000	rpm
– BL motors with Hall sensors (analog)		50 ... 60 000	rpm
– BL motors with digital Hall + encoder		50 ... 30 000	rpm
– DC motors with encoder		100 ... 30 000	rpm
Scanning rate		500	µs
Resolution of encoder with DC motors		≤ 65 535	inc./rev.
Operating temperature range		– 25 ... + 60	°C
Storage temperature		– 25 ... + 85	°C

[1] at 22°C ambient temperature
[2] for brushless DC-Motors without Hall sensors: f_{PWM} 24 kHz

Versions

Speed Controller	Version: Option	Motor Type	Sensor Type	Set speed value specification [1]	Speed at U_{nsoll} =10 V	Part No.	Conformity
SC 2804 S	**3530**	BL	Hall sensors (digital) [3]	0 ... 10 V	20 000 rpm	**6500.01390**	**CE**
SC 2804 S	**3531**	DC	Incremental encoder [2]	0 ... 10 V	10 000 rpm	**6500.01391**	**CE**
SC 2804 S	**4763**	BL	Absolute encoder 2 pole	0 ... 10 V	30 000 rpm	**6500.01598**	
SC 2804 S	**4289**	BL	Hall sensors (analog) 2 pole	0 ... 10 V	20 000 rpm	**6500.01473**	
SC 2804 S	**3980**	BL	Absolute encoder 4 pole	0 ... 10 V	20 000 rpm	**6500.01438**	
SC 2804 S	**4764**	BL	Hall sensors (analog) 4 pole	0 ... 10 V	10 000 rpm	**6500.01600**	
SC 2804 S	**4475**	BL	Digital Hall + encoder [3]	0 ... 10 V	20 000 rpm	**6500.01521**	
SC 2804 S	**4476**	BL	Digital Hall + brake/enable [3]	0 ... 10 V	20 000 rpm	**6500.01523**	

[1] The velocity range can be configured by software. Versions with PWM and other configurations are available on request.
[2] preset value is 512 lines
[3] Factory pre-configured for 2 pole motors. For operation with 4 pole motors the speed controller must be reconfigured with the software "Faulhaber Motion Manager".

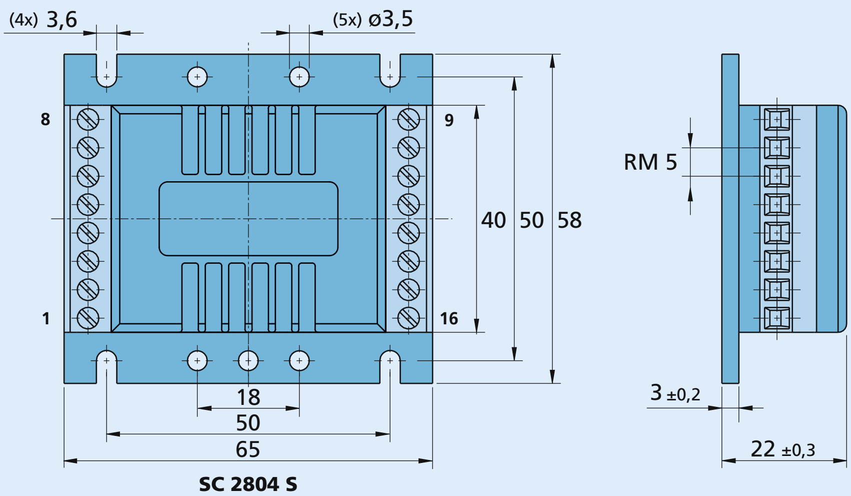
Accessories

		Motor-typ	for SC 2804 S Part No.
Programming adapter	**Starterkit**		**6501.00088**
Programming adapter			**6501.00096**
Motor connector adapter	**5 mm » 2,54 mm**		**6501.00087**
	BX4	BL	**6501.00086**
Encoder adapter	**IE2**	DC	**6501.00063**
	HEDS	DC	**6501.00001**

Drive Electronics

Dimensional drawing and connection information SC 2804 S

Scale reduced



Connection

No.	Function
1	U_P
2	U_{mot}
3	GND
4	U_{soll}
5	DIR
6	FG
7	IO 2
8	IO 1
9	Mot C
10	Mot B
11	Mot A
12	SGND
13	V_{CC}
14	Sens C
15	Sens B
16	Sens A

Speed Controller

4-Quadrant PWM configurable via PC

For combination with:
DC-Micromotors and
Brushless DC-Servomotors

Series SC 5004

		SC 5004 P	
Power supply for electronic	U_P	6 ... 50	V DC
Power supply for motor	U_{mot}	0 ... 50	V DC
Max. continuous output current [1]	I_{dauer}	4	A
Max. peak output current	I_{max}	8	A
Total standby current	$I_{el\ max}$	100	mA
Input/output (partially free configurable)		5	
Weight		14	g
PWM switching frequency [2]	f_{PWM}	96	kHz
Efficiency	η	95	%
Speed range:			
– BL motors with Hall sensors (digital)		500 ... 100 000	rpm
– BL motors with Hall sensors (analog)		50 ... 60 000	rpm
– BL motors with absolute encoder		50 ... 60 000	rpm
– BL motors with digital Hall + encoder		50 ... 30 000	rpm
– DC motors with encoder		100 ... 30 000	rpm
Scanning rate		500 / 1 000	µs
Resolution of encoder with DC motors		≤ 65 535	inc./rev.
Operating temperature range		– 25 ... + 60	°C
Storage temperature		– 25 ... + 85	°C

1) at 22°C ambient temperature
2) for brushless DC-Motors without Hall sensors: f_{PWM} 24 kHz

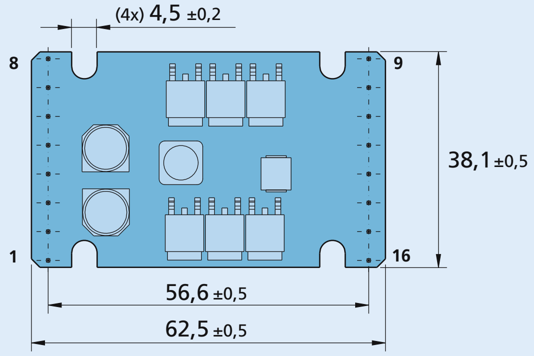
Versions

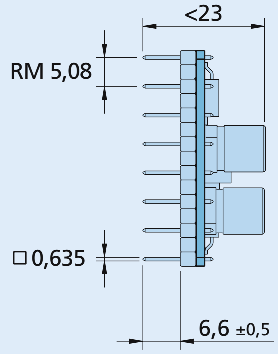
Speed Controller	Option	Version Motor Type	Sensor Type	Set speed value specification [1]	Speed at U_{nsoll} =10 V	Part No.
SC 5004 P	**3530**	BL	Hall sensors (digital) [3]	0 ... 10 V	20 000 rpm	**6500.01481**
SC 5004 P	**3531**	DC	Incremental encoder [2]	0 ... 10 V	10 000 rpm	**6500.01483**
SC 5004 P	**4763**	BL	Absolute encoder 2 pole	0 ... 10 V	30 000 rpm	**6500.01603**
SC 5004 P	**4289**	BL	Hall sensors (analog) 2 pole	0 ... 10 V	20 000 rpm	**6500.01485**
SC 5004 P	**3980**	BL	Absolute encoder 4 pole	0 ... 10 V	20 000 rpm	**6500.01528**
SC 5004 P	**4764**	BL	Hall sensors (analog) 4 pole	0 ... 10 V	10 000 rpm	**6500.01605**
SC 5004 P	**4475**	BL	Digital Hall + encoder [3]	0 ... 10 V	20 000 rpm	**6500.01524**
SC 5004 P	**4476**	BL	Digital Hall + brake/enable [3]	0 ... 10 V	20 000 rpm	**6500.01526**

1) The velocity range can be configured by software. Versions with PWM and other configurations are available on request.
2) preset value is 512 lines
3) Factory pre-configured for 2 pole motors. For operation with 4 pole motors the speed controller must be reconfigured with the software "Faulhaber Motion Manager".

Dimensional drawing and connection information SC 5004 P

Scale reduced





SC 5004 P

Connection

No.	Function
1	U_P
2	U_{mot}
3	GND
4	U_{nsoll}
5	DIR
6	FG
7	IO 2
8	IO 1
9	Mot C
10	Mot B
11	Mot A
12	SGND
13	V_{CC}
14	Sens C
15	Sens B
16	Sens A

Speed Controller

4-Quadrant PWM configurable via PC

For combination with:
DC-Micromotors and
Brushless DC-Servomotors

Series SC 5008

		SC 5008 S	
Power supply for electronic	U_P	6 ... 50	V DC
Power supply for motor	U_{mot}	0 ... 50	V DC
Max. continuous output current 1)	I_{dauer}	8	A
Max. peak output current	I_{max}	16	A
Total standby current	$I_{el\ max}$	100	mA
Input/output (partially free configurable)		5	
Tightening torque, terminal strip		0,5 ... 0,6	Nm
Weight		160	g
PWM switching frequency 2)	f_{PWM}	96	kHz
Efficiency	η	95	%
Speed range:			
– BL motors with Hall sensors (digital)		500 ... 100 000	rpm
– BL motors with Hall sensors (analog)		50 ... 60 000	rpm
– BL motors with absolute encoder		50 ... 60 000	rpm
– BL motors with digital Hall + encoder		50 ... 30 000	rpm
– DC motors with encoder		100 ... 30 000	rpm
Scanning rate		500 / 1 000	µs
Resolution of encoder with DC motors		≤ 65 535	inc./rev.
Operating temperature range		– 25 ... + 60	°C
Storage temperature		– 25 ... + 85	°C

1) at 22°C ambient temperature
2) for brushless DC-Motors without Hall sensors: f_{PWM} 24 kHz

Versions

Speed Controller	Option	Version: Motor Type	Sensor Type	Set speed value specification 1)	Speed at U_{nsoll} =10 V	Part No.
SC 5008 S	**3530**	BL	Hall sensors (digital) 3)	0 ... 10 V	20 000 rpm	**6500.01480**
SC 5008 S	**3531**	DC	Incremental encoder 2)	0 ... 10 V	10 000 rpm	**6500.01482**
SC 5008 S	**4763**	BL	Absolute encoder 2 pole	0 ... 10 V	30 000 rpm	**6500.01602**
SC 5008 S	**4289**	BL	Hall sensors (analog) 2 pole	0 ... 10 V	20 000 rpm	**6500.01484**
SC 5008 S	**3980**	BL	Absolute encoder 4 pole	0 ... 10 V	20 000 rpm	**6500.01529**
SC 5008 S	**4764**	BL	Hall sensors (analog) 4 pole	0 ... 10 V	10 000 rpm	**6500.01604**
SC 5008 S	**4475**	BL	Digital Hall + encoder 3)	0 ... 10 V	20 000 rpm	**6500.01525**
SC 5008 S	**4476**	BL	Digital Hall + brake/enable 3)	0 ... 10 V	20 000 rpm	**6500.01527**

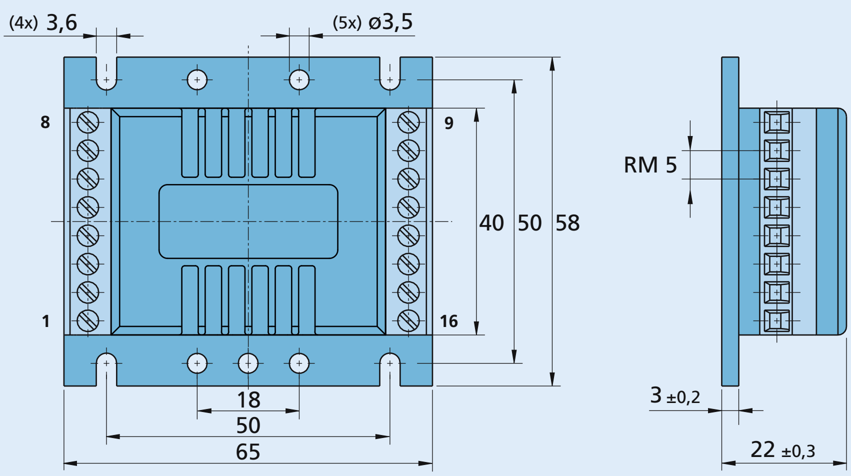
1) The velocity range can be configured by software. Versions with PWM and other configurations are available on request.
2) preset value is 512 lines
3) Factory pre-configured for 2 pole motors. For operation with 4 pole motors the speed controller must be reconfigured with the software "Faulhaber Motion Manager".

Accessories

		Motor-typ	for SC 5008 S Part No.
Programming adapter	**Starterkit**		**6501.00088**
Programming adapter			**6501.00096**
Motor connector adapter	**5 mm » 2,54 mm**		**6501.00087**
	BX4	BL	**6501.00086**
Encoder adapter	**IE2**	DC	**6501.00063**
	HEDS	DC	**6501.00001**

Dimensional drawing and connection information SC 5008 S

Scale reduced



SC 5008 S

Connection

No.	Function
1	U_P
2	U_{mot}
3	GND
4	U_{nsoll}
5	DIR
6	FG
7	IO 2
8	IO 1
9	Mot C
10	Mot B
11	Mot A
12	SGND
13	V_{CC}
14	Sens C
15	Sens B
16	Sens A

SC Function

Description of connections (Motor-dependent)

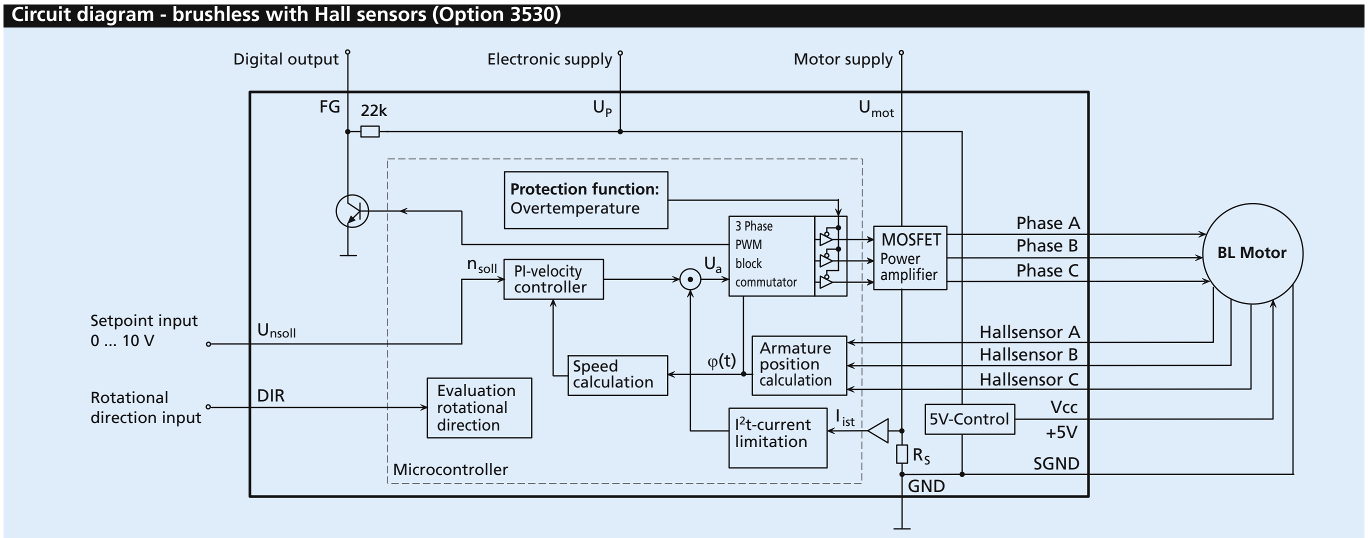
		DC-Motors with Encoder	BL-Motors with Hall sensors	BL-Motors with Absolute encoder	BL-Motors with digital Hall sensors + encoder	BL-Motors with digital Hall sensors + brake/enable
Connection "Mot A", "Mot B", "Mot C":						
– Motor connection	Mot A	Mot +	Phase A	Phase A	Phase A	Phase A
	Mot B	Mot -	Phase B	Phase B	Phase B	Phase B
	Mot C	*reserved*	Phase C	Phase C	Phase C	Phase C
Connection "Sens A", "Sens B", "Sens C":						
– Sensor input	Sens A	*reserved*	Hall sensor A	DATA	Hall sensor A	Hall sensor A
	Sens B	encoder canal A	Hall sensor B	*reserved*	Hall sensor B	Hall sensor B
	Sens C	encoder canal B	Hall sensor C	CLK	Hall sensor C	Hall sensor C
	f	≤ 400 kHz				
Connection „IO1", „IO2"						
- logic input	IO1	*reserved*	*reserved*	*reserved*	encoder B	brake
	IO2	*reserved*	*reserved*	*reserved*	encoder A	enable

Connection information (general)

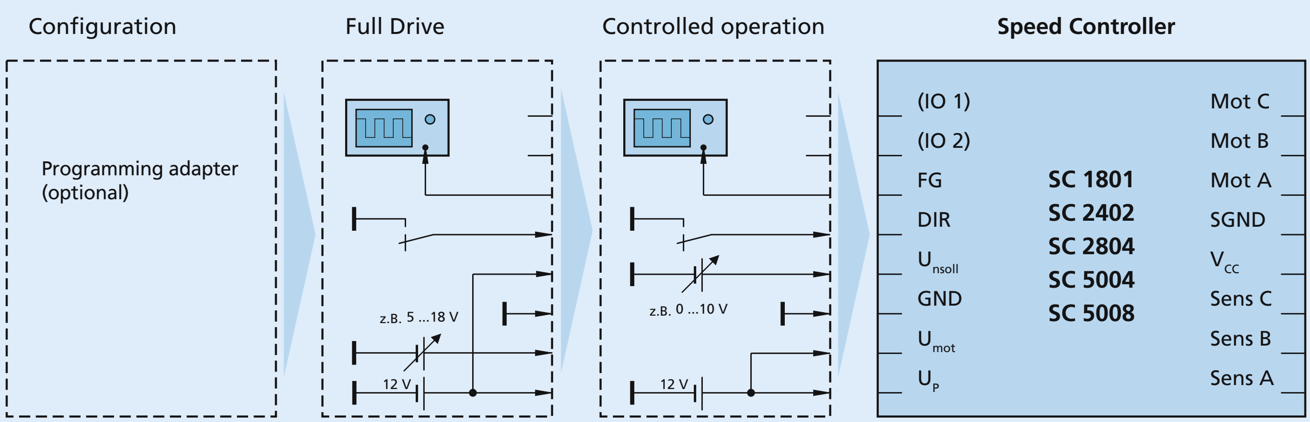
Connection "U_P":		U_P	power supply electronic
Connection "U_{mot}":		U_{mot}	power supply motor coil
Connection "GND":			ground
Connection "U_{nsoll}":		U_{in} = 0 ... 10 V / > 10 V ... max. U_P [1]	(standard version)
– analog input	set speed value	U_{in} < 0,15 V	motor stops
		U_{in} > 0,3 V (0,5 V) [2]	motor starts
– digital input	PWM for set speed value	500 ... 18 000 Hz	
	duty cycle	d = 0%	motor stopped
		d = 50%	half of maximum speed
		d = 100%	maximum speed
	input resistance	R_{in} ≥ 5 kΩ	
	signal level PLC	7,5 ... U_P	high
		0 ... 2	low
	signal level TTL [3]	2,8 ... U_P	high
		0 ... 0,5	low
Connection "DIR":			
– digital input	direction of rotation	to ground or level < 0,5 V	counterclockwise
		level > 3,0 V	clockwise
	input resistance	R_{in} ≥ 10 kΩ	
Connection "FG":		max. U_P/15 mA	open collector with pull-up resistor [4]
– fault output		switched through to GND	no error
– frequency output (BL motor only)		1, 3, 6, 8, 16 [5]	lines per revolution
Connection "IO1", "IO2":		n.c.	*reserved*
– digital input [6]			
	signal level TTL	2,8 ... Up	high
		0 ... 0,5	low
	(IO2)	high	motor enabled
		low	motor disabled
	(IO1)	high	motor stopped
		low	motor run
Connection "V_{CC}":			
	output voltage	5 V DC	for external use
	max. output current for	SC 1801 S, F, P	» I_{CC} = 25 mA
		SC 2402 P	» I_{CC} = 20 mA
		SC 2804 S	» I_{CC} = 30 mA
		SC 5004 P	» I_{CC} = 100 mA
		SC 5008 S	» I_{CC} = 100 mA
Connection "SGND":			signal ground

1) > 10 V for set speed value not defined.
2) Data in parentheses apply to BL motors operating without sensors.
3) Not available for SC 5004 / SC 5008
4) 22 kΩ (SC 1801, SC 2402, SC 2804)
47 kΩ (SC 5004, SC 5008)
An additional external pull-up resistor can be added to improve the rise time.
Caution: I_{out} max. 15 mA must not be exceeded.
5) Values apply to 2-pole motors. The given values double for 4-pole motors.
6) With appropriate hardware.

Circuit diagram - brushless with Hall sensors (Option 3530)



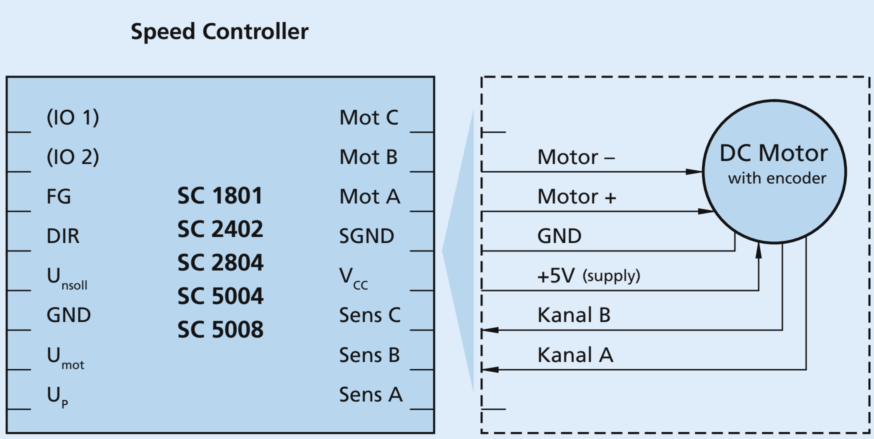
Connection diagramm supply unit



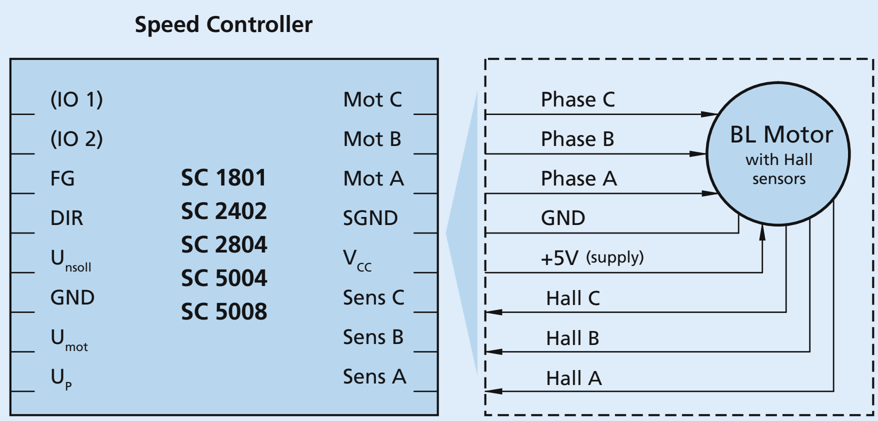
Rev controller
via parameter Umot

Rev set-point specification
via parameter Unsoll

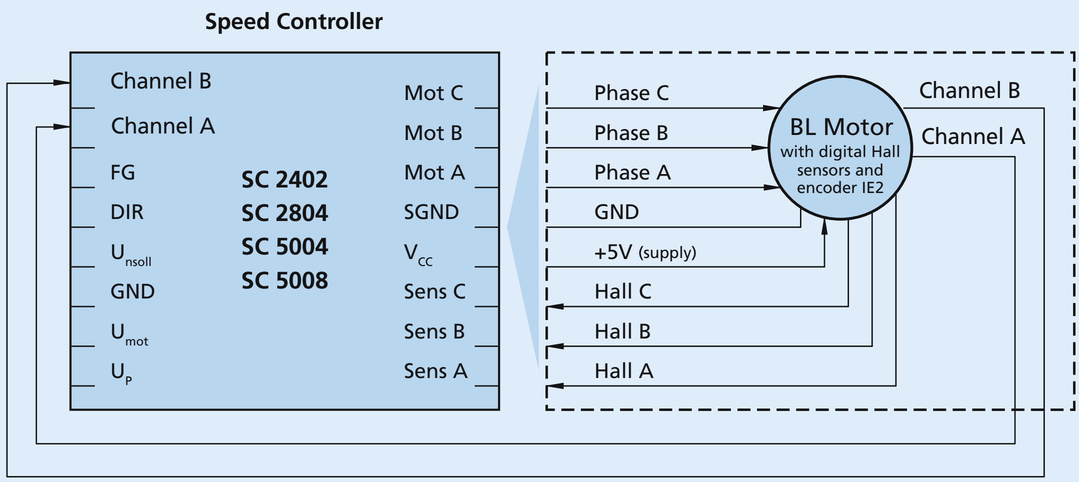
Connection diagram operation mode DC-Micromotor with encoder



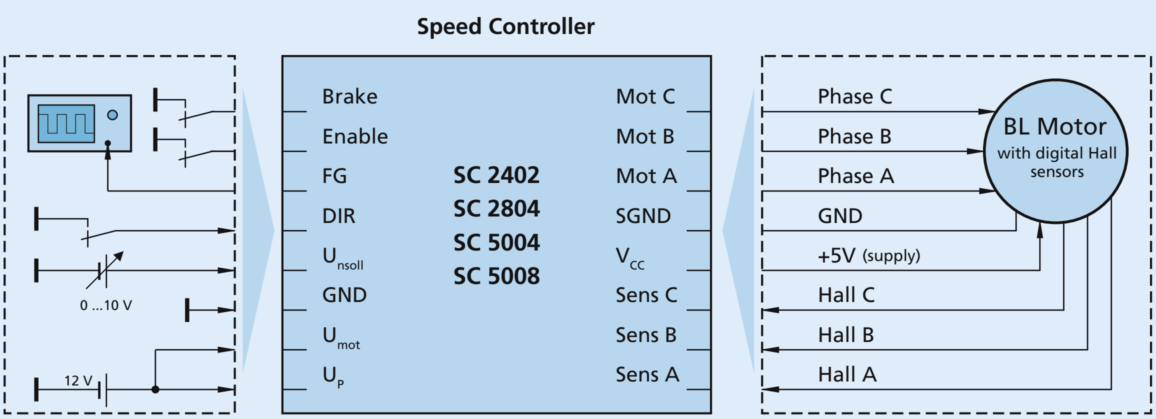
Connection diagram operation mode BL motor with Hall Sensors



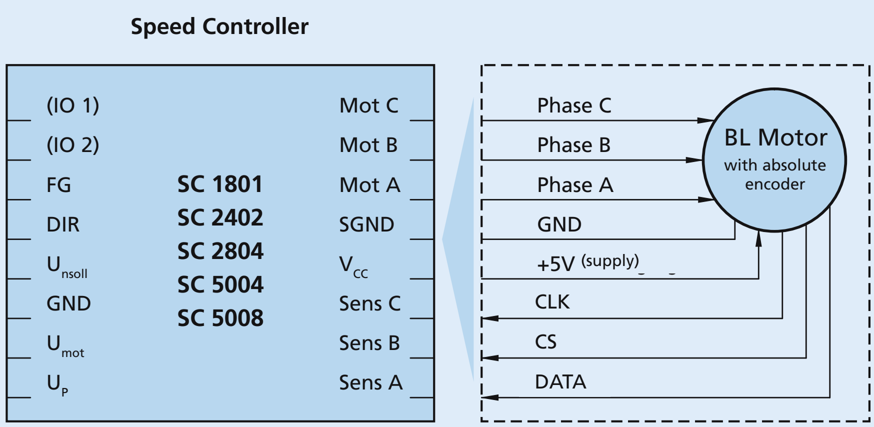
Connection diagram operation mode BL motor with digital Hall Sensors and Encoder



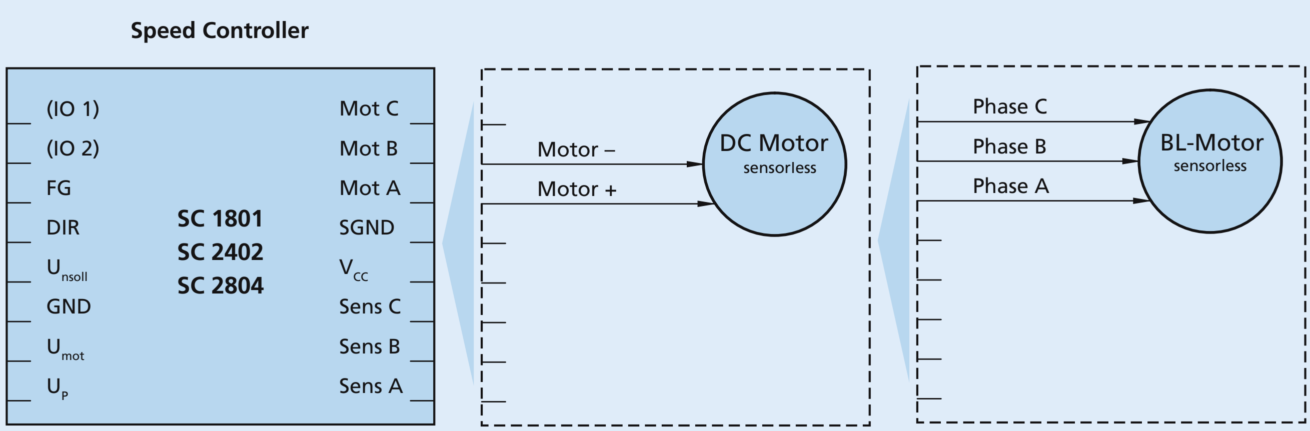
Connection diagram operation mode BL motor with digital Hall Sensors and Brake / Enable



Connection diagram operation mode BL motor with AES



Connection diagram operation mode DC and BL motor sensorless



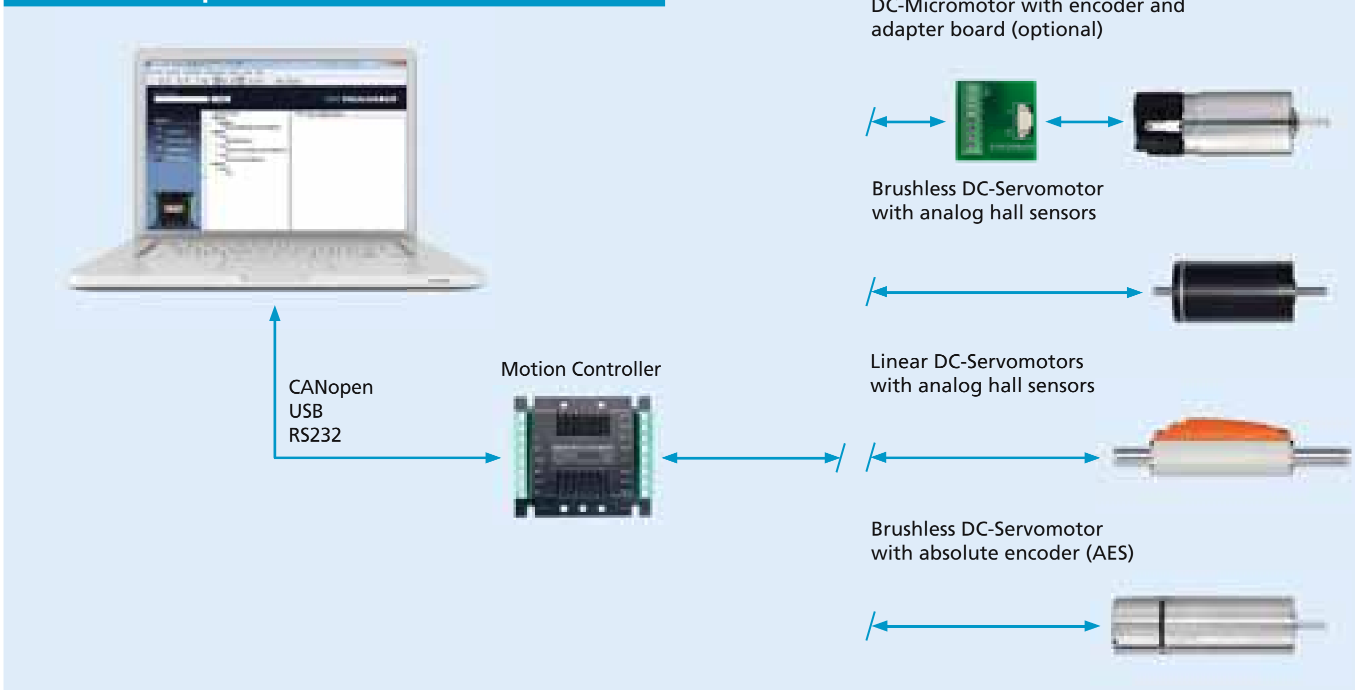
Drive Electronics

FAULHABER

Motion Controller

Technical Information

Connection options



Features

FAULHABER Motion Controllers are highly dynamic positioning systems tailored specifically to the requirements of micromotor operations.

In addition to being deployed as a positioning system, they can also operate as speed or current controllers.

The Motion Controllers are available as separate controllers for:

- DC-Micromotors (MCDC)
- Brushless DC-Servomotors (MCBL)
- Linear DC-Servomotors (MCLM)

Motion Control Systems – highly dynamic, low-maintenance BLDC servomotors with integrated motion controls – deliver the ultimate in slimline design. The integrated systems require less space, as well as making installation much simpler thanks to their reduced wiring.

Benefits

- Compact construction
- Controlled via RS232 or CAN interface
- Minimal wiring
- Parametrization with „FAULHABER Motion Manager“ software and USB interface
- Extensive accessories

Product Code

MC BL 30 06 S AES CF

MC	Motion Controller
BL	For Brushless DC-Motors
30	Max. supply voltage (30 V)
06	Max. continuous output current (6 A)
S	Housing with screw terminal
AES	Only for BLDC-Motors with absolute encoders
CF	CAN interface, FAULHABER CAN

Motion Controller

Configuration, Networking, Interfaces

Operating Modes

Speed control
PI speed controls, even for demanding synchronization requirements

Positioning
For moving to defined positions with a high level of re solution. Using a PD Controller, the dynamic response can be adjusted to suit the application. Reference and limit switches are evaluated by means of various homing modes.

Speed profiles
Acceleration ramps, deceleration ramps and maximum velocity can also be defined for each section. As a result, even complex profiles can be implemented quickly and effectively.

Current control
Protects the drive by limiting the motor current to the set peak current. The current is limited to the continuous current by means of integrated I^2t monitoring if required.

Protective features

- Protection against ESD
- Overload protection for electronics and motor
- Self-protection from overheating
- Overvoltage protection in generator mode

Extended operating modes

- Stepper motor mode
- Gearing mode
- Position control to analog set point
- Operation as servo amplifier in voltage adjuster mode
- Torque/force controller using variable set current input

Options

Separate supply of power to the motor and electronic actuator is optional (important for safety-critical applications). Third Input is not available with this option. Depending on the controller, additional programming adapters and connection aids are available. The modes and parameters can be specially pre-configured on request.

Interfaces - Discrete I/O

Setpoint input
Depending on the operating mode, setpoints can be input via the command interface, via an analog voltage value, a PWM signal or a quadrature signal.

Error output (Open Collector)
Configured as error output (factory setting). Also usable as digital input, free switch output, for speed control or signaling an achieved position.

Additional digital inputs
For evaluating reference switches.

Interfaces - Position Sensor

Depending on the model, one of the listed interfaces for the position and speed sensor is supported.

Analog Hall signals
Three analog Hall signals, offset by 120°, in Brushless DC-Motors and Linear DC-Servomotors.

Incremental encoders
In DC-Micromotors and as additional sensors for Brushless DC-Motors.

Absolute encoders
Serial SSI port, matching Brushless DC-Servomotors with AES encoders

Networking

FAULHABER Motion Controllers are available with three different interfaces.

RS: This indicates a system with an RS232 interface. It is ideal for applications that do not use a higher level controller. Operation is made simple through the use of a plain text command set which can be used to generate scripts and programs that can run automously on the controller itself.

CF: This indicates a system with a FAULHABER CAN interface. This version contains the CiA 402 commands and includes the RS232 interface commands which are translated into simple to use CAN commands. This version is intended as a user friendly, simple to use bridge into to the complex use of CAN communications. A CAN master is always required when using this version.

CO: This indicates a system with a CANopen interface. This version is ideal when integrating a FAULHABER motion controller into a system with a PLC, either directly or through the use of a gateway. All parameter settings are made via the object directory. Configuration is possible through the use of the FAULHABER Motion Manager 5.0 or better, or standard CAN configuration tools.

Motion Controller

Configuration, Networking, Interfaces

Interfaces – Bus Connection

Version with RS232

For coupling to a PC with a transfer rate of up to 115 kbaud. Multiple drives can be connected to a single controller using the RS232 interface. As regards the control computer, no special arrangements are necessary. The interface also offers the possibility of retrieving online operational data and values.

A comprehensive ASCII command set is available for programming and operation. This can be preset from the PC using the „FAULHABER Motion Manager" software or from another control computer.

Additionally, there is the possibility of creating complex processes from these commands and storing them on the drive. Once programmed as a speed or positioning controller via the analog input, as step motor or electronic gear unit, the drive can operate independently of the RS232 interface.

Versions with CAN CF or CO

Two controller versions with a CANopen interface are available for optimal integration within a wide range of applications. CANopen is the perfect choice for networking miniature drives because the interface can also be integrated into small electronics. Due to their compact size and efficient communication methods, they are the ideal solution for complex fields of application such as industrial automation.

CF version: CANopen with FAULHABER channel

The CF version supports not only CiA 402 standard operating modes but also a special FAULHABER Mode. Via PDO2, operator control is thus analogous to that of the RS232 version. Extended operating modes such as operation with analog setpoint input or the stepper or gearing mode are also supported. The CF version is therefore particularly suitable for users who are already familiar with the RS232 version and wish to exploit the benefits of CAN in networking.

CO version: pure CANopen

The CO version provides the CiA 402 standard operating modes. All the parameters are directly stored in the object directory. Configuration can therefore be performed with the help of the FAULHABER Motion Manager or by applying available standardized configuratons tools common to the automation market. The CO version is particularly suitable for users who already use various CANopen devices or operate the Motion Controllers on a PLC. With dynamic PDO mapping it is possible to achieve highly efficient networking on the CAN.

CF / CO comparison

	CF	CO
NMT with node guarding	•	•
Baud rate	1 Mbit max., LSS	1 Mbit max, LSS
EMCY object	•	•
SYNCH Objekt	•	•
Server SDO	1x	1x
PDOs	3 x Rx 3 x Tx each with static mapping	4 x Rx 4 x Tx each with dynamic mapping
PDO ID	fixed	adjustable
Configuration	Motion Manager	Motion Manager from V5
Trace	PDO3 (fixed)	Any PDO
Standard operating modes - Profile Position Mode - Profile Velocity Mode - Homing	•	•
Ext. operating modes	FAULHABER channel	-

Both versions support the CANopen communication profile to CiA 301 V4.02. The transfer rate and node number are set via the network in accordance with the LSS protocol conforming to CiA 305 V1.11.

For this purpose, we recommend using the latest version of the FAULHABER Motion Manager.

Notes

Device manuals for installation and start up, communication and function manuals, and the „FAULHABER Motion Manager" software are available on request and on the Internet at www.faulhaber.com.

Motion Controller

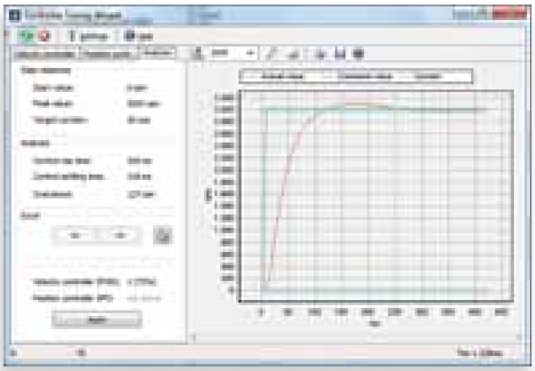
Software

Motion Manager

The high-performance software solution „FAULHABER Motion Manager" enables users to control and configure drive systems with Speed- and Motion Controllers.

The RS232, USB and CAN interfaces are supported. All the interface versions can be operated in a standardized manner via a graphical user interface. This also represents a user-friendly introduction to CAN technology, especially when using the CANopen Motion Controllers with FAULHABER-CAN (CF version).

„FAULHABER Motion Manager" for Microsoft Windows can be downloaded free of charge from www.faulhaber.com.



Startup and Configuration

The software provides convenient access to the settings and parameters of connected motor controls.

The graphical user interface can be used to read out, change and reload configurations. Individual commands or complete parameter sets and program sequences can be entered and transferred to the control.

In addition, analysis options are available in the form of status displays and graphic trace windows.

Operation of drives is also supported by a

- connection assistant
- motor selection assistant
- configuration assistant
- controller tuning assistant

The program also includes an Online Help and the integrated Visual Basic Script language.

FAULHABER

Motion Controller

V2.5, 4-Quadrant PWM
with RS232 or CAN interface

For combination with:
DC-Micromotors

Series MCDC 3002

		MCDC 3002 P	MCDC 3002 F	MCDC 3002 S	
Power supply	U_B	5 ... 30	5 ... 30	5 ... 30	V DC
PWM switching frequency	f_{PWM}	78,12	78,12	78,12	kHz
Efficiency	η	95	95	95	%
Max. continuous output current [1]	I_{dauer}	2	2	2	A
Max. peak output current	I_{max}	3	3	3	A
Total standby current	I_{el}	0,04	0,04	0,04	A
Speed range		5 ... 30 000	5 ... 30 000	5 ... 30 000	rpm
Scanning rate	N	100	100	100	µs
External encoder resolution		≤ 65 535	≤ 65 535	≤ 65 535	inc./rev.
Input/output (partially free configurable)		5	5	5	
Program memory: [2]					
– memory size		3,3	3,3	3,3	kWord
– Number of instructions		ca. 1 000	ca. 1 000	ca. 1 000	instructions
Operating temperature range		– 25 ... + 85	– 25 ... + 85	– 25 ... + 85	°C
Weight		7	13	16	g

[1] at 22°C ambient temperature
[2] Only for version with serial interface

Connection information					
Connection communication:					
Interface			RS232	CAN	
Communication profile			Faulhaber - ASCII	CANopen	
Max. transfer speed rate RS232			115 200		baud
Max. transfer speed rate CAN				1	Mbit/s
Connection 3 "AGND":					
– analog ground			analog GND		
– digital input	external encoder		channel B		
		R_{In}	10		kΩ
		f	≤ 400		kHz
Connection 4 "Fault":					
– digital input		R_{In}	100		kΩ
– digital output (open collector)		U	≤ U_B		V
		I	≤ 30		mA
		clear	switched to GND		
		set	high-impedance		
	fault output	no error	switched to GND		
		error	high-impedance		
Connection 5 "AnIn":			"AGND" as GND		
– analog input	set speed value	U_{In}	± 10		V
– digital input	PWM set speed value	f	100 ... 2 000		Hz
		T	50% ≙ 0 rpm		
	external encoder		channel A		
		f	≤ 400		kHz
	step frequency input	f	≤ 400		kHz
		R_{In}	5		kΩ
Connection 6 "U_B":		U_B	5 … 30		V DC
Connection 7 "GND":			ground		
Connection 8 "3. In":					
– digital input		R_{In}	22		kΩ
– electronic supply voltage		U_{EL}	5 … 30		V DC
Connection 16 "5. In":					
– digital input		R_{In}	22		kΩ
Connection 9 "4. In":					
– digital input		R_{In}	22		kΩ

Connection information

Connection 10-11 "Ch A", "Ch B":				
Encoder input	CH A		encoder channel A	
	CH B		encoder channel B	
Integrated pullup resistance + 5V		R	2,2	kΩ
		f	≤ 400	kHz
Connection 12 "U_{CC}":				
Output voltage for external use [1]		U_{Out}	5	V
Load current		I_{Out}	≤ 60	mA
Connection 13 "SGND":				
Signal GND			signal ground	
Connection 14-15 "Mot +", "Mot -":				
Motor connection	Mot +		Motor +	
	Mot –		Motor –	
		U_{Out}	0 … U_B	V DC
PWM switching frequency		f_{PWM}	78,12	kHz

[1] E.g. encoder

The signal level (PLC or TTL) of the digital inputs can be set over the interface (see operating instruction manual).
Standard (PLC): Low 0...4,5V / High 12,5V...U_B, TTL: Low 0...0,5V / High 2,5V...U_B

Options

- Separate power supply (Option no.: 3085)

Full product description

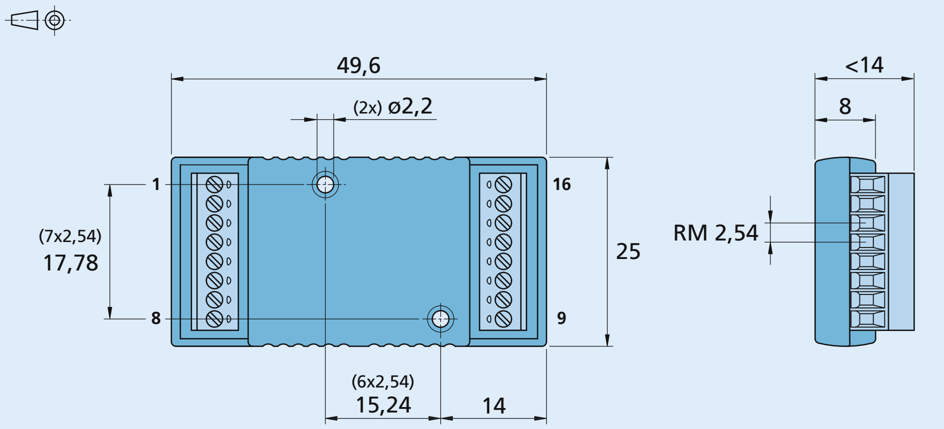
- Example:
  MCDC 3002 S RS (RS232)
  MCDC 3002 F CF (CANopen with Faulhaber CAN)
  MCDC 3002 P CO (CANopen CiA)

Accessories

		Motor Type	Part No. for MCDC 3002 S
Encoder adapter	**IE2**	DC	**6501.00143**
	PA2-50 / PA2-100	DC	**6501.00144**
	HEM3-256 [1]	DC	**6501.00146**
	HXM3-64	DC	**6501.00145**
			for MCDC 3002 S, F
Programming adapter	**RS232/CAN**	DC	**6501.00121**

[1] Only for $U_{DD\ Enc}$ = 5V

Dimensional drawing and connection information MCDC 3002 S



MCDC 3002 S

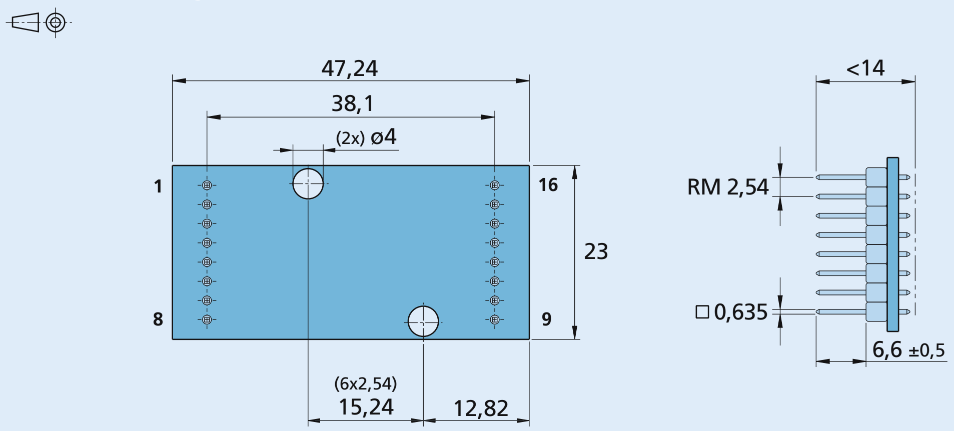
Supply connection

No.	Function
1	TxD / CAN_H
2	RxD / CAN_L
3	AGND
4	Fault
5	AnIn
6	U_B
7	GND
8	3. In

Motor connection

No.	Function
9	4. In
10	Ch A
11	CH B
12	U_{CC}
13	SGND
14	Mot +
15	Mot -
16	5. In

Dimensional drawing and connection information MCDC 3002 P



MCDC 3002 P

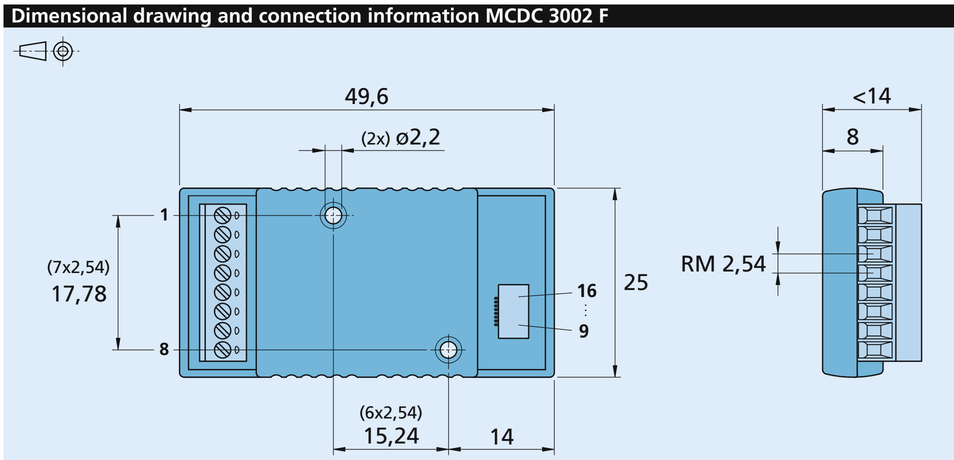
Supply connection

No.	Function
1	TxD / CAN_H
2	RxD / CAN_L
3	AGND
4	Fault
5	AnIn
6	U_B
7	GND
8	3. In

Motor connection

No.	Function
9	4. In
10	Ch A
11	CH B
12	U_{CC}
13	SGND
14	Mot +
15	Mot -
16	5. In

Dimensional drawing and connection information MCDC 3002 F



MCDC 3002 F

Supply connection

No.	Function
1	TxD / CAN_H
2	RxD / CAN_L
3	AGND
4	Fault
5	AnIn
6	U_B
7	GND
8	3. In

Motor connection

No.	Function
9	4. In
10	Ch A
11	CH B
12	U_{CC}
13	SGND
14	Mot +
15	Mot -
16	5. In

Notes

Motion Controller

V2.5, 4-Quadrant PWM
with RS232 or CAN interface

For combination with:
DC-Micromotors

Series MCDC 3003

		MCDC 3003 P	
Power supply	U_B	12 ... 30	V DC
PWM switching frequency	f_{PWM}	78,12	kHz
Efficiency	η	95	%
Max. continuous output current [1]	I_{dauer}	3	A
Max. peak output current	I_{max}	10	A
Total standby current	I_{el}	0,06	A
Speed range		5 ... 30 000	rpm
Scanning rate	N	100	µs
External encoder resolution		≤ 65 535	inc./rev.
Input/output (partially free configurable)		5	
Program memory: [2]			
– memory size		3,3	kWord
– Number of instructions		ca. 1 000	instructions
Operating temperature range		– 40 ... + 85	°C
Housing material		without housing	
Weight		18	g

[1] at 22°C ambient temperature
[2] Only for version with serial interface

Connection information					
Connection communication:					
Interface			RS232	CAN	
Communication profile			Faulhaber - ASCII	CANopen	
Max. transfer speed rate RS232			115 200		baud
Max. transfer speed rate CAN				1	Mbit/s
Connection 3 "AGND":					
– analog ground			analog GND		
– digital input	external encoder		channel B		
		R_{In}	10		kΩ
		f	≤ 400		kHz
Connection 4 "Fault":					
– digital input		R_{In}	100		kΩ
– digital output (open collector)		U	≤ U_B		V
		I	≤ 30		mA
		clear	switched to GND		
		set	high-impedance		
	fault output	no error	switched to GND		
		error	high-impedance		
Connection 5 "AnIn":			"AGND" as GND		
– analog input	set speed value	U_{In}	± 10		V
– digital input	PWM set speed value	f	100 ... 2 000		Hz
		T	50% ≙ 0 rpm		
	external encoder		channel A		
		f	≤ 400		kHz
	step frequency input	f	≤ 400		kHz
		R_{In}	5		kΩ
Connection 6 "U_B":		U_B	12 … 30		V DC
Connection 7 "GND":			ground		
Connection 8 "3. In":					
– digital input		R_{In}	22		kΩ
– electronic supply voltage		U_{EL}	12 … 30		V DC
Connection 9 "5. In":					
– digital input		R_{In}	22		kΩ
Connection 10 "4. In":					
– digital input		R_{In}	22		kΩ

FAULHABER

Connection information				
Connection 11-12 “Ch A”, “Ch B”:				
Encoder input	CH A		encoder channel A	
	CH B		encoder channel B	
Integrated pullup resistance + 5V		R	2,2	kΩ
		f	≤ 400	kHz
Connection 13 “U_{CC}”:				
Output voltage for external use [1]		U_{Out}	5	V
Load current		I_{Out}	≤ 60	mA
Connection 14 “SGND”:				
Signal GND			signal ground	
Connection 15-16 “Mot +”, “Mot -”:				
Motor connection	Mot +		Motor +	
	Mot –		Motor –	
		U_{Out}	0 … U_B	V DC
PWM switching frequency		f_{PWM}	78,12	kHz

[1] E.g. encoder

The signal level (PLC or TTL) of the digital inputs can be set over the interface (see operating instruction manual).
Standard (PLC): Low 0...7V / High 12,5V...U_B, TTL: Low 0...0,5V / High 3,5V...U_B

Options

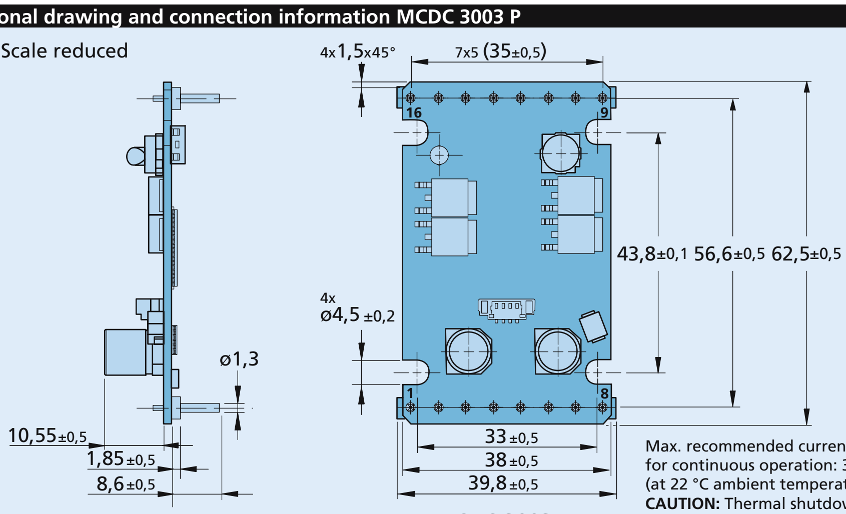
- Separate power supply (Option no.: 3085)

Full product description

- Example:
  MCDC 3003 P RS (RS232)
  MCDC 3003 P CF (CANopen with Faulhaber CAN)
  MCDC 3003 P CO (CANopen CiA)

Dimensional drawing and connection information MCDC 3003 P

Scale reduced



MCDC 3003 P

Max. recommended current
for continuous operation: 3A
(at 22 °C ambient temperature)
CAUTION: Thermal shutdown
is NOT guaranteed!

Connection

No.	Function
1	TxD / CAN_H
2	RxD / CAN_L
3	AGND
4	Fault
5	AnIn
6	U_B
7	GND
8	3. In
9	5. In
10	4. In
11	Ch A
12	Ch B
13	U_{CC}
14	SGND
15	Mot +
16	Mot –

FAULHABER

Motion Controller

V2.5, 4-Quadrant PWM
with RS232 or CAN interface

For combination with:
DC-Micromotors

Series MCDC 3006

		MCDC 3006 S	
Power supply	U_B	12 ... 30	V DC
PWM switching frequency	f_{PWM}	78,12	kHz
Efficiency	η	95	%
Max. continuous output current [1]	I_{dauer}	6	A
Max. peak output current	I_{max}	10	A
Total standby current	I_{el}	0,06	A
Speed range		5 ... 30 000	rpm
Scanning rate	N	100	µs
External encoder resolution		≤ 65 535	inc./rev.
Input/output (partially free configurable)		5	
Program memory: [2]			
– memory size		3,3	kWord
– Number of instructions		ca. 1 000	instructions
Operating temperature range		– 40 ... + 85	°C
Housing material		zinc, black coated	
Weight		160	g

[1] at 22°C ambient temperature
[2] Only for version with serial interface

Connection information					
Connection communication:					
Interface			RS232	CAN	
Communication profile			Faulhaber - ASCII	CANopen	
Max. transfer speed rate RS232			115 200		baud
Max. transfer speed rate CAN				1	Mbit/s
Connection 3 "AGND":					
– analog ground			analog GND		
– digital input	external encoder		channel B		
		R_{In}	10		kΩ
		f	≤ 400		kHz
Connection 4 "Fault":					
– digital input		R_{In}	100		kΩ
– digital output (open collector)		U	≤ U_B		V
		I	≤ 30		mA
		clear	switched to GND		
		set	high-impedance		
	fault output	no error	switched to GND		
		error	high-impedance		
Connection 5 "AnIn":			"AGND" as GND		
– analog input	set speed value	U_{In}	± 10		V
– digital input	PWM set speed value	f	100 ... 2 000		Hz
		T	50% ≙ 0 rpm		
	external encoder		channel A		
		f	≤ 400		kHz
	step frequency input	f	≤ 400		kHz
		R_{In}	5		kΩ
Connection 6 "U_B":		U_B	12 … 30		V DC
Connection 7 "GND":			ground		
Connection 8 "3. In":					
– digital input		R_{In}	22		kΩ
– electronic supply voltage		U_{EL}	12 … 30		V DC
Connection 9 "5. In":					
– digital input		R_{In}	22		kΩ
Connection 10 "4. In":					
– digital input		R_{In}	22		kΩ

Drive Electronics

Connection information				
Connection 11-12 “Ch A”, “Ch B”:				
Encoder input	CH A		encoder channel A	
	CH B		encoder channel B	
Integrated pullup resistance + 5V		R	2,2	kΩ
		f	≤ 400	kHz
Connection 13 “U_{CC}”:				
Output voltage for external use [1]		U_{Out}	5	V
Load current		I_{Out}	≤ 60	mA
Connection 14 “SGND”:				
Signal GND			signal ground	
Connection 15-16 “Mot +”, “Mot -”:				
Motor connection	Mot +		Motor +	
	Mot –		Motor –	
		U_{Out}	0 … U_B	V DC
PWM switching frequency		f_{PWM}	78,12	kHz

[1] E.g. encoder
The signal level (PLC or TTL) of the digital inputs can be set over the interface (see operating instruction manual).
Standard (PLC): Low 0...7V / High 12,5V...U_B, TTL: Low 0...0,5V / High 3,5V...U_B

D-SUB-connector information		
Connection D-SUB-connector:	**RS232**	**CAN**
Pin 2	RxD	CAN-L
Pin 3	TxD	GND
Pin 5	GND	-
Pin 7	-	CAN-H

Options

- Separate power supply (Option no.: 3085)

Accessories

- 6501.00128: USB-CAN-Adapter (only for version with CAN interface)
- 6501.00131: USB-RS232 Adapter (only for version with serial interface)
- 6501.00063: Adapter for motors with IE2 Encoder
- 6501.00064: Adapter for motors with HEDL Encoder

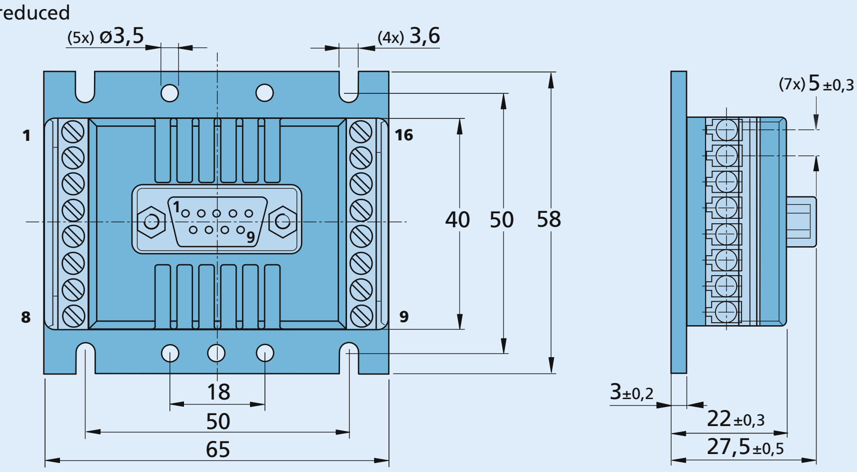
Full product description

- Example:

  MCDC 3006 S RS (RS232)
  MCDC 3006 S CF (CANopen with Faulhaber CAN)
  MCDC 3006 S CO (CANopen CiA)

Dimensional drawing and connection information MCDC 3006 S

Scale reduced



MCDC 3006 S

Supply connection

No.	Function
1	TxD / CAN_H
2	RxD / CAN_L
3	AGND
4	Fault
5	AnIn
6	U_B
7	GND
8	3. In

Motor connection

No.	Function
9	5. In
10	4. In
11	Ch A
12	Ch B
13	U_{CC}
14	SGND
15	Mot +
16	Mot –

Motion Controller

V2.5, 4-Quadrant PWM
with RS232 or CAN interface

For combination with:
Brushless DC-Servomotors
with analog Hall sensors

Series MCBL 3002

		MCBL 3002 P	MCBL 3002 F	MCBL 3002 S	
Power supply	U_B	5 ... 30	5 ... 30	5 ... 30	V DC
PWM switching frequency	f_{PWM}	78,12	78,12	78,12	kHz
Efficiency	η	95	95	95	%
Max. continuous output current [1]	I_{dauer}	2	2	2	A
Max. peak output current	I_{max}	3	3	3	A
Total standby current	I_{el}	0,04	0,04	0,04	A
Speed range		5 ... 30 000	5 ... 30 000	5 ... 30 000	rpm
Scanning rate	N	200	200	200	µs
Encoder resolution with linear Hall Sensors		3 000	3 000	3 000	inc./rev.
Resolution with external encoder		≤ 65 535	≤ 65 535	≤ 65 535	inc./rev.
Input/output (partially free configurable)		3	3	3	
Program memory: [2]					
– memory size		3,3	3,3	3,3	kWord
– Number of instructions		ca. 1 000	ca. 1 000	ca. 1 000	instructions
Operating temperature range		– 25 ... + 85	– 25 ... + 85	– 25 ... + 85	°C
Weight		7	13	16	g

[1] at 22°C ambient temperature
[2] Only for version with serial interface

Connection information					
Connection communication:					
Interface			RS232	CAN	
Communication profile			Faulhaber - ASCII	CANopen	
Max. transfer speed rate RS232			115 200		baud
Max. transfer speed rate CAN				1	Mbit/s
Connection 3 "AGND":					
– analog ground			analog GND		
– digital input	external encoder		channel B		
		R_{In}	10		kΩ
		f	≤ 400		kHz
Connection 4 "Fault":					
– digital input		R_{In}	100		kΩ
– digital output (open collector)		U	≤ U_B		V
		I	≤ 30		mA
		clear	switched to GND		
		set	high-impedance		
	fault output	no error	switched to GND		
		error	high-impedance		
	signal output	f	≤ 2		kHz
		resolution	1...255		inc./rev.
Connection 5 "AnIn":			"AGND" as GND		
– analog input	set speed value	U_{In}	± 10		V
– digital input	PWM set speed value	f	100 ... 2 000		Hz
		T	50% ≙ 0 rpm		
	external encoder		channel A		
		f	≤ 400		kHz
	step frequency input	f	≤ 400		kHz
		R_{In}	5		kΩ
Connection 6 "U_B":		U_B	5 … 30		V DC
Connection 7 "GND":			ground		
Connection 8 "3. In":					
– digital input		R_{In}	22		kΩ
– electronic supply voltage		U_{EL}	5 … 30		V DC

Connection information

Connection 9-11 „Sensor A, B, C":				
Hall sensor input	Sensor A		Hall Sensor A	
	Sensor B		Hall Sensor B	
	Sensor C		Hall Sensor C	
		U_{In}	≤ 5	V
Connection 12 "U_{CC}":				
Output voltage for external use [1]		U_{Out}	5	V
Load current		I_{Out}	≤ 60	mA
Connection 13 "SGND":				
Signal GND			Signal masse	
Connection 14-16 „Motor A, B, C":				
Motor connection	Motor A		Phase A	
	Motor B		Phase B	
	Motor C		Phase C	
		U_{Out}	0 … U_B	V DC
PWM switching frequency		f_{PWM}	78,12	kHz

[1] E.g. Hall sensor

The signal level (PLC or TTL) of the digital inputs can be set over the interface (see operating instruction manual).
Standard (PLC): Low 0...4,5V / High 12,5V...U_B, TTL: Low 0...0,5V / High 2,5V...U_B

Options

- Separate power supply (Option no.: 3085)

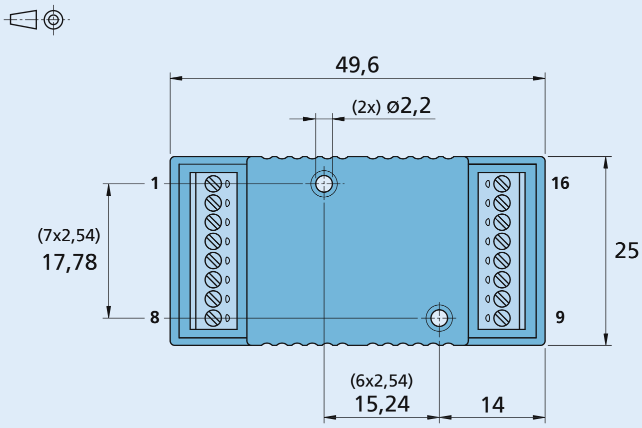
Full product description

- Example:
  MCBL 3002 S RS (RS232)
  MCBL 3002 F CF (CANopen with Faulhaber CAN)
  MCBL 3002 P CO (CANopen CiA)

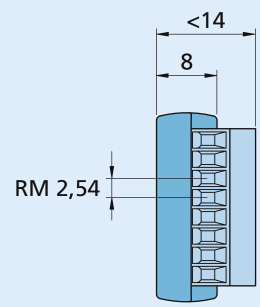
Accessories

		Motor Type	Part No.
Motor connector adapter	**0620 ... B**	BL	for MCBL 3002 S **6501.00083**
Programming adapter	**RS232/CAN**	BL	for MCBL 3002 S, F **6501.00121**

Dimensional drawing and connection information MCBL 3002 S



MCBL 3002 S



Connector Information
LIF-Connector 8-pole

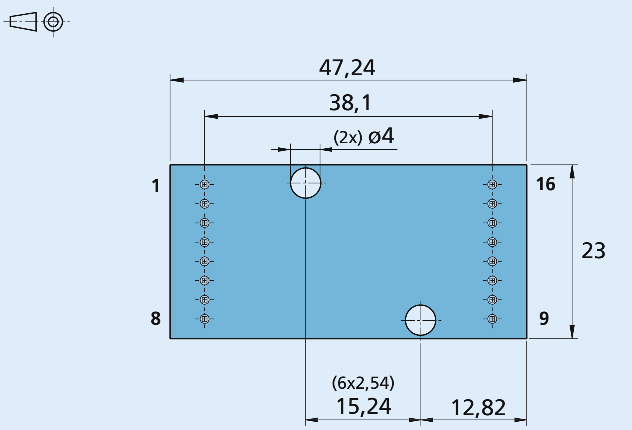
Supply connection

No.	Function
1	TxD / CAN_H
2	RxD / CAN_L
3	AGND
4	Fault
5	AnIn
6	U_B
7	GND
8	3. In

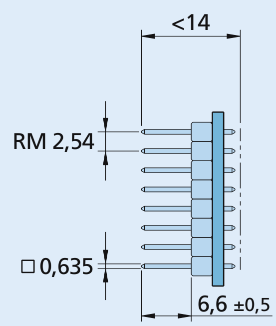
Motor connection

No.	Function
9	Sensor A
10	Sensor B
11	Sensor C
12	U_{CC}
13	SGND
14	Motor A
15	Motor B
16	Motor C

Dimensional drawing and connection information MCBL 3002 P



MCBL 3002 P



Connector Information
LIF-Connector 8-pole

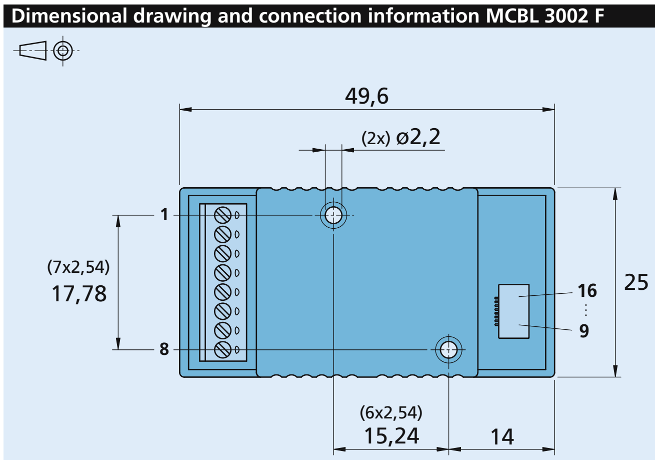
Supply connection

No.	Function
1	TxD / CAN_H
2	RxD / CAN_L
3	AGND
4	Fault
5	AnIn
6	U_B
7	GND
8	3. In

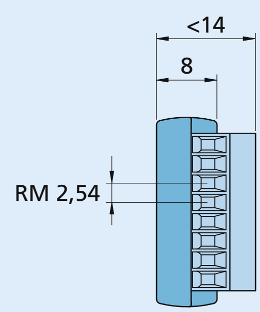
Motor connection

No.	Function
9	Sensor A
10	Sensor B
11	Sensor C
12	U_{CC}
13	SGND
14	Motor A
15	Motor B
16	Motor C

Dimensional drawing and connection information MCBL 3002 F



MCBL 3002 F



Connector Information
LIF-Connector 8-pole

Supply connection

No.	Function
1	TxD / CAN_H
2	RxD / CAN_L
3	AGND
4	Fault
5	AnIn
6	U_B
7	GND
8	3. In

Motor connection

No.	Function
9	Sensor A
10	Sensor B
11	Sensor C
12	U_{CC}
13	SGND
14	Motor A
15	Motor B
16	Motor C

Notes

FAULHABER

Motion Controller

V2.5, 4-Quadrant PWM
with RS232 or CAN interface

For combination with:
Brushless DC-Servomotors
with analog Hall sensors

Series MCBL 3003

		MCBL 3003 P	
Power supply	U_B	12 ... 30	V DC
PWM switching frequency	f_{PWM}	78,12	kHz
Efficiency	η	95	%
Max. continuous output current [1]	I_{dauer}	3	A
Max. peak output current	I_{max}	10	A
Total standby current	I_{el}	0,06	A
Speed range		5 ... 30 000	rpm
Scanning rate	N	200	µs
Encoder resolution with linear Hall Sensors		≤ 3 000	inc./rev.
Resolution with external encoder		≤ 65 535	inc./rev.
Input/output (partially free configurable)		3	
Program memory: [2]			
– memory size		3,3	kWord
– Number of instructions		ca. 1 000	instructions
Operating temperature range		– 40 ... + 85	°C
Housing material		without housing	
Weight		18	g

[1] at 22°C ambient temperature
[2] Only for version with serial interface

Connection information					
Connection communication:					
Interface			RS232	CAN	
Communication profile			Faulhaber - ASCII	CANopen	
Max. transfer speed rate RS232			115 200		baud
Max. transfer speed rate CAN				1	Mbit/s
Connection 3 "AGND":					
– analog ground			analog GND		
– digital input	external encoder		channel B		
		R_{In}	10		kΩ
		f	≤ 400		kHz
Connection 4 "Fault":					
– digital input		R_{In}	100		kΩ
– digital output (open collector)		U	≤ U_B		V
		I	≤ 30		mA
		clear	switched to GND		
		set	high-impedance		
	fault output	no error	switched to GND		
		error	high-impedance		
	signal output	f	≤ 2		kHz
		resolution	1...255		inc./rev.
Connection 5 "AnIn":			"AGND" as GND		
– analog input	set speed value	U_{In}	± 10		V
– digital input	PWM set speed value	f	100 ... 2 000		Hz
		T	50% ≙ 0 rpm		
	external encoder		channel A		
		f	≤ 400		kHz
	step frequency input	f	≤ 400		kHz
		R_{In}	5		kΩ
Connection 6 "U_B":		U_B	12 ... 30		V DC
Connection 7 "GND":			ground		
Connection 8 "3. In":					
– digital input		R_{In}	22		kΩ
– electronic supply voltage		U_{EL}	12 ... 30		V DC

Drive Electronics

Connection information			
Connection 9-11 „Sensor A, B, C“:			
Hall sensor input Sensor A		Hall sensor A	
Sensor B		Hall sensor B	
Sensor C		Hall sensor C	
	U_{In}	≤ 5	V
Connection 12 “U_{CC}”:			
Output voltage for external use [1]	U_{Out}	5	V DC
Load current	I_{Out}	≤ 60	mA
Connection 13 “SGND”:			
Signal GND		Signal ground	
Connection 14-16 „Motor A, B, C“:			
Motor connection Motor A		Phase A	
Motor B		Phase B	
Motor C		Phase C	
	U_{Out}	0 … U_B	V
PWM switching frequency	f_{PWM}	78,12	kHz

[1] E.g. Hall sensor

The signal level (PLC or TTL) of the digital inputs can be set over the interface (see operating instruction manual).
Standard (PLC): Low 0...7V / High 12,5V...U_B, TTL: Low 0...0,5V / High 3,5V...U_B

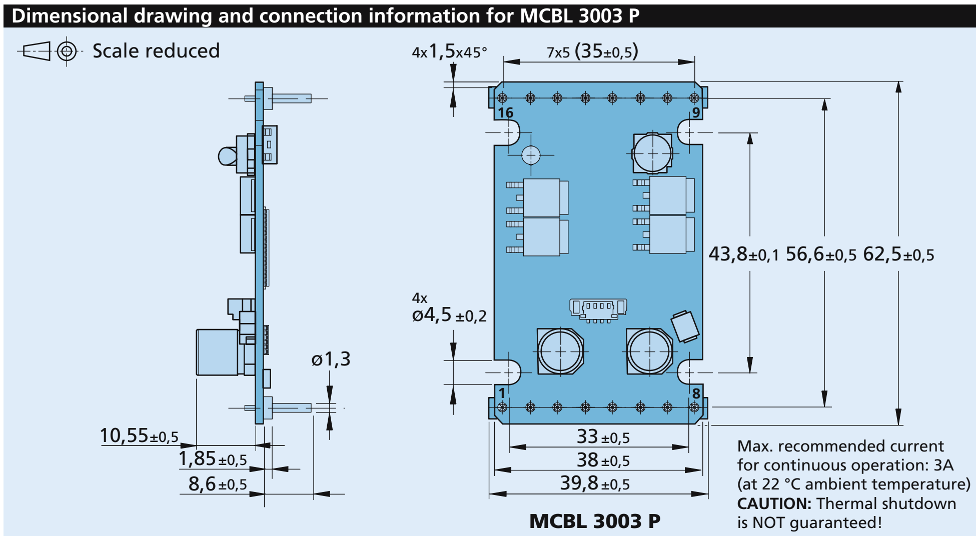
Options

- Separate power supply (Option no.: 3085)

Full product description

- Example:
  MCBL 3003 P RS (RS232)
  MCBL 3003 P CF (CANopen with Faulhaber CAN)
  MCBL 3003 P CO (CANopen CiA)

Dimensional drawing and connection information for MCBL 3003 P



MCBL 3003 P

Max. recommended current for continuous operation: 3A (at 22 °C ambient temperature)
CAUTION: Thermal shutdown is NOT guaranteed!

Connection

No.	Function
1	TxD / CAN_H
2	RxD / CAN_L
3	AGND
4	Fault
5	AnIn
6	U_B
7	GND
8	3. In
9	Sensor A
10	Sensor B
11	Sensor C
12	U_{CC}
13	SGND
14	Motor A
15	Motor B
16	Motor C

Drive Electronics

FAULHABER

Motion Controller

V2.5, 4-Quadrant PWM
with RS232 or CAN interface

For combination with:
Brushless DC-Servomotors
with analog Hall sensors

Series MCBL 3006

		MCBL 3006 S	
Power supply	U_B	12 ... 30	V DC
PWM switching frequency	f_{PWM}	78,12	kHz
Efficiency	η	95	%
Max. continuous output current 1)	I_{dauer}	6	A
Max. peak output current	I_{max}	10	A
Total standby current	I_{el}	0,06	A
Speed range		5 ... 30 000	rpm
Scanning rate	N	200	µs
Encoder resolution with linear Hall Sensors		≤ 3 000	inc./rev.
Resolution with external encoder		≤ 65 535	inc./rev.
Input/output (partially free configurable)		3	
Program memory: 2)			
– memory size		3,3	kWord
– Number of instructions		ca. 1 000	instructions
Operating temperature range		– 40 ... + 85	°C
Housing material		zinc, black coated	
Weight		160	g

1) at 22°C ambient temperature
2) Only for version with serial interface

Connection information					
Connection communication:					
Interface			RS232	CAN	
Communication profile			Faulhaber - ASCII	CANopen	
Max. transfer speed rate RS232			115 200		baud
Max. transfer speed rate CAN				1	Mbit/s
Connection 3 "AGND":					
– analog ground			analog GND		
– digital input	external encoder		channel B		
		R_{In}	10		kΩ
		f	≤ 400		kHz
Connection 4 "Fault":					
– digital input		R_{In}	100		kΩ
– digital output (open collector)		U	≤ U_B		V
		I	≤ 30		mA
		clear	switched to GND		
		set	high-impedance		
	fault output	no error	switched to GND		
		error	high-impedance		
	signal output	f	≤ 2		kHz
		resolution	1...255		inc./rev.
Connection 5 "AnIn":			"AGND" as GND		
– analog input	set speed value	U_{In}	± 10		V
– digital input	PWM set speed value	f	100 ... 2 000		Hz
		T	50% ≙ 0 rpm		
	external encoder		channel A		
		f	≤ 400		kHz
	step frequency input	f	≤ 400		kHz
		R_{In}	5		kΩ
Connection 6 "U_B":		U_B	12 … 30		V DC
Connection 7 "GND":			ground		
Connection 8 "3. In":					
– digital input		R_{In}	22		kΩ
– electronic supply voltage		U_{EL}	12 … 30		V DC

Drive Electronics

Connection information			
Connection 9-11 „Sensor A, B, C":			
Hall sensor input Sensor A		Hall Sensor A	
Sensor B		Hall Sensor B	
Sensor C		Hall Sensor C	
	U_{In}	≤ 5	V
Connection 12 "U_{CC}":			
Output voltage for external use [1]	U_{Out}	5	V
Load current	I_{Out}	≤ 60	mA
Connection 13 "SGND":			
Signal GND		Signal masse	
Connection 14-16 „Motor A, B, C":			
Motor connection Motor A		Phase A	
Motor B		Phase B	
Motor C		Phase C	
	U_{Out}	0 … U_B	V DC
PWM switching frequency	f_{PWM}	78,12	kHz

[1] E.g. Hall sensor

The signal level (PLC or TTL) of the digital inputs can be set over the interface (see operating instruction manual).

Standard (PLC): Low 0...7V / High 12,5V...U_B, TTL: Low 0...0,5V / High 3,5V...U_B

D-SUB-connector information		
Connection D-SUB-connector:	**RS232**	**CAN**
Pin 2	RxD	CAN-L
Pin 3	TxD	GND
Pin 5	GND	-
Pin 7	-	CAN-H

Options

- Separate power supply (Option no.: 3085)

Accessories

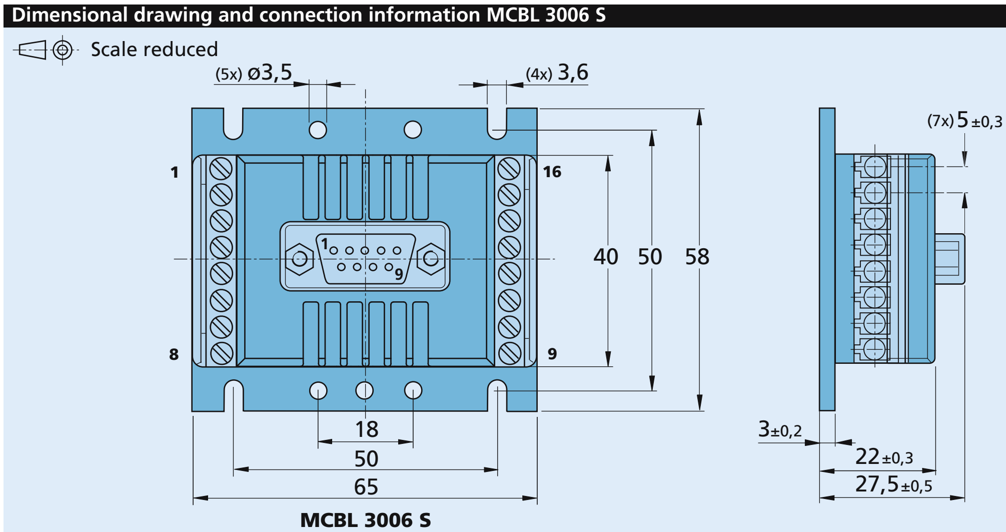
- 6501.00128: USB-CAN-Adapter (only for version with CAN interface)
- 6501.00131: USB-RS232 Adapter (only for version with serial interface)
- 6501.00086: Adapter for BX4 Motors with connector

Full product description

- Example:

  MCBL 3006 S RS (RS232)
  MCBL 3006 S CF (CANopen with Faulhaber CAN)
  MCBL 3006 S CO (CANopen CiA)

Dimensional drawing and connection information MCBL 3006 S



MCBL 3006 S

Supply connection

No.	Function
1	TxD / CAN_H
2	RxD / CAN_L
3	AGND
4	Fault
5	AnIn
6	U_B
7	GND
8	3. In

Motor connection

No.	Function
9	Sensor A
10	Sensor B
11	Sensor C
12	U_{CC}
13	SGND
14	Motor A
15	Motor B
16	Motor C

Motion Controller

V2.5, 4-Quadrant PWM with RS232 or CAN interface

For combination with:
Brushless DC-Servomotors
with absolute encoder

Series MCBL 3002 AES

		MCBL 3002 P AES	MCBL 3002 F AES	MCBL 3002 S AES	
Power supply	U_B	5 ... 30	5 ... 30	5 ... 30	V DC
PWM switching frequency	f_{PWM}	78,12	78,12	78,12	kHz
Efficiency	η	95	95	95	%
Max. continuous output current [1]	I_{dauer}	2	2	2	A
Max. peak output current	I_{max}	3	3	3	A
Total standby current	I_{el}	0,04	0,04	0,04	A
Speed range		5 ... 30 000	5 ... 30 000	5 ... 30 000	rpm
Scanning rate	N	100	100	100	µs
Encoder resolution with AES encoder		≤ 4 096	≤ 4 096	≤ 4 096	inc./rev.
Resolution with external encoder		≤ 65 535	≤ 65 535	≤ 65 535	inc./rev.
Input/output (partially free configurable)		3	3	3	
Program memory: [2]					
– memory size		3,3	3,3	3,3	kWord
– Number of instructions		ca. 1 000	ca. 1 000	ca. 1 000	instructions
Operating temperature range		– 25 ... + 85	– 25 ... + 85	– 25 ... + 85	°C
Weight		7	13	16	g

[1] at 22°C ambient temperature
[2] Only for version with serial interface

Connection information					
Connection communication:					
Interface			RS232	CAN	
Communication profile			Faulhaber - ASCII	CANopen	
Max. transfer speed rate RS232			115 200		baud
Max. transfer speed rate CAN				1	Mbit/s
Connection 3 “AGND”:					
– analog ground			analog GND		
– digital input	external encoder		channel B		
		R_{In}	10		kΩ
		f	≤ 400		kHz
Connection 4 “Fault”:					
– digital input		R_{In}	100		kΩ
– digital output (open collector)		U	≤ U_B		V
		I	≤ 30		mA
		clear	switched to GND		
		set	high-impedance		
	fault output	no error	switched to GND		
		error	high-impedance		
	signal output	f	≤ 2		kHz
		resolution	1...32		inc./rev.
Connection 5 “AnIn”:			“AGND” as GND		
– analog input	set speed value	U_{In}	± 10		V
– digital input	PWM set speed value	f	100 ... 2 000		Hz
		T	50% ≙ 0 rpm		
	external encoder		channel A		
		f	≤ 400		kHz
	step frequency input	f	≤ 400		kHz
		R_{In}	5		kΩ
Connection 6 “U_B”:		U_B	5 … 30		V DC
Connection 7 “GND”:			ground		
Connection 8 “3. In”:					
– digital input		R_{In}	22		kΩ
– electronic supply voltage		U_{EL}	5 … 30		V DC

Drive Electronics

Connection information

Connection 9-11 „DATA, CS, CLK ":				
	DATA	U_{In}	≤ 5	V
	$\overline{CS}$	U_{Out}	0 ... 5	V
	CLK	U_{Out}	0 ... 5	
Connection 12 "U_{CC}":				
Output voltage for external use [1]		U_{Out}	5	V
Load current		I_{Out}	≤ 60	mA
Connection 13 "SGND":				
Signal GND			Signal ground	
Connection 14-16 „Motor A, B, C":				
Motor connection	Motor A		Phase A	
	Motor B		Phase B	
	Motor C		Phase C	
		U_{Out}	0 … U_B	V DC
PWM switching frequency		f_{PWM}	78,12	kHz

[1] E.g. encoder

The signal level (PLC or TTL) of the digital inputs can be set over the interface (see operating instruction manual).
Standard (PLC): Low 0...4,5V / High 12,5V...U_B, TTL: Low 0...0,5V / High 2,5V...U_B

Options

- Separate power supply (Option no.: 3085)

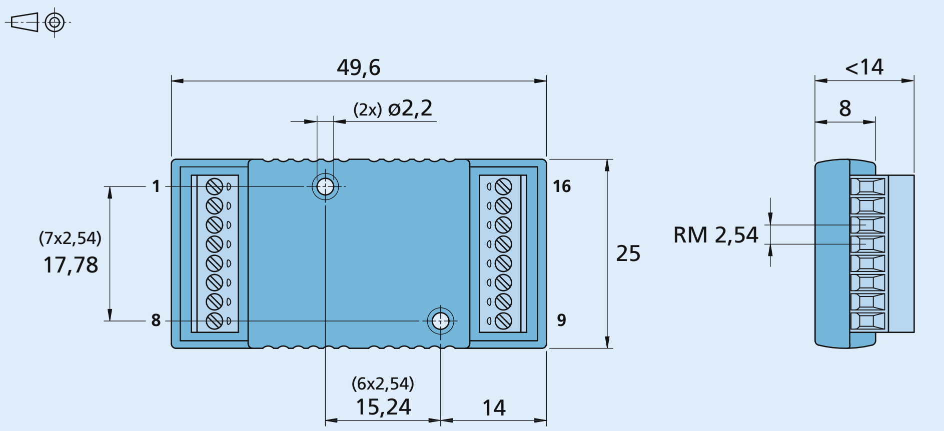
Full product description

- Example:
  MCBL 3002 S AES RS (RS232)
  MCBL 3002 F AES CF (CANopen with Faulhaber CAN)
  MCBL 3002 P AES CO (CANopen CiA)

Accessories

		Motor Type	Part No. for MCBL 3002 S AES, F AES
Programming adapter	**RS232/CAN**	BL	**6501.00121**

Dimensional drawing and connection information MCBL 3002 S AES



MCBL 3002 S AES

Connector Information
LIF-Connector 8-pole

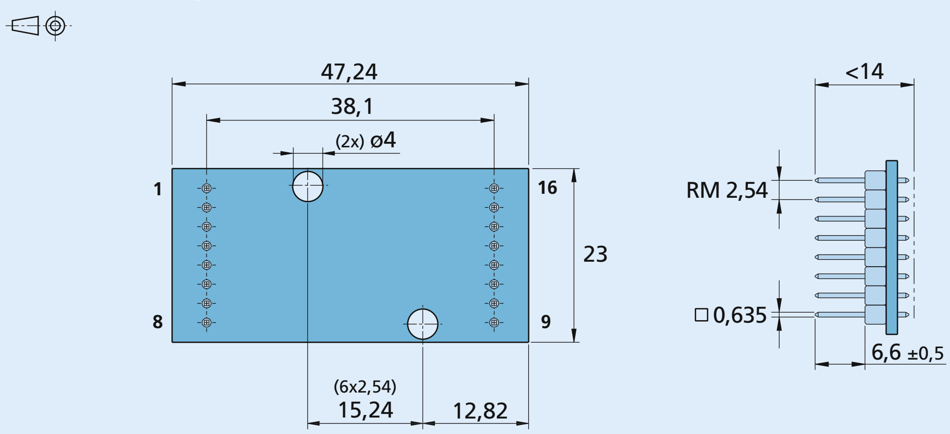
Supply connection

No.	Function
1	TxD / CAN_H
2	RxD / CAN_L
3	AGND
4	Fault
5	AnIn
6	U_B
7	GND
8	3. In

Motor connection

No.	Function
9	Sensor A / DATA
10	Sensor B / $\overline{CS}$
11	Sensor C / CLK
12	UCC
13	SGND
14	Motor A
15	Motor B
16	Motor C

Dimensional drawing and connection information MCBL 3002 P AES



MCBL 3002 P AES

Connector Information
LIF-Connector 8-pole

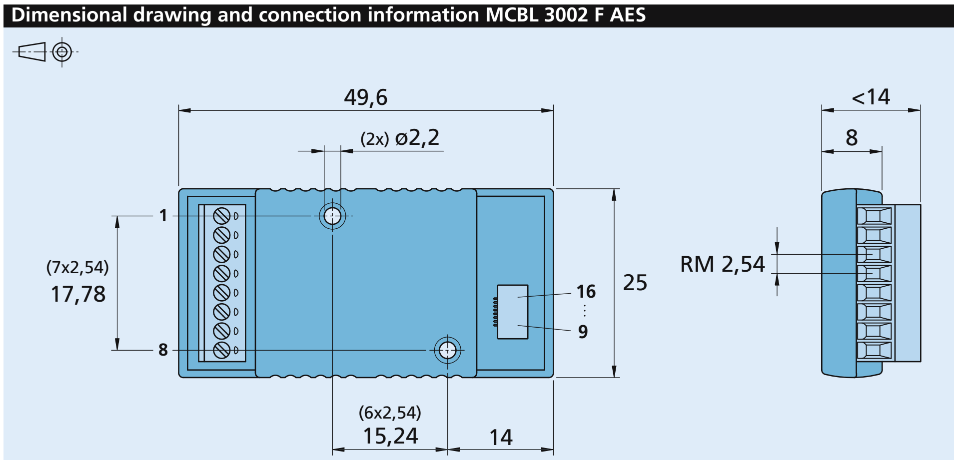
Supply connection

No.	Function
1	TxD / CAN_H
2	RxD / CAN_L
3	AGND
4	Fault
5	AnIn
6	U_B
7	GND
8	3. In

Motor connection

No.	Function
9	Sensor A / DATA
10	Sensor B / $\overline{CS}$
11	Sensor C / CLK
12	UCC
13	SGND
14	Motor A
15	Motor B
16	Motor C

Dimensional drawing and connection information MCBL 3002 F AES



MCBL 3002 F AES

Connector Information
LIF-Connector 8-pole

Supply connection

No.	Function
1	TxD / CAN_H
2	RxD / CAN_L
3	AGND
4	Fault
5	AnIn
6	U_B
7	GND
8	3. In

Motor connection

No.	Function
9	Sensor A / DATA
10	Sensor B / $\overline{CS}$
11	Sensor C / CLK
12	UCC
13	SGND
14	Motor A
15	Motor B
16	Motor C

Notes

FAULHABER

Motion Controller

V2.5, 4-Quadrant PWM
with RS232 or CAN interface

For combination with:
Brushless DC-Servomotors
with absolute encoder

Series MCBL 3003 AES

		MCBL 3003 P AES	
Power supply	U_B	12 ... 30	V DC
PWM switching frequency	f_{PWM}	78,12	kHz
Efficiency	η	95	%
Max. continuous output current [1]	I_{dauer}	3	A
Max. peak output current	I_{max}	10	A
Total standby current	I_{el}	0,06	A
Speed range		5 ... 30 000	rpm
Scanning rate	N	100	µs
Encoder resolution with AES encoder		≤ 4 096	inc./rev.
Resolution with external encoder		≤ 65 535	inc./rev.
Input/output (partially free configurable)		3	
Program memory: [2]			
– memory size		3,3	kWord
– Number of instructions		ca. 1 000	instructions
Operating temperature range		– 40 ... + 85	°C
Housing material		without housing	
Weight		18	g

[1] at 22°C ambient temperature
[2] Only for version with serial interface

Connection information					
Connection communication:					
Interface			RS232	CAN	
Communication profile			Faulhaber - ASCII	CANopen	
Max. transfer speed rate RS232			115 200		baud
Max. transfer speed rate CAN				1	Mbit/s
Connection 3 "AGND":					
– analog ground			analog GND		
– digital input	external encoder		channel B		
		R_{In}	10		kΩ
		f	≤ 400		kHz
Connection 4 "Fault":					
– digital input		R_{In}	100		kΩ
– digital output (open collector)		U	≤ U_B		V
		I	≤ 30		mA
		clear	switched to GND		
		set	high-impedance		
	fault output	no error	switched to GND		
		error	high-impedance		
	signal output	f	≤ 2		kHz
		resolution	1...32		inc./rev.
Connection 5 "AnIn":			"AGND" as GND		
– analog input	set speed value	U_{In}	± 10		V
– digital input	PWM set speed value	f	100 ... 2 000		Hz
		T	50% ≙ 0 rpm		
	external encoder		channel A		
		f	≤ 400		kHz
	step frequency input	f	≤ 400		kHz
		R_{In}	5		kΩ
Connection 6 "U_B":		U_B	12 … 30		V DC
Connection 7 "GND":			ground		
Connection 8 "3. In":					
– digital input		R_{In}	22		kΩ
– electronic supply voltage		U_{EL}	12 … 30		V DC

Drive Electronics

Connection information			
Connection 9-11 „DATA, $\overline{CS}$, CLK ":			
DATA	U_{In}	≤ 5	V
$\overline{CS}$	U_{Out}	0 ... 5	V
CLK	U_{Out}	0 ... 5	
Connection 12 "U_{CC}":			
Output voltage for external use [1]	U_{Out}	5	V DC
Load current	I_{Out}	≤ 60	mA
Connection 13 "SGND":			
Signal GND		Signal ground	
Connection 14-16 „Motor A, B, C":			
Motor connection Motor A		Phase A	
Motor B		Phase B	
Motor C		Phase C	
	U_{Out}	0 … U_B	V
PWM switching frequency	f_{PWM}	78,12	kHz

[1] E.g. encoder

The signal level (PLC or TTL) of the digital inputs can be set over the interface (see operating instruction manual).
Standard (PLC): Low 0...7V / High 12,5V...U_B, TTL: Low 0...0,5V / High 3,5V...U_B

Options

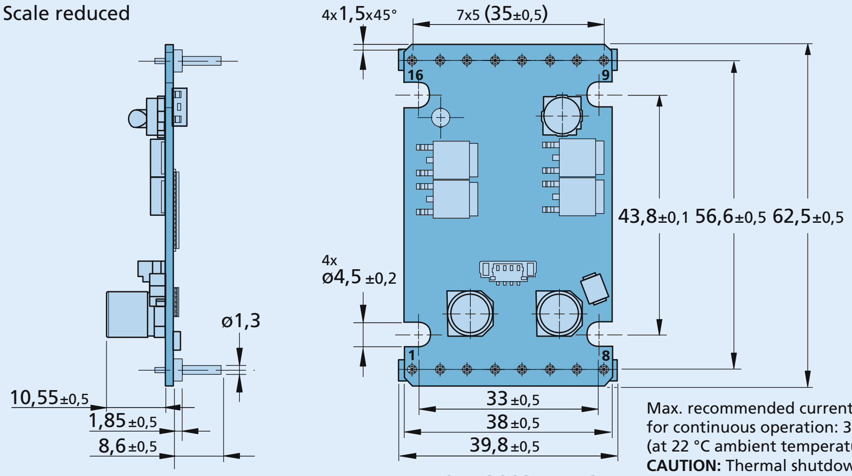
- Separate power supply (Option no.: 3085)

Full product description

- Example:
  MCBL 3003 P AES RS (RS232)
  MCBL 3003 P AES CF (CANopen with Faulhaber CAN)
  MCBL 3003 P AES CO (CANopen CiA)

Dimensional drawing and connection information for MCBL 3003 P AES

Scale reduced



MCBL 3003 P AES

Max. recommended current for continuous operation: 3A (at 22 °C ambient temperature)
CAUTION: Thermal shutdown is NOT guaranteed!

Connection

No.	Function
1	TxD / CAN_H
2	RxD / CAN_L
3	AGND
4	Fault
5	AnIn
6	U_B
7	GND
8	3. In
9	Sensor A
10	Sensor B
11	Sensor C
12	U_{CC}
13	SGND
14	Motor A
15	Motor B
16	Motor C

Drive Electronics

FAULHABER

Motion Controller

V2.5, 4-Quadrant PWM
with RS232 or CAN interface

For combination with:
Brushless DC-Servomotors
with absolute encoder

Series MCBL 3006 AES

		MCBL 3006 S AES	
Power supply	U_B	12 ... 30	V DC
PWM switching frequency	f_{PWM}	78,12	kHz
Efficiency	η	95	%
Max. continuous output current [1]	I_{dauer}	6	A
Max. peak output current	I_{max}	10	A
Total standby current	I_{el}	0,06	A
Speed range		5 ... 30 000	rpm
Scanning rate	N	100	µs
Encoder resolution with AES encoder		≤ 4 096	inc./rev.
Resolution with external encoder		≤ 65 535	inc./rev.
Input/output (partially free configurable)		3	
Program memory: [2]			
– memory size		3,3	kWord
– Number of instructions		ca. 1 000	instructions
Operating temperature range		– 40 ... + 85	°C
Housing material		zinc, black coated	
Weight		160	g

[1] at 22°C ambient temperature
[2] Only for version with serial interface

Connection information					
Connection communication:					
Interface			RS232	CAN	
Communication profile			Faulhaber - ASCII	CANopen	
Max. transfer speed rate RS232			115 200		baud
Max. transfer speed rate CAN				1	Mbit/s
Connection 3 "AGND":					
– analog ground			analog GND		
– digital input	external encoder		channel B		
		R_{In}	10		kΩ
		f	≤ 400		kHz
Connection 4 "Fault":					
– digital input		R_{In}	100		kΩ
– digital output (open collector)		U	≤ U_B		V
		I	≤ 30		mA
		clear	switched to GND		
		set	high-impedance		
	fault output	no error	switched to GND		
		error	high-impedance		
	signal output	f	≤ 2		kHz
		resolution	1...32		inc./rev.
Connection 5 "AnIn":			"AGND" as GND		
– analog input	set speed value	U_{In}	± 10		V
– digital input	PWM set speed value	f	100 ... 2 000		Hz
		T	50% ≙ 0 rpm		
	external encoder		channel A		
		f	≤ 400		kHz
	step frequency input	f	≤ 400		kHz
		R_{In}	5		kΩ
Connection 6 "U_B":		U_B	12 … 30		V DC
Connection 7 "GND":			ground		
Connection 8 "3. In":					
– digital input		R_{In}	22		kΩ
– electronic supply voltage		U_{EL}	12 … 30		V DC

Drive Electronics

Connection information

Connection 9-11 „DATA, $\overline{CS}$, CLK ":				
	DATA	U_{In}	≤ 5	V
	$\overline{CS}$	U_{Out}	0 ... 5	V
	CLK	U_{Out}	0 ... 5	
Connection 12 "U_{CC}":				
Output voltage for external use [1]		U_{Out}	5	V
Load current		I_{Out}	≤ 60	mA
Connection 13 "SGND":				
Signal GND			Signal ground	
Connection 14-16 „Motor A, B, C":				
Motor connection	Motor A		Phase A	
	Motor B		Phase B	
	Motor C		Phase C	
		U_{Out}	0 … U_B	V DC
PWM switching frequency		f_{PWM}	78,12	kHz

[1] E.g. encoder

The signal level (PLC or TTL) of the digital inputs can be set over the interface (see operating instruction manual).
Standard (PLC): Low 0...7V / High 12,5V...U_B, TTL: Low 0...0,5V / High 3,5V...U_B

D-SUB-connector information

Connection D-SUB-connector:	**RS232**	**CAN**
Pin 2	RxD	CAN-L
Pin 3	TxD	GND
Pin 5	GND	-
Pin 7	-	CAN-H

Options

- Separate power supply (Option no.: 3085)

Accessories

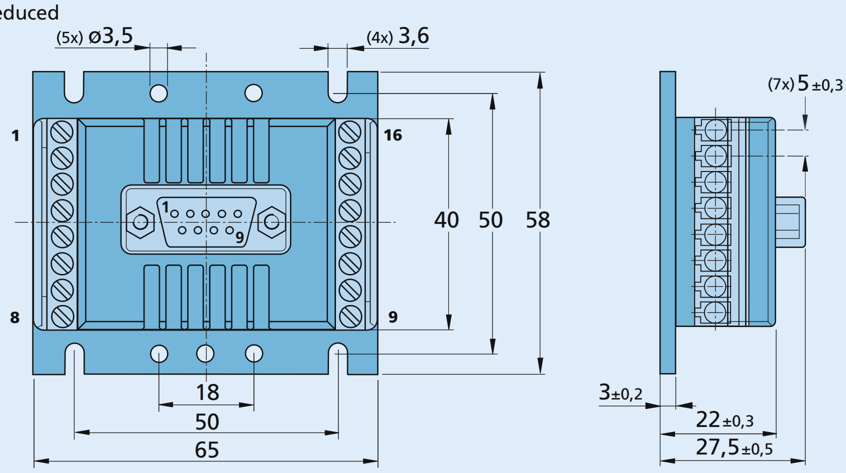
- 6501.00128: USB-CAN-Adapter (only for version with CAN interface)
- 6501.00131: USB-RS232 Adapter (only for version with serial interface)
- 6501.00086: Adapter for BX4 Motors with connector

Full product description

- Example:
  MCBL 3006 S AES RS (RS232)
  MCBL 3006 S AES CF (CANopen with CAN Faulhaber)
  MCBL 3006 S AES CO (CANopen CiA)

Dimensional drawing and connection information MCBL 3006 S AES

Scale reduced



MCBL 3006 S AES

Supply connection

No.	Function
1	TxD / CAN_H
2	RxD / CAN_L
3	AGND
4	Fault
5	AnIn
6	U_B
7	GND
8	3. In

Motor connection

No.	Function
9	Sensor A / DATA
10	Sensor B / $\overline{CS}$
11	Sensor C / CLK
12	U_{CC}
13	SGND
14	Motor A
15	Motor B
16	Motor C

Drive Electronics

Motion Controller

V2.5, 4-Quadrant PWM
with RS232 or CAN interface

For combination with:
Linear DC-Servomotors
with analog Hall sensors

Series MCLM 3002

		MCLM 3002 P	MCLM 3002 F	MCLM 3002 S	
Power supply	U_B	5 ... 30	5 ... 30	5 ... 30	V DC
PWM switching frequency	f_{PWM}	78,12	78,12	78,12	kHz
Efficiency	η	95	95	95	%
Max. continuous output current [1]	I_{dauer}	2	2	2	A
Max. peak output current	I_{max}	3	3	3	A
Total standby current	I_{el}	0,04	0,04	0,04	A
Speed range [2]		2 ... 10 000	2 ... 10 000	2 ... 10 000	rpm
Scanning rate	N	200	200	200	µs
Encoder resolution with linear Hall Sensors [3]		3 000	3 000	3 000	inc./τ_m
Resolution with external encoder		≤ 65 535	≤ 65 535	≤ 65 535	inc./mm
Input/output (partially free configurable)		3	3	3	
Program memory: [4]					
– memory size		3,3	3,3	3,3	kWord
– Number of instructions		ca. 1 000	ca. 1 000	ca. 1 000	instructions
Operating temperature range		– 25 ... + 85	– 25 ... + 85	– 25 ... + 85	°C
Weight		7	13	16	g

[1] at 22°C ambient temperature
[2] Speed in the range 1 ... 5 mm/s may have fluctuations due to the motor type, load characteristics and controller parameters
[3] τ_m is the magnetic pitch of the linear motor
[4] Only for version with serial interface

Connection information					
Connection communication:					
Interface			RS232	CAN	
Communication profile			Faulhaber - ASCII	CANopen	
Max. transfer speed rate RS232			115 200		baud
Max. transfer speed rate CAN				1	Mbit/s
Connection 3 **"AGND":**					
– analog ground			analog GND		
– digital input	external encoder		channel B		
		R_{In}	10		kΩ
		f	≤ 400		kHz
Connection 4 **"Fault":**					
– digital input		R_{In}	100		kΩ
– digital output (open collector)		U	≤ U_B		V
		I	≤ 30		mA
		clear	switched to GND		
		set	high-impedance		
	fault output	no error	switched to GND		
		error	high-impedance		
	signal output	f	≤ 2		kHz
		resolution	1...255		inc./τ_m
Connection 5 **"AnIn":**			"AGND" as GND		
– analog input	set position value	U_{In}	± 10		V
– digital input	external encoder		channel A		
		f	≤ 400		kHz
	step frequency input	f	≤ 400		kHz
		R_{In}	5		kΩ
Connection 6 **"U_B":**		U_B	5 … 30		V DC
Connection 7 **"GND":**			ground		
Connection 8 **"3. In":**					
– digital input		R_{In}	22		kΩ
– electronic supply voltage		U_{EL}	5 … 30		V DC

Drive Electronics

Connection information			
Connection 9-11 „Sensor A, B, C“:			
Hall sensor input — Sensor A		Hall Sensor A	
Sensor B		Hall Sensor B	
Sensor C		Hall Sensor C	
	U_{In}	≤ 5	V
Connection 12 “U_{CC}”:			
Output voltage for external use [1]	U_{Out}	5	V
Load current	I_{Out}	≤ 60	mA
Connection 13 “SGND”:			
Signal GND		Signal masse	
Connection 14-16 „Motor A, B, C“:			
Motor connection — Motor A		Phase A	
Motor B		Phase B	
Motor C		Phase C	
	U_{Out}	0 … U_B	V DC
PWM switching frequency	f_{PWM}	78,12	kHz

[1] E.g. Hall Sensors

The signal level (PLC or TTL) of the digital inputs can be set over the interface (see operating instruction manual).
Standard (PLC): Low 0...4,5V / High 12,5V...U_B, TTL: Low 0...0,5V / High 2,5V...U_B

Options

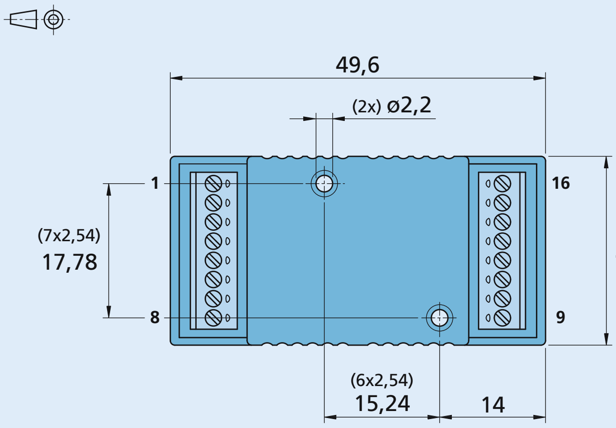
- Separate power supply (Option no.: 3085)

Full product description

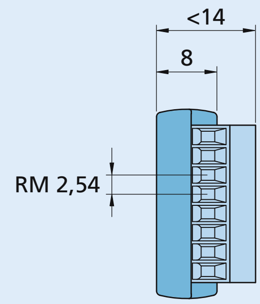
- Example:
  MCLM 3002 S RS (RS232)
  MCLM 3002 F CF (CANopen with Faulhaber CAN)
  MCLM 3002 P CO (CANopen CiA)

Accessories		Motor Type	Part No.
Programming adapter	**RS232/CAN**	BL	**6501.00121**

Dimensional drawing and connection information MCLM 3002 S



MCLM 3002 S



Connector Information
LIF-Connector 8-pole

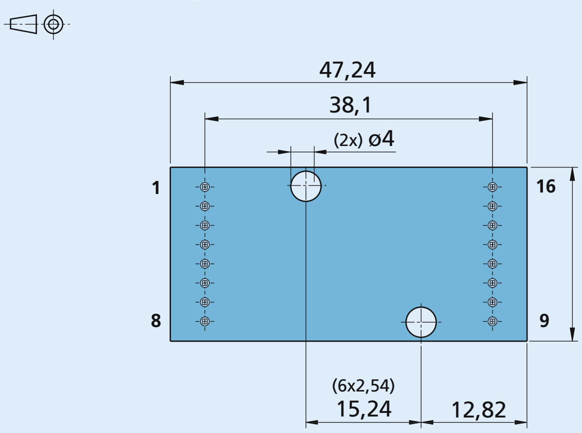
Supply connection

No.	Function
1	TxD / CAN_H
2	RxD / CAN_L
3	AGND
4	Fault
5	AnIn
6	U_B
7	GND
8	3. In

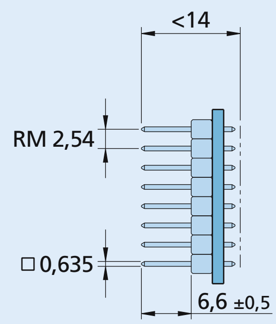
Motor connection

No.	Function
9	Sensor A
10	Sensor B
11	Sensor C
12	U_{CC}
13	SGND
14	Motor A
15	Motor B
16	Motor C

Dimensional drawing and connection information MCLM 3002 P



MCLM 3002 P



Connector Information
LIF-Connector 8-pole

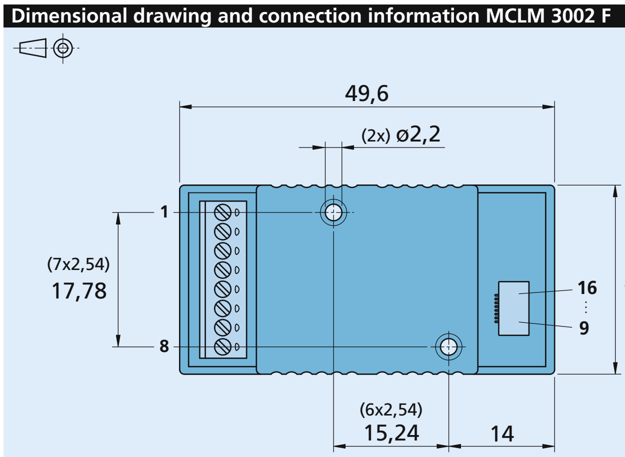
Supply connection

No.	Function
1	TxD / CAN_H
2	RxD / CAN_L
3	AGND
4	Fault
5	AnIn
6	U_B
7	GND
8	3. In

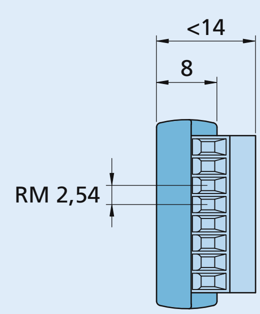
Motor connection

No.	Function
9	Sensor A
10	Sensor B
11	Sensor C
12	U_{CC}
13	SGND
14	Motor A
15	Motor B
16	Motor C

Dimensional drawing and connection information MCLM 3002 F



MCLM 3002 F



Connector Information
LIF-Connector 8-pole

Supply connection

No.	Function
1	TxD / CAN_H
2	RxD / CAN_L
3	AGND
4	Fault
5	AnIn
6	U_B
7	GND
8	3. In

Motor connection

No.	Function
9	Sensor A
10	Sensor B
11	Sensor C
12	U_{CC}
13	SGND
14	Motor A
15	Motor B
16	Motor C

Notes

Motion Controller

V2.5, 4-Quadrant PWM
with RS232 or CAN interface

For combination with:
Linear DC-Servomotors
with analog Hall sensors

Series MCLM 3003

		MCLM 3003 P	
Power supply	U_B	12 ... 30	V DC
PWM switching frequency	f_{PWM}	78,12	kHz
Efficiency	η	95	%
Max. continuous output current [1]	I_{dauer}	3	A
Max. peak output current	I_{max}	10	A
Total standby current	I_{el}	0,06	A
Speed range [2]		2 ... 10 000	mm/s
Scanning rate	N	200	µs
Encoder resolution with linear Hall Sensors [3]		≤ 3 000	inc./τ_m
Resolution with external encoder		≤ 65 535	inc./mm
Input/output (partially free configurable)		3	
Program memory: [4]			
– memory size		3,3	kWord
– Number of instructions		approx. 1 000	instructions
Operating temperature range		– 40 ... + 85	°C
Housing material		without housing	
Weight		18	g

[1] at 22°C ambient temperature
[2] speed in the range 1 ... 5 mm/s may have fluctuations due to the motor type, load characteristics and controller parameters
[3] τ_m is the magnetic pitch of the linear motor
[4] only for version with serial interface

Connection information					
Connection communication:					
Interface			RS232	CAN	
Communication profile			Faulhaber - ASCII	CANopen	
Max. transfer speed rate RS232			115 200		baud
Max. transfer speed rate CAN				1	Mbit/s
Connection 3 "AGND":					
– analog ground			analog GND		
– digital input	external encoder		channel B		
		R_{In}	10		kΩ
		f	≤ 400		kHz
Connection 4 "Fault":					
– digital input		R_{In}	100		kΩ
– digital output (open collector)		U	≤ U_B		V
		I	≤ 30		mA
		clear	switched to GND		
		set	high-impedance		
	fault output	no error	switched to GND		
		error	high-impedance		
	signal output	f	≤ 2		kHz
		resolution	1...255		inc./τ_m
Connection 5 "AnIn":			"AGND" as GND		
– analog input	set position value	U_{In}	± 10		V
– digital input	external encoder		channel A		
		f	≤ 400		kHz
	step frequency input	f	≤ 400		kHz
		R_{In}	5		kΩ
Connection 6 "U_B":		U_B	12 … 30		V DC
Connection 7 "GND":			ground		
Connection 8 "3. In":					
– digital input		R_{In}	22		kΩ
– electronic supply voltage		U_{EL}	12 … 30		V DC

Drive Electronics

Connection information				
Connection 9-11 „Sensor A, B, C“:				
Hall sensor input	Sensor A		Hall sensor A	
	Sensor B		Hall sensor B	
	Sensor C		Hall sensor C	
		U_{In}	≤ 5	V
Connection 12 “U_{CC}”:				
Output voltage for external use [1]		U_{Out}	5	V DC
Load current		I_{Out}	≤ 60	mA
Connection 13 “SGND”:				
Signal GND			Signal ground	
Connection 14-16 „Motor A, B, C“:				
Motor connection	Motor A		Phase A	
	Motor B		Phase B	
	Motor C		Phase C	
		U_{Out}	0 … U_B	V
PWM switching frequency		f_{PWM}	78,12	kHz

[1] E.g. Hall Sensors

The signal level (PLC or TTL) of the digital inputs can be set over the interface (see operating instruction manual).
Standard (PLC): Low 0...7V / High 12,5V...U_B, TTL: Low 0...0,5V / High 3,5V...U_B

Options

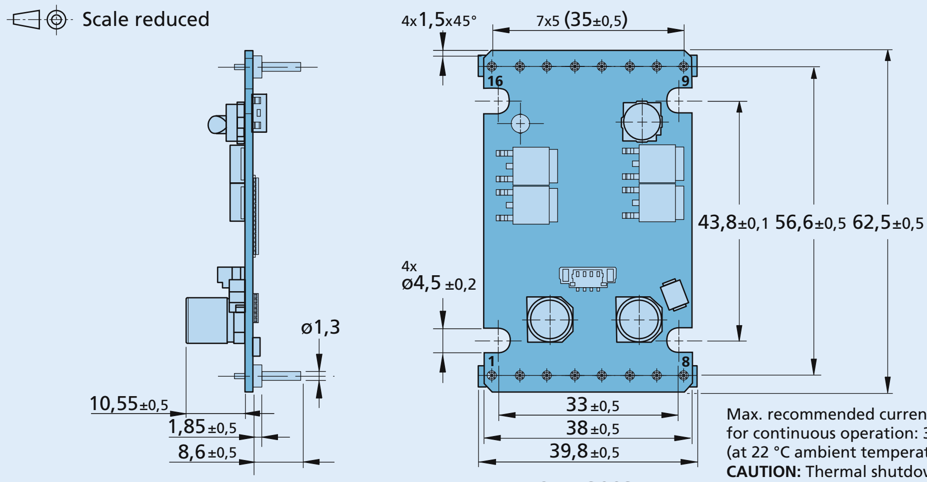
- Separate power supply (Option no.: 3085)

Full product description

- Example:
  MCLM 3003 P RS (RS232)
  MCLM 3003 P CF (CANopen with Faulhaber CAN)
  MCLM 3003 P CO (CANopen CiA)

Dimensional drawing and connection information MCLM 3003 P

Scale reduced



MCLM 3003 P

Max. recommended current for continuous operation: 3A (at 22 °C ambient temperature)
CAUTION: Thermal shutdown is NOT guaranteed!

Connection

No.	Function
1	TxD / CAN_H
2	RxD / CAN_L
3	AGND
4	Fault
5	AnIn
6	U_B
7	GND
8	3. In
9	Sensor A
10	Sensor B
11	Sensor C
12	U_{CC}
13	SGND
14	Motor A
15	Motor B
16	Motor C

FAULHABER

Motion Controller

V2.5, 4-Quadrant PWM
with RS232 or CAN interface

For combination with:
Linear DC-Servomotors
with analog Hall sensors

Series MCLM 3006

		MCLM 3006 S	
Power supply	U_B	12 ... 30	V DC
PWM switching frequency	f_{PWM}	78,12	kHz
Efficiency	η	95	%
Max. continuous output current [1]	I_{dauer}	6	A
Max. peak output current	I_{max}	10	A
Total standby current	I_{el}	0,06	A
Speed range [2]		2 ... 10 000	mm/s
Scanning rate	N	200	µs
Encoder resolution with linear Hall Sensors [3]		≤ 3 000	inc./τ_m
Resolution with external encoder		≤ 65 535	inc./mm
Input/output (partially free configurable)		3	
Program memory: [4]			
– memory size		3,3	kWord
– Number of instructions		approx. 1 000	instructions
Operating temperature range		– 40 ... + 85	°C
Housing material		zinc, black coated	
Weight		160	g

[1] at 22°C ambient temperature
[2] Speed in the range 1 ... 5 mm/s may have fluctuations due to the motor type, load characteristics and controller parameters
[3] τ_m is the magnetic pitch of the linear motor
[4] Only for version with serial interface

Connection information				
Connection communication:				
Interface		RS232	CAN	
Communication profile		Faulhaber - ASCII	CANopen	
Max. transfer speed rate RS232		115 200		baud
Max. transfer speed rate CAN			1	Mbit/s
Connection 3 “AGND”:				
– analog ground		analog GND		
– digital input external encoder		channel B		
	R_{In}	10		kΩ
	f	≤ 400		kHz
Connection 4 “Fault”:				
– digital input	R_{In}	100		kΩ
– digital output (open collector)	U	≤ U_B		V
	I	≤ 30		mA
	clear	switched to GND		
	set	high-impedance		
fault output	no error	switched to GND		
	error	high-impedance		
signal output	f	≤ 2		kHz
	resolution	1...255		inc./τ_m
Connection 5 “AnIn”:		“AGND” as GND		
– analog input set position value	U_{In}	± 10		V
– digital input external encoder		channel A		
	f	≤ 400		kHz
step frequency input	f	≤ 400		kHz
	R_{In}	5		kΩ
Connection 6 “U_B”:	U_B	12 … 30		V DC
Connection 7 “GND”:		ground		
Connection 8 “3. In”:				
– digital input	R_{In}	22		kΩ
– electronic supply voltage	U_{EL}	12 … 30		V DC

Connection information

Connection 9-11 „Sensor A, B, C":				
Hall sensor input	Sensor A		Hall Sensor A	
	Sensor B		Hall Sensor B	
	Sensor C		Hall Sensor C	
		U_{In}	≤ 5	V
Connection 12 "U_{CC}":				
Output voltage for external use [1]		U_{Out}	5	V
Load current		I_{Out}	≤ 60	mA
Connection 13 "SGND":				
Signal GND			Signal masse	
Connection 14-16 „Motor A, B, C":				
Motor connection	Motor A		Phase A	
	Motor B		Phase B	
	Motor C		Phase C	
		U_{Out}	0 … U_B	V DC
PWM switching frequency		f_{PWM}	78,12	kHz

[1] E.g. Hall Sensors
The signal level (PLC or TTL) of the digital inputs can be set over the interface (see operating instruction manual).
Standard (PLC): Low 0...7V / High 12,5V...U_B, TTL: Low 0...0,5V / High 3,5V...U_B

D-SUB-connector information

Connection D-SUB-connector:	**RS232**	**CAN**
Pin 2	RxD	CAN-L
Pin 3	TxD	GND
Pin 5	GND	-
Pin 7	-	CAN-H

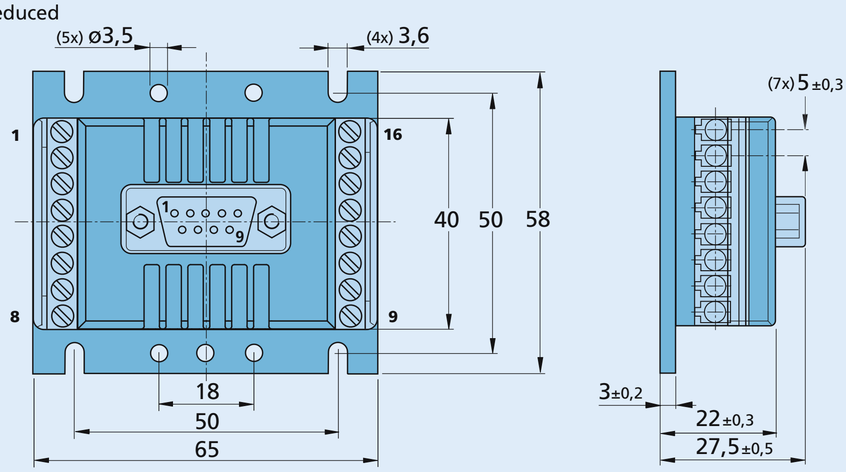
Options
- Separate power supply (Option no.: 3085)

Accessories
- 6501.00128: USB-CAN-Adapter
  (only for version with CAN interface)
- 6501.00131: USB-RS232 Adapter
  (only for version with serial interface)
- 6501.00117: Adapter for LM 0830
- 6501.00118: cable with connector for Adapter LM 0830

Full product description
- Example:
  MCLM 3006 S RS (RS232)
  MCLM 3006 S CF (CANopen with Faulhaber CAN)
  MCLM 3006 S CO (CANopen CiA)

Dimensional drawing and connection information for MCLM 3006 S

Scale reduced



MCLM 3006 S

Supply connection

No.	Function
1	TxD / CAN_H
2	RxD / CAN_L
3	AGND
4	Fault
5	AnIn
6	U_B
7	GND
8	3. In

Motor connection

No.	Function
9	Sensor A
10	Sensor B
11	Sensor C
12	U_{CC}
13	SGND
14	Motor A
15	Motor B
16	Motor C

Accessories

WE CREATE MOTION

FAULHABER

Accessories

USB Programming Board

For combination with
Speed Controller:
SC 1801 S / F, SC 2804 S, SC 5008 S

Part No.: 6501.0009x

		6501.00096 and 6501.00097	
Power supply for electronics	U_{elo}	5 ... 30	V
Power supply for motor	U_{mot}	0 ... 30	V
Current consumption of electronics	I_{el}	20	mA
Temperature range:			
– Operating temperature		0 ... + 65	°C
Dimensions and weight:			
– Dimensions (L x B x H)		55 x 48 x 18	mm
– Weight		35	g

General information

Standard programming board for configuration and changes of the operating modes for Speed Controller series SC 1801 S / F, SC 2804 S and SC 5008 S.

Automatic parameter download in connection with FAULHABER Motion Manager (from version 4.2) via USB interface.

Immediate test operation after successful data transfer within the customers application is feasible.

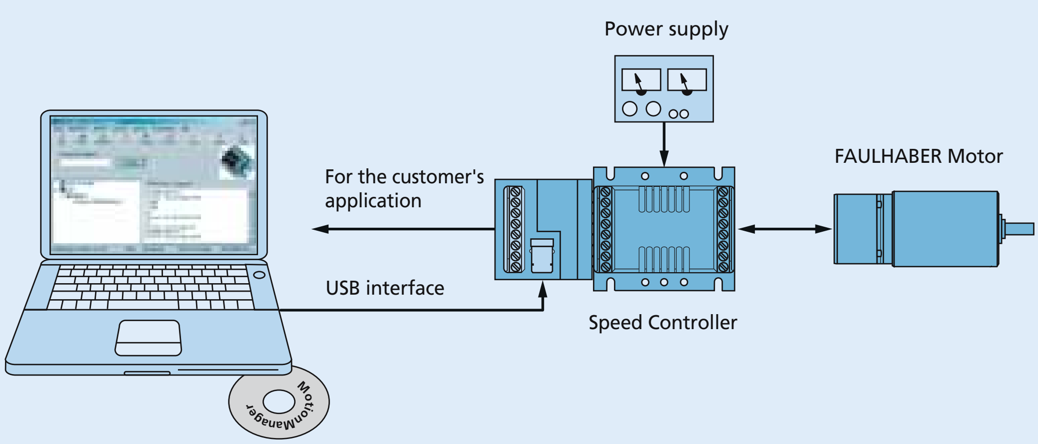
The programming board is to be operated via an USB interface. Therefore the installation of a special USB driver is required.

Driver installation

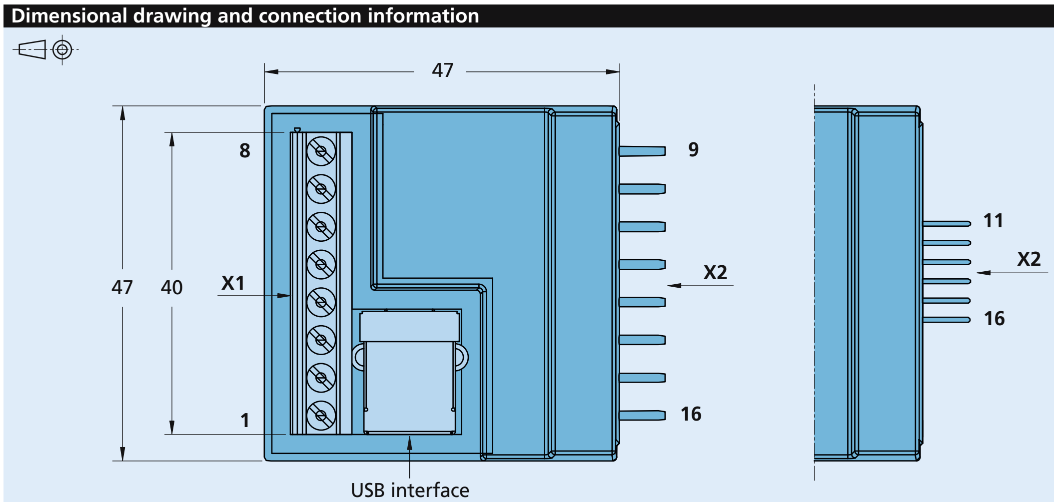
The driver is included in the setup package of FAULHABER Motion Manager (from version 4.2), which can be downloaded from the FAULHABER internet site www.faulhaber.com/MotionManager.

For detailed informations to install the driver please see instruction manual of SC programming board USB.

Connection diagram



Dimensional drawing and connection information



6501.00096 6501.00097

Connection

No.	Function
X1 Customer interface	
1	Up
2	Umot
3	GND
4	Unsoll
5	DIR
6	FG
7	IO2
8	IO1
X2 Controller interface	
9	IO1
10	IO2
11	FG
12	DIR
13	Unsoll
14	GND
15	Umot
16	Up

Accessories

Programming Board

For combination with
Speed Controller:
SC 1801, SC 2402, SC 2804, SC 5004 , SC 5008
Brushless DC-Micromotors
1525...BRC, 3153...BRC,
2232...BX4 SC, 2232...BX4S SC, 2250...BX4 SC,
2250...BX4S SC, 3242...BX4 SC, 3268...BX4 SC

Part No.: 6501.00088

		6501.00088	
Power supply for electronics	U_{elo}	3,5 ... 30	V
Power supply for motor	U_{mot}	0 ... 30	V
Current consumption of electronics	I_{el}	0,1	A
Temperature range:			
– Operating temperature		0 ... + 65	°C
Dimensions and weight:			
– Dimensions (L x B x H)		80 x 65 x 31	mm
– Weight		45	g

General information

Description of connectors / controls:

X1 Terminals for power supplies
- Pin 1: GND Ground connection of power supply/supplies
- Pin 2: U_{elo} Power supply for electronics
- Pin 3: U_{mot} Power supply for motor winding

X2, X3, X6, X10 Terminals for motor / motor controller
- Pin 1: U_P Power supply for motor electronics
- Pin 2: U_{mot} Power supply for motor winding
- Pin 3: GND Power supply negative pole
- Pin 4: U_{soll} Output for nominal speed setting 0...10V
- Pin 5: DIR Output for direction of rotation setting
- Pin 6: FG Input for speed signal from motor controller

X5 RS232 connector, may optionally be used instead of X9 in PROG mode for programming

X9 USB connector, may optionally be used instead of X5 in PROG mode for programming

JP1 Jumper can be removed and connected to an amperemeter for motor current measurement at U_{mot}.

JP3 Jumper to separate power supply for electronics and motor
- 1-2: $U_P = U_{mot}$ » Joint power supply to electronics and motor winding via terminal Umot
- 2-3: $U_P = U_{elo}$ » Power supply to electronics via separate terminal U_{elo} (separate power supply for electronics and motor winding). Power supply for adapter board also via the terminal selected for U_P

JP9 Connector for external signal for Unsoll, e.g. PWM signal for speed setting. Note: JP10 must then be removed.

JP10 Jumper for selection of the source for U_{soll}. Closed: U_{soll} adjustable with P1.

S1 Switch for setting the operating mode
PROG mode = software update
MOT mode = motor operation

S2 Switch for setting the direction of rotation of the motor

S3 Switch for switching the power supply U_P for the electronics on/off

P1 P1 is used to set U_{soll} from 0...10V. JP10 must be closed. The power supply U_P must be at least 10,5V.

LED 1 Indicates the adapter board is ready for operation

LED 2 Indicates the external controller status.
ON = ready for operation, OFF = error

Start-up

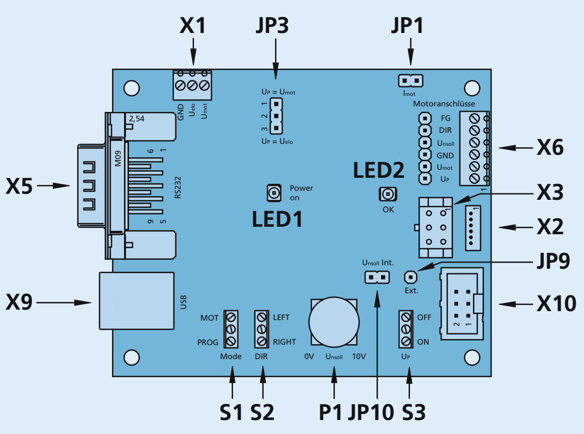
- Connect operating voltage to X1. Use alternatively joint or separate operating voltage for electronics and motor.
  Note: Pay attention to correct setting of JP3.
  Pay attention to minimum/maximum values for U_{mot} and U_{elo}.
- S3 in position OFF; JP1 and JP10 closed.
- Connect motor/motor controller to X2, X3, X6 or X10.
- For PROG mode, connect to a Windows PC at X5 (null modem cable) or X9 (USB connection cable type B).
- LED 1 and LED 2 lights up after power-on for U_{mot} or U_{mot} and U_{elo}.

Driver installation:

If the adapter board is to be operated via the USB connector X9, a special USB driver must be installed if using Windows XP (further details on request).

Dimensional drawing and connection information

scale reduced



6501.00088

Connection

No.	Function
LED 1	Ready for operation
LED 2	Status external controller
Terminals	
X1	Power supply
X2, X3, X6, X10	Connector for motor or SC controller
X5	RS232 connector
X9	USB connector, type B
Jumpers	
JP1	Motor current measurement
JP3	Separation of U_P from U_{mot}
JP9	U_{soll} external input signal
JP10	U_{soll} int. setting with P1
Switches	
S1	Operating mode
S2	Direction of motor rotation
S3	Power switch on/off
Potentiometer	
P1	U_{soll} setting

PROG mode

Settings	
S1	PROG
S2	RIGHT
S3	OFF
P1	0V
JP1	Closed
JP10	Closed

MOT mode

Settings	
S1	MOT
S2	RIGHT or LEFT
S3	OFF - ON
P1	0V ... 10V
JP1	Opt. current measurement
JP10	Select source for U_{soll}

Accessories

Adapter board

For combination with
Brushless DC-Servomotos with integrated Motion Controller:
3242 ... BX4 Cx, 3268 ... BX4 Cx, 3564 ... B Cx

Part No.: 6501.00065

	6501.00065	
Temperature range:		
– Operating temperature	– 10 ... + 65	°C
Dimension and Weight:		
– Dimension (L x B x H)	64 x 44,5 x 13,8	mm
– Weight	29,5	g

Note: The board has installation feet for 35 mm mounting rails.
All switches are in the "OFF" position in the as-delivered condition. These switches must be set accordingly depending on the application.

General information

The adapter board is used to connect Brushless DC-Servomotors with integrated Motion Controller and a serial RS232 or CAN interface.

The different operating modes can be selected using the 6 DIP switches.
A Brushless DC-Servomotor with integrated Motion Controller can be connected to each adapter board.

Description of DIP switch (S1) settings

1: Fault	ON	Pull-up resistor with LED connected to adapter board.
	OFF	Open collector
2: Term	ON	120 Ω terminating resistor for the final node in the CAN network connected to the adapter board.
	OFF	Terminating resistor not connected
3: CAN [1)]	ON	Operation with CAN interface
	OFF	Deactivated
4: RS232 [1)]	ON	Operation with RS232 interface
	OFF	Deactivated
5: NETMODE	ON	Pull-down resistor (10 kΩ) for RS232 wiring connected. This may only be connected to a node in the RS232 network.
	OFF	Deactivated
6: AGND	ON	AGND and GND interconnected.
	OFF	AGND and GND disconnected (with separate ground).

Connection

Pin	Connection X1
1	3. In
2	GND
3	+24V
4	An In
5	Fault
6	AGND

Pin	Connection X2	Wires
1	RS-232 TxD	green
2	RS-232 RxD	yellow
3	AGND	grey
4	Fault	white
5	An In	brown
6	+24V	pink
7	GND	blue
8	3. In	red

at RS232 operation [1)]

Pin	Connection X3
2	RS-232 / RxD
3	RS-232 / TxD
5	GND

at CAN operation [1)]

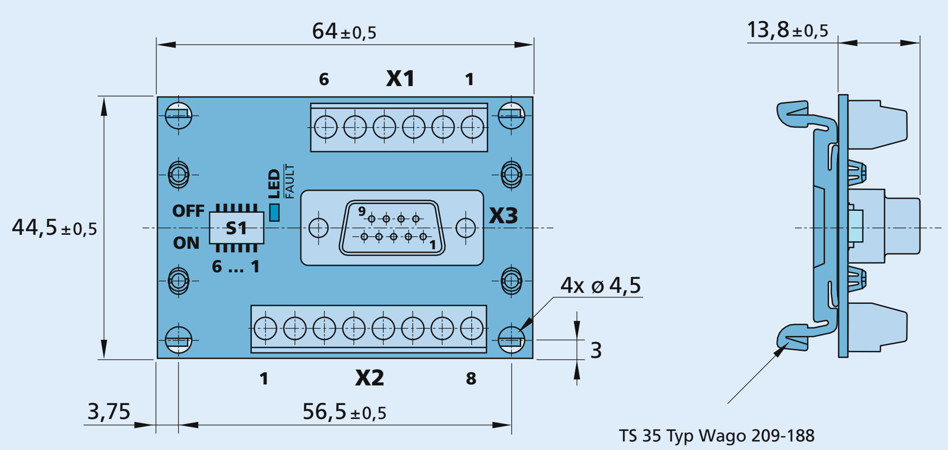
Pin	Connection X3
2	CAN_L
3	GND
7	CAN_H

LED	Status
LED illuminates	no error fault output switched to GND
LED does not illuminate	error fault output high-impedance

[1)] The pin assignments of X3 depend on the position of switches 3 and 4 of DIP switch S1.

Dimensional drawing and connection information

Scale reduced



TS 35 Typ Wago 209-188
for top hat rail mounting

6501.00065

Connection

Nr.	Function
X1	Supply connector; I/O
X2	Motor connector
X3	RS-232 / CAN

Nr.	Switch
S1	DIP-switch (6 switches)

Accessories

Adapter board BX4 CxD

For combination with
Brushless DC-Servomotos with integrated Motion Controller:
2232...BX4 CxD, 2250...BX4 CxD

Part No.: 6501.00113

	6501.00113	
Temperature range:		
– Operating temperature	– 10 ... + 65	°C
Dimension and Weight:		
– Dimension (L x B x H)	60 x 50 x 15	mm
– Weight	30	g

Note: All switches are in the “OFF” position in the as-delivered condition. These switches must be set accordingly depending on the application.

General information

The adapter board is used to connect Brushless DC-Servomotors with integrated Motion Controller and a serial RS232 or CAN interface.

The different operating modes can be selected using the 6 DIP switches.
A Brushless DC-Servomotor with integrated Motion Controller can be connected to each adapter board.

Description of DIP switch (S1) settings

1: Fault	ON	Pull-up resistor with LED connected to adapter board.
	OFF	Open collector
2: Term	ON	120Ω terminating resistor for the final node in the CAN network connected to the adapter board.
	OFF	Terminating resistor not connected
3: CAN [1]	ON	Operation with CAN interface
	OFF	Deactivated
4: RS232 [1]	ON	Operation with RS232 interface
	OFF	Deactivated
5: NETMODE	ON	Pull-down resistor (2,2 kΩ) for RS232 wiring connected. This may only be connected to a node in the RS232 network.
	OFF	Deactivated
6: AGND	ON	AGND and GND interconnected.
	OFF	AGND and GND disconnected (with separate ground).

[1] The pin assignments of X3 depend on the position of switches 3 and 4 of DIP switch S1.

Connection

Pin	Connection X1
1	3. In
2	+24V
3	GND
4	An In
5	AGND
6	Fault
7	RS-232 RxD / CAN-L
8	RS-232 TxD / CAN-H

Pin	Connection X2
1	3. In
2	+24V
3	GND
4	An In
5	AGND
6	Fault
7	RS-232 RxD / CAN-L
8	RS-232 TxD / CAN-H
9	n.c.
10	n.c.

at RS232 operation [1]

Pin	Connection X3
2	RS-232 / RxD
3	RS-232 / TxD
5	GND

at CAN operation [1]

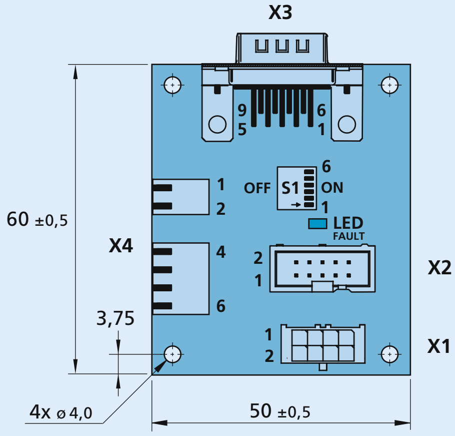
Pin	Connection X3
2	CAN_L
3	GND
7	CAN_H

Pin	Connection X4
1	+24V
2	GND
3	An In
4	AGND
5	Fault
6	3. In

LED	Status
(illuminated)	LED illuminates no error fault output switched to GND
(not illuminated)	LED does not illuminate error fault output high-impedance

Dimensional drawing and connection information

Scale reduced



6501.00113

Connection

Nr.	Function
X1, X2	Motor connector
X3	RS232 / CAN
X4	Supply connector; I/O

Nr.	Switch
S1	DIP-switch (6 switches)

Accessories

Adapter board MCxx 3002

For combination with
Motion Controller:
MCDC 3002 S / F, MCBL 3002 S / F, MCLM 3002 S / F

Part No.: 6501.00121

	6501.00121	
Temperature range:		
– Operating temperature	– 10 ... + 65	°C
Dimension and Weight:		
– Dimension (L x B x H)	47,5 x 31,5 x 15	mm
– Weight	21	g

Note: All switches are in the "OFF" position in the as-delivered condition. These switches must be set accordingly depending on the application.

General information

The adapter board is used to connect and for the parameter set-up of Motion Controller series MCxx 3002 S / F with serial RS232 or CAN interface.

The different operating modes can be selected using the 6 DIP switches. A Motion Controller can be connected to each adapter board.

Description of DIP switch (S1) settings

1: Fault	ON	Pull-up resistor with LED connected to adapter board.
	OFF	Open collector
2: Term	ON	120 Ω terminating resistor for the final node in the CAN network connected to the adapter board.
	OFF	Terminating resistor not connected
3: CAN [1]	ON	Operation with CAN interface
	OFF	Deactivated
4: RS232 [1]	ON	Operation with RS232 interface
	OFF	Deactivated
5: NETMODE	ON	Pull-down resistor (2,2 kΩ) for RS232 wiring connected. This may only be connected to a node in the RS232 network.
	OFF	Deactivated
6: AGND	ON	AGND and GND interconnected.
	OFF	AGND and GND disconnected (with separate ground).

Connection

at RS232 operation [1]

Pin	Connection X1
2	RS-232 / RxD
3	RS-232 / TxD
5	GND

at CAN operation [1]

Pin	Connection X1
2	CAN_L
3	GND
7	CAN_H

Pin	Connection X2 / X3
1	+24V
2	GND
3	An In
4	AGND
5	Fault
6	3. In

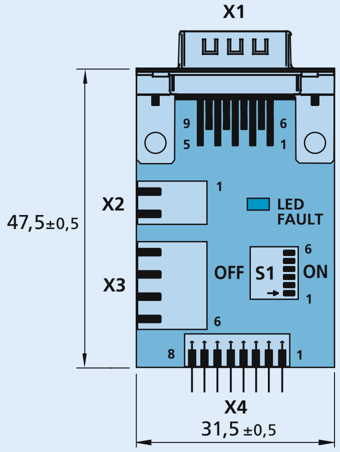
Pin	Connection X4
1	RS232 TxD / CAN-H
2	RS232 RxD / CAN-L
3	AGND
4	Fault
5	AnIn
6	U_b
7	GND
8	3. In

LED	Status
LED illuminates	no error fault output switched to GND
LED does not illuminate	error fault output high-impedance

[1] The pin assignments of X1 depend on the position of switches 3 and 4 of DIP switch S1.

Dimensional drawing and connection information

Scale reduced



6501.00121

Connection

Nr.	Function
X1,	RS232 / CAN
X2 / X3	Supply connector; I/O
X4	Controller connector

Nr.	Switch
S1	DIP-switch (6 switches)

NEW

FAULHABER

Accessories

Braking chopper

For combination with
Speed Controller
Motion Controller

Series BC 5004

		BC 5004	
Power supply		16 ... 50	V
Switching threshold	V_{th}	28 / 56	V
Max. continuous power losses [1]	P_{cont}	10	W
Max. peak current [1]		10	A
Total standby current, max.		20	mA
Temperature range:			
– Operating temperature		-25 … +60	°C
– Storage temperature		-25 … +85	°C
– Dimensions (L x W x H)		65 x 58 x 22	mm
– Weight		160	g

[1] at 22°C ambient temperature

General information

The function of the braking chopper BC 5004 is to limit the supply voltage of 4 quadrant controllers and other ancillary devices such as programming adapters. When braking the drive, a voltage is generated and these controllers can feed this voltage back into the power supply.

Typical power supplies do not have the ability to absorb this energy and this can lead to an overvoltage and damage to the power supply. The braking chopper limits this voltage to an allowable level. The resulting energy losses are converted into heat by the braking resistors. In this way, damage to the power supply and other devices can be prevented.

The braking chopper can be used with 24V and 48V power supplies. The voltage limit can be adjusted using the jumper included with the braking chopper.

Description of jumper setting:

Mode 24V — Jumper between IN 1 and IN 2 installed for 24V power supply, switching threshold V_{th} 28V

Mode 48V — Jumper between IN 1 and IN 2 **not** installed for 48V power supply, switching threshold V_{th} 56V

Status description:

The LED’s indicate the status of the braking chopper.

LED A (green), LED B (red)

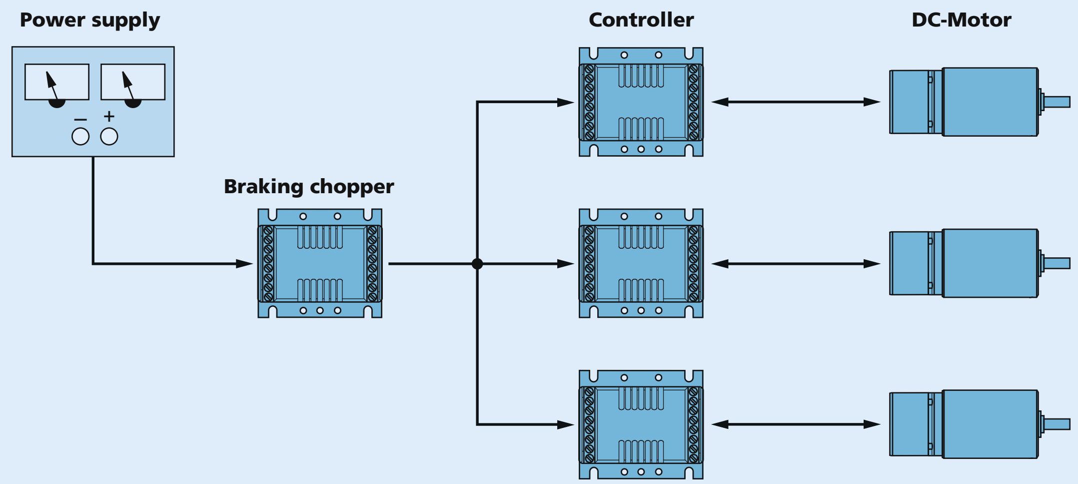
	LED A	LED B	LED A	LED B
Mode	24V		48V	
Not active	On	Off	On	On
Active	Blinking	Off	Blinking	On
Error	On	Blinking	On	Blinking

"Not active" — Switching threshold not reached

"Active" — Switching threshold exceeded; braking chopper limitation on

"Error" — Overload; braking chopper limitation off

Connection diagram



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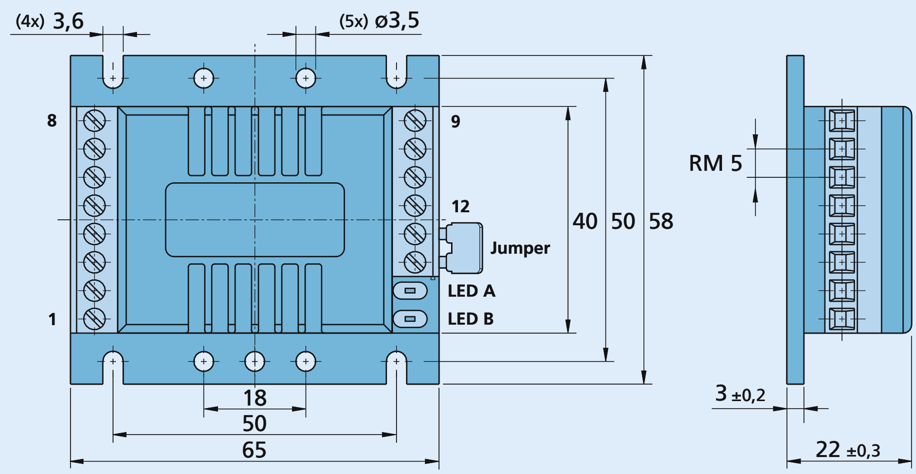


BC 5004

Connection

No.	Function
1	GND
2	GND
3	GND
4	GND
5	U_{mot}
6	U_{mot}
7	U_{mot}
8	U_{mot}
9	U_{mot}
10	U_{mot}
11	GND
12	GND
13	IN 1
14	IN 2

Brakes

Electromagnetically Released System

For combination with
DC-Micromotors:
2342, 2642, 2657, 3242, 3257, 3557, 3863
Brushless DC-Servomotors:
2444, 3056, 3564, 4490

Series MBZ

	MBZ	12 V	22 V	24 V	
Nominal coil data at 20°C					
Supply voltage (DC) ±10%	U_N	12	22	24	Volt
Resistance	R	24	81	96	Ω
Current	I	0,50	0,27	0,25	A
Power	$P_{2\ max.}$	6	6	6	W
Mechanical response times [1]					
Coupling time		13			ms
Disconnection time		27			ms
Static torque rating [2]		400			mNm
Moment of inertia		10			gcm²
Max. permissible speed		16 000			rpm
Temperature range: [3]					
Operating temperature		– 5…+120			°C
Storage temperature		–25…+120			°C
Weight		50			g

[1] Depending on the requirements, a Switch-off voltage-limitation function can be applied using an anti-parallel diode, varistor or other. However, this will influence the brake switching time.
[2] Under dry operation conditions, absolutely oil-free.
[3] Non condensing atmosphere.

Features

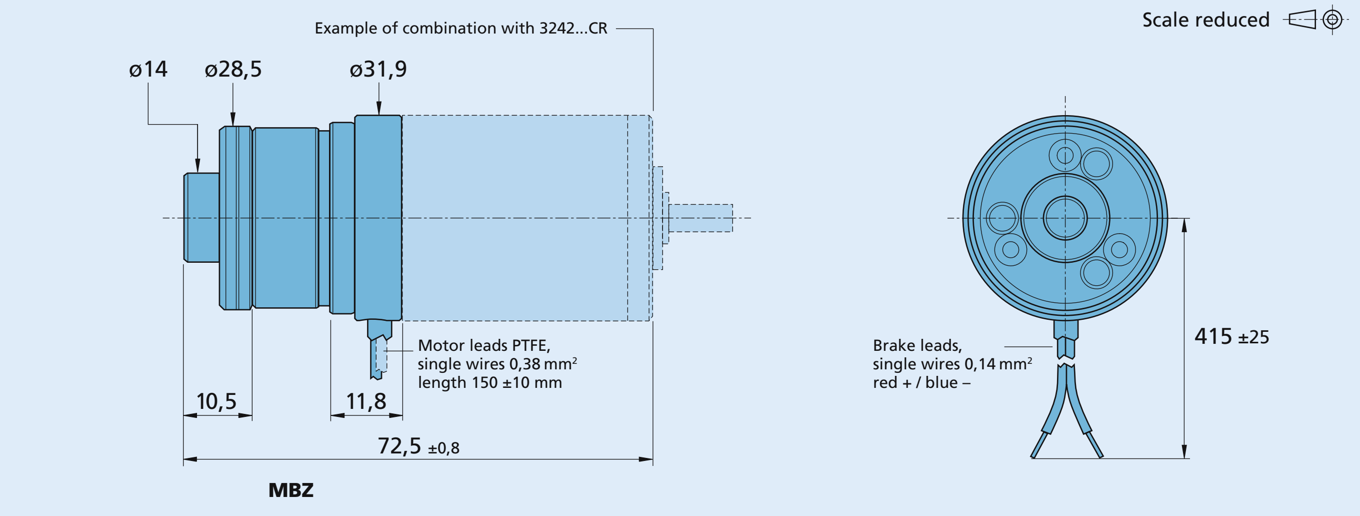
The brakes are designed as DC operated permanentmagnet single-surface brakes characterised by the fact that the braking effect is produced by a permanentmagnetic field (electromagnetically released system). This means that the required braking force is generated when voltage is removed.

In order to neutralise the braking effect, the permanentmagnetic field is counteracted by an opposing electromagnetic field.

The brakes are intended only for use as holding brakes (unsuitable for braking rotating motor shaft).

Full product description

- Examples:
  3242G024CR MBZ22V



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