Nanotec®
PLUG & DRIVE

# PRODUCT CATALOG

Linear actuators from 20 mm to 56 mm, up to 1000 N feed and 0.005 resolution

Optical miniature encoder NOE1, 3-channel, up to 2000 pulses/rev., 20 mm diameter

Controller SMCI36, 6A/24-72 V, fully programmable, for BLDC and stepper motors, dspDrive®, Closed Loop, CANopen

www.nanotec.com


# Contents

## The company

Nanotec Electronic GmbH & Co. KG has been a valued partner in the implementation of drive systems since 1991. These 20 years of experience are reflected in our products. Our motors and controllers are available in a wide range of options and provide the optimum solution for virtually all drive tasks.

With ingenious designs, observation of narrow production tolerances and strict quality control at all process stages, we ensure high quality and long-lasting drives. Innovative new developments take into account the demand for energy-efficient, compact and precisely positionable stepper and BLDC motors. Advanced software technologies provide platform-independence and guarantee easy integration of our motors and control systems. A strong focus on research & development guarantees products that will continue to meet our customers' needs in the future.

Certification to the latest ISO 9001:2008 standard by the TÜV Management Service, in addition to conformity with standards and regulations, is testament to the consistent customer orientation of our processes as well as our efforts to achieve continuous improvement of internal and external workflows.


ZERTIFIKAT

Die Zertifizierungsstelle der TÜV SÜD Management Service GmbH bescheinigt, dass das Unternehmen

Nanotec Electronic GmbH & Co. KG
Kapellenstraße 6
D-85622 Feldkirchen

für den Geltungsbereich

Entwicklung, Produktion und Vertrieb von elektrischen Antriebskomponenten

ein Qualitätsmanagementsystem eingeführt hat und anwendet.
Durch ein Audit, Bericht-Nr. 70068386 wurde der Nachweis erbracht, dass die Forderungen der

ISO 9001:2008

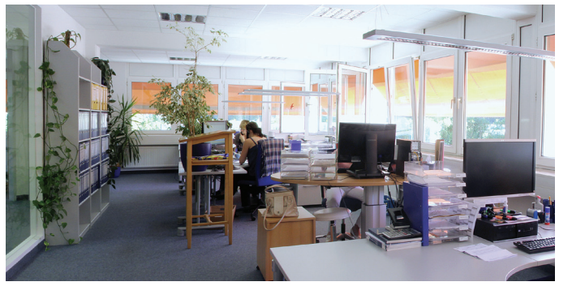
erfüllt sind. Dieses Zertifikat ist gültig bis 2013-06-29
Zertifikat-Registrier-Nr. 12 100 22636 TMS

München, 2011-07-25

TÜV SÜD Management Service GmbH • Zertifizierungsstelle • Ridlerstraße 65 • 80339 München • Germany

## Our vision: quality, innovation, reliability – und individuality

The requirements placed on a drive solution are many and varied. Only rarely can a standard motor or power electronics be used "out of the box" without any additional modifications to achieve the optimal result. This is precisely why we offer customized versions of our motors at relatively small order volumes. Our engineers develop the optimal mechanical and electrical design of a customized solution on request. Thanks to assembly at our production sites in Germany, and a comprehensive range of components kept in stock, we are able to respond quickly and flexibly to customer requirements.





## Worldwide sales network


Nanotec products are available both directly from us and via a worldwide network of sales partners.
A current list of our sales partners can be found at http://en.nanotec.com/nanotec_kontakt.html

## Our complete range of products can be found on the Internet at: www.nanotec.com

Our complete range of products can be found online, and a selection of these products is provided here.

- Minimum order quantities up to 25 units can be ordered directly via our website
- Diagrams drawn to scale are available as PDF, DWG, DXF or 3D – with no registration or long-winded searching – directly on the product page
- Torque characteristics of all motors for different operating voltages and controls
- Selection tool: Our stepper motor wizard will help you to find the right motor quickly
- Product configurator: The corresponding controllers and other options such as encoders, gears, safety brakes, etc. are displayed straight away. There is no time-consuming searching through different information to find the products that go together

## Low-cost products thanks to high-end production in China

Series production of our drives is carried out by our subsidiary company Nanotec ChangZhou in China, and by a joint venture company also located there. Thanks to our 20 years of experience in motor production in Asia, we place the greatest emphasis on quality assurance. Since 2008, we test samples of mechanical components on a Zeiss 3D coordinate measuring machine. For the final inspection of motors, at many stages we use testing equipment developed inhouse, e.g. for testing counter-electromotive force or the axial play of the motors. High quality factory equipment and in-depth staff training results in stable processes and a high vertical range of manufacture.

## Standard and custom solutions for optimum drive solutions

Whether as standard or individual solutions, Nanotec provides the optimum drive for applications that require maximum precision, reliability and functionality with a very small space requirement. Our motors and controls let you build on compliance with tight manufacturing tolerances and strict quality control in all processing steps. Virtually all automation tasks can be managed quickly, easily and efficiently with our universally deployable powerful motors and controls.

Customer-specific shaft, flange and connector versions provide the constructor and assembly team with an easy, fast and reliable electric connection to the machine. Speed-adapted windings optimize the working point and running performance.

Thanks to many years of experience in the design of stepper motor controls, Nanotec also offers its customers the complete development of control electronics to the latest standards for optimum integration in any existing machine concept.
Nanotec has implemented the very latest technological standards in the controls of the SMCI series as described in detail on the next pages. The customer can benefit from this extensive know-how and obtain an economic and future-oriented stepper motor drive. New functions in particular such as dspDrive® yield a considerable advance in stepper motors in terms of performance and resonance response.

The figures shown above present several examples of custom stepper motor controllers that we can offer our customers at a favorable price. An overview of the entire range and variety of product variants of our compact drives and the diverse customer-specific versions is available at www.nanotec.com

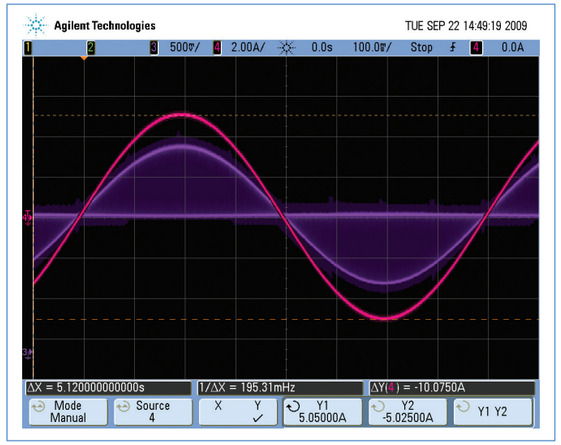


## New functions in our intelligent stepper motor controllers and Plug & Drive motors

### *dsp***Drive**® – software-based current control with high resolution in the open loop

The current in the motor of the latest generation of Nanotec hardware is no longer controlled by an integrated component, it is controlled directly by a digital signal processor. Unlike conventional ICs that resolve the winding current measurement and the target current value with only 6 or 8 bits, the new dspDrive carries out the entire control with a resolution of 12 bits. The PI controller parameters are adjusted according to the speed.
This has the following application advantages:

- Very smooth, low-resonance operation with a sinusoidal current in the windings. The high resolution of the control loop means no more degradations and noise, that cause the motor to resonate.



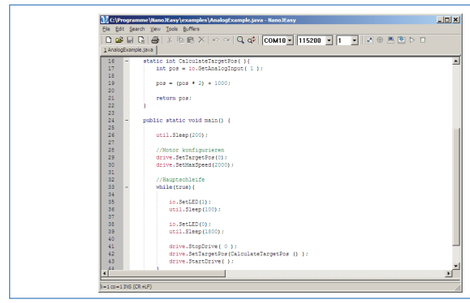

- Still more flexible: Direct control of the half-bridge with the DSP means that, in addition to 2-phase stepper motors, 3-phase stepper motors and BLDC motors can now also be controlled as well.

### Sinusoidal commutation with encoder in **ClosedLoop** operation

In contrast to conventional stepper motor positioning controls where only the motor is actuated or the position adjusted via the encoder, sinusoidal commutation controls the stator magnetic field via the rotary encoder as in a servomotor. In this mode the stepper motor behaves just like a high-pole servomotor, i.e. the conventional stepper motor noises and resonances disappear; up to its maximum torque the motor can no longer lose steps. This regulation always adjusts the level of the current to the torque currently required so that current consumption and heat generation are considerably reduced compared with a conventional stepper motor controller when the maximum torque is not permanently required.
Especially with speeds up to 1500 rpm or torques up to 10 Nm, the sinus commutated stepper motor presents an economic alternative to conventional servosystems as, in contrast to these, a direct drive without gears is often possible.

### Application programs with **Nano***J*

The integrated NanoJ programming language, based on the Java standard, means complete application programs can be realized on the controllers that can be executed independently without a higher-order controller. The polling and setting of digital and analog I/Os and access to all the parameters of the movement programs in connection with variables, loops, mathematical functions and everything else that distinguishes a fully functional high-level language makes a full control system out of the stepper motor controller. The programs can be created, compiled directly and written to the controller with the free NanoJEasy editor.

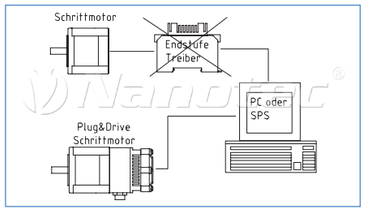


### Interpolated mode for **CAN**open

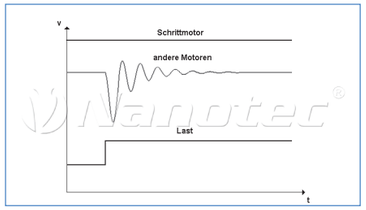
Until now, the Positioning, Velocity and Homing modes could be used with our controllers according to standard DS 402 via the CANopen interface, 6 wide input range 5-24 V inputs and the additional output for a holding brake. The Interpolated Mode now also makes it possible to drive Nanotec stepper motor controls directly via path controls with CANOpen interface. Thus, a ready-to-use driver is available for the CoDeSys V3 SoftMotion soft PLC, for example, which makes the controller easy to integrate.

## Benefits in application of stepper motors

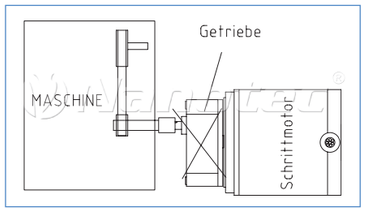
Stepper motors are digitally controlled and regulated drives that have achieved the highest level of acceptance and prevalence since the technology transition (from analog to digital technology and current software solutions) due to favorable prices with maximum service life and little control required.



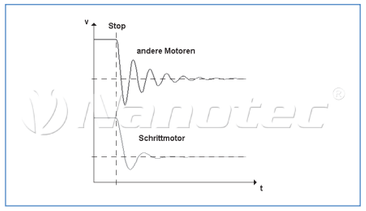

**a) PC+PLC-capable** (directly controllable via PC, PLC and microprocessor)
The use of the PC at the lowest, decentralized machine levels has given the Plug & Drive motors the maximum level of productivity. Nanotec was the first supplier worldwide to fulfill the requirement for a compact, efficient and cost-effective drive system with an industrial Plug & Drive motor. Not only have the development, wiring and assembly costs of a complete drive unit been drastically reduced, the EMC compatibility and machine availability have been improved, and the commissioning and service also considerably simplified. Continuous further development of the options for customer-specific requirements allow new and close partnerships to grow constantly to the advantage of a better and more economical end product.



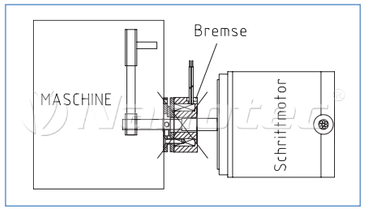

**b) Turning speed stability**
"No drop in speed when the load fluctuates": The stepper motor fulfills this requirement like no other motor at no extra cost. Particularly for precise closed-loop speed, synchronization or ratio controls (e.g. in precision dispensing pumps), the stepper motor can reach higher and finer resolutions thanks to digital processing. The improvement in control, process and surface quality is not only a theoretical advantage.



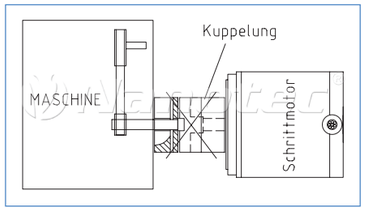

**c) Direct drive**
Stepper motors have maximum torque in the lower speed range and the Nanotec microstep drives enable still acceptable concentricity properties up to approx. 2 rpm. Other motors often need gears for this purpose in order to fulfill the requested speed and force requirements. Direct drives reduce system costs and, at the same time, increase operational reliability and life expectancy. Naturally, if the space available is limited or the external moments of inertia are high, gears are essential for power and force adjustment.




**d) Positioning accuracy**
As well as minimum coastdown, stepper motors also have a minimum transient response because of the narrow step angle. Even without external linear or angular encoders, stepper motors are excellent at fulfilling speed and positioning tasks. The microstep changeover of the Nanotec drivers can, in fact, further increase the accuracy or resolution at no extra cost. All Nanotec stepper motors are also available with competitively priced encoders for detecting any blockages and for closed-loop applications.




**e) High stiffness without brake**
Stepper motors have the maximum holding torque at a standstill and thus also offer high system rigidity. Because of this property, no external braking mechanism is necessary unless safety braking is required for the Z axis.




**f) Avoiding damage to machines and injuries**
The disadvantage sometimes referred to as the "loss of sync." if a motor is blocked can even be an advantage in some cases with regard to constantly increasing safety requirements. Sliding clutches and overload clutches in order to meet prescribed safety requirements are not normally necessary in association with stepper motors.



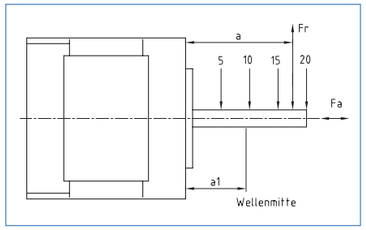
## Reliability

All Nanotec motors are brushless, have high-grade ball bearings in the front and rear bearing shells, and achieve an expected service life of more than 20,000 hours of operation under admissible operating conditions. The information on the service life is based on the test results of reputable ball bearing manufacturers as well as our own trials. The calculated L10h values are purely theoretical values for optimum operating conditions and are not subject to any claims under guarantee.

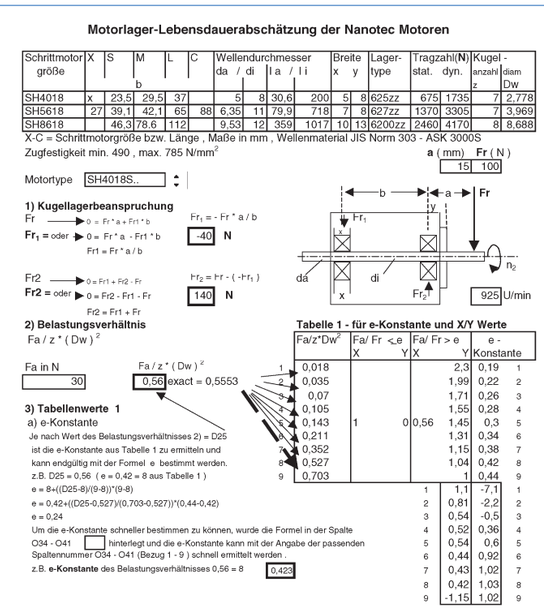
**a) Max. admissible axial and radial forces (Fa and Fr)**

| Forces in N | Radial forces (Fr) | | | | Axial forces (Fa) |
|---|---|---|---|---|---|
| **Distance a (in mm)** | **5** | **10** | **15** | **20** | |
| ST20; DB22<br>Shafts ∅ 4.00 mm | 30 | 18 | 14 | 8 | 4 |
| ST28; ST41; ST42; DB42<br>Shafts ∅ 5.00 mm | 58 | 36 | 26 | 20 | 7 |
| ST57; ST59; DB57<br>Shafts ∅ 6.35 mm | 130 | 90 | 70 | 52 | 10 |
| ST57; ST59; ST60<br>Shafts ∅ 8.00 mm | 163 | 112 | 85 | 63 | 14 |
| ST89; DB87<br>Shafts ∅ 14.0 mm | 535 | 355 | 265 | 200 | 25 |
| ST110<br>Shafts ∅ 19.05 mm | 640 | 425 | 320 | 240 | 80 |

| Type | Fr (distance a1) (in mm) | Fa (in N) |
|---|---|---|
| SP06-SP08 | 1.0 | 0.5 |
| SP10-SP20 | 2.0 | 1.0 |
| SP25-SP35 | 3.0 | 1.5 |
| SP42-SP55 | 5.0 | 2.0 |




**b) Reduction of the average expected service life**




Negative influences on the average expected service life L10 specified by Nanotec are:

- Intermittent load
- Excessive radial and axial loads
- Vibration and oscillation, very high cycl. acceleration
- Inaccurate angular and centering alignment
- Ambient conditions such as dust, humidity, corrosive gases, etc.
- at an increased operating temperature (over approx. +70 °C, the service lifetime is halved per ~ +15 °C due to the shortened lubrication periods)

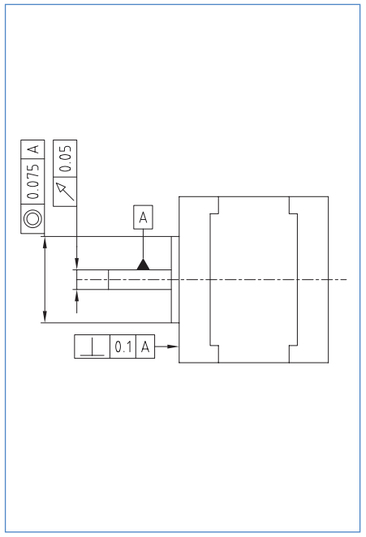
If there are an extremely high number of oscillating movements within an angle of 360°, suitably adapted greasing and lubricant fillings may be necessary under certain conditions. Custom motors with ball bearings of this type are available on request.

**c) Machining of the motor shaft!**

At unduly high radial forces or external blows, the inner shaft becomes bent and the rotor can come into contact with the stator. This can lead to damage of the rotor or stator causing microscopic particles to accumulate in the air gap and resulting in noise and blockages.
Also, in the **mechanical finishing of the motor shafts,** in addition to the maximum deflection, attention must be paid especially to the **necessary sealing,** so that no microparticles can get into the engine compartment through the thrust ball bearings despite the strong magnetic attraction of the rotor.

## Common specifications of the ST... types and DB motors

| | Motor size | 20 (28) | 41 (42) | 59 (57.60) | 89 | 110 |
|---|---|---|---|---|---|---|
| Concentricity: | ↗ | 0.05 mm | 0.05 mm | 0.05 mm | 0.1 mm | 0.05 mm |
| Parallelism: | ⊥ | 0.1 mm | 0.1 mm | 0.1 mm | 0.075 mm | 0.076 mm |
| Concentricity: | ◎ | 0.075 mm | 0.075 mm | 0.08 mm | 0.075 mm | 0.075 mm |




Radial play of the shaft: Max. 0.025 mm (at a radial load of 5N)

Axial play of the shaft: Max. 0.075 mm (at an axial load of 10N)

Step angle precision:(SH,ST) at full step ± 5% non cumulative (no load)

Insulation resistance: 100 MOhm at normal ambient temp. and ambient humidity, measured between the winding and motor housing

Dielectric strength: 0.5kV at 50Hz for min. 1 minute

Insulation class: Class B (130 °C)

Temperature increase: 80 °C or less determined by measuring the change in resistance after the nominal voltage has been applied to the blocked stepper motor

Operating temperature range: -10 C to +50 °C

Storage temperature: -20 C to +70 °C

Ambient humidity (working area): 20% to 90% non-condensing (free of corrosion)

Ambient humidity (storage area): 8% to 95% non-condensing (free of corrosion)

## Construction, protection classes and safety considerations

**a) General construction**

Practically all stepper motors are manufactured in accordance with ISO 9001 and, when used as designated, they comply with the safety requirements contained in the relevant standards and regulations. The motors have a closed construction (protection class IP 20) with a through opening provided with a small bushing for the cords. The bearing plates are made of die-cast aluminum and carefully connected by means of a centering ring and rotor rings. Ball bearings lubricated for the whole of their service life are chosen and their machining and smooth running is checked. The metal plates of the stands between the die-cast rings are connected by means of rivets or screws at all corners.

**b) Protection classes (acc. to DIN 40050 Aug. 1970)**

Nanotec also offers stepper motors suitable for tough environmental conditions.

**Protection classes**

**Ident characters IP 5 4**

First number

Second number

| First number | Protection against contact and foreign bodies |
|---|---|
| 0 | No protection |
| 1 | Protection against large foreign bodies (greater than 50 mm ∅) |
| 2 | Protection against medium-size foreign bodies (greater than 12.5 mm ∅) |
| 3 | Protection against small foreign bodies (greater than 2.5mm ∅) |
| 4 | Protection against granular foreign bodies (greater than 1 mm ∅) |
| 5 | Protection against heavy dust deposits |
| 6 | Protection against penetration of dust |

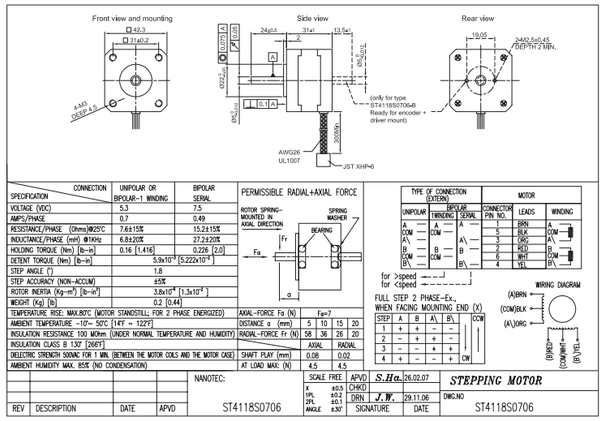
| Second number | Protection against water |
|---|---|
| 0 | No protection |
| 1 | Protection against vertically dripping water |
| 2 | Protection against dripping water falling at an angle (up to 15° C to the ↑) |
| 3 | Protection against spray water (up to 60° C to the vertical ↑) |
| 4 | Protection against spray water (from all directions) |
| 5 | Protection against hose water (12 l/min; min 0.3 bar) |
| 6 | Protection against powerful hose water (100 l/min; p~1 bar) |
| 7 | Protection against sporadic immersion |
| 8 | Protection against submersion |

**c) Safety instructions**

As with any form of concentrated energy, the use of electric motors is associated with possible dangers. The level of danger can be considerably reduced by suitable constructive realization, the correct selection, proper installation and well thought-out application. In terms of the load and ambient conditions, the user must pay attention to correct installation and application of the devices. Therefore, it is of utmost importance that the end user observes all electrical, thermal and mechanical safety instructions.



## CAD library




The CAD and PDF formats from Nanotec allow you to integrate the following product drawings quickly and efficiently in your construction:

- Stepper motors + BLDC motors (also in protection class IP 54 and IP 65)
- Stepper motors + brushless DC motorsin special versions (with junction box or plug&socket connection)
- Stepper motor + DC motor with attachment (encoder, brake)
- Stepper motor and servomotor with gear (spur, screw and planetary gears)
- Plug & Drive stepper motors
- Controls for internal integration or on top hat rails (microstep controller and motor controllers)

Many articles are available online in PDF, DXF or DWG format at www.nanotec.de
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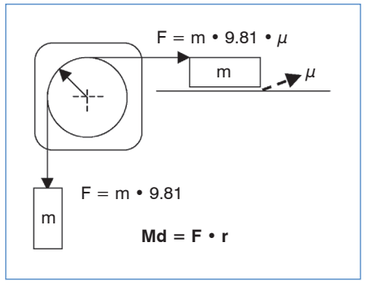
## Performance calculation and appropriate motor selection

The necessary power capacity and size of the motor depends primarily on the external mass movements and their frictional conditions.

**1) Friction force or moment of friction**

a) Linear : F = m • g • $\mu$
The **friction F** (N) is determined primarily by the mass = **m** (weight kg) and the friction coefficient = $\mu$.

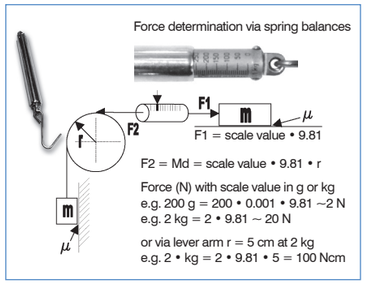
b) Rotation : Md = F • r
The **torque Md** (Ncm) is determined by the **friction F** (N) and the **lever arm r** (cm) (depending on the Angriffspunkt and distance to the force action line).




**2) Acceleration torque**
Due to the law of inertia, the force or torque is greater the faster the mass is accelerated:

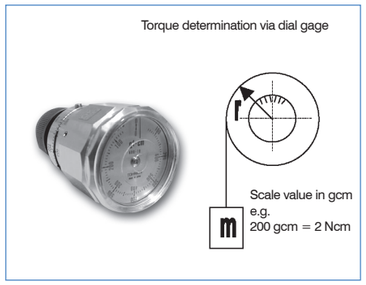
a) Linear : F = m • a
(a = $v_e$ - $v_a$/t)
$v_e$ = end speed, $v_a$ = starting speed

b) Rotation: Md = J • a
(J= pol. moment of inertia, e.g. full cyl. m • $r^2$)
(a = $n_e$ - $n_a$/t)
$n_e$ = end speed, $n_a$ = starting speed




**3) Power rating**
$P_2$ = Md • 6.28 • f / z (Md = torque from the motor curve, f = step frequency in Hz, z = steps/rotation)

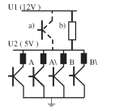
**4) Simple torque determination**
Apart from the mathematical determination, the determination of force and torque by means of spring balance and torque gage is especially advantageous because it takes into account the difficult-to-determine friction factor.



## Controllers and switching features

Practically all stepper motors can be delivered with 4, 6 and 8 power supply cords/leads where 4 leads are suitable for bipolar operation only, 6 leads for unipolar and somewhat restricted bipolar operation, and 8 leads for unipolar and bipolar operation. With only 4 switches, unipolar operation is very easy but is used less often nowadays because of highly-integrated constant current bipolar controller ICs available with a torque that is approx. 30% higher. Also constant voltage operation seldom appears on the market due to its high power loss.

### Unipolar connection




e.g. Constant voltage operation

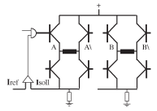
a) Bilevel

b) Series resistor

**Unipolar switching sequences**

| Mode | | winding | | | |
|---|---|---|---|---|---|
| 1/1 | 1/2 | A | A\ | B | B\ |
| 1 | 1 | + | 0 | 0 | + |
| | 2 | + | 0 | 0 | 0 |
| 2 | 3 | + | 0 | + | 0 |
| | 4 | 0 | 0 | + | 0 |
| 3 | 5 | 0 | + | + | 0 |
| | 6 | 0 | + | 0 | 0 |
| 4 | 7 | 0 | + | 0 | + |
| | 8 | 0 | 0 | 0 | + |
| 1 | 1 | + | 0 | 0 | + |

### Bipolar switching sequences




e.g. constantcurrent operation

**Unipolar switching sequences**

| Mode | | winding | |
|---|---|---|---|
| 1/1 | 1/2 | A | B |
| 1 | 1 | + | + |
| | 2 | + | 0 |
| 2 | 3 | + | - |
| | 4 | 0 | - |
| 3 | 5 | - | - |
| | 6 | - | 0 |
| 4 | 7 | - | + |
| | 8 | 0 | + |
| 1 | 1 | + | + |

### Stepper motor animation


Stepper motor animation at www.nanotec.de,

**Connection arrangement of stepper motors**
The stepper motors offered by Nanotec can be operated in different switching modes that give the motor different characteristics in each case. The 4-lead version is already wired up internally so there is only one connection possibility here. Motors with 6 leads can be operated with one half of the winding or serially, the version with 8 leads can be operated in all listed switching modes. We will only consider the bipolar control here, which is used almost exclusively today.

**1. One half of the winding:** Here only half of the windings of the motor are used, therefore the holding torque that can be achieved is also less than in the other modes. This mode only offers advantages in the high speed range of the 6-lead motors which is clearly apparent from the respective motor diagrams.

**2. Parallel:** The highest motor power is achieved in this mode. The low inductance keeps the torque of the motor constant, even at higher speeds, although a higher phase current is also required.

**3. Serial:** This mode is suited to the lower speed range where high torque is reached with low current. But due to the high inductance, the torque drops off quickly at higher speeds.

The values specified in the datasheet always refer to one half of the winding. The following table shows the rule for converting the individual parameters to serial and parallel switching mode. This function can also be listed online on the overview page of the individual stepper motor series (under Type, Control).

| Value | 1 winding half as in datasheet | Serial | Parallel |
|---|---|---|---|
| Resistance | R | 2 * R | R/2 |
| Inductance | L | 4 * L | L |
| Phase current | I | I/√2 | I * √2 |
| Holding torque | M | M * √2 | M * √2 |

The holding torque is reached at the respective nominal current. If the current deviates, the value can be calculated accordingly from the proportionality between the phase current and holding torque. Half the current (in the same connection), therefore, leads to half the holding torque.

! Attention: This correlation only applies for the holding torque and for the lower speed range (where the torque has not yet dropped), but not for the entire motor curve. At high speeds, the set current can no longer reach its maximum value because the switching operations on the winding are then too fast. This (real) current reduction leads to a drop in the motor curve with increasing speed.

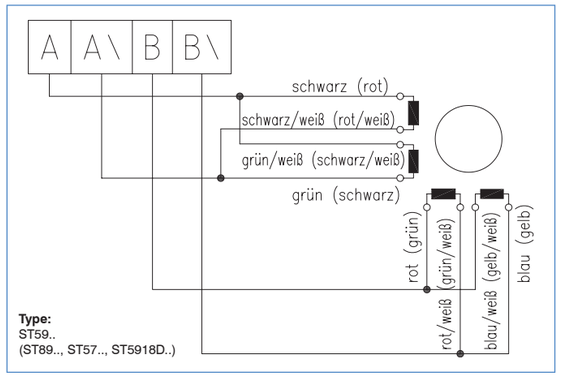
It is also possible to operate the motor briefly with higher current. Here, however, attention must be paid that the housing temperature does not exceed 80°. Depending on the motor, saturation is reached at 1.5 - 2 times the value of the nominal current, the torque then no longer increases.



## Motor connection: Nanotec stepper motors

8 leads - parallel for high frequency > 1 kHz

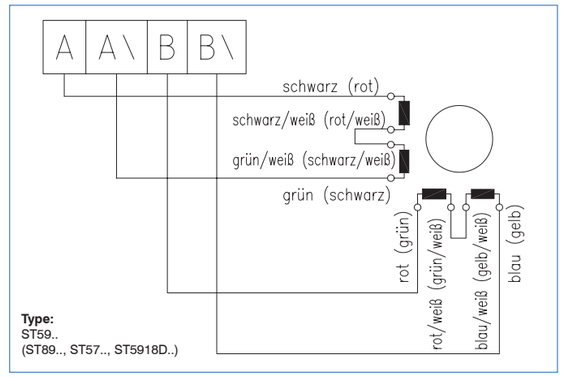
Current per winding x 1.4 = current per phase
**e.g.:** Current/winding 1 A = **1.4 A/phase**




**Type:**
ST59..
(ST89.., ST57.., ST5918D..)

8 leads - serial for low frequency < 1 kHz

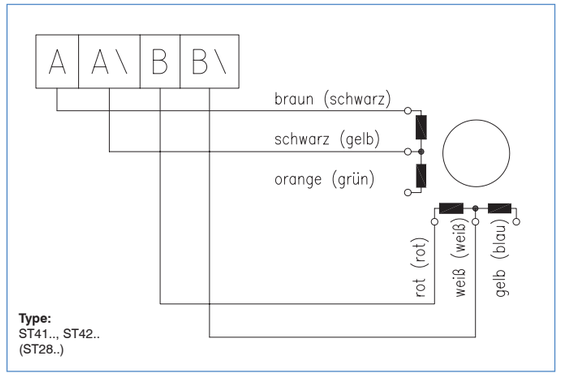
Current per winding x 0.7 **= current per phase**
**e.g.:** Current/winding 1 A = **0.7 A/phase**




**Type:**
ST59..
(ST89.., ST57.., ST5918D..)

**6 leads - 1 winding halves for high frequency >1 kHz**

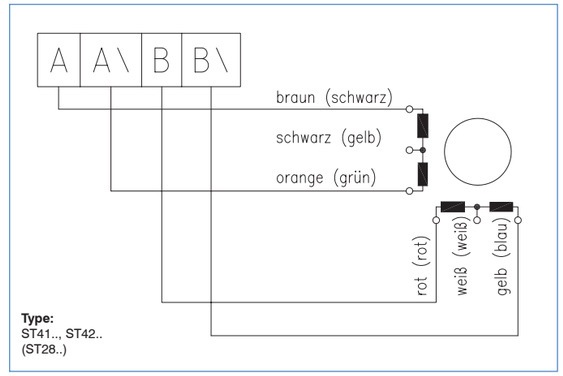
Current per winding = current per phase
**e.g.:** Current/winding 1 A = **1 A/phase**




**Type:**
ST41.., ST42..
(ST28..)

**6 leads - serial for lower frequency < 1 kHz**

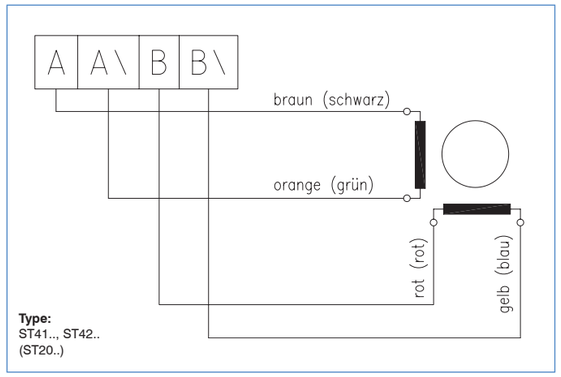
Current per winding x 0.7 = current per phase
**e.g.:** Current/winding 1 A = **0.7 A/phase**




**Type:**
ST41.., ST42..
(ST28..)

**4 leads**

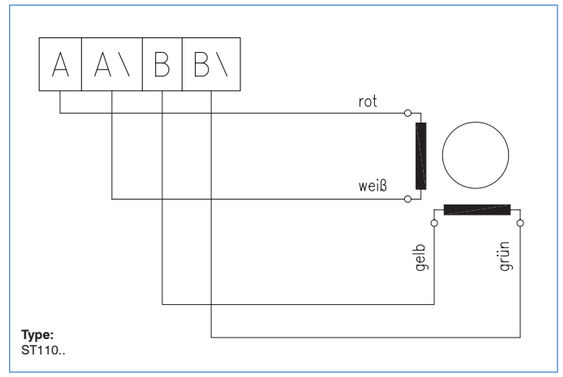
Current per winding = current per phase
**e.g.:** Current/winding 1 A = **1 A/phase**




**Type:**
ST41.., ST42..
(ST20..)

**4 leads**

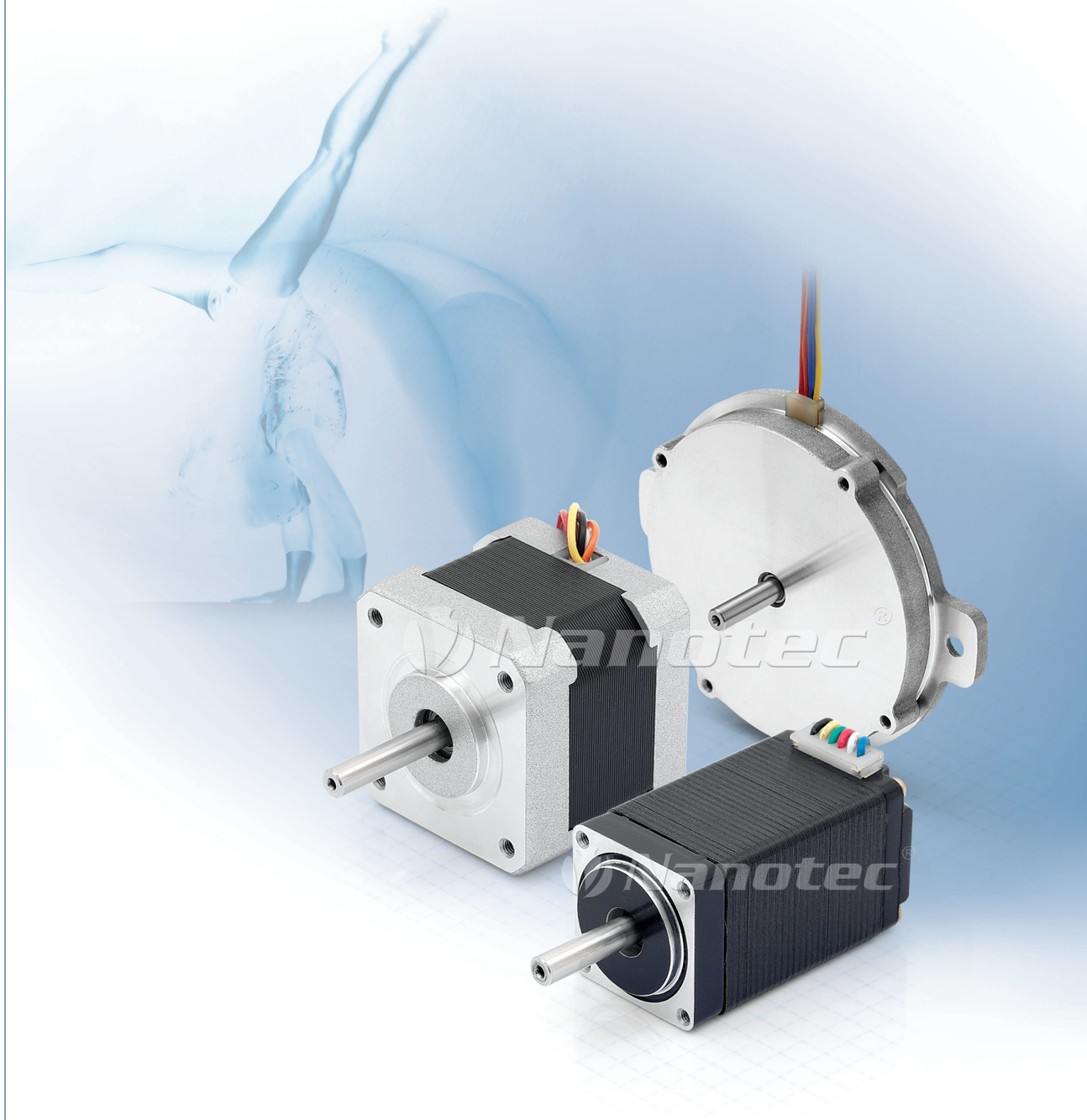
Current per winding = current per phase
**e.g.:** Current/winding 1 A = **1 A/phase**




**Type:**
ST110..

## Notes

# 2-phase stepper motors

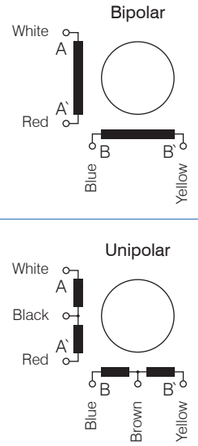


## Permanent magnet stepper motors, 7.5°-18°, types SP0618 - SP5575

### Option

Getriebe | Steuerung

### Pin configuration




**- with molded-on plug**
**- with high-quality plain bearings on both sides**

Thanks to the simple construction, SP permanent magnet motors are suitable for low-cost device applications where larger step angles suffice.
The SPG variants have an integrated gear with a reduction ratio from 50 or 102.

### Order identifier

**SP(G) 3575 S 0506 -(A)**

A = one shaft end

**Available versions (other version of winding, shaft and flange on request)**

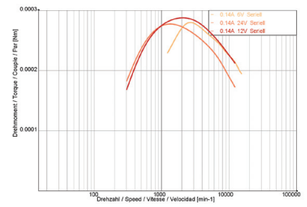
| Type | Step Resolution ° | Current per winding A/winding | Voltage per winding V/winding | Holding torque N cm | Resistance per winding Ohm/winding | Inductance per winding mH/winding | Rotor inertia torque g cm² | Weight kg | Dia meter (mm) |
|---|---|---|---|---|---|---|---|---|---|
| SP0618M0204 | 18° | 0.250 | 3.0 | 0.045 | 12.0 | 10.00 | 0.002 | 0.002 | 6 |
| SP0818M0204 | 18° | 0.238 | 5.0 | 0.059 | 21.0 | 1.37 | 0.002 | 0.003 | 8 |
| SP1018M0204 | 18° | 0.220 | 3.3 | 0.160 | 15.0 | 3.00 | 0.010 | 0.004 | 10 |
| SP1518M0104 | 18° | 0.065 | 12.0 | 0.320 | 190.0 | 37.00 | 1.000 | 0.012 | 15 |
| SP1518M0204 | 18° | 0.24 | 12.0 | 0.350 | 50.0 | 9.00 | 1.000 | 0.012 | 15 |
| SPG1518M0504-50 | 0.36° | 0.50 | 5.0 | 13.500 | 10.0 | 2.30 | 1.000 | 0.012 | 15 |
| SPG1518M0504-102 | 0.176° | 0.50 | 5.0 | 20.000 | 10.0 | 2.30 | 1.000 | 0.012 | 15 |
| SP2018M0506 | 18° | 0.500 | 5.0 | 0.500 | 10.0 | 1.85 | 1.000 | 0.026 | 20 |
| SP2515M0406 | 15° | 0.430 | 5.0 | 1.000 | 11.5 | 2.30 | 1.000 | 0.036 | 25 |
| SP2575M0206 | 7.5° | 0.240 | 12.0 | 1.600 | 50.0 | 12.00 | 1.000 | 0.036 | 25 |
| SP2575M0506 | 7.5° | 0.500 | 5.0 | 1.400 | 10.0 | 2.00 | 1.000 | 0.036 | 25 |
| SP2575M0704 | 7.5° | 0.760 | 3.8 | 1.000 | 5.0 | 3.00 | 1.000 | 0.036 | 25 |
| SP3575S0506 | 7.5° | 0.500 | 5.0 | 4.000 | 10.0 | 3.80 | 5.000 | 0.090 | 35 |
| SP3575M0906 | 7.5° | 0.860 | 5.0 | 5.500 | 5.8 | 6.50 | 7.500 | 0.090 | 35 |
| SP4275S0606 | 7.5° | 0.590 | 5.0 | 5.000 | 8.6 | 4.50 | 9.600 | 0.110 | 42 |
| SP4275M0806 | 7.5° | 0.810 | 5.0 | 6.000 | 6.2 | 5.50 | 9.600 | 0.130 | 42 |
| SP5575M0106 | 7.5° | 0.120 | 12.0 | 15.000 | 100.0 | 107.00 | 12.500 | 0.270 | 57 |
| SP5575M0604 | 7.5° | 0.625 | 5.6 | 12.000 | 9.0 | 19.50 | 12.500 | 0.270 | 57 |

All data refer to 1 half of the winding or unipolar!

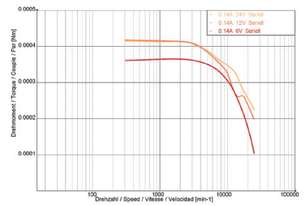


### Speed/torque curves

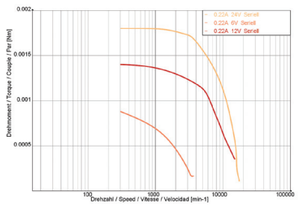
**SP0618M0204**



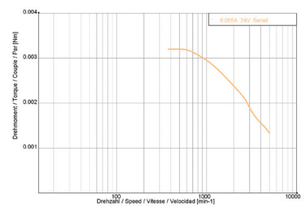

**SP0818M0204**



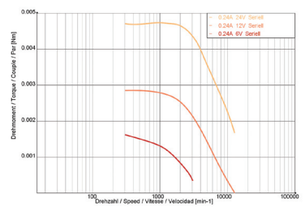

**SP1018M0204**



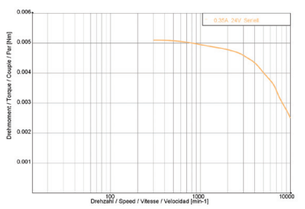

**SP1518M0104**



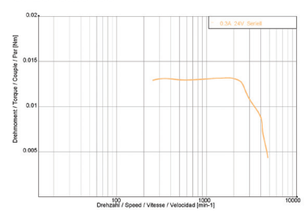

**SP1518M0204**



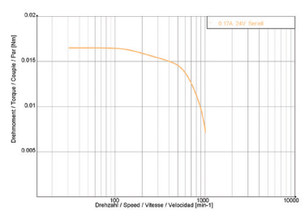

**SP2018M0506**



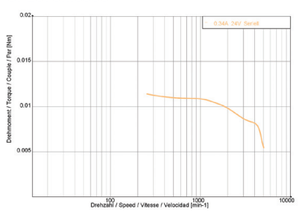

**SP2515M0406**



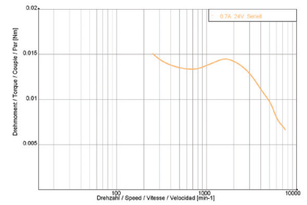

**SP2575M0206**



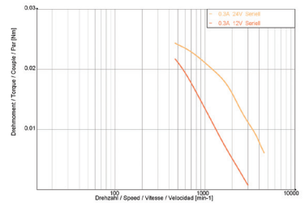

**SP2575M0506**



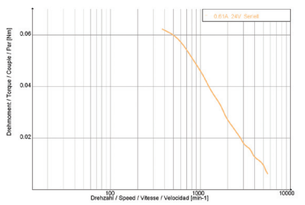

**SP2575M0704**



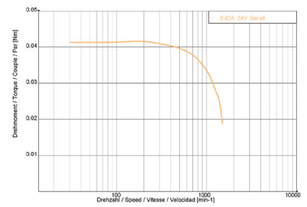

**SP3575S0506**



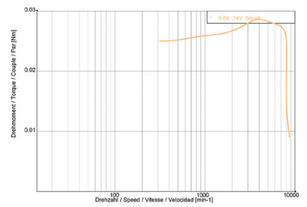

**SP3575M0906**



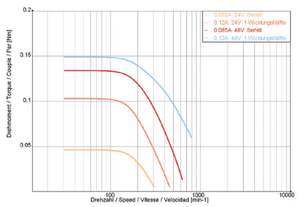

**SP4275S0606**



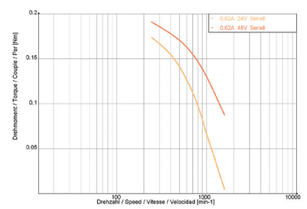

**SP4275M0806**




**SP5575M0106**

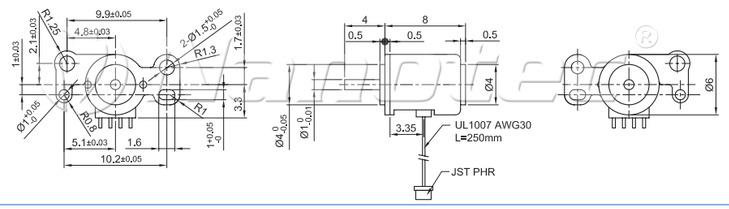



**SP5575M0604**

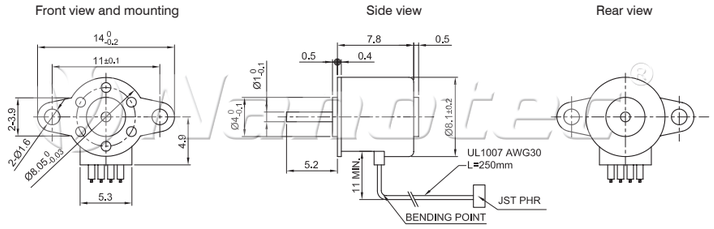


## Permanent magnet stepper motors, 7.5°-18°, types SP0618 - SP5575

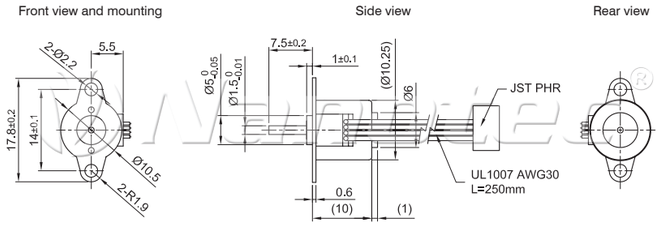
### SP0618M



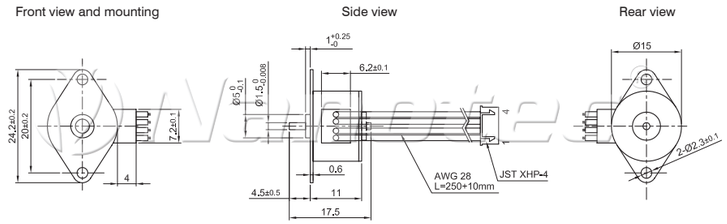

### SP0818M



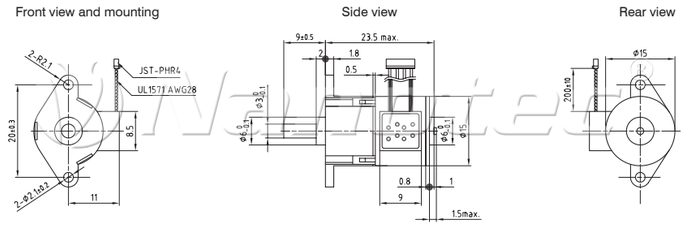

### SP1018M



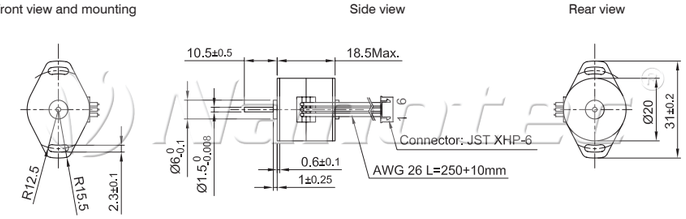

### SP1518M



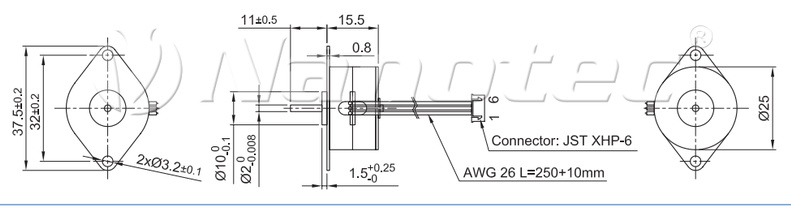

### SPG1518M



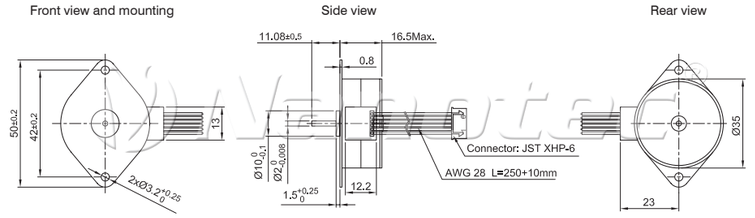

### SP2018M



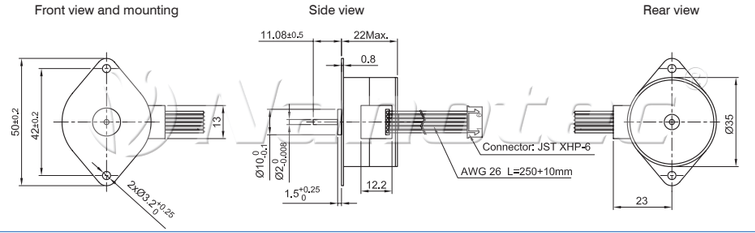

### SP2515M



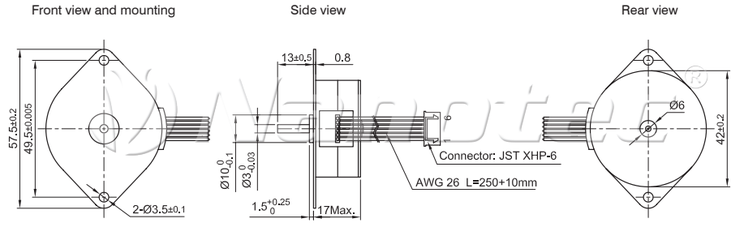

### SP3575S



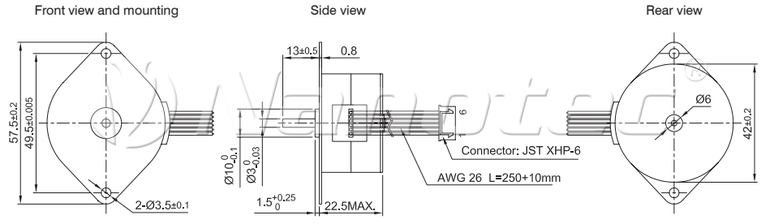

### SP3575M



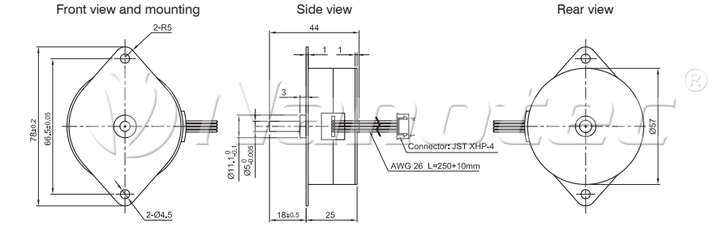

### SP4275S



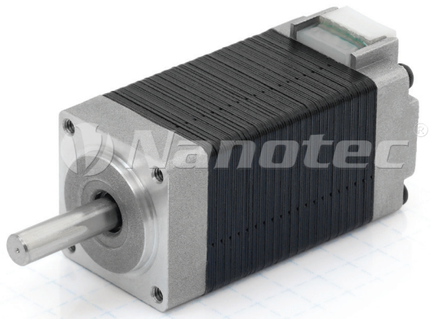

### SP4275M




### SP5575M



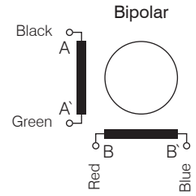
## Type ST2018 - sizes S, M, L - 1.8°



### Option

Getriebe · Steuerung · Encoder

### Pin configuration

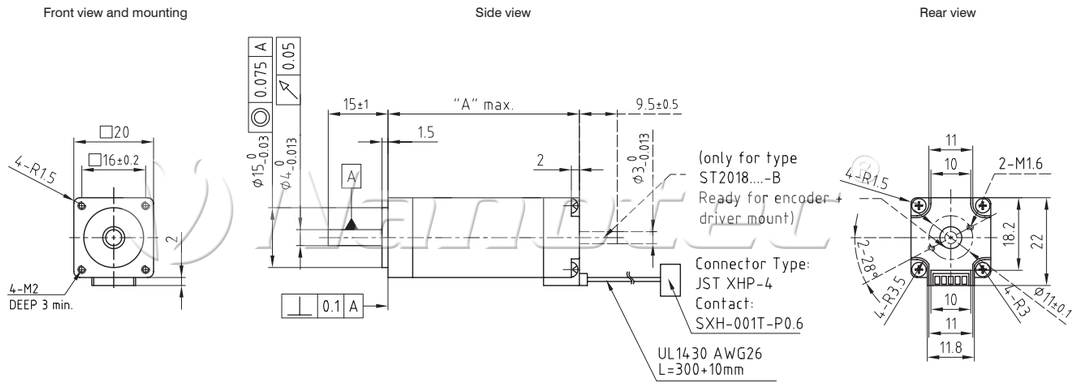



### Order identifier

**ST 2018 S 0604 -(A)**

A = one shaft end
B = two shaft ends for encoder

### Outline drawing (in mm)



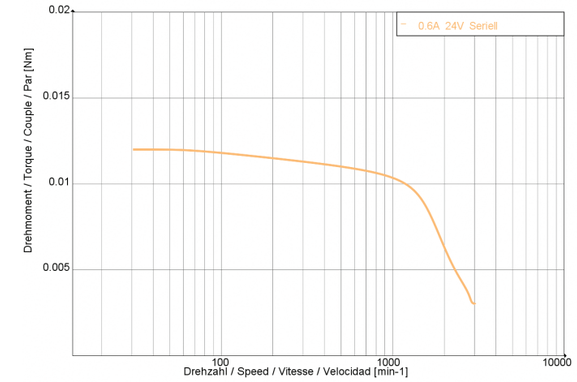

### Available versions (others on request)

| Type | Current per winding A/winding | Holding torque Ncm | Resistance per winding Ohm/winding | Inductance per winding mH/winding | Rotor inertia torque g cm² | Weight kg | Length "A" mm |
|---|---|---|---|---|---|---|---|
| ST2018S0604 | 0.60 | 1.80 | 6.5 | 1.70 | 2.0 | 0.06 | 33 |
| ST2018M0804 | 0.80 | 3.00 | 5.4 | 1.50 | 2.0 | 0.08 | 42 |
| ST2018L0804 | 0.80 | 3.60 | 6.0 | 2.20 | 2.3 | 0.09 | 48 |

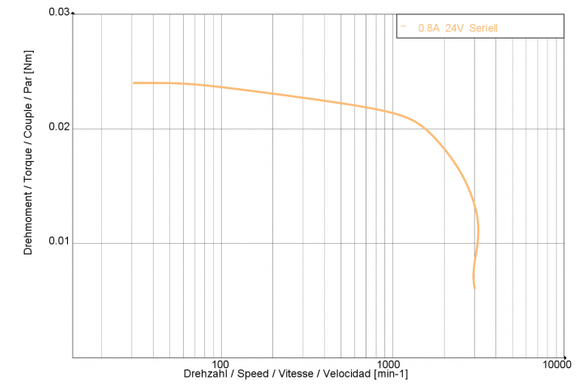


### Speed/torque curves

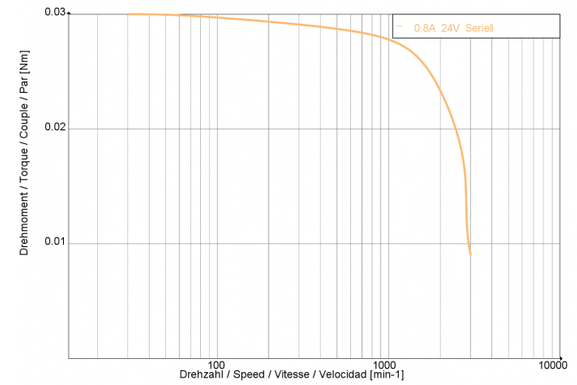
#### ST2018S0604




#### ST2018M0804




#### ST2018L0804

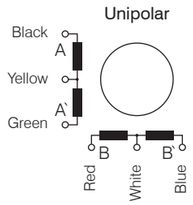


## Type ST2818 - sizes S, M, L - 1.8°

### Option

Getriebe · Bremse · Steuerung · Encoder

### Pin configuration

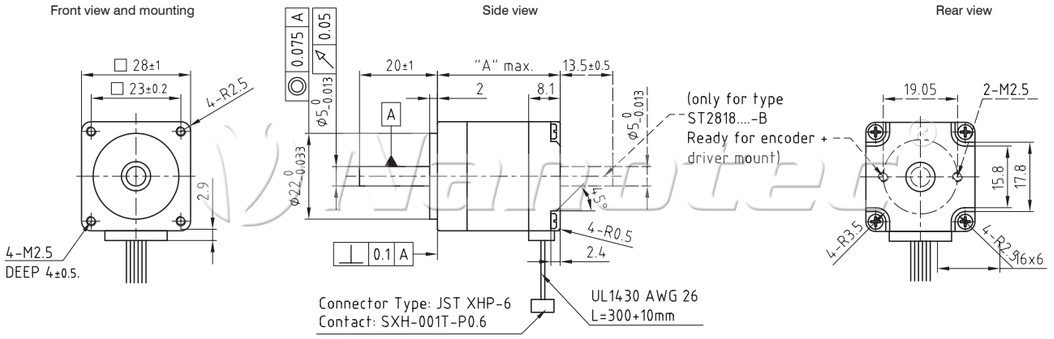



### Order identifier

**ST 2818 S 1006 -(A)**

A = one shaft end
B = two shaft ends for encoder or brake

### Outline drawing (in mm)

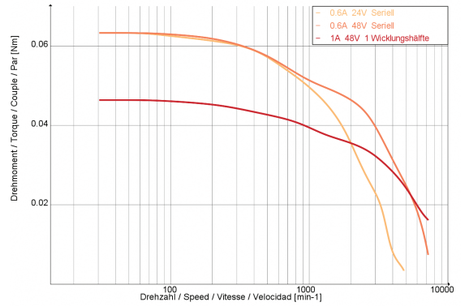



| Available versions (others on request) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Type** | **Current per winding** A/winding | **Holding torque** Ncm | **Resistance per winding** Ohm/winding | **Inductance per winding** mH/winding | **Rotor inertia torque** gcm² | **Weight** kg | **Length "A"** mm |
| ST2818S1006 | 0.95 | 4.3 | 2.8 | 1.0 | 9 | 0.110 | 32 |
| ST2818M1006 | 0.95 | 7.5 | 3.4 | 1.2 | 12 | 0.176 | 45 |
| ST2818L1006 | 0.95 | 9.0 | 4.6 | 1.4 | 18 | 0.250 | 51 |
| ST2818L1404 | 1.40 | 9.0 | 2.3 | 1.4 | 18 | 0.250 | 51 |

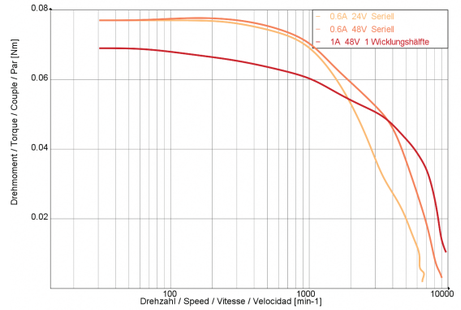
All data refer to 1 half of the winding or unipolar!

### Speed/torque curves

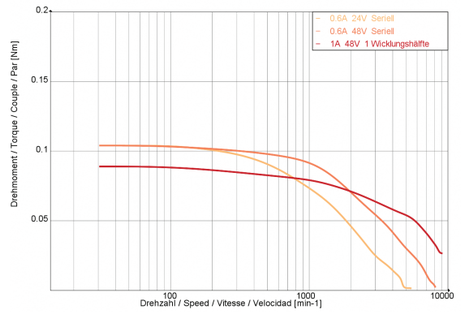
**ST2818S1006**



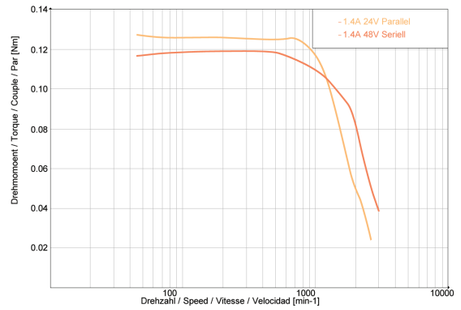

**ST2818M1006**



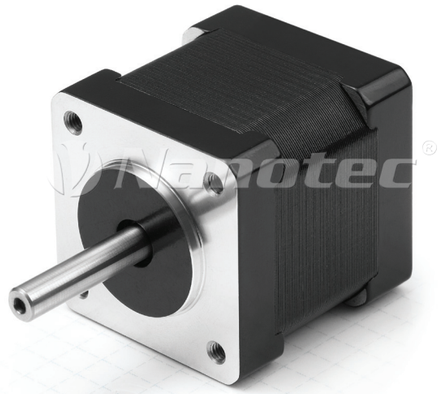

**ST2818L1006**




**ST2818L1404**



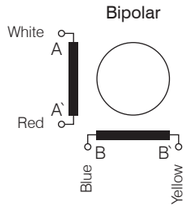
## Type ST3518 - sizes S, M, L - 1.8°



### Option

Steuerung Encoder

### Pin configuration

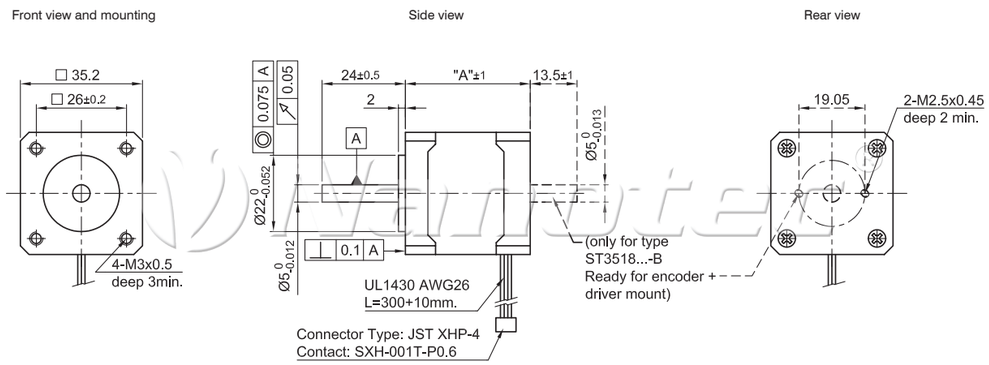



### Order identifier

**ST 3518 S 0804 -(A)**

A = one shaft end
B = two shaft ends for encoder

### Outline drawing (in mm)



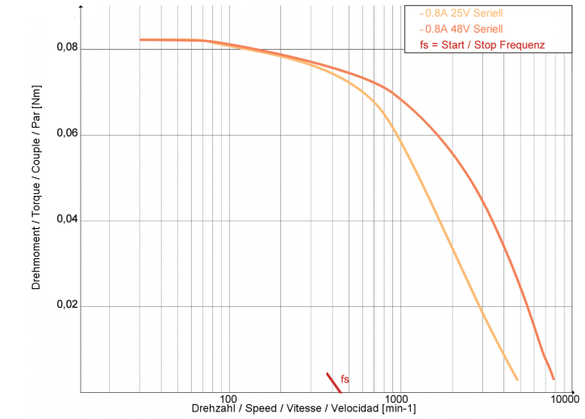

**Available versions (others on request)**

| Type | Current per winding A/winding | Holding torque Ncm | Resistance per winding Ohm/winding | Inductance per winding mH/winding | Rotor inertia torque g cm² | Weight kg | Length "A" mm |
|---|---|---|---|---|---|---|---|
| ST3518S0804 | 0.8 | 7.0 | 4.0 | 2.3 | 10 | 0.15 | 26.0 |
| ST3518M1004 | 1.0 | 14.0 | 2.7 | 4.3 | 14 | 0.18 | 36.0 |
| ST3518L1204 | 1.2 | 23.0 | 3.4 | 2.8 | 43 | 0.30 | 52.0 |

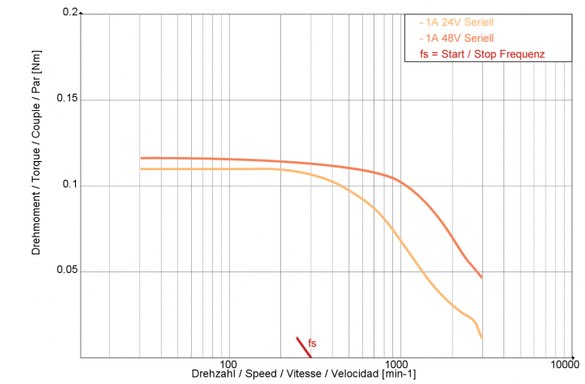
All data refer to 1 half of the winding or unipolar!

### Speed/torque curves

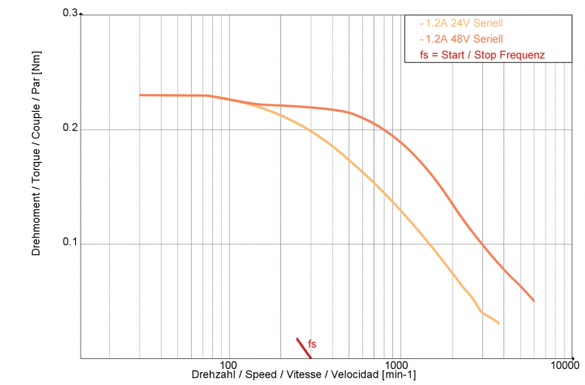
**ST3518S0804**




**ST3518M1004**




**ST3518L1204**

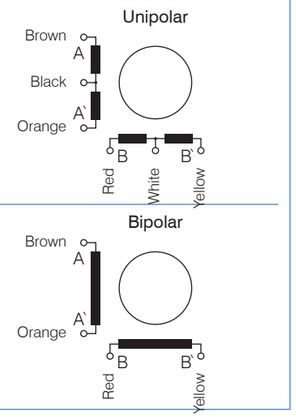


## Type ST4209 - size X, S, M, L - 0.9°

### Option

Getriebe · Bremse · Steuerung · Encoder

### Pin configuration

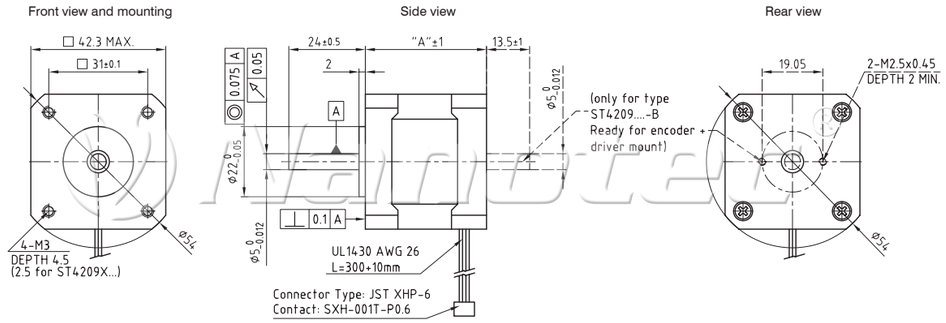



### Order identifier

**ST 4209 S 1006 -A**

A = one shaft end
B = two shaft ends for encoder or brake

### Outline drawing (in mm)




### Available versions (others on request)

| Type | Current per winding A/winding | Holding torque Ncm | Resistance per winding Ohm/winding | Inductance per winding mH/winding | Rotor inertia torque g cm² | Weight kg | Length "A" mm |
|---|---|---|---|---|---|---|---|
| ST4209X1004 | 1.00 | 17.0 | 8.70 | 18.0 | 20 | 0.15 | 22.0 |
| ST4209S0404 | 0.42 | 7.6 | 13.00 | 7.5 | 35 | 0.22 | 33.5 |
| ST4209S1006 | 0.95 | 15.0 | 4.20 | 4.0 | 35 | 0.22 | 33.5 |
| ST4209S1404 | 1.33 | 22.0 | 2.10 | 5.2 | 35 | 0.22 | 33.5 |
| ST4209M1206 | 1.20 | 25.0 | 3.30 | 4.0 | 54 | 0.28 | 39.5 |
| ST4209M1704 | 1.68 | 36.0 | 1.65 | 4.0 | 54 | 0.28 | 39.5 |
| ST4209L1206 | 1.20 | 31.0 | 3.30 | 4.8 | 68 | 0.35 | 47.5 |
| ST4209L1704 | 1.68 | 44.0 | 1.65 | 5.0 | 68 | 0.35 | 47.5 |

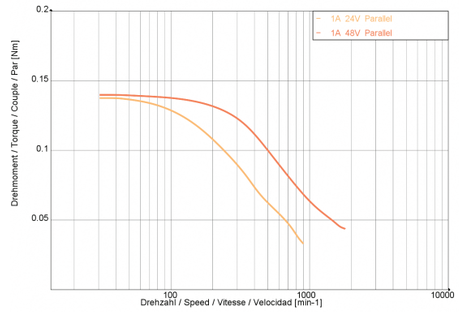
All data refer to 1 half of the winding or unipolar!



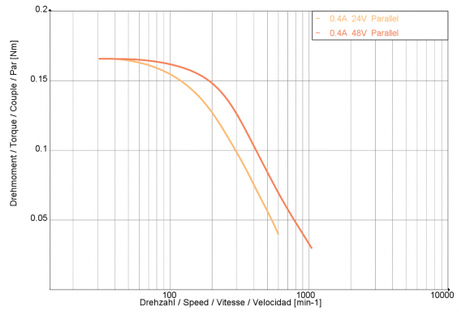


### Speed/torque curves

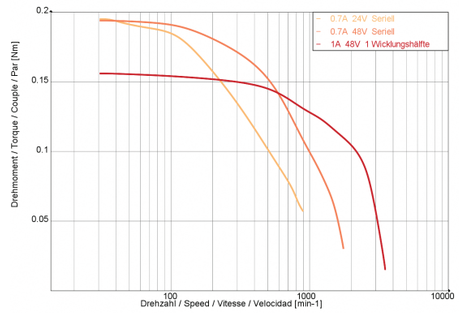
#### ST4209X1004



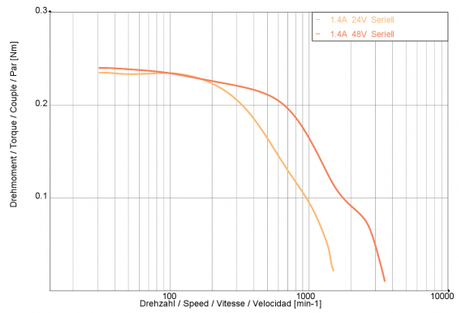

#### ST4209S0404



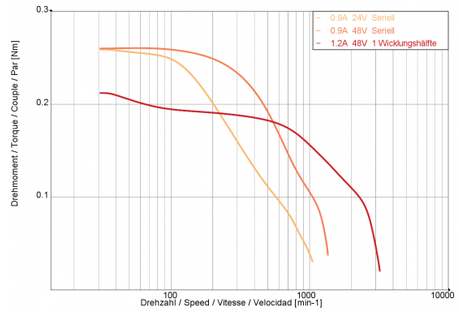

#### ST4209S1006



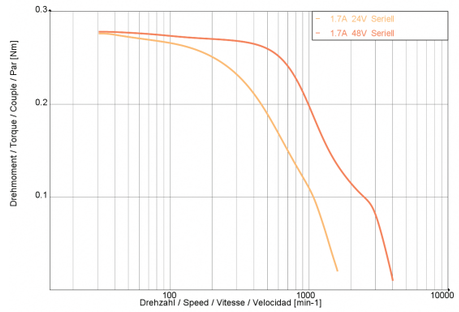

#### ST4209S1404



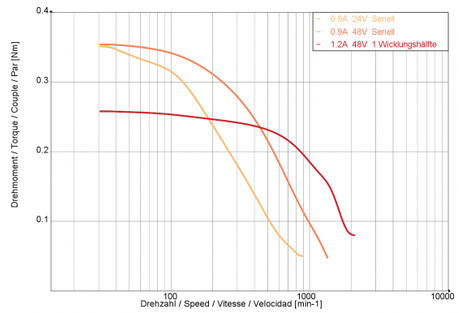

#### ST4209M1206



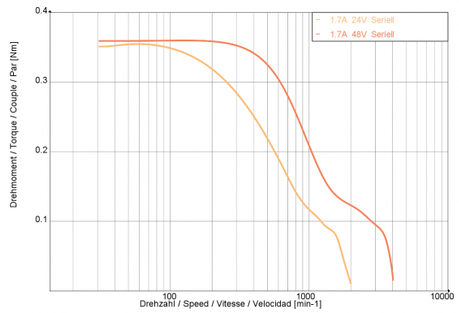

#### ST4209M1704



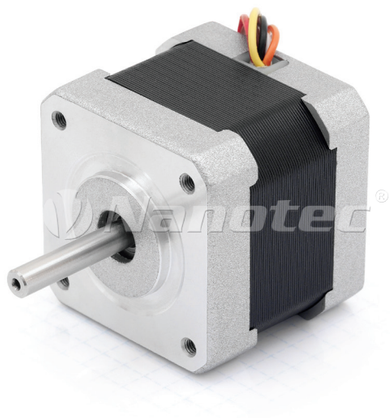

#### ST4209L1206




#### ST4209L1704



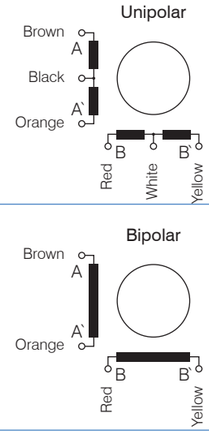
## Type ST4118 - sizes S, M, L, D - 1.8



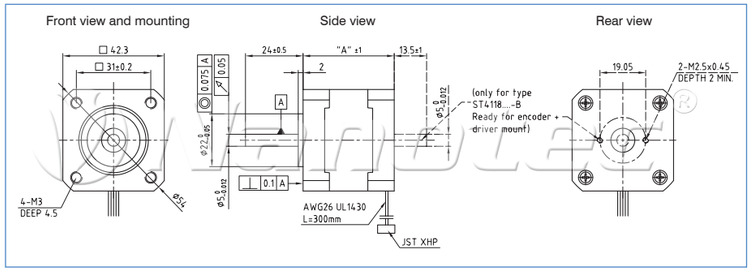
### Option

Getriebe · Bremse · Steuerung · Encoder

### Pin configuration




### Outline drawing (in mm)




### Order identifier

**ST 4118 S 1404 -A**

A = one shaft end
B = two shaft ends for encoder or brake

### Available versions (others on request)

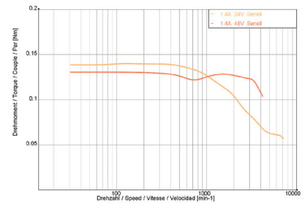
| Type | Current per winding A/winding | Holding torque Ncm | Resistance per winding Ohm/winding | Inductance per winding mH/winding | Rotor inertia torque g cm² | Weight kg | Length "A" mm |
|---|---|---|---|---|---|---|---|
| ST4118X0404 | 0.40 | 1.7 | 24.00 | 36.00 | 20 | 0.15 | 26 |
| ST4118X1404 | 1.40 | 9.0 | 2.00 | 1.60 | 20 | 0.15 | 26 |
| ST4118S0206 | 0.22 | 15.0 | 75.00 | 53.00 | 38 | 0.20 | 31 |
| ST4118S0406 | 0.35 | 16.0 | 30.00 | 21.70 | 38 | 0.20 | 31 |
| ST4118S0706 | 0.70 | 16.0 | 7.60 | 6.80 | 38 | 0.20 | 31 |
| ST4118S1006 | 0.95 | 15.0 | 3.90 | 2.80 | 38 | 0.20 | 31 |
| ST4118S1404 | 1.40 | 20.0 | 2.00 | 3.60 | 38 | 0.20 | 31 |
| ST4118M0406 | 0.40 | 28.0 | 30.00 | 25.00 | 57 | 0.24 | 38 |
| ST4118M0706 | 0.70 | 28.0 | 9.50 | 8.00 | 57 | 0.24 | 38 |
| ST4118M0906 | 0.90 | 28.0 | 5.70 | 6.80 | 57 | 0.24 | 38 |
| ST4118M1206 | 1.20 | 28.0 | 3.10 | 2.90 | 57 | 0.24 | 38 |
| ST4118M1404 | 1.40 | 24.0 | 1.20 | 1.70 | 57 | 0.24 | 38 |
| ST4118M1804 | 1.80 | 28.0 | 1.10 | 1.85 | 57 | 0.24 | 38 |
| ST4118L0804 | 0.80 | 50.0 | 9.30 | 17.00 | 82 | 0.34 | 49 |
| ST4118L1206 | 1.20 | 35.0 | 3.30 | 4.30 | 82 | 0.34 | 49 |
| ST4118L1804 | 1.80 | 50.0 | 1.75 | 3.30 | 82 | 0.34 | 49 |
| ST4118L3004 | 3.00 | 50.0 | 0.63 | 1.03 | 82 | 0.34 | 49 |
| ST4118D1804 | 1.80 | 80.0 | 3.00 | 7.00 | 102 | 0.50 | 60 |
| ST4118D3004 | 3.00 | 80.0 | 1.10 | 2.70 | 102 | 0.50 | 60 |

All data refer to 1 half of the winding or unipolar!

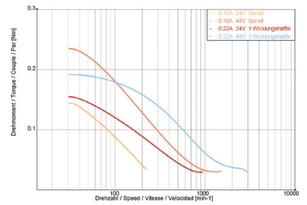


### Speed/torque curves

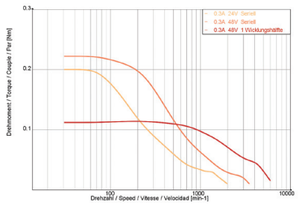
ST4118X1404



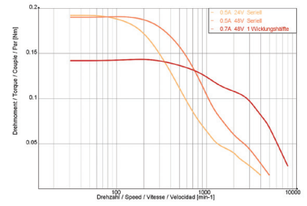

ST4118S0206



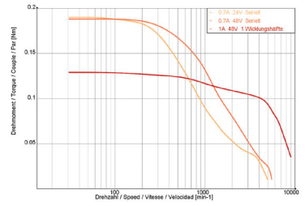

ST4118S0406



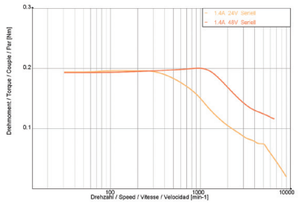

ST4118S0706



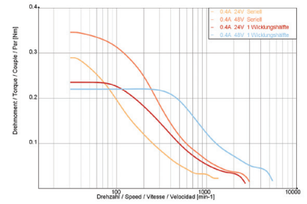

ST4118S1006



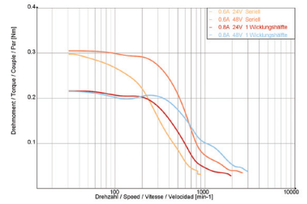

ST4118S1404



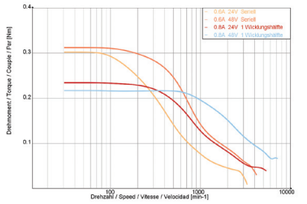

ST4118M0406



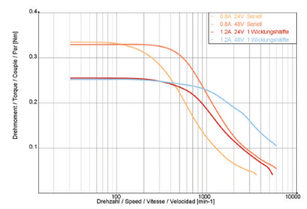

ST4118M0706



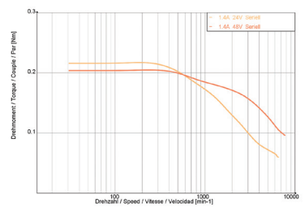

ST4118M0906



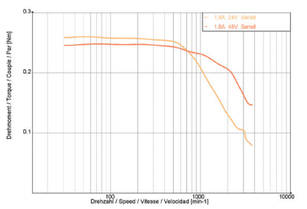

ST4118M1206



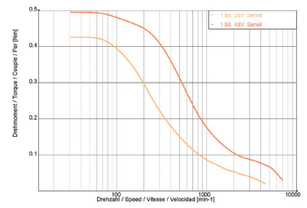

ST4118M1404



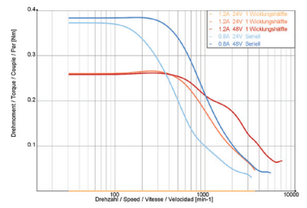

ST4118M1804



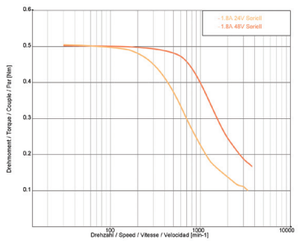

ST4118L0804



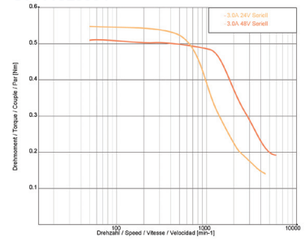

ST4118L1206



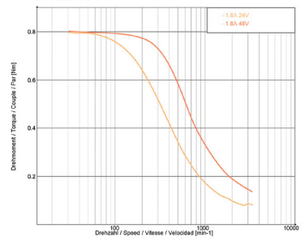

ST4118L1804



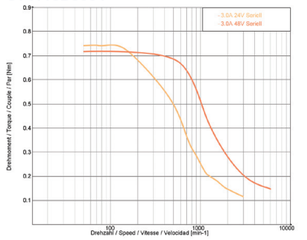

ST4118L3004




ST4118D1804




ST4118D3004

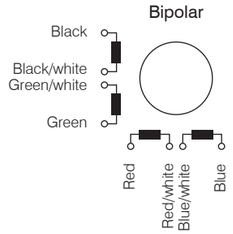


## Type ST5909 - size X, M, L - 0.9°

### Option

Getriebe, Bremse, Steuerung, Encoder

### Pin configuration

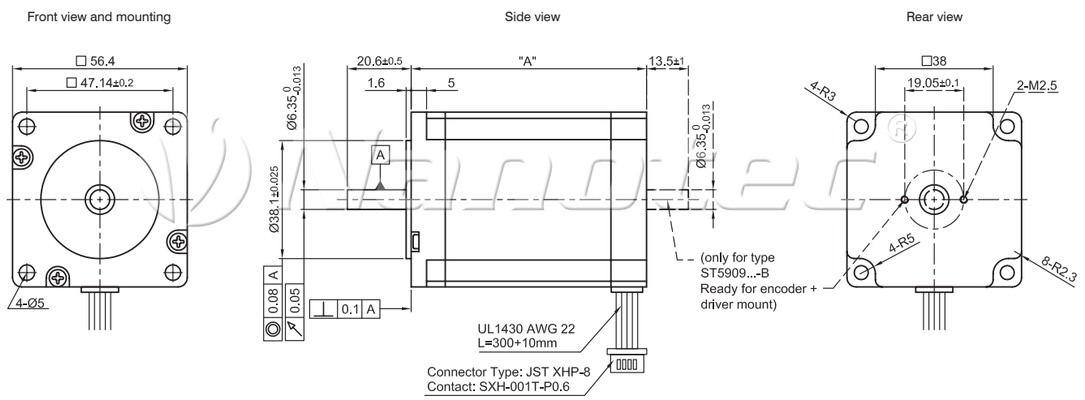



### Order identifier

**ST 5909M2008 -A**

A = one shaft end
B = two shaft ends for encoder or brake

### Outline drawing (in mm)



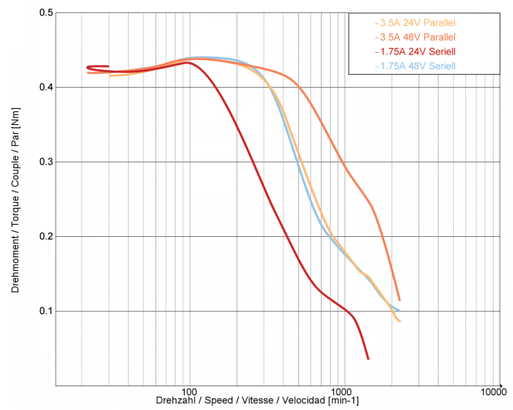

### Available versions (others on request)

| Type | Current per winding A/winding | Holding torque Ncm | Resistance per winding Ohm/winding | Inductance per winding mH/winding | Rotor inertia torque g cm² | Weight kg | Length "A" mm |
|---|---|---|---|---|---|---|---|
| ST5909X2508 | 2.5 | 43 | 0.85 | 1.6 | 120 | 0.45 | 41 |
| ST5909S1008 | 1.0 | 72 | 6,60 | 13 | 275 | 0.65 | 51 |
| ST5918M1008 | 2.0 | 74 | 1.80 | 4.5 | 300 | 0.70 | 56 |
| ST5909L1008 | 1.0 | 140 | 8,60 | 23.0 | 480 | 1.00 | 76 |
| ST5909L2008 | 2.0 | 140 | 2.40 | 6.7 | 480 | 1.00 | 76 |
| ST5909L3008 | 3.0 | 140 | 1.00 | 2.6 | 480 | 1.00 | 76 |

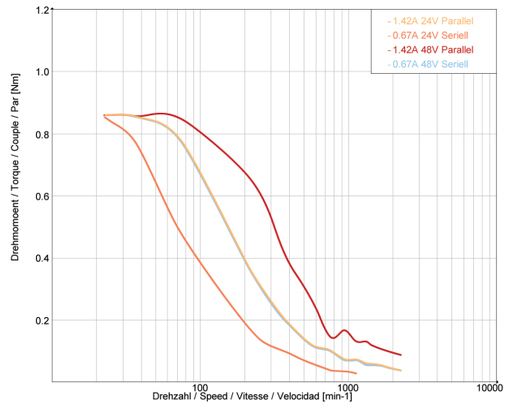
All data refer to 1 half of the winding or unipolar!

### Speed/torque curves

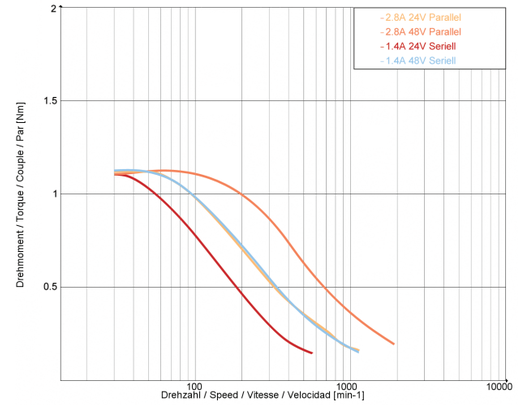
**ST5909X2508**



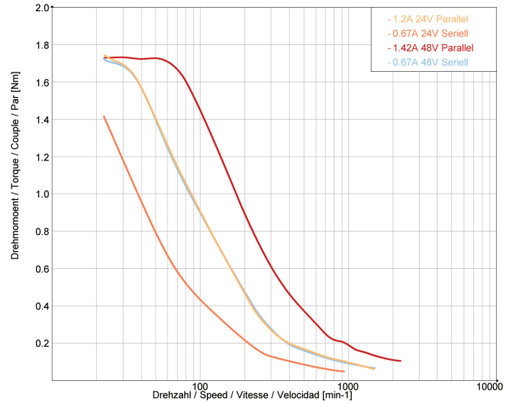

**ST5909S1008**



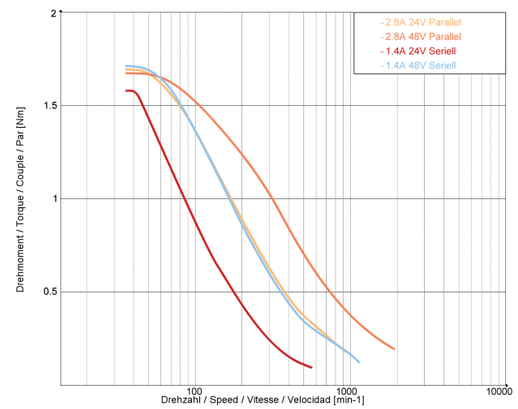

**ST5909M1008**



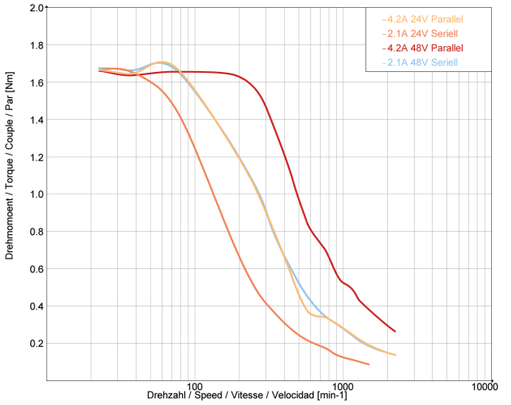

**ST5909L1008**




**ST5909L2008**




**ST5909L3008**



## Type ST5918 - size X, S, M, L, D - 1.8°

### Option

Getriebe · Bremse · Steuerung · Encoder

### Pin configuration

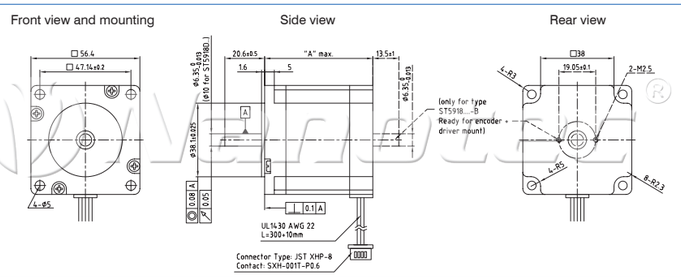
**ST5918X-L** — Bipolar

| Black | Black/white | Green/white | Green | Red | Red/white | Blue/white | Blue |
|---|---|---|---|---|---|---|---|

**ST5918D** — Bipolar

| Red | Red/white | Black/white | Black | Green | Green/white | Yellow/white | Yellow |
|---|---|---|---|---|---|---|---|

### Outline drawing (in mm)




### Order identifier

**ST 5918 X 1008 -** (A)

A = one shaft end
B = two shaft ends for encoder or brake

### Available versions (others on request)

| Type | Current per winding A/winding | Holding torque Ncm | Resistance per winding Ohm/winding | Inductance per winding mH/winding | Rotor inertia torque g cm² | Weight kg | Length "A" mm |
|---|---|---|---|---|---|---|---|
| ST5918X1008 | 1.0 | 38 | 5.00 | 5.40 | 135 | 0.49 | 41 |
| ST5918X2008 | 2.0 | 38 | 1.20 | 1.30 | 135 | 0.49 | 41 |
| ST5918X3008 | 3.0 | 38 | 0.50 | 0.54 | 135 | 0.49 | 41 |
| ST5918S1008 | 1.0 | 65 | 6.20 | 9.70 | 275 | 0.65 | 51 |
| ST5918S2008 | 2.0 | 60 | 1.50 | 2.60 | 275 | 0.65 | 51 |
| ST5918S3008 | 3.0 | 65 | 0.72 | 1.10 | 275 | 0.65 | 51 |
| ST5918M1008 | 1.0 | 74 | 6.90 | 14.0 | 300 | 0.70 | 56 |
| ST5918M2008 | 2.0 | 74 | 1.70 | 3.60 | 300 | 0.70 | 56 |
| ST5918M3008 | 3.0 | 80 | 0.70 | 1.30 | 300 | 0.70 | 56 |
| ST5918L1008 | 1.0 | 120 | 8.80 | 19.0 | 480 | 1.00 | 76 |
| ST5918L2008 | 2.0 | 140 | 2.40 | 5.10 | 480 | 1.00 | 76 |
| ST5918L3008 | 3.0 | 140 | 1.00 | 2.20 | 480 | 1.00 | 76 |
| ST5918D4208 | 4.2 | 180 | 1.00 | 2.60 | 650 | 1.80 | 115 |

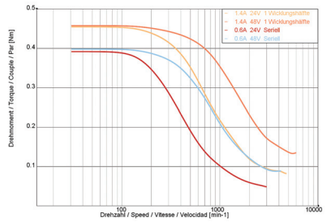
All data refer to 1 half of the winding or unipolar!



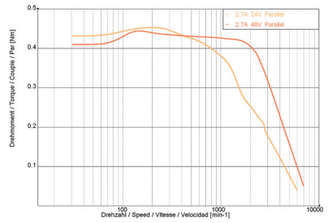


### Speed/torque curves

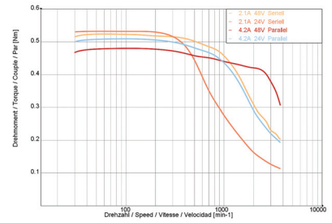
**ST5918X1008**



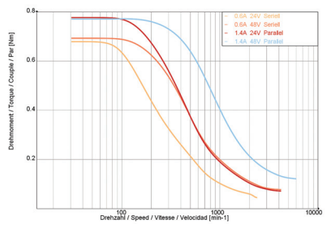

**ST5918X2008**



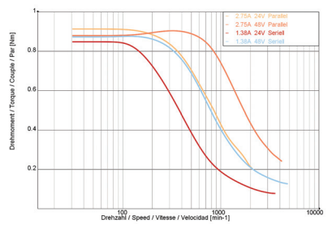

**ST5918X3008**



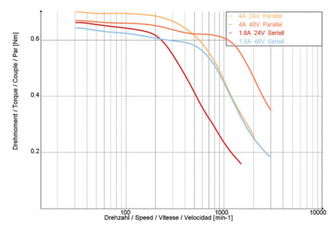

**ST5918S1008**



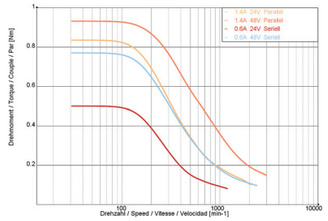

**ST5918S2008**



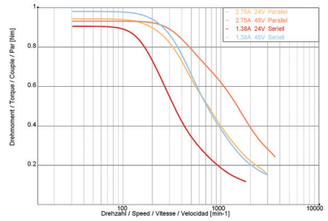

**ST5918S3008**



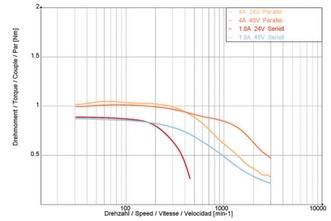

**ST5918M1008**



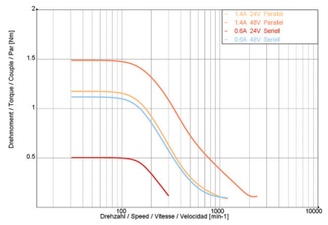

**ST5918M2008**



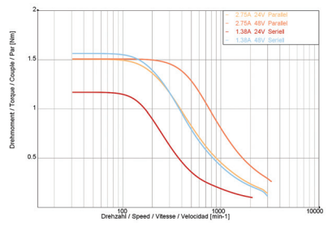

**ST5918M3008**



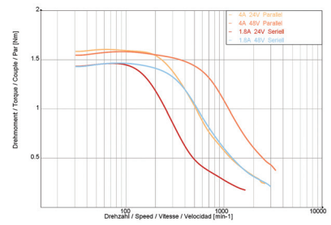

**ST5918L1008**



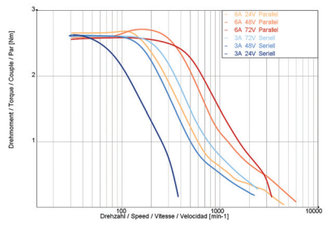

**ST5918L2008**




**ST5918L3008**




**ST5918D4208**

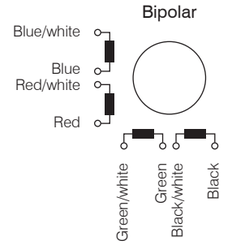


## Type ST6018 - size X, M, L - 1.8°

### Option

Getriebe · Bremse · Steuerung · Encoder

### Pin configuration

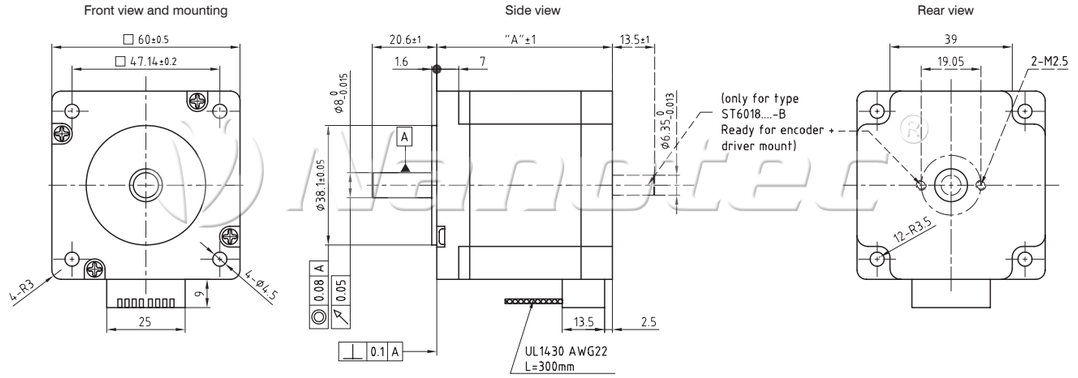



### Order identifier

**ST 6018 X 2008 -(A)**

A = one shaft end
B = two shaft ends for encoder or brake

### Outline drawing (in mm)




### Available versions (others on request)

| Type | Current per winding A/winding | Holding torque Ncm | Resistance per winding Ohm/winding | Inductance per winding mH/winding | Rotor inertia torque g cm² | Weight kg | Length "A" mm |
|---|---|---|---|---|---|---|---|
| ST6018X2008 | 2.0 | 75 | 1.46 | 1.80 | 275 | 0.60 | 47 |
| ST6018X3008 | 3.0 | 78 | 0.68 | 0.80 | 275 | 0.60 | 47 |
| ST6018M2008 | 2.0 | 138 | 2.00 | 5.60 | 450 | 0.77 | 56 |
| ST6018M3008 | 3.0 | 117 | 0.80 | 1.38 | 450 | 0.77 | 56 |
| ST6018K2008 | 2.0 | 150 | 2.40 | 4.60 | 570 | 1.20 | 67 |
| ST6018L3008 | 3.0 | 250 | 1.30 | 3.20 | 840 | 1.40 | 88 |
| ST6018D4508 | 4.5 | 283 | 0.75 | 1.40 | 1100 | 1.90 | 111 |

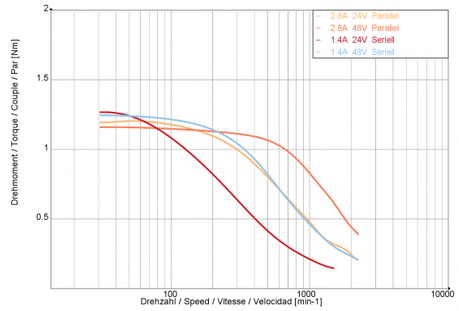
All data refer to 1 half of the winding or unipolar!



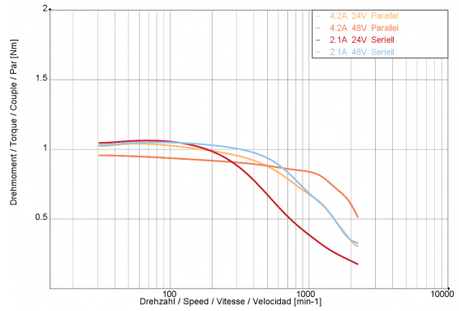


### Speed/torque curves

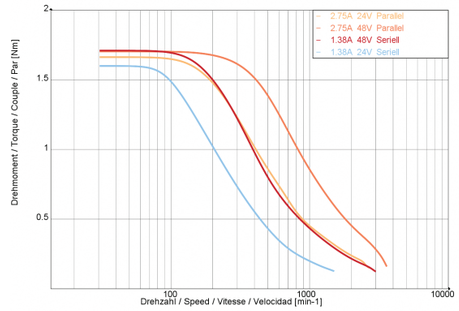
#### ST6018X2008



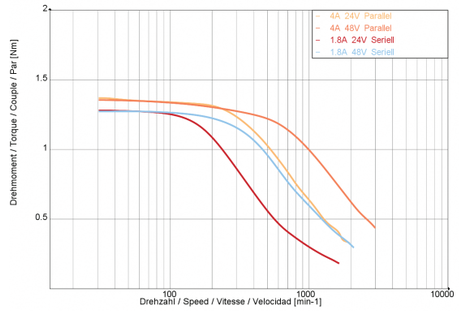

#### ST6018X3008



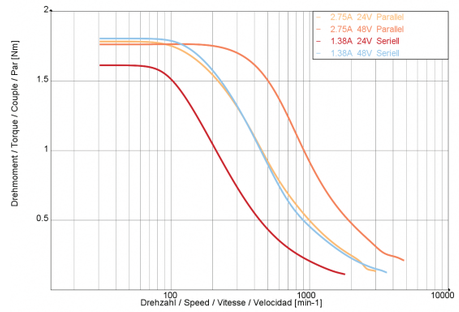

#### ST6018M2008



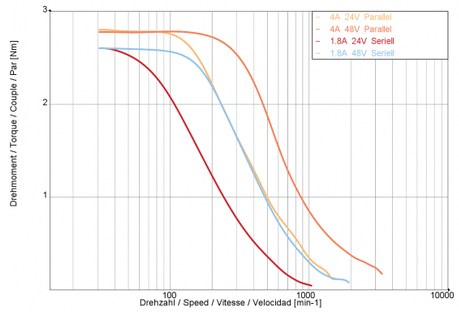

#### ST6018M3008



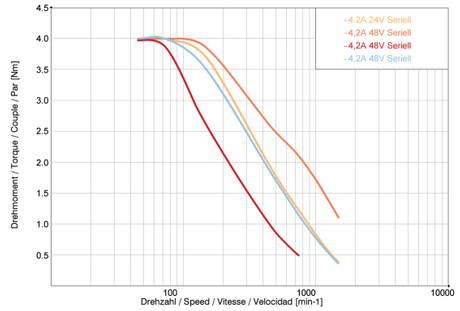

#### ST6018K2008



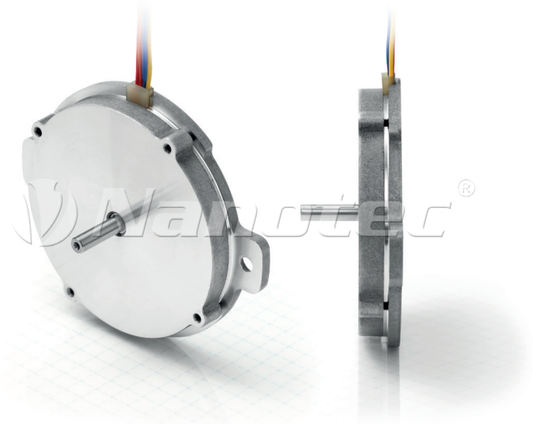

#### ST6018L3008




#### ST6018D4508



## Type ST6318 - ultraflat stepper motor

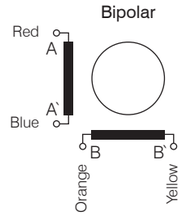


**Option**

Getriebe

Steuerung

**Pin configuration**

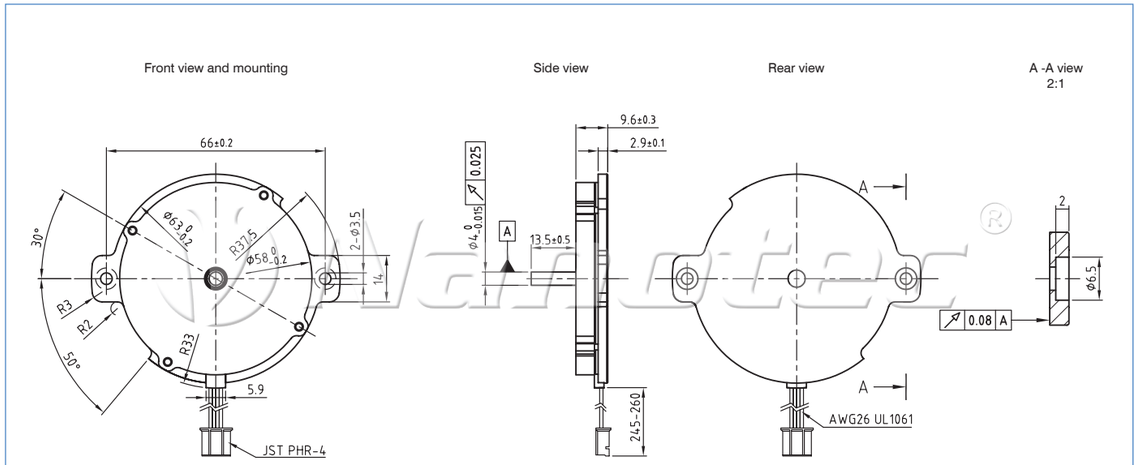



The ST6318F1004 ultraflat high-torque stepper motor with a step angle of 1.8° (with microstep up to < 0.02°) supports all engineers in obtaining maximum torque, as well as high positioning accuracy, with a minimal overall height. Thanks to the high torque, a stable speed response is possible at both minimal speeds and at high speeds. The benefits in use arise primarily in applications such as component feeding (feeder), in semi-conductor automation, medical lab and inspection equipment, laser technology, test equipment construction, monitoring cameras, etc. Custom designs are available.

**Order identifier**

**ST 6318 F 1004 - A**

**Outline drawing (in mm)**

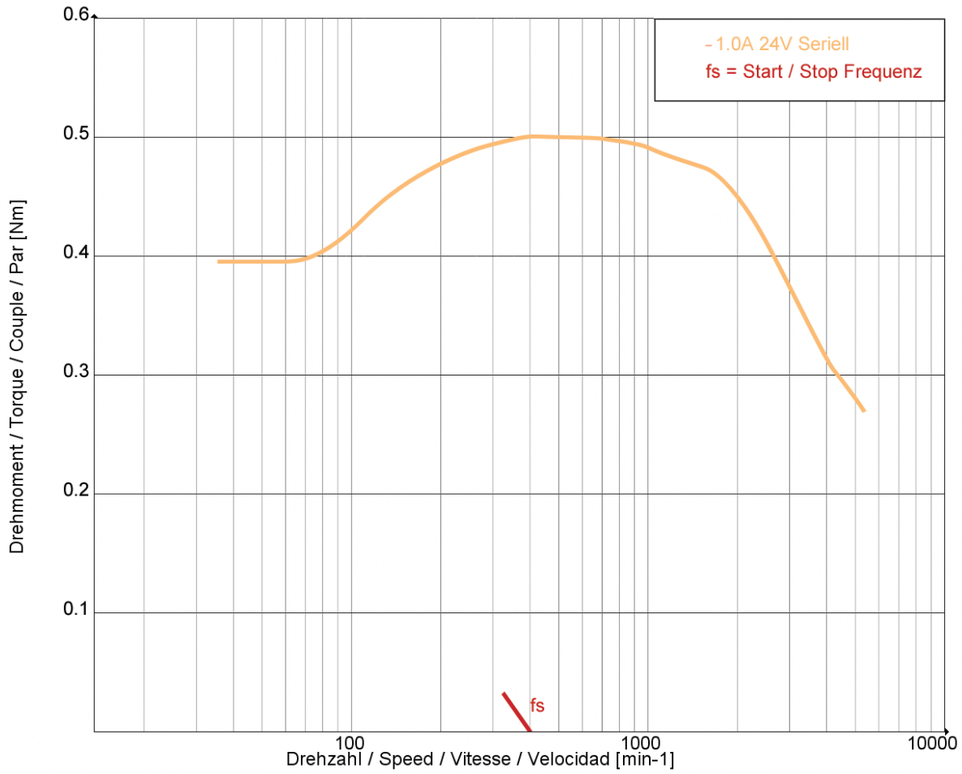



**Available versions (others on request)**

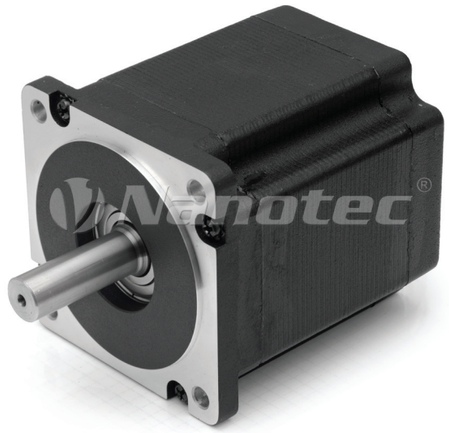
| Type | Current per winding A/winding | Holding torque Ncm | Resistance per winding Ohm/winding | Inductance per winding mH/winding | Rotor inertia torque g cm² | Weight kg | Length "A" mm |
|---|---|---|---|---|---|---|---|
| ST6318F1004 | 1.0 | 6.0 | 3.8 | 2.0 | 16 | 0.095 | 9.5 |

**Speed/torque curves**

**ST6318F1004**



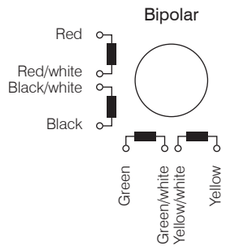
## Type ST8918 - sizes S, M, L - 1.8°



### Option

Getriebe · Bremse · Steuerung · Encoder

### Pin configuration

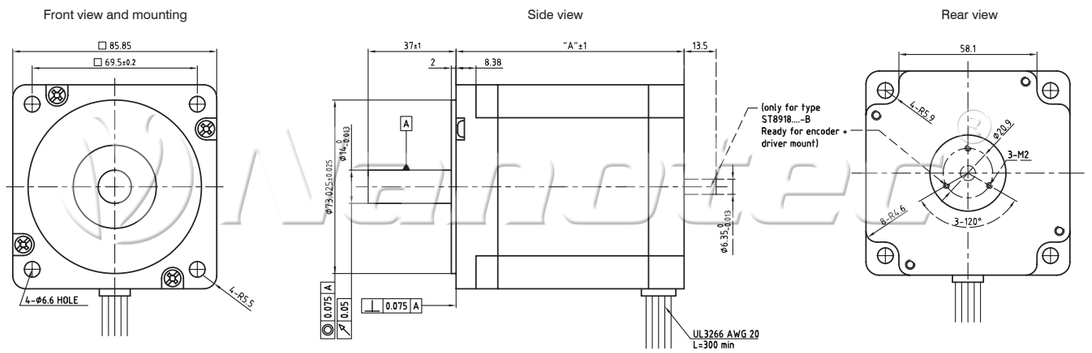



### Order identifier

**ST 8918 M 6708 -(A)**

A = one shaft end
B = two shaft ends for encoder or brake

### Outline drawing (in mm)




### Available versions (others on request)

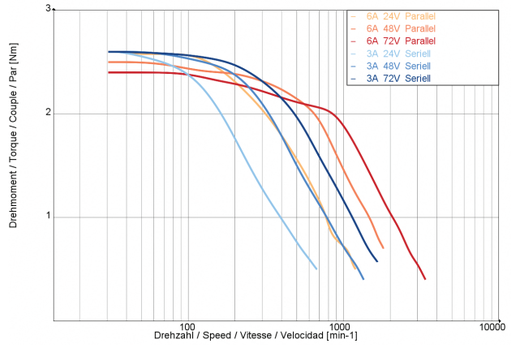
| Type | Current per winding A/winding | Holding torque Ncm | Resistance per winding Ohm/winding | Inductance per winding mH/winding | Rotor inertia torque g cm² | Weight kg | Length "A" mm |
|---|---|---|---|---|---|---|---|
| ST8918S4508 | 4.5 | 250 | 0.60 | 1.9 | 1000 | 1.70 | 65 |
| ST8918M4508 | 4.5 | 420 | 0.66 | 3.0 | 1900 | 2.80 | 96 |
| ST8918M6708 | 6.7 | 420 | 0.45 | 2.6 | 1900 | 2.80 | 96 |
| ST8918L4508 | 4.5 | 660 | 1.10 | 6.3 | 3000 | 3.95 | 126 |
| ST8918L6708 | 6.7 | 660 | 0.46 | 2.7 | 3000 | 3.95 | 126 |
| ST8918D6708 | 6.7 | 950 | 0.75 | 4.9 | 4000 | 5.40 | 156 |

All data refer to 1 half of the winding or unipolar!

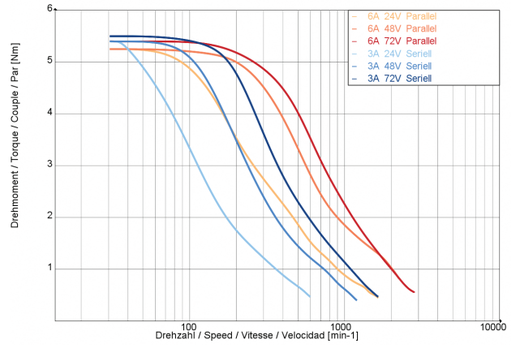


## Speed/torque curves

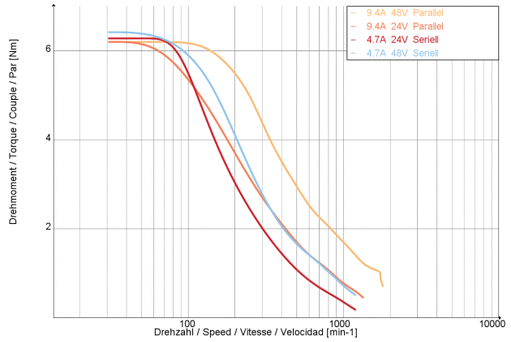
### ST8918S4508



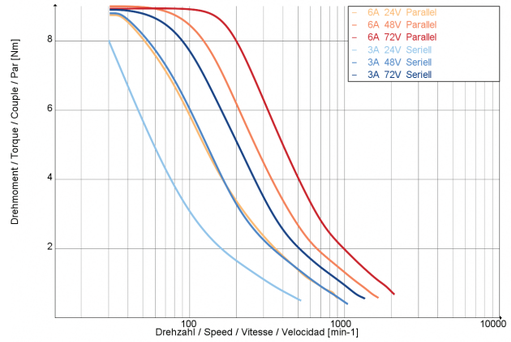

### ST8918M4508



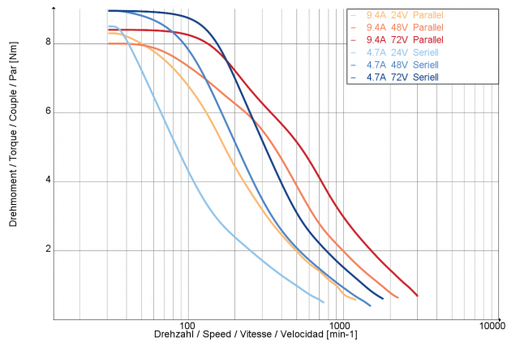

### ST8918M6708



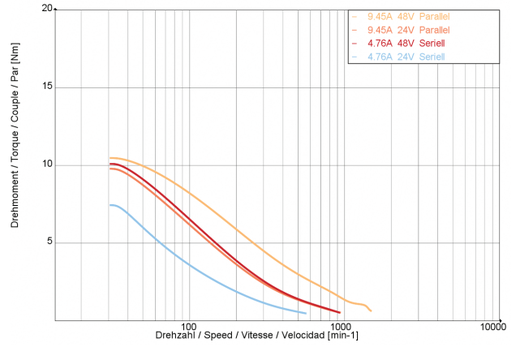

### ST8918L4508



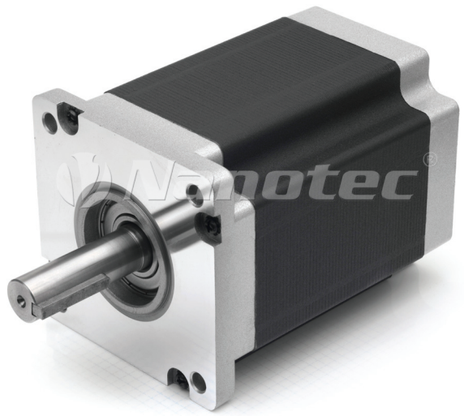

### ST8918L6708




### ST8918D6708



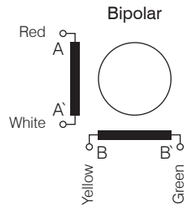
## Type ST11018 - sizes S, M, L - 1.8°



### Option

Getriebe · Bremse · Steuerung · Encoder

### Pin configuration

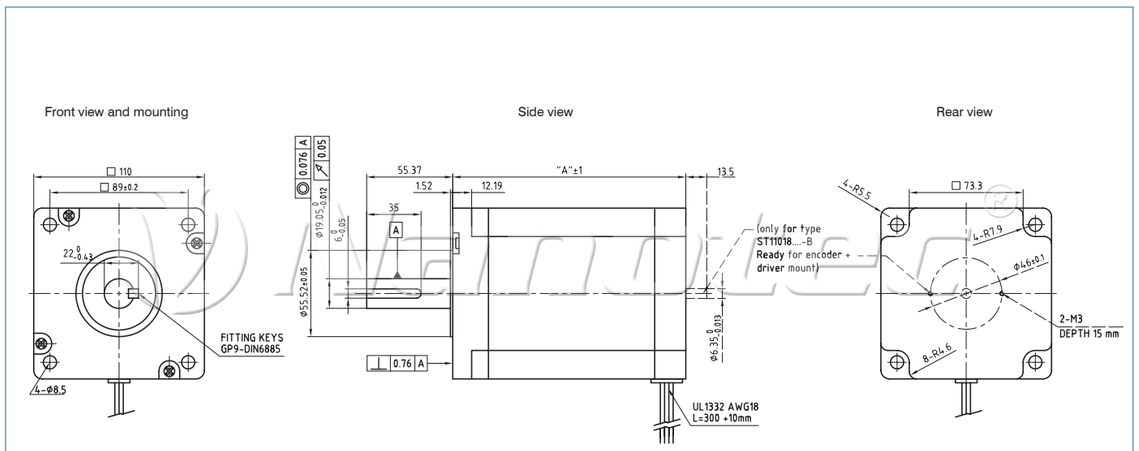



### Order identifier

**ST 11018 M 6504 -(A)**

A = one shaft end
B = two shaft ends for encoder or brake

### Outline drawing (in mm)



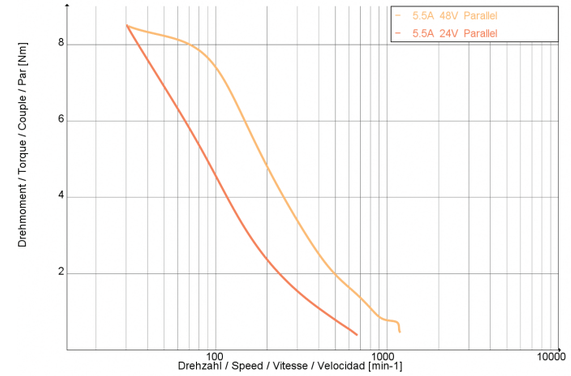

### Available versions (others on request)

| Type | Current per winding A/winding | Holding torque Ncm | Resistance per winding Ohm/winding | Inductance per winding mH/winding | Rotor inertia torque g cm² | Weight kg | Length "A" mm |
|---|---|---|---|---|---|---|---|
| ST11018S5504 | 5.5 | 11.7 | 0.70 | 9.8 | 5500 | 5.0 | 99 |
| ST11018M6504 | 6.5 | 21.0 | 1.15 | 15.2 | 10900 | 8.4 | 150 |
| ST11018L8004 | 8.0 | 25.0 | 1.00 | 17.1 | 16200 | 11.7 | 210 |

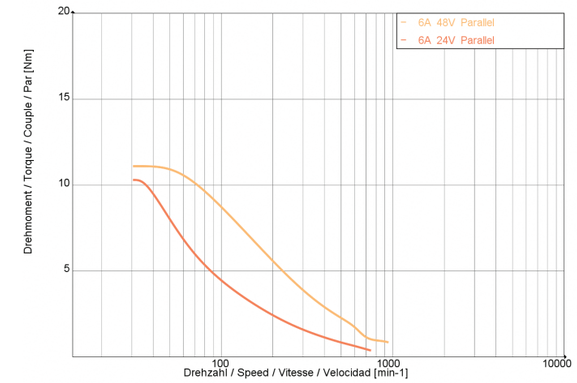


### Speed/torque curves

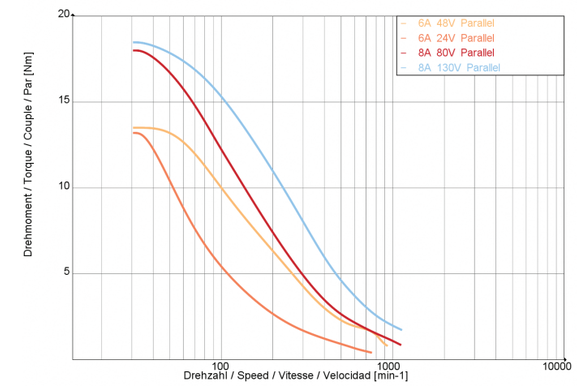
#### ST11018S5504




#### ST11018M6504




#### ST11018L8004



Notes

# Stepper motors in protection class IP65

## AS2818, AS4118, AS5918 stepper motor with terminal box


### Option

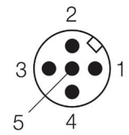
Getriebe · Bremse · Steuerung · Encoder

### Connector configuration

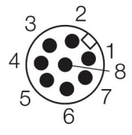
| M12 - 5-pin (MOTOR) | |
|---|---|
| Pin | assignment |
| 1 | A\ |
| 2 | A |
| 3 | B |
| 4 | B\ |
| 5 | Housing |

| M12 - 8-pin (ENCODER) | |
|---|---|
| Pin | assignment |
| 1 | A |
| 2 | A\ |
| 3 | B |
| 4 | B\ |
| 5 | GND |
| 6 | I |
| 7 | I\ |
| 8 | Vcc |
| Housing | GND/shielding |

M12 connector

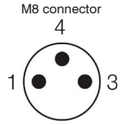



M12 connector




| M8 - 3-pin (BRAKE) | |
|---|---|
| Pin | assignment |
| 1 | Brake |
| 3 | Brake/GND |
| 4 | NC |

M8 connector




### Order identifier

A S 5918S2804 -

S = M12 connector

without option = with junction box
E = with encoder
EB = with encoder and brake

Connection cable:
Motor: ZK-M12-5-xx
Encoder: ZK-M12-8-xx
Brake: ZK-M8-3-xx
For further information, see section on "Cables"

The machine-compliant stepper motors up to a protection class of IP 65 (except for shaft output) offer a consistent drive concept. The matching flange dimensions mean that they are electrically and mechanically compatible with standard motors. The junction box on the rear panel makes the motors only slightly longer. Their main features include a large performance and application range as well as a high level of availability.

**Encoders used:**
3-channel with 500 pulses/revolution and line controller, 5 V TTL signal each
(for 24V, please contact us!)

**Available versions (others on request)**

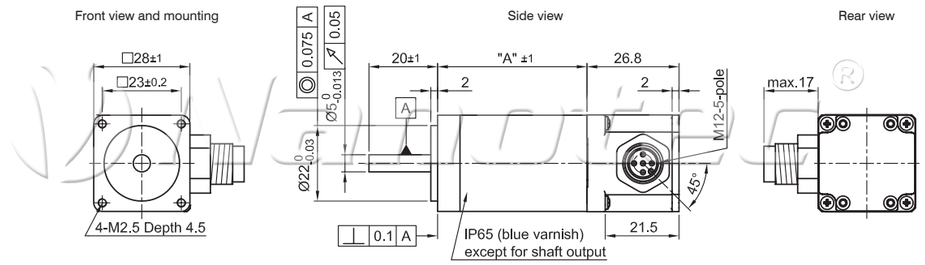
| Type | Current | Holding torque | Resistance | Inductance | Rotor inertia | Weight | Length "A" | Encoder | Brake |
|---|---|---|---|---|---|---|---|---|---|
| | A/phase | Ncm | Ohm/phase | mH | g cm² | kg | mm | | Nm |
| AS2818S0604 | 0.67 | 7.1 | 5.60 | 4.0 | 9 | 0.13 | 51.0 | | |
| AS2818L0604 | 0.67 | 12.7 | 9.20 | 5.6 | 18 | 0.22 | 70.3 | | |
| AS4118L1804 | 1.80 | 50 | 1.75 | 3.3 | 82 | 0.34 | 70.4 | | |
| AS4118L1804-E | 1.80 | 50 | 1.75 | 3.3 | 82 | 0.34 | 70.4 | X | |
| AS4118L1804-EB | 1.80 | 50 | 1.75 | 3.3 | 82 | 0.34 | 106,4 | X | 0,4 |
| AS5918S2804 | 2.83 | 85 | 0.75 | 2.6 | 230 | 0.80 | 73.0 | | |
| AS5918S2804-E | 2.83 | 85 | 0.75 | 2.6 | 230 | 0.80 | 73.0 | X | |
| AS5918M2804 | 2.82 | 105 | 0.85 | 3.6 | 300 | 0.85 | 77.0 | | |
| AS5918M2804-E | 2.82 | 105 | 0.85 | 3.6 | 300 | 0.85 | 77.0 | X | |
| AS5918L4204 | 4.20 | 198 | 0.50 | 1.9 | 480 | 1.14 | 98.0 | | |
| AS5918L4204-E | 4.20 | 198 | 0.50 | 1.9 | 480 | 1.14 | 98.0 | X | |
| AS5918L4204-EB | 4.20 | 198 | 0.50 | 1.9 | 480 | 1.14 | 138,0 | X | 1 |



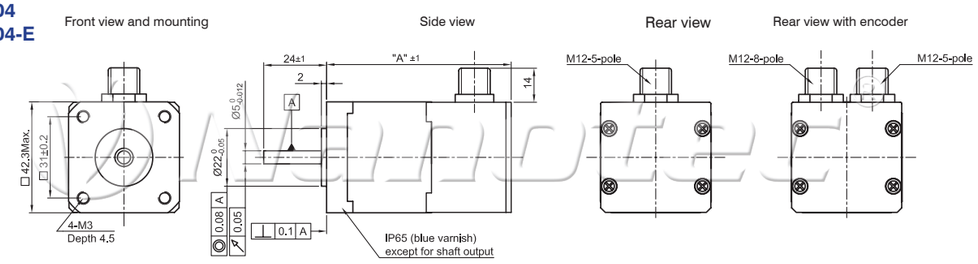


### Outline drawing AS28, AS41, AS59 for flange size 28, 42 and 56

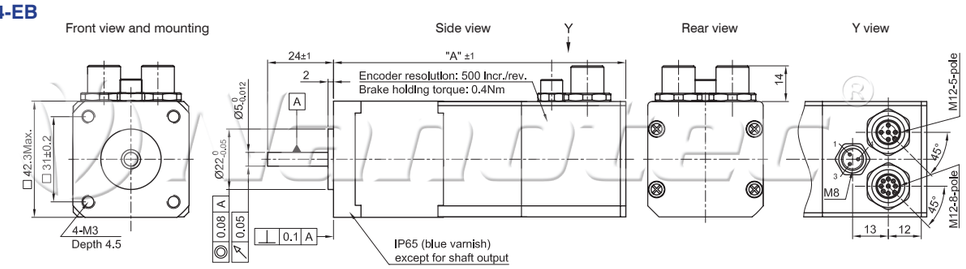
**AS2818**



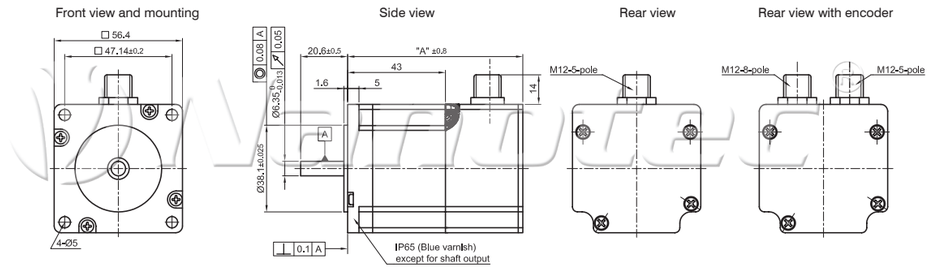

**AS4118L1804**
**AS4118L1804-E**



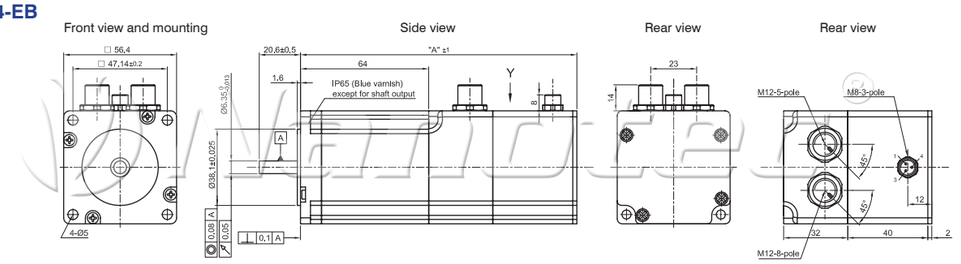

**AS4118L1804-EB**




**AS5918**
**AS5918...-E**

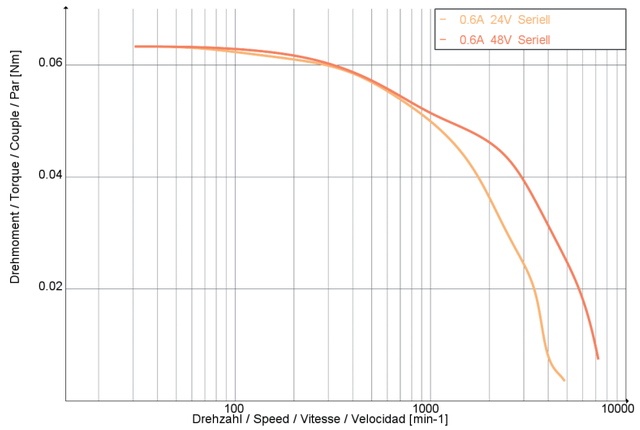



**AS5918L4204-EB**

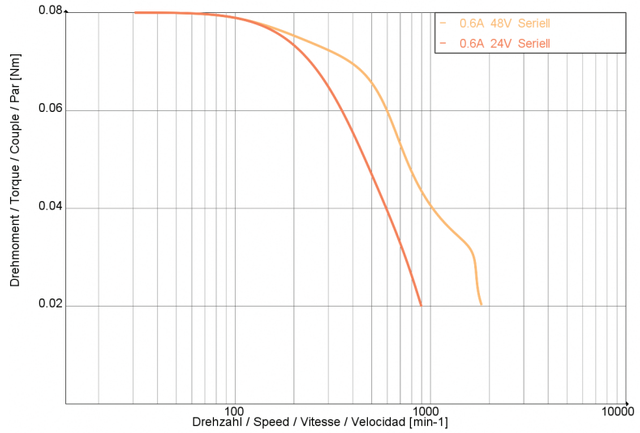


## Speed/torque curves

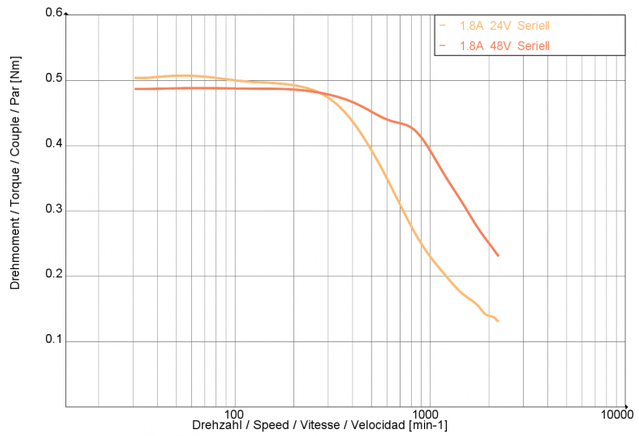
### AS2818S0604




### AS2818L0604



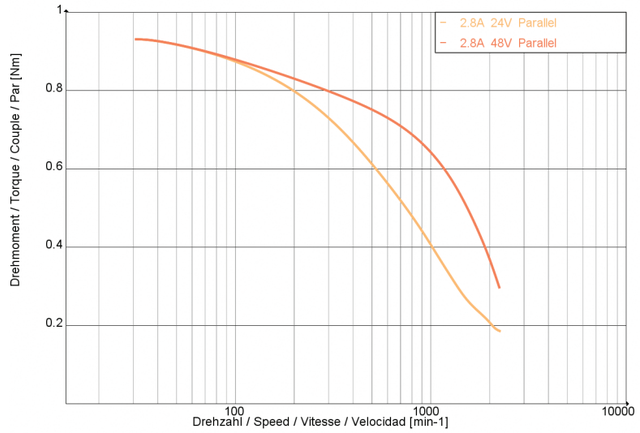

### AS4118L1804



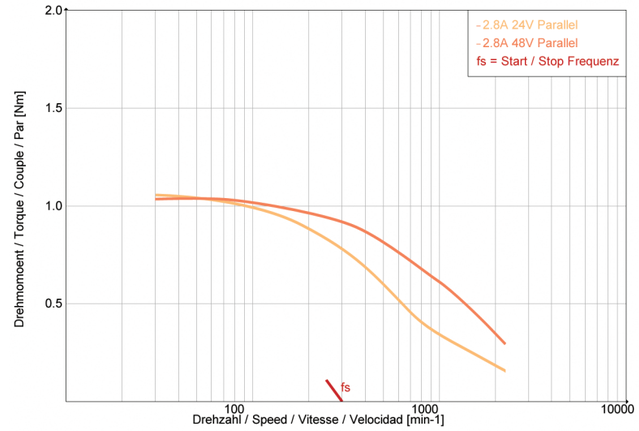



## Speed/torque curves

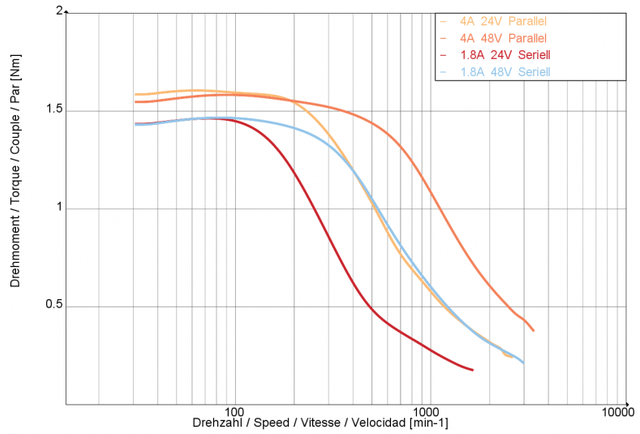
### AS5918S2804




### AS5918M2804




### AS5918L4204



## AP8918 stepper motor with junction box

### Option

Getriebe · Bremse · Steuerung · Encoder

### Cable connection

| Cable connector M16 (MOTOR) | | |
|---|---|---|
| Cable no. | Color | assignment |
| 1 | BLACK (MARKED WITH CABLE NO.) | A |
| 2 | | A\ |
| 3 | | B |
| 4 | | B\ |
| 5 | | Housing |

| Cable connector M16 (ENCODER) | | |
|---|---|---|
| Cable no. | Color | assignment |
| 1 | White | A |
| 2 | Brown | A\ |
| 3 | Green | B |
| 4 | Yellow | B\ |
| 5 | Gray | GND |
| 6 | Pink | I |
| 7 | Blue | I\ |
| 8 | Red | Vcc |

Through their electrical and mechanical interchangeability with the standard motors, the machine-compliant stepper motors up to a protection class of IP 65 (except for shaft output) offer a consistent drive concept.
The extremely compact motor with junction box is only 16 mm longer than standard motors.

Pre-assembled cables permit rapid and error-free wiring and commissioning when used in extreme environment conditions and reduce the amount of work in suppression and EMC activities.

The motors are delivered with a 5-pin shielded cable and an 8-pin shielded cable for the encoder as standard. The cable length is 2 m in each case.

Encoder:
500 increments / rotation, line controller and index (one pulse on 360°), 5 V TTL signal (other encoders available on request)

### Order identifier

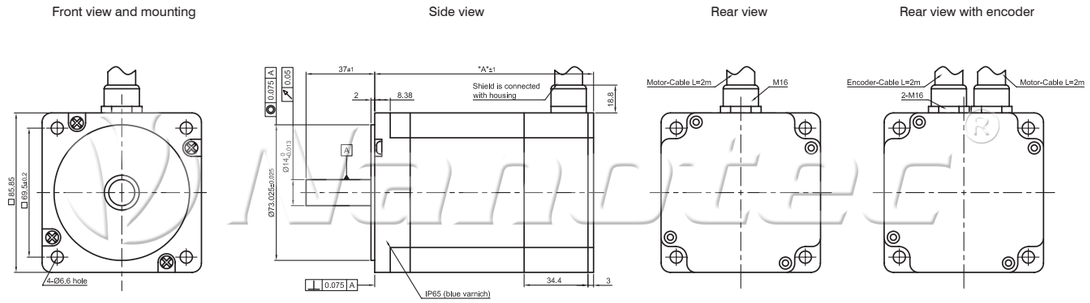
A P 8918M6404 - ○

P = PG gland

without option = with junction box
E = with encoder

### Outline drawing (mm) AP8918 for flange size 86

**AP8918**



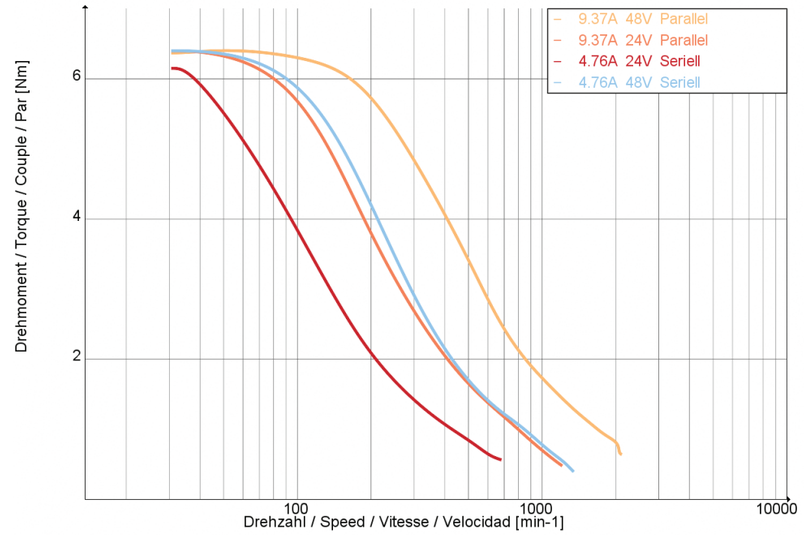

**Available versions (others on request)**

| Type | Current | Holding torque | Resistance | Inductance | Rotor inertia torque | Weight | Length "A" | Encoder |
|---|---|---|---|---|---|---|---|---|
| | A/phase | Ncm | Ohm/phase | mH | g cm² | kg | mm | |
| AP8918M6404 | 6.4 | 594 | 0.33 | 3.00 | 2700 | 3.4 | 118.0 | |
| AP8918M6404-E | 6.4 | 594 | 0.33 | 3.00 | 2700 | 3.5 | 118.0 | X |
| AP8918L9504 | 9.5 | 933 | 0.23 | 2.70 | 3000 | 4.6 | 148.0 | |
| AP8918L9504-E | 9.5 | 933 | 0.23 | 2.70 | 3000 | 4.7 | 148.0 | X |

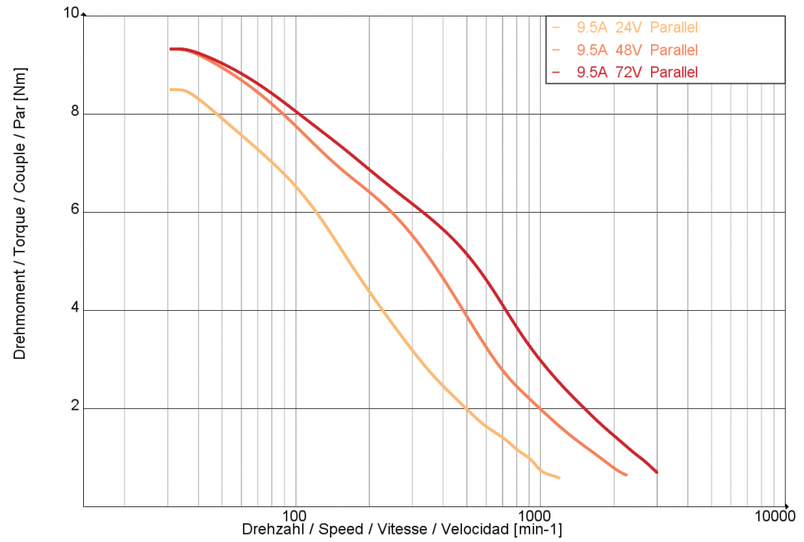


### Speed/torque curves

**AP8918M6404**



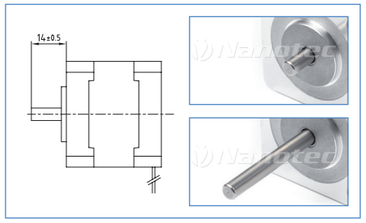

**AP8918L9504**



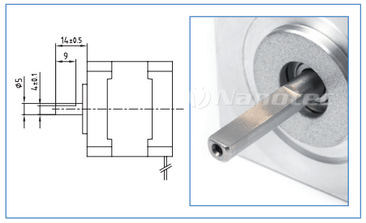
## Special shaft versions for all motors

Adapted, ready to assemble shaft versions allow the constructor and assembly team fast, economic and reliable machine and device adaptation.
Other examples and details - see website: www.nanotec.com
Depending on the complexity of the machine setting, we offer machining from 1, 25 or 250 pieces.
Not all machining options are available for all motor series.

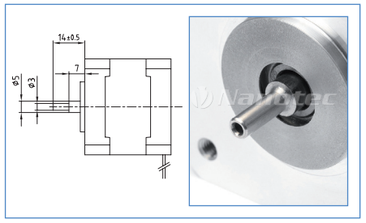
### Shorter (longer) shaft — min. 1 unit



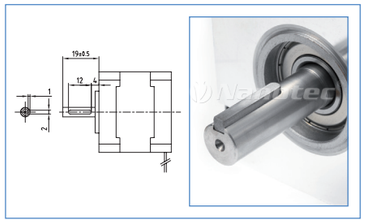

### Flat-sided shaft (D-cut) — min. 1 unit



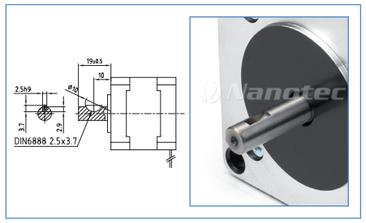

### Thinner shaft — min. 1 unit



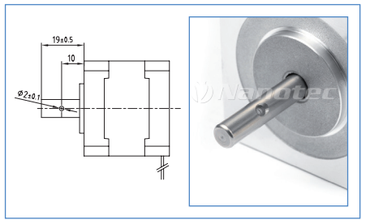

### Shaft with featherkey notch — min. 1 unit




### Shaft with Woodruff key notch — min. 1 unit




### Motor shaft with side-drilled hole — min. 1 unit




### Bigger shaft — on req.

Larger or thicker shafts are used primarily to enable higher radial forces.
Possible for all motors of the ST and DB series.

### Shaft with groove — min. 1 unit

Motors with shaft groove facilitate the attachment of safety disks for axial fixing of timing pulleys, spur gears, etc.
Possible for all motors of the ST and DB series.

### Hollow shaft — on req.

As well as the actual drive, hollow shafts also enable the feeding of cables, tubes or even laser beams through the motor.
Possible for selected motors of the ST series.

### Motor shaft with timing belt wheel — on req.

Motors with pinion or direct gearing mounted on the motor shaft considerably facilitate direct mounting on existing reduction ratios, gears provided by the customer, linear axes etc.

### Shaft with metric thread — on req.

Not only is a thread useful for fixing rotating parts on the motor shaft, but creative constructors also use this low-priced and simple method for the realization of a linear positioning drive with low positioning speed.

### Toothed shaft — on req.

Motors with a toothed shaft facilitate direct mounting on existing reduction ratios, gears, etc. Direct gearing is the best technical and most economical solution for many applications.

### Special transmission elements — on req.

In addition to standard-drive elements, Nanotec also offers its stepper and servomotors with a large number of other transmission elements made of a wide variety of different materials.

### Shaft with spur gear/pinion — on req.

Motors with pinion or direct gearing mounted on the motor shaft considerably facilitate direct mounting on existing reduction ratios, gears, toothed racks, etc.

### Shaft with worm gear — on req.

Motors with worm gear can be installed at an angle of 90° to the load which has an extremely favorable effect on some applications. In addition, they offer high reductionratios in the smallest space.



## Cable assembly

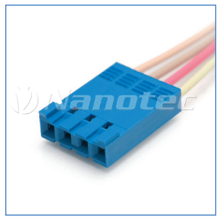
Customer-specific connector versions and cable assembly provide the constructor and assembly team with an easy, fast, economic and reliable electric connection to the machine. Nanotec offers a large number of different connectors for the most favorable and secure solution in each case. For orders of more than 100 pieces, the connector or cable assembly can be carried out very economically.

### with different connectors

**JST connectors**

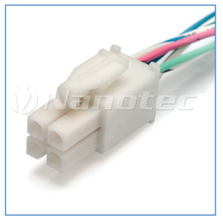
**JST connectors**

**Berg connectors**

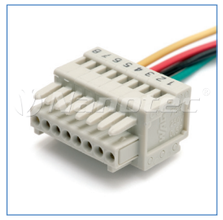


**Lumberg connectors**

**AMP connectors**



**Wago connectors**



**Insulation displacement-connecting technology**

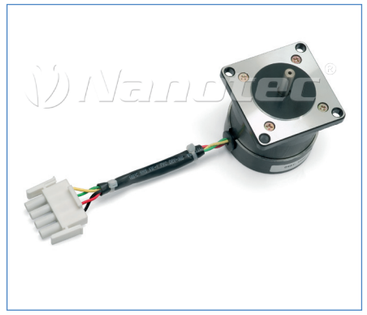
**Sub-D connectors**

**Sub-D connectors**

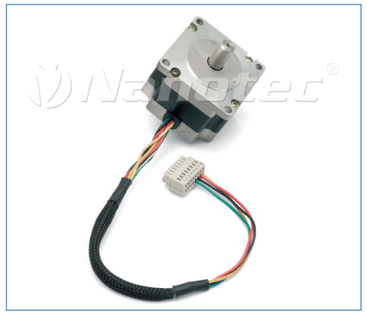
**M12 connectors**

### with different cable assemblies

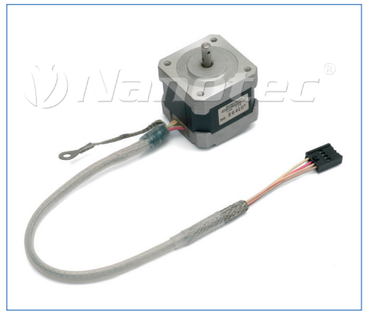
**Heat shrink sleeving**



**Protective braid**



**Braiding**



### with integrated plug

**Twintus connector**

**M12 connectors**

**Sub D-9 or D-15**

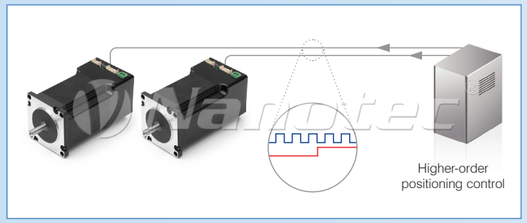
**JST connectors**

**M12 connectors**

# Plug & Drive® Stepper motors

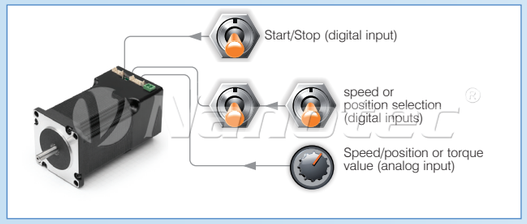



## Motors with integrated controller



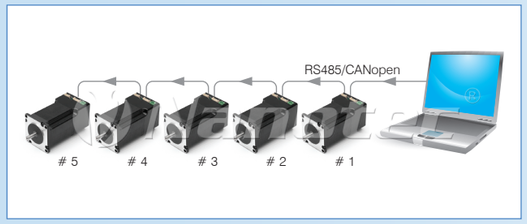

### Clock & direction

- Microstep up to a 64th of a step
- Step multiplication/microstep emulation so that the smooth running of the microstep can also be used with older higher-order controllers that only output fullor half steps.



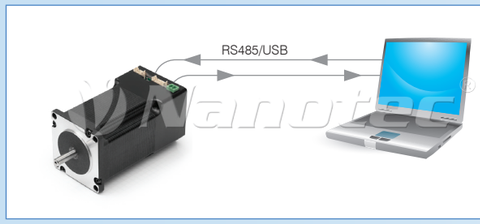

### Control via digital and analog inputs

- Up to 32 movement runs (position or speed profiles) can be stored on te controller,
  selected, started and stopped via digital inputs
- Also speed, position or torque can be controlled via the analog input
- Inputs are freely configurable for additional functions (e.g. reference switch, enable)




### Control over field bus

- Open protocol via RS232/RS485 with adjustable Baud rate of 9.6-115 Kbit
- Standard protocol in compliance with CANopen/DSP402 over CAN-Bus

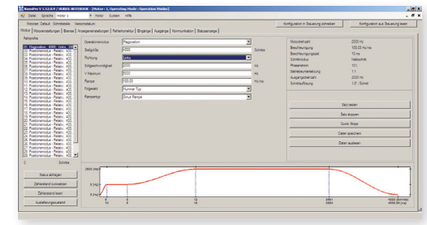



### Sequential control with NanoJ

- Java-based programming language, programs run autonomously (without a PC) on the Plug & Play motor
- Access to all control parameters and inputs/outputs
- Variables, branches, loops, logical and mathematical functions
- Programs can be stored in the controller via RS485/USB

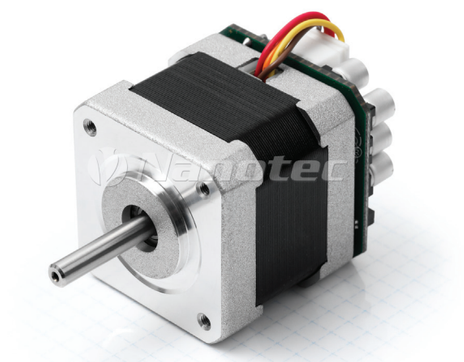
## Simple configuration and start-up with our free-of-charge NanoPro and NanoCAN software.

The NanoPro Windows software can be used to set up and start using a stepper motor in a few minutes.
It is just as easy to set specific motor and machine parameters, set up reference and limit switches, and much more. After the initial configuration of the drive, e.g. in positioning mode, the individual travel profiles – incl. different ramp types such as trapezoidal or sinusoidal ramps – can be set.
The behavior of the drive can be graphically displayed by an integrated scope function which is helpful, especially in the optimization of the control parameters in closed loop mode.
For an initial setting sample values for standard motors are recommended that can be adapted to the requirements of the application by an integrated auto tuning.
The NanoCAN set-up software developed especially for control via CANopen can be used to make the basic settings just as easily as with the NanoPro via RS485.



*After configuration, the positioning can be started either via the digital inputs or directly from a PLC via the interface or another higher-order controller.*

## PD2-O4118 series stepper motor with integrated controller



### Option

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### Pin configuration RS485

| JST-PHDR-12 | | JST-PHDR-8 | |
|---|---|---|---|
| PIN NO. | FUNCTION | PIN NO. | FUNCTION |
| 1 | GND | 1 | GND |
| 2 | Input 1 | 2 | GND |
| 3 | Input 2 | 3 | Rx- |
| 4 | Input 3 | 4 | Rx+ |
| 5 | Input 4 | 5 | Tx- |
| 6 | Input 5 | 6 | Tx+ |
| 7 | Input 6 | 7 | GND |
| 8 | Analog In | 8 | UB 12-24 VDC |
| 9 | Output 1 | | |
| 10 | Output 2 | | |
| 11 | Output 3 | | |
| 12 | GND | | |

### CAN Open pin configuration

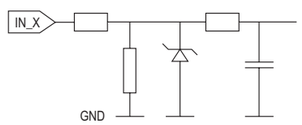
| JST-PHDR-12 | | JST-PHDR-8 | |
|---|---|---|---|
| PIN NO. | FUNCTION | PIN NO. | FUNCTION |
| 1 | GND | 1 | GND |
| 2 | Input 1 | 2 | GND |
| 3 | Input 2 | 3 | n.c. |
| 4 | Input 3 | 4 | n.c. |
| 5 | Input 4 | 5 | CAN low (CAN-) |
| 6 | Input 5 | 6 | CAN high (CAN+) |
| 7 | Input 6 | 7 | GND |
| 8 | Analog In | 8 | UB 12-24 VDC |
| 9 | Output 1 | | |
| 10 | Output 2 | | |
| 11 | Output 3 | | |
| 12 | GND | | |

### Technical data

| | |
|---|---|
| **Operating voltage:** | 12 to 24 V DC |
| **Max. phase current**: | max. 2.7 A (1% steps) = 150%. 100% = 1.8 A |
| **Interface:** | RS485 or CANopen |
| **Operating mode:** | Clock direction, position, speed, flag position, analog, joystick. CANopen: Profile positioning, velocity, homing |
| **Step frequency:** | up to 1MHz at 1/64 |
| **Inputs:** | 6 digital inputs (5V TTL), 1 analog input max. +10/min-10V adjustable |
| **Outputs:** | 3 open collector, 24V / 0.5 A max. |
| **current reduction:** | Adjustable in 1% values |
| **Protection circuit:** | Overvoltage, undervoltage and temperature > 80 °C, integr. ballast switching |
| **Temperature range:** | -10 to + 40 °C |
| **New functions:** | dspDrive / easily programmable as sequential controller with NanoJ |

Attention: An intermediate circuit capacitor of at least 4,700 µF (Z-K4700/50) must be provided on the supply voltage.

### Input circuits




### Order identifier

**PD2-O4118L1804 ②**

2 = RS485
3 = CANopen

### Accessories

**ZK-SMCI12 incl. RS485**
**ZK-SMCI12-IO excl. RS485**
**ZK-SMCI12-3 for CANopen**

Other cable lengths in large quantities on request.

**Available versions (others on request)**

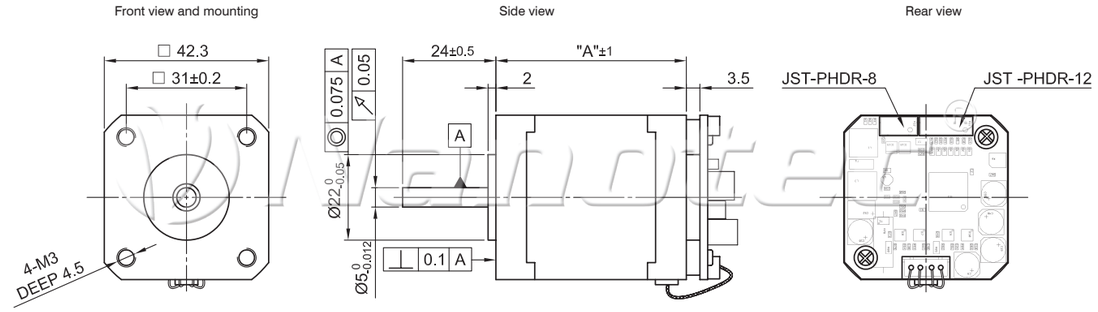
| Type | Holding torque (duration) Ncm | Weight kg | "A" mm | Interface |
|---|---|---|---|---|
| PD2-O4118S1404-2 | 20 | 0,21 | 31 | RS485 |
| PD2-O4118S1404-3 | 20 | 0,21 | 31 | CANopen |
| PD2-O4118L1804-2 | 50 | 0,39 | 49 | RS485 |
| PD2-O4118L1804-3 | 50 | 0,39 | 49 | CANopen |





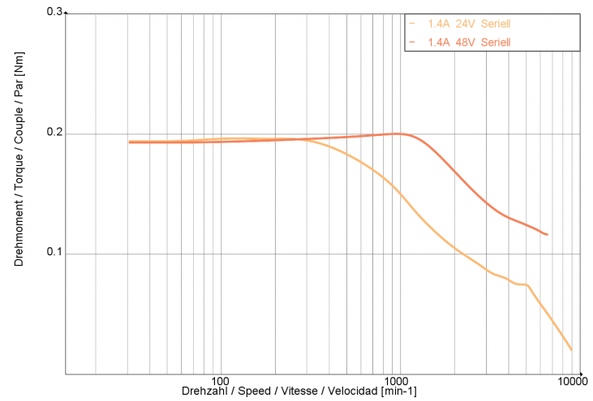
### Outline drawing (in mm)

**PD2NO4118**

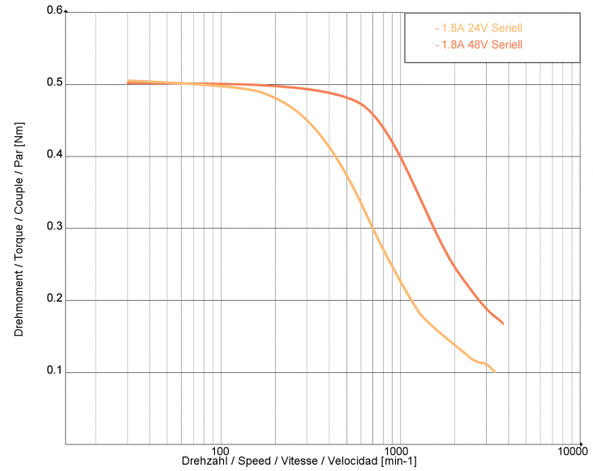



### Speed/torque curves

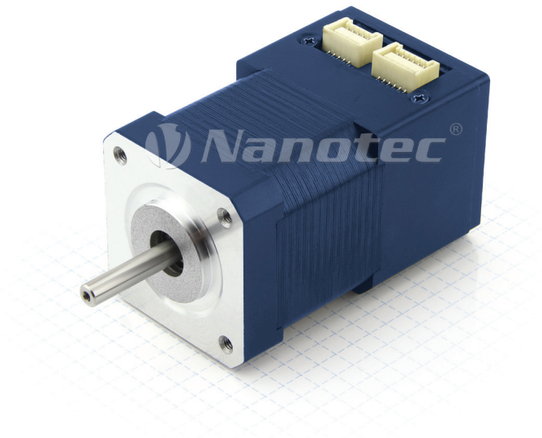
**PD2-O4118S1404**




**PD2-O4118L1804**



## PD2-N4118 series stepper motor with integrated controller



**Option**

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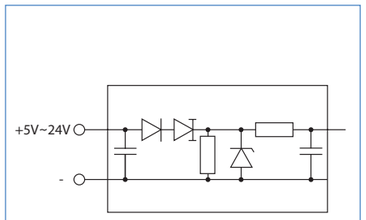
### Technical data

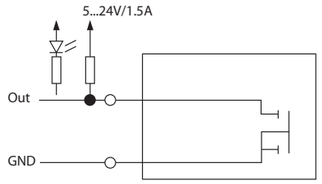
| | |
|---|---|
| **Operating voltage:** | 12 to 48 V DC |
| **Max. phase current**: | Adjustable per software up to 2.7 A (1% steps), 100%=1.8 A |
| **Interface:** | RS485 or CANopen |
| **Operating mode:** | Position, speed, flag position, clock direction, analog, analog position, torque |
| **Operating mode:** | 1/1, 1/2, 1/4, 1/5, 1/8, 1/10, 1/32, 1/64, adaptive (1/128) |
| **Step frequency:** | 0 to 50 kHz in the clock/direction mode, 0 to 25 kHz in all other modes |
| **Inputs:** | 6 digital inputs (5-24 V), 1 analog input (+-10V) |
| **Outputs:** | Open-Drain (0 switching, max. 24 V/0.5 A) |
| **Position monitoring:** | Automatic error correction up to 0.9° |
| **Current reduction:** | Adjustable in 1% values |
| **Protection circuit:** | Overvoltage and heatsink temperature > 80 °C |
| **Temperature range:** | -10 to + 40 °C |
| **Connection type :** | Connection with JST connectors, M12 variant possible |
| **New functions:** | Closed loop / sinusoidal commutation / dspDrive / easily programmable as sequential controller with NanoJ |

Attention: An intermediate circuit capacitor of at least 4,700 µF (Z-K4700/50) must be provided on the supply voltage.

### Input circuits




### Output circuits




### Pin configuration

| JST-ZPD-10 | | JST-ZPD-12 | |
|---|---|---|---|
| PIN NO. | FUNCTION | PIN NO. | FUNCTION |
| 1 | GND | 1 | GND |
| 2 | GND | 2 | Input 1 |
| 3 | RS485 Rx- | 3 | Input 2 |
| 4 | RS485 Rx+ | 4 | Input 3 |
| 5 | RS485 Tx- | 5 | Input 4 |
| 6 | RS485 Tx+ | 6 | Input 5 |
| 7 | GND | 7 | Input 6 |
| 8 | Vcc | 8 | Analog input |
| 9 | Vcc | 9 | Output 1 |
| 10 | GND | 10 | Output 2 |
| | | 11 | Output 3 |
| | | 12 | GND |

### Accessories

**ZK-PD2N**
Connecting cable set
500 mm long with connector

**ZIB-PDx-N** Interface board for rapid commissioning

**ZK-RS485-USB**
RS485-USB cable for PC connection

### Order identifier

**PD2-N4118L1804**
2= RS485
3= CANopen

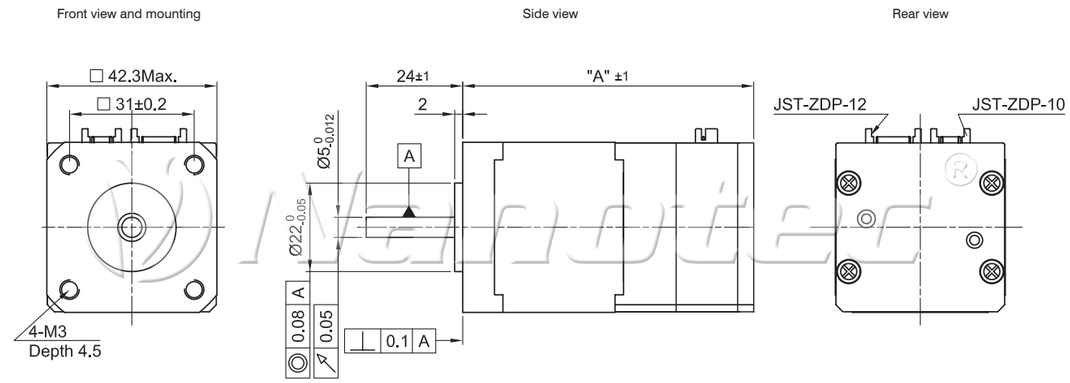
### Available versions (others on request)

| Type | Holding torque (duration) Ncm | Weight kg | "A" mm |
|---|---|---|---|
| PD2-N4118L1804 | 50 | 0,39 | 72 |



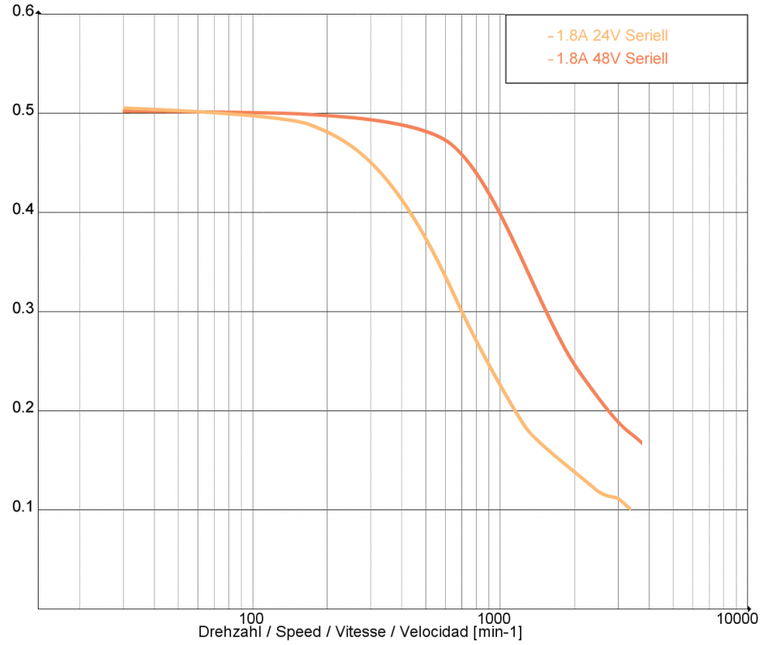
### Outline drawing (in mm)

**PD2-N4118...**




### Speed/torque curves

**PD2-N4118L1804**



## PD4-N5918/N6018 series stepper motor with integrated controller

### Option

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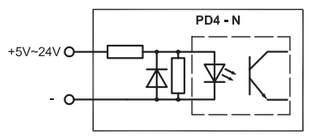
### Technical data

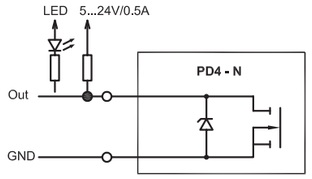
| | |
|---|---|
| **Operating voltage:** | 24 to 48 V DC |
| **Max. phase current**: | Adjustable per software up to 4.8 A (1% steps), 100%=3.2 A |
| **Interface:** | RS485 or CANopen |
| **Operating mode:** | Position, speed, flag position, clock direction, analog, analog position, torque |
| **Operating mode:** | 1/1, 1/2, 1/4, 1/5, 1/8, 1/10, 1/32, 1/64, adaptive (1/128) |
| **Step frequency:** | 0 to 50 kHz in the clock/direction mode, 0 to 25 kHz in all other modes |
| **Inputs:** | 6 optocoupler inputs (5 - 24 V) |
| **Outputs:** | Open-Drain (0 switching, max. 24 V/0.5 A) |
| **Position monitoring:** | Automatic error correction up to 0.9° |
| **Current reduction:** | Adjustable in 1% values |
| **Protection circuit:** | Overvoltage and heatsink temperature > 80 °C |
| **Temperature range:** | -10 to + 40 °C |
| **Connection type :** | Connector with JST plugs |
| **New functions:** | Closed loop / sinusoidal commutation / dspDrive / easily programmable as sequential controller with NanoJ |

Attention: An intermediate circuit capacitor of at least 4,700 µF (Z-K4700/50) must be provided on the supply voltage.

### Input circuits




### Output circuits




### Pin configuration

**JST PHD-8**

| PIN | CABLE COLOR | ASSIGNMENT |
|---|---|---|
| 1 | Blue | GND |
| 2 | White/pink | +Vb external |
| 3 | Yellow | RS485 Rx- |
| 4 | Green | RS485 Rx+ |
| 5 | Pink | RS485 Tx- |
| 6 | Gray | RS485 Tx+ |
| 7 | Brown | CAN+ |
| 8 | White | CAN- |

**JST PHD-12**

| PIN | CABLE COLOR | ASSIGNMENT |
|---|---|---|
| 1 | Gray/brown | COM |
| 2 | Red | GND |
| 3 | Black | Input 1 |
| 4 | Violet | Input 2 |
| 5 | Gray/pink | Input 3 |
| 6 | Red/blue | Input 4 |
| 7 | White/green | Input 5 |
| 8 | Brown/green | Input 6 |
| 9 | White/blue | Analog input |
| 10 | White/yellow | Output 1 |
| 11 | Yellow/brown | Output 2 |
| 12 | White/gray | Output 3 |

**PHÖNIX CONNECTOR FK-MCP 1.5/2-ST-3.5**

| PIN | CABLE COLOR | ASSIGNMENT |
|---|---|---|
| 1 | 1 | GND |
| 2 | 2 | UB_IN |

### Accessories

**ZK-PD4N**
Connecting cable set
500 mm long with connector

**ZIB-PDx-N** Interface board for rapid commissioning

**ZK-RS485-USB**
RS485-USB cable for PC connection

### Order identifier

**PD4-N5918X4204**
**PD4-N5918M4204**
**PD4-N5918L4204**

**PD4-N6018L4204**

### Available versions (others on request)

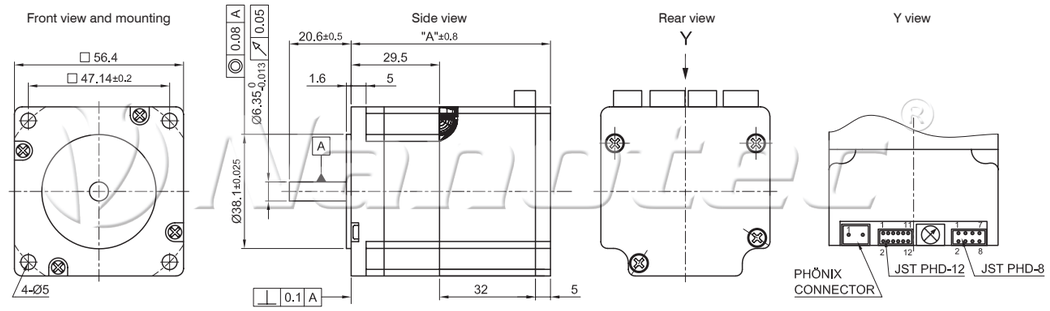
| Type | Holding torque Ncm | Weight kg | "A" mm |
|---|---|---|---|
| PD4-N5918X4204 | 53.7 | 0.49 | 66.5 |
| PD4-N5918M4204 | 113.0 | 0.80 | 80.6 |
| PD4-N5918L4204 | 198.0 | 1.22 | 101.6 |
| PD4-N6018L4204 | 354.0 | 1.48 | 112.5 |



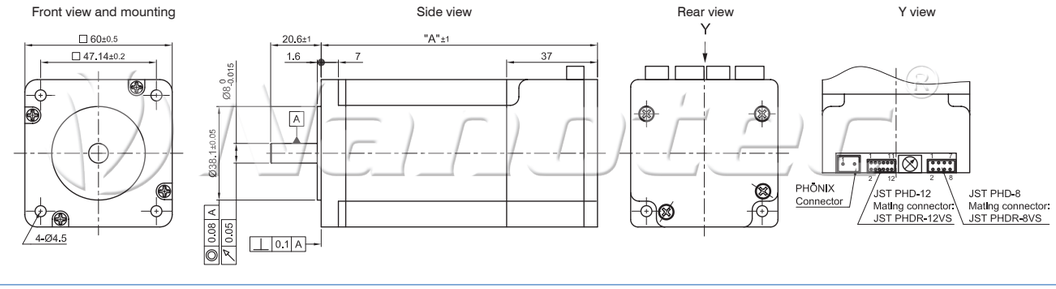


### Outline drawing (in mm)

**PD4-N5918...**

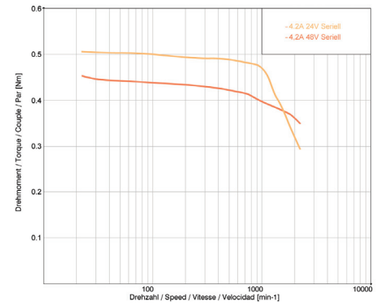



**PD4-N6018L4204**

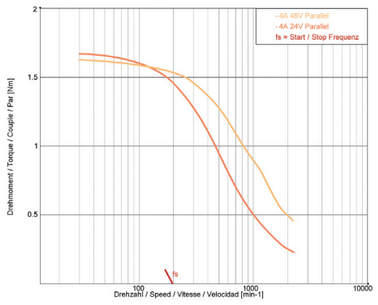



### Speed/torque curves

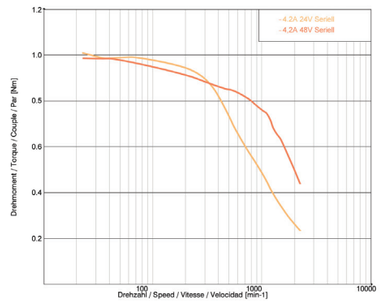
**PD4-N5918X4204**



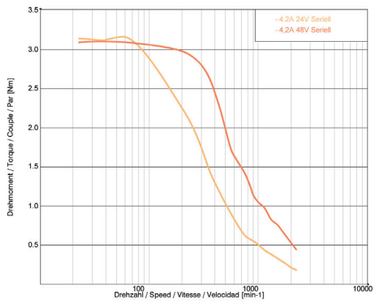

**PD4-N5918L4204**




**PD4-N5918M4204**




**PD4-N6018L4204**



# PD4-N5918 series stepper motor with integrated controller and junction box in protection class IP65

## Option

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## Technical data

| | |
|---|---|
| **Operating voltage:** | 24 to 48 V DC |
| **Max. phase current**: | Adjustable per software up to 4.8 A (1% steps), 100%=3.2 A |
| **Interface:** | RS485 or CANopen |
| **Operating mode:** | Position, speed, flag position, clock direction, analog, analog position, torque |
| **Operating mode:** | 1/1, 1/2, 1/4, 1/5, 1/8, 1/10, 1/32, 1/64, adaptive (1/128) |
| **Step frequency:** | 0 to 50 kHz in the clock/direction mode, 0 to 25 kHz in all other modes |
| **Inputs:** | 6 optocoupler inputs (5 - 24 V) |
| **Outputs:** | Open-Drain (0 switching, max. 24 V/0.5 A) |
| **Position monitoring:** | Automatic error correction up to 0.9° |
| **Current reduction:** | Adjustable in 1% values |
| **Protection circuit:** | Overvoltage and heatsink temperature > 80 °C |
| **Temperature range:** | -10 to + 40 °C |
| **Connection type :** | M12 |
| **New functions:** | Closed loop / sinusoidal commutation / dspDrive / easily programmable as sequential controller with NanoJ |

Attention: An intermediate circuit capacitor of at least 4,700 µF (Z-K4700/50) must be provided on the supply voltage.

## Order identifier

**PD4-N5918L4204 - IP - 2**

**IP = with IP protection**

2 = RS485

3 = CANopen

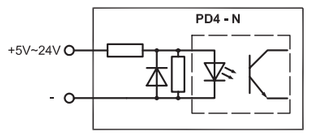
## Pin configuration RS485

| M12 CONNECTOR 17 PIN | | M12 CONNECTOR 5 PIN | |
|---|---|---|---|
| FUNCTION | PIN NO. | FUNCTION | PIN NO. |
| Output 1 | 1 | 24 - 48 V | 1 |
| Output 2 | 8 | 24 - 48 V | 2 |
| Output 3 | 3 | Power GND | 3 |
| Analog input | 4 | Power GND | 4 |
| +VB External | 5 | N.C. | 5 |
| GND | 6 | | |
| RS485 Tx+ | 7 | | |
| RS485 Tx- | 10 | | |
| RS485 Rx- | 9 | | |
| RS485 Rx+ | 2 | | |
| Input 1 | 11 | | |
| Input 2 | 12 | | |
| Input 3 | 13 | | |
| Input 4 | 14 | | |
| Input 5 | 15 | | |
| Input 6 | 16 | | |
| NC | 17 | | |

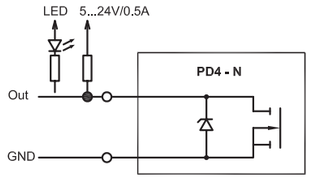
## CAN Open pin configuration

| M12 CONNECTOR 17 PIN | | M12 CONNECTOR 5 PIN | |
|---|---|---|---|
| FUNCTION | PIN NO. | FUNCTION | PIN NO. |
| Output 1 | 1 | 24 - 48 V | 1 |
| Output 2 | 2 | 24 - 48 V | 2 |
| Output 3 | 3 | Power GND | 3 |
| Analog input | 4 | Power GND | 4 |
| +VB External | 5 | N.C. | 5 |
| GND | 6 | | |
| CAN - H | 7 | | |
| CAN - L | 10 | | |
| N.C. | 9 | | |
| N.C. | 8 | | |
| Input 1 | 11 | | |
| Input 2 | 12 | | |
| Input 3 | 13 | | |
| Input 4 | 14 | | |
| Input 5 | 15 | | |
| Input 6 | 16 | | |
| NC | 17 | | |

## Input circuits




## Output circuits




## Accessories

**ZK-M12-17-1m-2-pur-S, angled, L=1.5m**

**ZK-M12-5-2m-2-pur-S, angled, L=2m**

Other cable lengths in large quantities on request.

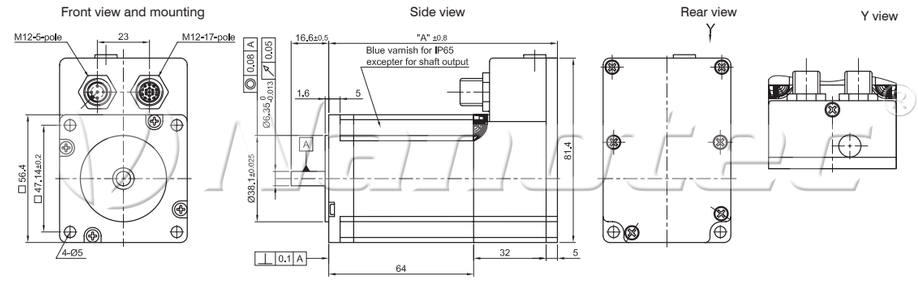
**Available versions (others on request)**

| Type | Holding torque Ncm | Weight kg | "A" mm | Interface |
|---|---|---|---|---|
| PD4-N5918X4204-IP-2 | 53.7 | 0.49 | 66.5 | RS485 |
| PD4-N5918X4204-IP-3 | 53.7 | 0.49 | 66.5 | CANopen |
| PD4-N5918M4204-IP-2 | 113.0 | 0.80 | 80.6 | RS485 |
| PD4-N5918M4204-IP-3 | 113.0 | 0.80 | 80.6 | CANopen |
| PD4-N5918L4204-IP-2 | 198.0 | 1.22 | 101.6 | RS485 |
| PD4-N5918L4204-IP-3 | 198.0 | 1.22 | 101.6 | CANopen |
| PD4-N6018L4204-IP-2 | 354.0 | 1.48 | 112,0 | RS485 |
| PD4-N6018L4204-IP-3 | 354.0 | 1.48 | 112,0 | CANopen |

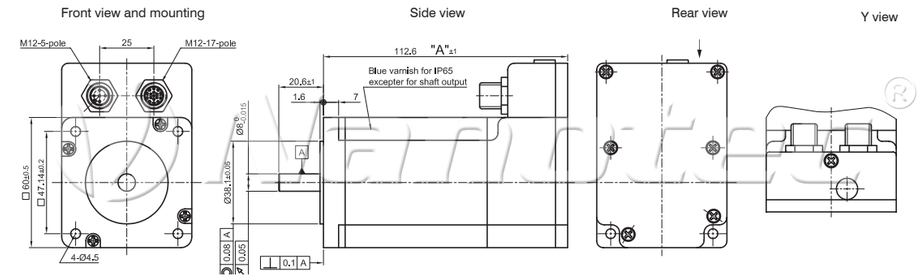


## Outline drawing (in mm)

### PD4N5918...-IP

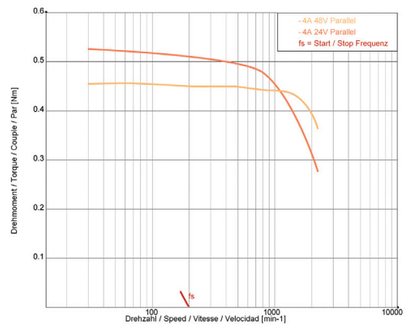



### PD4N6018...-IP

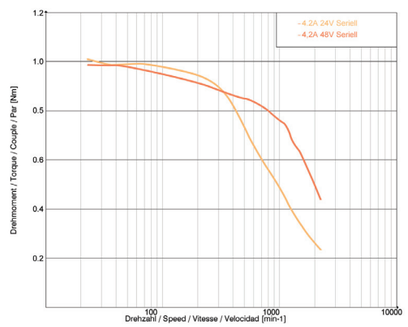



## Speed/torque curves

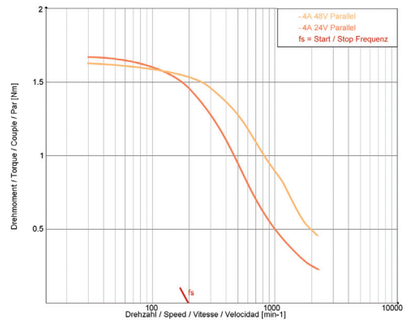
### PD4-N5918X4204



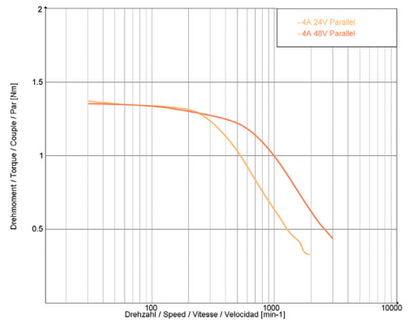

### PD4-N5918M4204



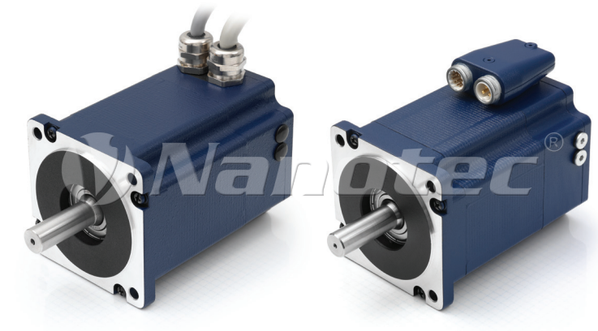

### PD4-N5918L4204




### PD4-N6018L4204



## PD6-N8918 series stepper motor with integrated controller



### Option

Getriebe

### Technical data

| | |
|---|---|
| **Operating voltage:** | 24 to 48 V DC |
| **Max. phase current**: | Adjustable up to max. 10.5 A/phase, 7A nominal current |
| **Interface:** | RS485 or CANopen |
| **Operating mode:** | Position, speed, flag position, clock direction, analog, analog position, torque |
| **Position monitoring:** | Automatic error correction up to 0.9° |
| **Operating mode:** | 1/1, 1/2, 1/4, 1/5, 1/8, 1/10, 1/32, 1/64, adaptive (1/128) |
| **Step frequency:** | 0 to 50 kHz in the clock/direction mode, 0 to 25 kHz in all other modes |
| **Inputs:** | 6 optocoupler inputs (5..24 V), analog input |
| **Outputs:** | Open-Drain (0 switching, max. 24 V/1.5 A) |
| **Current reduction:** | Adjustable in 1% values |
| **Protection circuit:** | Overvoltage and heatsink temperature > 80 °C |
| **Temperature range:** | 0 to + 40 °C |
| **Connection type :** | 2 x 2 m cable |

Attention: An intermediate circuit capacitor of at least 4,700 $\mu$F (Z-K4700/50) must be provided on the supply voltage.

### Pin configuration of cable

**SIGNAL CABLE**

| FUNCTION | COLOR |
|---|---|
| Input 1 | Black |
| Input 2 | Violet |
| Input 3 | Gray/pink |
| Input 4 | Red/blue |
| Input 5 | White/green |
| Input 6 | Brown/green |
| Analog input | White/blue |
| Output 1 | White/yellow |
| Output 2 | Yellow/brown |
| Output 3 | White/gray |

**SIGNAL CABLE**

| FUNCTION | COLOR |
|---|---|
| RS485 Tx+ | Gray |
| RS485 Tx- | Pink |
| RS485 Rx- | Yellow |
| RS485 Rx+ | Green |
| CAN + | Brown |
| CAN - | White |
| Signal GND (COM) | Gray/brown |
| GND | blue + pink/brown |
| GND LOGIC | Red |
| + UB LOGIC | White/pink (20~48V) |

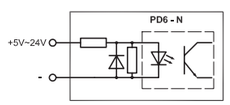
**POWER CABLE**

| FUNCTION | Cable no./COLOR |
|---|---|
| + UB | 1 |
| GND | 2 |
| PROTECTIVE CABLE | Green/yellow |

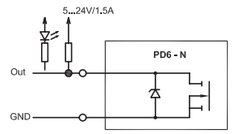
### M16 Twintus connector pin configuration

| M16 CONNECTOR 18 PIN | | M16 CONNECTOR 3 PIN | |
|---|---|---|---|
| FUNCTION | PIN NO. | FUNCTION | PIN NO. |
| Output 1 | 1 | + UB | 1 |
| Output 2 | 2 | GND | 2 |
| Output 3 | 3 | Protective wire | 3 |
| Analog input | 4 | | |
| +VB External | 5 | | |
| GND | 6 | | |
| RS485 Tx+ | 7 | | |
| RS485 Tx- | 8 | | |
| RS485 Rx- | 9 | | |
| RS485 Rx+ | 10 | | |
| Input 1 | 11 | | |
| Input 2 | 12 | | |
| Input 3 | 13 | | |
| Input 4 | 14 | | |
| Input 5 | 15 | | |
| Input 6 | 16 | | |
| CAN - | 17 | | |
| CAN + | 18 | | |

### Input circuits




### Output circuits




### Accessories

**ZIB-PDx-N** Interface board for rapid commissioning
**ZK-RS485-USB**
RS485-USB cable for PC connection
**ZK-TW-18 length 2 m**
**ZK-TW-3 length 2 m**
Cable for Twintus connector
Other lengths on request (from 50 units)

### Order identifier

**PD6-N8918S6404 -S**
**S = motor length**
**S = M16 Twintus connector**

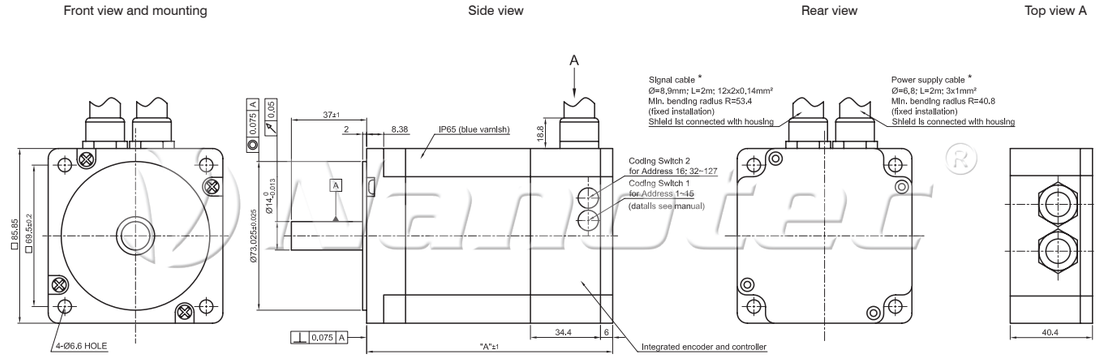
### Available versions (others on request)

| Type | Holding torque Ncm | Supply voltage Ncm | Weight kg | "A" mm | Option with Twintus connector |
|---|---|---|---|---|---|
| PD6-N8918S6404 | 320 | 24-48 | 1.7 | 89 | |
| PD6-N8918S6404-S | 320 | 24-48 | 1.7 | 89 | X |
| PD6-N8918M9504 | 590 | 24-48 | 3.4 | 121 | |
| PD6-N8918M9504-S | 590 | 24-48 | 3.4 | 121 | X |
| PD6-N8918L9504 | 930 | 24-48 | 4.0 | 151 | |
| PD6-N8918L9504-S | 930 | 24-48 | 4.0 | 151 | X |

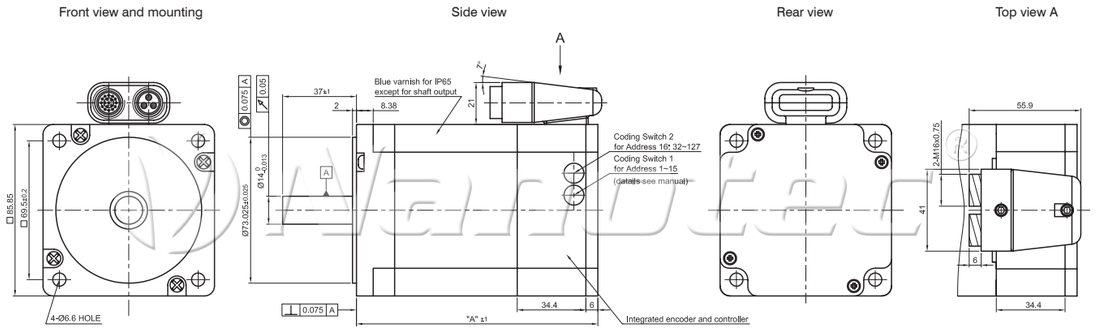


### Outline drawing (in mm)

**PD6-N8918...**

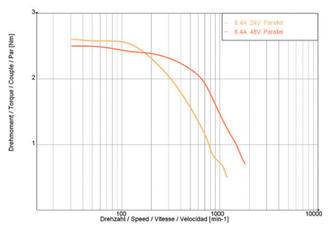



**PD6-N8918...-S**

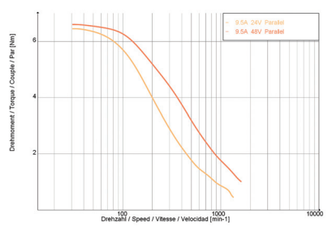



### Speed/torque curves

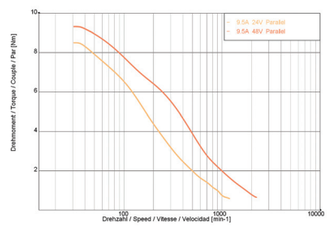
**PD6-N8918S6404**




**PD6-N8918M9504**




**PD6-N8918L9504**



# Linear actuators

## General information on linear actuators

### Advantages

**The universal linear drives from Nanotec offer a variety of new, cost-effective and powerful applications.**

- Simple and flexible motor construction considerably reduces system costs
- Stroke-independent movement to any position
- Highly reproducible resolutions (<1 µm) and fast feeds (>1000 mm/s) for the same construction volume achieve uniform construction platforms
- Direct force coupling to the load requires no additional components, thus offering rigid and light mechanics
- Static spindles enable highly dynamic and rigid machine constructions as well as multimotor operation
- Due to low energy requirements, even high forces can be delicately regulated
- Partly self-locking so no additional brake is necessary
- Travel depends solely on the available spindle length
- Replacement for hydraulic and pneumatic cylinders with considerably higher flexibility

**Performance calculation for selecting linear actuators**
The achievable resolutions, feed speeds and forces are calculated based on the spindle pitch (p in mm), torque (Md in Nm) and efficiency for a stepper motor as follows:

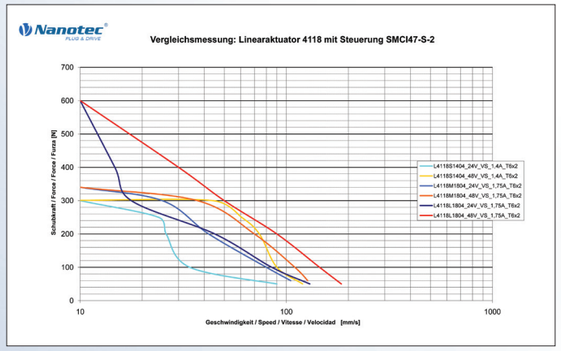
- Resolution in mm/step = p / (360° / step angle) e.g. 1 mm / (360°/0.9°) = 0.0025 mm/step
- Feed speed = speed x spindle pitch, e.g. 900 rpm x 2 mm = 30 mm/s
- Thrust in N = MdMot • 2π • efficiency / p e.g. L4118S approx. 0.22 Nm (at 48 V, 900 rpm, with 2 mm spindle pitch):
  F = 0.22 Nm • 6.28 • 0.43/0.002 m = 297 N

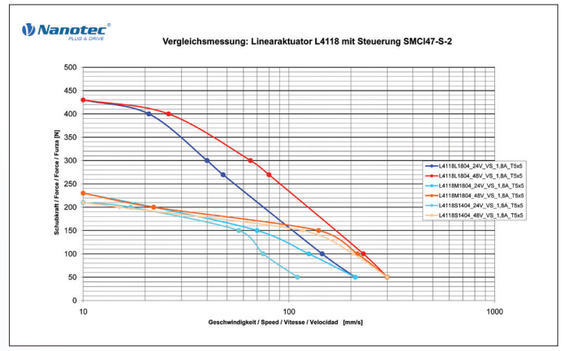
Efficiency = The efficiency of a trapezoidal linear drive is approx. 0.3-0.6, depending on the diameter and pitch, nut material and lubrication.

**Curve comparison for selecting a linear actuator**

The achievable resolutions, feed speeds and forces are calculated based on the spindle pitch (p in mm), torque (Md in Nm) and efficiency for a stepper motor. The curve comparision makes the differences obvious that need to be taken into account during the selection process.

Both graphics show the curves of an output comparison of the L4118 linear actuator model with T5x5 and T6x2 thread:




Note: It is important to ensure that **no** lateral forces affect the spindle and that the spindle runs concentrically to the motor shaft.. To achieve the linear motion, the spindle must be locked against rotation.

The force and power ratings specified in the datasheets are based on a power-up time of approx. 10% - 20% and must be reduced accordingly for higher values. The axial play in the direction of the motor is approx. 0.1 to 0.7 mm at 20N.
Different processes for surface treatment of the spindle greatly reduce the friction coefficient and improve resistance to abrasion.

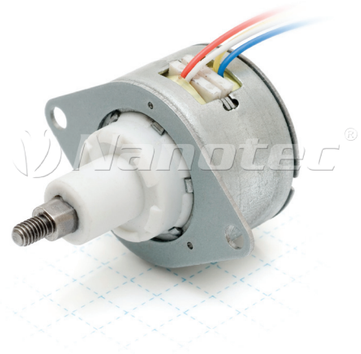
Normally the spindles are wedged or fixed into the moving part. For all other application where this fixing is not possible or a free spindle end must move the load, Nanotec offers linear actuators complete with the relevant trapezoidal screw thread, see pages 73, 75, 77. The displacement distance must then be specified (see Accessories, Spindle).

# Permanent magnet stepper motor linear actuator LP2515-LP3575

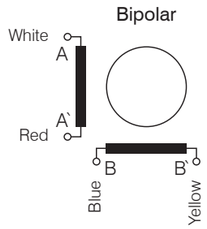
Via the threaded bush integrated into the motor, the rotational movement can be converted to a linear movement without a complex construction. This compact construction therefore allows space and weight-saving linear adjustment which the LP. provides at very low cost in terms of force and speed.

Note: The LP.. motors are supplied including spindle.

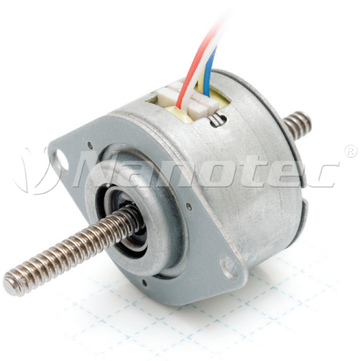
## LPV2515S0104



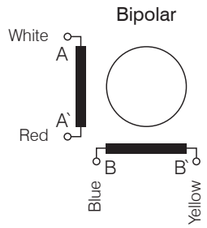
## Pin configuration




## LP2515S0104

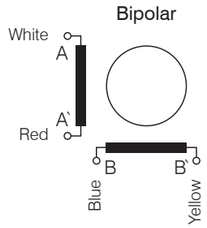


## Pin configuration




## LP3575S0504

## Pin configuration

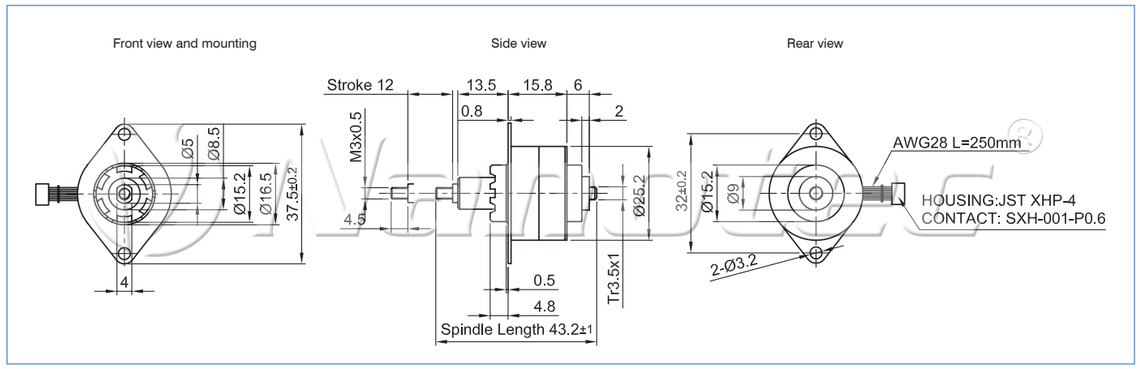



**Available versions (others on request)**

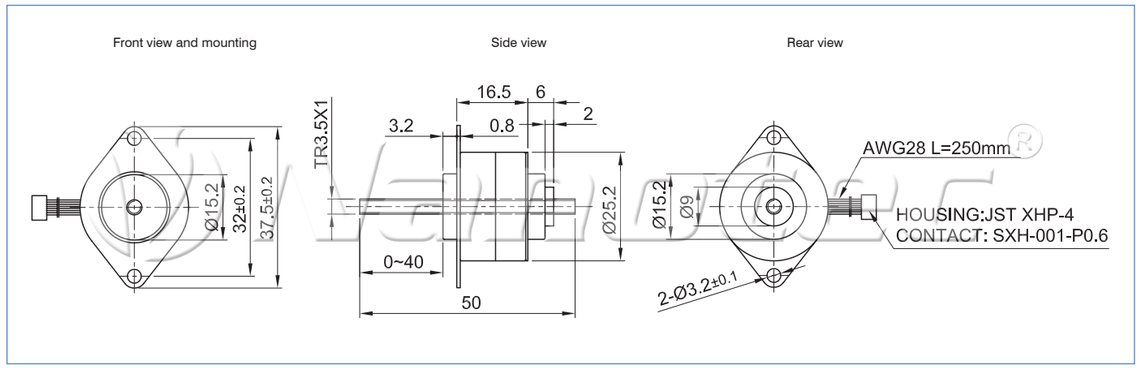
| Type | Thrust | Resolution | Spindle Pitch | Travel distance | Current | Resistance per winding | Step angle | Weight | Length "A" |
|---|---|---|---|---|---|---|---|---|---|
| | N | mm/step | mm | mm | A/winding | Ohm/winding | | kg | mm |
| | ----------Data in full step---------- | | | | | | | | |
| LPVD2515S0104-TR3.5 | 5 | 0.0417 | 1.00 | 12 | 0.10 | 53 | 15.0 | 0.036 | 15.8 |
| LP2515S0104-TR3.5X1 | 5 | 0.0417 | 1.00 | 40 | 0.10 | 53 | 15.0 | 0.036 | 16.5 |
| LP3575S0504-TR3.5X1.22 | 55 | 0.0254 | 1.22 | 75 | 0.46 | 11 | 7.5 | 0.086 | 17.5 |

All data refer to 1 half of the winding or unipolar!

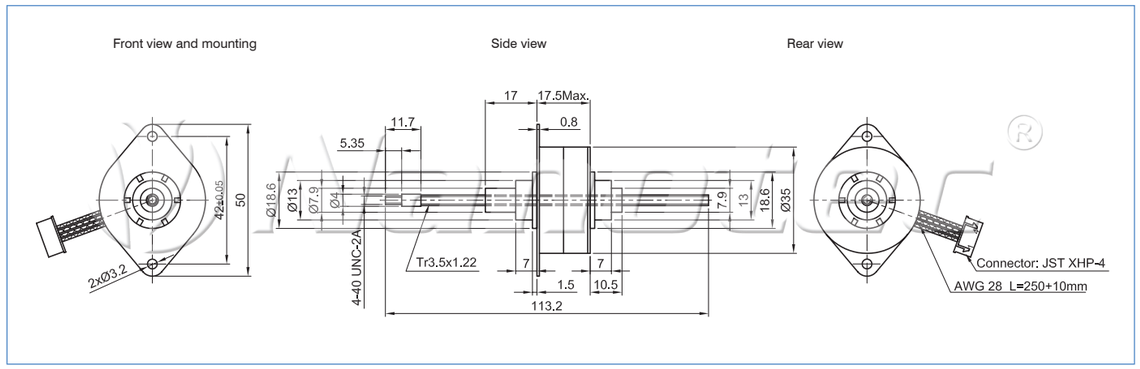
## LPV2515S0104 outline drawing (in mm)



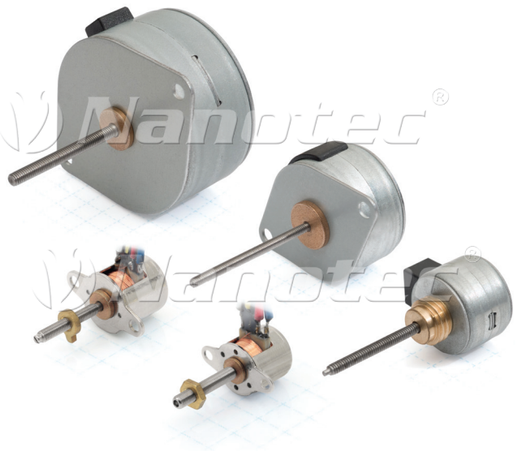

## LP2515S0104 outline drawing (in mm)




## Outline drawing LP3575S0504 (in mm)



## Permanent magnet linear positioning drive types LSP0818 - LSP4275

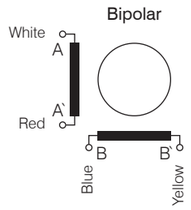


**Option**

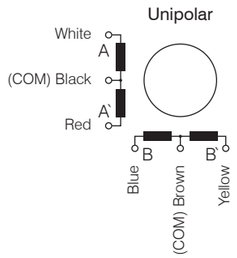
Steuerung

**Pin configuration**

**LSP08.., 10.., 15..**




**LSP25.., 35.., 42..**




The LSP linear positioning drives are based on a permanent magnet stepper motor with a metric thread on the motor shaft so that any rotation of the motor shaft with a matching nut is translated into a linear motion.
The actuators allow finely graduated linear adjustments, e.g. for adjusting and positioning sensors and mirrors in medical and optical equipment. They are also suitable for constructional tasks in the field of clamping, opening and closing as well as precision adjustment of valve and flap adjustments in conditioning and control systems.

**Available versions (others on request)**

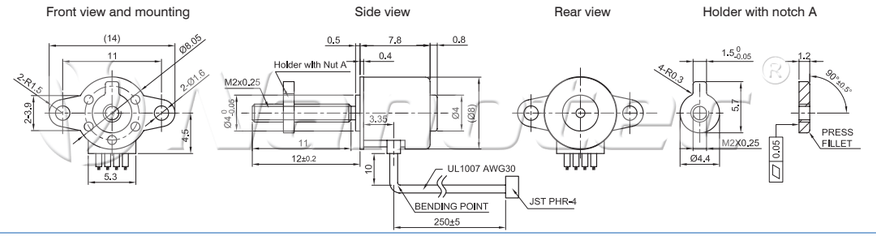
| Type | Thrust max. F (N) | max. Precision feed control mm/s | Resolution mm/step | Spindle pitch (mm) | Thread Length mm | Current A/winding | Resistance per winding Ohm/winding | Inductance per winding mH/winding | Weight kg | Length "A" mm |
|---|---|---|---|---|---|---|---|---|---|---|
| | | ----------Data in full step---------- | | | | | | | | |
| LSP0818M0104-M2X0.25 | 0.8 | 20 | 0.014 | 0.25 | 11.0 | 0.12 | 13 | 1.5 | 0.003 | 7.8 |
| LSP1018M0204-M2X0.25 | 4.0 | 20 | 0.014 | 0.25 | 13.5 | 0.22 | 15 | 3.0 | 0.0043 | 10.0 |
| LSP1518M0104-M2X0.4 | 3.0 | 20 | 0.020 | 0.40 | 18.0 | 0.07 | 170 | 28.0 | 0.013 | 11.0 |
| LSP2575M0506-M2X0.4 | 10.0 | 15 | 0.008 | 0.40 | 30.0 | 0.50 | 10 | 2.0 | 0.038 | 15.0 |
| LSP3575M0206-M3X0.5 | 40.0 | 10 | 0.010 | 0.50 | 30.0 | 0.22 | 60 | 45.0 | 0.094 | 22.0 |
| LSP4275M0206-M3X0.5 | 50.0 | 10 | 0.010 | 0.50 | 30.0 | 0.18 | 70 | 72.0 | 0.134 | 22.0 |

All data refer to 1 half of the winding or unipolar!

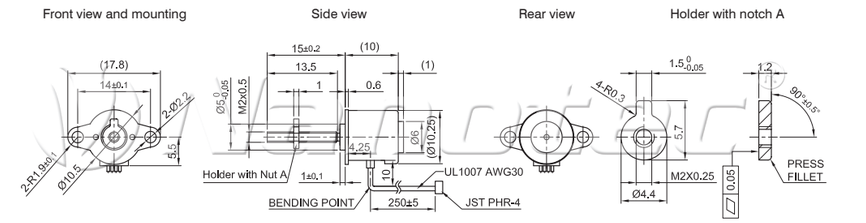


**Outline drawing (mm)**

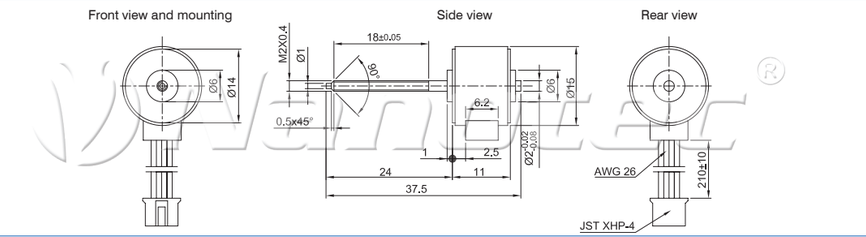
**LSP0818M0104**



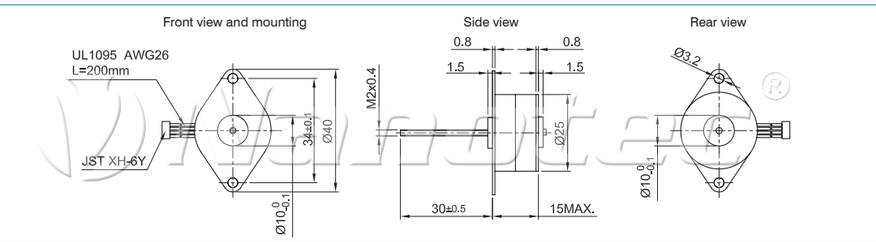

**LSP1018M0204**



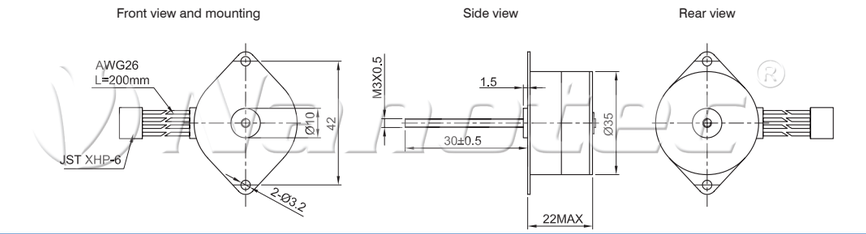

**LSP1518M0104**



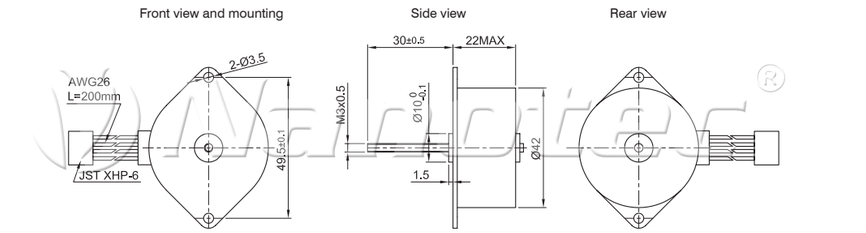

**LSP2575M0506**




**LSP3575M0206**




**LSP4275M0205**

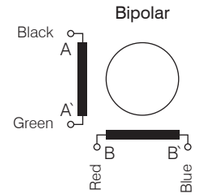


## Linear actuator with trapezoidal screw thread (size 20 mm)

### Option

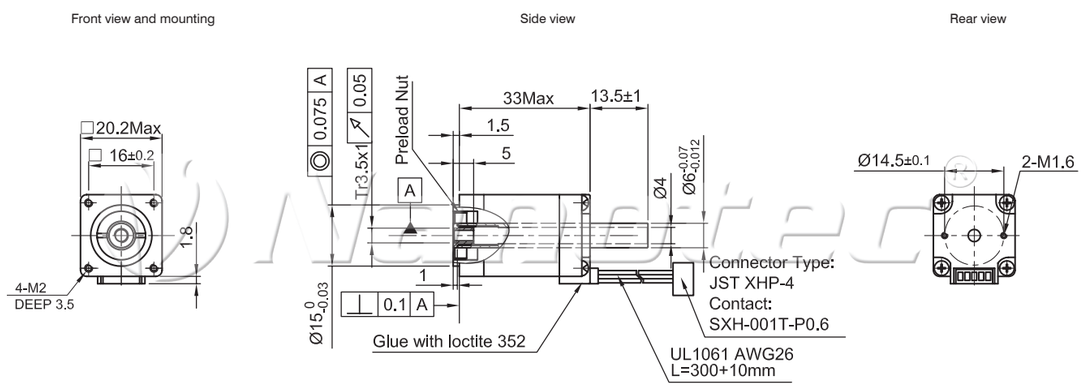
Encoder | Steuerung

### Pin configuration




Note: Matching thread spindles and lubricant directions for the integrated PEEK nuts can be found in the Accessories section. (please order spindle separately).

### L2018... outline drawing (in mm)



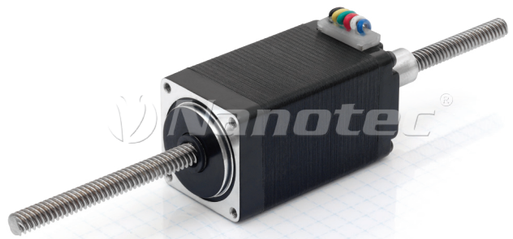

### Available versions (others on request)

| Type | Thrust max. F N | Precision feed control max. mm/s at 48 V | Spindle pitch mm | Resolution mm/step | Current/ winding A | Resistance Ohm/windg. | Inductance mH | Weight kg | Bush length 'L' mm | Motor length "A" mm |
|---|---|---|---|---|---|---|---|---|---|---|
| | ----------Data in full step---------- | | | | | | | | | |
| L2018S0604 -T3.5x1 | 40 | 40 | 1.0 | 0.025 | 0.67 | 5.60 | 4.0 | 0.11 | 20 | 31.5 |

All data refer to 1 half of the winding or unipolar!

### Notes

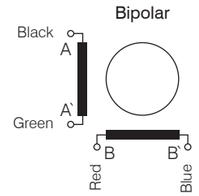
## Linear actuator with trapezoidal screw thread (size 28 mm)



**Option**

Encoder Steuerung

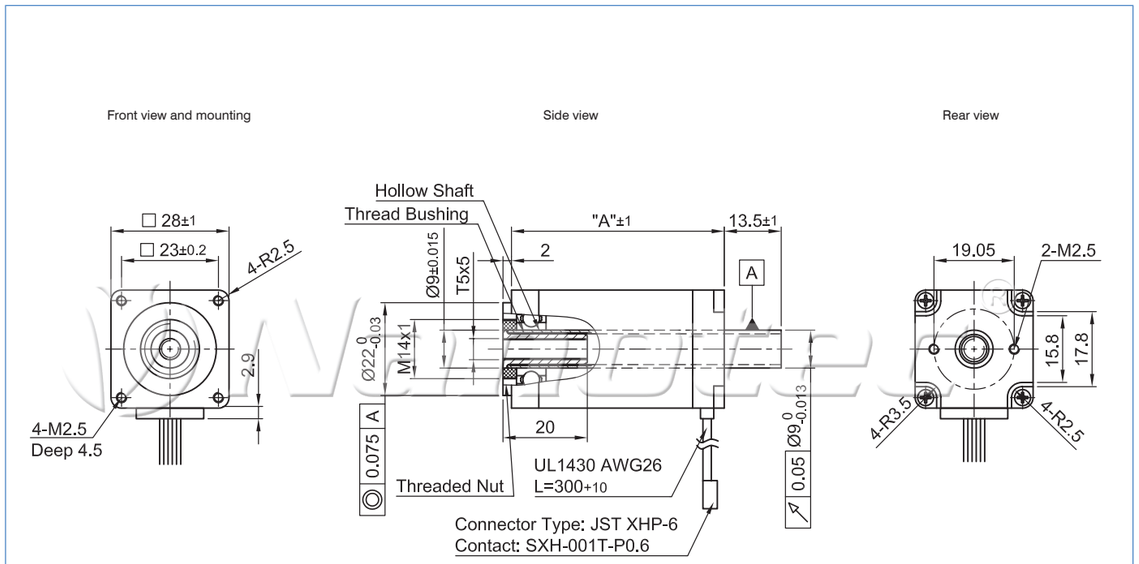
**Pin configuration**




The combination of the high-torque stepper motor with a low-cost trapezoidal spindle with a pitch of 5° not only gives the linear actuators L28 an extremely high adjustment speed of 0.25 m/s (or extremely short manipulating time) but its compact form also enables high thrust and tractive forces. Even higher service lifetimes have been achieved at the same time as well as the improvement in performance due to the relatively high spindle efficiency of >0.5. Also resolutions of < 0.01 mm / step are also possible with the compact microstep drivers, hence also making the linear motors ideal for precision linear axes. For Positionsrückmeldung, the linear actuators are also available with integrated encoder (or encoder + line driver; see Accessories).

! Note: Matching thread spindles and lubricant directions for the integrated PEEK nuts can be found in the Accessories section. (please order spindle separately).

**L2818... outline drawing (in mm)**




**Available versions (others on request)**

| Type | Thrust max. F N | Precision feed control max. mm/s at 48 V | Spindle pitch mm | Resolution mm/step | Current/ winding A | Resistance Ohm/windg. | Inductance mH | Weight kg | Bush length 'L' mm | Motor Length "A" mm |
|---|---|---|---|---|---|---|---|---|---|---|
| | ----------Data in full step---------- | | | | | | | | | |
| L2818S0604 -T5X5 | 30 | 100 | 5 | 0.025 | 0.67 | 5.60 | 4.0 | 0.11 | 20 | 31.5 |
| L2818L0604 -T5X5 | 60 | 140 | 5 | 0.025 | 0.67 | 9.20 | 7.20 | 0.25 | 20 | 50.5 |

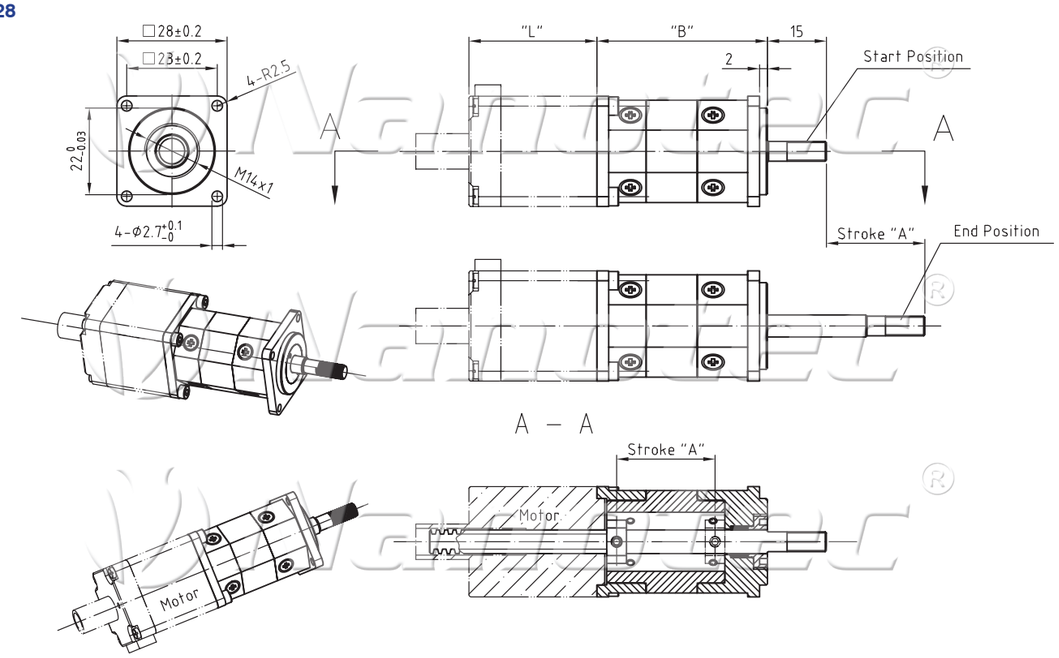
All data refer to 1 half of the winding or unipolar!



## Linear actuator with trapezoidal screw thread (size 28mm)

**Outline drawing (mm)**

**L28**

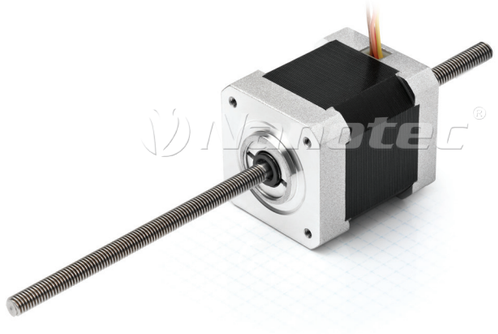



**Available versions (others on request)**

| Type | Thrust max. F N | Precision feed control max. mm/s at 48 V | Spindle pitch mm | Resolution mm/step | Current/ winding A | Resistance Ohm/windg. | Weight kg | Travel length "A" | Housing length B mm | Motor Length "L" mm |
|---|---|---|---|---|---|---|---|---|---|---|
| | ----------Data in full step---------- | | | | | | | | | |
| L2818S0604 -T5x5A25 | 30 | 100 | 5 | 0.025 | 0.67 | 5.6 | 0.26 | 25 | 44 | 31.5 |
| L2818S0604 -A50 | 30 | 100 | 5 | 0.025 | 0.67 | 5.6 | 0.30 | 50 | 69 | 31.5 |
| L2818L0604 -T5x5A25 | 60 | 140 | 5 | 0.025 | 0.67 | 9,7 | 0.34 | 25 | 44 | 50.5 |
| L2818L0604 -A50 | 60 | 140 | 5 | 0.025 | 0.67 | 9,7 | 0,39 | 50 | 69 | 50.5 |

All data refer to 1 half of the winding or unipolar!

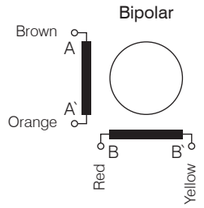
## Linear actuators with fine-pitch screw threads and trapezoidal screw threads (size 41 mm)



**Option**

Encoder | Steuerung

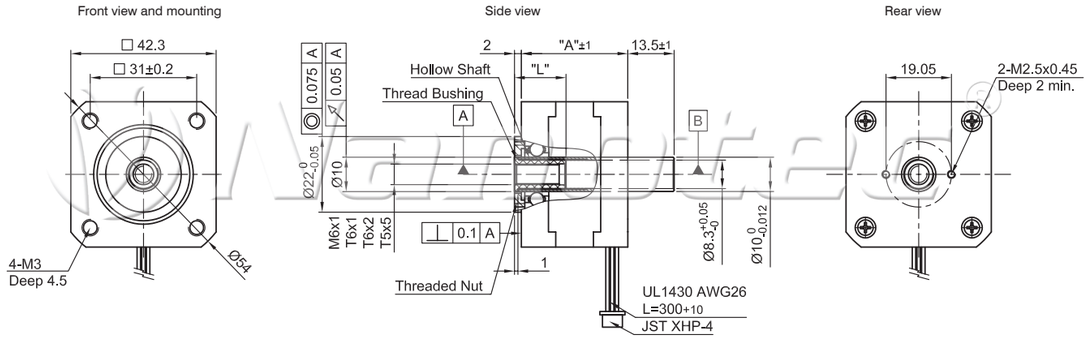
**Pin configuration**




Die L41.. precision linear actuators are used for a very wide range of applications where fewer large adjusting forces and speeds but high resolutionproperties are demanded at the lowest price possible, construction volume and constructive assembly effort. The adjustment path is only limited by the spindle length so that extremely flexible, path-independent linear motion tasks can be realized. Resolutions of < 0.005 mm/step for very fine positioning are possible with the compact microstep drivers such as SMC...
Integrated encoders are also optionally available (see Accessories).

**!** Attention: Matching thread spindles and lubricant directions for the integrated bronze nuts can be found under Accessories (please order spindle separately).

### L4118.. Outline drawing (in mm)



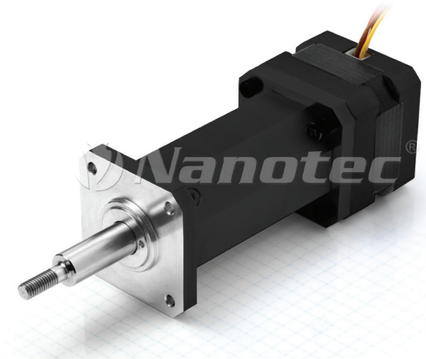

**Available versions (others on request)**

| Type | Thrust max. F N | Precision feed control max. mm/s at 48 V | Spindle pitch mm | Resolution mm/step | Current/ winding A | Resistance Ohm/windg. | Inductance mH | Weight kg | Bush length 'L' mm | Motor Length "A" mm |
|---|---|---|---|---|---|---|---|---|---|---|
| | ----------Data in full step---------- | | | | | | | | | |
| L4118S1404 -M6X1 | 90 | 20 | 1 | 0.005 | 1.4 | 2.00 | 3.60 | 0.20 | 15 | 31 |
| L4118L1804 -M6X1 | 200 | 40 | 1 | 0.005 | 1.8 | 1.75 | 3.30 | 0.34 | 15 | 49 |
| L4118S1404 -T6X1 | 200 | 50 | 1 | 0.005 | 1.4 | 2.00 | 3.60 | 0.20 | 15 | 31 |
| L4118S1404 -T6X2 | 200 | 50 | 2 | 0.010 | 1.4 | 2.00 | 3.60 | 0.20 | 15 | 31 |
| L4118S1404 -T5X5 | 100 | 250 | 5 | 0.025 | 1.4 | 2.00 | 3.60 | 0.20 | 20 | 31 |
| L4118M1804 -T6X1 | 250 | 50 | 1 | 0.005 | 1.8 | 1.10 | 1.85 | 0.24 | 15 | 38 |
| L4118M1804 -T6X2 | 250 | 100 | 2 | 0.010 | 1.8 | 1.10 | 1.85 | 0.24 | 15 | 38 |
| L4118M1804 -T5X5 | 150 | 250 | 5 | 0.025 | 1.8 | 1.10 | 1.85 | 0.24 | 20 | 38 |
| L4118L1804 -T6X1 | 300 | 300 | 1 | 0.005 | 1.8 | 1.75 | 3.20 | 0.34 | 15 | 49 |
| L4118L1804 -T6X2 | 400 | 150 | 2 | 0.010 | 1.8 | 1.75 | 3.30 | 0.34 | 15 | 49 |
| L4118L1804 -T5X5 | 250 | 250 | 5 | 0.025 | 1.8 | 1.75 | 3.30 | 0.34 | 20 | 49 |

All data refer to 1 half of the winding or unipolar!

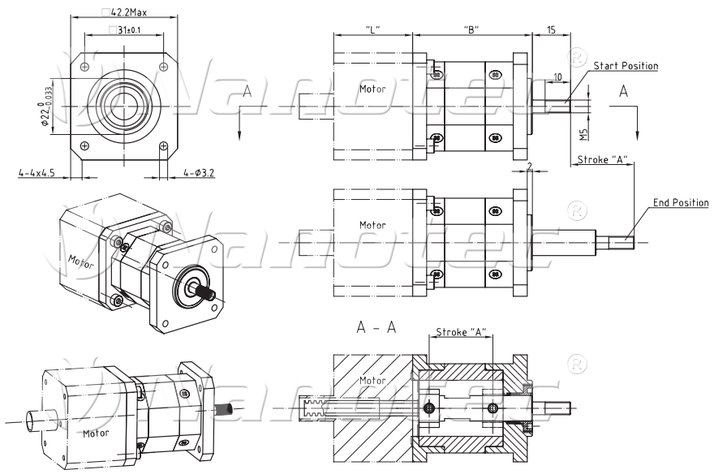


## Linear actuator with trapezoidal screw thread (size 41)



### Outline drawing (mm)

**L41**

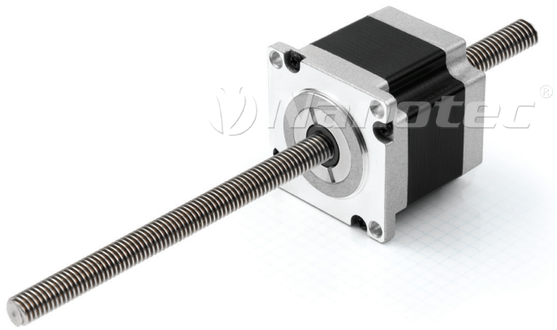



**Available versions (others on request)**

| Type | Thrust max. F N | Precision feed control max. mm/s at 48 V | Spindle pitch mm | Resolution mm/step | Current/ winding A | Resistance Ohm/windg. | Weight kg | Travel length "A" | Housing length "B" mm | Motor Length "L" mm |
|---|---|---|---|---|---|---|---|---|---|---|
| | ----------Data in full step---------- | | | | | | | | | |
| L4118S1404 -A25 | 200 | 20 | 1 | 0.005 | 1.40 | 2.0 | 0.35 | 25 | 47 | 31 |
| L4118S1404 -A50 | 200 | 20 | 1 | 0.005 | 1.40 | 2.0 | 0.40 | 50 | 72 | 31 |
| L4118S1404 -A25 | 120 | 40 | 2 | 0.010 | 1.40 | 2.0 | 0.35 | 25 | 47 | 31 |
| L4118S1404 -A50 | 120 | 40 | 2 | 0.010 | 1.40 | 2.0 | 0.40 | 50 | 72 | 31 |
| L4118S1404 -A25 | 80 | 100 | 5 | 0.025 | 1.40 | 2.0 | 0.35 | 25 | 47 | 31 |
| L4118S1404 -A50 | 80 | 100 | 5 | 0.025 | 1.40 | 2.0 | 0.40 | 50 | 72 | 31 |
| L4118M1804 -T6x1A25 | 250 | 40 | 1 | 0.005 | 1.80 | 1.10 | 0,39 | 25 | 47 | 38 |
| L4118M1804 -A50 | 250 | 40 | 1 | 0.005 | 1.80 | 1.10 | 0,44 | 50 | 72 | 38 |
| L4118M1804 -A25 | 150 | 80 | 2 | 0.010 | 1.80 | 1.10 | 0,39 | 25 | 47 | 38 |
| L4118M1804 -A50 | 150 | 80 | 2 | 0.010 | 1.80 | 1.10 | 0,44 | 50 | 72 | 38 |
| L4118M1804 -A25 | 100 | 200 | 5 | 0.025 | 1.80 | 1.10 | 0,39 | 25 | 47 | 38 |
| L4118M1804 -A50 | 100 | 200 | 5 | 0.025 | 1.80 | 1.10 | 0,44 | 50 | 72 | 38 |
| L4118L1804 -A25 | 400 | 40 | 1 | 0.005 | 1.80 | 1.75 | 0.49 | 25 | 47 | 38 |
| L4118L1804 -A50 | 400 | 40 | 1 | 0.005 | 1.80 | 1.75 | 0.54 | 50 | 72 | 38 |
| L4118L1804 -A25 | 300 | 80 | 2 | 0.010 | 1.80 | 1.75 | 0.49 | 25 | 47 | 38 |
| L4118L1804 -A50 | 300 | 80 | 2 | 0.010 | 1.80 | 1.75 | 0.54 | 50 | 72 | 38 |
| L4118L1804 -A25 | 220 | 200 | 5 | 0.025 | 1.80 | 1.75 | 0.49 | 25 | 47 | 38 |
| L4118L1804 -A50 | 220 | 200 | 5 | 0.025 | 1.80 | 1.75 | 0.54 | 50 | 72 | 38 |

All data refer to 1 half of the winding or unipolar!

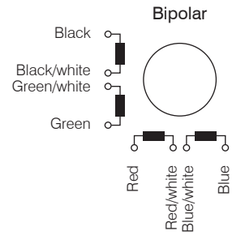
## Linear actuator with trapezoidal screw thread (size 59 mm)



**Option**

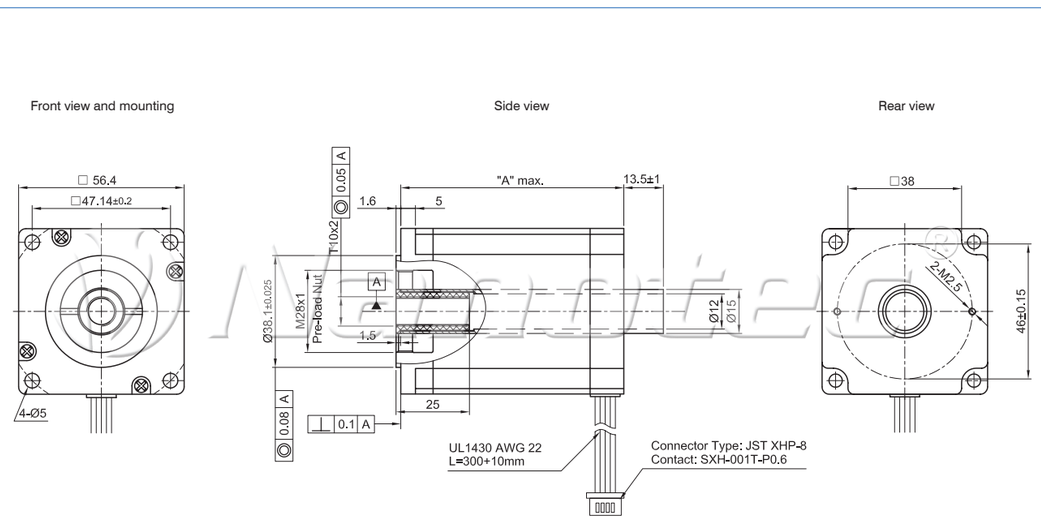
Encoder | Steuerung

**Pin configuration**




! Note: Matching thread spindles and lubricant directions for the integrated PEEK nuts can be found in the Accessories section (please order spindle separately).

**L5918S... outline drawing (in mm)**



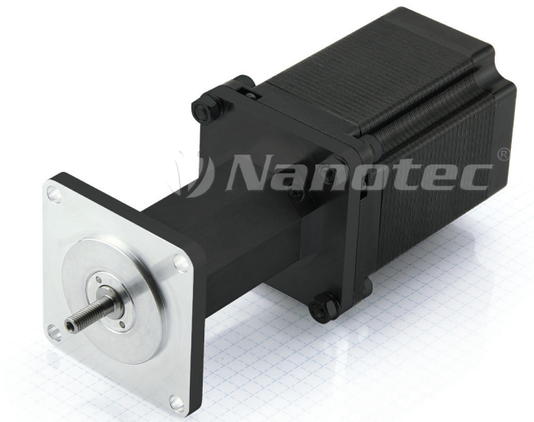

**Available versions (others on request)**

| Type | Thrust max. F N | Precision feed control max. mm/s at 48 V | Spindle pitch mm | Resolution mm/step | Current/ winding A | Resistance Ohm/windg. | Inductance mH | Weight kg | Bush length 'L' mm | Motor Length "A" mm |
|---|---|---|---|---|---|---|---|---|---|---|
| | | ----------Data in full step---------- | | | | | | | | |
| L5918S2008 -T10X2 | 600 | 50 | 2 | 0.010 | 2.0 | 1.5 | 2.6 | 0.65 | 25 | 51 |
| L5918L3008 -T10X2 | 1000 | 25 | 2 | 0.010 | 3.0 | 1.0 | 2.2 | 1.00 | 25 | 76 |

All data refer to half of the winding or unipolar.
All values are calculated and can differ in practice. Practical values were not available at the time of printing.

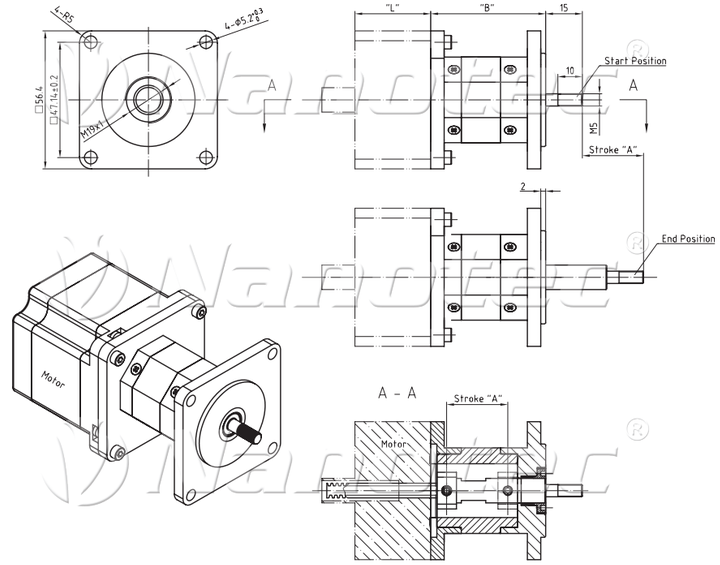


## Linear actuator with trapezoidal screw thread (size 59 mm)



**Outline drawing (mm)**

**L59**

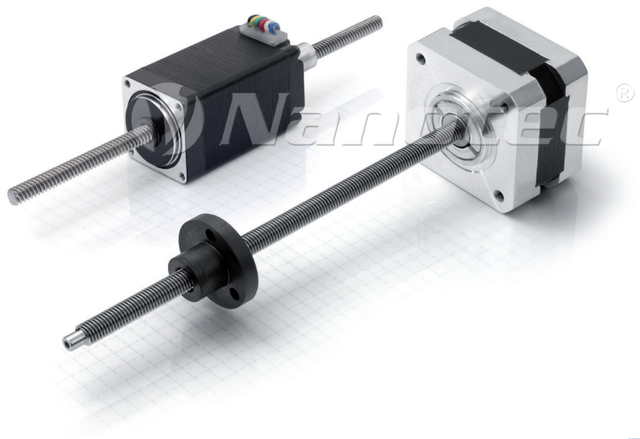



**Available versions (others on request)**

| Type | Thrust max. F N | Precision feed control max. mm/s at 48 V | Spindle pitch mm | Resolution mm/step | Current/ winding A | Resistance Ohm/windg. | Weight kg | Travel length "A" | Housing length B mm | Motor Length "L" mm |
|---|---|---|---|---|---|---|---|---|---|---|
| L5918S2008 -A25 | 600 | 50 | 2 | 0,01 | 2.00 | 1.5 | 0.80 | 25 | 47 | 51 |
| L5918S2008 -A50 | 600 | 50 | 2 | 0,01 | 2.00 | 1.5 | 0.85 | 50 | 72 | 51 |
| L5918L3008 -A25 | 1000 | 25 | 2 | 0,01 | 3.00 | 1.0 | 1.15 | 25 | 47 | 76 |
| L5918L3008 -A50 | 1000 | 25 | 2 | 0,01 | 3.00 | 1.0 | 1.20 | 50 | 72 | 76 |

All data refer to half of the winding or unipolar.
All values are calculated and can differ in practice. Practical values were not available at the time of printing.

## Linear positioning drive LS2818 - LS4118



### Option

Steuerung Encoder

The LS.. not only considerably reduce the costs and the space requirements for a linear system as there is no coupling, bearing support or assembly work required, and also increase the system features and availability of a compl. miniature linear axis. With small loads and load ratings as for scanning optical, mechanical or acoustic measurements, even the linear guide is no longer required. Other motor, threaded nut and spindle versions (>100 pieces) also enable simple, fast and low-cost system expansion.

### Order identifier

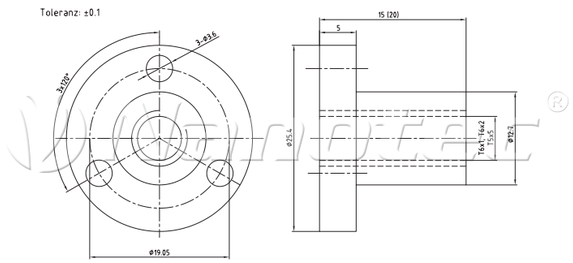
**LS4118S1404-T6x2-75**

**Thread length 75mm**

**Available thread lengths*:**
**75 mm and 150 mm**

*Only for LS4118

### Threaded nut




### Order identifier

**LSNUT-T6x1-F**
**LSNUT-T6x2-F**
**LSNUT-T5x5-F**

**Material:**

**PEEK black for LS2018, LS2818, LS4118**

### Available versions (others on request)

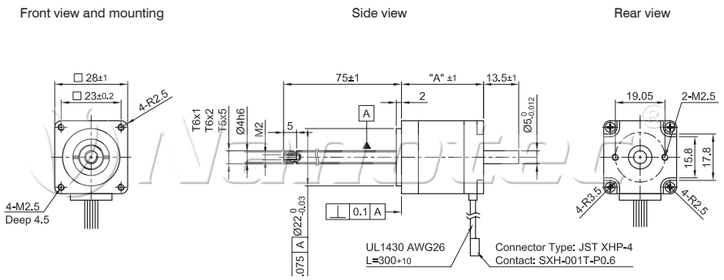
| Type | Thrust (N) | Max. precision feed control mm/s | Resolution µm/step | Current A/winding | Resistance Ohm/winding | Weight kg | Length "A" mm |
|---|---|---|---|---|---|---|---|
| | | ----------Data in full step---------- | | | | | |
| LS2818S0604-T6x1-75 | 60 | 20 | 0.005 | 0.67 | 5.6 | 0.11 | 32 |
| LS2818S0604-T6x2-75 | 60 | 20 | 0.010 | 0.67 | 5.6 | 0.11 | 32 |
| LS2818S0604-T5x5-75 | 30 | 100 | 0.025 | 0.67 | 5.6 | 0.11 | 32 |
| LS2818L0604-T6x1-75 | 120 | 30 | 0.005 | 0.67 | 9,2 | 0.25 | 51 |
| LS2818L0604-T6x2-75 | 120 | 30 | 0.010 | 0.67 | 9,2 | 0.25 | 51 |
| LS2818L0604-T5x5-75 | 60 | 140 | 0,0025 | 0.67 | 9,2 | 0.25 | 51 |
| LS4118S1404-T6x1-XX | 200 | 50 | 0.005 | 1.40 | 2.0 | 0.20 | 31 |
| LS4118S1404-T6x2-XX | 200 | 50 | 0.010 | 1.40 | 2.0 | 0.20 | 31 |
| LS4118S1404-T5x5-XX | 100 | 250 | 0.025 | 1.40 | 2.0 | 0.20 | 31 |

All data refer to 1 half of the winding or unipolar!

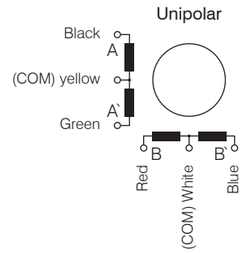




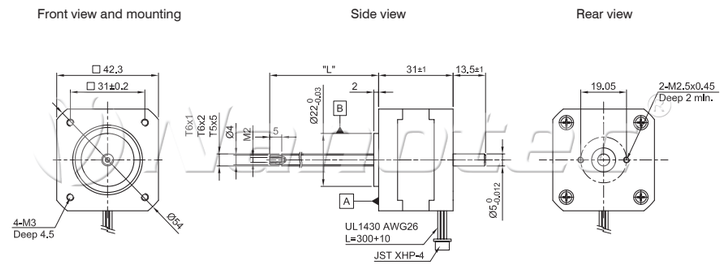
### LS2818 outline drawing (in mm)




### Pin configuration

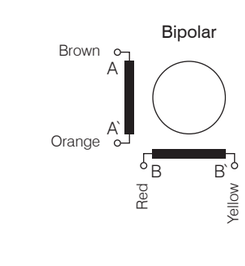



### LS4118S1404 outline drawing (in mm)




**Thread length "L":**
75 mm and 150 mm

### Pin configuration



# Brushless DC motors

## General information on brushless DC motors

### Advantages

- Significantly higher efficiency and power density than induction motors (by approx. 35% volume and weight reduction at the same load)
- Longest expected service life and quiet running in brushless technology with precision ball race
- thanks to the linear torque curve permits an exceptionally large speed range at full motor load and therefore improved matching to the required load conditions
- Reduced electrical interference emission along with excellent thermal properties
- Mechanically interchangeable with stepper motors, and hence less construction expense and greater parts variety

The low-price electronically commutated 3-phase brushless motors (EC motors) are ideally suited for applications with highly smooth operation and service life. The high-energy permanent magnets permits a high level of acceleration as well as speeds of up to 14,000 rpm with a very high level of efficiency. The rotor position feedback is provided electronically via three 60° or 120° offset hall sensors. Optional encoders to 2000 pulses/rev. enable high-resolution positioning controls.

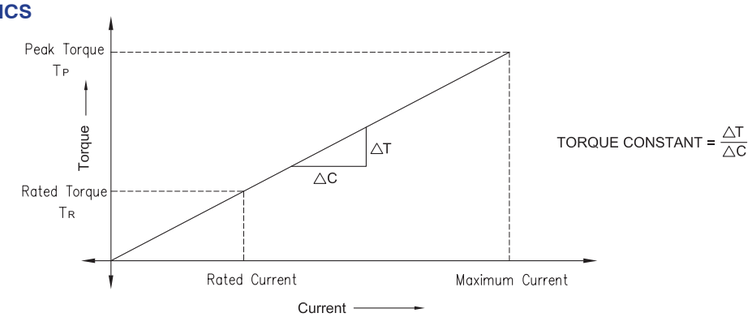
### Technical data

**Peak torque:** 15-630 Ncm

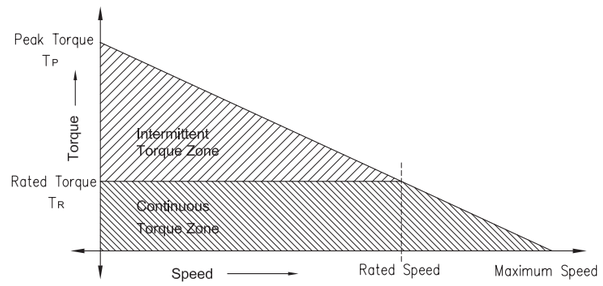
**Operating voltage:** DC 17-48 V
**Nominal speed:** 3000-14000 rpm.
**Temperature range:** 0° to 40°

### Properties

#### TORQUE/CURRENT CHARACTERISTICS




#### TORQUE/SPEED CHARACTERISTICS



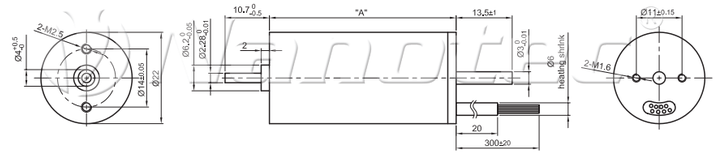
## Brushless DC motors - 3.8 W to 16 W

### Option

Getriebe · Bremse · Steuerung · Encoder

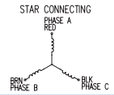
### Outline drawing (mm)

**DB22**



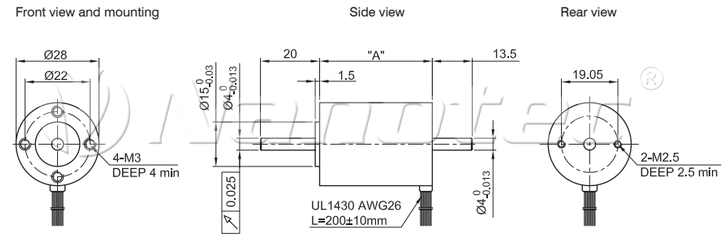

### Pin configuration DB22

| DB22 | Color | Function |
|---|---|---|
| Motor | Red | U |
| | Brown | V |
| | Black | W |
| Hall | Blue | +5 V |
| | Green | GND |
| | Red | H1 |
| | Yellow | H2 |
| | Brown | H3 |



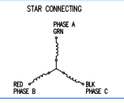

### Outline drawing (mm)

**DB28**



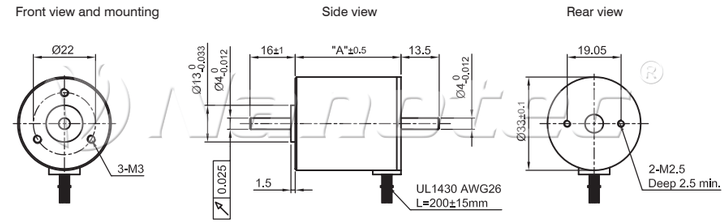

### Pin configuration DB28

| DB28 | Color | Function |
|---|---|---|
| Motor | Green | U |
| | Red | V |
| | Black | W |
| Hall | Yellow | +5 V |
| | White | GND |
| | Blue | H1 |
| | Orange | H2 |
| | Brown | H3 |



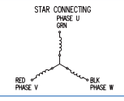

### Outline drawing (mm)

**DB33**




### Pin configuration DB33

| DB33 | Color | Function |
|---|---|---|
| Motor | Green | U |
| | Red | V |
| | Black | W |
| Hall | Yellow | +5 V |
| | Blue | H1 |
| | Orange | H2 |
| | Brown | H3 |
| | White | GND |

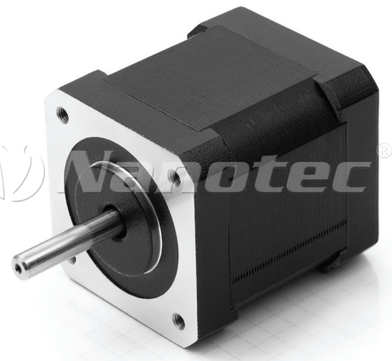



### Available versions (others on request)

| Type | Nom. output W | Nom./peak torque Ncm | Nom./peak Current A | Nom. voltage/speed V/rpm | Torque Constant Ncm/A | Resistance Ohm/winding | Inductance mH/winding | Rotor inertia gcm² | Weight kg | Length "A" mm |
|---|---|---|---|---|---|---|---|---|---|---|
| DB22M01 | 3.8 | 0.8 / 2.1 | 0.265 / 1.1 | 24 / 4800 | 3.02 | 23.0 | 6.2 | 0.66 | 0.075 | 45 |
| DB22L02 | 7.7 | 2.2 / 5.0 | 0.62 / 1.5 | 24 / 3500 | 3.55 | 11.80 | 4.2 | 1.32 | 0.120 | 68 |
| DB28S01 | 6.0 | 0.7 / 2.1 | 0.51 / 2.5 | 15 / 8000 | 1.37 | 8.00 | 2.5 | 1.23 | 0.060 | 28 |
| DB28M01 | 14.0 | 1.4 / 4.2 | 0.15 / 2.8 | 24 / 10000 | 1.60 | 4.63 | 1.6 | 2.12 | 0.082 | 38 |
| DB28L01 | 16.0 | 5.0 / 15.0 | 1.0 / 3.0 | 24 / 3700 | 5.00 | 4.20 | 2.2 | 5.98 | 0.280 | 77 |
| DB33S01 | 7.0 | 22.0 / 66.0 | 0.56 / 1.4 | 24 / 3000 | 4.60 | 12.40 | 7.0 | 2.94 | 0.115 | 38 |



## Brushless DC motors - 30 W to 150 W

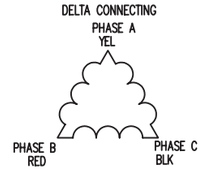


### Option

Getriebe · Bremse · Steuerung · Encoder

### Pin configuration DB42

| DB42 | Color | Function |
|---|---|---|
| Motor | Yellow | U |
| | Red | V |
| | Black | W |
| Hall | Red | +5 V |
| | Black | GND |
| | Blue | H1 |
| | White | H2 |
| | Green | H3 |



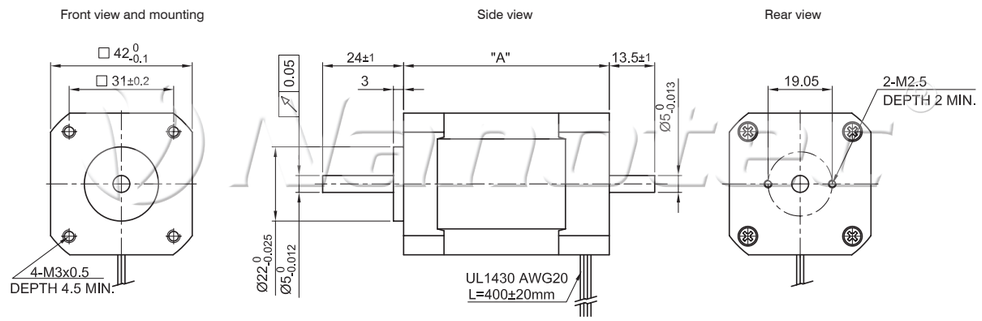

### Accessories

**Encoder:** WEDS…; WEDL… with 500-1000 pulses

**Brake:** Possible on request.

### Outline drawing (mm)

**DB42**




### Available versions (others on request)

| Type | Nom. output W | Nom./peak torque Ncm | Nom./peak current A | Nom. voltage/speed V/rpm | Torque Constant Ncm/A | Resistance Ohm/winding | Inductance mH/winding | Rotor inertia gcm² | Weight kg | Length "A" mm |
|---|---|---|---|---|---|---|---|---|---|---|
| DB42S01 | 30.0 | 5 / 15 | 0.88 / 2.63 | 48 / 6000 | 5.70 | 3.50 | 5.80 | 24 | 0.25 | 41 |
| DB42S02 | 40.0 | 5 / 30 | 3.57 / 10.78 | 17 / 8000 | 1.40 | 0.20 | 0.26 | 24 | 0.25 | 41 |
| DB42S03 | 26.0 | 6.25 / 19 | 1.79 / 5.4 | 24 / 4000 | 3.50 | 1.50 | 2.10 | 24 | 0.25 | 41 |
| DB42M01 | 70.0 | 11 / 30 | 2.12 / 5.77 | 48 / 6000 | 5.20 | 1.30 | 2.60 | 48 | 0.45 | 61 |
| DB42M02 | 60.0 | 7 / 21 | 1.63 / 4.88 | 48 / 8500 | 4.30 | 0.95 | 1.80 | 48 | 0.45 | 61 |
| DB42M03 | 52.5 | 12.5 / 38 | 3.47 / 10.6 | 24 / 4000 | 3.60 | 0.80 | 1.20 | 48 | 0.45 | 61 |
| DB42L01 | 77.5 | 18 / 56 | 5.14 / 15.5 | 24 / 4000 | 3.60 | 0.55 | 0.80 | 72 | 0.65 | 81 |
| DB42C01 | 150.0 | 25 / 75 | 4.63 / 13.89 | 48 / 6000 | 5.40 | 0.68 | 1.21 | 96 | 0.75 | 100 |
| DB42C02 | 140.0 | 10 / 30 | 3.57 / 10.71 | 48 / 14000 | 2.80 | 0.16 | 0.32 | 96 | 0.75 | 100 |
| DB42C03 | 105.0 | 25 / 75 | 6.65 / 20 | 24 / 4000 | 3.76 | 0.30 | 0.50 | 96 | 0.75 | 100 |

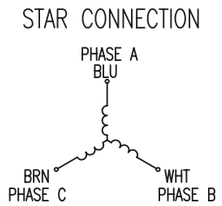
## Brushless DC motors - 50 W to 120 W

### Option

Getriebe · Bremse · Steuerung · Encoder

### Pin configuration DB57

| DB57 | Color | Function |
|---|---|---|
| Motor | Blue | U |
| | White | V |
| | Brown | W |
| Hall | Orange | +5 V |
| | Black | GND |
| | Yellow | H1 |
| | Gray | H2 |
| | Green | H3 |



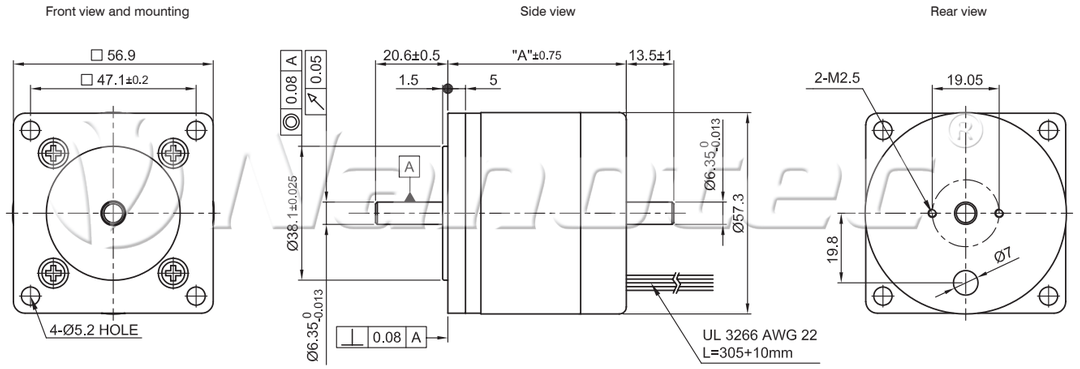

### Accessories

**Encoder:** WEDS…; WEDL…
with 500-1000 pulses

**Brake:** Possible on request.

### Outline drawing (mm)

**DB57 - sizes S, L, C**




### Available versions (others on request)

| Type | Nom. output W | Nom./peak torque Ncm | Nom./peak current A | Nom. voltage/speed V/rpm | Torque Constant Ncm/A | Resistance Ohm/winding | Inductance mH/winding | Rotor inertia gcm² | Weight kg | Length "A" mm |
|---|---|---|---|---|---|---|---|---|---|---|
| DB57S01 | 50 | 19 / 56 | 3.58 / 10.57 | 24 / 2700 | 5.30 | 1.50 | 1.53 | 200 | 0.60 | 50.8 |
| DB57L01 | 75 | 28 / 106 | 4.67 / 17.67 | 24 / 2740 | 6.00 | 0.80 | 1.05 | 330 | 1.10 | 76.2 |
| DB57C01 | 120 | 37 / 134 | 5.87 / 21.27 | 24 / 2800 | 6.30 | 0.42 | 0.62 | 500 | 1.50 | 101.6 |



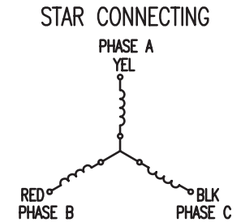
## Brushless DC motors - 250 W to 750 W

### Option

Getriebe · Bremse · Steuerung · Encoder

### Pin configuration DB87

| DB87 | Color | Function |
|---|---|---|
| Motor | Yellow | U |
| | Red | V |
| | Black | W |
| Hall | Red | +5 V |
| | Blue | H1 |
| | White | H2 |
| | Green | H3 |
| | Black | GND |



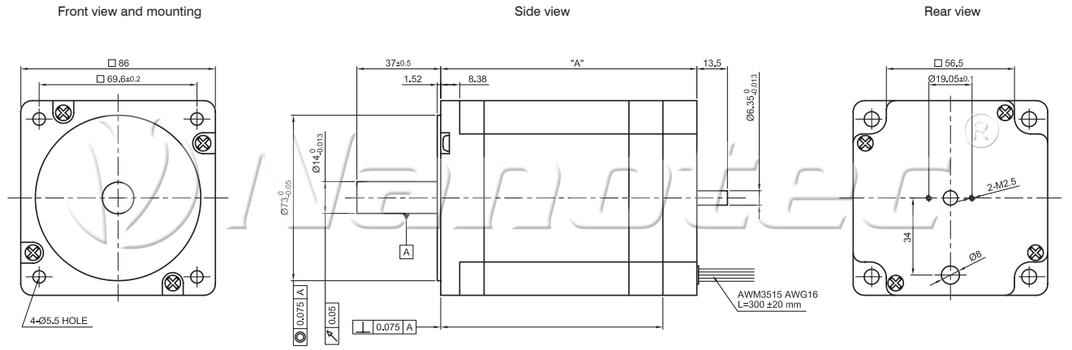

### Accessories

**Encoder:** WEDS…; WEDL…
with 500-1000 pulses

**Brake:** Possible on request.

### Outline drawing (mm)

**DB87 - sizes S, M, L**




### Available versions (others on request)

| Type | Nom. output W | Nom./peak torque Ncm | Nom./peak current A | Nom. voltage/speed V/rpm | Torque Constant Ncm/A | Resistance Ohm/winding | Inductance mH/winding | Rotor inertia gcm² | Weight kg | Length "A" mm |
|---|---|---|---|---|---|---|---|---|---|---|
| DB87S01-S | 220 | 70 / 201 | 6.25 / 17.95 | 48 / 3000 | 11.20 | 0.18 | 0.35 | 800 | 1.85 | 86 |
| DB87M01-S | 440 | 140 / 420 | 10.77 / 32.31 | 48 / 3000 | 13.00 | 0.07 | 0.53 | 1600 | 2.60 | 113 |
| DB87L01-S | 660 | 210 / 630 | 17.95 / 53.85 | 48 / 3000 | 11.70 | 0.07 | 0.10 | 2400 | 4.00 | 140 |

## ASB42 brushless DC motor with junction box


### Option

Getriebe · Bremse · Steuerung · Encoder

### Pin configuration

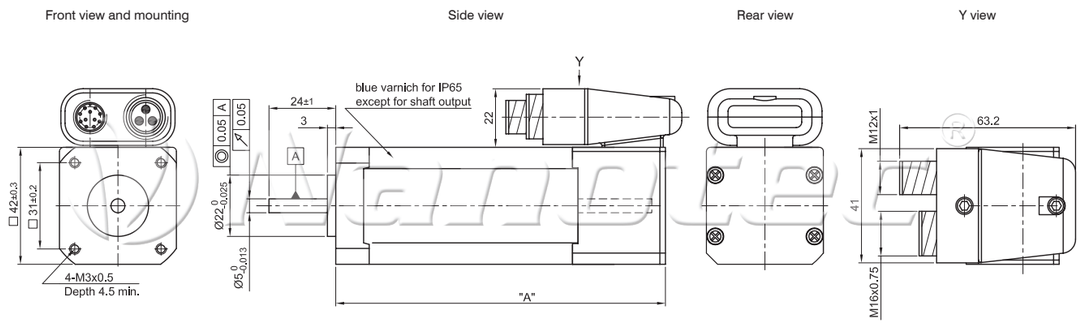
| TWINTUS CONNECTOR M12 12 pin | |
|---|---|
| PIN NO. | ENC./HALL |
| 1 | NC |
| 2 | 5 V |
| 3 | GND |
| 4 | A |
| 5 | A\ |
| 6 | B |
| 7 | B\ |
| 8 | I |
| 9 | I\ |
| 10 | H1 |
| 11 | H2 |
| 12 | H3 |

| TWINTUS CONNECTOR M16 3 pin | |
|---|---|
| PIN NO. | FUNCTION |
| 1 | U |
| 2 | V |
| 3 | W |

**Encoder:** integrated magnetic 3-channel encoder with line driver (5 V TTL), 4096 pulses/rpm

### Outline drawing (mm)

**ASB42 for flange size 42**



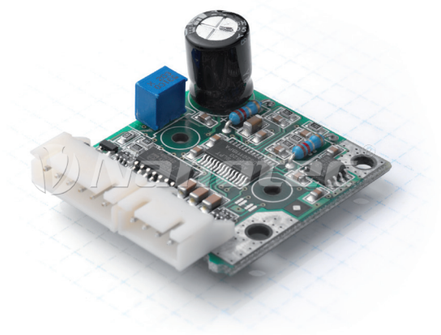

**Available versions (others on request)**

| Type | Nom. output W | Nom./peak torque Ncm | Nom./peak current A | Nom. voltage/speed V/rpm | Torque Constant Ncm/A | Resistance Ohm/winding | Inductance mH/winding | Rotor inertia gcm² | Weight kg | Length "A" mm |
|---|---|---|---|---|---|---|---|---|---|---|
| ASB42C048060-ENM | 150 | 25 / 75 | 4.63 / 13.89 | 48 / 6000 | 5.40 | 0.68 | 1.21 | 96 | 0.75 | 119 |



# Motor controls/controllers for Stepper motors and BLDC motors

## Compact microstep controller SMC11

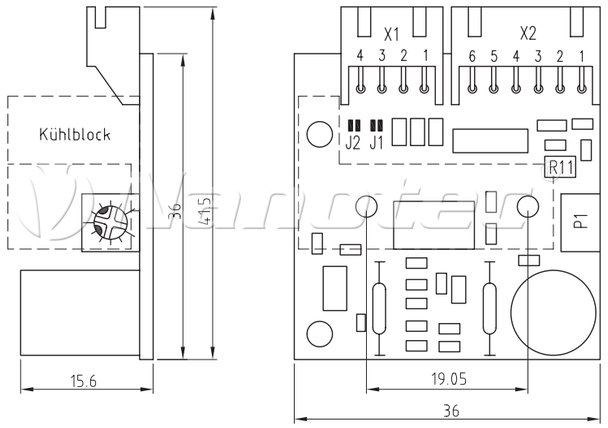


### Technical data

| | |
|---|---|
| **Operating voltage:** | 12 to 35 V DC |
| **Max. phase current**: | 1.0 A/full step (1.25 A with cooling block)<br>1.4 A/microstep (1.8 A with cooling block) |
| **Current setting:** | via potentiometer |
| **Operating mode:** | Bipolar |
| **Operating mode:** | 1/1, 1/2, 1/4, 1/8 (preset) |
| **Protection function:** | Overcurrent, overvoltage and overtemperature |
| **Step frequency:** | 0 to 200 kHz |
| **Current reduction:** | Switchable to 40% |
| **Input signals:** | 0 V active (L< 0.8 V; 3.5 V < H < 6 V or open) |
| **Temperature range:** | 0 to + 40 °C |
| **Connection type :** | JST plug connector |
| **Weight:** | 10 g |
| **Mounting type:** | 2 boreholes of ∅19.05 mm for M2.5 - mounted directly on stepper motor |

Attention: Always use a backup capacitor for the controller operating voltage. This capacitor should always be positioned as closely as possible to the controller. Controllers up to 4 A require a capacitor of 4700 µF and controllers up to 10 A require a capacitor of 10,000 µF. Otherwise there is a risk of the controller being destroyed.

### Outline drawing (mm)



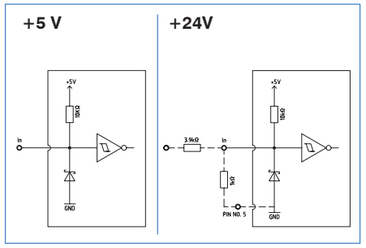

### Input configuration, X1:

| | |
|---|---|
| 1= | Phase A |
| 2= | Phase A\ |
| 3= | Phase B |
| 4= | Phase B\ |

### Input configuration, X2:

| | |
|---|---|
| 1= | Operating voltage, VSS |
| 2= | Enable (L=active, H or open = disable) |
| 3= | Direction |
| 4= | Clock |
| 5= | Operating voltage (0 V GND) |
| 6= | Current drop |

### Input circuits




### Order identifier

**SMC 11 - (2)**

1/16 step automatic current reduction

### Step switching

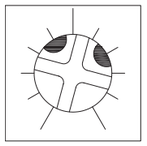
Configuration:
The module is configured to 1/8 step in the factory.

| Step mode | J1 | J2 |
|---|---|---|
| 1/1 step | X | X |
| 1/2 step | X | |
| 1/4 step | | X |
| 1/8 or 1/16 step | | |

### Current setting

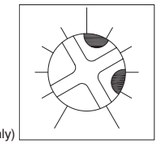
**Max. phase current: (microstep)**

**P1**



1.4 A (without cooling block)

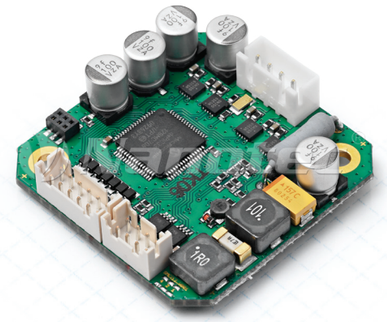
**P1**



1.8 A (with cooling block only)



## Motor controller SMCI12

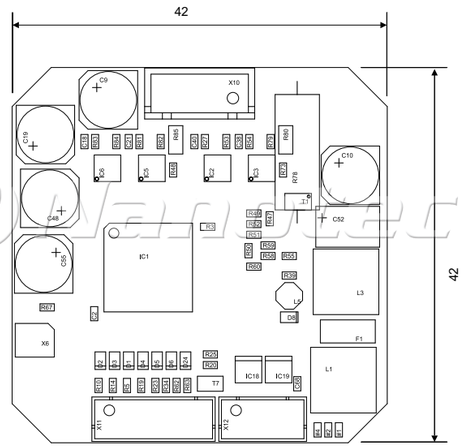


### Technical data

| | |
|---|---|
| **Operating voltage:** | 12 to 24 V DC |
| **Phase current**: | Nominal current 1,8 A, adjustable up to 2,7 A |
| **Interface:** | RS485 4-wire/CAN |
| **Operating mode:** | RS485 Position, speed, flag position, clock direction, analog, joystick<br>CANopen: Position, homing mode, velocity mode, interpolated position mode (in compliance with CAN standard DS402) |
| **Operating mode:** | 1/1, 1/2, 1/4, 1/5, 1/8, 1/10, 1/32, 1/64, adaptive (1/128) |
| **Step frequency:** | 16 kHz with a full step, corresponding multiples with a microstep (e.g. up to 1MHz with 1/64) |
| **Inputs:** | 6 digital inputs (TTL), 1 analog input +10/–10V |
| **Outputs:** | 3 Open Collector, 30 V / 0,5 A max. |
| **Current reduction:** | Adjustable 0 - 100% |
| **Protection circuit:** | Overvoltage, undervoltage and temperature > 80 °C |
| **Temperature range:** | 0 to + 40 °C |

Attention: Always use a backup capacitor for the controller operating voltage. This capacitor should always be positioned as closely as possible to the controller. Controllers up to 4 A require a capacitor of 4700 µF and controllers up to 10 A require a capacitor of 10,000 µF. Otherwise there is a risk of the controller being destroyed.

### Outline drawing (mm)




### Inputs/outputs (X11)

| Pin | Function* |
|---|---|
| 1 | GND |
| 2 | Input 1 |
| 3 | Input 2 |
| 4 | Input 3 |
| 5 | Input 4 |
| 6 | Input 5 |
| 7 | Input 6 |
| 8 | Analog In |
| 9 | Output 1 |
| 10 | Output 2 |
| 11 | Output 3 |
| 12 | GND |

### Supply and communication (X12)

| Pin | Function* | |
|---|---|---|
| | RS485 | CANopen |
| 1 | GND | GND |
| 2 | GND | GND |
| 3 | RX- | n.c. |
| 4 | RX+ | n.c. |
| 5 | TX- | CAN low (CAN-) |
| 6 | TX+ | CAN high (CAN+) |
| 7 | GND | GND |
| 8 | UB 12-24 VDC | UB 12-24 VDC |

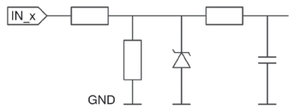
### Motor connection (X3)

| Pin | Function* |
|---|---|
| 1 | Motor coil A |
| 2 | Motor coil A\ |
| 3 | Motor coil B |
| 4 | Motor coil B\ |

*** from the perspective of the connected controller**

**Connection cable for motors with 6 or 8 connectors: ZK-XHP-4-300**

### Input circuits

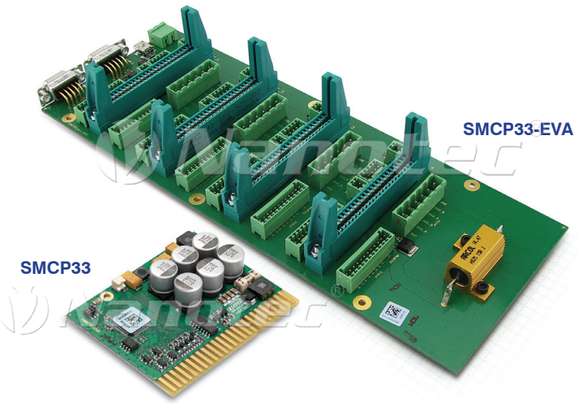



### Order identifier

**RS-485: SMCI12**

**CANopen: SMCI12 - 3**

## Closed loop motor controller with encoder input, SMCP33



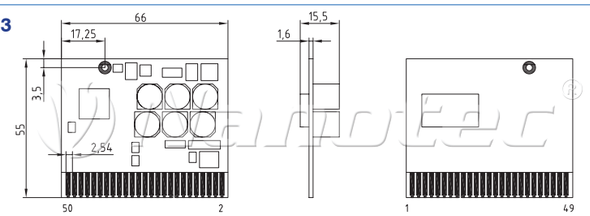

### Technical data

| | |
|---|---|
| **Operating voltage:** | 12 to 48 V DC |
| **Phase current**: | Nominal current 2 A (effective), with heatsink 4 A |
| **Interface:** | RS485, USB |
| **Operating mode:** | Position, speed, flag position, clock direction, analog, joystick, torque |
| **Operating mode:** | 1/1, 1/2, 1/4, 1/5, 1/8, 1/10, 1/32, 1/64, adaptive (1/128 ) |
| **Step frequency:** | 0 to 50kHz in the clock/direction mode,<br>0 to 25 kHz in all other modes |
| **Inputs:** | 8 inputs (5 V), 2 analog inputs (-10...+10 V) |
| **Outputs:** | 8 outputs (5 V, max. 20 mA TTL) |
| **Position monitoring:** | Automatic error correction to 0.9° only with optical encoder (e.g. WEDS5541 series) |
| **Current reduction:** | Adjustable 0 - 100% |
| **Protection circuit:** | Overvoltage, undervoltage and temperature > 80 °C |
| **Temperature range:** | 0 to + 40 °C |

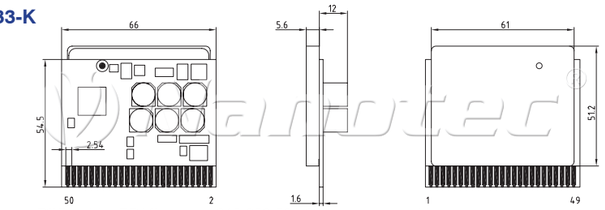
Attention: Always use a backup capacitor for the controller operating voltage. This capacitor should always be positioned as closely as possible to the controller. Controllers up to 4 A require a capacitor of 4700 µF and controllers up to 10 A require a capacitor of 10,000 µF. Otherwise there is a risk of the controller being destroyed.

### Outline drawing (mm)

**SMCP33**




**SMCP33-K**



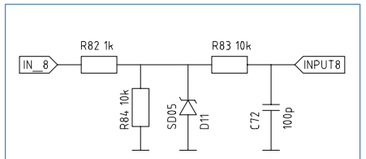

Mating plug/PCB holder EDAC type: 345-050-521-202
345-220-088
345-240-318

Mating plug
Inline plug-in unit, short
Encoding element between contact

### Inputs/outputs (X1)

| Pin | Function |
|---|---|
| 1 | GND |
| 2 | |
| 3 | SUPPLY + UB |
| 4 | |
| 5 | GND |
| 6 | |
| 7 | MOTOR PHASE B\ |
| 8 | |
| 9 | MOTOR PHASE B |
| 10 | |
| 11 | MOTOR PHASE A\ |
| 12 | |
| 13 | MOTOR PHASE A |
| 14 | |
| 15 | GND |
| 16 | |
| 17 | ENCODER INDEX |
| 18 | ENCODER CHANNEL A |
| 19 | ENCODER CHANNEL B |
| 20 | ENCODER +5V |
| 21 | TEMP_MOTOR_1 |
| 22 | OUTPUT BRAKE |
| 23 | OUTPUT BALLAST |
| 24 | |
| 25 | RS485 RX- |
| 26 | RS485 RX+ |
| 27 | RS485 TX- |
| 28 | RS485 TX+ |
| 29 | GND |
| 30 | |
| 31 | ANALOG INPUT 1 |
| 32 | ANALOG INPUT 2 |
| 33 | INPUT 1 |
| 34 | INPUT 2 |
| 35 | INPUT 3 |
| 36 | INPUT 4 |
| 37 | INPUT 5 |
| 38 | INPUT 6 |
| 39 | INPUT 7 |
| 40 | INPUT 8 |
| 41 | OUTPUT 1 |
| 42 | OUTPUT 2 |
| 43 | OUTPUT 3 |
| 44 | OUTPUT 4 |
| 45 | OUTPUT 5 |
| 46 | OUTPUT 6 |
| 47 | OUTPUT 7 |
| 48 | OUTPUT 8 |
| 49 | GND |
| 50 | |
| ALL GNDS INTERNALLY CONNECTED | |

### Input circuits




### Order identifier

**SMCP33**
**SMCP33-K** (with heatsink)

Suitable evaluation/motherboard:

**SMCP33-EVA**

## Closed loop motor controller with encoder input, SMCI33


### Technical data

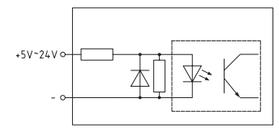
| | |
|---|---|
| **Operating voltage:** | 12 to 48 V DC |
| **Phase current**: | Nominal current 2A, adjustable to max. 3 A/phase |
| **Interface:** | RS485 or USB |
| **Operating mode:** | Position, speed, flag position, clock direction, analog, joystick |
| **Operating mode:** | 1/1, 1/2, 1/4, 1/5, 1/8, 1/10, 1/32, 1/64, adaptive (1/128 ) |
| **Step frequency:** | 0 to 50 kHz in the clock/direction mode,<br>0 to 25 kHz in all other modes |
| **Inputs:** | 6 optocoupler inputs (5 - 24V) |
| **Outputs:** | 3 open collector, 30 V/30 mA max. |
| **Position monitoring:** | Automatic error correction up to 0.9° |
| **Current reduction:** | Adjustable 0 - 100% |
| **Protection circuit:** | Overvoltage, undervoltage and heatsink temperature > 80 °C |
| **Temperature range:** | 0 to +40 °C |

* Phoenix connectors are included in the delivery.

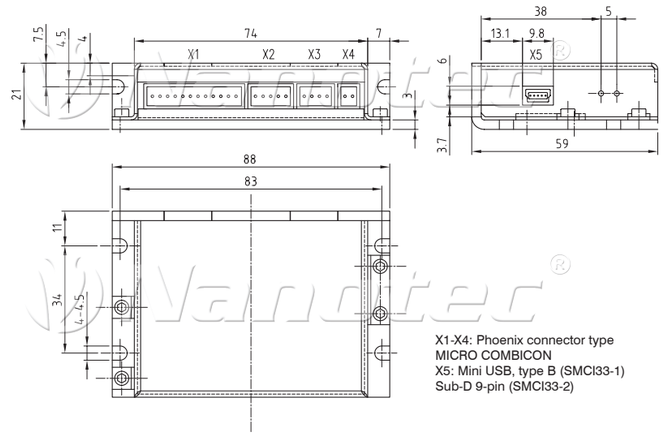
Note: Always use a backup capacitor for the controller operating voltage. This capacitor should always be positioned as closely as possible to the controller. Controllers up to 4 A require a capacitor of 4700 µF and controllers up to 10 A require a capacitor of 10,000 µF. Otherwise there is a risk of the controller being destroyed.

### Input circuits

Optocoupler




### Outline drawing (mm)




X1-X4: Phoenix connector type
MICRO COMBICON
X5: Mini USB, type B (SMCI33-1)
Sub-D 9-pin (SMCI33-2)

### Inputs/outputs (X1)

| Pin | Function |
|---|---|
| 1 | Input1 |
| 2 | Input2 |
| 3 | Input3 |
| 4 | Input4 |
| 5 | Input5 |
| 6 | Input6 |
| 7 | Com |
| 8 | Output 1 |
| 9 | Output 2 |
| 10 | Output 3 |
| 11 | Analog In |
| 12 | GND |

### Encoder (X2)

| Pin | Function |
|---|---|
| 1 | +5 V |
| 2 | CH-B |
| 3 | CH-A |
| 4 | INDEX |
| 5 | GND |

### Motor connection (X3)

| Pin | Function |
|---|---|
| 1 | Motor coil A |
| 2 | Motor coil A\ |
| 3 | Motor coil B\ |
| 4 | Motor coil B |

### Supply (X4)

| Pin | Function |
|---|---|
| 1 | UB24-48V |
| 2 | GND |

### SMCI33-2: RS485 (X5)

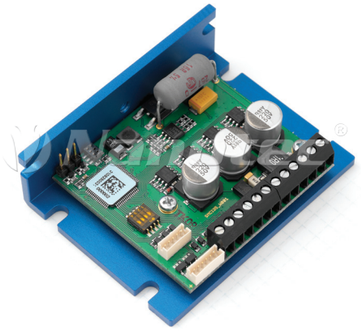
| Pin | Function |
|---|---|
| 1 | NC |
| 2 | RX+ |
| 3 | +5 V |
| 4 | TX+ |
| 5 | N.C. |
| 6 | N.C. |
| 7 | RX- |
| 8 | GND |
| 9 | TX- |

**SMCI33-1: USB (X5)**
**USB standard**

### Order identifier

**SMCI33 -**
1= USB
2= RS485

## Closed loop motor controller with encoder input, SMCI35

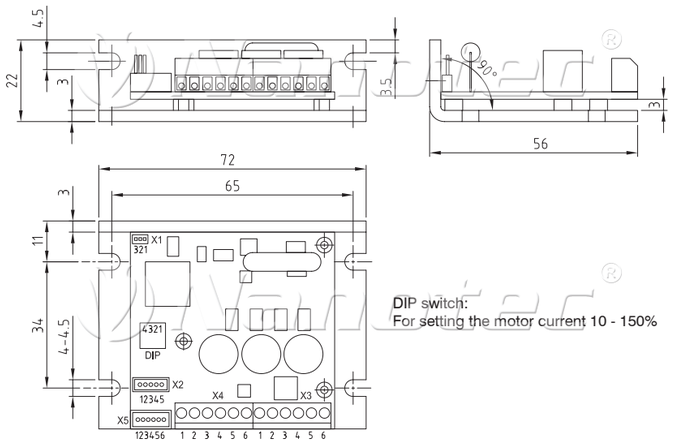


### Technical data

| | |
|---|---|
| **Operating voltage:** | 12 to 48 V DC |
| **Phase current**: | max. 6 A |
| **Interface:** | TTL-RS232 (3,3 V) |
| **Operating mode:** | Position, speed, flag position, clock direction, analog, joystick |
| **Operating mode:** | 1/1, 1/2, 1/4, 1/5, 1/8, 1/10, 1/32, 1/64, adaptive (1/128 ) |
| **Step frequency:** | 16 kHz with a full step, corresponding multiples with a microstep (e.g. up to 1MHz with 1/64) |
| **Inputs:** | 6 digital inputs (TTL), 1 analog input +10/–10V |
| **Outputs:** | 3 digital outputs (TTL) |
| **Position monitoring:** | Yes, depending on the encoder |
| **Current reduction:** | Adjustable 0 - 100% |
| **Protection circuit:** | Overvoltage, undervoltage and heatsink temperature > 80 °C |
| **Temperature range:** | 0 to + 40 °C |

Attention: Always use a backup capacitor for the controller operating voltage. This capacitor should always be positioned as closely as possible to the controller. Controllers up to 4 A require a capacitor of 4700 µF and controllers up to 10 A require a capacitor of 10,000 µF. Otherwise there is a risk of the controller being destroyed.

### Outline drawing (mm)




### Communication (X1)

| Pin | Function* | Wire color (ZK-RS232-USB-3.3V) |
|---|---|---|
| 1 | GND | Black |
| 2 | TX | Yellow |
| 3 | RX | Orange |

### Encoder (X2) JST-ZHR 5

| Pin | Function* |
|---|---|
| 1 | GND |
| 2 | CH-B |
| 3 | INDEX |
| 4 | CH-A |
| 5 | +5 V |

### Motor and supply (X3)

| Pin | Function* |
|---|---|
| 1 | Motor coil A |
| 2 | Motor coil A\ |
| 3 | Motor coil B |
| 4 | Motor coil B\ |
| 5 | UB 24-48 V |
| 6 | GND |

### Inputs/outputs (X4)

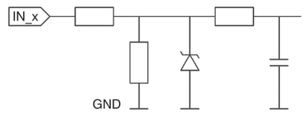
| Pin | Function* | Function on delivery |
|---|---|---|
| 1 | Output 1 | |
| 2 | Input 6 | CLOCK |
| 3 | Input 5 | DIRECTION |
| 4 | Input 4 | ENABLE |
| 5 | Analog in 1 | |
| 6 | GND | |

### Inputs/outputs (X5) JST-ZHR 6

| Pin | Function* |
|---|---|
| 1 | GND |
| 2 | Output 3 |
| 3 | Output 2 |
| 4 | Input 3 |
| 5 | Input 2 |
| 6 | Input 1 |

*** from the perspective of the connected controller**

### Input circuits

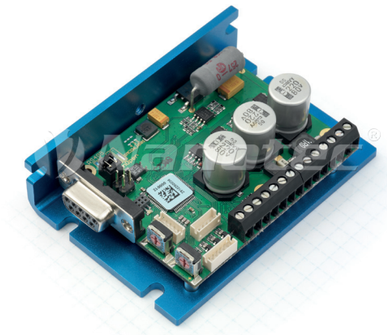



### Order identifier

**SMCI35**



## Closed loop motor controller with encoder input, SMCI36

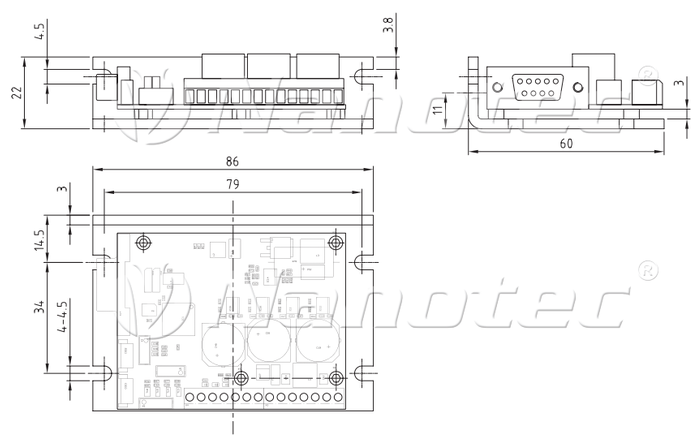


### Technical data

| | |
|---|---|
| **Operating voltage:** | 12 to 72 V DC |
| **Phase current**: | Nominal current 6 A, max. 9 A (eff) |
| **Interface:** | RS485 4-wire/CAN |
| **Operating mode:** | RS485 Position, speed, flag position, clock direction, analog, joystick<br>CANopen: Position, homing mode, velocity mode, interpolated position mode (in compliance with CAN standard DS402) |
| **Operating mode:** | 1/1, 1/2, 1/4, 1/5, 1/8, 1/10, 1/32, 1/64, adaptive microstep, Feed constant |
| **Step frequency:** | 16 kHz in full step, multiple conforming to microstep (e.g. up to 1 MHz at 1/64) |
| **Inputs:** | 6 digital inputs (TTL), 1 analog input +10/–10V |
| **Outputs:** | 3 digital outputs (Open Drain) |
| **Position monitoring:** | Yes, depending on the encoder |
| **Current reduction:** | Adjustable 0 - 100% |
| **Protection circuit:** | Overvoltage, undervoltage and heatsink temperature > 75 °C |
| **Temperature range:** | 0 to + 40 °C |

Attention: Always use a backup capacitor for the controller operating voltage. This capacitor should always be positioned as closely as possible to the controller. Controllers up to 4 A require a capacitor of 4700 µF and controllers up to 10 A require a capacitor of 10,000 µF. Otherwise there is a risk of the controller being destroyed.

### Outline drawing (mm)




### Hall sensor (X1)

| Pin | Function* |
|---|---|
| 1 | GND |
| 2 | Hall 1 |
| 3 | Hall 2 |
| 4 | Hall 3 |
| 5 | +5 V |

### Encoder (X2)

| Pin | Function* |
|---|---|
| 1 | GND |
| 2 | CH-B |
| 3 | INDEX |
| 4 | CH-A |
| 5 | +5 V |

### Motor and supply (X3)

| Pin | Function* Stepper motor | BLDC |
|---|---|---|
| 1 | GND | GND |
| 2 | Motor coil A | V |
| 3 | Motor coil A\ | U |
| 4 | Motor coil B | W |
| 5 | Motor coil B\ | n.c. |
| 6 | 72 V | 72 V |
| 7 | GND | GND |

### Inputs/outputs (X4)

| Pin | Function* |
|---|---|
| 1 | GND |
| 2 | Output 1 |
| 3 | Input 6 |
| 4 | Input 5 |
| 5 | Input 4 |
| 6 | Analog in 1 |
| 7 | GND |

### Inputs/outputs (X5)

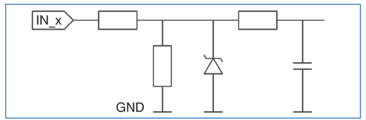
| Pin | Function* |
|---|---|
| 1 | GND |
| 2 | Output 3 |
| 3 | Output 2 |
| 4 | Input 3 |
| 5 | Input 2 |
| 6 | Input 1 |

### Communication (X14)

| Pin | Function* |
|---|---|
| 1 | n.c. |
| 2 | Rx+ / CAN- |
| 3 | GND |
| 4 | Tx+ |
| 5 | n.c. |
| 6 | GND |
| 7 | CAN + |
| 8 | GND |
| 9 | Tx- |

*** from the perspective of the connected controller**

### Input circuits




### Order identifier

**SMCI36**

## Closed loop motor controller with encoder input, SMCI47-S

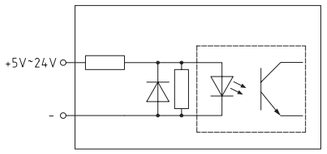

### Technical data

| | |
|---|---|
| **Operating voltage:** | 24 to 48 V DC |
| **Phase current**: | Nominal current 7.0A, adjustable to max. 10.5 A/phase |
| **Interface:** | RS485, CANopen |
| **Operating mode:** | Position, speed, flag position, clock direction, analog, joystick<br>CANopen: Position, homing mode, velocity mode, interpolated position mode |
| **Operating mode:** | 1/1, 1/2, 1/4, 1/5, 1/8, 1/10, 1/32, 1/64, adaptive (1/128 ) |
| **Step frequency:** | 0 to 50 kHz in the clock/direction mode,<br>0 to 25 kHz in all other modes |
| **Inputs:** | 6 optocoupler inputs: (5 V to 24 V) |
| **Outputs:** | 3 Open Collector, 30 V / 2 A max.<br>1 output for brake, max. 1.5 A |
| **Position monitoring:** | Automatic error correction up to 0.9° |
| **Current reduction:** | Adjustable 0 - 100% |
| **Protection circuit:** | Overvoltage, undervoltage and heatsink temperature > 80 °C |
| **Temperature range:** | 0 to + 40 °C |

* Phoenix connectors are included in the delivery.

### Input circuits

Optocoupler



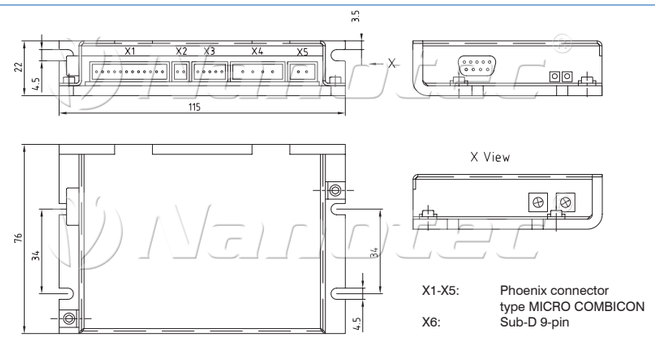

**Attention:** Always use a backup capacitor for the controller operating voltage. This capacitor should always be positioned as closely as possible to the controller. Controllers up to 4 A require a 4700µF and Controllers up to 10 A require a 10,000µF capacitor. Otherwise there is a risk of the controller being destroyed.

### Order identifier

**SMCI47-S-**

2= RS485
3= CANopen

### Outline drawing (mm)




X1-X5: Phoenix connector type MICRO COMBICON
X6: Sub-D 9-pin

### Inputs/outputs (X1)

| Pin | Function |
|---|---|
| 1 | Input1 |
| 2 | Input2 |
| 3 | Input3 |
| 4 | Input4 |
| 5 | Input5 |
| 6 | Input6 |
| 7 | Signal GND |
| 8 | Output 1 |
| 9 | Output 2 |
| 10 | Output 3 |
| 11 | Analog In |
| 12 | GND |

### Brake (X2)

| Pin | Function |
|---|---|
| 1 | Brake |
| 2 | GND |

### Encoder (X3)

| Pin | Function |
|---|---|
| 1 | +5 V |
| 2 | CH-B |
| 3 | CH-A |
| 4 | INDEX |
| 5 | GND |

### Motor connection (X4)

| Pin | Function |
|---|---|
| 1 | Motor coil A |
| 2 | Motor coil A\ |
| 3 | Motor coil B\ |
| 4 | Motor coil B |

### Supply (X5)

| Pin | Function |
|---|---|
| 1 | UB24-48V |
| 2 | GND |

### SMCI47-S-2: RS485 (X6)

| Pin | Function |
|---|---|
| 1 | NC |
| 2 | Rx+ |
| 3 | +5 V |
| 4 | Tx+ |
| 5 | NC |
| 6 | NC |
| 7 | Rx- |
| 8 | GND |
| 9 | Tx- |

### SMCI47-S-3: CAN (X6)

| Pin | Function |
|---|---|
| 1 | NC |
| 2 | CAN low (CAN-) |
| 3 | CAN Ground (internally connected with pin 6) |
| 4 | NC |
| 5 | NC |
| 6 | CAN Ground (internally connected with pin 3) |
| 7 | CAN high (CAN+) |
| 8 | NC |
| 9 | Supply Vcc to 30V (used for safety feature) |

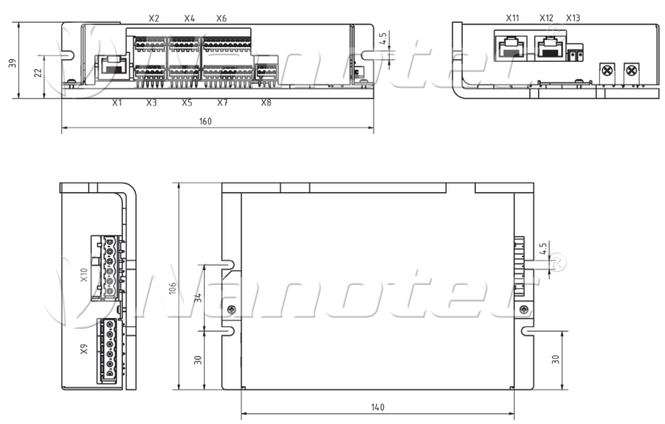


## N10 - closed loop controller for stepper motors and BLDC motor with Ethernet, EtherCAT or CANopen interfaces


### Technical data

| | |
|---|---|
| **Operating voltage:** | 12 to 80 V |
| **Phase current**: | N10-1: max. 10 A effective, N10-2: max. 20 A effective |
| **Commutation:** | Open loop stepper motor, closed loop stepper motor with encoder, BLDC<br>sinus commutated via hall, BLDC sinus commutated via encoder |
| **Operating mode:** | Torque, speed, positioning, interpolated positioning<br>Reference run, cycle direction, application program (NanoJ) |
| **Parameterization:** | browser-based via Ethernet with the NanoIP interface |
| **Field bus interfaces:** | CANopen or EtherCAT |
| **Inputs:** | 2 inputs 5-24 V, 6 inputs 24 V, 2 analog inputs - 10... +10 V |
| **Outputs:** | 4 transistor outputs, open drain, max. 0.5 A |
| **Brake:** | 1 open drain output with at least 5 A |
| **Encoder inputs:** | TTL encoder, max. 8000 increments, UVW for hall |
| **Protection circuit:** | Internal ballast switching 16 Ohm: Connection for external ballast resistance on open drain output with at least 5 A; at<br>Pole reversal short-circuit via power diode with 15 A, therefore circuit breaker (fuse) required in supply cable |
| **Temperature range:** | -40 to 0 °C |

### Outline drawing (mm)




### Ethernet (X1)

### Inputs/outputs (X2)

| Pin | Function* |
|---|---|
| 1 | GND |
| 2 | Input 1 |
| 3 | Input 2 |
| 4 | Input 3 |
| 5 | Input 4 |
| 6 | GND |

### Inputs/outputs (X3)

| Pin | Function* |
|---|---|
| 1 | GND |
| 2 | Output 1 |
| 3 | Output 2 |
| 4 | Output 3 |
| 5 | Output 4 |
| 6 | GND |

### Inputs/outputs (X4)

| Pin | Function* |
|---|---|
| 1 | GND |
| 2 | Input 5 |
| 3 | Input 6 |
| 4 | Input 7 |
| 5 | Input 8 |
| 6 | GND |

### Inputs/outputs (X5)

| Pin | Function* |
|---|---|
| 1 | GND |
| 2 | Analog in 1 |
| 3 | Analog in 2 |
| 4 | n.c. |
| 5 | n.c. |
| 6 | GND |

### Hall (X6)

| Pin | Function* |
|---|---|
| 1 | GND |
| 2 | U |
| 3 | V |
| 4 | W |
| 5 | n.c. |
| 6 | n.c. |
| 7 | n.c. |
| 8 | +5 V |
| 9 | n.c. |
| 10 | GND |

### Encoder (X7)

| Pin | Function* |
|---|---|
| 1 | GND |
| 2 | CH-A |
| 3 | CH-A |
| 4 | CH-B |
| 5 | CH-B |
| 6 | INDEX |
| 7 | INDEX |
| 8 | +5 V |
| 9 | n.c. |
| 10 | GND |

### Safety (X8)

| Pin | Function* |
|---|---|
| 1 | GND |
| 2 | STO_A |
| 3 | STO_B |
| 4 | GND |

### Supply (X9)

| Pin | Function* |
|---|---|
| 1 | GND |
| 2 | Brake |
| 3 | Ballast |
| 4 | +VB |
| 5 | +VB |
| 6 | GND |

### Motor connection (X10)

| Pin | Function* |
|---|---|
| 1 | GND |
| 2 | A |
| 3 | A\ |
| 4 | B |
| 5 | B\ |
| 6 | GND |

### EtherCAT Port 0 (X11)

### EtherCAT Port 0 (X12)

### Logic supply (X13)

| Pin | Function* |
|---|---|
| 1 | + UB LOGIC |
| 2 | GND |

*** from the perspective of the connected controller**

### Order identifier

**N10 - - - 000**

1 = 10A
2 = 20A

0 = Ethernet, no field bus
1 = Ethernet + EtherCAT
2 = Ethernet + CANopen

# Options

## Motor modular system: Over 4000 different options available from stock

From our extensive range of stepper motor and BLDC motors in many different sizes and windings, as well as a large range of accessories consisting of gears, safety brakes, optical encoders and other options such as vibration dampers, shaft couplings, connection cables, etc., we can build the optimal drive solution for you within a matter of days. Over 4000 possible combinations are possible with our modular stepper motor system.

### Also available for other sizes

Size 20 mm

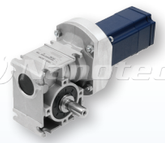
Size 42 mm

Size 60 mm

Size 86 mm

Size 110 mm

### Example: ST5918 (NEMA 23) stepper motor with options

| Gears | Motor | Brake | Encoder |
|---|---|---|---|
|  GPLE precision gear series from 22 to 80 mm, long expected service life |  Hybrid stepper motors with large performance range at reasonable prices |  BKE series safety brake for different motor sizes |  New WEDS5541 1000 incr./rev encoder series |
|  GSGE angular gear series for Nema 23 and Nema 34 motors |  BLDC motors (22 to 86 mm) for high speed and dynamics |  Customer-specific brakes are also possible (up to 9 Nm) |  Magnetic encoder, customized for integration |
|  Economy planetary gear Economic GPLL series for l arge series (22 to 56 mm) |  Economic permanent magnet stepper motors from a size of 6 mm |  BL safety brake series econo-mically in the series |  opt. encoder, 20 mm diameter |

## Optical encoder - WEDS/WEDL series

### Features

- Low-priced
- Resolution: 500 increments/rev.
  1000 increments/rev.
- Compact housing (also for hollow shaft with 10 mm diameter)
- TTL-compatible
- 3-channel (A/B track and index signal)
- Easy installation
- For 5 mm, 6.35 mm and 10 mm shaft diameter (hollow shaft)

The encoders of the WEDS/WEDL5541 series are powerful, 3-channel incremental encoders. The module includes the sender with LED source, the receiver and the code disc that rotates between the sender and receiver. In WEDL encoders, the signals prepared via a driver module are output as a differential signal which increases the immunity to interference. The interface to the application is formed by a pluggable flat ribbon cable or, optionally, a screened round cable.

### Technical specification

| Electrical specification | WEDS | WEDL |
|---|---|---|
| Signal form, output | Square wave signal | |
| Output signals | Phase A, B, I | Phase A, A\, B, B\, I, I\ |
| Current consumption | ≤ 60 mA | |
| Output current | 0 ~ 5 mA | |
| Limit frequency | 100 KHz | |
| Phase angle of the output signal | 90° ± 45° | |
| Connection voltage | 5 V DC | |
| Signal level | VH 85% VCC, VL ≤ 0.3 V | |
| Number of pulses per revolution | 500, 1000 (others on request) | |

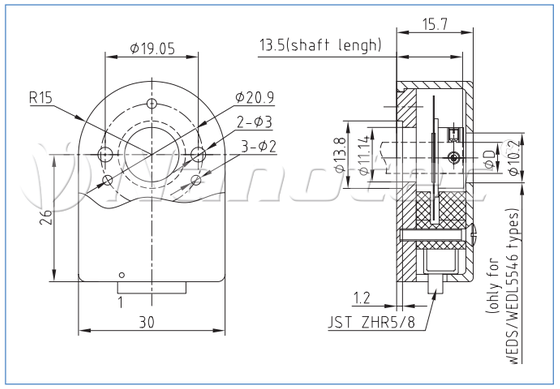
### Technical specification

| Mechanical specification | WEDS/WEDL |
|---|---|
| Mass inertia of the code wheel | Approx. 0.6 g cm² |
| Impact resistance | 980 m/s², 6 ms, 2 hours each in XYZ |
| Vibration test | 50 m/s², 10 ~ 200 Hz, 2 hours each in XYZ |
| Average service life | MTBF 50000 h (+25 °C, 2000 rpm) |
| Weight | Approx. 20 g (with 0.5 meter cable) |
| **Ambient conditions** | |
| Operating humidity | 30 ~ 85 % (no condensation) |
| Storage temperature | -40 °C ~ 100 °C |
| Working temperature | -25 °C ~ 100 °C |

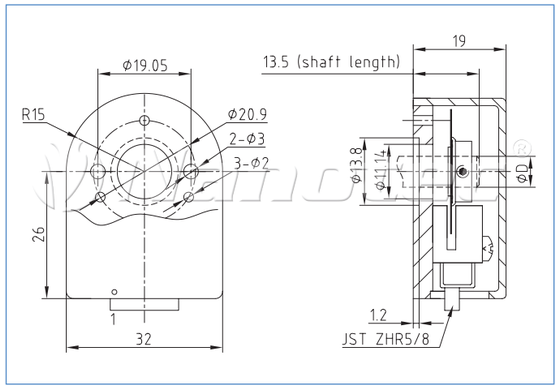
### Connector configuration

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Driver output | 0 V | I | A | Vcc | B | | | |
| Coding system of the flat ribbon cable | 1 (red) | 2 | 3 | 4 | 5 | | | |
| Core color WEDS-9000 cable | Black | Yellow | Green | Red | White | | | |
| Line driver output | 0 V | Vcc | A | A\ | B\ | B | I\ | I |
| Coding system of the flat ribbon cable | 1 (red) | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Core color WEDL-9000 cable | Black | Red | Green | Brown | Gray | White | Yellow | Orange |

### WEDS/WEDL 500 incr./rev., outline drawing in (mm)

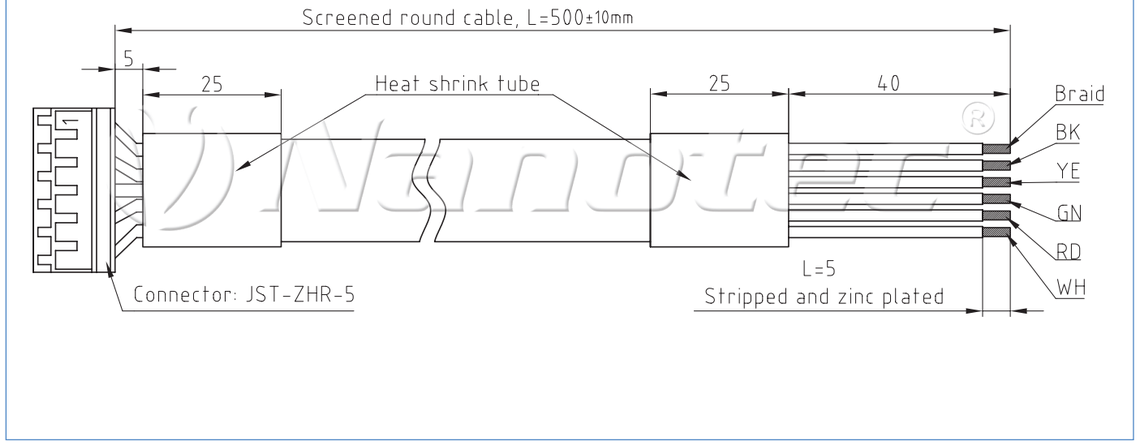



### WEDS/WEDL 1000 incr./rev. outline drawing in (mm)

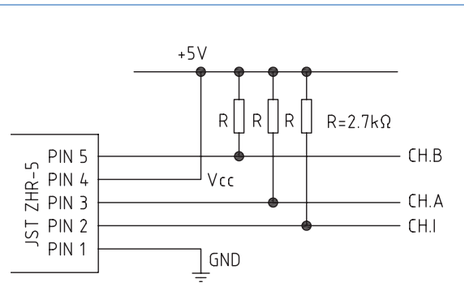



| Optical encoder: Standard encoder for stepper motor mounting | | | | |
|---|---|---|---|---|
| **Order identifier** | **Pulses per revolution** | **for shaft diameter (mm)** | **Type** | **Plug** |
| **WEDS5541-A14** | 500 | 5.00 | | JST-ZHR-5 |
| **WEDS5541-A06** | 500 | 6.35 | | |
| **WEDS5546-A10** | 500 | 10.00 | Hollow shaft | |
| **WEDS5541-B14** | 1000 | 5.00 | | |
| **WEDS5541-B06** | 1000 | 6.35 | | |
| **Encoder with line controller (for extremely interference-proof operating conditions or long supply cables)** | | | | |
| **WEDL5541-A14** | 500 | 5.00 | | JST-ZHR-8 |
| **WEDL5541-A06** | 500 | 6.35 | | |
| **WEDL5546-A10** | 500 | 10.00 | Hollow shaft | |
| **WEDL5541-B14** | 1000 | 5.00 | | |
| **WEDL5541-B06** | 1000 | 6.35 | | |
| **Flat ribbon cable, L=500** | | **Screened round cable, L=500** | | |
| ZK-WEDS-5-500 | | ZK-WEDS-5-500-S | | JST-ZHR-5 |
| ZK-WEDL-8-500 | | ZK-WEDL-8-500-S | | JST-ZHR-8 |

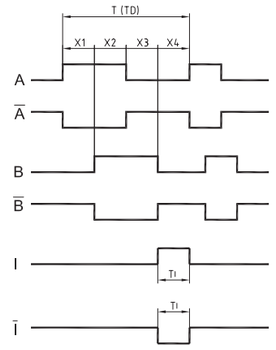
### ZK-WEDS-5/8-500-S



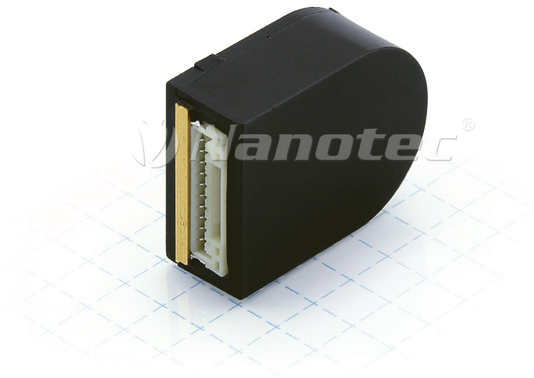

### WEDS encoder connector configuration




### WEDL encoder with line driver output signals



## Optical encoder - NOE1 series

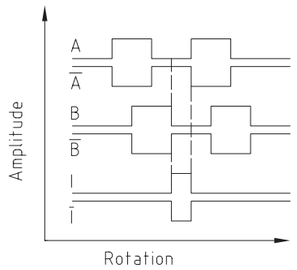


### Technical data

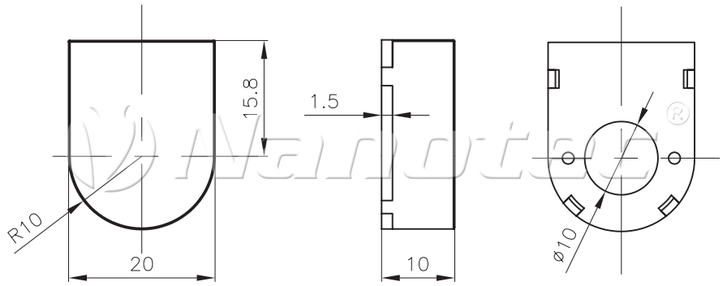
| | |
|---|---|
| **Resolution:** | 500, 1000, 2000 pulses/rpm |
| **Signal shape:** | TTL square wave signal |
| **Output signals:** | Phase A, A\, B, B\, I, I\ |
| **Operating voltage:** | 5 V DC (7 V DC max.) |
| **Current consumption:** | Type ≤ 100 mA |
| **Limit frequency:** | 60 KHz |
| **Limit speed:** | 7200 rpm (500 pulses), 3600 rpm (1000 pulses), 1800 rpm (2000 pulses) |
| **Pulse width:** | 180° ± 50° |
| **Phase shift:** | 90° ± 50° |
| **Signal level:** | Low 0 V, high operating voltage -0.5 V |
| **Max. output current per channel:** | ± 150mA, recommended working current ± 20 mA |
| **Operating temperature:** | 85 to -20 °C |
| **Storage temperature:** | 85 to -40 °C |
| **Air humidity:** | Max. 90%, non-condensing |

### Output signals

Line controller for 8 connections




### NOE1 outline drawing (mm)




### Output signals

| 10 pin JST GH | |
|---|---|
| **NO.** | **Function** |
| 1 | GND |
| 2 | B |
| 3 | B\ |
| 4 | A |
| 5 | A\ |
| 6 | I |
| 7 | I\ |
| 8 | GND |
| 9 | Vcc |
| 10 | GND |

### Order identifier

**NOE1-05-○**

A14 = 500 pulses/rpm (no interpolation)
B14 = 1000 pulses/rpm (2x interpolation)
C14 = 2000 pulses/rpm (4x interpolation)

for 5 mm shaft diameter



## Gears

### Application fields:

**The compact and proven gears from Nanotec are ideal for use in the following tasks:**

- Increase and matching of the output torques
  $M_{dgear.} = M_{dMot} \times i \times \eta$
- Reduction of the output torque
  $n_2 = n_{Mot} / i$
- Quadratic reduction of ext. moments of inertia
  $J_{red} = J_{ex} / i^2$
- Reduction of the step angle
  $\alpha_{Outp} = \alpha_{Mot} / i$

### Advantages

- Large speed reduction bandwidth
- Wide torque spectrum
- High running smoothness
- Maintenance-free due to permanent lubrication
- Versatile combination options

**!** Note: In the selection of the gears, it is essential to pay attention to the following criteria:

**a) Output torques**
Output torques rise in proportion to the speed reduction and can lead to damage of the gearing (do not exceed max. admissible power take-off values!).

**b) Radial and axial forces**
Radial and axial forces mainly impair the expected service life of the bearing and the shaft strength in some cases.

**c) Working temperatures**
Working temperatures affect the thermal loading of the bearing.

**d) Load types**
Various types of load lead to high gear, shaft and bearing stresses and hence reduce the service life.

**Which type of gear is advantageous?**

| | |
|---|---|
| **1) Planetary gear** | due to the triple meshing, these gears offer the highest torque at comparable volume and have the highest efficiency with concentric shaft output. |
| **2) Worm gear** | Enable smooth running performance and, due to the 90° force transfer, have a low installation depth and offer a self-locking torque due to continuous power transmission at higher reduction ratios. |

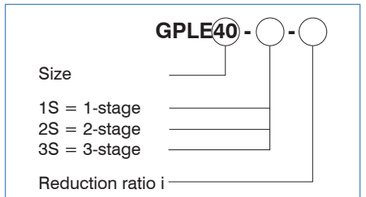
## Precision planetary gear GPLE

The low-play planetary gear from Nanotec are developed to state of the art in gearing technology and are manufactured to DIN/ISO 9001.

### Advantages

- High output torques
- High torsional rigidity
- Low circumferential backlash
- High admissible axial and radial shaft loading
- Low running noise
- Easy motor/gear assembly
- Protection class IP54
- 30,000 hours service life, 10,000 hours for GPLE22

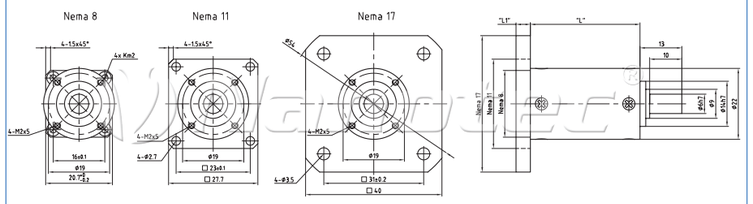
### Order identifier



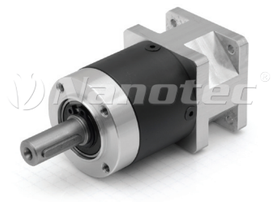

When ordering, it is important to specify the motor onto which the gear will be mounted.

### GPLE22

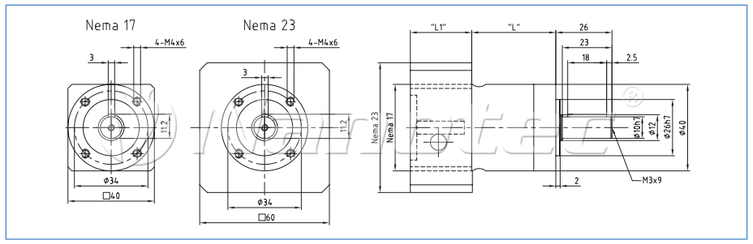
### Outline drawing (mm)



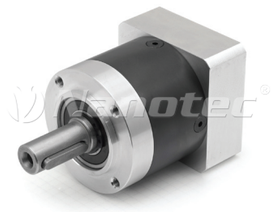

### GPLE40



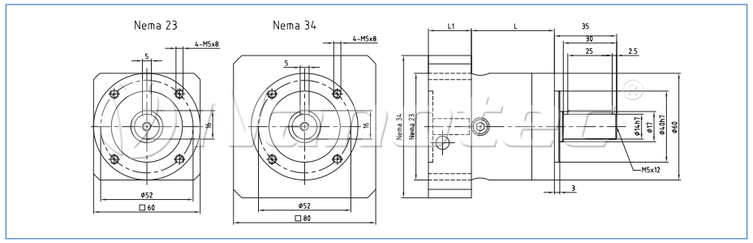
### Outline drawing (mm)



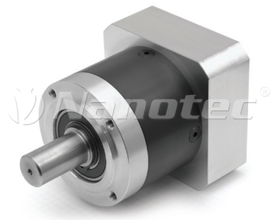

### GPLE60



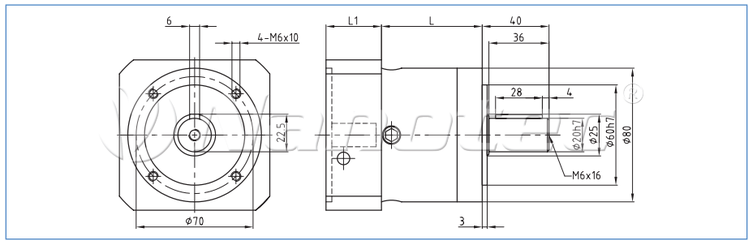
### Outline drawing (mm)




### GPLE80



### Outline drawing (mm)








## Precision planetary gear GPLE

**Available versions (others on request)**

| Type | | Backlash Angular minutes | Weight kg | Length L mm | Efficiency at full load *3. | Reduction ratio | Output torque Nm Nominal value(*1) | Output torque Nm Max. value (*2) | Moment of inertia kg mm² | Intermediate flange L1 mm | Combination option with motor | permissible radial/axial shaft load (N) 10,000 h service life (30,000 h service life) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GPLE22 | 2-stage | <55 | 0.1 | 34 | 80 | 9<br>12<br>15 | 1.5 | n.a. | 0.09 | 4.5 | ST20, ST28 ST41,ST42… (Nema 8,11,17) | 20/20 |
| GPLE40 | 1-stage | <15 | 0.35 | 39 | 98 | 3 | 11.0 | 17.6 | 3.1 | 27.5 | ST41, ST42, DB42… (Nema 17) | 200/200 |
| | | | | | 98 | 4 | 15.0 | 24 | 2.2 | | | |
| | | | | | 98 | 5 | 14.0 | 22 | 1.9 | | | |
| | | | | | 96 | 8 | 6.0 | 10 | 1.7 | | | |
| | 2-stage | <19 | 0.45 | 52 | 97 | 9 | 6.5 | 26 | 3.0 | | | |
| | | | | | 96 | 12 | 20.0 | 32 | 2.9 | | | |
| | | | | | 96 | 15 | 18.0 | 29 | 2.3 | | | |
| | | | | | 96 | 16 | 20.0 | 32 | 2.2 | | | |
| | | | | | 96 | 20 | 20.0 | 32 | 1.9 | | | |
| | | | | | 95 | 25 | 18.0 | 29 | 1.9 | | | |
| | | | | | 95 | 32 | 20.0 | 32 | 1.7 | | | |
| | | | | | 94 | 40 | 18.0 | 29 | 1.6 | | | |
| | | | | | 86 | 64 | 7.5 | 12 | 1.6 | | ST57, ST59, DB57… (Nema23) (cannot be combined with ST5918D | |
| | 3-stage | <22 | 0.55 | 64.5 | 92 | 60 | 20.0 | 32 | 2.9 | 24.5 | | (160/160) |
| | | | | | 90 | 80 | 20.0 | 32 | 1.9 | | | |
| | | | | | 89 | 100 | 20.0 | 32 | 1.9 | | | |
| | | | | | 87 | 120 | 18.0 | 29 | 2.9 | | | |
| | | | | | 86 | 160 | 20.0 | 32 | 1.6 | | | |
| | | | | | 82 | 200 | 18.0 | 29 | 1.6 | | | |
| | | | | | 81 | 256 | 20.0 | 32 | 1.6 | | | |
| | | | | | 76 | 320 | 18.0 | 29 | 1.6 | | | |
| | | | | | 48 | 512 | 7.5 | 12 | 1.6 | | | |
| GPLE60 | 1-stage | <12 | 0.9 | 47 | 98 | 3 | 28.0 | 45 | 13.5 | 24.5 | ST57, ST59, DB57… (Nema 23) (for ST5918D not all variants available) | 500/600 |
| | | | | | 98 | 4 | 38.0 | 61 | 9.3 | | | |
| | | | | | 98 | 5 | 40.0 | 64 | 7.8 | | | |
| | | | | | 97 | 8 | 18.0 | 29 | 6.5 | | | |
| | 2-stage | <15 | 1.1 | 59 | 97 | 9 | 44.0 | 70 | 13.1 | | | |
| | | | | | 96 | 12 | 44.0 | 70 | 12.7 | | | |
| | | | | | 96 | 15 | 44.0 | 70 | 7.7 | | | |
| | | | | | 96 | 16 | 44.0 | 70 | 8.8 | | | |
| | | | | | 96 | 20 | 44.0 | 70 | 7.5 | | | |
| | | | | | 95 | 25 | 40.0 | 64 | 7.5 | | | |
| | | | | | 95 | 32 | 44.0 | 70 | 6.4 | | | |
| | | | | | 94 | 40 | 40.0 | 64 | 6.4 | | | |
| | | | | | 87 | 64 | 18.0 | 29 | 6.4 | | | |
| | 3-stage | <18 | 1.3 | 72 | 92 | 60 | 44.0 | 70 | 7.5 | 33.5 | ST89, DB87… (Nema 34) | (340/450) |
| | | | | | 91 | 80 | 44.0 | 70 | 7.5 | | | |
| | | | | | 89 | 100 | 44.0 | 70 | 7.5 | | | |
| | | | | | 88 | 120 | 44.0 | 70 | 6.4 | | | |
| | | | | | 86 | 160 | 44.0 | 70 | 6.4 | | | |
| | | | | | 83 | 200 | 40.0 | 64 | 6.4 | | | |
| | | | | | 81 | 256 | 44.0 | 70 | 6.4 | | | |
| | | | | | 77 | 320 | 40.0 | 64 | 6.4 | | | |
| | | | | | 51 | 512 | 18.0 | 29 | 6.4 | | | |
| GPLE80 | 1-stage | <8 | 2.1 | 60 | 98 | 3 | 85.0 | 126 | 77.0 | 41.5 | ST89… (Nema 34) | 950/1200 |
| | | | | | 98 | 4 | 115.0 | 184 | 52.0 | | | |
| | | | | | 98 | 5 | 110.0 | 176 | 45.0 | | | |
| | | | | | 97 | 8 | 50.0 | 80 | 39.0 | | | |
| | 2-stage | <12 | 2.6 | 77.5 | 97 | 9 | 130.0 | 208 | 74.0 | | | |
| | | | | | 97 | 12 | 120.0 | 192 | 72.0 | | | |
| | | | | | 96 | 15 | 110.0 | 176 | 71.0 | | | |
| | | | | | 96 | 16 | 120.0 | 192 | 50.0 | | | |
| | | | | | 96 | 20 | 110.0 | 192 | 44.0 | | | |
| | | | | | 95 | 25 | 110.0 | 176 | 44.0 | | | |
| | | | | | 95 | 32 | 120.0 | 192 | 39.0 | | | |
| | | | | | 94 | 40 | 110.0 | 176 | 39.0 | | | |
| | | | | | 89 | 64 | 50.0 | 80 | 39.0 | | | |
| | 3-stage | <14 | 3.1 | 95 | 92 | 60 | 110.0 | 176 | 51.0 | | | (650/900) |
| | | | | | 91 | 80 | 120.0 | 192 | 50.0 | | | |
| | | | | | 80 | 100 | 120.0 | 192 | 44.0 | | | |
| | | | | | 89 | 120 | 110.0 | 176 | 70.0 | | | |
| | | | | | 88 | 160 | 120.0 | 192 | 39.0 | | | |
| | | | | | 85 | 200 | 110.0 | 176 | 39.0 | | | |
| | | | | | 84 | 256 | 120.0 | 192 | 39.0 | | | |
| | | | | | 80 | 320 | 110.0 | 176 | 39.0 | | | |
| | | | | | 57 | 512 | 50.0 | 80 | 39.0 | | | |

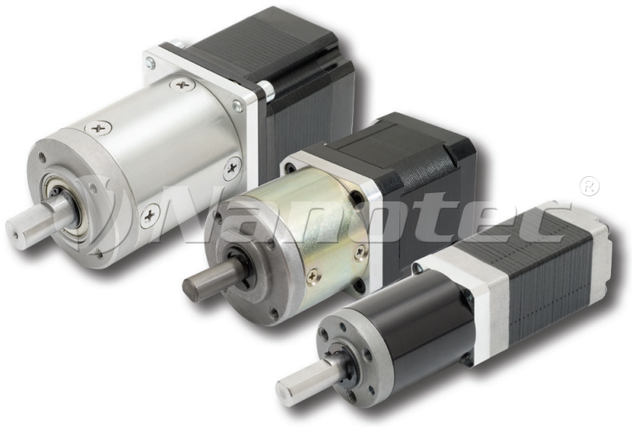
Long-term gearing rated, hardened
Working temperature: -25° to 90°
Service life lubricated, protection class IP54

*1. Continuous output torque on the drive shaft with dynamic load of 100min$^{-1}$ and application factor KA=1 an operating mode S1.

*2. Admissible for 30,000 revolutions of output shaft

*3. at T2N. Reference temperature 70° and n1=1000 rpm

## Economy planetary gear GPLL



The GPLL series economy planetary gear is ideal for applications in which the increased torque of a motor with gearing is needed with the same construction volumes.
The slightly higher circumferential backlash is not relevant for many applications such as transport drives or positioning in one rotation direction, many controllers also already offer automatic play compensation (such as SMCI..) and hence compensates the backlash electronically.

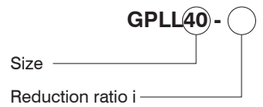
### Gears

**Circumferential backlash: Axial/radial play:**

| | | |
|---|---|---|
| GPLL22 | 2.5° | < = 0.3/< = 0.04 mm |
| GPLL40 | 3° | < = 0.3/< = 0.04 mm |
| GPLL52 | 3° | < = 0.3/< = 0.04 mm |

**Service life Lh10 > 1000 h**

### Order identifier

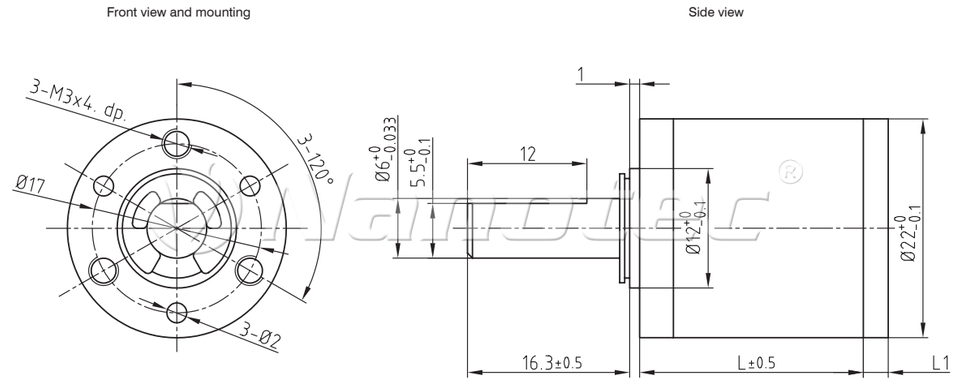



**Available versions (others on request)**

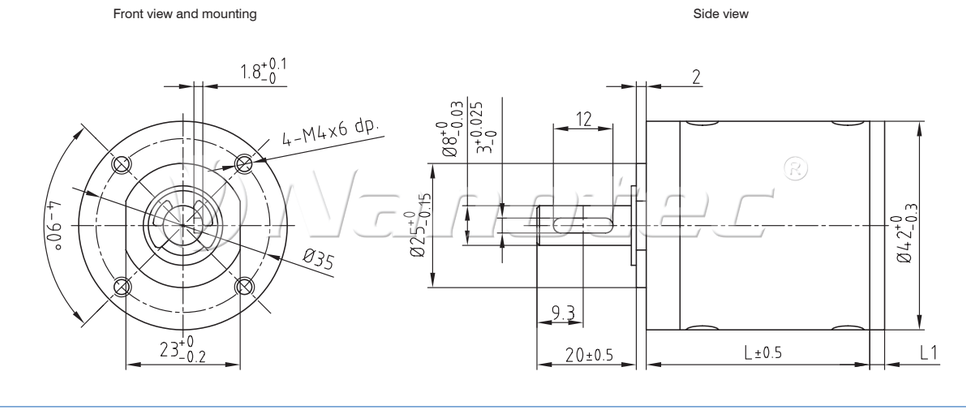
| Type | Reduction ratio | Nom. torque Ncm | max. torqueNcm | Efficiency | Weight kg | Length mm | Intermediate flange L1 mm | Combination option with motor | axial/radial force N |
|---|---|---|---|---|---|---|---|---|---|
| GPLL22-5 | 5:1($4_{2/3}$:1) | 20 | 60 | 80% | 0.046 | 23.3 | without | DB28 | |
| GPLL22-25 | 25:1($25_{1/5}$:1) | 30 | 90 | 70% | 0.051 | 29.5 | 5.0 | ST20, 28 | 7.2 |
| GPLL22-90 | 90:1($89_{121/169}$:1) | 40 | 120 | 60% | 0.058 | 35.7 | | | |
| GPLL40-14 | 14:1(14:1) | 100 | 300 | 70% | 0.191 | 39.2 | 6.0 | ST40, 41, 42 | |
| GPLL40-24 | 24:1(24:1) | 100 | 300 | 70% | 0.191 | 39.2 | 6.0 | DB42 | 30/80 |
| GPLL40-49 | 49:1(49:1) | 180 | 540 | 60% | 0.231 | 45.9 | | | |
| GPLL52-4 | 4:1($4_{1/3}$:1) | 150 | 450 | 80% | 0.475 | 53.0 | 6.0 | ST40, 41, 42 | |
| GPLL52-15 | 15:1($15_{1/6}$:1) | 500 | 1500 | 70% | 0.660 | 68.5 | 6.0 | ST57,58,59,60 | 100/200 |
| GPLL52-53 | 53:1($53_{1/12}$:1) | 1000 | 3000 | 60% | 0.850 | 84.0 | 6.0 | DB57 | |
| GPLL52-100 | 100:1($100_{2/7}$:1) | 1000 | 3000 | 60% | 0.850 | 84.0 | (on request) | DB87 | |



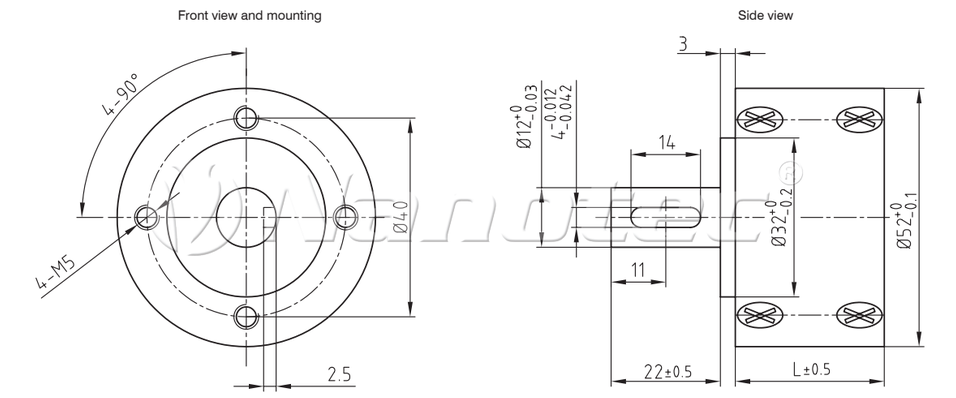
### GPLL22 Outline drawing (in mm)



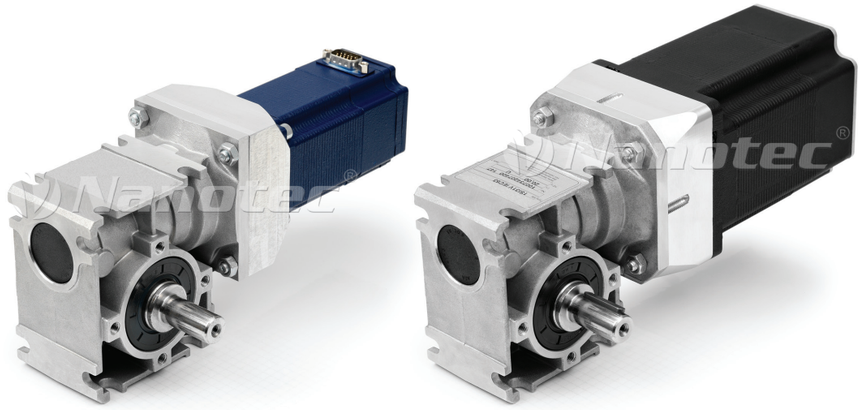

### GPLL40 Outline drawing (in mm)




### GPLL52 Outline drawing (in mm)



## Worm gear GSGE



The maximum Mmax drive torques represent the load limit in continuous operation at an even load.

The Mgrenz output limit torques are static and permissible during operation for short periods without gear damage occurring. The Mgrenz output limit torques represent the upper limit of the permissible load and should not be exceeded even in the event of surges.

### Order identifier

**GSGE60 -**

**Size**

**Reduction ratio i**

Available as options:

· Double shaft (order number: MG-DW-GSGE60)

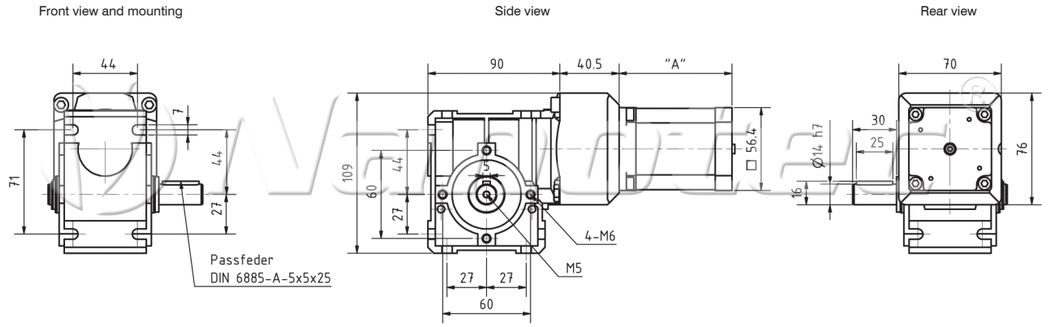
· Cover hood (order number: MG-D-GSGE60)

**Available versions (others on request)**

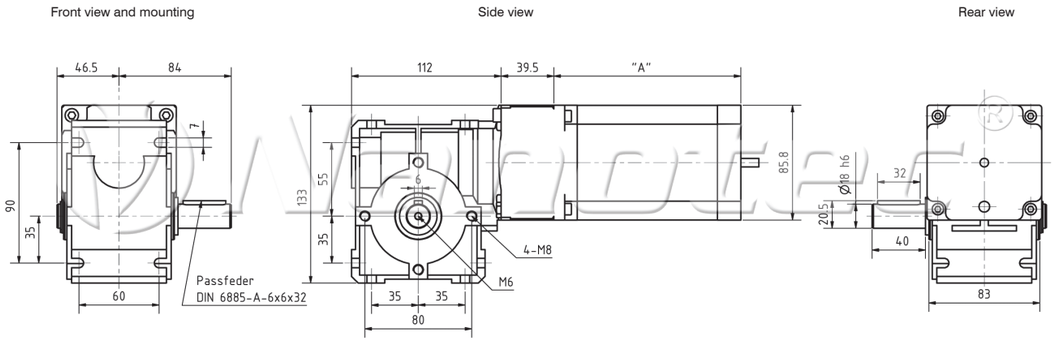
| Type | Reduction ratio | Mgrenz output limit torque Ncm | Mmax max. output torques Ncm | Efficiency | Weight kg | Self-locking | Combination option with motor |
|---|---|---|---|---|---|---|---|
| GSGE60-5-1 | 5 1 | 7500 | 3000 | 86% | 2.0 | no | (Nema 23) |
| GSGE60-15-1 | 15 1 | 7500 | 3000 | 71% | 2.0 | no | (Nema 23) |
| GSGE60-25-1 | 25 1 | 7500 | 3000 | 63% | 2.0 | no | (Nema 23) |
| GSGE60-50-1 | 50 1 | 7500 | 3000 | 45% | 2.0 | yes | (Nema 23) |
| GSGE80-12.5-1 | 12.5 : 1 | 12500 | 5000 | 80% | 3.0 | no | (Nema 34) |
| GSGE80-25-1 | 25 1 | 12500 | 5000 | 68% | 3.0 | no | (Nema 34) |
| GSGE80-50-1 | 50 1 | 12500 | 5000 | 50% | 3.0 | yes | (Nema 34) |



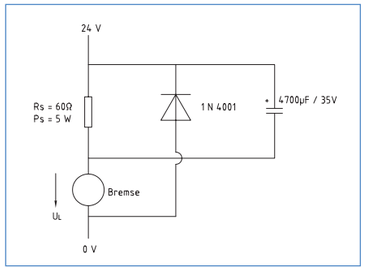
### GSGE 60 outline drawing (in mm)




### GSGE 80 outline drawing (in mm)



## Brakes




The safety brakes from Nanotec have a compact flange construction, are low wear, and are equipped with asbestos-free friction linings. They are fast and easy to install due to the permanently set air gap. The brakes are electromagnetically ventilated and can be used anywhere where moving masses are to be slowed in a very short time or defined to be maintained and the brake torque generated must be available – even if there is a power failure. The braking force is applied with the aid of a pressure spring (BW and BL brakes) or a permanent magnet (BKE brake). A voltage of 24 V DC must be applied to all brakes for venting.

### Brake type BL

#### Technical data

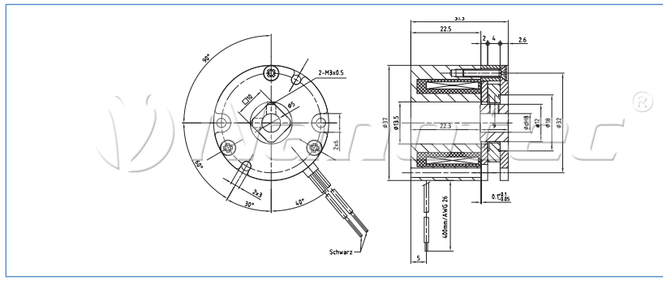
**Electrical data:** 24 V DC/5 W
**Moment of inertia:** 0.01 kgcm²
**Switch-on/switch-off time:** 11 ms/17 ms
**Nominal torque:** 0.24 Nm
**Hub:** Borehole Ø5H7 with 2 puncture screws M3
**Mounting:** with 3 screws M2.5
**Connection:** Lead L = 400 mm
**Weight** 0.1 kg
Mounting possibilities: 40-series motor with B shaft

#### Order identifier

**BRAKE-BL - 0.24 - 5.0**

5.0 = ID hub borehole 5.0

#### Outline drawing (in mm)




### Brake type BW

#### Technical data

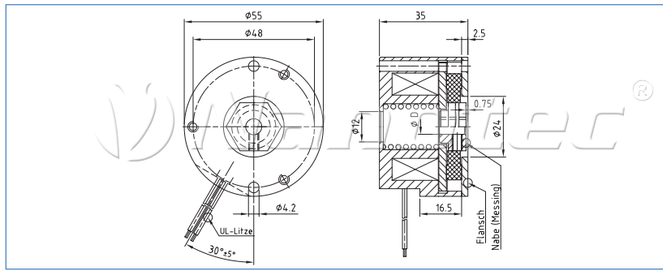
**Electrical data:** 24 V DC/10 W
**Moment of inertia:** 0.1 kgcm²
**Switch-on/switch-off time:** 35 ms/25 ms
**Nominal torque:** 1.4 Nm
**Hub:** Borehole … H7 with 2 puncture screws M4
**Mounting:** With 2 studs M3 or M4
**Connection:** Lead L = 400 mm
**Weight** 0.5 kg
Mounting possibilities: 56-series motor with B shaft

#### Order identifier

**BRAKE-BW - 1.4 - 6.3**

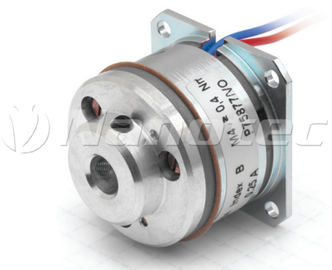
6.3 = hub borehole 6.35
9.5 = hub borehole 9.525

#### Outline drawing (in mm)






## Brakes



Integrated brakes with plug connection allow operation in tough environmental conditions (IP54) and ensure fast and mistake-free wiring.
The BKE brakes with the Nano brake module are used for this purpose.

The Nano brake module (PWM controller) reduces the power and heat losses of the brake by 35% thus enabling a higher stopping and activation time of the motor.

The anti-surge diode for the brake is also already integrated in the module.

#### Technical data

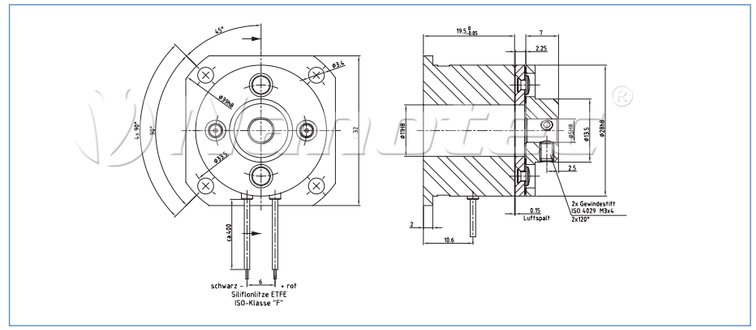
**Electrical data:** 24 V DC/8 W
**Moment of inertia:** 0.013 kgcm²
**Switch-on/switch-off time:** 10 ms/6 ms
**Nominal torque:** 0.4 Nm
**Hub:** Borehole ... H8 with 2 puncture screws AM3x4
**Mounting:** with 4 screws M3
**Connection:** Lead L = 400 mm
**Weight** 0.08 kg

#### Order identifier

**BRAKE-BKE - 0,4 - 5,0**

5.0 = ID hub borehole 5.0

#### Outline drawing (in mm)




#### Technical data

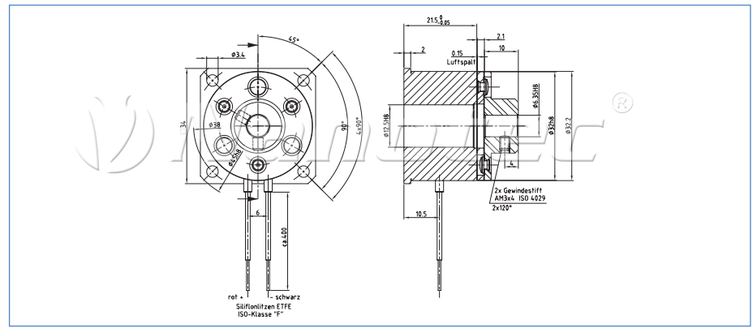
**Electrical data:** 24 V DC/10 W
**Moment of inertia:** 0.021 kgcm²
**Switch-on/switch-off time:** 12 ms/6 ms
**Nominal torque:** 1 Nm
**Hub:** Borehole … H8 with 2 puncture screws AM3x4
**Mounting:** with 4 screws M3
**Connection:** Lead L = 400 mm
**Weight** 0.11 kg

#### Order identifier

**BRAKE-BKE - 1.0 - 6.35**

6.35 = ID hub borehole 6.35

#### Outline drawing (in mm)




#### Technical data

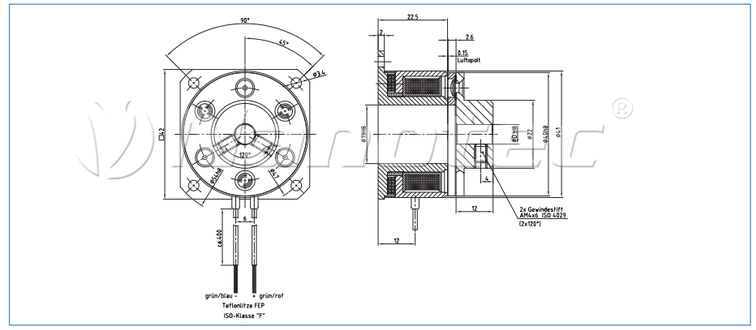
**Electrical data:** 24 V DC/11 W
**Moment of inertia:** 0.067 kgcm²
**Switch-on/switch-off time:** 25 ms/6 ms
**Nominal torque:** 2 Nm
**Hub:** Borehole … H8 with 2 puncture screws AM4x6
**Mounting:** with 4 screws M3
**Connection:** Lead L = 400 mm
**Weight** 0.185 kg

#### Order identifier

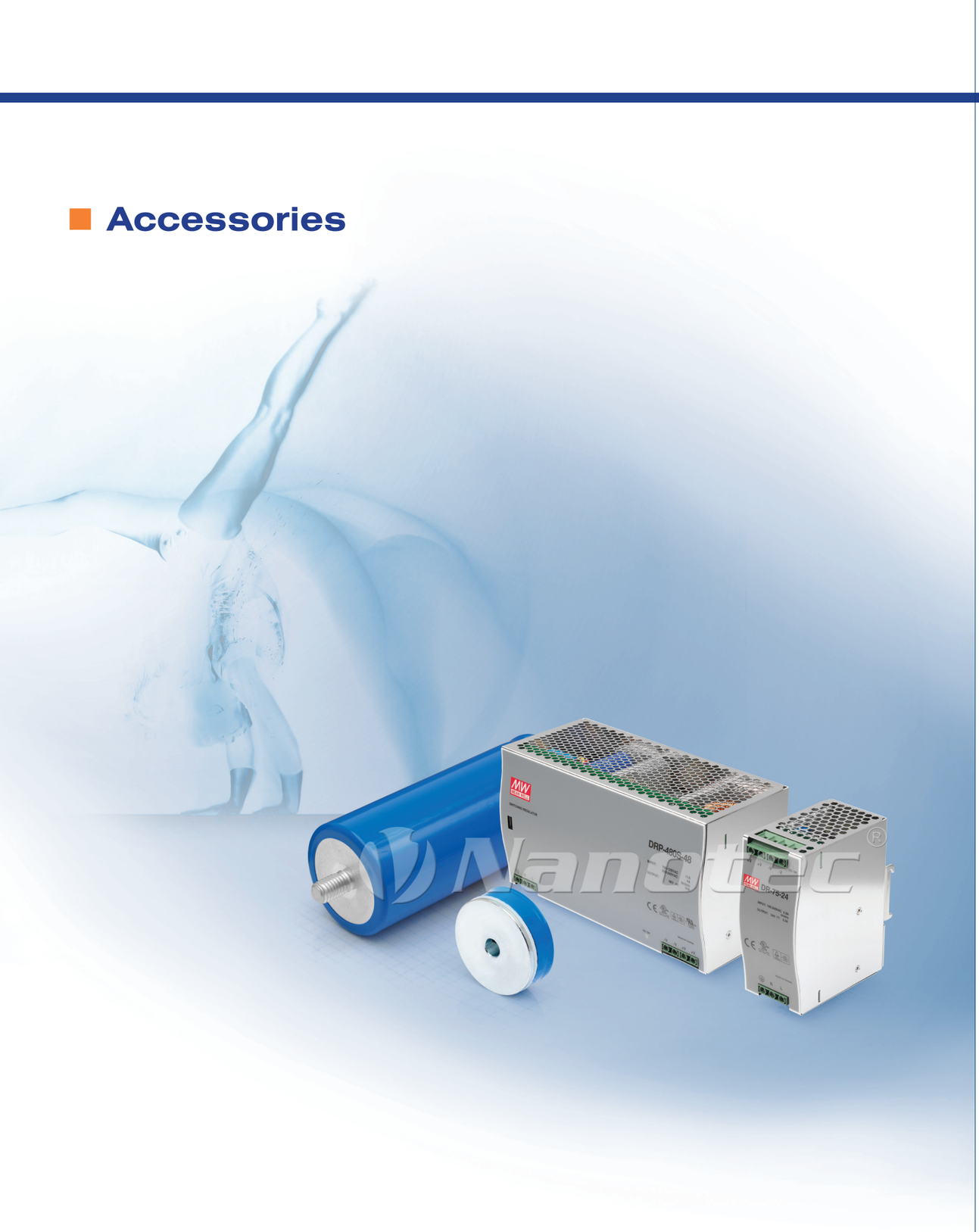
**BRAKE-BKE - 2,0 - 6,35**

6.35 = ID hub borehole 6.35
8.0 = ID hub borehole 8.0

#### Outline drawing (in mm)



# Accessories






## Switch-mode power supplies for DIN top hat rail 120 - 480 W (sealed construction)

### Technical data (all values related to 230 V AC/25 °C)

| | |
|---|---|
| **Input voltage:** | 180 V AC to 264 V AC |
| **Output voltage:** | 24 V, 48 V |
| **Safety:** | Softstart |
| **Protection circuit:** | Overload/overvoltage protection, power system failure buffering 20 ms at full load, short circuit-proof |
| **Temperature range:** | -10°C to +50°C (up to +70°C at 60% load) |
| **Certifications:** | CE/UL/TÜV |
| **Efficiency:** | 86% |
| **Connection type:** | Screw terminals |
| **Mounting type:** | DIN mounting rails |

### Pin assignment

**NTS-24 V-5 A; NTS-24 V-10 A**
**NTS-48 V-2.5 A; NTS-48 V-5 A**

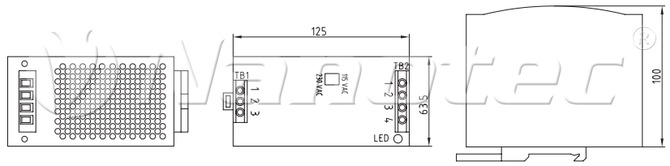
| Pin | Designation | |
|---|---|---|
| 1 | out | RDY |
| 2 | | |
| 3 | | $V^+$ DC |
| 4 | | $V^+$ DC |
| 5 | | V.DC |
| 6 | | V.DC |
| 7 | in | PE, grounding |
| 8 | | L |
| 9 | | N |
| | other | DC On |
| | | DC Lo |
| | | $V_{out}$ Adj. |

**NTS-48 V-10 A**

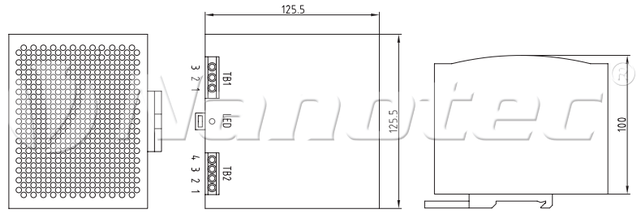
| | |
|---|---|
| TB1 = | AC input |
| 1 = | FG grounding |
| 2 = | AC/N |
| 3 = | AC/L |
| TB2 = | DC output |
| 1.2 = | +V |
| 3.4 = | -V |

### Outline drawing (mm)

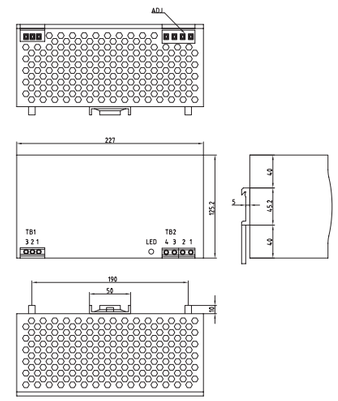
**NTS-24V-5A**
**NTS-48V-2.5A**




**NTS-24V-10A**
**NTS-48V-5A**




**NTS-48V-10A**



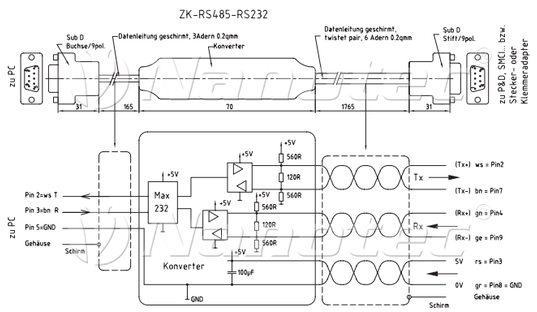

### Technical data

| | NTS-24V-5A(120 W) | NTS-48V-2.5A(120 W) | NTS-24V-10A(240 W) | NTS-48V-5A(240 W) | NTS-48V-10A(480 W) |
|---|---|---|---|---|---|
| **Nominal input current:** | 1.4 A/230 V | 1.4 A/230 V | 2.2 A/230 V | 2.2 A/230 V | 4.0 A/230 V |
| **Input current (cold start):** | 24 A/115 V<br>48 A/230 V | 24 A/115 V<br>48 A/230 V | 24 A/115 V<br>48 A/230 V | 24 A/115 V<br>48 A/230 V | 30 A/150<br>50 A/230 V |
| **Output voltage:** | 24 ~ 32 V | 46 ~ 57 V | 24 ~ 32 V | 46 ~ 57 V | 48 ~ 53 V |
| **Power output:** | 120 W (24 V/5 A) | 120 W (48 V/2.5 A) | 240 W (24 V/10.0 A) | 240 W (48 V/5 A) | 480 W (48 V/10 A) |
| **Weight:** | 0.64 kg | 0.64 kg | 1.0 kg | 1.0 kg | 2.2 kg |

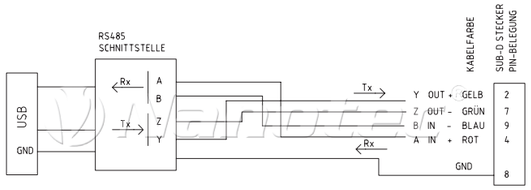
## Connection cable

| Order identifier | |
|---|---|
| **Interface converter** | |
| ZK-RS485-RS232 | Converter from RS232 to RS485, 4-wire |
| ZK-RS485-USB | Converter from USB to RS485, 4-wire |
| ZK-RS232-USB-3.3V | Converter RS232-USB (TTL for SMCI35) |

### ZK-RS485-RS232



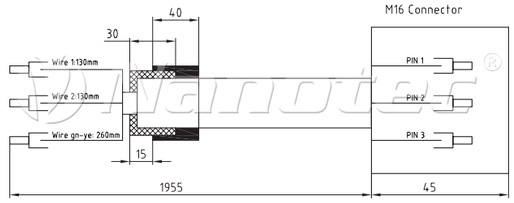

### ZK-RS485-USB



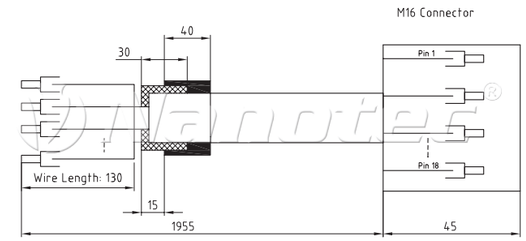

| Order identifier | |
|---|---|
| **M16 motor cable for PD6-N8918…-S motors** | **M16 signal cable for PD6-N8918…-S motors** |
| ZK-TW-3-2M motor cable, 3-pin, 2M | ZK-TW-18-2M signal cable, 18-pin, 2M |

## Outline drawing (mm)

### ZK-TW-3-2M




### ZK-TW-18-2M




## Pin configuration: ZK-TW-3-2M, ZK-TW-18-2M

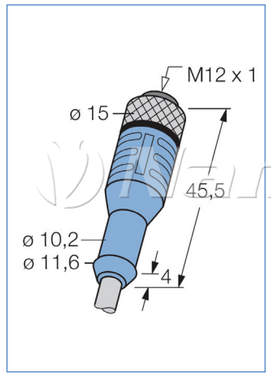

| ZK-TW-3-2M | |
|---|---|
| **WIRE NO./COLOR** | **FUNCTION** |
| 1 | +VB |
| 2 | GND |
| Green/yellow | Protective conductor |

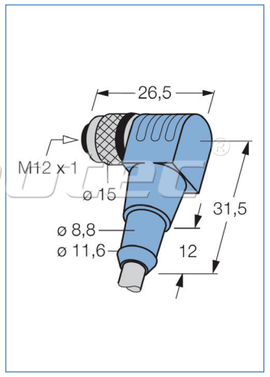

| ZK-TW-18-2M | | |
|---|---|---|
| **FUNCTION** | **PIN** | **COLOR** |
| Output 1 | 1 | White/yellow |
| Output 2 | 2 | Yellow/brown |
| Output 3 | 3 | White/gray |
| Analog input | 4 | White/blue |
| +Vb external | 5 | White/pink |
| GND (W001) | 6 | Red |
| RS485 Tx+ | 7 | Gray |
| RS485 Tx- | 8 | Pink |
| RS485 Rx- | 9 | Yellow |
| RS485 Rx+ | 10 | Green |
| Input 1 | 11 | Black |
| Input 2 | 12 | Purple |
| Input 3 | 13 | Gray/pink |
| Input 4 | 14 | Red/blue |
| Input 5 | 15 | White/green |
| Input 6 | 16 | Brown/green |
| CAN - | 17 | White |
| CAN + | 18 | Brown |



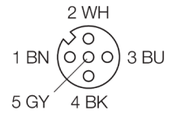
## Connection cable

| Order identifier | |
|---|---|
| **M12 cable for AS.. and AD.. motors with encoder** | |
| ZK-M12-8-2M-1-PUR-S | 8-pin, 2 m, straight connector, shielded |
| ZK-M12-8-5M-1-PUR-S | 8-pin, 5 m, straight connector, shielded |
| ZK-M12-8-2M-2-PUR-S | 8-pin, 2 m, angled connector, shielded |
| ZK-M12-8-5M-2-PUR-S | 8-pin, 5 m, angled connector, shielded |



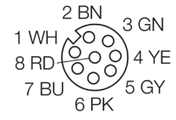




| Order identifier | |
|---|---|
| **M12 motor connection for AS.. motors** | |
| ZK-M12-5-2M-1-PUR-S | 5-pin, 2 m, straight connector, shielded |
| ZK-M12-5-5M-1-PUR-S | 5-pin, 5 m, straight connector, shielded |
| ZK-M12-5-2M-2-PUR-S | 5-pin, 2 m, angled connector, shielded |
| ZK-M12-5-5M-2-PUR-S | 5-pin, 5 m, angled connector, shielded |




| No. | COLOR |
|---|---|
| 1 | Brown |
| 2 | White |
| 3 | Blue |
| 4 | Black |
| 5 | Gray |

Shield placed on union nut



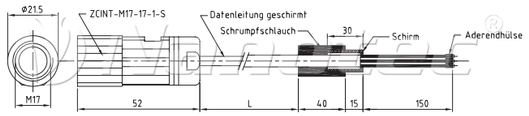

| No. | COLOR |
|---|---|
| 1 | White |
| 2 | Brown |
| 3 | Green |
| 4 | Yellow |
| 5 | Gray |
| 6 | Pink |
| 7 | Blue |
| 8 | Red |

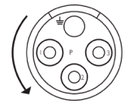
Shield placed on union nut

| Order identifier | |
|---|---|
| **M17 motor cable for ADB87 motors** | |
| ZK-M17-4-2M | Motor cable, 4-pin, 2 m |
| ZK-M17-4-5M | Motor cable, 4-pin, 5 m |
| ZK-M17-4-7M | Motor cable, 4-pin, 7 m |

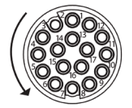
| Order identifier | |
|---|---|
| **M17 signal cable for ADB87 motors** | |
| ZK-M17-12-2M | Signal cable, 12-pin, 2 m |
| ZK-M17-12-5M | Signal cable, 12-pin, 5 m |
| ZK-M17-12-7M | Signal cable, 12-pin, 7 m |

### ZK-M17



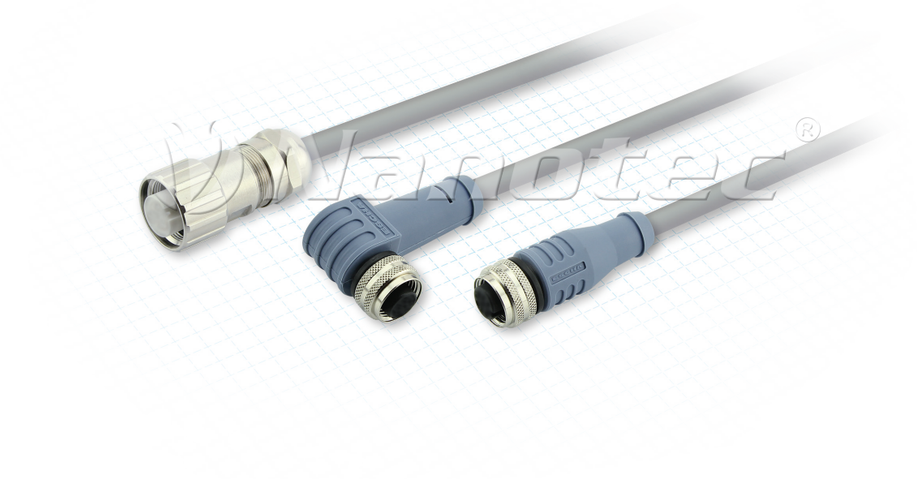

| M17 - 4-pin | |
|---|---|
| **No.** | **COLOR** |
| 1 | White |
| 2 | Yellow |
| 3 | Green |
| 4 | Brown |




| M17 - 17-pin | |
|---|---|
| **No.** | **COLOR** |
| 1 | Red |
| 2 | Black |
| 3 | Blue |
| 4 | White |
| 5 | Green |
| 6 | Yellow |
| 7 | Brown |
| 8 | Gray |
| 9 | Gray/pink |
| 10 | Purple |
| 11 | Red/blue |
| 12 | White/green |
| 13 | N.C. |
| 14 | |
| 15 | |
| 16 | |
| 17 | |

| Order identifier | |
|---|---|
| **Diverse cable sets** | |
| ZK-SMC11 | Assembled cable set for SMC11/G/GE, L=300 mm |
| ZK-SMCI12 | Assembled cable set for SMCI12 |
| ZK-SMCI12-3 | Assembled cable set for SMCI12 with CAN Open |
| ZK-USB | Programming cable for SMCI33-1 |

## Connection cable

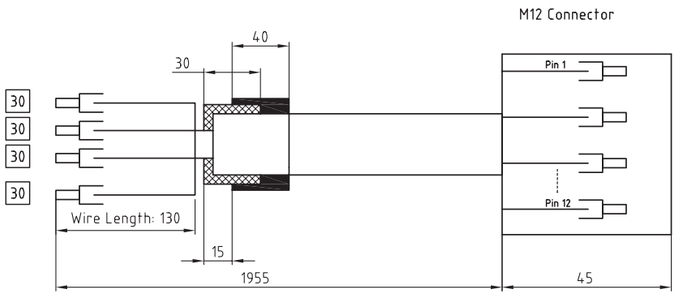


### Order identifier

| M16 motor cable for ASB42 | M12 signal cable for ASB42 |
|---|---|
| ZK-TW-3-2M motor cable, 3-pin, 2M | ZK-M12-12-2M motor cable, 12-pin, 2M |

### Outline drawing (mm)

**ZK-TW-3-2M**




### Pin configuration

**ZK-TW-3-2M, ZK-TW-12-2M**


| ZK-TW-3-2M | |
|---|---|
| **WIRE NO./COLOR** | **FUNCTION** |
| 1 | +VB |
| 2 | GND |
| Green/yellow | Protective conductor |

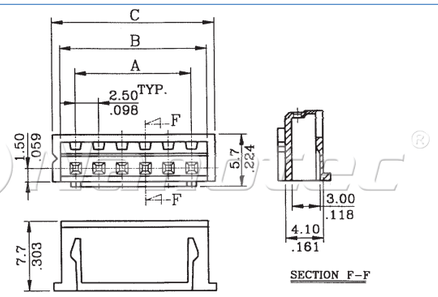
| ZK-TW-12-2M | | |
|---|---|---|
| **PIN NO.** | **ENC./HALL** | **Color** |
| 1 | NC | Brown |
| 2 | 5 V | Blue |
| 3 | GND | White |
| 4 | A | Green |
| 5 | A\ | Pink |
| 6 | B | Yellow |
| 7 | B\ | Black |
| 8 | I | Gray |
| 9 | I\ | Red |
| 10 | H1 | Violet |
| 11 | H2 | Gray/pink |
| 12 | H3 | Red/blue |



Notes

## Plug connector

### Socket housing JST-XHP



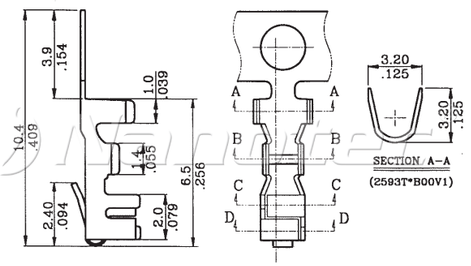

### Pin assignment

| Pins | Ⓧ | Size A | Size B | Size C |
|---|---|---|---|---|
| 2 | 2 | 2.5 | 5.7 | 7.3 |
| 3 | 3 | 5.0 | 8.2 | 9.8 |
| 4 | 4 | 7.5 | 10.7 | 12.3 |
| 5 | 5 | 10.0 | 13.2 | 14.8 |
| 6 | 6 | 12.5 | 15.7 | 17.3 |
| 8 | 8 | 17.5 | 20.7 | 22.3 |

### Order identifier

**ZCJST-XHP -Ⓧ**

### Contact springs AWG22 - 26



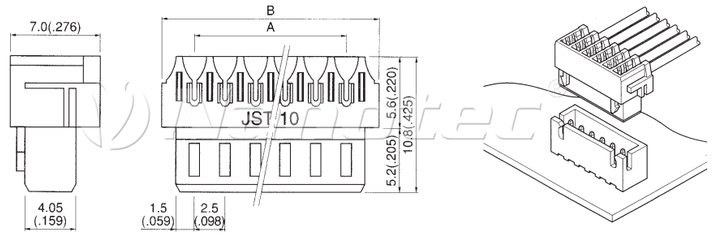

### Order identifier

**ZCJST-SXH**

### Order identifier

Crimping tool for individual contact springs
**ZC2WC-110**

### Insulation displacement connection technology, connector for AWG24



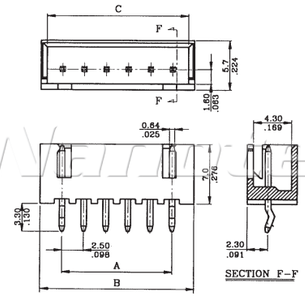

### Pin assignment

| Pins | Ⓧ | Size A | Size B |
|---|---|---|---|
| 4 | 04NR | 7.5 | 12.5 |
| 5 | 05NR | 10.0 | 15.0 |
| 6 | 06NR | 12.5 | 17.5 |
| 8 | 08NR | 17.5 | 22.5 |

### Order identifier

**ZCJST-Ⓧ**

### Pin connector for RM print assembly 2.54 mm (JST-XHP)




### Pin assignment

| Pins | Ⓧ | Size A | Size B | Size C |
|---|---|---|---|---|
| 4 | SL4-2.54 | 7.5 | 12.5 | 11.1 |
| 6 | SL6-2.54 | 12.5 | 17.5 | 16.1 |
| 8 | SL8-2.54 | 17.5 | 22.5 | 21.1 |

### Order identifier

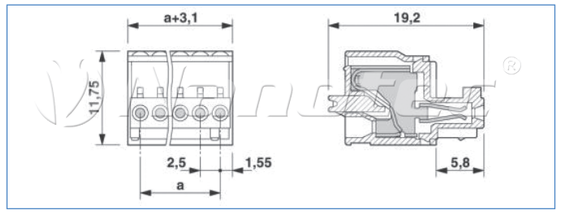
**ZC2-Ⓧ**





## Plug connector

### COMBICON connector socket housing



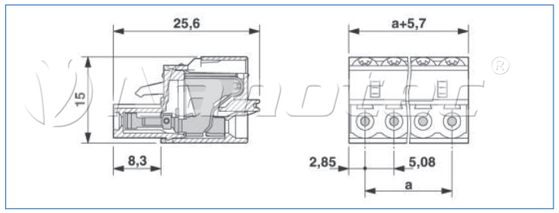

### Order identifier

**ZCPHOFK-MC0.5 -Ⓧ**

### Pin assignment

| Pins | X | Size A |
|---|---|---|
| 2 | 2 | 2.5 |
| 4 | 4 | 7.5 |
| 5 | 5 | 10.0 |
| 8 | 8 | 17.5 |
| 12 | 12 | 27.5 |

### COMBICON HC connector socket housing




### Order identifier

**ZCPHOFKC-2.5HC -Ⓧ**

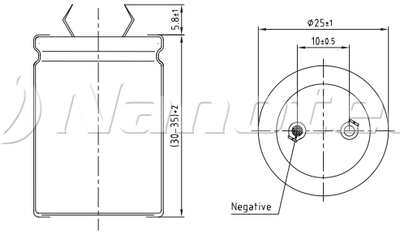
### Pin assignment

| Pins | X | Size A |
|---|---|---|
| 2 | 2 | 5.08 |
| 4 | 4 | 15.24 |

## Charging condenser

Parallel to the operating voltage, charging capacitors are required on drivers or Plug&Drive stepper motors so that the admissible voltage is not exceeded during the braking process.

### Outline drawing (in mm)



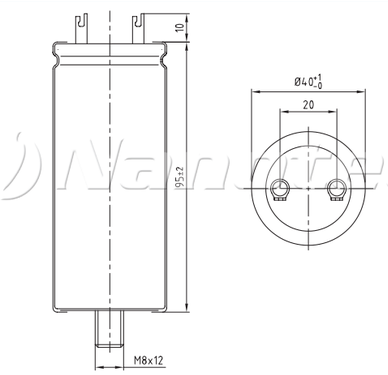

### Charging capacitor 4,700 µF

Capacity: 4,700 µF/50 V
Temperature range: -40 to +85°C
Dimensions: Round cylindrical aluminum case, 25 x 35 mm
Capacity tolerance: ± 20%
Contact spacing: 10 mm

### Order identifier

**Z-K4700/50**

### Outline drawing (in mm)



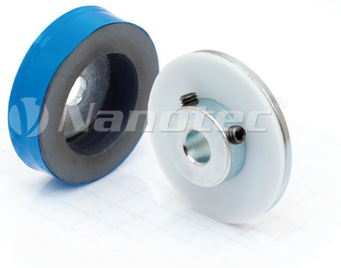

### Charging capacitor 10,000 µF

Capacity: 10,000 µF/100 V
Temperature range: -40 to +105 °C
Dimensions: Round cylindrical aluminum case, 40 x 95 mm
Capacity tolerance: -10% ~ 30%
Contact spacing: 20 mm

### Order identifier

**Z-K10000/100**

## Damper



The D28, D40 and D56 dampers from Nanotec can be mounted on all stepper motors with a second shaft end (28-58 mm construction size). In addition to the improved settling time, system resonances are suppressed, and vibrations and motor noise is greatly reduced in the lower speed range.
With device-specific resonance and noise problems, device setup is made considerably easier by fitting the damper.

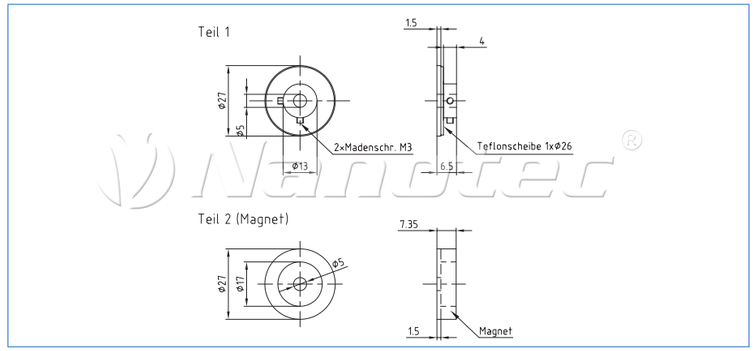
### ZD-D28

For all stepper motors with a shaft diameter of 5.0 mm and B shaft, weight: 26 g. Adapted for stepper motor size ST28.

**Order identifier**

| ZD-D28 |
|---|

**Outline drawing (in mm)**



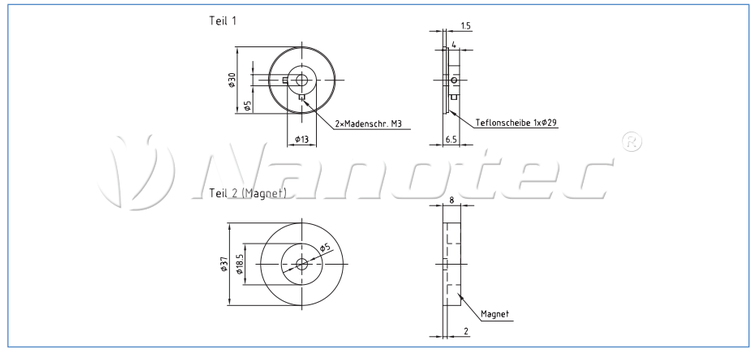

### ZD-D40

For all stepper motors with a shaft diameter of 5.0 mm and B shaft, weight: 40 g. Adapted for stepper motor sizes ST41.., ST42..

**Order identifier**

| ZD-D40 |
|---|

**Outline drawing (in mm)**



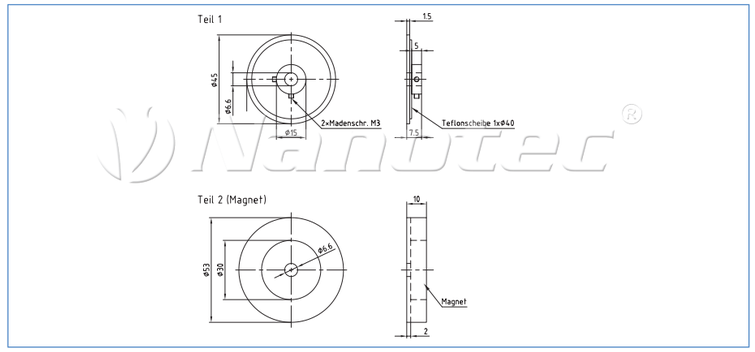

### ZD-D56

For all stepper motors with a shaft diameter of 6.35 mm and B shaft, weight: 100 g. Adapted for stepper motor sizes ST57.., ST59..

**Order identifier**

| ZD-D56 |
|---|

**Outline drawing (in mm)**






## Damper for mounting flange

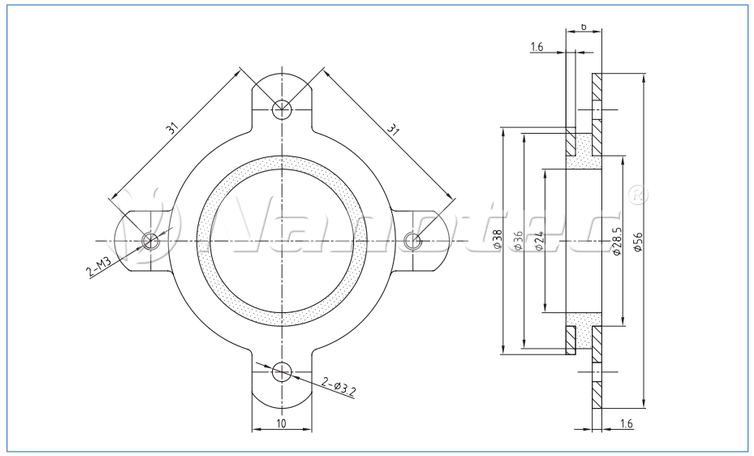
The rubber vulcanized onto the 2 flange rings is used primarily by the ZD-.. damper for attenuating the structure-borne noise* which can be reduced to approx. 3-10 dB(A) compared to direct flange mounting and its size, construction and stability and depending on the frequency. Due to the different sound velocities - steel / air / rubber = 5000 / 331 / 50 m/s - and the damping vibration tendency of the damper ZD-DF.. this provides cost-effective noise damping.

Compared to the well-known rubber silencer, the ZD silencer still provides an acceptable setting of the often important axis spacing between motor shaft and shaft to be driven.

The interrupted flange cooling surface (additional cooling surface that is often utilized for direct flange mounting) must be taken into account at the admissible motor temperature.

*** The generation of noise arises** initially as structure-borne noise and are only then emitted as air noise. If these air noise waves strike a component, such as a casing wall, this causes it to vibrate. Due to the oscillation of this wall (minimum bending vibrations), air in the room is excited and is amplified as air noise so that it can be heard by persons. As each component has its own resonant frequency, countless other noise sources can be excited and hence amplified too.

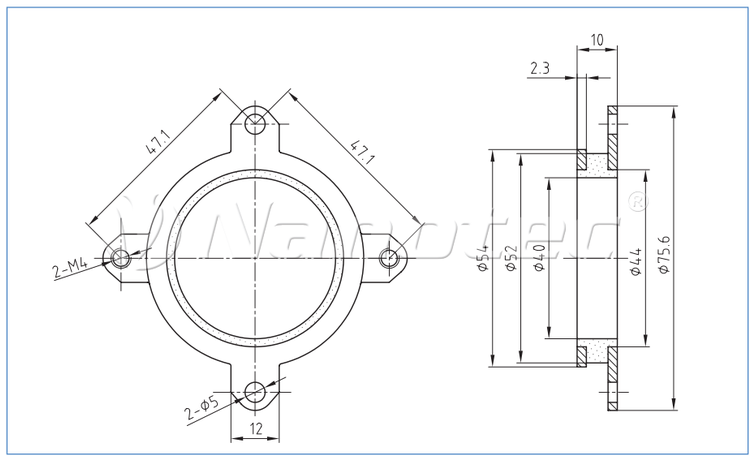
### ZD-DF40




**Order identifier**

| ZD-DF40 |
|---|

### ZD-DF56



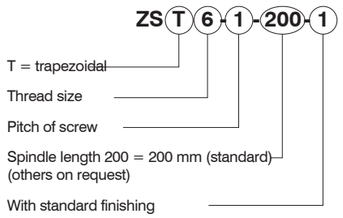

**Order identifier**

| ZD-DF56 |
|---|

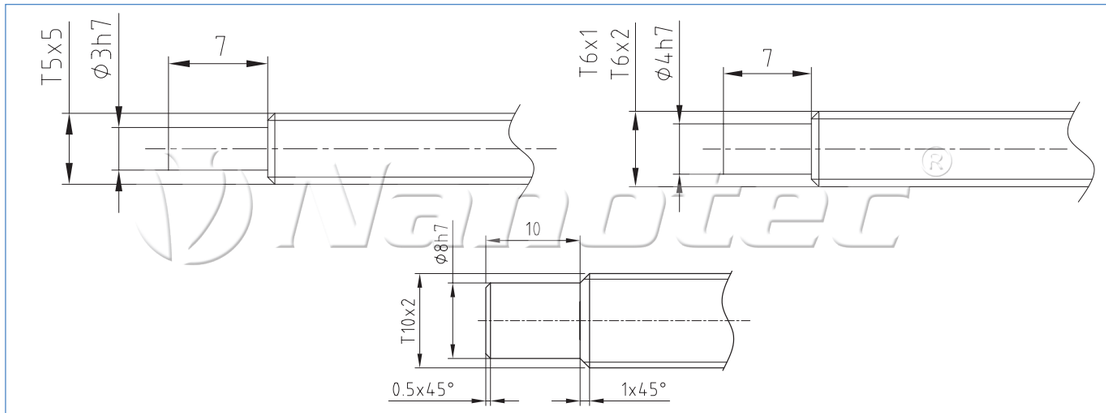
## Threaded spindles

**Fast and economic for the complete module**
To realize easy and fast linear movements with a stepper motor, we offer the matching thread spindles for every linear actuator or linear motor. This reduces not only the order and delivery costs, but at the same time increases the observation of the specified tolerance.
**Lubrication:**
The lubrication intervals depend on external operating conditions. Bronze nuts mustbe regularly lubricated (e.g. Klüber - Microlube GBUY131)

### Order identifier




### Standard finishing



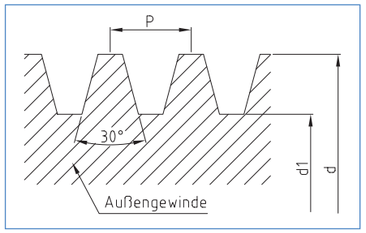

### Trapezoidal spindles p = 1 - 5 mm

The pitch of p = 1, 2 and 5 mm offers an extended range of applications, where larger strokes are conveyed in a minimum of time.

**Spindle material**
Material no.: 1.4021 = Rust-free (not acid and saltwater resistant) all trapezoidal threaded spindle except for T6X2 ( 1.4401)

**Tensile strength**
760 N/mm²

### Spindle with trapezoidal screw threads

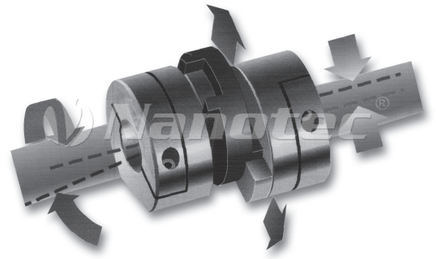



**Available spindles**

| Thread size Ø | Pitch p | Thread pitch delay mm/on section | Outside Ø d mm | Core Ø d1 mm | Standard axial play | for linear actuator | available spindle lengths mm |
|---|---|---|---|---|---|---|---|
| T3.5x1 | 1.00 | ± 0,1 / 300 mm | 3.50 | 2.30 | 0.03 | L.....-T3.5x1 | 200, 300 |
| T6x1 | 1.00 | ± 0,1 / 300 mm | 6.00 | 4.70 | 0.03 | L.....-T6x1 | 200, 300 |
| T6x2 P1 | 2.00 | ± 0,1 / 300 mm | 6.00 | 4.70 | 0.03 | L.....-T6x2 | 200, 300 |
| T5x5 | 5.00 | ± 0,1 / 300 mm | 5.40 | 3.60 | 0.10 | L.....-T5x5 | 200, 300 |
| T10x2 | 2.00 | ± 0,1 / 300 mm | 9.70 | 8.20 | 0.06 | L.....-T10x2 | 200, 300 |



## Shaft couplings



The Oldham couplings from Nanotec are easy to install due the short construction and can transfer high forces with low shaft offset. Damage to the shaft is excluded by the clamp fastening. A nylon transmission disc dampens noise and provides good insulation properties (3 kV between two shafts) with a potential-free construction.

**Use**
Wherever play-free power transmission is needed: Stepper motors, servomotors, encoder, tacho-generator, etc.

**Temperature range:** -20 °C to +60 °C
**Materials:** 2011T3 and 2011T8 BS4300/5FC1 aluminum alloy hub
**Transmission disc:** Nylon 11 (colorless)
**Blind hole:** Length of parallel borehole ±0.2.
Boreholes end with 118° angle

### Operating factors

Maximum torques based on drives with no displacement or axial movement.
The operating ratios are multiplied by the load moments as explained, e.g.

Load moment of the application = 1 Nm
Operating factor = 2
**Required torque = 2 Nm**

| Load duration | Operating factor |
|---|---|
| Momentary load | 1 |
| 1 hours per day | 2 |
| 3 hours per day | 4 |
| 6 hours per day | 6 |
| 12 hours per day | 8 |

### Order identifier

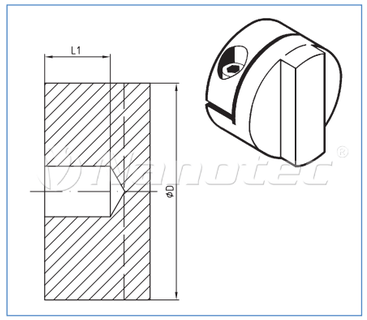
**ZW-X (e.g. ZW-235-19-20)**

**Order 2 hubs + 1 transmission disc**

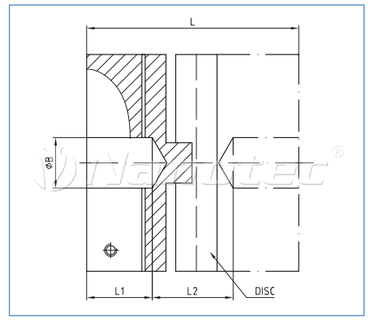
From 50 pcs, special boreholes are possible!

**Order number** for special hub boreholes:
e.g. 8.0 mm= ZW-235-19-99-8.0

### Hubs with blind hole




### Outline drawing (in mm)




### Coupling-specific parameters

| Size | Short-circuit torque Nm | Max. displacement @3000 r.p.m. Angle ± ° | Radial ± mm | Axial ± mm | Static break torque Nm |
|---|---|---|---|---|---|
| 19 | 1.7 | 0.5 | 0.2 | 0.10 | 10 |
| 25 | 4.0 | 0.5 | 0.2 | 0.10 | 13 |
| 41 | 17.0 | 0.5 | 0.2 | 0.15 | 57 |

**Available shaft couplings**

| Hubs | Size | Hub hole +0.03/-0 mm | Dimensions Ø D | L | L1 | L2 | Fixing screws Setting screw | removal torque Nm | Inertia torque kgm²x10⁻⁸ | Weight | Transmission disc Order number |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 235-19-20 | 19 | 5 | 19.1 | 22.0 | 6.3 | 9.4 | M3 | 0.94 | 67 | 12 | **235-19-0** |
| 235-19-99 | 19 | X | 19.1 | 22.0 | 6.3 | 9.4 | M3 | 0.94 | 67 | 12 | **235-19-0** |
| 234-25-24 | 25 | 6.35 | 25.4 | 28.4 | 8.6 | 11.2 | M4 | 2.27 | 252 | 31 | **234-25-0** |
| 234-25-28 | 25 | 8 | 25.4 | 28.4 | 8.6 | 11.2 | M4 | 2.27 | 252 | 31 | **234-25-0** |
| 234-25-99 | 25 | X | 25.4 | 28.4 | 8.6 | 11.2 | M4 | 2.27 | 252 | 31 | **234-25-0** |
| 234-41-31 | 41 | 9.525 | 41.3 | 50.8 | 16.7 | 17.4 | M5 | 4.62 | 3327 | 148 | **234-41-0** |
| 234-41-38 | 41 | 14 | 41.3 | 50.8 | 16.7 | 17.4 | M5 | 4.62 | 3327 | 148 | **234-41-0** |
| 234-41-99 | 41 | X | 41.3 | 50.8 | 16.7 | 17.4 | M5 | 4.62 | 3327 | 148 | **234-41-0** |

# Terms and Conditions of Sale and Delivery

## § 1 Ranges of Application

1.1 Our terms and conditions of sale and delivery apply exclusively. Any terms of the buyer that are in conflict with or differ from our vending or delivery terms are not recognized by us, unless we have agreed to their validity in writing. Our terms and conditions of sale and delivery are also valid if we carry out the delivery to the buyer without reservations and if we are aware of any contradictory or deviating conditions of the buyer.

1.2 All agreements made between us and the buyer for the purpose of the execution of this contract must be made in writing in this contract.

1.3 Our terms and conditions of sale also apply for all future transactions with the buyer.

## § 2 Quotation and Order

2.1 Our quotations are subject to change. Binding contracts of delivery will only be concluded through our confirmation of order unless a written contract has been concluded. If the order is to be qualified as a quotation according to § 145 of the German Civil Code [BGB], we can accept it within four weeks. All additional agreements and promises will not be effective unless included in the confirmation of order and/or confirmed in writing. Should the value added tax not be separately identified in the quotations, the price quoted shall be plus legal value added tax.

2.2 Orders which are to be carried out on the same working day on which they arrive at Nanotec, they must have arrived at Nanotec by 11 a.m. at the latest. In the event of larger orders for individual products, Nanotec reserves the right to extend the delivery time appropriately.

2.3 Written orders which repeat a previous telephone order without expressly pointing out the repetition shall be regarded as an additional order.

2.4 In the event of written, printing or calculation errors in the catalog, order, website or inadequate creditworthiness of the customer, Nanotec shall, however, be entitled to withdraw from the agreement. Claims for damages from the buyer shall not be accepted in such situations.

2.5 All photographs, drawings, weight, measurement, performance or other constructional data in the catalog, quotation and on the Internet are only binding insofar as it has been expressly agreed upon. Nanotec retains the right of changes and deviations. The customer is solely responsible for the use intended by him for the ordered items.

2.6 Nanotec retains the right to agree the delivery period of large quantities separately.

## § 3 Prices and Terms and Conditions of Payment

3.1 All prices are quoted in Euro. Unless otherwise agreed, the prices are ex works plus dispatch and packing costs and plus sales tax in the currently valid legal amount.

3.2 Nanotec retains the right to increase catalog, quotation or Internet prices adequately if, after publication of the catalog, quotation and Internet, price increases occur, in particular due to collective wage agreements, an increase in material prices or currency fluctuations. These increases will be verified to the buyer on demand.

3.3 Unless agreed otherwise, the purchase price is to be paid net (without any deductions) within thirty days from the date of invoice or within ten days with 2% cash discount. If the buyer is in delay with payment, Nanotec shall be entitled to claim interest on the amount in arrears at the rate of 4% above the respective base rate of the Deutsche Bundesbank p.a. If Nanotec verifiably incurs higher costs, Nanotec will be entitled to claim these.

3.4 The retention of payments or the setting off of any counterclaims of the buyer disputed by Nanotec are not admissible.

3.5 If a substantial deterioration of the financial circumstances of the buyer occurs or if Nanotec is informed of a previous deterioration of the financial circumstances after the conclusion of the contract, Nanotec will be entitled to demand either payment in advance or a security payment at its discretion. In the case of new customers, Nanotec retains the right of delivery against cash on delivery or payment in advance. In case of new customers, Nanotec retains the right of delivery against cash on delivery or payment in advance.

## § 4 Delivery

4.1 Unless otherwise agreed, delivery is ex the Feldkirchen site near Munich. The risk will be transferred to the buyer as soon as the consignment leaves the works of Nanotec, also in the case of partial deliveries.

4.2 Information on the period of delivery is non-binding, unless the date of delivery has been bindingly agreed. § 2.1 of these terms and conditions of sale and delivery remains unaffected.

4.3 If the buyer grants Nanotec an adequate extension with threat of rejection after Nanotec has already defaulted, the buyer will be entitled to withdraw from the contract after the futile expiry of this extension. The buyer will only be entitled to claims for damages due to non-fulfillment up to the amount of the predictable damage if the delay is due to intent or gross negligence. Moreover, the liability for damage is restricted to 50 % of the damage incurred.

4.4 If Nanotec is in delay with delivery for reasons for which Nanotec is responsible, the buyer will be entitled to demand a generalized compensation for delay to the amount of 0.5 % of the net good value for each complete week of delay, to a maximum of 5 % of the net value of the goods.

## § 5 Outline Supply Contracts

5.1 If an outline supply agreement has been concluded, the buyer's period of acceptance is 12 months from the day of confirmation of the order unless any written agreement deviating from this has been made. The outline supply agreement is accordingly scheduled for a period of 12 months from acceptance of the first partial delivery based on the partial quantities resulting from this. After the expiry of the period of acceptance, Nanotec will be entitled to invoice the remaining goods at their discretion or to claim damages for the delay of acceptance. The amount of the damages generally amounts to 25% of the order value unless the buyer can prove a lower damage amount or Nanotec a higher damage amount.

5.2 nless otherwise agreed, Nanotec will be entitled to pass on increases in material and wage costs to the buyer if the outline supply agreement exceeds a handling period of 12 months. 5.3 If the buyer states a binding date of delivery to Nanotec, he must adhere to this date. If the buyer defers the stated binding date more than once, Nanotec has to be compensated for the resulting additional expenses at 50.- Euro flat per deferral.

## § 6 Retention of Title

6.1 The goods delivered remain the property of Nanotec until the buyer has paid all outstanding amounts which Nanotec has now or in future.

6.2 The buyer is entitled to resell the purchased goods in the regular business process; he now, however, surrenders all claims to Nanotec in the amount of the final invoice total (including VAT) that arise to him from the resale against his acceptor or third party and, as such, is independent of whether the purchased goods have been resold with or without processing. The buyer will remain entitled to collect the outstanding amount after the assignment. Nanotec's right to collect the account receivable themselves remains unaffected by this. However, Nanotec undertakes not to call in the account receivable as long as the buyer fulfills his obligations to pay arising from the proceeds received, is not in default of payment and, in particular, so long as no application for instigating insolvency proceedings has been submitted or settlement proceedings or inability to pay exists. However, if this is the case, Nanotec may demand from the buyer to be informed about the assigned accounts receivable and their debtors, to provide all information required for collection, to submit the necessary documents and to inform the debtor (third party) about the assignment.

6.3 The processing or restructuring of the purchased goods by the buyer is always effected on behalf of Nanotec. If the purchased goods are processed with other objects which are not the property of Nanotec, Nanotec acquires co-ownership of the new items in proportion to the value of the purchased goods to the other processed goods at the time of processing.

6.4 In the case of assertion of the retention of title, the buyer already declares the toleration of the entry of the business premises now for the retrieval of the retained goods.

## § 7 Guarantee

7.1 The warranty rights of the buyer presuppose that he has satisfied his duty to inspect and complain according to §§ 377 of the German Commercial Code [HGB] in accordance with regulations.

7.2 In the case of sampled stepper, servo, linear and gear motors tested by the buyer before acceptance, any warranty is excluded unless they have not been sufficiently tested in relation to performance, quiet running, service life and operational conditions.

7.3 If the purchased good has a deficiency for which Nanotec is responsible, Nanotec is entitled to remedy the deficiency or supply a replacement at its own discretion. If Nanotec is not prepared to rectify the deficiency/ supply a replacement or is not in a position to do so or if this is delayed for reasons for which Nanotec is responsible or if the rectification of the deficiency or the supply of replacement fails in any other way, the buyer is entitled at his discretion to withdraw from the contract or to demand a corresponding decrease of the purchase price.

7.4 Unless agreed otherwise, any further claims of the buyer – for whatever legal reasons – are not admissible. Nanotec does not therefore accept liability for damages that do not occur to the article of sale itself; in particular Nanotec accepts no liability for loss of profits or for other financial losses of the buyer.

7.5 The above exemption from liability does not apply if the cause of the damage is based on intent or gross negligence. It is also not applicable if the buyer claims damages due to non- fulfillment of a guaranteed property according to §§ 463, 480 Para 2 BGB [German Civil Code].

7.6 If Nanotec negligently violates a contractual duty, Nanotec's obligation for compensation for damage to property or physical injury is restricted to the liability insured by Nanotec's products liability insurance. Nanotec is prepared to present the policy to the buyer on demand.

7.7 The warranty period is twelve months counted from the transfer of risk.

7.8 Nanotec is not the manufacturer of all products included in the scope of supply. The customer himself is responsible for the application of the products.

## § 8 Wrong Orders

8.1 The buyer is only entitled to return goods to Nanotec if he sends them back to Nanotec in the original condition and the original packaging and Nanotec has accepted the return consignment in advance in writing. In the case of a fault of the buyer (wrong order, double order, packaging unit not observed etc.), Nanotec is entitled to invoice the buyer for the contractual costs.

## § 9 Overall Liability

9.1 Any further liability for damage as provided by §§ 7.5 to 7.7 is excluded – irrespective of the legal nature of the claim made.

9.2 The stipulations according to Paragraph 1 do not apply for claims according to §§ 1, 4 of the Product Liability Act. The same applies for initial inability or impossibility.

9.3 Insofar as Nanotec's liability is excluded or restricted, this will also apply to the personal liability of Nanotec's employees, staff, representatives and vicarious agents.

## § 10 Export Control

10.1 In recognition of the American and other applicable (in particular, German) export control regulations, the buyer undertakes to obtain all required export licenses or other documents at his own cost before the export of the products or technical information, which he received from Nanotec.

10.2 The buyer undertakes not to sell, export, re-export, supply or pass on in any other way such products or technical information either directly or indirectly to persons, companies or countries if this violates any American or other (in particular German) laws or regulations. The buyer undertakes to inform the receiver of these products or technical information on the necessity to adhere these laws and regulations. The buyer is responsible for acquiring all licenses and export and import documents, which are required for the application of the products at his own cost. The rejection of an export license does not entitle the buyer to withdraw from the contract or claim for damages.

## § 11 Invalid Clauses

11.1 Should any individual clause(s) be or become invalid, this will not affect the validity of the other clauses in case of doubt. The General Terms and Conditions of Nanotec will remain unaffected in all other aspects and the invalid clause will be replaced by an admissible clause which best fits the purposes of the contract.

## § 12 Place of Fulfillment, Legal Venue

12.1 If the buyer is a businessman, Nanotec's registered office is its legal domicile; Nanotec is also entitled to sue at the buyer's location.

12.2 Unless otherwise agreed in the confirmation of order, the registered office of Nanotec is Feldkirchen, near Munich.

12.3 The application of the general UN purchase right (CISG) is excluded.

12.4 Any assignment of claims which the buyer incurs from its business connection with Nanotec® is excluded.

General terms and conditions version: 5.1 of 29.09.2011





## Notes

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PLUG & DRIVE


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