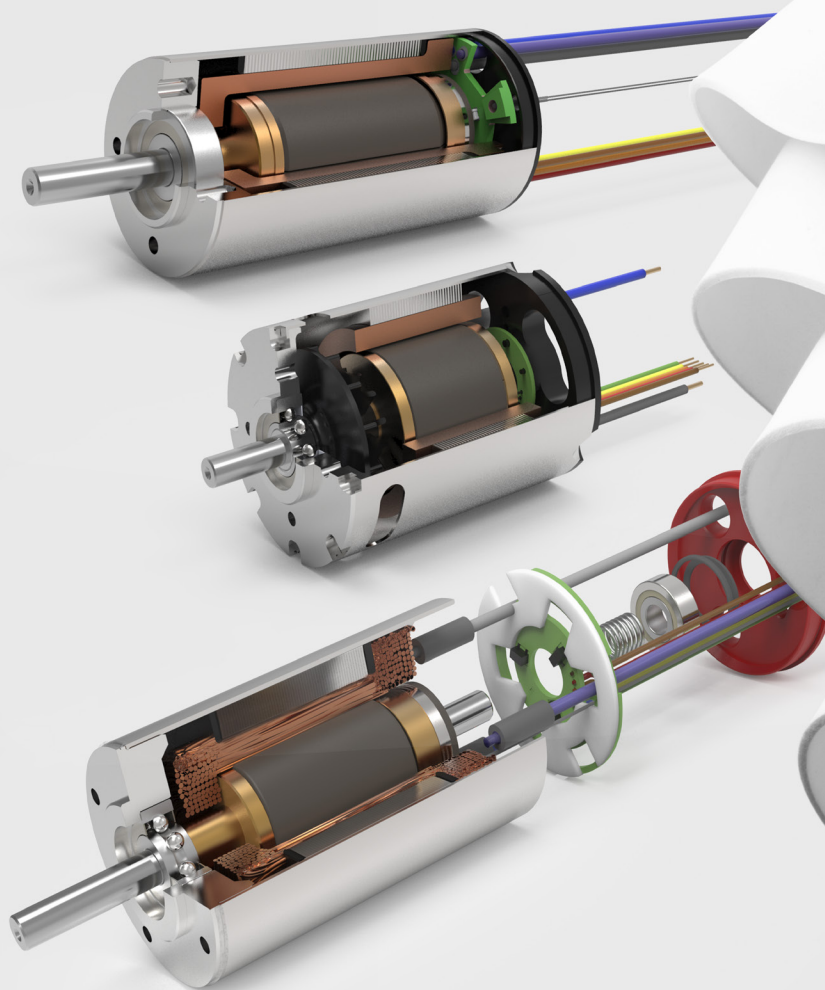


Product Catalog

Miniature motion solutions for
performance critical applications



Portescap

A REGAL REYNOLD BRAND

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Welcome to Portescap

Portescap is the innovation leader in miniature motors and precision motion control technologies for performance-critical applications that save, improve and enhance lives. We continually advance the state of the art for power, precision and efficiency in miniature motion. Driven by our passion for innovation, technical excellence and quality service, we deliver best-in-class products and custom engineering services to ensure a perfect fit for your applications.

Power, Precision, Efficiency



Brushless DC Motors

Optimum speed, torque and life; autoclavable option



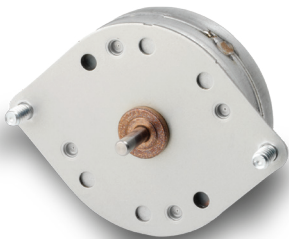
Brush DC Motors

Outstanding efficiency, power density and acceleration



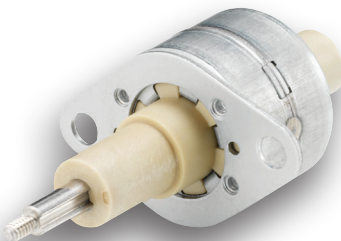
Disc Magnet Motors

Increased resolution with high speed capability



Can Stack Motors

Precise, cost-effective open-loop control



Can Stack Linear Actuators

Compact package delivers high force with direct linear motion

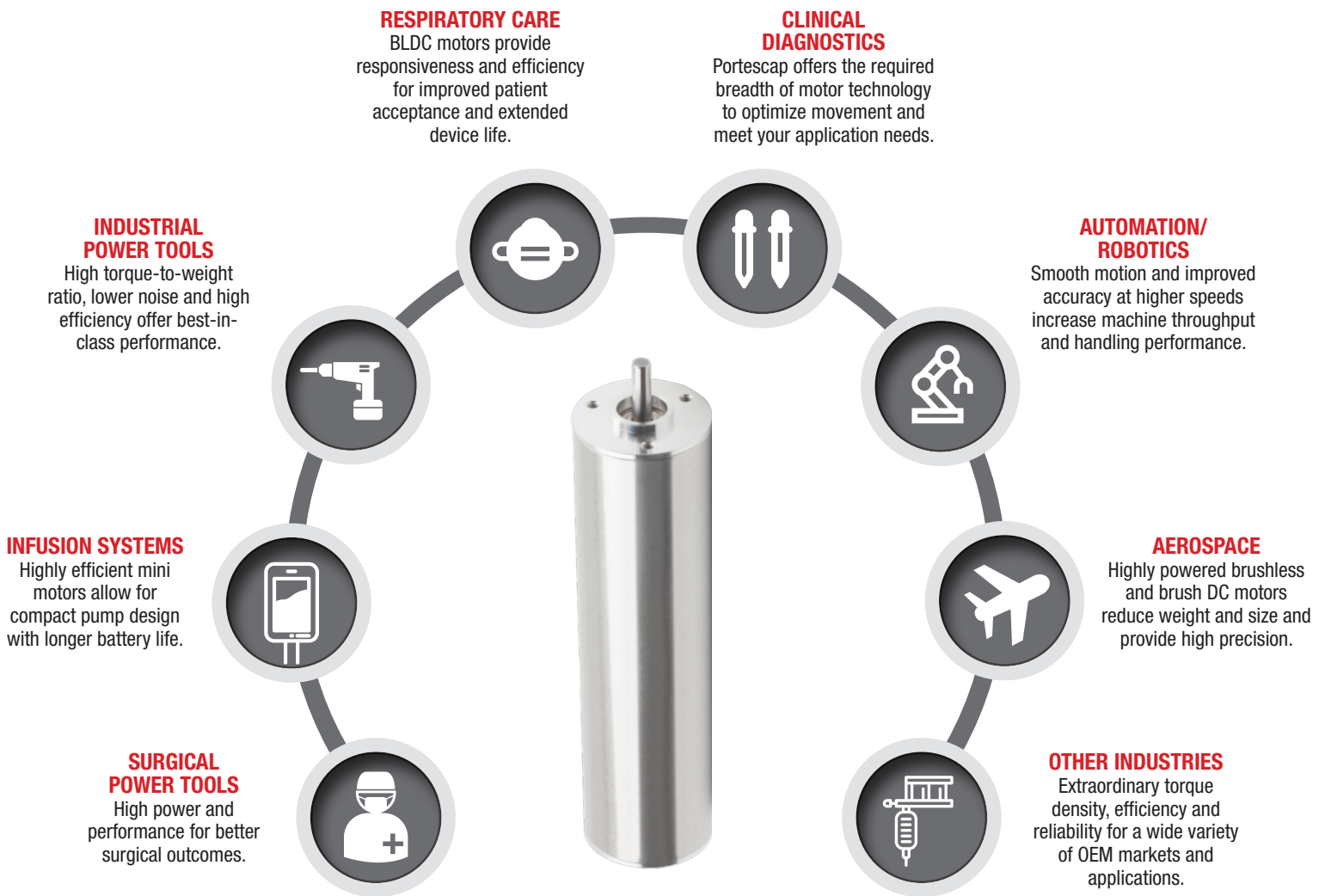


Gearheads & Encoders

Spur and planetary gearheads, optical and magnetic encoders

Miniature Motors For Performance-Critical Applications

Innovative motion technologies and custom engineering services that ensure a perfect fit for your individual application.



We leverage our miniature motor technologies and application know-how to serve a spectrum of motion control applications

Choose the Right Technology for Your Application

	Brushless DC Slotted	Brushless DC Slotless	Brush DC	Disc Magnet	Can Stack	Can Stack Linear Actuator
Efficiency/battery life	++	+++	++++	+	+	+
Motor lifetime	++++	++++	++	++++	+++	++
Autoclavability	++++		+			
Ability to withstand harsh environments	++++	+++	++	++	+	+
High power/weight ratio	++++	++++	+++	+++	+	+
High motor acceleration	++	++	+++	++++		
Open loop positioning	+	+		++++	++	+++
Simple control	+	+	++++	++	++	++
Low noise	+++	++++	+++	++	++	+
Ease of achieving linear motion						++++
Max rated continuous torque	++++	++++	+++	++++	+	
Max speed	++++	++++	+++	++	+	+



Brushless Slotted DC

Frame Size: 12.7 to 49.8 mm
Speed: up to 100,000 rpm
Torque: up to 6,526.6 mNm



Stepper Disc Magnet

Frame Size: 10* to 74 mm
Speed: up to 10,000 rpm
Torque: up to 325 mNm
**upon request*



Gearheads

Frame Size: 8* to 40 mm
Speed: up to 10,000 rpm
Torque: up to 10 Nm
**upon request*



Brushless Slotless DC

Frame Size: 8 to 40 mm
Speed: up to 70,000 rpm
Torque: up to 225 mNm



Stepper Can Stack

Frame Size: 15 to 60 mm
Speed: up to 1,000 rpm
Torque: up to 300 mNm



Encoders

Frame Size: 8* to 30 mm
Technology: Magnetic, Optical
Line Count: 1 to 1024
**upon request*



Brush DC Coreless

Frame Size: 8 to 35 mm
Speed: up to 16,000 rpm
Torque: up to 160 mNm



Digital Linear Actuator

Frame Size: 20 to 42 mm
Speed: up to 500 full steps
Force: up to 102 N

The Miniature Motion Leader

Continuous innovation to create the highest precision and performance in miniature motion applications.

The widest range of miniature motion technologies to suit virtually any configuration, environment and envelope.

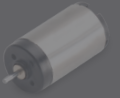
Application-specific customization and rapid prototyping, with research and development teams in strategic locations around the world.

Collaboration to understand your motion control needs and devise a smart, perfect-fit way to do the job better.

A commitment to service and support throughout your application's lifecycle, worldwide.



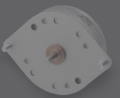
Brushless DC motors



Brush DC motors



Disc magnet motors



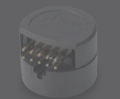
Can stack motors



Can stack linear actuators



Gearheads



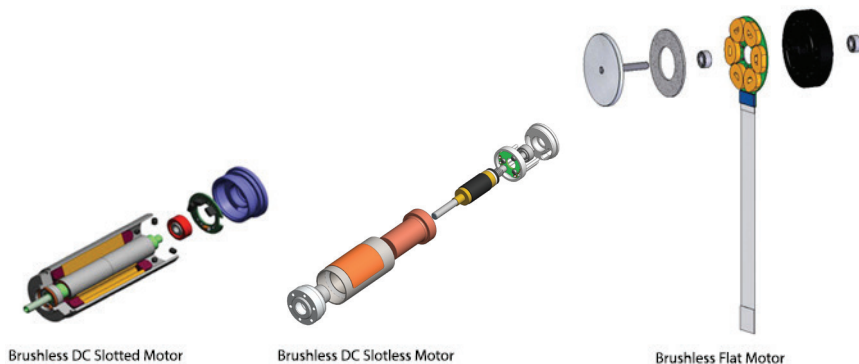
Encoders



Controllers

Brushless DC Motors





Built for precision, efficiency and reliability, these motors offer the power density needed to deliver top performance in the most compact applications. Available in slotted and slotless designs, they provide exceptional acceleration, speed, torque and position control over a long, trouble-free life.

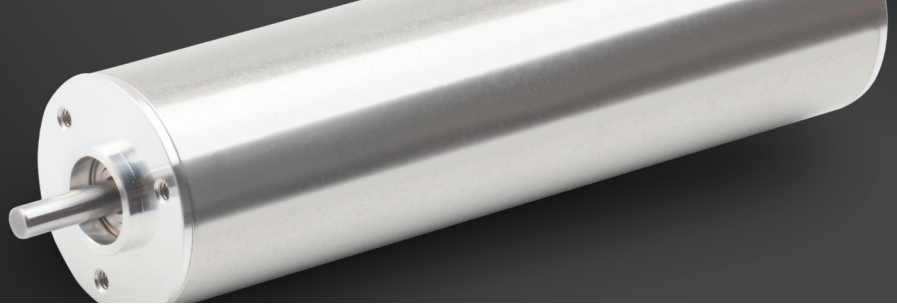


Exceptionally Efficient, Powerful and Durable

Feature	Details	Application Advantages
Slotless or slotted configurations	<ul style="list-style-type: none"> Slotless: self-supporting cylindrical coil 	<ul style="list-style-type: none"> Zero detent torque Reduced iron losses High efficiency Linear torque vs. speed
	<ul style="list-style-type: none"> Slotted: coils inserted in the slots of the stator 	<ul style="list-style-type: none"> Excellent torque-to-power ratio High current capability Withstands rugged environments Autoclavable option
Permanent magnet	<ul style="list-style-type: none"> Linear torque/speed curve (except iron losses) Torque proportional to current Speed proportional to voltage 	<ul style="list-style-type: none"> Ease of position and speed control
Brushless design	<ul style="list-style-type: none"> Electronic commutation No brushes to wear or spark 	<ul style="list-style-type: none"> Long life, limited only by ball bearing wear Reliable in harsh and dusty environments Reduced EMI Quiet operation
Winding attached to stator	<ul style="list-style-type: none"> Improved heat dissipation via conduction 	<ul style="list-style-type: none"> Superior overload capacity
Autoclavable versions for slotted motors	<ul style="list-style-type: none"> Motor design optimized to withstand exposure to harsh environments including high temperature and pressure cycling 	<ul style="list-style-type: none"> Long life in medical devices that undergo frequent sterilization

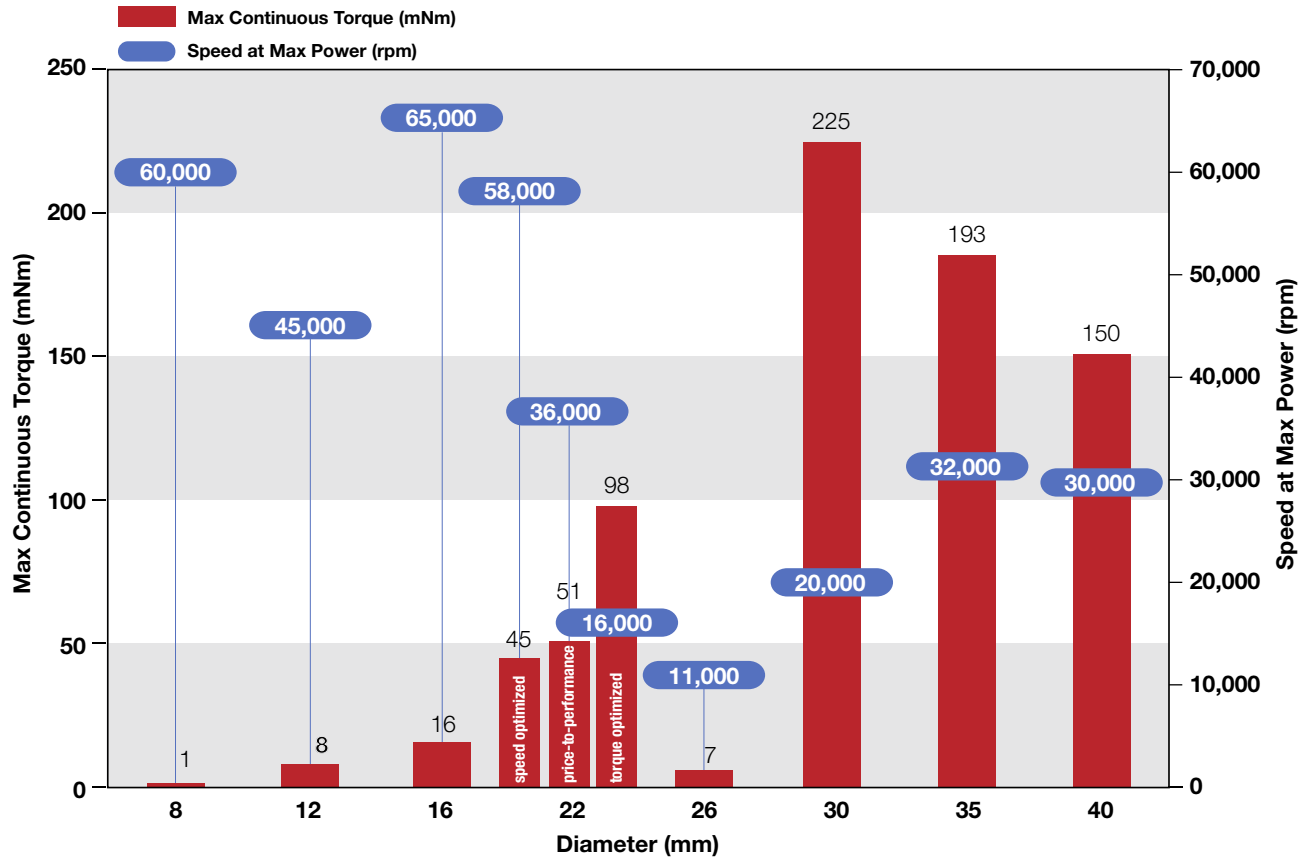
For a Wide Range of Miniature Motion Needs

 <p>Medical devices & clinical diagnostics</p> <ul style="list-style-type: none"> Arthroscopic shavers Respiratory and ventilation devices Miniature pumps Laboratory automation Powered ENT instruments Surgical robots Diagnostic analyzers Medical analyzers Sample prep workstations Powered orthopedic drills and saws Powered surgical screwdrivers 	 <p>Aerospace & Defense</p> <ul style="list-style-type: none"> Surveillance camera systems Seat actuation Valve actuation  <p>Instrumentation</p> <ul style="list-style-type: none"> Dosing & dispensing systems Gas detection Explosive trace detection systems 	 <p>Other</p> <ul style="list-style-type: none"> Nailers & framing systems Powered industrial fasteners Powered assembly screwdrivers Powered professional pruners
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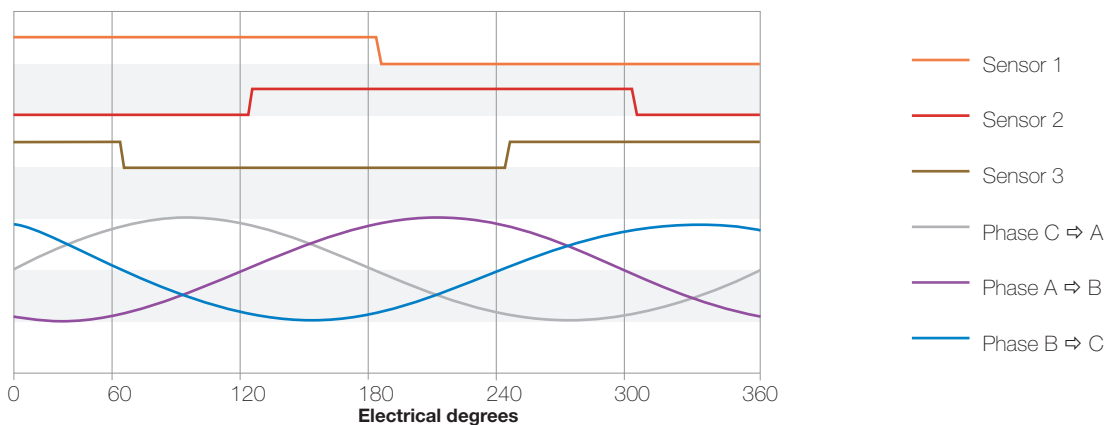


Meet your Application's Working Point Requirements*

* For Brushless Flat or Brushless Slotted motors' working point requirements, please refer to chart at the beginning of their respective section.



Motor signal sequence shaft rotation CW seen from front face for BH and EC series of slotless BLDC motors, or CCW for BF series



For complete product and application details, visit portescap.com/brushless

Glossary (for Brushless Slotless DC Motors)

Electrical Data

Nominal voltage

This voltage is used when measuring no-load speed, no-load current and other parameters. It does not represent a recommended voltage or a limitation of the motor.

Optimization direction

Brushless motors equipped with Hall sensors can be tuned so that the sensor positions compensate for the electrical and electronic time response of the commutation sequence. This is especially important for reducing motor losses in high-speed applications.

All the standard motors shown in this catalog are either symmetrical or optimized in the counterclockwise (CCW) direction as seen from the output shaft side of the motor. For optimized motors, optimization speed is mentioned in the specification document. Optimization speed and direction can be customized by request.

No-load speed

This is the motor speed as measured without any attachment or friction on the output shaft, with the driver being supplied by the nominal voltage.

Typical no-load current

This is the average current measured before the driver power stage, without any attachment or friction on the output shaft and with the driver being supplied by the nominal voltage. This parameter can vary significantly depending on the driver used and the motor temperature. All data are measured using the Hall-sensored version of the commutation, when available, after 30 seconds of running the motor at room temperature.

Max continuous mechanical power (@ 25°C)

Within maximum continuous operation specifications (see power curve graph), and with proper selection of speed and torque, this is the highest mechanical power output that can typically be achieved without exceeding the thermal limitation of the motor windings. In some cases, this maximum power can also be limited by the maximum recommended motor speed for the bearing assembly. Maximum continuous power is calculated with the motor in the air at 25°C, with no heat sink or forced air cooling. With improved cooling, it may be possible to exceed this value in short-term operation.

Max continuous current

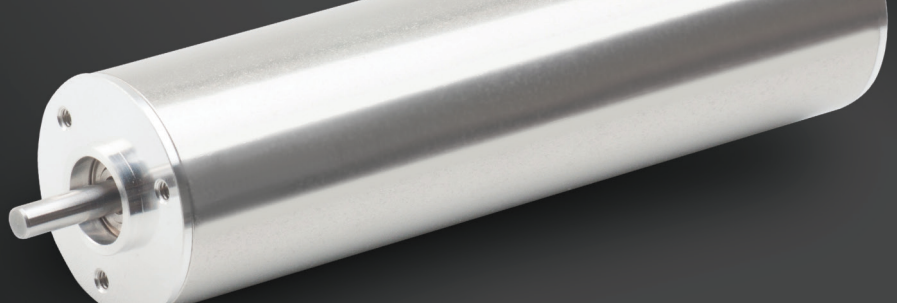
Within maximum continuous operation specifications (see power curve graph), this is the current drawn at the highest output torque the motor can continuously achieve without exceeding the thermal limitations of the windings. Maximum continuous current is usually reached at a very low speed where iron and friction losses are minimal.

This value is calculated with the motor in the air at 25°C, with no heat sink or forced air cooling. With improved cooling, it may be possible to exceed this value in short-term operation. This value does not apply to the very short peak current at startup, which can typically reach several tens of amps.

Max continuous torque

This is the torque corresponding to the maximum continuous current, usually reached at very low speed.

Stall torque, when the motor needs to start from a blocked position, may be lower than this figure due to motor torque ripple.

**Back EMF constant**

Back EMF is a voltage generated by the windings of a permanent magnet motor in rotation. Because this voltage increases with speed and is applied in the opposite direction from the input voltage, the back EMF constant can be used to calculate the motor's speed at any given input voltage, assuming no friction and no loading torque.

The specification document also gives the 0-peak value of the back EMF, which is typically higher than the average value and can be measured on motor phases with an oscilloscope while the motor is back-driven.

Torque constant

This value relates the current in the motor phases to the torque created at the rotor level.

Motor regulation R/k^2

This value gives the extra joule losses in the motor winding, in watts, multiplied by the torque squared (Nm^2). A lower number indicates a better magnetic design for dealing with high torques. The calculation is based on internal phase resistance, not including wire soldering and connector resistance.

Motor regulation $k/R^{1/2}$

This is simply another way of expressing the previous property. In this case, a higher number indicates a more efficient magnetic design for dealing with high torques.

Internal resistance - phase to phase

This is the coil phase resistance measured at room temperature before the coil is soldered to the motor circuit assembly.

Line to line resistance at connectors

This is the phase resistance measured for the completed motor at room temperature. It includes solder, wire and (if present) connector resistances. In motors with very low resistance, the line to line resistance may differ significantly from the internal resistance.

Inductance - phase to phase

This is the motor phase inductance measured with an inductance meter at 1000 Hz.

Mechanical time constant

This represents the motor's ability to accelerate quickly at a given voltage and without any current limitation. It typically represents the time needed to reach 63.2% of the motor's final speed under a constant voltage.

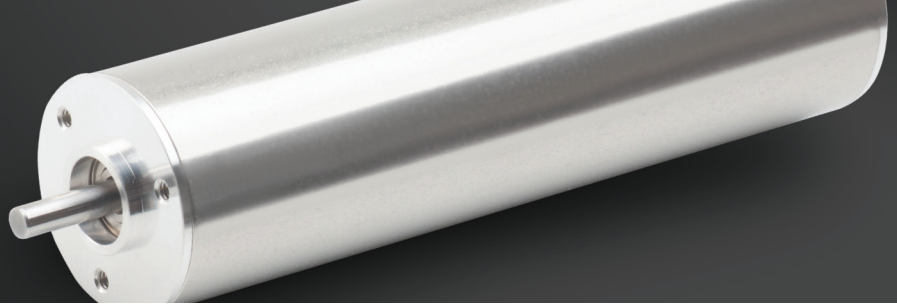
Electrical time constant

This is the time constant L/R (inductance divided by resistance) that is needed to properly size the driver PWM frequency. It represents the motor's ability to let the current vary quickly. This value is commonly very low in slotless BLDC motors.

Glossary (for Brushless Slotless DC Motors)

General Data

Maximum motor speed	This is the maximum recommended speed as limited by the bearing assembly type, taking into account the bearing supplier's specification, vibration behavior and other factors.
Ambient working temperature range	The recommended ambient working temperature range is based on the properties of the bearing lubricant.
Ambient storage temperature range	The recommended ambient storage temperature range is based on the properties of the bearing lubricant.
Ball bearings preload	This is the bearing preload force as implemented by design. This might be a static preload in bearings bonded to the shaft after assembly. In that case, it is not possible to measure preload force by applying an external force on the shaft, and there is very little axial play. To maximize bearing life, we recommend that forces on the shaft during operation do not exceed the preload force.
Axial static force without shaft support (max)	When press-fitting a part onto the shaft without providing support on the opposite end of the shaft, the applied force is supported entirely by the bearing races. This is the maximum pressing force recommended to avoid damage to the bearings.
Maximum winding temperature	<p>This specification is linked to the properties of the thermo-bonding material around the coil copper wires. The maximum winding temperature can be an important consideration for applications that require long product life because operation at high temperatures can lead to failure modes such as fast aging of the bearing lubricant.</p> <p>Thermal resistance is given either directly from the coil to the ambient air surrounding the motor, or in two steps: from coil to housing and then from housing to ambient.</p> <p>This value is calculated with the motor in the air at 25°C, with no heat sink or forced air cooling. With the motor installed, the value is likely to decrease in many applications, but it could also be higher if the motor is surrounded by a small volume of air that cannot cool down.</p> <p>Thermal resistance varies with air convection parameters, and is lower at a high temperature of the motor housing. The value can also vary based on speed, especially with flat motors.</p> <p>This value is measured during operation close to the maximum continuous power zone (see power curve graph).</p>
Thermal resistance	
Thermal time constant	This value is given directly from the coil to the ambient air surrounding the motor. Along with the thermal resistance, the thermal time constant allows for solving thermal differential equations for the motor. It is measured at a constant voltage supply over time, which means the amount of power loss that can be dissipated tends to decrease due to the increase in winding resistance with increasing temperature.
Mass	This is the total motor mass, including cables.
Rotor inertia	This assumes an unconnected rotor and is used to determine angular acceleration for a given torque.
Hall sensor electrical phasing	In a three-phase BLDC motor with Hall sensors, the sensors are commonly phased at 120° electrically from each other. (See the chart to the right for an example.) This affects driver selection.



Additional Information

Balancing

All cylinder motors in this section have their rotors dynamically balanced on two planes through a material removal process.

Hall sensors

An external pull-up resistor is required on drive electronics.

Power curve

The typical power curve shows the continuous operation working points possible (the colored part of the chart). This is based on purely thermal limitations (the same limitations described under “Max continuous current”) that change depending on the cooling conditions of the application – for example, when the motor is mounted to a metal part.

These power curves are common to all coils presented, and they represent typical motor performance with the understanding that many parameters influencing the curves have tolerances around nominal values (no-load current, resistance, torque constant, etc.). These power curves are not plotted at nominal voltage; each working point illustrated will require matching of coil, voltage and load to reach the indicated speed.

Dotted lines show the torque/speed relationships that deliver a given mechanical power value (in watts) at the motor shaft.

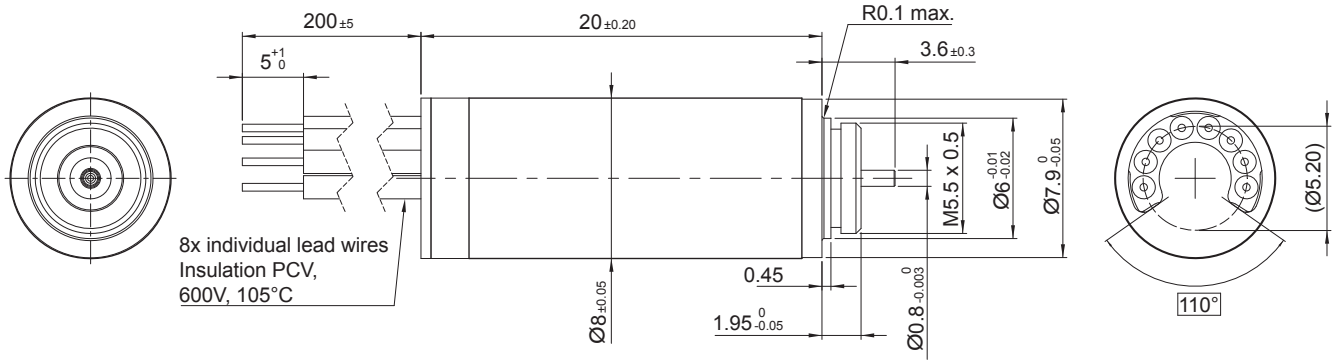
Working points outside of the illustrated continuous operation range are possible depending on the duty cycle.

In some cases, the power curve stops early on the high-speed side before the limitation is reached (the flat portion on top of the curve) because measurement was not possible at higher speeds.

In some cases, the maximum recommended motor speed is lower than the maximum continuous thermal limit shown on the power curve. This recommendation is based on characteristics of the bearing assembly.

Dielectric test

A dielectric test (also known as hipot or high potential test) is performed on all motors under 500V phases to the housing and during 5 seconds after voltage ramp up. Maximum allowed leakage is 1mA.



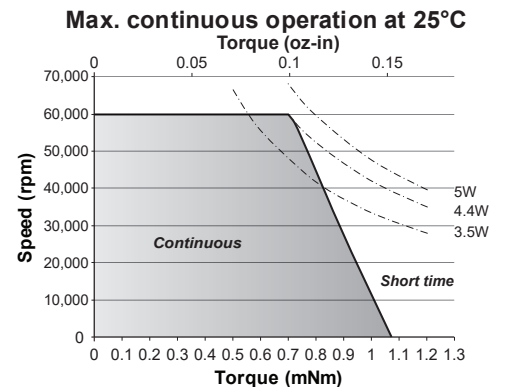
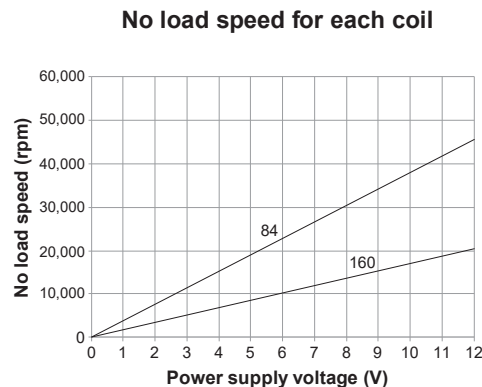
Dimensions in mm

Electrical Data	Symbol	08ECP20 8B XX		Unit
		84	160	
1 Nominal Voltage	U_N	6	12	Volt
2 Optimization Direction	-	Symmetrical	Symmetrical	-
3 No Load Speed	n_0	22'700	24'500	rpm
4 Typical No Load Current	I_0	40	110	mA
5 Max Continuous Mechanical Power (@25°C)	P_{max}	4.4	4.4	W
6 Max Continuous Current	$I_{e max}$	0.44	0.23	A
7 Max Continuous Torque	$M_{e max}$	1.07 (0.1516)	1.07 (0.1516)	mNm (oz-in)
8 Back EMF Constant	k_E	0.27	0.498	V/1000 rpm
9 Torque Constant	k_M	2.5 (0.35)	4.7 (0.666)	mNm/A
10 Motor Regulation	R/k^2	857.9	893.7	10 ³ /Nms
11 Motor Regulation	$k/R^{1/2}$	1.09 (0.15)	1.06 (0.15)	mNm/W ^{1/2} (oz-in/W ^{1/2})
12 Internal Resistance - phase to phase	R_1	5.23	19.75	ohms
13 Line to Line Resistance at Connectors	R_L	5.43	19.81	ohms
14 Inductance Phase to Phase	L	0.12	0.42	mH
15 Mechanical Time Constant	τ_m	1.7	1.7	ms
16 Electrical Time Constant	τ_e	0.023	0.023	ms

General Data				
17 Maximum Motor Speed	n_{max}		60'000	rpm
18 Ambient Working Temperature Range	-		-30 to +100 (-22 to +212)	°C (°F)
19 Ambient Storage Temperature Range	-		-40 to +100 (-40 to +212)	°C (°F)
20 Ball Bearings Preload	-		0.4 (0.09)	N (lbs)
21 Axial Static Force w/o Shaft Support (max)	-		6.8 (1.53)	N (lbs)
22 Maximum Winding Temperature	-		125 (257)	°C (°F)
23 Thermal Resistance	R_{th}		13 / 65	°C/W
24 Thermal Time Constant	τ_w		1'140	s
25 Weight	-		9 (0.32)	g (oz)
26 Rotor Inertia	J		0.02 (277.8)	gcm ² (oz-in-sec ² 10 ⁻⁶)
27 Hall Sensor Electrical Phasing*	-		120	Electrical °

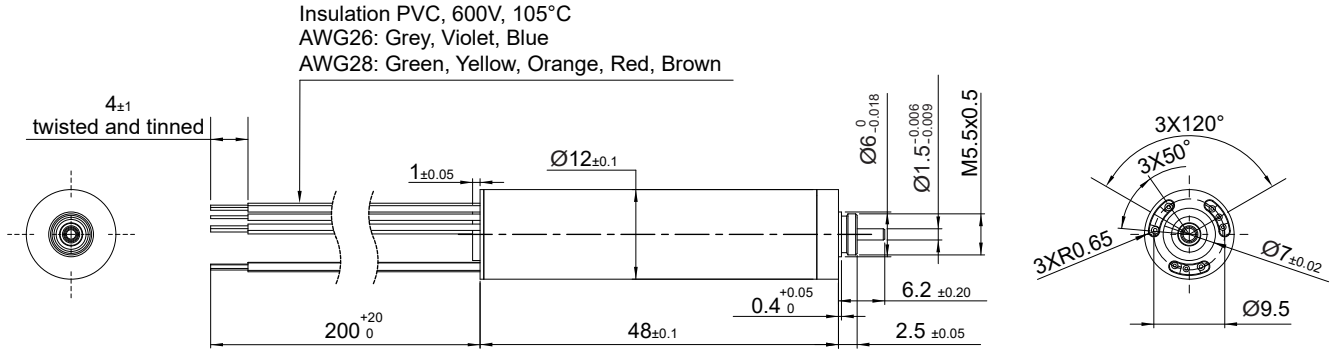
*Also available without Hall sensors

Wire	Description
Gray	Phase 1 (AWG 28)
Violet	Phase 2 (AWG 28)
Blue	Phase 3 (AWG 28)
Green	V DC (+2.5 to +5.5 V) (AWG 28)
Yellow	GND (AWG 28)
Orange	Hall sensor 1 (AWG 28)
Red	Hall sensor 2 (AWG 28)
Brown	Hall sensor 3 (AWG 28)



12ECP48 Ultra EC™

Ø 12 mm • 2-pole • 23 W



Dimensions in mm

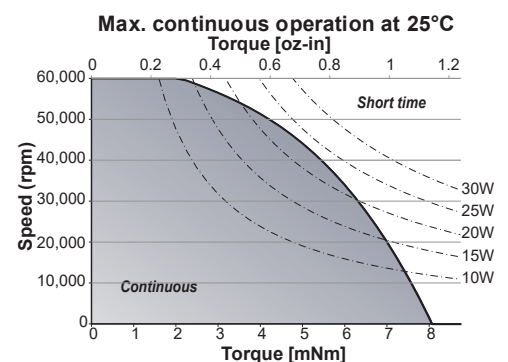
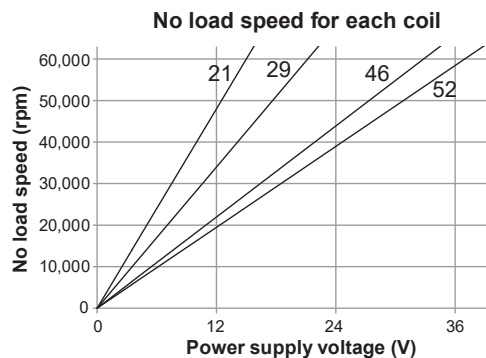
Electrical Data	Symbol	12ECP48 8B xx				Unit
		21	29	46	52	
1 Nominal Voltage	U_N	9	12	18	24	Volt
2 Optimization Direction	-	Symmetrical	Symmetrical	Symmetrical	Symmetrical	-
3 No Load Speed	n_0	36,000	34,000	32,900	38,950	rpm
4 Typical No Load Current	I_0	200	150	100	80	mA
5 Max Continuous Mechanical Power (@25°C)	P_{max}	23	23	23	23	W
6 Max Continuous Current	$I_{e,max}$	3.3	2.4	1.5	1.4	A
7 Max Continuous Torque	$M_{e,max}$	8.1 (1.13)	8.1 (1.13)	8.1 (1.13)	8.1 (1.13)	mNm (oz-in)
8 Back EMF Constant	k_E	0.26	0.36	0.58	0.65	V/1000 rpm
9 Torque Constant	k_M	2.40	3.31	5.26	5.94	mNm/A
10 Motor Regulation	R/k^2	42.85	42.51	40.75	41.22	10 ³ Nms
11 Motor Regulation	$k/R^{1/2}$	4.83 (0.68)	4.85 (0.68)	5.26 (0.74)	4.93 (0.69)	mNm/W ^{1/2} (oz-in/W ^{1/2})
12 Internal Resistance - phase to phase	R_i	0.246	0.465	1.126	1.45	ohms
13 Line to Line Resistance at Connectors	R_L	0.3	0.52	1.18	1.5	ohms
14 Inductance Phase to Phase	L	0.02	0.04	0.09	0.12	mH
15 Mechanical Time Constant	τ_m	1.1	1.1	1.1	1.1	ms
16 Electrical Time Constant	τ_e	0.08	0.08	0.08	0.08	ms

General Data				
17 Maximum Motor Speed	n_{max}	60'000		rpm
18 Ambient Working Temperature Range	-	-30 to +100 (-22 to +212)		°C (°F)
19 Ambient Storage Temperature Range	-	-40 to +100 (-40 to +212)		°C (°F)
20 Ball Bearings Preload	-	3		N
21 Axial Static Force w/o Shaft Support (max)	-	25		N
22 Maximum Winding Temperature	-	125 (257)		°C (°F)
23 Thermal Resistance	R_{th}	2.5 / 24.2		°C/W
24 Thermal Time Constant	τ_w	535		s
25 Weight	-	30 (1.06)		g (oz)
26 Rotor Inertia	J	0.27		g-cm ²
27 Hall Sensor Electrical Phasing*	-	120		Electrical °

*Also available without Hall sensors

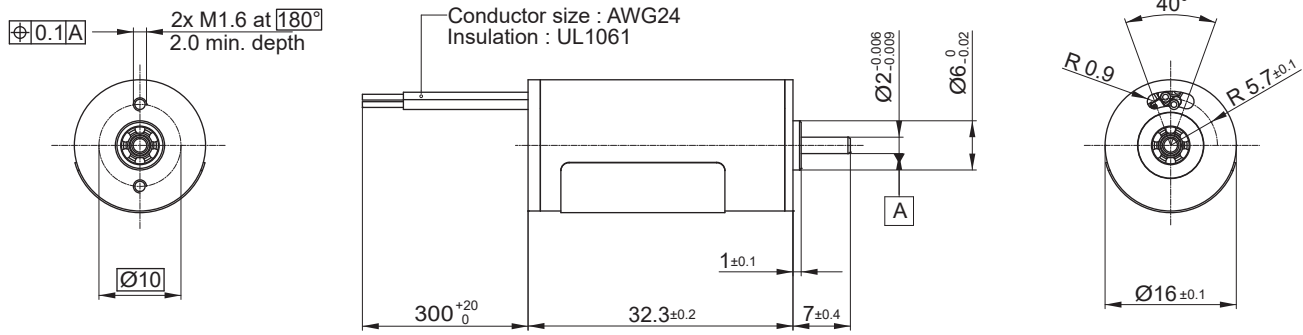
Wire	Description
Gray	Phase 1
Violet	Phase 2
Blue	Phase 3
Green	2.5 to 5.5V DC
Yellow	GND
Orange	Sensor 1
Red	Sensor 2
Brown	Sensor 3

with hall effect sensor



16BHS 2-Wire

Ø 16 mm • 2-pole • 6 W



Dimensions in mm

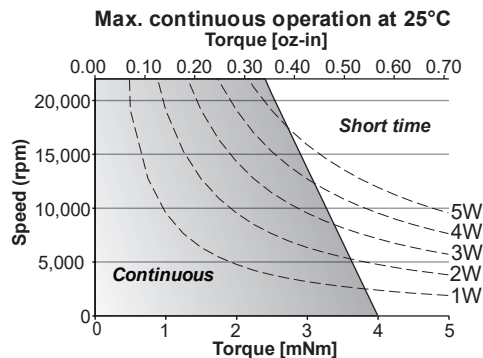
Electrical Data	Symbol	16BHS 2A-xxx.01				Unit
		E	L	P	T	
1 Nominal Voltage	U_N	12	12	12	12	Volt
2 Optimization Direction	-	n.a.	n.a.	n.a.	n.a.	-
3 No Load Speed	n_0	8,740	12,740	17,100	33,770	rpm
4 Typical No Load Current	I_0	55.0	75.0	112.0	235.0	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	6.0	6.0	6.0	6.0	W
6 Max. Continuous Current	$I_{e,max}$	0.3	0.4	0.6	1.2	A
7 Max. Continuous Torque	$M_{e,max}$	3.8 (0.54)	3.6 (0.51)	4 (0.57)	4 (0.57)	mNm (oz-in)
8 Back EMF Constant	k_E	1.19	0.84	0.65	0.34	V/1000 rpm
9 Torque Constant	k_M	11.4	8.1	6.2	3.3	mNm/A
10 Motor Regulation	R/k^2	225.5	251.5	205.5	192.8	$10^3/Nms$
11 Motor Regulation	$k/R^{1/2}$	2.1 (0.3)	2 (0.29)	2.2 (0.32)	2.2 (0.32)	mNm/W ^{1/2} (oz-in/W ^{1/2})
12 Internal Resistance - phase to phase	R_l	29.30	16.50	7.90	2.10	ohms
13 Line to Line Resistance at Connectors	R_L	n.a.	n.a.	n.a.	n.a.	ohms
14 Inductance Phase to Phase	L	1.17	0.66	0.32	0.08	mH
15 Mechanical Time Constant	τ_m	11.8	13.2	10.7	10.3	ms
16 Electrical Time Constant	τ_e	0.04	0.04	0.04	0.04	ms

General Data			
17 Maximum Motor Speed	n_{max}		10,900 rpm
18 Ambient Working Temperature Range	-		-30 to +80 (-22 to +176) °C (°F)
19 Ambient Storage Temperature Range	-		-40 to +80 (-40 to +176) °C (°F)
20 Ball Bearings Preload	-		2.0 N
21 Axial Static Force w/o Shaft Support (max)	-		25.0 N
22 Maximum Winding Temperature	-		125 (257) °C (°F)
23 Thermal Resistance	R_{th}		22.0 °C/W
24 Thermal Time Constant	τ_w		520 s
25 Weight	-		33 (1.17) g (oz)
26 Rotor Inertia	J		0.500 g-cm ²
27 Hall Sensor Electrical Phasing	-		NA Electrical °

Wire	Description
Red	VCC
Black	GND

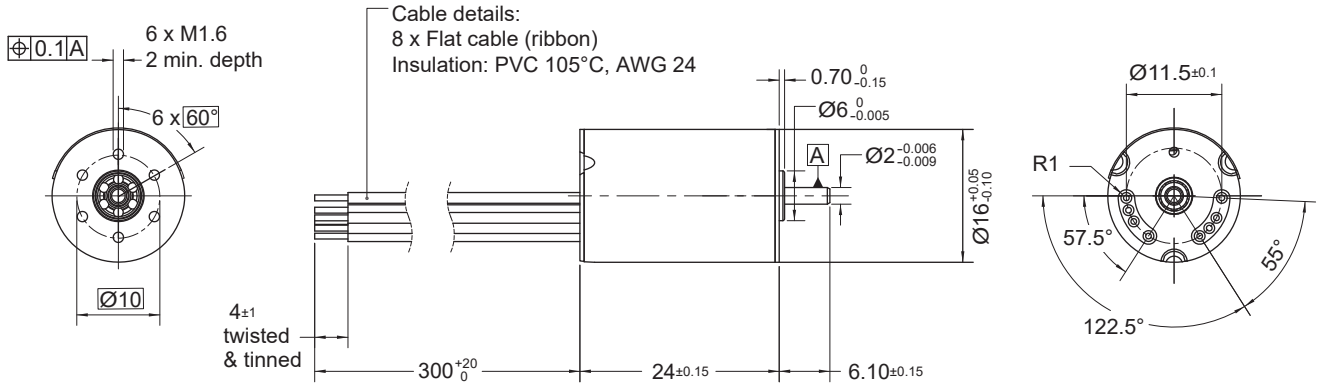
3.5-15V DC for E,L,P windings
 3.5-5V DC for T winding
 2.6A max - do not reverse polarity

When ordering, please choose CW or CCW for rotation direction seen from shaft output side



16ECP24

Ø16 mm • 2-pole • 6.8 W



Dimensions in mm

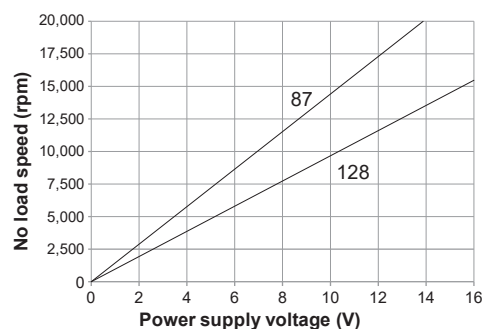
Electrical Data	Symbol	16ECP 24 8B xxx		Unit
		87	128	
1 Nominal Voltage	U_N	12	15	Volt
2 Optimization Direction	-	Symmetrical	Symmetrical	-
3 No Load Speed	n_0	17,600	14,900	rpm
4 Typical No Load Current	I_0	66	43	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	6.8	6.8	W
6 Max. Continuous Current	$I_{e,max}$	0.6	0.4	A
7 Max. Continuous Torque	$M_{e,max}$	4 (0.57)	4 (0.57)	mNm (oz-in)
8 Back EMF Constant	k_E	0.66	0.97	V/1000 rpm
9 Torque Constant	k_M	6.29 (0.89)	9.29 (1.32)	mNm/A
10 Motor Regulation	R/k^2	151.8	156.3	10 ³ /Nms
11 Motor Regulation	$k/R^{1/2}$	2.57 (0.36)	2.53 (0.36)	mNm/W ^{1/2} (oz-in/W ^{1/2})
12 Internal Resistance - phase to phase	R_I	6.1	13.6	ohms
13 Line to Line Resistance at Connectors	R_L	0.26	0.57	ohms
14 Inductance Phase to Phase	L	6	13.5	mH
15 Mechanical Time Constant	τ_m	5.5	5.6	ms
16 Electrical Time Constant	τ_e	0.04	0.04	ms

General Data				
17 Maximum Motor Speed	n_{max}	20,000		rpm
18 Ambient Working Temperature Range	-	-30 to +100 (-22 to +212)		°C (°F)
19 Ambient Storage Temperature Range	-	-40 to +100 (-40 to +212)		°C (°F)
20 Ball Bearings Preload	-	3.3		N
21 Axial Static Force w/o Shaft Support (max)	-	20 (4.5)		N
22 Maximum Winding Temperature	-	125 (257)		°C (°F)
23 Thermal Resistance	R_{th}	5.2 / 24		°C/W
24 Thermal Time Constant	τ_w	390		s
25 Weight	-	31 (1.09)		g (oz)
26 Rotor Inertia	J	0.36 (1968)		g-cm ²
27 Hall Sensor Electrical Phasing*	-	120		Electrical °

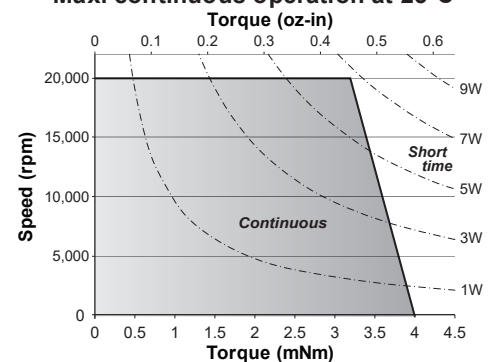
*Also available without Hall sensors

Wire	Description
Gray	Phase 1
Violet	Phase 2
Blue	Phase 3
Green	3.5 to 24V DC
Yellow	GND
Orange	Sensor 1
Red	Sensor 2
Brown	Sensor 3
with hall effect sensor	

No load speed for each coil



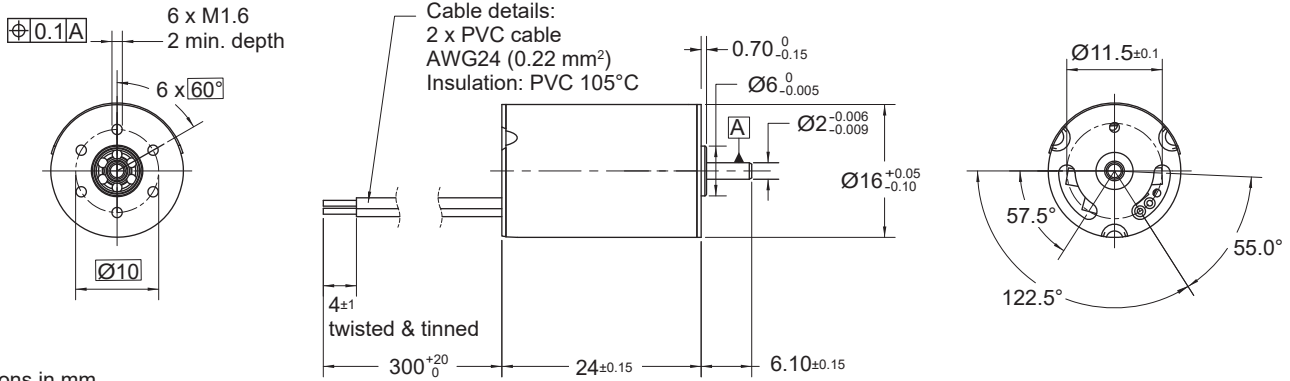
Max. continuous operation at 25°C



16ECP24 2-Wire

Ø16 mm • 2-pole • 4.6 W

With Integrated Electronics



Dimensions in mm

Electrical Data	Symbol	16ECP 24 2A xxx		Unit
		87	128	
1 Nominal Voltage	U_N	6	6	Volt
2 Optimization Direction	-	CW	CW	-
3 No Load Speed	n_0	8,700	5,700	rpm
4 Typical No Load Current	I_0	56	40	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	4.6	3.4	W
6 Max. Continuous Current	$I_{e max}$	0.6	0.4	A
7 Max. Continuous Torque	$M_{e max}$	4 (0.57)	4 (0.57)	mNm (oz-in)
8 Back EMF Constant	k_E	0.66	0.97	V/1000 rpm
9 Torque Constant	k_M	6.29 (0.89)	9.29 (1.32)	mNm/A
10 Motor Regulation	R/k^2	151.8	156.3	10 ³ /Nms
11 Motor Regulation	$k/R^{1/2}$	2.57 (0.36)	2.53 (0.36)	mNm/W ^{1/2} (oz-in/W ^{1/2})
12 Internal Resistance - phase to phase	R_1	N/A	N/A	ohms
13 Line to Line Resistance at Connectors	R_L	0.26	0.57	ohms
14 Inductance Phase to Phase	L	6	13.5	mH
15 Mechanical Time Constant	τ_m	5.5	5.6	ms
16 Electrical Time Constant	τ_e	0.04	0.04	ms

General Data				
17 Maximum Motor Speed	n_{max}		12,000	rpm
18 Ambient Working Temperature Range	-		-30 to +100 (-22 to +212)	°C (°F)
19 Ambient Storage Temperature Range	-		-40 to +100 (-40 to +212)	°C (°F)
20 Ball Bearings Preload	-		0	N
21 Axial Static Force w/o Shaft Support (max)	-		20 (4.5)	N
22 Maximum Winding Temperature	-		125 (257)	°C (°F)
23 Thermal Resistance	R_{th}		5.2 / 24	°C/W
24 Thermal Time Constant	τ_w		390	s
25 Weight	-		24 (0.85)	g (oz)
26 Rotor Inertia	J		0.36 (1968)	g-cm ²
27 Hall Sensor Electrical Phasing*	-		120	Electrical °

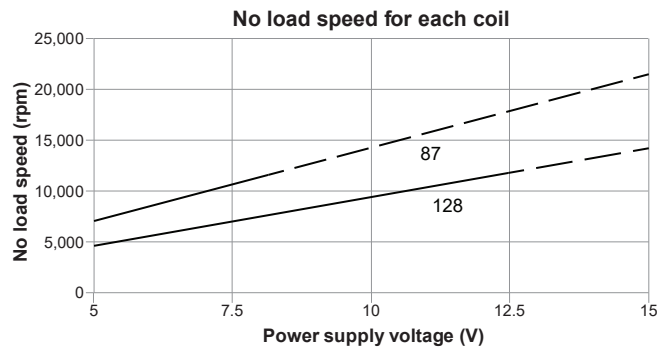
*Also available without Hall sensors

Wire	Description
Red	5 to 15V DC
Black	GND

A reverse polarity will damage the electronics permanently

PWM not allowed on power supply

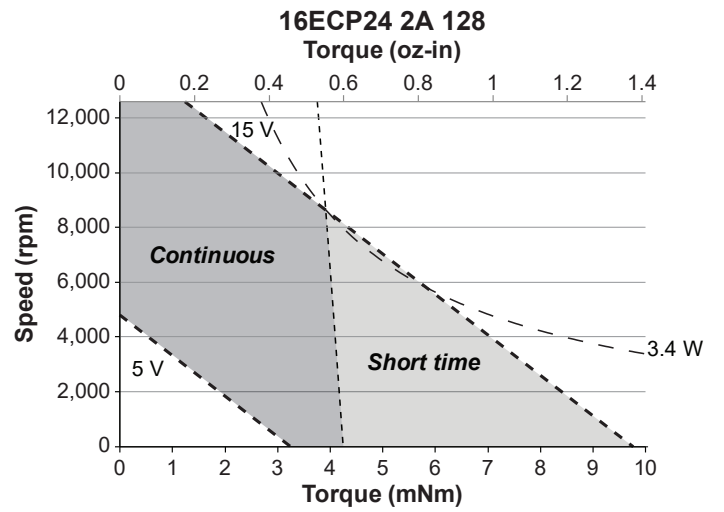
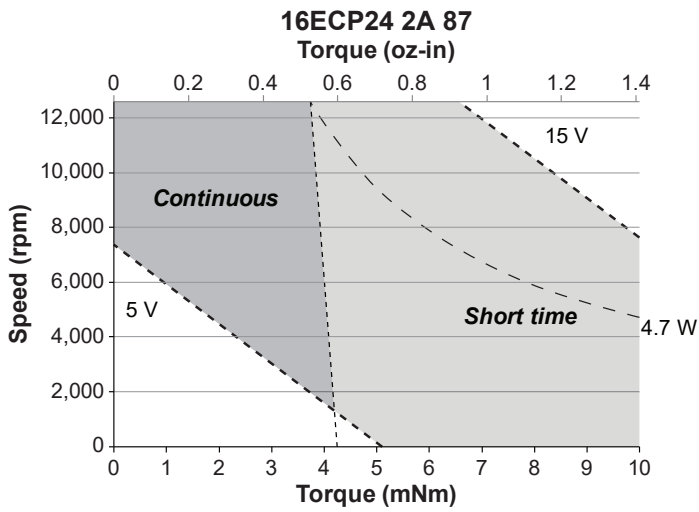
When ordering, please choose CW or CCW for rotation direction seen from shaft output side



Power curves on following page

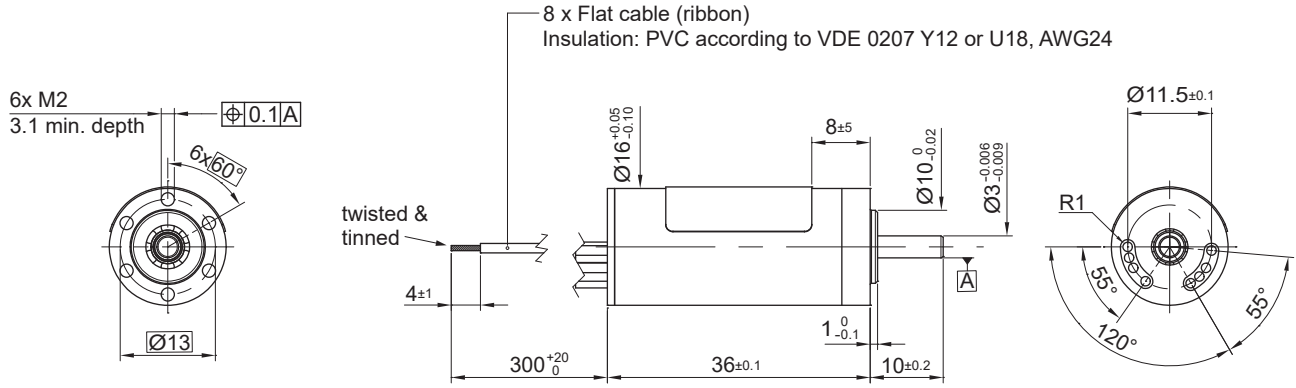
16ECP24 2-Wire
With Integrated Electronics

Ø16 mm • 2-pole • 4.6 W



16ECP36 Ultra EC™

Ø 16 mm • 2-pole • 27 W



Dimensions in mm

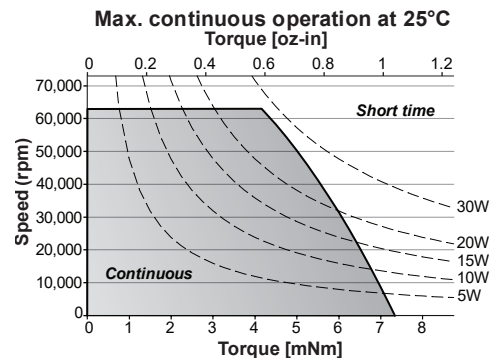
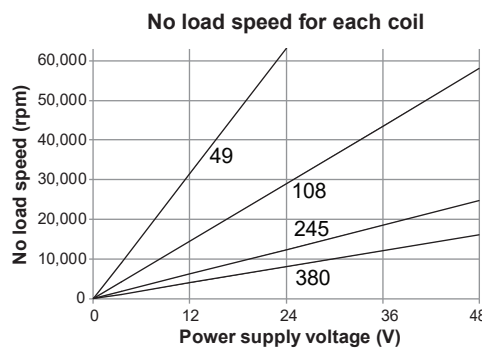
Electrical Data	Symbol	16ECP36-8B-xxx.01				Unit
		380	245	108	49	
1 Nominal Voltage	U_N	24	24	24	12	Volt
2 Optimization Direction	-	Symmetrical	Symmetrical	Symmetrical	Symmetrical	-
3 No Load Speed	n_0	8,100	12,420	29,000	31,550	rpm
4 Typical No Load Current	I_0	20	35	85	160	mA
5 Max Continuous Mechanical Power (@25°C)	P_{max}	27.5	27.5	27.5	27.5	W
6 Max Continuous Current	$I_{e,max}$	0.3	0.4	0.9	2.1	A
7 Max Continuous Torque	$M_{e,max}$	7.0 (1)	7.2 (1.02)	7.1 (1.01)	7.5 (1.07)	mNm (oz-in)
8 Back EMF Constant	k_E	2.82	1.84	0.80	0.37	V/1000 rpm
9 Torque Constant	k_M	26.9	17.6	7.7	3.5	mNm/A
10 Motor Regulation	R/k^2	71.8	67.9	69.2	62.4	$10^3/Nms$
11 Motor Regulation	$k/R^{1/2}$	3.7 (0.53)	3.8 (0.54)	3.8 (0.54)	4 (0.57)	$mNm/W^{1/2}$ (oz-in/ $W^{1/2}$)
12 Internal Resistance - phase to phase	R_l	52.00	21.00	4.05	0.78	ohms
13 Line to Line Resistance at Connectors	R_L	52.10	21.10	4.13	0.82	ohms
14 Inductance Phase to Phase	L	3.93	1.63	0.32	0.07	mH
15 Mechanical Time Constant	τ_m	3.9	3.7	3.8	3.4	ms
16 Electrical Time Constant	τ_e	0.08	0.08	0.08	0.08	ms

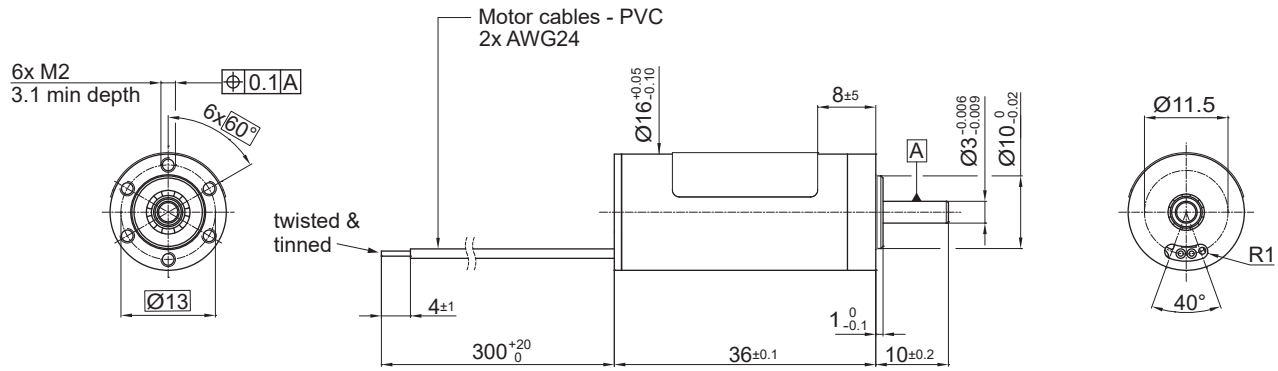
General Data				
17 Maximum Motor Speed	n_{max}	63,000		rpm
18 Ambient Working Temperature Range	-	-30 to +100 (-22 to +212)		°C (°F)
19 Ambient Storage Temperature Range	-	-40 to +100 (-40 to +212)		°C (°F)
20 Ball Bearings Preload	-	5.3		N
21 Axial Static Force w/o Shaft Support (max)	-	34		N
22 Maximum Winding Temperature	-	125 (257)		°C (°F)
23 Thermal Resistance	R_{th}	3.5 / 17		°C/W
24 Thermal Time Constant	τ_w	580		s
25 Weight	-	41 (1.45)		g (oz)
26 Rotor Inertia	J	0.60		g-cm ²
27 Hall Sensor Electrical Phasing*	-	120		Electrical °

*Also available without Hall sensors

Wire	Description
Gray	Phase 1
Violet	Phase 2
Blue	Phase 3
Green	3.5 to 24V DC
Yellow	GND
Orange	Sensor 1
Red	Sensor 2
Brown	Sensor 3

with hall effect sensor



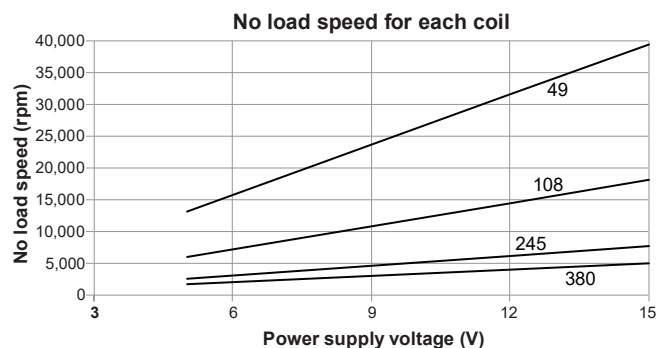


Dimensions in mm

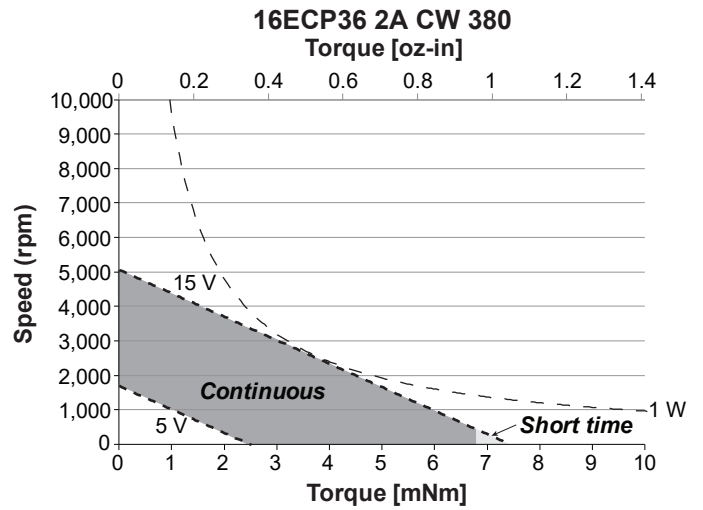
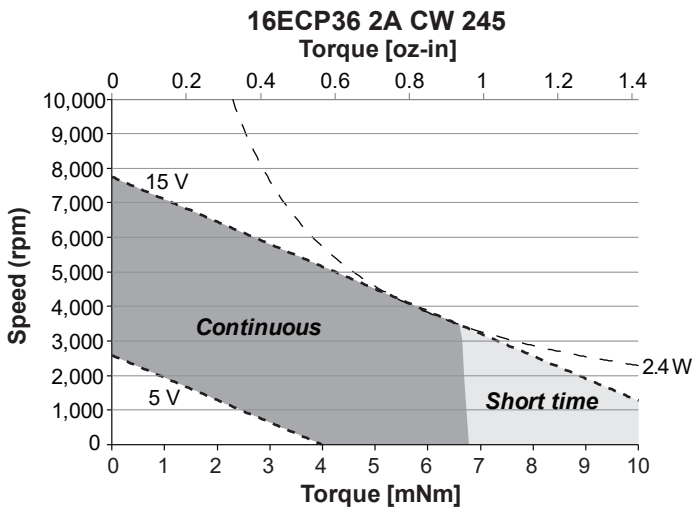
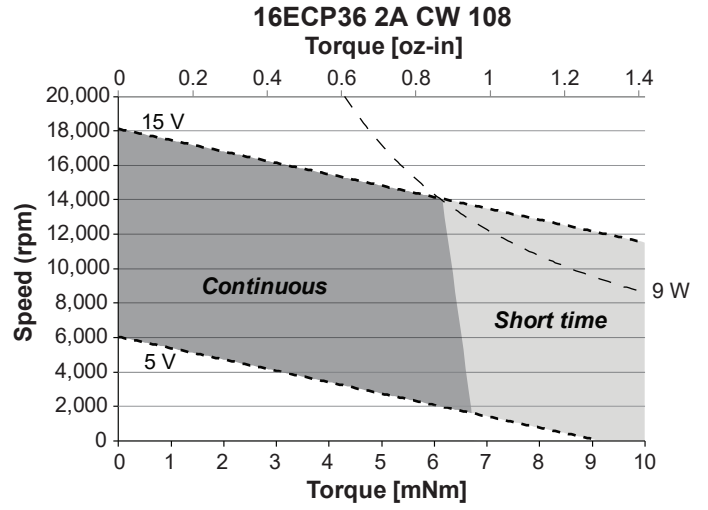
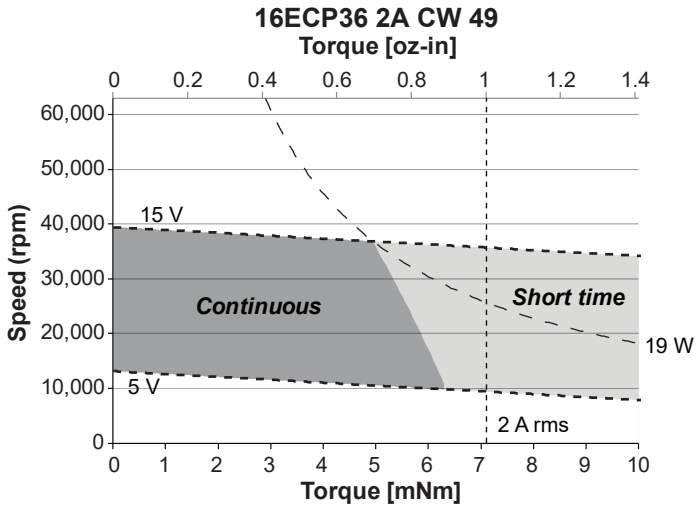
Electrical Data	Symbol	16ECP36-2A-**				Unit
		49	108	245	380	
1 Nominal Voltage	U_N	12	12	12	12	Volt
2 Optimization Direction	-	CW	CW	CW	CW	-
3 No Load Speed	n_0	31,550	14,500	6,200	4,050	rpm
4 Typical No Load Current	I_0	160	80	30	15	mA
5 Max Continuous Mechanical Power (@25°C)	P_{max}	19	9	2	1	W
6 Max Continuous Current	$I_{e,max}$	1.80	0.90	0.40	0.30	A
7 Max Continuous Torque	$M_{e,max}$	7.0 (1)	6.7 (0.95)	6.75 (0.96)	6.75 (0.96)	mNm (oz-in)
8 Back EMF Constant	k_E	0.39	0.84	1.93	2.96	V/1000 rpm
9 Torque Constant	k_M	3.5	7.7	17.6	26.9	mNm/A
10 Motor Regulation	R/k^2	55.4	69.2	67.9	71.9	10 ³ Nms
11 Motor Regulation	$k/R^{1/2}$	4.2 (0.61)	3.8 (0.54)	3.8 (0.55)	3.7 (0.53)	mNm/W ^{1/2} (oz-in/W ^{1/2})
12 Internal Resistance - phase to phase	R_i	0.69	4.05	21.00	52.00	ohms
13 Line to Line Resistance at Connectors	R_L	NA	NA	NA	NA	ohms
14 Inductance Phase to Phase	L	0.07	0.32	1.63	3.93	mH
15 Mechanical Time Constant	τ_m	3.0	3.8	3.7	3.9	ms
16 Electrical Time Constant	τ_e	0.09	0.08	0.08	0.8	ms

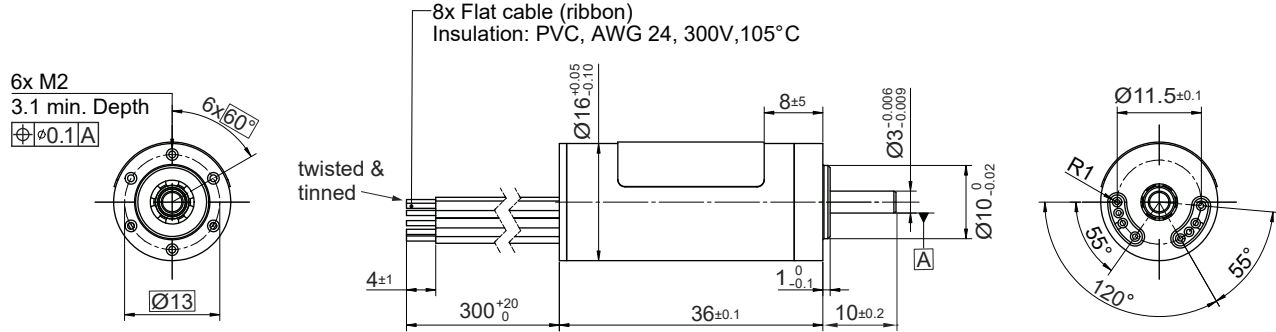
General Data						
17 Maximum Motor Speed	n_{max}	39,000	18,000	8,000	5,000	rpm
18 Ambient Working Temperature Range	-		-30 to +100 (-22 to +212)			°C (°F)
19 Ambient Storage Temperature Range	-		-40 to +100 (-40 to +212)			°C (°F)
20 Ball Bearings Preload	-		5.3			N
21 Axial Static Force w/o Shaft Support (max)	-		34			N
22 Maximum Winding Temperature	-		125 (257)			°C (°F)
23 Thermal Resistance	R_{th}		3.5 / 17			°C/W
24 Thermal Time Constant	τ_w		587			s
25 Weight	-		41 (1.45)			g (oz)
26 Rotor Inertia	J		0.60			g-cm ²
27 Hall Sensor Electrical Phasing	-		NA			Electrical °

Wire	Description
Red	5 to 15V DC
Black	GND
A reverse polarity will damage the electronics permanently	
PWM not allowed on power supply	
When ordering, please choose CW or CCW for rotation direction seen from shaft output side	



Power curves on following page





Dimensions in mm

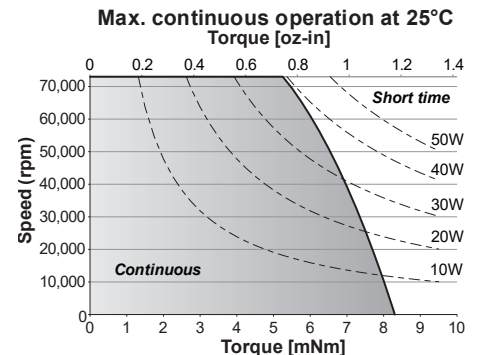
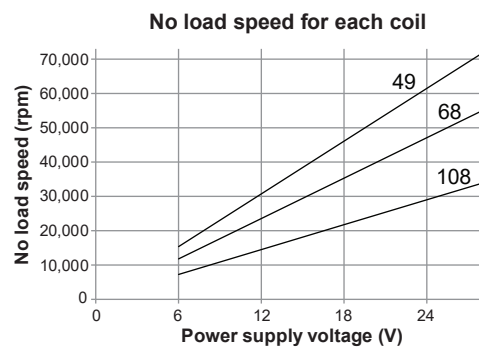
Electrical Data	Symbol	16ECS36-8B-xxx.01			Unit
		108	68	49	
1 Nominal Voltage	U_N	24	24	24	Volt
2 Optimization Direction	-	Symmetrical	Symmetrical	Symmetrical	-
3 No Load Speed	n_0	29,000	45,900	63,100	rpm
4 Typical No Load Current	I_0	50	80	110	mA
5 Max Continuous Mechanical Power (@25°C)	P_{max}	39.5	39.5	39.5	W
6 Max Continuous Current	$I_{e,max}$	0.9	1.6	2.3	A
7 Max Continuous Torque	$M_{e,max}$	7.1 (1)	7.9 (1.11)	8.2 (1.16)	mNm (oz-in)
8 Back EMF Constant	k_E	0.8	0.51	0.37	V/1000 rpm
9 Torque Constant	k_M	7.7	4.85	3.5	mNm/A
10 Motor Regulation	R/k^2	69.2	56.2	52	10 ³ /Nms
11 Motor Regulation	$k/R^{1/2}$	3.8 (0.54)	4.2 (0.59)	4.4 (0.61)	mNm/W ^{1/2} (oz-in/W ^{1/2})
12 Internal Resistance - phase to phase	R_i	4.05	1.32	0.65	ohms
13 Line to Line Resistance at Connectors	R_L	4.13	1.37	0.70	ohms
14 Inductance Phase to Phase	L	0.32	0.13	0.07	mH
15 Mechanical Time Constant	τ_m	3.8	3.1	2.9	ms
16 Electrical Time Constant	τ_e	0.08	0.09	0.1	ms

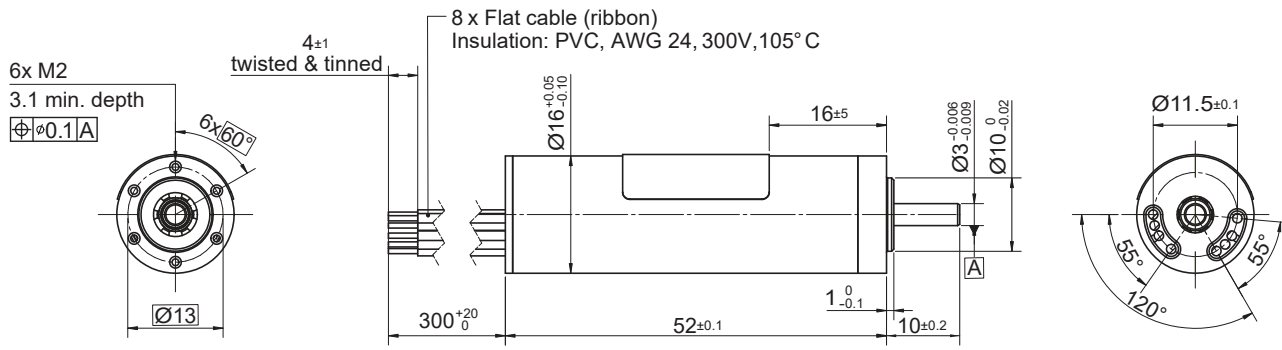
General Data				
17 Maximum Motor Speed	n_{max}		73,000	rpm
18 Ambient Working Temperature Range	-		-30 to +100 (-22 to +212)	°C (°F)
19 Ambient Storage Temperature Range	-		-40 to +100 (-40 to +212)	°C (°F)
20 Ball Bearings Preload	-		5.3	N
21 Axial Static Force w/o Shaft Support (max)	-		34	N
22 Maximum Winding Temperature	-		125 (257)	°C (°F)
23 Thermal Resistance	R_{th}		3.5 / 17	°C/W
24 Thermal Time Constant	τ_w		580	s
25 Weight	-		41 (1.45)	g (oz)
26 Rotor Inertia	J		0.6	g-cm ²
27 Hall Sensor Electrical Phasing*	-		120	Electrical °

*Also available without Hall sensors

Wire	Description
Gray	Phase 1
Violet	Phase 2
Blue	Phase 3
Green	3 to 24V DC
Yellow	GND
Orange	Sensor 1
Red	Sensor 2
Brown	Sensor 3

with hall effect sensor





Dimensions in mm

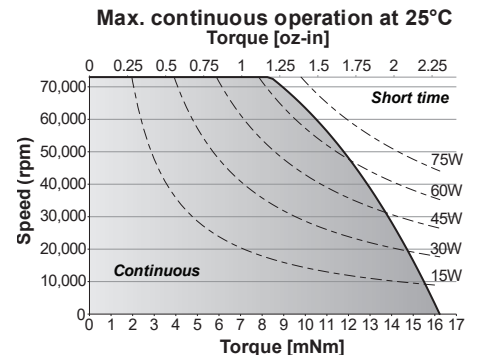
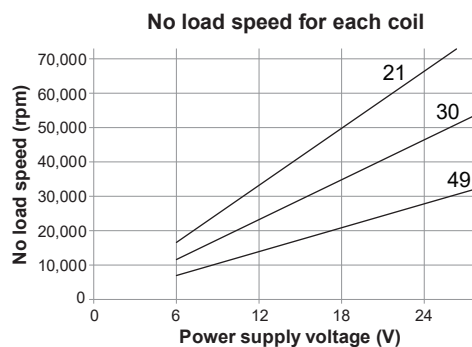
Electrical Data	Symbol	16ECS52-8B-xxx.01			Unit
		49	30	21	
1 Nominal Voltage	U_N	24	24	24	Volt
2 Optimization Direction	-	Symmetrical	Symmetrical	Symmetrical	-
3 No Load Speed	n_0	27,800	45,400	66,380	rpm
4 Typical No Load Current	I_0	85	135	240	mA
5 Max Continuous Mechanical Power (@25°C)	P_{max}	66	66	66	W
6 Max Continuous Current	$I_{e,max}$	2	3.2	4.6	A
7 Max Continuous Torque	$M_{e,max}$	16.1 (2.28)	15.9 (2.25)	15.8 (2.23)	mNm (oz-in)
8 Back EMF Constant	k_E	0.84	0.52	0.36	V/1000 rpm
9 Torque Constant	k_M	7.99	4.93	3.45	mNm/A
10 Motor Regulation	R/k^2	15.35	15.6	15.9	10 ³ /Nms
11 Motor Regulation	$k/R^{1/2}$	8.1 (1.15)	8 (1.13)	7.9 (1.11)	mNm/W ^{1/2} (oz-in/W ^{1/2})
12 Internal Resistance - phase to phase	R_l	0.98	0.38	0.19	ohms
13 Line to Line Resistance at Connectors	R_L	1.06	0.43	0.24	ohms
14 Inductance Phase to Phase	L	0.12	0.02	0.01	mH
15 Mechanical Time Constant	τ_m	1.5	1.6	1.6	ms
16 Electrical Time Constant	τ_e	0.12	0.06	0.05	ms

General Data					
17 Maximum Motor Speed	n_{max}	73,000			rpm
18 Ambient Working Temperature Range	-	-30 to +100 (-22 to +212)			°C (°F)
19 Ambient Storage Temperature Range	-	-40 to +100 (-40 to +212)			°C (°F)
20 Ball Bearings Preload	-	5.3			N
21 Axial Static Force w/o Shaft Support (max)	-	34			N
22 Maximum Winding Temperature	-	125 (257)			°C (°F)
23 Thermal Resistance	R_{th}	3 / 15			°C/W
24 Thermal Time Constant	τ_w	750			s
25 Weight	-	62 (2.19)			g (oz)
26 Rotor Inertia	J	1			g-cm ²
27 Hall Sensor Electrical Phasing*	-	120			Electrical °

*Also available without Hall sensors

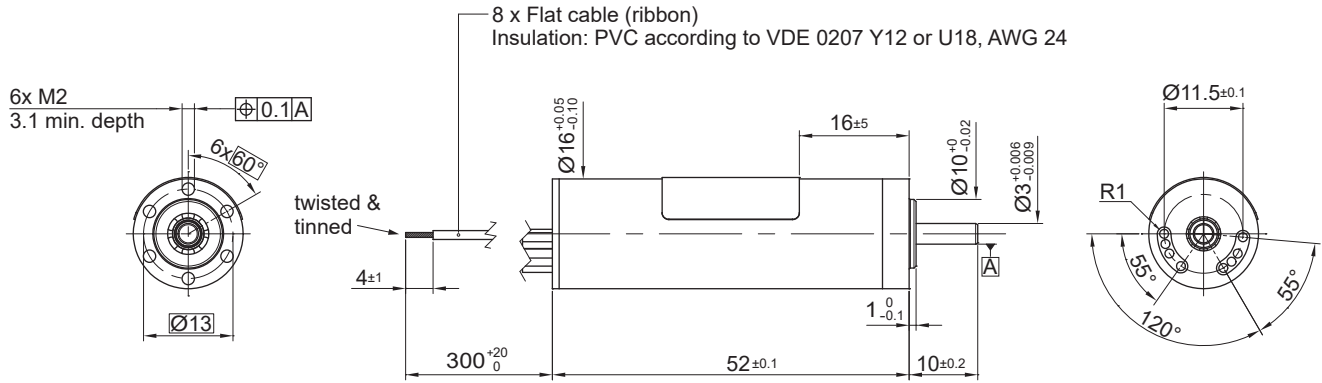
Wire	Description
Gray	Phase 1
Violet	Phase 2
Blue	Phase 3
Green	3 to 24V DC
Yellow	GND
Orange	Sensor 1
Red	Sensor 2
Brown	Sensor 3

with hall effect sensor



16ECP52 Ultra EC™

Ø 16 mm • 2-pole • 37 W



Dimensions in mm

Electrical Data	Symbol	16ECP52-8B-xxx.01			Unit
		220	112	49	
1 Nominal Voltage	U_N	24	24	24	Volt
2 Optimization Direction	-	Symmetrical	Symmetrical	Symmetrical	-
3 No Load Speed	n_0	6,144	12,100	27,800	rpm
4 Typical No Load Current	I_0	19	41	134	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	37.5	37.5	37.5	W
6 Max. Continuous Current	$I_{e,max}$	0.4	0.8	2.0	A
7 Max. Continuous Torque	$M_{e,max}$	14.5 (2.06)	14.7 (2.09)	16.1 (2.28)	mNm (oz-in)
8 Back EMF Constant	k_E	3.77	1.93	0.84	V/1000 rpm
9 Torque Constant	k_M	36.0	18.4	8.0	mNm/A
10 Motor Regulation	R/k^2	18.9	18.3	15.4	10 ³ /Nms
11 Motor Regulation	$k/R^{1/2}$	7.3 (1.04)	7.4 (1.05)	8.1 (1.15)	mNm/W ^{1/2} (oz-in/W ^{1/2})
12 Internal Resistance - phase to phase	R_i	24.50	6.20	0.98	ohms
13 Line to Line Resistance at Connectors	R_L	24.60	6.30	1.06	ohms
14 Inductance Phase to Phase	L	2.32	0.60	0.12	mH
15 Mechanical Time Constant	τ_m	1.9	1.8	1.5	ms
16 Electrical Time Constant	τ_e	0.10	0.10	0.12	ms

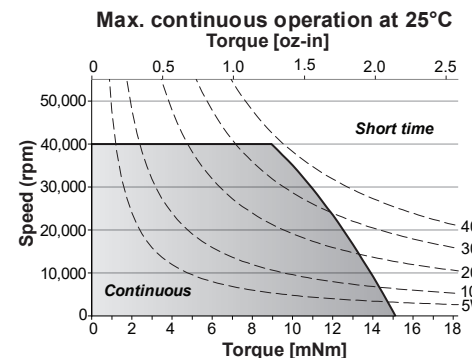
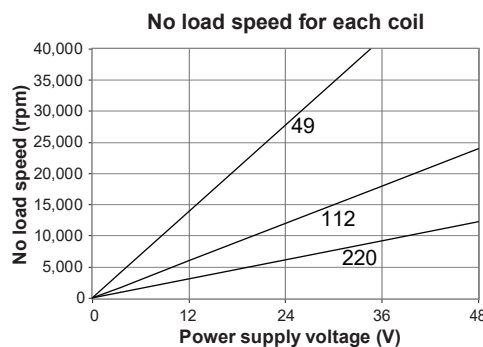
General Data

17 Maximum Motor Speed	n_{max}		40,000		rpm
18 Ambient Working Temperature Range	-		-30 to +100 (-22 to +212)		°C (°F)
19 Ambient Storage Temperature Range	-		-40 to +100 (-40 to +212)		°C (°F)
20 Ball Bearings Preload	-		5.3		N
21 Axial Static Force w/o Shaft Support (max)	-		34		N
22 Maximum Winding Temperature	-		125 (257)		°C (°F)
23 Thermal Resistance	R_{th}		3 / 15		°C/W
24 Thermal Time Constant	τ_w		750		s
25 Weight	-		62 (2.19)		g (oz)
26 Rotor Inertia	J		1		g-cm ²
27 Hall Sensor Electrical Phasing*	-		120		Electrical °

*Also available without Hall sensors

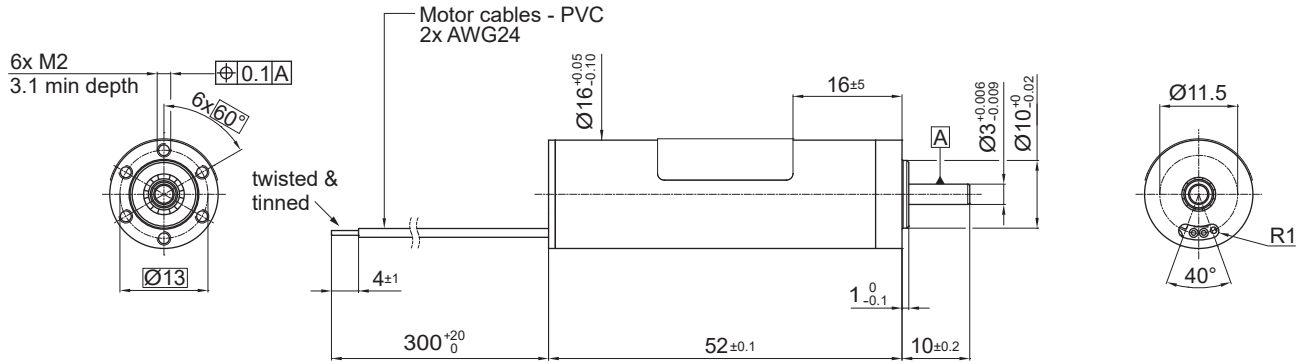
Wire	Description
Gray	Phase 1
Violet	Phase 2
Blue	Phase 3
Green	3.5 to 24V DC
Yellow	GND
Orange	Sensor 1
Red	Sensor 2
Brown	Sensor 3

with hall effect sensor



16ECP52 2-Wire Ultra EC™

Ø 16 mm • 2-pole • 19 W



Dimensions in mm

Electrical Data	Symbol	16ECP52-2A-***			Unit
		49	112	220	
1 Nominal Voltage	U_N	12	12	12	Volt
2 Optimization Direction	-	CW	CW	CW	-
3 No Load Speed	n_0	14,100	5,900	3,070	rpm
4 Typical No Load Current	I_0	120	35	15	mA
5 Max Continuous Mechanical Power (@25°C)	P_{max}	19.3	7.3	2.1	W
6 Max Continuous Current	$I_{e,max}$	1.70	0.72	0.39	A
7 Max Continuous Torque	$M_{e,max}$	13.4 (1.9)	13.9 (1.97)	13.93 (1.98)	mNm (oz-in)
8 Back EMF Constant	k_E	0.88	2.11	3.95	V/1000 rpm
9 Torque Constant	k_M	7.99	19.2	35.99	mNm/A
10 Motor Regulation	R/k^2	15.35	16.68	18.94	10 ³ /Nms
11 Motor Regulation	$k/R^{1/2}$	8 (1.15)	7.7 (1.1)	7.2 (1.03)	mNm/W ^{1/2} (oz-in/W ^{1/2})
12 Internal Resistance - phase to phase	R_l	0.98	6.15	24.53	ohms
13 Line to Line Resistance at Connectors	R_L	NA	NA	NA	ohms
14 Inductance Phase to Phase	L	0.12	0.60	2.32	mH
15 Mechanical Time Constant	τ_m	1.5	1.7	1.9	ms
16 Electrical Time Constant	τ_e	0.12	0.1	0.1	ms

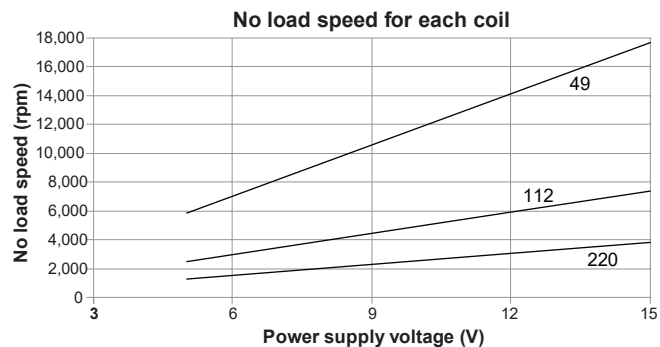
General Data					
17 Maximum Motor Speed	n_{max}	15,900	7,000	4,000	rpm
18 Ambient Working Temperature Range	-	-30 to +100 (-22 to +212)			°C (°F)
19 Ambient Storage Temperature Range	-	-40 to +100 (-40 to +212)			°C (°F)
20 Ball Bearings Preload	-	5.3			N
21 Axial Static Force w/o Shaft Support (max)	-	34			N
22 Maximum Winding Temperature	-	125 (257)			°C (°F)
23 Thermal Resistance	R_{th}	3 / 15			°C/W
24 Thermal Time Constant	τ_w	759			s
25 Weight	-	62 (2.19)			g (oz)
26 Rotor Inertia	J	1			g-cm ²
27 Hall Sensor Electrical Phasing	-	NA			Electrical °

Wire	Description
Red	5 to 15V DC
Black	GND

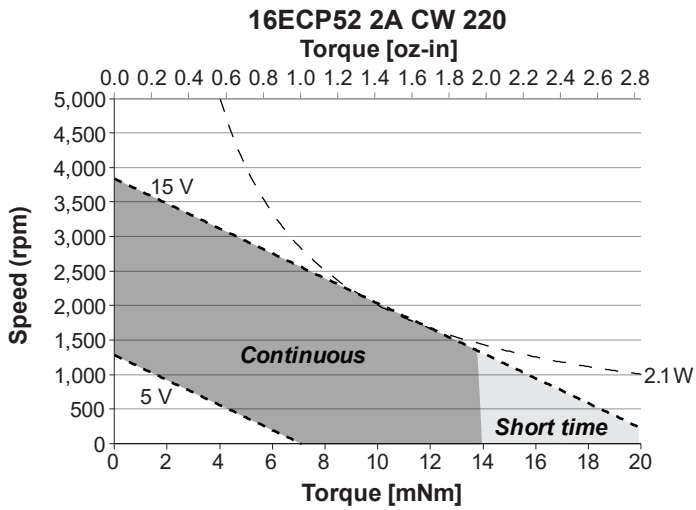
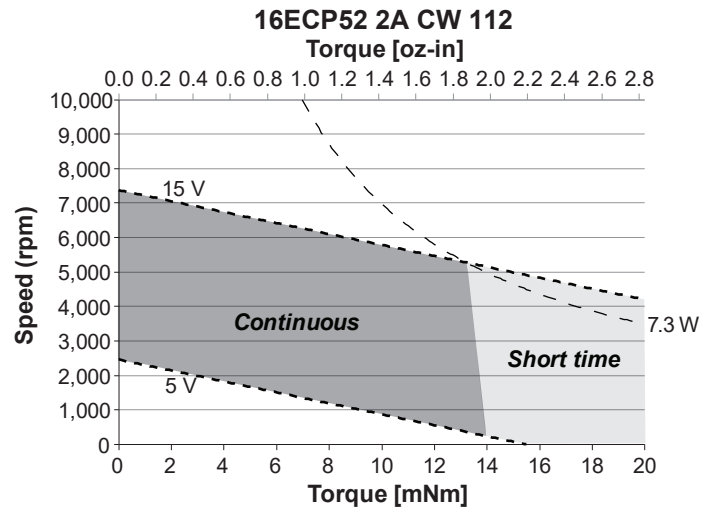
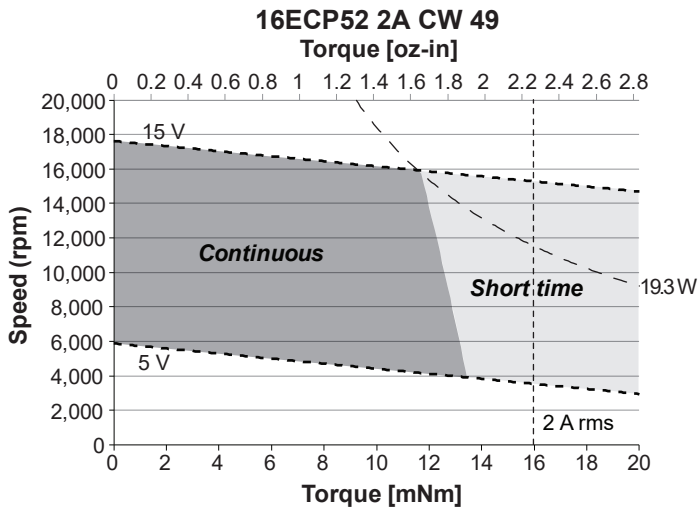
A reverse polarity will damage the electronics permanently

PWM not allowed on power supply

When ordering, please choose CW or CCW for rotation direction seen from shaft output side

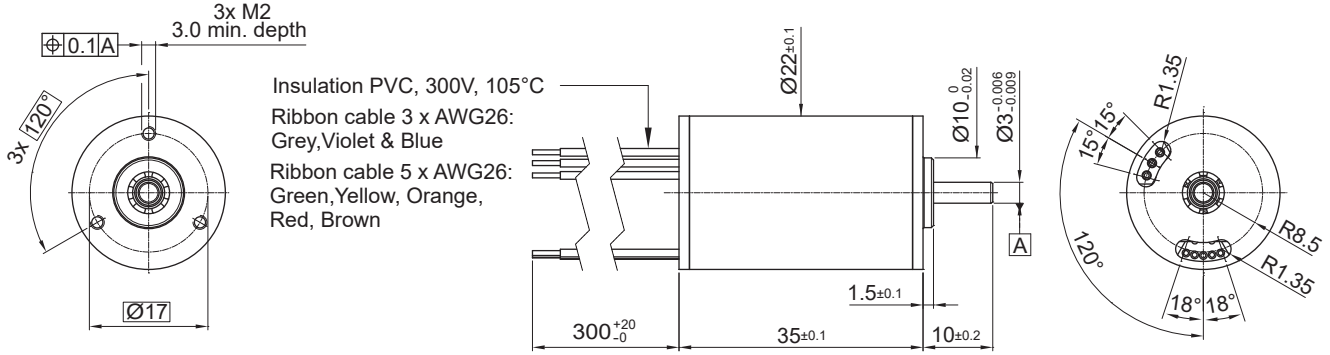


Power curves on following page



22ECP35 Ultra EC™

Ø 22 mm • 2-pole • 55 W



Dimensions in mm

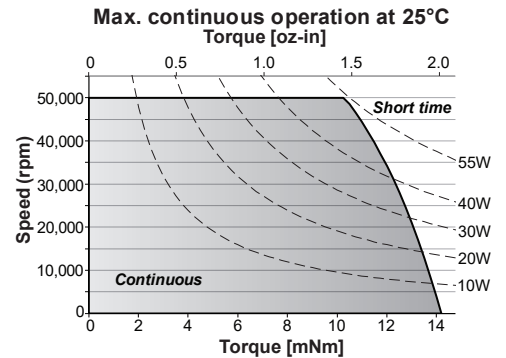
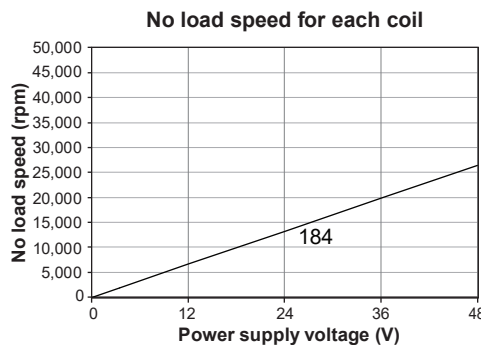
Electrical Data	Symbol	22ECP35 8B-184.01	Unit
1 Nominal Voltage	U_N	24	Volt
2 Optimization Direction	-	Symmetrical	-
3 No Load Speed	n_0	13,200	rpm
4 Typical No Load Current	I_0	30.0	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	56.0	W
6 Max. Continuous Current	$I_{e,max}$	0.8	A
7 Max. Continuous Torque	$M_{e,max}$	14.3 (2.03)	mNm (oz-in)
8 Back EMF Constant	k_E	1.82	V/1000 rpm
9 Torque Constant	k_M	17.4	mNm/A
10 Motor Regulation	R/k^2	21.8	10 ³ /Nms
11 Motor Regulation	$k/R^{1/2}$	6.77 (0.96)	mNm/W ^{1/2} (oz-in/W ^{1/2})
12 Internal Resistance - phase to phase	R_l	6.58	ohms
13 Line to Line Resistance at Connectors	R_L	6.71	ohms
14 Inductance Phase to Phase	L	0.89	mH
15 Mechanical Time Constant	τ_m	3.0	ms
16 Electrical Time Constant	τ_e	0.14	ms

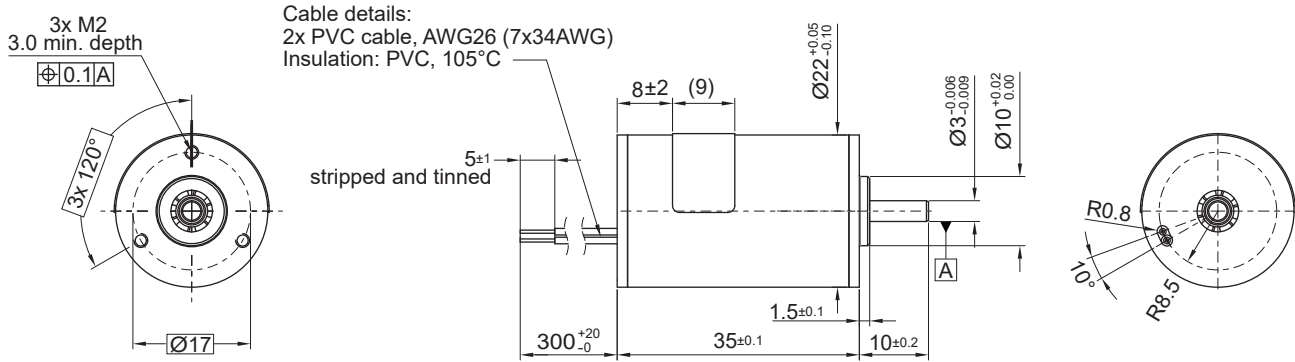
General Data			
17 Maximum Motor Speed	n_{max}	50000	rpm
18 Ambient Working Temperature Range	-	-30 to +100 (-22 to +212)	°C (°F)
19 Ambient Storage Temperature Range	-	-40 to +100 (-40 to +212)	°C (°F)
20 Ball Bearings Preload	-	5.50	N
21 Axial Static Force w/o Shaft Support (max)	-	34.00	N
22 Maximum Winding Temperature	-	125 (257)	°C (°F)
23 Thermal Resistance	R_{th}	3.5/12.5	°C/W
24 Thermal Time Constant	τ_w	550	s
25 Weight	-	64 (2.26)	g (oz)
26 Rotor Inertia	J	1.38	g-cm ²
27 Hall Sensor Electrical Phasing*	-	120.00	Electrical °

*Also available without Hall sensors

Wire	Description
Gray	Phase 1
Violet	Phase 2
Blue	Phase 3
Green	3.5 to 24V DC
Yellow	GND
Orange	Sensor 1
Red	Sensor 2
Brown	Sensor 3

with hall effect sensor



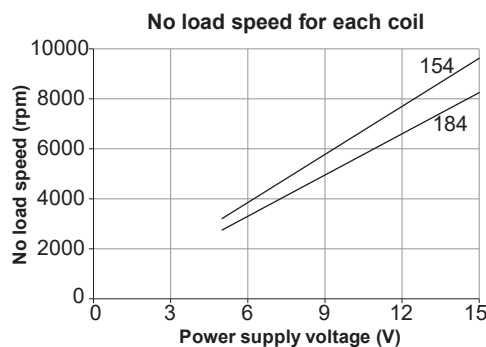


Dimensions in mm

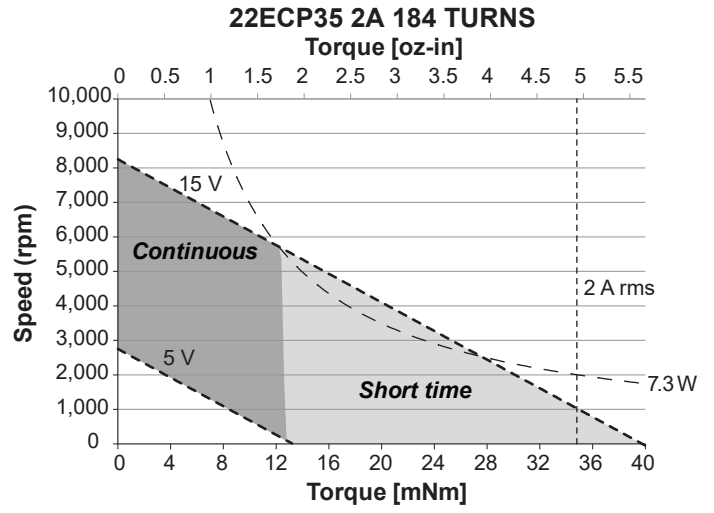
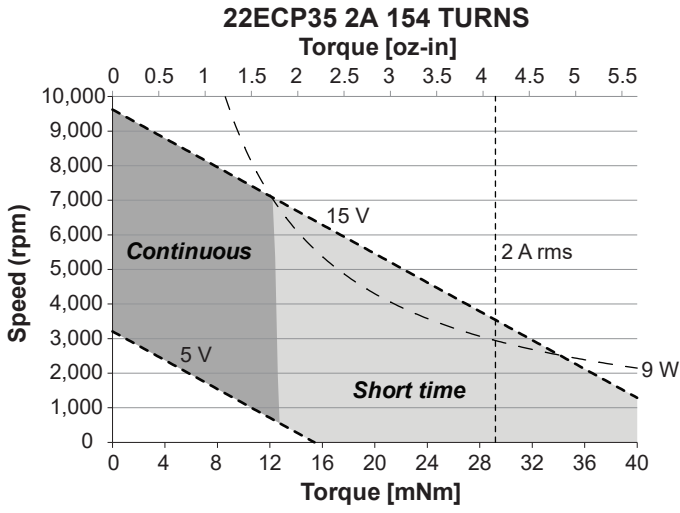
Electrical Data	Symbol	22ECP35 2A-xxx.01		Unit
		154	184	
1 Nominal Voltage	U_N	12	12	Volt
2 Optimization Direction	-	Bidirectional	Bidirectional	-
3 No Load Speed	n_0	7,700	6,600	rpm
4 Typical No Load Current	I_0	63	30	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	9	7.3	W
6 Max. Continuous Current	$I_{e,max}$	0.9	0.7	A
7 Max. Continuous Torque	$M_{e,max}$	12.6 (1.78)	12.6 (1.78)	mNm (oz-in)
8 Back EMF Constant	k_E	1.53	1.82	V/1000 rpm
9 Torque Constant	k_M	14.6	17.4	mNm/A
10 Motor Regulation	R/k^2	21.8	21.7	$10^3/Nms$
11 Motor Regulation	$k/R^{1/2}$	6.8 (0.96)	6.8 (0.96)	mNm/W ^{1/2} (oz-in/W ^{1/2})
12 Internal Resistance - phase to phase	R_i	4.65	6.58	ohms
13 Line to Line Resistance at Connectors	R_L	NA	NA	ohms
14 Inductance Phase to Phase	L	0.62	0.89	mH
15 Mechanical Time Constant	τ_m	3	3	ms
16 Electrical Time Constant	τ_e	0.13	0.14	ms

General Data				
17 Maximum Motor Speed	n_{max}	10000	8000	rpm
18 Ambient Working Temperature Range	-	-30 to +100 (-22 to +212)		°C (°F)
19 Ambient Storage Temperature Range	-	-40 to +100 (-40 to +212)		°C (°F)
20 Ball Bearings Preload	-	5.5		N
21 Axial Static Force w/o Shaft Support (max)	-	34.00		N
22 Maximum Winding Temperature	-	125 (257)		°C (°F)
23 Thermal Resistance	R_{th}	3.5/12.5		°C/W
24 Thermal Time Constant	τ_w	550		s
25 Weight	-	64 (2.26)		g (oz)
26 Rotor Inertia	J	1.38		g-cm ²
27 Hall Sensor Electrical Phasing (Sensorless)	-	NA		Electrical °

Wire	Description
Red	5 to 15V DC
Black	GND
A reverse polarity will damage the electronics permanently	
PWM not allowed on power supply	
When ordering, please choose CW or CCW for rotation direction seen from shaft output side	

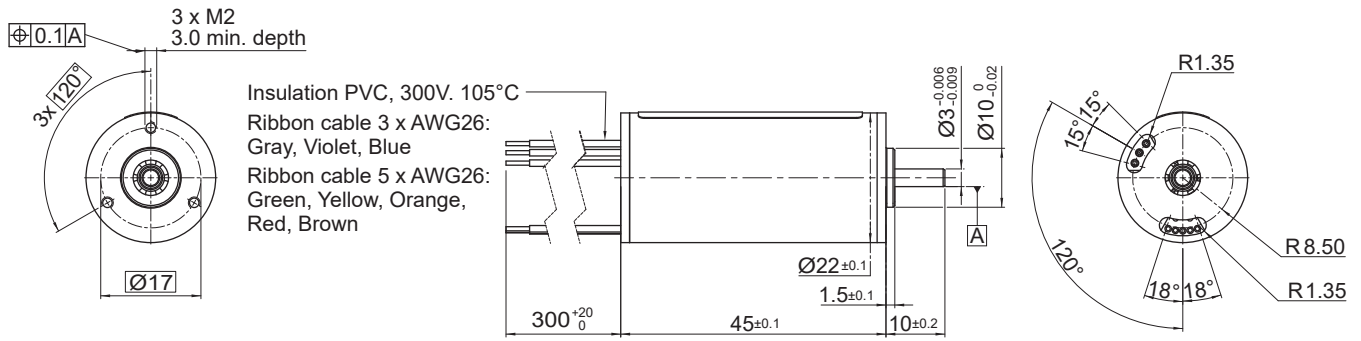


Power curves on following page



22ECP45 Ultra EC™

Ø 22 mm • 2-pole • 80 W



Dimensions in mm

Electrical Data	Symbol	22ECP45-8B-xxx.01		Unit
		154	82	
1 Nominal Voltage	U_N	24	24	Volt
2 Optimization Direction	-	Symmetrical	Symmetrical	-
3 No Load Speed	n_0	8,370	15,700	rpm
4 Typical No Load Current	I_0	25	60	mA
5 Max Continuous Mechanical Power (@25°C)	P_{max}	80	80	W
6 Max Continuous Current	$I_{e,max}$	1.0	2.0	A
7 Max Continuous Torque	$M_{e,max}$	27.7 (3.93)	29.4 (4.17)	mNm (oz-in)
8 Back EMF Constant	k_E	2.82	1.53	V/1000 rpm
9 Torque Constant	k_M	27.0	14.6	mNm/A
10 Motor Regulation	R/k^2	8.0	7.0	10 ³ /Nms
11 Motor Regulation	$k/R^{1/2}$	11.2 (1.59)	11.9 (1.69)	mNm/W ^{1/2} (oz-in/W ^{1/2})
12 Internal Resistance - phase to phase	R_i	5.80	1.50	ohms
13 Line to Line Resistance at Connectors	R_L	5.89	1.59	ohms
14 Inductance Phase to Phase	L	0.94	0.27	mH
15 Mechanical Time Constant	τ_m	1.8	1.6	ms
16 Electrical Time Constant	τ_e	0.16	0.18	ms

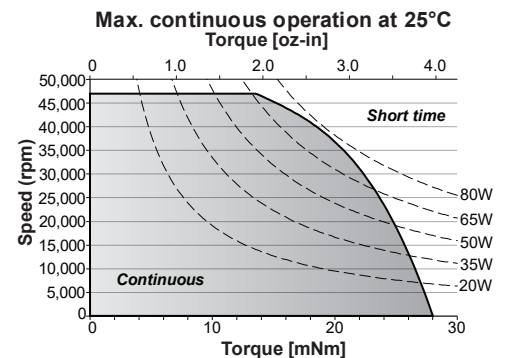
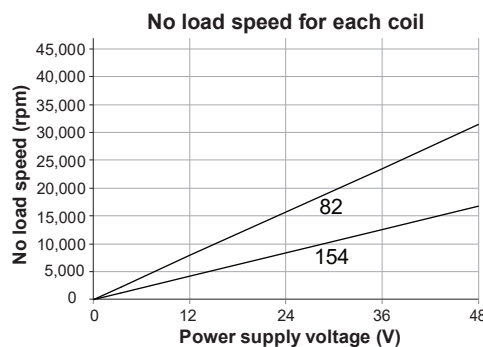
General Data

17 Maximum Motor Speed	n_{max}	47,000	rpm
18 Ambient Working Temperature Range	-	-30 to +100 (-22 to +212)	°C (°F)
19 Ambient Storage Temperature Range	-	-40 to +100 (-40 to +212)	°C (°F)
20 Ball Bearings Preload	-	5.5	N
21 Axial Static Force w/o Shaft Support (max)	-	34	N
22 Maximum Winding Temperature	-	125 (257)	°C (°F)
23 Thermal Resistance	R_{th}	2/9.7	°C/W
24 Thermal Time Constant	τ_w	850	s
25 Weight	-	100 (3.53)	g (oz)
26 Rotor Inertia	J	2.30	g-cm ²
27 Hall Sensor Electrical Phasing*	-	120	Electrical °

*Also available without Hall sensors

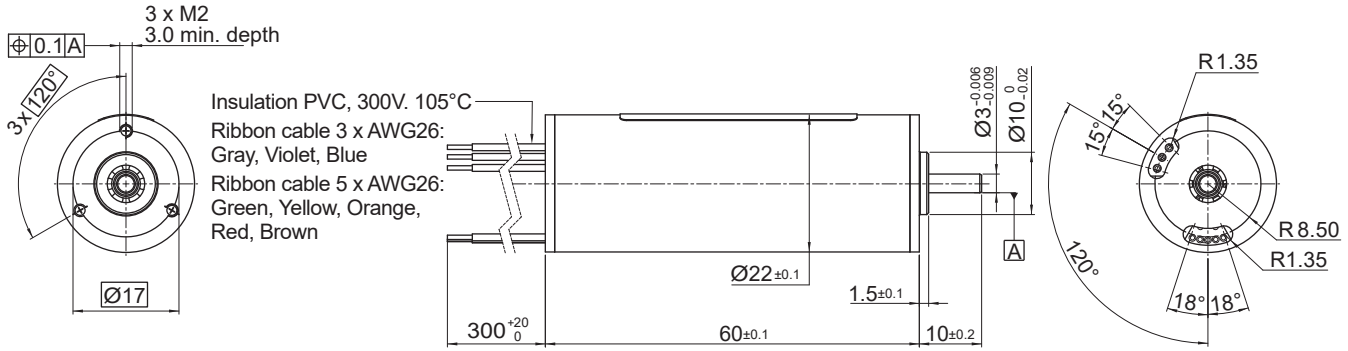
Wire	Description
Gray	Phase 1
Violet	Phase 2
Blue	Phase 3
Green	3.5 to 24V DC
Yellow	GND
Orange	Sensor 1
Red	Sensor 2
Brown	Sensor 3

with hall effect sensor



22ECP60 Ultra EC™

Ø 22 mm • 2-pole • 120 W



Dimensions in mm

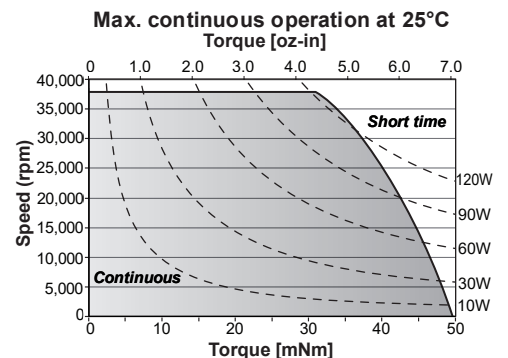
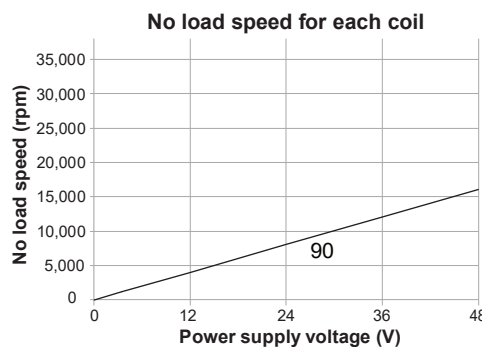
Electrical Data	Symbol	22ECP60 8B-90.01	Unit
1 Nominal Voltage	U_N	24	Volt
2 Optimization Direction	-	Symmetrical	-
3 No Load Speed	n_0	8,050	rpm
4 Typical No Load Current	I_o	40	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	120	W
6 Max. Continuous Current	$I_{e,max}$	1.8	A
7 Max. Continuous Torque	$M_{e,max}$	50.5 (7.16)	mNm (oz-in)
8 Back EMF Constant	k_E	2.96	V/1000 rpm
9 Torque Constant	k_M	28.3	mNm/A
10 Motor Regulation	R/k^2	3.0	10 ³ /Nms
11 Motor Regulation	$k/R^{1/2}$	18.3 (2.6)	mNm/W ^{1/2} (oz-in/W ^{1/2})
12 Internal Resistance - phase to phase	R_1	2.38	ohms
13 Line to Line Resistance at Connectors	R_L	2.47	ohms
14 Inductance Phase to Phase	L	0.48	mH
15 Mechanical Time Constant	τ_m	1.0	ms
16 Electrical Time Constant	τ_e	0.20	ms

General Data			
17 Maximum Motor Speed	n_{max}	38000	rpm
18 Ambient Working Temperature Range	-	-30 to +100 (-22 to +212)	°C (°F)
19 Ambient Storage Temperature Range	-	-40 to +100 (-40 to +212)	°C (°F)
20 Ball Bearings Preload	-	5.50	N
21 Axial Static Force w/o Shaft Support (max)	-	34	N
22 Maximum Winding Temperature	-	125 (257)	°C (°F)
23 Thermal Resistance	R_{th}	1/8.4	°C/W
24 Thermal Time Constant	τ_w	1100	s
25 Weight	-	140 (4.94)	g (oz)
26 Rotor Inertia	J	3.5	g-cm ²
27 Hall Sensor Electrical Phasing*	-	120	Electrical °

*Also available without Hall sensors

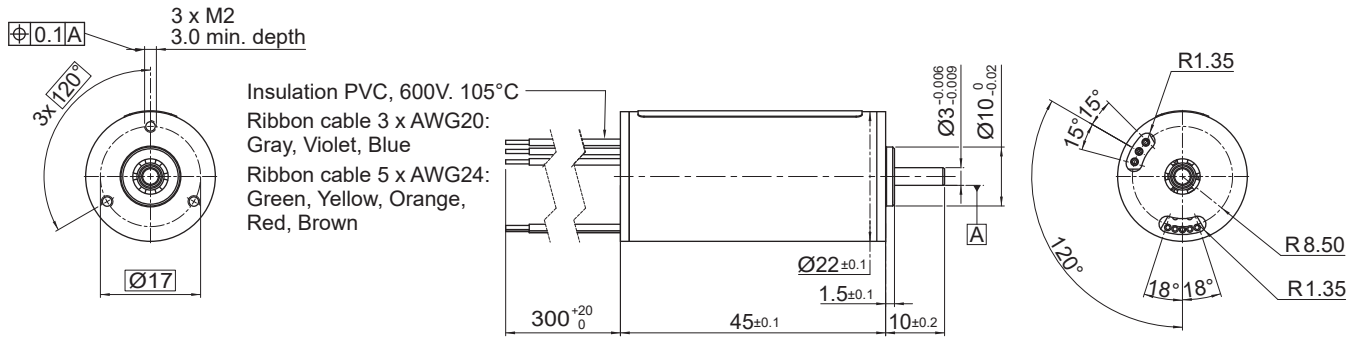
Wire	Description
Gray	Phase 1
Violet	Phase 2
Blue	Phase 3
Green	3.5 to 24V DC
Yellow	GND
Orange	Sensor 1
Red	Sensor 2
Brown	Sensor 3

with hall effect sensor



22ECS45 Ultra EC™

Ø 22 mm • 2-pole • 120 W



Dimensions in mm

Electrical Data	Symbol	22ECS45-10B-xxx.01				Unit
		38	30	24	18	
1 Nominal Voltage	U_N	24	24	24	24	Volt
2 Optimization Direction	-	CCW	CCW	CCW	CCW	-
3 No-Load Speed	n_0	34,500	43,500	51,600	68,500	rpm
4 Typical No-Load Current	I_0	160	195	240	300	mA
5 Max Continuous Mechanical Power (@25°C)	P_{max}	120	120	120	120	W
6 Max Continuous Current	$I_{e,max}$	4.0	5.2	6.4	8.2	A
7 Max Continuous Torque	$M_{e,max}$	26.6 (3.77)	26.8 (3.8)	26.7 (3.79)	26.8 (3.8)	mNm (oz-in)
8 Back EMF Constant	k_E	0.69	0.54	0.44	0.34	V/1000 rpm
9 Torque Constant	k_M	6.6	5.2	4.2	3.3	mNm/A
10 Motor Regulation	R/k^2	8.6	8.5	8.5	8.5	10 ³ Nms
11 Motor Regulation	$k/R^{1/2}$	10.8 (1.53)	10.8 (1.53)	10.8 (1.53)	10.8 (1.53)	mNm/W ^{1/2} (oz-in/W ^{1/2})
12 Internal Resistance - phase to phase	R_i	0.38	0.23	0.15	0.09	ohms
13 Line to Line Resistance at Connectors	R_L	0.42	0.25	0.18	0.11	ohms
14 Inductance Phase to Phase	L	0.057	0.035	0.022	0.013	mH
15 Mechanical Time Constant	τ_m	1.9	1.9	1.9	1.9	ms
16 Electrical Time Constant	τ_e	0.15	0.15	0.15	0.14	ms

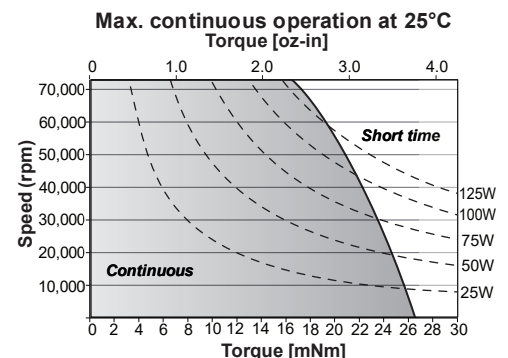
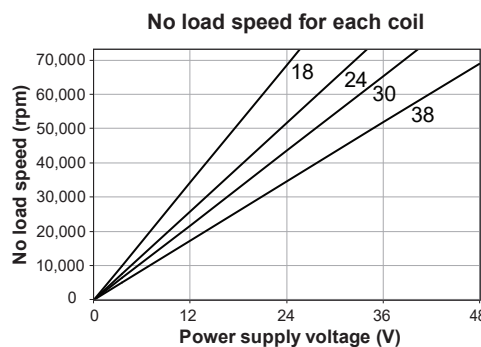
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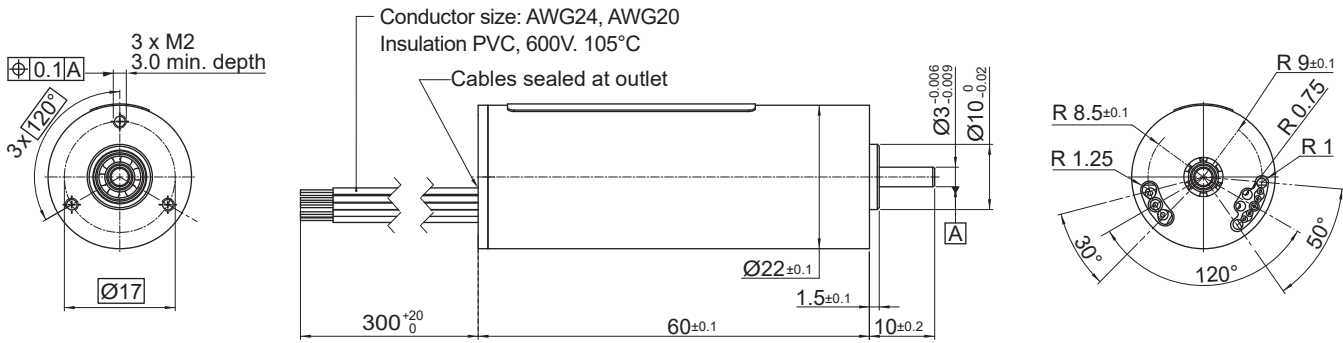
17 Maximum Motor Speed	n_{max}		73,000			rpm
18 Ambient Working Temperature Range	-		-30 to +100 (-22 to +212)			°C (°F)
19 Ambient Storage Temperature Range	-		-40 to +100 (-40 to +212)			°C (°F)
20 Ball Bearings Preload	-		5.5			N
21 Axial Static Force w/o Shaft Support (max)	-		34			N
22 Maximum Winding Temperature	-		125 (257)			°C (°F)
23 Thermal Resistance	R_{th}		2 / 9.7			°C/W
24 Thermal Time Constant	τ_w		1,000			s
25 Weight	-		100 (3.52)			g (oz)
26 Rotor Inertia	J		2.30			g-cm ²
27 Hall Sensor Electrical Phasing*	-		120			Electrical °

*Also available without Hall sensors

Wire	Description
Gray	Phase 1
Violet	Phase 2
Blue	Phase 3
Green	3.5 to 24V DC
Yellow	GND
Orange	Sensor 1
Red	Sensor 2
Brown	Sensor 3
Black	NTC 10 kohm
White	NTC 10 kohm

with hall effect sensor





Dimensions in mm

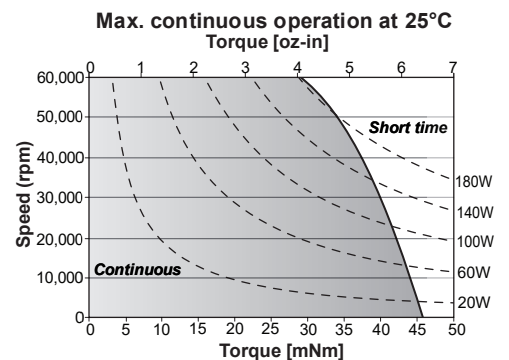
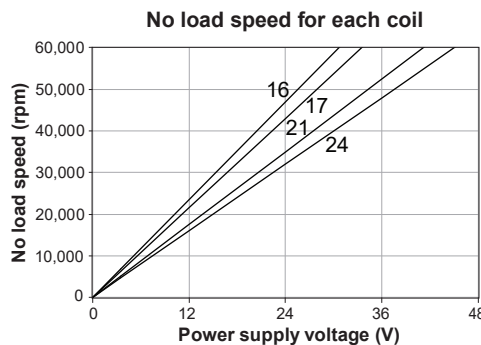
Electrical Data	Symbol	22ECS60 10B-xxx.01				Unit
		24	21	17	16	
1 Nominal Voltage	U_N	24	24	24	24	Volt
2 Optimization Direction	-	CCW	CCW	CCW	CCW	-
3 No Load Speed	n_0	32,000	35,000	43,000	47,000	rpm
4 Typical No Load Current	I_0	120	150	190	210	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	180	180	180	180	W
6 Max. Continuous Current	$I_{e,max}$	6.1	7.1	8.7	9.3	A
7 Max. Continuous Torque	$M_{e,max}$	44.1 (6.25)	45.9 (6.5)	44.5 (6.31)	45 (6.38)	mNm (oz-in)
8 Back EMF Constant	k_E	0.76	0.68	0.53	0.51	V/1000 rpm
9 Torque Constant	k_M	7.3	6.5	5.1	4.8	mNm/A
10 Motor Regulation	R/k^2	3.9	3.6	3.8	3.7	10 ³ /Nms
11 Motor Regulation	$k/R^{1/2}$	16 (2.27)	16.7 (2.37)	16.1 (2.28)	16.3 (2.31)	mNm/W ^{1/2} (oz-in/W ^{1/2})
12 Internal Resistance - phase to phase	R_i	0.21	0.15	0.10	0.09	ohms
13 Line to Line Resistance at Connectors	R_L	0.23	0.17	0.13	0.12	ohms
14 Inductance Phase to Phase	L	0.034	0.026	0.017	0.015	mH
15 Mechanical Time Constant	τ_m	1.4	1.3	1.3	1.3	ms
16 Electrical Time Constant	τ_e	0.17	0.17	0.17	0.17	ms

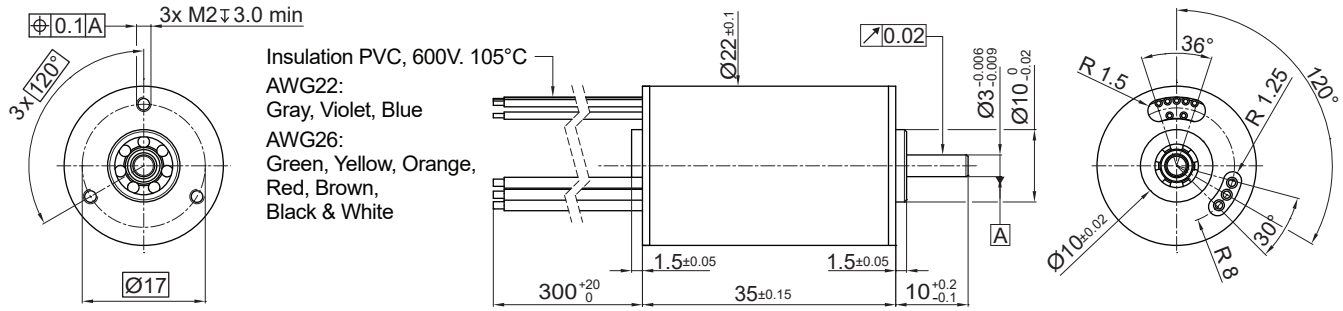
General Data						
17 Maximum Motor Speed	n_{max}	60,000				rpm
18 Ambient Working Temperature Range	-	-30 to +100 (-22 to +212)				°C (°F)
19 Ambient Storage Temperature Range	-	-40 to +100 (-40 to +212)				°C (°F)
20 Ball Bearings Preload	-	5.5				N
21 Axial Static Force w/o Shaft Support (max)	-	34				N
22 Maximum Winding Temperature	-	125 (257)				°C (°F)
23 Thermal Resistance	R_{th}	1 / 8.4				°C/W
24 Thermal Time Constant	τ_w	1,200				s
25 Weight	-	140 (4.93)				g (oz)
26 Rotor Inertia	J	3.50				g-cm ²
27 Hall Sensor Electrical Phasing*	-	120				Electrical °

*Also available without Hall sensors

Wire	Description
Gray	Phase 1
Violet	Phase 2
Blue	Phase 3
Green	3.5 to 24V DC
Yellow	GND
Orange	Sensor 1
Red	Sensor 2
Brown	Sensor 3
Black	NTC 10 kohm
White	NTC 10 kohm

with hall effect sensor





Dimensions in mm

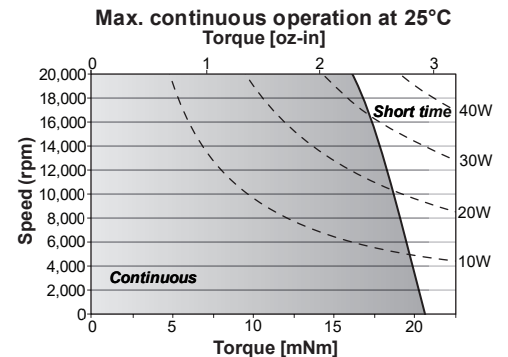
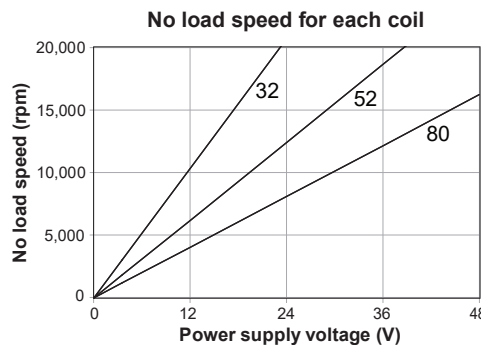
Electrical Data	Symbol	22ECT35 10B-xxx.01			Unit
		32	52	80	
1 Nominal Voltage	U_N	12	24	24	Volt
2 Optimization Direction	-	Symmetrical	Symmetrical	Symmetrical	-
3 No-Load Speed	n_0	10,330	12,400	8,100	rpm
4 Typical No-Load Current	I_0	100	90	40	mA
5 Max Continuous Mechanical Power (@25°C)	P_{max}	34.0	34.0	34.0	W
6 Max Continuous Current	$I_{e,max}$	1.8	1.1	0.7	A
7 Max Continuous Torque	$M_{e,max}$	20 (2.84)	19.9 (2.82)	19.5 (2.77)	mNm (oz-in)
8 Back EMF Constant	k_E	1.14	1.86	2.86	V/1000 rpm
9 Torque Constant	k_M	10.9	17.8	27.3	mNm/A
10 Motor Regulation	R/k^2	11.8	11.8	12.3	10 ³ /Nms
11 Motor Regulation	$k/R^{1/2}$	9.2 (1.31)	9.2 (1.31)	9 (1.28)	mNm/W ^{1/2} (oz-in/W ^{1/2})
12 Internal Resistance - phase to phase	R_i	1.40	3.73	9.20	ohms
13 Line to Line Resistance at Connectors	R_L	1.43	3.76	9.23	ohms
14 Inductance Phase to Phase	L	0.12	0.32	0.75	mH
15 Mechanical Time Constant	τ_m	4.2	4.2	4.4	ms
16 Electrical Time Constant	τ_e	0.09	0.08	0.08	ms

General Data				
17 Maximum Motor Speed	n_{max}		20,000	rpm
18 Ambient Working Temperature Range	-		-30 to +100 (-22 to +212)	°C (°F)
19 Ambient Storage Temperature Range	-		-40 to +100 (-40 to +212)	°C (°F)
20 Ball Bearings Preload	-		6.8	N
21 Axial Static Force w/o Shaft Support (max)	-		45	N
22 Maximum Winding Temperature	-		125 (257)	°C (°F)
23 Thermal Resistance	R_{th}		2.3 / 13	°C/W
24 Thermal Time Constant	τ_w		829	s
25 Weight	-		67 (2.37)	g (oz)
26 Rotor Inertia	J		3.6	g-cm ²
27 Hall Sensor Electrical Phasing*	-		120	Electrical °

*Also available without Hall sensors

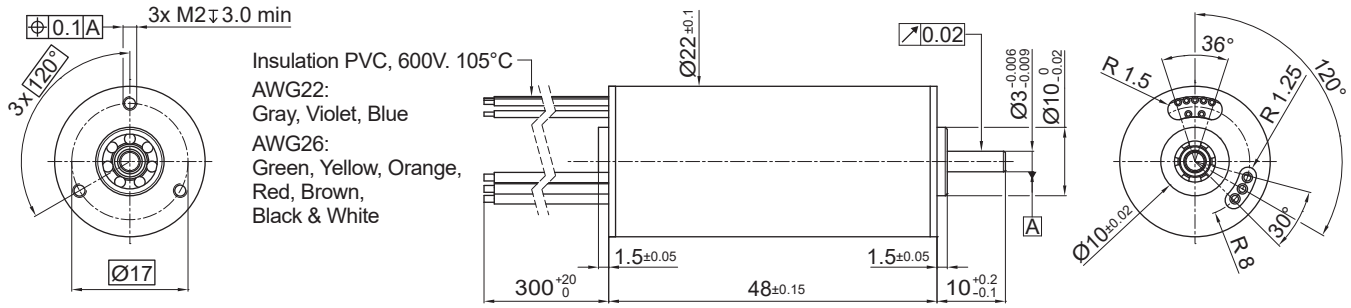
Wire	Description
Gray	Phase 1
Violet	Phase 2
Blue	Phase 3
Green	3.5 to 24V DC
Yellow	GND
Orange	Sensor 1
Red	Sensor 2
Brown	Sensor 3
Black	NTC 10 kohm
White	NTC 10 kohm

with hall effect sensor



22ECT48 Ultra EC™

Ø 22 mm • 4-pole • 54 W



Dimensions in mm

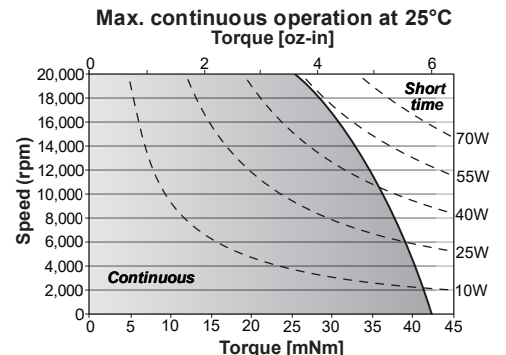
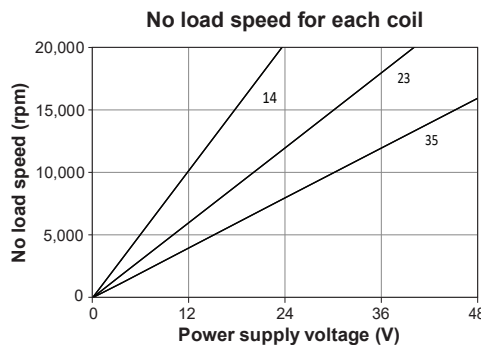
Electrical Data	Symbol	22ECT48 10B-xxx.01			Unit
		14	23	35	
1 Nominal Voltage	U_N	12	24	24	Volt
2 Optimization Direction	-	Symmetrical	Symmetrical	Symmetrical	-
3 No Load Speed	n_0	10,140	11,950	7,950	rpm
4 Typical No Load Current	I_0	155	120	70	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	54.0	54.0	54.0	W
6 Max. Continuous Current	$I_{e,max}$	3.7	2.2	1.5	A
7 Max. Continuous Torque	$M_{e,max}$	41.6 (5.9)	41.1 (5.82)	40.8 (5.78)	mNm (oz-in)
8 Back EMF Constant	k_E	1.17	1.95	2.94	V/1000 rpm
9 Torque Constant	k_M	11.2	18.6	28.1	mNm/A
10 Motor Regulation	R/k^2	2.9	3.0	3.0	10 ³ /Nms
11 Motor Regulation	$k/R^{1/2}$	18.4 (2.61)	18.2 (2.58)	18.1 (2.57)	mNm/W ^{1/2} (oz-in/W ^{1/2})
12 Internal Resistance - phase to phase	R_i	0.37	1.04	2.40	ohms
13 Line to Line Resistance at Connectors	R_L	0.40	1.07	2.43	ohms
14 Inductance Phase to Phase	L	0.04	0.11	0.24	mH
15 Mechanical Time Constant	τ_m	1.8	1.9	1.9	ms
16 Electrical Time Constant	τ_e	0.11	0.10	0.10	ms

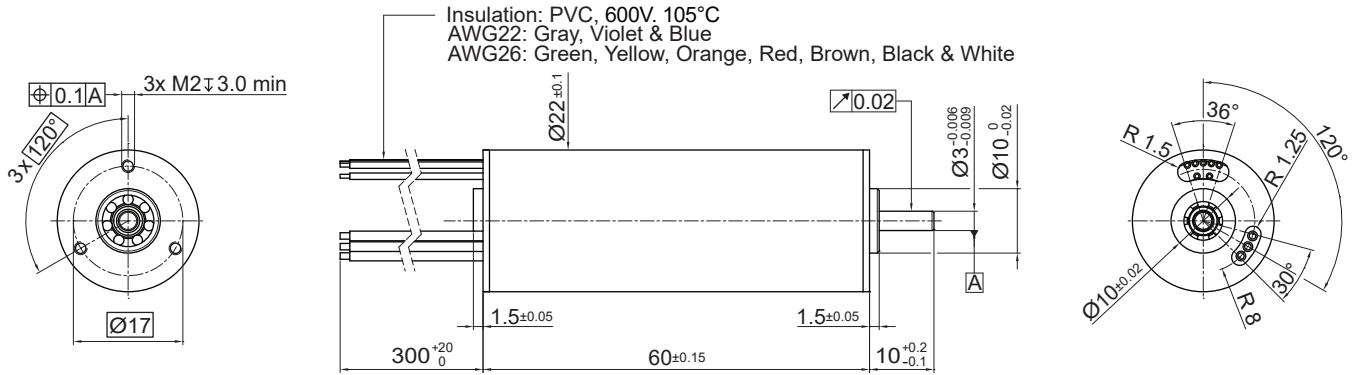
General Data				
17 Maximum Motor Speed	n_{max}		20,000	rpm
18 Ambient Working Temperature Range	-		-30 to +100 (-22 to +212)	°C (°F)
19 Ambient Storage Temperature Range	-		-40 to +100 (-40 to +212)	°C (°F)
20 Ball Bearings Preload	-		6.8	N
21 Axial Static Force w/o Shaft Support (max)	-		45	N
22 Maximum Winding Temperature	-		125 (257)	°C (°F)
23 Thermal Resistance	R_{th}		2.1 / 12	°C/W
24 Thermal Time Constant	τ_w		962	s
25 Weight	-		98 (3.46)	g (oz)
26 Rotor Inertia	J		6.3	g-cm ²
27 Hall Sensor Electrical Phasing*	-		120	Electrical °

*Also available without Hall sensors

Wire	Description
Gray	Phase 1
Violet	Phase 2
Blue	Phase 3
Green	3.5 to 24V DC
Yellow	GND
Orange	Sensor 1
Red	Sensor 2
Brown	Sensor 3
Black	NTC 10 kohm
White	NTC 10 kohm

with hall effect sensor





Dimensions in mm

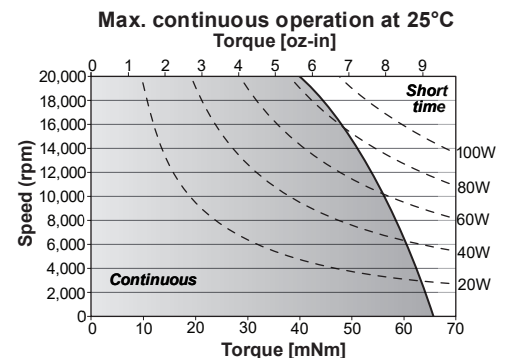
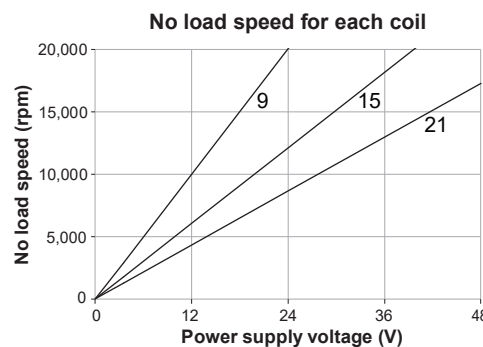
Electrical Data	Symbol	22ECT60-10B-xxx.01			Unit
		9	15	21	
1 Nominal Voltage	U_N	24	24	24	Volt
2 Optimization Direction	-	Symmetrical	Symmetrical	Symmetrical	-
3 No-Load Speed	n_0	20,370	12,350	9,180	rpm
4 Typical No-Load Current	I_0	370	170	115	mA
5 Max Continuous Mechanical Power (@25°C)	P_{max}	86	86	86	W
6 Max Continuous Current	$I_{e,max}$	5.9	3.6	2.6	A
7 Max Continuous Torque	$M_{e,max}$	65.9 (9.34)	66.9 (9.48)	64.3 (9.11)	mNm (oz-in)
8 Back EMF Constant	k_E	1.16	1.97	2.72	V/1000 rpm
9 Torque Constant	k_M	11.1	18.8	26.0	mNm/A
10 Motor Regulation	R/k^2	1.5	1.5	1.6	$10^3/Nms$
11 Motor Regulation	$k/R^{1/2}$	25.5 (3.6)	26 (3.7)	25 (3.5)	mNm/W ^{1/2} (oz-in/W ^{1/2})
12 Internal Resistance - phase to phase	R_i	0.19	0.52	1.08	ohms
13 Line to Line Resistance at Connectors	R_L	0.22	0.55	1.11	ohms
14 Inductance Phase to Phase	L	0.02	0.06	0.12	mH
15 Mechanical Time Constant	τ_m	1.3	1.3	1.4	ms
16 Electrical Time Constant	τ_e	0.12	0.12	0.11	ms

General Data				
17 Maximum Motor Speed	n_{max}		20,000	rpm
18 Ambient Working Temperature Range	-		-30 to +100 (-22 to +212)	°C (°F)
19 Ambient Storage Temperature Range	-		-40 to +100 (-40 to +212)	°C (°F)
20 Ball Bearings Preload	-		6.8	N
21 Axial Static Force w/o Shaft Support (max)	-		45.0	N
22 Maximum Winding Temperature	-		125 (257)	°C (°F)
23 Thermal Resistance	R_{th}		2.0 / 8.8	°C/W
24 Thermal Time Constant	τ_w		980	s
25 Weight	-		123 (4.34)	g (oz)
26 Rotor Inertia	J		8.71	g-cm ²
27 Hall Sensor Electrical Phasing*	-		120	Electrical °

*Also available without Hall sensors

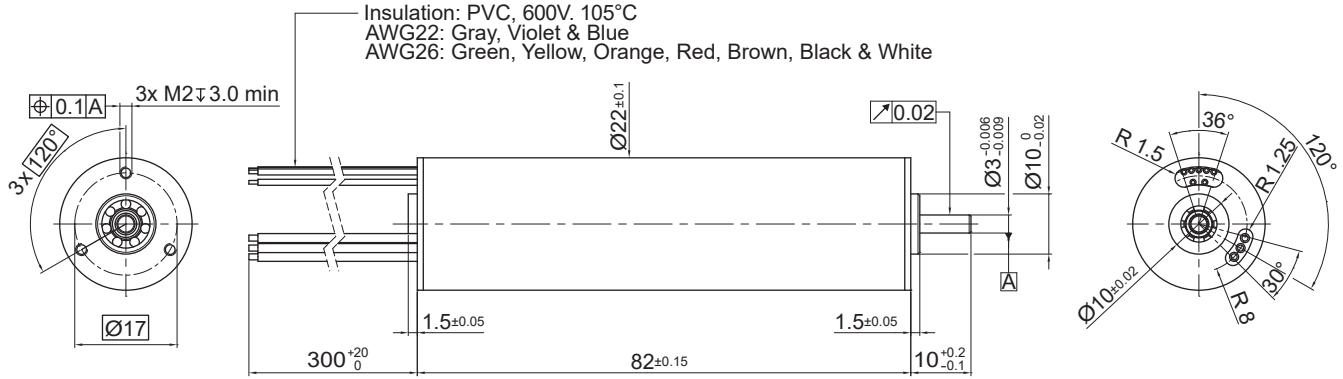
Wire	Description
Gray	Phase 1
Violet	Phase 2
Blue	Phase 3
Green	3.5 to 24V DC
Yellow	GND
Orange	Sensor 1
Red	Sensor 2
Brown	Sensor 3
Black	NTC 10 kohm
White	NTC 10 kohm

with hall effect sensor



22ECT82 Ultra EC™

Ø 22 mm • 4-pole • 104 W



Dimensions in mm

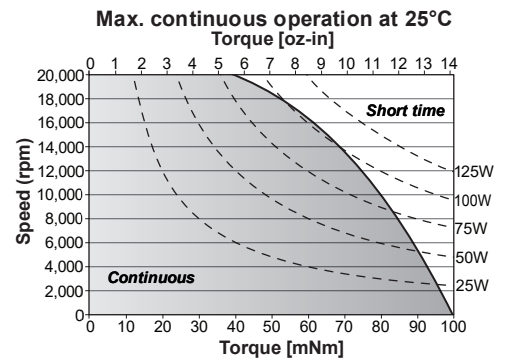
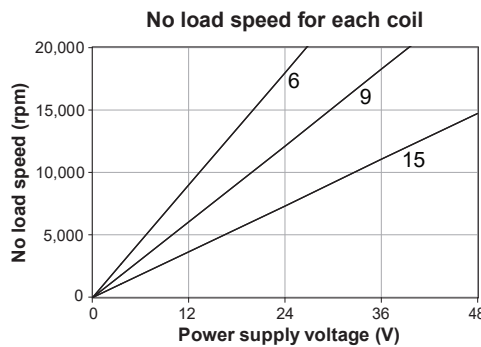
Electrical Data	Symbol	22ECT82 10B-xxx.01			Unit
		6	9	15	
1 Nominal Voltage	U_N	24	24	24	Volt
2 Optimization Direction	-	Symmetrical	Symmetrical	Symmetrical	-
3 No Load Speed	n_0	18,550	12,390	7,800	rpm
4 Typical No Load Current	I_0	435	250	130	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	104	104	104	W
6 Max. Continuous Current	$I_{e,max}$	7.9	5.3	3.2	A
7 Max. Continuous Torque	$M_{e,max}$	98.4 (13.94)	98.8 (14)	98.3 (13.92)	mNm (oz-in)
8 Back EMF Constant	k_E	1.30	1.96	3.22	V/1000 rpm
9 Torque Constant	k_M	12.4	18.7	30.8	mNm/A
10 Motor Regulation	R/k^2	0.8	0.8	0.8	10 ³ /Nms
11 Motor Regulation	$k/R^{1/2}$	35.8 (5.1)	35.9 (5.1)	36 (5.1)	mNm/W ^{1/2} (oz-in/W ^{1/2})
12 Internal Resistance - phase to phase	R_l	0.13	0.27	0.73	ohms
13 Line to Line Resistance at Connectors	R_L	0.16	0.30	0.76	ohms
14 Inductance Phase to Phase	L	0.02	0.03	0.09	mH
15 Mechanical Time Constant	τ_m	1.1	1.0	1.0	ms
16 Electrical Time Constant	τ_e	0.12	0.13	0.13	ms

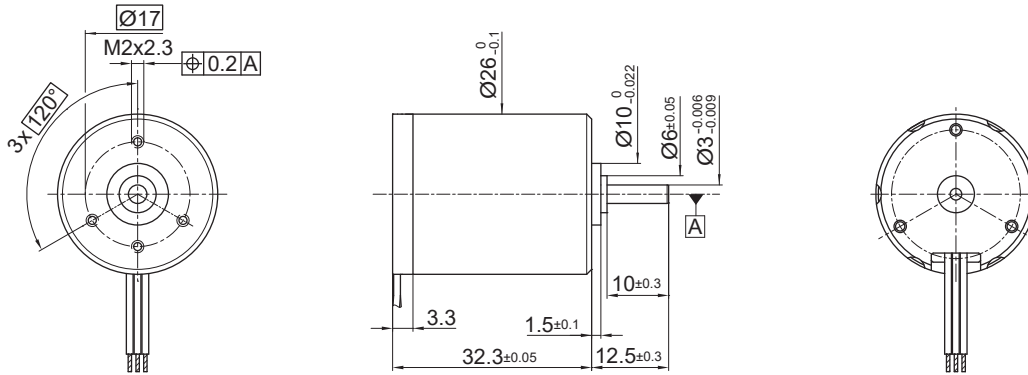
General Data					
17 Maximum Motor Speed	n_{max}	20,000			rpm
18 Ambient Working Temperature Range	-	-30 to +100 (-22 to +212)			°C (°F)
19 Ambient Storage Temperature Range	-	-40 to +100 (-40 to +212)			°C (°F)
20 Ball Bearings Preload	-	6.8			N
21 Axial Static Force w/o Shaft Support (max)	-	45.0			N
22 Maximum Winding Temperature	-	125 (257)			°C (°F)
23 Thermal Resistance	R_{th}	1.4 / 8.2			°C/W
24 Thermal Time Constant	τ_w	1,140			s
25 Weight	-	174 (6.14)			g (oz)
26 Rotor Inertia	J	13.17			g-cm ²
27 Hall Sensor Electrical Phasing*	-	120			Electrical °

*Also available without Hall sensors

Wire	Description
Gray	Phase 1
Violet	Phase 2
Blue	Phase 3
Green	3.5 to 24V DC
Yellow	GND
Orange	Sensor 1
Red	Sensor 2
Brown	Sensor 3
Black	NTC 10 kohm
White	NTC 10 kohm

with hall effect sensor



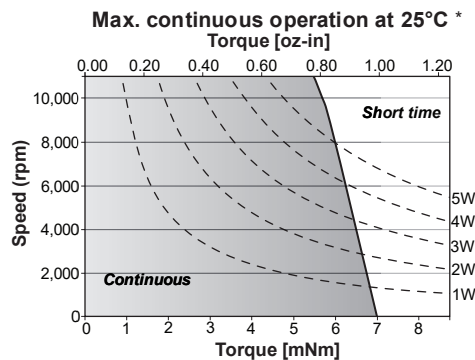


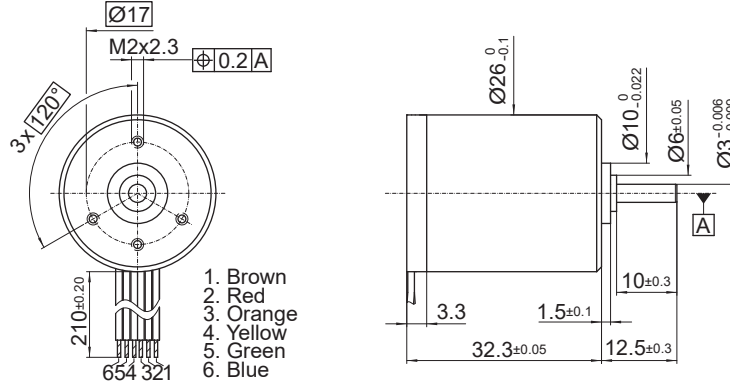
Dimensions in mm

Electrical Data	Symbol	26BC 3C-109P.101	Unit
1 Nominal Voltage	U_N	12	Volt
2 Optimization Direction	-	n.a.	-
3 No-Load Speed	n_0	14,800	rpm
4 Typical No-Load Current	I_0	180.0	mA
5 Max Continuous Mechanical Power (@25°C)	P_{max}	8.0	W
6 Max Continuous Current	$I_{e,max}$	0.8	A
7 Max Continuous Torque	$M_{e,max}$	7 (1)	mNm (oz-in)
8 Back EMF Constant	k_E	0.73	V/1000 rpm
9 Torque Constant	k_M	7.0	mNm/A
10 Motor Regulation	R/k^2	102.0	10 ³ /Nms
11 Motor Regulation	$k/R^{1/2}$	3.1 (0.44)	mNm/W ^{1/2} (oz-in/W ^{1/2})
12 Internal Resistance - phase to phase	R_i	5.00	ohms
13 Line to Line Resistance at Connectors	R_L	5.00	ohms
14 Inductance Phase to Phase	L	0.09	mH
15 Mechanical Time Constant	τ_m	95.0	ms
16 Electrical Time Constant	τ_e	0.02	ms

General Data			
17 Maximum Motor Speed	n_{max}	20,000	rpm
18 Ambient Working Temperature Range	-	0 to +70 (+32 to +158)	°C (°F)
19 Ambient Storage Temperature Range	-	0 to +70 (+32 to +158)	°C (°F)
20 Ball Bearings Preload	-	5.0	N
21 Axial Static Force w/o Shaft Support (max)	-	45.0	N
22 Maximum Winding Temperature	-	125 (257)	°C (°F)
23 Thermal Resistance	R_{th}	14.0	°C/W
24 Thermal Time Constant	τ_w	660	s
25 Weight	-	72 (2.54)	g (oz)
26 Rotor Inertia	J	9.400	g-cm ²
27 Hall Sensor Electrical Phasing	-	NA	Electrical °

Wire	Description
Gray	Phase 1
Violet	Phase 2
Blue	Phase 3
sensorless	





Dimensions in mm

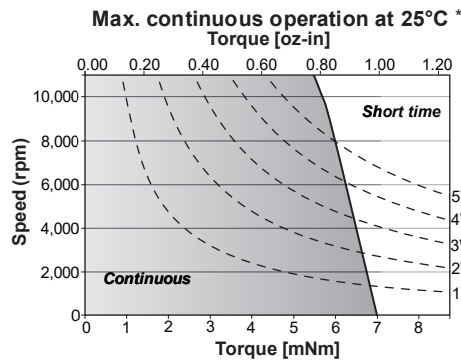
Electrical Data	Symbol	26BC 6A-xxx.101				Unit
		119	113	110	107	
1 Nominal Voltage	U_N	7.5	7.5	15	15	Volt
2 Optimization Direction	-	Symmetrical	Symmetrical	Symmetrical	Symmetrical	-
3 No Load Speed	n_0	12,500	7,250	9,300	4,700	rpm
4 Typical No Load Current	I_0	250.0	170.0	120.0	50.0	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	4.5	4.5	4.5	4.5	W
6 Max. Continuous Current	$I_{e,max}$	1.2	0.6	0.4	0.2	A
7 Max. Continuous Torque	$M_{e,max}$	4 (0.57)	4.2 (0.6)	4.4 (0.63)	4 (0.57)	mNm (oz-in)
8 Back EMF Constant	k_E	0.56	0.96	1.40	2.66	V/1000 rpm
9 Torque Constant	k_M	5.4	9.2	13.4	25.4	mNm/A
10 Motor Regulation	R/k^2	65.2	80.3	98.0	107.0	$10^3/Nms$
11 Motor Regulation	$k/R^{1/2}$	3.92 (0.56)	3.53 (0.5)	3.19 (0.46)	3.06 (0.44)	$mNm/W^{1/2}$ (oz-in/ $W^{1/2}$)
12 Internal Resistance - phase to phase	R_i	1.90	6.80	17.60	69.00	ohms
13 Line to Line Resistance at Connectors	R_L	1.90	6.80	17.60	69.00	ohms
14 Inductance Phase to Phase	L	0.03	0.12	0.32	1.23	mH
15 Mechanical Time Constant	τ_m	61.0	75.0	92.0	100.0	ms
16 Electrical Time Constant	τ_e	0.02	0.02	0.02	0.02	ms

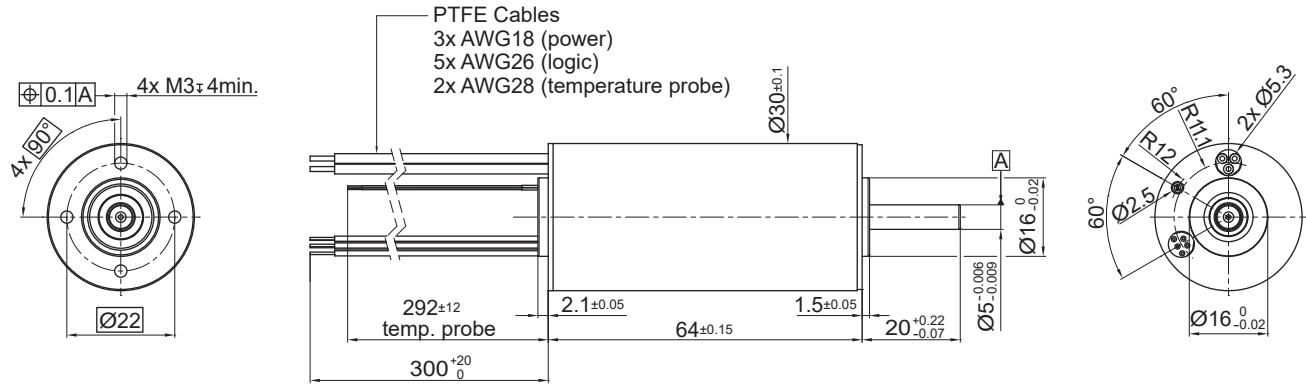
General Data			
17 Maximum Motor Speed	n_{max}		14,000 rpm
18 Ambient Working Temperature Range	-		0 to +70 (+32 to +158) °C (°F)
19 Ambient Storage Temperature Range	-		0 to +70 (+32 to +158) °C (°F)
20 Ball Bearings Preload	-		5.0 N
21 Axial Static Force w/o Shaft Support (max)	-		45.0 N
22 Maximum Winding Temperature	-		125 (257) °C (°F)
23 Thermal Resistance	R_{th}		14.0 °C/W
24 Thermal Time Constant	τ_w		660 s
25 Weight	-		72 (2.54) g (oz)
26 Rotor Inertia	J		9.400 g-cm ²
27 Hall Sensor Electrical Phasing	-		NA Electrical °

Wire	Description
Brown	Ground
Red	Power supply voltage(2.5 - 18 V)**
Orange	Direction CCW/CW
Yellow	Enable start / stop***
Green	Logic supply voltage(5 - 18 V)
Blue	Speed signal****
integrated electronics	

** For coil 119 and 113, do not exceed 7.5 V max.
 *** When grounded, motor is not powered
 **** Speed signal is a square wave voltage with one pulse per revolution

Do not reverse polarity!





Dimensions in mm

Electrical Data	Symbol	30ECT64-10B-xxx.01				Unit
		4	7	11	14	
1 Nominal Voltage	U_N	18	24	36	48	Volt
2 Optimization Direction	-	Symmetrical	Symmetrical	Symmetrical	Symmetrical	-
3 No-Load Speed	n_0	28,550	21,930	21,150	22,425	rpm
4 Typical No-Load Current	I_0	1,100	575	425	300	mA
5 Max Continuous Mechanical Power (@25°C)	P_{max}	187.0	187.0	187.0	187.0	W
6 Max Continuous Current	$I_{e,max}$	22.8	12.9	8.1	6.5	A
7 Max Continuous Torque	$M_{e,max}$	137 (19.40)	136 (19.26)	134 (18.98)	133 (18.84)	mNm (oz-in)
8 Back EMF Constant	k_E	0.63	1.10	1.74	2.14	V/1000 rpm
9 Torque Constant	k_M	6.0	10.5	16.6	20.5	mNm/A
10 Motor Regulation	R/k^2	0.55	0.57	0.59	0.60	10 ³ /Nms
11 Motor Regulation	$k/R^{1/2}$	42.5 (6.02)	41.8 (5.92)	41.3 (5.85)	40.8 (5.78)	mNm/W ^{1/2} (oz-in/W ^{1/2})
12 Internal Resistance - phase to phase	R_i	0.02	0.06	0.16	0.25	ohms
13 Line to Line Resistance at Connectors	R_L	0.04	0.08	0.18	0.27	ohms
14 Inductance Phase to Phase	L	0.01	0.02	0.04	0.06	mH
15 Mechanical Time Constant	τ_m	1.6	1.6	1.6	1.7	ms
16 Electrical Time Constant	τ_e	0.25	0.23	0.22	0.23	ms

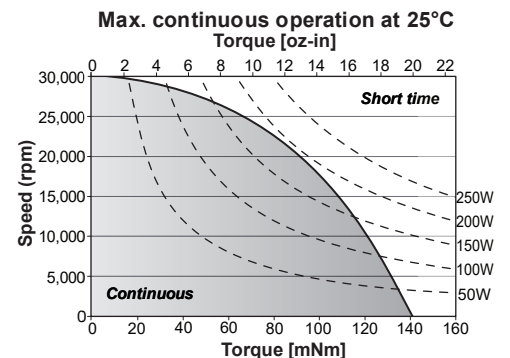
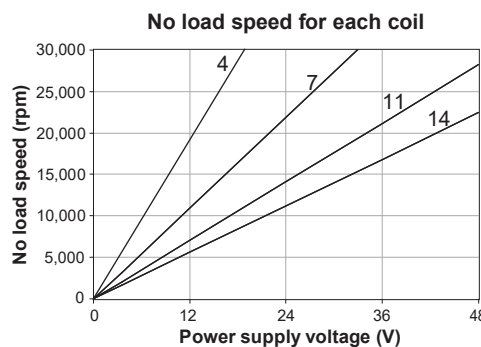
General Data

17 Maximum Motor Speed	n_{max}		30,000		rpm
18 Ambient Working Temperature Range	-		-30 to +100 (-22 to +212)		°C (°F)
19 Ambient Storage Temperature Range	-		-40 to +100 (-40 to +212)		°C (°F)
20 Ball Bearings Preload	-		13.5		N
21 Axial Static Force w/o Shaft Support (max)	-		134		N
22 Maximum Winding Temperature	-		150 (302)		°C (°F)
23 Thermal Resistance	R_{th}		0.9/7		°C/W
24 Thermal Time Constant	τ_w		1,327		s
25 Weight	-		263 (9.28)		g (oz)
26 Rotor Inertia	J		28.00		g-cm ²
27 Hall Sensor Electrical Phasing*	-		120		Electrical °

*Also available without Hall sensors

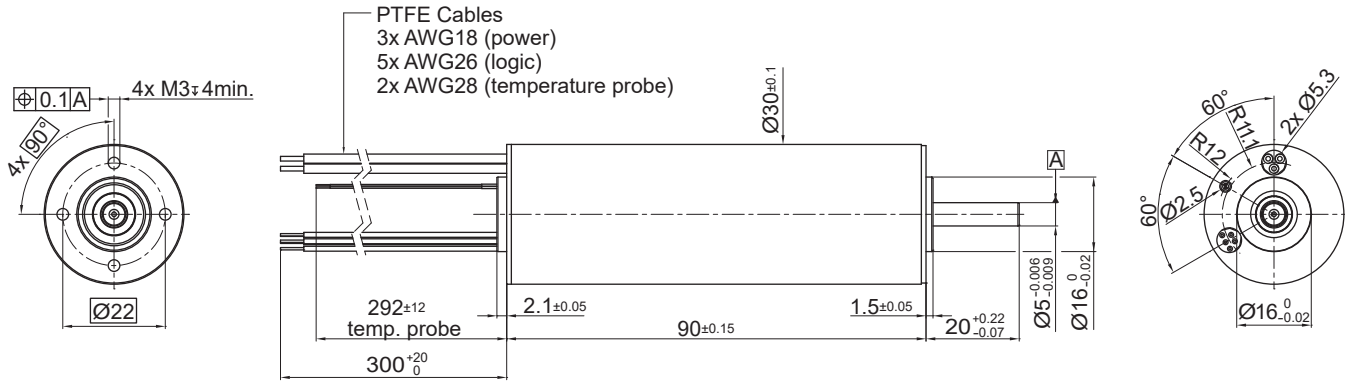
Wire	Description
Gray	Phase 1
Violet	Phase 2
Blue	Phase 3
Green	4 to 24V DC
Yellow	GND
Orange	Sensor 1
Red	Sensor 2
Brown	Sensor 3
White	NTC 10 kohm
White	NTC 10 kohm

with hall effect sensor



30ECT90 Ultra EC™

Ø 30 mm • 4-pole • 244 W



Dimensions in mm

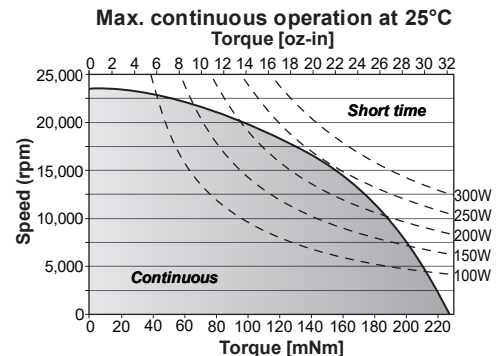
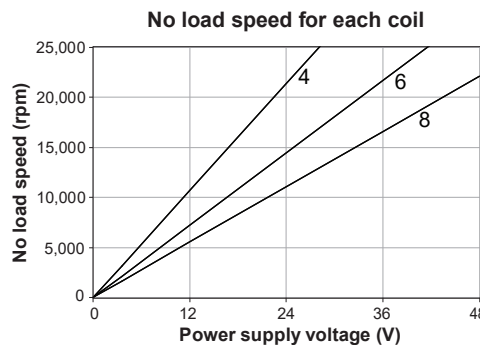
Electrical Data	Symbol	30ECT90 10B-xxx.01			Unit
		4	6	8	
1 Nominal Voltage	U_N	24	36	48	Volt
2 Optimization Direction	-	Symmetrical	Symmetrical	Symmetrical	-
3 No Load Speed	n_0	21,370	21,690	22,100	rpm
4 Typical No Load Current	I_0	1050	640	575	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	244.0	244.0	244.0	W
6 Max. Continuous Current	$I_{e,max}$	21.0	14.0	10.4	A
7 Max. Continuous Torque	$M_{e,max}$	225 (31.86)	221 (31.3)	219 (31.02)	mNm (oz-in)
8 Back EMF Constant	k_E	1.12	1.66	2.21	V/1000 rpm
9 Torque Constant	k_M	10.7	15.8	21.1	mNm/A
10 Motor Regulation	R/k^2	0.2	0.3	0.3	10 ³ /Nms
11 Motor Regulation	$k/R^{1/2}$	63.5 (9)	62.3 (8.83)	61.4 (8.69)	mNm/W ^{1/2} (oz-in/W ^{1/2})
12 Internal Resistance - phase to phase	R_l	0.03	0.06	0.12	ohms
13 Line to Line Resistance at Connectors	R_L	0.04	0.08	0.13	ohms
14 Inductance Phase to Phase	L	0.01	0.02	0.03	mH
15 Mechanical Time Constant	τ_m	1.1	1.2	1.2	ms
16 Electrical Time Constant	τ_e	0.27	0.26	0.25	ms

General Data					
17 Maximum Motor Speed	n_{max}		25,000		rpm
18 Ambient Working Temperature Range	-		-30 to +100 (-22 to +212)		°C (°F)
19 Ambient Storage Temperature Range	-		-40 to +100 (-40 to +212)		°C (°F)
20 Ball Bearings Preload	-		13.5		N
21 Axial Static Force w/o Shaft Support (max)	-		134		N
22 Maximum Winding Temperature	-		150 (302)		°C (°F)
23 Thermal Resistance	R_{th}		0.7/5.9		°C/W
24 Thermal Time Constant	τ_w		1,659		s
25 Weight	-		380 (13.41)		g (oz)
26 Rotor Inertia	J		45.00		g-cm ²
27 Hall Sensor Electrical Phasing*	-		120		Electrical °

*Also available without Hall sensors

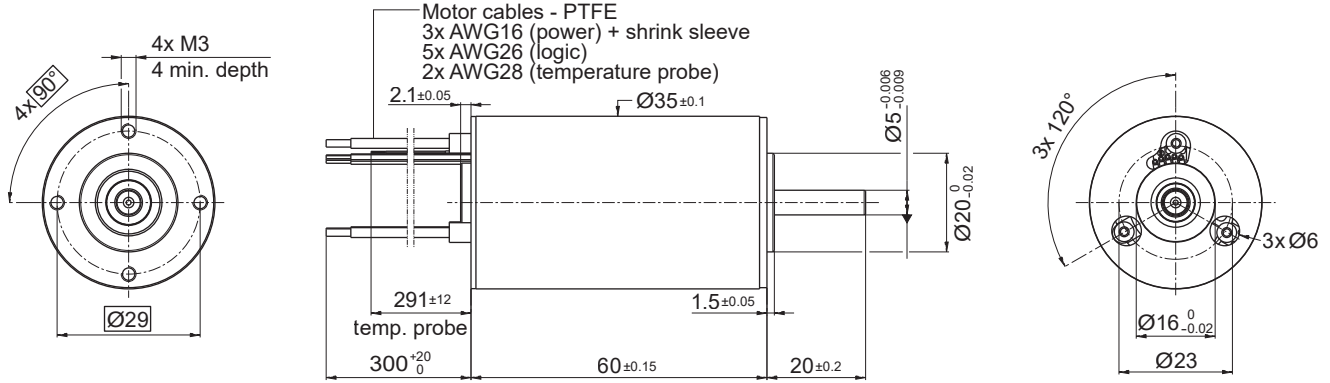
Wire	Description
Gray	Phase 1
Violet	Phase 2
Blue	Phase 3
Green	4 to 24V DC
Yellow	GND
Orange	Sensor 1
Red	Sensor 2
Brown	Sensor 3
Black	Thermistor (+)
White	Thermistor (-)

with hall effect sensor



35ECS60 Ultra EC™

Ø 35 mm • 2-pole • 262 W



Dimensions in mm

Electrical Data	Symbol	35ECS60 10B-xxx.01				Unit
		8	10	15	20	
1 Nominal Voltage	U_N	20	24	36	48	Volt
2 Optimization Direction	-	Symmetrical	Symmetrical	Symmetrical	Symmetrical	-
3 No Load Speed	n_0	38,900	38,500	39,000	39,300	rpm
4 Typical No Load Current	I_0	1000	900	500	360	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	262	262	262	262	W
6 Max. Continuous Current	$I_{e,max}$	25.3	20.1	13.2	9.8	A
7 Max. Continuous Torque	$M_{e,max}$	120.6 (17.1)	120.6 (17.1)	117.9 (16.7)	115.8 (16.4)	mNm (oz-in)
8 Back EMF Constant	k_E	0.51	0.63	0.94	1.24	V/1000 rpm
9 Torque Constant	k_M	4.90	6.01	8.94	11.83	mNm/A
10 Motor Regulation	R/k^2	0.832	0.886	0.928	0.961	10 ³ /Nms
11 Motor Regulation	$k/R^{1/2}$	34.6 (4.9)	33.6 (4.76)	32.8 (4.65)	32.3 (4.57)	mNm/W ^{1/2} (oz-in/W ^{1/2})
12 Internal Resistance - phase to phase	R_i	0.02	0.032	0.074	0.135	ohms
13 Line to Line Resistance at Connectors	R_L	0.026	0.044	0.086	0.147	ohms
14 Inductance Phase to Phase	L	0.011	0.017	0.037	0.064	mH
15 Mechanical Time Constant	τ_m	1.6	1.8	1.9	2.0	ms
16 Electrical Time Constant	τ_e	0.6	0.5	0.5	0.5	ms

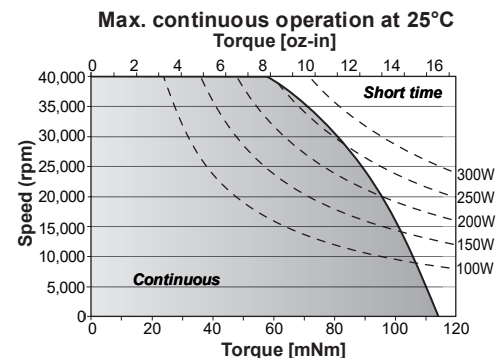
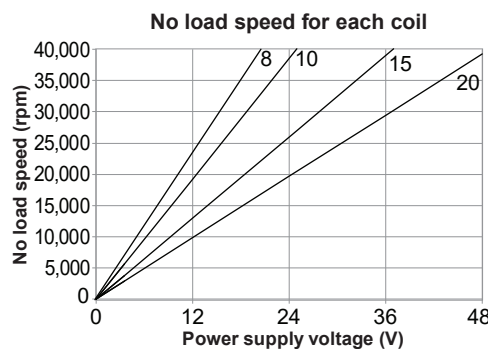
General Data

17 Maximum Motor Speed	n_{max}		40,000			rpm
18 Ambient Working Temperature Range	-		-30 to +100 (-22 to +212)			°C (°F)
19 Ambient Storage Temperature Range	-		-40 to +100 (-40 to +212)			°C (°F)
20 Ball Bearings Preload	-		9			N
21 Axial Static Force w/o Shaft Support (max)	-		134			N
22 Maximum Winding Temperature	-		150 (302)			°C (°F)
23 Thermal Resistance	R_{th}		0.8/5.7			°C/W
24 Thermal Time Constant	τ_w		1,618			s
25 Weight	-		315 (11.11)			g (oz)
26 Rotor Inertia	J		20.4			g-cm ²
27 Hall Sensor Electrical Phasing*	-		120			Electrical °

*Also available without Hall sensors

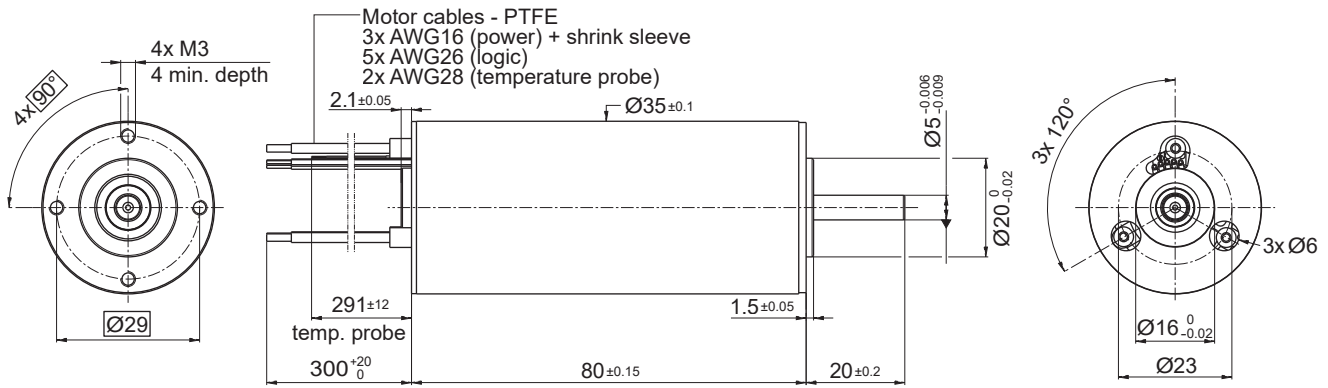
Wire	Description
Gray	Phase 1
Violet	Phase 2
Blue	Phase 3
Green	4 to 24V DC
Yellow	GND
Orange	Sensor 1
Red	Sensor 2
Brown	Sensor 3
White	NTC 10 kohm
White	NTC 10 kohm

with hall effect sensor



35ECS80 Ultra EC™

Ø 35 mm • 2-pole • 330 W



Dimensions in mm

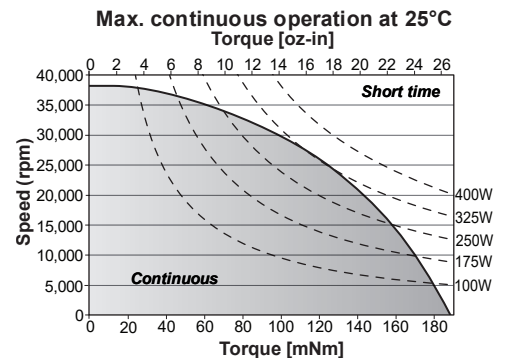
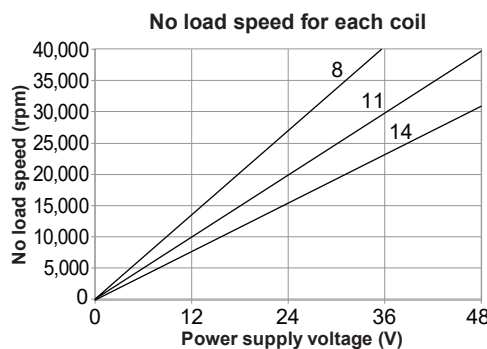
Electrical Data	Symbol	35ECS80 10B-xxx.01			Unit
		8	11	14	
1 Nominal Voltage	U_N	24	36	48	Volt
2 Optimization Direction	-	Symmetrical	Symmetrical	Symmetrical	-
3 No Load Speed	n_0	27,000	29,500	31,100	rpm
4 Typical No Load Current	I_0	700	550	430	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	330	330	330	W
6 Max. Continuous Current	$I_{e,max}$	22.6	16.4	12.9	A
7 Max. Continuous Torque	$M_{e,max}$	193.4 (27.3)	193.1 (27.3)	193.1 (27.3)	mNm (oz-in)
8 Back EMF Constant	k_E	0.9	1.23	1.57	V/1000 rpm
9 Torque Constant	k_M	8.56	11.78	14.98	mNm/A
10 Motor Regulation	R/k^2	0.367	0.368	0.369	10 ³ /Nms
11 Motor Regulation	$k/R^{1/2}$	52.2 (7.37)	52.1 (7.37)	52.1 (7.37)	mNm/W ^{1/2} (oz-in/W ^{1/2})
12 Internal Resistance - phase to phase	R_l	0.027	0.051	0.083	ohms
13 Line to Line Resistance at Connectors	R_L	0.039	0.063	0.095	ohms
14 Inductance Phase to Phase	L	0.017	0.03	0.047	mH
15 Mechanical Time Constant	τ_m	1.2	1.2	1.2	ms
16 Electrical Time Constant	τ_e	0.4	0.6	0.5	ms

General Data					
17 Maximum Motor Speed	n_{max}	40000			rpm
18 Ambient Working Temperature Range	-	-30 to +100 (-22 to +212)			°C (°F)
19 Ambient Storage Temperature Range	-	-40 to +100 (-40 to +212)			°C (°F)
20 Ball Bearings Preload	-	9			N
21 Axial Static Force w/o Shaft Support (max)	-	134			N
22 Maximum Winding Temperature	-	150 (302)			°C (°F)
23 Thermal Resistance	R_{th}	0.7/5.4			°C/W
24 Thermal Time Constant	τ_w	1,822			s
25 Weight	-	440 (15.52)			g (oz)
26 Rotor Inertia	J	33			g-cm ²
27 Hall Sensor Electrical Phasing*	-	120			Electrical °

*Also available without Hall sensors

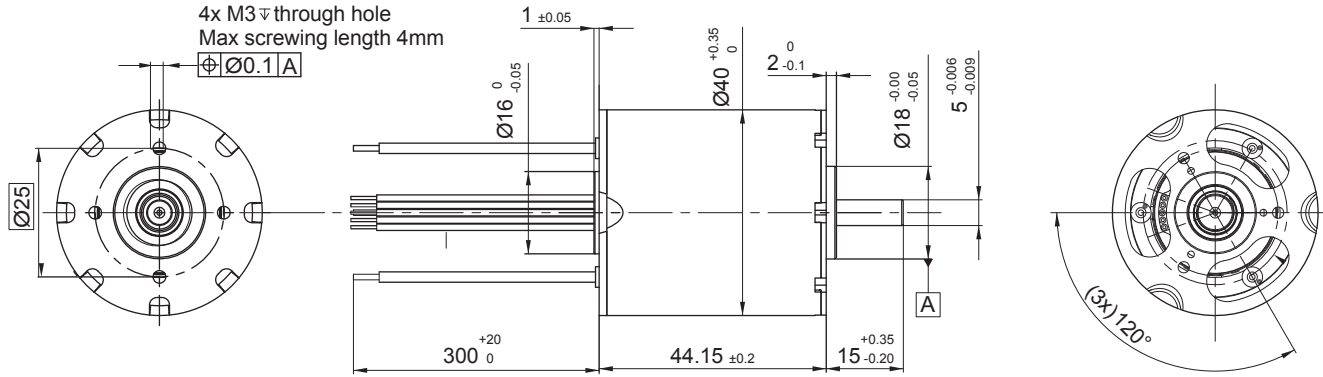
Wire	Description
Gray	Phase 1
Violet	Phase 2
Blue	Phase 3
Green	4 to 24V DC
Yellow	GND
Orange	Sensor 1
Red	Sensor 2
Brown	Sensor 3
White	NTC 10 kohm
White	NTC 10 kohm

with hall effect sensor



40ECP44

Ø 40mm • 4-pole • 150W



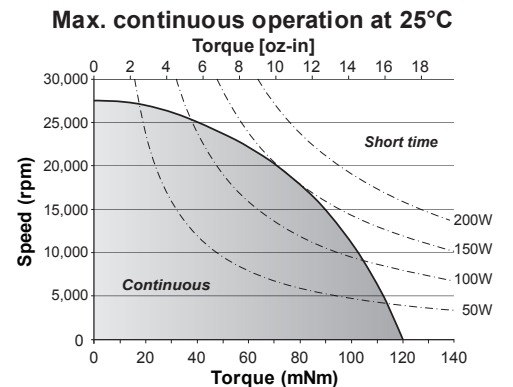
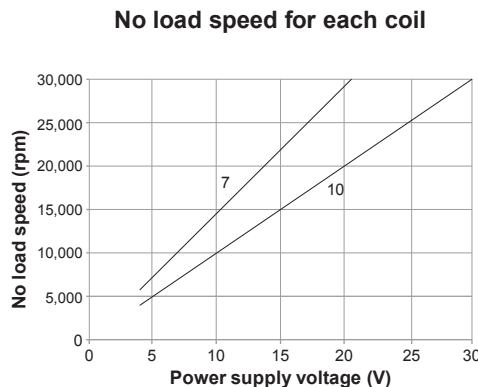
Dimensions in mm

Electrical Data	Symbol	40ECP44 8 XX		Unit
		7	10	
1 Nominal Voltage	U_N	18	18	Volt
2 Optimization Direction	-	Symmetrical	Symmetrical	-
3 No Load Speed	n_0	18'300	26'500	rpm
4 Typical No Load Current	I_0	770	1'410	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	150	150	W
6 Max. Continuous Current	$I_{e,max}$	13.2	18.85	A
7 Max. Continuous Torque	$M_{e,max}$	120 (17)	120 (17)	mNm (oz-in)
8 Back EMF Constant	k_E	0.95	0.67	V/1000 rpm
9 Torque Constant	k_M	9.11 (1.29)	6.38 (0.9)	mNm/A
10 Motor Regulation	R/k^2	0.63	0.639	10 ³ /Nms
11 Motor Regulation	$k/R^{1/2}$	40 (5.66)	39.5 (5.6)	mNm/W ^{1/2} (oz-in/W ^{1/2})
12 Internal Resistance - phase to phase	R_i	0.052	0.026	ohms
13 Line to Line Resistance at Connectors	R_L	0.066	0.04	ohms
14 Inductance Phase to Phase	L	0.01	0.005	mH
15 Mechanical Time Constant	τ_m	4.12	4.1	ms
16 Electrical Time Constant	τ_e	0.2	0.2	ms

General Data				
17 Maximum Motor Speed	n_{max}	30'000		rpm
18 Ambient Working Temperature Range	-	-30 to +100 (-22 to +212)		°C (°F)
19 Ambient Storage Temperature Range	-	-40 to +100 (-40 to +212)		°C (°F)
20 Ball Bearings Preload	-	16 (3.6)		N
21 Axial Static Force w/o Shaft Support (max)	-	134 (30)		N
22 Maximum Winding Temperature	-	125 (257)		°C (°F)
23 Thermal Resistance	R_{th}	1 / 5.4		°C/W
24 Thermal Time Constant	τ_w	1'019		s
25 Weight	-	230 (8.11)		g (oz)
26 Rotor Inertia	J	64 (906)		g-cm ²
27 Hall Sensor Electrical Phasing*	-	120		Electrical °

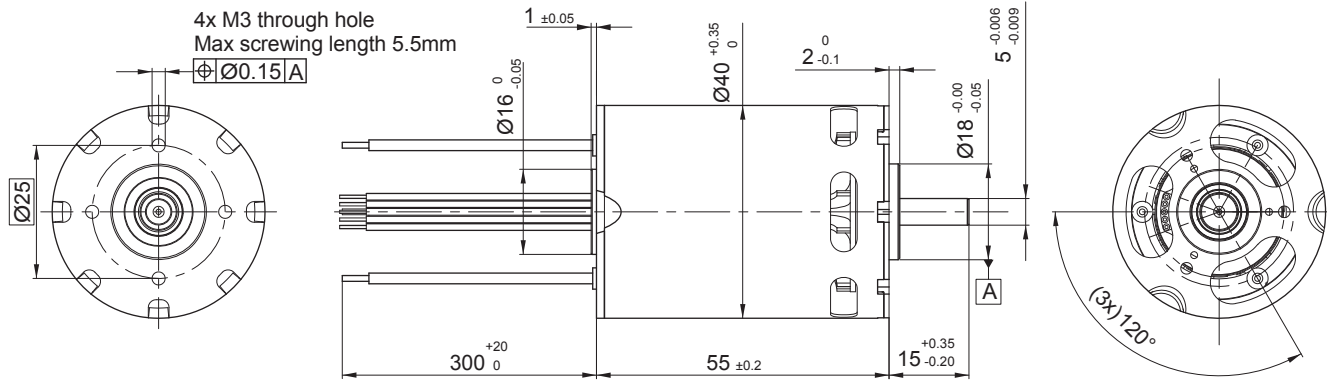
*Also available without Hall sensors

Wire	Description
Gray	Phase 1 (AWG 18)
Violet	Phase 2 (AWG 18)
Blue	Phase 3 (AWG 18)
Green	VDC (AWG 26)
Yellow	GND (AWG 26)
Orange	Hall Sensor 1 (AWG 26)
Red	Hall Sensor 2 (AWG 26)
Brown	Hall Sensor 3 (AWG 26)



40ECP55

Ø 40mm • 4-pole • 425W



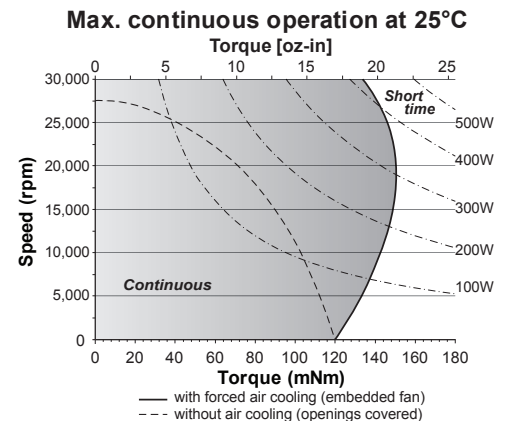
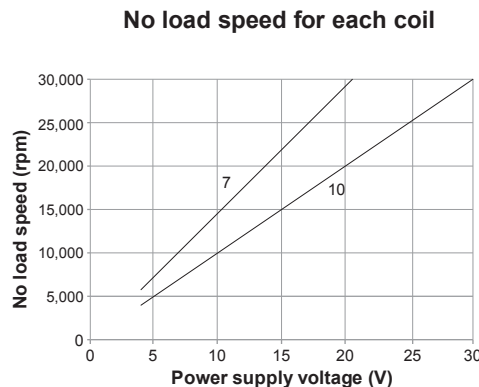
Dimensions in mm

Electrical Data	Symbol	40ECP55 8 XX		Unit
		7	10	
1 Nominal Voltage	U_N	18	18	Volt
2 Optimization Direction	-	Symmetrical	Symmetrical	-
3 No Load Speed	n_0	18'000	26'310	rpm
4 Typical No Load Current	I_0	790	1'450	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	420	420	W
6 Max. Continuous Current	$I_{e max}$	16.5	23.6	A
7 Max. Continuous Torque	$M_{e max}$	150.2 (21.3)	150.2 (21.3)	mNm (oz-in)
8 Back EMF Constant	k_E	0.95	0.67	V/1000 rpm
9 Torque Constant	k_M	9.11 (1.29)	6.38 (0.9)	mNm/A
10 Motor Regulation	R/k^2	0.63	0.639	10 ³ /Nms
11 Motor Regulation	$k/R^{1/2}$	40 (5.66)	39.5 (5.6)	mNm/W ^{1/2} (oz-in/W ^{1/2})
12 Internal Resistance - phase to phase	R_i	0.052	0.026	ohms
13 Line to Line Resistance at Connectors	R_L	0.066	0.04	ohms
14 Inductance Phase to Phase	L	0.01	0.005	mH
15 Mechanical Time Constant	τ_m	4.2	4.2	ms
16 Electrical Time Constant	τ_e	0.2	0.2	ms

General Data				
17 Maximum Motor Speed	n_{max}		30'000	rpm
18 Ambient Working Temperature Range	-		-30 to +100 (-22 to +212)	°C (°F)
19 Ambient Storage Temperature Range	-		-40 to +100 (-40 to +212)	°C (°F)
20 Ball Bearings Preload	-		16 (3.6)	N
21 Axial Static Force w/o Shaft Support (max)	-		134 (30)	N
22 Maximum Winding Temperature	-		125 (257)	°C (°F)
23 Thermal Resistance	R_{th}		2.3	°C/W
24 Thermal Time Constant	τ_w		110	s
25 Weight	-		240 (8.47)	g (oz)
26 Rotor Inertia	J		66 (935)	g-cm ²
27 Hall Sensor Electrical Phasing*	-		120	Electrical °

*Also available without Hall sensors

Wire	Description
Gray	Phase 1 (AWG 18)
Violet	Phase 2 (AWG 18)
Blue	Phase 3 (AWG 18)
Green	VDC (AWG 26)
Yellow	GND (AWG 26)
Orange	Hall Sensor 1 (AWG 26)
Red	Hall Sensor 2 (AWG 26)
Brown	Hall Sensor 3 (AWG 26)



Brushless DC Flat Motors

Our brushless DC flat motors are the ideal fit for space-constrained applications where power-packed performance is a necessity and where space comes at a premium.

Whether your device demands a higher load carrying capacity without a drop in speed or needs to excel in a high speed environment, the compact design and flat architecture of these flat motors make them the perfect choice for a variety of applications.



Compact, High Torque and Reliable

Feature	Details	Application Advantages
Brushless design	<ul style="list-style-type: none"> • Electronic commutation • No brushes to wear or spark 	<ul style="list-style-type: none"> • Long life (limited only by ball bearing wear) • Reliable in harsh environments • Reduced EMI • Quiet operation
Flat architecture	<ul style="list-style-type: none"> • Short length 	<ul style="list-style-type: none"> • Ideal for space-constrained applications • Excellent torque-to-length ratio
Permanent magnet	<ul style="list-style-type: none"> • Linear torque/speed curve (except iron losses) • Torque proportional to current • Speed proportional to voltage 	<ul style="list-style-type: none"> • Ease of position and speed control
Slotless and slotted configurations	<ul style="list-style-type: none"> • Slotless: self-supporting ironless coils 	<ul style="list-style-type: none"> • Zero detent torque • Reduced iron losses • High efficiency • Linear torque vs. speed • Dynamic motion due to low inertia
	<ul style="list-style-type: none"> • Slotted: coils wound around stator poles 	<ul style="list-style-type: none"> • Excellent torque-to-power ratio • High current capability
Outer rotor configuration	<ul style="list-style-type: none"> • Rotor spins around stator and favors heat dissipation • Enables higher number of poles • Simple drive solutions 	<ul style="list-style-type: none"> • Superior torque capacity for a given diameter • Application miniaturization
Integrated Electronics option*	<ul style="list-style-type: none"> • Simple drive controls 	<ul style="list-style-type: none"> • Plug and play solution • Lower installation time • Lesser complexity

*available on select motors

For a Wide Range of Miniature Motion Needs



Robotics & automation

- Drones
- Bionics & exoskeletons
- Wheel drives
- Service robots
- Surgical robots
- Electric grippers
- Lab automation
- Lidar
- Pumps
- Rotary tattoo machines
- Valve actuation



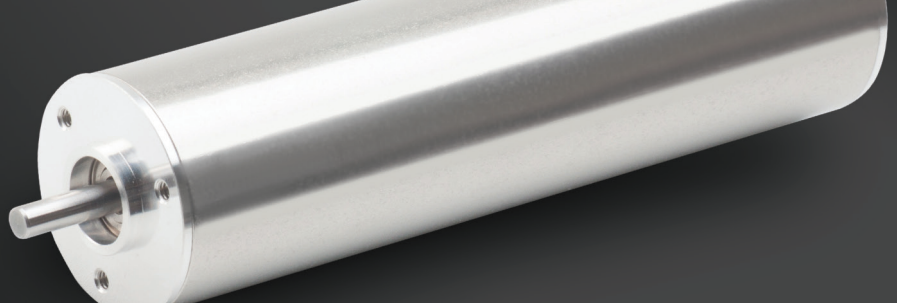
Medical devices & clinical diagnostics

- Infusion systems
- Medical analyzers
- Diagnostic analyzers

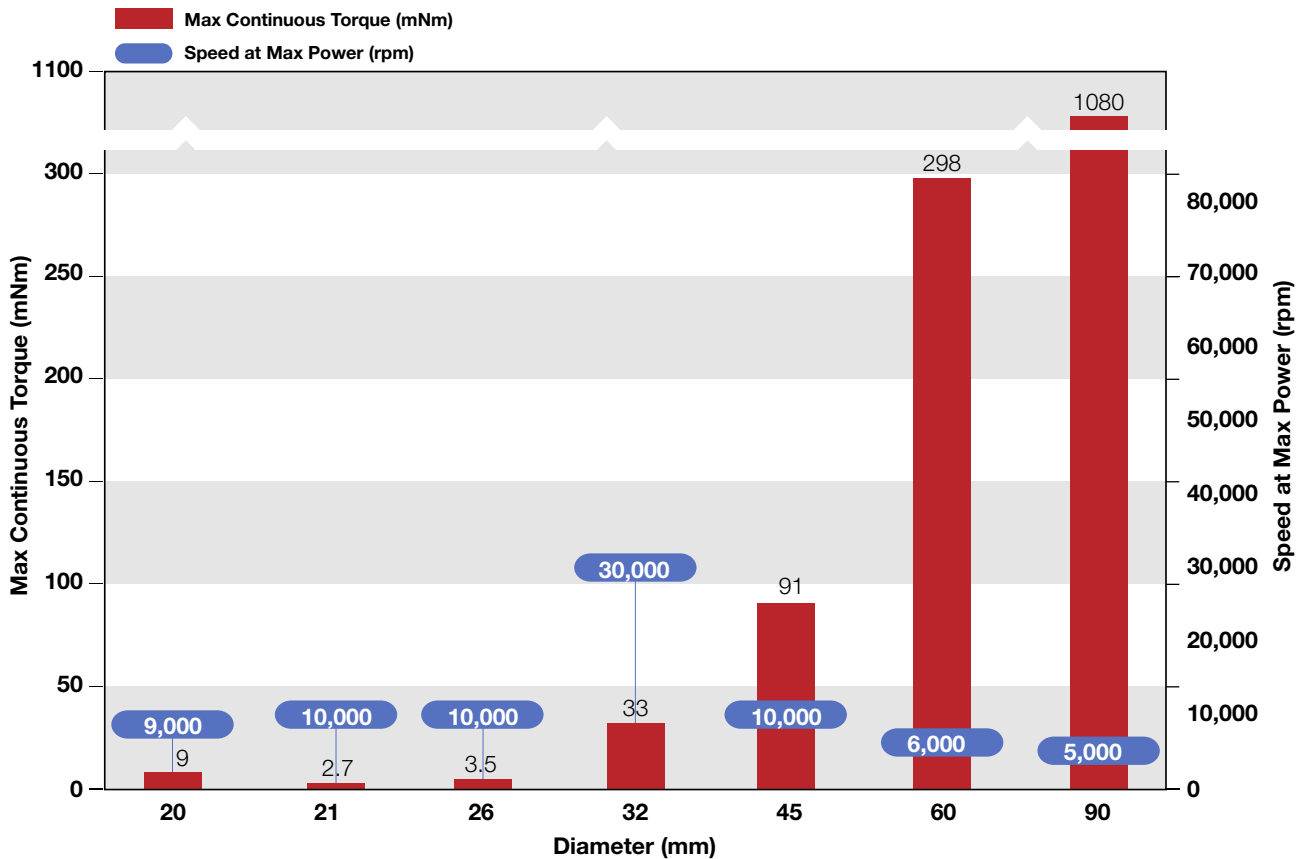


Aerospace & Defense

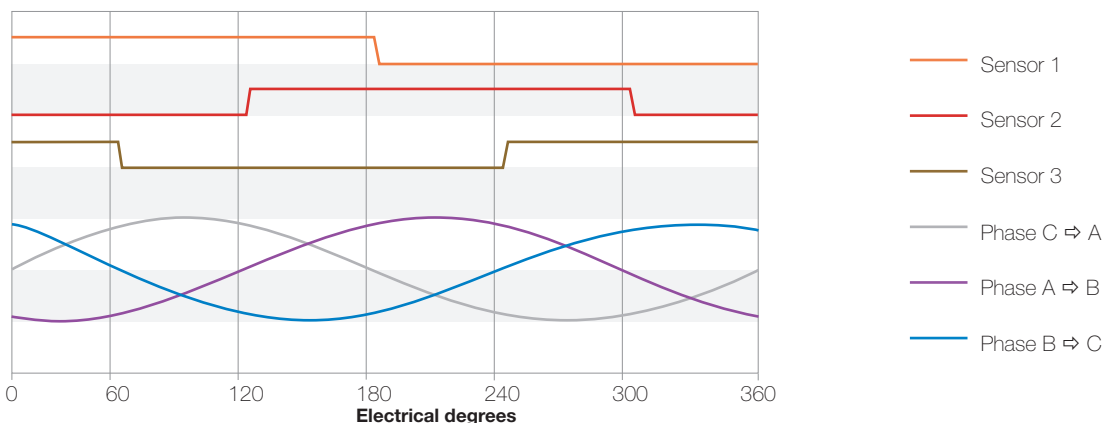
- Cockpit flight controls
- Military robotics
- Missile fin actuators
- Air cushion systems
- Flight control systems
- Window shades



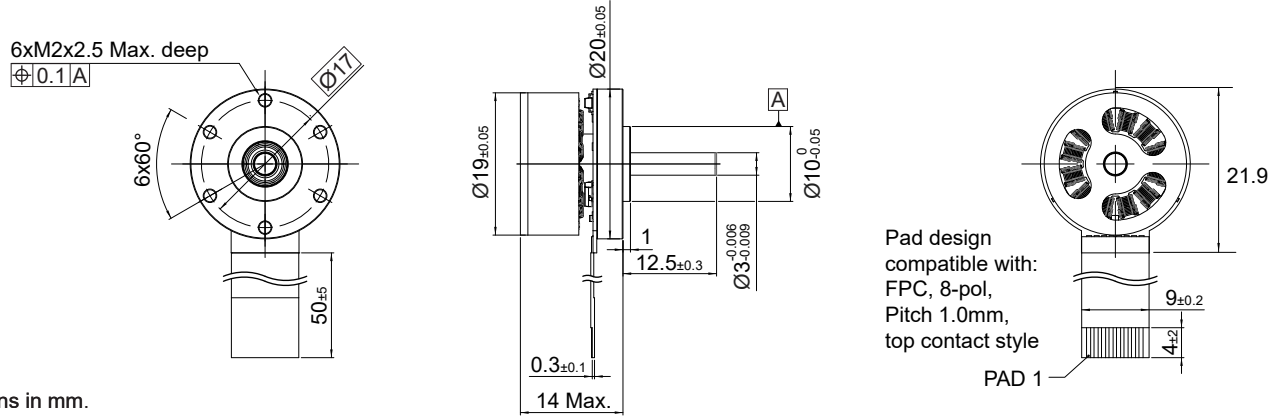
Meet your Application's Working Point Requirements



Motor signal sequence shaft rotation CW seen from front face for BH and EC series of slotless BLDC motors, or CCW for BF series



For complete product and application details, visit portescap.com/brushless



Dimensions in mm.

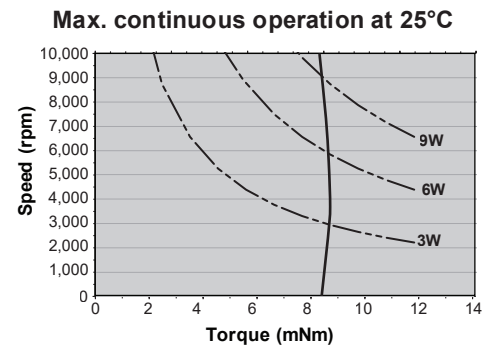
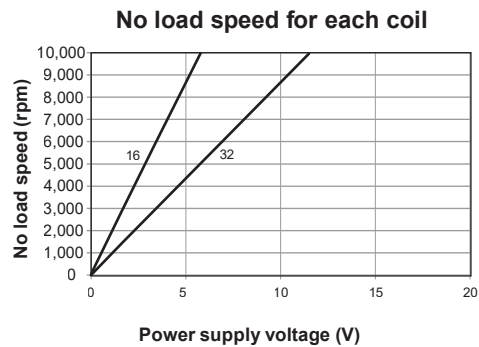
Electrical Data	Symbol	20ECF14 8B xx		Unit
		16	32	
1 Nominal Voltage	U_N	6	12	Volt
2 Optimization Direction	-	Symmetrical	Symmetrical	-
3 No Load Speed	n_0	8,417	8,407	rpm
4 Typical No Load Current	I_0	126	63	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	9	9	W
6 Max. Continuous Current	$I_{e,max}$	1.5	0.75	A
7 Max. Continuous Torque	$M_{e,max}$	9 (1.27)	9 (1.27)	mNm (oz-in)
8 Back EMF Constant	k_E	0.7	1.39	V/1000 rpm
9 Torque Constant	k_M	6.65	13.3	mNm/A
10 Motor Regulation	R/k^2	24.9	26.1	$10^3/Nms$
11 Motor Regulation	$k/R^{1/2}$	6.3 (0.89)	6.2 (0.88)	mNm/W ^{1/2} (oz-in/W ^{1/2})
12 Internal Resistance - phase to phase	R_1	1.1	4.61	ohms
13 Line to Line Resistance at Connectors	R_L	1.1	4.61	ohms
14 Inductance Phase to Phase	L	0.12	0.4	mH
15 Mechanical Time Constant	τ_m	7.5	7.8	ms
16 Electrical Time Constant	τ_e	0.16	0.16	ms

General Data

17 Maximum Motor Speed	n_{max}	10,000	rpm
18 Ambient Working Temperature Range	-	-30 to +80 (-22 to +176)	°C (°F)
19 Ambient Storage Temperature Range	-	-40 to +80 (-30 to +176)	°C (°F)
20 Ball Bearings Preload	-	2.7	N
21 Axial Static Force w/o Shaft Support (max)	-	10	N
22 Maximum Winding Temperature	-	125 (257)	°C (°F)
23 Thermal Resistance	R_{th}	23	°C/W
24 Thermal Time Constant	τ_w	645	s
25 Weight	-	15 (0.53)	g (oz)
26 Rotor Inertia	J	3	g-cm ²
27 Hall Sensor Electrical Phasing*	-	120	Electrical °

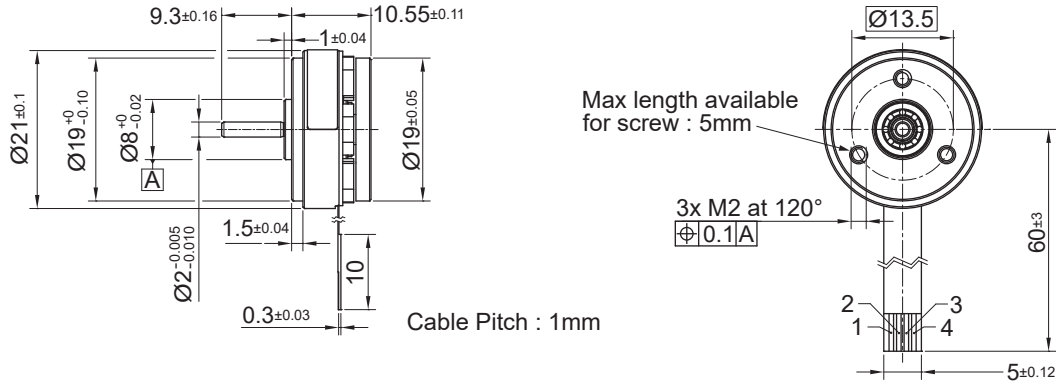
*Also available without Hall sensors

Pad Allocation	
Pad 1	Phase A
Pad 2	Phase B
Pad 3	Phase C
Pad 4	3 to 24 V DC
Pad 5	GND
Pad 6	Hall sensor 3
Pad 7	Hall sensor 2
Pad 8	Hall sensor 1



21BF nuvoDisc™

Ø 21 mm • 8-pole • 4 W

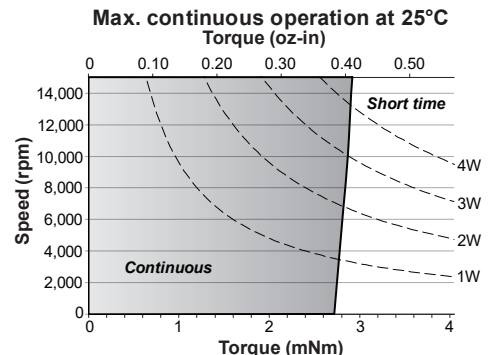
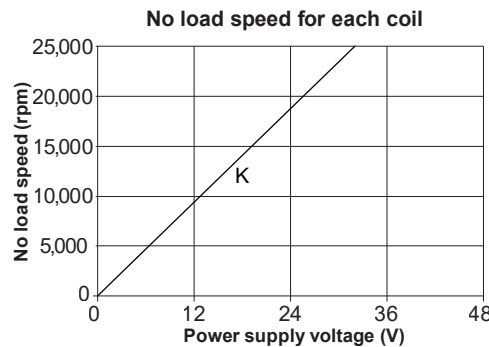


Dimensions in mm

Electrical Data	Symbol	21BF 3C-K.02	Unit
1 Nominal Voltage	U_N	5	Volt
2 Optimization Direction	-	n.a.	-
3 No Load Speed	n_0	3,900	rpm
4 Typical No Load Current	I_0	28.0	mA
5 Max Continuous Mechanical Power (@25°C)	P_{max}	4.0	W
6 Max Continuous Current	$I_{e,max}$	0.3	A
7 Max Continuous Torque	$M_{e,max}$	2.7 (0.39)	mNm (oz-in)
8 Back EMF Constant	k_E	0.89	V/1000 rpm
9 Torque Constant	k_M	8.5	mNm/A
10 Motor Regulation	R/k^2	784.0	$10^3/Nms$
11 Motor Regulation	$k/R^{1/2}$	1.1 (0.16)	mNm/W ^{1/2} (oz-in/W ^{1/2})
12 Internal Resistance - phase to phase	R_l	56.30	ohms
13 Line to Line Resistance at Connectors	R_L	56.30	ohms
14 Inductance Phase to Phase	L	1.22	mH
15 Mechanical Time Constant	τ_m	141.2	ms
16 Electrical Time Constant	τ_e	0.02	ms

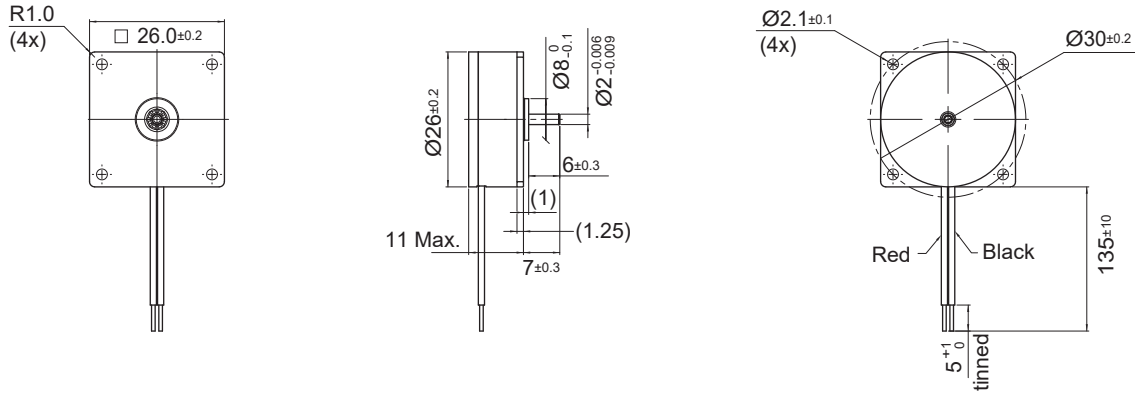
General Data			
17 Maximum Motor Speed	n_{max}	25000	rpm
18 Ambient Working Temperature Range	-	-30 to +80 (-22 to +176)	°C (°F)
19 Ambient Storage Temperature Range	-	-40 to +80 (-40 to +176)	°C (°F)
20 Ball Bearings Preload	-	2.70	N
21 Axial Static Force w/o Shaft Support (max)	-	27.00	N
22 Maximum Winding Temperature	-	125 (257)	°C (°F)
23 Thermal Resistance	R_{th}	12.00	°C/W
24 Thermal Time Constant	τ_w	200.00	s
25 Weight	-	10 (0.36)	g (oz)
26 Rotor Inertia	J	1.80	g-cm ²
27 Hall Sensor Electrical Phasing (Sensorless)	-	NA	Electrical °

Wire	Description
1	Phase 1
2	Phase 2
3	Phase 3
4	center point of Y winding
sensorless (3C)	



26BF 2-Wire nuvoDisc™

Ø 26 mm • 8-pole • 2.2 W



Dimensions in mm

Electrical Data	Symbol	26BF11-2A 96	Unit
1 Nominal Voltage	U_N	6	Volt
2 Optimization Direction	-	Clockwise	-
3 No-Load Speed	n_0	6,209	rpm
4 Typical No-Load Current	I_0	30	mA
5 Max Continuous Mechanical Power (@25°C)	P_{max}	2.2	W
6 Max Continuous Current	$I_{e,max}$	0.45	A
7 Max Continuous Torque	$M_{e,max}$	3.5 (0.5)	mNm (oz-in)
8 Back EMF Constant	k_E	0.94	V/1000 rpm
9 Torque Constant	k_M	8.96 (1.27)	mNm/A (oz-in/A)
10 Motor Regulation	R/k^2	72	10 ³ /Nms
11 Motor Regulation	$k/R^{1/2}$	3.72 (0.53)	mNm/W ^{1/2} (oz-in/W ^{1/2})
12 Internal Resistance - phase to phase	R_i	5.8	ohms
13 Line to Line Resistance at Connectors	R_L	5.8	ohms
14 Inductance Phase to Phase	L	0.37	mH
15 Mechanical Time Constant	τ_m	59	ms
16 Electrical Time Constant	τ_e	0.06	ms

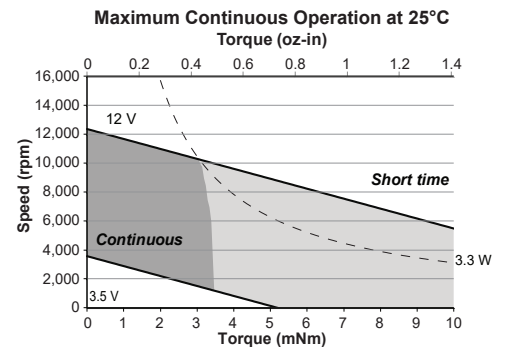
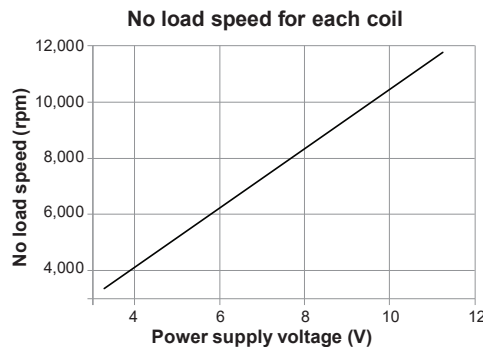
General Data			
17 Maximum Motor Speed	n_{max}	12,000	rpm
18 Ambient Working Temperature Range	-	-30 to +80 (-22 to +176)	°C (°F)
19 Ambient Storage Temperature Range	-	-40 to +80 (-40 to +176)	°C (°F)
20 Ball Bearings Preload	-	2.7 (0.6)	N
21 Axial Static Force w/o Shaft Support (max)	-	100 (22.5)	N
22 Maximum Winding Temperature	-	100 (212)	°C (°F)
23 Thermal Resistance	R_{th}	35	°C/W
24 Thermal Time Constant	τ_w	280	s
25 Weight	-	25 (0.88)	g (oz)
26 Rotor Inertia	J	8.14	g-cm ²
27 Hall Sensor Electrical Phasing	-	NA	Electrical °

Wire	Description
Red	3.5 to 15V DC
Black	GND

A reverse polarity will damage the electronics permanently

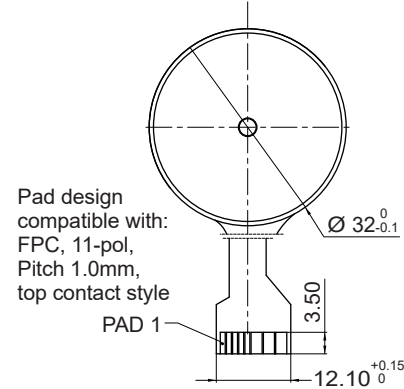
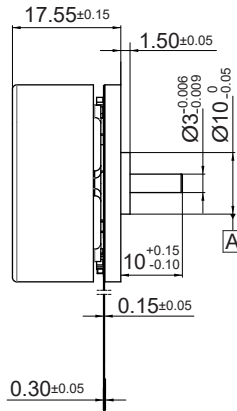
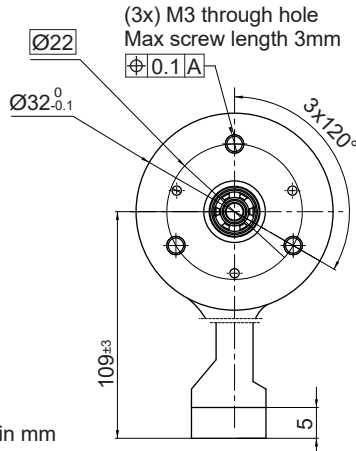
PWM not allowed on power supply

When ordering, please choose CW or CCW for rotation direction seen from shaft output side



32ECF

Ø 32 mm • 8-pole • 32 W



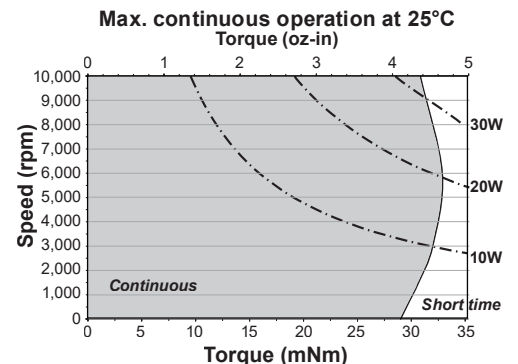
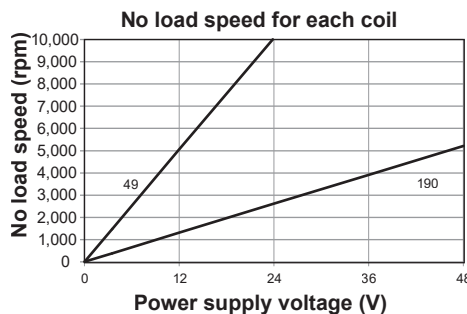
Dimensions in mm

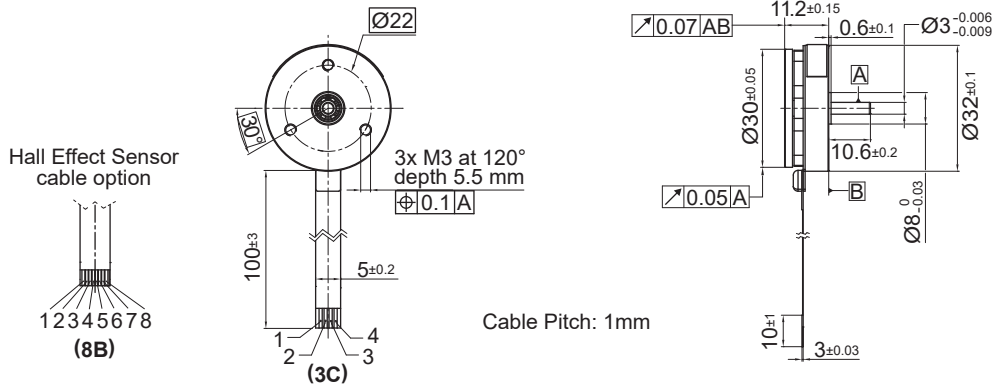
Electrical Data	Symbol	32ECF17.6 8B xxx		Unit
		49	190	
1 Nominal Voltage	U_N	12	24	Volt
2 Optimization Direction	-	Symmetrical	Symmetrical	-
3 No Load Speed	n_0	5,050	2,610	rpm
4 Typical No Load Current	I_0	85	17	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	32	32	W
6 Max. Continuous Current	$I_{e max}$	1.43	0.37	A
7 Max. Continuous Torque	$M_{e max}$	32.9 (4.66)	32.9 (4.66)	mNm (oz-in)
8 Back EMF Constant	k_E	2.52	9.68	V/1000 rpm
9 Torque Constant	k_M	22.95	88.19	mNm/A
10 Motor Regulation	R/k^2	3.0	3.1	$10^3/Nms$
11 Motor Regulation	$k/R^{1/2}$	18.3 (2.59)	18.0 (2.55)	mNm/W ^{1/2} (oz-in/W ^{1/2})
12 Internal Resistance - phase to phase	R_I	1.58	24.00	ohms
13 Line to Line Resistance at Connectors	R_L	1.64	24.06	ohms
14 Inductance Phase to Phase	L	0.79	12.27	mH
15 Mechanical Time Constant	τ_m	11.2	11.5	ms
16 Electrical Time Constant	τ_e	0.50	0.51	ms

General Data				
17 Maximum Motor Speed	n_{max}		10,000	rpm
18 Ambient Working Temperature Range	-		-30 to +85 (-22 to +185)	°C (°F)
19 Ambient Storage Temperature Range	-		-40 to +85 (-30 to +185)	°C (°F)
20 Ball Bearings Preload	-		6	N
21 Axial Static Force w/o Shaft Support (max)	-		34	N
22 Maximum Winding Temperature	-		125 (257)	°C (°F)
23 Thermal Resistance	R_{th}		11	°C/W
24 Thermal Time Constant	τ_w		110	s
25 Weight	-		52 (1.83)	g (oz)
26 Rotor Inertia	J		37.2	g-cm ²
27 Hall Sensor Electrical Phasing*	-		120	Electrical °

*Also available without Hall sensors

Pad Allocation	
Pad 1	2.5 to 5.5V DC
Pad 2	Hall sensor 3
Pad 3	Hall sensor 1
Pad 4	Hall sensor 2
Pad 5	GND
Pad 6	Phase 3
Pad 7	Phase 2
Pad 8	Phase 1





Dimensions in mm

Electrical Data	Symbol	32BF 3C-K.11	32BF 8B-10	Unit
1 Nominal Voltage	U_N	12		Volt
2 Optimization Direction	-	Symmetrical		-
3 No-Load Speed	n_0	13,600		rpm
4 Typical No-Load Current	I_0	100.0		mA
5 Max Continuous Mechanical Power (@25°C)	P_{max}	40.0		W
6 Max Continuous Current	$I_{e,max}$	1.5		A
7 Max Continuous Torque	$M_{e,max}$	13 (1.85)		mNm (oz-in)
8 Back EMF Constant	k_E	0.87		V/1000 rpm
9 Torque Constant	k_M	8.3		mNm/A
10 Motor Regulation	R/k^2	57.5		10 ³ /Nms
11 Motor Regulation	$k/R^{1/2}$	4.2 (0.6)		mNm/W ^{1/2} (oz-in/W ^{1/2})
12 Internal Resistance - phase to phase	R_i	3.95		ohms
13 Line to Line Resistance at Connectors	R_L	3.95		ohms
14 Inductance Phase to Phase	L	0.12		mH
15 Mechanical Time Constant	τ_m	64.9		ms
16 Electrical Time Constant	τ_e	0.03		ms

General Data				
17 Maximum Motor Speed	n_{max}	30,000		rpm
18 Ambient Working Temperature Range	-	-30 to +80 (-22 to +176)		°C (°F)
19 Ambient Storage Temperature Range	-	-40 to +80 (-40 to +176)		°C (°F)
20 Ball Bearings Preload	-	7		N
21 Axial Static Force w/o Shaft Support (max)	-	27.0		N
22 Maximum Winding Temperature	-	125 (257)		°C (°F)
23 Thermal Resistance	R_{th}	13.0		°C/W
24 Thermal Time Constant	τ_w	550		s
25 Weight	-	27 (0.96)		g (oz)
26 Rotor Inertia	J	11.300		g-cm ²
27 Hall Sensor Electrical Phasing*	-	120		Electrical °

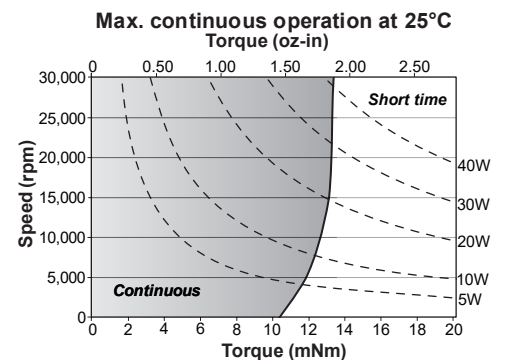
*Also available without Hall sensors

Wire	Description
1	Phase 1
2	Phase 2
3	Phase 3
4	3.5 to 24V DC
5	GND
6	Sensor 1
7	Sensor 2
8	Sensor 3

with hall effect sensor (8B)

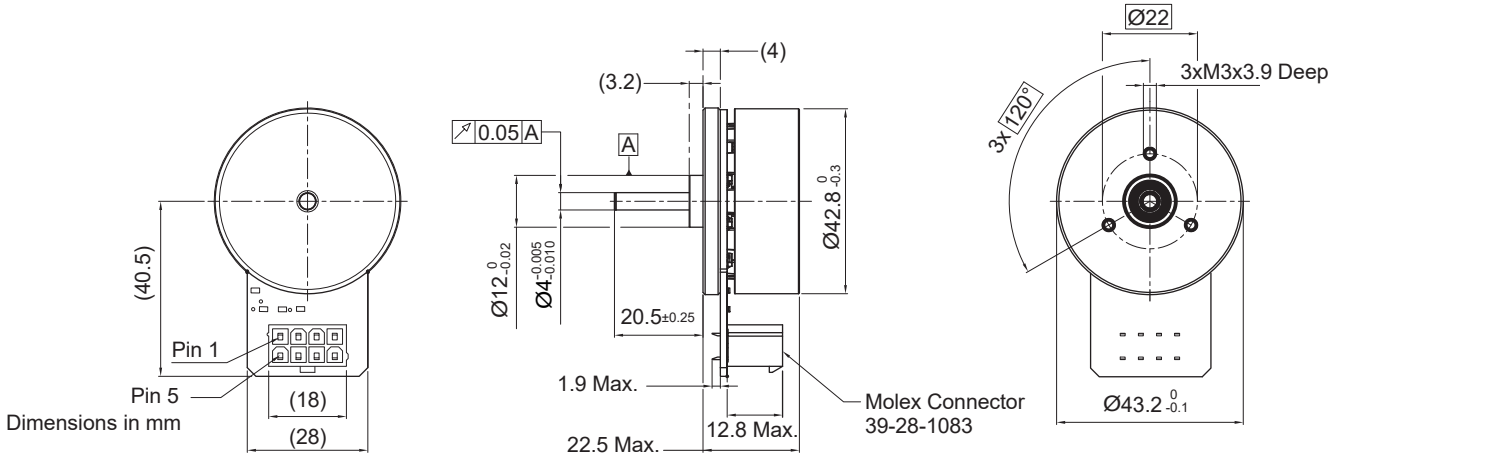
Wire	Description
1	center point of Y winding
2	Phase 1
3	Phase 2
4	Phase 3

sensorless (3C)



45ECF

Ø 45 mm • 16-pole • 50 W



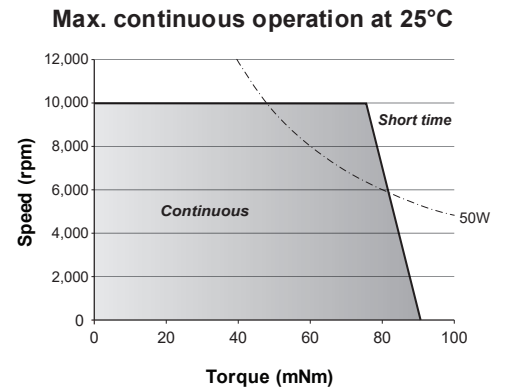
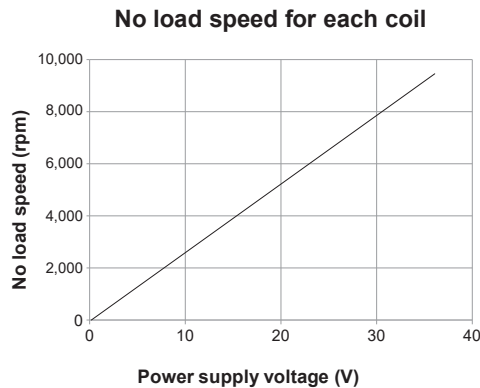
Electrical Data	Symbol	45ECF22-8B-25 .01	Unit
1 Nominal Voltage	U_N	24	Volt
2 Optimization Direction	-	Symmetrical	-
3 No Load Speed	n_0	6'310	rpm
4 Typical No Load Current	I_0	230	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	50	W
6 Max. Continuous Current	$I_{e max}$	2.5	A
7 Max. Continuous Torque	$M_{e max}$	91 (12.9)	mNm (oz-in)
8 Back EMF Constant	k_E	3.76	V/1000 rpm
9 Torque Constant	k_M	35.95 (5.09)	mNm/A
10 Motor Regulation	R/k^2	0.63	$10^3/Nms$
11 Motor Regulation	$k/R^{1/2}$	40.2 (5.7)	$mNm/W^{1/2}$ (oz-in/ $W^{1/2}$)
12 Internal Resistance - phase to phase	R_1	0.8	ohms
13 Line to Line Resistance at Connectors	R_L	0.82	ohms
14 Inductance Phase to Phase	L	0.5	mH
15 Mechanical Time Constant	τ_m	8.6	ms
16 Electrical Time Constant	τ_e	0.61	ms

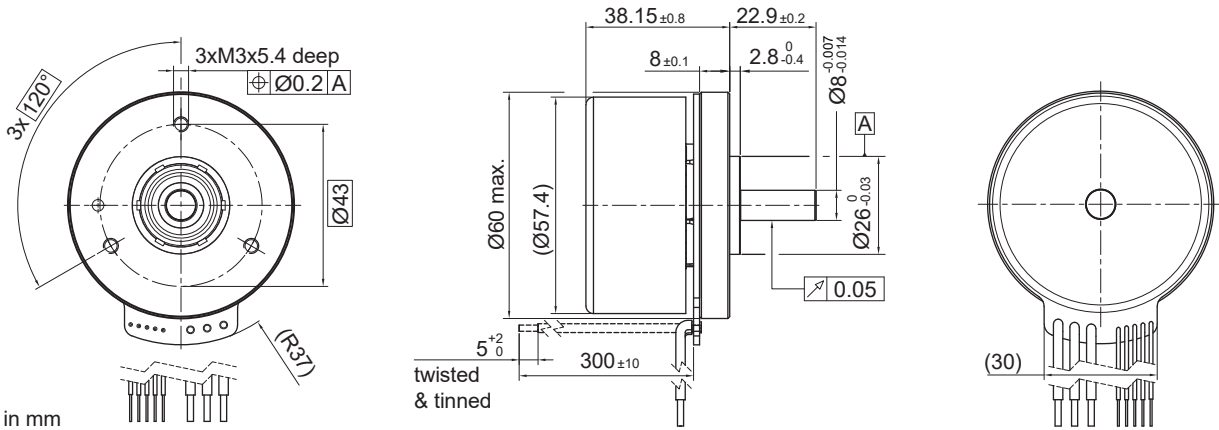
General Data			
17 Maximum Motor Speed	n_{max}	10'000	rpm
18 Ambient Working Temperature Range	-	-30 to +100 (-22 to +212)	°C (°F)
19 Ambient Storage Temperature Range	-	-40 to +100 (-40 to +212)	°C (°F)
20 Ball Bearings Preload	-	15 (4)	N (lbs)
21 Axial Static Force w/o Shaft Support (max)	-	53 (12)	N (lbs)
22 Maximum Winding Temperature	-	125 (257)	°C (°F)
23 Thermal Resistance	R_{th}	10	°C/W
24 Thermal Time Constant	τ_w	109	s
25 Weight	-	130 (4.59)	g (oz)
26 Rotor Inertia	J	135 (1911)	$g\text{-cm}^2 \cdot 10^{-4}$ (oz-in-sec ² 10^{-6})
27 Hall Sensor Electrical Phasing*	-	120	Electrical °

*Also available without Hall sensors

Wire	Description
Pin 1	Sensor 1
Pin 2	Sensor 2
Pin 3	4.5 to 18 Vdc
Pin 4	Phase 3
Pin 5	Sensor 3
Pin 6	GND
Pin 7	Phase 1
Pin 8	Phase 2

with hall effect sensor





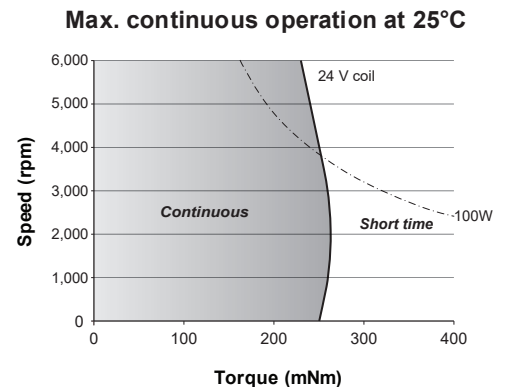
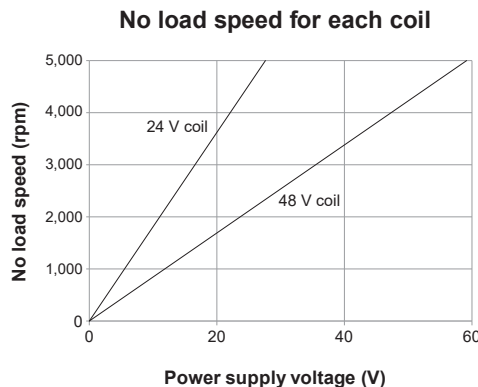
Dimensions in mm

Electrical Data	Symbol	60ECF38-8B-XXX.01		Unit
		14	28	
1 Nominal Voltage	U_N	24	48	Volt
2 Optimization Direction	-	Symmetrical	Symmetrical	-
3 No Load Speed	n_0	4'300	4'020	rpm
4 Typical No Load Current	I_0	493	221	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	100	100	W
6 Max. Continuous Current	$I_{e,max}$	5.14	2.61	A
7 Max. Continuous Torque	$M_{e,max}$	269 (38.09)	298 (42.2)	mNm (oz-in)
8 Back EMF Constant	k_E	5.5	11.8	V/1000 rpm
9 Torque Constant	k_M	57.3 (8.11)	113 (16)	mNm/A
10 Motor Regulation	R/k^2	0.089	0.08	$10^3/Nms$
11 Motor Regulation	$k/R^{1/2}$	106 (15)	112 (15.8)	mNm/W ^{1/2} (oz-in/W ^{1/2})
12 Internal Resistance - phase to phase	R_I	0.293	1.023	ohms
13 Line to Line Resistance at Connectors	R_L	0.293	1.023	ohms
14 Inductance Phase to Phase	L	0.279	1.28	mH
15 Mechanical Time Constant	τ_m	8.86	7.32	ms
16 Electrical Time Constant	τ_e	0.952	1.25	ms

General Data				
17 Maximum Motor Speed	n_{max}	6'000		rpm
18 Ambient Working Temperature Range	-	-40 to 100 (-40 to 212)		°C (°F)
19 Ambient Storage Temperature Range	-	-40 to 100 (-40 to 212)		°C (°F)
20 Ball Bearings Preload	-	12 (2.7)		N
21 Axial Static Force w/o Shaft Support (max)	-	170 (38.2)		N (lbs)
22 Maximum Winding Temperature	-	125 (257)		°C (°F)
23 Thermal Resistance	R_{th}	6.3		°C/W
24 Thermal Time Constant	τ_w	90		s
25 Weight	-	355 (12.52)		g (oz)
26 Rotor Inertia	J	835 (11824)		$g\text{-cm}^2 \cdot 10^{-4}$ (oz-in-sec ² 10^{-6})
27 Hall Sensor Electrical Phasing*	-	120		Electrical °

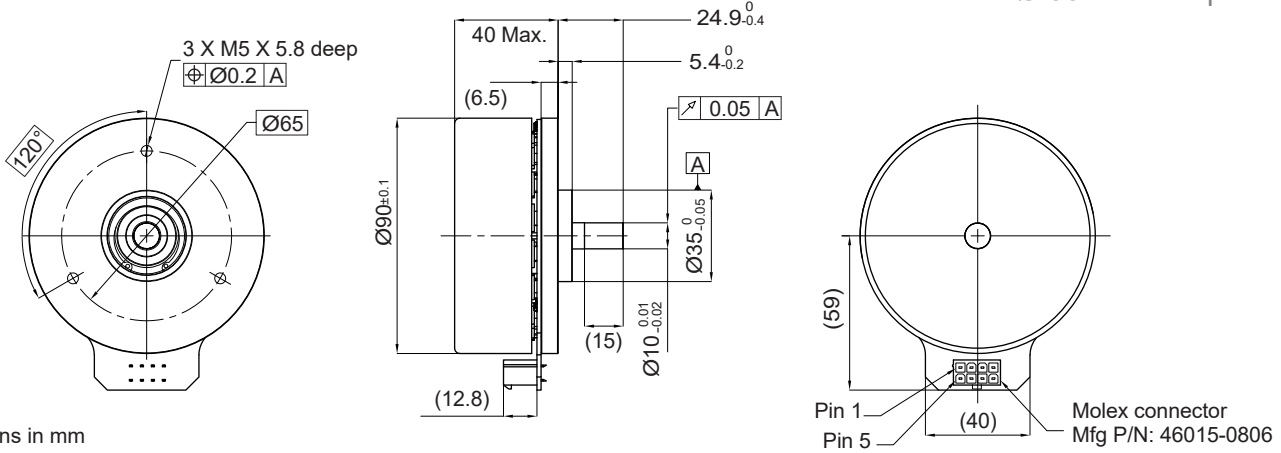
*Also available without Hall sensors

Wire	Description
Gray	Phase 1 (AWG 14)
Violet	Phase 2 (AWG 14)
Blue	Phase 3 (AWG 14)
Red	4.5 to 24 V DC (AWG 24)
Black	GND (AWG 24)
Brown	Hall Sensor 1 (AWG 24)
Yellow	Hall Sensor 2 (AWG 24)
Orange	Hall Sensor 3 (AWG 24)



90ECF

Ø 90 mm • 22-pole • 260 W



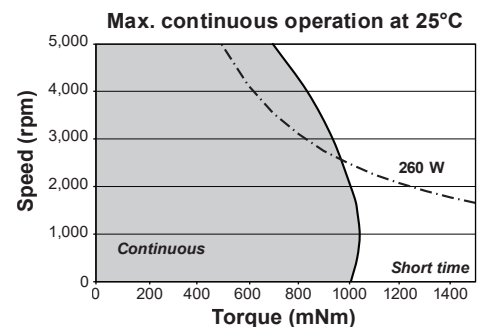
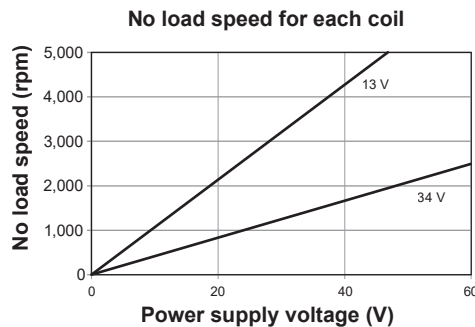
Dimensions in mm

Electrical Data	Symbol	90ECF40 8B xx		Unit
		34	13	
1 Nominal Voltage	U_N	48	18	Volt
2 Optimization Direction	-	Symmetrical	Symmetrical	-
3 No Load Speed	n_0	2,000	1,922	rpm
4 Typical No Load Current	I_0	250	733	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	260	260	W
6 Max. Continuous Current	$I_{e max}$	4.1	12.1	A
7 Max. Continuous Torque	$M_{e max}$	1000 (140.2)	1080 (154.3)	mNm (oz-in)
8 Back EMF Constant	k_E	24.5	9.37	V/1000 rpm
9 Torque Constant	k_M	225 (31.86)	89.47 (12.67)	mNm/A (oz-in/A)
10 Motor Regulation	R/k^2	0.0152	0.0125	$10^3/Nms$
11 Motor Regulation	$k/R^{1/2}$	256 (36.3)	283 (40)	mNm/W ^{1/2} (oz-in/W ^{1/2})
12 Internal Resistance - phase to phase	R_i	0.77	0.1	ohms
13 Line to Line Resistance at Connectors	R_L	0.78	0.114	ohms
14 Inductance Phase to Phase	L	1.07	0.14	mH
15 Mechanical Time Constant	τ_m	7	6.1	ms
16 Electrical Time Constant	τ_e	1.34	1.4	ms

General Data			
17 Maximum Motor Speed	n_{max}	5,000	rpm
18 Ambient Working Temperature Range	-	-40 to +100 (-40 to +212)	°C (°F)
19 Ambient Storage Temperature Range	-	-40 to +100 (-40 to +212)	°C (°F)
20 Ball Bearings Preload	-	90	N
21 Axial Static Force w/o Shaft Support (max)	-	50	N
22 Maximum Winding Temperature	-	125 (257)	°C (°F)
23 Thermal Resistance	R_{th}	3.5	°C/W
24 Thermal Time Constant	τ_w	270	s
25 Weight	-	960 (34)	g (oz)
26 Rotor Inertia	J	5083	g-cm ²
27 Hall Sensor Electrical Phasing*	-	120	Electrical °

*Also available without Hall sensors

Pad Allocation	
Pad 1	Hall sensor 1
Pad 2	Hall sensor 2
Pad 3	4.5 to 24V DC
Pad 4	Phase 3
Pad 5	Hall sensor 3
Pad 6	GND
Pad 7	Phase 1
Pad 8	Phase 2



A large grid of graph paper for taking notes, consisting of 20 columns and 40 rows of small squares.

Motors For Surgical Applications

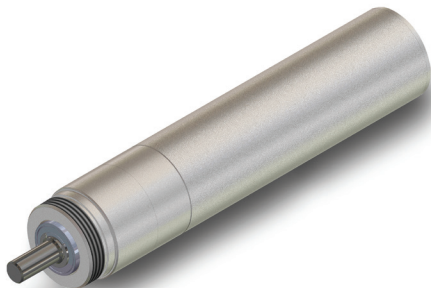
Epitomizing the exceptional quality of the Portescap brand, our application specific surgical motors are designed to meet the specialized performance requirements of high-precision powered surgical hand tools. With 20 years of experience designing and manufacturing motors for surgical applications, we understand how speed, torque and efficiency affect the performance of powered surgical hand tools. Portescap's autoclavable Brushless Direct Current (BLDC) motors are designed to provide high power in a lightweight ergonomic package. Our motors excel at meeting the requirements for exceptional surgical results, and have the durability to withstand sterilization and exposure to saline or other materials encountered in the surgical environment.



Spine Drills



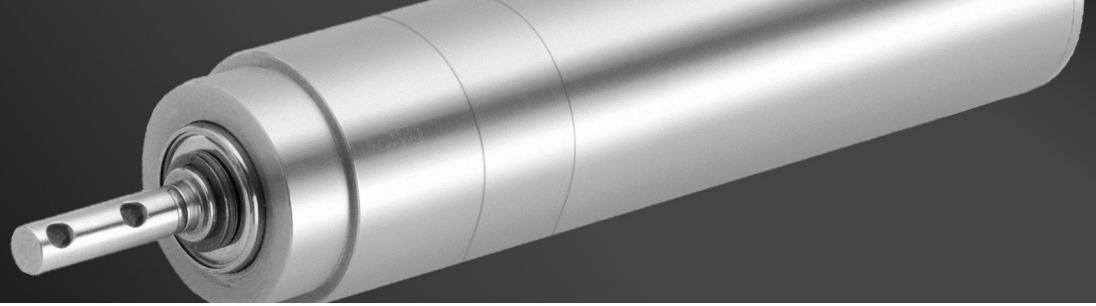
ENT Microdebridors



Arthroscopic Shavers

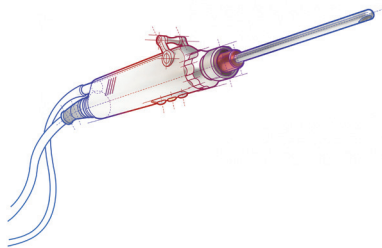


Large Bone Drills



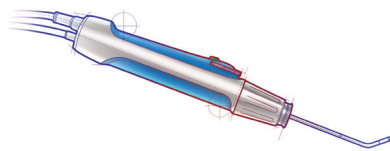
Application Specific Motors For Powered Surgical Hand Tools

Portescap designs and manufactures motors for various medical applications, including arthroscopic shavers, large bone orthopedic drills, ENT microdebriders, ENT drills, high-speed spine and neuro drills, and more.



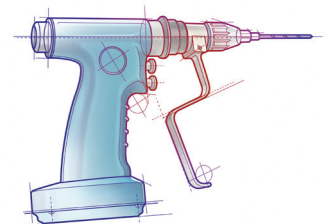
Arthroscopic joint shavers

Arthroscopic procedures require high torque, speed and efficiency. Portescap BLDC motors are an ideal solution for powered surgical hand tools used in minimally invasive surgical procedures to repair joints such as the hip, knee, and shoulder.



ENT microdebriders

Optimized for ENT microdebrider (ENT shaver) applications, the torque and speed requirements make Portescap motors an ideal solution for powered surgical hand tools used in minimally invasive surgical procedures of the ear, nose and throat. Also see our ENT drill motor for high speed drilling applications.



Large bone orthopedic drills

Orthopedic surgery procedures require high torque, speed and efficiency. Portescap BLDC motors enable the design of lightweight and powerful orthopedic drills, screwdrivers and reamers used in joint replacement procedures.

Working with You to Save, Improve and Enhance Lives

Motor performance tailored to your application requirements

High and low volume manufacturing

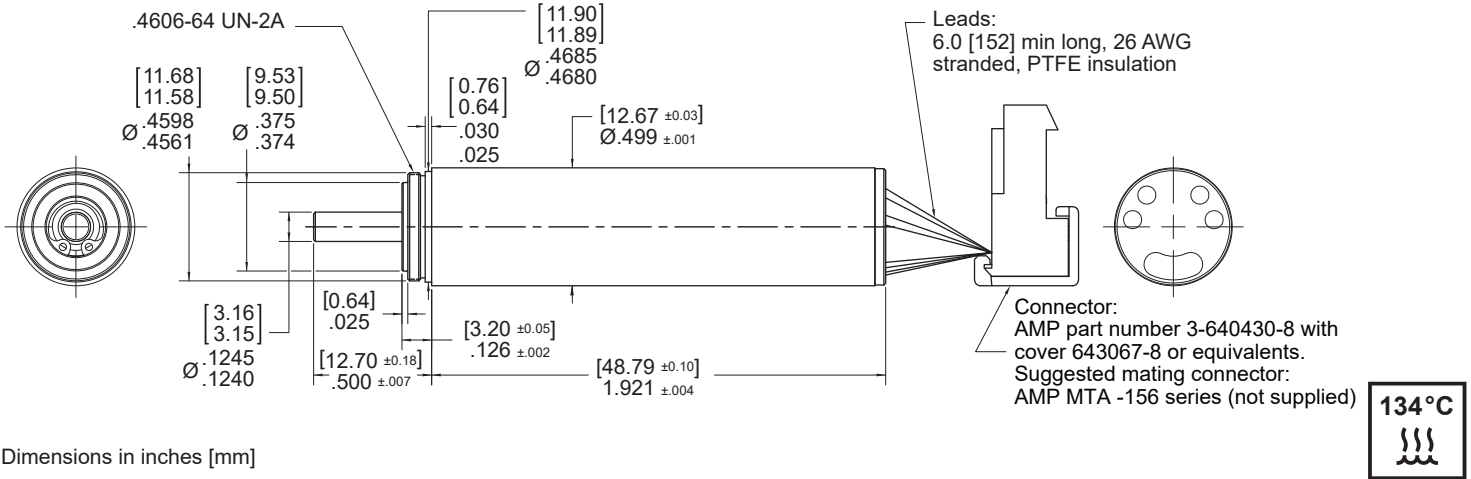
Samples available upon request

Vertically integrated design and manufacturing

Contact us for more information about our application specific surgical motors or to review requirements of your surgical application.

B0512A1 Spine Drill Surgical Motor

Ø 0.5 inch • Brushless Slotted



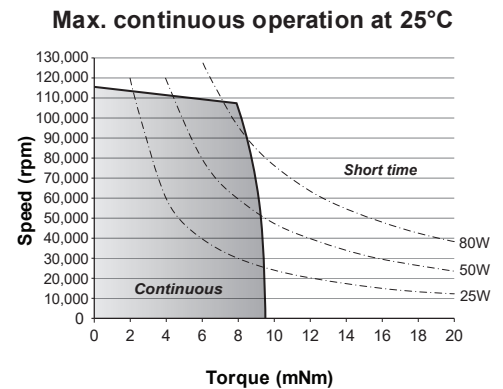
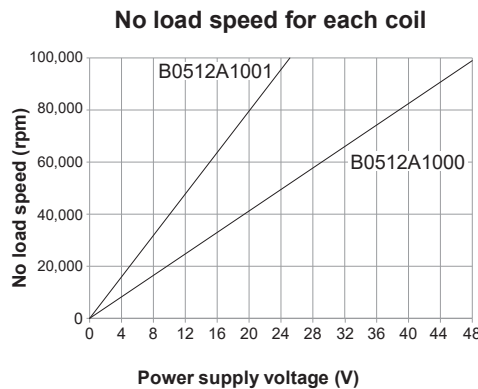
Dimensions in inches [mm]

Electrical Data	Symbol	B0512A1000	B0512A1001	Unit
1 Nominal Voltage	U_N	48	24	Volt
2 Optimization Direction	-	Symmetrical	Symmetrical	-
3 No Load Speed	n_0	97'400	96'000	rpm
4 Typical No Load Current	I_0	120	269	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	87.4	87.4	W
6 Max. Continuous Current	I_{cs}	2.02	3.63	A
7 Max. Continuous Torque	T_{CS}	9.5	8.28	mNm (oz-in)
8 Back EMF Constant	k_E	0.515	0.25	V/1000 rpm
9 Torque Constant	k_T	4.92 (0.7)	2.39 (0.34)	mNm/A (oz-in/A)
10 Motor Regulation	R/k^2	55	72	$10^3/Nms$
11 Peak Torque	T_{pk}	176 (24.9)	139 (19.8)	mNm (oz-in)
12 Motor Constant	k_M	4.27 (0.61)	3.73 (0.53)	mNm/W ^{1/2} (oz-in/W ^{1/2})
13 Line to Line Resistance	R_L	1.33	0.41	ohms
14 Inductance Phase to Phase	L	0.094	0.028	mH
15 Mechanical Time Constant	τ_m	2.62	3.42	ms
16 Electrical Time Constant	T_e	0.07	0.068	ms

General Data				
17 Gearhead Ratio	-	N/A	N/A	Ratio
18 Ambient Working Temperature Range	-	-30 to +135 (-22 to +275)	-30 to +135 (-22 to +275)	°C (°F)
19 Maximum Winding Temperature	-	155 (311)	155 (311)	°C (°F)
20 Radial Static Force w/o Shaft Support (max)	-	68.2 (15.3)	40.5 (9.1)	N (lbs)
21 Axial Static Force w/o Shaft Support (max)	-	14.8 (3.3)	3.5 (0.8)	N (lbs)
22 Thermal Resistance	R_{th}	15.9	15.9	°C/W
23 Thermal Time Constant	T_w	485	485	s
24 Weight	-	39 (1.36)	45.2 (1.59)	g (oz)
25 Rotor Inertia	J_m	3.15 (4.45)	3.15 (4.45)	kg-cm ² 10 ⁻⁴ (oz-in-sec ² 10 ⁻⁶)
26 Hall Sensor Electrical Phasing*	-	60	60	Electrical °
27 Autoclave Cycles	-	1000+	1000+	Cycles

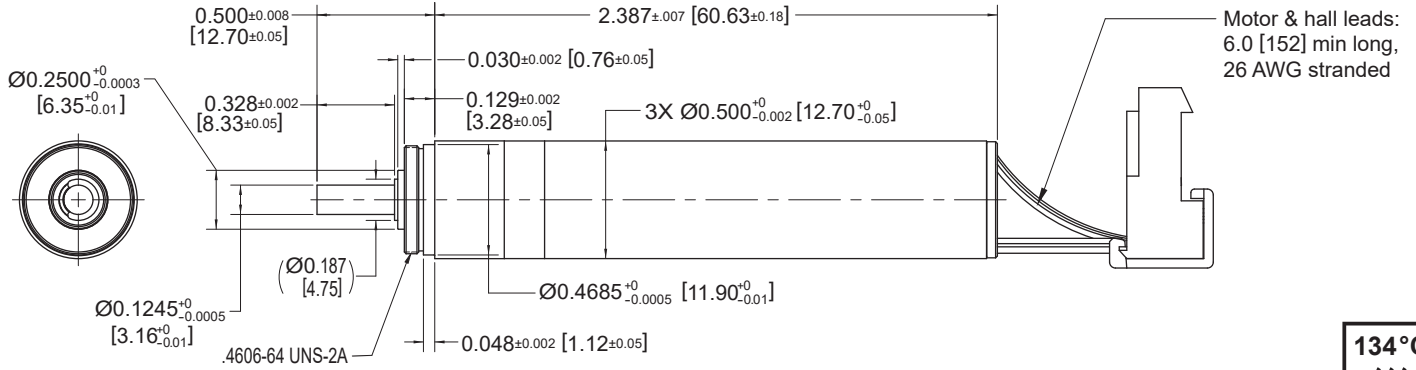
*Also available without Hall sensors

Wire	Description
Blue	Phase A
Brown	Phase B
Violet	Phase C
Red	4.5 to 24 Vdc
Yellow	Sensor 1
Orange	Sensor 2
White	Sensor 3
Black	GND



B0512A4 ENT Microdebrider/Shaver Surgical Gearmotor

Ø 0.5 inch • Brushless Slotted



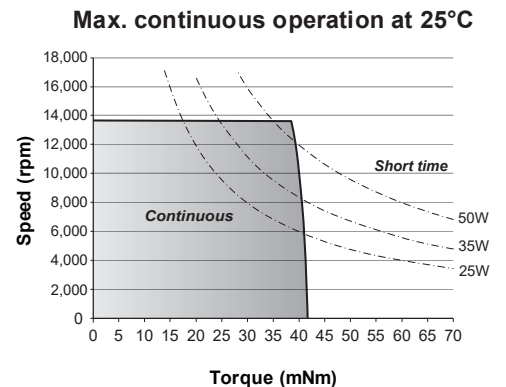
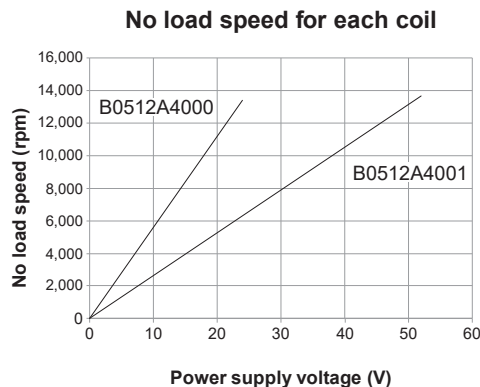
Dimensions in inches [mm]

Electrical Data	Symbol	B0512A4xxx		Unit
		B0512A4000	B0512A4001	
1 Nominal Voltage	U_N	24	48	Volt
2 Optimization Direction	-	Symmetrical	Symmetrical	-
3 No Load Speed	n_o	13'385	12'800	rpm
4 Typical No Load Current	I_o	510	248	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	48	50.8	W
6 Max. Continuous Current	I_{cs}	2.56	1.35	A
7 Max. Continuous Torque	T_{cs}	37.8 (5.36)	41.6 (5.9)	mNm (oz-in)
8 Back EMF Constant	k_E	1.81	3.75	V/1000 rpm
9 Torque Constant	k_T	15.5 (2.21)	32.2 (4.6)	mNm/A (oz-in/A)
10 Motor Regulation	R/k^2	3.434	2.845	$10^3/Nms$
11 Peak Torque	T_{pk}	445.1 (63)	518.9 (73.5)	mNm (oz-in)
12 Motor Constant	k_M	17 (2.41)	18.7 (2.65)	mNm/W ^{1/2} (oz-in/W ^{1/2})
13 Line to Line Resistance	R_L	0.825	2.95	ohms
14 Inductance Phase to Phase	L	0.058	0.24	mH
15 Mechanical Time Constant	T_m	3.3	2.74	ms
16 Electrical Time Constant	T_e	0.07	0.081	ms

General Data				
17 Gearhead Ratio	-	5:1		ratio
18 Ambient Working Temperature Range	-	-30 to +135 (-22 to +275)		°C (°F)
19 Maximum Winding Temperature	-	155 (311)		°C (°F)
20 Radial Static Force w/o Shaft Support (max)	-	17.6 (4)		N (lbs)
21 Axial Static Force w/o Shaft Support (max)	-	5.78 (1.3)	44 (9.9)	N (lbs)
22 Thermal Resistance	R_{th}	15.9		°C/W
23 Thermal Time Constant	T_w	485		s
24 Weight	-	54 (1.9)		g (oz)
25 Rotor Inertia	J_m	3.15 (4.46)		kg-cm ² 10 ⁻⁴ (oz-in-sec ² 10 ⁻⁶)
26 Hall Sensor Electrical Phasing*	-	60		Electrical °
27 Autoclave Cycles	-	1000+		Cycles

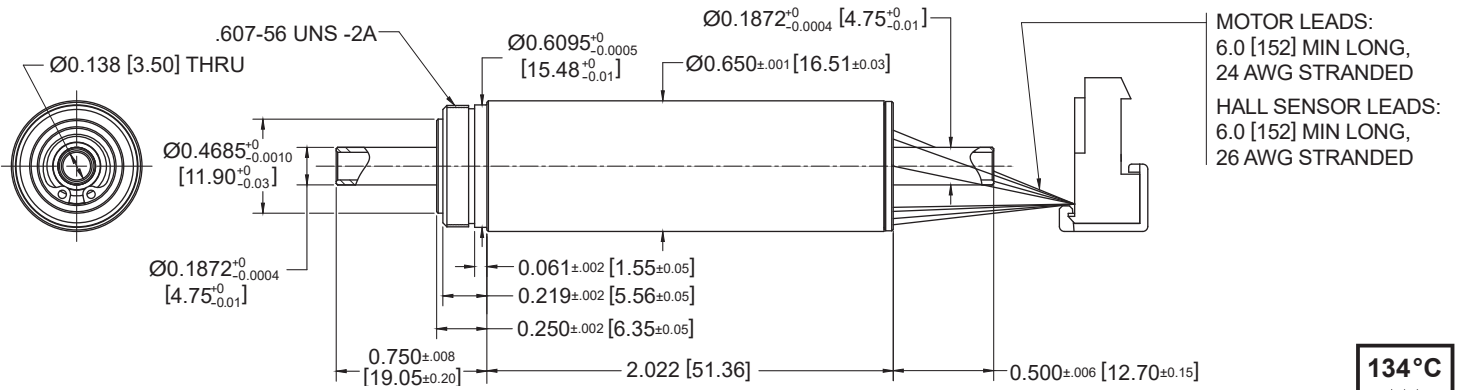
*Also available without Hall sensors

Wire	Description
Blue	Phase A
Brown	Phase B
Violet	Phase C
Red	4.5 to 24 Vdc
Yellow	Sensor 1
Orange	Sensor 2
White	Sensor 3
Black	GND



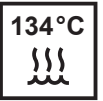
B0612H1005 Cannulated Shaver/Microdebrider

Ø 0.65 inch • Brushless Slotted • 48 V



MOTOR LEADS:
6.0 [152] MIN LONG,
24 AWG STRANDED

HALL SENSOR LEADS:
6.0 [152] MIN LONG,
26 AWG STRANDED



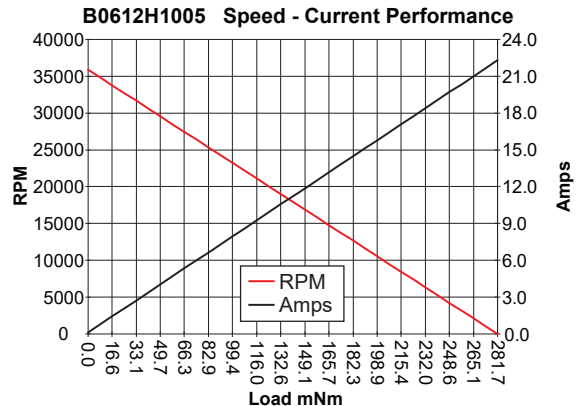
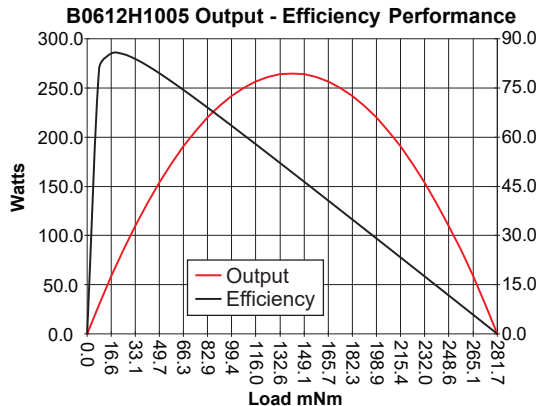
Dimensions in inches [mm]

Electrical Data	Symbol	SMX B0612H1005	Unit
1 Nominal Voltage	U_N	48.0	Volt
2 Optimization Direction	-	Bi-Directional	-
3 No Load Speed	n_0	35,300	rpm
4 Typical No Load Current	I_0	125	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	68.5	W
6 Max. Continuous Current	I_{cs}	1.80	A
7 Max. Continuous Torque	T_{cs}	19.6 (2.78)	mNm (oz-in)
8 Back EMF Constant	k_E	1.33	V/1000 rpm
9 Torque Constant	k_T	12.71 (1.8)	mNm/A (oz-in/A)
10 Motor Regulation	R/k^2	13321	$10^3/Nms$
11 Peak Torque	T_{pk}	141.7 (20.1)	mNm (oz-in)
12 Motor Constant	k_M	8.69 (1.23)	mNm/W ^{1/2} (oz-in/W ^{1/2})
13 Line to Line Resistance	R_L	2.152	ohms
14 Inductance Phase to Phase	L	0.525	mH
15 Mechanical Time Constant	T_m	0.80	ms
16 Electrical Time Constant	T_e	0.244	ms

General Data	Symbol	SMX B0612H1005	Unit
17 Gearhead Ratio	-	N/A	Ratio
18 Ambient Working Temperature Range	-	25 (77)	°C (°F)
19 Max Operating Temperature Range	-	155 (311)	°C (°F)
20 Radial Static Force w/o Shaft Support (max)	-	25.99	lbs
21 Axial Static Force w/o Shaft Support (max)	-	10.33	lbs
22 Thermal Resistance	R_{th}	12.0	°C/W
23 Thermal Time Constant	T_w	936	s
24 Weight	-	75.8 (2.67)	g (oz)
25 Rotor Inertia	J_m	9.79 (13.86)	kg-cm ² 10 ⁻⁴ (oz-in-sec ² 10 ⁻⁶)
26 Hall Sensor Electrical Phasing*	-	60	Electrical °
27 Autoclave Cycles	-	1000+	Cycles

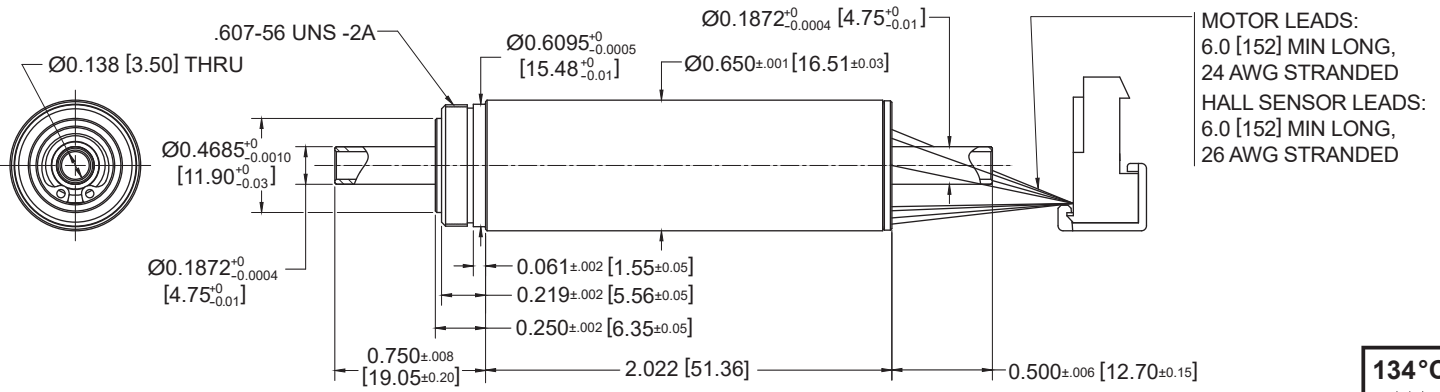
*Also available without Hall sensors

Wire	Description
Blue	Phase A
Brown	Phase B
Violet	Phase C
Red	4.5 to 24 Vdc
Yellow	Sensor 1
Orange	Sensor 2
White	Sensor 3
Black	GND



B0612H1007 Cannulated Shaver/Microdebrider

Ø 0.65 inch • Brushless Slotted • 24 V



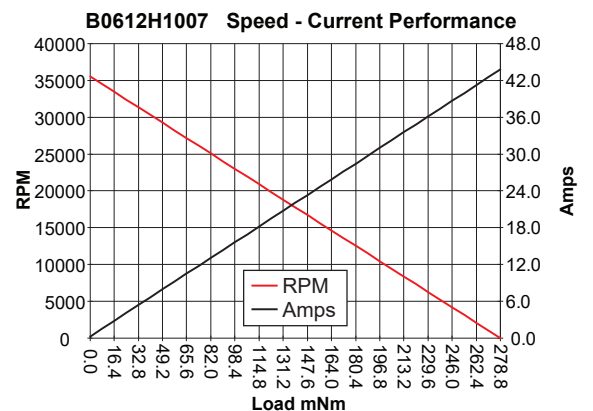
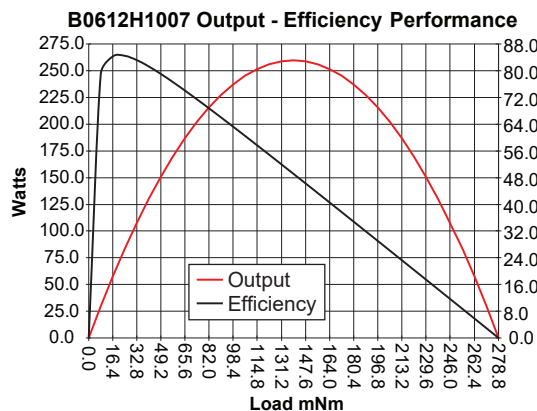
Dimensions in inches [mm]

Electrical Data	Symbol	SMX B0612H1007	Unit
1 Nominal Voltage	U_N	24.0	Volt
2 Optimization Direction	-	Bi-Directional	-
3 No Load Speed	n_0	35,597	rpm
4 Typical No Load Current	I_0	284	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	68.5	W
6 Max. Continuous Current	I_{cs}	3.62	A
7 Max. Continuous Torque	T_{cs}	19.8 (2.81)	mNm (oz-in)
8 Back EMF Constant	k_E	0.671	V/1000 rpm
9 Torque Constant	k_T	6.40 (0.907)	mNm/A (oz-in/A)
10 Motor Regulation	R/k^2	13379	$10^3/Nms$
11 Peak Torque	T_{pk}	278.2 (39.4)	mNm (oz-in)
12 Motor Constant	k_M	8.69 (1.23)	$mNm/W^{1/2}$ (oz-in/ $W^{1/2}$)
13 Line to Line Resistance	R_L	0.548	ohms
14 Inductance Phase to Phase	L	0.119	mH
15 Mechanical Time Constant	τ_m	0.80	ms
16 Electrical Time Constant	τ_e	0.217	ms

General Data			
17 Gearhead Ratio	-	N/A	Ratio
18 Ambient Working Temperature Range	-	25 (77)	°C (°F)
19 Max Operating Temperature Range	-	155 (311)	°C (°F)
20 Radial Static Force w/o Shaft Support (max)	-	25.99	lbs
21 Axial Static Force w/o Shaft Support (max)	-	10.33	lbs
22 Thermal Resistance	R_{th}	12.0	°C/W
23 Thermal Time Constant	τ_w	936	s
24 Weight	-	75.8 (2.67)	g (oz)
25 Rotor Inertia	J_m	9.79 (13.86)	$kg\cdot cm^2 \cdot 10^{-4}$ (oz-in-sec ² 10^{-6})
26 Hall Sensor Electrical Phasing*	-	60	Electrical °
27 Autoclave Cycles	-	1000+	Cycles

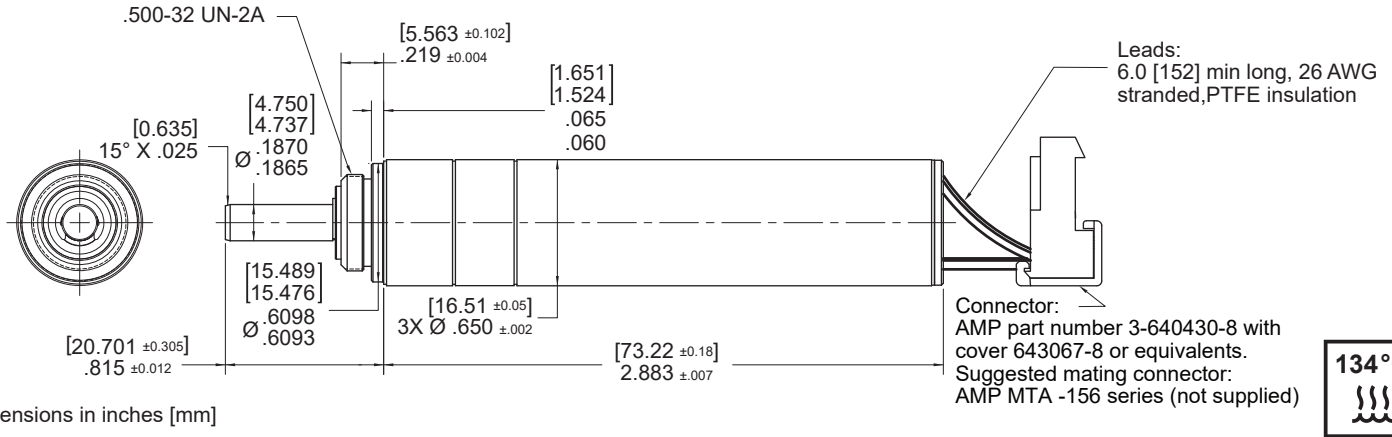
*Also available without Hall sensors

Wire	Description
Blue	Phase A
Brown	Phase B
Violet	Phase C
Red	4.5 to 24 Vdc
Yellow	Sensor 1
Orange	Sensor 2
White	Sensor 3
Black	GND



B0614A4 Arthroscopic Joint Shaver High Speed Gearmotor

Ø 0.65 inch • Brushless Slotted

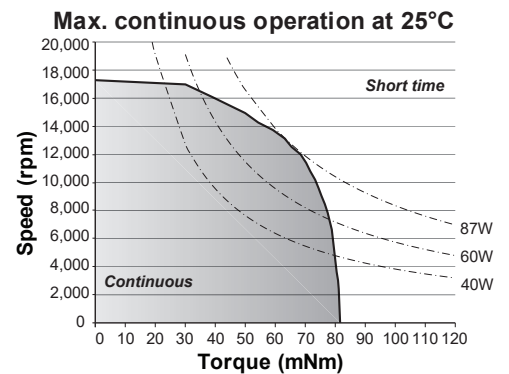
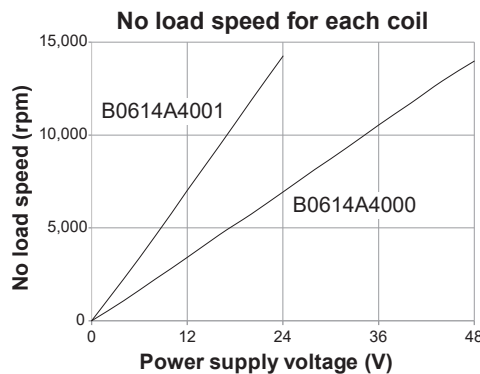


Electrical Data	Symbol	B0614A4000	B0614A4001	Unit
1 Nominal Voltage	U_N	48.0	24.0	Volt
2 Optimization Direction	-	Bi-Directional	Bi-Directional	-
3 No Load Speed	n_0	13,710	13,500	rpm
4 Typical No Load Current	I_0	417	663	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	112.2	96.1	W
6 Max. Continuous Current	I_{cs}	2.86	4.95	A
7 Max. Continuous Torque	T_{cs}	81.48 (11.54)	71.0 (10.1)	mNm (oz-in)
8 Back EMF Constant	k_E	3.48	1.75	V/1000 rpm
9 Torque Constant	k_T	29.9 (4.24)	15.1 (2.1)	mNm/A (oz-in/A)
10 Motor Regulation	R/k^2	0.941	1.239	$10^3/Nms$
11 Peak Torque	T_{pk}	1705.1 (241.5)	1286.1 (182.1)	mNm (oz-in)
12 Motor Constant	k_M	32.6 (4.62)	28.4 (4.02)	mNm/W ^{1/2} (oz-in/W ^{1/2})
13 Line to Line Resistance	R_L	0.842	0.281	ohms
14 Inductance Phase to Phase	L	0.13	0.038	mH
15 Mechanical Time Constant	τ_m	2.32	3.05	ms
16 Electrical Time Constant	τ_e	0.154	0.135	ms

General Data				
17 Gearhead Ratio	-	4:1	4:1	Ratio
18 Ambient Working Temperature Range	-	-30 to +135 (-22 to +275)	-30 to +135 (-22 to +275)	°C (°F)
19 Maximum Winding Temperature	-	155 (311)	155 (311)	°C (°F)
20 Radial Static Force w/o Shaft Support (max)	-	13.01 (58)	13.01 (58)	lbs (N)
21 Axial Static Force w/o Shaft Support (max)	-	7.3 (32.5)	7.3 (32.5)	lbs (N)
22 Thermal Resistance	R_{th}	12.5	12.5	°C/W
23 Thermal Time Constant	τ_w	950	950	s
24 Weight	-	106 (3.74)	106 (3.74)	g (oz)
25 Rotor Inertia	J_m	12.6 (17.8)	12.6 (17.8)	kg-cm ² 10 ⁻⁴ (oz-in-sec ² 10 ⁻⁶)
26 Hall Sensor Electrical Phasing*	-	60	60	Electrical °
27 Autoclave Cycles	-	1000+	1000+	Cycles

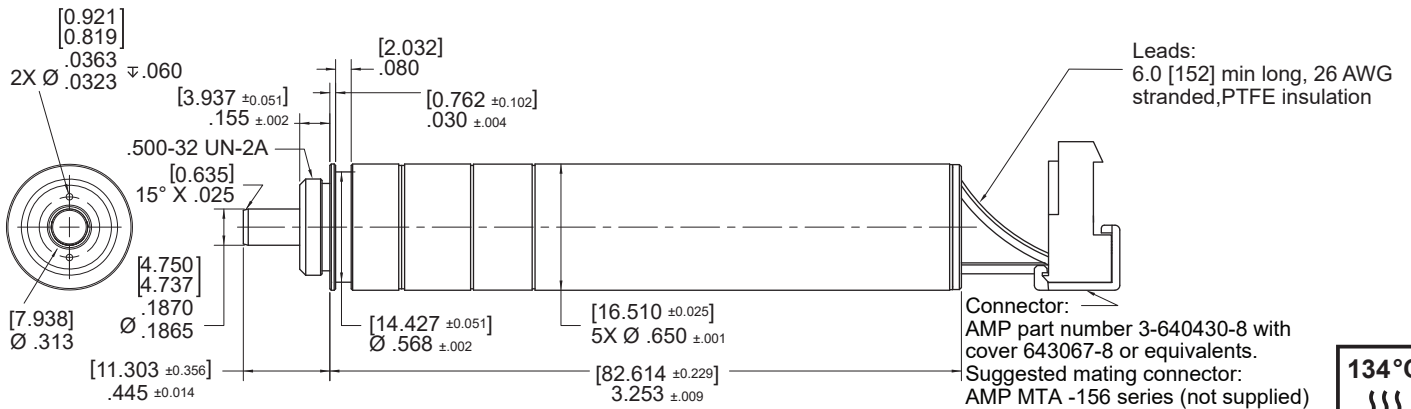
*Also available without Hall sensors

Wire	Description
Blue	Phase A
Brown	Phase B
Violet	Phase C
Red	4.5 to 24 Vdc
Yellow	Sensor 1
Orange	Sensor 2
White	Sensor 3
Black	GND



B0614A4 Arthroscopic Joint Shaver High Speed Gearmotor With Sealed Shaft

Ø 0.65 inch • Brushless Slotted



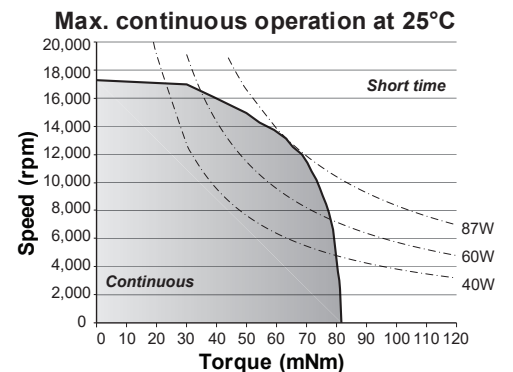
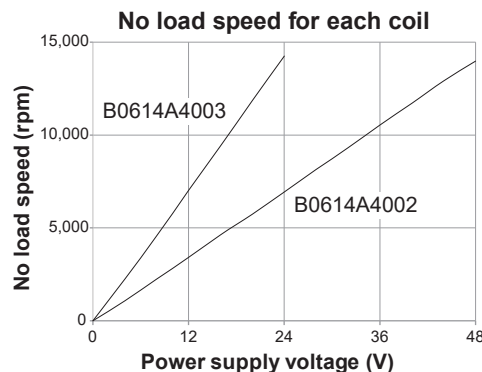
Dimensions in inches [mm]

Electrical Data	Symbol	B0614A4002	B0614A4003	Unit
1 Nominal Voltage	U_N	48.0	24.0	Volt
2 Optimization Direction	-	Bi-Directional	Bi-Directional	-
3 No Load Speed	n_o	13,710	13,500	rpm
4 Typical No Load Current	I_o	483	933	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	112.2	96.1	W
6 Max. Continuous Current	I_{cs}	2.86	4.95	A
7 Max. Continuous Torque	T_{cs}	81.48 (11.54)	71.0 (10.1)	mNm (oz-in)
8 Back EMF Constant	k_E	3.48	1.75	V/1000 rpm
9 Torque Constant	k_T	29.9 (4.24)	15.1 (2.1)	mNm/A (oz-in/A)
10 Motor Regulation	R/k^2	0.941	1.239	$10^3/Nms$
11 Peak Torque	T_{pk}	1705.1 (241.5)	1286.1 (182.1)	mNm (oz-in)
12 Motor Constant	k_M	32.6 (4.62)	28.4 (4.02)	$mNm/W^{1/2}$ (oz-in/ $W^{1/2}$)
13 Line to Line Resistance	R_L	0.842	0.281	ohms
14 Inductance Phase to Phase	L	0.13	0.038	mH
15 Mechanical Time Constant	T_m	2.32	3.05	ms
16 Electrical Time Constant	T_e	0.154	0.135	ms

General Data				
17 Gearhead Ratio	-	4:1	4:1	Ratio
18 Ambient Working Temperature Range	-	-30 to +135 (-22 to +275)	-30 to +135 (-22 to +275)	°C (°F)
19 Maximum Winding Temperature	-	155 (311)	155 (311)	°C (°F)
20 Radial Static Force w/o Shaft Support (max)	-	13.01 (58)	13.01 (58)	lbs (N)
21 Axial Static Force w/o Shaft Support (max)	-	7.3 (32.5)	7.3 (32.5)	lbs (N)
22 Thermal Resistance	R_{th}	12.5	12.5	°C/W
23 Thermal Time Constant	T_w	950	950	s
24 Weight	-	115 (4.05)	115 (4.05)	g (oz)
25 Rotor Inertia	J_m	12.6 (17.8)	12.6 (17.8)	$kg\text{-}cm^2 \cdot 10^{-4}$ (oz-in-sec ² 10^{-6})
26 Hall Sensor Electrical Phasing*	-	60	60	Electrical °
27 Autoclave Cycles	-	1000+	1000+	Cycles

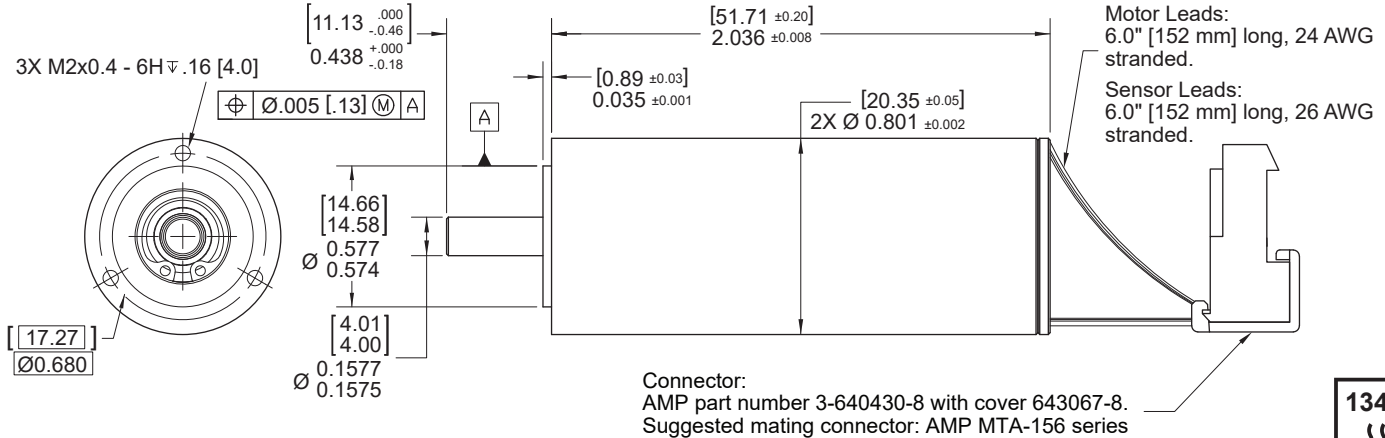
*Also available without Hall sensors

Wire	Description
Blue	Phase A
Brown	Phase B
Violet	Phase C
Red	4.5 to 24 Vdc
Yellow	Sensor 1
Orange	Sensor 2
White	Sensor 3
Black	GND



B0810A1 Multi-tool Surgical Motor

Ø 0.8 inch • Brushless Slotted



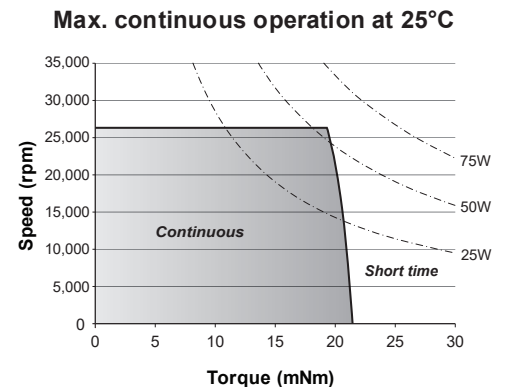
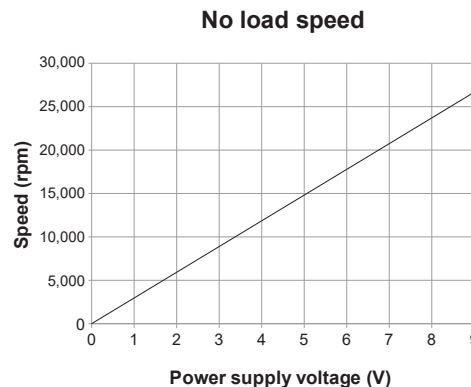
Dimensions in inches [mm]

Electrical Data	Symbol	B0810A1000	Unit
1 Nominal Voltage	U_N	9	Volt
2 Optimization Direction	-	Symmetrical	-
3 No Load Speed	n_0	26'700	rpm
4 Typical No Load Current	I_0	705	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	12	W
6 Max. Continuous Current	I_{cs}	7.75	A
7 Max. Continuous Torque	T_{cs}	21.4 (3)	mNm (oz-in)
8 Back EMF Constant	k_E	0.337	V/1000 rpm
9 Torque Constant	k_T	3.22 (0.456)	mNm/A (oz-in/A)
10 Motor Regulation	R/k^2	14.08	$10^3/Nms$
11 Peak Torque	T_{pk}	198 (28.1)	mNm (oz-in)
12 Motor Constant	k_M	8.43 (1.2)	mNm/W ^{1/2} (oz-in/W ^{1/2})
13 Line to Line Resistance	R_L	0.146	ohms
14 Inductance Phase to Phase	L	0.027	mH
15 Mechanical Time Constant	τ_m	2.76	ms
16 Electrical Time Constant	τ_e	0.185	ms

General Data			
17 Gearhead Ratio	-	N/A	Ratio
18 Ambient Working Temperature Range	-	-30 to +135 (-22 to +275)	°C (°F)
19 Maximum Winding Temperature	-	155 (311)	°C (°F)
20 Radial Static Force w/o Shaft Support (max)	-	60 (15.8)	N (lbs)
21 Axial Static Force w/o Shaft Support (max)	-	15.8 (3.5)	N (lbs)
22 Thermal Resistance	R_{th}	9.8	°C/W
23 Thermal Time Constant	τ_w	285	s
24 Weight	-	110 (3.88)	g (oz)
25 Rotor Inertia	J_m	19.6 (27.7)	kg-cm ² 10 ⁻⁴ (oz-in-sec ² 10 ⁻⁶)
26 Hall Sensor Electrical Phasing*	-	60	Electrical °
27 Autoclave Cycles	-	1000+	Cycles

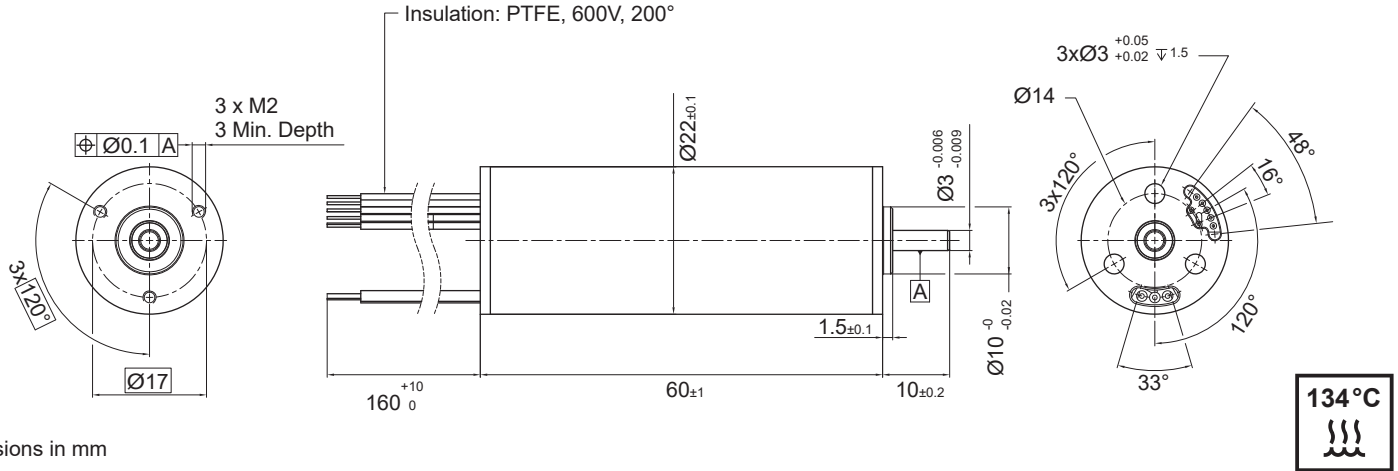
*Also available without Hall sensors

Wire	Description
Blue	Phase A
Brown	Phase B
Violet	Phase C
Red	4.5 to 24 Vdc
Yellow	Sensor 1
Orange	Sensor 2
White	Sensor 3
Black	GND



22ECA60 Small/Medium Bone Surgical Motor

Ø 22 mm • Brushless Slotless



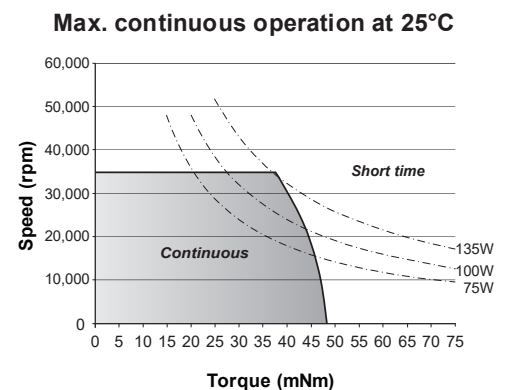
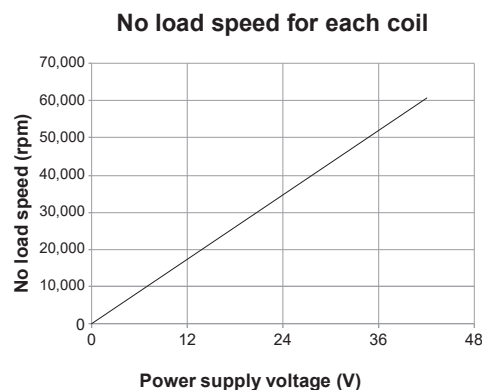
Dimensions in mm

Electrical Data	Symbol	22ECA60 10B XX.206 21	Unit
1 Nominal Voltage	U_N	24	Volt
2 Optimization Direction	-	CCW	-
3 No Load Speed	n_o	34'500	rpm
4 Typical No Load Current	I_o	200	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	180	W
6 Max. Continuous Current	I_{cs}	7.8	A
7 Max. Continuous Torque	T_{cs}	51 (7.22)	mNm (oz-in)
8 Back EMF Constant	k_E	0.69	V/1000 rpm
9 Torque Constant	k_T	6.6 (0.935)	mNm/A (oz-in/A)
10 Motor Regulation	R/k^2	3.5	10 ³ /Nms
11 Peak Torque	T_{pk}	N/A	mNm (oz-in)
12 Motor Constant	k_M	17.04 (2.42)	mNm/W ^{1/2} (oz-in/W ^{1/2})
13 Line to Line Resistance	R_L	0.17	ohms
14 Inductance Phase to Phase	L	0.026	mH
15 Mechanical Time Constant	τ_m	1.2	ms
16 Electrical Time Constant	τ_e	0.17	ms

General Data			
17 Gearhead Ratio	-	N/A	Ratio
18 Ambient Working Temperature Range	-	-30 to +135 (-22 to +275)	°C (°F)
19 Maximum Winding Temperature	-	155 (311)	°C (°F)
20 Radial Static Force w/o Shaft Support (max)	-	89 (20) @8mm from front mounting face	N (lbs)
21 Axial Static Force w/o Shaft Support (max)	-	34 (7.5)	N (lbs)
22 Thermal Resistance	R_{th}	9.4	°C/W
23 Thermal Time Constant	τ_w	1'200	s
24 Weight	-	140 (4.94)	g (oz)
25 Rotor Inertia	J_m	35 (49.5)	kg-cm ² 10 ⁻⁴ (oz-in-sec ² 10 ⁻⁶)
26 Hall Sensor Electrical Phasing*	-	120	Electrical °
27 Autoclave Cycles	-	200	Cycles

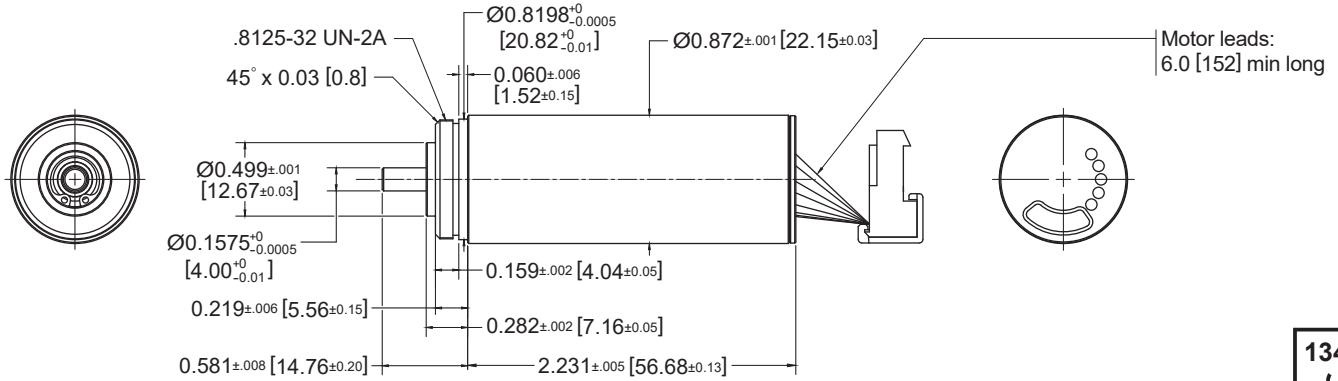
*Also available without Hall sensors

Wire	Description
Gray	Phase 1 (AWG18)
Violet	Phase 2 (AWG18)
Blue	Phase 3 (AWG18)
Green	3.5 to 24 V DC (AWG24)
Yellow	GND (AWG24)
Orange	Sensor 1 (AWG24)
Red	Sensor 2 (AWG24)
Brown	Sensor 3 (AWG24)
Black	NTC 10 kohm (AWG24)
White	NTC 10 kohm (AWG24)



B0912N1 Small Bone Surgical motor - Drill/Reamer

Ø 0.872 inch • Brushless Slotted



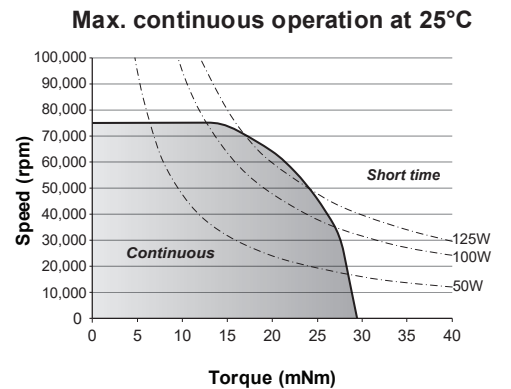
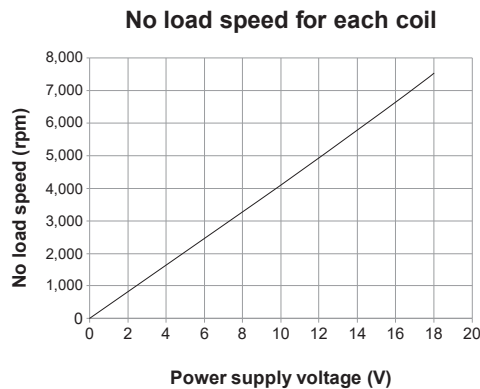
Dimensions in inches [mm]

Electrical Data	Symbol	B0912N1016	Unit
1 Nominal Voltage	U_N	9.6	Volt
2 Optimization Direction	-	Symmetrical	-
3 No Load Speed	n_0	38'633	rpm
4 Typical No Load Current	I_0	1'053	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	112.5	W
6 Max. Continuous Current	I_{cs}	14.48	A
7 Max. Continuous Torque	T_{cs}	29.4 (4.16)	mNm (oz-in)
8 Back EMF Constant	k_E	0.248	V/1000 rpm
9 Torque Constant	k_T	2.37 (0.336)	mNm/A (oz-in/A)
10 Motor Regulation	R/k^2	7.121	$10^3/Nms$
11 Peak Torque	T_{pk}	564.6 (80)	mNm (oz-in)
12 Motor Constant	k_M	11.84 (1.68)	mNm/W ^{1/2} (oz-in/W ^{1/2})
13 Line to Line Resistance	R_L	0.04	ohms
14 Inductance Phase to Phase	L	0.009	mH
15 Mechanical Time Constant	T_m	2.63	ms
16 Electrical Time Constant	T_e	0.225	ms

General Data			
17 Gearhead Ratio	-	N/A	Ratio
18 Ambient Working Temperature Range	-	-30 to +135 (-22 to +275)	°C (°F)
19 Maximum Winding Temperature	-	155 (311)	°C (°F)
20 Radial Static Force w/o Shaft Support (max)	-	175 (40)	N (lbs)
21 Axial Static Force w/o Shaft Support (max)	-	35 (8.5)	N (lbs)
22 Thermal Resistance	R_{th}	10	°C/W
23 Thermal Time Constant	T_w	926	s
24 Weight	-	145 (5.11)	g (oz)
25 Rotor Inertia	J_m	24.7 (35)	kg-cm ² 10 ⁻⁴ (oz-in-sec ² 10 ⁻⁶)
26 Hall Sensor Electrical Phasing*	-	60	Electrical °
27 Autoclave Cycles	-	1000+	Cycles

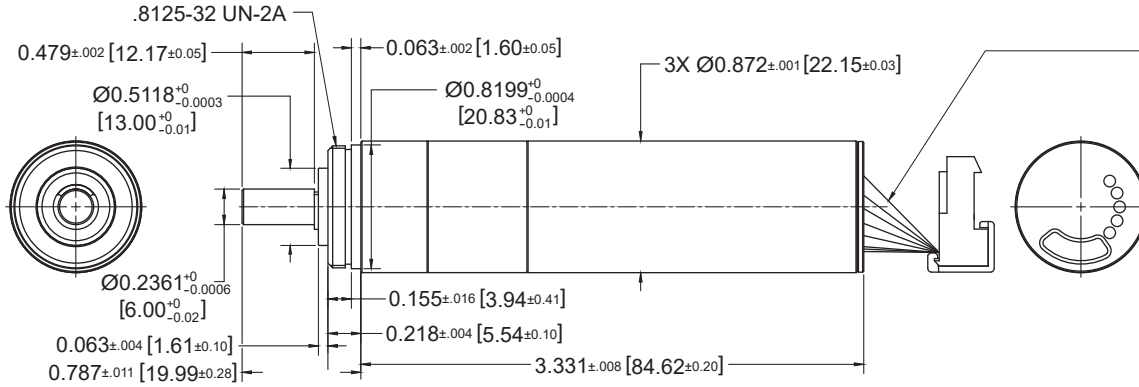
*Also available without Hall sensors

Wire	Description
Blue	Phase A (AWG18)
Brown	Phase B (AWG18)
Violet	Phase C (AWG18)
Red	4.5 to 24 Vdc (AWG26)
Yellow	Sensor 1 (AWG26)
Orange	Sensor 2 (AWG26)
White	Sensor 3 (AWG26)
Black	GND (AWG26)



B0912N4023 Small Bone Orthopedic Drill

Ø 0.872 inch • Brushless Slotted • 9.6 V



MOTOR LEADS:
6.0 [152] MIN LONG,
18 AWG STRANDED

HALL SENSOR LEADS:
6.0 [152] MIN LONG,
26 AWG STRANDED



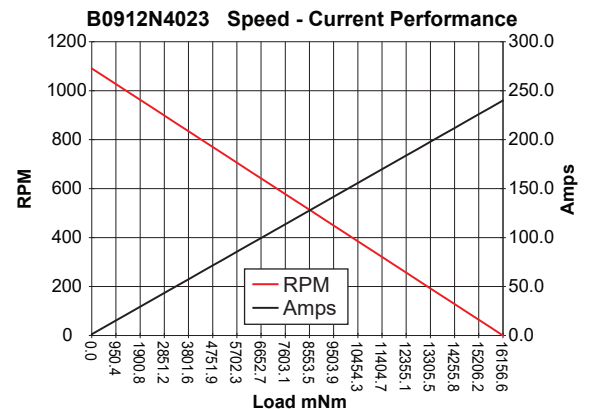
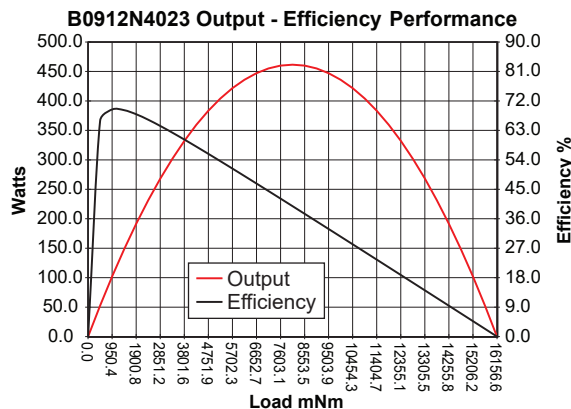
Dimensions in inches [mm]

Electrical Data	Symbol	SMX B0912N4023	Unit
1 Nominal Voltage	U_N	9.6	Volt
2 Optimization Direction	-	Bi-Directional	-
3 No Load Speed	n_o	1,104	rpm
4 Typical No Load Current	I_o	1300	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	90.3	W
6 Max. Continuous Current	I_{cs}	14.48	A
7 Max. Continuous Torque	T_{cs}	833 (118)	mNm (oz-in)
8 Back EMF Constant	k_E	8.75	V/1000 rpm
9 Torque Constant	k_T	67.69 (9.59)	mNm/A (oz-in/A)
10 Motor Regulation	R/k^2	8.73	$10^3/Nms$
11 Peak Torque	T_{pk}	16007 (2266)	mNm (oz-in)
12 Motor Constant	k_M	11.84 (1.68)	$mNm/W^{1/2}$ (oz-in/ $W^{1/2}$)
13 Line to Line Resistance	R_L	0.040	ohms
14 Inductance Phase to Phase	L	0.009	mH
15 Mechanical Time Constant	τ_m	2.63	ms
16 Electrical Time Constant	τ_e	0.225	ms

General Data			
17 Gearhead Ratio	-	35:1	Ratio
18 Ambient Working Temperature Range	-	25 (77)	°C (°F)
19 Max Operating Temperature Range	-	155 (311)	°C (°F)
20 Radial Static Force w/o Shaft Support (max)	-	47.28	lbs
21 Axial Static Force w/o Shaft Support (max)	-	64.50	lbs
22 Thermal Resistance	R_{th}	10.0	°C/W
23 Thermal Time Constant	τ_w	950	s
24 Weight	-	214 (7.55)	g (oz)
25 Rotor Inertia	J_m	24.7 (35.0)	$kg\cdot cm^2 \cdot 10^{-4}$ (oz-in-sec ² 10^{-6})
26 Hall Sensor Electrical Phasing*	-	60	Electrical °
27 Autoclave Cycles	-	1000+	Cycles

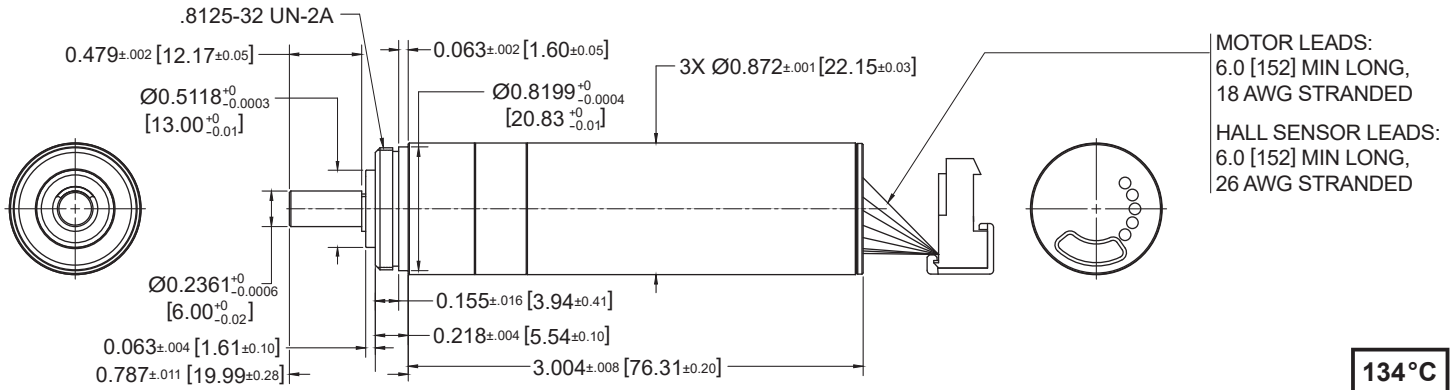
*Also available without Hall sensors

Wire	Description
Blue	Phase A
Brown	Phase B
Violet	Phase C
Red	4.5 to 24 Vdc
Yellow	Sensor 1
Orange	Sensor 2
White	Sensor 3
Black	GND



B0912N4024 Small Bone Orthopedic Saw

Ø 0.872 inch • Brushless Slotted • 9.6 V



MOTOR LEADS:
6.0 [152] MIN LONG,
18 AWG STRANDED

HALL SENSOR LEADS:
6.0 [152] MIN LONG,
26 AWG STRANDED

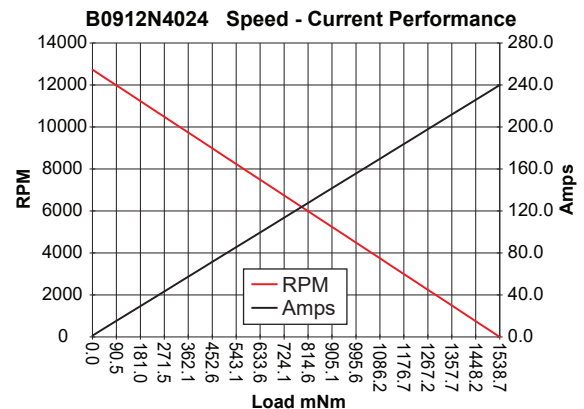
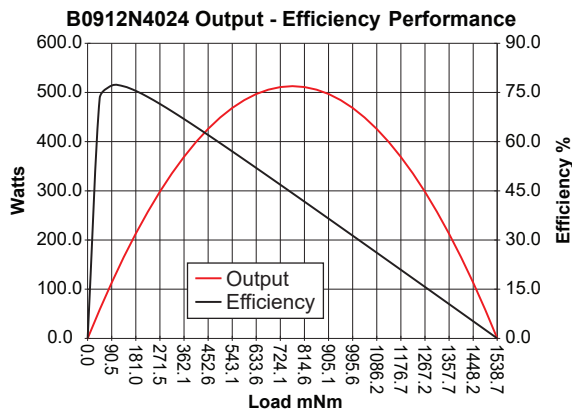
Dimensions in inches [mm]

Electrical Data	Symbol	SMX B0912N4024	Unit
1 Nominal Voltage	U_N	9.6	Volt
2 Optimization Direction	-	Bi-Directional	-
3 No Load Speed	n_0	12,851	rpm
4 Typical No Load Current	I_0	1250	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	111.6	W
6 Max. Continuous Current	I_{cs}	14.52	A
7 Max. Continuous Torque	T_{cs}	88.8 (12.6)	mNm (oz-in)
8 Back EMF Constant	k_E	0.747	V/1000 rpm
9 Torque Constant	k_T	6.42 (0.909)	mNm/A (oz-in/A)
10 Motor Regulation	R/k^2	970	$10^3/Nms$
11 Peak Torque	T_{pk}	1534.5 (217.3)	mNm (oz-in)
12 Motor Constant	k_M	11.89 (1.68)	mNm/W ^{1/2} (oz-in/W ^{1/2})
13 Line to Line Resistance	R_L	0.040	ohms
14 Inductance Phase to Phase	L	0.009	mH
15 Mechanical Time Constant	T_m	3.77	ms
16 Electrical Time Constant	T_e	0.225	ms

General Data			
17 Gearhead Ratio	-	3:1	Ratio
18 Ambient Working Temperature Range	-	25 (77)	°C (°F)
19 Max Operating Temperature Range	-	155 (311)	°C (°F)
20 Radial Static Force w/o Shaft Support (max)	-	47.28	lbs
21 Axial Static Force w/o Shaft Support (max)	-	64.50	lbs
22 Thermal Resistance	R_{th}	10.2	°C/W
23 Thermal Time Constant	T_w	926	s
24 Weight	-	191 (6.74)	g (oz)
25 Rotor Inertia	J_m	24.7 (35.0)	kg-cm ² 10 ⁻⁴ (oz-in-sec ² 10 ⁻⁶)
26 Hall Sensor Electrical Phasing*	-	60	Electrical °
27 Autoclave Cycles	-	1000+	Cycles

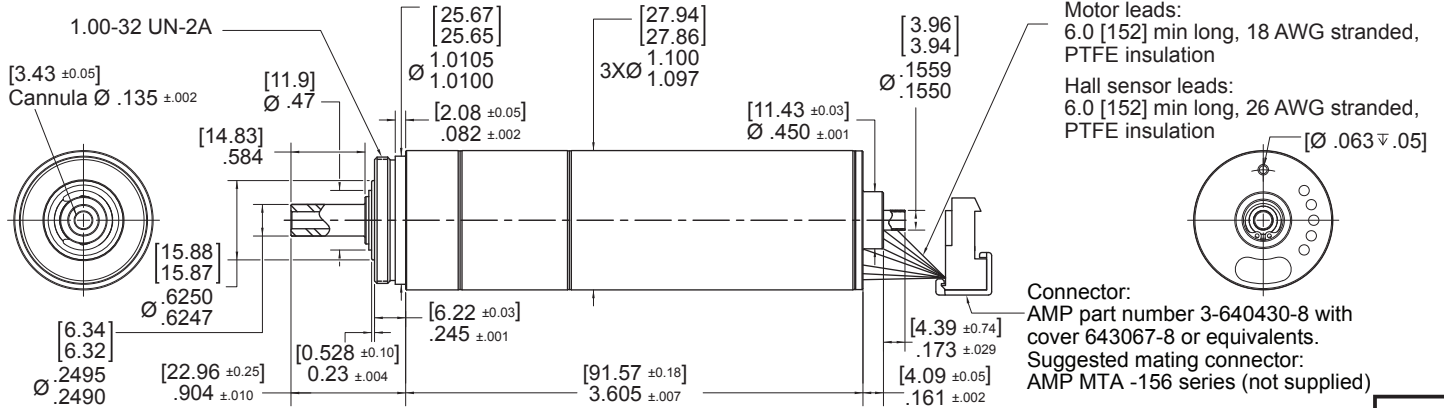
*Also available without Hall sensors

Wire	Description
Blue	Phase A
Brown	Phase B
Violet	Phase C
Red	4.5 to 24 Vdc
Yellow	Sensor 1
Orange	Sensor 2
White	Sensor 3
Black	GND



B1112A4 Large Bone Surgical Gearmotor - Drill/Reamer

Ø 1.1 inch • Brushless Slotted



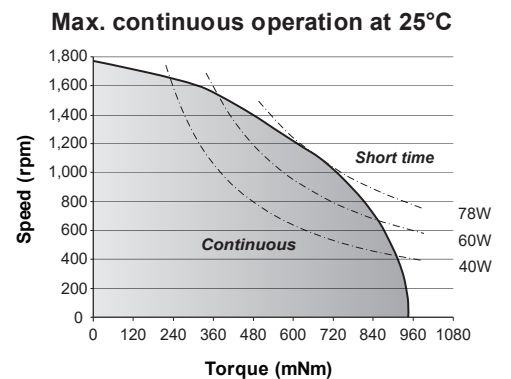
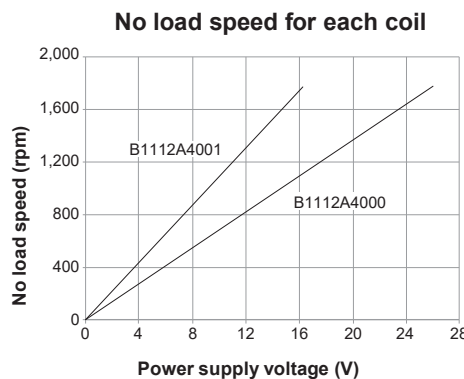
Dimensions in inches [mm]

Electrical Data	Symbol	B1112A4000	B1112A4001	Unit
1 Nominal Voltage	U_N	14.4	9.6	Volt
2 Optimization Direction	-	Symmetrical	Symmetrical	-
3 No Load Speed	n_o	938	1'053	rpm
4 Typical No Load Current	I_o	1'090	1'487	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	85.2	83.6	W
6 Max. Continuous Current	I_{cs}	9.2	13.5	A
7 Max. Continuous Torque	T_{cs}	937 (132.8)	815 (115.5)	mNm (oz-in)
8 Back EMF Constant	k_E	15	9.1	V/1000 rpm
9 Torque Constant	k_T	118.7 (16.8)	70.6 (10)	mNm/A (oz-in/A)
10 Motor Regulation	R/k^2	0.008	0.011	$10^3/Nms$
11 Peak Torque	T_{pk}	14'200 (2015)	11'900 (1683)	mNm (oz-in)
12 Motor Constant	k_M	345 (48.7)	295 (41.8)	mNm/W ^{1/2} (oz-in/W ^{1/2})
13 Line to Line Resistance	R_L	0.119	0.057	ohms
14 Inductance Phase to Phase	L	0.057	0.023	mH
15 Mechanical Time Constant	T_m	1.79	2.46	ms
16 Electrical Time Constant	T_e	0.48	0.4	ms

General Data				
17 Gearhead Ratio	-	16:1	16:1	Ratio
18 Ambient Working Temperature Range	-	-30 to +135 (-22 to +275)	-30 to +135 (-22 to +275)	°C (°F)
19 Maximum Winding Temperature	-	155 (311)	155 (311)	°C (°F)
20 Radial Static Force w/o Shaft Support (max)	-	78 (17.5)	100 (22.5)	N (lbs)
21 Axial Static Force w/o Shaft Support (max)	-	85 (19)	55 (12.5)	N (lbs)
22 Thermal Resistance	R_{th}	8.3	8.3	°C/W
23 Thermal Time Constant	T_w	900	900	s
24 Weight	-	354 (12.5)	350 (12.4)	g (oz)
25 Rotor Inertia	J_m	84.7 (120)	84.7 (120)	kg-cm ² 10 ⁻⁴ (oz-in-sec ² 10 ⁻⁶)
26 Hall Sensor Electrical Phasing*	-	60	60	Electrical °
27 Autoclave Cycles	-	1000+	1000+	Cycles

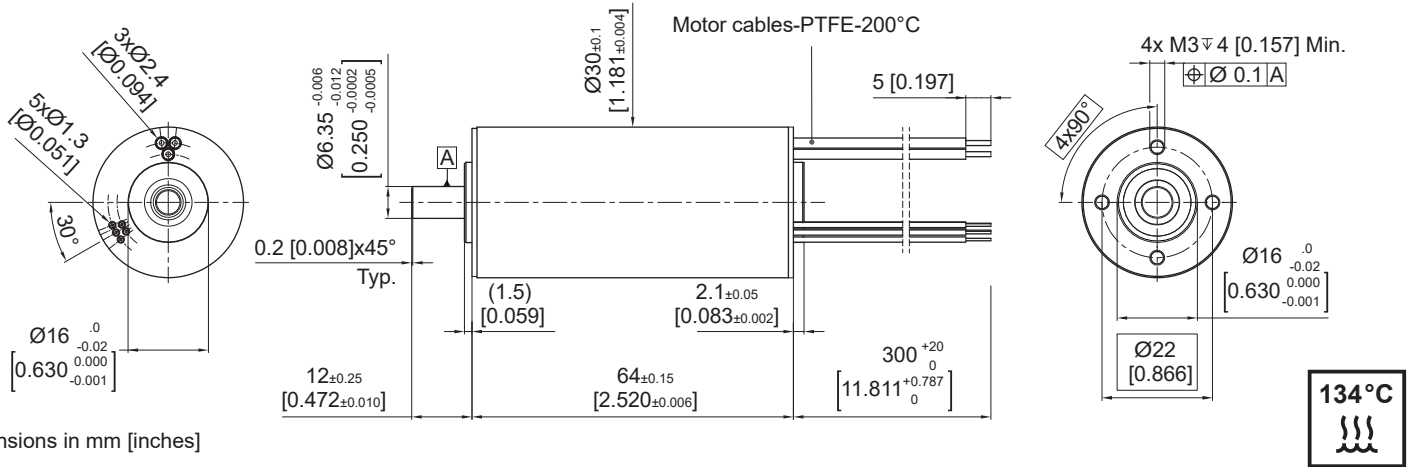
*Also available without Hall sensors

Wire	Description
Blue	Phase A
Brown	Phase B
Violet	Phase C
Red	4.5 to 24 Vdc
Yellow	Sensor 1
Orange	Sensor 2
White	Sensor 3
Black	GND



30ECA64 Large Bone Orthopedic Surgical Motor

Ø30 mm • Brushless Slotless



Dimensions in mm [inches]

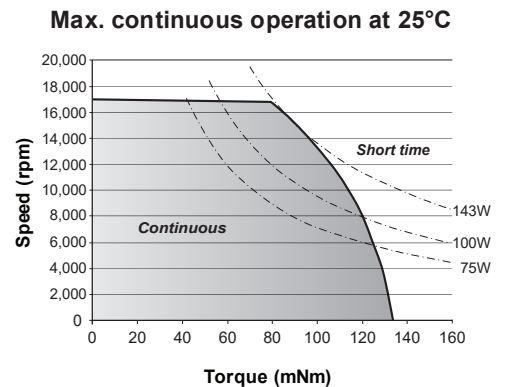
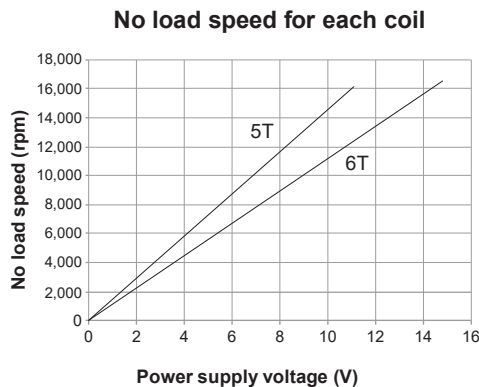
Electrical Data	Symbol	30ECA64 8B XX.01		Unit
		5T	6T	
1 Nominal Voltage	U_N	11.1	14.8	Volt
2 Optimization Direction	-	Symmetrical	Symmetrical	-
3 No Load Speed	n_o	16'100	16'488	rpm
4 Typical No Load Current	I_o	700	700	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	165	142	W
6 Max. Continuous Current	I_{cs}	18.5	15.6	A
7 Max. Continuous Torque	T_{cs}	121.4 (17.19)	133.5 (18.91)	mNm (oz-in)
8 Back EMF Constant	k_E	0.69	0.9	V/1000 rpm
9 Torque Constant	k_T	6.6 (0.935)	8.6 (1.218)	mNm/A (oz-in/A)
10 Motor Regulation	R/k^2	0.777	0.612	10 ³ /Nms
11 Peak Torque	T_{pk}	N/A	N/A	mNm (oz-in)
12 Motor Constant	k_M	32 (4.54)	36.7 (5.12)	mNm/W ^{1/2} (oz-in/W ^{1/2})
13 Line to Line Resistance	R_L	0.0426	0.0548	ohms
14 Inductance Phase to Phase	L	0.0077	0.011	mH
15 Mechanical Time Constant	T_m	2.1	1.6	ms
16 Electrical Time Constant	T_e	0.23	0.24	ms

General Data			
17 Gearhead Ratio	-	N/A	Ratio
18 Ambient Working Temperature Range	-	-30 to +135 (-22 to +275)	°C (°F)
19 Maximum Winding Temperature	-	155 (311)	°C (°F)
20 Radial Static Force w/o Shaft Support (max)	-	294 (66) @10mm from front mounting face	N (lbs)
21 Axial Static Force w/o Shaft Support (max)	-	134 (30)	N (lbs)
22 Thermal Resistance	R_{th}	7.9	°C/W
23 Thermal Time Constant	T_w	1310	s
24 Weight	-	260 (9.2)	g (oz)
25 Rotor Inertia	J_m	266 (377)	kg-cm ² 10 ⁻⁴ (oz-in-sec ² 10 ⁻⁶)
26 Hall Sensor Electrical Phasing*	-	120	Electrical °
27 Autoclave Cycles	-	500	Cycles

*Also available without Hall sensors

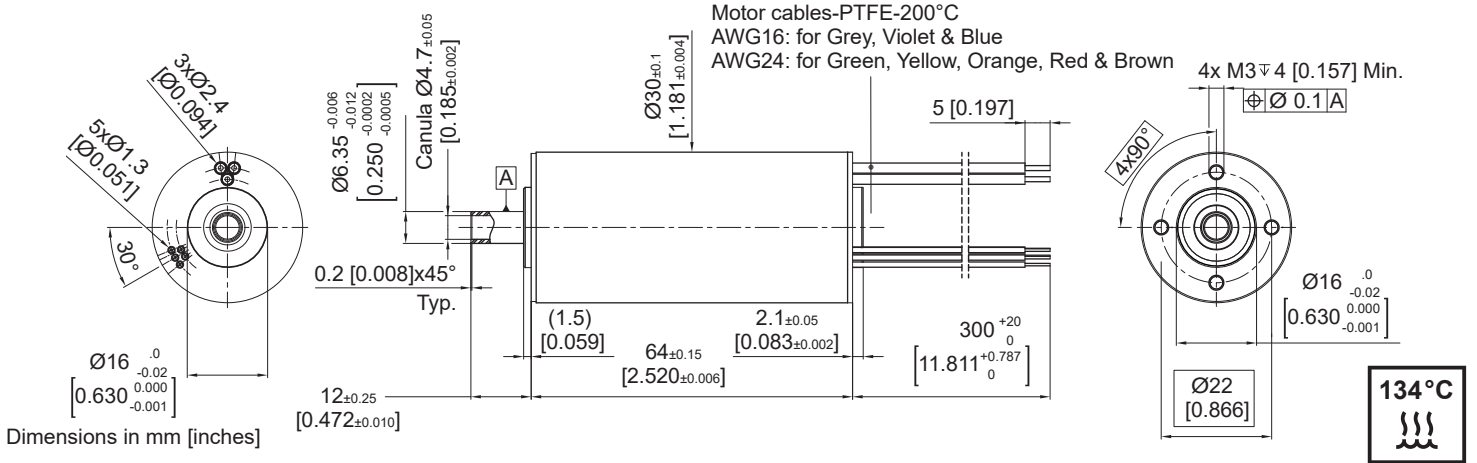
Wire	Description
Gray	Phase 1 (AWG16)
Violet	Phase 2 (AWG16)
Blue	Phase 3 (AWG16)
Green	3.5 to 24V DC (AWG24)
Yellow	GND (AWG24)
Orange	Sensor 1 (AWG24)
Red	Sensor 2 (AWG24)
Brown	Sensor 3 (AWG24)

with hall effect sensor



30ECA64 Large Bone Orthopedic Surgical Motor
Cannulated

Ø30 mm • Brushless Slotless



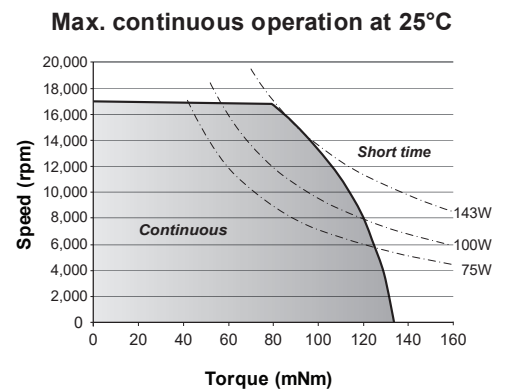
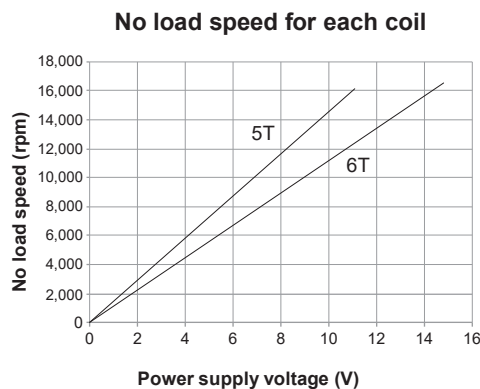
Electrical Data	Symbol	30ECA64 8B XX.01		Unit
		5T	6T	
1 Nominal Voltage	U_N	11.1	14.8	Volt
2 Optimization Direction	-	Symmetrical	Symmetrical	-
3 No Load Speed	n_o	16'100	16'488	rpm
4 Typical No Load Current	I_o	700	700	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	165	142	W
6 Max. Continuous Current	I_{cs}	18.5	15.6	A
7 Max. Continuous Torque	T_{cs}	121.4 (17.19)	133.5 (18.91)	mNm (oz-in)
8 Back EMF Constant	k_E	0.69	0.9	V/1000 rpm
9 Torque Constant	k_T	6.6 (0.935)	8.6 (1.218)	mNm/A (oz-in/A)
10 Motor Regulation	R/k^2	0.777	0.612	10 ³ /Nms
11 Peak Torque	T_{pk}	N/A	N/A	mNm (oz-in)
12 Motor Constant	k_M	32 (4.54)	36.7 (5.12)	mNm/W ^{1/2} (oz-in/W ^{1/2})
13 Line to Line Resistance	R_L	0.0426	0.0548	ohms
14 Inductance Phase to Phase	L	0.0077	0.011	mH
15 Mechanical Time Constant	T_m	2.1	1.6	ms
16 Electrical Time Constant	T_e	0.23	0.24	ms

General Data			
17 Gearhead Ratio	-	N/A	Ratio
18 Ambient Working Temperature Range	-	-30 to +135 (-22 to +275)	°C (°F)
19 Maximum Winding Temperature	-	155 (311)	°C (°F)
20 Radial Static Force w/o Shaft Support (max)	-	294 (66) @10mm from front mounting face	N (lbs)
21 Axial Static Force w/o Shaft Support (max)	-	134 (30)	N (lbs)
22 Thermal Resistance	R_{th}	7.9	°C/W
23 Thermal Time Constant	T_w	1310	s
24 Weight	-	260 (9.2)	g (oz)
25 Rotor Inertia	J_m	266 (377)	kg-cm ² 10 ⁻⁴ (oz-in-sec ² 10 ⁻⁶)
26 Hall Sensor Electrical Phasing*	-	120	Electrical °
27 Autoclave Cycles	-	500	Cycles

*Also available without Hall sensors

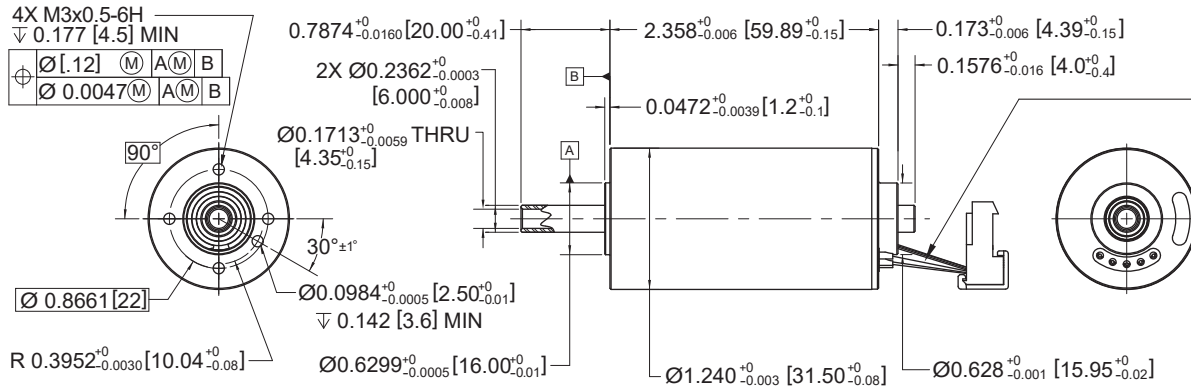
Wire	Description
Gray	Phase 1 (AWG16)
Violet	Phase 2 (AWG16)
Blue	Phase 3 (AWG16)
Green	3.5 to 24V DC (AWG24)
Yellow	GND (AWG24)
Orange	Sensor 1 (AWG24)
Red	Sensor 2 (AWG24)
Brown	Sensor 3 (AWG24)

with hall effect sensor



B1210N1021 Large Bone Orthopedic Drill/Wire Driver

Ø 1.24 inch • Brushless Slotted • 9.6 V



HALL SENSOR LEADS:
6.0 [152.4] MIN LONG,
26 AWG STRANDED

MOTOR LEADS:
6.0 [152.4] MIN LONG,
18 AWG STRANDED

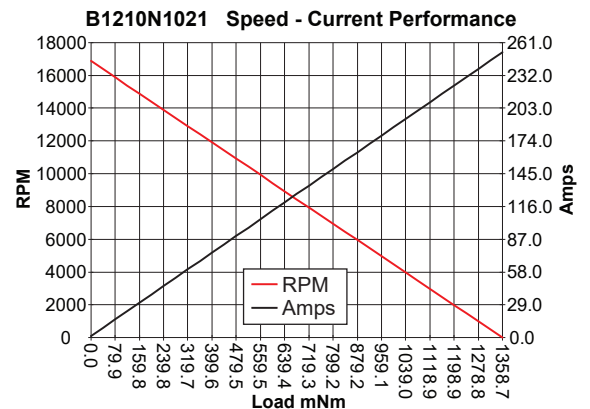
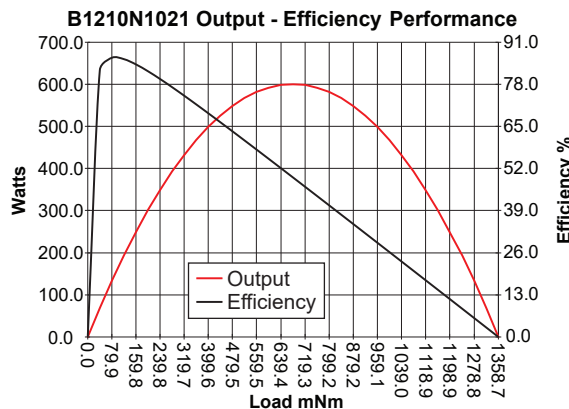
Dimensions in inches [mm]

Electrical Data	Symbol	SMX B1210N1021	Unit
1 Nominal Voltage	U_N	9.6	Volt
2 Optimization Direction	-	Bi-Directional	-
3 No Load Speed	n_0	16,800	rpm
4 Typical No Load Current	I_0	1267	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	123.4	W
6 Max. Continuous Current	I_{cs}	16.1	A
7 Max. Continuous Torque	T_{cs}	83.1 (11.77)	mNm (oz-in)
8 Back EMF Constant	k_E	0.566	V/1000 rpm
9 Torque Constant	k_T	5.41 (0.77)	mNm/A (oz-in/A)
10 Motor Regulation	R/k^2	1298	$10^3/Nms$
11 Peak Torque	T_{pk}	1365.4 (193.4)	mNm (oz-in)
12 Motor Constant	k_M	27.73 (3.93)	mNm/W ^{1/2} (oz-in/W ^{1/2})
13 Line to Line Resistance	R_L	0.038	ohms
14 Inductance Phase to Phase	L	0.018	mH
15 Mechanical Time Constant	T_m	1.85	ms
16 Electrical Time Constant	T_e	0.474	ms

General Data	Symbol	SMX B1210N1021	Unit
17 Gearhead Ratio	-	N/A	Ratio
18 Ambient Working Temperature Range	-	25 (77)	°C (°F)
19 Max Operating Temperature Range	-	155 (311)	°C (°F)
20 Radial Static Force w/o Shaft Support (max)	-	80.28	lbs
21 Axial Static Force w/o Shaft Support (max)	-	27.17	lbs
22 Thermal Resistance	R_{th}	8.7	°C/W
23 Thermal Time Constant	T_w	975	s
24 Weight	-	265 (9.35)	g (oz)
25 Rotor Inertia	J_m	133 (189)	kg-cm ² 10 ⁻⁴ (oz-in-sec ² 10 ⁻⁶)
26 Hall Sensor Electrical Phasing*	-	60	Electrical °
27 Autoclave Cycles	-	1000+	Cycles

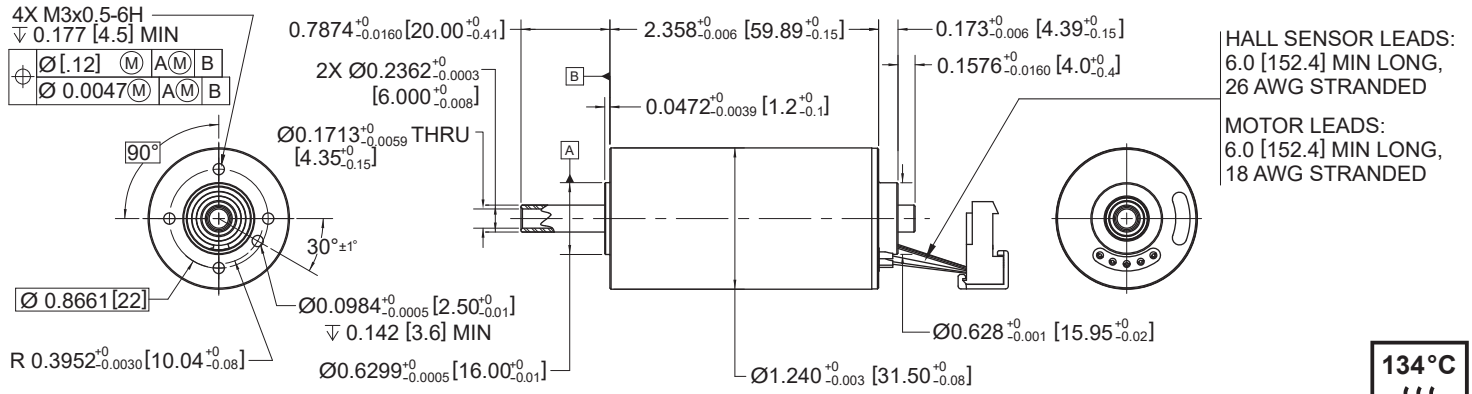
*Also available without Hall sensors

Wire	Description
Blue	Phase A
Brown	Phase B
Violet	Phase C
Red	4.5 to 24 Vdc
Yellow	Sensor 1
Orange	Sensor 2
White	Sensor 3
Black	GND



B1210N1023 Large Bone Orthopedic Drill/Wire Driver

Ø 1.24 inch • Brushless Slotted • 14.4 V

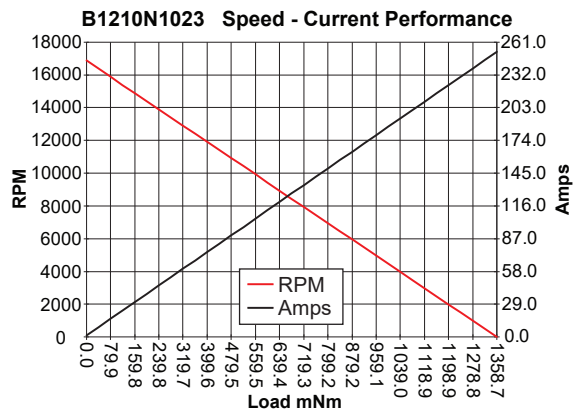
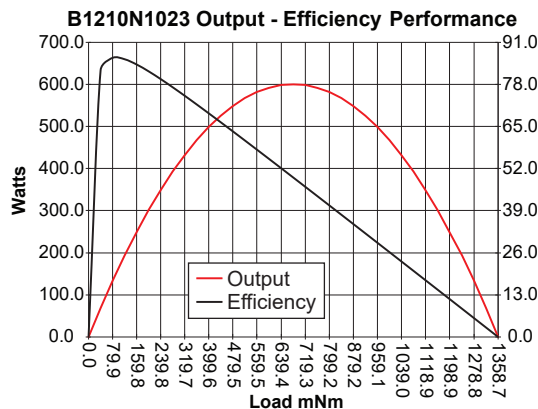


Electrical Data	Symbol	SMX B1210N1023	Unit
1 Nominal Voltage	U _N	14.4	Volt
2 Optimization Direction	-	Bi-Directional	-
3 No Load Speed	n ₀	15,700	rpm
4 Typical No Load Current	I ₀	760	mA
5 Max. Continuous Mechanical Power (@25°C)	P _{max}	130.4	W
6 Max. Continuous Current	I _{cs}	11.3	A
7 Max. Continuous Torque	T _{cs}	95.9 (13.58)	mNm (oz-in)
8 Back EMF Constant	k _E	0.93	V/1000 rpm
9 Torque Constant	k _T	8.88 (1.26)	mNm/A (oz-in/A)
10 Motor Regulation	R/k ²	976	10 ³ /Nms
11 Peak Torque	T _{pk}	1660.8 (235.2)	mNm (oz-in)
12 Motor Constant	k _M	32.01 (4.53)	mNm/W ^{1/2} (oz-in/W ^{1/2})
13 Line to Line Resistance	R _L	0.077	ohms
14 Inductance Phase to Phase	L	0.045	mH
15 Mechanical Time Constant	τ _m	1.39	ms
16 Electrical Time Constant	τ _e	0.584	ms

General Data			
17 Gearhead Ratio	-	N/A	Ratio
18 Ambient Working Temperature Range	-	25 (77)	°C (°F)
19 Max Operating Temperature Range	-	155 (311)	°C (°F)
20 Radial Static Force w/o Shaft Support (max)	-	80.28	lbs
21 Axial Static Force w/o Shaft Support (max)	-	27.17	lbs
22 Thermal Resistance	R _{th}	8.7	°C/W
23 Thermal Time Constant	τ _w	975	s
24 Weight	-	267 (9.42)	g (oz)
25 Rotor Inertia	J _m	133 (189)	kg-cm ² 10 ⁻⁴ (oz-in-sec ² 10 ⁻⁶)
26 Hall Sensor Electrical Phasing*	-	60	Electrical °
27 Autoclave Cycles	-	1000+	Cycles

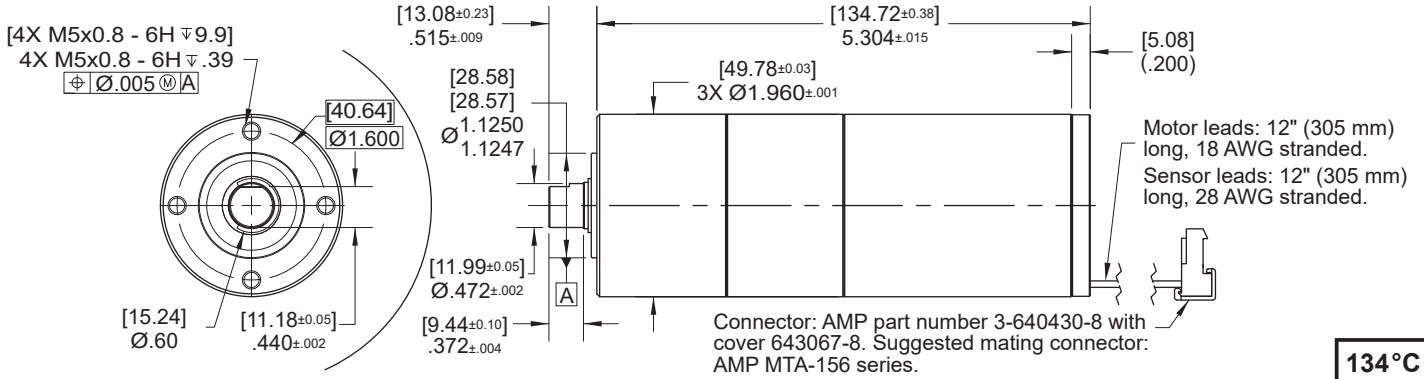
*Also available without Hall sensors

Wire	Description
Blue	Phase A
Brown	Phase B
Violet	Phase C
Red	4.5 to 24 Vdc
Yellow	Sensor 1
Orange	Sensor 2
White	Sensor 3
Black	GND

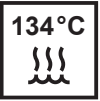


B2010A4 Bone Mill Surgical Gearmotor

Ø 2 inch • Brushless Slotted



Dimensions in inches [mm]

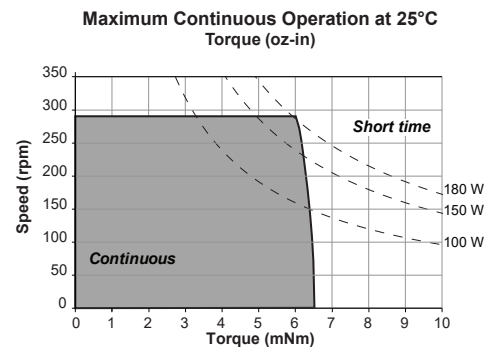
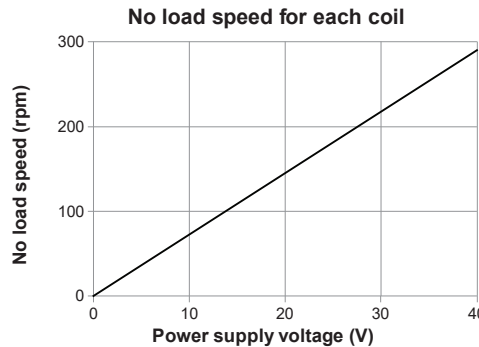


Electrical Data	Symbol	B2010A4000	Unit
1 Nominal Voltage	U_N	40.0	Volt
2 Optimization Direction	-	Symmetrical	-
3 No Load Speed	n_0	290	rpm
4 Typical No Load Current	I_0	1010	mA
5 Max. Continuous Mechanical Power (@25°C)	P_{max}	180	W
6 Max. Continuous Current	I_{cs}	6.42	A
7 Max. Continuous Torque	T_{cs}	6526.6 (923.4)	mNm (oz-in)
8 Back EMF Constant	k_E	146.6	V/1000 rpm
9 Torque Constant	k_T	1067.2 (151.3)	mNm/A (oz-in/A)
10 Motor Regulation	R/k^2	0.483	$10^3/Nms$
11 Peak Torque	T_{pk}	76'966 (10'898)	mNm (oz-in)
12 Motor Constant	k_M	71.1 (10.1)	mNm/W ^{1/2} (oz-in/W ^{1/2})
13 Line to Line Resistance	R_L	0.550	ohms
14 Inductance Phase to Phase	L	0.430	mH
15 Mechanical Time Constant	τ_m	4.14	ms
16 Electrical Time Constant	τ_e	0.782	ms

General Data			
17 Gearhead Ratio	-	25:1	Ratio
18 Ambient Working Temperature Range	-	30 to +135 (-22 to +275)	°C (°F)
19 Max Winding Temperature	-	155 (311)	°C (°F)
20 Radial Static Force w/o Shaft Support (max)	-	205 (912)	lbs (N)
21 Axial Static Force w/o Shaft Support (max)	-	98.2 (437)	lbs (N)
22 Thermal Resistance	R_{th}	3.81	°C/W
23 Thermal Time Constant	τ_w	1109	s
24 Weight	-	1495 (52.73)	g (oz)
25 Rotor Inertia	J_m	3601.9 (0.051)	kg-cm ² 10 ⁻⁴ (oz-in-sec ² 10 ⁻⁶)
26 Hall Sensor Electrical Phasing*	-	60	Electrical °
27 Autoclave Cycles	-	1000+	Cycles

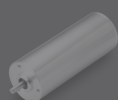
*Also available without Hall sensors

Wire	Description
Blue	Phase A
Brown	Phase B
Violet	Phase C
Red	4.5 to 24 Vdc
Yellow	Sensor 1
Orange	Sensor 2
White	Sensor 3
Black	GND



A large grid of graph paper for taking notes, consisting of 20 columns and 40 rows of small squares.





Brushless DC motors



Brush DC motors



Disc magnet motors



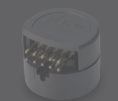
Can stack motors



Can stack linear actuators



Gearheads



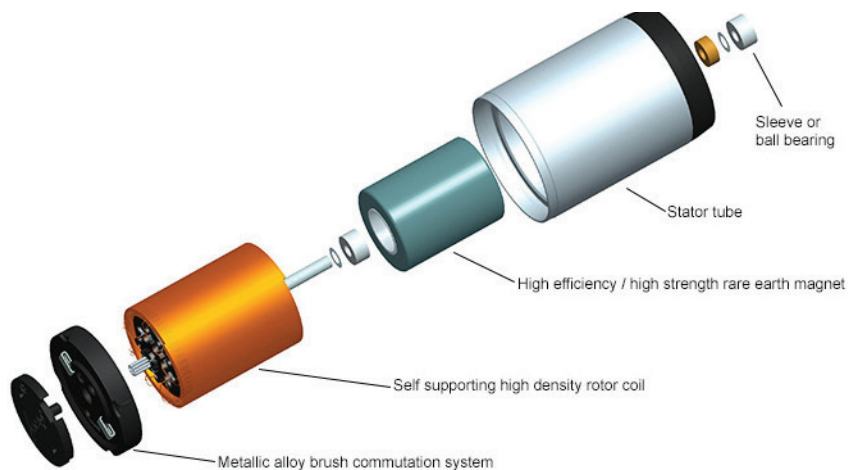
Encoders



Controllers

Brush DC Motors

Featuring a permanent magnet, coreless design, our brush DC motors deliver high efficiency and power density in a small, lightweight package. Built of high-quality materials for optimal performance, these motors offer a low moment of inertia, low friction and a long commutator life. They're perfect for compact applications requiring high acceleration, torque and efficiency, with no cogging.



Compact, Efficient, Versatile Performance

Feature	Details	Application Advantages
Ultra-compact design	<ul style="list-style-type: none"> • Exceptional power density • High torque-to-volume ratio • Lightweight • Excellent heat dissipation 	<ul style="list-style-type: none"> • Greater design flexibility • User comfort and convenience in handheld applications
Coreless rotor	<ul style="list-style-type: none"> • Ironless, self-supporting coil • Minimal air gaps • No inactive coil heads 	<ul style="list-style-type: none"> • High acceleration, low moment of inertia • Low friction, low starting voltage • No cogging • No iron losses
Precious metal commutation system	<ul style="list-style-type: none"> • Low contact resistance, low friction • Available with REE coils 	<ul style="list-style-type: none"> • Low no-load current, low starting voltage • Reduced electro erosion for longer brush lifetime
Graphite-copper commutation	<ul style="list-style-type: none"> • High current carrying capacity • Available with REE coils 	<ul style="list-style-type: none"> • Perfect for boost in start-stop applications or incremental motions • Reduced electro erosion for longer brush lifetime
Neodymium permanent magnet	<ul style="list-style-type: none"> • High magnetic flux • Exceptional resistance to demagnetization 	<ul style="list-style-type: none"> • High power and efficiency in a small, lightweight package • Linear speed-torque curve • Consistent power density over the motor lifetime
Alnico permanent magnet	<ul style="list-style-type: none"> • Medium magnetic flux 	<ul style="list-style-type: none"> • Low magnetic flux leakage • Cost-effective • Linear speed-torque curve • Consistent power density over the motor lifetime



Ideal for Small, Portable and Handheld Devices



Medical devices & clinical diagnostics

- Laboratory automation
- Infusion systems
- Insulin pumps
- Diagnostic analyzers
- Miniature pumps



Instrumentation

- Dosing & dispensing systems
- Gas detection
- Land surveying
- Microscopes
- Explosive trace detection systems



Automation

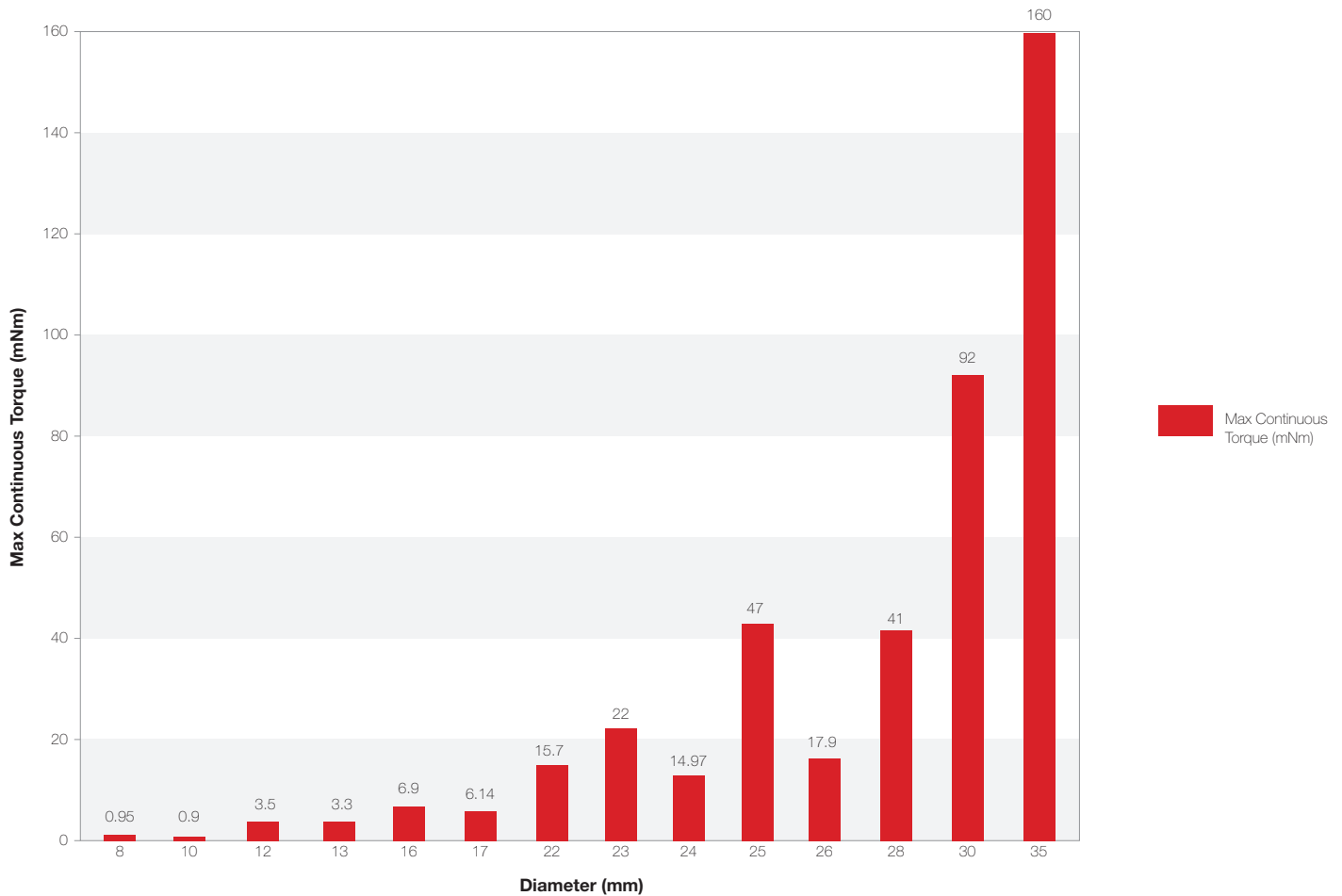
- Humanoid robots



Other

- Power hand tools
- Rotary tattoo machines
- Valve actuation

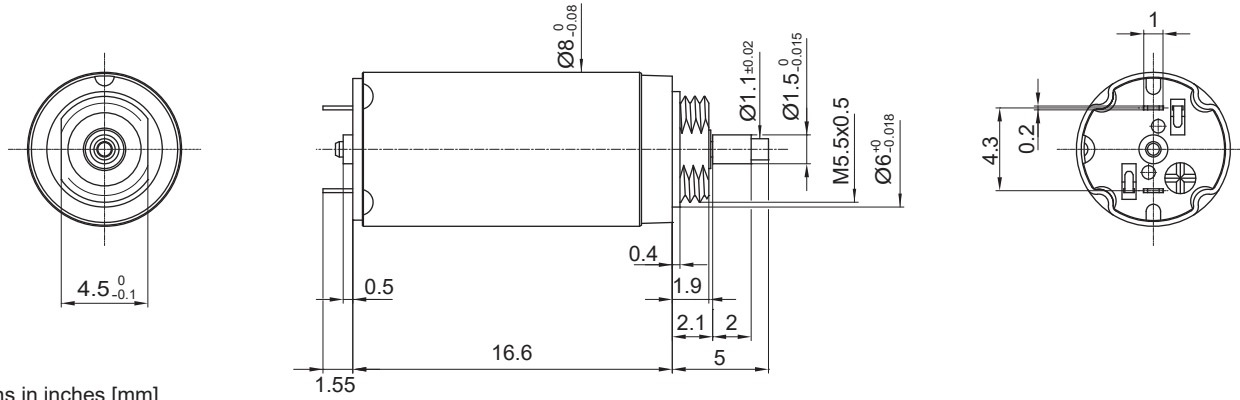
Meet your Application's Working Point Requirements



For complete product and application details, visit portescap.com/brush-dc

08GS61

Ø 8 mm • Precious metal commutation • 0.65 mNm



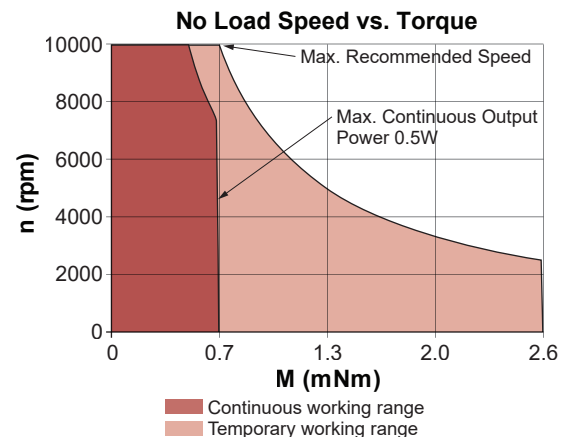
Dimensions in inches [mm]

Electrical Data	Symbol	08GS613			Unit
		107	105	105C	
1 Nominal Voltage	V	2	4.5	6	Volt
2 No-Load Speed	n ₀	7,000	10,670	11,000	rpm
3 No-Load Current	I ₀	6.0	4.0	3.0	mA
4 Terminal Resistance	R	12.6	30.0	45.8	Ω
5 Output Power	P _{2max.}	0.5	0.5	0.5	W
6 Stall Torque	mNm	0.42 (0.06)	0.59 (0.09)	0.64 (0.1)	mNm (oz-in)
7 Efficiency	h _{max.}	65	70	72	%
8 Max Continuous Speed	n _{e max.}	10,000	10,000	10,000	rpm
9 Max Continuous Torque	M _{e max.}	0.64 (0.1)	0.64 (0.1)	0.66 (0.1)	mNm (oz-in)
10 Max Continuous Current	I _{e max.}	0.25	0.17	0.13	A
11 Back-EMF Constant	k _E	0.28	0.41	0.53	mV/rpm
12 Torque Constant	k _M	2.63	3.92	5.10	mNm/A
13 Motor Regulation	R/k ²	1,820.0	1,950.0	1,760.0	10 ³ /Nms
14 Friction Torque	T _F	0.02 (0.01)	0.02 (0.01)	0.02 (0.01)	mNm (oz-in)
15 Rotor Inductance	L	0.06	0.11	0.20	mH
16 Mechanical Time Constant	τ _m	5.5	5.9	5.3	ms
17 Rotor Inertia	J	0.03	0.03	0.03	g-cm ²

General Data				
18 Thermal Resistance (rotor/body)	R _{th1} /R _{th2}	20/100		°C/W
19 Thermal Time Constant (rotor/stator)	t _{w1} /t _{w2}	5/100		S
20 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)		°C (°F)
	rotor	100°C (212°F)		°C (°F)
21 Shaft Load Max.: (2 mm from bearing)	With sleeve bearings			
	-radial	0.5 (1.8)		N (oz)
	-axial	30 (107.9)		N (oz)
22 Shaft Play:	-radial	<0.015 (0.0006)		mm (inch)
	-axial	0.100 (0.0039)		mm (inch)
23 Weight	g	3.8 (0.14)		g (oz)
24 Commutation Segments	-	5		segments

Execution Table

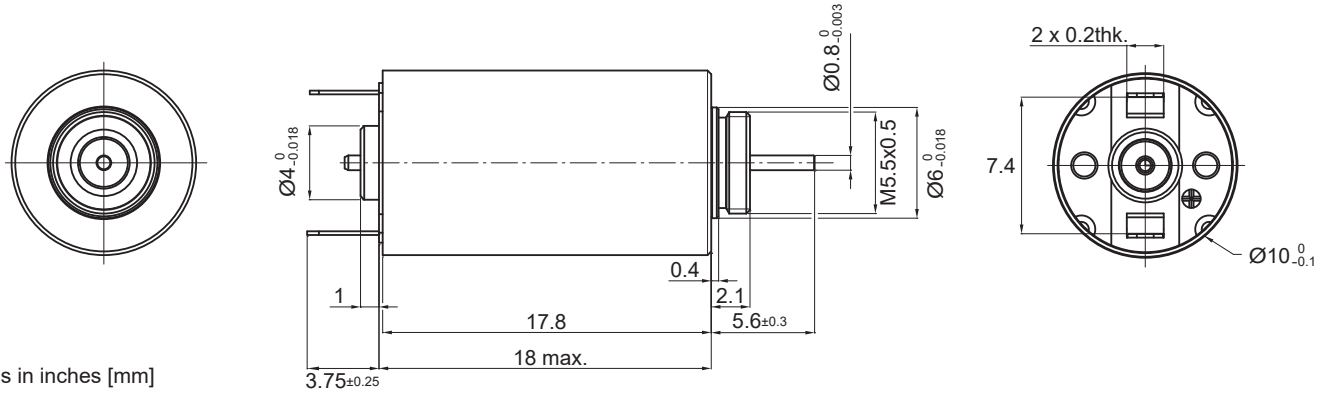
Gearbox	Single Shaft
R10	Upon Request
R08	Upon Request



► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.

10NS61 Athlonix™

Ø 10 mm • Precious metal commutation • 0.9 mNm



Dimensions in inches [mm]

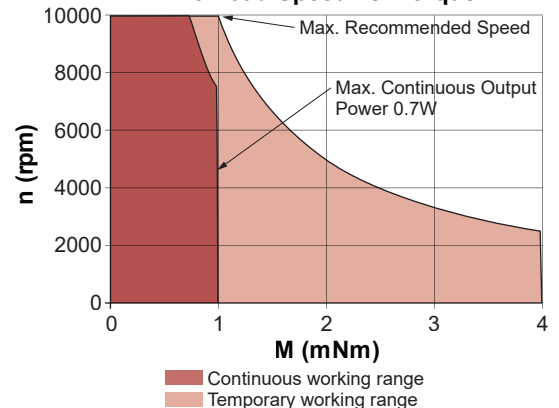
Electrical Data	Symbol	10NS61 5 107C	Unit
1 Nominal Voltage	V	3	Volt
2 No-Load Speed	n_0	10,100	rpm
3 No-Load Current	I_0	11.0	mA
4 Terminal Resistance	R	10.8	Ω
5 Output Power	$P_{2max.}$	0.7	W
6 Stall Torque	mNm	0.76 (0.11)	mNm (oz-in)
7 Efficiency	$h_{max.}$	64	%
8 Max Continuous Speed	$n_{e max.}$	10,000	rpm
9 Max Continuous Torque	$M_{e max.}$	0.9 (0.13)	mNm (oz-in)
10 Max Continuous Current	$I_{e max.}$	0.34	A
11 Back-EMF Constant	k_E	0.29	mV/rpm
12 Torque Constant	k_M	2.72	mNm/A
13 Motor Regulation	R/k ²	1,500.0	10 ³ /Nms
14 Friction Torque	T_F	0.02 (0.01)	mNm (oz-in)
15 Rotor Inductance	L	0.01	mH
16 Mechanical Time Constant	τ_m	7.3	ms
17 Rotor Inertia	J	0.05	g-cm ²

General Data			
18 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	23/48	°C/W
19 Thermal Time Constant (rotor/stator)	t_{W1}/t_{W2}	5/150	S
20 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)	°C (°F)
	rotor	100°C (212°F)	°C (°F)
21 Shaft Load Max.: (2 mm from bearing)		With sleeve bearings	
	-radial	0.5 (1.8)	N (oz)
	-axial	30 (107.9)	N (oz)
22 Shaft Play:	-radial	<0.015 (0.0006)	mm (inch)
	-axial	0.100 (0.0039)	mm (inch)
23 Weight	g	7 (0.25)	g (oz)
24 Commutation Segments	-	9	segments

Execution Table

Gearbox	Single Shaft
R10	3

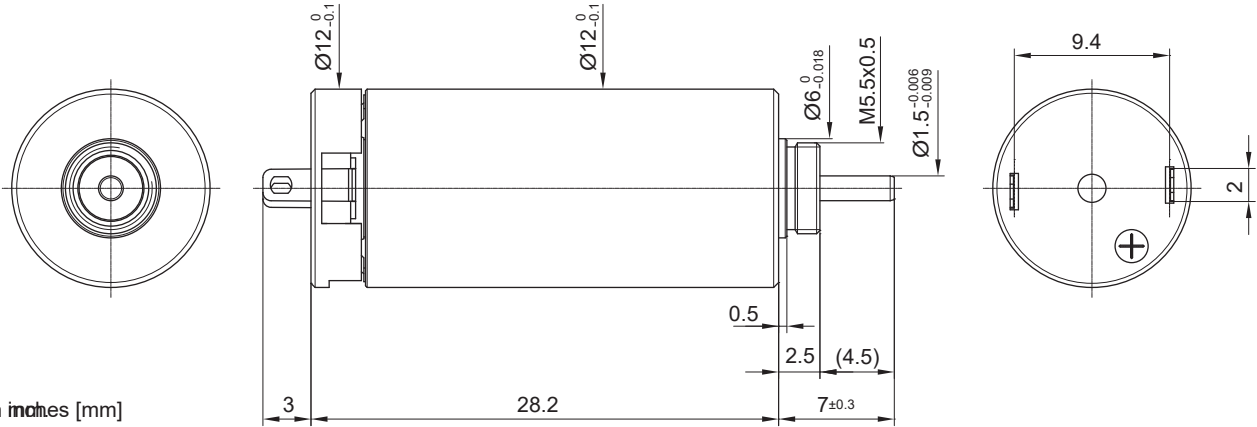
No Load Speed vs. Torque



► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.

12G88 Athlonix™

Ø 12 mm • Precious metal commutation • 3.5 mNm



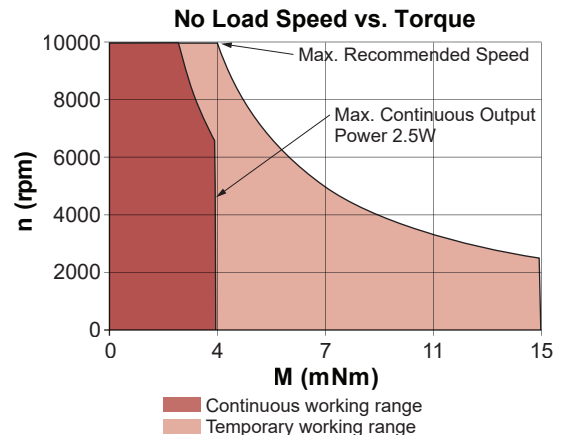
Dimensions in inches [mm]

Electrical Data	Symbol	12G88 *** .1001		Unit
		215E	210E	
1 Nominal Voltage	V	4.5	9	Volt
2 No-Load Speed	n_0	8,670	9,900	rpm
3 No-Load Current	I_0	16.0	9.0	mA
4 Terminal Resistance	R	3.2	12.3	Ω
5 Output Power	P_{2max}	2.7	2.4	W
6 Stall Torque	mNm	6.8 (0.97)	6.3 (0.9)	mNm (oz-in)
7 Efficiency	η_{max}	80	79	%
8 Max Continuous Speed	$n_{e max}$	10,000	10,000	rpm
9 Max Continuous Torque	$M_{e max}$	3.5 (0.50)	3.1 (0.44)	mNm (oz-in)
10 Max Continuous Current	$I_{e max}$	0.73	0.37	A
11 Back-EMF Constant	k_E	0.51	0.90	mV/rpm
12 Torque Constant	k_M	4.90	8.60	mNm/A
13 Motor Regulation	R/k^2	130.0	170.0	10 ³ /Nms
14 Friction Torque	T_F	0.08 (0.02)	0.08 (0.02)	mNm (oz-in)
15 Rotor Inductance	L	0.08	0.25	mH
16 Mechanical Time Constant	τ_m	3.8	4.3	ms
17 Rotor Inertia	J	0.29	0.26	g-cm ²

General Data				
18 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	10/50		°C/W
19 Thermal Time Constant (rotor/stator)	t_{w1}/t_{w2}	6/300		S
20 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)		°C (°F)
	rotor	100°C (212°F)		°C (°F)
21 Shaft Load Max.: (5 mm from bearing)	With sleeve bearings			
	-radial	1.5 (5.4)		N (oz)
	-axial	150 (539.5)		N (oz)
22 Shaft Play:	-radial	<0.015 (0.0006)		mm (inch)
	-axial	0.300 (0.012)		mm (inch)
23 Weight	g	15 (0.53)		g (oz)
24 Commutation Segment	-	9		segment

Execution Table

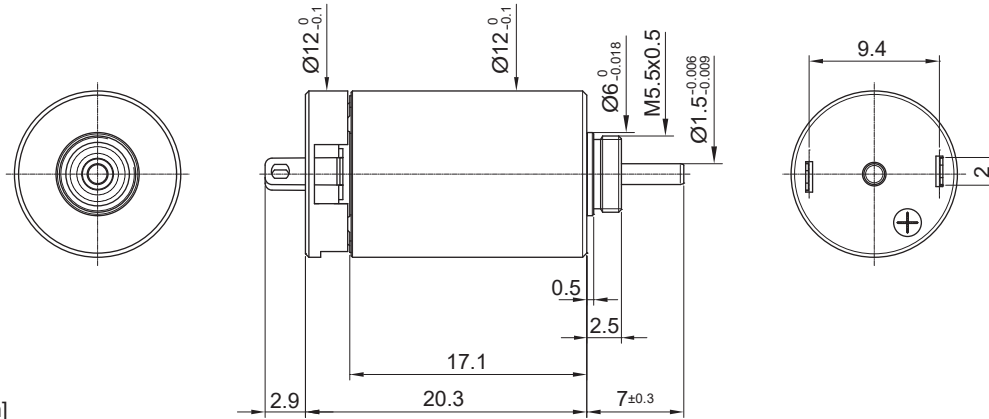
Gearbox	Single Shaft	MR2
R10	1003	1005
R13	1002	1004



► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.

12GS88 Athlonix™

Ø 12 mm • Precious metal commutation • 1.5 mNm



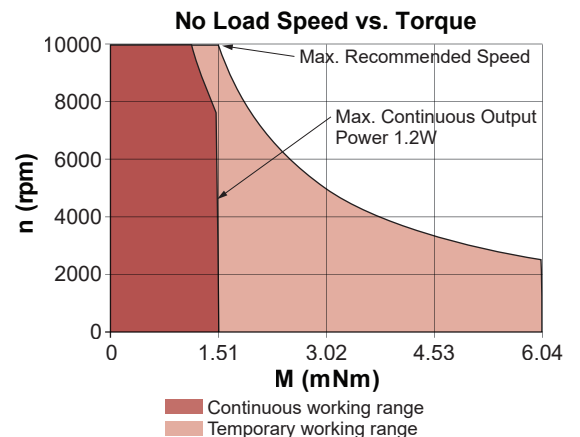
Dimensions in inches [mm]

Electrical Data	Symbol	12GS881007		Unit
		210E	208F	
1 Nominal Voltage	V	3	6	Volt
2 No-Load Speed	n_0	7,280	9,000	rpm
3 No-Load Current	I_0	14.0	12.0	mA
4 Terminal Resistance	R	7.4	20.6	Ω
5 Output Power	P_{2max}	1.2	1.1	W
6 Stall Torque	mNm	1.54 (0.22)	1.78 (0.26)	mNm (oz-in)
7 Efficiency	η_{max}	66	64	%
8 Max Continuous Speed	$n_{e max}$	10,000	10,000	rpm
9 Max Continuous Torque	$M_{e max}$	1.51 (0.21)	1.45 (0.21)	mNm (oz-in)
10 Max Continuous Current	$I_{e max}$	0.41	0.25	A
11 Back-EMF Constant	k_E	0.40	0.64	mV/rpm
12 Torque Constant	k_M	3.80	6.10	mNm/A
13 Motor Regulation	R/k^2	512.0	550.0	$10^3/Nms$
14 Friction Torque	T_F	0.07 (0.01)	0.07 (0.01)	mNm (oz-in)
15 Rotor Inductance	L	0.09	0.25	mH
16 Mechanical Time Constant	τ_m	9.7	12.0	ms
17 Rotor Inertia	J	0.19	0.21	g-cm ²

General Data			
18 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	14/66	$^{\circ}C/W$
19 Thermal Time Constant (rotor/stator)	t_{W1}/t_{W2}	5/150	S
20 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)	$^{\circ}C (^{\circ}F)$
	rotor	100°C (212°F)	$^{\circ}C (^{\circ}F)$
21 Shaft Load Max.: (5 mm from bearing)	-radial	1.5 (5.4)	N (oz)
	-axial	150 (539.5)	N (oz)
	-radial	<0.03 (0.0012)	mm (inch)
22 Shaft Play:	-radial	0.15 (0.0059)	mm (inch)
	-axial		
23 Weight	g	13.5 (0.48)	g (oz)
24 Commutation Segment	-	9	segment

Execution Table

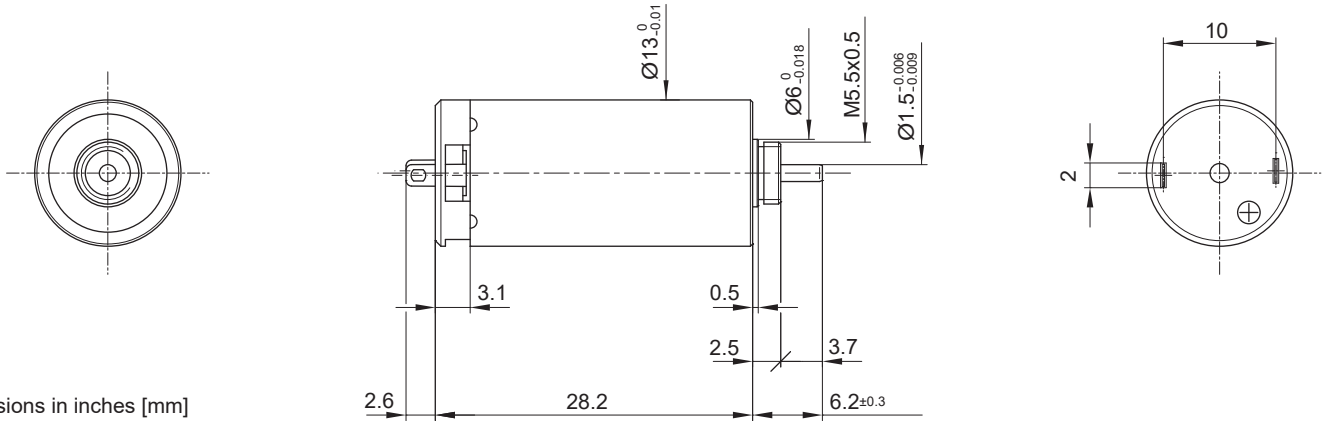
Gearbox	Single Shaft	MR2
R10	Upon Request	Upon Request
R13	Upon Request	Upon Request



► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.

13N88

Ø 13 mm • Precious metal commutation • 3.3 mNm



Dimensions in inches [mm]

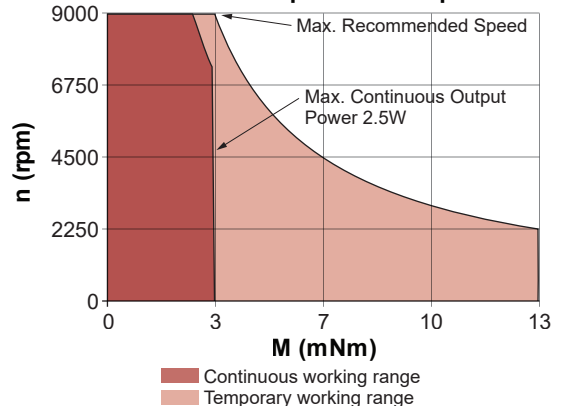
Electrical Data	Symbol	13N88 1			Unit
		213E	110	107	
1 Nominal Voltage	V	6	12	24	Volt
2 No-Load Speed	n ₀	12,290	12,400	14,150	rpm
3 No-Load Current	I ₀	25.6	13.6	8.8	mA
4 Terminal Resistance	R	4.2	13.7	47.4	Ω
5 Output Power	P _{2max.}	2.4	2.6	2.5	W
6 Stall Torque	mNm	6.5 (0.93)	8 (1.14)	8.2 (1.17)	mNm (oz-in)
7 Efficiency	h _{max.}	75	77	75	%
8 Max Continuous Speed	n _{e max.}	9,000	9,000	9,000	rpm
9 Max Continuous Torque	M _{e max.}	3 (0.47)	3.3 (0.47)	3.2 (0.46)	mNm (oz-in)
10 Max Continuous Current	I _{e max.}	0.69	0.38	0.21	A
11 Back-EMF Constant	k _E	0.48	0.95	1.67	mV/rpm
12 Torque Constant	k _M	4.58	9.10	15.90	mNm/A
13 Motor Regulation	R/k ²	200.0	165.0	185.0	10 ³ /Nms
14 Friction Torque	T _F	0.12 (0.02)	0.12 (0.02)	0.14 (0.02)	mNm (oz-in)
15 Rotor Inductance	L	0.07	0.25	0.80	mH
16 Mechanical Time Constant	τ _m	5.6	5.5	5.3	ms
17 Rotor Inertia	J	0.28	0.33	0.29	g-cm ²

General Data					
18 Thermal Resistance (rotor/body)	R _{th1} /R _{th2}	10/40			°C/W
19 Thermal Time Constant (rotor/stator)	t _{w1} /t _{w2}	6/300			S
20 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)			°C (°F)
	rotor	100°C (212°F)			°C (°F)
21 Shaft Load Max.: (5 mm from bearing)	-radial -axial	With sleeve bearings			
			1.5 (5.4)		N (oz)
22 Shaft Play:	-radial	150 (539.5)			N (oz)
	-axial	<0.03 (0.0012)			mm (inch)
23 Weight	g	0.15 (0.0059)			mm (inch)
		18 (0.64)			g (oz)
24 Commutation Segment	-	9			segment

Execution Table

Gearbox	Single Shaft	13N88D12	MR2
R13	1	3	Upon Request

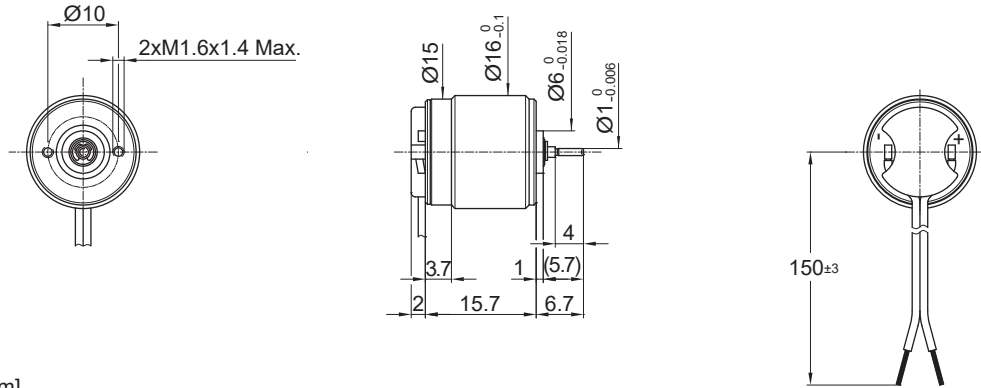
No Load Speed vs. Torque



► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.

16C18

Ø 16 mm • Precious metal commutation • 1.12 mNm



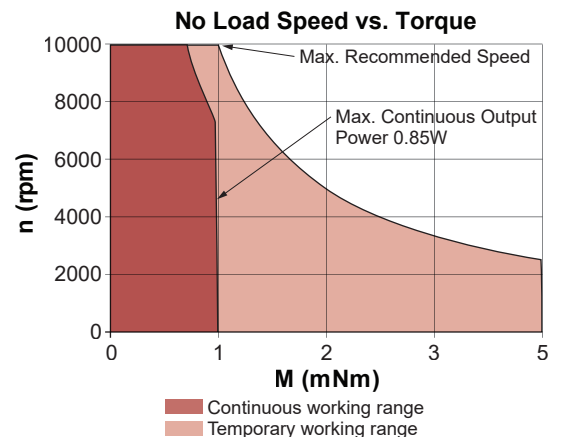
Dimensions in inches [mm]

Electrical Data	Symbol	16C18 67					Unit
		115	210	207	205	204	
1 Nominal Voltage	V	1.5	4	6	12	15	Volt
2 No-Load Speed	n_0	15,300	14,700	15,700	16,200	16,000	rpm
3 No-Load Current	I_0	74.8	23.0	18.4	10.4	6.9	mA
4 Terminal Resistance	R	1.2	7.5	18.0	65.0	162.0	Ω
5 Output Power	P_{2max}	0.7	0.8	0.7	0.8	0.7	W
6 Stall Torque	mNm	1.1	1.3	1.1	1.2	0.8	mNm (oz-in)
7 Efficiency	η_{max}	57	63	59	58	53	%
8 Max Continuous Speed	$n_{e max}$	10,000	10,000	10,000	10,000	10,000	rpm
9 Max Continuous Torque	$M_{e max}$	0.98 (0.15)	1.12 (0.15)	1 (0.15)	1 (0.14)	0.79 (0.11)	mNm (oz-in)
10 Max Continuous Current	$I_{e max}$	1.19	0.48	0.31	0.16	0.10	A
11 Back-EMF Constant	k_E	0.09	0.26	0.36	0.70	0.87	mV/rpm
12 Torque Constant	k_M	0.88	2.48	3.44	6.68	8.30	mNm/A
13 Motor Regulation	R/k^2	1555.0	1220.0	1520.0	1460.00	2350.00	10 ³ /Nms
14 Friction Torque	T_F	0.07 (0.02)	0.06 (0.01)	0.06 (0.01)	0.07 (0.02)	0.06 (0.01)	mNm (oz-in)
15 Rotor Inductance	L	20.00	150.00	250.00	1000.00	1000.00	mH
16 Mechanical Time Constant	τ_m	48.0	50.0	41.0	60.0	63.0	ms
17 Rotor Inertia	J	0.31	0.41	0.27	0.41	0.27	g-cm ²

General Data				
18 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	15/40		°C/W
19 Thermal Time Constant (rotor/stator)	t_{W1}/t_{W2}	4/230		S
20 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)		°C (°F)
	rotor	100°C (212°F)		°C (°F)
21 Shaft Load Max.: (5 mm from bearing)	-radial -axial	With sleeve bearings		
		1.5 (5.4)		N (oz)
		100 (359.6)		N (oz)
22 Shaft Play:	-radial	<0.03 (0.0012)		mm (inch)
	-axial	0.15 (0.0059)		mm (inch)
23 Weight	g	14 (0.49)		g (oz)
24 Commutation Segment	-	5		segment

Execution Table

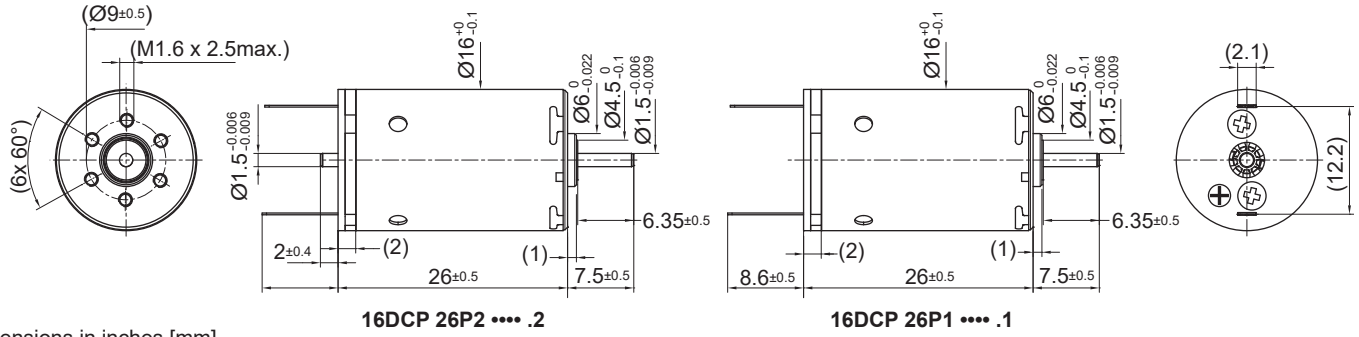
Gearbox	Single Shaft	F16
B16	67	76
BA16	67	76
R16	30	76



► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.

16DCP Athlonix™

Ø 16 mm • Precious metal commutation • 2.63 mNm



Dimensions in inches [mm]

Electrical Data	Symbol	16DCP 26P1/P2 *				Unit
		211P	208P	209E	205P	
1 Nominal Voltage	V	3	6	9	12	Volt
2 No-Load Speed	n_0	7727	8044	7904	7658	rpm
3 No-Load Current	I_0	19.4	10.1	6.6	4.8	mA
4 Terminal Resistance	R	3.3	12.1	30.7	51.4	Ω
5 Output Power	P_{2max}	1.4	1.4	1.3	1.4	W
6 Stall Torque	mNm	3.25 (0.47)	3.4 (0.49)	3.04 (0.44)	3.35 (0.48)	mNm (oz-in)
7 Efficiency	h_{max}	73	74	72	73	%
8 Max Continuous Speed	$n_{e max}$	10000	10000	10000	10000	rpm
9 Max Continuous Torque	$M_{e max}$	2.58 (0.37)	2.59 (0.37)	2.46 (0.35)	2.63 (0.38)	mNm (oz-in)
10 Max Continuous Current	$I_{e max}$	0.73	0.38	0.24	0.18	A
11 Back-EMF Constant	k_E	0.38	0.73	1.11	1.53	mV/rpm
12 Torque Constant	k_M	3.63	6.98	10.63	14.65	mNm/A
13 Motor Regulation	R/k^2	248.57	247.65	272.02	239.14	10 ³ /Nms
14 Friction Torque	T_F	0.063 (0.009)	0.063 (0.009)	0.063 (0.009)	0.063 (0.009)	mNm (oz-in)
15 Mechanical Time Constant	τ_m	25.64	25.06	28.22	24.90	ms
16 Rotor Inertia	J	1.03	1.01	1.04	1.04	g-cm ²

General Data				
17 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	7/35		°C/W
18 Thermal Time Constant (rotor/stator)	t_{w1}/t_{w2}	6/380		S
19 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)		°C (°F)
	rotor	100°C (212°F)		°C (°F)
20 Shaft Load Max.: (5 mm from bearing)	-radial	With sleeve bearings 1.5 (5.39)		N (oz)
	-axial	100 (359.6)		N (oz)
	-radial	0.03 (0.0012)		mm (inch)
21 Shaft Play:	-axial	0.15 (0.0059)		mm (inch)
	-	23 (0.82)		g (oz)
22 Weight	g	9		segment
23 Commutation Segment	-	9		

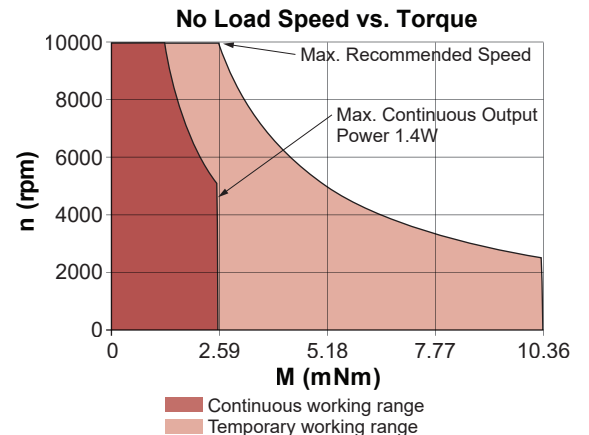
*Also available with ball bearing

Execution Table

Gearbox	Single Shaft	MR2	M Sense B
R16	1	2	10
B16	3	4	11
BA16	3	4	11

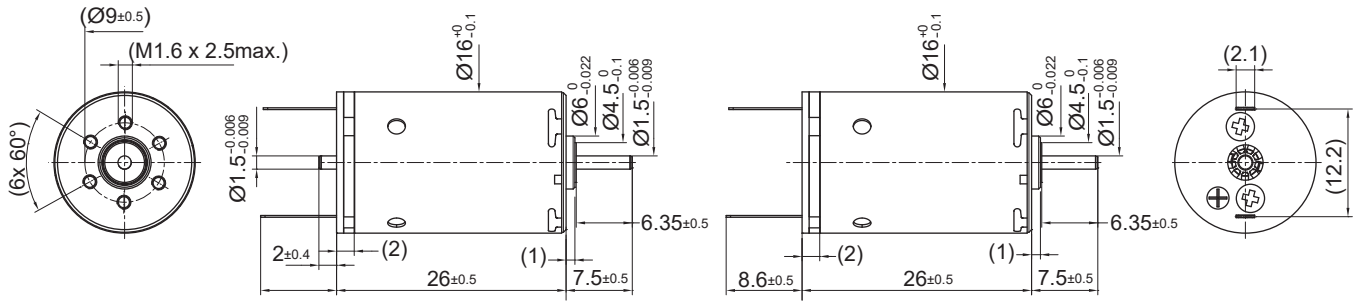
Note:
P1: standard commutation
P2: special commutation for double shaft version

► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.



16DCP Athlonix™

Ø 16 mm • Precious metal commutation • 2.63 mNm



16DCP 26P2 2

16DCP 26P1 1

Dimensions in inches [mm]

Electrical Data	Symbol	16DCP 26P1/P2 *			Unit
		107P	106P	205E	
1 Nominal Voltage	V	18	21	24	Volt
2 No-Load Speed	n_0	9684	9259	8022	rpm
3 No-Load Current	I_0	4.0	3.3	2.5	mA
4 Terminal Resistance	R	76.0	129.4	208.1	Ω
5 Output Power	P_{2max}	1.4	1.3	1.3	W
6 Stall Torque	mNm	4.06 (0.58)	3.37 (0.48)	3.15 (0.45)	mNm (oz-in)
7 Efficiency	h_{max}	76	73	73	%
8 Max Continuous Speed	$n_{e max}$	10000	10000	10000	rpm
9 Max Continuous Torque	$M_{e max}$	2.57 (0.37)	2.39 (0.34)	2.49 (0.36)	mNm (oz-in)
10 Max Continuous Current	$I_{e max}$	0.15	0.12	0.09	A
11 Back-EMF Constant	k_E	1.83	2.22	2.93	mV/rpm
12 Torque Constant	k_M	17.45	21.21	27.94	mNm/A
13 Motor Regulation	R/k^2	249.78	287.47	266.44	$10^3/Nms$
14 Friction Torque	T_F	0.063 (0.009)	0.063 (0.009)	0.063 (0.009)	mNm (oz-in)
15 Mechanical Time Constant	τ_m	24.89	24.87	28.14	ms
16 Rotor Inertia	J	1.00	0.87	1.06	g-cm ²

General Data				
17 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	7/35		°C/W
18 Thermal Time Constant (rotor/stator)	t_{W1}/t_{W2}	6/380		S
19 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)		°C (°F)
	rotor	100°C (212°F)		°C (°F)
20 Shaft Load Max.: (5 mm from bearing)	-radial	With sleeve bearings 1.5 (5.39)		N (oz)
	-axial	100 (359.6)		N (oz)
	-radial	0.03 (0.0012)		mm (inch)
21 Shaft Play:	-axial	0.15 (0.0059)		mm (inch)
	-axial			mm (inch)
22 Weight	g	23 (0.82)		g (oz)
23 Commutation Segment	-	9		segment

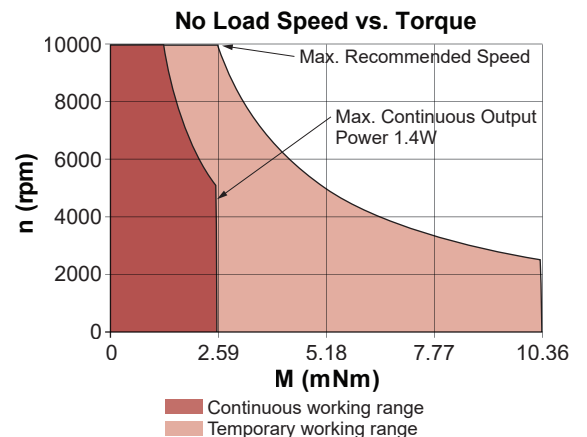
*Also available with ball bearing

Execution Table

Gearbox	Single Shaft	MR2	M Sense B
R16	1	2	10
B16	3	4	11
BA16	3	4	11

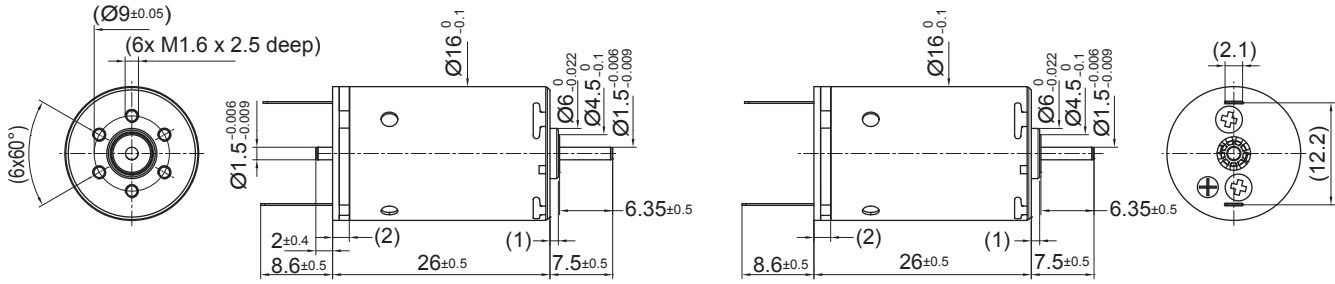
Note:
P1: standard commutation
P2: special commutation for double shaft version

► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.



16DCP Athlonix™

Ø 16 mm • Graphite-Copper commutation • 2.42 mNm



16DCP 26G2 2

16DCP 26G1 1

Dimensions in inches [mm]

Electrical Data	Symbol	16DCP 26G1/G2 *				Unit
		211P	208P	209E	205P	
1 Nominal Voltage	V	3	6	9	12	Volt
2 No-Load Speed	n_0	7210	7543	7358	7179	rpm
3 No-Load Current	I_0	77.2	40.1	26.3	19.1	mA
4 Terminal Resistance	R	3.4	12.2	30.8	51.5	Ω
5 Output Power	P_{2max}	1.2	1.2	1.2	1.3	W
6 Stall Torque	mNm	2.94 (0.42)	3.16 (0.45)	2.82 (0.4)	3.13 (0.45)	mNm (oz-in)
7 Efficiency	η_{max}	50	51	49	51	%
8 Max Continuous Speed	$n_{e max}$	10000	10000	10000	10000	rpm
9 Max Continuous Torque	$M_{e max}$	2.33 (0.33)	2.36 (0.34)	2.25 (0.32)	2.42 (0.35)	mNm (oz-in)
10 Max Continuous Current	$I_{e max}$	0.72	0.38	0.24	0.18	A
11 Back-EMF Constant	k_E	0.38	0.73	1.11	1.53	mV/rpm
12 Torque Constant	k_M	3.63	6.98	10.63	14.65	mNm/A
13 Motor Regulation	R/k^2	256.16	249.71	272.91	239.61	10 ³ /Nms
14 Friction Torque	T_F	0.25 (0.035)	0.25 (0.035)	0.25 (0.035)	0.25 (0.035)	mNm (oz-in)
15 Mechanical Time Constant	τ_m	26.42	25.27	28.31	24.95	ms
16 Rotor Inertia	J	1.03	1.01	1.04	1.04	g-cm ²

General Data				
17 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	7/35		°C/W
18 Thermal Time Constant (rotor/stator)	t_{w1}/t_{w2}	6/380		S
19 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)		°C (°F)
	rotor	100°C (212°F)		°C (°F)
20 Shaft Load Max.: (5 mm from bearing)	-radial	With sleeve bearings 1.5 (5.39)		N (oz)
	-axial	100 (359.6)		N (oz)
	-radial	0.03 (0.0012)		mm (inch)
21 Shaft Play:	-axial	0.15 (0.0059)		mm (inch)
	-	23 (0.82)		g (oz)
22 Weight	g	9		segment
23 Commutation Segment	-	9		

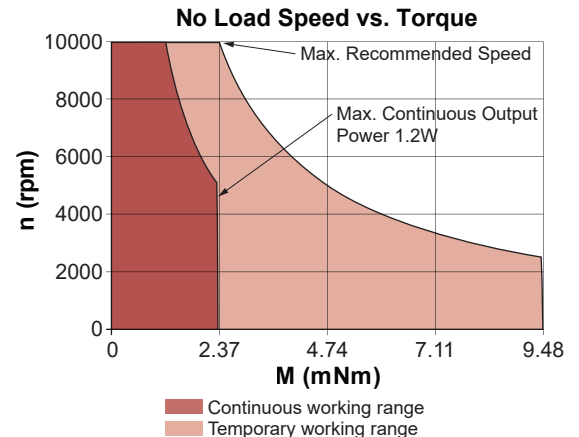
*Also available with ball bearing

Execution Table

Gearbox	Single Shaft	MR2	M Sense B
R16	1	2	10
B16	3	4	11
BA16	3	4	11

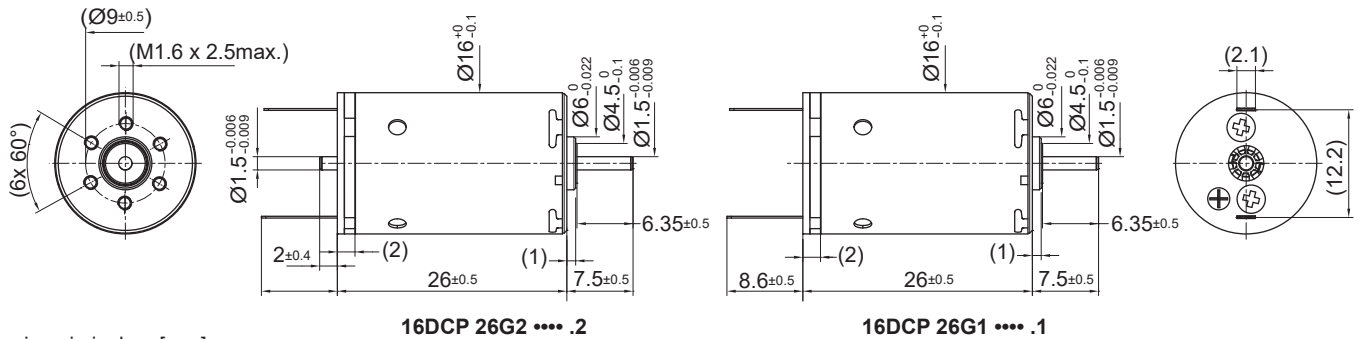
Note:
P1: standard commutation
P2: special commutation for double shaft version

► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.



16DCP Athlonix™

Ø 16 mm • Graphite-Copper commutation • 2.42 mNm



Dimensions in inches [mm]

Electrical Data	Symbol	16DCP 26G1/G2 *			Unit
		107P	106P	205E	
1 Nominal Voltage	V	18	21	24	Volt
2 No-Load Speed	n_0	9184	8684	7489	rpm
3 No-Load Current	I_0	16.0	13.2	10.0	mA
4 Terminal Resistance	R	76.1	129.5	208.2	Ω
5 Output Power	P_{2max}	1.2	1.1	1.2	W
6 Stall Torque	mNm	3.84 (0.55)	3.16 (0.45)	2.94 (0.42)	mNm (oz-in)
7 Efficiency	h_{max}	55	51	50	%
8 Max Continuous Speed	$n_{e max}$	10000	10000	10000	rpm
9 Max Continuous Torque	$M_{e max}$	2.36 (0.34)	2.18 (0.31)	2.28 (0.33)	mNm (oz-in)
10 Max Continuous Current	$I_{e max}$	0.15	0.12	0.09	A
11 Back-EMF Constant	k_E	1.83	2.22	2.93	mV/rpm
12 Torque Constant	k_M	17.45	21.21	27.94	mNm/A
13 Motor Regulation	R/k^2	250.11	287.70	266.57	$10^3/Nms$
14 Friction Torque	T_F	0.25 (0.035)	0.25 (0.035)	0.25 (0.035)	mNm (oz-in)
15 Mechanical Time Constant	τ_m	24.92	24.89	28.15	ms
16 Rotor Inertia	J	1.00	0.87	1.06	g-cm ²

General Data				
17 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	7/35		$^{\circ}C/W$
18 Thermal Time Constant (rotor/stator)	t_{W1}/t_{W2}	6/380		S
19 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)		$^{\circ}C (^{\circ}F)$
	rotor	100°C (212°F)		$^{\circ}C (^{\circ}F)$
20 Shaft Load Max.: (5 mm from bearing)	-radial -axial	With sleeve bearings		
		1.5 (5.39)		N (oz)
		100 (359.6)		N (oz)
21 Shaft Play:	-radial	0.03 (0.0012)		mm (inch)
	-axial	0.15 (0.0059)		mm (inch)
22 Weight	g	23 (0.82)		g (oz)
23 Commutation Segment	-	9		segment

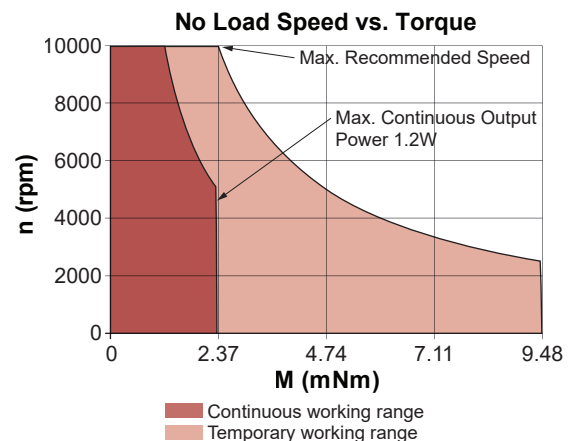
*Also available with ball bearing

Execution Table

Gearbox	Single Shaft	MR2	M Sense B
R16	1	2	10
B16	3	4	11
BA16	3	4	11

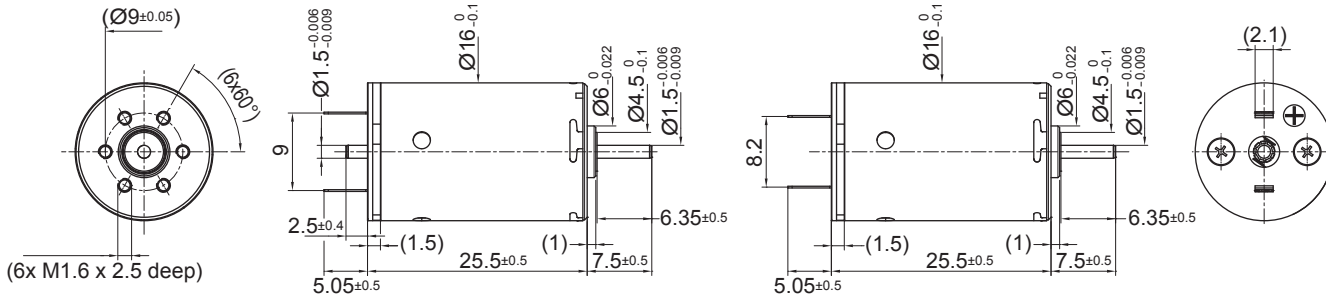
Note:
P1: standard commutation
P2: special commutation for double shaft version

► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.



16DCT Athlonix™

Ø 16 mm • Precious metal commutation • 5.45 mNm



Dimensions in inches [mm]

16DCT 26P2 2

16DCT 26P1 1

Electrical Data	Symbol	16DCT 26P1/P2 *					Unit
		219P	219E	213E	211E	207P	
1 Nominal Voltage	V	3	6	9	12	15	Volt
2 No-Load Speed	n_0	8081	8600	7970	7968	8599	rpm
3 No-Load Current	I_0	28.6	15.2	9.4	7.1	6.1	mA
4 Terminal Resistance	R	0.7	2.3	7.5	13.8	18.6	Ω
5 Output Power	P_{2max}	4.2	4.2	4.2	4.1	4.1	W
6 Stall Torque	mNm	16.12 (2.29)	17.13 (2.43)	12.77 (1.81)	12.33 (1.75)	13.21 (1.88)	mNm (oz-in)
7 Efficiency	h_{max}	85	85	83	83	83	%
8 Max Continuous Speed	$n_{e max}$	10000	10000	10000	10000	10000	rpm
9 Max Continuous Torque	$M_{e max}$	5.28 (0.75)	5.27 (0.75)	5.36 (0.76)	5.27 (0.75)	5.25 (0.75)	mNm (oz-in)
10 Max Continuous Current	$I_{e max}$	1.53	0.81	0.51	0.38	0.32	A
11 Back-EMF Constant	k_E	0.37	0.69	1.12	1.49	1.73	mV/rpm
12 Torque Constant	k_M	3.52	6.62	10.70	14.27	16.53	mNm/A
13 Motor Regulation	R/k^2	52.47	52.55	65.35	67.66	68.15	10 ³ /Nms
14 Friction Torque	T_F	0.08 (0.011)	0.08 (0.011)	0.08 (0.011)	0.08 (0.011)	0.08 (0.011)	mNm (oz-in)
15 Mechanical Time Constant	τ_m	7.79	7.80	7.56	7.51	6.63	ms
16 Rotor Inertia	J	1.48	1.48	1.16	1.11	0.97	g-cm ²

General Data				
17 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	7/35		°C/W
18 Thermal Time Constant (rotor/stator)	t_{w1}/t_{w2}	6/380		S
19 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)		°C (°F)
	rotor	100°C (212°F)		°C (°F)
20 Shaft Load Max.: (5 mm from bearing)	-radial	With sleeve bearings 1.5 (5.39)		N (oz)
	-axial	100 (359.6)		N (oz)
	-radial	0.03 (0.0012)		mm (inch)
21 Shaft Play:	-axial	0.15 (0.0059)		mm (inch)
	g	23 (0.82)		g (oz)
22 Weight	g	9		segment
23 Commutation Segment	-	9		segment

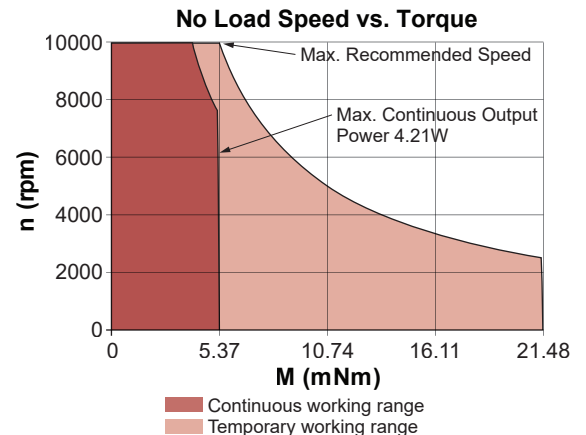
*Also available with ball bearing

Execution Table

Gearbox	Single Shaft	MR2	M Sense B
R16	1	2	10
B16	3	4	11
BA16	3	4	11

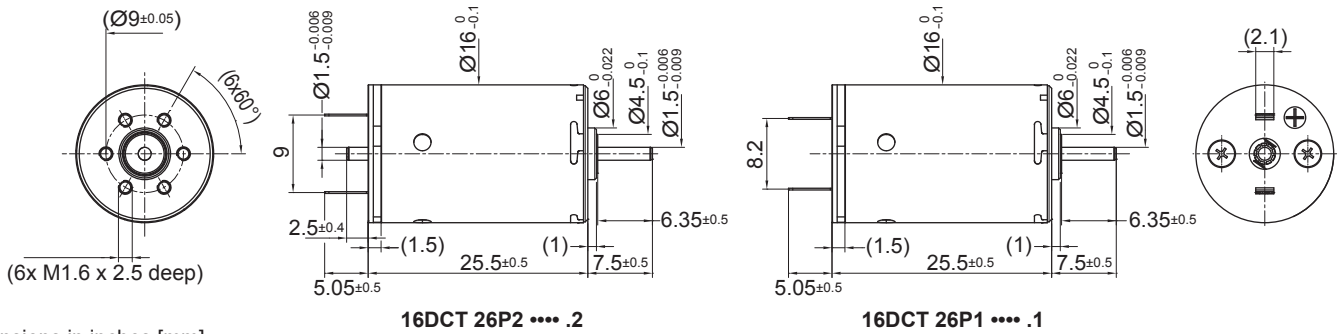
Note:
 P1: standard commutation
 P2: special commutation for double shaft version
 *Special Ball bearing system available for high radial load requirements

► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.



16DCT Athlonix™

Ø 16 mm • Precious metal commutation • 5.45 mNm



Dimensions in inches [mm]

Electrical Data	Symbol	16DCT 26P1/P2 *				Unit
		209E	205P	207E	205E	
1 Nominal Voltage	V	18	24	36	48	Volt
2 No-Load Speed	n_0	8261	7993	10079	8380	rpm
3 No-Load Current	I_0	4.9	3.5	3.0	1.9	mA
4 Terminal Resistance	R	30.7	51.4	80.9	208.1	Ω
5 Output Power	P_{2max}	4.0	4.3	4.1	4.1	W
6 Stall Torque	mNm	11.99 (1.7)	13.2 (1.87)	14.97 (2.13)	12.41 (1.76)	mNm (oz-in)
7 Efficiency	η_{max}	83	83	84	83	%
8 Max Continuous Speed	$n_{e max}$	10000	10000	10000	10000	rpm
9 Max Continuous Torque	$M_{e max}$	5.1 (0.73)	5.45 (0.78)	5.16 (0.74)	5.15 (0.73)	mNm (oz-in)
10 Max Continuous Current	$I_{e max}$	0.25	0.19	0.16	0.10	A
11 Back-EMF Constant	k_E	2.16	2.98	3.55	5.68	mV/rpm
12 Torque Constant	k_M	20.63	28.46	33.88	54.26	mNm/A
13 Motor Regulation	R/k^2	72.15	63.00	70.46	70.67	$10^3/Nms$
14 Friction Torque	T_F	0.08 (0.011)	0.08 (0.011)	0.08 (0.011)	0.08 (0.011)	mNm (oz-in)
15 Mechanical Time Constant	τ_m	7.48	6.60	7.47	7.46	ms
16 Rotor Inertia	J	1.04	1.04	1.06	1.06	g-cm ²

General Data				
17 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	7/35		$^{\circ}C/W$
18 Thermal Time Constant (rotor/stator)	t_{W1}/t_{W2}	6/380		S
19 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F) 100°C (212°F)		$^{\circ}C (^{\circ}F)$
	rotor			$^{\circ}C (^{\circ}F)$
20 Shaft Load Max.: (5 mm from bearing)		With sleeve bearings		
	-radial	1.5 (5.39)		N (oz)
	-axial	100 (359.6)		N (oz)
21 Shaft Play:	-radial	0.03 (0.0012)		mm (inch)
	-axial	0.15 (0.0059)		mm (inch)
22 Weight	g	23 (0.82)		g (oz)
23 Commutation Segment	-	9		segment

*Also available with ball bearing

Execution Table

Gearbox	Single Shaft	MR2	M Sense B
R16	1	2	10
B16	3	4	11
BA16	3	4	11

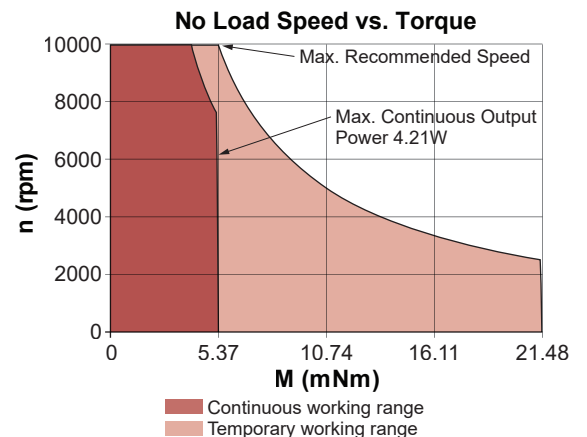
Note:

P1: standard commutation

P2: special commutation for double shaft version

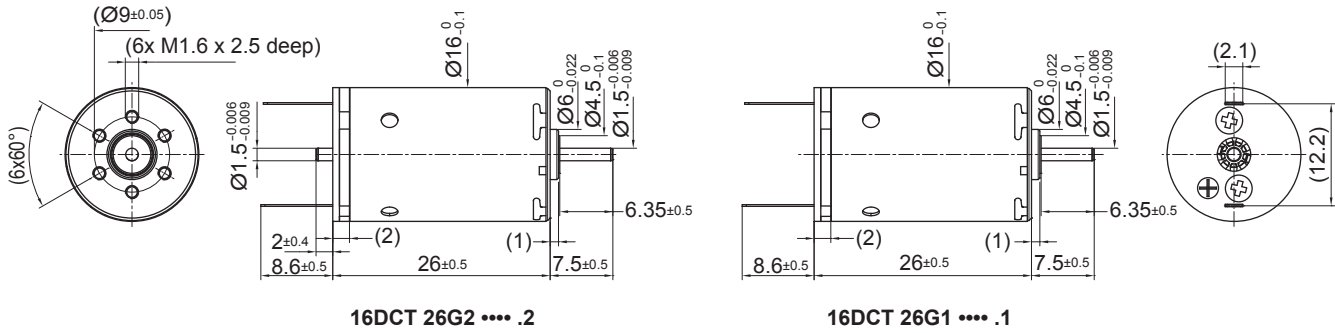
*Special Ball bearing system available for high radial load requirements

► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.



16DCT Athlonix™

Ø 16 mm • Graphite-Copper commutation • 5.06 mNm



Dimensions in inches [mm]

Electrical Data	Symbol	16DCT 26G1/G2 *					Unit
		220P	213P	215E	213E	211E	
1 Nominal Voltage	V	3	6	9	12	15	Volt
2 No-Load Speed	n_0	9311	9798	9648	10427	9749	rpm
3 No-Load Current	I_0	150.3	78.7	51.7	41.9	31.4	mA
4 Terminal Resistance	R	0.6	2.0	4.8	7.6	13.9	Ω
5 Output Power	P_{2max}	3.3	3.5	4.0	3.9	3.9	W
6 Stall Torque	mNm	13.95 (1.98)	16.24 (2.3)	15.7 (2.23)	16.48 (2.34)	14.98 (2.13)	mNm (oz-in)
7 Efficiency	η_{max}	68	70	69	70	69	%
8 Max Continuous Speed	$n_{e max}$	10000	10000	10000	10000	10000	rpm
9 Max Continuous Torque	$M_{e max}$	4.21 (0.6)	4.45 (0.64)	5.06 (0.72)	4.98 (0.71)	4.9 (0.7)	mNm (oz-in)
10 Max Continuous Current	$I_{e max}$	1.56	0.86	0.64	0.51	0.38	A
11 Back-EMF Constant	k_E	0.31	0.60	0.91	1.12	1.49	mV/rpm
12 Torque Constant	k_M	2.98	5.69	8.66	10.70	14.27	mNm/A
13 Motor Regulation	R/k^2	69.88	63.14	64.34	66.22	68.15	10 ³ /Nms
14 Friction Torque	T_F	0.3 (0.042)	0.3 (0.042)	0.3 (0.042)	0.3 (0.042)	0.3 (0.042)	mNm (oz-in)
15 Mechanical Time Constant	τ_m	9.72	7.31	7.78	7.66	7.57	ms
16 Rotor Inertia	J	1.39	1.16	1.21	1.16	1.11	g-cm ²

General Data					
17 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	7/35		°C/W	
18 Thermal Time Constant (rotor/stator)	t_{w1}/t_{w2}	6/380		S	
19 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)		°C (°F)	
	rotor			100°C (212°F)	°C (°F)
20 Shaft Load Max.: (5 mm from bearing)	-radial -axial	With sleeve bearings		N (oz) N (oz)	
					1.5 (5.39)
					100 (359.6)
21 Shaft Play:	-radial -axial	0.03 (0.0012) 0.15 (0.0059)		mm (inch) mm (inch)	
				22 Weight	g
23 Commutation Segment	-	9		segment	

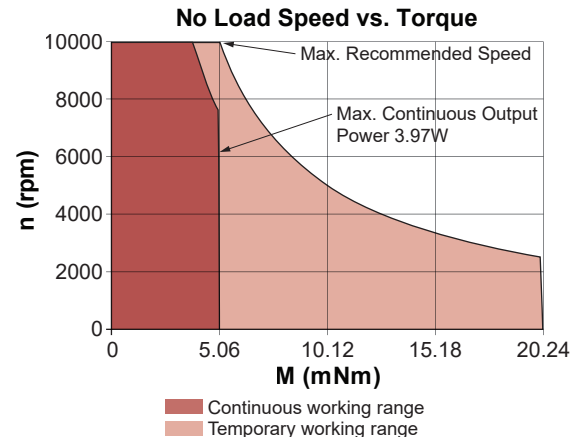
*Also available with ball bearing

Execution Table

Gearbox	Single Shaft	MR2	M Sense B
R16	1	2	10
B16	3	4	11
BA16	3	4	11

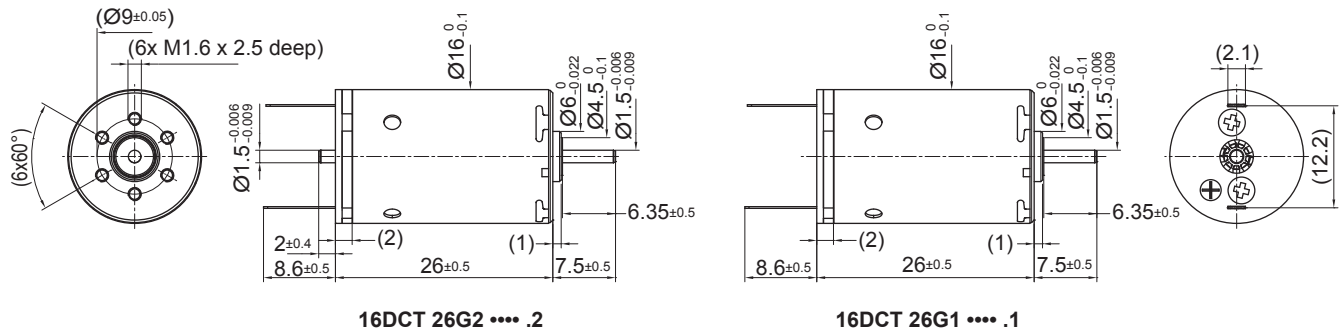
Note:
G1: standard commutation
G2: special commutation for double shaft version
*Special Ball bearing system available for high radial load requirements

► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.



16DCT Athlonix™

Ø 16 mm • Graphite-Copper commutation • 5.06 mNm



Dimensions in inches [mm]

Electrical Data	Symbol	16DCT 26G1/G2 *				Unit
		207P	209F	207E	205E	
1 Nominal Voltage	V	18	24	36	48	Volt
2 No-Load Speed	n_0	10105	10053	9845	8145	rpm
3 No-Load Current	I_0	27.1	20.2	13.2	8.3	mA
4 Terminal Resistance	R	18.7	33.1	81.0	208.2	Ω
5 Output Power	P_{2max}	3.8	3.9	3.8	3.8	W
6 Stall Torque	mNm	15.44 (2.19)	15.62 (2.22)	14.61 (2.07)	12.06 (1.71)	mNm (oz-in)
7 Efficiency	h_{max}	69	69	68	66	%
8 Max Continuous Speed	$n_{e max}$	10000	10000	10000	10000	rpm
9 Max Continuous Torque	$M_{e max}$	4.89 (0.7)	4.93 (0.7)	4.81 (0.69)	4.8 (0.68)	mNm (oz-in)
10 Max Continuous Current	$I_{e max}$	0.32	0.24	0.16	0.10	A
11 Back-EMF Constant	k_E	1.73	2.32	3.55	5.68	mV/rpm
12 Torque Constant	k_M	16.53	22.16	33.88	54.26	mNm/A
13 Motor Regulation	R/k^2	69.00	67.36	70.55	70.70	$10^3/Nms$
14 Friction Torque	T_F	0.3 (0.042)	0.3 (0.042)	0.3 (0.042)	0.3 (0.042)	mNm (oz-in)
15 Mechanical Time Constant	τ_m	6.66	7.51	7.48	7.47	ms
16 Rotor Inertia	J	0.97	1.11	1.06	1.06	g-cm ²

General Data				
17 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	7/35		$^{\circ}C/W$
18 Thermal Time Constant (rotor/stator)	t_{W1}/t_{W2}	6/380		S
19 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)		$^{\circ}C (^{\circ}F)$
	rotor			100°C (212°F)
20 Shaft Load Max.: (5 mm from bearing)	-radial	With sleeve bearings		N (oz)
	-axial	1.5 (5.39)		N (oz)
	-radial	100 (359.6)		mm (inch)
21 Shaft Play:	-radial	0.03 (0.0012)		mm (inch)
	-axial	0.15 (0.0059)		mm (inch)
22 Weight	g	23 (0.82)		g (oz)
23 Commutation Segment	-	9		segment

*Also available with ball bearing

Execution Table

Gearbox	Single Shaft	MR2	M Sense B
R16	1	2	10
B16	3	4	11
BA16	3	4	11

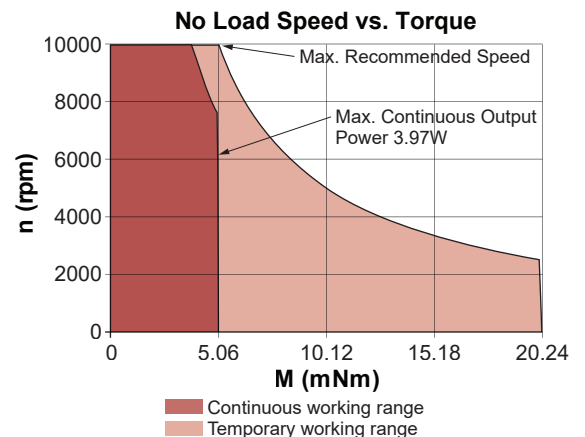
Note:

G1: standard commutation

G2: special commutation for double shaft version

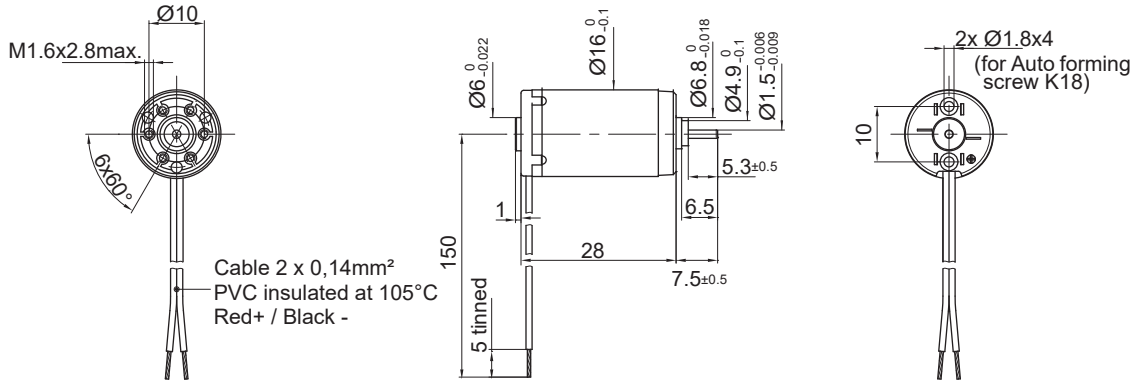
*Special Ball bearing system available for high radial load requirements

► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.



16G88

Ø 16 mm • Precious metal commutation • 5.8 mNm



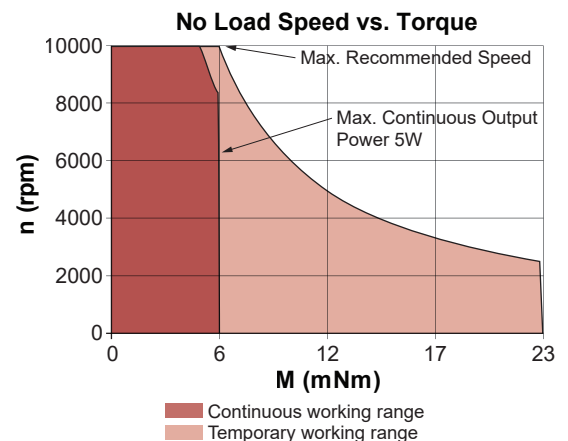
Dimensions in inches [mm]

Electrical Data	Symbol	16G88 1						Unit
		220P	214E	213E	211E	210E	205E	
1 Nominal Voltage	V	3	8	9	12	15	32	Volt
2 No-Load Speed	n_0	11,025	9,250	7,980	8,690	9,000	8,150	rpm
3 No-Load Current	I_0	45.0	10.0	8.0	6.5	5.5	2.0	mA
4 Terminal Resistance	R	0.5	5.4	7.6	13.0	19.5	135.0	Ω
5 Output Power	P_{2max}	4.1	4.2	4.6	4.2	4.2	2.5	W
6 Stall Torque	mNm	16 (2.27)	12.1 (1.72)	12.7 (1.8)	12.1 (1.72)	12.2 (1.73)	8.8 (1.25)	mNm (oz-in)
7 Efficiency	η_{max}	83	84	84	84	84	82	%
8 Max Continuous Speed	$n_{e,max}$	10,000	10,000	10,000	10,000	10,000	10,000	rpm
9 Max Continuous Torque	$M_{e,max}$	5.5 (0.76)	5.3 (0.76)	5.8 (0.83)	5.4 (0.77)	5.4 (0.77)	4.8 (0.68)	mNm (oz-in)
10 Max Continuous Current	$I_{e,max}$	2.20	0.66	0.55	0.42	0.35	0.13	A
11 Back-EMF Constant	k_E	0.27	0.86	1.12	1.37	1.65	3.90	mV/rpm
12 Torque Constant	k_M	2.58	8.20	10.70	13.10	15.80	37.20	mNm/A
13 Motor Regulation	R/k^2	75.1	80.3	66.4	75.75	78.11	97.55	10 ³ /Nms
14 Friction Torque	T_F	0.12 (0.02)	0.08 (0.02)	0.09 (0.02)	0.09 (0.02)	0.09 (0.02)	0.07 (0.01)	mNm (oz-in)
15 Rotor Inductance	L	0.01	0.12	0.15	0.26	0.40	1.70	mH
16 Mechanical Time Constant	τ_m	6.0	6.4	5.3	6.1	5.8	7.8	ms
17 Rotor Inertia	J	0.80	0.80	0.80	0.80	0.74	0.80	g-cm ²

General Data				
18 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	8/35		°C/W
19 Thermal Time Constant (rotor/stator)	t_{W1}/t_{W2}	6/500		S
20 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)		°C (°F)
	rotor			100°C (212°F)
21 Shaft Load Max.: (5 mm from bearing)	-radial -axial	With sleeve bearings		
		1.5 (5.4)	100 (359.6)	N (oz) N (oz)
22 Shaft Play:	-radial	<0.03 (0.0012)		mm (inch)
	-axial	0.15 (0.0059)		mm (inch)
23 Weight	g	24 (0.85)		g (oz)
24 Commutation Segment	-	9		segment

Execution Table

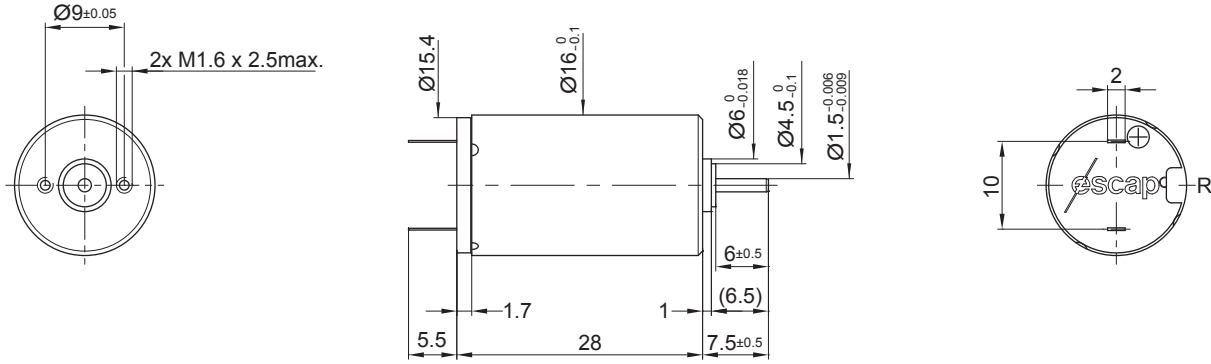
Gearbox	Single Shaft	MR2
B16	5	Upon Request
BA16	5	Upon Request
R16	1	Upon Request



► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.

16N78 Athlonix™

Ø 16 mm • Precious metal commutation • 6.9 mNm



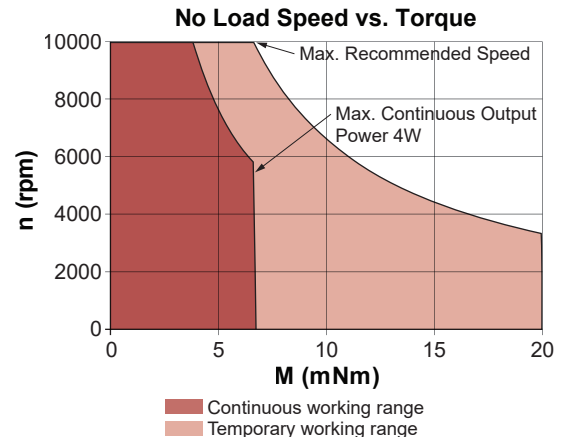
Dimensions in inches [mm]

Electrical Data	Symbol	16N781001						Unit
		135	212P	214E	212E	210E	208E	
1 Nominal Voltage	V	1.5	6	9	12	18	24	Volt
2 No-Load Speed	n_0	7,894	8,350	8,275	8,380	8,530	8,200	rpm
3 No-Load Current	I_0	90.0	18.0	10.0	5.0	5.0	4.0	mA
4 Terminal Resistance	R	0.2	3.0	7.5	13.2	27.5	60.5	Ω
5 Output Power	P_{2max}	4.7	5.4	5.2	5.2	4.9	4.9	W
6 Stall Torque	mNm	13.5 (1.91)	13.6 (1.93)	12.4 (1.76)	12.4 (1.76)	13.1 (1.86)	11 (1.56)	mNm (oz-in)
7 Efficiency	η_{max}	83	82	83	86	83	81	%
8 Max Continuous Speed	$n_{e max}$	10,000	10,000	10,000	10,000	10,000	10,000	rpm
9 Max Continuous Torque	$M_{e max}$	6 (0.98)	6.9 (0.98)	6.6 (0.94)	6.6 (0.94)	6.2 (0.88)	6.3 (0.9)	mNm (oz-in)
10 Max Continuous Current	$I_{e max}$	3.41	1.03	0.65	0.49	0.34	0.23	A
11 Back-EMF Constant	k_E	0.19	0.71	1.08	1.42	2.09	2.90	mV/rpm
12 Torque Constant	k_M	1.80	6.80	10.30	13.60	20.00	27.70	mNm/A
13 Motor Regulation	R/k^2	62.0	64.9	70.7	71.37	69.0	78.85	$10^3/Nms$
14 Friction Torque	T_F	0.09 (0.02)	0.12 (0.02)	0.1 (0.02)	0.07 (0.01)	0.09 (0.02)	0.08 (0.02)	mNm (oz-in)
15 Rotor Inductance	L	0.01	0.10	0.30	0.50	1.00	2.40	mH
16 Mechanical Time Constant	τ_m	6.8	6.8	8.8	8.6	8.3	9.3	ms
17 Rotor Inertia	J	1.10	1.05	1.25	1.20	1.20	1.18	g-cm ²

General Data					
18 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	6/25		$^{\circ}C/W$	
19 Thermal Time Constant (rotor/stator)	t_{W1}/t_{W2}	12/250		S	
20 Operating Temperature Range:	motor	-30 $^{\circ}C$ to 85 $^{\circ}C$ (-22 $^{\circ}F$ to 185 $^{\circ}F$)		$^{\circ}C$ ($^{\circ}F$)	
	rotor			100 $^{\circ}C$ (212 $^{\circ}F$)	$^{\circ}C$ ($^{\circ}F$)
21 Shaft Load Max.: (5 mm from bearing)	-radial -axial	With sleeve bearings		N (oz)	
				1.5 (5.4)	N (oz)
				100 (359.6)	mm (inch)
22 Shaft Play:	-radial -axial	<0.03 (0.0012)		mm (inch)	
				0.15 (0.0059)	mm (inch)
23 Weight	g	24 (0.85)		g (oz)	
24 Commutation Segment	-	9		segment	

Execution Table

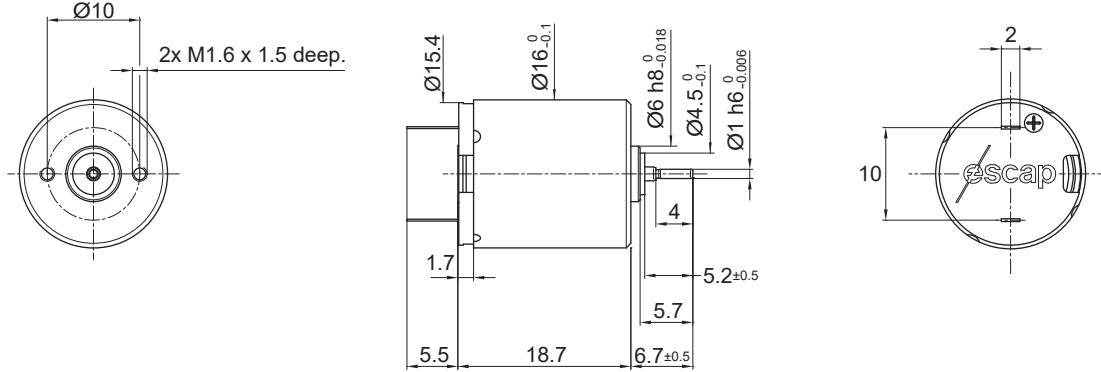
Gearbox	Single Shaft	MR2
B16	1005	1008
BA16	1005	1008
R16	1001	1007



► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.

16S78 Athlonix™

Ø 16 mm • Precious metal commutation • 2.8 mNm



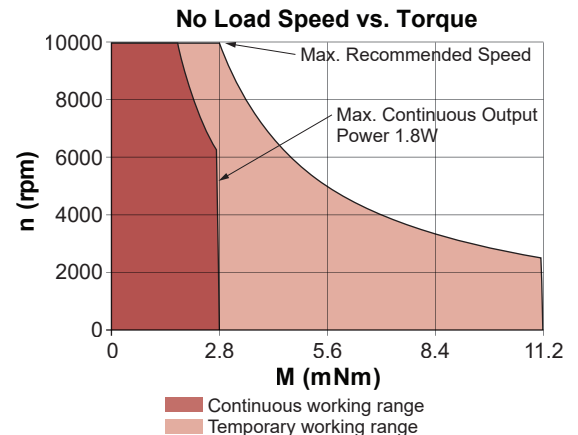
Dimensions in inches [mm]

Electrical Data	Symbol	16S78 1		Unit
		208P	210E	
1 Nominal Voltage	V	6	7.5	Volt
2 No-Load Speed	n ₀	10,280	10,865	rpm
3 No-Load Current	I ₀	25.0	18.0	mA
4 Terminal Resistance	R	7.5	12.2	Ω
5 Output Power	P _{2max.}	1.7	1.6	W
6 Stall Torque	mNm	4.3	3.9	mNm (oz-in)
7 Efficiency	h _{max.}	68	69	%
8 Max Continuous Speed	n _{e max.}	10,000	10,000	rpm
9 Max Continuous Torque	M _{e max.}	2.6 (0.34)	2.4 (0.34)	mNm (oz-in)
10 Max Continuous Current	I _{e max.}	0.50	0.38	A
11 Back-EMF Constant	k _E	0.57	0.67	mV/rpm
12 Torque Constant	k _M	5.40	6.40	mNm/A
13 Motor Regulation	R/k ²	255.0	300.0	10 ³ /Nms
14 Friction Torque	T _F	0.12 (0.02)	0.12 (0.02)	mNm (oz-in)
15 Rotor Inductance	L	0.15	0.23	mH
16 Mechanical Time Constant	τ _m	12.8	15.0	ms
17 Rotor Inertia	J	0.50	0.50	g-cm ²

General Data				
18 Thermal Resistance (rotor/body)	R _{th1} /R _{th2}	13/38		°C/W
19 Thermal Time Constant (rotor/stator)	t _{w1} /t _{w2}	7/400		S
20 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)		°C (°F)
	rotor	100°C (212°F)		°C (°F)
21 Shaft Load Max.: (5 mm from bearing)	-radial -axial	With sleeve bearings		
		1.5 (5.4) 100 (359.6)		N (oz) N (oz)
22 Shaft Play:	-radial	<0.03 (0.0012)		mm (inch)
	-axial	0.15 (0.0059)		mm (inch)
23 Weight	g	19 (0.68)		g (oz)
24 Commutation Segment	-	9		segment

Execution Table

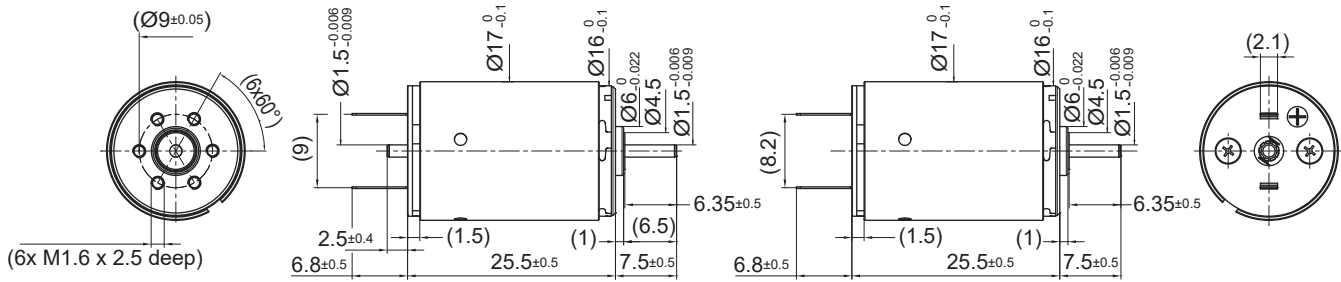
Gearbox	Single Shaft	MR2
B16	2	3
BA16	2	3
R16	2	3



► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.

17DCT Athlonix™

Ø 17 mm • Precious metal commutation • 6.14 mNm



17DCT 26P2 2

17DCT 26P1 1

Dimensions in inches [mm]

Electrical Data	Symbol	17DCT 26P1/P2 *					Unit
		216P	211P	209P	208P	207P	
1 Nominal Voltage	V	3	6	9	12	15	Volt
2 No-Load Speed	n_0	7838	7842	7645	8158	8358	rpm
3 No-Load Current	I_0	24.7	12.3	8.0	6.4	5.3	mA
4 Terminal Resistance	R	0.9	3.3	7.7	12.1	18.6	Ω
5 Output Power	P_{2max}	4.6	4.7	4.8	4.7	4.7	W
6 Stall Torque	mNm	12.31 (1.75)	13.21 (1.88)	13.02 (1.85)	13.79 (1.96)	13.62 (1.93)	mNm (oz-in)
7 Efficiency	h_{max}	84	84	84	85	84	%
8 Max Continuous Speed	$n_{e max}$	10000	10000	10000	10000	10000	rpm
9 Max Continuous Torque	$M_{e max}$	5.81 (0.83)	6.02 (0.86)	6.05 (0.86)	6.03 (0.86)	5.92 (0.84)	mNm (oz-in)
10 Max Continuous Current	$I_{e max}$	1.63	0.84	0.55	0.44	0.35	A
11 Back-EMF Constant	k_E	0.38	0.76	1.17	1.46	1.78	mV/rpm
12 Torque Constant	k_M	3.63	7.26	11.16	13.96	17.03	mNm/A
13 Motor Regulation	R/k^2	66.64	62.15	61.45	61.92	64.25	$10^3/Nms$
14 Friction Torque	T_F	0.08 (0.011)	0.08 (0.011)	0.08 (0.011)	0.08 (0.011)	0.08 (0.011)	mNm (oz-in)
15 Mechanical Time Constant	τ_m	7.01	6.41	6.30	6.27	6.25	ms
16 Rotor Inertia	J	1.05	1.03	1.02	1.01	0.97	g-cm ²

General Data

17 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	6/25					°C/W
18 Thermal Time Constant (rotor/stator)	t_{W1}/t_{W2}	12/250					S
19 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F) 100°C (212°F)					°C (°F)
	rotor						°C (°F)
20 Shaft Load Max.: (5 mm from bearing)	-radial	With sleeve bearings 1.5 (5.39)					N (oz)
	-axial	100 (359.6)					N (oz)
	-radial	0.03 (0.0012)					mm (inch)
21 Shaft Play:	-axial	0.15 (0.0059)					mm (inch)
	-axial	0.15 (0.0059)					mm (inch)
22 Weight	g	27 (0.96)					g (oz)
23 Commutation Segment	-	9					segment

*Also available with ball bearing

Execution Table

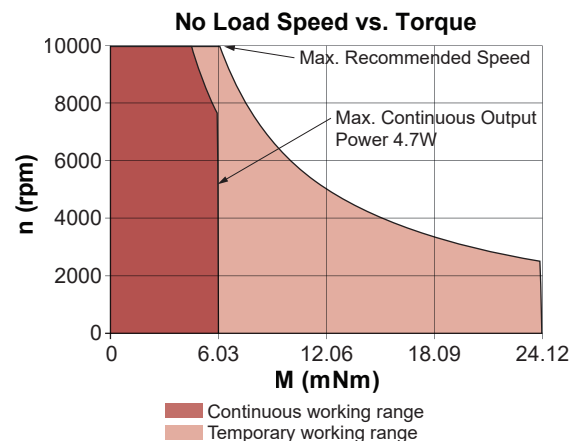
Gearbox	Single Shaft	MR2	M Sense B
R16	1	2	10
B16	3	4	11
BA16	3	4	11

Note:

P1: standard commutation

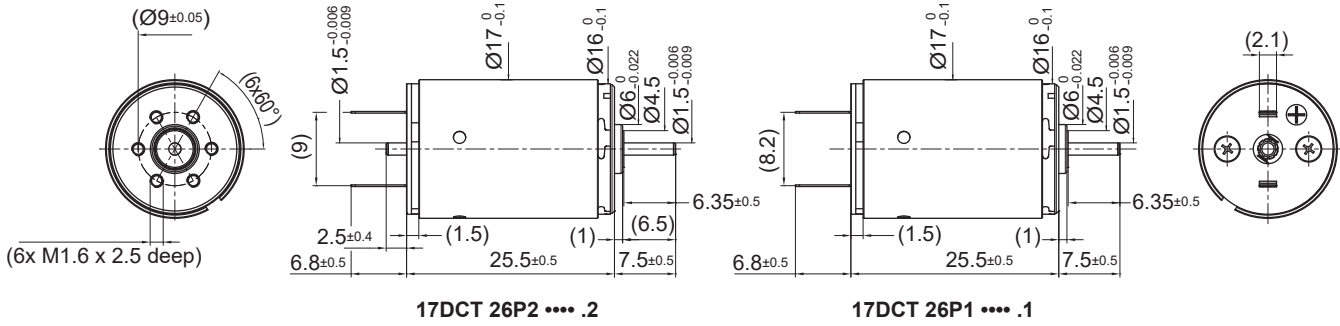
P2: special commutation for double shaft version

► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.



17DCT Athlonix™

Ø 17 mm • Precious metal commutation • 6.14 mNm



Dimensions in inches [mm]

Electrical Data	Symbol	17DCT 26P1/P2 *				Unit
		209E	205P	107P	205E	
1 Nominal Voltage	V	18	24	36	48	Volt
2 No-Load Speed	n_0	8030	7769	9800	8145	rpm
3 No-Load Current	I_0	4.2	3.1	2.6	1.6	mA
4 Terminal Resistance	R	30.7	51.4	76.0	208.1	Ω
5 Output Power	P_{2max}	4.5	4.8	4.7	4.6	W
6 Stall Torque	mNm	12.36 (1.76)	13.6 (1.93)	16.43 (2.33)	12.8 (1.82)	mNm (oz-in)
7 Efficiency	h_{max}	84	84	86	84	%
8 Max Continuous Speed	$n_{e max}$	10000	10000	10000	10000	rpm
9 Max Continuous Torque	$M_{e max}$	5.75 (0.82)	6.14 (0.87)	6 (0.85)	5.8 (0.83)	mNm (oz-in)
10 Max Continuous Current	$I_{e max}$	0.27	0.21	0.17	0.11	A
11 Back-EMF Constant	k_E	2.23	3.07	3.65	5.85	mV/rpm
12 Torque Constant	k_M	21.25	29.31	34.89	55.88	mNm/A
13 Motor Regulation	R/k^2	68.01	59.79	62.45	66.62	10 ³ /Nms
14 Friction Torque	T_F	0.08 (0.011)	0.08 (0.011)	0.08 (0.011)	0.08 (0.011)	mNm (oz-in)
15 Mechanical Time Constant	τ_m	7.06	6.23	6.22	7.04	ms
16 Rotor Inertia	J	1.04	1.04	1.00	1.06	g-cm ²

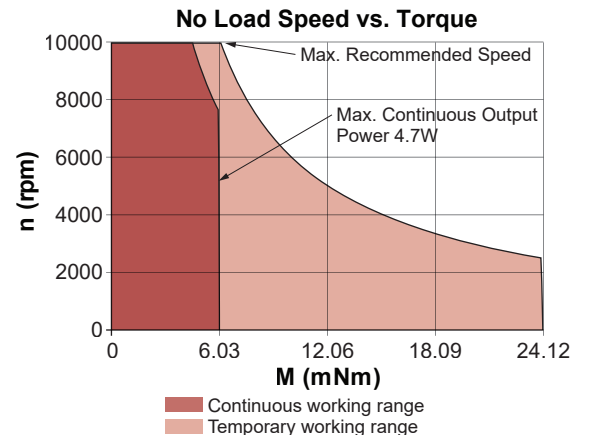
General Data				
17 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	6/25		°C/W
18 Thermal Time Constant (rotor/stator)	t_{W1}/t_{W2}	12/250		S
19 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)		°C (°F)
	rotor	100°C (212°F)		°C (°F)
20 Shaft Load Max.: (5 mm from bearing)	-radial	With sleeve bearings 1.5 (5.39)		N (oz)
	-axial	100 (359.6)		N (oz)
21 Shaft Play:	-radial	0.03 (0.0012)		mm (inch)
	-axial	0.15 (0.0059)		mm (inch)
22 Weight	g	27 (0.96)		g (oz)
23 Commutation Segment	-	9		segment

*Also available with ball bearing

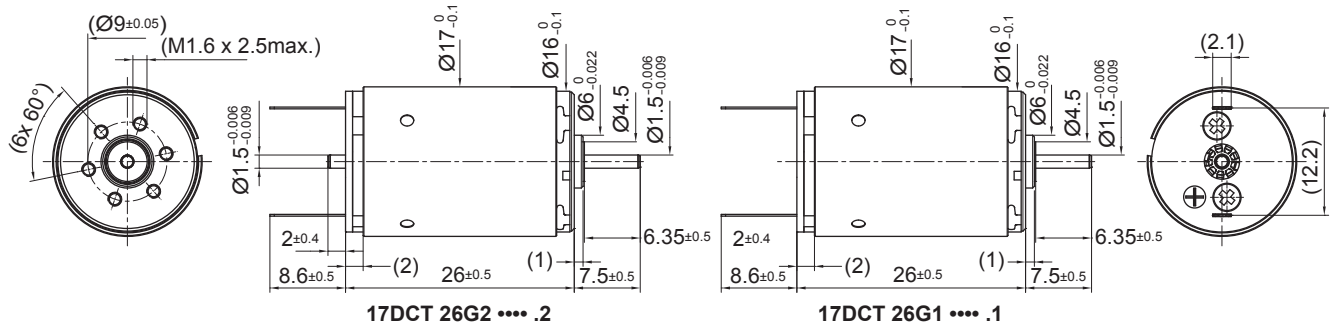
Execution Table

Gearbox	Single Shaft	MR2	M Sense B
R16	1	2	10
B16	3	4	11
BA16	3	4	11

Note:
P1: standard commutation
P2: special commutation for double shaft version



► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.



Dimensions in inches [mm]

Electrical Data	Symbol	17DCT 26G1/G2 *					Unit
		216P	211P	209P	208P	207P	
1 Nominal Voltage	V	3	6	9	12	15	Volt
2 No-Load Speed	n_0	7657	7690	7498	8011	8206	rpm
3 No-Load Current	I_0	92.6	46.3	30.1	24.1	19.7	mA
4 Terminal Resistance	R	1.0	3.4	7.8	12.2	18.7	Ω
5 Output Power	P_{2max}	4.1	4.5	4.5	4.5	4.4	W
6 Stall Torque	mNm	10.8 (1.53)	12.57 (1.79)	12.61 (1.79)	13.43 (1.91)	13.3 (1.89)	mNm (oz-in)
7 Efficiency	h_{max}	68	70	70	71	71	%
8 Max Continuous Speed	$n_{e max}$	10000	10000	10000	10000	10000	rpm
9 Max Continuous Torque	$M_{e max}$	5.25 (0.75)	5.68 (0.81)	5.77 (0.82)	5.76 (0.82)	5.65 (0.81)	mNm (oz-in)
10 Max Continuous Current	$I_{e max}$	1.54	0.83	0.55	0.44	0.35	A
11 Back-EMF Constant	k_E	0.38	0.76	1.17	1.46	1.78	mV/rpm
12 Torque Constant	k_M	3.63	7.26	11.16	13.96	17.03	mNm/A
13 Motor Regulation	R/k ²	74.24	64.05	62.25	62.43	64.59	10 ³ /Nms
14 Friction Torque	T_F	0.3 (0.042)	0.3 (0.042)	0.3 (0.042)	0.3 (0.042)	0.3 (0.042)	mNm (oz-in)
15 Mechanical Time Constant	τ_m	7.81	6.61	6.38	6.32	6.28	ms
16 Rotor Inertia	J	1.05	1.03	1.02	1.01	0.97	g-cm ²

General Data				
17 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	6/25		°C/W
18 Thermal Time Constant (rotor/stator)	t_{W1}/t_{W2}	12/250		S
19 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)		°C (°F)
	rotor			100°C (212°F)
20 Shaft Load Max.: (5 mm from bearing)	-radial	With sleeve bearings		N (oz)
	-axial	1.5 (5.39)		N (oz)
	-radial	100 (359.6)		mm (inch)
21 Shaft Play:	-axial	0.03 (0.0012)		mm (inch)
	-axial	0.15 (0.0059)		mm (inch)
22 Weight	g	27 (0.96)		g (oz)
23 Commutation Segment	-	9		segment

*Also available with ball bearing

Execution Table

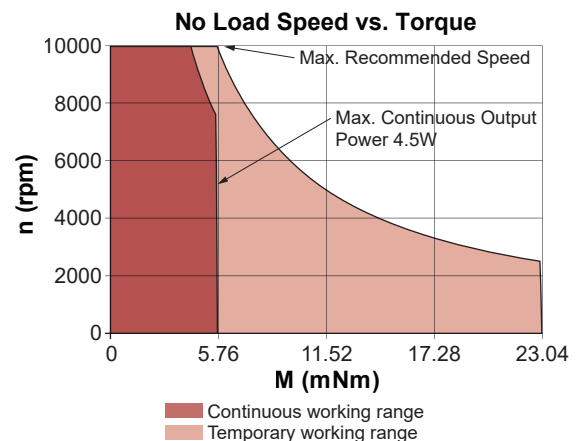
Gearbox	Single Shaft	MR2	M Sense B
R16	1	2	10
B16	3	4	11
BA16	3	4	11

Note:

G1: standard commutation

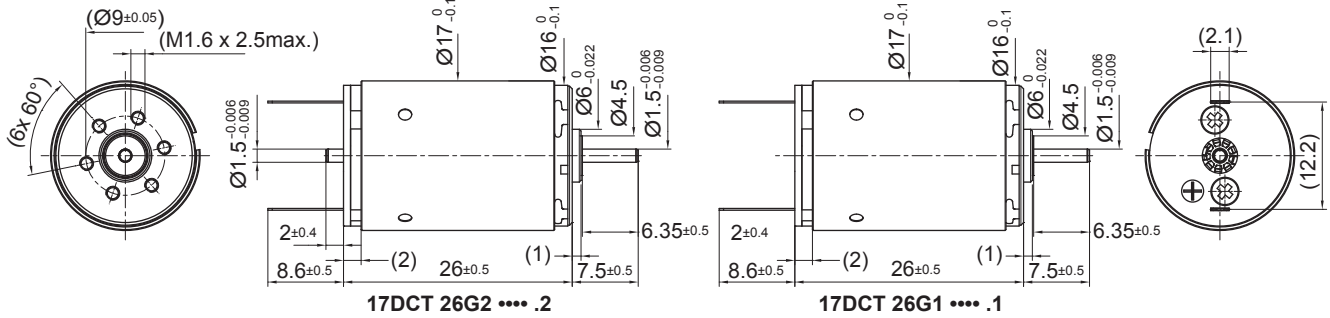
G2: special commutation for double shaft version

► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.



17DCT Athlonix™

Ø 17 mm • Graphite-Copper commutation • 5.88 mNm



Dimensions in inches [mm]

Electrical Data	Symbol	17DCT 26G1/G2 *				Unit
		209E	205P	107P	205E	
1 Nominal Voltage	V	18	24	36	48	Volt
2 No-Load Speed	n_0	7869	7628	9653	7988	rpm
3 No-Load Current	I_0	15.8	11.5	9.6	6.0	mA
4 Terminal Resistance	R	30.8	51.5	76.1	208.2	Ω
5 Output Power	P_{2max}	4.3	4.6	4.5	4.4	W
6 Stall Torque	mNm	12.07 (1.71)	13.33 (1.89)	16.16 (2.29)	12.55 (1.78)	mNm (oz-in)
7 Efficiency	h_{max}	70	71	73	70	%
8 Max Continuous Speed	$n_{e max}$	10000	10000	10000	10000	rpm
9 Max Continuous Torque	$M_{e max}$	5.49 (0.78)	5.88 (0.84)	5.75 (0.82)	5.56 (0.79)	mNm (oz-in)
10 Max Continuous Current	$I_{e max}$	0.27	0.21	0.17	0.11	A
11 Back-EMF Constant	k_E	2.23	3.07	3.65	5.85	mV/rpm
12 Torque Constant	k_M	21.25	29.31	34.89	55.88	mNm/A
13 Motor Regulation	R/k^2	68.23	59.91	62.53	66.65	10 ³ /Nms
14 Friction Torque	T_F	0.3 (0.042)	0.3 (0.042)	0.3 (0.042)	0.3 (0.042)	mNm (oz-in)
15 Mechanical Time Constant	τ_m	7.08	6.24	6.23	7.04	ms
16 Rotor Inertia	J	1.04	1.04	1.00	1.06	g-cm ²

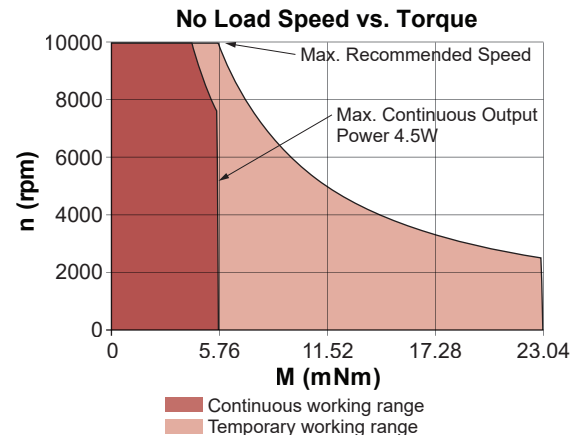
General Data				
17 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	6/25		°C/W
18 Thermal Time Constant (rotor/stator)	t_{W1}/t_{W2}	12/250		S
19 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)		°C (°F)
	rotor	100°C (212°F)		°C (°F)
20 Shaft Load Max.: (5 mm from bearing)	-radial	With sleeve bearings 1.5 (5.39)		N (oz)
	-axial	100 (359.6)		N (oz)
	-radial	0.03 (0.0012)		mm (inch)
21 Shaft Play:	-axial	0.15 (0.0059)		mm (inch)
		27 (0.96)		g (oz)
22 Weight	g	9		segment
23 Commutation Segment	-			

*Also available with ball bearing

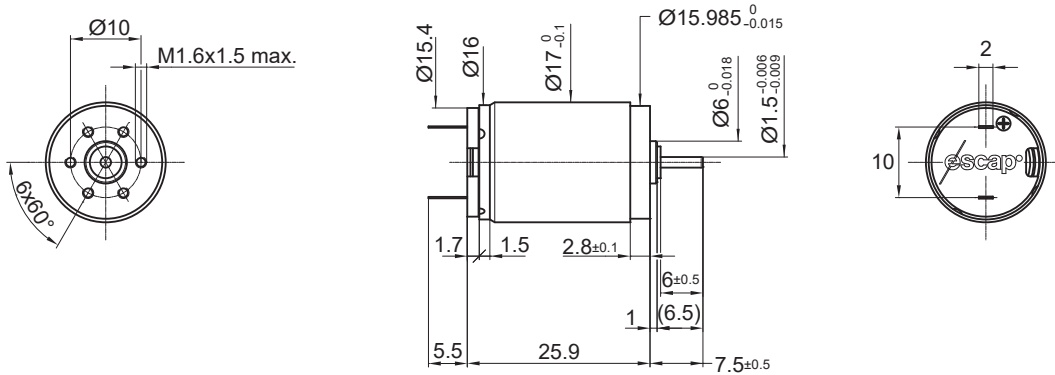
Execution Table

Gearbox	Single Shaft	MR2	M Sense B
R16	1	2	10
B16	3	4	11
BA16	3	4	11

Note:
G1: standard commutation
G2: special commutation for double shaft version



► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.



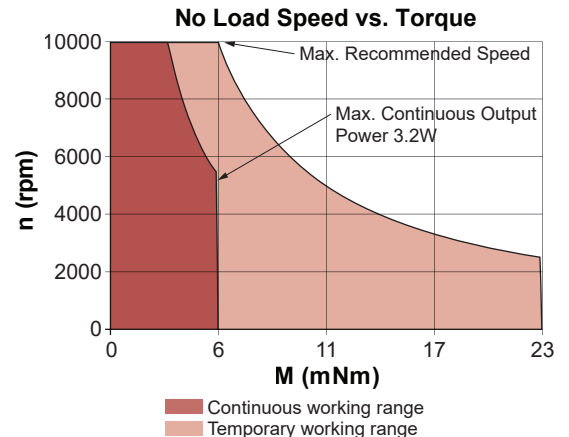
Dimensions in inches [mm]

Electrical Data	Symbol	17N78 1				Unit
		216E	210E	208E	207E	
1 Nominal Voltage	V	6	12	18	24	Volt
2 No-Load Speed	n_0	8,480	8,460	8,460	8,900	rpm
3 No-Load Current	I_0	16.0	7.7	4.9	3.5	mA
4 Terminal Resistance	R	3.2	17.3	38.4	65.0	Ω
5 Output Power	P_{2max}	3.6	3.1	3.2	3.1	W
6 Stall Torque	mNm	12.5 (1.78)	9.3 (1.32)	9.4 (1.34)	9.4 (1.34)	mNm (oz-in)
7 Efficiency	η_{max}	82	80	81	81	%
8 Max Continuous Speed	$n_{e max}$	10,000	10,000	10,000	10,000	rpm
9 Max Continuous Torque	$M_{e max}$	5.7 (0.81)	4.8 (0.68)	4.9 (0.7)	4.8 (0.68)	mNm (oz-in)
10 Max Continuous Current	$I_{e max}$	0.86	0.37	0.25	0.19	A
11 Back-EMF Constant	k_E	0.70	1.40	2.10	2.67	mV/rpm
12 Torque Constant	k_M	6.70	13.40	20.10	25.50	mNm/A
13 Motor Regulation	R/k ²	71.3	96.3	95.05	99.96	10 ³ /Nms
14 Friction Torque	T_F	0.1 (0.02)	0.1 (0.02)	0.1 (0.02)	0.09 (0.02)	mNm (oz-in)
15 Rotor Inductance	L	0.11	0.40	0.90	1.41	mH
16 Mechanical Time Constant	τ_m	7.8	7.7	7.2	7.2	ms
17 Rotor Inertia	J	1.10	0.80	0.76	0.72	g-cm ²

General Data				
18 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	10/30		°C/W
19 Thermal Time Constant (rotor/stator)	t_{W1}/t_{W2}	7/400		S
20 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)		°C (°F)
	rotor			100°C (212°F)
21 Shaft Load Max.: (5 mm from bearing)	-radial -axial	With sleeve bearings		
		1.5 (5.4)		N (oz)
		100 (359.6)		N (oz)
22 Shaft Play:	-radial	<0.03 (0.0012)		mm (inch)
	-axial	0.15 (0.0059)		mm (inch)
23 Weight	g	27 (0.96)		g (oz)
24 Commutation Segment	-	9		segment

Execution Table

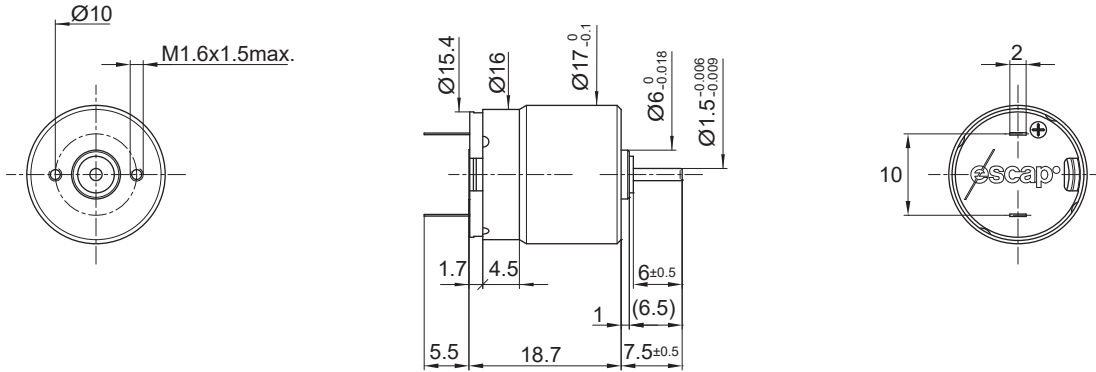
Gearbox	Single Shaft	F16	MR2
B16	5	5	Upon Request
BA16	5	5	Upon Request
R16	1	1	Upon Request



► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.

17S78

Ø 17 mm • Precious metal commutation • 2.8 mNm



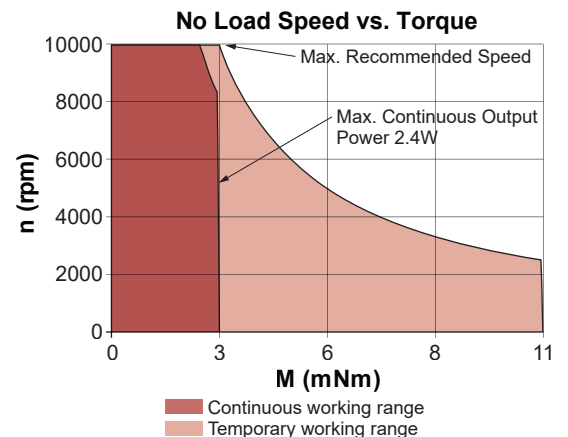
Dimensions in inches [mm]

Electrical Data	Symbol	17S78 1			Unit
		208P	210E	209E	
1 Nominal Voltage	V	6	7.5	12	Volt
2 No-Load Speed	n_0	10,280	10,865	12,430	rpm
3 No-Load Current	I_0	25.0	18.0	8.4	mA
4 Terminal Resistance	R	7.5	12.2	18.6	Ω
5 Output Power	P_{2max}	1.7	1.6	1.8	W
6 Stall Torque	mNm	4.3 (0.61)	3.9 (0.56)	5.9 (0.84)	mNm (oz-in)
7 Efficiency	h_{max}	68	69	78	%
8 Max Continuous Speed	$n_{e max}$	10,000	10,000	10,000	rpm
9 Max Continuous Torque	$M_{e max}$	2.6 (0.34)	2.4 (0.34)	2.8 (0.4)	mNm (oz-in)
10 Max Continuous Current	$I_{e max}$	0.50	0.38	0.32	A
11 Back-EMF Constant	k_E	0.57	0.67	0.95	mV/rpm
12 Torque Constant	k_M	5.40	6.40	9.10	mNm/A
13 Motor Regulation	R/k^2	255.0	300.0	225.0	10 ³ /Nms
14 Friction Torque	T_F	0.12 (0.02)	0.12 (0.02)	0.08 (0.02)	mNm (oz-in)
15 Rotor Inductance	L	0.15	0.23	0.35	mH
16 Mechanical Time Constant	τ_m	12.8	15.0	11.3	ms
17 Rotor Inertia	J	0.50	0.50	0.50	g-cm ²

General Data					
18 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	13/38			°C/W
19 Thermal Time Constant (rotor/stator)	t_{W1}/t_{W2}	7/400			S
20 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)			°C (°F)
	rotor	100°C (212°F)			°C (°F)
21 Shaft Load Max.: (5 mm from bearing)	-radial -axial	With sleeve bearings			
		1.5 (5.4) 100 (359.6)			N (oz) N (oz)
22 Shaft Play:	-radial	<0.03 (0.0012)			mm (inch)
	-axial	0.15 (0.0059)			mm (inch)
23 Weight	g	19 (0.68)			g (oz)
24 Commutation Segment	-	9			segment

Execution Table

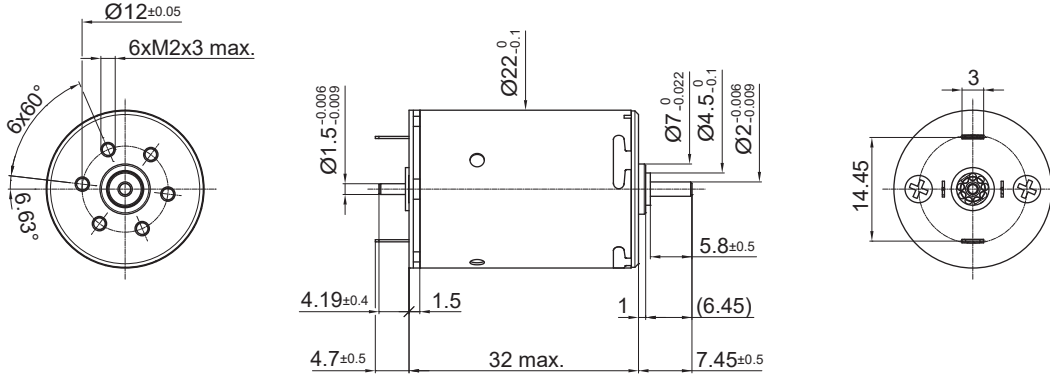
Gearbox	Single Shaft	F16	MR2
B16	5	5	Upon Request
BA16	5	5	Upon Request
R16	1	1	96



► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.

22DCP Athlonix™

Ø 22 mm • Precious metal commutation • 6.5 mNm



Dimensions in inches [mm]

Electrical Data	Symbol	221P	216P	22DCP 32P2	213P	211P	210P	209P	Unit
1 Nominal Voltage	V	3	6	9	12	15	18		Volt
2 No-Load Speed	n_0	8321	9739	10022	9741	9741	9348		rpm
3 No-Load Current	I_0	58.9	34.4	23.6	17.2	13.8	11.0		mA
4 Terminal Resistance	R	0.7	2.0	4.1	7.8	12.1	18.6		Ω
5 Output Power	P_{2max}	2.9	4.1	4.4	4.2	4.2	4.0		W
6 Stall Torque	mNm	13.65 (1.94)	17.47 (2.48)	18.34 (2.6)	17.81 (2.53)	17.83 (2.53)	17.37 (2.46)		mNm (oz-in)
7 Efficiency	η_{max}	77	80	80	80	80	80		%
8 Max Continuous Speed	$n_{e,max}$	10000	10000	10000	10000	10000	10000		rpm
9 Max Continuous Torque	$M_{e,max}$	6.09 (0.87)	6.38 (0.91)	6.45 (0.92)	6.44 (0.92)	6.45 (0.92)	6.5 (0.93)		mNm (oz-in)
10 Max Continuous Current	$I_{e,max}$	1.85	1.13	0.78	0.57	0.46	0.37		A
11 Back-EMF Constant	k_E	0.36	0.61	0.89	1.22	1.52	1.90		mV/rpm
12 Torque Constant	k_M	3.39	5.82	8.48	11.63	14.54	18.18		mNm/A
13 Motor Regulation	R/k^2	63.83	58.37	57.22	57.28	57.22	56.34		$10^3/Nms$
14 Friction Torque	T_F	0.2 (0.03)	0.2 (0.03)	0.2 (0.03)	0.2 (0.03)	0.2 (0.03)	0.2 (0.03)		mNm (oz-in)
15 Mechanical Time Constant	τ_m	30.63	27.87	27.12	26.81	26.68	26.60		ms
16 Rotor Inertia	J	4.80	4.78	4.74	4.68	4.66	4.72		g-cm ²

General Data				
17 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	6/22		$^{\circ}C/W$
18 Thermal Time Constant (rotor/stator)	t_{W1}/t_{W2}	9/550		S
19 Operating Temperature Range:	motor rotor	-30 $^{\circ}C$ to 85 $^{\circ}C$ (-22 $^{\circ}F$ to 185 $^{\circ}F$) 100 $^{\circ}C$ (212 $^{\circ}F$)		$^{\circ}C$ ($^{\circ}F$) $^{\circ}C$ ($^{\circ}F$)
20 Shaft Load Max.: (5 mm from bearing)	-radial -axial	With sleeve bearings 1.5 (5.39) 100 (359.6)		N (oz) N (oz)
21 Shaft Play:	-radial -axial	0.03 (0.0012) 0.15 (0.0059)		mm (inch) mm (inch)
22 Weight	g	58 (2.05)		g (oz)
23 Commutation Segment	-	9		segment

*Also available with ball bearing

Execution Table

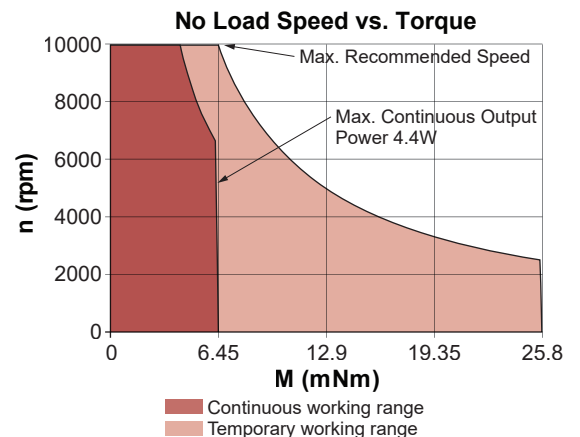
Gearbox	Single Shaft	MR2	E9
R22	4	5	6
K24	7	8	9
K27	1	2	3
R22HT	11	Upon Request	Upon Request

Note:

P1: standard commutation

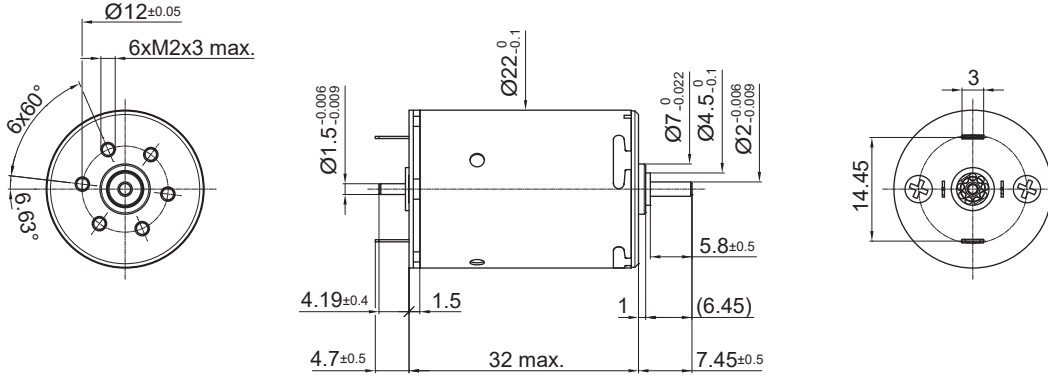
P2: special commutation for double shaft version

► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.



22DCP Athlonix™

Ø 22 mm • Precious metal commutation • 6.5 mNm



Dimensions in inches [mm]

Electrical Data	Symbol	22DCP 32P2 2					Unit
		212E	211E	210E	209E	208E	
1 Nominal Voltage	V	21	24	30	36	48	Volt
2 No-Load Speed	n_0	10,357	10,465	10,806	10,281	11,049	rpm
3 No-Load Current	I_0	10.5	9.2	7.6	6.1	4.9	mA
4 Terminal Resistance	R	23.4	30.4	46.1	71.7	112.6	Ω
5 Output Power	P_{2max}	4.2	4.3	4.4	4.1	4.5	W
6 Stall Torque	mNm	16.95 (2.41)	16.89 (2.4)	16.85 (2.39)	16.39 (2.33)	17.28 (2.45)	mNm (oz-in)
7 Efficiency	h_{max}	80	80	80	79	80	%
8 Max Continuous Speed	$n_{e max}$	10,000	10,000	10,000	10,000	10,000	rpm
9 Max Continuous Torque	$M_{e max}$	6.08 (0.86)	6.04 (0.86)	5.93 (0.84)	6 (0.85)	5.94 (0.85)	mNm (oz-in)
10 Max Continuous Current	$I_{e max}$	0.33	0.29	0.23	0.19	0.15	A
11 Back-EMF Constant	k_E	2.00	2.27	2.74	3.46	4.29	mV/rpm
12 Torque Constant	k_M	19.14	21.64	26.20	33.03	41.01	mNm/A
13 Motor Regulation	R/k^2	64.0	64.9	67.2	65.70	66.95	10 ³ /Nms
14 Friction Torque	T_F	0.2 (0.03)	0.2 (0.03)	0.2 (0.03)	0.2 (0.03)	0.2 (0.03)	mNm (oz-in)
15 Mechanical Time Constant	τ_m	30.1	30.0	30.0	30.0	30.0	ms
16 Rotor Inertia	J	4.70	4.63	4.47	4.56	4.48	g-cm ²

General Data				
17 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	6/22		°C/W
18 Thermal Time Constant (rotor/stator)	t_{w1}/t_{w2}	9/550		S
19 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)		°C (°F)
	rotor	100°C (212°F)		°C (°F)
20 Shaft Load Max.: (5 mm from bearing)	-radial	With sleeve bearings 1.5 (5.39)		N (oz)
	-axial	100 (359.6)		N (oz)
21 Shaft Play:	-radial	0.03 (0.0012)		mm (inch)
	-axial	0.15 (0.0059)		mm (inch)
22 Weight	g	58 (2.05)		g (oz)
23 Commutation Segment	-	9		segment

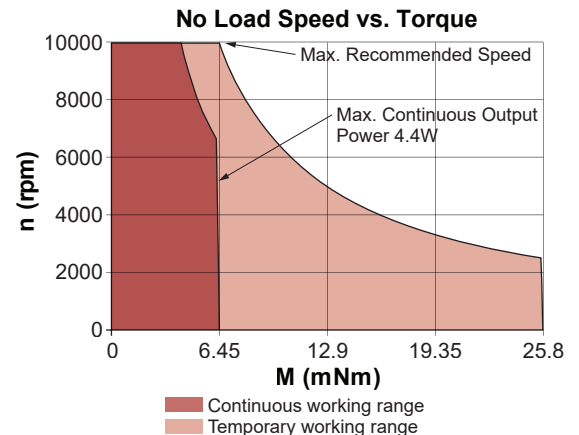
*Also available with ball bearing

Execution Table

Gearbox	Single Shaft	MR2	E9
R22	4	5	6
K24	7	8	9
K27	1	2	3
R22HT	11	Upon Request	Upon Request

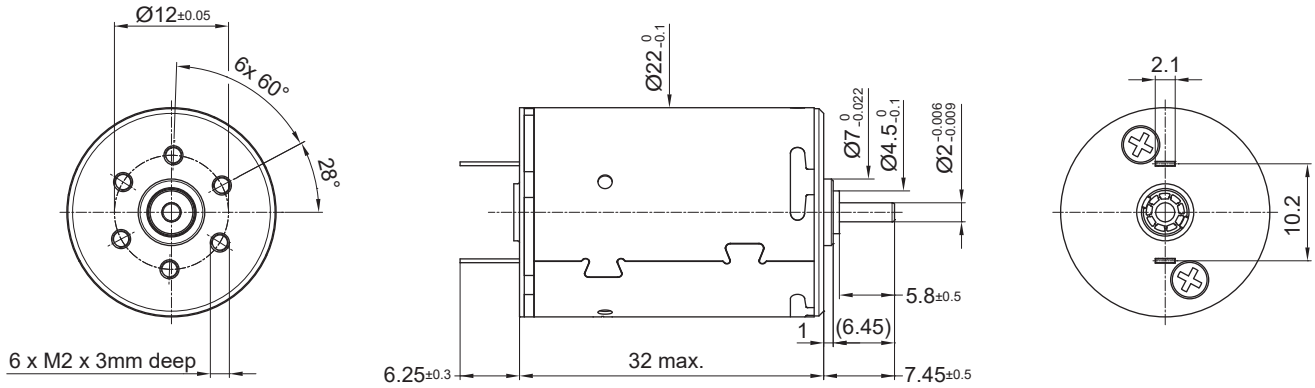
Note:
P1: standard commutation
P2: special commutation for double shaft version

► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.



22DCP Athlonix™

Ø 22 mm • Graphite-Copper commutation • 6.21 mNm



Dimensions in inches [mm]

Electrical Data	Symbol	221P	216P	22DCP 32G1 213P	211P	210P	209P	Unit
1 Nominal Voltage	V	3	6	9	12	15	18	Volt
2 No-Load Speed	n_0	8094	9574	9874	9598	9600	9211	rpm
3 No-Load Current	I_0	132.6	77.4	53.0	38.7	30.9	24.8	mA
4 Terminal Resistance	R	0.9	2.2	4.3	8.0	12.3	18.8	Ω
5 Output Power	$P_{2\text{max}}$	2.2	3.7	4.1	3.9	4.0	3.8	W
6 Stall Torque	mNm	10.44 (1.48)	15.6 (2.21)	17.23 (2.45)	17.1 (2.43)	17.29 (2.45)	16.94 (2.4)	mNm (oz-in)
7 Efficiency	η_{max}	63	69	71	71	71	70	%
8 Max Continuous Speed	$n_{e \text{ max.}}$	10000	10000	10000	10000	10000	10000	rpm
9 Max Continuous Torque	$M_{e \text{ max.}}$	5.13 (0.73)	5.82 (0.83)	6.04 (0.86)	6.11 (0.87)	6.14 (0.87)	6.21 (0.88)	mNm (oz-in)
10 Max Continuous Current	$I_{e \text{ max.}}$	1.64	1.08	0.77	0.56	0.45	0.37	A
11 Back-EMF Constant	k_E	0.36	0.61	0.89	1.22	1.52	1.90	mV/rpm
12 Torque Constant	k_M	3.39	5.82	8.48	11.63	14.54	18.18	mNm/A
13 Motor Regulation	R/k^2	81.20	64.28	60.00	58.76	58.16	56.95	$10^3/\text{Nms}$
14 Friction Torque	T_F	0.45 (0.07)	0.45 (0.07)	0.45 (0.07)	0.45 (0.07)	0.45 (0.07)	0.45 (0.07)	mNm (oz-in)
15 Mechanical Time Constant	τ_m	38.97	30.70	28.44	27.50	27.12	26.89	ms
16 Rotor Inertia	J	4.80	4.78	4.74	4.68	4.66	4.72	g-cm ²

General Data				
17 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	6/22		$^\circ\text{C}/\text{W}$
18 Thermal Time Constant (rotor/stator)	t_{W1}/t_{W2}	9/550		S
19 Operating Temperature Range:	motor rotor	-30 $^\circ\text{C}$ to 85 $^\circ\text{C}$ (-22 $^\circ\text{F}$ to 185 $^\circ\text{F}$) 100 $^\circ\text{C}$ (212 $^\circ\text{F}$)		$^\circ\text{C}$ ($^\circ\text{F}$) $^\circ\text{C}$ ($^\circ\text{F}$)
20 Shaft Load Max.: (5 mm from bearing)	-radial -axial	With sleeve bearings 1.5 (5.39) 100 (359.6)		N (oz) N (oz)
21 Shaft Play:	-radial -axial	0.03 (0.0012) 0.15 (0.0059)		mm (inch) mm (inch)
22 Weight	g	58 (2.05)		g (oz)
23 Commutation Segment	-	9		segment

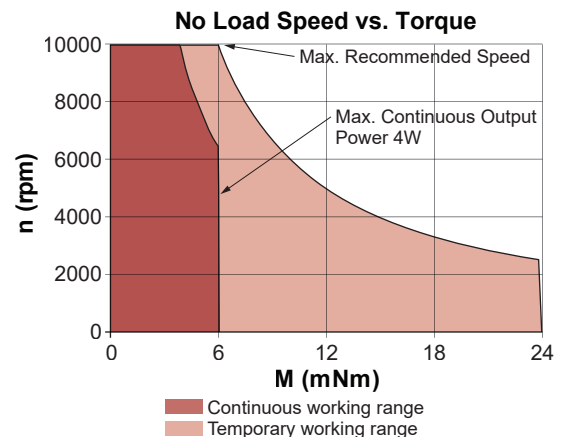
*Also available with ball bearing

Execution Table

Gearbox	Single Shaft	MR2	E9
R22	4	5	6
K24	7	8	9
K27	1	2	3
R22HT	11	Upon Request	Upon Request

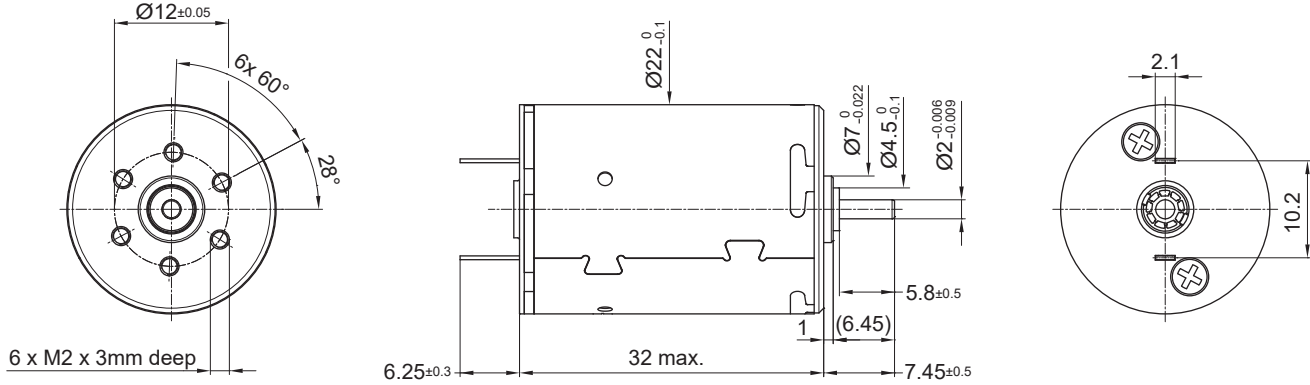
Note:
G1: standard commutation
G2: special commutation for double shaft version

► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.



22DCP Athlonix™

Ø 22 mm • Graphite-Copper commutation • 6.21 mNm



Dimensions in inches [mm]

Electrical Data	Symbol	22DCP 32G1 ***.1					Unit
		212E	211E	210E	209E	208E	
1 Nominal Voltage	V	21	24	30	36	48	Volt
2 No-Load Speed	n_0	10,201	10,308	10,645	10,123	10,889	rpm
3 No-Load Current	I_0	23.5	20.8	17.2	13.6	11.0	mA
4 Terminal Resistance	R	23.6	30.6	46.3	71.9	112.8	Ω
5 Output Power	$P_{2\text{max}}$	4.0	4.1	4.2	3.9	4.3	W
6 Stall Torque	mNm	16.56 (2.35)	16.53 (2.35)	16.53 (2.35)	16.09 (2.28)	17 (2.41)	mNm (oz-in)
7 Efficiency	h_{max}	70	70	70	70	70	%
8 Max Continuous Speed	$n_{e \text{ max}}$	10,000	10,000	10,000	10,000	10,000	rpm
9 Max Continuous Torque	$M_{e \text{ max}}$	5.81 (0.83)	5.77 (0.82)	5.67 (0.81)	5.74 (0.82)	5.69 (0.81)	mNm (oz-in)
10 Max Continuous Current	$I_{e \text{ max}}$	0.33	0.29	0.23	0.19	0.15	A
11 Back-EMF Constant	k_E	2.00	2.27	2.74	3.46	4.29	mV/rpm
12 Torque Constant	k_M	19.14	21.64	26.20	33.03	41.01	mNm/A
13 Motor Regulation	R/k^2	64.5	65.3	67.4	65.89	67.07	$10^3/\text{Nms}$
14 Friction Torque	T_F	0.45 (0.07)	0.45 (0.07)	0.45 (0.07)	0.45 (0.07)	0.45 (0.07)	mNm (oz-in)
15 Mechanical Time Constant	τ_m	30.3	30.2	30.1	30.1	30.0	ms
16 Rotor Inertia	J	4.70	4.63	4.47	4.56	4.48	g-cm ²

General Data				
17 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	6.22		$^\circ\text{C}/\text{W}$
18 Thermal Time Constant (rotor/stator)	t_{w1}/t_{w2}	9/550		S
19 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)		$^\circ\text{C}$ ($^\circ\text{F}$)
	rotor	100°C (212°F)		$^\circ\text{C}$ ($^\circ\text{F}$)
20 Shaft Load Max.: (5 mm from bearing)	-radial	With sleeve bearings 1.5 (5.39)		N (oz)
	-axial	100 (359.6)		N (oz)
	-radial	0.03 (0.0012)		mm (inch)
21 Shaft Play:	-axial	0.15 (0.0059)		mm (inch)
	-radial	58 (2.05)		g (oz)
22 Weight	g	9		segment
23 Commutation Segment	-	9		

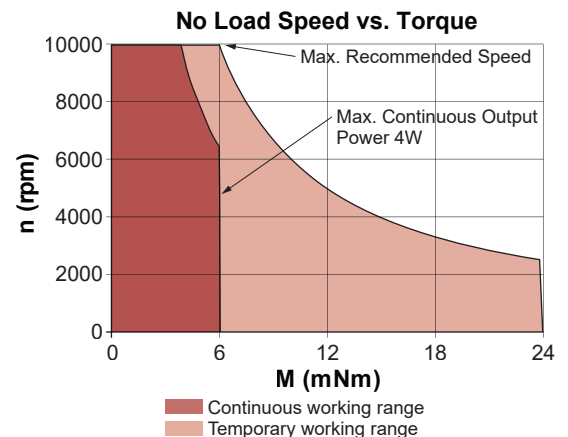
*Also available with ball bearing

Execution Table

Gearbox	Single Shaft	MR2	E9
R22	4	5	6
K24	7	8	9
K27	1	2	3
R22HT	11	Upon Request	Upon Request

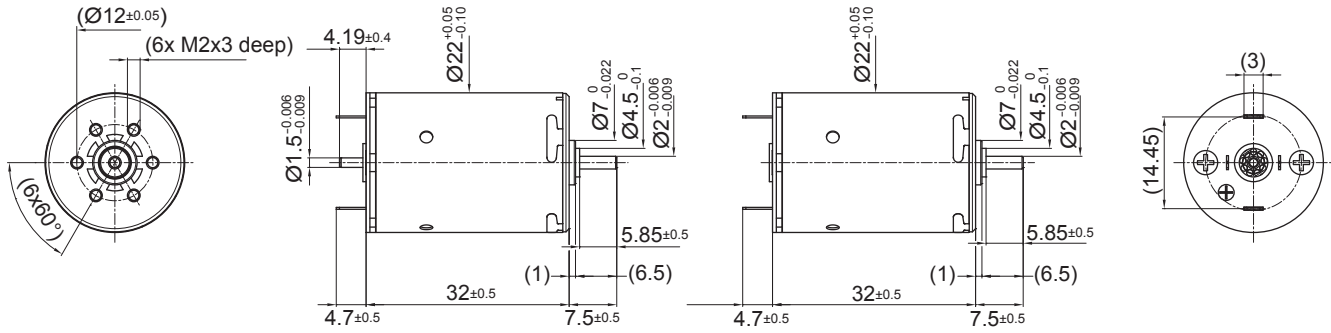
Note:
G1: standard commutation
G2: special commutation for double shaft version

► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.



22DCT Athlonix™

Ø 22 mm • Precious metal commutation • 13.28 mNm



Dimensions in inches [mm]

22DCT 32P22

22DCT 32P214

Electrical Data	Symbol	22DCT 32P2 *						Unit
		135P	225P	228E	226E	224E	220E	
1 Nominal Voltage	V	3	6	6	9	12	12	Volt
2 No-Load Speed	n_0	5525	8525	5887	7071	8131	6040	rpm
3 No-Load Current	I_0	42.7	32.8	22.7	18.2	15.7	11.6	mA
4 Terminal Resistance	R	0.4	0.5	1.1	1.6	2.1	4.0	Ω
5 Output Power	P_{2max}	4.7	9.6	5.9	7.9	9.4	6.3	W
6 Stall Torque	mNm	37.59 (5.33)	77.71 (11.01)	51.68 (7.32)	68.82 (9.75)	79.56 (11.27)	56.48 (8)	mNm (oz-in)
7 Efficiency	η_{max}	85	90	87	89	90	88	%
8 Max Continuous Speed	$n_{e,max}$	10000	10000	10000	10000	10000	10000	rpm
9 Max Continuous Torque	$M_{e,max}$	11.04 (1.57)	12.81 (1.82)	12.57 (1.79)	13.25 (1.88)	13.28 (1.89)	12.98 (1.84)	mNm (oz-in)
10 Max Continuous Current	$I_{e,max}$	2.19	1.95	1.32	1.11	0.96	0.70	A
11 Back-EMF Constant	k_E	0.54	0.70	1.01	1.27	1.47	1.98	mV/rpm
12 Torque Constant	k_M	5.16	6.70	9.69	12.12	14.05	18.90	mNm/A
13 Motor Regulation	R/k^2	15.00	11.49	11.93	10.76	10.70	11.20	10 ³ /Nms
14 Friction Torque	T_F	0.22 (0.04)	0.22 (0.04)	0.22 (0.04)	0.22 (0.04)	0.22 (0.04)	0.22 (0.04)	mNm (oz-in)
15 Mechanical Time Constant	τ_m	7.54	7.25	7.27	7.07	6.95	6.79	ms
16 Rotor Inertia	J	4.90	6.32	6.09	6.57	6.49	6.06	g-cm ²

General Data

17 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	6/22						°C/W
18 Thermal Time Constant (rotor/stator)	t_{W1}/t_{W2}	9/550						S
19 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)						°C (°F)
	rotor							100°C (212°F)
20 Shaft Load Max.: (5 mm from bearing)	-radial	With sleeve bearings						N (oz)
	-axial	3 (10.79)						N (oz)
	-radial	100 (359.6)						mm (inch)
21 Shaft Play:	-radial	0.03 (0.0012)						mm (inch)
	-axial	0.15 (0.0059)						mm (inch)
22 Weight	g	65 (2.3)						g (oz)
23 Commutation Segment	-	9						segment

*Also available with ball bearing

Execution Table

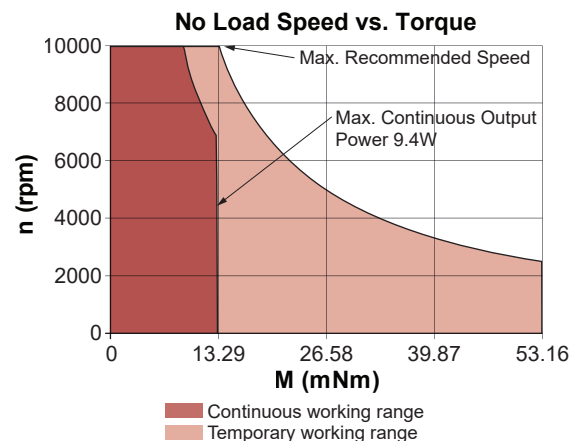
Gearbox	Single Shaft	MR2	E9
R22	4	5	6
K24	7	8	9
K27	1	2	3
R22HT	20	21	22

Note:

P1: standard commutation

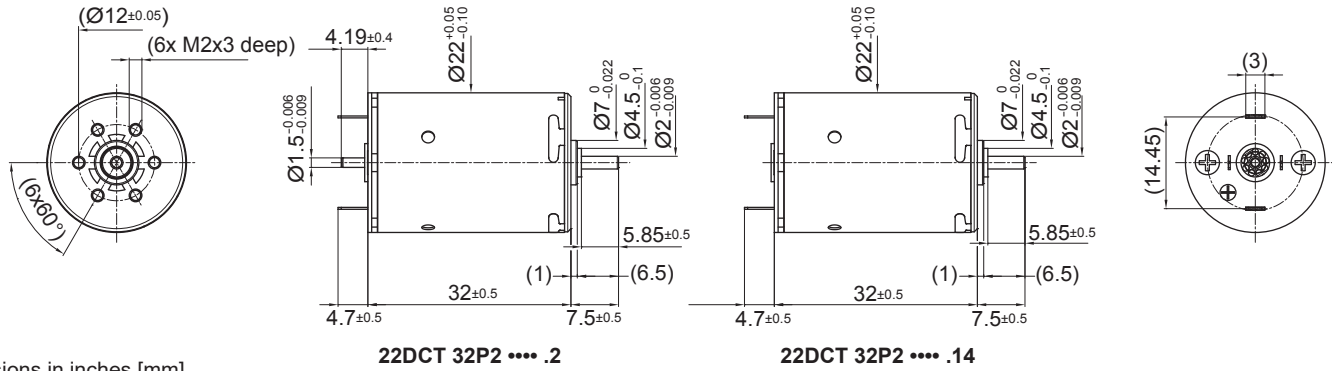
P2: special commutation for double shaft version

► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.



22DCT Athlonix™

Ø 22 mm • Precious metal commutation • 13.28 mNm



Dimensions in inches [mm]

Electrical Data	Symbol	22DCT 32P2 *					Unit
		216E	215E	212E	211E	209E	
1 Nominal Voltage	V	18	24	24	36	48	Volt
2 No-Load Speed	n_0	6666	8569	5600	7437	6493	rpm
3 No-Load Current	I_0	8.6	8.3	5.4	4.8	3.1	mA
4 Terminal Resistance	R	8.4	9.9	23.4	30.4	71.7	Ω
5 Output Power	P_{2max}	6.6	8.6	4.9	7.0	5.9	W
6 Stall Torque	mNm	54.94 (7.79)	64.54 (9.15)	41.47 (5.88)	54.31 (7.7)	46.82 (6.64)	mNm (oz-in)
7 Efficiency	η_{max}	88	89	86	88	87	%
8 Max Continuous Speed	$n_{e max}$	10000	10000	10000	10000	10000	rpm
9 Max Continuous Torque	$M_{e max}$	12.17 (1.73)	11.63 (1.65)	11.53 (1.64)	11.44 (1.63)	11.37 (1.62)	mNm (oz-in)
10 Max Continuous Current	$I_{e max}$	0.48	0.44	0.29	0.25	0.17	A
11 Back-EMF Constant	k_E	2.69	2.79	4.26	4.82	7.36	mV/rpm
12 Torque Constant	k_M	25.68	26.65	40.71	46.04	70.27	mNm/A
13 Motor Regulation	R/k^2	12.70	13.90	14.14	14.34	14.52	10 ³ /Nms
14 Friction Torque	T_F	0.22 (0.04)	0.22 (0.04)	0.22 (0.04)	0.22 (0.04)	0.22 (0.04)	mNm (oz-in)
15 Mechanical Time Constant	τ_m	6.70	6.69	6.65	6.64	6.63	ms
16 Rotor Inertia	J	5.27	4.81	4.70	4.63	4.56	g-cm ²

General Data				
17 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	6/22		°C/W
18 Thermal Time Constant (rotor/stator)	t_{w1}/t_{w2}	9/550		S
19 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)		°C (°F)
	rotor	100°C (212°F)		°C (°F)
20 Shaft Load Max.: (5 mm from bearing)	-radial	With sleeve bearings 3 (10.79)		N (oz)
	-axial	100 (359.6)		N (oz)
21 Shaft Play:	-radial	0.03 (0.0012)		mm (inch)
	-axial	0.15 (0.0059)		mm (inch)
22 Weight	g	65 (2.3)		g (oz)
23 Commutation Segment	-	9		segment

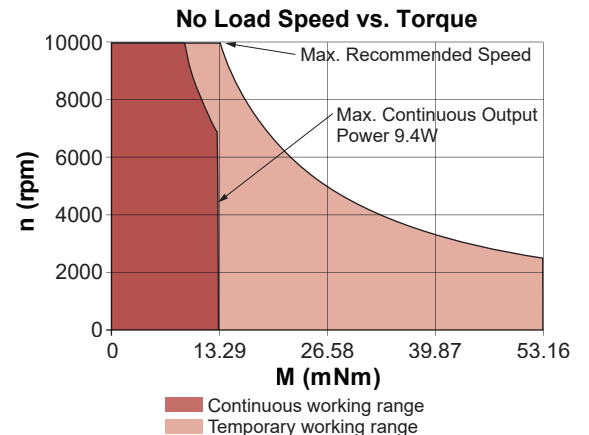
*Also available with ball bearing

Execution Table

Gearbox	Single Shaft	MR2	E9
R22	4	5	6
K24	7	8	9
K27	1	2	3
R22HT	20	21	22

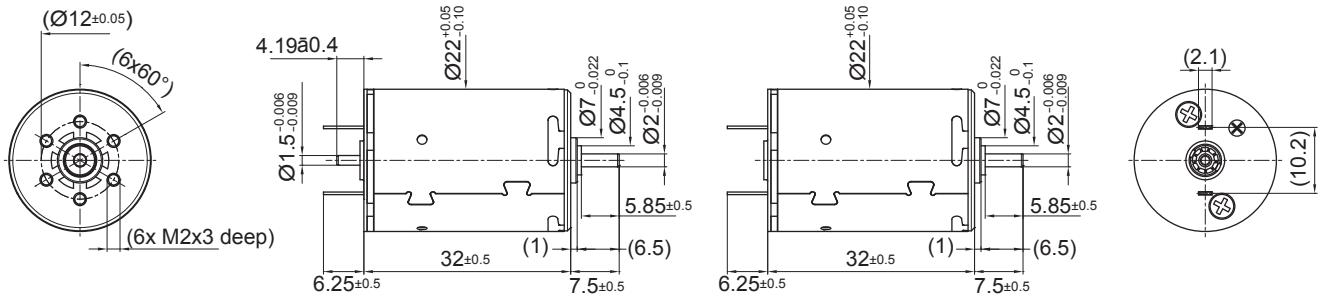
Note:
P1: standard commutation
P2: special commutation for double shaft version

► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.



22DCT Athlonix™

Ø 22 mm • Graphite-Copper commutation • 12.74 mNm



22DCT 32G2 2

22DCT 32G2 1

Dimensions in inches [mm]

Electrical Data	Symbol	22DCT 32G2 *						Unit
		135P	225P	228E	226E	224E	220E	
1 Nominal Voltage	V	3	6	6	9	12	12	Volt
2 No-Load Speed	n_0	5475	8490	5856	7045	8106	6014	rpm
3 No-Load Current	I_0	87.3	67.1	46.4	37.1	32.0	23.8	mA
4 Terminal Resistance	R	0.5	0.6	1.2	1.7	2.2	4.1	Ω
5 Output Power	P_{2max}	3.9	8.4	5.4	7.5	9.0	6.1	W
6 Stall Torque	mNm	29.93 (4.24)	64.83 (9.19)	47.2 (6.69)	64.48 (9.14)	75.72 (10.73)	54.86 (7.77)	mNm (oz-in)
7 Efficiency	η_{max}	77	84	82	84	85	83	%
8 Max Continuous Speed	$n_{e,max}$	10000	10000	10000	10000	10000	10000	rpm
9 Max Continuous Torque	$M_{e,max}$	9.65 (1.37)	11.48 (1.63)	11.8 (1.68)	12.61 (1.79)	12.74 (1.81)	12.59 (1.79)	mNm (oz-in)
10 Max Continuous Current	$I_{e,max}$	1.96	1.78	1.26	1.08	0.94	0.69	A
11 Back-EMF Constant	k_E	0.54	0.70	1.01	1.27	1.47	1.98	mV/rpm
12 Torque Constant	k_M	5.16	6.70	9.69	12.12	14.05	18.90	mNm/A
13 Motor Regulation	R/k^2	19.00	13.71	12.99	11.44	11.21	11.48	10 ³ /Nms
14 Friction Torque	T_F	0.45 (0.07)	0.45 (0.07)	0.45 (0.07)	0.45 (0.07)	0.45 (0.07)	0.45 (0.07)	mNm (oz-in)
15 Mechanical Time Constant	τ_m	9.38	8.66	7.92	7.51	7.28	6.96	ms
16 Rotor Inertia	J	4.90	6.32	6.09	6.57	6.49	6.06	g-cm ²

General Data

17 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	6/22						°C/W
18 Thermal Time Constant (rotor/stator)	t_{W1}/t_{W2}	9/550						S
19 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)						°C (°F)
	rotor							100°C (212°F)
20 Shaft Load Max.: (5 mm from bearing)	-radial	With sleeve bearings						N (oz)
	-axial	3 (10.79)						N (oz)
	-radial	100 (359.6)						mm (inch)
21 Shaft Play:	-radial	0.03 (0.0012)						mm (inch)
	-axial	0.15 (0.0059)						mm (inch)
22 Weight	g	65 (2.3)						g (oz)
23 Commutation Segment	-	9						segment

*Also available with ball bearing

Execution Table

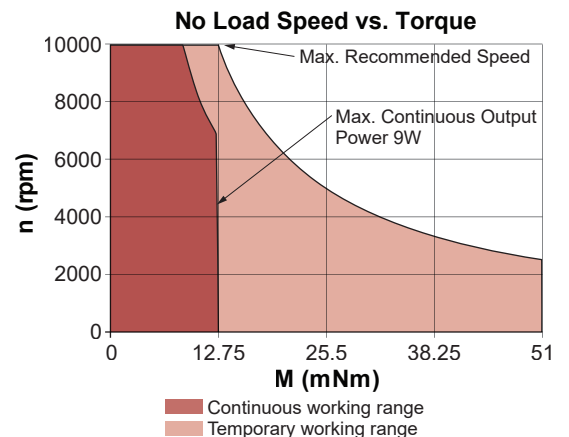
Gearbox	Single Shaft	MR2	E9
R22	4	5	6
K24	7	8	9
K27	1	2	3
R22HT	20	21	22

Note:

G1: standard commutation

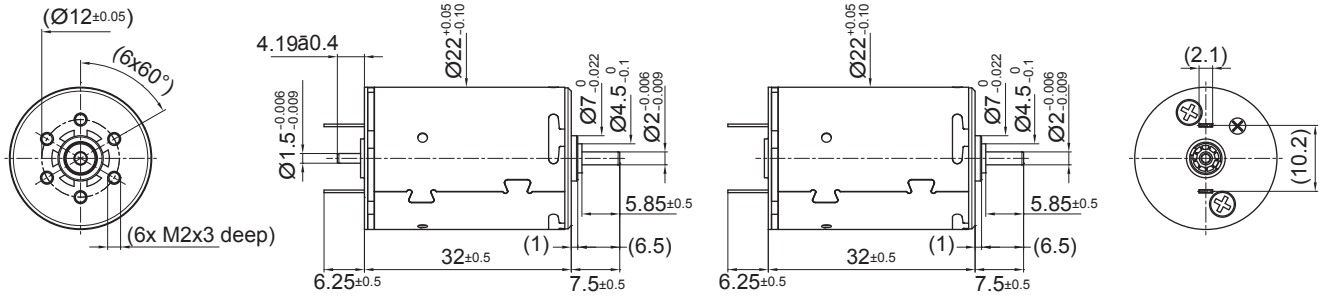
G2: special commutation for double shaft version

► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.



22DCT Athlonix™

Ø 22 mm • Graphite-Copper commutation • 12.74 mNm



Dimensions in inches [mm]

22DCT 32G2 2

22DCT 32G2 1

Electrical Data	Symbol	22DCT 32G2 *					Unit
		216E	215E	212E	211E	209E	
1 Nominal Voltage	V	18	24	24	36	48	Volt
2 No-Load Speed	n_0	6637	8538	5569	7405	6461	rpm
3 No-Load Current	I_0	17.5	16.9	11.1	9.8	6.4	mA
4 Terminal Resistance	R	8.5	10.0	23.5	30.5	71.8	Ω
5 Output Power	P_{2max}	6.4	8.3	4.8	6.9	5.7	W
6 Stall Torque	mNm	54.06 (7.66)	63.66 (9.02)	41.06 (5.82)	53.9 (7.64)	46.52 (6.59)	mNm (oz-in)
7 Efficiency	h_{max}	83	84	80	83	81	%
8 Max Continuous Speed	$n_{e max}$	10000	10000	10000	10000	10000	rpm
9 Max Continuous Torque	$M_{e max}$	11.87 (1.69)	11.34 (1.61)	11.27 (1.6)	11.19 (1.59)	11.13 (1.58)	mNm (oz-in)
10 Max Continuous Current	$I_{e max}$	0.48	0.44	0.29	0.25	0.16	A
11 Back-EMF Constant	k_E	2.69	2.79	4.26	4.82	7.36	mV/rpm
12 Torque Constant	k_M	25.68	26.65	40.71	46.04	70.27	mNm/A
13 Motor Regulation	R/k^2	12.86	14.04	14.20	14.39	14.54	10 ³ /Nms
14 Friction Torque	T_F	0.45 (0.07)	0.45 (0.07)	0.45 (0.07)	0.45 (0.07)	0.45 (0.07)	mNm (oz-in)
15 Mechanical Time Constant	τ_m	6.78	6.75	6.68	6.66	6.64	ms
16 Rotor Inertia	J	5.27	4.81	4.70	4.63	4.56	g-cm ²

General Data				
17 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	6/22		°C/W
18 Thermal Time Constant (rotor/stator)	t_{w1}/t_{w2}	9/550		S
19 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)		°C (°F)
	rotor			100°C (212°F)
20 Shaft Load Max.: (5 mm from bearing)	-radial -axial	With sleeve bearings		
		3 (10.79)		N (oz)
		100 (359.6)		N (oz)
21 Shaft Play:	-radial -axial	0.03 (0.0012)		mm (inch)
		0.15 (0.0059)		mm (inch)
22 Weight	g	65 (2.3)		g (oz)
23 Commutation Segment	-	9		segment

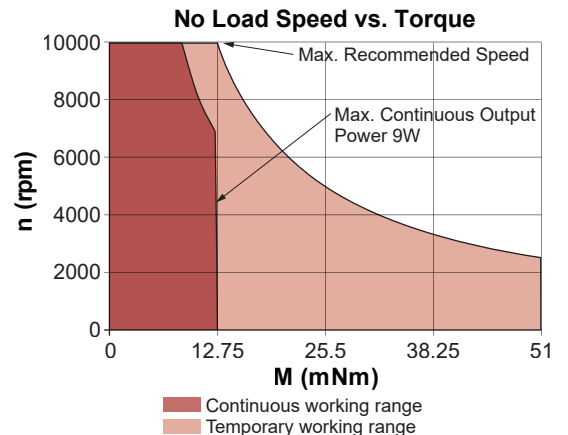
*Also available with ball bearing

Execution Table

Gearbox	Single Shaft	MR2	E9
R22	4	5	6
K24	7	8	9
K27	1	2	3
R22HT	20	21	22

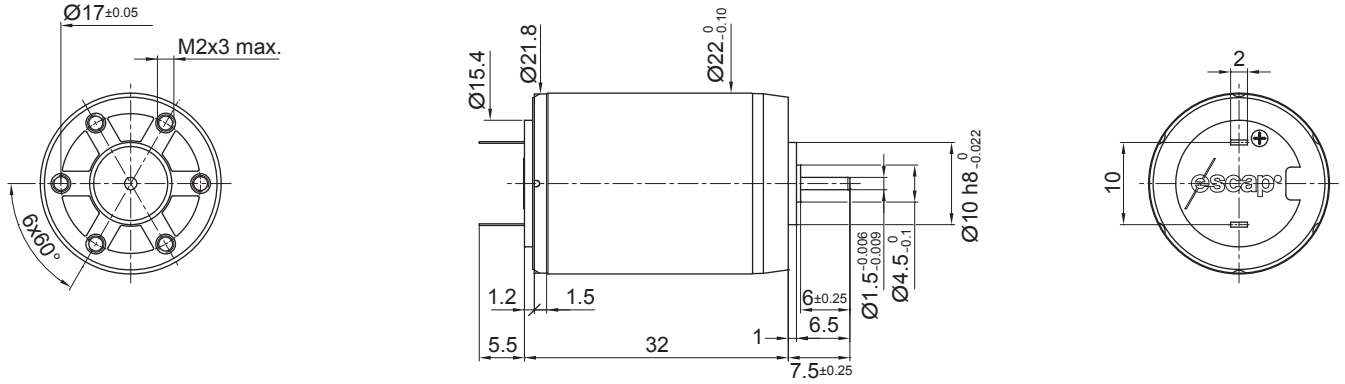
Note:
G1: standard commutation
G2: special commutation for double shaft version

► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.



22N78 Athlonix™

Ø 22 mm • Precious metal commutation • 15.7 mNm



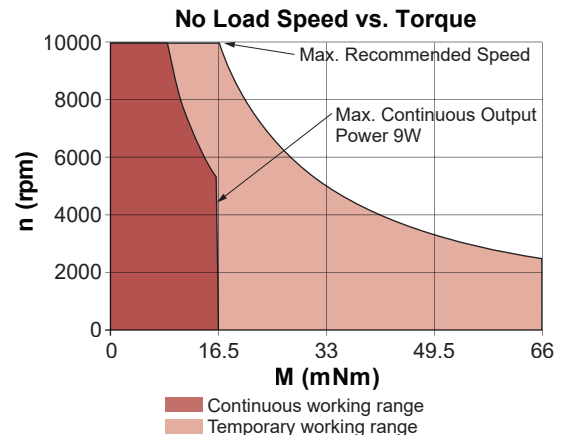
Dimensions in inches [mm]

Electrical Data	Symbol	22N781001						Unit
		319P	313P	311P	216E	215E	208E	
1 Nominal Voltage	V	6	9	12	18	24	48	Volt
2 No-Load Speed	n_0	8,660	6,860	7,280	8,250	9,075	6,350	rpm
3 No-Load Current	I_0	28.0	20.0	11.0	6.0	5.0	1.5	mA
4 Terminal Resistance	R	0.6	2.5	3.9	7.7	11.0	107.0	Ω
5 Output Power	P_{2max}	13.0	12.0	12.0	11.3	11.5	10.0	W
6 Stall Torque	mNm	66 (9.35)	45 (6.38)	48 (6.8)	49 (6.94)	55 (7.79)	32 (4.54)	mNm (oz-in)
7 Efficiency	h_{max}	90	90	88	90	91	91	%
8 Max Continuous Speed	$n_{e max}$	10,000	10,000	10,000	10,000	10,000	10,000	rpm
9 Max Continuous Torque	$M_{e max}$	15.7 (2.06)	14.5 (2.06)	14.8 (2.1)	13.8 (1.96)	14.5 (2.06)	12.9 (1.83)	mNm (oz-in)
10 Max Continuous Current	$I_{e max}$	2.40	1.18	0.95	0.67	0.58	0.18	A
11 Back-EMF Constant	k_E	0.69	1.31	1.64	2.18	2.64	7.54	mV/rpm
12 Torque Constant	k_M	6.60	12.50	15.70	20.80	25.20	72.00	mNm/A
13 Motor Regulation	R/k^2	13.8	16.0	15.8	17.80	17.32	20.64	$10^3/Nms$
14 Friction Torque	T_F	0.07 (0.01)	0.25 (0.04)	0.11 (0.02)	0.12 (0.02)	0.12 (0.02)	0.07 (0.01)	mNm (oz-in)
15 Rotor Inductance	L	0.04	0.16	0.25	0.50	0.60	7.00	mH
16 Mechanical Time Constant	τ_m	6.7	7.0	6.6	8.4	7.8	6.9	ms
17 Rotor Inertia	J	4.90	4.39	4.20	4.74	4.50	3.32	g-cm ²

General Data				
18 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	6/22		°C/W
19 Thermal Time Constant (rotor/stator)	t_{W1}/t_{W2}	9/550		S
20 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F) 100°C (212°F)		°C (°F)
	rotor			°C (°F)
21 Shaft Load Max.: (5 mm from bearing)	-radial -axial	With sleeve bearings		N (oz)
				N (oz)
				mm (inch)
22 Shaft Play:	-radial	<0.03 (0.0012) 0.15 (0.0059)		mm (inch)
	-axial			mm (inch)
23 Weight	g	53 (1.87)		g (oz)
24 Commutation Segment	-	9		segment

Execution Table

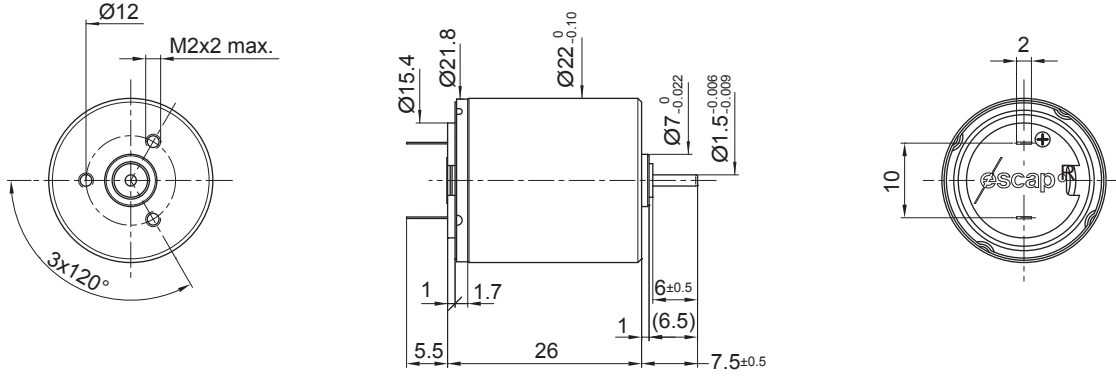
Gearbox	Single Shaft	MR2	E9
R22	1001	1008	1005
K24	1001	1008	1005
K27	1001	1008	1005
R22HT	1024	Upon Request	1025



► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.

22S28

Ø 22 mm • Precious metal commutation • 4.1 mNm



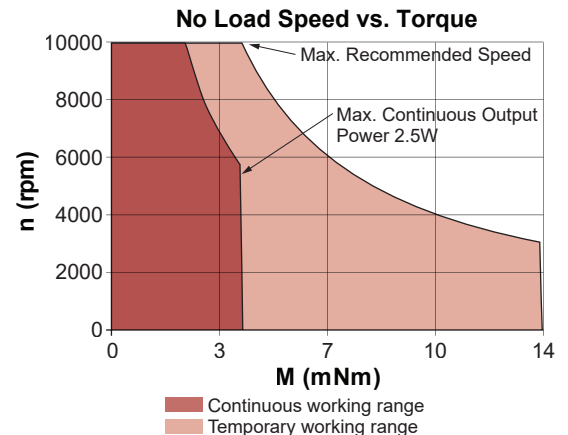
Dimensions in inches [mm]

Electrical Data	Symbol	22S28 1		Unit
		208E	205E	
1 Nominal Voltage	V	15	24	Volt
2 No-Load Speed	n_0	9,600	7,940	rpm
3 No-Load Current	I_0	6.0	2.8	mA
4 Terminal Resistance	R	35.0	140.0	Ω
5 Output Power	$P_{2max.}$	2.5	2.4	W
6 Stall Torque	mNm	6.3 (0.9)	4.9 (0.7)	mNm (oz-in)
7 Efficiency	$\eta_{max.}$	78	76	%
8 Max Continuous Speed	$n_{e max.}$	10,000	10,000	rpm
9 Max Continuous Torque	$M_{e max.}$	4.1 (0.56)	3.9 (0.56)	mNm (oz-in)
10 Max Continuous Current	$I_{e max.}$	0.29	0.15	A
11 Back-EMF Constant	k_E	1.54	2.97	mV/rpm
12 Torque Constant	k_M	14.70	28.40	mNm/A
13 Motor Regulation	R/k^2	160.0	170.0	10 ³ /Nms
14 Friction Torque	T_F	0.09 (0.02)	0.08 (0.02)	mNm (oz-in)
15 Rotor Inductance	L	0.92	3.60	mH
16 Mechanical Time Constant	τ_m	25.6	25.5	ms
17 Rotor Inertia	J	1.60	1.50	g-cm ²

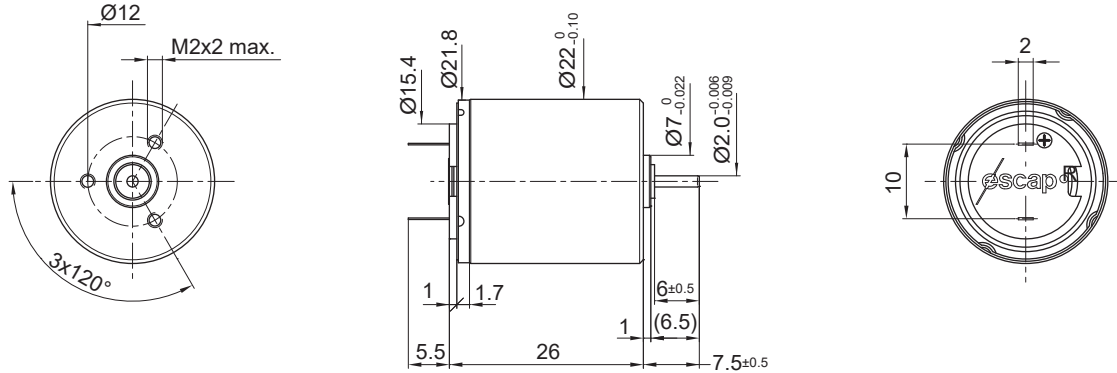
General Data				
18 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	5/30		°C/W
19 Thermal Time Constant (rotor/stator)	t_{w1}/t_{w2}	5/480		S
20 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)		°C (°F)
	rotor	100°C (212°F)		°C (°F)
21 Shaft Load Max.: (5 mm from bearing)		With sleeve bearings		
	-radial	1.5 (5.4)		N (oz)
	-axial	100 (359.6)		N (oz)
22 Shaft Play:	-radial	<0.03 (0.0012)		mm (inch)
	-axial	0.15 (0.0059)		mm (inch)
23 Weight	g	49 (1.73)		g (oz)
24 Commutation Segment	-	9		segment

Execution Table

Gearbox	Single Shaft	MR2
R22	Upon Request	Upon Request
K24	Upon Request	Upon Request
K27	Upon Request	Upon Request



► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.



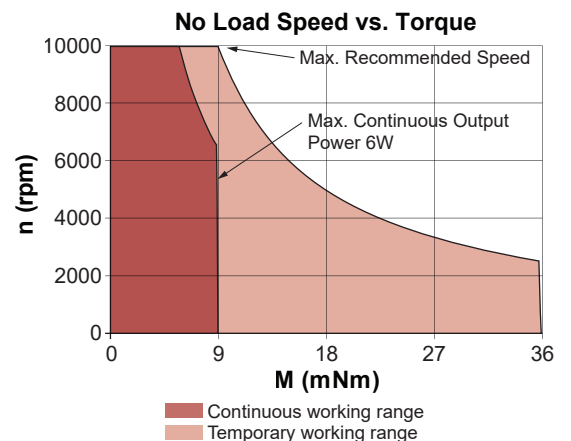
Dimensions in inches [mm]

Electrical Data	Symbol	210E	22S78 *** .1	208E	Unit
1 Nominal Voltage	V	18		24	Volt
2 No-Load Speed	n_0	7,780		8,550	rpm
3 No-Load Current	I_0	4.5		3.3	mA
4 Terminal Resistance	R	18.0		35.0	Ω
5 Output Power	P_{2max}	5.5		4.6	W
6 Stall Torque	mNm	22 (3.12)		18.3 (2.6)	mNm (oz-in)
7 Efficiency	h_{max}	87		87	%
8 Max Continuous Speed	$n_{e max}$	10,000		10,000	rpm
9 Max Continuous Torque	$M_{e max}$	8.9 (1.1)		7.7 (1.1)	mNm (oz-in)
10 Max Continuous Current	$I_{e max}$	0.41		0.29	A
11 Back-EMF Constant	k_E	2.30		2.80	mV/rpm
12 Torque Constant	k_M	22.00		26.70	mNm/A
13 Motor Regulation	R/k^2	37.0		49.0	10 ³ /Nms
14 Friction Torque	T_F	0.09 (0.02)		0.09 (0.02)	mNm (oz-in)
15 Rotor Inductance	L	0.50		0.92	mH
16 Mechanical Time Constant	τ_m	7.0		7.8	ms
17 Rotor Inertia	J	1.90		1.60	g-cm ²

General Data					
18 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}		5/30		°C/W
19 Thermal Time Constant (rotor/stator)	t_{w1}/t_{w2}		5/480		S
20 Operating Temperature Range:	motor		-30°C to 85°C (-22°F to 185°F)		°C (°F)
	rotor		100°C (212°F)		°C (°F)
21 Shaft Load Max.: (5 mm from bearing)			With sleeve bearings		
	-radial		1.5 (5.4)		N (oz)
	-axial		100 (359.6)		N (oz)
22 Shaft Play:	-radial		<0.03 (0.0012)		mm (inch)
	-axial		0.15 (0.0059)		mm (inch)
23 Weight	g		49 (1.73)		g (oz)
24 Commutation Segment	-		9		segment

Execution Table

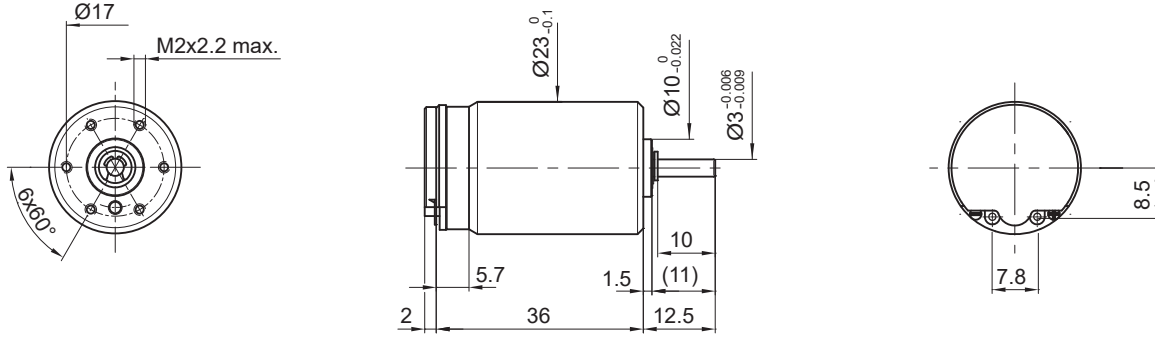
Gearbox	Single Shaft
R22	1



► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.

23GST2R82

Ø 23 mm • Graphite-Copper commutation • 22 mNm

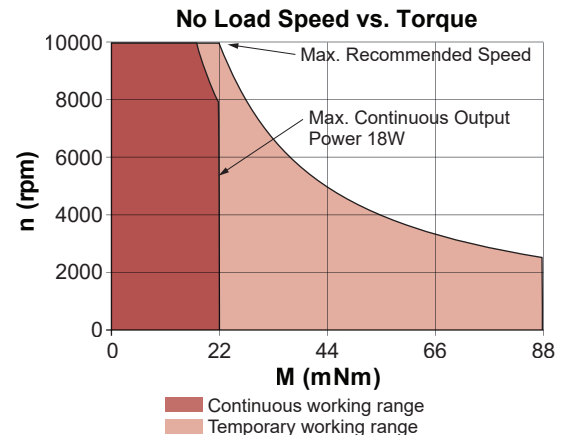


Dimensions in inches [mm]

Electrical Data	Symbol	23GST2R82 1		Unit
		216P	216E	
1 Nominal Voltage	V	12	24	Volt
2 No-Load Speed	n_0	8,690	9,010	rpm
3 No-Load Current	I_0	90.0	60.0	mA
4 Terminal Resistance	R	2.0	6.9	Ω
5 Output Power	P_{2max}	17.2	18.0	W
6 Stall Torque	mNm	80 (11.33)	87 (12.33)	mNm (oz-in)
7 Efficiency	η_{max}	77	76	%
8 Max Continuous Speed	$n_{e max}$	10,000	10,000	rpm
9 Max Continuous Torque	$M_{e max}$	21 (3.12)	22 (3.12)	mNm (oz-in)
10 Max Continuous Current	$I_{e max}$	1.70	0.90	A
11 Back-EMF Constant	k_E	1.36	2.62	mV/rpm
12 Torque Constant	k_M	13.00	25.00	mNm/A
13 Motor Regulation	R/k^2	12.0	11.0	10 ³ /Nms
14 Friction Torque	T_F	1.17 (0.17)	1.5 (0.22)	mNm (oz-in)
15 Rotor Inductance	L	0.08	0.30	mH
16 Mechanical Time Constant	τ_m	5.6	5.2	ms
17 Rotor Inertia	J	4.70	4.70	g-cm ²
General Data				
18 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	7/16		°C/W
19 Thermal Time Constant (rotor/stator)	t_{w1}/t_{w2}	12/460		S
20 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)		°C (°F)
	rotor	100°C (212°F)		°C (°F)
21 Shaft Load Max.: (5 mm from bearing)		With ball bearings		
	-radial	6.0 (21.6)		N (oz)
	-axial	250 (899.2)		N (oz)
22 Shaft Play:	-radial	<0.03 (0.0012)		mm (inch)
	-axial	0.15 (0.0059)		mm (inch)
23 Weight	g	80 (2.83)		g (oz)
24 Commutation Segment	-	9		segment

Execution Table

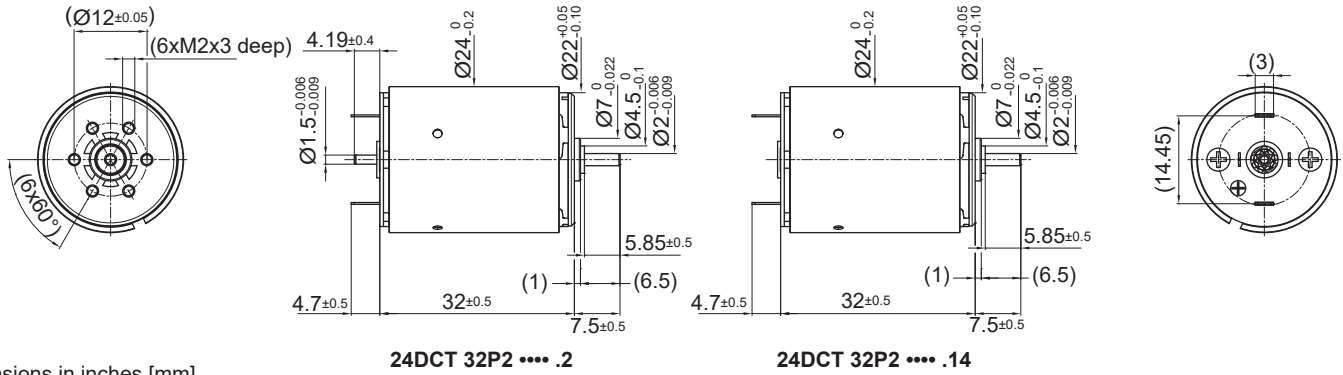
Gearbox	Single Shaft	MR2	E9
R22	2	Upon Request	Upon Request
K27	2	Upon Request	Upon Request
R22HT	11	12	Upon Request



► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.

24DCT Athlonix™

Ø 24 mm • Precious metal commutation • 14.97 mNm



Dimensions in inches [mm]

Electrical Data	Symbol	24DCT 32P2 *						Unit
		226P	221P	216P	215P	213P	212P	
1 Nominal Voltage	V	3	6	9	12	15	18	Volt
2 No-Load Speed	n_0	5718	7365	6444	7641	7368	7370	rpm
3 No-Load Current	I_0	44.1	28.4	16.6	14.7	11.4	8.6	mA
4 Terminal Resistance	R	0.4	0.7	2.0	2.5	4.1	5.9	Ω
5 Output Power	P_{2max}	5.3	8.5	7.5	9.4	9.1	9.1	W
6 Stall Torque	mNm	40.6 (5.75)	63.07 (8.94)	60.34 (8.55)	71.54 (10.14)	70.38 (9.97)	70.35 (9.97)	mNm (oz-in)
7 Efficiency	η_{max}	86	89	88	89	89	90	%
8 Max Continuous Speed	$n_{e,max}$	10000	10000	10000	10000	10000	10000	rpm
9 Max Continuous Torque	$M_{e,max}$	12.86 (1.83)	14.15 (2.01)	14.81 (2.1)	14.81 (2.1)	14.96 (2.12)	14.97 (2.13)	mNm (oz-in)
10 Max Continuous Current	$I_{e,max}$	2.62	1.85	1.13	1.00	0.78	0.65	A
11 Back-EMF Constant	k_E	0.52	0.81	1.39	1.57	2.03	2.44	mV/rpm
12 Torque Constant	k_M	4.98	7.75	13.29	14.95	19.38	23.26	mNm/A
13 Motor Regulation	R/k^2	14.75	12.23	11.18	11.18	10.96	10.97	10 ³ /Nms
14 Friction Torque	T_F	0.22 (0.04)	0.22 (0.04)	0.22 (0.04)	0.22 (0.04)	0.22 (0.04)	0.22 (0.04)	mNm (oz-in)
15 Mechanical Time Constant	τ_m	6.97	5.87	5.34	5.28	5.20	5.16	ms
16 Rotor Inertia	J	4.73	4.80	4.78	4.72	4.74	4.70	g-cm ²

General Data				
17 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	6/22		°C/W
18 Thermal Time Constant (rotor/stator)	t_{W1}/t_{W2}	9/550		S
19 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)		°C (°F)
	rotor			100°C (212°F)
20 Shaft Load Max.: (5 mm from bearing)	-radial -axial	With sleeve bearings		
		3 (10.79)		N (oz)
		100 (359.6)		N (oz)
21 Shaft Play:	-radial	0.03 (0.0012)		mm (inch)
	-axial	0.15 (0.0059)		mm (inch)
22 Weight	g	72 (2.54)		g (oz)
23 Commutation Segment	-	9		segment

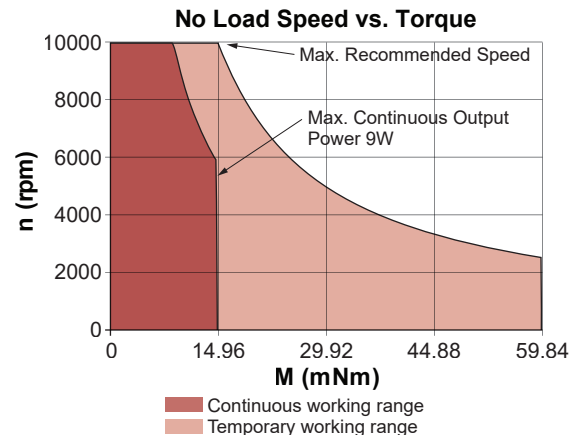
*Also available with ball bearing

Execution Table

Gearbox	Single Shaft	MR2	E9
R22	4	5	6
K24	7	8	9
K27	1	2	3
R22HT	11	Upon Request	Upon Request

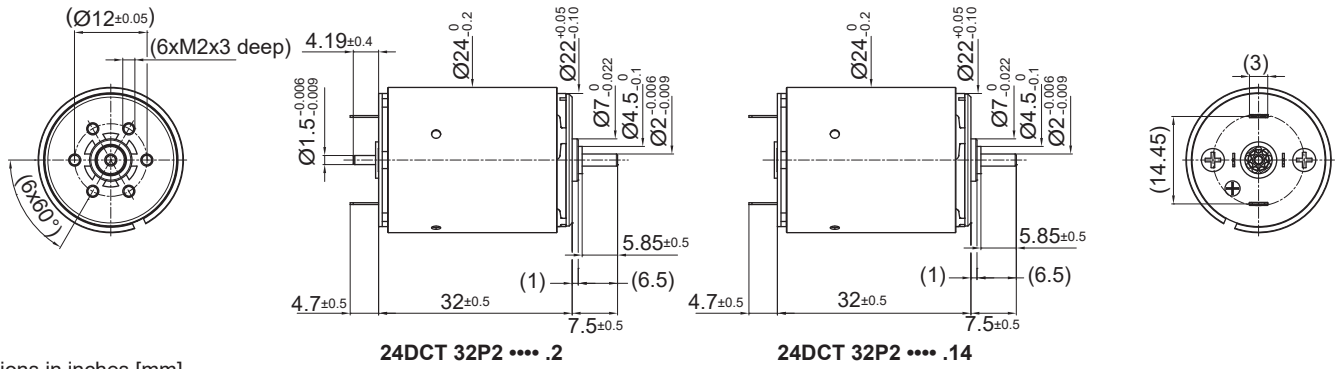
Note:
P1: standard commutation
P2: special commutation for double shaft version

► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.



24DCT Athlonix™

Ø 24 mm • Precious metal commutation • 14.97 mNm



Dimensions in inches [mm]

Electrical Data	Symbol	24DCT 32P2 *					Unit
		215E	214E	213E	212E	210E	
1 Nominal Voltage	V	21	24	30	36	48	Volt
2 No-Load Speed	n_0	6980	7076	7837	7837	7631	rpm
3 No-Load Current	I_0	7.7	6.8	6.0	5.0	3.7	mA
4 Terminal Resistance	R	9.9	12.8	16.2	23.4	46.1	Ω
5 Output Power	P_{2max}	8.0	8.0	9.2	9.2	8.6	W
6 Stall Torque	mNm	60.64 (8.59)	60.51 (8.57)	67.38 (9.55)	66.95 (9.49)	62.1 (8.8)	mNm (oz-in)
7 Efficiency	h_{max}	88	88	89	89	88	%
8 Max Continuous Speed	$n_{e max}$	10000	10000	10000	10000	10000	rpm
9 Max Continuous Torque	$M_{e max}$	14.25 (2.02)	14.14 (2.01)	14.18 (2.01)	14.13 (2.01)	13.79 (1.96)	mNm (oz-in)
10 Max Continuous Current	$I_{e max}$	0.50	0.44	0.39	0.32	0.23	A
11 Back-EMF Constant	k_E	3.00	3.38	3.82	4.58	6.27	mV/rpm
12 Torque Constant	k_M	28.63	32.27	36.44	43.72	59.86	mNm/A
13 Motor Regulation	R/k^2	12.05	12.24	12.18	12.26	12.87	10 ³ /Nms
14 Friction Torque	T_F	0.22 (0.04)	0.22 (0.04)	0.22 (0.04)	0.22 (0.04)	0.22 (0.04)	mNm (oz-in)
15 Mechanical Time Constant	τ_m	5.80	5.78	5.77	5.76	5.75	ms
16 Rotor Inertia	J	4.81	4.72	4.74	4.70	4.47	g-cm ²

General Data		24DCT 32P2 *					Unit
17 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	6/22					°C/W
18 Thermal Time Constant (rotor/stator)	t_{w1}/t_{w2}	9/550					S
19 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)					°C (°F)
	rotor	100°C (212°F)					°C (°F)
20 Shaft Load Max.: (5 mm from bearing)	-radial	With sleeve bearings 3 (10.79)					N (oz)
	-axial	100 (359.6)					N (oz)
21 Shaft Play:	-radial	0.03 (0.0012)					mm (inch)
	-axial	0.15 (0.0059)					mm (inch)
22 Weight	g	72 (2.54)					g (oz)
23 Commutation Segment	-	9					segment

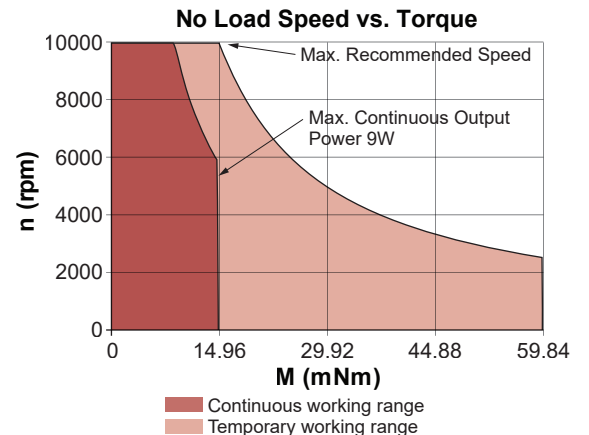
*Also available with ball bearing

Execution Table

Gearbox	Single Shaft	MR2	E9
R22	4	5	6
K24	7	8	9
K27	1	2	3
R22HT	11	Upon Request	Upon Request

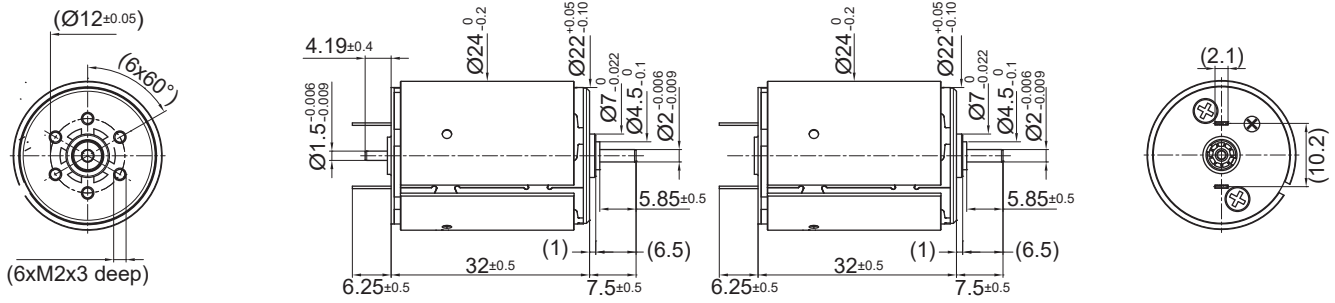
Note:
P1: standard commutation
P2: special commutation for double shaft version

► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.



24DCT Athlonix™

Ø 24 mm • Graphite-Copper commutation • 14.47 mNm



24DCT 32G2 2

24DCT 32G2 1

Dimensions in inches [mm]

Electrical Data	Symbol	24DCT 32G2 *						Unit
		226P	221P	216P	215P	213P	212P	
1 Nominal Voltage	V	3	6	9	12	15	18	Volt
2 No-Load Speed	n_0	5651	7324	6414	7613	7342	7342	rpm
3 No-Load Current	I_0	90.3	58.0	33.9	30.1	23.2	19.3	mA
4 Terminal Resistance	R	0.6	0.9	2.2	2.7	4.3	6.1	Ω
5 Output Power	P_{2max}	3.6	7.1	6.9	8.8	8.7	8.8	W
6 Stall Torque	mNm	25.95 (3.68)	49.3 (6.99)	54.54 (7.73)	66 (9.35)	66.88 (9.48)	67.8 (9.61)	mNm (oz-in)
7 Efficiency	η_{max}	76	82	83	84	84	84	%
8 Max Continuous Speed	$n_{e,max}$	10000	10000	10000	10000	10000	10000	rpm
9 Max Continuous Torque	$M_{e,max}$	10.07 (1.43)	12.29 (1.75)	13.87 (1.97)	14.01 (1.99)	14.37 (2.04)	14.47 (2.05)	mNm (oz-in)
10 Max Continuous Current	$I_{e,max}$	2.11	1.64	1.07	0.96	0.76	0.64	A
11 Back-EMF Constant	k_E	0.52	0.81	1.39	1.57	2.03	2.44	mV/rpm
12 Torque Constant	k_M	4.98	7.75	13.29	14.95	19.38	23.26	mNm/A
13 Motor Regulation	R/k^2	22.80	15.56	12.31	12.08	11.49	11.34	$10^3/Nms$
14 Friction Torque	T_F	0.45 (0.07)	0.45 (0.07)	0.45 (0.07)	0.45 (0.07)	0.45 (0.07)	0.45 (0.07)	mNm (oz-in)
15 Mechanical Time Constant	τ_m	10.78	7.47	5.88	5.70	5.45	5.33	ms
16 Rotor Inertia	J	4.73	4.80	4.78	4.72	4.74	4.70	g-cm ²

General Data

17 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	6/22						°C/W
18 Thermal Time Constant (rotor/stator)	t_{W1}/t_{W2}	9/550						S
19 Operating Temperature Range:	motor rotor	-30°C to 85°C (-22°F to 185°F) 100°C (212°F)						°C (°F) °C (°F)
20 Shaft Load Max.: (5 mm from bearing)	-radial -axial	With sleeve bearings 3 (10.79) 100 (359.6)						N (oz) N (oz)
21 Shaft Play:	-radial -axial	0.03 (0.0012) 0.15 (0.0059)						mm (inch) mm (inch)
22 Weight	g	72 (2.54)						g (oz)
23 Commutation Segment	-	9						segment

*Also available with ball bearing

Execution Table

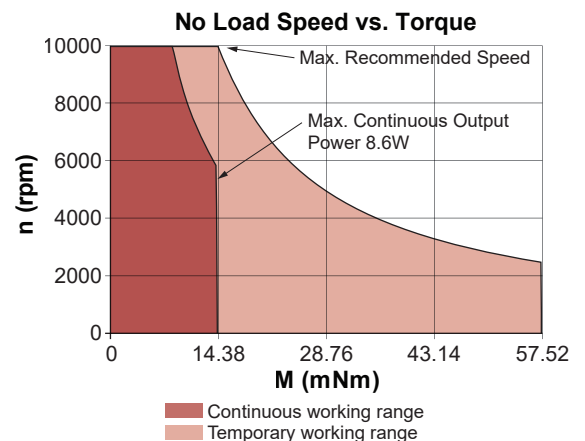
Gearbox	Single Shaft	MR2	E9
R22	4	5	6
K24	7	8	9
K27	1	2	3
R22HT	11	Upon Request	Upon Request

Note:

G1: standard commutation

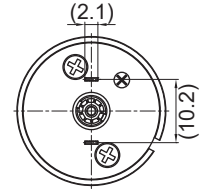
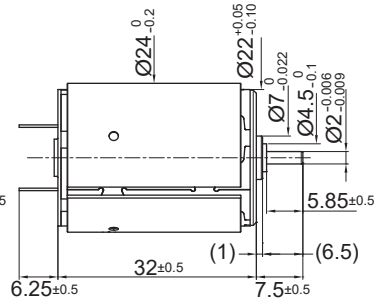
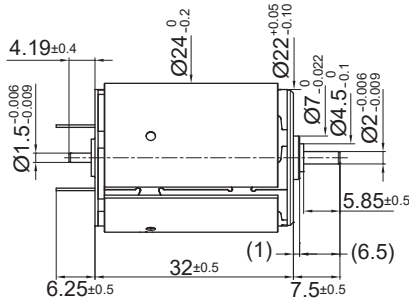
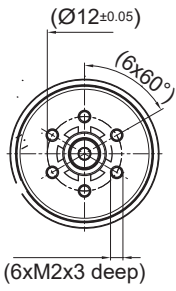
G2: special commutation for double shaft version

► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.



24DCT Athlonix™

Ø 24 mm • Graphite-Copper commutation • 14.47 mNm



24DCT 32G2 2

24DCT 32G2 1

Dimensions in inches [mm]

Electrical Data	Symbol	24DCT 32G2 *					Unit
		215E	214E	213E	212E	210E	
1 Nominal Voltage	V	21	24	30	36	48	Volt
2 No-Load Speed	n_0	6952	7048	7810	7810	7602	rpm
3 No-Load Current	I_0	15.7	13.9	12.4	10.3	7.5	mA
4 Terminal Resistance	R	10.1	13.0	16.4	23.6	46.3	Ω
5 Output Power	P_{2max}	7.7	7.8	9.0	9.0	8.4	W
6 Stall Torque	mNm	59.2 (8.39)	59.34 (8.41)	66.32 (9.4)	66.15 (9.37)	61.6 (8.73)	mNm (oz-in)
7 Efficiency	h_{max}	83	83	84	84	84	%
8 Max Continuous Speed	$n_{e max}$	10000	10000	10000	10000	10000	rpm
9 Max Continuous Torque	$M_{e max}$	13.88 (1.97)	13.8 (1.96)	13.86 (1.97)	13.84 (1.97)	13.53 (1.92)	mNm (oz-in)
10 Max Continuous Current	$I_{e max}$	0.50	0.44	0.39	0.32	0.23	A
11 Back-EMF Constant	k_E	3.00	3.38	3.82	4.58	6.27	mV/rpm
12 Torque Constant	k_M	28.63	32.27	36.44	43.72	59.86	mNm/A
13 Motor Regulation	R/k^2	12.30	12.44	12.33	12.36	12.92	10 ³ /Nms
14 Friction Torque	T_F	0.45 (0.07)	0.45 (0.07)	0.45 (0.07)	0.45 (0.07)	0.45 (0.07)	mNm (oz-in)
15 Mechanical Time Constant	τ_m	5.91	5.87	5.84	5.81	5.77	ms
16 Rotor Inertia	J	4.81	4.72	4.74	4.70	4.47	g-cm ²

General Data				
17 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	6/22		°C/W
18 Thermal Time Constant (rotor/stator)	t_{w1}/t_{w2}	9/550		S
19 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)		°C (°F)
	rotor	100°C (212°F)		°C (°F)
20 Shaft Load Max.: (5 mm from bearing)	-radial	With sleeve bearings 3 (10.79)		N (oz)
	-axial	100 (359.6)		N (oz)
21 Shaft Play:	-radial	0.03 (0.0012)		mm (inch)
	-axial	0.15 (0.0059)		mm (inch)
22 Weight	g	72 (2.54)		g (oz)
23 Commutation Segment	-	9		segment

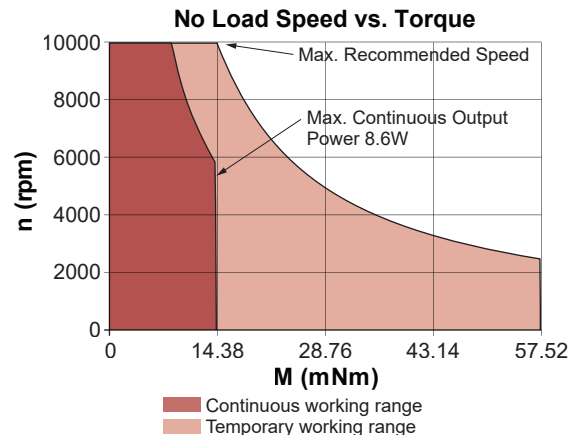
*Also available with ball bearing

Execution Table

Gearbox	Single Shaft	MR2	E9
R22	4	5	6
K24	7	8	9
K27	1	2	3
R22HT	11	Upon Request	Upon Request

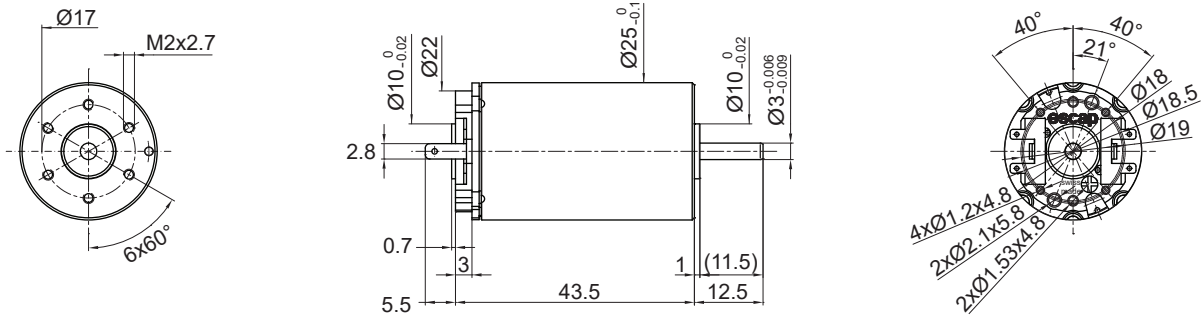
Note:
G1: standard commutation
G2: special commutation for double shaft version

► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.



25GST2R82

Ø 25 mm • Graphite-Copper commutation • 33 mNm



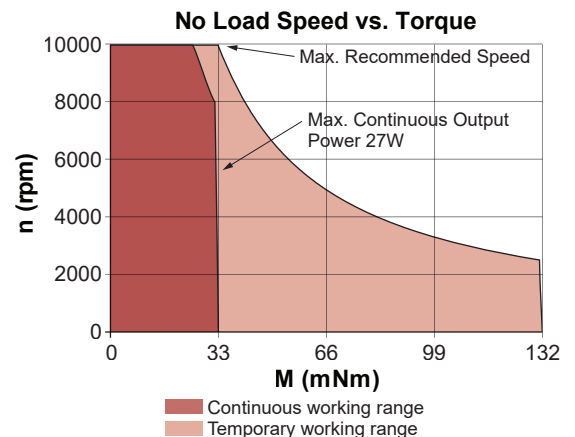
Dimensions in inches [mm]

Electrical Data	Symbol	25GST2R82 1				Unit
		228E	230E	216P	216E	
1 Nominal Voltage	V	18	18	24	35	Volt
2 No-Load Speed	n_0	11,125	11,450	10,320	7,850	rpm
3 No-Load Current	I_0	110.0	110.0	70.0	40.0	mA
4 Terminal Resistance	R	1.6	1.3	3.3	12.5	Ω
5 Output Power	P_{2max}	23.8	26.0	24.0	23.3	W
6 Stall Torque	mNm	172 (24.36)	206 (29.18)	160 (22.66)	118 (16.72)	mNm (oz-in)
7 Efficiency	η_{max}	81	83	81	78	%
8 Max Continuous Speed	$n_{e max}$	10,000	10,000	10,000	10,000	rpm
9 Max Continuous Torque	$M_{e max}$	30 (4.68)	33 (4.68)	30 (4.25)	30 (4.25)	mNm (oz-in)
10 Max Continuous Current	$I_{e max}$	2.10	2.30	1.45	0.75	A
11 Back-EMF Constant	k_E	1.60	1.56	2.30	4.40	mV/rpm
12 Torque Constant	k_M	15.30	14.90	22.00	42.00	mNm/A
13 Motor Regulation	R/k ²	6.9	5.9	6.8	7.10	10 ³ /Nms
14 Friction Torque	T_F	1.68 (0.24)	1.64 (0.24)	1.54 (0.22)	1.68 (0.24)	mNm (oz-in)
15 Rotor Inductance	L	0.10	0.10	0.10	0.80	mH
16 Mechanical Time Constant	τ_m	6.9	5.9	6.8	7.1	ms
17 Rotor Inertia	J	10.00	10.00	10.00	10.00	g-cm ²

General Data				
18 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	6/13		$^{\circ}\text{C}/\text{W}$
19 Thermal Time Constant (rotor/stator)	t_{W1}/t_{W2}	10/450		S
20 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)		$^{\circ}\text{C}$ ($^{\circ}\text{F}$)
	rotor			100°C (212°F)
21 Shaft Load Max.: (5 mm from bearing)		With ball bearings		
	-radial	12.0 (43.2)		N (oz)
	-axial	68 (244.59)		N (oz)
22 Shaft Play:	-radial	<0.03 (0.0012)		mm (inch)
	-axial	0.15 (0.0059)		mm (inch)
23 Weight	g	111 (3.92)		g (oz)
24 Commutation Segment	-	9		segment

Execution Table

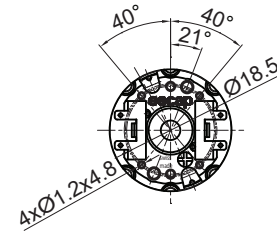
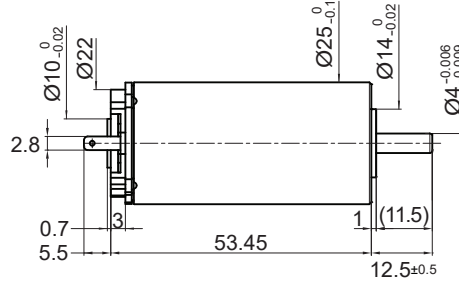
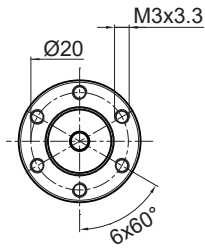
Gearbox	Single Shaft	E9	HEDS	MR2
R32	1	2	4	Upon Request
R22HT	24	25	Upon Request	Upon Request



► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.

25GT2R82

Ø 25 mm • Graphite-Copper commutation • 47 mNm



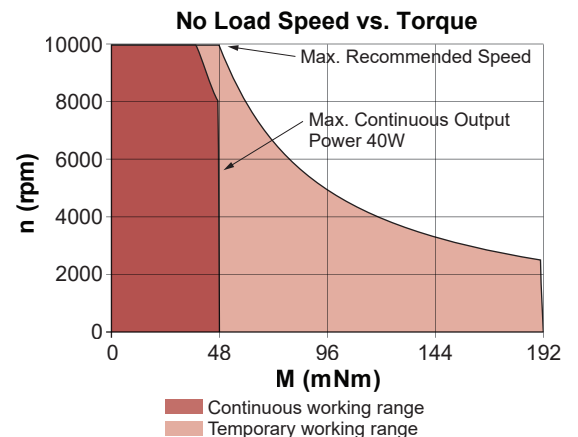
Dimensions in inches [mm]

Electrical Data	Symbol	25GT2R82 1				Unit
		222E	222P	230E	219E	
1 Nominal Voltage	V	15	18	24	36	Volt
2 No-Load Speed	n_0	4,075	9,460	10,000	8,260	rpm
3 No-Load Current	I_0	80.0	140.0	120.0	65.0	mA
4 Terminal Resistance	R	4.0	1.3	1.8	7.4	Ω
5 Output Power	P_{2max}	36.8	33.0	37.0	33.0	W
6 Stall Torque	mNm	129 (18.27)	249 (35.27)	315 (44.61)	194 (27.48)	mNm (oz-in)
7 Efficiency	η_{max}	73	81	82	78	%
8 Max Continuous Speed	$n_{e max}$	10,000	10,000	10,000	10,000	rpm
9 Max Continuous Torque	$M_{e max}$	47 (5.95)	42 (5.95)	47 (6.67)	41 (5.81)	mNm (oz-in)
10 Max Continuous Current	$I_{e max}$	1.44	2.50	2.20	1.06	A
11 Back-EMF Constant	k_E	3.60	1.88	2.40	4.30	mV/rpm
12 Torque Constant	k_M	34.40	18.00	23.00	41.10	mNm/A
13 Motor Regulation	R/k^2	3.4	4.0	3.4	4.40	$10^3/Nms$
14 Friction Torque	T_F	2.75 (0.39)	2.5 (0.36)	2.76 (0.4)	2.65 (0.38)	mNm (oz-in)
15 Rotor Inductance	L	0.30	0.08	0.14	0.50	mH
16 Mechanical Time Constant	τ_m	4.4	5.2	5.5	5.7	ms
17 Rotor Inertia	J	13.00	13.00	12.50	13.00	g-cm ²

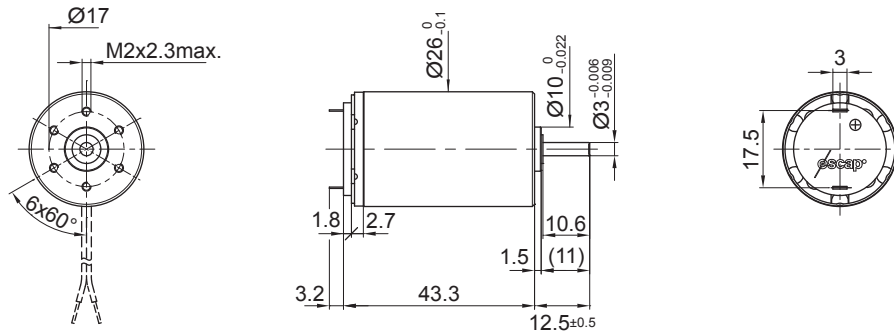
General Data				
18 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	5/11		$^{\circ}C/W$
19 Thermal Time Constant (rotor/stator)	t_{W1}/t_{W2}	10/450		S
20 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)		$^{\circ}C (^{\circ}F)$
	rotor	100°C (212°F)		$^{\circ}C (^{\circ}F)$
21 Shaft Load Max.: (5 mm from bearing)		With ball bearings		
	-radial	25.0 (89.9)		N (oz)
	-axial	100 (359.69)		N (oz)
22 Shaft Play:	-radial	<0.03 (0.0012)		mm (inch)
	-axial	0.15 (0.0059)		mm (inch)
23 Weight	g	145 (5.12)		g (oz)
24 Commutation Segment	-	9		segment

Execution Table

Gearbox	Single Shaft	E9	HEDS	MR2
R32	6	8	-	Upon Request
R40	1	2	4	Upon Request
R22HT	20	21	Upon Request	Upon Request



► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.



Dimensions in inches [mm]

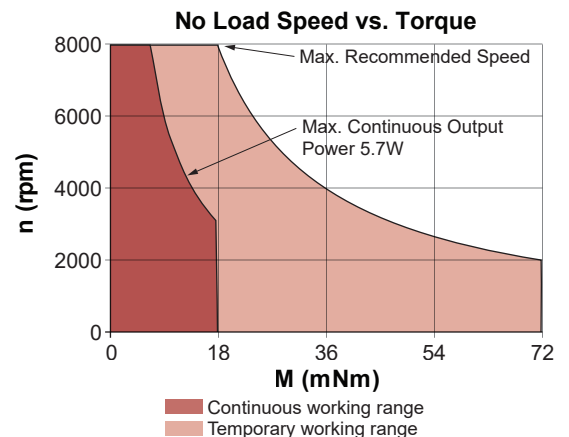
Electrical Data	Symbol	26N58 1				Unit
		216P	216E	113	110	
1 Nominal Voltage	V	6	12	15	24	Volt
2 No-Load Speed	n_0	4,600	4,735	5,470	6,660	rpm
3 No-Load Current	I_0	31.0	16.0	15.0	20.0	mA
4 Terminal Resistance	R	2.5	10.0	15.2	32.0	Ω
5 Output Power	P_{2max}	6.2	6.0	5.2	4.6	W
6 Stall Torque	mNm	29.6 (4.2)	28.6 (4.06)	25 (3.55)	25 (3.55)	mNm (oz-in)
7 Efficiency	η_{max}	79	78	77	70	%
8 Max Continuous Speed	$n_{e max}$	8,000	8,000	8,000	8,000	rpm
9 Max Continuous Torque	$M_{e max}$	17.9 (2.45)	17.3 (2.45)	15.1 (2.14)	13.3 (1.89)	mNm (oz-in)
10 Max Continuous Current	$I_{e max}$	1.47	0.74	0.60	0.41	A
11 Back-EMF Constant	k_E	1.29	2.50	2.70	3.51	mV/rpm
12 Torque Constant	k_M	12.30	23.90	25.80	33.50	mNm/A
13 Motor Regulation	R/k^2	16.5	17.5	22.8	28.51	10 ³ /Nms
14 Friction Torque	T_F	0.38 (0.06)	0.38 (0.06)	0.38 (0.06)	0.38 (0.06)	mNm (oz-in)
15 Rotor Inductance	L	0.22	0.80	1.00	1.50	mH
16 Mechanical Time Constant	τ_m	9.9	10.5	13.7	17.1	ms
17 Rotor Inertia	J	6.00	6.00	6.00	6.00	g-cm ²

General Data				
18 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	5/12		°C/W
19 Thermal Time Constant (rotor/stator)	t_{W1}/t_{W2}	10/640		S
20 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)		°C (°F)
	rotor			100°C (212°F)
21 Shaft Load Max.: (5 mm from bearing)	-radial -axial	With sleeve bearings		
		6.0 (21.6)		N (oz)
		250 (899.2)		N (oz)
22 Shaft Play:	-radial	<0.03 (0.0012)		mm (inch)
	-axial	0.15 (0.0059)		mm (inch)
23 Weight	g	114 (4.03)		g (oz)
24 Commutation Segment	-	9		segment

Execution Table

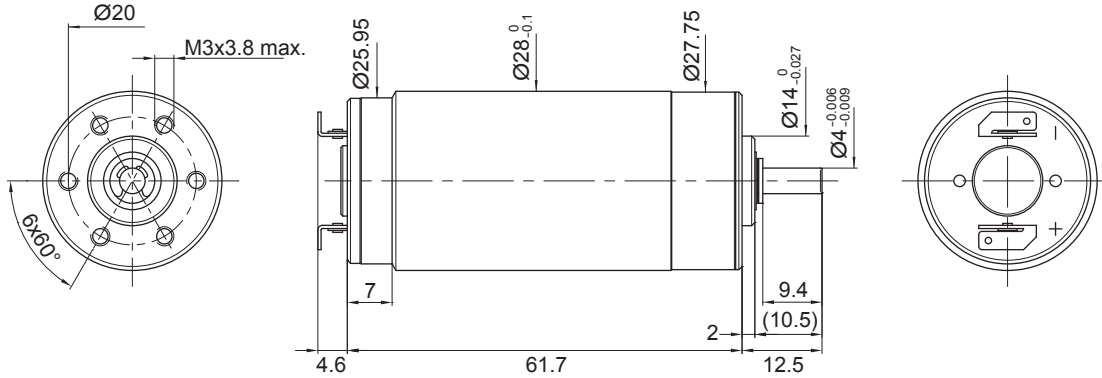
Gearbox	Single Shaft	Double Shaft for E9
R22	5	9
K24	5	9
K27	5	9

► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.



28DT12

Ø 28 mm • Graphite-Copper commutation • 41 mNm



Dimensions in inches [mm]

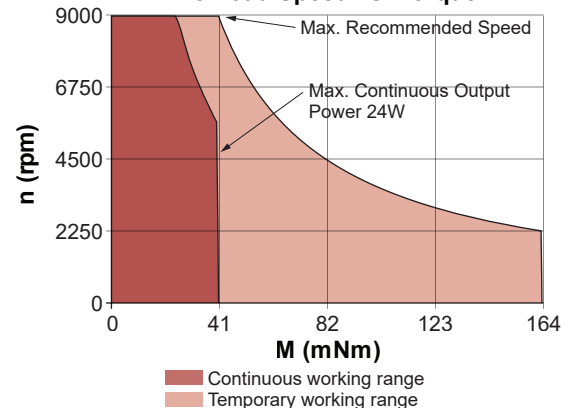
Electrical Data	Symbol	28DT12 1				Unit
		222P	219P	222E	219E	
1 Nominal Voltage	V	12	15	24	28	Volt
2 No-Load Speed	n_0	6,840	7,100	6,851	6,870	rpm
3 No-Load Current	I_0	210.0	180.0	110.0	90.0	mA
4 Terminal Resistance	R	1.9	2.9	6.2	9.9	Ω
5 Output Power	P_{2max}	24.0	24.0	27.0	24.0	W
6 Stall Torque	mNm	102 (14.45)	101 (14.31)	126 (17.85)	107 (15.16)	mNm (oz-in)
7 Efficiency	η_{max}	67	66	69	68	%
8 Max Continuous Speed	$n_{e max}$	9,000	9,000	9,000	9,000	rpm
9 Max Continuous Torque	$M_{e max}$	37 (5.1)	36 (5.1)	41 (5.81)	37 (5.24)	mNm (oz-in)
10 Max Continuous Current	$I_{e max}$	2.50	2.00	1.40	1.10	A
11 Back-EMF Constant	k_E	1.70	2.04	3.40	3.95	mV/rpm
12 Torque Constant	k_M	16.20	19.50	32.50	37.70	mNm/A
13 Motor Regulation	R/k^2	7.0	8.0	6.0	7.00	$10^3/Nms$
14 Friction Torque	T_F	3.4 (0.49)	3.4 (0.49)	3.4 (0.49)	3.4 (0.49)	mNm (oz-in)
15 Rotor Inductance	L	0.20	0.30	0.75	1.10	mH
16 Mechanical Time Constant	τ_m	14.0	14.4	12.0	12.6	ms
17 Rotor Inertia	J	20.00	18.00	20.00	18.00	g-cm ²

General Data				
18 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	3.5/8		$^{\circ}C/W$
19 Thermal Time Constant (rotor/stator)	t_{W1}/t_{W2}	18/630		S
20 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)		$^{\circ}C (^{\circ}F)$
	rotor			100°C (212°F)
21 Shaft Load Max.: (5 mm from bearing)	-radial	With sleeve bearings		N (oz)
	-axial			
22 Shaft Play:	-radial	<0.025 (0.001)		mm (inch)
	-axial			
23 Weight	g	200 (7.06)		g (oz)
24 Commutation Segment	-	13		segment

Execution Table

Gearbox	Single Shaft	Double Shaft for E9	HEDS
R32	4	106	103
R40	1	98	Upon Request

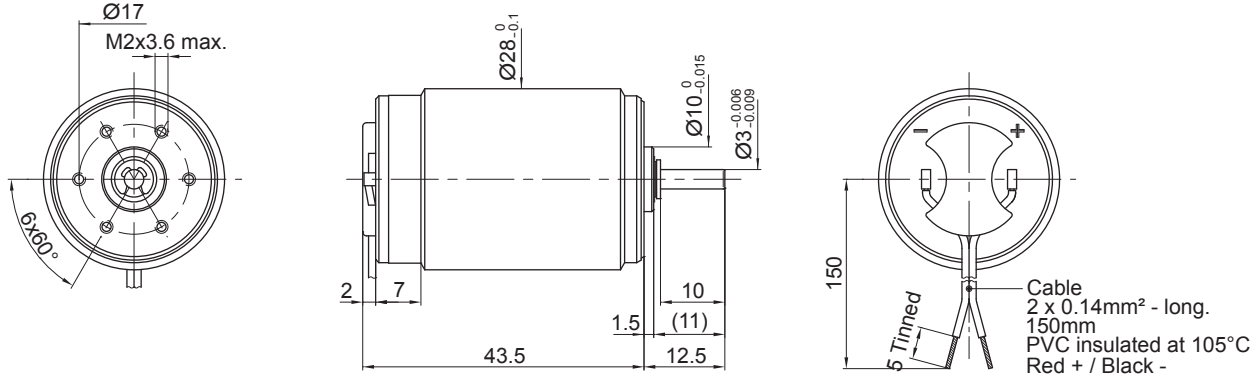
No Load Speed vs. Torque



► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.

28L28

Ø 28 mm • Precious metal commutation • 21 mNm



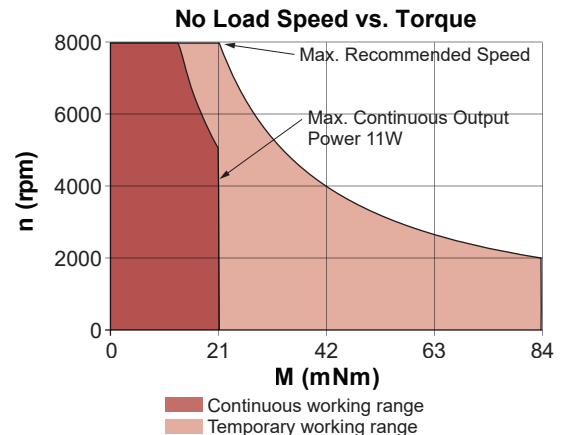
Dimensions in inches [mm]

Electrical Data	Symbol	28L28 49				Unit
		219	416E	413E	410E	
1 Nominal Voltage	V	12	24	28	36	Volt
2 No-Load Speed	n_0	5,300	5,590	5,325	5,000	rpm
3 No-Load Current	I_0	22.0	11.0	9.0	6.6	mA
4 Terminal Resistance	R	6.0	19.5	33.0	71.0	Ω
5 Output Power	P_{2max}	9.6	10.0	9.3	9.0	W
6 Stall Torque	mNm	43 (6.09)	50 (7.09)	32 (4.54)	34 (4.82)	mNm (oz-in)
7 Efficiency	η_{max}	80	82	80	78	%
8 Max Continuous Speed	$n_{e max}$	8,000	8,000	8,000	8,000	rpm
9 Max Continuous Torque	$M_{e max}$	19.9 (2.98)	21 (2.98)	19.4 (2.75)	18.5 (2.62)	mNm (oz-in)
10 Max Continuous Current	$I_{e max}$	0.95	0.53	0.40	0.28	A
11 Back-EMF Constant	k_E	2.24	4.26	5.20	7.10	mV/rpm
12 Torque Constant	k_M	21.40	40.70	49.70	67.80	mNm/A
13 Motor Regulation	R/k ²	13.0	12.0	13.2	15.20	10 ³ /Nms
14 Friction Torque	T_F	0.47 (0.07)	0.45 (0.07)	0.45 (0.07)	0.45 (0.07)	mNm (oz-in)
15 Rotor Inductance	L	0.50	2.40	3.20	5.20	mH
16 Mechanical Time Constant	τ_m	13.5	21.0	17.8	16.7	ms
17 Rotor Inertia	J	10.40	17.50	13.50	11.00	g-cm ²

General Data				
18 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	5/12		°C/W
19 Thermal Time Constant (rotor/stator)	t_{W1}/t_{W2}	13/760		S
20 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)		°C (°F)
	rotor			100°C (212°F)
21 Shaft Load Max.: (5 mm from bearing)		With sleeve bearings		
	-radial	6.0 (21.6)		N (oz)
	-axial	250 (899.2)		N (oz)
22 Shaft Play:	-radial	<0.18 (0.0007)		mm (inch)
	-axial	0.15 (0.0059)		mm (inch)
23 Weight	g	125 (4.41)		g (oz)
24 Commutation Segment	-	9		segment

Execution Table

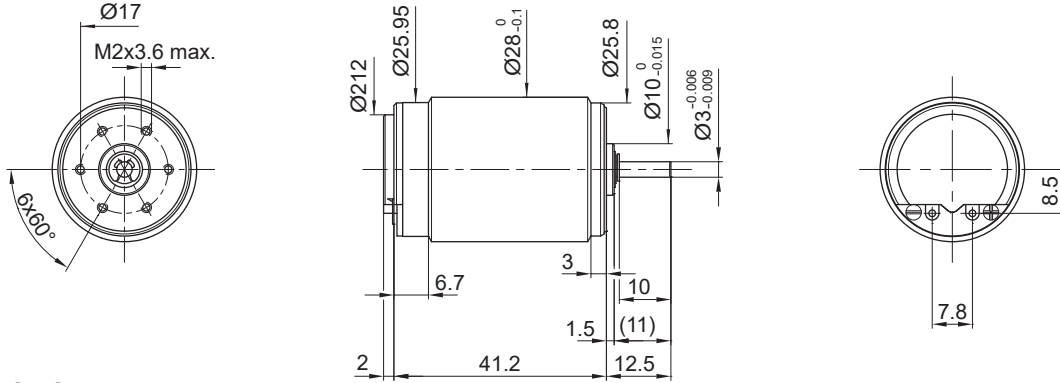
Gearbox	Single Shaft	Double Shaft for E9
R22	164	317
R32	49	315



► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.

28LT12

Ø 28 mm • Graphite-Copper commutation • 24 mNm



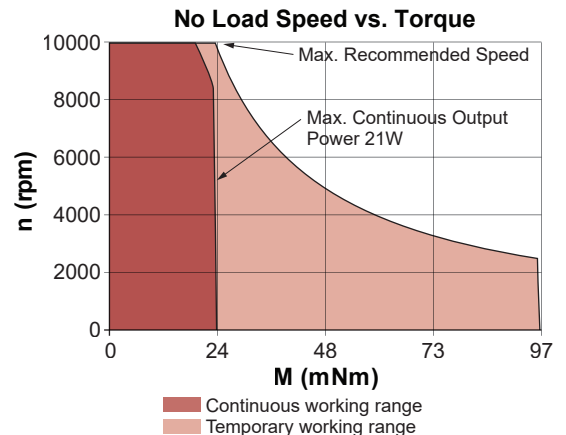
Dimensions in inches [mm]

Electrical Data	Symbol	28LT1249		Unit
		219	416E	
1 Nominal Voltage	V	18	32	Volt
2 No-Load Speed	n_0	7,860	7,345	rpm
3 No-Load Current	I_0	65.0	35.0	mA
4 Terminal Resistance	R	6.2	19.9	Ω
5 Output Power	P_{2max}	19.0	20.0	W
6 Stall Torque	mNm	63 (8.93)	65 (9.21)	mNm (oz-in)
7 Efficiency	η_{max}	72	73	%
8 Max Continuous Speed	$n_{e max}$	10,000	10,000	rpm
9 Max Continuous Torque	$M_{e max}$	23 (3.4)	24 (3.4)	mNm (oz-in)
10 Max Continuous Current	$I_{e max}$	1.13	0.63	A
11 Back-EMF Constant	k_E	2.24	4.26	mV/rpm
12 Torque Constant	k_M	21.40	40.70	mNm/A
13 Motor Regulation	R/k ²	13.0	12.0	10 ³ /Nms
14 Friction Torque	T_F	1.39 (0.2)	1.42 (0.21)	mNm (oz-in)
15 Rotor Inductance	L	0.50	2.40	mH
16 Mechanical Time Constant	τ_m	13.9	21.4	ms
17 Rotor Inertia	J	10.70	17.80	g-cm ²

General Data				
18 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	5/12		°C/W
19 Thermal Time Constant (rotor/stator)	t_{W1}/t_{W2}	27/760		S
20 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)		°C (°F)
	rotor	100°C (212°F)		°C (°F)
21 Shaft Load Max.: (5 mm from bearing)	-radial	With sleeve bearings 6.0 (21.6)		N (oz)
	-axial	250 (899.2)		N (oz)
	-radial	<0.018 (0.0007)		mm (inch)
22 Shaft Play:	-axial	0.15 (0.0059)		mm (inch)
23 Weight	g	135 (4.77)		g (oz)
24 Commutation Segment	-	9		segment

Execution Table

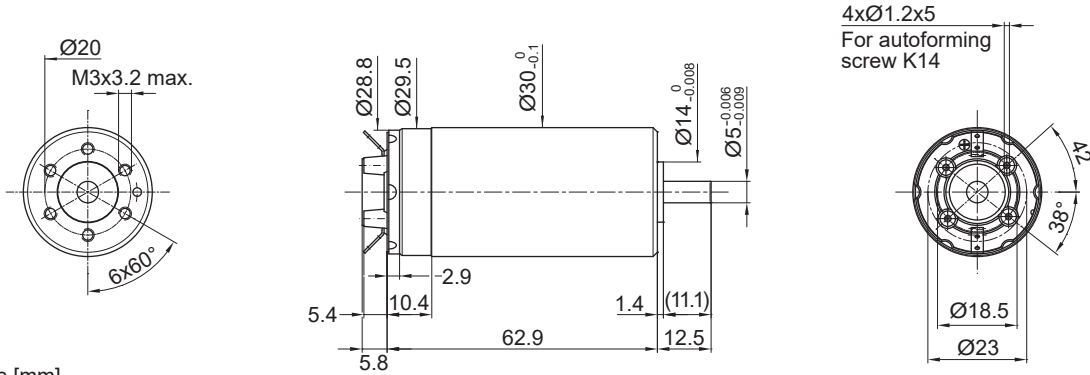
Gearbox	Single Shaft	Double Shaft for E9
R22	164	319
R32	49	316



► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.

30GT2R82

Ø 30 mm • Graphite-Copper commutation • 92 mNm



Dimensions in inches [mm]

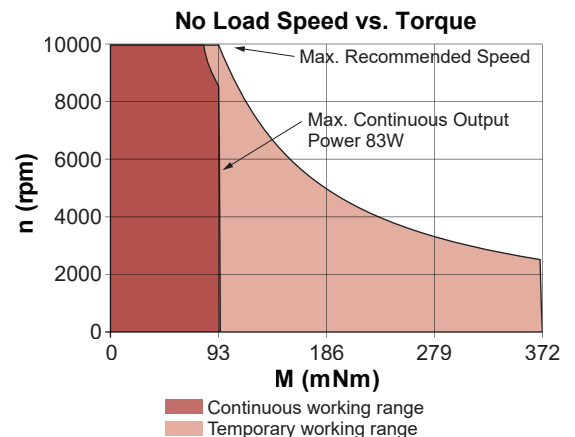
Electrical Data	Symbol	30GT2R82 4		Unit
		234P	234E	
1 Nominal Voltage	V	15	35	Volt
2 No-Load Speed	n_0	7,090	8,600	rpm
3 No-Load Current	I_0	180.0	90.0	mA
4 Terminal Resistance	R	0.5	1.6	Ω
5 Output Power	P_{2max}	77.0	82.0	W
6 Stall Torque	mNm	628 (88.94)	847 (119.95)	mNm (oz-in)
7 Efficiency	η_{max}	85	88	%
8 Max Continuous Speed	$n_{e max}$	10,000	10,000	rpm
9 Max Continuous Torque	$M_{e max}$	87 (13.03)	92 (13.03)	mNm (oz-in)
10 Max Continuous Current	$I_{e max}$	4.50	2.50	A
11 Back-EMF Constant	k_E	2.10	4.05	mV/rpm
12 Torque Constant	k_M	20.10	38.70	mNm/A
13 Motor Regulation	R/k^2	1.2	1.1	$10^3/Nms$
14 Friction Torque	T_F	3.62 (0.52)	3.48 (0.5)	mNm (oz-in)
15 Rotor Inductance	L	0.06	0.24	mH
16 Mechanical Time Constant	τ_m	4.0	3.6	ms
17 Rotor Inertia	J	33.00	33.00	g-cm ²

General Data				
18 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	4.5/9		$^{\circ}C/W$
19 Thermal Time Constant (rotor/stator)	t_{W1}/t_{W2}	18/630		S
20 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F) 100°C (212°F)		$^{\circ}C (^{\circ}F)$
	rotor			$^{\circ}C (^{\circ}F)$
21 Shaft Load Max.: (5 mm from bearing)		With ball bearings		
	-radial	35.0 (125.9)		N (oz)
	-axial	100 (359.6)		N (oz)
22 Shaft Play:	-radial	negligible		mm (inch)
	-axial	negligible		mm (inch)
23 Weight	g	310 (10.94)		g (oz)
24 Commutation Segment	-	13		segment

Execution Table

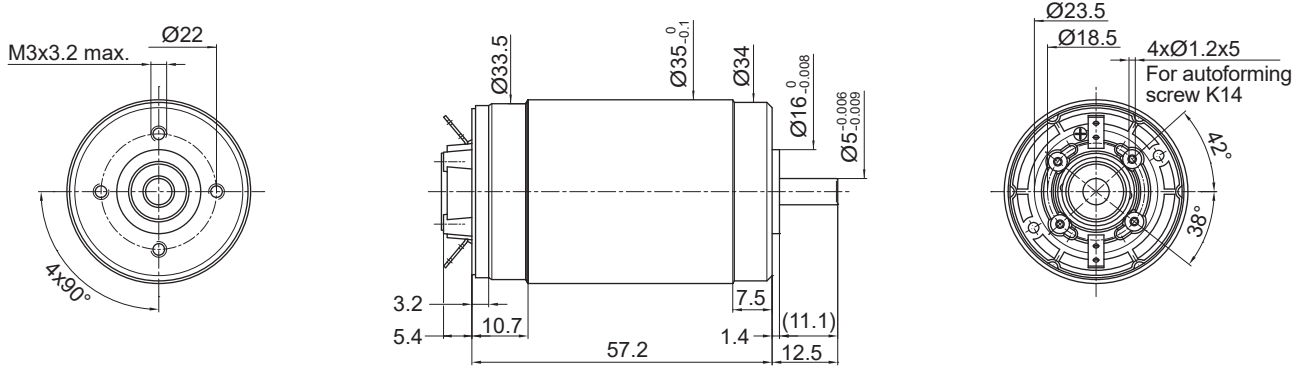
Gearbox	Single Shaft	E9	HEDS
R32	4	5	20
R40	4	5	Upon Request

► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.



35NT2R32

Ø 35 mm • Graphite-Copper commutation • 56 mNm



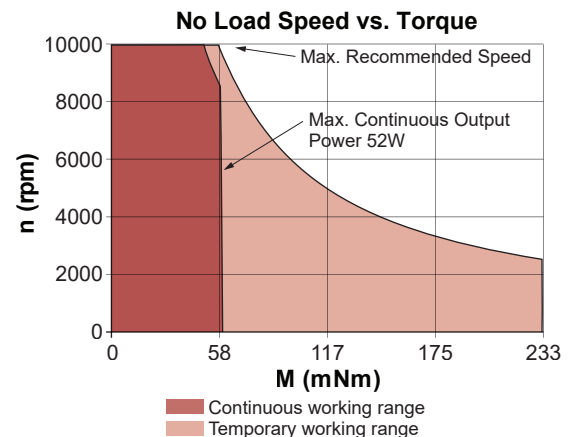
Dimensions in inches [mm]

Electrical Data	Symbol	35NT2R32 **** .1			Unit
		228P	228E	416SP	
1 Nominal Voltage	V	9	15	24	Volt
2 No-Load Speed	n_0	5,020	4,315	4,365	rpm
3 No-Load Current	I_0	180.0	90.0	50.0	mA
4 Terminal Resistance	R	1.0	3.6	8.3	Ω
5 Output Power	P_{2max}	33.0	33.0	35.0	W
6 Stall Torque	mNm	151 (21.39)	137 (19.41)	150 (21.25)	mNm (oz-in)
7 Efficiency	η_{max}	74	73	75	%
8 Max Continuous Speed	$n_{e max}$	9,000	9,000	9,000	rpm
9 Max Continuous Torque	$M_{e max}$	52 (7.65)	54 (7.65)	56 (7.94)	mNm (oz-in)
10 Max Continuous Current	$I_{e max}$	3.30	1.75	1.18	A
11 Back-EMF Constant	k_E	1.76	3.40	5.40	mV/rpm
12 Torque Constant	k_M	16.80	32.50	51.60	mNm/A
13 Motor Regulation	R/k^2	3.5	3.4	3.1	$10^3/Nms$
14 Friction Torque	T_F	3 (0.43)	2.93 (0.42)	2.6 (0.37)	mNm (oz-in)
15 Rotor Inductance	L	0.13	0.52	1.30	mH
16 Mechanical Time Constant	τ_m	16.8	16.3	16.2	ms
17 Rotor Inertia	J	48.00	48.00	52.00	g-cm ²

General Data					
18 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	4/8			$^{\circ}C/W$
19 Thermal Time Constant (rotor/stator)	t_{W1}/t_{W2}	40/920			S
20 Operating Temperature Range:	motor	-30 $^{\circ}C$ to 85 $^{\circ}C$ (-22 $^{\circ}F$ to 185 $^{\circ}F$)			$^{\circ}C$ ($^{\circ}F$)
	rotor				100 $^{\circ}C$ (212 $^{\circ}F$)
21 Shaft Load Max.: (5 mm from bearing)	-radial -axial	With ball bearings			
			35.0 (125.9)		N (oz)
			100 (359.6)		N (oz)
22 Shaft Play:	-radial	negligible			mm (inch)
	-axial	negligible			mm (inch)
23 Weight	g	310 (10.94)			g (oz)
24 Commutation Segment	-	13			segment

Execution Table

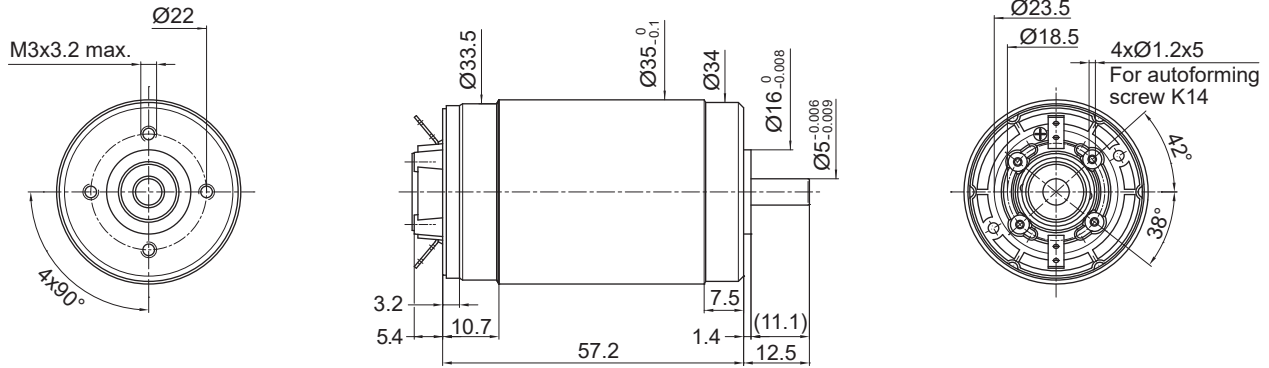
Gearbox	Single Shaft	E9	HEDS
R32	54	66	Upon Request
R40	1	96	Upon Request



► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.

35NT2R82

Ø 35 mm • Graphite-Copper commutation • 114 mNm



Dimensions in inches [mm]

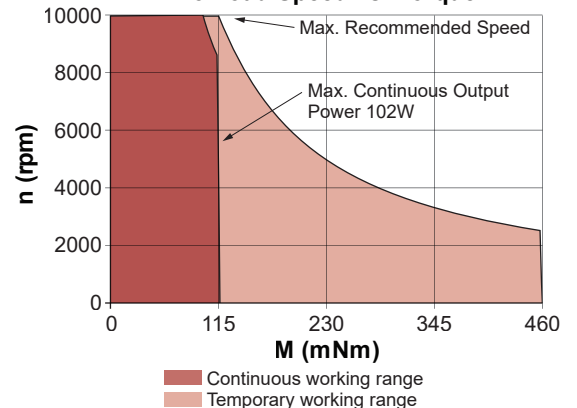
Electrical Data	Symbol	35NT2R82 1				Unit
		426P	226E	426SP	426E	
1 Nominal Voltage	V	18	28	32	60	Volt
2 No-Load Speed	n_0	6,765	6,935	5,850	5,760	rpm
3 No-Load Current	I_0	141.0	80.0	80.0	40.0	mA
4 Terminal Resistance	R	0.6	1.6	2.2	7.7	Ω
5 Output Power	P_{2max}	102.0	91.0	103.0	107.0	W
6 Stall Torque	mNm	828 (117.26)	676 (95.73)	756 (107.06)	782 (110.75)	mNm (oz-in)
7 Efficiency	η_{max}	87	87	86	86	%
8 Max Continuous Speed	$n_{e max}$	9,000	9,000	9,000	9,000	rpm
9 Max Continuous Torque	$M_{e max}$	108 (13.74)	97 (13.74)	109 (15.44)	114 (16.15)	mNm (oz-in)
10 Max Continuous Current	$I_{e max}$	4.40	2.60	2.20	1.19	A
11 Back-EMF Constant	k_E	2.65	4.02	5.45	10.37	mV/rpm
12 Torque Constant	k_M	25.30	38.40	52.00	99.00	mNm/A
13 Motor Regulation	R/k^2	0.9	1.1	0.8	0.77	10 ³ /Nms
14 Friction Torque	T_F	3.57 (0.51)	3.07 (0.44)	4.16 (0.59)	3.96 (0.57)	mNm (oz-in)
15 Rotor Inductance	L	0.10	0.22	0.40	1.70	mH
16 Mechanical Time Constant	τ_m	6.1	5.9	5.9	5.5	ms
17 Rotor Inertia	J	71.40	54.00	71.40	71.40	g-cm ²

General Data				
18 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}	4/8		°C/W
19 Thermal Time Constant (rotor/stator)	t_{W1}/t_{W2}	40/920		S
20 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)		°C (°F)
	rotor			100°C (212°F)
21 Shaft Load Max.: (5 mm from bearing)	-radial -axial	With ball bearings		
		35.0 (125.9)		N (oz)
		100 (359.6)		N (oz)
22 Shaft Play:	-radial	negligible		mm (inch)
	-axial	negligible		mm (inch)
23 Weight	g	310 (10.94)		g (oz)
24 Commutation Segment	-	13		segment

Execution Table

Gearbox	Single Shaft	E9	HEDS
R32	54	66	Upon Request
R40	1	96	Upon Request

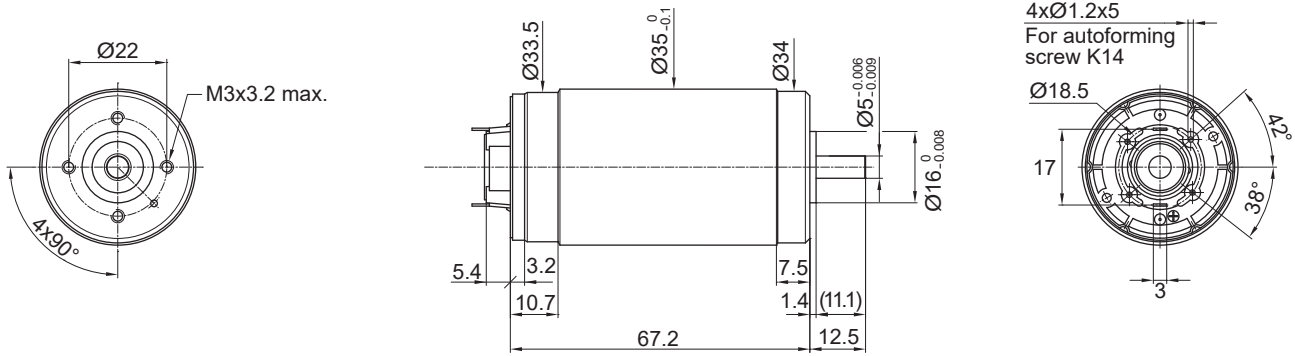
No Load Speed vs. Torque



► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.

35GLT2R82

Ø 35 mm • Graphite-Copper commutation • 160 mNm



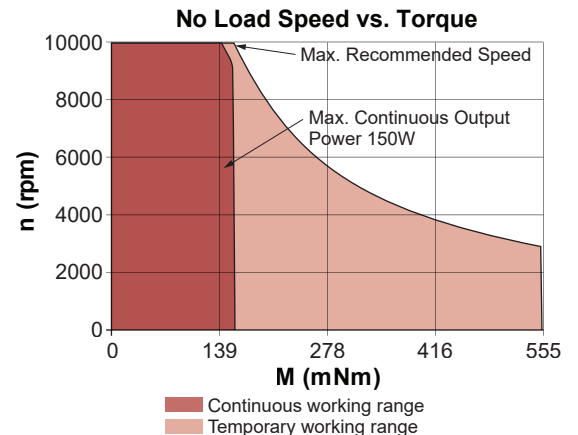
Dimensions in inches [mm]

Electrical Data	Symbol	426P	326P	35GLT2R82 1	234E	426SP	426E	Unit
1 Nominal Voltage	V	24	24	48	48	90		Volt
2 No-Load Speed	n_0	6,260	5,835	7,490	6,175	5,439		rpm
3 No-Load Current	I_0	120.0	120.0	70.0	60.0	60.0		mA
4 Terminal Resistance	R	0.7	0.9	2.3	2.5	9.5		Ω
5 Output Power	P_{2max}	136.0	124.0	122.0	142.0	150.0		W
6 Stall Torque	mNm	1327 (187.92)	1043 (147.71)	1300 (184.1)	1409 (199.54)	1487 (210.58)		mNm (oz-in)
7 Efficiency	η_{max}	89	87	89	89	85		%
8 Max Continuous Speed	$n_{e max}$	10,000	10,000	10,000	10,000	10,000		rpm
9 Max Continuous Torque	$M_{e max}$	142 (18.7)	132 (18.7)	130 (18.41)	150 (21.25)	160 (22.66)		mNm (oz-in)
10 Max Continuous Current	$I_{e max}$	4.20	3.50	2.20	2.10	1.05		A
11 Back-EMF Constant	k_E	3.82	4.09	6.39	7.75	16.44		mV/rpm
12 Torque Constant	k_M	36.50	39.10	61.00	74.00	157.00		mNm/A
13 Motor Regulation	R/k^2	0.5	0.6	0.6	0.46	0.39		10 ³ /Nms
14 Friction Torque	T_F	4.38 (0.63)	4.69 (0.67)	4.27 (0.61)	4.44 (0.63)	9.42 (1.34)		mNm (oz-in)
15 Rotor Inductance	L	0.10	0.15	0.25	0.40	1.70		mH
16 Mechanical Time Constant	τ_m	3.9	4.4	4.0	4.0	2.7		ms
17 Rotor Inertia	J	83.00	75.00	65.00	85.00	70.00		g-cm ²

General Data				
18 Thermal Resistance (rotor/body)	R_{th1}/R_{th2}		4/8	°C/W
19 Thermal Time Constant (rotor/stator)	t_{W1}/t_{W2}		75/950	S
20 Operating Temperature Range:	motor	-30°C to 85°C (-22°F to 185°F)		°C (°F)
	rotor			100°C (212°F)
21 Shaft Load Max.: (5 mm from bearing)		With ball bearings		
	-radial		35.0 (125.9)	N (oz)
	-axial		100 (359.6)	N (oz)
22 Shaft Play:	-radial		negligible	mm (inch)
	-axial		negligible	mm (inch)
23 Weight	g		360 (12.7)	g (oz)
24 Commutation Segment	-		13	segment

Execution Table

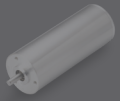
Gearbox	Single Shaft	E9	HEDS
R32	1	50	Upon Request
R40	1	50	Upon Request



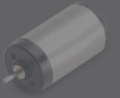
► Motor shaft rotates CW when seen from motor front face when +ve and -ve supply is given to respective terminals.

A large grid of graph paper for taking notes, consisting of 20 columns and 40 rows of small squares.





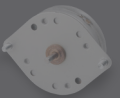
Brushless DC motors



Brush DC motors



Disc magnet motors



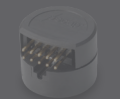
Can stack motors



Can stack linear actuators



Gearheads



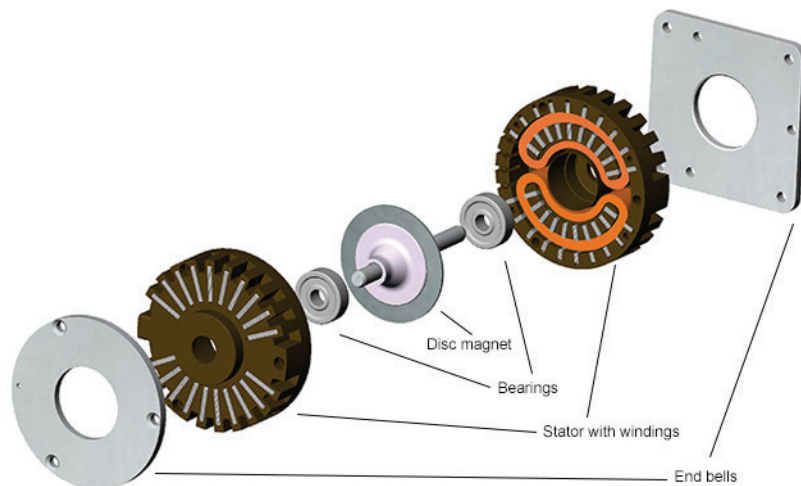
Encoders



Controllers

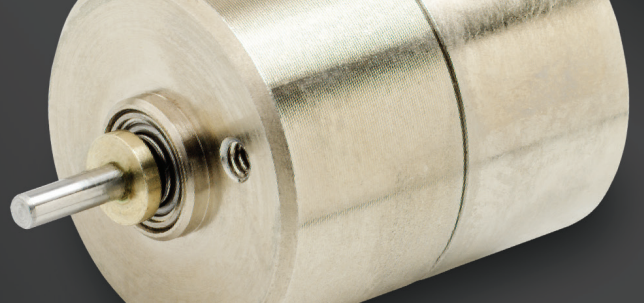
Disc Magnet Motors

Get the simple motion control and precision of a stepper motor with the speed and acceleration of a brushless DC motor. The unique thin disc magnet enables finer step resolutions compared to a conventional permanent magnet stepper, while the low inertia and a shorter magnetic circuit with lower iron losses deliver significantly higher acceleration and maximum speed. These motors can be driven as a servo motor in applications requiring extremely fast incremental motion.



Simple Speed, Power and Precision

Feature	Details	Application Advantages
Stepper motor design	<ul style="list-style-type: none"> No need for encoder feedback 	<ul style="list-style-type: none"> Simple open-loop positioning that can be digitally controlled
Microstepping capability	<ul style="list-style-type: none"> Axial magnetization with high number of poles Much smaller step angles compared to conventional stepper 	<ul style="list-style-type: none"> Nearly servo-like accuracy in a simpler positioning system
Thin multipolar rare earth disc magnet	<ul style="list-style-type: none"> Low rotor inertia 	<ul style="list-style-type: none"> High acceleration High start and stop frequencies High power rate
Simple magnetic circuit	<ul style="list-style-type: none"> No coupling between phases Sinusoidal torque function Low detent torque 	<ul style="list-style-type: none"> Superior angular resolution in microstep mode
Optimally dimensioned iron circuit	<ul style="list-style-type: none"> Torque constant linear up to two times nominal current 	<ul style="list-style-type: none"> High peak torques Capability to boost current
Choice of sintered bronze bearings or ball bearings	<ul style="list-style-type: none"> Long bearing and lubrication life Choice of bearing performance characteristics 	<ul style="list-style-type: none"> Increased service life and reliability for any application



Exceptional Dynamic Performance



Medical devices & clinical diagnostics

- Laboratory automation
- Medical pipettes
- Diagnostic analyzers
- Medical analyzers
- Sample preparation workstations



Security

- Access systems
- Surveillance



Aerospace

- Surveillance camera systems
- Valve actuation



Automation

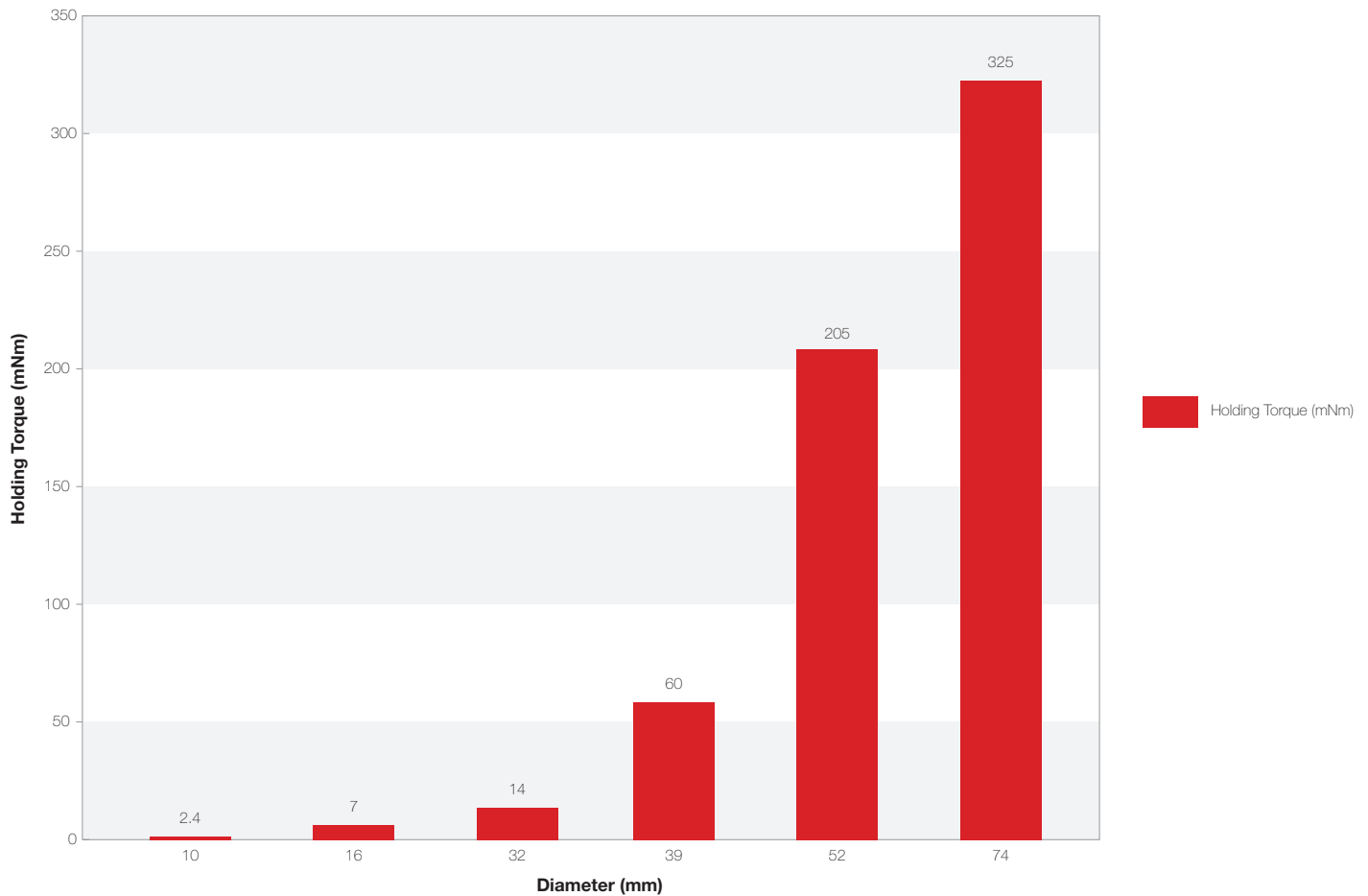
- Textile yarn guide
- Pick and place machines



Other

- Electronics assembly
- Semiconductor assembly systems

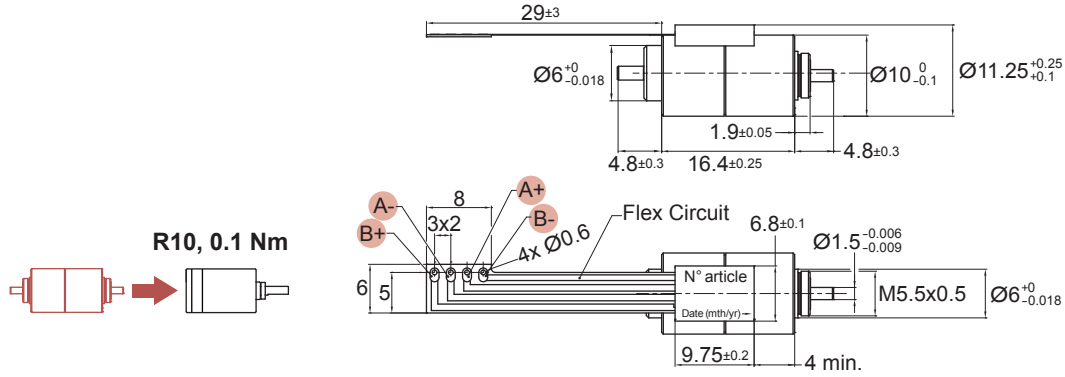
Meet your Application's Working Point Requirements



For complete product and application details, visit portescap.com/disc-magnet

P010 104 (Upon Request)

Ø 10 mm • 1.5 mNm



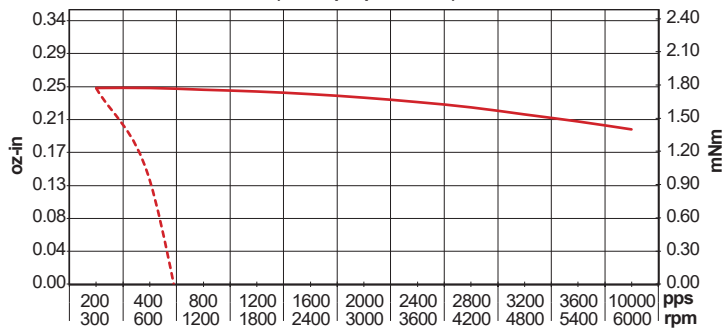
Dimensions in mm

Electrical Data	P010 104			Unit
	020 02	P010 104	003 02	
1 Resistance per Phase, typ	19.0		3.0	Ohms
2 Inductance per Phase, typ	13.7		1.8	mH
3 Nominal Phase Current (2 ph. On)	0.17		0.44	A
4 Nominal Phase Current (1 ph. On)	0.24		0.62	A
5 Back EMF Amplitude	1.10		0.46	V/kstep/s
General Data				
6 Holding Torque, nominal current		1.5 (0.21)		mNm (oz-in)
7 Holding Torque, 1.5x nominal current (1)		2.1 (0.3)		mNm (oz-in)
8 Detent Torque		0.9 (0.13)		mNm (oz-in)
9 Rotor Inertia		0.070		kgm ² x 10 ⁻⁷
10 Step Angle		9		Degree
11 Absolute Accuracy 2 ph. On, Full step mode		+/- 5%		% Full Step
12 Steps Per Revolution		40		
13 Ambient Temperature Range (operating)		-20 to 50 (-4 to 122)		°C (°F)
14 Maximum Coil Temperature		130 (266)		°C (°F)
15 Thermal Resistance Coil-ambient (2)		66		°C/W
16 Natural Resonance Frequency (nominal current)		230		Hz
17 Electrical Time Constant		0.60		ms
18 Angular Acceleration (nominal current)		210,000		rad/s ²
19 Bearing Type		Ball		
20 Dielectric Withstanding Voltage		500 VRMS for 5 seconds		VAC
21 Radial Shaft Play		30 @ 2N		µm
22 Axial Shaft Play		40 @ 2N		µm
23 Maximum Radial Shaft Load		2.5 (9)		N (oz)
24 Maximum Axial Shaft Load (3)		2.5 (9)		N (oz)
25 Weight		9 (0.32)		g (oz)
26 Power Rate (nominal current)		0.5		kW/s

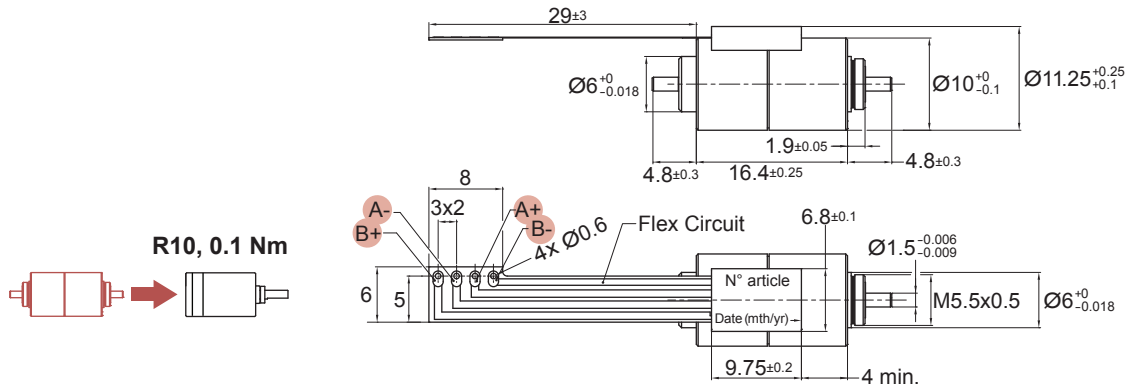
Notes:

1. Measured with 1 phase ON. The max coil temperature must be respected
2. Motor unmounted
3. Shaft must be supported when press-fitting a pulley or pinion

Turbo Disc P010 104 003 Torque vs Speed
(full step bipolar drive)



— P010 104 003 Pull-Out Torque @ 0.6A, 12V - - - P010 104 003 Pull-In Torque @ 0.6A, 12V

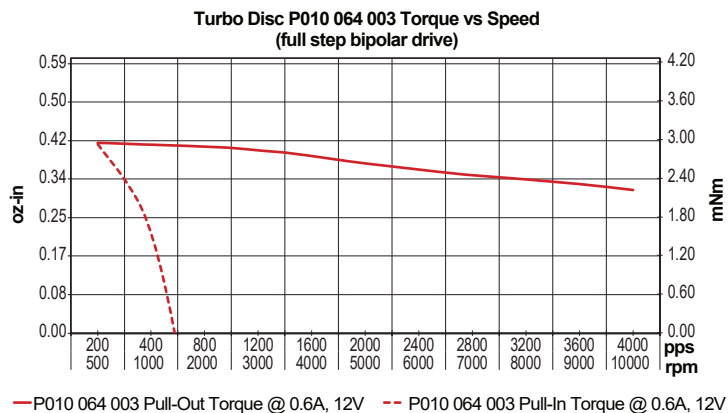


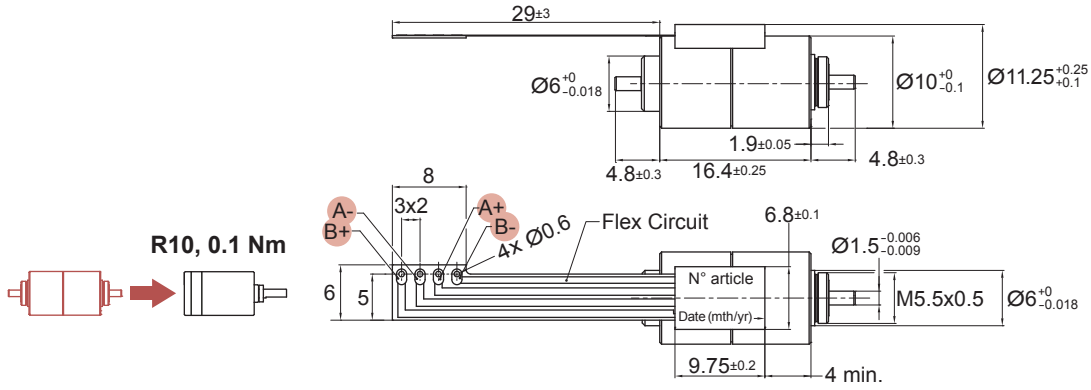
Dimensions in mm

Electrical Data	P010 064		Unit
	020 02	003 02	
1 Resistance per Phase, typ	19.0	3.0	Ohms
2 Inductance per Phase, typ	13.7	1.8	mH
3 Nominal Phase Current (2 ph. On)	0.17	0.44	A
4 Nominal Phase Current (1 ph. On)	0.24	0.62	A
5 Back EMF Amplitude	2.20	0.94	V/kstep/s
General Data			
6 Holding Torque, nominal current	1.8 (0.25)		mNm (oz-in)
7 Holding Torque, 1.5x nominal current (1)	2.5 (0.35)		mNm (oz-in)
8 Detent Torque	0.9 (0.13)		mNm (oz-in)
9 Rotor Inertia	0.070		kgm ² x 10 ⁻⁷
10 Step Angle	15		Degree
11 Absolute Accuracy 2 ph. On, Full step mode	+/- 5%		% Full Step
12 Steps Per Revolution	24		
13 Ambient Temperature Range (operating)	-20 to 50 (-4 to 122)		°C (°F)
14 Maximum Coil Temperature	130 (266)		°C (°F)
15 Thermal Resistance Coil-ambient (2)	66		°C/W
16 Natural Resonance Frequency (nominal current)	200		Hz
17 Electrical Time Constant	0.60		ms
18 Angular Acceleration (nominal current)	260,000		rad/s ²
19 Bearing Type	Ball		
20 Dielectric Withstanding Voltage	500 VRMS for 5 seconds		VAC
21 Radial Shaft Play	30 @ 2N		µm
22 Axial Shaft Play	40 @ 2N		µm
23 Maximum Radial Shaft Load	2.5 (9)		N (oz)
24 Maximum Axial Shaft Load (3)	2.5 (9)		N (oz)
25 Weight	9 (0.32)		g (oz)
26 Power Rate (nominal current)	0.5		kW/s

Notes:

1. Measured with 1 phase ON. The max coil temperature must be respected
2. Motor unmounted
3. Shaft must be supported when press-fitting a pulley or pinion





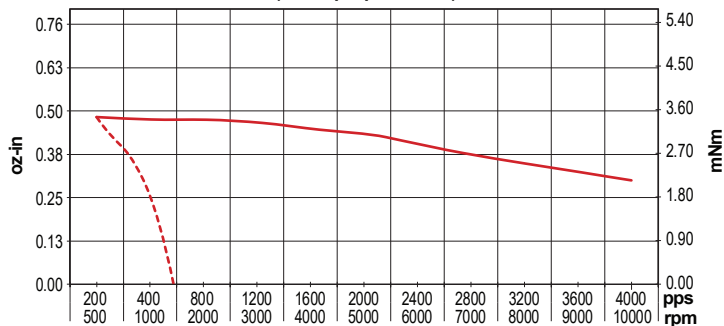
Dimensions in mm

Electrical Data	020 04	PH10 064 010 04	003 04	Unit
1 Resistance per Phase, typ	19.0	10.0	3.0	Ohms
2 Inductance per Phase, typ	8.4	4.2	1.3	mH
3 Nominal Phase Current (2 ph. On)	0.17	0.24	0.44	A
4 Nominal Phase Current (1 ph. On)	0.24	0.34	0.62	A
5 Back EMF Amplitude	3.00	2.25	1.21	V/kstep/s
General Data				
6 Holding Torque, nominal current		2.4 (0.34)		mNm (oz-in)
7 Holding Torque, 1.5x nominal current (1)		3.6 (0.51)		mNm (oz-in)
8 Detent Torque		1.1 (0.16)		mNm (oz-in)
9 Rotor Inertia		0.070		kgm ² x 10 ⁻⁷
10 Step Angle		15		Degree
11 Absolute Accuracy 2 ph. On, Full step mode		+/- 5%		% Full Step
12 Steps Per Revolution		24		
13 Ambient Temperature Range (operating)		-20 to 50 (-4 to 122)		°C (°F)
14 Maximum Coil Temperature		130 (266)		°C (°F)
15 Thermal Resistance Coil-ambient (2)		66		°C/W
16 Natural Resonance Frequency (nominal current)		229		Hz
17 Electrical Time Constant		0.42		ms
18 Angular Acceleration (nominal current)		343,775		rad/s ²
19 Bearing Type		Ball		
20 Dielectric Withstanding Voltage		500 VRMS for 5 seconds		VAC
21 Radial Shaft Play		30@2N		µm
22 Axial Shaft Play		40@2N		µm
23 Maximum Radial Shaft Load		2.5 (9)		N (oz)
24 Maximum Axial Shaft Load (3)		2.5 (9)		N (oz)
25 Weight		9 (0.32)		g (oz)
26 Power Rate (nominal current)		0.5		kW/s

Notes:

1. Measured with 1 phase ON. The max coil temperature must be respected
2. Motor unmounted
3. Shaft must be supported when press-fitting a pulley or pinion

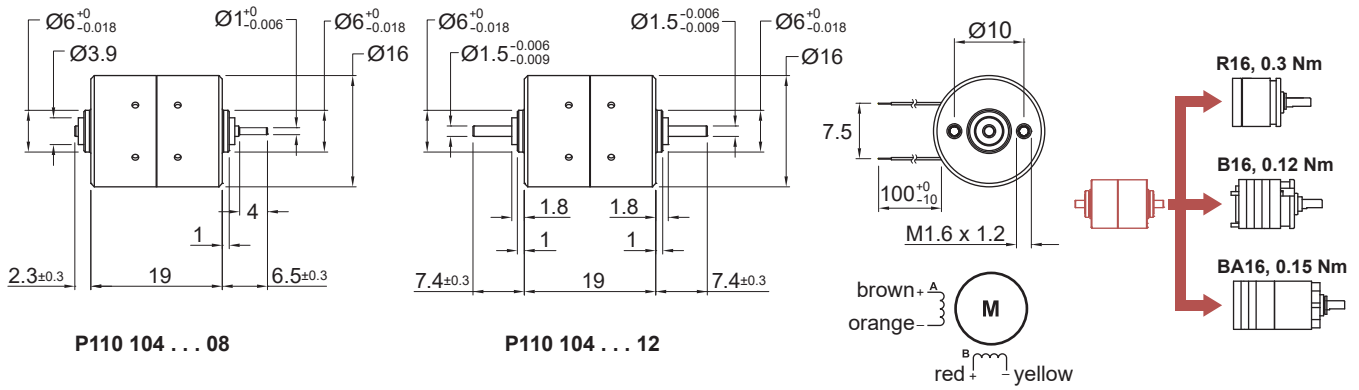
Turbo Disc PH10 064 003 Torque vs Speed
(full step bipolar drive)



— PH10 064 003 Pull-Out Torque @ 0.6A, 12V - - - PH10 064 003 Pull-In Torque @ 0.6A, 12V

P110 104

Ø 16 mm • 6.2 mNm

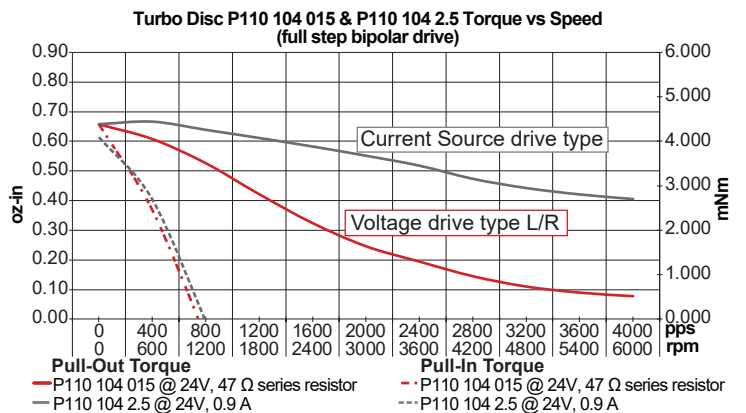
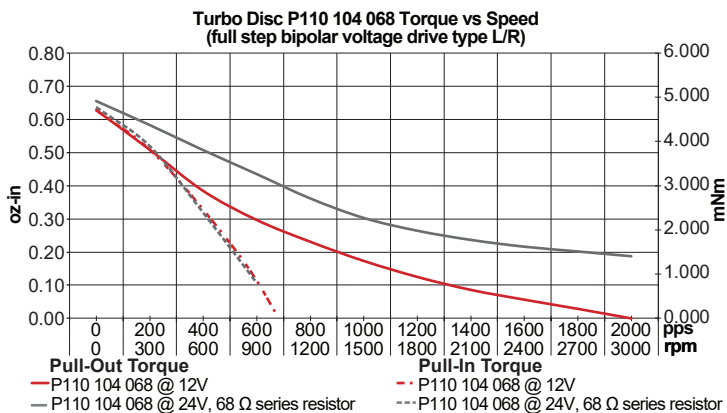


Dimensions in mm

Electrical Data	P110 104			Unit
	068 08/12	015 08/12	2.5 08/12	
1 Resistance per Phase, typ	62.0	15.0	2.5	Ohms
2 Inductance per Phase, typ	46.0	12.0	2.2	mH
3 Nominal Phase Current (2 ph. On)	0.12	0.25	0.63	A
4 Nominal Phase Current (1 ph. On)	0.17	0.35	0.90	A
5 Back EMF Amplitude	5.70	2.80	1.10	V/kstep/s
General Data				
6 Holding Torque, nominal current	6.2 (0.88)			mNm (oz-in)
7 Holding Torque, 1.5x nominal current (1)	8.7 (1.23)			mNm (oz-in)
8 Detent Torque	1.65 (0.24)			mNm (oz-in)
9 Rotor Inertia	0.400			kgm ² x 10 ⁻⁷
10 Step Angle	9			Degree
11 Absolute Accuracy 2 ph. On, Full step mode	+/- 5%			% Full Step
12 Steps Per Revolution	40			
13 Ambient Temperature Range (operating)	-20 to 50 (-4 to 122)			°C (°F)
14 Maximum Coil Temperature	130 (266)			°C (°F)
15 Thermal Resistance Coil-ambient (2)	45			°C/W
16 Natural Resonance Frequency (nominal current)	200			Hz
17 Electrical Time Constant	0.80			ms
18 Angular Acceleration (nominal current)	155,000			rad/s ²
19 Bearing Type	Ball			
20 Dielectric Withstanding Voltage	500 VRMS for 5 seconds			VAC
21 Radial Shaft Play	30@2N			µm
22 Axial Shaft Play	40@2N			µm
23 Maximum Radial Shaft Load	2.5 (9)			N (oz)
24 Maximum Axial Shaft Load (3)	2.5 (9)			N (oz)
25 Weight	23 (0.81)			g (oz)
26 Power Rate (nominal current)	1.2			kW/s

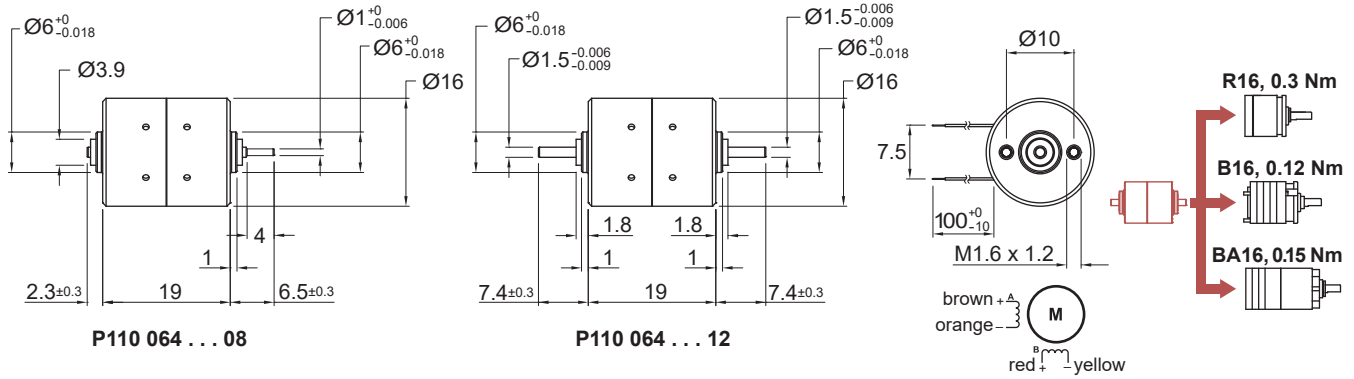
Notes:

1. Measured with 1 phase ON. The max coil temperature must be respected
2. Motor unmounted
3. Shaft must be supported when press-fitting a pulley or pinion



P110 064

Ø 16 mm • 7 mNm

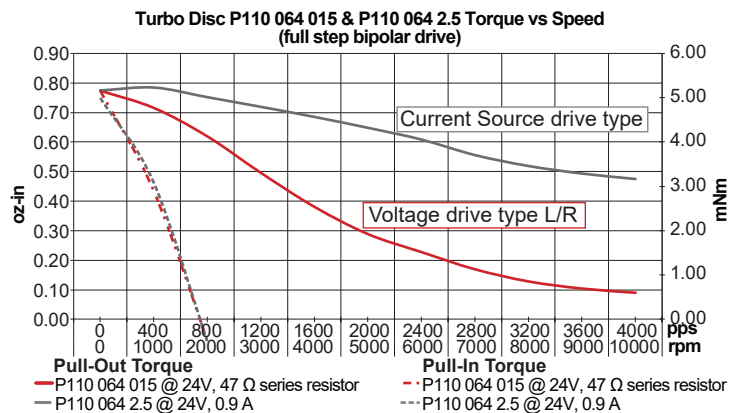
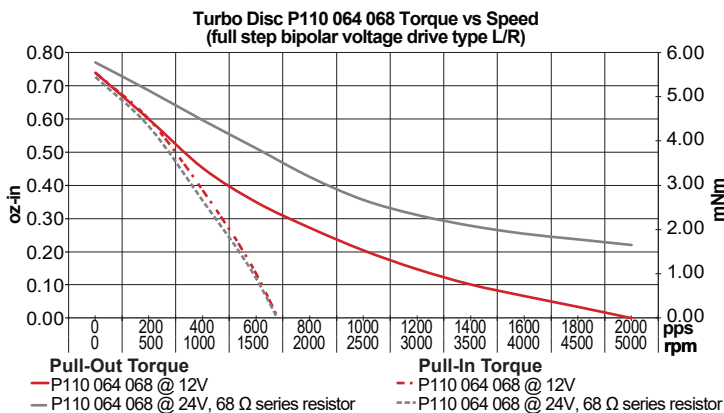


Dimensions in mm

Electrical Data	P110 064			Unit
	068 08/12	015 08/12	2.5 08/12	
1 Resistance per Phase, typ	62.0	15.0	2.5	Ohms
2 Inductance per Phase, typ	46.0	12.0	2.2	mH
3 Nominal Phase Current (2 ph. On)	0.12	0.25	0.63	A
4 Nominal Phase Current (1 ph. On)	0.17	0.35	0.90	A
5 Back EMF Amplitude	10.80	5.20	2.00	V/kstep/s
General Data				
6 Holding Torque, nominal current		7 (0.99)		mNm (oz-in)
7 Holding Torque, 1.5x nominal current (1)		10 (1.42)		mNm (oz-in)
8 Detent Torque		1.65 (0.24)		mNm (oz-in)
9 Rotor Inertia		0.400		kgm ² x 10 ⁻⁷
10 Step Angle		15		Degree
11 Absolute Accuracy 2 ph. On, Full step mode		+/- 5%		% Full Step
12 Steps Per Revolution		24		
13 Ambient Temperature Range (operating)		-20 to 50 (-4 to 122)		°C (°F)
14 Maximum Coil Temperature		130 (266)		°C (°F)
15 Thermal Resistance Coil-ambient (2)		45		°C/W
16 Natural Resonance Frequency (nominal current)		160		Hz
17 Electrical Time Constant		0.80		ms
18 Angular Acceleration (nominal current)		175,000		rad/s ²
19 Bearing Type		Ball		
20 Dielectric Withstanding Voltage		500 VRMS for 5 seconds		VAC
21 Radial Shaft Play		30@2N		µm
22 Axial Shaft Play		40@2N		µm
23 Maximum Radial Shaft Load		2.5 (9)		N (oz)
24 Maximum Axial Shaft Load (3)		2.5 (9)		N (oz)
25 Weight		23 (0.81)		g (oz)
26 Power Rate (nominal current)		1.2		kW/s

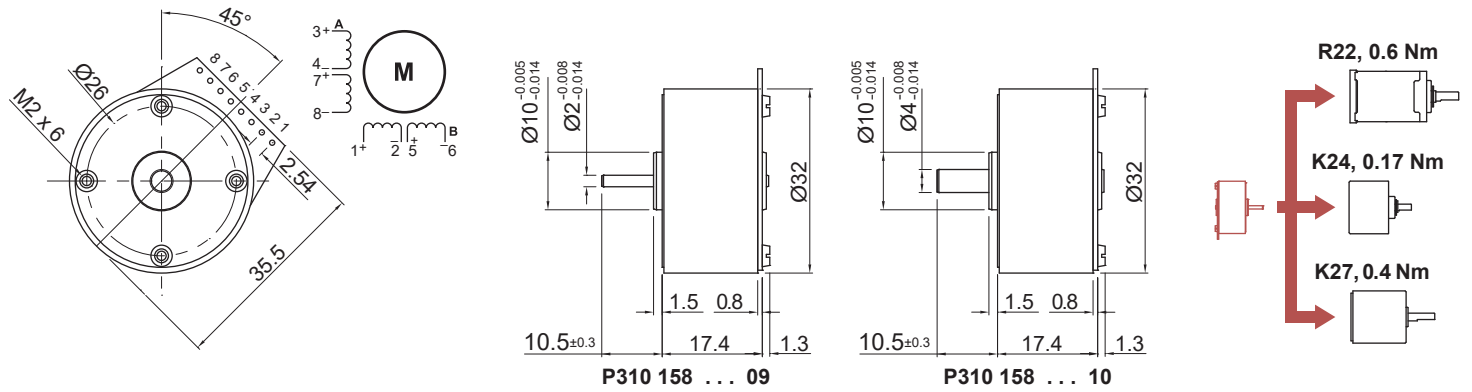
Notes:

1. Measured with 1 phase ON. The max coil temperature must be respected
2. Motor unmounted
3. Shaft must be supported when press-fitting a pulley or pinion



P310

Ø 32 mm • 14 mNm

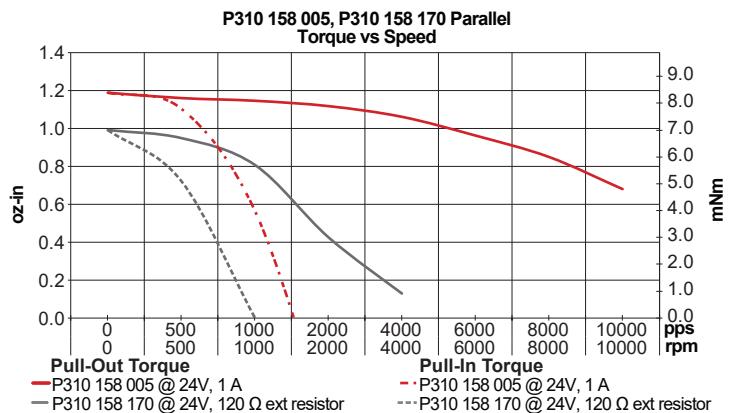
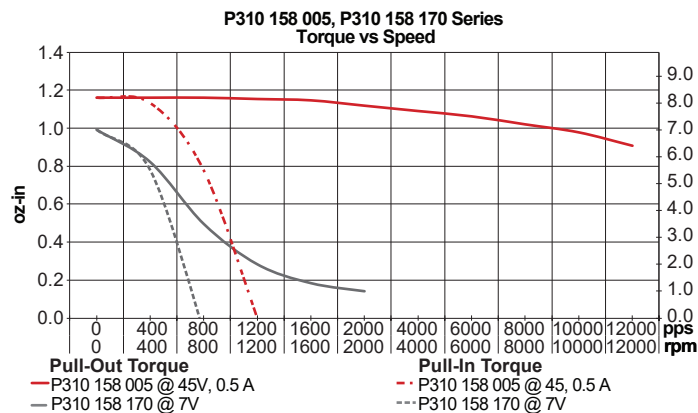


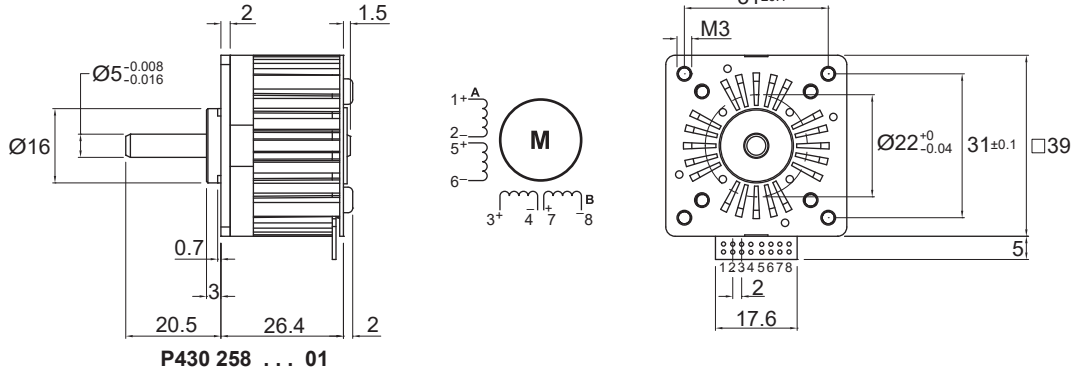
Dimensions in mm

Electrical Data	P310 158 170		P310 158 005		Unit
	09/10 (series)	09/10 (parallel)	09/10 (series)	09/10 (parallel)	
1 Resistance per Phase, typ	332.0	83.0	10.5	2.6	Ohms
2 Inductance per Phase, typ	184.0	46.0	6.4	1.6	mH
3 Nominal Phase Current (2 ph. On)	0.06	0.12	0.36	0.72	A
4 Nominal Phase Current (1 ph. On)	0.09	0.17	0.51	1.00	A
5 Back EMF Amplitude	18.00	9.00	3.20	1.60	V/kstep/s
General Data					
6 Holding Torque, nominal current	14 (2)				mNm (oz-in)
7 Holding Torque, 1.5x nominal current (1)	20 (2.83)				mNm (oz-in)
8 Detent Torque	2.6 (0.37)				mNm (oz-in)
9 Rotor Inertia	0.860				kgm ² x 10 ⁻⁷
10 Step Angle	6				Degree
11 Absolute Accuracy 2 ph. On, Full step mode	+/- 5%				% Full Step
12 Steps Per Revolution	60				
13 Ambient Temperature Range (operating)	-20 to 50 (-4 to 122)				°C (°F)
14 Maximum Coil Temperature	130 (266)				°C (°F)
15 Thermal Resistance Coil-ambient (2)	25				°C/W
16 Natural Resonance Frequency (nominal current)	230				Hz
17 Electrical Time Constant	0.60				ms
18 Angular Acceleration (nominal current)	140,000				rad/s ²
19 Bearing Type	Sleeve or Ball				
20 Dielectric Withstanding Voltage	500 VRMS for 5 seconds				VAC
21 Radial Shaft Play	35@5N / 15@1N				µm
22 Axial Shaft Play	100@5N / 10@1N				µm
23 Maximum Radial Shaft Load	1 / 10 (3.6 / 36)				N (oz)
24 Maximum Axial Shaft Load (3)	0.5 / 20 (1.8 / 72)				N (oz)
25 Weight	40 (1.4)				g (oz)
26 Power Rate (nominal current)	1.7				kW/s

Notes:

1. Measured with 1 phase ON. The max coil temperature must be respected
2. Motor unmounted
3. Shaft must be supported when press-fitting a pulley or pinion

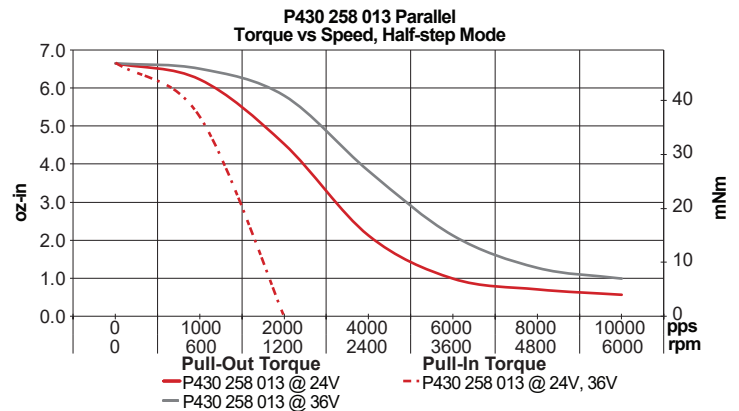
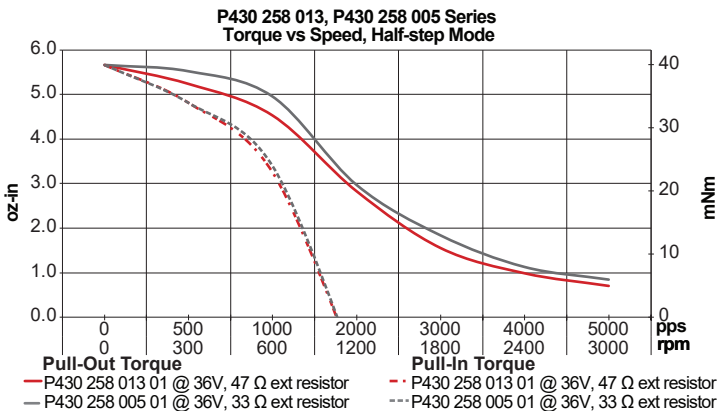




Dimensions in mm

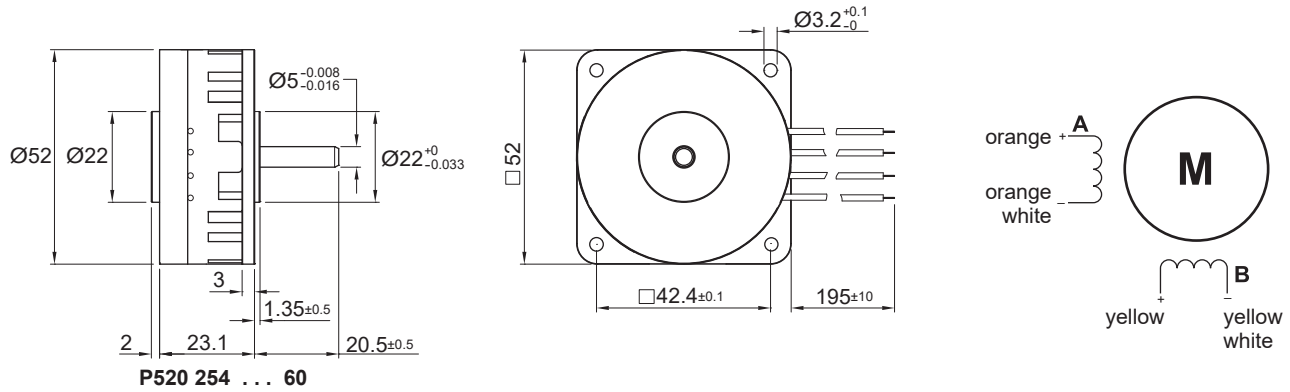
Electrical Data	P430 258 013 01		P430 258 005 01		Unit
	(series)	(parallel)	(series)	(parallel)	
1 Resistance per Phase, typ	26.0	6.5	10.0	2.5	Ohms
2 Inductance per Phase, typ	40.0	10.0	14.0	3.5	mH
3 Nominal Phase Current (2 ph. On)	0.34	0.68	0.56	1.12	A
4 Nominal Phase Current (1 ph. On)	0.50	1.00	0.80	1.60	A
5 Back EMF Amplitude	7.50	3.80	4.70	2.30	V/kstep/s
General Data					
6 Holding Torque, nominal current	60 (8.5)				mNm (oz-in)
7 Holding Torque, 1.5x nominal current (1)	86 (12)				mNm (oz-in)
8 Detent Torque	6.5 (0.93)				mNm (oz-in)
9 Rotor Inertia	3.000				kgm ² x 10 ⁻⁷
10 Step Angle	3.6				Degree
11 Absolute Accuracy 2 ph. On, Full step mode	+/- 5%				% Full Step
12 Steps Per Revolution	100				
13 Ambient Temperature Range (operating)	-20 to 50 (-4 to 122)				°C (°F)
14 Maximum Coil Temperature	130 (266)				°C (°F)
15 Thermal Resistance Coil-ambient (2)	11				°C/W
16 Natural Resonance Frequency (nominal current)	360				Hz
17 Electrical Time Constant	1.50				ms
18 Angular Acceleration (nominal current)	200,000				rad/s ²
19 Bearing Type	Ball				
20 Dielectric Withstanding Voltage	500 VRMS for 5 seconds				VAC
21 Radial Shaft Play	15@5N				µm
22 Axial Shaft Play	10@5N				µm
23 Maximum Radial Shaft Load	20 (72)				N (oz)
24 Maximum Axial Shaft Load (3)	30 (108)				N (oz)
25 Weight	100 (3.5)				g (oz)
26 Power Rate (nominal current)	12.0				kW/s

- Notes:
1. Measured with 1 phase ON. The max coil temperature must be respected
 2. Motor unmounted
 3. Shaft must be supported when press-fitting a pulley or pinion



P520

Ø 52 mm • 120 mNm

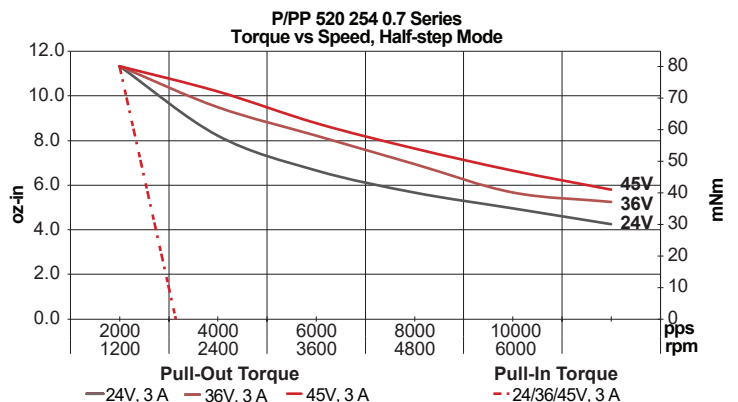
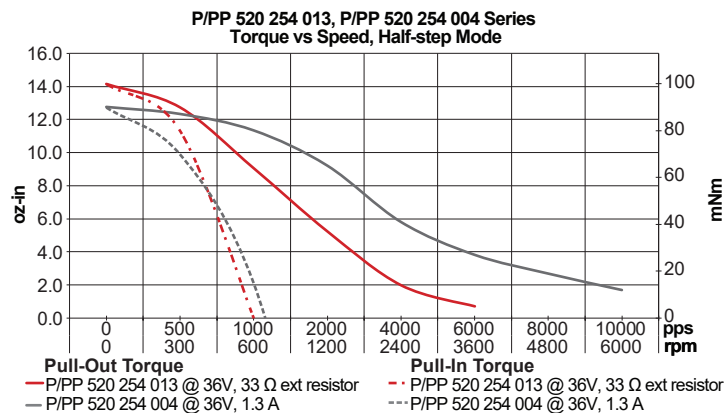


Dimensions in mm

Electrical Data	P520 254			Unit
	013 60	004 60	0.7 60	
1 Resistance per Phase, typ	13.5	4.4	0.7	Ohms
2 Inductance per Phase, typ	27.0	8.0	1.3	mH
3 Nominal Phase Current (2 ph. On)	0.50	0.90	2.30	A
4 Nominal Phase Current (1 ph. On)	0.75	1.30	3.30	A
5 Back EMF Amplitude	9.80	5.50	2.10	V/kstep/s
General Data				
6 Holding Torque, nominal current		120 (17)		mNm (oz-in)
7 Holding Torque, 1.5x nominal current (1)		170 (24)		mNm (oz-in)
8 Detent Torque		18 (2.55)		mNm (oz-in)
9 Rotor Inertia		12.000		kgm ² x 10 ⁻⁷
10 Step Angle		3.6		Degree
11 Absolute Accuracy 2 ph. On, Full step mode		+/- 5%		% Full Step
12 Steps Per Revolution		100		
13 Ambient Temperature Range (operating)		-20 to 50 (-4 to 122)		°C (°F)
14 Maximum Coil Temperature		130 (266)		°C (°F)
15 Thermal Resistance Coil-ambient (2)		9.5		°C/W
16 Natural Resonance Frequency (nominal current)		250		Hz
17 Electrical Time Constant		1.80		ms
18 Angular Acceleration (nominal current)		100,000		rad/s ²
19 Bearing Type		Ball		
20 Dielectric Withstanding Voltage		500 VRMS for 5 seconds		VAC
21 Radial Shaft Play		15@5N		µm
22 Axial Shaft Play		10@5N		µm
23 Maximum Radial Shaft Load		20 (72)		N (oz)
24 Maximum Axial Shaft Load (3)		30 (108)		N (oz)
25 Weight		180 (6.3)		g (oz)
26 Power Rate (nominal current)		12.0		kW/s

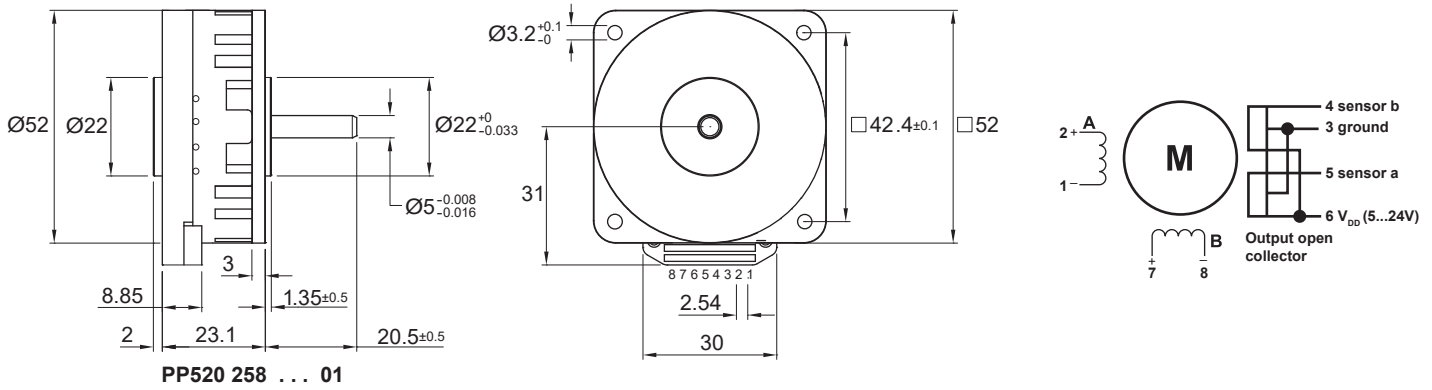
Notes:

1. Measured with 1 phase ON. The max coil temperature must be respected
2. Motor unmounted
3. Shaft must be supported when press-fitting a pulley or pinion



PP520

Ø 52 mm • 120 mNm

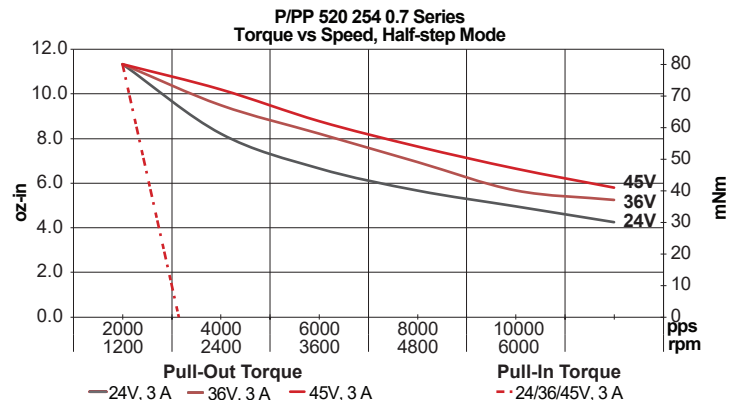
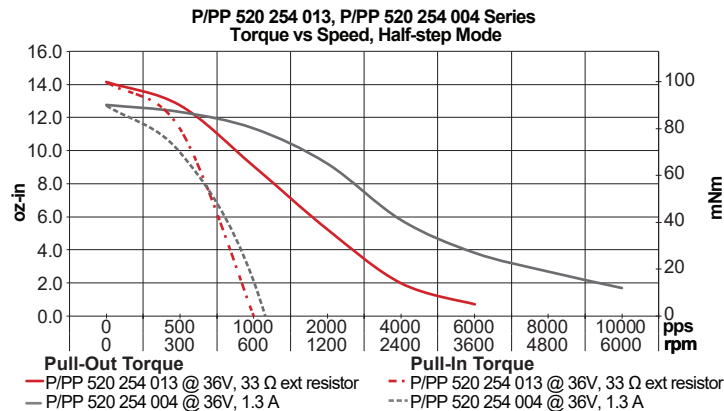


Dimensions in mm

Electrical Data	013 01	PP520 258 004 01	0.7 01	Unit
1 Resistance per Phase, typ	13.5	4.4	0.7	Ohms
2 Inductance per Phase, typ	27.0	8.0	1.3	mH
3 Nominal Phase Current (2 ph. On)	0.50	0.90	2.30	A
4 Nominal Phase Current (1 ph. On)	0.75	1.30	3.30	A
5 Back EMF Amplitude	9.80	5.50	2.10	V/kstep/s
General Data				
6 Holding Torque, nominal current		120 (17)		mNm (oz-in)
7 Holding Torque, 1.5x nominal current (1)		170 (24)		mNm (oz-in)
8 Detent Torque		18 (2.55)		mNm (oz-in)
9 Rotor Inertia		12.000		kgm ² x 10 ⁻⁷
10 Step Angle		3.6		Degree
11 Absolute Accuracy 2 ph. On, Full step mode		+/- 5%		% Full Step
12 Steps Per Revolution		100		
13 Ambient Temperature Range (operating)		-20 to 50 (-4 to 122)		°C (°F)
14 Maximum Coil Temperature		130 (266)		°C (°F)
15 Thermal Resistance Coil-ambient (2)		9.5		°C/W
16 Natural Resonance Frequency (nominal current)		250		Hz
17 Electrical Time Constant		1.80		ms
18 Angular Acceleration (nominal current)		100,000		rad/s ²
19 Bearing Type		Ball		
20 Dielectric Withstanding Voltage		500 VRMS for 5 seconds		VAC
21 Radial Shaft Play		15@5N		µm
22 Axial Shaft Play		10@5N		µm
23 Maximum Radial Shaft Load		20 (72)		N (oz)
24 Maximum Axial Shaft Load (3)		30 (108)		N (oz)
25 Weight		180 (6.3)		g (oz)
26 Power Rate (nominal current)		12.0		kW/s

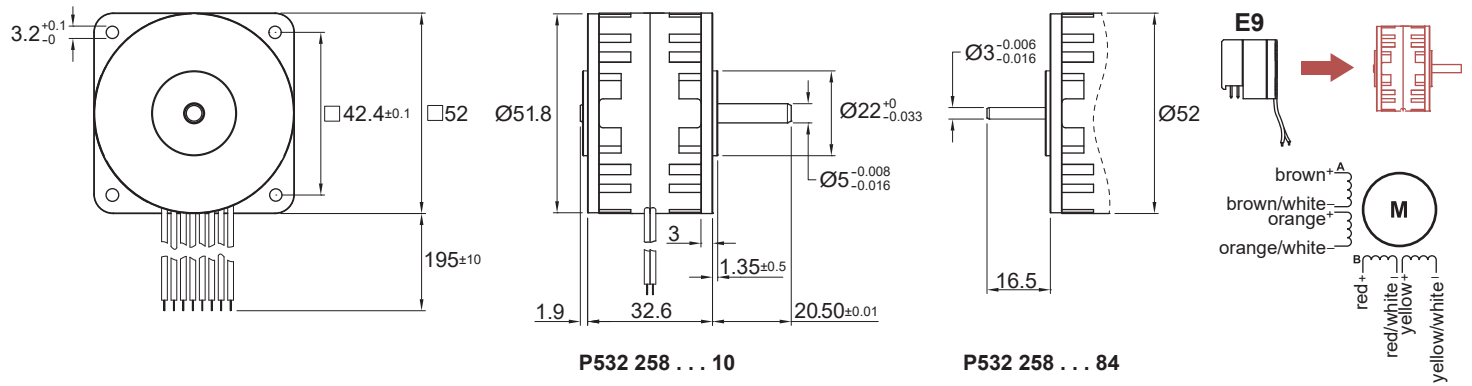
Notes:

1. Measured with 1 phase ON. The max coil temperature must be respected
2. Motor unmounted
3. Shaft must be supported when press-fitting a pulley or pinion



P532

Ø 52 mm • 205 mNm

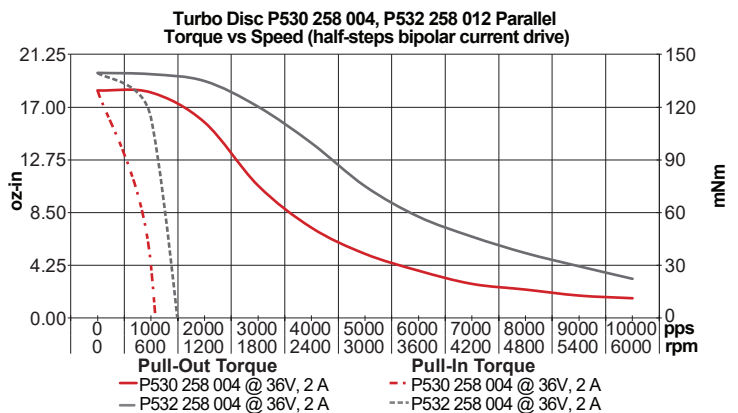
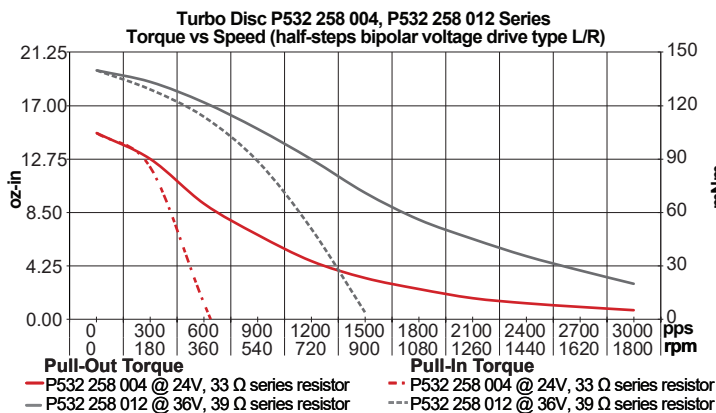


Dimensions in mm

Electrical Data	P532 258 012	P532 258 004		P532 258 0.7	Unit
	10/84 (series)	10/84 (series)	10/84 (parallel)	10/84 (parallel)	
1 Resistance per Phase, typ	27.0	8.8	2.2	0.35	Ohms
2 Inductance per Phase, typ	64.0	20.0	5.0	0.70	mH
3 Nominal Phase Current (2 ph. On)	0.40	0.70	1.40	3.70	A
4 Nominal Phase Current (1 ph. On)	0.56	1.00	2.00	5.20	A
5 Back EMF Amplitude	21.00	12.00	6.00	2.30	V/kstep/s
General Data					
6 Holding Torque, nominal current				205 (29)	mNm (oz-in)
7 Holding Torque, 1.5x nominal current (1)				300 (42.5)	mNm (oz-in)
8 Detent Torque				40 (5.67)	mNm (oz-in)
9 Rotor Inertia				12.000	kgm ² x 10 ⁻⁷
10 Step Angle				3.6	Degree
11 Absolute Accuracy 2 ph. On, Full step mode				+/- 5%	% Full Step
12 Steps Per Revolution				100	
13 Ambient Temperature Range (operating)				-20 to 50 (-4 to 122)	°C (°F)
14 Maximum Coil Temperature				130 (266)	°C (°F)
15 Thermal Resistance Coil-ambient (2)				7.3	°C/W
16 Natural Resonance Frequency (nominal current)				330	Hz
17 Electrical Time Constant				2.30	ms
18 Angular Acceleration (nominal current)				195,000	rad/s ²
19 Bearing Type				Ball	
20 Dielectric Withstanding Voltage				500 VRMS for 5 seconds	VAC
21 Radial Shaft Play				25@5N	µm
22 Axial Shaft Play				25@5N	µm
23 Maximum Radial Shaft Load				20 (72)	N (oz)
24 Maximum Axial Shaft Load (3)				30 (108)	N (oz)
25 Weight				250 (8.8)	g (oz)
26 Power Rate (nominal current)				35.0	kW/s

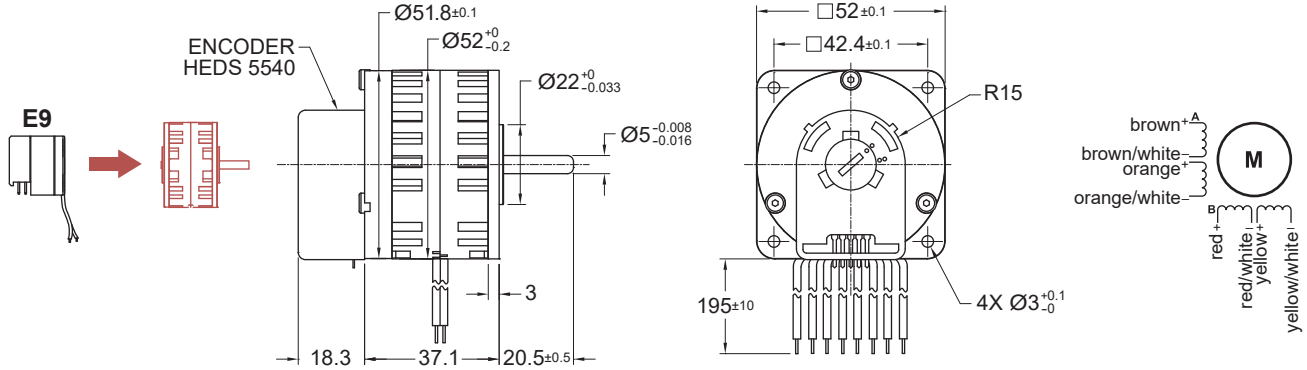
Notes:

1. Measured with 1 phase ON. The max coil temperature must be respected
2. Motor unmounted
3. Shaft must be supported when press-fitting a pulley or pinion



P532 with Encoder

Ø 52 mm • 205 mNm



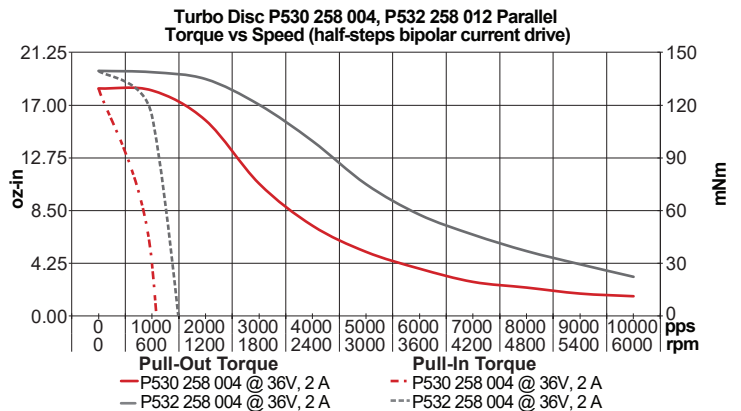
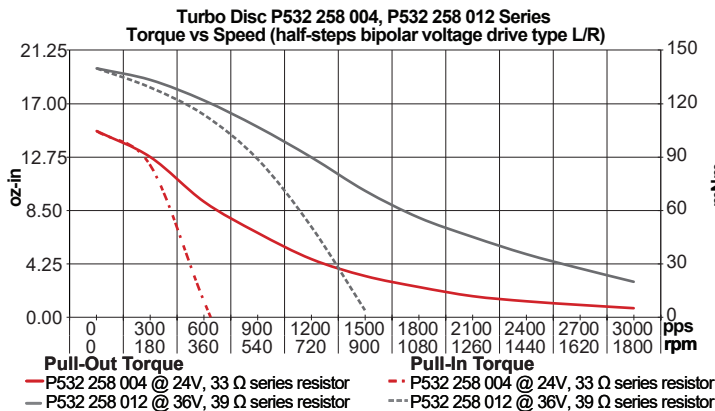
Dimensions in mm

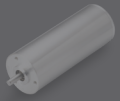
Electrical Data	P532 012 150 HEDS		P532 004 150 HEDS		P532 0.7 150 HEDS	Unit
	5540 A11 (series)	5540 A11 (series)	5540 A11 (parallel)	5540 A11 (parallel)	5540 A11 (parallel)	
1 Resistance per Phase, typ	27.0	8.80	2.20	0.31	Ohms	
2 Inductance per Phase, typ	64.0	20.0	5.0	0.70	mH	
3 Nominal Phase Current (2 ph. On)	0.40	0.70	1.40	3.74	A	
4 Nominal Phase Current (1 ph. On)	0.56	1.00	2.00	5.29	A	
5 Back EMF Amplitude	21.00	12.00	6.00	2.30	V/kstep/s	
General Data						
6 Holding Torque, nominal current	205 (29)				mNm (oz-in)	
7 Holding Torque, 1.5x nominal current (1)	300 (42.5)				mNm (oz-in)	
8 Detent Torque	45 (6.4)				mNm (oz-in)	
9 Rotor Inertia	13.0				kgm ² x 10 ⁻⁷	
10 Step Angle	3.6				Degree	
11 Absolute Accuracy 2 ph. On, Full step mode	+/- 5%				% Full Step	
12 Steps Per Revolution	100					
13 Ambient Temperature Range (operating)	-20 to 50 (-4 to 122)				°C (°F)	
14 Maximum Coil Temperature	130 (266)				°C (°F)	
15 Thermal Resistance Coil-ambient (2)	7.3				°C/W	
16 Natural Resonance Frequency (nominal current)	350				Hz	
17 Electrical Time Constant	2.30				ms	
18 Angular Acceleration (nominal current)	171,000				rad/s ²	
19 Bearing Type	Ball					
20 Dielectric Withstanding Voltage	500 VRMS for 5 seconds				VAC	
21 Radial Shaft Play	25@5N				µm	
22 Axial Shaft Play	25@5N				µm	
23 Maximum Radial Shaft Load	20 (72)				N (oz)	
24 Maximum Axial Shaft Load (3)	30 (108)				N (oz)	
25 Weight	260 (9.2)				g (oz)	
26 Power Rate (nominal current)	35.0				kW/s	

Notes:

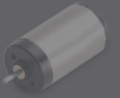
1. Measured with 1 phase ON. The max coil temperature must be respected
2. Motor unmounted
3. Shaft must be supported when press-fitting a pulley or pinion

4. For encoder specification, please refer to the dedicated encoder catalog page for HEDS 5540





Brushless DC motors



Brush DC motors



Disc magnet motors



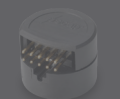
Can stack motors



Can stack linear actuators



Gearheads



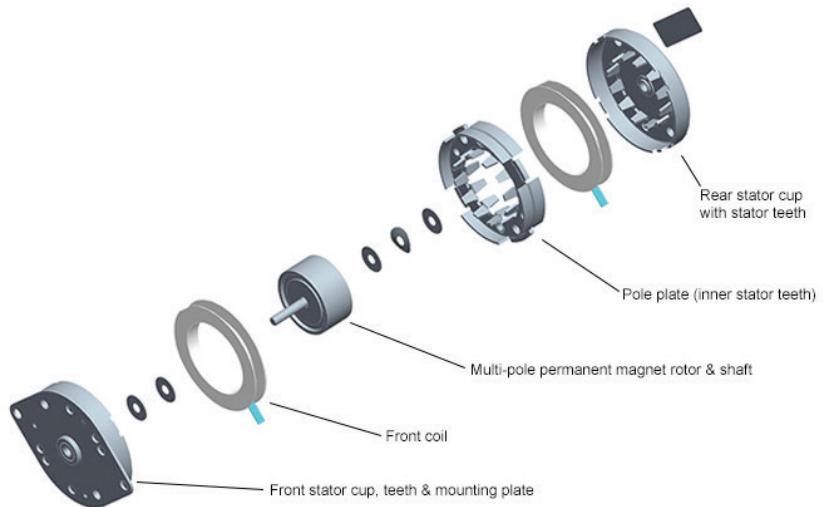
Encoders



Controllers

Can Stack Motors

These stepper motors eliminate the need for closed-loop feedback, providing accurate positioning in steps that typically range from 3.6 to 18 degrees (100 to 20 steps per revolution). Our can stack motors are the simplest motion solution for a wide range of applications that require high continuous motor torque but don't require the absolute positioning of a servo system.



Simple, Cost-Effective, Accurate Positioning

Feature	Details	Application Advantages
Stepper motor design	<ul style="list-style-type: none"> No need for encoder feedback 	<ul style="list-style-type: none"> Simple open-loop positioning that can be digitally controlled
Step angle variation: 3.6° to 18°	<ul style="list-style-type: none"> Designed to accommodate coarse to fine mechanical resolution 	<ul style="list-style-type: none"> Flexibility to meet most application positioning requirements
Simple construction	<ul style="list-style-type: none"> Basic mechanical design with proven performance No brushes to replace 	<ul style="list-style-type: none"> Compact, reliable, cost-effective motion control
Radially magnetized permanent magnet rotor	<ul style="list-style-type: none"> High torque-to-size ratio 	<ul style="list-style-type: none"> Design flexibility Overall reduction in machine size
Bobbin wound coil design	<ul style="list-style-type: none"> Unipolar/bipolar windings designed for optimum performance 	<ul style="list-style-type: none"> Exceptionally efficient motor output for power input
Sintered bronze bearing design, Ball bearings optional	<ul style="list-style-type: none"> Long bearing and lubrication life Choice of bearing performance characteristics 	<ul style="list-style-type: none"> Increased service life and reliability for any application



A Classic Design with Wide-Ranging Application



Medical devices & clinical diagnostics

- Laboratory automation
- Infusion systems
- Diagnostic analyzers
- Miniature pumps
- Pipettes



Instrumentation

- Dosing & dispensing systems
- Gas detection
- Land surveying
- Microscopes



Security

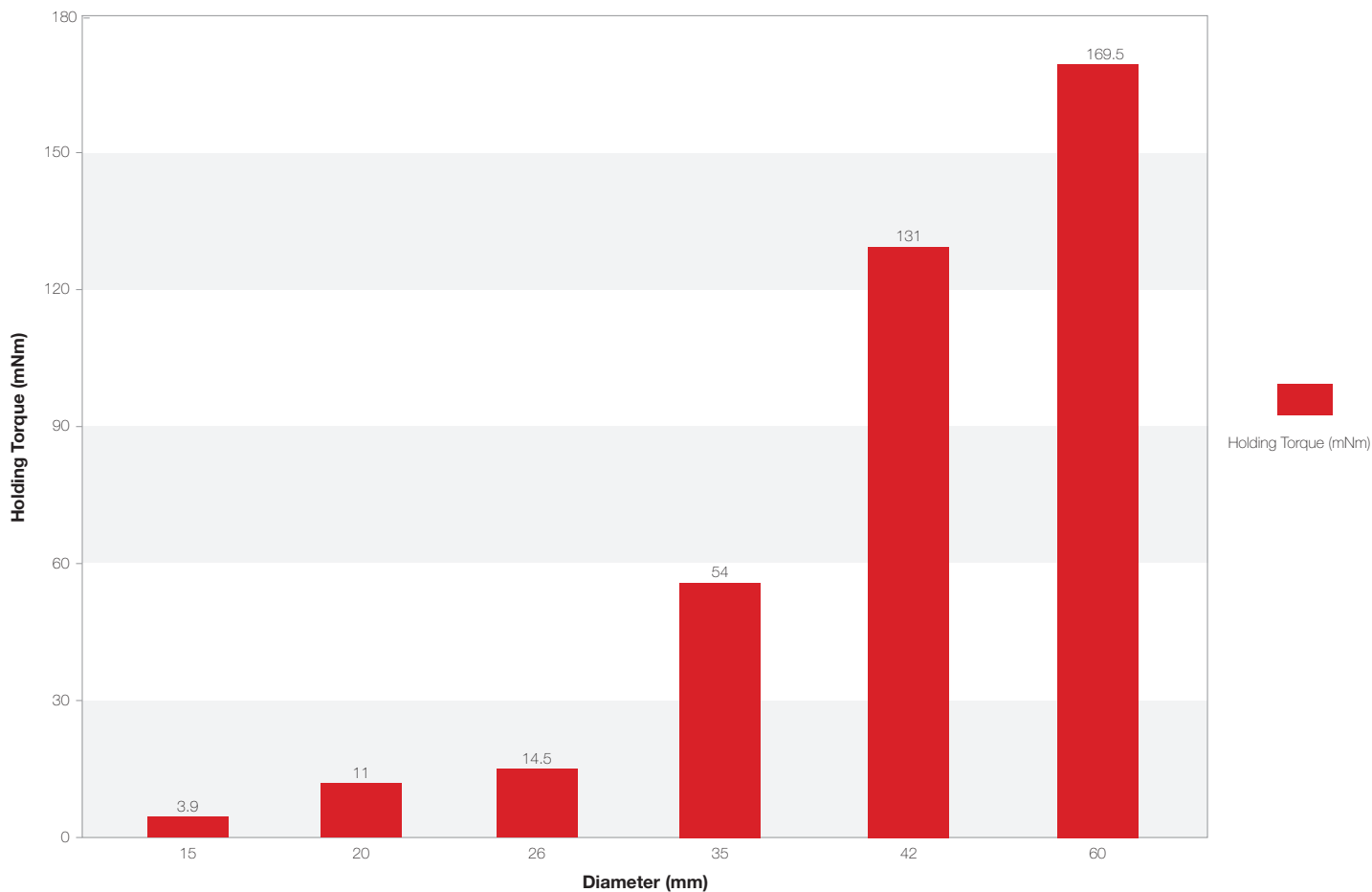
- Access systems
- Camera positioning



Other

- Damper actuation
- Valve actuation

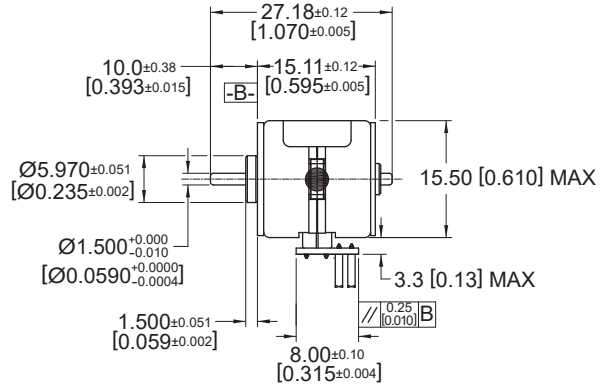
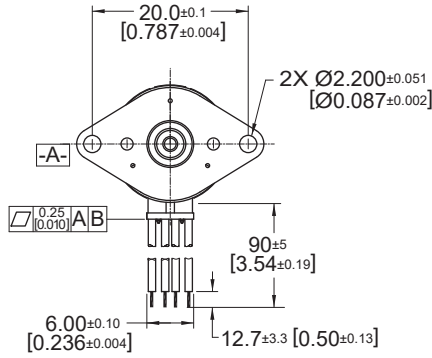
Meet your Application's Working Point Requirements



For complete product and application details, visit portescap.com/can-stack

15M020D

Ø 15 mm • RoHS Compliant • 3.87 mNm

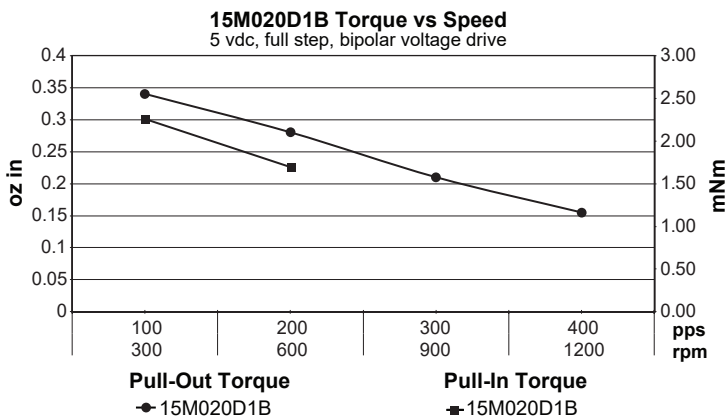
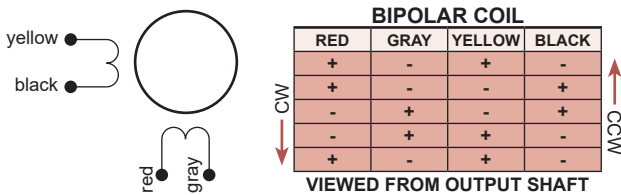


Dimensions in mm [inches]

Electrical Data	15M020D•• 1B Bipolar	Unit
1 Operating Voltage	5	VDC
2 Resistance per Phase, ± 10%	40.0	Ohms
3 Inductance per Phase, typ	14.0	mH
4 Rated Current per Phase *	0.13	A
Coil Independent Parameters		
5 Holding Torque, MIN *	3.87 (0.55)	mNm (oz-in)
6 Detent Torque, Max	1.62 (0.23)	mNm (oz-in)
7 Rotor Inertia	0.115 (0.00063)	gcm ² (oz-in ²)
8 Step Angle	18.0	Degree
9 Absolute accuracy 2 ph. On, Full step	± 1.5	Degree
10 Steps per Revolution	20	
11 Ambient Temp Range (operating)	-20 to +70 (-4 to +158)	°C (°F)
12 Maximum Coil Temperature	130 (266)	°C (°F)
13 Bearing Type	Sintered Bronze Sleeve	
14 Insulation Resistance at 500 VDC	100	Mohms
15 Dielectric Withstanding Voltage	450 VRMS for 2 Seconds	VAC
16 Weight	14 (0.5)	g (oz)
17 Leadwire	AWG #28, UL1429 (80° C, 150 V)	

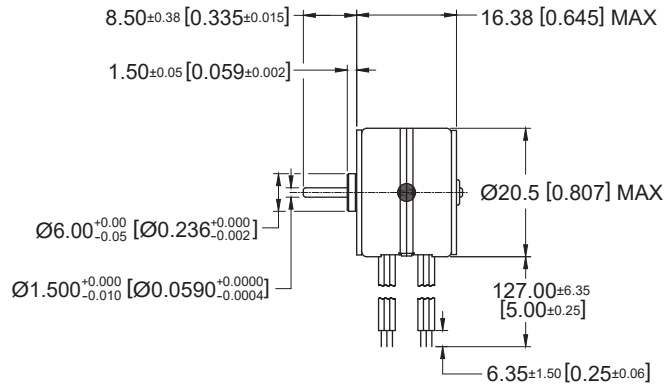
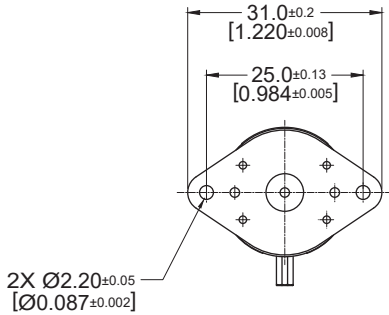
Note: All motor data values at 20° C unless otherwise specified

* Engergize at rated current, 2-Phase On



20M020D

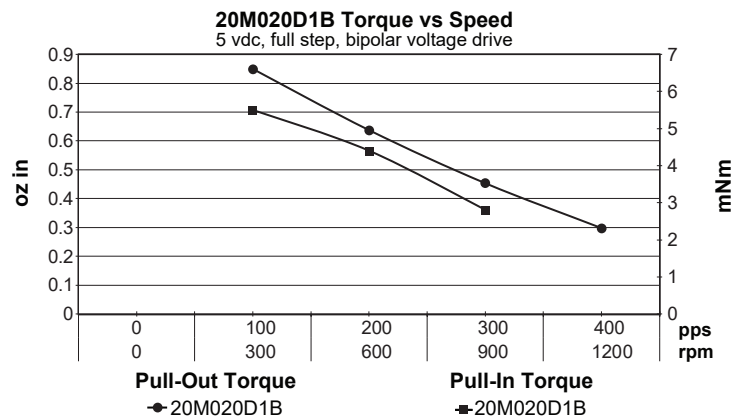
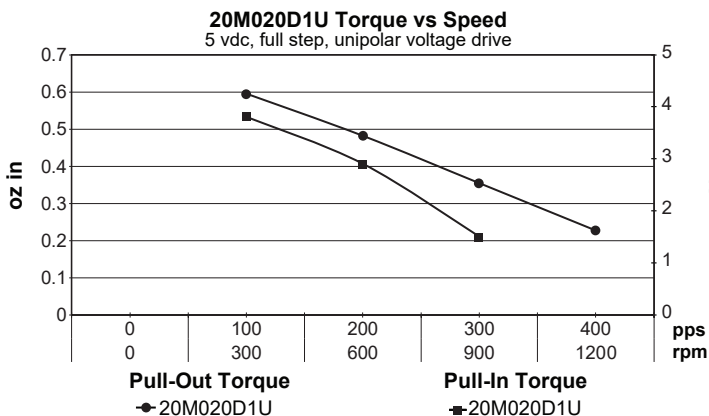
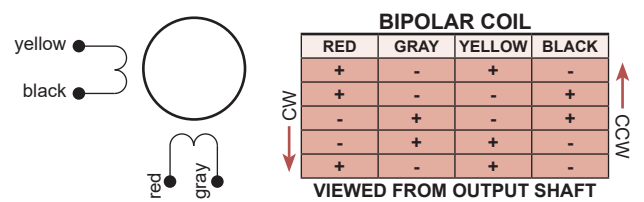
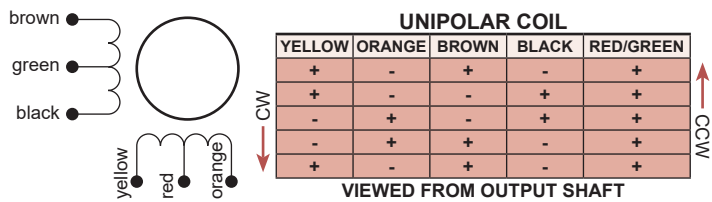
Ø 20 mm • RoHS Compliant • 11 mNm



Dimensions in mm [inches]

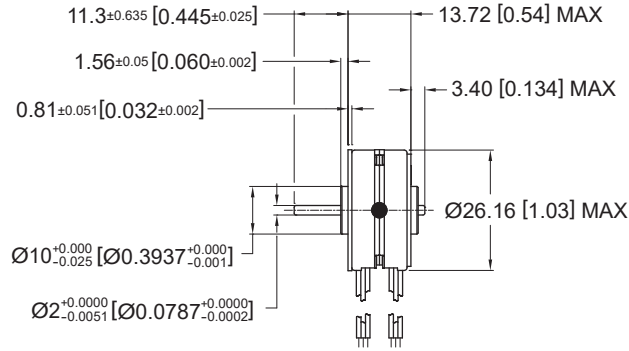
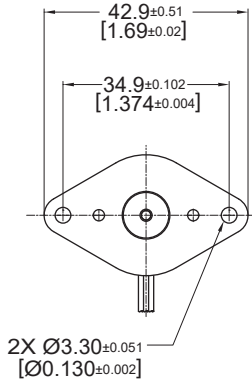
Electrical Data	20M020D••				Unit
	1U Unipolar	2U Unipolar	1B Bipolar	2B Bipolar	
1 Operating Voltage	5	12	5	12	VDC
2 Resistance per Phase, ± 10%	20.0	115.2	20.0	115.2	Ohms
3 Inductance per Phase, typ	3.9	20.3	7.8	52.8	mH
4 Rated Current per Phase *	0.25	0.10	0.25	0.10	A
Coil Independent Parameters					
5 Holding Torque, MIN *	7.8 (1.11)	7.8 (1.11)	11.0 (1.56)	11.0 (1.56)	mNm (oz-in)
6 Detent Torque, Max		3.53 (0.5)			mNm (oz-in)
7 Rotor Inertia		0.41 (0.00224)			gcm ² (oz-in ²)
8 Step Angle		18.0			Degree
9 Absolute accuracy 2 ph. On, Full step		± 1.5			Degree
10 Steps per Revolution		20			
11 Ambient Temp Range (operating)		-20 to +70 (-4 to +158)			°C (°F)
12 Maximum Coil Temperature		130 (266)			°C (°F)
13 Bearing Type		Sintered Bronze Sleeve			
14 Insulation Resistance at 500 VDC		100			Mohms
15 Dielectric Withstanding Voltage		450 VRMS for 2 seconds			VAC
16 Weight		23.5 (0.832)			g (oz)
17 Leadwire		AWG 28, UL 1429			

Note: All motor data values at 20° C unless otherwise specified
 * Engergize at rated current, 2-Phase On



26M024B

Ø 26 mm • RoHS Compliant • 7.8 mNm

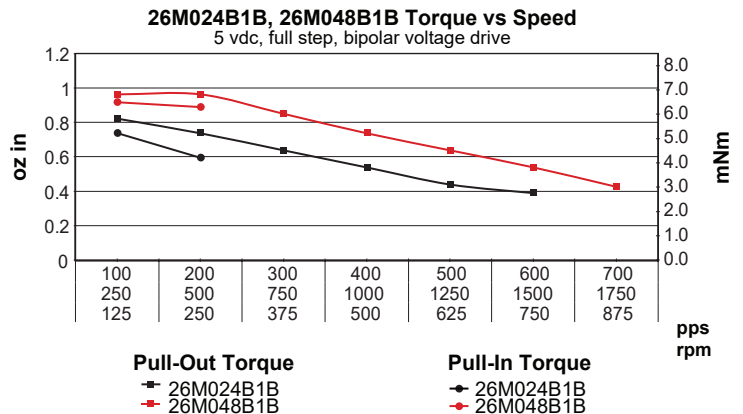
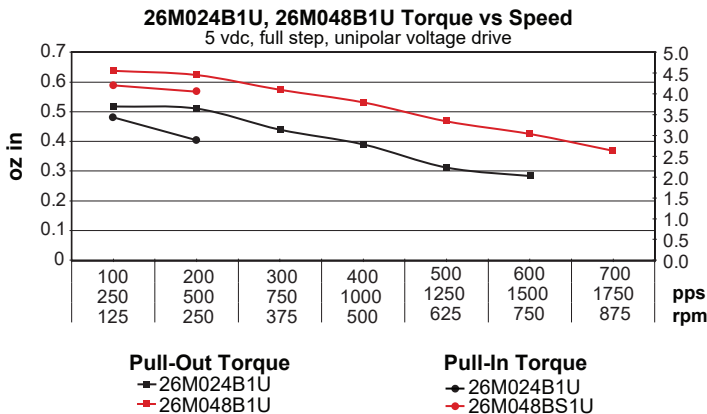
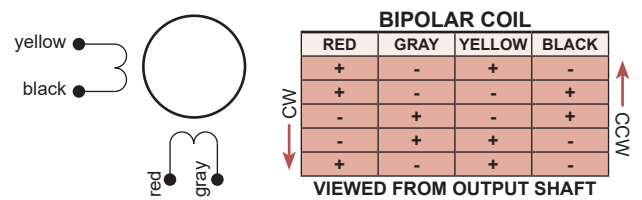
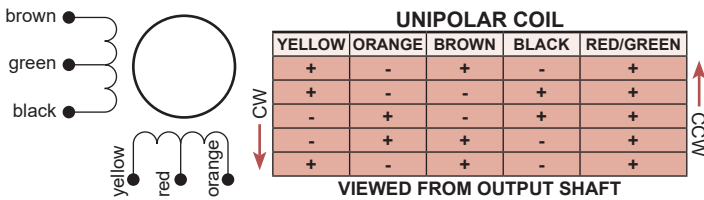


Dimensions in mm [inches]

Electrical Data	26M024B••				Unit
	1U Unipolar	2U Unipolar	1B Bipolar	2B Bipolar	
1 Operating Voltage	5	12	5	12	VDC
2 Resistance per Phase, ± 10%	19.6	110.0	19.8	108.0	Ohms
3 Inductance per Phase, typ	4.1	29.9	7.7	52.4	mH
4 Rated Current per Phase *	0.26	0.11	0.25	0.11	A
Coil Independent Parameters					
5 Holding Torque, MIN *	6.3 (0.9)	6.3 (0.9)	7.8 (1.1)	7.8 (1.1)	mNm (oz-in)
6 Detent Torque, Max			1.34 (0.19)		mNm (oz-in)
7 Rotor Inertia			1.1 (0.00601)		gcm ² (oz-in ²)
8 Step Angle			15.0		Degree
9 Absolute accuracy 2 ph. On, Full step			± 1		Degree
10 Steps per Revolution			24		
11 Ambient Temp Range (operating)			-20 to +70 (-4 to +158)		°C (°F)
12 Maximum Coil Temperature			130 (266)		°C (°F)
13 Bearing Type			Sintered Bronze Sleeve		
14 Insulation Resistance at 500 VDC			100		Mohms
15 Dielectric Withstanding Voltage			650 for 2 seconds		VAC
16 Weight			34 (1.2)		g (oz)
17 Leadwire			AWG #28, UL1429 (80° C, 150 V)		

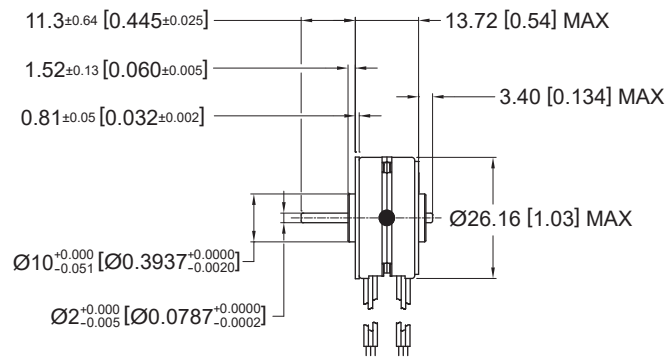
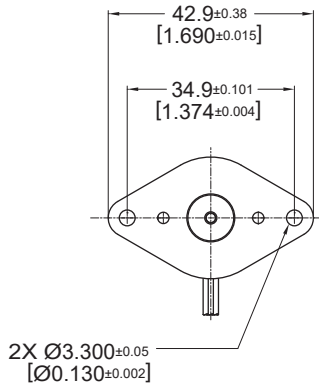
Note: All motor data values at 20° C unless otherwise specified

* Engergize at rated current, 2-Phase On



26M024D

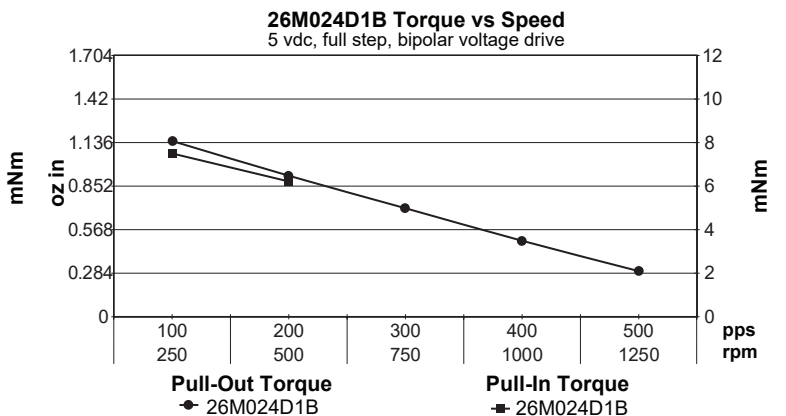
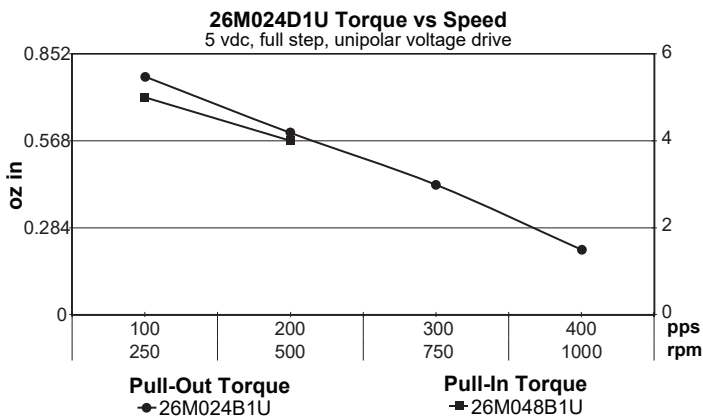
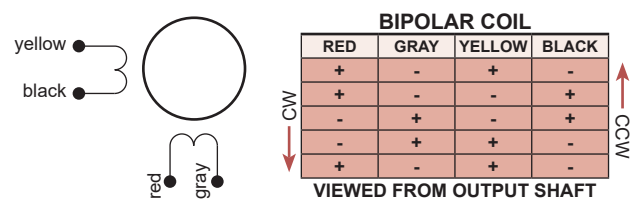
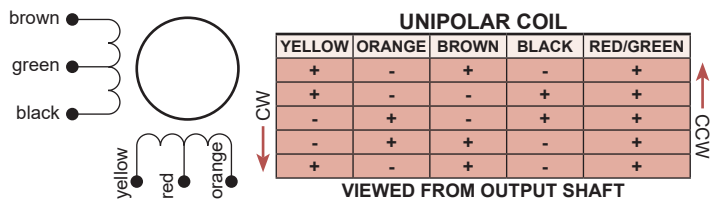
Ø 26 mm • RoHS Compliant • 12 mNm



Dimensions in mm [inches]

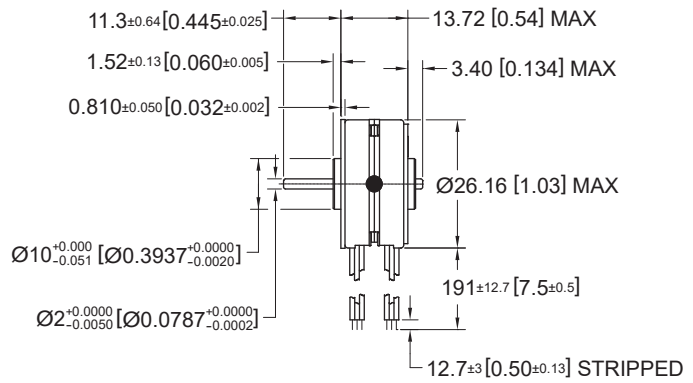
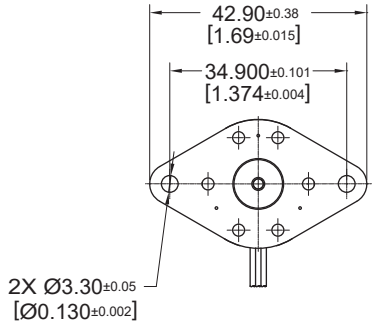
Electrical Data	26M024D••				Unit
	1U Unipolar	2U Unipolar	1B Bipolar	2B Bipolar	
1 Operating Voltage	5	12	5	12	VDC
2 Resistance per Phase, ± 10%	19.6	110.0	19.8	108.0	Ohms
3 Inductance per Phase, typ	3.8	26.6	9.0	44.3	mH
4 Rated Current per Phase *	0.26	0.11	0.25	0.11	A
Coil Independent Parameters					
5 Holding Torque, MIN *	9.5 (1.35)	9.5 (1.35)	12 (1.7)	12 (1.7)	mNm (oz-in)
6 Detent Torque, Max					4.2 (0.6)
7 Rotor Inertia					1.1 (0.00601)
8 Step Angle					15.0
9 Absolute accuracy 2 ph. On, Full step					± 1
10 Steps per Revolution					24.0
11 Ambient Temp Range (operating)					-20 to +70 (-4 to +158)
12 Maximum Coil Temperature					130 (266)
13 Bearing Type					Sintered Bronze Sleeve
14 Insulation Resistance at 500 VDC					100.0
15 Dielectric Withstanding Voltage					650 VRMS for 2 seconds
16 Weight					34 (1.2)
17 Leadwire					AWG #28, UL 1429 (80° C, 150 V)

Note: All motor data values at 20° C unless otherwise specified
 * Engergize at rated current, 2-Phase On



26M048B

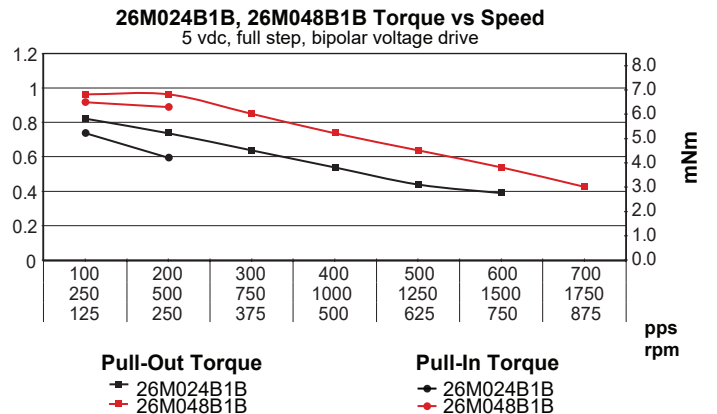
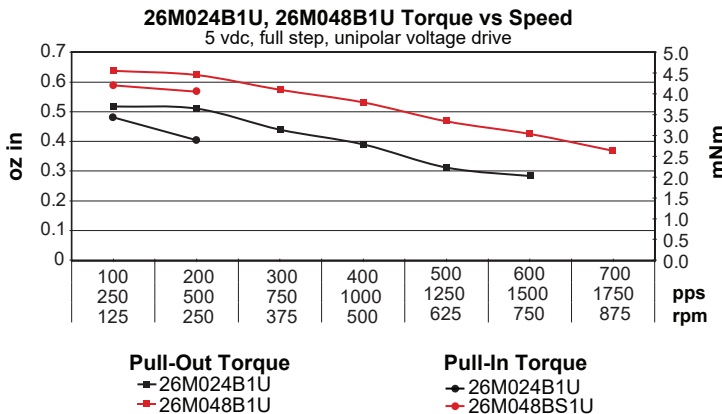
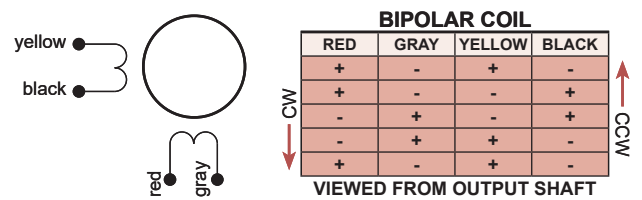
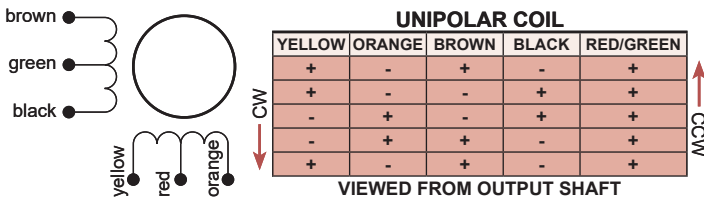
Ø 26 mm • RoHS Compliant • 10.6 mNm



Dimensions in mm [inches]

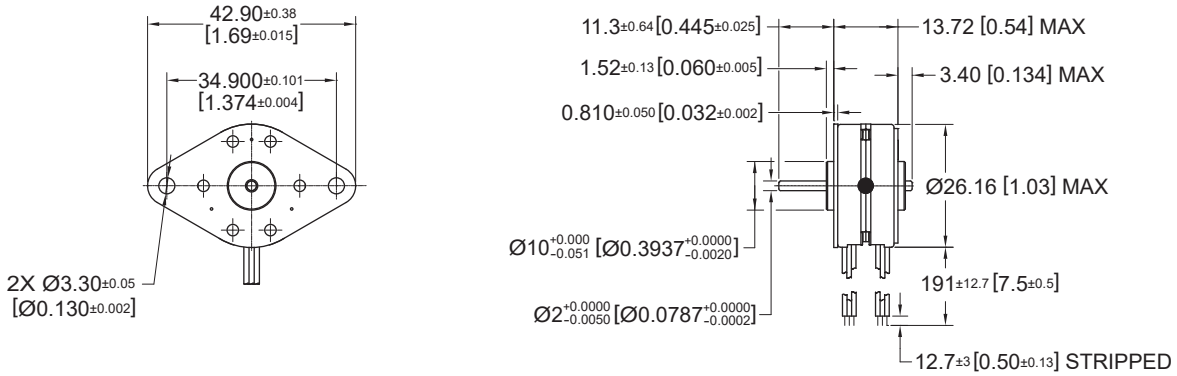
Electrical Data	26M048B••				Unit
	1U Unipolar	2U Unipolar	1B Bipolar	2B Bipolar	
1 Operating Voltage	5	12	5	12	VDC
2 Resistance per Phase, ± 10%	19.6	110.0	19.8	108.0	Ohms
3 Inductance per Phase, typ	5.3	36.5	13.0	60.7	mH
4 Rated Current per Phase *	0.26	0.11	0.25	0.11	A
Coil Independent Parameters					
5 Holding Torque, MIN *	9.2 (1.3)	9.2 (1.3)	10.6 (1.5)	10.6 (1.5)	mNm (oz-in)
6 Detent Torque, Max		0.85 (0.12)			mNm (oz-in)
7 Rotor Inertia		1.1 (0.00601)			gcm ² (oz-in ²)
8 Step Angle		7.5			Degree
9 Absolute accuracy 2 ph. On, Full step		± 0.5			Degree
10 Steps per Revolution		48.0			
11 Ambient Temp Range (operating)		-20 to +70 (-4 to +158)			°C (°F)
12 Maximum Coil Temperature		130 (266)			°C (°F)
13 Bearing Type		Sintered Bronze Sleeve			
14 Insulation Resistance at 500 VDC		100.0			Mohms
15 Dielectric Withstanding Voltage		650 VRMS for 2 seconds			VAC
16 Weight		34 (1.2)			g (oz)
17 Leadwire		AWG #28, UL1429 (80° C, 150 V)			

Note: All motor data values at 20° C unless otherwise specified
 * Engergize at rated current, 2-Phase On



26M048D

Ø 26 mm • RoHS Compliant • 14.5 mNm

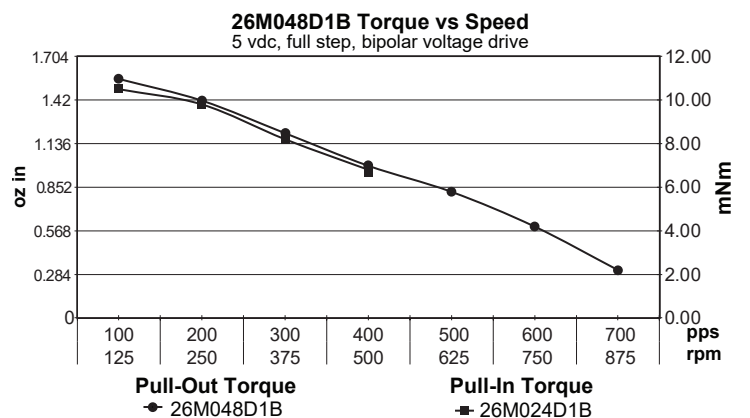
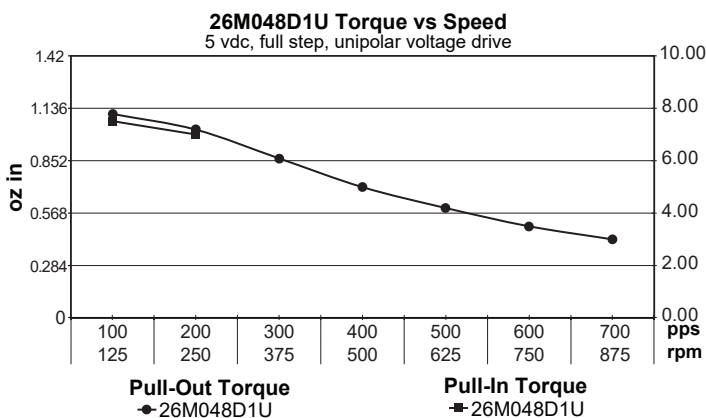
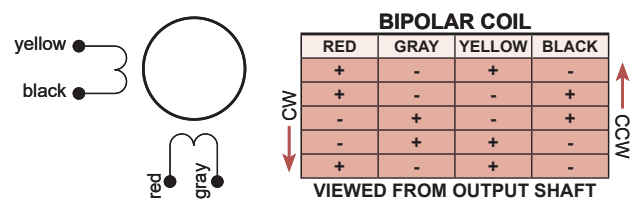
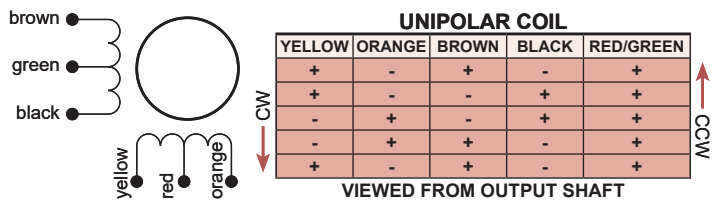


Dimensions in mm [inches]

Electrical Data	26M048D••				Unit
	1U Unipolar	2U Unipolar	1B Bipolar	2B Bipolar	
1 Operating Voltage	5	12	5	12	VDC
2 Resistance per Phase, ± 10%	19.6	110.0	19.8	108.0	Ohms
3 Inductance per Phase, typ	4.9	33.0	12.0	55.0	mH
4 Rated Current per Phase *	0.26	0.11	0.25	0.11	A
Coil Independent Parameters					
5 Holding Torque, MIN *	11.5 (1.63)	11.5 (1.63)	14.5 (2.05)	14.5 (2.05)	mNm (oz-in)
6 Detent Torque, Max					4.2 (0.6)
7 Rotor Inertia					1.1 (0.00601)
8 Step Angle					7.5
9 Absolute accuracy 2 ph. On, Full step					± 0.5
10 Steps per Revolution					48.0
11 Ambient Temp Range (operating)					-20 to +70 (-4 to +158)
12 Maximum Coil Temperature					130 (266)
13 Bearing Type					Sintered Bronze Sleeve
14 Insulation Resistance at 500 VDC					100.0
15 Dielectric Withstanding Voltage					650 VRMS for 2 seconds
16 Weight					34 (1.2)
17 Leadwire					AWG #28, UL 1429 (80° C, 150 V)

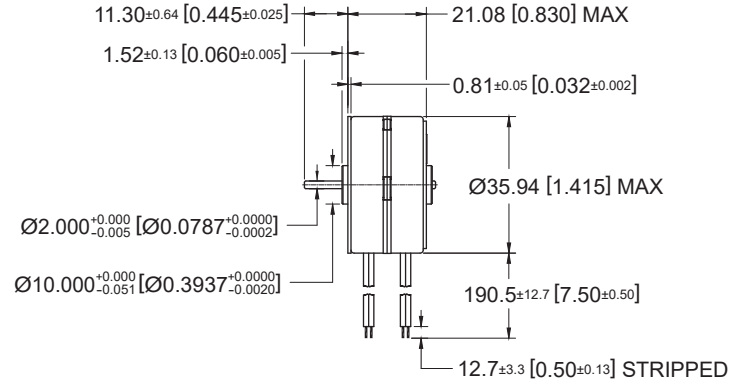
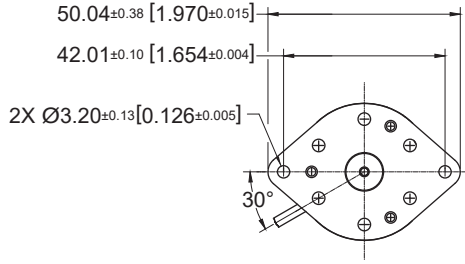
Note: All motor data values at 20° C unless otherwise specified

* Engergize at rated current, 2-Phase On



35L048B

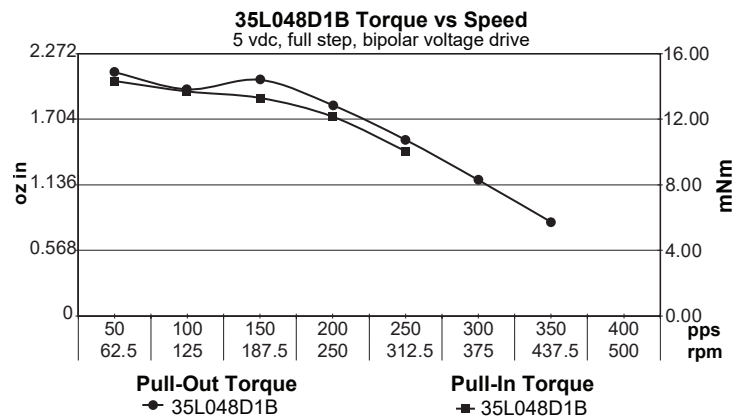
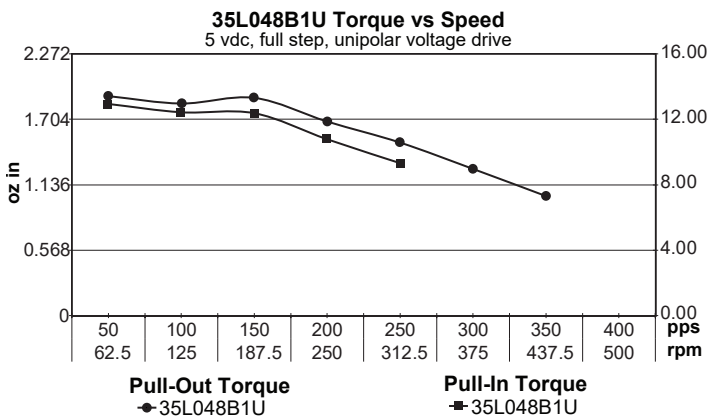
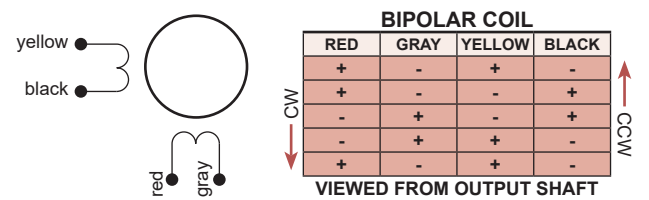
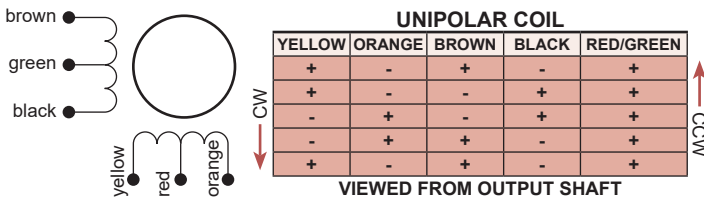
Ø 35 mm • RoHS Compliant • 28 mNm



Dimensions in mm [inches]

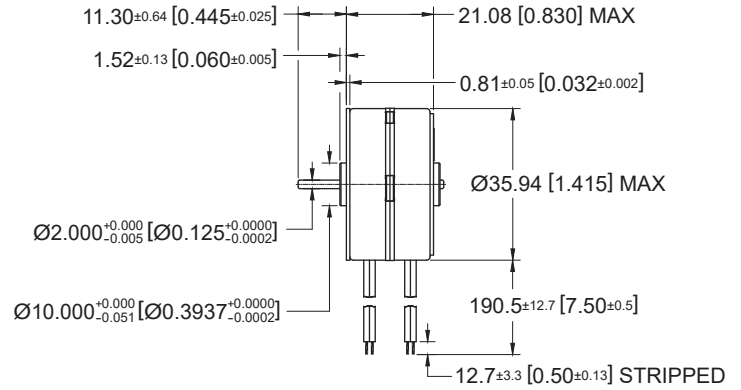
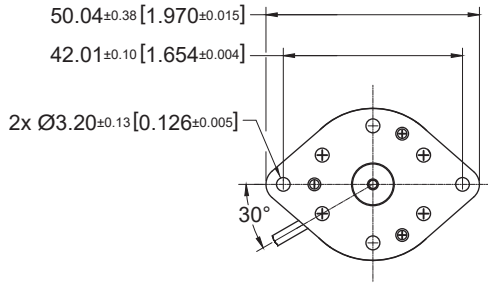
Electrical Data	35L048B••				Unit
	1U Unipolar	2U Unipolar	1B Bipolar	2B Bipolar	
1 Operating Voltage	5	12	5	12	VDC
2 Resistance per Phase, ± 10%	11.0	64.0	11.0	64.0	Ohms
3 Inductance per Phase, typ	7.8	40.0	15.0	72.0	mH
4 Rated Current per Phase *	0.45	0.19	0.45	0.19	A
Coil Independent Parameters					
5 Holding Torque, MIN *	25 (3.5)	25 (3.5)	28 (4)	28 (4)	mNm (oz-in)
6 Detent Torque, Max		4.2 (0.6)			mNm (oz-in)
7 Rotor Inertia		4 (0.021)			gcm ² (oz-in ²)
8 Step Angle		7.5			Degree
9 Absolute accuracy 2 ph. On, Full step		± 0.5			Degree
10 Steps per Revolution		48.0			
11 Ambient Temp Range (operating)		-20 to +70 (-4 to +158)			°C (°F)
12 Maximum Coil Temperature		130 (266)			°C (°F)
13 Bearing Type		Sintered Bronze Sleeve			
14 Insulation Resistance at 500 VDC		100.0			Mohms
15 Dielectric Withstanding Voltage		650 VRMS for 2 seconds			VAC
16 Weight		88 (3.1)			g (oz)
17 Leadwire		AWG #26, UL1430 (105° C, 300 V)			

Note: All motor data values at 20° C unless otherwise specified
 * Engergize at rated current, 2-Phase On



35L048D

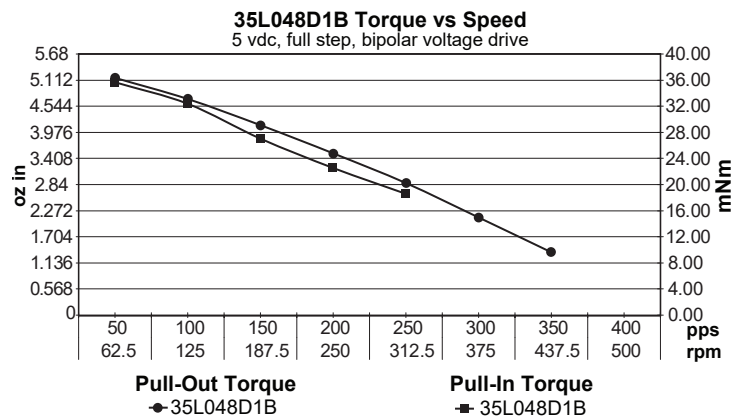
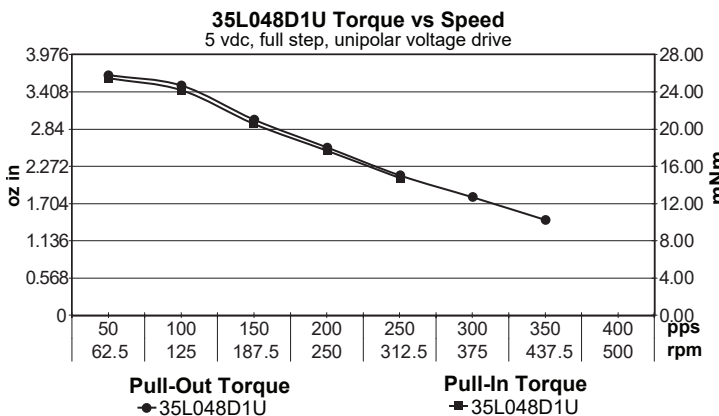
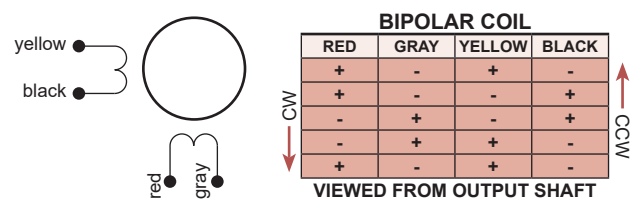
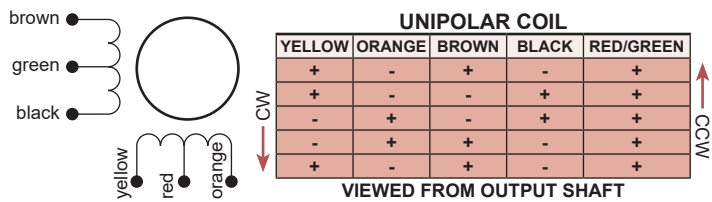
Ø 35 mm • RoHS Compliant • 54 mNm



Dimensions in mm [inches]

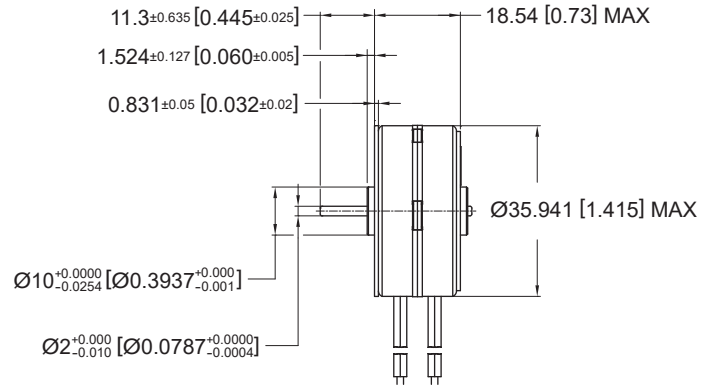
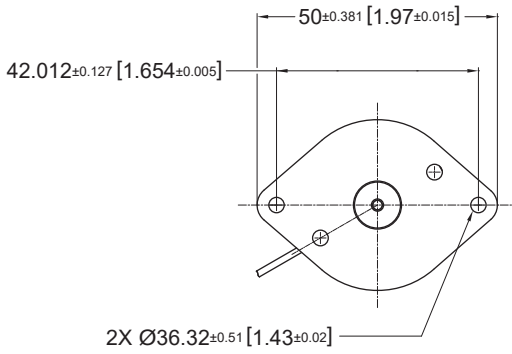
Electrical Data	35L048D••				Unit
	1U Unipolar	2U Unipolar	1B Bipolar	2B Bipolar	
1 Operating Voltage	5	12	5	12	VDC
2 Resistance per Phase, ± 10%	11.0	64.0	11.0	64.0	Ohms
3 Inductance per Phase, typ	7.4	35.0	13.0	60.0	mH
4 Rated Current per Phase *	0.45	0.19	0.45	0.19	A
Coil Independent Parameters					
5 Holding Torque, MIN *	46 (6.5)	46 (6.5)	54 (7.6)	54 (7.6)	mNm (oz-in)
6 Detent Torque, Max		12.1 (1.8)			mNm (oz-in)
7 Rotor Inertia		4 (0.021)			gcm ² (oz-in ²)
8 Step Angle		7.5			Degree
9 Absolute accuracy 2 ph. On, Full step		± 0.5			Degree
10 Steps per Revolution		48.0			
11 Ambient Temp Range (operating)		-20 to +70 (-4 to +158)			°C (°F)
12 Maximum Coil Temperature		130 (266)			°C (°F)
13 Bearing Type		Sintered Bronze Sleeve			
14 Insulation Resistance at 500 VDC		100.0			Mohms
15 Dielectric Withstanding Voltage		650 VRMS for 2 seconds			VAC
16 Weight		88 (3.1)			g (oz)
17 Leadwire		AWG #26, UL1430 (105° C, 300 V)			

Note: All motor data values at 20° C unless otherwise specified
 * Engergize at rated current, 2-Phase On



35M048B

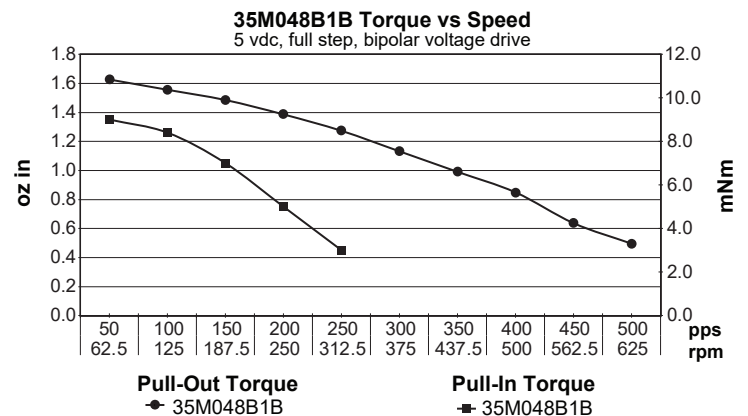
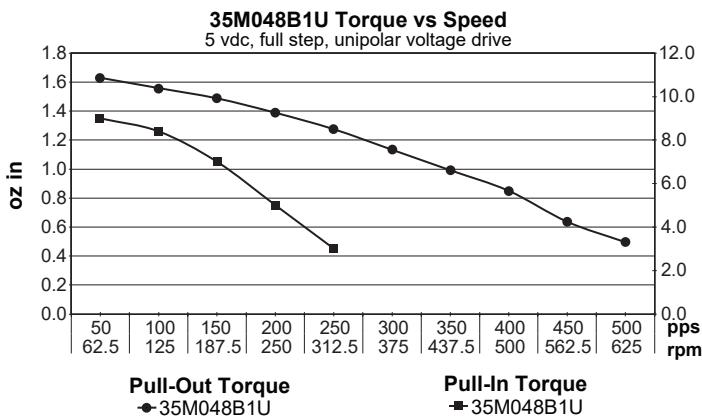
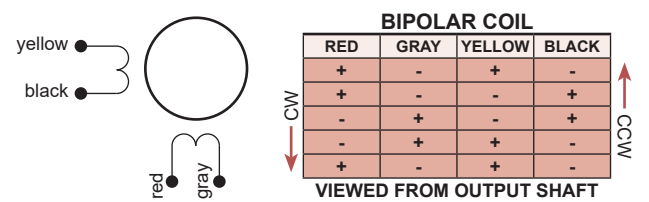
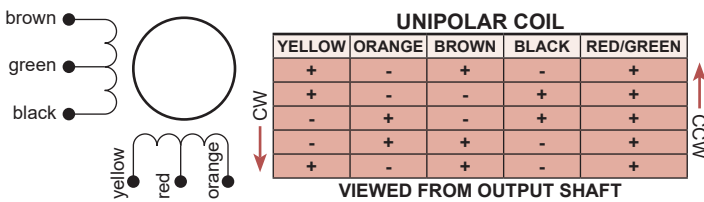
Ø 35 mm • RoHS Compliant • 20 mNm



Dimensions in mm [inches]

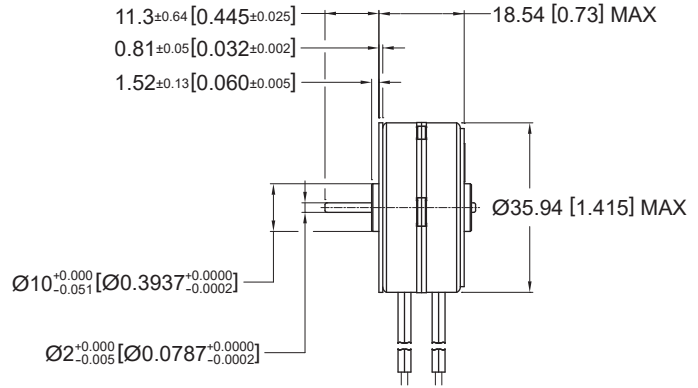
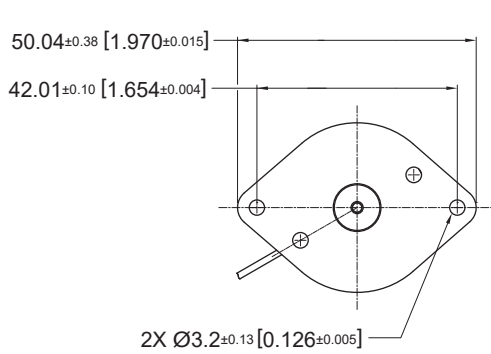
Electrical Data	35M048B••				Unit
	1U Unipolar	2U Unipolar	1B Bipolar	2B Bipolar	
1 Operating Voltage	5	12	5	12	VDC
2 Resistance per Phase, ± 10%	12.5	72.0	12.5	72.0	Ohms
3 Inductance per Phase, typ	7.8	36.0	16.4	86.0	mH
4 Rated Current per Phase *	0.40	0.17	0.40	0.17	A
Coil Independent Parameters					
5 Holding Torque, MIN *	18.35 (2.6)	18.35 (2.6)	19.76 (2.8)	19.76 (2.8)	mNm (oz-in)
6 Detent Torque, Max	2.12 (0.3)				mNm (oz-in)
7 Rotor Inertia	2 (0.011)				gcm ² (oz-in ²)
8 Step Angle	7.5				Degree
9 Absolute accuracy 2 ph. On, Full step	± 0.5				Degree
10 Steps per Revolution	48.0				
11 Ambient Temp Range (operating)	-20 to +70 (-4 to +158)				°C (°F)
12 Maximum Coil Temperature	130 (266)				°C (°F)
13 Bearing Type	Sintered Bronze Sleeve				
14 Insulation Resistance at 500 VDC	100.0				Mohms
15 Dielectric Withstanding Voltage	650 VRMS for 2 seconds				VAC
16 Weight	88 (3.1)				g (oz)
17 Leadwire	AWG #26, UL1430 (105° C, 300 V)				

Note: All motor data values at 20° C unless otherwise specified
 * Engergize at rated current, 2-Phase On



35M048D

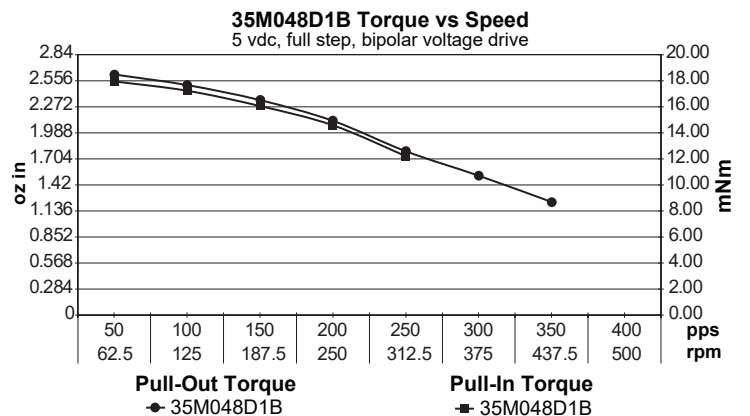
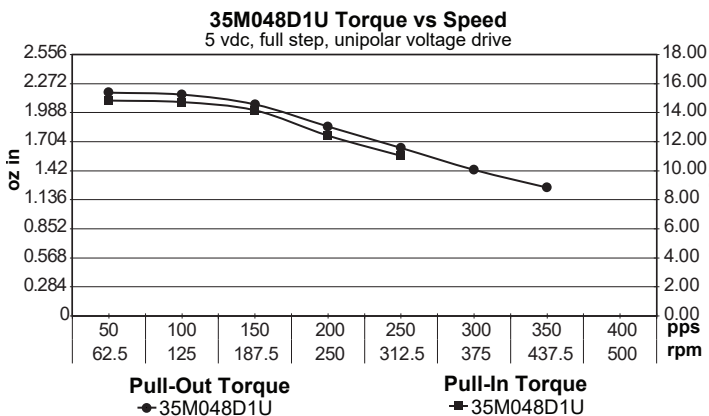
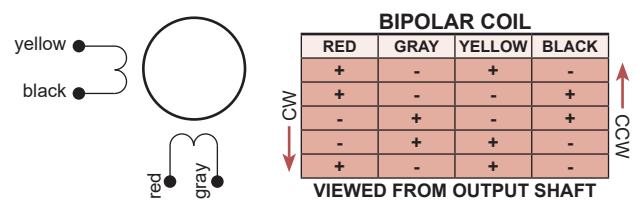
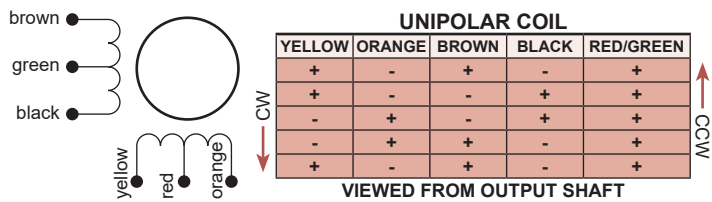
Ø 35 mm • RoHS Compliant • 25 mNm



Dimensions in mm [inches]

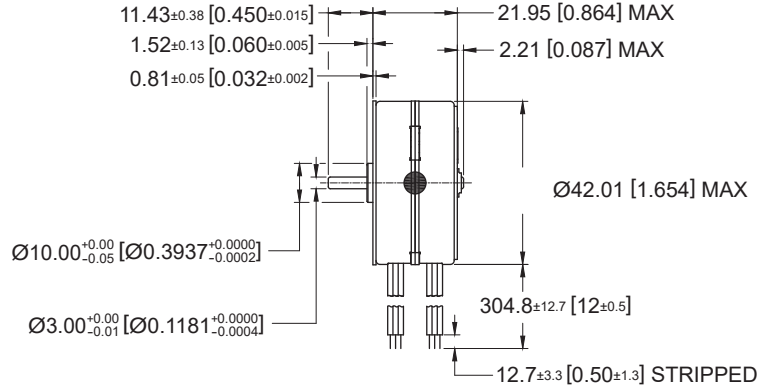
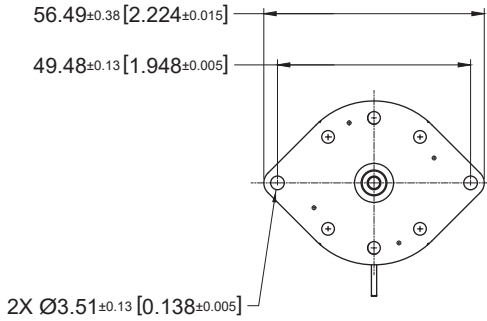
Electrical Data	35M048D••				Unit
	1U Unipolar	2U Unipolar	1B Bipolar	2B Bipolar	
1 Operating Voltage	5	12	5	12	VDC
2 Resistance per Phase, ± 10%	12.5	72.0	12.5	72.0	Ohms
3 Inductance per Phase, typ	8.5	38.0	16.3	90.0	mH
4 Rated Current per Phase *	0.40	0.17	0.40	0.17	A
Coil Independent Parameters					
5 Holding Torque, MIN *	20 (2.8)	20 (2.8)	25 (3.5)	25 (3.5)	mNm (oz-in)
6 Detent Torque, Max		6.3 (0.89)			mNm (oz-in)
7 Rotor Inertia		2 (0.011)			gcm ² (oz-in ²)
8 Step Angle		7.5			Degree
9 Absolute accuracy 2 ph. On, Full step		± 0.5			Degree
10 Steps per Revolution		48.0			
11 Ambient Temp Range (operating)		-20 to +70 (-4 to +158)			°C (°F)
12 Maximum Coil Temperature		130 (266)			°C (°F)
13 Bearing Type		Sintered Bronze Sleeve			
14 Insulation Resistance at 500 VDC		100.0			Mohms
15 Dielectric Withstanding Voltage		650 VRMS for 2 seconds			VAC
16 Weight		88 (3.1)			g (oz)
17 Leadwire		AWG #26, UL1430 (105° C, 300 V)			

Note: All motor data values at 20° C unless otherwise specified
 * Engergize at rated current, 2-Phase On



42L048D

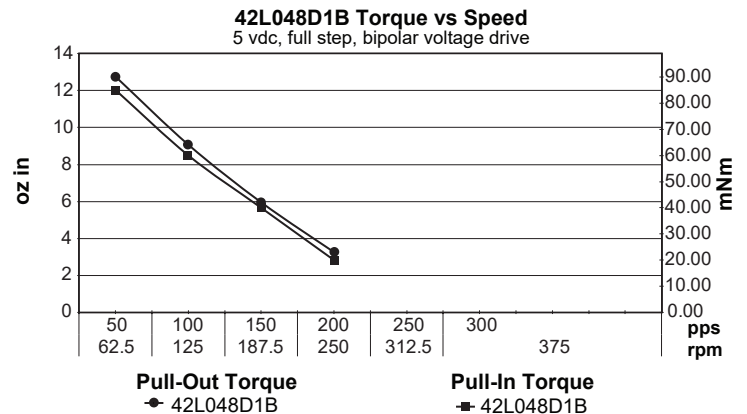
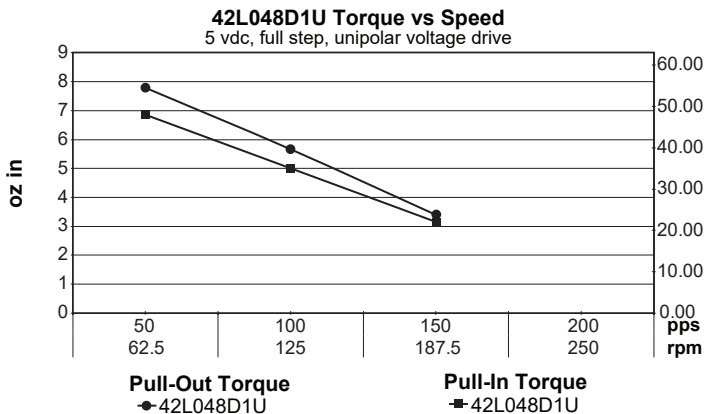
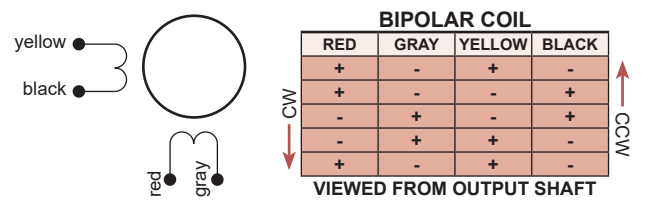
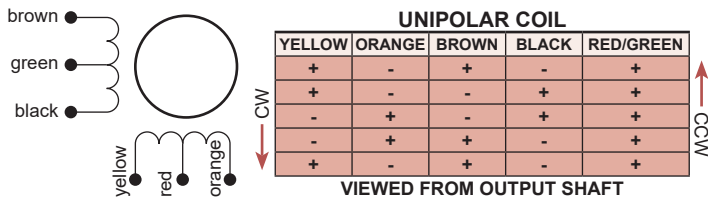
Ø 42 mm • RoHS Compliant • 131 mNm



Dimensions in mm [inches]

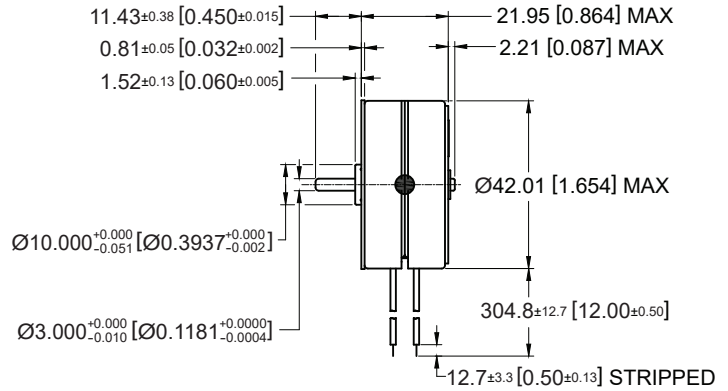
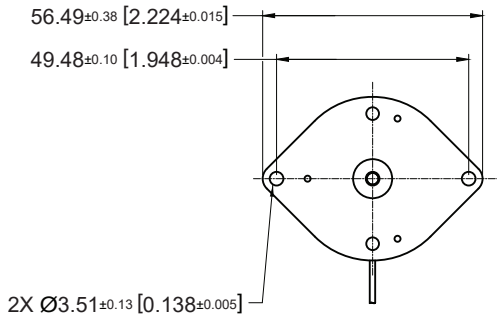
Electrical Data	42L048D••				Unit
	1U Unipolar	2U Unipolar	1B Bipolar	2B Bipolar	
1 Operating Voltage	5	12	5	12	VDC
2 Resistance per Phase, ± 10%	5.2	30.0	5.2	30.0	Ohms
3 Inductance per Phase, typ	2.1	11.3	4.2	22.3	mH
4 Rated Current per Phase *	0.96	0.40	0.96	0.40	A
Coil Independent Parameters					
5 Holding Torque, MIN *	106 (15.1)	106 (15.1)	131 (18.5)	131 (18.5)	mNm (oz-in)
6 Detent Torque, Max	29.7 (4.2)				mNm (oz-in)
7 Rotor Inertia	19.5 (0.1066)				gcm ² (oz-in ²)
8 Step Angle	7.5				Degree
9 Absolute accuracy 2 ph. On, Full step	± 0.5				Degree
10 Steps per Revolution	48.0				
11 Ambient Temp Range (operating)	-20 to +70 (-4 to +158)				°C (°F)
12 Maximum Coil Temperature	130 (266)				°C (°F)
13 Bearing Type	Sintered Bronze Sleeve				
14 Insulation Resistance at 500 VDC	100.0				Mohms
15 Dielectric Withstanding Voltage	650 VRMS for 2 seconds				VAC
16 Weight	116.4 (4.1)				g (oz)
17 Leadwire	AWG #26, UL1430 (105° C, 300 V)				

Note: All motor data values at 20° C unless otherwise specified
 * Engergize at rated current, 2-Phase On



42M048C

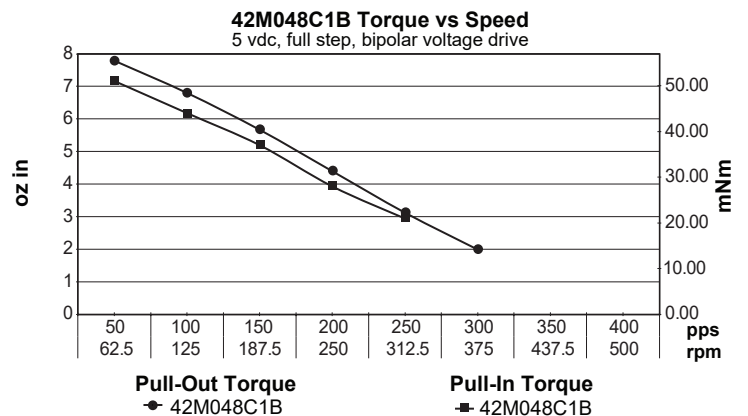
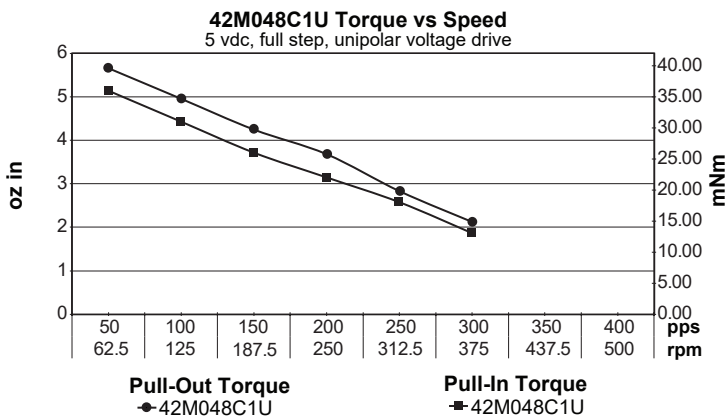
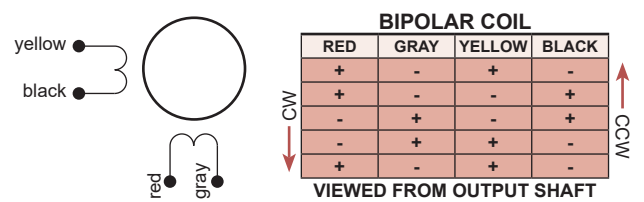
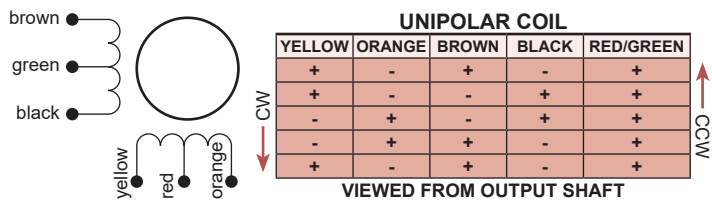
Ø 42 mm • RoHS Compliant • 83.8 mNm



Dimensions in mm [inches]

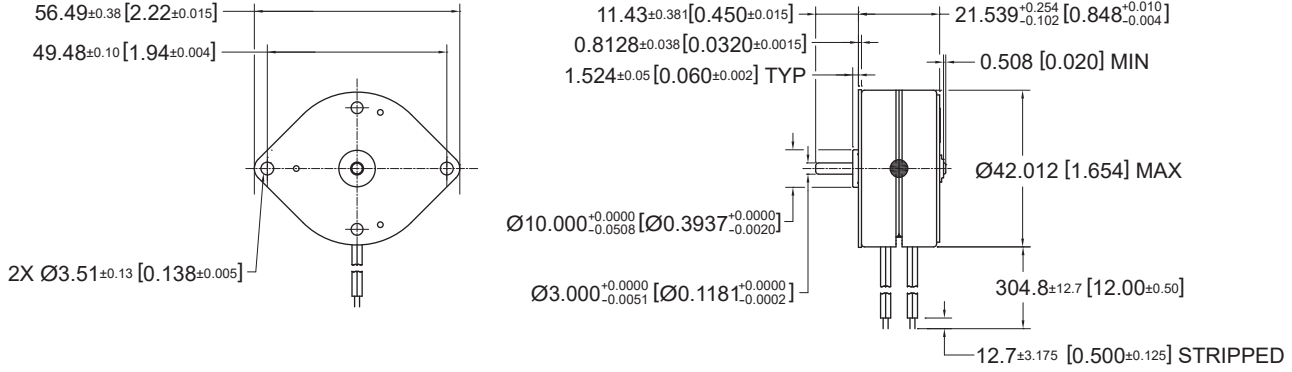
Electrical Data	42M048C●●				Unit
	1U Unipolar	2U Unipolar	1B Bipolar	2B Bipolar	
1 Operating Voltage	5	12	5	12	VDC
2 Resistance per Phase, ± 10%	9.1	52.4	9.1	52.4	Ohms
3 Inductance per Phase, typ	8.1	51.7	16.7	85.7	mH
4 Rated Current per Phase *	0.55	0.23	0.55	0.23	A
Coil Independent Parameters					
5 Holding Torque, MIN *	66.2 (9.4)	66.2 (9.4)	83.8 (11.9)	83.8 (11.9)	mNm (oz-in)
6 Detent Torque, Max		12.7 (1.8)			mNm (oz-in)
7 Rotor Inertia		12.5 (0.068)			gcm ² (oz-in ²)
8 Step Angle		7.5			Degree
9 Absolute accuracy 2 ph. On, Full step		± 0.5			Degree
10 Steps per Revolution		48.0			
11 Ambient Temp Range (operating)		-20 to +70 (-4 to +158)			°C (°F)
12 Maximum Coil Temperature		130 (266)			°C (°F)
13 Bearing Type		Sintered Bronze Sleeve			
14 Insulation Resistance at 500 VDC		100.0			Mohms
15 Dielectric Withstanding Voltage		650 VRMS for 2 seconds			VAC
16 Weight		145 (5.1)			g (oz)
17 Leadwire		AWG #26, UL1430 (105° C, 300 V)			

Note: All motor data values at 20° C unless otherwise specified
 * Engergize at rated current, 2-Phase On



42M048D

Ø 42 mm • RoHS Compliant • 114.4 mNm

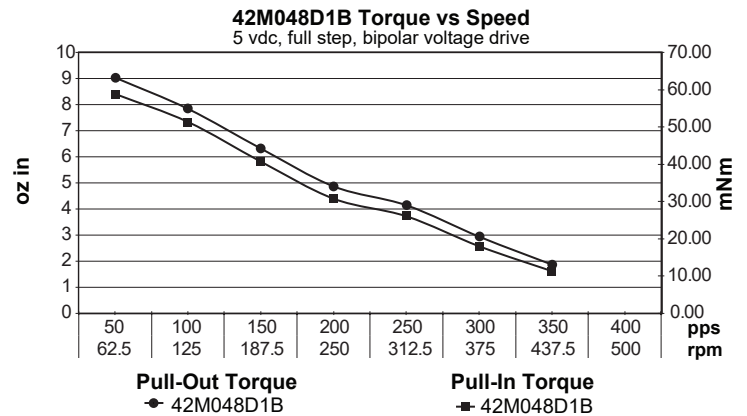
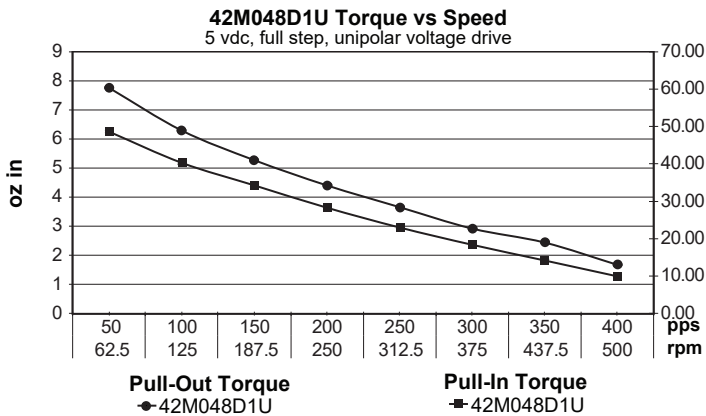
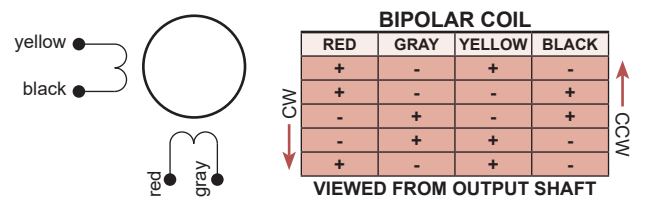
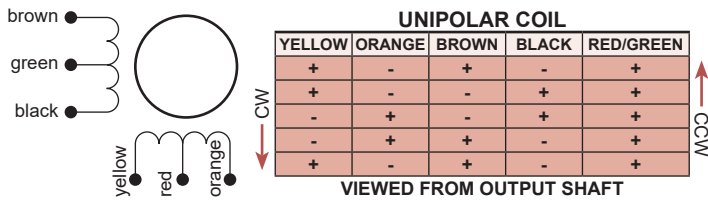


Dimensions in mm [inches]

Electrical Data	42M048D••				Unit
	1U Unipolar	2U Unipolar	1B Bipolar	2B Bipolar	
1 Operating Voltage	5	12	5	12	VDC
2 Resistance per Phase, ± 10%	9.1	52.4	9.1	52.4	Ohms
3 Inductance per Phase, typ	6.5	42.6	14.1	69.3	mH
4 Rated Current per Phase *	0.55	0.23	0.55	0.23	A
Coil Independent Parameters					
5 Holding Torque, MIN *	101.7 (14.4)	101.7 (14.4)	114.4 (16.21)	114.4 (16.21)	mNm (oz-in)
6 Detent Torque, Max	29.66 (4.2)				mNm (oz-in)
7 Rotor Inertia	9.5 (0.05195)				gcm ² (oz-in ²)
8 Step Angle	7.5				Degree
9 Absolute accuracy 2 ph. On, Full step	± 0.5				Degree
10 Steps per Revolution	48.0				
11 Ambient Temp Range (operating)	-20 to +70 (-4 to +158)				°C (°F)
12 Maximum Coil Temperature	130 (266)				°C (°F)
13 Bearing Type	Sintered Bronze Sleeve				
14 Insulation Resistance at 500 VDC	100.0				Mohms
15 Dielectric Withstanding Voltage	650 VRMS for 2 seconds				VAC
16 Weight	144.58 (5.1)				g (oz)
17 Leadwire	AWG #26, UL1430 (105° C, 300 V)				

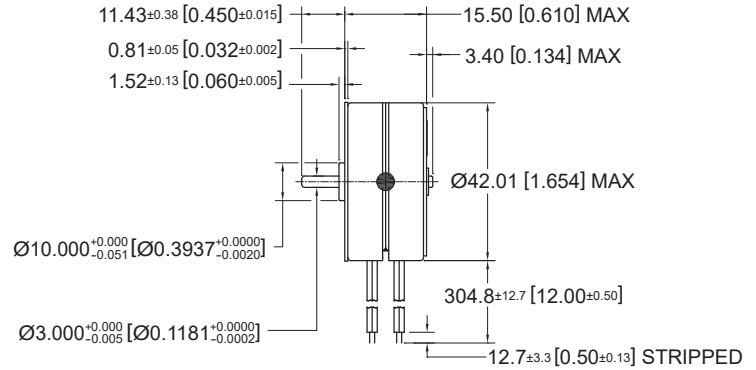
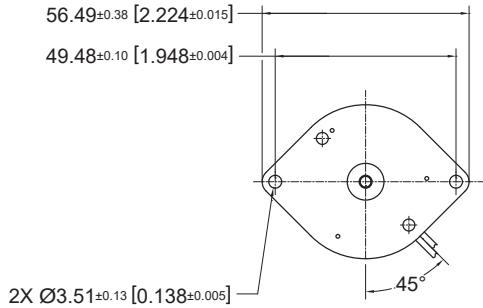
Note: All motor data values at 20° C unless otherwise specified

* Energize at rated current, 2-Phase On



42M100B

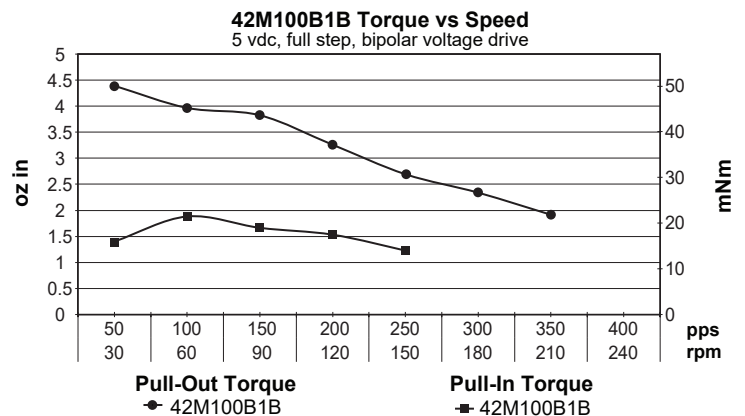
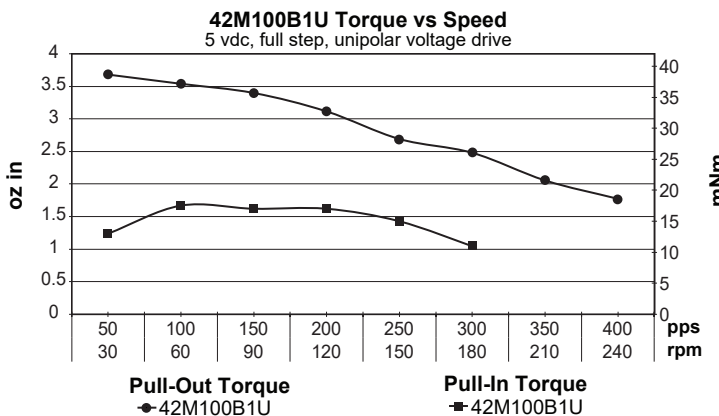
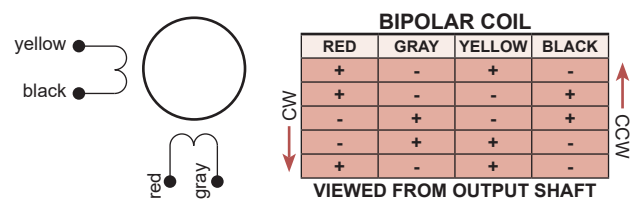
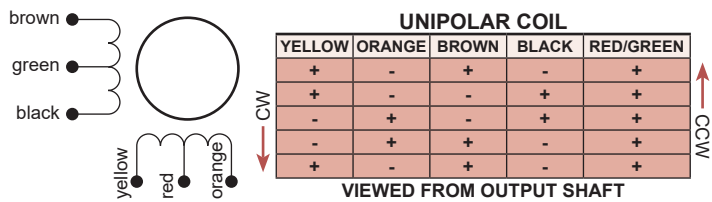
Ø 42 mm • RoHS Compliant • 49.4 mNm



Dimensions in mm [inches]

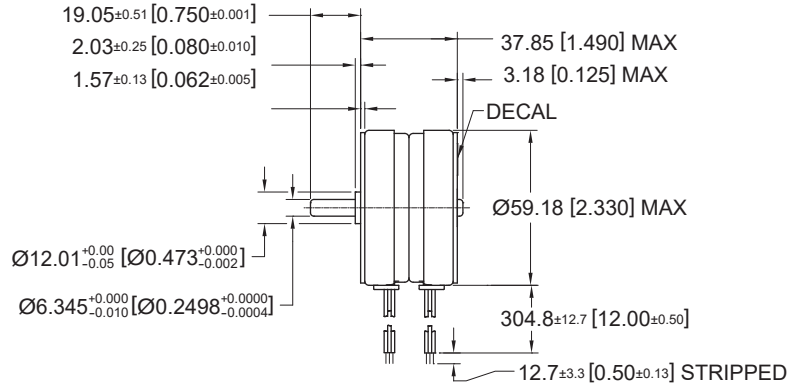
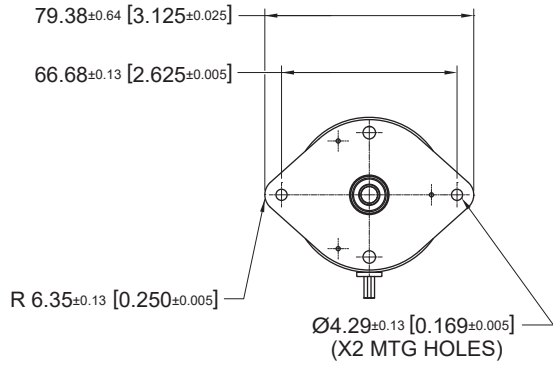
Electrical Data	42M100B••				Unit
	1U Unipolar	2U Unipolar	1B Bipolar	2B Bipolar	
1 Operating Voltage	5	12	5	12	VDC
2 Resistance per Phase, ± 10%	12.5	75.0	12.5	75.0	Ohms
3 Inductance per Phase, typ	6.6	37.7	11.3	62.1	mH
4 Rated Current per Phase *	0.40	0.16	0.40	0.16	A
Coil Independent Parameters					
5 Holding Torque, MIN *	45.2 (6.4)	45.2 (6.4)	49.4 (7)	49.4 (7)	mNm (oz-in)
6 Detent Torque, Max			5 (0.7)		mNm (oz-in)
7 Rotor Inertia			11.8 (0.065)		gcm ² (oz-in ²)
8 Step Angle			3.6		Degree
9 Absolute accuracy 2 ph. On, Full step			± 0.5		Degree
10 Steps per Revolution			100.0		
11 Ambient Temp Range (operating)		-20 to +70 (-4 to +158)			°C (°F)
12 Maximum Coil Temperature		130 (266)			°C (°F)
13 Bearing Type		Sintered Bronze Sleeve			
14 Insulation Resistance at 500 VDC		100.0			Mohms
15 Dielectric Withstanding Voltage		650 VRMS for 2 seconds			VAC
16 Weight		87.89 (3.1)			g (oz)
17 Leadwire		AWG #28, UL3265 (125° C, 150 V)			

Note: All motor data values at 20° C unless otherwise specified
 * Engergize at rated current, 2-Phase On



60L024B

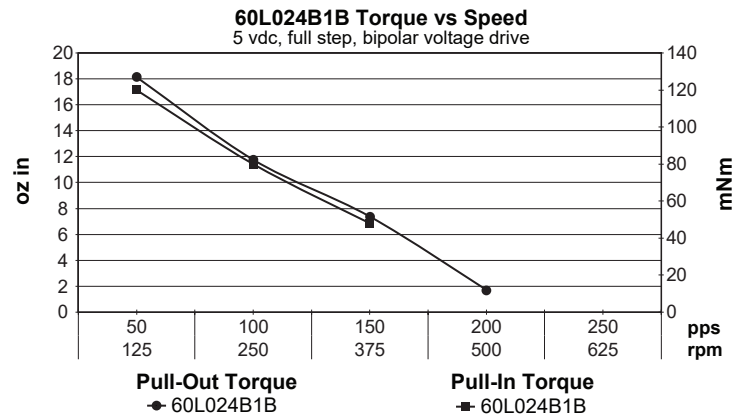
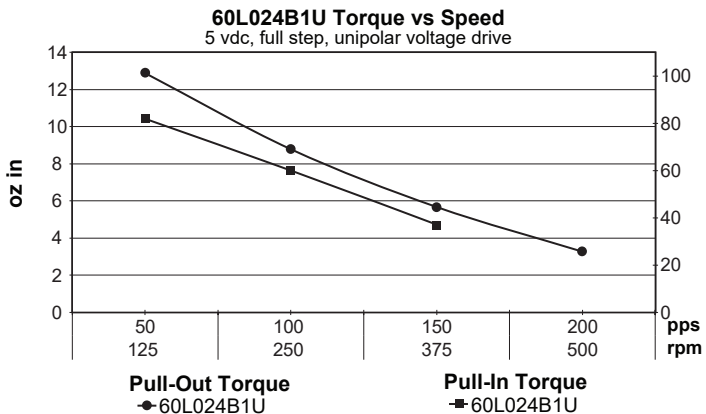
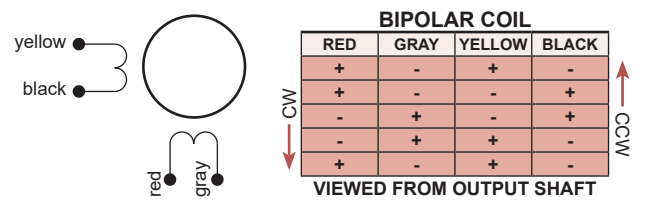
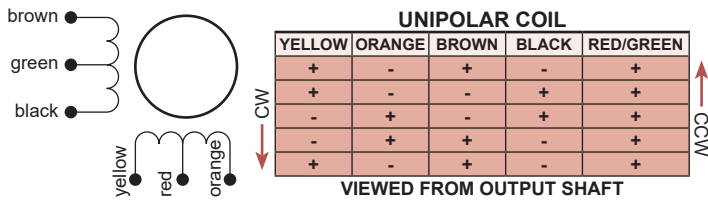
Ø 60 mm • RoHS Compliant • 169.5 mNm



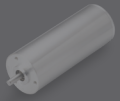
Dimensions in mm [inches]

Electrical Data	60L024B••				Unit
	1U Unipolar	2U Unipolar	1B Bipolar	2B Bipolar	
1 Operating Voltage	5	12	5	12	VDC
2 Resistance per Phase, ± 10%	4.6	26.2	4.6	26.2	Ohms
3 Inductance per Phase, typ	6.0	32.0	11.5	65.0	mH
4 Rated Current per Phase *	1.09	0.46	1.09	0.46	A
Coil Independent Parameters					
5 Holding Torque, MIN *	130.64 (18.5)	130.64 (18.5)	169.48 (24)	169.48 (24)	mNm (oz-in)
6 Detent Torque, Max	28.25 (4)				mNm (oz-in)
7 Rotor Inertia	95 (0.52)				gcm ² (oz-in ²)
8 Step Angle	15.0				Degree
9 Absolute accuracy 2 ph. On, Full step	± 1				Degree
10 Steps per Revolution	24				
11 Ambient Temp Range (operating)	-20 to +70 (-4 to +158)				°C (°F)
12 Maximum Coil Temperature	130 (266)				°C (°F)
13 Bearing Type	Sintered Bronze Sleeve				
14 Insulation Resistance at 500 VDC	100				Mohms
15 Dielectric Withstanding Voltage	650 VRMS for 2 seconds				VAC
16 Weight	440 (15.5)				g (oz)
17 Leadwire	AWG #24, UL1430 (105° C, 300 V)				

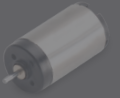
Note: All motor data values at 20° C unless otherwise specified
 * Engergize at rated current, 2-Phase On



A large grid of graph paper for taking notes, consisting of 20 columns and 40 rows of small squares.



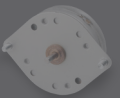
Brushless DC motors



Brush DC motors



Disc magnet motors



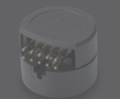
Can stack motors



Can stack linear actuators



Gearheads



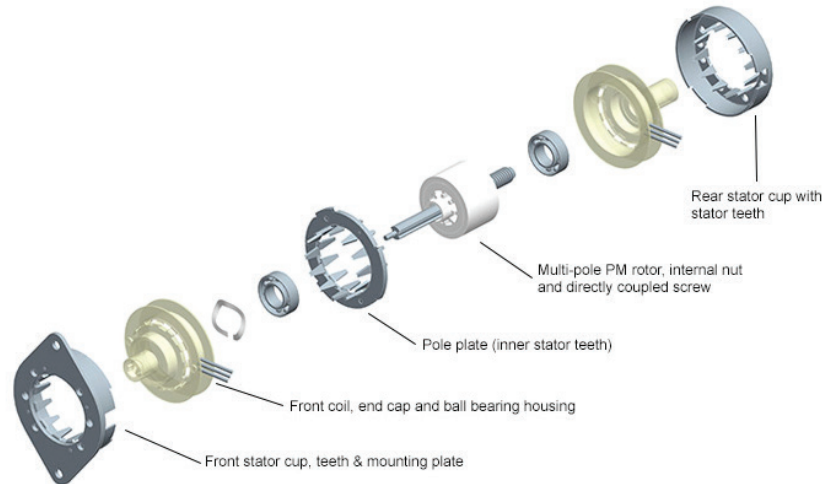
Encoders



Controllers

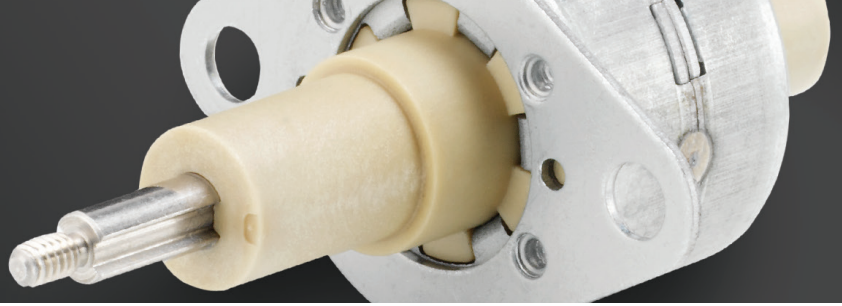
Can Stack Linear Actuators

Provide high linear force and accurate positioning in a small package. Our can stack linear actuators combine a 7.5 or 15 degree stepping can stack motor with an integrated lead screw. By eliminating the need for external gears, belts or separate threaded shafts, these compact linear actuators help lower total costs while increasing the performance and reliability of your machine.



Powerful, Self-Contained Linear Motion

Feature	Details	Application Advantages
Can stack design with built-in lead screw	<ul style="list-style-type: none"> • No need for separate transmission components • Reversible • Unipolar or bipolar windings 	<ul style="list-style-type: none"> • Compact, cost-effective control of linear positioning and velocity • Simpler, more reliable machine design • High linear power in compact package • Less maintenance
Operation in single step, half step or microstepping modes	<ul style="list-style-type: none"> • Open-loop, digitally controlled positioning • No need for feedback devices such as encoders 	<ul style="list-style-type: none"> • Reduced machine cost and complexity • Precise resolution to suit almost any application • Quiet operation
Captive and non-captive actuator designs	<ul style="list-style-type: none"> • Anti-rotation can be part of machine design (non-captive) or integrated with the actuator (captive) • Tip of actuator threaded to accept adapters or direct connection to load 	<ul style="list-style-type: none"> • Ease of assembly, longer stroke lengths • Adaptable to application requirements
Brushless commutation	<ul style="list-style-type: none"> • No brushes to wear out or replace 	<ul style="list-style-type: none"> • Long life with minimal maintenance • Quiet operation
Ball bearings	<ul style="list-style-type: none"> • Long bearing life • Dependable performance in wide range of operating conditions 	<ul style="list-style-type: none"> • Reliable, low-maintenance operation for any application



Medical devices & clinical diagnostics

- Infusion systems
- Diagnostic analyzers
- Medical analyzers
- Pipettes
- Sample preparation workstations
- Dosing and dispensing systems



Instrumentation

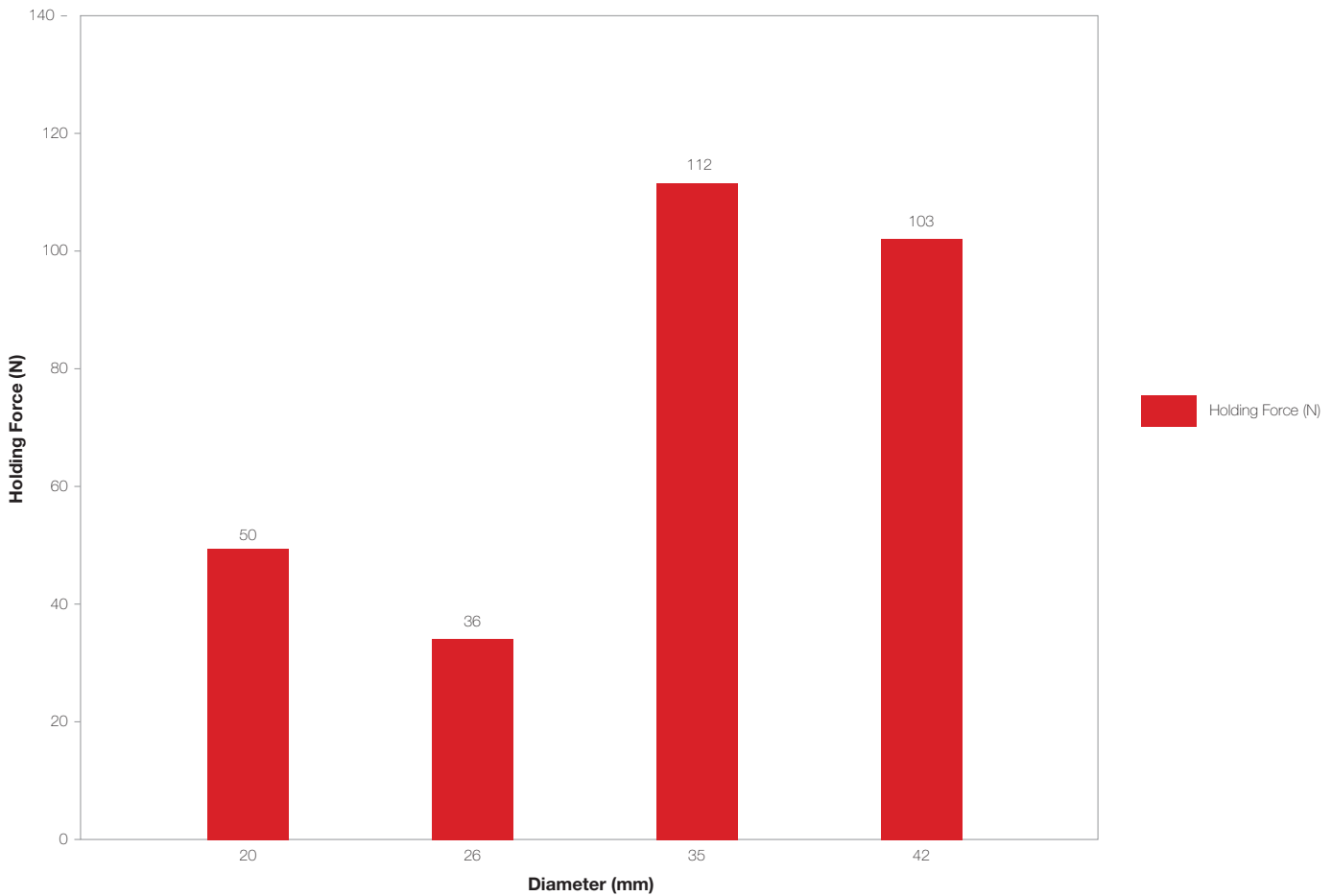
- Land surveying
- Microscopes



Other

- Stage lighting
- Valve actuation
- Security & access

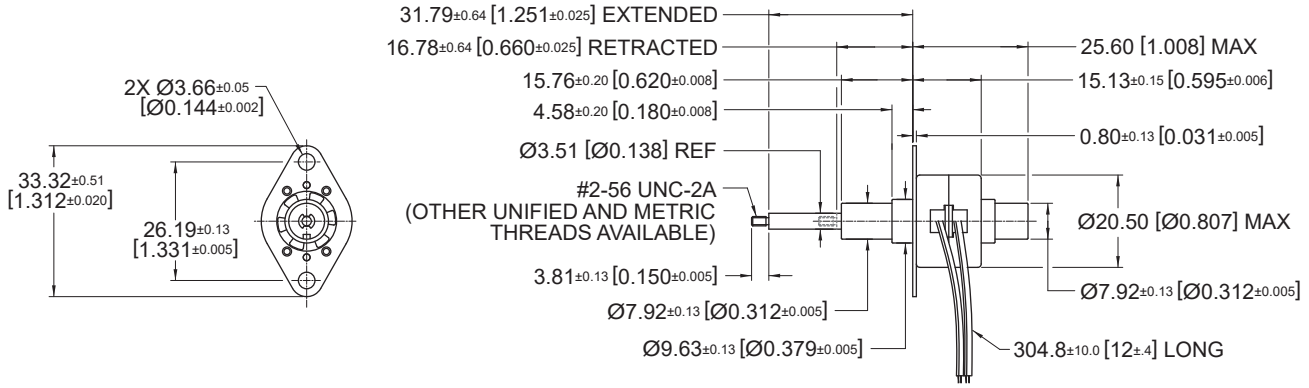
Meet your Application's Working Point Requirements



For complete product and application details, visit portescap.com/linear-actuators

20DAM-K

Ø 20 mm • RoHS Compliant • 30.6 N

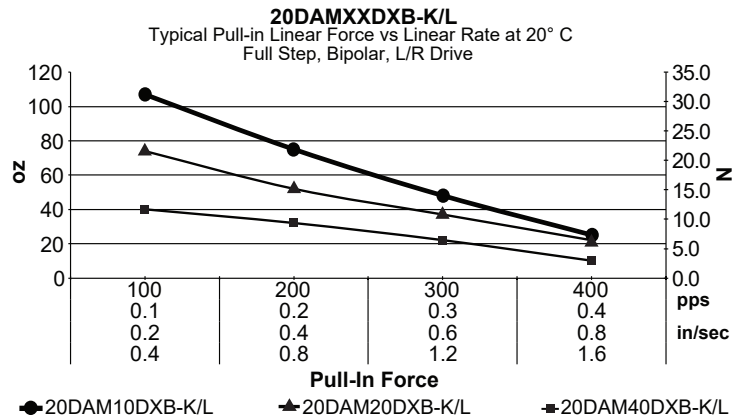
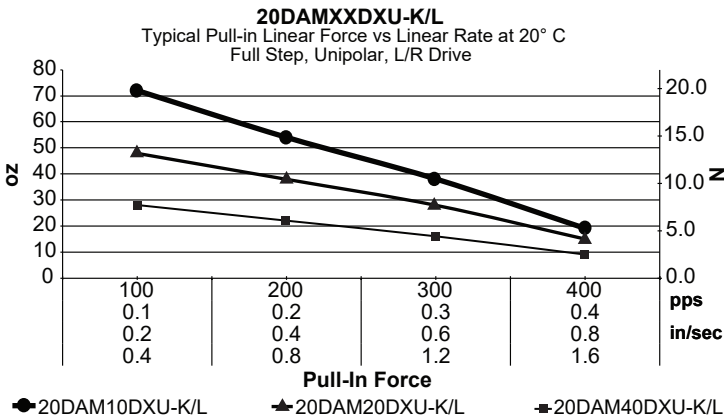
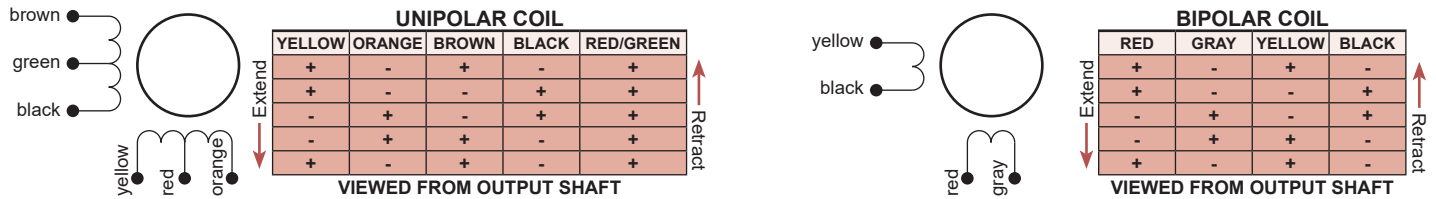


Dimensions in mm [inches]

Electrical Data	20DAMXX●●●-K				Unit
	D1B Bipolar	D2B Bipolar	D1U Unipolar	D2U Unipolar	
1 Operating Voltage #	5	12	5	12	VDC
2 Resistance per Phase, ± 10%	20.0	115.2	20.0	115.2	Ohms
3 Inductance per Phase, typ	7.2	40.8	3.8	20.3	mH
4 Rated Current per Phase, 1 Phase ON	0.35	0.14	0.35	0.14	A
5 Input Power	2.5	2.5	2.5	2.5	W

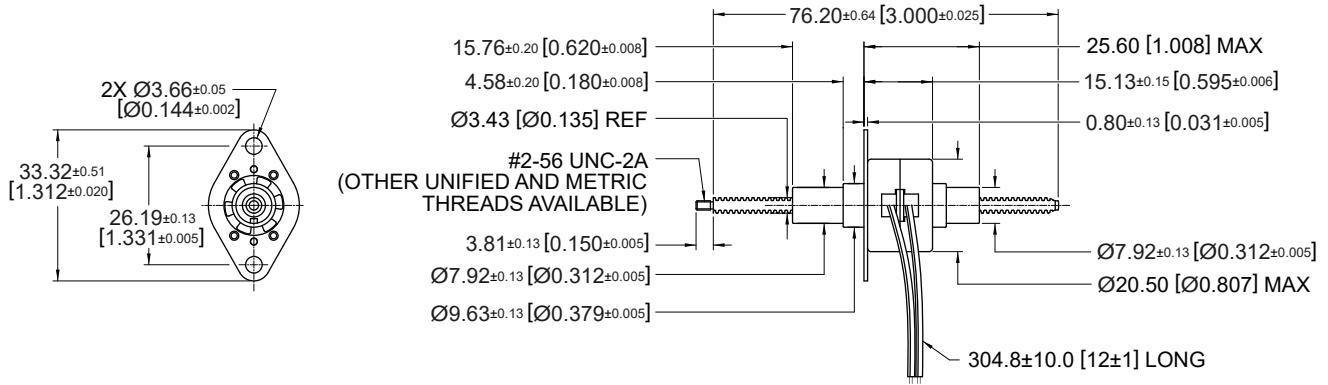
General Data	XX	Linear travel per step	20DAMXX●●●-K		Unit
			D1B Bipolar	D2B Bipolar	
6 Min. Holding Force @ rated current	10	@ .001" (0.0254mm)	30.6 (110)	20.9 (75)	N (oz)
	20	@ .002" (0.0508mm)	20.9 (75)	13.9 (50)	N (oz)
	40	@ .004" (0.1016mm)	11.1 (40)	8.3 (30)	N (oz)
7 Min. Holding Force (Unenergized)	10	@ .001" (0.0254mm)		20.9 (75)	N (oz)
	20	@ .002" (0.0508mm)		11.1 (40)	N (oz)
	40	@ .004" (0.1016mm)		2.8 (10)	N (oz)
8 Stroke Length, Typ				15 (0.59)	mm (in)
9 Linear Travel Accuracy				± 1 Step	
10 Steps per Revolution				24	
11 Ambient Temperature Range (operating)				-20 to +70 (-4 to +158)	°C (°F)
12 Maximum Coil Temperature				130 (266)	°C (°F)
13 Bearing Type				Ball Bearing	
14 Insulation Resistance at 500 VDC				20	Mohms
15 Dielectric Withstanding Voltage				650 for 2 seconds	VAC
16 Weight				25 (0.88)	g (oz)
17 Leadwire				AWG #28, UL1429 (80° C, 150 V)	

Notes: 1. All motor data values at 20° C unless otherwise specified – 2. # Voltage in case of voltage driver (indicator R•I)



20DAM-L

Ø 20 mm • RoHS Compliant • 30.6 N

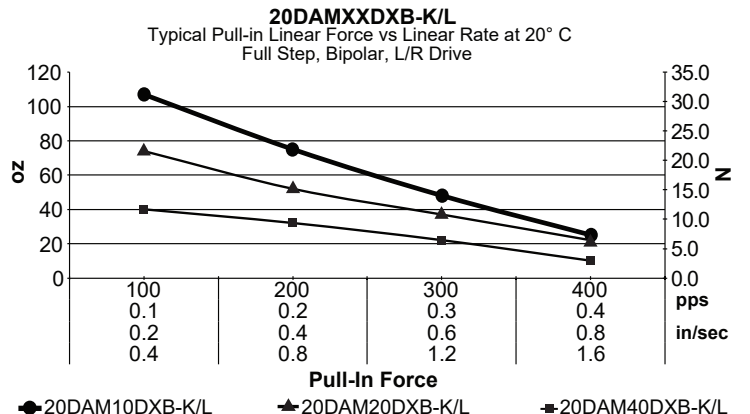
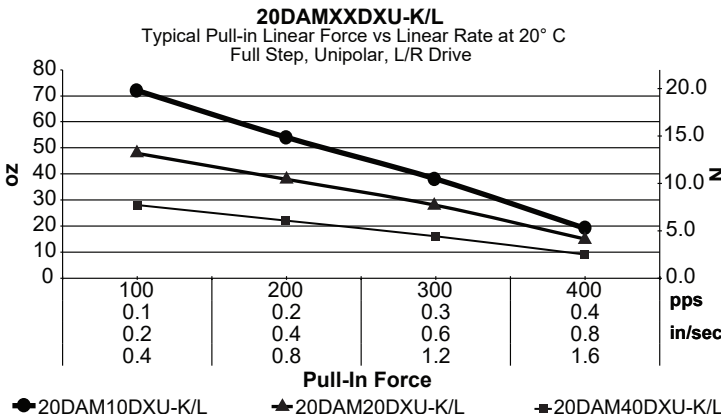
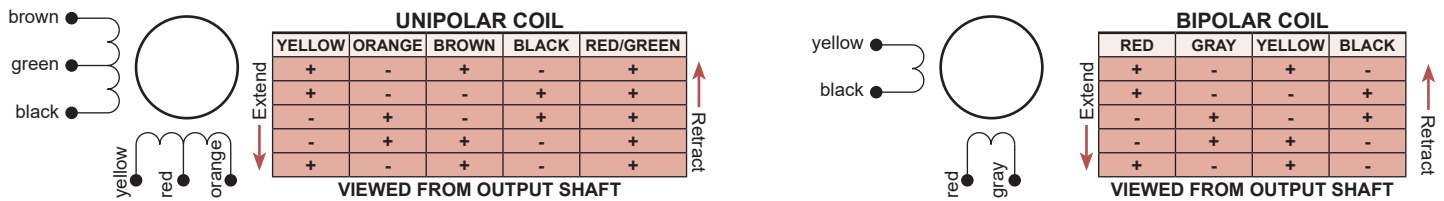


Dimensions in mm [inches]

Electrical Data	20DAMXX●●●-L				Unit
	D1B Bipolar	D2B Bipolar	D1U Unipolar	D2U Unipolar	
1 Operating Voltage #	5	12	5	12	VDC
2 Resistance per Phase, ± 10%	20.0	115.2	20.0	115.2	Ohms
3 Inductance per Phase, typ	7.2	40.8	3.8	20.3	mH
4 Rated Current per Phase, 1 Phase ON	0.35	0.14	0.35	0.14	A
5 Input Power	2.5	2.5	2.5	2.5	W

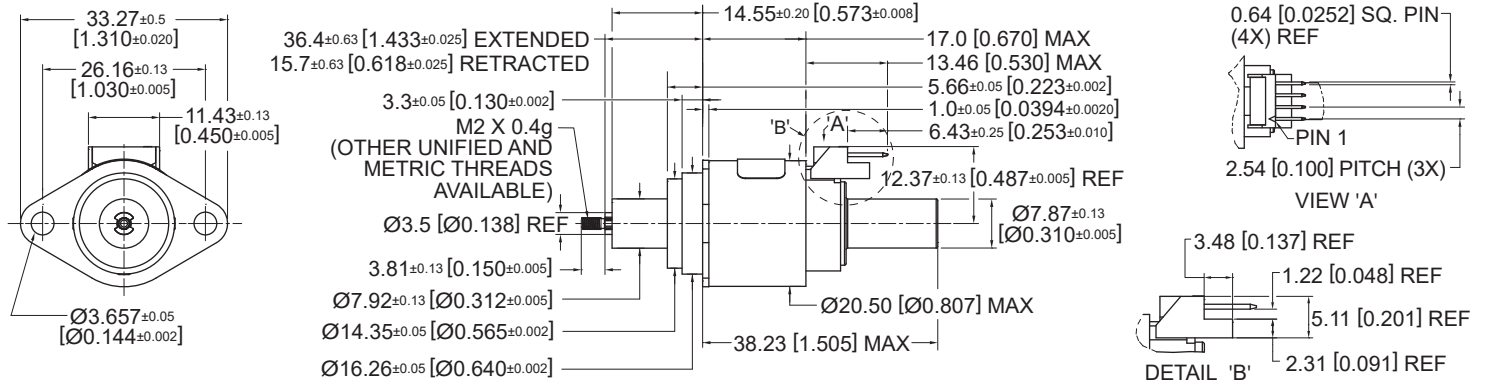
General Data	XX	Linear travel per step	20DAMXX●●●-L				Unit
			D1B Bipolar	D2B Bipolar	D1U Unipolar	D2U Unipolar	
6 Min. Holding Force @ rated current	10	@ .001" (0.0254mm)	30.6 (110)		20.9 (75)		N (oz)
	20	@ .002" (0.0508mm)	20.9 (75)		13.9 (50)		N (oz)
	40	@ .004" (0.1016mm)	11.1 (40)		8.3 (30)		N (oz)
7 Min. Holding Force (Unenergized)	10	@ .001" (0.0254mm)		20.9 (75)			N (oz)
	20	@ .002" (0.0508mm)		11.1 (40)			N (oz)
	40	@ .004" (0.1016mm)		2.8 (10)			N (oz)
8 Stroke Length, Typ				50 (1.97)			mm (in)
9 Linear Travel Accuracy				± 1 Step			
10 Steps per Revolution				24			
11 Ambient Temperature Range (operating)				-20 to +70 (-4 to +158)			°C (°F)
12 Maximum Coil Temperature				130 (266)			°C (°F)
13 Bearing Type				Ball Bearing			
14 Insulation Resistance at 500 VDC				20			Mohms
15 Dielectric Withstanding Voltage				650 for 2 seconds			VAC
16 Weight				25 (0.88)			g (oz)
17 Leadwire				AWG #28, UL1429 (80° C, 150 V)			

Notes: 1. All motor data values at 20° C unless otherwise specified – 2. # Voltage in case of voltage driver (indicator R+I)



20DBM-K

Ø 20 mm • RoHS Compliant • 50 N

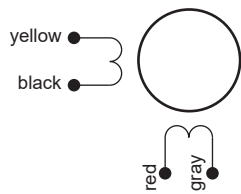


Dimensions in mm [inches]

Electrical Data	20DBMXX•••-K				Unit
	D2B Bipolar	D1B Bipolar	D3B Bipolar	D4B Bipolar	
1 Operating Voltage #	12	5	2.9	1.4	VDC
2 Resistance per Phase, ± 10%	100.5	17.5	5.7	1.4	Ohms
3 Inductance per Phase, typ	45.0	7.0	2.4	0.6	mH
4 Rated Current per Phase, 1 Phase ON	0.17	0.41	0.71	1.41	A
5 Input Power	2.9	2.9	2.9	2.9	W

General Data	XX	Linear travel per step		
6 Min. Holding Force @ rated current	05	@ .0005" (0.0127mm)	50 (180)	N (oz)
	10	@ .001" (0.0254mm)	35 (126)	N (oz)
	20	@ .002" (0.0508mm)	22 (79)	N (oz)
7 Min. Holding Force (Unenergized)	05	@ .0005" (0.0127mm)	50 (180)	N (oz)
	10	@ .001" (0.0254mm)	13.9 (50)	N (oz)
	20	@ .002" (0.0508mm)	5.5 (20)	N (oz)
8 Stroke Length, Typ			20 (0.79)	mm (in)
9 Linear Travel Accuracy			± 1 Step	
10 Steps per Revolution			48	
11 Ambient Temperature Range (operating)			-20 to +70 (-4 to +158)	°C (°F)
12 Maximum Coil Temperature			130 (266)	°C (°F)
13 Bearing Type			Ball Bearing	
14 Insulation Resistance at 500 VDC			20	Mohms
15 Dielectric Withstanding Voltage			650 for 2 seconds	VAC
16 Weight			35 (1.23)	g (oz)
17 Leadwire				

Notes: 1. All motor data values at 20° C unless otherwise specified – 2. # Voltage in case of voltage driver (indicator R•I)

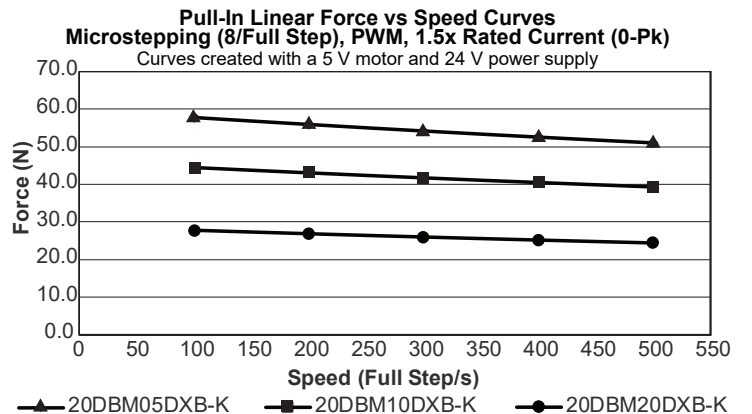
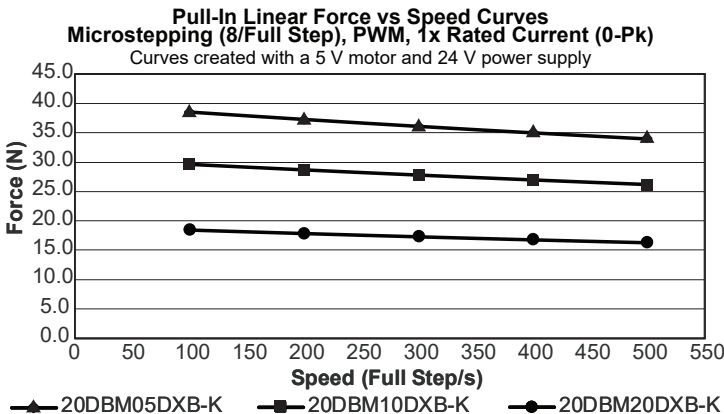


BIPOLAR COIL

	RED	GRAY	YELLOW	BLACK	
Extend ↑	+	-	+	-	↓ Retract
	+	-	-	+	
	-	+	-	+	
	-	+	+	-	
	+	-	+	-	

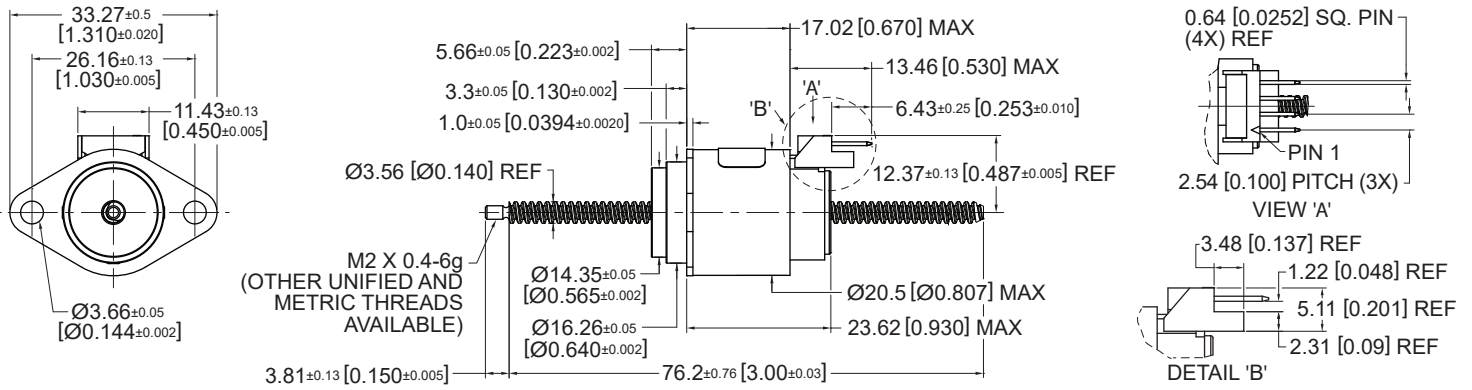
VIEWED FROM OUTPUT SHAFT

PIN#	COIL	LEADWIRE
1	Front Start	Yellow
2	Front End	Black
3	Rear End	Gray
4	Rear Start	Red



20DBM-L

Ø 20 mm • RoHS Compliant • 50 N

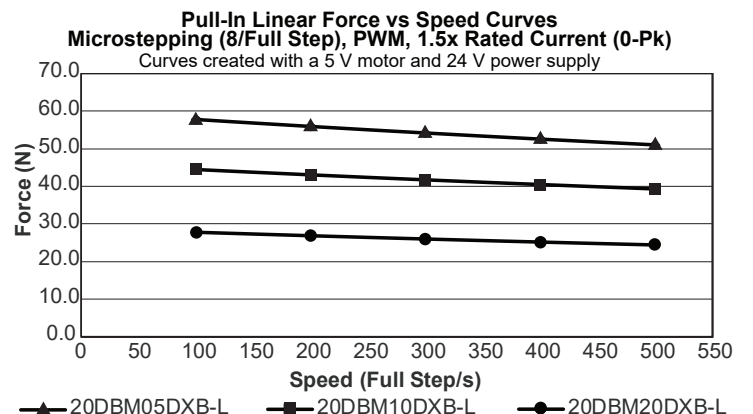
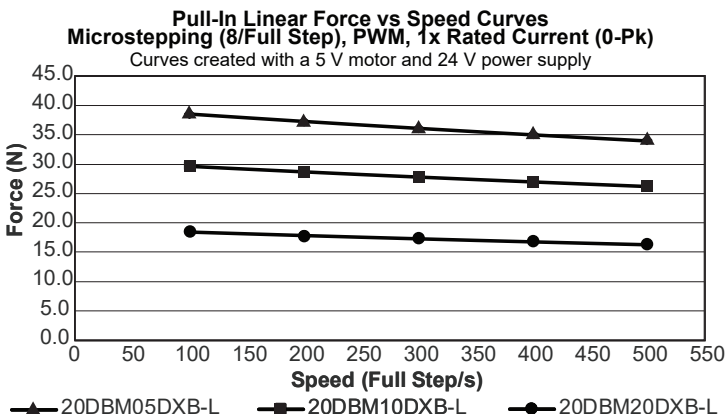
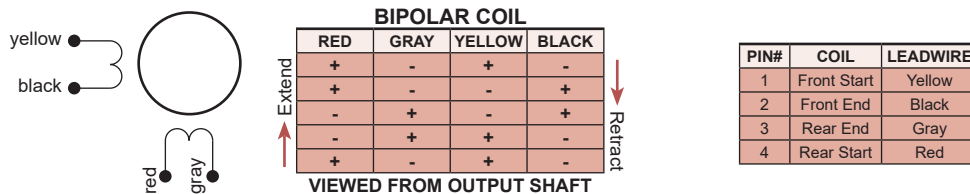


Dimensions in mm [inches]

Electrical Data	20DBMXX●●●-L				Unit
	D2B Bipolar	D1B Bipolar	D3B Bipolar	D4B Bipolar	
1 Operating Voltage #	12	5	2.9	1.4	VDC
2 Resistance per Phase, ± 10%	100.5	17.5	5.7	1.4	Ohms
3 Inductance per Phase, typ	45.0	7.0	2.4	0.6	mH
4 Rated Current per Phase, 1 Phase ON	0.17	0.41	0.71	1.41	A
5 Input Power	2.9	2.9	2.9	2.9	W

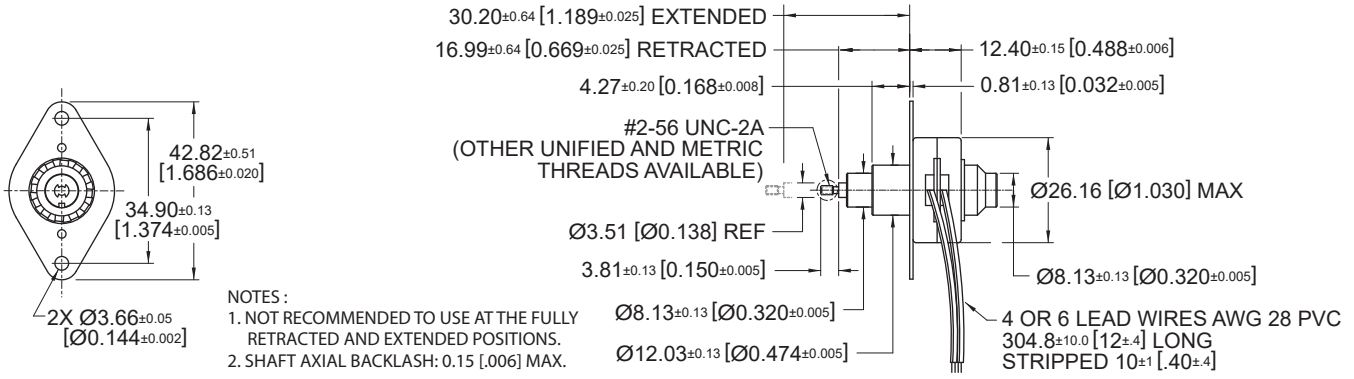
General Data	XX	Linear travel per step	20DBMXX●●●-L			
			D2B Bipolar	D1B Bipolar	D3B Bipolar	D4B Bipolar
6 Min. Holding Force @ rated current	05	@ .0005" (0.0127mm)	50 (180)	35 (126)	22 (79)	15 (53)
	10	@ .001" (0.0254mm)				
	20	@ .002" (0.0508mm)				
7 Min. Holding Force (Unenergized)	05	@ .0005" (0.0127mm)	50 (180)	13.9 (50)	5.5 (20)	3.5 (125)
	10	@ .001" (0.0254mm)				
	20	@ .002" (0.0508mm)				
8 Stroke Length, Typ			50 (1.97)			
9 Linear Travel Accuracy			± 1 Step			
10 Steps per Revolution			48			
11 Ambient Temperature Range (operating)			-20 to +70 (-4 to +158)			
12 Maximum Coil Temperature			130 (266)			
13 Bearing Type			Ball Bearing			
14 Insulation Resistance at 500 VDC			20			
15 Dielectric Withstanding Voltage			650 for 2 seconds			
16 Weight			35 (1.23)			
17 Leadwire						

Notes: 1. All motor data values at 20° C unless otherwise specified – 2. # Voltage in case of voltage driver (indicator R=1)



26DAM-K

Ø 26 mm • RoHS Compliant • 33.4 N

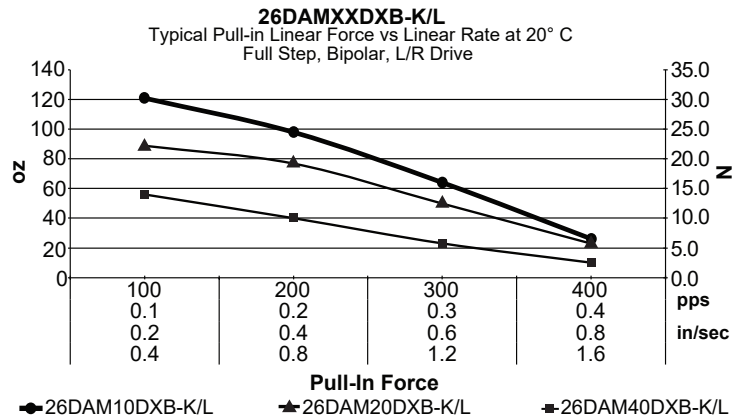
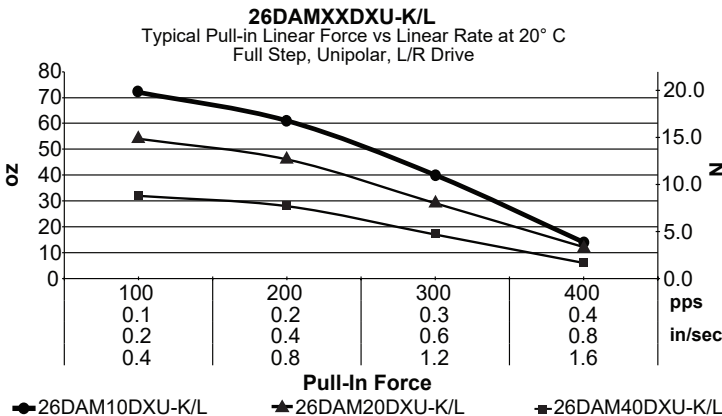
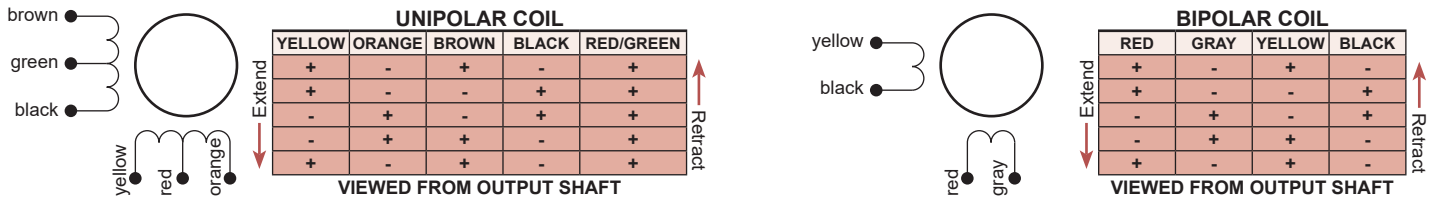


Dimensions in mm [inches]

Electrical Data	26DAMXX•••-K				Unit
	D1B Bipolar	D2B Bipolar	D1U Unipolar	D2U Unipolar	
1 Operating Voltage #	5	12	5	12	VDC
2 Resistance per Phase, ± 10%	14.6	84.0	14.6	84.0	Ohms
3 Inductance per Phase, typ	6.5	33.6	3.8	20.5	mH
4 Rated Current per Phase, 1 Phase ON	0.48	0.20	0.48	0.20	A
5 Input Power	3.4	3.4	3.4	3.4	W

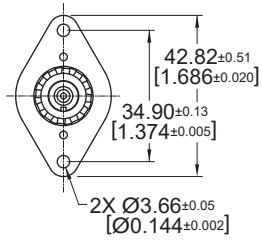
General Data	XX	Linear travel per step	26DAMXX•••-K		Unit	
			D1B Bipolar	D2B Bipolar		D1U Unipolar
6 Min. Holding Force @ rated current	10	@ .001" (0.0254mm)	33.4 (120)		20 (72)	N (oz)
	20	@ .002" (0.0508mm)	25 (90)		15.3 (55)	N (oz)
	40	@ .004" (0.1016mm)	14.5 (52)		8.9 (32)	N (oz)
7 Min. Holding Force (Unenergized)	10	@ .001" (0.0254mm)		20 (72)		N (oz)
	20	@ .002" (0.0508mm)		13.9 (50)		N (oz)
	40	@ .004" (0.1016mm)		5.56 (20)		N (oz)
8 Stroke Length, Typ				13.2 (0.52)		mm (in)
9 Linear Travel Accuracy				± 1 Step		
10 Steps per Revolution				24		
11 Ambient Temperature Range (operating)				-20 to +70 (-4 to +158)		°C (°F)
12 Maximum Coil Temperature				130 (266)		°C (°F)
13 Bearing Type				Ball Bearing		
14 Insulation Resistance at 500 VDC				20		Mohms
15 Dielectric Withstanding Voltage				650 for 2 seconds		VAC
16 Weight				34 (1.2)		g (oz)
17 Leadwire				AWG #28, UL1429 (80° C, 150 V)		

Notes: 1. All motor data values at 20° C unless otherwise specified – 2. # Voltage in case of voltage driver (indicator R•I)

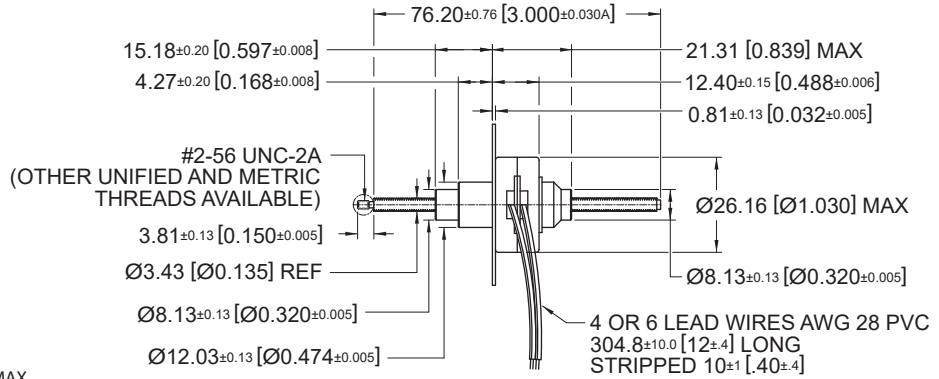


26DAM-L

Ø 26 mm • RoHS Compliant • 33.4 N



NOTE: SHAFT AXIAL BACKLASH : 0.15 [.006] MAX.

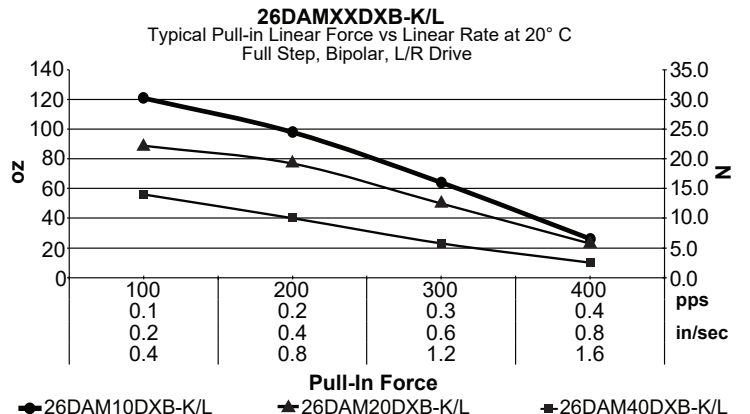
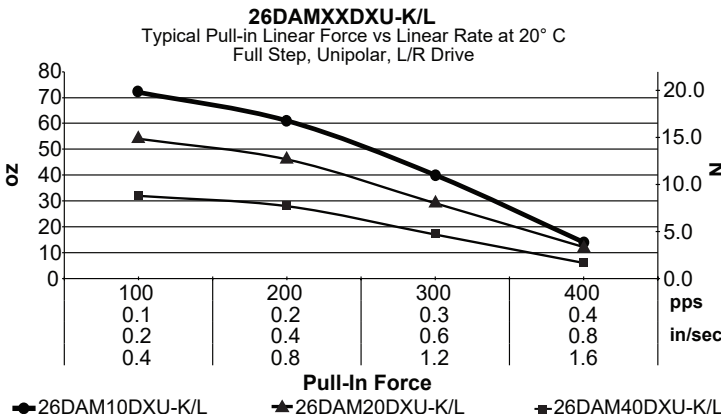
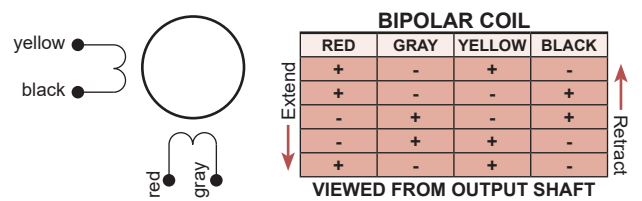
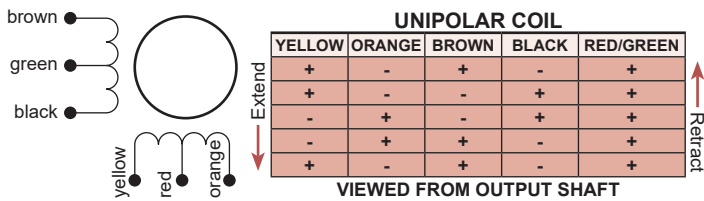


Dimensions in mm [inches]

Electrical Data	26DAMXX●●●-L				Unit
	D1B Bipolar	D2B Bipolar	D1U Unipolar	D2U Unipolar	
1 Operating Voltage #	5	12	5	12	VDC
2 Resistance per Phase, ± 10%	14.6	84.0	14.6	84.0	Ohms
3 Inductance per Phase, typ	6.5	33.6	3.8	20.5	mH
4 Rated Current per Phase, 1 Phase ON	0.48	0.20	0.48	0.20	A
5 Input Power	3.4	3.4	3.4	3.4	W

General Data	XX	Linear travel per step	26DAMXX●●●-L		Unit
			D1B Bipolar	D2B Bipolar	
6 Min. Holding Force @ rated current	10	@ .001" (0.0254mm)	33.4 (120)	20 (72)	N (oz)
	20	@ .002" (0.0508mm)	25 (90)	15.3 (55)	N (oz)
	40	@ .004" (0.1016mm)	14.5 (52)	8.9 (32)	N (oz)
7 Min. Holding Force (Unenergized)	10	@ .001" (0.0254mm)		20 (72)	N (oz)
	20	@ .002" (0.0508mm)		13.9 (50)	N (oz)
	40	@ .004" (0.1016mm)		5.56 (20)	N (oz)
8 Stroke Length, Typ				48 (1.89)	mm (in)
9 Linear Travel Accuracy				± 1 Step	
10 Steps per Revolution				24	
11 Ambient Temperature Range (operating)				-20 to +70 (-4 to +158)	°C (°F)
12 Maximum Coil Temperature				130 (266)	°C (°F)
13 Bearing Type				Ball Bearing	
14 Insulation Resistance at 500 VDC				20	Mohms
15 Dielectric Withstanding Voltage				650 for 2 seconds	VAC
16 Weight				34 (1.2)	g (oz)
17 Leadwire				AWG #28, UL1429 (80° C, 150 V)	

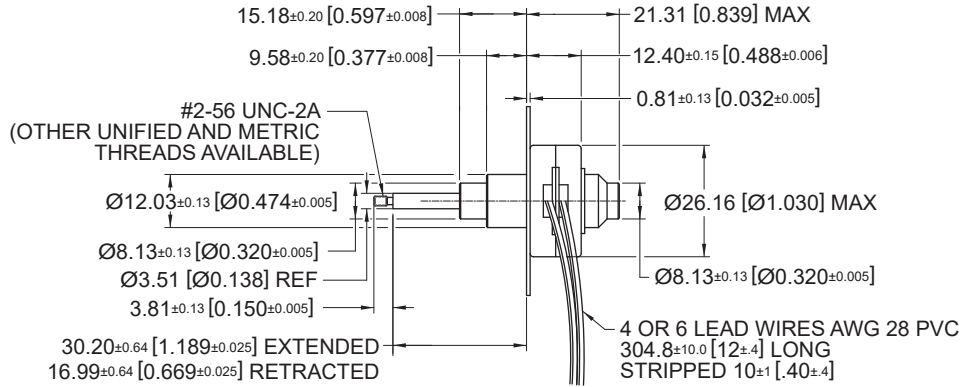
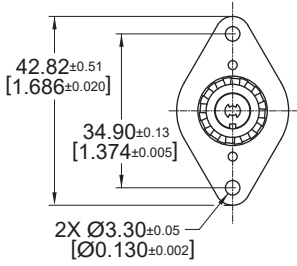
Notes: 1. All motor data values at 20° C unless otherwise specified – 2. # Voltage in case of voltage driver (indicator R=1)



26DBM-K

Ø 26 mm • RoHS Compliant • 35.6 N

- NOTES:
1. NOT RECOMMENDED TO USE AT THE FULLY RETRACTED AND EXTENDED POSITIONS.
2. SHAFT AXIAL BACKLASH: 0.15 [0.006] MAX.

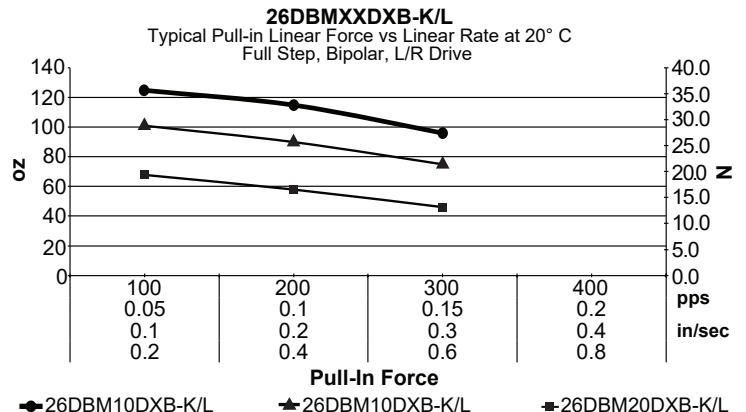
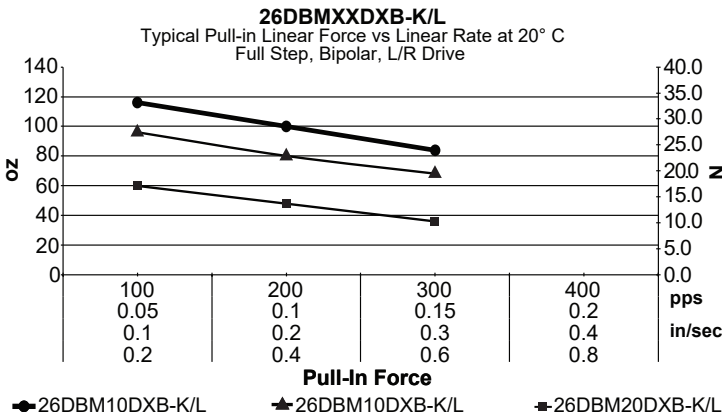
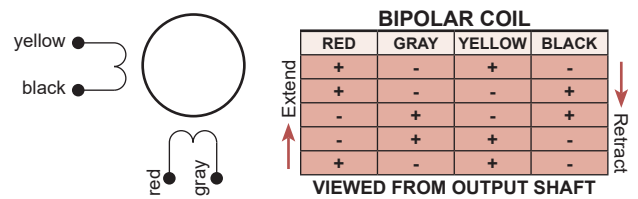
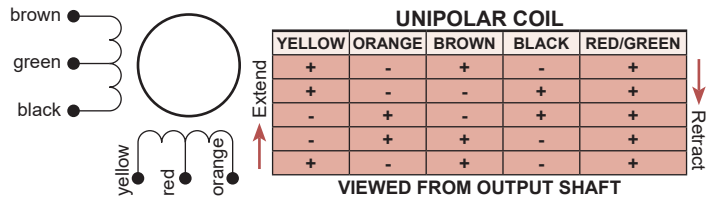


Dimensions in mm [inches]

Electrical Data	26DBMXX●●●-K				Unit
	D1B Bipolar	D2B Bipolar	D1U Unipolar	D2U Unipolar	
1 Operating Voltage #	5	12	5	12	VDC
2 Resistance per Phase, ± 10%	14.6	84.0	14.6	84.0	Ohms
3 Inductance per Phase, typ	8.4	43.3	5.0	26.5	mH
4 Rated Current per Phase, 1 Phase ON	0.48	0.20	0.48	0.20	A
5 Input Power	3.4	3.4	3.4	3.4	W

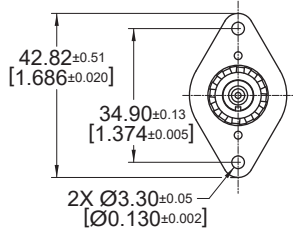
General Data	XX	Linear travel per step	26DBMXX●●●-K			
			D1B Bipolar	D2B Bipolar	D1U Unipolar	D2U Unipolar
6 Min. Holding Force @ rated current	05	@ 0.0005" (0.0127mm)	35.6 (128)		34.2 (123)	N (oz)
	10	@ 0.001" (0.0254mm)	28.9 (104)		28.1 (101)	N (oz)
	20	@ 0.002" (0.0508mm)	19.2 (69)		17.8 (64)	N (oz)
7 Min. Holding Force (Unenergized)	05	@ 0.0005" (0.0127mm)		34.2 (123)		N (oz)
	10	@ 0.001" (0.0254mm)		13.9 (50)		N (oz)
	20	@ 0.002" (0.0508mm)		5.5 (20)		N (oz)
8 Stroke Length, Typ				13.2 (0.52)		mm (in)
9 Linear Travel Accuracy				± 1 Step		
10 Steps per Revolution				48		
11 Ambient Temperature Range (operating)				-20 to +70 (-4 to +158)		°C (°F)
12 Maximum Coil Temperature				130 (266)		°C (°F)
13 Bearing Type				Ball Bearing		
14 Insulation Resistance at 500 VDC				20		Mohms
15 Dielectric Withstanding Voltage				650 for 2 seconds		VAC
16 Weight				34 (1.2)		g (oz)
17 Leadwire				AWG #28, UL1429 (80° C, 150 V)		

Notes: 1. All motor data values at 20° C unless otherwise specified – 2. # Voltage in case of voltage driver (indicator R•I)

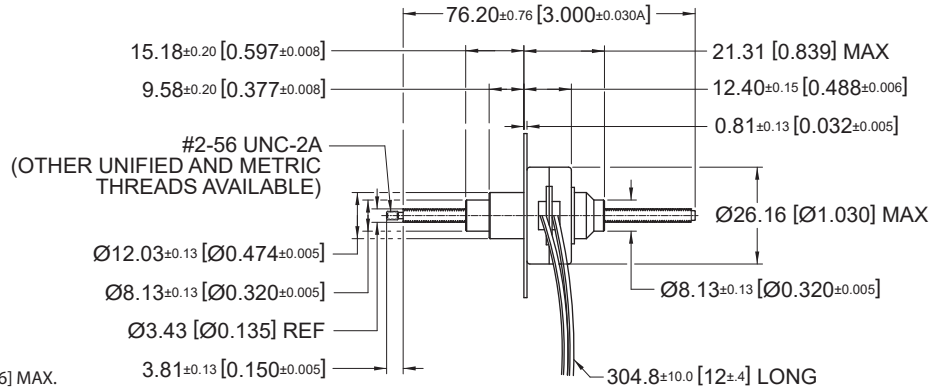


26DBM-L

Ø 26 mm • RoHS Compliant • 35.6 N



NOTE: SHAFT AXIAL BACKLASH : 0.15 [0.006] MAX.

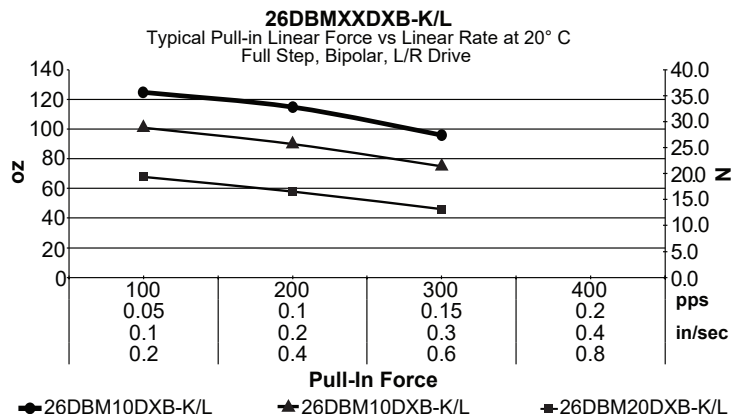
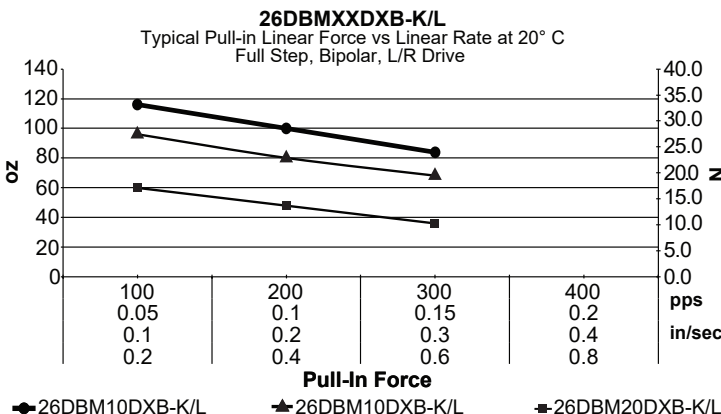
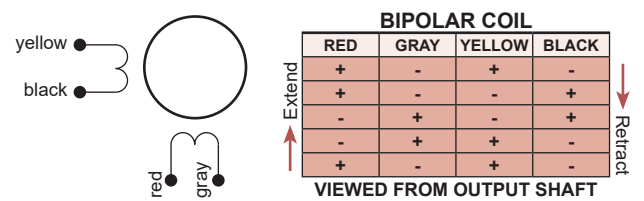
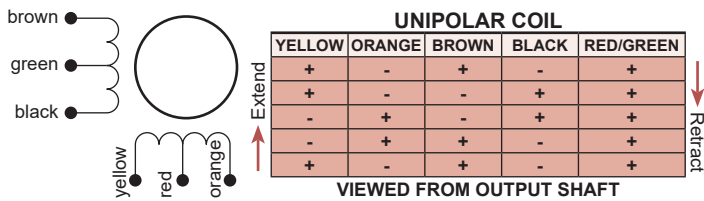


Dimensions in mm [inches]

Electrical Data	26DBMXX●●●-L				Unit
	D1B Bipolar	D2B Bipolar	D1U Unipolar	D2U Unipolar	
1 Operating Voltage #	5	12	5	12	VDC
2 Resistance per Phase, ± 10%	14.6	84.0	14.6	84.0	Ohms
3 Inductance per Phase, typ	8.4	43.3	5.0	26.5	mH
4 Rated Current per Phase, 1 Phase ON	0.48	0.20	0.48	0.20	A
5 Input Power	3.4	3.4	3.4	3.4	W

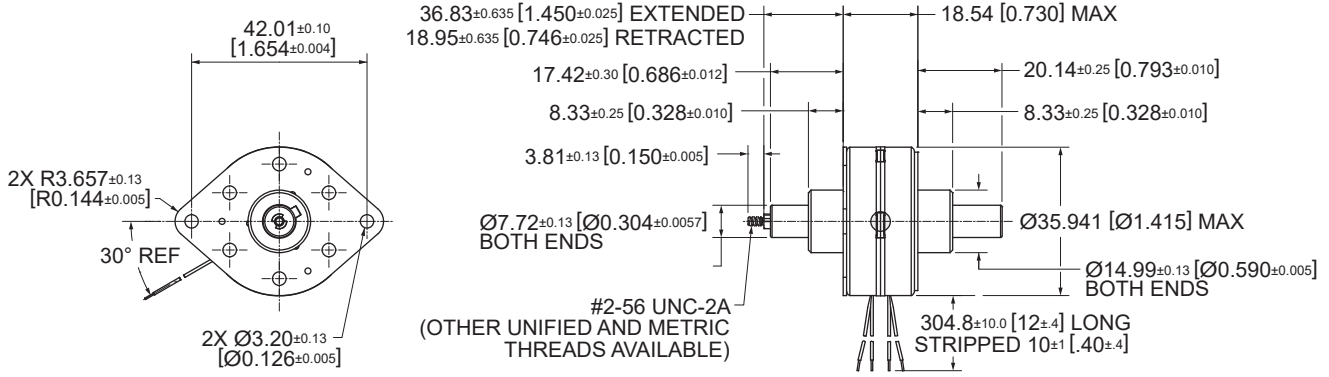
General Data	XX	Linear travel per step	26DBMXX●●●-L		Unit
6 Min. Holding Force @ rated current	05	@ 0.0005" (0.0127mm)	35.6 (128)	34.2 (123)	N (oz)
	10	@ 0.001" (0.0254mm)	28.9 (104)	28.1 (101)	N (oz)
	20	@ 0.002" (0.0508mm)	19.2 (69)	17.8 (64)	N (oz)
7 Min. Holding Force (Unenergized)	05	@ 0.0005" (0.0127mm)		34.2 (123)	N (oz)
	10	@ 0.001" (0.0254mm)		13.9 (50)	N (oz)
	20	@ 0.002" (0.0508mm)		5.5 (20)	N (oz)
8 Stroke Length, Typ				48 (1.89)	mm (in)
9 Linear Travel Accuracy				± 1 Step	
10 Steps per Revolution				48	
11 Ambient Temperature Range (operating)				-20 to +70 (-4 to +158)	°C (°F)
12 Maximum Coil Temperature				130 (266)	°C (°F)
13 Bearing Type				Ball Bearing	
14 Insulation Resistance at 500 VDC				20	Mohms
15 Dielectric Withstanding Voltage				650 for 2 seconds	VAC
16 Weight				34 (1.2)	g (oz)
17 Leadwire				AWG #28, UL1429 (80° C, 150 V)	

Notes: 1. All motor data values at 20° C unless otherwise specified – 2. # Voltage in case of voltage driver (indicator R=1)



35DBM-K

Ø 35 mm • RoHS Compliant • 112 N

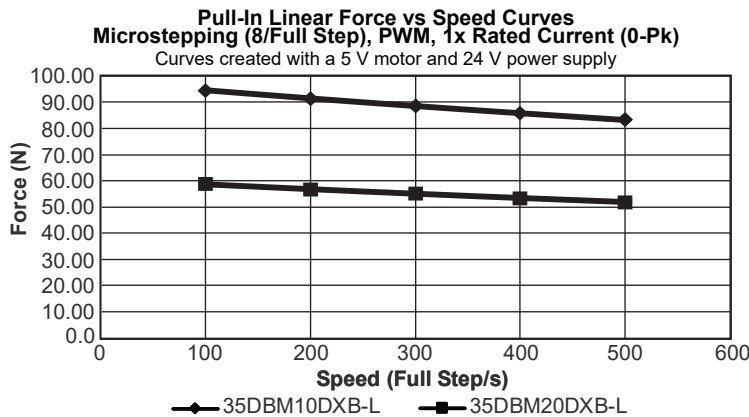
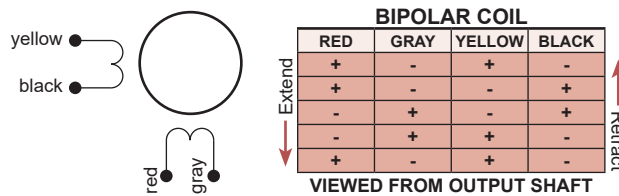


Dimensions in mm [inches]

Electrical Data	35DBMXX●●●-K			Unit
	D1B Bipolar	D2B Bipolar	D3B Bipolar	
1 Operating Voltage #	5	12	2.5	VDC
2 Resistance per Phase, ± 10%	10.0	58.0	2.5	Ohms
3 Inductance per Phase, typ	9.5	51.4	2.4	mH
4 Rated Current per Phase, 1 Phase ON	0.71	0.29	1.41	A
5 Input Power	5.0	5.0	5.0	W

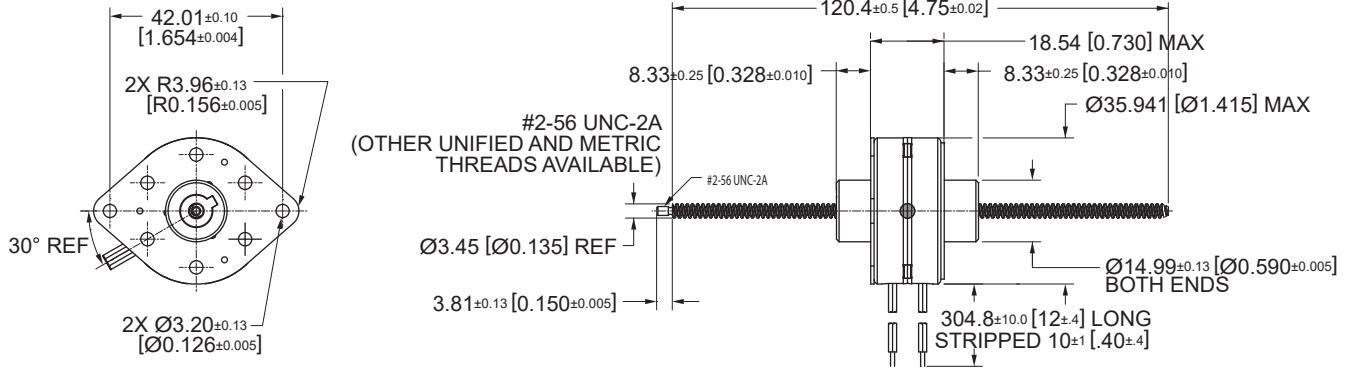
General Data	XX	Linear travel per step		
6 Min. Holding Force @ rated current	10	@ .001" (0.0254mm)	112 (403)	N (oz)
	20	@ .002" (0.0508mm)	70 (252)	N (oz)
7 Min. Holding Force (Unenergized)	10	@ .001" (0.0254mm)	40 (144)	N (oz)
	20	@ .002" (0.0508mm)	10 (36)	N (oz)
8 Stroke Length, Typ			17 (0.67)	mm (in)
9 Linear Travel Accuracy			± 1 Step	
10 Steps per Revolution			48	
11 Ambient Temperature Range (operating)			-20 to +70 (-4 to +158)	°C (°F)
12 Maximum Coil Temperature			130 (266)	°C (°F)
13 Bearing Type			Ball Bearing	
14 Insulation Resistance at 500 VDC			20	Mohms
15 Dielectric Withstanding Voltage			650 for 2 seconds	VAC
16 Weight			85 (3)	g (oz)
17 Leadwire			AWG 26, UL 1429	

Notes: 1. All motor data values at 20° C unless otherwise specified – 2. # Voltage in case of voltage driver (indicator R•)



35DBM-L

Ø 35 mm • RoHS Compliant • 112 N

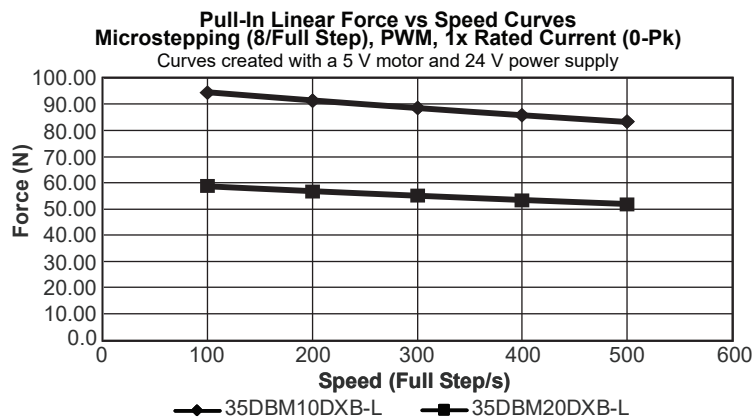
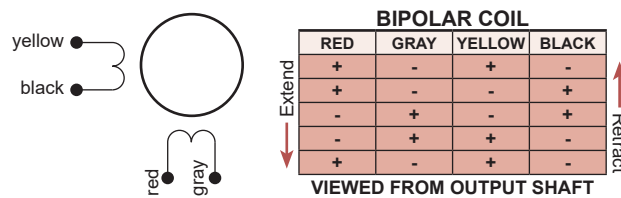


Dimensions in mm [inches]

Electrical Data		35DBMXX●●●-L			Unit
		D1B Bipolar	D2B Bipolar	D3B Bipolar	
1	Operating Voltage #	5	12	2.5	VDC
2	Resistance per Phase, ± 10%	10.0	58.0	2.5	Ohms
3	Inductance per Phase, typ	9.5	51.4	2.4	mH
4	Rated Current per Phase, 1 Phase ON	0.71	0.29	1.41	A
5	Input Power	5.0	5.0	5.0	W

General Data		XX	Linear travel per step		
6	Min. Holding Force @ rated current	10	@ .001" (0.0254mm)	112 (403)	N (oz)
		20	@ .002" (0.0508mm)	70 (252)	N (oz)
7	Min. Holding Force (Unenergized)	10	@ .001" (0.0254mm)	40 (144)	N (oz)
		20	@ .002" (0.0508mm)	10 (36)	N (oz)
8	Stroke Length, Typ			63.5 (2.5)	mm (in)
9	Linear Travel Accuracy			± 1 Step	
10	Steps per Revolution			48	
11	Ambient Temperature Range (operating)			-20 to +70 (-4 to +158)	°C (°F)
12	Maximum Coil Temperature			130 (266)	°C (°F)
13	Bearing Type			Ball Bearing	
14	Insulation Resistance at 500 VDC			20	Mohms
15	Dielectric Withstanding Voltage			650 for 2 seconds	VAC
16	Weight			85 (3)	g (oz)
17	Leadwire			AWG 26, UL 1429	

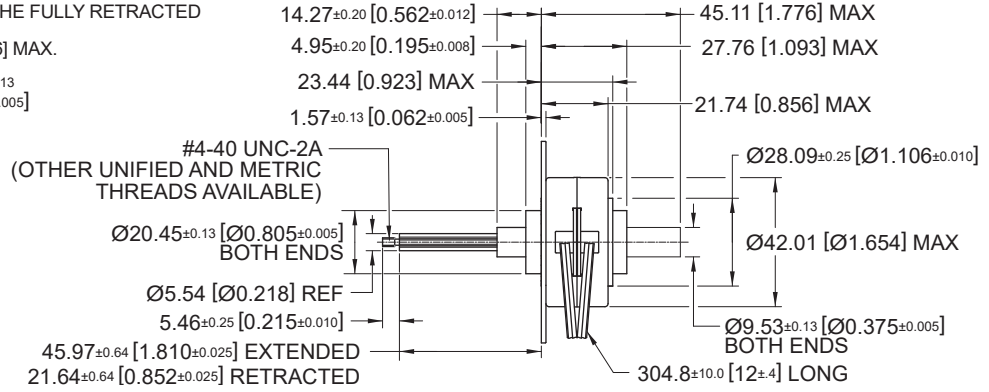
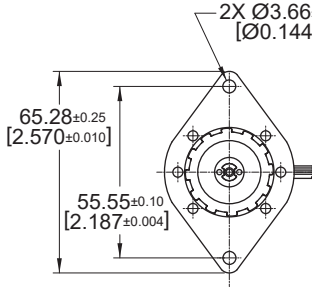
Notes: 1. All motor data values at 20° C unless otherwise specified – 2. # Voltage in case of voltage driver (indicator R=1)



42DBL-K

Ø 42 mm • RoHS Compliant • 102.9 N

1. NOT RECOMMENDED TO USE AT THE FULLY RETRACTED AND EXTENDED POSITIONS.
2. SHAFT AXIAL BACKLASH: 0.15 [0.006] MAX.

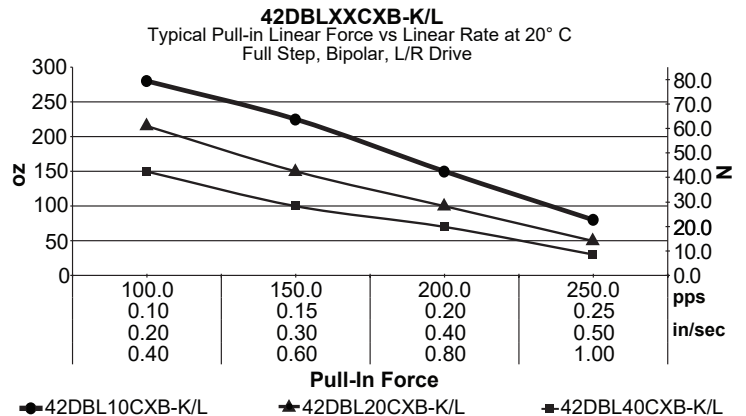
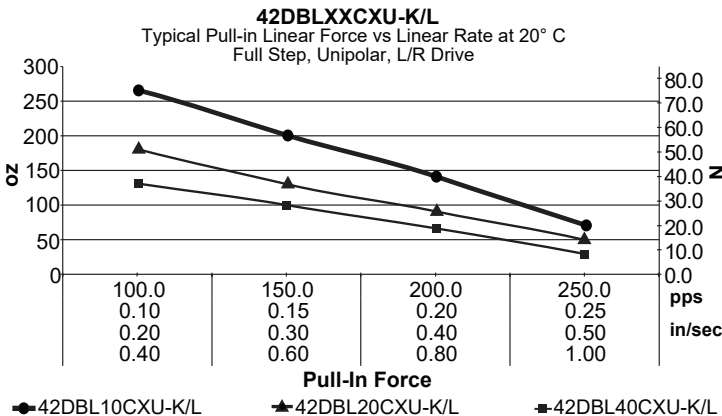
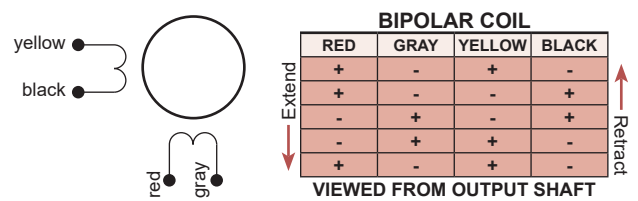
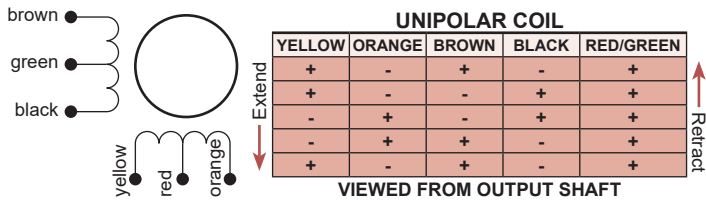


Dimensions in mm [inches]

Electrical Data	42DBLXX●●●-K				Unit
	C1B Bipolar	C2B Bipolar	C1U Unipolar	C2U Unipolar	
1 Operating Voltage #	5	12	5	12	VDC
2 Resistance per Phase, ± 10%	5.0	28.8	5.0	28.8	Ohms
3 Inductance per Phase, typ	5.5	39.3	3.7	15.0	mH
4 Rated Current per Phase, 1 Phase ON	1.41	0.59	1.41	0.59	A
5 Input Power	10.0	10.0	10.0	10.0	W

General Data	XX	Linear travel per step	42DBLXX●●●-K		Unit
			C1B Bipolar	C2B Bipolar	
6 Min. Holding Force @ rated current	10	@ .001" (0.0254mm)	102.9 (370)	100 (360)	N (oz)
	20	@ .002" (0.0508mm)	83.4 (300)	72.3 (260)	N (oz)
	40	@ .004" (0.1016mm)	55.6 (200)	50 (180)	N (oz)
7 Min. Holding Force (Unenergized)	10	@ .001" (0.0254mm)		100 (360)	N (oz)
	20	@ .002" (0.0508mm)		83.4 (300)	N (oz)
	40	@ .004" (0.1016mm)		19.5 (70)	N (oz)
8 Stroke Length, Typ			24.1 (0.95)		mm (in)
9 Linear Travel Accuracy			± 1 Step		
10 Steps per Revolution			48		
11 Ambient Temperature Range (operating)			-20 to +70 (-4 to +158)		°C (°F)
12 Maximum Coil Temperature			130 (266)		°C (°F)
13 Bearing Type			Ball Bearing		
14 Insulation Resistance at 500 VDC			20		Mohms
15 Dielectric Withstanding Voltage			650 for 2 seconds		VAC
16 Weight			156 (5.51)		g (oz)
17 Leadwire			AWG 26, UL 1430		

Notes: 1. All motor data values at 20° C unless otherwise specified – 2. # Voltage in case of voltage driver (indicator R•I)

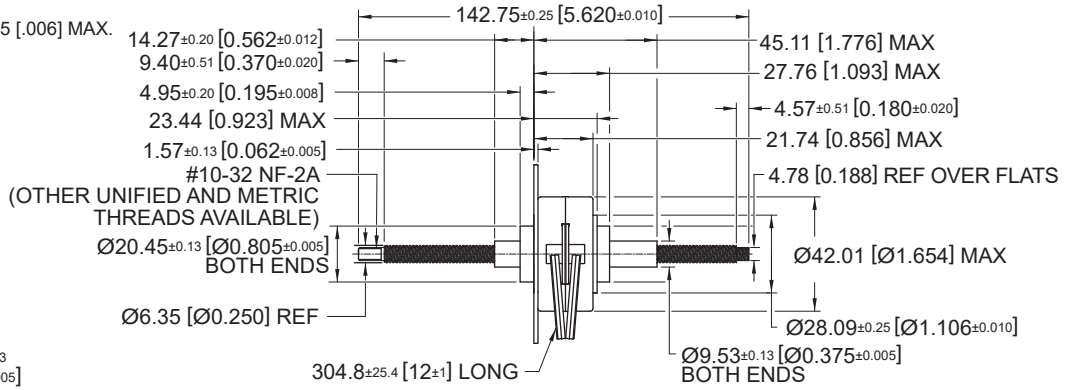
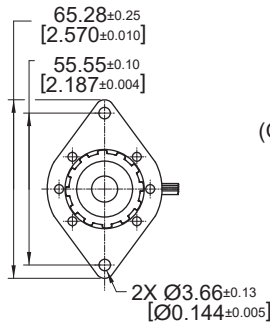


42DBL-L

Ø 42 mm • RoHS Compliant • 102.9 N

NOTES :

1. SHAFT AXIAL BACKLASH : 0.15 [0.006] MAX.

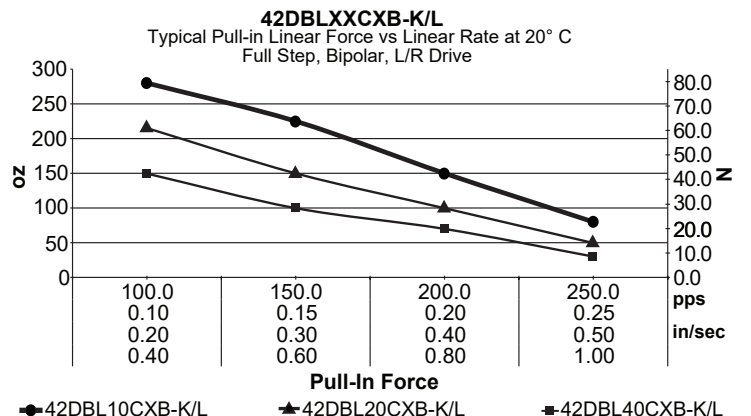
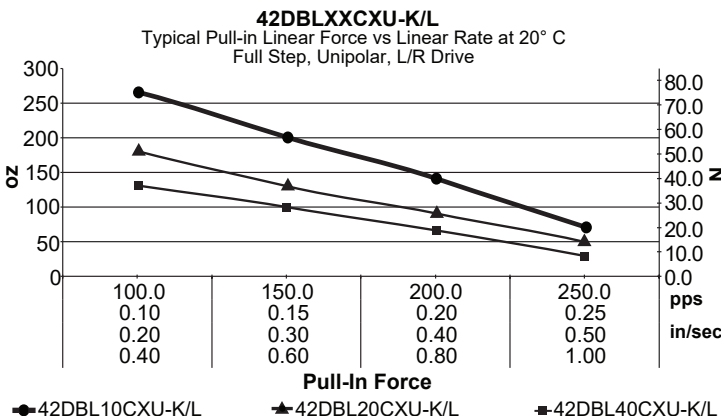
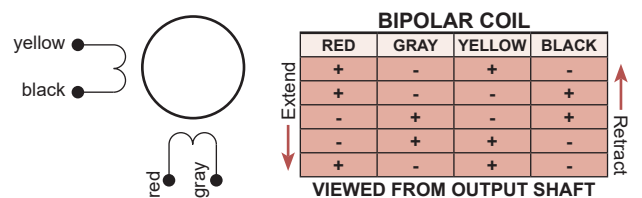
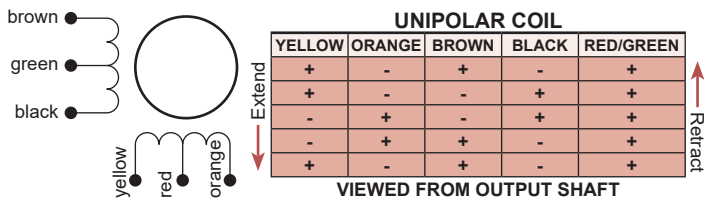


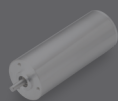
Dimensions in mm [inches]

Electrical Data	42DBLXX...-L				Unit
	C1B Bipolar	C2B Bipolar	C1U Unipolar	C2U Unipolar	
1 Operating Voltage #	5	12	5	12	VDC
2 Resistance per Phase, ± 10%	5.0	28.8	5.0	28.8	Ohms
3 Inductance per Phase, typ	5.5	39.3	3.7	15.0	mH
4 Rated Current per Phase, 1 Phase ON	1.41	0.59	1.41	0.59	A
5 Input Power	10.0	10.0	10.0	10.0	W

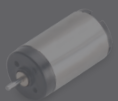
General Data	XX	Linear travel per step	42DBLXX...-L			
			C1B Bipolar	C2B Bipolar	C1U Unipolar	C2U Unipolar
6 Min. Holding Force @ rated current	10 @ .001" (0.0254mm)		102.9 (370)		100 (360)	N (oz)
	20 @ .002" (0.0508mm)		83.4 (300)		72.3 (260)	N (oz)
	40 @ .004" (0.1016mm)		55.6 (200)		50 (180)	N (oz)
7 Min. Holding Force (Unenergized)	10 @ .001" (0.0254mm)			100 (360)		N (oz)
	20 @ .002" (0.0508mm)			83.4 (300)		N (oz)
	40 @ .004" (0.1016mm)			19.5 (70)		N (oz)
8 Stroke Length, Typ				76.2 (3)		mm (in)
9 Linear Travel Accuracy				± 1 Step		
10 Steps per Revolution				48		
11 Ambient Temperature Range (operating)				-20 to +70 (-4 to +158)		°C (°F)
12 Maximum Coil Temperature				130 (266)		°C (°F)
13 Bearing Type				Ball Bearing		
14 Insulation Resistance at 500 VDC				20		Mohms
15 Dielectric Withstanding Voltage				650 for 2 seconds		VAC
16 Weight				156 (5.51)		g (oz)
17 Leadwire				AWG 26, UL 1430		

Notes: 1. All motor data values at 20° C unless otherwise specified – 2. # Voltage in case of voltage driver (indicator R=1)





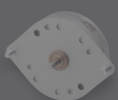
Brushless DC motors



Brush DC motors



Disc magnet motors



Can stack motors



Can stack linear actuators



Gearheads



Encoders

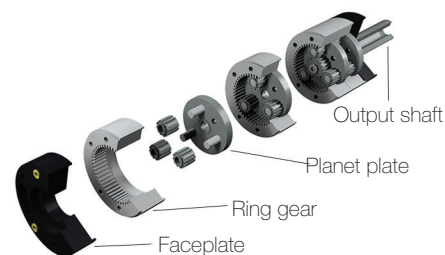


Controllers

Gearheads & Encoders

Gearheads

Gearheads are used between the motor and the load to reduce the speed and/or increase the torque delivered to the load with the best possible efficiency. We offer both planetary and spur gearheads, with each design offering advantages suited to particular applications.

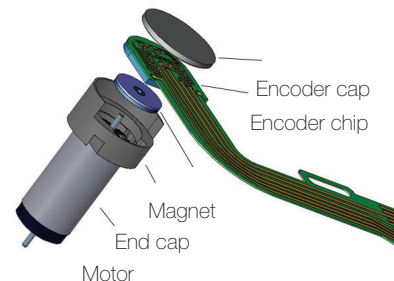


Spur and Planetary Gearheads

Type	Details	Application Advantages
Spur gear concept: Only one transmission point per train	<ul style="list-style-type: none"> • Low friction per train • Multiple trains can be configured to suit design intent • Input and output shaft not necessarily in line • Dual output shafts possible • Direction of rotation can be reversed by using an odd number of reduction stages 	<ul style="list-style-type: none"> • Good efficiency, about 0.9 per train • Long gearbox of smaller diameter or short gearbox of large diameter • Free choice for placing the motor relative to the output shaft • Accommodates mounting of a sensor, potentiometer, etc. • Low noise
Planetary concept: 3 or 4 transmission points per train	<ul style="list-style-type: none"> • Higher reduction ratio per train, with a tradeoff of higher friction • Can transmit higher torques • Input and output of a train have the same direction of rotation • Less backlash 	<ul style="list-style-type: none"> • Higher lifetime due to planetary arrangement • Efficiency about 0.85 per train • Exceptional performance in a very compact gearbox • For any number of trains, the load always rotates in the same direction as the motor • Less shock in case of a rapid reversal of motor rotation

Encoders

Encoders provide feedback for accurate control of speed and positioning. We offer three types – optical, magnetic and magnetoresistive – all featuring a robust design suitable for severe environments. Resolutions from 1 to 1024 lines per revolution are available, with up to 3 channels.



Optical, Magnetic and Magnetoresistive Encoders

Type	Details / Features	Advantages for Application
Optical	<ul style="list-style-type: none"> • Transmissive optical system • 3 Channel (A, B, Z) • Optional line driver 	<ul style="list-style-type: none"> • High accuracy • High line count • Ultra low jitter • Very precise positioning • No sensitivity to external magnetic field
Magnetic: M-Sense	<ul style="list-style-type: none"> • Hall sensor array interpolated • 3 Channel (A, B, Z) • Integrated RS422 line driver 	<ul style="list-style-type: none"> • Integrated design • High line count • High resolution in a compact design and low diameter • Long commutation lines can be handled between encoder and driver • Axial and radial cable output
Magnetic: MR2	<ul style="list-style-type: none"> • Magnetoresistive sensor interpolated • 3 Channel (A, B, Z) • Integrated design 	<ul style="list-style-type: none"> • Compact design • High line count • Insensitive to temperature • Very low sensitivity to unwanted external field • High resolution in a shorter length
Magnetic: Type D/F	<ul style="list-style-type: none"> • Digital Hall sensor (not interpolated) • 2 Channel (A, B) • Insensitive to hostile environment 	<ul style="list-style-type: none"> • Compact design • Negligible unit length increase for Type F • Very low current consumption • Very low power consumption • Gamma ray-proof version available on request



Gearheads and Encoders for any Miniature Application



Medical devices & clinical diagnostics

- Surgical hand tools
- Laboratory automation
- Infusion systems
- Insulin pumps
- Medical analyzers
- Sample preparation workstations



Aerospace

- Surveillance camera systems
- Seat actuation
- Valve actuation

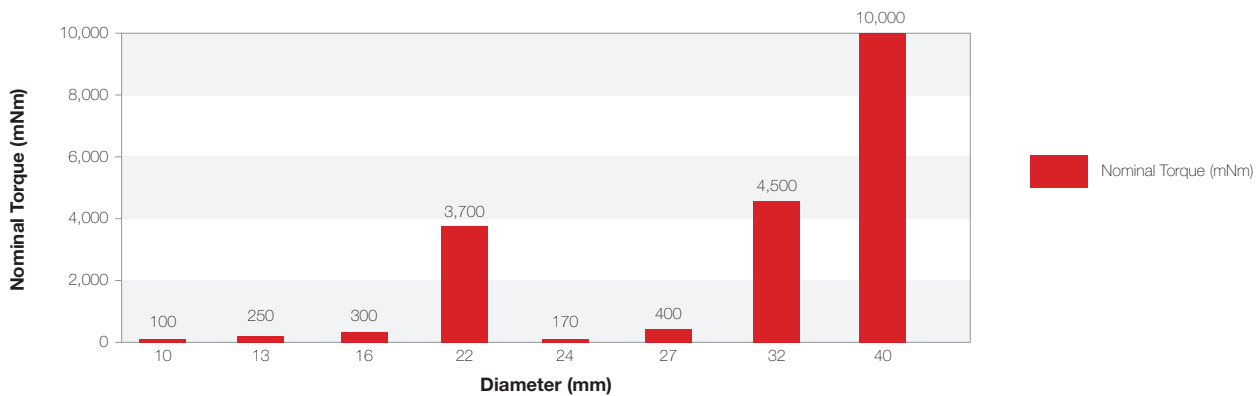


Other

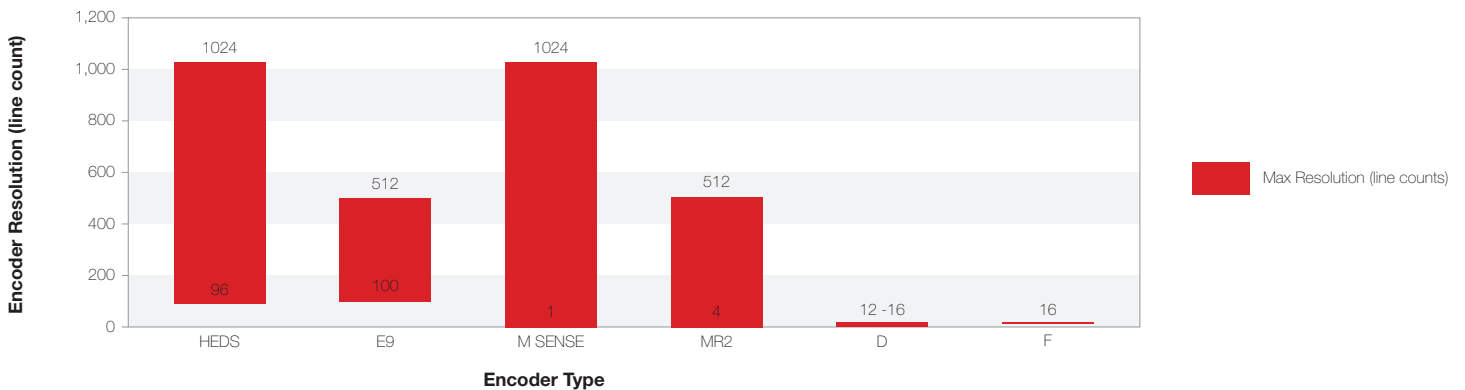
- Nailers & framing systems
- Power hand tools

Meet your Application's Working Point Requirements

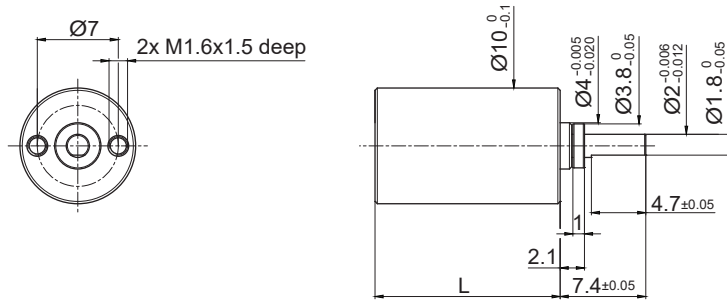
Gearheads



Encoders



For complete product and application details, visit portescap.com/gearheads-encoders



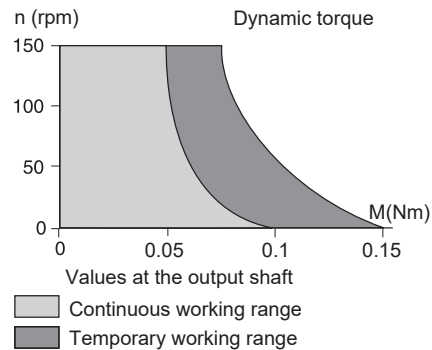
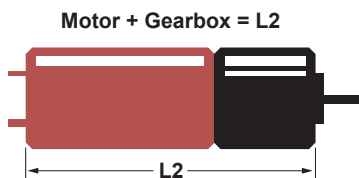
Dimensions in mm

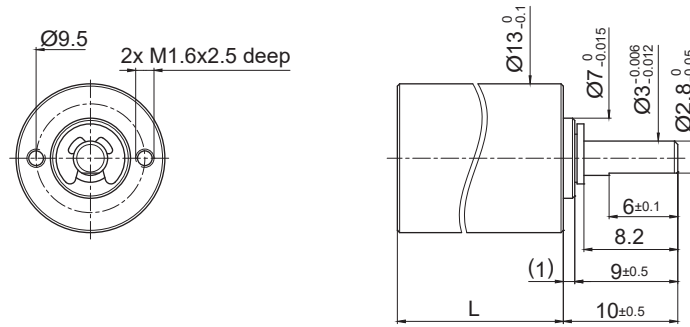
Ratio	4*	16	64	256*	1024*	4096*	
1 Number of Gear Stages	1	2	3	4	5	6	
2 Direction of Rotation	=	=	=	=	=	=	
3 Efficiency	0.9	0.8	0.7	0.65	0.6	0.5	
4 L (mm)	9	12.5	16	19.5	23	26.5	
5 Weight	g (oz)	3 (0.105)	4 (0.141)	5 (0.176)	6 (0.211)	7 (0.246)	8 (0.282)

*Ratio available upon request. Please contact us.

6 Available with Motor – L2 - Length with motor (mm)	4*	16	64	256*	1024*	4096*
08GS61	25.6	29.1	32.6	36.1	39.6	43.1
P010	25.4	28.9	32.4	35.9	39.4	42.9
10NS61	27	30.5	34	37.5	41	44.5
12G88	37.2	40.7	44.2	47.7	51.2	54.7

Characteristics	Unit	R10 • 200 •
7 Shaft Bearings		Sleeve
8 Maximum Static Torque	Nm (oz-in)	0.15 (21.2)
9 Maximum Radial Force @ 8mm from mounting face	N (lb)	2 (0.45)
10 Maximum Axial Force	N (lb)	5 (1.125)
11 Maximum Press Fit Force	N (lb)	10 (2.25)
12 Average Backlash @ no-load		1°
13 Average Backlash @ 0.3 Nm		3°
Shaft Play:		
14 -radial	µm	≤ 25
15 -axial	µm	50-150
16 Maximum Recommended Input Speed	rpm	10,000
17 Operating Temperature Range:	°C (°F)	-30 to +65 (-22 to +150)

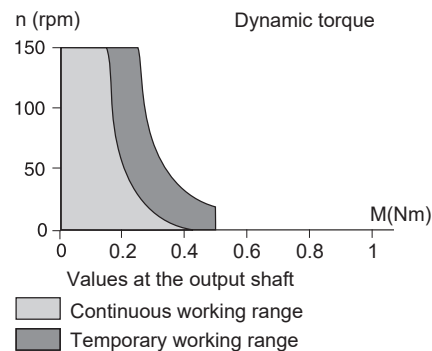
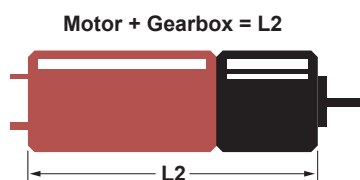


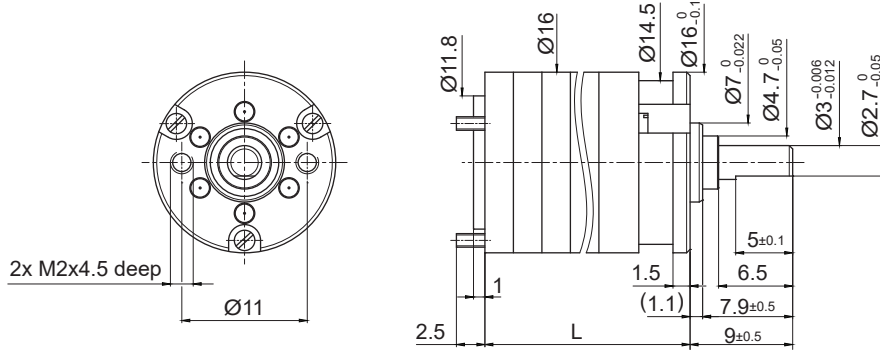


Dimensions in mm

Ratio	5.5	22	30.2	88	121	166	352	484	665.5	915
1 Number of Gear Stages	1	2	2	3	3	3	4	4	4	4
2 Direction of Rotation	=	=	=	=	=	=	=	=	=	=
3 Efficiency	0.85	0.75	0.75	0.65	0.65	0.65	0.55	0.55	0.55	0.55
4 L (mm)	14.5	18.6	18.6	22.7	22.7	22.7	26.8	26.8	26.8	26.8
5 Weight	g	6	9	9	12	12	12	15	15	15
	(oz)	(0.211)	(0.317)	(0.317)	(0.423)	(0.423)	(0.423)	(0.529)	(0.529)	(0.529)
6 Available with Motor – L2 - Length with motor (mm)										
13N 88	42.7	46.8	46.8	50.9	50.9	50.9	55	55	55	55
12G 88	42.7	46.8	46.8	50.9	50.9	50.9	55	55	55	55

Characteristics	Unit	R13 • 0 •	R13 2R • 0 •
7 Shaft Bearings		Sleeve	Ball Bearing
8 Maximum Static Torque	Nm (oz-in)	0.5 (71)	0.5 (71)
9 Maximum Radial Force @ 8mm from mounting face	N (lb)	5 (1.12)	20 (4.5)
10 Maximum Axial Force	N (lb)	8 (1.8)	10 (2.2)
11 Maximum Press Fit Force	N (lb)	100 (23)	100 (23)
12 Average Backlash @ no-load		1.25°	1.25°
13 Average Backlash @ 0.3 Nm		2°	2°
Shaft Play:			
14 -radial	µm	≤ 20	≤ 10
15 -axial	µm	50-150	≤50
16 Maximum Recommended Input Speed	rpm	7,500	7,500
17 Operating Temperature Range:	°C (°F)	-30 to +65 (-22 to +150)	



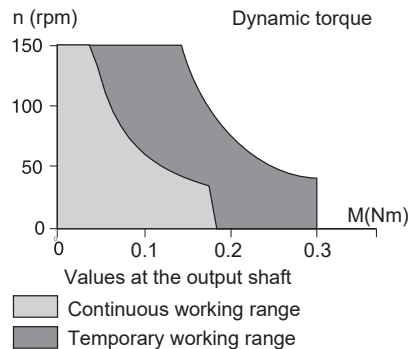
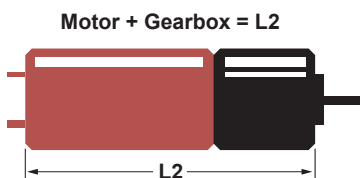


Dimensions in mm

Ratio	5	9	15	27	45	81	135	141	243	405	729	1215	2187	
1 Number of Gear Stages	2	2	3	3	4	4	5	5	5	6	6	7	7	
2 Direction of Rotation	=	=	≠	≠	=	=	≠	≠	≠	=	=	≠	≠	
3 Efficiency	0.81	0.81	0.73	0.73	0.65	0.65	0.59	0.59	0.59	0.53	0.53	0.48	0.48	
4 L (mm)	10.5	10.5	13	13	15.5	15.5	18	18	18	20.5	20.5	23	23	
5 Weight	g (oz)	7 (0.246)	7 (0.246)	8 (0.282)	8 (0.282)	9 (0.317)	9 (0.317)	10 (0.352)	10 (0.352)	10 (0.352)	11 (0.388)	11 (0.388)	12 (0.423)	12 (0.423)

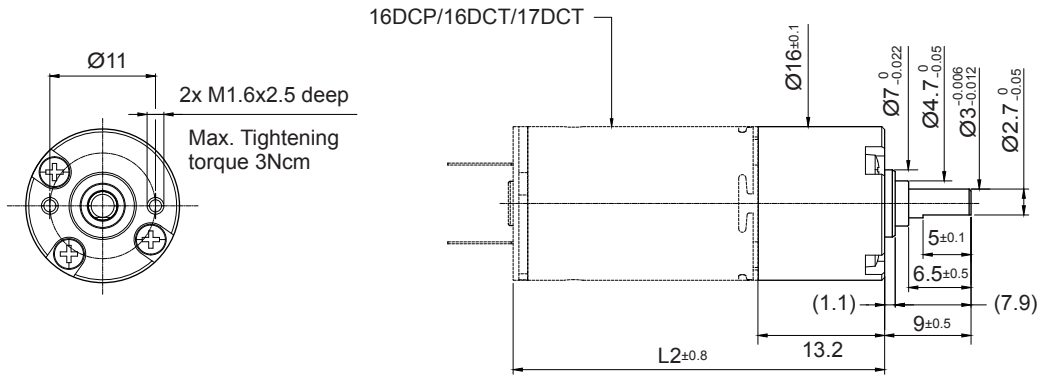
6 Available with Motor – L2 - Length with motor (mm)	5	9	15	27	45	81	135	141	243	405	729	1215	2187
16C18	29.2	29.2	31.7	31.7	34.2	34.2	36.7	36.7	36.7	39.2	39.2	41.7	41.7
16N78	41.5	41.5	44	44	46.5	46.5	49	49	49	51.5	51.5	54	54
16G88	41.5	41.5	44	44	46.5	46.5	49	49	49	51.5	51.5	54	54
17S78	32.2	32.2	34.7	34.7	37.2	37.2	39.7	39.7	39.7	42.2	42.2	44.7	44.7
17N78	39.4	39.4	41.9	41.9	44.4	44.4	47.9	47.9	47.9	49.4	49.4	51.9	51.9
P110	29.5	29.5	32	32	34.5	34.5	37	37	37	39.5	39.5	42	42
16DCP/16DCT/17DCT CB	39.5	39.5	42	42	44.5	44.5	47	47	47	49.5	49.5	52	52
16DCP/16DCT/17DCT PM	39	39	41.5	41.5	44	44	46.5	46.5	46.5	49	49	51.5	51.5

Characteristics	5	B16 • 0 •	B16 2R • 0 •
7 Shaft Bearings		Sleeve	Ball Bearing
8 Maximum Static Torque	Nm (oz-in)	0.3 (42)	0.3 (42)
9 Maximum Radial Force @ 8mm from mounting face	N (lb)	5 (1.1)	10 (2.2)
10 Maximum Axial Force	N (lb)	5 (1.1)	10 (2.2)
11 Maximum Press Fit Force	N (lb)	100 (23)	100 (23)
12 Average Backlash @ no-load		1.5°	1.5°
13 Average Backlash @ 0.3 Nm		3°	3°
Shaft Play:			
14 -radial	µm	≤ 20	≤ 10
15 -axial	µm	50-150	≤ 100
16 Maximum Recommended Input Speed	rpm	8000	8000
17 Operating Temperature Range:	°C (°F)	-30 to +65 (-22 to +150)	



B16C

Ø 16 mm • Spur Gearhead • 0.1 Nm

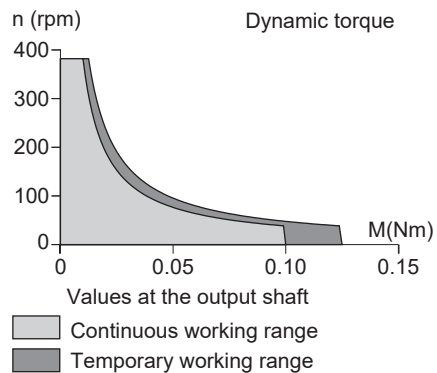
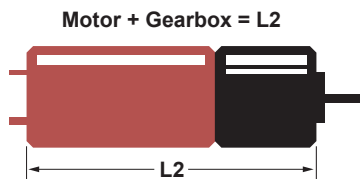


Dimensions in mm

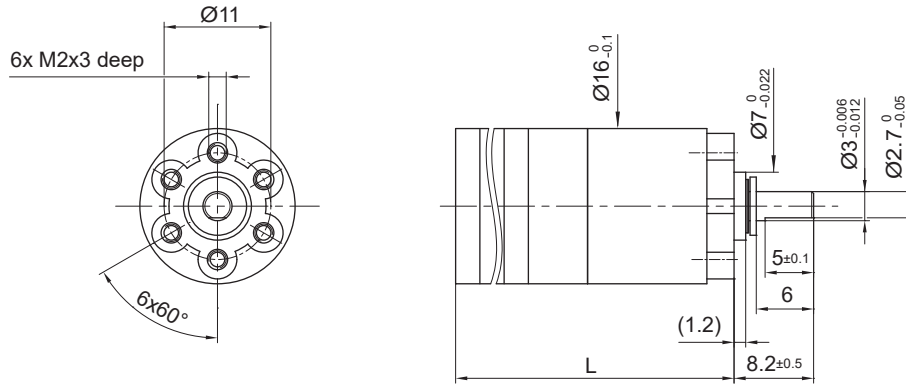
Ratio		24*
1	Number of Gear Stages	3
2	Direction of Rotation	≠
3	Efficiency	0.73
4	Weight	30 (1.06)
5 Available with Motor – L2 - Length with motor (mm)		
16DCP/16DCT/17DCT PM		38.7
16DCP/16DCT/17DCT CB		39.2

Characteristics	Unit	B16C • 0 • ...
6	Shaft Bearings	Sleeve
7	Maximum Static Torque	Nm (oz-in) 0.2 (28)
8	Maximum Radial Force @ 8mm from mounting face	N (lb) 5 (1.1)
9	Maximum Axial Force	N (lb) 5 (1.1)
10	Maximum Press Fit Force	N (lb) 100 (23)
11	Average Backlash @ no-load	1.5°
12	-radial	µm ≤ 50
13	-axial	µm 50-150
14	Maximum Recommended Input Speed	rpm 8000
15	Operating Temperature Range:	°C (°F) -30 to +65 (-22 to +149)

*Other gear reduction ratios can be made available upon request.



BA16 Ø 16 mm • Gearbox with Spur Gear and Planetary Output • 0.2 Nm

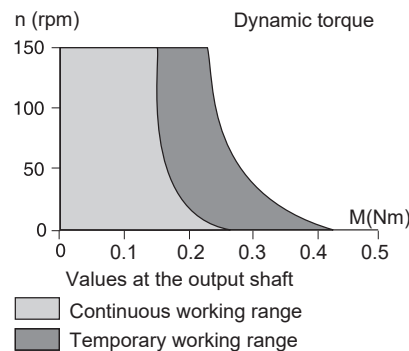
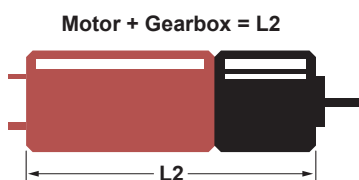


Dimensions in mm

Ratio	22.5	40.5	67.5	121.5	202.5	243	364.5	607.8	1093.5	1822.5	3280.5	
1 Number of Gear Stages	3	3	4	4	5	5	5	6	6	7	7	
2 Direction of Rotation	=	=	≠	≠	=	=	=	≠	≠	=	=	
3 Efficiency	0.72	0.72	0.65	0.65	0.59	0.59	0.59	0.53	0.53	0.48	0.48	
4 L (mm)	26.7	26.7	29.2	29.2	31.7	31.7	31.7	34.2	34.2	36.7	36.7	
5 Weight	g (oz)	12 (0.423)	12 (0.423)	13 (0.458)	13 (0.458)	14 (0.493)	14 (0.493)	15 (0.529)	15 (0.529)	15 (0.529)	16 (0.564)	16 (0.564)

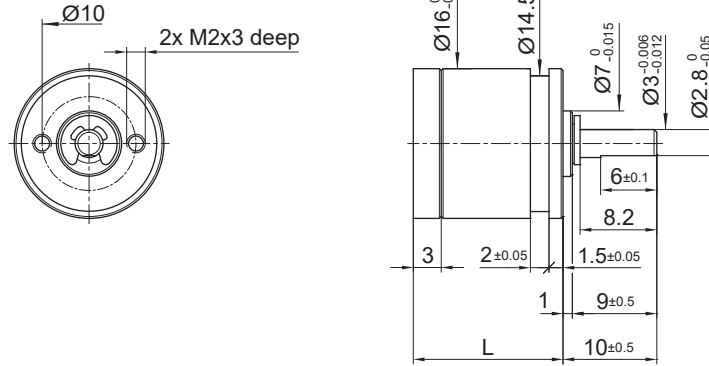
6 Available with Motor – L2 - Length with motor (mm)	22.5	40.5	67.5	121.5	202.5	243	364.5	607.8	1093.5	1822.5	3280.5
16C18	45.4	45.4	47.9	47.9	51.4	51.4	51.4	52.9	52.9	55.4	55.4
16N78	54.7	54.7	57.2	57.2	59.7	59.7	59.7	62.2	62.2	64.7	64.7
16G88	54.7	54.7	57.2	57.2	59.7	59.7	59.7	62.2	62.2	64.7	64.7
17S78	48.4	48.4	50.9	50.9	53.4	53.4	53.4	55.9	55.9	58.4	58.4
17N78	52.6	52.6	55.1	55.1	57.6	57.6	57.6	60.1	60.1	62.6	62.6
P110	45.7	45.7	48.2	48.2	50.7	50.7	50.7	53.2	53.2	55.7	55.7
16DCP/16DCT/17DCT CB	52.7	52.7	55.2	55.2	57.7	57.7	57.7	60.2	60.2	62.7	62.7
16DCP/16DCT/17DCT PM	52.2	52.2	54.7	54.7	57.2	57.2	57.2	59.7	59.7	62.2	62.2

Characteristics	Unit	BA16 • 0 •	BA16 2R • 0 •
7 Shaft Bearings		Sleeve	Ball Bearing
8 Maximum Static Torque	Nm (oz-in)	0.4 (57)	0.4 (56)
9 Maximum Radial Force @ 8mm from mounting face	N (lb)	5 (1.1)	15 (3.3)
10 Maximum Axial Force	N (lb)	5 (1.1)	10 (2.2)
11 Maximum Press Fit Force	N (lb)	200 (44)	200 (44)
12 Average Backlash @ no-load		1.5°	1.5°
13 Average Backlash @ 0.3 Nm		3°	3°
Shaft Play:			
14 -radial	µm	≤ 30	≤ 10
15 -axial	µm	≤ 150	≤ 100
16 Maximum Recommended Input Speed	rpm	8000	8000
17 Operating Temperature Range:	°C (°F)	-30 to +65 (-22 to +150)	



R16

Ø 16 mm • Planetary Gearbox • 0.3 Nm

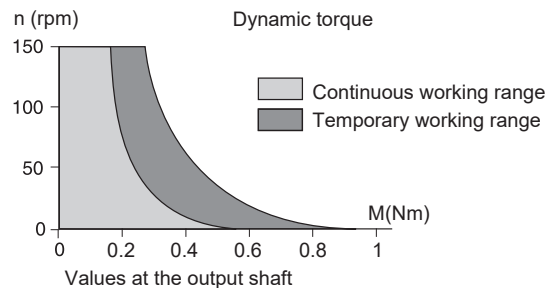
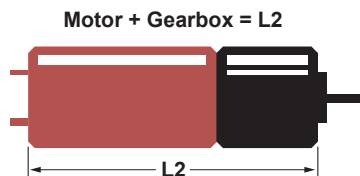


Dimensions in mm

Ratio	5.5	22	30.2	88	121	166	352	484	665.5	915
1 Number of Gear Stages	1	2	2	3	3	3	4	4	4	4
2 Direction of Rotation	=	=	=	=	=	=	=	=	=	=
3 Efficiency	0.85	0.75	0.75	0.65	0.65	0.65	0.55	0.55	0.55	0.55
4 L (mm)	16	20.1	20.1	24.2	24.2	24.2	28.3	28.3	28.3	28.3
5 Weight	g (oz)	10 (0.352)	13 (0.458)	13 (0.458)	16 (0.564)	16 (0.564)	16 (0.564)	19 (0.670)	19 (0.670)	19 (0.670)

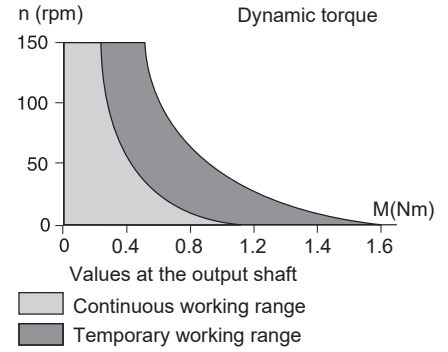
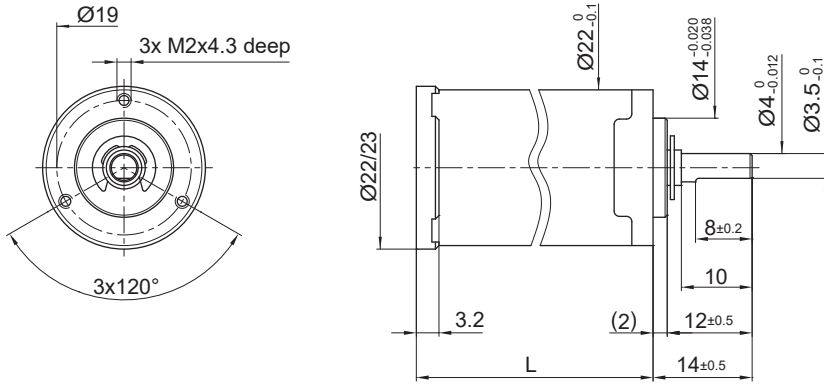
6 Available with Motor – L2 - Length with motor (mm)	5.5	22	30.2	88	121	166	352	484	665.5	915
16C18	31.7	35.8	35.8	39.9	39.9	39.9	44	44	44	44
16N78	44	48.1	48.1	52.2	52.2	52.2	56.3	56.3	56.3	56.3
16G88	44	48.1	48.1	52.2	52.2	52.2	56.3	56.3	56.3	56.3
17S78	34.7	38.8	38.8	42.9	42.9	42.9	47	47	47	47
17N78	41.9	46	46	50.1	50.1	50.1	54.2	54.2	54.2	54.2
P110	35	39.1	39.1	43.2	43.2	43.2	47.3	47.3	47.3	47.3
16DCP/16DCT/17DCT CB	42	46.1	46.1	50.2	50.2	50.2	54.3	54.3	54.3	54.3
16DCP/16DCT/17DCT PM	41.5	45.6	45.6	49.7	49.7	49.7	53.8	53.8	53.8	53.8
16ECP36	50.5	54.6	54.6	58.7	58.7	58.7	62.8	62.8	62.8	62.8
16ECP52	66.5	70.6	70.6	74.7	74.7	74.7	78.8	78.8	78.8	78.8
32BF	27.2	31.3	31.3	35.4	35.4	35.4	39.5	39.5	39.5	39.5

Characteristics	Unit	R16 • 0 •	R16 2R • 0 •
7 Shaft Bearings		Sleeve	Ball Bearing
8 Maximum Static Torque	Nm (oz-in)	1 (141)	1 (141)
9 Maximum Radial Force @ 8mm from mounting face	N (lb)	5 (1.12)	20 (4.5)
10 Maximum Axial Force	N (lb)	8 (1.8)	10 (2.2)
11 Maximum Press Fit Force	N (lb)	100 (23)	100 (23)
12 Average Backlash @ no-load		1.25°	1.25°
13 Average Backlash @ 0.3 Nm		2°	2°
Shaft Play:			
14 -radial	µm	≤ 20	≤ 10
15 -axial	µm	50-150	≤ 50
16 Maximum Recommended Input Speed	rpm	7,500	7,500
17 Operating Temperature Range:	°C (°F)	-30 to +65 (-22 to +150)	



R22

Ø 22 mm • Planetary Gearbox • 0.6 Nm

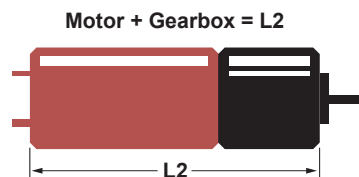


Dimensions in mm

Ratio	5.75	16.2	19.4	27.6	33.1	65.5	93.2	111	132	159	190	376	641	1090
1 Number of Gear Stages	1	2	2	2	2	3	3	3	3	3	3	4	4	4
2 Direction of Rotation	=	=	=	=	=	=	=	=	=	=	=	=	=	=
3 Efficiency	0.8	0.7	0.7	0.7	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.5	0.5	0.5
4 L (mm)	25	32.5	32.5	32.5	32.5	40	40	40	40	40	40	40	40	40
5 Weight	g (oz)	20 (0.705)	25 (0.881)	25 (0.881)	25 (0.881)	25 (0.881)	30 (1.058)	30 (1.058)	30 (1.058)	30 (1.058)	30 (1.058)	33 (1.164)	33 (1.164)	33 (1.164)

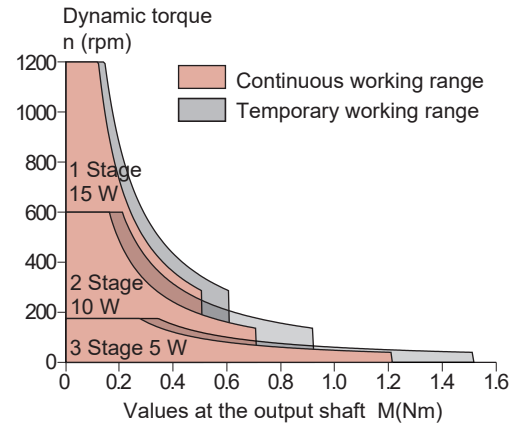
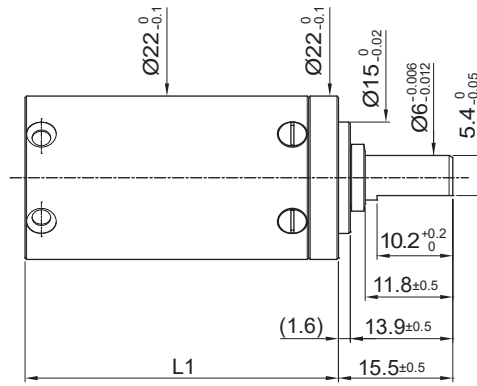
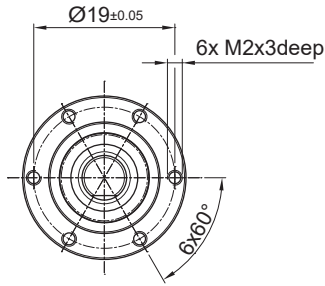
6 Available with Motor – L2 - Length with motor (mm)														
22S78	51	58.5	58.5	58.5	58.5	66	66	66	66	66	66	66	66	66
22N78	57	64.5	64.5	64.5	64.5	72	72	72	72	72	72	72	72	72
23GST82	60.1	67.6	67.6	67.6	67.6	75.1	75.1	75.1	75.1	75.1	75.1	75.1	75.1	75.1
26N58	68.3	75.8	75.8	75.8	75.8	83.3	83.3	83.3	83.3	83.3	83.3	83.3	83.3	83.3
26N48	67.1	74.6	74.6	74.6	74.6	82.1	82.1	82.1	82.1	82.1	82.1	82.1	82.1	82.1
28L18/28	68.5	76	76	76	76	83.5	83.5	83.5	83.5	83.5	83.5	83.5	83.5	83.5
28LT12	66.2	73.7	73.7	73.7	73.7	81.2	81.2	81.2	81.2	81.2	81.2	81.2	81.2	81.2
P310	42.4	49.9	49.9	49.9	49.9	57.4	57.4	57.4	57.4	57.4	57.4	57.4	57.4	57.4
22DCP/22DCT/24DCT	55*	62.5	62.5	62.5	62.5	70	70*	70	70	70	70	70	70	70
22ECP35 / 22ECT35	60	67.5	67.5	67.5	67.5	75	75	75	75	75	75	75	75	75
22ECP45	70	77.5	77.5	77.5	77.5	85	85	85	85	85	85	85	85	85
22ECT48	73	80.5	80.5	80.5	80.5	88	88	88	88	88	88	88	88	88
22ECP60 / 22ECT60	85	92.5	92.5	92.5	92.5	100	100	100	100	100	100	100	100	100
22ECT82	107	114.5	114.5	114.5	114.5	122	122	122	122	122	122	122	122	122

Characteristics	Unit	R22 • 0 •	R22 2R • 0 •
7 Shaft Bearings		Sleeve	Ball Bearing
8 Maximum Static Torque	Nm (oz-in)	2 (283)	2 (283)
9 Maximum Radial Force			
@ 8mm from mounting face	N (lb)	10 (2.2)	15 (3.3)
10 Maximum Axial Force	N (lb)	10 (2.2)	10 (2.2)
11 Maximum Press Fit Force	N (lb)	300 (67.4)	300 (67.4)
12 Average Backlash @ no-load		1.5°	1.5°
13 Average Backlash @ 0.3 Nm		3°	3°
Shaft Play:			
14 -radial	µm	≤ 25	≤ 10
15 -axial	µm	50-150	50-150
16 Maximum Recommended Input Speed	rpm	5,000	5,000
17 Operating Temperature Range:	°C (°F)	-30 to +65 (-22 to +150)	



R22T

Ø 22 mm • Planetary Gearbox • 1.5 Nm

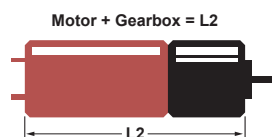


Dimensions in mm

Ratio	5.4	14.1	29.2	52.7	157.5	
1 Number of Gear Stages	1	2	2	3	3	
2 Direction of Rotation	=	=	=	=	=	
3 Efficiency	0.9	0.81	0.81	0.73	0.73	
4 L1 (mm)	21.6	28.45	28.45	35.25	35.25	
5 Weight	g (oz)	40 (1.41)	52 (1.83)	52 (1.83)	66 (2.33)	66 (2.33)

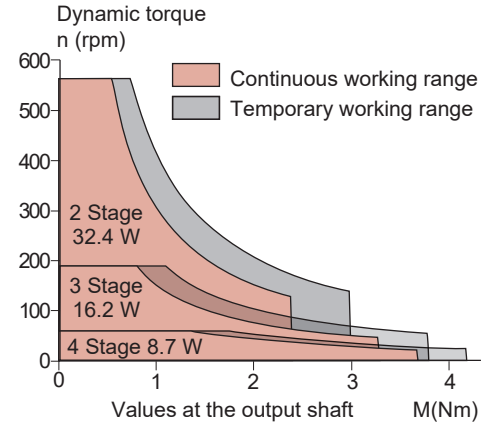
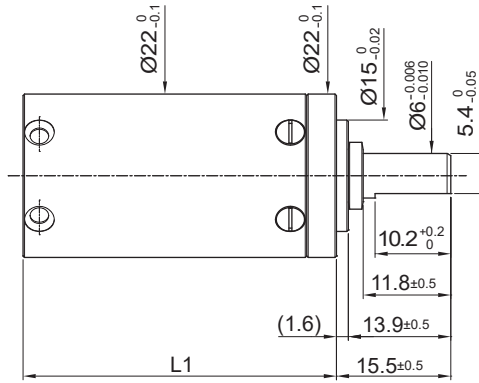
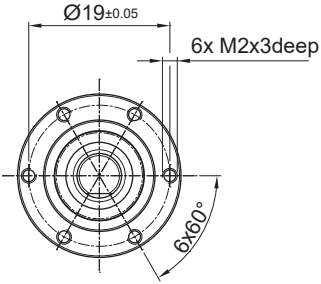
6 Available with Motor – L2 - Length with motor (mm)	5.4	14.1	29.2	52.7	157.5
22DCP / 22DCT / 22N78 / 24DCT	56.05	62.9	62.9	69.7	69.7
22N98	57.95	64.8	64.8	71.6	71.6
23GST2R82	62.05	68.9	68.9	75.7	75.7
25GT2R82	77.5	84.35	84.35	91.15	91.15
25GST2R82	67.55	74.4	74.4	81.2	81.2
22ECP35 / 22ECP35-2A / 22ECT35	56.6	63.45	63.45	70.25	70.25
22ECP45	66.6	73.45	73.45	80.25	80.25
22ECT48	69.6	76.45	76.45	83.25	83.25
22ECP60 / 22ECT60	81.6	88.45	88.45	95.25	95.25
22ECT82	103.6	110.45	110.45	117.25	117.25

Characteristics	Unit	R22T 2R 0 xxx		
7 Shaft Bearings		Ball bearing		
8 Maximum Continuous Torque	Nm (oz-in)	0.5 (70.8)	0.7 (99)	1.2 (170)
9 Maximum Continuous Power	W	15	10	5
10 Maximum Intermittent Torque	Nm (oz-in)	0.6 (85)	0.9 (127)	1.5 (212)
11 Maximum Radial Force @ 10 mm from mounting face	N (lb)	65 (14.6)	100 (22.5)	120 (26.9)
12 Maximum Axial Force	N (lb)	40 (9)		
13 Maximum Press-Fit Force	N (lb)	50 (11.2)		
14 Shaft Play:				
-Radial (@ 10 mm from flange)	µm	<50		
-Axial	µm	<30		
15 Maximum Recommended Input Speed	rpm	6000	8000	
16 Operating Temperature Range:	°C (°F)	-40 to +100 (-40 to +212)		



R22HT

Ø 22 mm • Planetary Gearbox • 3.7 Nm

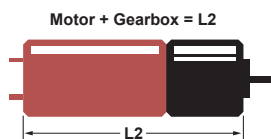


Dimensions in mm

Ratio		10.9	16.4	36.5	61.7	88.8	120.9	211.4	294.4	423.9
		12.4	17.9	41.2	63.7	96.7	136.7	222.6	316.1	455.2
		14.1	19.2	46.6	67.1	103.8	154.6	231.2	320.6	479.5
		14.5	20.2	48.2	72.1	109.4	159.8	239.0	333.0	522.1
			23.7	52.7	75.9	127.9	174.8	251.8	344.2	560.6
			29.2	54.5	78.5	157.5	180.8	260.3	362.6	590.5
				59.4	84.3		196.8	270.3	369.6	690.4
							197.8	279.5	389.3	850.3
							204.4	284.8	410.1	
1	Number of Gear Stages	2	2	3	3	3	4	4	4	4
2	Direction of Rotation	=	=	=	=	=	=	=	=	=
3	Efficiency	0.82	0.82	0.72	0.72	0.72	0.62	0.62	0.62	0.62
4	L (mm)	28.3	28.3	35.1	35.1	35.1	41.9	41.9	41.9	41.9
5	Weight	g	52	52	66	66	66	81	81	81
		(oz)	(1.834)	(1.834)	(2.328)	(2.328)	(2.328)	(2.857)	(2.857)	(2.857)

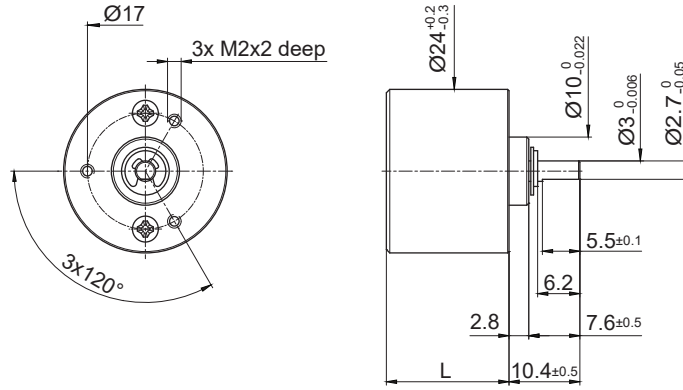
6 Available with Motor – L2 - Length with motor (mm)										
22DCP / 22DCT / 22N78 / 24DCT	62.7	62.7	69.5	69.5	69.5	76.3	76.3	76.3	76.3	76.3
22N98	64.6	64.6	71.4	71.4	71.4	78.2	78.2	78.2	78.2	78.2
23GST2R	68.7	68.7	75.5	75.5	75.5	82.3	82.3	82.3	82.3	82.3
25GT2R	84.2	84.2	91	91	91	97.8	97.8	97.8	97.8	97.8
25GST2R	74.2	74.2	81	81	81	87.8	87.8	87.8	87.8	87.8
22ECT35	63.3	63.3	70.1	70.1	70.1	76.9	76.9	76.9	76.9	76.9
22ECP45	73.3	73.3	80.1	80.1	80.1	86.9	86.9	86.9	86.9	86.9
22ECT48	76.3	76.3	83.1	83.1	83.1	89.9	89.9	89.9	89.9	89.9
22ECP60 / 22ECT60	88.3	88.3	95.1	95.1	95.1	101.9	101.9	101.9	101.9	101.9
22ECT82	110.3	110.3	117.1	117.1	117.1	123.9	123.9	123.9	123.9	123.9

Characteristics	Unit	R22HT 2R . 0 .								
7 Shaft Bearings		Ball bearing								
8 Maximum Continuous Torque	Nm (oz-in)	2.4 (340)	2.4 (340)	3.3 (467)	3.3 (467)	3.3 (467)	3.7 (524)	3.7 (524)	3.7 (524)	3.7 (524)
9 Maximum Continuous Power	W	32.4	32.4	16.2	16.2	16.2	8.7	8.7	8.7	8.7
10 Maximum Static Torque	N (lb)	3 (425)	3 (425)	3.8 (538)	3.8 (538)	3.8 (538)	4.2 (595)	4.2 (595)	4.2 (595)	4.2 (595)
11 Maximum Radial Force @ 10 mm from mounting face	N (lb)	150 (33.7)								
12 Maximum Axial Force	N (lb)	100 (22.4)								
13 Maximum Press-Fit Force	N (lb)	120 (26.9)								
14 Average Backlash @ no-load	(deg)	1.2°	1.2°	1.6°	1.6°	1.6°	1.9°	1.9°	1.9°	1.9°
15 Shaft Play:										
-Radial (@ 10 mm from flange)	µm	≤ 200								
-Axial	µm	<30								
16 Maximum Recommended Input Speed	rpm	12,000								
17 Operating Temperature Range:	°C (°F)	-30 to +85 (-22 to +185)								



K24

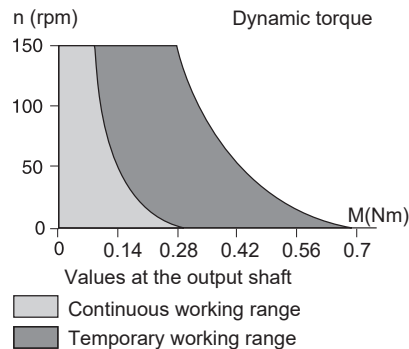
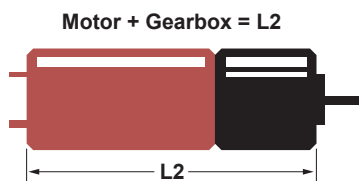
Ø 24 mm • Spur Gearbox • 0.17 Nm



Dimensions in mm

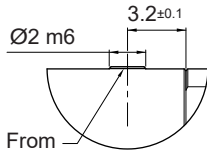
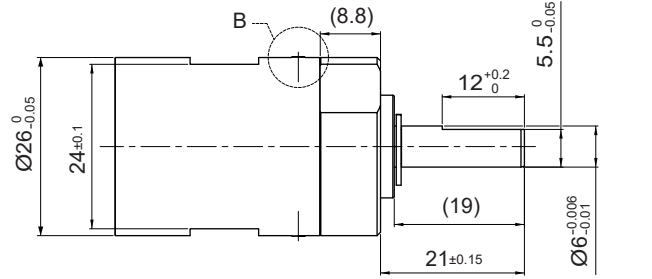
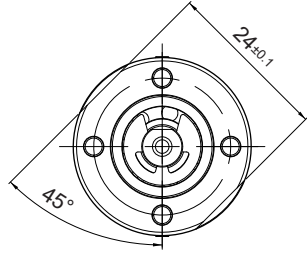
Ratio	5	8	20	32	64	128	320	800	2048	
1 Number of Gear Stages	2	2	4	4	4	4	6	6	6	
2 Direction of Rotation	=	=	=	=	=	=	=	=	=	
3 Efficiency	0.85	0.85	0.75	0.75	0.75	0.75	0.65	0.65	0.65	
4 L (mm)	15	15	18	18	18	18	21	21	21	
5 Weight	g (oz)	15 (0.529)	15 (0.529)	18 (0.634)	18 (0.634)	18 (0.634)	18 (0.634)	21 (0.705)	21 (0.705)	21 (0.705)
6 Available with Motor – L2 - Length with motor (mm)										
22N78	47	47	50	50	50	50	53	53	53	
22N98	48.9	48.9	51.9	51.9	51.9	51.9	54.9	54.9	54.9	
26N58	58.3	58.3	61.3	61.3	61.3	61.3	64.3	64.3	64.3	
26N48	57.1	57.1	60.1	60.1	60.1	60.1	63.1	63.1	63.1	
P310	32.4	32.4	35.4	35.4	35.4	35.4	38.4	38.4	38.4	
22DCP/22DCT/24DCT	50.2	50.2	53.2	53.2	53.2	53.2	56.2	56.2	56.2	

Characteristics	Unit	K24 • 0 •	K24 2R • 0 •
7 Shaft Bearings		Sleeve	Ball Bearing
8 Maximum Static Torque	Nm (oz-in)	0.7 (100)	0.7 (100)
9 Maximum Radial Force			
@ 8mm from mounting face	N (lb)	5 (1.1)	20 (4.5)
10 Maximum Axial Force	N (lb)	8 (1.8)	10 (2.2)
11 Maximum Press Fit Force	N (lb)	30 (6.7)	30 (6.7)
12 Average Backlash @ no-load		1.5°	1.5°
13 Average Backlash @ 0.3 Nm		2.5°	2.5°
Shaft Play:			
14 -radial	µm	≤ 40	≤ 10
15 -axial	µm	50-150	≤ 10
16 Maximum Recommended Input Speed	rpm	5,000	5,000
17 Operating Temperature Range:	°C (°F)	-30 to +65 (-22 to +150)	



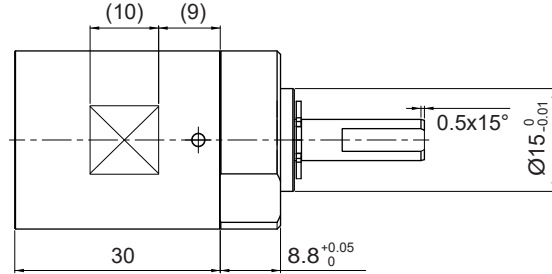
R26HT

Ø 26 mm • Planetary Gearbox • 4 Nm



2x Pin Protrusion From Internal Gear Tube
0.23 mm Max.

DETAIL B
Scale 8:1



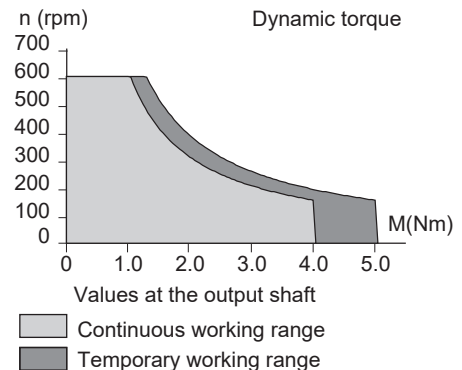
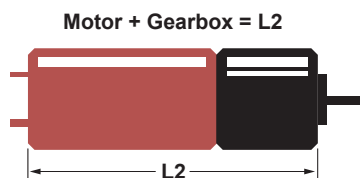
Dimensions in mm

Dimensions in mm.

Ratio		24.1*
1	Number of Gear Stages	2
2	Direction of Rotation	=
3	Efficiency	0.85
4	Weight	100 (3.53)
5 Available with Motor – L2 - Length with motor (mm)		
	22ECT35 Ultra EC	65
	22ECT48 Ultra EC	78
	22ECT60 Ultra EC	90
	22ECT82 Ultra EC	112

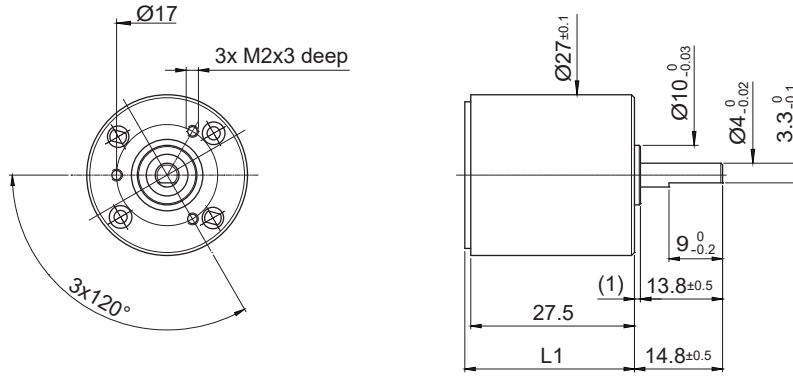
Characteristics	Unit	
6 Shaft Bearings		Ball Bearing
7 Maximum Static Torque	Nm (oz-in)	5 (708)
8 Maximum Radial Force @ 10mm from mounting face	N (lb)	180 (40.5)
9 Maximum Axial Force	N (lb)	120 (27)
10 Maximum Press Fit Force	N (lb)	500 (112.5)
11 Average Backlash @ no-load		1°
12 Average Backlash @ 0.3 Nm		2°
Shaft Play:		
13 -radial	µm	≤ 10
14 -axial	µm	≤ 10
15 Maximum Recommended Input Speed	rpm	18,000
16 Operating Temperature Range:	°C (°F)	-30 to +100 (-22 to +212)

*Other gear reduction ratios and motor combinations can be made available upon request.



K27

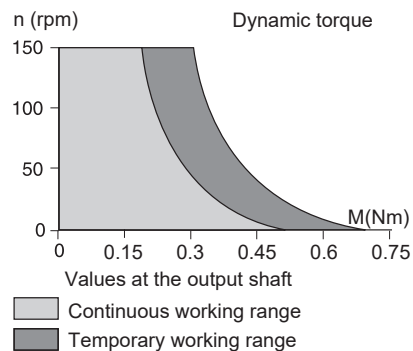
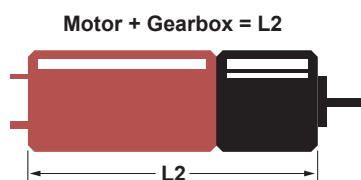
Ø 27 mm • Spur Gearbox • 0.4 Nm

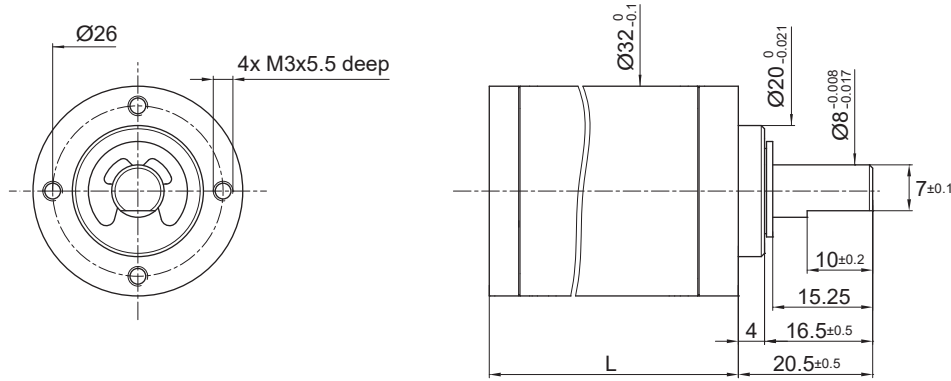


Dimensions in mm

Ratio	6.2	18.6	27.9	55.7	99.1	198	501	979	2970	
1 Number of Gear Stages	4	4	4	4	6	6	6	6	9	
2 Direction of Rotation	=	=	=	=	=	=	=	=	≠	
3 Efficiency	0.65	0.65	0.65	0.65	0.55	0.55	0.55	0.55	0.4	
4 L (mm)	28.5	28.5	28.5	28.5	28.5	28.5	28.5	28.5	28.5	
5 Weight	g (oz)	40 (1.410)	40 (1.410)	40 (1.410)	40 (1.410)	42 (1.481)	42 (1.481)	42 (1.481)	42 (1.481)	48 (1.693)
6 Available with Motor – L2 - Length with motor (mm)										
22N78	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	
22N98	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4	
23GST82	63.6	63.6	63.6	63.6	63.6	63.6	63.6	63.6	63.6	
26N58	71.8	71.8	71.8	71.8	71.8	71.8	71.8	71.8	71.8	
26N48	70.6	70.6	70.6	70.6	70.6	70.6	70.6	70.6	70.6	
P310	45.9	45.9	45.9	45.9	45.9	45.9	45.9	45.9	45.9	
22DCP/22DCT/24DCT	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	

Characteristics	Unit	K27 • 0 • ----	K27 2R • 0 • ----
7 Shaft Bearings		Sleeve	Ball Bearing
8 Maximum Static Torque	Nm (oz-in)	0.7 (100)	0.7 (100)
9 Maximum Radial Force @ 8mm from mounting face	N (lb)	20 (4.5)	25 (5.5)
10 Maximum Axial Force	N (lb)	8 (1.8)	40 (9)
11 Maximum Press Fit Force	N (lb)	300 (67.5)	60 (13.5)
12 Average Backlash @ no-load		2°	2°
13 Average Backlash @ 0.3 Nm		3°	3°
Shaft Play:			
14 -radial	µm	≤ 60	≤ 20
15 -axial	µm	50-150	≤ 100
16 Maximum Recommended Input Speed	rpm	4,000	4,000
17 Operating Temperature Range:	°C (°F)	-30 to +65 (-22 to +150)	



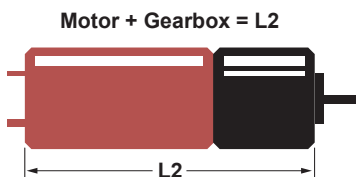
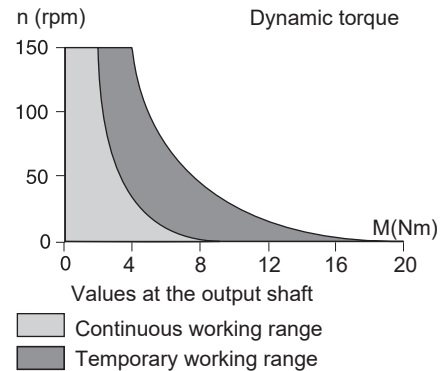


Dimensions in mm

Ratio	5.75	17.4	24	33	72.3	99.8	138	190	301	416	574	792	1090
1 Number of Gear Stages	1	2	2	2	3	3	3	3	4	4	4	4	4
2 Direction of Rotation	=	=	=	=	=	=	=	=	=	=	=	=	=
3 Efficiency	0.8	0.75	0.75	0.75	0.65	0.65	0.65	0.65	0.55	0.55	0.55	0.55	0.55
4 L (mm)	32	38	38	38	44	44	44	44	50	50	50	50	50
5 Weight	g (oz)	124 (4.373)	145 (5.114)	145 (5.114)	145 (5.114)	175 (6.172)	175 (6.172)	175 (6.172)	175 (6.172)	205 (7.231)	205 (7.231)	205 (7.231)	205 (7.231)

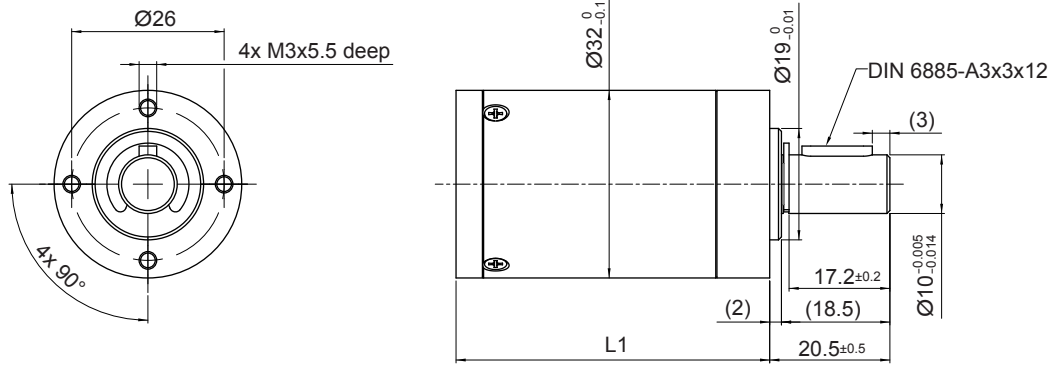
6 Available with Motor – L2 - Length with motor (mm)													
25GST82	75.5	81.5	81.5	81.5	87.5	87.5	87.5	87.5	93.5	93.5	93.5	93.5	93.5
25GT82	85.45	91.45	91.45	91.45	97.45	97.45	97.45	97.45	103.45	103.45	103.45	103.45	103.45
28L18/28	75.5	81.5	81.5	81.5	87.5	87.5	87.5	87.5	93.5	93.5	93.5	93.5	93.5
28LT12	73.2	79.2	79.2	79.2	85.2	85.2	85.2	85.2	91.2	91.2	91.2	91.2	91.2
28DT12	96.6	102.6	102.6	102.6	108.6	108.6	108.6	108.6	114.6	114.6	114.6	114.6	114.6
30GT82	94.9	100.9	100.9	100.9	106.9	106.9	106.9	106.9	112.9	112.9	112.9	112.9	112.9
35NT32/82	89.2	95.2	95.2	95.2	101.2	101.2	101.2	101.2	107.2	107.2	107.2	107.2	107.2
35GLT2R82	99.2	105.2	105.2	105.2	111.2	111.2	111.2	111.2	117.2	117.2	117.2	117.2	117.2
22ECT35	67	73	73	73	79	79	79	79	85	85	85	85	85
22ECT48	80	86	86	86	92	92	92	92	98	98	98	98	98
22ECT60	92	98	98	98	104	104	104	104	110	110	110	110	110
22ECT82	114	120	120	120	126	126	126	126	132	132	132	132	132
30ECT64	96	102	102	102	108	108	108	108	114	114	114	114	114
30ECT90	122	128	128	128	134	134	134	134	140	140	140	140	140

Characteristics	Unit	R32 2R • 0 •
7 Shaft Bearings		Ball bearing
8 Maximum Static Torque	Nm (oz-in)	20 (2832)
9 Maximum Radial Force		
@ 8mm from mounting face	N (lb)	180 (40.5)
10 Maximum Axial Force	N (lb)	150 (33.75)
11 Maximum Press Fit Force	N (lb)	500 (112.5)
12 Average Backlash @ no-load		1°
13 Average Backlash @ 0.3 Nm		2°
Shaft Play:		
14 -radial	µm	≤ 10
15 -axial	µm	≤ 10
16 Maximum Recommended Input Speed	rpm	6,000
17 Operating Temperature Range:	°C (°F)	-30 to +85 (-22 to +185)



R32HT

Ø 32 mm • Planetary Gearbox • 8 Nm

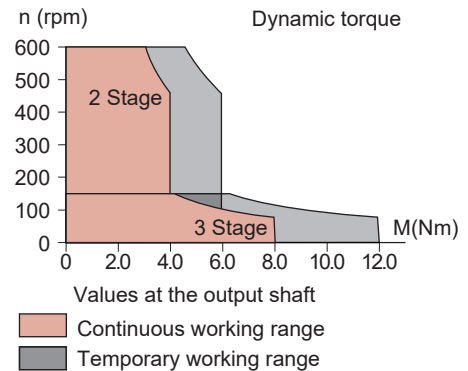
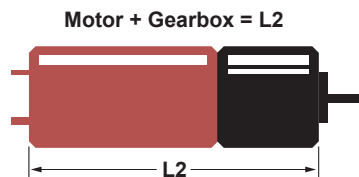


Dimensions in mm

Ratio	17.6	33	73.4	99.8	138	190
1 Number of Gear Stages	2	2	3	3	3	3
2 Direction of Rotation	=	=	=	=	=	=
3 Efficiency	0.8	0.8	0.75	0.75	0.75	0.75
4 L1 (mm)	47.5	47.5	53.5	53.5	53.5	53.5
5 Weight	g (oz)	180 (6.35)	180 (6.35)	210 (7.4)	210 (7.4)	210 (7.4)
6 Available with Motor – L2 - Length with motor (mm)						
35GLT2R82*	114.7	114.7	120.7	120.7	120.7	120.7

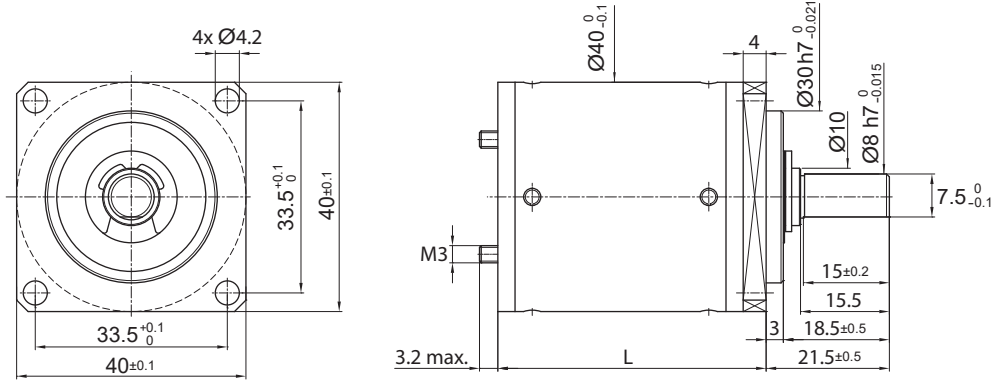
Characteristics	Unit	R32HT 2R 0 xxx	
7 Shaft Bearings		Ball Bearings	
8 Maximum Continuous Torque	Nm (oz-in)	4 (566)	8 (1132)
9 Maximum Continuous Power	W	194	92
10 Maximum Intermittent Torque	Nm (oz-in)	12 (1699)	
11 Maximum Radial Force @ 10 mm from mounting face	N (lb)	180 (40)	
12 Maximum Axial Force	N (lb)	150 (33.75)	
13 Average Backlash @ no-load	°	0.8	1
14 Shaft Play			
-Radial (@ 10 mm from flange)	µm	≤ 50	
-Axial	µm	≤ 50	
15 Maximum Recommended Input Speed	rpm	8'000	
16 Operating Temperature Range	°C (°F)	-30 to +85 (-22 to +185)	

*Other motor combinations can be made available upon request



R40

Ø 40 mm • Planetary Gearbox • 10 Nm

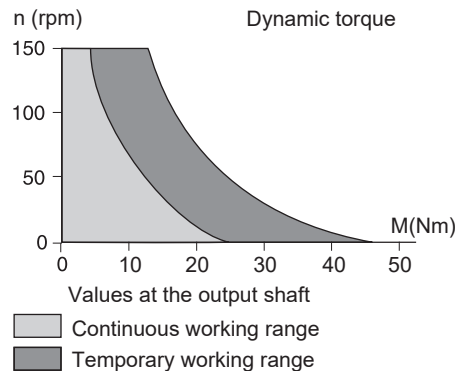
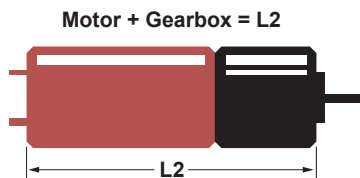


Dimensions in mm

Ratio	3.56	5.6	15.2	24	54.2	85.3	134	193	303	478	753
1 Number of Gear Stages	1	1	2	2	3	3	3	4	4	4	4
2 Direction of Rotation	=	=	=	=	=	=	=	=	=	=	=
3 Efficiency	0.85	0.85	0.7	0.7	0.6	0.6	0.6	0.5	0.5	0.5	0.5
4 L (mm)	38.3	38.3	46.8	46.8	55.3	55.3	55.3	63.8	63.8	63.8	63.8
5 Weight											
g	245	245	285	285	340	340	340	400	400	400	400
(oz)	(8.642)	(8.642)	(10.052)	(10.052)	(11.993)	(11.993)	(11.993)	(14.109)	(14.109)	(14.109)	(14.109)

6 Available with Motor – L2 - Length with motor (mm)											
25GT82	91.75	91.75	100.25	100.25	108.75	108.75	108.75	117.25	117.25	117.25	117.25
28DT12	102.9	102.9	111.4	111.4	119.9	119.9	119.9	128.4	128.4	128.4	128.4
30GT82	101.2	101.2	109.7	109.7	118.2	118.2	118.2	126.7	126.7	126.7	126.7
35NT32/82	95.5	95.5	104	104	112.5	112.5	112.5	121	121	121	121
35GLT82	105.5	105.5	114	114	122.5	122.5	122.5	131	131	131	131

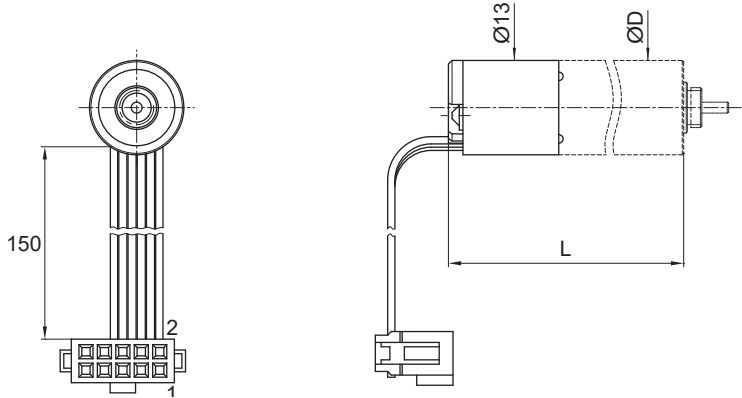
Characteristics	Unit	R40 • 0 • ...
7 Shaft Bearings		Ball Bearing
8 Maximum Static Torque	Nm (oz-in)	40 (5700)
9 Maximum Radial Force		
@ 8mm from mounting face	N (lb)	600 (135)
10 Maximum Axial Force	N (lb)	400 (90)
11 Maximum Press Fit Force	N (lb)	600 (135)
12 Average Backlash @ no-load		1°
13 Average Backlash @ 0.3 Nm		1.3°
Shaft Play:		
14 -radial	µm	≤ 10
15 -axial	µm	≤ 10
16 Maximum Recommended Input Speed	rpm	6,000
17 Operating Temperature Range:	°C (°F)	-30 to +85 (-22 to +185)



A large grid of graph paper for taking notes, consisting of 20 columns and 40 rows of small squares.

D12

Integrated Magnetic Encoder



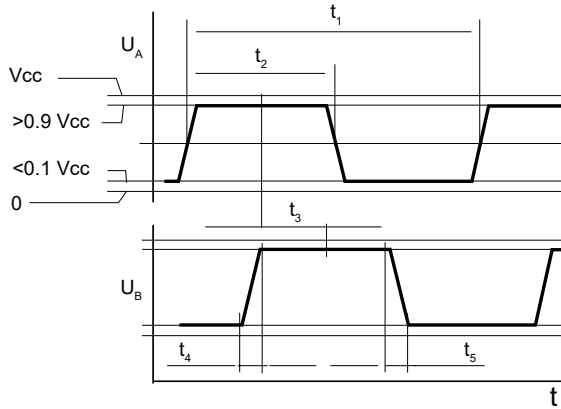
Dimensions in mm

Encoder Type D Connections	
1	Motor +
2	Vcc
3	Channel A
4	Channel B
5	GND
6	Motor -
7	Strobe
8	NC
9	NC
10	NC

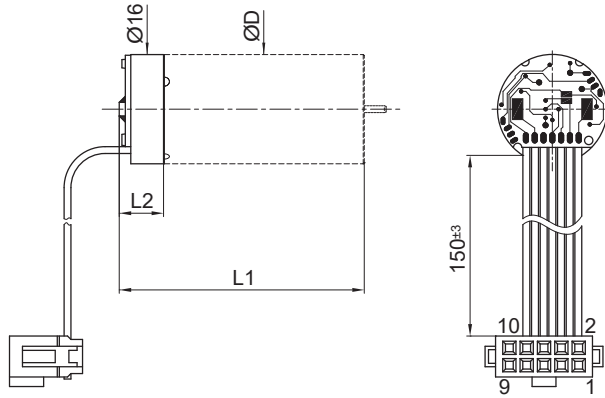
Electrical Data	Characteristics @ 22° C	Unit
1 Number of Lines Available	12	LPR
2 Supply Voltage	5	Volt
3 Supply Current	Typical 4	mA
4 Rise Time	125	ns
5 Fall Time	50	ns
6 Output Signal	Two channels square wave	
7 Electrical Phase Shift	90 ± 40	degree
8 Signal Ratio	50 ± 25	%
9 Maximum Count Frequency	10	kHz
10 Operating Temperature Range:	-20 to +85 (-4 to +185)	°C (°F)
11 Code Wheel Moment of Inertia	0.1	10 ⁻⁷ x kgm ²
12 Weight	Varies by motor size. Contact us.	g (oz)

Available on Motor Types	13N88
Length with motor mm (in)	40.4 (1.59)

Typical Encoder Output Signal



t_1	Period
t_2/t_1	Signal Ratio
t_3	Phase Shift
t_4	Rise Time
t_5	Fall Time



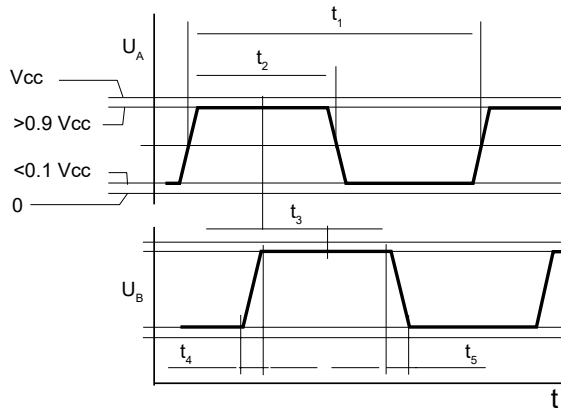
Encoder Type D Connections	
1	Motor +
2	Vcc
3	Channel A
4	Channel B
5	GND
6	Motor -
7	Strobe
8	NC
9	NC
10	NC

Dimensions in mm

Electrical Data	Characteristics @ 22° C	Unit
1 Number of Lines Available	16	LPR
2 Supply Voltage	5	Volt
3 Supply Current	Typical 4	mA
4 Rise Time	125	ns
5 Fall Time	50	ns
6 Output Signal	Two channels square wave	
7 Electrical Phase Shift	90 ± 40	degree
8 Signal Ratio	50 ± 25	%
9 Maximum Count Frequency	10	kHz
10 Operating Temperature Range:	-20 to +85 (-4 to +185)	°C (°F)
11 Code Wheel Moment of Inertia	0.1	10 ⁻⁷ x kgm ²
12 Weight	Varies by motor size. Contact us.	
		g (oz)

Available upon request	22N88	22V28
Length with motor mm (in)	37.8 (1.49)	40.1 (1.58)

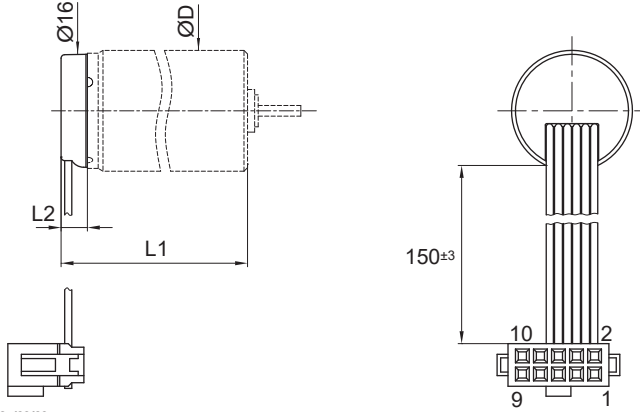
Typical Encoder Output Signal



t ₁	Period
t ₂ /t ₁	Signal Ratio
t ₃	Phase Shift
t ₄	Rise Time
t ₅	Fall Time

F16

Integrated Magnetic Encoder



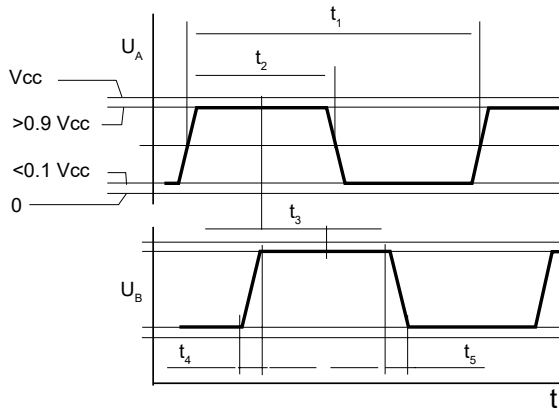
Dimensions in mm

Encoder Type F Connections	
1	Motor +
2	Vcc
3	Channel A
4	Channel B
5	GND
6	Motor -
7	NC
8	NC
9	NC
10	NC

Electrical Data	Characteristics @ 22° C	Unit
1 Number of Lines Available	16	LPR
2 Supply Voltage	3.5 to 15	Volt
3 Supply Current Typical	6	mA
4 Rise Time	5	µs
5 Fall Time	0.2	µs
6 Output Signal	Two channels square wave	
7 Electrical Phase Shift	90 ± 40	degree
8 Signal Ratio	50 ± 25	%
9 Maximum Count Frequency	15	kHz
10 Operating Temperature Range:	-20 to +85 (-4 to +185)	°C (°F)
11 Code Wheel Moment of Inertia	0.1	10 ⁻⁷ x kgm ²
12 Weight	Varies by motor size. Contact us.	g (oz)

Available on Motor Types	16C 18	17S78	17N78
Length with motor mm (in)	18.6 (0.73)	20.2 (0.795)	27.8 (1.09)

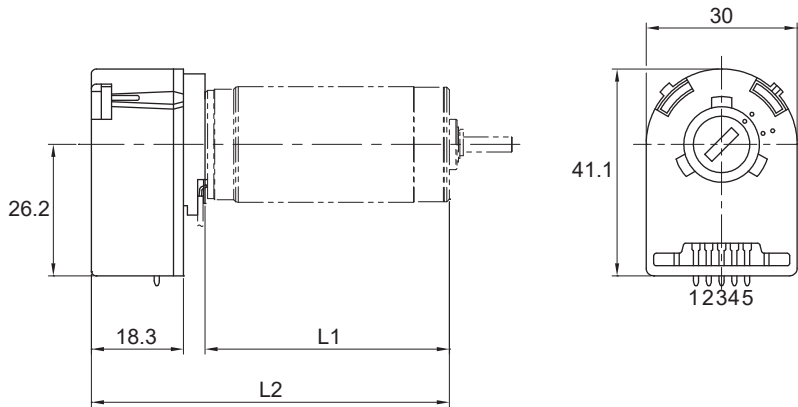
Typical Encoder Output Signal



t ₁	Period
t ₂ /t ₁	Signal Ratio
t ₃	Phase Shift
t ₄	Rise Time
t ₅	Fall Time

HEDS 5500/5540

3 Channel Optical Encoder



Encoder Connections	
1	Mass
2	NC
3	Channel A
4	Vcc
5	Channel B

Dimensions in mm

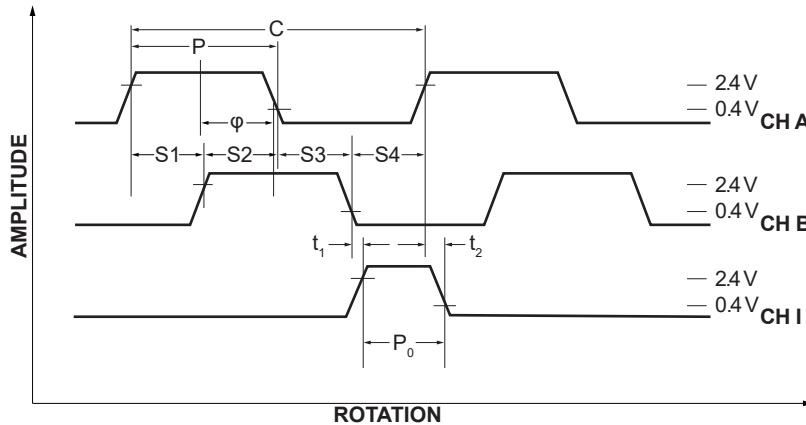
Electrical Data	Characteristics @ 22° C	Unit
1 Number of Lines Available	96 to 512	LPR
2 Supply Voltage	5 ± 10%	Volt
3 Supply Current	Typical/Maximum	17 - 57
4 Output Signal	2 channels, square wave in quadrature 3 Channels (with index)	
5 Electrical Phase Shift	90 ± 10	degree
6 Maximum Count Frequency	100	kHz
7 Operating Temperature Range:	-40 to +100 (-40 to +212)	°C (°F)
8 Code Wheel Moment of Inertia	0.6 X 10 ⁻⁷	10 ⁻⁷ x kgm ²
9 Weight	17	g (oz)

Available on Motor Types*	22N98	23GST	26N48	28LT12	28DT12
Length with motor mm (in)	54.9 (2.16)	58.6 (2.31)	63 (2.48)	63.8 (2.51)	85.2 (3.35)

Available on Motor Types*	35NT
Length with motor mm (in)	83.45 (3.29)

*On request, encoder available on other motors. Encoder also available with line-driver.

Output Waveforms



Phase (ϕ): This value is nominally 90°e for quadrature output.

Index Pulse Width (P_0): This value is nominally 90°e or 1/4 cycle.

State Width (S): Each state is nominally 90°e.

Pulse Width (P): This value is nominally 180°e or 1/2 cycle.

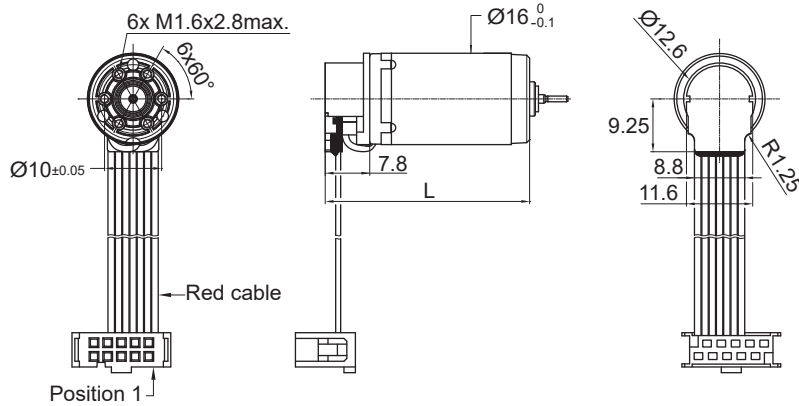
One Cycle (C): 360°e, 1 bar and window pair.

Channel I rising time (t_1): The value is nominally 100 ns.

Channel I falling time (t_2): The value is nominally 150 ns.

MR2

Integrated Magnetic Encoder



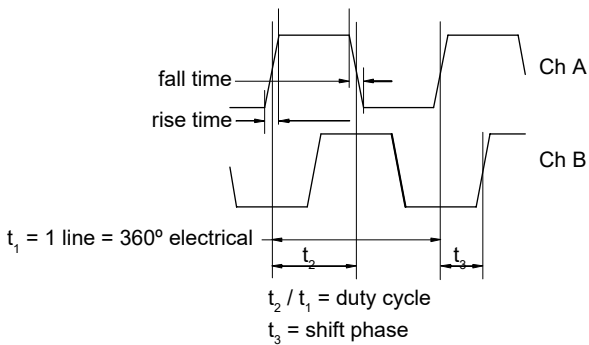
Dimensions in mm

Electrical Data	Characteristics @ 22° C	Unit
1 Number of Lines Available	512, 500, 400, 256, 250, 200, 160, 128, 100, 80, 64, 50, 40, 32, 20, 16, 8, 4	LPR
2 Supply Voltage	5 ± 10%	Volt
3 Supply Current	Typical/Maximum	20/25
4 Rise Time	60	ns
5 Fall Time	60	ns
6 Maximum Count Frequency	1.28	MHz
7 Electrical Phase Shift	90 ± 45	degree
8 Duty Cycle	50 ± 15	%
9 Maximum Speed @ 512	37,500	rpm
10 Operating Temperature Range:	-25 to +85 (-13 to +185)	°C (°F)
11 Weight	Varies by motor size. Contact us.	g (oz)

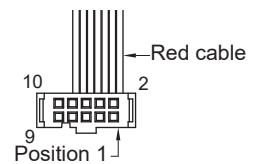
Available on Motor Types*	12G88	13N88	16G88	16N98	17S98	17N98
Length with motor mm (in)	33.8 (1.33)	34.35 (1.35)	35.8 (1.41)	33.2 (1.31)	23.9 (0.94)	31.1 (1.22)

Available on Motor Types*	22N98	25GST
Length with motor mm (in)	39.35 (1.55)	53.9 (2.12)

Output signals:



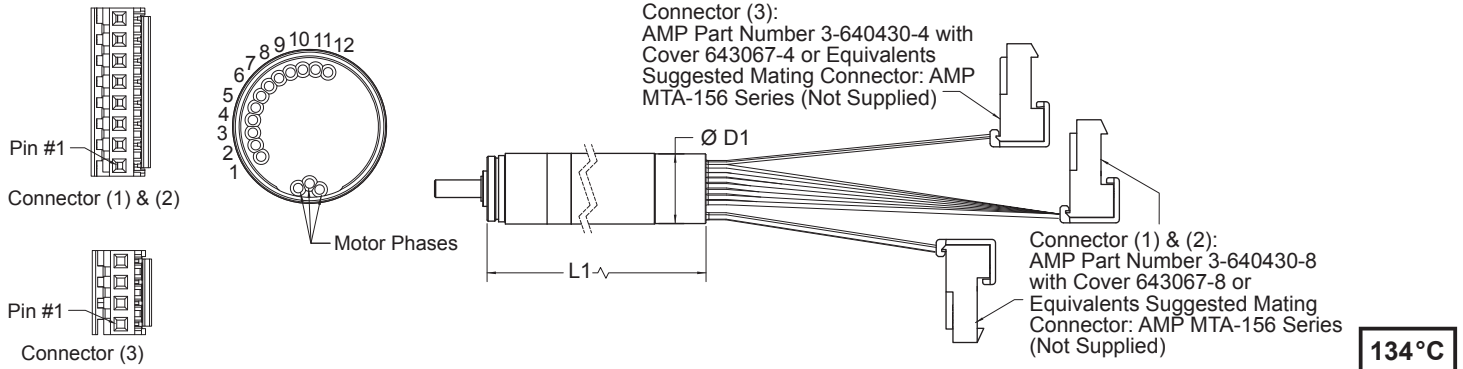
Encoder Connections	
1	Motor+
2	Vcc
3	Channel A
4	Channel B
5	GND
6	Motor -
7	Channel Z



Connector 10 poles type Quickie II or equivalent DIN 41651 A (UL E68080)

M-Sense12A

Autoclavable Magnetic Encoder (incremental/absolute output)



Dimensions in mm

General Data			M-Sense12Ai Incremental	M-Sense12Aa Absolute	Unit
1	Number of Lines Available*		1 to 1024	1 to 1024	LPR
2	Supply Voltage	Min/Max	4.5 / 5.5	4.5 / 5.5	Volt
3	Supply Current	Max	30	30	mA
4	Rise/Fall Time (CL=50pF)		60 / 60	60 / 60	ns
5	Output Frequency		16	-	MHz
6	Maximum Communication Speed		-	10	Mbit/s
7	Electrical Phase Shift	Binary Resolutions	up to 256 LPR	90 ±45	°e
		Binary Resolutions	up to 1024 LPR	90 ±75	°e
	Non-Binary Resolutions	up to 250 LPR	90 ±50	-	°e
		up to 1000 LPR	90 -75/+145	-	°e
8	Duty Cycle	Binary Resolutions	up to 256 LPR	50 ±15	%
		Binary Resolutions	up to 1024 LPR	50 ±25	%
	Non-Binary Resolutions	up to 250 LPR	50 ±25	-	%
		up to 1000 LPR	50 ±35	-	%
9	INL (Integral Non-Linearity)		1.5	1.5	°m
10	Maximum Speed		120'000	120'000	rpm
11	Line Driver Parameters*		4 mA / 10 MHz (default)	-	
12	Interface type		-	Absolute BiSS-C or SSI	
13	Cable Type		8 in (203 mm) min long, AWG26 Stranded, Extruded PTFE Insulation	8 in (203 mm) min long, AWG26 Stranded, Extruded PTFE Insulation	
14	Operating Temperature Range		-40 to +125 (-40 to 257)	-40 to +125 (-40 to 257)	°C (°F)
15	Weight		8 (0.28)	8 (0.28)	g (oz)
16	Autoclaves Cycles		2000	2000	Cycles

Notes:

All parameters are given at 22°C - room temperature. Most of those parameters will vary w/ temperature

Supply Voltage for measurement is 5Vdc / - Phase Shift & Duty cycle are given for 5'000 rpm

*Factory configured

Available on Motor Types	B0512A4002
L1 Length with motor mm (in)	64.54 (2.54)
D1 Diameter mm (in)	12.67 (0.5)

Encoder performance option available on request (contact us):

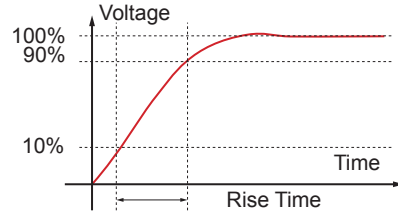
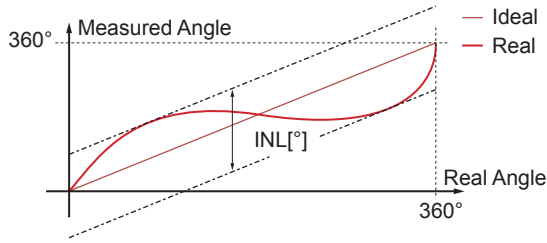
Optional Line driver type: 4mA-10MHz (default) / 60mA-10MHz / 60mA-300kHz / 20mA-3MHz. 4mA-10MHz is recommended for use as single ended outputs. Other options are dedicated for use of differential outputs.

Other parameters can be customized: Index synchronization mode, minimal edge distance, direction of rotation, low current mode and others.

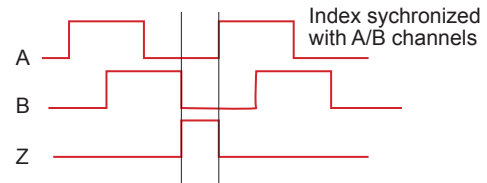
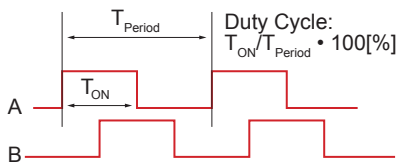
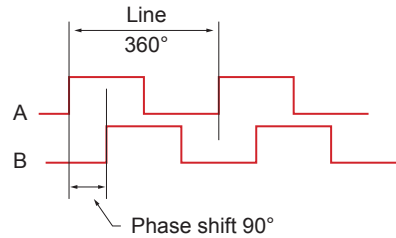
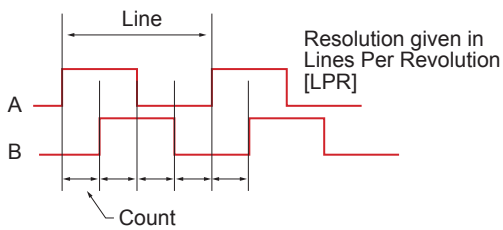
CONNECTOR WIRING (1)			
Motor Pinout	Pos. #	Color	Function
N/A	1	Blue	Phase A
N/A	2	Brown	Phase B
N/A	3	Violet	Phase C
CONNECTOR WIRING (2)			
1	1	White	NZ
2	2	White	Z
3	3	White	NB
4	4	White	B
5	5	White	NA
6	6	White	A
7	7	White	GND
8	8	White	VCC
CONNECTOR WIRING (3)			
9	1	White	SLO
10	2	White	MA
11	3	White	SLI
12	4	White	VZAP

M-Sense12A

Autoclavable Magnetic Encoder (incremental/absolute output)

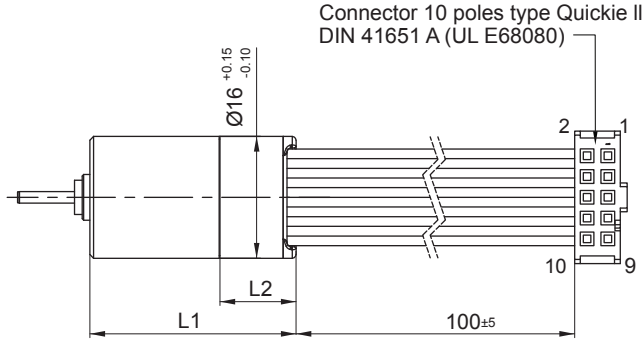


For incremental version:



M-Sense16

Magnetic Encoder (incremental/absolute output)



Dimensions in mm

Pin allocation				
	with DC Motor		with BLDC Motor	
	M-Sense16i	M-Sense16a	M-Sense16i	M-Sense16a
1 (red)	Motor +(LM)	VCC	Do not connect	VCC
2	VCC	GND	VCC	GND
3	GND	SLO	GND	SLO
4	Motor -(RM)	MA	Do not connect	MA
5	Channel A/	SLI	Channel A/	SLI
6	Channel A	Do not connect	Channel A	Do not connect
7	Channel B/	Motor +(LM)	Channel B/	Do not connect
8	Channel B	Motor -(RM)	Channel B	Do not connect
9	Channel Z/	Not connected	Channel Z/	Not connected
10	Channel Z/	Not connected	Channel Z/	Not connected

General Data			M-Sense16i Incremental	M-Sense16a Absolute	Unit
1	Number of Lines Available*		1 to 1024	1 to 1024	LPR
2	Supply Voltage	Min/Max	4.5 / 5.5	4.5 / 5.5	Volt
3	Supply Current	Max	30	30	mA
4	Rise/Fall Time (CL=50pF)		60 / 60	60 / 60	ns
5	Output Frequency		16	-	MHz
6	Maximum Communication Speed		-	10	Mbit/s
7	Electrical Phase Shift	Binary Resolutions	up to 256 LPR	90 ±45	°e
		Binary Resolutions	up to 1024 LPR	90 ±75	°e
	Non-Binary Resolutions	up to 250 LPR	90 ±50	-	°e
		up to 1000 LPR	90 -75/+145	-	°e
8	Duty Cycle	Binary Resolutions	up to 256 LPR	50 ±15	%
		Binary Resolutions	up to 1024 LPR	50 ±25	%
	Non-Binary Resolutions	up to 250 LPR	50 ±25	-	%
		up to 1000 LPR	50 ±35	-	%
9	INL (Integral Non-Linearity)		1.5	1.5	°m
10	Maximum Speed		120'000	120'000	rpm
11	Line Driver Parameters*		4 mA / 10 MHz (default)	-	
12	Interface type		-	Absolute BiSS-C or SSI	
13	Cable Type		AWG28 Ribbon cable pitch 1.27mm	AWG28 Ribbon cable pitch 1.27mm	
14	Operating Temperature Range		-40 to +125 (-40 to 257)	-40 to +125 (-40 to 257)	°C (°F)
15	Weight		8 (0.28)	8 (0.28)	g (oz)

Notes:

All parameters are given at 22°C - room temperature. Most of those parameters will vary w/ temperature
 Supply Voltage for measurement is 5Vdc / - Phase Shift & Duty cycle are given for 5'000 rpm
 *Factory configured

Available on Motor Types	16DCP 26P1/P2	16DCP 26G1/G2	16DCT 26P1/P2	16DCT 26G1/G2	16S78	16N98	17DCT 26P1/P2	17DCT 26G1/G2
L1 Length with motor mm (in)	36.1 (1.42)	36.6 (1.44)	36.1 (1.42)	36.6 (1.44)	27.1 (1.07)	36.4(1.43)	36.1 (1.42)	36.6 (1.44)
L2 Length without motor mm (in)	10 (0.40)	10 (0.40)	10 (0.40)	10 (0.40)	10 (0.39)	10 (0.40)	10 (0.40)	10 (0.40)

Available on Motor Types	17N78	22S48	22N98	22DCP	22DCT	24DCT	23GST	25GST
L1 Length with motor mm (in)	34.4 (1.35)	36.6 (1.44)	46.4 (1.83)	**	**	**	**	**
L2 Length without motor mm (in)	10 (0.40)	9.45 (0.38)	13.1 (0.52)	**	**	**	**	**

Available on Motor Types	30GT	35NT	35GLT	16ECP24	16ECP36	16ECP52	**Available on request	
L1 Length with motor mm (in)	**	**	**	35.4 (1.39)	47.4 (1.86)	63.4 (2.50)		
L2 Length without motor mm (in)	**	**	**	11.4 (0.45)	11.4 (0.45)	11.4 (0.45)		

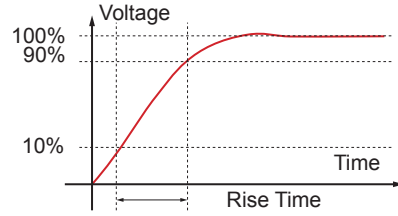
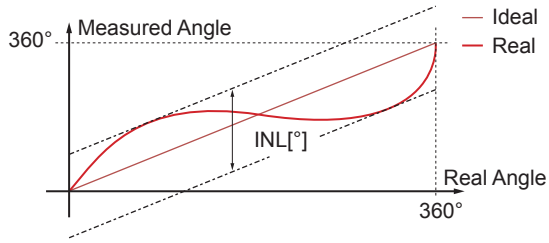
Encoder performance option available on request (contact us):

Optional Line driver type: 4mA-10MHz (default) / 60mA-10MHz / 60mA-300kHz / 20mA-3MHz. 4mA-10MHz is recommended for use as single ended outputs. Other options are dedicated for use of differential outputs.

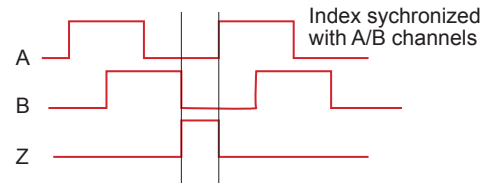
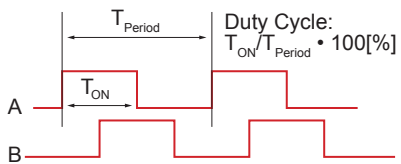
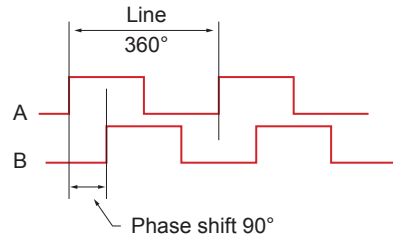
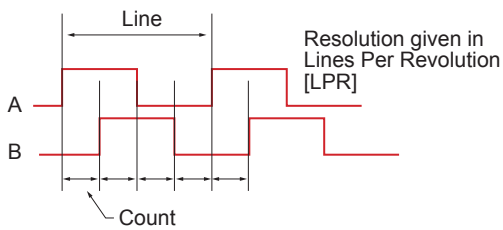
Other parameters can be customized: Index synchronization mode, minimal edge distance, direction of rotation, low current mode and others.

M-Sense16

Magnetic Encoder (incremental/absolute output)

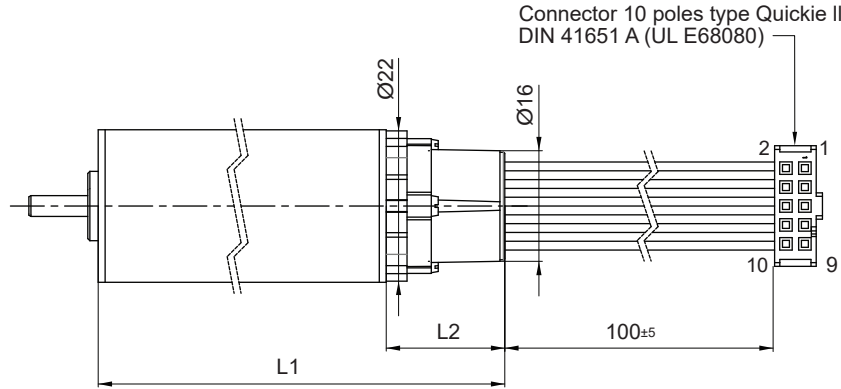


For incremental version:



M-Sense22

Magnetic Encoder (incremental/absolute output)



Dimensions in mm

Pin allocation		
	M-Sense22i	M-Sense22a
1 (red)	Do not connect	VCC
2	VCC	GND
3	GND	SLO
4	Do not connect	MA
5	Channel A/	SLI
6	Channel A	Do not connect
7	Channel B/	Not connected
8	Channel B	Not connected
9	Channel Z/	Not connected
10	Channel Z/	Not connected

General Data			M-Sense22i Incremental	M-Sense22a Absolute	Unit
1	Number of Lines Available*		1 to 1024	1 to 1024	LPR
2	Supply Voltage	Min/Max	4.5 / 5.5	4.5 / 5.5	Volt
3	Supply Current	Max	23	23	mA
4	Rise/Fall Time (CL=50pF)		60 / 60	60 / 60	ns
5	Output Frequency		16	-	MHz
6	Maximum Communication Speed		-	10	Mbit/s
7	Electrical Phase Shift	Binary Resolutions up to 256 LPR	90 ±45	-	°e
		Binary Resolutions up to 1024 LPR	90 ±75	-	°e
	Non-Binary Resolutions	up to 250 LPR	90 ±50	-	°e
		up to 1000 LPR	90 -75/+145	-	°e
8	Duty Cycle	Binary Resolutions up to 256 LPR	50 ±15	-	%
		Binary Resolutions up to 1024 LPR	50 ±25	-	%
	Non-Binary Resolutions	up to 250 LPR	50 ±25	-	%
		up to 1000 LPR	50 ±35	-	%
9	INL (Integral Non-Linearity)		1.5	1.5	°m
10	Maximum Speed		120'000	120'000	rpm
11	Line Driver Parameters*		4 mA / 10 MHz (default)	-	-
12	Interface type		-	Absolute BiSS-C or SSI	-
13	Cable Type		AWG28 Ribbon cable pitch 1.27mm	AWG28 Ribbon cable pitch 1.27mm	-
14	Operating Temperature Range		-40 to +125 (-40 to 257)	-40 to +125 (-40 to 257)	°C (°F)
15	Weight		6 (0.21)	6 (0.21)	g (oz)

Notes:

All parameters are given at 22°C - room temperature. Most of those parameters will vary w/ temperature
 Supply Voltage for measurement is 5Vdc / - Phase Shift & Duty cycle are given for 5'000 rpm
 *Factory configured

Available on Motor Types	22ECP35 Ultra EC	22ECP45 Ultra EC	22ECP60 Ultra EC	22ECS45 Ultra EC	22ECS60 Ultra EC	22ECT35 Ultra EC	22ECT48 Ultra EC	22ECT60 Ultra EC
L1 Length with motor mm (in)	52.1 (2.05)	62.1 (2.44)	77.1 (3.04)	62.1 (2.44)	77.1 (3.04)	52.1 (2.05)	65.1 (2.56)	77.1 (3.04)
L2 Length without motor mm (in)	17.1 (0.67)	17.1 (0.67)	17.1 (0.67)	17.1 (0.67)	17.1 (0.67)	17.1 (0.67)	17.1 (0.67)	17.1 (0.67)

Available on Motor Types	22ECT82 Ultra EC	30ECT64 Ultra EC	30ECT90 Ultra EC	35ECS60 Ultra EC	35ECS80 Ultra EC
L1 Length with motor mm (in)	99.1 (3.90)	78.1 (3.07)	104.1 (4.10)	74.1 (2.92)	94.1 (3.70)
L2 Length without motor mm (in)	17.1 (0.67)	14.1 (0.56)	14.1 (0.56)	14.1 (0.56)	14.1 (0.56)

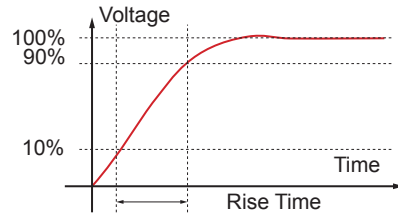
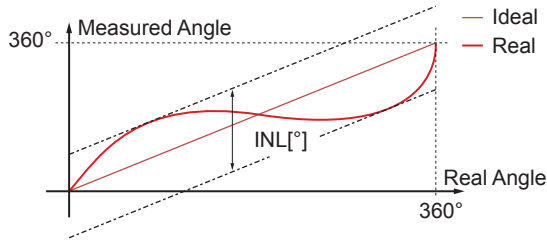
Encoder performance option available on request (contact us):

Optional Line driver type: 4mA-10MHz (default) / 60mA-10MHz / 60mA-300kHz / 20mA-3MHz. 4mA-10MHz is recommended for use as single ended outputs. Other options are dedicated for use of differential outputs.

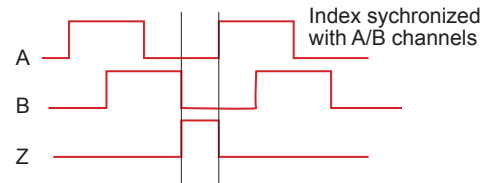
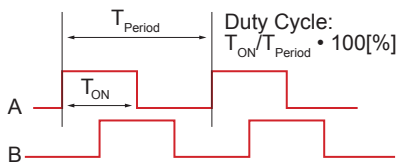
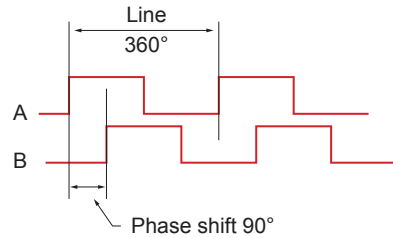
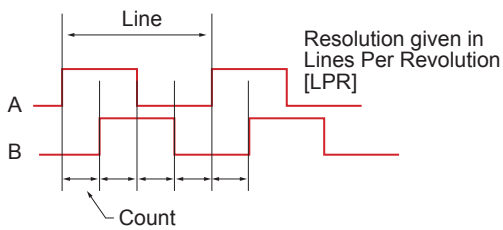
Other parameters can be customized: Index synchronization mode, minimal edge distance, direction of rotation, low current mode and others.

M-Sense22

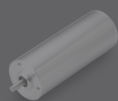
Magnetic Encoder (incremental/absolute output)



For incremental version:



A large grid of graph paper for taking notes, consisting of 20 columns and 40 rows of small squares.



Brushless DC motors



Brush DC motors



Disc magnet motors



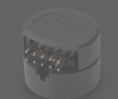
Can stack motors



Can stack linear actuators



Gearheads



Encoders



Controllers

Controllers

Controllers enable precise control over a motor's performance characteristics and will operate differently depending on the specific motor technology they are paired with; this means that brushless DC and stepper motor controllers each feature unique operating characteristics.

Regardless of the motor technology, the choice of drive is dependent on the specific requirements of the application. These requirements include desired speed range, torque control, and positional accuracy, as well as market-specific needs like autoclavability.

Portescap's autoclavable controllers can withstand up to 1,000 sterilization cycles, include both sensed and sensorless options, and are compatible with our BLDC slotted and slotless sterilizable motors.

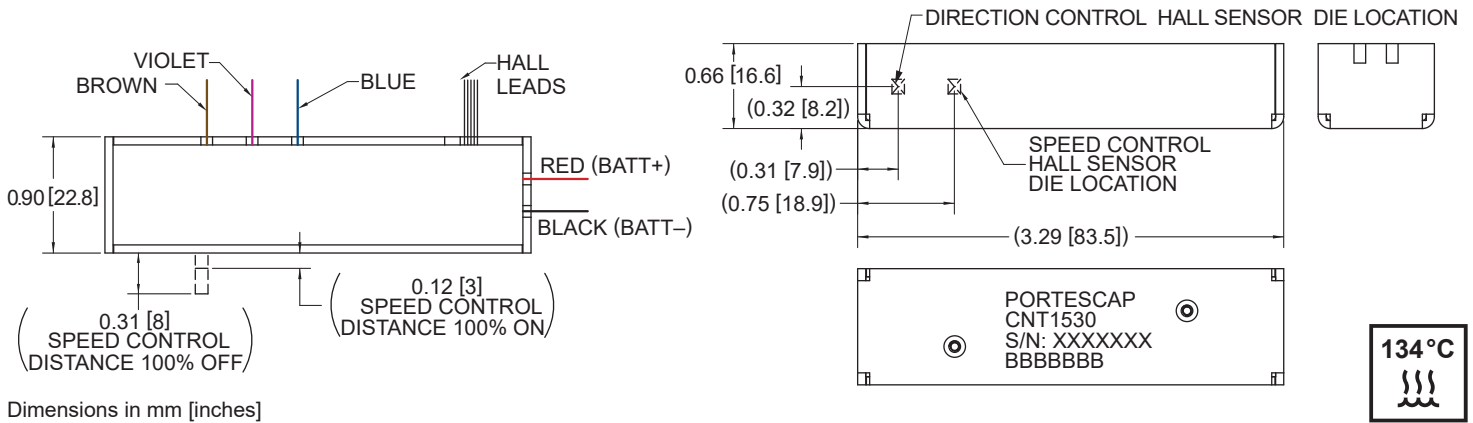


Stay in Control of Your Motion Needs

Feature	Details	Application Advantages
Motor technology options	<ul style="list-style-type: none">• Different controllers for brushless DC and stepper motors	<ul style="list-style-type: none">• Greater design flexibility
Sensed and sensorless options	<ul style="list-style-type: none">• Electronic commutation of brushless motors• With or without Hall sensor feedback	<ul style="list-style-type: none">• Motion performance and number of wires adapted to the type of motion required
Speed, torque, and positioning control	<ul style="list-style-type: none">• Driving mode based on different parameters	<ul style="list-style-type: none">• Versatility to fit motion needs
Autoclavability	<ul style="list-style-type: none">• Withstands 1,000+ sterilization cycles	<ul style="list-style-type: none">• Compatible with autoclavable power tools
Magnetic control	<ul style="list-style-type: none">• Speed and/or direction controlled by magnets	<ul style="list-style-type: none">• Simple integration into portable hand tools

CNT1530

SMS Controller



Dimensions in mm [inches]

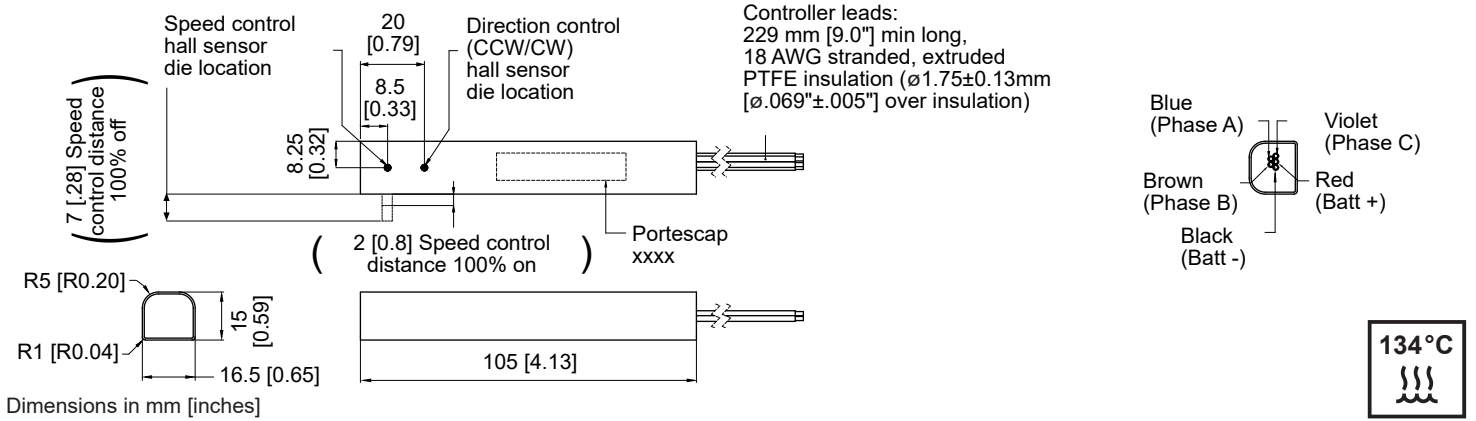
Electrical Data	CNT1530	Unit
1 Min. Operating Voltage	9	Volt
2 Max. Operating Voltage	15	Volt
3 Standby Current	40	mA DC
4 Current Limit {1}	>75 for >10 ms	A DC
5 Max. Continuous Input Power	300	W
6 Continuous Output Current	20	A DC
Operating Modes		
7 Control Method	Open Loop Speed	
8 Switching Waveform	Trapezoidal	
9 Feedback Type	Sensored	
Inputs		
10 Hall Sensors	H1, H2, H3	
11 Power Input	BATT+, BATT-	
12 Magnetic Triggers	Direction (FD/REV), Speed (0-100% PWM)	
13 Recommended Speed Magnet Grade {2}	SmCo 1:5	
14 Recommended Speed Magnet Dimensions	4.76 x 1.52 (0.188" x 0.060") Dia x Thick	mm (in)
15 Recommended Direction Magnet Grade {2}	SmCo 1:5	
16 Recommended Direction Magnet Dimension	3.18 x 3.18 (0.125" x 0.125") Dia x Thick	mm (in)
Outputs		
17 Phase Leads	A, B, C	
Environmental		
18 Maximum Storage Temperature	150 (302)	°C (°F)
19 Autoclave Cycles	1,000	
Mechanical		
20 Housing Material	Aluminum	
21 Dimensions	22.8 x 83.5 x 16.6 (0.90 x 3.29 x 0.66)	mm (in)
22 Weight	70 (2.5)	g (oz)
23 Wire Insulation Material	PTFE	
24 Power Lead AWG	18	
25 Hall Sensor Lead AWG	26	

Notes:

1. Current limit allows brief excursions beyond 75ADC so long as they are less than 10ms in length. The response time is dependent upon the slew rate of the current excursion, and the current limit features is intended to prevent against prolonged motor stall conditions from inducing further damage in the system.
2. Recommended SmCo 1:5 Disk Magnets are suggestions for the appropriate magnet to incorporate into the speed trigger and direction switch in the customer's handpiece. Please contact Portescap with further specification questions.

CNT2440

SMS Controller



Electrical Data	CNT2440	Unit
1 Min. Operating Voltage	5	Volt
2 Max. Operating Voltage	24	Volt
3 Standby Current	70	mA DC
4 Current Limit	70 for <10 ms	A DC
5 Max. Continuous Input Power	960	W
6 Continuous Output Current	40	A DC

Operating Modes		
7 Control Method	Open Loop Speed Control	
8 Switching Waveform	Hybrid of Six-Step and Sinusoidal	
9 Feedback Type	Sensorless	

Inputs		
10 Power Input	BATT+, BATT-	
11 Magnetic Triggers	Direction (FD/REV), Speed (0-100% PWM)	
12 Recommended Speed Magnet Grade {1}	SmCo18 1:5	
13 Recommended Speed Magnet Dimensions	4.76 x 1.52 (0.188" x 0.060") Dia x Thick	mm (in)
14 Recommended Direction Magnet Grade {1}	SmCo20 1:5	
15 Recommended Direction Magnet Dimension	3.18 x 3.18 (0.125" x 0.125") Dia x Thick	mm (in)

Outputs		
16 Phase Leads	A, B, C	

Environmental		
17 Maximum Storage Temperature	150 (302)	°C (°F)
18 Autoclave Cycles	1,000	

Mechanical		
19 Housing Material	Aluminum	
20 Dimensions	16.5 x 105 x 15 (0.65 x 4.13 x 0.59)	mm (in)
21 Weight	60 (2.11)	g (oz)
22 Wire Insulation Material	PTFE	
23 Power Lead AWG	18	

Notes:
 1. Recommended disk magnets are suggestions for the appropriate magnet to incorporate into the speed trigger and direction switch of customer's hand piece. Please contact Portescap for any different magnet specifications or further questions.

A large grid of graph paper for taking notes, consisting of 20 columns and 40 rows of small squares.

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Examples of DC Coreless Motor Calculations

This section aims to provide all the information necessary to select a DC Coreless Motor and to calculate the values at the desired operating point.

Example: Direct drive without a gearhead attached to the motor.

For this application we are looking for a DC Coreless Motor for a continuous duty application. The application requirements are:

Available voltage:	10 Vdc		
Available current:	1 Amp		
Motor operating point:	2,000 rpm	[n]	desired motor speed
	6 mNm	[τ]	desired output shaft torque
	22° C	[T _{amb}]	ambient temperature
	Continuous operation		
Motor dimensions:	45 mm		maximum allowable length
	25 mm		maximum allowable diameter

The Portescap DC Coreless motor 22DCP can deliver 6.21 mNm of torque continuously, and is a good starting point for our calculation.

Let's examine the motor series 22DCP 32G1 213P.1, which has a nominal voltage of 9 Vdc. The characteristics we are most interested in are the torque constant (k) of 8.48 mNm/A, the terminal resistance (R) of 4.3 Ω and the no-load current (I₀) of 53 mA. For a load torque (τ) of 6 mNm the motor current is:

$$I = \tau / k + I_0 \quad [\text{A}]$$

$$I = 6 \text{ mNm} / (8.48 \times 10^{-3} \text{ mNm/A}) + 53 \text{ mA} = 0.76 \text{ A}$$

The current value obtained is just below the maximum continuous current of the selected product. Now let's verify that to meet this working point, we have enough supply voltage (U).

$$U = R \times I + k \times \omega \quad [\text{Vdc}]$$

$$\omega = 2\pi/60 \times n = 2\pi/60 \times 2,000 \text{ rpm} = 209.44 \text{ rad/s} \quad [\text{rad/s}]$$

$$U = 4.3 \Omega \times .76 \text{ A} + (8.48 \times 10^{-3} \text{ Nm/A}) \times 209.44 \text{ rad/s} = 5.0 \text{ Vdc}$$

With 10V supply voltage available and only 5V required, the motor will be able to meet the required working point. We note that the current of 0.76 A is quite close to the rated continuous current of 0.77 A. This means the coil temperature reached at this current is likely to be very close the motor specified maximum coil temperature of 100°C. The below chapter explores thermal considerations applied to this case.



Thermal considerations while selecting a motor:

When torque is applied to a motor, joule losses are created ($P_{\text{Joule}} = R \times I^2$) and the rotor temperature increases. The motor dissipates the heat generated at two levels:

1. From the coil to the motor body ($R_{\text{th rotor-body}}$)
2. From the motor body to the ambient environment ($R_{\text{th body-ambient}}$)

The ability for a motor to dissipate heat is determined by these thermal resistances. Moreover, the coil resistance value increases with temperature. Therefore P_{Joule} increases until it reaches a steady state value. In this exercise we would like to check whether at a given continuous operating point the coil temperature stays below the maximum rated coil temperature.

The 22DCP 32G1 213P.1 requires 0.76 A and 5.0 V at a working point 6.45 mNm and 2,000 RPM. The given catalogue parameters are:

Maximum rated coil temperature:	100	[°C]
Thermal resistance $R_{\text{th rotor-body}}$:	6	[°C/W]
Thermal resistance $R_{\text{th body-ambient}}$:	22	[°C/W]
Terminal resistance R_0^* :	4.3	[Ω]
Thermal coefficient of resistance for Copper α :	0.0039	[°C ⁻¹]

*The terminal resistance in the catalog is always given at room temperature (22 °C).

The resistance increase with temperature is given by the following equation:

$$R_{T_{\text{Final}}} = R_0 \times (1 + \alpha \times (T_{\text{Final}} - 22 \text{ °C}))$$

According to the Thermal Law:

$$\Delta T = P_{\text{dissipated}} \times R_{\text{th}}$$

In our case, we consider the following thermal law between the coil and the ambient environment. ΔT [°C] is the temperature difference between the coil and the ambient temperature $T_{\text{coil}} - T_{\text{amb}}$.

$$P_{\text{dissipated}} = P_{\text{Joule}} = R \times I^2 = R_0 \times (1 + \alpha \times (T_{\text{coil}} - 22 \text{ °C})) \times I^2 \quad [\text{W}]$$

$$R_{\text{th}} = R_{\text{th rotor-body}} + R_{\text{th body-ambient}} = 28 \text{ °C/W} \quad (\text{total thermal resistance between the coil and ambient})$$

$$\text{Thus:} \quad T_{\text{coil}} - T_{\text{amb}} = R_{\text{th}} \times R_0 \times (1 + \alpha \times (T_{\text{coil}} - 22 \text{ °C})) \times I^2 \quad [^\circ\text{C}]$$

Finally, isolating T_{coil} gives:

$$T_{\text{coil}} = \frac{T_{\text{amb}} + R_{\text{th}} \times R_0 \times (1 - \alpha \times 22 \text{ °C}) \times I^2}{1 - R_0 \times I^2 \times R_{\text{th}} \times \alpha} = \frac{22 \text{ °C} + 28 \text{ °C/W} \times 4.3 \Omega \times \left(1 - 0.0039 \text{ °C}^{-1} \times 22 \text{ °C}\right) \times (0.76 \text{ A})^2}{1 - 4.3 \Omega \times (0.76 \text{ A})^2 \times 28 \text{ °C/W} \times 0.0039 \text{ °C}^{-1}} = 118 \text{ °C}$$

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At steady state, the final coil temperature calculated is 118°C which is above the 100°C limit. In theory this motor coil insulation would burn and create a short-circuit in the coil. However, the thermal resistance R_{th} body– ambient is usually overestimated. It is measured when the motor is placed in air with no contact with another part. In reality, the motor is always fixed in the application (fixed by the front flange, clamped on the outside diameter, etc.). These fixations usually act as heat sinks and allow the motor to dissipate more heat. Therefore a real value for R_{th} body–ambient in the application is usually closer to half of the value given in the datasheet. Doing the math with R_{th} body– ambient = 11°C/W ($R_{th} = 17$ °C/W) will give you a final coil temperature of 73°C, providing enough security compared to the 100°C limit.

Let's now take into account the impact of the 73° C coil temperature :

$$R_{T_{Final}} = R_0 \times (1 + \alpha \times (T_{Final} - 22^\circ C)) = 4.3 \Omega \times (1 + 0.0039 \text{ }^\circ C \times (73^\circ C - 22^\circ C)) = 5.14 \Omega$$

In our case, the resistance has increased and therefore the joule losses have also increased. To keep the same mechanical power output, we need to provide more electrical input:

$$U = R_{T_{Final}} \times I + k \times \omega = 5.14 \Omega \times 0.76 \text{ A} + (8.48 \times 10^{-3} \text{ Nm/A}) \times 209.44 \text{ rad/s} = 5.7 \text{ V}$$

Thus, to achieve the requested speed at 73° C coil temperature, the voltage has to be increased at 5.7 V.

$$P_{mech} = 6 \text{ mNm} \times 2,000 \text{ rpm} \times 2\pi/60 \text{ rad}\cdot\text{s}^{-1}/\text{rpm} = 1.25 \text{ W}$$

$$P_{elec} = 5.7 \text{ V} \times 0.76 \text{ A} = 4.33 \text{ W}$$

$$P_{joule} = 5.14 \Omega \times (0.76 \text{ A})^2 = 2.97 \text{ W}$$

$$\text{Efficiency} = P_{mech} / P_{elec} = 29\%$$

Note: The above model is only valid for continuous operation. For intermittent duty, a time step model is necessary to estimate the final temperatures.

In conclusion, the 22DCP will be an appropriate choice if the mountings will help dissipate heat. But to achieve better efficiency, another stronger motor can be selected. The below example takes efficiency into consideration for the same working point.

Selecting a DC Brush Motor for better efficiency and temperature regulation:

Let's consider the fundamental equation of DC motors:

$$U = R \times I + k \times \omega$$

Multiplying both sides of the equation by the current:

$$U \times I = R \times I^2 + k \times I \times \omega$$

From $\tau = k \times I$ we know that $I = \tau/k$. Substituting into the previous equation and simplifying gives:

$$U \times I = R/k^2 \times \tau^2 + \tau \times \omega$$

By examining this equation we can identify the key parameters.

$$U \times I = P_{elec} \text{ is the electrical power supplied}$$

$$\tau \times \omega = P_{mech} \text{ is the mechanical power converted by the motor}$$

$$R/k^2 \times \tau^2 = \text{joule losses}$$



Therefore the motor regulation parameter R/k^2 is directly related to the motor's capability of converting electrical power to mechanical power. A lower value of R/k^2 means better heat conversion. R/k^2 values are usually in the same range for a motor family and are very good indicators of motor performance across different motor types.

For example:

22DCP types offer R/k^2 values around $60 \times 10^3/\text{Nms}$.

22DCT types offer R/k^2 values around $11 \times 10^3/\text{Nms}$.

For the same package size (22 mm diameter, 32 mm length) and the same mechanical output power, the Athlonix 22DCT will have five times less joules losses and therefore better efficiency.

To take into consideration thermal properties of the motor, we can compare the values for $R/k^2 \times R_{th}$ which reflect the ability of a motor to convert electrical power to mechanical power and dissipate joule losses for a given job:

	R/k^2 [$10^3/\text{Nms}$]	$R_{th} = R_{th \text{ rotor - body}} + R_{th \text{ body - ambient}}$	$R/k^2 \times R_{th}$ [$^\circ\text{C} \times 10^3/(\text{Nm})^2$]
22DCP 32G1 213P	60	28	1680
22DCT 32G1 226E	11	28	308

The above table predicts best thermal behavior under load conditions for 22DCT motor. If we do the math, we will have the following parameters and results:

22DCT 32G1 226E

$$k = 12.12 \text{ mNm/A}$$

$$I = \tau/k + I_0 = 0.53 \text{ A}$$

$$R_0 = 1.7 \Omega$$

$$R_{th} = 6 \text{ }^\circ\text{C/W} + (22 \text{ }^\circ\text{C/W})/2 = 17 \text{ }^\circ\text{C/W}$$

Using the method of calculation as the previous example:

$$T_{coil} = 30 \text{ }^\circ\text{C}$$

$$R_{30 \text{ }^\circ\text{C}} = 1.75 \Omega$$

$$U_{required} = 3.47 \text{ V}$$

$$P_{elec} = 3.47 \text{ V} \times 0.53 \text{ A} = 1.84 \text{ W}$$

$$P_{mech} = 6 \times 10^{-3} \text{ Nm} \times 2,000 \text{ rpm} \times 2\pi/60 \text{ rad}\cdot\text{s}^{-1}/\text{rpm} = 1.26 \text{ W}$$

$$P_{Joule} = R_{30 \text{ }^\circ\text{C}} \times I^2 = 1.75 \Omega \times 0.53 \text{ A}^2 = 0.49 \text{ W}$$

$$\text{Efficiency} = P_{mech} / P_{elec} = 1.26 \text{ W} / 1.84 \text{ W} = 68\%$$

Selecting a motor with better R/k^2 enabled us to more than double the efficiency. Thermal considerations are important for an optimal motor selection and to ensure best performance.

During the whole exercise we could identify two solutions that meet the requirements. If efficiency was a critical parameter in the application (battery operation for example), the 22DCT is a more suitable option.

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Examples of DC Coreless Gearmotor Calculations

Example: Direct drive with a gearhead attached to the motor.

For this application we are looking for a DC Coreless Motor & Gearhead for a continuous duty application. The application requirements are:

Available voltage:	15 Vdc		
Available current:	1.5 Amp		
Motor operating point:	30 rpm	[n]	desired motor speed
	500 mNm	[τ]	desired output shaft torque
	22°C	[T _{amb}]	ambient temperature
	Continuous operation		
Motor dimensions:	80 mm		maximum allowable length
	25 mm		maximum allowable diameter

The specification page for the R22 gearhead shows a maximum continuous torque of 600 mNm, so the required 500 mNm can be handled by this planetary gearhead. When choosing the reduction ratio, we should keep in mind that the recommended maximum input speed of the R22 gearhead is 5,000 rpm. We should keep the input speed below this value to assure low wear and low audible noise.

$$i = n_{\max} / n_{\text{load}}$$
$$i = 5,000 \text{ rpm} / 30 \text{ rpm} = 166.7$$

The catalog indicates that the closest ratio to the desired value calculated above is 159:1. The efficiency for this ratio is $\eta = 0.6$ (or 60%). We may now calculate the motor speed (n_m) and the reflected torque (τ_m) on the motor shaft.

$$\tau_m = \tau / (i \times \eta) \text{ [mNm]}$$
$$\tau_m = 500 \text{ mNm} / (159 \times 0.6) = 5.24 \text{ mNm}$$
$$n_m = n_{\text{load}} \times i = 30 \text{ rpm} \times 159 = 4,770 \text{ rpm}$$

The motor data sheet shows the 22DCP family of motors can deliver a torque up to 6.21 mNm continuously and will be our candidate. The 22DCP is available as a standard combination with the planetary gearhead R22. Based on the available voltage let's consider the 211P winding (12 V measuring voltage) and calculate the motor current and voltage the same way as in the previous example.

The motor is required to be driven at a speed of 4,770 rpm under a load of 5.24 mNm. The ambient temperature (T_{amb}) is 22 °C and the available voltage in the application is 15 Vdc. The characteristics we are most interested in are the torque constant (k) of 11.63 mNm/A, and the terminal resistance of 7.8 Ω. Neglecting the no-load current (I_0), for a torque load of 5.24 mNm the motor current is:
 $I = \tau / k = 5.24 \text{ mNm} / 11.63 \text{ mNm/A} = 0.45 \text{ A}$

Now we can calculate the drive voltage required to run the motor at 22°C, for a desired speed of 4,770 rpm with a load torque of 5.24 mNm:

$$U = R \times I + k \times \omega \text{ [Vdc]}$$
$$\omega = 2\pi/60 \times n = 2\pi/60 \text{ rad/rpm-s} \times 4,770 \text{ rpm} = 499.51 \text{ rad/s}$$
$$U = (7.8 \Omega \times 0.45 \text{ A}) + (11.63 \times 10^{-3} \text{ Nm/A} \times 499.51 \text{ rad/s}) = 9.3 \text{ Vdc}$$

We note the current of the motor under load is 0.45 A, which is under the rated continuous current of 0.57 A. We therefore can safely assume that the final rotor temperature (T_r) will stay below the maximum rated coil temperature of 100 °C. We can also be sure that the voltage will remain within the 15 Vdc due to raise in coil resistance. The final coil temperature would be 76 °C and the required voltage due to higher coil resistance would be 10 Vdc. Both are well within the limits and our assumptions are justified.

The problem is now solved. The gearmotor 22DCP 32P2 211P.5 R22 0 159 would be a good choice for the application. If the application requires particularly long motor life or if this were a battery application, the 22DCT could also be considered to increase efficiency and extend battery life.

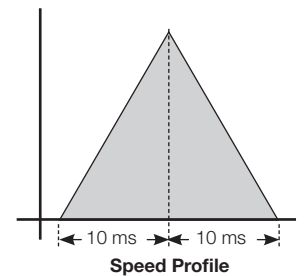


Examples of DC Motor Calculations

Example: Positioning with a DC Coreless Motor.

In this application we are looking for a DC Coreless Motor to move an inertial load (J_{load}) of $40 \times 10^{-7} \text{ kgm}^2$ by an angle of 1 rad in 20 msec. The application requirements are:

Available voltage:	48 Vdc		
Available current:	4 Amp		
Motor operating point:	1 rad	$[\emptyset]$	desired motor movement
	$30 \times 10^{-7} \text{ kgm}^2$	$[J_{load}]$	motor load inertia on output shaft
	20 msec	$[\Delta t]$	desired move time
	22° C	$[T_{amb}]$	ambient temperature
Motor dimensions:	68 mm		maximum allowable length
	35 mm		maximum allowable diameter



Friction is negligible. With this incremental application we consider a duty cycle of 100% and a triangular speed profile.

The motor must rotate 0.5 rad ($\emptyset/2$) in 10 msec ($\Delta t/2$) while accelerating, then another 0.5 rad (also $\emptyset/2$) in 10 msec (also $\Delta t/2$) while decelerating. First let us calculate the angular acceleration α .

$$\alpha = (2 \times \emptyset/2) / (\Delta t/2)^2 \quad [\text{rad/s}^2]$$

$$\alpha = 2 \times .5 \text{ rad} / (.01 \text{ s})^2 = 10,000 \text{ rad/s}^2$$

The torque necessary to accelerate the load is:

$$\tau_{load} = J_{load} \times \alpha \quad [\text{mNm}]$$

$$\tau_{load} = 30 \times 10^{-7} \text{ kgm}^2 \times 10,000 \text{ rad/s}^2 = .030 \text{ Nm} = 30 \text{ mNm}$$

When selecting a motor for incremental motion, it is best if the inertia of the rotor is equal to the inertia of the load. If the rotor inertia is much larger, then a large portion of the mechanical power is used just to move the rotor. The rotor inertia should also not be less than half the load inertia. If it is, then a gearbox should be used to reduce the load inertia felt by the motor. This process is referred to as matching inertias. We will thus select a motor that has a rotor inertia close to $40 \times 10^{-7} \text{ kgm}^2$.

According to the motor specification page, the 30GT2R82-234P.4 has a rotor inertia of $33 \times 10^{-7} \text{ kgm}^2$ and has a torque constant of 20.1 mNm/A. It can deliver enough continuous torque (87 mNm) to handle the combined load calculated below.

$$\tau_{rotor+load} = (30 \times 10^{-7} \text{ kgm}^2 + 33 \times 10^{-7} \text{ kgm}^2) \times 10,000 \text{ rad/s}^2 = .063 \text{ Nm} = 63 \text{ mNm}$$

$$I = \tau / k + I_0 = 63 \text{ mNm} / (20.1 \text{ mNm/A}) + 180 \text{ mA} = 3.31 \text{ A}$$

The coil resistance (at 22° C) is 0.50 Ω , and the thermal resistance is $4.5^\circ \text{ C/W} + 9^\circ \text{ C/W} / 2 = 9^\circ \text{ C/W}$. By using the equation from the first example we find:

$$T_F = 83^\circ \text{ C} \quad R_{83^\circ \text{ C}} = .62 \Omega$$

Since we are using a triangular speed profile, we must determine the maximum speed of the motor during the move and then calculate the required voltage at that speed for the above coil resistance at operating temperature. This maximum speed will occur at the peak of the triangle (after 10 msec).

$$\omega_{max} = \alpha \times \Delta t \quad [\text{rad/s}]$$

$$\omega_{max} = 10,000 \text{ rad/s}^2 \times 0.010 \text{ sec} = 100 \text{ rad/s}$$

$$U = R \times I + K \times \omega = 0.62 \Omega \times 3.31 \text{ A} + (20.1 \times 10^{-3} \text{ Nm/A}) \times 100 \text{ rad/s} = 4.06 \text{ Vdc}$$

The problem is now solved. Since the maximum permissible coil temperature of the 35NT is 155° C, and the available voltage in the application is 48 V, this motor is perfectly capable of performing the required movement.

It is interesting to note here that, had we chosen the larger motor 35NT2R82, the coil temperature would be calculated at over 300° C! Even though the motor is capable of providing more torque, the higher rotor inertia requires it to supply much more power just to move its rotor at the desired speed. This demonstrates the importance of inertia matching.

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Examples of BLDC Slotless Motor calculations

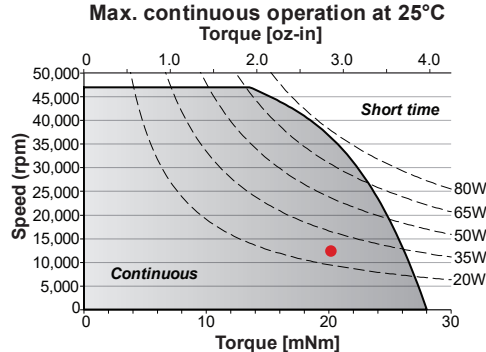
This chapter aims to provide all the information necessary to select a BLDC Slotless motor and to calculate the values at the desired operating point. The following examples are for motor applications running in continuous operation.

1) Example: Brushless application requirements

For this application we are looking for a BLDC motor with high speed capabilities in a continuous duty operation. The motor will be controlled by an amplifier for a motor with Hall Effect sensors.

Available voltage:	30 Vdc		
Available current:	3 Amps		
Motor operating point:	12,000 rpm	$[\omega]$	desired motor speed
	20 mNm	$[\tau]$	motor shaft output torque
	22° C	$[T_{amb}]$	ambient temperature
	Continuous operation		
Motor physical dimensions:	60 mm		maximum allowable length
	25 mm		maximum allowable diameter

Using the speed-torque curve and maximum allowable operating specifications from the data sheet, it is possible to select the correct motor solution. Here we find the BLDC motor 22ECP45 capable of operating at the desired working point.



The motor 22ECP45 is available in 2 different 24 Vdc windings. Windings offer same overall performance (maximum torque, merit factor, etc...) but help using different voltage and current configurations. Since the desired motor speed is 12,000 rpm we will investigate the "82" winding with a no load speed of 15,700 rpm. The torque constant is 14.6 mNm/A and the resistance is 1.59 Ω .

Calculating for the motor current we find:

$$I = \tau / k + I_0 = 20 \text{ mNm} / 14.6 \text{ mNm/A} + 60 \text{ mA} = 1.43 \text{ A}$$

The supply current of the system is 3 Amps and therefore current draw is not an issue. Calculating the voltage required to run the motor at 12,000 rpm:

$$U = R \times I + k \times \omega$$

$$\omega = 2\pi/60 \times n = 2\pi/60 \text{ rad/rpm-s} \times 12,000 \text{ rpm} = 1257 \text{ rad/s}$$

$$U = 1.59 \Omega \times 1.43 \text{ A} + (14.6 \times 10^{-3} \text{ Nm/A}) \times 1257 \text{ rad/s} = 20.6 \text{ Vdc}$$

The problem is now solved. Since the voltage required is less than the available voltage, it is possible to reach the operating point with the BLDC Slotless motor 22ECP45 8B 82 .01. The 22ECP45 with coil "154", despite being able to work at the same working point, would have required higher voltage but lower current.



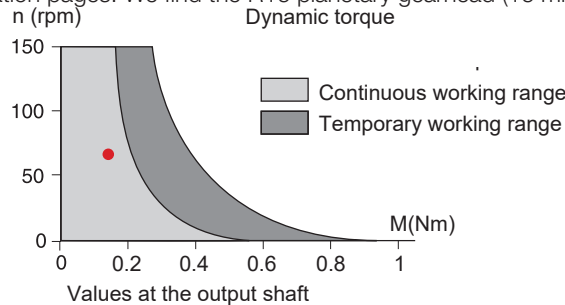
2) Example: Brushless motor with a Gearhead

For this application we want to drive a load at an extremely low constant speed. The customer needs a combination of a Brushless DC motor with a gearhead.

Available voltage:	20 Vdc		
Available current:	2 Amps		
Gearmotor operating point:	60 rpm	$[\omega]$	desired gearmotor speed
	150 mNm	$[\tau]$	gearmotor shaft output torque
	22° C	$[T_{amb}]$	ambient temperature
	Continuous operation		
Motor physical dimensions:	120 mm		maximum allowable length
	20 mm		maximum allowable diameter

Before selecting a motor we must first determine which gearhead is suitable for the application. The important parameters are the specifications relating to the operating point at the shaft of the gearhead. Once an appropriate gearhead has been determined, the working point at the motor shaft can be calculated. From here the motor type can be defined using the same procedure as in the previous example for motor only.

We start the elimination process by comparing the desired gearhead output torque with the data of the various gearheads in continuous operation as listed in the catalog specification pages. We find the R16 planetary gearhead (16 mm diameter) capable of operating at the desired working point.



For continuous operation, one of the most important gearhead parameters to be considered is the maximum recommended input speed into the gearhead ($n_{\text{max input-gearhead}}$). This specification allows us to calculate the maximum reduction ratio (i_{max}) to use for the application.

$$i_{\text{max}} = n_{\text{max input-gearhead}} / n_{\text{output-gearhead}} = 7,500 \text{ rpm} / 60 \text{ rpm} = 125$$

The gearhead can be chosen by selecting the largest available ratio that is below the above result. By reviewing the catalog we choose the 121:1 ratio R16 gearhead.

Motor speed at the shaft:

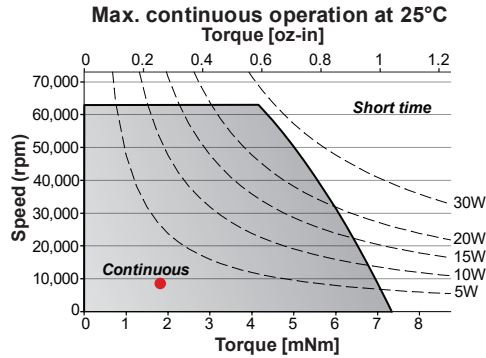
$$n_{\text{motor}} = i \times n_{\text{output-gearhead}} = 121 \times 60 \text{ rpm} = 7,260 \text{ rpm}$$

Motor torque at the shaft:

$$\eta = 0.65 \text{ (gearhead efficiency)}$$

$$\tau_{\text{motor}} = \tau_{\text{gearhead}} / i \times \eta = 150 \text{ mNm} / (121 \times .65) = 1.91 \text{ mNm}$$

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Since the gearhead has a diameter of 16 mm we will be looking at 16 mm Brushless DC motors. Based on the load torque (τ_m) the motor will be required to turn, we select the 16ECP36 8B (the 8B refers to the option for Hall Effect Sensors).

The 16ECP36 8B is available in 4 different windings. Windings offer same overall performance (maximum torque, merit factor, etc...) but help using different voltage and current configurations. Since the desired motor speed is 7,260 rpm we will investigate the 16ECP36 8 B 245 with a no load speed of 12,420 rpm under a 24V supply voltage. The torque constant is 17.6 mNm/A and the line to line resistance is 21.1 Ω .

Calculating for the motor current we find:

$$I = \tau / k + I_0 = 1.91 \text{ mNm} / (17.6 \text{ mNm/A}) + 35 \text{ mA} = 0.14 \text{ A}$$

There are no issues with the current because the system is able to supply 2 amps and the maximum recommended continuous current is 0.4 Amps. The voltage required to run the motor at 7,260 rpm is determined by the following formula:

$$U = R \times I + k \times \omega$$

$$\omega = 2\pi/60 \times n = 2\pi/60 \text{ rad/rpm-s} \times 7,260 \text{ rpm} = 760.3 \text{ rad/s}$$

$$U = 21.1 \Omega \times 0.14 \text{ A} + (17.6 \times 10^{-3} \text{ Nm/A}) \times 760.3 \text{ rad/s} = 16.33 \text{ Vdc}$$

The problem is now solved. The voltage required is less than the available voltage, therefore the motor 16ECP36 8B 245 with the planetary gearhead R16 0 121 can achieve the desired working point. If the application were very noise sensitive, a lower ratio would help reducing the gearbox input speed which is the main contributor of noise.



Examples of DMM Stepper Motor Calculations

Example: Positioning with a DMM Stepper Motor

For this application we are looking for a Stepper motor for an intermittent duty application. The application requirements are:

Available voltage:	45 Vdc		
Available current:	2 Amp		
Motor operating point:	0.5 rad	[θ]	desired motor position
	$20 \times 10^{-7} \text{ kgm}^2$	[J_{load}]	motor load inertia on the output shaft
	20 msec	[Δt]	desired move time
	40 °C	[T_{amb}]	operating temperature Intermittent operation
Motor dimensions:	68 mm		maximum allowable length
	35 mm		maximum allowable diameter

L/R Driver - No Gearbox - No Ramping Acceleration

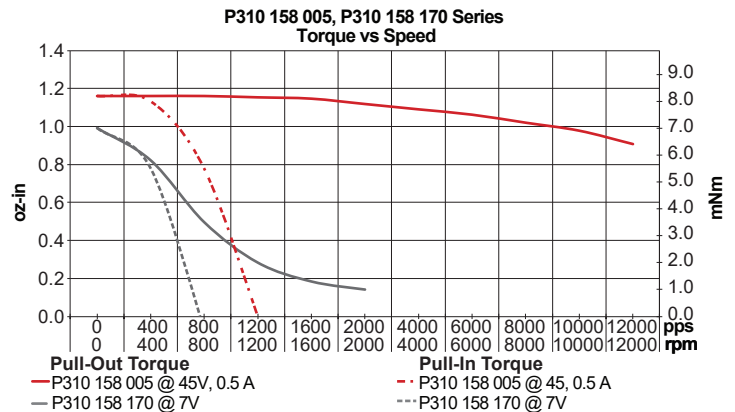
Let us first see whether the move can be accomplished with a simple L/R drive not featuring ramping acceleration. In this case we need to check whether the motor can start at the required speed and load inertia.

We consider the speed profile to be rectangular with constant speed:

$$\text{Speed} = \omega = 0.5 \text{ rad} / 0.02 \text{ sec} = 25 \text{ rad/s}$$

$$n_{\text{motor}} = 25 \text{ rad/s} \times 60/2\pi \text{ rpm-s/rad} = 239 \text{ rpm}$$

The figure shows the pull-in and pull-out torque curves for the P310 motor. We will use a simple L/R drive which provides 7 Vdc in full step mode. Since no ramping is provided (constant speed), the pull-in torque curve shows a maximum starting speed of 800 rpm when accelerating an inertia equal to the motor inertia and without any additional torque (friction torque is zero for example). With a safety factor of 75% the maximum starting frequency is $f_0 = 600 \text{ steps/s}$. The inertia of the P310 is 0.86 kg-m^2 but we need to accelerate 20 kg-m^2 . Therefore the maximum starting frequency f_1 to move this load is:



$$f_1 = f_0 \times \sqrt{((2 \times J_m) / (J_m + J_{load}))}$$

$$f_1 = 600 \text{ steps/s} \times \sqrt{((2 \times 0.86 \text{ kg-m}^2) / (20 \text{ kg-m}^2 + 0.86 \text{ kg-m}^2))} = 172 \text{ rpm}$$

As a result, P310 with a simple L/R drive would not be able to suit the requirements.

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The stepper motor P430 makes 100 steps/rev. To move the load 0.50 rad with a stepper motor that has a 3.6° step angle, it will take the motor 8 steps to make this move.

$$0.50 \text{ rad} = 28.65^\circ$$

$$28.65^\circ / 3.6^\circ = 7.96 \rightarrow 8 \text{ steps of the motor needed}$$

The starting frequency equivalent to 25 rad/s is :

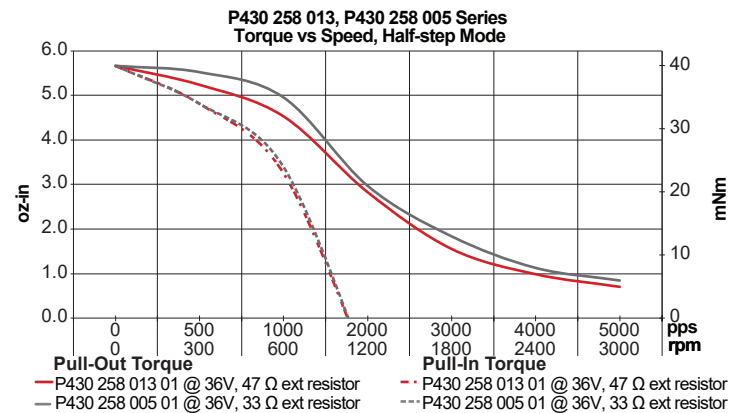
$$f = (25 \text{ rad/s} / 2\pi \text{ rad/rev}) \times 100 \text{ steps/rev} = 398 \text{ steps/s}$$

With 36 Vdc available in the L/R drive and 47 Ω resistors in series, the P430 can start at up to 1,700 steps/s while moving an inertial load equal to its own rotor inertia without any additional torque required. With 75% safety margin:

$$f_0 = 1,700 \times 0.75 = 1,275 \text{ steps/s}$$

With an inertial load of $20 \times 10^{-7} \text{ kg}\cdot\text{m}^2$ this pull-in frequency becomes:

$$f_1 = 1,275 \text{ steps/s} \times \sqrt{(2 \times 3 \text{ kgm}^2) / (20 \text{ kg}\cdot\text{m}^2 + 3 \text{ kgm}^2)} = 651 \text{ steps/s}$$



The problem is now solved. The working point of 398 steps/s is well below the pull-in torque curve of the P430, and no ramping is necessary to perform the desired operation.

The move could be made in an even shorter time if we use a starting frequency closer to the maximum allowed:

$$f = 600 \text{ steps/s}$$

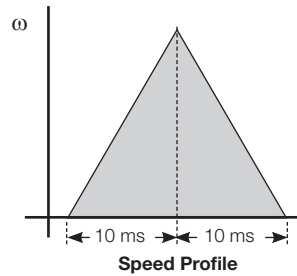
$$\omega = (600 \text{ steps/s} / 100 \text{ steps/rev}) \times 2\pi \text{ rad/rev} = 38 \text{ rad/s}$$

$$\Delta t = 0.5 \text{ rad} / 38 \text{ rad/s} = 13 \text{ msec}$$



Chopper Driver – No Gearbox – With Ramping Acceleration

The load inertia of $20 \times 10^{-7} \text{ kg-m}^2$ has to be moved by an angle of 0.50 rad (θ) in 20 msec using an acceleration ramp. We will use a triangular speed profile with an acceleration time of 10 msec for a shaft movement of .25 rad. The speed required is calculated as follows.



$$\text{Acceleration} = \alpha = 2 \times (\theta / \Delta t^2) = 2 \times .25 \text{ rad} / (0.01 \text{ sec})^2 = 5,000 \text{ rad/s}^2$$

$$\text{Speed} = \omega = (5,000 \text{ rad/s}^2) \times 0.01 \text{ sec} = 50 \text{ rad/s}$$

$$n_{\text{motor}} = 50 \text{ rad/s} \times 60 / 2\pi \text{ rpm-s/rad} = 477.5 \text{ rpm}$$

The torque necessary to accelerate the load is:

$$\tau_{\text{load}} = J_{\text{load}} \times \alpha \quad [\text{Nm}]$$

$$\tau_{\text{load}} = 20 \times 10^{-7} \text{ kg-m}^2 \times 5,000 \text{ rad/s}^2 = .010 \text{ Nm}$$

With a triangular speed profile this requires a peak speed up to 477.5 rpm, with a load torque of 10 mNm. Therefore the peak power required for the load alone is 0.50 W.

$$P = \tau \times \omega = .010 \text{ Nm} \times 50 \text{ rad/s} = .50 \text{ Watts}$$

Let us first consider the P430 with rotor inertia of $3 \times 10^{-7} \text{ kgm}^2$. We have:

$$J_{\text{total}} = J_{\text{load}} + J_{\text{motor}} = (20 \times 10^{-7} \text{ kg-m}^2) + (3 \times 10^{-7} \text{ kg-m}^2) = 23 \times 10^{-7} \text{ kg-m}^2$$

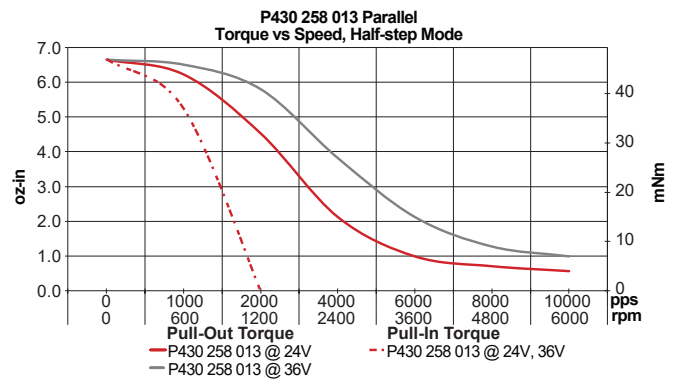
$$\tau_{\text{total}} = J_{\text{total}} \times \alpha = 23 \times 10^{-7} \text{ kg-m}^2 \times 5,000 \text{ rad/s}^2 = .0115 \text{ Nm} = 11.5 \text{ mNm}$$

The curve shows that P430-258-005 with current limit of 1.6 A and 24 V can easily do the job.

In fact, at around 500 rpm the motor can provide up to 43 mNm. With a safety factor of 75% we could easily provide 32 mNm with the P430 and the motion time could be reduced as followed:

$$\alpha_{\text{max}} = \tau_{\text{max}} / J_{\text{total}} = 32 \times 10^{-3} \text{ Nm} / 23 \times 10^{-7} \text{ kg-m}^2 = 13,913 \text{ rad/s}^2.$$

$$\Delta t = \sqrt{(2 \times \theta / \alpha_{\text{max}})} = \sqrt{(2 \times 0.25 \text{ rad} / 13,913 \text{ rad/s}^2)} = 6.0 \text{ msec}$$



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Chopper Driver – With Gearbox – With Ramping Acceleration

The P310 has a holding torque 14 mNm at nominal current and would not be able to directly provide 10 mNm at 477 rpm for accelerating the load. However we could use a gearbox to achieve the work. A first choice consists of matching inertias, and then making sure that with the selected ratio the motor speed remains within a reasonable range and the necessary torque can be delivered. With incremental motion, an inertial match assures the shortest move time, with the motor providing constant torque over the speed range considered. In our example this calls for a desired ratio i_0 of:

$$i_0 = \sqrt{(J_{\text{load}}/J_{\text{motor}})} = \sqrt{(20 \text{ kg-m}^2/0.86 \text{ kg-m}^2)} = 4.82 \quad [\text{no units}]$$

From the various gearhead models available for combination with the P310 stepper motor, we select the K24. This gearhead offers a ratio of 5:1 which is close enough to our target 4.82, and has an efficiency of 85%.

The load inertia reflected onto the motor shaft is calculated by:

$$J_{\text{load at motor}} = J_{\text{load at gearbox}} / (i^2 \times 0.85) = 20 \times 10^{-7} / (5^2 \times 0.85)$$

$$J_{\text{load at motor}} = 0.94 \times 10^{-7} \text{ kg-m}^2.$$

If we now consider the previous values reflected on the motor shaft, the required motor acceleration, angular speed, and step rate are:

$$\alpha_{\text{at motor}} = \alpha_{\text{at gearbox}} \times i = 5,000 \text{ rad/s}^2 \times 5 = 25,000 \text{ rad/s}^2$$

$$\omega_{\text{at motor}} = \omega_{\text{at gearbox}} \times i = 50 \text{ rad/s} \times 5 = 250 \text{ rad/s}$$

$$f = (250 \text{ rad/s}) / (2\pi \text{ rad/rev}) \times 60 \text{ steps/rev} = 2,387 \text{ steps/s}$$

$$\tau = (J_{\text{load at motor}} + J_{\text{motor}}) \times \alpha_{\text{at motor}} = (0.94 + 0.86) \times 10^{-7} \text{ kgm}^2 \times 25,000 \text{ rad/s}^2 = .0045 \text{ Nm} = 4.5 \text{ mNm}$$

The pull-out torque curve shows that at around 2,000 steps/s the P310-158-005 with coil in series, chopper drive, 45 V Vdc and a 0.5 A current limit can provide up to 8 mNm. With a safety factor of 75% we have up to 6 mNm available and the motor with gearhead can easily perform the job.

Here again, the shortest move time would be:

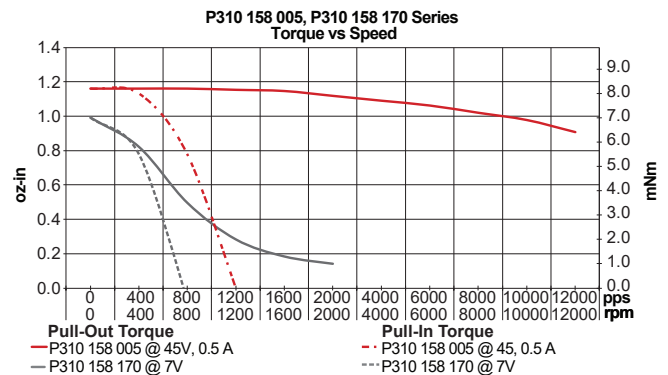
$$\tau_{\text{max}} = 6 \text{ mNm}$$

$$\alpha_{\text{max at motor}} = \tau_{\text{max}} / (J_{\text{load at motor}} + J_{\text{motor}}) = .006 \text{ Nm} / 1.8 \times 10^{-7} \text{ kg-m}^2 = 33,333 \text{ rad/s}^2$$

$$\alpha_{\text{max at gearbox}} = \alpha_{\text{max at motor}} / 5 = 6,666 \text{ rad/s}^2$$

$$\Delta t = \sqrt{(2 \times \theta / \alpha_{\text{max at gearbox}})} = \sqrt{(2 \times 0.25 \text{ rad} / 7,230 \text{ rad/s}^2)} = 8.7 \text{ msec}$$

The P310 with K24 0 5 is an excellent alternative to the P430 if a smaller diameter is required. DMM motors feature not only a low inertia rotor, but also a very strong magnetic design which enables use at high speed compared to other multi-pole stepper motors.





Examples of Can Stack Step Motor calculations

Example: Drive with a Can Stack Step Motor with a frictional torque load

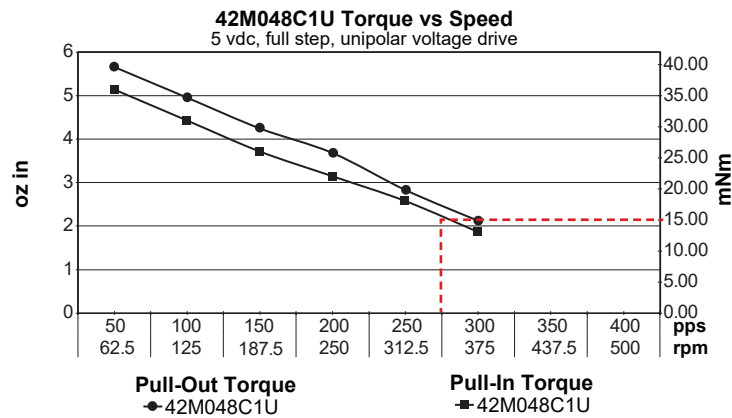
For this application we will consider a Step Motor for an intermittent duty application. The application requirements are:

Available voltage:	24 Vdc		
Available current:	2 Amp		
Motor operating point:	67.5°	[θ]	desired motor position
	15 mNm	[τ]	desired motor torque
	0.06	[Δt]	desired move time
	Intermittent operation		

If a 7.5° per step motor is used, then the motor would have to take nine steps to move 67.5°.

$$67.5^\circ / 7.5^\circ = 9 \text{ steps} \quad f = \text{step rate} = 9 \text{ steps} / 0.06 \text{ sec} = 150 \text{ steps/s}$$

In the figure below the maximum pull-in rate with a torque of 15 mNm is 275 steps/s. We use the pull-in torque curve for this calculation because the control circuit does not provide any ramping. The maximum speed the motor can reach during operation is limited by the maximum speed the motor can start at without missing any steps. This is what the pull-in torque curve represents.



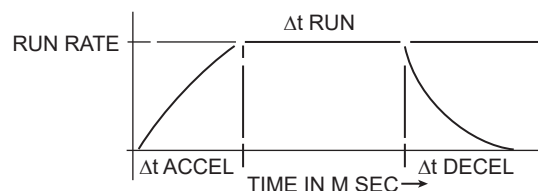
The problem is now solved. The Can Stack motor 42M048C1U motor could be used at 150 steps/s because this point falls well below the pull-in torque curve.

Use the pull-out torque curve in conjunction with a Torque = Inertia × Acceleration ($\tau = J \times \alpha$) analysis when the load is inertial and/or acceleration control is provided.

In this equation acceleration or ramping is in rad/s^2 $\alpha = \Delta\omega / \Delta t = \text{rad/s}^2$

Ramping:

Acceleration control or ramping is normally accomplished by gating on a voltage controlled oscillator (VCO) and the associated charging capacitor. Varying the RC time constant will give different ramping times. A typical VCO acceleration control frequency plot for an incremental movement with equal acceleration and deceleration time would be as shown below.



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Acceleration also may be accomplished by changing the timing of the input pulses (frequency). For example, the frequency could start at a ¼ rate; go to ½ rate, ¾ rate and finally the running rate.

For applications where ramping acceleration or deceleration control time is allowed:

$$\tau_j = J_T \times \Delta\omega/\Delta t$$

Where J_T = rotor inertia (gm^2) + load inertia (gm^2)

Δf = step rate change

Δt = time allowed for acceleration in seconds

λ = steps per revolution (for Portescap Can Stacks this can be 20 steps/rev, 24 steps/rev, or 48 steps/rev)

$$\omega = f \text{ steps/s} \times 2\pi \text{ rad/rev} \times 1/(\lambda \text{ steps/rev}) \quad [\text{rad/s}]$$

Dividing by Δt :

$$\Delta\omega/\Delta t = \Delta f/\Delta t \text{ step/s}^2 \times 2\pi \text{ rad/rev} \times 1/(\lambda \text{ step/rev}) \quad [\text{rad/s}^2]$$

Plugging this definition of $\Delta\omega/\Delta t$ into the equation for τ_j yields:

$$\tau_j = J_T \times \Delta f/\Delta t \text{ step/s}^2 \times 2\pi \text{ rad/rev} \times 1/(\lambda \text{ step/rev}) \quad [\text{mNm}]$$

In order to solve an application problem using acceleration ramping, it is usually necessary to make several estimates to avoid needing a procedure similar to the one used in the following example.

Example: Frictional torque plus inertial load with acceleration control

For this application we are looking for Stepper Motor for an intermittent duty application. The application requirements are:

Available voltage:	24 Vdc	
Available current:	3 Amp	
Motor operating point:	67.5°	$[\theta]$ - desired motor position
	15 mNm	$[\tau_f]$ - frictional load
	< 0.5	$[\Delta t]$ - desired move time
	Intermittent operation	
Motor dimensions:	60 mm	maximum allowable length
	60 mm	maximum allowable diameter

An assembly device must move 4 mm in less than 0.5 seconds. The motor will drive a lead screw through a gear reduction. The lead screw and gear ratio were selected so that 100 steps of a 7.5° per step motor results in 4 mm of linear motion.

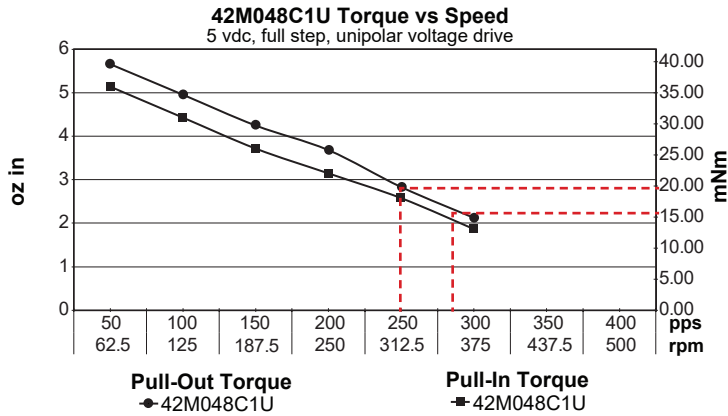
The total inertial load (rotor + gear + screw) = $25 \times 10^{-4} \text{ gm}^2$. The frictional load is 15 mNm.

(1) Select a stepper motor pull-out torque curve which allows a torque in excess of 15 mNm at a step rate greater than:

$$f = 100 \text{ steps}/0.5 \text{ sec} = 200 \text{ steps/s}$$



At a step rate of 250 steps/s (safely over 200 steps/s) the 42M048C1U is capable of providing 20 mNm.



(2) Make a first an estimate of a working rate (a running rate less than the maximum) and determine the torque available to accelerate the inertia (excess over τ_f) τ_A = torque available.

$$\tau_A - \tau_f = 20 \text{ mNm} - 15 \text{ mNm} = 5 \text{ mNm}$$

(3) Using a 60% safety margin

$$5 \text{ mNm} \times 0.6 = 3 \text{ mNm}$$

Calculate Δt to accelerate.

From the equation:

$$\tau_j = J_T \times \Delta f / \Delta t \text{ steps/s}^2 \times 2\pi \text{ rad/rev} \times 1 / (\lambda \text{ steps/rev})$$

$$\lambda = 48 \text{ steps/rev (from } 7.5^\circ \text{ per step)}$$

We rearrange to solve for Δt .

$$\Delta t = (25 \times 10^{-4} \text{ kgm}^2 \times 250 \text{ steps/s} \times 2\pi \text{ rad/rev} \times 1 / (48 \text{ steps/rev})) / 3 \text{ mNm} = 0.027 \text{ sec}$$

Note: The same amount of time is allowed to decelerate the load.

(4) Determine the number of steps used to accelerate and decelerate.

$$N_A + N_D = f/2 \times \Delta t \times 2$$

< OR >

$$N_A + N_D = f \times \Delta t = 250 \text{ steps/s} \times 0.027 \text{ sec} = 6.75 \text{ steps} \rightarrow 7 \text{ steps needed to complete the move}$$

(5) Calculate the time to move at the run rate.

N_T = total steps/revolution – steps required to make the desired move

$$N_T = 100 \text{ steps} - 7 \text{ steps} = 93 \text{ steps}$$

$$\Delta t_{\text{run}} = N_T / (N_A + N_D) = 93 \text{ steps} / (125 \text{ steps} + 125 \text{ steps}) = 0.37 \text{ sec}$$

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(6) The total time to move is determined as follows:

$$\Delta t_{\text{run}} + \Delta t_{\text{accel}} + \Delta t_{\text{decel}} = \Delta t_{\text{total}}$$
$$0.37 \text{ sec} + 0.027 \text{ sec} + 0.027 \text{ sec} = 0.42 \text{ sec}$$

The problem is now solved. The Can Stack stepper motor 42M048C1U is a good first estimate. This motor can be moved slower if more of a safety factor is desired.

Example: No ramping acceleration or deceleration control is allowed.

Even though no acceleration time is provided, the stepper can lag a maximum of two steps or 180° electrical degrees. If the motor goes from zero steps/sec to f steps/sec the lag time Δt would be

$$\Delta t = 2/f$$

The torque equation for no acceleration or deceleration is:

$$\tau_J = J_T \times f^2/2 \times 2\pi/\lambda$$

Where: $J_T = \text{rotor inertia (gm}^2\text{)} + \text{load inertia (gm}^2\text{)} = 25 \times 10^{-4} \text{ gm}^2$

$$f = 250 \text{ steps/s}$$

$$\lambda = 48 \text{ steps/rev (from } 7.5^\circ \text{ per step)}$$

Example: Friction plus inertia and no acceleration ramping.

For this application we are looking for Stepper motor for a continuous duty application. The application requirements are:

A tape capstan is to be driven by a stepper motor.

Motor operating point: 12 mNm $[\tau_f]$ – frictional load
 $10 \times 10^{-4} \text{ gm}^2$ $[J_L]$ – load inertia
 Continuous operation

The capstan must rotate in 7.5° increments at a rate of 200 steps/s.

Since a torque greater than 12 mNm at 200 steps/s is required, consider the Can Stack stepper motor 42M048C1U.

The total inertia = motor rotor inertia + load inertia

$$J_T = J_R + J_L$$
$$J_T = 12.5 \times 10^{-4} \text{ gm}^2 + 10 \times 10^{-4} \text{ gm}^2$$
$$J_T = 22.5 \times 10^{-4} \text{ gm}^2$$



(1) Since no acceleration ramping will be provided, use the following equation:

$$\tau_J = J_r \times f^2 / 2 \times 2\pi / \lambda$$

$$\tau_J = 22.5 \times 10^{-4} \text{ gm}^2 \times (200 \text{ steps/s})^2 / 2 \times 2\pi / (48 \text{ steps/rev})$$

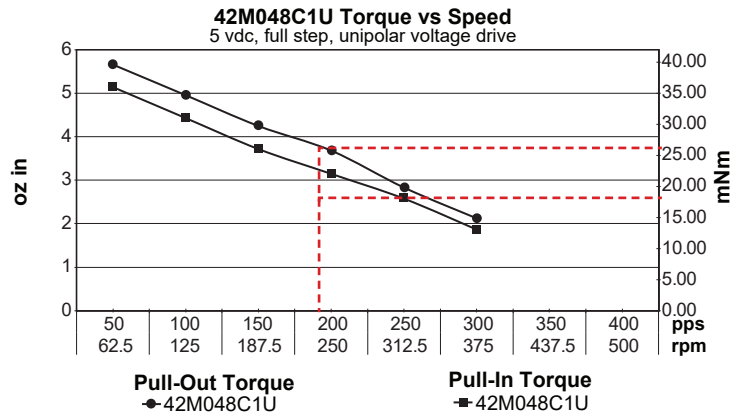
$$\tau_J = 5.85 \text{ mNm}$$

(2) Total torque

$$\tau_T = \tau_F + \tau_J$$

$$\tau_T = 12 \text{ mNm} + 5.85 \text{ mNm} = 17.85 \text{ mNm}$$

(3) Refer to the pull-out torque curve below at a speed of 200 steps/s, where the available torque is 26 mNm.



The problem is now solved. The Can Stack stepper motor 42M048C1U can perform in this application, with a safety factor.