

MOTION TECHNOLOGY

MOTORS

SILENCER® SERIES
DB MATRIX™ SERIES
C SERIES
POSITION SENSORS

HIGH PERFORMANCE BRUSH AND BRUSHLESS
DC MOTORS IN COMPACT PACKAGE DESIGNS
FOR INDUSTRIAL APPLICATIONS

Moog's fractional / integral horsepower DC motors are electronically commutated (brushless) or mechanically commutated (brush) motion components that provide high performance operation in a compact package design for a wide range of industrial applications.

Moog has a legacy of providing high-quality products used in critical defense and space applications. Over the years, this foundation has expanded to a broad spectrum of industrial markets, including medical, automation, marine and communications. The company is ISO9001 and AS9100 certified and utilizes world-class manufacturing concepts, including Six-Sigma and Lean Manufacturing, to allow the company to produce the highest quality products at competitive prices.

Product Range

Moog is a premier technology company with unique design and manufacturing capabilities. This guide is an overview of our industrial motor products. Designs can be modified, please consult the factory for details. Specific applications include: factory automation, semiconductor handling, medical equipment (pumps, blowers and compressors), medical centrifuges, packaging equipment, robotics, oil exploration equipment and aerospace.

INSIDE ROTOR BRUSHLESS DC MOTORS

The Silencer® series of brushless motors offers diameters from 1.2 to 4.1 inches (30.48 to 105.41 mm) and lengths from 1.3 to 5.5 inches (33.02 to 139.7 mm). It offers continuous torques from 2.4 to 519 oz-in and speeds up to 40,000 rpm. Built for rugged applications and environments, the Silencer series motors feature bonded rare earth magnets and aluminum housings. Options include electronic drivers, encoders and gearheads, as well as Hall effect, resolver and sensorless feedback. Our very quiet, efficient, brushless design is well suited for applications where low noise and reliable, long life operation are particularly important.

Silencer® Series Brushless DC Motors

MODEL		DIAMETER in (mm)	AVAILABLE LENGTH in (mm)	VOLTAGE RATINGS VDC	RANGE RATED TORQUE oz-in (Nm)	RANGE RATED SPEED rpm	RANGE RATED POWER watts
	BN12	1.20 (30.48)	1.3 - 2.8 (33.02 - 71.12)	12, 24, 36	1.8 - 6.2 (0.0127 - 0.0438)	0 - 13,753	17 - 44.7
	BN17	1.70 (43.18)	1.5 - 2.5 (38.1 - 63.5)	12, 24, 36	8.2 - 17.81 (0.058 - 0.126)	0 - 13,498	55 - 97
	BN23	2.25 (57.15)	1.41 - 2.91 (35.8 - 73.9)	24, 36, 48	12.1 - 51.9 (0.035 - 0.366)	0 - 9,190	82 - 222
	BN28	2.80 (71.12)	2.1 - 4.4 (53.3 - 111.8)	24, 48, 72	31 - 86 (0.2189 - 0.673)	0 - 9,240	210 - 306
	BN34	3.40 (86.36)	1.40 - 2.90 (35.6 - 73.7)	24, 36, 48	60 - 258 (0.4237 - 1.8219)	0 - 7,550	328 - 696
	BN42	4.15 (105.41)	2.3 - 5.5 (58.4 - 139.7)	24, 50, 100	102 - 451 (0.7203 - 3.1847)	0 - 6,140	456 - 874

Note: Brushless DC Frameless Motors and Brushless DC IP Rated Motors are also available. Please refer to website for specifications, www.moog.com

Silencer® Series Brushless DC High Speed Motors

MODEL		DIAMETER in (mm)	AVAILABLE LENGTH in (mm)	VOLTAGE RATINGS VDC	RANGE RATED TORQUE oz-in (Nm)	RANGE RATED SPEED rpm	RANGE RATED POWER watts
	BN12HS	1.20 (30.48)	1.30 - 2.80 (33.0 - 71.1)	12, 24, 36	1.2 - 4.2 (0.0085 - 0.0297)	18,450 - 35,670	21 - 60
	BN23HS	2.25 (57.15)	1.41 - 2.91 (35.8 - 73.9)	24, 36, 48	3.5 - 21.0 (0.025 - 0.148)	13,285 - 19,818	49 - 232
	BN34HS	3.40 (86.36)	2.50 - 3.50 (63.5 - 88.9)	24, 50, 100	34 - 78 (0.2401 - 0.5508)	9,340 - 14,640	381 - 591

Silencer® Series Brushless DC High Performance Motors

	BS17	1.7 (43.18)	1.5 - 2.0 (38.2 - 50.8)	12, 24, 48	14 - 20 (0.0988 - 0.1412)	2,760 - 6,180	37 - 91
	BS23	2.60 (66.04)	1.91 - 2.91 (48.5 - 73.9)	24, 36, 48	29 - 58 (0.20 - 0.41)	2,796 - 5,151	71 - 148

Silencer® Series Brushless DC Motors - Unique Stator Design

	BSG23	2.25 (57.15)	1.90 (48.26)	12, 24, 48	109 - 117 (0.7697 - 0.8262)	2,255 - 2,319	182 - 201
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Silencer® Series Brushless DC Frameless Motors

	Often a customer's application already involves extensive mechanical assemblies and also requires an electric motor (pumps, fans, compressors, etc.). When it does not make sense to implement a fully housed motor, rotor-stator part sets are a viable and economical solution. Moog provides a wide range of standard brushless DC frameless motors that are custom configurable to meet each requirement.						
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Minature Brushless Motors

	DBH-0472	0.472 (11.98)	0.99 - 1.66 (25.15 - 42.16)	12	1.4 (9.88)	11,090 (1,161)	1.0
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HIGH PERFORMANCE DIRECT DRIVE BRUSHLESS DC MOTORS

Moog brushless torque motors are designed to operate over a range of speeds for a wide variety of defense, aerospace and industrial applications. Different applications require unique configurations of mounting flanges, housings, output shafts and electrical requirements. Our motors have high torque-to-power and torque-to-inertia ratios, high linearity and low electrical time constants. Reliability and long life are hallmarks of our products and since these are brushless motors, there are no carbon brushes to wear out.



DB Matrix™ Series Motors

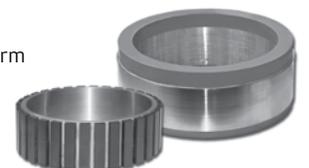
MODEL	PEAK TORQUE, T _P oz-in (Nm)	Amps @ PEAK TORQUE, I _P amps	TORQUE SENS., K _T oz-in/amp (Nm/amp)	MOTOR CONST., K _M oz-in/√W (Nm/√W)	WEIGHT oz (nom) (kg)	OD in (mm)	ID in (mm)	STACK LENGTH in (mm)
DB-1500	21 - 212 (0.15 - 1.48)	15.0	1.43 - 14.1 (0.01 - 0.10)	2.76 - 14.66 (0.02 - 0.10)	2.7 - 15 (0.08 - 0.43)	1.5 (38.1)	0.250 (6.35)	0.25 - 2.5 (6.35 - 63.5)
DB-2000	34.4 - 376 (0.24 - 2.63)	5.0	6.89 - 75.2 (0.05 - 0.53)	4.75 - 25.7 (0.03 - 0.18)	4.0 - 33 (0.11 - 0.93)	2.0 (50.80)	0.375 (9.53)	0.25 - 3.0 (6.35 - 76.2)
DBE-2000 with Hall Effects	43 - 377 (0.30 - 2.64)	5.0	8.60 - 75.5 (0.06 - 0.53)	5.93 - 25.8 (0.04 - 0.18)	4.6 - 34 (0.13 - 0.96)	2.0 (50.80)	0.375 (9.53)	0.25 - 3.0 (6.35 - 76.2)
DB-3000	151 - 1210 (1.06 - 8.47)	10.0	15.1 - 121 (0.11 - 0.85)	10.4 - 51.2 (0.07 - 0.36)	8.0 - 41.0 (0.23 - 1.16)	3.0 (76.2)	1.250 (31.75)	0.25 - 2.0 (6.35 - 50.8)
DB-4000	2,000 - 5,000 (14 - 35)	30.1	66.5 - 166.1 (0.47 - 1.16)	67.2 - 129.7 (0.47 - 0.91)	5.9 - 13.6 (0.17 - 0.39)	4.0 (101.6)	0.44 (11.18)	2.0 - 5.0 (50.8 - 127.0)
DB-5000	578 - 9,024 (4.08 - 63.74)	8.0	72.0 - 1,128 (0.51 - 7.96)	22.2 - 186 (0.155 - 1.31)	31 - 255 (0.87 - 7.22)	5.0 (127)	2.0 (50.8)	0.25 - 4.05 (6.35 - 102.8)
DB-6000	1,686 - 10,083 (11.80 - 70.58)	20.0	84.3 - 504.0 (0.59 - 3.53)	84.0 - 270.0 (0.59 - 1.89)	33.7 - 156 (0.95 - 4.42)	6.0 (152.4)	4.0 (101.6)	0.45 - 2.95 (11.43 - 74.93)
DBE-6000 with Hall Effects	1,686 - 10,083 (11.80 - 70.58)	20.0	84.3 - 504.0 (0.59 - 3.53)	84.0 - 270.0 (0.59 - 1.89)	45 - 168 (1.26 - 4.73)	6.0 (152.4)	4.0 (101.6)	0.45 - 2.95 (11.43 - 74.93)
DB-8000	3,619 - 17,979 (25.33 - 125.85)	14.6	250.0 - 1,223.0 (1.75 - 8.56)	149.0 - 456.0 (1.04 - 3.19)	83.2 - 328 (2.36 - 9.28)	8.0 (203.2)	5.0 (127)	0.5 - 2.5 (12.7 - 63.5)
DBE-8000 with Hall Effects	3,619 - 17,979 (25.33 - 125.85)	14.5	250.0 - 1,223.0 (1.75 - 8.56)	149.0 - 456.0 (1.04 - 3.19)	83.2 - 328 (2.36 - 9.28)	8.0 (203.2)	5.0 (127)	0.5 - 2.5 (12.7 - 63.5)
DB-9000	5,102 - 30,665 (35.71 - 214.66)	20.0	255.0 - 1,533.0 (1.79 - 10.73)	176.0 - 636.0 (1.23 - 4.45)	75.0 - 357.0 (2.12 - 10.10)	9.0 (228.6)	6.375 (161.93)	1.6 - 2.95 (40.64 - 74.93)
DB-14540	2,1674 - 10,8319 (151.72 - 758.23)	34.0	639.0 - 3,149.0 (4.47 - 22.04)	324.0 - 1,142.0 (2.27 - 7.99)	171.0 - 720.0 (4.84 - 20.38)	14.540 (369.32)	11.46 (291.08)	0.5 - 2.5 (12.7 - 63.5)
DB-22000	102660 - 678689 (725 - 4793)	40.0	2573 - 16974 (18.17 - 119.87)	1218 - 4743 (8.60 - 33.49)	768 - 3968 (21.5 - 111.1)	22.0 (559)	17.50 (445)	1.00 - 7.00 (25.4 - 177.8)

FRAMELESS PERMANENT MAGNET ALTERNATORS

The AG Matrix™ Series alternators are used in applications that require high power density. The designs are optimized for maximum output power and maximum efficiency. Utilizing high energy rare earth magnets and dense slot fills, the AG Series achieves higher AC output power. This provides the highest performance per volume and minimizes the alternators footprint within the system.

The alternators are supplied as a direct drive rotor / stator frameless part set that is directly attached to the load. This form of attachment eliminates backlash and increases stiffness for an optimized direct drive system.

The AG Matrix Series is a family of alternators consisting of a range of sizes, outside diameters from 5.25 to 22 inches (133.35 to 558.8 mm) with multiple stack sizes and winding options for each diameter.



AG Matrix™ Series Brushless Permanent Magnet Alternators

MODEL	CONTINUOUS RATED POWER watts	RATED SPEED rpm	VOLTAGE VRMS	CURRENT amps rms	INPUT TORQUE at RATED SPEED lb-ft (Nm)	WEIGHT lb (Kg)	OD* in (mm)	ID in (mm)
			AT RATED POWER					
AG-5250	345 - 3,590	650 - 1,500	237 - 259	0.84 - 8.01	5.06 - 18.90 (6.86 - 25.63)	5.2 - 16.6 (2.36 - 7.53)	5.25 (133.35)	2.35 (59.69)
AG-7350	868 - 8,550	600 - 1,200	232 - 239	4.08 - 21.6	12.40 - 55.1 (16.81 - 74.72)	10.5 - 40.0 (4.76 - 18.14)	7.350 (186.69)	3.350 (85.09)
AG-8000	1,249 - 12,780	3600	208 - 219	3.48 - 33.7	2.9 - 28.2 (3.9 - 38.2)	8.2 - 55.0 (3.72 - 24.95)	8.0 (203.2)	3.00 (76.2)
AG-12600	966 - 23,986	250 - 800	256 - 301	2.18 - 163.17	35.8 - 230.0 (48.54 - 311.88)	21.0 - 96.0 (9.53 - 43.55)	12.60 (320.0)	8.75 (222.25)
AG-15275	1,631 - 36,536	220 - 500	248 - 280	3.8 - 75.2	65.7 - 562.0 (89.09 - 762.07)	38.0 - 230.0 (17.24 - 104.34)	15.275 (387.99)	10.157 (257.99)

*Dimensions do not reflect mounting lip.

BRUSH DC MOTORS

Moog designs and manufactures precision motion technology components and subsystems for defense, aerospace and industrial applications. Our broad range of components include DC torque and servomotors and position feedback devices. Our specialty DC brush torque and servomotors can be supplied housed with a variety of shaft configurations but typically as a direct drive rotor / stator part-set that will be directly attached to the load.

Miniature High Torque Motors (C13 Samarium Cobalt)

MODEL	LENGTH in (mm)	VOLTAGE RATINGS (VDC)	RANGE RATED (VDC)	RANGE RATED SPEED (rpm)	RANGE RATED POWER (watts)
 C13	1.902 - 2.802 (48.3 - 71.2)	12, 24, 36, 48	5.8 - 14.0	1,643 - 3,000	9.6 - 22.2

Permanent Magnet Motors (C23, 34 and 42)

 C23	3.33 - 5.45 (84.6 - 138.1)	12, 24, 36, 48, 60	7.5 - 43.5	887 - 4,700	20 - 67.9
 C34	6.00 - 8.00 (152.40 - 203.20)	24, 36, 48, 60, 72	55.1 - 115.0	952 - 4,450	53.6 - 247
 C42	5.00 - 9.00 (127.0 - 228.6)	36, 48, 60, 72, 90	80.3 - 341	1,060 - 3,226	137 - 359

POSITION SENSORS

Moog brushless resolvers are economical and highly accurate. Motion feedback sensors can be used to provide velocity and position information for closed-loop electronic control, as well as brushless DC motor commutation. They contain no internal electronics or optics and are unaffected by electrical noise, heat, shock and vibration.

Digital Resolvers



Moog's size 11 digital resolver is a compact, low-cost angular position transducer with DC input and digital output. No external circuitry is required – simply energize with ± 5 VDC and obtain 12-bit serial data for direct computer interface, or the A Quad B and North Marker outputs of an incremental encoder. Brushless resolvers are superior to encoders in terms of ruggedness, size, accuracy and resolution. Resolvers perform efficiently under temperature extremes, humidity, shock and vibration.

Size 11 Single Speed Brushless Resolvers



For use in applications that range from computer-controlled machine tools to sophisticated medical instrumentation, Moog resolvers with their proven brushless design – are the accurate, safe and quiet way to sense position and / or velocity in your position feedback system. Their rugged design provides reliable performance in even the toughest, vibration-prone industrial and instrument applications.

Rotary Variable Differential Transformer (RVDT)

MODEL		INPUT		OUTPUT			
		VOLTAGE VRMS*	FREQUENCY	SCALE FACTOR V/Deg.	ACCURACY +/- Deg.	VARIATION/TEMP. Deg. C Max.	WEIGHT oz
	AS-827 Series	8.0	1,870	0.061 - 0.068	0.2 - 0.6	0.05	2.0
	AS-865 Series	6.0	3,000	0.061	0.2	0.05	4.0
	AS-887 Series	7.0	3,000	0.052	0.25	0.05	2.0
	RV-08-B-05C Series	5.7	3,500	0.019	0.50**	0.05	2.0
	PRV-15-A-15A Series	3.5	2,879	0.015	0.2	0.05	1.0

*Voltage and frequencies shown are typical. RVDTs can operate at other voltages and frequencies. Our design engineers can design an RVDT to meet your voltage and frequency requirements. **Accuracy varies with excursion angle.

Low Cost Brushless Pancake Resolvers

PRIMARY		SPEED	INPUT VOLTAGE	INPUT CURRENT	INPUT POWER	TRANS. RATIO +/-10%	PHASE SHIFT	NULL VOLTAGE	ELECTRICAL ERROR †	OUTPUT VOLTAGE
Size 11	Rotor	1	4 Vrms 4.74 KHz - 5.3 Vrms 5 KHz	14.4 - 43 mA	0.06 - 0.125 watt	0.5	5.5° to 6.5°	15 - 20 mV	± 10 min. to ± 20 min.	2 - 2.65 Vms
Size 14	Rotor	1	4 Vrms 3.4 KHz - 7 Vrms 10 KHz	0.042 - 18.8 mA	0.046 - 0.126 watt	0.5	-2.3° +/- 2° to 12.5 +/- 3°	15 mV	± 10 min. to ± 20 min.	2 - 3.5 Vms
Size 15	Rotor	1	4 Vrms 3.4 KHz - 7 Vrms 10 KHz	50 - 75 mA	0.046 - 0.2 watt	0.5	1° to 5°	15 - 20 mV	± 15 min. to ± 20 min.	2 - 3.5 Vms
Size 21	Rotor	1 - 4	4 Vrms 5 KHz - 7.5 Vrms 6.6 KHz	2.5 - 70 mA	.007 - .29 watt	0.46 - 1.0	-8° to -14.5°	20 - 30 mV	± 10 min. to ± 21 min.	2 - 7.5 Vms
Size 22	Rotor	1 - 4	4 Vrms 5 KHz - 7.5 Vrms 6.6 KHz	2.5 - 70 mA	.007 - .29 watt	0.46 - 1.0	-8° to -14.5°	20 - 30 mV	± 10 min. to ± 21 min.	2 - 7.5 Vms

Typical performance characteristics at 25°C

† Higher accuracies available

Synchros



As a circuit element, the synchro is essentially a variable-coupling transformer; the magnitude of the magnetic coupling between the primary and secondary, and hence the magnitude of the output voltage, varies according to the position of the rotatable element. In function, the synchro is an electromechanical transducer. A mechanical input such as a shaft rotation is converted to a unique set of output voltages, or a set of input voltages is used to turn a synchro rotor to a desired position.

DRIVE ELECTRONICS

Moog Silencer® Series electronic drives are matched for optimum performance with our line of brushless motors. The drives are low profile packages designed for ease of mounting in a small envelope, requiring minimal space in a cabinet / enclosure.

Silencer Series® Drive Electronics

MODEL	MODE OF OPERATION	MAX. POWER watts	INPUT VOLTAGE volts	MAX. MOTOR CURRENT amps	WEIGHT oz (gm)
 BDO-Q2-40-05-01	2 Quadrant - Velocity	175	12 - 40	5	4.37 (124)
 BDP-Q2-50-10	2 Quadrant - Velocity	475	20 - 50	10	5.00 (142)
 BDO-Q2-50-18	2 Quadrant - Velocity	850	20 - 50	18	13.76 (390)
 BDO-Q2-50-40	2 Quadrant - Velocity	1,900	20 - 50	40	13.76 (390)

GEARHEADS

The primary reason to use a gearhead is that it makes it possible to control a large load inertia with a comparatively small motor inertia. Moog offers a selection of windings in each frame size that, combined with a selection of reduction ratios, offers an assortment of solution to output requirements.

Precision Planetary Gearheads

MODEL		AVAILABLE RATIOS	NUMBER OF STAGES	OUTPUT TORQUE	SHAFT INERTIA gcm ²
	32 mm (1.26 inch Diameter) Low Cost	4:1 (3.70:1) to 308:1 (307.54:1)	1 to 3	0.40 to 2.0 Nm (56.6 to 283.2 oz-in)	1.35 to 0.89
	32 mm (1.26 inch Diameter)	4:1 (3.70:1) to 308:1 (307.54:1)	1 to 3	0.75 to 4.5 Nm (106.2 to 637.3 oz-in)	1.54 to 0.96
	52 mm (2.05 inch Diameter)	4:1 (3.70:1) to 308:1 (307.54:1)	1 to 3	4.0 to 25.0 Nm (2.95 to 18.4 ft-lbs)	16.57 to 9.21
	62 mm (2.44 inch Diameter)	4:1 (3.70:1) to 308:1 (307.54:1)	1 to 3	8.0 to 50.0 Nm (5.90 to 36.88 ft-lbs)	0.037 to 0.017
	81 mm (3.19 inch Diameter)	4:1 (3.70:1) to 308:1 (307.54:1)	1 to 3	20.0 to 120.0 Nm (14.75 to 88.50 ft-lbs)	0.165 to 0.089
	120 mm (4.72 inch Diameter)	4:1 (3.70:1) to 308:1 (307.54:1)	1 to 3	50.0 to 300.0 Nm (36.88 to 221.3 ft-lbs)	1.112 to 0.519

Moog has offices around the world.

For more information or the office nearest you, contact us online.

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For product information, visit

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This technical data is based on current available information and is subject to change at any time. Specifications for specific systems or applications may vary.