

# Motion Technology Motors

*Product Guide*



**A complete line of DC motors for commercial, industrial, medical, aerospace and defense applications.**

- Brush and Brushless
- Torque
- Drive Electronics
- Resolvers
- Gearheads

**MOOG**  
COMPONENTS GROUP

# Commercial / Industrial

Moog Components Group is a premier technology company with unique design and manufacturing capabilities. This guide is an overview of our motor products.

## Brushless Motors



### Silencer® Series Brushless DC Motors BN12, 17, 23, 28, 34 and 42

(Standard, European, Frameless and IP Rated)

Silencer brushless motors provide smooth, efficient operation and increased speed ranges. Utilizing bonded neodymium magnets, our BN series motors provide excellent value with their low cost and high torque. Each frame size of the BN motors is available in four different lengths with a variety of electrical options to meet a wide range of commercial and industrial operating specifications.

The compact BN motors are well suited for applications demanding low audible noise and long life. An aluminum housing protects the unit in rugged applications and environments. Typical options include electronic drives, encoders and gearheads, as well as Hall effect, resolver and sensorless feedback.

- Inside rotor construction for quick acceleration
- 8 pole motor standard, 4 pole motors optional for high speed applications
- Compact size – lengths from 1.3 to 5.5 inches
- Diameter – 1.2 to 4.15 inches
- Continuous torques from 2.4 to 519 oz-in
- High energy neodymium magnets
- Safe, arcless operation
- High speed capability – up to 20,000 rpm
- High torque per dollar ratio

### Silencer® Series Brushless DC Slotless Motors BMS09 and BSS09

Slotless motors provide zero detent torque for near zero vibration.



The BSS09 provides excellent value with a lower cost and high torque. Both versions are available in two standard lengths with three standard winding codes. Custom configurations available upon request. In addition, we offer a variety of electrical options to meet a wide range of commercial and industrial operating specifications.

- Rare earth magnet for high power density
- Zero detent torque for near zero vibration
- Compact design
- Available with Hall device commutation or sensorless
- Custom windings available
- High efficiency
- High speed operation
- Low acoustical noise
- BMS model is designed for 1,000 autoclave sterilization cycles
- BSS model designed for industrial applications
- Standard motor speeds up to 42,000 rpm (contact factory for higher speed applications up to 100,000 rpm)

### Silencer® Series Brushless DC Motors BN12, 23 and BN34 High Speed

BN high speed brushless motors offer relatively high speeds in the same BN package size. Ideal for applications involving higher speeds at higher power levels, such as medical centrifuge, pumps and blowers. Utilizing high energy rare earth magnets, these motors provide excellent value in a high speed, high power motor.



- Inside rotor construction for quick acceleration
- 4 pole motors for high speed applications
- Compact size
- Continuous torques to 78.0 oz-in
- High energy neodymium magnets

- Safe, arcless operation
- High speed capability – up to 35,000 rpm
- High torque per dollar ratio

### Silencer® Series Brushless DC Motor BS12 High Performance

The BS12 is a very high energy size 12 BLDC motor. Utilizing rare earth sintered magnets and hand inserted stator windings, the motor has a very high torque / volume ratio. Ideal for applications requiring a high energy, high efficiency BLDC motor where space is limited. Hall-effect feedback is standard with sensorless or resolver feedback optional. Other options include gearheads and ballscrews. Custom solutions available. For more information about how this product can be tailored to fit your specific application, contact our applications engineers.



- 6 pole inside rotor for quick acceleration
- High torque / volume ratio
- High energy sintered neodymium magnets
- High stator slot fill for high km
- Skewed rotor for minimum detent torque

### Silencer® Series Brushless DC Motor BS23 High Performance

Utilizing high energy sintered neodymium magnets, the BS23 brushless motor offers almost 2 times the torque capability of the standard BN23. When maximum performance and minimum size are important, the BS23 offers an effective solution.



- Inside rotor construction for quick acceleration
- 8 pole motor standard, 4 pole motors optional for high speed applications
- Compact size – lengths from 1.8 to 2.8 inches
- Continuous torques from 29 to 58 oz-in
- High energy sintered neodymium magnets
- Safe, arcless operation
- High torque per dollar ratio

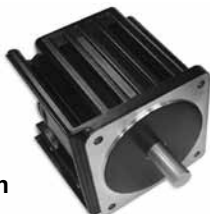
## Silencer® Series Brushless DC Motor BSG23 High Performance Unique Stator Design



Utilizing high energy sintered neodymium magnets and a unique stator design, the BSG23 brushless motor offers over two times the torque capability of our standard BN23 brushless motor. Ideal for applications where maximum performance and compact size are critical. Designed for maximum efficiency, this motor is a viable alternative to costly traditional brushless DC servomotors. Typical options include electronic drives, encoders, gearheads, as well as Hall effect, resolvers, sensorless feedback and black finned aluminum housing (for additional heat transfer).

- Inside rotor construction for quick acceleration
- 8 pole motor
- Compact size, 1.9 inches long
- Diameter size, 2.25 inches
- Continuous torque up to 57 oz-in
- High energy sintered neodymium magnets
- Safe, arcless operation
- High torque per dollar ratio
- Unique stator construction - optimal copper slot fill for high motor constant (km)

## Silencer® Series Brushless DC Motor BSG34 High Performance Unique Stator Design



Utilizing high energy sintered neodymium magnets and a unique stator design, the BSG34 brushless motor offers over two times the torque capability of our standard BN34 brushless motor. Ideal for applications where maximum performance and compact size are critical. Designed for maximum efficiency, this motor is a viable alternative to costly traditional brushless DC servo motors.

- Inside rotor construction for quick acceleration

- 8 pole motor
- Compact size, 3.5 inches long
- Diameter size, 3.4 inches
- Continuous torque up to 310 oz-in
- High energy sintered neodymium magnets
- Safe, arcless operation
- High torque per dollar ratio
- Unique stator construction - optimal copper slot fill for high motor constant (km)

## Silencer® Series Brushless DC Motors with Integral Drive BN23 Low Cost



Utilizing bonded neodymium magnets and Surface Mount Technology (SMT), the low cost BN series motors provide excellent value with their low cost and ease of installation. The compact BN motors are well suited for applications demanding low audible noise, long life and ease of installation.

- Integral two quadrant speed controllers for electronically commutating three-phase brushless motors
- Uses built-in Hall effect sensors for rotor position feedback
- All motor, drive and feedback connections are pre-wired internally to the package
- Maximum current limit has been preset to protect motor and drive
- Compact size – lengths from 1.8 to 2.3 inches
- Torque ratings from 4.5 oz-in to 5.5 oz-in
- Operating temperature -20 to +45°C
- Optional cover for electronics available

## Silencer® Series Brushless DC Motors with Integral Drive BN12 and BN23



Silencer® Series Brushless DC motors with integral electronics provide smooth, quiet and efficient operation over a wide speed range. Each frame size is available in several different lengths, with the electronics optimized for the specific motor's operating parameters.

- Integral two quadrant speed controllers for electronically commutating three-phase brushless motors
- Uses built-in Hall effect sensors for rotor position feedback
- All motor, drive and feedback connections are pre-wired internally to the package
- Motor speed is controlled by an external 0 - 5 VDC command voltage
- Direction of rotation is set by the direction input control
- Maximum current limit has been pre-set to protect motor and drive
- Controller is protected against thermal overload by means of an internal thermal cutoff (BN23)
- Efficient PWM speed control using power MOSFET technology
- Compact size – lengths from 2.4 to 4.3 inches
- Diameter – 1.2 inches and 2.25 inches
- Torque ratings from 1.7 oz-in to 22.0 oz-in
- Operating temperature range -10 to 45° C

## Brushless DC Motors Outside Rotor Fractional Horsepower BOF16 Series



BOF16 motors provide smooth, efficient operation at high speeds. The brushless design ensures low audible noise and long life. Utilizing bonded ferrite magnets, these brushless motors provide excellent performance and value demonstrated by their low cost to high torque ratio. They are available in two lengths with a variety of options, including custom windings to achieve different speed / torque operating points, electronic drives, encoders and Hall effect or sensorless feedback.

- Compact lengths from 1.1 to 1.8 inches
- Continuous torques from 4.0 to 8.2 oz-in
- Low cost bonded ferrite magnets
- Safe, arcless operation
- High speed capabilities – up to 16,000 rpm
- 4 pole motors standard
- Options include electronic drives, encoders, Hall effect or sensorless feedback
- Available as a parts-set or a complete housed motor

## Brushless DC Motors Outside Rotor Fractional Horsepower BOF23 Series



BOF 23 motors provide smooth, efficient operation at high speeds. The brushless design ensures low audible noise and long life. Utilizing bonded ferrite magnets, these brushless motors provide excellent performance and value demonstrated by their low cost to high torque ratio.

- Compact lengths – from 1.1 to 2.4 inches
- Continuous torques from 5.9 to 19.2 oz-in
- Low cost bonded ferrite magnets
- Safe, arcless operation
- High speed capabilities – up to 6,890 rpm
- 8 pole motors standard
- Options include electronic drives, encoders, Hall effect or sensorless feedback
- Available as a parts-set or a complete housed motor

## Brushless DC Motors Outside Rotor Fractional Horsepower BOF35 Series



BOF 35 motors provide smooth, efficient operation at high speeds. The brushless design ensures low audible noise and long life. Utilizing bonded ferrite magnets, these brushless motors provide excellent performance and value demonstrated by their low cost to high torque ratio.

- Lengths – from 1.9 to 2.2 inches
- Continuous torques from 29.9 to 44.5 oz-in
- Low cost bonded ferrite magnets
- Safe, arcless operation
- High speed capabilities – up to 5,500 rpm
- 4 and 8 pole designs
- Options include electronic drives, encoders, Hall effect or sensorless feedback
- Available as a parts-set or a complete housed motor

## Brushless DC Motors Outside Rotor Fractional Horsepower BON35 Series

BON 35 motors provide smooth, efficient

operation at high speeds. The brushless design ensures low audible noise and long life. Utilizing bonded neodymium magnets, these brushless motors provide excellent performance and value demonstrated by their low cost to high torque ratio.

- Length – 2.0 inches
- Continuous torques from 58.0 to 76.0 oz-in
- Bonded neodymium magnets
- Safe, arcless operation
- High speed capabilities – up to 6,700 rpm
- 4 and 8 pole designs
- Options include electronic drives, encoders, Hall effect or sensorless feedback
- Available as a parts-set or a complete housed motor

## Brush Motors

### Miniature High Torque Brush DC Motors C13 Series Samarium Cobalt\*



The series C13 high energy rare earth servomotors provide fast response and high starting torque, but are priced significantly less than comparable rare earth motors. They offer high coercivity and high flux density for greater mechanical output. Permanent magnet DC rare earth motors are lightweight, yet highly reliable. They will not demagnetize under severe conditions. A series of high precision gearmotors is obtained by matching high precision planetary gearheads with the C13 rare earth motors. We offer a wide range of output torque and speed options with standard and custom gear ratios.

- Available with integrated tachometers or encoders for closed-loop control
- Long-life, replaceable metal graphite brushes
- Stainless steel shafts, 0.125 and 0.187 inch diameters, single and double extensions
- Permanently lubricated ball bearings, ABEC 5 standard
- Polyester resin impregnated insulated windings for reliable high speed and

high voltage operation

- Rare earth magnets for high power density
- Diamond turned commutator for quiet operation and long brush life
- 13 bar commutator for superior servo performance
- High torque in a “small package” size
- Low noise and backlash

*\*Previously the AS-780D Series*

### Permanent Magnet DC Brush Motors C23, 34, 42 Series



Moog Components

Group offers a complete line of 2.25 to 4 inches diameter permanent magnet motors. Integrated feedback devices (tachometers and encoders) are available for closed-loop control.

- Long-life, externally replaceable brushes; various grade materials available for high / low voltage applications
- Superior protection provided by totally enclosed, high strength, zinc-plated steel housing
- Shaft configuration optional
- Machined aluminum end-cap for precise locating; round or square. Precision-tapped mounting holes provided to your specifications
- Silicon steel laminations
- Diamond turned commutator for quiet operation and long brush life
- Skewed rotors available for minimal cogging torque
- Rotors are dynamically balanced to ISO G2.5
- Available with standard NEMA mountings
- Polyester resin impregnated insulated windings
- Double-shielded, permanently lubricated ball bearings, ABEC 5 standard; others optional

## Resolvers

### Digital Resolvers

Brushless resolver with built-in electronics that functions as an absolute encoder -

DC in / digital out. The 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  $\pm 5$  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 heavy-duty brushless resolver
- Totally digital input / output
- Absolute position data output
- 12-bit resolution standard
- Maximum system error of  $\pm 15$  arc minutes
- Incremental encoder with A Quad B and North Marker outputs
- 1,024 line incremental resolution standard
- High readout rate
- Mechanical modifications to order

### Size 11 Single Speed Brushless Resolvers

For use in applications that range from computer controlled machine tools to sophisticated medical instrumentation, Moog Components Group 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. As a custom manufacturer, Moog Components Group can provide a size 11 brushless resolver to the exact configuration and accuracy your application demands.



\*\*In conjunction with resolver-to-digital converter

- Uncompromised reliability
- $\pm 7'$  accuracy standard,  $\pm 3'$  available
- Eliminates electrically generated noise
- High speed rotation
- Reliable performance in presence of high vibration
- 400 - 10,000 Hz frequency range standard

- Compatible with converters
- .250<sup>+0.000</sup>/<sub>-.0005</sub> diameter shaft readily available
- Short housing lengths available
- Low cost
- Custom modifications available

### Low Cost Brushless Pancake Resolvers



Rugged, reliable - ideal for demanding environments. Brushless resolvers provide accurate position and velocity feedback as well as commutation in precision equipment, without the structural or temperature restrictions imposed by other electronic feedback devices. They are resistant to the shock and vibration levels often encountered in industrial and instrument applications. These low cost brushless resolvers are available in standard sizes or with custom modifications.

Our engineering department is available for consultation to help tailor a brushless resolver to fit your needs.

- 1, 2, 3, 4 speeds standard; others available
- Ideal for brushless DC motor commutation
- Compact design
- Mounts directly on motor shaft: no coupling devices needed
- No brushes or contacts
- High reliability: long-life design; no bearings or electronics
- Compatible with A / D converters
- 1,200 - 10,000 Hz frequency range standard
- Low electrical noise
- Ruggedness in demanding environments: no glass discs or optics to fail
- Low cost
- Custom modifications available

*NOTE: The resolver products listed here represent only a fraction of the resolvers and synchros we manufacture. Please contact the factory if you have an application and can not locate a suitable product listed here.*

## Drive Electronics

### Silencer® Series Brushless Motor Drive Electronics

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 or enclosure.



- Compact size
- High performance
- Compatible with Silencer® series motors
- Low cost
- 5 - 40 amp motor current
- 12 - 50 VDC supply voltage
- 175 - 1,900 watt output
- Multiple operating modes available - commutation, velocity, torque, 2 and 4 quadrant
- Feedback using Hall effect sensor or encoder
- Efficient PWM speed control
- CE approved for European applications
- Operating temperature range is  $-10^{\circ}$  to  $45^{\circ}$  C, storage temperature  $-40^{\circ}$  to  $85^{\circ}$  C

## Gearheads

### Precision Planetary Gearheads

Precision gearheads, when coupled to



our line of brush-type and brushless motors, provide the user with a quiet and powerful precision gearmotor. Available in a wide range of ratios and output torques. Life-time lubrication ensures long life and maintenance-free operation. Offered in a range from 32 mm to 120 mm, each combination of motor and gearhead offers unique advantages.

- Fits brushless and brush-type motors
- Precision manufactured in accordance with DIN EN ISO 9001 Standards
- Compact design
- High efficiency
- Suitable for continuous, reversing and intermittent operation
- Can be installed in any attitude
- Life-time lubricant for maintenance-free operation
- Available in either sintered or ball bearing versions
- Non-metallic input gear

## Brushless Motors

### Brushless Torque and Toroidal Motors

Our specialty brushless 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. This form of attachment eliminates backlash and increases servo stiffness for an optimized direct drive system. Brushless torque motors are used in applications that require high torque at slow speeds with input power minimized. Our servomotors are used in applications that require high speed and positional accuracy. Custom controllers can be supplied on a design-to-specification basis.

- Double insulated high temp magnet wire minimizes leakage current, promotes superior insulation
- Stable high temp encapsulation material minimizes movement or working of windings under large temperature variations. This high temp material will not crack under temperature variations, and eliminates voids, exposed windings and humidity traps.
- Special magnetic material alloy allows higher torque per unit of volume, higher torque to inertia ratio
- Plated magnet assemblies resist environmental extremes and require no special handling
- Rare earth magnets typical
- High torque and low speed
- High torque to inertia ratio
- Low speed with high accuracy
- Compact
- Large axial holes through armature for easy application to shafts and bosses



### Torque Brushless Motors DB Series

Our DB Series, brushless DC torque motors are known for their high quality, high energy density, and ruggedness. We make standard and custom designs for both military and commercial use.

- Higher torque per unit volume
- Higher torque to inertia ratio
- Low speed with high accuracy
- Compact
- Environmental ruggedness
- Superior electrical insulation

## Brush Motors

### DC Cube Torque Brush Motors 21, 22, 23 and 24 Series



Moog Components Group's family of miniature permanent magnet DC cube torque motors is available in .75 and 1 inch frame sizes. These are rapid response motors at all operating speeds because of their high torque-to-inertia ratio and low self-inductance. Torque increases directly with input current for high linearity. Cube motors are often used in applications where high torque is required, but the available space is limited. Cube motors lend themselves to easier mounting than cylindrical motors in many applications and are easier to lock into an envelope.

- 4 pole 13 bar motors - 2 brushes standard and 4 brushes available
- Stainless steel shafts for durable, rugged wear
- Meets MIL-SPEC 810
- Standard nickel plated housing resists corrosion in harsh environments
- Peak torques from 1.0 to 20 oz-in
- Optional gearheads, brakes, resolvers, encoders and potentiometers available

- Available in .75 and 1 inch frame sizes:
  - Model 21 – 1 in x 1 in x 1 in
  - Model 22 – 1 in x 1 in x .75 in
  - Model 23 – 1 in x 1 in x 1.35 in
  - Model 24 – .75 in x .75 in x .75 in
- Silver alloy brushes
- Speeds up to (7,500) rpm
- Variety of windings available
- Gold plated terminals
- Gold alloy commutator
- Shaft can be modified with front and rear extensions, integrated gear or a pinion

### Torque Brush Motors

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. This form of attachment eliminates backlash and increases servo stiffness for an optimized direct drive system. DC torque motors are used in applications that require high torque at slow speeds with input power minimized. Our DC servomotors are used in applications that require high speed and positional accuracy. Custom controllers can be supplied on a design-to specification basis.

- Double insulated high temp magnet wire minimizes leakage current, promotes superior insulation
- Molded brush block assembly features interchangeable brush blocks, optimizing brush position on commutator. Brush contour is done on automatic tooling rather than "run-in" individually
- Brushes mechanically fastened to brush spring in addition to soldering assures brush alignment during soldering operation plus proper mechanical and electrical bond between brush spring and brush
- Stable high temp encapsulation material minimizes movement or working of windings under large temperature



variations. This high temp material will not crack under temperature variations, and eliminates voids, exposed windings and humidity traps.

- Special magnetic material alloy allows higher torque per unit of volume, higher torque to inertia ratio
- Plated magnet assemblies resist environmental extremes and require no special handling
- Rare earth magnets typical
- High torque and low speed
- High torque to inertia ratio
- Low speed with high accuracy
- Compact
- Large axial holes through armature for easy application to shafts and bosses

## Resolvers

### Rotary Variable Differential Transformer (RVDT)

A Rotary Variable Differential Transformer is an electro-mechanical transducer that provides a variable alternating current (AC) output voltage that is linearly proportional to the angular displacement of its input shaft. When energized with a fixed AC source, the output signal is linear within a specified range over the angular displacement. RVDT's utilize brushless, non-contacting technology to ensure long-life and reliable, repeatable position sensing with infinite resolution. Such reliable and repeatable performance assures accurate position sensing under the most extreme operating conditions. Moog Components Group offers six frequency optimized RVDT's in a basic size 8 configured housing. Each is designed to operate at a specific frequency. Frequency optimization provides the benefit of an increased operating range of angular displacement with a reduction in sensor size and weight.

- Brushless, non-contacting technology
- Repeatable position sensing with infinite resolution



- Standard size 8 housing

Basic RVDT construction and operation is provided by rotating an iron-core bearing supported within a housed stator assembly. The housing is passivated stainless steel. The stator consists of a primary excitation coil and a pair of secondary output coils.

### Military / Aerospace Resolvers

Resolvers provide accurate position and velocity feedback as well as commutation in precision equipment, without the structural or temperature restrictions imposed by other electronic feedback devices. They are resistant to the shock and vibration levels often encountered in military and aerospace applications. These resolvers are available in standard sizes, or with custom modifications.



- 1, 2, 4, 8, 16, 32 and 36 speeds standard; others available
- 400 - 5,000 Hz frequency range standard; frequencies up to 20,000 Hz available
- High immunity to electrical noise
- Rugged design to meet demanding environments – no glass discs or optics to fail
- Mounts directly to shaft and housing – no coupling devices needed
- Brush or brushless designs
- High reliability – long-life design; no bearings or electronics
- Custom modifications available
- Compact design

### Pancake Resolvers

Pancake resolvers are so named for their physical dimensions – they typically have a diameter that exceeds their axial length. Pancake resolvers are supplied as separate rotor and stator assemblies, which are then mounted directly in the

user's system. They are often supplied with a custom ring on the stator and hub on the rotor which facilitate mounting in the user's system. This also improves performance in the operating temperature ranges typically found in military systems.

### Brushless Pancake Resolvers

A rotary transformer can be added to a pancake resolver so that all of the leads exit from the stationary element. Since the rotor is energized through this rotary transformer, slip rings and brushes are not required in the user's system.

### Housed Resolvers

A pancake resolver can be mounted in a housing and shaft configuration that includes a set of ball bearings. Usually, the resolver housing is hard-mounted to the stationary portion of the user's system and the resolver shaft is connected to the rotating portion through a torsionally rigid flexible connector such as a bellows coupler. A housed resolver such as this can also incorporate a rotary transformer.

Our engineering department is available for consultation to help tailor a resolver to fit your needs.

*NOTE: The products and information contained in this catalog consists of basic marketing information and general part descriptions. With respect to the U.S. export regulations, the products identified herein fall under the jurisdiction of the U.S. Commerce Department or the U.S. State Department. Contact Moog Components Group for additional details on the export controls that are applicable to your part.*

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