# Silencer® Series
# Brushless DC Motors

## Medical and Commercial / Industrial

## BMS09 and BSS09

### TYPICAL APPLICATIONS

- Medical equipment - handheld devices, drills and saws
- Robotic systems
- Test and measurement equipment
- Pumps
- Scanners
- Data storage
- Semiconductor handling

### FEATURES

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

***Slotless Motors***

Slotless motors provide zero detent torque for near zero vibration. Utilizing SmCo magnets and a stainless steel housing, the BMS09 is ideal for medical applications where the motor has to withstand autoclave conditions. Utilizing NdFeB magnets, 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.

***Reliable Operation***

The compact slotless motors are well suited for applications demanding high efficiency, high speed, low acoustical noise, and zero detent torque. Typical options include Hall effect feedback or sensorless.

## SPECIFICATION AND NUMBERING SYSTEM

### *Part Numbering System Guide*

**B S 09 – □ □ – □ □ – □ □ T F O**

**BRUSHLESS MOTOR**

**MOTOR TYPE**
Slotless

**MAGNET TYPE**
M - Sintered samarium cobalt
S - Sintered neodymium

**FRAME**
COMMERCIAL DC MOTOR
09 – Size 09

**MOTOR LENGTH**
Refer to motor data table for standard offerings.

**MECHANICAL OPTIONS**
Refer to Notes for standard motor options offered. Many other custom mechanical options are available.

**WINDING CODE**
Corresponds to terminal voltage, refer to specifications tables throughout this brochure for standard offerings. Many other winding options are available.

**TERMINATION OPTIONS**

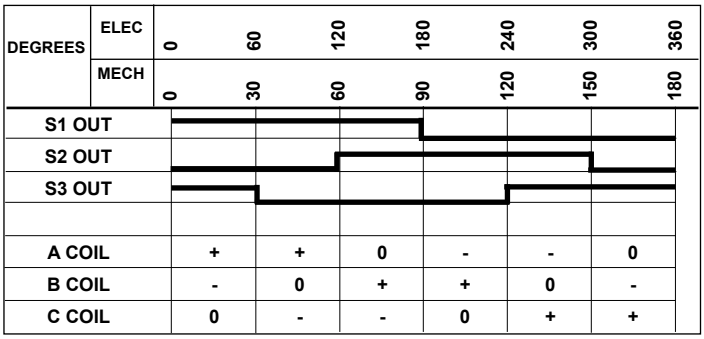
**FEEDBACK OPTIONS**

**OTHER OPTIONS**

### *Conversion Table*

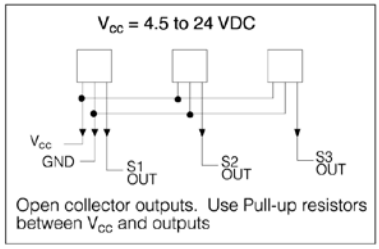
| FROM | TO | MULTIPLY BY |
|---|---|---|
| **Length** | | |
| inches | cm | 2.540 |
| feet | cm | 30.48 |
| cm | inches | .3937 |
| cm | feet | $3.281 \times 10^{-2}$ |
| **Mass** | | |
| oz | g | 28.35 |
| lb | g | 453.6 |
| g | oz | $3.527 \times 10^{-2}$ |
| lb | oz | 16.0 |
| g | lb | $2.205 \times 10^{-3}$ |
| oz | lb | $6.250 \times 10^{-2}$ |
| **Torque** | | |
| oz-in | g-cm | 72.01 |
| lb-ft | g-cm | $1.383 \times 10^{4}$ |
| g-cm | oz-in | $1.389 \times 10^{-2}$ |
| lb-ft | oz-in | 192.0 |
| g-cm | lb-ft | $7.233 \times 10^{-5}$ |
| oz-in | lb-ft | $5.208 \times 10^{-3}$ |
| **Rotation** | | |
| rpm | degrees / sec | 6.0 |
| rad / sec | degrees / sec | 57.30 |
| degrees / sec | rpm | .1667 |
| rad / sec | rpm | 9.549 |
| degrees / sec | rad / sec | $1.745 \times 10^{-2}$ |
| rpm | rad / sec | .1047 |
| **Moment Of Inertia** | | |
| oz-in$^2$ | g-cm$^2$ | 182.9 |
| lb-ft$^2$ | g-cm$^2$ | $4.214 \times 10^{5}$ |
| g-cm$^2$ | oz-in$^2$ | $5.467 \times 10^{-3}$ |
| lb-ft$^2$ | oz-in$^2$ | $2.304 \times 10^{3}$ |
| g-cm$^2$ | lb-ft$^2$ | $2.373 \times 10^{-6}$ |
| oz-in$^2$ | lb-ft$^2$ | $4.340 \times 10^{-4}$ |
| oz-in-sec$^2$ | g-cm$^2$ | $7.062 \times 10^{4}$ |

### *Timing Diagram (4 Pole) CCW Rotation (Shaft End)*




| | | | | | | |
|---|---|---|---|---|---|---|
| A COIL | + | + | 0 | - | - | 0 |
| B COIL | - | 0 | + | + | 0 | - |
| C COIL | 0 | - | - | 0 | + | + |

### *Hall Effect Switches*




IMPORTANT

The operational life and performance of any motor is dependent upon individual operating parameters, environment, temperature and other factors. Your specific application results may vary. Please consult the factory to discuss your requirements.

## BMS09 SPECIFICATIONS - *Continuous Stall Torque 4.0 - 6.0 oz-in (0.0282 - 0.0424 Nm)*
## *Peak Torque 19.0 - 53.0 oz-in (0.1342 - 0.3743 Nm)*

| Part Number* | | BMS09-23AB - ☐☐ T F O | | | BMS09-28AB - ☐☐ T F O | | |
|---|---|---|---|---|---|---|---|
| Winding Code** | | 01 | 02 | 03 | 01 | 02 | 03 |
| Medical Grade (Autoclavable) | | Yes | | | Yes | | |
| L = Length | inches | 2.29 | | | 2.79 | | |
| | millimeter | 58.2 | | | 70.9 | | |
| Terminal Voltage | volts DC (nom) | 12.0 | 24.0 | 24.0 | 12.0 | 24.0 | 24.0 |
| Peak Torque | oz-in | 21.5 | 21.0 | 20.0 | 30.0 | 30.0 | 27.5 |
| | Nm | 0.1518 | 0.1483 | 0.1412 | 0.2119 | 0.2119 | 0.1942 |
| Continuous Stall Torque | oz-in | 4.5 | 4.4 | 4.2 | 6.2 | 6.2 | 5.8 |
| | Nm | 0.0318 | 0.0311 | 0.0297 | 0.0438 | 0.0438 | 0.0410 |
| No-Load Speed | rpm | 11600.0 | 11500.0 | 44000.0 | 11700.0 | 10500.0 | 40300.0 |
| | rad / sec | 1215 | 1204 | 4608 | 1225 | 1100 | 4220 |
| Rated Speed | rpm | 8400.0 | 8100.0 | 41400.0 | 8000.0 | 7700.0 | 37800.0 |
| | rad / sec | 880 | 848 | 4335 | 838 | 806 | 3958 |
| Rated Torque | oz-in max | 4.3 | 4.2 | 4.0 | 6.0 | 6.0 | 5.5 |
| | Nm (max) | 0.0304 | 0.0297 | 0.0282 | 0.0424 | 0.0424 | 0.0388 |
| Rated Current | amps | 3.55 | 1.59 | 6.55 | 5.20 | 2.20 | 8.30 |
| Rated Power | watts | 26.7 | 25.2 | 122.5 | 35.5 | 34.2 | 153.8 |
| Torque Sensitivity (Kt) | oz-in / amp +/- 10% | 1.34 | 2.78 | 0.71 | 1.36 | 3.03 | 0.74 |
| | Nm / amp +/- 10% | 0.0095 | 0.0196 | 0.0050 | 0.0096 | 0.0214 | 0.0052 |
| Back-EMF-(Ke) | volts / krpm +/- 10% | 0.99 | 2.06 | 0.52 | 1.01 | 2.24 | 0.55 |
| | volts / rad / sec | 0.0095 | 0.0196 | 0.0050 | 0.0096 | 0.0214 | 0.0052 |
| Terminal Resistance | ohms +/- 10% | 0.66 | 3.06 | 0.21 | 0.45 | 2.04 | 0.14 |
| Terminal Inductance | millihenries +/- 30% | 0.08 | 0.33 | 0.02 | 0.043 | 0.24 | 0.015 |
| Motor Constant (Km) | oz-in / sq rt Watts (nom) | 1.65 | 1.59 | 1.55 | 2.03 | 2.12 | 1.98 |
| | Nm / sq rt Watts (nom) | 0.01165 | 0.01122 | 0.01094 | 0.01432 | 0.01498 | 0.01397 |
| Rotor Inertia | (oz-in-sec^2) x 10^-3 | 0.060 | 0.060 | 0.060 | 0.081 | 0.081 | 0.081 |
| | g-cm^2 | 4.2 | 4.2 | 4.2 | 5.7 | 5.7 | 5.7 |
| Weight | oz | 4.1 | 4.1 | 4.1 | 5.0 | 5.0 | 5.0 |
| | gm | 116.4 | 116.4 | 116.4 | 142.0 | 142.0 | 142.0 |
| # of Poles | | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Timing | degrees | 120 | 120 | 120 | 120 | 120 | 120 |
| Mech. Time Constant | ms | 3.1 | 3.4 | 3.5 | 2.8 | 2.6 | 2.9 |
| Electrical Time Constant | ms | 0.11 | 0.11 | 0.10 | 0.10 | 0.12 | 0.11 |
| Thermal Resistivity[1] | deg C / watt | 7.0 | 7.0 | 6.0 | 6.0 | 6.0 | 5.0 |
| Speed / Torque | rpm / oz-in | 497.1 | 535.5 | 563.4 | 329.0 | 300.5 | 345.8 |

Notes:
1. Motor mounted to a 4" x 4" x 1/4" aluminum plate, still air.
2. Maximum winding temperature of 155°C.
3. Typical electrical specifications at 25°C.
4. Motor Terminal Voltages are representative only; motors may be operated at voltages other than those listed in the table. For assistance please contact our applications engineer.
5. For MS (military style) connector, please specify connector housing and terminal.
6. Data for informational purposes only. Should not be considered a binding performance agreement. For specific applications, please contact the factory.

*Many other custom mechanical options are available – consult factory.
**Many other winding options are available – consult factory.

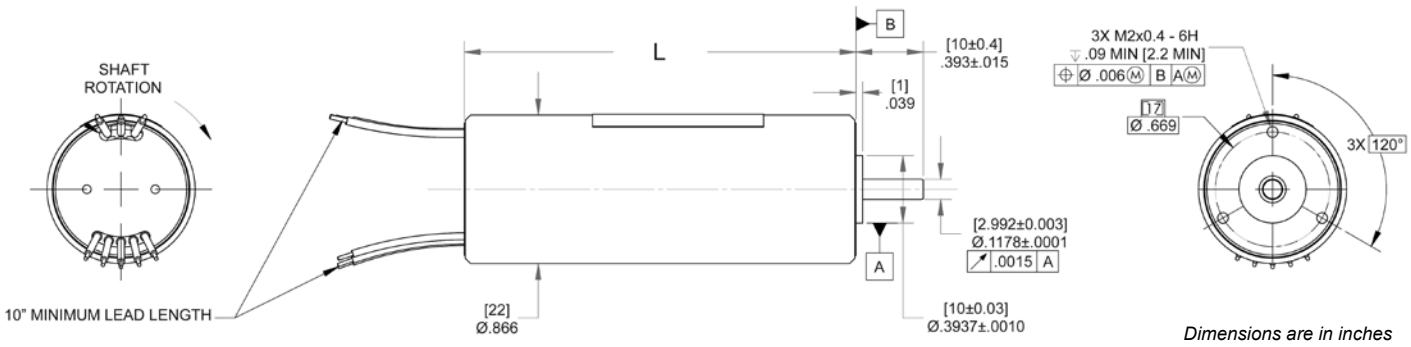
Select your options below and place their code in its corresponding block as shown on page 44.

**T TERMINATION**
L – Leads (std)
C – Connector
M – MS Connector

**F FEEDBACK OPTIONS**
H – Hall Effect (std)
S – Sensorless

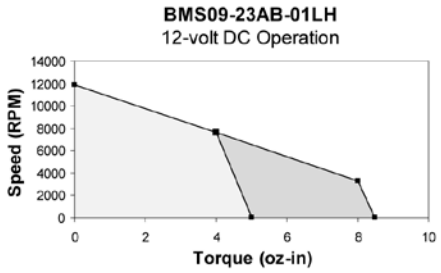
**O OTHER OPTIONS**

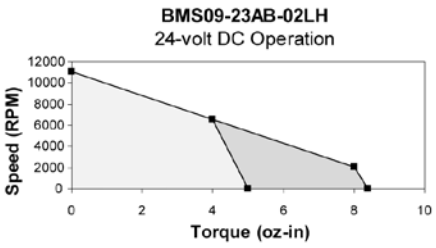
## BMS09 Typical Outline

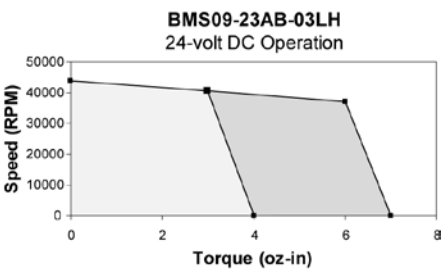


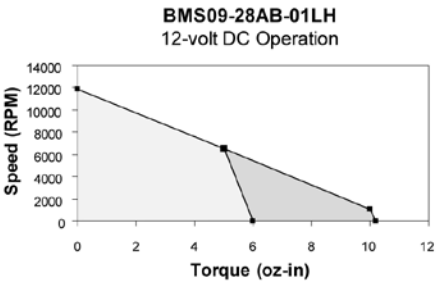

*Dimensions are in inches*

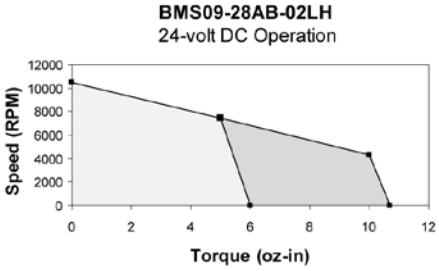
## BMS09 Performance Curves

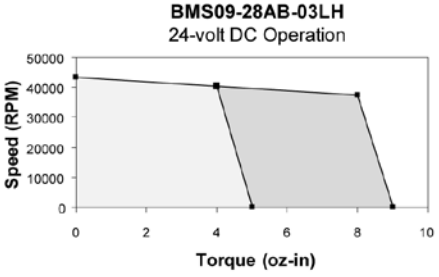


## BSS09 SPECIFICATIONS -

*Continuous Stall Torque 4.0 - 6.0 oz-in (0.0282 - 0.0424 Nm)*
*Peak Torque 19 - 53 oz-in (0.1342 - 0.3743 Nm)*

| Part Number* | | BSS09-23AB - □□ T F O | | | BSS09-28AB - □□ T F O | | |
|---|---|---|---|---|---|---|---|
| Winding Code** | | 01 | 02 | 03 | 01 | 02 | 03 |
| Medical Grade (Autoclavable) | | No | | | No | | |
| L = Length | inches | 2.29 | | | 2.79 | | |
| | millimeter | 58.2 | | | 70.9 | | |
| Terminal Voltage | volts DC (nom.) | 12.0 | 24.0 | 24.0 | 12.0 | 24.0 | 24.0 |
| Peak Torque | oz-in | 27.5 | 26.0 | 25.0 | 32.5 | 32.5 | 32.0 |
| | Nm | 0.1942 | 0.1836 | 0.1766 | 0.2295 | 0.2295 | 0.2260 |
| Continuous Stall Torque | oz-in | 5.6 | 5.3 | 5.2 | 6.8 | 6.8 | 6.8 |
| | Nm | 0.0392 | 0.0374 | 0.0367 | 0.0480 | 0.0480 | 0.0480 |
| No-Load Speed | rpm | 11400.0 | 10900.0 | 42400.0 | 11500.0 | 10700.0 | 40600.0 |
| | rad / sec | 1194 | 1141 | 4440 | 1204 | 1120 | 4252 |
| Rated Speed | rpm | 7300.0 | 7200.0 | 33400.0 | 8100.0 | 8250.0 | 32000.0 |
| | rad / sec | 764 | 754 | 3498 | 848 | 864 | 3351 |
| Rated Torque | oz.-in. max. | 5.5 | 5.2 | 5.0 | 6.5 | 6.5 | 6.4 |
| | Nm (max.) | 0.0388 | 0.0367 | 0.0353 | 0.0459 | 0.0459 | 0.0452 |
| Rated Current | amps | 4.38 | 2.00 | 7.94 | 5.44 | 2.43 | 9.40 |
| Rated Power | watts | 29.7 | 27.7 | 123.5 | 38.9 | 39.7 | 151.5 |
| Torque Sensitivity (Kt) | oz.-in. / amp +/- 10% | 1.39 | 2.92 | 0.73 | 1.42 | 2.98 | 0.77 |
| | Nm / amp +/- 10% | 0.0098 | 0.0206 | 0.0052 | 0.0100 | 0.0210 | 0.0054 |
| Back-EMF-(Ke) | volts / krpm +/- 10% | 1.03 | 2.16 | 0.54 | 1.05 | 2.20 | 0.57 |
| | volts / rad / sec | 0.0098 | 0.0206 | 0.0052 | 0.0100 | 0.0210 | 0.0054 |
| Terminal Resistance | ohms +/- 10% | 0.69 | 3.06 | 0.22 | 0.45 | 2.00 | 0.16 |
| Terminal Inductance | millihenries +/- 30% | 0.07 | 0.33 | 0.02 | 0.048 | 0.22 | 0.015 |
| Motor Constant (Km) | oz.-in. / sq.rt. Watts (nom.) | 1.67 | 1.67 | 1.57 | 2.12 | 2.11 | 1.95 |
| | Nm / sq. rt. Watts (nom.) | 0.01182 | 0.01179 | 0.01112 | 0.01495 | 0.01488 | 0.01377 |
| Rotor Inertia | (oz.-in.-sec.^2) x 10^-3 | 0.055 | 0.055 | 0.055 | 0.076 | 0.076 | 0.076 |
| | g-cm^2 | 3.9 | 3.9 | 3.9 | 5.4 | 5.4 | 5.4 |
| Weight | oz. | 3.3 | 3.3 | 3.3 | 4.2 | 4.2 | 4.2 |
| | gm. | 93.7 | 93.7 | 93.7 | 119.3 | 119.3 | 119.3 |
| # of Poles | | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Timing | degrees | 120 | 120 | 120 | 120 | 120 | 120 |
| Mech. Time Constant | ms | 2.8 | 2.8 | 3.1 | 2.4 | 2.4 | 2.8 |
| Electrical Time Constant | ms | 0.11 | 0.11 | 0.10 | 0.11 | 0.11 | 0.10 |
| Thermal Resistivity[1] | deg. C / watt | 6.0 | 6.0 | 5.0 | 5.0 | 5.0 | 4.0 |
| Speed / Torque | rpm / oz.-in. | 483.0 | 485.4 | 545.6 | 301.8 | 304.6 | 355.8 |

Notes:
1. Motor mounted to a 4" x 4" x 1/4" aluminum plate, still air.
2. Maximum winding temperature of 155°C.
3. Typical electrical specifications at 25°C.
4. Motor Terminal Voltages are representative only; motors may be operated at voltages other than those listed in the table. For assistance please contact our applications engineer.
5. For MS (military style) connector, please specify connector housing and terminal.
6. Data for informational purposes only. Should not be considered a binding performance agreement. For specific applications, please contact the factory.

*Many other custom mechanical options are available – consult factory.
**Many other winding options are available – consult factory.

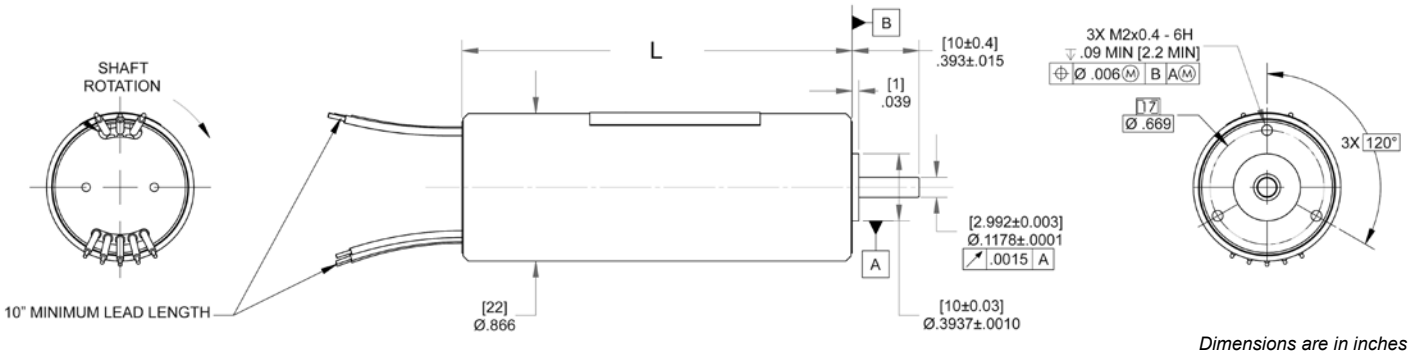
Select your options below and place their code in its corresponding block as shown on page 44.

**T TERMINATION**
L – Leads (Std.)
C – Connector
M – MS Connector

**F FEEDBACK OPTIONS**
H – Hall Effect (Std.)
S – Sensorless

**O OTHER OPTIONS**

## BSS09 Typical Outline




*Dimensions are in inches*

## BSS09 Performance Curves