

# *Silencer*<sup>®</sup> Series Brushless DC Motors

Medical and Commercial / Industrial

## 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)

## *BMS09 and BSS09*



### **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.

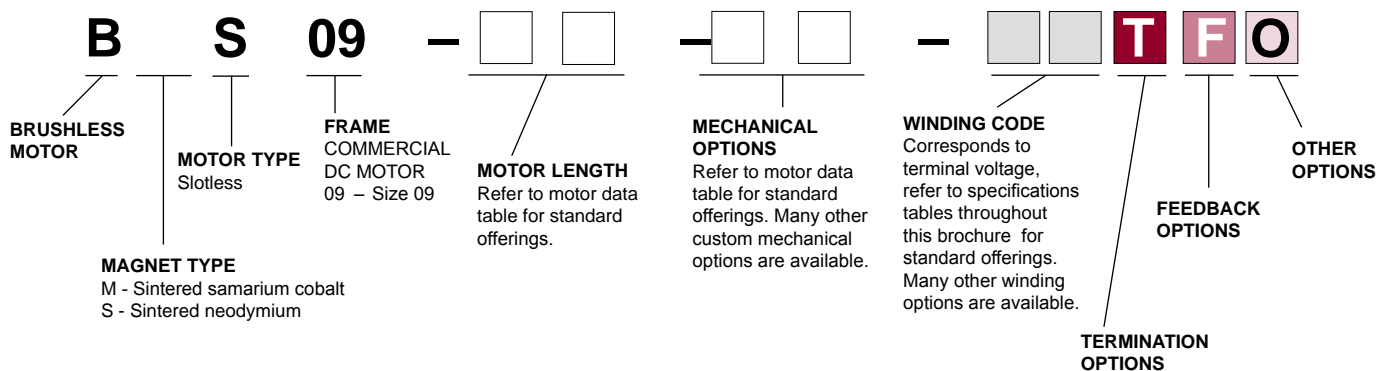
### **Reliable Operation**

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.

# Brushless Motors

## SPECIFICATION AND NUMBERING SYSTEM

### Part Numbering System Guide



### Conversion Table

FROM	TO	MULTIPLY BY
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Length		
inches	cm	2.540
feet	cm	30.48
cm	inches	.3937
cm	feet	3.281 x 10 <sup>-2</sup>

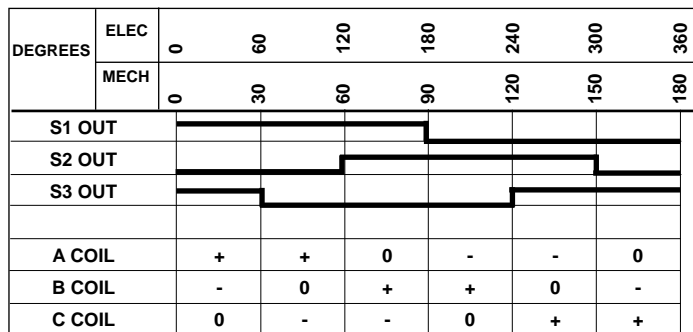
Mass		
oz	g	28.35
lb	g	453.6
g	oz	3.527 x 10 <sup>-2</sup>
lb	oz	16.0
g	lb	2.205 x 10 <sup>-3</sup>
oz	lb	6.250 x 10 <sup>-2</sup>

Torque		
oz-in	g-cm	72.01
lb-ft	g-cm	1.383 x 10 <sup>4</sup>
g-cm	oz-in	1.389 x 10 <sup>-2</sup>
lb-ft	oz-in	192.0
g-cm	lb-ft	7.233 x 10 <sup>-5</sup>
oz-in	lb-ft	5.208 x 10 <sup>-3</sup>

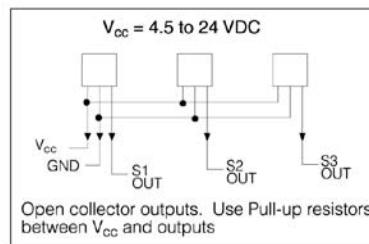
Rotation		
rpm	degrees / sec	6.0
rad / sec	degrees / sec	57.30
degrees / sec	rpm	.1667
rad / sec	rpm	9.549
degrees / sec	rad / sec	1.745 x 10 <sup>-2</sup>
rpm	rad / sec	.1047

Moment Of Inertia		
oz-in <sup>2</sup>	g-cm <sup>2</sup>	182.9
lb-ft <sup>2</sup>	g-cm <sup>2</sup>	4.214 x 10 <sup>5</sup>
g-cm <sup>2</sup>	oz-in <sup>2</sup>	5.467 x 10 <sup>-3</sup>
lb-ft <sup>2</sup>	oz-in <sup>2</sup>	2.304 x 10 <sup>3</sup>
g-cm <sup>2</sup>	lb-ft <sup>2</sup>	2.373 x 10 <sup>-6</sup>
oz-in <sup>2</sup>	lb-ft <sup>2</sup>	4.340 x 10 <sup>-4</sup>
oz-in-sec <sup>2</sup>	g-cm <sup>2</sup>	7.062 x 10 <sup>4</sup>

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



### 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 - <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>			BMS09-28AB - <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		
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	19.0	19.0	40.0	37.0	31.0	53.0
	Nm	0.1342	0.1342	0.2825	0.2613	0.2189	0.3743
Continuous Stall Torque	oz-in	5.0	5.0	4.0	6.0	6.0	5.0
	Nm	0.0353	0.0353	0.0282	0.0424	0.0424	0.0353
No-Load Speed	rpm	11500.0	10900.0	44200.0	10300.0	10500.0	42000.0
	rad / sec	1204	1141	4629	1079	1100	4398
Rated Speed	rpm	7600.0	6600.0	40500.0	7200.0	7500.0	39940.0
	rad / sec	796	691	4241	754	785	4183
Rated Torque	oz-in max	4.0	4.0	3.0	5.0	5.0	4.0
	Nm (max)	0.0282	0.0282	0.0212	0.0353	0.0353	0.0282
Rated Current	amps	3.30	1.50	4.70	3.60	1.80	6.00
Rated Power	watts	22.5	19.5	89.9	26.6	27.7	118.2
Torque Sensitivity (Kt)	oz-in / amp +/- 10%	1.29	2.86	0.71	1.49	2.97	0.74
	Nm / amp +/- 10%	0.0091	0.0202	0.0050	0.0105	0.0210	0.0052
Back-EMF-(Ke)	volts / krpm +/- 10%	0.95	2.11	0.52	1.10	2.20	0.55
	volts / rad / sec	0.0091	0.0202	0.0050	0.0105	0.0210	0.0052
Terminal Resistance	ohms +/- 10%	0.70	3.48	0.23	0.54	2.13	0.16
Terminal Inductance	millihenries +/- 30%	0.08	0.34	0.02	0.058	0.23	0.015
Motor Constant (Km)	oz-in / sq rt Watts (nom)	1.54	1.53	1.48	2.03	2.04	1.85
	Nm / sq rt Watts (nom)	0.01089	0.01083	0.01045	0.01432	0.01437	0.01306
Rotor Inertia	(oz-in-sec <sup>2</sup> ) x 10 <sup>-3</sup>	0.060	0.060	0.060	0.081	0.081	0.081
	g-cm <sup>2</sup>	4.2	4.2	4.2	5.7	5.7	5.7
Weight	oz	4.0	4.0	4.0	5.0	5.0	5.0
	gm	113.6	113.6	113.6	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	3.6	3.6	3.9	2.8	2.8	3.4
Electrical Time Constant	ms	0.11	0.10	0.09	0.11	0.11	0.09
Thermal Resistivity <sup>1</sup>	deg C / watt	8.0	8.0	8.0	5.0	5.0	5.0
Speed / Torque	rpm / oz-in	568.9	575.4	617.0	328.9	326.6	395.1

**Notes:**

- Motor mounted to a 4" x 4" x 1/4" aluminum plate, still air.
- Maximum winding temperature of 155°C.
- Typical electrical specifications at 25°C.
- 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.
- For MS (military style) connector, please specify connector housing and terminal.
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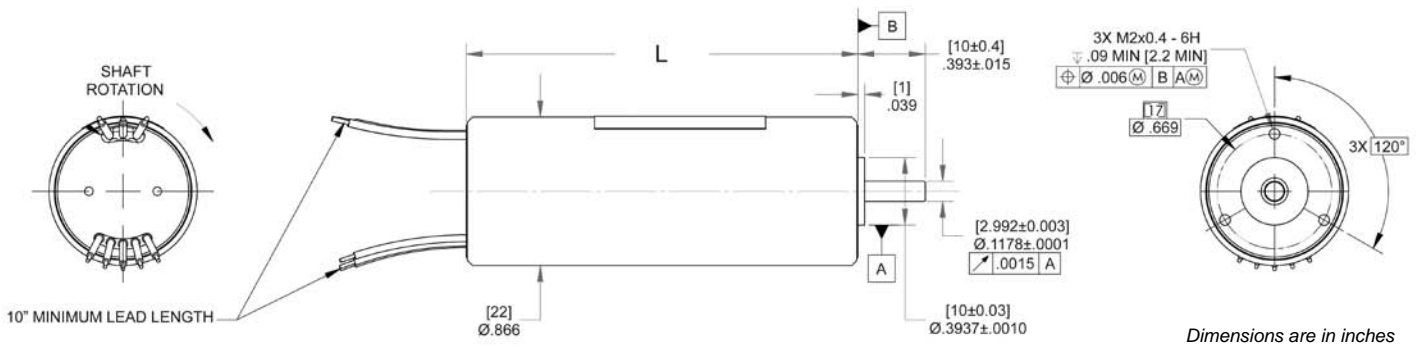
\*Many other custom mechanical options are available – consult factory.  
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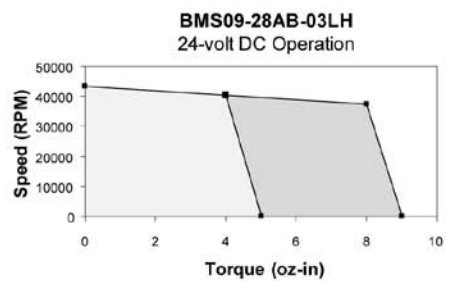
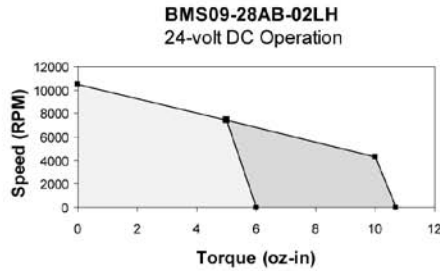
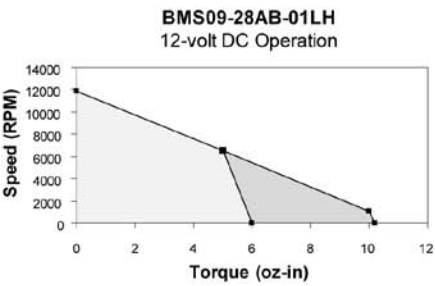
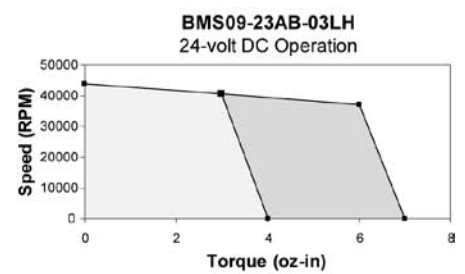
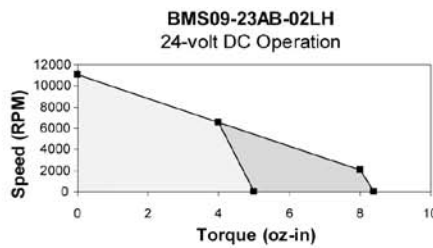
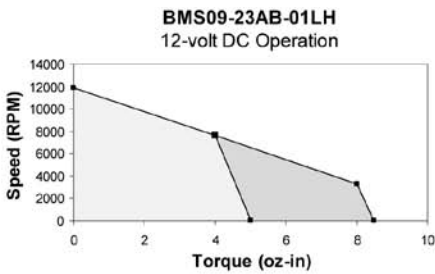
- TERMINATION**       **FEEDBACK OPTIONS**       **OTHER OPTIONS**  
 L – Leads (std)      H – Hall Effect (std)  
 C – Connector      S – Sensorless  
 M – MS Connector

# Brushless Motors

## BMS09 Typical Outline



## BMS09 Performance Curves



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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	19.0	19.0	40.0	37.0	31.0	53.0
	Nm	0.1342	0.1342	0.2825	0.2613	0.2189	0.3743
Continuous Stall Torque	oz-in	5.0	5.0	4.0	6.0	6.0	5.0
	Nm	0.0353	0.0353	0.0282	0.0424	0.0424	0.0353
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	rad / sec	796	691	4241	754	785	4183
Rated Torque	oz.-in. max.	4.0	4.0	3.0	5.0	5.0	4.0
	Nm (max.)	0.0282	0.0282	0.0212	0.0353	0.0353	0.0282
Rated Current	amps	3.30	1.50	4.70	3.60	1.80	6.00
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	Nm / sq. rt. Watts (nom.)	0.01089	0.01083	0.01045	0.01432	0.01437	0.01306
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.	3.5	3.5	3.5	4.5	4.5	4.5
	gm.	99.4	99.4	99.4	127.8	127.8	127.8
# 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	3.3	3.3	3.6	2.6	2.6	3.1
Electrical Time Constant	ms	0.11	0.10	0.09	0.11	0.11	0.09
Thermal Resistivity <sup>1</sup>	deg. C / watt	8.0	8.0	8.0	5.0	5.0	5.0
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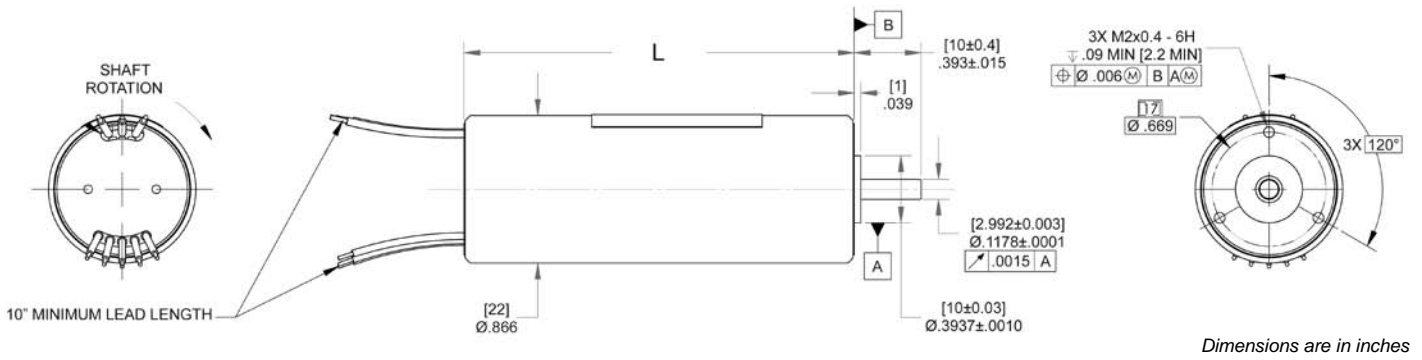
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- |  |   |  |
|--|---|--|
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| L – Leads (Std.)                                       | H – Hall Effect (Std.)                                      |  |
| C – Connector  | S – Sensorless  |  |
| M – MS Connector                                       |   |  |

# Brushless Motors

## BSS09 Typical Outline



## BSS09 Performance Curves

