

# Brushless DC Motors

## Outside Rotor Fractional Horsepower

### TYPICAL APPLICATIONS

- Medical equipment (pumps, blowers, others)
- HVAC systems (air handling equipment)
- Industrial automation
- Scanners
- Office automation equipment

### FEATURES

- Lengths - from 1.9" to 2.2"
- Continuous torques from 29.9 to 44.5 oz-in
- Low cost bonded ferrite magnets
- Safe, arcless operation
- High speed capabilities – up to 16,000 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

### BENEFITS

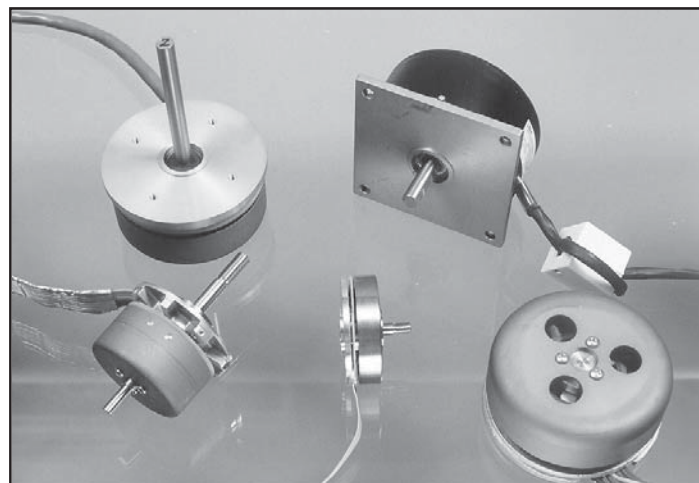
- Operate over a wide range of speeds - not limited to AC frequency
- Extremely quiet operation with long life capability
- Precise, variable speed control
- Motor life is not limited to brush or commutator life
- Efficient operation without losses associated with brushes and commutation or armature induction

### ENCODERS

High resolution, high reliability, and state-of-the-art technology in a small package:

- Bidirectional incremental code
- Up to 1024 cycles standard
- Up to 3 channels: A, B, and index
- TTL/CMOS compatible
- Other configurations and resolutions available

### BOF35 Series



### Quiet, Brushless Motors

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. 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.

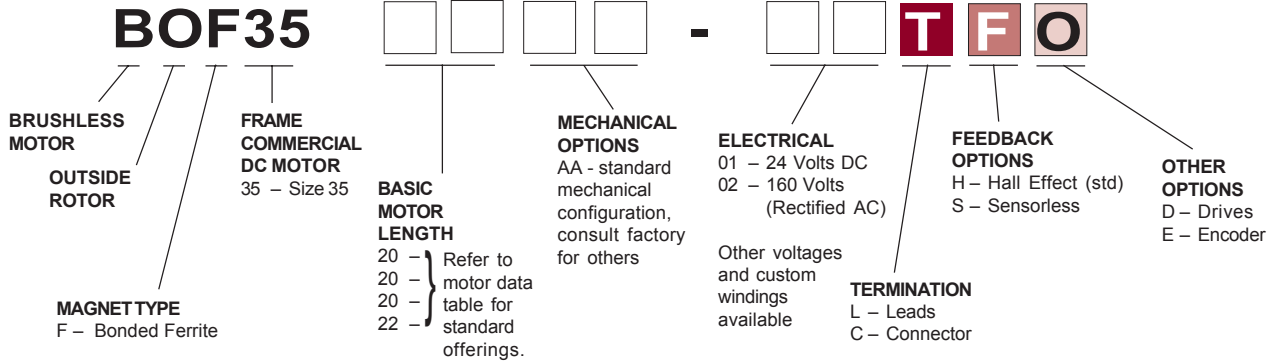
In some applications, motors with an outside rotor enjoy several advantages over their counterparts with inside rotors. Motors with outside rotors perform especially well in applications with significant torque oscillation. Also, BOF outside rotor motors have relatively low profile dimensions for height so they can easily fit in an envelope that is wider than it is tall - such as some medical equipment or industrial machines.

We've designed thousands of DC motors, so if our BOF series doesn't meet your needs, call us to talk about your specifications. One of our other designs may meet your needs, or our engineering department can design a motor to meet your specific requirement.

# Brushless Motors

## SPECIFICATION AND NUMBERING SYSTEM

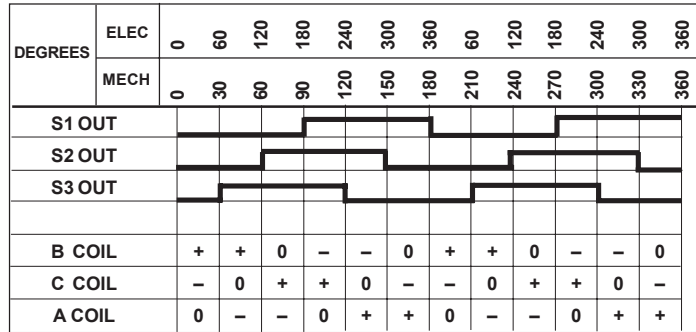
### Part Numbering System Guide



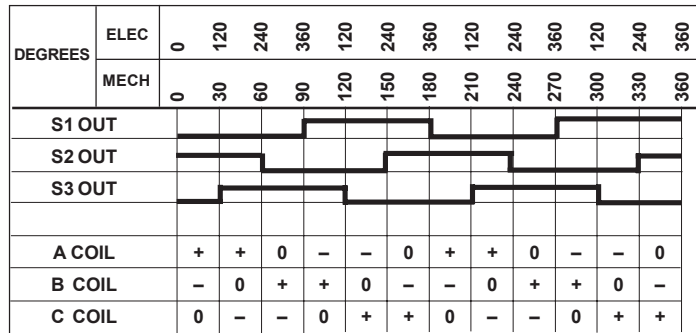
### Conversion Table

FROM	TO	MULTIPLY BY
<b>Length</b>		
inches	cm	2.540
feet	cm	30.48
cm	inches	.3937
cm	feet	3.281 x 10 <sup>-2</sup>
<b>Mass</b>		
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>
<b>Torque</b>		
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>
<b>Rotation</b>		
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
<b>Moment Of Inertia</b>		
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>

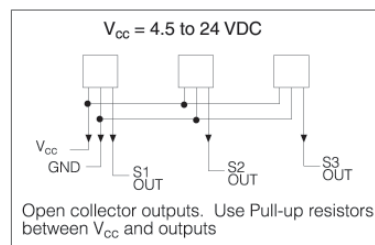
### Timing Diagram CCW Shaft Rotation - 4 Poles



### Timing Diagram CCW Shaft Rotation - 8 Poles



### Hall Effect Switches



### Termination Table

PIN NUMBER	FUNCTION	COLOR
3	A	BLUE
2	B	PURPLE
1	C	GRAY
6	S1	ORANGE
5	S2	YELLOW
4	S3	GREEN
7	V <sub>cc</sub>	RED
8	GROUND	BROWN

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## BOF35 SPECIFICATIONS - Continuous Stall Torque 29.9 - 44.5 oz-in (0.2111 - 0.3142 Nm) Peak Torque 117 - 286 oz-in (0.8262 - 2.0196 Nm)

Part Number*		BOF35-20AA- <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		BOF35-22AA- <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		BOF35-20BA- <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		BOF35-22BA- <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
Winding Code**		01	02	01	02	01	02	01	02
L = Length	inches	1.91		2.20		1.91		2.20	
	millimeters	48.5		55.9		48.5		55.9	
Terminal Voltage	volts DC	24.0	160.0	24.0	160.0	24.0	160.0	24.0	160.0
Peak Torque	oz-in	117.0	126.0	177.0	195.0	180.0	200.0	253.0	286.0
	Nm	0.8262	0.8897	1.2499	1.3770	1.2711	1.4123	1.7866	2.0196
Continuous Stall Torque	oz-in	29.9	30.5	39.5	40.1	32.6	33.9	42.7	44.5
	Nm	0.2111	0.2154	0.2789	0.2832	0.2302	0.2394	0.3015	0.3142
Rated Speed	RPM	3986.0	4354.0	4173.0	4641.0	5140.0	5451.0	4853.0	5195.0
	rad/sec	417	456	437	486	538	571	508	544
Rated Torque	oz-in	29.1	29.6	38.4	38.9	31.7	32.9	41.5	43.2
	Nm	0.2055	0.2090	0.2712	0.2747	0.2238	0.2323	0.2931	0.3051
Rated Current	Amps	6.50	1.03	8.09	1.30	7.50	1.20	8.92	1.44
Rated Power	watts	86.0	95.0	118.0	133.0	120.0	133.0	149.0	166.0
Torque Sensitivity	oz-in/amp	5.42	34.65	5.70	35.84	5.13	33.20	5.60	36.02
	Nm/amp	0.0383	0.2447	0.0403	0.2531	0.0362	0.2344	0.0395	0.2544
Back EMF	volts/KRPM	4.01	25.62	4.22	26.50	3.79	24.55	4.14	26.63
	volts/rad/sec	0.0383	0.2447	0.0403	0.2531	0.0362	0.2344	0.0395	0.2544
Terminal Resistance	ohms	1.11	43.51	0.77	29.26	0.68	26.37	0.53	20.06
Terminal Inductance	mH	1.13	45.97	0.86	34.12	0.53	22.13	0.47	19.48
Motor Constant	oz-in/sq.rt.watt	5.14	5.25	6.50	6.63	6.22	6.47	7.69	8.04
	Nm/sq.rt.watt	0.03633	0.03709	0.04587	0.04679	0.04393	0.04565	0.05432	0.05679
Rotor Inertia	oz-in-sec <sup>2</sup>	53.00	53.00	65.00	65.00	53.00	53.00	65.00	65.00
	g-cm <sup>2</sup>	3740.2	3740.2	4587.1	4587.1	3740.2	3740.0	4587.1	4587.1
Weight	oz	32.2	32.2	39.5	39.5	30.5	30.5	37.9	37.9
	g	913.9	913.9	1121.8	1120.9	866.8	866.2	1076.4	1076.4
# of Poles		4.0	4.0	4.0	4.0	8.0	8.0	8.0	8.0
Timing		60°	60°	60°	60°	120°	120°	120°	120°
Mech. Time Constant	m s	283.4	271.8	218.0	209.5	193.8	179.4	155.5	142.2
Electrical Time Constant	m s	1.02	1.06	1.12	1.17	0.78	0.84	0.89	0.97
Thermal Resistivity	°C/watt	1.5	1.5	1.4	1.4	1.8	1.8	1.6	1.6

### Notes:

- Motor mounted to a 6" x 6" x 1/4" aluminum plate, in still, 25°C ambient air.
- Maximum winding temperature of 155°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.

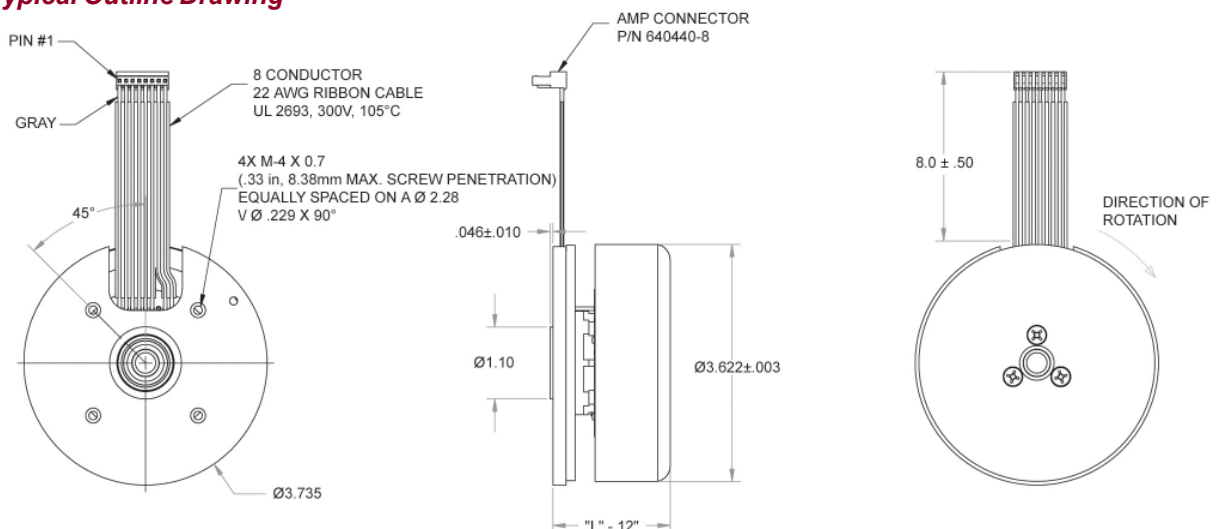
\*Many other custom mechanical options are available – consult factory.

\*\*Many other winding options are available – consult factory.

Select your options below and place their code in its corresponding block as shown on page 60.

- |                      |                           |                        |
|----------------------|---------------------------|------------------------|
| <b>T</b> TERMINATION | <b>F</b> FEEDBACK OPTIONS | <b>O</b> OTHER OPTIONS |
| L – Leads (std)      | H – Hall Effect (std)     | D – Drive              |
| C – Connector        | R – Resolver              | E – Encoder            |
| M – MS connector     | S – Sensorless            | G – Gearhead           |

### BOF35 Typical Outline Drawing

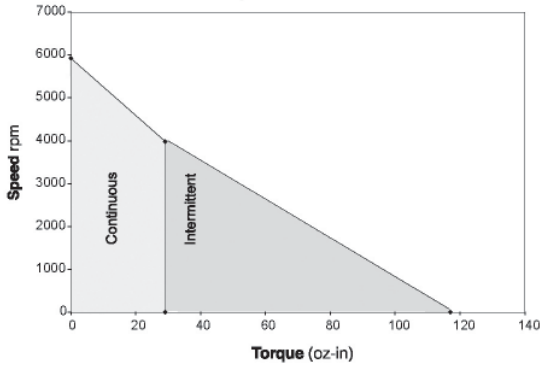


**Note:** Available with and without cover can.

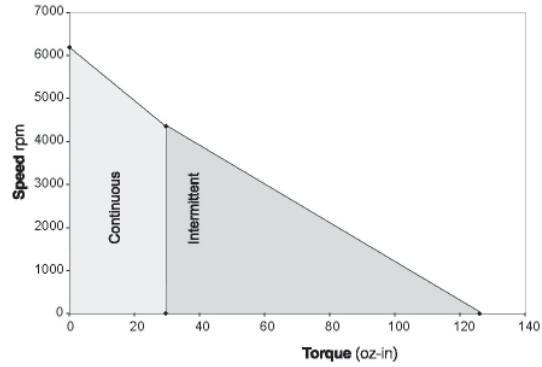
# Brushless Motors

## BOF35 Performance Curves

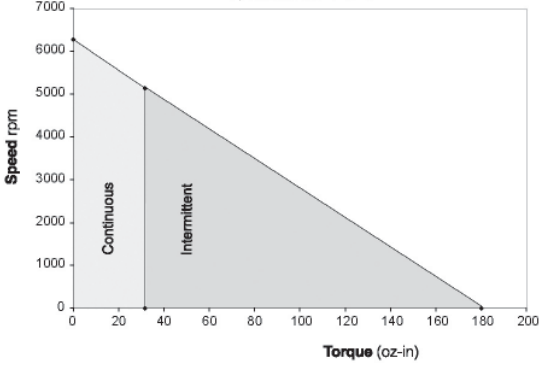
**BOF35-20AA-01 Speed-Torque: Continuous and Intermittent Operation at 24 VDC**



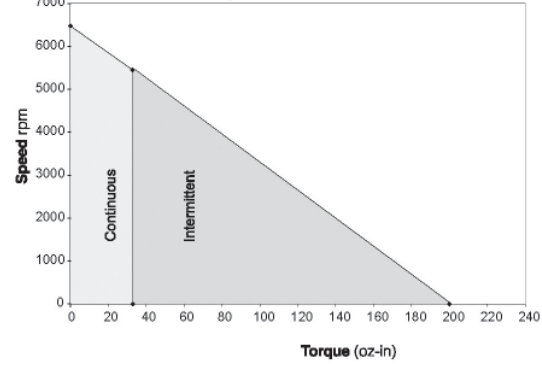
**BOF35-20AA-02 Speed-Torque: Continuous and Intermittent Operation at 160 VDC**



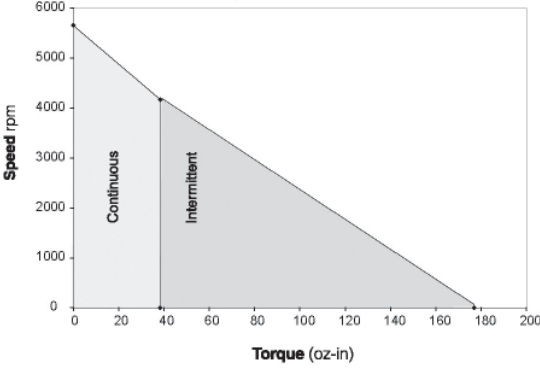
**BOF35-20BA-01 Speed-Torque: Continuous and Intermittent Operation at 24 VDC**



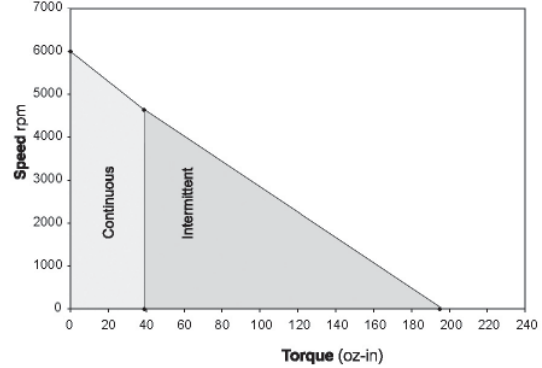
**BOF35-20BA-02 Speed-Torque: Continuous and Intermittent Operation at 160 VDC**



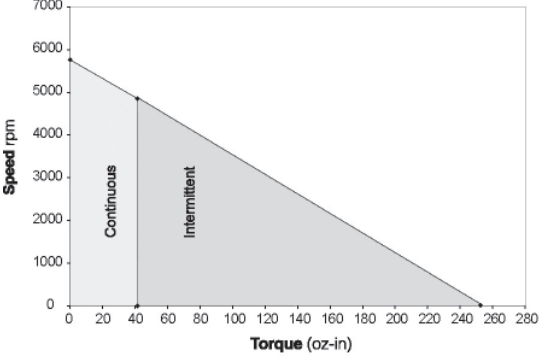
**BOF35-22AA-01 Speed-Torque: Continuous and Intermittent Operation at 24 VDC**



**BOF35-22AA-02 Speed-Torque: Continuous and Intermittent Operation at 160 VDC**



**BOF35-22BA-01 Speed-Torque: Continuous and Intermittent Operation at 24 VDC**



**BOF35-22BA-02 Speed-Torque: Continuous and Intermittent Operation at 160 VDC**

