

# S-Series

## Brushless, Frameless Torque Motors

Slotless, brushless ring motors with high torque output and zero cogging

Frameless design for easy integration into OEM machines

Various winding options available

Includes Hall effect sensors for commutation



The S-series motors are Aerotech's high-performance brushless, frameless torque motors. The motors feature neodymium iron boron magnets for maximum torque and acceleration in a compact assembly.

### High-Performance Design

The S-series motors utilize a slotless stator design and high pole-count rotor to provide zero cogging for exceptional velocity stability. The laminations contain no slots, eliminating torque ripple and cogging torque that produces velocity disturbance. The S-series motors are well-suited for direct-drive applications such as printing and scanning where velocity ripple cannot be tolerated.

### Wide Range of Output Torque and Sizes

The S-series slotless motors cover a wide range of torque and package sizes. Continuous torque ranges from 0.20 N-m to 29.09 N-m. Peak torque ranges from 0.82 N-m to 116.37 N-m. The open design of the S-series motors allows for custom winding or mechanical variations to meet any application need.

The S-series motors are designed for applications in OEM machines. The S-50 (50-mm diameter) motor is ideal for small, tight spaces such as spindles or small feed rolls. The S-180 (180 mm diameter) and S-240 (240 mm diameter) can accelerate large print drums or precision positioning tables.

### Easy Machine Integration

All S-series motors are supplied as two pieces – a slotless stator coil and permanent magnet rotor. The stator is a standard 3-phase coil assembly with Hall-effect devices. They can be driven using a simple six-step or sinusoidal commutation algorithm. Aerotech's Ndrive series amplifiers are performance-matched to the S-series motors for easy integration. The hollow rotor mounts directly to a drive axis with no gearing required.

Custom variations can be engineered to your requirements with minimal lead time.



*S-series motor is used in Aerotech's high-performance ADR direct-drive rotary stage.*

## S-Series SPECIFICATIONS

Motor Model	Units	S-50-39		S-50-52		S-50-86		S-76-35		S-76-85		S-76-149	
Winding Designation		-A	-B	-A	-B	-A	-B	-A	-B	-A	-B	-A	-B
<b>Performance Specifications<sup>(1,5)</sup></b>													
Stall Torque, Continuous <sup>(2)</sup>	N-m	0.20		0.33		0.56		0.53		1.60		2.86	
Peak Torque <sup>(3)</sup>	N-m	0.82		1.31		2.26		2.12		6.41		11.43	
Rated Speed	rpm	4,000	8,000	4,000	8000	3,000	8000	3,000	5,000	3,000	4,000	2,000	1,500
Power Output, Continuous	W	85.7	171.5	136.7	273.4	177.5	473.2	166.3	277.2	503.5	671.3	598.5	448.9
<b>Electrical Specifications<sup>(5)</sup></b>													
BEMF Const., Line-Line, Max	V <sub>pk</sub> /krpm	10.3	3.4	17.2	5.7	32.6	10.9	32.1	16.0	51.1	34.0	70.6	105.9
Continuous Current, Stall <sup>(2)</sup>	Amp <sub>pk</sub>	2.4	7.2	2.3	6.9	2.1	6.3	2.0	4.0	3.80	5.70	4.90	3.27
	Amp <sub>rms</sub>	1.7	5.1	1.6	4.9	1.5	4.5	1.4	2.8	2.7	4.0	3.5	2.3
Peak Current, Stall <sup>(2)</sup>	A <sub>pk</sub>	9.6	28.8	9.2	27.6	8.4	25.2	8.0	16.0	15.2	22.8	19.6	13.1
Torque Constant <sup>(4,9)</sup>	N-m/Amp <sub>pk</sub>	0.09	0.03	0.14	0.05	0.27	0.09	0.26	0.13	0.42	0.28	0.58	0.87
	N-m/Amp <sub>rms</sub>	0.12	0.04	0.20	0.07	0.38	0.13	0.37	0.19	0.60	0.40	0.82	1.24
Motor Constant <sup>(2,4)</sup>	N-m/ $\sqrt{W}$	0.034		0.050		0.076		0.083		0.179		0.280	
Resistance, 25°C, Line-Line	ohms	6.6	0.7	8.4	0.9	12.9	1.4	10.5	2.6	5.7	2.5	4.4	10.0
Inductance, Line-Line	mH	1.50	0.17	1.30	0.14	2.40	0.27	1.40	0.35	1.10	0.49	0.87	1.96
Maximum Bus Voltage	VDC	340	160	340	160	340	160	340	160	340	160	340	340
Thermal Resistance	°C/W	2.02		1.73		1.35		1.83		0.93		0.72	
Number of Poles		8						14					
<b>Mechanical Specifications</b>													
Frameless Motor Weight	kg	0.32		0.48		0.90		0.64		2.20		4.30	
Frameless Rotor Inertia	kg-m <sup>2</sup>	1.11x10 <sup>-5</sup>		1.70x10 <sup>-5</sup>		3.40x10 <sup>-5</sup>		1.06x10 <sup>-4</sup>		4.20x10 <sup>-4</sup>		8.30x10 <sup>-4</sup>	
Length of Winding, Frameless Motor	mm	39.1		51.8		85.8		35.0		84.8		149.0	
Outside Diameter, Frameless Motor	mm	50.8						76.0					
Inside Shaft Diameter, Frameless Motor	mm	9.5						30.0					

Notes:

- Performance is dependent upon heat sink configuration, system cooling conditions, and ambient temperature.
- Values shown @ 75°C rise above a 25°C ambient temperature, with housed motor mounted to a 250 mm x 250 mm x 6 mm aluminum heat sink.
- Peak torque assumes correct rms current; consult Aerotech.
- Torque constant and motor constant specified at stall.
- All performance and electrical specifications  $\pm 10\%$ .
- Losses due to bearings and aerodynamics considered negligible.
- Maximum winding temperature is 100°C; thermistor trips at 100°C.
- Ambient operating temperature range 0°C - 25°C; consult Aerotech for performance in elevated ambient temperatures.
- All Aerotech amplifiers are rated A<sub>pk</sub>; use torque constant in N-m/A<sub>pk</sub> when sizing.

## S-Series SPECIFICATIONS

Motor Model	Units	S-130-39		S-130-60		S-130-81		S-130-102		S-130-123	
Winding Designation		-A	-B	-A	-B	-A	-B	-A	-B	-A	-B
<b>Performance Specifications<sup>(1,5)</sup></b>											
Stall Torque, Continuous <sup>(2)</sup>	N-m	2.36		4.18		5.89		7.69		8.65	
Peak Torque <sup>(3)</sup>	N-m	9.42		16.73		23.55		30.75		34.61	
Rated Speed	rpm	2,000	4,000	1,000	2,000	750	1,500	500	1,000	375	750
Power Output, Continuous	W	493.4	986.9	437.9	875.9	462.4	924.9	402.5	805.1	339.8	679.5
<b>Electrical Specifications<sup>(5)</sup></b>											
BEMF Const., line-line, max	V <sub>pk</sub> /krpm	75.1	37.5	148.9	74.4	222.7	111.4	300.2	150.1	374.1	187.0
Continuous Current, Stall <sup>(2)</sup>	Amp <sub>pk</sub>	3.8	7.6	3.4	6.8	3.2	6.4	3.1	6.2	2.8	5.6
	Amp <sub>rms</sub>	2.7	5.4	2.4	4.8	2.3	4.5	2.2	4.4	2.0	4.0
Peak Current, Stall <sup>(3)</sup>	A <sub>pk</sub>	15.2	30.4	13.6	27.2	12.8	25.6	12.4	24.8	11.2	22.4
Torque Constant <sup>(4,9)</sup>	N-m/Amp <sub>pk</sub>	0.62	0.31	1.23	0.62	1.84	0.92	2.48	1.24	3.09	1.55
	N-m/Amp <sub>rms</sub>	0.88	0.44	1.74	0.87	2.60	1.30	3.51	1.75	4.37	2.18
Motor Constant <sup>(2,4)</sup>	N-m/√W	0.265		0.446		0.586		0.710		0.816	
Resistance, 25°C, line-line	ohms	5.6	1.4	7.8	2.0	10.1	2.5	12.5	3.1	14.7	3.7
Inductance, line-line	mH	1.70	0.43	1.80	0.45	2.80	0.70	3.67	0.92	4.60	1.15
Maximum Bus Voltage	VDC	340	160	340	160	340	340	340	340	340	340
Thermal Resistance	°C/W	0.95		0.85		0.74		0.64		0.67	
Number of Poles		18									
<b>Mechanical Specifications</b>											
Frameless Motor Weight	kg	1.87		3.60		5.30		7.00		8.70	
Frameless Rotor Inertia	kg-m <sup>2</sup>	1.60x10 <sup>-3</sup>		3.00x10 <sup>-3</sup>		4.70x10 <sup>-3</sup>		6.20x10 <sup>-3</sup>		7.80x10 <sup>-3</sup>	
Length of Winding, Frameless Motor	mm	38.7		59.7		80.7		101.7		122.7	
Outside Diameter, Frameless Motor	mm	128.9									
Inside Shaft Diameter, Frameless Motor	mm	50.8									

Notes:

- Performance is dependent upon heat sink configuration, system cooling conditions, and ambient temperature.
- Values shown @ 75°C rise above a 25°C ambient temperature, with housed motor mounted to a 330 mm x 330 mm x 13 mm aluminum heat sink.
- Peak torque assumes correct rms current; consult Aerotech.
- Torque constant and motor constant specified at stall.
- All performance and electrical specifications ±10%.
- Losses due to bearings and aerodynamics considered negligible.
- Maximum winding temperature is 100°C; thermistor trips at 100°C.
- Ambient operating temperature range 0°C - 25°C; consult Aerotech for performance in elevated ambient temperatures.
- All Aerotech amplifiers are rated Apk; use torque constant in N-m/ Apk when sizing.

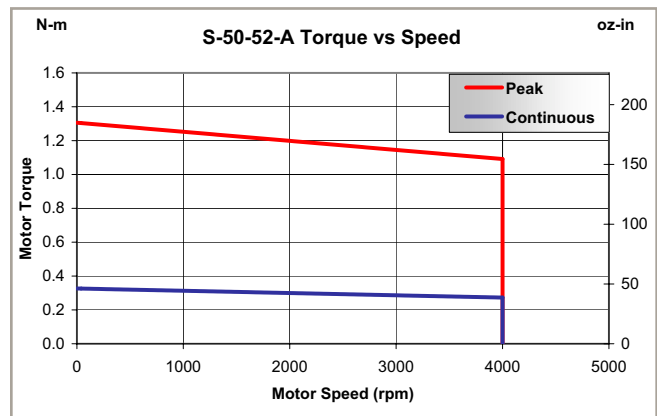
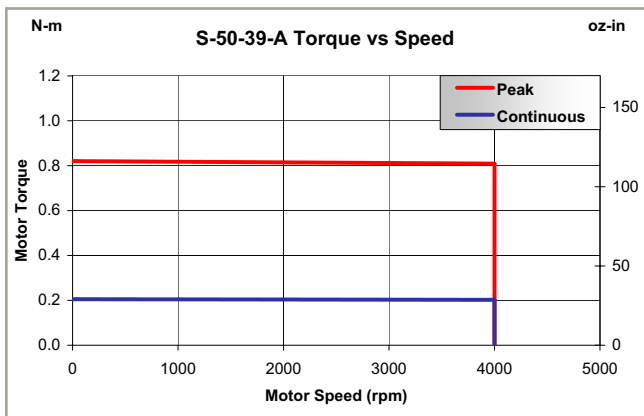
## S-Series SPECIFICATIONS

Motor Model	Units	S-180-44		S-180-69		S-180-94		S-240-43		S-240-63		S-240-83	
Winding Designation		-A	-B	-A	-B	-A	-B	-A	-B	-A	-B	-A	-B
<b>Performance Specifications<sup>(1,5)</sup></b>													
Stall Torque, Continuous <sup>(2)</sup>	N-m	5.99		11.12		15.93		10.73		19.71		29.09	
Peak Torque <sup>(2)</sup>	N-m	23.98		44.47		63.70		42.90		78.82		116.37	
Rated Speed	rpm	500	1000	500	1000	250	500	600	1200	250	500	200	400
Power Output, Continuous	W	313.8	627.7	582.1	1164.3	416.9	833.8	673.9	1347.9	515.9	1031.8	609.3	1218.6
<b>Electrical Specifications<sup>(5)</sup></b>													
BEMF Const., line-line, max	V <sub>pk</sub> /krpm	268.7	134.4	263.9	131.9	393.4	196.7	209.4	104.7	404.3	202.2	607.2	303.6
Continuous Current, Stall <sup>(2)</sup>	Amp <sub>pk</sub>	2.7	5.4	5.1	10.2	4.9	9.8	6.2	12.4	5.9	11.8	5.8	11.6
	Amp <sub>rms</sub>	1.9	3.8	3.6	7.2	3.5	6.9	4.4	8.8	4.2	8.3	4.1	8.2
Peak Current, Stall <sup>(2)</sup>	A <sub>pk</sub>	10.8	21.6	20.4	40.8	19.6	39.2	24.8	49.6	23.6	47.2	23.2	46.4
Torque Constant <sup>(4,9)</sup>	N-m/Amp <sub>pk</sub>	2.22	1.11	2.18	1.09	3.25	1.63	1.73	0.87	3.34	1.67	5.02	2.51
	N-m/Amp <sub>rms</sub>	3.14	1.57	3.08	1.54	4.60	2.30	2.45	1.22	4.72	2.36	7.09	3.55
Motor Constant <sup>(2,4)</sup>	N-m/√W	0.628		1.053		1.391		0.845		1.405		1.893	
Resistance, 25°C, line-line	ohms	12.8	3.2	4.4	1.1	5.6	1.4	4.3	1.1	5.8	1.5	7.2	1.8
Inductance, line-line	mH	3.40	0.85	1.70	0.43	2.60	0.65	2.15	0.54	2.90	0.73	4.30	1.08
Maximum Bus Voltage	VDC	340	340	340	160	340	340	340	160	340	340	340	340
Thermal Resistance	°C/W	0.82		0.67		0.57		0.47		0.38		0.32	
Number of Poles		18						26					
<b>Mechanical Specifications</b>													
Frameless Motor Weight	kg	4.24		8.10		11.90		5.80		11.00		16.20	
Frameless Rotor Inertia	kg-m <sup>2</sup>	7.40x10 <sup>-3</sup>		1.48x10 <sup>-2</sup>		2.20x10 <sup>-2</sup>		2.30x10 <sup>-2</sup>		4.50x10 <sup>-2</sup>		7.00x10 <sup>-2</sup>	
Length of Winding, Frameless Motor	mm	43.2		68.2		93.2		42.7		62.7		82.7	
Outside Diameter, Frameless Motor	mm	180.0						239.2					
Inside Shaft Diameter, Frameless Motor	mm	86.4						120.6					

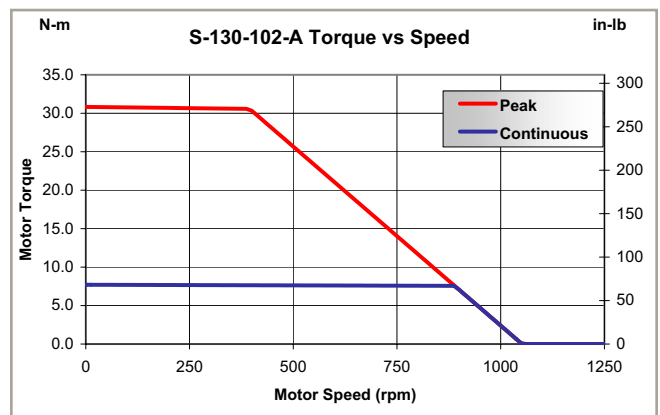
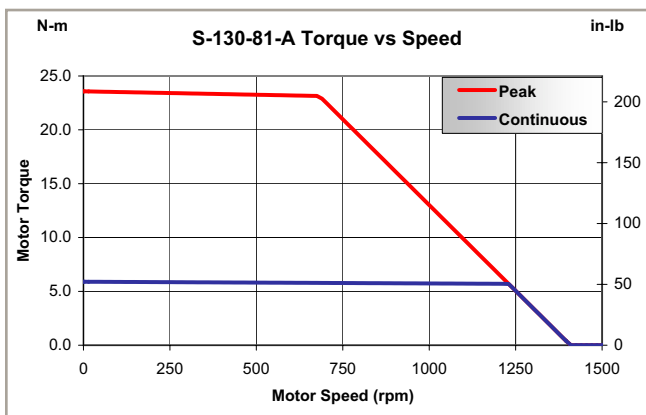
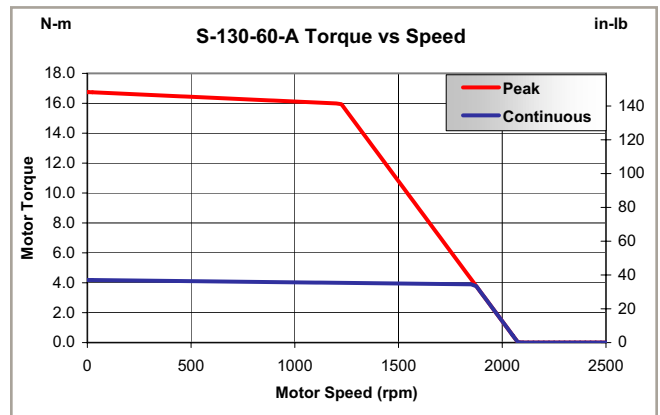
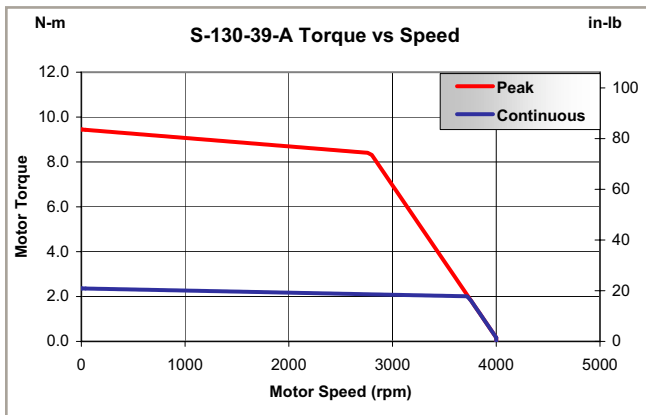
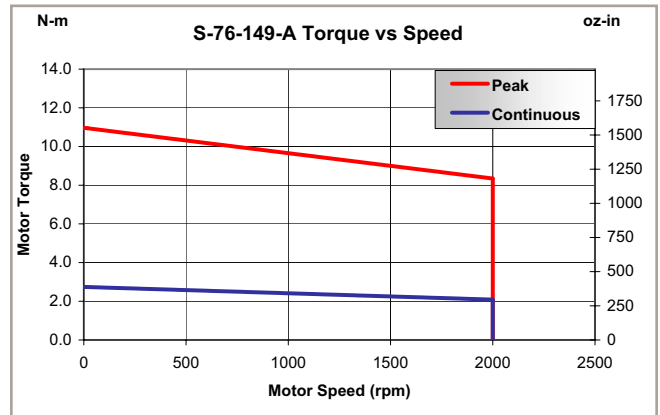
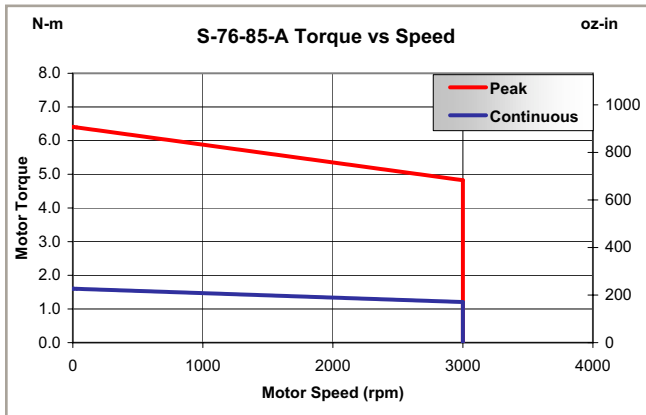
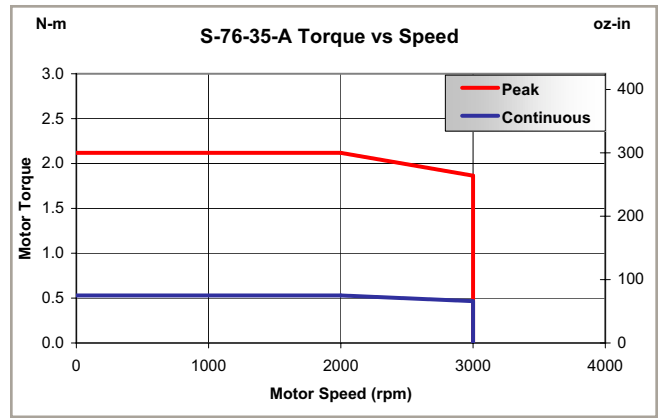
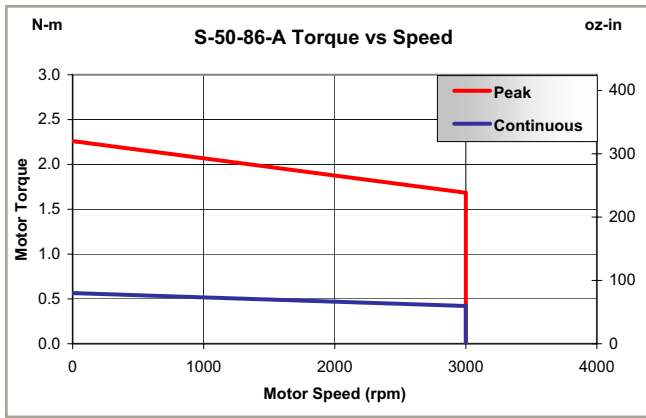
Notes:

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- Torque constant and motor constant specified at stall.
- All performance and electrical specifications ±10%.
- Losses due to bearings and aerodynamics considered negligible.
- Maximum winding temperature is 100°C; thermistor trips at 100°C.
- Ambient operating temperature range 0°C - 25°C; consult Aerotech for performance in elevated ambient temperatures.
- All Aerotech amplifiers are rated Apk; use torque constant in N-m/ Apk when sizing.

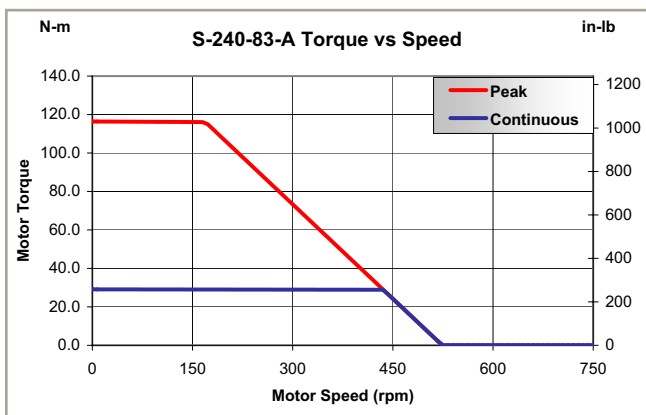
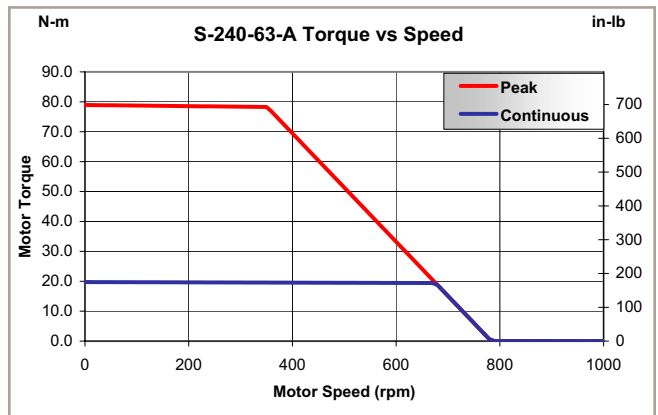
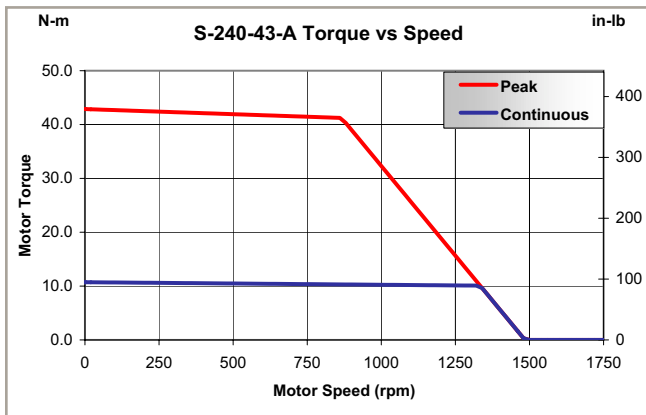
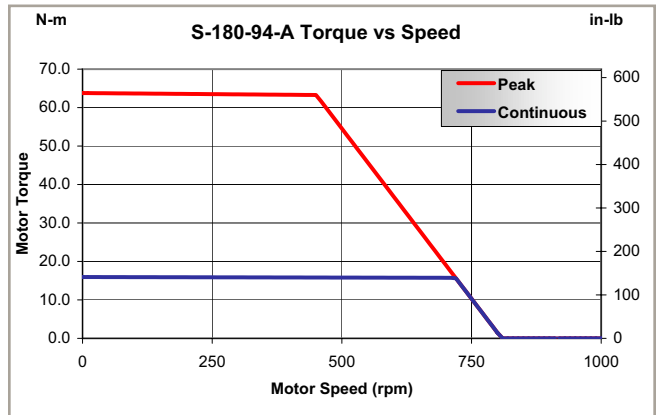
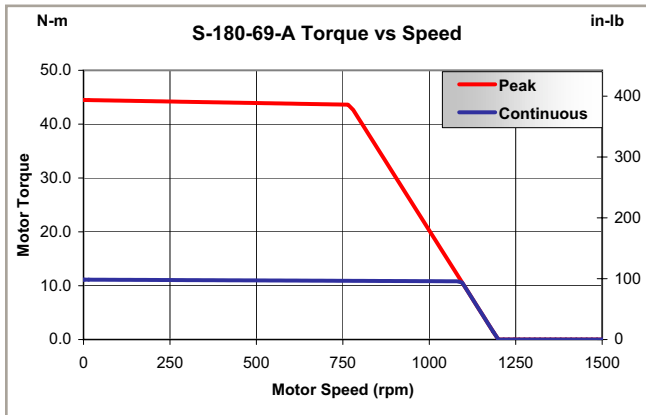
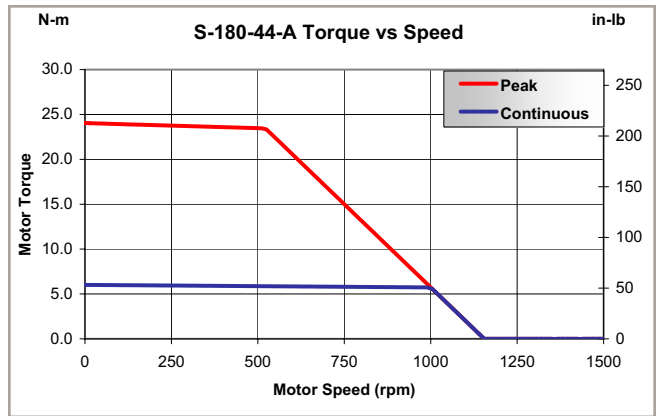
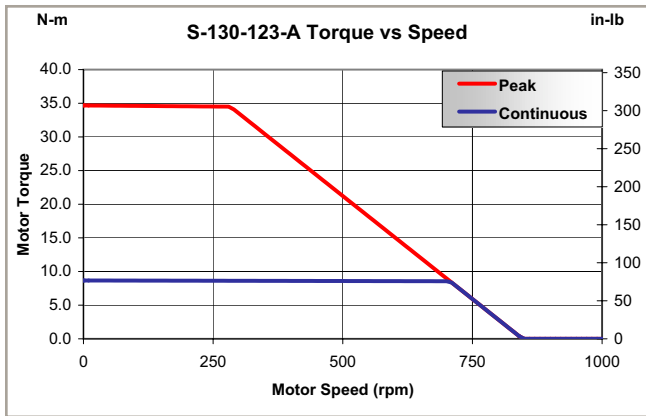
## S-Series PERFORMANCE



## S-Series PERFORMANCE



# S-Series PERFORMANCE

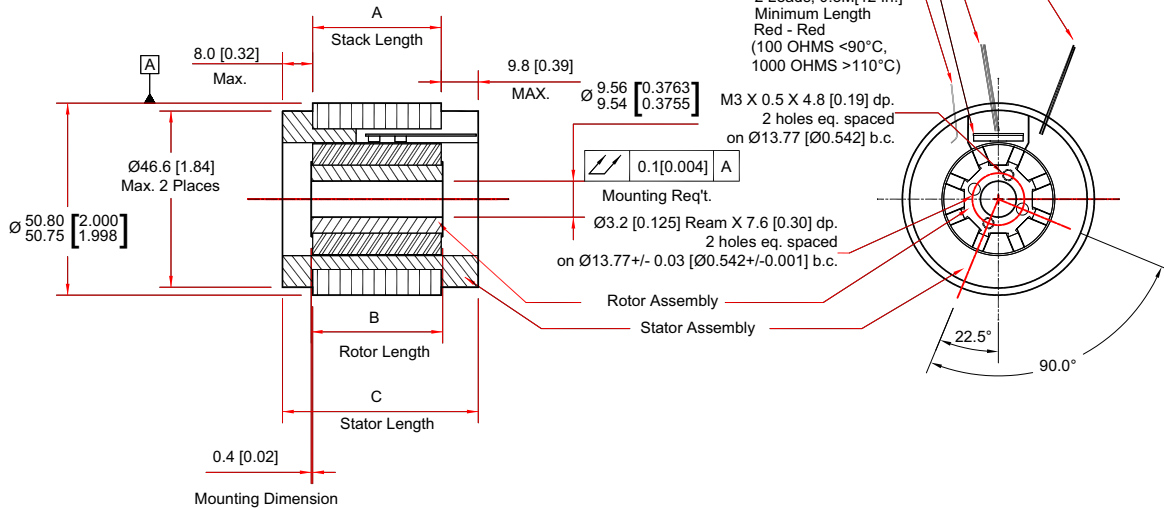


## S-Series DIMENSIONS

### S-50

Dimensions - millimeters [inches]

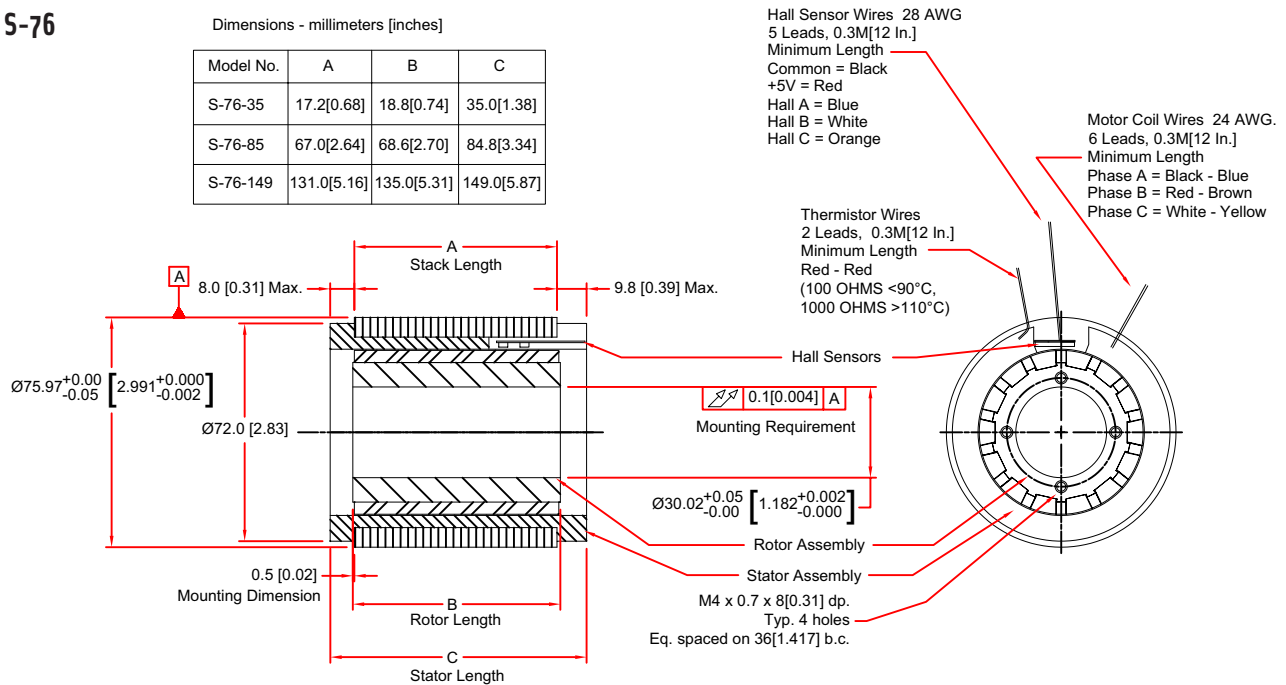
Model No.	A	B	C
S-50-39	21.3[0.84]	22.0[0.87]	39.1[1.54]
S-50-52	34.0[1.34]	34.8[1.37]	51.8[2.04]
S-50-86	67.0[2.64]	68.8[2.71]	84.8[3.34]



### S-76

Dimensions - millimeters [inches]

Model No.	A	B	C
S-76-35	17.2[0.68]	18.8[0.74]	35.0[1.38]
S-76-85	67.0[2.64]	68.6[2.70]	84.8[3.34]
S-76-149	131.0[5.16]	135.0[5.31]	149.0[5.87]



# S-Series DIMENSIONS

## S-130

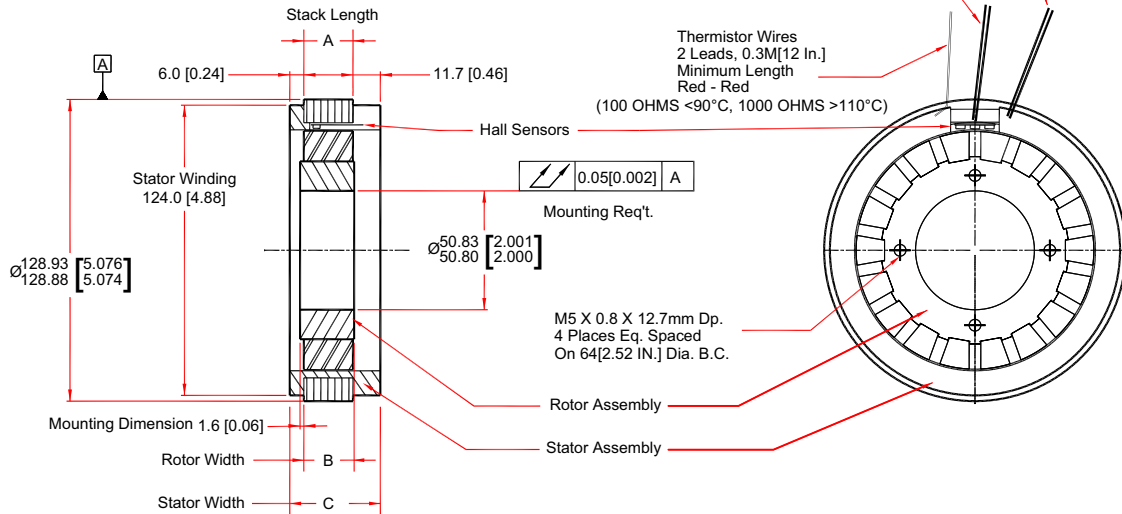
Dimensions - millimeters [inches]

Model No.	A	B	C
S-130-39	$\frac{21.0}{0.82}$ "	$\frac{23.1}{0.91}$ "	$\frac{38.7}{1.52}$ "
S-130-60	$\frac{42.0}{1.65}$ "	$\frac{44.1}{1.74}$ "	$\frac{59.7}{2.35}$ "
S-130-81	$\frac{63.0}{2.48}$ "	$\frac{65.1}{2.56}$ "	$\frac{80.7}{3.18}$ "
S-130-102	$\frac{84.0}{3.30}$ "	$\frac{86.1}{3.39}$ "	$\frac{101.7}{4.00}$ "
S-130-123	$\frac{105.0}{4.13}$ "	$\frac{107.1}{4.22}$ "	$\frac{122.7}{4.83}$ "

Motor Coil Wires  
6 Leads, 0.3M[12 In.]  
Minimum Length  
Phase A = Black - Blue  
Phase B = Red - Brown  
Phase C = White - Yellow

Hall Sensor Wires  
5 Leads, 0.3M[12 In.]  
Minimum Length  
Common = Black  
+5V = Red  
Hall A = Blue  
Hall B = White  
Hall C = Orange

Thermistor Wires  
2 Leads, 0.3M[12 In.]  
Minimum Length  
Red - Red  
(100 OHMS <90°C, 1000 OHMS >110°C)



## S-180

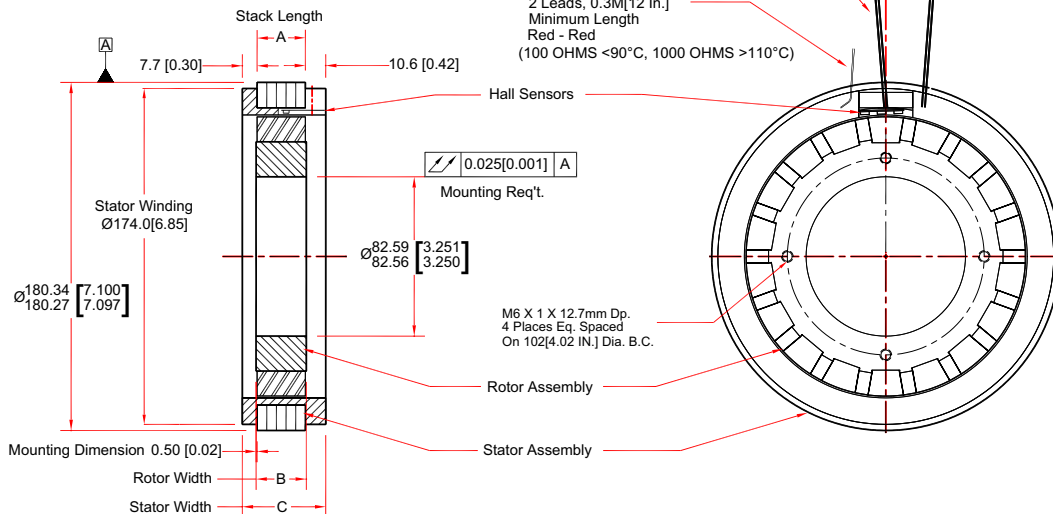
Dimensions - millimeters [inches]

Model No.	A	B	C
S-180-44	$\frac{25.0}{0.98}$ "	$\frac{26.0}{1.02}$ "	$\frac{43.2}{1.70}$ "
S-180-69	$\frac{50.0}{1.97}$ "	$\frac{51.0}{2.01}$ "	$\frac{68.2}{2.69}$ "
S-180-94	$\frac{75.0}{2.95}$ "	$\frac{76.0}{2.99}$ "	$\frac{93.2}{3.67}$ "

Motor Coil Wires  
6 Leads, 0.3M[12 In.]  
Minimum Length  
Phase A = Black - Blue  
Phase B = Red - Brown  
Phase C = White - Yellow

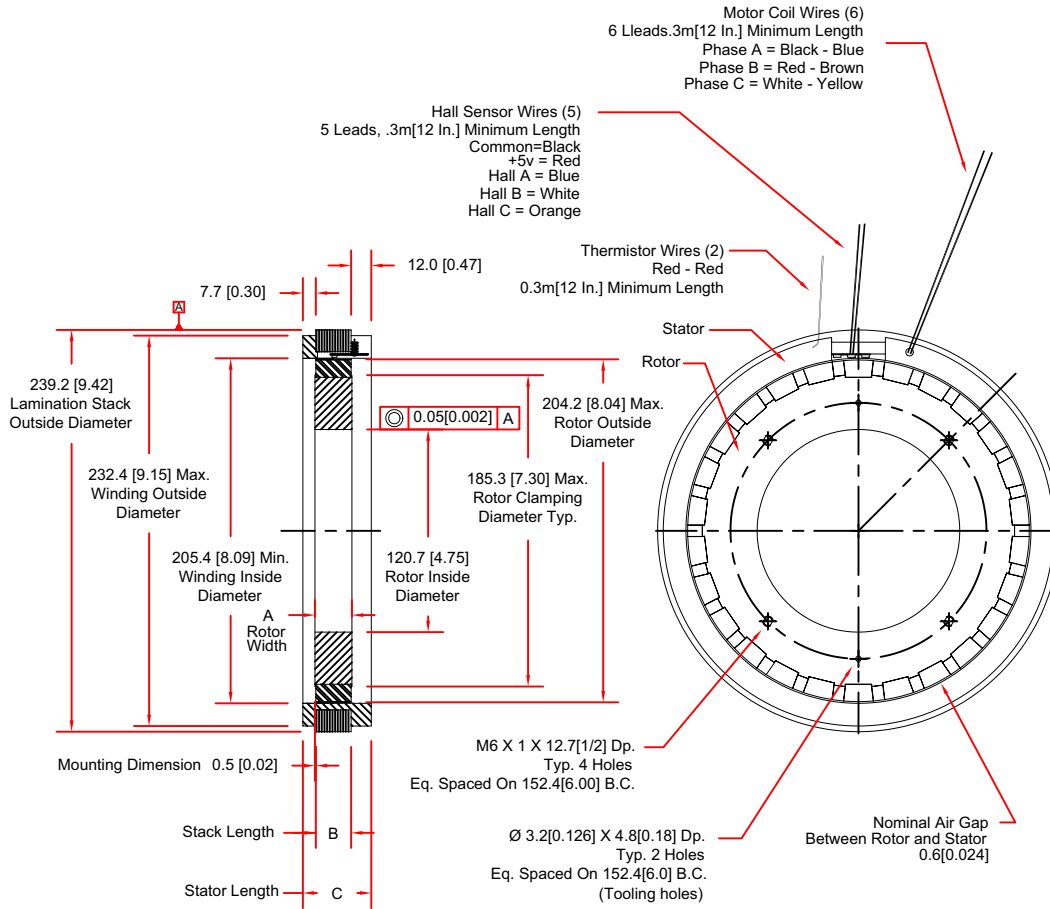
Hall Sensor Wires  
5 Leads, 0.3M[12 In.]  
Minimum Length  
Common = Black  
+5V = Red  
Hall A = Blue  
Hall B = White  
Hall C = Orange

Thermistor Wires  
2 Leads, 0.3M[12 In.]  
Minimum Length  
Red - Red  
(100 OHMS <90°C, 1000 OHMS >110°C)



# S-Series DIMENSIONS

## S-240



Metric Dimensions - [Inches]

Model Number	S-240-43	S-240-63	S-240-83
"A" Dimension	22.0[0.866]	43.0[1.693]	64.0[2.520]
"B" Dimension	21.0[0.827]	42.0[1.653]	63.0[2.480]
"C" Dimension	40.7[1.602]	61.7[2.429]	82.7[3.256]

## S-Series ORDERING INFORMATION

### Ordering Example

S	-130	-60	-A
Motor Series	Motor Diameter (mm)	Length of Motor (Laminations and Windings) in mm	Winding
	50, 76, 130, 180, 240	39, 52, 86 for 50 mm diameter motors 35, 85, 149 for 76 mm diameter motors 39, 60, 81, 102, 123 for 130 mm diameter motors 44, 69, 94 for 180 mm diameter motors 43, 63, 83 for 240 mm diameter motors	A B

### Slotless Torque Ring "Kit" Servomotors

S-50-39-A	Slotless motor, rotor and stator, 50 mm O.D., cont. stall torque: 0.20 Nm
S-50-52-A	Slotless motor, rotor and stator, 50 mm O.D., cont. stall torque: 0.33 Nm
S-50-86-A	Slotless motor, rotor and stator, 50 mm O.D., cont. stall torque: 0.56 Nm
S-76-35-A	Slotless motor, rotor and stator, 50 mm O.D., cont. stall torque: 0.53 Nm
S-76-85-A	Slotless motor, rotor and stator, 76 mm O.D., cont. stall torque: 1.60 Nm
S-76-149-A	Slotless motor, rotor and stator, 76 mm O.D., cont. stall torque: 2.86 Nm
S-130-39-A	Slotless motor, rotor and stator, 130 mm O.D., cont. stall torque: 2.36 Nm
S-130-60-A	Slotless motor, rotor and stator, 130 mm O.D., cont. stall torque: 4.18 Nm
S-130-81-A	Slotless motor, rotor and stator, 130 mm O.D., cont. stall torque: 5.89 Nm
S-130-102-A	Slotless motor, rotor and stator, 130 mm O.D., cont. stall torque: 7.69 Nm
S-130-123-A	Slotless motor, rotor and stator, 130 mm O.D., cont. stall torque: 8.65 Nm
S-180-44-A	Slotless motor, rotor and stator, 180 mm O.D., cont. stall torque: 5.99 Nm
S-180-69-A	Slotless motor, rotor and stator, 180 mm O.D., cont. stall torque: 11.12 Nm
S-180-94-A	Slotless motor, rotor and stator, 180 mm O.D., cont. stall torque: 15.93 Nm
S-240-43-A	Slotless motor, rotor and stator, 240 mm O.D., cont. stall torque: 10.73 Nm
S-240-63-A	Slotless motor, rotor and stator, 240 mm O.D., cont. stall torque: 19.71 Nm
S-240-83-A	Slotless motor, rotor and stator, 240 mm O.D., cont. stall torque: 29.09 Nm

Note: S-Series torque ring motors include the stator w/flying leads, adjustable-phase Hall bd., and rotor w/magnets