Motion Technology Catalog

Brushless & Brush Motors • Drive Electronics • Gearheads & Encoders • Resolvers • Synchros

MOOG
COMPONENTS GROUP

Your work demands the right moves.

Moog Components Group is an innovative motion technology company with unique design and manufacturing capabilities for electromechanical and fiber optic products. Founded over 50 years ago, the company's original vision was to become a research and development business offering new technologies for the emerging inertial navigation marketplace for aircrafts. Quickly, it evolved into a manufacturing operation where the designs were crafted into products that were in high demand.

Moog Components Group has a legacy for providing high-quality products used in critical defense and space applications. Over the years, this foundation has expanded to a broad spectrum of industrial markets, including medical, automation, marine and communications. The company utilizes world-class manufacturing concepts, including Six-Sigma and Lean Manufacturing, to allow the company to produce the highest quality products at competitive prices.

Today, Moog Components Group's core business is motion. Product lines include slip rings, fiber optic rotary joints, motors, resolvers, actuators, fluid rotary unions, fiber optic components and air moving systems. There are seven manufacturing operations with locations in Virginia (Blacksburg and Galax), North Carolina (Murphy), Pennsylvania (Springfield), Canada (Halifax), England (Reading) and Florida (Naples) with over 1,800 employees worldwide.

Moog Components Group offers standard and customer-specific solutions for industrial, medical, marine, aerospace and defense applications. More information about Moog Components Group is available at www.moog.com/components.

"Our success is attributed to the ideas, skills and dedication of our employees. These individuals have conquered new markets and built a company that today has a diverse portfolio of applications. With recent acquisitions, our slip ring and fiber optic product lines have expanded and we have evolved into new markets. Now our customers have one company for all their motion solutions - Moog Components Group."
- Larry Ball, President

We have the motion solutions.

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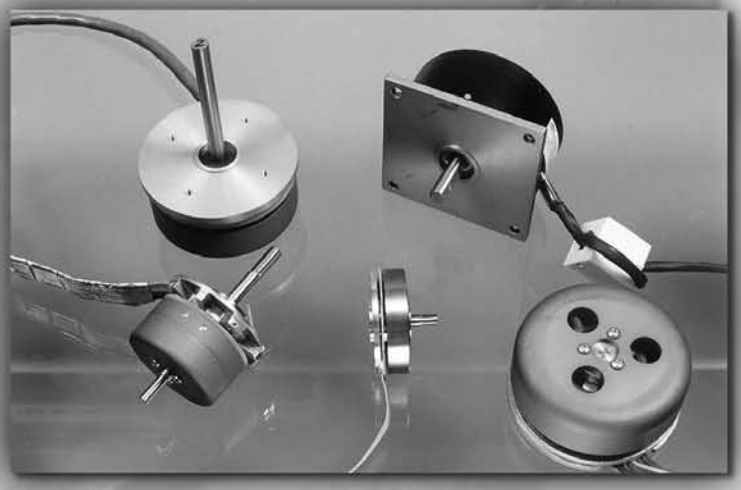
Note: *This catalog contains basic marketing information and general part descriptions of Moog Components Group product lines. With respect to the U.S. export regulations, the products described herein are controlled by the U.S. Commerce Department or the U.S. State Department. Contact Moog Components Group for additional detail on the export controls that are applicable to your part.*

Brushless Motors



Silencer® Series
Brushless DC Motors
Commercial and Industrial

BN12, 17, 23, 28, 34 and 42

TYPICAL APPLICATIONS

- Medical equipment - pumps, blowers and electric scooters and wheelchairs
- Automatic door and window openers
- Computer-controlled embroidery machines
- Scanners
- Packaging equipment and printing products
- HVAC equipment (air handling)
- Robotic tape storage and retrieval
- Semiconductor handling and insertion machines
- Actuators

FEATURES

- 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

BENEFITS

- Operation at any single speed - not limited to AC frequency
- Motor life is not limited to brush or commutator life
- An essentially linear speed / torque curve
- Efficient operation without losses associated with brushes and commutation or armature induction
- Precise, variable speed control
- Extremely quiet operation
- Long-life operation

ENCODERS

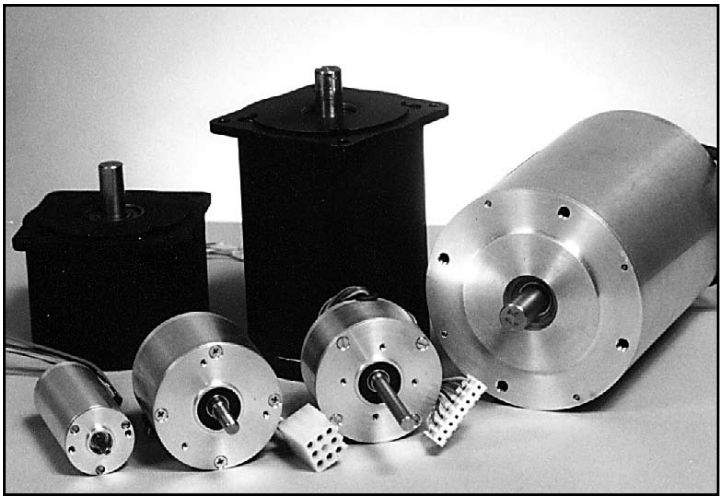
High resolution, high reliability, and state-of-the-art technology in a small package:

- Bidirectional incremental code
- Up to 1024 cycles standard
- Up to 3 channels: A, B, and index
- TTL / CMOS compatible
- Hewlett Packard HEDS-5500 encoder standard, other configurations and resolutions available

SILENCER BRUSHLESS MOTOR DRIVES

Optimized for use with Silencer Brushless DC motors, these drives provide:

- Multiple operating modes - commutation, velocity, torque, 2 and 4 quadrant
- Feedback using Hall effect sensor or encoder
- Efficient PWM speed control
- CE approved for European applications
- Low cost



Quiet, Brushless Motors

Silencer Brushless motors provide smooth, efficient operation and increased speed ranges. Utilizing bonded neo magnets, our BN series motors provide excellent value with their low cost and high torque. Each frame 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.

Reliable, Low-cost Operation

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.

Our engineering department is available for consultation to help you tailor a brushless motor for your specific application.

SPECIFICATION AND NUMBERING SYSTEM

Part Numbering System Guide

BN □ □ – □ □ □ □ – □ □ **T F O**

BRUSHLESS MOTOR

MAGNET TYPE
N - Bonded Neo

FRAME
COMMERCIAL DC MOTOR
12 – Size 12
17 – Size 17
23 – Size 23
28 – Size 28
34 – Size 34
42 – Size 42

MOTOR LENGTH
Refer to motor data table for standard offerings.

MECHANICAL OPTIONS
Refer to motor data table for standard offerings. 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

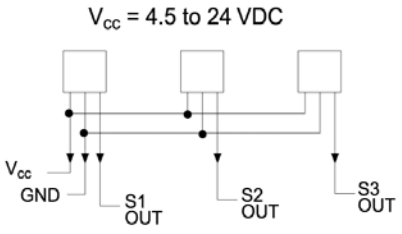
Conversion Table

FROM	*TO*	*MULTIPLY BY*
Length		
inches	cm	2.540
feet	cm	30.48
cm	inches	.3937
cm	feet	3.281×10^{-2}
Mass		
oz	g	28.35
lb	g	453.6
g	oz	3.527×10^{-2}
lb	oz	16.0
g	lb	2.205×10^{-3}
oz	lb	6.250×10^{-2}
Torque		
oz-in	Nm	141.61^{-1}
oz-in	g-cm	72.01
lb-ft	g-cm	1.383×10^{4}
g-cm	oz-in	1.389×10^{-2}
lb-ft	oz-in	192.0
g-cm	lb-ft	7.233×10^{-5}
oz-in	lb-ft	5.208×10^{-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	1.745×10^{-2}
rpm	rad/sec	.1047
Moment Of Inertia		
$oz\text{-}in^2$	$g\text{-}cm^2$	182.9
$lb\text{-}ft^2$	$g\text{-}cm^2$	4.214×10^{5}
$g\text{-}cm^2$	$oz\text{-}in^2$	5.467×10^{-3}
$lb\text{-}ft^2$	$oz\text{-}in^2$	2.304×10^{3}
$g\text{-}cm^2$	$lb\text{-}ft^2$	2.373×10^{-6}
$oz\text{-}in^2$	$lb\text{-}ft^2$	4.340×10^{-4}
$oz\text{-}in\text{-}sec^2$	$g\text{-}cm^2$	7.062×10^{4}

Timing Diagram for Hall Switches

DEGREES														
ELEC	0	60	120	180	240	300	360	60	120	180	240	300	360	
MECH	0	15	30	45	60	75	90	105	120	135	150	165	180	
S1 OUT														
S2 OUT														
S3 OUT														
A COIL	–	0	+	+	0	–	–	0	+	+	0	–		
B COIL	+	+	0	–	–	0	+	+	0	–	–	0		
C COIL	0	–	–	0	+	+	0	–	–	0	+	+		

Hall Effect Switches



Open collector outputs. Use pull-up resistors between V_{cc} and outputs.

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.

Bearing Load Rating (lbs)

Motor Size	Dynamic	Static
BN-12	295	110
BN-17	331	134
BN-23	743	304
BN-28	1022	422
BN-34	1532	683
BN-42	1340	725

BN12 SPECIFICATIONS - *Continuous Stall Torque 2.4 - 8.6 oz-in (0.0170 - 0.0607 Nm)*
Peak Torque 13 - 77 oz-in (0.0918 - 0.5437 Nm)

Part Number*		BN12-13AF- □□ T F O			BN12-18AF- □□ T F O			BN12-23AF- □□ T F O			BN12-28AF- □□ T F O		
Winding Code**		01	02	03	01	02	03	01	02	03	01	02	03
L = Length	inches	1.30			1.80"			2.30			2.80		
	millimeters	33.02			45.72			58.42			71.12		
Terminal Voltage	volts DC	12.0	24.0	36.0	12.0	24.0	36.0	12.0	24.0	36.0	12.0	24.0	36.0
Peak Torque	oz-in	13.0	13.0	14.0	37.0	37.0	39.0	58.0	58.0	61.0	77.0	77.0	72.0
	Nm	0.0918	0.0918	0.0989	0.2613	0.2613	0.2754	0.4096	0.4096	0.4308	0.5437	0.5437	0.5084
Continuous Stall Torque	oz-in	2.4	2.4	2.4	4.9	5.0	5.0	6.9	6.9	6.9	8.3	8.6	8.6
	Nm	0.0169	0.0169	0.0169	0.0346	0.0353	0.0353	0.0487	0.0487	0.0487	0.0586	0.0607	0.0607
Rated Speed	RPM	13027.0	12736.0	13753.0	11928.0	11448.0	12320.0	10604.0	10601.0	11489.0	11036.0	10253.0	9529.0
	rad/sec	1364	1334	1440	1249	1199	1290	1110	1110	1203	1156	1074	998
Rated Torque	oz-in	1.8	1.8	1.8	3.5	3.6	3.5	5.0	5.0	4.7	5.4	5.9	6.2
	Nm	0.0127	0.0127	0.0127	0.0247	0.0254	0.0247	0.0353	0.0353	0.0332	0.0381	0.0417	0.0438
Rated Current	Amps	2.26	1.13	0.77	3.49	1.76	1.20	4.32	2.16	1.46	4.81	2.46	1.61
Rated Power	watts	17.3	17.0	18.3	30.9	30.5	31.9	39.2	39.2	39.9	44.1	44.7	43.7
Torque Sensitivity	oz-in/amp	1.02	2.06	2.95	1.24	2.56	3.64	1.42	2.84	4.01	1.41	2.99	4.75
	Nm/amp	0.0072	0.0145	0.0208	0.0088	0.0181	0.0257	0.0100	0.0201	0.0283	0.0100	0.0211	0.0335
Back EMF	volts/KRPM	0.75	1.53	2.18	0.92	1.89	2.69	1.05	2.10	2.96	1.04	2.21	3.51
	volts/rad/sec	0.0072	0.0145	0.0208	0.0088	0.0181	0.0257	0.0100	0.0201	0.0283	0.0100	0.0211	0.0335
Terminal Resistance	ohms	0.953	3.89	7.85	0.403	1.67	3.36	0.294	1.18	2.36	0.219	0.934	2.36
Terminal Inductance	mH	0.254	1.100	2.210	0.181	0.742	1.460	0.172	0.692	1.374	0.128	0.447	1.220
Motor Constant	oz-in/sq.rt.watt	1.04	1.04	1.05	1.95	1.98	1.99	2.62	2.61	2.61	3.01	3.09	3.09
	Nm/sq.rt.watt	0.00738	0.00738	0.00744	0.01379	0.01399	0.01402	0.01849	0.01846	0.01843	0.02128	0.02185	0.02183
Rotor Inertia	oz-in-sec^{2}x10^{-3}	0.040	0.040	0.040	0.080	0.080	0.080	0.120	0.120	0.120	0.16	0.16	0.16
	g-cm^2	2.82	2.82	2.82	5.65	5.65	5.65	8.47	8.47	8.47	11.3	11.3	11.3
Weight	oz	3.6	3.6	3.6	5.5	5.5	5.5	7.3	7.3	7.3	9.1	9.2	9.2
	g	102.2	102.2	102.2	156.2	156.2	156.2	207.3	207.3	207.3	258.4	261.3	261.3
# of Poles		8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Timing		120°	120°	120°	120°	120°	120°	120°	120°	120°	120°	120°	120°
Mech. Time Constant	ms	5.2	5.2	5.1	3.0	2.9	2.9	2.5	2.5	2.5	2.5	2.4	2.4
Electrical Time Constant	ms	0.14	0.14	0.14	0.24	0.25	0.25	0.29	0.29	0.29	0.29	0.31	0.31
Thermal Resistivity	deg. C/watt	10.7	10.3	11.2	9.5	8.9	9.3	8.3	8.3	8.3	7.7	7.3	7.4
Speed/Torque Gradient	rpm/oz-in	1245.8	1234.2	1220.6	353.3	345.2	343.2	197.2	197.9	198.8	149.3	141.3	141.6

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.

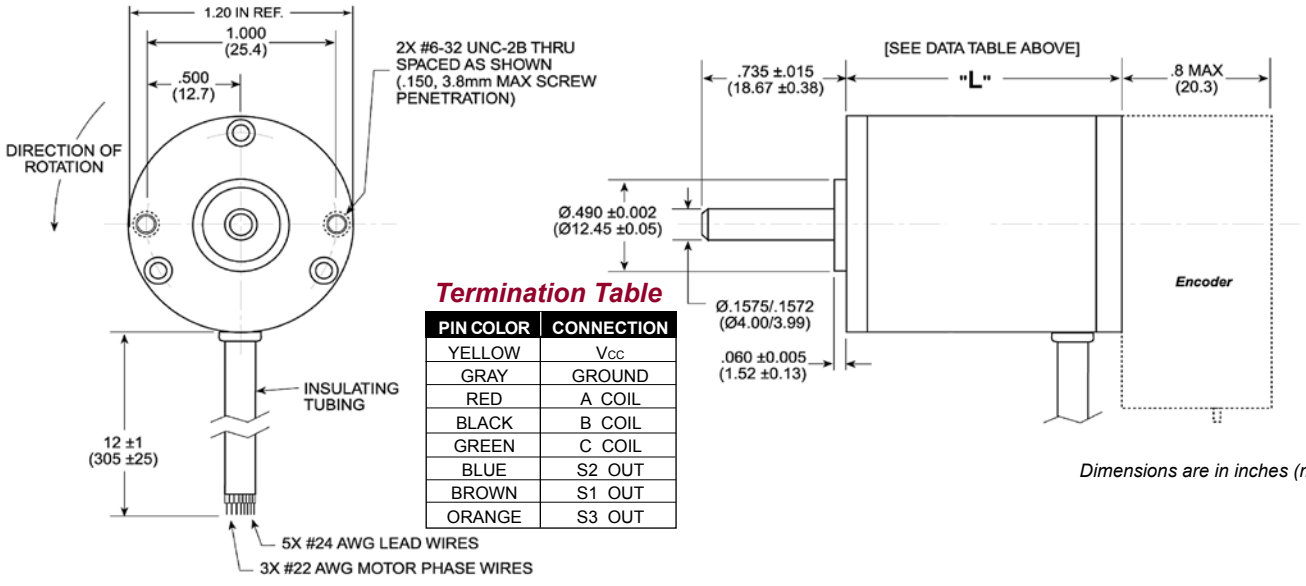
Select your options below and place their code in its corresponding block as shown on page 6.

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

F FEEDBACK OPTIONS
- H – Hall Effect (std)
- R – Resolver
- S – Sensorless

O OTHER OPTIONS
- D – Drive
- E – Encoder
- G – Gearhead

BN12 Typical Outline



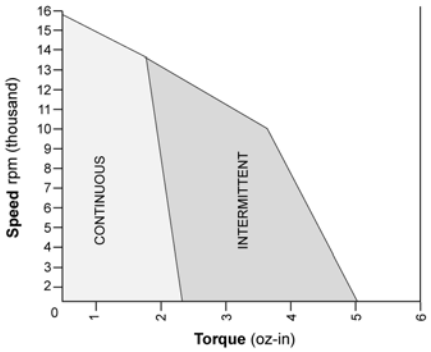
Termination Table

PIN COLOR	CONNECTION
YELLOW	Vcc
GRAY	GROUND
RED	A COIL
BLACK	B COIL
GREEN	C COIL
BLUE	S2 OUT
BROWN	S1 OUT
ORANGE	S3 OUT

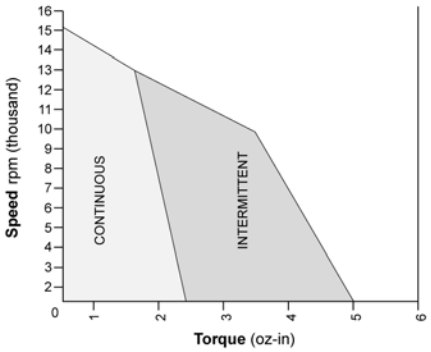
Dimensions are in inches (millimeters)

BN12 Performance Curves

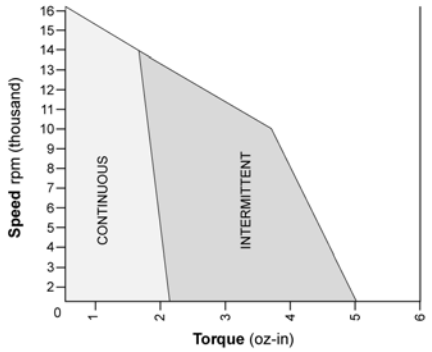
BN12-13AF-01: Continuous & Intermittent Operation at 12 Volt DC



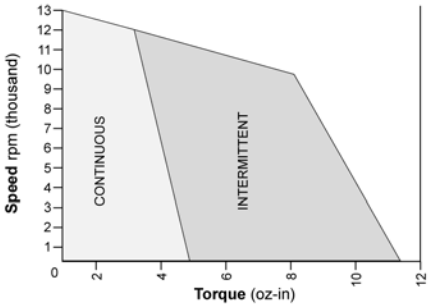
BN12-13AF-02: Continuous & Intermittent Operation at 24 Volt DC



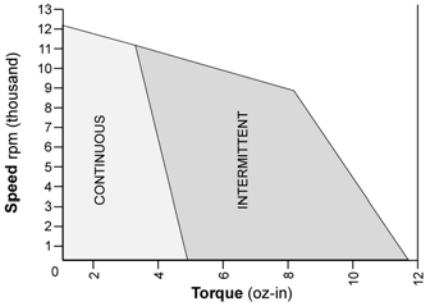
BN12-13AF-03: Continuous & Intermittent Operation at 36 Volt DC



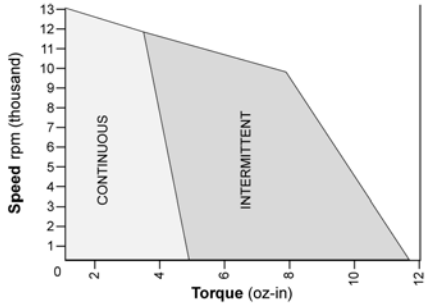
BN12-18AF-01: Continuous & Intermittent Operation at 12 Volt DC



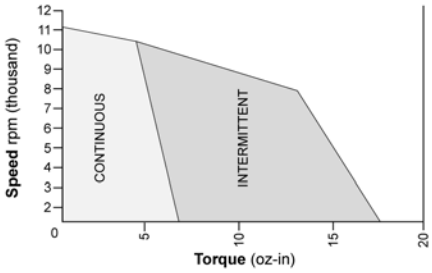
BN12-18AF-02: Continuous & Intermittent Operation at 24 Volt DC



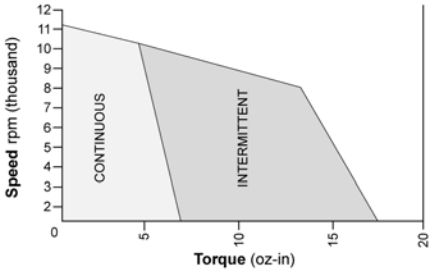
BN12-18AF-03: Continuous & Intermittent Operation at 36 Volt DC



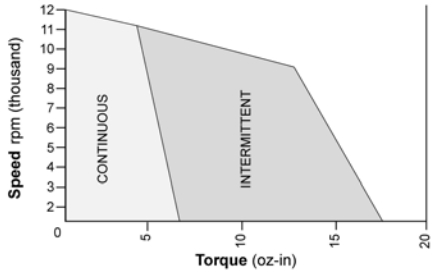
BN12-23AF-01: Continuous & Intermittent Operation at 12 Volt DC



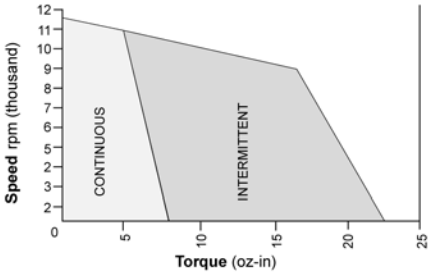
BN12-23AF-02: Continuous & Intermittent Operation at 24 Volt DC



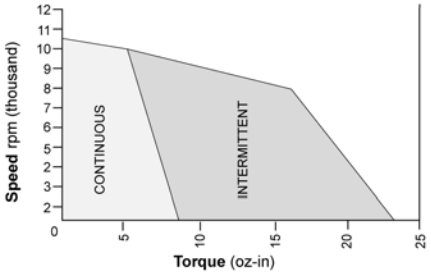
BN12-23AF-03: Continuous & Intermittent Operation at 36 Volt DC



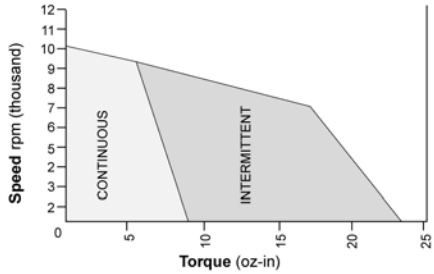
BN12-28AF-01: Continuous & Intermittent Operation at 12 Volt DC



BN12-28AF-02: Continuous & Intermittent Operation at 24 Volt DC



BN12-28AF-03: Continuous & Intermittent Operation at 36 Volt DC



Note: Intermittent operation is based on a 20% duty cycle of one minute on, four minutes off.
Please contact the factory regarding the duty cycle of your application.

BN12 EU SPECIFICATIONS - *Continuous Stall Torque 2.4 - 8.6 oz-in (0.0170 - 0.0587 Nm)*
Peak Torque 13 - 77 oz-in (0.0918 - 0.544 Nm)

Part Number*		BN12-13EU- □□ T F O			BN12-18EU- □□ T F O			BN12-23EU- □□ T F O			BN12-28EU- □□ T F O		
Winding Code**		01	02	03	01	02	03	01	02	03	01	02	03
L = Length	inches	1.30			1.80			2.30			2.80		
	millimeters	33.02			45.72			58.42			71.12		
Terminal Voltage	volts DC	12	24	36	12	24	36	12	24	36	12	24	36
Peak Torque	oz-in	13	13	14	37	37	39	58	58	61	77	77	72
	Nm	0.0918	0.0918	0.0989	0.262	0.262	0.276	0.410	0.410	0.431	0.544	0.544	0.509
Continuous Stall Torque	oz-in	2.4	2.4	2.4	4.9	5.0	5.0	6.9	6.9	6.9	8.3	8.6	8.6
	Nm	0.0170	0.0170	0.0170	0.0346	0.0354	0.0354	0.0488	0.0488	0.0488	0.0587	0.0587	0.0587
Rated Speed	RPM	13027	12736	13753	11928	11448	12320	10604	10601	11489	11036	10253	9529
	rad/sec	1364	1333	1440	1249	1198	1290	1110	1110	1203	1155	1073	997
Rated Torque	oz-in	1.80	1.80	1.80	3.50	3.60	3.50	5.00	5.00	4.70	5.40	5.90	6.20
	Nm	0.0127	0.0127	0.0127	0.0248	0.0255	0.0248	0.0354	0.0354	0.0332	0.0382	0.0417	0.0438
Rated Current	Amps	2.26	1.13	0.77	3.49	1.76	1.20	4.32	2.16	1.46	4.81	2.46	1.61
Rated Power	watts	17.3	17.0	18.3	30.9	30.5	31.9	39.2	39.2	39.9	44.1	44.7	43.7
Torque Sensitivity	oz-in/amp	1.02	2.06	2.95	1.24	2.56	3.64	1.42	2.84	4.01	1.41	2.99	4.75
	Nm/amp	0.0072	0.0146	0.0209	0.0088	0.0180	0.0257	0.0101	0.0201	0.0284	0.0100	0.0212	0.0336
Back EMF	volts/KRPM	0.75	1.53	2.18	0.92	1.89	2.69	1.05	2.10	2.96	1.04	2.21	3.51
	volts/rad/sec	0.0072	0.0146	0.0209	0.0088	0.0180	0.0257	0.0101	0.0201	0.0284	0.0100	0.0212	0.0336
Terminal Resistance	ohms	0.953	3.89	7.85	0.403	1.67	3.36	0.294	1.18	2.36	0.219	0.934	2.36
Terminal Inductance	mH	0.254	1.100	2.210	0.181	0.742	1.460	0.172	0.692	1.374	0.128	0.447	1.220
Motor Constant	oz-in/sq.rt.watt	1.0	1.1	1.1	2.0	2.0	2.0	2.6	2.6	2.6	3.0	3.1	3.1
	Nm/sq.rt.watt	0.0071	0.0078	0.0078	0.0142	0.0142	0.0142	0.0184	0.0184	0.0184	0.0212	0.0219	0.0219
Rotor Inertia	oz-in-sec^2	4.0E-05	4.0E-05	4.0E-05	8.0E-05	8.0E-05	8.0E-05	1.2E-04	1.2E-04	1.2E-04	1.6E-04	1.6E-04	1.6E-04
	g-cm^2	2.83	2.83	2.83	5.65	5.65	5.65	8.48	8.48	8.48	11.3	11.3	11.3
Weight	oz	3.6	3.6	3.6	5.5	5.5	5.5	7.3	7.3	7.3	9.1	9.2	9.2
	g	102	102	102	156	156	156	207	207	207	258	261	261

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.

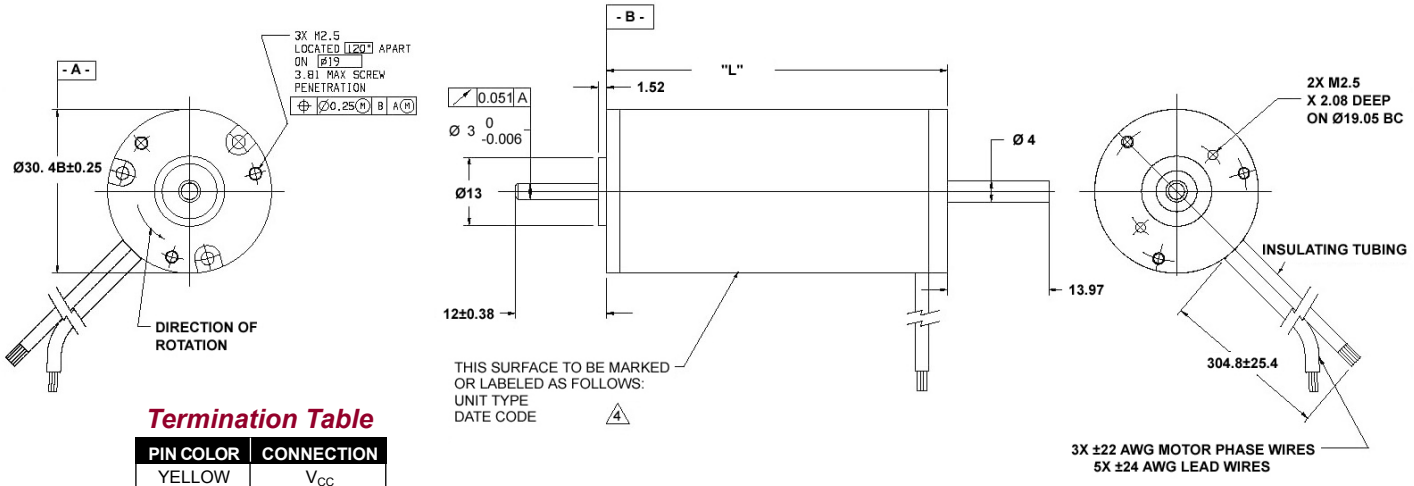
Select your options below and place their code in its corresponding block as shown on page 6.

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

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

O OTHER OPTIONS
D – Drive
E – Encoder
G – Gearhead

BN12 EU Typical Outline



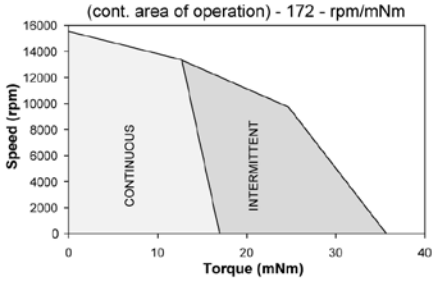
Termination Table

PIN COLOR	CONNECTION
YELLOW	V_{CC}
GRAY	GROUND
RED	A COIL
BLACK	B COIL
GREEN	C COIL
BLUE	S2 OUT
BROWN	S1 OUT
ORANGE	S3 OUT

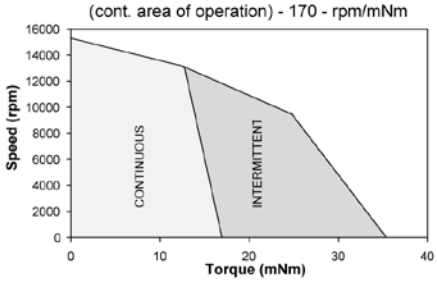
Dimensions are in millimeters

BN12 EU Performance Curves

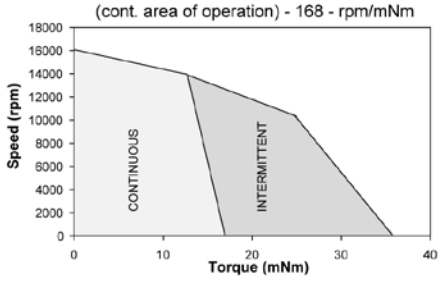
BN12-13EU-01LH: Speed/Torque Gradient - (cont. area of operation) - 172 - rpm/mNm



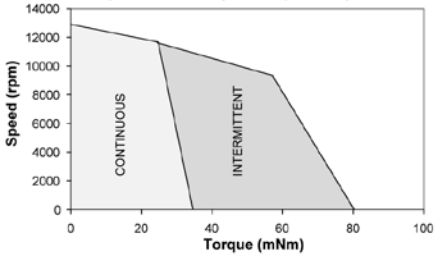
BN12-13EU-02LH: Speed/Torque Gradient - (cont. area of operation) - 170 - rpm/mNm



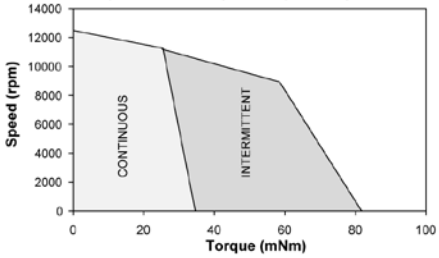
BN12-13EU-03LH: Speed/Torque Gradient - (cont. area of operation) - 168 - rpm/mNm



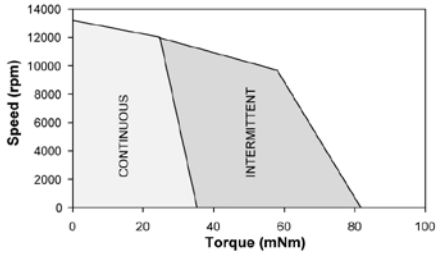
BN12-18EU-01LH: Speed/Torque Gradient - (cont. area of operation) - 50 - rpm/mNm



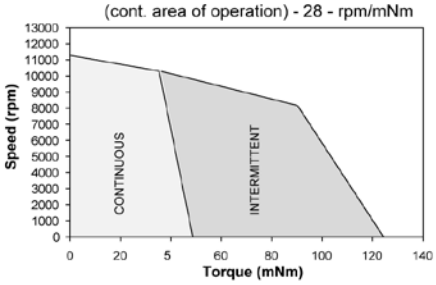
BN12-18EU-02LH: Speed/Torque Gradient - (cont. area of operation) - 48 - rpm/mNm



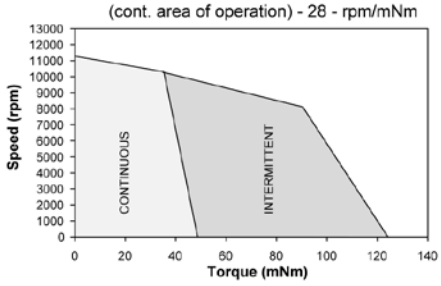
BN12-18EU-03LH: Speed/Torque Gradient - (cont. area of operation) - 48 - rpm/mNm



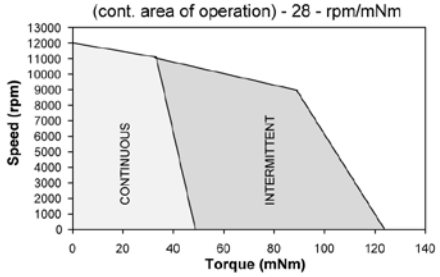
BN12-23EU-01LH: Speed/Torque Gradient - (cont. area of operation) - 28 - rpm/mNm



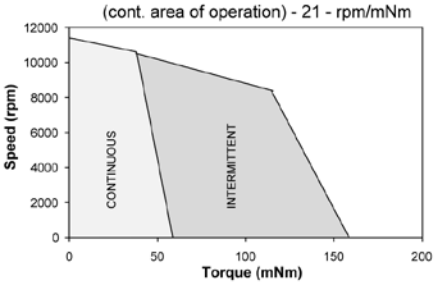
BN12-23EU-02LH: Speed/Torque Gradient - (cont. area of operation) - 28 - rpm/mNm



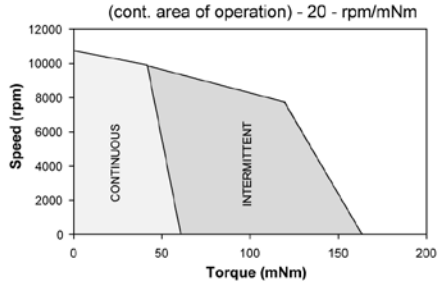
BN12-23EU-03LH: Speed/Torque Gradient - (cont. area of operation) - 28 - rpm/mNm



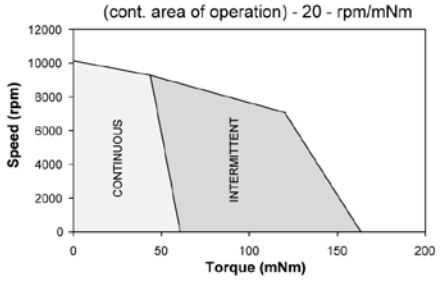
BN12-28EU-01LH: Speed/Torque Gradient - (cont. area of operation) - 21 - rpm/mNm



BN12-28EU-02LH: Speed/Torque Gradient - (cont. area of operation) - 20 - rpm/mNm



BN12-28EU-03LH: Speed/Torque Gradient - (cont. area of operation) - 20 - rpm/mNm



Note: Intermittent operation is based on a 20% duty cycle of one minute on, four minutes off.
Please contact the factory regarding the duty cycle of your application.

BN12 IP SPECIFICATIONS - *Continuous Stall Torque 2.4 - 8.6 oz-in (0.0170 - 0.0607 Nm)*
Peak Torque 13 - 77 oz-in (0.0918 - 0.5437 Nm)

Part Number*		BN12-13IP- □□ T F O			BN12-18IP- □□ T F O			BN12-23IP- □□ T F O			BN12-28IP- □□ T F O		
Winding Code**		01	02	03	01	02	03	01	02	03	01	02	03
L = Length	inches	1.82			2.32			2.82			3.32		
	millimeters	46.2			58.9			71.6			84.3		
Terminal Voltage	volts DC	12.0	24.0	36.0	12.0	24.0	36.0	12.0	24.0	36.0	12.0	24.0	36.0
Peak Torque	oz-in	13.0	13.0	14.0	37.0	37.0	39.0	58.0	58.0	61.0	77.0	77.0	72.0
	Nm	0.0918	0.0918	0.0989	0.2613	0.2613	0.2754	0.4096	0.4096	0.4308	0.5437	0.5437	0.5084
Continuous Stall Torque	oz-in	2.4	2.4	2.4	4.9	5.0	5.0	6.9	6.9	6.9	8.3	8.6	8.6
	Nm	0.0169	0.0169	0.0169	0.0346	0.0353	0.0353	0.0487	0.0487	0.0487	0.0586	0.0607	0.0607
Rated Speed	RPM	13027.0	12736.0	13753.0	11928.0	11448.0	12320.0	10604.0	10601.0	11489.0	11036.0	10253.0	9529.0
	rad/sec	1364	1334	1440	1249	1199	1290	1110	1110	1203	1156	1074	998
Rated Torque	oz-in	1.8	1.8	1.8	3.5	3.6	3.5	5.0	5.0	4.7	5.4	5.9	6.2
	Nm	0.0127	0.0127	0.0127	0.0247	0.0254	0.0247	0.0353	0.0353	0.0332	0.0381	0.0417	0.0438
Rated Current	Amps	2.26	1.13	0.77	3.49	1.76	1.20	4.32	2.16	1.46	4.81	2.46	1.61
Rated Power	watts	17.3	17.0	18.3	30.9	30.5	31.9	39.2	39.2	39.9	44.1	44.7	43.7
Torque Sensitivity	oz-in/amp	1.02	2.06	2.95	1.24	2.56	3.64	1.42	2.84	4.01	1.41	2.99	4.75
	Nm/amp	0.0072	0.0145	0.0208	0.0088	0.0181	0.0257	0.0100	0.0201	0.0283	0.0100	0.0211	0.0335
Back EMF	volts/KRPM	0.75	1.53	2.18	0.92	1.89	2.69	1.05	2.10	2.96	1.04	2.21	3.51
	volts/rad/sec	0.0072	0.0145	0.0208	0.0088	0.0181	0.0257	0.0100	0.0201	0.0283	0.0100	0.0211	0.0335
Terminal Resistance	ohms	0.953	3.89	7.85	0.403	1.67	3.36	0.294	1.18	2.36	0.219	0.934	2.36
Terminal Inductance	mH	0.254	1.100	2.210	0.181	0.742	1.460	0.172	0.692	1.374	0.128	0.447	1.220
Motor Constant	oz-in/sq.rt.watt	1.04	1.04	1.05	1.95	1.98	1.99	2.62	2.61	2.61	3.01	3.09	3.09
	Nm/sq.rt.watt	0.00738	0.00738	0.00744	0.01379	0.01399	0.01402	0.01849	0.01846	0.01843	0.02128	0.02185	0.02183
Rotor Inertia	oz-in-sec^{2}x10^{-3}	0.040	0.040	0.040	0.080	0.080	0.080	0.120	0.120	0.120	0.16	0.16	0.16
	g-cm^2	2.82	2.82	2.82	5.65	5.65	5.65	8.47	8.47	8.47	11.3	11.3	11.3
Weight	oz	3.6	3.6	3.6	5.5	5.5	5.5	7.3	7.3	7.3	9.1	9.2	9.2
	g	102.2	102.2	102.2	156.2	156.2	156.2	207.3	207.3	207.3	258.4	261.3	261.3
# of Poles		8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Timing		120°	120°	120°	120°	120°	120°	120°	120°	120°	120°	120°	120°
Mech. Time Constant	ms	5.2	5.2	5.1	3.0	2.9	2.9	2.5	2.5	2.5	2.5	2.4	2.4
Electrical Time Constant	ms	0.14	0.14	0.14	0.24	0.25	0.25	0.29	0.29	0.29	0.29	0.31	0.31
Thermal Resistivity	deg. C/watt	10.7	10.3	11.2	9.5	8.9	9.3	8.3	8.3	8.3	7.7	7.3	7.4
Speed/Torque Gradient	rpm/oz-in	1245.8	1234.2	1220.6	353.3	345.2	343.2	197.2	197.9	198.8	149.3	141.3	141.6

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. Calculated (theoretical) speed/torque gradient.
6. For MS (military style) connector, please specify connector housing and terminal.
7. 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.

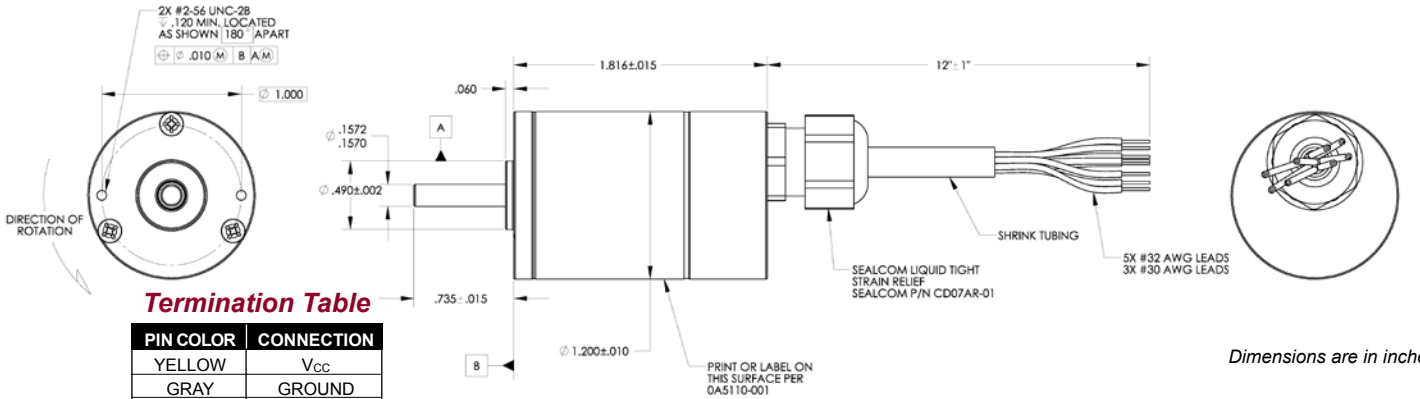
Select your options below and place their code in its corresponding block as shown on page 6.

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

F FEEDBACK OPTIONS
H – Hall Effect (std)

O OTHER OPTIONS
D – Drive
G – Gearhead

BN12 IP Typical Outline



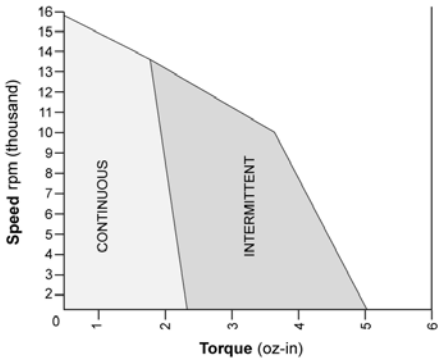
Termination Table

PIN COLOR	CONNECTION
YELLOW	V_{CC}
GRAY	GROUND
RED	A COIL
BLACK	B COIL
GREEN	C COIL
BLUE	S2 OUT
BROWN	S1 OUT
ORANGE	S3 OUT

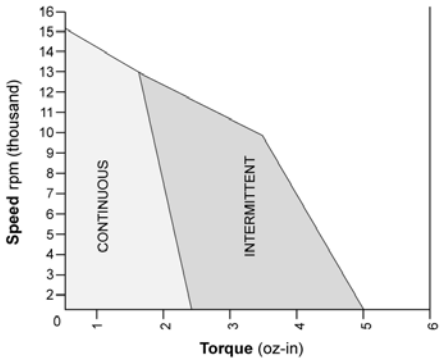
Dimensions are in inches

BN12 IP Performance Curves

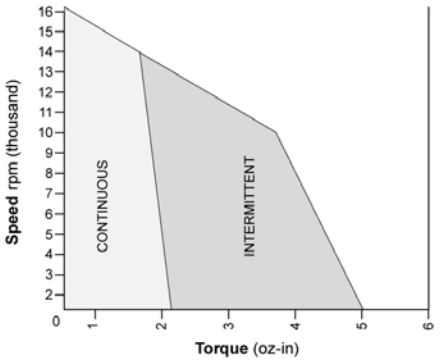
BN12-13IP-01: Continuous & Intermittent Operation at 12 Volt DC



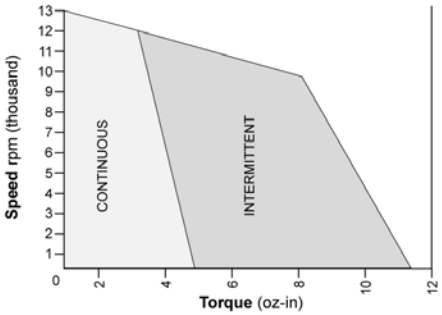
BN12-13IP-02: Continuous & Intermittent Operation at 24 Volt DC



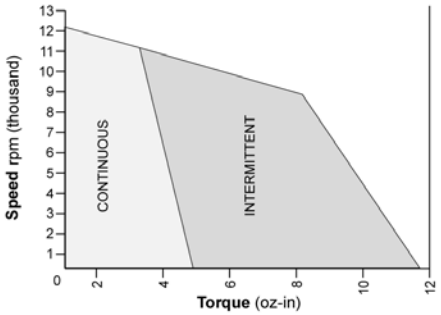
BN12-13IP-03: Continuous & Intermittent Operation at 36 Volt DC



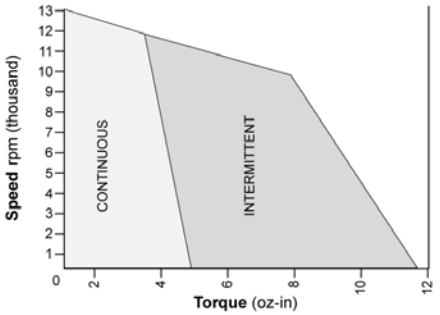
BN12-18IP-01: Continuous & Intermittent Operation at 12 Volt DC



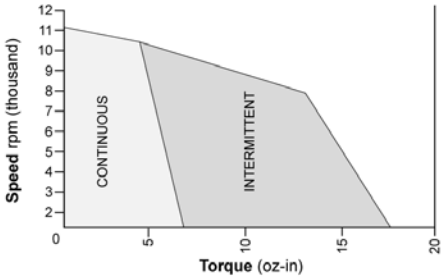
BN12-18IP-02: Continuous & Intermittent Operation at 24 Volt DC



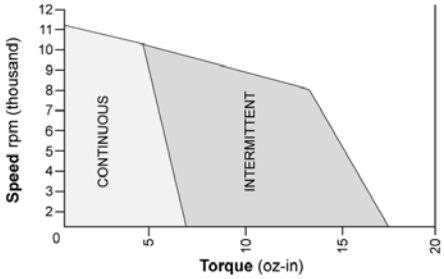
BN12-18IP-03: Continuous & Intermittent Operation at 36 Volt DC



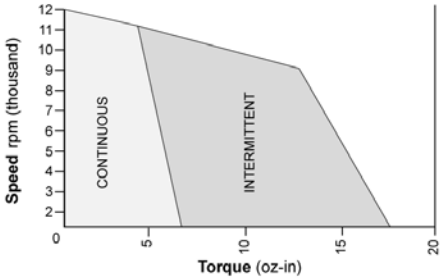
BN12-23IP-01: Continuous & Intermittent Operation at 12 Volt DC



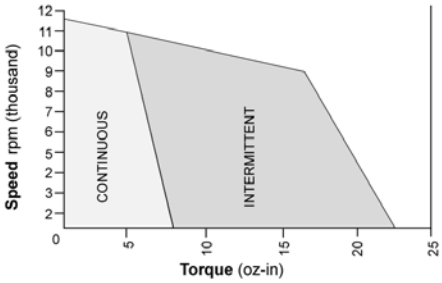
BN12-23IP-02: Continuous & Intermittent Operation at 24 Volt DC



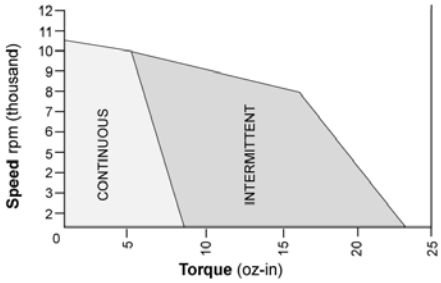
BN12-23IP-03: Continuous & Intermittent Operation at 36 Volt DC



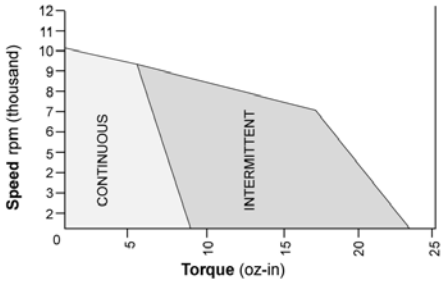
BN12-28IP-01: Continuous & Intermittent Operation at 12 Volt DC



BN12-28IP-02: Continuous & Intermittent Operation at 24 Volt DC



BN12-28IP-03: Continuous & Intermittent Operation at 36 Volt DC



Note: Intermittent operation is based on a 20% duty cycle of one minute on, four minutes off.
Please contact the factory regarding the duty cycle of your application.

BN17 SPECIFICATIONS -

Continuous Stall Torque 7.0 to 16.0 oz-in (0.049 - 0.113 Nm)
Peak Torque 64 - 149 oz-in (0.45 - 1.05 Nm)

Part Number*		BN17-15AA- ☐☐ T F O			BN17-20AA- ☐☐ T F O			BN17-25AA- ☐☐ T F O		
Winding Code**		01	02	03	01	02	03	01	02	03
L = Length	inches	1.50			2.00			2.50		
	millimeters	38.1			50.8			63.5		
Terminal Voltage	volts DC	12.0	24.0	36.0	12.0	24.0	36.0	12.0	24.0	36.0
Peak Torque	oz-in	64.0	83.0	88.00	116.0	116.0	124.0	140.0	149.0	142.0
	Nm	0.4519	0.5861	0.6214	0.8191	0.8191	0.8756	0.9886	1.0522	1.0027
Continuous Stall Torque	oz-in	7.0	7.0	8.0	12.0	12.0	12.0	15.0	15.0	16.0
	Nm	0.0494	0.0494	0.0565	0.0847	0.0847	0.0847	0.1059	0.1059	0.1130
Rated Speed	RPM	10623.0	15627.0	14644.0	8659.0	9172.0	9771.0	8414.0	8452.0	7834.0
	rad/sec	1112	1636	1534	907	960	1023	881	885	820
Rated Torque	oz-in	6.7	5.4	6.3	9.5	8.7	8.5	10.7	11.0	11.5
	Nm	0.0473	0.0381	0.0445	0.0671	0.0614	0.0600	0.0756	0.0777	0.0812
Rated Current	Amps	5.65	3.27	2.38	6.29	3.05	2.10	6.90	3.54	2.30
Rated Power	watts	52.2	62.4	68.8	60.8	59.0	61.4	66.6	68.7	66.6
Torque Sensitivity	oz-in/amp	1.28	1.86	2.95	1.64	3.13	4.45	1.70	3.40	5.44
	Nm/amp	0.0090	0.0131	0.0208	0.0116	0.0221	0.0314	0.0120	0.0240	0.0384
Back EMF	volts/KRPM	0.95	1.38	2.18	1.21	2.31	3.29	1.26	2.51	4.02
	volts/rad/sec	0.0090	0.0131	0.0208	0.0116	0.0221	0.0314	0.0120	0.0240	0.0384
Terminal Resistance	ohms	0.24	0.54	1.20	0.17	0.65	1.30	0.15	0.55	1.38
Terminal Inductance	mH	0.23	0.48	1.22	0.17	0.69	1.40	0.15	0.61	1.57
Motor Constant	oz-in/sq.rt.watts	2.69	2.56	2.71	4.13	3.92	3.93	4.67	4.64	4.65
	Nm/sq.rt.watts	0.01900	0.01808	0.01914	0.02916	0.02768	0.02775	0.03298	0.03277	0.03284
Rotor Inertia	oz-in-sec^{2}x10^{-3}	0.23	0.23	0.23	0.39	0.39	0.39	0.54	0.54	0.54
	g-cm^2	16.2	16.2	16.2	27.5	27.5	27.5	38.1	38.1	38.1
Weight	oz	6.7	6.7	6.7	10.5	10.5	10.5	13.4	13.4	13.4
	g	190	190	190	298	298	298	380	380	380
# of Poles		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Timing		120°	120°	120°	120°	120°	120°	120°	120°	120°
Mech. Time Constant	ms	4.8	5.1	4.5	3.5	3.7	3.6	4.0	3.6	3.6
Electrical Time Constant	ms	0.96	0.89	1.02	1.00	1.06	1.08	1.00	1.11	1.14
Thermal Resistivity	deg. C/watt	8.2	8.3	8.1	6.9	6.9	6.9	6.0	6.0	6.0
Speed/Torque Gradient	rpm/oz-in.	197.4	210.4	186.6	85.7	89.9	88.8	70.0	64.4	63.1

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. Calculated (theoretical) speed/torque gradient.
5. Shaft options for encoder mounting available.
6. For MS (military style) connector, please specify connector housing and terminal.
7. 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.

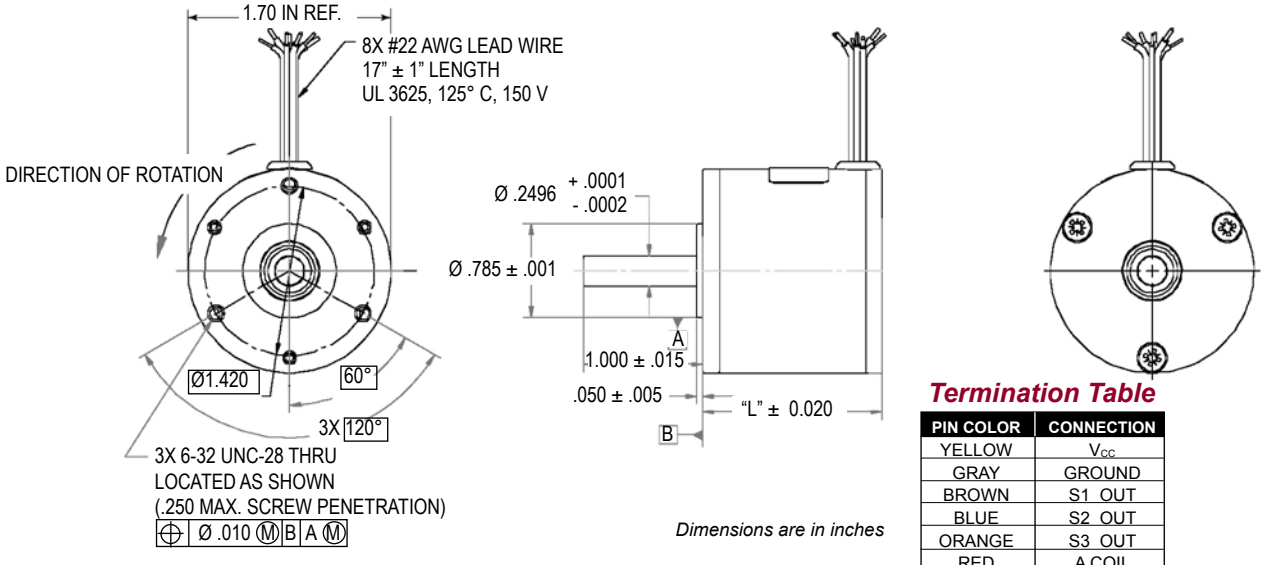
Select your options below and place their code in its corresponding block as shown on page 6.

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

F FEEDBACK OPTIONS
- H – Hall Effect (std)
- R – Resolver
- S – Sensorless

O OTHER OPTIONS
- E – Encoder
- G – Gearhead

BN17 Typical Outline



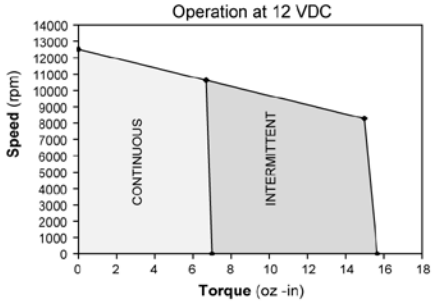
Dimensions are in inches

Termination Table

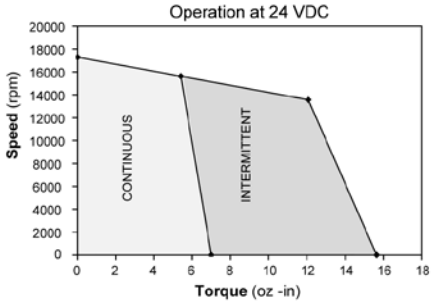
PIN COLOR	CONNECTION
YELLOW	V_{CC}
GRAY	GROUND
BROWN	S1 OUT
BLUE	S2 OUT
ORANGE	S3 OUT
RED	A COIL
BLACK	B COIL
GREEN	C COIL

BN17 Performance Curves

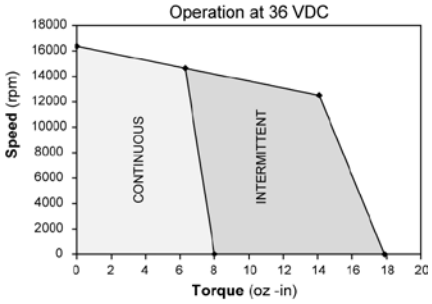
BN17-15AA-01: Continuous and Intermittent Operation at 12 VDC



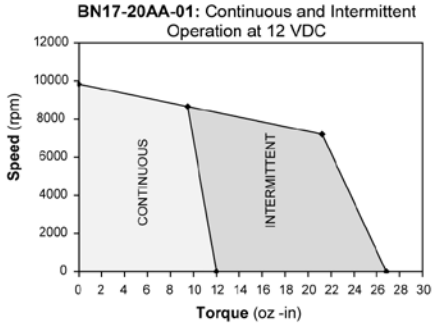
BN17-15AA-02: Continuous and Intermittent Operation at 24 VDC



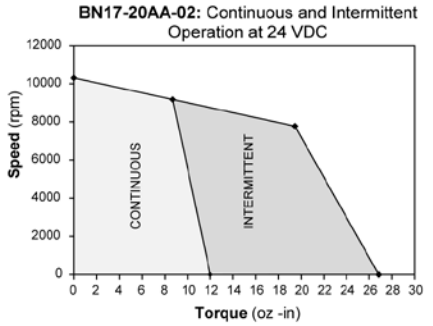
BN17-15AA-03: Continuous and Intermittent Operation at 36 VDC



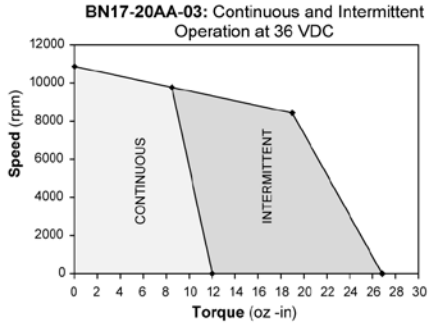
BN17-20AA-01: Continuous and Intermittent Operation at 12 VDC



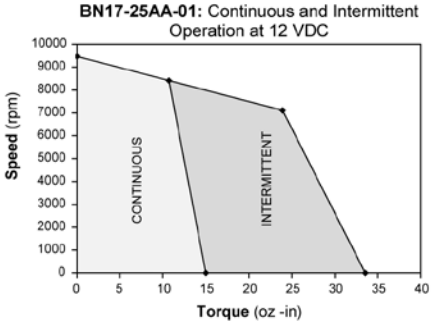
BN17-20AA-02: Continuous and Intermittent Operation at 24 VDC



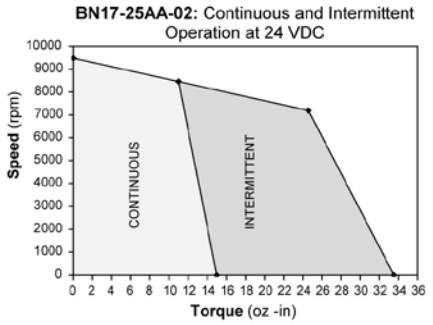
BN17-20AA-03: Continuous and Intermittent Operation at 36 VDC



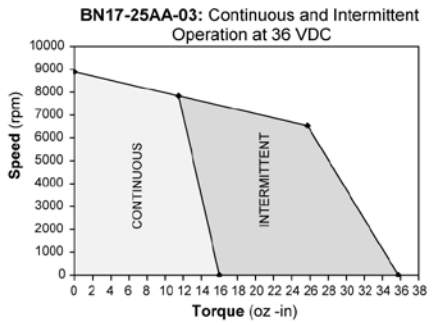
BN17-25AA-01: Continuous and Intermittent Operation at 12 VDC



BN17-25AA-02: Continuous and Intermittent Operation at 24 VDC



BN17-25AA-03: Continuous and Intermittent Operation at 36 VDC



Note: Intermittent operation is based on a 20% duty cycle of one minute on, four minutes off.
Please contact the factory regarding the duty cycle of your application.

Timing Diagram (4 Pole) CCW Rotation

DEGREES														
	ELEC	0	60	120	180	240	300	360	60	120	180	240	300	360
	MECH	0	30	60	90	120	150	180	210	240	270	300	330	360
S1 OUT														
S2 OUT														
S3 OUT														
A COIL		0	–	–	0	+	+	0	–	–	0	+	+	
B COIL		+	+	0	–	–	0	+	+	0	–	–	0	
C COIL		–	0	+	+	0	–	–	0	+	+	0	–	

BN17 IP SPECIFICATIONS - *Continuous Stall Torque 7.0 to 16.0 oz-in (0.049 - 0.113 Nm)*
Peak Torque 64 - 149 oz-in (0.45 - 1.05 Nm)

Part Number*		BN17-15IP- □□ T F O			BN17-20IP- □□ T F O			BN17-25IP- □□ T F O		
Winding Code**		01	02	03	01	02	03	01	02	03
L = Length	inches	2.06			2.56			3.06		
	millimeters	52.32			65.02			77.72		
Terminal Voltage	volts DC	12.0	24.0	36.0	12.0	24.0	36.0	12.0	24.0	36.0
Peak Torque	oz-in	64.0	83.0	88.00	116.0	116.0	124.0	140.0	149.0	142.0
	Nm	0.4519	0.5861	0.6214	0.8191	0.8191	0.8756	0.9886	1.0522	1.0027
Continuous Stall Torque	oz-in	7.0	7.0	8.0	12.0	12.0	12.0	15.0	15.0	16.0
	Nm	0.0494	0.0494	0.0565	0.0847	0.0847	0.0847	0.1059	0.1059	0.1130
Rated Speed	RPM	10623.0	15627.0	14644.0	8659.0	9172.0	9771.0	8414.0	8452.0	7834.0
	rad/sec	1112	1636	1534	907	960	1023	881	885	820
Rated Torque	oz-in	6.7	5.4	6.3	9.5	8.7	8.5	10.7	11.0	11.5
	Nm	0.0473	0.0381	0.0445	0.0671	0.0614	0.0600	0.0756	0.0777	0.0812
Rated Current	Amps	5.65	3.27	2.38	6.29	3.05	2.10	6.90	3.54	2.30
Rated Power	watts	52.2	62.4	68.8	60.8	59.0	61.4	66.6	68.7	66.6
Torque Sensitivity	oz-in/amp	1.28	1.86	2.95	1.64	3.13	4.45	1.70	3.40	5.44
	Nm/amp	0.0090	0.0131	0.0208	0.0116	0.0221	0.0314	0.0120	0.0240	0.0384
Back EMF	volts/KRPM	0.95	1.38	2.18	1.21	2.31	3.29	1.26	2.51	4.02
	volts/rad/sec	0.0090	0.0131	0.0208	0.0116	0.0221	0.0314	0.0120	0.0240	0.0384
Terminal Resistance	ohms	0.24	0.54	1.20	0.17	0.65	1.30	0.15	0.55	1.38
Terminal Inductance	mH	0.23	0.48	1.22	0.17	0.69	1.40	0.15	0.61	1.57
Motor Constant	oz-in/sq.rt.watts	2.69	2.56	2.71	4.13	3.92	3.93	4.67	4.64	4.65
	Nm/sq.rt.watts	0.01900	0.01808	0.01914	0.02916	0.02768	0.02775	0.03298	0.03277	0.03284
Rotor Inertia	oz-in-sec^{2}x10^{-3}	0.23	0.23	0.23	0.39	0.39	0.39	0.54	0.54	0.54
	g-cm^2	16.2	16.2	16.2	27.5	27.5	27.5	38.1	38.1	38.1
Weight	oz	6.7	6.7	6.7	10.5	10.5	10.5	13.4	13.4	13.4
	g	190	190	190	298	298	298	380	380	380
# of Poles		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Timing		120°	120°	120°	120°	120°	120°	120°	120°	120°
Mech. Time Constant	ms	4.8	5.1	4.5	3.5	3.7	3.6	4.0	3.6	3.6
Electrical Time Constant	ms	0.96	0.89	1.02	1.00	1.06	1.08	1.00	1.11	1.14
Thermal Resistivity	deg. C/watt	8.2	8.3	8.1	6.9	6.9	6.9	6.0	6.0	6.0
Speed/Torque Gradient	rpm/oz-in.	197.4	210.4	186.6	85.7	89.9	88.8	70.0	64.4	63.1

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. Calculated (theoretical) speed/torque gradient.
6. For MS (military style) connector, please specify connector housing and terminal.
7. 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.

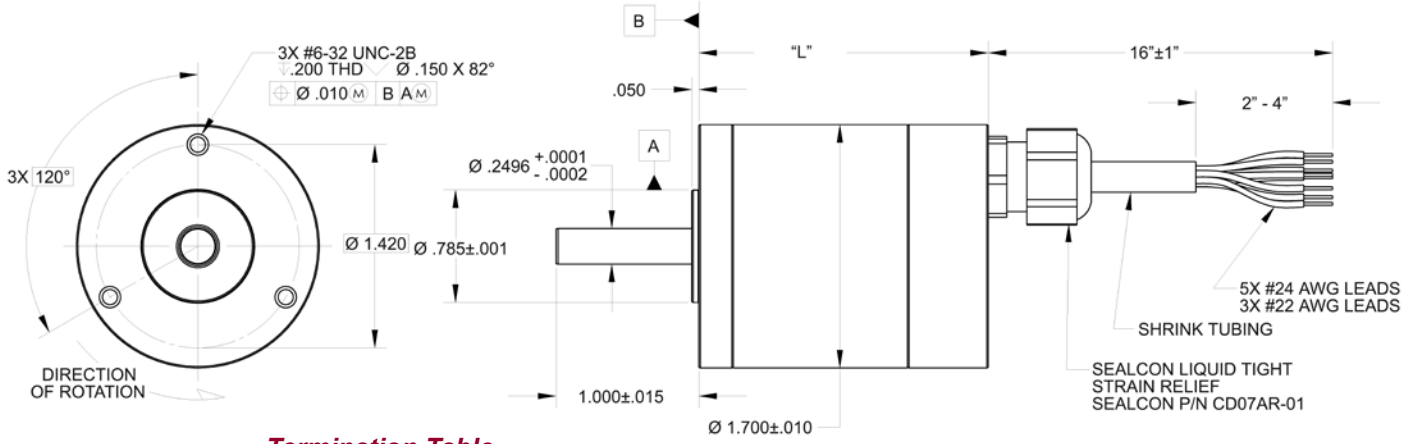
Select your options below and place their code in its corresponding block as shown on page 6.

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

F FEEDBACK OPTIONS
H – Hall Effect (std)

O OTHER OPTIONS
D - Drive
G – Gearhead

BN17 IP Typical Outline - Housed

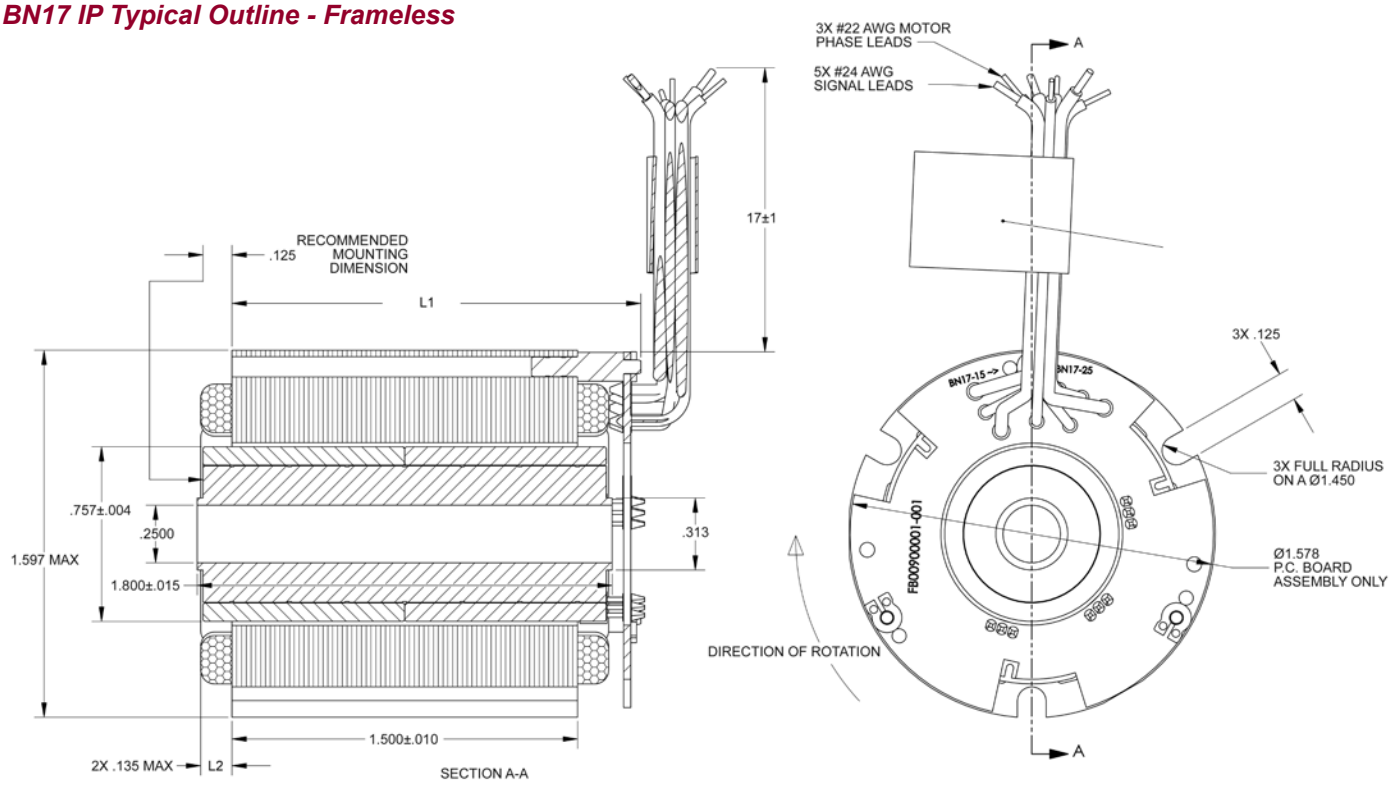


Dimensions are in inches

Termination Table

PIN COLOR	CONNECTION
YELLOW	V_{CC}
GRAY	GROUND
BROWN	S1 OUT
BLUE	S2 OUT
ORANGE	S3 OUT
RED	A COIL
BLACK	B COIL
GREEN	C COIL

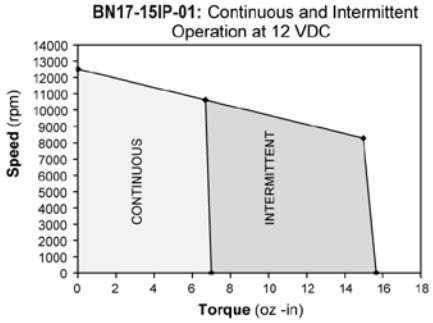
BN17 IP Typical Outline - Frameless

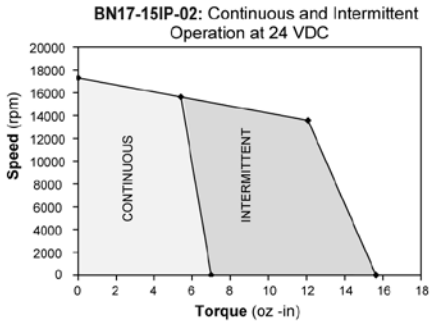


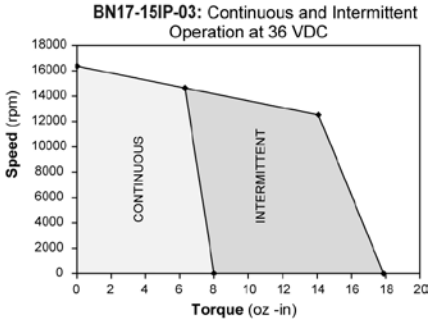
PART NUMBER	L1	L2
BN17-15ZA-XXLH	0.500	0.135
BN17-20ZA-XXLH	1.000	0.135
BN17-25ZA-XXLH	1.500	0.135

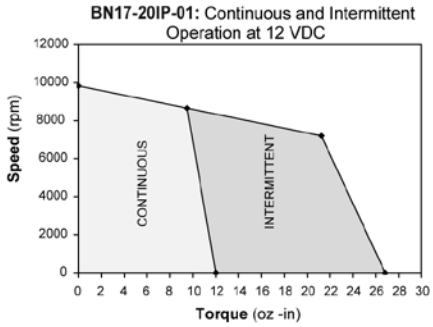
Note: For electrical performance see page 15.

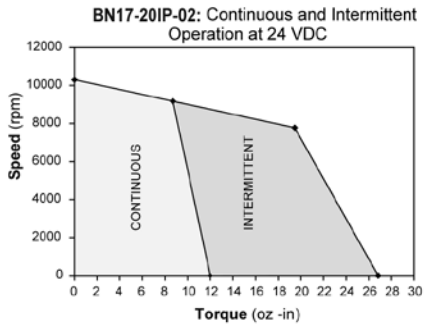
BN17 IP Performance Curves

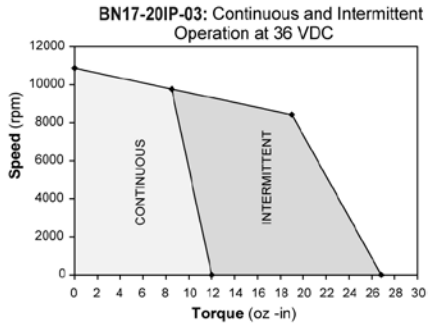


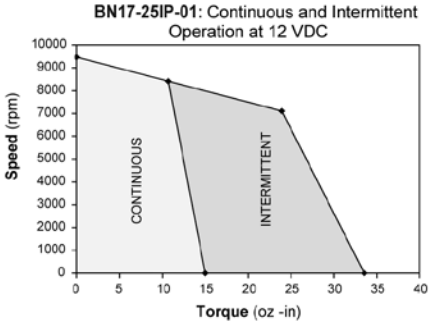


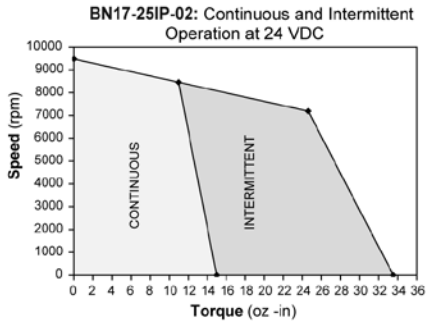


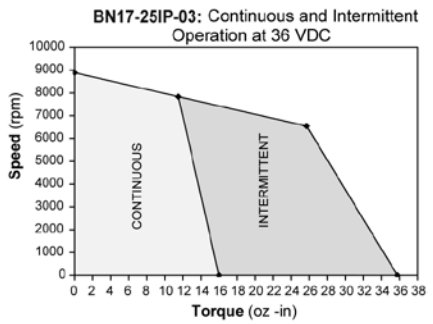






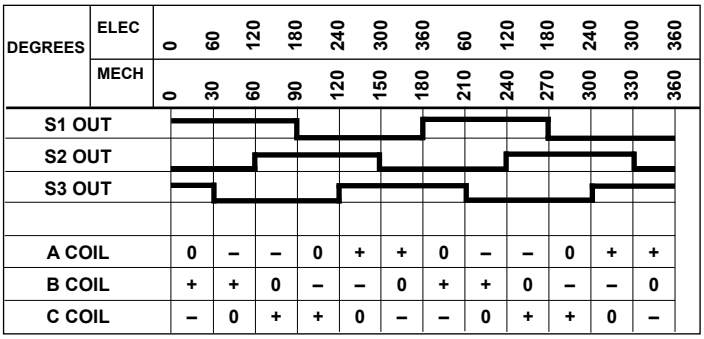






Note: Intermittent operation is based on a 20% duty cycle of one minute on, four minutes off.
Please contact the factory regarding the duty cycle of your application.

Timing Diagram (4 Pole) CCW Rotation



BN23 SPECIFICATIONS -

Continuous Stall Torque 14.6 - 54.3 oz-in (0.103 - 0.384 Nm)
Peak Torque 35 - 186 oz-in (0.2472 - 1.3134 Nm)

Part Number*		BN23-13MG-□□ T F O			BN23-18MG-□□ T F O			BN23-23MG-□□ T F O			BN23-28MG-□□ T F O		
Winding Code**		01	02	03	01	02	03	01	02	03	01	02	03
L = Length	inches	1.41			1.91			2.41			2.91		
	millimeters	35.8			48.5			61.2			73.9		
Terminal Voltage	volts DC	24	36	48	24	36	48	24	36	48	24	36	48
Peak Torque	oz-in	35	35	35	88	88	88	143	143	143	186	186	186
	Nm	0.2472	0.2472	0.2472	0.6214	0.6214	0.6214	1.0098	1.0098	1.0098	1.3134	1.3134	1.3134
Continuous Stall Torque	oz-in	14.6	17.7	14.2	30.7	31.4	35.2	42.8	44.7	42.9	50.4	54.3	53.2
	Nm	0.103	0.125	0.100	0.217	0.221	0.248	0.303	0.315	0.303	0.356	0.384	0.376
No-Load Speed		12,200	12,500	12,300	9,100	9,700	10,200	8,100	8,800	8,200	7,300	7,500	8,100
Rated Speed	RPM	8650	9060	9190	6460	7000	7130	6060	6700	6250	5340	5590	6140
	rad/sec	906	949	962	676	733	747	635	702	655	559	585	643
Rated Torque	oz-in	14.2	16.1	12.1	29.7	29.8.0	32.9	40.3	42.3	41.8	49.1	51.9	48.8
	Nm	0.100	0.114	0.085	0.210	0.210	0.232	0.285	0.299	0.295	0.347	0.366	0.345
Rated Current	Amps	5.80	4.30	2.38	7.75	5.43	4.88	9.47	7.44	5.00	10.45	7.66	5.85
Rated Power	watts	91	108	82	142	154	174	181	210	193	194	215	222
Torque Sensitivity	oz-in/amp	2.55	3.78	5.18	3.40	4.90	6.25	3.85	5.35	7.79	4.26	6.30	7.80
	Nm/amp	0.0180	0.0267	0.0366	0.0240	0.0346	0.0441	0.0272	0.0378	0.0550	0.0301	0.0445	0.0551
Back EMF	volts/KRPM	1.89	2.80	3.83	2.51	3.62	4.62	2.85	3.96	5.76	3.15	4.66	5.77
	volts/rad/sec	0.018	0.027	0.037	0.024	0.035	0.044	0.027	0.038	0.055	0.030	0.044	0.055
Terminal Resistance	ohms	0.465	0.939	1.890	0.246	0.507	0.800	0.178	0.347	0.715	0.181	0.366	0.576
Terminal Inductance	mH	0.350	0.758	1.53	0.275	0.580	0.930	0.220	0.420	0.900	0.230	0.490	0.770
Motor Constant	oz-in/sq.rt.watt	3.74	3.90	3.77	6.86	6.88	6.99	9.13	9.08	9.21	10.01	10.41	10.28
	Nm/sq.rt.watt	0.026	0.028	0.027	0.048	0.049	0.049	0.064	0.064	0.065	0.071	0.074	0.073
Rotor Inertia	oz-in-sec^{2}x10^{-3}	0.64	0.64	0.64	1.21	1.21	1.21	1.70	1.70	1.70	2.17	2.17	2.17
	g-cm^2	44.9	44.9	44.9	85.0	85.0	85.0	120.0	120.0	120.0	153.1	153.1	153.1
Weight	oz	8.3	8.4	8.3	13.6	13.7	13.8	19.1	19.1	19.1	24.4	24.7	24.5
	g	234.0	238.0	234.0	386.0	389.0	391.0	542.0	542.0	542.0	693.0	699.0	694.0
# of Poles		8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Timing		120°	120°	120°	120°	120°	120°	120°	120°	120°	120°	120°	120°
Mech. Time Constant	ms	6.4	5.9	6.3	3.6	3.6	3.5	2.9	2.9	2.8	3.1	2.8	2.9
Electrical Time Constant	ms	0.75	0.81	0.81	1.12	1.14	1.16	1.24	1.21	1.26	1.27	1.34	1.34
Thermal Resistivity	deg. C/watt	2.28	2.34	3.44	2.49	2.67	1.81	2.36	1.89	2.35	1.93	1.80	1.86
Speed/Torque Gradient	rpm/oz-in	250.0	213.7	257.0	88.9	90.6	93.3	50.6	49.6	46.7	39.9	36.8	40.2

Notes:
1. Motor mounted to a 6" x 6" x 1/4" aluminum plate, still air.
2. Maximum winding temperature of 155°C.
3. Typical electrical specifications at 25°C.
4. Data shown for 8 pole motors. Please consult factory for 4 pole specifications.
5. 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.
6. For MS (military style) connector, please specify connector housing and terminal.
7. 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.

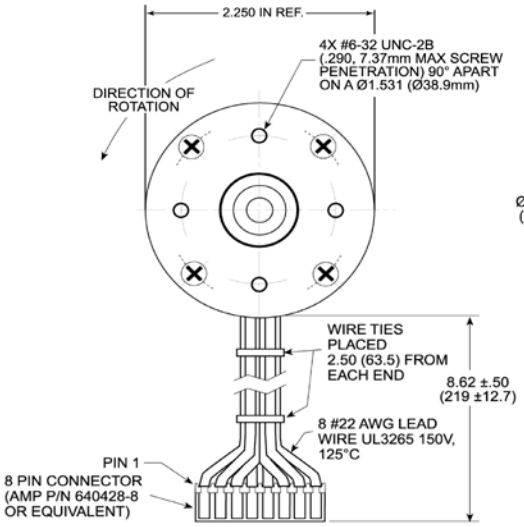
Select your options below and place their code in its corresponding block as shown on page 6.

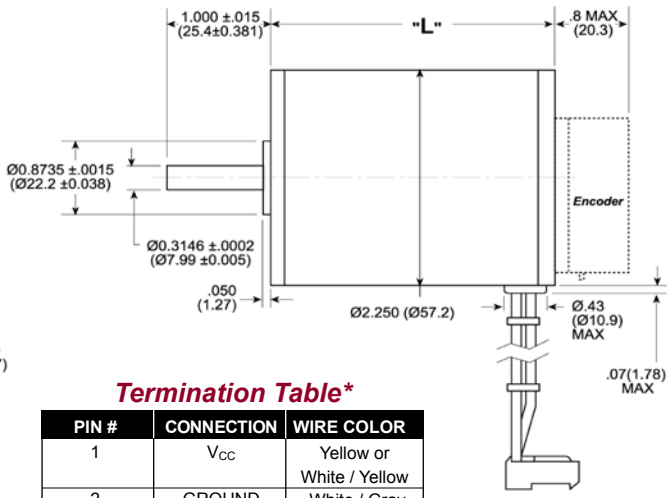
T TERMINATION
L – Leads (std)
C – Connector
M – MS connector

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

O OTHER OPTIONS
D – Drive
E – Encoder
G – Gearhead

BN23 Typical Outline - Housed





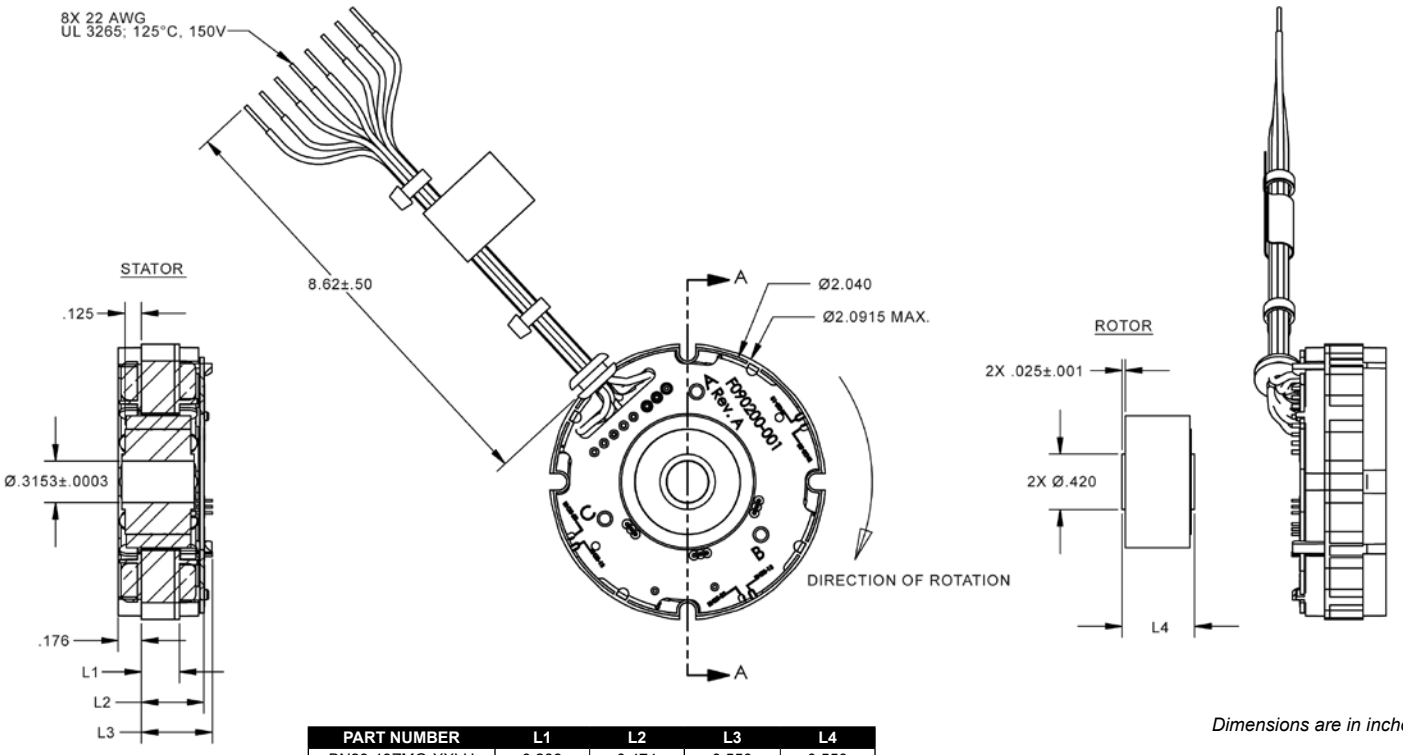
Termination Table*

PIN #	CONNECTION	WIRE COLOR
1	V_{CC}	Yellow or White / Yellow
2	GROUND	White / Gray
3	A COIL	White / Violet
4	B COIL	White / Black
5	C COIL	Green
6	S2 OUT	White / Blue
7	S1 OUT	White / Brown
8	S3 OUT	White

We reserve the right to use solid color wires or white wires with color trace.

Dimensions are in inches (millimeters)

BN23 Typical Outline - Frameless



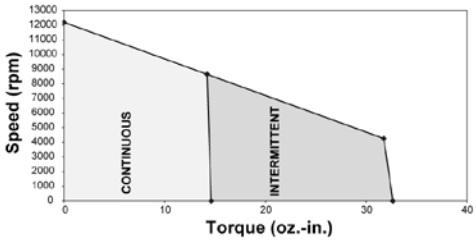
PART NUMBER	L1	L2	L3	L4
BN23-13ZMG-XXLH	0.288	0.474	0.550	0.550
BN23-18ZMG-XXLH	0.788	0.974	1.050	1.050
BN23-23ZMG-XXLH	1.288	1.470	1.550	1.550
BN23-28ZMG-XXLH	1.788	1.970	2.050	2.050

Note: For electrical performance see page 18.

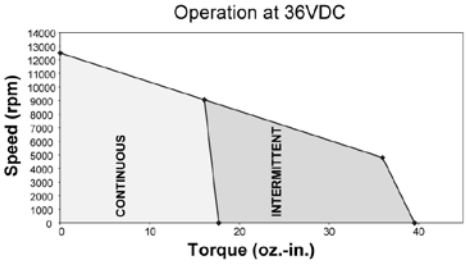
Dimensions are in inches

BN23 Performance Curves

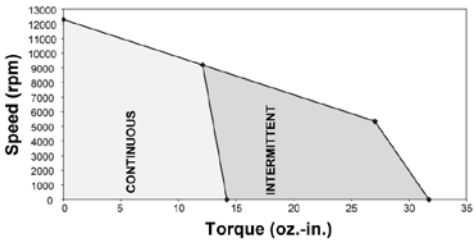
BN23-13MG-01: Continuous & Intermittent Operation at 24 VDC



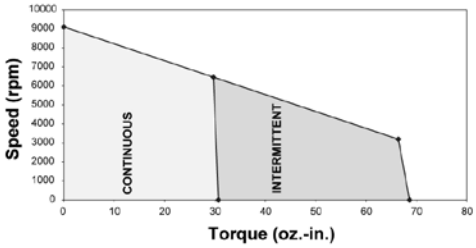
BN23-13MG-02: Continuous & Intermittent Operation at 36VDC



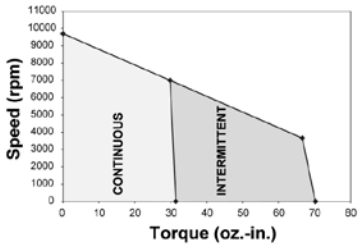
BN23-13MG-03: Continuous & Intermittent Operation at 48 VDC



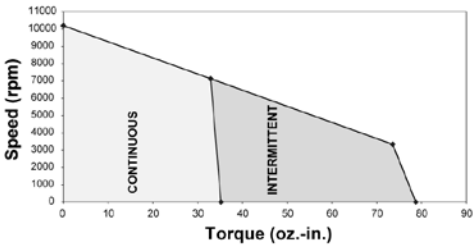
BN23-18MG-01: Continuous & Intermittent Operation at 24 VDC



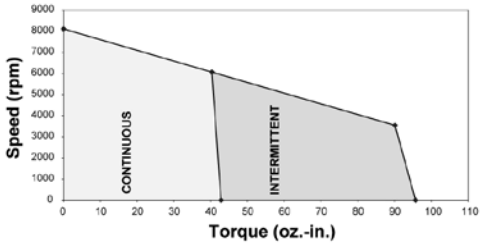
BN23-18MG-02: Continuous & Intermittent Operation at 36 VDC



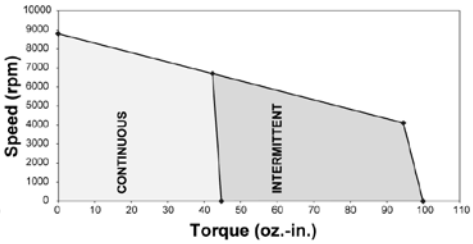
BN23-18MG-03: Continuous & Intermittent Operation at 48 VDC



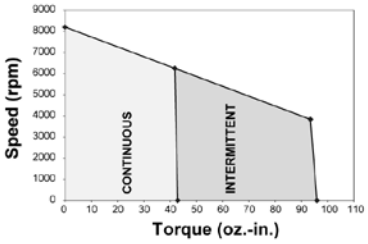
BN23-23MG-01: Continuous & Intermittent Operation at 24 VDC



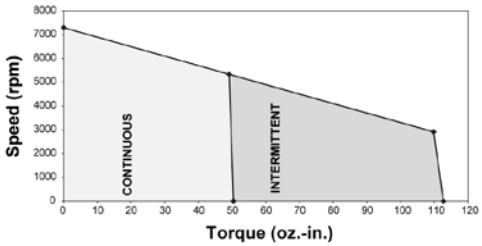
BN23-23MG-02: Continuous & Intermittent Operation at 36 VDC



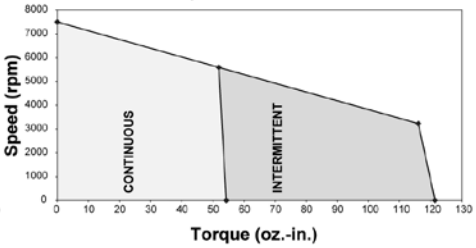
BN23-23MG-03: Continuous & Intermittent Operation at 48 VDC



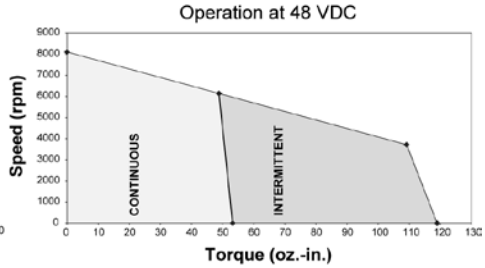
BN23-28MG-01: Continuous & Intermittent Operation at 24 VDC



BN23-28MG-02: Continuous & Intermittent Operation at 36 VDC



BN23-28MG-03: Continuous & Intermittent Operation at 48 VDC



Note: Intermittent operation is based on a 20% duty cycle of one minute on, four minutes off.
Please contact the factory regarding the duty cycle of your application.

BN23 EU SPECIFICATIONS -

Continuous Stall Torque 14.6 - 54.3 oz-in (0.103 - 0.384 Nm)
Peak Torque 35 - 186 oz-in (0.2472 - 1.3134 Nm)

Part Number*		BN23-13EU- □□ T F O			BN23-18EU- □□ T F O			BN23-23EU- □□ T F O			BN23-28EU- □□ T F O		
Winding Code**		01	02	03	01	02	03	01	02	03	01	02	03
L = Length	inches	1.41			1.91			2.41			2.91		
	millimeters	35.8			48.5			61.2			73.9		
Terminal Voltage	volts DC	24	36	48	24	36	48	24	36	48	24	36	48
Peak Torque	oz-in	35	35	35	88	88	88	143	143	143	186	186	186
	Nm	0.2472	0.2472	0.2472	0.6214	0.6214	0.6214	1.0098	1.0098	1.0098	1.3134	1.3134	1.3134
Continuous Stall Torque	oz-in	14.6	17.7	14.2	30.7	31.4	35.2	42.8	44.7	42.9	50.4	54.3	53.2
	Nm	0.103	0.125	0.100	0.217	0.221	0.248	0.303	0.315	0.303	0.356	0.384	0.376
No-Load Speed		12,200	12,500	12,300	9,100	9,700	10,200	8,100	8,800	8,200	7,300	7,500	8,100
Rated Speed	RPM	8650	9060	9190	6460	7000	7130	6060	6700	6250	5340	5590	6140
	rad/sec	906	949	962	676	733	747	635	702	655	559	585	643
Rated Torque	oz-in	14.2	16.1	12.1	29.7	29.8.0	32.9	40.3	42.3	41.8	49.1	51.9	48.8
	Nm	0.100	0.114	0.085	0.210	0.210	0.232	0.285	0.299	0.295	0.347	0.366	0.345
Rated Current	Amps	5.80	4.30	2.38	7.75	5.43	4.88	9.47	7.44	5.00	10.45	7.66	5.85
Rated Power	watts	91	108	82	142	154	174	181	210	193	194	215	222
Torque Sensitivity	oz-in/amp	2.55	3.78	5.18	3.40	4.90	6.25	3.85	5.35	7.79	4.26	6.30	7.80
	Nm/amp	0.0180	0.0267	0.0366	0.0240	0.0346	0.0441	0.0272	0.0378	0.0550	0.0301	0.0445	0.0551
Back EMF	volts/KRPM	1.89	2.80	3.83	2.51	3.62	4.62	2.85	3.96	5.76	3.15	4.66	5.77
	volts/rad/sec	0.018	0.027	0.037	0.024	0.035	0.044	0.027	0.038	0.055	0.030	0.044	0.055
Terminal Resistance	ohms	0.465	0.939	1.890	0.246	0.507	0.800	0.178	0.347	0.715	0.181	0.366	0.576
Terminal Inductance	mH	0.350	0.758	1.53	0.275	0.580	0.930	0.220	0.420	0.900	0.230	0.490	0.770
Motor Constant	oz-in/sq.rt.watt	3.74	3.90	3.77	6.86	6.88	6.99	9.13	9.08	9.21	10.01	10.41	10.28
	Nm/sq.rt.watt	0.026	0.028	0.027	0.048	0.049	0.049	0.064	0.064	0.065	0.071	0.074	0.073
Rotor Inertia	oz-in-sec^{2}x10^{-3}	0.64	0.64	0.64	1.21	1.21	1.21	1.70	1.70	1.70	2.17	2.17	2.17
	g-cm^2	44.9	44.9	44.9	85.0	85.0	85.0	120.0	120.0	120.0	153.1	153.1	153.1
Weight	oz	8.3	8.4	8.3	13.6	13.7	13.8	19.1	19.1	19.1	24.4	24.7	24.5
	g	234.0	238.0	234.0	386.0	389.0	391.0	542.0	542.0	542.0	693.0	699.0	694.0
# of Poles		8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Timing		120°	120°	120°	120°	120°	120°	120°	120°	120°	120°	120°	120°
Mech. Time Constant	ms	6.4	5.9	6.3	3.6	3.6	3.5	2.9	2.9	2.8	3.1	2.8	2.9
Electrical Time Constant	ms	0.75	0.81	0.81	1.12	1.14	1.16	1.24	1.21	1.26	1.27	1.34	1.34
Thermal Resistivity	deg. C/watt	2.28	2.34	3.44	2.49	2.67	1.81	2.36	1.89	2.35	1.93	1.80	1.86
Speed/Torque Gradient	rpm/oz-in	250.0	213.7	257.0	88.9	90.6	93.3	50.6	49.6	46.7	39.9	36.8	40.2

Notes:
1. Motor mounted to a 6" x 6" x 1/4" aluminum plate, still air.
2. Maximum winding temperature of 155°C.
3. Typical electrical specifications at 25°C.
4. Data shown for 8 pole motors. Please consult factory for 4 pole specifications.
5. 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.
6. For MS (military style) connector, please specify connector housing and terminal.
7. 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.

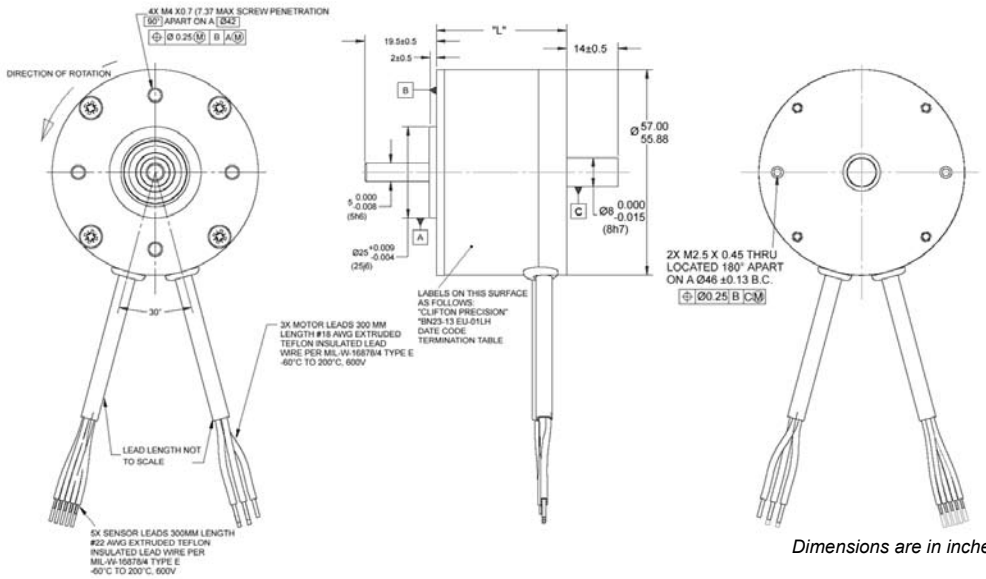
Select your options below and place their code in its corresponding block as shown on page 6.

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

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

O OTHER OPTIONS
D – Drive
E – Encoder
G – Gearhead

BN23 EU Typical Outline



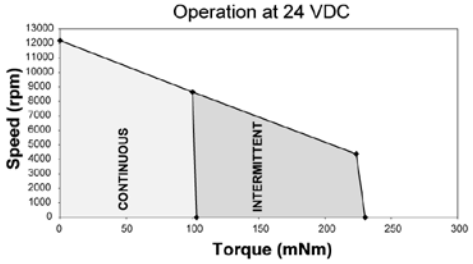
Dimensions are in inches (millimeters)

Termination Table

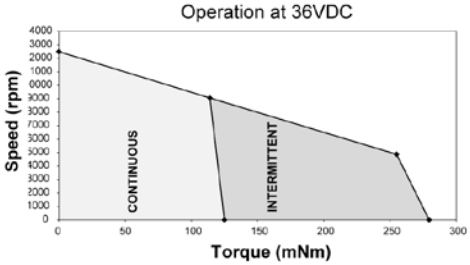
PIN #	CONNECTION
1	V_{CC}
2	GROUND
3	A COIL
4	B COIL
5	C COIL
6	S2 OUT
7	S1 OUT
8	S3 OUT

BN23 EU Performance Curves

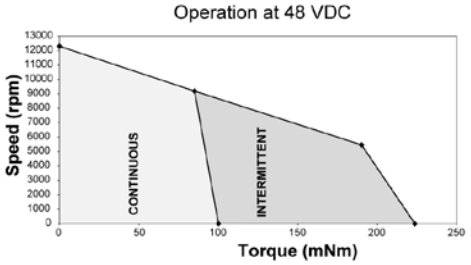
BN23-13EU-01: Continuous & Intermittent Operation at 24 VDC



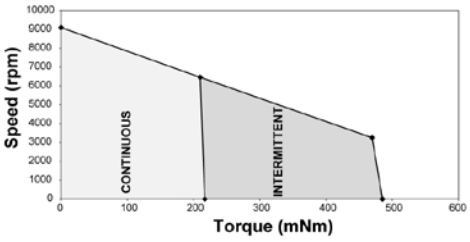
BN23-13EU-02: Continuous & Intermittent Operation at 36VDC



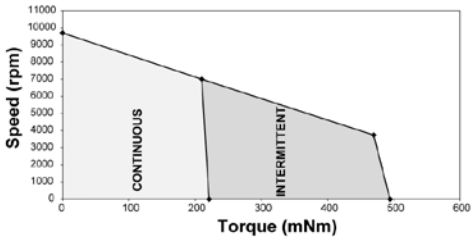
BN23-13EU-03: Continuous & Intermittent Operation at 48 VDC



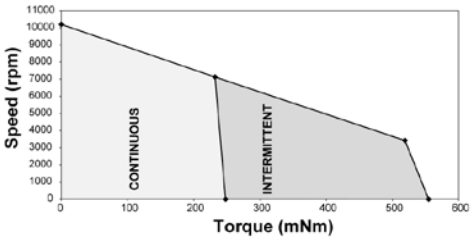
BN23-18EU-01: Continuous & Intermittent Operation at 24 VDC



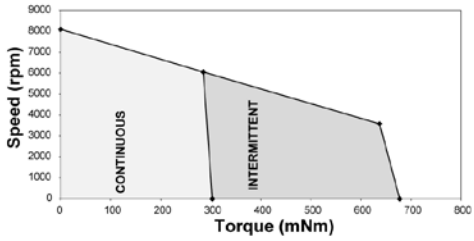
BN23-18EU-02: Continuous & Intermittent Operation at 36 VDC



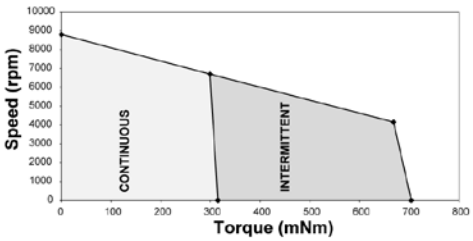
BN23-18EU-03: Continuous & Intermittent Operation at 48 VDC



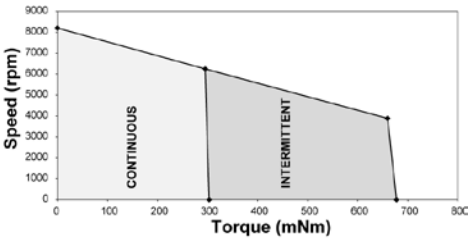
BN23-23EU-01: Continuous & Intermittent Operation at 24 VDC



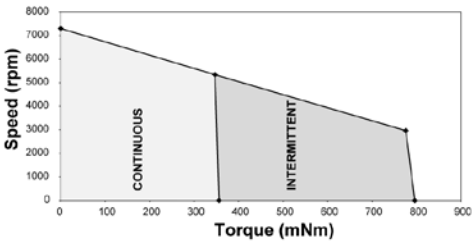
BN23-23EU-02: Continuous & Intermittent Operation at 36 VDC



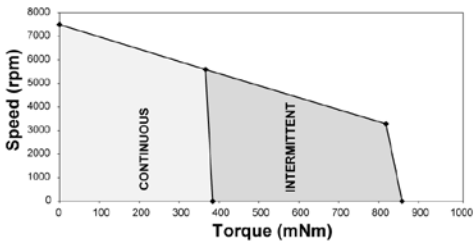
BN23-23EU-03: Continuous & Intermittent Operation at 48 VDC



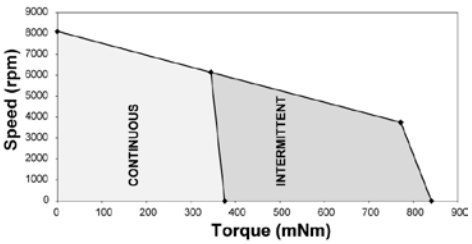
BN23-28EU-01: Continuous & Intermittent Operation at 24 VDC



BN23-28EU-02: Continuous & Intermittent Operation at 36 VDC



BN23-28EU-03: Continuous & Intermittent Operation at 48 VDC



S/T Gradient = 35.4 rpm/mNm

Note: Intermittent operation is based on a 20% duty cycle of one minute on, four minutes off.
Please contact the factory regarding the duty cycle of your application.

BN23 IP SPECIFICATIONS -

Continuous Stall Torque 12.6 - 41 oz-in (0.0890 - 0.290 Nm)
Peak Torque 35 - 186 oz-in (0.248 - 1.32 Nm)

Part Number*		BN23-13IP- □□ T F O			BN23-18IP- □□ T F O			BN23-23IP- □□ T F O			BN23-28IP- □□ T F O		
Winding Code**		01	02	03	01	02	03	01	02	03	01	02	03
L = Length	inches	2.43			2.93			3.43			3.93		
	millimeters	61.72			74.42			87.12			99.82		
Terminal Voltage	volts DC	24	36	48	24	36	48	24	36	48	24	36	48
Peak Torque	oz-in	35	35	35	88	88	88	143	143	143	186	186	186
	Nm	0.2472	0.2472	0.2472	0.6214	0.6214	0.6214	1.0098	1.0098	1.0098	1.3134	1.3134	1.3134
Continuous Stall Torque	oz-in	14.6	17.7	14.2	30.7	31.4	35.2	42.8	44.7	42.9	50.4	54.3	53.2
	Nm	0.103	0.125	0.100	0.217	0.221	0.248	0.303	0.315	0.303	0.356	0.384	0.376
No-Load Speed		12,200	12,500	12,300	9,100	9,700	10,200	8,100	8,800	8,200	7,300	7,500	8,100
Rated Speed	RPM	8650	9060	9190	6460	7000	7130	6060	6700	6250	5340	5590	6140
	rad/sec	906	949	962	676	733	747	635	702	655	559	585	643
Rated Torque	oz-in	14.2	16.1	12.1	29.7	29.8.0	32.9	40.3	42.3	41.8	49.1	51.9	48.8
	Nm	0.100	0.114	0.085	0.210	0.210	0.232	0.285	0.299	0.295	0.347	0.366	0.345
Rated Current	Amps	5.80	4.30	2.38	7.75	5.43	4.88	9.47	7.44	5.00	10.45	7.66	5.85
Rated Power	watts	91	108	82	142	154	174	181	210	193	194	215	222
Torque Sensitivity	oz-in/amp	2.55	3.78	5.18	3.40	4.90	6.25	3.85	5.35	7.79	4.26	6.30	7.80
	Nm/amp	0.0180	0.0267	0.0366	0.0240	0.0346	0.0441	0.0272	0.0378	0.0550	0.0301	0.0445	0.0551
Back EMF	volts/KRPM	1.89	2.80	3.83	2.51	3.62	4.62	2.85	3.96	5.76	3.15	4.66	5.77
	volts/rad/sec	0.018	0.027	0.037	0.024	0.035	0.044	0.027	0.038	0.055	0.030	0.044	0.055
Terminal Resistance	ohms	0.465	0.939	1.890	0.246	0.507	0.800	0.178	0.347	0.715	0.181	0.366	0.576
Terminal Inductance	mH	0.350	0.758	1.53	0.275	0.580	0.930	0.220	0.420	0.900	0.230	0.490	0.770
Motor Constant	oz-in/sq.rt.watt	3.74	3.90	3.77	6.86	6.88	6.99	9.13	9.08	9.21	10.01	10.41	10.28
	Nm/sq.rt.watt	0.026	0.028	0.027	0.048	0.049	0.049	0.064	0.064	0.065	0.071	0.074	0.073
Rotor Inertia	oz-in-sec^{2}x10^{-3}	0.64	0.64	0.64	1.21	1.21	1.21	1.70	1.70	1.70	2.17	2.17	2.17
	g-cm^2	44.9	44.9	44.9	85.0	85.0	85.0	120.0	120.0	120.0	153.1	153.1	153.1
Weight	oz	8.3	8.4	8.3	13.6	13.7	13.8	19.1	19.1	19.1	24.4	24.7	24.5
	g	234.0	238.0	234.0	386.0	389.0	391.0	542.0	542.0	542.0	693.0	699.0	694.0
# of Poles		8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Timing		120°	120°	120°	120°	120°	120°	120°	120°	120°	120°	120°	120°
Mech. Time Constant	ms	6.4	5.9	6.3	3.6	3.6	3.5	2.9	2.9	2.8	3.1	2.8	2.9
Electrical Time Constant	ms	0.75	0.81	0.81	1.12	1.14	1.16	1.24	1.21	1.26	1.27	1.34	1.34
Thermal Resistivity	deg. C/watt	2.28	2.34	3.44	2.49	2.67	1.81	2.36	1.89	2.35	1.93	1.80	1.86
Speed/Torque Gradient	rpm/oz-in	250.0	213.7	257.0	88.9	90.6	93.3	50.6	49.6	46.7	39.9	36.8	40.2

Notes:
1. Motor mounted to a 6" x 6" 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. Calculated (theoretical) speed/torque gradient.
6. For MS (military style) connector, please specify connector housing and terminal.
7. 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.

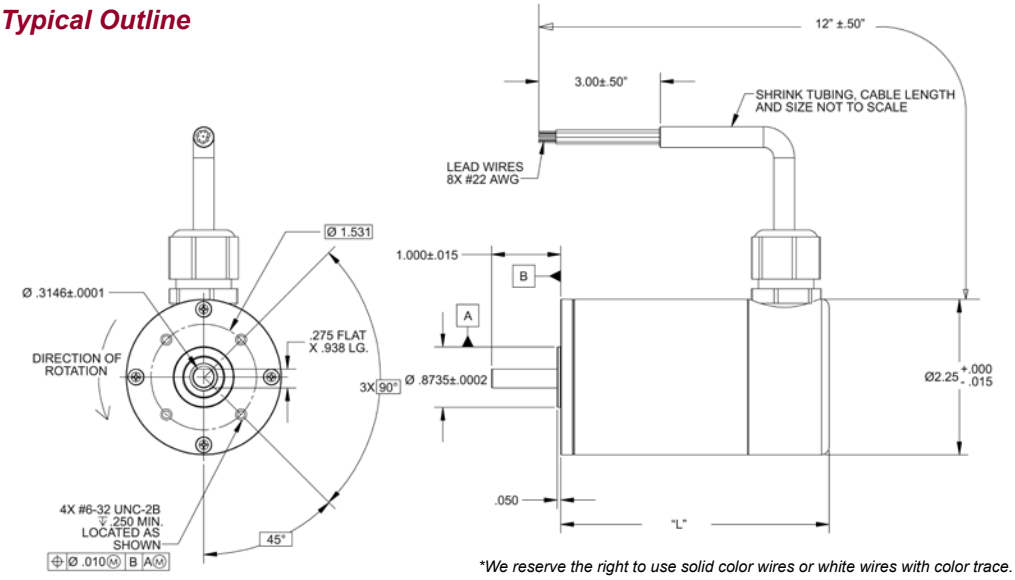
Select your options below and place their code in its corresponding block as shown on page 6.

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

F FEEDBACK OPTIONS
H – Hall Effect (std)

O OTHER OPTIONS
D – Drive
G – Gearhead

BN23 IP Typical Outline



We reserve the right to use solid color wires or white wires with color trace.

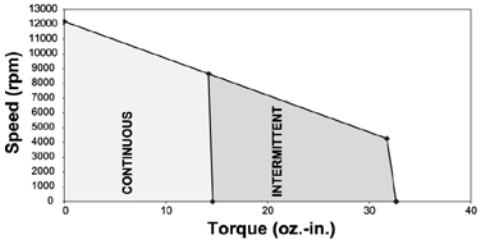
Termination Table*

COLOR	CONNECTION
RED	A COIL
GREEN	C COIL
BLACK	B COIL
GRAY	HALL GND
YELLOW	HALL V_{CC}
WHITE	HALL S3
BLUE	HALL S2
BROWN	HALL S1

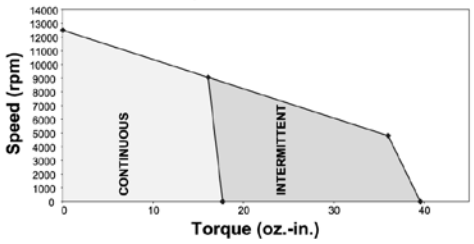
Dimensions are in inches

BN23 IP Performance Curves

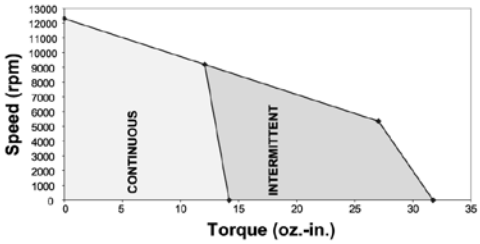
BN23-13IP-01: Continuous & Intermittent Operation at 24 VDC



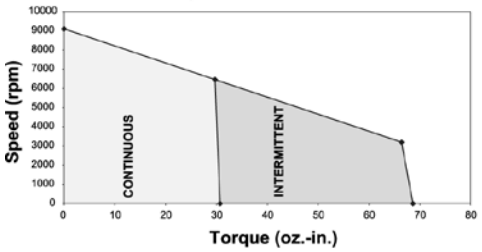
BN23-13IP-02: Continuous & Intermittent Operation at 36VDC



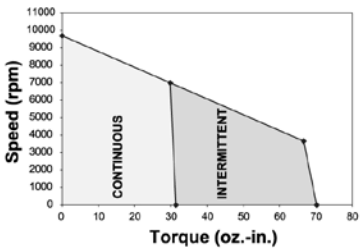
BN23-13IP-03: Continuous & Intermittent Operation at 48 VDC



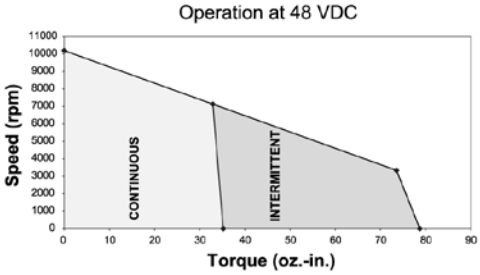
BN23-18IP-01: Continuous & Intermittent Operation at 24 VDC



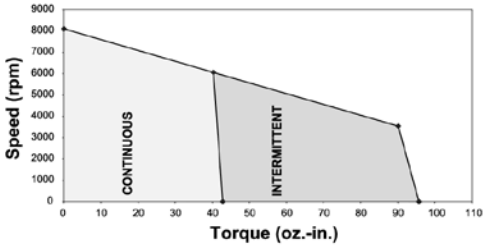
BN23-18IP-02: Continuous & Intermittent Operation at 36 VDC



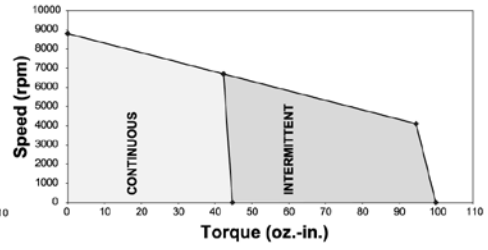
BN23-18IP-03: Continuous & Intermittent Operation at 48 VDC



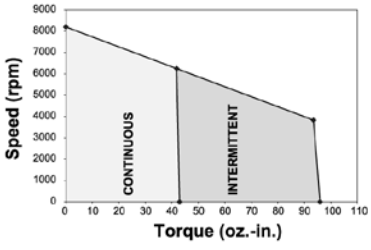
BN23-23IP-01: Continuous & Intermittent Operation at 24 VDC



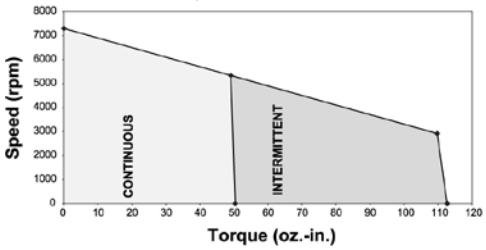
BN23-23IP-02: Continuous & Intermittent Operation at 36 VDC



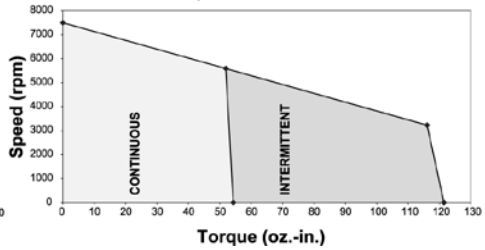
BN23-23IP-03: Continuous & Intermittent Operation at 48 VDC



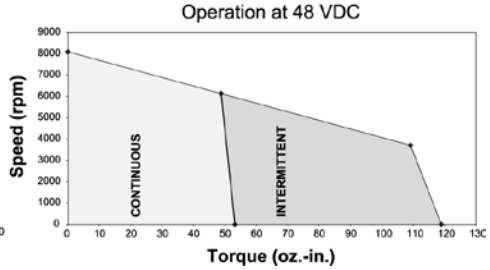
BN23-28IP-01: Continuous & Intermittent Operation at 24 VDC



BN23-28IP-02: Continuous & Intermittent Operation at 36 VDC



BN23-28IP-03: Continuous & Intermittent Operation at 48 VDC



Note: Intermittent operation is based on a 20% duty cycle of one minute on, four minutes off.
Please contact the factory regarding the duty cycle of your application.

BN28 SPECIFICATIONS -

Continuous Stall Torque 43 - 108 oz-in (0.30 - 0.76 Nm)
Peak Torque 188 - 737 oz-in (1.33 - 5.2 Nm)

Part Number*		BN28-21AF-□□ T F O			BN28-29AF-□□ T F O			BN28-36AF-□□ T F O			BN28-44AF-□□ T F O		
Winding Code**		01	02	03	01	02	03	01	02	03	01	02	03
L = Length	inches	2.10			2.90			3.60			4.40		
	millimeters	53.3			73.7			91.4			111.8		
Terminal Voltage	volts DC	24.0	48.0	72.0	24.0	48.0	72.0	24.0	48.0	72.0	24.0	48.0	72.0
Peak Torque	oz-in	188.0	188.0	188.0	407.0	407.0	407.0	596.0	596.0	596.0	737.0	737.0	737.0
	Nm	1.3276	1.3276	1.3276	2.8740	2.8740	2.8740	4.2087	4.2087	4.2087	5.2043	5.2043	5.2043
Continuous Stall Torque	oz-in	43.0	44.0	46.0	71.0	74.0	72.0	93.0	95.0	93.0	106.0	108.0	105.0
	Nm	0.3036	0.3107	0.3248	0.5014	0.5226	0.5084	0.6567	0.6708	0.6567	0.7485	0.7626	0.7415
Rated Speed	RPM	9170	9230	9240	8870	8900	7890	5890	5910	5230	4660	4680	4120
	rad/sec	960	967	968	929	932	826	617	619	548	488	490	431
Rated Torque	oz-in	31	31	33	40	40	46	68	70	72	84	84	86
	Nm	0.2189	0.2189	0.2330	0.2825	0.2825	0.3248	0.4802	0.4943	0.5084	0.5932	0.5932	0.6073
Rated Current	Amps	10.26	5.13	3.63	12.67	6.33	4.29	14.31	7.35	4.51	14.25	7.13	4.35
Rated Power	watts	210.3	211.6	225.5	262.4	263.3	268.4	296.2	306.0	278.5	289.5	290.8	262.1
Torque Sensitivity	oz-in/amp	3.24	6.49	9.73	3.48	6.95	11.59	5.07	10.13	16.89	6.25	12.50	20.84
	Nm/amp	0.0229	0.0458	0.0687	0.0246	0.0491	0.0818	0.0358	0.0715	0.1193	0.0441	0.0883	0.1472
Back EMF	volts/KRPM	2.40	4.80	7.20	2.57	5.14	8.57	3.75	7.49	12.49	4.62	9.24	15.41
	volts/rad/sec	0.0229	0.0458	0.0687	0.0246	0.0491	0.0818	0.0358	0.0715	0.1193	0.0441	0.0883	0.1472
Terminal Resistance	ohms	0.14	0.51	1.08	0.07	0.25	0.72	0.10	0.36	1.05	0.12	0.47	1.38
Terminal Inductance	mH	0.18	0.72	1.62	0.11	0.43	1.19	0.17	0.69	1.92	0.24	0.97	2.69
Motor Constant	oz-in/sq.rt.watt	8.72	9.06	9.38	13.44	13.93	13.69	16.45	16.86	16.49	17.82	18.18	17.73
	Nm/sq.rt.watt	0.062	0.064	0.066	0.095	0.098	0.097	0.116	0.119	0.11645	0.12584	0.12835	0.12518
Rotor Inertia	oz-in-sec^{2}x10^{-3}	2.30	2.30	2.30	4.40	4.40	4.40	6.60	6.60	6.60	8.80	8.80	8.80
	g-cm^2	162.3	162.3	162.3	310.5	310.5	310.5	465.8	465.8	465.8	621.0	621.0	621.0
Weight	oz	23.0	23.0	23.0	35.0	35.0	35.0	48.0	48.0	48.0	61.0	61.0	61.0
	g	653.2	653.2	653.2	994.0	994.0	994.0	1363.2	1363.2	1363.2	1732.4	1732.4	1732.4
# of Poles		8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Timing		120°	120°	120°	120°	120°	120°	120°	120°	120°	120°	120°	120°
Mech. Time Constant	ms	4.3	4.0	3.7	3.4	3.2	3.3	3.5	3.3	3.4	3.9	3.8	4.0
Electrical Time Constant	ms	1.30	1.40	1.51	1.64	1.73	1.66	1.79	1.91	1.83	1.95	2.05	1.95
Thermal Resistivity	deg. C/watt	2.9	3.0	2.9	2.5	2.6	2.6	2.2	2.2	2.3	2.0	2.0	2.1
Speed/Torque Gradient	rpm/oz-in	17.7	16.5	15.4	7.5	7.0	7.2	5.0	4.8	5.0	4.3	4.1	4.3

Notes:
1. Motor mounted to a 10" x 10" 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.

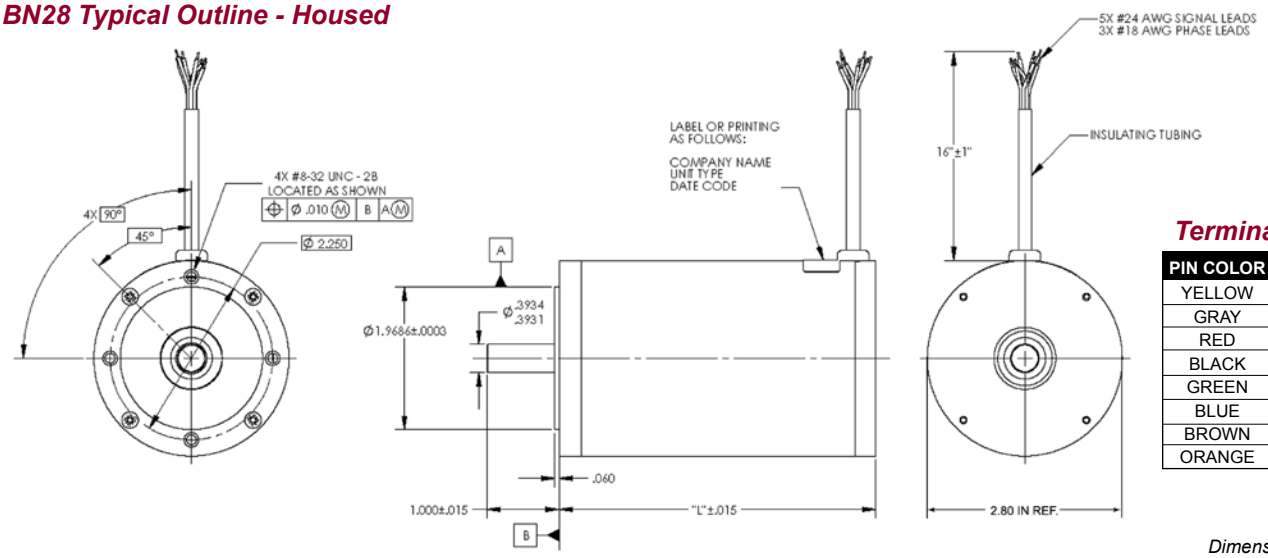
Select your options below and place their code in its corresponding block as shown on page 6.

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

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

O OTHER OPTIONS
D – Drive
E – Encoder
G – Gearhead

BN28 Typical Outline - Housed

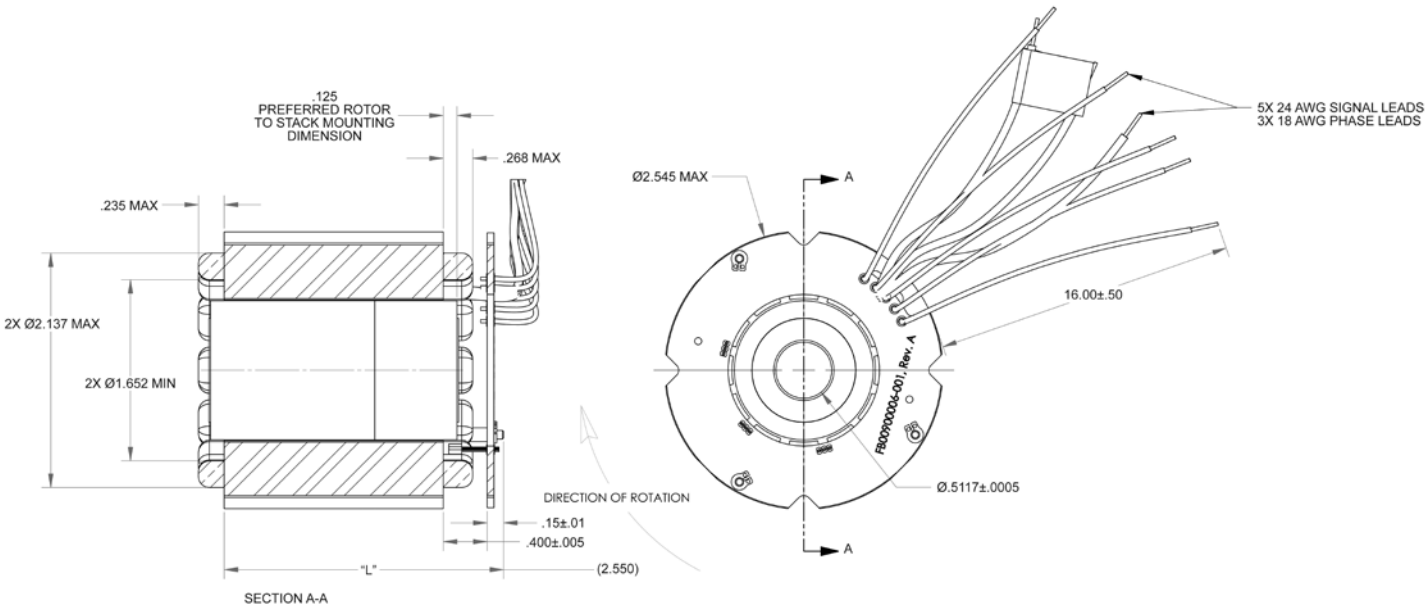


Termination Table

PIN COLOR	CONNECTION
YELLOW	V_{CC}
GRAY	GROUND
RED	A COIL
BLACK	B COIL
GREEN	C COIL
BLUE	S2 OUT
BROWN	S1 OUT
ORANGE	S3 OUT

Dimensions are in inches

BN28 Typical Outline - Frameless

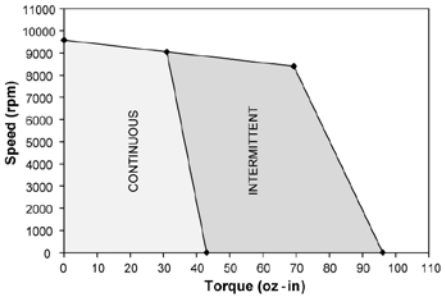


PART NUMBER	"L"
BN28-21ZP-XXLH	1.050
BN28-29ZP-XXLH	1.80
BN28-36ZP-XXLH	2.550
BN28-44ZP-XXLH	3.300

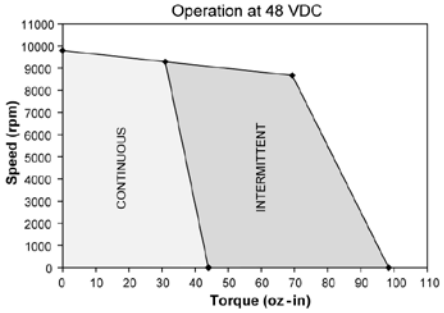
Note: For electrical performance see page 25.

BN28 Performance Curves

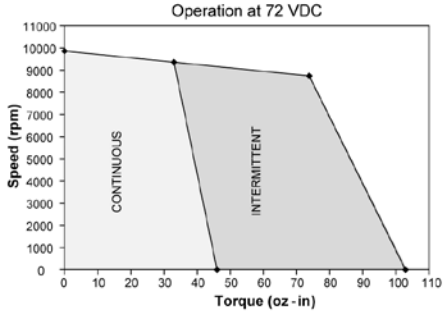
BN28-21AF-01LH: Continuous and Intermittent Operation at 24 VDC



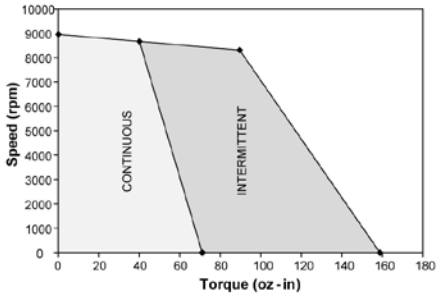
BN28-21AF-02: Continuous and Intermittent Operation at 48 VDC



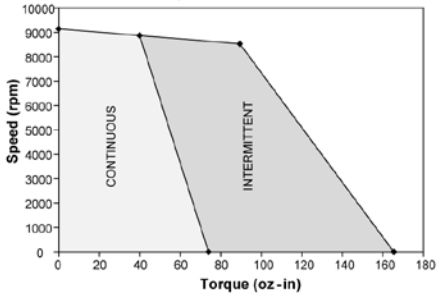
BN28-21AF-03: Continuous and Intermittent Operation at 72 VDC



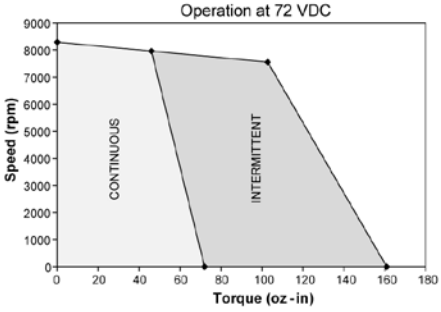
BN28-29AF-01: Continuous and Intermittent Operation at 24 VDC



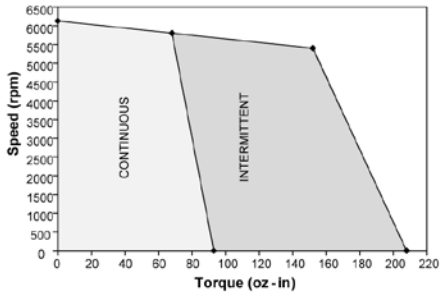
BN28-29AF-02: Continuous and Intermittent Operation at 48 VDC



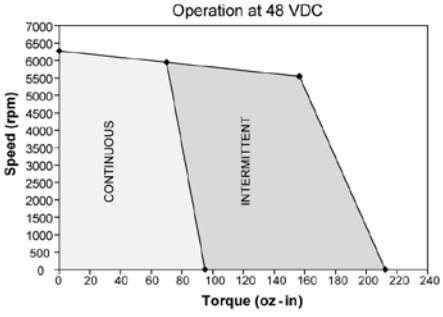
BN28-29AF-03: Continuous and Intermittent Operation at 72 VDC



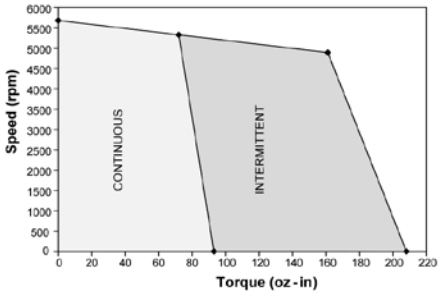
BN28-36AF-01: Continuous and Intermittent Operation at 24 VDC



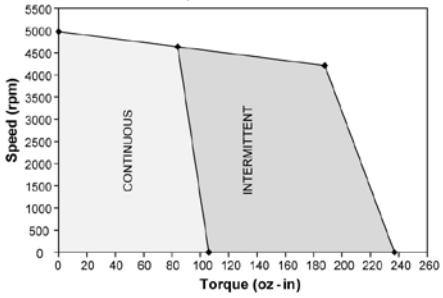
BN28-36AF-02: Continuous and Intermittent Operation at 48 VDC



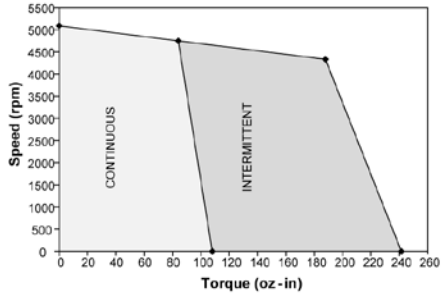
BN28-36AF-03: Continuous and Intermittent Operation at 72 VDC



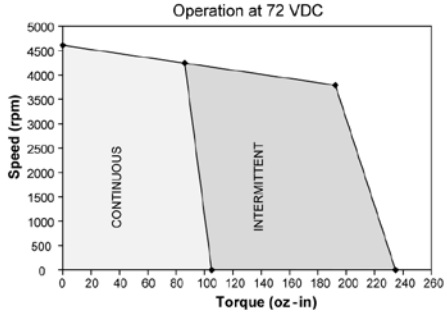
BN28-44AF-01: Continuous and Intermittent Operation at 24 VDC



BN28-44AF-02: Continuous and Intermittent Operation at 48 VDC



BN28-44AF-03: Continuous and Intermittent Operation at 72 VDC



Note: Intermittent operation is based on a 20% duty cycle of one minute on, four minutes off.
Please contact the factory regarding the duty cycle of your application.

BN28 IP SPECIFICATIONS -

Continuous Stall Torque 43 - 108 oz-in (0.30 - 0.76 Nm)
Peak Torque 188 - 737 oz-in (1.33 - 5.2 Nm)

Part Number*		BN28-21IP - □□ T F O			BN28-29IP - □□ T F O			BN28-36IP - □□ T F O			BN28-44IP - □□ T F O		
Winding Code**		01	02	03	01	02	03	01	02	03	01	02	03
L = Length	inches	2.10			2.90			3.60			4.40		
	millimeters	53.3			73.7			91.4			111.8		
Terminal Voltage	volts DC	24.0	48.0	72.0	24.0	48.0	72.0	24.0	48.0	72.0	24.0	48.0	72.0
Peak Torque	oz-in	188.0	188.0	188.0	407.0	407.0	407.0	596.0	596.0	596.0	737.0	737.0	737.0
	Nm	1.3276	1.3276	1.3276	2.8740	2.8740	2.8740	4.2087	4.2087	4.2087	5.2043	5.2043	5.2043
Continuous Stall Torque	oz-in	43.0	44.0	46.0	71.0	74.0	72.0	93.0	95.0	93.0	106.0	108.0	105.0
	Nm	0.3036	0.3107	0.3248	0.5014	0.5226	0.5084	0.6567	0.6708	0.6567	0.7485	0.7626	0.7415
Rated Speed	RPM	9170	9230	9240	8870	8900	7890	5890	5910	5230	4660	4680	4120
	rad/sec	960	967	968	929	932	826	617	619	548	488	490	431
Rated Torque	oz-in	31	31	33	40	40	46	68	70	72	84	84	86
	Nm	0.2189	0.2189	0.2330	0.2825	0.2825	0.3248	0.4802	0.4943	0.5084	0.5932	0.5932	0.6073
Rated Current	Amps	10.26	5.13	3.63	12.67	6.33	4.29	14.31	7.35	4.51	14.25	7.13	4.35
Rated Power	watts	210.3	211.6	225.5	262.4	263.3	268.4	296.2	306.0	278.5	289.5	290.8	262.1
Torque Sensitivity	oz-in/amp	3.24	6.49	9.73	3.48	6.95	11.59	5.07	10.13	16.89	6.25	12.50	20.84
	Nm/amp	0.0229	0.0458	0.0687	0.0246	0.0491	0.0818	0.0358	0.0715	0.1193	0.0441	0.0883	0.1472
Back EMF	volts/KRPM	2.40	4.80	7.20	2.57	5.14	8.57	3.75	7.49	12.49	4.62	9.24	15.41
	volts/rad/sec	0.0229	0.0458	0.0687	0.0246	0.0491	0.0818	0.0358	0.0715	0.1193	0.0441	0.0883	0.1472
Terminal Resistance	ohms	0.14	0.51	1.08	0.07	0.25	0.72	0.10	0.36	1.05	0.12	0.47	1.38
Terminal Inductance	mH	0.18	0.72	1.62	0.11	0.43	1.19	0.17	0.69	1.92	0.24	0.97	2.69
Motor Constant	oz-in/sq.rt.watt	8.72	9.06	9.38	13.44	13.93	13.69	16.45	16.86	16.49	17.82	18.18	17.73
	Nm/sq.rt.watt	0.062	0.064	0.066	0.095	0.098	0.097	0.116	0.119	0.11645	0.12584	0.12835	0.12518
Rotor Inertia	oz-in-sec^{2}x10^{-3}	2.30	2.30	2.30	4.40	4.40	4.40	6.60	6.60	6.60	8.80	8.80	8.80
	g-cm^2	162.3	162.3	162.3	310.5	310.5	310.5	465.8	465.8	465.8	621.0	621.0	621.0
Weight	oz	23.0	23.0	23.0	35.0	35.0	35.0	48.0	48.0	48.0	61.0	61.0	61.0
	g	653.2	653.2	653.2	994.0	994.0	994.0	1363.2	1363.2	1363.2	1732.4	1732.4	1732.4
# of Poles		8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Timing		120°	120°	120°	120°	120°	120°	120°	120°	120°	120°	120°	120°
Mech. Time Constant	ms	4.3	4.0	3.7	3.4	3.2	3.3	3.5	3.3	3.4	3.9	3.8	4.0
Electrical Time Constant	ms	1.30	1.40	1.51	1.64	1.73	1.66	1.79	1.91	1.83	1.95	2.05	1.95
Thermal Resistivity	deg. C/watt	2.9	3.0	2.9	2.5	2.6	2.6	2.2	2.2	2.3	2.0	2.0	2.1
Speed/Torque Gradient	rpm/oz-in	17.7	16.5	15.4	7.5	7.0	7.2	5.0	4.8	5.0	4.3	4.1	4.3

Notes:
1. Motor mounted to a 10" x 10" 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. Calculated (theoretical) speed/torque gradient.
6. For MS (military style) connector, please specify connector housing and terminal.
7. 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.

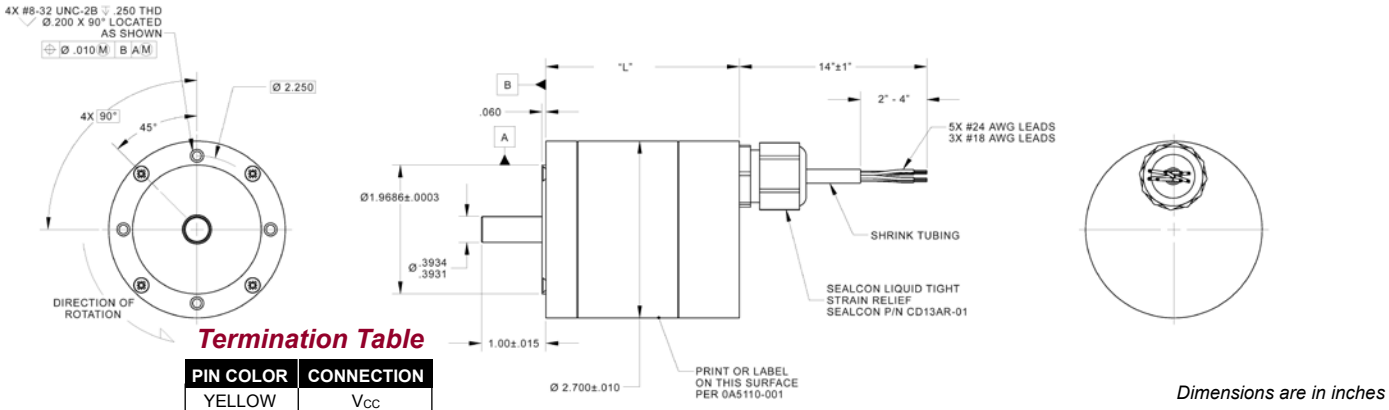
Select your options below and place their code in its corresponding block as shown on page 6.

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

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

O OTHER OPTIONS
D – Drive
E – Encoder
G – Gearhead

BN28 IP Typical Outline



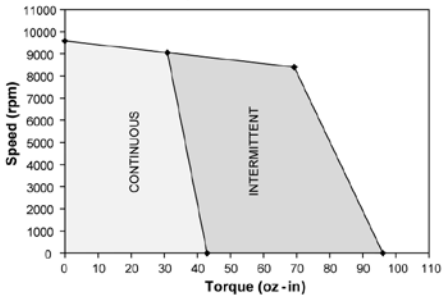
Termination Table

PIN COLOR	CONNECTION
YELLOW	V_{CC}
GRAY	GROUND
RED	A COIL
BLACK	B COIL
GREEN	C COIL
BLUE	S2 OUT
BROWN	S1 OUT
ORANGE	S3 OUT

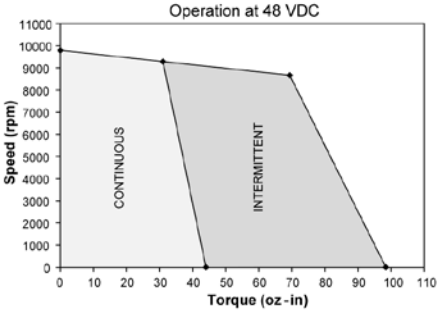
Dimensions are in inches

BN28 IP Performance Curves

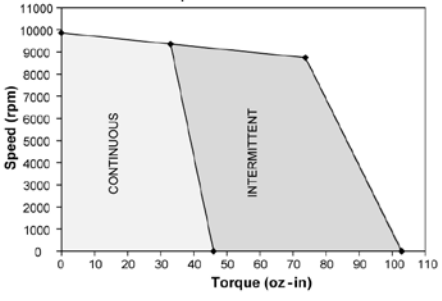
BN28-21IP-01LH: Continuous and Intermittent Operation at 24 VDC



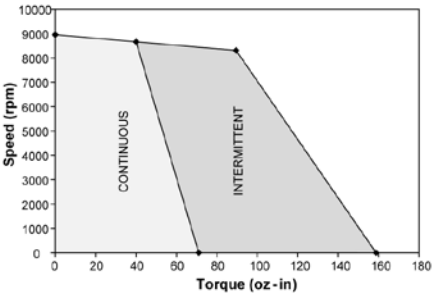
BN28-21IP-02: Continuous and Intermittent Operation at 48 VDC



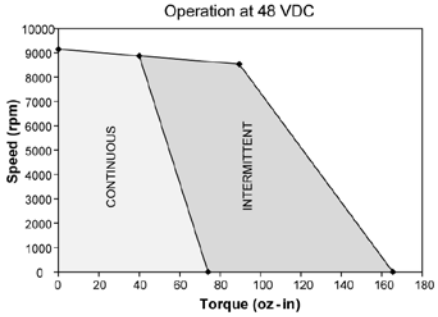
BN28-21IP-03: Continuous and Intermittent Operation at 72 VDC



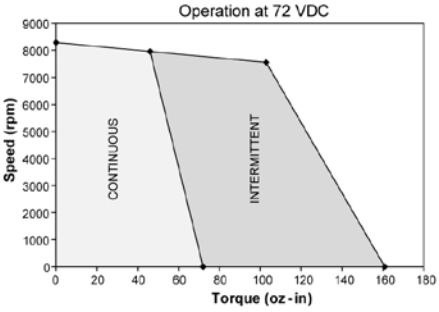
BN28-29IP-01: Continuous and Intermittent Operation at 24 VDC



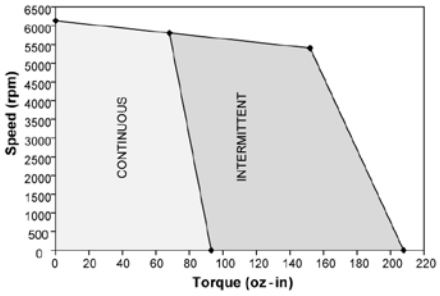
BN28-29IP-02: Continuous and Intermittent Operation at 48 VDC



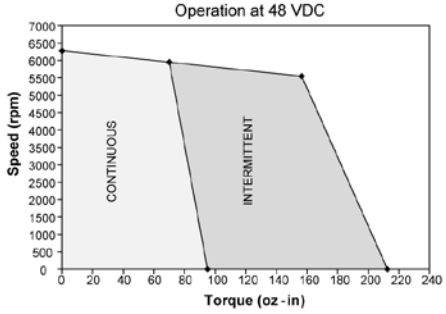
BN28-29IP-03: Continuous and Intermittent Operation at 72 VDC



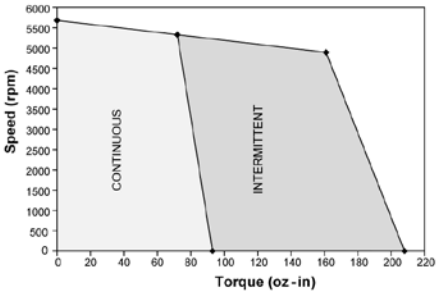
BN28-36IP-01: Continuous and Intermittent Operation at 24 VDC



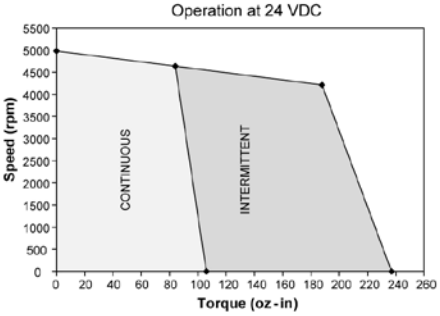
BN28-36IP-02: Continuous and Intermittent Operation at 48 VDC



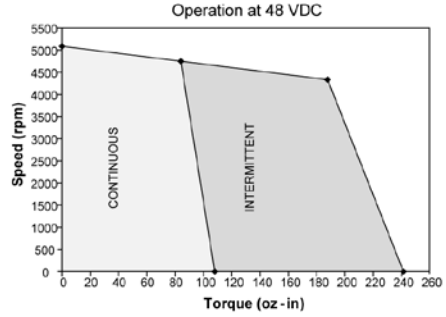
BN28-36IP-03: Continuous and Intermittent Operation at 72 VDC



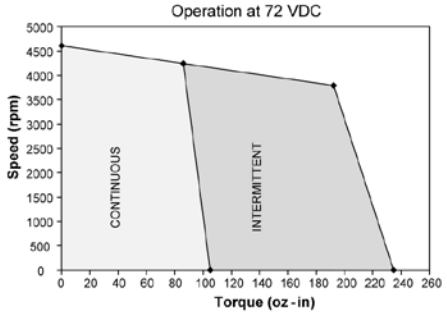
BN28-44IP-01: Continuous and Intermittent Operation at 24 VDC



BN28-44IP-02: Continuous and Intermittent Operation at 48 VDC



BN28-44IP-03: Continuous and Intermittent Operation at 72 VDC



Note: Intermittent operation is based on a 20% duty cycle of one minute on, four minutes off.
Please contact the factory regarding the duty cycle of your application.

BN34 SPECIFICATIONS -

Continuous Stall Torque 83 - 309 oz-in (0.587 - 2.19 Nm)
Peak Torque 326 - 1445 oz-in (2.31 - 10.21 Nm)

Part Number*		BN34-25AF- □□ T F O			BN34-35AF- □□ T F O			BN34-45AF- □□ T F O			BN34-55AF- □□ T F O		
Winding Code**		01	02	03	01	02	03	01	02	03	01	02	03
L = Length	inches	2.50			3.50			4.50			5.50		
	millimeters	63.5			88.9			114.3			139.7		
Terminal Voltage	volts DC	24.0	50.0	100.0	24.0	50.0	100.0	24.0	50.0	100.0	24.0	50.0	100.0
Peak Torque	oz-in	326.0	326.0	326.0	566.0	643.0	697.0	1070.0	1070.0	1070.0	1445.0	1445.0	1445.0
	Nm	2.3020	2.3020	2.3020	3.9968	4.5405	4.9219	7.5558	7.5558	7.5558	10.2039	10.2039	10.2039
Continuous Stall Torque	oz-in	83.0	93.0	93.0	133.0	162.0	159.0	220.0	224.0	231.0	287.0	306.0	309.0
	Nm	0.5861	0.6567	0.6567	0.9392	1.144	1.1228	1.5535	1.5818	1.6312	2.0267	2.1608	2.1820
Rated Speed	RPM	7400.0	7330.0	7550.0	5916.0	6400.0	6240.0	3300.0	4710.0	4710.0	2410.0	3910.0	3920.0
	rad/sec	775	768	791	620	670	653	346	493	493	252	409	411
Rated Torque	oz-in	60.0	67.0	66.0	93.0	106.0	106.0	188.0	165.0	170.0	258.0	240.0	240.0
	Nm	0.4237	0.4731	0.4661	0.6567	0.749	0.7485	1.3276	1.1651	1.2005	1.8219	1.6948	1.6948
Rated Current	Amps	16.40	8.70	4.40	18.74	11.0	5.80	23.0	13.70	7.00	23.30	16.50	8.20
Rated Power	watts	328.0	363.0	368.0	407.0	502.0	489.0	459.0	575.0	592.0	460.0	694.0	696.0
Torque Sensitivity	oz-in/amp	4.19	8.90	17.20	5.24	9.92	21.0	9.20	13.80	27.70	12.40	16.60	33.20
	Nm/amp	0.0296	0.0628	0.1215	0.0370	0.0701	0.1483	0.0650	0.0974	0.1956	0.0876	0.1172	0.2344
Back EMF	volts/KRPM	3.10	6.50	12.80	3.88	7.34	15.50	6.83	10.20	20.50	9.20	12.30	24.50
	volts/rad/sec	0.0296	0.0628	0.1215	0.0370	0.070	0.1483	0.0650	0.0974	0.1956	0.0876	0.1172	0.2344
Terminal Resistance	ohms	0.069	0.251	0.941	0.057	0.147	0.575	0.069	0.147	0.552	0.086	0.135	0.504
Terminal Inductance	mH	0.129	0.575	2.180	0.143	0.430	1.570	0.200	0.450	1.800	0.271	0.482	1.930
Motor Constant	oz-in/sq.rt.watt	15.95	17.76	17.73	21.95	25.87	27.69	35.02	35.99	37.28	42.28	45.18	46.77
	Nm/sq.rt.watt	0.11264	0.12544	0.12521	0.15499	0.183	0.19556	0.24732	0.25417	0.26328	0.29859	0.31904	0.33023
Rotor Inertia	oz-in-sec^{2}x10^{-3}	6.00	6.00	6.00	12.00	12.00	12.00	18.00	18.00	18.00	24.00	24.00	24.00
	g-cm^2	423.4	423.4	423.4	846.8	846.8	846.8	1270.3	1270.3	1270.3	1693.7	1693.7	1693.7
Weight	oz	37.0	37.0	37.0	62.0	62.0	62.0	88.0	88.0	88.0	115.0	115.0	115.0
	g	1050.8	1050.8	1050.8	1760.8	1760.8	1760.8	2499.2	2499.2	2499.2	3266.0	3266.0	3266.0
# of Poles		8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Timing		120°	120°	120°	120°	120°	120°	120°	120°	120°	120°	120°	120°
Mech. Time Constant	ms	3.3	2.7	2.7	3.5	2.5	2.2	2.1	2.0	1.8	1.9	1.7	1.6
Electrical Time Constant	ms	1.87	2.29	2.32	2.51	2.90	2.73	2.90	3.06	3.26	3.15	3.57	3.83
Thermal Resistivity	deg. C/watt	1.6	1.5	1.5	2.5	1.84	1.2	1.1	1.0	1.0	1.1	0.8	0.8
Speed/Torque Gradient	rpm/oz-in	5.3	4.3	4.3	2.8	2.8	1.8	1.1	1.0	1.0	0.8	0.7	0.6

Notes:
1. Motor mounted to a 10" x 10" 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.

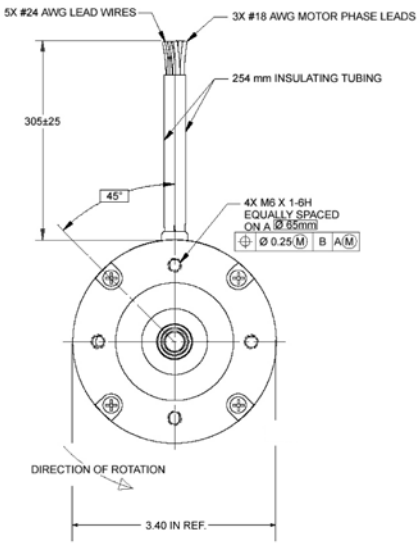
Select your options below and place their code in its corresponding block as shown on page 6.

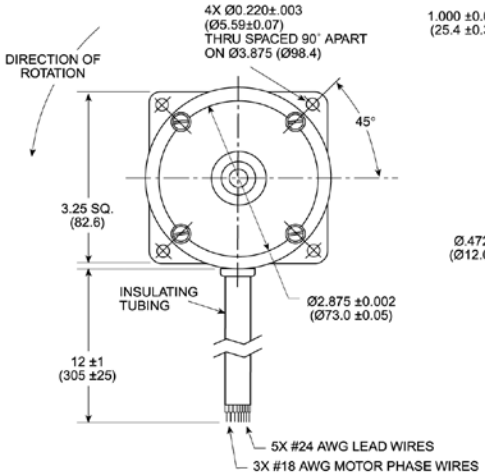
T TERMINATION
L – Leads (std)
C – Connector
M – MS connector

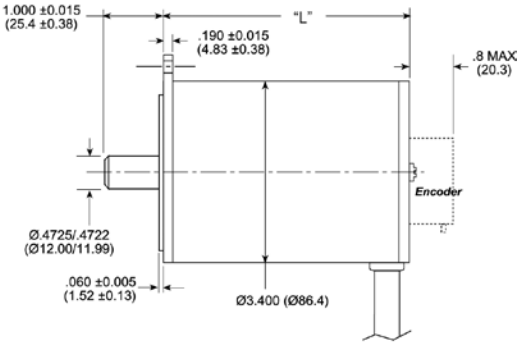
F FEEDBACK OPTIONS
H – Hall Effect (std)
R – Resolver
S – Sensorless

O OTHER OPTIONS
D – Drive
E – Encoder
G – Gearhead

BN34 Typical Outline - Housed





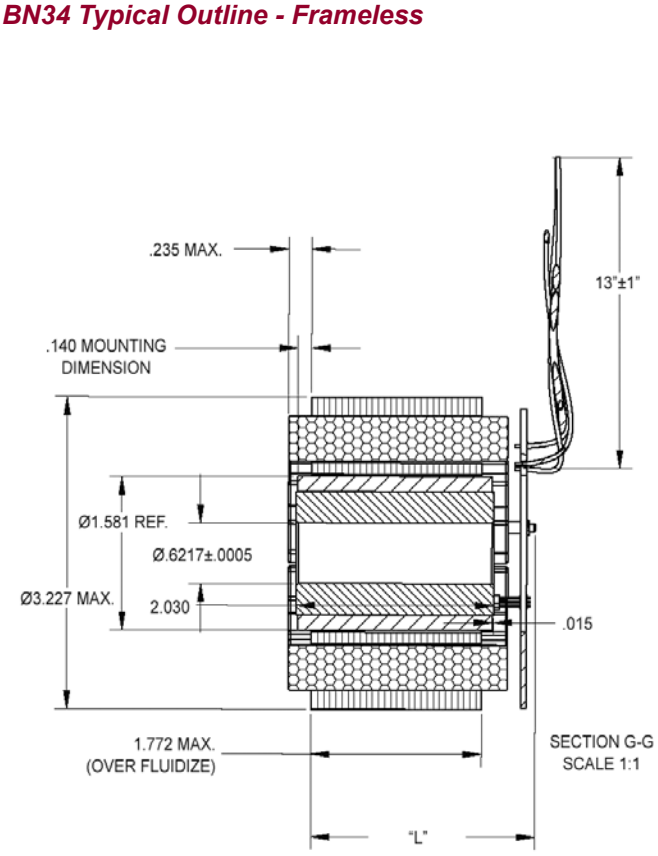


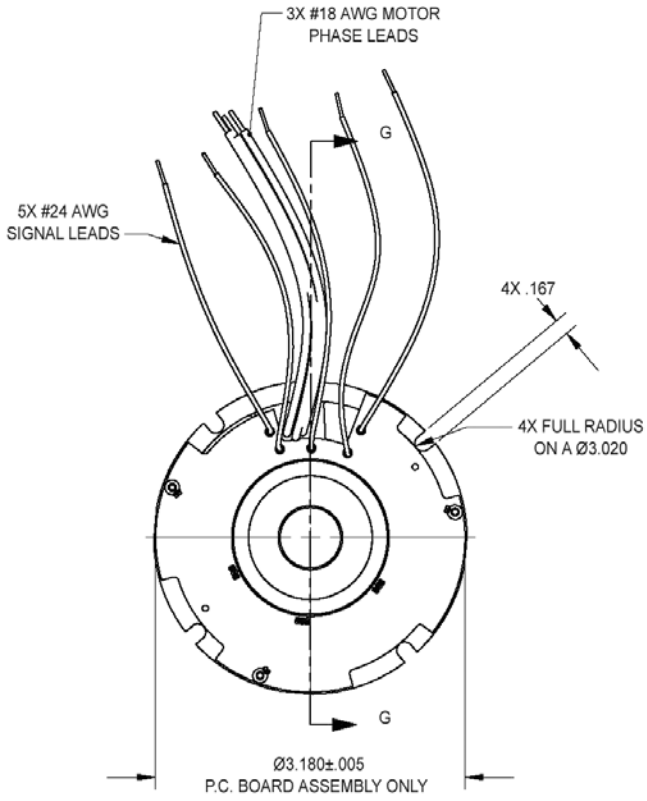
Dimensions are in inches (millimeters)

Termination Table

PIN COLOR	CONNECTION
YELLOW	V_{CC}
GRAY	GROUND
RED	A COIL
BLACK	B COIL
GREEN	C COIL
BLUE	S2 OUT
BROWN	S1 OUT
ORANGE	S3 OUT

BN34 Typical Outline - Frameless





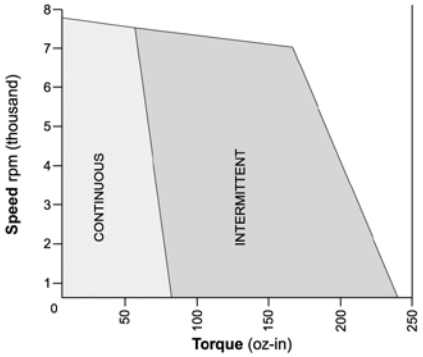
Dimensions are in inches

PART NUMBER	"L"
BN34-25ZP-[ ][ ]-LH	1.337
BN34-35ZP-[ ][ ]-LH	2.337
BN34-45ZP-[ ][ ]-LH	3.337
BN34-55ZP-[ ][ ]-LH	4.337

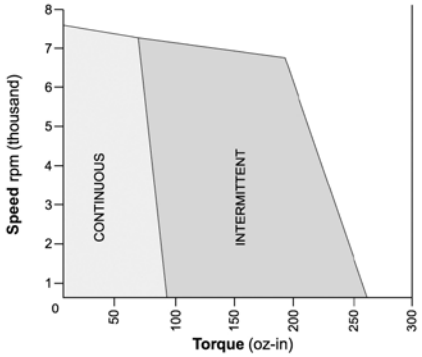
Note: See page 30 for performance data.

BN34 Performance Curves

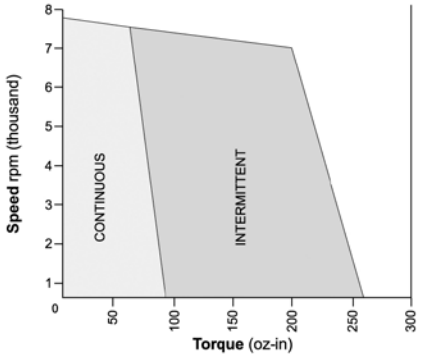
BN34-25AF-01: Continuous & Intermittent Operation at 24 Volt DC



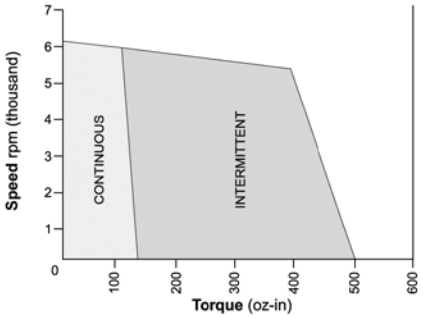
BN34-25AF-02: Continuous & Intermittent Operation at 50 Volt DC



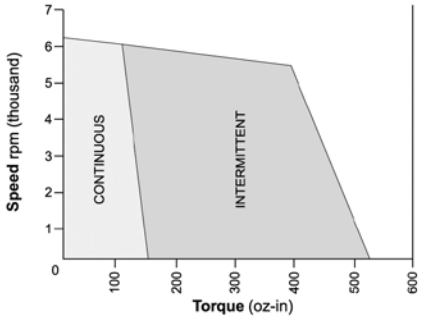
BN34-25AF-03: Continuous & Intermittent Operation at 100 Volt DC



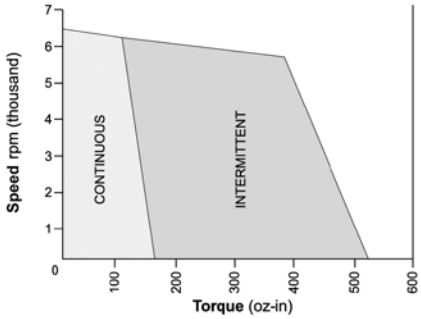
BN34-35AF-01: Continuous & Intermittent Operation at 24 Volt DC



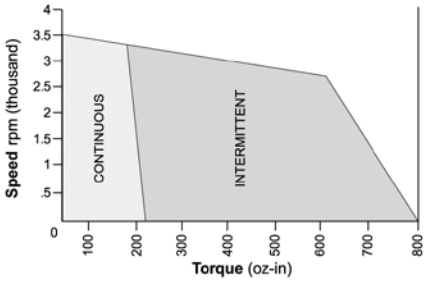
BN34-35AF-02: Continuous & Intermittent Operation at 50 Volt DC



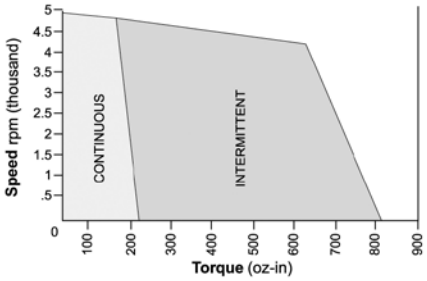
BN34-35AF-03: Continuous & Intermittent Operation at 100 Volt DC



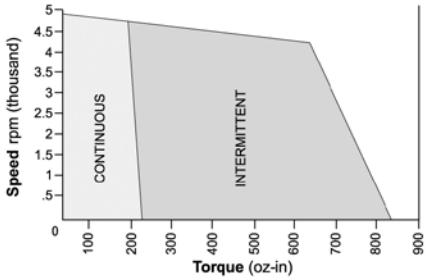
BN34-45AF-01: Continuous & Intermittent Operation at 24 Volt DC



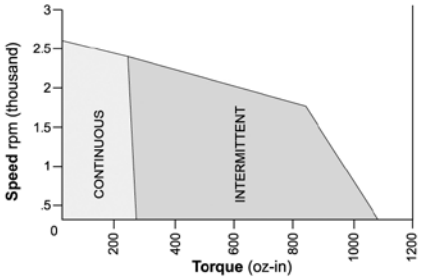
BN34-45AF-02: Continuous & Intermittent Operation at 50 Volt DC



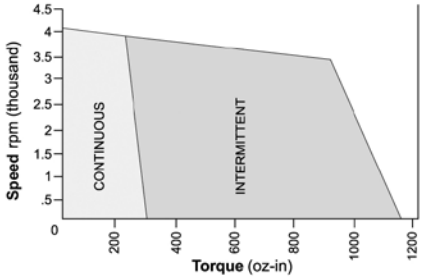
BN34-45AF-03: Continuous & Intermittent Operation at 100 Volt DC



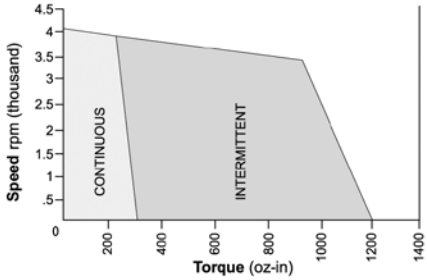
BN34-55AF-01: Continuous & Intermittent Operation at 24 Volt DC



BN34-55AF-02: Continuous & Intermittent Operation at 50 Volt DC



BN34-55AF-03: Continuous & Intermittent Operation at 100 Volt DC



Note: Intermittent operation is based on a 20% duty cycle of one minute on, four minutes off.
Please contact the factory regarding the duty cycle of your application.

BN34 EU SPECIFICATIONS -

Continuous Stall Torque 83 - 309 oz-in (0.587 - 2.19 Nm)
Peak Torque 326 - 1445 oz-in (2.31 - 10.21 Nm)

Part Number*		BN34-25EU- □□ T F O			BN34-35EU- □□ T F O			BN34-45EU- □□ T F O			BN34-55EU- □□ T F O		
Winding Code**		01	02	03	01	02	03	01	02	03	01	02	03
L = Length	inches	2.50			3.50			4.50			5.50		
	millimeters	63.5			88.9			114.3			139.7		
Terminal Voltage	volts DC	24	50	100	24	50	100	24	50	100	24	50	100
Peak Torque	oz-in	326	326	326	697	697	697	1070	1070	1070	1445	1445	1445
	Nm	2.31	2.31	2.31	4.93	4.93	4.93	7.56	7.56	7.56	10.21	10.21	10.21
Continuous Stall Torque	oz-in	83	93	93	152	159	159	220	224	231	287	306	309
	Nm	0.587	0.657	0.657	1.074	1.13	1.13	1.54	1.59	1.64	2.03	2.17	2.19
Rated Speed	RPM	7400	7330	7550	5160	5930	6240	3300	4710	4710	2410	3910	3920
	rad/sec	775	768	791	541	621	654	346	494	494	253	410	411
Rated Torque	oz-in	60	67	66	117	110	106	188	165	170	258	240	240
	Nm	0.424	0.474	0.467	0.827	0.777	0.749	1.33	1.17	1.20	1.83	1.70	1.70
Rated Current	Amps	16.4	8.7	4.4	22.3	11.5	5.8	23.0	13.7	7.0	23.3	16.5	8.2
Rated Power	watts	328	363	368	446	482	489	459	575	592	460	694	696
Torque Sensitivity	oz-in/amp	4.19	8.90	17.2	6.01	11.0	21.0	9.20	13.8	27.7	12.40	16.6	33.2
	Nm/amp	0.0296	0.0621	0.123	0.0424	0.0774	0.148	0.0653	0.0974	0.196	0.0879	0.118	0.234
Back EMF	volts/KRPM	3.10	6.50	12.8	4.44	8.10	15.5	6.83	10.2	20.5	9.20	12.3	24.5
	volts/rad/sec	0.0296	0.0621	0.123	0.0424	0.0774	0.148	0.0653	0.0974	0.196	0.0879	0.118	0.234
Terminal Resistance	ohms	0.069	0.251	0.941	0.053	0.160	0.575	0.069	0.147	0.552	0.086	0.135	0.504
Terminal Inductance	mH	0.129	0.575	2.18	0.129	0.432	1.57	0.200	0.450	1.80	0.271	0.482	1.93
Motor Constant	oz-in/sq.rt.watt	17.7	18.2	17.9	30.1	28.7	28.0	38.9	37.8	37.7	46.1	47.4	47.4
	Nm/sq.rt.watt	0.125	0.129	0.127	0.213	0.203	0.198	0.275	0.267	0.267	0.326	0.335	0.335
Rotor Inertia	oz-in-sec^2	0.006	0.006	0.006	0.012	0.012	0.012	0.018	0.018	0.018	0.024	0.024	0.024
	g-cm^2	424	424	424	848	848	848	1271	1271	1271	1695	1695	1695
Weight	oz	37	37	37	62	62	62	88	88	88	115	115	115
	g	1049	1049	1049	1758	1758	1758	2495	2495	2495	3261	3261	3261

Notes:
1. Motor mounted to a 10" x 10" 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.

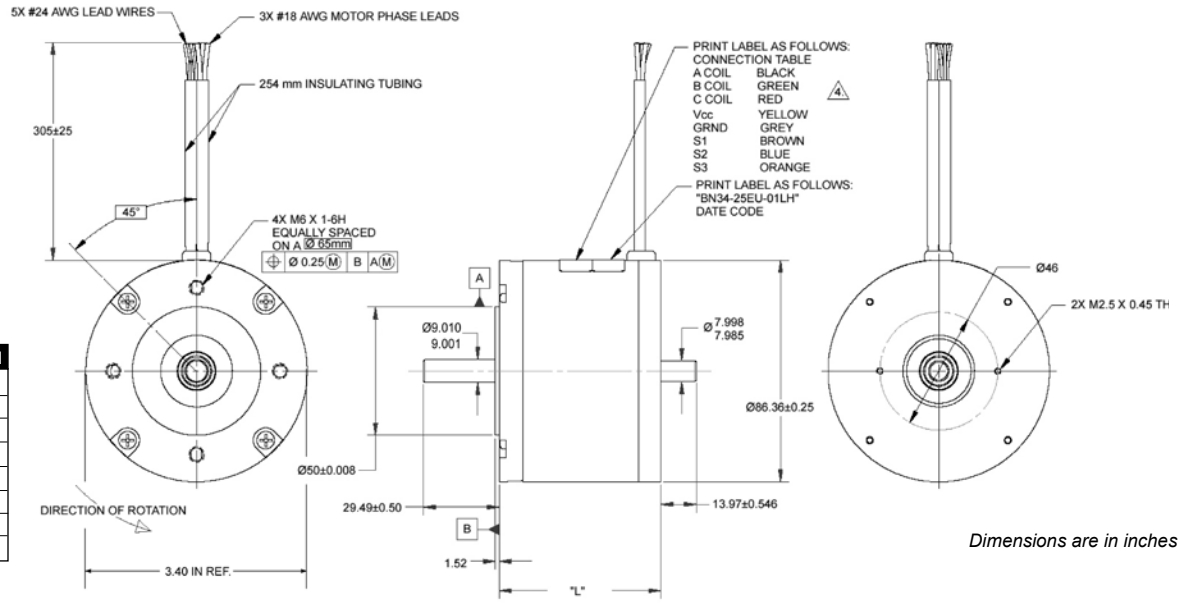
Select your options below and place their code in its corresponding block as shown on page 6.

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

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

O OTHER OPTIONS
D – Drive
E – Encoder
G – Gearhead

BN34 EU Typical Outline



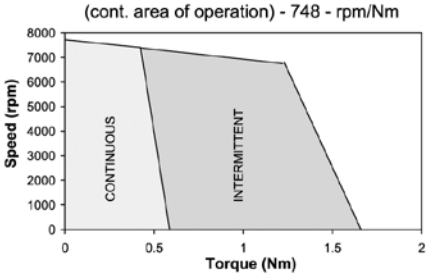
Dimensions are in inches

Termination Table

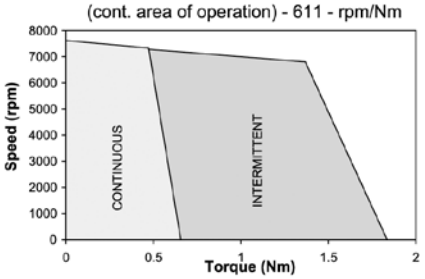
PIN COLOR	CONNECTION
YELLOW	V_{CC}
GRAY	GROUND
RED	A COIL
BLACK	B COIL
GREEN	C COIL
BLUE	S2 OUT
BROWN	S1 OUT
ORANGE	S3 OUT

BN34 EU Performance Curves

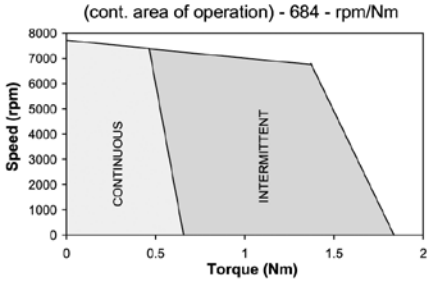
BN34-25EU-01LH: Speed/Torque Gradient - (cont. area of operation) - 748 - rpm/Nm



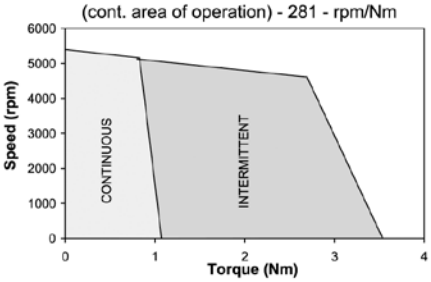
BN34-25EU-02LH: Speed/Torque Gradient - (cont. area of operation) - 611 - rpm/Nm



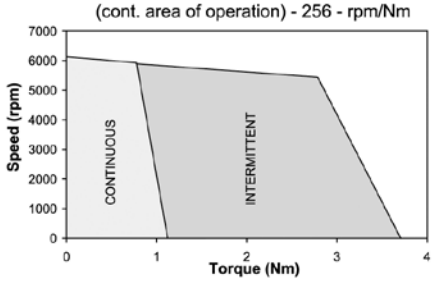
BN34-25EU-03LH: Speed/Torque Gradient - (cont. area of operation) - 684 - rpm/Nm



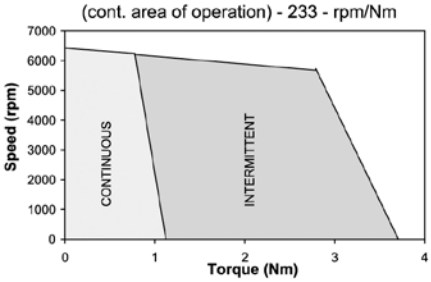
BN34-35EU-01LH: Speed/Torque Gradient - (cont. area of operation) - 281 - rpm/Nm



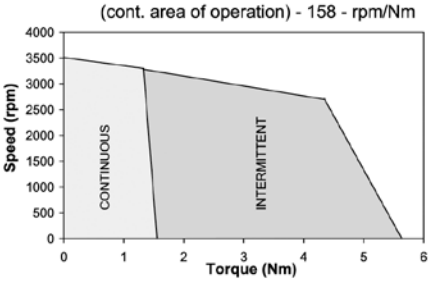
BN34-35EU-02LH: Speed/Torque Gradient - (cont. area of operation) - 256 - rpm/Nm



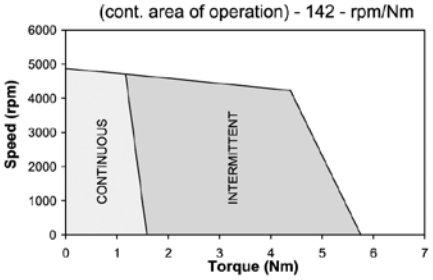
BN34-35EU-03LH: Speed/Torque Gradient - (cont. area of operation) - 233 - rpm/Nm



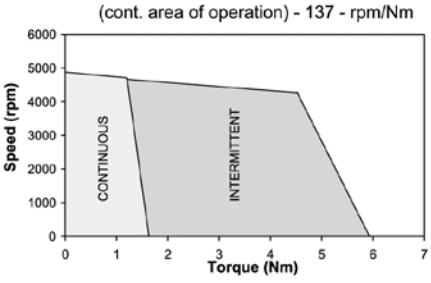
BN34-45EU-01LH: Speed/Torque Gradient - (cont. area of operation) - 158 - rpm/Nm



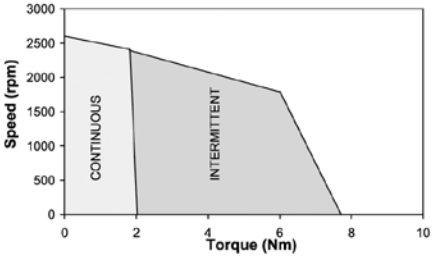
BN34-45EU-02LH: Speed/Torque Gradient - (cont. area of operation) - 142 - rpm/Nm



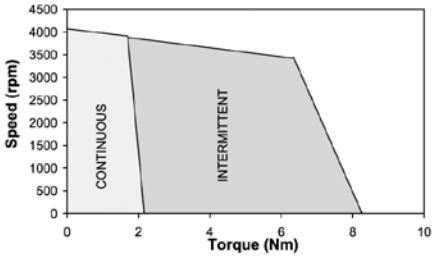
BN34-45EU-03LH: Speed/Torque Gradient - (cont. area of operation) - 137 - rpm/Nm



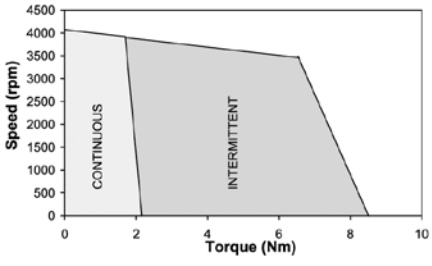
BN34-55EU-01LH: Speed/Torque Gradient - (cont. area of operation) - 104 - rpm/Nm



BN34-55EU-02LH: Speed/Torque Gradient - (cont. area of operation) - 95 - rpm/Nm



BN34-55EU-03LH: Speed/Torque Gradient - (cont. area of operation) - 89 - rpm/Nm



Note: Intermittent operation is based on a 20% duty cycle of one minute on, four minutes off. Please contact the factory regarding the duty cycle of your application.

BN34 IP SPECIFICATIONS -

Continuous Stall Torque 83 - 309 oz-in (0.587 - 2.19 Nm)
Peak Torque 326 - 1445 oz-in (2.31 - 10.21 Nm)

Part Number*		BN34-25IP - □□ T F O			BN34-35IP - □□ T F O			BN34-45IP - □□ T F O			BN34-55IP - □□ T F O		
Winding Code**		01	02	03	01	02	03	01	02	03	01	02	03
L = Length	inches		2.50			3.50			4.50			5.50	
	millimeters		63.5			88.9			114.3			139.7	
Terminal Voltage	volts DC	24.0	50.0	100.0	24.0	50.0	100.0	24.0	50.0	100.0	24.0	50.0	100.0
Peak Torque	oz-in	326.0	326.0	326.0	566.0	643.0	697.0	1070.0	1070.0	1070.0	1445.0	1445.0	1445.0
	Nm	2.3020	2.3020	2.3020	3.9968	4.5405	4.9219	7.5558	7.5558	7.5558	10.2039	10.2039	10.2039
Continuous Stall Torque	oz-in	83.0	93.0	93.0	133.0	162.0	159.0	220.0	224.0	231.0	287.0	306.0	309.0
	Nm	0.5861	0.6567	0.6567	0.9392	1.144	1.1228	1.5535	1.5818	1.6312	2.0267	2.1608	2.1820
Rated Speed	RPM	7400.0	7330.0	7550.0	5916.0	6400.0	6240.0	3300.0	4710.0	4710.0	2410.0	3910.0	3920.0
	rad/sec	775	768	791	620	670	653	346	493	493	252	409	411
Rated Torque	oz-in	60.0	67.0	66.0	93.0	106.0	106.0	188.0	165.0	170.0	258.0	240.0	240.0
	Nm	0.4237	0.4731	0.4661	0.6567	0.749	0.7485	1.3276	1.1651	1.2005	1.8219	1.6948	1.6948
Rated Current	Amps	16.40	8.70	4.40	18.74	11.0	5.80	23.0	13.70	7.00	23.30	16.50	8.20
Rated Power	watts	328.0	363.0	368.0	407.0	502.0	489.0	459.0	575.0	592.0	460.0	694.0	696.0
Torque Sensitivity	oz-in/amp	4.19	8.90	17.20	5.24	9.92	21.0	9.20	13.80	27.70	12.40	16.60	33.20
	Nm/amp	0.0296	0.0628	0.1215	0.0370	0.0701	0.1483	0.0650	0.0974	0.1956	0.0876	0.1172	0.2344
Back EMF	volts/KRPM	3.10	6.50	12.80	3.88	7.34	15.50	6.83	10.20	20.50	9.20	12.30	24.50
	volts/rad/sec	0.0296	0.0628	0.1215	0.0370	0.070	0.1483	0.0650	0.0974	0.1956	0.0876	0.1172	0.2344
Terminal Resistance	ohms	0.069	0.251	0.941	0.057	0.147	0.575	0.069	0.147	0.552	0.086	0.135	0.504
Terminal Inductance	mH	0.129	0.575	2.180	0.143	0.430	1.570	0.200	0.450	1.800	0.271	0.482	1.930
Motor Constant	oz-in/sq.rt.watt	15.95	17.76	17.73	21.95	25.87	27.69	35.02	35.99	37.28	42.28	45.18	46.77
	Nm/sq.rt.watt	0.11264	0.12544	0.12521	0.15499	0.183	0.19556	0.24732	0.25417	0.26328	0.29859	0.31904	0.33023
Rotor Inertia	oz-in-sec^{2}x10^{-3}	6.00	6.00	6.00	12.00	12.00	12.00	18.00	18.00	18.00	24.00	24.00	24.00
	g-cm^2	423.4	423.4	423.4	846.8	846.8	846.8	1270.3	1270.3	1270.3	1693.7	1693.7	1693.7
Weight	oz	37.0	37.0	37.0	62.0	62.0	62.0	88.0	88.0	88.0	115.0	115.0	115.0
	g	1050.8	1050.8	1050.8	1760.8	1760.8	1760.8	2499.2	2499.2	2499.2	3266.0	3266.0	3266.0
# of Poles		8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Timing		120°	120°	120°	120°	120°	120°	120°	120°	120°	120°	120°	120°
Mech. Time Constant	ms	3.3	2.7	2.7	3.5	2.5	2.2	2.1	2.0	1.8	1.9	1.7	1.6
Electrical Time Constant	ms	1.87	2.29	2.32	2.51	2.90	2.73	2.90	3.06	3.26	3.15	3.57	3.83
Thermal Resistivity	deg. C/watt	1.6	1.5	1.5	2.5	1.84	1.2	1.1	1.0	1.0	1.1	0.8	0.8
Speed/Torque Gradient	rpm/oz-in	5.3	4.3	4.3	2.8	2.8	1.8	1.1	1.0	1.0	0.8	0.7	0.6

Notes:
1. Motor mounted to a 10" x 10" 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. Calculated (theoretical) speed/torque gradient.
6. For MS (military style) connector, please specify connector housing and terminal.
7. 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.

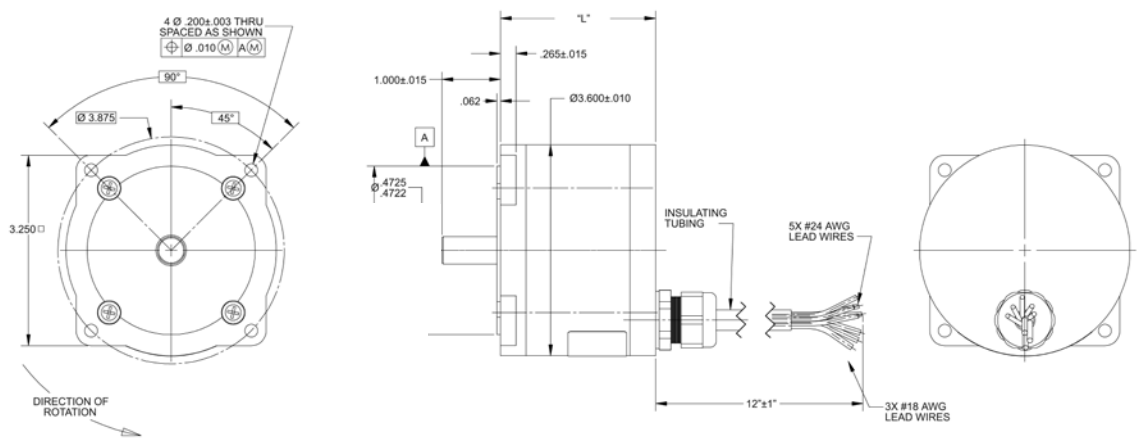
Select your options below and place their code in its corresponding block as shown on page 6.

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

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

O OTHER OPTIONS
D – Drive
E – Encoder
G – Gearhead

BN34 IP Typical Outline



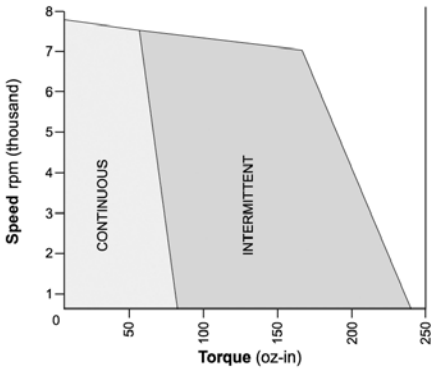
Termination Table

PIN COLOR	CONNECTION
YELLOW	V_{CC}
GRAY	GROUND
RED	A COIL
BLACK	B COIL
GREEN	C COIL
BLUE	S2 OUT
BROWN	S1 OUT
ORANGE	S3 OUT

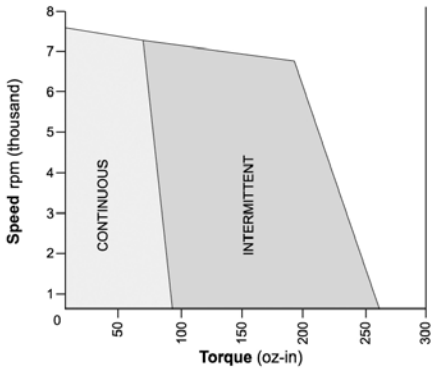
Dimensions are in inches

BN34 IP Performance Curves

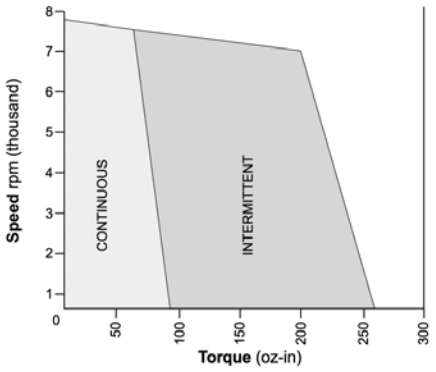
BN34-25IP-01: Continuous & Intermittent Operation at 24 Volt DC



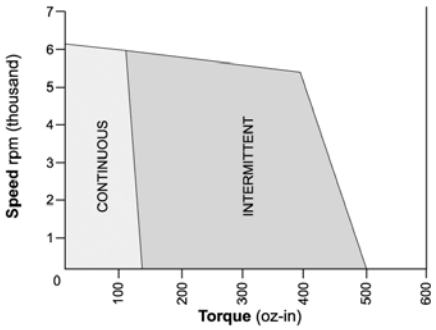
BN34-25IP-02: Continuous & Intermittent Operation at 50 Volt DC



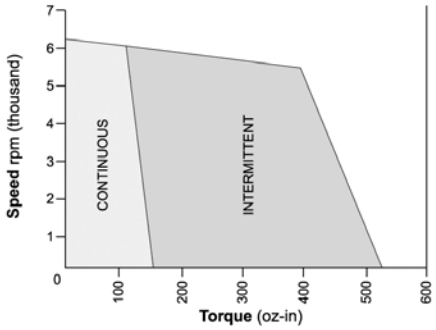
BN34-25IP-03: Continuous & Intermittent Operation at 100 Volt DC



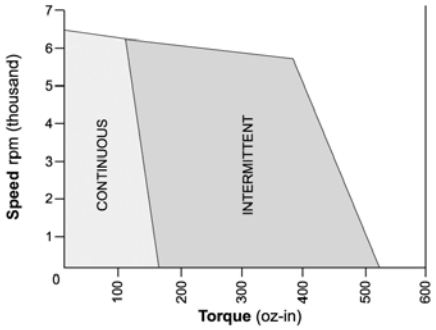
BN34-35IP-01: Continuous & Intermittent Operation at 24 Volt DC



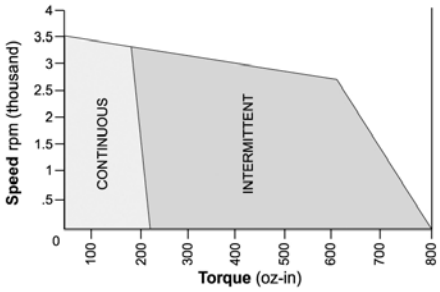
BN34-35IP-02: Continuous & Intermittent Operation at 50 Volt DC



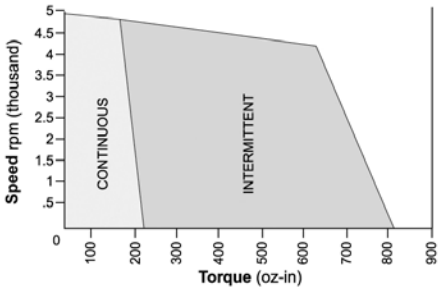
BN34-35IP-03: Continuous & Intermittent Operation at 100 Volt DC



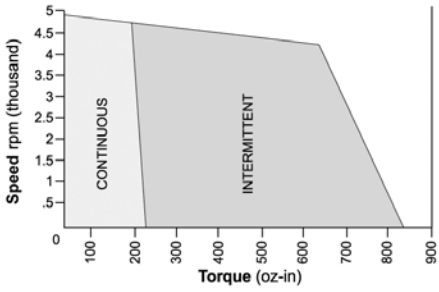
BN34-45IP-01: Continuous & Intermittent Operation at 24 Volt DC



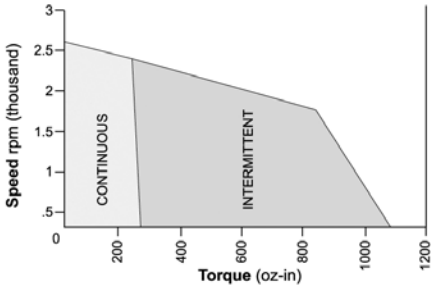
BN34-45IP-02: Continuous & Intermittent Operation at 50 Volt DC



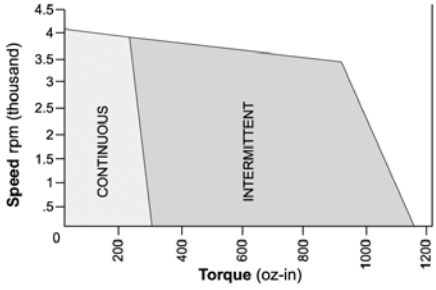
BN34-45IP-03: Continuous & Intermittent Operation at 100 Volt DC



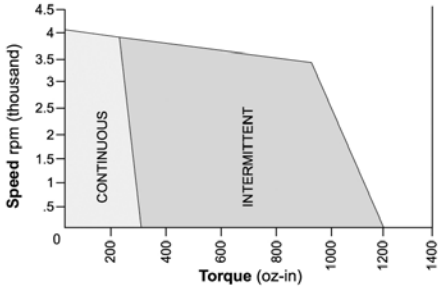
BN34-55IP-01: Continuous & Intermittent Operation at 24 Volt DC



BN34-55IP-02: Continuous & Intermittent Operation at 50 Volt DC



BN34-55IP-03: Continuous & Intermittent Operation at 100 Volt DC



Note: Intermittent operation is based on a 20% duty cycle of one minute on, four minutes off.
Please contact the factory regarding the duty cycle of your application.

BN42 SPECIFICATIONS -

Continuous Stall Torque 144 - 519 oz-in (1.02 - 3.67 Nm)
Peak Torque 609 - 2560 oz-in (4.30 - 18.1 Nm)

Part Number*		BN42-23AF- ☐☐ T F O			BN42-33AF- ☐☐ T F O			BN42-43AF- ☐☐ T F O			BN42-53AF- ☐☐ T F O		
Winding Code**		01	02	03	01	02	03	01	02	03	01	02	03
L = Length	inches	2.30			3.30			4.30			5.30		
	millimeters	58.4			83.8			109.2			134.6		
Terminal Voltage	volts DC	24.0	50.0	100.0	24.0	50.0	100.0	24.0	50.0	100.0	24.0	50.0	100.0
Peak Torque	oz-in	609.0	609.0	609.0	1248.0	1248.0	1248.0	1906.0	1906.0	1906.0	2560.0	2560.0	2560.0
	Nm	4.3005	4.3005	4.3005	8.8128	8.8128	8.8128	13.4592	13.4592	13.4592	18.0774	18.0774	18.0774
Continuous Stall Torque	oz-in	144.0	156.0	155.0	266.0	281.0	287.0	387.0	398.0	407.0	496.0	510.0	519.0
	Nm	1.0169	1.1016	1.0945	1.8784	1.9843	2.0267	2.7328	2.8105	2.8740	3.5025	3.6014	3.6649
Rated Speed	RPM	6050.0	5950.0	6140.0	3710.0	4710.0	4710.0	2380.0	3840.0	3840.0	1740.0	2820.0	2820.0
	rad/sec	634	623	643	389	493	493	249	402	402	182	295	295
Rated Torque	oz-in	102.0	113.0	110.0	213.0	198.0	200.0	340.0	290.0	296.0	451.0	413.0	419.0
	Nm	0.7203	0.7979	0.7768	1.5041	1.3982	1.4123	2.4009	2.0478	2.0902	3.1847	2.9164	2.9588
Rated Current	Amps	22.60	11.70	5.90	28.90	16.20	8.20	29.70	19.20	9.80	29.20	20.20	10.20
Rated Power	watts	456.0	497.0	499.0	584.0	690.0	697.0	598.0	824.0	841.0	580.0	861.0	874.0
Torque Sensitivity	oz-in/amp	5.20	11.00	21.40	8.41	14.00	28.00	12.90	17.20	34.30	17.40	23.10	46.30
	Nm/amp	0.0367	0.0777	0.1511	0.0594	0.0989	0.1977	0.0911	0.1215	0.2422	0.1229	0.1631	0.3269
Back EMF	volts/KRPM	3.80	8.20	15.80	6.22	10.40	20.70	9.52	12.70	25.40	12.80	17.10	34.20
	volts/rad/sec	0.0367	0.0777	0.1511	0.0594	0.0989	0.1977	0.0911	0.1215	0.2422	0.1229	0.1631	0.3269
Terminal Resistance	ohms	0.040	0.154	0.584	0.039	0.095	0.364	0.052	0.084	0.320	0.065	0.106	0.408
Terminal Inductance	mH	0.090	0.408	1.540	0.115	0.318	1.270	0.178	0.316	1.260	0.241	0.428	1.710
Motor Constant	oz-in/sq.rt.watt	26.00	28.03	28.00	42.59	45.42	46.41	56.57	59.35	60.63	68.25	70.95	72.49
	Nm/sq.rt.watt	0.18360	0.19794	0.19775	0.30072	0.32075	0.32772	0.39947	0.41907	0.42817	0.48194	0.50102	0.51186
Rotor Inertia	oz-in-sec^{2}x10^{-3}	18.00	18.00	18.00	35.00	35.00	35.00	52.00	52.00	52.00	70.00	70.00	70.00
	g-cm^2	1270.3	1270.3	1270.3	2470.0	2470.0	2470.0	3669.6	3669.6	3669.6	4939.9	4939.9	4939.9
Weight	oz	65.0	65.0	65.0	104.0	104.0	104.0	143.0	143.0	143.0	182.0	182.0	182.0
	g	1846.0	1846.0	1846.0	2953.6	2953.6	2953.6	4061.2	4061.2	4061.2	5168.8	5168.8	5168.8
# of Poles		8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Timing		120°	120°	120°	120°	120°	120°	120°	120°	120°	120°	120°	120°
Mech. Time Constant	ms	3.8	3.2	3.2	2.7	2.4	2.3	2.3	2.1	2.0	2.1	2.0	1.9
Electrical Time Constant	ms	2.25	2.65	2.64	2.95	3.35	3.49	3.42	3.76	3.94	3.71	4.04	4.19
Thermal Resistivity	deg. C/watt	1.2	1.2	1.2	1.0	0.9	0.9	0.9	0.8	0.8	0.9	0.7	0.7
Speed/Torque Gradient	rpm/oz-in	2.0	1.7	1.7	0.7	0.7	0.6	0.4	0.4	0.4	0.3	0.3	0.3

Notes:
1. Motor mounted to a 10" x 10" 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.

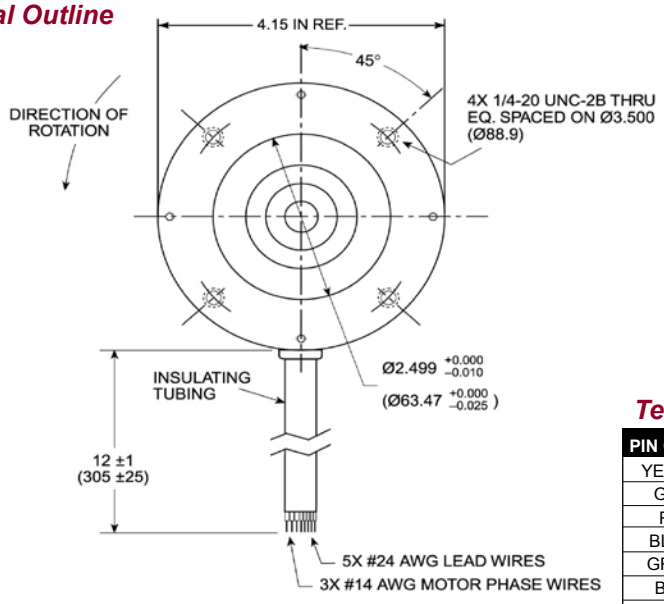
Select your options below and place their code in its corresponding block as shown on page 6.

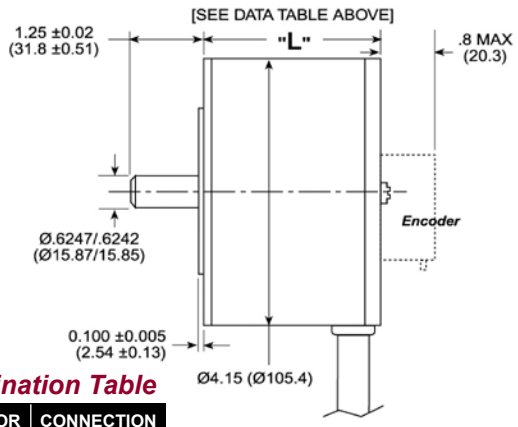
T TERMINATION
L – Leads (std)
C – Connector
M – MS connector

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

O OTHER OPTIONS
D – Drive
E – Encoder
G – Gearhead

BN42 Typical Outline





Termination Table

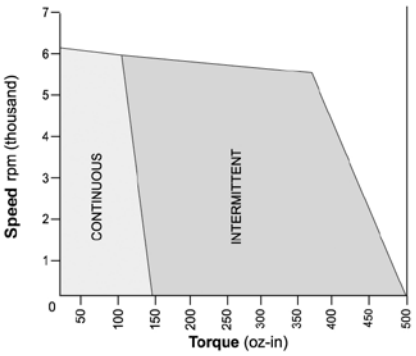
PIN COLOR	CONNECTION
YELLOW	V_{CC}
GRAY	GROUND
RED	A COIL
BLACK	B COIL
GREEN	C COIL
BLUE	S2 OUT
BROWN	S1 OUT
ORANGE	S3 OUT

Dimensions are in inches (millimeters)

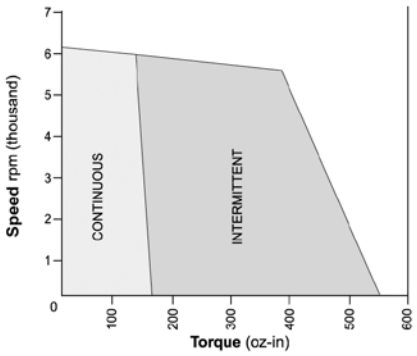
Note: An optional 4.15 (105.4) square front end cap is available.

BN42 Performance Curves

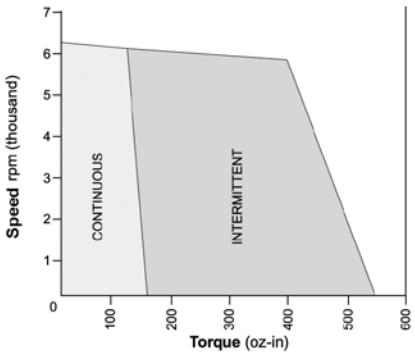
BN42-23AF-01: Continuous & Intermittent Operation at 24 Volt DC



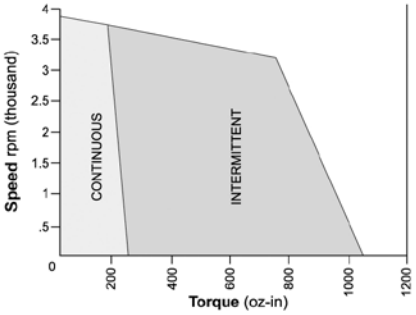
BN42-23AF-02: Continuous & Intermittent Operation at 50 Volt DC



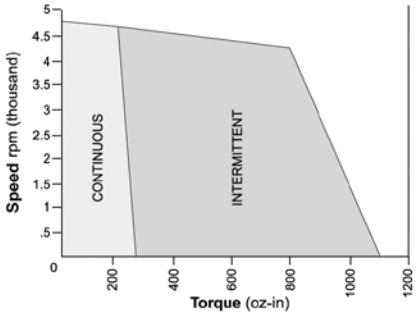
BN42-23AF-03: Continuous & Intermittent Operation at 100 Volt DC



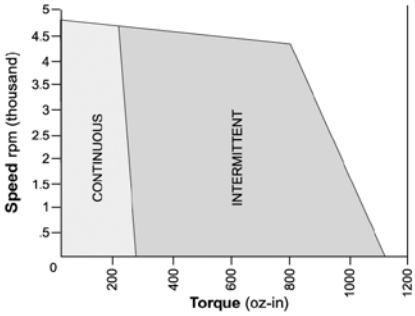
BN42-33AF-01: Continuous & Intermittent Operation at 24 Volt DC



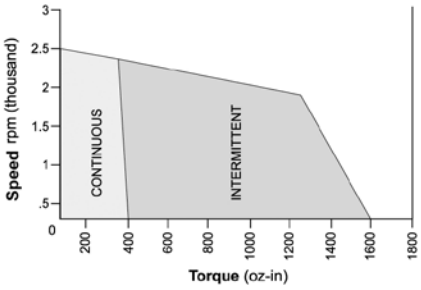
BN42-33AF-02: Continuous & Intermittent Operation at 50 Volt DC



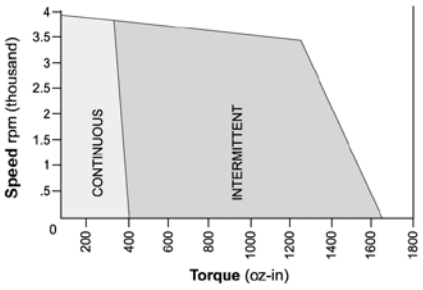
BN42-33AF-03: Continuous & Intermittent Operation at 100 Volt DC



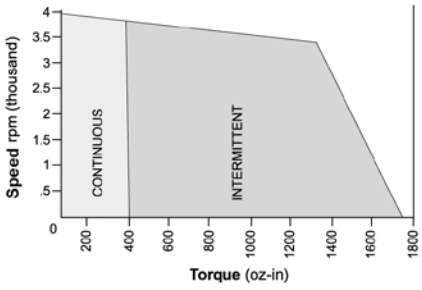
BN42-43AF-01: Continuous & Intermittent Operation at 24 Volt DC



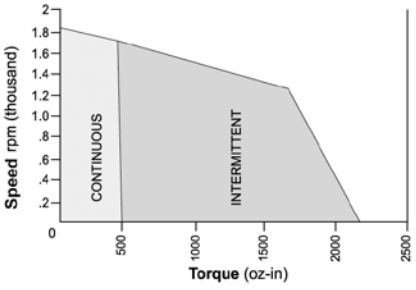
BN42-43AF-02: Continuous & Intermittent Operation at 50 Volt DC



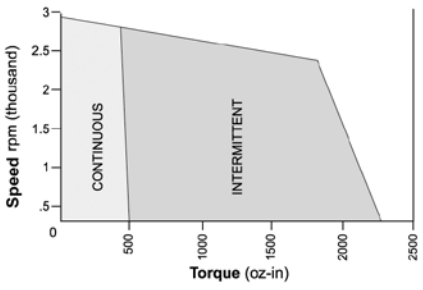
BN42-43AF-03: Continuous & Intermittent Operation at 100 Volt DC



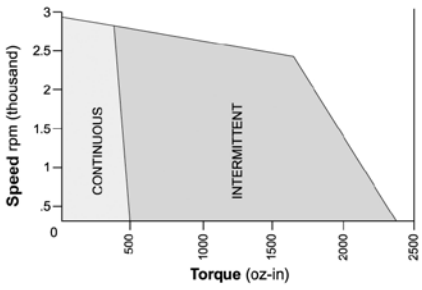
BN42-53AF-01: Continuous & Intermittent Operation at 24 Volt DC



BN42-53AF-02: Continuous & Intermittent Operation at 50 Volt DC



BN42-53AF-03: Continuous & Intermittent Operation at 100 Volt DC



Note: Intermittent operation is based on a 20% duty cycle of one minute on, four minutes off.
Please contact the factory regarding the duty cycle of your application.

BN42 EU SPECIFICATIONS -

Continuous Stall Torque 144 - 519 oz-in (1.02 - 3.67 Nm)
Peak Torque 609 - 2560 oz-in (4.30 - 18.1 Nm)

Part Number*		BN42-23EU- ☐☐ T F O			BN42-33EU- ☐☐ T F O			BN42-43EU- ☐☐ T F O			BN42-53EU- ☐☐ T F O		
Winding Code**		01	02	03	01	02	03	01	02	03	01	02	03
L = Length	inches	2.30			3.30			4.30			5.30		
	millimeters	58.5			83.9			109.3			134.7		
Terminal Voltage	volts DC	24	50	100	24	50	100	24	50	100	24	50	100
Peak Torque	oz-in	609	609	609	1248	1248	1248	1906	1906	1906	2560	2560	2560
	Nm	4.30	4.30	4.30	8.82	8.82	8.82	13.5	13.5	13.5	18.1	18.1	18.1
Continuous Stall Torque	oz-in	144	156	155	266	281	287	387	398	407	496	510	519
	Nm	1.02	1.11	1.10	1.88	1.99	2.03	2.74	2.81	2.88	3.51	3.61	3.67
Rated Speed	RPM	6050	5950	6140	3710	4710	4710	2380	3840	3840	1740	2820	2820
	rad/sec	634	623	643	389	494	494	250	403	403	183	296	296
Rated Torque	oz-in	102	113	110	213	198	200	340	290	296	451	413	419
	Nm	0.721	0.798	0.777	1.51	1.40	1.42	2.41	2.05	2.09	3.19	2.92	2.96
Rated Current	Amps	22.6	11.7	5.9	28.9	16.2	8.2	29.7	19.2	9.8	29.2	20.2	10.2
Rated Power	watts	456	497	499	584	690	697	598	824	841	580	861	874
Torque Sensitivity	oz-in/amp	5.20	11.0	21.4	8.41	14.0	28.0	12.9	17.2	34.3	17.4	23.1	46.3
	Nm/amp	0.0363	0.0783	0.151	0.0594	0.0992	0.198	0.0909	0.122	0.243	0.123	0.164	0.327
Back EMF	volts/KRPM	3.80	8.20	15.8	6.22	10.4	20.7	9.52	12.7	25.4	12.8	17.1	34.2
	volts/rad/sec	0.0363	0.0783	0.151	0.0594	0.0992	0.198	0.0909	0.122	0.243	0.123	0.164	0.327
Terminal Resistance	ohms	0.040	0.154	0.584	0.039	0.095	0.364	0.052	0.084	0.320	0.065	0.106	0.408
Terminal Inductance	mH	0.090	0.408	1.54	0.115	0.318	1.27	0.178	0.316	1.26	0.241	0.428	1.71
Motor Constant	oz-in/sq.rt.watt	27.8	28.6	28.2	45.7	46.8	46.8	59.5	61.2	61.1	71.0	73.0	72.9
	Nm/sq.rt.watt	0.197	0.202	0.199	0.323	0.331	0.331	0.421	0.433	0.432	0.502	0.516	0.515
Rotor Inertia	oz-in-sec^2	0.018	0.018	0.018	0.035	0.035	0.035	0.052	0.052	0.052	0.070	0.070	0.070
	g-cm^2	1271	1271	1271	2472	2472	2472	3672	3672	3672	4943	4943	4943
Weight	oz	65	65	65	104	104	104	143	143	143	182	182	182
	g	1843	1843	1843	2949	2949	2949	4054	4054	4054	5160	5160	5160

Notes:
1. Motor mounted to a 10" x 10" 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.

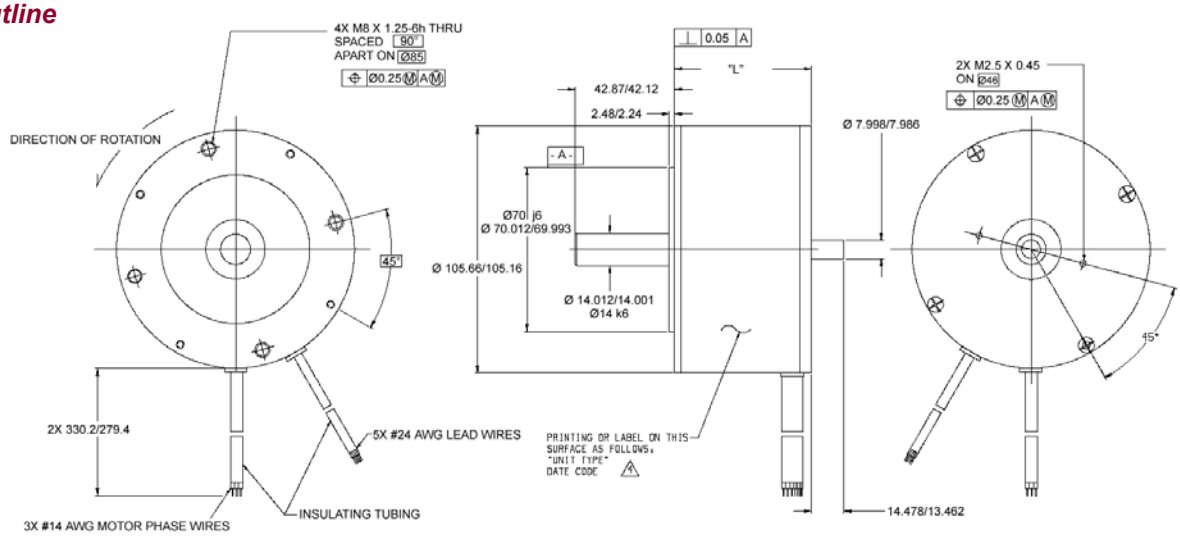
Select your options below and place their code in its corresponding block as shown on page 6.

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

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

O OTHER OPTIONS
D – Drive
E – Encoder
G – Gearhead

BN42 EU Typical Outline



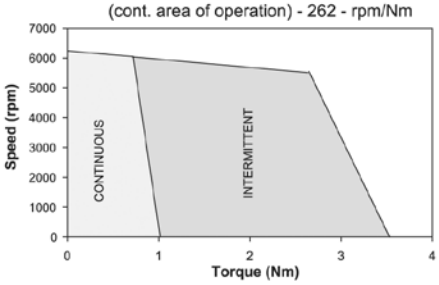
Dimensions are in inches

Termination Table

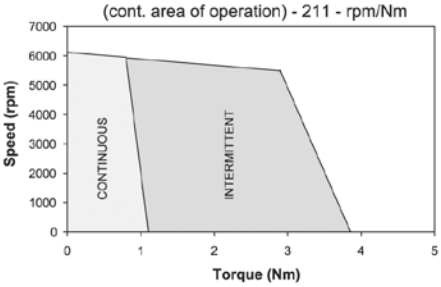
PIN COLOR	CONNECTION
YELLOW	V_{CC}
GRAY	GROUND
RED	A COIL
BLACK	B COIL
GREEN	C COIL
BLUE	S2 OUT
BROWN	S1 OUT
ORANGE	S3 OUT

BN42 EU Performance Curves

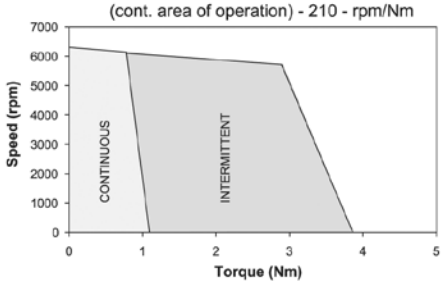
BN42-23EU-01LH: Speed/Torque Gradient - (cont. area of operation) - 262 - rpm/Nm



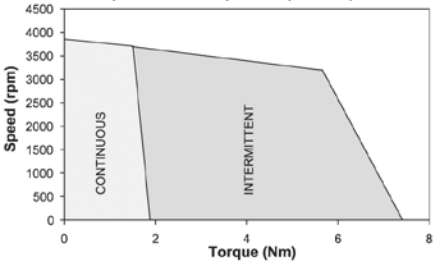
BN42-23EU-02LH: Speed/Torque Gradient - (cont. area of operation) - 211 - rpm/Nm



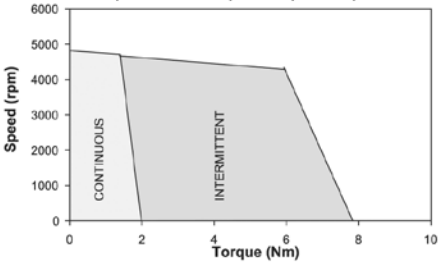
BN42-23EU-03LH: Speed/Torque Gradient - (cont. area of operation) - 210 - rpm/Nm



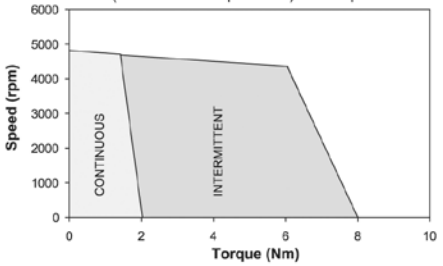
BN42-33EU-01LH: Speed/Torque Gradient - (cont. area of operation) - 96 - rpm/Nm



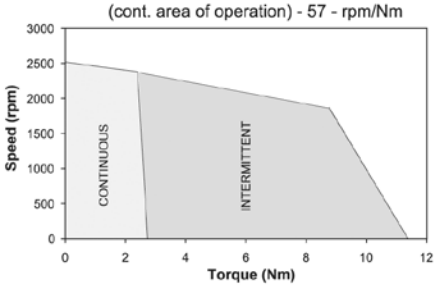
BN42-33EU-02LH: Speed/Torque Gradient - (cont. area of operation) - 79 - rpm/Nm



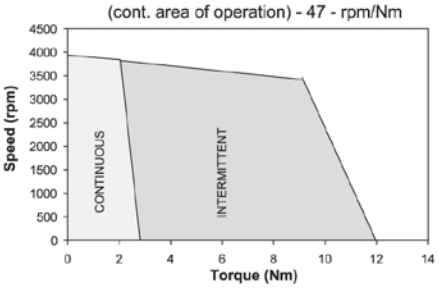
BN42-33EU-03LH: Speed/Torque Gradient - (cont. area of operation) - 79 - rpm/Nm



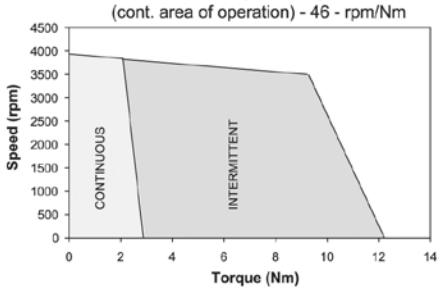
BN42-43EU-01LH: Speed/Torque Gradient - (cont. area of operation) - 57 - rpm/Nm



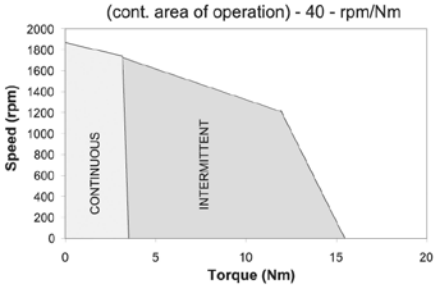
BN42-43EU-02LH: Speed/Torque Gradient - (cont. area of operation) - 47 - rpm/Nm



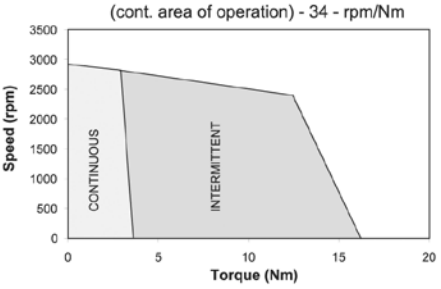
BN42-43EU-03LH: Speed/Torque Gradient - (cont. area of operation) - 46 - rpm/Nm



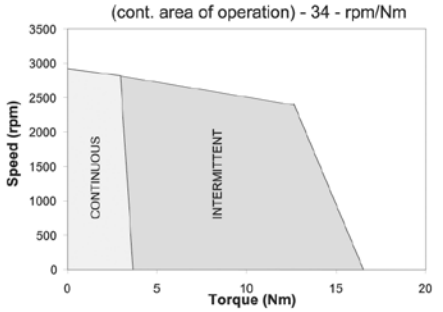
BN42-53EU-01LH: Speed/Torque Gradient - (cont. area of operation) - 40 - rpm/Nm



BN42-53EU-02LH: Speed/Torque Gradient - (cont. area of operation) - 34 - rpm/Nm



BN42-53EU-03LH: Speed/Torque Gradient - (cont. area of operation) - 34 - rpm/Nm



Note: Intermittent operation is based on a 20% duty cycle of one minute on, four minutes off. Please contact the factory regarding the duty cycle of your application.

BN42 IP SPECIFICATIONS -

Continuous Stall Torque 144 - 519 oz-in (1.02 - 3.67 Nm)
Peak Torque 609 - 2560 oz-in (4.30 - 18.1 Nm)

Part Number*		BN42-23IP - □□ T F O			BN42-33IP - □□ T F O			BN42-43IP - □□ T F O			BN42-53IP - □□ T F O		
Winding Code**		01	02	03	01	02	03	01	02	03	01	02	03
L = Length	inches	2.30			3.30			4.30			5.30		
	millimeters	58.4			83.8			109.2			134.6		
Terminal Voltage	volts DC	24.0	50.0	100.0	24.0	50.0	100.0	24.0	50.0	100.0	24.0	50.0	100.0
Peak Torque	oz-in	609.0	609.0	609.0	1248.0	1248.0	1248.0	1906.0	1906.0	1906.0	2560.0	2560.0	2560.0
	Nm	4.3005	4.3005	4.3005	8.8128	8.8128	8.8128	13.4592	13.4592	13.4592	18.0774	18.0774	18.0774
Continuous Stall Torque	oz-in	144.0	156.0	155.0	266.0	281.0	287.0	387.0	398.0	407.0	496.0	510.0	519.0
	Nm	1.0169	1.1016	1.0945	1.8784	1.9843	2.0267	2.7328	2.8105	2.8740	3.5025	3.6014	3.6649
Rated Speed	RPM	6050.0	5950.0	6140.0	3710.0	4710.0	4710.0	2380.0	3840.0	3840.0	1740.0	2820.0	2820.0
	rad/sec	634	623	643	389	493	493	249	402	402	182	295	295
Rated Torque	oz-in	102.0	113.0	110.0	213.0	198.0	200.0	340.0	290.0	296.0	451.0	413.0	419.0
	Nm	0.7203	0.7979	0.7768	1.5041	1.3982	1.4123	2.4009	2.0478	2.0902	3.1847	2.9164	2.9588
Rated Current	Amps	22.60	11.70	5.90	28.90	16.20	8.20	29.70	19.20	9.80	29.20	20.20	10.20
Rated Power	watts	456.0	497.0	499.0	584.0	690.0	697.0	598.0	824.0	841.0	580.0	861.0	874.0
Torque Sensitivity	oz-in/amp	5.20	11.00	21.40	8.41	14.00	28.00	12.90	17.20	34.30	17.40	23.10	46.30
	Nm/amp	0.0367	0.0777	0.1511	0.0594	0.0989	0.1977	0.0911	0.1215	0.2422	0.1229	0.1631	0.3269
Back EMF	volts/KRPM	3.80	8.20	15.80	6.22	10.40	20.70	9.52	12.70	25.40	12.80	17.10	34.20
	volts/rad/sec	0.0367	0.0777	0.1511	0.0594	0.0989	0.1977	0.0911	0.1215	0.2422	0.1229	0.1631	0.3269
Terminal Resistance	ohms	0.040	0.154	0.584	0.039	0.095	0.364	0.052	0.084	0.320	0.065	0.106	0.408
Terminal Inductance	mH	0.090	0.408	1.540	0.115	0.318	1.270	0.178	0.316	1.260	0.241	0.428	1.710
Motor Constant	oz-in/sq.rt.watt	26.00	28.03	28.00	42.59	45.42	46.41	56.57	59.35	60.63	68.25	70.95	72.49
	Nm/sq.rt.watt	0.18360	0.19794	0.19775	0.30072	0.32075	0.32772	0.39947	0.41907	0.42817	0.48194	0.50102	0.51186
Rotor Inertia	oz-in-sec^{2}x10^{-3}	18.00	18.00	18.00	35.00	35.00	35.00	52.00	52.00	52.00	70.00	70.00	70.00
	g-cm^2	1270.3	1270.3	1270.3	2470.0	2470.0	2470.0	3669.6	3669.6	3669.6	4939.9	4939.9	4939.9
Weight	oz	65.0	65.0	65.0	104.0	104.0	104.0	143.0	143.0	143.0	182.0	182.0	182.0
	g	1846.0	1846.0	1846.0	2953.6	2953.6	2953.6	4061.2	4061.2	4061.2	5168.8	5168.8	5168.8
# of Poles		8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Timing		120°	120°	120°	120°	120°	120°	120°	120°	120°	120°	120°	120°
Mech. Time Constant	ms	3.8	3.2	3.2	2.7	2.4	2.3	2.3	2.1	2.0	2.1	2.0	1.9
Electrical Time Constant	ms	2.25	2.65	2.64	2.95	3.35	3.49	3.42	3.76	3.94	3.71	4.04	4.19
Thermal Resistivity	deg. C/watt	1.2	1.2	1.2	1.0	0.9	0.9	0.9	0.8	0.8	0.9	0.7	0.7
Speed/Torque Gradient	rpm/oz-in	2.0	1.7	1.7	0.7	0.7	0.6	0.4	0.4	0.4	0.3	0.3	0.3

Notes:
1. Motor mounted to a 10" x 10" 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. Calculated (theoretical) speed/torque gradient.
6. For MS (military style) connector, please specify connector housing and terminal.
7. 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.

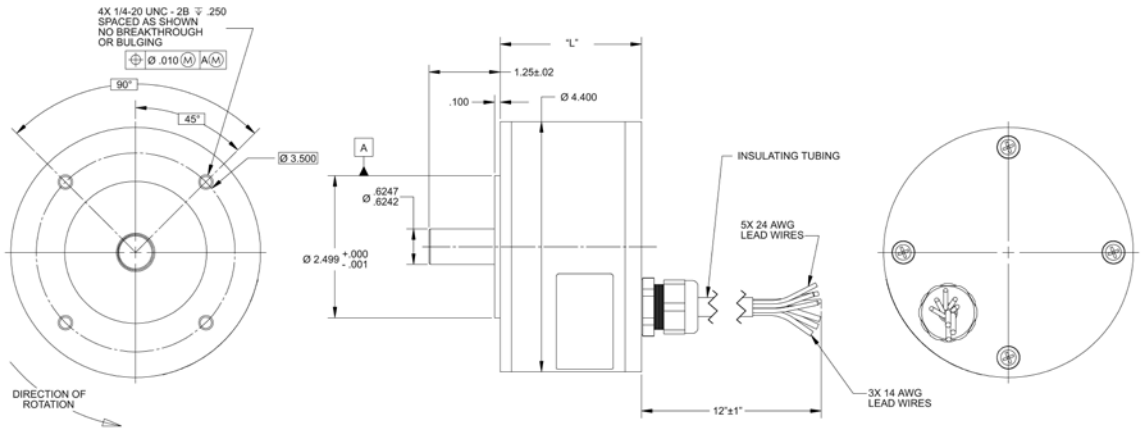
Select your options below and place their code in its corresponding block as shown on page 6.

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

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

O OTHER OPTIONS
D – Drive
E – Encoder
G – Gearhead

BN42 Typical Outline



Termination Table

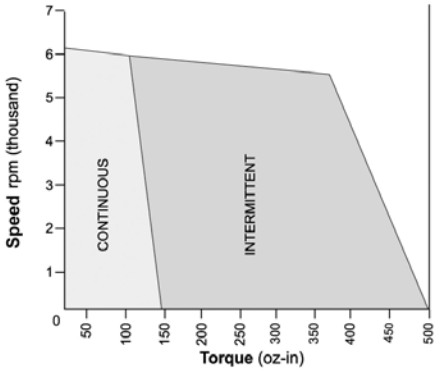
PIN COLOR	CONNECTION
YELLOW	V_{CC}
GRAY	GROUND
RED	A COIL
BLACK	B COIL
GREEN	C COIL
BLUE	S2 OUT
BROWN	S1 OUT
ORANGE	S3 OUT

Dimensions are in inches

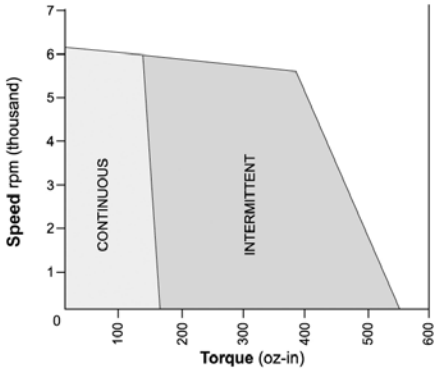
Note: An optional 4.15 (105.4) square front end cap is available.

BN42 IP Performance Curves

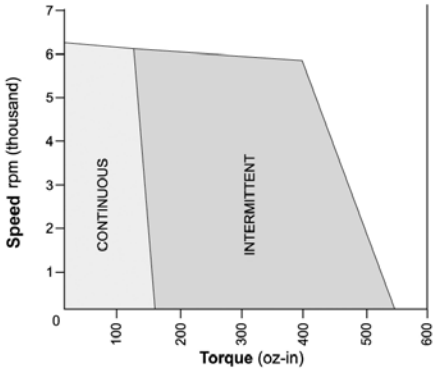
BN42-23IP-01: Continuous & Intermittent Operation at 24 Volt DC



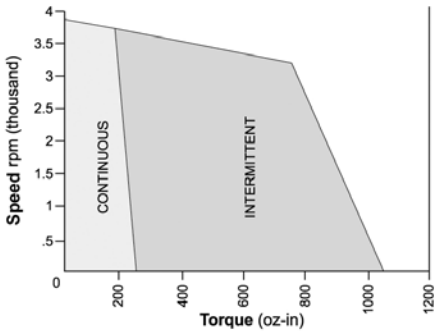
BN42-23IP-02: Continuous & Intermittent Operation at 50 Volt DC



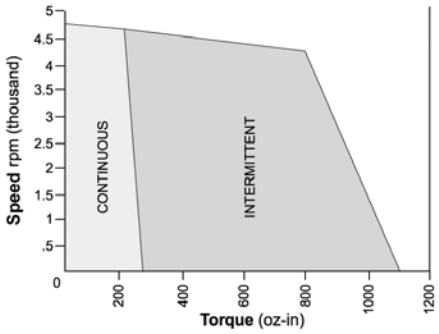
BN42-23IP-03: Continuous & Intermittent Operation at 100 Volt DC



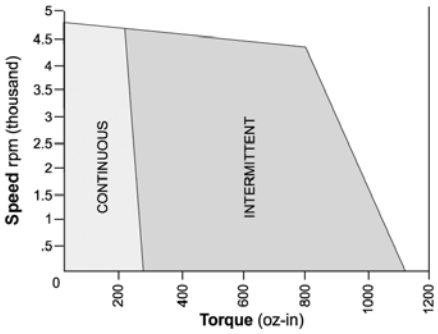
BN42-33IP-01: Continuous & Intermittent Operation at 24 Volt DC



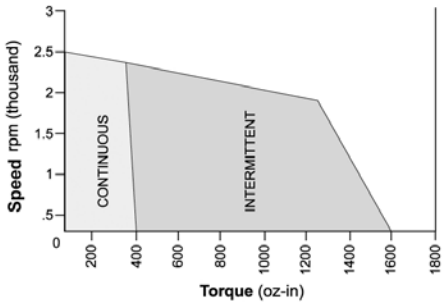
BN42-33IP-02: Continuous & Intermittent Operation at 50 Volt DC



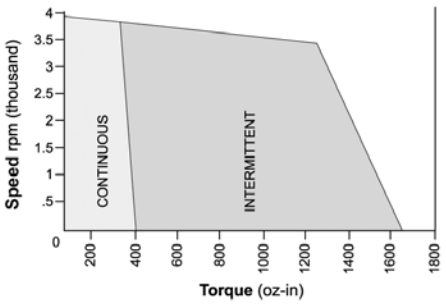
BN42-33IP-03: Continuous & Intermittent Operation at 100 Volt DC



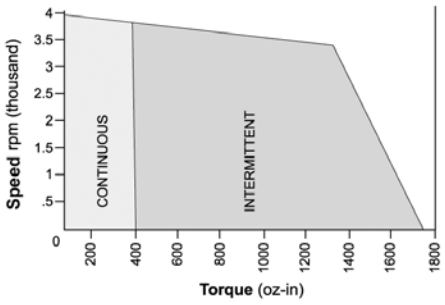
BN42-43IP-01: Continuous & Intermittent Operation at 24 Volt DC



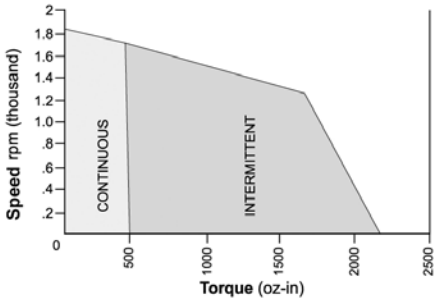
BN42-43IP-02: Continuous & Intermittent Operation at 50 Volt DC



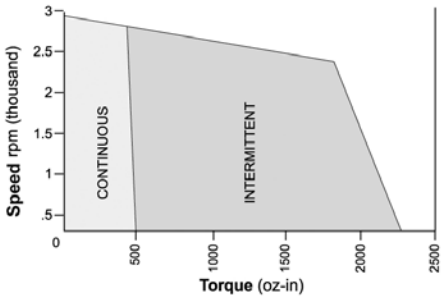
BN42-43IP-03: Continuous & Intermittent Operation at 100 Volt DC



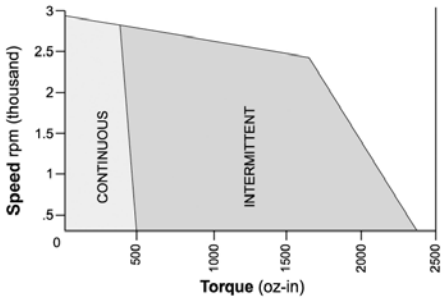
BN42-53IP-01: Continuous & Intermittent Operation at 24 Volt DC



BN42-53IP-02: Continuous & Intermittent Operation at 50 Volt DC



BN42-53IP-03: Continuous & Intermittent Operation at 100 Volt DC



Note: Intermittent operation is based on a 20% duty cycle of one minute on, four minutes off.
Please contact the factory regarding the duty cycle of your application.

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 motor data table for standard offerings. 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

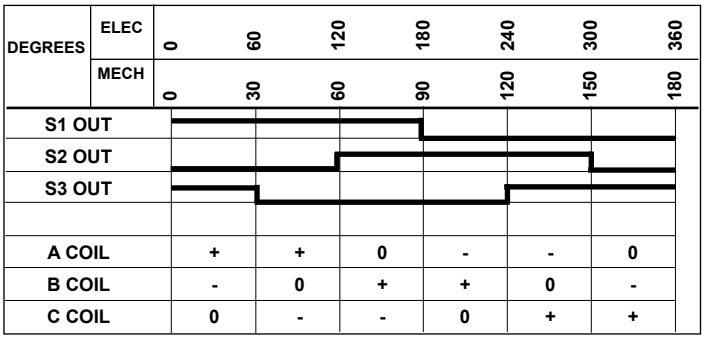
FEEDBACK OPTIONS

OTHER OPTIONS

Conversion Table

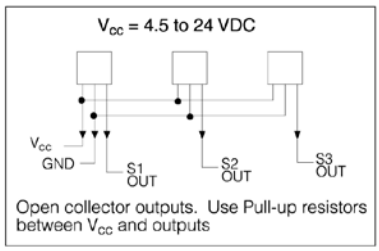
FROM	TO	MULTIPLY BY
Length		
inches	cm	2.540
feet	cm	30.48
cm	inches	.3937
cm	feet	3.281×10^{-2}
Mass		
oz	g	28.35
lb	g	453.6
g	oz	3.527×10^{-2}
lb	oz	16.0
g	lb	2.205×10^{-3}
oz	lb	6.250×10^{-2}
Torque		
oz-in	g-cm	72.01
lb-ft	g-cm	1.383×10^{4}
g-cm	oz-in	1.389×10^{-2}
lb-ft	oz-in	192.0
g-cm	lb-ft	7.233×10^{-5}
oz-in	lb-ft	5.208×10^{-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	1.745×10^{-2}
rpm	rad / sec	.1047
Moment Of Inertia		
oz-in^2	g-cm^2	182.9
lb-ft^2	g-cm^2	4.214×10^{5}
g-cm^2	oz-in^2	5.467×10^{-3}
lb-ft^2	oz-in^2	2.304×10^{3}
g-cm^2	lb-ft^2	2.373×10^{-6}
oz-in^2	lb-ft^2	4.340×10^{-4}
oz-in-sec^2	g-cm^2	7.062×10^{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	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^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	4.0	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[1]	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:
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.

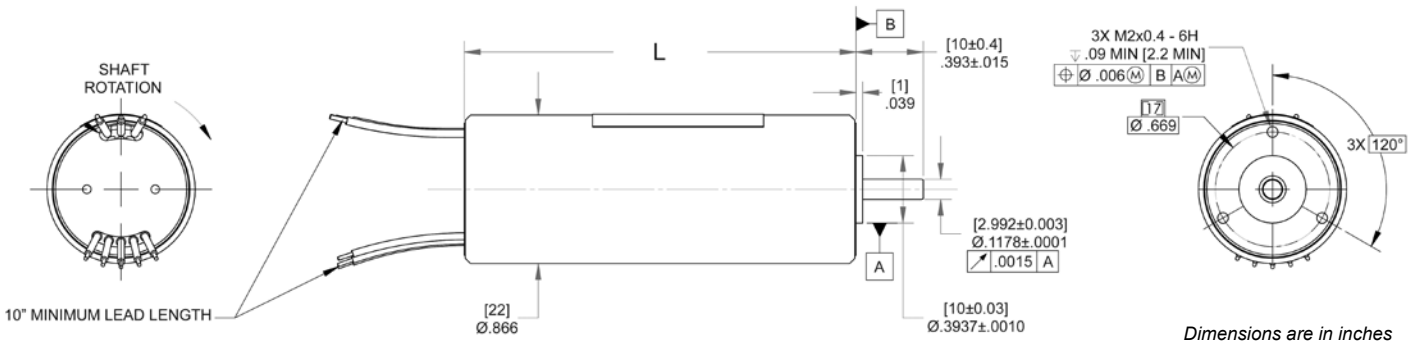
Select your options below and place their code in its corresponding block as shown on page 44.

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

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

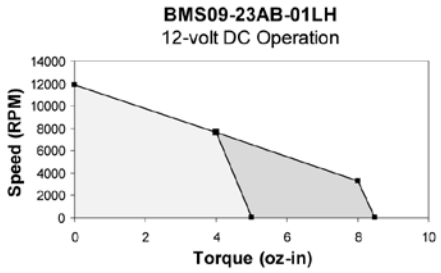
O OTHER OPTIONS

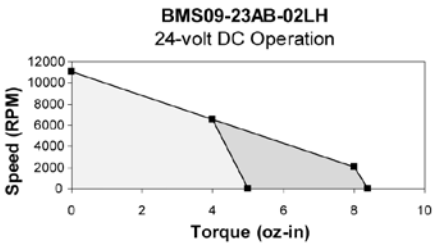
BMS09 Typical Outline

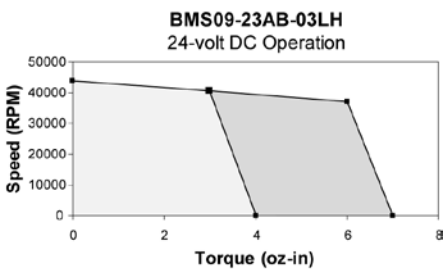


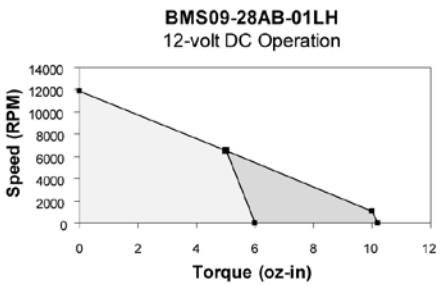
Dimensions are in inches

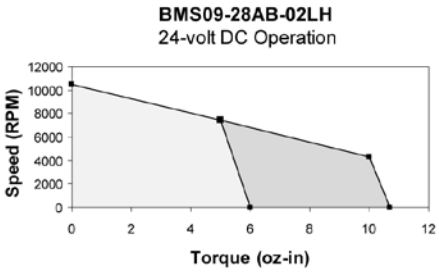
BMS09 Performance Curves

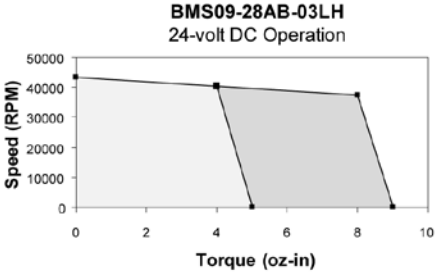












BSS09 SPECIFICATIONS -

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	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.^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[1]	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:
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.

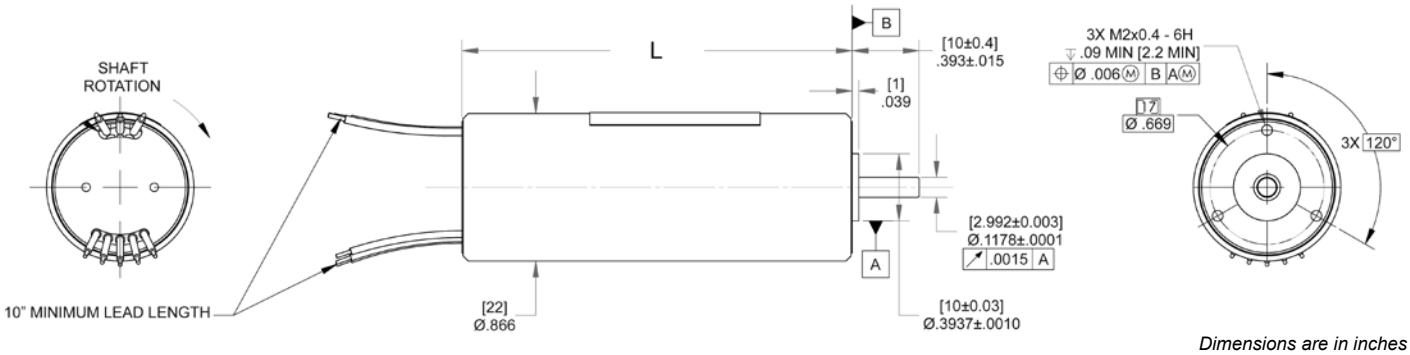
Select your options below and place their code in its corresponding block as shown on page 44.

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

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

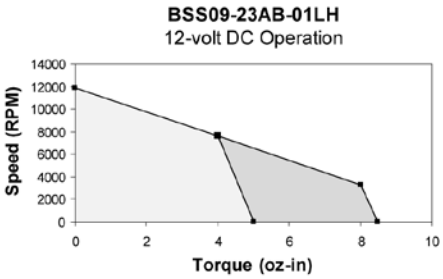
O OTHER OPTIONS

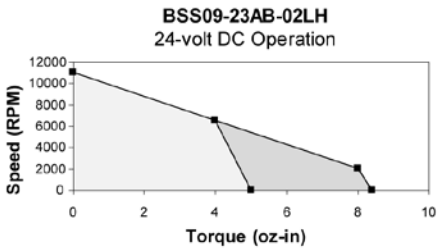
BSS09 Typical Outline

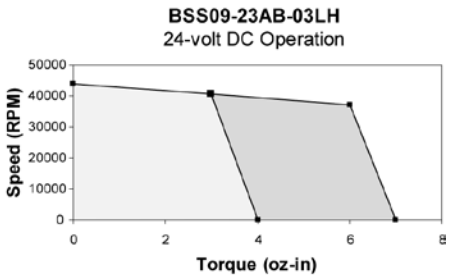


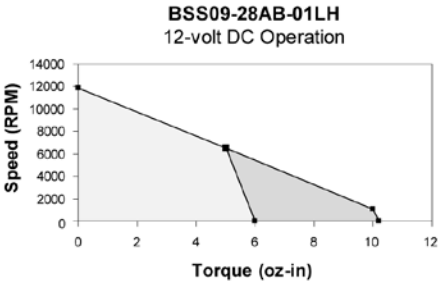
Dimensions are in inches

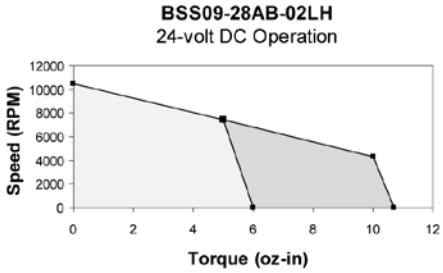
BSS09 Performance Curves

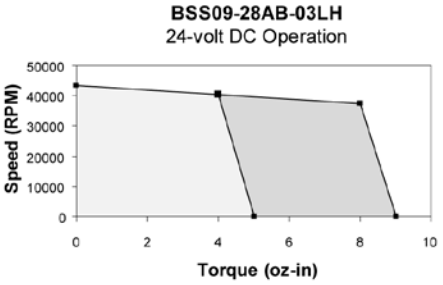












Silencer® Series Brushless DC Motors

BN12, 23 and 34 High Speed

TYPICAL APPLICATIONS

- Medical equipment - pumps, blowers and centrifuges
- Scanners
- Packaging equipment and printing products
- HVAC equipment (air handling)

FEATURES

- 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

BENEFITS

- Operation at any single speed - not limited to AC frequency
- Motor life is not limited to brush or commutator life
- An essentially linear speed / torque curve
- Efficient operation without losses associated with brushes and commutation or armature induction
- Precise, variable speed control
- Extremely quiet operation
- Long-life operation

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
- Hewlett Packard HEDS-5500 encoder standard, other configurations and resolutions available

SILENCER BRUSHLESS MOTOR DRIVES

Optimized for use with Silencer Brushless DC motors, these drives provide:

- Multiple operating modes - commutation, velocity, torque, 2 and 4 quadrant
- Feedback using Hall effect sensor or encoder
- Efficient PWM speed control
- CE approved for European applications
- Low cost
- Operating temperatures from -10° to 45°C

High Speed Brushless Motors

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.

Reliable, Low-Cost Operation

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.

For more information about how this product can be tailored to fit your specific application, contact our applications engineers.

SPECIFICATION AND NUMBERING SYSTEM

Part Numbering System Guide

BN □□HS – □□ □□ – □□ T F O

BRUSHLESS MOTOR

MAGNET TYPE
N – Bonded Neo

FRAME COMMERCIAL DC MOTOR
12 – Size 12
23 – Size 23
34 – Size 34

MOTOR LENGTH
Refer to motor data table for standard offerings.

MECHANICAL OPTIONS
Refer to motor data table for standard offerings. 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

BN12HS SPECIFICATIONS - *Continuous Stall Torque 1.2 - 4.5 oz-in (0.0088 - 0.0318 Nm)*
Peak Torque 5 - 27 oz-in (0.0353 - 0.1907 Nm)

Part Number*		BN12HS-13AF-□□TFO			BN12HS-18AF-□□TFO			BN12HS-23AF-□□TFO			BN12HS-28AF-□□TFO		
Winding Code**		01	02	03	01	02	03	01	02	03	01	02	03
L = Length	inches	1.30			1.80			2.30			2.80		
	millimeters	33.0			45.7			58.4			71.1		
Terminal Voltage	volts DC	12.0	24.0	36.0	12.0	24.0	36.0	12.0	24.0	36.0	12.0	24.0	36.0
Peak Torque	oz-in	5.0	5.0	5.0	11.0	11.0	12.0	18.0	20.0	20.0	27.0	27.0	27.0
	Nm	0.0353	0.0353	0.0353	0.0777	0.0777	0.0847	0.1271	0.1412	0.1412	0.1907	0.1907	0.1907
Continuous Stall Torque	oz-in	1.2	1.3	1.3	2.0	2.0	2.0	3.2	3.6	3.6	4.3	4.4	4.5
	Nm	0.0088	0.0092	0.0092	0.0141	0.0141	0.0141	0.0229	0.0254	0.0254	0.0304	0.0311	0.0318
Rated Speed	RPM	26000.00	35670.0	27570.0	23520.0	22800.0	24520.0	19650.0	20500.0	22740.0	20050.0	20270.0.0	18450.0
	rad/sec	2723	3735	2887	2463	2388	2568	2058	2147	2381	2100	2123	1932
Rated Torque	oz-in	1.2	1.2	1.2	2.0	2.0	2.0	3.0	3.3	3.3	3.9	4.0	4.2
	Nm	0.0085	0.0083	0.0083	0.0138	0.0141	0.0141	0.0212	0.0233	0.0233	0.0275	0.0282	0.0297
Rated Current	Amps	2.50	1.40	1.00	3.90	2.00	1.40	5.00	2.70	2.00	6.30	3.20	2.10
Rated Power	watts	21.00	22.0	24.00	34.0	34.0	37.0	44.0	50.0	55.0	58.0	60.0	57.0
Torque Sensitivity	oz-in/amp	0.44	0.89	1.27	0.51	1.05	1.50	0.62	1.25	1.72	0.64	1.28	2.07
	Nm/amp	0.0031	0.0063	0.0090	0.0036	0.0074	0.0106	0.0044	0.0088	0.0121	0.0045	0.0090	0.0146
Back EMF	volts/KRPM	0.32	0.66	0.94	0.38	0.78	1.11	0.46	0.92	1.27	0.48	0.95	1.53
	volts/rad/sec	0.0031	0.0063	0.0090	0.0036	0.0074	0.0106	0.0044	0.0088	0.0121	0.0045	0.0090	0.0146
Terminal Resistance	ohms	0.92	3.69	7.45	0.56	2.25	4.52	0.42	1.32	2.54	0.28	1.04	2.63
Terminal Inductance	mH	0.27	1.11	2.28	0.17	0.70	1.43	0.14	0.54	1.01	0.10	0.42	1.08
Motor Constant	oz-in/sq.rt.watt	0.46	0.46	0.47	0.68	0.70	0.71	0.96	1.09	1.08	1.21	1.26	1.28
	Nm/sq.rt.watt	0.00324	0.00327	0.00329	0.00481	0.00494	0.00498	0.00676	0.00768	0.00762	0.00854	0.00886	0.00901
Rotor Inertia	oz-in-sec^{2}x10^{-3}	0.02	0.02	0.02	0.04	0.04	0.04	0.06	0.06	0.06	0.08	0.08	0.08
	g-cm^2	1.4	1.4	1.4	2.8	2.8	2.8	4.0	4.2	4.2	5.4	5.6	5.6
Weight	oz	5.0	5.0	5.0	6.0	6.0	6.0	7.0	7.0	7.0	9.0	9.0	9.0
	g	142.0	142.0	142.0	170.4	170.4	170.4	198.8	198.8	198.8	255.6	255.6	255.6
# of Poles		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Timing		120°	120°	120°	120°	120°	120°	120°	120°	120°	120°	120°	120°
Mech. Time Constant	ms	13.5	13.2	13.1	12.2	11.6	11.4	8.8	7.2	7.3	7.4	7.2	6.9
Electrical Time Constant	ms	0.29	0.30	0.31	0.30	0.31	0.32	0.33	0.41	0.40	0.36	0.40	0.41
Thermal Resistivity	deg. C/watt	15.2	42.5	8.8	8.2	7.4	7.4	6.4	7.1	6.4	5.9	6.2	5.7
Speed/Torque Gradient	rpm/oz-in	6534.1	6281.9	6240.6	2889.6	2747.3	2714.7	1472.7	1147.8	1162.8	911.5	855.3	830.4

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 an applications engineer.
5. For MS (military style) connector, please specify connector housing and terminal.
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*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 above.

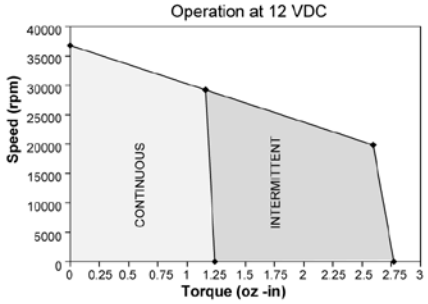
T TERMINATION
L – Leads (std)
C – Connector
M – MS Connector

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

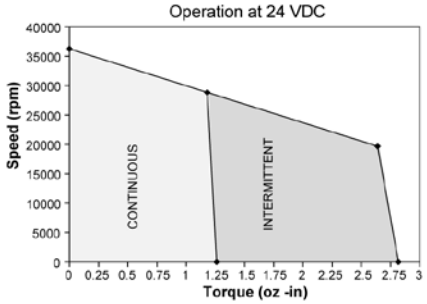
O OTHER OPTIONS
D – Drive
E – Encoder
G – Gearhead

BN12 Performance Curves

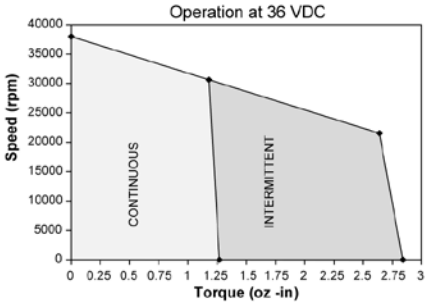
BN12HS-13AF-01: Continuous and Intermittent Operation at 12 VDC



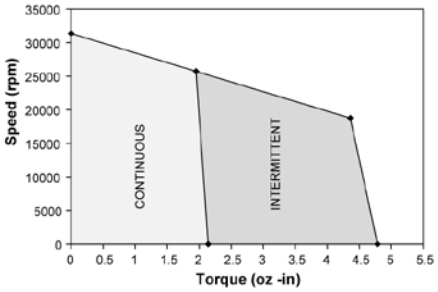
BN12HS-13AF-02: Continuous and Intermittent Operation at 24 VDC



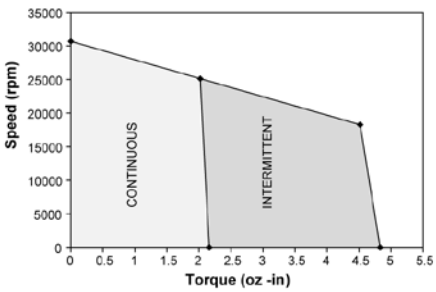
BN12HS-13AF-03: Continuous and Intermittent Operation at 36 VDC



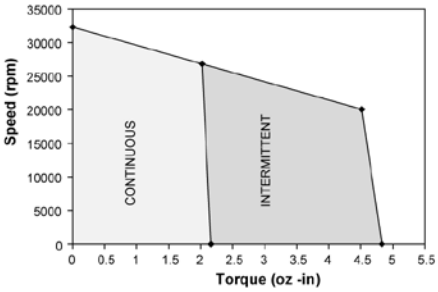
BN12HS-18AF-01: Continuous and Intermittent Operation at 12 VDC



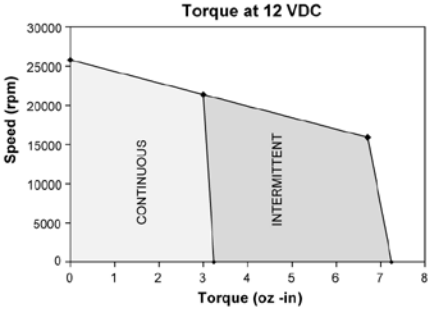
BN12HS-18AF-02: Continuous and Intermittent Operation at 24 VDC



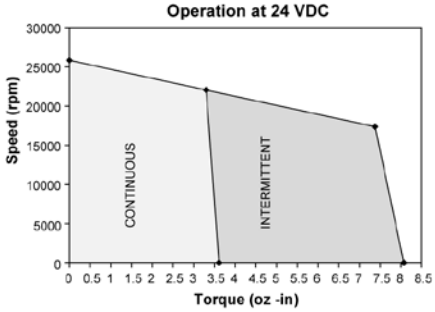
BN12HS-18AF-03: Continuous and Intermittent Operation at 36 VDC



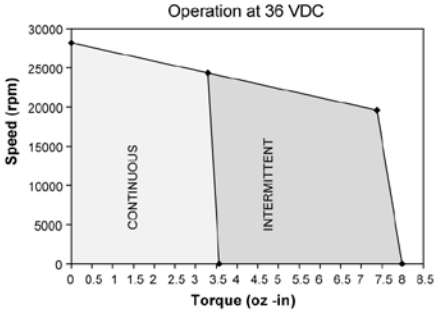
BN12HS-23AF-01: Continuous and Intermittent Torque at 12 VDC



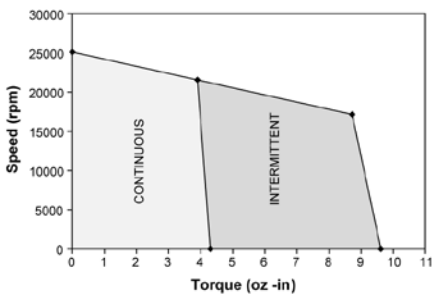
BN12HS-23AF-02: Continuous and Intermittent Operation at 24 VDC



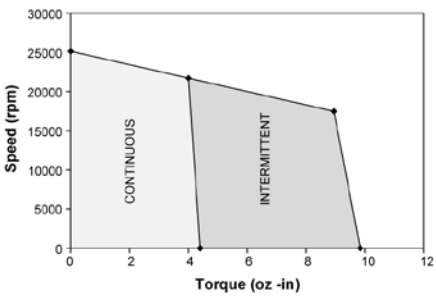
BN12HS-23AF-03: Continuous and Intermittent Operation at 36 VDC



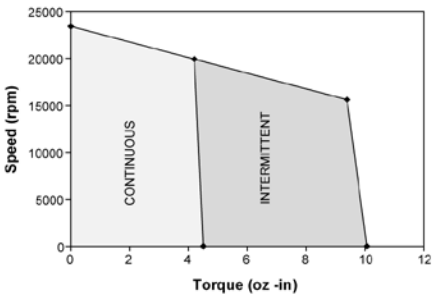
BN12HS-28AF-01: Continuous and Intermittent Operation at 12 VDC



BN12HS-28AF-02: Continuous and Intermittent Operation at 24 VDC

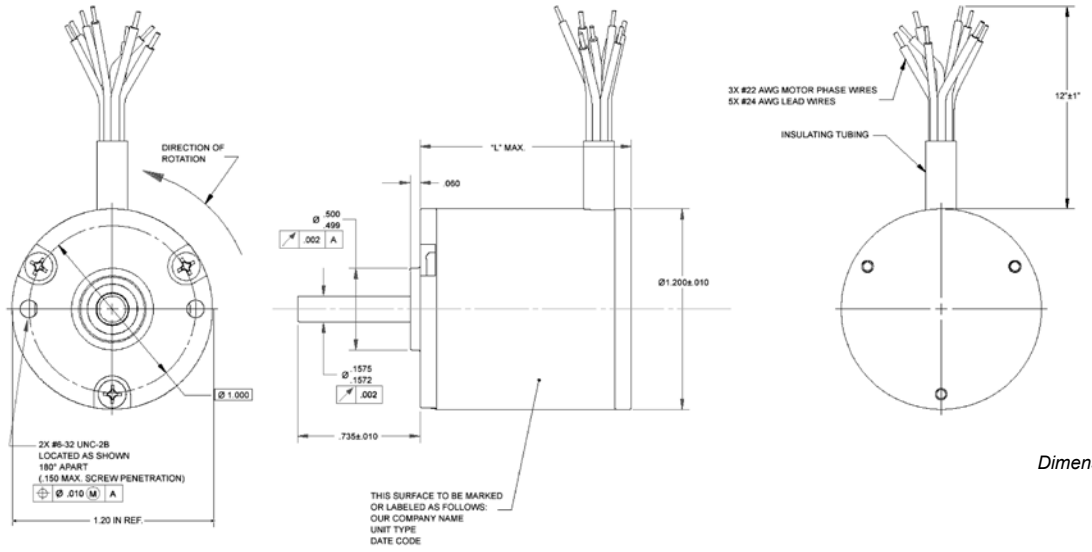


BN12HS-28AF-03: Continuous and Intermittent Operation at 36 VDC



Note: Intermittent operation is based on a 20% duty cycle of one minute on, four minutes off.
Please contact the factory regarding the duty cycle of your application.

Typical Outline Drawing - BN12



Dimensions are in inches

BN23HS SPECIFICATIONS -

Continuous Stall Torque 6 - 32 oz-in (0.042 - 0.226 Nm)
Peak Torque 41 - 222 oz-in (0.2895 - 1.5677 Nm)

Part Number*		BN23HS-13HS- ☐☐ T F O			BN23HS-18HS- ☐☐ T F O			BN23HS-23HS- ☐☐ T F O			BN23HS-28HS- ☐☐ T F O		
Winding Code**		01	02	03	01	02	03	01	02	03	01	02	03
L = Length	inches	1.41			1.91			2.41			2.91		
	millimeters	35.8			48.5			61.2			73.9		
Terminal Voltage	volts DC	24	36	48	24	36	48	24	36	48	24	36	48
Peak Torque	oz-in	41	41	41	101	101	101	162	162	162	222	222	222
	Nm	0.2895	0.2895	0.2895	0.7132	0.7132	0.7132	1.1440	1.1440	1.1440	1.5677	1.5677	1.5677
Continuous Stall Torque	oz-in	6	6	6	16	16	16	23	25	24	27	32	32
	Nm	0.042	0.042	0.042	0.113	0.113	0.113	0.162	0.177	0.169	0.191	0.226	0.226
Rated Speed	RPM	18991	19048	19531	19644	19818	19225	14702	14875	14908	13285	14917	14629
	rad/sec	1989	1995	2045	2057	2075	2013	1540	1558	1561	1391	1562	1532
Rated Torque	oz-in	3.5	3.5	3.5	8.0	8.0	8.0	16.0	16.0	16.0	21.0	21.0	21.0
	Nm	0.025	0.025	0.025	0.056	0.056	0.056	0.113	0.113	0.113	0.148	0.148	0.148
Rated Current	Amps	2.7	1.8	1.4	5.8	3.9	2.9	8.3	5.6	4.2	9.9	7.3	5.3
Rated Power	watts	49	49	51	116	117	114	174	176	176	206	232	227
Torque Sensitivity	oz-in/amp	1.54	2.31	3.03	1.56	2.34	3.13	2.06	3.09	4.12	2.25	3.10	4.22
	Nm/amp	0.0109	0.0163	0.0214	0.0110	0.0165	0.0221	0.0145	0.0218	0.0291	0.0159	0.0219	0.0298
Back EMF	volts/KRPM	1.14	1.71	2.24	1.15	1.73	2.31	1.52	2.28	3.04	1.66	2.29	3.12
	volts/rad/sec	0.011	0.016	0.021	0.011	0.017	0.022	0.015	0.022	0.029	0.016	0.022	0.030
Terminal Resistance	ohms	0.70	1.65	2.72	0.14	0.30	0.50	0.14	0.28	0.51	0.14	0.19	0.35
Terminal Inductance	mH	0.48	1.08	1.86	0.23	0.52	0.93	0.26	0.59	1.04	0.23	0.44	0.81
Motor Constant	oz-in/sq.rt.watt	1.84	1.80	1.84	4.17	4.27	4.43	5.51	5.84	5.77	6.01	7.11	7.13
	Nm/sq.rt.watt	0.13	0.13	0.013	0.029	0.030	0.031	0.039	0.041	0.041	0.042	0.050	0.050
Rotor Inertia	oz-in-sec^{2}x10^{-3}	0.51	0.51	0.51	0.99	0.99	0.99	1.50	1.50	1.50	1.90	1.90	1.90
	g-cm^2	36.0	36.0	36.0	69.9	69.9	69.9	105.9	105.9	105.9	134.1	134.1	134.1
Weight	oz	10.0	10.0	10.0	15.0	15.0	15.0	21.0	21.0	21.0	26.0	26.0	26.0
	g	284.0	284.0	284.0	426.0	426.0	426.0	596.4	596.4	596.4	738.4	738.4	738.4
# of Poles		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Timing		120°	120°	120°	120°	120°	120°	120°	120°	120°	120°	120°	120°
Mech. Time Constant	ms	21.3	22.3	21.4	8.1	7.7	7.2	7.0	6.2	6.4	7.4	5.3	5.3
Electrical Time Constant	ms	0.69	0.65	0.68	1.64	1.73	1.86	1.86	2.11	2.04	1.64	2.32	2.31
Thermal Resistivity	deg. C/watt	6.7	6.8	6.3	4.6	4.5	4.1	4.2	4.1	4.2	3.4	3.4	3.9
Speed/Torque Gradient	rpm/oz-in	398.7	417.7	400.8	78.0	74.1	69.2	44.7	39.7	40.7	37.5	26.8	26.6

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 an 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 50.

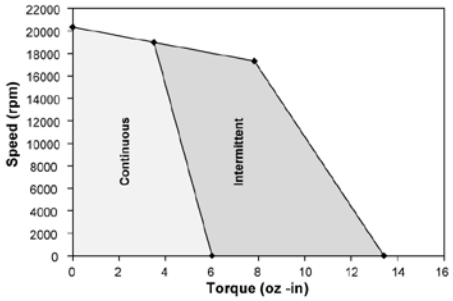
T TERMINATION
L – Leads (std)
C – Connector
M – MS Connector

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

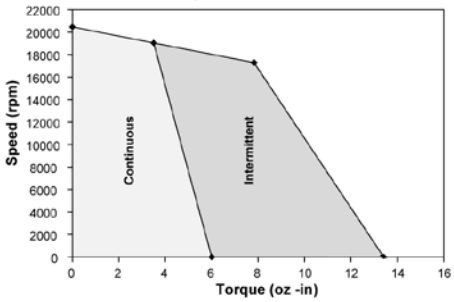
O OTHER OPTIONS
D – Drive
E – Encoder
G – Gearhead

BN23 Performance Curves

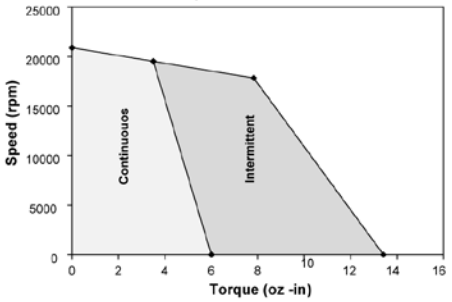
BN23HS-13HS-01: Continuous and Intermittent Operation at 24 VDC



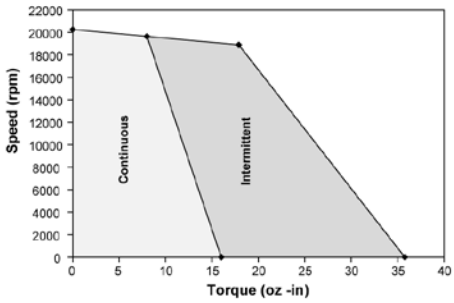
BN23HS-13HS-02: Continuous and Intermittent Operation at 36 VDC



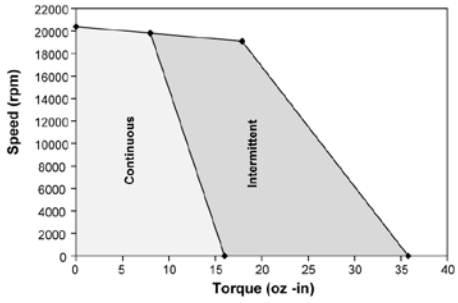
BN23HS-13HS-03: Continuous and Intermittent Operation at 48 VDC



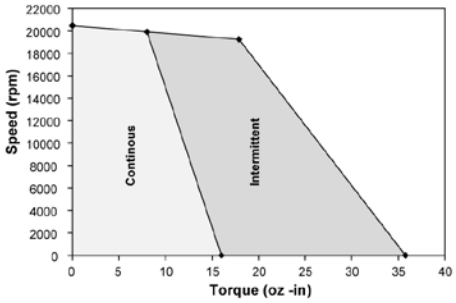
BN23HS-18HS-01: Continuous and Intermittent Operation at 24 VDC



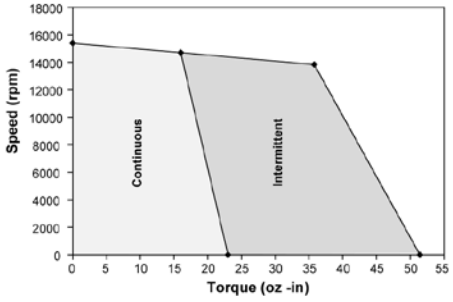
BN23HS-18HS-02: Continuous and Intermittent Operation at 36 VDC



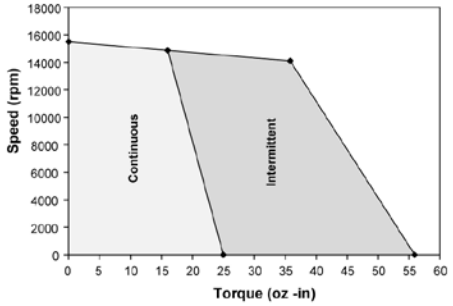
BN23HS-18HS-03: Continuous and Intermittent Operation at 48 VDC



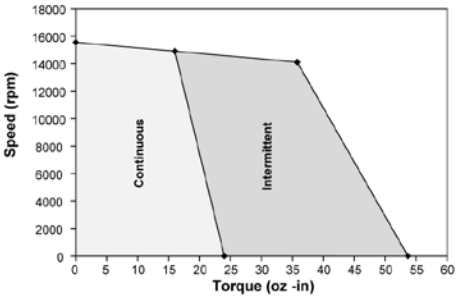
BNHS-23HS-01: Continuous and Intermittent Operation at 24 VDC



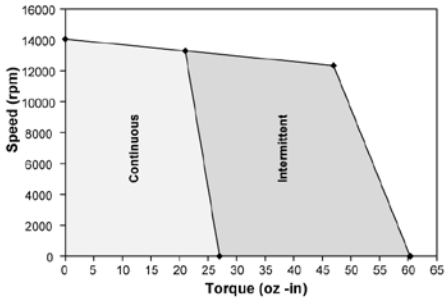
BNHS23-23HS-02: Continuous and Intermittent Operation at 36 VDC



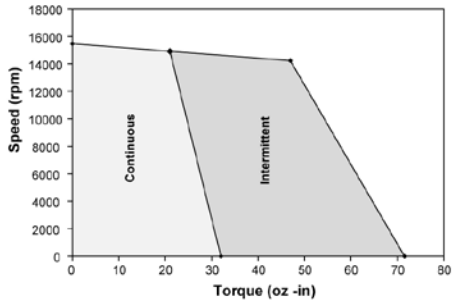
BN23HS-23HS-03: Continuous and Intermittent Operation at 48 VDC



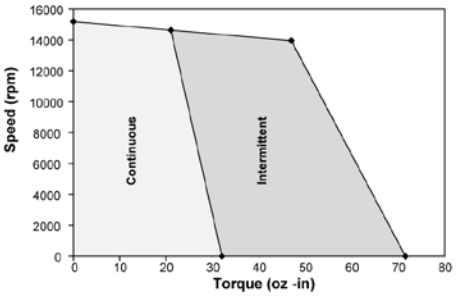
BN23HS-28HS-01: Continuous and Intermittent Operation at 24 VDC



BN23HS-28HS-02: Continuous and Intermittent Operation at 36 VDC

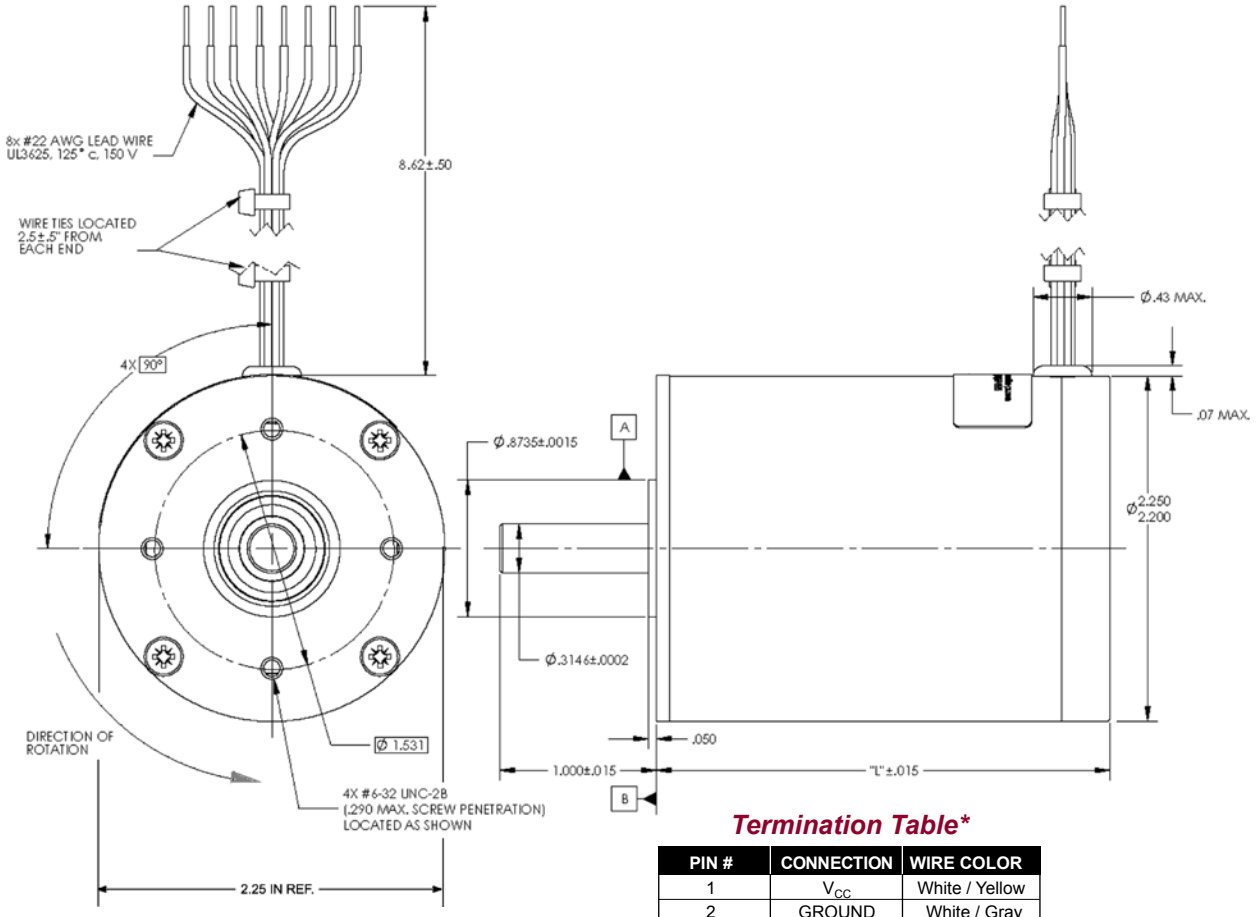


BN23HS-28HS-03: Continuous and Intermittent Operation at 48 VDC



Note: Intermittent region based upon 20% duty cycle - 1 minute on, 4 minutes off.

Typical Outline Drawing - BN23



Termination Table*

PIN #	CONNECTION	WIRE COLOR
1	V_{CC}	White / Yellow
2	GROUND	White / Gray
3	A COIL	White / Violet
4	B COIL	White / Black
5	C COIL	Green
6	S2 OUT	White / Blue
7	S1 OUT	White / Brown
8	S3 OUT	White

Dimensions are in inches

*We reserve the right to use solid color wires or white wires with color trace.

Timing Diagram (4 Pole) CCW Rotation

DEGREES														
	ELEC	0	60	120	180	240	300	360	60	120	180	240	300	360
	MECH	0	30	60	90	120	150	180	210	240	270	300	330	360
S1 OUT														
S2 OUT														
S3 OUT														
A COIL		–	0	+	+	0	–	–	0	+	+	0	–	
B COIL		+	+	0	–	–	0	+	+	0	–	–	0	
C COIL		0	–	–	0	+	+	0	–	–	0	+	+	

BN34HS SPECIFICATIONS -

Continuous Stall Torque 48 - 99 oz-in (0.3390 - 0.6991 Nm)
Peak Torque 177 - 363 oz-in (1.2499 - 2.5633 Nm)

Part Number*		BN34HS-25AF-□□ T F O			BN34HS-35AF-□□ T F O		
Winding Code**		01	02	03	01	02	03
L = Length	inches	2.50			3.50		
	millimeters	63.5			88.9		
Terminal Voltage	volts DC	24.0	50.0	100.0	24.0	50.0	100.0
Peak Torque	oz-in	177.0	177.0	177.0	363.0	363.0	363.0
	Nm	1.2499	1.2499	1.2499	2.5633	2.5633	2.5633
Continuous Stall Torque	oz-in	48.0	49.0	48.0	91.0	98.0	99.0
	Nm	0.3390	0.3460	0.3390	0.6426	0.6920	0.6991
Rated Speed	RPM	14011.0	13900.0	14640.0	7100.0	9340.0	9400.0
	rad/sec	1467	1456	1533	744	978	984
Rated Torque	oz-in	34.0	34.0	34.0	78.0	78.0	78.0
	Nm	0.2401	0.2401	0.2401	0.5508	0.5508	0.5508
Rated Current	Amps	18.60	8.60	4.50	22.40	13.00	6.50
Rated Power	watts	396.0	381.0	397.0	478.0	591.0	591.0
Torque Sensitivity	oz-in/amp	1.94	4.20	8.08	3.59	6.21	12.42
	Nm/amp	0.0137	0.0297	0.0571	0.0254	0.0439	0.0877
Back EMF	volts/KRPM	1.43	3.10	5.97	2.66	4.59	9.18
	volts/rad/sec	0.0137	0.0297	0.0571	0.0254	0.0439	0.0877
Terminal Resistance	ohms	0.054	0.242	0.920	0.063	0.163	0.638
Terminal Inductance	mH	0.18	0.85	3.14	0.33	0.99	3.95
Motor Constant	oz-in/sq.rt.watts	8.35	8.54	8.42	14.30	15.38	15.55
	Nm/sq.rt.watts	0.05895	0.06029	0.05949	0.10100	0.10862	0.10980
Rotor Inertia	oz-in-sec^{2}x10^{-3}	7.30	7.30	7.30	14.00	14.00	14.00
	g-cm^2	515.2	515.2	515.2	988.0	988.0	988.0
Weight	oz	38.0	38.0	38.0	65.0	66.0	66.0
	g	1079.2	1079.2	1079.2	1846.0	1874.4	1874.4
# of Poles		4.0	4.0	4.0	4.0	4.0	4.0
Timing		120°	120°	120°	120°	120°	120°
Mech. Time Constant	ms	14.8	14.2	14.6	9.7	8.4	8.2
Electrical Time Constant	ms	3.33	3.51	3.41	5.24	6.07	6.19
Thermal Resistivity	deg. C/watt	1.1	1.3	1.3	0.8	0.9	1.0
Speed/Torque Gradient	rpm/oz-in	58.5	55.8	57.3	19.8	17.1	16.8

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 an 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.

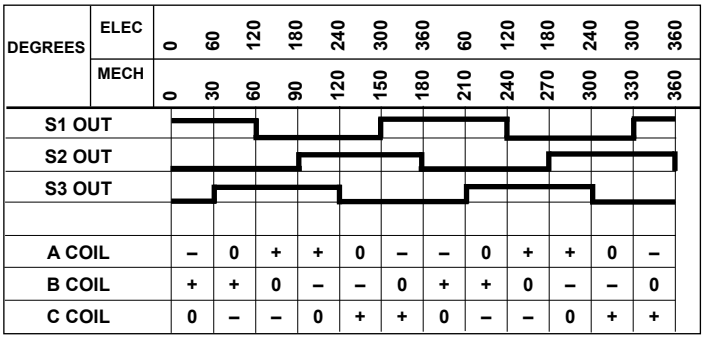
Select your options below and place their code in its corresponding block as shown on page 50.

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

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

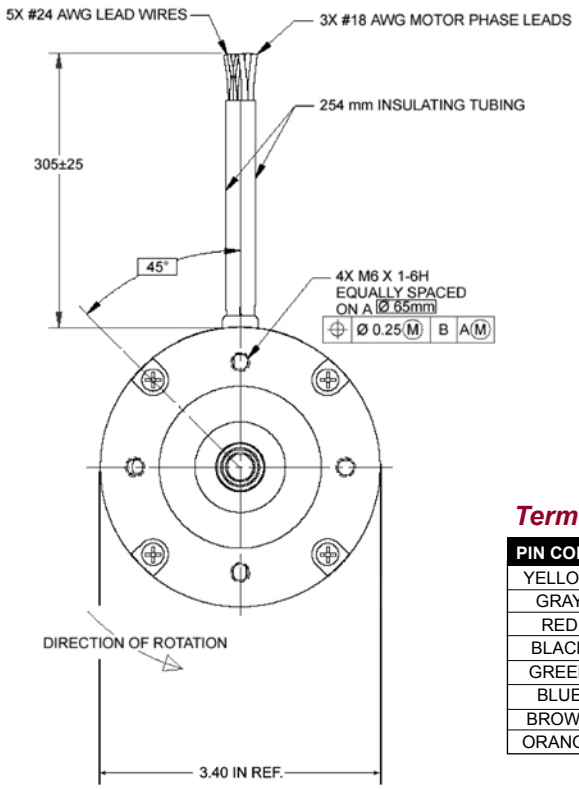
O OTHER OPTIONS
D – Drive
E – Encoder
G – Gearhead

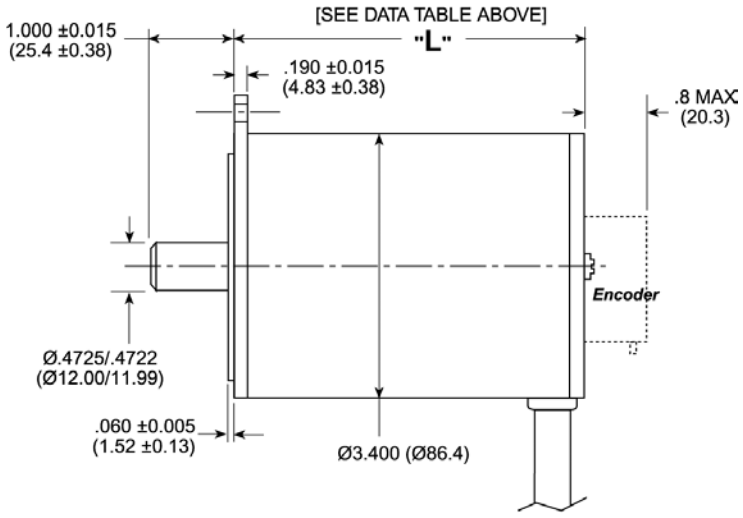
Timing Diagram (4 Pole) CCW Rotation



Typical Outline Drawing - BN34

Figure 1





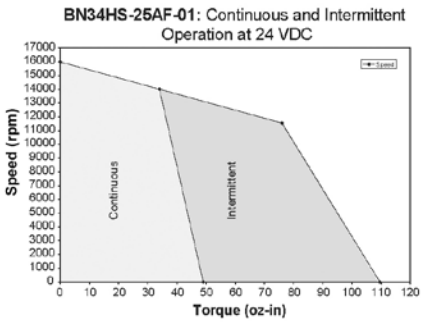
Dimensions are in inches (millimeters)

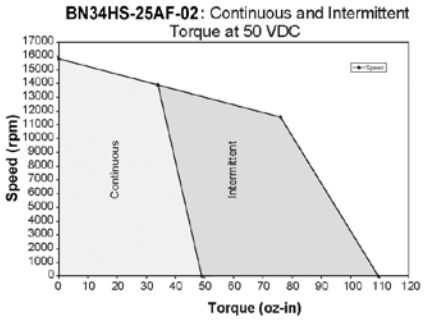
Termination Table

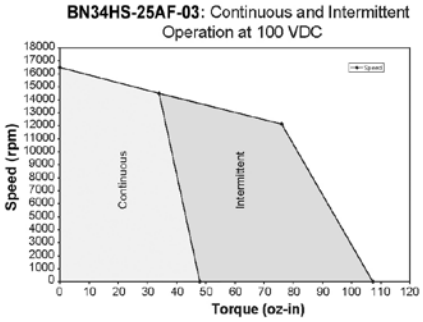
PIN COLOR	CONNECTION
YELLOW	V_{CC}
GRAY	GROUND
RED	C COIL
BLACK	A COIL
GREEN	B COIL
BLUE	S2 OUT
BROWN	S1 OUT
ORANGE	S3 OUT

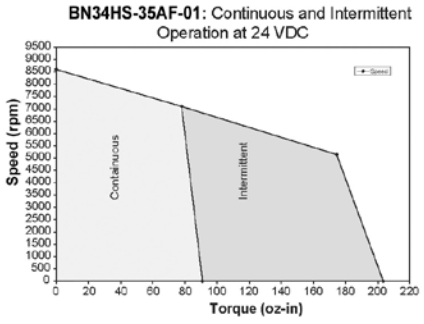
Note: Square or Round Cap Available: AF (standard version) comes standard with square cap, see drawing on page 31. For round cap version, see Figure 1 above.

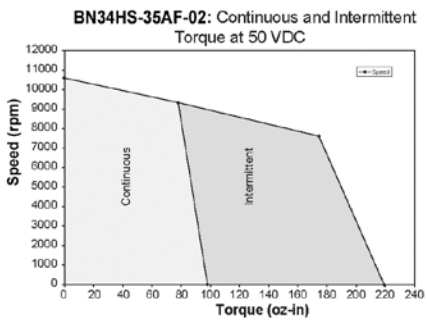
BN34 Performance Curves

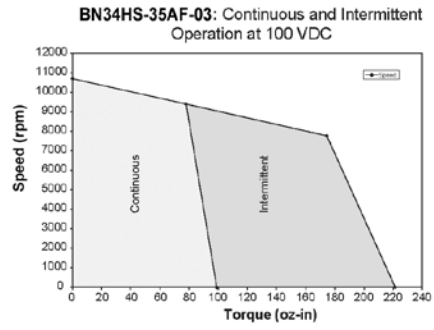












Note: Intermittent region based upon 20% duty cycle - 1 minute on, 4 minutes off.

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.

TYPICAL APPLICATIONS

- Robotics
- Commercial and military aircraft actuation systems
- Oil exploration equipment
- Medical pumps and compressors
- Packaging equipment

FEATURES

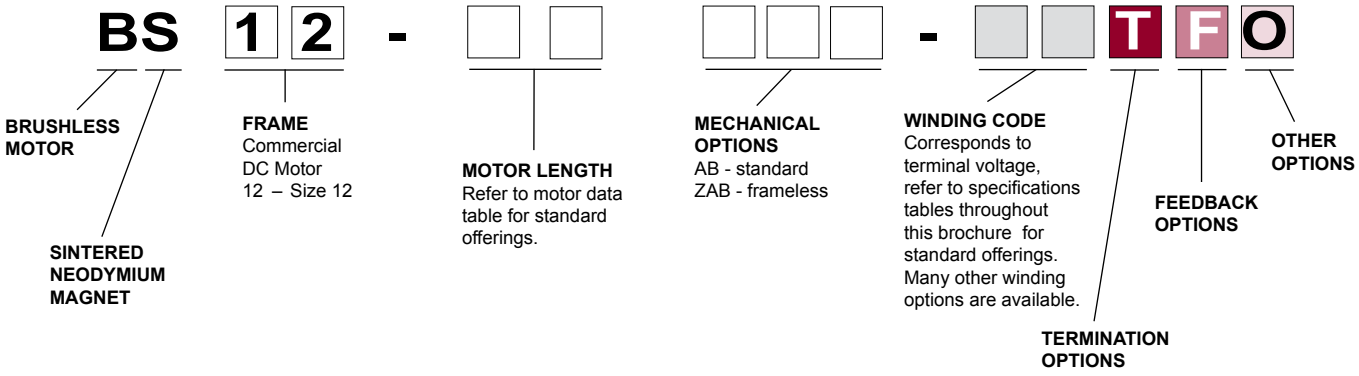
- 6 pole inside rotor for quick acceleration
- High torque / volume ratio
- High energy sintered neodymium magnets
- High stator slot fill for high Km
- Skewed rotor for minimum detent torque

BENEFITS

- Operation at any single speed - not limited to AC frequency
- Motor life is not limited to brush or commutator life
- An essentially linear speed / torque curve
- Efficient operation without losses associated with brushes and commutation or armature induction
- Precise, variable speed control
- Extremely quiet operation
- Long-life operation
- High performance in a compact package

SPECIFICATION AND NUMBERING SYSTEM

Part Numbering System Guide



BS12 SPECIFICATIONS - *Continuous Stall Torque 12 - 14 oz-in (.085 - .099 Nm)*
Peak Torque 35 oz-in (0.25 Nm)

Part Number*		BS12-20AB-□□TFO			BS12-20ZAB-□□TFO		
Winding Code**		01	02	03	01	02	03
L = Length	inches	2			1.485		
	millimeters	50.8			37.7		
Terminal Voltage	volts DC	12	24	24	12	24	24
Peak Torque	oz-in	35	35	35	35	35	35
	Nm	0.25	0.25	0.25	0.25	0.25	0.25
Continuous Stall Torque	oz-in	14	13	12	14	13	12
	Nm	.099	.092	.085	.099	.092	.085
Rated Speed	rpm	4750	5250	15000	4750	5250	15000
	rad/sec	497	550	1571	497	550	1571
Rated Torque	oz-in	12	11.6	10	12	11.6	10
	Nm	0.0847	0.0819	0.0706	0.0847	0.0819	0.0706
Rated Current	Amps	6.30	2.90	8	6.30	2.90	8
Rated Power	watts	42.2	45	110	42.2	45	110
Torque Sensitivity	oz-in/amp	1.99	4.28	1.42	1.99	4.28	1.42
	Nm/amp	0.0141	0.0302	0.0100	0.0141	0.0302	0.0100
Back EMF	volts/KRPM	1.47	3.16	1.05	1.47	3.16	1.05
	volts/rad/sec	0.0141	0.0302	0.0100	0.0141	0.0302	0.0100
Terminal Resistance	ohms	0.32	1.43	0.22	0.32	1.43	0.22
Terminal Inductance	mH	0.22	0.95	0.11	0.22	0.95	0.11
Motor Constant	oz-in/sq.rt.watts	3.52	3.58	3.03	3.52	3.58	3.03
	Nm/sq.rt.watts	0.02484	0.02527	0.02138	0.02484	0.02527	0.02138
Rotor Inertia	oz-in-sec^{2}x10^{-3}	0.048	0.048	0.048	0.037	0.037	0.037
	g-cm^2	3.4	3.4	3.4	2.6	2.6	2.6
Weight	oz	5.3	5.3	5.3	4.4	4.4	4.4
	g	150.5	150.5	150.5	125.0	125.0	125.0
# of Poles		6	6	6	6	6	6
Timing		120°	120°	120°	120	120°	120°
Mech. Time Constant	ms	0.5	0.5	0.7	0.4	0.4	0.6
Electrical Time Constant	ms	0.69	0.66	0.50	0.69	0.66	0.50
Thermal Resistivity	deg. C/watt	3.5	3.5	3.5	3.5	3.5	3.5
Speed/Torque Gradient	rpm/oz-in	109.3	105.6	147.6	109.3	105.6	147.6
No Load Speed	rpm	7480	7255	21900	7480	7255	21900
	rad/sec	783	760	2293	783	760	2293

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. Calculated (theoretical) speed/torque gradient.

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

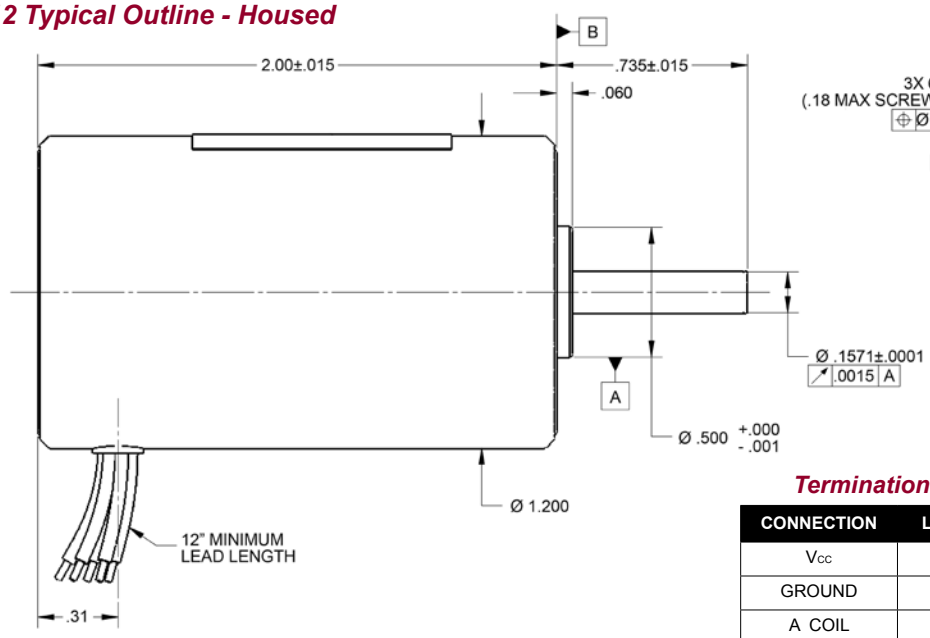
Select your options below and place their code in its corresponding block as shown above.

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

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

O OTHER OPTIONS
D – Drive
G – Gearhead
E – Encoder

BS12 Typical Outline - Housed



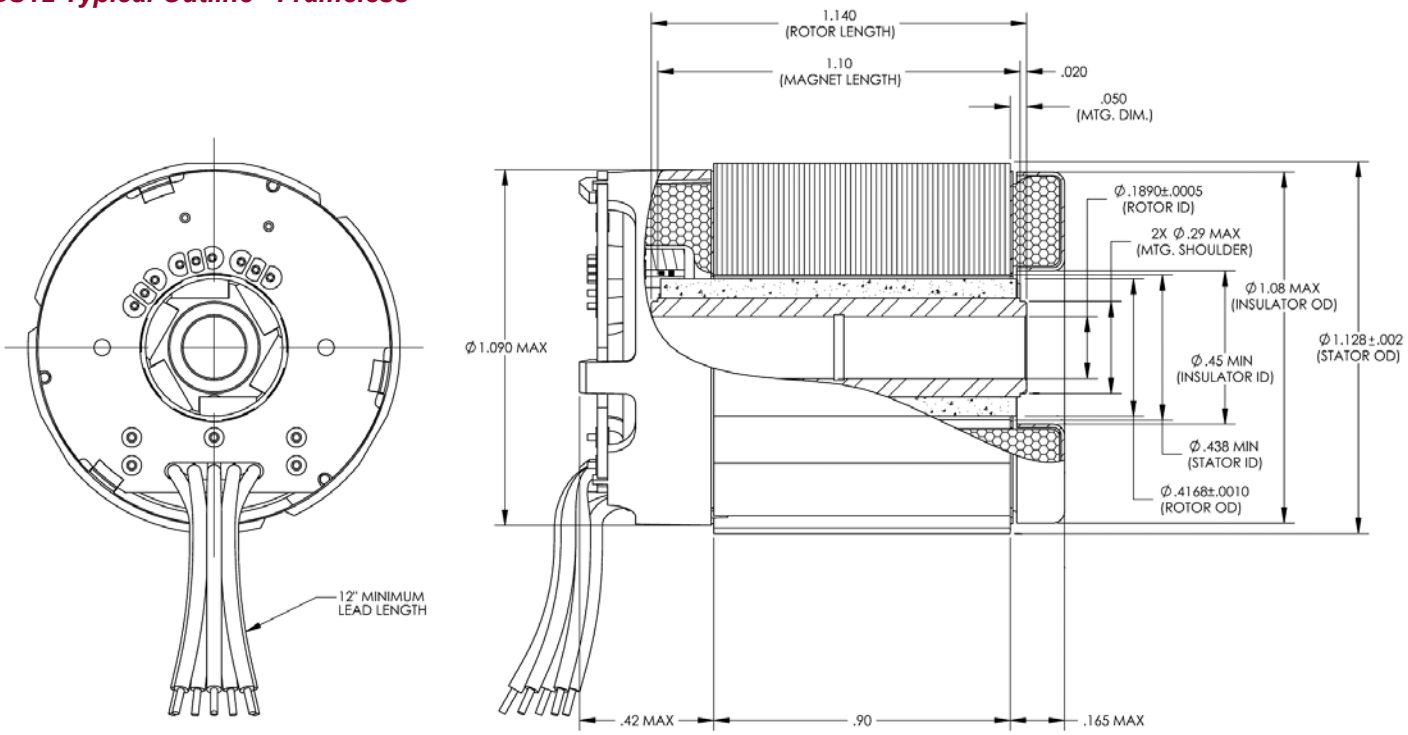
Termination Table*

CONNECTION	LEAD COLOR
V_{CC}	BLUE
GROUND	GREEN
A COIL	RED
B COIL	WHITE
C COIL	BLACK
S2 OUT	ORANGE
S1 OUT	BROWN
S3 OUT	YELLOW

*We reservethe right to use solid color wires or white wires with color trace.

Dimensions are in inches

BS12 Typical Outline - Frameless

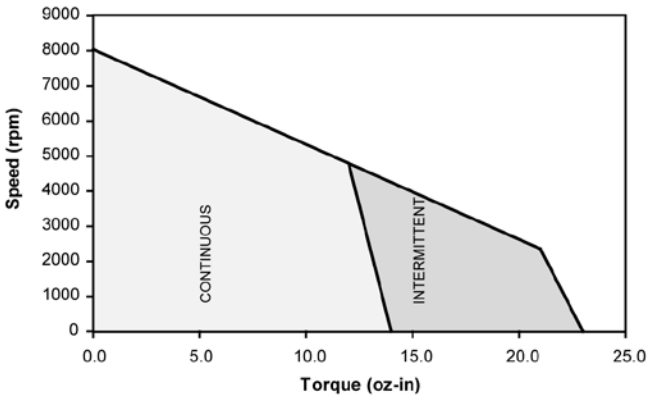


Note: For electrical performance see page 58.

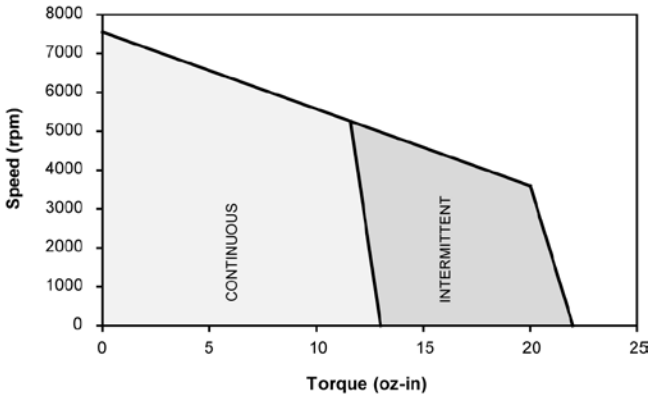
Dimensions are in inches

BS12 Performance Curves

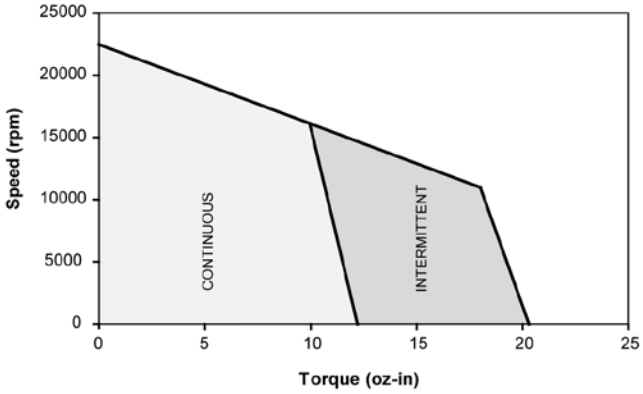
BS12 -01: Continuous & Intermittent
12-Volt Winding



BS12 -02: Continuous & Intermittent
24-Volt Winding



BS12 -03: Continuous & Intermittent
24-Volt Winding



Note: Intermittent operation is based on a 20% duty cycle of one minute on, four minutes off.
Please contact the factory regarding the duty cycle of your application.

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.

Finned black motor housing offers excellent heat transfer characteristics. Typical options include electronic drives, encoders, gearheads, as well as Hall effect, resolvers, and sensorless feedback.

For more information about how this product can be tailored to fit your specific application, contact our application engineers.

TYPICAL APPLICATIONS

- Medical equipment - pumps, blowers and electric scooters and wheelchairs
- Automatic door and window openers
- Computer-controlled embroidery machines
- Scanners
- Packaging equipment and printing products
- HVAC equipment (air handling)
- Robotic tape storage and retrieval
- Semiconductor handling and insertion machines
- Actuators

FEATURES

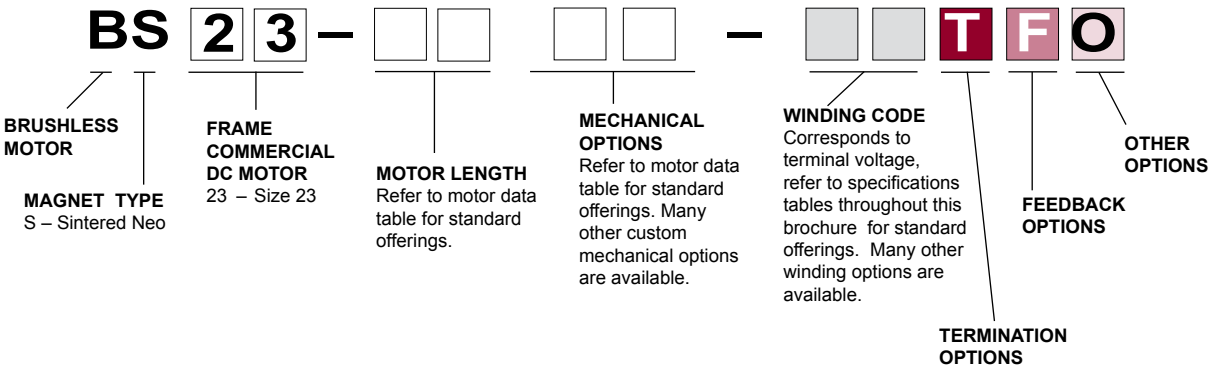
- Inside rotor construction for quick acceleration
- 8 pole motor standard, 4 pole motors optional for high speed applications
- Compact size – lengths from 1.8 to 2.8 inches
- Continuous torques from 29 to 58 oz-in
- High energy sintered neodymium magnets
- Safe, arcless operation
- High torque per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

BENEFITS

- Operation at any single speed - not limited to AC frequency
- Motor life is not limited to brush or commutator life
- An essentially linear speed / torque curve
- Efficient operation without losses associated with brushes and commutation or armature induction
- Precise, variable speed control
- Extremely quiet operation
- Long-life operation

SPECIFICATION AND NUMBERING SYSTEM

Part Numbering System Guide



BS23 SPECIFICATIONS -

Continuous Stall Torque 36 - 70 oz-in (0.25 - 0.49 Nm)
Peak Torque 238 - 729 oz-in (1.68 - 5.15 Nm)

Part Number*		BS23-18HP- □□TFO			BS23-23-HP □□TFO			BS23-28HP □□TFO		
Winding Code**		01	02	03	01	02	03	01	02	03
L = Length	inches	1.91			2.41			2.91		
	millimeters	48.5			61.2			73.9		
Terminal Voltage	volts DC	24	36	48	24	36	48	24	36	48
Peak Torque	oz-in	238	287	307	514	637	684	556	681	729
	Nm	1.68	2.03	2.17	3.63	4.50	4.83	3.93	4.81	5.15
Continuous Stall Torque	oz-in	36	35	35	52	53	53	68	69	70
	Nm	0.25	0.25	0.25	0.37	0.37	0.37	0.48	0.49	0.49
Rated Speed	RPM	3000	3881	4198	4022	4800	5151	2796	3368	3628
	rad/sec	314	406	440	421	503	539	293	353	380
Rated Torque	oz-in	32	30	29	40	37	36	58	56	55
	Nm	0.23	0.21	0.20	0.28	0.26	0.25	0.41	0.40	0.39
Rated Current	Amps	3.7	2.9	2.3	5.9	4.3	3.3	6.1	4.6	3.6
Rated Power	watts	71	86	90	119	131	137	120	140	148
Torque Sensitivity	oz-in/amp	9.11	11.02	13.71	7.26	9.38	11.76	10.06	12.94	16.37
	Nm/amp	0.064	0.078	0.097	0.051	0.066	0.083	0.071	0.091	0.116
Back EMF	volts/KRPM	6.74	8.15	10.14	5.37	6.94	8.70	7.44	9.57	12.10
	volts/rad/sec	0.064	0.078	0.097	0.051	0.066	0.083	0.071	0.091	0.116
Terminal Resistance	ohms	0.90	1.36	2.13	0.33	0.52	0.82	0.43	0.68	1.06
Terminal Inductance	mH	0.86	1.26	1.98	0.34	0.57	0.90	0.48	0.79	1.25
Motor Constant	oz-in/sq.rt.watt	9.60	9.45	9.39	12.64	13.0	13.0	15.34	15.69	15.90
	Nm/sq.rt.watt	0.068	0.067	0.066	0.089	0.092	0.092	0.108	0.111	0.112
Rotor Inertia	oz-in-sec^{2}x10^{-3}	0.99	0.99	0.99	1.50	1.50	1.50	1.90	1.90	1.90
	g-cm^2	69.9	69.9	69.9	105.9	105.9	105.9	134.1	134.1	134.1
Weight	oz	15	15	15	21	21	21	26	26	26
	g	426	426	426	596	596	596	738	738	738
# of Poles		8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Timing		120°	120°	120°	120°	120°	120°	120°	120°	120°
Mech. Time Constant	ms	1.5	1.6	1.6	1.3	1.3	1.3	1.1	1.1	1.1
Electrical Time Constant	ms	0.96	0.93	0.93	1.03	1.10	1.10	1.12	1.16	1.18
Thermal Resistivity	deg. C/watt	5.9	5.7	5.2	4.6	4.5	4.9	4.0	4.0	4.2
Speed/Torque Gradient	rpm/oz-in	14.7	15.1	15.3	8.5	8.0	8.0	5.7	5.5	5.4

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 an 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.

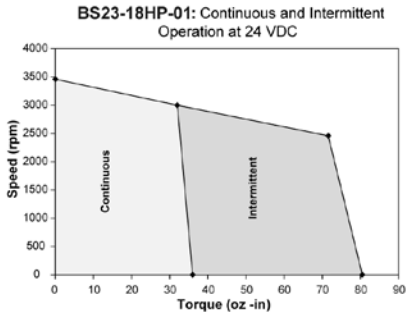
Select your options below and place their code in its corresponding block as shown above.

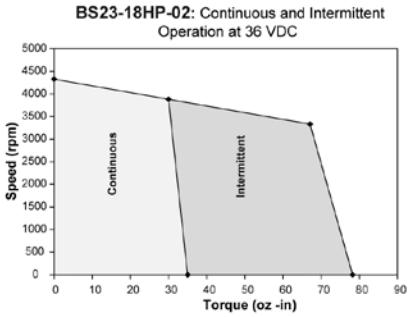
T TERMINATION
L – Leads (std)
C – Connector
M – MS Connector

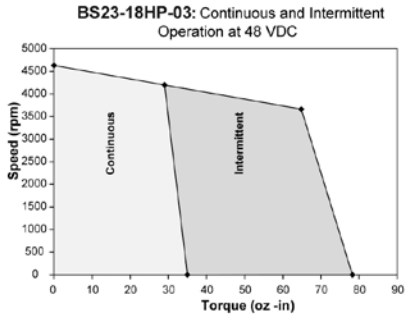
F FEEDBACK OPTIONS
H – Hall Effect (std)
R – Resolver
S – Sensorless

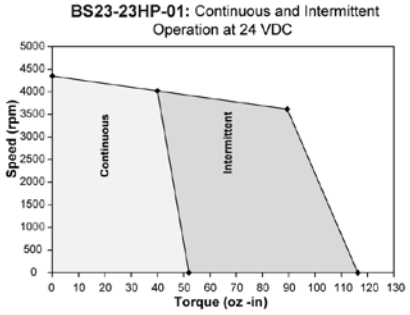
O OTHER OPTIONS
E – Encoder
G – Gearhead

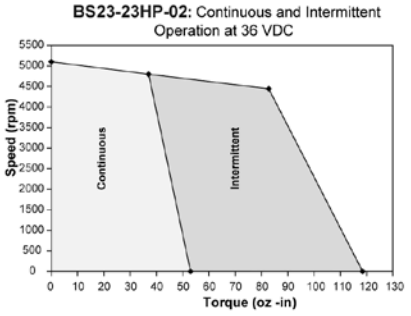
BS23 Performance Curves

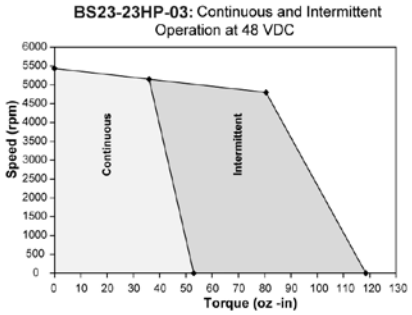


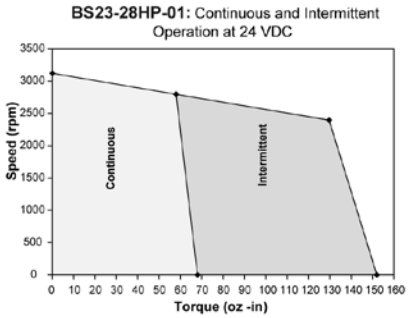


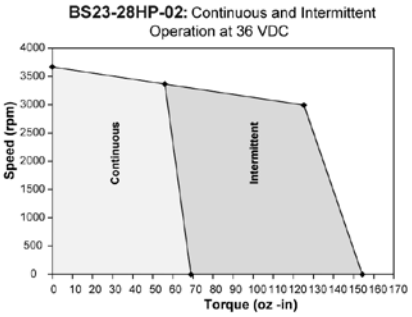


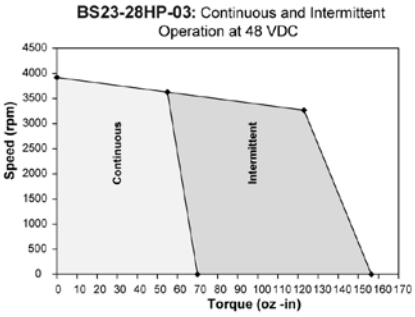




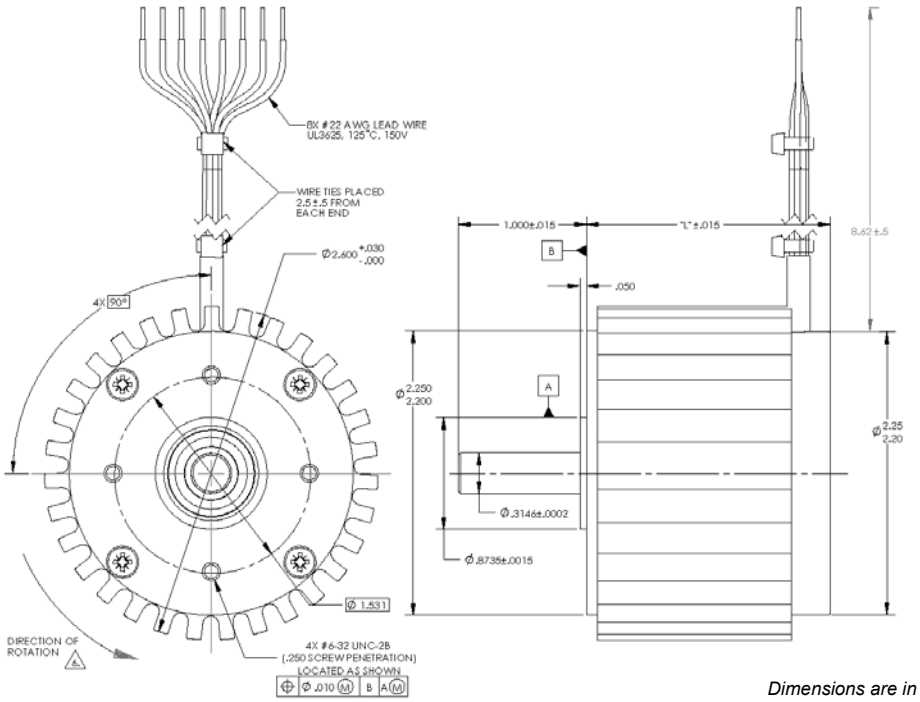








Typical Outline Drawing - BS23



Termination Table*

MOTOR LEADS		SENSOR LEADS	
COLOR	CONNECTION	COLOR	CONNECTION
VIOLET	A COIL	YELLOW	Vcc
BLACK	B COIL	BROWN	S1 OUT
GREEN	C COIL	BLUE	S2 OUT
		WHITE	S3 OUT
		GRAY	GROUND

**We reserve the right to use solid color wires or white wires with color trace.*

Dimensions are in inches

Note: Standard housing Ø2.250 is available.

Silencer® Series
Brushless DC Motor

BSG23 High Performance
Unique Stator Design

TYPICAL APPLICATIONS

- Commercial and military aerospace
- Computer-controlled embroidery machines
- Scanners
- Packaging equipment and printing products
- HVAC equipment (air moving)
- Robotics applications
- Semiconductor handling and insertion machines
- Actuators
- Battery-powered medical applications
  - Portable oxygen concentrators
  - Mobility and patient assistance

FEATURES

- 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)

BENEFITS

- Operation at any single speed - not limited to AC frequency
- Motor life is not limited to brush or commutator life
- An essentially linear speed / torque curve
- Efficient operation without losses associated with brushes and commutation or armature induction
- Precise, variable speed control
- Extremely quiet operation
- Long-life operation
- High performance in a compact package

Quiet, Brushless Motors

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 servo motors.

Typical options include electronic drives, encoders, gearheads, as well as Hall effect, resolvers, sensorless feedback and black finned aluminum housing (for additional heat transfer).

For more information about how this product can be tailored to fit your specific application, contact our applications engineers.

SPECIFICATION AND NUMBERING SYSTEM

Part Numbering System Guide

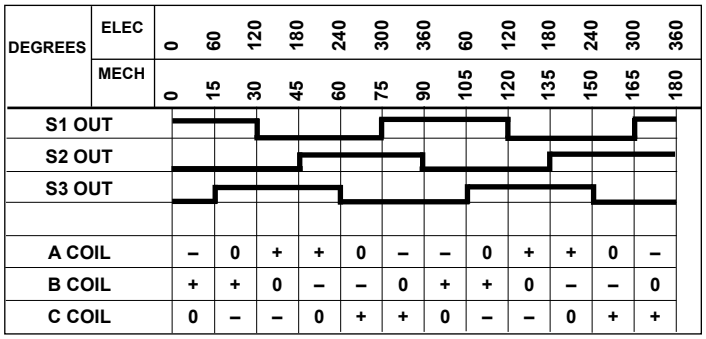
BSG □□ - □□ - □□ **T F O**

- **BSG** — **BRUSHLESS MOTOR**
- □□ — **FRAME** Commercial DC Motor 23 – Size 23
- **UNIQUE STATOR CONSTRUCTION**
- **SINTERED NEODYMIUM MAGNET**
- □□ — **MOTOR LENGTH** Refer to motor data table for standard offerings.
- □□ — **MECHANICAL OPTIONS** Refer to motor data table for standard offerings. 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.
- **T** — **TERMINATION OPTIONS**
- **F** — **FEEDBACK OPTIONS**
- **O** — **OTHER OPTIONS**

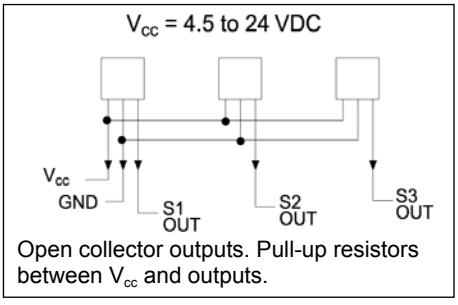
BSG23-18 SPECIFICATIONS - *Continuous Stall Torque 49 - 62 oz-in (0.35 - 0.44 Nm) Peak Torque 300 oz-in (2.1 Nm)*

Part Number*		BSG23-18AB- □□ T F O		
Winding Code**		01	02	03
L = Length	inches	1.90		
	millimeters	48.26		
Terminal Voltage	volts DC	12	24	48
Peak Torque	oz-in	300	300	300
	Nm	2.1	2.1	2.1
Continuous Stall Torque	oz-in	47	56	59
	Nm	0.33	0.40	0.42
Rated Speed	RPM	4000	4000	4000
	rad/sec	419	419	419
Rated Torque	oz-in	45	54	57
	Nm	0.32	0.38	0.40
Rated Current	Amps	14.0	8.4	4.7
Rated Power	watts	133.14	159.76	168.64
Torque Sensitivity	oz-in/amp	3.54	7.08	14.0
	Nm/amp	0.025	0.050	0.099
Back EMF	volts/KRPM	2.62	5.24	10.35
	volts/rad/sec	0.025	0.050	0.099
Terminal Resistance	ohms	0.10	0.28	1.00
Terminal Inductance	mH	0.12	0.46	1.84
Motor Constant	oz-in/sq.rt.watt	11.19	13.38	14.00
	Nm/sq.rt.watt	0.079	0.094	0.099
Rotor Inertia	oz-in-sec^{2}x10^{-3}	0.99	0.99	0.99
	g-cm^2	69.9	69.9	69.9
Weight	oz	17	17	17
	g	483	483	483
# of Poles		8	8	8
Timing		120°	120°	120°
Mech. Time Constant	ms	1.12	0.78	0.72
Electrical Time Constant	ms	1.15	1.64	1.84
Thermal Resistivity	deg. C/watt	3.00	3.00	3.00
Speed/Torque Gradient	rpm/oz-in	13.0	10.8	11.2
No Load	rpm	4600	4600	4600

Timing Diagram for Hall Switches



Hall Effect Switches



Open collector outputs. Pull-up resistors between V_{cc} and outputs.

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. Calculated (theoretical) speed/torque gradient.

*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 above.

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

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

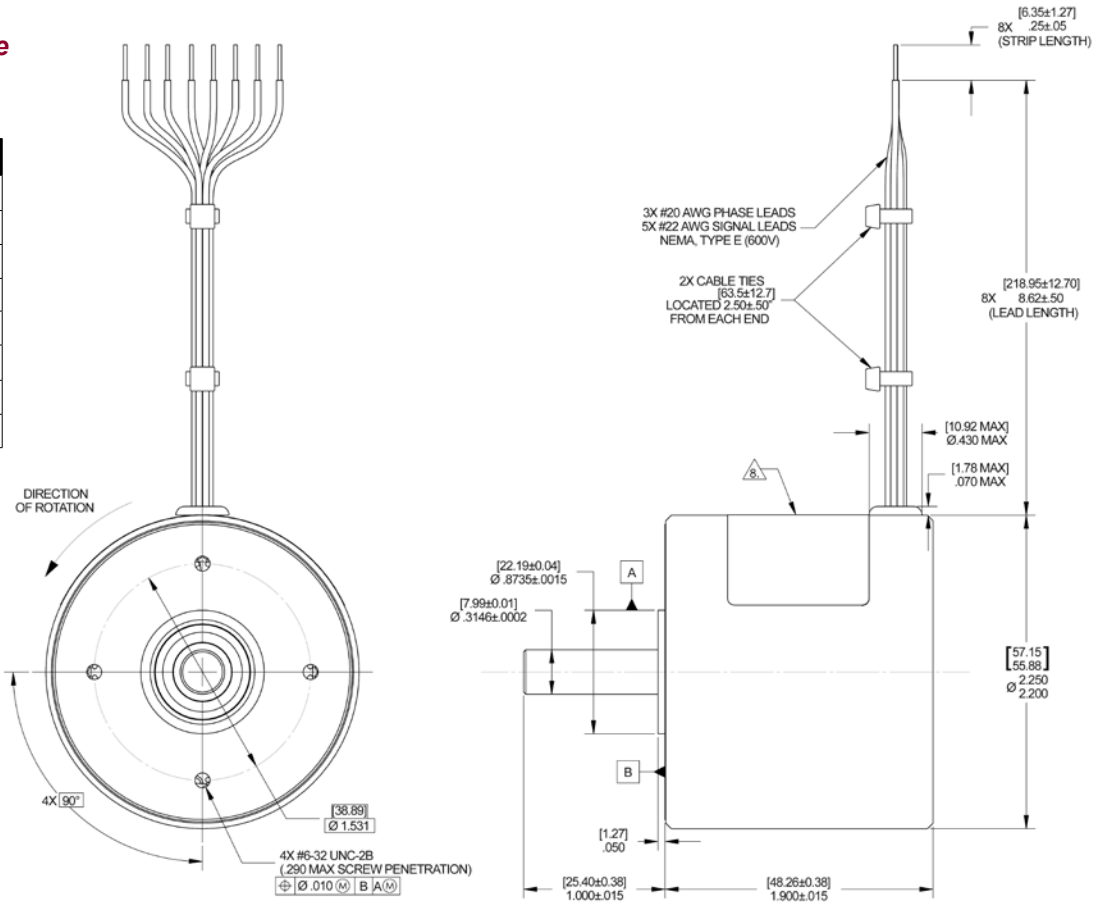
O OTHER OPTIONS
D – Drive
G – Gearhead
E – Encoder

BSG23-18 Typical Outline

Termination Table*

CONNECTION	LEAD COLOR
Vcc	YELLOW
GROUND	GRAY
A COIL	VIOLET
B COIL	BLACK
C COIL	GREEN
S2 OUT	BLUE
S1 OUT	BROWN
S3 OUT	WHITE

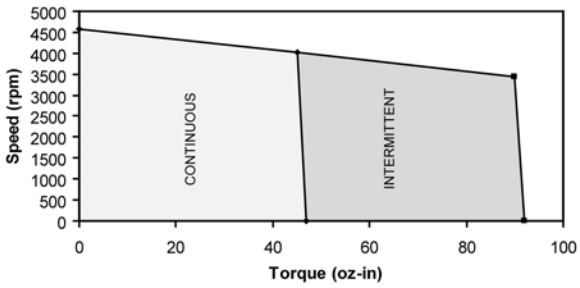
*We reservethe right to use solid color wires or white wires with color trace.



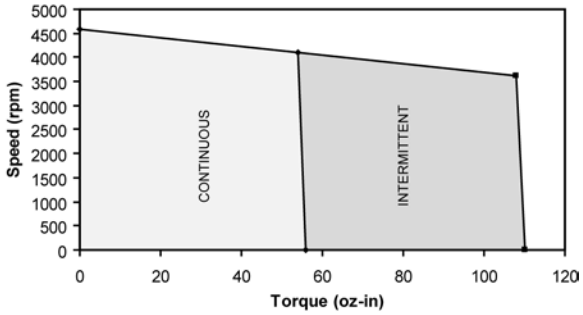
Dimensions are in inches [mm]

BSG23-18 Performance Curves

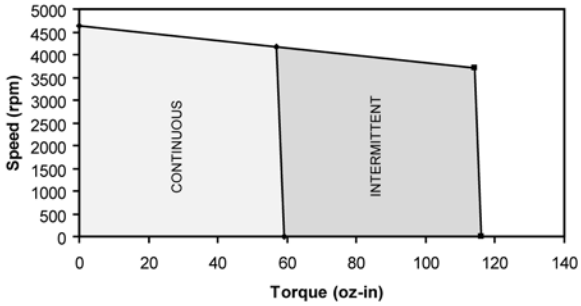
BSG23-18[ ][ ]-01LH: Continuous & Intermittent Operation at 12 Volt DC



BSG23-18[ ][ ]-02LH: Continuous & Intermittent Operation at 24 Volt DC



BSG23-18[ ][ ]-03LH: Continuous & Intermittent Operation at 48 Volt DC



Note: Intermittent operation is based on a 20% duty cycle of one minute on, four minutes off. Please contact the factory regarding the duty cycle of your application.

Silencer® Series Brushless DC Motors with Integral Drive

TYPICAL APPLICATIONS

- Medical equipment - small pumps and blowers
- Semiconductor handling and insertion machines
- Robotic tape storage and retrieval
- Industrial automation equipment
- Office automation equipment
- Actuators

FEATURES

- 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 pre-set 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 range -20 to +45° C
- Optional cover can for electronics available

BENEFITS

- Compact packaging minimizes space required
- Integrated electronics simplifies installation and wiring
- Complete system testing insures high reliability
- High performance, low cost speed controller
- Motor life not limited to brush and commutator life
- Extremely quiet operation
- Low emitted EMI
- Efficient operation
- Long life

BN23 Low Cost

Low Cost Brushless Motors

Silencer™ brushless DC motors with integral electronics provide smooth, quiet and efficient operation over a wide speed range. Moog Components Group has already performed motor / drive system integration, mechanically, electrically and thermally and offers off-the-shelf models for a wide variety of applications.

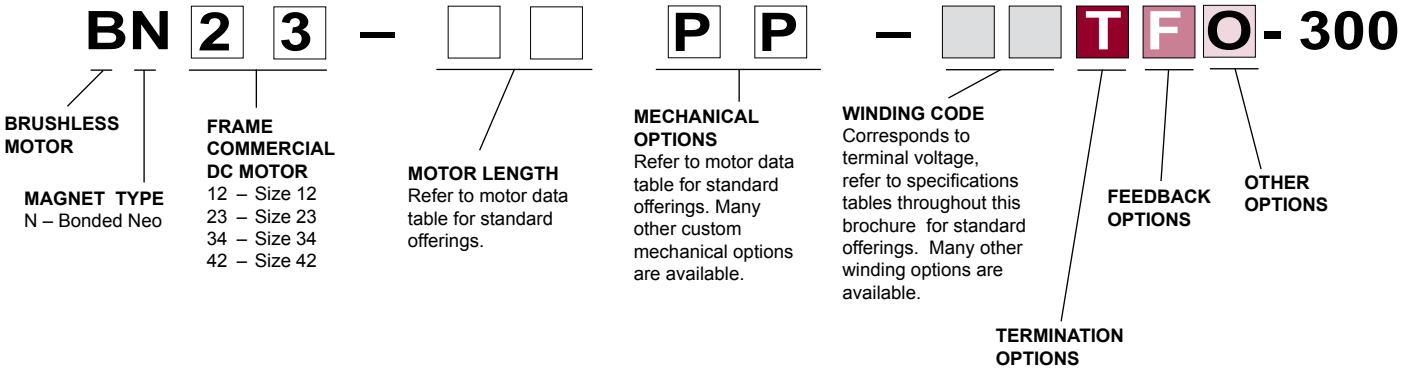
Very simple, low cost integral driver allows the end user to replace existing brush motors with highly reliable brushless motors.

Utilizing bonded neo 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.

For more information about how this product can be tailored to fit your specific application, contact our applications engineers.

SPECIFICATION AND NUMBERING SYSTEM

Part Numbering System Guide



BN23 SPECIFICATIONS - *Typical Electrical Specifications (25°C)*

Part Number*		BN23-13PP-□□TFO-300	BN23-18PP-□□TFO-300
Winding Code**		03	03
L = Length	inches	1.85	2.35
(Motor + Driver)	millimeters	46.7	59.4
No-Load Speed	RPM	2272.0	1947.0
@ 12 VDC	rad/sec	238	204
Rated Speed	RPM	1660	1740
@ 12 VDC @ 1.0 Amp	rad/sec	174	182
Rated Torque	oz-in (max)	4.5	5.5
@ 12 VDC @ 1.0 Amp	Nm (max)	0.0318	0.0388
No-Load Speed	RPM	5363	4566
@ 24 VDC	rad/sec	562	478
Rated Speed	RPM	4750	4370
@ 24 VDC @ 1.0 Amp	rad/sec	497	458
Rated Torque	oz-in (max)	4.5	5.0
@ 24 VDC @1.0 Amp	Nm (max)	0.0318	0.0353
Torque Sensitivity (Kt)	oz-in/amp +/- 10%	5.26	6.18
	Nm/amp +/- 10%	0.0371	0.0436
Rotor Inertia	oz-in-sec^2 x 10^{-3}	0.51	0.99
	g-cm^2	36.0	69.0
Weight	oz	14.0	19.0
	gm	397.6	539.6
Number of Poles		8.0	8.0
Mech. Time Constant	ms	4.9	2.9
Electrical Time Constant	ms	0.81	1.04
Speed/Torque Gradient	RPM/oz-in	140.0	45.0

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.

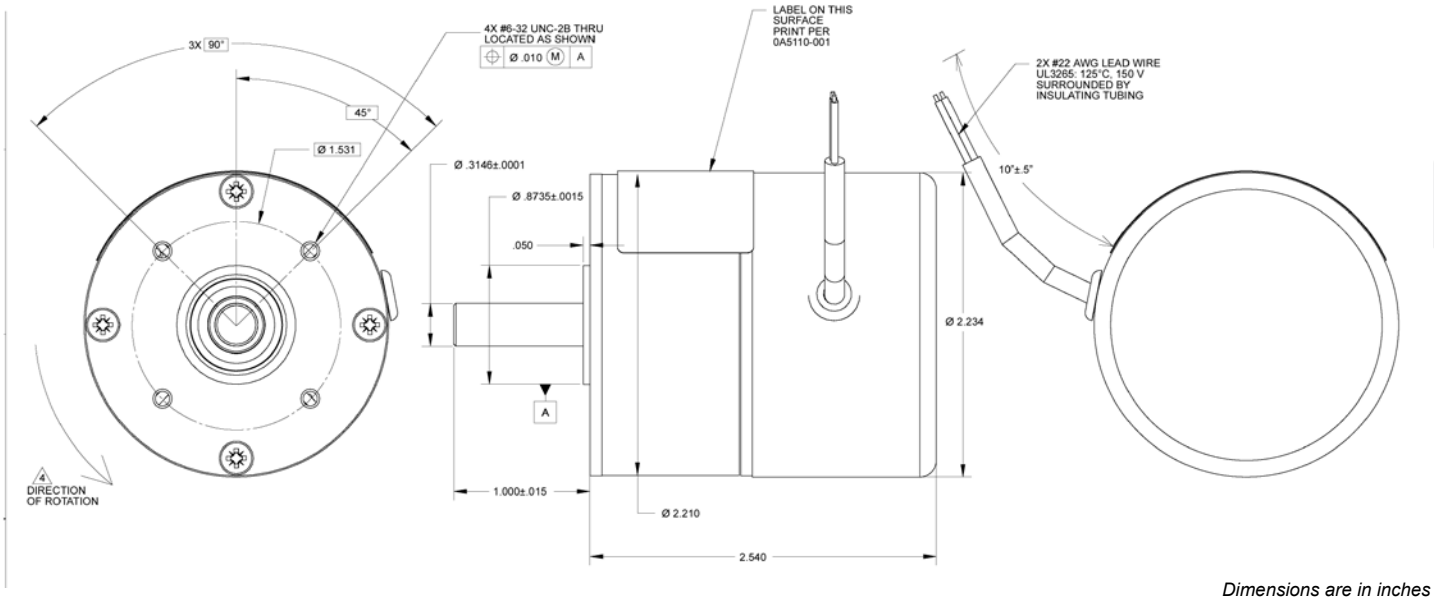
Select your options below and place their code in its corresponding block as shown above.

T TERMINATION OPTIONS
L – Leads (std)
C – Connector

F FEEDBACK OPTIONS
H – Hall Effect (std)

O OTHER OPTIONS
D – Drive
G – Gearhead

Typical Outline Drawing - BN23



Dimensions are in inches

Connection Diagram

DESIGNATOR	WIRE COLOR
+ VDC	RED
GND	BLACK

UNIT TYPE	"L"
BN23-13PP - [ ] [ ]	2.54
BN23-18PP - [ ] [ ]	3.04

Notes:

1. Observe proper polarity in connecting + input and GND to power supply. Reverse polarity will damage or destroy drive circuity and will void warranty.
2. Voltage range 12 to 24 VDC.
3. **This is an open loop controller.**

Silencer® Series Brushless DC Motors with Integral Drives

BN12 and BN23 with Integral Drive Electronics

Silencer™ 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. Moog Components Group has already performed motor / drive system integration, mechanically, electrically and thermally and offers off-the-shelf models for a wide variety of applications.

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

If you have any questions about the Silencer BN motors and drives, or would like to speak with an application engineer, please call us toll-free or visit our web site.

TYPICAL APPLICATIONS

- Medical equipment - pumps, blowers and centrifuges
- HVAC and other air handling equipment
- Packaging and printing equipment
- Semiconductor handling and insertion machines
- Robotic tape storage and retrieval
- Industrial automation equipment
- Office automation equipment
- Actuators

FEATURES

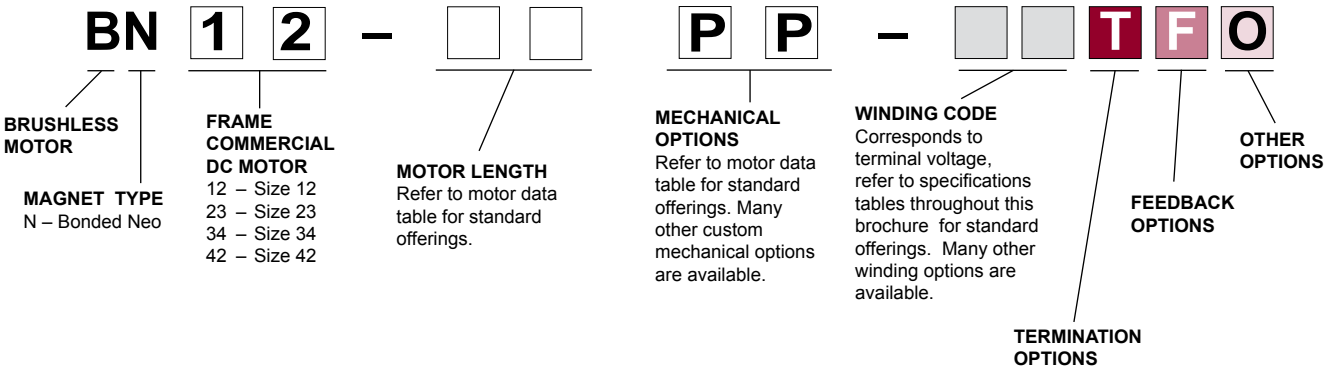
- Integral two quadrant speed controllers for electronically commutating three-phase brushless motors
- Uses built-in Hall effect sensors for rotor position feedback
- All motor, drive and feedback connections are pre-wired internally to the package
- Motor speed is controlled by an external 0 - 5 VDC 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

BENEFITS

- Compact packaging minimizes space required
- Matched motors and drives from a single supplier
- Integrated electronics simplifies installation and wiring
- Complete system testing insures high reliability
- High performance, low cost speed controller
- Motor life not limited to brush and commutator life
- Extremely quiet operation
- Low emitted EMI
- Efficient operation
- Long life

SPECIFICATION AND NUMBERING SYSTEM

Part Numbering System Guide



BN12 SPECIFICATIONS - *Continuous Stall Torque 3 - 5 oz-in (0.0212 - 0.0353 Nm)*
Peak Torque 15 - 27 oz-in (0.1059 - 0.1907 Nm)

Part Number*		BN12-13PP-□□TFO-100		BN12-18PP-□□TFO-100	BN12-23PP-□□TFO-100
Winding Code**		02	03	03	03
L = Length	inches	2.37	2.37	2.87	3.37
	millimeters	60.2	60.2	72.9	85.6
Terminal Voltage	volts DC (nom)	24	24	24	24
Peak Torque	oz-in (max)	15	9	24	27
	Nm (max)	0.1059	0.0636	0.1695	0.1907
Continuous Stall Torque	oz-in (max)	3	2	5	5
	Nm (max)	0.0212	0.0141	0.0353	0.0353
Rated Speed	RPM	11700	6510	6480	8130
	rad/sec	1225	682	679	851
Rated Torque	oz-in (max)	1.7	2.1	4.0	4.2
	Nm (max)	0.0120	0.0148	0.0282	0.0297
Rated Current	amps	0.93	0.75	1.20	1.50
Rated Power	watts	15	10	19	25
Torque Sensitivity (K_T)	oz-in/amp	2.22	3.18	3.69	3.04
	Nm/amp	0.0157	0.0225	0.0261	0.0215
Back EMF (K_E)	volts/KRPM	1.64	2.35	2.73	2.25
	volts/rad/sec	0.0157	0.0225	0.0261	0.0215
Motor Constant (K_M)	oz-in/sq.rt.watt	1.17	1.11	1.91	1.86
	Nm/sq.rt.watt	0.00823	0.00738	0.01348	0.01311
Rotor Inertia	oz-in-sec^2 x 10^{-3}	0.04	0.04	0.08	0.08
	g-cm^2	2.8	2.9	5.7	5.6
Weight	oz	5	5	7	7.5
	gm	142.0	142.0	198.8	213.0
Number of Poles		8	8	8	8
Timing		120°	120°	120°	120°
Mech. Time Constant	ms	4.2	4.7	3.1	3.3
Electrical Time Constant	ms	0.14	0.13	0.21	0.24
Thermal Resistivity	deg. C/watt	13.8	13.3	10.9	9.8
Speed/Torque Gradient	rpm/oz-in	996.8	1100.5	370.7	391.8

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.

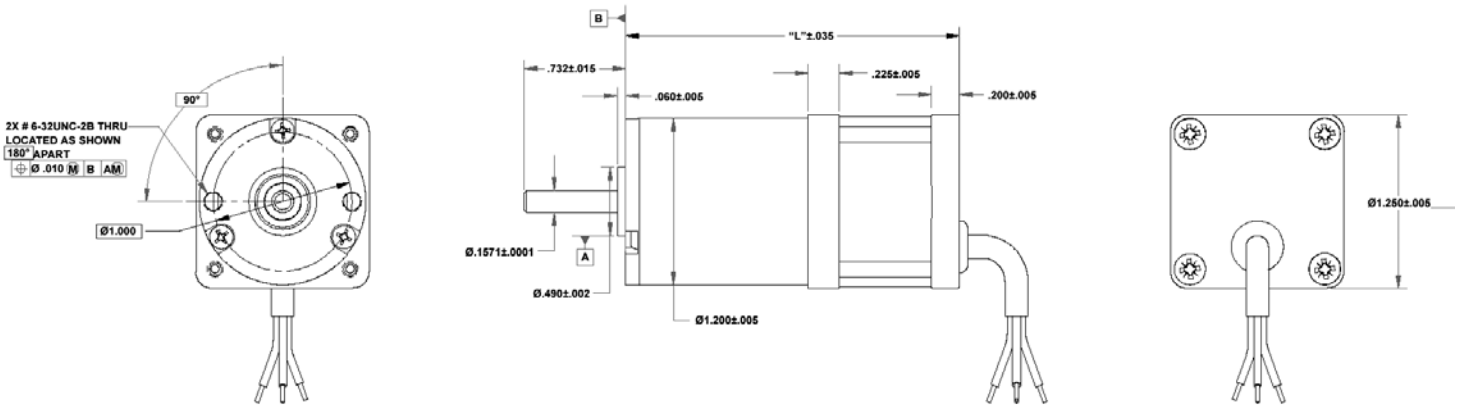
Select your options below and place their code in its corresponding block as shown above.

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

F FEEDBACK OPTIONS
H – Hall Effect (std)

O OTHER OPTIONS
D – Integral Drive
G – Gearhead

Typical Outline Drawing



Dimensions are in inches

Connection Diagram

DESIGNATOR	WIRE COLOR
+ Input	RED
GND	BLACK*
Speed Command	YELLOW*
Tach	ORG
Direction	WHT

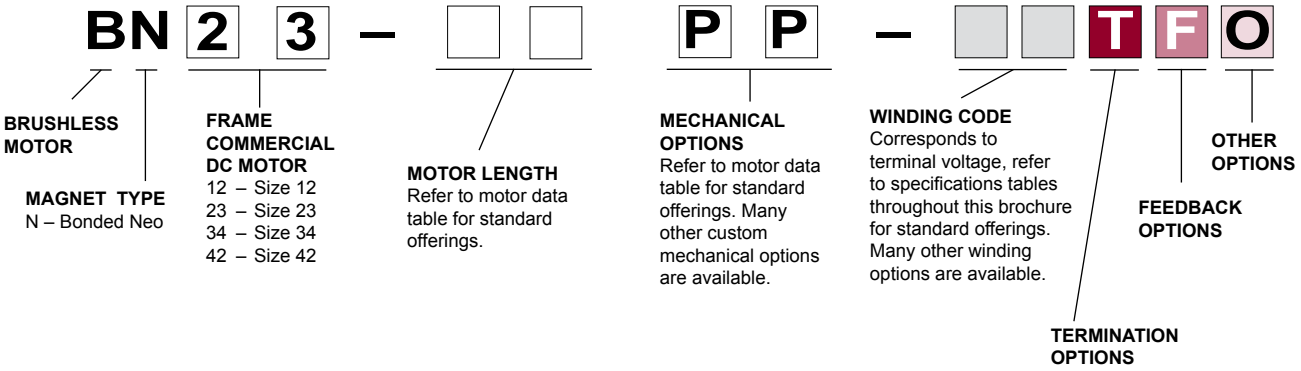
*Apply 0 - 5 VDC speed command between (+) and GND (-), being sure to observe polarity.

UNIT TYPE	"L"
BN12-13PP - [ ] [ ]	3.11
BN12-15PP - [ ] [ ]	3.61
BN12-18PP - [ ] [ ]	4.11

Notes:
1. Observe proper polarity in connecting + input and GND to power supply. Reverse polarity will damage or destroy drive circuity and will void warranty.
2. Reverse and TACH output available upon request - contact factory for information.
3. Voltage range 12 to 24 VDC.
4. **This is a closed loop velocity feedback controller.**

SPECIFICATION AND NUMBERING SYSTEM

Part Numbering System Guide



BN23 SPECIFICATIONS - *Typical Electrical Specifications (25°C)*

Part Number*		BN23-13PP-□□TFO-100		BN23-18PP-□□TFO-100	BN23-23PP-□□TFO-100
Winding Code**		01	02	02	02
L = Length	inches	3.27	3.27	3.77	4.27
(Motor + Driver)	millimeters	83.1	83.1	95.8	108.5
No Load Speed	rpm	5659	3967	3058	2792
@ 12 VDC	rad/sec	593	415	320	292
Rated Speed	rpm	4820	2690	2280	2270
@ 12 VDC	rad/sec	505	282	239	238
Rated Torque	oz-in (max)	11	12	20	22
@12 VDC	Nm (max)	0.0777	0.0847	0.1412	0.1554
Rated Current @ 12 VDC	amps	4.5	3.4	4.3	4.4
No-Load Speed	rpm	11956	8335	6377	5885
@ 24 VDC	rad/sec	1252	873	668	616
Rated Speed	rpm	10850	7050	5610	5360
@ 24 VDC	rad/sec	1136	738	587	561
Rated Torque	oz-in (max)	8.7	12	20	22
@ 24 VDC	Nm (max)	0.0614	0.0847	0.1412	0.1554
Rated Current @ 24 VDC	amps	3.8	3.5	4.4	4.5
Torque Sensitivity (Kt)	oz-in/amp	2.59	3.70	4.84	5.26
	Nm/amp	0.0183	0.0261	0.0342	0.0371
Rotor Inertia	oz-in-sec^2 x 10^{-3}	0.51	0.51	0.99	1.50
	g-cm^2	36	36	69.9	105.9
Weight	oz	14	14	19	25
	gm	397.06	397.6	539.6	710
Number Of Poles		8	8	8	8
Mech. Time Constant	ms	5	5	3	2.7
Elect. Time Constant	ms	0.80	0.81	1.05	1.18
Thermal Resistivity	deg. C/watt	1.7	1.2	1	0.9
Speed/Torque Gradient	rpm/oz-in	127	108	39	24

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.

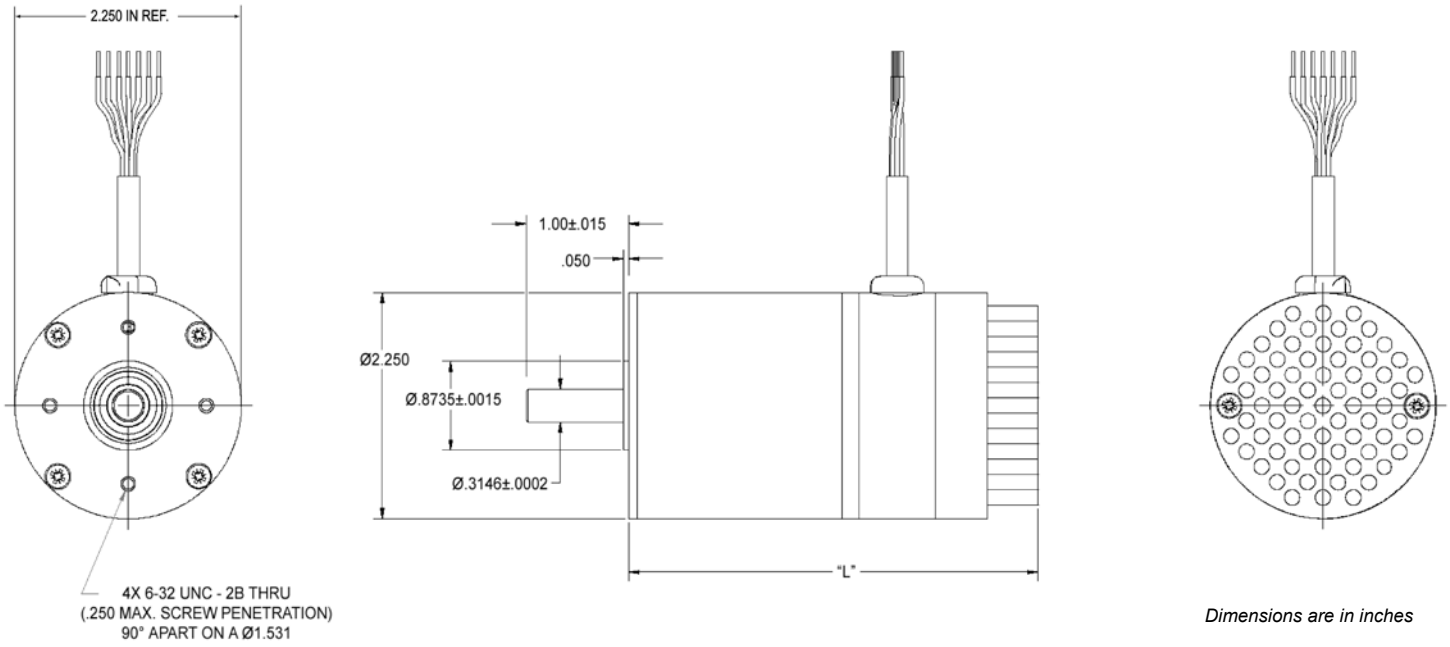
Select your options below and place their code in its corresponding block as shown above.

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

T FEEDBACK OPTIONS
H – Hall Effect (std)

O OTHER OPTIONS
D – Drive
G – Gearhead

Typical Outline Drawing - BN23D



Dimensions are in inches

CONTROL INPUT	INPUT OPEN OR HIGH	INPUT GND OR LOW
REV	Motor Runs CCW	Motor Runs CW
DIS	Controller Active	Controller Inactive
BRAKE	Controller Inactive	Controller Active

Connection Diagram

DESIGNATOR	WIRE COLOR
+ Input	RED
GND	BLACK*
SV	YELLOW*
REV	ORANGE
DIS	WHITE
BRAKE	BLUE

* Apply 0 - 5 VDC speed command between SV (+) and GND (-), being sure to observe polarity.

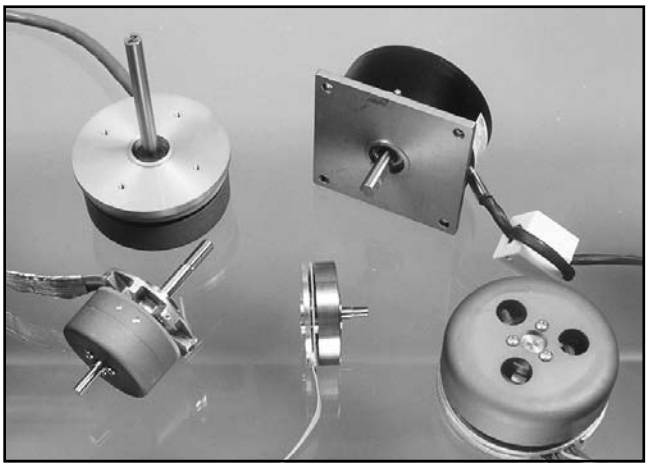
UNIT TYPE	"L"
BN23-13PP - [ ] [ ]	3.11
BN23-18PP - [ ] [ ]	3.61
BN23-23PP - [ ] [ ]	4.11

Notes:

1. Observe proper polarity in connecting + input and GND to power supply. Reverse polarity will damage or destroy drive circuity and will void warranty.
2. Reverse and TACH output available upon request - contact factory for information.
3. Voltage range 12 to 40 VDC.

Brushless DC Motors
Outside Rotor
Fractional Horsepower

BOF Series



TYPICAL APPLICATIONS

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

FEATURES

- Compact lengths – from 1.1 to 2.4 inches
- Continuous torques from 4.0 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

Quiet, Brushless Motors

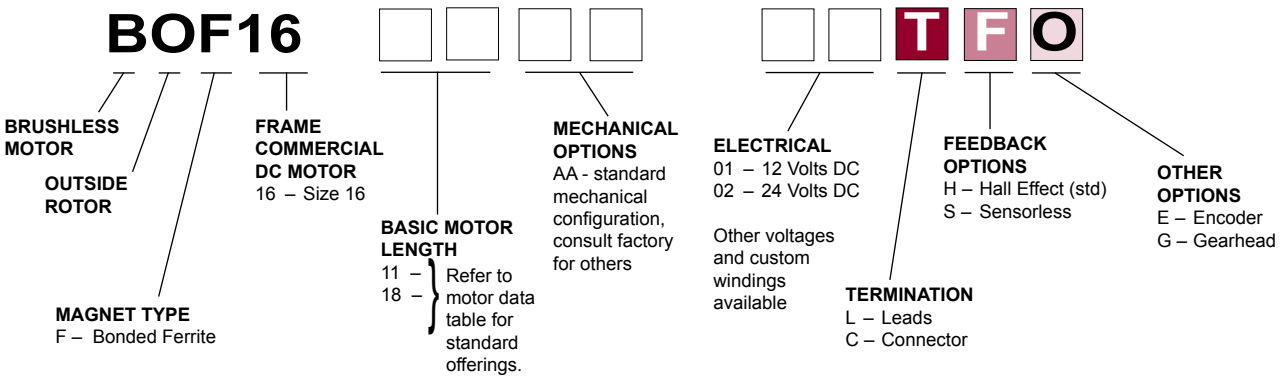
BOF motors provide smooth, efficient operation at high speeds. The brushless design ensures low audible noise and long life. Utilizing bonded ferrite magnets, these brushless motors provide excellent performance and value demonstrated by their low cost to high torque ratio. They are available in two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

SPECIFICATION AND NUMBERING SYSTEM

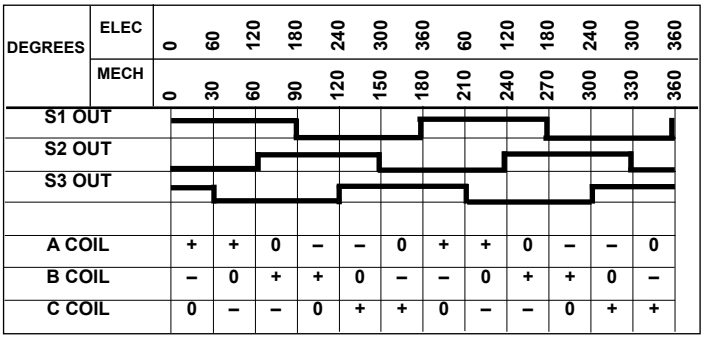
Part Numbering System Guide



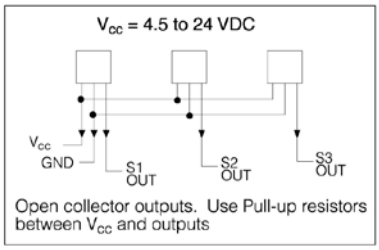
Conversion Table

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

Timing Diagram CCW @ SHAFT



Hall Effect Switches



Termination Table

PIN NUMBER	CONNECTION	COLOR
1	GROUND	BROWN
2	S3 OUT	RED
3	S2 OUT	ORANGE
4	S1 OUT	YELLOW
5	Vcc	GREEN
6	C COIL	BLUE
7	B COIL	VIOLET
8	A COIL	GRAY

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.

BOF16 SPECIFICATIONS - *Continuous Stall Torque 4.3 - 8.6 oz-in (0.0304 - 0.0607 Nm)*
Peak Torque 19 - 39 oz-in (0.1342 - 0.2754 Nm)

Part Number*		BOF16-11AA-□□ T F O		BOF16-18AA-□□ T F O	
Winding Code**		01	02	01	02
L = Length	inches	1.1		1.8	
	millimeters	27.94		45.72	
Terminal Voltage	volts DC (nom)	12.0	24.0	12.0	24.0
Peak Torque	oz-in (max)	19.0	18.0	38.0	39.0
	Nm (max)	0.1342	0.1271	0.2683	0.2754
Continuous Stall Torque	oz-in (max)	4.3	4.2	8.5	8.6
	Nm (max)	0.0304	0.0297	0.0600	0.0607
Rated Speed	RPM	7432.0	6789.0	4903.0	5100.0
	rad/sec	778	711	513	534
Rated Torque	oz-in (max)	4.1	4.0	8.1	8.2
	Nm (max)	0.0290	0.0282	0.0572	0.0579
Rated Current	Amps	3.26	1.50	4.11	2.12
Rated Power	watts	23.0	20.0	29.0	31.0
Torque Sensitivity	oz-in/amp +/-10%	1.59	3.38	2.42	4.75
	Nm/amp +/-10%	0.0112	0.0239	0.0171	0.0335
Back EMF	volts/KRPM +/-10%	1.18	2.50	1.79	3.51
	volts/rad/sec	0.0112	0.0238	0.0171	0.0335
Terminal Resistance	ohms +/-10%	0.97	4.45	0.77	2.88
Terminal Inductance	mH +/-30%	0.36	1.61	0.42	1.61
Motor Constant	oz-in/sq.rt.watt	1.61	1.60	2.76	2.80
	Nm/sq.rt.watt	0.01140	0.01131	0.01947	0.01977
Rotor Inertia	$(oz\text{-}in\text{-}sec^2) \times 10^{-3}$	2.00	2.00	3.90	3.90
	$g\text{-}cm^2$	141.1	141.1	275.2	275.2
Weight	oz	6.96	6.96	9.00	9.00
	gm	197.7	197.7	255.6	255.6
# of Poles		4.0	4.0	4.0	4.0
Timing		120°	120°	120°	120°
Mech. Time Constant	ms	108.6	110.2	72.6	70.5
Elect. Time Constant	ms	0.37	.036	0.55	0.56
Thermal Resistivity	°C/watt	6.3	6.6	5.3	5.3

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.

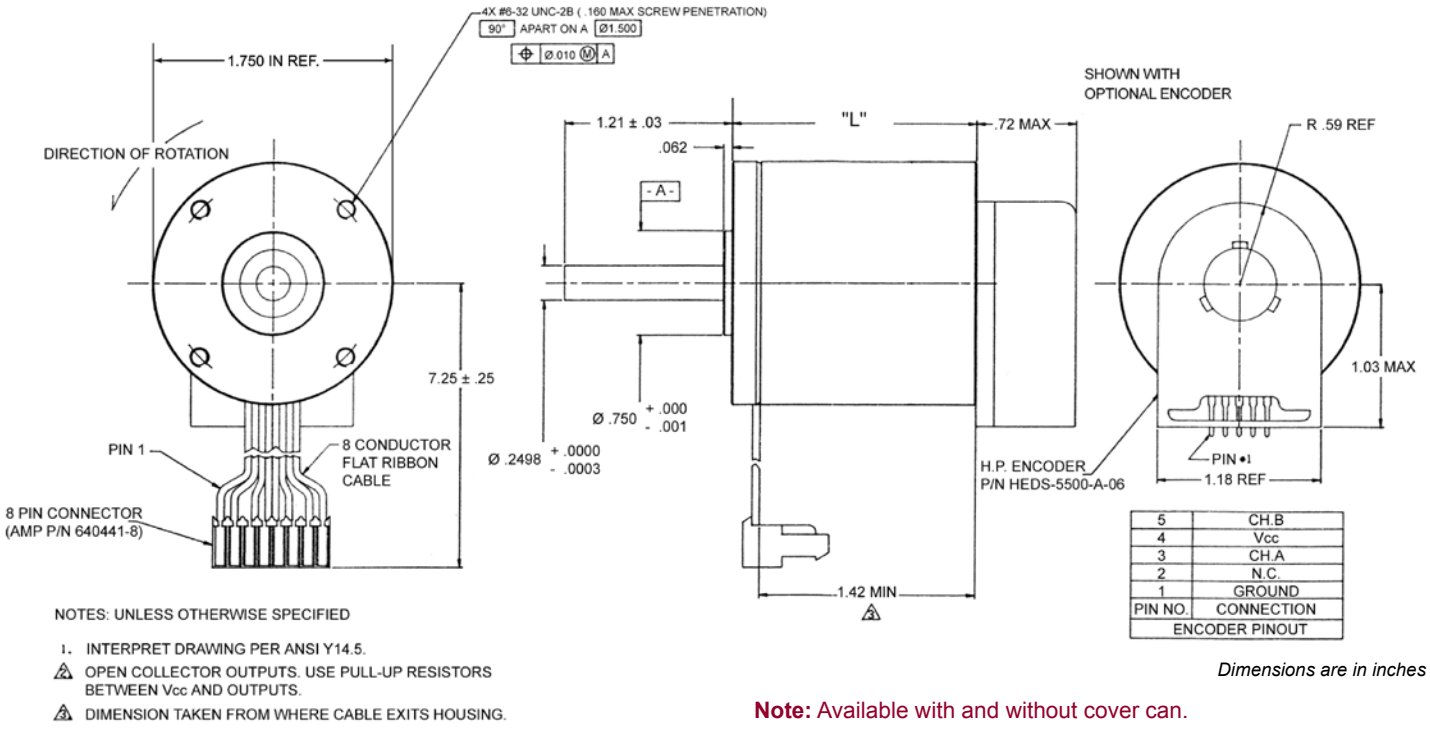
Select your options below and place their code in its corresponding block as shown on page 76.

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

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

O OTHER OPTIONS
E – Encoder
G – Gearhead

BOF16 Typical Outline Drawing



PIN NO.	CONNECTION
5	CH.B
4	Vcc
3	CH.A
2	N.C.
1	GROUND
ENCODER PINOUT	

NOTES: UNLESS OTHERWISE SPECIFIED

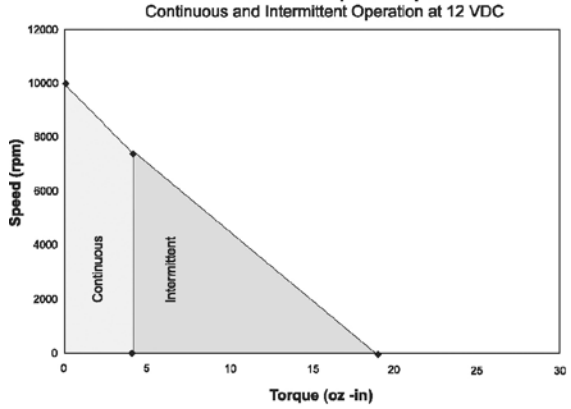
1. INTERPRET DRAWING PER ANSI Y14.5.
2. OPEN COLLECTOR OUTPUTS. USE PULL-UP RESISTORS BETWEEN Vcc AND OUTPUTS.
3. DIMENSION TAKEN FROM WHERE CABLE EXITS HOUSING.

Dimensions are in inches

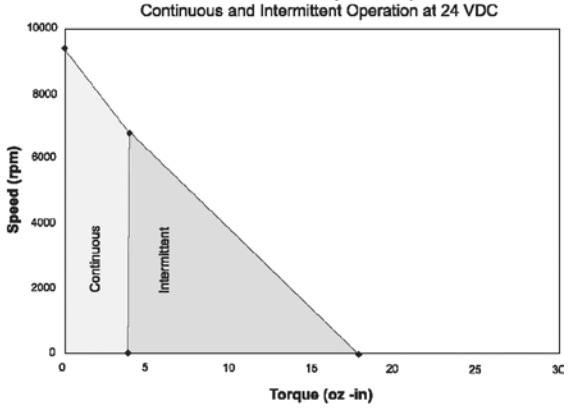
Note: Available with and without cover can.

BOF16 Performance Curves

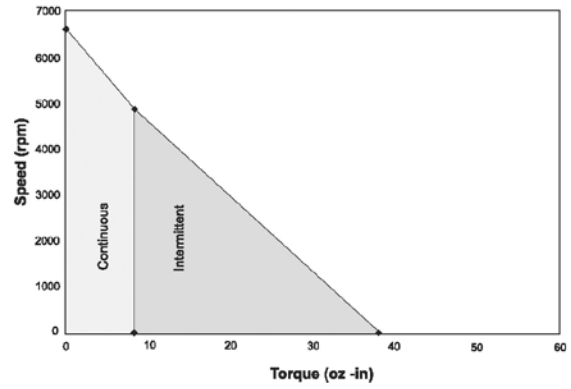
BOF16-11AA-01 Speed-Torque:
Continuous and Intermittent Operation at 12 VDC



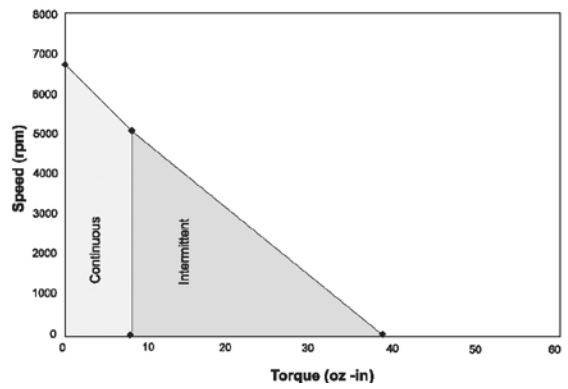
BOF16-11AA-02 Speed-Torque:
Continuous and Intermittent Operation at 24 VDC



BOF16-18AA-01 Speed-Torque:
Continuous and Intermittent Operation at 12 VDC



BOF16-18AA-02 Speed-Torque:
Continuous and Intermittent Operation at 24 VDC



SPECIFICATION AND NUMBERING SYSTEM

Part Numbering System Guide

BOF23 □□□□ □□TFO

BRUSHLESS MOTOR

OUTSIDE ROTOR

FRAME COMMERCIAL DC MOTOR
23 – Size 23

MAGNET TYPE
F – Bonded Ferrite

BASIC MOTOR LENGTH
11 –
19 –
24 –
Refer to motor data table for standard offerings.

MECHANICAL OPTIONS
AA - standard mechanical configuration, consult factory for others

ELECTRICAL
01 – 24 Volts DC
02 – 160 Volts (Rectified AC)

Other voltages and custom windings available

TERMINATION
L – Leads
C – Connector

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

OTHER OPTIONS
E – Encoder
G – Gearhead

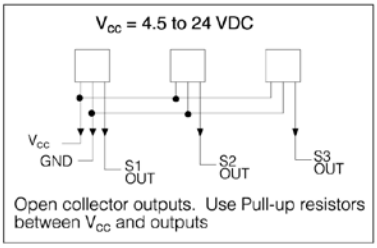
Conversion Table

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

Timing Diagram for Hall Switches

DEGREES														
	ELEC	0	60	120	180	240	300	360	60	120	180	240	300	360
	MECH	0	15	30	45	60	75	90	105	120	135	150	165	180
S1 OUT														
S2 OUT														
S3 OUT														
A COIL		+	+	0	–	–	0	+	+	0	–	–	0	
B COIL		0	–	–	0	+	+	0	–	–	0	+	+	
C COIL		–	0	+	+	0	–	–	0	+	+	0	–	

Hall Effect Switches



Termination Table

PIN NUMBER	CONNECTION	COLOR
1	C COIL	BROWN
2	B COIL	RED
3	A COIL	ORANGE
4	S1 OUT	YELLOW
5	S3 OUT	GREEN
6	S2 OUT	BLUE
7	Vcc	VIOLET
8	GROUND	GRAY

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.

BOF23 SPECIFICATIONS - *Continuous Stall Torque 5.9 - 19.2 oz-in (0.0417 - 0.1356 Nm)*
Peak Torque 33 - 155 oz-in (0.2330 - 1.0945 Nm)

Part Number*		BOF23-11AA-□□TFO		BOF23-19AA-□□TFO		BOF23-24AA-□□TFO	
Winding Code**		01	02	01	02	01	02
L = Length	inches	1.10		1.90		2.40	
	millimeters	27.9		48.3		61.0	
Terminal Voltage	volts DC (nom.)	24.0	160.0	24.0	160.0	24.0	160.0
Peak Torque	oz-in (max.)	33.0	31.0	94.0	90.0	141.0	155.0
	Nm (max.)	0.2330	0.2189	0.6638	0.6355	0.9957	1.0945
Continuous Stall Torque	oz-in (max.)	5.9	6.0	13.6	13.6	18.4	19.2
	Nm (max.)	0.0417	0.0424	0.0960	0.0960	0.1299	0.1356
Rated Speed	RPM	6890.0	6251.0	5387.0	5080.0	5513.0	5582.0
	rad/sec	722	655	564	532	577	585
Rated Torque	oz-in (max.)	5.5	5.6	12.9	13.0	17.4	18.2
	Nm (max.)	0.0388	0.0395	0.0911	0.0918	0.1229	0.1285
Rated Current	Amps	1.90	0.27	3.07	0.44	4.06	0.64
Rated Power	watts	28.0	25.9	51.4	48.8	71.0	75.1
Torque Sensitivity	oz-in/amp +/-10%	3.82	27.20	5.33	37.00	5.39	35.90
	Nm/amp +/-10%	0.0270	0.1921	0.0376	0.2613	0.0381	0.2535
Back EMF	volts/KRPM +/-10%	2.83	20.10	3.94	27.40	3.99	26.60
	volts/rad/sec	0.0270	0.1921	0.0376	0.2613	0.0381	0.2535
Terminal Resistance	ohms +/-10%	2.75	138.00	1.36	65.80	0.91	37.10
Terminal Inductance	mH +/-30%	1.33	67.40	1.06	51.30	0.73	32.20
Motor Constant	oz-in/sq.rt.watt	2.30	2.32	4.57	4.56	5.65	5.89
	Nm/sq.rt.watt	0.01627	0.01635	0.03227	0.03221	0.03990	0.04162
Rotor Inertia	(oz-in-sec^2) x 10^{-3}	5.80	5.80	12.30	12.30	17.50	17.50
	g-cm^2	409.3	409.3	868.0	868.0	1235.0	1235.0
Weight	oz	10.0	10.0	16.0	16.0	21.0	21.0
	gm	284.0	284.0	454.4	454.4	596.4	596.4
# of Poles		8.0	8.0	8.0	8.0	8.0	8.0
Timing		120°	120°	120°	120°	120°	120°
Mech. Time Constant	ms	154.7	153.1	83.3	83.7	77.6	71.3
Elect. Time Constant	ms	0.48	.049	0.78	0.78	0.80	0.87
Thermal Resistivity	°C/watt	6.0	6.1	4.7	4.9	4.0	3.9

Notes:
1. Motor mounted to a 6" x 6" x 1/4" aluminum plate, in still, 25°C ambient air.
2. Maximum winding temperature of 155°C.
3. 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.

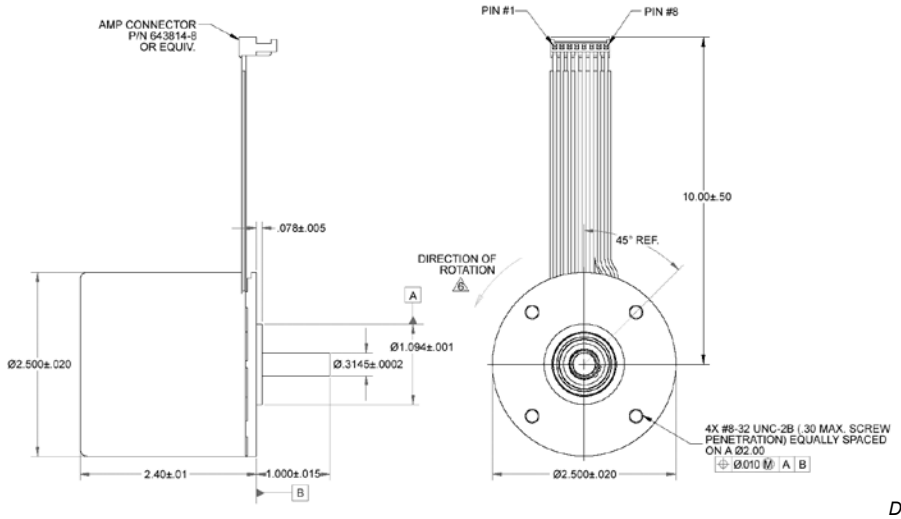
Select your options below and place their code in its corresponding block as shown on page 79.

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

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

O OTHER OPTIONS
E – Encoder
G – Gearhead

BOF23 Typical Outline Drawing

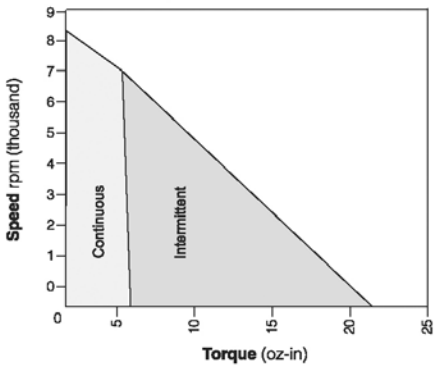


Dimensions are in inches

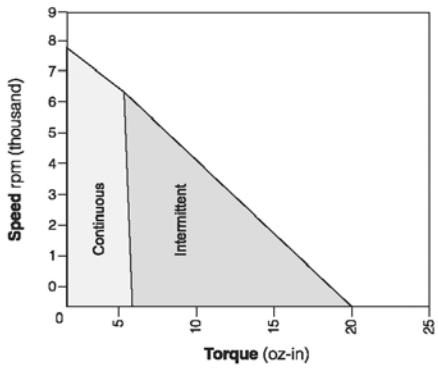
Note: Available with and without cover can.

BOF23 Performance Curves

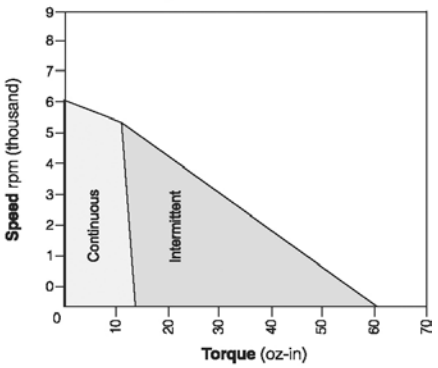
BOF23-11AA-01: Continuous & Intermittent Operation at 24 Volt DC



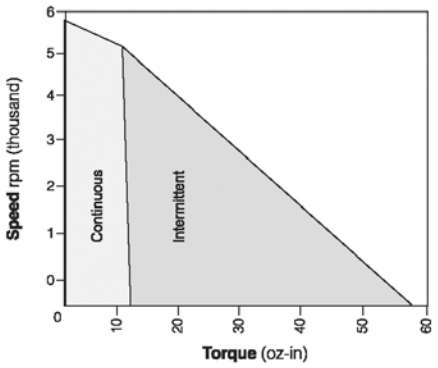
BOF23-11AA-02: Continuous & Intermittent Operation at 160 Volt DC



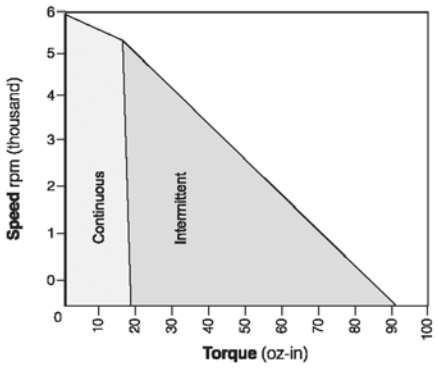
BOF23-19AA-01: Continuous & Intermittent Operation at 24 Volt DC



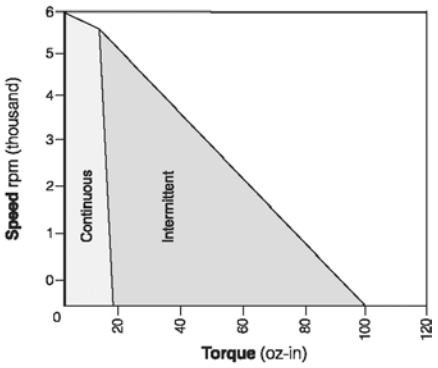
BOF23-19AA-02: Continuous & Intermittent Operation at 160 Volt DC



BOF23-24AA-01: Continuous & Intermittent Operation at 24 Volt DC



BOF23-24AA-02: Continuous & Intermittent Operation at 160 Volt DC



SPECIFICATION AND NUMBERING SYSTEM

Part Numbering System Guide

BOF35 □□ □□ □□ **TFO**

BRUSHLESS MOTOR

OUTSIDE ROTOR

FRAME COMMERCIAL DC MOTOR
35 – Size 35

MAGNET TYPE
F – Bonded Ferrite

BASIC MOTOR LENGTH
20 –
22 – } Refer to motor data table for standard offerings.

MECHANICAL OPTIONS
AA - standard mechanical configuration, consult factory for others

ELECTRICAL
01 – 24 Volts DC
02 – 160 Volts (Rectified AC)

Other voltages and custom windings available

TERMINATION
L – Leads
C – Connector

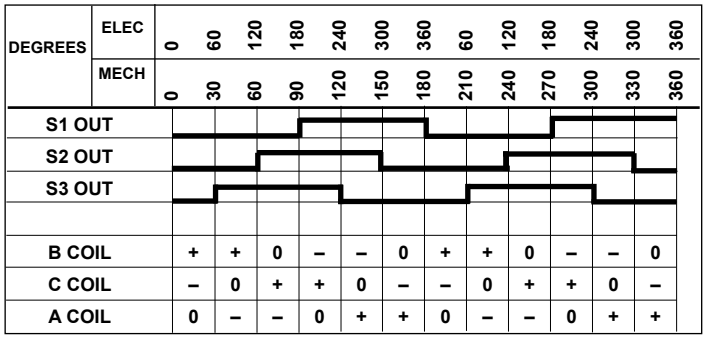
FEEDBACK OPTIONS
H – Hall Effect (std)
S – Sensorless

OTHER OPTIONS
E – Encoder

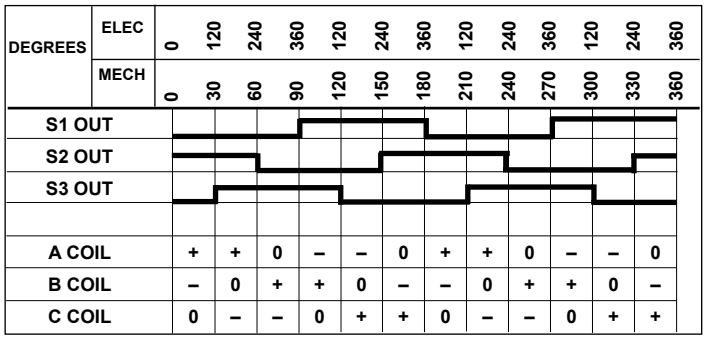
Conversion Table

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

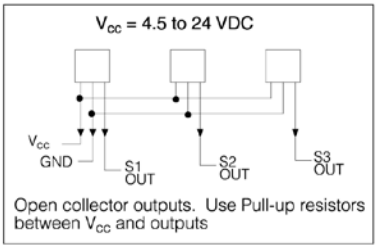
Timing Diagram CCW Shaft Rotation - 4 Poles



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	Vcc	RED
8	GROUND	BROWN

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-□□ T F O		BOF35-22AA-□□ T F O		BOF35-20BA-□□ T F O		BOF35-22BA-□□ T F O	
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^2	53.00	53.00	65.00	65.00	53.00	53.00	65.00	65.00
	g-cm^2	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	ms	283.4	271.8	218.0	209.5	193.8	179.4	155.5	142.2
Electrical Time Constant	ms	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:
1. Motor mounted to a 6" x 6" x 1/4" aluminum plate, in still, 25°C ambient air.
2. Maximum winding temperature of 155°C.
3. 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.

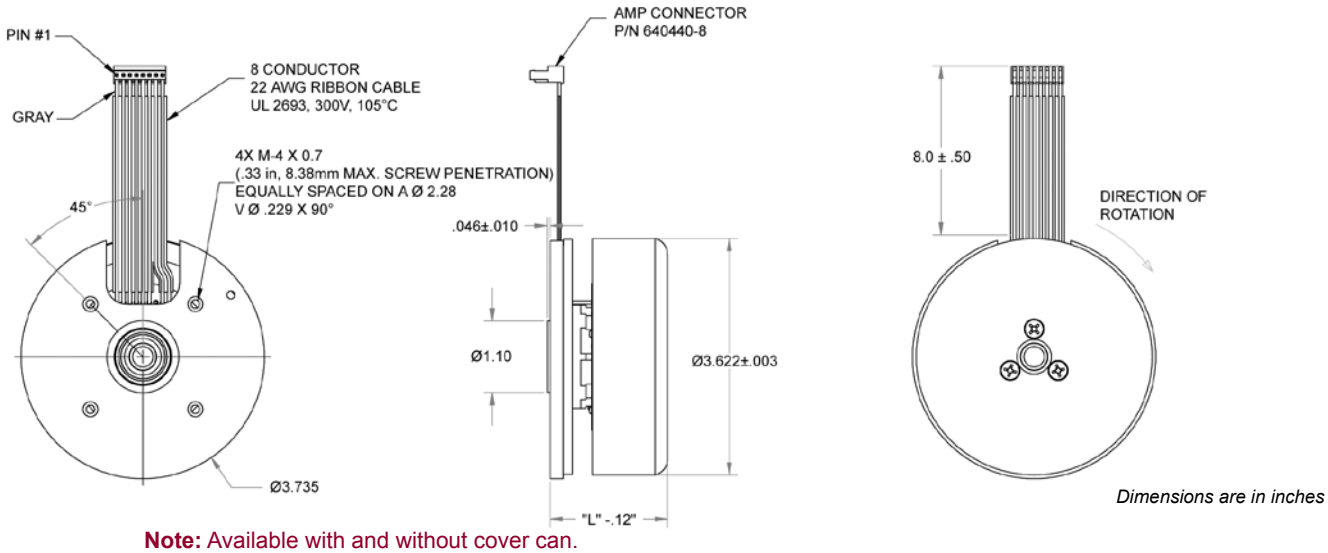
Select your options below and place their code in its corresponding block as shown on page 82.

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

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

O OTHER OPTIONS
E – Encoder
G – Gearhead

BOF35 Typical Outline Drawing

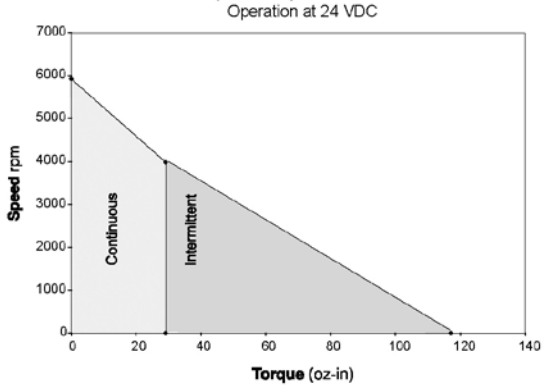


Dimensions are in inches

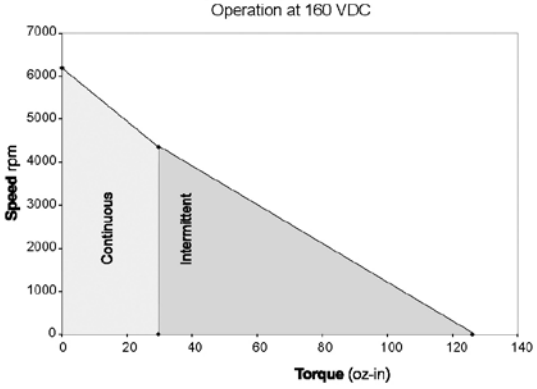
Note: Available with and without cover can.

BOF35 Performance Curves

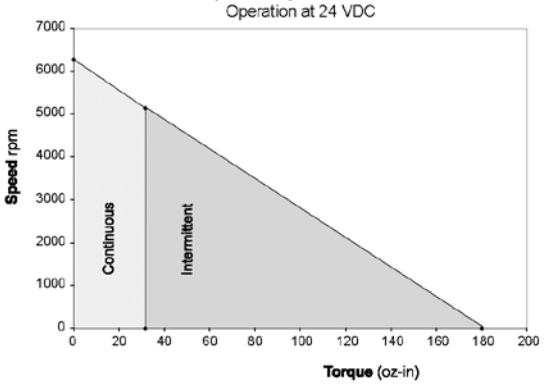
BOF35-20AA-01 Speed-Torque: Continuous and Intermittent Operation at 24 VDC



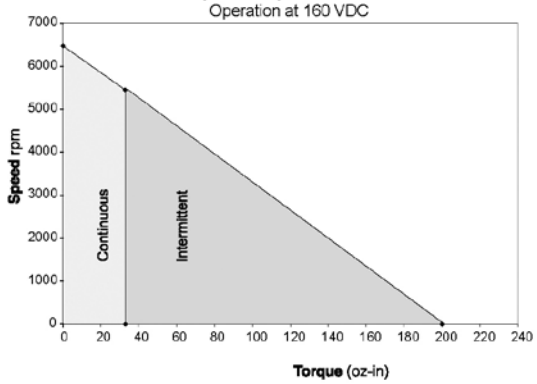
BOF35-20AA-02 Speed-Torque: Continuous and Intermittent Operation at 160 VDC



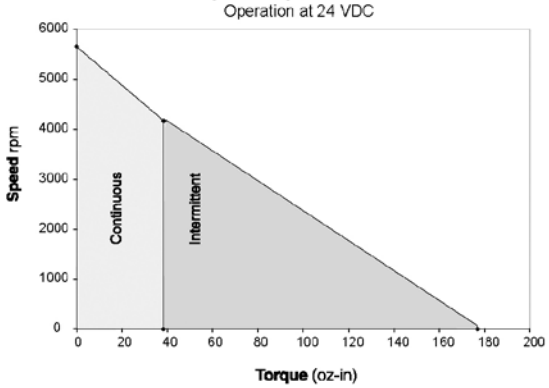
BOF35-20BA-01 Speed-Torque: Continuous and Intermittent Operation at 24 VDC



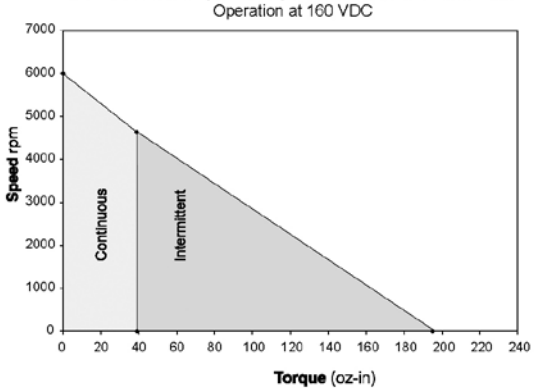
BOF35-20BA-02 Speed-Torque: Continuous and Intermittent Operation at 160 VDC



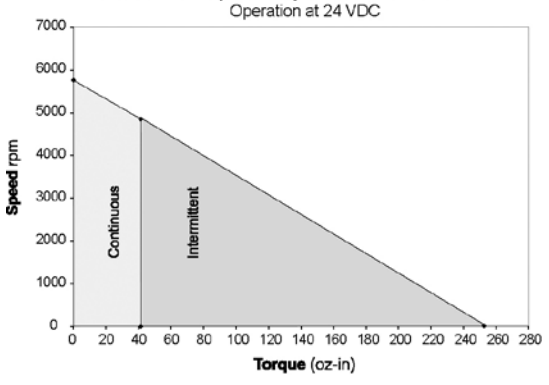
BOF35-22AA-01 Speed-Torque: Continuous and Intermittent Operation at 24 VDC



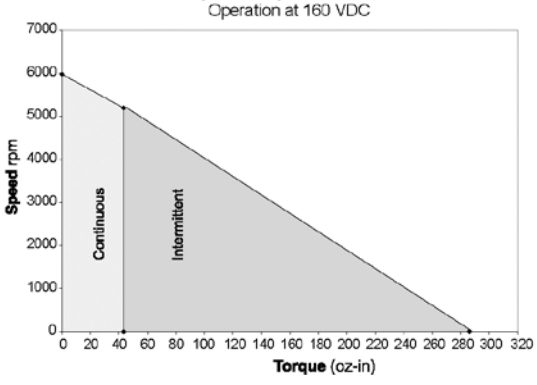
BOF35-22AA-02 Speed-Torque: Continuous and Intermittent Operation at 160 VDC



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



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



Brushless DC Motors

Outside Rotor
Fractional Horsepower

TYPICAL APPLICATIONS

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

FEATURES

- Length – 2.0 inches
- Continuous torques from 58.0 to 76.0 oz-in
- Bonded neodynium 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

BENEFITS

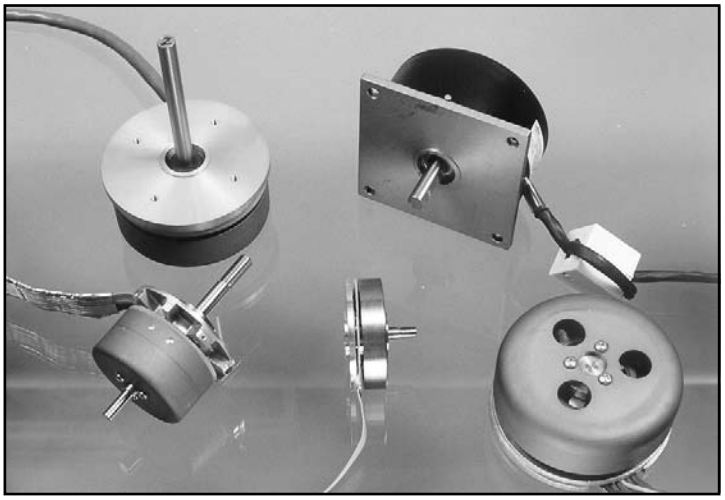
- Operate over a wide range of speeds - not limited to AC frequency
- Extremely quiet operation with long life capability
- Precise, variable speed control
- Motor life is not limited to brush or commutator life
- Efficient operation without losses associated with brushes and commutation or armature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

BON35 Series



Quiet, Brushless Motors

BON 35 motors provide smooth, efficient operation at high speeds. The brushless design ensures low audible noise and long life. Utilizing bonded neodynium magnets, these brushless motors provide excellent performance and value demonstrated by their low cost to high torque ratio. Available 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, BON 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 medical equipment or industrial machines.

We've designed thousands of DC motors, so if our BON 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.

SPECIFICATION AND NUMBERING SYSTEM

Part Numbering System Guide

BON35 □ □ □ □ □ □ **T** **F** **O**

BRUSHLESS MOTOR

OUTSIDE ROTOR

FRAME COMMERCIAL DC MOTOR
35 – Size 35

MAGNET TYPE
N – Bonded Neodymium

BASIC MOTOR LENGTH
20 – Refer to motor data table for standard offerings.

MECHANICAL OPTIONS
AA - standard mechanical configuration, consult factory for others

ELECTRICAL
01 – 48 Volts DC
02 – 160 Volts (Rectified AC)

Other voltages and custom windings available

TERMINATION
L – Leads
C – Connector

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

OTHER OPTIONS
E – Encoder

Conversion Table

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

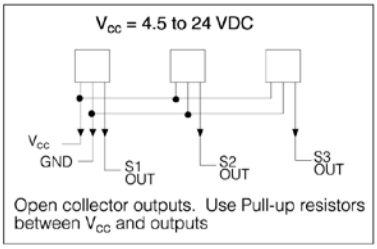
Timing Diagram CCW Shaft Rotation - 4 Poles

DEGREES													
ELEC	0	60	120	180	240	300	360	60	120	180	240	300	360
MECH	0	30	60	90	120	150	180	210	240	270	300	330	360
S1 OUT													
S2 OUT													
S3 OUT													
B COIL	+	+	0	–	–	0	+	+	0	–	–	0	
C COIL	–	0	+	+	0	–	–	0	+	+	0	–	
A COIL	0	–	–	0	+	+	0	–	–	0	+	+	

Timing Diagram CCW Shaft Rotation - 8 Poles

DEGREES													
ELEC	0	120	240	360	120	240	360	120	240	360	120	240	360
MECH	0	30	60	90	120	150	180	210	240	270	300	330	360
S1 OUT													
S2 OUT													
S3 OUT													
A COIL	+	+	0	–	–	0	+	+	0	–	–	0	
B COIL	–	0	+	+	0	–	–	0	+	+	0	–	
C COIL	0	–	–	0	+	+	0	–	–	0	+	+	

Hall Effect Switches



Open collector outputs. Use Pull-up resistors between V_{cc} and outputs

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	Vcc	BROWN
8	GROUND	RED

BON35 SPECIFICATIONS -

Continuous Stall Torque 59.7 - 78.3 oz-in (0.4216 - 0.5529 Nm)
Peak Torque 379 - 806 oz-in (2.6763 - 5.6916 Nm)

Part Number*		BON35-20AA-□□ T F O		BON35-20BA-□□ T F O	
Winding Code**		01	02	01	02
L = Length	inches	2.00		2.00	
	millimeters	50.8		50.8	
Terminal Voltage	volts DC	48.0	160.0	48.0	160.0
Peak Torque	oz-in	379.0	457.0	755.0	806.0
	Nm	2.6763	3.2271	5.3314	5.6916
Continuous Stall Torque	oz-in	59.7	60.3	76.2	78.3
	Nm	0.4216	0.4258	0.5382	0.5529
Rated Speed	RPM	4000.0	4900.00	4000.0	4000.0
	rad/sec	419	513	419	419
Rated Torque	oz-in	58.0	58.5	74.0	76.0
	Nm	0.4096	0.4131	0.5226	0.5367
Rated Current	Amps	5.56	1.95	6.74	2.10
Rated Power	watts	172.0	212.0	219.0	225.0
Torque Sensitivity	oz-in/amp	11.72	33.80	12.44	41.04
	Nm/amp	0.0828	0.2387	0.0878	0.2898
Back EMF	volts/KRPM	8.66	24.99	9.20	30.35
	volts/rad/sec	0.0828	0.2387	0.0878	0.2898
Terminal Resistance	ohms	1.48	11.80	0.79	8.13
Terminal Inductance	mH	2.26	18.78	1.16	12.62
Motor Constant	oz-in/sq.rt.watt	9.63	9.84	14.00	14.39
	Nm/sq.rt.watt	0.06803	0.06948	0.09883	0.10164
Rotor Inertia	oz-in-sec^2	99.00	99.00	99.00	99.00
	g-cm^2	6986.4	6986.4	6986.4	6986.4
Weight	oz	44.1	44.1	42.5	42.5
	g	1251.6	1253.3	1207.9	1207.0
# of Poles		4.0	4.0	8.0	8.0
Timing		60°	60°	120°	120°
Mech. Time Constant	ms	151.0	144.7	71.5	67.6
Electrical Time Constant	ms	1.53	1.59	1.47	1.55
Thermal Resistivity	°C/watt	1.1	1.1	1.0	0.9

Notes:
1. Motor mounted to a 6" x 6" x 1/4" aluminum plate, in still, 25°C ambient air.
2. Maximum winding temperature of 155°C.
3. 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.

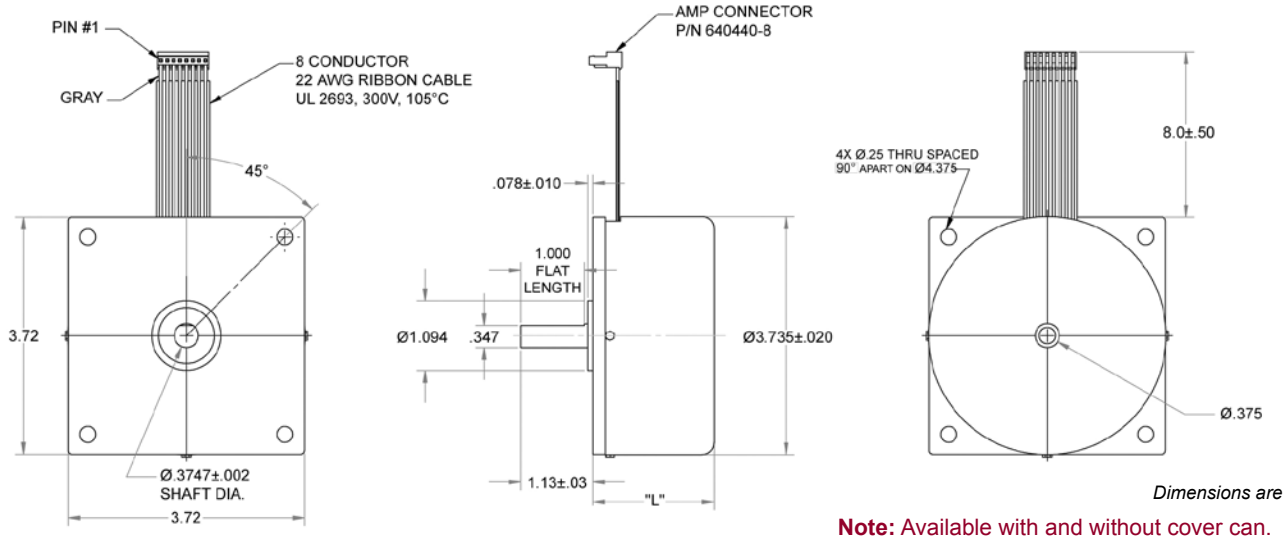
Select your options below and place their code in its corresponding block as shown on page 86.

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

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

O OTHER OPTIONS
E – Encoder
G – Gearhead

BON35 Typical Outline Drawing

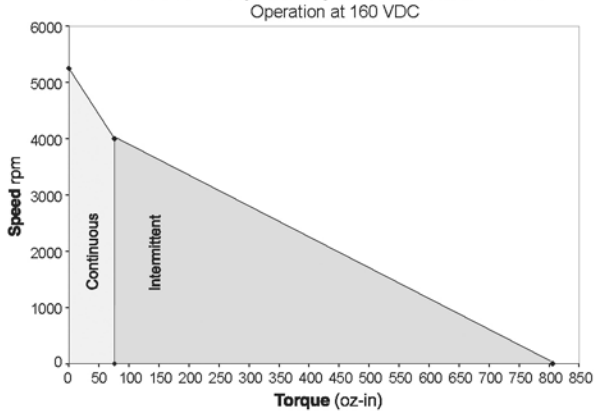


Dimensions are in inches

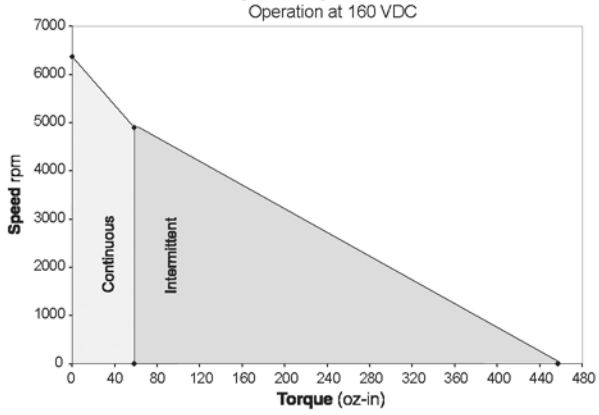
Note: Available with and without cover can.

BON35 Performance Curves

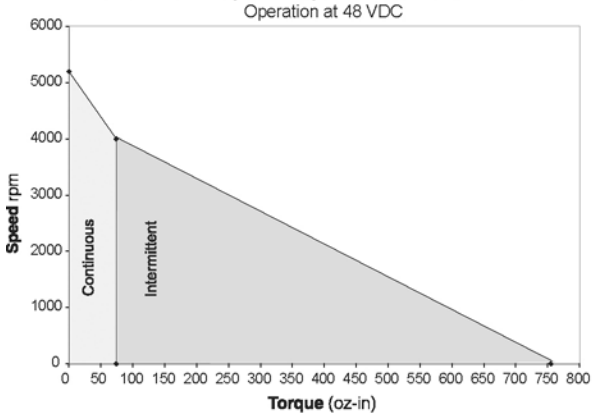
BON35-20BA-02 Speed-Torque: Continuous and Intermittent Operation at 160 VDC



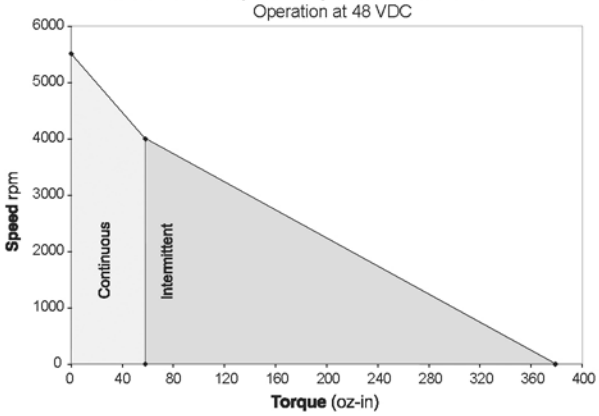
BON35-20AA-02 Speed-Torque: Continuous and Intermittent Operation at 160 VDC



BON35-20BA-01 Speed-Torque: Continuous and Intermittent Operation at 48 VDC



BON35-20AA-01 Speed-Torque: Continuous and Intermittent Operation at 48 VDC



Brushless Torque and Toroidal Motors

TYPICAL APPLICATIONS

- Speed and rotation control systems
- Gimbals for FLIR and inertial navigation systems
- Stabilized gun and fire control systems for combat vehicles
- Fire control radars for land and ship board defense
- Cockpit instrumentation for military and commercial aircraft
- Missile seeker and fin actuator systems
- Space and vacuum instruments, actuation systems and momentum wheels

FEATURES

- 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

Note: *This catalog contains basic marketing information and general part descriptions of Moog Components Group product lines. With respect to the U.S. export regulations, the products described herein are controlled by the U.S. Commerce Department or the U.S. State Department. Contact Moog Components Group for additional detail on the export controls that are applicable to your part.*

Moog Components Group designs and manufactures precision motion technology components and subsystems for defense, aerospace and industrial applications. Our broad range of components includes torque and servomotors, position feedback devices and slip ring / twist capsule products.

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.

For more information about how this product can be tailored to fit your specific application, contact our applications engineers.

Brushless Motors

A brushless DC torque motor is a motor which is electronically commutated and exhibits the linear speed torque characteristic of a conventional DC motor. The performance of the brushless DC motor is dependent on the commutation of current in the motor windings, which is controlled by a separate electronic controller. Most controllers require some type of position feedback for proper operation. Common feedback devices are Hall Effect sensors, resolvers and encoders. Moog Components Group offers all three types, and provides technical assistance in choosing the correct sensor for your application. We offer a wide variey of single and multi-speed resolvers including design to specification.

- Brushless DC motor
- Rapid response, limited travel
- Constant torque sensitivity over the limited excursion angle
- Slotless stator core ensures ripple free torque
- Rare earth magnets
- Windings are encapsulated for ruggedness
- Unhoused or housed
- Can be custom modified to meet specific requirements
- Brushless torque motors range from 0.840 to 16.750 inches O.D. and peak torques up to 103,300 oz-in
- Brushless designs *(no commutator and flex leads)* can be available in the above mechanical configurations

Design Considerations

All diameters listed have finished, ground lamination surfaces. They can be complemented with rings and hubs for mounting convenience.

Moog Components Group torque motors are normally delivered in frameless kit form.

If you require a housing that may also include bearings, torquer motor, synchro, potentiometer, or similar components, we can design the entire assembly to meet your mechanical dimensions and performance requirements.

Electrical Considerations

For each mechanical configuration shown, different winding designs to modify torque, torque sensitivity, DC resistance, and so on, can be supplied by Moog Components Group to suit your system requirement. In each case, you have the option of selecting one of the existing designs or specifying a new winding designed to meet your special requirements. If your power source (voltage or current) is limited, the mathematical relationships shown to the right in Table 1 will allow you to calculate a particular performance characteristic (for those listed) at the voltage or power capability of your existing power supply.

Mounting Considerations

Since torque motors are normally delivered in kit form, you provide the mounting surfaces and bearings. When you design the mechanics of the mount, be sure to observe these rules:

1. Eccentricities from the inner member mounting surface should not exceed 0.002 inches for Alnico designs and 0.004 for rare earth motor designs.
2. Surfaces in contact with the permanent magnet portion of the motor must be non-magnetic (Alnico motors only).
3. The bore of the mounting surface should be perpendicular to the mounting seat within 0.001 inch for Alnico designs and 0.002 for rare earth designs.

Table 1

PARAMETER	SYMBOL	UNITS	RELATIONSHIP TO PUBLISHED PARAMETER
Electrical Time Constant	τ_E	ms	L_M / R_M
Mechanical Time Constant	τ_M	ms	$\frac{J_M \cdot R_M}{K_E \cdot K_T}$
Power Input, Stalled At Peak Torque (25°C)	P_P	watts	$V_P \cdot I_P$
Viscous Damping Coefficients			$\frac{K_T \cdot K_E}{R_M}$
Zero Source Impedance	F_O	oz-in per rad/s	
Infinite Source Impedance	F_I	oz-in per rad/s	Small % of F_O
[1] Motor Friction Torque (Actual)	T_F	oz-in	T_F
Maximum Power Rate	$\dot{P}$	oz-in/s^2	T_P^2 / J_M
Maximum Theoretical Acceleration	α_M	rad/s^2	T_P / J_M
Theoretical No Load Speed	ω_{NL}	rad/s	V_P / K_E

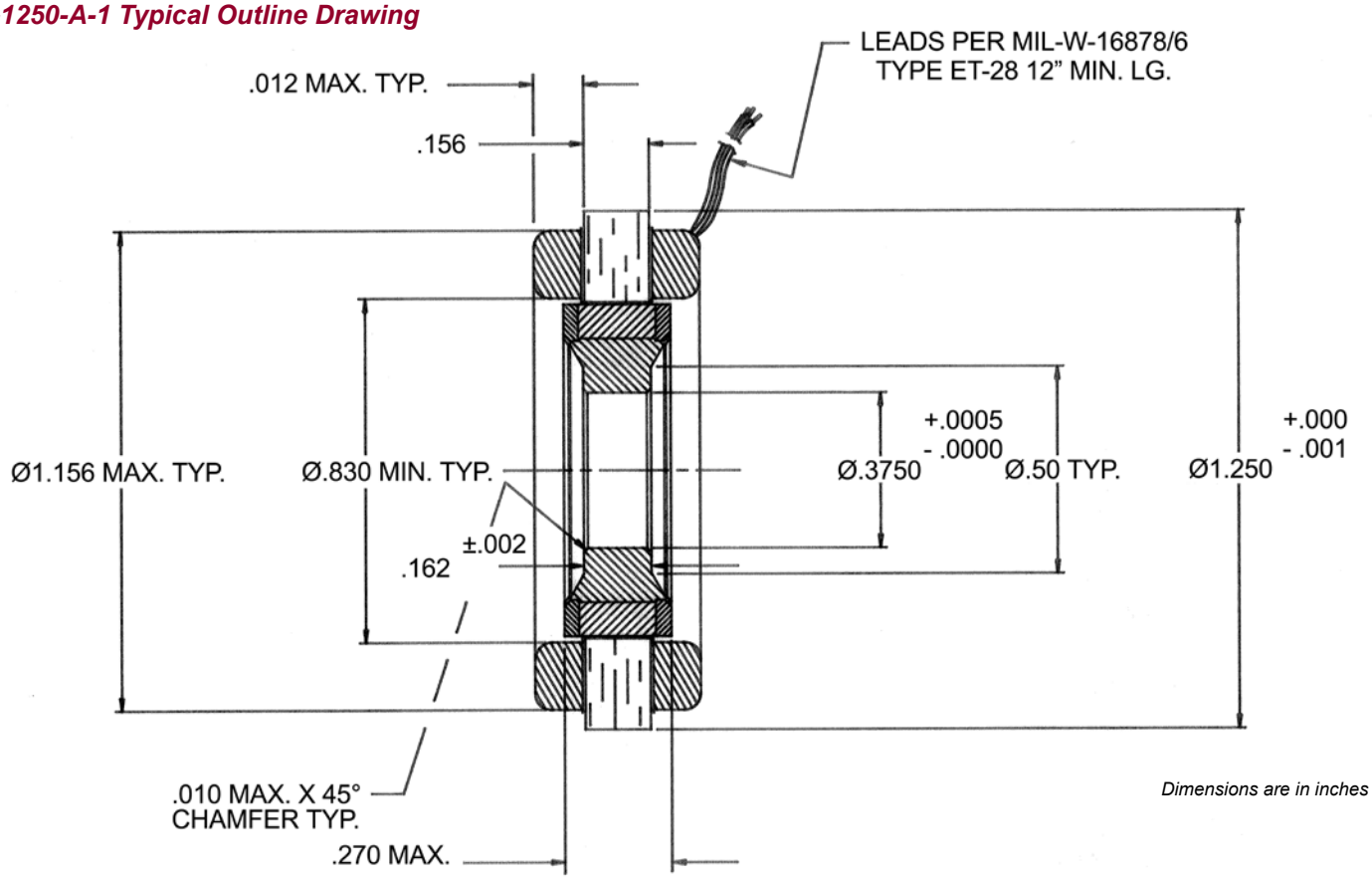
[1] T_F is specified as a maximum value that includes magnetic detent or cogging torque and bearing friction where applicable.

The following frame sizes represent only a small sampling of the total range manufactured. Consult factory for additional designs. Refer to our online documentation for product updates.

DB-1250-A-1 SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	1.4	oz-in
Motor Constant, K_M	1.11	oz-in/√W
Number of Poles	8	
Number of Phases	3"Δ"	
Weight	1	oz (nom)
Motor Inertia, J_M	1.22E-04	oz-in-s^2
Friction Torque, T_F	0.35	oz-in
Electrical Time Constant, τ_E	0.09	ms
Mechanical Time Constant, τ_M	14.10	ms
Temperature Rise, Housed TPR'	29.6	°C/W
Integral Feedback Device	None	
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	7	oz-in/amp
Back EMF, K_E	0.049	V per rad/s
Terminal Resistance, R_M	40	ohms (nom)
Terminal Inductance, L_M	3.7	mH (nom)
Voltage, Stalled at Peak Torque, V_P	8	volts
Amps at Peak Torque, I_P	0.20	amps

DB-1250-A-1 Typical Outline Drawing

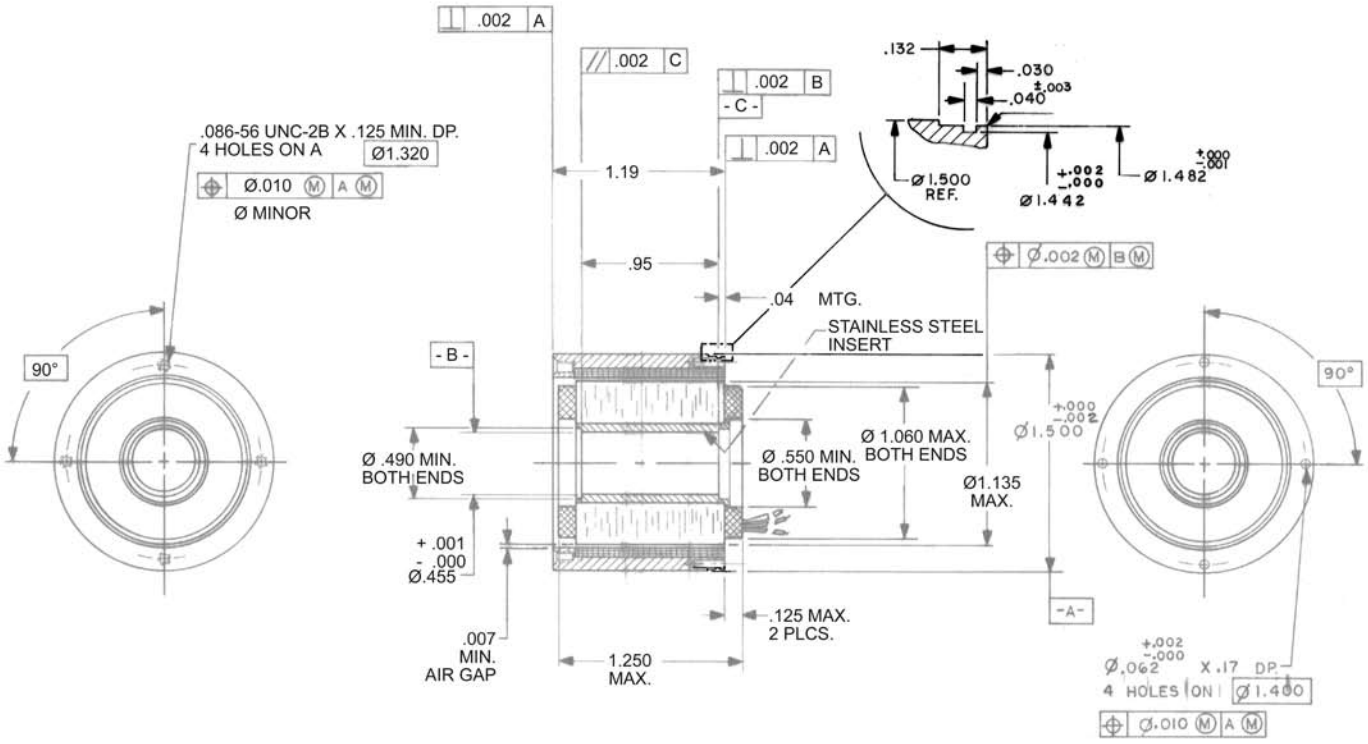


Dimensions are in inches

DB-1500-G-4 SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	53	oz-in
Motor Constant, K_M	6.27	oz-in/√W
Number of Poles	8	
Number of Phases	3"Y"	
Weight	7	oz (nom)
Motor Inertia, J_M	4.53E-03	oz-in-s^2
Friction Torque, T_F	1	oz-in
Electrical Time Constant, τ_E	0.47	ms
Mechanical Time Constant, τ_M	16.31	ms
Temperature Rise, Housed TPR'	9.8	°C/W
Integral Feedback Device	None	
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	11.9	oz-in/amp
Back EMF, K_E	0.084	V per rad/s
Terminal Resistance, R_M	3.6	ohms (nom)
Terminal Inductance, L_M	1.7	mH (nom)
Voltage, Stalled at Peak Torque, V_P	16.1	volts
Amps at Peak Torque, I_P	4.46	amps

DB-1500-G-4 Typical Outline Drawing

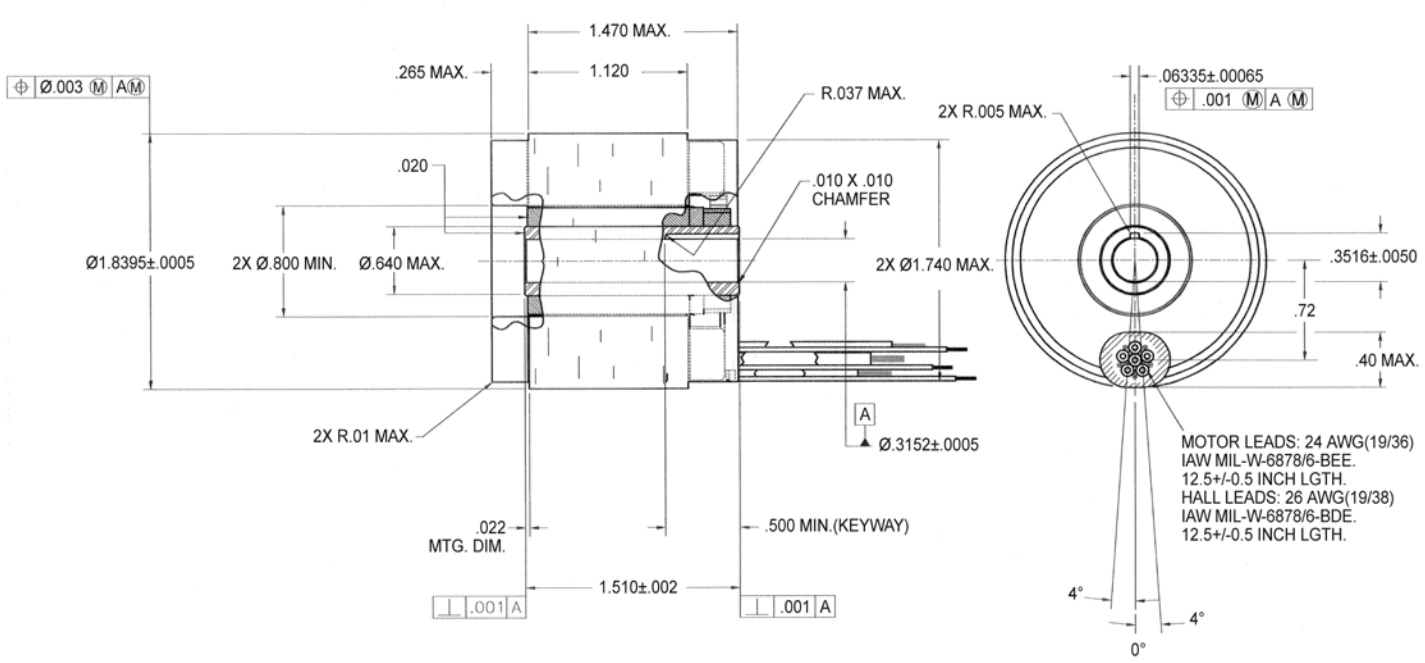


Dimensions are in inches

DB-1840-C-1S / K057 SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	243.9	oz-in
Motor Constant, K_M	11.85	oz-in/√W
Number of Poles	6	
Number of Phases	3"Y"	
Weight	14	oz (nom)
Motor Inertia, J_M	4.80E-04	oz-in-s^2
Friction Torque, T_F	1.8	oz-in
Electrical Time Constant, τ_E	0.884	ms
Mechanical Time Constant, τ_M	0.48	ms
Temperature Rise, Housed TPR'	2	°C/W
Integral Feedback Device	Halls	
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	7.77	oz-in/amp
Back EMF, K_E	0.055	V per rad/s
Terminal Resistance, R_M	0.43	ohms (nom)
Terminal Inductance, L_M	0.38	mH (nom)
Voltage, Stalled at Peak Torque, V_P	13.5	volts
Amps at Peak Torque, I_P	31.4	amps

DB-1840-C-1S / K057 Typical Outline Drawing

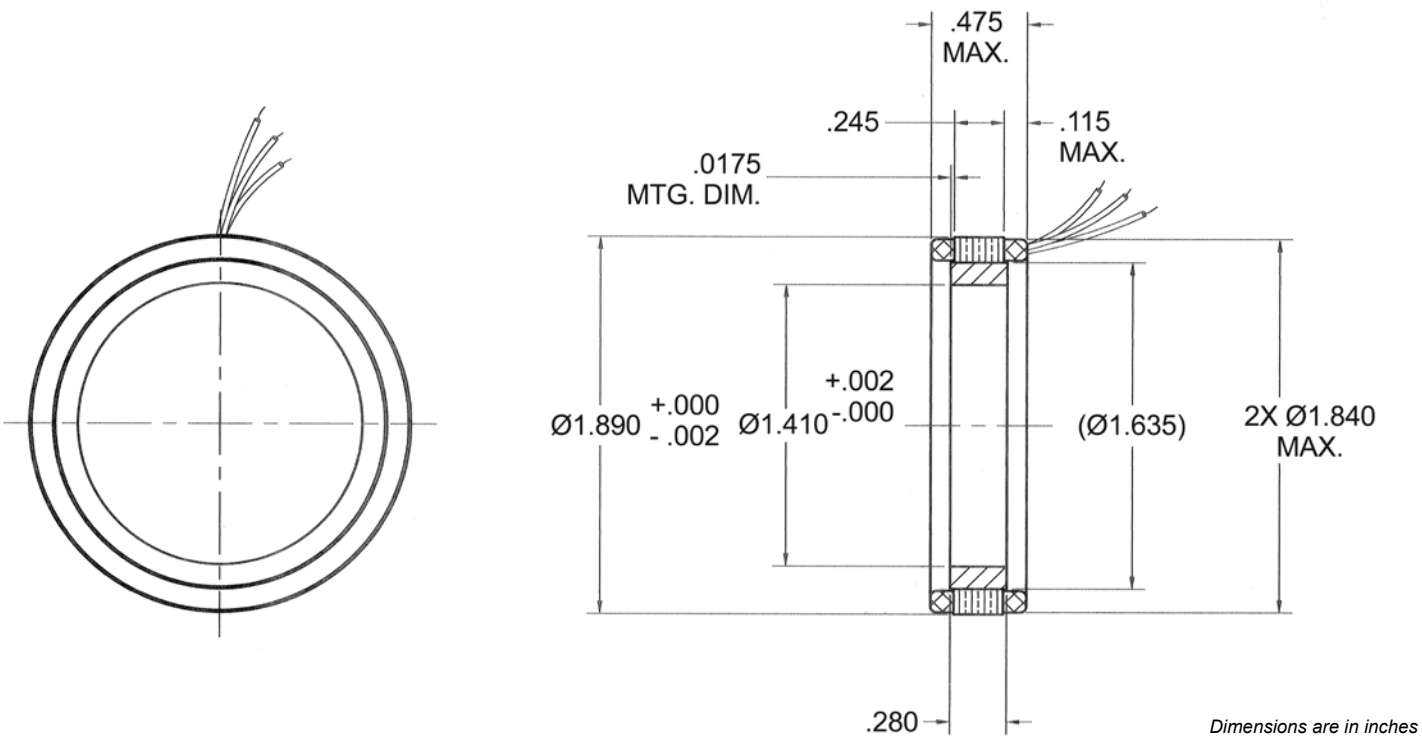


Dimensions are in inches

DB-1890-A-1S SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	45	oz-in
Motor Constant, K_M	2.52	oz-in/√W
Number of Poles	16	
Number of Phases	3"Y"	
Weight	1.8	oz (nom)
Motor Inertia, J_M	9.00E-04	oz-in-s^2
Friction Torque, T_F	2.0	oz-in
Electrical Time Constant, τ_E	0.04	ms
Mechanical Time Constant, τ_M	20.11	ms
Temperature Rise, Housed TPR'	18.5	°C/W
Sensors	No	
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	3.90	oz-in/amp
Back EMF, K_E	0.028	V per rad/s
Terminal Resistance, R_M	2.40	ohms (nom)
Terminal Inductance, L_M	0.11	mH (nom)
Voltage, Stalled at Peak Torque, V_P	27.8	volts
Amps at Peak Torque, I_P	11.6	amps

DB-1890-A-1S Typical Outline Drawing

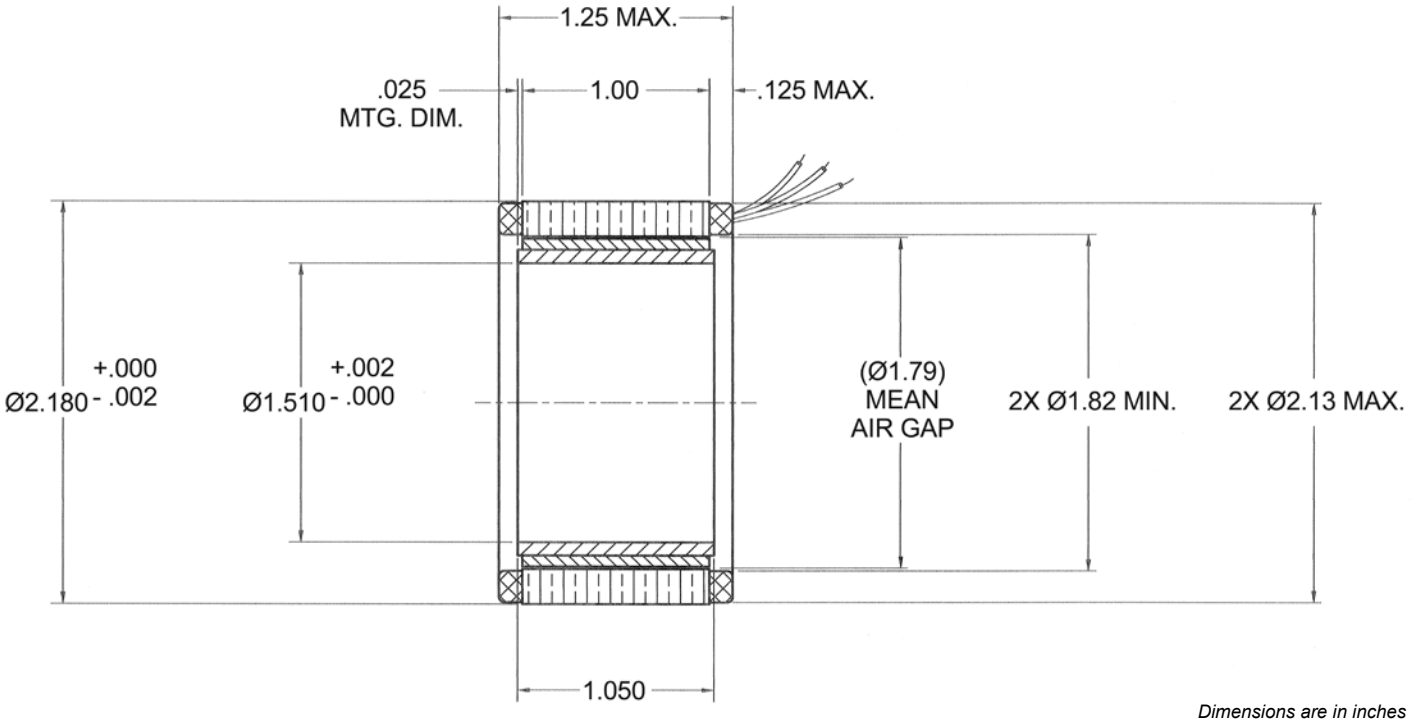


Dimensions are in inches

DB-2180-A-1S SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	230	oz-in
Motor Constant, K_M	13.9	oz-in/√W
Number of Poles	16	
Number of Phases	3"Y"	
Weight	8	oz (nom)
Motor Inertia, J_M	5.00E-03	oz-in-s^2
Friction Torque, T_F	4.0	oz-in
Electrical Time Constant, τ_E	0.17	ms
Mechanical Time Constant, τ_M	3.65	ms
Temperature Rise, Housed TPR'	5.5	°C/W
Sensors	No	
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	19.2	oz-in/amp
Back EMF, K_E	0.136	V per rad/s
Terminal Resistance, R_M	1.90	ohms (nom)
Terminal Inductance, L_M	0.32	mH (nom)
Voltage, Stalled at Peak Torque, V_P	22.8	volts
Amps at Peak Torque, I_P	12.0	amps

DB-2180-A-1S Typical Outline Drawing

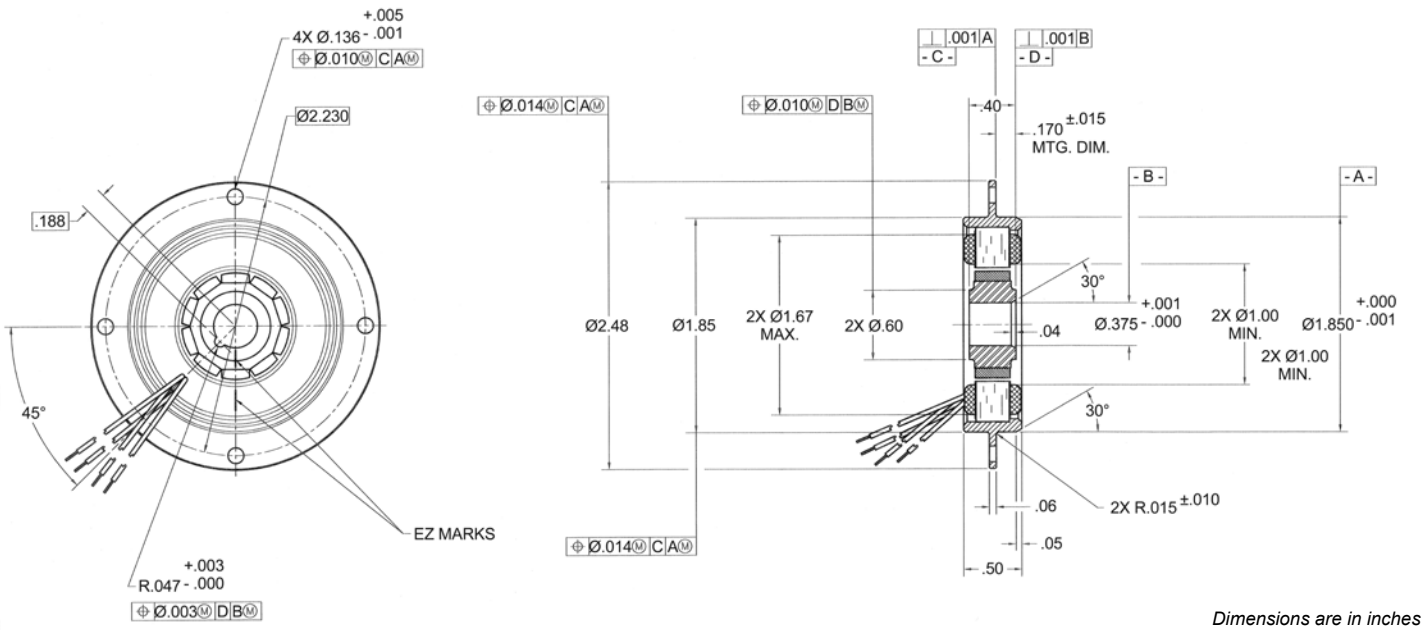


Dimensions are in inches

DB-2480-A-1ES SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	7.4	oz-in
Motor Constant, K_M	2.73	oz-in/√W
Number of Poles	10	
Number of Phases	1"Y"	
Weight	3.3	oz (nom)
Motor Inertia, J_M	2.90E-04	oz-in-s^2
Friction Torque, T_F	0.30	oz-in
Electrical Time Constant, τ_E	0.27	ms
Mechanical Time Constant, τ_M	5.52	ms
Temperature Rise, Housed TPR'	14.4	°C/W
Sensors	No	
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	49.0	oz-in/amp
Back EMF, K_E	0.346	V per rad/s
Terminal Resistance, R_M	323	ohms (nom)
Terminal Inductance, L_M	88	mH (nom)
Voltage, Stalled at Peak Torque, V_P	48.5	volts
Amps at Peak Torque, I_P	0.15	amps

DB-2480-A-1ES Typical Outline Drawing

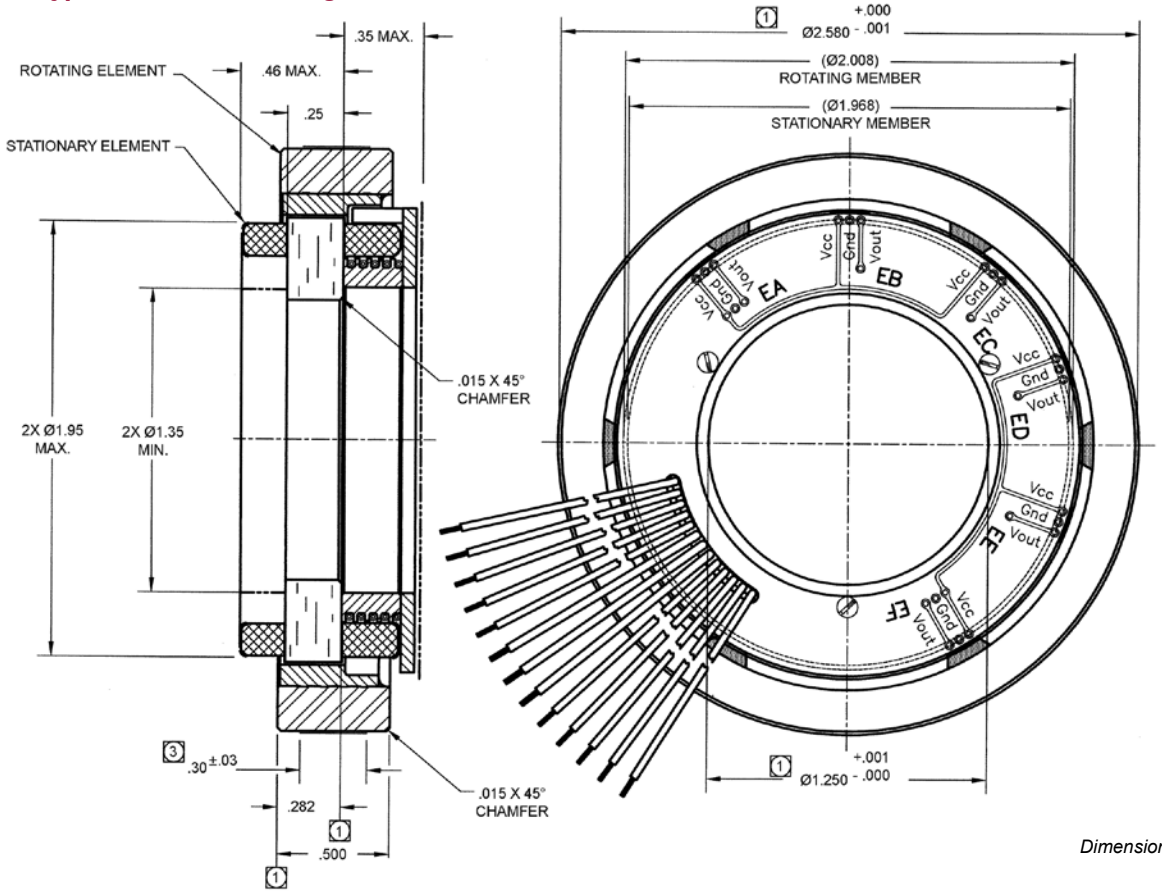


Dimensions are in inches

DB-2580-A-1S SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	46	oz-in
Motor Constant, K_M	2.56	oz-in/√W
Number of Poles	6	
Number of Phases	3"Y"	
Weight	7.8	oz (nom)
Motor Inertia, J_M	1.58E-02	oz-in-s^2
Friction Torque, T_F	0.50	oz-in
Electrical Time Constant, τ_E	0.42	ms
Mechanical Time Constant, τ_M	342.44	ms
Temperature Rise, Housed TPR'	12.5	°C/W
Sensors	Yes	
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	2.80	oz-in/amp
Back EMF, K_E	0.020	V per rad/s
Terminal Resistance, R_M	1.20	ohms (nom)
Terminal Inductance, L_M	0.50	mH (nom)
Voltage, Stalled at Peak Torque, V_P	19.5	volts
Amps at Peak Torque, I_P	16.25	amps

DB-2580-A-1S Typical Outline Drawing

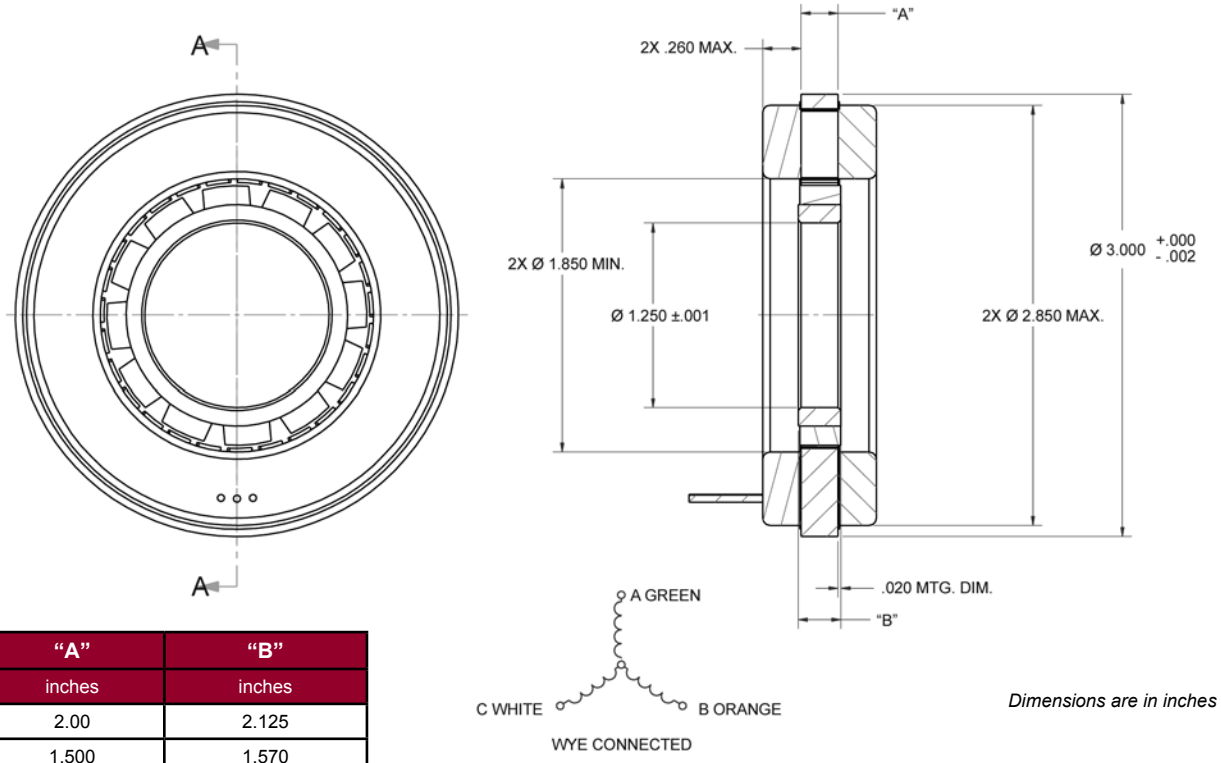


Dimensions are in inches

DB-3000 SERIES SPECIFICATIONS @ 25°C

Part Number		DB-3000-F-1ES	DB-3000-G-1ES	DB-3000-H-1ES	DB-3000-J-1ES	DB-3000-K-1ES	DB-3000-L-1ES
Size Constants	**Units**						
Peak Torque, T_P	oz-in	151	302	454	604	909	1210
Motor Constant, K_M	oz-in/√W	10.4	18.7	25.8	31.8	42.4	51.2
Number of Poles		12	12	12	12	12	12
Number of Phases		3	3	3	3	3	3
Weight	oz (nom)	8	13	18	22	31	41
Motor Inertia, J_M	oz-in-s^2	2.11E-03	4.17E-03	6.25E-03	8.32E-03	1.17E-02	1.58E-02
Friction Torque, T_F	oz-in	3.0	5.0	8.0	10	16	20
Electrical Time Constant, τ_E	ms	0.7	1.1	1.4	1.6	1.9	2.0
Mechanical Time Constant, τ_M	ms	2.76487	1.68976	1.33105	1.16256	0.92031	0.85420
Temperature Rise, Housed TPR'	°C/W	6.3	5.0	4.1	3.5	2.7	2.2
Sensors		No	No	No	No	No	No
Winding Constants	**Units**						
Torque Sensitivity, K_T	oz-in/amp	15.1	30.2	45.4	60.4	90.9	121
Back EMF, K_E	V per rad/s	0.107	0.213	0.321	0.427	0.642	0.855
Terminal Resistance, R_M	ohms (nom)	2.11	2.61	3.10	3.60	4.59	5.59
Terminal Inductance, L_M	mH (nom)	1.4	2.9	4.3	5.7	8.6	11
Voltage, Stalled at Peak Torque, V_P	volts	21.1	26.1	31.0	36.0	45.9	55.9
Amps at Peak Torque, I_P	amps	10	10	10	10	10	10

DB-3000 Series Typical Outline Drawing



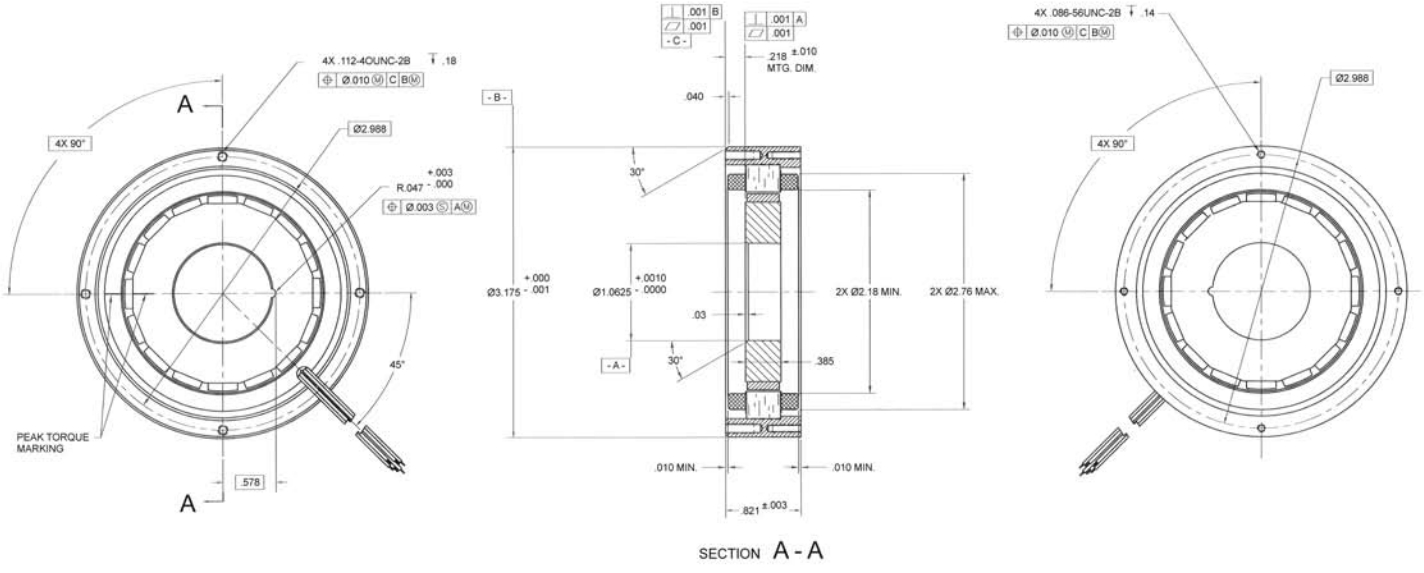
Modular	"A"	"B"
	inches	inches
DB-3000-L-1ES	2.00	2.125
DB-3000-K-1ES	1.500	1.570
DB-3000-J-1ES	1.000	1.120
DB-3000-H-1ES	.750	.845
DB-3000-G-1ES	.500	.565
DB-3000-F-1ES	.250	.290

Dimensions are in inches

DB-3175-A-1ES SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	54	oz-in
Motor Constant, K_M	7.38	oz-in/√W
Number of Poles	16	
Number of Phases	2"Y"	
Weight	12	oz (nom)
Motor Inertia, J_M	8.30E-02	oz-in-s^2
Friction Torque, T_F	1.5	oz-in
Electrical Time Constant, τ_E	0.15	ms
Mechanical Time Constant, τ_M	21.60	ms
Temperature Rise, Housed TPR'	7.7	°C/W
Sensors	No	
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	68.0	oz-in/amp
Back EMF, K_E	0.480	V per rad/s
Terminal Resistance, R_M	85.0	ohms (nom)
Terminal Inductance, L_M	13	mH (nom)
Voltage, Stalled at Peak Torque, V_P	68.0	volts
Amps at Peak Torque, I_P	0.800	amps

DB-3175-A-1ES Typical Outline Drawing

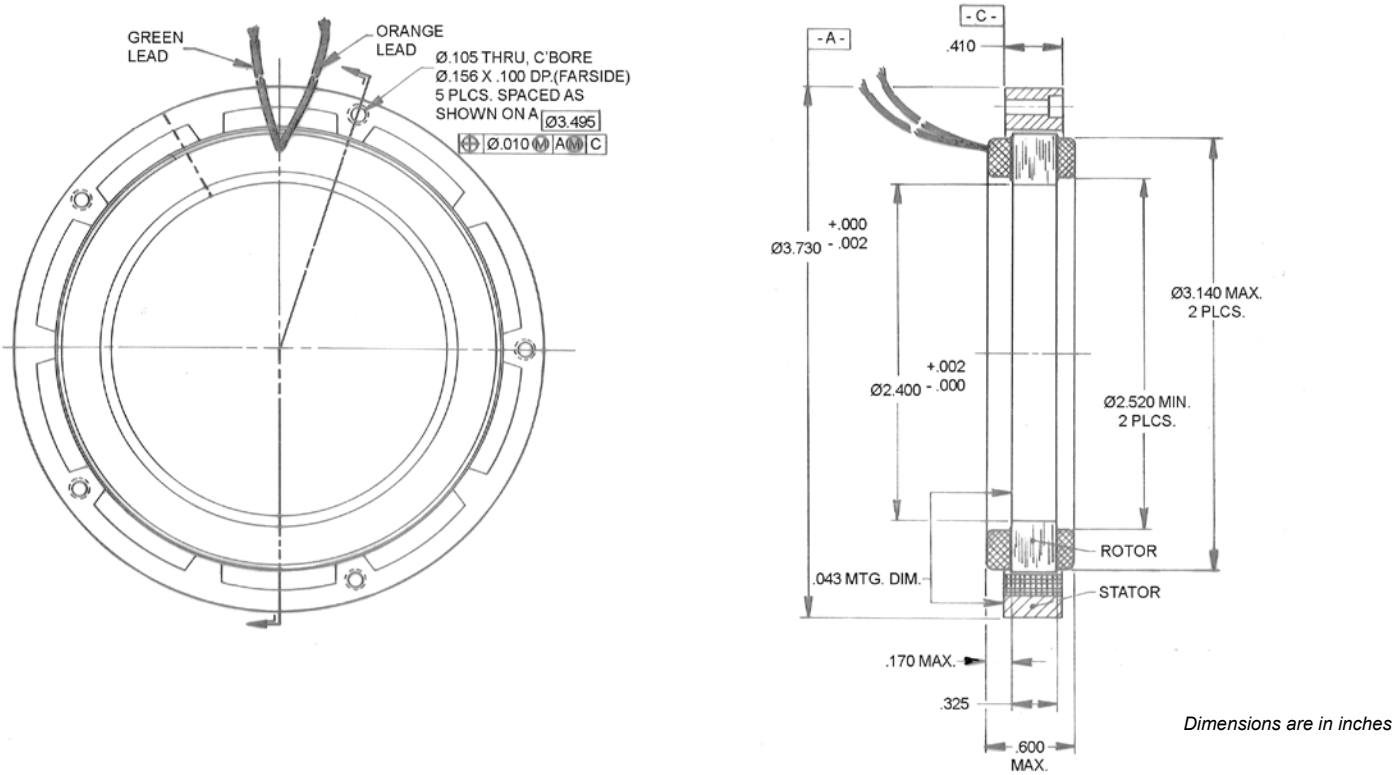


Dimensions are in inches

DB-3730-B-1ES SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	179	oz-in
Motor Constant, K_M	14.9	oz-in/√W
Number of Poles	10	
Number of Phases	1"Y"	
Weight	11.3	oz (nom)
Motor Inertia, J_M	2.60E-02	oz-in-s^2
Friction Torque, T_F	4.5	oz-in
Electrical Time Constant, τ_E	0.33	ms
Mechanical Time Constant, τ_M	16.67	ms
Temperature Rise, Housed TPR'	5.9	°C/W
Sensors	No	
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	47.0	oz-in/amp
Back EMF, K_E	0.332	V per rad/s
Terminal Resistance, R_M	10.0	ohms (nom)
Terminal Inductance, L_M	3.3	mH (nom)
Voltage, Stalled at Peak Torque, V_P	38.1	volts
Amps at Peak Torque, I_P	3.81	amps

DB-3730-B-1ES Typical Outline Drawing

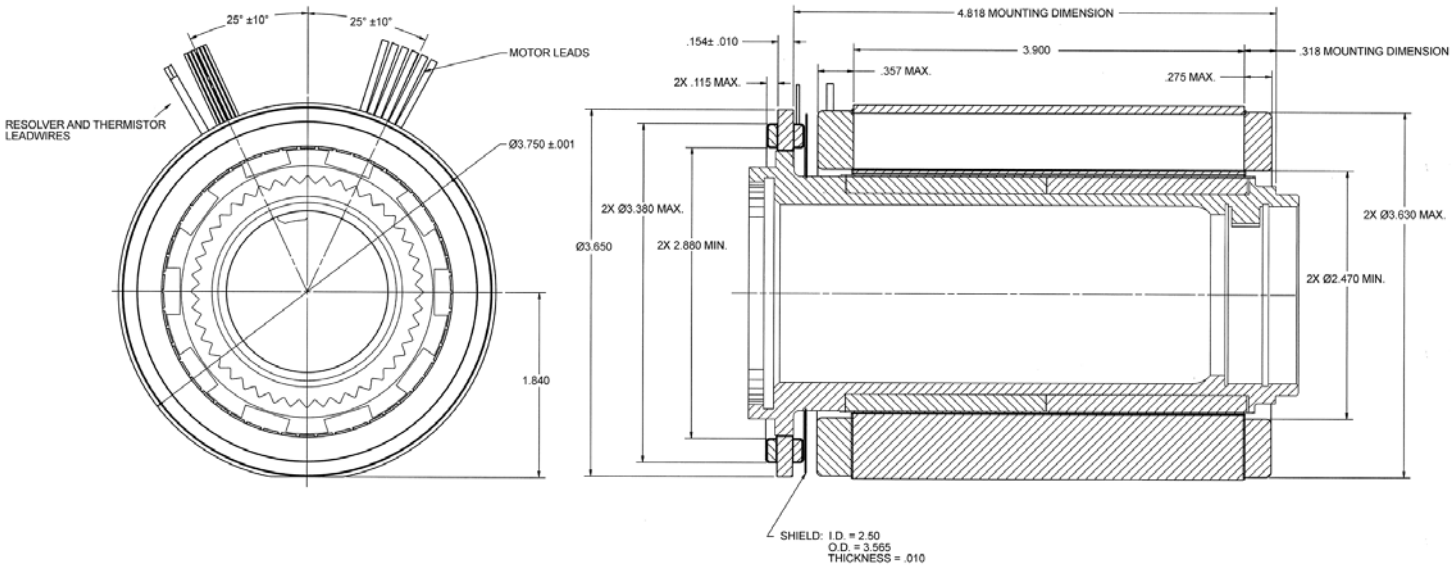


Dimensions are in inches

DB-3750-A-2ES SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	5840	oz-in
Motor Constant, K_M	115	oz-in/√W
Number of Poles	20	
Number of Phases	3"Y"	
Weight	115	oz (nom)
Motor Inertia, J_M	8.78E-02	oz-in-s^2
Friction Torque, T_F	26	oz-in
Electrical Time Constant, τ_E	1.75	ms
Mechanical Time Constant, τ_M	0.93	ms
Temperature Rise, Housed TPR'	1.0	°C/W
Sensors	No	
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	146	oz-in/amp
Back EMF, K_E	1.03	V per rad/s
Terminal Resistance, R_M	1.60	ohms (nom)
Terminal Inductance, L_M	2.8	mH (nom)
Voltage, Stalled at Peak Torque, V_P	64.0	volts
Amps at Peak Torque, I_P	40.0	amps

DB-3750-A-2ES Typical Outline Drawing



Dimensions are in inches

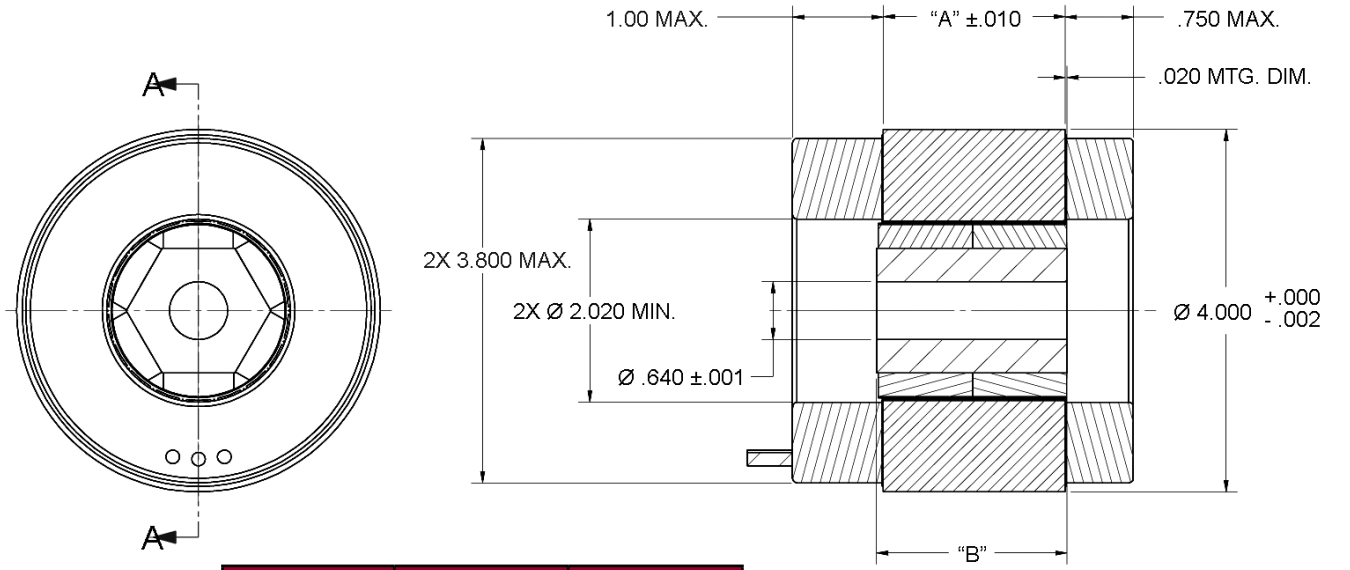
DB-4000 SERIES SPECIFICATIONS @ 25°C

Part Number		DB-4000-B-1ES	DB-4000-C-1ES	DB-4000-D-1ES	DB-4000-E-1ES
Size Constants	**Units**				
Peak Torque, T_P	oz-in	2000	3000	4000	5000
Motor Constant, K_M	oz-in/√W	67.2	91.0	111.5	129.7
Number of Poles		6	6	6	6
Number of Phases		3	3	3	3
Weight	oz (nom)	5.9	8.5	11.1	13.6
Motor Inertia, J_M	oz-in-s^2	3.65E-02	5.50E-02	7.35E-02	9.20E-02
Friction Torque, T_F	oz-in	10	15	20	25
Electrical Time Constant, τ_E	ms	3.27	3.92	4.44	4.76
Mechanical Time Constant, τ_M	ms	1.15	0.94	0.84	0.77
Temperature Rise, Housed TPR'	°C/W	1.6	1.2	1.0	0.8
Winding Constants	**Units**				
Torque Sensitivity, K_T*	oz-in/amp	66.5	99.7	132.9	166.1
Back EMF, K_E	V per rad/s	0.469	0.704	0.938	1.173
Terminal Resistance, R_M	ohms (nom)	0.98	1.20	1.42	1.64
Terminal Inductance, L_M	mH (nom)	3.2	4.7	6.3	7.8
Voltage, Stalled at Peak Torque, V_P	volts	29.5	36.0	42.6	49.4
Amps at Peak Torque, I_P	amps	30.1	30.0	30.0	30.1

Integral Horsepower Design Maximums: 650 VDC, 12,000 RPM, 7% Kt roll off at Ip

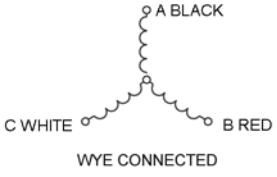
**For Six-Step Excitation*

DB-4000 Series Typical Outline Drawing



Modular	"A"	"B"
	inches	inches
DB-4000-B-1ES	2.000	2.095
DB-4000-C-1ES	3.000	3.136
DB-4000-D-1ES	4.000	4.180
DB-4000-E-1ES	5.000	5.222

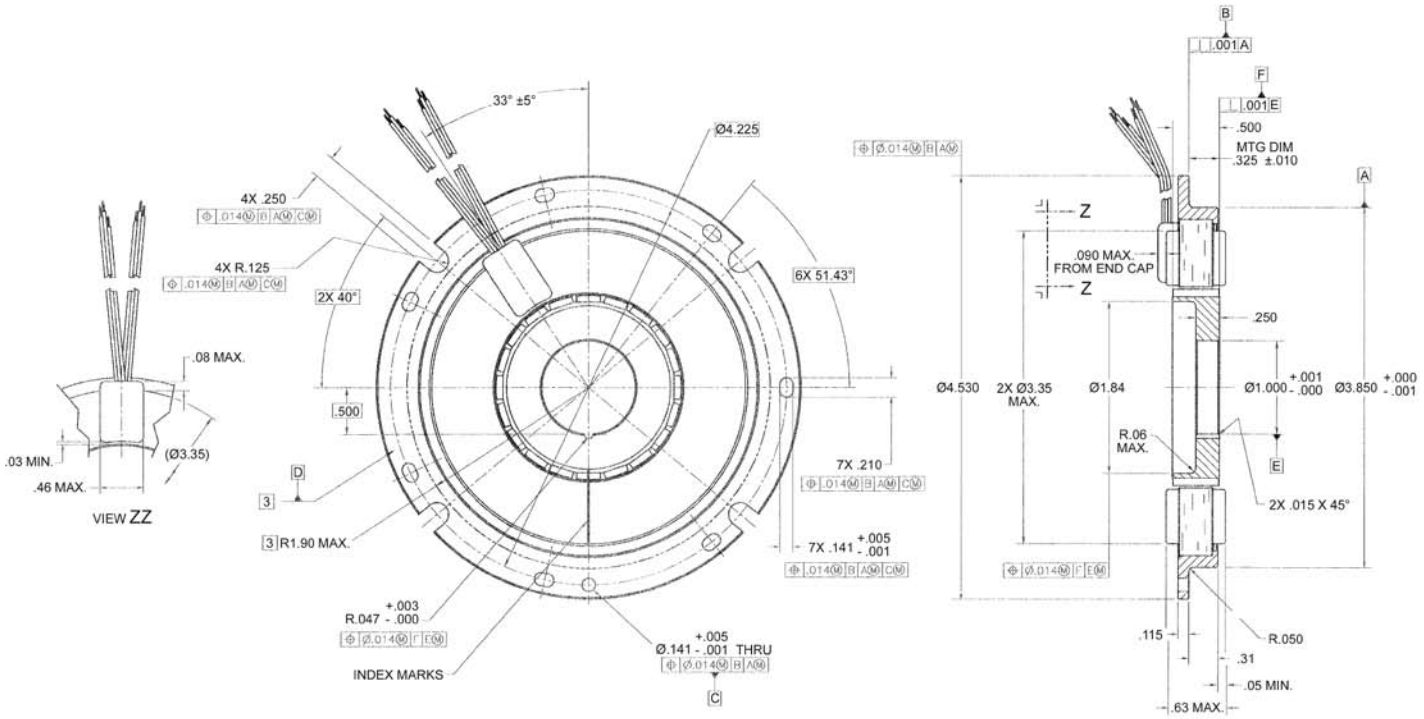
SECTION A - A



DB-4530-A-1ES SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	192.7	oz-in
Motor Constant, K_M	16.14	oz-in/√W
Number of Poles	20	
Number of Phases	2	
Weight	17	oz (nom)
Motor Inertia, J_M	7.80E-03	oz-in-s^2
Friction Torque, T_F	2	oz-in
Electrical Time Constant, τ_E	0.450	ms
Mechanical Time Constant, τ_M	4.24	ms
Temperature Rise, Housed TPR'	1.5	°C/W
Integral Feedback Device	None	
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	250	oz-in/amp
Back EMF, K_E	1.765	V per rad/s
Terminal Resistance, R_M	240	ohms (nom)
Terminal Inductance, L_M	108	mH (nom)
Voltage, Stalled at Peak Torque, V_P	185	volts
Amps at Peak Torque, I_P	0.77	amps

DB-4530-A-1ES Typical Outline Drawing

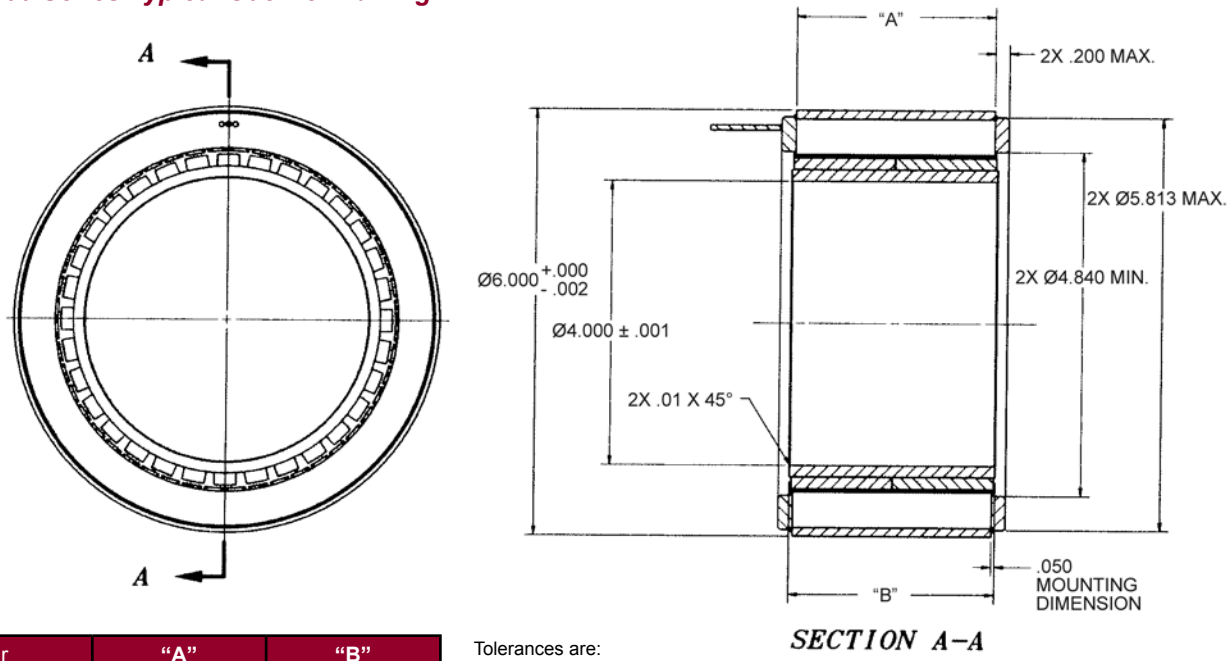


Dimensions are in inches

DB-6000 SERIES SPECIFICATIONS @ 25°C

Part Number		DB-6000-B-2ES	DB-6000-C-2ES	DB-6000-D-2ES	DB-6000-E-2ES	DB-6000-F-2ES	DB-6000-G-2ES
Size Constants	**Units**						
Peak Torque, T_P	oz-in	10083	8407	6727	5048	3368	1686
Motor Constant, K_M	oz-in/√W	270	243	213	178	137	84
Number of Poles		32	32	32	32	32	32
Number of Phases		3	3	3	3	3	3
Weight	oz (nom)	156	136	110	84.6	59.1	33.7
Motor Inertia, J_M	oz-in-s^2	0.637	0.532	0.427	0.321	0.216	0.111
Friction Torque, T_F	oz-in	125	104	83	62	42	20
Electrical Time Constant, τ_E	ms	1.92	1.87	1.76	1.65	1.47	0.99
Mechanical Time Constant, τ_M	ms	1.24	1.27	1.34	1.43	1.62	2.24
Temperature Rise, Housed TPR'	°C/W	0.72	0.90	1.1	1.3	1.7	2.4
Sensors		No	No	No	No	No	No
Winding Constants	**Units**						
Torque Sensitivity, K_T	oz-in/amp	504	420	336	252	168	84.3
Back EMF, K_E	V per rad/s	3.56	2.97	2.38	1.78	1.19	0.60
Terminal Resistance, R_M	ohms (nom)	3.49	2.99	2.50	2.00	1.50	1.01
Terminal Inductance, L_M	mH (nom)	6.7	5.6	4.4	3.3	2.2	1.0
Voltage, Stalled at Peak Torque, V_P	volts	69.8	59.8	50.0	40.0	30.0	20.2
Amps at Peak Torque, I_P	amps	20	20	20	20	20	20

DB-6000 Series Typical Outline Drawing



Modular	"A"	"B"
	inches	inches
DB-6000-B-2ES	2.950	3.050
DB-6000-C-2ES	2.450	2.550
DB-6000-D-2ES	1.950	2.050
DB-6000-E-2ES	1.450	1.550
DB-6000-F-2ES	0.950	1.050
DB-6000-G-2ES	0.450	0.550

Tolerances are:
Angles ± 0.5
.XXX ± .005
.XX ± .01
.X ± .03

Dimensions are in inches

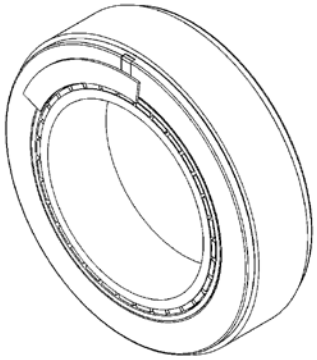
Dimensions and tolerances are inaccordance with ASME Y14.5 - 1994

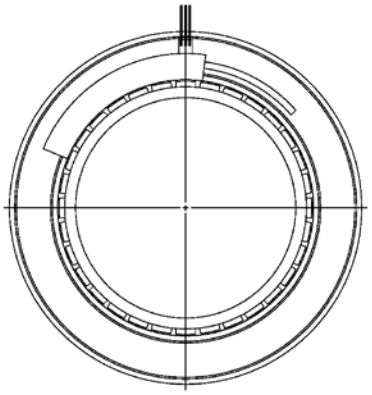
Unless otherwise Specified
Finish: E.S. 411
For machined surfaces

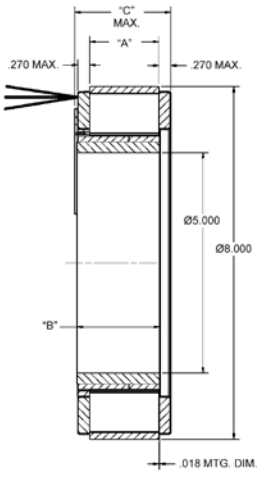
DB-8000 SERIES SPECIFICATIONS @ 25°C

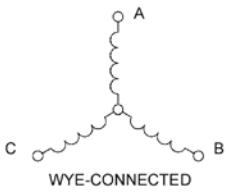
Part Number		DB-8000-A-1ES	DB-8000-B-1ES	DB-8000-C-1ES	DB-8000-D-1ES	DB-8000-E-1ES
Size Constants	**Units**					
Peak Torque, T_P	oz-in	3619	7204	11177	14394	17979
Motor Constant, K_M	oz-in/√W	149	250	337	396	456
Number of Poles		32	32	32	32	32
Number of Phases		3	3	3	3	3
Weight	oz (nom)	83.2	144	211	266	328
Motor Inertia, J_M	oz-in-s^2	0.356	0.581	0.934	1.16	1.42
Friction Torque, T_F	oz-in	48	96	150	192	240
Electrical Time Constant, τ_E	ms	0.50	0.69	0.80	0.87	0.90
Mechanical Time Constant, τ_M	ms	2.27	1.32	1.17	1.04	0.97
Temperature Rise, Housed TPR'	°C/W	1.3	1.0	0.83	0.71	0.62
Sensors		Yes	Yes	Yes	Yes	Yes
Winding Constants	**Units**					
Torque Sensitivity, K_T	oz-in/amp	250	493	760	979	1223
Back EMF, K_E	V per rad/s	1.76	3.48	5.37	6.92	8.64
Terminal Resistance, R_M	ohms (nom)	2.80	3.90	5.10	6.10	7.20
Terminal Inductance, L_M	mH (nom)	1.4	2.7	4.1	5.3	6.5
Voltage, Stalled at Peak Torque, V_P	volts	40.6	56.9	75.0	89.7	106
Amps at Peak Torque, I_P	amps	14.5	14.6	14.7	14.7	14.7

DB-8000 Series Typical Outline Drawing









Dimensions are in inches

Modular	"A"	"B"	"C"
	inches	inches	inches
DB-8000-A-1ES	0.520	0.715	1.20
DB-8000-B-1ES	1.020	1.165	1.700
DB-8000-C-1ES	1.570	1.873	2.250
DB-8000-D-1ES	2.020	2.323	2.700
DB-8000-E-1ES	2.520	2.839	3.200

Tolerances are:
Angles ± 0.5
.XXX ± .005
.XX ± .01
.X ± .03

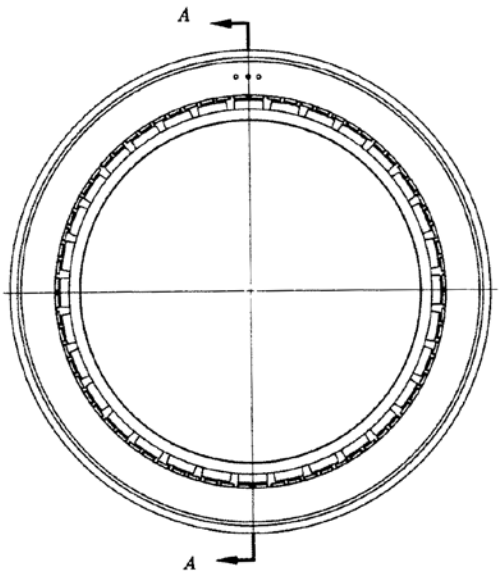
Dimensions and tolerances are inaccordance with ASME Y14.5 - 1994

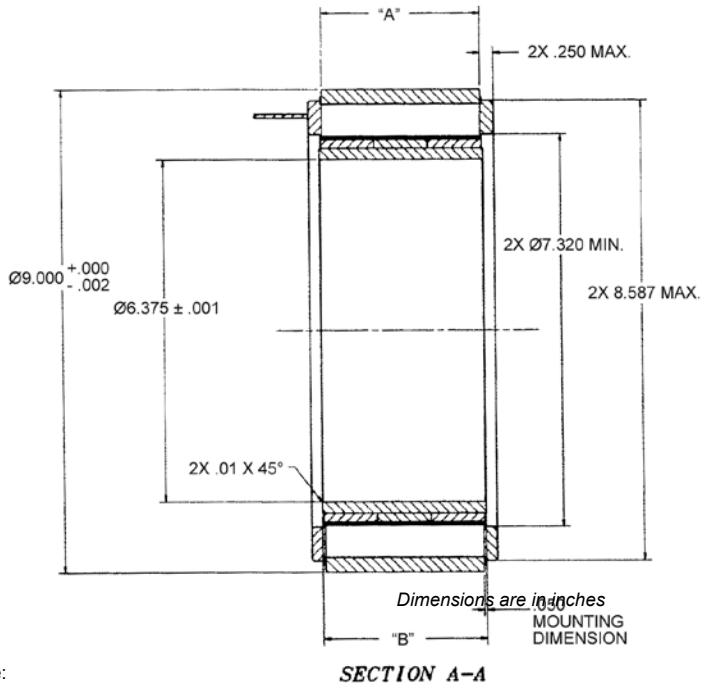
Unless otherwise Specified
Finish: E.S. 411
For machined surfaces

DB-9000 SERIES SPECIFICATIONS @ 25°C

Part Number		DB-9000-G-2ES	DB-9000-H-2ES	DB-9000-I-2ES	DB-9000-J-2ES	DB-9000-K-2ES
Size Constants	**Units**					
Peak Torque, T_P	oz-in	5102	10232	15338	25560	30665
Motor Constant, K_M	oz-in/√W	176	304	405	568	636
Number of Poles		32	32	32	32	32
Number of Phases		3	3	3	3	3
Weight	oz (nom)	75	131	188	301	357
Motor Inertia, J_M	oz-in-s^2	0.518	1.01	1.50	2.47	2.96
Friction Torque, T_F	oz-in	53	112	171	289	348
Electrical Time Constant, τ_E	ms	1.24	1.94	2.35	2.76	2.93
Mechanical Time Constant, τ_M	ms	2.36	1.55	1.29	1.09	1.04
Temperature Rise, Housed TPR'	°C/W	1.3	0.99	0.79	0.57	0.50
Sensors		No	No	No	No	No
Winding Constants	**Units**					
Torque Sensitivity, K_T	oz-in/amp	255	512	767	1278	1533
Back EMF, K_E	V per rad/s	1.80	3.61	5.42	9.03	10.8
Terminal Resistance, R_M	ohms (nom)	2.09	2.83	3.58	5.07	5.81
Terminal Inductance, L_M	mH (nom)	2.6	5.5	8.4	14	17
Voltage, Stalled at Peak Torque, V_P	volts	41.8	56.6	71.6	101	116
Amps at Peak Torque, I_P	amps	20	20	20	20	20

DB-9000 Series Typical Outline Drawing





Dimensions are in inches

Modular	"A"	"B"
	inches	inches
DB-9000-G-2ES	0.450	0.550
DB-9000-H-2ES	0.950	1.050
DB-9000-I-2ES	1.450	1.550
DB-9000-J-2ES	2.450	2.550
DB-9000-K-2ES	2.950	3.050

Tolerances are:
Angles ± 0.5
.XXX ± .005
.XX ± .01
.X ± .03

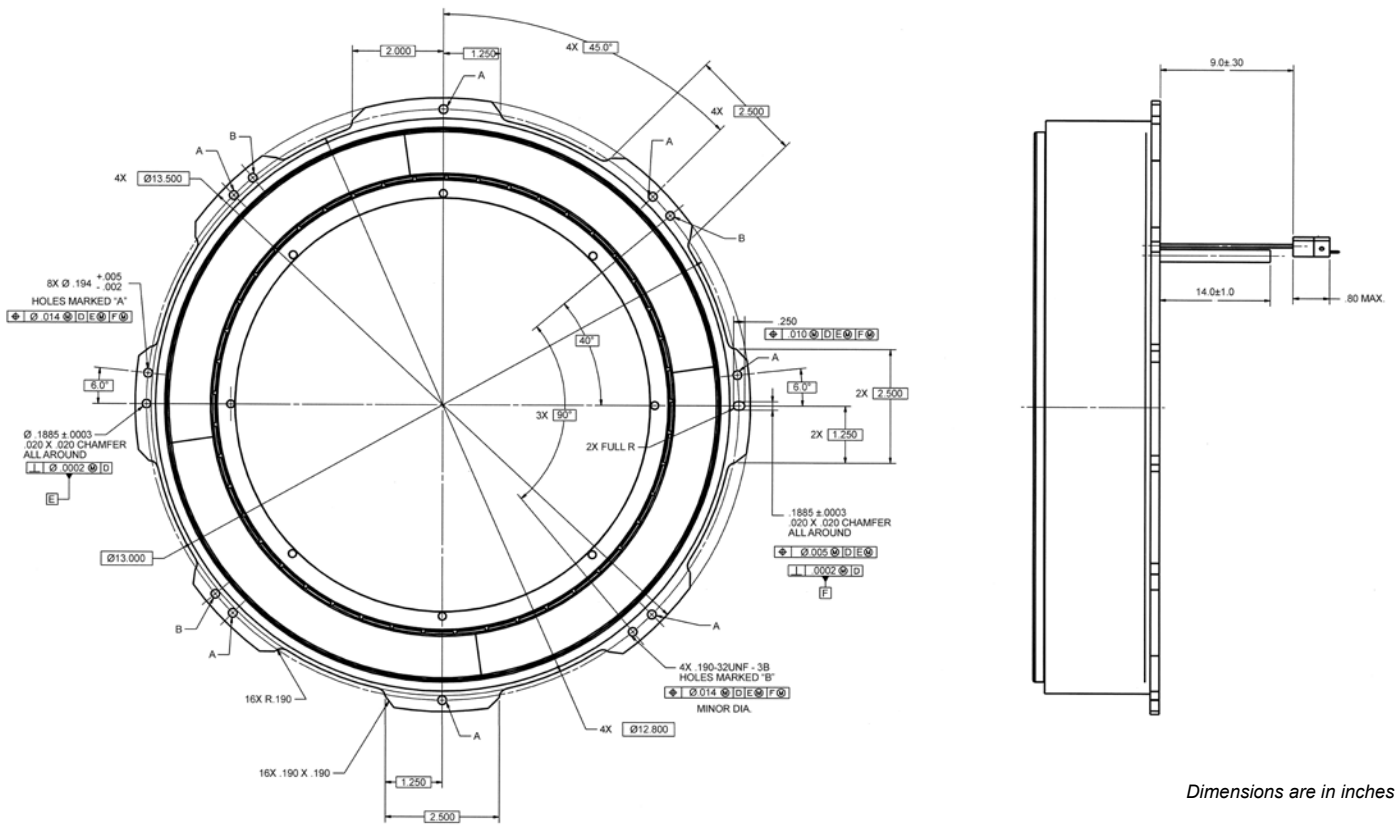
Dimensions and tolerances are inaccordance with ASME Y14.5 - 1994

Unless otherwise Specified
Finish: E.S. 411
For machined surfaces

DB-12600-A-1ESC SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	21248	oz-in
Motor Constant, K_M	973	oz-in/√W
Number of Poles	32	
Number of Phases	3"Y"	
Weight	528	oz (nom)
Motor Inertia, J_M	7.14	oz-in-s^2
Friction Torque, T_F	96	oz-in
Electrical Time Constant, τ_E	4.83	ms
Mechanical Time Constant, τ_M	1.07	ms
Temperature Rise, Housed TPR'	0.43	°C/W
Sensors	No	
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	2656	oz-in/amp
Back EMF, K_E	18.8	V per rad/s
Terminal Resistance, R_M	7.45	ohms (nom)
Terminal Inductance, L_M	36	mH (nom)
Voltage, Stalled at Peak Torque, V_P	60	volts
Amps at Peak Torque, I_P	8.0	amps

DB-12600-A-1ESC Typical Outline Drawing

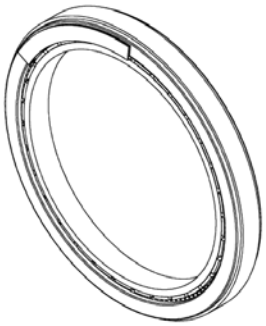


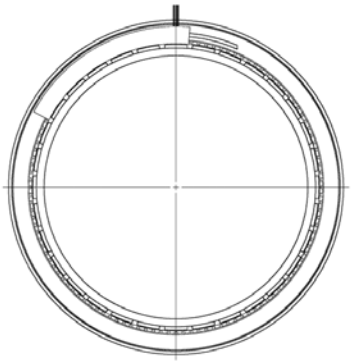
Dimensions are in inches

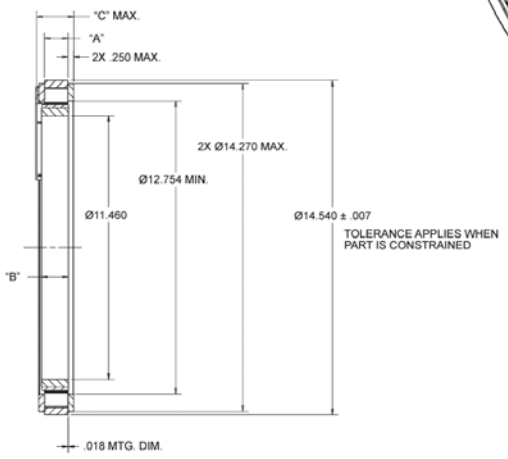
DB-14540 SERIES SPECIFICATIONS @ 25°C

Part Number		DB-14540-A-1ES	DB-14540-B-1ES	DB-14540-C-1ES	DB-14540-D-1ES	DB-14540-E-1ES
Size Constants	**Units**					
Peak Torque, T_P	oz-in	21674	43273	67041	96523	108319
Motor Constant, K_M	oz-in/√W	324	579	812	976	1142
Number of Poles		32	32	32	32	32
Number of Phases		3	3	3	3	3
Weight	oz (nom)	171	312	464	584	720
Motor Inertia, J_M	oz-in-s^2	5.22	8.52	13.7	17.0	20.8
Friction Torque, T_F	oz-in	64	128	200	256	320
Electrical Time Constant, τ_E	ms	1.03	1.66	2.09	2.35	2.55
Mechanical Time Constant, τ_M	ms	7.05	3.59	2.95	2.53	2.26
Temperature Rise, Housed TPR'	°C/W	0.74	0.57	0.46	0.39	0.34
Sensors		Yes	Yes	Yes	Yes	Yes
Winding Constants	**Units**					
Torque Sensitivity, K_T	oz-in/amp	639	1265	1955	2515	3149
Back EMF, K_E	V per rad/s	4.52	8.94	13.8	17.8	22.2
Terminal Resistance, R_M	ohms (nom)	3.90	4.77	5.80	6.64	7.60
Terminal Inductance, L_M	mH (nom)	4.0	7.9	12	16	19
Voltage, Stalled at Peak Torque, V_P	volts	132	163	199	228	261
Amps at Peak Torque, I_P	amps	33.9	34.2	34.3	34.4	34.4

DB-14540 Series Typical Outline Drawing







Dimensions are in inches

Modular	"A"	"B"	"C"
	inches	inches	inches
DB-14540-A-1ES	0.520	0.715	1.20
DB-14540-B-1ES	1.020	1.165	1.700
DB-14540-C-1ES	1.570	1.873	2.250
DB-14540-D-1ES	2.020	2.323	2.700
DB-14540-E-1ES	2.520	2.839	3.200
Tolerances	Per Drawing	Per Drawing	Maximum

Tolerances are:
Angles ± 0.5
.XXX ± .005
.XX ± .01
.X ± .03

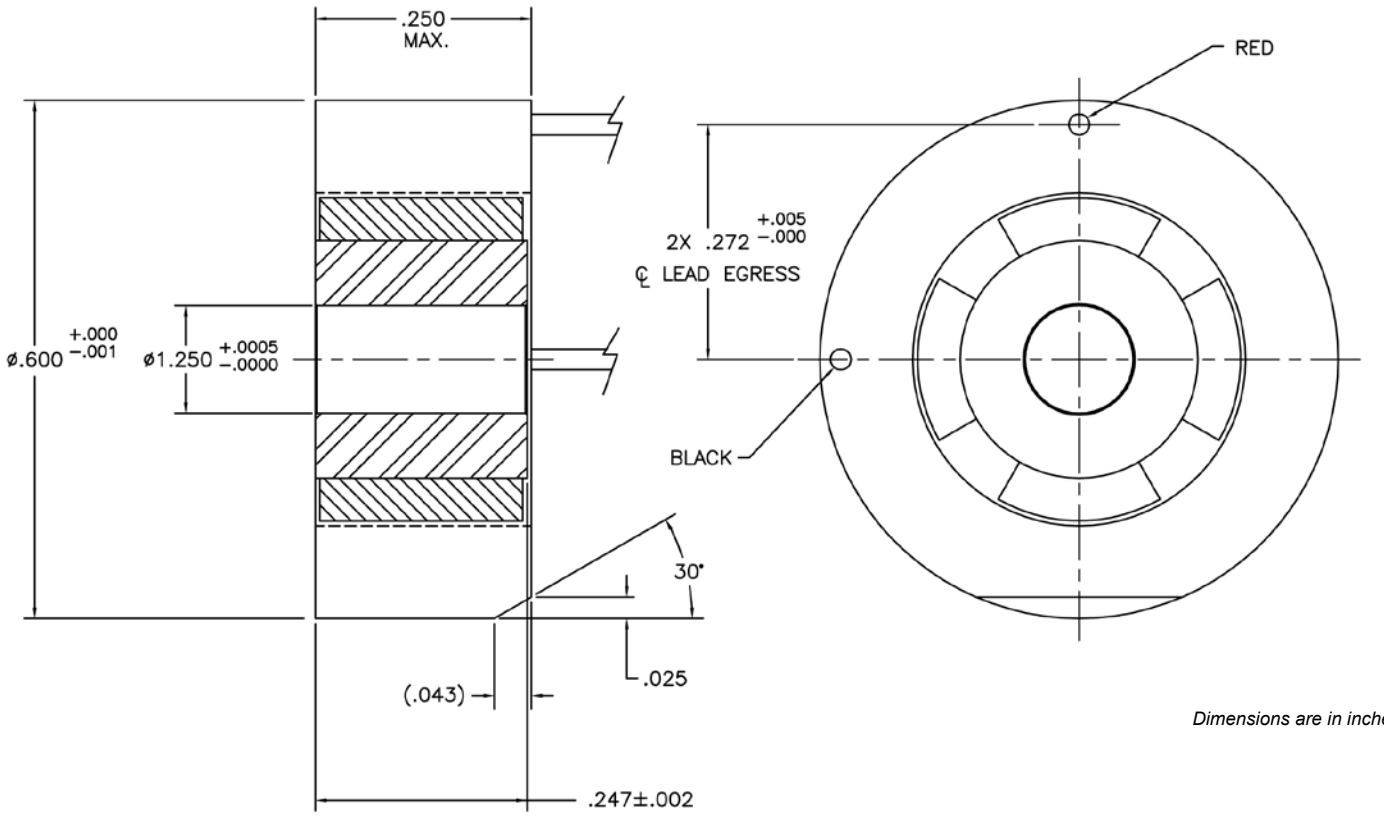
Dimensions and tolerances are inaccordance with ASME Y14.5 - 1994

Unless otherwise Specified
Finish: E.S. 411
For machined surfaces

TD-0600-A SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	1	oz-in
Motor Constant, K_M	0.293	oz-in/√W
Excursion Angle	5	°
Number of Poles	4	
Weight	0.25	oz (nom)
Motor Inertia, J_M	4.69E-06	oz-in-s^2
Friction Torque, T_F	0.06	oz-in
Electrical Time Constant, τ_E	0.077	ms
Mechanical Time Constant, τ_M	5.37	ms
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	1	oz-in/amp
Back EMF, K_E	0.0072	V per rad/s
Terminal Resistance, R_M	8.25	ohms (nom)
Terminal Inductance, L_M	0.634	mH (nom)
Voltage, Stalled at Peak Torque, V_P	12	volts
Amps at Peak Torque, I_P	1.5	amps

TD-0600-A Typical Outline Drawing

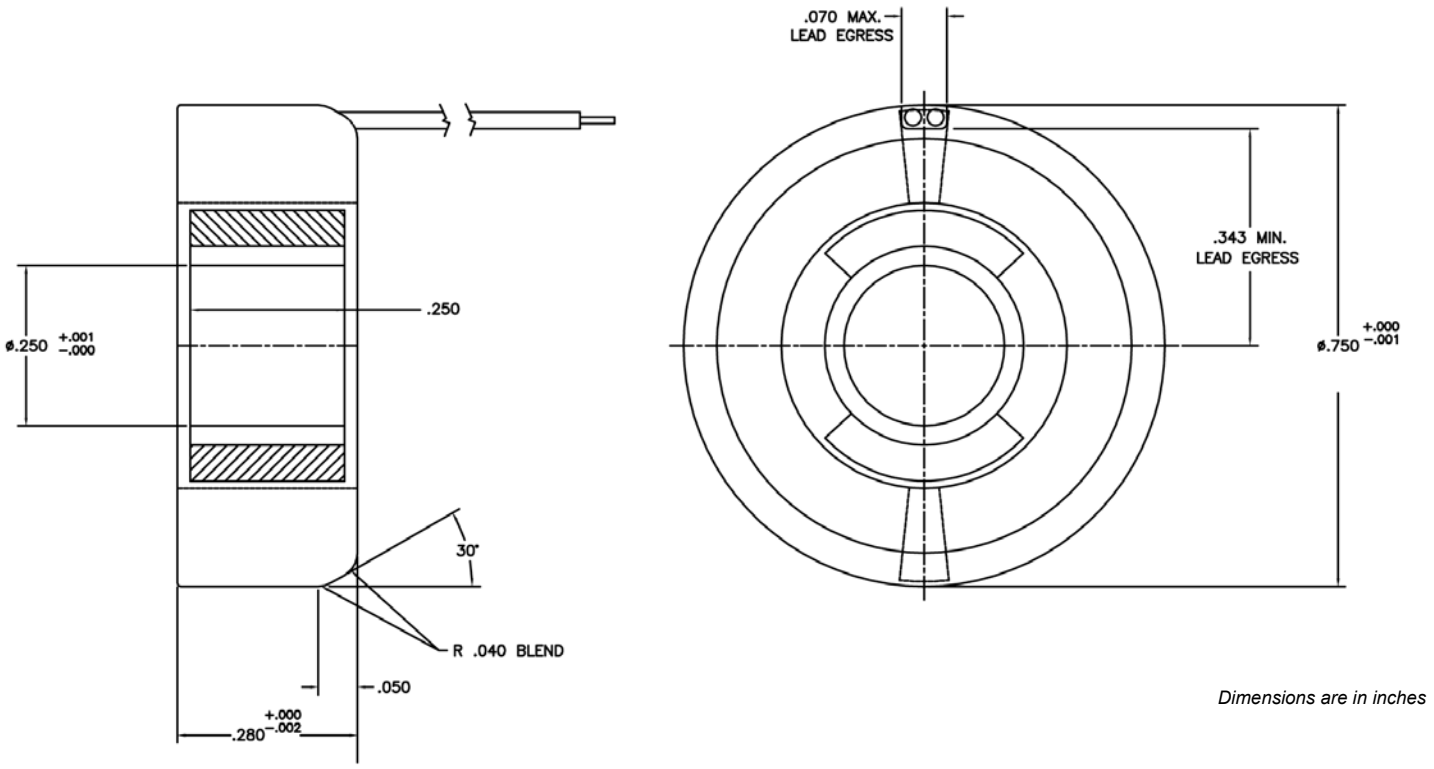


Dimensions are in inches

TD-0805-A SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	1.25	oz-in
Motor Constant, K_M	0.3	oz-in/√W
Excursion Angle	42	°
Number of Poles	2	
Weight	0.75	oz (nom)
Motor Inertia, J_M	1.00E-05	oz-in-s^2
Friction Torque, T_F	0.045	oz-in
Electrical Time Constant, τ_E	0.293	ms
Mechanical Time Constant, τ_M	15.80	ms
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	1.02	oz-in/amp
Back EMF, K_E	0.0072	V per rad/s
Terminal Resistance, R_M	11.6	ohms (nom)
Terminal Inductance, L_M	3.4	mH (nom)
Voltage, Stalled at Peak Torque, V_P	16	volts
Amps at Peak Torque, I_P	1.37	amps

TD-0805-A Typical Outline Drawing

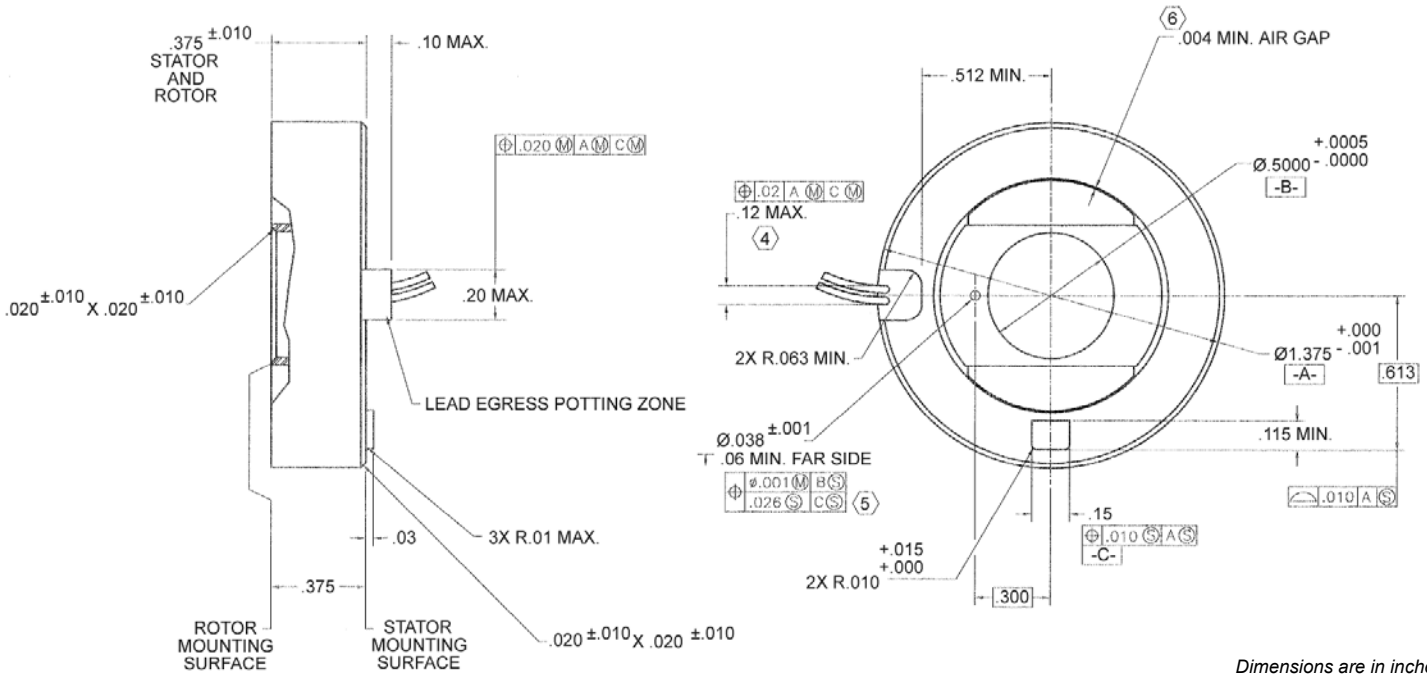


Dimensions are in inches

TD-1375-D SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	5.5	oz-in
Motor Constant, K_M	1.06	oz-in/√W
Excursion Angle	35	°
Number of Poles	2	
Weight	1.8	oz (nom)
Motor Inertia, J_M	2.10E-04	oz-in-s^2
Friction Torque, T_F	0.06	oz-in
Electrical Time Constant, τ_E	2.500	ms
Mechanical Time Constant, τ_M	23.50	ms
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	3.3	oz-in/amp
Back EMF, K_E	0.026	V per rad/s
Terminal Resistance, R_M	9.6	ohms (nom)
Terminal Inductance, L_M	24	mH (nom)
Voltage, Stalled at Peak Torque, V_P	20.2	volts
Amps at Peak Torque, I_P	2	amps

TD-1375-D Typical Outline Drawing

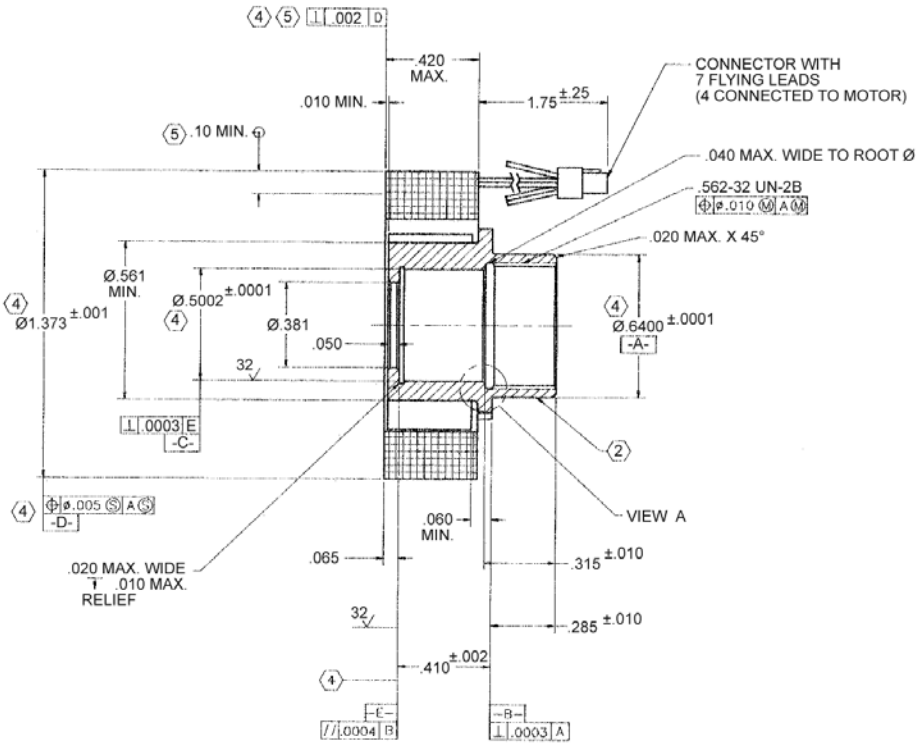


Dimensions are in inches

TD-1375-F-1C SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	16.5	oz-in
Motor Constant, K_M	1.37	oz-in/√W
Excursion Angle	28	°
Number of Poles	4	
Weight	1.5	oz (nom)
Motor Inertia, J_M	1.80E-04	oz-in-s^2
Friction Torque, T_F	0.08	oz-in
Electrical Time Constant, τ_E	TBD	ms
Mechanical Time Constant, τ_M	13.39	ms
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	3.36	oz-in/amp
Back EMF, K_E	0.024	V per rad/s
Terminal Resistance, R_M	6	ohms (nom)
Terminal Inductance, L_M	TBD	mH (nom)
Voltage, Stalled at Peak Torque, V_P	34	volts
Amps at Peak Torque, I_P	5.7	amps

TD-1375-F-1C Typical Outline Drawing

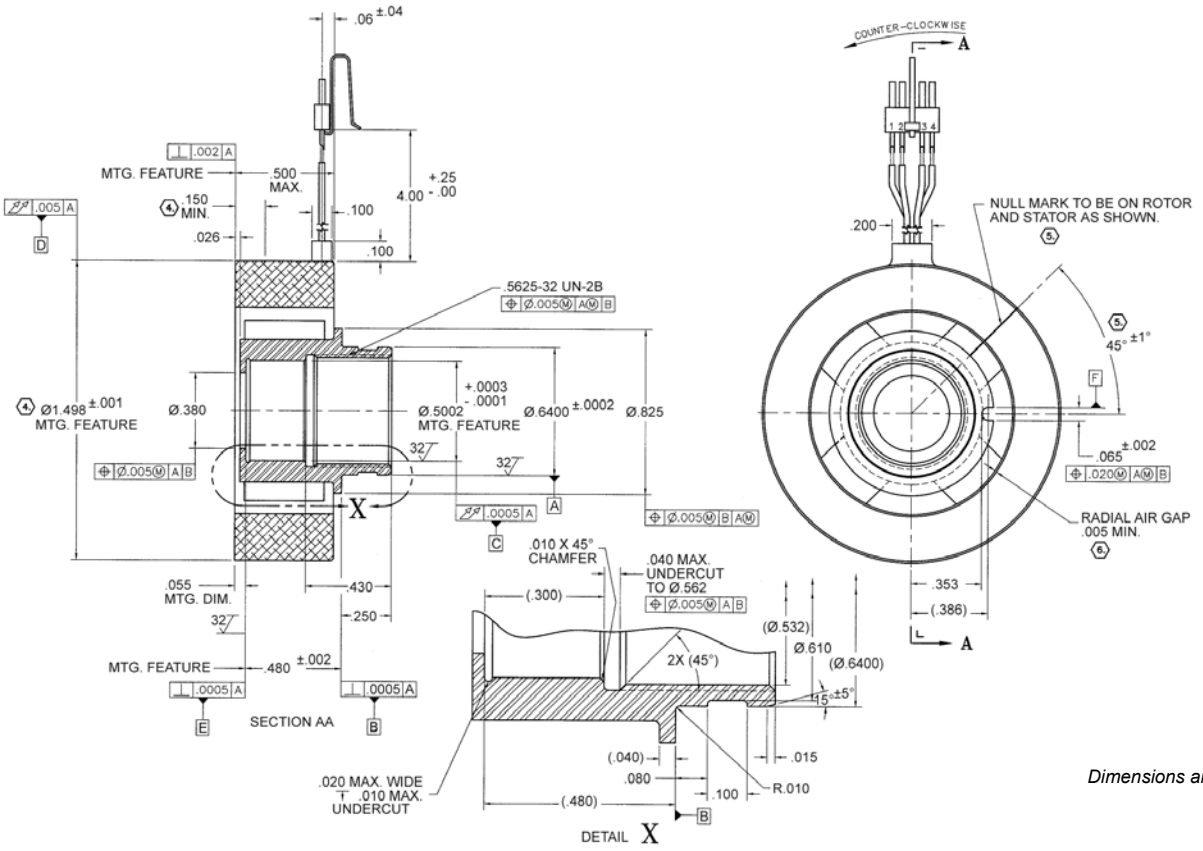


Dimensions are in inches

TD-1500-H SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	22	oz-in
Motor Constant, K_M	2.4	oz-in/√W
Excursion Angle	+/-30	°
Number of Poles	4	
Weight	2.5	oz (nom)
Motor Inertia, J_M	2.00E-03	oz-in-s^2
Friction Torque, T_F	0.35	oz-in
Electrical Time Constant, τ_E	0.348	ms
Mechanical Time Constant, τ_M	49.26	ms
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	5.75	oz-in/amp
Back EMF, K_E	0.0406	V per rad/s
Terminal Resistance, R_M	5.75	ohms (nom)
Terminal Inductance, L_M	2	mH (nom)
Voltage, Stalled at Peak Torque, V_P	27	volts
Amps at Peak Torque, I_P	4.25	amps

TD-1500-H Typical Outline Drawing

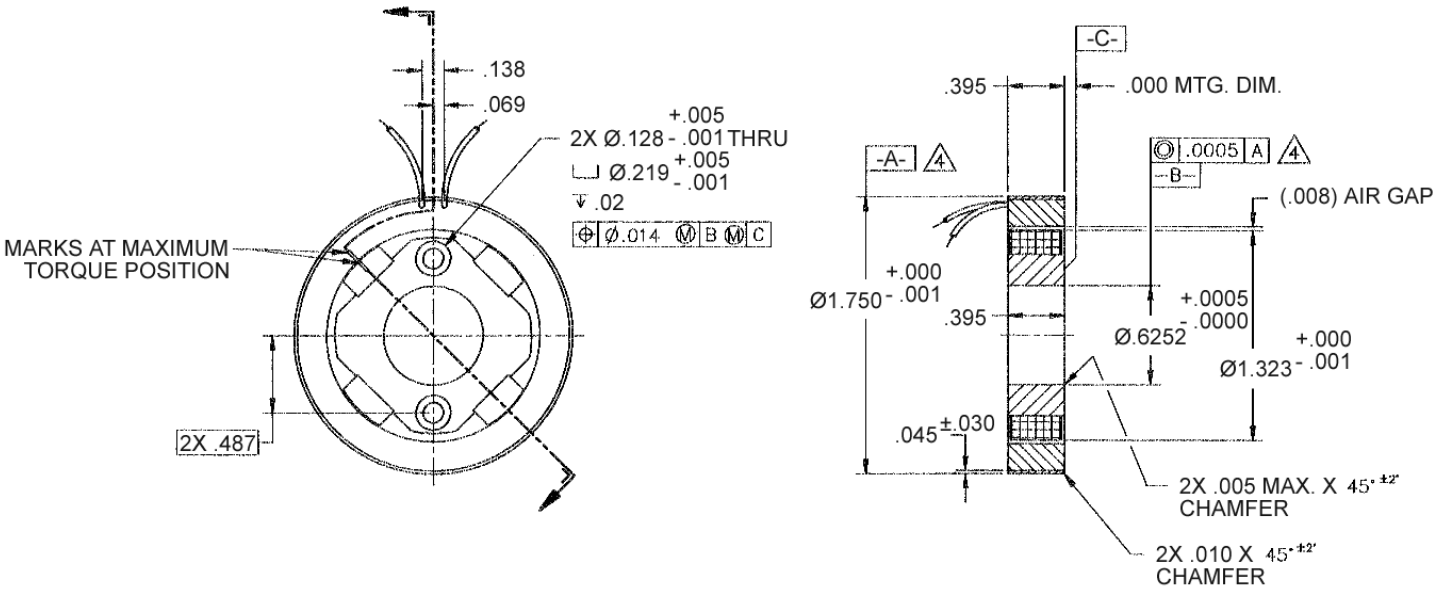


Dimensions are in inches

TD-1750-C SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	12	oz-in
Motor Constant, K_M	1.48	oz-in/√W
Excursion Angle	31	°
Number of Poles	4	
Weight	2.5	oz (nom)
Motor Inertia, J_M	6.60E-04	oz-in-s^2
Friction Torque, T_F	0.05	oz-in
Electrical Time Constant, τ_E	TBD	ms
Mechanical Time Constant, τ_M	36.54	ms
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	4	oz-in/amp
Back EMF, K_E	0.028	V per rad/s
Terminal Resistance, R_M	6.2	ohms (nom)
Terminal Inductance, L_M	TBD	mH (nom)
Voltage, Stalled at Peak Torque, V_P	19	volts
Amps at Peak Torque, I_P	3	amps

TD-1750-C Typical Outline Drawing

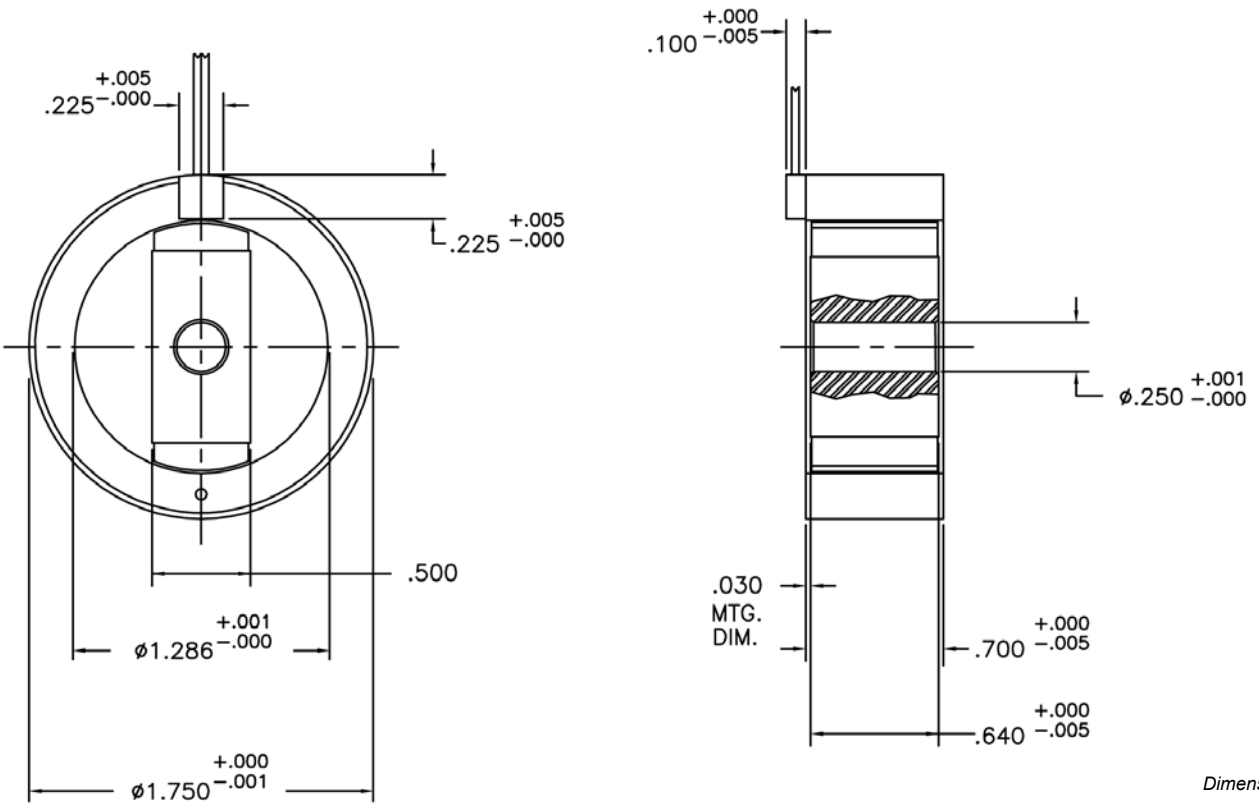


Dimensions are in inches

TD-1750-E SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	7.5	oz-in
Motor Constant, K_M	1.35	oz-in/√W
Excursion Angle	60	°
Number of Poles	2	
Weight	5	oz (nom)
Motor Inertia, J_M	1.90E-03	oz-in-s^2
Friction Torque, T_F	0.3	oz-in
Electrical Time Constant, τ_E	0.529	ms
Mechanical Time Constant, τ_M	152	ms
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	2.5	oz-in/amp
Back EMF, K_E	0.017	V per rad/s
Terminal Resistance, R_M	3.4	ohms (nom)
Terminal Inductance, L_M	1.8	mH (nom)
Voltage, Stalled at Peak Torque, V_P	9	volts
Amps at Peak Torque, I_P	2.5	amps

TD-1750-E Typical Outline Drawing

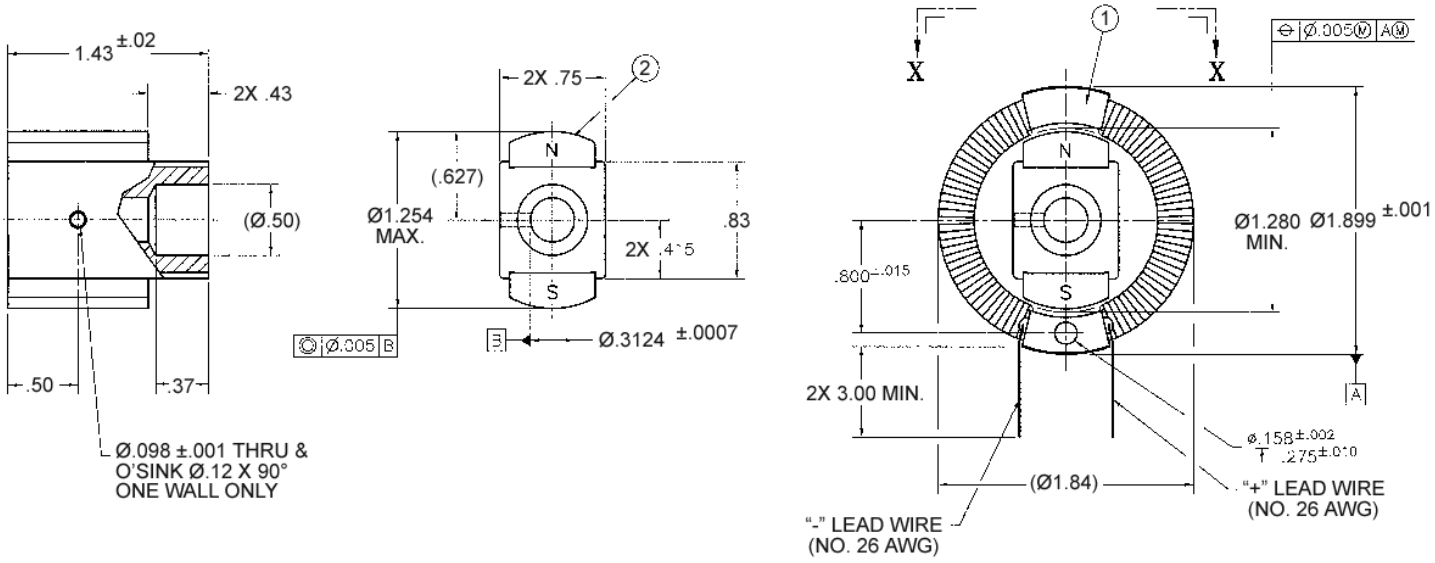


Dimensions are in inches

TD-1900-A SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	18	oz-in
Motor Constant, K_M	0.61	oz-in/√W
Excursion Angle	35	°
Number of Poles	2	
Weight	10	oz (nom)
Motor Inertia, J_M	3.40E-03	oz-in-s^2
Friction Torque, T_F	0.5	oz-in
Electrical Time Constant, τ_E	0.625	ms
Mechanical Time Constant, τ_M	39.37	ms
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	6.28	oz-in/amp
Back EMF, K_E	0.044	V per rad/s
Terminal Resistance, R_M	3.2	ohms (nom)
Terminal Inductance, L_M	2	mH (nom)
Voltage, Stalled at Peak Torque, V_P	10	volts
Amps at Peak Torque, I_P	3	amps

TD-1900-A Typical Outline Drawing

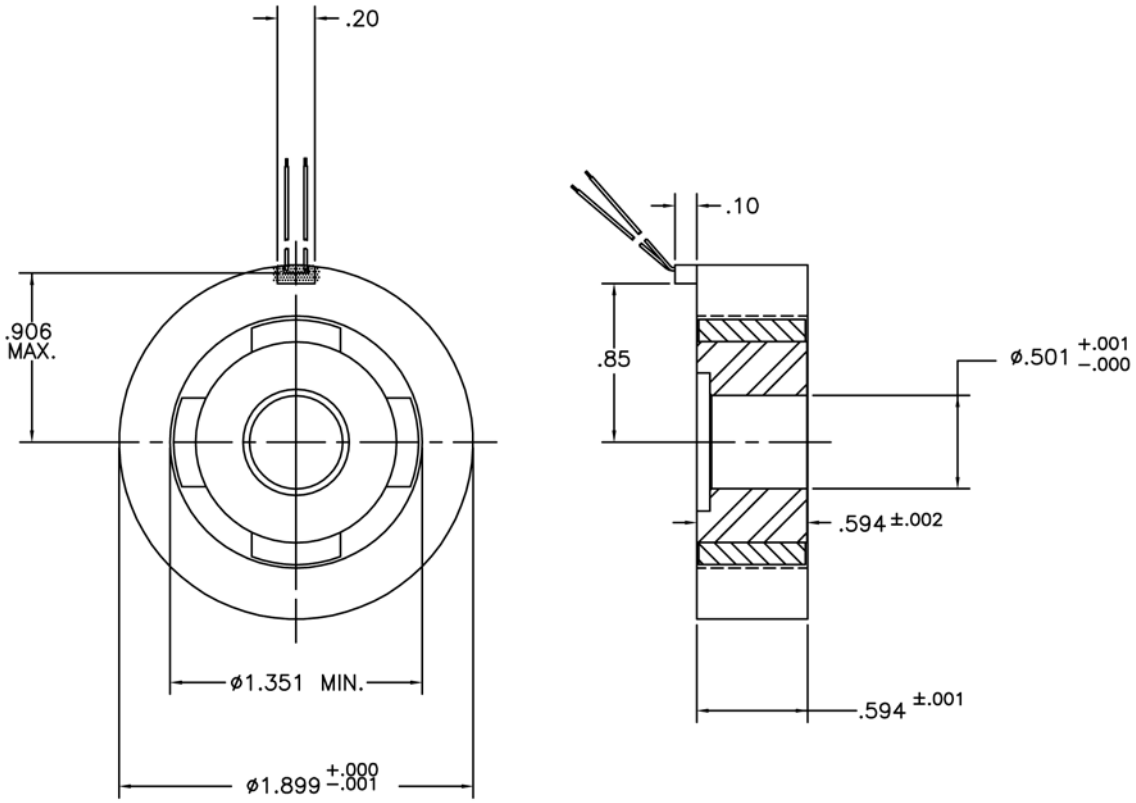


Dimensions are in inches

TD-1900-B SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	27	oz-in
Motor Constant, K_M	3.53	oz-in/√W
Excursion Angle	+/-15	°
Number of Poles	4	
Weight	5.5	oz (nom)
Motor Inertia, J_M	2.00E-03	oz-in-s^2
Friction Torque, T_F	0.34	oz-in
Electrical Time Constant, τ_E	0.615	ms
Mechanical Time Constant, τ_M	22.93	ms
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	9	oz-in/amp
Back EMF, K_E	0.063	V per rad/s
Terminal Resistance, R_M	6.5	ohms (nom)
Terminal Inductance, L_M	4	mH (nom)
Voltage, Stalled at Peak Torque, V_P	22	volts
Amps at Peak Torque, I_P	3	amps

TD-1900-B Typical Outline Drawing

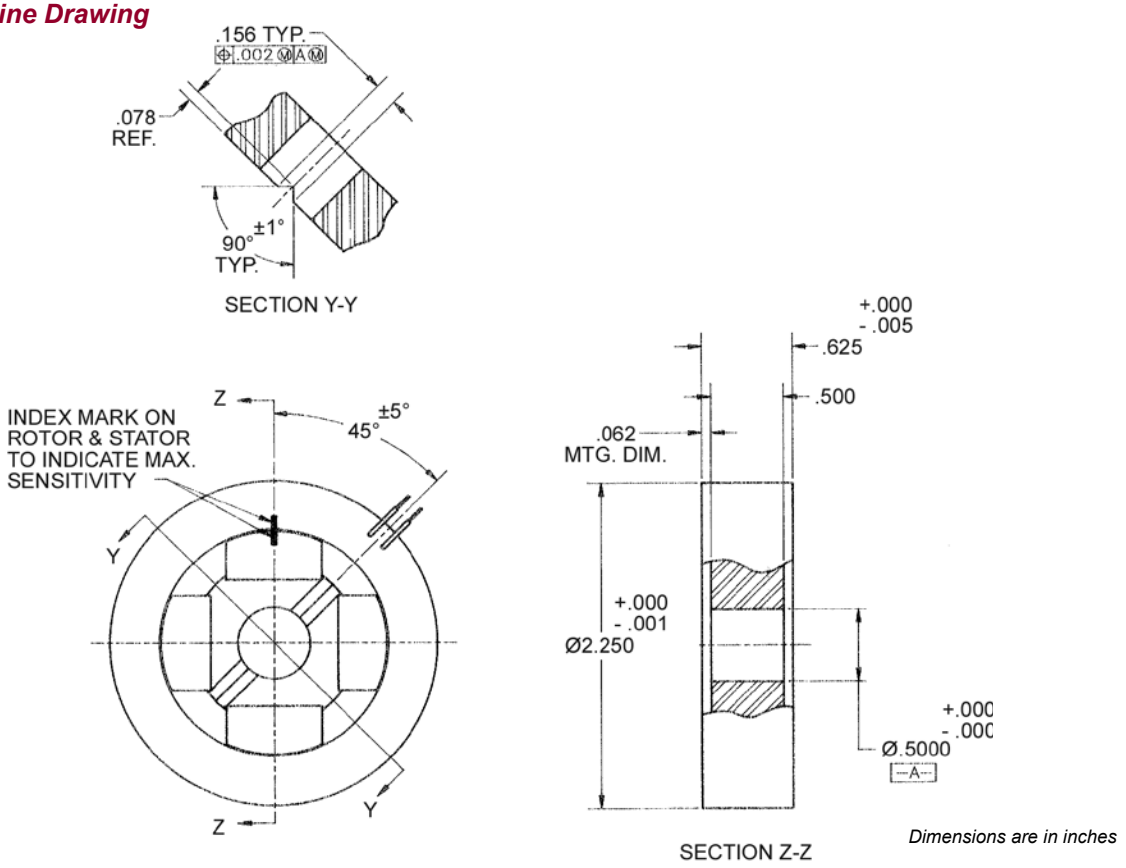


Dimensions are in inches

TD-2250-A SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	18.8	oz-in
Motor Constant, K_M	4.77	oz-in/√W
Excursion Angle	7.5	°
Number of Poles	4	
Weight	7.5	oz (nom)
Motor Inertia, J_M	2.26E-03	oz-in-s^2
Friction Torque, T_F	0.5	oz-in
Electrical Time Constant, τ_E	26.866	ms
Mechanical Time Constant, τ_M	0.20	ms
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	33	oz-in/amp
Back EMF, K_E	0.233	V per rad/s
Terminal Resistance, R_M	0.67	ohms (nom)
Terminal Inductance, L_M	18	mH (nom)
Voltage, Stalled at Peak Torque, V_P	24	volts
Amps at Peak Torque, I_P	0.648	amps

TD-2250-A Typical Outline Drawing

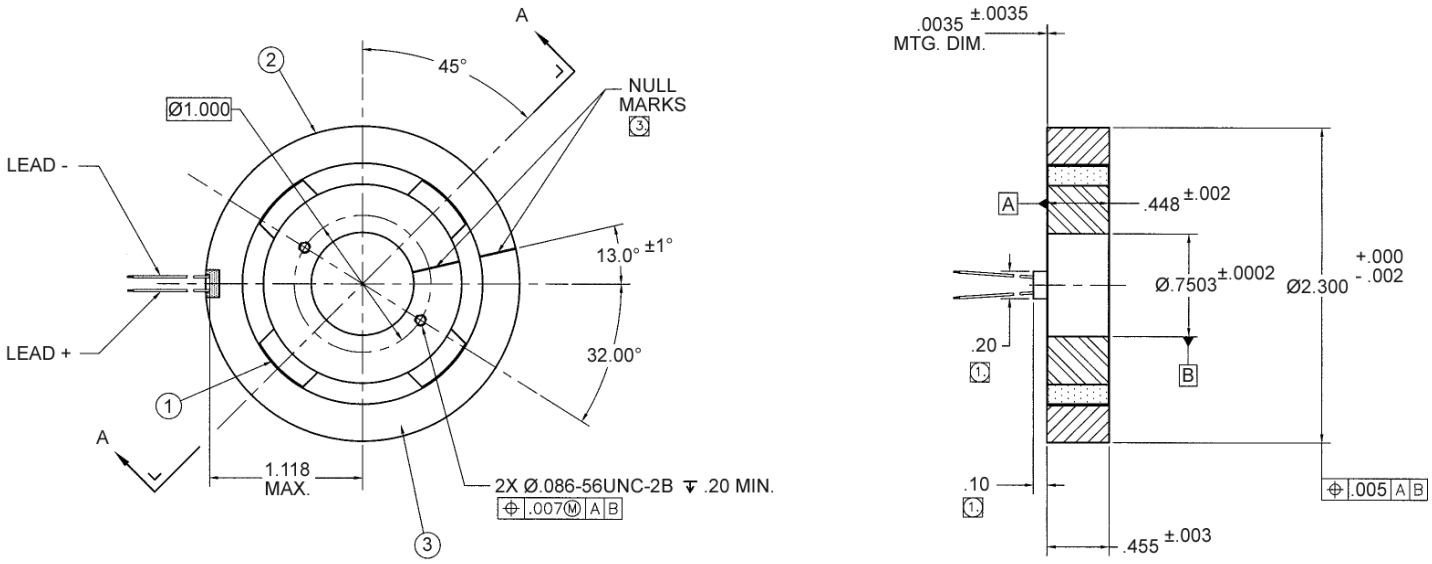


Dimensions are in inches

TD-2300-A SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	10.5	oz-in
Motor Constant, K_M	3.2	oz-in/√W
Excursion Angle	+/-23	°
Number of Poles	4	
Weight	7	oz (nom)
Motor Inertia, J_M	3.80E-03	oz-in-s^2
Friction Torque, T_F	0.35	oz-in
Electrical Time Constant, τ_E	0.357	ms
Mechanical Time Constant, τ_M	52.16	ms
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	12	oz-in/amp
Back EMF, K_E	0.085	V per rad/s
Terminal Resistance, R_M	14	ohms (nom)
Terminal Inductance, L_M	5	mH (nom)
Voltage, Stalled at Peak Torque, V_P	14	volts
Amps at Peak Torque, I_P	1	amps

TD-2300-A Typical Outline Drawing

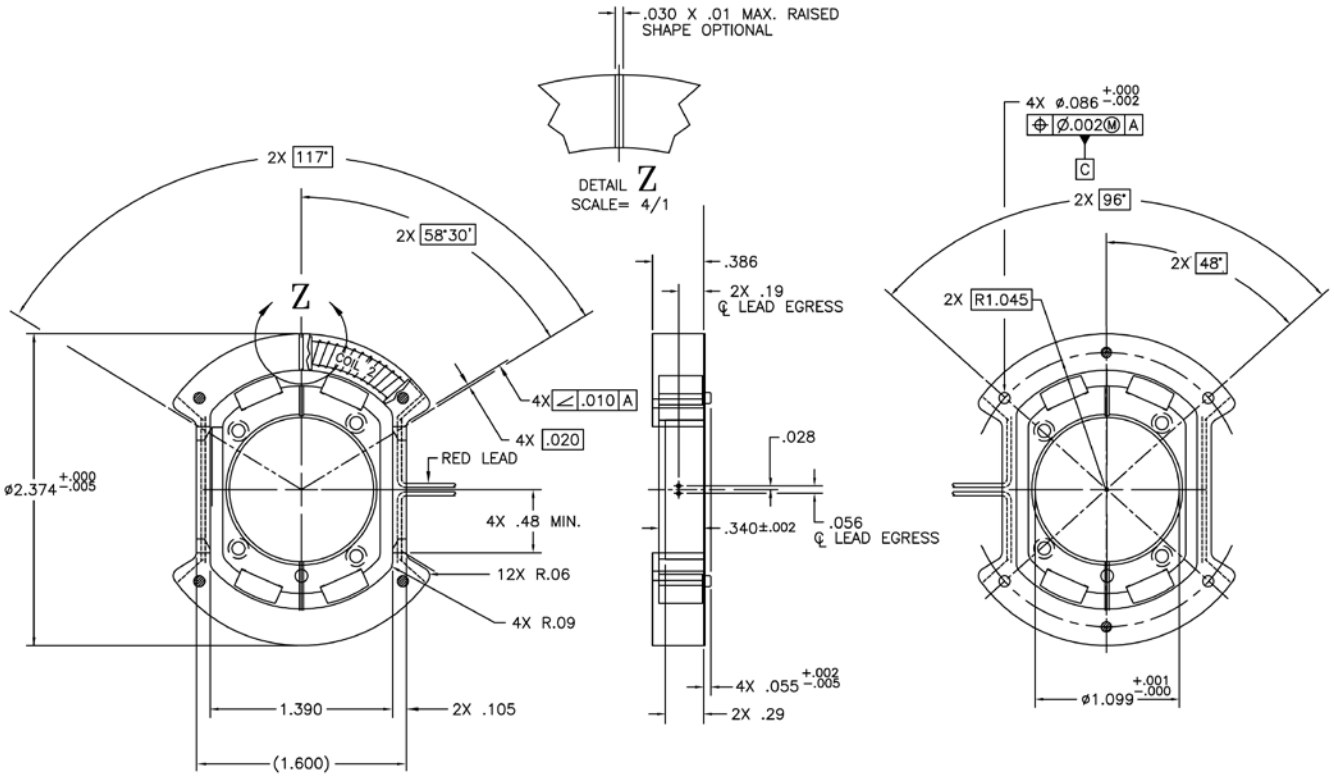


Dimensions are in inches

TD-2380-A SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	12.5	oz-in
Motor Constant, K_M	2.04	oz-in/√W
Excursion Angle	+/-8	°
Number of Poles	4	
Weight	3.5	oz (nom)
Motor Inertia, J_M	1.78E-03	oz-in-s^2
Friction Torque, T_F	0.35	oz-in
Electrical Time Constant, τ_E	0.500	ms
Mechanical Time Constant, τ_M	6.10	ms
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	5	oz-in/amp
Back EMF, K_E	0.35	V per rad/s
Terminal Resistance, R_M	6	ohms (nom)
Terminal Inductance, L_M	3	mH (nom)
Voltage, Stalled at Peak Torque, V_P	15	volts
Amps at Peak Torque, I_P	2.5	amps

TD-2380-A Typical Outline Drawing

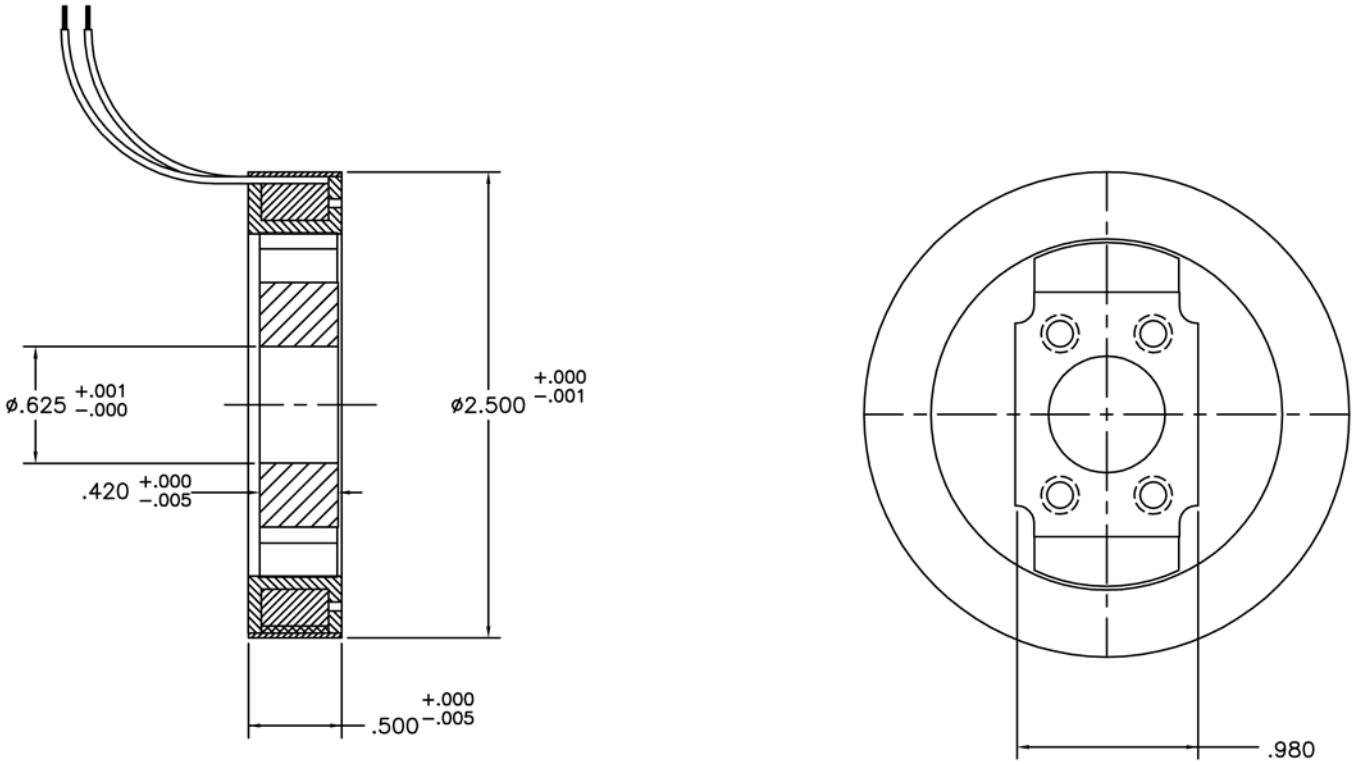


Dimensions are in inches

TD-2500-F SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	18	oz-in
Motor Constant, K_M	2.35	oz-in/√W
Excursion Angle	60	°
Number of Poles	2	
Weight	6.5	oz (nom)
Motor Inertia, J_M	2.30E-03	oz-in-s^2
Friction Torque, T_F	0.3	oz-in
Electrical Time Constant, τ_E	TBD	ms
Mechanical Time Constant, τ_M	58.90	ms
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	5.9	oz-in/amp
Back EMF, K_E	0.0417	V per rad/s
Terminal Resistance, R_M	6.3	ohms (nom)
Terminal Inductance, L_M	TBD	mH (nom)
Voltage, Stalled at Peak Torque, V_P	20	volts
Amps at Peak Torque, I_P	3.17	amps

TD-2500-F Typical Outline Drawing

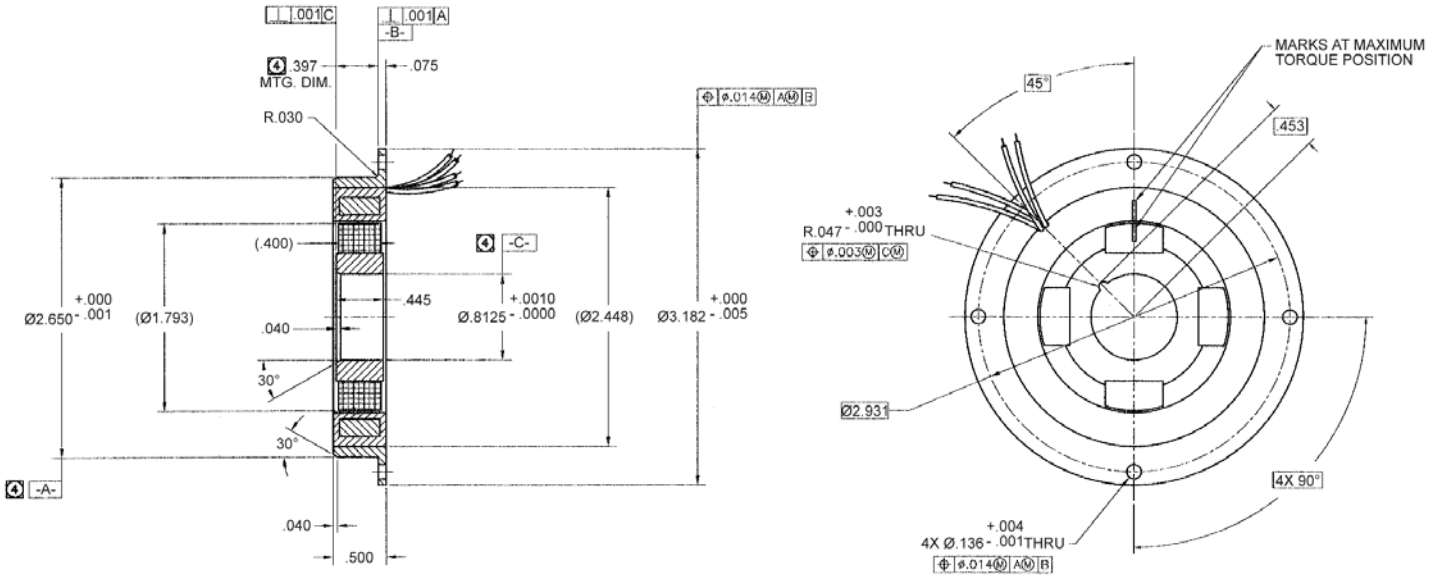


Dimensions are in inches

TD-3182-2 SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	20	oz-in
Motor Constant, K_M	3.17	oz-in/√W
Excursion Angle	+/-6	°
Number of Poles	4	
Weight	8.5	oz (nom)
Motor Inertia, J_M	6.00E-03	oz-in-s^2
Friction Torque, T_F	0.2	oz-in
Electrical Time Constant, τ_E	0.656	ms
Mechanical Time Constant, τ_M	84.46	ms
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	22	oz-in/amp
Back EMF, K_E	0.155	V per rad/s
Terminal Resistance, R_M	48	ohms (nom)
Terminal Inductance, L_M	31.5	mH (nom)
Voltage, Stalled at Peak Torque, V_P	95	volts
Amps at Peak Torque, I_P	1.96	amps

TD-3182-2- Typical Outline Drawing

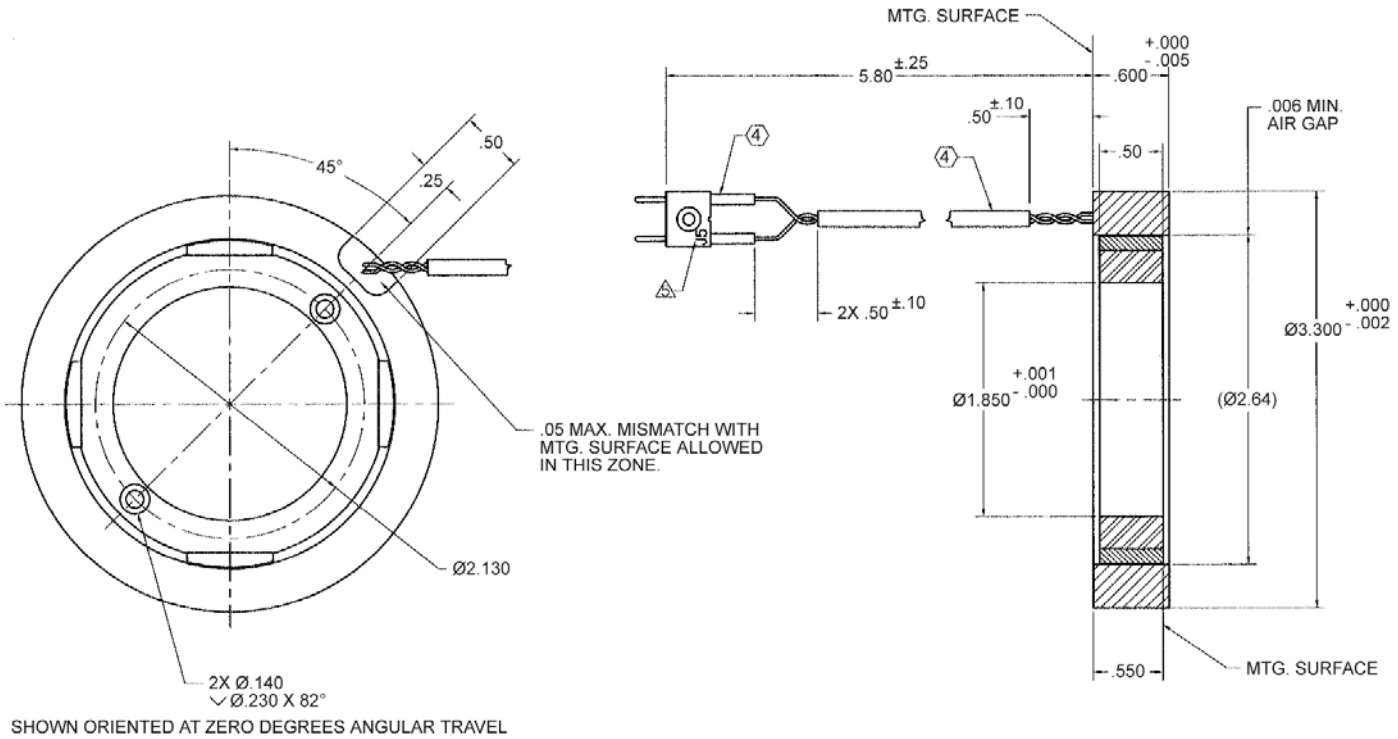


Dimensions are in inches

TD-3300-J SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	25	oz-in
Motor Constant, K_M	6.82	oz-in/√W
Excursion Angle	22.5	°
Number of Poles	4	
Weight	11	oz (nom)
Motor Inertia, J_M	1.49E-02	oz-in-s^2
Friction Torque, T_F	1	oz-in
Electrical Time Constant, τ_E	1.144	ms
Mechanical Time Constant, τ_M	45.15	ms
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	22	oz-in/amp
Back EMF, K_E	0.156	V per rad/s
Terminal Resistance, R_M	10.4	ohms (nom)
Terminal Inductance, L_M	11.9	mH (nom)
Voltage, Stalled at Peak Torque, V_P	24	volts
Amps at Peak Torque, I_P	1.14	amps

TD-3300-J Typical Outline Drawing

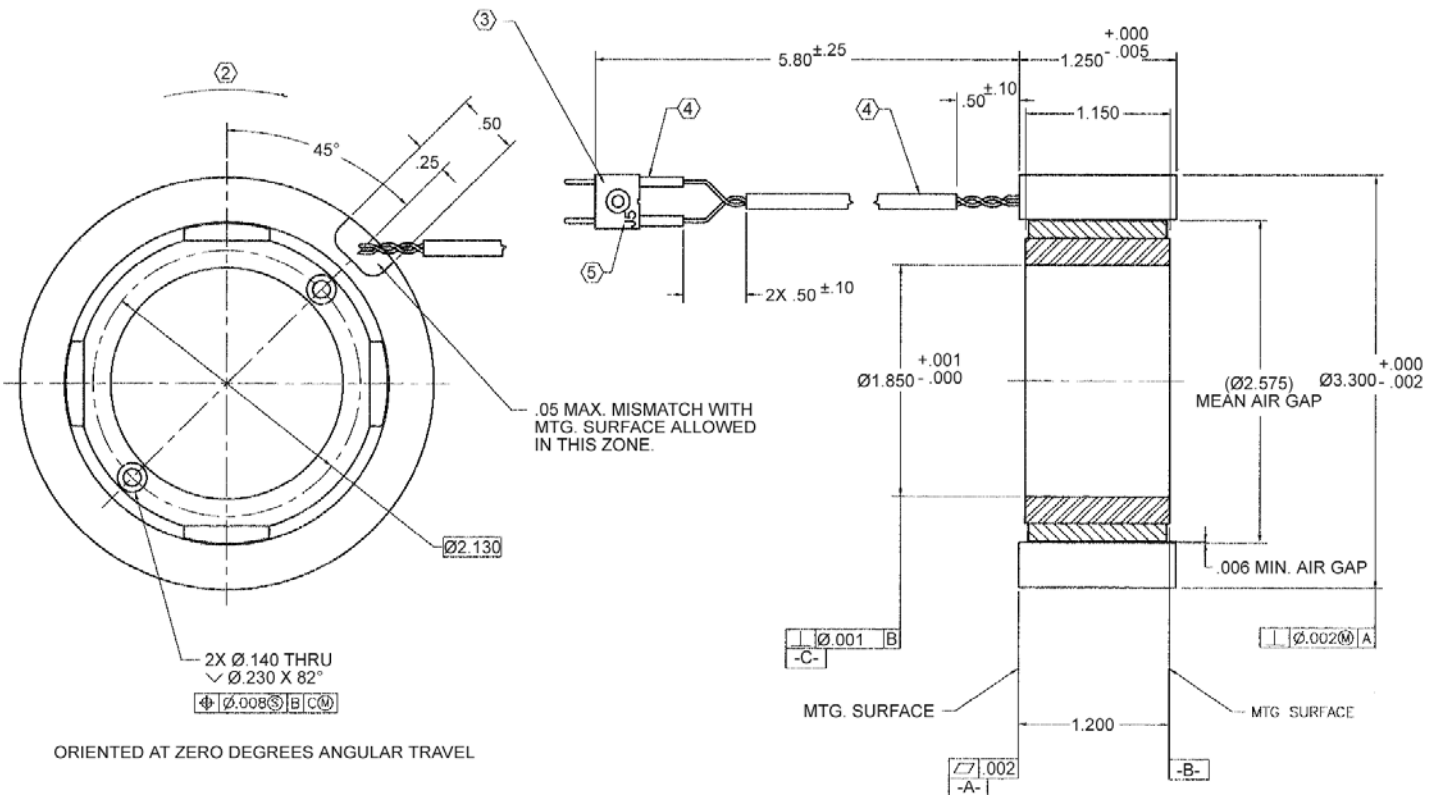


Dimensions are in inches

TD-3300-K SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	65	oz-in
Motor Constant, K_M	13.34	oz-in/√W
Excursion Angle	22.5	°
Number of Poles	4	
Weight	23.2	oz (nom)
Motor Inertia, J_M	3.10E-02	oz-in-s^2
Friction Torque, T_F	1	oz-in
Electrical Time Constant, τ_E	TBD	ms
Mechanical Time Constant, τ_M	24.62	ms
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	26	oz-in/amp
Back EMF, K_E	0.184	V per rad/s
Terminal Resistance, R_M	3.8	ohms (nom)
Terminal Inductance, L_M	TBD	mH (nom)
Voltage, Stalled at Peak Torque, V_P	12	volts
Amps at Peak Torque, I_P	3.16	amps

TD-3300-K Typical Outline Drawing

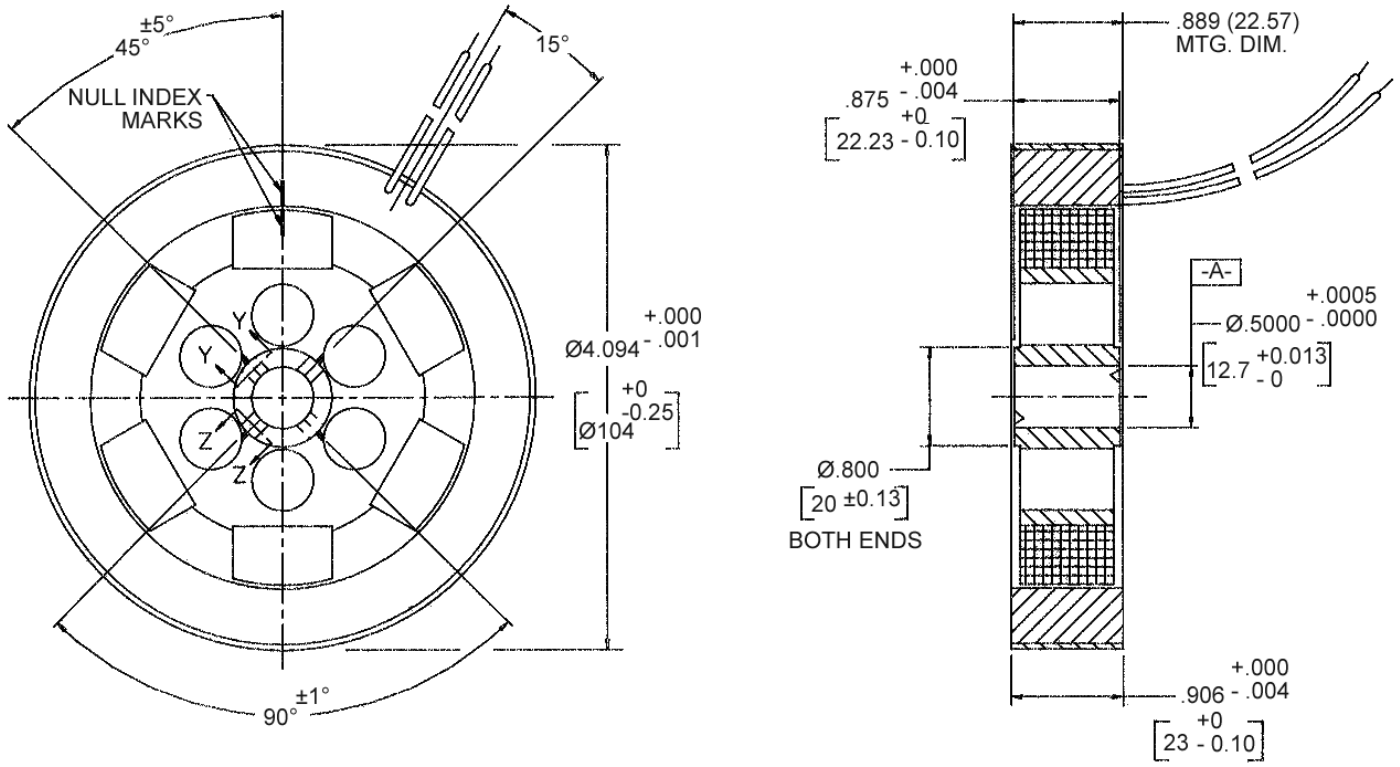


Dimensions are in inches

TD-4094-A SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	144	oz-in
Motor Constant, K_M	21.5	oz-in/√W
Excursion Angle	15	°
Number of Poles	6	
Weight	24	oz (nom)
Motor Inertia, J_M	7.60E-02	oz-in-s^2
Friction Torque, T_F	0.75	oz-in
Electrical Time Constant, τ_E	0.520	ms
Mechanical Time Constant, τ_M	23.42	ms
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	48	oz-in/amp
Back EMF, K_E	0.338	V per rad/s
Terminal Resistance, R_M	5	ohms (nom)
Terminal Inductance, L_M	2.6	mH (nom)
Voltage, Stalled at Peak Torque, V_P	28	volts
Amps at Peak Torque, I_P	3	amps

TD-4094-A Typical Outline Drawing

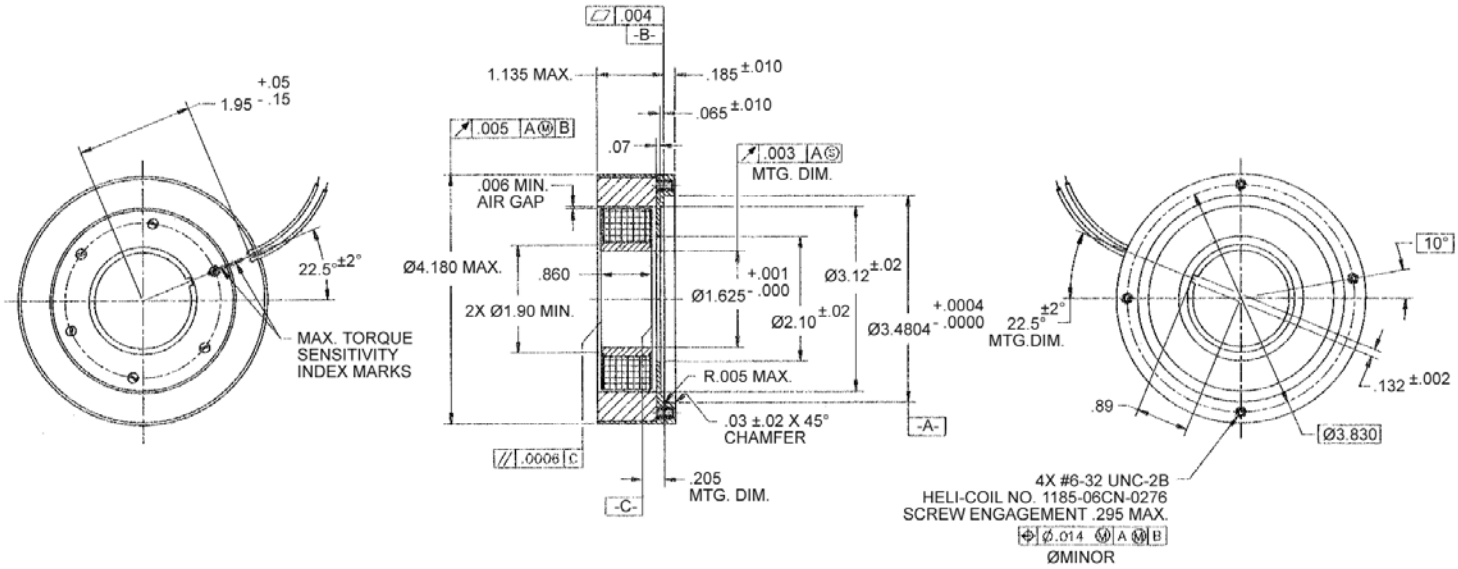


Dimensions are in inches

TD-4180-A SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	50	oz-in
Motor Constant, K_M	9.5	oz-in/√W
Excursion Angle	7	°
Number of Poles	6	
Weight	16	oz (nom)
Motor Inertia, J_M	2.50E-02	oz-in-s^2
Friction Torque, T_F	0.1	oz-in
Electrical Time Constant, τ_E	2.000	ms
Mechanical Time Constant, τ_M	39.55	ms
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	25	oz-in/amp
Back EMF, K_E	0.177	V per rad/s
Terminal Resistance, R_M	7	ohms (nom)
Terminal Inductance, L_M	14	mH (nom)
Voltage, Stalled at Peak Torque, V_P	14	volts
Amps at Peak Torque, I_P	2	amps

TD-4180-A Typical Outline Drawing

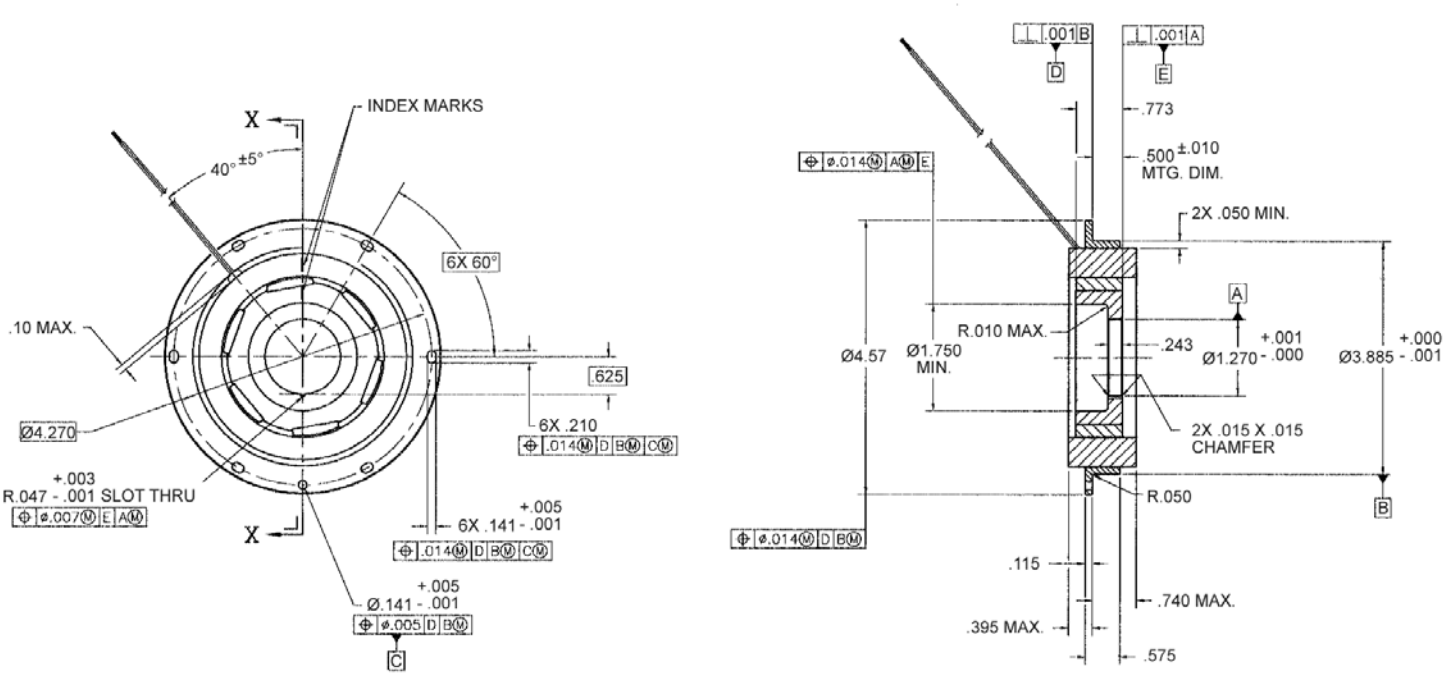


Dimensions are in inches

TD-4580-B SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	120	oz-in
Motor Constant, K_M	33.17	oz-in/√W
Excursion Angle	+/-5	°
Number of Poles	6	
Weight	30.5	oz (nom)
Motor Inertia, J_M	3.20E-02	oz-in-s^2
Friction Torque, T_F	6	oz-in
Electrical Time Constant, τ_E	1.364	ms
Mechanical Time Constant, τ_M	4.12	ms
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	110	oz-in/amp
Back EMF, K_E	0.777	V per rad/s
Terminal Resistance, R_M	11	ohms (nom)
Terminal Inductance, L_M	15	mH (nom)
Voltage, Stalled at Peak Torque, V_P	17	volts
Amps at Peak Torque, I_P	1.55	amps

TD-4580-B Typical Outline Drawing

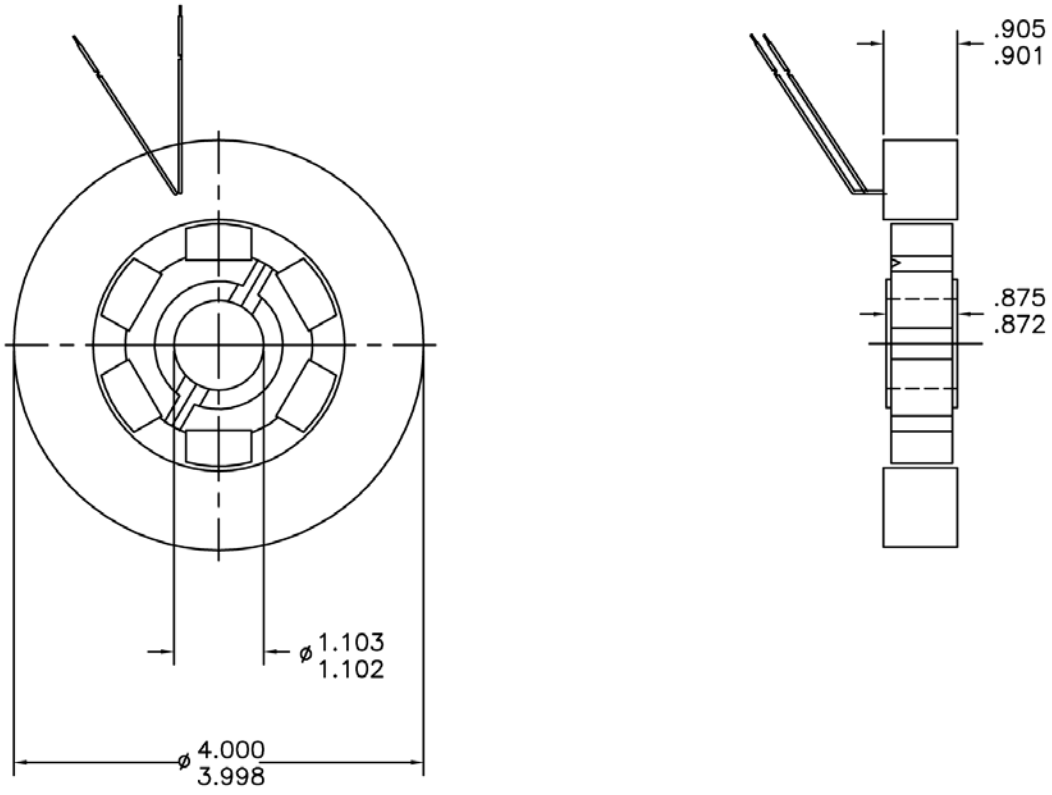


Dimensions are in inches

TD-4882-A SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	350	oz-in
Motor Constant, K_M	23.3	oz-in/√W
Excursion Angle	15	°
Number of Poles	6	
Weight	41.3	oz (nom)
Motor Inertia, J_M	8.30E-02	oz-in-s^2
Friction Torque, T_F	0.75	oz-in
Electrical Time Constant, τ_E	2.300	ms
Mechanical Time Constant, τ_M	21.69	ms
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	52	oz-in/amp
Back EMF, K_E	0.368	V per rad/s
Terminal Resistance, R_M	5	ohms (nom)
Terminal Inductance, L_M	11.5	mH (nom)
Voltage, Stalled at Peak Torque, V_P	34	volts
Amps at Peak Torque, I_P	6.73	amps

TD-4882-A Typical Outline Drawing

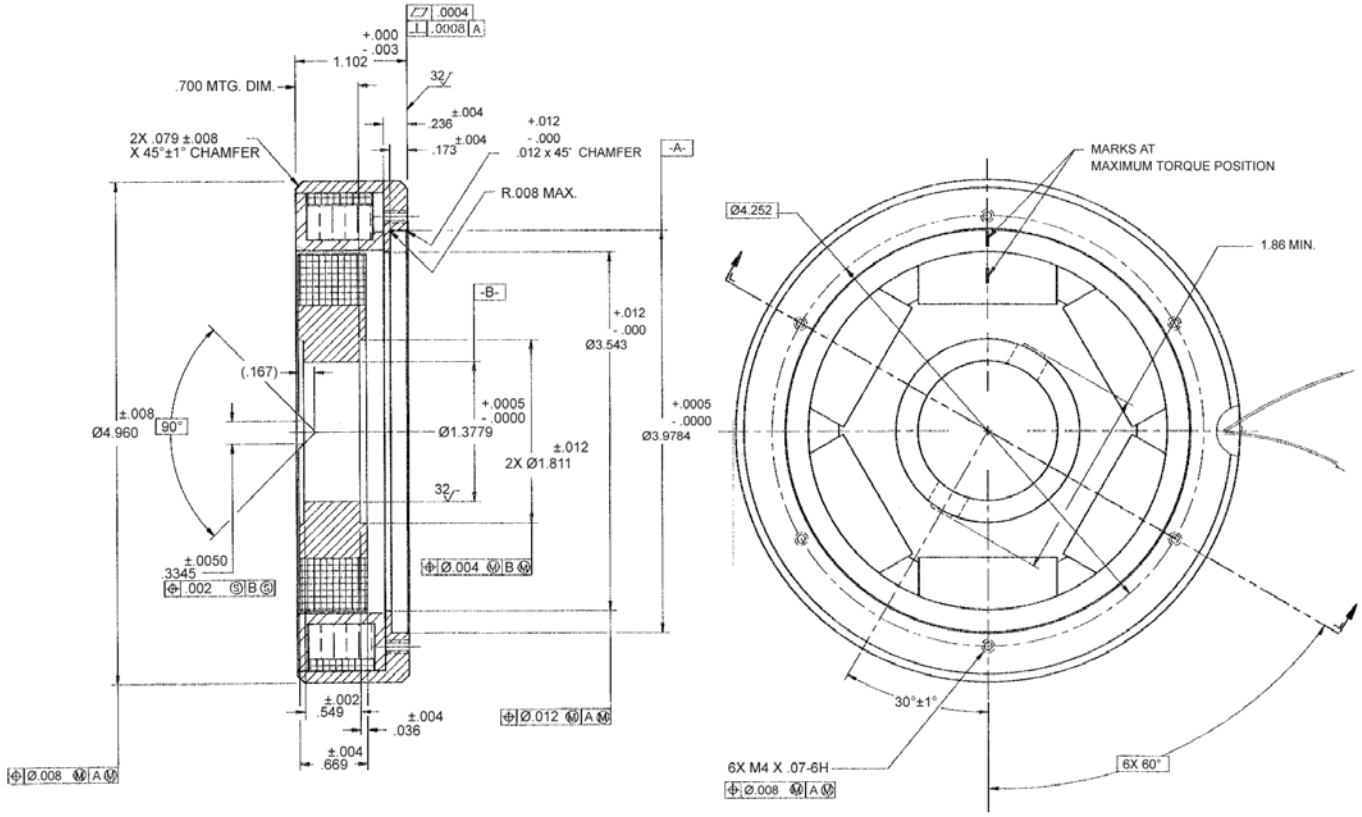


Dimensions are in inches

TD-4960-A SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	120	oz-in
Motor Constant, K_M	35	oz-in/√W
Excursion Angle	15	°
Number of Poles	6	
Weight	24	oz (nom)
Motor Inertia, J_M	1.19E-01	oz-in-s^2
Friction Torque, T_F	0.75	oz-in
Electrical Time Constant, τ_E	0.455	ms
Mechanical Time Constant, τ_M	13.76	ms
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	82	oz-in/amp
Back EMF, K_E	0.58	V per rad/s
Terminal Resistance, R_M	5.5	ohms (nom)
Terminal Inductance, L_M	2.5	mH (nom)
Voltage, Stalled at Peak Torque, V_P	18	volts
Amps at Peak Torque, I_P	1.46	amps

TD-4960-A Typical Outline Drawing

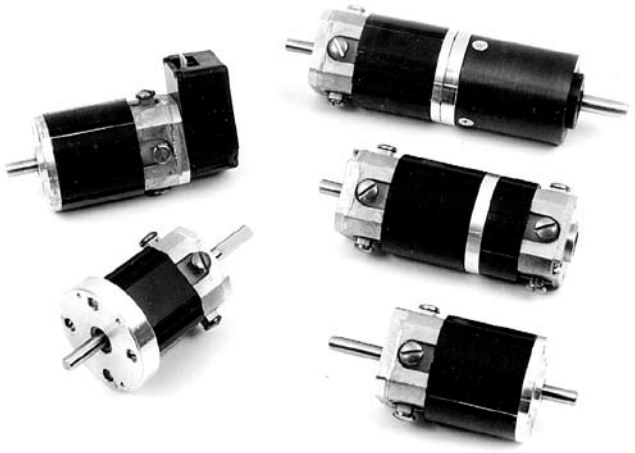


Dimensions are in inches

Brush Motors

Miniature High-Torque, DC Servomotors and DC Gearmotors

Series C13 Samarium Cobalt †



TYPICAL APPLICATIONS

- Robotics
- Factory automation
- Medical equipment
- Computer peripherals and office equipment
- Portable, battery-operated equipment
- Textile machinery
- Packaging machinery
- Actuators

FEATURES

- 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

BENEFITS

- High torque-to-inertia ratio
- Up to 1274 oz-in peak starting torque
- Highly resistant to demagnetization
- Weighs only 6.8 oz
- High energy / high power in small packages

OPTIONS AVAILABLE

- Custom endcaps and mounting configurations are available
- Skewed rotors available for minimum cogging torque
- Encoder and tachometer packages
- Custom shaft and end cap configurations

Available with integrated tachometers or encoders for closed-loop control

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 are 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 offers a wide range of output torque and speed options with standard and custom gear ratios.

Custom-modified shaft designs, mounting configurations, speed variations, and various DC input voltages are available. Consult our engineering department to help you develop a motor that is tailored to your application.

† Previously the AS–780D Series

SPECIFICATION AND NUMBERING SYSTEM

Part Numbering System Guide

C13 □ -L □ □ W □ □ M □ □ □ □ □ - □ □ □

FRAME
Leave blank for standard motor
G = Gearmotor

LENGTH
19 –
25 –
28 –
Refer to motor data table for standard offerings.

WINDING
10 –
20 –
30 –
40 –
50 –
Refer to motor data table for standard offerings. Call factory for custom windings.

MECHANICAL OPTIONS
00 – Standard Shaft

FEEDBACK OPTIONS
T – Tachometer
R – Resolver
E – Encoder

FEEDBACK OPTIONS

FACTORY OPTIONS
For custom unit types. Consult factory for gear ratio part number.

C13 SERIES SPECIFICATIONS – *Continuous Stall Torque 7.5 - 13.0 oz-in (0.053 - 0.092 Nm)*
Peak Torque 50 - 100 oz-in (0.353 - 0.706 Nm)

Part Number*		C13-L19-					C13-L25-	C13-L28-	
Winding Code**		10	20	30	40	50	10	10	20
L = Length	inches	1.902					2.45	2.802	
	millimeters	48.3					62.2	71.2	
Peak Torque	oz-in	50	50	50	50	50	75	100	100
	Nm	0.353	0.353	0.353	0.353	0.353	0.530	0.706	0.706
Continuous Stall Torque	oz-in	7.5	7.5	7.5	7.5	7.5	10.0	13.0	13.0
	Nm	0.053	0.053	0.053	0.053	0.053	0.071	0.092	0.092
Rated Terminal Voltage	volts DC	6 - 18	6 - 24	6 - 24	12 - 36	12 - 48	12 - 24	6 - 24	12 - 36
Terminal Voltage	volts DC	12	12	24	36	48	12	12	24
Rated Speed	RPM	3000	1880	2875	2225	2877	2400	1643	2439
	rad/sec	314	197	301	233	301	251	172	255
Rated Torque	oz-in	5.8	6.9	6.4	6.7	7.5	10.3	14	12.3
	Nm	0.04	0.05	0.05	0.05	0.05	0.07	0.10	0.09
Rated Current	Amps	2.05	1.8	1.4	0.95	1.4	1.95	3.5	2
Rated Power	Watts	12.9	9.6	13.6	11.0	16.0	18.0	17.0	22.2
	Horsepower	0.02	0.01	0.02	0.01	0.02	0.09	0.02	0.03
Torque Senstivity	oz-in/amp	3.42	4.35	5.45	8.1	10.25	6.04	4.6	7.85
	Nm/amp	0.0242	0.0307	0.0385	0.0572	0.0724	0.0427	0.0325	0.0554
Back EMF	volts/KRPM	2.53	3.21	4.03	5.99	7.57	4.47	3.4	5.81
	volts/rad/sec	0.0242	0.0307	0.0385	0.0572	0.0723	0.0427	0.0325	0.0555
Terminal Resistance	ohms	1.55	2.30	3.35	7.90	12.00	2.64	1.30	3.70
Terminal Inductance	mH	0.52	0.84	1.30	3.00	4.80	0.71	0.90	2.60
Motor Constant	oz-in/watt^1/2	2.7	2.9	3.0	2.9	3.0	3.7	4.0	4.1
	Nm/watt	0.019	0.020	0.021	0.020	0.021	0.026	0.028	0.029
Rotor Inertia	oz-in-sec^2	.00026	.00026	.00026	.00026	.00026	0.004	.00043	.00043
	g-cm^2	18.4	18.4	18.4	18.4	18.4	282.5	30.4	30.4
Friction Torque	oz-in	0.75	0.75	0.75	0.75	0.75	1.00	1.00	1.00
	Nm	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Thermal Resistance	°C/watt	11.0	11.0	11.0	11.0	11.0	7.8	5.5	5.5
Damping Factor	oz-in/KRPM	0.1	0.1	0.1	0.1	0.1	0.1	0.57	0.57
	Nm/KRPM	0.001	0.001	0.001	0.001	0.001	0.001	0.004	0.004
Weight	oz	6.8	6.8	6.8	6.8	6.8	9	11.2	11.2
	g	193	193	193	193	193	255	318	318
Electrical Time Constant	millisecond	0.3355	0.3652	0.3881	0.3797	0.4000	0.2689	0.6923	0.7027
Mech. Time Constant	millisecond	4.8764649	4.483876	4.152057	4.432363	4.209995	40.95115	3.742155	3.652339
Speed/Torque Gradient	rpm/oz-in	-179.1369	-164.715	-152.526	-162.8228	-154.654	-97.7821	-83.1202	-81.1252

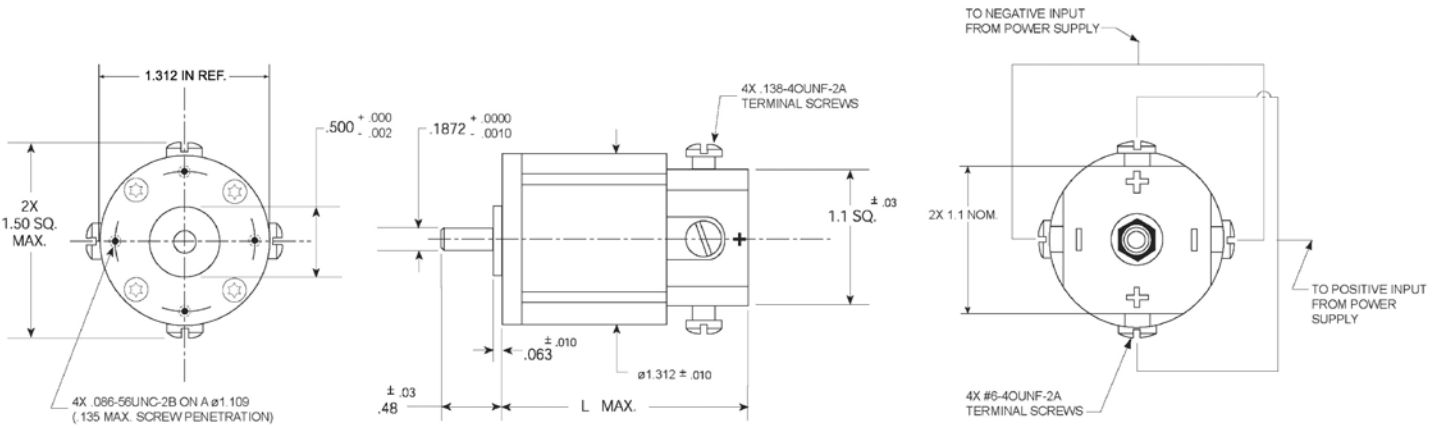
IMPORTANT

Typical performance characteristics at 25°C. The operational life 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.

Notes:
1. For MS (military style) connector, please specify connector housing and terminal.
2. 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.

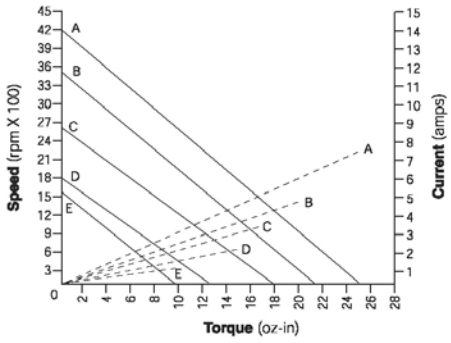
Typical Outline Drawing



Dimensions are in inches

Torque/Speed Curves

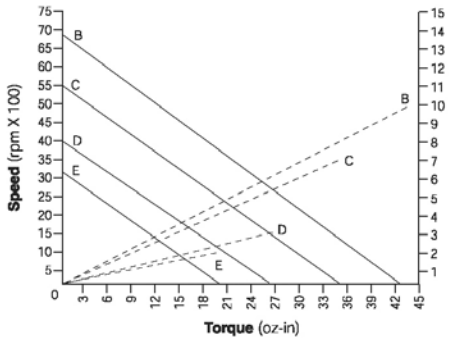
C13-L19: 12 Volt input



A = C13-L19-W10
B = C13-L19-W20
C = C13-L19-W30
D = C13-L19-W40
E = C13-L19-W50

OPERATING CURRENT
OPERATING SPEED

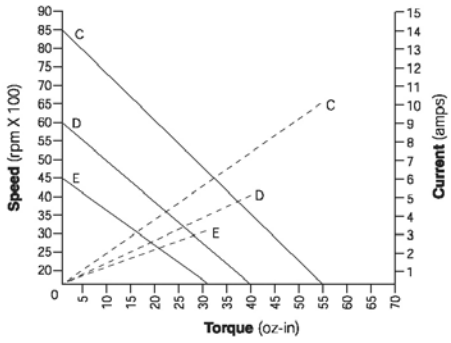
C13-L19: 24 Volt input



B = C13-L19-W20
C = C13-L19-W30
D = C13-L19-W40
E = C13-L19-W50

OPERATING CURRENT
OPERATING SPEED

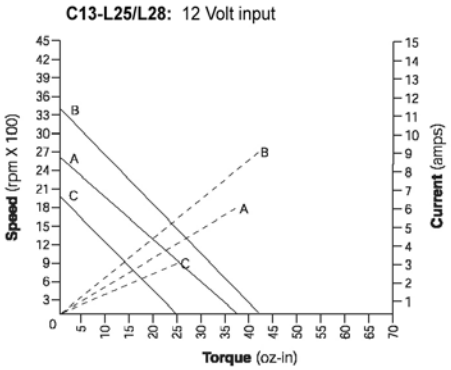
C13-L19: 36 Volt input



C = C13-L19-W30
D = C13-L19-W40
E = C13-L19-W50

OPERATING CURRENT
OPERATING SPEED

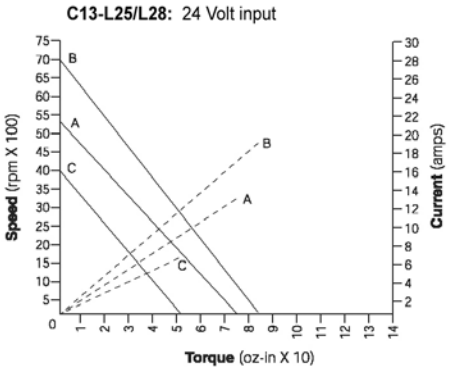
C13-L25/L28: 12 Volt input



A = C13-L25-W10
B = C13-L28-W10
C = C13-L28-W20

OPERATING CURRENT
OPERATING SPEED

C13-L25/L28: 24 Volt input



A = C13-L25-W10
B = C13-L28-W10
C = C13-L28-W10

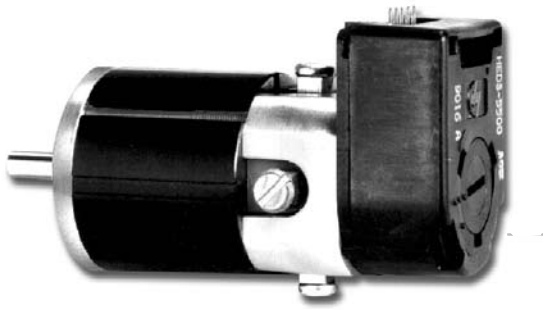
OPERATING CURRENT
OPERATING SPEED

INTEGRAL FEEDBACK DEVICES FOR CLOSED-LOOP CONTROL

All feedback devices are pre-assembled, aligned and fully tested, with output requirements matched (even custom designed) to your application. They are ideal for sensing rotary speed and angular position where space is a premium and low inertia is required.

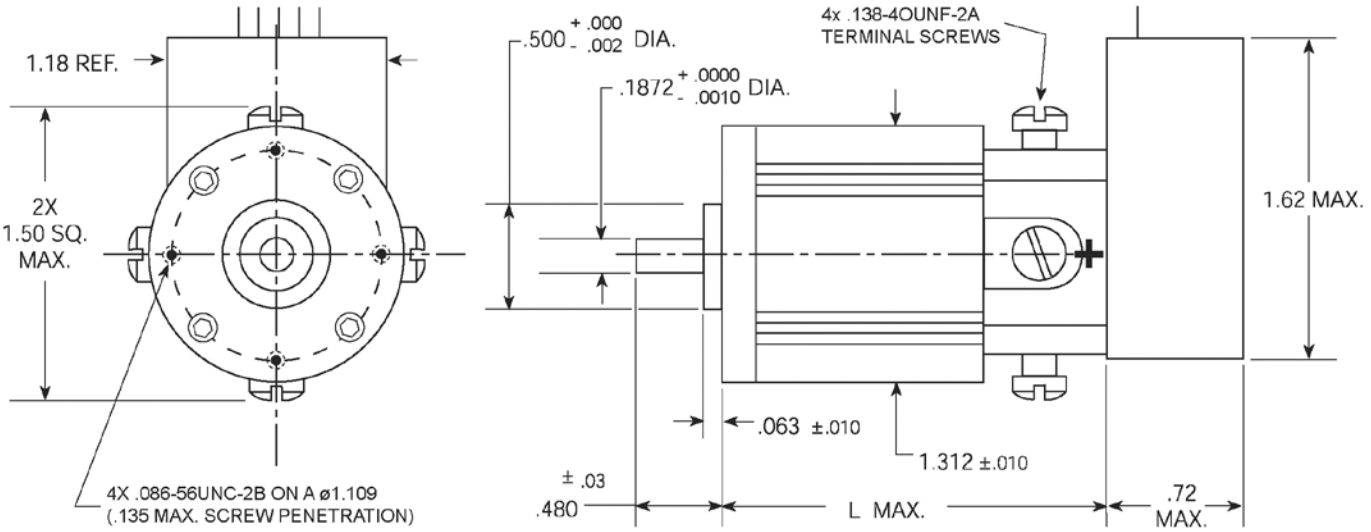
Encoders
High resolution, high reliability, and state-of-the-art technology in a small package.

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



Reproduced with permission of Hewlett-Packard Company.

Typical Outline Drawing



Dimensions are in inches

C13G Series – DC Gearmotors – 27 - 637 oz-in

Our gearboxes are assembled in a modular configuration from one, two or three planetary gear stages connected in series.

All planetary gearboxes conform to protection class IP 44. The output shaft ball bearings are protected by sealing washers, the input side is sealed from the motor as well.

FEATURES

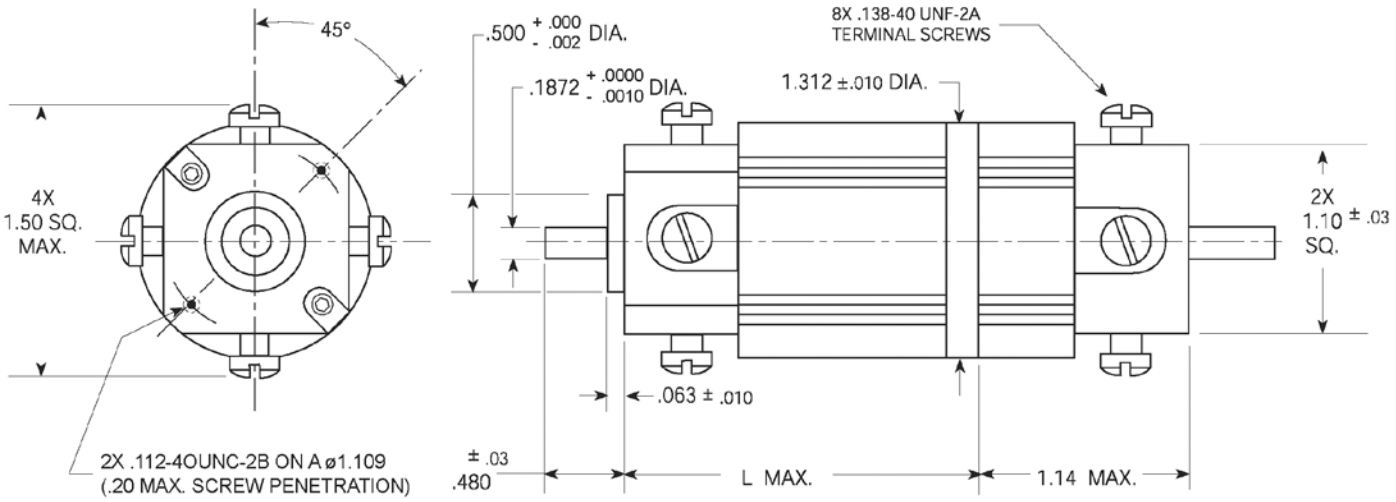
- Coaxial input and output
- Small size
- High tooth efficiency
- Small rotating mass
- Power distributed among several planet gears
- Low noise and backlash
- Reduction ratios from 4:1 to 308:1 in standard range (other ratios available, please consult factory)

Tachometers

Analog tachometers are an economical and efficient choice for applications requiring velocity feedback. These tachometers are integral to the motor on a common shaft, eliminating coupling or mounting irregularities.

- Voltage gradient: 2 V / Krpm
- Ripple voltage: 20% max peak to peak

Typical Outline Drawing



Dimensions are in inches

Permanent Magnet DC Motors

C23, 34, 42 Series

Available with integrated tachometers, resolvers and encoders for closed-loop control

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.

We offer a variety of standard sizes. If mechanical modifications are needed custom options are available for your specific application. Our engineering department is prepared to discuss your application to help tailor a permanent magnet motor to fit your needs.

TYPICAL APPLICATIONS

Robotics and factory automation
- Pick-and-place robots
- Positioning tables
- Welding wire feeders
- Automatic guided vehicles
- Barcoding equipment

Computer and office equipment
- Copier and microfilm machines
- Printers / plotters
- Tape drives

Industrial equipment
- Automatic door actuators
- Material handling equipment
- Packaging, marking and sorting equipment
- Machine tools
- Web drives
- Gimbal controlled cameras for security systems
- Antenna drives

Medical equipment
- Electric wheelchairs and scooters
- Bio-analytical equipment
- Medical pumps
- Centrifuges

FEATURES

- 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

BENEFITS

- Optional pre-aligned encoders provide accurate positioning
- Tachometers are available – 7, 10, 14 V / KRPM
- These motors offer continuous torques from 16.5 to 560 oz-in, peak torques from 125 to 3500 oz-in
- Motor lengths – 3.33 to 9.0 inches
- Diameter – 2.25 to 4.0 inches
- Permanently lubricated bearings
- Available with carbon steel or stainless steel shafts; single or double ended extensions
- Custom shaft and end cap configurations are also available

SPECIFICATION AND NUMBERING SYSTEM

Part Numbering System

C□□-L□□ W□□M□□ □□□-□□□

FRAME
COMMERCIAL
DC MOTOR
23 – Size 23
34 – Size 34
42 – Size 42

LENGTH
33 –
40 –
45 –
50 –
55 –
60 –
70 –
80 –
90 –
Refer to motor data table for standard offerings.

WINDING
10 –
20 –
30 –
40 –
50 –
Refer to motor data table for standard offerings. Call factory for custom windings.

MECHANICAL OPTIONS
00 – Standard Shaft

FEEDBACK OPTIONS
T – Tachometer
R – Resolver
E – Encoder

FEEDBACK OPTIONS

FACTORY OPTIONS
For custom unit types.

C23 SERIES SPECIFICATIONS – *Continuous Stall Torque 16.5 - 27 oz-in (0.117 - 0.191 Nm)*
Peak Torque 125 - 250 oz-in (0.883 - 1.765 Nm)

Part Number*		C23-L33					C23-L40				
Winding Code**		10	20	30	40	50	10	20	30	40	50
L = Length	inches	3.33					4				
	millimeters	84.6					101.6				
Peak Torque	oz-in	125.0	125.0	125.0	125.0	125.0	250.0	250.0	250.0	250.0	250.0
	Nm	0.883	0.883	0.883	0.883	0.883	1.765	1.765	1.765	1.765	1.765
Continuous Stall Torque	oz-in	16.5	16.5	16.5	16.5	16.5	27.0	27.0	27.0	27.0	27.0
	Nm	0.117	0.117	0.117	0.117	0.117	0.191	0.191	0.191	0.191	0.191
Rated Terminal Voltage	volts DC	12 -24	12 - 24	12 -36	12 - 60	12 - 60	12 - 24	12 - 48	12 - 60	12 - 60	12 - 60
Terminal Voltage	volts DC	12	12	24	36	48	12	24	36	48	60
Rated Speed	RPM	4700	2150	4200	3750	3000	2300	3600	3500	2850	2250
	rad/sec	492	225	440	393	314	241	377	367	298	236
Rated Torque	oz-in	7.5	12.6	12.7	14.4	15.8	17.3	25.5	25.3	25.6	24.2
	Nm	0.05	0.09	0.09	0.10	0.11	0.12	0.18	0.18	0.18	0.17
Rated Current	Amps	4.75	4.3	3	2	1.4	4.9	4.3	2.75	1.8	1.1
Rated Power	Watts	26.1	20.0	39.5	40.0	35.1	29.4	67.9	65.5	54.0	40.3
	Horsepower	0.03	0.03	0.05	0.05	0.05	0.04	0.09	0.09	0.07	0.05
Torque Senstivity	oz-in/amp	2.65	4.25	6.2	10.25	15.75	4.84	7.74	12	18.5	28.75
	Nm/amp	0.0187	0.0300	0.0438	0.0724	0.1112	0.0342	0.0547	0.0847	0.1306	0.2030
Back EMF	volts/KRPM	2	3.15	4.6	7.6	11.5	3.58	5.72	8.82	13.82	21.22
	volts/rad/sec	0.0191	0.0301	0.0439	0.0726	0.1098	0.0342	0.0546	0.0842	0.1320	0.2026
Terminal Resistance	ohms	0.60	1.00	1.70	4.00	9.00	0.70	0.96	2.30	5.50	12.00
Terminal Inductance	mH	0.35	0.94	2.00	5.50	13.00	0.50	1.30	3.10	7.36	18.00
Motor Constant	oz-in/watt^1/2	3.4	4.3	4.8	5.1	5.3	5.8	7.9	7.9	7.9	8.3
	Nm/watt	0.024	0.030	0.034	0.036	0.037	0.041	0.056	0.056	0.056	0.059
Rotor Inertia	oz-in-sec^2	0.0022	0.0022	0.0022	0.0022	0.0022	0.004	0.004	0.004	0.004	0.004
	g-cm^2	155.4	155.4	155.4	155.4	155.4	282.5	282.5	282.5	282.5	282.5
Friction Torque	oz-in	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	Nm	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Thermal Resistance	°C/watt	6.2	6.2	6.2	6.2	6.2	5.4	5.4	5.4	5.4	5.4
Damping Factor	oz-in/KRPM	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Nm/KRPM	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Weight	oz	27	27	27	27	27	38	38	38	38	38
	g	765	765	765	765	765	1077	1077	1077	1077	1077
Electrical Time Constant	millisecond	0.5833	0.9400	1.1765	1.3750	1.4444	0.7143	1.3584	1.3478	1.3382	1.5000
Mech. Time Constant	millisecond	26.07623	17.2056	13.72994	11.82747	11.44547	16.91906	9.052773	9.100907	9.00927	8.237676
Speed/Torque Gradient	rpm/oz-in	-113.2075	-74.69655	-59.60729	-51.34788	-49.68944	-40.39891	-21.61598	-21.73091	-21.51211	-19.66971

(continued on next page)

Notes:
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**Many other winding options are available – consult factory.

C23 SERIES SPECIFICATIONS –

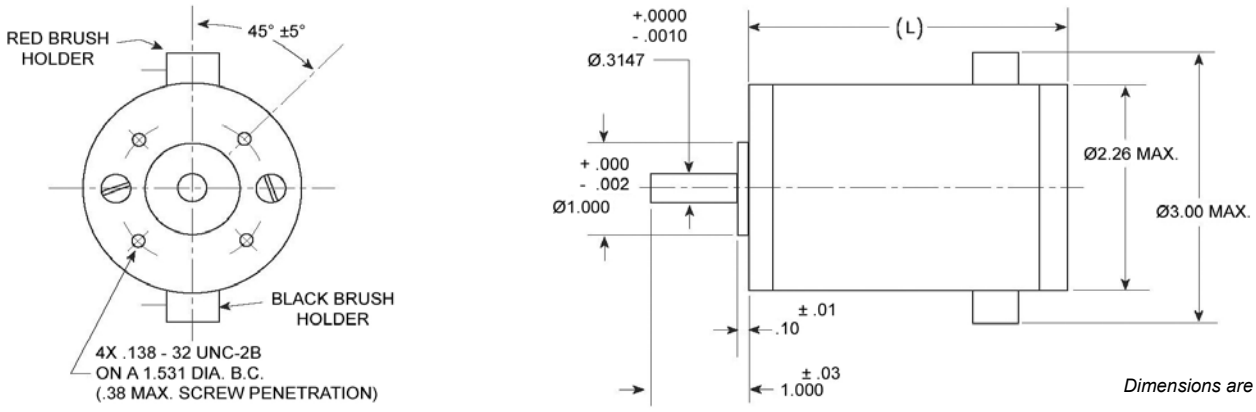
Continuous Stall Torque 34 - 50 oz-in (0.240 - 0.353 Nm)
Peak Torque 310 - 430 oz-in (2.189 - 3.037 Nm)

Part Number*		C23-L45					C23-L50					C23-L55				
Winding Code**		10	20	30	40	50	10	20	30	40	50	10	20	30	40	50
L = Length	inches	4.5					5					5.45				
	millimeters	114.3					127.0					138.4				
Peak Torque	oz-in	310.0	310.0	310.0	310.0	310.0	360.0	360.0	360.0	360.0	360.0	430.0	430.0	430.0	430.0	430.0
	Nm	2.189	2.189	2.189	2.189	2.189	2.542	2.542	2.542	2.542	2.542	3.037	3.037	3.037	3.037	3.037
Continuous Stall Torque	oz-in	34.0	34.0	34.0	34.0	34.0	42.0	42.0	42.0	42.0	42.0	50.0	50.0	50.0	50.0	50.0
	Nm	0.240	0.240	0.240	0.240	0.240	0.297	0.297	0.297	0.297	0.297	0.353	0.353	0.353	0.353	0.353
Rated Terminal Voltage	volts DC	12 -24	12 - 48	12 -60	12 - 60	12 - 60	12 - 24	12 - 60	12 - 60	18 - 60	24 - 60	12 - 24	12 - 60	12 - 60	18 - 60	24 - 60
Terminal Voltage	volts DC	12	24	36	48	60	12	24	36	48	60	12	24	36	48	60
Rated Speed	RPM	1950	2600	2600	2100	1555	1600	2150	2150	1800	1283	1350	1800	1700	1300	887
	rad/sec	204	272	272	220	163	168	225	225	188	134	141	188	178	136	93
Rated Torque	oz-in	25.3	26.5	25.8	23.3	23	27.1	30.1	32	31.5	34.3	36.4	39.3	40.5	40.9	43.5
	Nm	0.18	0.19	0.18	0.16	0.16	0.19	0.21	0.23	0.22	0.24	0.26	0.28	0.29	0.29	0.31
Rated Current	Amps	5.8	3.75	2.4	1.4	0.95	5.1	3.5	2.4	1.5	1.05	5.6	3.75	2.5	1.6	1.1
Rated Power	Watts	36.5	51.0	49.6	36.2	26.5	32.1	47.9	50.9	42.0	32.6	36.4	52.3	50.9	39.3	28.6
	Horsepower	0.05	0.07	0.07	0.05	0.04	0.04	0.06	0.07	0.06	0.04	0.05	0.07	0.07	0.05	0.04
Torque Senstivity	oz-in/amp	6.06	9.75	14.9	23.5	36	7.32	11.7	18	28.3	43.4	8.78	14.04	21.6	34	52.1
	Nm/amp	0.0428	0.0689	0.1052	0.1659	0.2542	0.0517	0.0826	0.1271	0.1998	0.3065	0.0620	0.0991	0.1525	0.2401	0.3679
Back EMF	volts/KRPM	4.5	7.2	11	17.25	26.5	5.41	8.65	13.3	20.9	32	6.49	10.38	16	25.14	38.5
	volts/rad/sec	0.0430	0.0688	0.1050	0.1647	0.2531	0.0517	0.0826	0.1270	0.1996	0.3056	0.0620	0.0991	0.1528	0.2401	0.3676
Terminal Resistance	ohms	0.54	1.40	3.27	8.13	19.0	0.63	1.60	3.20	7.00	16.50	0.56	1.43	3.39	8.40	19.10
Terminal Inductance	mH	0.72	1.75	4.26	10.24	24.20	0.77	1.96	4.66	11.44	27.00	0.97	2.38	5.50	13.73	32.28
Motor Constant	oz-in/watt^1/2	8.2	8.2	8.2	8.2	8.2	9.3	9.2	10.1	10.7	10.7	11.7	11.7	11.7	11.7	11.7
	Nm/watt	0.058	0.058	0.058	0.058	0.058	0.065	0.065	0.071	0.076	0.075	0.083	0.083	0.083	0.083	0.083
Rotor Inertia	oz-in-sec^2	0.0052	0.0052	0.0052	0.0052	0.0052	0.0065	0.0065	0.0065	0.0065	0.0065	0.0078	0.0078	0.0078	0.0078	0.0078
	g-cm^2	367.2	367.2	367.2	367.2	367.2	459.0	459.0	459.0	459.0	459.0	550.8	550.8	550.8	550.8	550.8
Friction Torque	oz-in	5	5	5	5	5	5	5	5	5	5	6	6	6	6	6
	Nm	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Thermal Resistance	°C/watt	4.7	4.7	4.7	4.7	4.7	4.3	4.3	4.3	4.3	4.3	3.9	3.9	3.9	3.9	3.9
Damping Factor	oz-in/KRPM	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3
	Nm/KRPM	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.002
Weight	oz	46	46	46	46	46	56	56	56	56	56	65	65	65	65	65
	g	1304	1304	1304	1304	1304	1588	1588	1588	1588	1588	1843	1843	1843	1843	1843
Electrical Time Constant	millisecond	1.3309	1.2500	1.3028	1.2595	1.2670	1.2300	1.2250	1.4563	1.6343	1.6364	1.7321	1.6643	1.6224	1.6345	1.6386
Mech. Time Constant	millisecond	10.80095	10.85778	10.86223	10.91902	10.90021	10.75786	10.75915	9.096742	8.054255	8.085451	8.025833	8.013327	8.010641	8.025579	8.020641
Speed/Torque Gradient	rpm/oz-in	-19.83865	-19.94302	-19.95119	-20.0555	-20.02096	-15.8076	-15.8095	-13.36675	-11.83492	-11.88076	-9.82763	-9.812617	-9.809028	-9.82732	-9.821273

Notes:
1. For MS (military style) connector, please specify connector housing and terminal.
2. 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.

C23 Typical Outline Drawing

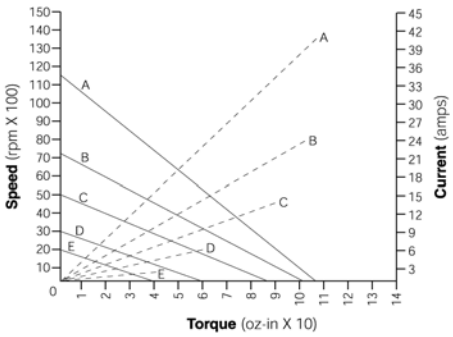


Dimensions are in inches

IMPORTANT
Typical performance characteristics at 25°C. The operational life 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.

C23 Torque / Speed Curves

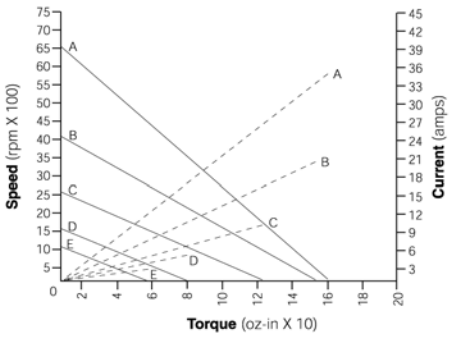
C23-L33: 24 Volt input



A = C23-L33-W10
B = C23-L33-W20
C = C23-L33-W30
D = C23-L33-W40
E = C23-L33-W50

OPERATING CURRENT
OPERATING SPEED

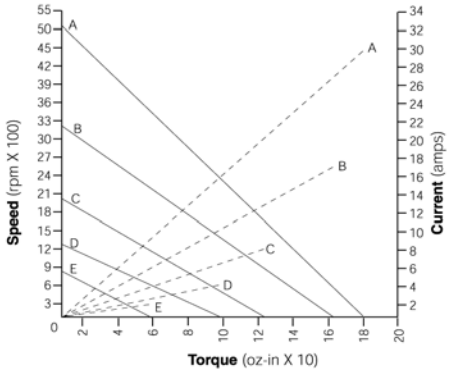
C23-L40: 24 Volt input



A = C23-L40-W10
B = C23-L40-W20
C = C23-L40-W30
D = C23-L40-W40
E = C23-L40-W50

OPERATING CURRENT
OPERATING SPEED

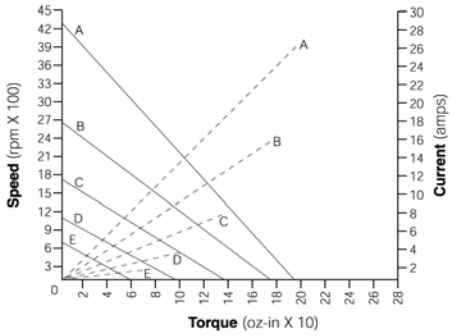
C23-L45: 24 Volt input



A = C23-L45-W10
B = C23-L45-W20
C = C23-L45-W30
D = C23-L45-W40
E = C23-L45-W50

OPERATING CURRENT
OPERATING SPEED

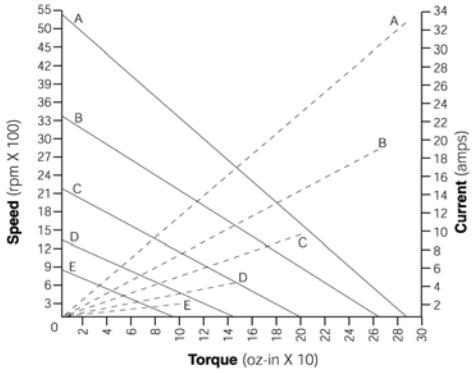
C23-L50: 24 Volt input



A = C23-L50-W10
B = C23-L50-W20
C = C23-L50-W30
D = C23-L50-W40
E = C23-L50-W50

OPERATING CURRENT
OPERATING SPEED

C23-L55: 36 Volt input



A = C23-L55-W10
B = C23-L55-W20
C = C23-L55-W30
D = C23-L55-W40
E = C23-L55-W50

OPERATING CURRENT
OPERATING SPEED

• Skewed Armatures standard on C13 series - available on all other series upon request.

Note:
A skewed armature is one in which the laminations do not line up, but rather are on a skew for the length of the armature stack. There are some distinct advantages to a motor utilizing a skewed armature, the greatest being a REDUCTION OF COGGING.

C34 SERIES SPECIFICATIONS –

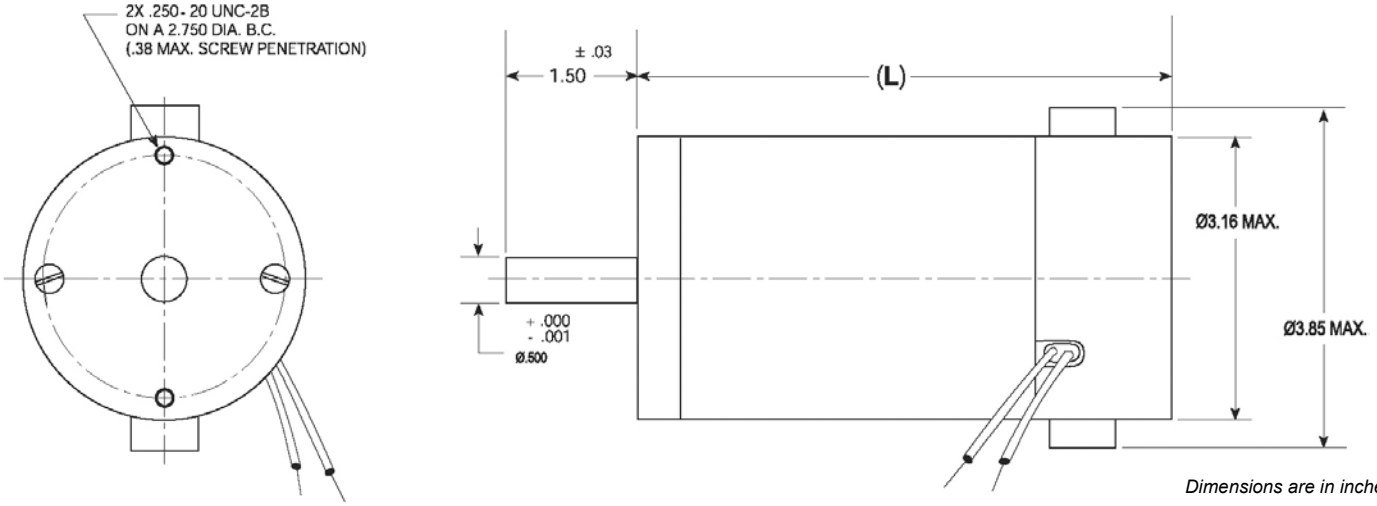
Continuous Stall Torque 63 - 125 oz-in (0.445 - 0.883 Nm)
Peak Torque 580 - 1110 oz-in (4.096 - 7.838 Nm)

Part Number*		C34-L60				C34-L70				C34-L80			
Winding Code**		10	20	30	40	10	20	30	40	10	20	30	40
L = Length	inches	6.00					7.00			8.00			
	millimeters	152.40					177.80			203.20			
Peak Torque	oz-in	580.0	580.0	580.0	580.0	855.0	855.0	855.0	855.0	1110.0	1110.0	1110.0	1110.0
	Nm	4.096	4.096	4.096	4.096	6.038	6.038	6.038	6.038	7.838	7.838	7.838	7.838
Continuous Stall Torque	oz-in	63.0	63.0	63.0	63.0	95.0	95.0	95.0	95.0	125.0	125.0	125.0	125.0
	Nm	0.445	0.445	0.445	0.445	0.671	0.671	0.671	0.671	0.883	0.883	0.883	0.883
Rated Terminal Voltage	volts DC	12 - 30	12 - 48	18 - 60	30 - 72	12 - 30	12 - 48	18 - 78	30 - 120	12 - 30	12 - 48	18 - 90	30 - 132
Terminal Voltage	volts DC	24	36	60	72	24	36	48	72	12	24	48	72
Rated Speed	RPM	2700	1900	1447	952	4450	2720	1800	1313	1800	1750	1847	1424
	rad/sec	282.74	198.97	151.53	99.69	466.00	284.84	188.50	137.50	188.50	183.26	193.42	149.12
Rated Torque	oz-in	60.7	55.1	63.9	76.1	75.0	110.0	85.0	96.1	81.7	94.9	80.4	115.0
	Nm	0.43	0.39	0.45	0.54	0.53	0.78	0.60	0.68	0.58	0.67	0.57	0.81
Rated Current	Amps	8.20	3.70	2.05	1.55	13.00	7.00	3.75	2.15	15.00	8.50	3.70	2.50
Rated Power	Watts	121.3	77.5	68.4	53.6	247.0	221.4	113.2	93.4	108.8	122.9	109.9	121.2
	Horsepower	0.16	0.10	0.09	0.07	0.33	0.30	0.15	0.13	0.15	0.16	0.15	0.16
Torque Senstivity	oz-in/amp	10.90	21.80	43.60	68.00	7.79	15.58	31.20	59.00	7.50	15.00	30.00	60.00
	Nm/amp	0.08	0.15	0.31	0.48	0.06	0.11	0.22	0.42	0.05	0.11	0.21	0.42
Back EMF	volts/KRPM	8.00	16.10	32.20	50.30	5.76	11.50	23.00	43.60	5.50	11.00	22.00	44.40
	volts/rad/sec	0.08	0.15	0.31	0.48	0.06	0.11	0.22	0.42	0.05	0.11	0.21	0.42
Terminal Resistance	ohms	0.43	1.72	6.80	14.50	0.14	0.56	2.24	7.40	0.15	0.60	2.40	4.90
Terminal Inductance	mH	0.90	4.80	18.00	35.00	0.24	1.12	4.50	14.50	0.18	0.72	3.10	11.20
Motor Constant	oz-in/watt^1/2	16.62	16.62	16.72	17.86	20.82	20.82	20.85	21.69	19.36	19.36	19.36	27.11
	Nm/watt	0.12	0.12	0.12	0.13	0.15	0.15	0.15	0.15	0.14	0.14	0.14	0.19
Rotor Inertia	oz-in-sec^2	0.030	0.030	0.030	0.030	0.042	0.042	0.042	0.042	0.055	0.055	0.055	0.055
	g-cm^2	2118.45	2118.45	2118.45	2118.45	2965.83	2965.83	2965.83	2965.83	3883.83	3883.83	3883.83	3883.83
Friction Torque	oz-in	15	15	15	15	17	17	17	17	20	20	20	20
	Nm	0.11	0.11	0.11	0.11	0.12	0.12	0.12	0.12	0.14	0.14	0.14	0.14
Thermal Resistance	°C/watt	3.90	3.90	3.90	3.90	3.70	3.70	3.70	3.70	3.50	3.50	3.50	3.50
Damping Factor	oz-in/KRPM	2.50	2.50	2.50	2.50	3.00	3.00	3.00	3.00	3.80	3.80	3.80	3.80
	Nm/KRPM	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03
Weight	oz	100.00	100.00	100.00	100.00	128.00	128.00	128.00	128.00	152.00	152.00	152.00	152.00
	g	2834.95	2834.95	2834.95	2834.95	3628.74	3628.74	3628.74	3628.74	4309.12	4309.12	4309.12	4309.12
Electrical Time Constant	millisecond	2.0930	2.7907	2.6471	2.4138	1.7143	2.0000	2.0089	1.9595	1.2000	1.2000	1.2917	2.2857
Mech. Time Constant	millisecond	15.48888	15.39267	15.21369	13.31555	13.72031	13.74418	13.72656	12.64996	20.94	20.94	20.94	10.59184
Speed/Torque Gradient	rpm/oz-in	-4.931193	-4.900564	-4.843581	-4.23927	-3.120097	-3.125523	-3.121516	-2.876691	-3.636364	-3.636364	-3.636364	-1.839339

Notes:
1. For MS (military style) connector, please specify connector housing and terminal.
2. 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.

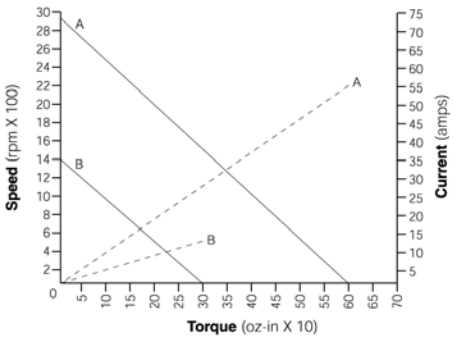
C34 Typical Outline Drawing



Dimensions are in inches

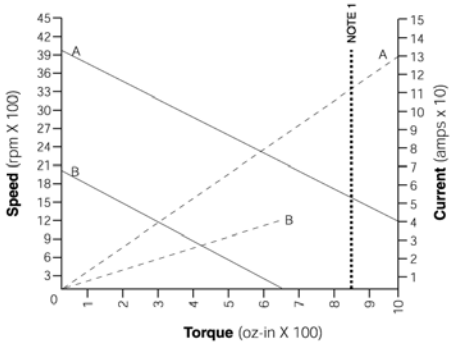
C34 Torque / Speed Curves

C34-L60: 24 Volt input



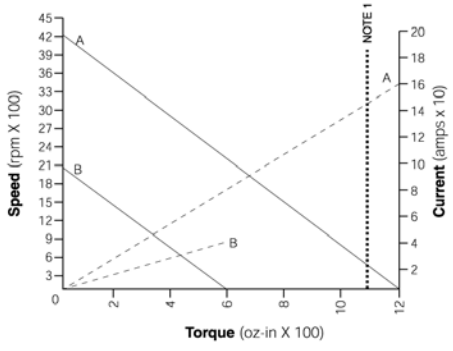
A = C34 - L60 - W10
B = C34 - L60 - W20
OPERATING CURRENT
OPERATING SPEED

C34-L70: 24 Volt input



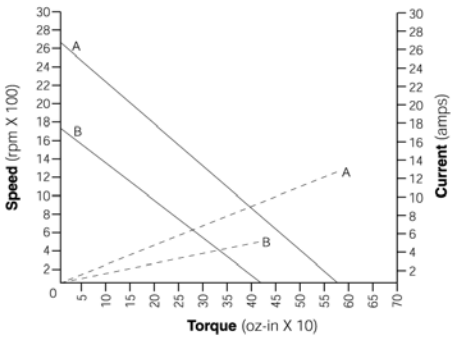
A = C34 - L70 - W10
B = C34 - L70 - W20
OPERATING CURRENT
OPERATING SPEED

C34-L80: 24 Volt input



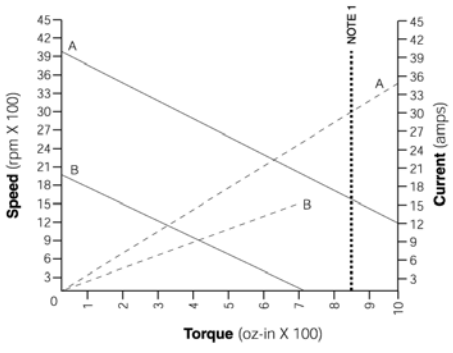
A = C34 - L80 - W10
B = C34 - L80 - W20
OPERATING CURRENT
OPERATING SPEED

C34-L60: 90 Volt input



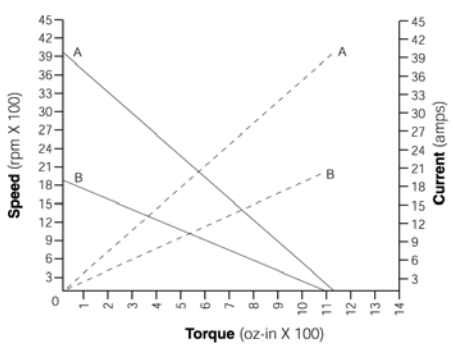
A = C34 - L60 - W30
B = C34 - L60 - W40
OPERATING CURRENT
OPERATING SPEED

C34-L70: 90 Volt input



A = C34 - L70 - W30
B = C34 - L70 - W40
OPERATING CURRENT
OPERATING SPEED

C34-L80: 90 Volt input



A = C34 - L80 - W30
B = C34 - L80 - W40
OPERATING CURRENT
OPERATING SPEED

• Skewed Armatures standard on C13 series - available on all other series upon request.

Note:
A skewed armature is one in which the laminations do not line up, but rather are on a skew for the length of the armature stack. There are some distinct advantages to a motor utilizing a skewed armature, the greatest being a REDUCTION OF COGGING.

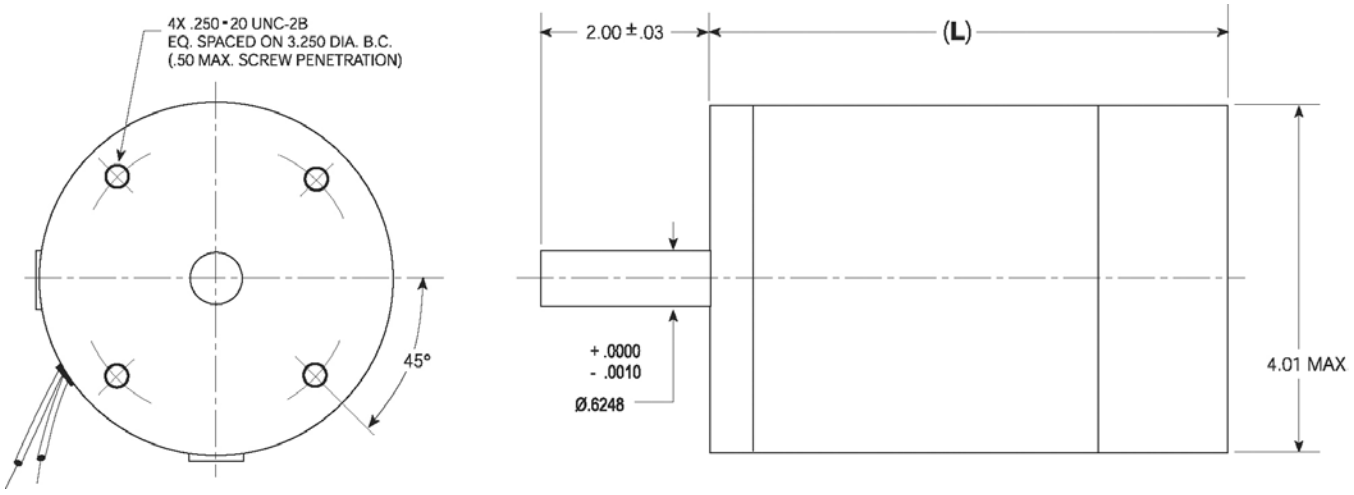
C42 SERIES SPECIFICATIONS – *Continuous Stall Torque 145 - 560 oz-in (1.024 - 3.955 Nm)*
Peak Torque 1100 - 3500 oz-in (7.768 - 24.716 Nm)

Part Number*		C42-L50			C42-L70			C42-L90		
Winding Code**		10	20	30	10	20	30	10	20	30
L = Length	inches	5.00			7.00			9.00		
	millimeters	127.0			177.8			228.6		
Peak Torque	oz-in	1100.0	1100.0	1100.0	2400.0	2400.0	2400.0	3500.0	3500.0	3500.0
	Nm	7.768	7.768	7.768	16.948	16.948	16.948	24.716	24.716	24.716
Continuous Stall Torque	oz-in	145.0	145.0	145.0	400.0	400.0	400.0	560.0	560.0	560.0
	Nm	1.024	1.024	1.024	2.825	2.825	2.825	3.955	3.955	3.955
Rated Terminal Voltage	volts DC	12 - 48	24 - 72	36 - 96	12 - 48	24 - 72	36 - 96	24 - 60	24 - 84	36 - 96
Terminal Voltage	volts DC	48	72	84	36	48	72	48	60	90
Rated Speed	RPM	3226	1885	1526	1160	1130	1060	1273	1238	1517
	rad/sec	338	197	160	121	118	111	133	130	159
Rated Torque	oz-in	80.3	98.2	126.7	249	237	263	336	341	320
	Nm	0.57	0.69	0.89	1.76	1.67	1.86	2.37	2.41	2.26
Rated Current	Amps	5.3	2.7	2.4	8	5.75	3.9	8.5	6.7	5
Rated Power	Watts	192	137	143	214	198	206	317	312	359
	Horsepower	0.26	0.18	0.19	0.29	0.27	0.28	0.42	0.42	0.48
Torque Senstivity	oz-in/amp	20	46	65	39	52.8	85	50	64.3	82
	Nm/amp	0.1412	0.3248	0.4590	0.2754	0.3729	0.6002	0.3531	0.4541	0.5791
Back EMF	volts/KRPM	14.8	34	48	28.8	39	62.85	37	47.5	60
	volts/rad/sec	0.1413	0.3247	0.4584	0.2750	0.3724	0.6002	0.3533	0.4536	0.5730
Terminal Resistance	ohms	0.7	4	5.7	0.62	1.2	2.6	0.6	0.95	1.45
Terminal Inductance	mH	1.3	6.6	13.5	2	3.7	9.6	2	3.3	5.4
Motor Constant	oz-in/watt^1/2	23.9	23.0	27.2	49.5	48.2	52.7	64.5	66.0	68.1
	Nm/watt	0.169	0.162	0.192	0.350	0.340	0.372	0.456	0.466	0.481
Rotor Inertia	oz-in-sec^2	0.09	0.09	0.09	0.21	0.21	0.21	0.31	0.31	0.31
	g-cm^2	6355.4	6355.4	6355.4	14829.2	14829.2	14829.2	21890.7	21890.7	21890.7
Friction Torque	oz-in	14.0	14.0	14.0	20.0	20.0	20.0	24	24	24
	Nm	0.10	0.10	0.10	0.14	0.14	0.14	0.17	0.17	0.17
Thermal Resistance	°C/watt	2.20	2.20	2.20	1.30	1.30	1.30	0.85	0.85	0.85
Damping Factor	oz-in/KRPM	5.25	5.25	5.25	10.00	10.00	10.00	10.00	10.00	10.00
	Nm/KRPM	0.037	0.037	0.037	0.071	0.071	0.071	0.071	0.071	0.071
Weight	oz	110	110	110	200	200	200	262	262	262
	g	3118	3118	3118	5670	5670	5670	7428	7428	7428
Electrical Time Constant	millisecond	1.8571	1.6500	2.3684	3.2258	3.0833	3.6923	3.3333	3.4737	3.7241
Mech. Time Constant	millisecond	22.28412	24.09974	17.2151	12.1367	12.81294	10.70077	10.52659	10.09549	9.565579
Speed/Torque Gradient	rpm/oz-in	-2.36486	-2.55754	-1.82692	-0.55199	-0.58275	-0.48669	-0.32432	-0.31104	-0.29472

Notes:
1. For MS (military style) connector, please specify connector housing and terminal.
2. Data for informational purposes only. Should not be considered a binding performance agreement. For specific applications, please contact the factory.

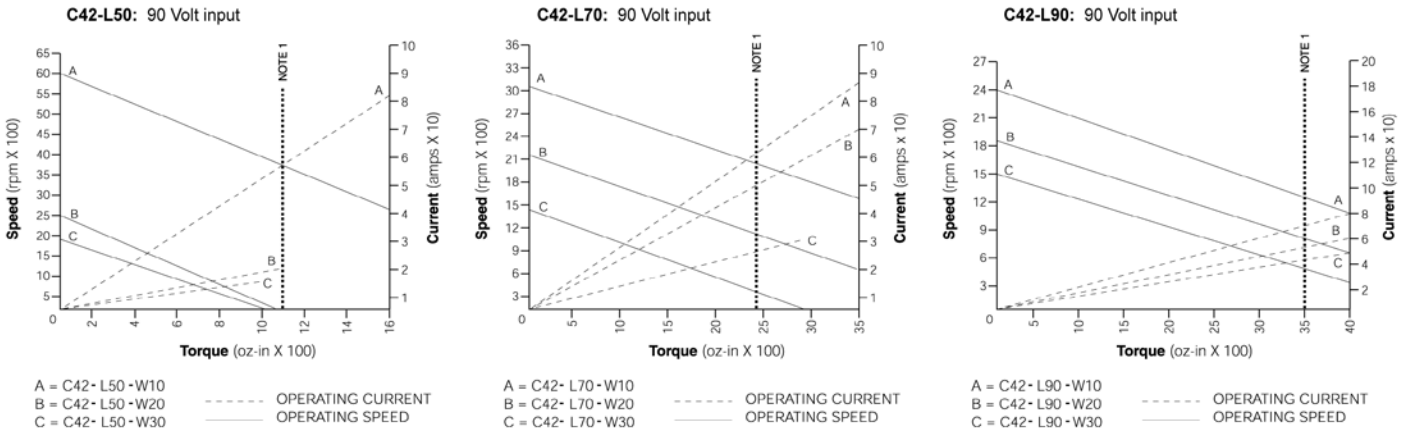
*Many other custom mechanical options are available – consult factory.
**Many other winding options are available – consult factory.

C42 Typical Outline Drawing



Dimensions are in inches

C42 Torque / Speed Curves



NOTE 1: Do not operate motor beyond this line. Maximum current and torque must be limited to data sheet values to avoid possibility of magnet demagnetization.

INTEGRAL FEEDBACK DEVICES FOR CLOSED-LOOP CONTROL

All feedback devices are pre-assembled, aligned and fully tested, with output requirements matched (even custom designed) to your application. They are ideal for sensing rotary speed and angular position where space is a premium and low inertia is required.

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

Tachometers

Analog tachometers are an economical and efficient choice for applications requiring velocity feedback. These tachometers are integral to the motor on a common shaft, eliminating coupling or mounting irregularities.

- Voltage gradient: 7, 10, 14 V / Krpm
- Ripple voltage: 20% max peak to peak

Note: Tachometers not available for C34 and C42 models.

HOW TO SELECT A MOTOR

The motor you require can be customized to your application. Review the motor data tables shown above to determine the size and winding that most closely matches your needs. Then supply us with the following information:

- ❑ Maximum voltage and current available
- ❑ Load torque required
- ❑ Load inertia, oz-in / sec^2
- ❑ Velocity profile: speed vs time
- ❑ Maximum motor dimensions
- ❑ Shaft and endcap configuration
- ❑ Feedback options

DC Cube Torque Motors

21, 22, 23 and 24 Series

TYPICAL APPLICATIONS

- Avionics - cockpit instrumentation (altitude, latitude) and displays (indicators and instruments)
- Robotic control systems
- Military targeting / fire control systems
- Sighting systems
- Missiles
- Military actuators
- Direct drive servo systems
- Medical equipment

FEATURES

- 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 x 1 x 1 inches
  - Model 22 – 1 x 1 x .75 inches
  - Model 23 – 1 x 1 x 1.35 inches
  - Model 24 – 75 x .75 x .75 inches
- Silver alloy brushes
- Speeds up to (7500) 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

BENEFITS

- High torque-to-inertia ratio in a small package
- Rapid response at all speeds
- Cartridge brush is easily field-replaceable
- Skewed rotors provide minimum cogging torque
- Gold-clad commutator for long life
- Rare earth magnets provide higher performance than standard permanent magnets
- Cubical shape provides weight and space savings and easy mounting
- Torque increases directly with input current for high linearity as a direct servo drive
- Low self inductance

High torque-to-inertia ratio in a compact size

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.

Moog Components Group offers a choice of Alnico or Samarium Cobalt magnet materials to satisfy most any requirement. These rare earth magnets produce a higher magnetic energy per unit volume than most commercially available permanent magnets. Alnico magnets provide enhanced temperature stability while Samarium Cobalt magnets offer high energy with good, stable performance.

We're tooled for hundreds of designs with different windings, end caps and other options including gearheads, brakes, resolvers, encoders and potentiometers. Most designs can easily be adapted to meet different requirements. We can also provide custom engineering services.

CUBE MOTOR PARAMETERS

Part Numbering System Guide

NN NNN A – AA – NN / ANNN [ ]

DESIGN SERIES
(2 Numbers)

HOUSING TYPE
(3 Numbers)
Sequentially assigned by factory

FRAME SIZE
21 1 inch square cube motor
22 1 inch square short version of series 21
23 1 inch square long version of series 21
24 .75 inch square cube motor

TERMINATIONS TYPE
(1 Letter)

A Solder eyelet terminals (pin type terminals, 2 leaf springs)
B Lead out the rear
C (Not used)
D Cover can and unshielded leads (radial exit)
E (Not used)
F (Not used)
G (Not used)
H (Not used)
I (Not used)
J Leads out the side
K Turret type terminals
L Screw terminals #4-40, side exit with cartridge brushes (4)
M Screw terminals #4-40, side exit with cartridge brushes (2)
N Pin type terminals with flush cartridge brushes (2)
O (Not used)
P (Not used)
Q Turret type terminals with flush (snap in) cartridge brushes (2)
R Leads out the side with flush (snap in) cartridge brushes (2)
S (Not used)
T (Not used)
U 4 leaf springs, 2 pin terminals, 2 leads
V Pin type terminals with flush (snap in) cartridge brushes (4)
W Leads out the side with flush (snap in) cartridge brushes (4)
X 4 cartridge brushes, 2 pin terminals, 2 leads
Y #2-64 screw terminals, 180° apart
Z 4 leaf springs, 4 pin terminals

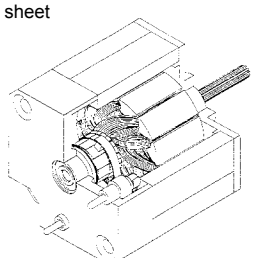
SHAFT
(2 Letters)

ELECTRICAL OPTIONS
(2 Numbers)
Unique to design series

MODIFICATION NUMBER
"D" + 3 Numbers
Each modification number (slash number) has a separate outline modification sheet

HOUSING CODE
(Either Location)
P = Paladin black
S = Samarium Cobalt magnets
C = Connector

Examples of Typical Cube Motors



Standard Cube Motor

1.21 Cube Series
- 1.02 in x 1.02 in x 1.069 in max
- 1.355 in x 1.355 in x 1.02 in max - cartridge screw type
- Peak Torques: 7.6 oz-in Alnico magnet
  15.0 oz-in Samarium Cobalt magnet

2.22 Cube Series
- 1.02 in x 1.02 in x 0.812 in max
- Peak Torques: 3.6 oz-in Alnico magnet
  7.0 oz-in Samarium Cobalt magnet

3.23 Cube Series
- 1.02 in x 1.02 in x 1.343 in max
- 1.355 in x 1.355 in x 1.500 in max - cartridge screw type
- Peak Torques: 12.0 oz-in Alnico magnet
  20.0 oz-in Samarium Cobalt magnet

4.24 Cube Series
- 0.750 in x 0.750 in x 0.750 in max
- Peak Torques: 2.7 oz-in Alnico magnet
  (2.7) oz-in Samarium Cobalt magnet

Integrated Motion Technology

In many gimballed systems for the military, aerospace and industrial market segments, rotary electromechanical components such as motors, resolvers and slip ring assemblies often find themselves sharing common envelopes and structures. For this reason, Moog Components Group has a unique niche in the marketplace by providing and integrating these traditional components into one assembly so the individual components have been optimized to work together.

Today, Moog Components Group is in the unique position to provide engineering and manufacturing expertise for all rotary components that share the gimbal's structure. Moog Components Group's fractional horsepower DC motors provide the torque for continuous rotation for scanning applications such as radar, missiles, seekers, aerial targets and target acquisition systems while the slip ring assemblies pass the power and data (up to 1 Gbps) across the rotating interface. Our resolvers provide the positional feedback often within arc seconds of accuracy.

These components can, of course, be provided separately or be integrated. Integrated products typically share a common structure and bearing which reduces piece part count and system weight. Integration and test is performed at the factory providing a "plug and play" subsystem. Moog Components Group also provides complete actuator systems with control electronics. This integrated concept reduces the number of items that would otherwise have to be procured and stocked by the OEM.

System enhancements and upgrades occur naturally when dealing with one company that has the engineering and manufacturing expertise for rotary component needs.

SPECIFICATIONS ON TYPICAL CUBE MOTORS

The following tables presents a cross-section of Moog Components Group cube motor designs. Tooling charges may apply to new designs.

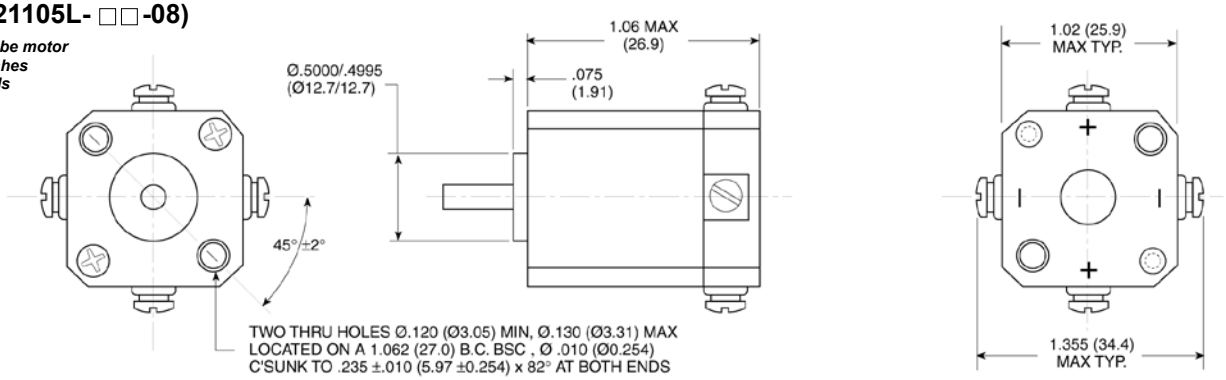
Part Number	Length inches (metric)	Peak Torque (oz-in) (Nm)	Volts at Peak Torque (Volts)	Current at Peak Torque (amps)	Torque Constant (oz-in/amp)	Back EMF (V/rad/sec) x10E–2 (Nm/amp)	DC Resistance (Ohms)	Inductance (mH)	Inertia (oz-in-sec2) x10E–4 (KgCm2 x10E–4)	No Load Speed (RPM)	No Load Current (Ma)	Starling Voltage (Volts)	Weight (oz) (gm)
21105N-□□-03	1.06	7.5	26.0	1.7	5.3	3.74	15.0	6.0	1.3	6500	85	1.0	2.93
	26.9	.053	26.0	1.7	.037	3.74	15.0	6.0	.018	6500	85	1.0	83.06
21105A-□□-04	1.06	7.5	41.7	0.975	7.55	5.3	44.0	16.0	1.3	6500	60	0.75	2.93
	26.9	.053	41.7	0.975	.053	5.3	44.0	16.0	.018	6500	60	0.75	83.06
21105N-□□-08	1.06	8.6	13.0	3.3	2.6	1.8	3.9	1.3	1.3	6500	150	1.0	2.93
	26.9	.061	13.0	3.3	.018	1.8	3.9	1.3	.018	6500	150	1.0	83.06
21105N-□□-10	1.06	6.0	8.0	5.0	1.2	0.85	1.6	0.4	1.3	6500	225	1.0	2.93
	26.9	.042	8.0	5.0	.009	0.85	1.6	0.4	.018	6500	225	1.0	83.06
21105N-□□-12	1.06	6.5	26.0	1.7	4.6	3.25	15.0	6.0	1.3	7000	85	1.0	2.93
	26.9	.046	26.0	1.7	.033	3.25	15.0	6.0	.018	7000	85	1.0	83.06
21105N-□□-13	1.06	6.5	41.7	0.975	6.7	4.8	44.0	16.0	1.3	7000	60	1.0	2.93
	26.9	.046	41.7	0.975	.048	4.8	44.0	16.0	.018	7000	60	1.0	83.06
21605A-□□-14S	1.06	11.0 min.	20.5	2.95	3.8	2.68	7	3.3	1.3	7000	217	1.0	2.93
	26.9	.078	20.5	2.95	.027	2.68	7	3.3	.018	7000	217	1.0	83.06
21607A-□□-15S	1.06	12.0 min.	24	3.5	4.75	3.35	7.5	3.5	1.3	6500	90	0.75	2.93
	26.9	.85	24	3.5	.034	3.35	7.5	3.5	.018	6500	90	0.75	83.06
21607J-□□-16S	1.06	8.5	20	1.5	5.5	3.9	13	5	1.3	4600	100	1.5	2.93
	26.9	.060	20	1.5	.039	3.9	13	5	.018	4600	100	1.5	83.06
21607J-□□-19S	1.06	12.0	25.9	2.9	5.0	3.5	9	4	1.3	6800	60	1.0	2.93
	26.9	.085	25.9	2.9	.035	3.5	9	4	.018	6800	60	1.0	83.06
21605A-□□-20S	1.06	12.0	28	3.2	5.4	3.8	10.5	5	1.3	6700	60	0.75	2.93
	26.9	.085	28	3.2	.038	3.8	10.5	5	.018	6700	60	0.75	83.06
21105K-□□-22S	1.06	7.2	12	2.1	4.5	3.2	7	3.3	1.3	3400	60	1.0	2.93
	26.9	.051	12	2.1	.032	3.2	7	3.3	.018	3400	60	1.0	83.06
22613J-□□-01	0.812	3.6	26.0	0.6	6.0	4.2	43.0	12.0	0.65	5000	45	1.0	2.0
	20.6	.025	26.0	0.6	.042	4.2	43.0	12.0	.009	5000	45	1.0	56.70
22613M-□□-01	0.812	3.6	26.0	0.6	6.0	4.2	43.0	12.0	0.65	5000	45	1.5	2.0
	20.6	.025	26.0	0.6	.042	4.2	43.0	12.0	.009	5000	45	1.5	56.70
23101L-□□-01	1.50	10.0	26.0	2.1	4.8	3.4	12.0	5.0	2.2	5800	125	1.0	4.3
	38.1	.071	26.0	2.1	.034	3.4	12.0	5.0	.031	5800	125	1.0	121.9
23101L-□□-02	1.50	12.0	18.0	3.27	3.7	2.6	5.5	2.2	2.2	5500	175	1.0	4.3
	38.1	.085	18.0	3.27	.026	2.6	5.5	2.2	.031	5500	175	1.0	121.9
24618R-□□-04	0.75	1.7	15.0	0.58	3.7	2.6	26.0	8.5	0.35	5000	50	1.5	1.25
	19.1	.012	15.0	0.58	.026	2.6	26.0	8.5	.005	5000	50	1.5	35.44
24618N-□□-05	0.75	2.7	12.0	1.0	2.7	1.9	12	—	0.35	5725	50	1.0	1.25
	19.1	.019	12.0	1.0	.019	1.9	12	—	.005	5725	50	1.0	35.44
24618R-□□-09	0.75	1.0	6	0.75	1.35	0.95	8	1.4	0.35	6000	125	1.0	1.25
	19.1	.007	6	0.75	.010	0.95	8	1.4	.005	6000	125	1.0	35.44
24618V-□□-10	0.75	2.5	26	0.425	5.75	4.1	61	—	0.35	5500	30	1.0	1.25
	19.1	.018	26	0.425	.041	4.1	61	—	.005	5500	30	1.0	35.44
24618V-□□-11	0.75	1.5	15.0	0.555	2.7	1.9	22.5	—	0.35	6600	75	1.25	1.25
	19.1	.011	15.0	0.555	.019	1.9	22.5	—	.005	6600	75	1.25	35.44
24618V-□□-15	0.75	1.0	7.5	0.575	1.8	1.3	13	1.4	0.35	5000	70	0.75	1.25
	19.1	.007	7.5	0.575	.013	1.3	13	1.4	.005	5000	70	0.75	35.44

Part Number	Length (inches)	Peak Torque (oz.-in.)	Volts at Peak Torque (Volts)	Current at Peak Torque (amp)	Torque Constant (oz.in./amp)	Back EMF (V/Rad./s)	Term. Res. (Ohms)	Term. Ind. (mH)	Rotor Inertia (oz.in.s²)	Frictional Torque (oz.in.)	Motor Constant (oz.in./sq.rt.watts)	Weight (oz.)	(Commutation)	Pot. End-End Travel	Pot. Linearity
DC MT/POT AS-889-003	1.500	12.0	21.6	2.40	5.00	0.035	9.00	4.50	1.6E-04	0.30	1.67	4.0	Potentiometer	250°	Absolute +/- .50%
MT/RESOLVER AS-891-002	2.000	1.3	13.3	0.42	3.50	0.025	32.00	6.00	7.8E-06	0.20	0.62	3.2	Resolver	Accuracy < 6'	Transformation Ratio 0.454 +/- 5%
MT/POT/GHD AS-915-001	3.375	66.5	26.1	2.90	5.50	0.039	9.00	4.50	3.0E-04	3.50	1.83	6.0	None	Gear Ratio 4.84:1	Back Lash < 0.5°

Cube Motor Typical Outlines

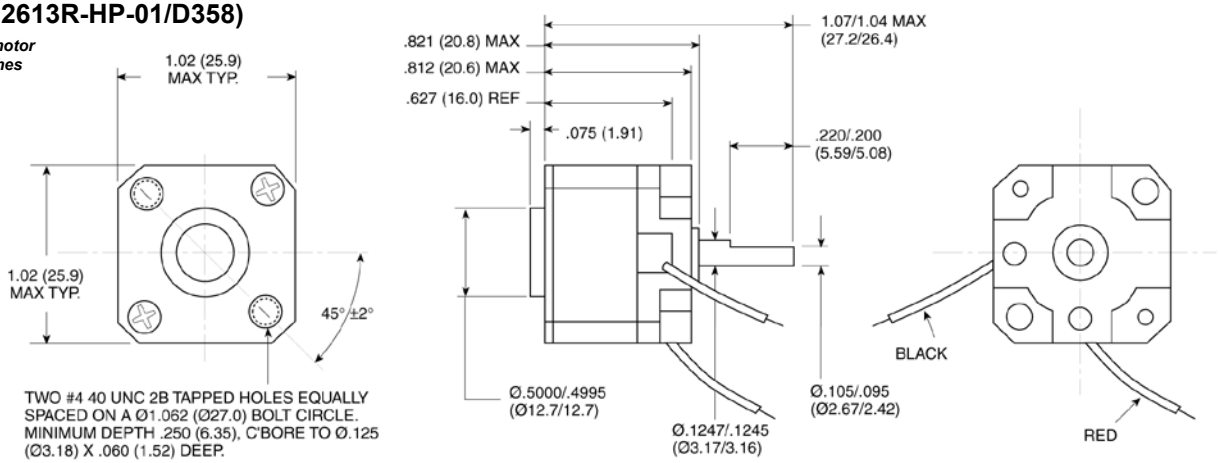
21 Series (21105L- □□-08)

Standard 1 inch cube motor with cartridge brushes and screw terminals



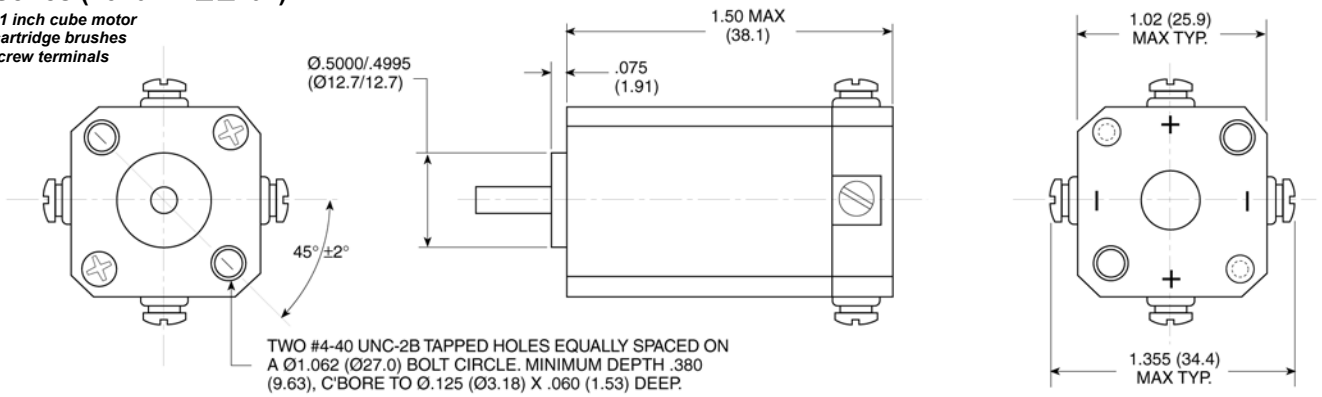
22 Series (22613R-HP-01/D358)

Short 1 inch cube motor with cartridge brushes and lead wires



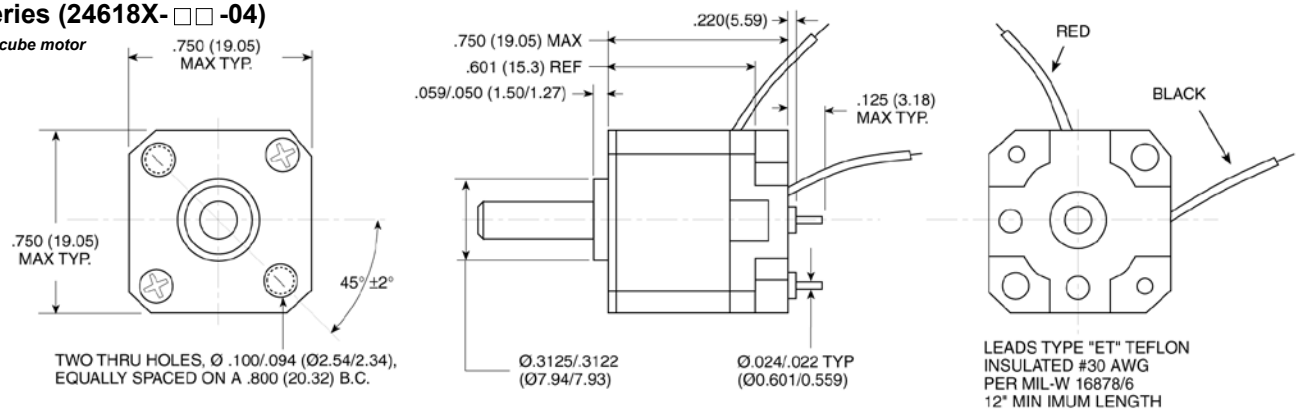
23 Series (23101L- □□-02)

Long 1 inch cube motor with cartridge brushes and screw terminals



24 Series (24618X- □□-04)

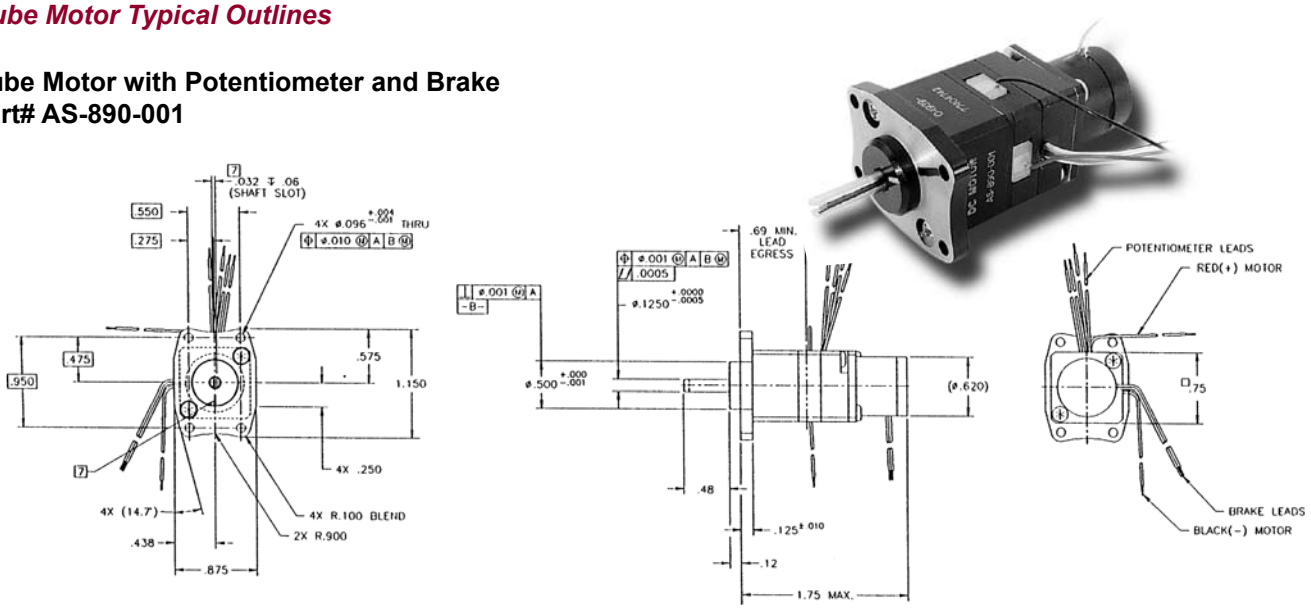
3/4 inch cube motor



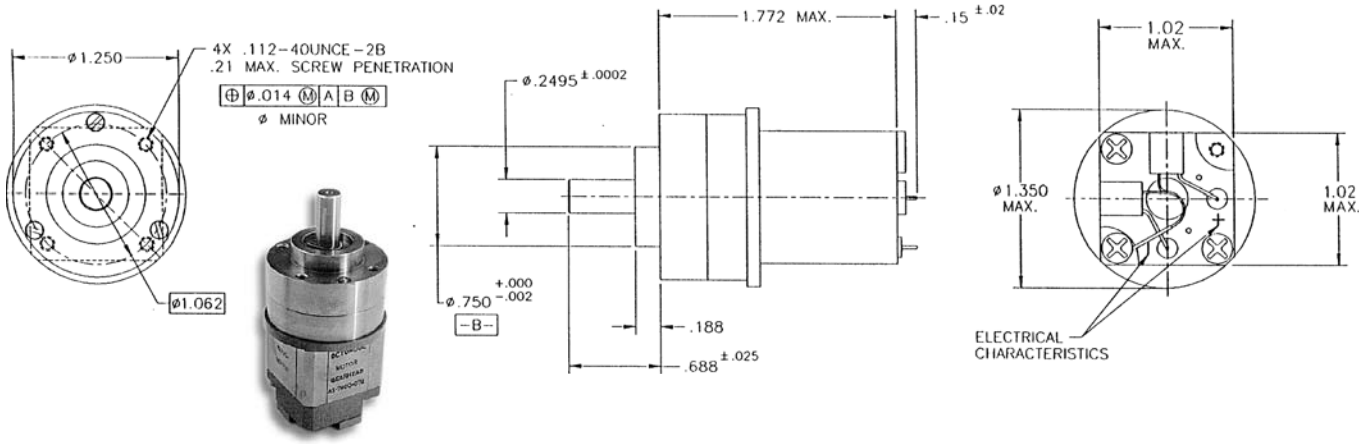
Dimensions are in inches (millimeters)

Cube Motor Typical Outlines

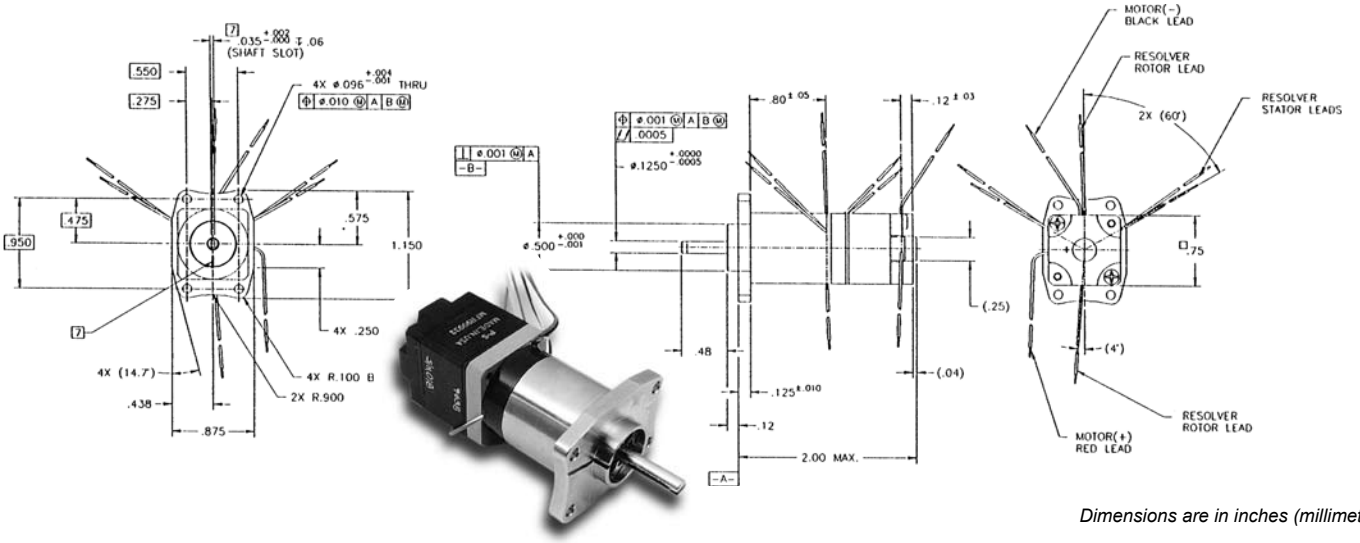
Cube Motor with Potentiometer and Brake
Part# AS-890-001



Cube Motor with a Gearhead
Part# AS-798Q-002



Cube Motor with a Resolver
Part# AS-891-001



Dimensions are in inches (millimeters)

Brush Torque Motors

TYPICAL APPLICATIONS

- Speed and rotation control systems
- Gimbals for FLIR and inertial navigation systems
- Stabilized gun and fire control systems for combat vehicles
- Fire control radars for land and ship board defense
- Cockpit instrumentation for military and commercial aircraft
- Missle seeker and fin actuator systems
- Space and vacuum instruments, actuation systems and momentum wheels

FEATURES

- 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

Note: *This catalog contains basic marketing information and general part descriptions of Moog Components Group product lines. With respect to the U.S. export regulations, the products described herein are controlled by the U.S. Commerce Department or the U.S. State Department. Contact Moog Components Group for additional detail on the export controls that are applicable to your part.*

Moog Components Group designs and manufactures precision motion technology components and subsystems for defense, aerospace and industrial applications. Our broad range of components includes DC torque and servomotors, position feedback devices and slip ring / twist capsule products.

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.

For more information about how this product can be tailored to fit your specific application, contact our applications engineers.

Design Considerations

All diameters listed have finished, ground lamination surfaces. They can be complemented with rings and hubs for mounting convenience.

Moog Components Group torque motors are normally delivered in kit form.

If you require integral bearings such as, a cartridge assembly containing a torquer motor and synchro, potentiometer or similar component, we can design the entire assembly to your mechanical dimensions and performance requirements.

Mounting Considerations

Since torque motors are normally delivered in kit form, you provide the mounting surfaces and bearings. When you design the mechanics of the mount, be sure to observe these rules:

1. Eccentricities from the inner member mounting surface should not exceed 0.002 inches for Alnico designs and 0.004 for rare earth motor designs.
2. Surfaces in contact with the permanent magnet portion of the motor must be non-magnetic.
3. The bore of the mounting surface should be perpendicular to the mounting seat within 0.001 inch for Alnico designs and 0.002 for rare earth designs.

Electrical Considerations

For each mechanical configuration shown, different winding designs to modify torque, torque sensitivity, DC resistance, and so on, can be supplied by Moog Components Group to suit your special system requirement. In each case, you have the option of selecting one of the existing designs or specifying a new winding designed to meet your special requirements. If your power source (voltage or current) is limited, the mathematical relationships shown in *Table 1* will allow you to calculate a particular performance characteristic at the voltage or power capability of your existing power supply.

Table 1

PARAMETER	SYMBOL	UNITS	RELATIONSHIP TO PUBLISHED PARAMETER
Electrical Time Constant	τ_E	ms	L_M / R_M
Mechanical Time Constant	τ_M	ms	$\frac{J_M \cdot R_M}{K_E \cdot K_T}$
Power Input, Stalled At Peak Torque (25°C)	P_P	watts	$V_P \cdot I_P$
Viscous Damping Coefficients			$\frac{K_T \cdot K_E}{R_M}$
Zero Source Impedance	F_O	oz-in per rad/s	
Infinite Source Impedance	F_I	oz-in per rad/s	Small % of F_O
[1] Motor Friction Torque (Actual)	T_F	oz-in	T_F
Maximum Power Rate	$\dot{P}$	oz-in/s^2	T_P^2 / J_M
Maximum Theoretical Acceleration	α_M	rad/s^2	T_P / J_M
[2] Theoretical No Load Speed	ω_{NL}	rad/s	V_P / K_E

[1] T_F is specified as a maximum value and includes brush friction, magnetic detent and test fixture bearing friction which is considered negligible.

[2] In cases where motor is to be operated at some voltage less than V_P due to power supply limitations the new ω_{NL} becomes V_A / K_E where V_A = voltage applied.

The following frame sizes represent only a small sampling of the total range manufactured. Consult factory for additional designs. Refer to our online documentation for product updates.

- Brush torque motors range from 1.125 to 10.2 inches O.D.
- Tachometers range in similar configurations and specifications.
- Torque motors and tachometers are designed to meet the requirements of MIL-E-5400.
- All published parameters are considered nominal (25°C) unless otherwise specified.
- We are currently tooled on some items to house the torque motor on its own bearings and incorporate, if required, a potentiometer and a tachometer.
- Windings can be modified for specific applications.

Brush type DC cube servomotors are also available from Moog Components Group.

Conversion Factors

For convenience of calculation or comparison, the following constants are provided for rapid conversion to or from the units Moog Components Group uses to express torque motor parameters.

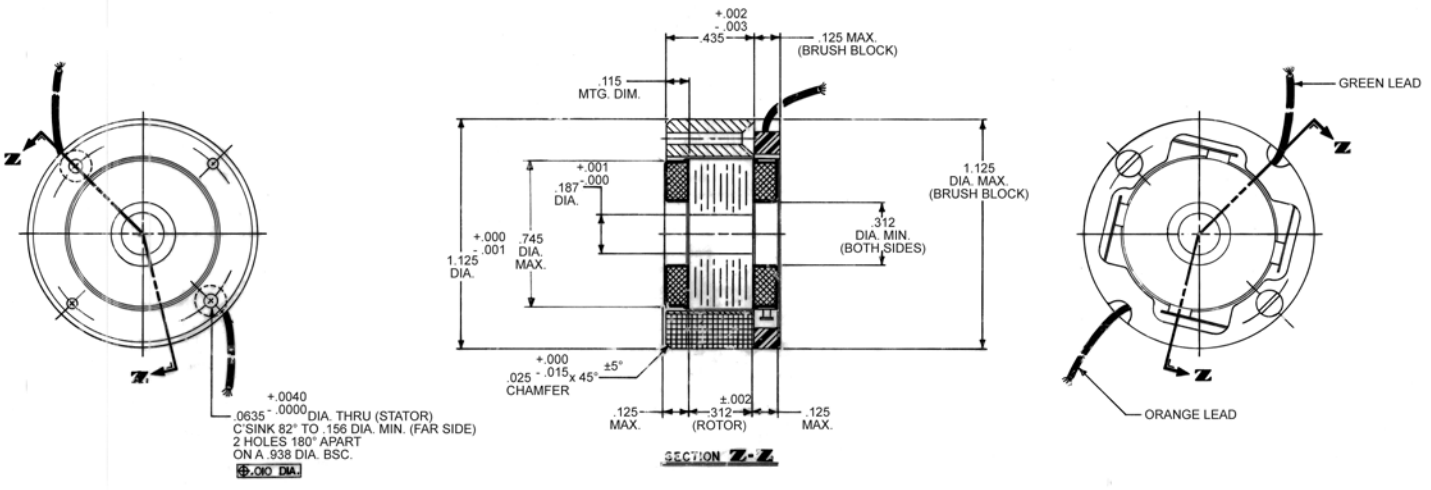
Conversion Table

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

D-1125-A-4 SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	6.6	oz-in
Motor Constant, K_M	0.929	oz-in/√W
Number of Poles	4	
Weight	1.8	oz (nom)
Motor Inertia, J_M	1.50E-04	oz-in-s^2
Friction Torque, T_F	0.20	oz-in
Electrical Time Constant, τ_E	0.246	ms
Mechanical Time Constant, τ_M	25.00	ms
Temperature Rise, Housed TPR'	34	° C/W
Ripple Torque, T_R	7	max. avg. to peak (%)
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	3.45	oz-in/amp
Back EMF, K_E	0.024	V per rad/s
Terminal Resistance, R_M	13.8	ohms (nom)
Terminal Inductance, L_M	3.4	mH (nom)
Voltage, Stalled at Peak Torque, V_P	26.4	volts
Amps at Peak Torque, I_P	1.91	amps

D-1125-A-4 Typical Outline Drawing

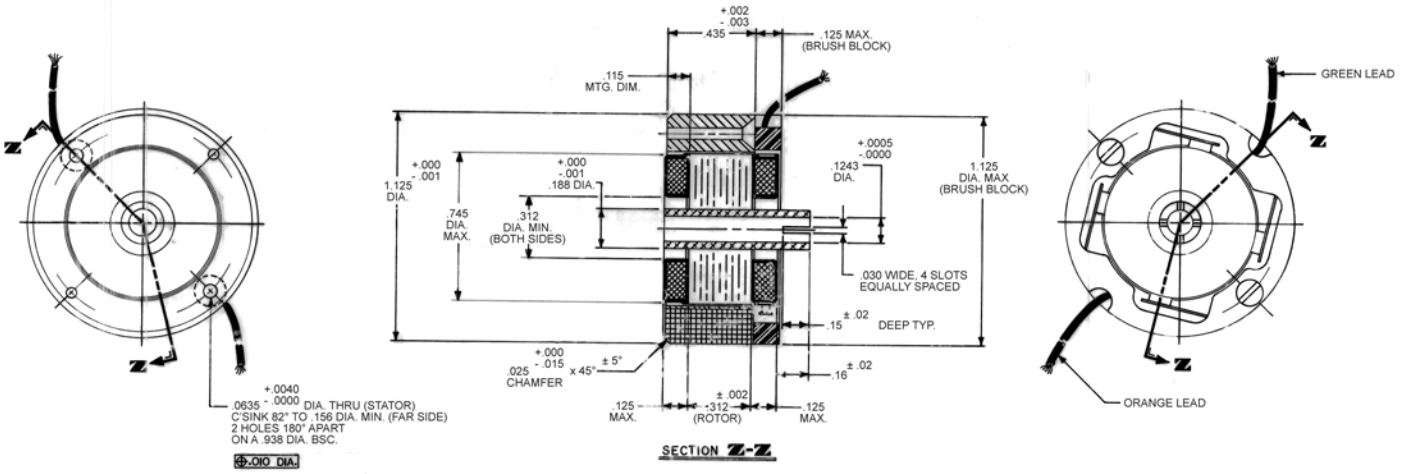


Dimensions are in inches

D-1125-B-1 SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	6.6	oz-in
Motor Constant, K_M	0.899	oz-in/√W
Number of Poles	4	
Weight	1.8	oz (nom)
Motor Inertia, J_M	1.50E-04	oz-in-s^2
Friction Torque, T_F	0.20	oz-in
Electrical Time Constant, τ_E	0.216	ms
Mechanical Time Constant, τ_M	26.24	ms
Temperature Rise, Housed TPR'	33	° C/W
Ripple Torque, T_R	7	max. avg. to peak (%)
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	4.10	oz-in/amp
Back EMF, K_E	0.029	V per rad/s
Terminal Resistance, R_M	20.8	ohms (nom)
Terminal Inductance, L_M	4.5	mH (nom)
Voltage, Stalled at Peak Torque, V_P	33.3	volts
Amps at Peak Torque, I_P	1.60	amps

D-1125-B-1 Typical Outline Drawing

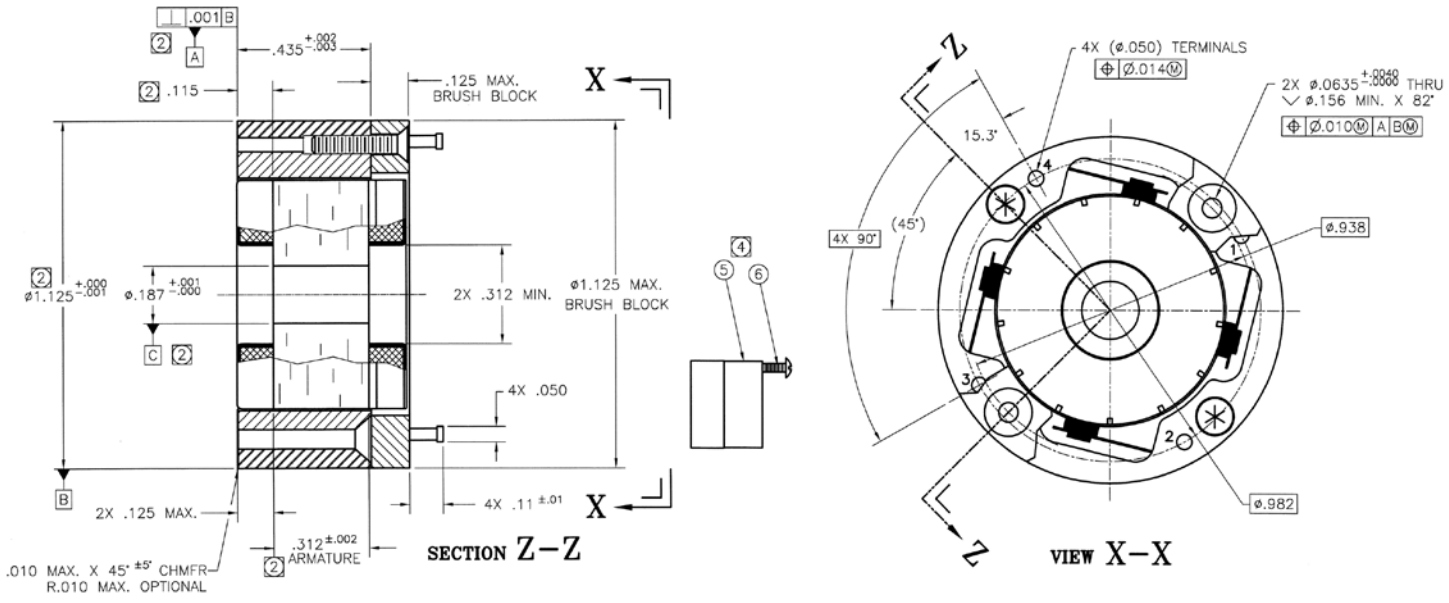


Dimensions are in inches

D-1125-F-10-T SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	6.6	oz-in
Motor Constant, K_M	0.865	oz-in/√W
Number of Poles	4	
Weight	1.8	oz (nom)
Motor Inertia, J_M	1.50E-04	oz-in-s^2
Friction Torque, T_F	0.20	oz-in
Electrical Time Constant, τ_E	0.246	ms
Mechanical Time Constant, τ_M	28.41	ms
Temperature Rise, Housed TPR'	34	° C/W
Ripple Torque, T_R	7	max. avg. to peak (%)
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	3.12	oz-in/amp
Back EMF, K_E	0.022	V per rad/s
Terminal Resistance, R_M	13	ohms (nom)
Terminal Inductance, L_M	3.2	mH (nom)
Voltage, Stalled at Peak Torque, V_P	27.6	volts
Amps at Peak Torque, I_P	2.12	amps

D-1125-F-10-T Typical Outline Drawing

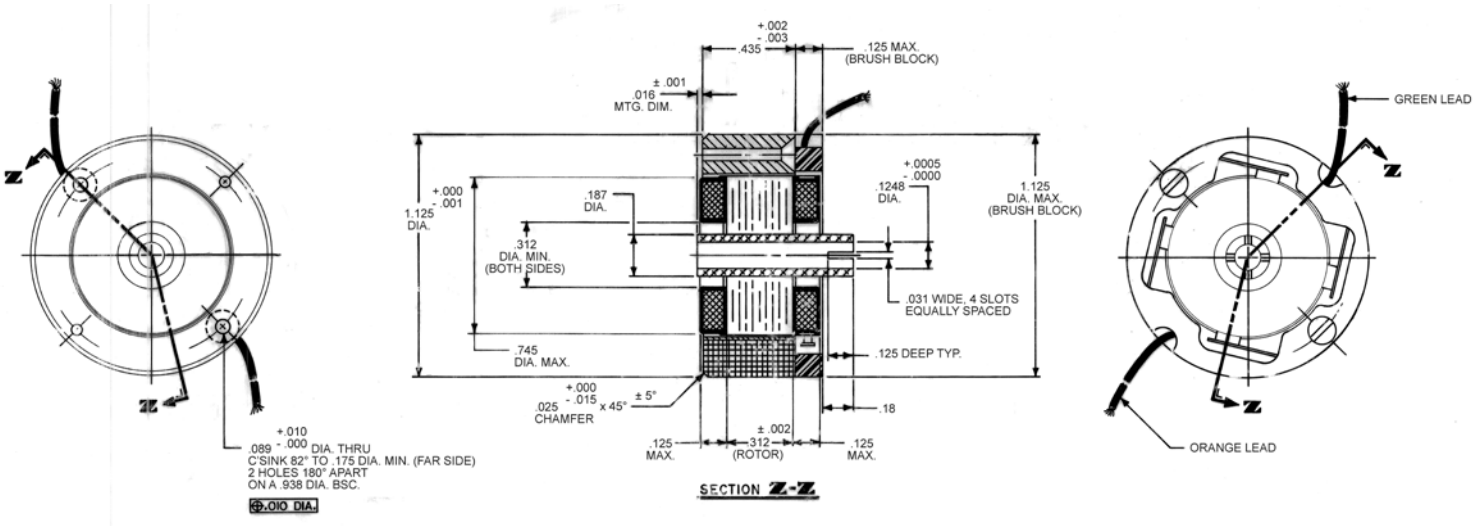


Dimensions are in inches

D-1125-N-1 SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	6.6	oz-in
Motor Constant, K_M	0.899	oz-in/√W
Number of Poles	4	
Weight	1.8	oz (nom)
Motor Inertia, J_M	1.50E-04	oz-in-s^2
Friction Torque, T_F	0.20	oz-in
Electrical Time Constant, τ_E	0.216	ms
Mechanical Time Constant, τ_M	26.24	ms
Temperature Rise, Housed TPR'	33	° C/W
Ripple Torque, T_R	7	max. avg. to peak (%)
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	4.10	oz-in/amp
Back EMF, K_E	0.029	V per rad/s
Terminal Resistance, R_M	20.8	ohms (nom)
Terminal Inductance, L_M	4.5	mH (nom)
Voltage, Stalled at Peak Torque, V_P	33.3	volts
Amps at Peak Torque, I_P	1.60	amps

D-1125-N-1 Typical Outline Drawing

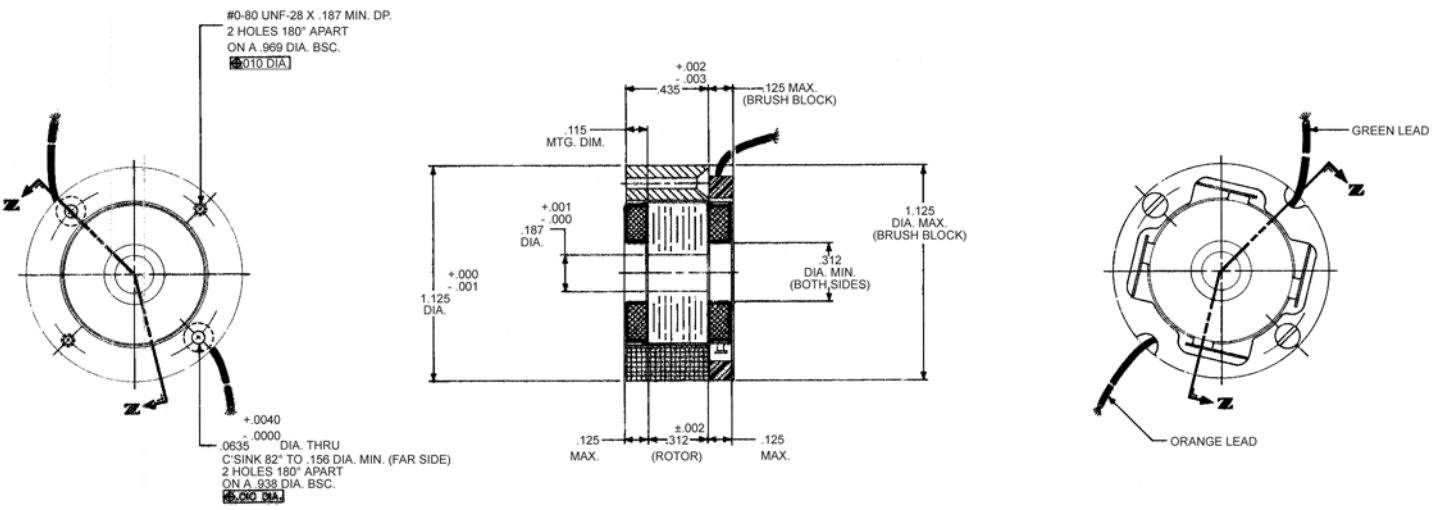


Dimensions are in inches

D-1125-P-10 SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	6.6	oz-in
Motor Constant, K_M	0.87	oz-in/√W
Number of Poles	4	
Weight	1.8	oz (nom)
Motor Inertia, J_M	1.50E-04	oz-in-s^2
Friction Torque, T_F	0.20	oz-in
Electrical Time Constant, τ_E	0.246	ms
Mechanical Time Constant, τ_M	2.84	ms
Temperature Rise, Housed TPR'	34	° C/W
Ripple Torque, T_R	7	max. avg. to peak (%)
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	3.12	oz-in/amp
Back EMF, K_E	0.022	V per rad/s
Terminal Resistance, R_M	13	ohms (nom)
Terminal Inductance, L_M	3.2	mH (nom)
Voltage, Stalled at Peak Torque, V_P	27.6	volts
Amps at Peak Torque, I_P	2.12	amps

D-1125-P-10 Typical Outline Drawing

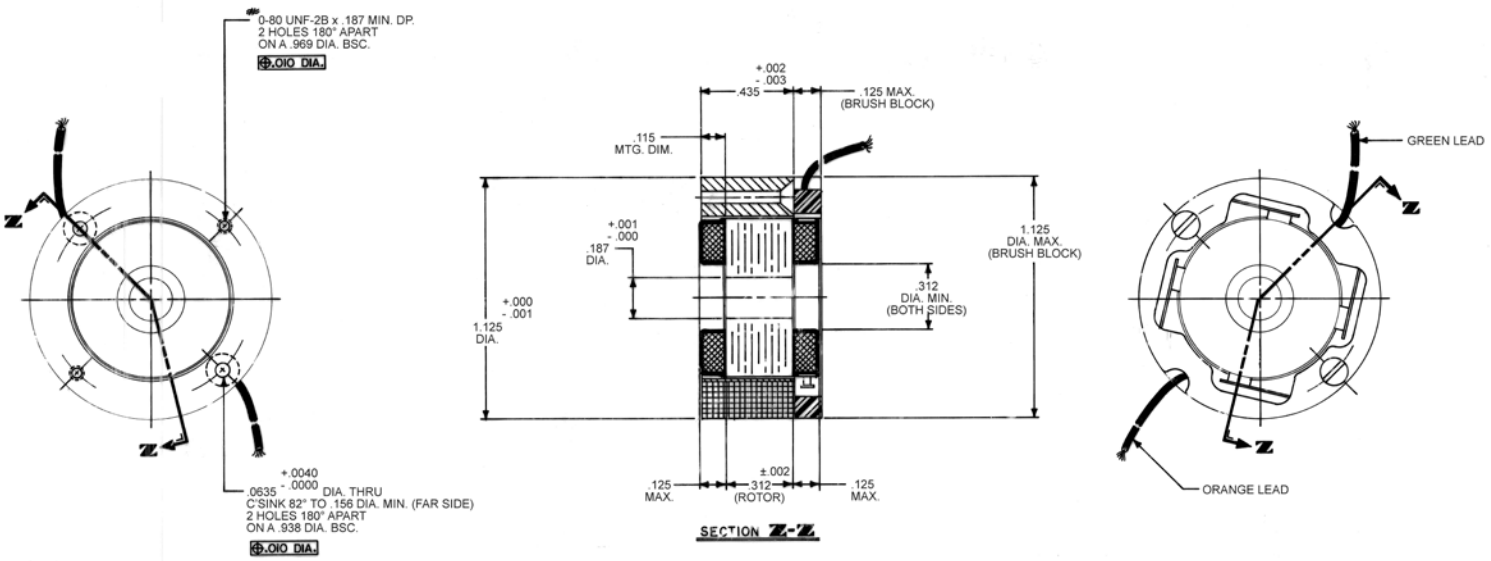


Dimensions are in inches

D-1125-P-7 / K044 SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	6.6	oz-in
Motor Constant, K_M	0.851	oz-in/√W
Number of Poles	4	
Weight	1.8	oz (nom)
Motor Inertia, J_M	1.50E-04	oz-in-s^2
Friction Torque, T_F	0.20	oz-in
Electrical Time Constant, τ_E	0.231	ms
Mechanical Time Constant, τ_M	29.26	ms
Temperature Rise, Housed TPR'	34	° C/W
Ripple Torque, T_R	7	max. avg. to peak (%)
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	4.95	oz-in/amp
Back EMF, K_E	0.035	V per rad/s
Terminal Resistance, R_M	33.8	ohms (nom)
Terminal Inductance, L_M	7.8	mH (nom)
Voltage, Stalled at Peak Torque, V_P	45.0	volts
Amps at Peak Torque, I_P	1.33	amps

D-1125-P-7 / K044 Typical Outline Drawing

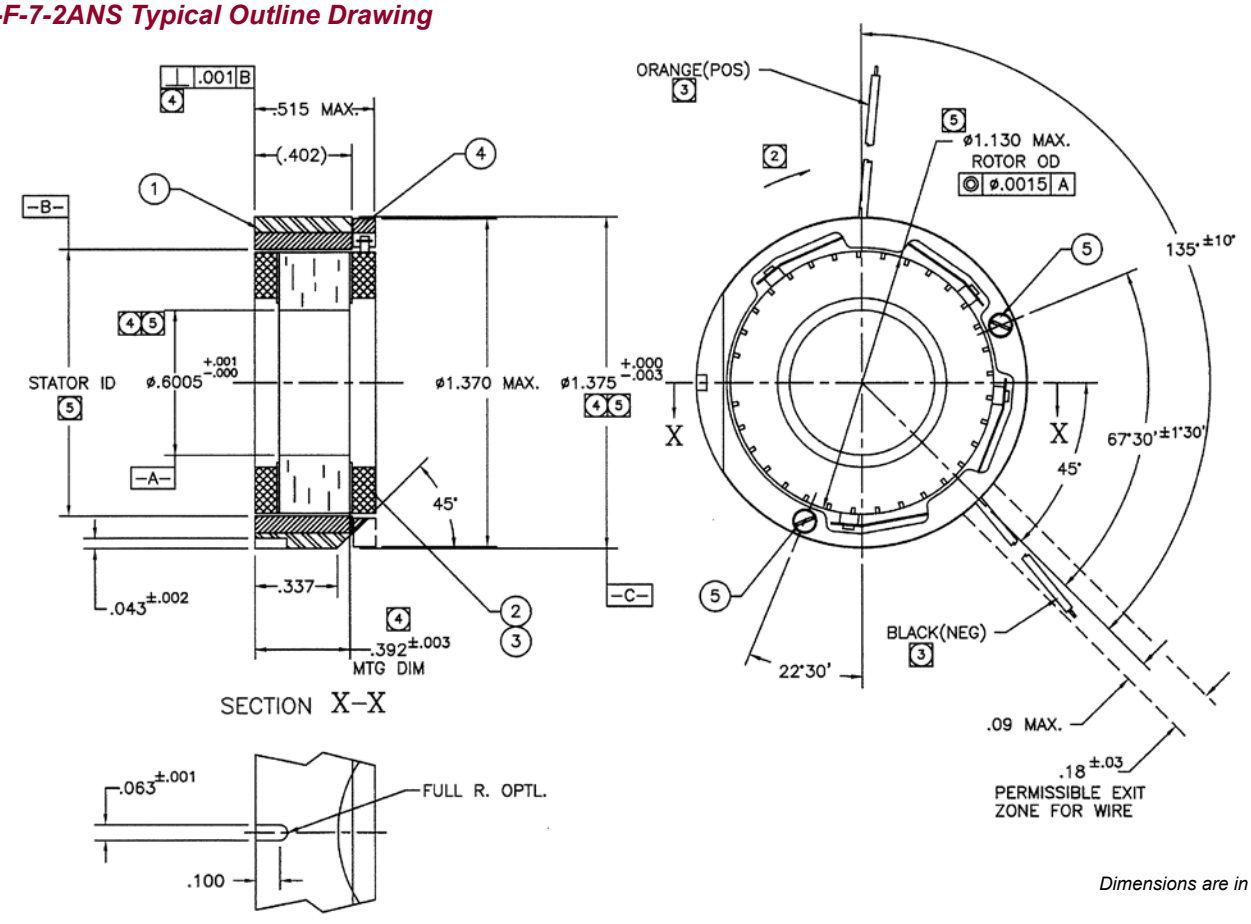


Dimensions are in inches

D-1375-F-7-2ANS SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	43	oz-in
Motor Constant, K_M	2.70	oz-in/√W
Number of Poles	8	
Weight	2.4	oz (nom)
Motor Inertia, J_M	5.35E-04	oz-in-s^2
Friction Torque, T_F	0.88	oz-in
Electrical Time Constant, τ_E	0.172	ms
Mechanical Time Constant, τ_M	10.24	ms
Temperature Rise, Housed TPR'	17	° C/W
Ripple Torque, T_R	6	max. avg. to peak (%)
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	5.05	oz-in/amp
Back EMF, K_E	0.036	V per rad/s
Terminal Resistance, R_M	3.48	ohms (nom)
Terminal Inductance, L_M	0.60	mH (nom)
Voltage, Stalled at Peak Torque, V_P	30.0	volts
Amps at Peak Torque, I_P	8.62	amps

D-1375-F-7-2ANS Typical Outline Drawing

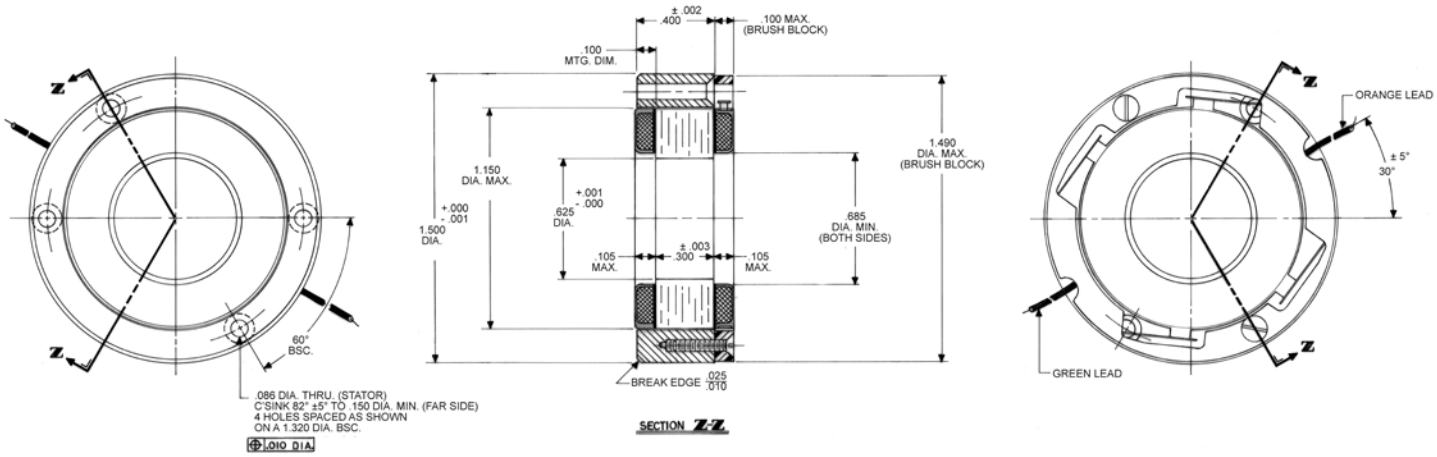


Dimensions are in inches

D-1500-C-3 SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	15	oz-in
Motor Constant, K_M	1.78	oz-in/√W
Number of Poles	6	
Weight	2.4	oz (nom)
Motor Inertia, J_M	5.50E-04	oz-in-s^2
Friction Torque, T_F	0.50	oz-in
Electrical Time Constant, τ_E	0.368	ms
Mechanical Time Constant, τ_M	24.36	ms
Temperature Rise, Housed TPR'	19	° C/W
Ripple Torque, T_R	7	max. avg. to peak (%)
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	5.50	oz-in/amp
Back EMF, K_E	0.039	V per rad/s
Terminal Resistance, R_M	9.5	ohms (nom)
Terminal Inductance, L_M	3.5	mH (nom)
Voltage, Stalled at Peak Torque, V_P	25.9	volts
Amps at Peak Torque, I_P	2.73	amps

D-1500-C-3 Typical Outline Drawing

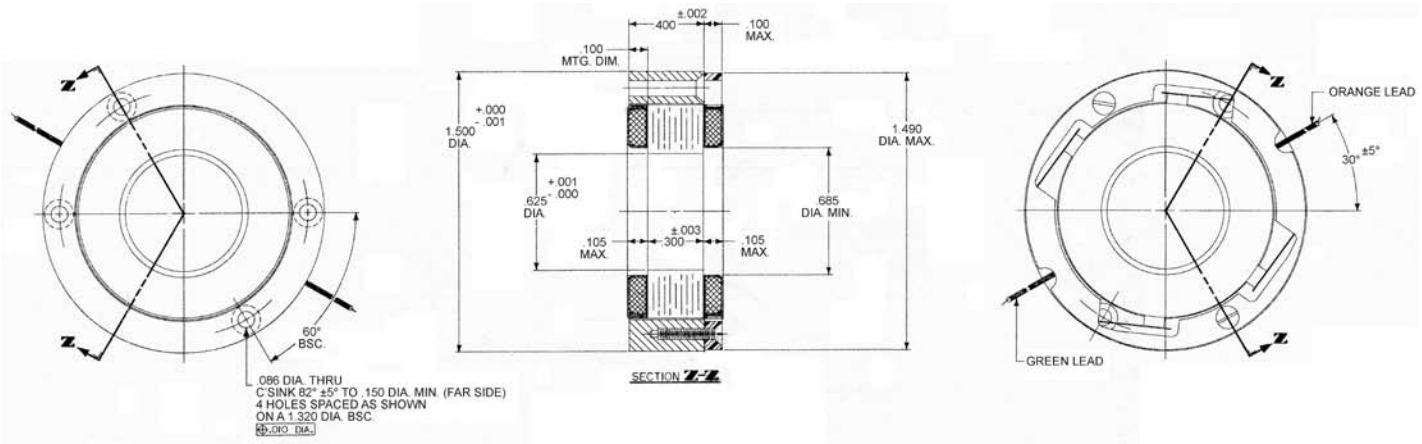


Dimensions are in inches

D-1500-E-6 / K012 SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	15	oz-in
Motor Constant, K_M	2.01	oz-in/√W
Number of Poles	6	
Weight	2.4	oz (nom)
Motor Inertia, J_M	5.50E-04	oz-in-s^2
Friction Torque, T_F	0.50	oz-in
Electrical Time Constant, τ_E	0.304	ms
Mechanical Time Constant, τ_M	19.38	ms
Temperature Rise, Housed TPR'	19	° C/W
Ripple Torque, T_R	7	max. avg. to peak (%)
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	6.80	oz-in/amp
Back EMF, K_E	0.048	V per rad/s
Terminal Resistance, R_M	11.5	ohms (nom)
Terminal Inductance, L_M	3.5	mH (nom)
Voltage, Stalled at Peak Torque, V_P	25.4	volts
Amps at Peak Torque, I_P	2.21	amps

D-1500-E-6 / K012 Typical Outline Drawing

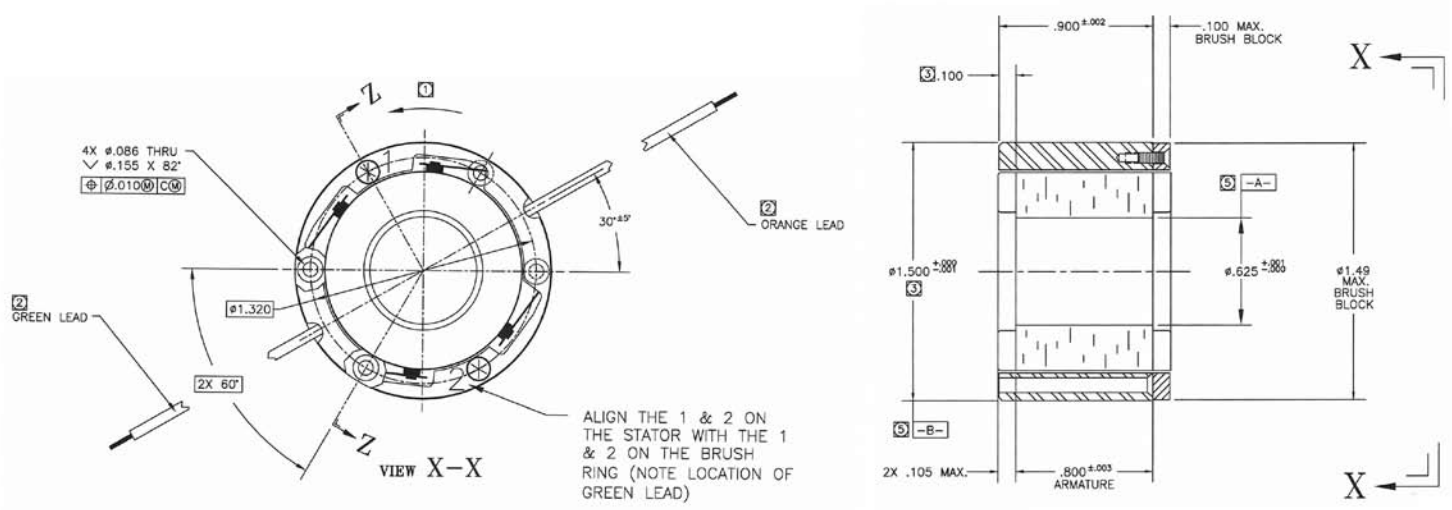


Dimensions are in inches

D-1500-Z-1 SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	18	oz-in
Motor Constant, K_M	3.02	oz-in/√W
Number of Poles	6	
Weight	6.4	oz (nom)
Motor Inertia, J_M	1.40E-03	oz-in-s^2
Friction Torque, T_F	0.95	oz-in
Electrical Time Constant, τ_E	0.451	ms
Mechanical Time Constant, τ_M	21.72	ms
Temperature Rise, Housed TPR'	12	° C/W
Ripple Torque, T_R	10	max. avg. to peak (%)
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	14	oz-in/amp
Back EMF, K_E	0.099	V per rad/s
Terminal Resistance, R_M	21.5	ohms (nom)
Terminal Inductance, L_M	9.7	mH (nom)
Voltage, Stalled at Peak Torque, V_P	28	volts
Amps at Peak Torque, I_P	1.30	amps

D-1500-Z-1 Typical Outline Drawing

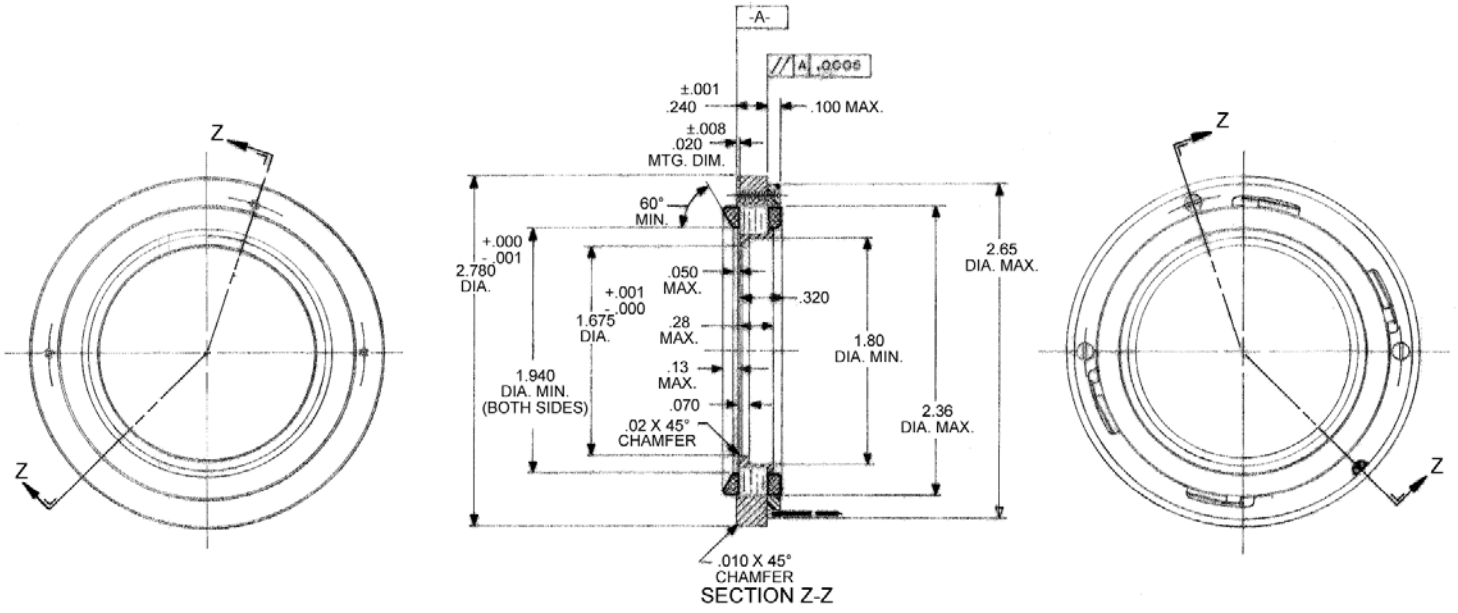


Dimensions are in inches

D-2780-B-1AEN SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	14	oz-in
Motor Constant, K_M	4.05	oz-in/√W
Number of Poles	10	
Weight	4	oz (nom)
Motor Inertia, J_M	5.00E-03	oz-in-s^2
Friction Torque, T_F	1.2	oz-in
Electrical Time Constant, τ_E	0.123	ms
Mechanical Time Constant, τ_M	43.12	ms
Temperature Rise, Housed TPR'	5.7	° C/W
Ripple Torque, T_R	6	max. avg. to peak (%)
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	30.6	oz-in/amp
Back EMF, K_E	0.216	V per rad/s
Terminal Resistance, R_M	57	ohms (nom)
Terminal Inductance, L_M	7	mH (nom)
Voltage, Stalled at Peak Torque, V_P	26	volts
Amps at Peak Torque, I_P	0.46	amps

D-2780-B-1AEN Typical Outline Drawing

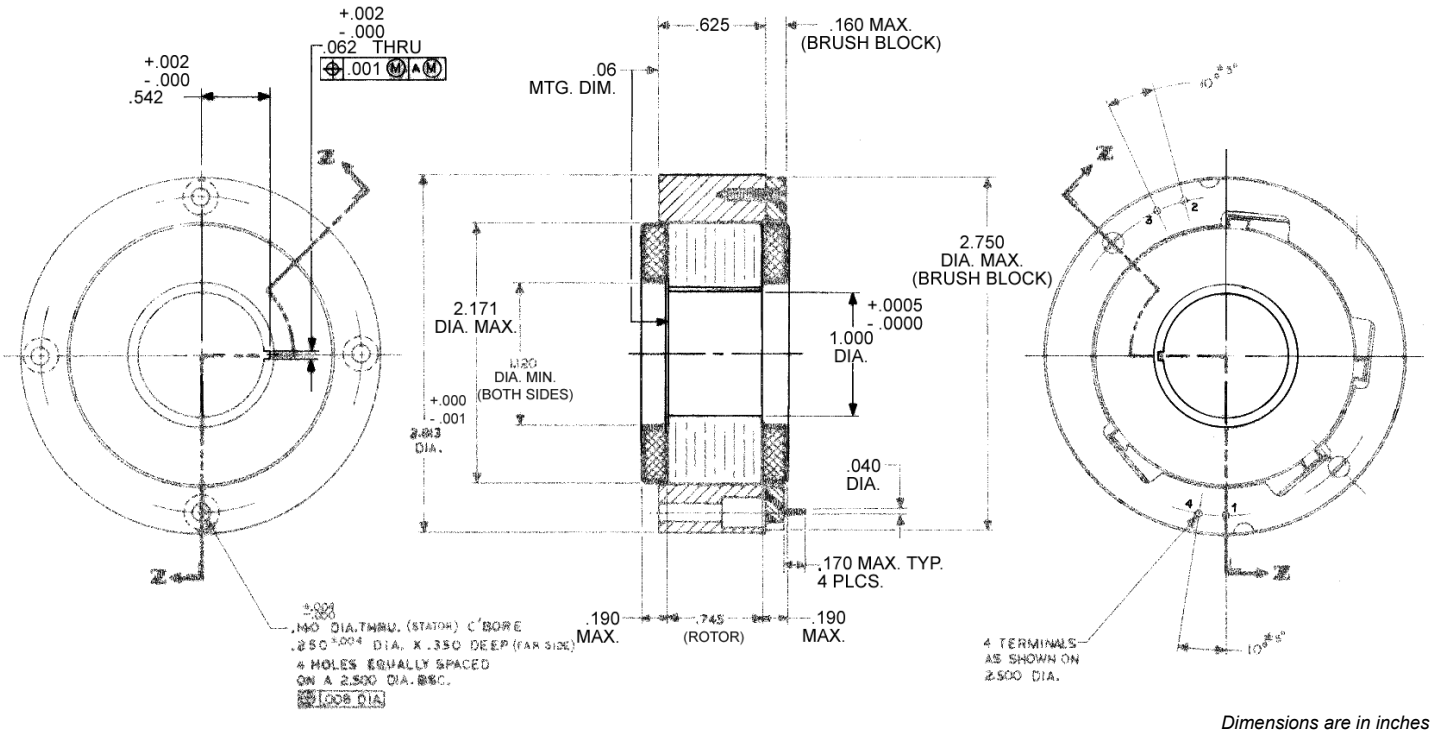


Dimensions are in inches

D-2813-G-1HT SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	95	oz-in
Motor Constant, K_M	15.3	oz-in/√W
Number of Poles	8	
Weight	21	oz (nom)
Motor Inertia, J_M	1.46E-02	oz-in-s^2
Friction Torque, T_F	2.5	oz-in
Electrical Time Constant, τ_E	0.575	ms
Mechanical Time Constant, τ_M	8.82	ms
Temperature Rise, Housed TPR'	7	° C/W
Ripple Torque, T_R	5	max. avg. to peak (%)
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	43.3	oz-in/amp
Back EMF, K_E	0.306	V per rad/s
Terminal Resistance, R_M	8	ohms (nom)
Terminal Inductance, L_M	4.6	mH (nom)
Voltage, Stalled at Peak Torque, V_P	17.6	volts
Amps at Peak Torque, I_P	2.2	amps

D-2813-G-1HT Typical Outline Drawing

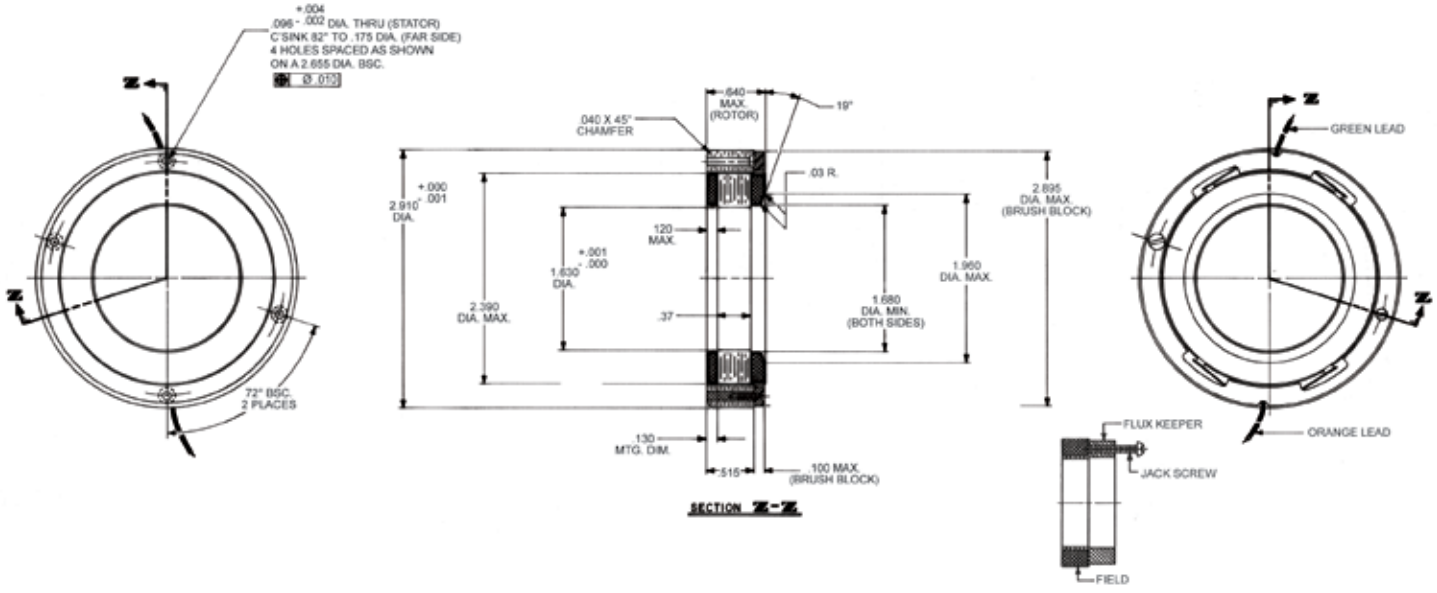


Dimensions are in inches

D-2910-B-1ENS SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	165	oz-in
Motor Constant, K_M	10.2	oz-in/√W
Number of Poles	10	
Weight	9.5	oz (nom)
Motor Inertia, J_M	1.25E-02	oz-in-s^2
Friction Torque, T_F	3	oz-in
Electrical Time Constant, τ_E	0.319	ms
Mechanical Time Constant, τ_M	16.84	ms
Temperature Rise, Housed TPR'	7.5	° C/W
Ripple Torque, T_R	7	max. avg. to peak (%)
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	16.5	oz-in/amp
Back EMF, K_E	0.117	V per rad/s
Terminal Resistance, R_M	2.6	ohms (nom)
Terminal Inductance, L_M	0.83	mH (nom)
Voltage, Stalled at Peak Torque, V_P	26	volts
Amps at Peak Torque, I_P	10	amps

D-2910-B-1ENS Typical Outline Drawing

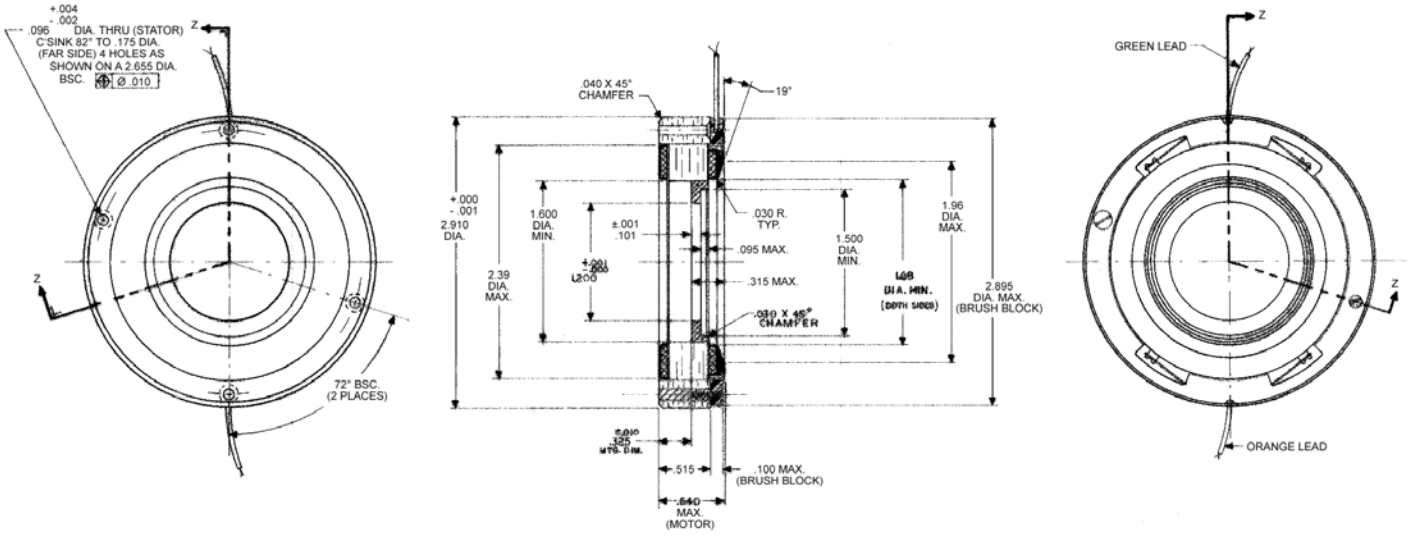


Dimensions are in inches

D-2910-G-1ENS SPECIFICIATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	59	oz-in
Motor Constant, K_M	9.66	oz-in/√W
Number of Poles	10	
Weight	9.5	oz (nom)
Motor Inertia, J_M	1.25E-02	oz-in-s^2
Friction Torque, T_F	1.2	oz-in
Electrical Time Constant, τ_E	0.333	ms
Mechanical Time Constant, τ_M	18.92	ms
Temperature Rise, Housed TPR'	7.5	° C/W
Ripple Torque, T_R	5	max. avg. to peak (%)
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	41	oz-in/amp
Back EMF, K_E	0.29	V per rad/s
Terminal Resistance, R_M	18	ohms (nom)
Terminal Inductance, L_M	6	mH (nom)
Voltage, Stalled at Peak Torque, V_P	26.1	volts
Amps at Peak Torque, I_P	1.45	amps

D-2910-G-1ENS Typical Outline Drawing

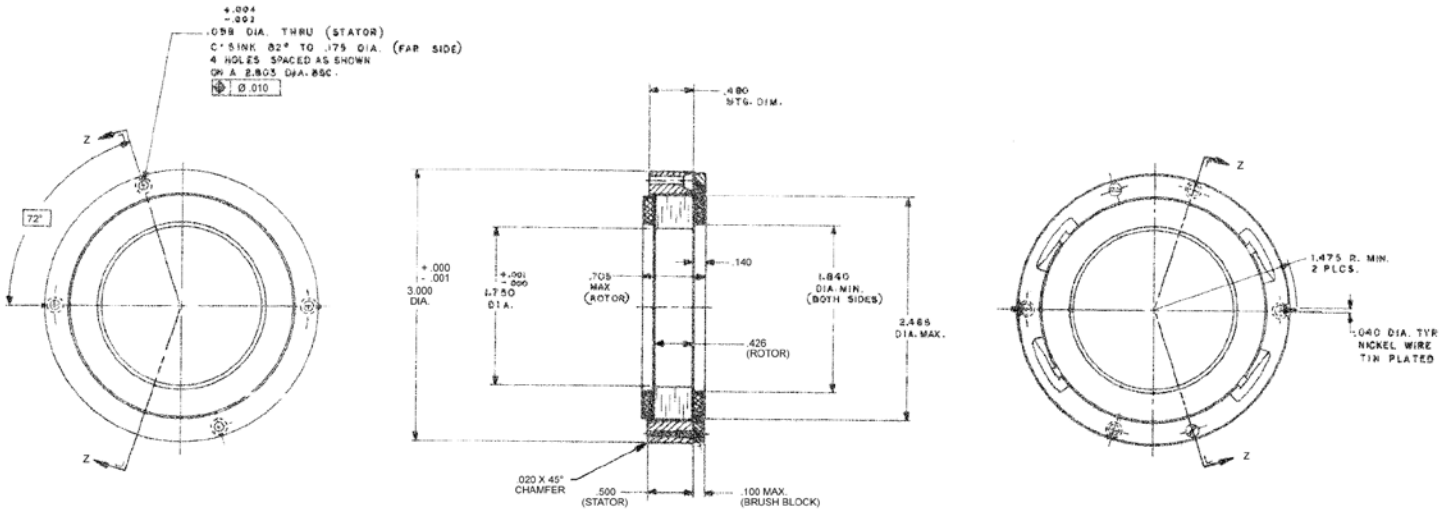


Dimensions are in inches

D-3000-F-1T SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	93	oz-in
Motor Constant, K_M	12.2	oz-in/√W
Number of Poles	10	
Weight	9.7	oz (nom)
Motor Inertia, J_M	1.60E-02	oz-in-s^2
Friction Torque, T_F	2.5	oz-in
Electrical Time Constant, τ_E	0.615	ms
Mechanical Time Constant, τ_M	15.32	ms
Temperature Rise, Housed TPR'	6.5	° C/W
Ripple Torque, T_R	5	max. avg. to peak (%)
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	62	oz-in/amp
Back EMF, K_E	0.438	V per rad/s
Terminal Resistance, R_M	26	ohms (nom)
Terminal Inductance, L_M	16	mH (nom)
Voltage, Stalled at Peak Torque, V_P	39	volts
Amps at Peak Torque, I_P	1.5	amps

D-3000-F-1T Typical Outline Drawing

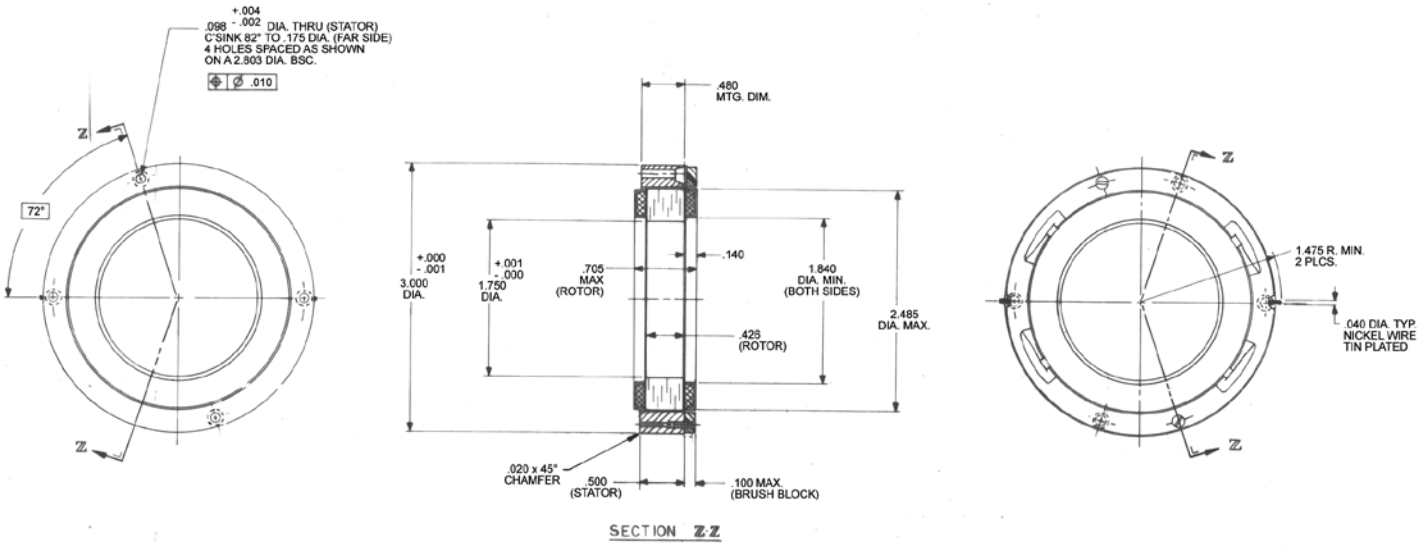


Dimensions are in inches

D-3000-F-3T SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	95	oz-in
Motor Constant, K_M	12.2	oz-in/√W
Number of Poles	10	
Weight	9.7	oz (nom)
Motor Inertia, J_M	1.60E-02	oz-in-s^2
Friction Torque, T_F	2.5	oz-in
Electrical Time Constant, τ_E	0.622	ms
Mechanical Time Constant, τ_M	15.34	ms
Temperature Rise, Housed TPR'	6.5	° C/W
Ripple Torque, T_R	5	max. avg. to peak (%)
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	28	oz-in/amp
Back EMF, K_E	0.198	V per rad/s
Terminal Resistance, R_M	5.3	ohms (nom)
Terminal Inductance, L_M	3.3	mH (nom)
Voltage, Stalled at Peak Torque, V_P	18	volts
Amps at Peak Torque, I_P	3.40	amps

D-3000-F-3T Typical Outline Drawing

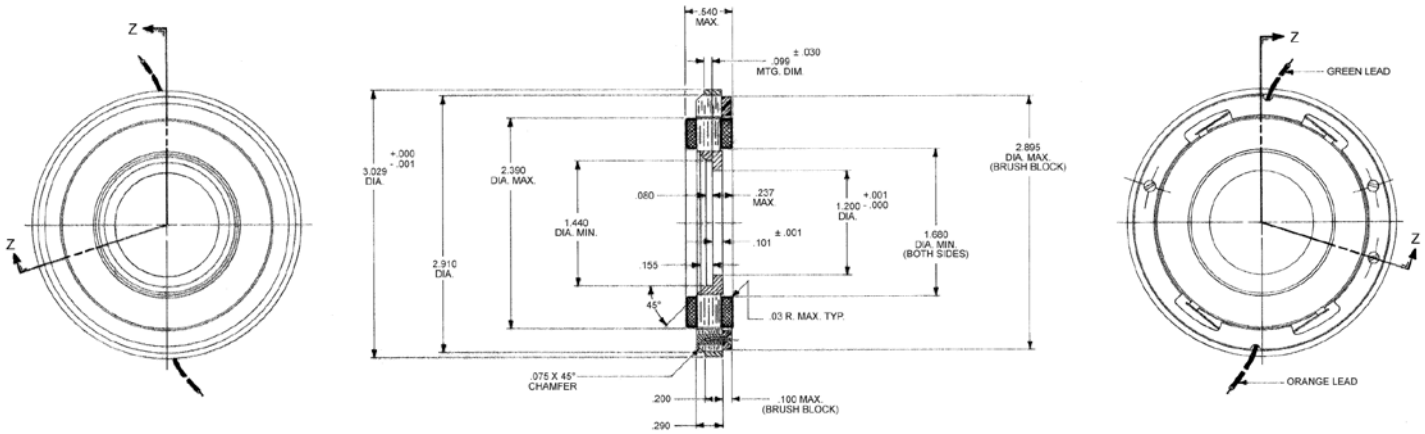


Dimensions are in inches

D-3029-A-2EN SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	37	oz-in
Motor Constant, K_M	7.85	oz-in/√W
Number of Poles	10	
Weight	6.5	oz (nom)
Motor Inertia, J_M	1.24E-02	oz-in-s^2
Friction Torque, T_F	1	oz-in
Electrical Time Constant, τ_E	0.50	ms
Mechanical Time Constant, τ_M	28.46	ms
Temperature Rise, Housed TPR'	8.0	° C/W
Ripple Torque, T_R	5	max. avg. to peak (%)
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	43	oz-in/amp
Back EMF, K_E	0.304	V per rad/s
Terminal Resistance, R_M	30	ohms (nom)
Terminal Inductance, L_M	15	mH (nom)
Voltage, Stalled at Peak Torque, V_P	26	volts
Amps at Peak Torque, I_P	0.87	amps

D-3029-A-2EN Typical Outline Drawing

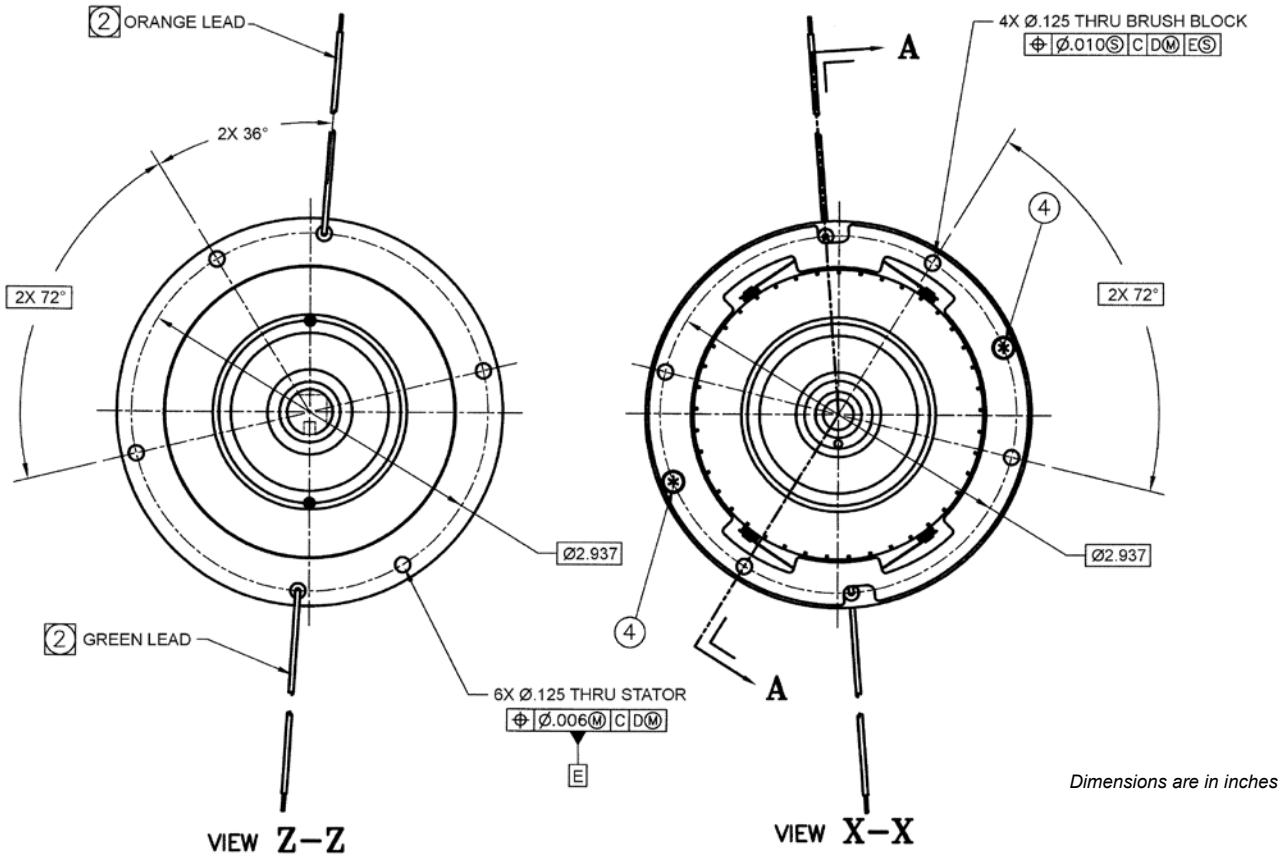


Dimensions are in inches

D-3180-C-2A SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	480	oz-in
Motor Constant, K_M	29.8	oz-in/√W
Number of Poles	10	
Weight	36	oz (nom)
Motor Inertia, J_M	3.50E-02	oz-in-s^2
Friction Torque, T_F	10	oz-in
Electrical Time Constant, τ_E	0.923	ms
Mechanical Time Constant, τ_M	5.59	ms
Temperature Rise, Housed TPR'	5	° C/W
Ripple Torque, T_R	7	max. avg. to peak (%)
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	48	oz-in/amp
Back EMF, K_E	0.339	V per rad/s
Terminal Resistance, R_M	2.60	ohms (nom)
Terminal Inductance, L_M	2.4	mH (nom)
Voltage, Stalled at Peak Torque, V_P	26	volts
Amps at Peak Torque, I_P	10	amps

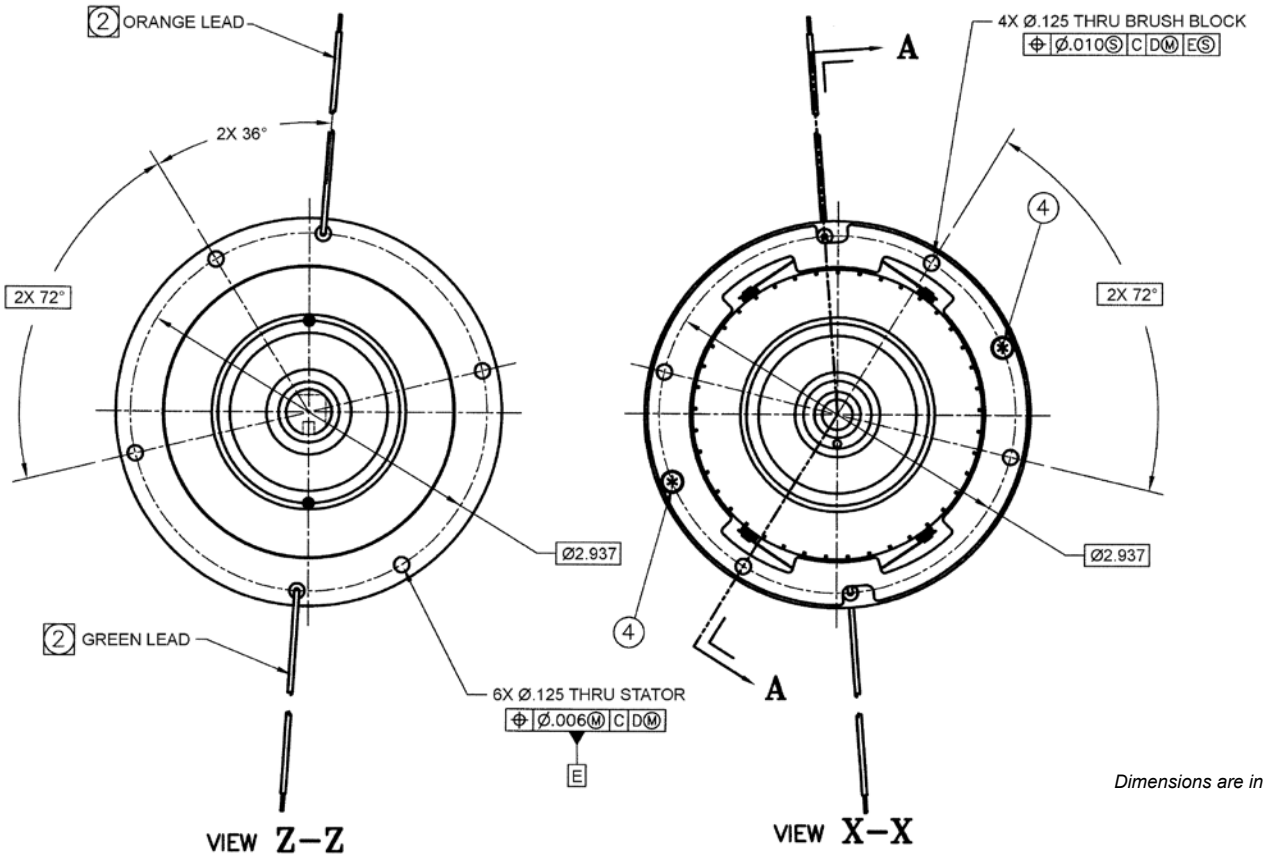
D-3180-C-2A Typical Outline Drawing



D-3180-C-2AE SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	445	oz-in
Motor Constant, K_M	27.6	oz-in/√W
Number of Poles	10	
Weight	36	oz (nom)
Motor Inertia, J_M	3.50E-02	oz-in-s^2
Friction Torque, T_F	10	oz-in
Electrical Time Constant, τ_E	0.769	ms
Mechanical Time Constant, τ_M	6.51	ms
Temperature Rise, Housed TPR'	5	° C/W
Ripple Torque, T_R	7	max. avg. to peak (%)
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	44.5	oz-in/amp
Back EMF, K_E	0.314	V per rad/s
Terminal Resistance, R_M	2.60	ohms (nom)
Terminal Inductance, L_M	2	mH (nom)
Voltage, Stalled at Peak Torque, V_P	26	volts
Amps at Peak Torque, I_P	10	amps

D-3180-C-2AE Typical Outline Drawing

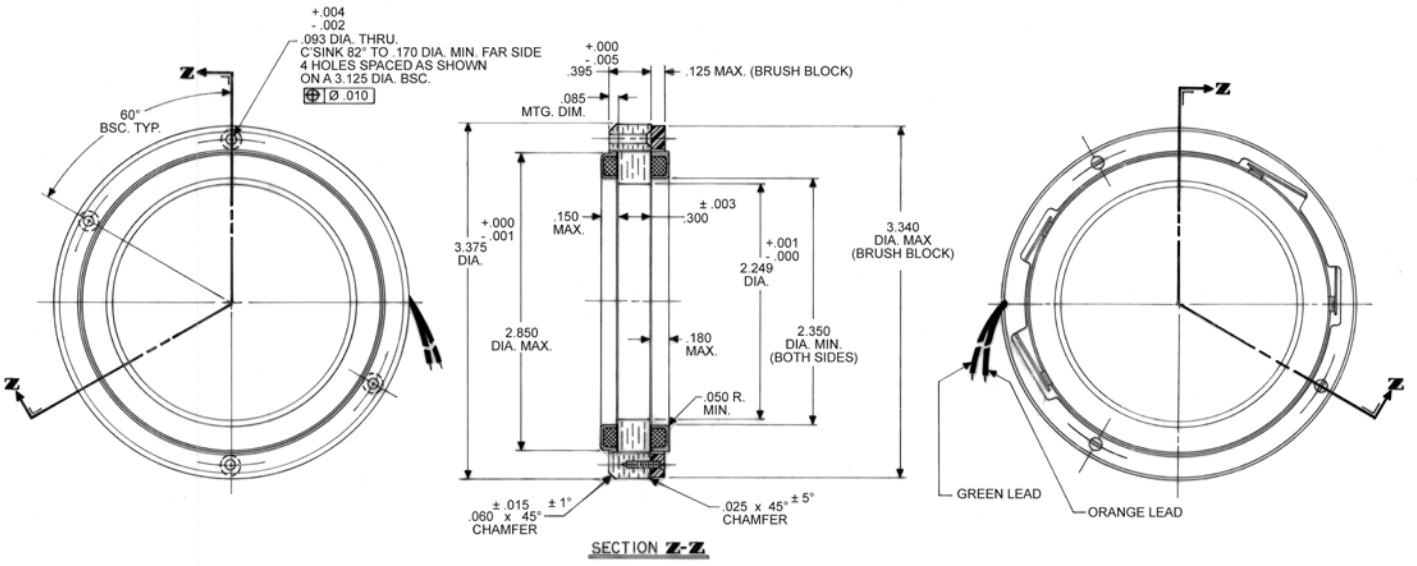


Dimensions are in inches

D-3375-A-1 SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	33	oz-in
Motor Constant, K_M	9.03	oz-in/√W
Number of Poles	12	
Weight	8.5	oz (nom)
Motor Inertia, J_M	1.60E-02	oz-in-s^2
Friction Torque, T_F	2	oz-in
Electrical Time Constant, τ_E	0.243	ms
Mechanical Time Constant, τ_M	27.72	ms
Temperature Rise, Housed TPR'	6.2	° C/W
Ripple Torque, T_R	5	max. avg. to peak (%)
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	41	oz-in/amp
Back EMF, K_E	0.290	V per rad/s
Terminal Resistance, R_M	20.6	ohms (nom)
Terminal Inductance, L_M	5	mH (nom)
Voltage, Stalled at Peak Torque, V_P	16.5	volts
Amps at Peak Torque, I_P	0.80	amps

D-3375-A-1 Typical Outline Drawing

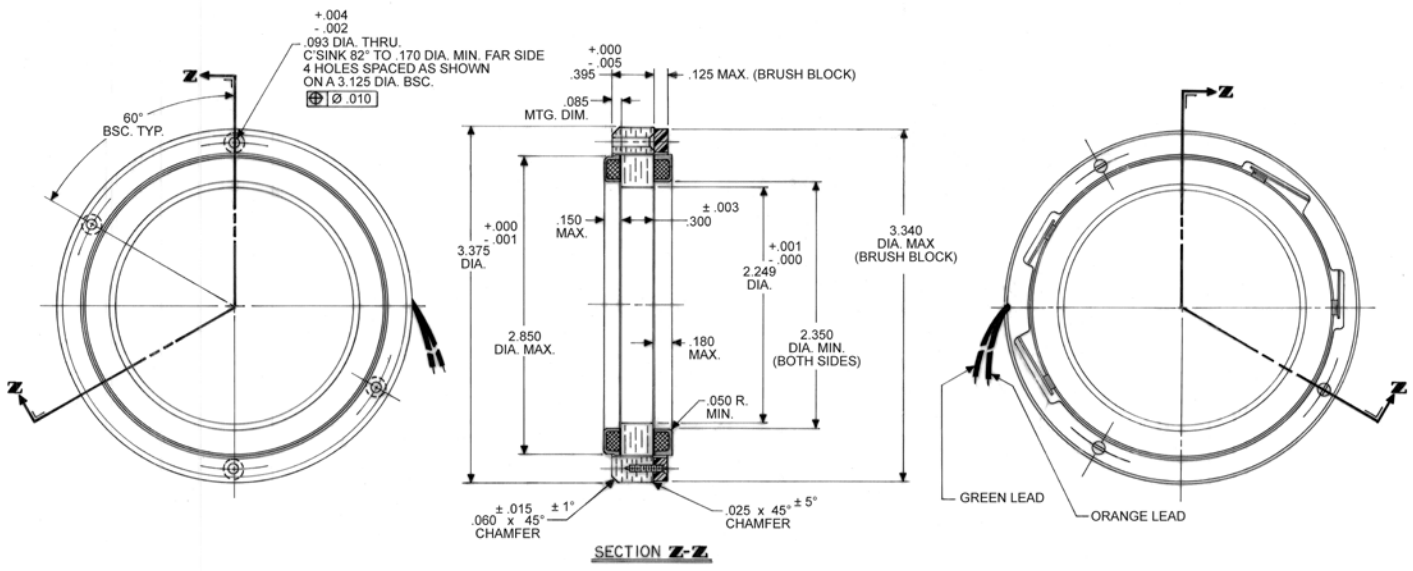


Dimensions are in inches

D-3375-A-2 SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	58	oz-in
Motor Constant, K_M	10	oz-in/√W
Number of Poles	12	
Weight	8.5	oz (nom)
Motor Inertia, J_M	1.63E-02	oz-in-s^2
Friction Torque, T_F	2	oz-in
Electrical Time Constant, τ_E	0.243	ms
Mechanical Time Constant, τ_M	22.46	ms
Temperature Rise, Housed TPR'	6.2	° C/W
Ripple Torque, T_R	7	max. avg. to peak (%)
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	46	75oz-in/amp
Back EMF, K_E	0.325	V per rad/s
Terminal Resistance, R_M	20.6	ohms (nom)
Terminal Inductance, L_M	5	mH (nom)
Voltage, Stalled at Peak Torque, V_P	26	volts
Amps at Peak Torque, I_P	1.26	amps

D-3375-A-2 Typical Outline Drawing

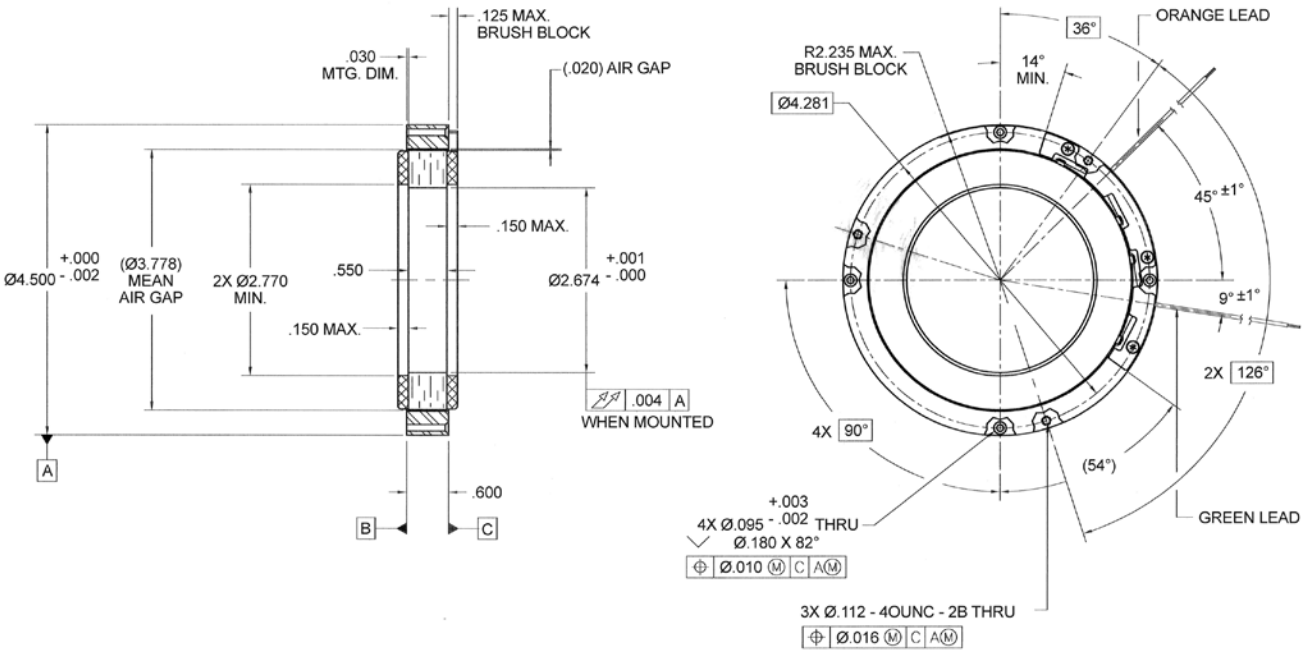


Dimensions are in inches

D-4500-B-1AS SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	305	oz-in
Motor Constant, K_M	50	oz-in/√W
Number of Poles	20	
Weight	26	oz (nom)
Motor Inertia, J_M	8.50E-02	oz-in-s^2
Friction Torque, T_F	5	oz-in
Electrical Time Constant, τ_E	0.353	ms
Mechanical Time Constant, τ_M	4.83	ms
Temperature Rise, Housed TPR'	2.4	° C/W
Ripple Torque, T_R	5	max. avg. to peak (%)
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	92	oz-in/amp
Back EMF, K_E	0.650	V per rad/s
Terminal Resistance, R_M	3.4	ohms (nom)
Terminal Inductance, L_M	1.2	mH (nom)
Voltage, Stalled at Peak Torque, V_P	11.2	volts
Amps at Peak Torque, I_P	3.31	amps

D-4500-B-1AS Typical Outline Drawing

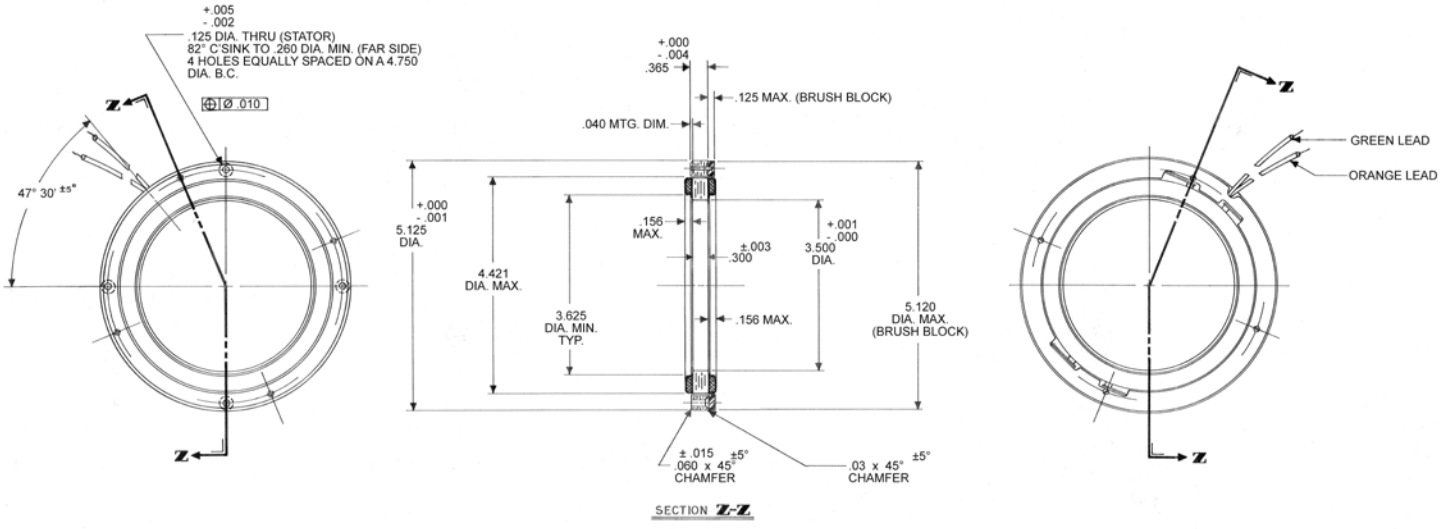


Dimensions are in inches

D-5125-C-3 SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	160	oz-in
Motor Constant, K_M	22.1	oz-in/√W
Number of Poles	16	
Weight	19	oz (nom)
Motor Inertia, J_M	9.80E-02	oz-in-s^2
Friction Torque, T_F	5	oz-in
Electrical Time Constant, τ_E	0.447	ms
Mechanical Time Constant, τ_M	28.31	ms
Temperature Rise, Housed TPR'	4.5	° C/W
Ripple Torque, T_R	5	max. avg. to peak (%)
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	48	oz-in/amp
Back EMF, K_E	0.339	V per rad/s
Terminal Resistance, R_M	4.70	ohms (nom)
Terminal Inductance, L_M	2.1	mH (nom)
Voltage, Stalled at Peak Torque, V_P	15.7	volts
Amps at Peak Torque, I_P	3.33	amps

D-5125-C-3 Typical Outline Drawing

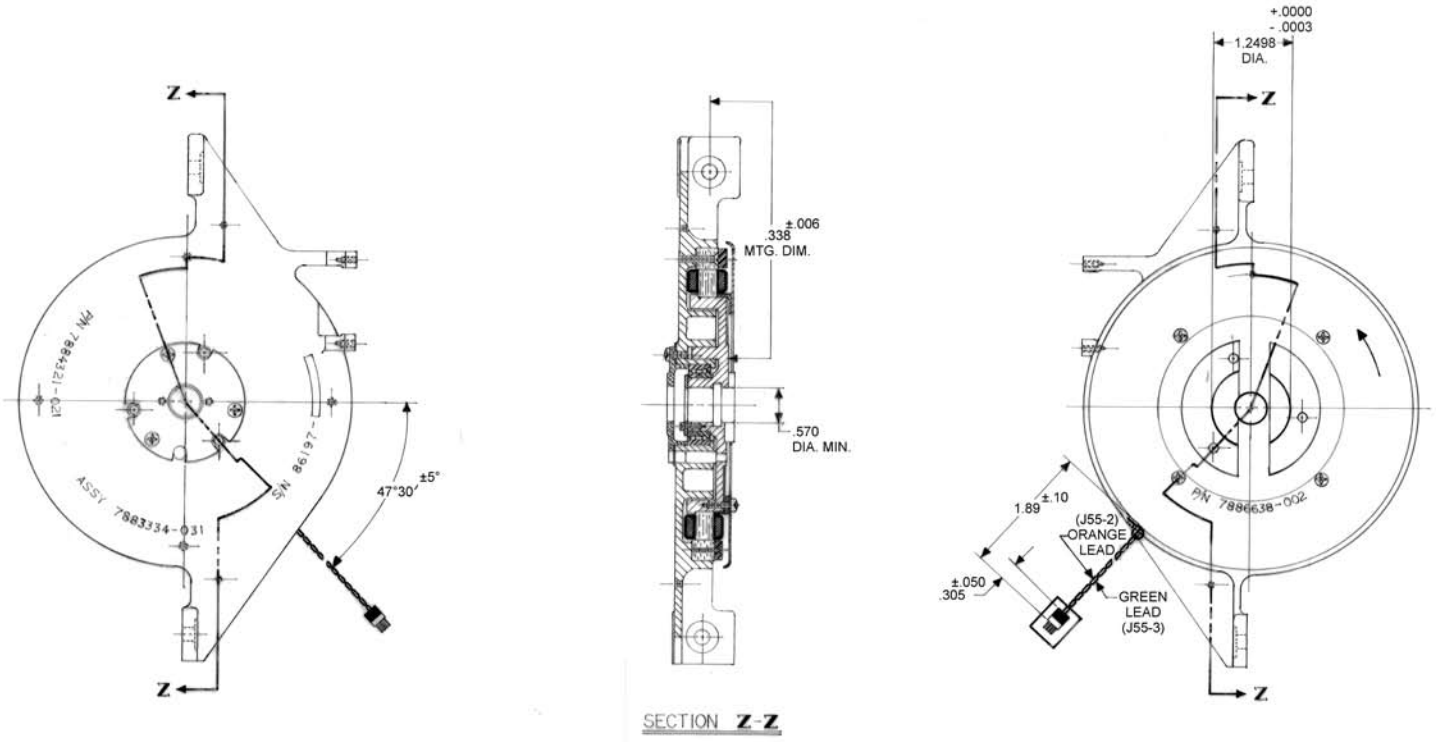


Dimensions are in inches

D-8630-C-1 SPECIFICATIONS @ 25°C

Size Constants	Value	Units
Peak Torque, T_P	160	oz-in
Motor Constant, K_M	22.1	oz-in/√W
Number of Poles	16	
Weight	37	oz (nom)
Motor Inertia, J_M	1.40E-02	oz-in-s^2
Friction Torque, T_F	8	oz-in
Electrical Time Constant, τ_E	0.532	ms
Mechanical Time Constant, τ_M	404.38	ms
Temperature Rise, Housed TPR'	3	° C/W
Ripple Torque, T_R	8	max. avg. to peak (%)
Winding Constants	**Value**	**Units**
Torque Sensitivity, K_T	48	oz-in/amp
Back EMF, K_E	0.339	V per rad/s
Terminal Resistance, R_M	4.70	ohms (nom)
Terminal Inductance, L_M	2.5	mH (nom)
Voltage, Stalled at Peak Torque, V_P	15.7	volts
Amps at Peak Torque, I_P	3.34	amps

D-8630-C-1 Typical Outline Drawing



Dimensions are in inches

Digital Resolver

Model DRBB-11-AA-01AA
DC Input / Digital Output

TYPICAL APPLICATIONS

Wherever precise position data is required for computer input

- Position and velocity sensing
- Brushless DC servo commutation
- Robotics and factory automation
- CNC machine tools
- Material handling
- Medical devices

FEATURES

- Size 11 heavy-duty brushless resolver
- Totally digital input / output
- Absolute position data output
- 12-bit resolution standard
- Maximum system error of ±15 arc minutes
- Incremental encoder with A Quad B and North Marker outputs
- 1024 line incremental resolution standard
- High readout rate
- Mechanical modifications to order

Brushless resolver with built-in electronics that functions as an absolute encoder - DC in / digital out

Moog Components Group's 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 ±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.

Model DRBB-11-AA-01AA requires two power supplies and two inputs and provides four outputs, all of which are TTL compatible. RS-422 differential line drivers / receivers and operation from a single 5 volt supply are available options.

SPECIFICATIONS

Dynamic Performance

Rotational speed: 375 rps max. (Intermittent Duty)

Settling Time: 7 ms (1° step) 20 ms (179° step)

Life: 16,000 hours at 80 rps

Mechanical Characteristics

Termination: 12 inch min. #28 AWG (7 / 36) type ET leads in accordance with MIL-W-16878 / 6–BCB. Lead and connector variations available.

Shaft End Play: .0015 max. spring loaded toward front end

Shaft Radial Play: .0005 max. when measured next to bearin with an 8 oz reversing gage load

Input Current: 35 mA

Operating Temperature: -40°C to +85°C

Weight: 142 grams (typ)

Inputs / Outputs And Lead Wire Color Code

	Lead Wire	Part Number Base			
	Color	DRBB	DRBD	DRBE	DRBG
Inputs	RED	+5 VDC	+5 VDC	+5 VDC	+5 VDC
	YEL	–5 VDC	–5 VDC	—	—
	BLK	GND	GND	GND	GND
	GRN	$\overline{CS}$	—	—	$\overline{CS}$
	BLU	SCLK	—	—	SCLK
	GRN / RED	—	$\overline{CS}$	$\overline{CS}$	—
	GRN / YEL	—	$\overline{CS}$ comp	$\overline{CS}$ comp	—
	BLU / RED	—	SCLK	SCLK	—
	BLU / YEL	—	SCLK comp	SCLK comp	—
Outputs	RED / WHT	DATA	—	—	DATA
	YEL / WHT	A	—	—	A
	BLU / WHT	B	—	—	B
	BLK / WHT	NM	—	—	NM
	WHT / RED	—	DATA	DATA	—
	WHT / YEL	—	DATA comp	DATA comp	—
	BRN / RED	—	A	A	—
	BRN / YEL	—	A comp	A comp	—
	GRY / RED	—	B	B	—
	GRY / YEL	—	B comp	B comp	—
	VIO / RED	—	NM	NM	—
	VIO / YEL	—	NM comp	NM comp	—
Optional	RED / GRN	VEL	—	—	VEL
	BLK / GRN	DIR	—	—	DIR
	YEL / GRN	NMC	—	—	NMC
	BLU / GRN	CLKOUT	—	—	CLKOUT
	VIO / WHT	NMC	—	—	NMC

Digital Resolver Base Part Number	RS-422 Differential Digital I / O	Single +5 Volt Supply
DRBB-11-AA-01AA	No	No
DRBD-11-AA-01AA	Yes	No
DRBE-11-AA-01AA	Yes	Yes
DRBG-11-AA-01AA	No	Yes

Input / Output Descriptions

Inputs

Voltages: +5 VDC, –5 VDC, Ground

△ $\overline{CS}$: Chip Select. Active LO. Logic transition enables data output.

△ SCLK: Serial interface clock. Data is clocked out on "first" negative edge of SCLK, after a LO transition on $\overline{CS}$. Twelve pulses to clock data out.

Outputs

Standard

Absolute Position

▲△ DATA: Serial Interface Data

(DRBB & DRBG versions) High impedance with $\overline{CS}$=HI

(DRBD & DRBE versions) Data output undefined with $\overline{CS}$=HI

Enabled by $\overline{CS}$=0

Resolution: 12 bits

Max. read rate: 144 K readings / second with 2 MHz serial clock

Logic I / O: Standard TTL or RS-422

Accuracy: 15' max. (resolver plus converter)

Incremental Encoder (1024-line)

▲△ A: Encoder A Output

▲△ B: Encoder B Output

A leads B for increasing angular rotation

Symmetry: 180° ±15°

Quadrature: 90° ±11°

Edge separation: ž550ns at max. > scanning frequency (384 KHz)

▲△ NM: Encoder North Marker emulation output. Pulse triggered as code passes through zero. 90° pulse width (180° and 360° using NMC)

Optional

VEL: Indicates angular velocity of input signals (150 rps / VDC)

Load drive capability: ±250 µA at V_{out} = ±2.5 VDC

NMC: North Marker width Controller (90°, 180°, or 360°)

▲ CLKOUT: Internal VCO clock output; indicates angular velocity of input signals (4 KHz / rps)

▲ DIR: Indicates direction of rotation of input

LOGIC HI = Increasing angular rotation = CW shaft rotation

LOGIC LO = Decreasing angular rotation = CCW shaft rotation

(DRBB & DRBG versions)

▲ NOTE: OUTPUT LOAD CAPABILITY:

Output high voltage: 4 VDC at 1_{OH} = 1 mA

Output low voltage: 1 VDC at 1_{OL} = 1 mA

(DRBD & DRBE versions)

△ NOTE: Digital inputs and outputs meet the requirements of EIA standard RS-422. Signal and Signal compliment are utilized for all digital signals.

TIMING CHARACTERISTICS

Absolute Position Output

Serial Interface

Absolute angular position is represented by serial binary data and is extracted via a three wire interface: DATA, $\overline{CS}$ and SCLK. The DATA output is held in a high impedance state when $\overline{CS}$ is HI.

Upon the application of a LOGIC LO to the $\overline{CS}$ pin. The DATA output is enabled and the current angular information is transferred from the counters to the serial interface. Data is retrieved by appling an external clock to the SCLK pin. The maximum data rate of the SCLK is 2 MHz. To ensure secure data retrieval it is important to note that SCLK should not be applied until a minimum period of 600 ns after the application of a LOGIC LO to $\overline{CS}$.

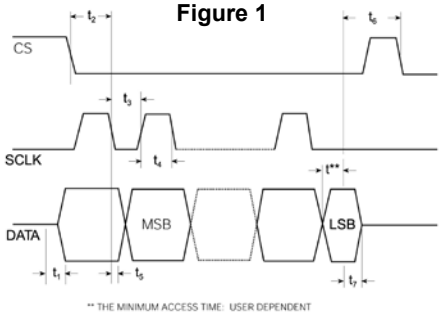
Data is then clocked out, MSB first. On successive negative edges of the SCLK: 12 clock edges are required to extract the full 12 bits of data. Subsequent negtive edges greater than the defined resolution of the converter will clock zeros from the data output if $\overline{CS}$ remains in a low state.

If a resolution of less than 12 bits is required, the data access can be terminated by releasing $\overline{CS}$ after the required number of bits have been read.

$\overline{CS}$ can be released a minimum of 100ns after the last negative edge. If the user is reading data continuously, $\overline{CS}$ can be reapplied a minimum of 250ns after it is released (see Figure 1).

The maximum read time is given by: (12-bits read @ 2 MHz) MAX RD TIME = [600 + (12 x 500) + 250 +100] = 6.95 µs

Figure 1



Parameter	Units	Test Conditions / Notes
t_1	150 ns Max.	$\overline{CS}$ to DATA enable
t_2	600 ns Min.	$\overline{CS}$ to ist SCLK negative edge
t_3	250 ns Min.	SCLK low pulse
t_4	250 ns Min.	SCLK high pulse
t_5	100 ns Max.	SCLK negative edge to DATA valid
t_6	250 ns Min.	$\overline{CS}$ high pulse width
t_7	150 ns Max.	$\overline{CS}$ high to DATA high Z (BUS Relinquish)

SCLK can only be applyed after t_2 has elapsed.

NOTES:
1. Timing data are not 100% production tested. Sample tested at +25°C only to ensure conformance to data sheet limits. Logic output timing tests carried out using 10pF, 100ka load.
2. Capacitance of DATA pin in high impedance state = 15 pF.

Incremental Encoder Output

The Incremental encoder emulation outputs A, B and NM are free running and are always valid.

The digital resolver emulates a 1024-line encoder. Relating this to converter resolution means one revolution produces 1024, A, B Pulses. A leads B for increasing angular rotation. The addition of the DIR output negates the need for external A and B direction decode logic. DIR is HI for increasing angular rotation (CW shaft rotation).

The North Marker Pulse is generated as the absolute angular position passes through zero. The digital rsolver supports the three industry standard widths controlled using the NMC pin. Figure 2 details the relationship between A, B and NM. The width of NM is defined relative to the A cycle.

Unlike the incremental encoders, the digital resolver output is not subject to error specifications such as cycle error, eccentricity, pulse and state width errors, count density and pulse error.

The maximum speed rating, N, of an encoder is calculated from its maximum switching frequency, F_{MAX}, and its PPR (Pulse Per Revolution).

$$n = \frac{60 \times F_{MAX}}{PPR}$$

The digital resolver A, B pulses are initiated from CLKOUT which has a maximum frequency of 1.536 MHz. The equivalent encoder switching frequency is:

1/4 x 1.536 MHz = 384 kHz (4 UPDATES = 1 PULSE)

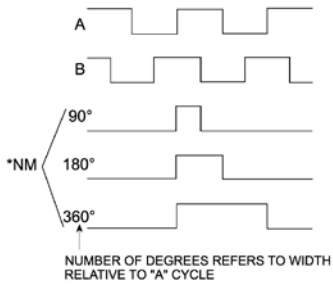
At 12 bits the PPR = 1024. Therefore the maximum speed, N, of the digital resolver is:

$$n = \frac{60 \times 384000}{1024} = 22500 \text{ rpm}$$

This compares favorably with encoder specifications where F_{MAX} is specified from 20 kHz (photo diodes) to 125 kHz (laser based) depending on the light system used. A 1024 line laser-based encoder will have a maximum speed of 7300 rpm.

The inclusion of A, B outputs allows the digital resolver solution to replace optical encoders directly without the need to change or upgrade existing application software.

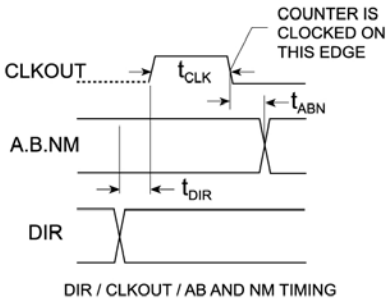
Figure 2



Level	Width
+5 VDC	90°
0	180°
-5 VDC	360°

*Selectable with three - level control pin "marker" default to 90° using internal pull-up.

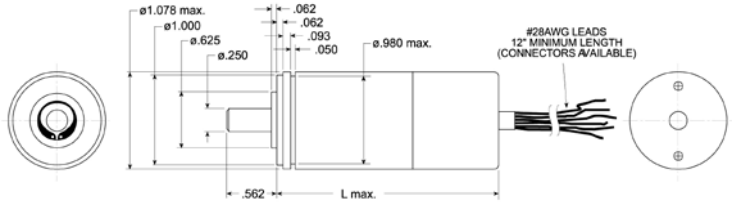
DIMENSIONS



DIR / CLKOUT / AB AND NM TIMING

Parameter	Min.	Max.	Units	Test Conditions / Notes
t_{DIR}		200	ns	DIR to CLKOUT positive edge
t_{CLK}	250	400	ns	CLKOUT Pulse width
t_{ABN}		250	ns	CLKOUT negative edge to A, B and NM transition

Digital Resolver Dimensions



Dimensions are in inches

	DRBB	DRBD	DRBE	DRBG
L_{MAX}	2.443	2.827	2.943	2.827

Rotary Variable Differential Transformer (RVDT)

TYPICAL APPLICATIONS

- Flight control / navigation
- Flap actuators
- Fuel control
- Cockpit control

FEATURES

- Brushless, non-contacting technology
- Repeatable position sensing with infinite resolution
- Standard size 8 housing

BENEFITS

- Long life
- High reliability
- Repeatable performance
- Frequency optimization

A Rotary Variable Differential Transformer (RVDT) is an electromechanical 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.

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.

A fixed alternating current excitation is applied to the primary stator coil that is electromagnetically coupled to the secondary coils. This coupling is proportional to the angle of the input shaft. The output pair is structured so that one coil is in-phase with the excitation coil, and the second is 180 degrees out-of-phase with the excitation coil.

When the rotor is in a position that directs the available flux equally in both the in-phase and out-of-phase coils, the output voltages cancel and result in a zero value signal. This is referred to as the electrical zero position or E.Z. When the rotor shaft is displaced from E.Z., the resulting output signals have a magnitude and phase relationship proportional to the direction of rotation.

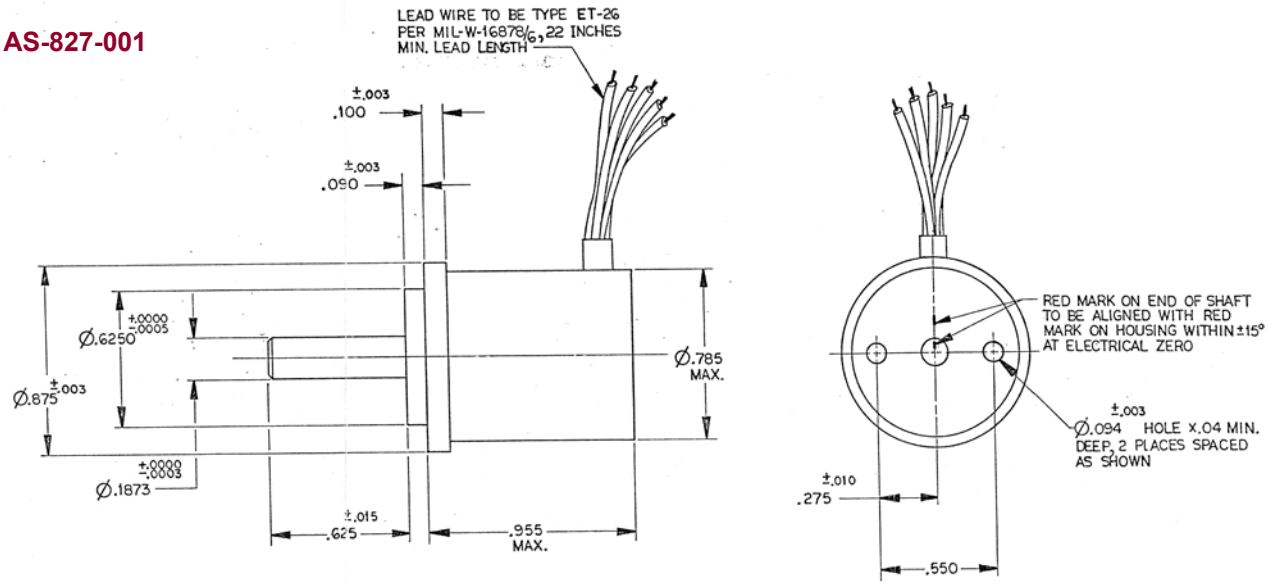
Because RVDT's perform essentially like a transformer, excitation voltages changes will cause directly proportional changes to the output (transformation ratio). However, the voltage out to excitation voltage ratio will remain constant. Since most RVDT signal conditioning systems measure signal as a function of the transformation ratio (TR), excitation voltage drift beyond 7.5% typically has no effect on sensor accuracy and strict voltage regulation is not typically necessary. Excitation frequency should be controlled within +/- 1% to maintain accuracy.

SPECIFICATIONS

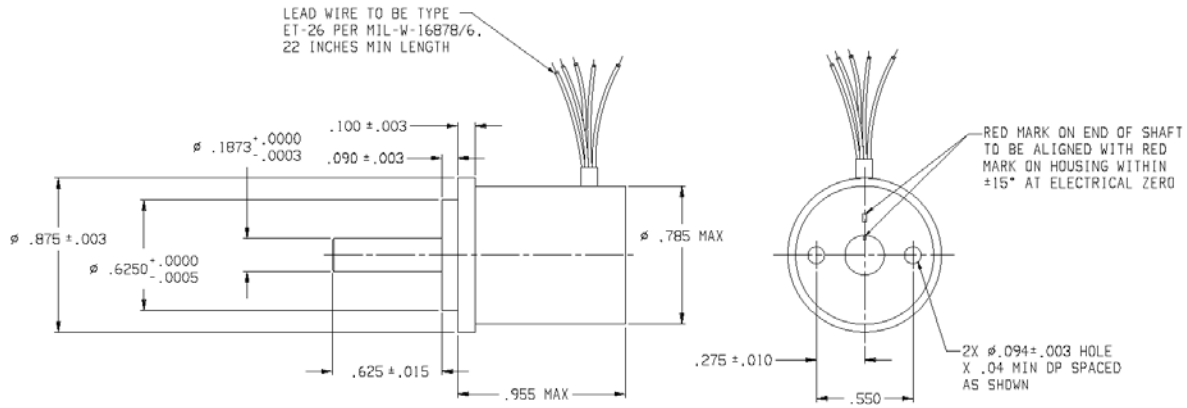
Model No.	AS-827-001	AS-827-002	AS-827-003	AS-827-004	AS-865-001	AS-887-001
Input						
Voltage	8.0 Vrms	8.0 Vrms	8.0 Vrms	8.0 Vrms	6.0 Vrms	7.0 Vrms
Frequency	1870 Hz	1870 Hz	1870 Hz	1870 Hz	3000 Hz	3000 Hz
Impedance	65 + j475	65 + j475	65 + j475	65 + j475	50 + j455	217 + j448
Output						
Scale Factor	0.061 V / Deg.	0.068 V / Deg.	0.068 V / Deg.	0.061 V / Deg.	0.061 V / Deg.	0.052275 V / Deg.
Angular Disp.	+/- 40 Deg.	+/- 40 Deg.	+/- 40 Deg.	+/- 42 Deg.	+/- 40 Deg.	+/- 30 Deg.
Accuracy	+/- 0.2 Deg.	+/- 0.2 Deg.	+/- 0.3 Deg.	+0.4; -0.6 Deg.	+/- 0.2 Deg.	+/- 0.25 Deg.
Phase Angle	+/- 5 Deg.	+/- 5 Deg.	+/- 5 Deg.	+/- 7 Deg.	+/- 5 Deg.	+/- 7 Deg.
Impedance	78 + j88	78 + j88	78 + j88	78 + j88	82 + j194	114 + j103
Test Load	7,000 pF	7,000 pF	7,000 pF	7,000 pF	100 KOhm	40,000 Ohm
Variation with Temp.	0.05% / Deg. C Max.	0.05% / Deg. C Max.	0.05% / Deg. C Max.	0.05% / Deg. C Max.		0.01% / Deg. C Max.

Typical Outline

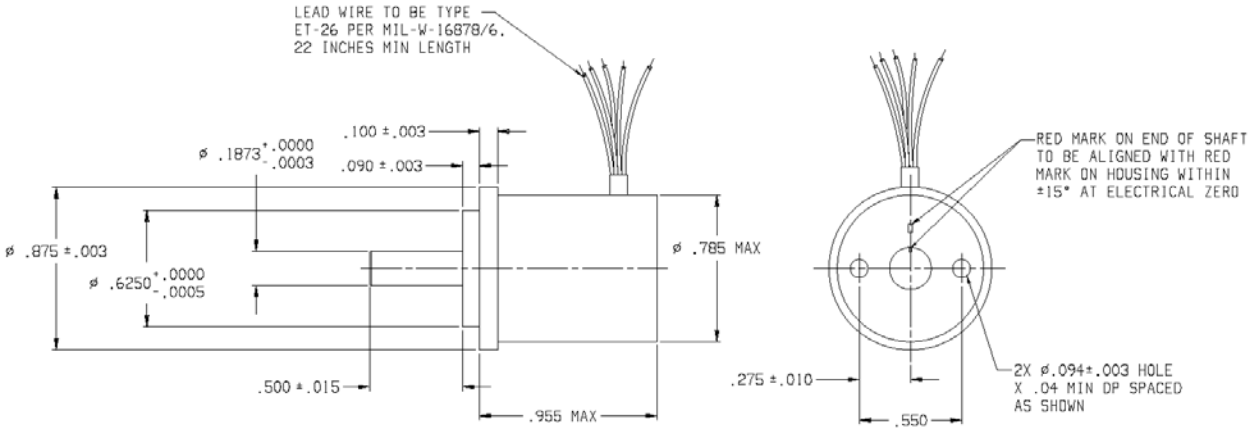
AS-827-001



AS-827-002



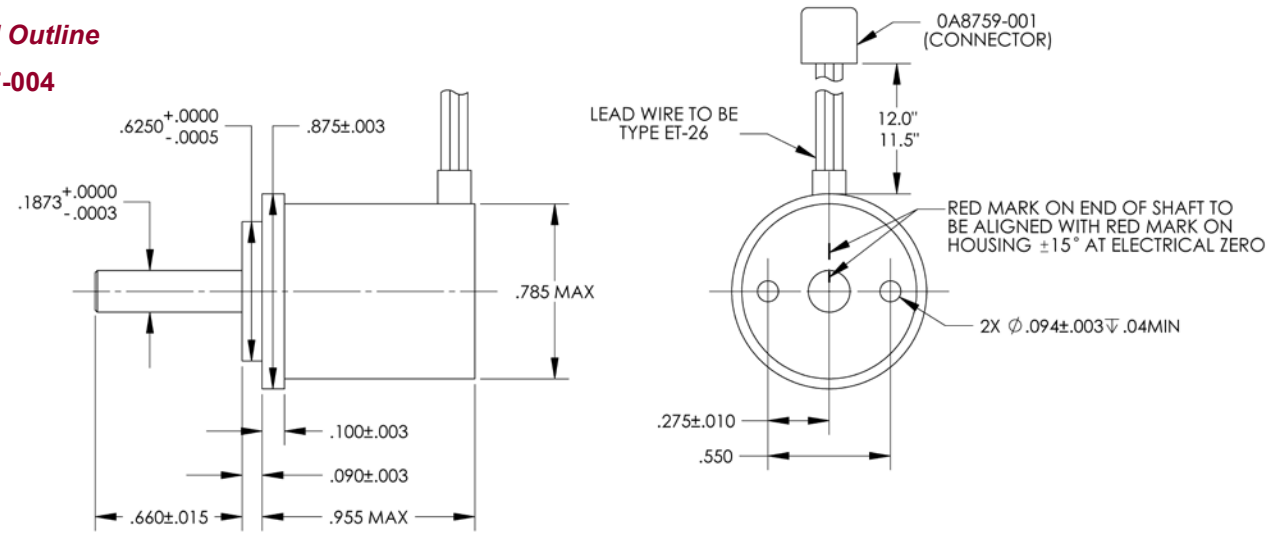
AS-827-003



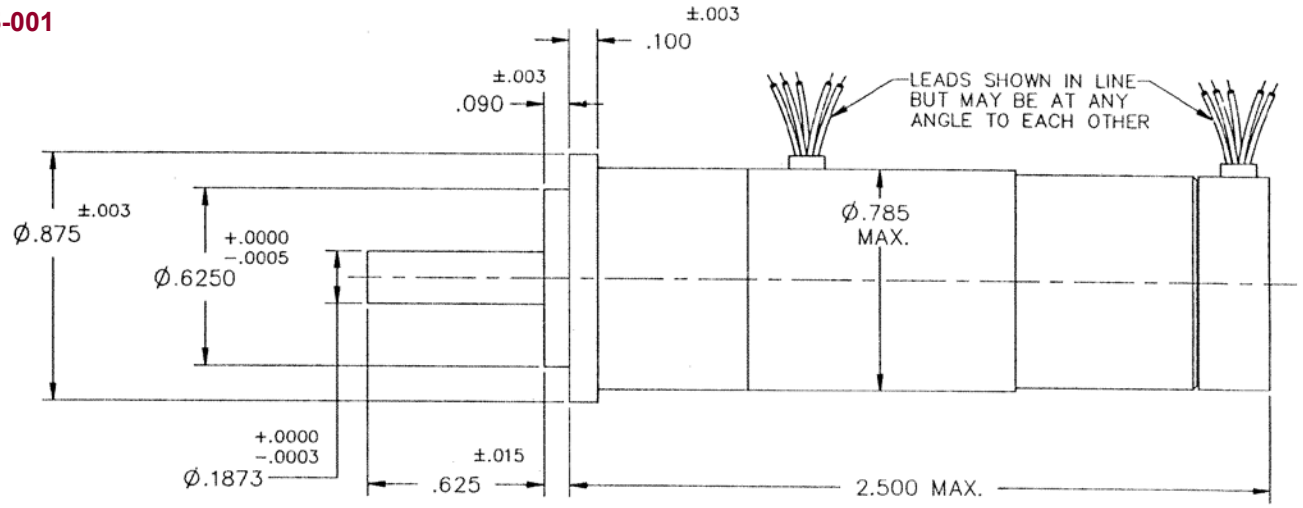
Dimensions are in inches

Typical Outline

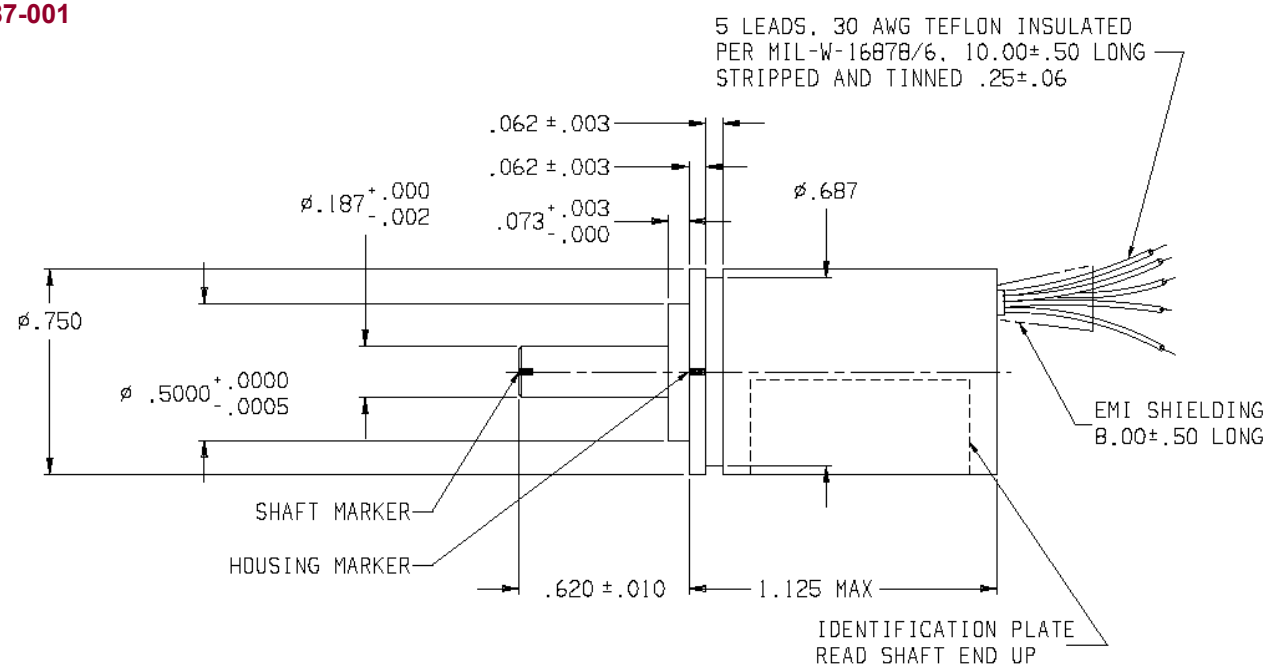
AS-827-004



AS-865-001



AS-887-001



Dimensions are in inches

Size 11 Single Speed Brushless Resolvers

TYPICAL APPLICATIONS

Where precise position indication is required to interface with computers*

- Brushless DC servo commutation, position, and velocity feedback
- Robotics and factory automation
- Machine tools
- Material handling equipment
- Medical instrumentation
- Packaging equipment

FEATURES

- Uncompromised reliability
- ±7' accuracy standard, ±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 $^{+.0000}_{-.0005}$ dia. shaft readily available
- Short housing lengths available
- Low cost
- Custom modifications available

Accurate, reliable position sensing for computer interface*

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.

* Used in conjunction with resolver-to-digital converter.

ELECTRICAL SPECIFICATIONS - *Size 11 Single Speed Brushless Resolvers*

PARAMETER	11-BHW-27☐	11-BHW-31☐	11-BHW-32☐	11-BHW-37☐	11-BHW-38☐	11-BHW-42☐
Primary	Stator	Rotor	Stator	Stator	Rotor	Rotor
Input Voltage	12V, 2000 Hz	6.5V, 5000Hz	12V, 400Hz	12V, 5000Hz	6V, 1000Hz	5.6V, 10,000Hz
Input Current	0.0091 amp	0.0088 amp	0.0132 amp	0.0114 amp	0.0163 amp	0.00231 amp max
Input Power	0.060 watt	0.35 watt	0.058 watt	0.081 watt	0.057 watt	0.0071 watt
Transformation Ratio (±5%)	0.500	0.954	1.750	0.500	0.454	0.485
Phase Shift	0.5° ±2°	–1.2°	18°	–4.6°	3.9°	–8.8°
Impedance Zso	725 + j1100	1064 + j1647	332 + j848	625 + j848	131 + j166	237 + j428
Zro	480 + j704	450 + j586	3736 + j4856	373 + j447	216 + j299	1621 + j2155
DC Resistance						
Stator	110 ohms	143 ohms	147 ohms	110 ohms	28.6 ohms	106 ohms
Rotor	58 ohms	83 ohms	1135 ohms	47 ohms	33.8 ohms	97 ohms
Null Voltage, Max.	0.015V	0.015V	0.030V	0.015V	0.030V	0.015V
Electrical Error †	±7 minutes	±7 minutes	±7 minutes	±7 minutes	±7 minutes	±7 minutes
Output Voltage	6V (±5%)	6.2V (±5%)	21V (±5%)	6V (±5%)	2.72V (±5%)	2.72V (±5%)
Schematic Diag.	A	B	A	A	B	B

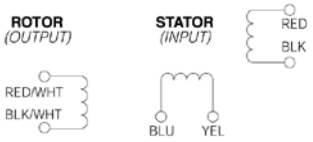
† Higher accuracies available

Typical performance characteristics at 25°C

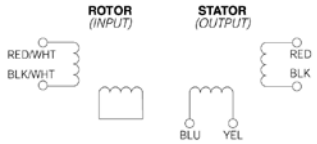
PARAMETER	11-BHW-43☐	11-BHW-52☐	11-BHW-53☐	11-BHW-58☐	11-BHW-60☐	11-BNW-62☐
Primary	Rotor	Stator	Rotor	Rotor	Rotor	Rotor
Input Voltage	7.5V, 4000 Hz	12V, 400Hz	8.5V, 1000Hz	12V, 1000Hz	26V, 2381Hz	5.9V, 2500Hz
Input Current	0.014 amp	0.011 amp	0.0104 amp	6.9 mA	10 mA	0.019 amp
Input Power	0.070 watt max.	0.049 watt	0.047 watt	0.0437 watt	0.176 watt	0.060 watt
Transformation Ratio (±5%)	0.535	1.933	1.000	1.000	0.454	2.000
Phase Shift	0° ±5°	15.4°	3.7°	3.4°	0° ±5°	–.5°
Impedance Zso	192 + j155	375 + j980	720 + j1154	2340 + j3082	738 + j980	2400 + j4600
Zro	360 + j400	4652 + j6080	434 + j695	919 + j1480	1775 +j1910	165 + j263
DC Resistance						
Stator	110 ohms	147 ohms	120 ohms	465 ohms	180 ohms	378 ohms
Rotor	72 ohms	1480 ohms	29 ohms	120 ohms	92 ohms	33.4 ohms
Null Voltage, Max.	0.015V	0.030V	0.030V	0.030V	0.030V	0.030V
Electrical Error †	±7 minutes	±7 minutes	±7 minutes	±7 minutes	±7 minutes	±7 minutes
Output Voltage	4V (±5%)	23.2V (±5%)	8.5V (±5%)	12V (±5%)	11.8V (±5%)	11.8V (±5%)
Schematic Diag.	B	A	B	B	B	B

Typical Schematics

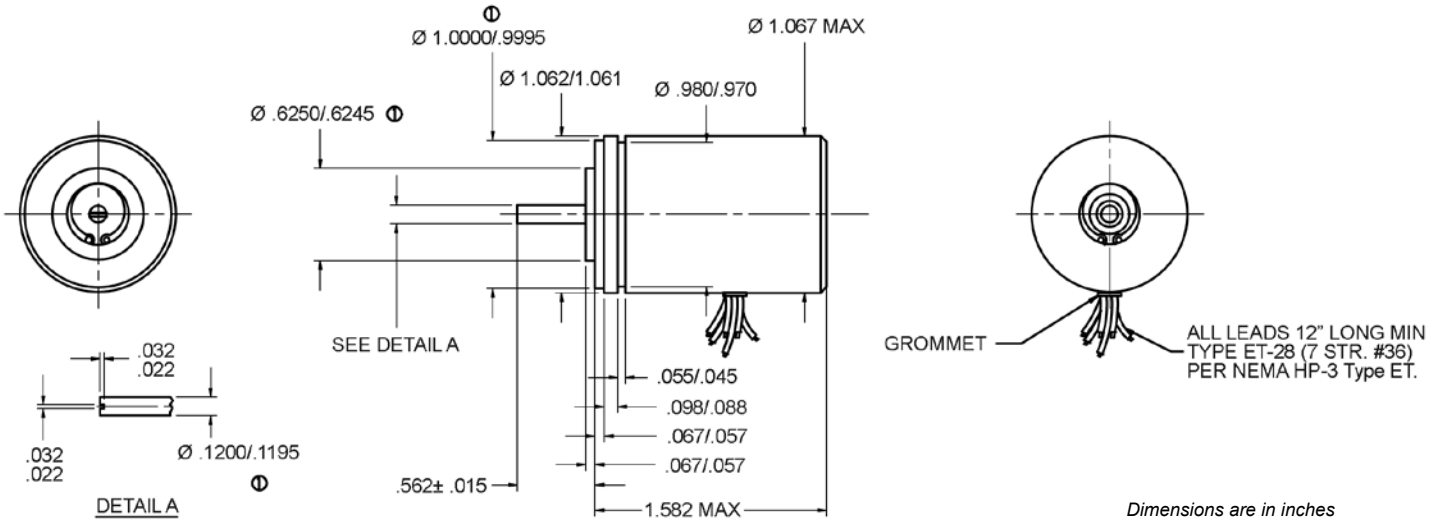
Schematic A



Schematic B



Typical Outline Drawing



Dimensions are in inches

Low Cost Brushless Pancake Resolver

TYPICAL APPLICATIONS

Where precise position indication is required to interface with computers

- Brushless DC servo commutation, position, and velocity feedback
- Robotics and factory automation
- Machine tools
- Material handling equipment
- Medical instrumentation
- Packaging equipment

FEATURES

- 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

Sizes 15, 21 and 22

For commutation, position, and velocity feedback

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.

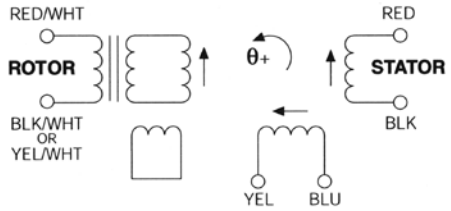
These low cost brushless resolvers are available in standard sizes or with custom modifications. Our Engineering Department is available for consultation to help tailor a brushless resolver to fit your needs.

SIZE 15 and 21 BRUSHLESS RESOLVER SPECIFICATIONS

Size 15	Brushless Resolvers		
PARAMETER	**JSSB-15-J-05K**	**JSSB-15-D-01H**	**JSSB-15-H-04D**
Primary	Rotor	Rotor	Rotor
Speed	One	One	One
Input Voltage	7Vrms 10KHz	4Vrms 3.4KHz	4Vrms 5KHz
Input Current	50 mA max	75 mA max	25 mA max
Input Power	0.2 watt max.	0.13 watt	0.046 watt
Transformation Ratio (±10%)	0.5	0.5	0.5
Phase Shift	2°	5°	1°
Impedance Zro Zso Zrs	105+j170 185+j311 160+j270	28+j60 23+j34 25+j34	132+j195 260+j280 116+j161
DC Resistance Stator Rotor	 77 ohms 40 ohms	 10.8 ohms 5.6 ohms	 150 ohms 25 ohms
Null Voltage	20 mV	15 mV	20 mV
Electrical Error †	±15 minutes	±20 minutes	±15 minutes
Output Voltage	3.5 Vrms	2 Vrms	2 Vrms
Drawing	A	**	B

Typical Schematic

CCW is positive when viewed from mounting end.

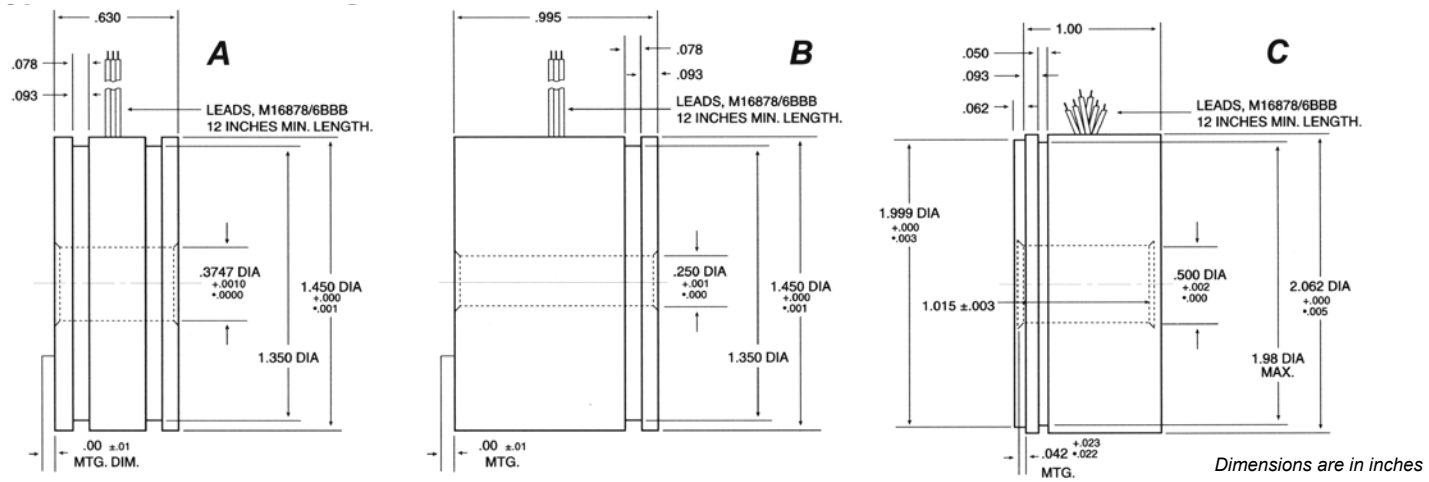


Alternate phasing available on request.

Typical performance characteristics at 25°C
† Higher accuracies available
*± 21 minutes max with 30 minutes max spread
**Contact the Engineering Department
£ 20 minutes spread

Size 21	Brushless Resolvers							
PARAMETER	**JSSB-21-B-02J**	**JSSB-21-B-04J**	**JSSB-21-B-03J**	**JSSB-21-F-06E**	**JSMB-21-B-06J**	**JSMB-21-B-04J**	**JSMB-21-B-05J**	**JSMB-21-B-07J**
Primary	Rotor	Rotor	Rotor	Rotor	Rotor	Rotor	Rotor	Stator
Speed	One	One	One	One	Four	Three	Two	Two
Input Voltage	7.5 Vrms 6.6 KHz	6 Vrms 1.2 KHz	4 Vrms 5 KHz	7 Vrms 10 KHz	7.5 Vrms 4 KHz	7.5 Vrms 4 KHz	7.5 Vrms 4 KHz	7 Vrms 4 KHz
Input Current	55 mA Max.	10 mA Max.	25 mA Max.	50 mA Max.	70 mA Max.	66 mA Max.	58 mA Max.	2.5 mA Max.
Input Power	0.22 watt	0.03 watt	0.05 watt	0.17 watt	0.225 watt	0.29 watt	0.26 watt	0.007 watt
Transformation Ratio (±10%)	1.0	0.46	0.5	0.5	1.0	1.0	1.0	0.5
Phase Shift	–14.5°	21°	–7.5°	–7°	12°	4°	6°	–8°
Impedance Zro Zso Zrs	100 + j125 862 + j1760 90 + j120	505 + j590 1120 + j975 520 + j505	115 + j150 350 + j620 105 + j145	100 + j140 190 + j300 83 + j130	70 + j110 730 + j1400 67 + j100	85 + j100 1070 + j1760 80 + j94	75 + j105 600 + j985 68 + j92	3100 + j5800 1300 + j2800 2600 + j5220
DC Resistance Stator Rotor	 290 ohms 25 ohms	 675 ohms 200 ohms	 145 ohms 31 ohms	 24 ohms 55 ohms	 450 ohms 25 ohms	 590 ohms 25 ohms	 360 ohms 25 ohms	 444 ohms 856 ohms
Null Voltage	30 mV	30 mV	20 mV	30 mV	30 mV	30 mV	30 mV	20 mV
Electrical Error †	±21 minutes £	±21 minutes *	±15 minutes	±21 minutes *	±10 minutes	±10 minutes	±10 minutes	±10 minutes
Output Voltage	7.5 Vrms	2.76 Vrms	2 Vrms	3.5 Vrms	7.5 Vrms	7.5 Vrms	7.5 Vrms	3.5 Vrms
Drawing	C	C	C	**	C	C	C	C

Typical Outline Drawing



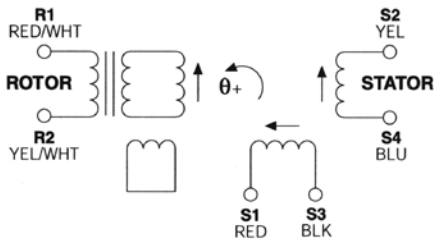
Dimensions are in inches

Size 22 BRUSHLESS RESOLVER SPECIFICATIONS

Size 22	Brushless Resolvers		
PARAMETER	**JSSB-22-A-01A**	**JSMB-22-D-03D**	**JSMB-22-D-02D**
Primary	Rotor	Rotor	Rotor
Speed	One	Two	Three
Input Voltage	5Vrms 4KHz	7.5Vrms 4KHz	7.5Vrms 4KHz
Input Current	30 mA Max.	65 mA Max.	65 mA Max.
Input Power	0.61 watt Max.	0.290 watt	0.290 watt
Transformation Ratio (±10%)	0.525	0.750	0.750
Phase Shift ±3°	–9°	2.6°	5°
Impedance Zro	92 + j175	80 + j106	82 + j107
Zso	230 + j425	435 + j725	613 + j994
Zrs	194 + j390	72 + j95	77 + j100
DC Resistance			
Stator	75 ohms	217 ohms	357 ohms
Rotor	19.5 ohms	25 ohms	25 ohms
Null Voltage	20 mV	20 mV Max.	20 mV Max.
Electrical Error †	±14 minutes	±7 minutes	±5 minutes
Output Voltage	2.1 Vrms	5.6 Vrms	5.6 Vrms
Operating Temp.	–55° to +150°C	–55° to +150°C	–55° to +150°C
Weight	230 grams nom.	230 grams nom.	230 grams nom.
HI-POT TEST:			
windings to GND	500 V 60Hz	500 V 60Hz	500 V 60Hz
between windings	250 V 60Hz	250 V 60Hz	250 V 60Hz

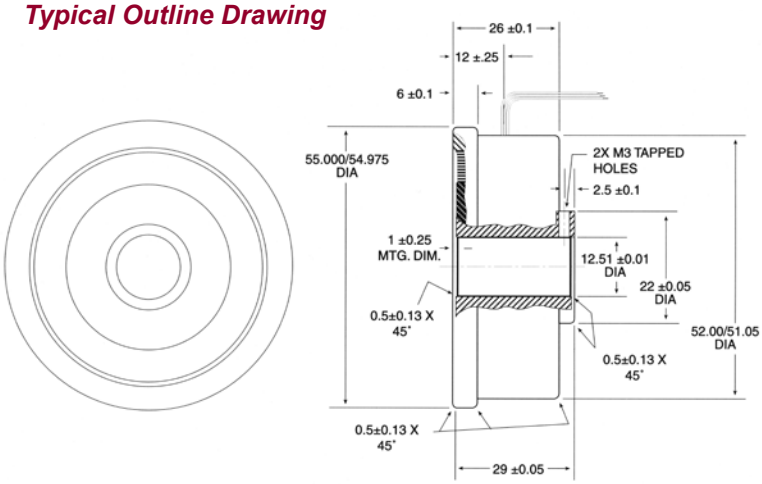
Typical Schematic

CCW is positive when viewed from side opposite mounting end.



Alternate phasing available on request.

Typical Outline Drawing



Dimensions are in inches

Pancake Brushless Resolvers

These units 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 highly resistant to the shock and vibration levels often encountered in industrial environments, and do not require protection from the dirt, oil or other contaminants that normally occur in factory conditions.

Pancake brushless resolvers are supplied as separate rotor and stator assemblies, which are then mounted directly in the user's system. Since the energy is transmitted into and out of the rotor assembly by means of electromagnetic fields, no slip rings and brushes are necessary, reducing the cost and increasing the reliability of these devices.

The pancake brushless resolvers are designed with larger than normal airgaps, in comparison with a "standard" pancake resolver, to allow for a greater degree of imprecision in mounting. Normal considerations for these units require the rotor to be mounted inside the stator with an eccentricity no greater than 0.003 inch, and that the rotor and stator mounting surfaces be set in line within 0.020 inch. If eccentricities larger than 0.003 inch occur, the accuracy of the resolver will probably degrade; if the axial alignment exceeds 0.020 inch, input current, input power and phase shift will increase, while the output voltage drops. The mounting surfaces and the actual quantitative specifications for mounting, both concentrically and axially, may be found on the individual outline drawing for each unit type.

Normally, the housing assembly is held in place in the user's equipment by the use of synchro clamps and the mounting grooves or flanges provided on the outside of the housing. Rotor assemblies are usually mounted adhesively, by using a keyway provided in the rotor bore, by clamping against the end of the hub, by set screws in tapped holes provided in the rotor hub, or by some combination of these methods.

These low cost pancake brushless resolvers are available in the standard sizes and configurations shown, or with custom modifications to either the given mechanical or electrical characteristics. Our Engineering Department is available to assist you in tailoring these units to fit the specific requirements of your system.

Military / Aerospace Resolvers

TYPICAL APPLICATIONS

Where precise position indication is required to interface with resolver to digital converters

- Target acquisition systems
- Gun trunnions
- Forward-Looking-Infra-Red (FLIR) systems
- Electro-optical systems
- Radar systems
- Missile seekers
- Motor commutation

FEATURES

- 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
- Compact design
- 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

INTEGRATION CAPABILITIES

- Ideal for vertical integration with brushless motors and slip ring assemblies
- Commutation of brushless motors
- Feedback sensor for servo systems
- Compatible with R / D converters

Note: *This catalog contains basic marketing information and general part descriptions of Moog Components Group product lines. With respect to the U.S. export regulations, the products described herein are controlled by the U.S. Commerce Department or the U.S. State Department. Contact Moog Components Group for additional detail on the export controls that are applicable to your part.*

For position, commutation, and velocity feedback

Rugged, reliable - ideal for demanding environments

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

MECHANICAL PARAMETERS AND SCHEMATICS OF RESOLVERS

Types of Resolvers

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. *Figure A* shows a typical physical configuration for a pancake resolver with a ring and hub.

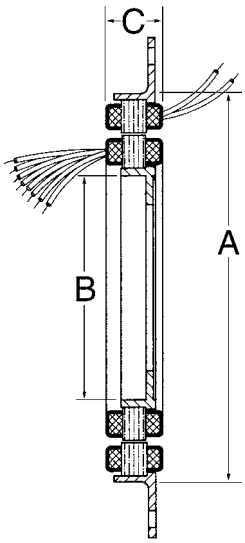


Figure A. Dimension Configuration for Single or Multispeed Unhoused Pancake Resolvers

A pancake resolver can also be supplied in a multispeed configuration. Multispeeds are mechanically and electrically similar to a standard pancake, but produce "N" cycles of electrical output for each mechanical revolution of the rotor. "N" is called the ratio or speed of the resolver. For example, an 8 speed resolver has one electrical output cycle in 360/8 = 45 degrees of mechanical rotation. The individual electrical cycles can be distinguished from each other by inserting a single speed in the same slots with the multispeed, creating a multiple speed unit.

Figure B. Typical Schematic for Single Speed Pancake Resolvers

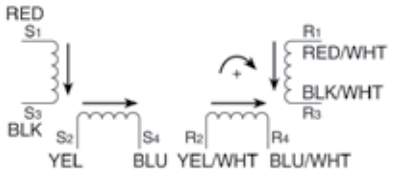
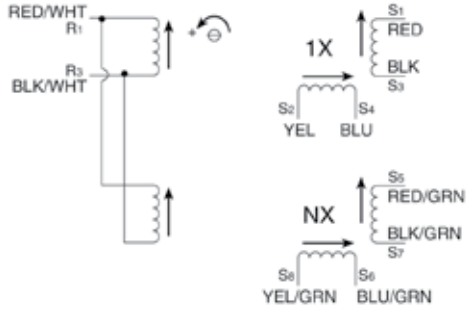


Figure C. Typical Schematic for Multispeed Pancake Resolvers



Figures B and *C* below show typical wiring schematics for single speed and multispeed resolvers, respectively. Mounting diameters A and B and overall thickness C (refer to *Figure A*) as well as electrical parameters for a variety of units are tabulated on page 190.

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. This type of resolver is called a brushless pancake resolver and is designated as "B/L" in the function column in the table on page 190. *Figure E* below shows a typical wiring schematic for a brushless resolver. Brushless resolvers often offer a less costly and more reliable alternative to resolvers that are energized through slip rings.

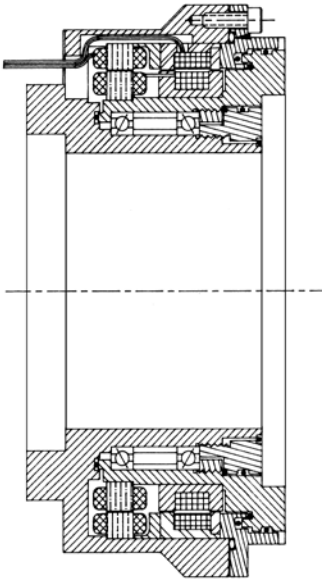


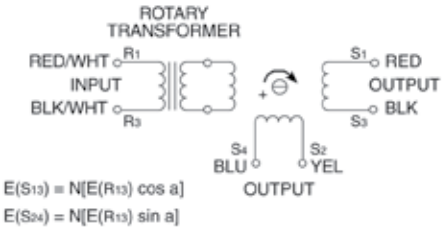
Figure D. Typical Outline for Housed Resolvers

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. A typical outline for a housed, brushless resolver is shown in *Figure D*. Often, a housed resolver will be more accurate than an equivalent unhoused unit because the air gap of the resolver can be ground concentric with the bearing seats.

Our engineering department is available to assist you in obtaining a mechanical configuration that will fit your system's requirements.

Figure E. Schematic and Phasing Equation of Typical Transformer Type Resolvers



SPECIFICATIONS

Part Number	Function	Primary Winding	Speed	Input (Volts/Hz)	Max Error (Accuracy) (+/-)	Trans. Ratio	Phase Shift (DEG)	Max Null V (mV)	Pin (mW)	Impedances		Unit Dimensions (See Figure A)			Notes
										Zpo	Zso	A OD	B ID	C Overall Width	
SMH-12-A-1	RES RX	R	3X	5 / 5950	3'	0.4	23	20	40	113 + j245	33 + j75	1.19	0.56	0.37	3
SSH-12-A-2	RES RX	R	1X	10 / 3200	6'	1	8	20	32	250 + j850	330 + j1000	1.19	0.56	0.23	3
SSH-12-D-2	RES RX	R	1X	10 / 400	7'	0.434	26	15	88	225 + j455	65 + j128	1.19	0.09	0.7	3
SMH-14-A-1	RES RX	R	4X	26 / 500	6'	0.454	32	15	60	320 + j640	620 + j440	1.31	0.187	0.465	3
SMH-16-J-1	RES RX	R	2X	26 / 400	3'	0.454	40	20	814	350 + j410	157 + j165	1.56	0.81	0.38	3
SMH-17-B-3	RES RX	R	4X	26 / 500	6'	0.454	32	15	60	320 + j640	620 + j440	1.66	0.156	0.54	3
SSH-23-S-1	RES RX	S	1X	26 / 400	10'	0.454	30	30	225	900 + j1380	320 + j480	2.29	0.32	0.408	3
SMH-32-D-1	RES RX	R	16X	7 / 12500	60"	0.286	4	30	75	660	62 + j110	2.850	1.745	0.530	3
SMH-30-B-1	RES RX	R	16X	15 / 1200	30"	0.5	23	15	370	100 + j225	540 + j475	2.94	1.5	0.708	3
SMH-30-C-1	RES RX	R	8X	15 / 1200	1'	0.5	15	20	125	120 + j450	600 + j575	2.94	1.5	0.708	3
SMH-30-E-1	RES RX	S	16X	26 / 1440	30"	0.454	23	30	240	502 + j1098	935 + j1398	2.960	0.740	0.550	3
SSH-32-D-1	RES RX	R	1X	2 / 4800	6'	1	0	5	0.6	600 + j1850	650 + j2050	3.15	1.16	0.51	3
SMH-32-C-2	RES RX	R	2X	18 / 400	5'	0.656	45	18	500	590 + j670	550 + j580	3.21	1.51	1.01	3
SMH-34-G-1	RES RX	S	8X	26 / 1440	30"	0.454	17.5	30	460	155 + j455	300 + j200	3.34	1.075	0.55	3
SMH-34-C-1	RES RX	R	8X	26 / 2400	2'	0.454	42	20	1200	206 + j358	——	3.39	0.875	0.914	3
SSJH-36-B-3	RES RX	R	1X and	26 / 400	15'	0.454	8	30	530	225 + j480	750 + j225	3.57	2	0.6	1, 3
			16X		1'	0.454	25	20			460 + j460				
SSJH-36-K-1	RES RX	R	1X and	26 / 2400	10'	0.454	4	20	40	4000 + j8800	——	3.58	1.31	1.11	3
			8X	26 / 2400	1'	0.454	13	20	140	200 + j890	——				
SMH-37-A-3	RES RX	R	8X	11.8 / 400	1'	0.4	27	10	60	650 + j1270	——	3.61	0.54	0.61	3
SMH-37-J-1	RES RX	R	16X	26 / 400	30"	0.454	29	25	600	330 + j540	——	3.61	0.728	0.65	3
SSJH-37-J-4	RES RX	R	1X and	8 / 2400	60'	0.25	2.5	15	150	160 + j300	81 + j48	3.610	.728	.650	1, 3
			32X		20"	0.25	25	5			150 + j172				
SMH-43-E-1	RES RX	S	16X	7 / 12500	60"	0.286	2.5	30	54	860	51 + j207	3.695	2.405	0.530	3
SSBH-40-C-1	B/L R RX	S	1X	7 / 1200	6'	0.683	3	15	65	180 + j320	313 + j487	3.95	2	1	3
SSJH-43-C-1	RES RX	R	1X and	7 / 4500	15'	0.454	0	30	16	122 + j686	530 + j545	4.245	3.175	0.545	4
			16X	7 / 4500	60"	0.454	4.5	15							
SMVH-44-A-2	RES VR	S	2X	12 / 5000	2°	0.275	12	40	3125	32 + j120	42 + j245	4.4	0.945	0.65	3
SSJH-46-C-1	RES RX	R	1X and	7 / 800	10'	0.357	10	6	3	1650 + j5040	295 + j725	4.52	2.08	0.578	3
			16X	7 / 800	30"	0.345	35	4	225	61 + j97	80 + j39				
SSH-50-B-1	RES RX	R	1X	26 / 400	3'	0.454	3	25	120	1435 + j253	360 + j565	4.99	3.456	0.7	4
SSJH-50-B-3	RES RX	R	1X and	26 / 2600	15'	0.454	4	25	282	162 + j602	278 + j295	4.994	3.456	0.750	4
			32X	26 / 2600	20"	0.454	11.5	25			265 + j1060				
SMH-53-A-1	RES RX	R	2X	18 / 400	5'	0.656	45	18	50	760 + j1400	780 + j855	5.26	2.385	0.855	3
SSJH-60-A-1	RES RX	R	1X and	26 / 400	10'	0.454	10	25	670	145 + j352	——	6	3.455	1	1, 4
			32X		20"	0.454	23	30			——				
SSJH-60-D-1	RES RX	R	1X and	115 / 400	20'	0.783	5	200	330	7978 + j17680	5100 + j12228	6	3.455	1	4
			16X	115 / 400	40"	0.783	18	200	3,200	560 + j1668	2216 + j2380				
SSJH-63-A-1	RES RX	R	1X and	26 / 400	15'	0.454	21	30	1570	152 + j203	730 + j255	6.25	5.01	0.61	1, 4
			16X		60"	0.454	36	15			400 + j250				
SGH-78-B-2	SYN CX	R	1X	26 / 400	4'	0.454	20	30	500	2480 + j3285	720 + j885	7.75	4.27	1.88	3
SGH-78-C-2	SYN CX	R	1X	26 / 401	4'	0.454	20	30	500	2480 + j3286	720 + j886	7.75	4.27	1.88	3
SGH-78-D-2	SYN CX	R	1X	26 / 402	4'	0.454	20	30	500	2480 + j3287	720 + j887	7.75	4.27	1.88	3
SSJH-98-A-1	RES RX	R	1X and	26 / 400	10'	0.450	7	30	120	2080 + j2700	130 + j690	9.750	6.000	1.000	3
			16X	26 / 400	60"	0.450	9.3	30	180	535 + j750	265 + j280				

Abbreviations:

Function: RES RX = Resolver Transmitter
SYN CX = Synchro Transmitter
B/L R RX = Brushless Resolver Transmitter

Winding: R = Rotor
S = Stator

Accuracy: ' = arc minutes, " = arc seconds

Higher accuracy units available, please call factory.

Impedances:
Zpo = Impedance of the primary with the secondary open
Zso = Impedance of the secondary with the primary open

Other: —— = please consult factory

Notes:
1. Primary windings of both speeds are in parallel.
2. Rotation limited to ±30° due to connector.
3. These dimensions refer to the resolver ***with*** mounting rings and hubs. We can alter or delete the mounting rings and hubs as needed to meet your requirements. Tooling charges may apply.
4. These dimensions refer to resolver ***without*** mounting rings and hubs. We can add mounting rings and hubs as required to meet your requirements. Tooling charges may apply.

SYNCHRO FUNDAMENTALS

As a circuit element, the synchro is essentially a variable-coupling transformer; the magnitude of the magnetic coupling between the primary and secondary, and hence the magnitude of the output voltage, varies according to the position of the rotatable element. In function, the synchro is an electromechanical transducer. A mechanical input such as a shaft rotation is converted to a unique set of output voltages, or a set of input voltages is used to turn a synchro rotor to a desired position.

Synchros can be classified in two overlapping groups: torque synchros and control synchros.

Torque synchros include transmitters (CG), differentials (CD) and receivers (CR).

Control synchros include transmitters (CG), differentials (CD) control transformers (CT), resolvers (CS), linear transformers (LT), and the two hybrid units – transolvers (CSD), and differential resolvers (CDS).

SYNCHRO TYPES

Transmitter

The synchro transmitter (CG) consists of a single-phase, salient-pole (dumbbell-shaped) rotor and a three-phase, Y-connected stator.* The primary or input winding is usually the rotor; the stator is usually the secondary or output element. The rotor is excited through a pair of slip rings with an AC voltage. The field produced by the input voltage induces a voltage into each of the stator phases. The magnitude of the induced phase-voltage depends on the angle between the rotor field and the resultant axis of the coils forming that stator phase. Since the axes of the three stator phases are 120° apart, the magnitudes of the stator output voltages can be written as:

$$V_{s1\text{-}3} = k\, V_{r2\text{-}1} \sin\theta$$
$$V_{s3\text{-}2} = k\, V_{r2\text{-}1} \sin(\theta+120)$$
$$V_{s2\text{-}1} = k\, V_{r2\text{-}1} \sin(\theta+240)$$

- Where k is the maximum coupling transformation ratio (TR)
- Which is further defined as TR=$\frac{\text{Vout (max.)}}{\text{Vin}}$ and is a scalar quantity.
- θ is the rotor position angle.
- $V_{s1\text{-}3}$ is the voltage from the S1 terminal to the S3 terminal, and all other voltages are similarly defined here and throughout this discussion.

These stator voltages are either approximately in time-phase or approximately 180° out-of-time-phase with the applied voltage. The amount by which the output voltages differ from the exact 0° or 180° time-phase relationship with the input voltage is known as the synchro (time) phase shift. For a synchro operated at 400 Hz working into an open circuit, the output voltage will always lead the input voltage by a few degrees (8° to 20° for small sizes; 2° to 8° for larger sizes).

From the above transmitter equations it can readily be seen that nowhere over the entire 360° rotation of the rotor will the same set of stator voltages appear. The transmitter thus supplies information about the rotor position angle as a set of three output voltages. To make use of this information, however, it is necessary to find an instrument which will measure the magnitude of these voltages, examine their time-phase relationships and return them to their original form – a shaft position. Such an instrument is the synchro receiver (CR). These two units – the transmitter and the receiver – form the most basic synchro system.

Receiver

In construction, the receiver is electrically identical to the transmitter. The output voltages vary with rotor position in the identical manner as that given for the transmitter. In use, the receiver is connected back-to-back with a transmitter; i.e., like-numbered terminals are connected together (See Figure 1) and the rotors are excited in parallel. At the instant the system is energized, if the rotors of each unit are not at the exact same angle relative to the stator phases, voltage differences exist across each pair of stator windings causing current to flow in both stators. This stator current produces a torque on each rotor.

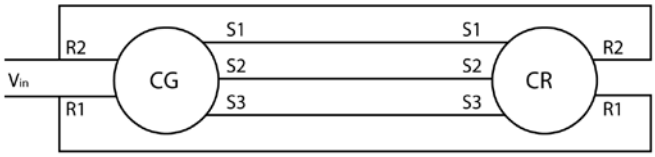


FIGURE 1

Since the CG rotor is constrained from turning, the resultant torque acts on the CR rotor in such a direction as to align itself with the transmitter. When alignment occurs, the voltages at each stator terminal are equal and opposite, and no current flows. Perfect synchronization is never achieved in practice because of the internal friction (due to bearings and brushes) of the receiver. To minimize this error, the receiver is designed to have a maximum starting friction of 2700 mg-mm.

Turning the transmitter rotor from the equilibrium position will again exert a force on the receiver rotor. As soon as this developed force exceeds the internal friction of the receiver, the CR will track the CG to its new position. The torque developed on the receiver shaft is proportional to the angle between the two rotors and is usually expressed in mg-mm/deg. Methods for measuring the torque produced by a transmitter-receiver pair are to be found in Society of Automotive Engineers Specification ARP-461.

Receivers are constructed to minimize oscillations and overshoot or spinning when the rotor is turning to a new position. The time required for the rotor to reach and stabilize at its new rest position is called the damping or synchronizing time. This time varies with the size of the receiver, the inertia of the load, and the system torque. By special receiver construction, the damping time can be reduced if required by system considerations.

The CG-CR system is used to transmit angular information from one point to another without mechanical linkages. The standard transmission accuracy for such a system is 30 arc minutes. The information can be sent to more than one location by paralleling more than one receiver across the transmitter. The more receivers used, however, the less accurate the system, and the larger the power draw from the source.

Differential

A third type of synchro may be added to our basic torque system – the differential (CD). The differential stator is three-phase, Y-connected and is usually the primary element; the rotor is cylindrical and is also wound with three Y-connected phases. The output voltages of the CD depend not only on the input voltages but also on the rotor shaft position. As shown in figure 2, the differential stator is normally excited from a transmitter stator, and the differential rotor is connected to the receiver stator. The output voltages of the differential are dependent now on both the transmitter rotor position (θ_{CG}) and its own rotor position (θ_{CD}). The receiver rotor will seek a position (θ_{CR}) which is either the sum or difference of the transmitter and differential rotor angles ($\theta_{CR} = \theta_{CG} \pm \theta_{CD}$), depending on how the CG and CD stators are interconnected.

**Note: the use of the word "phase" will always indicate a space-phase relationship, unless a time-phase relationship is specifically referenced.*

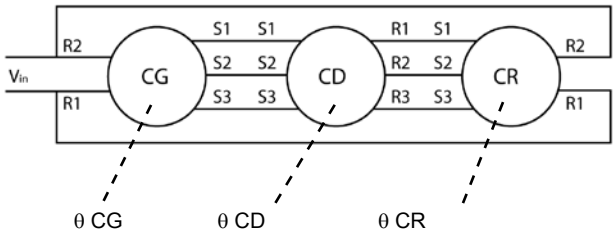


FIGURE 2

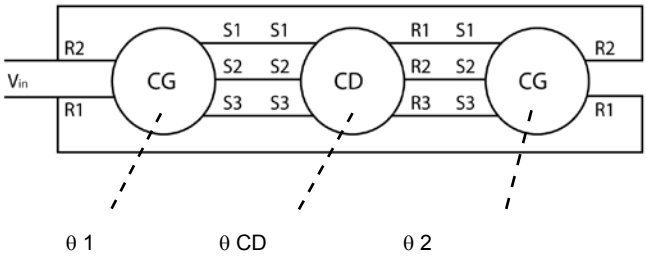


FIGURE 3

The differential may also be energized between two transmitters as shown in Figure 3. In this system, each transmitter is turned to its desired angle, and the differential rotor is forced to assume a position which is either the sum or the difference of the angles between the transmitter rotors ($\theta_{CD} = \theta_1 \pm \theta_2$). In this application, the differential is sometimes called a differential receiver and is especially constructed with an extremely low starting friction (5000 mg-mm) to minimize system errors. An accuracy of 1° is standard. All synchro systems are subject to one serious drawback – torque levels typically run around 3000 mg-mm per degree of receiver displacement. This is sufficient to turn a dial or a pointer but nothing larger without increasing system errors. When higher torques are required, synchros are used to control other devices which will provide these torques. An integral part of these control systems is the synchro control transformer. (CT).

Control Transformer

The CT consists of a three-phase, Y-connected stator and a single-phase drum (cylindrical) rotor. In normal usage, the stator is the primary element, the rotor is the secondary, and the unit is connected as shown in Figure 4. From the schematic of Figure 4, it can be seen that the transmitter sets up a voltage field in the CT stator whose direction is exactly that of the transmitter and whose magnitude is directly proportional. As the transmitter rotor turns with the CT rotor stationary, the magnitude of the CT stator field remains constant, and its direction exactly matches that of the transmitter. The field cutting across the CT rotor induces a voltage in the rotor. The magnitude of this voltage depends on the sine of the angle between the axis of the rotor winding and the stator flux vector; the time phase of the CT output voltage is either approximately in time-phase or 180° out-of-time-phase with the exciting voltage on the transmitter rotor. Since the angle of the CT stator flux field depends upon the transmitter rotor angle, the CT output voltage can be used to obtain information about the transmitter rotor angle.

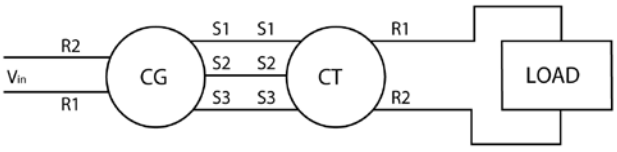


FIGURE 4

The basic CG-CT control system is shown in Figure 5.

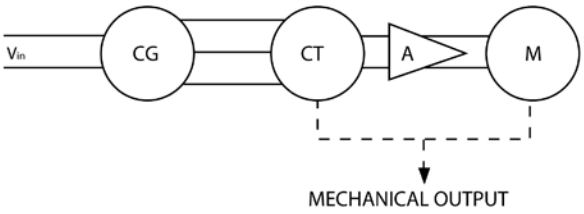


FIGURE 5

If the CT rotor angle is not the same as that of the transmitter, a voltage proportional to the sine of the angular difference appears on the CT rotor. This voltage is impressed across the input of a servo amplifier, which, in turn, is connected to the control phase of a servomotor. The motor, which is geared back to the CT rotor shaft, will turn to oppose the voltage causing its motion. It will rotate until the CT rotor is at the same angle as the CG rotor; at this position, the CT output voltage is theoretically zero and motion will cease. With additional gearing the synchro motor provides a mechanical output for other useful work. This synchro system, which develops no torque of it own, acts as the control device which moves high torque loads. The accuracy of the entire system depends on synchro error, amplifier gain, servo response, and gearing errors. Using standard components, the synchro system error is usually specified as 10 arc minutes maximum; by selecting synchros or by trimming, this error can be reduced well below the given figure. If multispeed pancake synchros are used, accuracies measured in seconds of arc are standard.

In some systems, a control transformer is made to act, through switching circuits, as both a transmitter and a CT. This practice is not recommended. Because of its impedance levels and its cylindrical, distributed-winding rotor, the CT can never act as a transmitter without causing degradation in system accuracy and system null voltage. Whenever a synchro must serve as both a CG and a CT, we recommend the use of a transolver (CSD).

Transolver, Differential Resolver

The transolver is essentially a control transformer with a second rotor winding wound in space quadrature to the main winding. When used as CT, the transolver's second rotor winding is dummy-loaded symmetrically with the main winding to avoid unbalances. When using the transolver as a transmitter, the unused rotor winding is shorted to ground, thus providing electrical saliency and permitting the transolver to operate as a transmitter without introducing additional errors. The differential resolver (CDS) is the inverse of the transolver (i.e., the rotor is the three-phase element, the stator is two-phase). In function, the transolver and differential resolver are identical. The advantage of the differential resolver over the transolver lies in those applications where four-wire outputs are desired; it is more economical to bring out four stator leads than to provide four rotor slip rings and four sets of brushes. Both the transolver and the differential resolver find considerable usage in systems where it is desirable to convert three-wire data into four-wire data. These units form the bridge between the three-phase devices – transmitters, receivers, differentials, and control transformers – and the two-phase units, or resolvers.

Resolver

The resolver (CS) consists of a cylindrical rotor with two phases wound in space quadrature and a stator also with two quadrature phases. In standard resolvers (CS), the ends of the rotor phases are internally connected and brought out with a common lead. A resolver with all four rotor leads brought out separately is designated by CZ. The classic function of a resolver, as the name implies, is to resolve a vector into its components. Energizing one phase of the input element – either rotor or stator – with a voltage V induces a voltage into one output winding whose magnitude varies according to the sine of the rotor position angle θ. The other output

winding, being in space quadrature to the first, must then have an induced voltage whose magnitude varies as sin (90-θ) or cosθ. The two outputs are thus V sinθ and V cosθ (assuming a unity transformation ratio), which are the components of the input vector V.

A resolver which is specifically meant to separate a vector into its components is the vector resolver (CV or CW). This unit type differs from the standard resolver because the rotor is wound with only one phase. The vector resolution is reversible because if two voltages, (X and Y), representing vector components are applied to the inputs of the resolver, the corresponding polar coordinates, (R, θ), can be obtained. Since the two inputs are in quadrature, applying voltages X and Y to these inputs will set up a resultant field whose magnitude is $\sqrt{(X^2 + Y^2)}$ or R. If one output phase is connected through an amplifier to a servomotor which is geared back to the resolver shaft, the voltage on the other output will be proportional to R, and the rotor position angle will indicate θ ($\tan^{-1} Y/X$).

Exciting one input of a resolver with voltage A produces outputs of A sinθ and A cosθ. Exciting the other input with voltage B produces outputs of B sin (θ + 90) or B cosθ and B cos (θ - 90) or –B sinθ. Energizing both windings at once then gives two outputs Y and X whose magnitudes are of the form:

$$Y = A\sin\theta + B\cos\theta$$
$$X = A\cos\theta - B\sin\theta$$

From analytic geometry, these two equations represent a transformation of axes by rotating without translation; Y and X are the new components obtained by rotating A and B through the angle θ. Resolvers then find usage wherever transformation of coordinates from one system to another is desired. Spacecraft and aircraft often require the craft's pitch, roll and yaw to be transformed back to earth references. One resolver is needed to provide two-axis transformation; three resolvers, to provide three-axis transformation.

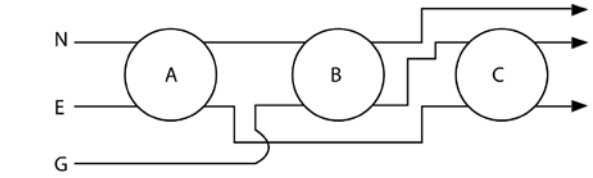


FIGURE 6

Figure 6 schematically represents the interconnections of three resolvers necessary to transform from inertial platform coordinates (N,E,G) to an airborne vehicle's coordinates (X,Y,Z). This resolver chain essentially solves the matrix equation:

$$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos C & \sin C \\ 0 & -\sin C & \cos C \end{bmatrix} \begin{bmatrix} \cos B & 0 & \sin B \\ 0 & 1 & 0 \\ -\sin B & 0 & \cos B \end{bmatrix} \begin{bmatrix} \cos A & \sin A & 0 \\ -\sin A & \cos A & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} N \\ E \\ G \end{bmatrix}$$

Resolver chains are commonly used to solve trigonometric problems of varying degrees of complexity. The resolvers in this application are specially designed to work with a buffer, booster, or feedback amplifier and they are known as feedback or compensated resolvers (CQ or CY). The rotor of a compensated resolver is identical to that of a standard resolver; however, the stator has two additional sets of coils called the compensator or feedback winding. The compensator winding is laid in the same slots as the stator winding. Practically all the flux generated by the stator exciting current links all the turns of the compensator, so that the compensator output is essentially equal to the input voltage, and is naturally constant with rotor position. The time phase shift of the rotor output voltage of the compensator voltage is identical with the time phase shift of the rotor output voltage, since both voltages were induced by the stator flux field. Because of the resolver's construction, any change in the stator flux due to temperature or voltage immediately produces a change in the compensator voltage. The negative feedback through the amplifier restores the stator field to its original conditions. A resolver-amplifier pair is thus basically error-free, with respect to resolver chain performance, over a wide range of environmental conditions.

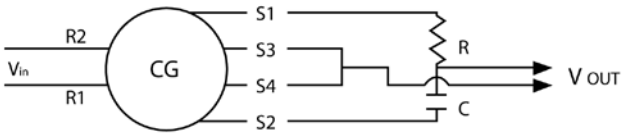


FIGURE 7

Resolvers also are used in time-phase-shifting applications. A typical connection for a resolver phase shifter is shown in Figure 7. The resistance R is chosen to match the reactance of the capacitor C at the operating frequency, and both R and X_C are substantially higher than the resolver output short circuit impedance. Under proper operating conditions, the phase shifter output is:

$$\mathbf{Vout = k\ Vin} \angle \theta$$

Note that the output voltage is constant with rotor position, but the time phase shift in electrical degrees between the output and the input is equal to the rotor position angle in mechanical degrees. Using a balanced R-C network and a stable frequency source, standard resolvers can be used as phase shifters with an accuracy of ±¼° or better.

Resolvers are also used in control systems exactly like those described for three-phase units. In such applications, the units are sometimes referred to as resolver transmitters, resolver differentials, and resolver control transformers. Their construction is identical to standard resolvers with the exception of the resolver differential, which should have four-wire input and four-wire output. Data transmission by resolvers is usually preferred over three-phase transmission, as resolvers are generally more accurate than their three-phase counterparts.

Linear Transformer

In many resolver circuits involving vector resolution, the input voltage to the resolver is taken from the output of a linear transformer (LT). The linear transformer consists of a one-phase, salient-pole rotor and a single-phase stator. Unlike all other synchros where the output voltage is proportional to the sine of the rotor position angle, the LT is constructed so that the output voltage is directly proportional to the angle itself. In equation form:

$$\mathbf{Vout = k}\ \theta \quad \mathbf{(-50° < \theta < 50°)}$$

The angular band over which the output equation remains valid is known as the excursion range. Beyond the excursion range, the plot of output voltage against rotor position tends toward a sinusoid. The LT acts as a circuit replacement for a potentiometer with the chief advantages of low starting friction and infinite resolution over the excursion range. Because of construction similarities, the LT also matches the performance of resolvers over environmental service conditions.

SYNCHRO PARAMETERS

Accuracy

Of all synchro parameters, accuracy is probably the most important. The synchro is meant to give unique information about the rotor position angle as a set of output voltages. Synchro error is thus defined as the electrical angle, as indicated by the output voltages, minus the rotor position angle. Calibration is the process of determining the error at specified angular intervals for the full 360° rotor travel. The calibration starts at a reference point called electrical zero (EZ) and defined as a rotor position angle of 0°. The electrical zero point is defined differently for each synchro type, but it always is a rotor position where a

specified output winding has minimum voltage induced in it with a specified input winding energized with rated voltage and frequency. During calibration, the units are held and precisely positioned in an Index Stand. The Index Stand provides a mechanical position that is accurate within ten (10) arc seconds. The calibration itself is in accordance with the proportional voltage methods of military specifications MIL-S-20708E and MIL-R-23417B.

Synchro accuracy is of necessity a function of the electrical balance of the windings comprising the input and output phases.

Total turns, pitch factors, distribution factors, insertion patterns, winding integrity must all be in accordance with design requirements if the synchro is to be calibrated within specification limits. Surpassing the electrical problems, however, are the mechanical ones. Accuracy is to a great extent dependent on mechanical perfection. To obtain proper accuracy, it is extremely important to control eccentricities of the air gap surfaces with respect to the mounting surfaces, roundness of the air gap surfaces, mechanical parallelism and perpendicularity, and the radial and axial position of the rotor inside the stator. Our long experience in recognizing and combating these problems insures you of accurate, repeatable synchros.

Component accuracy itself, however, is only one part of system accuracy. When units are cascaded in a synchro chain, unbalances in time phase shift, transformation ratio, and impedance may far outweigh inherent unit accuracy in determining system error. A resolver with a five minutes maximum error cannot exhibit that accuracy when working into unbalanced loads. Severe impedance mismatches may cause sufficient distortion of the voltage waveforms with subsequent loss of accuracy. Our Engineering Department stands ready to help you with recommendations for proper synchro usage in your applications.

Null Voltage

Theoretically, when a coil is exactly parallel to the direction of a flux field – such as at electrical zero – no flux lines link the turns of this coil and the voltage induced in it is exactly zero. At any minimum-coupling position, however, there is always some residual voltage. This voltage is called the null voltage.

The null is composed of a fundamental component, which is in time quadrature with the exciting voltage (the in-time phase component is always forced to zero), and odd harmonics. The fundamental component is due mainly to winding imperfections and magnetic circuit distortions; the harmonics, to non-sinusoidal distribution of the air gap flux.

Nulls are measured in accordance with the phase-sensitive voltmeter method of MIL-S-20708E at each synchro minimum-coupling point. Because of symmetry, each output winding has two null points which are 180° apart, for each input winding. A transmitter has six null points; a resolver, eight; and a differential, eighteen.

Low synchro nulls are essential to proper system performance. Currently, we specify that the maximum null voltage shall not exceed 0.1% of the applied voltage.

Other Electrical Parameters

The remaining electrical tests – transformation ratio, phase shift, DC resistance, input current and power, impedance - are performed in accordance with applicable industry and military specifications.

Mechanical Parameters

In addition to checking mounting dimensions, our Final Test checks each synchro for conformance to our shaft end play, shaft radial play, and starting friction requirements. Shaft end play is the total axial motion of the shaft when an eight-ounce reversing load is applied along the shaft axis. Shaft radial play is the total side-to-side motion of the shaft measured as close to the bearing as possible, when a four-ounce reversing load is applied radially to the shaft within ¼ inch of the bearing. Starting friction is the torque necessary to overcome the internal friction of the bearings and brushes and to commence shaft rotation.

Because of the important relationship between accuracy and shaft end and radial play, these parameters are controlled as rigidly as possible. If end and radial play are too loose, higher errors and non-repeatability of the calibration pattern result; if they are too tight, performance over environmental service conditions may suffer. Friction, except in receivers, is relatively unimportant. We currently specify four gram-centimeter maximum friction which has been found to be an optimum level for operation in both normal and extreme temperature ambients. On units where lower friction limits are a system requirement, however, we will work with our customers to establish these limits consistent with the end requirement and with good design practices.

BRUSHLESS SYNCHROS

For synchro applications where conventional commutation such as slip rings and brushes is either undesirable or unwanted, we has developed several varieties of brushless synchros, for both full rotation and limited rotation.

Electromagnetic Type

In the electromagnetic brushless synchro, energy is transferred from the rotor by means of a circular transformer mounted at the rear of the unit. There are no physical connections to the rotor so the life of the unit is limited solely by the life of the bearings. Tens of thousands of hours of operational life at high rotational speeds are easily achievable with this type of unit. The major disadvantage of the electromagnetic brushless synchro is that the dual magnetic structures (synchro and transformer) do not allow the duplication in this design of standard synchro parameters. In general, when compared with a standard unit, the brushless synchro will have higher power consumption, lower impedance angle, higher phase shift and lower unit torque gradient. This can be a problem if the intent is to replace a synchro in an existing system. In new applications, the variations in unit performance can be accommodated. Closer conformance to existing synchros can be achieved with additional unit length. In any case, multi-phase rotors require additional length.

Hairspring Type

Limited rotation units are made with spirally wound conductors used to pick off information from the rotor. These hairspring conductors allow a rotation of as much as ±165° from the electrical zero position. The units are normally supplied with a mechanical stop to prevent damage to the hairsprings due to excessive shaft rotation. The addition of the stop normally engenders extra length.

The advantage of a hairspring synchro over an electromagnetic brushless synchro is that any standard synchro can be manufactured in a hairspring design with no change in electrical parameters. If the application permits limited rotation, a hairspring unit can replace the conventional unit already in the system with no effect on system performance except for the benefits attendant on the elimination of sliding contacts. Properly designed hairsprings, such as ours, will perform millions of operations without failure.

Flex Lead Type

A flex lead brushless synchro is designed with thin flexible lead wires to transfer energy from/to the rotor. These units have all the advantages of the hairspring type and are used in applications where short unit length and low friction are required. Rotation is usually limited to ±90°.

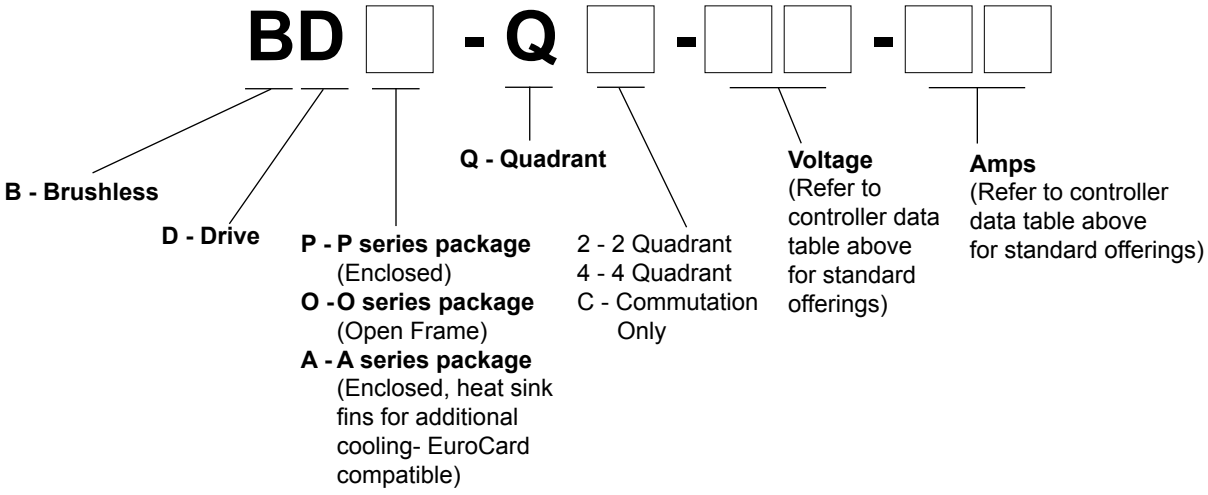
To discuss the possibility of the use of a type of brushless unit in your application, contact our Engineering Department.

SELECTION GUIDE AND AVAILABLE MODELS

CONTROLLERS FOR MOOG COMPONENTS GROUP BN SERIES BRUSHLESS MOTORS						
Part Number	Mode of Operation	Max Power (watts)	Input Voltage (volts)	Max Motor Current (amps)	Size - L x W x H (mm), (inches)	Weight (gm), (oz)
BDO-Q2-40-05-01	2 Quadrant - Velocity	175	12-40	5	(90x30x50), (3.54x1.81x1.97)	(124), (4.37)
BDP-Q2-50-10	2 Quadrant - Velocity	475	20-50	10	(94x55x39), (3.70x2.17x1.54)	(142), (5.00)
BDO-Q2-20-18	2 Quadrant - Velocity	325	12-28	18	(170x90x44), (6.69x3.54x1.73)	(366), (12.91)
BDO-Q2-50-18	2 Quadrant - Velocity	850	20-50	18	(170x90x44), (6.69x3.54x1.73)	(390), (13.76)
BDO-Q2-50-40	2 Quadrant - Velocity	1900	20-50	40	(170x90x44), (6.69x3.54x1.73)	(390), (13.76)

SPECIFICATION AND NUMBERING SYSTEM

Part Numbering System Guide



Silencer® Series
Brushless Controllers

BDO-Q2-40-05-01
2-quadrant speed controller for brushless motors

Silencer® brushless controllers are available in a variety of voltage and current ratings. Their compact packaging minimizes space demands. All controllers have generous terminal blocks to facilitate ease of wiring.

Silencer drives are compatible with Silencer Series Brushless DC Motors. Silencer motors are available in sizes 12, 17, 23, 28, 34 and 42 in standard frames with 1.2 to 4.15 inch diameters. They offer speeds up to 20,000 rpm and continuous torques ranging from 1.2 to 519 oz-in. Standard options include gearheads, resolvers and encoders.

If you have questions about Silencer drives or would like to speak to an applications engineer, please call us or visit our web site.

TYPICAL APPLICATIONS

Control of Brushless Motors for:

- Medical pumps and blowers
- Air-handling equipment
- Packaging and printing products
- Semiconductor handling and insertion machines
- Industrial automation equipment
- Office automation and equipment

FEATURES

- 2-quadrant speed controllers for brushless motors
- Feedback using Hall effect sensors
- Motor speed is set by either an internal or external potentiometer
- Motor rotation direction can be present by the direction control input; the controller output stage can be activated and deactivated by the disable control input and brake input
- Maximum constant current can be adjusted via an on-board potentiometer
- Internal thermal cutoff prevents heat overload
- Very high efficiency is achieved by using POWER-MOS-FET technology in the controller output stage
- Efficient PWM speed control
- Operating temperatures from -10 to 45°C and storage temperatures from -40 to 85°C

BENEFITS

- Compact packaging minimizes space demands
- Matched drives and motors from a single supplier
- Complete system testing provides high reliability
- Terminal block connections for ease of wiring
- Multiple methods of speed control
  - Input voltage
  - Internal potentiometer
  - External potentiometer
  - External voltage reference

BDO-Q2-40-05-01 SPECIFICATIONS

Electrical Data	BDO-Q2-40-05-01
Operating voltage -+input and Gnd Residual voltage < 5 %	12 - 40 VDC
Maximum constant current (adjustable) • Without additional cooling surfaces (free convection) • With additional convection (< 1,8 K / W)	 0.5 - 3.5 A 0.5 - 5.0 A
Peak current limitation (cycle by cycle)	10.0 A
Supply voltage for Hall sensors	6 V / 20 mA

Inputs

- Direction of rotation – (REV) open collector / TTL / CMOS / switch
- Brake - (BRAKE) open collector / TTI / CMOS / switch
- Disable output stage – (DIS) open collector / TTL / CMOS / switch

Temperature Range

Storage -40 to +85°C
Operation -10 to +45°C

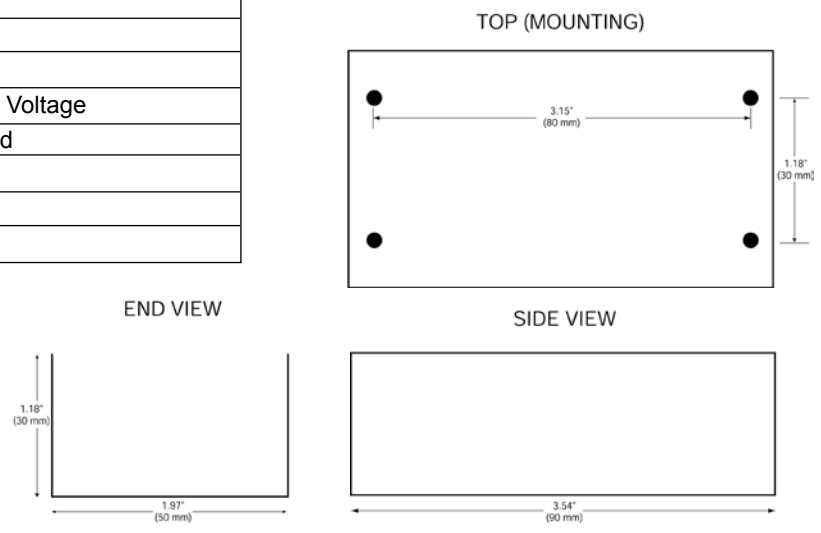
Moisture Range

20 to 80% non-condensed

Mechanical Data	BDO-Q2-40-05-01
Weight	4.37 oz 124 gm
Dimensions - (L x W x H) - 3.54 x 1.97 x 1.18 in (90 x 50 x 30 mm)	
Mounting - 4 x M4 with a distance between holes of 3.15 x 1.18 in (80 x 30 mm)	

Termination Table		
Terminal #	*Nomenclature*	*Description*
1	REV	Reverse Motor Direction
2	GND	Signal Ground
3	SV	External Speed Input
4	+6V	Reference Voltage for Control Inputs
5	GND	Supply Voltage - Ground
6	+INPUT	Supply Voltage - Positive
7	DIS	Controller Disable Input
8	BRAKE	Controller Brake Input
9	S1	Hall Switch #1
10	S2	Hall Switch #2
11	S3	Hall Switch #3
12	VCC	Hall SwitchSupply Voltage
13	GND	Hall Switch Ground
14	ØB	Motor Phase B
15	ØC	Motor Phase C
16	ØA	Motor Phase A

Outline Drawing - Three views

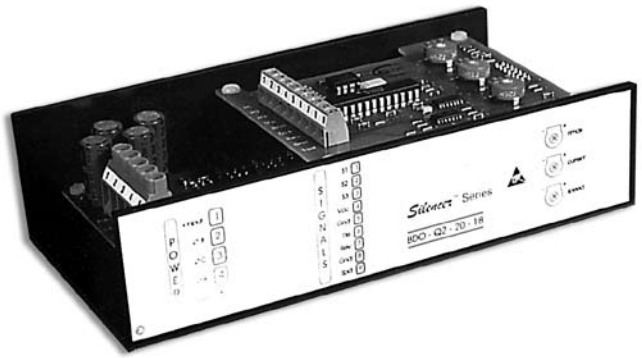


Dimensions are in inches

Silencer® Series
Brushless Controllers

BDO-Q2-20-18, BDO-Q2-50-18, BDO-Q2-50-40

2-quadrant speed controllers for brushless motors



Silencer® brushless controllers are available in a variety of voltage and current ratings. Their compact packaging minimizes space demands. All controllers have generous terminal blocks to facilitate ease of wiring.

Silencer drives are compatible with Silencer Series Brushless DC Motors. Silencer motors are available in sizes 12, 17, 23, 28, 34 and 42 in standard frames with 1.2 to 4.15 inch diameters. They offer speeds up to 20,000 rpm and continuous torques ranging from 1.2 to 519 oz-in. Standard options include gearheads, resolvers and encoders.

If you have questions about Silencer drives or would like to speak to an applications engineer, please call us or visit our web site.

TYPICAL APPLICATIONS

Control of Brushless Motors for:

- Medical pumps and blowers
- Air-handling equipment
- Packaging and printing products
- Semiconductor handling and insertion machines
- Industrial automation equipment
- Office automation and equipment

FEATURES

- 2-quadrant speed controllers for brushless motors
- Feedback using Hall effect sensors
- Motor speed is set by either an internal or external potentiometer
- Motor rotation direction can be present by the direction control input; the controller output stage can be activated and deactivated by the disable control input
- Maximum constant current can be adjusted via an on-board potentiometer
- Internal thermal cutoff prevents heat overload
- Very high efficiency is achieved by using POWER-MOS-FET technology in the controller output stage
- Efficient PWM speed control
- Operating temperatures from -10 to 45°C and storage temperatures from -40 to 85°C

BENEFITS

- Compact packaging minimizes space demands
- Matched drives and motors from a single supplier
- Complete system testing provides high reliability
- Terminal block connections for ease of wiring
- Multiple methods of speed control
  - Input voltage
  - Internal potentiometer
  - External potentiometer
  - External voltage reference

BDO-Q2-20-18, BDO-Q2-50-18 and BDO-Q2-50-40 SPECIFICATIONS

Electrical Data	BDO-Q2-20-18	BDO-Q2-50-18	BDO-Q2-50-40
Operating voltage -+input and Gnd Residual voltage < 5 %	12-28 VDC	20-50 VDC	20-50 VDC
Maximum constant current (adjustable)	18 A	18 A	40 A

Inputs

- Direction of rotation – (REV) open collector / TTL / CMOS / switch
- Disable output stage – (DIS) open collector / TTL / CMOS / switch

Temperature Range

Storage -40 to +85°C
Operation -10 to +45°C

Moisture Range

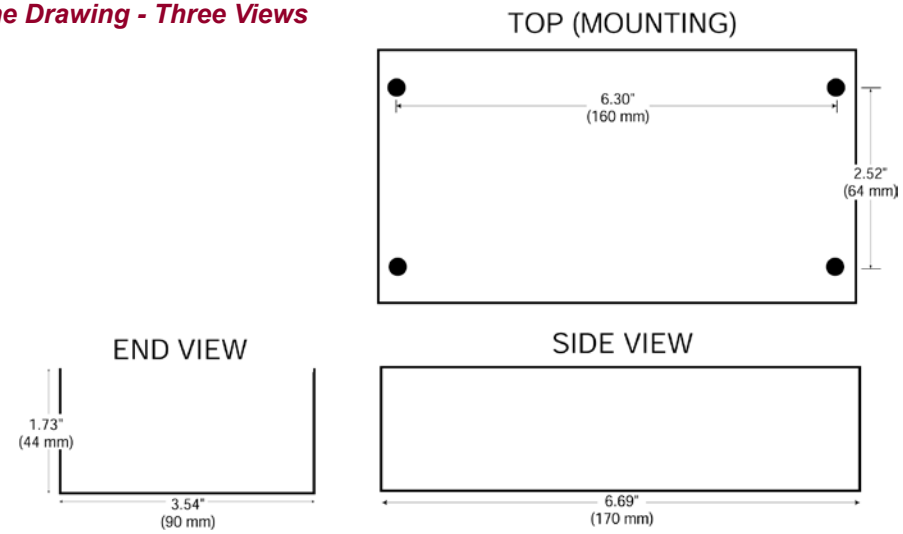
20 to 80% non-condensed

Mechanical Data	BDO-Q2-20-18	BDO-Q2-50-18	BDO-Q2-50-40
Weight	12.91 oz 366 gm	12.91 oz 366 gm	13.76 oz 390 gm
Dimensions - (L x W x H) - 6.69 x 3.54 x 1.73 in (170 x 90 x 44 mm)			
Mounting - 4 x M4 with a distance between holes of 6.30 x 2.52 in (160 x 64 mm)			
Diameter - 4.5 mm - (4) places - M4 screw			

Termination Table

Signal			**Power**		
Terminal #	*Nomenclature*	*Description*	*Terminal #*	*Nomenclature*	*Description*
1	S1	Hall Switch #1	1	Positive Input	Positive Supply Voltage
2	S2	Hall Switch #2	2	Phase B	Motor Phase B
3	S3	Hall Switch #3	3	Phase C	Motor Phase C
4	VCC	Supply for Hall Switches	4	Phase A	Motor Phase A
5	Gnd	Gnd for Hall Switches	5	Gnd	Gnd for Supply Voltage
6	DIS	Control Input - Disable			
7	REV	Control Input - Reverse			
8	GND	Gnd for Dis and Rev			
9	SPD	Set value input for speed			

Outline Drawing - Three Views



Dimensions are in inches

Silencer® Series Brushless Controllers

TYPICAL APPLICATIONS

Control of Brushless Motors for:

- Medical pumps and blowers
- Air-handling equipment
- Packaging and printing products
- Semiconductor handling and insertion machines
- Industrial automation equipment
- Office automation and equipment

FEATURES

- 2-quadrant speed controllers for electronically commutating three-phase brushless motors with Hall sensors, which are arranged offset at 120 electrical degrees
- Speed of the motor is preset by means of either an internal or an external potentiometer
- Maximum constant current can be adjusted via an on-board potentiometer
- Direction of rotation of the motor can be preset by means of the direction control input. The controller output stage can be activated and deactivated by means of the disable control input
- Controller is safeguarded against heat overload by means of an internal thermal cutoff
- Controller output stage has been constructed using POWER-MOSFET technology, resulting in very high efficiency

BENEFITS

- Compact packaging minimizes space demands
- Matched drives and motors from a single supplier
- Complete system testing provides high reliability
- Terminal block connections for ease of wiring
- Multiple methods of speed control
  - Input voltage
  - Internal potentiometer
  - External potentiometer
  - External voltage reference

BDP-Q2-50-10

2-quadrant speed controller for brushless motors

Silencer® brushless controllers are available in a variety of voltage and current ratings. Their compact packaging minimizes space demands. All controllers have generous terminal blocks to facilitate ease of wiring.

Silencer drives are compatible with Silencer Series Brushless DC Motors. Silencer motors are available in sizes 12, 17, 23, 28, 34 and 42 in standard frames with 1.2 to 4.15 inch diameters. They offer speeds up to 20,000 rpm and continuous torques ranging from 1.2 to 519 oz-in. Standard options include gearheads, resolvers and encoders.

If you have questions about Silencer drives or would like to speak to an applications engineer, please call us or visit our web site.

BDP-Q2-50-10SPECIFICATIONS

Electrical Data	BDP-Q2-50-10
Operating voltage -+input and Gnd Residual voltage < 5%	20 - 50 VDC
Maximum constant current (adjustable)*	10A
Supply voltage for Hall switches	6 V / 20 mA

**At higher input voltages, additional heat-sinking may be required for maximum current.*

Inputs

- Direction of rotation – (REV) open collector / TTL / CMOS / switch
- Disable output stage – (DIS) open collector / TTL / CMOS / switch

Temperature Range

Storage -40 to +85° C
Operation -10 to +45° C

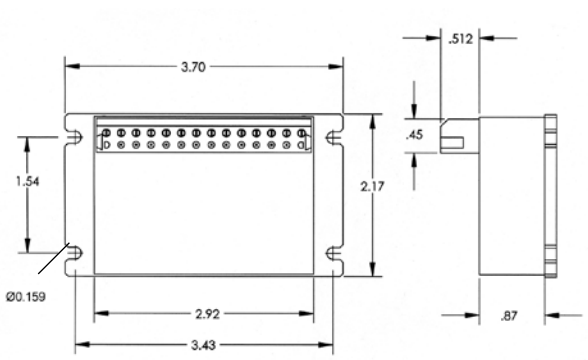
Moisture Range

20 to 80% non-condensed

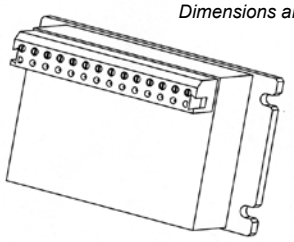
Mechanical Data	BDP-Q2-50-10
Weight	4.93 oz
	140 gm
Dimensions - (L x W x H) - 2.17 x 3.70 x 1.54 in (55 x 94 x 39 mm)	
Mounting - 4 x M3 with a distance between holes of 1.54 x 3.43 in (39 x 87 mm)	
Drill Diameter - 4.0 mm - (4) places	

Termination Table		
Terminal #	***Nomenclature***	***Description***
1	GND	Gnd for Supply Voltage
2	Positive Input	Positive Supply Voltage
3	Phase A	Motor Phase A
4	Phase C	Motor Phase C
5	Phase B	Motor Phase B
6	S3	Hall Switch #3
7	S2	Hall Switch #2
8	S1	Hall Switch #1
9	VCC	Supply for Hall Switches
10	GND	Gnd for Hall Switches
11	DIS	Control Input - Disable
12	REV	Control Input - Reverse
13	GND	Gnd for Dis and Rev
14	SPD	Set value input for speed

Outline Drawing - Three Views



Dimensions are in inches



Gearheads and Encoders

Low Cost Precision Planetary Gearheads

TYPICAL APPLICATIONS

- Conveyor systems
- Medical pumps
- Packaging equipment
- Machine tools
- Factory automation
- Any application requiring:
  - Speed reduction
  - Torque multiplication

FEATURES

- Fits C13 brush-type motors
- Fits BN12 brushless 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

BENEFITS

- Coaxial arrangement of input and output
- Compact design
- High efficiency
- Low moments-of-inertia
- Can be installed in any attitude
- Suitable for continuous, reversing and intermittent operation
- Low sensitivity to impact load
- Large range of ratios available

32 mm (1.26 inch) Diameter

Quiet Precision Gearheads

Moog Components Group 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, these gearmotors will meet the requirements of a vast number of applications. Life-time lubrication ensures long life and maintenance-free operation.

Our engineering department is available for consultation to help you tailor a gearmotor for your specific application.

32 MM SPECIFICATIONS

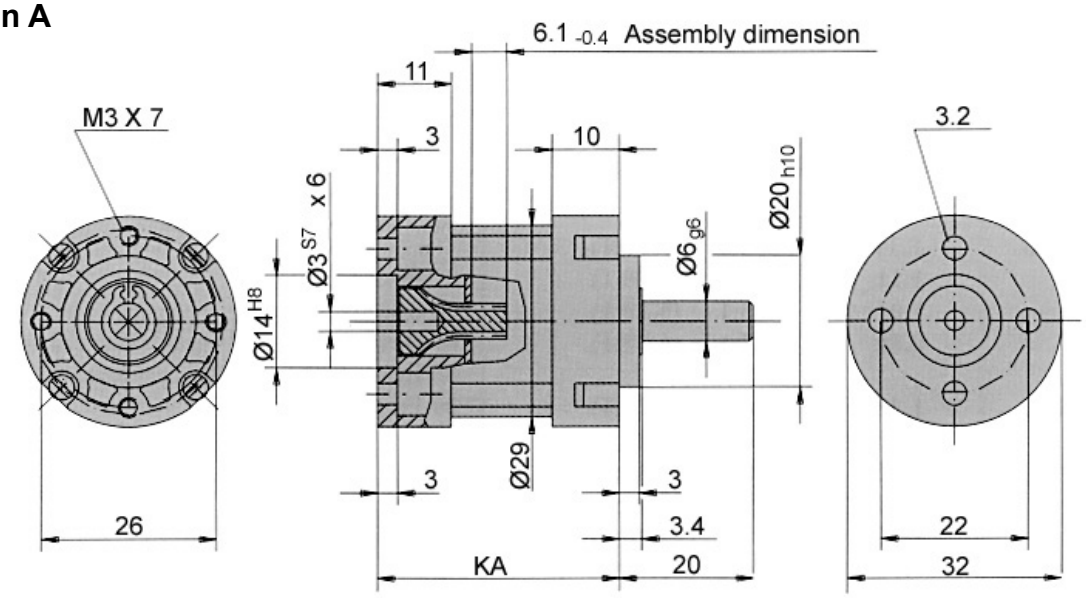
Available Ratios	# of Stages	Output Torque	Shaft Inertia (gcm^2)
4:1 (3.70:1)	One	0.40 Nm (56.6 oz - in)	1.35
4:1 (4.28:1)	One	0.40 Nm (56.6 oz - in)	1.11
5:1 (5.18:1)	One	0.40 Nm (56.6 oz - in)	1.01
7:1 (6.75:1)	One	0.40 Nm (56.6 oz - in)	0.89
14:1 (13.73:1)	Two	1.0 Nm (141.6 oz - in)	1.38
16:1 (15.88:1)	Two	1.0 Nm (141.6 oz - in)	1.13
18:1 (18.36:1)	Two	1.0 Nm (141.6 oz - in)	1.12
19:1 (19.20:1)	Two	1.0 Nm (141.6 oz - in)	1.03
22:1 (22.20:1)	Two	1.0 Nm (141.6 oz - in)	1.02
25:1 (25.01:1)	Two	1.0 Nm (141.6 oz - in)	0.90
27:1 (26.85:1)	Two	1.0 Nm (141.6 oz - in)	1.01
29:1 (28.93:1)	Two	1.0 Nm (141.6 oz - in)	0.89
35:1 (34.97:1)	Two	1.0 Nm (141.6 oz - in)	0.89
46:1 (45.56:1)	Two	1.0 Nm (141.6 oz - in)	0.89
51:1 (50.89:1)	Three	2.0 Nm (283.2 oz - in)	1.38
59:1 (58.85:1)	Three	2.0 Nm (283.2 oz - in)	1.13
68:1 (68.06:1)	Three	2.0 Nm (283.2 oz - in)	1.12
71:1 (71.16:1)	Three	2.0 Nm (283.2 oz - in)	1.03
79:1 (78.71:1)	Three	2.0 Nm (283.2 oz - in)	1.12
93:1 (92.70:1)	Three	2.0 Nm (283.2 oz - in)	0.90
95:1 (95.17:1)	Three	2.0 Nm (283.2 oz - in)	1.02
100:1 (99.50:1)	Three	2.0 Nm (283.2 oz - in)	1.01
107:1 (107.20:1)	Three	2.0 Nm (283.2 oz - in)	0.89
115:1 (115.07:1)	Three	2.0 Nm (283.2 oz - in)	1.01
124:1 (123.97:1)	Three	2.0 Nm (283.2 oz - in)	0.89
130:1 (129.62:1)	Three	2.0 Nm (283.2 oz - in)	0.89
139:1 (139.13:1)	Three	2.0 Nm (283.2 oz - in)	1.01
150:1 (149.90:1)	Three	2.0 Nm (283.2 oz - in)	0.89
169:1 (168.84:1)	Three	2.0 Nm (283.2 oz - in)	0.89
181:1 (181.24:1)	Three	2.0 Nm (283.2 oz - in)	0.89
195:1 (195.26:1)	Three	2.0 Nm (283.2 oz - in)	0.89
236:1 (236.09:1)	Three	2.0 Nm (283.2 oz - in)	0.89
308:1 (307.54:1)	Three	2.0 Nm (283.2 oz - in)	0.89

32 mm Low Cost Technical Data

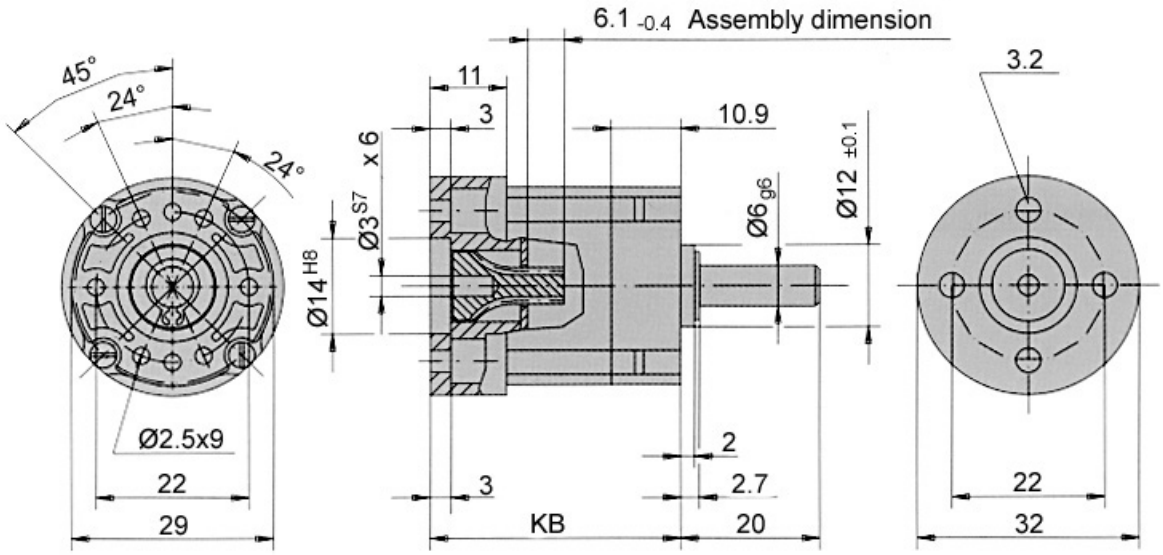
Parameter	Units	1-Stage	2-Stage	3-Stage
Max Input Speed	rpm	5000	5000	5000
Efficiency	%	75	70	65
Approx. Backlash(no-load, input locked)	DMS°	2.5	3.0	3.5
Sintered Bearing	-	-	-	-
Radial Load	N	15	30	45
Axial Load	N	5	10	15
Weight	g	100	115	130
Max Permitted Fitting Pressure	N	150	150	150
Dimension (diameter x length)	mm	32 x 56	32 x 65.5	32 x 84.5
Ball Bearing	-	-	-	-
Radial Load	N	40	70	100
Axial Load	N	10	20	30
Weight	g	120	135	150
Max Permitted Fitting Pressure	N	120	120	120
Dimension (diameter x length)	mm	32 x 52	32 x 61.5	32 x 80.5
Lubrication	Grease (life-time lubrication)			
Installation Attitude	Any			
Operating Temperature	-15 to +65° C			
Direction of Rotation	Same for input and output shaft			

Package Dimensions

Version A



Version B



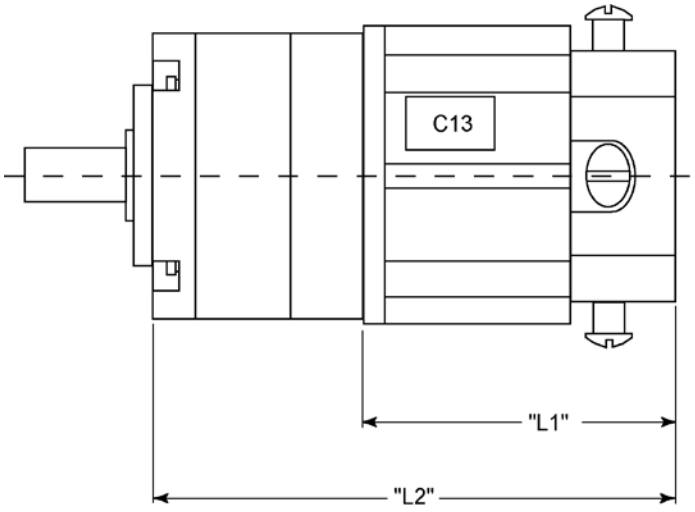
Gear Unit Length		1-Stage	2-Stage	3-Stage
KA	Bearing flange of plastic, sintered bearing on output	36	45.5	55
KA	Bearing flange of die-cast zinc, ball bearing on output	32	41.5	51

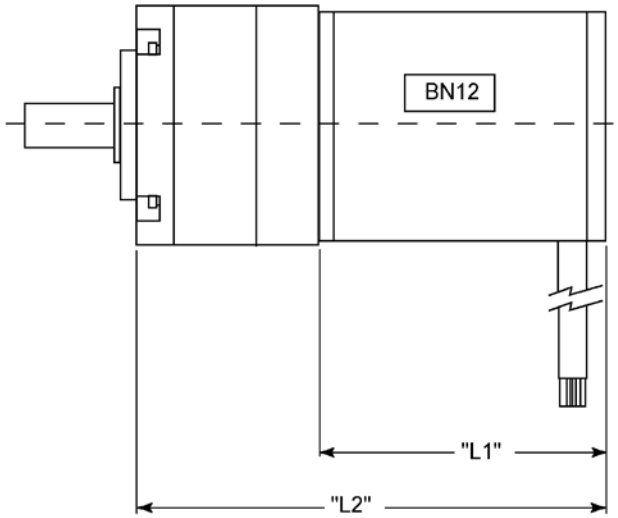
Gear Unit Length		1-Stage	2-Stage	3-Stage
KB	Bearing flange of plastic, sintered bearing on output	37	46.5	56

Preferred series Version A. We reserve the right to make technical changes.

Note: All dimension on this page are in millimeters.

32 mm Dimensional Drawings





*Motor + Gearhead Dimensions**

Sintered Bearing Version	L1 Max	L2 Max (1-Stage)	L2 Max (2-Stage)	L2 Max (3-Stage)
C13-L19	1.90 in (48.3 mm)	3.317 in (84.3 mm)	3.691 in (93.8 mm)	4.065 in (103.3 mm)
C13-L25	2.45 in (62.2 mm)	3.867 in 98.2 mm)	4.241 in (107.7 mm)	4.615 in (117.2 mm)
C13-L28	2.78 in (70.6 mm)	4.197 in (106.6 mm)	4.571 in (116.1 mm)	4.945 in (125.6 mm)
BN12-15	1.50 in (38.1 mm)	3.350 in (85.1 mm)	3.724 in (94.6 mm)	4.098 in (104.1 mm
BN12-20	2.00 in (50.8 mm)	3.850 in (97.8 mm)	4.224 in (107.3 mm)	4.598 in (116.8 mm)
BN12-25	2.50 in (63.5 mm)	4.350 in (110.5 mm)	4.724 in (120 mm)	5.098 in (129.5 mm)
BN12-30	3.00 in (76.2 mm)	4.850 in (123.2 mm)	5.224 in (132.7 mm)	5.598 in (142.2 mm)
Ball Bearing Version	**L1 Max**	**L2 Max (1-Stage)**	**L2 Max (2-Stage)**	**L2 Max (3-Stage)**
C13-L19	1.90 in (48.3 mm)	3.160 in (80.3 mm)	3.534 in (89.8 mm)	3.908 in (99.3 mm)
C13-L25	2.45 in (62.2 mm)	3.710 in (94.2 mm)	4.084 in (103.7 mm)	4.458 in (113.2 mm)
C13-L28	2.78 in (70.6 mm)	4.040 in (102.6 mm)	4.414 in (112.1 mm)	4.788 in (121.6 mm)
BN12-15	1.50 in (38.1 mm)	3.193 in (81.1 mm)	3.567 in (90.6 mm)	3.941 in (100.1 mm)
BN12-20	2.00 in (50.8 mm)	3.693 in (93.8 mm)	4.067 in (103.3 mm)	4.441 in (112.8 mm)
BN12-25	2.50 in (63.5 mm)	4.193 in (106.5 mm)	4.567 in (116 mm)	4.941 in (125.5 mm)
BN12-30	3.00 in (76.2 mm)	4.693 in (119.2 mm)	5.067 in (128.7 mm)	5.441 in (138.2 mm)

**All dimensions are reference dimensions*

Ordering Information - Examples

32-SB-46:1 – 32 mm gearhead, 46:1 ratio, sintered bearing
32-BB-308:1 – 32 mm gearhead, 308:1 ratio, ball bearing

Precision Planetary Gearheads

TYPICAL APPLICATIONS

- Conveyor systems
- Medical pumps
- Packaging equipment
- Machine tools
- Factory automation
- Any application requiring:
  - Speed reduction
  - Torque multiplication

FEATURES

- Fits our brush and brushless 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

BENEFITS

- Coaxial arrangement of input and output
- Compact design
- High efficiency
- Low moments-of-inertia
- Can be installed in any attitude
- Suitable for continuous, reversing and intermittent operation
- Low sensitivity to impact load
- Large range of ratios available

32, 52, 62, 81 and 120 mm (1.26 - 4.72 inch) Diameter

Quiet Precision Gearheads

Moog Components Group 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, these gearmotors will meet the requirements of a vast number of applications. Life-time lubrication ensures long life and maintenance-free operation.

Our engineering department is available for consultation to help you tailor a gearmotor for your specific application.

32 MM (1.26 INCH) DIAMETER SPECIFICATIONS

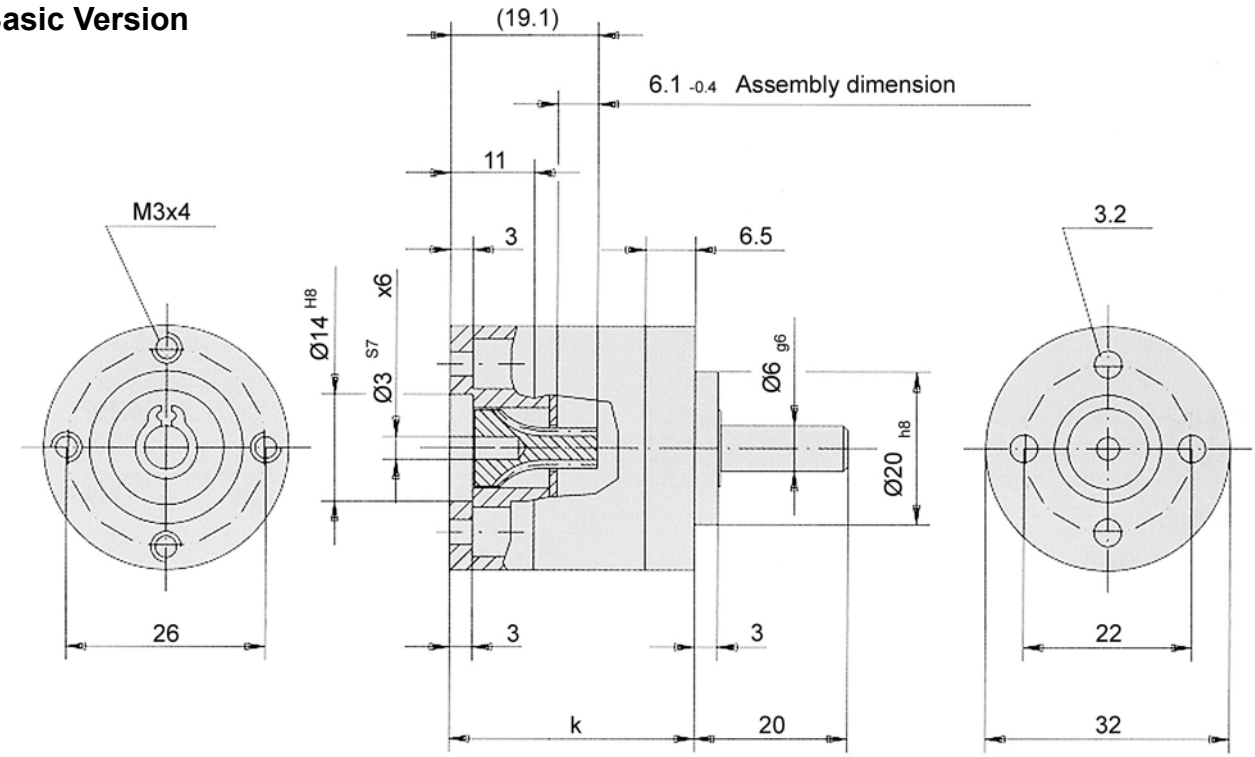
Available Ratios	# of Stages	Output Torque	Shaft Inertia (gcm^2)
4:1 (3.70:1)	One	0.75 Nm (106.2 oz - in)	1.54
4:1 (4.28:1)	One	0.75 Nm (106.2 oz - in)	1.29
5:1 (5.18:1)	One	0.75 Nm (106.2 oz - in)	1.14
7:1 (6.75:1)	One	0.75 Nm (106.2 oz - in)	0.89
14:1 (13.73:1)	Two	2.5 Nm (318.6 oz - in)	1.49
16:1 (15.88:1)	Two	2.5 Nm (318.6 oz - in)	1.25
18:1 (18.36:1)	Two	2.5 Nm (318.6 oz - in)	1.26
19:1 (19.20:1)	Two	2.5 Nm (318.6 oz - in)	1.12
22:1 (22.20:1)	Two	2.5 Nm (318.6 oz - in)	1.12
25:1 (25.01:1)	Two	2.5 Nm (318.6 oz - in)	0.96
27:1 (26.85:1)	Two	2.5 Nm (318.6 oz - in)	1.13
29:1 (28.93:1)	Two	2.5 Nm (318.6 oz - in)	0.96
35:1 (34.97:1)	Two	2.5 Nm (318.6 oz - in)	0.97
46:1 (45.56:1)	Two	2.5 Nm (318.6 oz - in)	0.98
51:1 (50.89:1)	Three	4.5 Nm (637.3 oz - in)	1.49
59:1 (58.85:1)	Three	4.5 Nm (637.3 oz - in)	1.25
68:1 (68.06:1)	Three	4.5 Nm (637.3 oz - in)	1.26
71:1 (71.16:1)	Three	4.5 Nm (637.3 oz - in)	1.12
79:1 (78.71:1)	Three	4.5 Nm (637.3 oz - in)	1.26
93:1 (92.70:1)	Three	4.5 Nm (637.3 oz - in)	0.96
95:1 (95.17:1)	Three	4.5 Nm (637.3 oz - in)	1.12
100:1 (99.50:1)	Three	4.5 Nm (637.3 oz - in)	1.13
107:1 (107.20:1)	Three	4.5 Nm (637.3 oz - in)	0.96
115:1 (115.07:1)	Three	4.5 Nm (637.3 oz - in)	1.13
124:1 (123.97:1)	Three	4.5 Nm (637.3 oz - in)	0.96
130:1 (129.62:1)	Three	4.5 Nm (637.3 oz - in)	0.97
139:1 (139.13:1)	Three	4.5 Nm (637.3 oz - in)	1.13
150:1 (149.90:1)	Three	4.5 Nm (637.3 oz - in)	0.97
169:1 (168.84:1)	Three	4.5 Nm (637.3 oz - in)	0.96
181:1 (181.24:1)	Three	4.5 Nm (637.3 oz - in)	0.97
195:1 (195.26:1)	Three	4.5 Nm (637.3 oz - in)	0.96
236:1 (236.09:1)	Three	4.5 Nm (637.3 oz - in)	0.96
308:1 (307.54:1)	Three	4.5 Nm (637.3 oz - in)	0.96

32 mm Technical Data

Parameter	Units	1-Stage	2-Stage	3-Stage
Max Input Speed	rpm	5000	5000	5000
Efficiency	%	80	75	70
Approx. Backlash (no-load, input locked)	DMS°	1.5	2.0	2.5
Radial Load	N	40	70	100
Axial Load	N	10	20	30
Max Permitted Fitting Pressure	N	120	120	120
Weight	g	160	210	260
Dimension (diameter x length)	mm	32 x 52	32 x 61.5	32 x 71
Lubrication	Grease (life-time lubrication)			
Installation Attitude	Any			
Operating Temperature	-15 to +80° C			
Direction of Rotation	Same for input and output shaft			

Package Dimensions

Basic Version

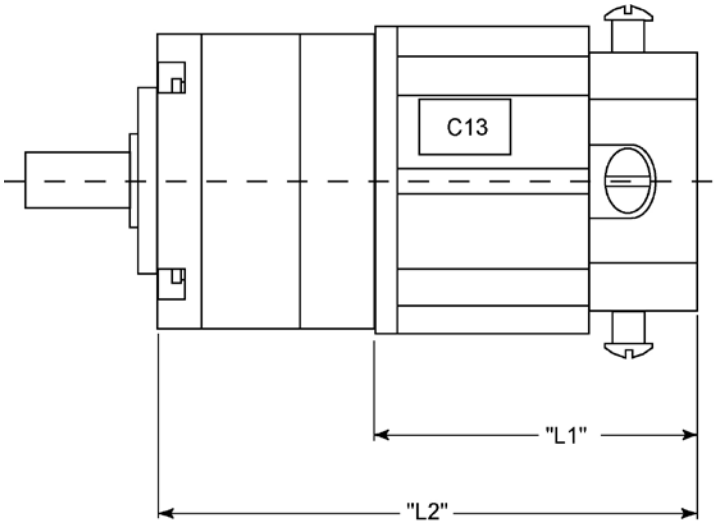


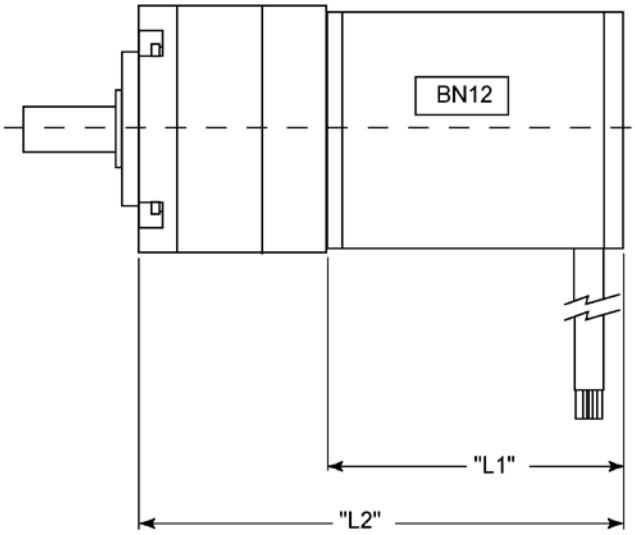
Gear Unit Length			1-Stage	2-Stage	3-Stage	4-Stage
K			32	41.5	51	60.5

We reserve the right to make technical changes.

Note: All dimension on this page are in millimeters.

32 mm Dimensional Drawings





*Motor + Gearhead Dimensions**

	L1 Max	L2 Max (1-Stage)	L2 Max (2-Stage)	L2 Max (3-Stage)
C13-L19	1.90 in (48.3 mm)	3.160 in (80.3 mm)	3.534 in (89.8 mm)	3.908 in (99.3 mm)
C13-L25	2.45 in (62.2 mm)	3.710 in (94.2 mm)	4.084 in (103.7 mm)	4.458 in (113.2 mm)
C13-L28	2.78 in (70.6 mm)	4.040 in (102.6 mm)	4.414 in (112.1 mm)	4.788 in (121.6 mm)
BN12-15	1.50 in (38.1 mm)	3.193 in (81.1 mm)	3.567 in (90.6 mm)	3.941 in (100.1 mm)
BN12-20	2.00 in (50.8 mm)	3.693 in (93.8 mm)	4.067 in (103.3 mm)	4.441 in (112.8 mm)
BN12-25	2.50 in (63.5 mm)	4.193 in (106.5 mm)	4.567 in (116 mm)	4.941 in (125.5 mm)
BN12-30	3.00 in (76.2 mm)	4.693 in (119.2 mm)	5.067 in (128.7 mm)	5.441 in (138.2 mm)

**All dimensions are reference dimensions*

Ordering Information - Examples

32-46:1 – 32 mm gearhead, 46:1 ratio
32-308:1 – 32 mm gearhead, 308:1 ratio

52 MM (2.05INCH) DIAMETER SPECIFICATIONS

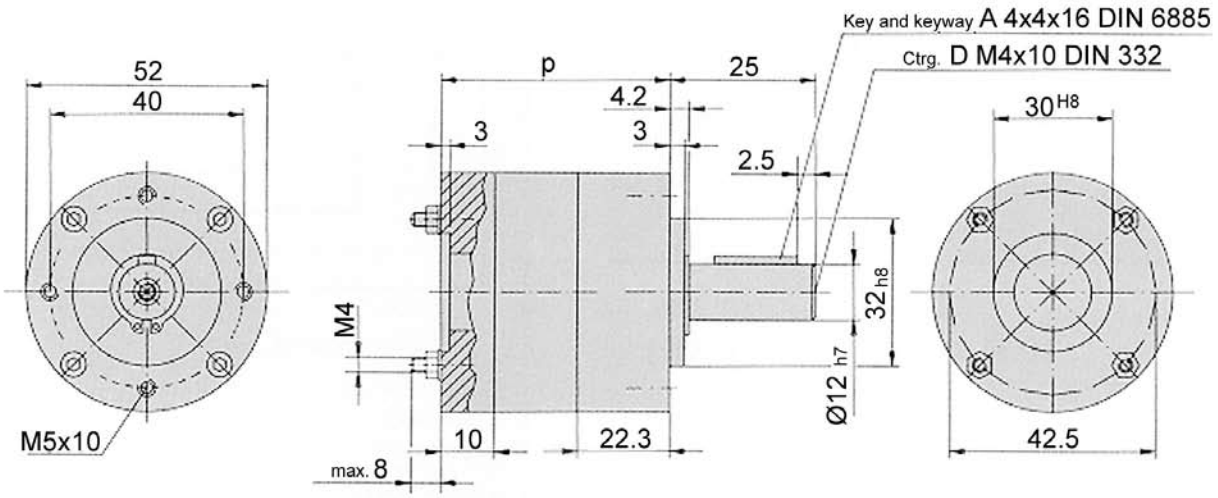
Available Ratios	# of Stages	Output Torque	Shaft Inertia (gcm^2)
4:1 (3.70:1)	One	4.0 Nm (2.95 ft - lbs)	16.57
7:1 (6.75:1)	One	4.0 Nm (2.95 ft - lbs)	9.52
14:1 (13.73:1)	Two	12.0 Nm (8.85 ft - lbs)	16.49
25:1 (25.01:1)	Two	12.0 Nm (8.85 ft - lbs)	9.33
46:1 (45.56:1)	Two	12.0 Nm (8.85 ft - lbs)	9.21
51:1 (50.89:1)	Three	25.0 Nm (18.4 ft - lbs)	16.49
93:1 (92.70:1)	Three	25.0 Nm (18.4 ft - lbs)	9.32
169:1 (168.84:1)	Three	25.0 Nm (18.4 ft - lbs)	9.21
308:1 (307.54:1)	Three	25.0 Nm (18.4 ft - lbs)	9.21

52 mm Technical Data

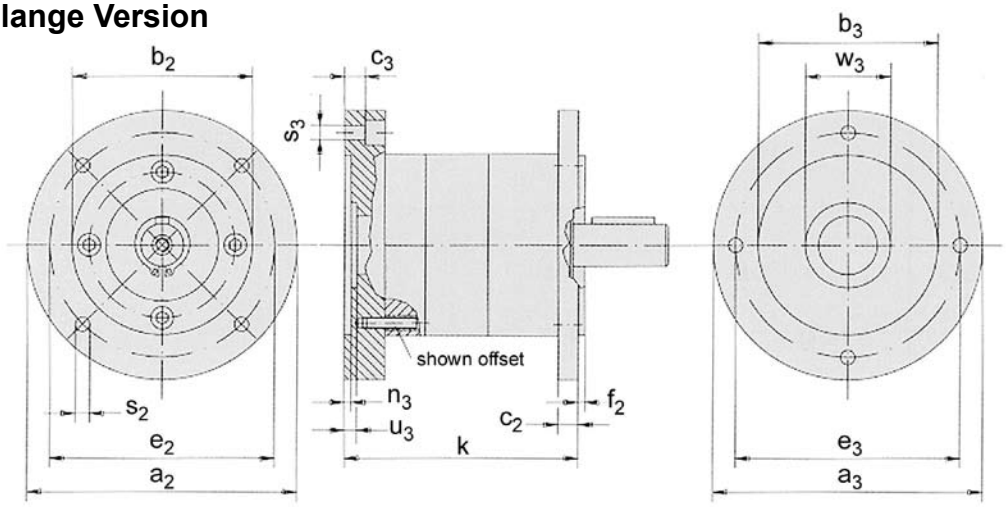
Parameter	Units	1-Stage	2-Stage	3-Stage
Max Input Speed	rpm	5000	5000	5000
Efficiency	%	80	75	70
Approx. Backlash(no-load, input locked)	Minutes	45	45	45
Radial Load	N	200	320	450
Axial Load	N	60	100	150
Max Permitted Fitting Pressure	N	500	500	500
Weight	kg	0.7	0.9	1.1
Dimension (diameter x length)	mm	52 x 81	52 x 95	52 x 109
Lubrication	Grease (life-time lubrication)			
Installation Attitude	Any			
Operating Temperature	-15 to +80° C			
Direction of Rotation	Same for input and output shaft			

Package Dimensions

Basic Version



Standard Flange Version



Gear Unit Length				1-Stage	2-Stage	3-Stage
P				56	70	84
K				83	97	111

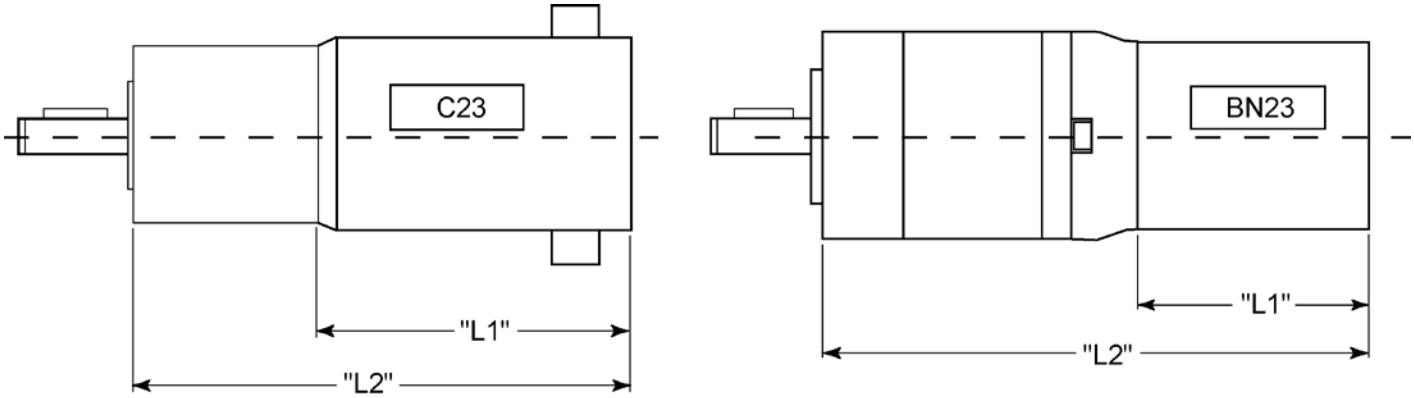
DIM of Motor Mounting Flange		a_3	b_3	u_3	c_3	e_3	n_3	w_3	s_3
Motor size 56	C 80	80	50 H7	38 H7	10.2	65	3	5.5	5.5
(B14, B3/B14)	C 105	105	70 H7	-	10.2	85	3	-	6.5

DIM of Gear Unit Output Flan	a_2	b_2	c_2	e_2	f_2	s_2
C 80	80	50 j7	9	65	2.5	5.5
C 90	90	60 j7	9	75	2.5	5.5
C 105	105	70 j7	9	85	2.5	6.5
C 120	120	80 j7	9	100	3.0	6.5

We reserve the right to make technical changes.

Note: All dimension on this page are in millimeters.

52 mm Dimensional Drawings



*Motor + Gearhead Dimensions**

Unit Type	L1 Max	L2 Max (1-Stage)	L2 Max (2-Stage)	L2 Max (3-Stage)
C23-L33	3.30 in (83.8 mm)	5.986 in (152 mm)	6.538 in (166 mm)	7.089 in (180 mm)
C23-L40	4.00 in (101.6 mm)	6.686 in (169.8 mm)	7.238 in (183.8 mm)	*7.789 in (197.8 mm)
C23-L45	4.50 in (114.3 mm)	7.186 in (182.5 mm)	7.738 in (196.5 mm)	8.289 in (210.5 mm)
C23-L50	5.00 in (127 mm)	7.686 in (195.2 mm)	8.238 in (209.2 mm)	8.789 in (223.2 mm)
C23-L55	5.50 in (139.7 mm)	8.186 in (207.9 mm)	8.738 in (222 mm)	9.289 in (236 mm)
BN23-13	1.41 in (35.8 mm)	4.484 in (113.9 mm)	5.044 in (128.1 mm)	5.594 in (142 mm)
BN23-18	1.91 in (48.5 mm)	4.984 in (126.6 mm)	5.544 in (140.8 mm)	6.094 in (154.8 mm)
BN23-23	2.41 in (61.2 mm)	5.484 in (139.3 mm)	6.044 in (153.5 mm)	6.594 in (167.5 mm)
BN23-28	2.91 in (73.9 mm)	5.984 in (152 mm)	6.544 in (166.2 mm)	7.454 in (189.3 mm)

**All dimensions are reference dimensions*

Ordering Information - Examples

52-46:1 – 52 mm gearhead, 46:1 ratio
52-308:1 – 52 mm gearhead, 308:1 ratio

62 MM (2.44 INCH) DIAMETER SPECIFICATIONS

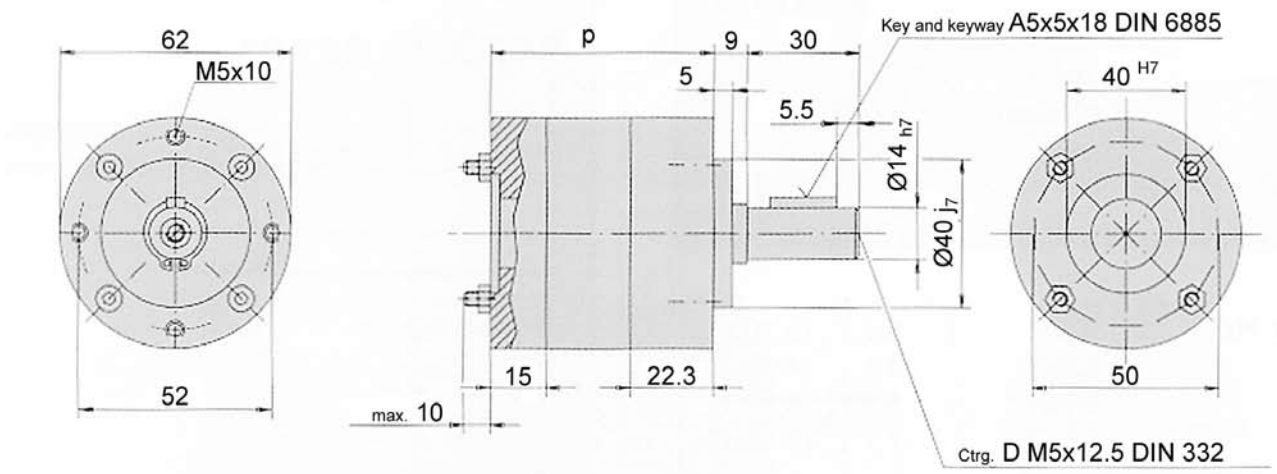
Available Ratios	# of Stages	Output Torque	Shaft Inertia (gcm^2)
4:1 (3.70:1)	One	8.0 Nm (5.90 ft - lbs)	0.037
4:1 (4.28:1)	One	8.0 Nm (5.90 ft - lbs)	0.029
5:1 (5.18:1)	One	8.0 Nm (5.90 ft - lbs)	0.023
7:1 (6.75:1)	One	8.0 Nm (5.90 ft - lbs)	0.017
14:1 (13.73:1)	Two	25.0 Nm (18.44 ft - lbs)	0.035
16:1 (15.88:1)	Two	25.0 Nm (18.44 ft - lbs)	0.028
18:1 (18.36:1)	Two	25.0 Nm (18.44 ft - lbs)	0.028
19:1 (19.20:1)	Two	25.0 Nm (18.44 ft - lbs)	0.022
22:1 (22.20:1)	Two	25.0 Nm (18.44 ft - lbs)	0.022
25:1 (25.01:1)	Two	25.0 Nm (18.44 ft - lbs)	0.017
27:1 (26.85:1)	Two	25.0 Nm (18.44 ft - lbs)	0.022
29:1 (28.93:1)	Two	25.0 Nm (18.44 ft - lbs)	0.017
35:1 (34.97:1)	Two	25.0 Nm (18.44 ft - lbs)	0.017
46:1 (45.56:1)	Two	25.0 Nm (18.44 ft - lbs)	0.017
51:1 (50.89:1)	Three	50.0 Nm (36.88 ft - lbs)	0.035
59:1 (58.85:1)	Three	50.0 Nm (36.88 ft - lbs)	0.028
68:1 (68.06:1)	Three	50.0 Nm (36.88 ft - lbs)	0.028
71:1 (71.16:1)	Three	50.0 Nm (36.88 ft - lbs)	0.021
79:1 (78.71:1)	Three	50.0 Nm (36.88 ft - lbs)	0.028
93:1 (92.70:1)	Three	50.0 Nm (36.88 ft - lbs)	0.016
95:1 (95.17:1)	Three	50.0 Nm (36.88 ft - lbs)	0.022
100:1 (99.50:1)	Three	50.0 Nm (36.88 ft - lbs)	0.022
107:1 (107.20:1)	Three	50.0 Nm (36.88 ft - lbs)	0.017
115:1 (115.07:1)	Three	50.0 Nm (36.88 ft - lbs)	0.022
124:1 (123.97:1)	Three	50.0 Nm (36.88 ft - lbs)	0.017
130:1 (129.62:1)	Three	50.0 Nm (36.88 ft - lbs)	0.017
139:1 (139.13:1)	Three	50.0 Nm (36.88 ft - lbs)	0.022
150:1 (149.90:1)	Three	50.0 Nm (36.88 ft - lbs)	0.017
169:1 (168.84:1)	Three	50.0 Nm (36.88 ft - lbs)	0.017
181:1 (181.24:1)	Three	50.0 Nm (36.88 ft - lbs)	0.017
195:1 (195.26:1)	Three	50.0 Nm (36.88 ft - lbs)	0.017
236:1 (236.09:1)	Three	50.0 Nm (36.88 ft - lbs)	0.017
308:1 (307.54:1)	Three	50.0 Nm (36.88 ft - lbs)	0.017

62 mm Technical Data

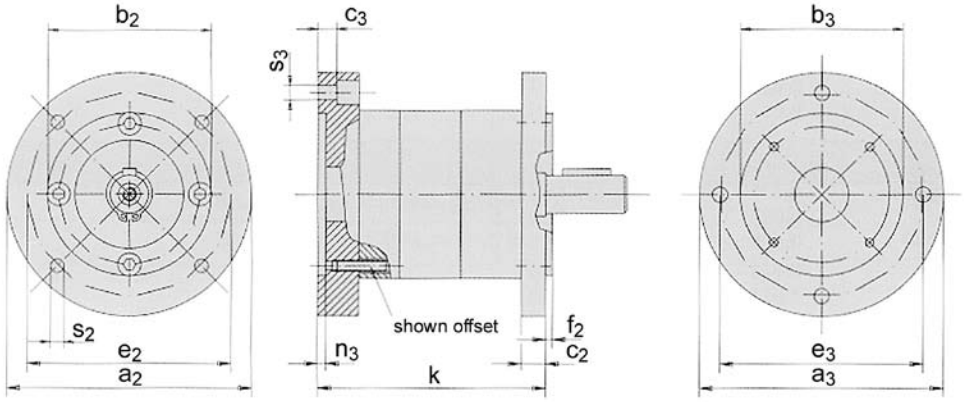
Parameter	Units	1-Stage	2-Stage	3-Stage
Max Input Speed	rpm	5000	5000	5000
Efficiency	%	80	75	70
Approx. Backlash (no-load, input locked)	DMS°	1.0	1.5	2.0
Radial Load	N	240	360	520
Axial Load	N	50	70	120
Max Permitted Fitting Pressure	N	1000	1000	1000
Weight	kg	0.8	1.2	1.6
Dimension (diameter x length)	mm	62 x 102	62 x 118	62 x 134
Lubrication	Grease (life-time lubrication)			
Installation Attitude	Any			
Operating Temperature	-15 to +80° C			
Direction of Rotation	Same for input and output shaft			

Package Dimensions

Basic Version



Standard Flange Version



Gear Unit Length				1-Stage	2-Stage	3-Stage
P				63	77	93
K				84	100	116

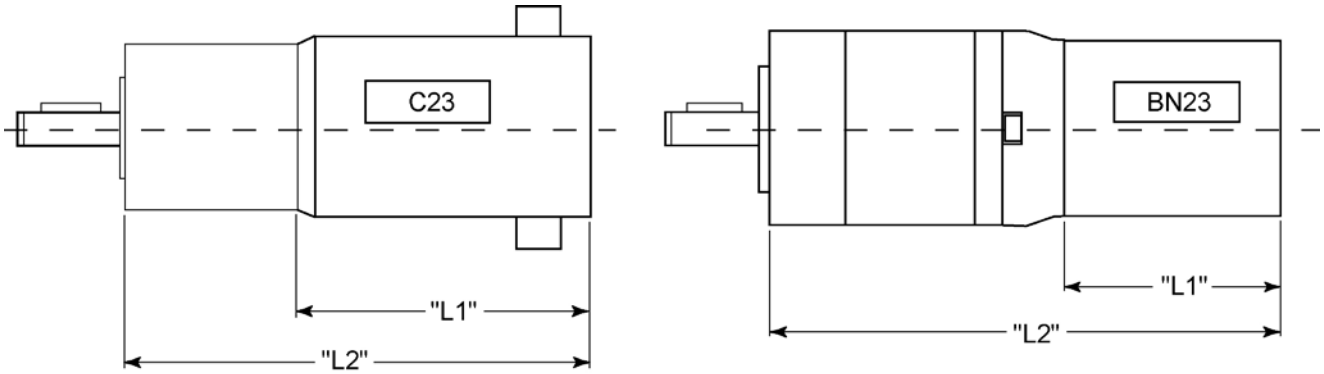
DIM of Motor Mounting Flange		a_3	b_3	c_3	e_3	n_3	s_3
Motor size 56	C 80	80	50 H7	7	65	3	5.5
(B14, B3/B14)	C 105	105	70 H7	7	85	3	6.5
Motor size 63	C 90	90	60 H7	7	75	3	5.5
(B14, B3/B14)	C 120	120	80 H7	7	100	3.5	6.5

DIM of Gear Unit Output Flange	a_2	b_2	c_2	e_2	f_2	s_2
C 80	80	50 J7	9	65	2.5	M5
C 90	90	60 J7	9	75	2.5	5.5
C 105	105	70 J7	9	85	2.5	6.5
C 120	120	80 J7	9	100	3.0	6.5

We reserve the right to make technical changes.

Note: All dimension on this page are in millimeters.

62 mm Dimensional Drawings



*Motor + Gearhead Dimensions**

Unit Type	L1 Max	L2 Max (1-Stage)	L2 Max (2-Stage)	L2 Max (3-Stage)
C23-L33	3.30 in (83.8 mm)	5.986 in (152 mm)	6.538 in (166 mm)	7.089 in (180 mm)
C23-L40	4.00 in (101.6 mm)	6.686 in (169.8 mm)	7.238 in (183.8 mm)	7.789 in (197.8 mm)
C23-L45	4.50 in (114.3 mm)	7.186 in (182.5 mm)	7.738 in (196.5 mm)	8.289 in (210.5 mm)
C23-L50	5.00 in (127 mm)	7.686 in (195.2 mm)	8.238 in (209.2 mm)	8.789 in (223.2 mm)
C23-L55	5.50 in (139.7 mm)	8.186 in (207.9 mm)	8.738 in (222 mm)	9.289 in (236 mm)
BN23-13	1.41 in (35.8 mm)	4.865 in (123.6 mm)	5.415 in (137.5 mm)	6.045 in (153.5 mm)
BN23-18	1.91 in (48.5 mm)	5.365 in (136.3 mm)	5.915 in (150.2 mm)	6.545 in (166.2 mm)
BN23-23	2.41 in (61.2 mm)	5.865 in (149.9 mm)	6.415 in (162.9 mm)	7.045 in (178.9 mm)
BN23-28	2.91 in (73.9 mm)	6.365 in (161.7 mm)	6.915 in (175.6 mm)	7.545 in (191.6 mm)

**All dimensions are reference dimensions*

Ordering Information - Examples

62-46:1 – 62 mm gearhead, 46:1 ratio
62-308:1 – 62 mm gearhead, 308:1 ratio

81 MM (3.19 INCH) DIAMETER SPECIFICATIONS

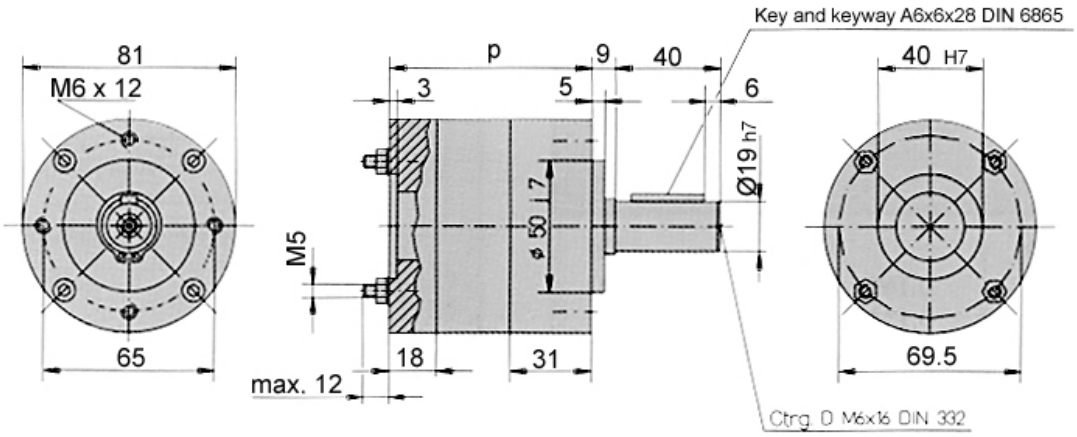
Available Ratios	# of Stages	Output Torque	Shaft Inertia (gcm^2)
4:1 (3.70:1)	One	20.0 Nm (14.75 ft - lbs)	0.165
4:1 (4.28:1)	One	20.0 Nm (14.75 ft - lbs)	0.134
5:1 (5.18:1)	One	20.0 Nm (14.75 ft - lbs)	0.109
7:1 (6.75:1)	One	20.0 Nm (14.75 ft - lbs)	0.091
14:1 (13.73:1)	Two	60.0 Nm (44.25 ft - lbs)	0.155
16:1 (15.88:1)	Two	60.0 Nm (44.25 ft - lbs)	0.127
18:1 (18.36:1)	Two	60.0 Nm (44.25 ft - lbs)	0.129
19:1 (19.20:1)	Two	60.0 Nm (44.25 ft - lbs)	0.100
22:1 (22.20:1)	Two	60.0 Nm (44.25 ft - lbs)	0.105
25:1 (25.01:1)	Two	60.0 Nm (44.25 ft - lbs)	0.125
27:1 (26.85:1)	Two	60.0 Nm (44.25 ft - lbs)	0.105
29:1 (28.93:1)	Two	60.0 Nm (44.25 ft - lbs)	0.088
35:1 (34.97:1)	Two	60.0 Nm (44.25 ft - lbs)	0.089
46:1 (45.56:1)	Two	60.0 Nm (18.44 ft - lbs)	0.089
51:1 (50.89:1)	Three	120.0 Nm (88.50 ft - lbs)	0.154
59:1 (58.85:1)	Three	120.0 Nm (88.50 ft - lbs)	0.126
68:1 (68.06:1)	Three	120.0 Nm (88.50 ft - lbs)	0.127
71:1 (71.16:1)	Three	120.0 Nm (88.50 ft - lbs)	0.104
79:1 (78.71:1)	Three	120.0 Nm (88.50 ft - lbs)	0.127
93:1 (92.70:1)	Three	120.0 Nm (88.50 ft - lbs)	0.088
95:1 (95.17:1)	Three	120.0 Nm (88.50 ft - lbs)	0.104
100:1 (99.50:1)	Three	120.0 Nm (88.50 ft - lbs)	0.105
107:1 (107.20:1)	Three	120.0 Nm (88.50 ft - lbs)	0.088
115:1 (115.07:1)	Three	120.0 Nm (88.50 ft - lbs)	0.105
124:1 (123.97:1)	Three	120.0 Nm (88.50 ft - lbs)	0.088
130:1 (129.62:1)	Three	120.0 Nm (88.50 ft - lbs)	0.088
139:1 (139.13:1)	Three	120.0 Nm (88.50 ft - lbs)	0.102
150:1 (149.90:1)	Three	120.0 Nm (88.50 ft - lbs)	0.088
169:1 (168.84:1)	Three	120.0 Nm (88.50 ft - lbs)	0.089
181:1 (181.24:1)	Three	120.0 Nm (88.50 ft - lbs)	0.088
195:1 (195.26:1)	Three	120.0 Nm (88.50 ft - lbs)	0.089
236:1 (236.09:1)	Three	120.0 Nm (88.50 ft - lbs)	0.089
308:1 (307.54:1)	Three	120.0 Nm (88.50 ft - lbs)	0.089

81 mm Technical Data

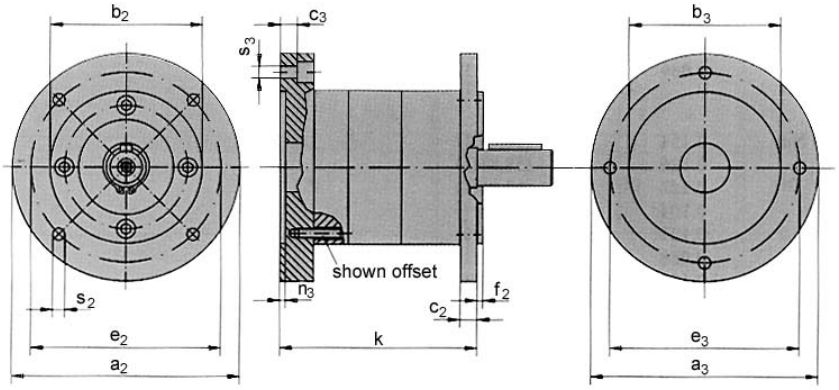
Parameter	Units	1-Stage	2-Stage	3-Stage
Max Input Speed	rpm	5000	5000	5000
Efficiency	%	80	75	70
Approx. Backlash (no-load, input locked)	DMS°	1.0	1.5	2.0
Radial Load	N	400	600	1000
Axial Load	N	80	120	200
Max Permitted Fitting Pressure	N	1500	1500	1500
Weight	kg	1.8	2.5	3.2
Dimension (diameter x length)	mm	81 x 126	81 x 148	81 x 170
Lubrication	Grease (life-time lubrication)			
Installation Attitude	Any			
Operating Temperature	-15 to +80° C			
Direction of Rotation	Same for input and output shaft			

Package Dimensions

Basic Version



Standard Flange Version



Gear Unit Length P81 / SP81		1-Stage	2-Stage	3-Stage
P		77	99	121
K		104	125	147

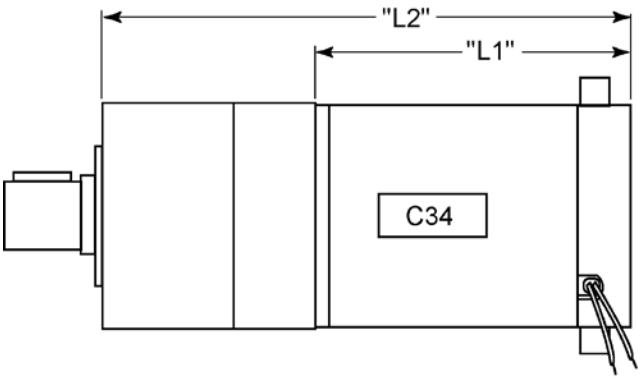
DIM of Motor Mounting Flange		a_3	b_3	c_3	e_3	n_3	s_3
Motor size 56	C 80	81	50 H7	9	65	3.0	5.3
(B14, B3/B14)	C 105	105	70 H7	9	85	3.0	6.3
Motor size 63	C 90	90	60 H7	9	75	3.0	5.3
(B14, B3/B14)	C 120	120	80 H7	9	100	3.5	6.3

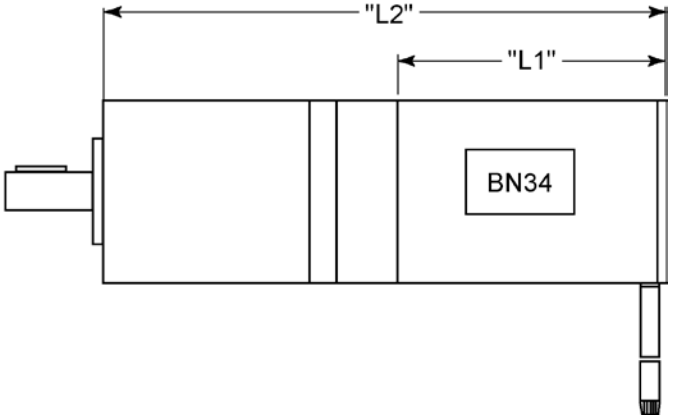
DIM of Gear Unit Output Flange	a_2	b_2	c_2	e_2	f_2	s_2
C 90	90	60 J7	9	75	2.5	M5
C 105	105	70 J7	9	85	2.5	M6
C 120	120	80 J7	9	100	3.0	6.5

We reserve the right to make technical changes.

Note: All dimension on this page are in millimeters.

81 mm Dimensional Drawings





*Motor + Gearhead Dimensions**

Unit Type	L1 Max	L2 Max (1-Stage)	L2 Max (2-Stage)	L2 Max (3-Stage)
C34-L60	6.00 in (152.4 mm)	9.781 in (248.4 mm)	10.647 in (270.4 mm)	11.514 in (292.5 mm)
C34-L70	7.00 in (177.8 mm)	10.781 in (273.8 mm)	11.647 in (295.8 mm)	12.514 in (317.9 mm)
C34-L80	8.00 in (203.2 mm)	11.781 in (299.2 mm)	12.647 in (321.2 mm)	13.514 in (343.3 mm)
BN34-25	2.50 in (63.5 mm)	6.281 in (159.5 mm)	7.147 in (181.5 mm)	8.014 in (203.6 mm)
BN34-35	3.50 in (88.9 mm)	7.281 in (184.9 mm)	8.147 in (213.8 mm)	9.014 in (229 mm)
BN34-45	4.50 in (114.3 mm)	8.281 in (210.3 mm)	9.147 in (232.3 mm)	10.014 in (254.4 mm)
BN34-55	5.50 in (139.7 mm)	9.281 in (235.7 mm)	10.147 in (257.7mm)	11.014 in (279.8 mm)

**All dimensions are reference dimensions*

Ordering Information - Examples

81-46:1 – 81 mm gearhead, 46:1 ratio
81-308:1 – 81 mm gearhead, 308:1 ratio

120 MM (4.72 INCH) DIAMETER SPECIFICATIONS

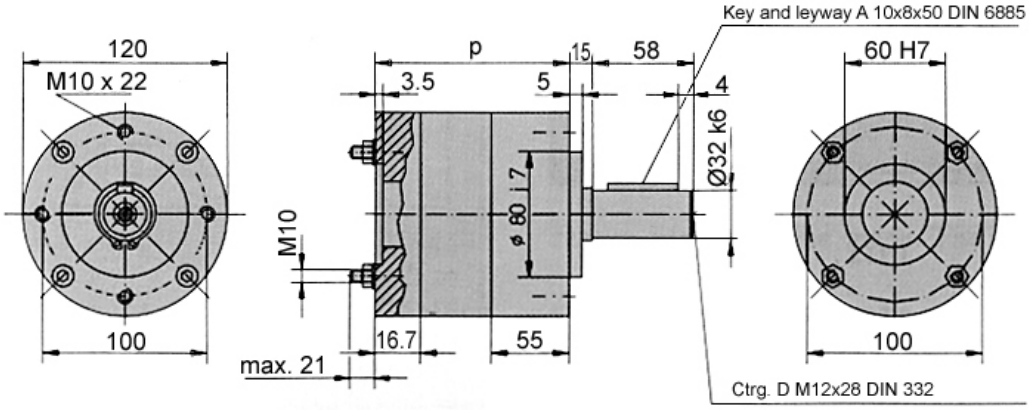
Available Ratios	# of Stages	Output Torque	Shaft Inertia (gcm^2)
4:1 (3.70:1)	One	50.0 Nm (36.88 ft - lbs)	1.112
7:1 (6.75:1)	One	50.0 Nm (36.88 ft - lbs)	0.557
14:1 (13.73:1)	Two	150.0 Nm (110.6 ft - lbs)	0.997
25:1 (25.01:1)	Two	150.0 Nm (110.6 ft - lbs)	0.515
46:1 (45.56:1)	Two	150.0 Nm (110.6 ft - lbs)	0.520
51:1 (50.89:1)	Three	300.0 Nm (221.3 ft - lbs)	0.967
93:1 (92.70:1)	Three	300.0 Nm (221.3 ft - lbs)	0.513
169:1 (168.84:1)	Three	300.0 Nm (221.3 ft - lbs)	0.519
308:1 (307.54:1)	Three	300.0 Nm (221.3 ft - lbs)	0.519

120 mm Technical Data

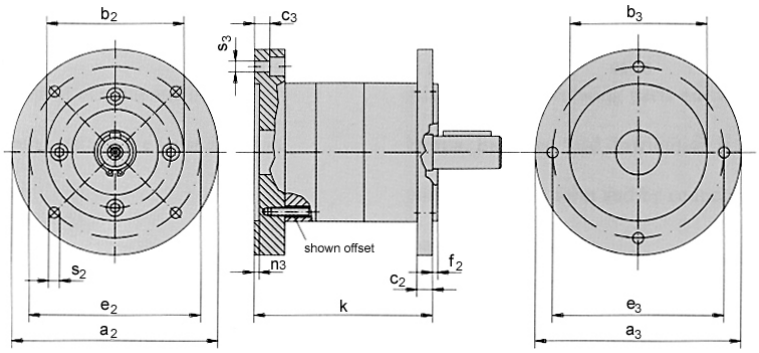
Parameter	Units	1-Stage	2-Stage	3-Stage
Max Input Speed	rpm	5000	5000	5000
Efficiency	%	80	75	70
Approx. Backlash (no-load, input locked)	DMS°	1.0	1.5	2.0
Radial Load	N	600	900	1500
Axial Load	N	120	180	300
Max Permitted Fitting Pressure	N	2500	2500	2500
Weight	kg	5.6	8.0	10.4
Dimension (diameter x length)	mm	120 x 180	120 x 214	120 x 248
Lubrication	Grease (life-time lubrication)			
Installation Attitude	Any			
Operating Temperature	-15 to +80° C			
Direction of Rotation	Same for input and output shaft			

Package Dimensions

Basic Version



Standard Flange Version



Gear Unit Length			1-Stage	2-Stage	3-Stage
	P		107	141	175
Motor size 71	K		150	184	218
Motor size 80	K		160	194	228

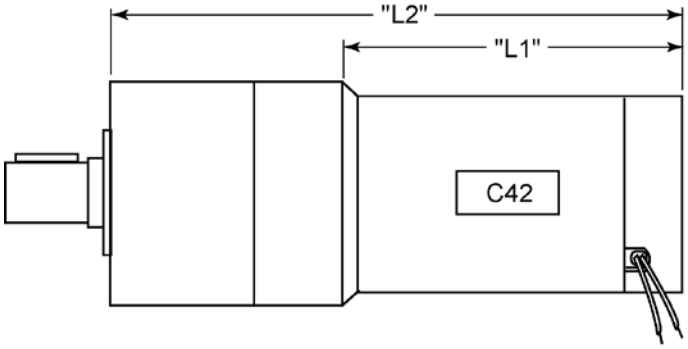
DIM of Motor Mounting Flange		a_3	b_3	c_3	e_3	n_3	s_3
Motor size 71	C 105	120	70 H7	15	85	3.0	6.4
(B14, B3/B14)	C 140	140	95 H7	15	115	3.5	8.4
Motor size 80	C 120	120	80 H7	15	100	3.5	6.4
(B14, B3/B14)	C 160	160	110 H7	15	130	4.0	8.4

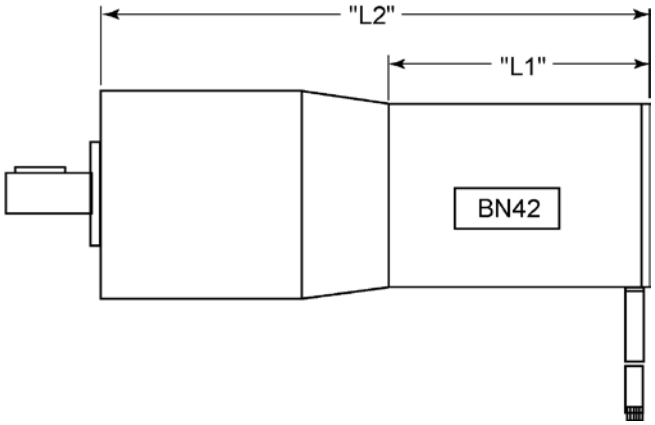
DIM of Gear Unit Output Flange	a_2	b_2	c_2	e_2	f_2	s_2
C 140	140	95 J7	15	115	3.0	M8
C 160	160	110 J7	15	130	3.5	M8

We reserve the right to make technical changes.

Note: All dimension on this page are in millimeters.

120 mm Dimensional Drawings





*Motor + Gearhead Dimensions**

Unit Type	L1 Max	L2 Max (1-Stage)	L2 Max (2-Stage)	L2 Max (3-Stage)
C42-L50	5.00 in (127 mm)	10.213 in (259.4 mm)	11.551 in (293.4 mm)	12.890 in (327.4 mm)
C42-L70	7.00 in (177.8 mm)	12.213 in (310.2 mm)	13.551 in (344.2 mm)	14.890 in (378.2 mm)
C42-L90	9.00 in (228.6 mm)	14.213 in (361 mm)	15.551 in (395 mm)	16.890 in (429 mm)
BN42-23	2.30 in (63.5 mm)	7.513 in (190.8 mm)	8.851 in (224.8 mm)	10.190 in (258.8 mm)
BN42-33	3.30 in (88.9 mm)	8.513 in (216.2 mm)	9.851 in (250.2 mm)	11.190 in (284.2 mm)
BN42-43	4.30 in (114.3 mm)	9.513 in (241.6 mm)	10.851 in (275.6 mm)	12.190 in (309.6 mm)
BN42-53	5.30 in (134.6 mm)	10.513 in (267 mm)	11.851 in (301 mm)	13.190 in (335 mm)

**All dimensions are reference dimensions*

Ordering Information - Examples

120-46:1 – 120 mm gearhead, 46:1 ratio
120-308:1 – 120 mm gearhead, 308:1 ratio

Optical Encoders

TYPICAL APPLICATIONS

Low cost motion detection for motors used in:

- Factory automation
- Packaging and printing products
- Office equipment and computer peripherals
- Robotic tape storage and retrieval
- Semiconductor handling and insertion machines
- Industrial automation
- Computer controlled embroidery machines
- Positioning tables
- Machine tools

FEATURES

- Two channel quadrature output with optional index pulse
- No signal adjustment required
- Low cost
- Small size
- Resolutions up to 1024 counts per revolution
- -40°C to 100°C operating temperature
- TTL compatible
- Single 5 volt supply

BENEFITS

- Feedback information may be used in conjuction with a position controller for precise motor shaft position
- Encoders used in conjuction with a 4-quadrant velocity controller, such as the BDA-Q4-70-10, allow precise velocity control of brushless motors.

All Moog Components Group motors can be fitted with an encoder. Moog Components Group uses the Hewlett-Packard HEDS and HEDM series of optical encoders as their standard offering. Other encoders are available; if you have a specific need please contact one of our applications engineers.

RENCO RCML15 encoders are also a standard offering.

SPECIFICATIONS

Specifications at 25°C (77°F)	HEDS 5500	HEDS 5540	HEDM 5500
Counts Per Revolution	96 to 512	96 to 512	1000 to 1024
Number of Channels	Two	Two + Index	Two
Supply Voltage (V_{cc}) (vdc)	4.5 to 5.5	4.5 to 5.5	4.5 to 5.5
Supply Current (I_{cc}) (mA – typical)	17	17	17
Load Capacitance (C_L) (pF max)	100	100	100
Count Frequency (f) (kHz max)	100	100	100
Pulse Width (P) (°e)	180 +/- 45	180 +/- 45	180 +/- 45
Phase Shift (ϕ) (°e)	90 +/- 20	90 +/- 20	90 +/- 20
Pulse Width Error (ΔP) (°e max)	45	35	45
Index Pulse Width (P_o) (°e max)	N/A	125	N/A
Signal Rise Time (t_r) (ns typ.)	200	180	180
Signal Fall Time (t_f) (ns typ.)	50	40	40
Operating Temperature (°C)	-40 to 100	-40 to 100	-40 to 100
Velocity (rpm) (max.)	30000	30000	30000
Acceleration (rad/sec^2) (max)	250000	250000	250000

Definitions

- **Count (N)** – the number of bar and window pairs or counts per revolution (CPR) of the codewheel
- **Pulse Width (P)** – the number of electrical degrees that an output is high during 1 cycle. This value is nominally 180°e or 1/2 cycle
- **Pulse Width Error (ΔP)** – the deviation, in electrical degrees, of the pulse width from its ideal value of 180°e
- **Phase (ϕ)** – the number of electrical degrees between the center of the high state of channel A and the center of channel B. This value is nominally 90°e for quadrature output.
- **Phase Error (Δf)** – the deviation of the phase from its ideal value of 90°e.
- **Index Pulse Width (P_o)** – the number of electrical degrees that an index output is high during one full shaft rotation. This value is nominally 90°e or 1/4 cycle.

Ordering Information

In order for us to provide the correct encoder for your application, it is necessary that you provide us with:
A. # of channels
B. CPR (counts per revolution)
C. Whether or not Differential Lines Drivers are required
To facilitate the correct selection, simply fill in the blocks below.

HEDS 55 [ ] [0] [ ]

 # OF CHANNELS
0 = 2 Channel
4 = 3 Channel

RESOLUTION (CPR)

K = 96	C = 100
D = 192	E = 200
F = 256	G = 360
H = 400	A = 500
I = 512	

HEDM 55 [ ] [0] [ ]

 # OF CHANNELS
0 = 2 Channel

RESOLUTION (CPR)
B = 1000
J = 1024

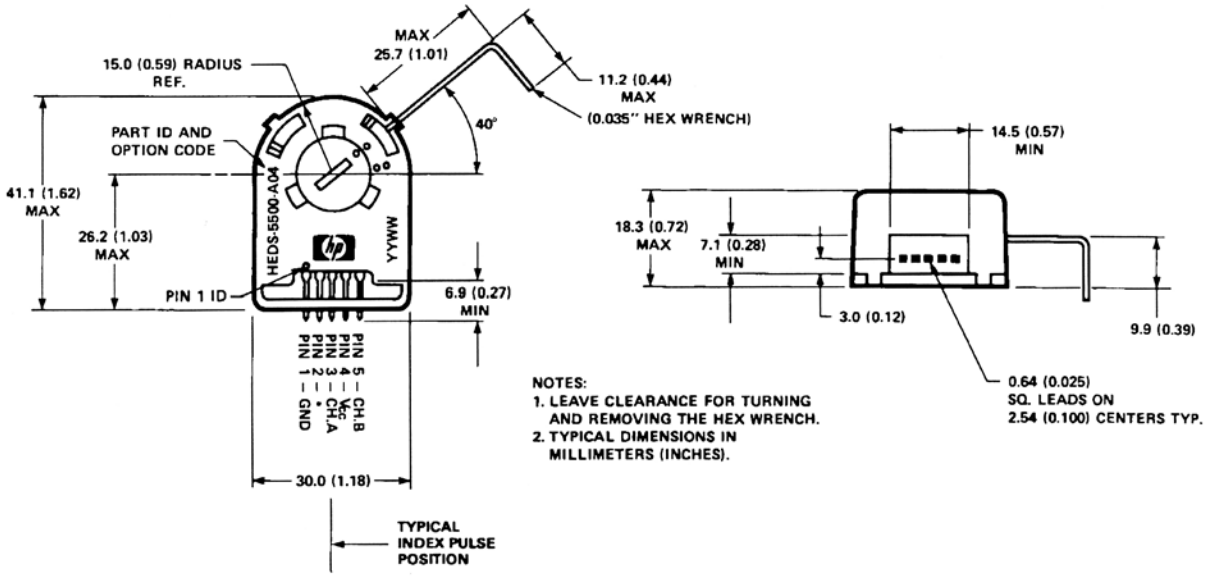
Note: If Differential Line Drivers are needed, simply substitute an L into the part # (ex. HEDL)

EXAMPLE

You need a 2-channel encoder with a line count (CPR) of 512, the correct part # would be: HEDS-5500-I.
If you needed the 2-channel, 512 CPR, but with differential line drivers, the correct part # would be: HEDL-5500-I.

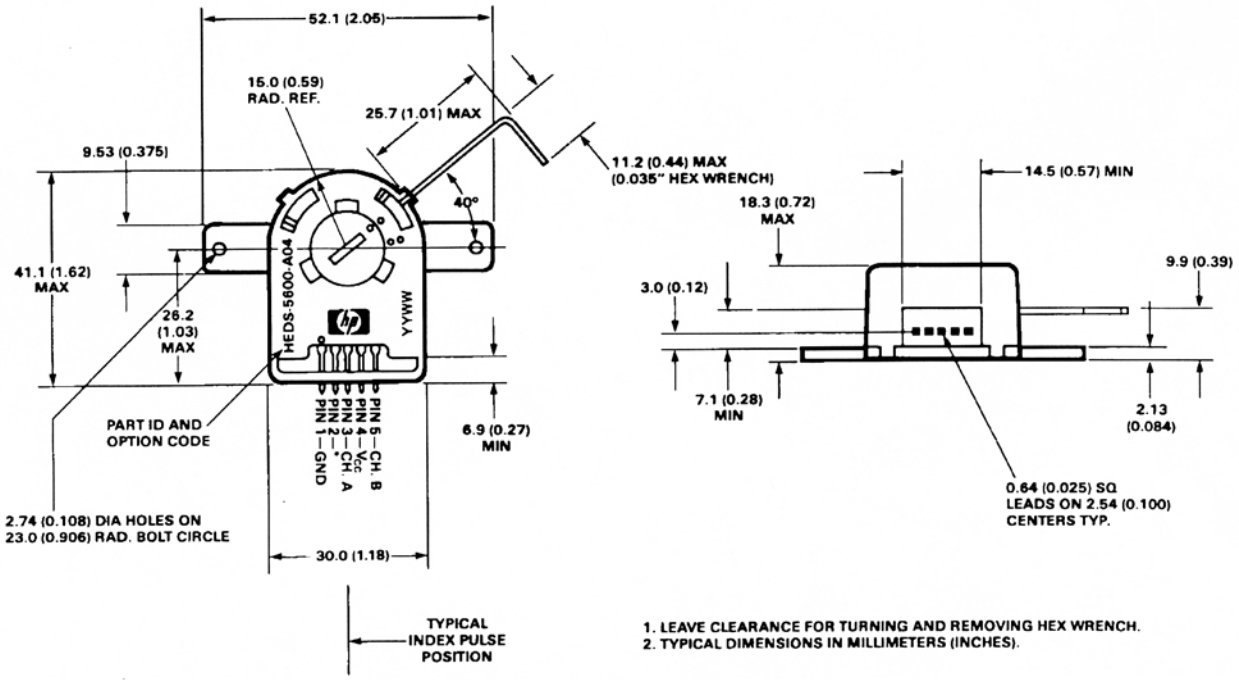
Package Dimensions

HEDS-5500 / 5540, HEDM-5500



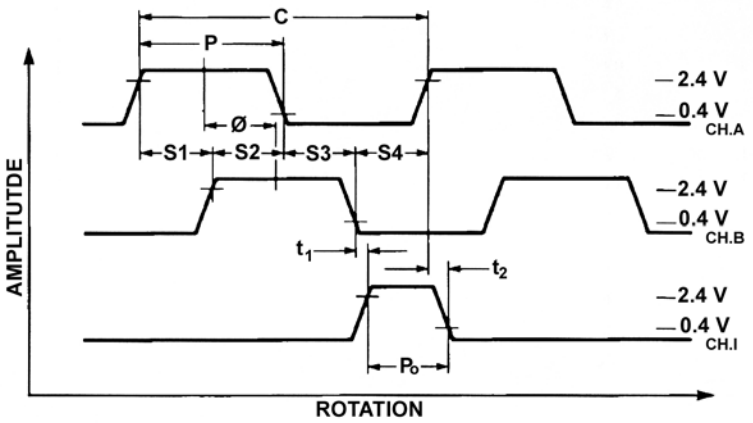
Note: For the HEDS-5500 and HEDM-5500, Pin #2 is a No Connect. For the HEDS-5540, Pin #2 is CH. I, the index output.

HEDS-5600 / 5640, HEDM-5600

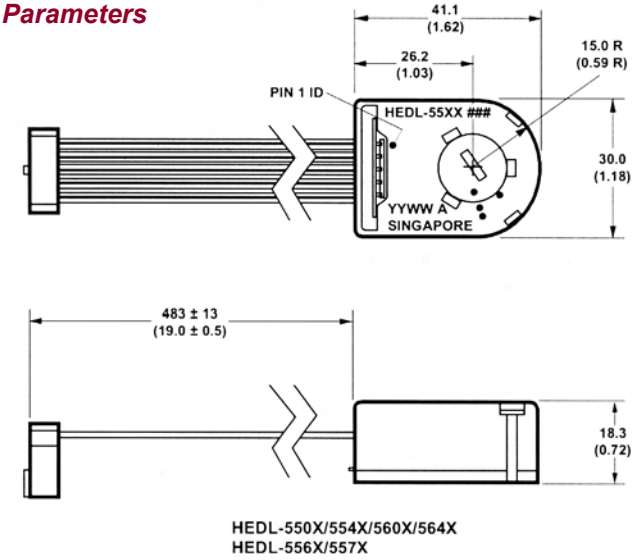


Note: For the HEDS-5600 and HEDM-5600, Pin #2 is a No Connect. For the HEDS-5640, Pin #2 is CH. I, the index output.

Output Waveforms



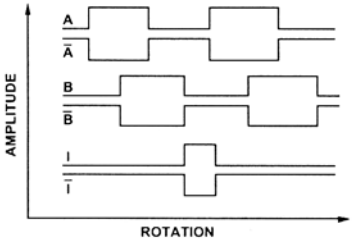
HEDL Parameters



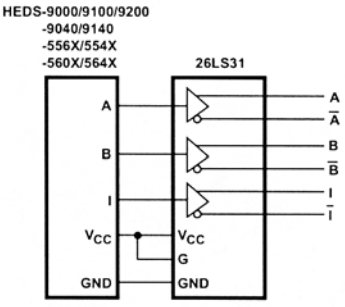
HEDL-550X/554X/560X/564X
HEDL-556X/557X

NOTE: DIMENSIONS IN MILLIMETERS (INCHES)

Waveforms



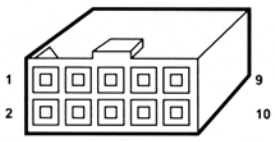
Block Diagram



Pinouts

10-PIN CONNECTOR

NO.	COLOR	PARAMETER
1	BROWN	NC
2	RED	V_{CC} (+ 5 V)
3	ORANGE	GND
4	YELLOW	NC
5	GREEN	Ā
6	BLUE	A
7	VIOLET	B̄
8	GREY	B
9	WHITE	Ī (INDEX)



10 POSITION IDC CONNECTOR
CENTER POLARIZED.

Model RCML15 Commutation Encoder

RENCO Encoders, Inc.

MOUNTING REQUIREMENTS

Mounting Requirements	Per Figure 1
Outline	Per Figure 3
Shaft Size	.2500 +0/-.0007 [6.35 mm +0/-.017]
Shaft Endplay	± 0.010 inch [± .254 mm]
Shaft Runout	0.002 inch TIR [.051 mm]
Set Screw	2-56 X 1/8 4-Spline (Wrench Supplied)
Disc Material	Metal Etched
Cover Material	Black Polycarbonate
Base Material	Polyphenylene Sulfide (Ryton R4)
Hub Material	Aluminum
Moment of Inertia	1.17 x 10^{-5} oz-in sec^2 [.83 g-cm^2]

ELECTRICAL

Output	Per Figure 2
Supply Voltage	5.0 VDC ± 10%
Output Logic Levels	"1" 2.5 VDC MIN
	"0" 0.5 VDC MAX
	4 mA MAX Sink Current
Output Type	Open Collector
Operating Frequency	300 KHz MAX
Flutter	1% MAX

ENVIRONMENTAL

Operating Temperature	-30°C to +100°C
Storage Temperature	-40°C to +115°C
Shock	50 G's for 11ms Duration
Vibration	5-2000 Hz @ 10 G's
IP Rating	IP 40
Humidity	90% Relative (Non-condensing)

TERMINATION TABLE

Pin Number	Function
1	GND
2	Z
3	CH A
4	+VCC
5	CH B
6	U
7	V
8	W

RESOLUTIONS*

Currently Available:

No Commutation
500/0, 512/0, 1000/0, 1024/0, 2000/0, 2048/0

2 Cycles/360° (2 Pole Pairs)
500/2, 512/2, 1000/2, 1024/2, 2000/2, 2048/2

3 Cycles/360° (3 Pole Pairs)
500/3, 512/3, 1000/3, 1024/3, 2000/3, 2048/3

4 Cycles/360° (4 Pole Pairs)
500/4, 512/4, 1000/4, 1024/4, 2000/4, 2048/4

*Resolutions listed are for metal disks only. Consult factory for other options.

FEATURES

- Low profile .350 inch height [8.9 mm]
- Patented slide lock for easy installation
- 2 data channels in quadrature
- Standard 90° zero pulse
- 3 commutation channels
- Self-aligning
- Self-centering
- Self-gapping
- 300 KHz frequency response
- Wide selection of line counts & pole pairs
- Meets NEMA ICS-16 standard

The RCML15 combines brushless motor commutation pulses and incremental position feedback in a low profile single optical encoder. This RENCO feature reduces cost while improving performance and reliability of the brushless motor/encoder package.

The patented slide lock mechanism makes installation and commutation track alignment simple. The low profile makes the RCML15 perfect for designs where space is critical.

This newly developed encoder has many standard resolutions/ pole pairs available. If your requirements are not listed, please consult factory for availability.

FIGURE 1 - *Mounting Requirements*

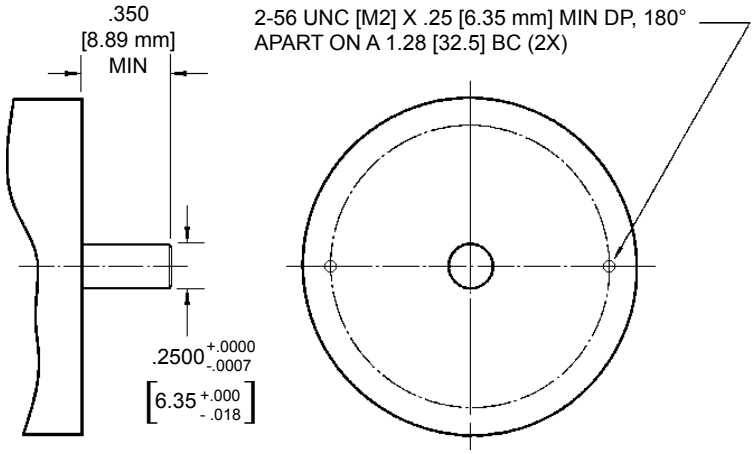


FIGURE 2 - *Output Configuration*

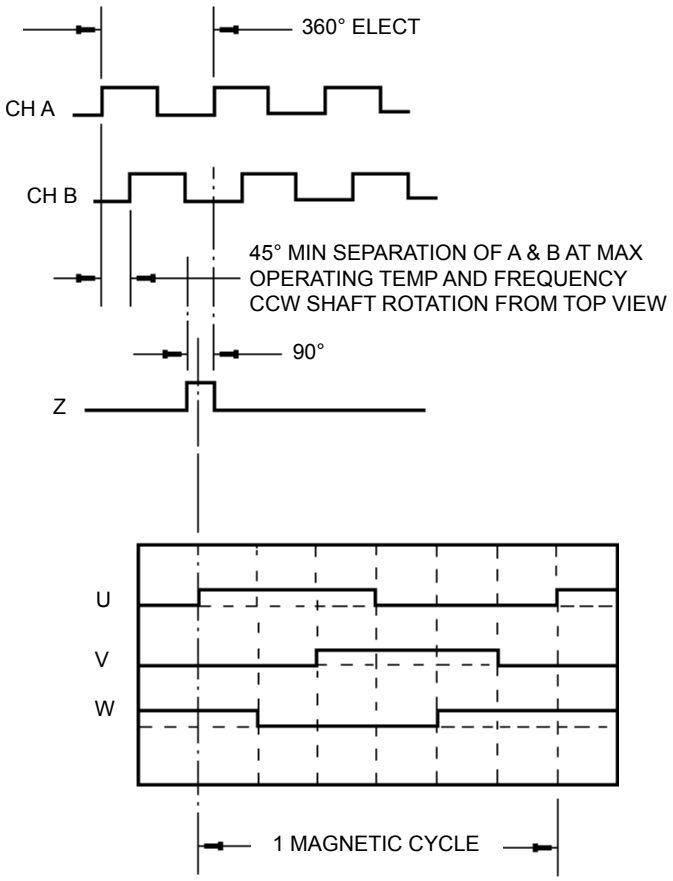
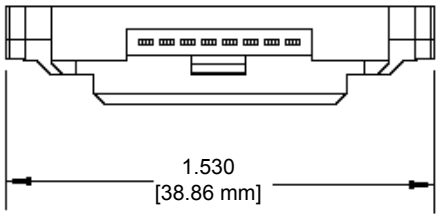
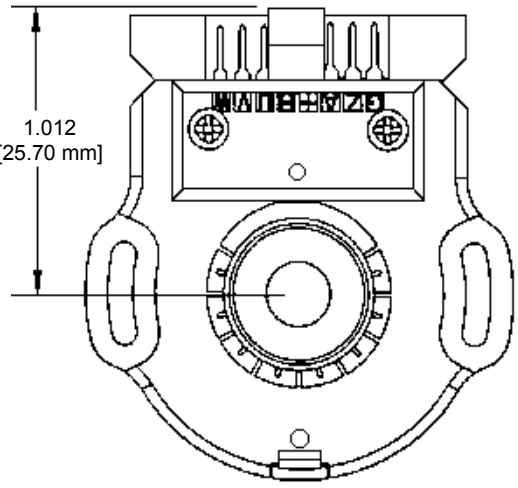


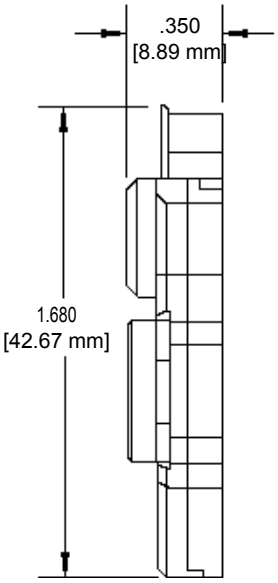
FIGURE 3 - *Mechanical Outline*

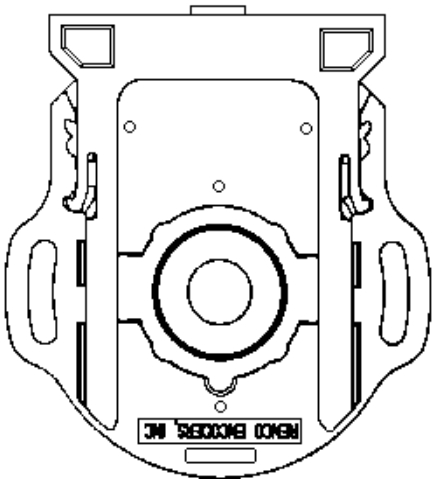


Recommended connector
BERG 90312-008 and
contact 77138-001



TOP VIEW





BOTTOM VIEW

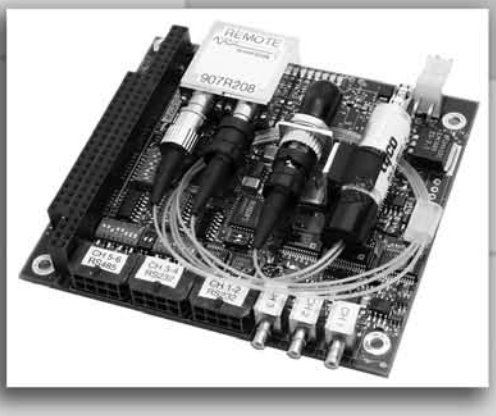
Housing height
at mounting slot
is .200 inch

All dimensions are in inches [Metric in brackets]
Product specifications subject to change without notice.

Ordering Information: To order, specify model resolution/commutation

RCML15 - ____ /____

RESOLUTION/COMMUTATION
See Front of Sheet


REMOTE
907R208

Integrated Mechanisms

Moog Components Group's unique product offering of motion technology (slip rings, motors, resolvers, drives and actuators) and fiber optic and multiplexing products provides the capital assets and engineering capabilities to design, manufacture and integrate these discrete products into an integrated gimbaled mechanism. In today's business environment where many corporate strategies are to focus on core competencies, let Moog Components Group take the design and integration of these discrete components into fully functional and tested subassemblies that are ready for installation into the end-item assembly. Should your strategy be to outsource these assemblies on a build-to-print or build-to-spec basis, we are ready to apply our resources so you can achieve those goals too.

Our integrated assemblies range from simple combinations of motors and resolvers to sophisticated electro-mechanical assemblies including the slip ring, brake, drive electronics, fiber optic rotary joints, hydraulic and pneumatic swivels and RF rotary joints. We also offer and provide fully integrated servo and utility actuators complete with precision gearing, clutches, brakes and closed-loop control electronics.

Our business strategy is simple, let Moog Components Group focus on what we do best so our customer can focus on what they do best. This strategy provides our customers with many measurable benefits.

Optimized systems that operate at peak performance

Tolerance stack up can rob magnetic and electromechanical designs of their intended performance capabilities. Maintaining air gap and mechanical tolerances are critical in precision electromechanical mechanisms. Even though the discrete components fall within specified tolerances, tolerance stack up may result in system performance problems. The end result is costly system redesign, component matching or assembly shimming for each item produced.

When a single manufacturer of these magnetic and electromechanical components has this responsibility, these issues are mitigated by careful attention to processing of the discrete components, thus ensuring a final assembly, that is electrically and mechanically aligned and fully tested.

System design can often be verified when a single manufacturer is able to conduct trade studies of the various components. Within a given mechanical envelop, space can be minimized, total component count reduced and structures sculpted with an end result of increased MTBF and reduced end-item weight.

Resource Optimization

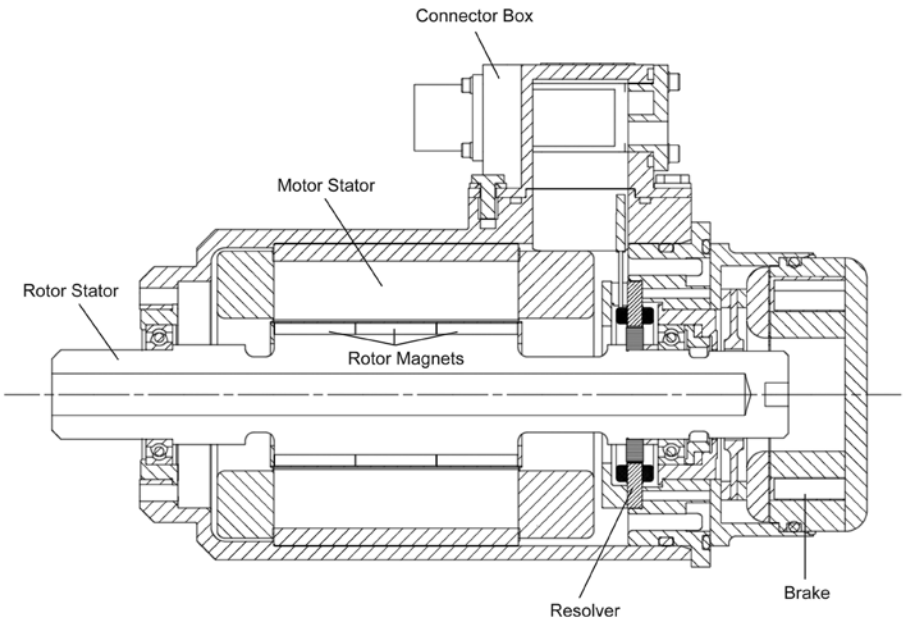
This approach ensures system engineers are focused on the system, not its components. By focusing engineering resources, program risks are minimized, schedules maintained and costs reduced. Additionally, overhead costs are reduced by eliminating the manpower of soliciting multiple contractors and resulting contract administration, multiple incoming inspections of discreet components and the resulting expenses of pulling and distributing component kits. Additional program costs are saved by eliminating the need of holding multiple design reviews at different locations, multiple qualification tests and the review and approval of their related documents.

Accountability

You are assured that all system components are integrated properly and a fully tested end-item assembly is delivered. And, in the rare case that a technical problem should occur, you know exactly who to call for immediate help.

Example of Integrated Motion Technology

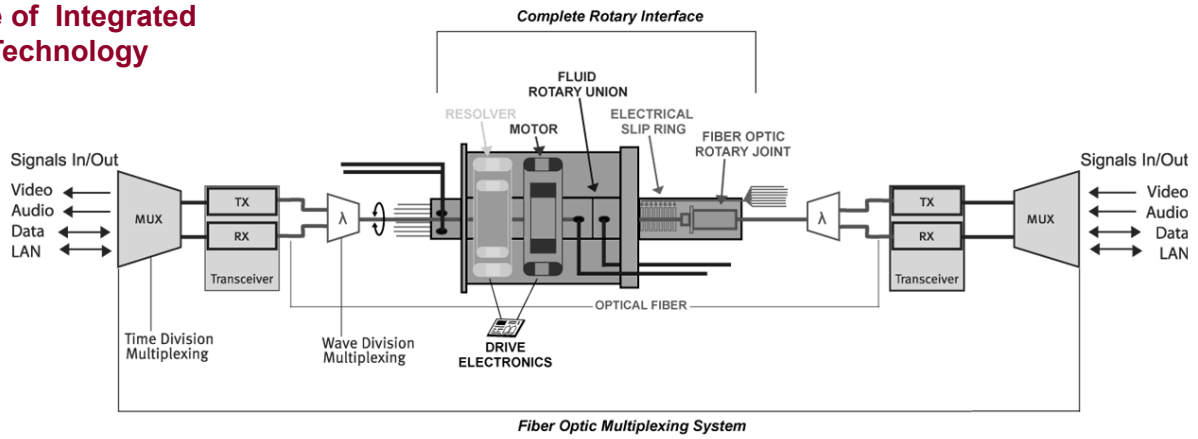
Primary Flight Control Surface Drive Assembly



With all marine, military and aerospace programs, a heritage of program success is essential. Moog Components Group has successfully provided integrated mechanisms to many mission critical programs including the following:

Marine Market		
Platform	***Integrated Assembly***	***Status***
Floating Production Storage and Offloading Vessel (FPSO)	Slip ring, FORJ, HUS and OEO converter Cables and junction boxes	Production
Remotely Operated Vehicles	Multiplexer, slip ring and FORJ	Production
Seismic Streamer	Slip ring and FRU Slip ring and FORJ	Production Production
Single Point Mooring System CALM Buoys	Slip ring, FORJ and FRU	Production
Military Market		
Platform	***Integrated Assembly***	***Status***
Helicopter	Slip ring, resolver and RF rotary joint	Production
Helicopter	Twist cap and resolver	EMD
Rotorcraft	Slip ring, resolver and monopole sensor	Production
Armored Vehicle	Slip ring, resolver, R-to-D network, hydraulic and pneumatic swivel, and power distribution	Production
Armored Vehicle	Slip ring, encoder and pneumatic swivel	Production
Radar	Slip ring, motor, resolver, motor control and drive electronics, and 2-channel FORJ	EMD
Radar	Slip ring, digital resolver, motor and bull-gear	EMD
Radar	Servo actuator, motor and drive electronics	Production
Radar	Slip ring, FORJ and FRU	Production
Naval Towed Arrays	Slip ring, FORJ and FRU	Production
Space Market		
Platform	***Integrated Assembly***	***Status***
Solar Array Drive	Slip ring, motor, harmonic drive and potentiometer	Flight
Solar Array Drive	Slip ring, motor and resolver	To-be-flown
Satellite Mechanism	Motor, ball screw and balanced weight	Flight
Industrial Market		
Rotary Piston Machining Centre	Mux, slip ring, FORJ and FRU	Prototype
Coal Stacker, Reclaimer	Slip ring, FORJ, FRU and encoder	Production

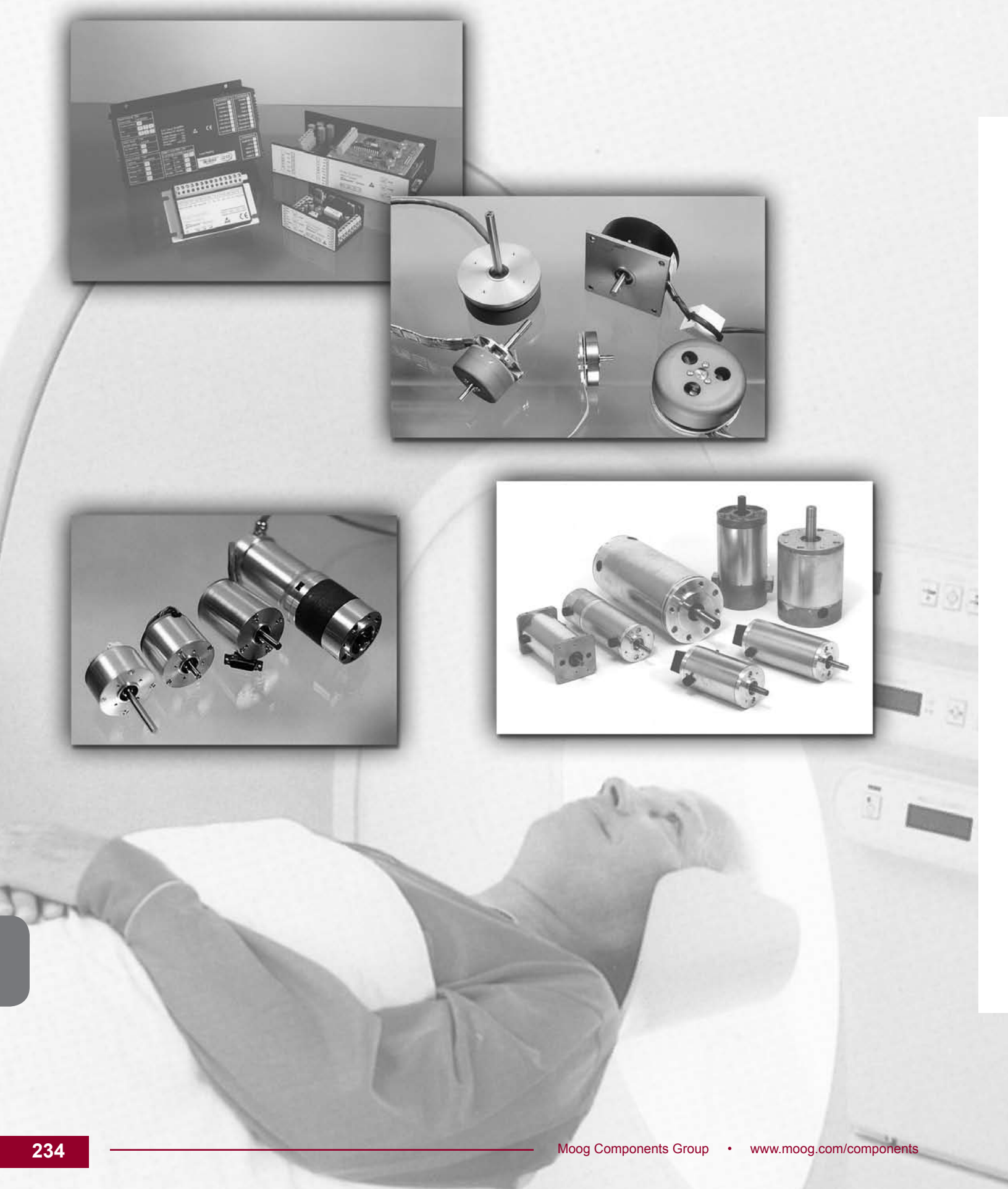
Example of Integrated Motion Technology



Fiber Optic Multiplexing System

Moog Components Group looks forward to applying our design and manufacturing resources to your program's integrated assembly needs.

Application Information



Application Form

Please complete this form to tell us about your motor specifications. We'll contact you with information about the motor that matches your application. There is a conversion chart included on this form for your convenience.

Please provide the following information:

First Name _____ Last Name _____

Function: ❑ Procurement ❑ Engineering ❑ Other: _____

Organization _____

Street Address _____

City _____ State / Province _____

Zip / Postal Code _____ Country _____

Work Phone _____ Fax _____

E-mail _____

Please provide as much information as possible, enter NA for those questions that are not critical or important to you. Do not be concerned if you do not have all of the specifications that are requested, we are happy to work with as much information as you can provide. However, the more complete your response, the more thorough our analysis.

Select which category best describes your application:

❑ Actuators
❑ Food Processing
❑ Medical Equipment
❑ Machining Tools
❑ Material Handling
❑ Printing
❑ Military / Aerospace
❑ Packaging Equipment
❑ Textile Machinery
❑ ***DFARS Alt 1***
❑ Semiconductor Mfg.
❑ Robotics
❑ Industrial Automation
❑ Other: _____

Technical Information:
Please give us a description of your application:

_____

_____

_____

Type of motor:

❑ Brushless DC ❑ Brush DC ❑ Stepper ❑ Torque Motor
❑ Other: _____

This application is:

❑ New
❑ Retrofit / Replacement
Current Supplier _____
Part Number _____

Moog Components Group can also provide you with an electronic driver to go with your brushless motor. Would you like more information on our electronic drivers?

❑ Yes ❑ No

Application Form

Do you require: ❑ Brake ❑ Encoder

If Yes, please specify:

Brake ❑ Fail Safe ❑ Dynamic Stopping

Static Holding Torque: _____

Voltage: _____

Encoder ❑ Single Ended ❑ Differential

Line Count _____

Number of Channels _____

Life and Usage:

Estimated annual usage _____

Estimated life of program _____

Price target _____

Production start date _____

Delivery time frame _____

Regulatory / Environmental Requirements: ❑ UL ❑ CE ❑ IP

RoHS Compliance? ❑ Yes ❑ No ❑ Comments: _____

Environmental Operating Conditions:

❑ Submersion in water

❑ Extreme temperatures

❑ Excessive amounts of dust and / or dirt

❑ Humidity

❑ Other: _____

Heat Removal:

❑ Application is in free air ❑ Heat sink ❑ Fan-cooled

Electromechanical Specifications:

Max. loaded speed (RPM) _____ Max. continuous torque (oz-in) _____

Peak torque (oz-in) _____

Duty Cycle _____ Minutes on, _____ Minutes off

Operating temp range (°C) _____ Ambient temp in application (°C) _____

Max terminal voltage (Vdc) _____ Rated current (A) _____

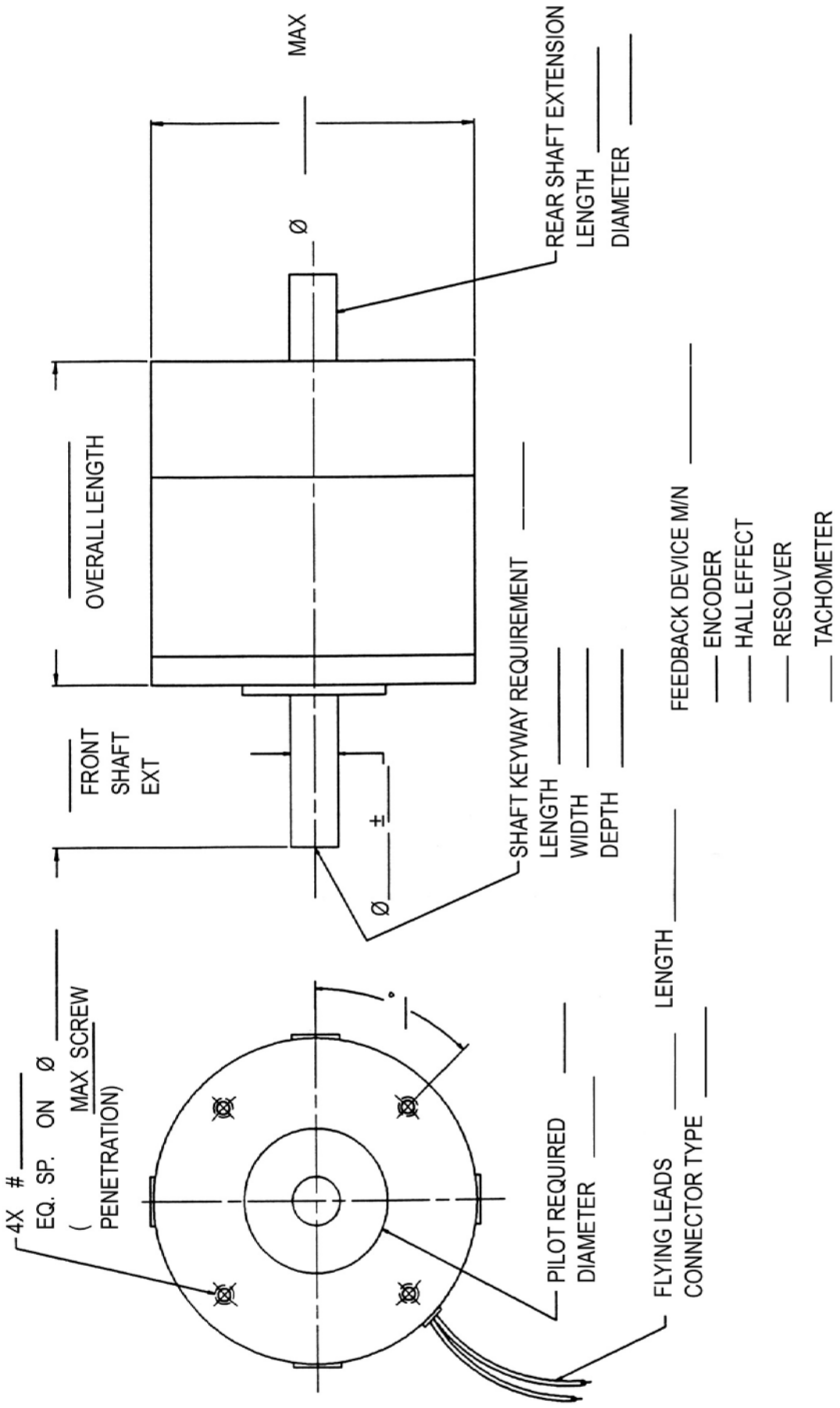
Load Inertia _____ Radial Shaft Load _____

Axial Shaft Load _____

If a new design is required, is funding available to cover non-recurring engineering and tooling costs?

Non-recurring engineering costs ❑ Yes ❑ No

Tooling costs ❑ Yes ❑ No


MAX
Ø
REAR SHAFT EXTENSION
LENGTH
DIAMETER
OVERALL LENGTH
FRONT SHAFT EXT
±
Ø
SHAFT KEYWAY REQUIREMENT
LENGTH
WIDTH
DEPTH
FEEDBACK DEVICE M/N
ENCODER
HALL EFFECT
RESOLVER
TACHOMETER
4X # EQ. SP. ON Ø
(MAX SCREW
PENETRATION)
°
PILOT REQUIRED
DIAMETER
LENGTH
FLYING LEADS
CONNECTOR TYPE

Notes

Product Summary

Motion Technology

Slip Rings

Moog Components Group is the world leader in slip ring design and manufacturing -- offering thousands of models. Slip rings are used in systems that require continuous rotation while transmitting power and data from a stationary unit to a rotating device.

Fiber Optic Rotary Joints

Moog Components Group's fiber optic rotary joints are to optical signals what electrical slip rings are to electrical signals, a means to pass signals across rotating interfaces, particularly when transmitting large amounts of data.

Motors

Moog Components Group provides a complete line of brush and brushless DC motors. These high performance motors are developed for a wide variety of applications, including medical, automation, industrial, aerospace and defense.

Resolvers

Moog Components Group's line of brushless resolvers are economical and highly accurate motion feedback sensors that are used to provide position and velocity information for closed-loop control, as well as brushless DC motor commutation.

Actuators

Moog Components Group offers high technology and utility electromechanical rotary and linear actuators for aerospace and industrial applications. These actuators utilize brush and brushless DC motors, planetary gears, modulated smart servo amplifiers, PWM amplifiers, multi-speed resolvers and potentiometers.

Fluid Rotary Unions

Moog Components Group's expanded line of fluid rotary unions offer reliable transmission of life support, process, power and control fluids. Fluid rotary unions can be combined with slip rings, fiber optic rotary joints, motors and resolver.

Air Moving

Moog Components Group now offers tailored airflow products that are designed using off-the-shelf components to provide cost effective solutions. With Moog's expertise in thermal management and innovative motor technology, there are new ways to solve difficult thermal, airflow, acoustic and efficiency problems.

Fiber Optics

Moog Components Group expands and enhances its motion capabilities with expertise in fiber optic design. From MEMS-based fiber optic switches to large rotary joints and multiplexers to fiber optic modems, we offer an array of solutions for today's demanding applications.

Custom Solutions

Moog Components Group does not stop with just standard models. Over the years, we have learned that many projects require a product that has unique specifications - either designed from scratch or modified from another design. One of Moog Components Group's strong points is providing exactly the right custom solution.

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