LIN ENGINEERING
MOTOR SPECIALISTS IN MOTION
A MOONS' COMPANY

AEROSPACE & AVIATION

HARSH ENVIRONMENTS

DESIGNED FOR EXTREME SMOOTHNESS, STEADINESS, SPEED & STRENGTH

SPECIAL SOLUTIONS

FROM THE STEPPING MOTOR SPECIALISTS

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TABLE OF CONTENTS

SPACE & AVIATION

VACUUM RATED STEPPER MOTORS — PAGE 5

SEALED STEPPER MOTORS — PAGE 11

HARSH ENVIRONMENT

IP RATED STEPPER MOTORS — PAGE 14

HOT/COLD STEPPER MOTORS — PAGE 20

DESIGNED FOR XTREME SMOOTHNESS, STEADINESS, SPEED & STRENGTH

Z/ZH/ZN SERIES STEPPER MOTORS — PAGE 23

HERCULES STEPPER MOTORS — PAGE 30

106 MINIATURE STEPPER MOTORS — PAGE 32

3709 STEPPER MOTORS — PAGE 34

G3718V WHISPER TORQUE — PAGE 36

ABOUT LIN ENGINEERING

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www.linengineering.com

ASSEMBLED IN USA

CUSTOMIZATION

We can customize windings to ensure maximum torque and performance at a desired speed as well as customize the wiring, shaft, housing, and add an encoder. Our motors are designed to fit your application, not the other way around.

CERTIFICATIONS

ISO9001:2015 - Medical, Automation
AS9100D - Space, Aviation

ISO 9001:2015 REGISTERED
AS9100D REGISTERED

RAPID PROTOTYPING

We can provide working prototypes quickly, which allows you to begin critical testing of the application right away so that getting the product to market happens as fast as possible.

OFFSHORE QUALITY TEAM

Should problems arise in high volume production, our overseas quality assurance team guarantees that the issue will be dealt with at the source.

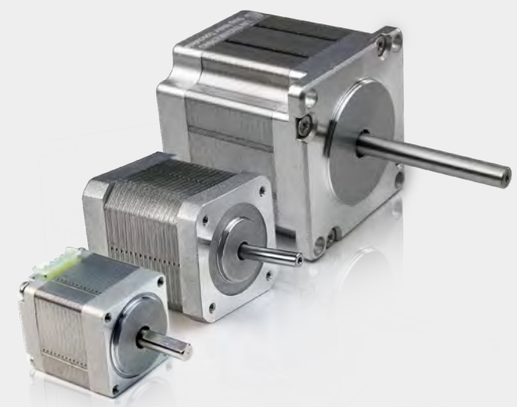
EXTENSIVE SALES NETWORK

In addition to our inside sales team, Lin Engineering employs a worldwide network of over 40 sales representative firms located throughout the United States, Canada, Europe, the Middle East and Asia. Our sales reps can provide the service and personal attention required to serve your company.

DOMESTIC & OVERSEAS OPERATIONS

In addition to minimizing lead-time, our U.S. facility also functions to support our overseas production. This allows us to meet the initial demands for high volume orders, thus helping you avoid the delays associated with high volume production ramp-ups.

SPACE & AVIATION



Vacuum
RATED STEPPER MOTORS

- AS9100D compliant facility
- Low outgassing
- Optimized power consumption
- Heat dissipation provisions
- Withstand temperature range from -80C to +200C
- Low vibration generation
- High amplitude vibration tolerance
- Complete component origin traceability

The harsh environment of vacuum and microgravity pose many issues which we don't commonly have to deal with here on earth. That is especially true when it comes to motion control in space. There are many inherent problems with creating motion in that environment mainly due to the fact that motors require, considerable amount of power, they can generate excessive heat, they can introduce unwanted vibrations, and they can also become a source of contaminants.

Dealing with these issues can come at a substantial cost. Higher power requirements necessitate larger power generation systems, more heat generated requires bigger cooling systems, dealing with unwanted vibrations requires more robust damping systems, and contaminations can cause havoc on instruments and other on-board components. This complexity can translate in to potential component or system failures—yet, there is no room for that in space applications, which is why it's important to work with a company that has expertise in space flight requirements. Lin Engineering has designed their space hybrid stepper motors to work in harsh environments and accurately deal with the inherent problems of motion control in space. Plus, the motors are assembled in accordance with Aerospace AS9100D standards in a fully compliant facility in California, where each component origin is traceable to maintain strict control over the manufacturing process as well as the final product specifications. How do we address these challenges?

OPTIMIZED POWER CONSUMPTION

In space applications, power comes at a premium. Every watt that is wasted by a system that has not been fully optimized for space costs precious resources. Optimizing for power consumption includes customizing motor windings so that they are able to deliver a peak amount of dynamic torque at the desired operating speed—which takes the proper integration of high-precision components, such as low inertia rotors operating at their highest efficiency. Depending on the specific application, each motor is tailored to deliver the ideal performance necessary while accounting for the power constraints of the overall system. Using proprietary, and proven, algorithms based on 30+ years of tailoring the performance of electric motors to meet the specifications needed for particular applications, Lin Engineering is able to optimize torque and speed, noise reduction, heat generation or loss, and/or power optimization.

TEMPERATURE MANAGEMENT

Two critical concerns related to temperature affecting the performance of hybrid stepper motors in space include the temperature range in which the motor operates and the amount of heat the motor generates. Satellites and other spacecraft operate in extreme temperature ranges. Externally mounted systems expected to function in these extreme temperature variations can cause operational issues if not designed properly.

For example, heat affects the magnetic strength of permanent magnets embedded in the rotor. As heat increases, motor performance decreases. The solution to this challenge is to incorporate permanent magnets that are constructed from an alloy that provides greater magnetic power at higher and lower temperatures. For example, either rare-earth samarium-cobalt or neodymium are both used for this purpose.

Heat also drastically effects the life of the bearings used in the motor and therefore shortens the lifespan of the whole system. To alleviate this problem, it is necessary to use bearings with grease that can withstand high dynamic temperature ranges—from -80C to +200C. Any type of oils or grease imaginable can be specified for a particular application, including dry-lube, no-lube. Plus, high-temperature, non-outgassing bearings can be designed in as well.

Excessive heat generated by the motor itself can also be an issue. Although all motors generate some heat, in a vacuum environment, this can become a major problem because there is no atmospheric medium through which heat can dissipate—from the motor or the vehicle. On Earth, air acts as a conductor, which dissipates the generated heat, while in space, heat needs to be dissipated by other means. Those other means often include unwanted weight additions and increased mass, which adds unnecessary build complexity into the craft or satellite. Further, any heat generated by a stepper motor can affect nearby instruments and components, especially in insulated areas of the craft. By optimizing the winding of the stepper motor, the amount of heat generated can be reduced considerably. In addition, the incorporation of conductive pathways in the motor design also assist in temperature management. These pathways include thermally conductive materials that allow for heat dissipation between the insulator (glue) and motor end bells.

VIBRATION MANAGEMENT

Getting a spacecraft into orbit is a violent ordeal. Components are exposed to high amplitude vibration, low amplitude vibration, and shock from several different directions during the launch. Then there are the vibrations generated by the stepper motor during its normal operations.

The optimization of the motor windings is a practical way to minimize the resonance frequency that develops at specific operating speeds. By using high quality components, which are specifically machined to high concentricity and dimensional accuracy, it is possible to ensure that components such as rotors or shafts do not introduce unwanted vibrations into the system.

In space, however, vibrations need to be avoided at every turn. Unwanted vibration can affect on-board sensors and instruments. Low-level oscillations can affect measurement sensors as well as the quality of imaging devices. Dampening vibrations in a microgravity environment is challenging since the craft or satellite is suspended in space where there is nothing to transfer the energy to. Every component has to withstand these challenges, which is why every stepper motor designed for space must use the proper materials to create the structural integrity to handle any and all expected forces it may encounter—without altering dimensional accuracy or mechanical integrity. In fact, Lin Engineering has incorporated such materials in their standard motors, which makes them sufficiently robust for space applications where launch stress and wide temperature variations are typical.

OUTGASSING AND CONTAMINATIONS

On the microscopic level, there are plenty of gases and liquids trapped inside of paints, coatings, greases, and materials. In the vacuum of space, these trapped gases from inside the motor can expand or condensate, and liquids can evaporate, introducing unwanted contaminates into the environment. If these contaminants settle on imaging sensors, measurement instruments, or other critical systems, they will reduce overall performance or render them useless.

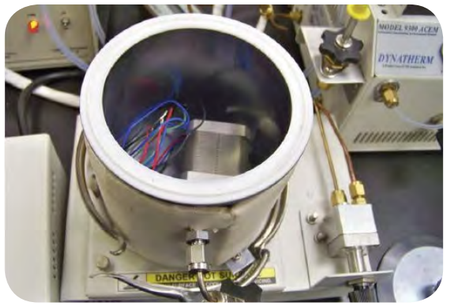
Motors can be designed to minimize outgassing. This happens when all of the stepper motor components—including the end caps, stator, rotor, and screws—are made from low outgassing materials. Most components on the motors are metal alloys, which, without paint, are rated for vacuum use. Plastic materials used in the design are non-outgassing polyamide or nylon. Special sealed bearings filled with low outgassing lubricants are also available. Additionally, all components are thoroughly cleaned and vacuum baked. After the bake-out process each stepper motor is assembled in a cleanroom environment and vacuum sealed to ensure no contaminates enter the package during transportation and storage. Finally, corrosion protection is achieved by the use of specially made vacuum- and space-compatible coatings, whether for ferrous components or aluminum.

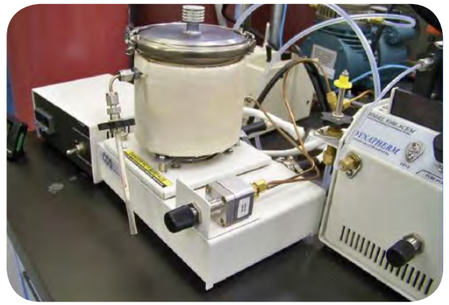
Overall, the longevity of components that go into space is a factor of the time and effort put into the proper design of the components and their final assembly using the latest materials while manufactured in a clean room facility. Maintaining the value of a product is always evident by the time put into understanding the environment in which it will be placed. Space flight and satellite applications require a keen sense of the problems associated with their operating environment. Lin Engineering has provided custom motors for a wide variety of applications, and has the expertise to design a stepper motor for use in any harsh environment—including deep space.

PROPRIETARY MOTOR ASSEMBLY PROCESS

In order to create the cleanest motor on the market, we've created our own motor assembly process and put the results to the test—against a known competitor's motor. To do so, we placed our motor into a positive flow chamber (N2 Gas flow 1mm/1min) and measured its outgassing levels over a 72 hour period at a temperature of 125°C. Then we took the following measurements:

- **Total Mass Loss Percentage** (%TML)—The larger the percentage, the more contaminated the specimen.
- **Total Mass Loss** (ug/motor)—This is the weight of the mass that was evaporated into the chamber from the specimen. The larger the number, the more *contaminated* the specimen.





OUR RESULTS

SAMPLE	%TOTAL MASS LOSS (TML)	MASS LOSS (ug/motor)
COMPETITOR	0.030	105,000
LIN ENGINEERING	0.008	29,000

The Lin Engineering vacuum rated motor lost far less mass than the competitor's motor, proving the cleanliness of the system. Our cleaning process in 375% cleaner than the competition.

ADDITIONAL APPLICATIONS

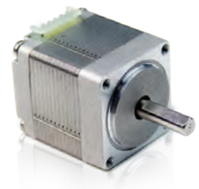
Cleanrooms

Since vacuum rated motors do not introduce contaminants into the environment, they are perfect for sensitive environments where outgassing needs to be avoided, particularly during the semiconductor manufacturing process where even the smallest contamination can ruin the production yield.

Vacuum chambers

Vacuum rated motors are often used in vacuum chambers for testing and manufacturing purposes.

VACUUM MOTOR OPTIONS



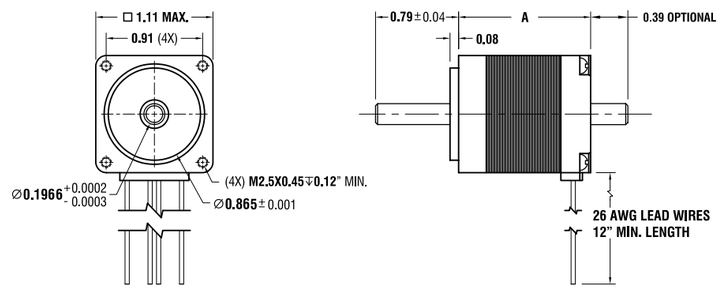
211 Series

- NEMA 11 (28 mm)
- Up to 16 oz-in (0.12 N-m) Holding Torque

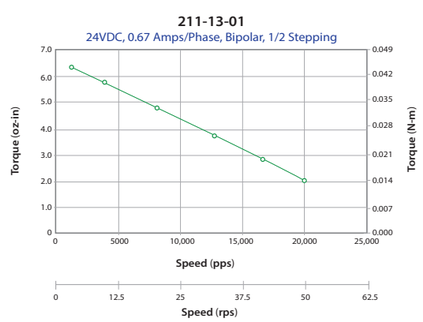
SPECIFICATIONS

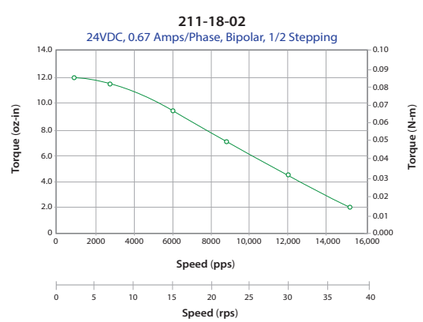
Dimension A (MAX)	Model Number	Connection	Rated Current (Amps/Phase)	Holding Torque		Resistance (Ohms/Phase)	Inertia (oz-in²)	Weight (Lbs.)	Number of Leads
				(oz-in)	(N-m)				
1.26" (32.0 mm)	**211-13-01**	Bipolar	0.67	9.2	0.06	5.60	0.05	0.24	4
1.77" (45.0 mm)	**211-18-01**	Bipolar	0.67	13.7	0.10	7.10	0.07	0.31	4
2.01" (51.1 mm)	**211-20-01**	Bipolar	0.67	16.6	0.12	8.60	0.10	0.44	4

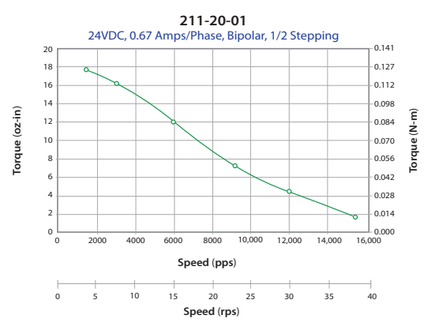
DIMENSIONS



TORQUE CURVES







More Torque Curves available online at www.linengineering.com

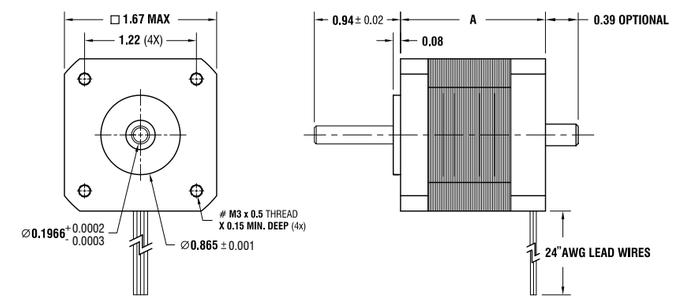
4118 Series

- NEMA 17 (42 mm)
- Up to 115 oz-in (0.81 N-m) Holding Torque

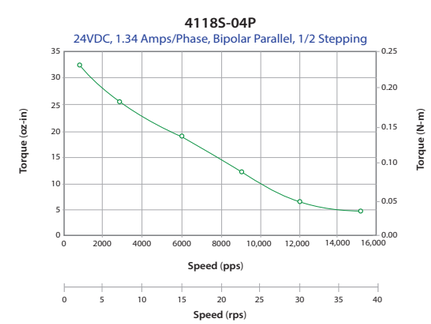
SPECIFICATIONS

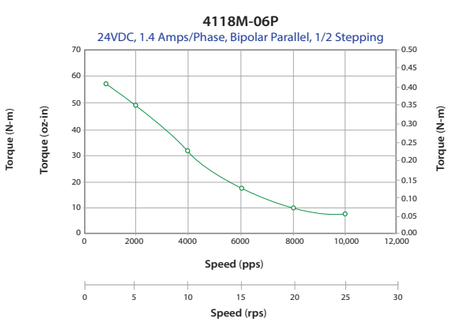
Dimension A (MAX)	Model Number	Connection	Rated Current (Amps/Phase)	Holding Torque		Resistance (Ohms/Phase)	Inertia (oz-in²)	Weight (Lbs.)	Number of Leads
				(oz-in)	(N-m)				
1.34" (34.0mm)	**4118S-04P**	Parallel	1.34	42.0	0.30	2.50	0.18	0.40	4
1.58" (40.1 mm)	**4118M-06P**	Parallel	1.40	63.0	0.44	2.70	0.28	0.60	4
1.89" (48.0 mm)	**4118L-07S**	Series	1.05	83.0	0.59	5.20	0.37	0.70	4
2.34" (59.4 mm)	**4118C-01**	Bipolar	2.00	115.0	0.88	2.00	0.56	0.90	4

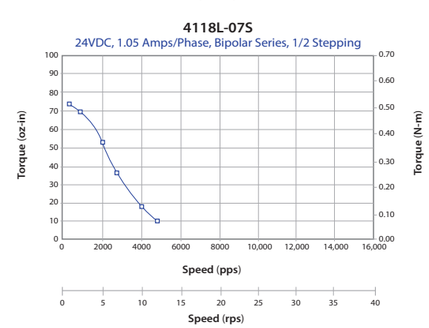
DIMENSIONS

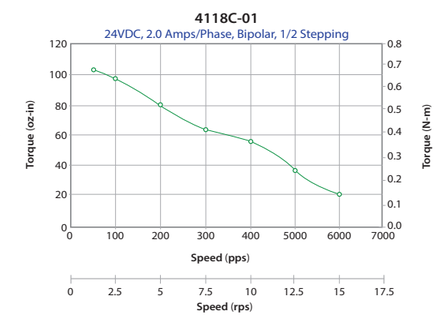


TORQUE CURVES









More Torque Curves available online at www.linengineering.com

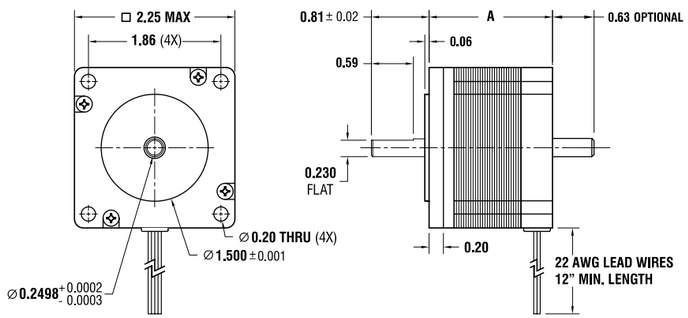
5718 Series

- NEMA 23 (57 mm)
- Up to 305 oz-in (2.16 N-m) Holding Torque

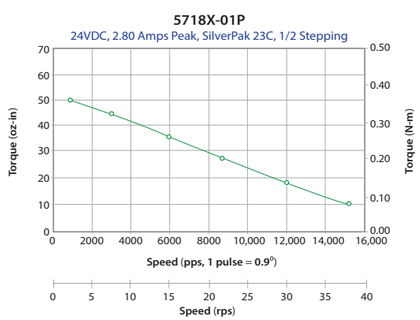
SPECIFICATIONS

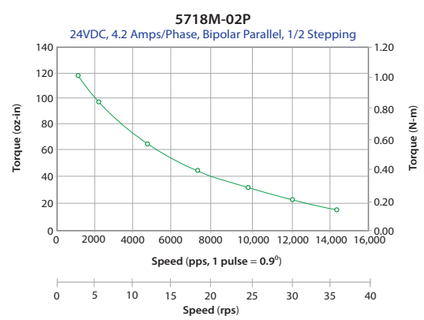
Dimension A (MAX)	Model Number	Connection	Rated Current (Amps/Phase)	Holding Torque (oz-in)	Holding Torque (N-m)	Resistance (Ohms/Phase)	Inertia (oz-in²)	Weight (Lbs.)	Number of Leads
1.74" (44.2mm)	**5718X-01P**	Parallel	2.80	100.0	100.0	0.70	0.70	1.05	4
2.22" (56.4 mm)	**5718M-02P**	Parallel	4.20	173.0	173.0	0.50	1.50	1.50	4
3.10" (78.7 mm)	**5718L-01P**	Parallel	2.80	294.0	294.0	1.10	2.60	2.35	4

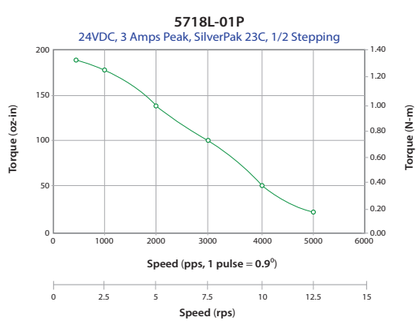
DIMENSIONS



TORQUE CURVES

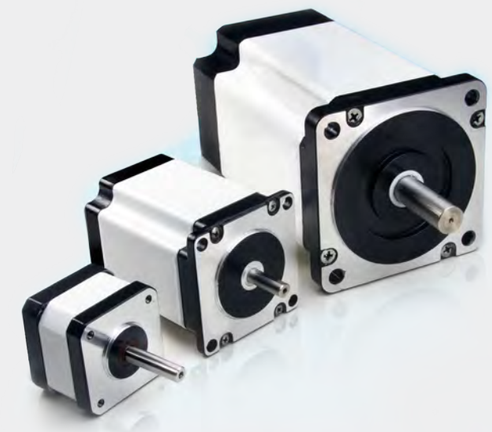






Ask us about more vacuum options:
- Bigger and Smaller motors
- 0.9˚ and 0.45˚ step angle

More Torque Curves available online at www.linengineering.com

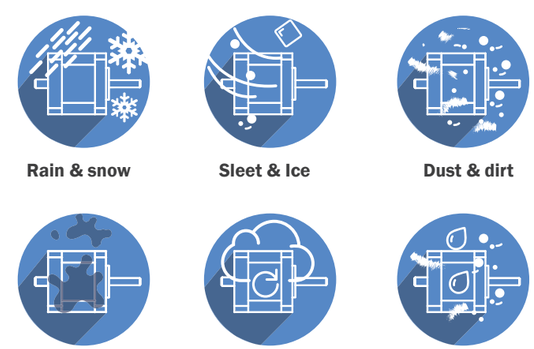


Sealed Motors
FOR AVIATION INDUSTRY

- Manufactured in accordance to AS9100D standards
- IP65 and IPX7 rated
- Sealed and protected against weather
- Wide temperature operation range

AEROSPACE INDUSTRY APPLICATIONS FOR IP RATED MOTORS

The aerospace industry—and especially general aviation applications—where exposure to the elements can cause problems with your equipment, it is essential to use IP Rated motors manufactured in accordance to AS9100D Aerospace Standards. Aerospace engineers constantly face the challenge of designing products that will be exposed to a variety of environments including:



Taking environmental conditions under consideration during the design process, will allow for product features that can eliminate even microscopic levels of dust. Although, IP ratings assure that levels of dust and moisture are within the range of the protection code they are given, additional elements must also be controlled—like the ability to operate under the wide temperature ranges.

Material selection is a critical design concern when working with aerospace industry applications. Not only must the devices be properly sealed, they must provide component longevity to maintain operation when located in areas that may be exposed to the environment.

For motor design, the proper IP Ratings might require permanent joints that are continuous. Motor surfaces that are smooth, impervious, and free of sharp corners. Materials must provide a minimum of outgassing, and be quiet in operation. Because we've worked in this industry for years, our IP65 and IPX7 motors are ideal for aerospace applications. Contact us for specific information.

MOTORS AVAILABLE WITH THE IP65 & IPX7 RATTING

4118 Series

- NEMA 17
- 1.8 Deg Step Angle
- IP65 and IPX7 Rated Motor
- Up to 125 oz-in (0.88 N-m) Holding Torque

5718 Series

- NEMA 23
- 1.8 Deg Step Angle
- IP65 and IPX7 Rated Motor
- Up to 294 oz-in (2.08 N-m) Holding Torque

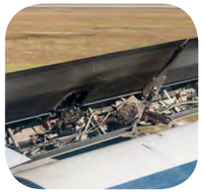
8718 Series

- NEMA 34
- 1.8 Deg Step Angle
- IP65 and IPX7 Rated Motor
- Up to 1,288 oz-in (9.09 N-m) Holding Torque

ADDITIONAL APPLICATIONS

Avionics

IP rated motors can be used in avionic devices which may be exposed to outside environment, such as communication and navigation equipment.

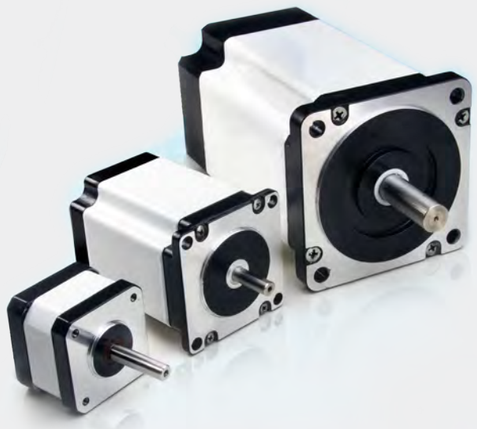


Control surfaces

Sealed motors are ideal for implementation in aircraft control surfaces that are exposed to harsh environment.

Externally mounted application

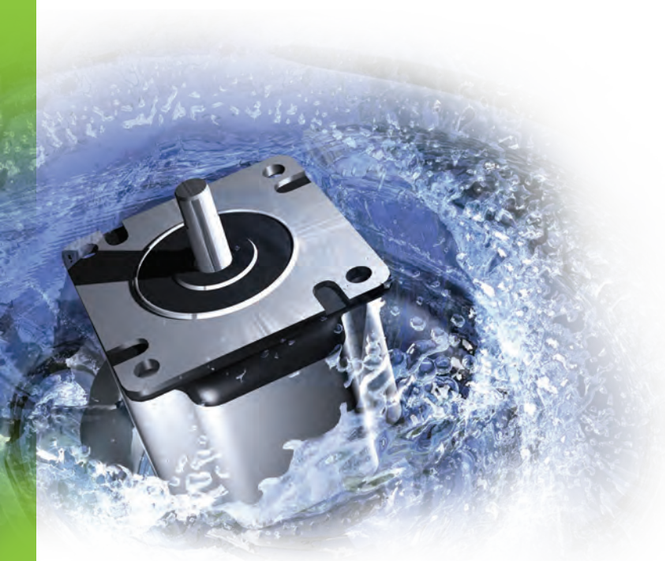
Any application that can come in contact with the outside environment.



Sealed Motors
IP65/IPX7

Features and Benefits

- Dust proof
- Water resistant
- Multiple stack lengths



Every new application creates its own restrictions and challenges, so when you discover that your motion system will have to operate in extreme environmental conditions, such as rain, dust, or even under water, what do you do?

Luckily, Lin Engineering continues to research, develop, and unveil cutting-edge technologies to facilitate wider and wider ranges of applications. While the company's standard lines of stepper motors are well-known for their durability, their IP 65 and IPX7 lines can also withstand harsh environments where typical motors will fail.

IP65 SEALED STEPPERS

The IP65 Rated Series provides dust proof operation, and can withstand low-pressure jets of water sprayed from all directions from a distance as close as three meters for extended periods of time. The water jets can be delivered at pressures of up to 30kPa, at a rate of 12.5 l/mi, and for durations of up to three minutes. In addition to extended protection from challenging environmental factors, the IP65 rated motors have a food grade coating, making them ideal for the wash down cycles of food processing applications.

IPX7 SEALED STEPPERS

The IPX7 Rated Series of motors are completely protected against dust and withstand immersion into liquids at depths of 15cm to 1m for up to 30 minutes or longer. Lin Engineering stepper motors are now available with an IPX7 Rating in three sizes—NEMA 17, 23, and 34. The motors are capable of producing holding torque up to 1,288 oz-in. Plus, unipolar and bipolar windings are available to allow for the torque and speed required to accommodate your specific application.

MOTORS AVAILABLE WITH THE IP65 & IPX7 RATTING

4118 Series
- NEMA 17
- 1.8 Deg Step Angle
- IP65 and IPX7 Rated Motor
- Up to 125 oz-in (0.88 N-m) Holding Torque

5718 Series
- NEMA 23
- 1.8 Deg Step Angle
- IP65 and IPX7 Rated Motor
- Up to 294 oz-in (2.08 N-m) Holding Torque

8718 Series
- NEMA 34
- 1.8 Deg Step Angle
- IP65 and IPX7 Rated Motor
- Up to 1,288 oz-in (9.09 N-m) Holding Torque

IP MOTORS APPLICATIONS

Food

Commonly used in food production and packaging applications. IP65 and IPX7 use FDA approved coatings and are suitable for wash-down procedures

Aerospace

IP65 and IPX7 stepper motors are routinely used in Aerospace applications where motors are exposed to extreme environments. For instance: wing control surfaces, landing gears, and other externally mounted applications. Our IP65 and IPX7 motors are assembled in accordance to AS9100D Aerospace standards.

Medical

Medical and Laboratory equipment such as liquid handlers or devices exposed to moisture or particles.

Harsh Environment

Any application where dust, liquids, or corrosion is of concern.

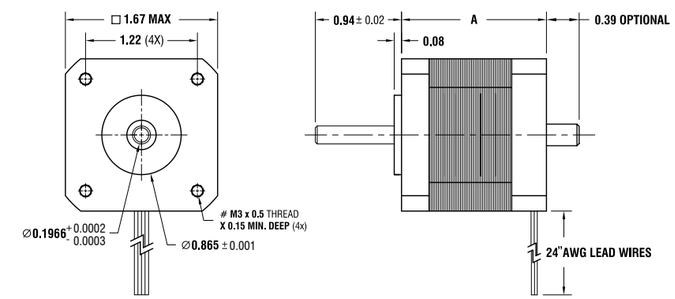
4118 Series

- NEMA 17 (42 mm)
- Up to 115 oz-in (0.81 N-m) Holding Torque

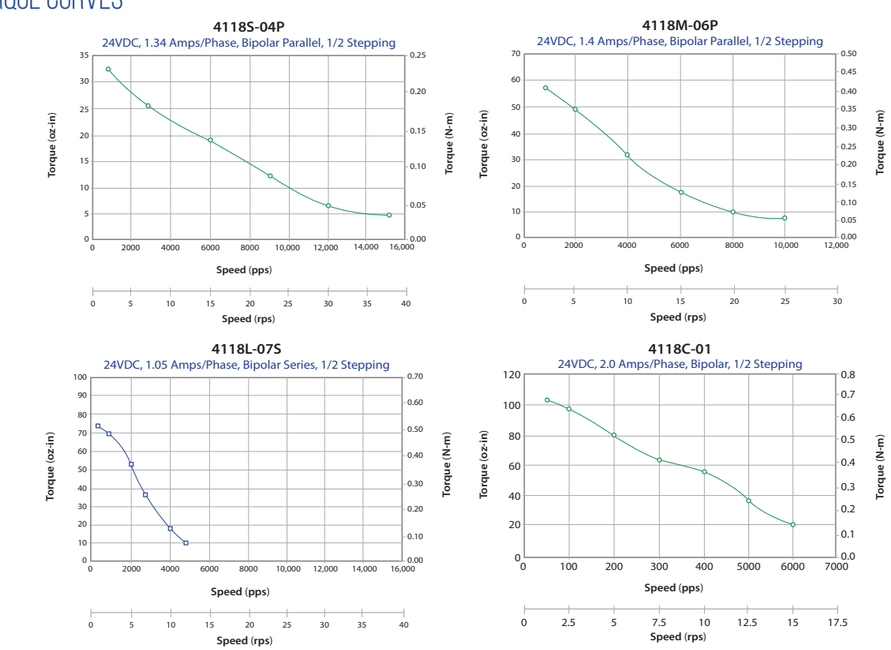
SPECIFICATIONS

Dimension A (MAX)	Model Number	Connection	Rated Current (Amps/Phase)	Holding Torque		Resistance (Ohms/Phase)	Inertia (oz-in²)	Weight (Lbs.)	Number of Leads
				(oz-in)	(N-m)				
1.34" (34.0mm)	**4118S-04P**	Parallel	1.34	42.0	0.30	2.50	0.18	0.40	4
1.58" (40.1 mm)	**4118M-06P**	Parallel	1.40	63.0	0.44	2.70	0.28	0.60	4
1.89" (48.0 mm)	**4118L-07S**	Series	1.05	83.0	0.59	5.20	0.37	0.70	4
2.34" (59.4 mm)	**4118C-01**	Bipolar	2.00	115.0	0.88	2.00	0.56	0.90	4

DIMENSIONS



TORQUE CURVES



More Torque Curves available online at www.linengineering.com

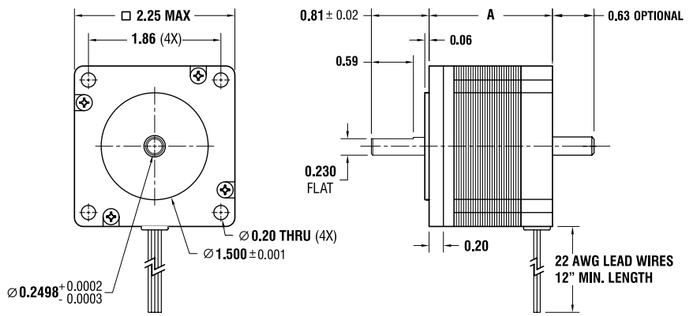
5718 Series

- NEMA 23 (57 mm)
- Up to 305 oz-in (2.16 N-m) Holding Torque

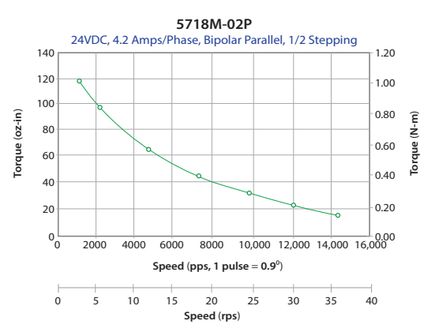
SPECIFICATIONS

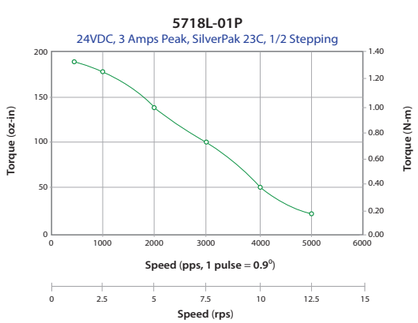
Dimension A (MAX)	Model Number	Connection	Rated Current (Amps/Phase)	Holding Torque		Resistance (Ohms/Phase)	Inertia (oz-in²)	Weight (Lbs.)	Number of Leads
				(oz-in)	(N-m)				
1.74" (44.2mm)	**5718X-01P**	Parallel	2.80	100.0	100.0	0.70	0.70	1.05	4
2.22" (56.4 mm)	**5718M-02P**	Parallel	4.20	173.0	173.0	0.50	1.50	1.50	4
3.10" (78.7 mm)	**5718L-01P**	Parallel	2.80	294.0	294.0	1.10	2.60	2.35	4

DIMENSIONS



TORQUE CURVES





More Torque Curves available online at www.linengineering.com

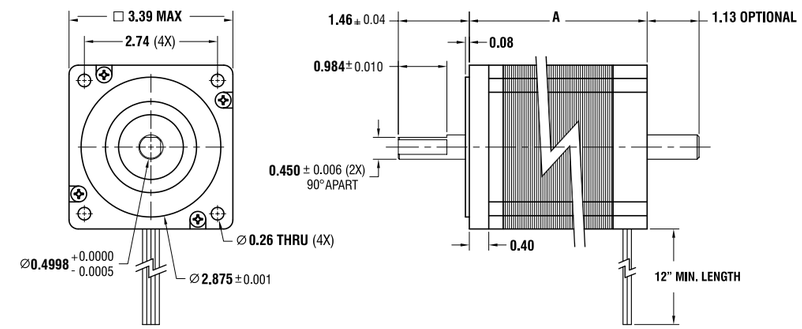
8718 Series

- NEMA 34 (80 mm)
- Up to 1288 oz-in (9.09 Nm Holding Torque

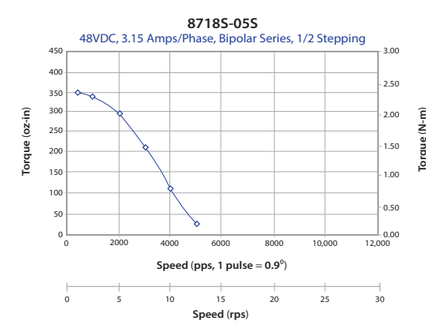
SPECIFICATIONS

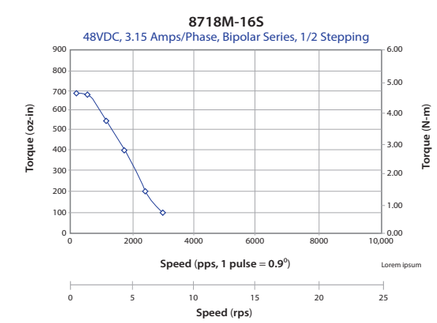
Dimension A (MAX)	Model Number	Connection	Rated Current (Amps/Phase)	Holding Torque		Resistance (Ohms/Phase)	Inertia (oz-in²)	Weight (Lbs.)	Number of Leads
				(oz-in)	(N-m)				
2.64" (67.1 mm)	**8708S-05S**	Series	3.15	434.0	3.06	1.00	7.66	3.85	4
3.82" (97.0 mm)	**8718M-16S**	Series	3.15	861.0	6.08	1.20	14.80	5.94	4
5.00" (127.0 mm)	**8718L-08S**	Series	3.85	1288.0	9.10	1.20	21.90	8.44	4

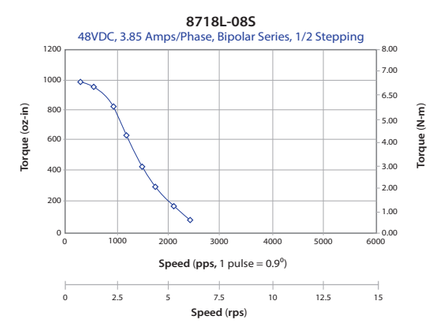
DIMENSIONS



TORQUE CURVES

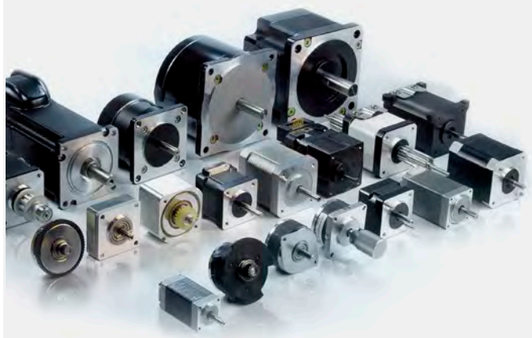






Ask us about more vacuum options:
- Bigger and Smaller motors
- 0.9˚ and 0.45˚ step angle

More Torque Curves available online at www.linengineering.com



Hot/Cold
SPECIALTY MOTORS

Lin Engineering standard motors are rated to operate in ambient temperatures between 50 degrees C and -20 degrees C. While this satisfies the majority of uses, there are certain applications that require the motor to operate at higher or lower temperature ranges than what standard motors allow for. Unfortunately, operating standard motors anywhere outside these temperature ranges will result in poor performance.

Like any specific application concerns, motors that must work under extreme conditions of hot and cold require critical design features to accommodate their use. Whether your application is situated in the heat of a desert or the freezing temperatures of the arctic, Lin Engineering has the expertise to provide the right motor for you. The company has designed two types of specialty hot/cold motors meant to operate specifically in extreme temperature ranges—Type I and Type II.

Magnet performance degrades at high temperatures unless a special alloy with high-temperature tolerance and high curie point is used—similar to what might be used in a space or vacuum motor depending on the application. For these applications, the wire has to have special insulation that can tolerate high heat as well. Upgraded insulation also helps to reduce stress fractures due to heat-up and cool-down cycles. Type II motors require additional insulation material to prevent burnout.

The bearings for hot/cold motors require special grease dependent on whether they are used in high or low temperature and can be selected at the time of purchase for the specific application they will be used for.

Through the use of higher grade, specially formulated materials, motors can be designed for extreme temperatures well beyond what a standard motor can withstand. Other factors that can affect motor use in extreme temperature situations includes how often the load is applied. Most standard motor ratings are for continuous duty operation, but if your load cycling specifications are anything less than continuous, it will affect your motor selection process.

Although most Lin Engineering motors are available as Type I components, we currently have two standard Type II motors available:

TYPE I

OPERATING CONDITIONS:

	Range
Ambient	-40°C to 80°C
Case Temperature	110°C to 230°C

TYPE II

OPERATING CONDITIONS:

	Range
Ambient	-40°C to 110°C
Case Temperature	110°C to 230°C

MOTOR OPTIONS

MOTOR FRAME	TORQUE RANGE
NEMA 8 (20mm)	up to 4 oz-in (0.03Nm)
NEMA 11 (28mm)	up to 16 oz-in (0.12Nm)
NEMA 17 (42mm)	up to 115 oz-in (0.81Nm)
NEMA 23 (57mm)	up to 305 oz-in (2.16Nm)
NEMA 34 (80mm)	up to 1,288 oz-in (09.09Nm)

APPLICATION EXAMPLES

Refrigerated Environments

Medical and Laboratory equipment such as liquid handlers or devices exposed to moisture or particles.

Heated Environment

Perfect for use in devices operating in heated environments or exposed to heat for extended periods of time.

DESIGNED FOR EXTREME SMOOTHNESS, STEADINESS, SPEED, AND STRENGTH

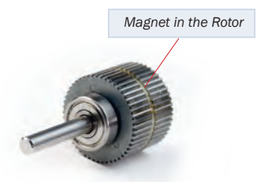
PATENTED DESIGN

Zero Detent Torque

Z417 - EXTREMELY ACCURATE AND SMOOTH

- √ NEMA 17, 0.9° Step Angle
- √ Virtually Zero Detent Torque
- √ High Step Accuracy
- √ Reduced Resonance
- √ Up to 28 oz-in (0.20 N-m) Holding Torque

Conventional Motor

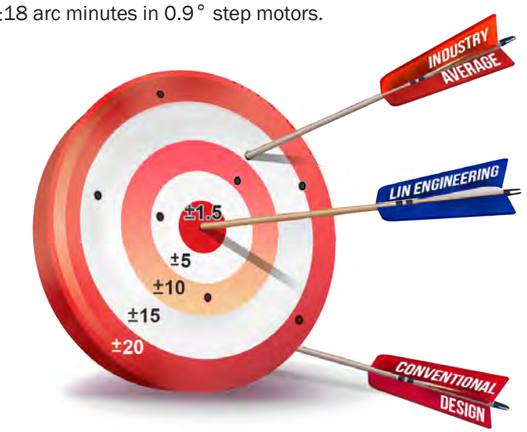


Z Series Motor

A conventional hybrid stepper motor utilizes a permanent magnet in the rotor. Our patented design uses a ring magnet in the stator instead. This drastically reduces the detent torque (unenergized drag torque) because the magnetic flux path is able to reach over the stator windings and only go through the outer edge of the rotor. Reducing detent torque improves accuracy, smooth operation and reduces noise. Best of all, modifying the magnet location does not change the dynamic torque.

Extreme Step Accuracy

Z-Series motor maintains ±1.5 arc minutes error under 64x microstepping. Industry average can range from ±4.5 to ±18 arc minutes in 0.9° step motors.



STEP ERROR IN ARC MINUTES

Quiet Operation

By eliminating detent torque, the motor operates substantially quieter than regular hybrid stepper motors.

Application

Z-Series motors are perfect for any application which requires extreme precision, smoothness, and quiet operation.

APPLICATION EXAMPLES

Scanners & Printers

Medical Tools

Semiconductor manufacturing

Camera stabilization & surveillance

PATENTED DESIGN

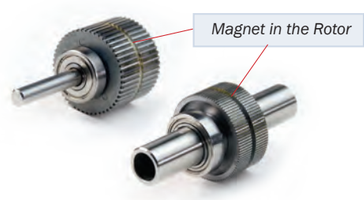
Large Diameter Hollow Shaft

ZH417

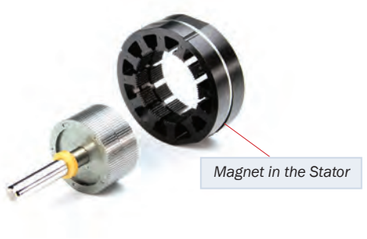
Same benefits of Z-Series motor with addition of:

- √ Hollow Shaft up to 11mm in diameter
- √ No Torque Loss Due to Large Hollow Bore
- √ Up to 33.5 oz-in (0.24 N-m) Holding Torque
- √ Smooth and Quiet Operation

Conventional Motor



ZH Series Motor



Conventional stepper motors cannot accommodate large diameter shafts without sacrificing torque and performance. Torque is dependent on the size of the magnet placed in the rotor. A large diameter shaft reduces space available for the magnet, thus sacrificing torque.

Since we've moved the magnet from the rotor into the stator stack, we can accommodate a large shaft without sacrificing torque or performance.

Performance

ZH-Series motors benefit from the same performance enhancements as the Z-Series motors. Eliminating the detent torque drastically improves the accuracy, smoothness and noise emissions.

Application

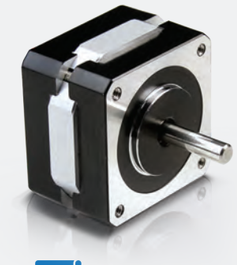
ZH-Series motors are perfect for any application which requires a hollow shaft. Hollow shaft lets you pass instrumentation through the motor and are ideal for:

APPLICATION EXAMPLES

Passing Optical Instruments

Feed through Cabling

Dispensing



PATENTED DESIGN

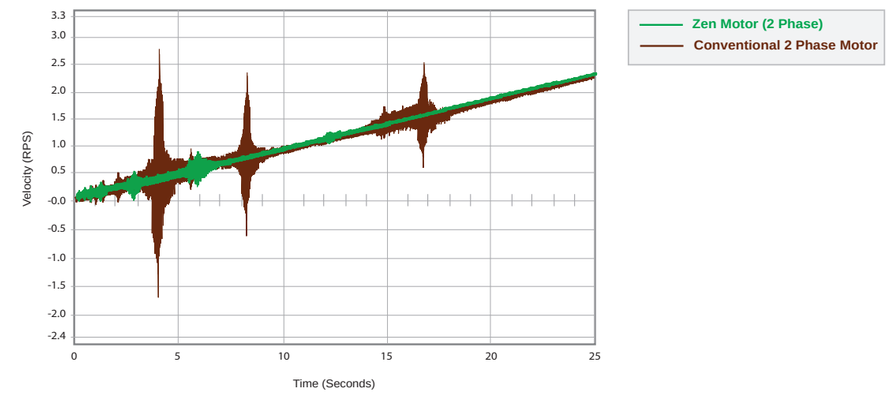
Low Vibration

ZN417

Same benefits of Z-Series motor with addition of:

- √ Low Vibration/Resonance
- √ Virtually Zero Detent Torque
- √ Up to 28 oz-in (0.20 N-m) Holding Torque
- √ Smooth and Quiet Operation

CONVENTIONAL MOTOR VS. ZEN MOTOR



Zen technology significantly reduces vibration without the use of external dampers: this results in extremely smooth and accurate motion.

Cost effective alternative to 5-phase systyems

With use of our Zen Technology we're able to reduce resonance by up to 50% over a standard motor. This makes the ZEN motors an attractive and cost effective alternative to costly 5-phase systems.

Application

Vibration can cause serious problems when smooth and precise motion is critical. This is especially the case in the semiconductor industry where assemblies are getting exponentially smaller or medial applications where precision and accuracy could literally be a life or death matter.

APPLICATION EXAMPLES

Precision surgical equipment

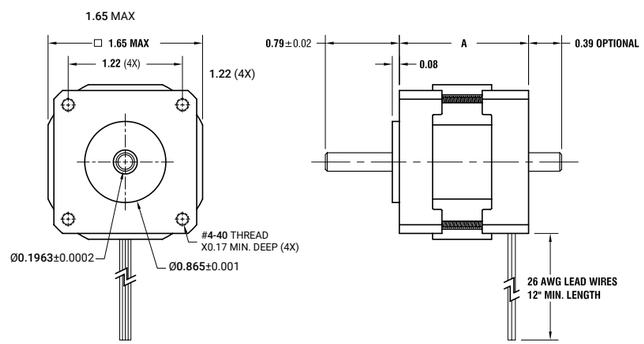
Semiconductor manufacturing

Z417 Series

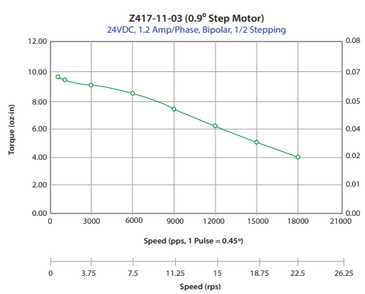
SPECIFICATIONS

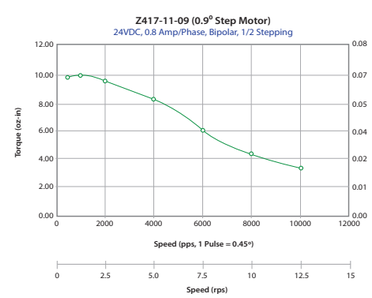
Dimension A (MAX)	Model Number	Rated Current (Amps/Phase)	Holding Torque		Resistance (Ohms/Phase)	Inertia (oz-in²)	Weight (Lbs.)	Number of Leads
			(oz-in)	(N-m)				
1.1" (27.9 mm)	Z417-11-03	1.20	12.5	0.08	2.95	0.07	0.31	4
	Z417-11-06	0.80	12.5	0.08	7.39	0.07	0.31	4
	Z417-11-09	0.80	12.5	0.08	10.21	0.07	0.31	4
	Z417-11-18	0.80	12.5	0.08	10.00	0.07	0.31	4
1.70" (43.2 mm)	Z417-17-01	0.50	28	0.20	18.2	0.14	0.53	4
	Z417-17-02	1.40	28	0.20	3.21	0.14	0.53	4
	Z417-17-03	1.10	28	0.08	5.13	0.14	0.53	4
	Z417-17-04	0.70	28	0.08	14.00	0.14	0.53	4

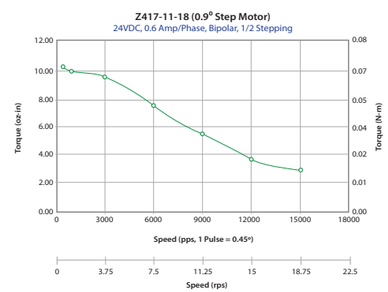
DIMENSIONS

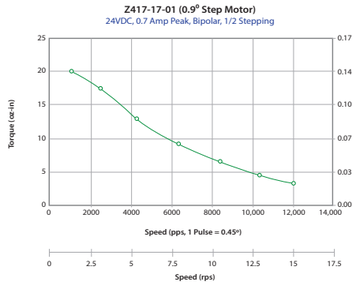


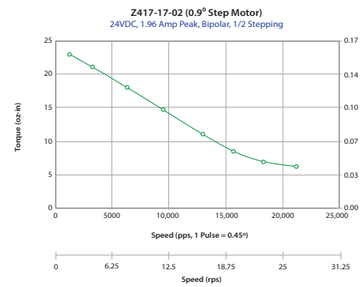
TORQUE CURVES

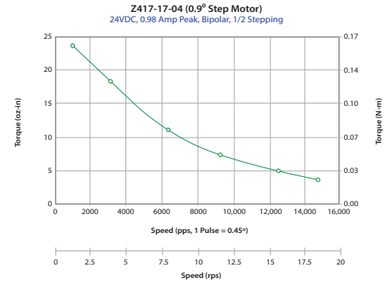












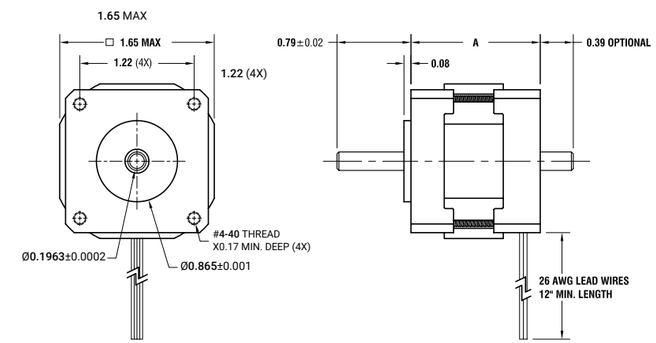
More Torque Curves available online at www.linengineering.com

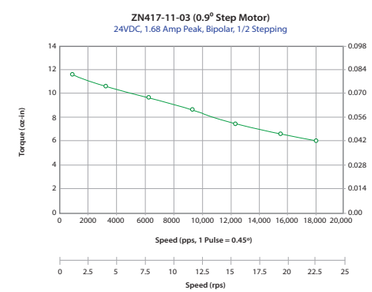
ZN417 Series

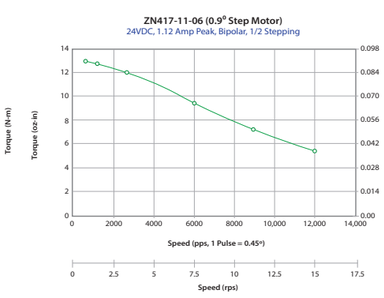
SPECIFICATIONS

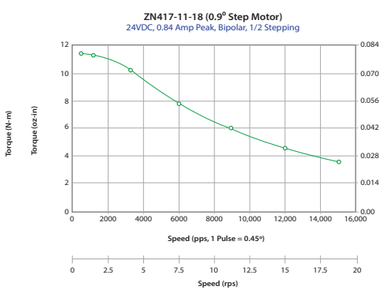
Dimension A (MAX)	Model Number	Rated Current (Amps/Phase)	Holding Torque		Resistance (Ohms/Phase)	Inertia (oz-in²)	Weight (Lbs.)	Number of Leads
			(oz-in)	(N-m)				
1.1" (27.9 mm)	ZN417-11-03	1.20	12.5	0.08	2.95	0.07	0.31	4
	ZN417-11-06	0.8 0	12.5	0.08	7.39	0.07	0.31	4
	ZN417-11-06	0.8 0	12.5	0.08	10.21	0.07	0.31	4
	ZN417-11-06	0.8 0	12.5	0.08	10.00	0.07	0.31	4
1.70" (43.2 mm)	ZN417-17-01	0.50	28.0	0.20	18.20	0.14	0.53	4
	ZN417-17-02	1.40	28.0	0.20	3.21	0.14	0.53	4
	ZN417-17-03	1.10	28.0	0.20	5.13	0.14	0.53	4
	ZN417-17-04	0.70	28.0	0.20	14.0	0.14	0.53	4

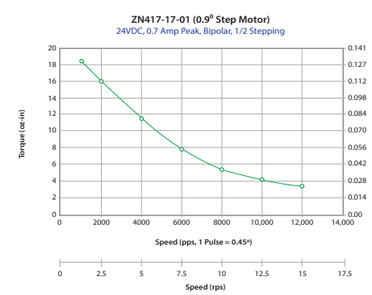
DIMENSIONS

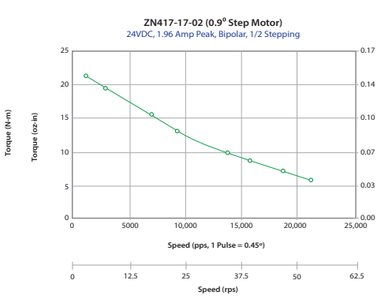


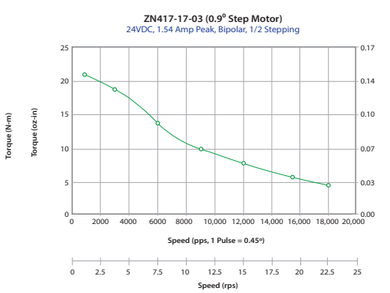












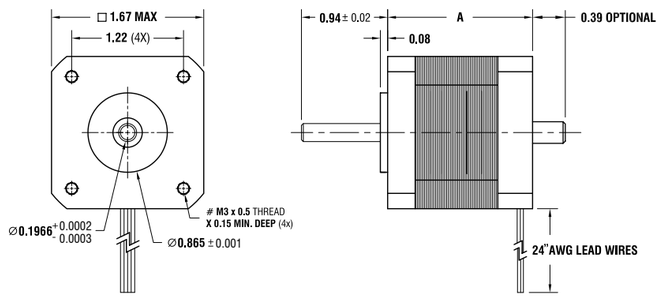
More Torque Curves available online at www.linengineering.com

Z417 Series

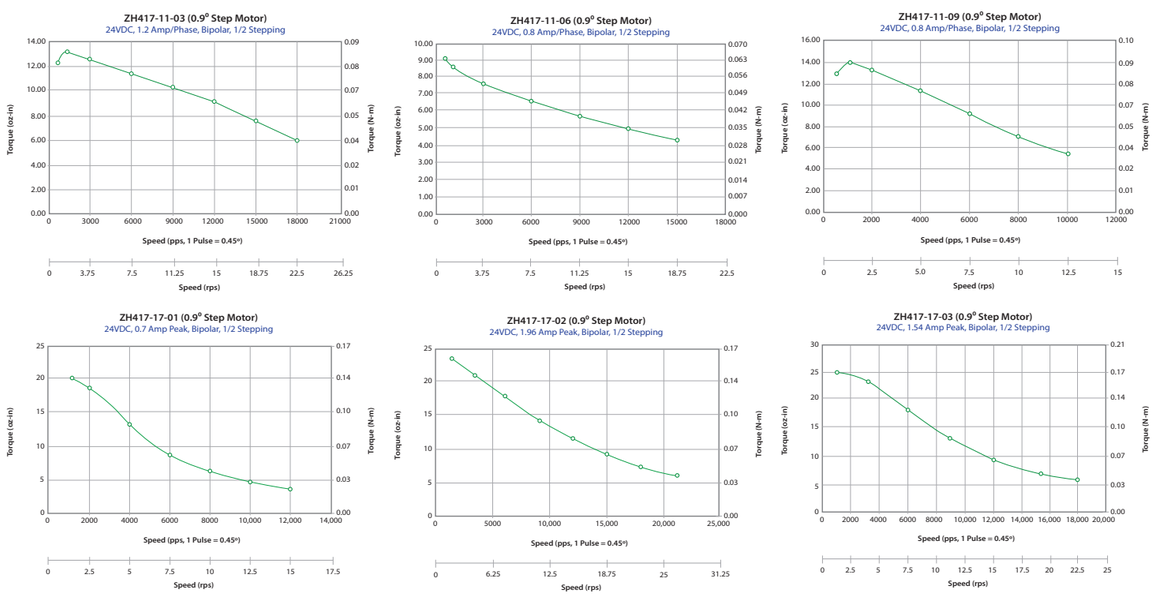
SPECIFICATIONS

Dimension A (MAX)	Model Number	Rated Current (Amps/Phase)	Holding Torque		Resistance (Ohms/Phase)	Inertia (oz-in²)	Weight (Lbs.)	Number of Leads
			(oz-in)	(N-m)				
1.1" (27.9 mm)	ZH417-11-03	1.20	17.4	0.12	2.85	0.12	0.35	4
	ZH417-11-06	0.8 0	17.4	0.12	7.35	0.12	0.35	4
	ZH417-11-09	0.80	17.4	0.12	10.23	0.12	0.35	4
	ZH417-11-13	0.60	17.4	0.12	10.66	0.12	0.35	4
1.70" (43.2 mm)	ZH417-17-01	0.50	33.5	0.24	18.60	0.14	0.54	4
	ZH417-17-02	1.40	33.5	0.24	3.35	0.14	0.54	4
	ZH417-17-03	1.10	33.5	0.24	5.42	0.14	0.54	4
	ZH417-17-04	0.70	33.5	0.24	13.70	0.14	0.54	4

DIMENSIONS



TORQUE CURVES

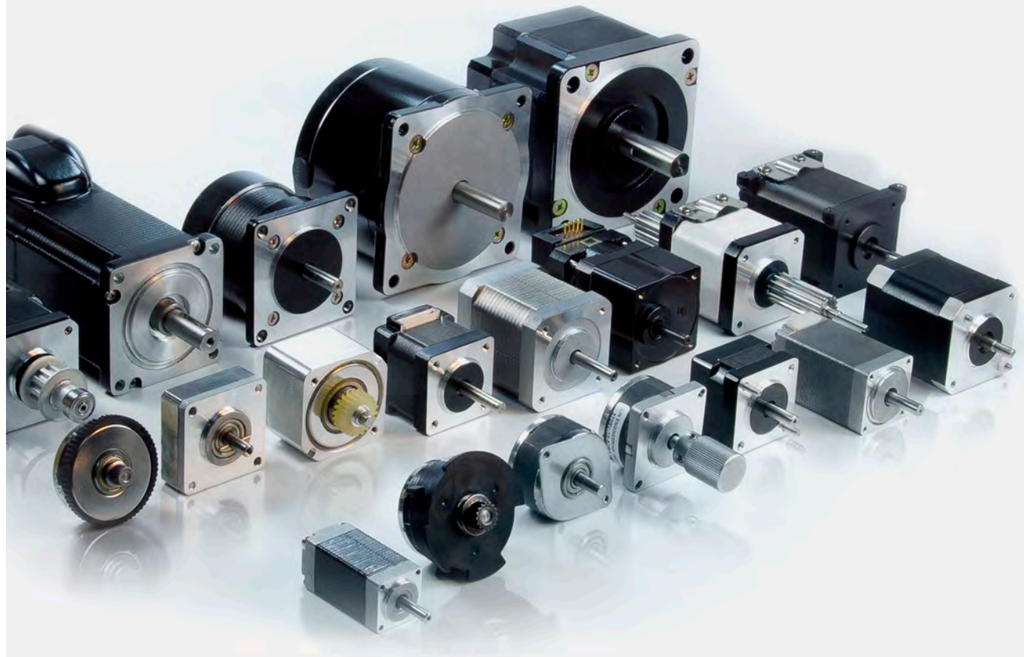


More Torque Curves available online at www.linengineering.com

Ask us about more vacuum options:

- Bigger and Smaller motors

- 0.9˚ and 0.45˚ step angle



Hercules
STEPPER MOTORS

EXTREME TORQUE IN A SMALL PACKAGE

- √ Up to 40% More Holding Torque
- √ Less Resonance
- √ More Efficient

HOW DO THE HERCULES STEPPER WORKS?

Inherently, every stepper has flux leakage which equates to torque loss. By inserting magnetic pins within the rotor, Lin Engineering was able to mitigate flux leakage, resulting in improved torque by up to 40%.

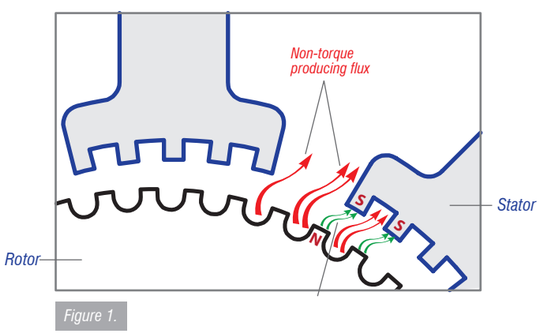


Figure 1.

Standard Stepper Motors

Figure 1. Typical Stepper Motor Flux Path

All standard stepper motors experience some non-torque producing flux, or flux leakage

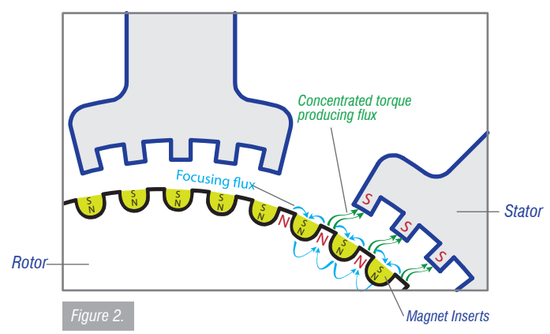
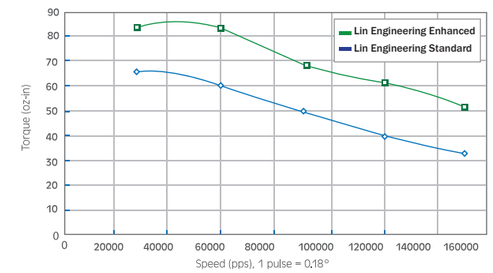


Figure 2.

Hercules Stepper Motor from Lin Engineering

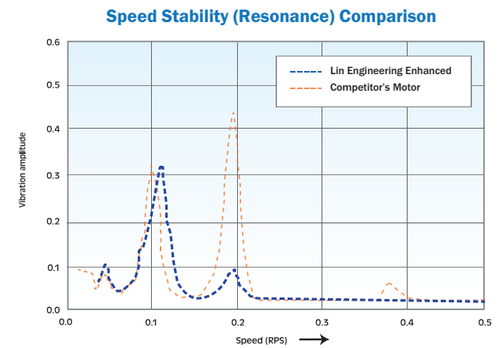
Figure 2. Lin Engineering Hercules Motor Flux Path

Magnet pins are located between rotor teeth. Full circumferential coverage over rotor increases focusing flux and overall torque performance



MORE HOLDING TORQUE

Hercules steppers provide up to 40% more torque throughout the entire speed range than standard motor of the same size.



LESS RESONANCE

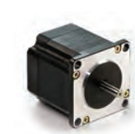
Hercules steppers generate less resonant frequency due to the oscillation. Making the motor smoother, quieter, and precise.

AVAILABLE HERCULES MOTORS

NEMA 23 | 1.8° Step Angle

E5618

HOLDING TORQUE
Up to 150 oz-in
(1.06 N-m)
2.01" Max body length



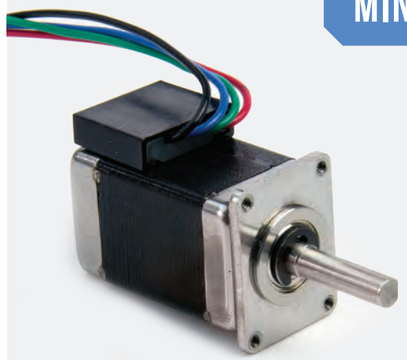
E5718

HOLDING TORQUE
Up to 600 oz-in
(4.20 N-m)
3.54" Max body length

NEMA 34 | 1.8° Step Angle

E8718

HOLDING TORQUE
Up to 1500 oz-in
(10.59 N-m)



PATENTED DESIGN PENDING

106
HYBRID STEPPER MOTORS

- √ Just 16mm Wide - our smallest Hybrid Stepper
- √ 4x More Holding Torque than Can Stack PM Steppers
- √ 5x More Accurate than Can Stack PM Steppers
- √ Operates at over 8,000 RPM

JUST
16MM WIDE
OUR SMALLEST
HYBRID STEPPER

The 106 measures just 16mm in width, making it one of the smallest Hybrid Stepper Motors on the market today. The NEMA 6 frame size means that the 106 Hybrid Stepper Motor can be designed into challenging spots with minimal allotted space. Spots where conventional hybrid stepper motors could not previously fit. This opens up a far broader Engineering flexibility and the ability to design much smaller equipment.

By increasing the step angle from a typical 1.8 degree to 3.46 degree, we are able to achieve nearly twice as much holding torque as the closest competing design, and nearly four times more holding torque than a conventional permanent magnet (PM) stepper motor of similar size (which usually top-out at only 0.5 oz-in of holding torque).

BIG PUNCH
4X MORE
HOLDING TORQUE

5X
MORE ACCURATE

A typical PM motor may only deliver 20 steps per revolution, or a step angle of 18 degrees. In comparison, our 3.46 degree motor delivers 5.7 times higher resolution than a typical PM motor. High resolution translates to higher precision. The 106 offers all of the benefits of a hybrid stepper, and none of the drawbacks of a PM motor.

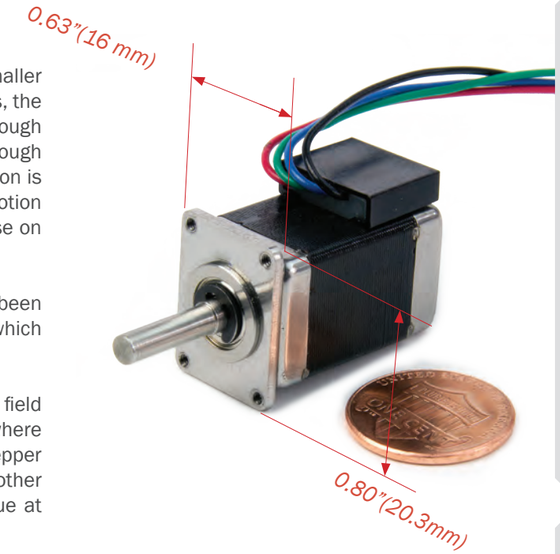
The 106 can deliver similar speed performance of a BLDC motor. By combining the 3.46 degree step angle with our low inertia rotor design, we are able to achieve over 1 oz-in of dynamic torque at 8,000 RPM.

OVER
1 OZ-IN OF DYNAMIC TORQUE
AT 8,000 RPM

One of the biggest problems Engineers face while designing ever-smaller devices is making things move. As the size of equipment decreases, the demand for smaller motors increases. However, oftentimes small enough motors simply don't exist, and if they do, they do not provide enough torque or speed to be useful in the application. Often, the only option is to use a large framed motor and shrink everything else around it. Motion control is the real bottleneck which forces Engineers to compromise on the footprint of their device.

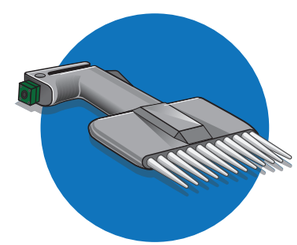
Our new 106 Hybrid Stepper Motor is what many Engineers have been waiting for. It solves many of the problems in motion control which prevented equipment from getting smaller.

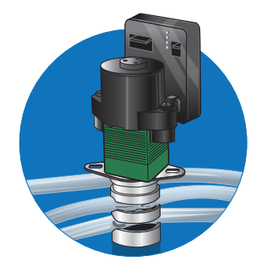
By applying our experience and our Engineering know-how in the field of Hybrid Stepper Motor technology, we were able to succeed where many have failed. We've successfully created a NEMA 6 sized stepper motor that delivers plenty of performance. The 106 outperforms all other motors of similar size on nearly all metrics: it delivers more torque at higher speeds with greater accuracy.

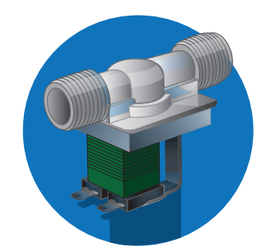


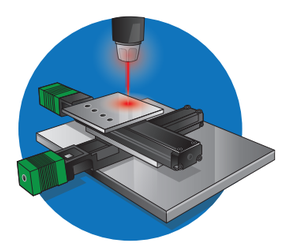
APPLICATION EXAMPLES

The 106 is a perfect candidate for many applications that require tiny motors, especially in the field of medical devices and laboratory automation. Applications that require high degree of precision like miniature pumps, fluid metering and control, and optical sensor controls can take advantage of the 106 motor. The 106 can even be incorporated into motorized hand tools like electronic pipettes, and other handheld devices where Hybrid Stepper Motors were previously impossible to integrate.

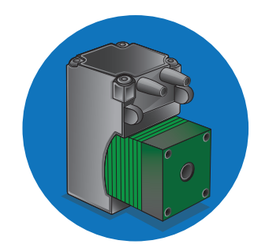

Handheld Tools


Pinch Valves


Flow Control Valves


Optical Sensor Control


Shutter/Aperture Control


Pump

SLIM & COMPACT

PATENTED DESIGN

Small, Smooth, & Extremely Precise

STEPPER MOTORS

3709

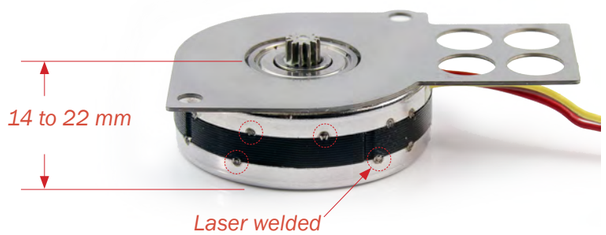
- √ NEMA 14, 0.9° Step Angle
- √ Signature Series Technology for ultimate smooth motion and high accuracy
- √ 8 different mounting options
- √ Up to 16 oz-in (0.12 N-m) holding torque.

THIN & COMPACT

3709 Series motors feature a flat/puck-shaped design and range from 14 to 22 mm in thickness. Making the motor a perfect fit for compact and portable devices, where size or weight is essential.

HOW DID WE DO IT?

The motors feature a unique end-cap design that incorporates the bearings, and the entire unit is sealed and laser welded for strength and longevity of the product. Being resourceful allows us to create a very compact motor.



HIGH TORQUE

3709 Series motors are capable of producing up to 16 oz-in of holding torque. This is quite astounding for such a small motor.

MULTIPLE MOUNTING OPTIONS

Motors are offered in variety of standard mounting options in NEMA 17 offsets. Available hole patterns include Thru hole DO 0.13, #4-40 UNC and M3 x 0.5.

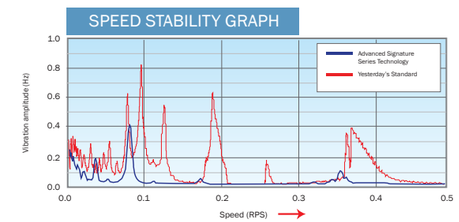
Additionally, Lin Engineering can place the motor in almost any customer supplied/designed housing imaginable. Multiple Shaft options are also available.

PATENTED

PART OF OUR SIGNATURE SERIES

0.9 Degree step angle ensures smooth motion, while Signature Series further reduces resonance for higher accuracy. The Signature Series was developed to help reduce system resonance and provide overall smooth motion.

Depending on Application, using motors with the Signature Series technology may result in up to 40% less resonance being produced.



REDUCE RESONANCE

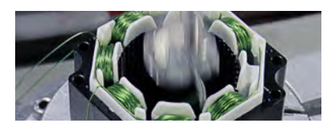
Depending on application, Signature Series Stepper Motor user can expect anywhere from 10-40% less resonance being produced.

STEP ERROR IN ARC MINUTES

INCREASE ACCURACY

The design creates double the detent positions (un-energized cogging) in the standard stepper. When doubled, the amount of torque or drag that each detent position has is decreased by half, thus creating a smoother motor during operation.

AVAILABLE OPTIONS



Custom Winding
Custom windings can insure maximumtorque at a desired speed. This service is offered free of charge.

Customized Leads
Custom connections can range from EMI or IP protection, to custom color coding.

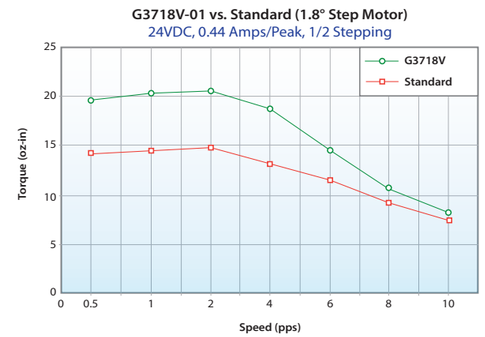
Various Shaft Options
With in-house machining capabilities, we're able to provide a variety of shaft options at a cost effective price with minimal lead times.

Compact & Powerful

STEP MOTOR

G3718V

- √ Improved passive cooling by design
- √ Up to 50% more torque than similar size motors
- √ Smooth Motion, high accuracy similar to a 0.9° motor
- √ Holding Torque: Up to 25 oz-in (0.18N-m)



IT'S SMOOTH, QUIET, ACCURATE, AND DELIVERS AMPLE AMOUNT OF TORQUE

This stepper motor is a 1.8 degree per step motor, but it is as smooth as Lin's smoothest 0.9 degree stepper. With all the know-how and technology that Lin Engineering brings, implementing key design aspects from the 0.9 line into the G3718V has created a motor that wins in both smoothness, accuracy and torque. In traditional designs, one must compromise torque for smoothness or vice versa. With the G3718V, you can still get both.

IT RUNS COOLER

The G3718V whisper torque motor incorporates a heat-sink design within the stator laminations to allow for passive cooling. When your motor operates cooler, you can increase power to gain more torque without overheating, or you can save energy and still perform at an optimal performance. This is what makes all G-series steppers from Lin so unique: the motors are green and energy efficient.

IT'S SLIMMER

The G3718V is slim by design. End caps are laser welded to the stator, eliminating much wasted space in traditional stepper motor designs. This laser welding assembly eliminates the need for assembly screws to hold the motor together. This unique construction offers great length to torque ration. At only 22.8mm long, the motor produces 25 oz-in of torque. Applications can mount this motor by utilizing the 4 through holes that are designed into the stator lamination.

IT'S CUSTOMIZABLE

If encoder feedback is needed, the sleek and slim CUI encoder is a great addition to the G3718V. The CUI incremental encoder uses a patented capacitive ASIC Technology with low power consumption. Choose from various quadrature resolutions up to 2048.

APPLICATION EXAMPLES

PE Eletronic Assembly

SMT Placement

PTZ Camera

Laboratory automation system

AVAILABLE OPTIONS

Custom Winding
Custom windings can insure maximumtorque at a desired speed. This service is offered free of charge.

Customized Leads
Custom connections can range from EMI or IP protection, to custom color coding.

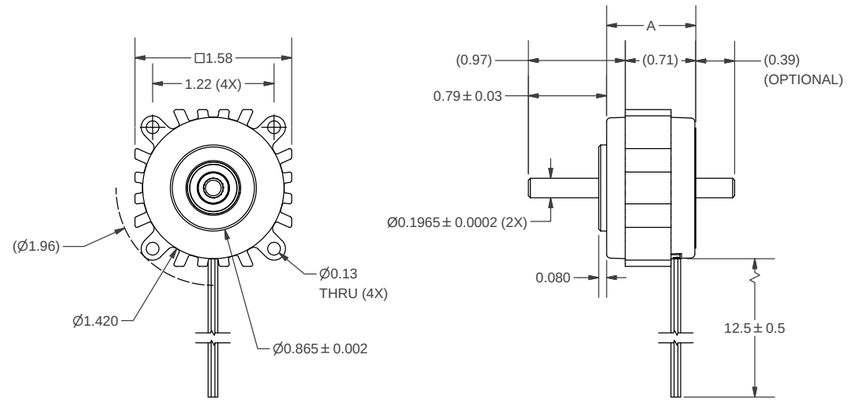
Various Shaft Options
With in-house machining capabilities, we're able to provide a variety of shaft options at a cost effective price with minimal lead times.

G3718V MOTOR OPTIONS

SPECIFICATIONS

Dimension A (MAX)	Model Number	Rated Current (Amps/Phase)	Holding Torque (oz-in)	Holding Torque (N-m)	Resistance (Ohms/Phase)	Inertia (oz-in^2	Weight (Lbs.)	Number of Leads
0.90" (22.86 mm)	**G3718V-01**	0.44	25	0.18	18.00	0.08	0.29	4
0.90" (22.86 mm)	**G3718V-02**	0.65	25	0.18	8.42	0.08	0.29	4
0.90" (22.86 mm)	**G3718V-03**	1.20	25	0.18	2.33	0.08	0.29	4
0.90" (22.86 mm)	**G3718V-04**	1.60	25	0.18	1.39	0.08	0.29	4
0.90" (22.86 mm)	**G3718V-05**	0.30	25	0.18	33.13	0.08	0.29	4

DIMENSIONS



TORQUE CURVES