STEP MOTORS

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PowerPlus Technology

MOONS' PowerPlus technology provides 25% to 40% more torque across the entire speed range of the motor. The increased torque is a result of higher motor efficiency, and is available without increasing the drive voltage or current.

Typical Applications:

Machine Upgrades: Changing existing machines to PowerPlus motors can be a quick path to new models with improved performance. Because the motor, drive and mechanical parts remain the same, benefits include:

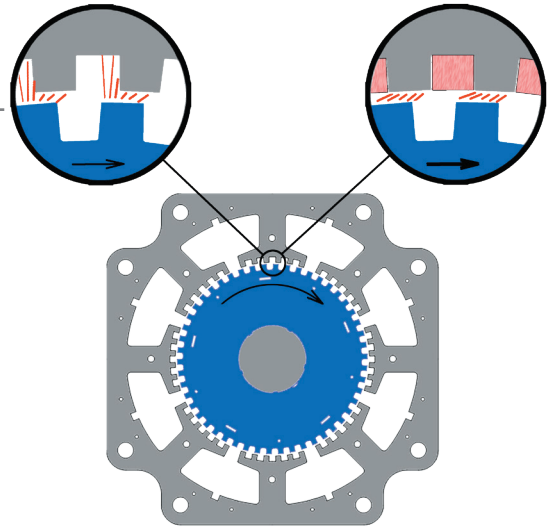
- Faster new product introduction
- Reduced engineering costs
- Easy production phase in
- Reduced spare parts inventory

Correct stalling problems with existing machines:
Problems with occasional machine stalling are often due to unexpected field conditions such as: low temperature, dirt, and customers using machines in unexpected ways. Using PowerPlus motors can be a quick effective solution.

Overcome drive or power supply limitations in new designs:
Often a higher current drive or higher voltage power supply can provide needed extra torque. However, in many designs the drive current cannot be increased without changing to a substantially more expensive drive. And increasing drive voltage can be impractical, expensive, or may not be allowed for safety reasons. In these cases using PowerPlus motors can be especially useful.

Conventional Motor

Some of the torque producing magnetic flux that links the rotor to the stator is outside the stator teeth. This stray flux adds little to motor torque.



PowerPlus Technology

Magnets placed between the stator teeth redirect most of the stray magnetic flux into the stator teeth. This produces additional torque with the same input power.

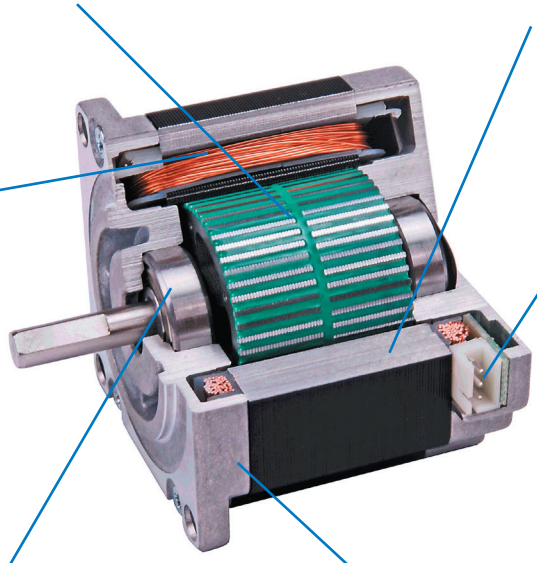
MOONS' Step Motor Advantages

These step motors from MOONS' include a number of improvements for even greater performance and value:

- Many refinements that increase torque by an average of 20%
- Complete range of sizes: 8, 11, 14, 16, 17, 23, 24, 34, 42
- Size 17 and larger 2 phase motors are UL recognized
- 0.9 degree 2 phase motors, and 3 phase motors for extra smooth, quiet, performance
- PowerPlus technology: for maximum efficiency and performance at all speeds
- Lower inertia rotors provide faster acceleration
- High voltage insulation for use with high voltage, high performance drives
- Low loss stators have better high speed performance
- Standard windings with high fill for more torque
- Updated model numbering system includes a wider range of windings and standard options

Rare earth magnets and optimized rotors designed for maximum torque, and high efficiency

Laminations optimized for high torque, high accuracy and low losses.



Stators with maximum winding fill for lower temperatures, long life and maximum torque

Connectors integrated into motors for quick reliable connections.

Large ball bearings, also optimized for short repetitive moves to ensure long life.

Die cast endbells provide strength, precision, and help cool the motor.

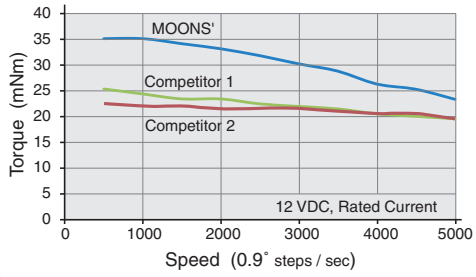
Encapsulated Motors

Encapsulation Technology From MOONS' Offers Many Advantages

Ideal for Security Cameras
In addition to all the advantages of normal step motors, these new encapsulated motors can help achieve a breakthrough in miniaturization of security cameras. Small step motors are a core component in security camera systems. With MOONS' encapsulation technology, the 36mm diameter motor is now available with a thickness as little as 12.8mm.

Low Temperature Rise
The winding resistance of these new motors is nearly 30% lower than other motors with the same thickness and output-torque. In addition, the new encapsulation technology increases the heat-conducting property of these motors. The lower winding resistance and improved thermal conductivity combine to drastically lower the temperature of these motors to less than 80% of standard motors.

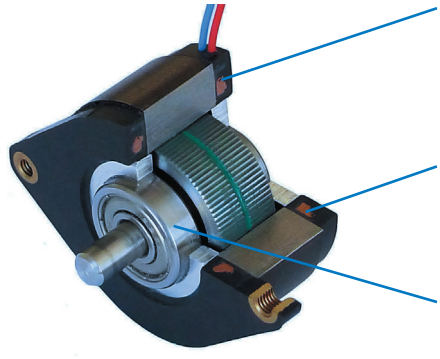
35% More Torque
Lower resistance coils allows these encapsulated motors to handle more power. With the same temperature rise. These motors can produce 35% more torque.



Quieter & Smoother
New materials and improved manufacturing processes, means these motors have a higher precision, more stable design. This controls vibration and reduces noise. It also makes the motor run smoothly.

More Load & Longer Life
MOONS' encapsulated stepping motors use large bearings that can handle large axial and radial loads, ensure long life.

RoHS
Encapsulated stepping motors are RoHS compliant.



Molded Construction

Encapsulated winding	Runs cooler – Longer life
Better sealing	Longer life
Reduced vibration	Smoother moves - Quieter

High Winding Fill

Larger wire size	More torque
Uses less energy	Longer battery life

Large Ball Bearings

Large shaft loads	Fewer design restrictions
Long Life	27 times with the same load

2 Phase and 3 Phase Motors

MOONS' offers several families of hybrid step motors with a different number of phases and step angles. Each has a combination of advantages that are better suited to specific applications.

- **2 Phase - 1.8 degree step angle**
  This is the most popular step motor. It has a great combination of torque, speed and accuracy. Due to their high volumes, drives for 2 phase motors are very common and economical.

  The basic method of control is to have the motor make one full step as the drive applies full current to the motor windings. This causes the motor to move in full step increments. When the motor is stepped at different rates it may make a distinctive sound and can vibrate (resonate) at certain speeds. This is not a problem for most applications. If it is an issue, motors can be controlled with micro-stepping drives that smooth motor torque. And many times, resonate speeds can simply be avoided by programming the drive.

  MOONS' offers 2 phase 0.9 degree step motors, and three phase 1.2 degree step motors, for applications that need even more accuracy, or motion that is very smooth and quiet.

- **2 Phase - 0.9 degree step angle**
  Because each step moves only ½ the distance of 1.8 degree motors, these motors have higher accuracy and very smooth movement. The drive for this motor is exactly the same as the 2 phase, 1.8 degree motors. For the same speed, these motors must have a step rate that is 2 times that of a 1.8 degree motor. This higher step rate leads to less torque at high speeds. However, for many applications high speed is not needed, or higher voltage drives can be used to increase torque at high speeds.

14HK0 Shown Full Size

  An example of a good application for 0.9 degree motors are security cameras. These motors allow the camera to be precisely moved without "camera shake" which causes the picture to vibrate. MOONS' offers small encapsulated sizes that reduce camera package size, and helps withstand the outdoor environment.

- **3 Phase - 1.2 degree step angle**
  The use of three phases inherently helps to reduce torque ripple and smooth motor performance. 3 phase motors require a 3 phase drive that is different than the drive for 2 phase motors. As compared to the 1.8 degree two phase motors, the low speed torque is somewhat less. But design improvements introduced by MOONS', minimizes this difference. High speed torque can also be comparable. In addition, MOONS' size 24 three phase motors are available with PowerPlus technology, for maximon torque.

  3 phase motors are used where maximum performance, and very quiet, smooth precise movement is need. An example of a good application for three phase motors is in performance lighting. These spotlights lights need quick movement, and quiet operation so as not disturb the performance.

Model Numbering System

Models starting with M or P

M S 17 HD 2 P 4 040 -M

Stator - Series

M	Standard Step Motor
P	PowerPlus Step Motor

Rotor

S	Standard Inertia	Size 8,11,14,16,17,23,24
L	Lower Inertia	Size 23,24,34,42

Frame Size

##	8,11,14,16,17,23,24,34,42

Motor Technology

HA	Hybrid Step Motor, 2 Phase 0.9 degree
HD,HS	Hybrid Step Motor, 2 Phase 1.8 degree
HC	Hybrid Step Motor, 3 Phase 1.2 degree

Length Code

#	Non significant number or letter

Connection Construction / IP Rating

L	Leads	IP40
P	Plug In Connector - Standard	IP40

Number of connections / Winding Type

4	Bipolar
6	Unipolar (can be used bipolar)
8	Can be connected any way

Winding Current

###	Current rating x 100 050 = 0.5 amps, 500 = 5 amps
X##	for 11 to 19 amps: X10= 11 amps, X40 = 14 amps

Options

Omit	No Options
-E	Standard English rear shaft
-M	Standard Metric rear shaft

Other Models

14 HC 0 3 01 N

Frame Size

##	8,11,14,16,17,23,24,34

Motor Technology

HK,HA	Hybrid Step Motor, 2 Phase 0.9 degree
HY,HD,HS	Hybrid Step Motor, 2 Phase 1.8 degree
HC	Hybrid Step Motor, 3 Phase 1.2 degree

Length Code

#	Non significant number or letter

Connection Construction / IP Rating

0	Plug In Connector - Standard	IP40
3,4,8	Number of Leads	IP40

Winding Current

##	Non significant number

Optional Construction Code

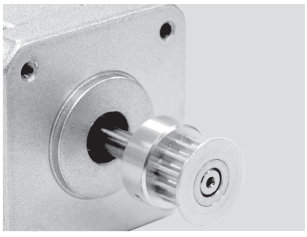
-##
N

Custom Motors

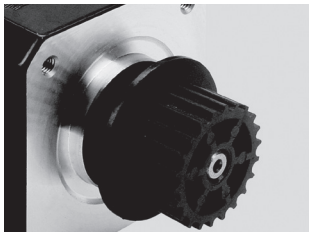
MOONS' provides motors to meet the needs of many applications.
Common modifications include:

- Corrosion resistant motors. These are often used in outdoor equipment where humidity and temperature changes can cause corrosion.
- Sealed motors to keep out dust and water
- Special shaft sizes and features
- Pulleys, gears and couplings mounted on the shaft
- Encoders and other feedback devices
- Special lead lengths or cables, with many different connectors

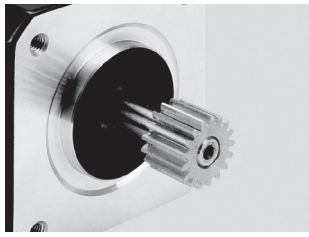
Press Fit Pulley & Gear



Metal Pulley

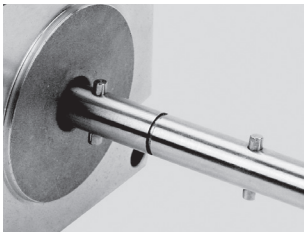


Plastic Pulley

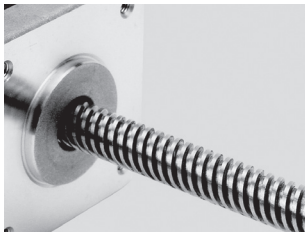


Gear

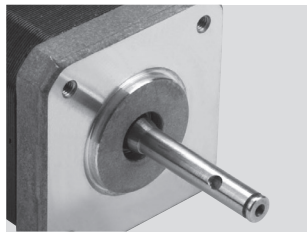
Shaft Options



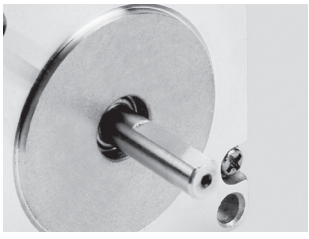
Dowel



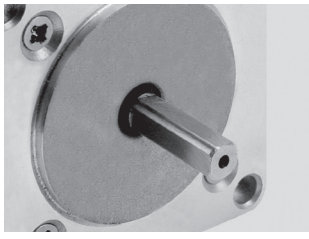
Worm Shaft



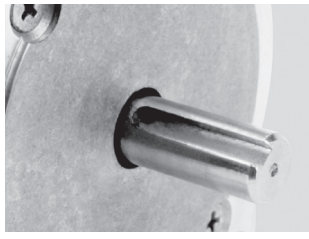
Cross Drilled Shaft



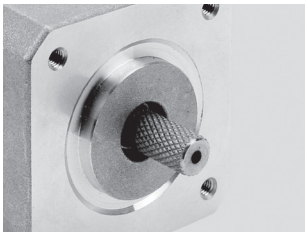
Single Flat



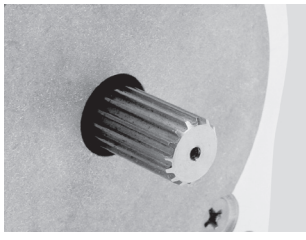
Double Flat



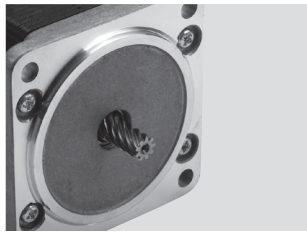
Key Way



Knurl



Hobbed Gear



Helical Cut

MS08HY Series: 1.8° - Size 8

- Phases 2
- Steps / Revolution 200
- Step Accuracy ±5%
- Shaft Load (20,000 Hours at 1000 RPM)
  - Axial: 6 N (1.3 Lbs.) Push; 25 N (5.6 Lbs.) Pull
  - Radial: 18 N (4 Lbs.) At End of Shaft
- IP Rating 40
- Approvals RoHS
- Operating Temp. -20°C to +50°C
- Insulation Class B, 130°C
- Insulation Resistance 100 MegOhms

MS08HY 1 P 4 050 -M

Basic Motor Length (Max)
- **1** 29.5 mm (1.16 in.)
- **3** 39.5 mm (1.56 in.)
- **5** 46.5 mm (1.83 in.)

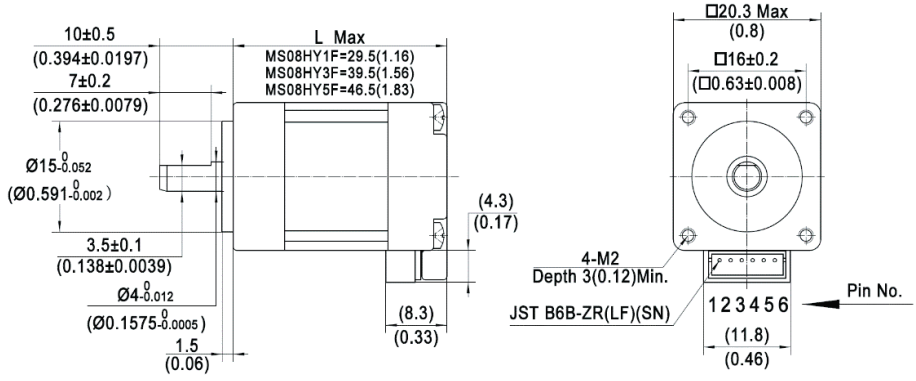
Electrical Connection
- **P** Side facing plug
- **F** Front facing plug
- **R** Rear facing plug
- **L** Lead wire type

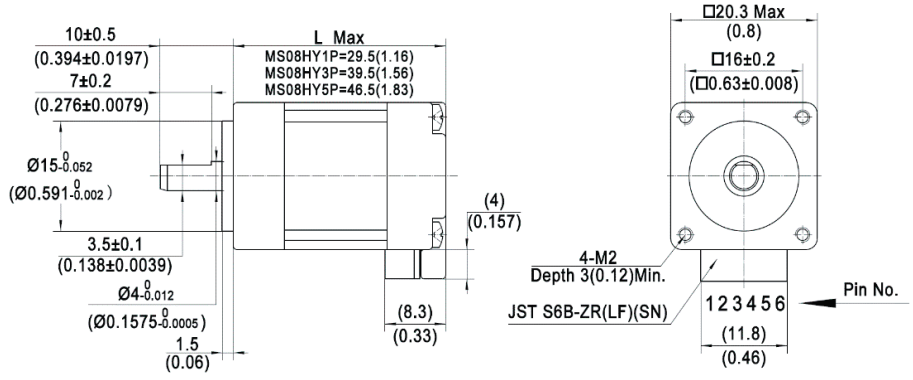
Number of Connections
- **4** 4 Lead - Bipolar
- **6** 6 Lead - Unipolar (or Bipolar)

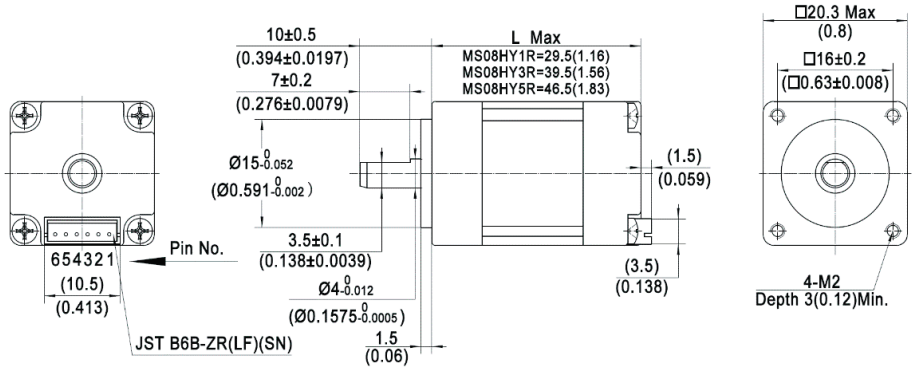
Winding
- **###** Current rating x 100

Options
- **-M** 4 mm diameter rear shaft with encoder mounting holes

Dimensions: mm (in)







MS08HY - 4 Lead Bi-Polar

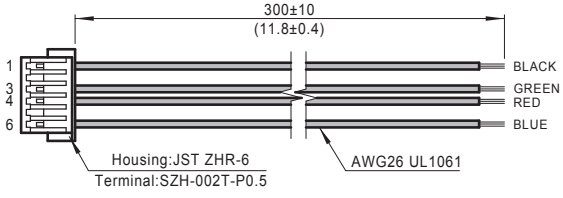
Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms mH		Detent Torque		Rotor Inertia		Motor Weight	
	Single Shaft	P=Side Plug F=Front plug R=Rear plug	Amps (mounted)	Nm Typ.	oz-in TYP.	@20 C	Typ.	mNm	oz-in	g cm²	oz-in²	kg	Lbs
29.5mm (1.16in.)	^ MS08HY1P4050 ^ MS08HY1F4050 ^ MS08HY1R4050	P F R	0.5	0.032	4.53	8.6	5.6	2	0.28	1.6	0.009	0.04	0.09
39.5mm (1.56in.)	^ MS08HY3P4060 ^ MS08HY3F4060 ^ MS08HY3R4060	P F R	0.6	0.049	6.94	6.6	4.1	3	0.42	2.9	0.016	0.06	0.13
46.5mm (1.83in.)	^ MS08HY5P4060 ^ MS08HY5R4060 ^ MS08HY5F4060	P R F	0.6	0.058	8.2	8	6.1	4	0.57	4.2	0.023	0.08	0.18

^ Preferred model

Mating Connector With Leads (order separately)

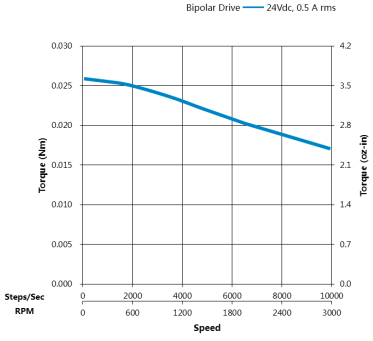
Dimensions: mm (in)

4 Lead Part Number 4634 1402 03659



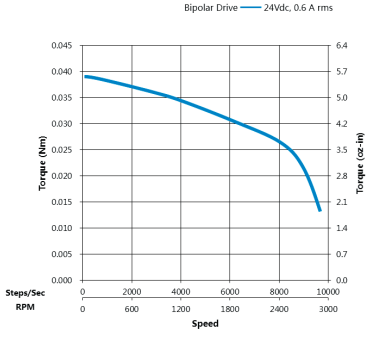
MS08HY1-Bipolar

MS08HY1P/F/R4050



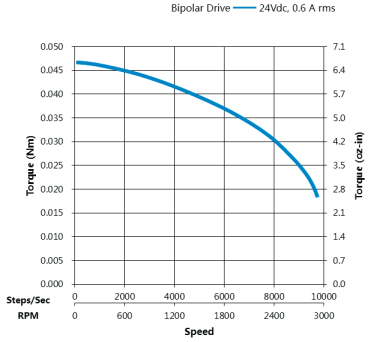
MS08HY3-Bipolar

MS08HY3P/F/R4060



MS08HY5-Bipolar

MS08HY5P/F/R4060



MS11HS Series: 1.8° - Size 11

- Phases 2
- Steps / Revolution 200
- Step Accuracy ±5%
- Shaft Load (20,000 Hours at 1000 RPM)
  - Axial: 15 N (3.4 Lbs.) Push; 25 N (5.6 Lbs.) Pull
  - Radial: 30 N (6.5 Lbs.) At Flat Center
- IP Rating 40
- Approvals RoHS
- Operating Temp. -20°C to +50°C
- Insulation Class B, 130°C
- Insulation Resistance 100 MegOhms

MS11HS 3 P 4 040

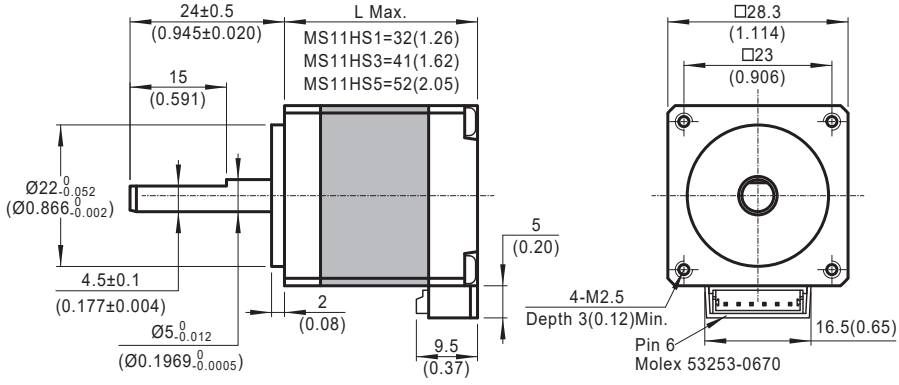
Basic Motor Length (Max)
- 1 32mm(1.26)
- 3 41mm(1.62)
- 5 52mm(2.05)

Electrical Connection
- P Plug-in Connector

Number of Connections
- 4 4 Lead-Bipolar
- 6 6 Lead-Unipolar (or Bipolar)

Winding
- ### Current rating x 100

Dimensions: mm (in)



MS11HS - 4 Lead Bi-Polar

Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms	mH	Detent Torque		Rotor Inertia		Motor Weight	
	Single Shaft	P=Plug L=Leads	Amps (mounted)	Nm Typ.	oz-in TYP.	@20 C	Typ.	mNm	oz-in	g cm²	oz-in²	kg	Lbs
32 mm (1.26 in.)	MS11HS1P4024	P	0.24	0.09	13	49	38	5	0.71	9	0.049	0.1	0.22
	^ MS11HS1P4050	P	0.5	0.09	13	10.9	9.6						
	^ MS11HS1P4067	P	0.67	0.09	13	6.1	5.4						
	^ MS11HS1P4100	P	1	0.09	13	2.7	2.5						
41 mm (1.62 in.)	MS11HS3P4029	P	0.29	0.12	17	39	26	6	0.85	12	0.066	0.15	0.33
	^ MS11HS3P4067	P	0.67	0.12	17	7.2	5.1						
	^ MS11HS3P4095	P	0.95	0.13	18	3.7	2.8						
	^ MS11HS3P4140	P	1.4	0.13	18	1.77	1.24						
52 mm (2.05 in.)	MS11HS5P4030	P	0.3	0.17	24	40	38	8	1.1	18	0.098	0.2	0.44
	^ MS11HS5P4070	P	0.7	0.17	24	6.7	6.8						
	^ MS11HS5P4100	P	1	0.17	24	3.7	3.1						
	^ MS11HS5P4150	P	1.5	0.17	24	1.65	1.48						

^ Preferred model

MS11HS - 6 Lead Uni-Polar

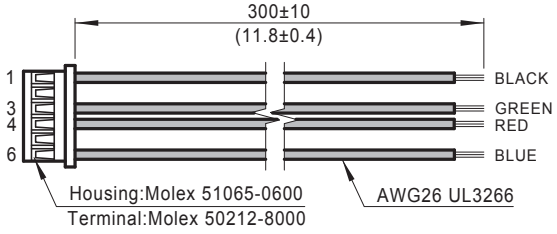
Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms	mH	Detent Torque		Rotor Inertia		Motor Weight	
	Single Shaft	P=Plug L=Leads	Amps (mounted)	Nm Typ.	oz-in TYP.	@20 C	Typ.	mNm	oz-in	g cm²	oz-in²	kg	Lbs
32 mm (1.26 in.)	MS11HS1P6024	P	0.24	0.06	9	48	18.2	5	0.71	9	0.049	0.1	0.22
	MS11HS1P6050	P	0.5	0.07	9	10.9	4.5						
	MS11HS1P6070	P	0.7	0.07	9	5.5	2.3						
41 mm (1.62 in.)	MS11HS3P6026	P	0.26	0.09	13	48	20	6	0.85	12	0.066	0.15	0.33
	MS11HS3P6067	P	0.67	0.09	13	7.4	3.3						
	MS11HS3P6095	P	0.95	0.09	13	3.5	1.56						
52 mm (2.05 in.)	MS11HS5P6033	P	0.33	0.13	18	36.8	14.6	8	1.1	18	0.098	0.2	0.44
	MS11HS5P6067	P	0.67	0.13	18	8.1	3.5						
	MS11HS5P6095	P	0.95	0.13	18	4.3	1.7						

^ Preferred model

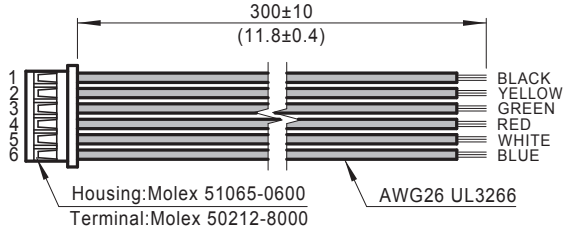
Mating Connector With Leads (order separately)

Dimensions: mm (in)

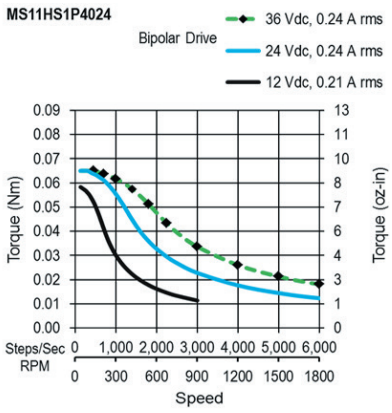
4 Lead Part Number 4634 1402 04190

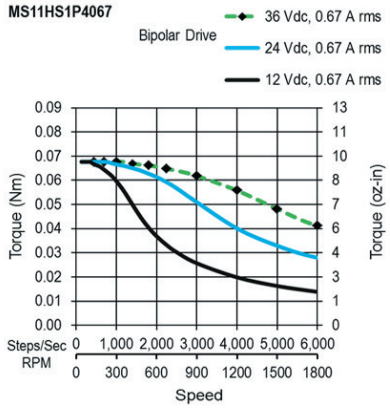


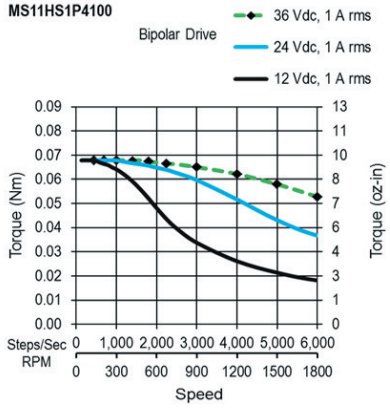
6 Lead Part Number 4634 1402 04490



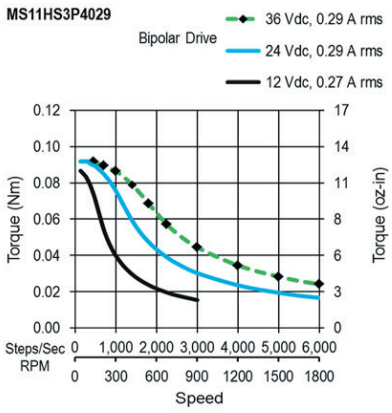
MS11HS1-Bipolar

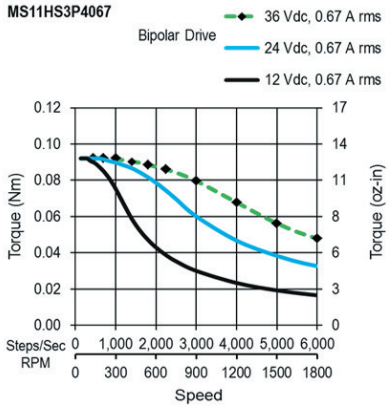


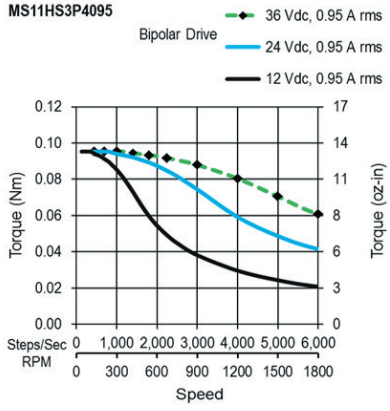


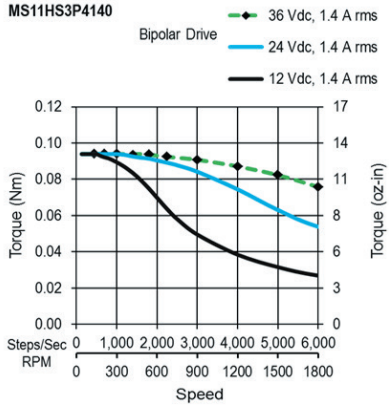


MS11HS3-Bipolar

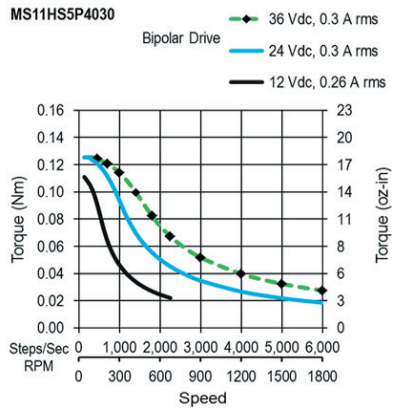


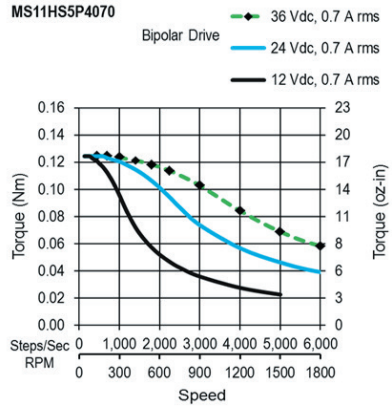


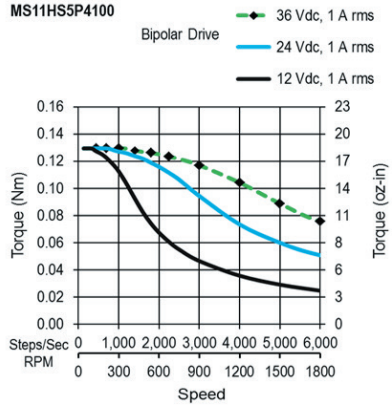


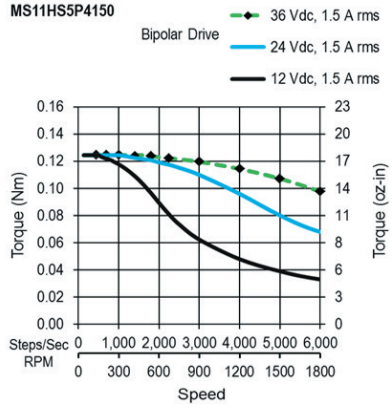


MS11HS5-Bipolar



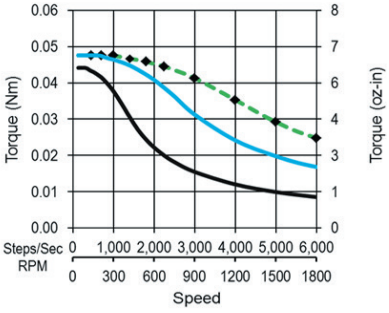




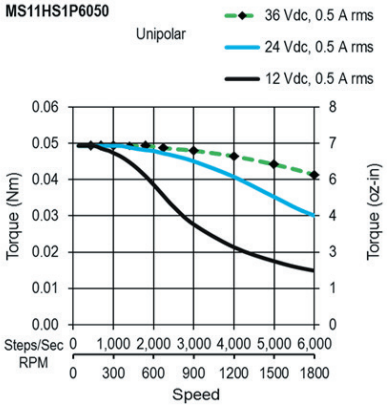


MS11HS1-Unipolar

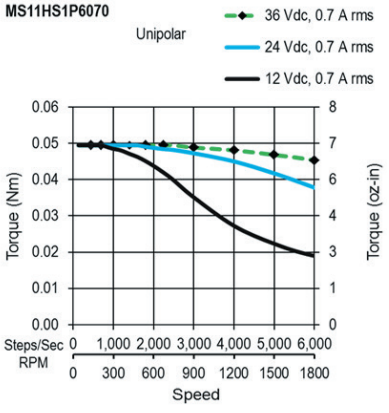
MS11HS1P6024



MS11HS1P6050

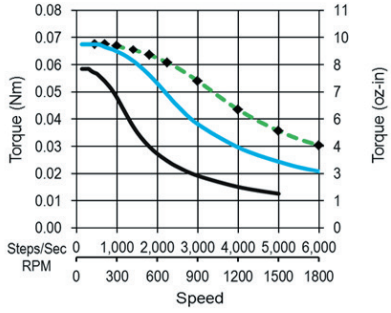


MS11HS1P6070

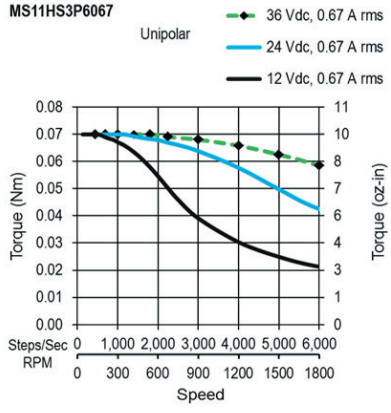


MS11HS3-Unipolar

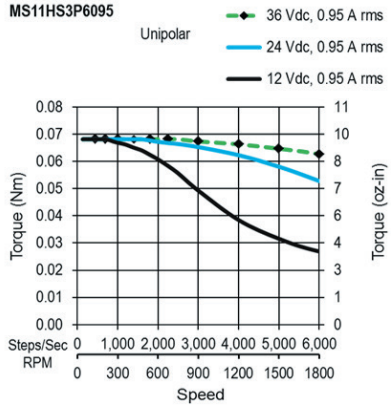
MS11HS3P6026



MS11HS3P6067

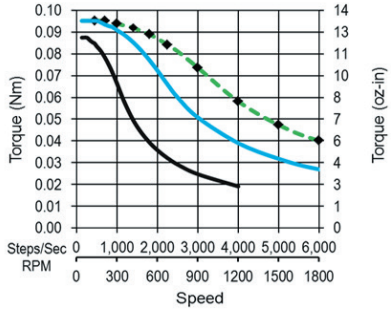


MS11HS3P6095



MS11HS5-Unipolar

MS11HS5P6033



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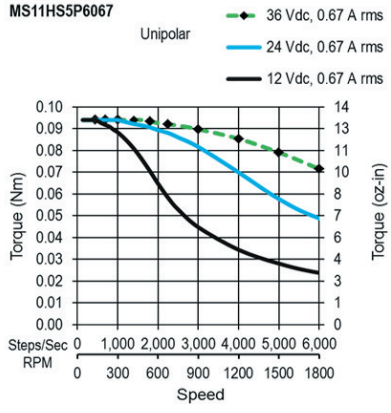

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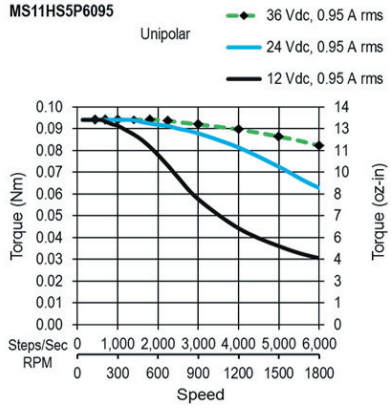


14HK Series: 0.9° - Size 14 Encapsulated

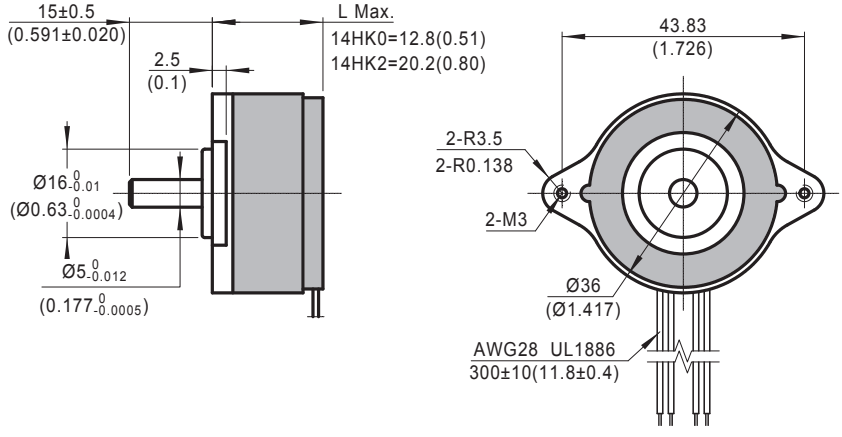
- Phases 2
- Steps / Revolution 200
- Step Accuracy ±5%
- Shaft Load (20,000 Hours at 1000 RPM)
  - Axial: 25 N (5.6 Lbs.) Push; 65 N (15 Lbs.) Pull
  - Radial: 30 N (6.5 Lbs.) At End of Shaft
- IP Rating 40
- Approvals RoHS
- Operating Temp. -20°C to +50°C
- Insulation Class B, 130°C
- Insulation Resistance 100 MegOhms

14HK - 4 Lead Bipolar

Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms	Winding mH	Detent Torque		Rotor Inertia		Motor Weight	
	Single Shaft	P=Plug L=Leads	Amps (mounted)	Nm Typ.	oz-in TYP.	@20℃	Typ.	mNm	oz-in	g cm²	oz-in²	kg	Lbs
12.8 mm (0.5 in.)	^ 14HK0405N	L	0.3	0.044	6	16	8.5	4	0.57	4	0.022	0.05	0.11
	^ 14HK0406N	L	0.5	0.044	6	6.4	3.1						
	^ 14HK0407N	L	0.6	0.044	6	4.2	2.1						
	^ 14HK0408N	L	0.8	0.044	6	2.6	1.2						
20.2 mm (0.8 in.)	14HK2404N	L	0.3	0.12	17	26.7	21	10	1.4	11	0.06	0.11	0.24
	^ 14HK2405N	L	0.5	0.12	17	11.8	9.5						
	^ 14HK2406N	L	0.6	0.12	17	7.1	5.4						
	^ 14HK2407N	L	0.8	0.12	17	4.4	3.2						

^ Preferred model

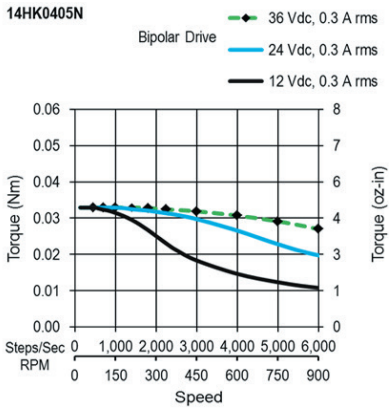
Dimensions: mm (in)



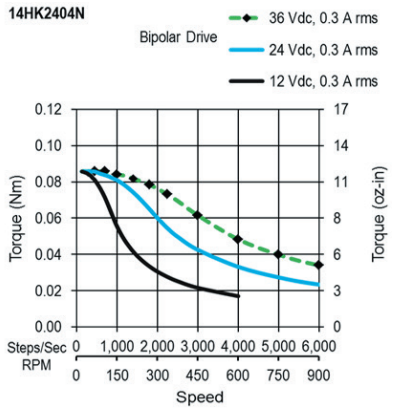
14HK0-0.9° Bipolar

14HK2-0.9° Bipolar

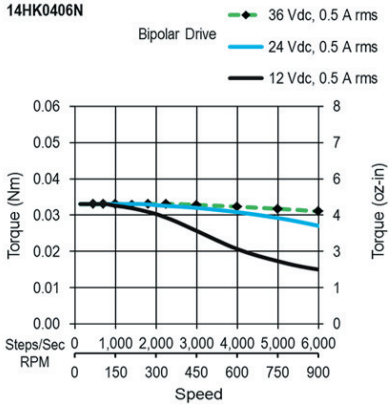
14HK0405N



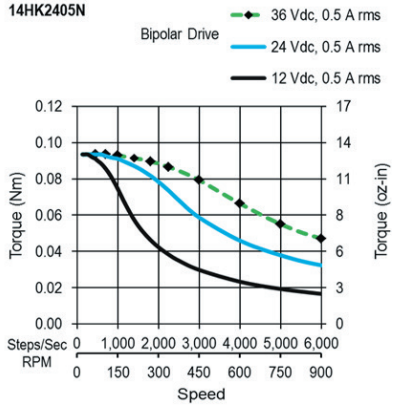
14HK2404N



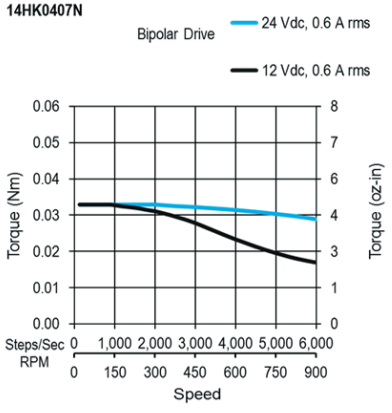
14HK0406N



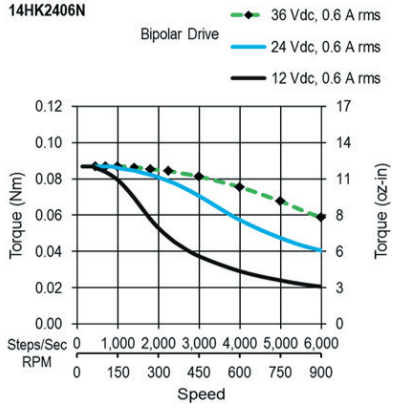
14HK2405N



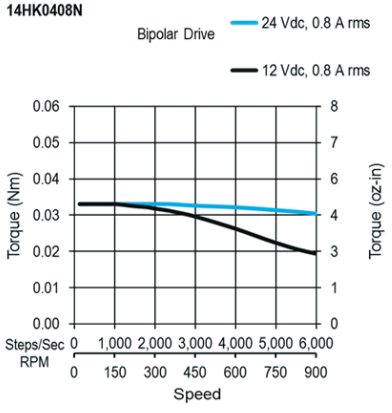
14HK0407N



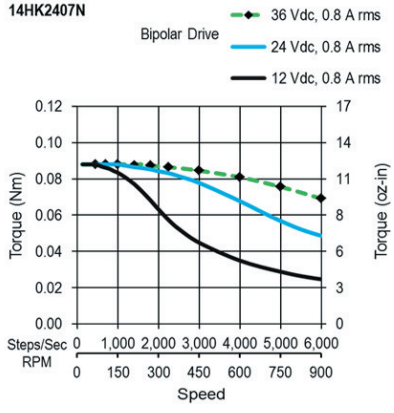
14HK2406N



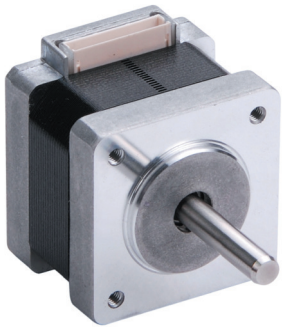
14HK0408N



14HK2407N



MS14HA Series: 0.9° - Size 14



- Phases 2
- Steps / Revolution 400
- Step Accuracy ±5%
- Shaft Load (20,000 Hours at 1000 RPM)
  - Axial: 25 N (5.6 Lbs.) Push; 65 N (15 Lbs.) Pull
  - Radial: 30 N (6.5 Lbs.) At Flat Center
- IP Rating 40
- Approvals RoHS
- Operating Temp. -20°C to +50°C
- Insulation Class B, 130°C
- Insulation Resistance 100 MegOhms

MS14HA 5 P 4 040

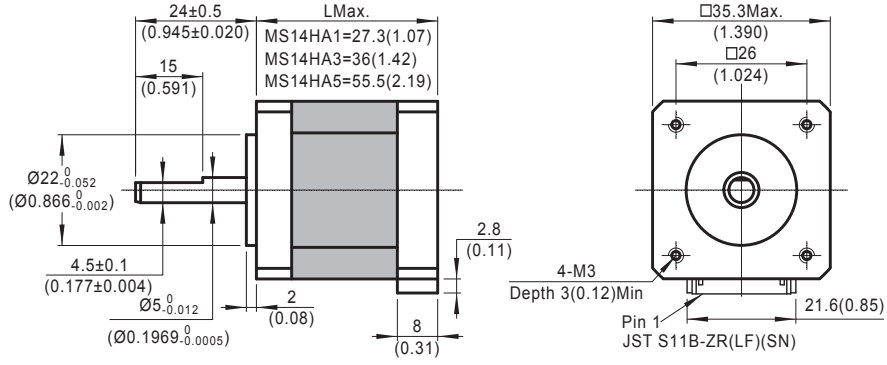
Basic Motor Length (Max)
- 1 27.3mm(1.07 in.)
- 3 36mm (1.42 in.)
- 5 55.5mm (2.19 in.)

Electrical Connection
- P Plug-in Connector

Number of Connections
- 4 4 Lead-Bipolar
- 6 6 Lead-Unipolar (or Bipolar)

Winding
- ### Current rating x 100

Dimensions: mm (in)



MS14HA - 4 Lead Bi-Polar

Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms mH		Detent Torque		Rotor Inertia		Motor Weight	
	Single Shaft	P=Plug L=Leads	Amps (mounted)	Nm Typ.	oz-in TYP.	@20℃	Typ.	mNm	oz-in	g cm²	oz-in²	kg	Lbs
27.3 mm (1.07 in.)	MS14HA1P4026	P	0.26	0.12	17	49	56	4	0.57	12	0.066	0.15	0.33
	^ MS14HA1P4070	P	0.7	0.12	17	6.6	8.2						
	^ MS14HA1P4100	P	1	0.12	17	3.3	3.9						
	^ MS14HA1P4150	P	1.5	0.12	17	1.55	1.8						
36 mm (1.42 in.)	MS14HA3P4032	P	0.32	0.19	27	37	51	8	1.1	20	0.11	0.21	0.46
	^ MS14HA3P4075	P	0.75	0.18	25	6	8.6						
	^ MS14HA3P4100	P	1	0.18	25	3.3	4.9						
	^ MS14HA3P4150	P	1.5	0.18	25	1.61	2.2						
55.5 mm (2.19 in.)	MS14HA5P4040	P	0.4	0.32	45	30	49	10	1.4	35	0.19	0.24	0.53
	^ MS14HA5P4100	P	1	0.32	45	5.1	8.2						
	^ MS14HA5P4150	P	1.5	0.32	45	2.2	3.6						
	^ MS14HA5P4200	P	2	0.32	45	1.34	2.1						

^ Preferred model

MS14HA - 6 Lead Uni-Polar

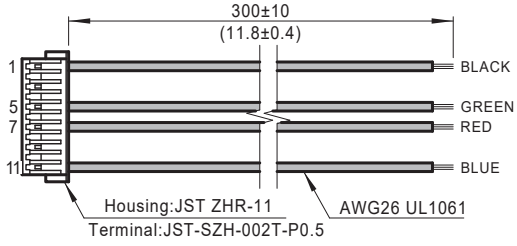
Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms mH		Detent Torque		Rotor Inertia		Motor Weight	
	Single Shaft	P=Plug L=Leads	Amps (mounted)	Nm Typ.	oz-in TYP.	@20℃	Typ.	mNm	oz-in	g cm²	oz-in²	kg	Lbs
27.3 mm (1.07 in.)	MS14HA1P6026	P	0.26	0.09	12	48	27	4	0.57	12	0.066	0.15	0.33
	MS14HA1P6060	P	0.6	0.09	12	8.9	5.3						
	MS14HA1P6100	P	1	0.09	12	3.3	2						
36 mm (1.42 in.)	MS14HA3P6032	P	0.32	0.13	18	37	21	8	1.1	20	0.11	0.21	0.46
	MS14HA3P6070	P	0.7	0.14	20	7.5	5.3						
	MS14HA3P6110	P	1.1	0.14	20	3	2						
55.5 mm (2.19 in.)	MS14HA5P6040	P	0.4	0.25	35	31	26	10	1.4	35	0.19	0.24	0.53
	MS14HA5P6085	P	0.85	0.26	37	7.1	6.1						
	MS14HA5P6120	P	1.2	0.25	35	3.5	2.9						

^ Preferred model

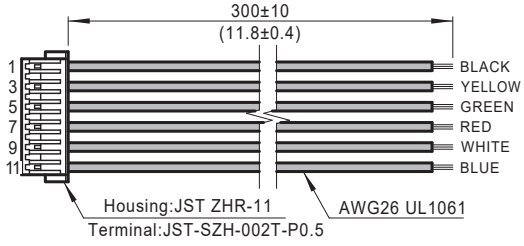
Mating Connector With Leads (order separately)

Dimensions: mm (in)

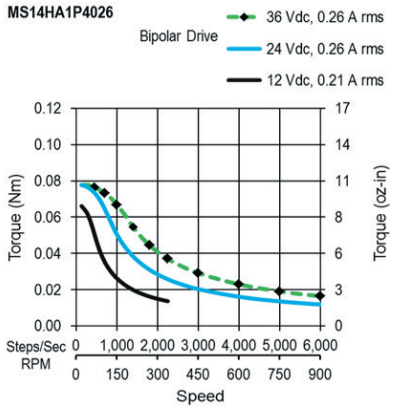
4 Lead Part Number 4634 1402 02846

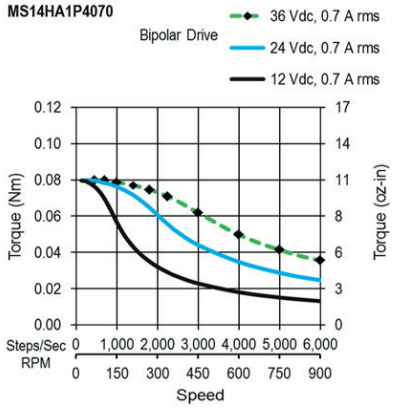


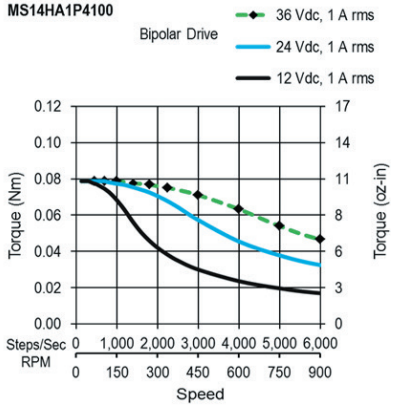
6 Lead Part Number 4634 1402 04489

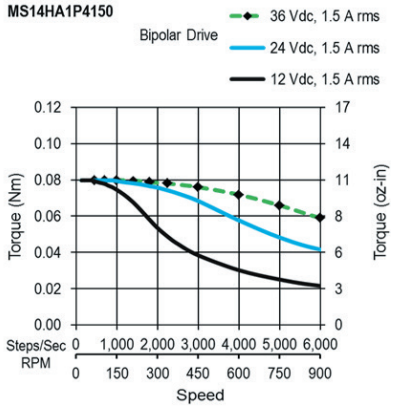


MS14HA1-0.9° Bipolar

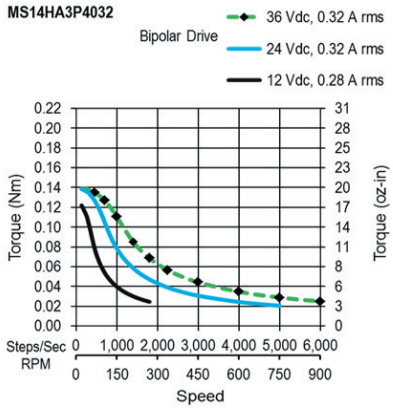


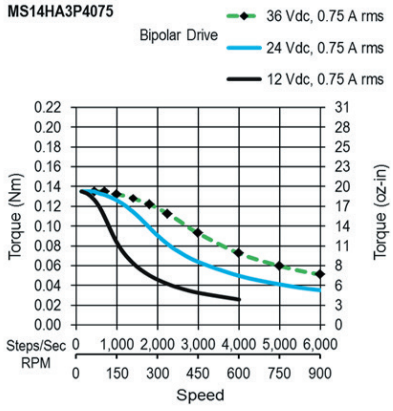


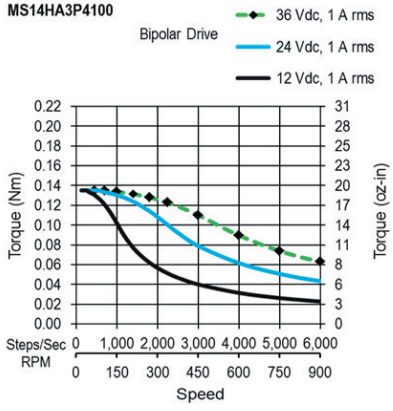


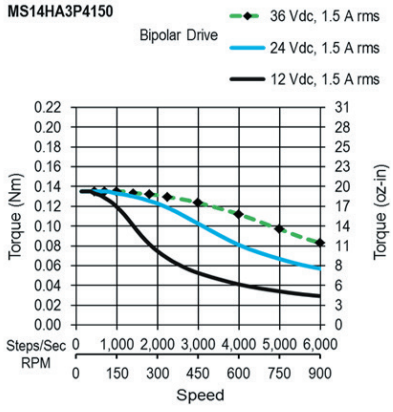


MS14HA3-0.9° Bipolar

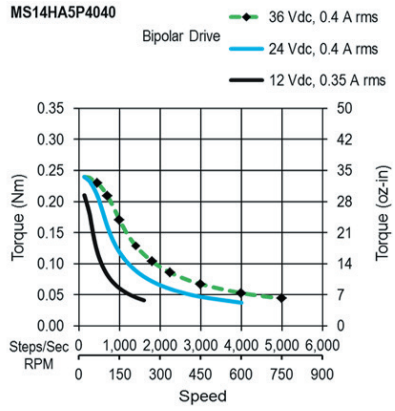


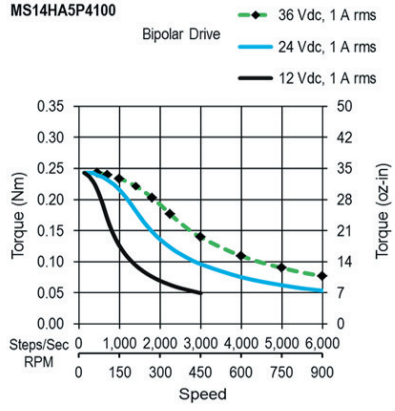


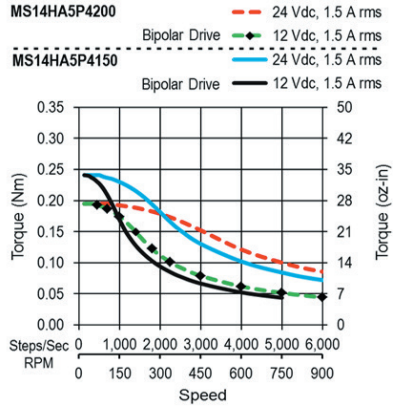




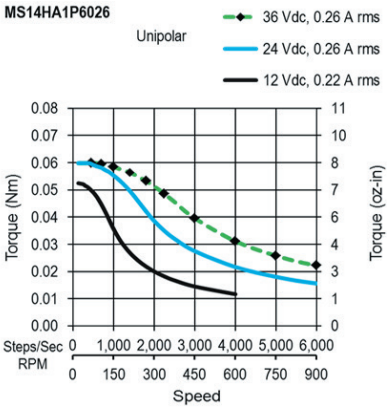
MS14HA5-0.9° Bipolar

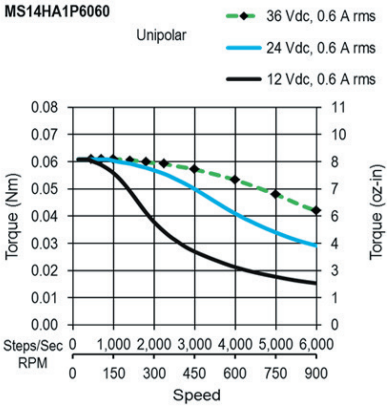


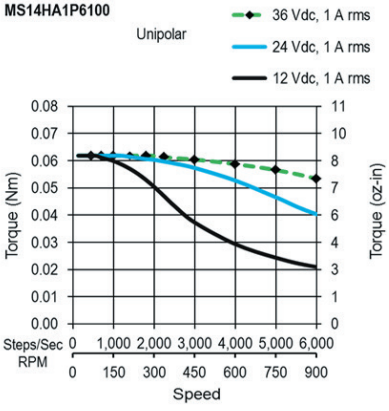




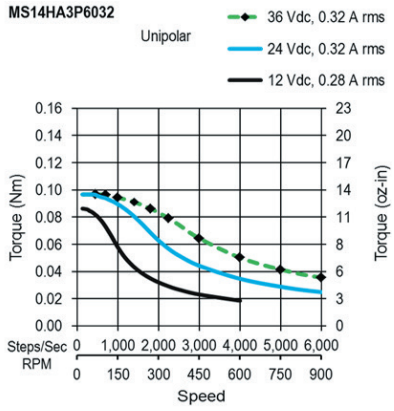
MS14HA1-0.9° Unipolar

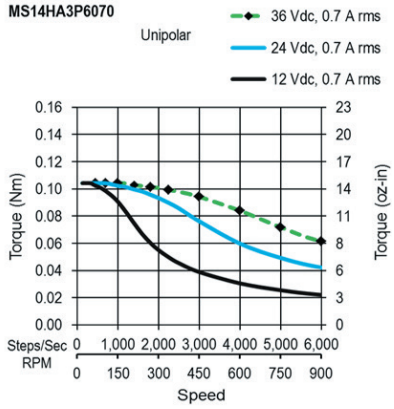


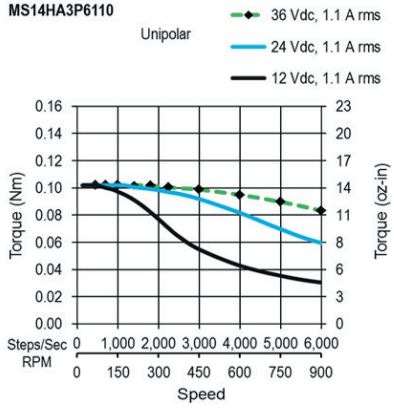




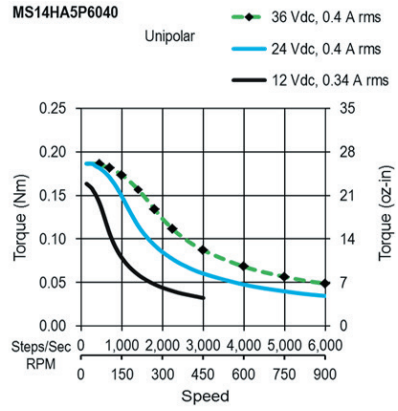
MS14HA3-0.9° Unipolar

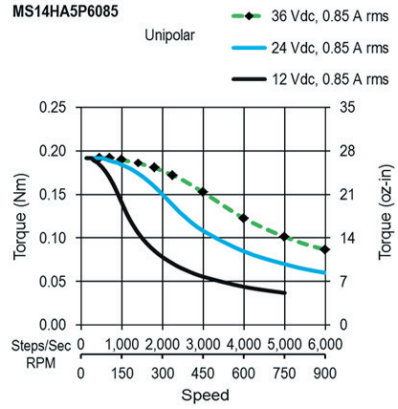


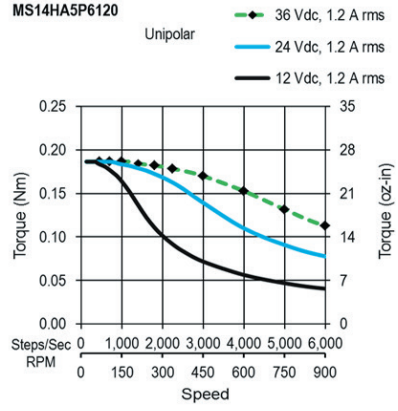




MS14HA5-0.9° Unipolar







MS14HS Series: 1.8° - Size14

- Phases 2
- Steps / Revolution 200
- Step Accuracy ±5%
- Shaft Load (20,000 Hours at 1000 RPM)
  - Axial: 25 N (5.6 Lbs.) Push; 65 N (15 Lbs.) Pull
  - Radial: 30 N (6.5 Lbs.) At Flat Center
- IP Rating 40
- Approvals RoHS
- Operating Temp. -20°C to +50°C
- Insulation Class B, 130°C
- Insulation Resistance 100 MegOhms

MS14HS 3 P 4 040

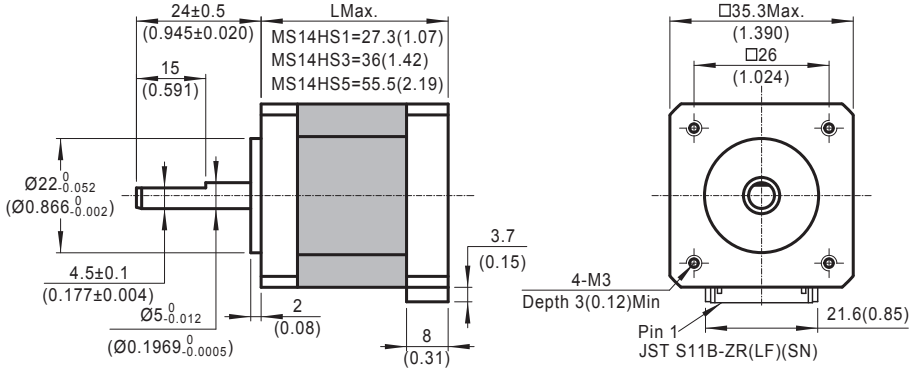
Basic Motor Length (Max)
- 1 27.3mm (1.07 in.)
- 3 36mm (1.42 in.)
- 5 55.5mm (2.19 in.)

Electrical Connection
- P Plug-in Connector

Number of Connections
- 4 4 Lead-Bipolar
- 6 6 Lead-Unipolar (or Bipolar)

Winding
- ### Current rating x 100

Dimensions: mm (in)



MS14HS - 4 Lead Bi-Polar

Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms mH		Detent Torque		Rotor Inertia		Motor Weight	
	Single Shaft	P=Plug L=Leads	Amps (mounted)	Nm Typ.	oz-in TYP.	@20℃	Typ.	mNm	oz-in	g cm²	oz-in²	kg	Lbs
27.3 mm (1.07 in.)	MS14HS1P4026	P	0.26	0.14	20	49	50	10	1.4	12	0.066	0.15	0.33
	^ MS14HS1P4070	P	0.7	0.14	20	6.6	7.5						
	^ MS14HS1P4100	P	1	0.14	20	3.3	3.5						
	^ MS14HS1P4150	P	1.5	0.14	20	1.55	1.8						
36 mm (1.42 in.)	MS14HS3P4032	P	0.32	0.24	34	37	52	15	2.1	20	0.11	0.21	0.46
	^ MS14HS3P4075	P	0.75	0.23	33	6	8.9						
	^ MS14HS3P4100	P	1	0.23	33	3.4	5						
	^ MS14HS3P4150	P	1.5	0.23	33	1.62	2.2						
55.5 mm (2.19 in.)	MS14HS5P4040	P	0.4	0.39	55	30	50	18	2.5	35	0.19	0.24	0.53
	^ MS14HS5P4100	P	1	0.40	57	5.1	8.3						
	^ MS14HS5P4150	P	1.5	0.40	57	2.2	3.6						
	^ MS14HS5P4200	P	2	0.40	57	1.34	2.1						

^ Preferred model

MS14HS - 6 Lead Uni-Polar

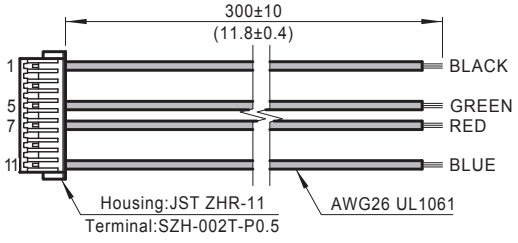
Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms mH		Detent Torque		Rotor Inertia		Motor Weight	
	Single Shaft	P=Plug L=Leads	Amps (mounted)	Nm Typ.	oz-in TYP.	@20℃	Typ.	mNm	oz-in	g cm²	oz-in²	kg	Lbs
27.3 mm (1.07 in.)	MS14HS1P6026	P	0.26	0.10	14	48	23	10	1.4	12	0.066	0.15	0.33
	MS14HS1P6060	P	0.6	0.10	14	8.9	4.5						
	MS14HS1P6100	P	1	0.10	14	3.3	1.7						
36 mm (1.42 in.)	MS14HS3P6032	P	0.32	0.17	24	37	22	15	2.1	20	0.11	0.21	0.46
	MS14HS3P6070	P	0.7	0.18	25	7.5	5.4						
	MS14HS3P6110	P	1.1	0.18	25	3	2.1						
55.5 mm (2.19 in.)	MS14HS5P6040	P	0.4	0.30	42	31	26	18	2.5	35	0.19	0.24	0.53
	MS14HS5P6085	P	0.85	0.31	44	7.1	6.2						
	MS14HS5P6120	P	1.2	0.30	42	3.5	2.9						

^ Preferred model

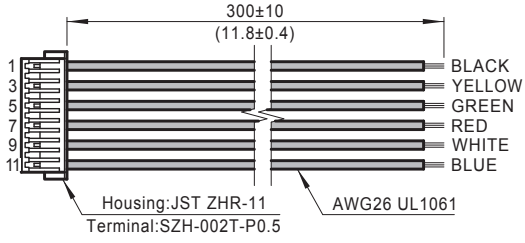
Mating Connector With Leads (order separately)

Dimensions: mm (in)

4 Lead Part Number 4634 1402 02846

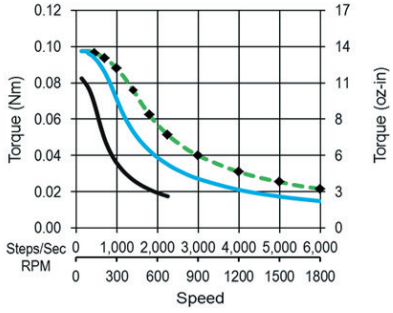


6 Lead Part Number 4634 1402 04489

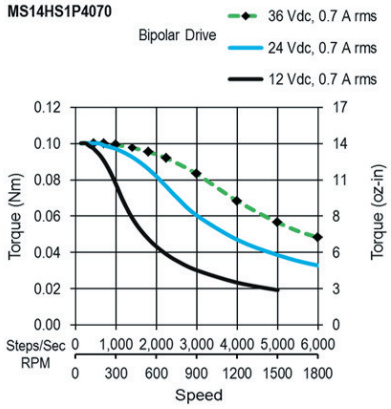


MS14HS1-1.8° Bipolar

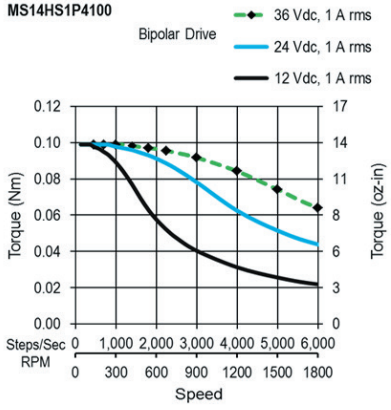
MS14HS1P4026



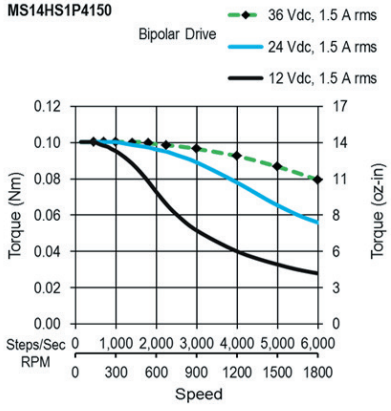
MS14HS1P4070



MS14HS1P4100

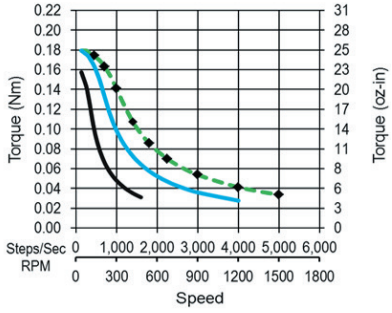


MS14HS1P4150

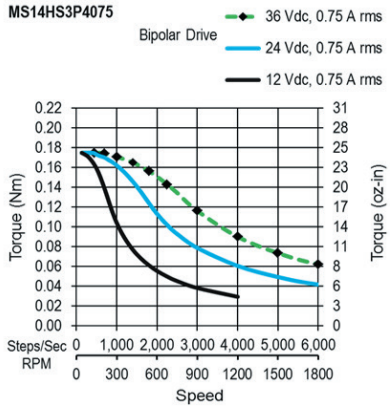


MS14HS3-1.8° Bipolar

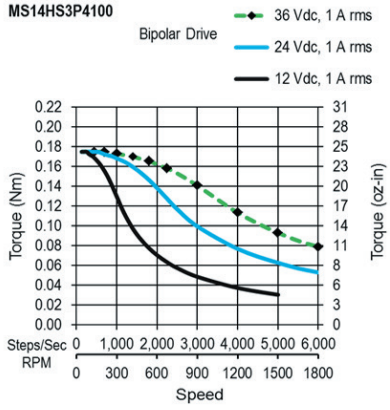
MS14HS3P4032



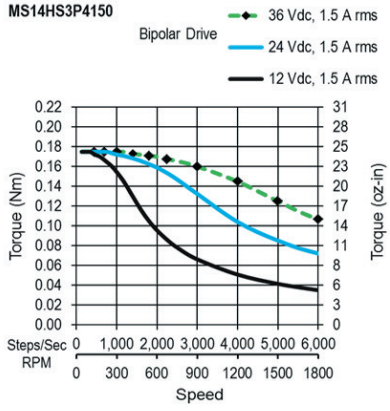
MS14HS3P4075



MS14HS3P4100

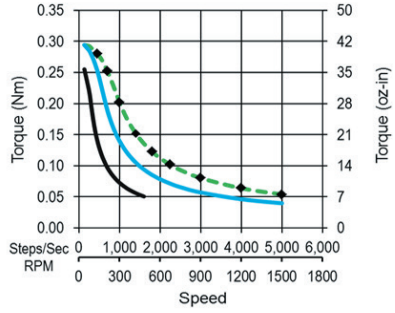


MS14HS3P4150

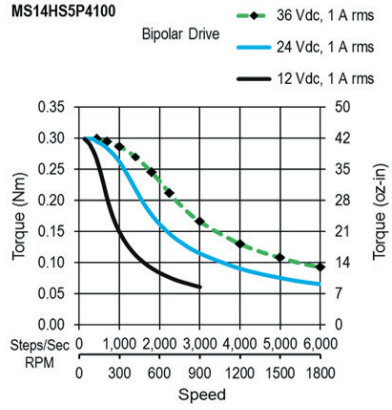


MS14HS5-1.8° Bipolar

MS14HS5P4040

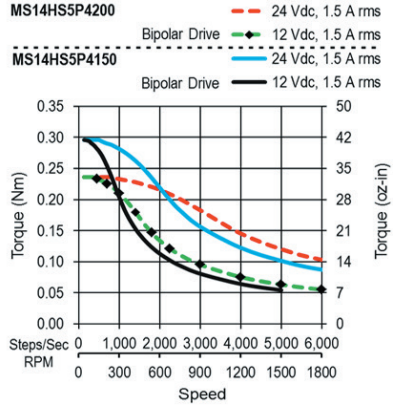


MS14HS5P4100



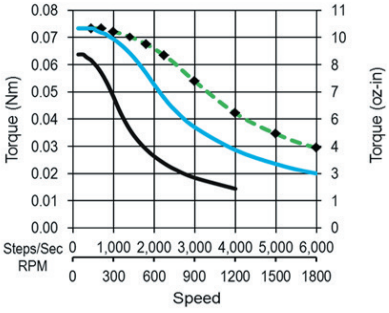
MS14HS5P4200

MS14HS5P4150

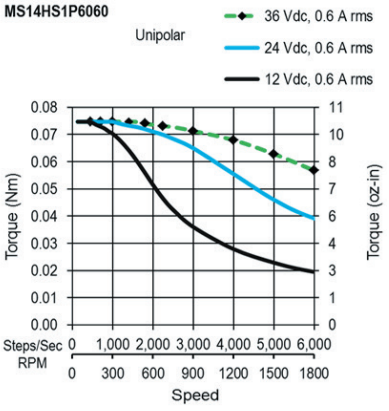


MS14HS1-1.8° Unipolar

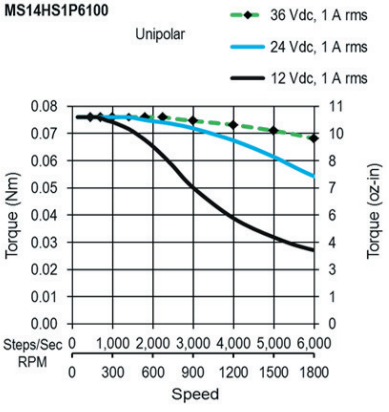
MS14HS1P6026



MS14HS1P6060

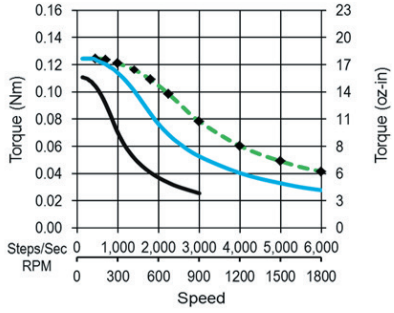


MS14HS1P6100

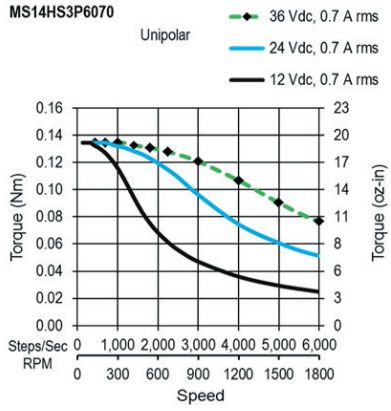


MS14HS3-1.8° Unipolar

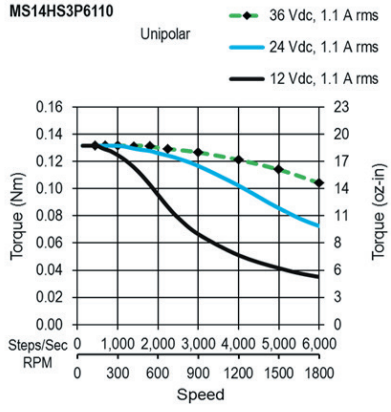
MS14HS3P6032



MS14HS3P6070

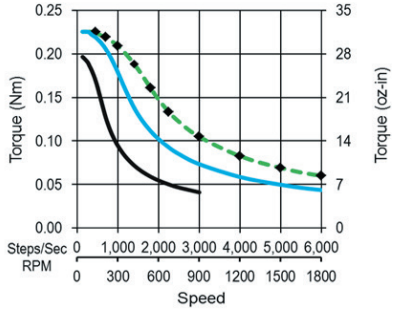


MS14HS3P6110

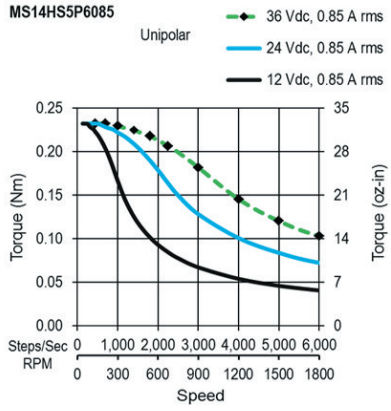


MS14HS5-1.8° Unipolar

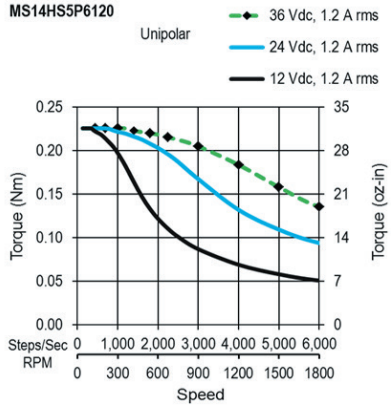
MS14HS5P6040



MS14HS5P6085



MS14HS5P6120



MS16HS Series: 1.8° - Size 16

- Phases 2
- Steps / Revolution 200
- Step Accuracy ±5%
- Shaft Load (20,000 Hours at 1000 RPM)
  - Axial: 25 N (5.6 Lbs.) Push; 65 N (15 Lbs.) Pull
  - Radial: 30 N (6.5 Lbs.) At Flat Center
- IP Rating 40
- Approvals RoHS
- Operating Temp. -20°C to +50°C
- Insulation Class B, 130°C
- Insulation Resistance 100 MegOhms

MS16HS 7 P 4 040

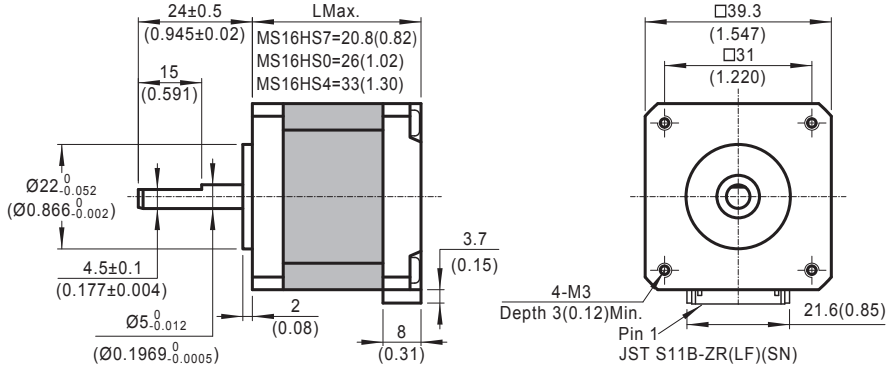
Basic Motor Length (Max)
- 7 20.8mm (0.82 in.)
- 0 26mm (1.02 in.)
- 4 33mm (1.30 in.)

Electrical Connection
- P Plug-in Connector

Winding
- ### Current rating x 100

Number of Connections
- 4 4 Lead-Bipolar
- 6 6 Lead-Unipolar (or Bipolar)

Dimensions: mm (in)



MS16HS - 4 Lead Bi-Polar

Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms mH		Detent Torque		Rotor Inertia		Motor Weight	
	Single Shaft	P=Plug L=Leads	Amps (mounted)	Nm Typ.	oz-in TYP.	@20℃	Typ.	mNm	oz-in	g cm²	oz-in²	kg	Lbs
20.8 mm (0.82 in.)	MS16HS7P4027	P	0.27	0.10	14	41	36	5	0.71	14	0.077	0.11	0.24
	^ MS16HS7P4070	P	0.7	0.10	14	5.6	5.6						
	^ MS16HS7P4100	P	1	0.10	14	3	2.8						
	^ MS16HS7P4150	P	1.5	0.10	14	1.45	1.28						
26 mm (1.02 in.)	MS16HS0P4029	P	0.29	0.20	28	40	52	8	1.1	20	0.11	0.15	0.33
	^ MS16HS0P4070	P	0.7	0.20	28	6.8	9.5						
	^ MS16HS0P4100	P	1	0.20	28	3.6	4.7						
	^ MS16HS0P4150	P	1.5	0.20	28	1.53	2						
33 mm (1.3 in.)	MS16HS4P4037	P	0.37	0.26	37	31	50	12	1.7	27	0.15	0.21	0.46
	^ MS16HS4P4070	P	0.7	0.26	37	8.4	14						
	^ MS16HS4P4100	P	1	0.27	38	4.4	7						
	^ MS16HS4P4150	P	1.5	0.27	38	1.89	3.1						

^ Preferred model

MS16HS - 6 Lead Uni-Polar

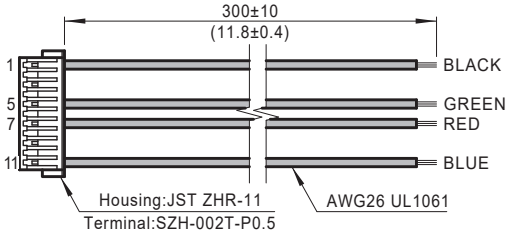
Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms mH		Detent Torque		Rotor Inertia		Motor Weight	
	Single Shaft	P=Plug L=Leads	Amps (mounted)	Nm Typ.	oz-in TYP.	@20℃	Typ.	mNm	oz-in	g cm²	oz-in²	kg	Lbs
20.8 mm (0.82 in.)	MS16HS7P6024	P	0.24	0.07	10	50	21	5	0.71	14	0.077	0.11	0.24
	^ MS16HS7P6070	P	0.7	0.07	10	5.5	2.6						
	^ MS16HS7P6100	P	1	0.07	10	2.7	1.23						
26 mm (1.02 in.)	MS16HS0P6027	P	0.27	0.15	21	45	27	8	1.1	20	0.11	0.15	0.33
	^ MS16HS0P6070	P	0.7	0.16	23	7	4.7						
	^ MS16HS0P6100	P	1	0.15	21	3.4	2.2						
33 mm (1.3 in.)	MS16HS4P6036	P	0.36	0.20	28	33	26	12	1.7	27	0.15	0.21	0.46
	^ MS16HS4P6085	P	0.85	0.20	28	5.8	4.7						
	^ MS16HS4P6120	P	1.2	0.20	28	3	2.3						

^ Preferred model

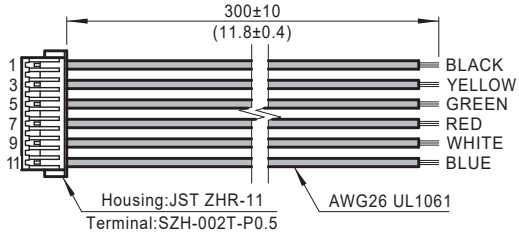
Mating Connector With Leads (order separately)

Dimensions: mm (in)

4 Lead Part Number 4634 1402 04581



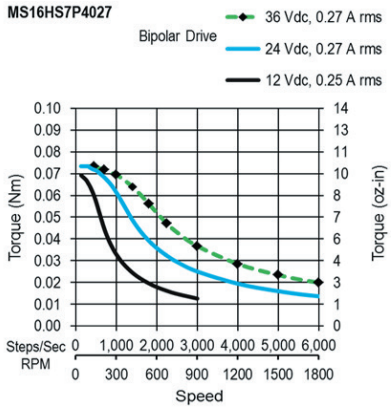
6 Lead Part Number 4634 1402 04489

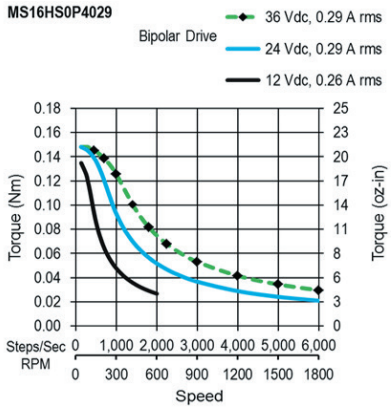


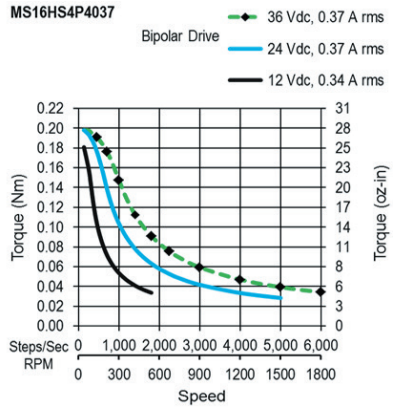
MS16HS7- Bipolar

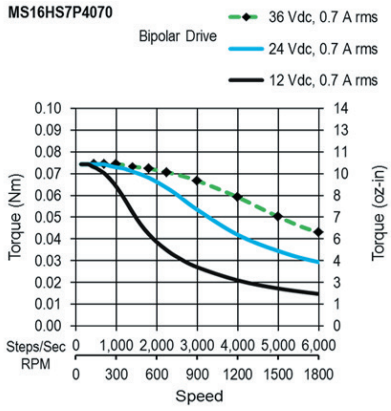
MS16HS0- Bipolar

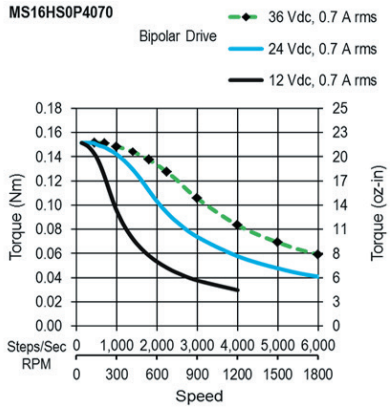
MS16HS4- Bipolar

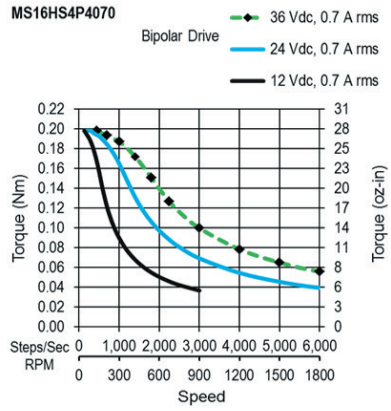


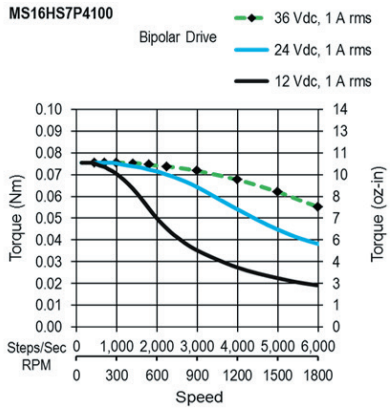


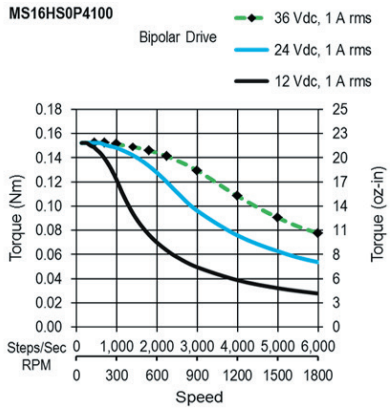


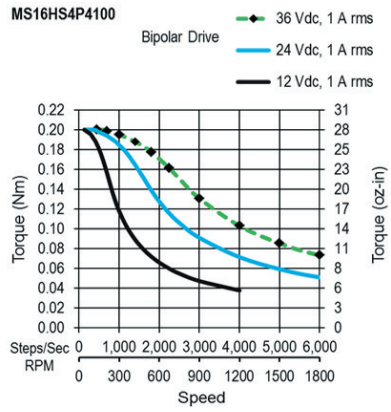


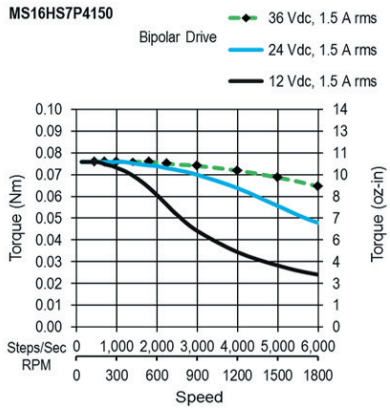


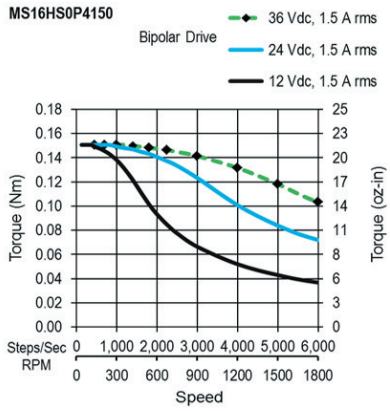


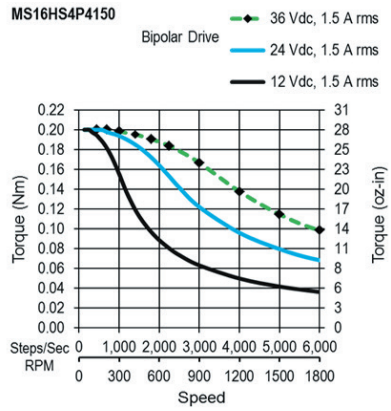




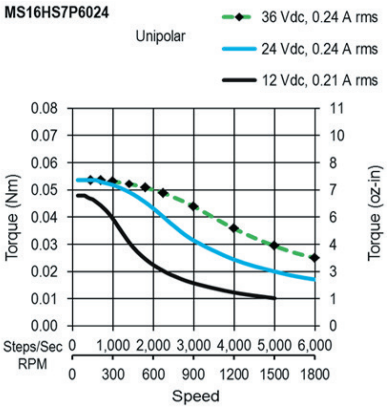


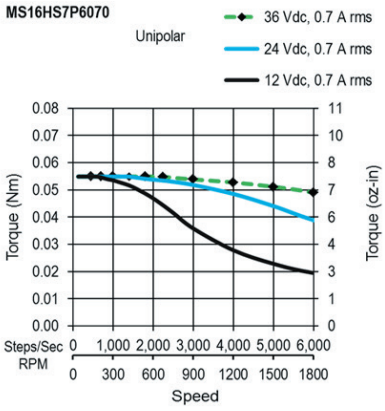


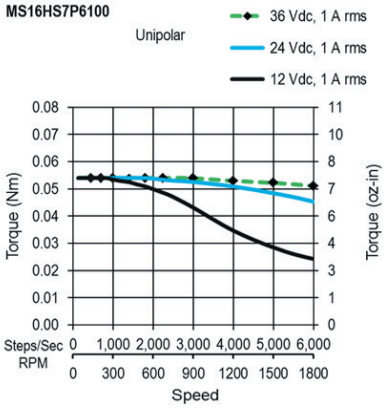




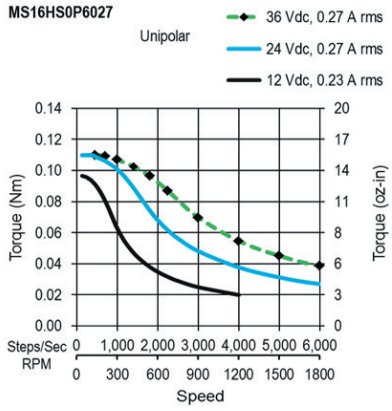
MS16HS7- Unipolar

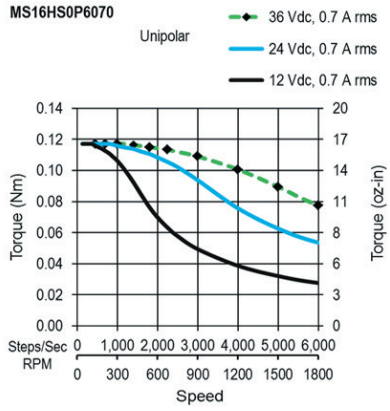


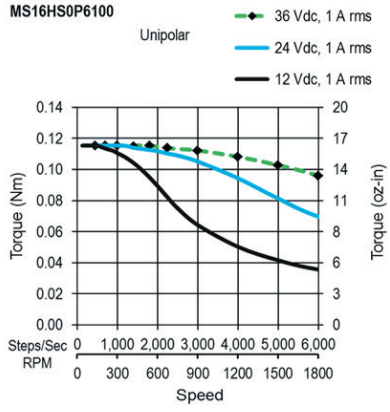




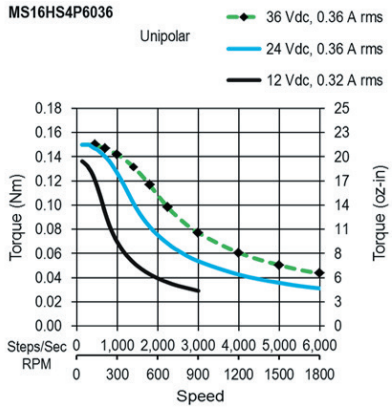
MS16HS0- Unipolar

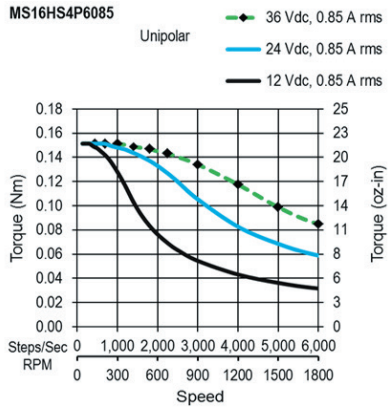


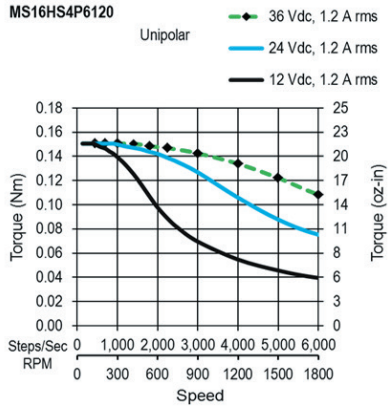




MS16HS4- Unipolar







MS17HA Series: 0.9° - Size 17

- Phases 2
- Steps / Revolution 400
- Step Accuracy ±5%
- Shaft Load (20,000 Hours at 1000 RPM)
  - Axial: 25 N (5.6 Lbs.) Push; 65 N (15 Lbs.) Pull
  - Radial: 30 N (6.5 Lbs.) At Flat Center
- IP Rating 40
- Approvals UL Recognized File E465363, RoHS
- Operating Temp. -20°C to +50°C
- Insulation Class B, 130°C
- Insulation Resistance 100 MegOhms

MS17HA 4 P 4 040 -M

Basic Motor Length (Max)

4	34.3mm (1.35 in.)	Short
2	39.8mm (1.57 in.)	1 Stack
6	48.3mm (1.90 in.)	2 Stack

Electrical Connection

P Plug-in Connector

Number of Connections

4 4 Lead-Bipolar
6 6 Lead-Unipolar(or Bipolar)

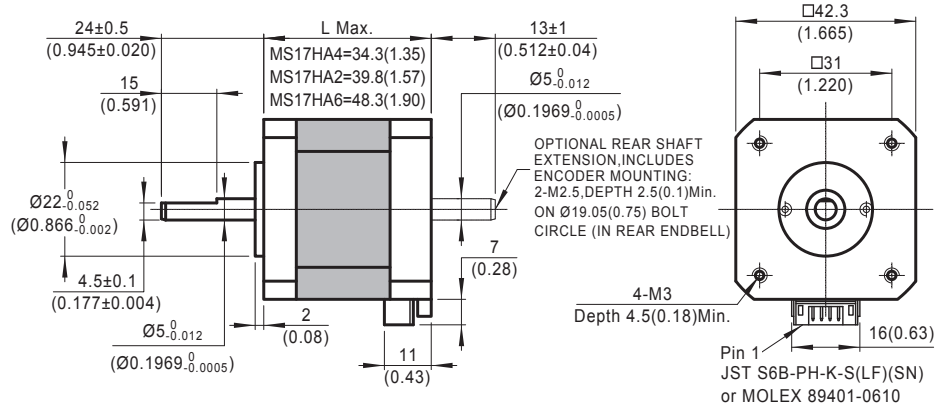
Options

Omit No Options
-M 5 mm Diameter Rear Shaft With Encoder Mounting Holes

Winding

Current rating x 100

Dimensions: mm (in)



MS17HA - 4 Lead Bi-Polar

Length		Model Number	Connect	Rated Current	Holding Torque		Winding Ohms	mH	Detent Torque		Rotor Inertia		Motor Weight	
		Single Shaft	P=Plug L=Leads	Amps (mounted)	Nm Typ.	oz-in TYP.	@20℃	Typ.	mNm	oz-in	g cm²	oz-in²	kg	Lbs
34.3 mm (1.35 in.)		MS17HA4P4040	P	0.4	0.3	42	29	71	12	1.7	38	0.21	0.21	0.46
	^	MS17HA4P4100	P	1	0.3	42	4.05	10.5						
	^	MS17HA4P4150	P	1.5	0.28	40	1.56	4.1						
	^	MS17HA4P4200	P	2	0.29	41	1	2.5						
39.8 mm (1.57 in.) 1 Stack		MS17HA2P4040	P	0.4	0.41	58	25	70	16	2.3	57	0.31	0.28	0.62
	^	MS17HA2P4100	P	1	0.39	55	3.9	11.2						
	^	MS17HA2P4150	P	1.5	0.40	57	1.95	5.4						
	^	MS17HA2P4200	P	2	0.41	58	1	2.8						
48.3 mm (1.9 in.) 2 Stack		MS17HA6P4050	P	0.5	0.54	76.5	25	74	25	3.5	82	0.45	0.35	0.77
	^	MS17HA6P4100	P	1	0.54	76.5	5	16						
	^	MS17HA6P4150	P	1.5	0.54	76.5	2.2	6.8						
	^	MS17HA6P4200	P	2	0.54	76.5	1.25	4						

^ Preferred model

MS17HA - 6 Lead Uni-Polar

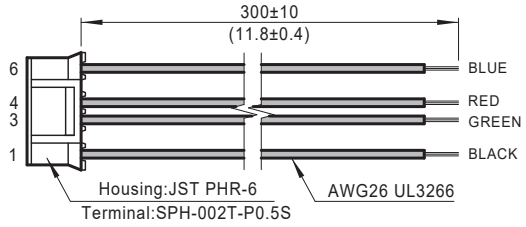
Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms mH		Detent Torque		Rotor Inertia		Motor Weight	
	Single Shaft	P=Plug L=Leads	Amps (mounted)	Nm Typ.	oz-in TYP.	@20℃	Typ.	mNm	oz-in	g cm²	oz-in²	kg	Lbs
34.3 mm (1.35 in.)	MS17HA4P6038	P	0.38	0.22	31	31	38	12	1.7	38	0.21	0.21	0.46
	MS17HA4P6085	P	0.85	0.21	30	4.85	6.2						
	MS17HA4P6120	P	1.2	0.22	31	2.68	3.6						
39.8 mm (1.57 in.) 1 Stack	MS17HA2P6040	P	0.4	0.32	45	29	39	16	2.3	57	0.31	0.28	0.62
	MS17HA2P6085	P	0.85	0.32	45	6	8.3						
	MS17HA2P6130	P	1.3	0.32	45	2.5	3.5						
48.3 mm (1.9 in.) 2 Stack	MS17HA6P6040	P	0.4	0.41	58	30	45	25	3.5	82	0.45	0.35	0.77
	MS17HA6P6080	P	0.8	0.41	58	7.6	11.9						
	MS17HA6P6130	P	1.3	0.43	61	3.2	5						
	MS17HA6P6200	P	2	0.42	59	1.24	1.94						

^ Preferred model

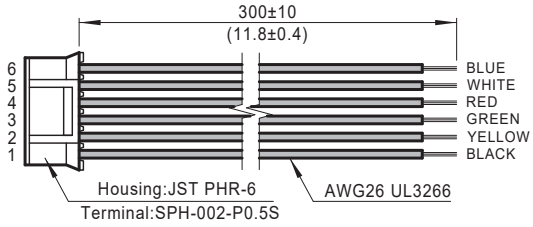
Mating Connector With Leads (order separately)

Dimensions: mm (in)

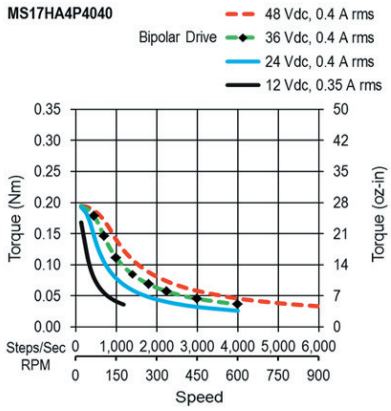
4 Lead Part Number 4634 1402 00723

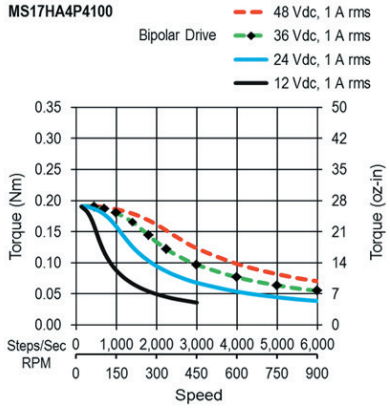


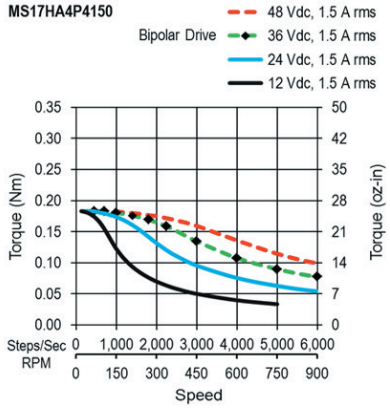
6 Lead Part Number 4634 1402 00922



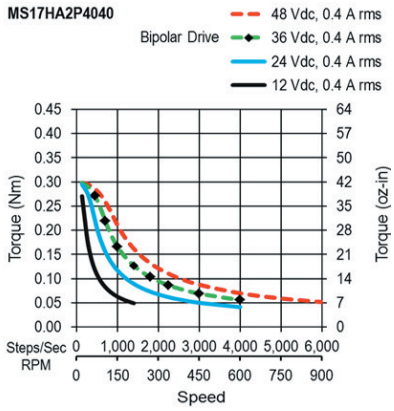
MS17HA4-0.9° Bipolar

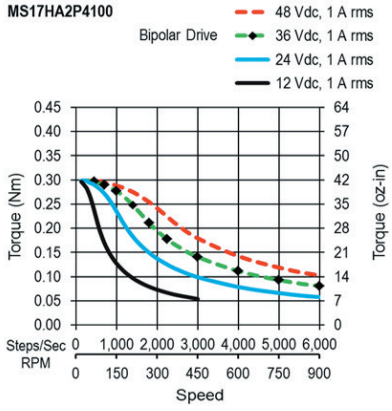


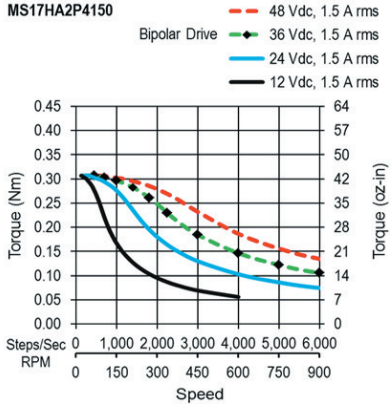


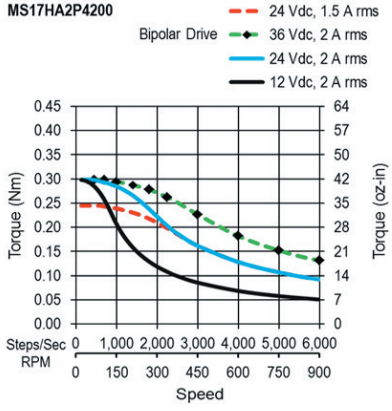


MS17HA2-0.9° Bipolar

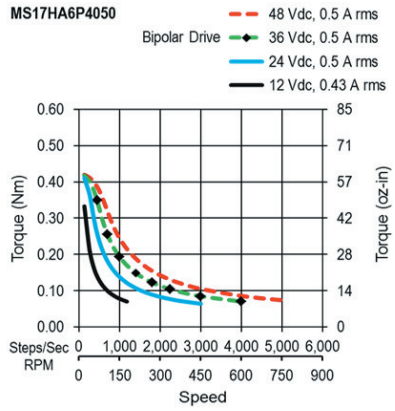


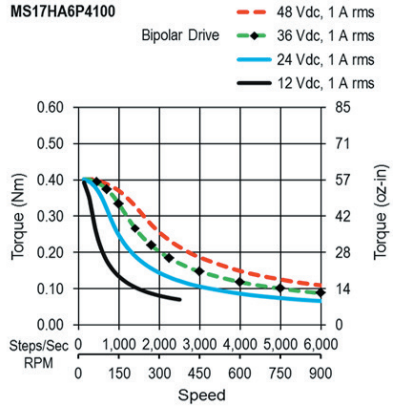


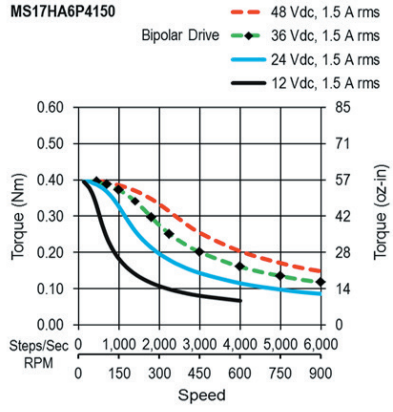


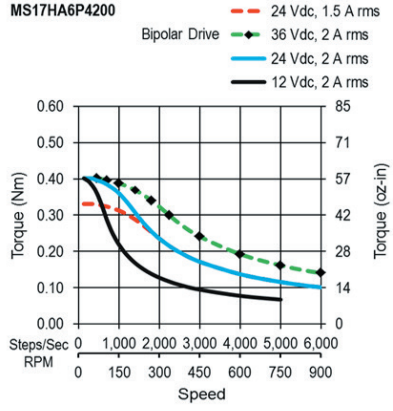


MS17HA6-0.9° Bipolar



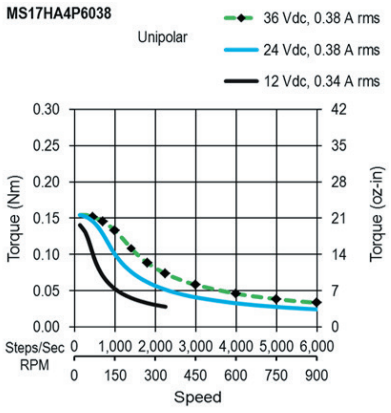




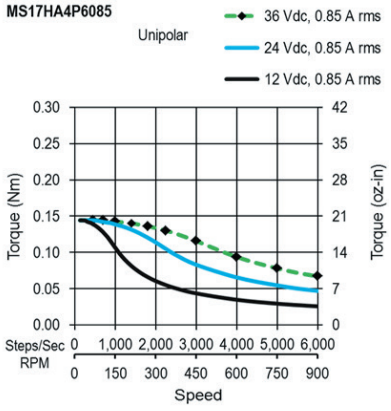


MS17HA4-0.9° Unipolar

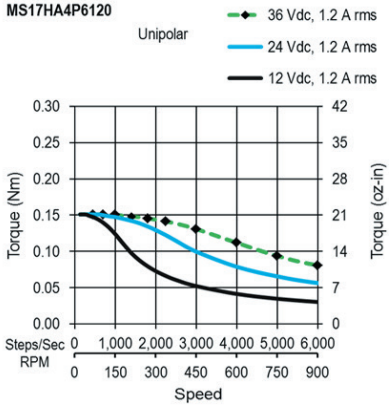
MS17HA4P6038



MS17HA4P6085

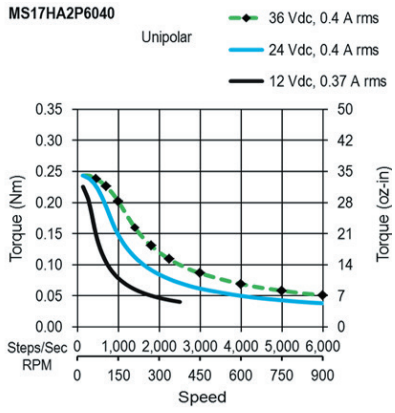


MS17HA4P6120

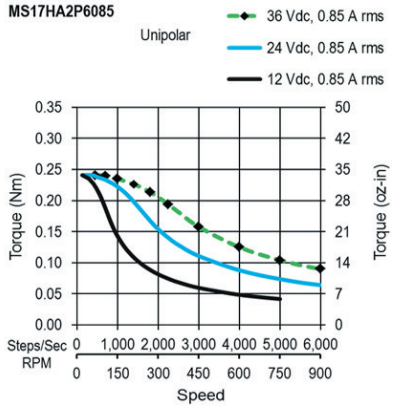


MS17HA2-0.9° Unipolar

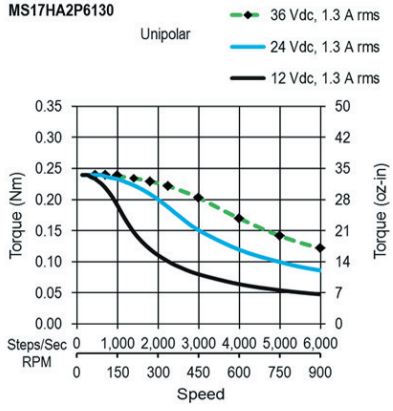
MS17HA2P6040



MS17HA2P6085

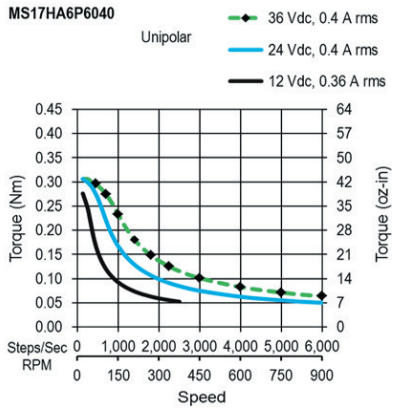


MS17HA2P6130

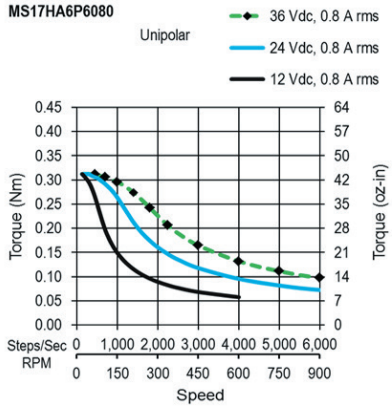


MS17HA6-0.9° Unipolar

MS17HA6P6040



MS17HA6P6080



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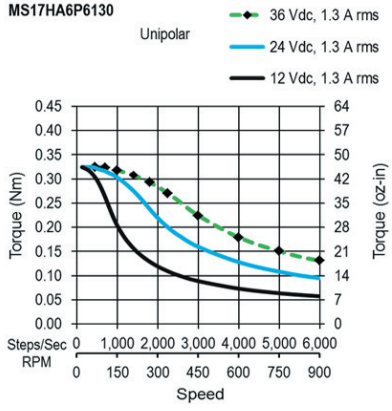
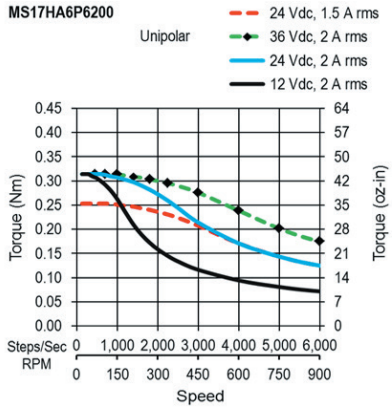


MS17HA6P6200



MS17HD Series: 1.8° - Size 17

- Phases 2
- Steps / Revolution 200
- Step Accuracy ±5%
- Shaft Load (20,000 Hours at 1000 RPM)
  - Axial: 25 N (5.6 Lbs.) Push, 65 N (15 Lbs.) Pull
  - Radial: 29 N (6.5 Lbs.) At Flat Center
- IP Rating 40
- Approvals UL Recognized File E465363, RoHS
- Operating Temp. -20°C to +50°C
- Insulation Class B, 130°C
- Insulation Resistance 100 MegOhms

MS17HD 4 P 4 040 -M

Basic Motor Length (Max)

5	25.3mm (1.0 in.)	
4	34.3mm (1.35 in.)	
2	39.8mm (1.57 in.)	1 Stack
6	48.3mm (1.90 in.)	2 Stack
B	62.8mm (2.47 in.)	3 Stack

Electrical Connection

P Plug-in Connector

Number of Connections

4 4 Lead-Bipolar
6 6 Lead-Unipolar(or Bipolar)

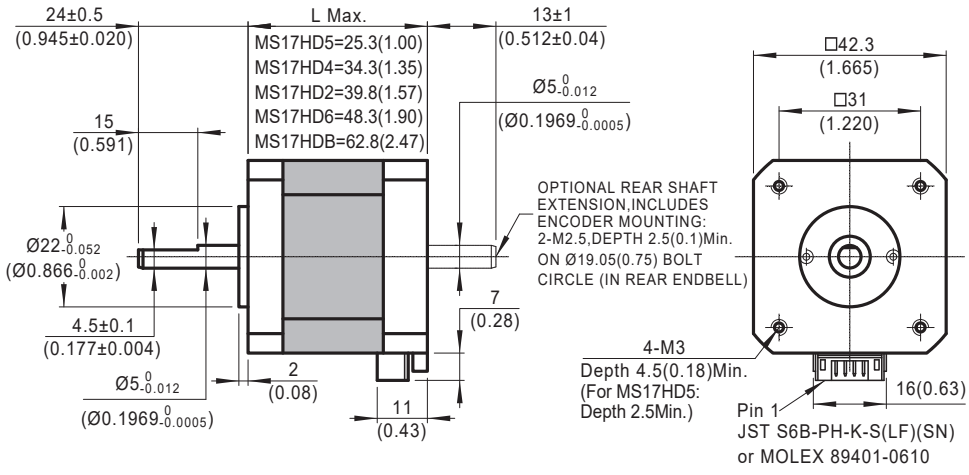
Options

Omit No Options
-M 5 mm Diameter Rear Shaft With Encoder Mounting Holes

Winding

Current rating x 100

Dimensions: mm (in)



MS17HD - 4 Lead Bi-Polar

Length		Model Number	Connect	Rated Current	Holding Torque		Winding Ohms	mH	Detent Torque		Rotor Inertia		Motor Weight	
		Single Shaft	P=Plug L=Leads	Amps (mounted)	Nm Typ.	oz-in TYP.	@20℃	Typ.	mNm	oz-in	g cm²	oz-in²	kg	Lbs
25.3 mm (1 in.)		MS17HD5P4027	P	0.27	0.20	28	44	53	5	0.71	20	0.11	0.15	0.33
	^	MS17HD5P4070	P	0.7	0.21	30	6.5	8.8						
	^	MS17HD5P4100	P	1	0.21	30	3.2	4.3						
	^	MS17HD5P4150	P	1.5	0.20	28	1.12	1.62						
34.3 mm (1.35 in.)		MS17HD4P4040	P	0.4	0.34	48	30	51	12	1.7	38	0.21	0.21	0.46
	^	MS17HD4P4065	P	0.65	0.32	45	8.7	15.4						
	^	MS17HD4P4100	P	1	0.33	47	4.2	7.5						
	^	MS17HD4P4150	P	1.5	0.32	45	1.7	2.9						
39.8 mm (1.57 in.) 1 Stack		MS17HD2P4040	P	0.4	0.48	68	24	56	15	2.1	57	0.31	0.28	0.62
	^	MS17HD2P4100	P	1	0.48	68	3.9	8.9						
	^	MS17HD2P4150	P	1.5	0.50	71	1.98	4.3						
	^	MS17HD2P4200	P	2	0.48	68	1.04	2.2						
48.3 mm (1.9 in.) 2 Stack		MS17HD6P4050	P	0.5	0.67	95	24	53	25	3.5	82	0.45	0.36	0.79
	^	MS17HD6P4100	P	1	0.63	89	4.9	11.5						
	^	MS17HD6P4150	P	1.5	0.62	88	2.2	4.9						
	^	MS17HD6P4200	P	2	0.63	89	1.3	2.9						
62.8 mm (2.47 in.) 3 Stack	^	MS17HDBP4100	P	1	0.82	120	5.6	14.6	30	4.2	123	0.67	0.6	1.3
	^	MS17HDBP4150	P	1.5	0.88	120	3	7.7						
	^	MS17HDBP4200	P	2	0.83	120	1.49	3.8						

^ Preferred model

MS17HD - 6 Lead Uni-Polar

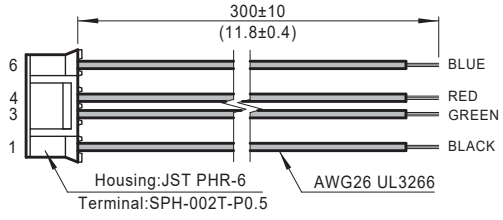
Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms	mH	Detent Torque		Rotor Inertia		Motor Weight	
	Single Shaft	P=Plug L=Leads	Amps (mounted)	Nm Typ.	oz-in TYP.	@20℃	Typ.	mNm	oz-in	g cm²	oz-in²	kg	Lbs
25.3 mm (1 in.)	MS17HD5P6030	P	0.3	0.16	23	37	25	5	0.71	20	0.11	0.15	0.33
	MS17HD5P6070	P	0.7	0.16	23	6	4.4						
	MS17HD5P6100	P	1	0.16	23	3	2.2						
34.3 mm (1.35 in.)	MS17HD4P6038	P	0.38	0.26	37	31	27	12	1.7	38	0.21	0.21	0.46
	MS17HD4P6085	P	0.85	0.24	34	5.1	4.5						
	MS17HD4P6120	P	1.2	0.25	35	2.9	2.5						
39.8 mm (1.57 in.) 1 Stack	MS17HD2P6040	P	0.4	0.38	54	28	31	15	2.1	57	0.31	0.28	0.62
	MS17HD2P6085	P	0.85	0.38	54	6	6.7						
	MS17HD2P6130	P	1.3	0.38	54	2.5	2.8						
48.3 mm (1.9 in.) 2 Stack	MS17HD6P6040	P	0.4	0.48	68	29	33	25	3.5	82	0.45	0.36	0.79
	MS17HD6P6080	P	0.8	0.49	69	7.6	8.6						
	MS17HD6P6130	P	1.3	0.51	72	3.2	3.6						
	MS17HD6P6200	P	2	0.50	71	1.3	1.4						

^ Preferred model

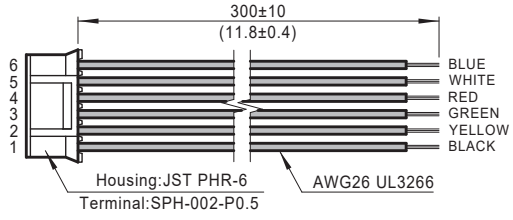
Mating Connector With Leads (order separately)

Dimensions: mm (in)

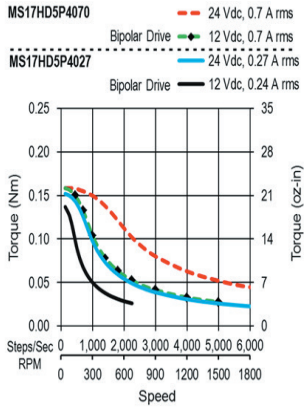
4 Lead Part Number 4634 1402 00723

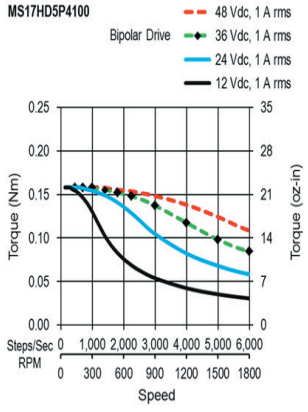


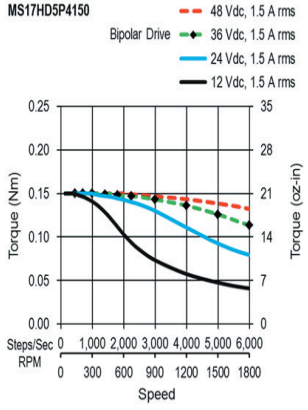
6 Lead Part Number 4634 1402 00922



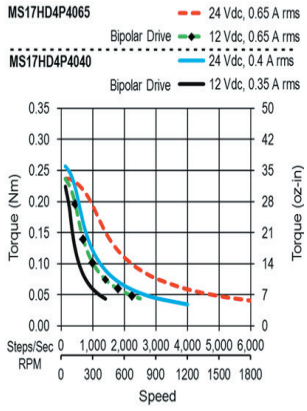
MS17HD5 - Bipolar

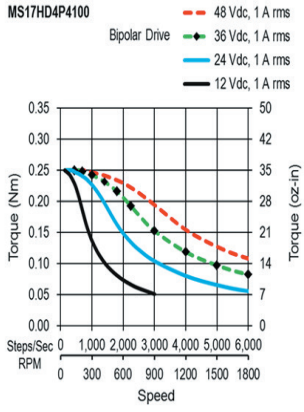


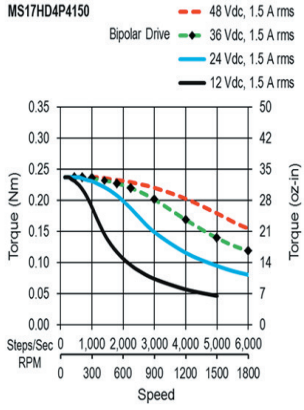




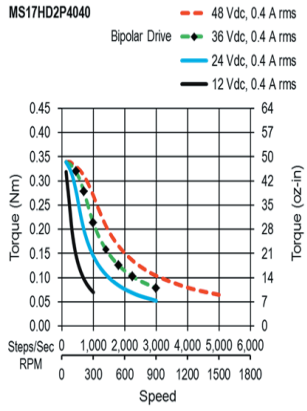
MS17HD4 - Bipolar

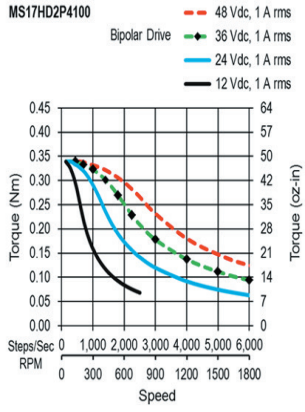


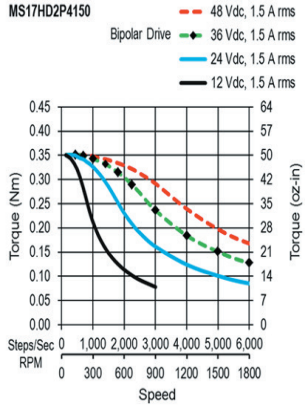


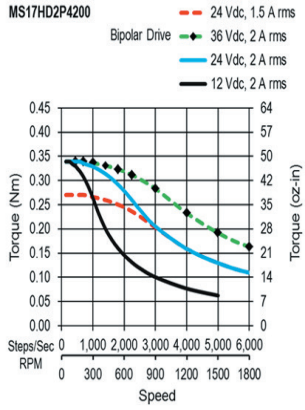


MS17HD2 - Bipolar

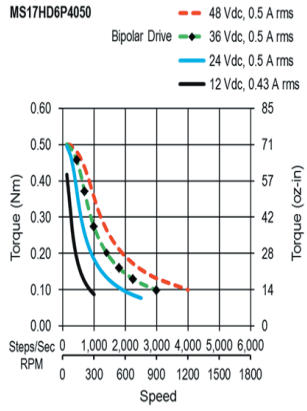


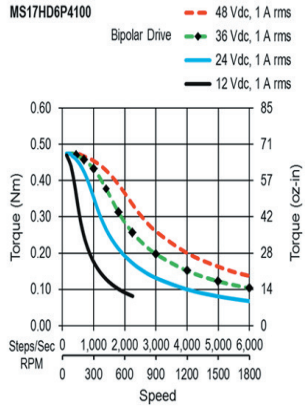


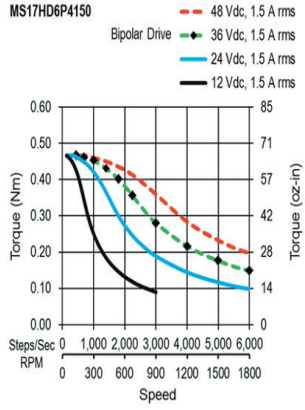


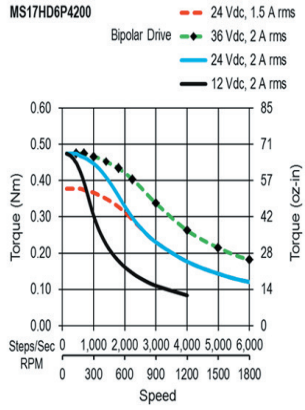


MS17HD6 - Bipolar

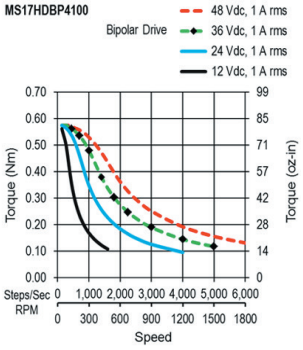


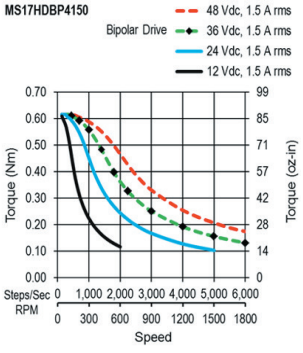


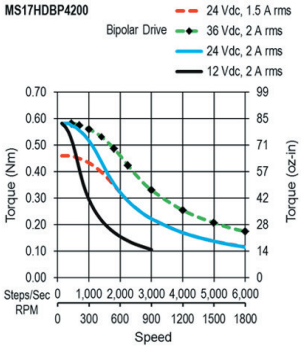




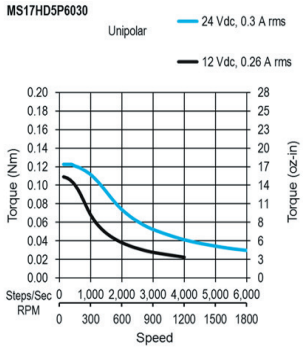
MS17HDB - Bipolar

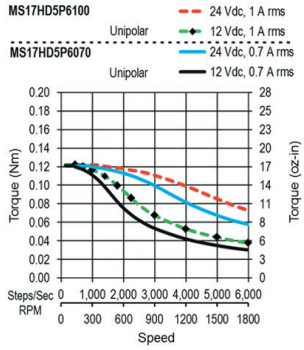




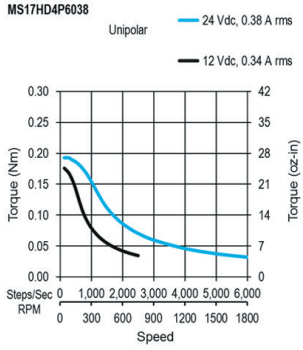


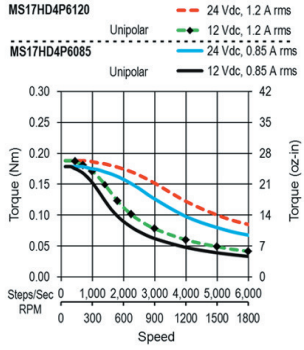
MS17HD5 - Unipolar



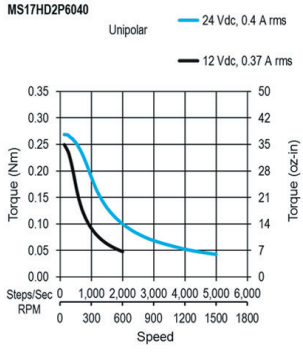


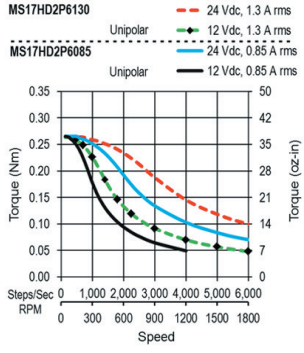
MS17HD4 - Unipolar



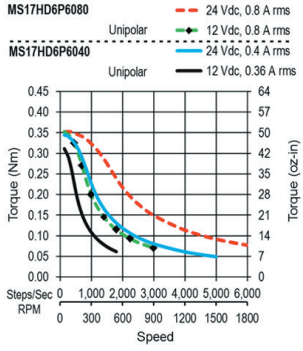


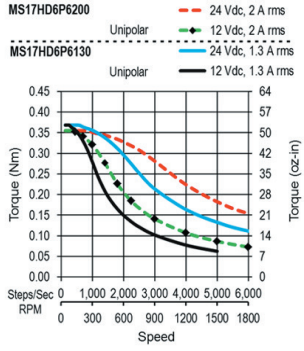
MS17HD2 - Unipolar



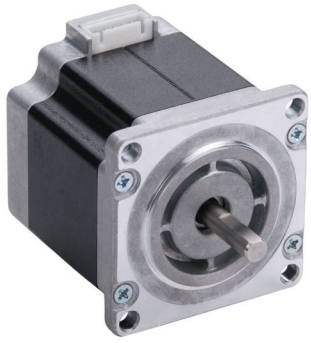


MS17HD6 - Unipolar





MS23HA Series: 0.9° - Size 23



- Phases 2
- Steps / Revolution 400
- Step Accuracy ±5%
- Shaft Load (20,000 Hours at 1000 RPM)
  - Axial: 40 N (9 Lbs.) Push, 130 N (30 Lbs.) Pull
  - Radial: 70 N (15.5 Lbs.) At Flat Center
- IP Rating 40
- Approvals UL Recognized File E465363, RoHS
- Operating Temp. -20°C to +50°C
- Insulation Class B, 130°C
- Insulation Resistance 100 MegOhms

MS23HA 0 P 4 100 -E

Basic Motor Length (Max)
- 0 39mm (1.54 in.)
- 8 55mm (2.17 in.) 1 Stack
- A 77mm (3.03 in.) 2 Stack

Electrical Connection
- P Plug-in Connector

Number of Connections
- 4 4 Lead-Bipolar
- 6 6 Lead-Unipolar(or Bipolar)

Winding
- ### Current rating x 100

Options
- Omit No Options
- -E 0.25 inch diameter rear shaft With Encoder Mounting Holes

MS23HA - 4 Lead Bi-Polar

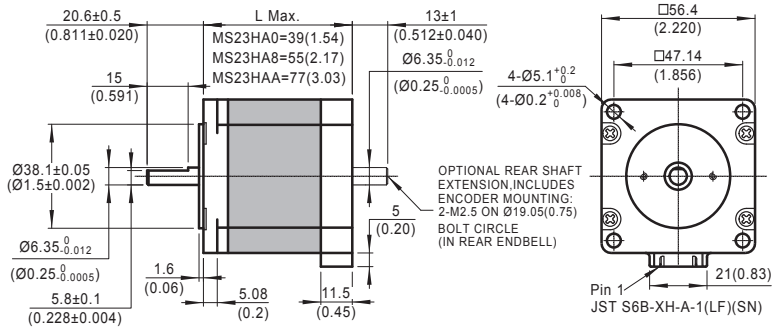
Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms mH		Detent Torque		Rotor Inertia		Motor Weight	
	Single Shaft	P=Plug L=Leads	Amps (mounted)	Nm Typ.	oz-in TYP.	@20℃	Typ.	mNm	oz-in	g cm²	oz-in²	kg	Lbs
39 mm (1.54 in.)	^ MS23HA0P4100	P	1	0.7	99	6.3	23	20	2.8	121.5	0.66	0.42	0.93
	^ MS23HA0P4160	P	1.6	0.71	100	2.6	9.4						
	^ MS23HA0P4220	P	2.2	0.71	100	1.39	5						
	^ MS23HA0L4350	L	3.5	0.7	99	0.56	1.9						
55 mm (2.17 in.) 1 Stack	^ MS23HA8P4100	P	1	1.50	210	7.6	50	45	6.4	221	1.2	0.6	1.3
	^ MS23HA8P4150	P	1.5	1.40	200	3.1	21						
	^ MS23HA8P4220	P	2.2	1.50	210	1.6	10.5						
	^ MS23HA8L4360	L	3.6	1.50	210	0.63	3.9						
	^ MS23HA8L4550	L	5.5	1.50	210	0.31	1.56						
77 mm (3.03 in.) 2 Stack	^ MS23HAAP4100	P	1	2.30	330	8.8	61	70	9.9	391	2.1	1	2.2
	^ MS23HAAP4150	P	1.5	2.40	340	4.3	29						
	^ MS23HAAP4200	P	2	2.30	330	2.3	15.2						
	^ MS23HAAP4300	P	3	2.40	340	1.1	6.9						
	^ MS23HAAL4500	L	5	2.30	330	0.39	2.4						

^ Preferred model

Dimensions: mm (in)

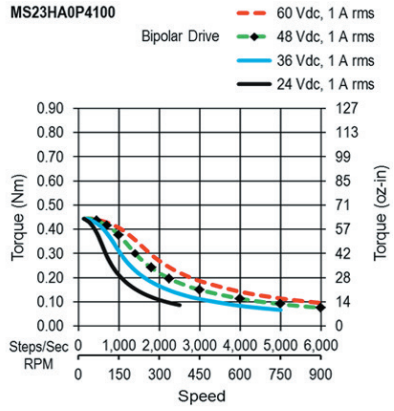
Mating Connector with 4 Leads: 300 ±10 (12 ±.5) long (order separately) Part Number: 4634 1402 01891

Motors with leads: Lead wire is 22 AWG UL3266, 300 ±10 (12 ±.5) long

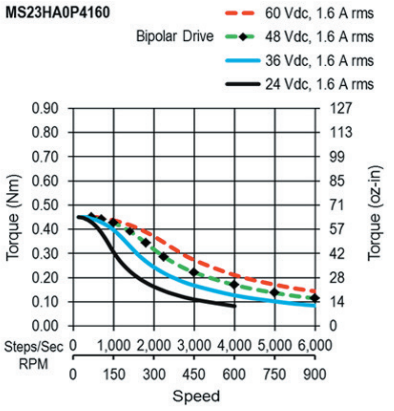


MS23HA0

MS23HA0P4100



MS23HA0P4160



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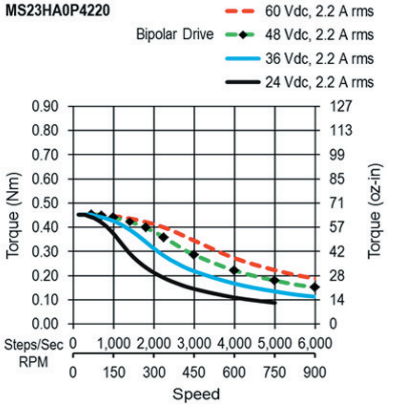
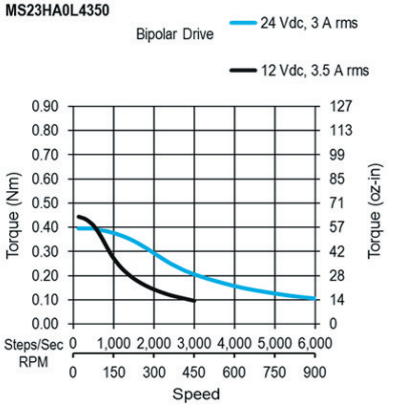
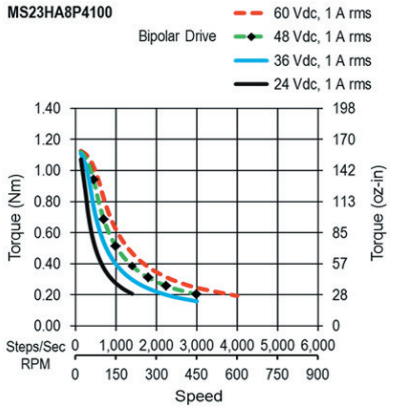


MS23HA0L4350



MS23HA8

MS23HA8P4100



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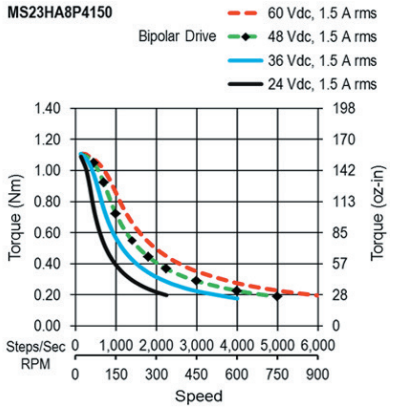

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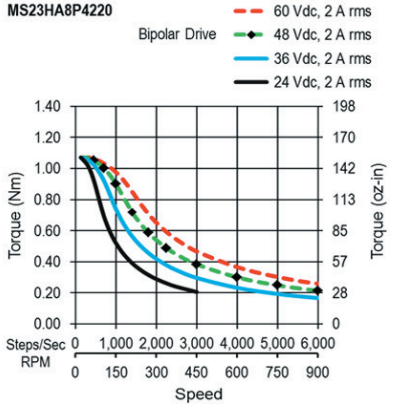
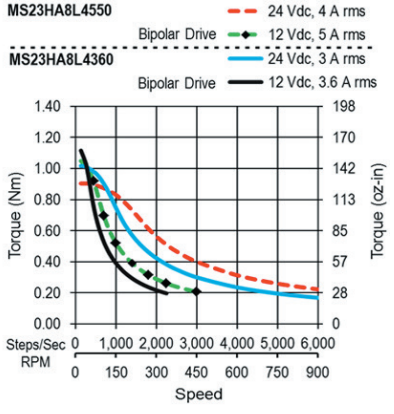


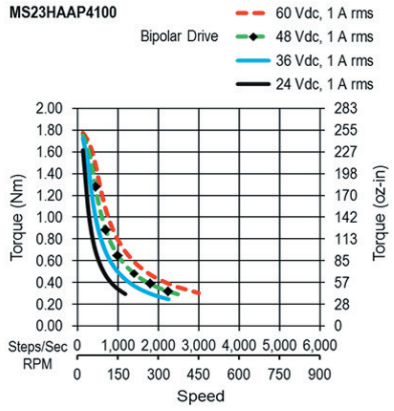
MS23HA8L4550



MS23HA8L4360

MS23HAA

MS23HAAP4100



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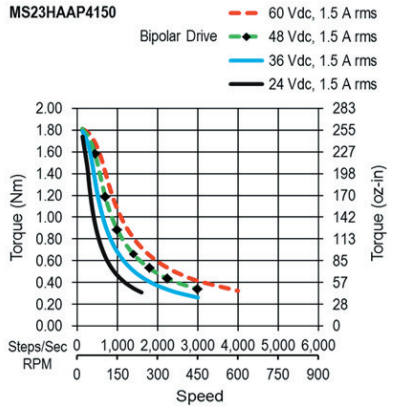
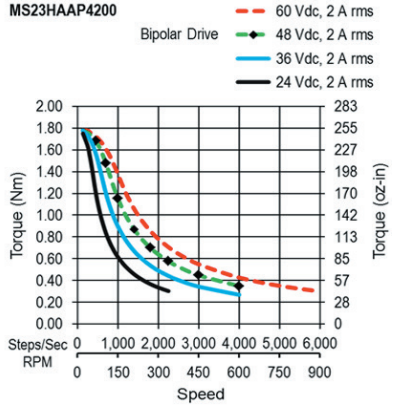
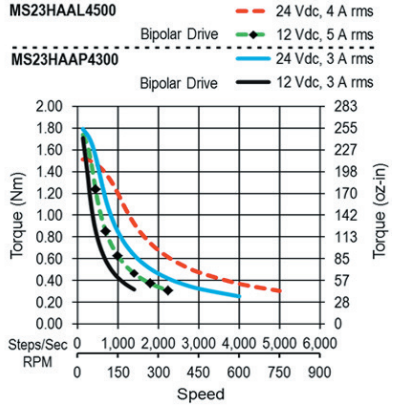


MS23HAAP4200



MS23HAAL4500



MS23HAAP4300

ML23HS / PL23HS Series: 1.8° - Size 23

- Phases 2
- Steps / Revolution 200
- Step Accuracy ±5%
- Shaft Load (20,000 Hours at 1000 RPM)
  - Axial: 40 N (9 Lbs.) Push; 130 N (30 Lbs.) Pull
  - Radial: 70 N (15.5 Lbs.) At Flat Center
- IP Rating 40
- Approvals UL Recognized File E465363, RoHS
- Operating Temp. -20°C to +50°C
- Insulation Class B, 130°C
- Insulation Resistance 100 MegOhms

M L23HS 0 P 4 100 -E

Motor Technology
- M High Torque Step Motor
- P PowerPlus Step Motor

Basic Motor Length (Max)
- 0 39mm (1.54 in.)
- 4 45mm (1.77 in.)
- 8 55mm (2.17 in.) 1 Stack
- A 77mm (3.03 in.) 2 Stack
- C 112mm (4.41 in.) 3 Stack

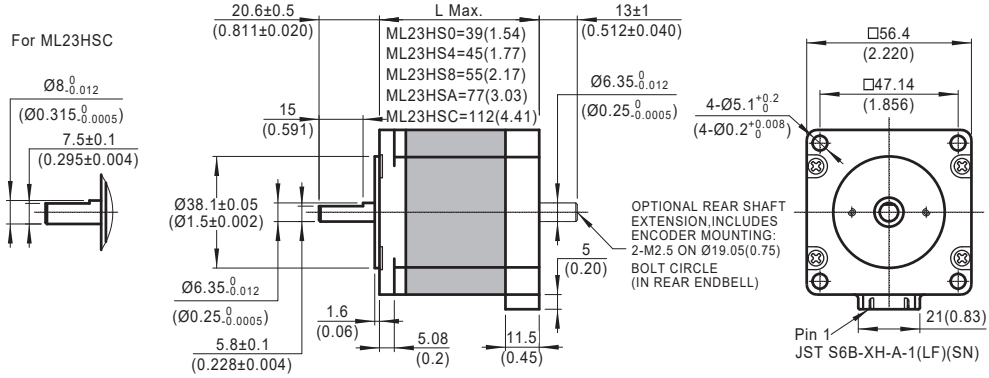
Electrical Connection
- L Leads
- P Plug-in Connector

Number of Connections
- 4 4 Lead-Bipolar
- 6 6 Lead-Unipolar(or Bipolar)

Winding
- ### Current rating x 100

Options
- Omit No Options
- -E 0.25 inch Diameter Rear Shaft with Encoder Mounting Holes

Dimensions: mm (in)



ML23HS - 4 Lead Bi-Polar

Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms mH		Detent Torque		Rotor Inertia		Motor Weight	
	Single Shaft	P=Plug L=Leads	Amps (mounted)	Nm Typ.	oz-in TYP.	@20℃	Typ.	mNm	oz-in	g cm²	oz-in²	kg	Lbs
39 mm (1.54 in.)	^ ML23HS0P4100	P	1	0.82	120	6.3	15.9	24	3.4	105	0.66	0.42	0.93
	^ ML23HS0P4160	P	1.6	0.83	120	2.6	6.5						
	^ ML23HS0P4220	P	2.2	0.84	120	1.39	3.5						
	^ ML23HS0L4350	L	3.5	0.82	120	0.56	1.3						
45 mm (1.77 in.)	^ ML23HS4P4100	P	1	1.20	170	7.3	22	28	4	135	0.85	0.48	1.1
	^ ML23HS4P4150	P	1.5	1.20	170	3.1	9.2						
	^ ML23HS4P4210	P	2.1	1.20	170	1.62	4.8						
	^ ML23HS4L4340	L	3.4	1.20	170	0.65	1.8						
55 mm (2.17 in.) 1 Stack	^ ML23HS8P4100	P	1	1.50	210	7.6	33	45	6.4	215	1.2	0.6	1.3
	^ ML23HS8P4150	P	1.5	1.50	210	3.1	13.6						
	^ ML23HS8P4220	P	2.2	1.50	210	1.6	6.9						
	^ ML23HS8L4360	L	3.6	1.50	210	0.63	2.6						
	^ ML23HS8L4550	L	5.5	1.50	210	0.28	1.03						
77 mm (3.03 in.) 2 Stack	^ ML23HSAP4100	P	1	2.30	330	8.8	39	75	11	365	2.1	1	2.2
	^ ML23HSAP4150	P	1.5	2.30	330	4.3	18.5						
	^ ML23HSAP4200	P	2	2.30	330	2.3	9.8						
	^ ML23HSAP4300	P	3	2.30	330	1.1	4.5						
	^ ML23HSAL4500	L	5	2.30	330	0.39	1.53						
112 mm (4.41 in.) 3 Stack	^ ML23HSCP4150	P	1.5	3.20	450	5.1	23	120	17	750	3.3	1.5	3.3
	^ ML23HSCP4200	P	2	3.20	450	2.7	13						
	^ ML23HSCP4300	P	3	3.20	450	1.29	5.5						
	^ ML23HSCL4500	L	5	3.20	450	0.51	2.2						

^ Preferred model

PL23HS - PowerPlus - 4 Lead Bi-Polar

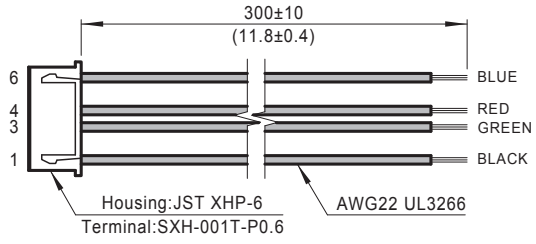
Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms mH		Detent Torque		Rotor Inertia		Motor Weight	
	Single Shaft	P=Plug L=Leads	Amps (mounted)	Nm Typ.	oz-in TYP.	@20℃	Typ.	mNm	oz-in	g cm²	oz-in²	kg	Lbs
55 mm (2.17 in.) 1 Stack	^ PL23HS8P4100	P	1	2.30	330	7.6	26	100	14	215	1.4	0.65	1.4
	^ PL23HS8P4150	P	1.5	2.20	310	3.1	10.7						
	^ PL23HS8P4220	P	2.2	2.30	330	1.6	5.4						
	^ PL23HS8L4360	L	3.6	2.30	330	0.63	2						
	^ PL23HS8L4550	L	5.5	2.20	310	0.28	0.8						
77 mm (3.03 in.) 2 Stack	^ PL23HSAP4100	P	1	3.30	470	8.8	32	150	21	365	2.5	1.1	2.4
	^ PL23HSAP4150	P	1.5	3.40	480	4.3	15.2						
	^ PL23HSAP4200	P	2	3.30	470	2.3	8.1						
	^ PL23HSAP4300	P	3	3.30	470	1.1	3.7						
	^ PL23HSAL4500	L	5	3.30	470	0.39	1.27						

^ Preferred model

Mating Connector With Leads (order separately)

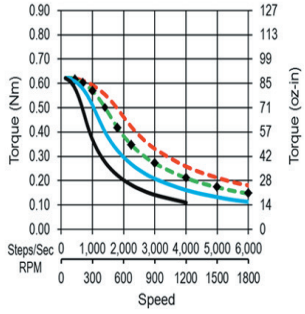
Dimensions: mm (in)

4 Lead Part Number 4634 1402 01891



ML23HS0	ML23HS4	ML23HS8	ML23HSA

ML23HS0P4100



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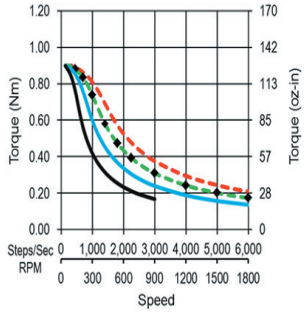

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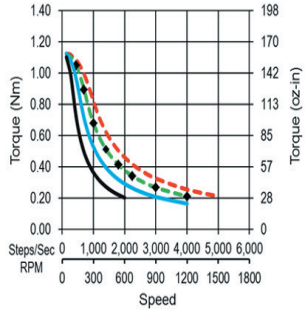

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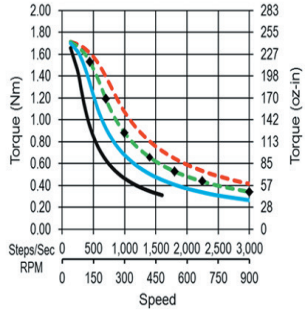

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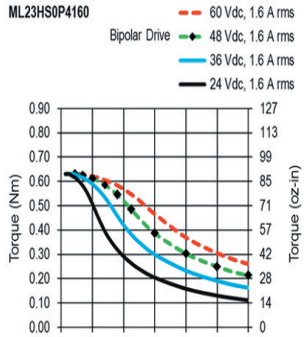

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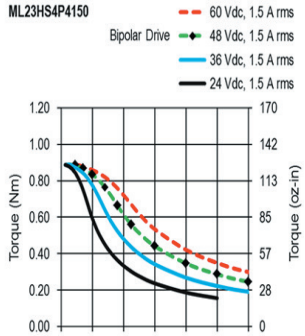

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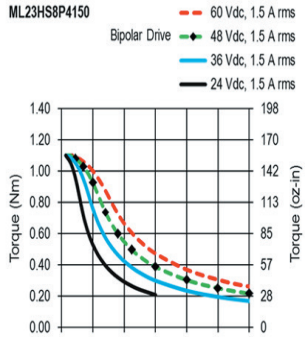

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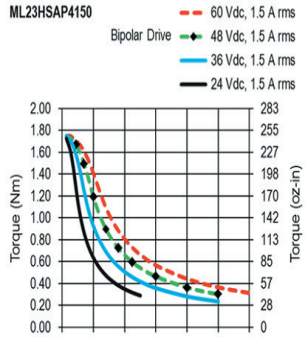

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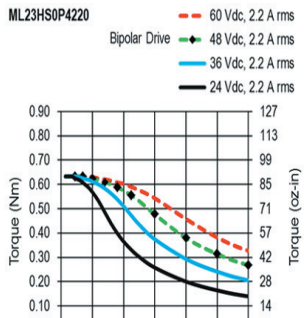

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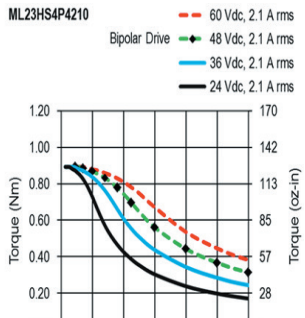

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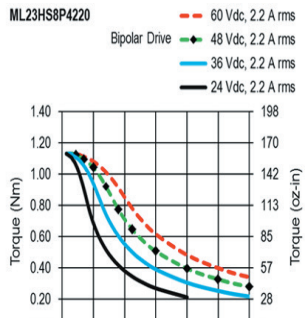

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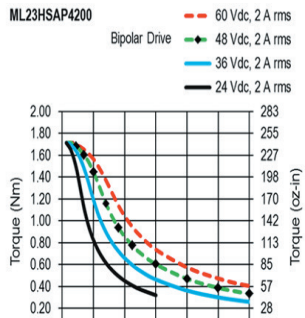

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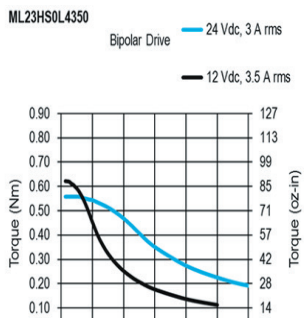

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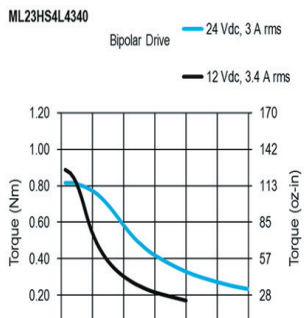

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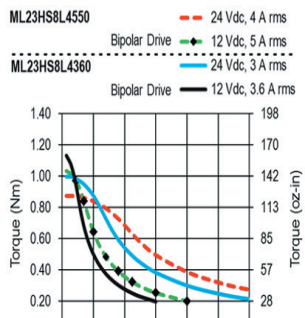

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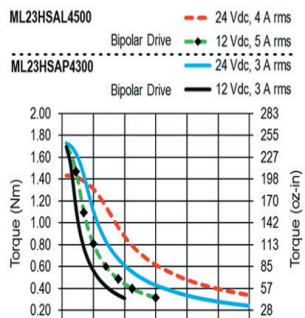
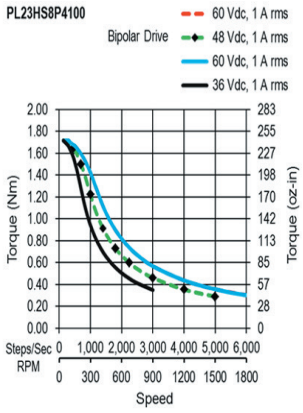
ML23HSAP4300

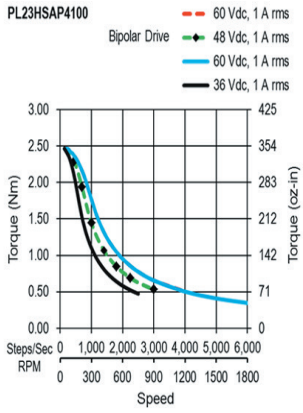


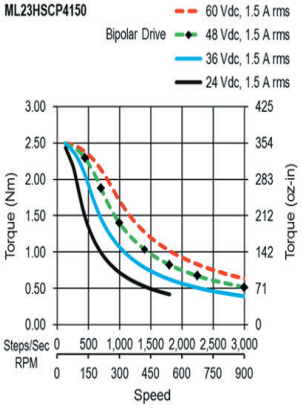
ML23HSC

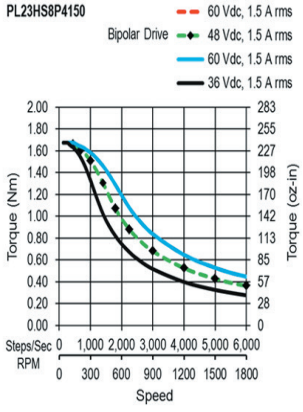
PowerPlus PL23HS8

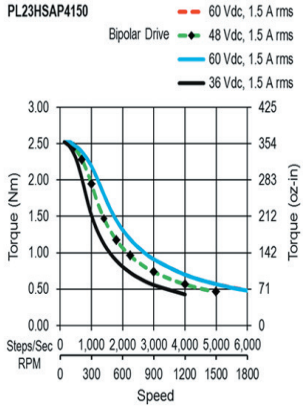
PowerPlus PL23HSA

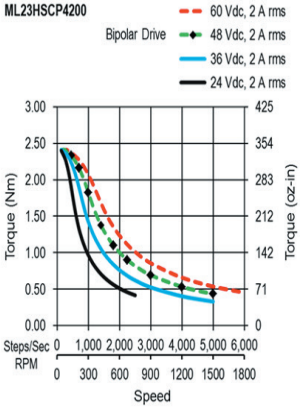


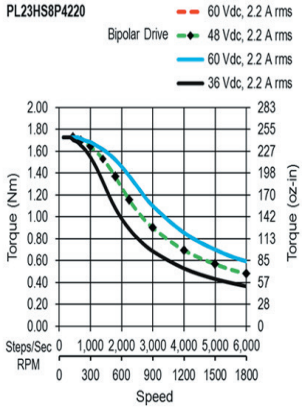


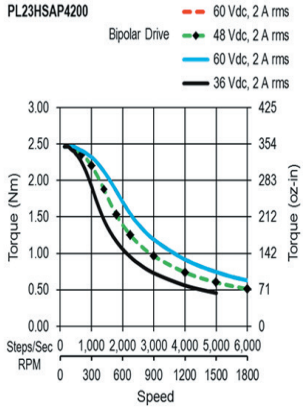


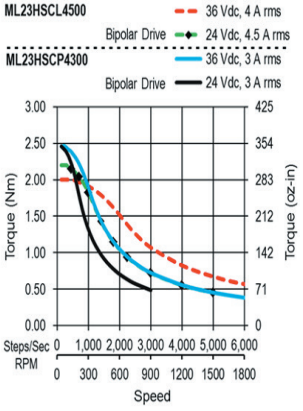


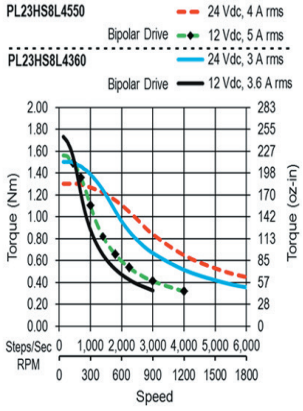


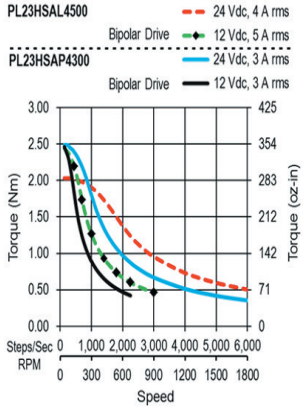




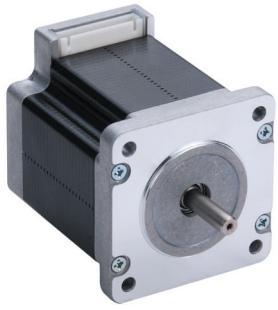








MS24HS Series: 1.8° - Size 24



- Phases 2
- Steps / Revolution 200
- Step Accuracy ±5%
- Shaft Load (20,000 Hours at 1000 RPM)
  - Axial: 40 N (9 Lbs.) Push; 130 N (30 Lbs.) Pull
  - Radial: 70 N (15.5 Lbs.) At Flat Center
- IP Rating 40
- Approvals UL Recognized File E465363, RoHS
- Operating Temp. -20°C to +50°C
- Insulation Class B, 130°C
- Insulation Resistance 100 MegOhms

MS24HS 1 P 4 150 -E

Basic Motor Length (Max)
- 1 46mm (1.81 in.)
- 2 56mm (2.21 in.)
- 3 67mm (2.64 in.)
- 5 87MM (3.43IN.)

Electrical Connection
- L Leads
- P Plug-in Connector

Number of Connections
- 4 4 Lead-Bipolar
- 6 6 Lead-Unipolar(or Bipolar)

Winding
- ### Current rating x 100

Options
- Omit No Options
- -E 0.25 inch diameter rear shaft With Encoder Mounting Holes

MS24HS – 4 Lead Bi-Polar

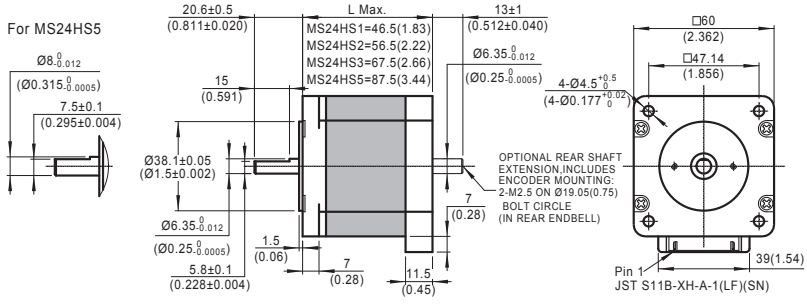
Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms mH		Detent Torque		Rotor Inertia		Motor Weight	
	Single Shaft	P=Plug L=Leads	Amps (mounted)	Nm Typ.	oz-in TYP.	@20 C	Typ.	mNm	oz-in	g cm²	oz-in²	kg	Lbs
46 mm (1.81 in.)	^ MS24HS1P4150	P	1.5	1.28	180	3.2	7.1	40	5.7	280	1.5	0.6	1.3
	^ MS24HS1P4200	P	2	1.26	180	1.69	3.9						
	^ MS24HS1P4300	P	3	1.23	170	0.73	1.61						
56 mm (2.2 in.)	^ MS24HS2P4150	P	1.5	1.90	270	4	12.5	90	13	450	2.5	0.83	1.8
	^ MS24HS2P4200	P	2	1.90	270	2.1	6.8						
	^ MS24HS2P4300	P	3	1.80	250	0.92	2.8						
	^ MS24HS2L4420	L	4.2	1.80	250	0.47	1.35						
67 mm (2.64 in.)	^ MS24HS3P4150	P	1.5	2.40	340	4.2	12.1	95	13	560	3.1	1.05	2.3
	^ MS24HS3P4200	P	2	2.30	330	2.2	6						
	^ MS24HS3P4300	P	3	2.40	340	1.1	3						
	^ MS24HS3L4420	L	4.2	2.30	330	0.56	1.44						
87 mm (3.43 in.)	^ MS24HS5P4150	P	1.5	3.20	450	4.6	15.8	100	14	900	4.9	1.4	3.1
	^ MS24HS5P4200	P	2	3.30	470	2.8	9.2						
	^ MS24HS5P4300	P	3	3.30	470	1.21	4.1						
	^ MS24HS5L4420	L	4.2	3.20	450	0.61	1.97						

^ Preferred model

Dimensions: mm (in)

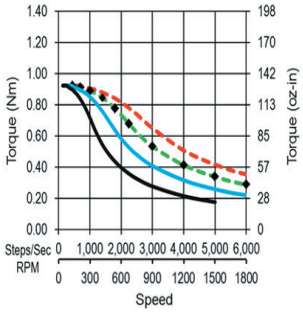
Mating Connector with 4 Leads: 300 ±10 (12 ±.5) long (order separately) Part Number: 4634 1402 01393

Motors with leads: Lead wire is 22 AWG UL3266, 300 ±10 (12 ±.5) long



MS24HS1	MS24HS2	MS24HS3	MS24HS5

MS24HS1P4150



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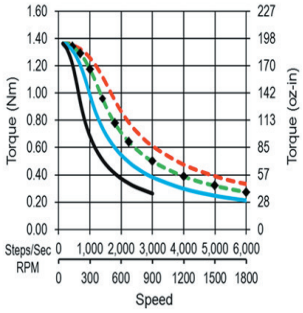

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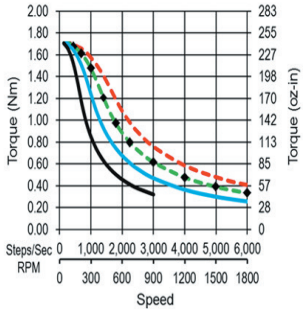
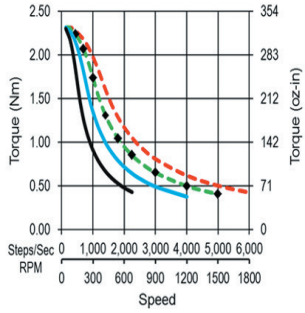


MS24HS5P4150



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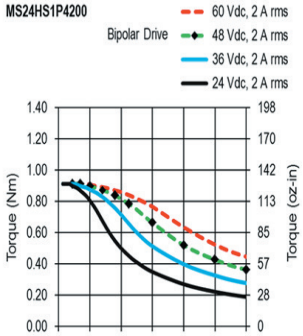

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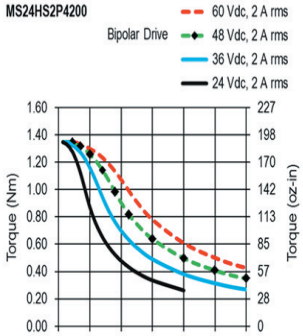

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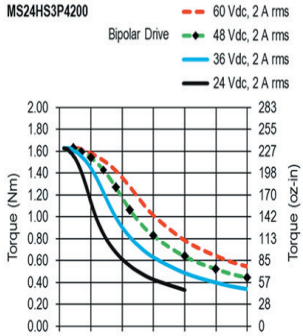

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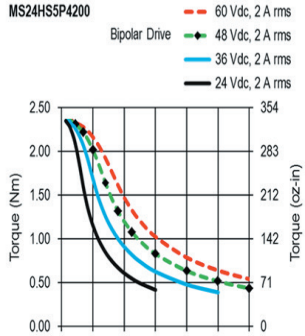

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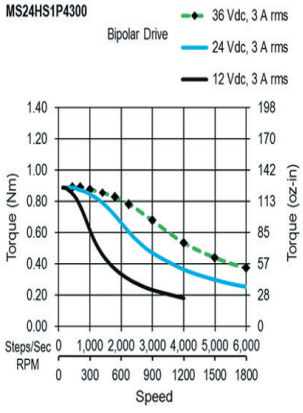

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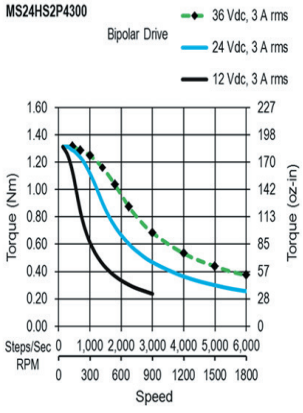
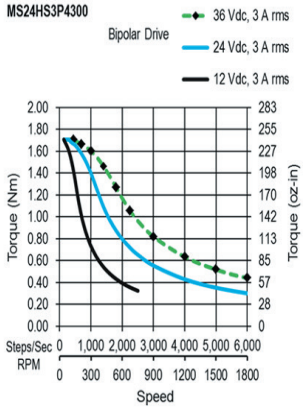


MS24HS3P4300



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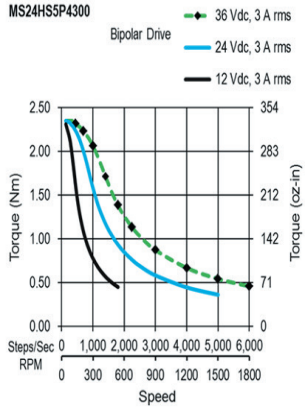

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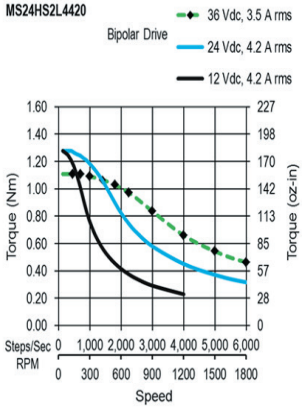

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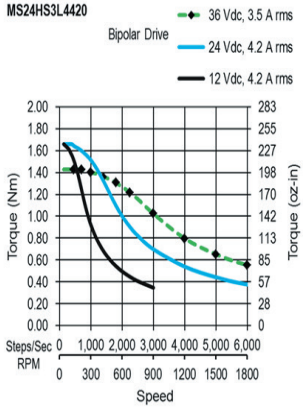

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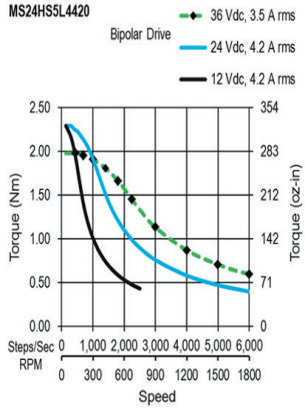
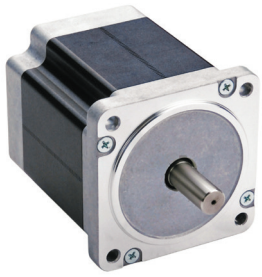


ML34HD / PL34HD Series: 1.8° - Size 34



- Phases 2
- Steps / Revolution 200
- Step Accuracy ±5%
- Shaft Load (20,000 Hours at 1000 RPM)
  - Axial 65 N (15 Lbs.) Push
    155 N (35 Lbs.) Pull
  - Radial 220 N (50 Lbs.) At Flat Center
- IP Rating 40
- Approvals UL Recognized File E465363, RoHS
- Operating Temp. -20°C to +50°C
- Insulation Class B, 130°C

M L34HD 0 L 8 350 -E

Motor Technology
- M High Torque Step Motor
- P PowerPlus Step Motor

Basic Motor Length (Max)
- 0 67mm (2.64 in.) 1 Stack
- 1 97mm (3.82 in.) 2 Stack
- 2 126mm (4.96 in.) 3 Stack
- 3 157mm (6.18 in.) 4 Stack

L Leads

Number of Connections
- 4 4 Lead-Bipolar
- 8 8 Lead-Unipolar(or Bipolar)

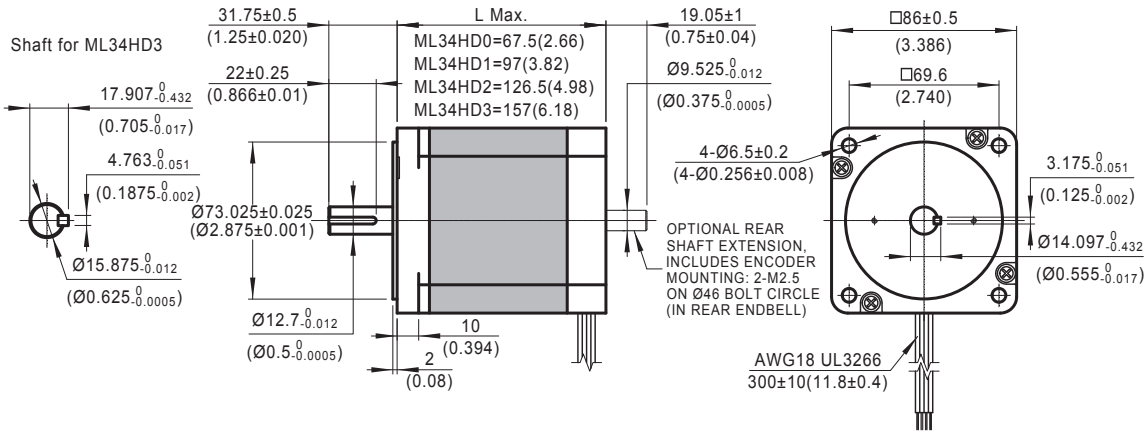
Winding
- ### Current rating x 100
- X## for 11 to 19 amps:
  X10= 11 amps, X40 = 14 amps

Options
- Omit No Options
- -E 0.375 inch Diameter Rear Shaft with Encoder Mounting Holes

ML34HD – 4 Lead & 8 Lead

Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms mH		Detent Torque		Rotor Inertia		Motor Weight	
	Single Shaft	P=Plug L=Leads	Amps (mounted)	Nm Typ.	oz-in TYP.	@20 ℃	Typ.	mNm	oz-in	g cm²	oz-in²	kg	Lbs
67 mm (2.64 in.) 1 Stack	^ ML34HD0L4160	L	1.6	3.70	520	3.9	42	90	13	915	5	1.6	3.5
	ML34HD0L4350	L	3.5	3.80	540	0.95	9.5						
	ML34HD0L4500	L	5	3.80	540	0.48	4.5						
	ML34HD0L4700	L	7	3.80	540	0.26	2.4						
	ML34HD0L4X00	L	10	3.80	540	0.14	1.13						
97 mm (3.82 in.) 2 Stack	^ ML34HD1L4200	L	2	7.20	1,000	3.6	50	150	21	1480	8.1	2.7	6
	ML34HD1L4350	L	3.5	7.20	1,000	1.34	15.9						
	ML34HD1L4500	L	5	7.20	1,000	0.61	8						
	ML34HD1L4700	L	7	7.20	1,000	0.36	4						
	ML34HD1L4X00	L	10	7.20	1,000	0.19	2						
126 mm (4.96 in.) 3 Stack	^ ML34HD2L4200	L	2	10.00	1,400	4.1	63	200	28	2200	12	3.8	8.4
	ML34HD2L4350	L	3.5	9.90	1,400	1.44	20						
	ML34HD2L4500	L	5	9.80	1,400	0.72	9.4						
	ML34HD2L4700	L	7	9.90	1,400	0.38	4.5						
	ML34HD2L4X00	L	10	9.80	1,400	0.22	2.3						
157 mm (6.18 in.) 4 Stack	^ ML34HD3L4230	L	2.3	13.2	1,869	3.9	58	250	35	3740	17	4.9	11
	ML34HD3L4350	L	3.5	13.2	1,869	1.81	25						
	ML34HD3L4500	L	5	13.2	1,869	0.9	11.7						
	ML34HD3L4700	L	7	13.2	1,869	0.47	6.3						
	ML34HD3L4X00	L	10	13.2	1,869	0.24	2.9						
67 mm (2.64 in.) 1 Stack	^ ML34HD0L8350	L Series L Parallel	3.5 7	3.80 3.80	540 540	0.98 0.25	9.5 2.4	90	13	915	5	1.6	3.5
	^ ML34HD0L8500	L Series L Parallel	5 10	3.80 3.80	540 540	0.5 0.126	4.5 1.13						
97 mm (3.82 in.) 2 Stack	^ ML34HD1L8350	L Series L Parallel	3.5 7	7.20 7.20	1,000 1,000	1.37 0.34	15.9 4	150	21	1480	8.1	2.7	6
	^ ML34HD1L8500	L Series L Parallel	5 10	7.20 7.20	1,000 1,000	0.71 0.177	8 2						
126 mm (4.96 in.) 3 Stack	^ ML34HD2L8350	L Series L Parallel	3.5 7	9.90 9.90	1,400 1,400	1.48 0.37	20 5	200	28	2200	12	3.8	8.4
	^ ML34HD2L8500	L Series L Parallel	5 10	9.80 9.80	1,400 1,400	0.82 0.21	9.4 2.3						
157 mm (6.18 in.) 4 Stack	^ ML34HD3L8350	L Series L Parallel	3.5 7	13.2 13.2	1,869 1,869	1.85 0.46	25 6.3	250	35	3740	17	4.9	11
	^ ML34HD3L8500	L Series L Parallel	5 10	13.2 13.2	1,869 1,869	0.92 0.23	11.7 2.9						

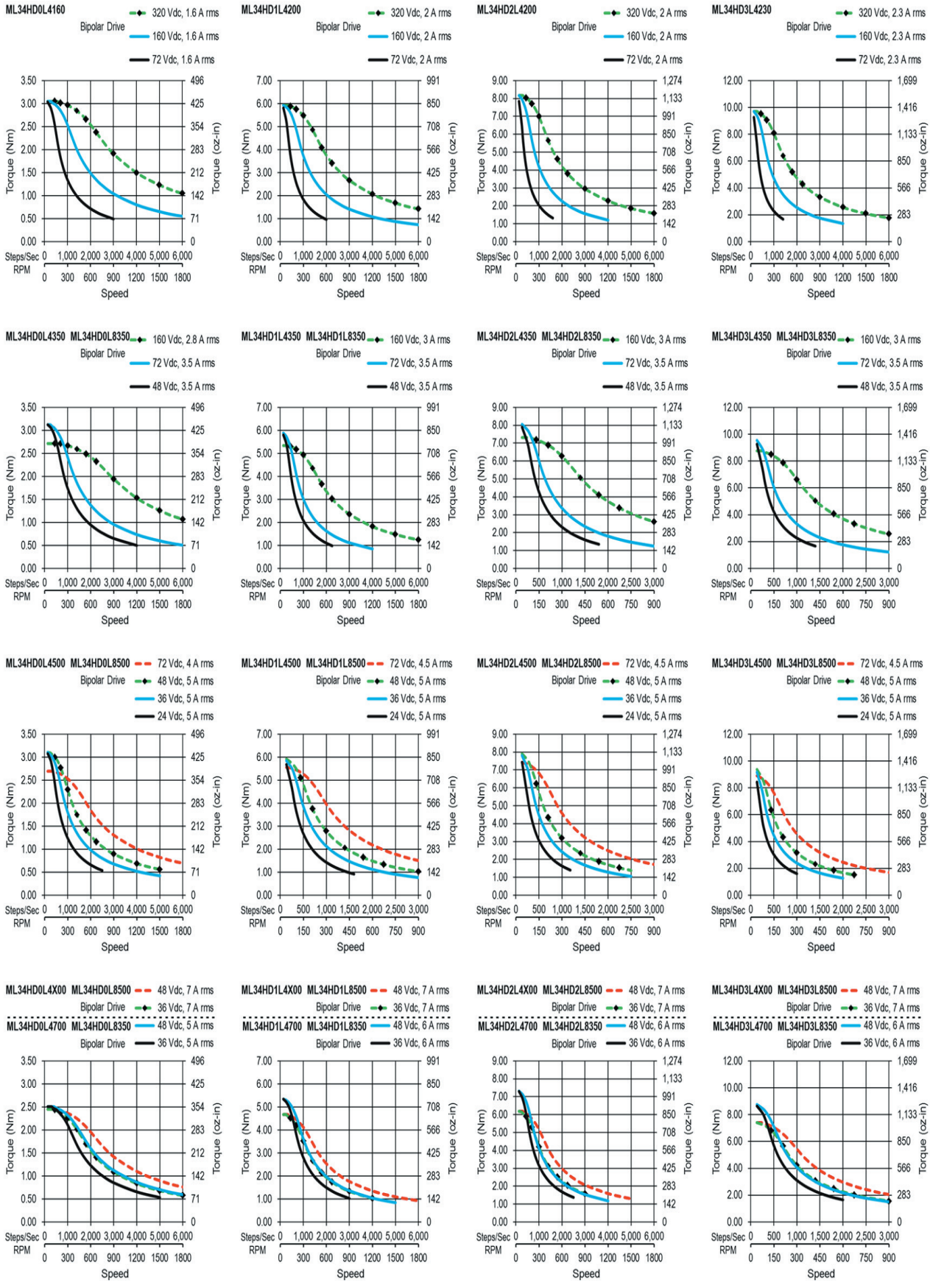
Dimensions: mm (in)



PL34HD – PowerPlus – 4 Lead & 8 Lead

Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms mH		Detent Torque		Rotor Inertia		Motor Weight	
	Single Shaft	P=Plug L=Leads	Amps (mounted)	Nm Typ.	oz-in TYP.	@20 ℃	Typ.	mNm	oz-in	g cm²	oz-in²	kg	Lbs
67 mm (2.64 in.) 1 Stack	^ PL34HD0L4160	L	1.6	4.70	670	3.9	33	120	17	915	5	1.6	3.5
	PL34HD0L4350	L	3.5	4.75	670	0.95	7.6						
	PL34HD0L4500	L	5	4.75	670	0.48	3.6						
	PL34HD0L4700	L	7	4.75	670	0.26	1.89						
	PL34HD0L4X00	L	10	4.75	670	0.138	0.91						
97 mm (3.82 in.) 2 Stack	^ PL34HD1L4200	L	2	9.20	1,300	3.6	40	250	37	1480	8.1	2.7	6
	PL34HD1L4350	L	3.5	9.00	1,300	1.34	12.8						
	PL34HD1L4500	L	5	9.00	1,300	0.61	6.4						
	PL34HD1L4700	L	7	9.00	1,300	0.36	3.2						
	PL34HD1L4X00	L	10	9.00	1,300	0.188	1.6						
126 mm (4.96 in.) 3 Stack	^ PL34HD2L4200	L	2	12.3	1,740	4.1	51	300	42	2200	12	3.8	8.4
	PL34HD2L4350	L	3.5	12.3	1,740	1.44	16.1						
	PL34HD2L4500	L	5	12.3	1,740	0.72	7.5						
	PL34HD2L4700	L	7	12.3	1,740	0.38	3.75						
	PL34HD2L4X00	L	10	12.3	1,740	0.22	1.87						
157 mm (6.18 in.) 4 Stack	^ PL34HD3L4230	L	2.3	15.00	2,100	3.9	47	375	53	3740	17	4.9	11
	PL34HD3L4350	L	3.5	15.00	2,100	1.81	20						
	PL34HD3L4500	L	5	15.00	2,100	0.9	9.4						
	PL34HD3L4700	L	7	15.00	2,100	0.47	5						
	PL34HD3L4X00	L	10	15.00	2,100	0.24	2.3						
67 mm (2.64 in.) 1 Stack	^ PL34HD0L8350	L Series	3.5	4.75	670	0.98	7.6	120	17	915	5	1.6	3.5
		L Parallel	7	4.75	670	0.25	1.89						
	^ PL34HD0L8500	L Series	5	4.75	670	0.5	3.6						
		L Parallel	10	4.75	670	0.126	0.91						
97 mm (3.82 in.) 2 Stack	^ PL34HD1L8350	L Series	3.5	9.00	1,300	1.37	12.8	250	37	1480	8.1	2.7	6
		L Parallel	7	9.00	1,300	0.34	3.2						
	^ PL34HD1L8500	L Series	5	9.00	1,300	0.71	6.4						
		L Parallel	10	9.00	1,300	0.177	1.6						
126 mm (4.96 in.) 3 Stack	^ PL34HD2L8350	L Series	3.5	12.3	1,740	1.48	16.1	300	42	2200	12	3.8	8.4
		L Parallel	7	12.3	1,740	0.37	4						
	^ PL34HD2L8500	L Series	5	12.3	1,740	0.82	7.5						
		L Parallel	10	12.3	1,740	0.21	1.87						
157 mm (6.18 in.) 4 Stack	^ PL34HD3L8350	L Series	3.5	15.00	2,100	1.85	20	375	53	3740	17	4.9	11
		L Parallel	7	15.00	2,100	0.46	5						
	^ PL34HD3L8500	L Series	5	15.00	2,100	0.92	9.4						
		L Parallel	10	15.00	2,100	0.23	2.3						

ML34HD0	ML34HD1	ML34HD2	ML34HD3



PL34HD0	PL34HD1	PL34HD2	PL34HD3

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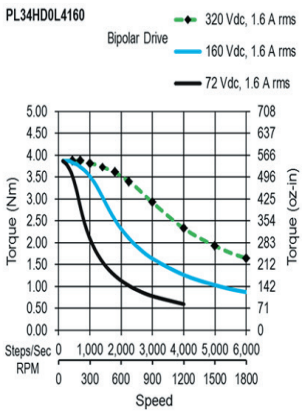

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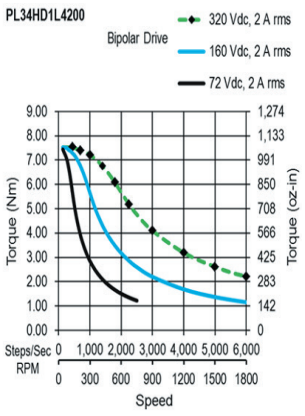

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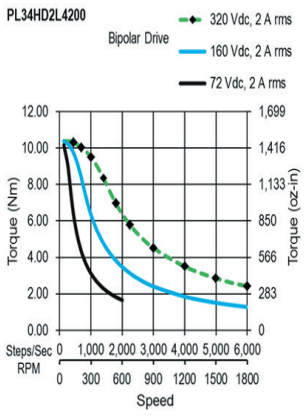

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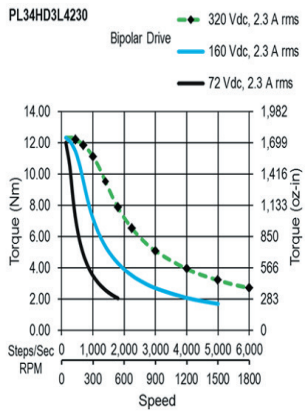

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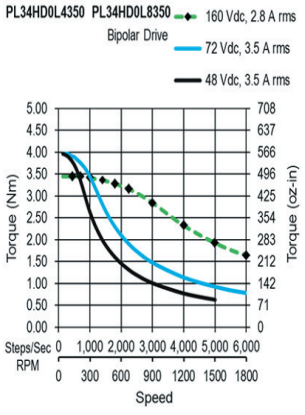

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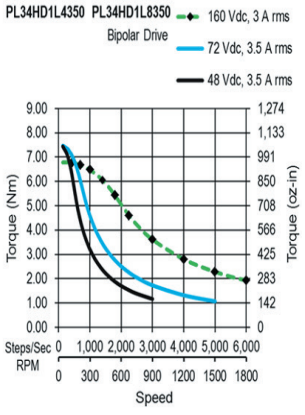

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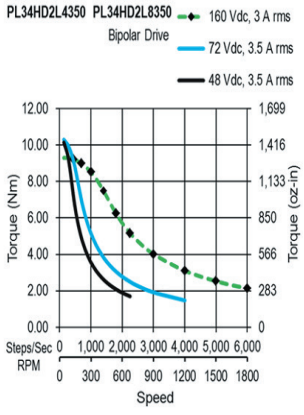

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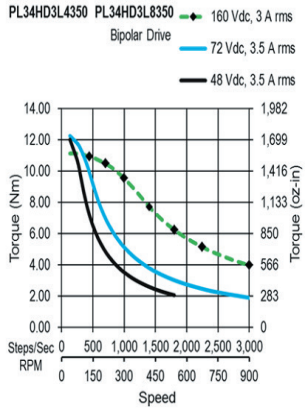

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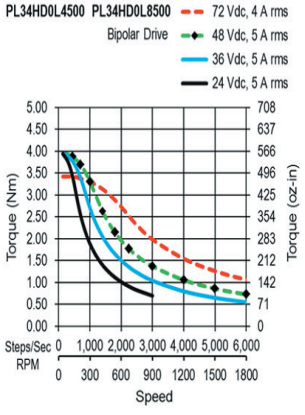

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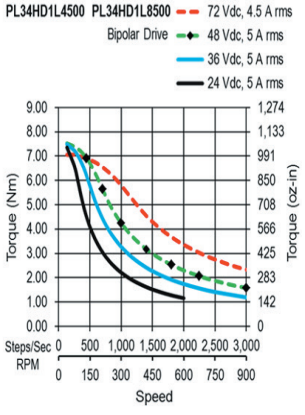

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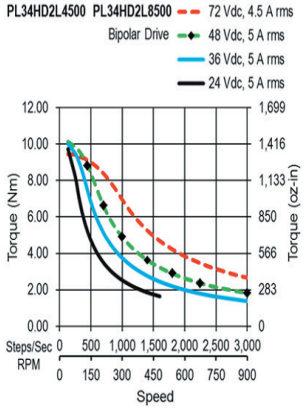
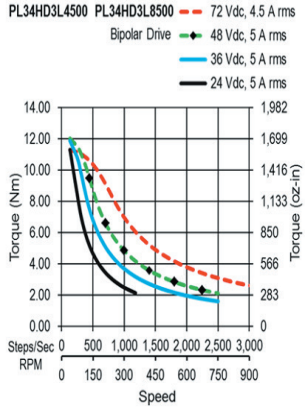
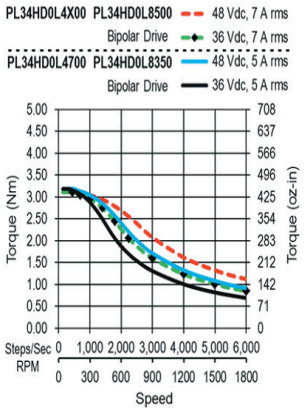


PL34HD3L4500 PL34HD3L8500



PL34HD0L4X00 PL34HD0L8500
PL34HD0L4700 PL34HD0L8350



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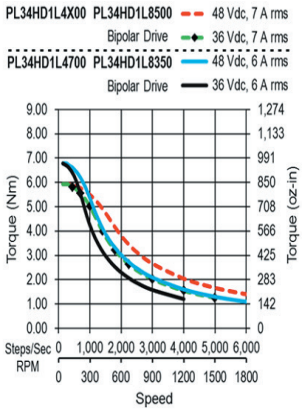
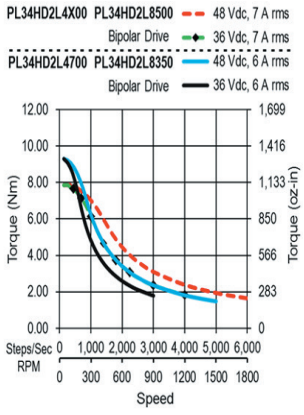
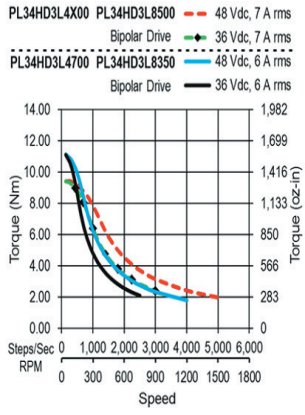
PL34HD1L4700 PL34HD1L8350



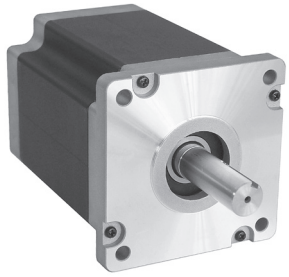
PL34HD2L4X00 PL34HD2L8500
PL34HD2L4700 PL34HD2L8350



PL34HD3L4X00 PL34HD3L8500
PL34HD3L4700 PL34HD3L8350



ML42HS Series: 1.8° - Size 42



- Phases 2
- Steps / Revolution 200
- Step Accuracy ±5%
- Shaft Load (20,000 Hours at 1000 RPM)
  - Axial 250 N (56 Lbs.) Push & Pull
  - Radial 450 N (100 Lbs.) At Keyway Center
- IP Rating 40
- Approvals UL Recognized File E465363, RoHS
- Operating Temp. - 20°C to +40°C
- Insulation Class B, 130°C
- Insulation Resistance 100 MegOhms

M L42HS 0 L 8 350

Motor Technology
- M High Torque Step Motor
- P PowerPlus Step Motor

Basic Motor Length (Max)
- 0 100mm (3.94 in.) 1 Stack
- 2 151mm (5.95 in.) 2 Stack
- 3 202mm (7.95 in.) 3 Stack

Electrical Connection
- L Leads

Winding
- ### Current rating x 100
- X## for 11 to 19 amps:
  X10= 11 amps, X40 = 14 amps

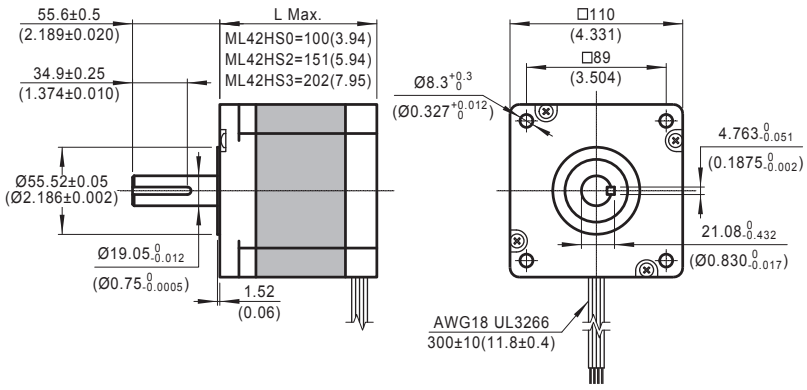
Number of Connections
- 4 4 Lead-Bipolar
- 8 8 Lead-Unipolar(or Bipolar)

ML42HS – 4 Lead & 8 Lead

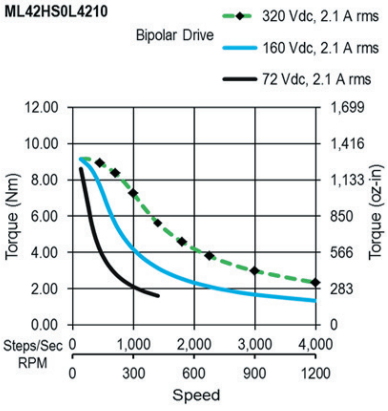
Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms mH		Detent Torque		Rotor Inertia		Motor Weight	
	Single Shaft	P=Plug L=Leads	Amps (mounted)	Nm Typ.	oz-in TYP.	@20 C	Typ.	mNm	oz-in	g cm²	oz-in²	kg	Lbs
100 mm (3.94 in.) 1 Stack	^ ML42HS0L4210	L	2.1	12.10	1,700	4.1	68	500	71	5500	30	4.8	11
	ML42HS0L4420	L	4.2	12.20	1,700	1.16	17.4						
	ML42HS0L4600	L	6	12.30	1,700	0.61	9						
	ML42HS0L4840	L	8.4	12.20	1,700	0.31	4.4						
	ML42HS0L4X20	L	12	12.30	1,700	0.167	2.25						
151 mm (5.94 in.) 2 Stack	^ ML42HS2L4240	L	2.4	22.00	3,100	4.2	76	650	92	10900	60	8	18
	ML42HS2L4600	L	6	22.00	3,100	0.75	12.5						
	ML42HS2L4800	L	8	22.00	3,100	0.41	7.3						
	ML42HS2L4X20	L	12	22.00	3,100	0.177	3.1						
	ML42HS2L4X60	L	16	22.00	3,100	0.116	1.8						
202 mm (7.95 in.) 3 Stack	^ ML42HS3L4270	L	2.7	31.00	4,400	4.2	83.5	800	110	16200	89	11.6	26
	ML42HS3L4600	L	6	31.00	4,400	1.02	18.5						
	ML42HS3L4800	L	8	32.00	4,500	0.55	10.8						
	ML42HS3L4X20	L	12	31.00	4,400	0.24	4.6						
	ML42HS3L4X60	L	16	32.00	4,500	0.152	2.7						
100 mm (3.94 in.) 1 Stack	^ PL42HS0L8420	L Series L Parallel	4.2 8.4	12.20 12.20	1,700 1,700	1.19 0.3	19.8 5	500	71	5500	30	4.8	11
	^ PL42HS0L8600	L Series L Parallel	6 12	12.30 12.30	1,700 1,700	0.64 0.159	10.1 2.5						
151 mm (5.94 in.) 2 Stack	^ PL42HS2L8600	L Series L Parallel	6 12	22.00 22.00	3,100 3,100	0.68 0.17	14.5 3.6	650	92	10900	60	8	18
	^ PL42HS2L8800	L Series L Parallel	8 16	22.00 22.00	3,100 3,100	0.43 0.108	7.6 1.9						
202 mm (7.95 in.) 3 Stack	^ PL42HS3L8600	L Series L Parallel	6 12	31.00 31.00	4,400 4,400	0.91 0.23	22 5.5	800	110	16200	89	11.6	26
	^ PL42HS3L8800	L Series L Parallel	8 16	32.00 32.00	4,500 4,500	0.58 0.144	13 3.2						

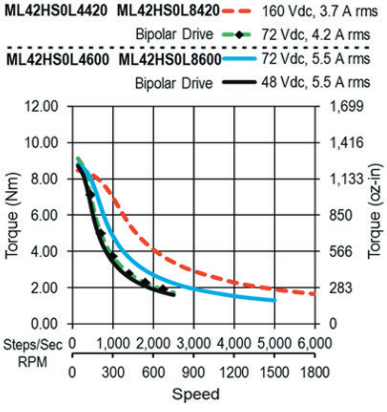
^ Preferred model

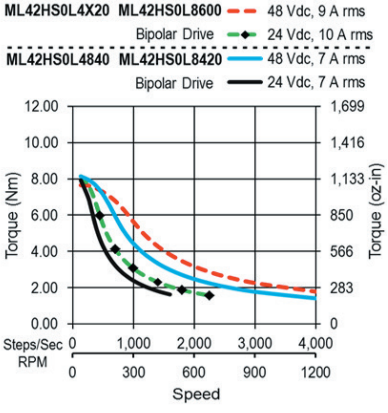
Dimensions: mm (in)



ML42HS0







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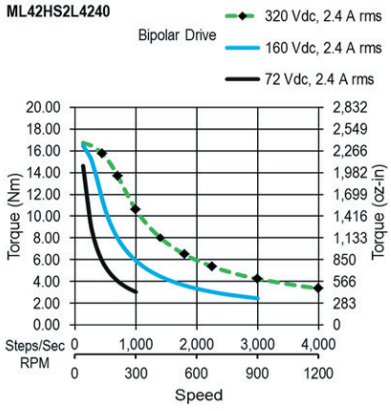

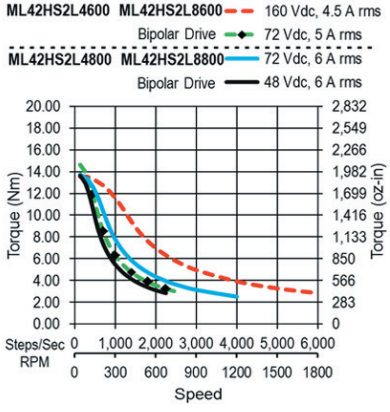

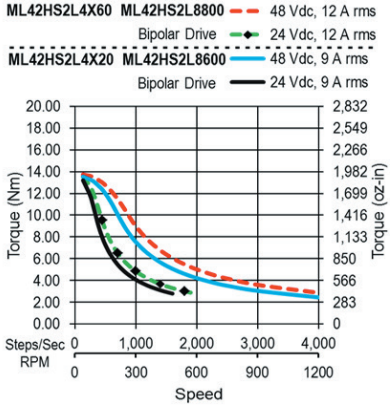

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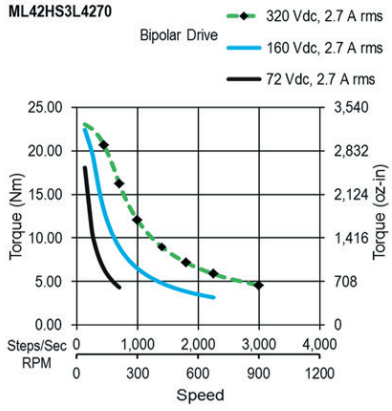
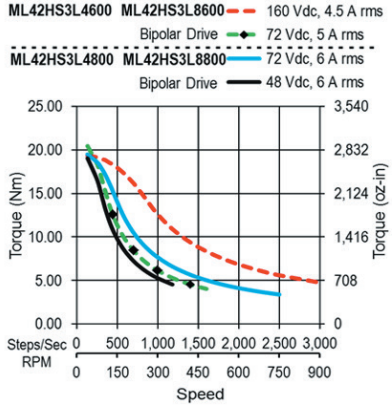
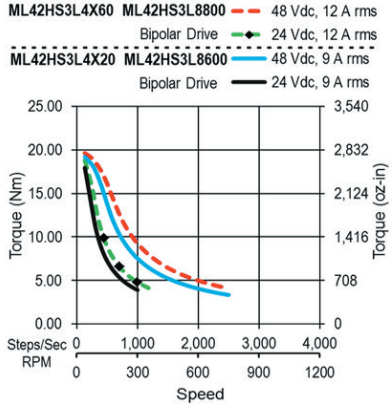






17HC Series: 1.2° - Size 17, 3 Phase Encapsulated

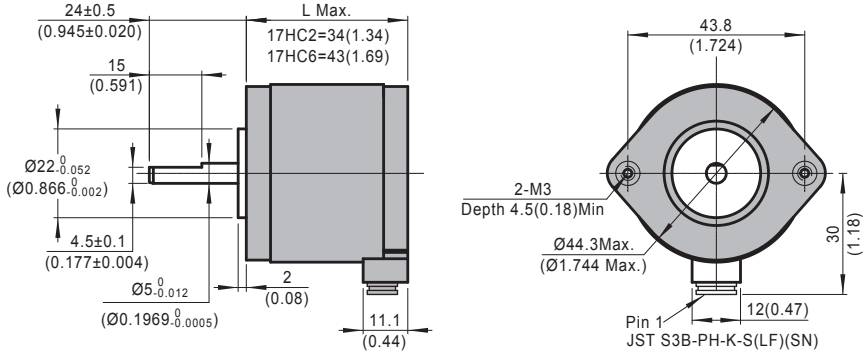
- Phases 3
- Steps / Revolution 300
- Step Accuracy ±5%
- Shaft Load (20,000 Hours at 1000 RPM)
  - Axial: 25 N (5.6 Lbs.) Push; 65 N (15 Lbs.) Pull
  - Radial: 29 N (6.5 Lbs.) At Flat Center
- IP Rating 40
- Approvals RoHS
- Operating Temp. -20°C to +50°C
- Insulation Class B, 130°C
- Insulation Resistance 100 MegOhms

17HC – 3 Phase

Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms mH		Detent Torque		Rotor Inertia		Motor Weight	
	Single Shaft	P=Plug L=Leads	Amps (mounted)	Nm Typ.	oz-in TYP.	@20℃	Typ.	mNm	oz-in	g cm²	oz-in²	kg	Lbs
34 mm (1.34 in.)	^ 17HC2005N	P	0.8	0.36	51	11	14.8	14	2	57	0.31	0.245	0.54
	^ 17HC2006N	P	1.5	0.36	51	3.6	4.9						
	^ 17HC2002N	P	2.3	0.36	51	1.65	2						
43 mm (1.69 in.)	^ 17HC6003N	P	0.82	0.46	65	14.3	21	25	3.5	82	0.45	0.35	0.77
	^ 17HC6004N	P	1.5	0.46	65	4.35	6.5						
	^ 17HC6005N	P	2.3	0.46	65	1.85	2.7						

^ Preferred model

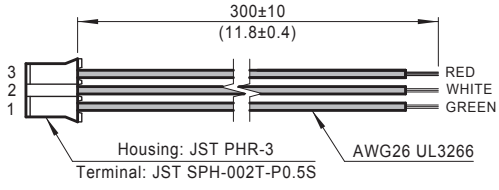
Dimensions: mm (in)



Mating Connector With Leads (order separately)

Dimensions: mm (in)

3 Lead Part Number 4634 1402 04496



MOONS' 17HC, 3 phase step motors, offer numerous advantages:

- More Torque
- Low Noise
- Low Vibration
- Low Resonance
- Encapsulated Construction

Molded Stator

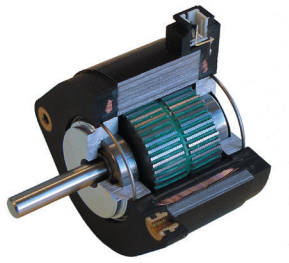
Encapsulated winding	>>>>	Runs cooler – Longer life
Better sealing	>>>>	Longer life
Reduced vibration	>>>>	Smoother moves – Quieter

Large Ball Bearings

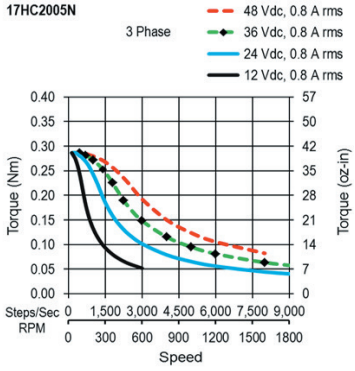
Large shaft loads	>>>>	Fewer design restrictions
Long Life	>>>>	Less down time

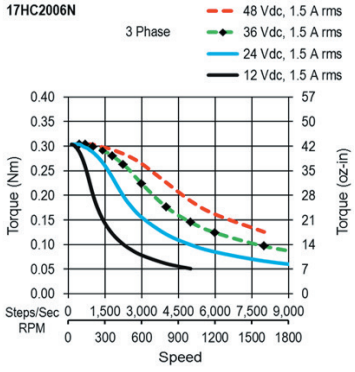
High Winding Fill

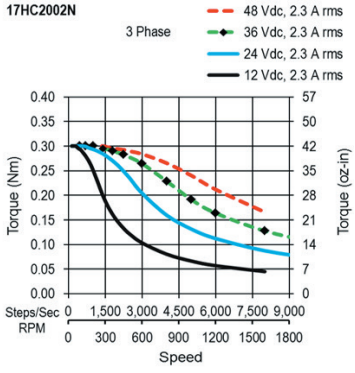
Larger wire size	>>>>	More torque
Uses less energy	>>>>	Longer battery life



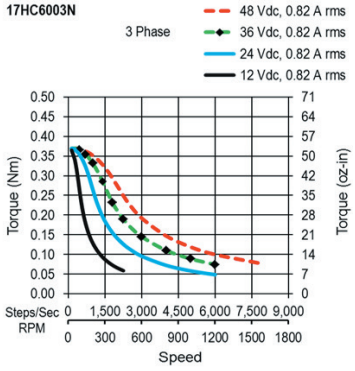
17HC2

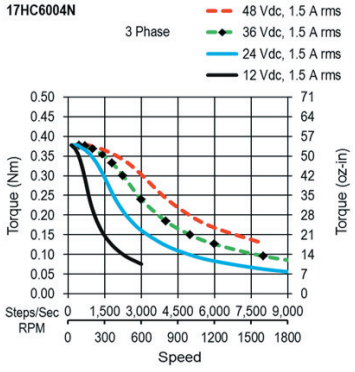


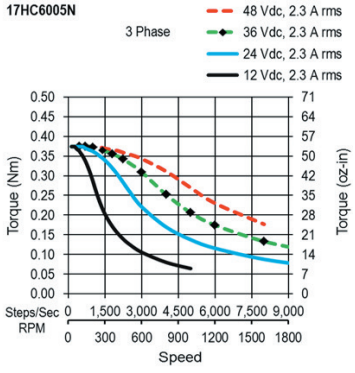




17HC6







ML24HC / PL24HC Series: 1.2° - Size 24, 3 Phase

- Phases 3
- Steps / Revolution 300
- Step Accuracy ±5%
- Shaft Load (20,000 Hours at 1000 RPM)
  - Axial: 40 N (9 Lbs.) Push; 130 N (30 Lbs.) Pull
  - Radial: 70 N (15.5 Lbs.) At Flat Center
- IP Rating 40
- Approvals RoHS
- Operating Temp. -20°C to +50°C
- Insulation Class B, 130°C
- Insulation Resistance 100 MegOhms

M L24HC 4 P 3 150 -E

Motor Technology
- M High Torque Step Motor
- P PowerPlus Step Motor

Basic Motor Length (Max)
- 4 45mm (1.77 in.)
- 8 55mm (2.17 in.) 1 Stack
- A 77mm (3.03 in.) 2 Stack

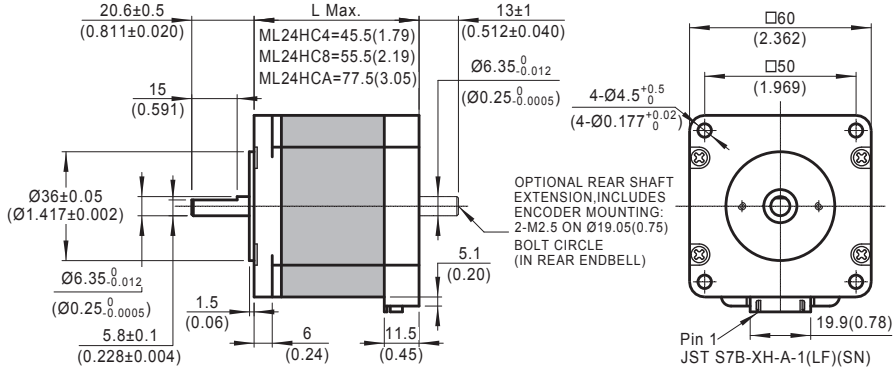
Electrical Connection
- L Leads
- P Plug-In Connector

Number of Connections
- 3 3 Lead-Bipolar

Winding
- ### Current rating x 100

Options
- Omit No Options
- -E 0.25 inch Diameter Rear Shaft with Encoder Mounting Holes

Dimensions: mm (in)



ML24HC – 3 Phase

Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms mH		Detent Torque		Rotor Inertia		Motor Weight	
	Single Shaft	P=Plug L=Leads	Amps (mounted)	Nm Typ.	oz-in TYP.	@20˚C	Typ.	mNm	oz-in	g cm²	oz-in²	kg	Lbs
45 mm (1.77 in.)	^ ML24HC4P3150	P	1.5	0.72	100	4.8	7.9	28	4	159	0.87	0.65	1.4
	^ ML24HC4P3230	P	2.3	0.72	100	2.1	3.4						
	^ ML24HC4L3410	L	4.1	0.72	100	0.67	1.05						
55 mm (2.17 in.) 1 Stack	^ ML24HC8P3150	P	1.5	0.97	140	6	15.1	45	6.4	221	1.2	0.85	1.9
	^ ML24HC8P3220	P	2.2	0.97	140	2.7	6.9						
	^ ML24HC8L3350	L	3.5	0.97	140	1.15	2.7						
	^ ML24HC8L3550	L	5.5	0.97	140	0.51	1.05						
77 mm (3.03 in.) 2 Stack	^ ML24HCAP3150	P	1.5	1.65	234	7.7	19.6	75	11	391	2.1	1.35	3
	^ ML24HCAP3220	P	2.2	1.65	234	3.85	9.3						
	^ ML24HCAL3340	L	3.4	1.65	234	1.6	3.7						
	^ ML24HCAL3550	L	5.5	1.65	234	0.64	1.45						

^ Preferred model

PL24HC - PowerPlus – 3 Phase

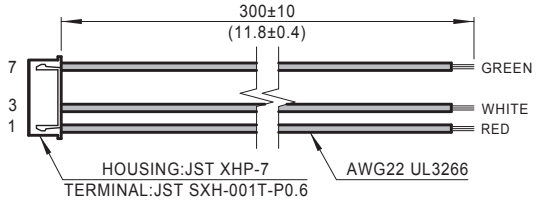
Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms mH		Detent Torque		Rotor Inertia		Motor Weight	
	Single Shaft	P=Plug L=Leads	Amps (mounted)	Nm Typ.	oz-in TYP.	@20˚C	Typ.	mNm	oz-in	g cm²	oz-in²	kg	Lbs
45 mm (1.77 in.)	^ PL24HC4P3150	P	1.5	0.87	120	4.8	7	55	7.8	159	0.87	0.73	1.6
	^ PL24HC4P3230	P	2.3	0.87	120	2.1	3						
	^ PL24HC4L3410	L	4.1	0.87	120	0.67	0.94						
55 mm (2.17 in.) 1 Stack	^ PL24HC8P3150	P	1.5	1.40	200	6	12.2	90	13	221	1.2	0.93	2.1
	^ PL24HC8P3220	P	2.2	1.40	200	2.7	5.5						
	^ PL24HC8L3350	L	3.5	1.40	200	1.15	2.1						
	^ PL24HC8L3550	L	5.5	1.40	200	0.51	0.9						
77 mm (3.03 in.) 2 Stack	^ PL24HCAP3150	P	1.5	2.30	330	7.3	15.7	150	21	391	2.1	1.45	3.2
	^ PL24HCAP3220	P	2.2	2.30	330	3.6	7.4						
	^ PL24HCAL3340	L	3.4	2.30	330	1.6	3						
	^ PL24HCAL3550	L	5.5	2.30	330	0.64	1.15						

^ Preferred model

Mating Connector With Leads (order separately)

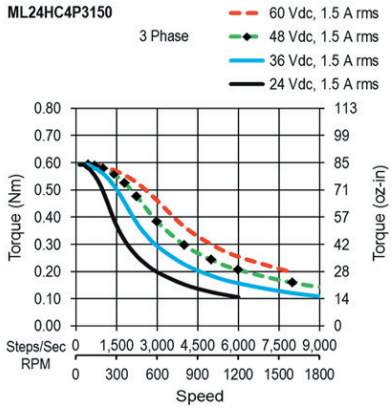
Dimensions: mm (in)

3 Lead Part Number 4634 1402 04485



ML24HC4

ML24HC4P3150



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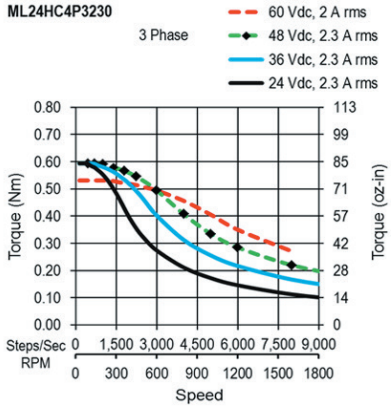

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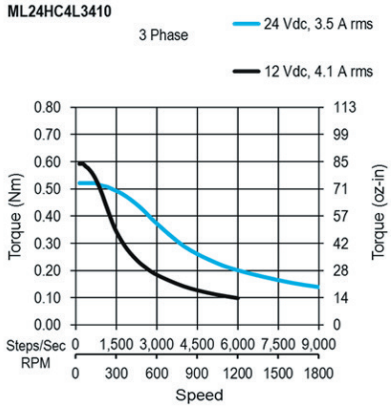
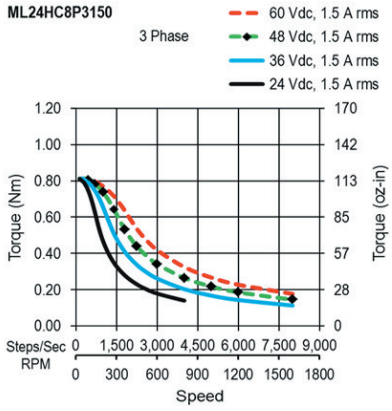


ML24HC8

ML24HC8P3150



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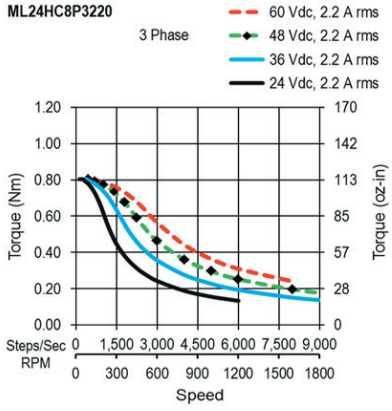

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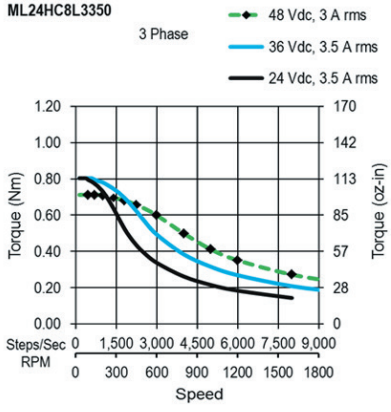

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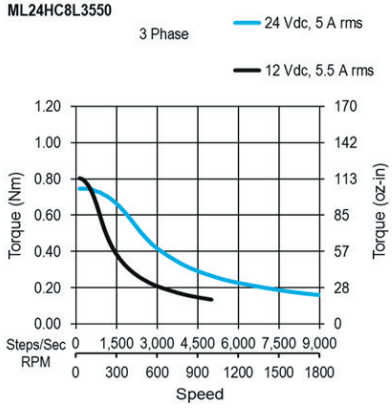
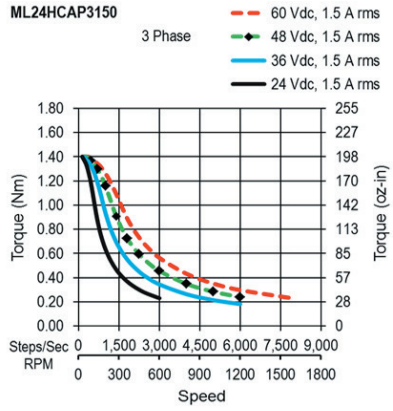


ML24HCA

ML24HCAP3150



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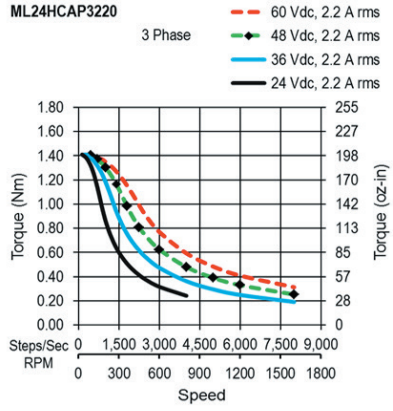

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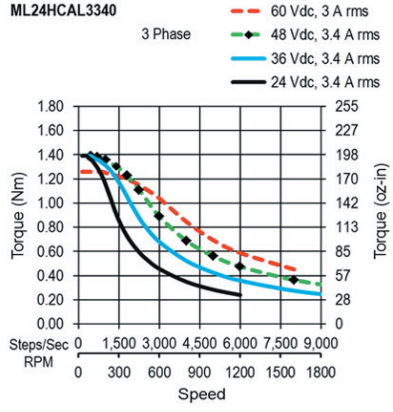

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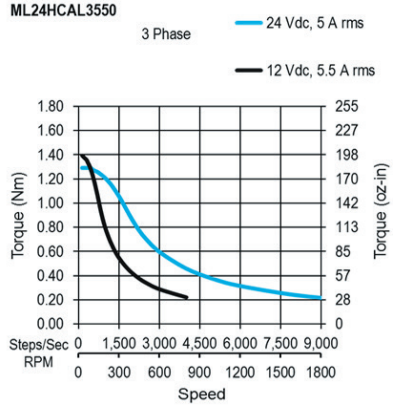
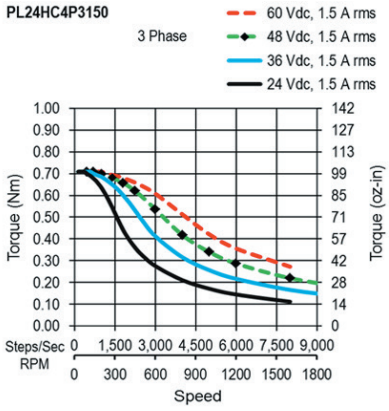


PowerPlus PL24HC4

PL24HC4P3150



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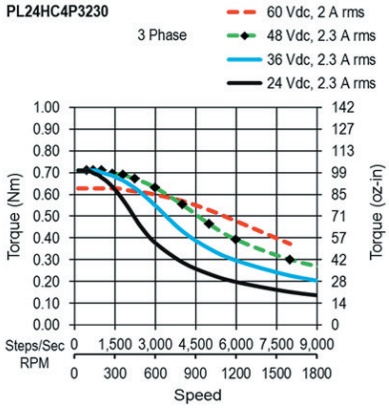

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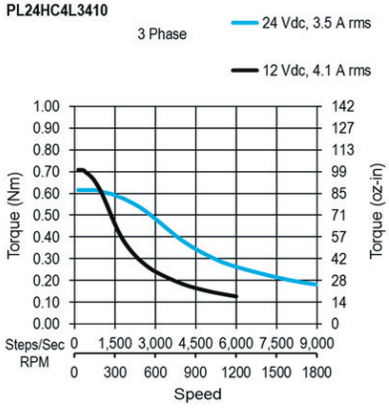
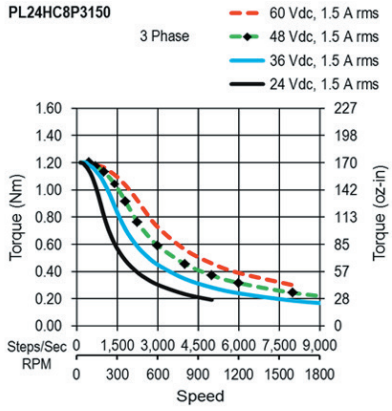


PowerPlus PL24HC8

PL24HC8P3150



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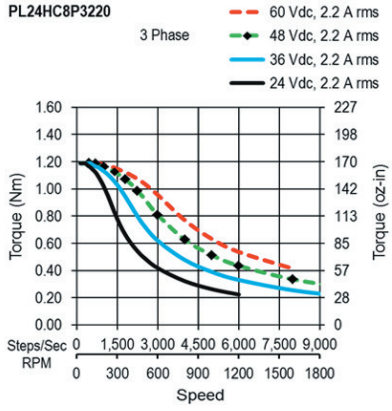

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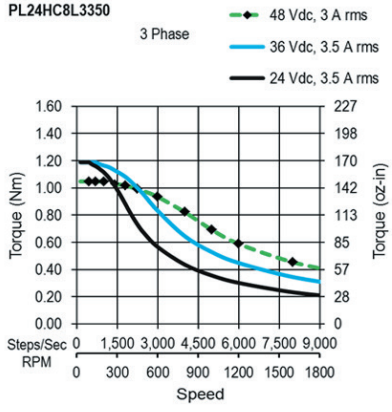

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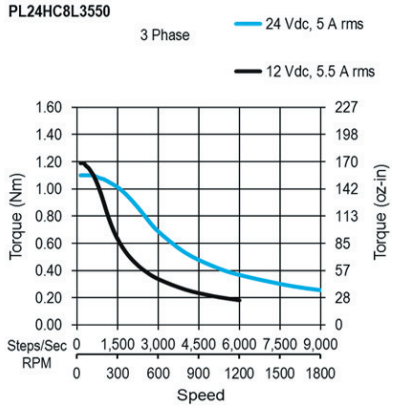

PowerPlus PL24HCA

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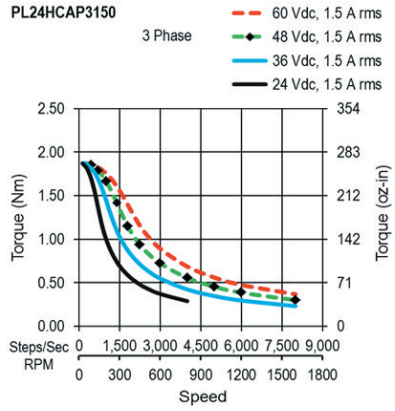

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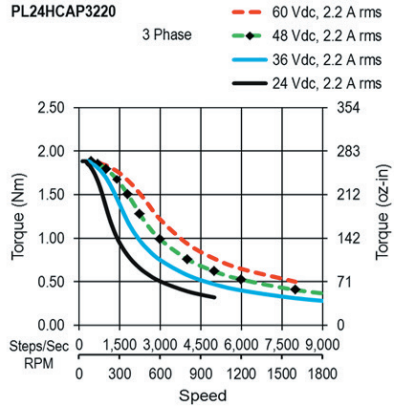

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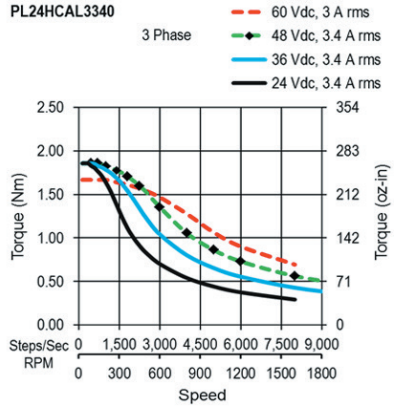

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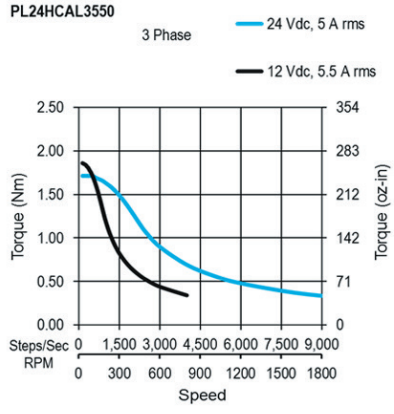
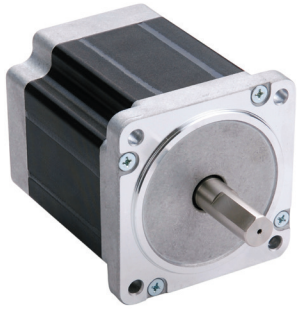


34HC Series: 1.2° - Size 34, 3 Phase



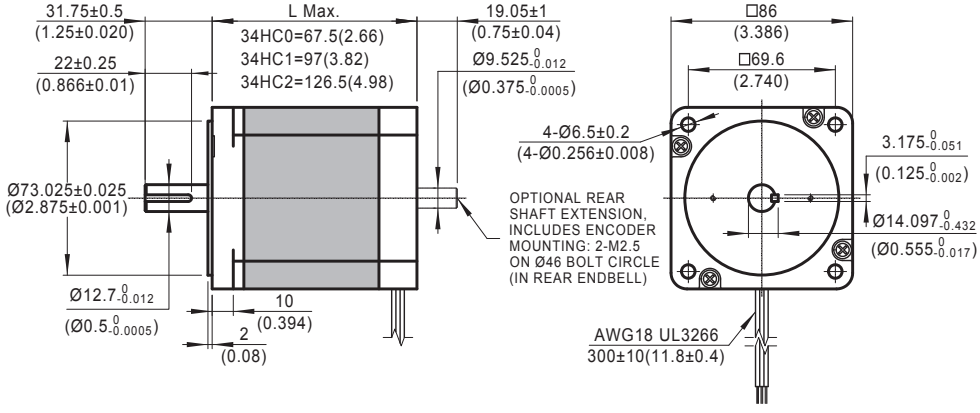
- Phases 3
- Steps / Revolution 300
- Step Accuracy ±5%
- Shaft Load (20,000 Hours at 1000 RPM)
  - Axial: 65 N (15 Lbs.) Push; 155 N (35 Lbs.) Pull
  - Radial: 220 N (50 Lbs.) At Flat Center
- IP Rating 40
- Approvals RoHS
- Operating Temp. -20°C to +50°C
- Insulation Class B, 130°C
- Insulation Resistance 100 MegOhms

34HC - 3 Phase

Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms	Winding mH	Detent Torque		Rotor Inertia		Motor Weight	
	Single Shaft	P=Plug L=Leads	Amps (mounted)	Nm Typ.	oz-in TYP.	@20℃	Typ.	mNm	oz-in	g cm²	oz-in²	kg	Lbs
67 mm (2.64 in.) 1 Stack	^ 34HC0309	L	2	2.80	400	5	19.1	100	14	1100	6	1.6	3.5
	^ 34HC0310	L	3	2.80	400	2.3	8.4						
	^ 34HC0305	L	5.8	2.70	380	0.54	1.95						
96.5 mm (3.8 in.) 2 Stack	^ 34HC1308	L	2	5.40	760	6	28	230	33	1850	10	2.7	6
	^ 34HC1309	L	3	5.30	750	2.5	12						
	^ 34HC1305	L	5.8	5.00	710	0.62	2.7						
126 mm (4.96 in.) 3 Stack	^ 34HC2310	L	2	6.70	950	6.8	36	350	50	2750	15	3.8	8.4
	^ 34HC2311	L	3	6.80	960	3.3	16.8						
	^ 34HC2306	L	5.8	6.80	960	0.88	4.5						

^ Preferred model

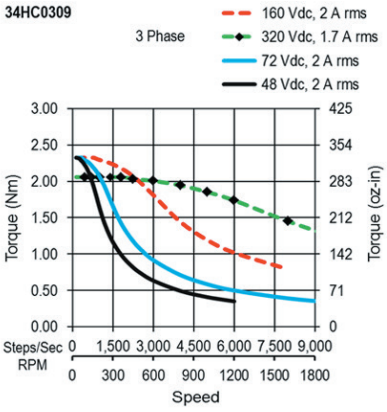
Dimensions: mm (in)

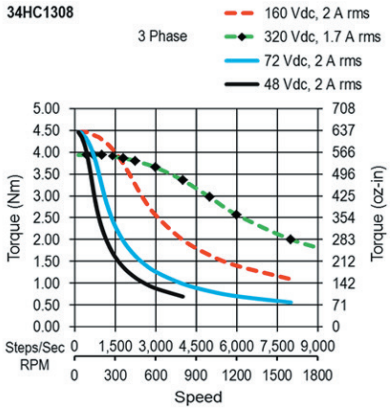


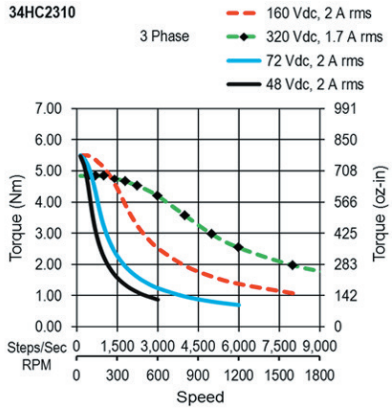
34HC0

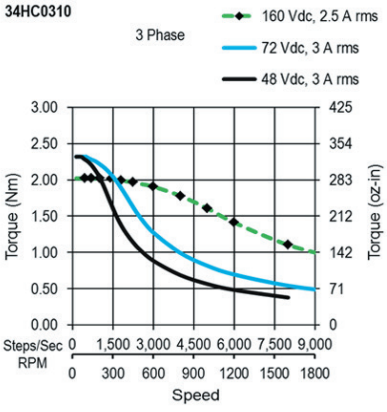
34HC1

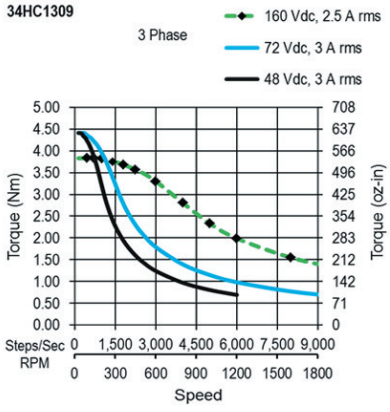
34HC2

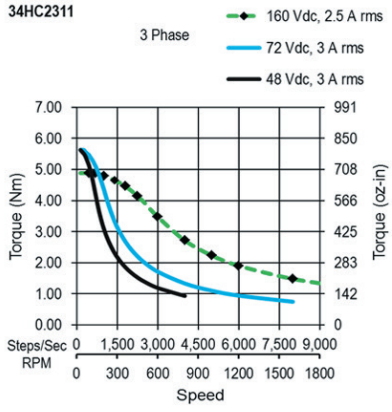


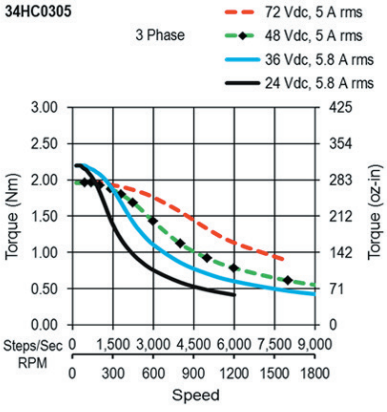


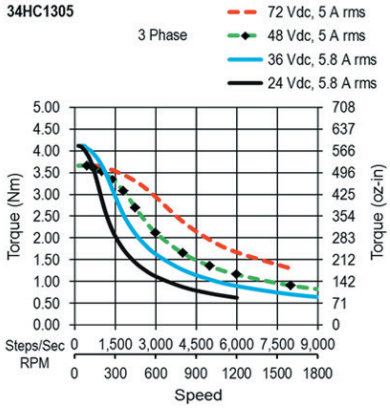


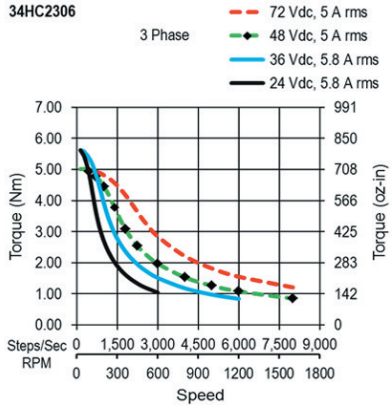












Step Motor Basics – Applicatons

- **Applications**
  MOONS' stepping motors are widely used to create the motion needed in many types of equipment. Examples include:
  - office automation: printers, scanners, copy machines
  - stage lighting: pointing, focus, color changes, spot size, special effects
  - banking: check processing, credit card manufacturing, money scanners & counters
  - medical: body scanning, blood analyzers, chemical analysis
  - industrial: textile, packaging, robotics, conveyers, assembly, labeling
  - telecommunication: phase shift, Tuning, mobile antenna positioning
  - security: camera movement
  - automotive: fuel metering, steering control

- **What Is A Stepping Motor**
  Stepping Motors provide precise position and speed control, without the need for feedback devices to sense position. The operation of step motors is controlled through electrical pulses that the drive converts to current flowing through the windings of the motor. As the current is switched the motor rotates in precise steps of a fixed angle. The motor and drive constitutes a low cost control system that is precise and simple to construct.

- **Performance Features of MOONS' Stepping Motors**
  - Accurate Position Control

    The number of control pulses defines the motor shaft position. Position error is very small (less than 1/10th of a degree), and non cumulative.

  - Precise Motor Speed

    Step motor running speed, is exactly determined by the frequency of the control pulses. Because the speed is very precise and easy to control, step motors are often used where coordinated motion control is needed.

  - Forward & Reverse, Pause and Holding Function

    Motor torque and position control is effective throughout the entire speed range, including zero speed holding torque. The zero speed holding torque locks the shaft at the desired position to hold the load in place.

  - Low Speed Operation

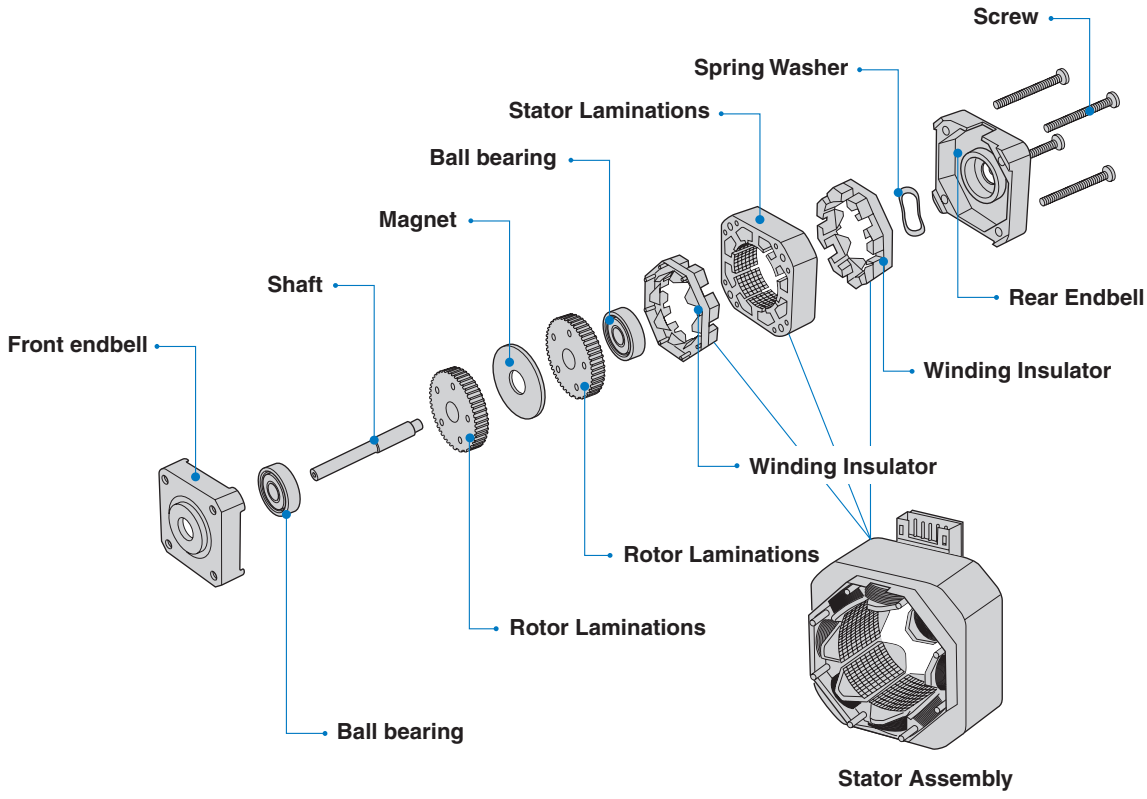
    Step motors produce a large amount of torque, and are easy to control, at low speeds. This often eliminates the need for speed reduction gearboxes, reduces costs and saves space.

  - Long Life

    The brushless design of step motors leads to motors with a very long life. Step motor life is usually determined by the life of the bearings.

Step Motor Basics – Structure & Operation

- **Basic Structure**

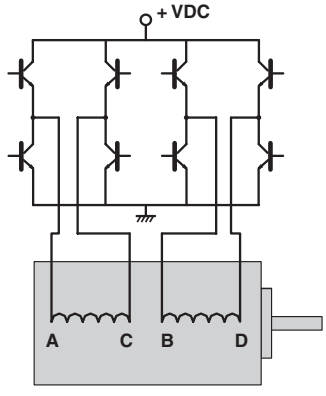


- **Operating Principles**

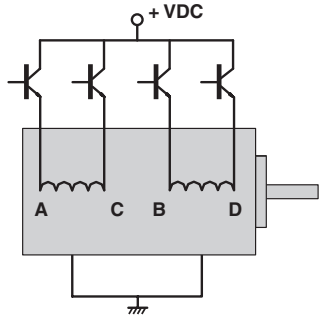
In response to each individual control pulse and direction signal, the drive applies power to the motor windings to cause the rotor to take a step forward, a step in reverse, or hold in position. For example, in a 1.8 degree two phase step motor: When both phases are energized with DC current, the motor will stop rotating and hold in position. The maximum torque the motor can hold in place with rated DC current, is the rated holding torque. If the current in one phase is reversed, the motor will move 1 step (1.8 degrees) in a known direction.

If the current in the other phase had been reversed, the motor would move 1 step (1.8 degrees) in the other direction. As current is reversed in each phase in sequence, the motor continues to step in the desired direction. These steps are very accurate. For a 1.8 degree step motor, there are exactly 200 steps in one revolution.

Two phase stepping motors are furnished with two types of windings: bipolar or unipolar. In a bipolar motor there is one winding on each phase. The motor moves in steps as the current in each winding is reversed. This requires a drive with eight electronic switches. In a unipolar motor there are two windings on each phase. The two windings on each phase are connected in opposite directions. Phase current is reversed by turning on alternate windings on the same phase. This requires a drive with only four electronic switches. Bipolar operation typically provides 40% more holding torque than unipolar, because 100% of the winding is energized in the bipolar arrangement.



2 phase step motor with bipolar driver

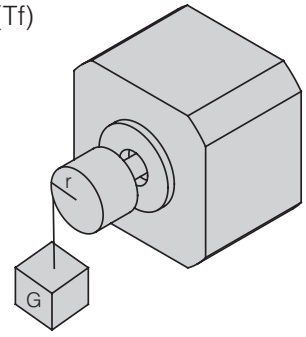


2 phase step motor with unipolar driver

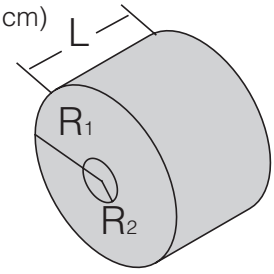
Load Calculations & Tips for Using Step Motors

- **Load Calculations**

Torque load (Tf)
Tf = G * r
G: weight
r: radius



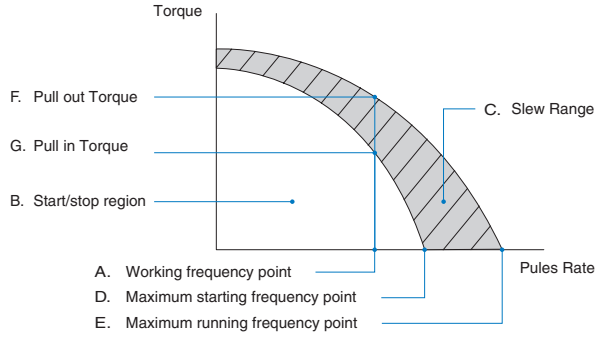
Inertia load (TJ)
TJ = J * dw/dt
J = M * (R12+R22) / 2 (Kg * cm)
M: mass
R1: outside radius
R2: inside radius
dw/dt: angular acceleration



- **Speed-Torque Characteristics**
The dynamic torque curve is an important aspect of stepping motor's output performance. The followings are some keyword explanations.

A. Working frequency point express the stepping motors rotational speed versus the drive pulse rate.
n = q * Hz / (360 * D)
n: rev/sec
Hz: the frequency value or the driver pulse rate.
D: the subdividing value of motor driver
q: the step angle of stepping motor

E.g.: 1.8° stepping motor, in the condition of I/2 subdividing (each step 0.9°) runs at 500Hz its speed is 1.25r/s.



B. Start/Stop region: the region in which a stepping motor can be directly started or stopped.

C. Slew Range: the motor cannot be started directly in this area. It must be started in the start/stop region first and then accelerated to this area. In this area, the motor can not be directly stopped, either. Otherwise this will lead to losing-step. The motor must be decelerated back to the start/stop region before it can be stopped.

D. Maximum starting frequency point at this point, the stepping motor can reach its maximum starting speed under unloaded condition.

E. Maximum running frequency point at this point the stepping motor can reach its maximum running speed under an unloaded condition.

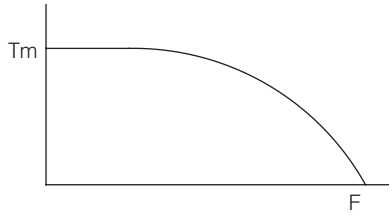
F. Pull-in Torque: the maximum dynamic torque value that a stepping motor can load directly at the particular operating frequency point.

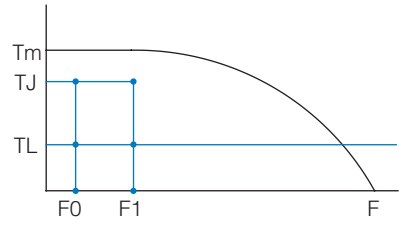
G. Pull-out Torque: the maximum dynamic torque value that a stepping motor can load at the particular operating frequency point when the motor has been started. Because of the inertia of rotation the Pull-Out Torque is always larger than the Pull-In Torque.

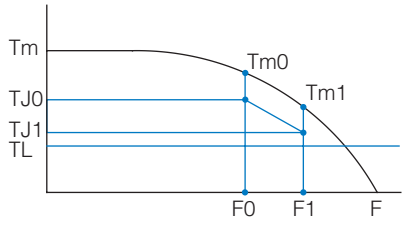
Load Calculations & Tips for Using Step Motors

- **Calculate the Acceleration Torque**
  The torque meeded to accelerate the system inertia is often larger than the friction torque of the load. This limits how quickly the load can be accelerated.

  As shown by the following graph: the dynamic torque performance of a stepping motor is constant at low speeds. But at higher speeds, the torque drops as speed increases (influenced by the motor inductance and drive voltage).







  A. Accelerated Motion of Straight Line
  Motor's load value is known as TL, it has to be accelerated from F0 to F1 in the shortest time (tr), what is the value of tr?
  (1). Generally TJ = 70%Tm
  (2). tr = 1.8 * 10 -5 * J * q * (F1-F0)/(TJ-TL)
  (3). F (t) = (F1-F0) * t/tr + F0, 0<t<tr

  B. Exponential Acceleration
  (1). Generally
  TJ0 = 70%Tm0,
  TJ1 = 70%Tm1,
  TL = 60%Tm1
  (2). tr = F4 * In [(TJ0-TL)/(TJ1-TL)]
  (3). F (t) = F2 * [1 – e^(-t/F4)] + F0, 0<t<tr
  F2 = (TL-TJ0) * (F1-F0)/(FJ1-TJ0)
  F4 = 1.8 * 10-5 * J * q * F2/(TJ0-TL)

  Note: J is the rotational inertia of motor rotor plus the load, q is the angle of each step, it equals the step angle of stepping motor when motor runs in full step.

- **Reduction of Vibration and Noise**
  In a non-loading condition, stepping motors may appear to have vibration or even lose steps when the motor is running at or close to resonant frequency. Solutions for these conditions include:

  A. Have the motor operate outside of this speed range.

  B. Micro-step is used for increasing a motor's step resolution. By adopting the micro-step driving method, you can divide one step into multiple steps thereby reducing the vibration. This is accomplished by controlling the motor's phase current ratio. Micro-step does not increase step accuracy. However it will allow a motor to run more smoothly and with less noise. When the motor runs in half step mode the motor torque will be 15% less than running in full step mode. If the motor is controlled by sine wave current the motor torque will be reduced by 30% if using the same peak current.

  C. Use 0.9° 2 phase step motor, or a three phase step motor.

Step Sequence & Schematic Diagrams

- **2 Phase Motors**

Bipolar, Full Step

STEP	Phase 1		Phase 2	
	A	C	B	D
1	+	-	+	-
2	-	+	+	-
3	-	+	-	+
4	+	-	-	+

CW ↓ ↑ CCW

CW & CCW rotation when seen from flange side of the motor.

Unipolar, Full step

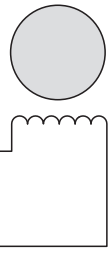
STEP	Phase 1			Phase 2		
	A	O	C	B	M	D
1	-	+		-	+	
2		+	-	-	+	
3		+	-		+	-
4	-	+			+	-

CW ↓ ↑ CCW

CW & CCW rotation when seen from flange side of the motor.

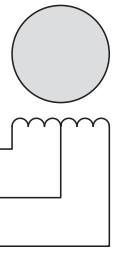
- **4 Lead (bipolar)**

Lead Color	Connector Pin # Motor Size 8, 11, 17	Motor Size 14,16	
BLK	1	1	A
GRN	3	5	C
RED	4	7	B
BLU	6	11	D



- **6 Lead (unipolar)**

Lead Color	Connector Pin # Motor Size 8, 11, 17	Motor Size 14,16	
BLK	1	1	A
YEL	2	3	O
GRN	3	5	C
RED	4	7	B
WHT	5	9	M
BLU	6	11	D



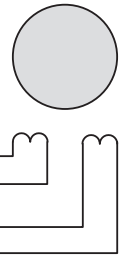
- **8 Lead**

8 Lead Connection Options

Bipolar Series	Bipolar Parallel	Unipolar
A	A	A
		O
C	C	C
B	B	B
		M
D	D	D

8 lead Motors

Lead Color	Connector Pin #	
BLK	3	A
YEL	7	$\bar{A}$
ORG	4	$\bar{C}$
GRN	8	C
RED	6	B
WHT	2	$\bar{B}$
BRN	5	$\bar{D}$
BLU	1	D



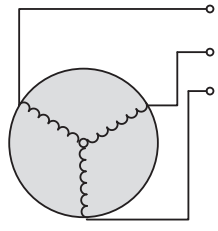
- **3 Phase Motors**

STEP	Phase		
	A	B	C
1	+	-	
2		-	+
3	-		+
4	-	+	
5		+	-
6	+		-

CW ↓ ↑ CCW

CW & CCW rotation when seen from flange side of the motor.

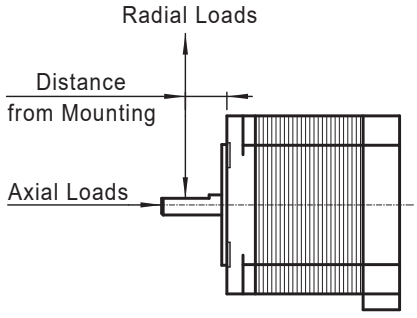
	Connector Pin # Size 17	Size 23	Lead Color
A	1	1	RED
B	2	3	WHT
C	3	7	GRN



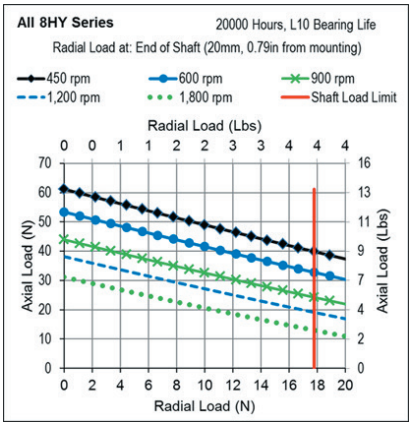
Bearing Life & Shaft Loading

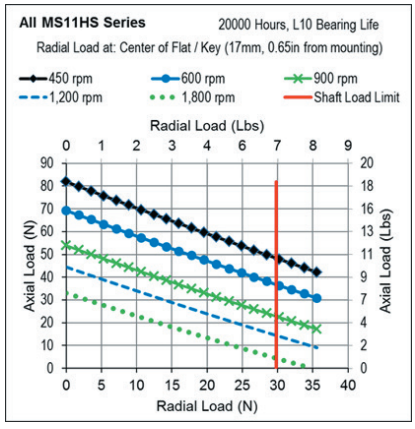
Moons' uses high quality bearings optimized for step motors for long life from every motor. To meet the most demanding applicatons. Most motors can also be provided with larger bearings shafts and custom construction.

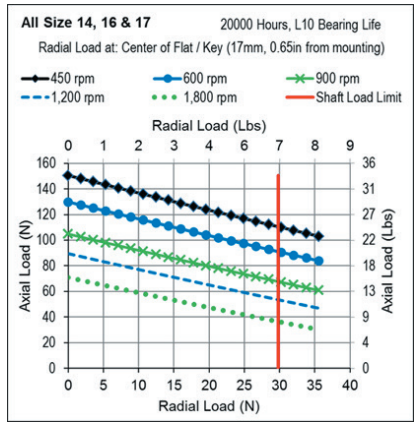
These bearing life curves represent the maximum axial and radial loads for 20,000 hours L10 bearing life at various speeds. The shaft radial load limit (and bearing load ratings) are highly dependent on the the distance from the mounting face where the load is applied. These curves were calculated with the radial load applied at the distance from the mounting face shown on the curve (usually the center of the flat / keyway).

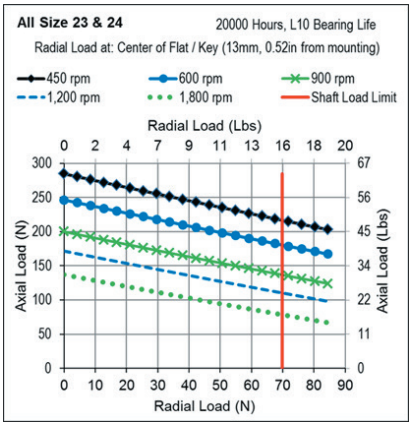


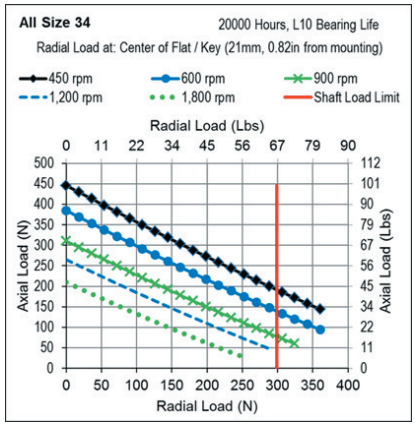
A common cause for shaft (and bearing) failure, are high radial loads that are created when a pulley is attached to the motor shaft at a large distance from the motor mounting face, and the belt has high tension. To avoid this condition mount pulleys and gears as close to the face of the motor as possible, and avoid over tightening belts. This will dramatically reduce the shaft stress, and increases the life of the bearings.

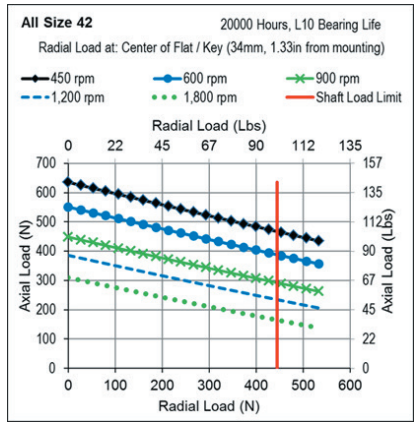












Conversion Factors

- **Length**

A \ B	mm	cm	m	inch	feet
mm	--	0.1	0.001	0.03937	0.003281
cm	10	--	0.01	0.3937	0.03281
m	1,000	100	--	39.37	3.281
inch	25.4	2.54	0.0254	--	0.08333
feet	304.8	30.48	0.348	12	--

Multiply "A" units by conversion factor to obtain "B" units

- **Force**

A \ B	g	kgf	oz	lb	Newton
g	--	0.001	0.03527	0.002205	0.0098
kgf	1,000	--	35.27	22.05	9.807
oz	28.35	0.02835	--	0.0625	0.278
lb	453.6	0.4536	16	--	4.448
Newton	102	0.102	3.597	0.2248	--

- **Torque**

A \ B	Nm	Ncm	mNm	kgm*	kgcm*	gcm*	oz-in	lb-ft	lb-in
Nm	--	100	1,000	0.102	10.2	10,200	141.6	0.7376	8.851
Ncm	0.01	--	10	0.00102	0.102	102	1.416	0.007376	0.08851
mNm	0.001	0.1	--	0.000102	1.0102	10.2	0.1416	0.000738	0.008851
kgm*	9.807	980.7	9807	--	100	100,000	1,389	7.233	86.8
kgcm*	0.09807	9.807	98.07	0.01	--	1,000	13.89	0.07233	0.868
gcm*	9.81E-05	0.009807	0.09807	0.00001	0.001	--	0.01389	7.23E-05	0.000868
oz-in	0.007062	0.7062	7.062	0.00072	0.07201	72.01	--	0.00521	0.0625
lb-ft	1.356	135.6	135.6	0.1383	13.83	13,830	192	--	12
lb-in	0.113	11.3	113	0.01152	1.152	1,152	16	0.0833	--

- **Inertia**

A \ B	kgm²	kgcm²	gcm²	oz-in²	oz-in-sec²	lb-in²	lb-in-sec²	lb-ft²	lb-ft-sec² (slug ft²)
kgm²	--	10,000	10,000,000	54,700	142	3,420	8.85	23.7	0.738
kgcm²	0.0001	--	1,000	5.47	0.0142	0.342	0.000885	0.00237	7.38E-05
gcm²	1E-07	0.001	--	0.00547	1.42E-05	0.000342	8.85E-07	2.37E-06	7.38E-08
oz-in²	1.83E-05	0.1829	183	--	0.00259	0.0625	0.000162	0.000434	1.35E-05
oz-in-sec²	0.00706	70.62	70,600	386	--	24.1	0.0625	0.168	0.00521
lb-in²	0.000293	2.926	2,930	16	0.0414	--	0.00259	0.00694	0.000216
lb-in-sec²	0.113	1,130	1,130,000	6,180	1.6	386	--	2.68	0.0833
lb-ft²	0.0421	421.4	421,000	2,300	5.97	144	0.373	--	0.318
lb-ft-sec² (slug ft²)	1.36	13,600	13,600,000	74,100	192	4,630	12	32.2	--