

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:

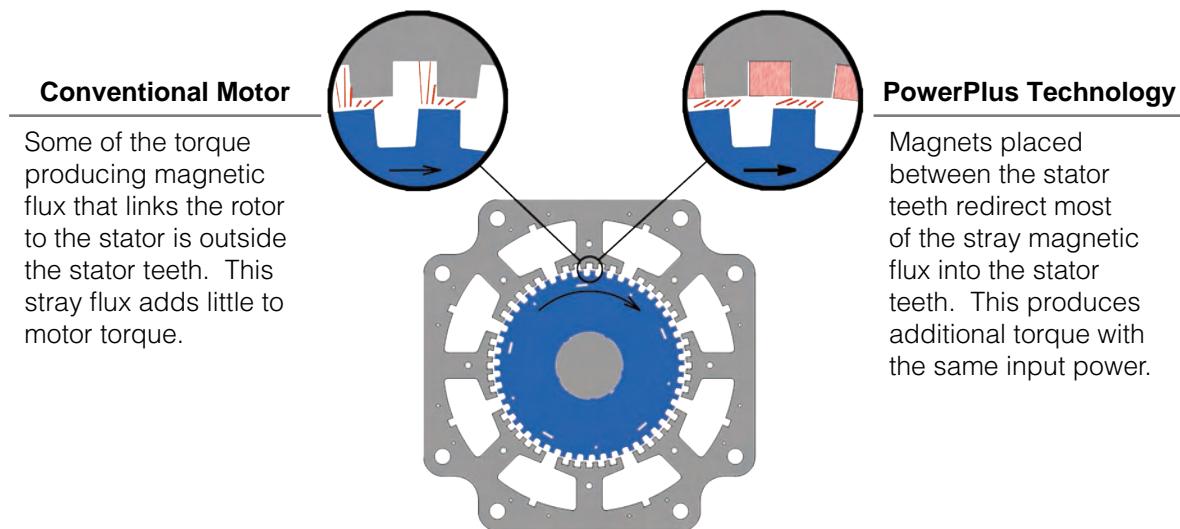
- Faster new product introduction
- Reduced engineering costs
- Easy production phase in
- Reduced spare parts inventory

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.



MOONS' Step Motor Advantages

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

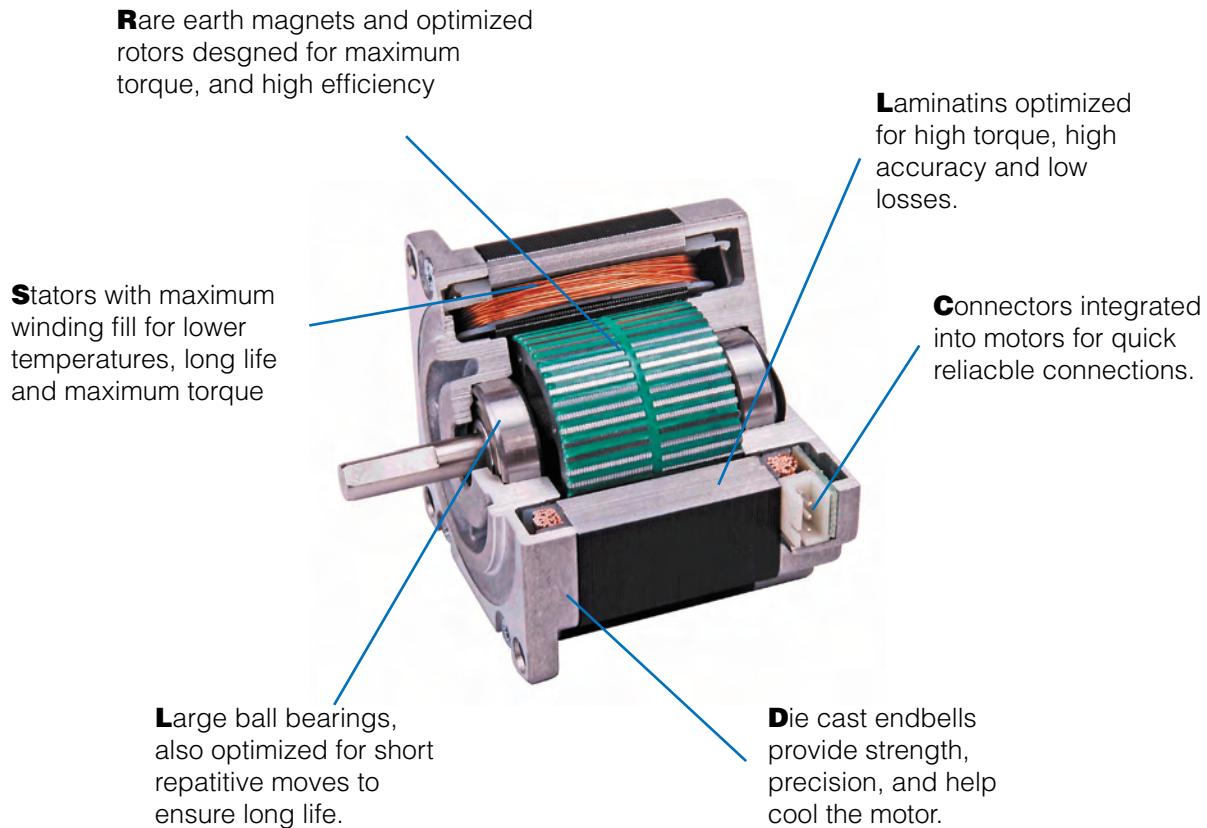
- Many refinements that increase torque by an average of 20%
- Complete range of sizes: 8, 11, 14, 16, 17, 23, 24, 34, 42
- Size 17 and larger 2 phase motors are UL recognized
- 0.9 degree 2 phase motors, and 3 phase motors for extra smooth, quiet, performance
- PowerPlus technology: for maximum efficiency 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

MOONS'
Technology

2 Phase
Step Motors

3 Phase
Step Motors

Technical



Encapsulated Motors

Encapsulation Technology From MOONS' Offers Many Advantages

Ideal for Security Cameras

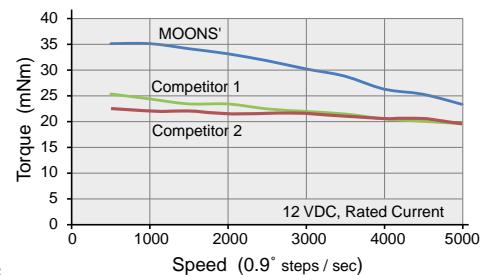
In addition to all the advantages of normal step motors, these new encapsulated motors can help achieve a breakthrough in miniaturization of security cameras. Small step motors are a core component in security camera systems. With MOONS' encapsulation technology, the 36mm diameter motor is now available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

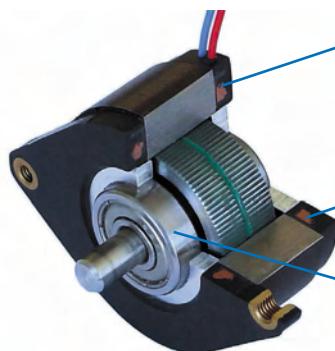
New materials and improved manufacturing processes, means these motors have a higher precision, more stable design. This controls vibration and reduces noise. It also makes the motor run smoothly.

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
Better sealing
Reduced vibration

Runs cooler – Longer life
Longer life
Smoother moves - Quieter

High Winding Fill

Larger wire size
Uses less energy

More torque
Longer battery life

Large Ball Bearings

Large shaft loads
Long Life

Fewer design restrictions
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 $\frac{1}{2}$ 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 maximum 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 8,11,14,16,17,24 |
| 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

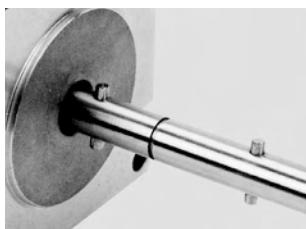


Plastic Pulley



Gear

Shaft Options



Dowel



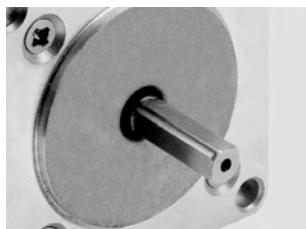
Worm Shaft



Cross Drilled Shaft



Single Flat



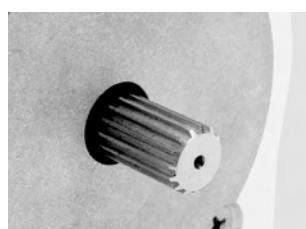
Double Flat



Key Way



Knurl



Hobbed Gear



Helical Cut

8HY Series: 1.8° - Size 8



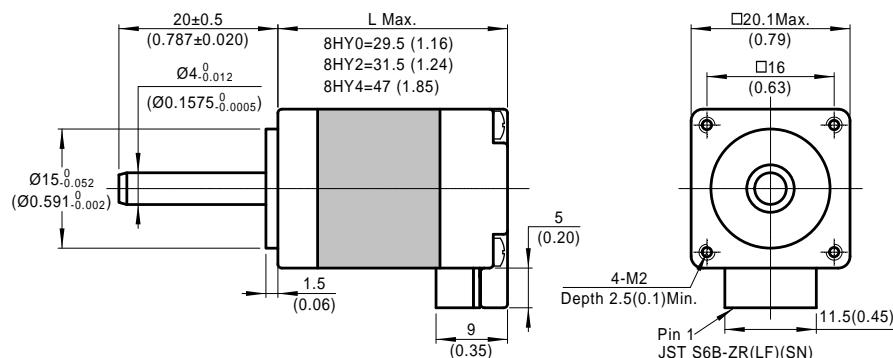
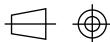
- | | |
|---|---|
| • Phases | 2 |
| • Steps / Revolution | 200 |
| • Step Accuracy | ±5% |
| • Shaft Load (20,000 Hours at 1000 RPM) | |
| Axial | 6 N (1.3 Lbs.) Push
25 N (5.6 Lbs.) Pull |
| Radial | 18 N (4 Lbs.) At End of Shaft |
| • IP Rating | 40 |
| • Approvals | RoHS |
| • Operating Temp. | -20°C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

8HY - 4 Lead Bi-Polar

Length	Model Number	Connect	Rated Current	Holding Torque		Winding		Detent Torque		Rotor Inertia		Motor Weight	
				Nm	oz-in	Ohms	mH						
	Single Shaft	P=Plug L=Leads	Amps (mounted)	Nm Typ.	oz-in TYP.	±10% @20°C	Typ.	mNm	oz-in	g cm²	oz-in²	kg	Lbs
29.5mm (1.16in)	8HY0007N ^ 8HY0008N ^ 8HY0009N	P P P	0.2 0.4 0.6	0.02 0.02 0.02	3 3 3	54 13.9 6.1	10.7 3 1.31	1.7	0.24	27	0.015	0.065	0.14
47mm (1.85in)	8HY4044N ^ 8HY4045N ^ 8HY4046N ^ 8HY4047N	P P P P	0.2 0.4 0.6 0.8	0.04 0.04 0.04 0.04	5 6 6 6	61 17.4 8 4.4	19 5.9 27 1.54	2	0.28	4.2	0.023	0.09	0.2

^ Preferred model

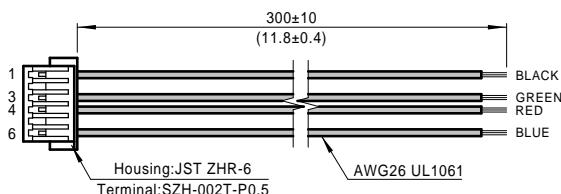
Dimensions: mm (in)

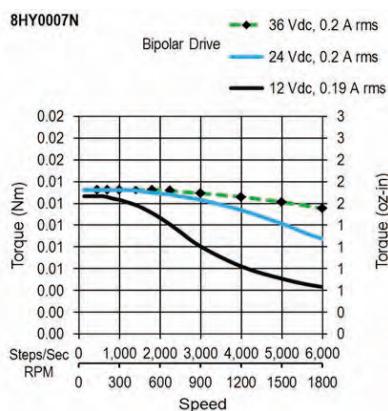
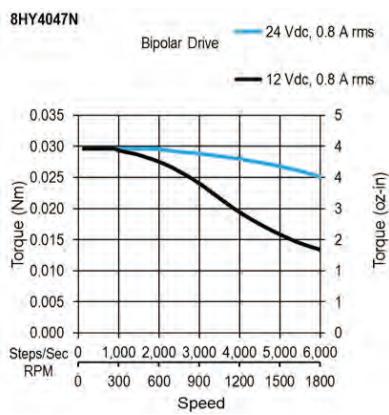
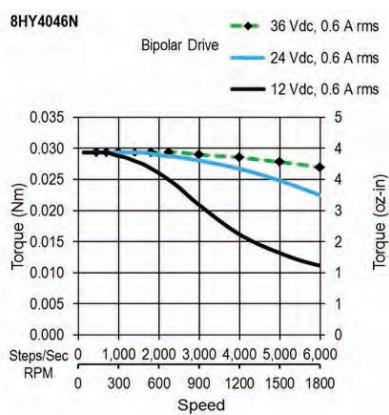
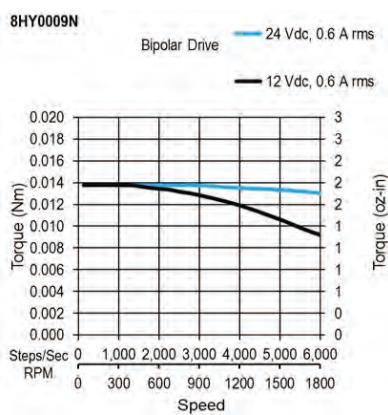
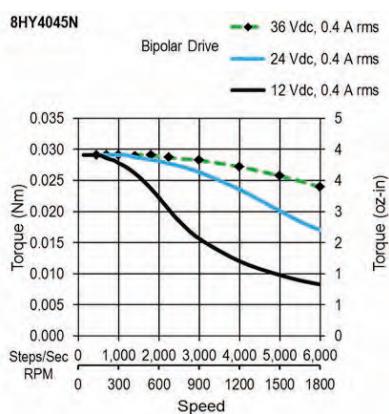
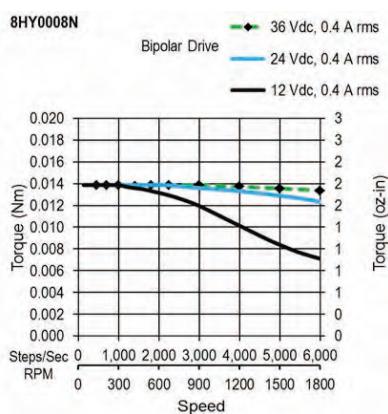
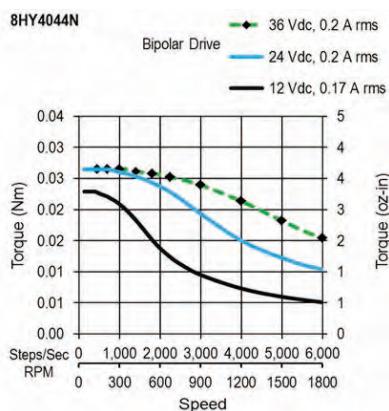


Mating Connector With Leads (order separately)

Dimensions: mm (in)

4 Lead Part Number 4634 1402 03659



8HY0-Bipolar**8HY4-Bipolar**

MS11HS Series: 1.8° - Size 11



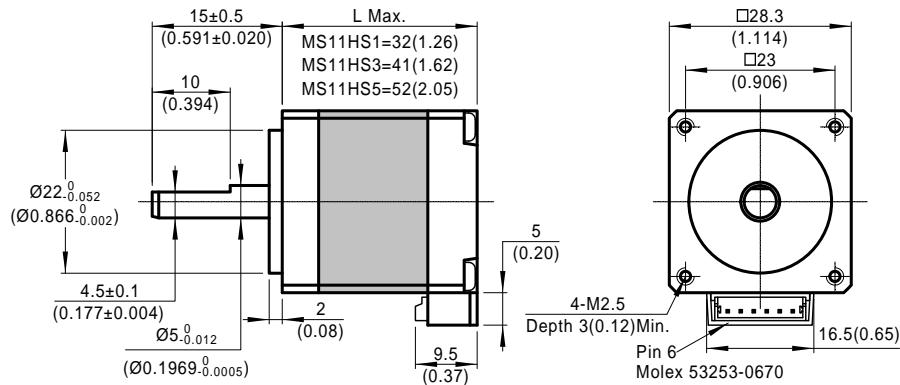
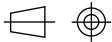
- Phases 2
 - Steps / Revolution 200
 - Step Accuracy $\pm 5\%$
 - Shaft Load (20,000 Hours at 1000 RPM)
 - Axial 15 N (3.4 Lbs.) Push
 - Radial 25 N (5.6 Lbs.) Pull
 - 30 N (6.5 Lbs.) At Flat Center
 - IP Rating 40
 - Approvals RoHS
 - Operating Temp. -20°C to $+50^{\circ}\text{C}$
 - Insulation Class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

MS11HS 3 P 4 040

Basic Motor Length (Max)	
1	31mm (1.22 in.)
3	40mm (1.57 in.)
5	51mm (2.01 in.)

Winding	###	Current rating x 100
Number of Connections		
4	4	Lead-Bipolar
6	6	Lead-Unipolar (or Bipolar)

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.	±10% @20°C	Typ.	mNm	oz-in	g cm² oz-in²	kg Lbs
31 mm (1.22 in.)	MS11HS1P4024	P	0.24	0.09	12	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				
40 mm (1.57 in.)	MS11HS3P4029	P	0.29	0.12	17	39	34	6	0.85	12 0.066	0.15 0.33
	MS11HS3P4067	P	0.67	0.12	17	6.9	6.5				
	MS11HS3P4095	P	0.95	0.13	18	3.7	3.5				
	MS11HS3P4140	P	1.4	0.13	18	1.77	1.56				
51 mm (2.01 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	3.6				
	MS11HS5P4150	P	1.5	0.17	24	1.65	1.48				

^ Preferred model

MS11HS - 6 Lead Uni-Polar

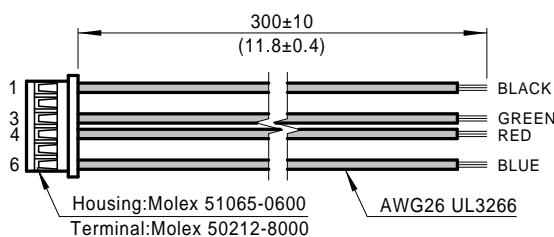
Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms	mH	Detent Torque	Rotor Inertia	Motor Weight	
	Single Shaft	P=Plug L=Leads	Amps (mounted)	Nm Typ.	oz-in TYP.	±10% @20°C	Typ.	mNm	oz-in	g cm² oz-in²	kg Lbs
31 mm (1.22 in.)	MS11HS1P6024	P	0.24	0.06	9	48	18.2	5	0.71	9 0.049	0.1 0.22
	MS11HS1P6050	P	0.5	0.07	9	10.9	4.5				
	MS11HS1P6070	P	0.7	0.07	9	5.5	2.3				
40 mm (1.57 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				
51 mm (2.01 in.)	MS11HS5P6033	P	0.33	0.13	18	40	16.4	8	1.1	18 0.098	0.2 0.44
	MS11HS5P6067	P	0.67	0.13	18	6.7	3.9				
	MS11HS5P6095	P	0.95	0.13	18	3.7	1.93				

^ Preferred model

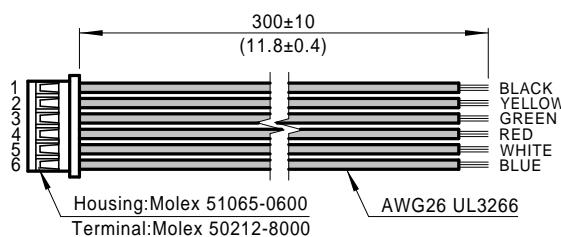
Mating Connector With Leads (order separately)

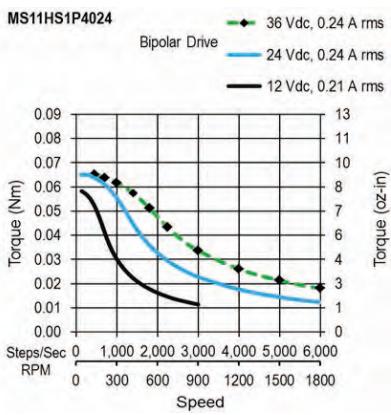
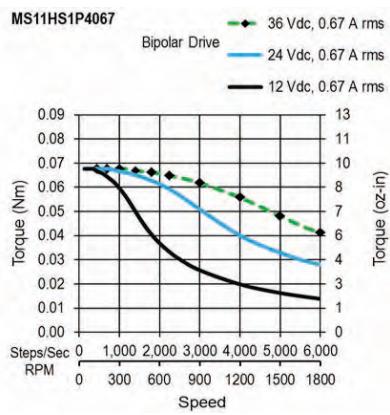
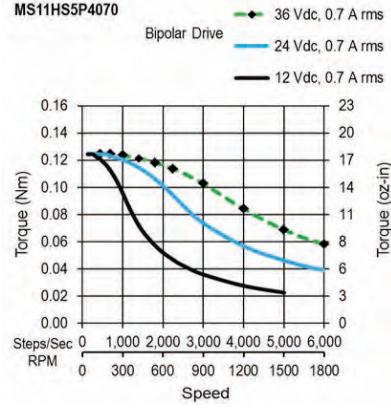
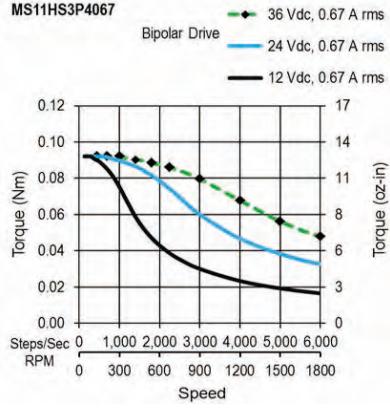
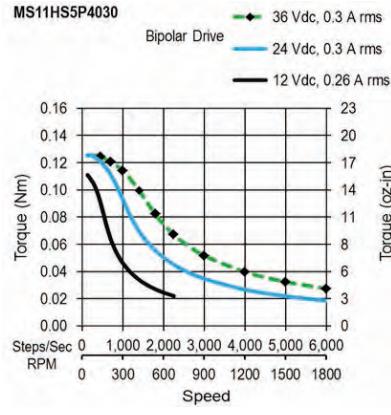
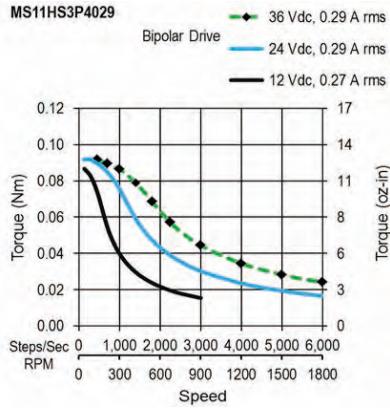
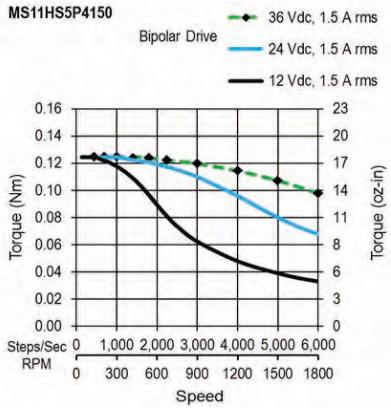
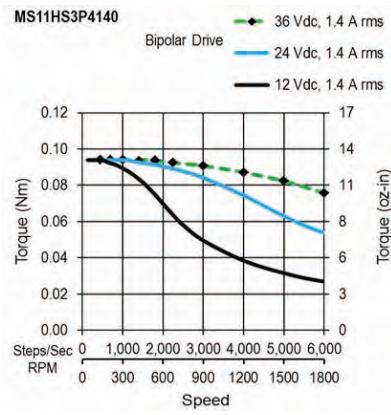
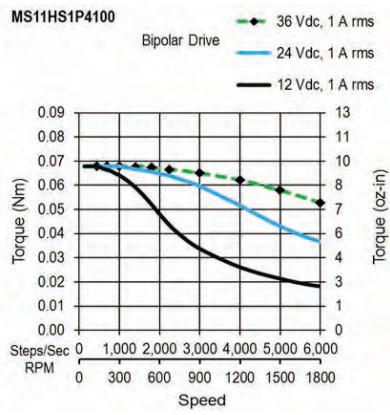
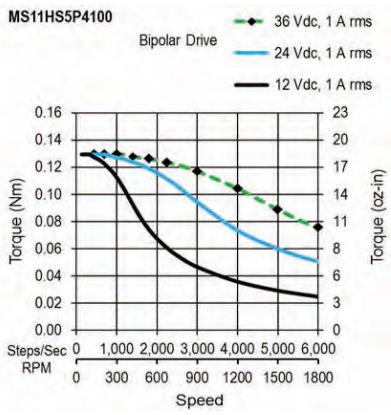
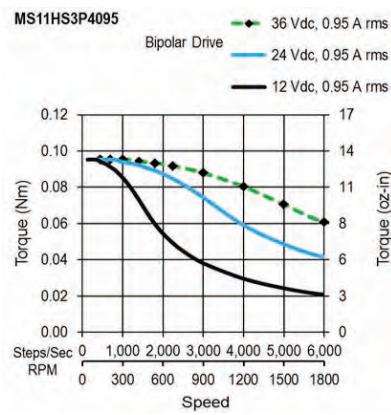
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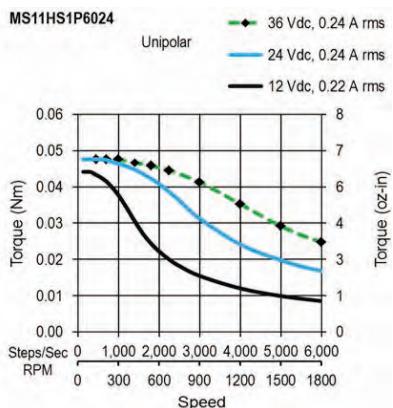
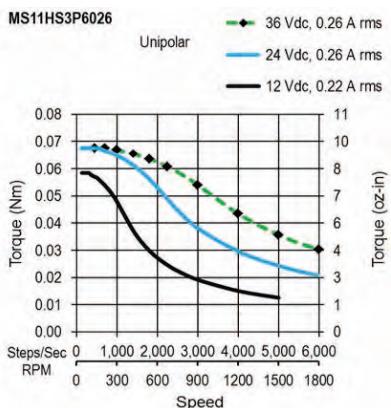
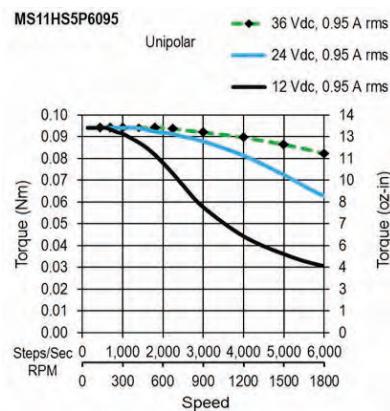
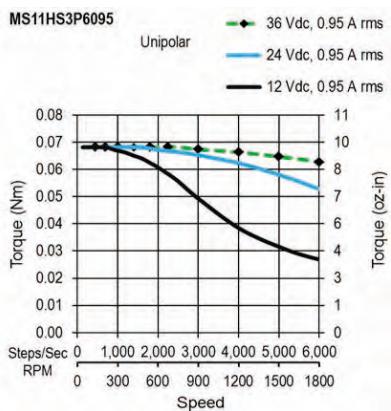
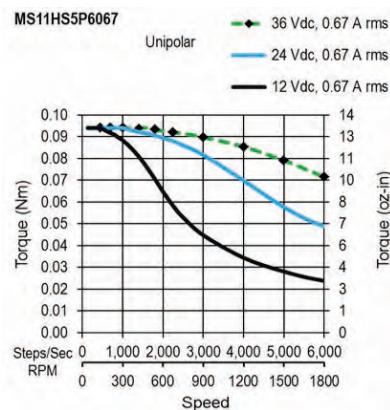
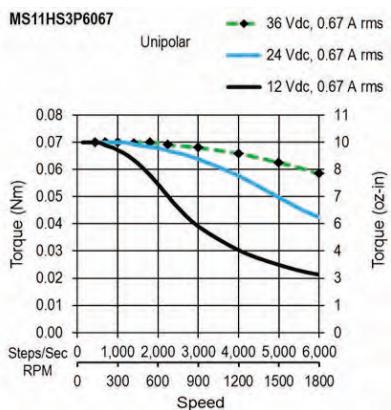
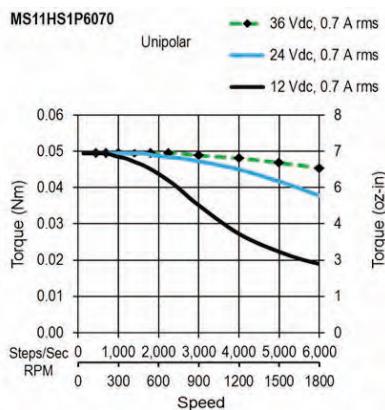
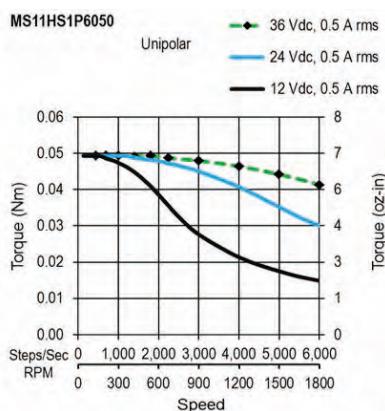
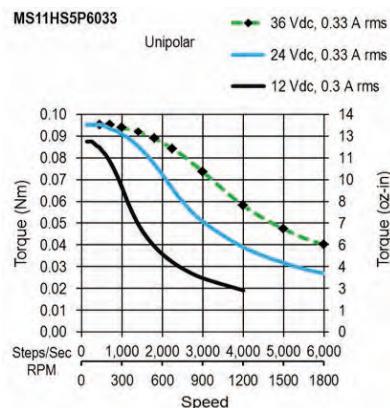
4 Lead Part Number 4634 1402 04190



6 Lead Part Number 4634 1402 04490



MS11HS1-Bipolar**MS11HS3-Bipolar****MS11HS5-Bipolar**

MS11HS1-Unipolar**MS11HS3-Unipolar****MS11HS5-Unipolar**

14HK Series: 0.9° - Size 14 Encapsulated



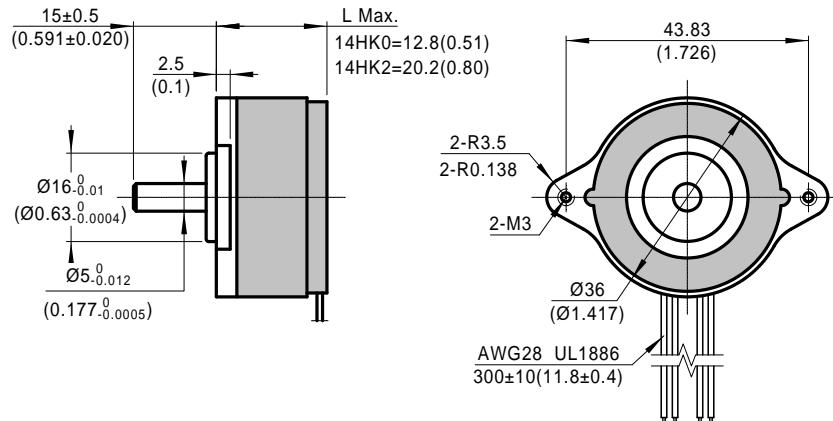
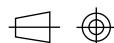
- Phases 2
- Steps / Revolution 200
- Step Accuracy ±5%
- Shaft Load (20,000 Hours at 1000 RPM)
 - Axial 25 N (5.6 Lbs.) Push
 - 65 N (15 Lbs.) Pull
 - Radial 30 N (6.5 Lbs.) At End of Shaft
- IP Rating 40
- Approvals RoHS
- Operating Temp. -20°C to +50°C
- Insulation Class B, 130°C
- Insulation Resistance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

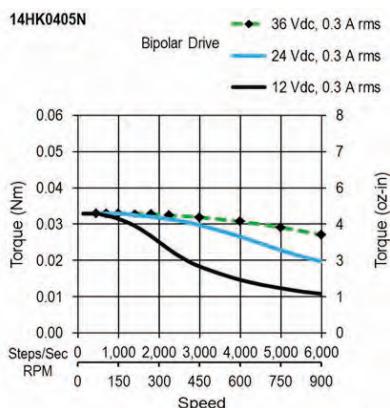
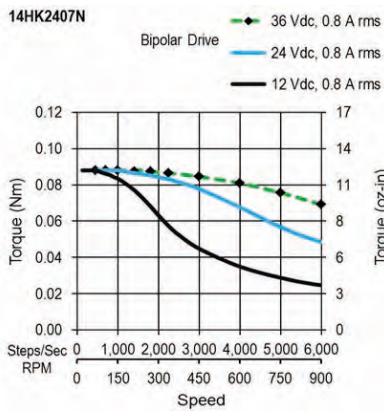
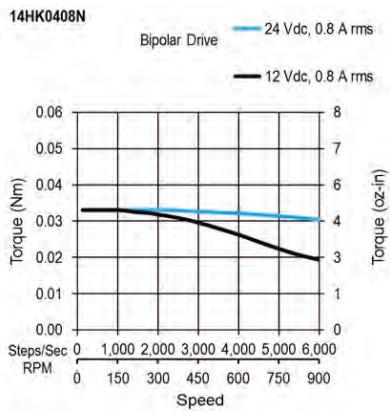
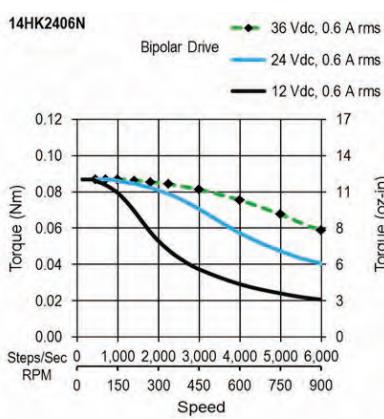
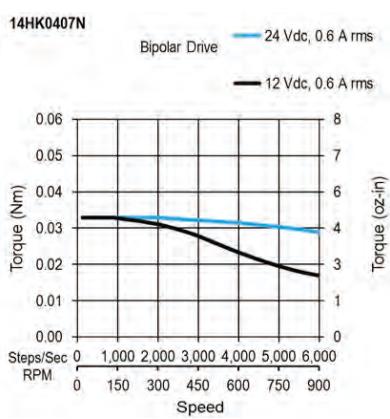
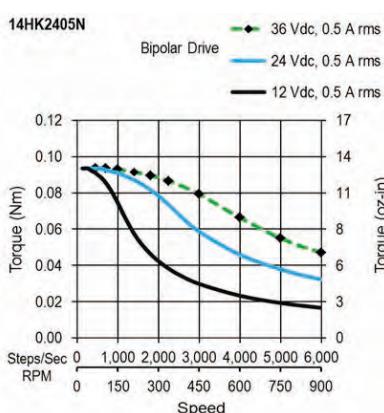
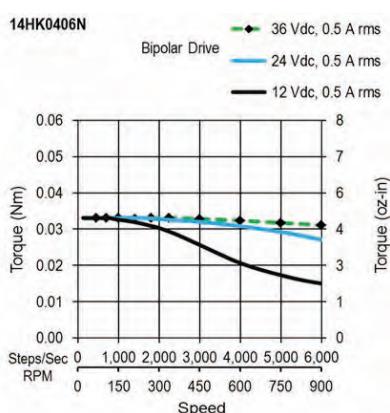
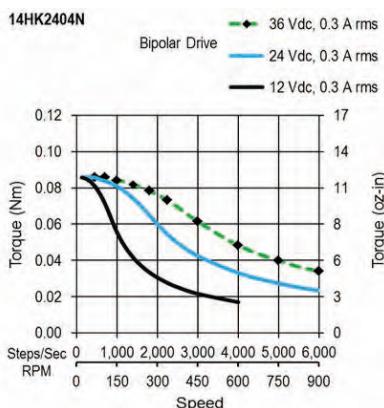
14HK - 4 Lead Bipolar

Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms	mH	Detent Torque		Rotor Inertia	Motor Weight		
		P=Plug L=Leads	Amps (mounted)	Nm Typ.	oz-in TYP.	±10% @20 C	Typ.	mNm	oz-in	g cm²	oz-in²	kg	Lbs
12.8 mm (0.5 in.)	^ 14HK0405N	L	0.3	0.044	6	15.6	8.5	4	0.57	4	0.022	0.05	0.11
	^ 14HK0406N	L	0.5	0.044	6	6.3	3.1						
	^ 14HK0407N	L	0.6	0.044	6	4.2	2.1						
	^ 14HK0408N	L	0.8	0.044	6	2.6	1.21						
20.2 mm (0.8 in.)	14HK2404N	L	0.3	0.12	17	26	21	10	1.4	11	0.06	0.11	0.24
	^ 14HK2405N	L	0.5	0.12	17	11.7	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**

MOONS' Technology

2 Phase Step Motors

3 Phase Step Motors

Technical

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
 - Radial 65 N (15 Lbs.) Pull
 - At Flat Center 30 N (6.5 Lbs.)
- 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 | 27mm (1.06 in.) |
| 3 | 36mm (1.42 in.) |
| 5 | 55mm (2.17 in.) |

Electrical Connection

P Plug-in Connector

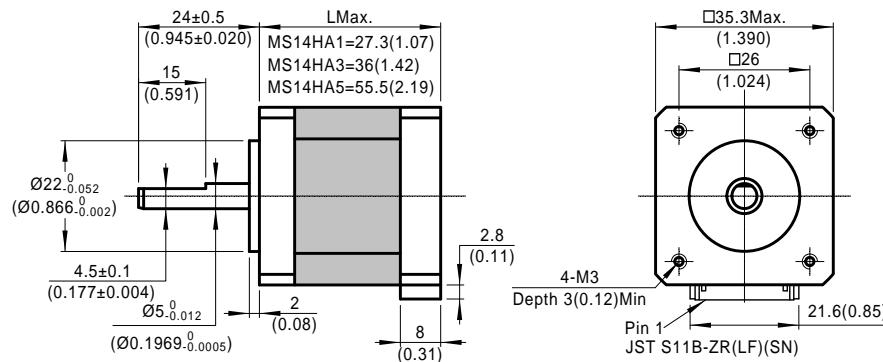
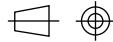
Winding

Current rating x 100

Number of Connections

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

Dimensions: mm (in)



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.	±10% @20 C	Typ.	mNm	oz-in	g cm ²	oz-in ²	kg Lbs
27 mm (1.06 in.)	MS14HA1P4026	P	0.26	0.10	15	49	56	4	0.57	12	0.066	0.15 0.33
	^ MS14HA1P4070	P	0.7	0.11	15	6.6	8.2					
	^ MS14HA1P4100	P	1	0.10	15	3.3	3.9					
	^ MS14HA1P4150	P	1.5	0.11	15	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 mm (2.17 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	2.1	3.6					
	^ MS14HA5P4200	P	2	0.32	45	1.34	2.1					

^ Preferred model

MS14HA - 6 Lead Uni-Polar

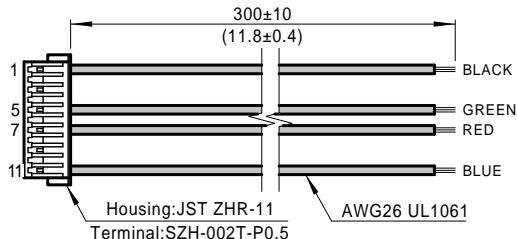
Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms mH		Detent Torque	Rotor Inertia		Motor Weight	
	Single Shaft	P=Plug L=Leads	Amps (mounted)	Nm Typ.	oz-in TYP.	±10% @20 C	Typ.	mNm	oz-in	g cm ²	oz-in ²	kg Lbs
27 mm (1.06 in.)	MS14HA1P6026	P	0.26	0.08	11	48	27	4	0.57	12	0.066	0.15 0.33
	MS14HA1P6060	P	0.6	0.08	11	8.9	5.3					
	MS14HA1P6100	P	1	0.08	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 mm (2.17 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

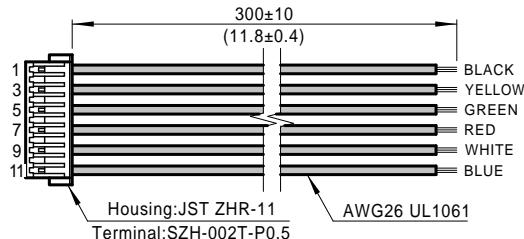
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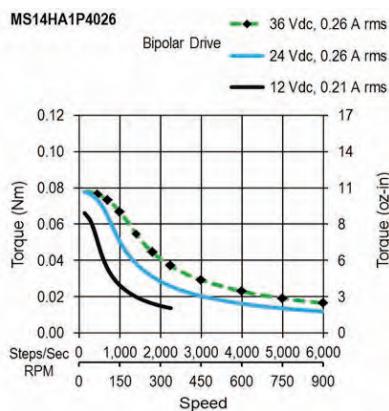
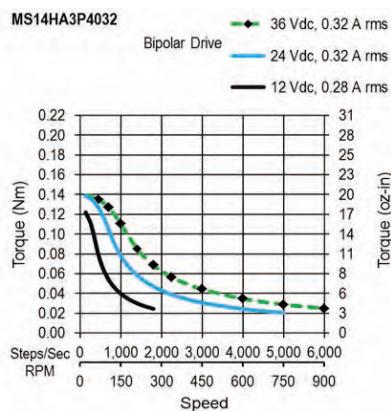
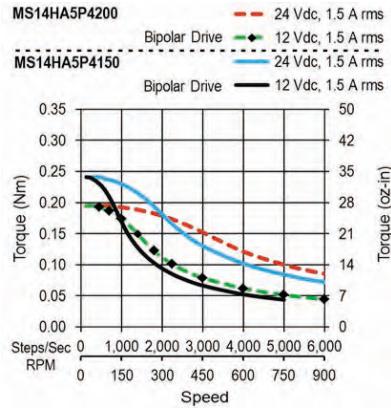
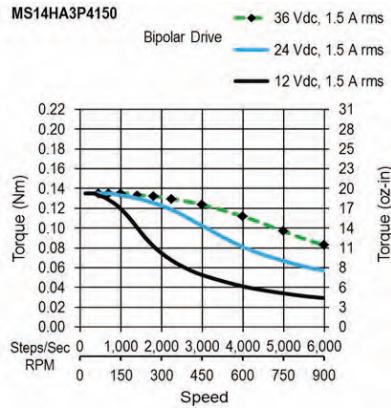
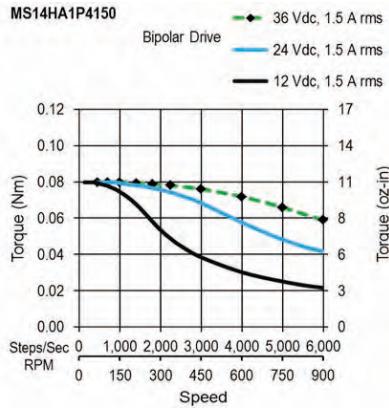
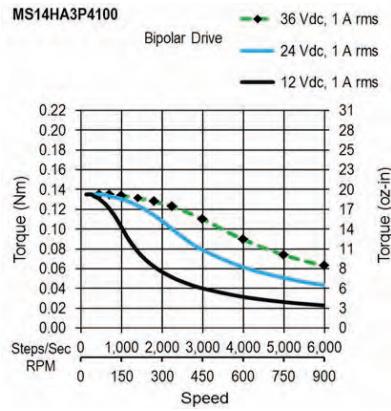
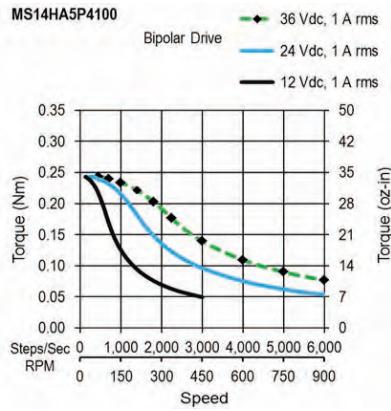
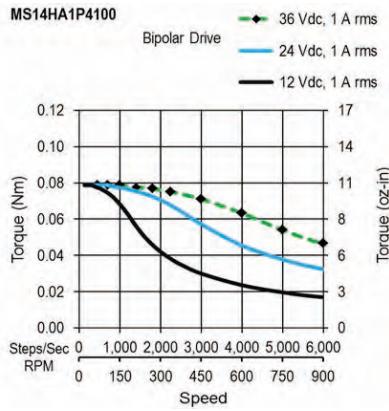
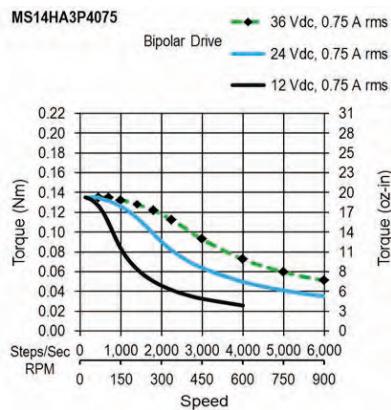
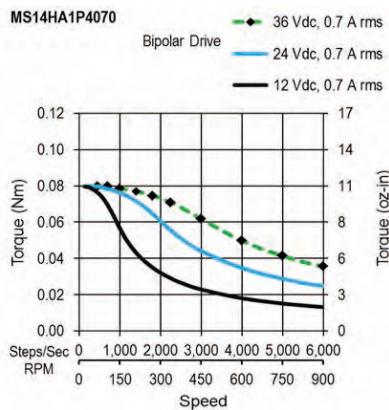
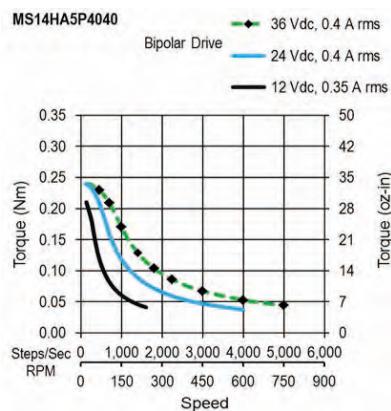
Dimensions: mm (in)

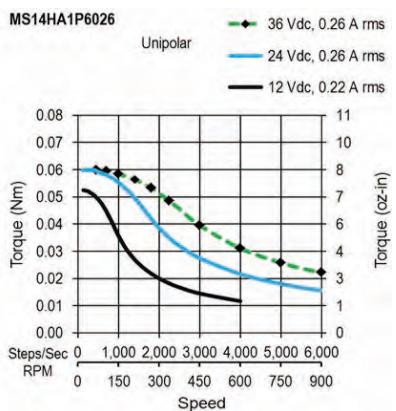
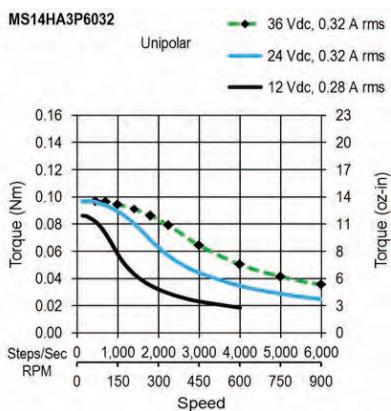
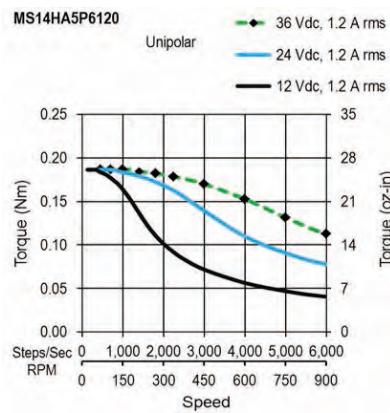
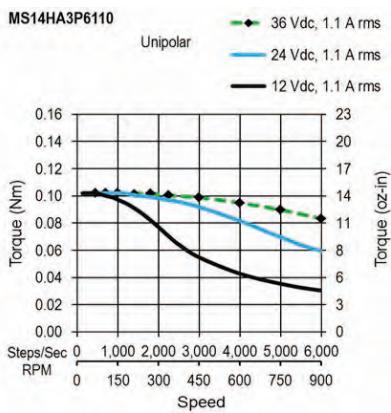
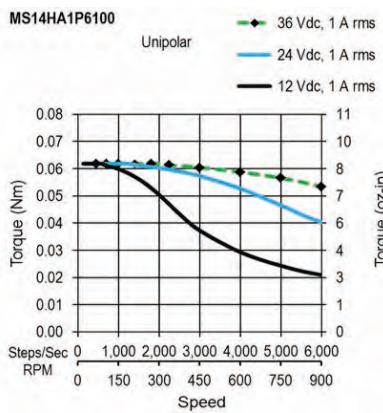
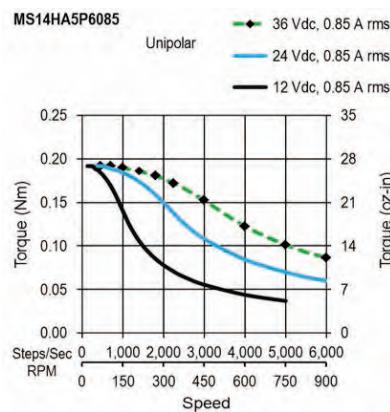
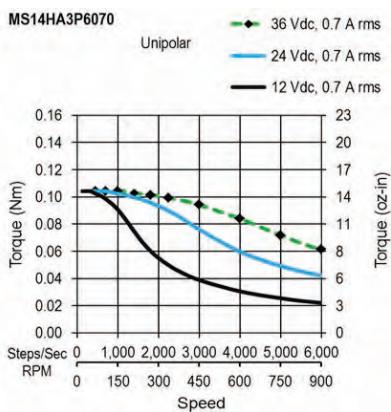
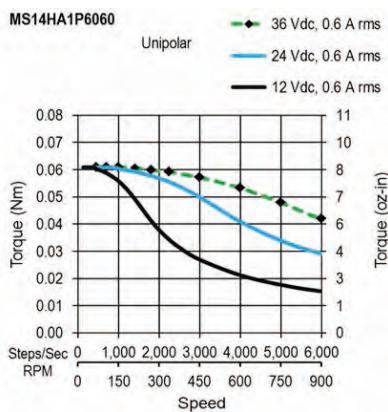
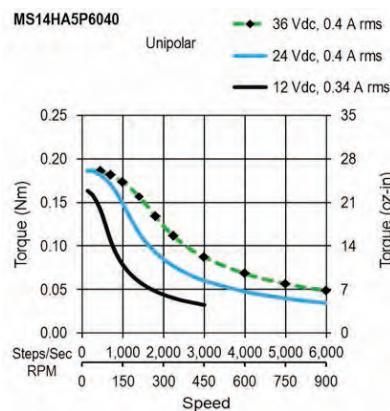
4 Lead Part Number 4634 1402 02846



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
 - Radial 65 N (15 Lbs.) Pull
 - At Flat Center 30 N (6.5 Lbs.)
- 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	55mm (2.17 in.)

Winding

Current rating x 100

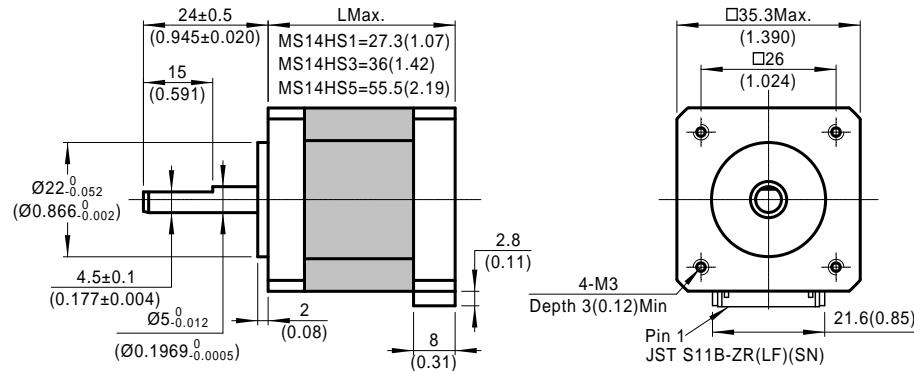
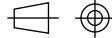
Number of Connections

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

Electrical Connection

P Plug-in Connector

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.	±10% @20 C	Typ.	mNm	oz-in	g cm ²	oz-in ²	kg Lbs
27.3 mm (1.07 in.)	MS14HS1P4026 ^ MS14HS1P4070 ^ MS14HS1P4100 ^ MS14HS1P4150	P P P P	0.26 0.7 1 1.5	0.13 0.13 0.13 0.13	18 19 19 19	49 6.6 3.3 1.55	47 7 3.3 1.53	10	1.4	12	0.066	0.15 0.33
36 mm (1.42 in.)	MS14HS3P4032 ^ MS14HS3P4075 ^ MS14HS3P4100 ^ MS14HS3P4150	P P P P	0.32 0.75 1 1.5	0.24 0.23 0.23 0.23	34 33 33 33	37 6 3.4 1.62	52 8.9 5 2.2	15	2.1	20	0.11	0.21 0.46
55 mm (2.17 in.)	MS14HS5P4040 ^ MS14HS5P4100 ^ MS14HS5P4150 ^ MS14HS5P4200	P P P P	0.4 1 1.5 2	0.39 0.40 0.40 0.40	55 57 57 57	30 5.1 2.2 1.34	50 8.3 3.6 2.1	18	2.5	35	0.19	0.24 0.53

^ Preferred model

MS14HS - 6 Lead Uni-Polar

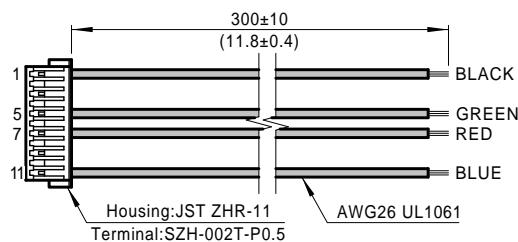
Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms mH		Detent Torque	Rotor Inertia		Motor Weight	
	Single Shaft	P=Plug L=Leads	Amps (mounted)	Nm Typ.	oz-in TYP.	±10% @20 C	Typ.	mNm	oz-in	g cm ²	oz-in ²	kg Lbs
27.3 mm (1.07 in.)	MS14HS1P6026 MS14HS1P6060 MS14HS1P6100	P P P	0.26 0.6 1	0.10 0.10 0.10	14 14 14	48 8.9 3.3	23 4.5 1.7	10	1.4	12	0.066	0.15 0.33
36 mm (1.42 in.)	MS14HS3P6032 MS14HS3P6070 MS14HS3P6110	P P P	0.32 0.7 1.1	0.17 0.18 0.18	24 25 25	37 7.5 3	22 5.4 2.1	15	2.1	20	0.11	0.21 0.46
55 mm (2.17 in.)	MS14HS5P6040 MS14HS5P6085 MS14HS5P6120	P P P	0.4 0.85 1.2	0.30 0.31 0.30	42 44 42	31 7.1 3.5	26 6.2 2.9	18	2.5	35	0.19	0.24 0.53

^ Preferred model

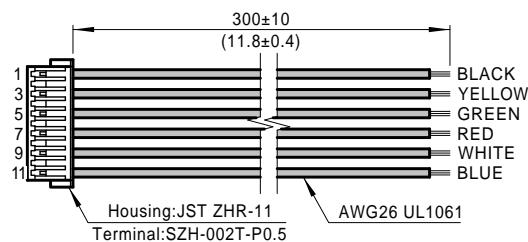
Mating Connector With Leads (order separately)

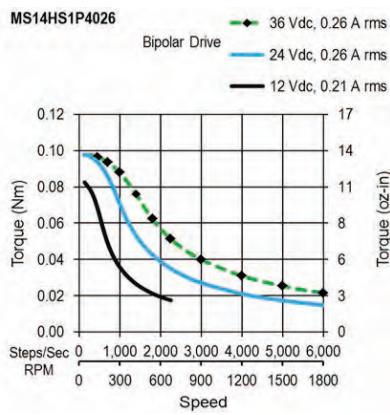
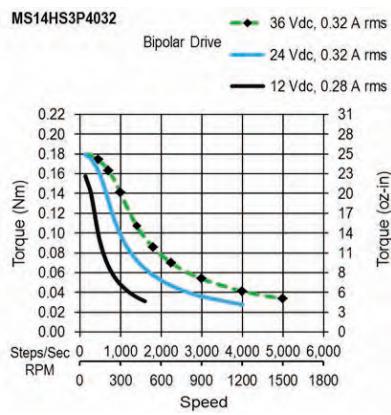
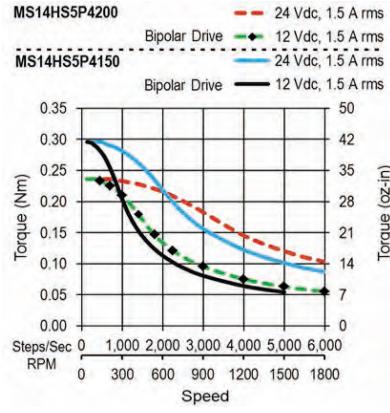
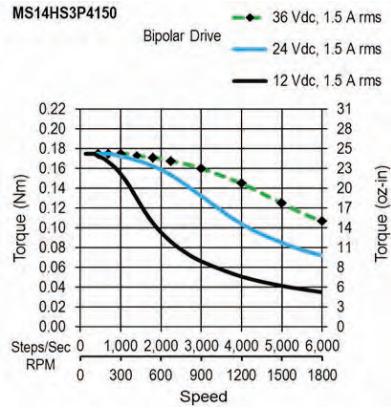
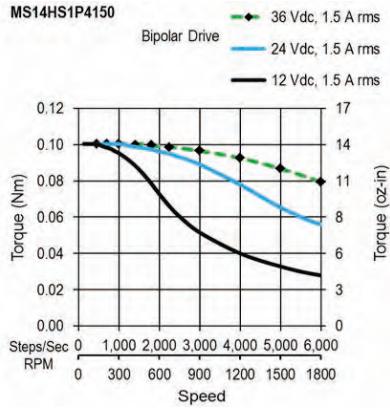
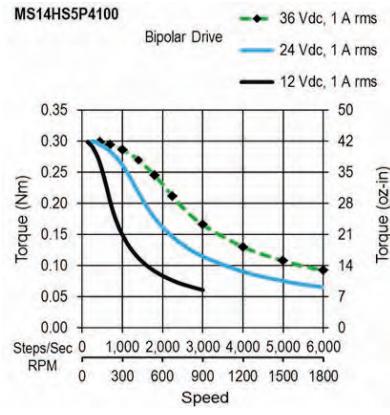
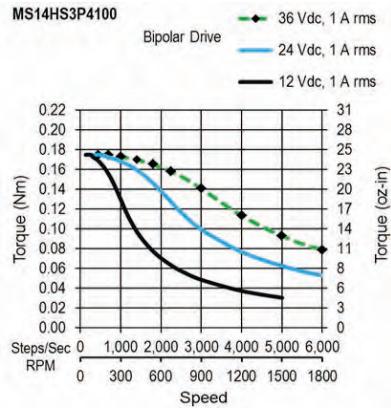
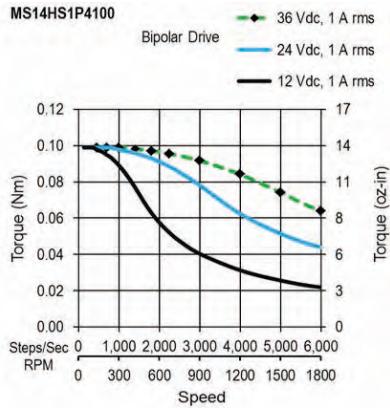
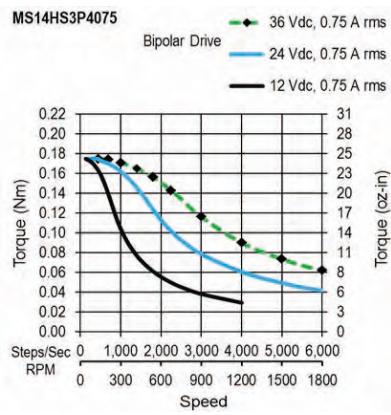
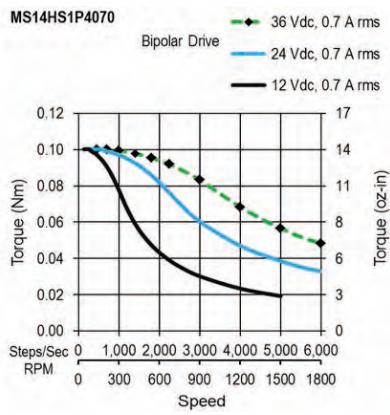
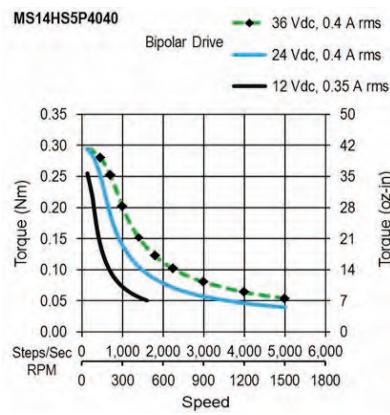
Dimensions: mm (in)

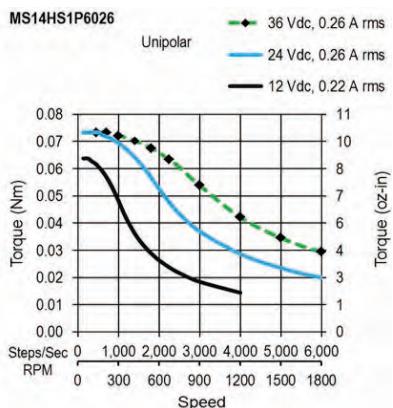
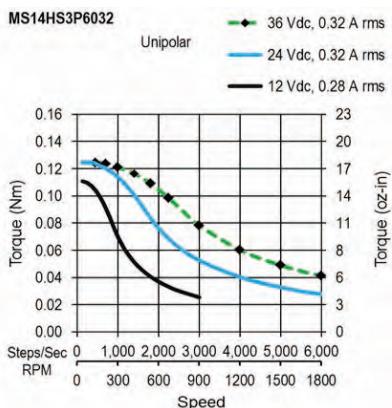
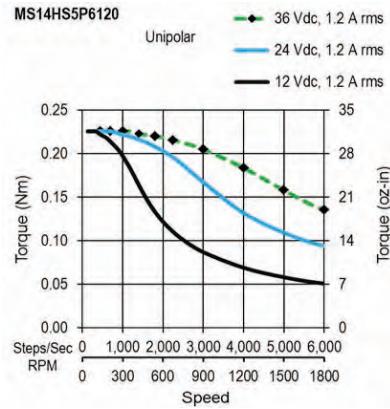
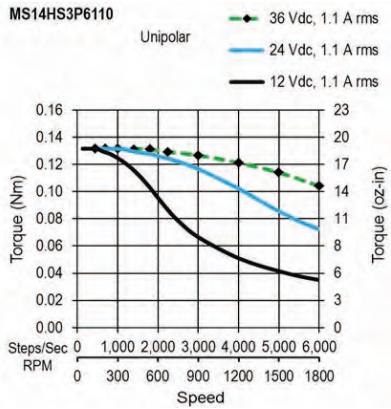
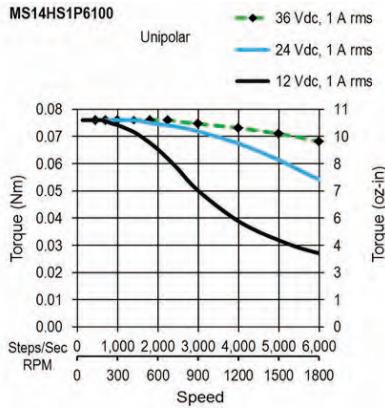
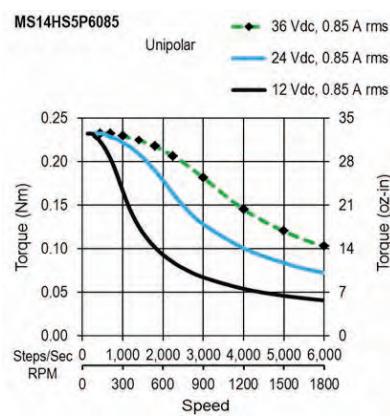
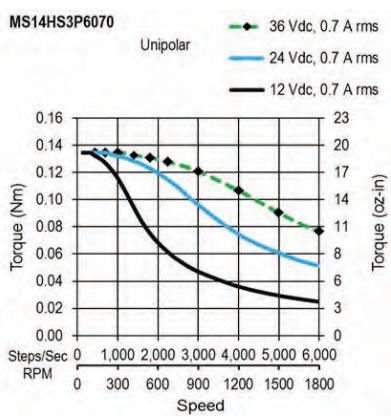
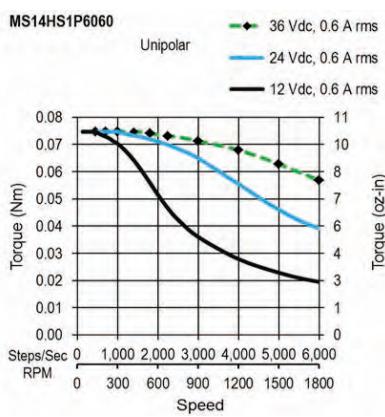
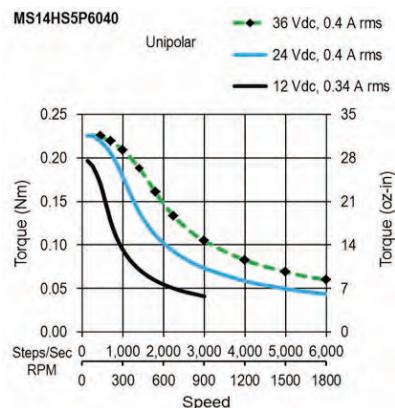
4 Lead Part Number 4634 1402 02846



6 Lead Part Number 4634 1402 04489



MS14HS1-1.8° Bipolar**MS14HS3-1.8° Bipolar****MS14HS5-1.8° Bipolar**

MS14HS1-1.8° Unipolar**MS14HS3-1.8° Unipolar****MS14HS5-1.8° Unipolar**

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
 - Radial 65 N (15 Lbs.) Pull
 - At Flat Center 30 N (6.5 Lbs.)
- 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

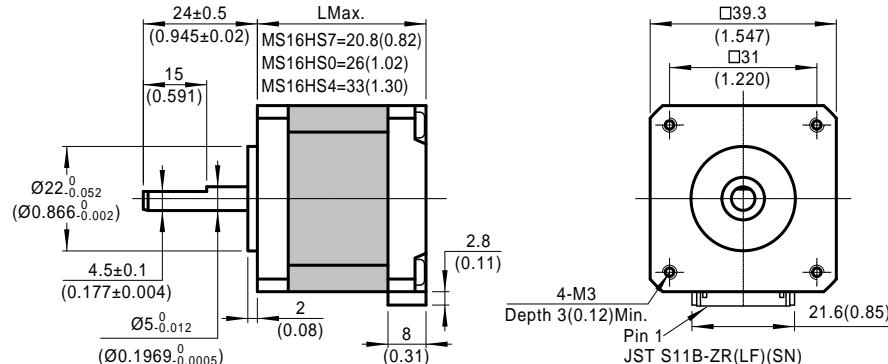
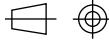
Winding

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
				Amps (mounted)	Nm Typ.	oz-in TYP.	±10% @20°C		mNm	oz-in	
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

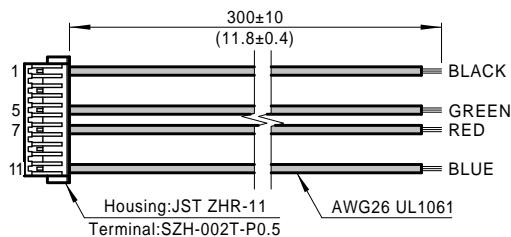
Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms mH		Detent Torque	Rotor Inertia		Motor Weight
				Amps (mounted)	Nm Typ.	oz-in TYP.	±10% @20°C		mNm	oz-in	
20.8 mm (0.82 in.)	MS16HS7P6024	P	0.24	0.07	10	50	21	5	0.71	14 0.077	0.11 0.24
	^ MS16HS7P6070	P	0.7	0.07	10	5.5	2.6				
	^ 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

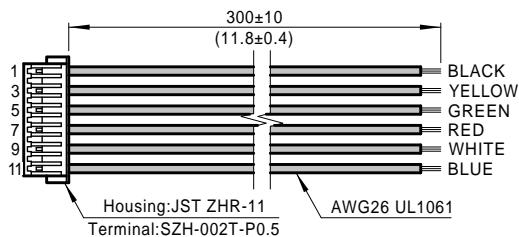
Mating Connector With Leads (order separately)

Dimensions: mm (in)

4 Lead Part Number 4634 1402 02846

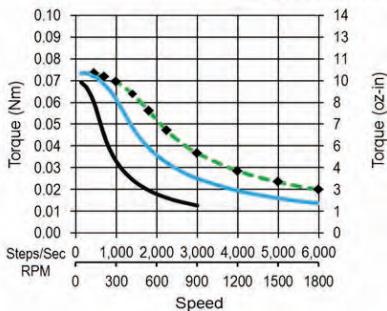


6 Lead Part Number 4634 1402 04489

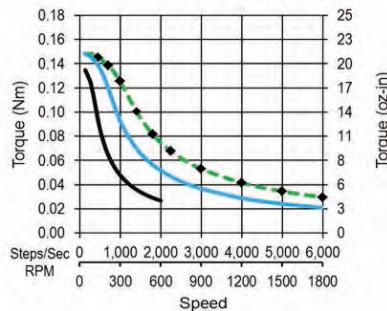


MS16HS7- Bipolar

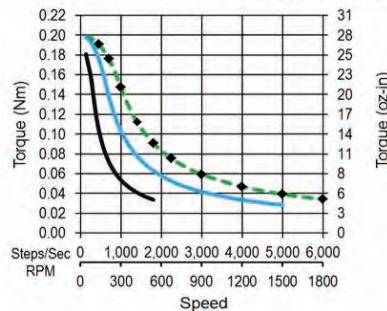
MS16HS7P4027
 Bipolar Drive
 — 36 Vdc, 0.27 A rms
 — 24 Vdc, 0.27 A rms
 — 12 Vdc, 0.25 A rms

**MS16HS0- Bipolar**

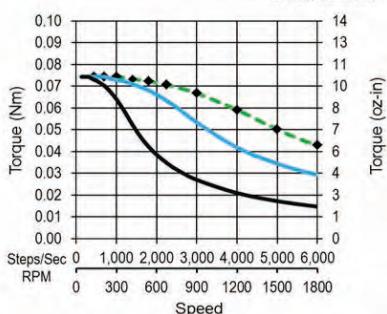
MS16HS0P4029
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 — 36 Vdc, 0.29 A rms
 — 24 Vdc, 0.29 A rms
 — 12 Vdc, 0.26 A rms

**MS16HS4- Bipolar**

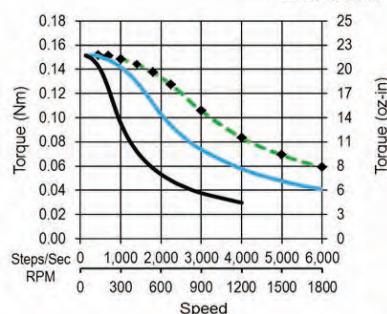
MS16HS4P4037
 Bipolar Drive
 — 36 Vdc, 0.37 A rms
 — 24 Vdc, 0.37 A rms
 — 12 Vdc, 0.34 A rms



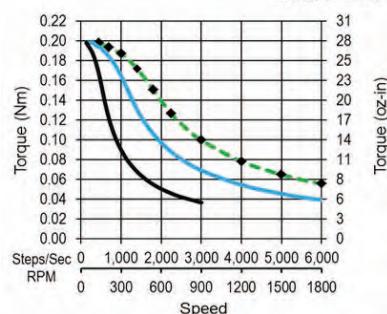
MS16HS7M4070
 Bipolar Drive
 — 36 Vdc, 0.7 A rms
 — 24 Vdc, 0.7 A rms
 — 12 Vdc, 0.7 A rms



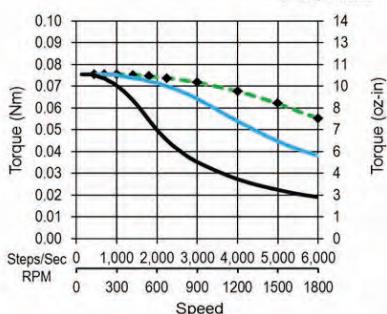
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 Bipolar Drive
 — 36 Vdc, 0.7 A rms
 — 24 Vdc, 0.7 A rms
 — 12 Vdc, 0.7 A rms



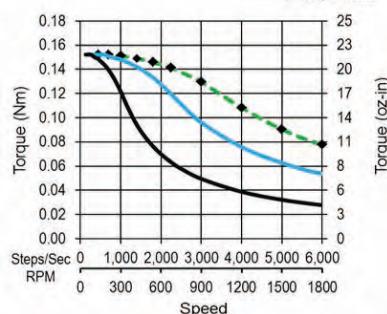
MS16HS4P4070
 Bipolar Drive
 — 36 Vdc, 0.7 A rms
 — 24 Vdc, 0.7 A rms
 — 12 Vdc, 0.7 A rms



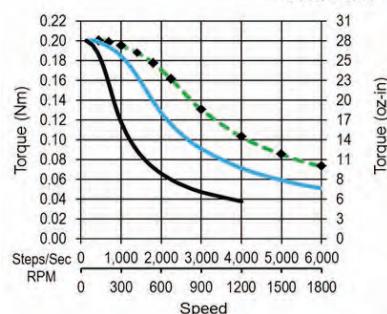
MS16HS7M4100
 Bipolar Drive
 — 36 Vdc, 1 A rms
 — 24 Vdc, 1 A rms
 — 12 Vdc, 1 A rms



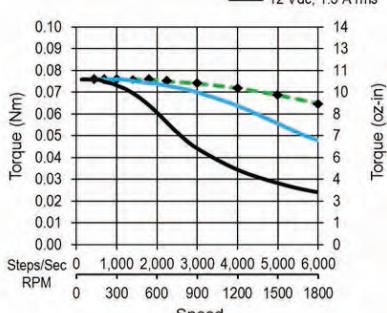
MS16HS0M4100
 Bipolar Drive
 — 36 Vdc, 1 A rms
 — 24 Vdc, 1 A rms
 — 12 Vdc, 1 A rms



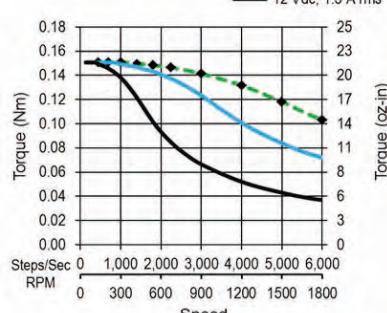
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 Bipolar Drive
 — 36 Vdc, 1 A rms
 — 24 Vdc, 1 A rms
 — 12 Vdc, 1 A rms



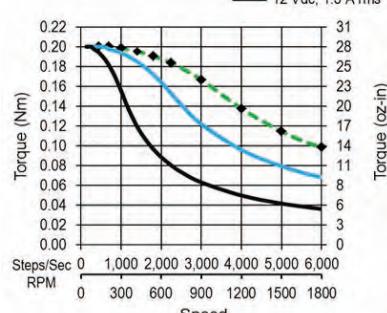
MS16HS7M4150
 Bipolar Drive
 — 36 Vdc, 1.5 A rms
 — 24 Vdc, 1.5 A rms
 — 12 Vdc, 1.5 A rms

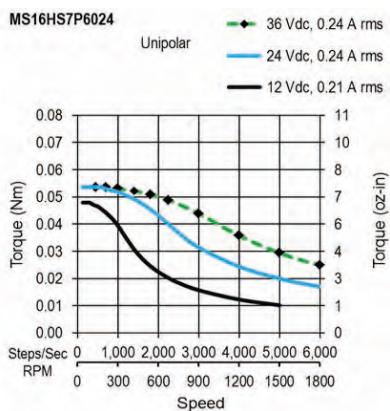
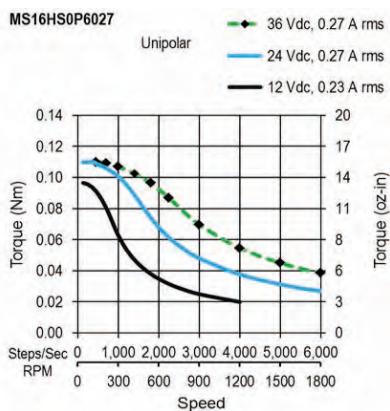
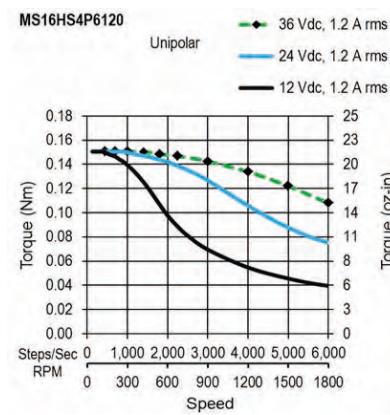
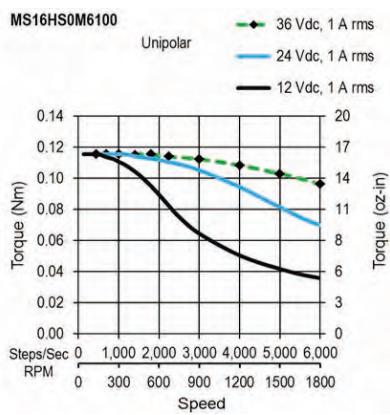
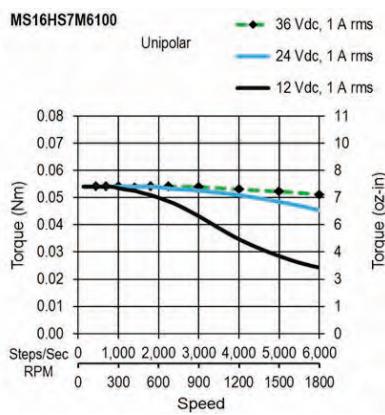
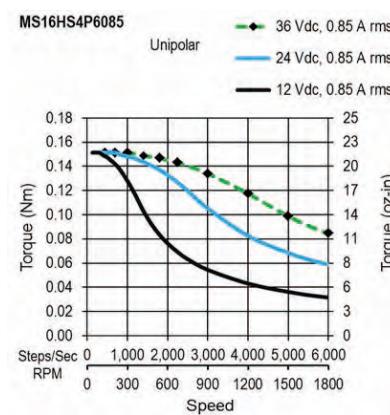
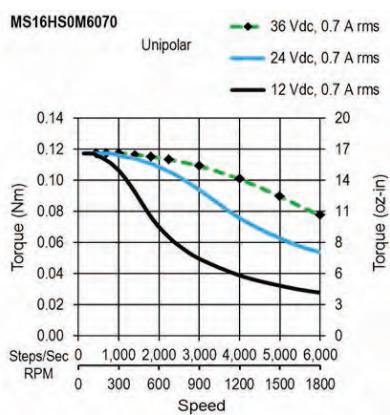
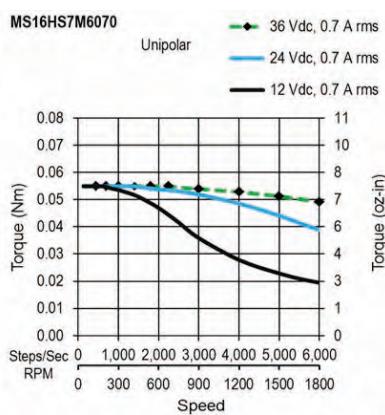
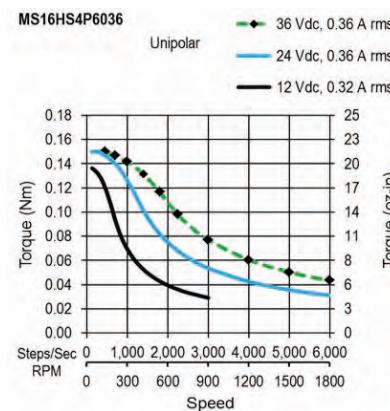


MS16HS0M4150
 Bipolar Drive
 — 36 Vdc, 1.5 A rms
 — 24 Vdc, 1.5 A rms
 — 12 Vdc, 1.5 A rms



MS16HS4P4150
 Bipolar Drive
 — 36 Vdc, 1.5 A rms
 — 24 Vdc, 1.5 A rms
 — 12 Vdc, 1.5 A rms



MS16HS7- Unipolar**MS16HS0- Unipolar****MS16HS4- Unipolar**

MOONS' Technology

2 Phase Step Motors

3 Phase Step Motors

Technical

MS17HA Series: 0.9° - Size 17

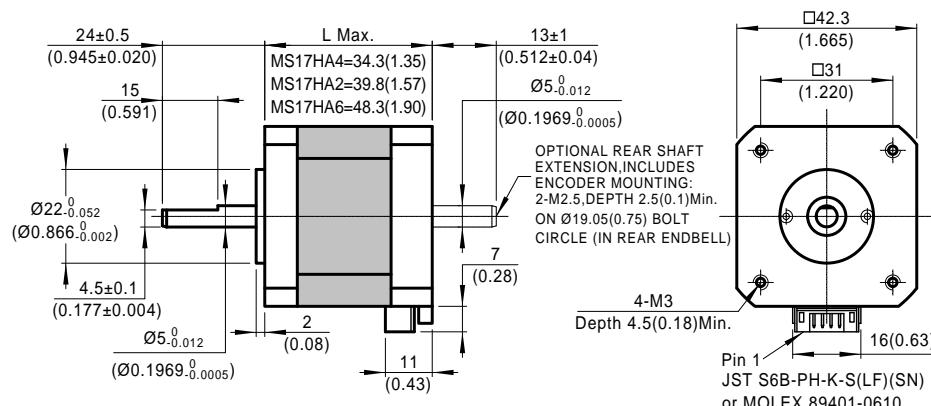
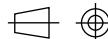


• Phases	2
• Steps / Revolution	400
• Step Accuracy	±5%
• Shaft Load (20,000 Hours at 1000 RPM)	
Axial	25 N (5.6 Lbs.) Push
Radial	65 N (15 Lbs.) Pull
Radial	30 N (6.5 Lbs.) At Flat Center
• IP Rating	40
• Approvals	UL Recognized File E465363, RoHS
• Operating Temp.	-20°C to +50°C
• Insulation Class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

MS17HA 4 P 4 040 -M

<u>Basic Motor Length (Max)</u>			<u>Options</u>	
4	34.3mm (1.35 in.)	Short	Omit	No Options
2	39.8mm (1.57 in.)	1 Stack	-M	5 mm Diameter Rear Shaft
6	48.3mm (1.90 in.)	2 Stack		With Encoder Mounting Holes
<u>Electrical Connection</u>			<u>Winding</u>	
P Plug-in Connector			### Current rating x 100	
<u>Number of Connections</u>				
4 4 Lead-Bipolar				
6 6 Lead-Unipolar(or Bipolar)				

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.	±10% @20 C	Typ.	mNm	oz-in	g cm ²	oz-in ²	kg	Lbs
34.3 mm (1.35 in.)	MS17HA4P4040	P	0.4	0.25	35	30	71	12	1.7	38	0.21	0.23	0.51
	MS17HA4P4100	P	1	0.25	35	4.3	10.5						
	MS17HA4P4150	P	1.5	0.24	34	1.71	4.1						
	MS17HA4P4200	P	2	0.25	35	1.11	2.5						
39.8 mm (1.57 in.) 1 Stack	MS17HA2P4040	P	0.4	0.39	55	24	70	16	2.3	57	0.31	0.29	0.64
	MS17HA2P4100	P	1	0.39	55	3.9	11.2						
	MS17HA2P4150	P	1.5	0.40	57	1.98	5.4						
	MS17HA2P4200	P	2	0.39	55	1.05	2.8						
48.3 mm (1.9 in.) 2 Stack	MS17HA6P4050	P	0.5	0.55	78	24	74	25	3.5	82	0.45	0.351	0.77
	MS17HA6P4100	P	1	0.53	75	4.9	16						
	MS17HA6P4150	P	1.5	0.52	74	2.2	6.8						
	MS17HA6P4200	P	2	0.53	75	1.31	4						

^ Preferred model

MS17HA - 6 Lead Uni-Polar

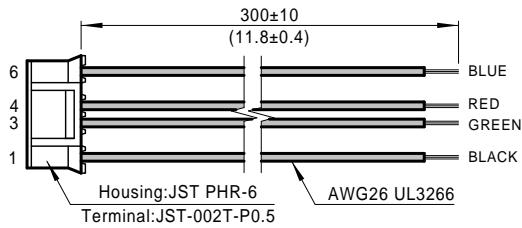
Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms	mH	Detent Torque	Rotor Inertia	Motor Weight			
	Single Shaft	P=Plug L=Leads	Amps (mounted)	Nm Typ.	oz-in TYP.	±10% @20 C	Typ.	mNm	oz-in	g cm ²	oz-in ²	kg	Lbs
34.3 mm (1.35 in.)	MS17HA4P6038	P	0.38	0.20	28	31	38	12	1.7	38	0.21	0.23	0.51
	MS17HA4P6085	P	0.85	0.19	27	5.1	6.2						
	MS17HA4P6120	P	1.2	0.20	28	2.9	3.6						
39.8 mm (1.57 in.) 1 Stack	MS17HA2P6040	P	0.4	0.32	45	28	39	16	2.3	57	0.31	0.29	0.64
	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	29	45	25	3.5	82	0.45	0.351	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	1.3	1.94						

^ Preferred model

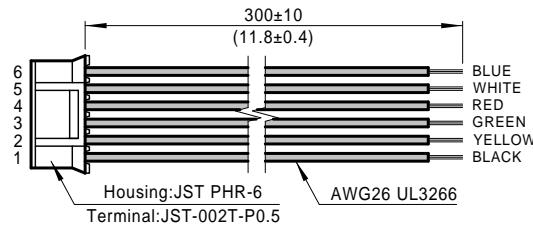
Mating Connector With Leads (order separately)

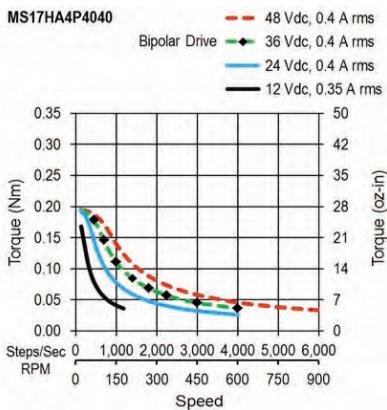
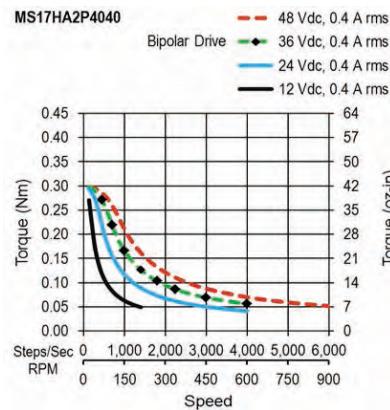
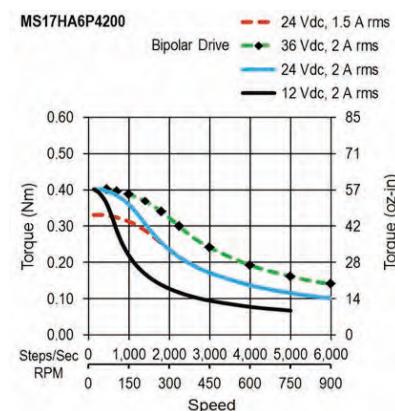
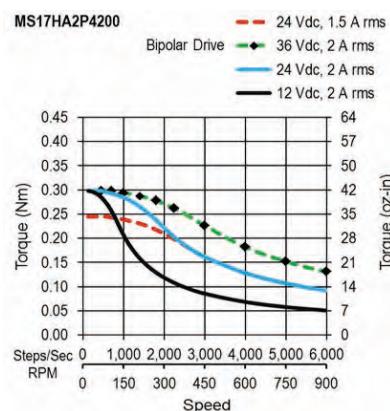
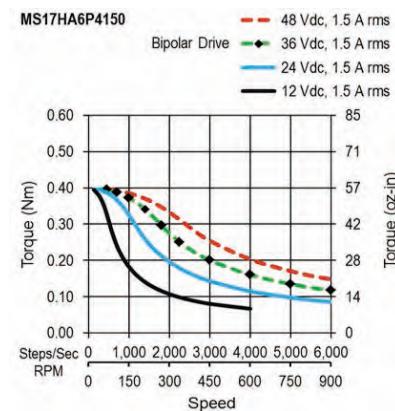
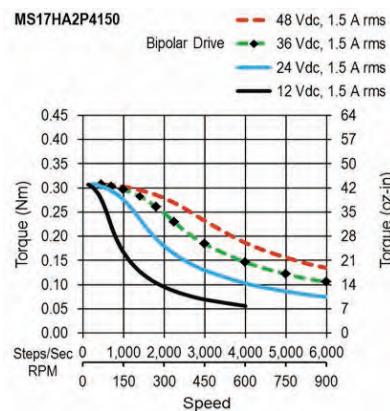
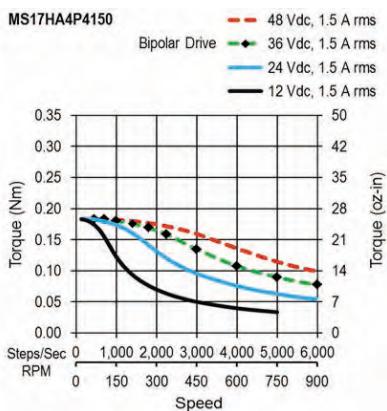
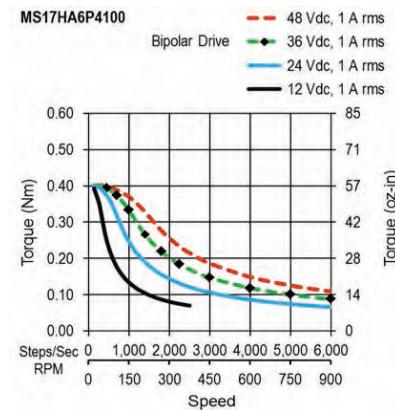
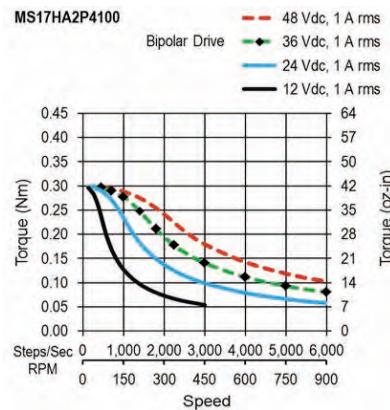
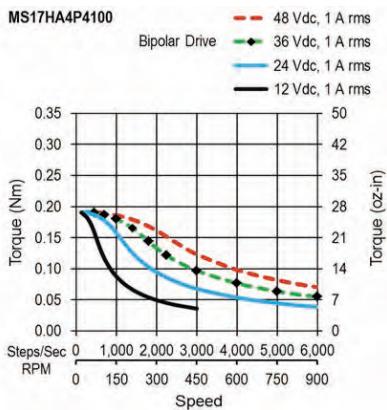
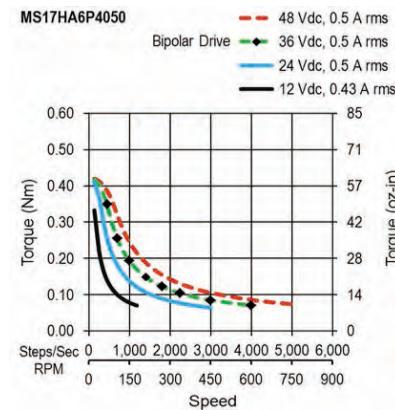
Dimensions: mm (in)

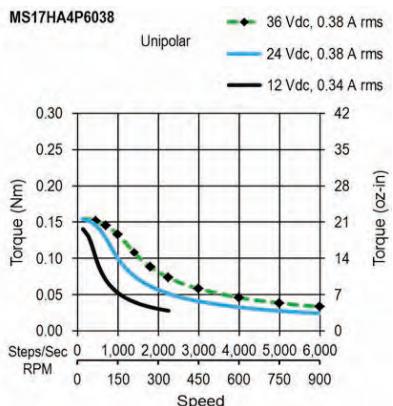
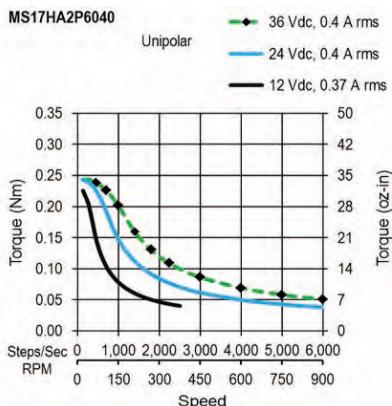
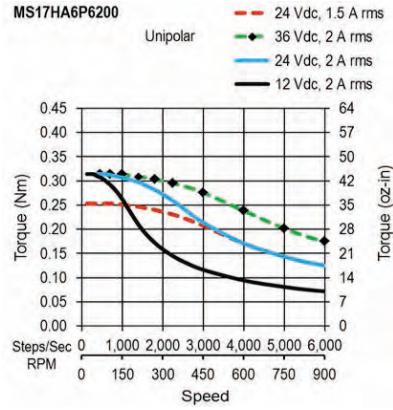
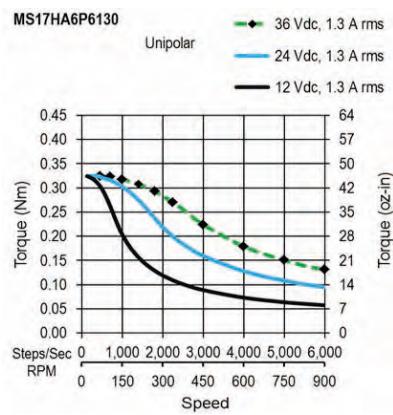
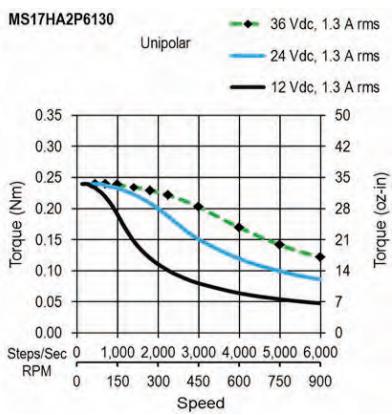
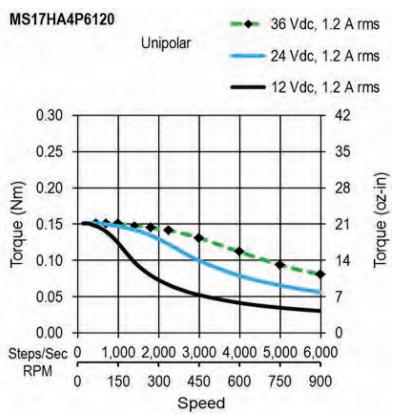
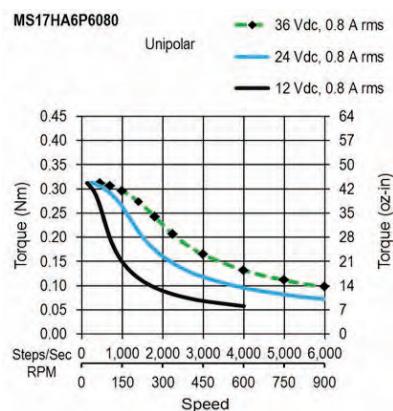
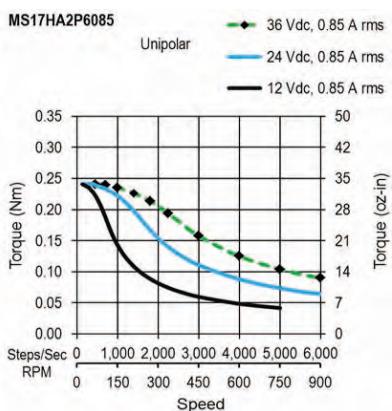
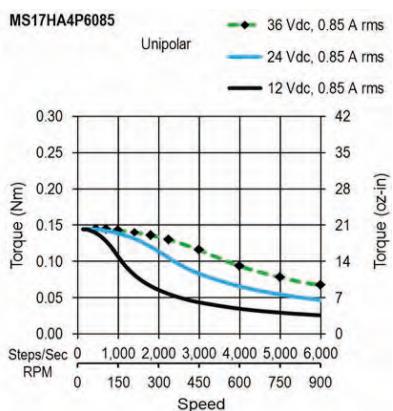
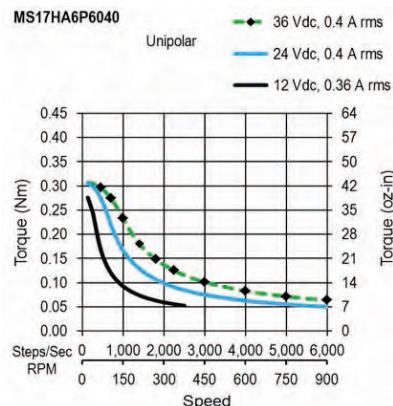
4 Lead Part Number 4634 1402 00723



6 Lead Part Number 4634 1402 00922



MS17HA4-0.9° Bipolar**MS17HA2-0.9° Bipolar****MS17HA6-0.9° Bipolar**

MS17HA4-0.9° Unipolar**MS17HA2-0.9° Unipolar****MS17HA6-0.9° Unipolar**

MS17HD Series: 1.8° - Size 17

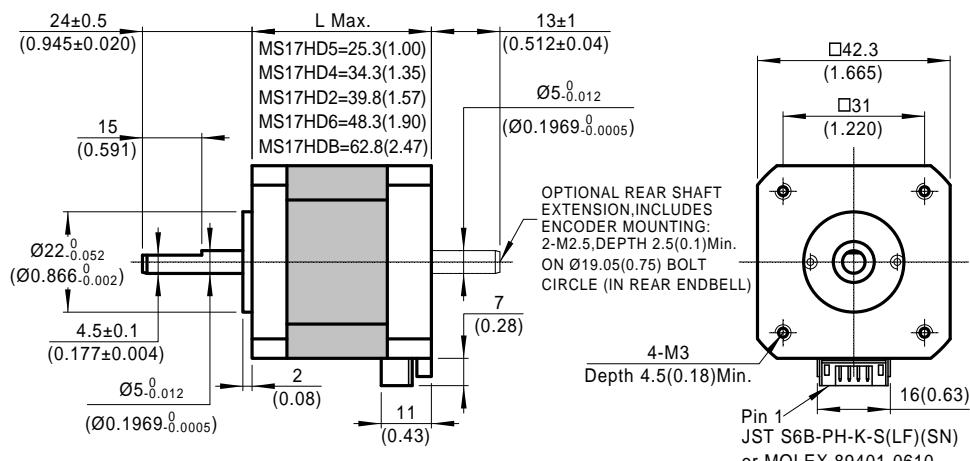
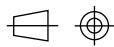


- | | |
|---|---|
| • Phases | 2 |
| • Steps / Revolution | 200 |
| • Step Accuracy | ±5% |
| • Shaft Load (20,000 Hours at 1000 RPM) | |
| Axial | 25 N (5.6 Lbs.) Push
65 N (15 Lbs.) Pull |
| Radial | 29 N (6.5 Lbs.) At Flat Center |
| • IP Rating | 40 |
| • Approvals | UL Recognized File E465363, RoHS |
| • 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)		Options	
5	25.3mm (1.0 in.)	Omit	No Options
4	39.8mm (1.35 in.)	-M	5 mm Diameter Rear Shaft
2	39.8mm (1.57 in.)	With Encoder Mounting Holes	1 Stack
6	48.3mm (1.90 in.)		2 Stack
B	62.8mm (2.47 in.)		3 Stack
Electrical Connection		Winding	
P	Plug-in Connector	###	Current rating x 100
Number of Connections			
4	4 Lead-Bipolar		
6	6 Lead-Unipolar(or Bipolar)		

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.	±10% @20 C	Typ.	mNm	oz-in	g cm ²	oz-in ²	kg
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	1.31	1.66					
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

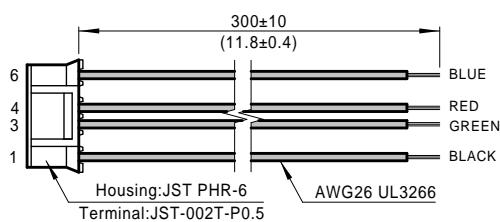
Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms mH		Detent Torque	Rotor Inertia	Motor Weight		
	Single Shaft	P=Plug L=Leads	Amps (mounted)	Nm Typ.	oz-in TYP.	±10% @20 C	Typ.	mNm	oz-in	g cm ²	oz-in ²	kg
25.3 mm (1 in.)	MS17HD5P6030	P	0.3	0.16	23	40	25	5	0.71	20	0.11	0.15 0.33
	MS17HD5P6070	P	0.7	0.16	23	6.6	4.4					
	MS17HD5P6100	P	1	0.16	23	3.3	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

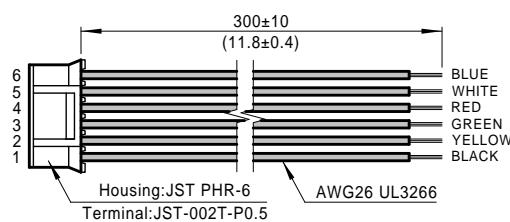
Mating Connector With Leads (order separately)

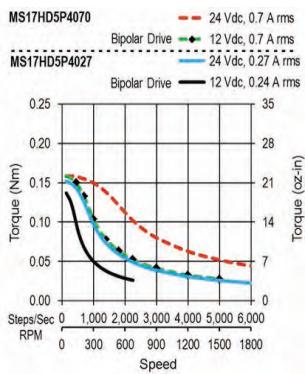
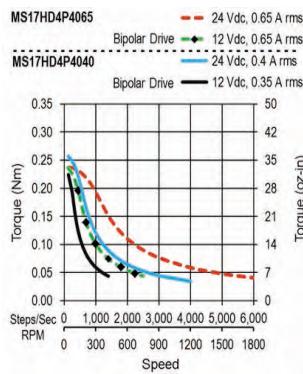
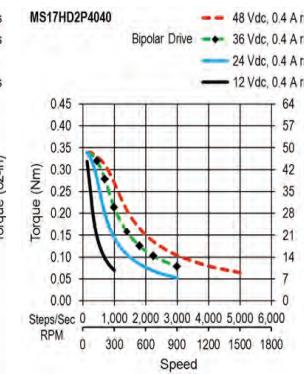
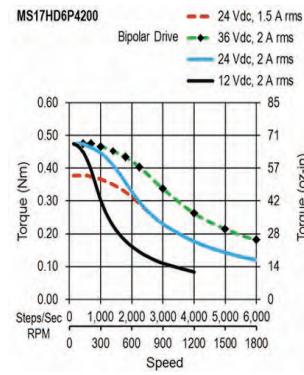
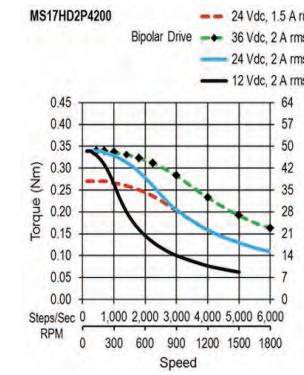
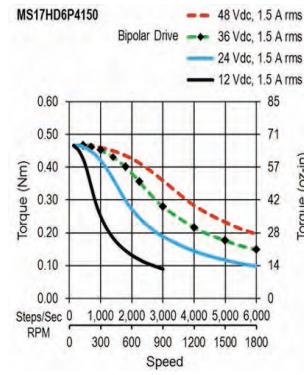
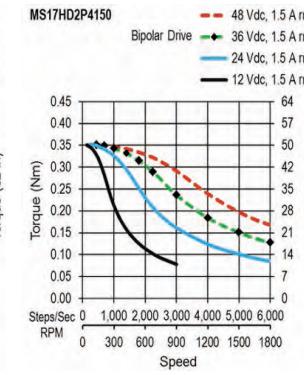
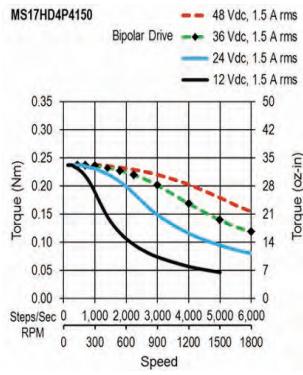
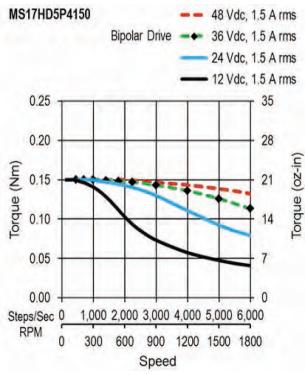
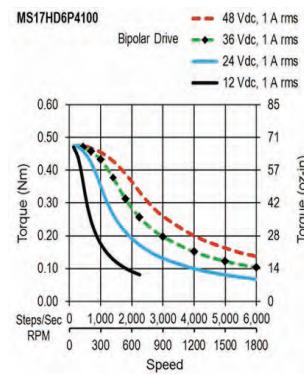
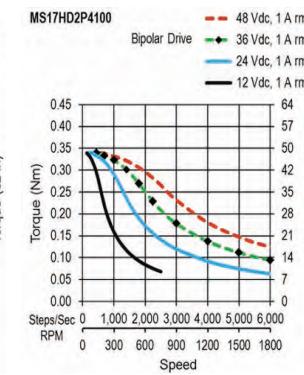
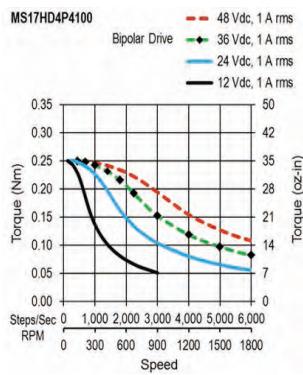
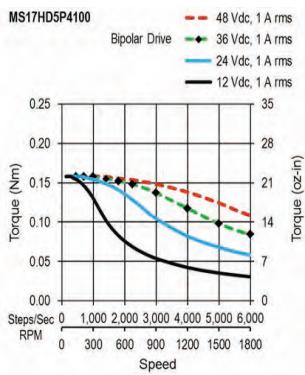
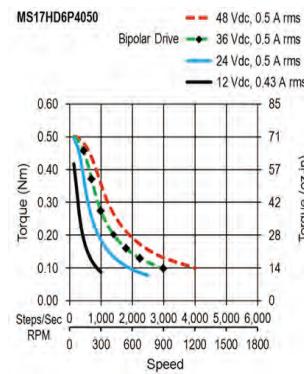
Dimensions: mm (in)

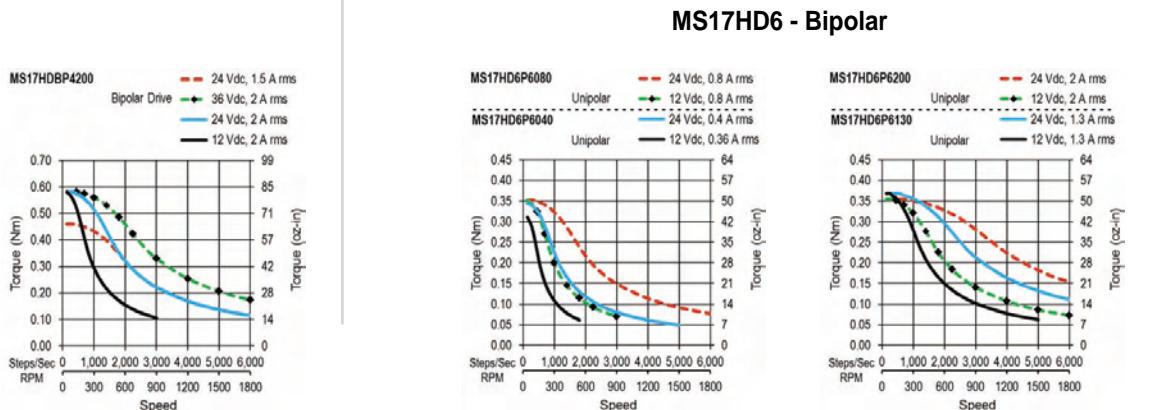
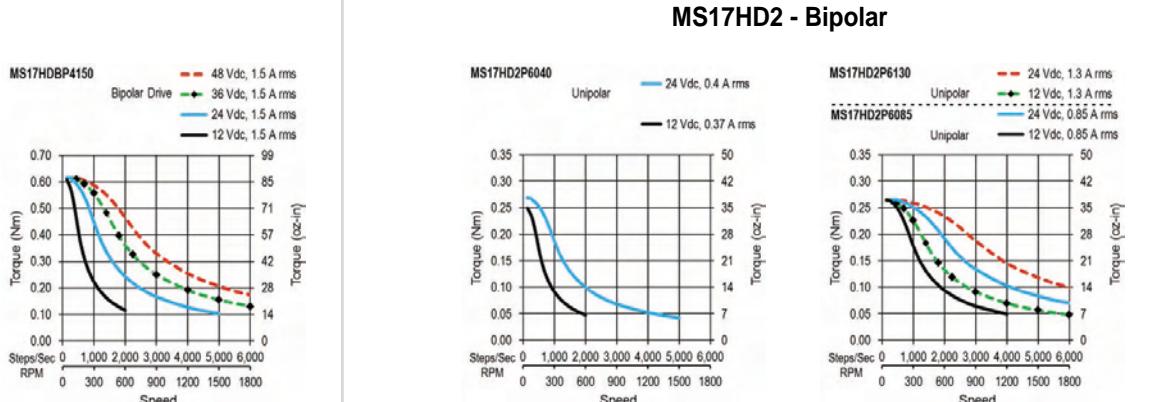
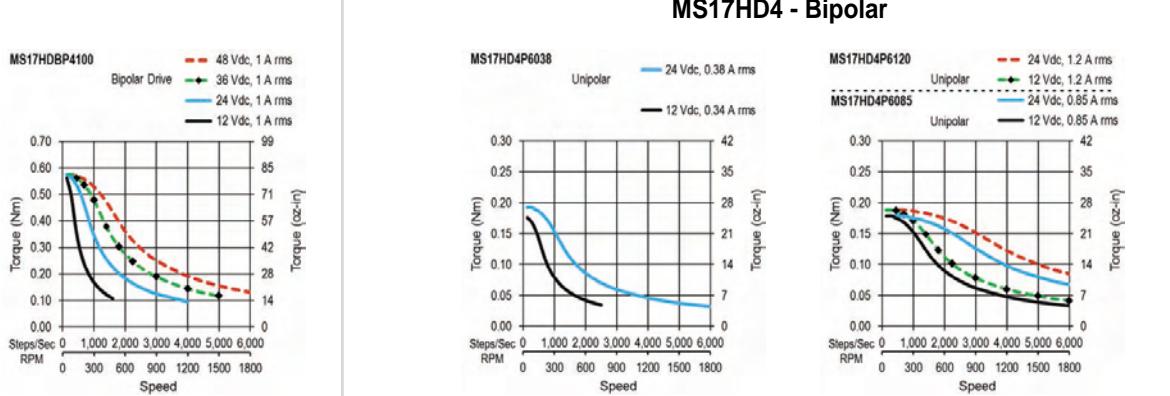
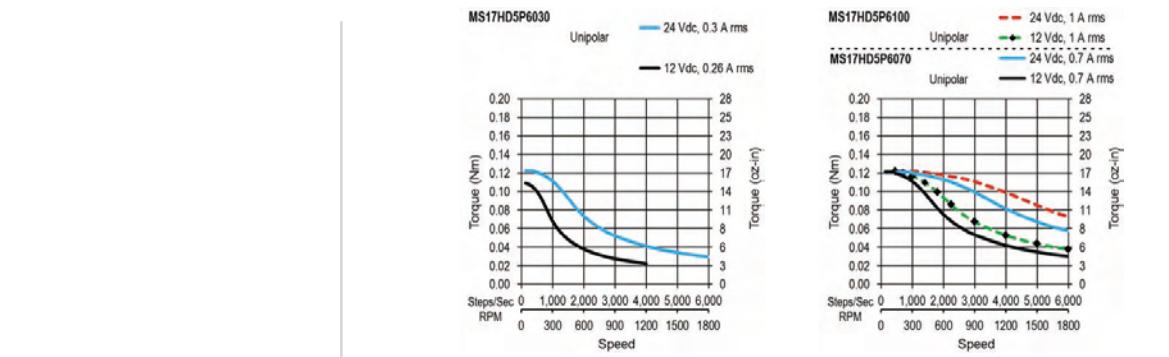
4 Lead Part Number 4634 1402 00723



6 Lead Part Number 4634 1402 00922



MS17HD5 - Bipolar**MS17HD4 - Bipolar****MS17HD2 - Bipolar****MS17HD6 - Bipolar**

MS17HDB - Bipolar**MS17HD5 - Bipolar**MOONS'
Technology3 Phase
Step Motors

Technical

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
 - Radial 130 N (30 Lbs.) Pull
 - 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)			Options		
0	39mm (1.54 in.)		Omit	No Options	
8	55mm (2.17 in.)	1 Stack	-E	0.25 inch diameter rear shaft With Encoder Mounting Holes	
A	77mm (3.03 in.)	2 Stack			
Electrical Connection			Winding		
P	Plug-in Connector		###	Current rating x 100	
Number of Connections					
4	4 Lead-Bipolar				
6	6 Lead-Unipolar(or Bipolar)				

MS23HA - 4 Lead Bi-Polar

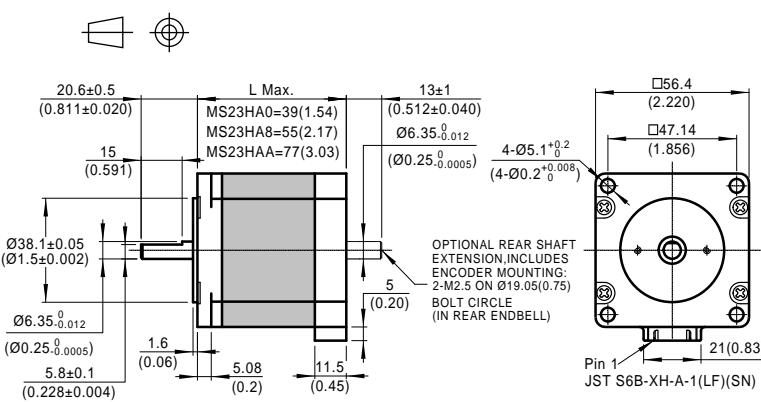
Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms mH	Detent Torque	Rotor Inertia	Motor Weight	
				Nm Typ.	oz-in TYP.				kg	Lbs
39 mm (1.54 in.)	^ MS23HA0P4100 ^ MS23HA0P4160 ^ MS23HA0P4220 ^ MS23HA0L4350	P P P L	1 1.6 2.2 3.5	0.59 0.60 0.60 0.59	84 85 85 84	6.3 2.6 1.39 0.56	19.8 8.1 4.3 1.62	24 3.4	121.5 0.66	0.42 0.93
55 mm (2.17 in.) 1 Stack	^ MS23HA8P4100 ^ MS23HA8P4150 ^ MS23HA8P4220 ^ MS23HA8L4360 ^ MS23HA8L4550	P P P L L	1 1.5 2.2 3.6 5.5	1.50 1.40 1.50 1.50 1.50	210 200 210 210 210	7.6 3.1 1.6 0.63 0.28	50 21 10.5 3.9 1.56	45 6.4	221 1.2	0.6 1.3
77 mm (3.03 in.) 2 Stack	^ MS23HAAP4100 ^ MS23HAAP4150 ^ MS23HAAP4200 ^ MS23HAAP4300 ^ MS23HAAL4500	P P P L L	1 1.5 2 3 5	2.30 2.40 2.30 2.40 2.30	330 340 330 340 330	8.8 4.3 2.3 1.1 0.39	61 29 15.2 6.9 2.4	70 9.9	391 2.1	1 2.2

^ Preferred model

Dimensions: mm (in)

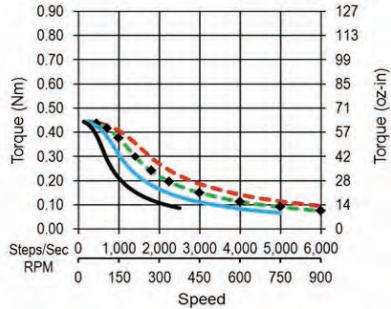
Mating Connector with 4 Leads: 300 ±10 (12 ±.5) long
(order separately) Part Number: 4634 1402 01891

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

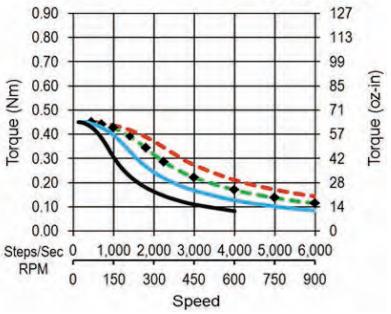


MS23HA0

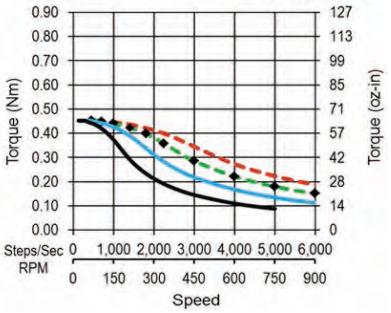
MS23HA0P4100
 Bipolar Drive
 - - - 60 Vdc, 1 A rms
 - - - 48 Vdc, 1 A rms
 - - - 36 Vdc, 1 A rms
 - - - 24 Vdc, 1 A rms



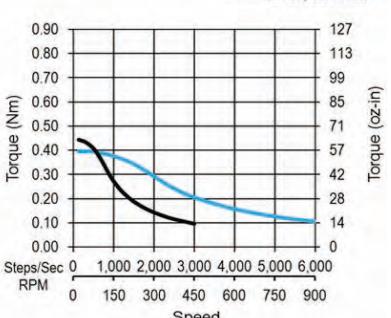
MS23HA0P4160
 Bipolar Drive
 - - - 60 Vdc, 1.6 A rms
 - - - 48 Vdc, 1.6 A rms
 - - - 36 Vdc, 1.6 A rms
 - - - 24 Vdc, 1.6 A rms



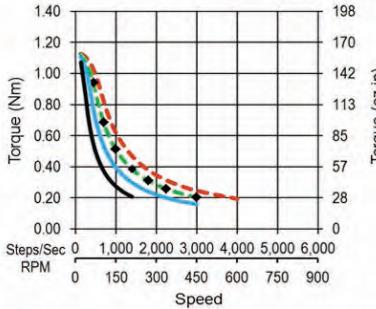
MS23HA0P4220
 Bipolar Drive
 - - - 60 Vdc, 2.2 A rms
 - - - 48 Vdc, 2.2 A rms
 - - - 36 Vdc, 2.2 A rms
 - - - 24 Vdc, 2.2 A rms



MS23HA0L4350
 Bipolar Drive
 - - - 24 Vdc, 3 A rms
 - - - 12 Vdc, 3.5 A rms

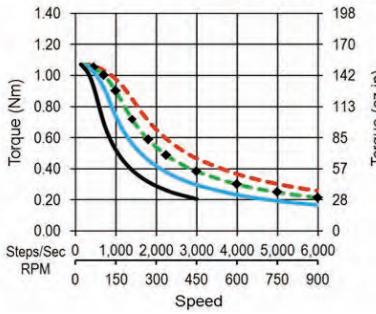
**MS23HA8**

MS23HA8P4100
 Bipolar Drive
 - - - 60 Vdc, 1 A rms
 - - - 48 Vdc, 1 A rms
 - - - 36 Vdc, 1 A rms
 - - - 24 Vdc, 1 A rms



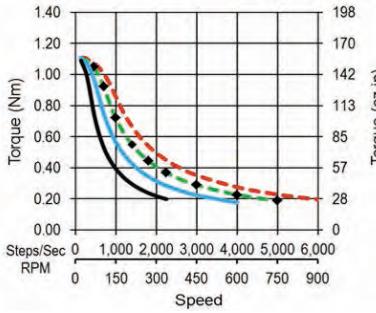
MS23HA8P4220

Bipolar Drive
 - - - 60 Vdc, 2 A rms
 - - - 48 Vdc, 2 A rms
 - - - 36 Vdc, 2 A rms
 - - - 24 Vdc, 2 A rms



MS23HA8P4150

Bipolar Drive
 - - - 60 Vdc, 1.5 A rms
 - - - 48 Vdc, 1.5 A rms
 - - - 36 Vdc, 1.5 A rms
 - - - 24 Vdc, 1.5 A rms

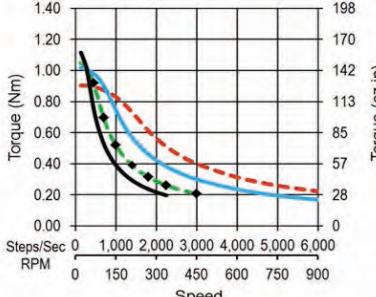


MS23HA8L4550

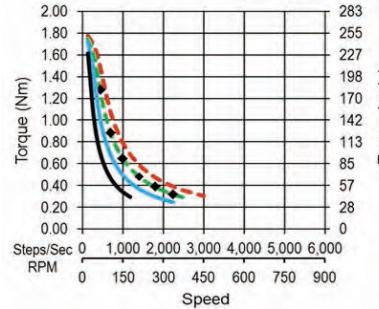
Bipolar Drive
 - - - 24 Vdc, 4 A rms
 - - - 12 Vdc, 5 A rms
 - - - 24 Vdc, 3 A rms

MS23HA8L4360

Bipolar Drive
 - - - 12 Vdc, 3.6 A rms

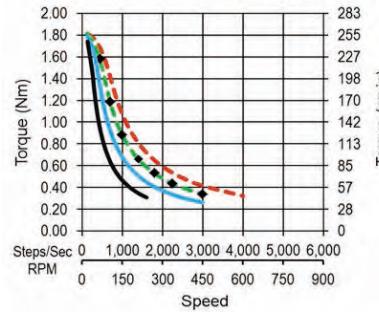
**MS23HAA**

MS23HAA4100
 Bipolar Drive
 - - - 60 Vdc, 1 A rms
 - - - 48 Vdc, 1 A rms
 - - - 36 Vdc, 1 A rms
 - - - 24 Vdc, 1 A rms



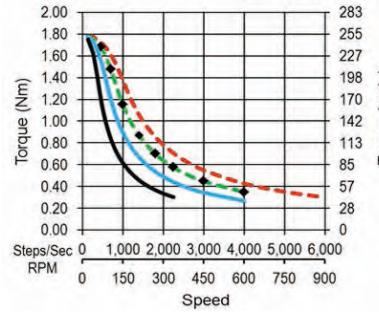
MS23HAA4150

Bipolar Drive
 - - - 60 Vdc, 1.5 A rms
 - - - 48 Vdc, 1.5 A rms
 - - - 36 Vdc, 1.5 A rms
 - - - 24 Vdc, 1.5 A rms



MS23HAA4200

Bipolar Drive
 - - - 60 Vdc, 2 A rms
 - - - 48 Vdc, 2 A rms
 - - - 36 Vdc, 2 A rms
 - - - 24 Vdc, 2 A rms

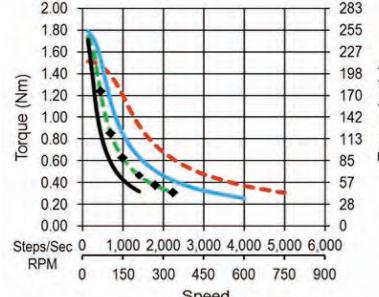


MS23HAAL4500

Bipolar Drive
 - - - 24 Vdc, 4 A rms
 - - - 12 Vdc, 5 A rms
 - - - 24 Vdc, 3 A rms

MS23HAA4300

Bipolar Drive
 - - - 12 Vdc, 3 A rms



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

Options

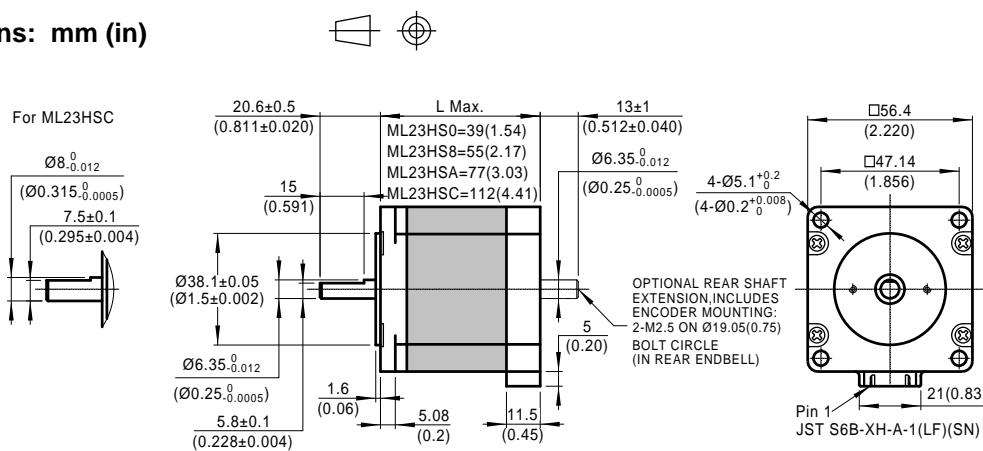
Omit No Options
-E 0.25 inch Diameter Rear Shaft
with Encoder Mounting Holes

Current rating x 100

Number of Connections

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

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.	$\pm 10\%$ @20°C	Typ.	mNm	oz-in	g cm ²	oz-in ²	kg Lbs
39 mm (1.54 in.)	^ ML23HS0P4100	P	1	0.82	120	6.3	15.9	24	3.4	121.5	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	155	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	221	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	391	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	610	3.3	1.5 3.3
	^ ML23HSCP4200	P	2	3.20	450	2.7	11.8					
	^ ML23HSCP4300	P	3	3.20	450	1.29	5.5					
	^ ML23HSCL4500	L	5	3.20	450	0.51	1.85					

^ Preferred model

PL23HS - PowerPlus - 4 Lead Bi-Polar

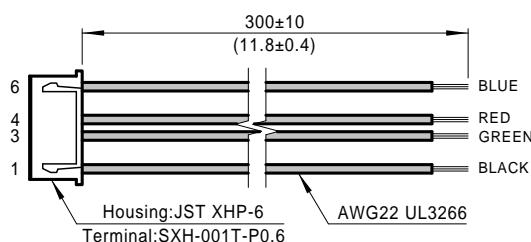
Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms mH		Detent Torque	Rotor Inertia		Motor Weight	
	Single Shaft	P=Plug L=Leads	Amps (mounted)	Nm Typ.	oz-in TYP.	$\pm 10\%$ @20°C	Typ.	mNm	oz-in	g cm ²	oz-in ²	kg Lbs
55 mm (2.17 in.) 1 Stack	^ PL23HS8P4100	P	1	2.30	330	7.6	26	100	14	260	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	460	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					

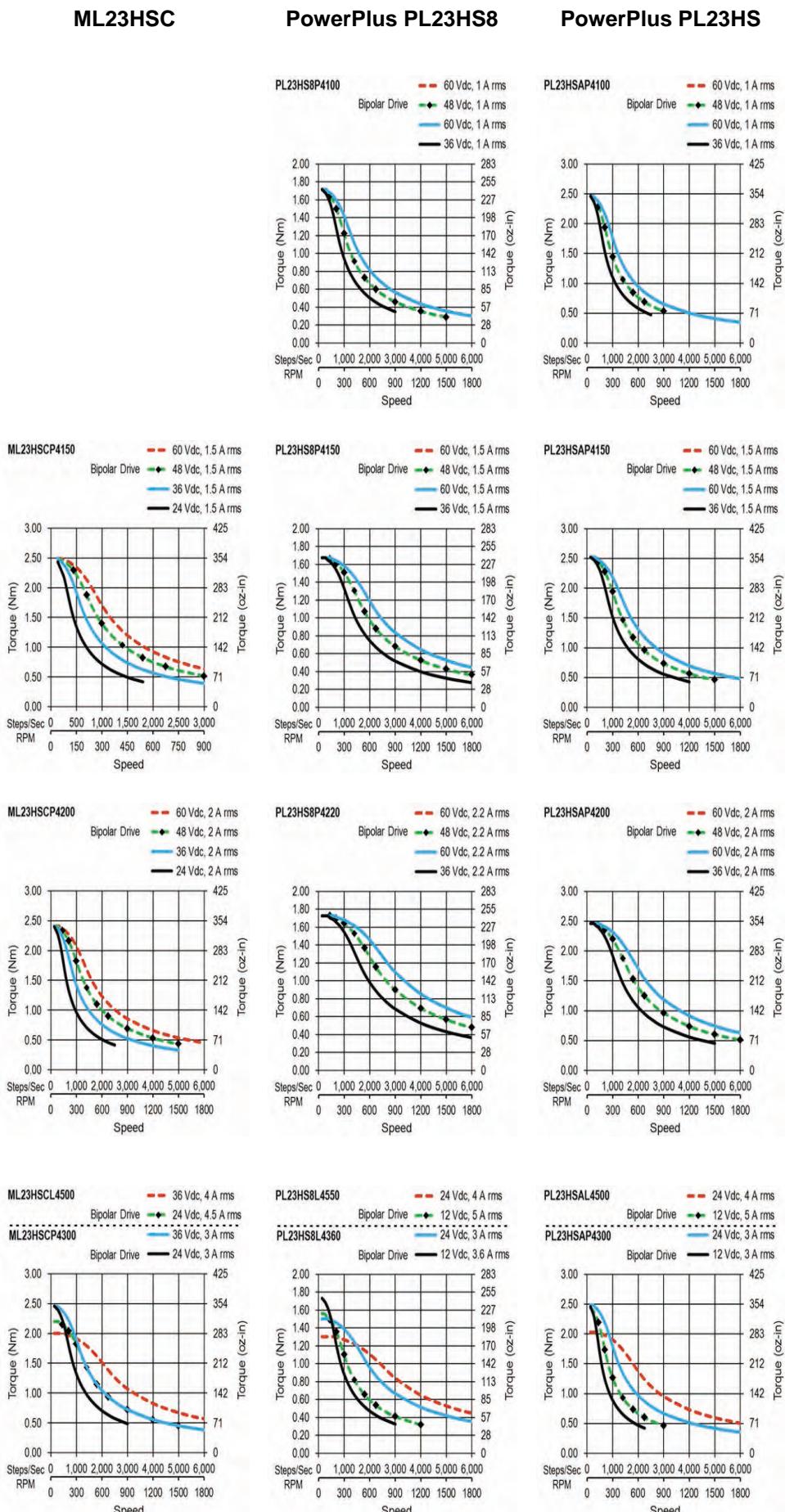
^ Preferred model

Mating Connector With Leads (order separately)

Dimensions: mm (in)

4 Lead Part Number 4634 1402 01891



ML23HSC**PowerPlus PL23HS8****PowerPlus PL23HS**MOONS'
Technology2 Phase
Step Motors3 Phase
Step Motors

Technical

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)		Options	
1	46mm (1.81 in.)	Omit	No Options
2	56mm (2.21 in.)	-E	0.25 inch diameter rear shaft With Encoder Mounting Holes
3	67mm (2.64 in.)		
5	87MM (3.43IN.)		
Electrical Connection		Winding	
L	Leads	### Current rating x 100	
P	Plug-in Connector		
Number of Connections			
4	4 Lead-Bipolar		
6	6 Lead-Unipolar(or Bipolar)		

MS24HS – 4 Lead Bi-Polar

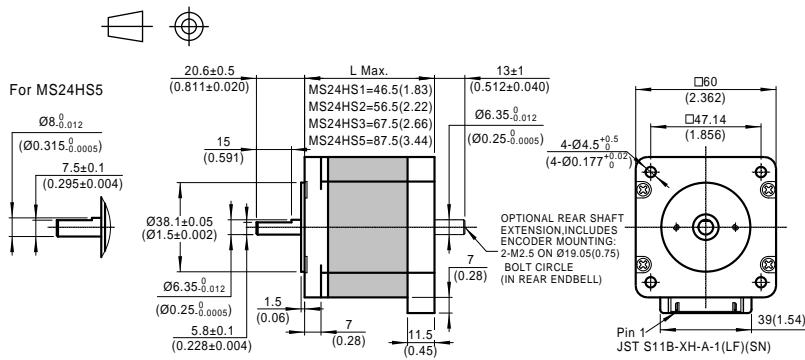
Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms mH		Detent Torque	Rotor Inertia		Motor Weight	
				Nm Typ.	oz-in TYP.	±10% @20 C	Typ.		mNm	oz-in		
46 mm (1.81 in.)	^ MS24HS1P4150 ^ MS24HS1P4200 ^ MS24HS1P4300	P P P	1.5 2 3	1.28 1.26 1.23	180 180 170	3.2 1.69 0.73	7.1 3.9 1.61	40	5.7	280	1.5	0.6 1.3
56 mm (2.2 in.)	^ MS24HS2P4150 ^ MS24HS2P4200 ^ MS24HS2P4300 ^ MS24HS2L4420	P P P L	1.5 2 3 4.2	1.90 1.90 1.80 1.80	270 270 250 250	4 2.1 0.92 0.47	12.5 6.8 2.8 1.35	90	13	450	2.5	0.83 1.8
67 mm (2.64 in.)	^ MS24HS3P4150 ^ MS24HS3P4200 ^ MS24HS3P4300 ^ MS24HS3L4420	P P P L	1.5 2 3 4.2	2.40 2.30 2.40 2.30	340 330 340 330	4.2 2.2 1.1 0.56	12.1 6 3 1.44	95	13	560	3.1	1.05 2.3
87 mm (3.43 in.)	^ MS24HS5P4150 ^ MS24HS5P4200 ^ MS24HS5P4300 ^ MS24HS5L4420	P P P L	1.5 2 3 4.2	3.20 3.30 3.30 3.20	450 470 470 450	4.6 2.8 1.21 0.61	15.8 9.2 4.1 1.97	100	14	900	4.9	1.4 3.1

^ Preferred model

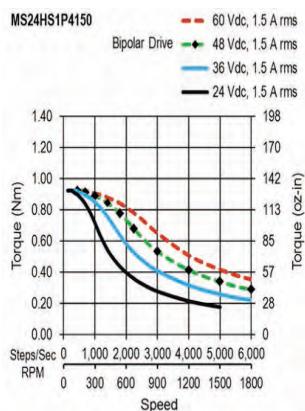
Dimensions: mm (in)

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

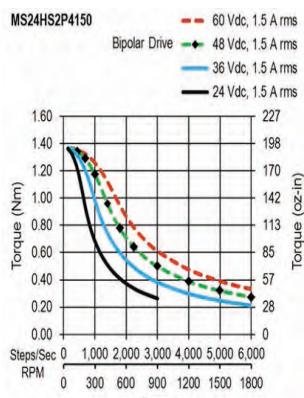
Motors with leads:
Lead wire is 22 AWG
UL3266, 300 ±10 (12 ±.5) long



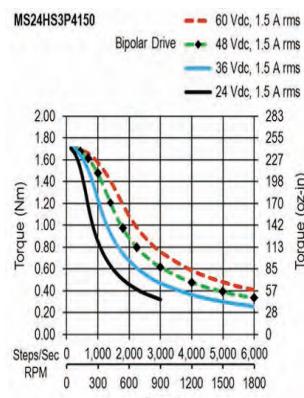
MS24HS1



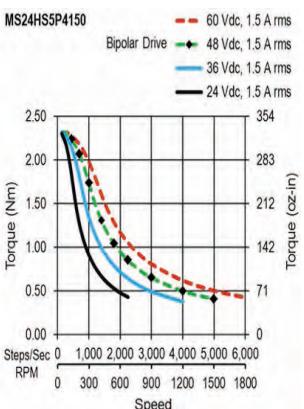
MS24HS2



MS24HS3



MS24HS5

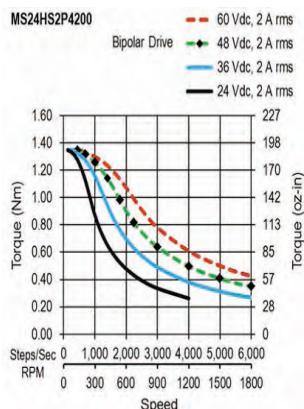


The graph plots Torque (Nm) on the left y-axis (0.00 to 1.40) and Torque (oz-in) on the right y-axis (28 to 198) against Speed (RPM) on the x-axis (0 to 1800). Four curves represent different operating conditions:

- 60 Vdc, 2 A rms** (Red dashed line)
- 48 Vdc, 2 A rms** (Green dashed line)
- 36 Vdc, 2 A rms** (Blue solid line)
- 24 Vdc, 2 A rms** (Black solid line)

All curves show a decreasing trend of torque as speed increases, with higher voltages resulting in higher torque levels.

Speed (RPM)	60 Vdc, 2 A rms (Nm)	48 Vdc, 2 A rms (Nm)	36 Vdc, 2 A rms (Nm)	24 Vdc, 2 A rms (Nm)
0	0.90	0.90	0.90	0.90
300	0.85	0.85	0.85	0.85
600	0.75	0.75	0.70	0.65
900	0.65	0.60	0.50	0.40
1200	0.55	0.45	0.35	0.25
1500	0.45	0.35	0.25	0.15
1800	0.35	0.30	0.20	0.10



The graph plots Torque (Nm) on the y-axis (0.00 to 2.00) against Speed (RPM) on the x-axis (0 to 6,000). Four curves represent different DC voltages: 60 Vdc (red dashed), 48 Vdc (green dashed), 36 Vdc (blue solid), and 24 Vdc (black solid). All curves show a decreasing trend as speed increases. Higher Vdc results in higher torque.

Speed (RPM)	60 Vdc (Nm)	48 Vdc (Nm)	36 Vdc (Nm)	24 Vdc (Nm)
0	1.6	1.6	1.6	1.6
300	1.5	1.5	1.5	1.5
600	1.3	1.2	1.1	1.0
900	1.0	0.8	0.6	0.4
1200	0.8	0.6	0.4	0.3
1500	0.6	0.4	0.3	0.2
1800	0.4	0.3	0.2	0.15

MS24HS5P4200

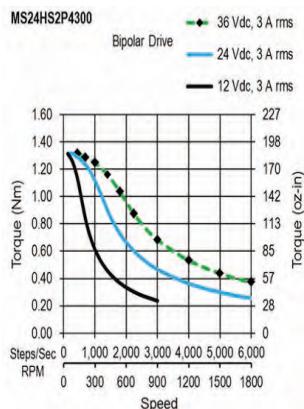
Bipolar Drive

Speed (RPM)	60 Vdc, 2 A rms (Nm)	48 Vdc, 2 A rms (Nm)	36 Vdc, 2 A rms (Nm)	24 Vdc, 2 A rms (Nm)
0	2.50	2.50	2.50	2.50
300	2.00	2.00	2.00	2.00
600	1.50	1.50	1.50	1.50
900	1.00	1.00	1.00	0.80
1200	0.80	0.80	0.70	0.50
1500	0.60	0.50	0.40	0.30
1800	0.50	0.40	0.30	0.20

The graph plots Torque (Nm) on the left y-axis (0.00 to 1.40) and Torque (oz-in) on the right y-axis (0 to 198) against Speed (RPM) on the x-axis (0 to 1800). Three curves represent different power levels at 3 A rms:

- 36 Vdc, 3 A rms** (green dashed line with diamond markers): The highest torque curve, starting at approximately 0.9 Nm at 0 RPM and decreasing to about 0.4 Nm at 6000 RPM.
- 24 Vdc, 3 A rms** (blue solid line with circle markers): The middle torque curve, starting at approximately 0.85 Nm at 0 RPM and decreasing to about 0.2 Nm at 6000 RPM.
- 12 Vdc, 3 A rms** (black solid line with square markers): The lowest torque curve, starting at approximately 0.85 Nm at 0 RPM and decreasing to about 0.1 Nm at 6000 RPM.

Speed (RPM)	36 Vdc, 3 A rms (Nm)	24 Vdc, 3 A rms (Nm)	12 Vdc, 3 A rms (Nm)
0	0.90	0.85	0.85
300	0.85	0.80	0.75
600	0.80	0.75	0.70
900	0.65	0.60	0.55
1200	0.50	0.45	0.40
1500	0.40	0.35	0.30
1800	0.35	0.30	0.25
2100	0.30	0.25	0.20
2400	0.25	0.20	0.15
2700	0.20	0.18	0.12
3000	0.18	0.15	0.10
3300	0.15	0.12	0.08
3600	0.12	0.10	0.06
3900	0.10	0.08	0.05
4200	0.08	0.06	0.04
4500	0.06	0.05	0.03
4800	0.05	0.04	0.02
5100	0.04	0.03	0.01
5400	0.03	0.02	0.005
5700	0.02	0.01	0.002
6000	0.01	0.005	0.001



Speed (RPM)	Torque (Nm) - 36 Vdc, 3 A rms	Torque (Nm) - 24 Vdc, 3 A rms	Torque (Nm) - 12 Vdc, 3 A rms
0	1.65	1.65	1.65
300	1.55	1.55	1.55
600	1.35	1.35	1.35
900	1.05	1.05	1.05
1200	0.85	0.85	0.85
1500	0.65	0.65	0.65
1800	0.55	0.55	0.55

Speed (RPM)	36 Vdc, 3 A rms (Nm)	24 Vdc, 3 A rms (Nm)	12 Vdc, 3 A rms (Nm)
0	2.3	2.3	2.3
300	2.0	1.8	1.5
600	1.5	1.2	0.9
900	1.0	0.8	0.6
1200	0.7	0.5	0.4
1500	0.5	0.4	0.3
1800	0.4	0.3	0.2

The graph plots Torque (N.m) on the y-axis (0.00 to 1.60) against Speed (RPM) on the x-axis (0 to 1800). Three curves represent different operating conditions:

- 36 Vdc, 3.5 A rms:** Represented by green diamonds. The curve starts at approximately 1.2 N.m at 200 RPM and decreases to about 0.4 N.m at 1800 RPM.
- 24 Vdc, 4.2 A rms:** Represented by blue circles. The curve starts at approximately 1.3 N.m at 200 RPM and decreases to about 0.3 N.m at 1800 RPM.
- 12 Vdc, 4.2 A rms:** Represented by black squares. The curve starts at approximately 1.2 N.m at 200 RPM and decreases to about 0.2 N.m at 1800 RPM.

The graph plots Torque (Nm) on the left y-axis (0.00 to 2.00) and Torque (oz-in) on the right y-axis (0 to 283) against Speed (RPM) on the x-axis (0 to 1800). Three curves represent different drive modes:

- 36 Vdc, 3.5 A rms**: Dashed green line, highest torque.
- 24 Vdc, 4.2 A rms**: Solid blue line, middle torque.
- 12 Vdc, 4.2 A rms**: Solid black line, lowest torque.

Speed (RPM)	36 Vdc (Nm)	24 Vdc (Nm)	12 Vdc (Nm)
0	1.5	1.5	1.5
300	1.4	1.3	1.4
600	1.2	0.9	1.2
900	1.0	0.7	0.9
1200	0.8	0.5	0.7
1500	0.6	0.4	0.5
1800	0.5	0.3	0.4

The graph plots Torque (Nm) on the left y-axis (0.00 to 2.50) and Torque (oz-in) on the right y-axis (0 to 354) against Speed (RPM) on the x-axis (0 to 6,000). Three curves are shown: a green curve for 36 Vdc, 3.5 A rms; a blue curve for 24 Vdc, 4.2 A rms; and a black curve for 12 Vdc, 4.2 A rms. The 36 Vdc curve has the highest torque at low speeds, while the 12 Vdc curve has the highest torque at higher speeds.

Speed (RPM)	36 Vdc, 3.5 A rms (Nm)	24 Vdc, 4.2 A rms (Nm)	12 Vdc, 4.2 A rms (Nm)
0	2.00	2.30	2.30
300	1.90	1.80	1.70
600	1.70	1.40	1.30
900	1.40	1.10	1.00
1200	1.00	0.80	0.70
1500	0.70	0.55	0.50
1800	0.55	0.45	0.40

ML34HD / PL34HD Series: 1.8° - Size 34



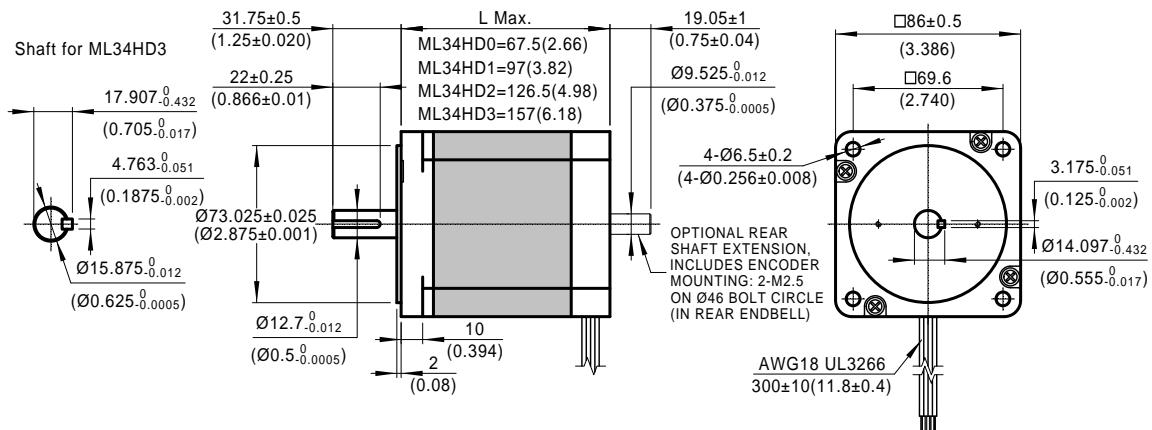
- Phases 2
- Steps / Revolution 200
- Step Accuracy ±5%
- Shaft Load (20,000 Hours at 1000 RPM)
 - Axial 65 N (15 Lbs.) Push
 - Radial 155 N (35 Lbs.) Pull
 - 220 N (50 Lbs.) At Flat Center
- IP Rating 40
- Approvals UL Recognized File E465363, RoHS
- Operating Temp. -20°C to +50°C
- Insulation Class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

M L34HD 0 L 8 350 -E

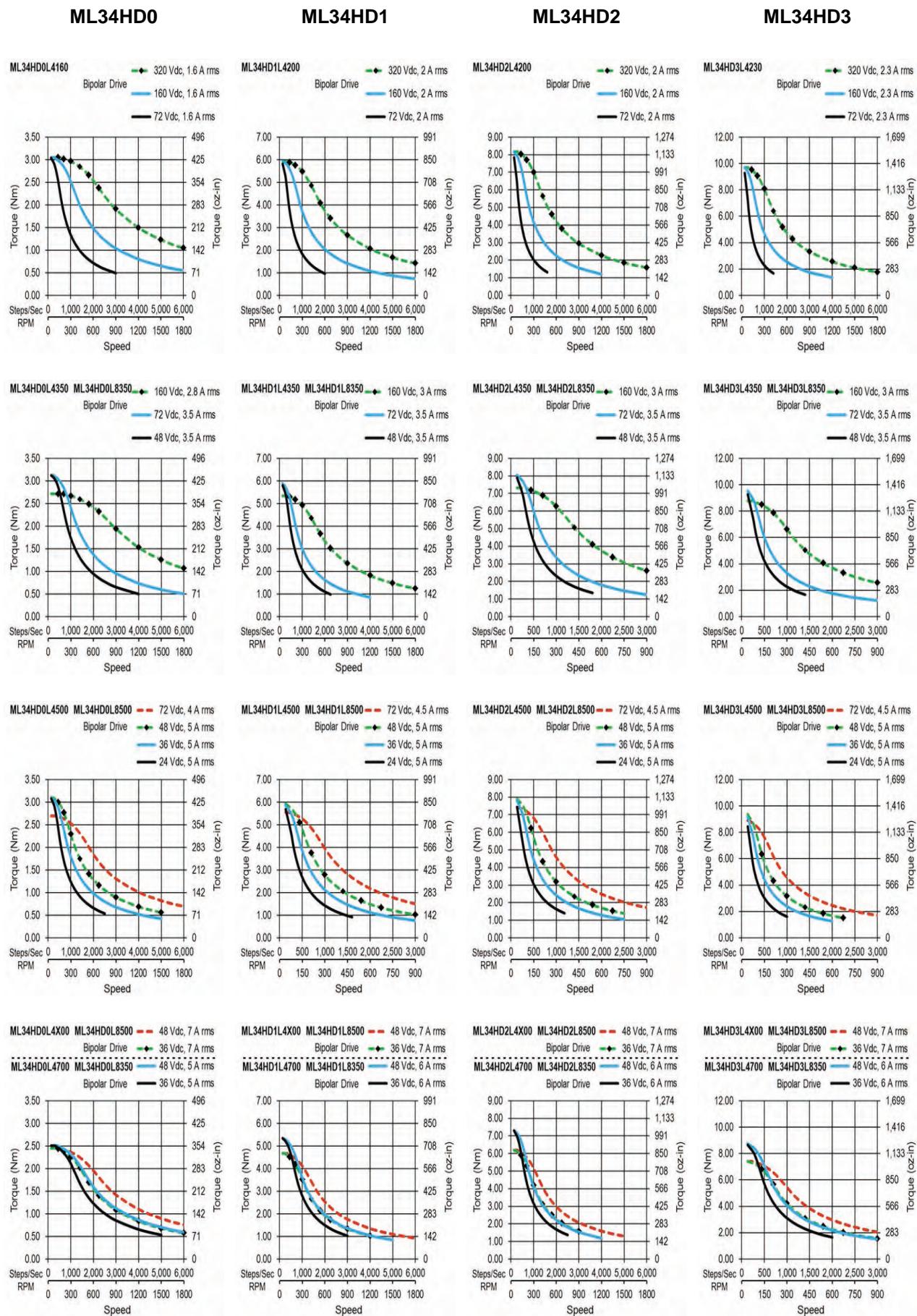
Motor Technology		Options	
M High Torque Step Motor		Omit No Options	
P PowerPlus Step Motor		-E 0.375 inch Diameter Rear Shaft with Encoder Mounting Holes	
Basic Motor Length (Max)		Winding	
0 67mm (2.64 in.)		### Current rating x 100	
1 97mm (3.82 in.)		X## for 11 to 19 amps:	
2 126mm (4.96 in.)		X10= 11 amps, X40 = 14 amps	
3 157mm (6.18 in.)		Number of Connections	
L Leads		4 4 Lead-Bipolar	
8 8 Lead-Unipolar(or Bipolar)			

ML34HD – 4 Lead & 8 Lead

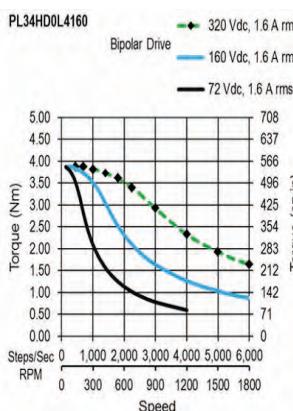
Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms mH		Detent Torque	Rotor Inertia	Motor Weight
				P=Plug	L=Leads	Amps (mounted)	Nm Typ.	oz-in TYP.	±10% @20 C	Typ.
67 mm (2.64 in.) 1 Stack	^ ML34HD0L4160	L	1.6	3.70	520	3.9	42	90 13	940 5.1	1.6 3.5
	ML34HD0L4350	L	3.5	3.80	540	0.95	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	0.138	1.13			
97 mm (3.82 in.) 2 Stack	^ ML34HD1L4200	L	2	7.20	1,000	3.6	50	150 21	1570 8.6	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	0.188	2			
126 mm (4.96 in.) 3 Stack	^ ML34HD2L4200	L	2	10.00	1,400	4.1	63	200 28	2340 13	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	5			
	ML34HD2L4X00	L	10	9.80	1,400	0.22	2.3			
157 mm (6.18 in.) 4 Stack	^ ML34HD3L4230	L	2.3	11.90	1,700	3.9	58	250 35	3110 17	4.9 11
	ML34HD3L4350	L	3.5	11.90	1,700	1.81	25			
	ML34HD3L4500	L	5	11.70	1,700	0.9	11.7			
	ML34HD3L4700	L	7	11.90	1,700	0.47	6.3			
	ML34HD3L4X00	L	10	11.70	1,700	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	940 5.1	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	1570 8.6	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	2340 13	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	11.90 11.90	1,700 1,700	1.85 0.46	25 6.3	250 35	3110 17	4.9 11
	ML34HD3L8500	L Series L Parallel	5 10	11.70 11.70	1,700 1,700	0.92 0.23	11.7 2.9			

Dimensions: mm (in)**PL34HD – PowerPlus – 4 Lead & 8 Lead**

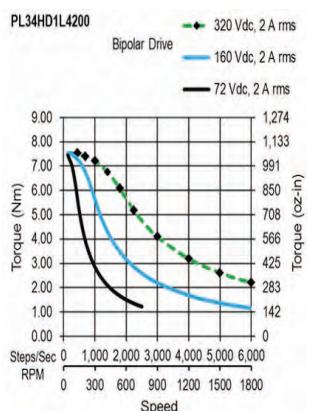
Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms mH		Detent Torque		Rotor Inertia		Motor Weight	
				P=Plug	L=Leads	Amps (mounted)	Nm Typ.	oz-in TYP.	±10% @20 C	Typ.	mNm	oz-in	g cm ²
67 mm (2.64 in.) 1 Stack	^ PL34HD0L4160	L	1.6	4.70	670	3.9	33	135	19	940	5.1	1.6	3.5
	PL34HD0L4350	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	225	32	1570	8.6	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	12.70	1,800	4.1	51	300	42	2340	13	3.8	8.4
	PL34HD2L4350	L	3.5	12.38	1,800	1.44	16.1						
	PL34HD2L4500	L	5	12.25	1,700	0.72	7.5						
	PL34HD2L4700	L	7	12.38	1,800	0.38	4						
	PL34HD2L4X00	L	10	12.25	1,700	0.22	1.87						
157 mm (6.18 in.) 4 Stack	^ PL34HD3L4230	L	2.3	15.00	2,100	3.9	47	375	53	3110	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 L Parallel	3.5 7	4.75 4.75	670 670	0.98 0.25	7.6 1.89	135	19	940	5.1	1.6	3.5
	^ PL34HD0L8500	L Series L Parallel	5 10	4.75 4.75	670 670	0.5 0.126	3.6 0.91						
97 mm (3.82 in.) 2 Stack	^ PL34HD1L8350	L Series L Parallel	3.5 7	9.00 9.00	1,300 1,300	1.37 0.34	12.8 3.2	225	32	1570	8.6	2.7	6
	^ PL34HD1L8500	L Series L Parallel	5 10	9.00 9.00	1,300 1,300	0.71 0.177	6.4 1.6						
126 mm (4.96 in.) 3 Stack	^ PL34HD2L8350	L Series L Parallel	3.5 7	12.38 12.38	1,800 1,800	1.48 0.37	16.1 4	300	42	2340	13	3.8	8.4
	^ PL34HD2L8500	L Series L Parallel	5 10	12.25 12.25	1,700 1,700	0.82 0.21	7.5 1.87						
157 mm (6.18 in.) 4 Stack	^ PL34HD3L8350	L Series L Parallel	3.5 7	15.00 15.00	2,100 2,100	1.85 0.46	20 5	375	53	3110	17	4.9	11
	^ PL34HD3L8500	L Series L Parallel	5 10	15.00 15.00	2,100 2,100	0.92 0.23	9.4 2.3						



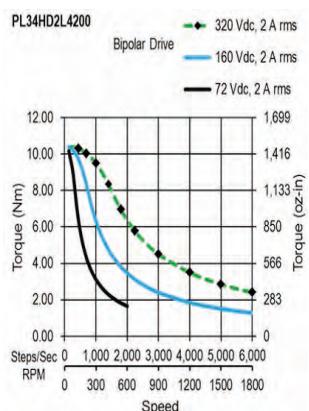
PL34HD0



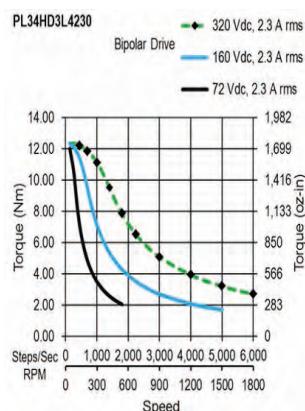
PL34HD1



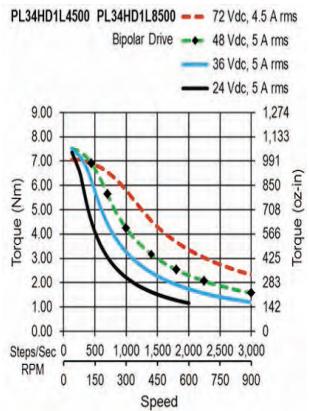
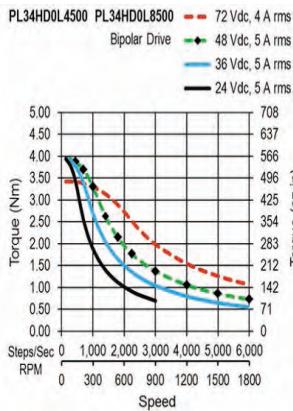
PL34HD2



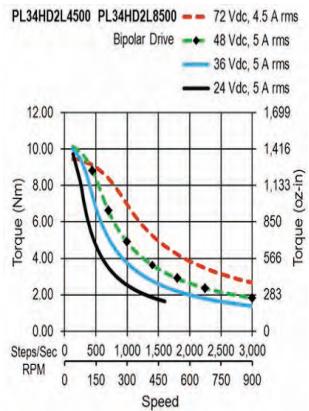
PL34HD3



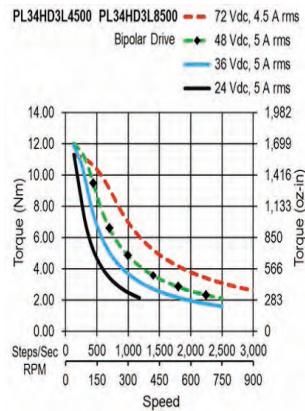
Speed (RPM)	Torque (Nm) - PL34HD0L4350	Torque (oz-in) - PL34HD0L4350	Torque (Nm) - PL34HD0L8350	Torque (oz-in) - PL34HD0L8350
0	3.5	496	3.5	425
300	3.5	496	3.2	425
600	3.2	463	2.8	354
900	2.8	425	2.2	308
1200	2.2	354	1.8	238
1500	1.8	308	1.4	191
1800	1.5	250	1.0	142
2100	1.2	212	0.8	104
2400	1.0	174	0.6	85
2700	0.8	142	0.4	63
3000	0.6	114	0.3	42
3300	0.4	85	0.2	21
3600	0.3	63	0.15	10
4500	0.15	21	0.05	4
5400	0.05	4	0.02	1



Speed (RPM)	Torque (Nm) - 160 Vdc (3 A rms)	Torque (Nm) - 72 Vdc (3.5 A rms)	Torque (Nm) - 48 Vdc (3.5 A rms)
0	10.0	10.0	10.0
300	8.5	8.0	7.5
600	6.5	5.5	4.5
900	4.5	3.5	3.0
1200	3.0	2.0	1.5
1500	2.0	1.0	-
1800	2.0	-	-

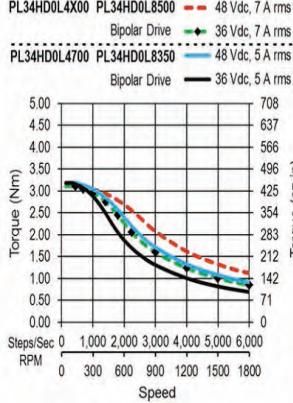


Speed (RPM)	Torque (Nm) - 16Vdc	Torque (Nm) - 72Vdc	Torque (Nm) - 48Vdc
0	12.0	12.0	12.0
150	11.0	10.5	10.0
300	9.5	8.5	7.5
450	7.5	6.5	5.5
600	6.0	5.0	4.0
750	4.5	3.5	3.0
900	4.0	3.0	2.5

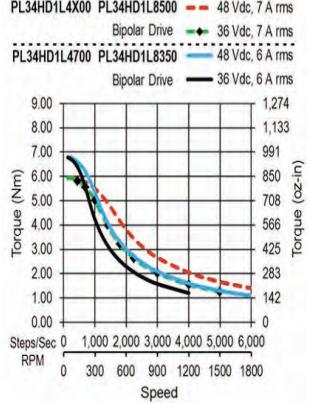


Detailed description: This is a line graph comparing the torque characteristics of four different motor models. The Y-axis represents Torque in Nm, ranging from 0.00 to 5.00. The X-axis represents RPM, ranging from 0 to 6,000. There are two main sets of curves for each model, corresponding to different power ratings. The first set (red dashed line for PL34HD0L4X00, green dashed line for PL34HD0L8500) represents 48Vdc, 7A rms operation. The second set (black solid line for PL34HD0L4700, blue solid line for PL34HD0L8350) represents 36Vdc, 7A rms operation. The 48Vdc curves show higher torque at lower speeds compared to their 36Vdc counterparts. The PL34HD0L4X00 and PL34HD0L8500 models have very similar performance, while the PL34HD0L4700 and PL34HD0L8350 models also show very similar results.

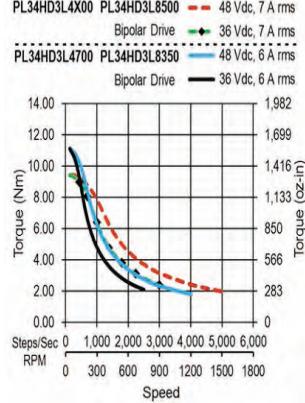
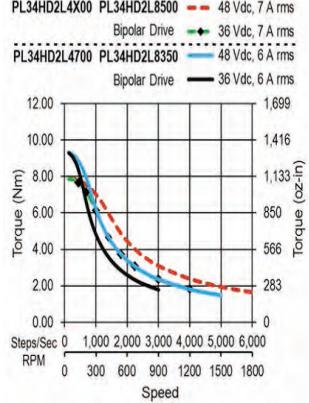
RPM	PL34HD0L4X00 (48Vdc, 7A rms)	PL34HD0L8500 (48Vdc, 7A rms)	PL34HD0L4700 (36Vdc, 7A rms)	PL34HD0L8350 (36Vdc, 7A rms)
0	3.0	3.0	3.0	3.0
300	2.8	2.8	2.8	2.8
600	2.4	2.4	2.4	2.4
900	1.8	1.8	1.8	1.8
1200	1.4	1.4	1.4	1.4
1500	1.0	1.0	1.0	1.0
1800	0.7	0.7	0.7	0.7



Speed (RPM)	PL34H1L4000 (Nm)	PL34H1L8500 (Nm)	PL34H1L4700 (Nm)	PL34H1L8350 (Nm)
0	0.0	0.0	0.0	0.0
300	6.0	6.0	6.0	6.0
600	4.0	4.0	4.0	4.0
900	2.5	2.5	2.5	2.5
1200	1.8	1.8	1.8	1.8
1500	1.4	1.4	1.4	1.4
1800	1.1	1.1	1.1	1.1



Speed (RPM)	PL34HDLX00 (Nm)	PL34HDL8500 (Nm)	PL34HDL4700 (Nm)	PL34HDL8350 (Nm)
0	10.0	10.0	9.0	9.0
300	8.0	8.0	7.5	7.5
600	6.0	6.0	5.5	5.5
900	4.5	4.5	4.0	4.0
1200	3.5	3.5	3.0	3.0
1500	2.5	2.5	2.0	2.0
1800	2.0	2.0	1.5	1.5



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

Winding

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

Number of Connections

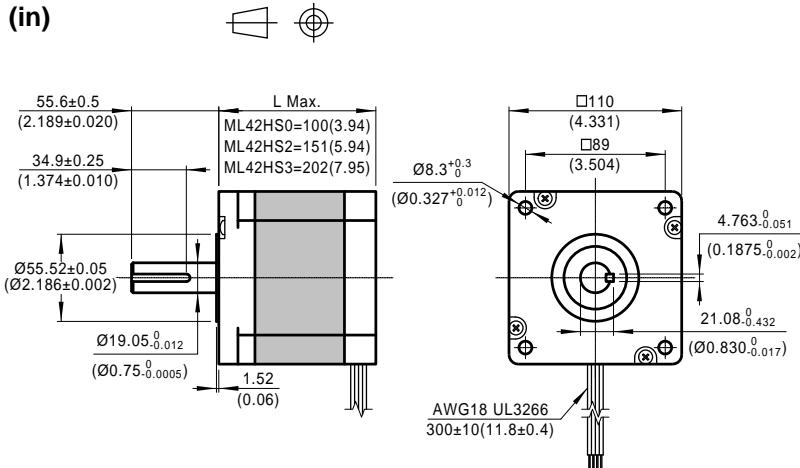
4 4 Lead-Bipolar

ML42HS – 4 Lead & 8 Lead

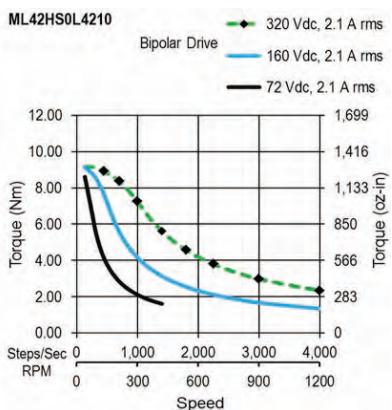
Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms mH		Detent Torque	Rotor Inertia	Motor Weight				
				P=Plug	L=Leads	Amps (mounted)	Nm Typ.	oz-in TYP.	±10% @20°C	Typ.	mNm oz-in	g cm²	oz-in²	kg Lbs
3 Phase Step Motors	100 mm (3.94 in.) 1 Stack	^ ML42HS0L4210 ML42HS0L4420 ML42HS0L4600 ML42HS0L4840 ML42HS0L4X20	L L L L L	2.1 4.2 6 8.4 12	12.10 12.20 12.30 12.20 12.30	1,700 1,700 1,700 1,700 1,700	4.1 1.16 0.61 0.31 0.167	78 19.8 10.1 5 2.5	300 42	5500 30	5 11			
Technical	151 mm (5.94 in.) 2 Stack	^ ML42HS2L4240 ML42HS2L4600 ML42HS2L4800 ML42HS2L4X20 ML42HS2L4X60	L L L L L	2.4 6 8 12 16	22.00 22.00 22.00 22.00 22.00	3,100 3,100 3,100 3,100 3,100	4.2 0.75 0.41 0.177 0.116	90 14.5 8.5 3.6 2.1	600 85	10900 60	8.3 18			
	202 mm (7.95 in.) 3 Stack	^ ML42HS3L4270 ML42HS3L4600 ML42HS3L4800 ML42HS3L4X20 ML42HS3L4X60	L L L L L	2.7 6 8 12 16	31.00 31.00 32.00 31.00 32.00	4,400 4,400 4,500 4,400 4,500	4.2 1.02 0.55 0.24 0.152	100 22 13 5.5 3.2	800 110	16200 89	11.6 26			
	100 mm (3.94 in.) 1 Stack	^ PL34HD0L8350	L Series L Parallel	4.2 8.4	12.20 12.20	1,700 1,700	1.19 0.3	19.8 5	300 42	5500 30	5 11			
		^ PL34HD0L8500	L Series L Parallel	6 12	12.30 12.30	1,700 1,700	0.64 0.159	10.1 2.5						
		^ PL34HD1L8350	L Series L Parallel	6 12	22.00 22.00	3,100 3,100	0.68 0.17	14.5 3.6	600 85	10900 60	8.3 18			
	151 mm (5.94 in.) 2 Stack	^ PL34HD1L8500	L Series L Parallel	8 16	22.00 22.00	3,100 3,100	0.43 0.108	8.5 2.1						
		^ PL34HD2L8350	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			
		^ PL34HD2L8500	L Series L Parallel	8 16	32.00 32.00	4,500 4,500	0.58 0.144	13 3.2						

^ Preferred model

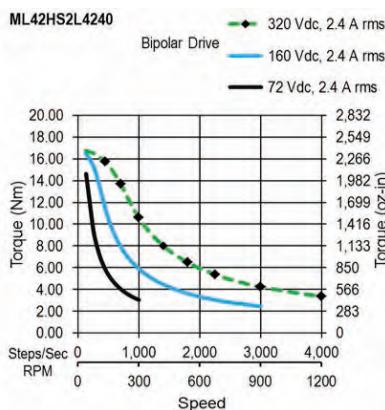
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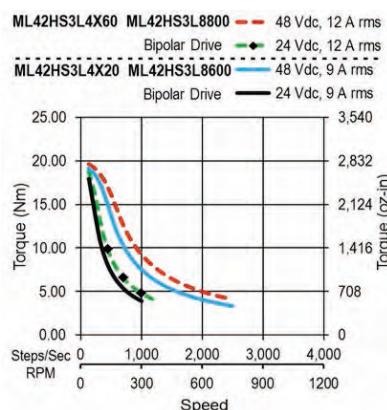
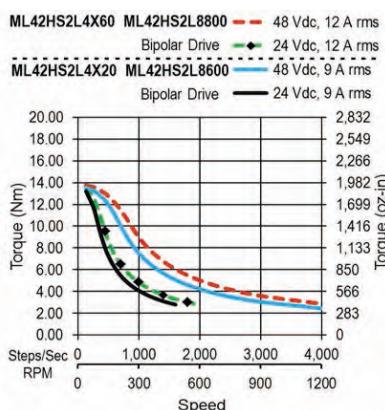
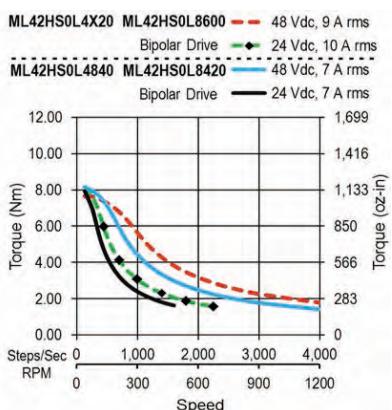
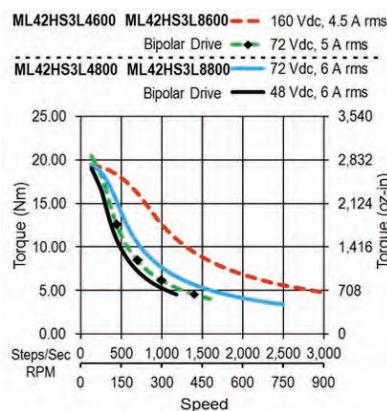
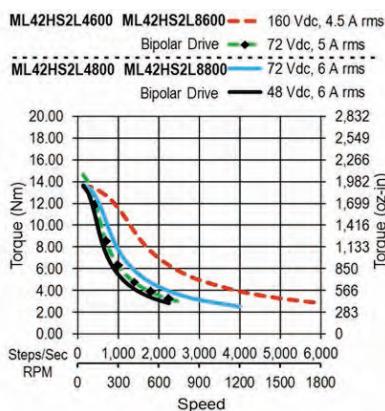
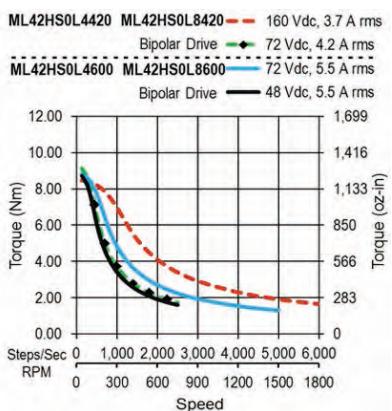
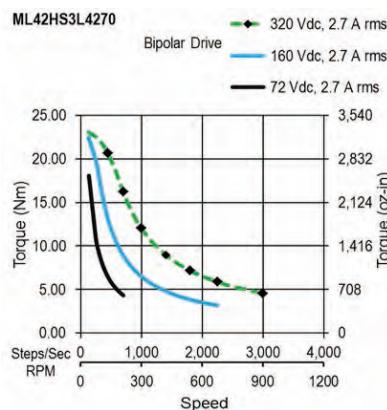
ML42HS0



ML42HS2



ML42HS3



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



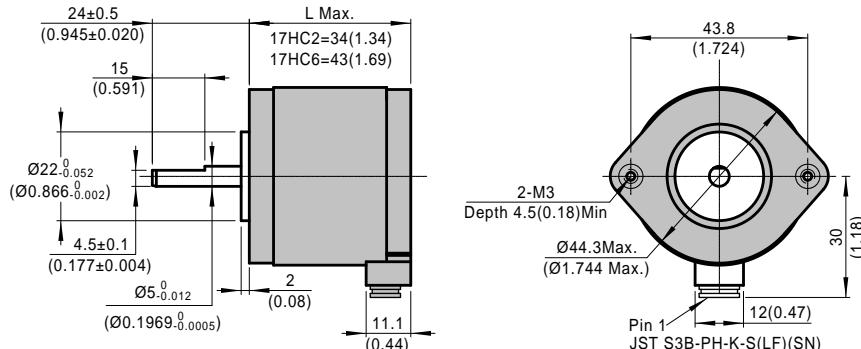
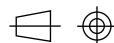
• Phases	3
• Steps / Revolution	300
• Step Accuracy	±5%
• Shaft Load (20,000 Hours at 1000 RPM)	
Axial	25 N (5.6 Lbs.) Push
Radial	65 N (15 Lbs.) Pull
	29 N (6.5 Lbs.) At Flat Center
• IP Rating	40
• Approvals	RoHS
• Operating Temp.	-20°C to +50°C
• Insulation Class	B, 130°C
• Insulation Resistance	100 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.	±10% @20°C	Typ.	mNm	oz-in	g cm²	oz-in²	kg	Lbs
34 mm (1.34 in.)	^ 17HC2005N	P	0.8	0.36	51	11	16.5	14	2	57	0.31	0.245	0.54
	^ 17HC2006N	P	1.5	0.36	51	3.7	5.5						
	^ 17HC2002N	P	2.3	0.36	51	1.74	2.3						
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	4.6	6.5						
	^ 17HC6005N	P	2.3	0.46	65	1.93	2.7						

^ Preferred model

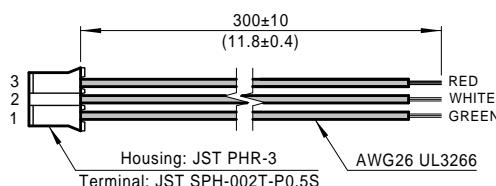
Dimensions: mm (in)



Mating Connector With Leads (order separately)

Dimensions: mm (in)

3 Lead Part Number 4634 1402 04496

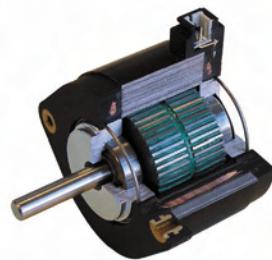


MOONS' 17HC, 3 phase step motors, offer numerous advantages:

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

Molded Stator

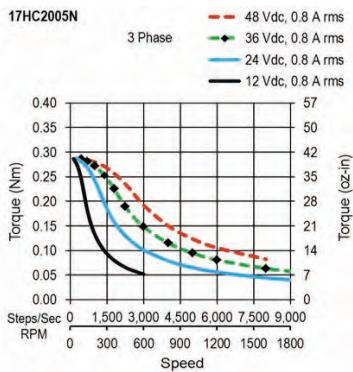
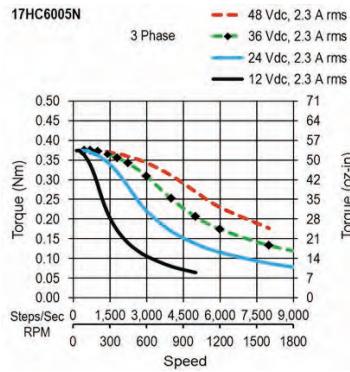
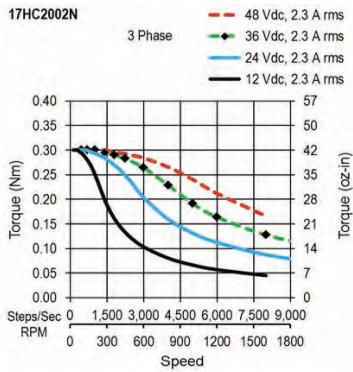
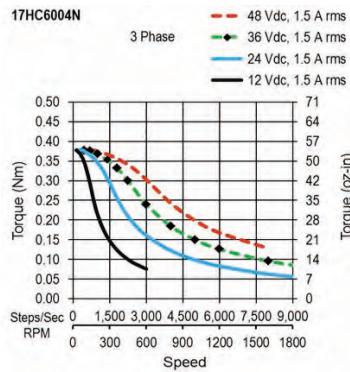
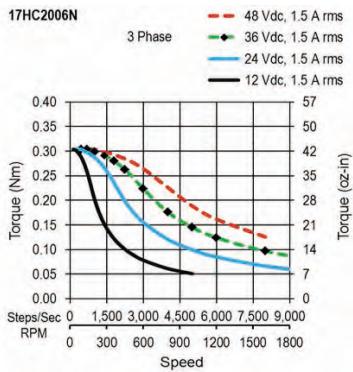
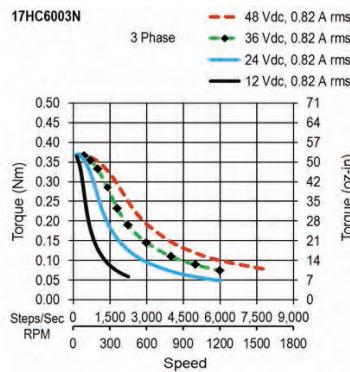
Encapsulated winding >>> Runs cooler – Longer life
 Better sealing >>> Longer life
 Reduced vibration >>> Smoother moves – Quieter

**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

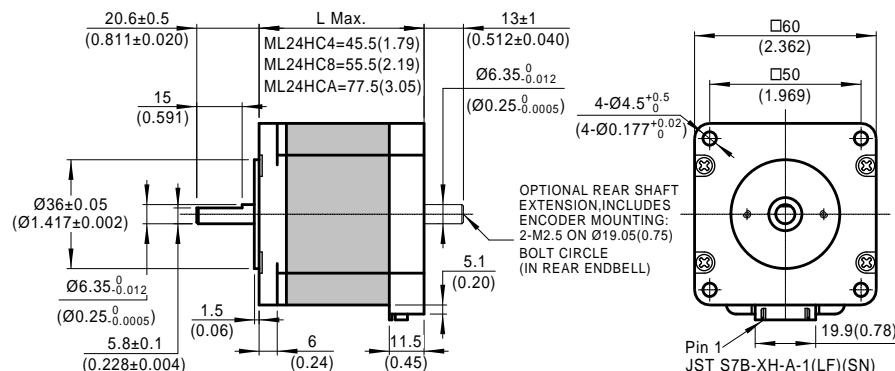
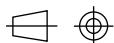


- Phases 3
- Steps / Revolution 300
- Step Accuracy ±5%
- Shaft Load (20,000 Hours at 1000 RPM)
 - Axial 40 N (9 Lbs.) Push
 - Radial 130 N (30 Lbs.) Pull
 - 70 N (15.5 Lbs.) At Flat Center
- IP Rating 40
- Approvals RoHS
- Operating Temp. -20°C to +50°C
- Insulation Class B, 130°C
- Insulation Resistance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

M L24HC 4 P 3 150 -E

Motor Technology	M High Torque Step Motor	Options
P PowerPlus Step Motor		Omit No Options
Basic Motor Length (Max)		-E 0.25 inch Diameter Rear Shaft with Encoder Mounting Holes
4 45mm (1.77 in.)		
8 55mm (2.17 in.)	1 Stack	
A 77mm (3.03 in.)	2 Stack	
Electrical Connection		Winding
L Leads		### Current rating x 100
P Plug-In Connector		
		Number of Connections
		3 3 Lead-Bipolar

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.	±10% @20°C	Typ.	mNm	oz-in	g cm² oz-in²	kg Lbs	
45 mm (1.77 in.)	^ ML24HC4P3150 ^ ML24HC4P3230 ^ ML24HC4L3410	P P L	1.5 2.3 4.1	0.72 0.72 0.72	100 100 100	4.8 2.1 0.7	8.9 3.8 1.2	28	4	159	0.87	0.65 1.4
55 mm (2.17 in.) 1 Stack	^ ML24HC8P3150 ^ ML24HC8P3220 ^ ML24HC8L3350 ^ ML24HC8L3550	P P L L	1.5 2.2 3.5 5.5	0.97 0.97 0.97 0.97	140 140 140 140	6 2.7 1.09 0.46	15.1 6.9 2.7 1.1	45	6.4	221	1.2	0.85 1.9
77 mm (3.03 in.) 2 Stack	^ ML24HCAP3150 ^ ML24HCAP3220 ^ ML24HCAL3340 ^ ML24HCAL3550	P P L L	1.5 2.2 3.4 5.5	1.70 1.70 1.70 1.70	240 240 240 240	7.3 3.6 1.49 0.61	19.6 9.3 3.7 1.5	75	11	391	2.1	1.35 3

^ Preferred model

PL24HC - PowerPlus – 3 Phase

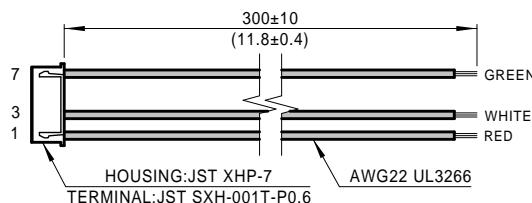
Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms	mH	Detent Torque	Rotor Inertia	Motor Weight		
	Single Shaft	P=Plug L=Leads	Amps (mounted)	Nm Typ.	oz-in TYP.	±10% @20°C	Typ.	mNm	oz-in	g cm² oz-in²	kg Lbs	
45 mm (1.77 in.)	^ PL24HC4P3150 ^ PL24HC4P3230 ^ PL24HC4L3410	P P L	1.5 2.3 4.1	0.87 0.87 0.87	120 120 120	4.8 2.1 0.67	7 3 0.94	55	7.8	159	0.87	0.73 1.6
55 mm (2.17 in.) 1 Stack	^ PL24HC8P3150 ^ PL24HC8P3220 ^ PL24HC8L3350 ^ PL24HC8L3550	P P L L	1.5 2.2 3.5 5.5	1.40 1.40 1.40 1.40	200 200 200 200	6 2.7 1.09 0.46	12.2 5.5 2.2 0.9	90	13	221	1.2	0.93 2.1
77 mm (3.03 in.) 2 Stack	^ PL24HCAP3150 ^ PL24HCAP3220 ^ PL24HCAL3340 ^ PL24HCAL3550	P P L L	1.5 2.2 3.4 5.5	2.30 2.30 2.30 2.30	330 330 330 330	7.3 3.6 1.49 0.61	15.7 7.4 3 1.15	150	21	391	2.1	1.45 3.2

^ Preferred model

Mating Connector With Leads (order separately)

Dimensions: mm (in)

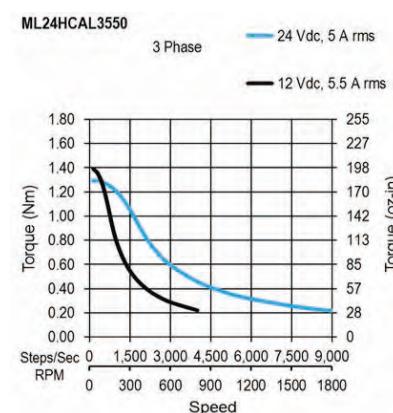
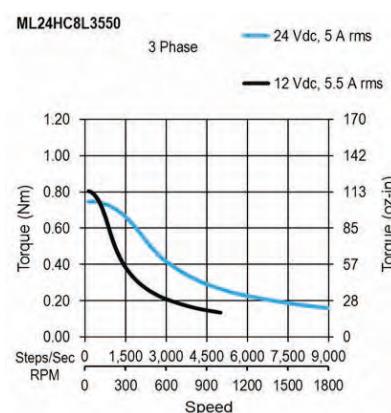
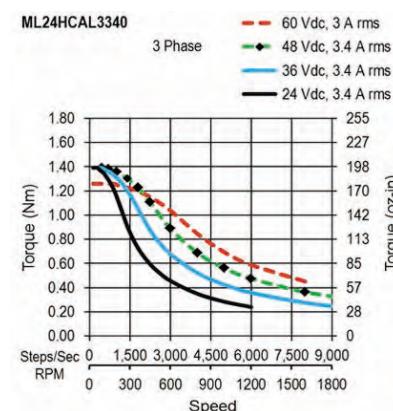
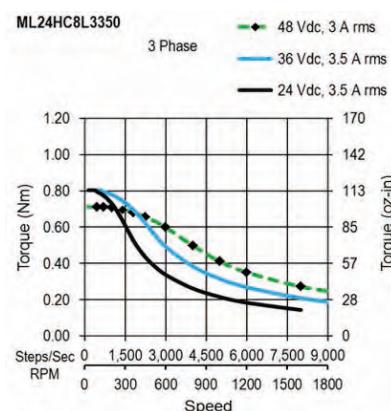
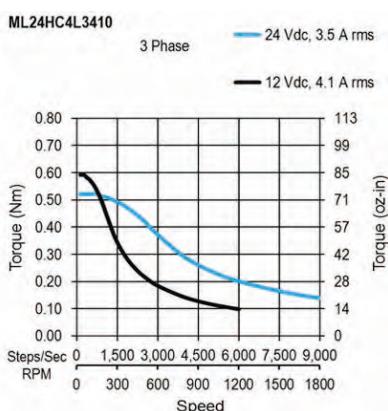
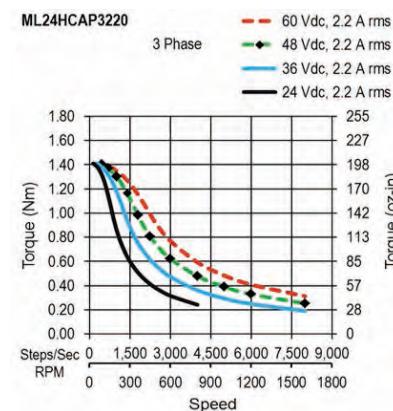
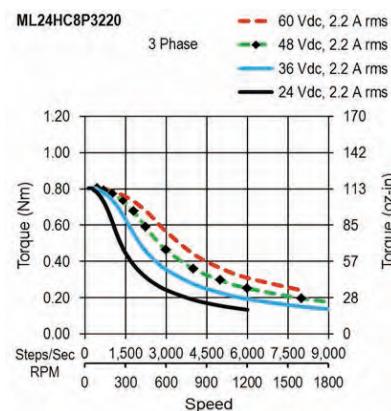
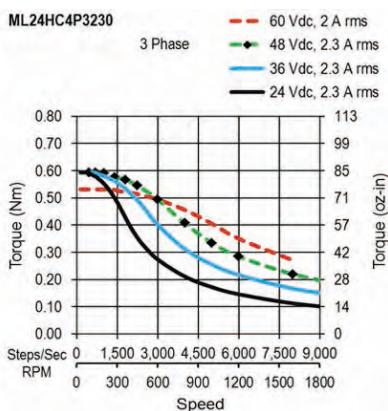
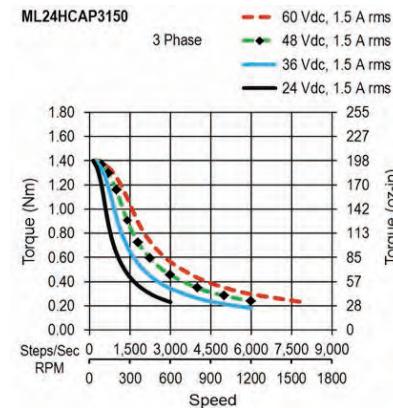
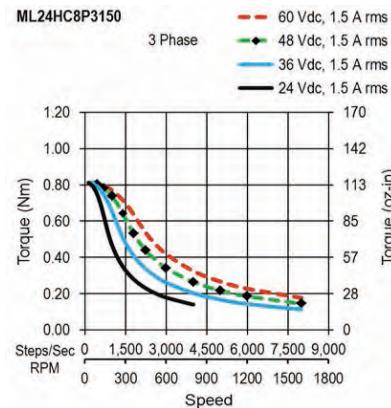
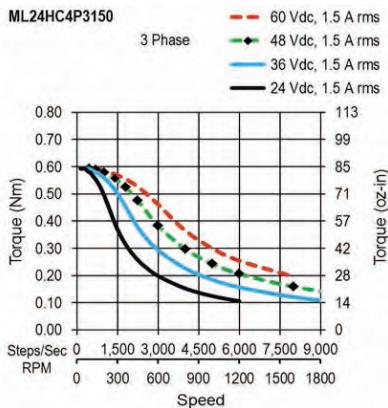
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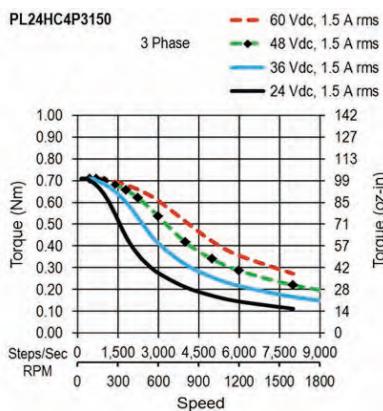
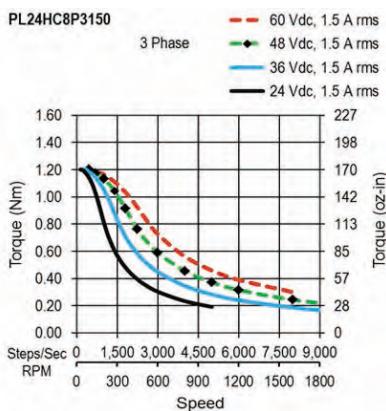
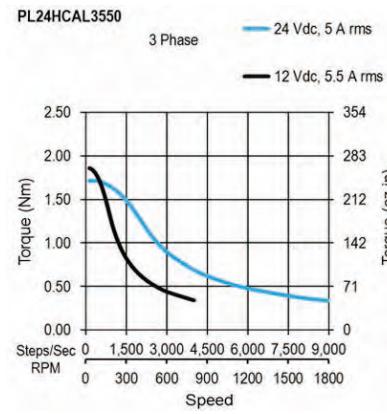
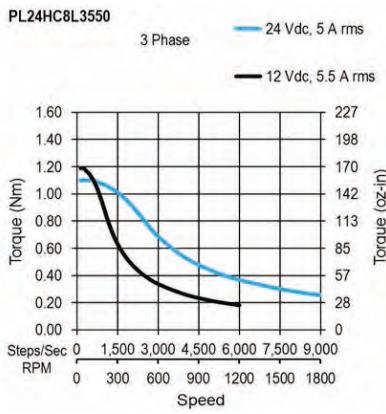
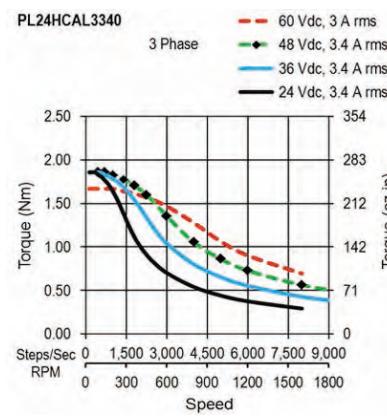
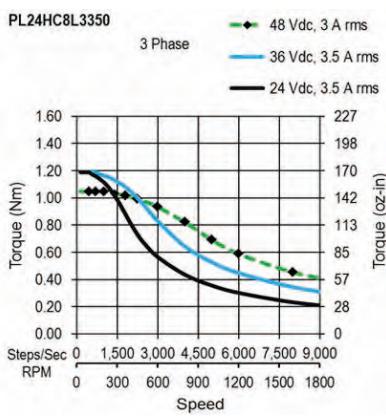
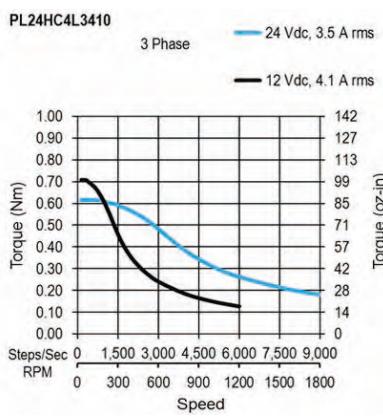
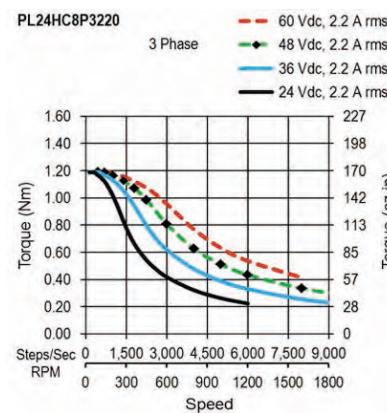
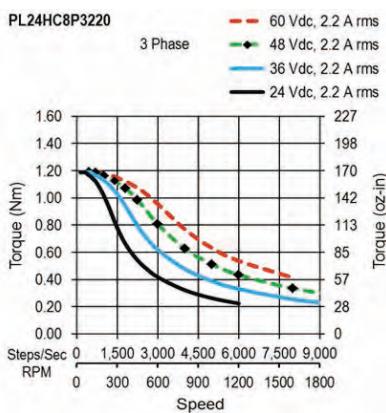
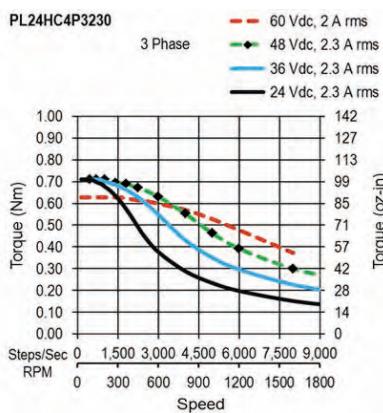
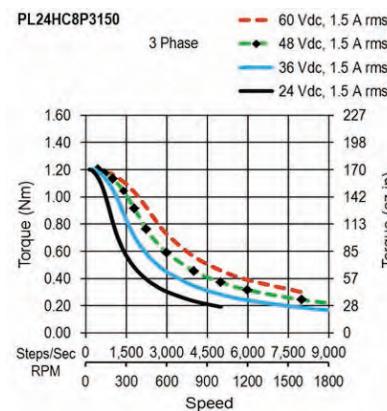


2 Phase Step Motors

3 Phase Step Motors

Technical

ML24HC4**ML24HC8****ML24HCA**

PowerPlus PL24HC4**PowerPlus PL24HC8****PowerPlus PL24HCA**

34HC Series: 1.2° - Size 34, 3 Phase



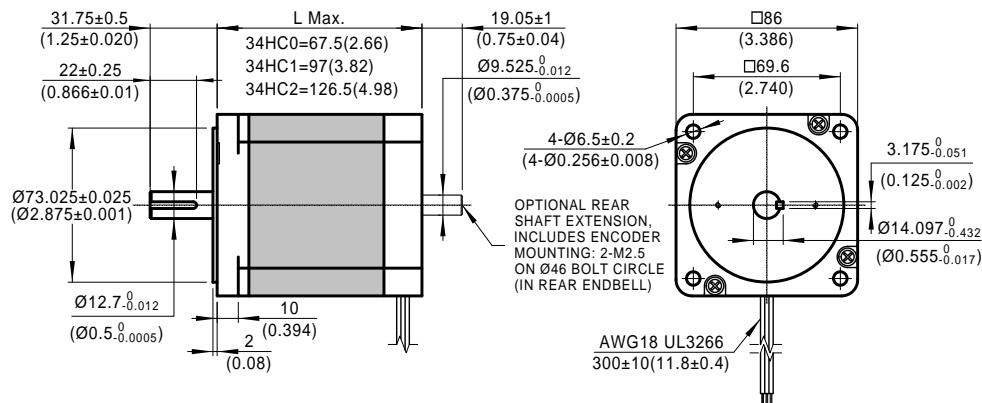
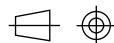
• Phases	3
• Steps / Revolution	300
• Step Accuracy	±5%
• Shaft Load (20,000 Hours at 1000 RPM)	
Axial	65 N (15 Lbs.) Push 155 N (35 Lbs.) Pull 220 N (50 Lbs.) At Flat Center
Radial	
• IP Rating	40
• Approvals	RoHS
• Operating Temp.	-20°C to +50°C
• Insulation Class	B, 130°C
• Insulation Resistance	100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

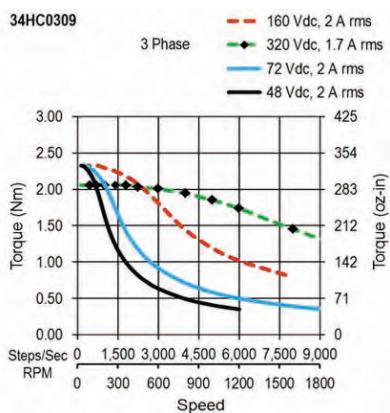
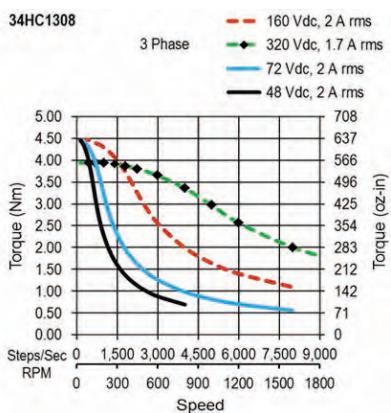
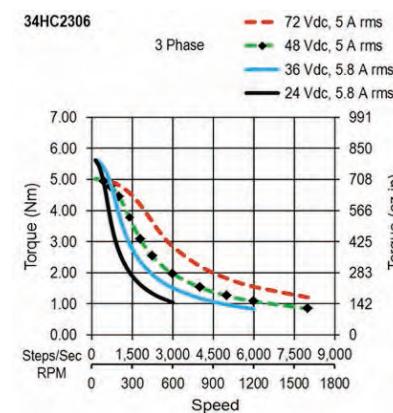
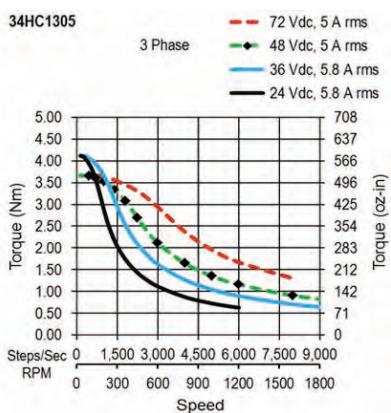
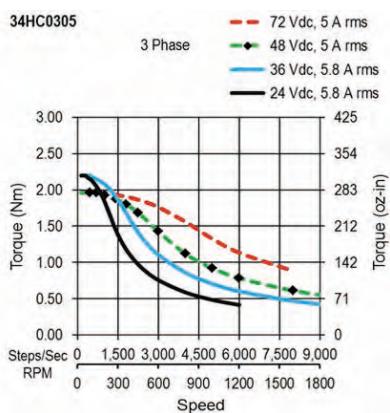
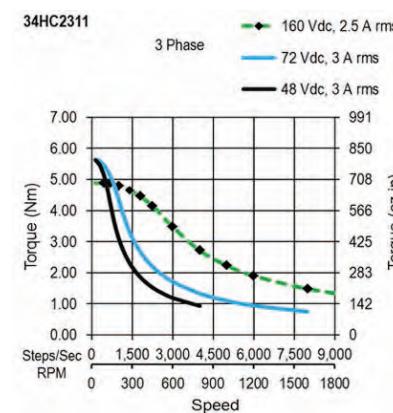
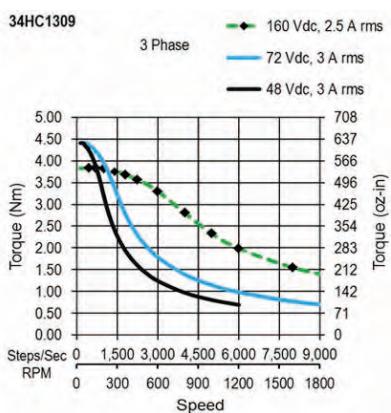
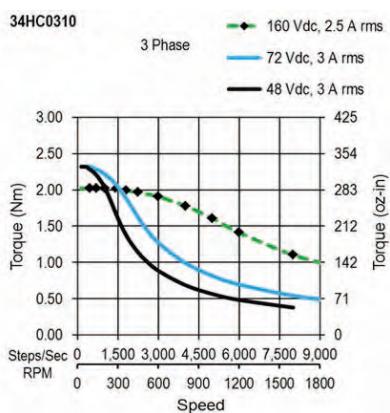
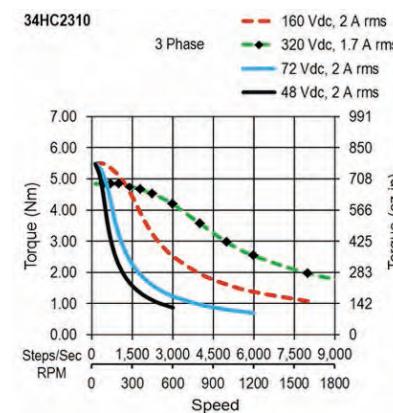
34HC - 3 Phase

Length	Model Number	Connect	Rated Current	Holding Torque		Winding Ohms mH	Detent Torque	Rotor Inertia	Motor Weight
				Nm Typ.	oz-in TYP.				
67 mm (2.64 in.) 1 Stack	^ 34HC0309	L	2	2.80	400	5	19.1	100 14	1100 6
	^ 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
	^ 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
	^ 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 – Applications

• 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, conveyors, 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

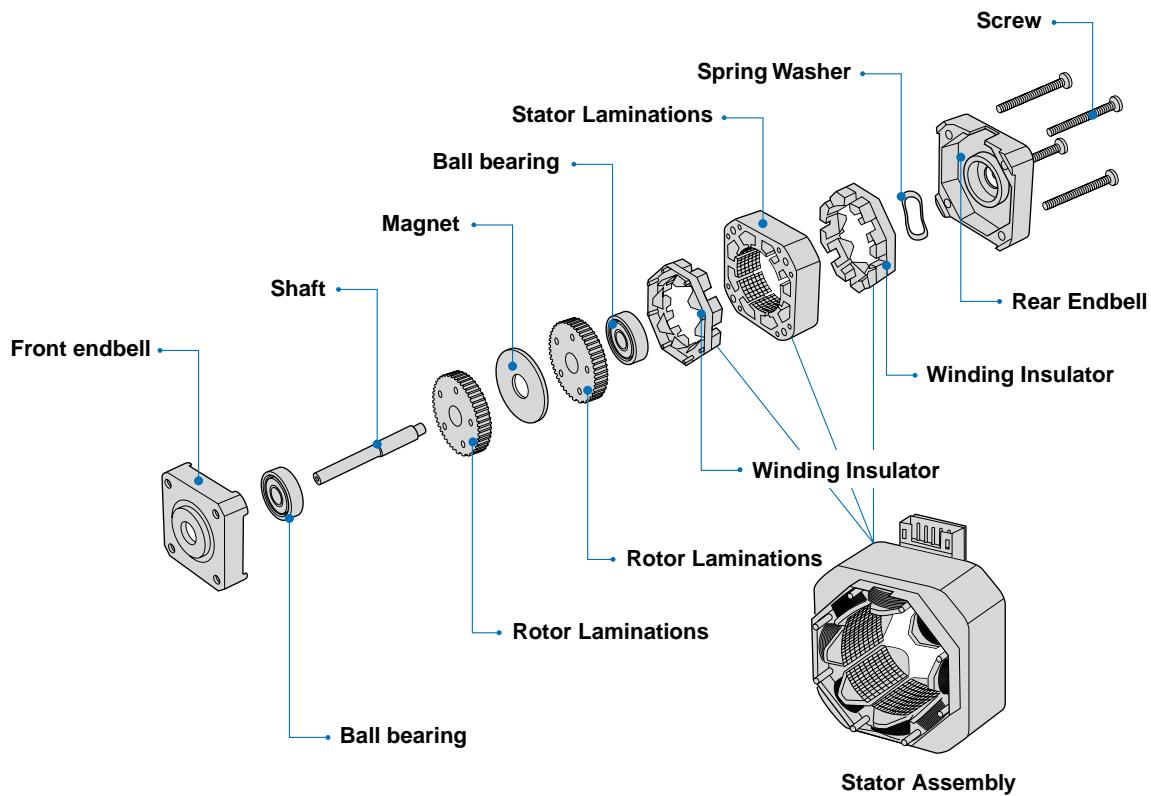
Step motors produce a large amount of torque, and are easy to control, at low speeds. This often eliminates the need for speed reduction gearboxes, reduces costs and saves space.

- 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.

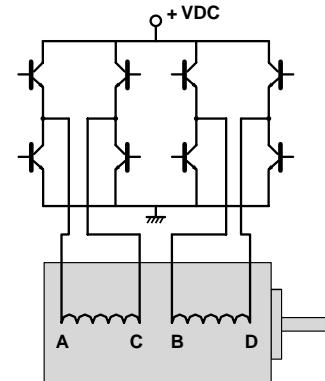
Step Motor Basics – Structure & Operation

- Basic Structure

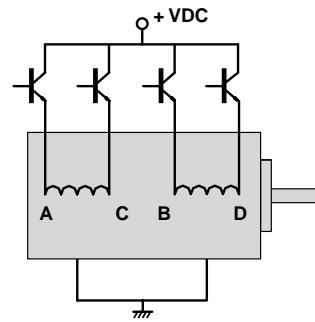


- Operating Principles**

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

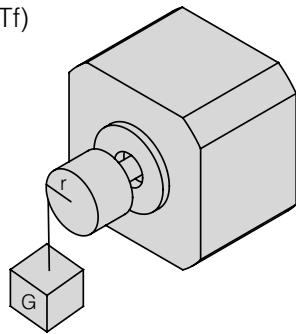
Load Calculations & Tips for Using Step Motors

- Load Calculations

Torque load (T_f)

$$T_f = G * r$$

G: weight
r: radius

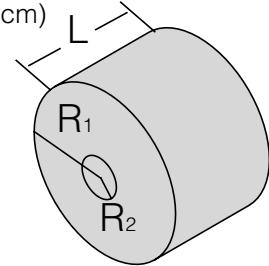


Inertia load (T_J)

$$T_J = J * dw/dt$$

$$J = M * (R_{12} + R_{22}) / 2 \text{ (Kg * cm)}$$

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.

$$n = q * \text{Hz} / (360 * D)$$

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 1/2 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.

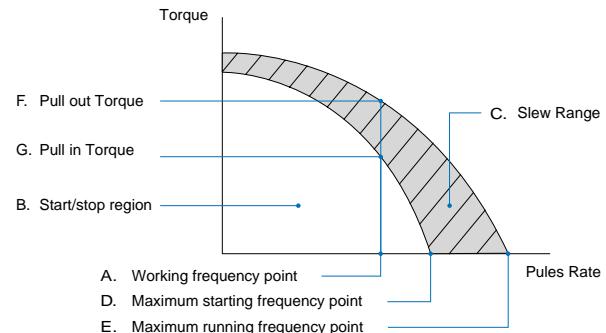
C. Slew Range: the motor cannot be started directly in this area. It must be started in the start/stop region first and then accelerated to this area. In this area, the motor can not be directly stopped, either. Otherwise this will lead to losing-step. The motor must be decelerated back to the start/stop 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 needed 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 T_L , it has to be accelerated from F_0 to F_1 in the shortest time (t_r), what is the value of t_r ?

- (1). Generally $T_J = 70\%T_m$
- (2). $t_r = 1.8 * 10^{-5} * J * q * (F_1 - F_0) / (T_J - T_L)$
- (3). $F(t) = (F_1 - F_0) * t/t_r + F_0, 0 < t < t_r$

B. Exponential Acceleration

- (1). Generally

$$T_{J0} = 70\%T_{m0}$$

$$T_{J1} = 70\%T_{m1}$$

$$T_L = 60\%T_{m1}$$

$$(2). t_r = F_4 * \ln [(T_{J0} - T_L) / (T_{J1} - T_L)]$$

$$(3). F(t) = F_2 * [1 - e^{(-t/F_4)}] + F_0, 0 < t < t_r$$

$$F_2 = (T_L - T_{J0}) * (F_1 - F_0) / (F_1 - T_{J0})$$

$$F_4 = 1.8 * 10^{-5} * J * q * F_2 / (T_{J0} - T_L)$$

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.

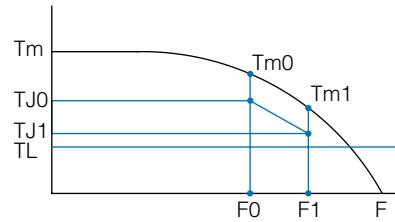
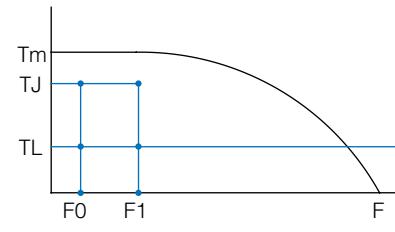
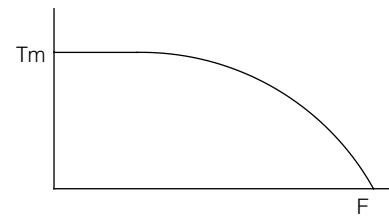
- Reduction of Vibration and Noise**

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	+	-

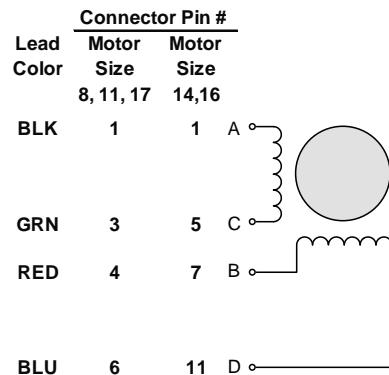
CW & CCW rotation when seen from flange side of the motor.

Unipolar, Full step

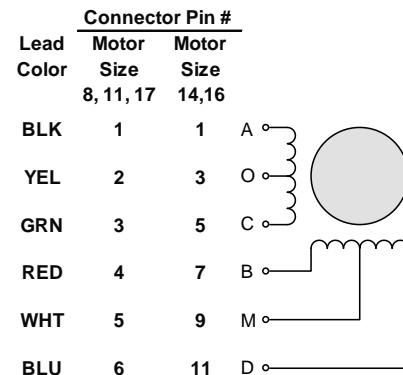
STEP	Phase 1	Phase 2
	A O C	B M D
1	- +	- +
2	+ -	- +
3	+ -	+ -
4	- +	+ -

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

- 4 Lead (bipolar)

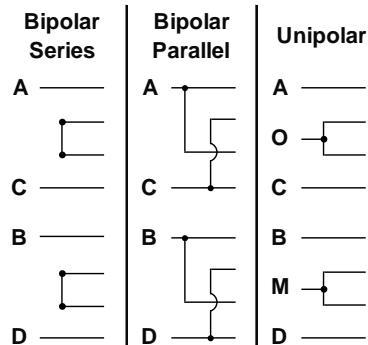


- 6 Lead (unipolar)

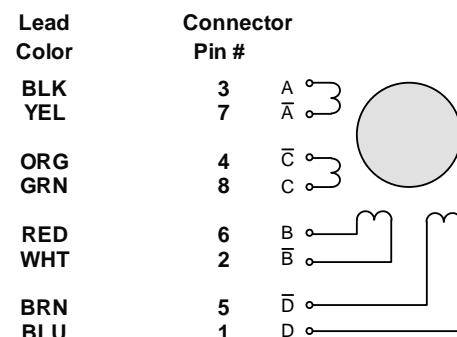


- 8 Lead

8 Lead Connection Options



8 lead Motors



- 3 Phase Motors

Bipolar, Full Step

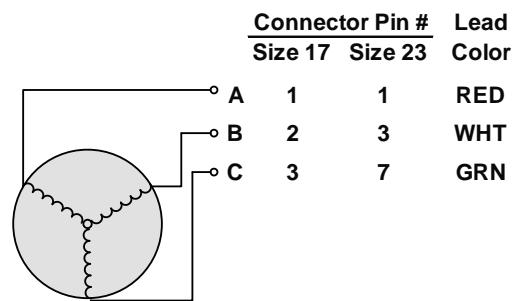
STEP	Phase
	A B C
1	+
2	- +
3	- +
4	- +
5	+
6	-

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 rotation when seen from flange side of the motor.

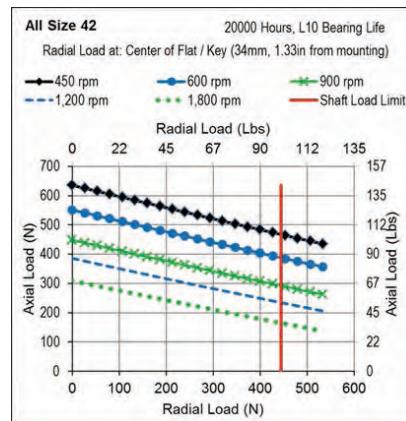
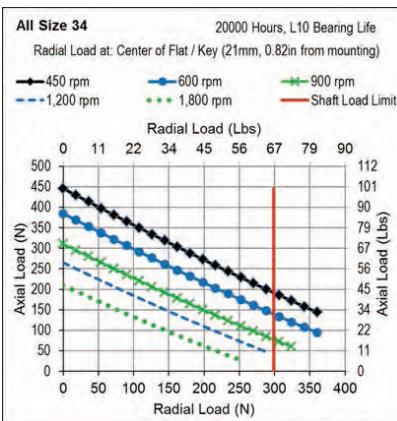
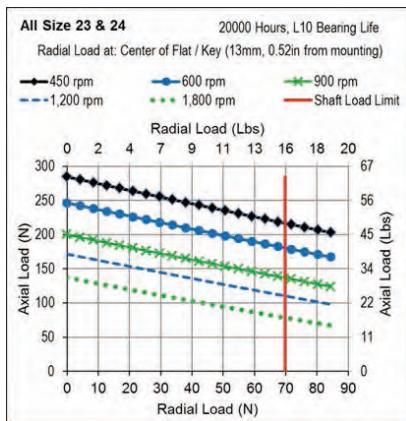
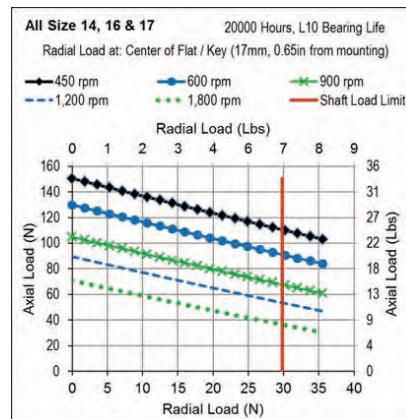
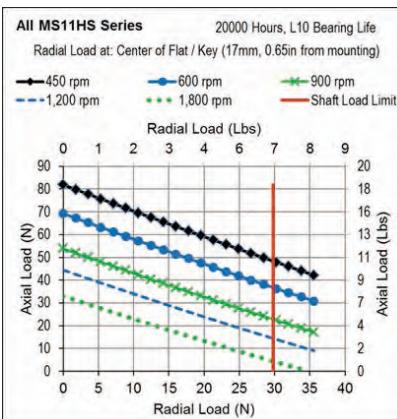
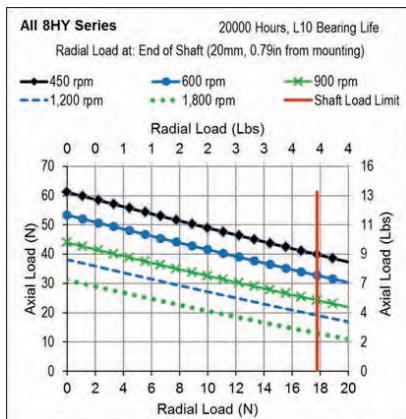
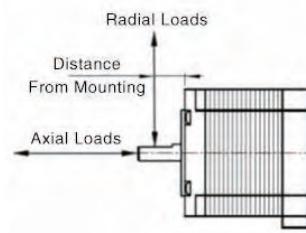


Bearing Life & Shaft Loading

Moons' uses high quality bearings optimized for step motors for long life from every motor. To meet the most demanding applications. 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 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	kgm ²	kgcm ²	gcm ²	oz-in ²	oz-in-sec ²	lb-in ²	lb-in-sec ²	lb-ft ²	lb-ft-sec ² (slug ft ²)
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	--	