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PowerPlus Technology

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

Typical Applications:

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

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

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

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

Conventional Motor

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

PowerPlus Technology

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

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

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

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

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

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

Connectors integrated into motors for quick reliable connections.

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

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

Encapsulation Technology From MOONS’ Offers Many Advantages

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

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

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

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

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

RoHS
Encapsulated stepping motors are RoHS compliant.
2 Phase and 3 Phase Motors

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

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

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

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

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

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

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

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

### Models starting with M or P

<table>
<thead>
<tr>
<th>M</th>
<th>S</th>
<th>17</th>
<th>HD</th>
<th>2</th>
<th>P</th>
<th>4</th>
<th>040</th>
<th>-M</th>
</tr>
</thead>
</table>

#### Stator - Series
- **M**: Standard Step Motor
- **P**: PowerPlus Step Motor

#### Rotor
- **S**: Standard Inertia (Size 8,11,14,16,17,23,24)
- **L**: Lower Inertia (Size 23,24,34,42)

#### Frame Size
- ##: 8,11,14,16,17,23,24,34,42

#### Motor Technology
- **HA**: Hybrid Step Motor, 2 Phase 0.9 degree
- **HD, HS**: Hybrid Step Motor, 2 Phase 1.8 degree
- **HC**: Hybrid Step Motor, 3 Phase 1.2 degree

#### Length Code
- #: Non significant number or letter

#### Connection Construction / IP Rating
- **L**: Leads (IP40)
- **P**: Plug In Connector - Standard (IP40)

#### Number of connections / Winding Type
- **4**: Bipolar
- **6**: Unipolar (can be used bipolar)
- **8**: Can be connected any way

#### Winding Current
- ###: Current rating x 100 (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

<table>
<thead>
<tr>
<th>14</th>
<th>HC</th>
<th>0</th>
<th>3</th>
<th>01</th>
<th>N</th>
</tr>
</thead>
</table>

#### 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
---

---
Custom Motors

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

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

Press Fit Pulley & Gear

Metal Pulley  Plastic Pulley  Gear

Shaft Options

Dowel  Worm Shaft  Cross Drilled Shaft
Single Flat  Double Flat  Key Way
Knurl  Hobbed Gear  Helical Cut
**MS08HY Series: 1.8° - Size 8**

- Phases: 2
- Steps / Revolution: 200
- Step Accuracy: ±5%
- Shaft Load (20,000 Hours at 1000 RPM)
  - Axial: 6 N (1.3 Lbs.) Push
  - Radial: 18 N (4.1 Lbs.) At End of Shaft
- IP Rating: 40
- Approvals: RoHS
- Operating Temp.: -20°C to +50°C
- Insulation Class: B, 130°C
- Insulation Resistance: 100 MegOhms

### MS08HY 1 P 4 050-M

**Basic Motor Length (Max)**

<table>
<thead>
<tr>
<th>Number</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>29.5 mm (1.16 in.)</td>
</tr>
<tr>
<td>3</td>
<td>39.5 mm (1.56 in.)</td>
</tr>
<tr>
<td>5</td>
<td>49.5 mm (1.93 in.)</td>
</tr>
</tbody>
</table>

**Electrical Connection**

- P: Side facing plug
- F: Front facing plug
- R: Rear facing plug
- L: Lead wire type

**Options**

- M: 4 mm diameter rear shaft with encoder mounting holes

**Winding**

### Current rating x 100

**Number of Connections**

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

**Dimensions:** mm (in)

[Diagram of motor dimensions]
MS08HY - 4 Lead Bi-Polar

<table>
<thead>
<tr>
<th>Length</th>
<th>Model Number</th>
<th>Connect</th>
<th>Rated Current</th>
<th>Holding Torque</th>
<th>Winding Ohms</th>
<th>mH</th>
<th>Detent Torque</th>
<th>Rotor Inertia</th>
<th>Motor Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>29.5mm (1.16m.)</td>
<td>^ MS08HY1P4050</td>
<td>P</td>
<td>0.5</td>
<td>0.032</td>
<td>4.53</td>
<td>8.6</td>
<td>5.6</td>
<td>2</td>
<td>0.28</td>
</tr>
<tr>
<td></td>
<td>^ MS08HY1F4050</td>
<td>F</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>^ MS08HY1R4050</td>
<td>R</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>39.5mm (1.56m.)</td>
<td>^ MS08HY3P4060</td>
<td>P</td>
<td>0.6</td>
<td>0.049</td>
<td>6.94</td>
<td>6.6</td>
<td>4.1</td>
<td>3</td>
<td>0.42</td>
</tr>
<tr>
<td></td>
<td>^ MS08HY3F4060</td>
<td>F</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>^ MS08HY3R4060</td>
<td>R</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>46.5mm (1.83m.)</td>
<td>^ MS08HY5P4060</td>
<td>P</td>
<td>0.6</td>
<td>0.058</td>
<td>8.2</td>
<td>8</td>
<td>6.1</td>
<td>4</td>
<td>0.57</td>
</tr>
<tr>
<td></td>
<td>^ MS08HY5R4060</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>^ MS08HY5F4060</td>
<td>F</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

^ Preferred model

Mating Connector With Leads (order separately)
Dimensions: mm (in)

4 Lead Part Number 4634 1402 03659

MS08HY1-Bipolar

MS08HY3-Bipolar

MS08HY5-Bipolar
MS11HS Series: 1.8° - Size 11

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

**MS11HS 3 P 4 040**

**Basic Motor Length (Max)**

<table>
<thead>
<tr>
<th>Number</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>32mm (1.26)</td>
</tr>
<tr>
<td>3</td>
<td>41mm (1.62)</td>
</tr>
<tr>
<td>5</td>
<td>52mm (2.05)</td>
</tr>
</tbody>
</table>

**Electrical Connection**

<table>
<thead>
<tr>
<th>Number</th>
<th>Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>Plug-in Connector</td>
</tr>
</tbody>
</table>

**Winding**

<table>
<thead>
<tr>
<th>Number</th>
<th>Connections</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>4 Lead-Bipolar</td>
</tr>
<tr>
<td>6</td>
<td>6 Lead-Unipolar (or Bipolar)</td>
</tr>
</tbody>
</table>

**Dimensions: mm (in)**

- **L Max:** 24±0.5
- **D28.3:** (1.114)
- **D23:** (0.906)
- **D15:** (0.591)
- **D15:** (0.591)
- **D10:** (0.394)
- **D5:** (0.20)
- **D4.5:** (0.177±0.004)
- **D5.5:** (0.217±0.009)
- **D2:** (0.08)
- **D4:** (0.16)
- **D16.5:** (0.65)
- **Pin 6 Moex 53253-0670**

**MS11HS1 = 32 (1.26)**
**MS11HS3 = 41 (1.62)**
**MS11HS5 = 52 (2.05)**

**www.moonsindustries.com**
### MS11HS - 4 Lead Bi-Polar

<table>
<thead>
<tr>
<th>Length</th>
<th>Model Number</th>
<th>Connect</th>
<th>Rated Current</th>
<th>Holding Torque</th>
<th>Winding Ohms</th>
<th>@20°C</th>
<th>Detent Torque</th>
<th>Rotor Inertia</th>
<th>Motor Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>32 mm (1.26 in.)</td>
<td>MS11HS1P4024 P</td>
<td>0.24</td>
<td>0.09</td>
<td>13</td>
<td>49</td>
<td>38</td>
<td>5</td>
<td>9</td>
<td>0.049</td>
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<td></td>
<td>MS11HS1P4050 P</td>
<td>0.5</td>
<td>0.09</td>
<td>13</td>
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<td>9.6</td>
<td>6.1</td>
<td>5.4</td>
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<tr>
<td></td>
<td>MS11HS1P4067 P</td>
<td>0.67</td>
<td>0.09</td>
<td>13</td>
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<td>5.4</td>
<td>2.7</td>
<td>2.5</td>
<td></td>
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<tr>
<td></td>
<td>MS11HS1P4100 P</td>
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<td>0.09</td>
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<td>27</td>
<td>3.3</td>
<td>1.7</td>
<td>1.28</td>
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</tr>
<tr>
<td>41 mm (1.62 in.)</td>
<td>MS11HS3P4029 P</td>
<td>0.29</td>
<td>0.12</td>
<td>17</td>
<td>39</td>
<td>26</td>
<td>6</td>
<td>0.85</td>
<td>12 0.066</td>
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<tr>
<td></td>
<td>MS11HS3P4067 P</td>
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<td>17</td>
<td>7.2</td>
<td>5.1</td>
<td>3.7</td>
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<td></td>
<td>MS11HS3P4095 P</td>
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<td>0.13</td>
<td>18</td>
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<td>2.8</td>
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<td>1.28</td>
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<td>MS11HS3P4140 P</td>
<td>1.4</td>
<td>0.13</td>
<td>18</td>
<td>1.77</td>
<td>1.24</td>
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<tr>
<td>52 mm (2.05 in.)</td>
<td>MS11HS5P4030 P</td>
<td>0.3</td>
<td>0.17</td>
<td>24</td>
<td>40</td>
<td>38</td>
<td>8</td>
<td>1.1</td>
<td>18 0.098</td>
</tr>
<tr>
<td></td>
<td>MS11HS5P4070 P</td>
<td>0.7</td>
<td>0.17</td>
<td>24</td>
<td>6.7</td>
<td>6.8</td>
<td>2.5</td>
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<tr>
<td></td>
<td>MS11HS5P4100 P</td>
<td>1</td>
<td>0.17</td>
<td>24</td>
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<td></td>
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<td>1.65</td>
<td>1.48</td>
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</tbody>
</table>

^ Preferred model

### MS11HS - 6 Lead Uni-Polar

<table>
<thead>
<tr>
<th>Length</th>
<th>Model Number</th>
<th>Connect</th>
<th>Rated Current</th>
<th>Holding Torque</th>
<th>Winding Ohms</th>
<th>@20°C</th>
<th>Detent Torque</th>
<th>Rotor Inertia</th>
<th>Motor Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>32 mm (1.26 in.)</td>
<td>MS11HS1P6024 P</td>
<td>0.24</td>
<td>0.06</td>
<td>9</td>
<td>48</td>
<td>18.2</td>
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<td>9</td>
<td>0.049</td>
</tr>
<tr>
<td></td>
<td>MS11HS1P6050 P</td>
<td>0.5</td>
<td>0.07</td>
<td>9</td>
<td>10.9</td>
<td>4.5</td>
<td>6.1</td>
<td>5.4</td>
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<tr>
<td></td>
<td>MS11HS1P6070 P</td>
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<td>0.07</td>
<td>9</td>
<td>5.5</td>
<td>2.3</td>
<td>2.7</td>
<td>2.5</td>
<td></td>
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<tr>
<td>41 mm (1.62 in.)</td>
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<td>0.09</td>
<td>13</td>
<td>48</td>
<td>20</td>
<td>6</td>
<td>0.85</td>
<td>12 0.066</td>
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<tr>
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<td>MS11HS3P6067 P</td>
<td>0.67</td>
<td>0.09</td>
<td>13</td>
<td>7.4</td>
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<td></td>
<td>MS11HS3P6095 P</td>
<td>0.95</td>
<td>0.09</td>
<td>13</td>
<td>3.5</td>
<td>1.56</td>
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<tr>
<td>52 mm (2.05 in.)</td>
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<td>0.13</td>
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<td>18 0.098</td>
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<tr>
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<td>0.13</td>
<td>18</td>
<td>8.1</td>
<td>3.5</td>
<td>4.3</td>
<td>1.7</td>
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<tr>
<td></td>
<td>MS11HS5P6095 P</td>
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<td>18</td>
<td>4.3</td>
<td>1.7</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

^ Preferred model

### Mating Connector With Leads (order separately)

Dimensions: mm (in)

4 Lead Part Number: 4634 1402 04190

6 Lead Part Number: 4634 1402 04490

---

**Housing:** Molex 51065-0600

**Terminal:** Molex 50212-8000

**AWG26 UL3266**
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
  - Radial: 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

<table>
<thead>
<tr>
<th>Length</th>
<th>Model Number</th>
<th>Connect</th>
<th>Rated Current</th>
<th>Holding Torque</th>
<th>Winding Ohms</th>
<th>Detent Torque</th>
<th>Rotor Inertia</th>
<th>Motor Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Amps</td>
<td>Nm Typ.</td>
<td>@20°C Typ.</td>
<td>mNm oz-in TYP</td>
<td>g cm² oz-in²</td>
<td>kg Lbs</td>
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<tr>
<td>12.8 mm (0.5 in.)</td>
<td>14HK0405N</td>
<td>L</td>
<td>0.3</td>
<td>0.044 6</td>
<td>16 8.5</td>
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<td>4 0.022</td>
<td>0.05 0.11</td>
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<td>0.044 6</td>
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<td>4 0.57</td>
<td>4 0.022</td>
<td>0.05 0.11</td>
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<tr>
<td>20.2 mm (0.8 in.)</td>
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<td>L</td>
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<td>0.12 17</td>
<td>26.7 21</td>
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<td>11 0.06</td>
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<td>11 0.06</td>
<td>0.11 0.24</td>
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</tbody>
</table>

^ Preferred model

Dimensions: mm (in)
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: 30 N (6.5 Lbs.) At Flat Center
- IP Rating: 40
- Approvals: RoHS
- Operating Temp.: -20°C to +50°C
- Insulation Class: B, 130°C
- Insulation Resistance: 100 MegOhms

MS14HA  5  P 4 040

Basic Motor Length (Max)

<table>
<thead>
<tr>
<th></th>
<th>27.3mm (1.07 in.)</th>
<th>36mm (1.42 in.)</th>
<th>55.5mm (2.19 in.)</th>
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<tr>
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<tr>
<td>5</td>
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Electrical Connection

P  Plug-in Connector

Winding

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

Dimensions: mm (in)

- Ø22.5 ±0.012
- 5 ±0.012
- 4.5 ±0.1
- 2.8 ±0.1
- 2 ±0.08
- 15 ±0.5
- 24 ±0.020
- LMax. 35.3 ±0.11
- Pin 1 JST S11B-2R(LF)(SN)
### MS14HA - 4 Lead Bi-Polar

<table>
<thead>
<tr>
<th>Length</th>
<th>Model Number</th>
<th>Connect</th>
<th>Rated Current</th>
<th>Holding Torque</th>
<th>Winding Ohms</th>
<th>Detent Torque</th>
<th>Rotor Inertia</th>
<th>Motor Weight</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>P=Plug L=Leads</td>
<td>Amps (mounted)</td>
<td>@20 C Typ.</td>
<td>mNm oz-in</td>
<td>g cm² oz-in²</td>
<td>kg lbs</td>
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<td>0.15 0.33</td>
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<td>0.12 17</td>
<td>6.6 8.2</td>
<td>3 3.3</td>
<td>6 3.9</td>
<td>1.55 1.8</td>
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<tr>
<td></td>
<td>MS14HA1P4100</td>
<td>P</td>
<td>1</td>
<td>0.12 17</td>
<td>3.3 3.9</td>
<td>1.55 1.8</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>MS14HA1P4150</td>
<td>P</td>
<td>1.5</td>
<td>0.12 17</td>
<td>1.55 1.8</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>36 mm</td>
<td>MS14HA3P4032</td>
<td>P</td>
<td>0.32</td>
<td>0.19 27</td>
<td>37 51</td>
<td>8 1.1</td>
<td>20 0.11</td>
<td>0.21 0.46</td>
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<tr>
<td>(1.42 in.)</td>
<td>MS14HA3P4075</td>
<td>P</td>
<td>0.75</td>
<td>0.18 25</td>
<td>6 8.6</td>
<td>3 3.3</td>
<td>4.9 2.2</td>
<td>6 4.9</td>
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<tr>
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<td>MS14HA3P4100</td>
<td>P</td>
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<td>0.18 25</td>
<td>3 3.3</td>
<td>1.61 2.2</td>
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<td>P</td>
<td>1.5</td>
<td>0.18 25</td>
<td>1.61 2.2</td>
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<tr>
<td>55.5 mm</td>
<td>MS14HA5P4040</td>
<td>P</td>
<td>0.4</td>
<td>0.32 45</td>
<td>30 49</td>
<td>10 1.4</td>
<td>35 0.19</td>
<td>0.24 0.53</td>
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<tr>
<td>(2.19 in.)</td>
<td>MS14HA5P4070</td>
<td>P</td>
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<td>0.32 45</td>
<td>5.1 8.2</td>
<td>10 1.4</td>
<td>35 0.19</td>
<td>0.24 0.53</td>
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<td>MS14HA5P4100</td>
<td>P</td>
<td>1.5</td>
<td>0.32 45</td>
<td>2.2 3.6</td>
<td>10 1.4</td>
<td>35 0.19</td>
<td>0.24 0.53</td>
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<td>0.32 45</td>
<td>1.34 2.1</td>
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<td>35 0.19</td>
<td>0.24 0.53</td>
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</tbody>
</table>

^ Preferred model

### MS14HA - 6 Lead Uni-Polar

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<tr>
<th>Length</th>
<th>Model Number</th>
<th>Connect</th>
<th>Rated Current</th>
<th>Holding Torque</th>
<th>Winding Ohms</th>
<th>Detent Torque</th>
<th>Rotor Inertia</th>
<th>Motor Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>P=Plug L=Leads</td>
<td>Amps (mounted)</td>
<td>@20 C Typ.</td>
<td>mNm oz-in</td>
<td>g cm² oz-in²</td>
<td>kg lbs</td>
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<td>27.3 mm</td>
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<td>48 27</td>
<td>4 0.57</td>
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<tr>
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<td>MS14HA1P6100</td>
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<td>3 3.3</td>
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<tr>
<td>36 mm</td>
<td>MS14HA3P6032</td>
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<td>0.32</td>
<td>0.13 18</td>
<td>37 21</td>
<td>8 1.1</td>
<td>20 0.11</td>
<td>0.21 0.46</td>
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<tr>
<td>(1.42 in.)</td>
<td>MS14HA3P6070</td>
<td>P</td>
<td>0.7</td>
<td>0.14 20</td>
<td>7.5 5.3</td>
<td>3 2</td>
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<td></td>
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<td>MS14HA3P6110</td>
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<td>0.14 20</td>
<td>3 2</td>
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<td></td>
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</tr>
<tr>
<td>55.5 mm</td>
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<td>0.4</td>
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<td>35 0.19</td>
<td>0.24 0.53</td>
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<td>7.1 6.1</td>
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<td>35 0.19</td>
<td>0.24 0.53</td>
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<td>0.25 35</td>
<td>3.5 2.9</td>
<td>10 1.4</td>
<td>35 0.19</td>
<td>0.24 0.53</td>
</tr>
</tbody>
</table>

^ 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

---

[MS14HA - 4 Lead Bi-Polar](#)

[MS14HA - 6 Lead Uni-Polar](#)
MS14HS Series: 1.8° - Size 14

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

MS14HS 3 P 4 040

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

Electrical Connection
P  Plug-in Connector

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

Number of Connections

Dimensions: mm (in)

- MS14HS1 = 27.3mm (1.07 in.)
- MS14HS3 = 36mm (1.42 in.)
- MS14HS5 = 55.5mm (2.19 in.)

- Ø22±0.052 (0.866±0.002)
- 4.5±0.1 (0.177±0.004)
- 24±0.5 (0.945±0.020)
- 15 (0.591)

Electrical Connection

- Ø5±0.12 (0.200±0.005)

- 2

- LMax.

- 4-M3

- Pin 1:
  - JST S11B-ZR(LF)(SN)

- 35.3Max.

- 21.6 (0.85)
### MS14HS - 4 Lead Bi-Polar

<table>
<thead>
<tr>
<th>Length</th>
<th>Model Number</th>
<th>Connect</th>
<th>Rated Current</th>
<th>Holding Torque</th>
<th>Winding Ohms</th>
<th>Detent Torque</th>
<th>Rotor Inertia</th>
<th>Motor Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Amps (mounted)</td>
<td>Nm</td>
<td>oz-in</td>
<td>@20 ℃</td>
<td>Typ.</td>
<td>mNm</td>
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<td>3.3</td>
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<td>P</td>
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<td>0.14</td>
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^ Preferred model

### MS14HS - 6 Lead Uni-Polar

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<th>Model Number</th>
<th>Connect</th>
<th>Rated Current</th>
<th>Holding Torque</th>
<th>Winding Ohms</th>
<th>Detent Torque</th>
<th>Rotor Inertia</th>
<th>Motor Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Amps (mounted)</td>
<td>Nm</td>
<td>oz-in</td>
<td>@20 ℃</td>
<td>Typ.</td>
<td>mNm</td>
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<td>26</td>
<td>18</td>
</tr>
</tbody>
</table>

^ Preferred model

### Mating Connector With Leads (order separately)

Dimensions: mm (in)

#### 4 Lead Part Number 4634 1402 02846

[Diagram of 4 lead mating connector with leads]

#### 6 Lead Part Number 4634 1402 04489

[Diagram of 6 lead mating connector with leads]
# 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: 30 N (6.5 Lbs.) At Flat Center
- **IP Rating**: 40
- **Approvals**: RoHS
- **Operating Temp.**: -20°C to +50°C
- **Insulation Class**: B, 130°C
- **Insulation Resistance**: 100 MegOhms

### MS16HS 7 P 4 040

<table>
<thead>
<tr>
<th>Basic Motor Length (Max)</th>
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<tbody>
<tr>
<td>7</td>
<td>20.8mm (0.82 in.)</td>
</tr>
<tr>
<td>0</td>
<td>26mm (1.02 in.)</td>
</tr>
<tr>
<td>4</td>
<td>33mm (1.30 in.)</td>
</tr>
</tbody>
</table>

| Electrical Connection | P Plug-in Connector |

<table>
<thead>
<tr>
<th>Winding</th>
<th>Current rating x 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>4 Lead-Bipolar</td>
</tr>
<tr>
<td>6</td>
<td>6 Lead-Unipolar (or Bipolar)</td>
</tr>
</tbody>
</table>

### Dimensions: mm (in)

![Dimensions Diagram]

- **MS16HS7**: 20.8mm (0.82 in.)
- **MS16HS0**: 26mm (1.02 in.)
- **MS16HS4**: 33mm (1.30 in.)

**Electrical Connection**

- **Pin 1**: JST S11B-ZR(LF)(SN)

**Winding**

<table>
<thead>
<tr>
<th>Number of Connections</th>
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<tbody>
<tr>
<td>4</td>
<td>4 Lead-Bipolar</td>
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<tr>
<td>6</td>
<td>6 Lead-Unipolar (or Bipolar)</td>
</tr>
</tbody>
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**Technical**

25

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### MS16HS - 4 Lead Bi-Polar

<table>
<thead>
<tr>
<th>Length</th>
<th>Model Number</th>
<th>Connect</th>
<th>Rated Current</th>
<th>Holding Torque</th>
<th>Winding Ohms</th>
<th>Detent Torque</th>
<th>Rotor Inertia</th>
<th>Motor Weight</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Amps</td>
<td>Nm Typ.</td>
<td>oz-in TYP.</td>
<td>@20 ℃</td>
<td>mNm</td>
<td>oz-in</td>
</tr>
<tr>
<td>20.8 mm</td>
<td>MS16HS7P4027</td>
<td>P</td>
<td>0.27</td>
<td>0.10</td>
<td>14</td>
<td>41</td>
<td>36</td>
<td>5.6</td>
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<tr>
<td>(0.82 in.)</td>
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<td>1.45</td>
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<td>MS16HS7P4100</td>
<td>P</td>
<td>1.5</td>
<td>0.10</td>
<td>14</td>
<td>1.45</td>
<td>1.28</td>
<td></td>
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<tr>
<td>26 mm</td>
<td>MS16HS0P4029</td>
<td>P</td>
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<td>0.20</td>
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<td>6.8</td>
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<tr>
<td>(1.02 in.)</td>
<td>MS16HS0P4070</td>
<td>P</td>
<td>0.7</td>
<td>0.20</td>
<td>28</td>
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<td>4.7</td>
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<td>0.20</td>
<td>28</td>
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<td>33 mm</td>
<td>MS16HS4P4037</td>
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<td>0.37</td>
<td>0.26</td>
<td>37</td>
<td>31</td>
<td>50</td>
<td>8.4</td>
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<tr>
<td>(1.3 in.)</td>
<td>MS16HS4P4070</td>
<td>P</td>
<td>0.7</td>
<td>0.26</td>
<td>37</td>
<td>4.1</td>
<td>7</td>
<td>4.4</td>
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<tr>
<td></td>
<td>MS16HS4P4100</td>
<td>P</td>
<td>1.5</td>
<td>0.27</td>
<td>38</td>
<td>1.89</td>
<td>3.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MS16HS4P4150</td>
<td>P</td>
<td>1.5</td>
<td>0.27</td>
<td>38</td>
<td>1.89</td>
<td>3.1</td>
<td></td>
</tr>
</tbody>
</table>

^ Preferred model

### MS16HS - 6 Lead Uni-Polar

<table>
<thead>
<tr>
<th>Length</th>
<th>Model Number</th>
<th>Connect</th>
<th>Rated Current</th>
<th>Holding Torque</th>
<th>Winding Ohms</th>
<th>Detent Torque</th>
<th>Rotor Inertia</th>
<th>Motor Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Amps</td>
<td>Nm Typ.</td>
<td>oz-in TYP.</td>
<td>@20 ℃</td>
<td>mNm</td>
<td>oz-in</td>
</tr>
<tr>
<td>20.8 mm</td>
<td>MS16HS6P6024</td>
<td>P</td>
<td>0.24</td>
<td>0.07</td>
<td>10</td>
<td>50</td>
<td>21</td>
<td>5.5</td>
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<tr>
<td>(0.82 in.)</td>
<td>MS16HS6P6070</td>
<td>P</td>
<td>0.7</td>
<td>0.07</td>
<td>10</td>
<td>5.5</td>
<td>2.6</td>
<td>2.7</td>
</tr>
<tr>
<td></td>
<td>MS16HS6P6100</td>
<td>P</td>
<td>1.5</td>
<td>0.07</td>
<td>10</td>
<td>5.5</td>
<td>2.6</td>
<td>2.7</td>
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<tr>
<td>26 mm</td>
<td>MS16HS6P6027</td>
<td>P</td>
<td>0.27</td>
<td>0.15</td>
<td>21</td>
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<td>7.4</td>
</tr>
<tr>
<td>(1.02 in.)</td>
<td>MS16HS6P6070</td>
<td>P</td>
<td>0.7</td>
<td>0.16</td>
<td>23</td>
<td>7.4</td>
<td>2.2</td>
<td>3.4</td>
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<td></td>
<td>MS16HS6P6100</td>
<td>P</td>
<td>1.5</td>
<td>0.15</td>
<td>21</td>
<td>3.4</td>
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<td>33 mm</td>
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<td>33</td>
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<tr>
<td>(1.3 in.)</td>
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<td>4.7</td>
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<td>3.6</td>
<td>4.7</td>
<td>1.2</td>
</tr>
</tbody>
</table>

^ Preferred model

### Mating Connector With Leads (order separately)

Dimensions: mm (in)

<table>
<thead>
<tr>
<th>Part Number</th>
<th>AWG</th>
<th>Terminal</th>
<th>UL10 61</th>
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</thead>
<tbody>
<tr>
<td>4634 1402 04581</td>
<td>26</td>
<td>SZH-002T-P0.5</td>
<td>BLACK  GREEN  RED  BLUE</td>
</tr>
<tr>
<td>4634 1402 04489</td>
<td>26</td>
<td>SZH-002T-P0.5</td>
<td>BLACK  YELLOW  GREEN  WHITE  BLUE</td>
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</tbody>
</table>
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
- IP Rating: 40
- Approvals: UL Recognized File E465363, RoHS
- Operating Temp.: -20°C to +50°C
- Insulation Class: B, 130°C
- Insulation Resistance: 100 MegOhms

MS17HA 4 P 4 040 -M

Basic Motor Length (Max)

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

Electrical Connection

- P: Plug-in Connector

Number of Connections

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

Options

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

Winding

### Current rating x 100

Dimensions: mm (in)

- L Max.
  - MS17HA4: 34.3 (1.35)
  - MS17HA2: 39.8 (1.57)
  - MS17HA6: 48.3 (1.90)

- Ø50 (-0.012) (-0.0005)
- Ø42.3 (1.665)
- Ø31 (1.220)
- 4-M3 Depth 4.5 (0.18) Min.

Optional Rear Shaft Extension Includes Encoder Mounting: 2-M2.5 Depth 2.5 (0.1) Min.

ON Ø19.05 (0.75) Bolt Circle (In Rear Endbell)

Pin 1

JST S6B-PH-K-S(LF)(SN)

or MOLEX 89401-0610

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### MS17HA - 4 Lead Bi-Polar

<table>
<thead>
<tr>
<th>Length</th>
<th>Model Number</th>
<th>Connect</th>
<th>Rated Current</th>
<th>Holding Torque</th>
<th>Winding Ohms</th>
<th>Detent Torque</th>
<th>Rotor Inertia</th>
<th>Motor Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>P=Plug L=Leads</td>
<td>Amps (mounted)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>34.3 mm (1.35 in.)</td>
<td>MS17HA4P4040</td>
<td>P</td>
<td>0.4</td>
<td>0.3</td>
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<td>29</td>
<td>71</td>
<td>1</td>
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<td></td>
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<td>0.3</td>
<td>42</td>
<td>4.05</td>
<td>10.5</td>
<td>1.7</td>
</tr>
<tr>
<td></td>
<td>MS17HA4P4150</td>
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<td>1.5</td>
<td>0.28</td>
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<td>0.29</td>
<td>41</td>
<td>1</td>
<td>2.5</td>
<td>0.2</td>
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<tr>
<td>39.8 mm (1.57 in.) 1 Stack</td>
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<td>P</td>
<td>0.4</td>
<td>0.41</td>
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<td>25</td>
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<td>0.39</td>
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<td>0.40</td>
<td>57</td>
<td>1.95</td>
<td>5.4</td>
<td>1.2</td>
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<tr>
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<td>MS17HA2P4200</td>
<td>P</td>
<td>2</td>
<td>0.41</td>
<td>58</td>
<td>1</td>
<td>2.8</td>
<td>0.0</td>
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<tr>
<td>48.3 mm (1.9 in.) 2 Stack</td>
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<td>0.54</td>
<td>76.5</td>
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<td>0.54</td>
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<td>MS17HA6P4150</td>
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<td>0.39</td>
<td>0.54</td>
<td>76.5</td>
<td>1.56</td>
<td>4.1</td>
<td>1</td>
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<td>MS17HA6P4200</td>
<td>P</td>
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<td>0.54</td>
<td>76.5</td>
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<td>2.5</td>
<td>0.2</td>
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^ Preferred model

### MS17HA - 6 Lead Uni-Polar

<table>
<thead>
<tr>
<th>Length</th>
<th>Model Number</th>
<th>Connect</th>
<th>Rated Current</th>
<th>Holding Torque</th>
<th>Winding Ohms</th>
<th>Detent Torque</th>
<th>Rotor Inertia</th>
<th>Motor Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>P=Plug L=Leads</td>
<td>Amps (mounted)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>0.22</td>
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<td>39.8 mm (1.57 in.) 1 Stack</td>
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<td>0.41</td>
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<td>2.5</td>
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<td>59</td>
<td>1.24</td>
<td>1.94</td>
<td>0.45</td>
</tr>
</tbody>
</table>

^ 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
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
  - Radial: 29 N (6.5 Lbs.) At Flat Center
- IP Rating: 40
- Approvals: UL Recognized File E465363, RoHS
- Operating Temp.: -20°C to +50°C
- Insulation Class: B, 130°C
- Insulation Resistance: 100 MegOhms

MS17HD 4 P 4 040 -M

Basic Motor Length (Max)

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

Electrical Connection

- P: Plug-in Connector

Number of Connections

- 4: 4 Lead-Bipolar
- 6: 6 Lead-Unipolar or Bipolar

Options

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

Winding

--- Current rating x 100

Dimensions: mm (in)

- Basic Motor Length (Max)
  - MS17HD5=25.3(1.00)
  - MS17HD4=34.3(1.35)
  - MS17HD2=39.8(1.57)
  - MS17HD6=48.3(1.90)
  - MS17HDB=62.8(2.47)

- Electrical Connection:
  - L Max.
  - P: Plug-in Connector

- Number of Connections
  - 4: 4 Lead-Bipolar
  - 6: 6 Lead-Unipolar or Bipolar

- Winding
  - \#\#\# Current rating x 100

- Dimensions:
  - \(24 \pm 0.5\) (0.0945 ± 0.020)
  - \(15\) (0.591)
  - \(\Omega 22.3\) (0.866 ± 0.003)
  - \(4.5 \pm 0.1\) (0.177 ± 0.004)
  - \(\Omega 5.012\) (0.1996 ± 0.005)

- OPTIONAL REAR SHAFT EXTENSION INCLUDES ENCODER MOUNTING: 2-M2.5, DEPTH 2.5(0.1) Min.
  ON Ø19.05(0.75) BOLT CIRCLE (IN REAR ENDBELL)

- Electrical Connection:
  - JST S6B-PH-K-S(LF)(SN)
  - MOLEX 89401-0610

- Pin 1
  - Depth 4.5(0.18) Min.
  - For MS17HD5:
  - Depth 2.5 Min.
### MS17HD - 4 Lead Bi-Polar

<table>
<thead>
<tr>
<th>Length</th>
<th>Model Number</th>
<th>Connect</th>
<th>Rated Current</th>
<th>Holding Torque</th>
<th>Winding Ohms</th>
<th>Detent Torque</th>
<th>Rotor Inertia</th>
<th>Motor Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>P=Plug L=Leads</td>
<td>Amps (mounted)</td>
<td>Nm Typical oz-in Typical</td>
<td>@20°C Typical</td>
<td>mNm oz-in g cm² oz-in²</td>
<td>kg Lbs</td>
<td></td>
</tr>
<tr>
<td>25.3 mm (1 in.)</td>
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<td>MS17HD5P4070</td>
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<td>0.7</td>
<td>0.21</td>
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^ Preferred model

### MS17HD - 6 Lead Uni-Polar

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<th>Model Number</th>
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<th>Rated Current</th>
<th>Holding Torque</th>
<th>Winding Ohms</th>
<th>Detent Torque</th>
<th>Rotor Inertia</th>
<th>Motor Weight</th>
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<tr>
<td></td>
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<td>P=Plug L=Leads</td>
<td>Amps (mounted)</td>
<td>Nm Typical oz-in Typical</td>
<td>@20°C Typical</td>
<td>mNm oz-in g cm² oz-in²</td>
<td>kg Lbs</td>
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<td>71</td>
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</tr>
</tbody>
</table>

^ 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**

![Mating Connector Diagram](image-url)
### 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
  - Radial: 70 N (15.5 Lbs.) At Flat Center
- **IP Rating**: 40
- **Approvals**: UL Recognized File E465363, RoHS
- **Operating Temp.**: -20°C to +50°C
- **Insulation Class**: B, 130°C
- **Insulation Resistance**: 100 MegOhms

#### MS23HA 0 P 4 100 -E

<table>
<thead>
<tr>
<th>Basic Motor Length (Max)</th>
<th>P</th>
<th>Electrical Connection</th>
<th>Number of Connections</th>
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</thead>
<tbody>
<tr>
<td>39 mm (1.54 in.)</td>
<td>P</td>
<td>Plug-in Connector</td>
<td>4, 6</td>
</tr>
<tr>
<td>55 mm (2.17 in.)</td>
<td>L</td>
<td>Plug-in Connector</td>
<td>4, 6</td>
</tr>
<tr>
<td>77 mm (3.03 in.)</td>
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<td>Plug-in Connector</td>
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#### MS23HA - 4 Lead Bi-Polar

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<th>Length</th>
<th>Model Number</th>
<th>Connect</th>
<th>Rated Current</th>
<th>Holding Torque</th>
<th>Winding Ohms</th>
<th>Detent Torque</th>
<th>Rotor Inertia</th>
<th>Motor Weight</th>
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<tbody>
<tr>
<td>Single Shaft</td>
<td></td>
<td></td>
<td>Amps (mounted)</td>
<td>@20°C Typ.</td>
<td>mH Typ.</td>
<td>mNcm oz-in</td>
<td>g cm² oz-in²</td>
<td>kg Lbs</td>
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<tr>
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<td>99</td>
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<td>P</td>
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<td>0.71</td>
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<td>0.71</td>
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<td>L</td>
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<td>0.56</td>
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<td>55 mm (2.17 in.)</td>
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<td>P</td>
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<td>0</td>
<td>210</td>
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</tbody>
</table>

^ 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

www.moonsindustries.com
ML23HS / PL23HS Series: 1.8° - Size 23

- Phases: 2
- Steps / Revolution: 200
- Step Accuracy: ±5%
- Shaft Load (20,000 Hours at 100 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

Winding
- #:# Current rating x 100

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

Dimensions: mm (in)

For ML23HSC
- Ø8.3±0.012
- 7.5±0.1
- 15
- 5.8±0.1
- 0.228±0.004
- 0.20

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

www.moonsindustries.com
### ML23HS - 4 Lead Bi-Polar

<table>
<thead>
<tr>
<th>Length</th>
<th>Model Number</th>
<th>Connect</th>
<th>Rated Current</th>
<th>Holding Torque Nm</th>
<th>Winding Ohms mH</th>
<th>@20 °C Typ. mNm</th>
<th>Rotor Inertia oz-in²</th>
<th>Motor Weight kg</th>
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<td>1.5</td>
<td>1.50</td>
<td>210</td>
<td>7.6</td>
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<td>^ ML23HSP4220 P</td>
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<td>1.50</td>
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<td>3.6</td>
<td>1.50</td>
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<td>^ ML23HSL4550 L</td>
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<td>1.50</td>
<td>210</td>
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<td></td>
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<tr>
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<td>^ ML23HSP4300 P</td>
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<td>330</td>
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<td>39</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>^ ML2HSL4550 L</td>
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<td>330</td>
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<td>39</td>
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<td>450</td>
<td>5.1</td>
<td>23</td>
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^ Preferred model

### PL23HS - PowerPlus - 4 Lead Bi-Polar

<table>
<thead>
<tr>
<th>Length</th>
<th>Model Number</th>
<th>Connect</th>
<th>Rated Current</th>
<th>Holding Torque Nm</th>
<th>Winding Ohms mH</th>
<th>@20 °C Typ. mNm</th>
<th>Rotor Inertia oz-in²</th>
<th>Motor Weight kg</th>
</tr>
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<tbody>
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<td>330</td>
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<td>3.1</td>
<td>10.7</td>
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<tr>
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<td>^ PL23HSL4550 L</td>
<td>5.5</td>
<td>2.30</td>
<td>310</td>
<td>3.1</td>
<td>10.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>77 mm (3.03 in.) 2 Stack</td>
<td>^ PL23HSP4100 P</td>
<td>1</td>
<td>3.30</td>
<td>470</td>
<td>8.8</td>
<td>32</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>^ PL23HSP4150 P</td>
<td>1.5</td>
<td>3.40</td>
<td>480</td>
<td>8.8</td>
<td>32</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>^ PL23HSP4220 P</td>
<td>2.2</td>
<td>3.30</td>
<td>470</td>
<td>8.8</td>
<td>32</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>^ PL23HSP4300 P</td>
<td>3</td>
<td>3.30</td>
<td>470</td>
<td>8.8</td>
<td>32</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>^ PL23HSL4550 L</td>
<td>5</td>
<td>3.30</td>
<td>470</td>
<td>8.8</td>
<td>32</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

^ Preferred model

### Mating Connector With Leads (order separately)

Dimensions: mm (in)

4 Lead Part Number 4634 1402 01891

Dimensions: mm (in)

```
300±10
(11.8±0.4)

Housing: JST XHP-6
Terminal: SXH-001T-P0.8

AWG22 UL3266
```

www.moonsindustries.com
### 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
  - 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

<table>
<thead>
<tr>
<th>Basic Motor Length (Max)</th>
<th>Options</th>
<th>Winding</th>
</tr>
</thead>
<tbody>
<tr>
<td>46 mm (1.81 in.)</td>
<td>^</td>
<td></td>
</tr>
<tr>
<td>56 mm (2.21 in.)</td>
<td>^</td>
<td></td>
</tr>
<tr>
<td>67 mm (2.64 in.)</td>
<td>^</td>
<td></td>
</tr>
<tr>
<td>87 mm (3.43 in.)</td>
<td>^</td>
<td></td>
</tr>
</tbody>
</table>

**Electrical Connection**
- L Leads
- P Plug-in Connector

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

#### MS24HS – 4 Lead Bi-Polar

<table>
<thead>
<tr>
<th>Length</th>
<th>Model Number</th>
<th>Connect</th>
<th>Rated Current</th>
<th>Holding Torque</th>
<th>Winding Ohms</th>
<th>Detent Torque</th>
<th>Rotor Inertia</th>
<th>Motor Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>46 mm (1.81 in.)</td>
<td>^ MS24HS1P4150</td>
<td>P</td>
<td>1.5</td>
<td>1.28 180</td>
<td>3.2</td>
<td>7.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>^ MS24HS1P4200</td>
<td>P</td>
<td>2</td>
<td>1.26 180</td>
<td>1.69</td>
<td>3.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>^ MS24HS1P4300</td>
<td>P</td>
<td>3</td>
<td>1.23 170</td>
<td>0.73</td>
<td>1.61</td>
<td></td>
<td></td>
</tr>
<tr>
<td>56 mm (2.21 in.)</td>
<td>^ MS24HS2P4150</td>
<td>P</td>
<td>1.5</td>
<td>1.90 270</td>
<td>4</td>
<td>12.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>^ MS24HS2P4200</td>
<td>P</td>
<td>2</td>
<td>1.90 270</td>
<td>2.1</td>
<td>6.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>^ MS24HS2P4300</td>
<td>P</td>
<td>3</td>
<td>1.80 250</td>
<td>0.92</td>
<td>2.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>^ MS24HS2L4420</td>
<td>L</td>
<td>4.2</td>
<td>1.80 250</td>
<td>0.47</td>
<td>1.35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>67 mm (2.64 in.)</td>
<td>^ MS24HS3P4150</td>
<td>P</td>
<td>1.5</td>
<td>2.40 340</td>
<td>4</td>
<td>12.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>^ MS24HS3P4200</td>
<td>P</td>
<td>2</td>
<td>2.30 330</td>
<td>2.2</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>^ MS24HS3P4300</td>
<td>P</td>
<td>3</td>
<td>2.40 340</td>
<td>1.1</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>^ MS24HS3L4420</td>
<td>L</td>
<td>4.2</td>
<td>2.30 330</td>
<td>0.56</td>
<td>1.44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>87 mm (3.43 in.)</td>
<td>^ MS24HS5P4150</td>
<td>P</td>
<td>1.5</td>
<td>3.20 450</td>
<td>4.6</td>
<td>15.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>^ MS24HS5P4200</td>
<td>P</td>
<td>2</td>
<td>3.30 470</td>
<td>2.8</td>
<td>9.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>^ MS24HS5P4300</td>
<td>P</td>
<td>3</td>
<td>3.30 470</td>
<td>1.21</td>
<td>4.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>^ MS24HS5L4420</td>
<td>L</td>
<td>4.2</td>
<td>3.20 450</td>
<td>0.61</td>
<td>1.97</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

^ 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

www.moonsindustries.com
### 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,
  - Radial: 220 N (50 Lbs.) At Flat Center
- **IP Rating**: 40
- **Approvals**: UL Recognized File E465363, RoHS
- **Operating Temp.**: -20°C to +50°C
- **Insulation Class**: B, 130°C

### M L34HD 0 L 8 350 -E

#### Motor Technology
- **M**: High Torque Step Motor
- **P**: PowerPlus Step Motor

#### Basic Motor Length (Max)
- **L** = Leads
- **L** = Parallel

<table>
<thead>
<tr>
<th>Leads</th>
<th>Options</th>
<th>Winding</th>
<th>Number of Connections</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>4 Lead-Bipolar</td>
<td>### for 11 to 19 amps: X## Current rating x 100</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>8 Lead-Unipolar(or Bipolar)</td>
<td>with Encoder Mounting Holes</td>
<td>8</td>
</tr>
</tbody>
</table>

#### ML34HD – 4 Lead & 8 Lead

<table>
<thead>
<tr>
<th>Length</th>
<th>Model Number</th>
<th>Connect</th>
<th>Rated Current</th>
<th>Holding Torque</th>
<th>Winding Ohms</th>
<th>Detent Torque</th>
<th>Rotor Inertia</th>
<th>Motor Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>L</td>
<td>Amps (mounted)</td>
<td>Nm</td>
<td>(@20°C</td>
<td>typ.</td>
<td>oz-in</td>
<td>Typ.</td>
</tr>
<tr>
<td>67 mm (2.64 in.)</td>
<td>ML34HD0L4160</td>
<td>L</td>
<td>1.6</td>
<td>3.70</td>
<td>520</td>
<td>3.9</td>
<td>42</td>
<td>90</td>
</tr>
<tr>
<td>97 mm (3.82 in.)</td>
<td>ML34HD1L4200</td>
<td>L</td>
<td>2</td>
<td>7.20</td>
<td>1,000</td>
<td>3.6</td>
<td>50</td>
<td>150</td>
</tr>
<tr>
<td>126 mm (4.96 in.)</td>
<td>ML34HD2L4200</td>
<td>L</td>
<td>3.5</td>
<td>7.20</td>
<td>1,000</td>
<td>1.34</td>
<td>15.9</td>
<td>200</td>
</tr>
<tr>
<td>157 mm (6.18 in.)</td>
<td>ML34HD3L4200</td>
<td>L</td>
<td>2.3</td>
<td>10.00</td>
<td>1,400</td>
<td>4.1</td>
<td>63</td>
<td>250</td>
</tr>
<tr>
<td>67 mm (2.64 in.)</td>
<td>ML34HD0L8350</td>
<td>L Series</td>
<td>3.5</td>
<td>3.80</td>
<td>540</td>
<td>0.98</td>
<td>9.5</td>
<td>90</td>
</tr>
<tr>
<td>97 mm (3.82 in.)</td>
<td>ML34HD1L8350</td>
<td>L Series</td>
<td>3.5</td>
<td>7</td>
<td>7.20</td>
<td>1,000</td>
<td>1.37</td>
<td>15.9</td>
</tr>
<tr>
<td>126 mm (4.96 in.)</td>
<td>ML34HD2L8350</td>
<td>L Series</td>
<td>3.5</td>
<td>9.90</td>
<td>1,400</td>
<td>1.48</td>
<td>20</td>
<td>200</td>
</tr>
<tr>
<td>157 mm (6.18 in.)</td>
<td>ML34HD3L8350</td>
<td>L Series</td>
<td>3.5</td>
<td>13.2</td>
<td>1,869</td>
<td>1.85</td>
<td>25</td>
<td>250</td>
</tr>
</tbody>
</table>
### PL34HD – PowerPlus – 4 Lead & 8 Lead

#### Dimensions: mm (in)

<table>
<thead>
<tr>
<th>Length</th>
<th>Model Number</th>
<th>Connect</th>
<th>Rated Current</th>
<th>Holding Torque</th>
<th>Winding Ohms mH</th>
<th>Detent Torque</th>
<th>Rotor Inertia</th>
<th>Motor Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Amps (mounted))</td>
<td>(Nm Typ. oz-in TYP.)</td>
<td>@20℃ Typ.</td>
<td>mNm oz-in g cm² oz-in² kg Lbs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>67 mm (2.64 in.) 1 Stack</td>
<td>^ PL34HD0L4160</td>
<td>L</td>
<td>1.6</td>
<td>4.70 670</td>
<td>3.9 33</td>
<td>120 17</td>
<td>915 5 1.6 3.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>^ PL34HD0L4350</td>
<td>L</td>
<td>3.5</td>
<td>4.75 670</td>
<td>0.95 7.6</td>
<td>250 37</td>
<td>1480 8.1 2.7 6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>^ PL34HD0L4500</td>
<td>L</td>
<td>5</td>
<td>4.75 670</td>
<td>0.48 3.6</td>
<td>300 42</td>
<td>2200 12 3.8 8.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>^ PL34HD0L4700</td>
<td>L</td>
<td>7</td>
<td>4.75 670</td>
<td>0.26 1.89</td>
<td>375 53</td>
<td>3740 17 4.9 11</td>
<td></td>
</tr>
<tr>
<td></td>
<td>^ PL34HD0L4X00</td>
<td>L</td>
<td>10</td>
<td>4.75 670</td>
<td>0.138 0.91</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>97 mm (3.82 in.) 2 Stack</td>
<td>^ PL34HD1L4200</td>
<td>L</td>
<td>2</td>
<td>9.20 1,300</td>
<td>3.6 40</td>
<td>120 17</td>
<td>915 5 1.6 3.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>^ PL34HD1L4350</td>
<td>L</td>
<td>3.5</td>
<td>9.00 1,300</td>
<td>1.34 12.8</td>
<td>250 37</td>
<td>1480 8.1 2.7 6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>^ PL34HD1L4500</td>
<td>L</td>
<td>5</td>
<td>9.00 1,300</td>
<td>0.61 6.4</td>
<td>300 42</td>
<td>2200 12 3.8 8.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>^ PL34HD1L4700</td>
<td>L</td>
<td>7</td>
<td>9.00 1,300</td>
<td>0.36 3.2</td>
<td>375 53</td>
<td>3740 17 4.9 11</td>
<td></td>
</tr>
<tr>
<td></td>
<td>^ PL34HD1L4X00</td>
<td>L</td>
<td>10</td>
<td>9.00 1,300</td>
<td>0.188 1.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>126 mm (4.96 in.) 3 Stack</td>
<td>^ PL34HD2L4200</td>
<td>L</td>
<td>2</td>
<td>12.3 1,740</td>
<td>4.1 51</td>
<td>120 17</td>
<td>915 5 1.6 3.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>^ PL34HD2L4350</td>
<td>L</td>
<td>3.5</td>
<td>12.3 1,740</td>
<td>1.44 16.1</td>
<td>250 37</td>
<td>1480 8.1 2.7 6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>^ PL34HD2L4500</td>
<td>L</td>
<td>5</td>
<td>12.3 1,740</td>
<td>0.72 7.5</td>
<td>300 42</td>
<td>2200 12 3.8 8.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>^ PL34HD2L4700</td>
<td>L</td>
<td>7</td>
<td>12.3 1,740</td>
<td>0.38 3.75</td>
<td>375 53</td>
<td>3740 17 4.9 11</td>
<td></td>
</tr>
<tr>
<td></td>
<td>^ PL34HD2L4X00</td>
<td>L</td>
<td>10</td>
<td>12.3 1,740</td>
<td>0.22 1.87</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>157 mm (6.18 in.) 4 Stack</td>
<td>^ PL34HD3L4230</td>
<td>L</td>
<td>2.3</td>
<td>15.00 2,100</td>
<td>3.9 47</td>
<td>120 17</td>
<td>915 5 1.6 3.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>^ PL34HD3L4350</td>
<td>L</td>
<td>3.5</td>
<td>15.00 2,100</td>
<td>1.81 20</td>
<td>250 37</td>
<td>1480 8.1 2.7 6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>^ PL34HD3L4500</td>
<td>L</td>
<td>5</td>
<td>15.00 2,100</td>
<td>0.9 9.4</td>
<td>300 42</td>
<td>2200 12 3.8 8.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>^ PL34HD3L4700</td>
<td>L</td>
<td>7</td>
<td>15.00 2,100</td>
<td>0.47 5</td>
<td>375 53</td>
<td>3740 17 4.9 11</td>
<td></td>
</tr>
<tr>
<td></td>
<td>^ PL34HD3L4X00</td>
<td>L</td>
<td>10</td>
<td>15.00 2,100</td>
<td>0.24 2.3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

www.moonsindustries.com
### 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

#### ML42HS 0 L 8 350

| Winding | Current rating x 100
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>###</td>
<td>100 mm (3.94 in.)</td>
</tr>
<tr>
<td>X##</td>
<td>for 11 to 19 amps:</td>
</tr>
</tbody>
</table>

#### Number of Connections

- **4**: 4 Lead-Bipolar
- **8**: 8 Lead-Unipolar(or Bipolar)

### ML42HS – 4 Lead & 8 Lead

<table>
<thead>
<tr>
<th>Length</th>
<th>Model Number</th>
<th>Connect</th>
<th>Rated Current</th>
<th>Holding Torque</th>
<th>Winding Ohms</th>
<th>Detent Torque</th>
<th>Rotor Inertia</th>
<th>Motor Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Shaft</td>
<td>P=Plug</td>
<td>L=Leads</td>
<td>Amps (mounted)</td>
<td>Nm Typ.</td>
<td>oz-in Typ.</td>
<td>@20°C</td>
<td>Typ.</td>
<td>mNm</td>
</tr>
<tr>
<td>100 mm (3.94 in.)</td>
<td>1 Stack</td>
<td>^ ML42HS0L4210</td>
<td>L</td>
<td>2.1</td>
<td>12.10</td>
<td>1,700</td>
<td>4.1</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ML42HS0L4420</td>
<td>L</td>
<td>4.2</td>
<td>12.20</td>
<td>1,700</td>
<td>1.16</td>
<td>17.4</td>
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<tr>
<td></td>
<td></td>
<td>ML42HS0L4600</td>
<td>L</td>
<td>6</td>
<td>12.30</td>
<td>1,700</td>
<td>0.61</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ML42HS0L4840</td>
<td>L</td>
<td>8.4</td>
<td>12.20</td>
<td>1,700</td>
<td>0.31</td>
<td>4.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ML42HS0L4X20</td>
<td>L</td>
<td>12</td>
<td>12.30</td>
<td>1,700</td>
<td>0.167</td>
<td>2.25</td>
</tr>
<tr>
<td>151 mm (5.94 in.)</td>
<td>2 Stack</td>
<td>^ ML42HS2L4240</td>
<td>L</td>
<td>2.4</td>
<td>22.00</td>
<td>3,100</td>
<td>4.2</td>
<td>76</td>
</tr>
<tr>
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<td>ML42HS2L4600</td>
<td>L</td>
<td>6</td>
<td>22.00</td>
<td>3,100</td>
<td>0.75</td>
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<tr>
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<td>ML42HS2L4800</td>
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<td>8</td>
<td>22.00</td>
<td>3,100</td>
<td>0.41</td>
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<td>ML42HS2L4X20</td>
<td>L</td>
<td>12</td>
<td>22.00</td>
<td>3,100</td>
<td>0.177</td>
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<tr>
<td></td>
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<td>ML42HS2L4X60</td>
<td>L</td>
<td>16</td>
<td>22.00</td>
<td>3,100</td>
<td>0.116</td>
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<tr>
<td>202 mm (7.95 in.)</td>
<td>3 Stack</td>
<td>^ ML42HS3L4270</td>
<td>L</td>
<td>2.7</td>
<td>31.00</td>
<td>4,400</td>
<td>4.2</td>
<td>83.5</td>
</tr>
<tr>
<td></td>
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<td>ML42HS3L4600</td>
<td>L</td>
<td>6</td>
<td>31.00</td>
<td>4,400</td>
<td>1.02</td>
<td>18.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ML42HS3L4800</td>
<td>L</td>
<td>8</td>
<td>32.00</td>
<td>4,500</td>
<td>0.55</td>
<td>10.8</td>
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<tr>
<td></td>
<td></td>
<td>ML42HS3L4X20</td>
<td>L</td>
<td>12</td>
<td>31.00</td>
<td>4,400</td>
<td>0.24</td>
<td>4.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ML42HS3L4X60</td>
<td>L</td>
<td>16</td>
<td>32.00</td>
<td>4,500</td>
<td>0.152</td>
<td>2.7</td>
</tr>
</tbody>
</table>

#### Electrical Connection

- **Basic Motor Length (Max)**:
  - 0: 100mm (3.94 in.)
  - 2: 151mm (5.94 in.)
  - 3: 202mm (7.95 in.)
- **Motor Technology**:
  - **M**: High Torque Step Motor
  - **P**: PowerPlus Step Motor

### Electrical Connection

- **L**: Leads

#### Preferred model

- ^ Preferred model

www.moonsindustries.com
Dimensions: mm (in)

**ML42HS0**

- Bipolar Drive: 320 Vdc, 2.1 A rms
- 160 Vdc, 2.1 A rms
- 72 Vdc, 2.1 A rms

**ML42HS2**

- Bipolar Drive: 320 Vdc, 2.4 A rms
- 160 Vdc, 2.4 A rms
- 72 Vdc, 2.4 A rms

**ML42HS3**

- Bipolar Drive: 320 Vdc, 2.7 A rms
- 160 Vdc, 2.7 A rms
- 72 Vdc, 2.7 A rms

---

**ML42H50L4210**

- 320 Vdc, 2.1 A rms
- 160 Vdc, 2.1 A rms
- 72 Vdc, 2.1 A rms

**ML42H50L4240**

- 320 Vdc, 2.4 A rms
- 160 Vdc, 2.4 A rms
- 72 Vdc, 2.4 A rms

**ML42H50L4270**

- 320 Vdc, 2.7 A rms
- 160 Vdc, 2.7 A rms
- 72 Vdc, 2.7 A rms

---

**ML42H50L4420**

- 160 Vdc, 3.7 A rms
- 72 Vdc, 4.3 A rms
- 48 Vdc, 5.5 A rms

**ML42H50L4600**

- 160 Vdc, 4.5 A rms
- 72 Vdc, 5.7 A rms
- 48 Vdc, 6.6 A rms

**ML42H50L4800**

- 160 Vdc, 5.4 A rms
- 72 Vdc, 6.8 A rms
- 48 Vdc, 8.8 A rms

**ML42H50L4840**

- 160 Vdc, 6.2 A rms
- 72 Vdc, 7.7 A rms
- 48 Vdc, 9.7 A rms

---

**ML42H50L4860**

- 160 Vdc, 6.8 A rms
- 72 Vdc, 8.4 A rms
- 48 Vdc, 10.2 A rms

---

**AWG18 UL3266**

- 200 x 10 (11.8 x 0.4)
# 17HC Series: 1.2° - Size 17, 3 Phase Encapsulated

## 17HC – 3 Phase

<table>
<thead>
<tr>
<th>Length</th>
<th>Model Number</th>
<th>Connect</th>
<th>Rated Current</th>
<th>Holding Torque</th>
<th>Winding Ohms</th>
<th>Detent Torque</th>
<th>Rotor Inertia</th>
<th>Motor Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>34 mm</td>
<td>17HC2005N</td>
<td>P</td>
<td>0.8</td>
<td>0.36</td>
<td>51</td>
<td>11</td>
<td>14</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>17HC2006N</td>
<td>P</td>
<td>1.5</td>
<td>0.36</td>
<td>51</td>
<td>3.6</td>
<td>4.9</td>
<td></td>
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<tr>
<td></td>
<td>17HC2002N</td>
<td>P</td>
<td>2.3</td>
<td>0.36</td>
<td>51</td>
<td>1.65</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>43 mm</td>
<td>17HC6003N</td>
<td>P</td>
<td>0.82</td>
<td>0.46</td>
<td>65</td>
<td>14.3</td>
<td>21</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>17HC6004N</td>
<td>P</td>
<td>1.5</td>
<td>0.46</td>
<td>65</td>
<td>4.35</td>
<td>6.5</td>
<td></td>
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<tr>
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<td>17HC6005N</td>
<td>P</td>
<td>2.3</td>
<td>0.46</td>
<td>65</td>
<td>1.85</td>
<td>2.7</td>
<td></td>
</tr>
</tbody>
</table>

| Preferred model |

## Dimensions: mm (in)

<table>
<thead>
<tr>
<th>L Max.</th>
<th>17HC2=34 (1.34)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ø22.3±0.12</td>
<td>(Ø0.866±0.005)</td>
</tr>
<tr>
<td>16</td>
<td>(0.591)</td>
</tr>
<tr>
<td>4.5±0.1</td>
<td>(0.177±0.004)</td>
</tr>
<tr>
<td>Ø5.0±0.12</td>
<td>(Ø0.1969±0.0005)</td>
</tr>
<tr>
<td>H Max.</td>
<td>11.1</td>
</tr>
<tr>
<td></td>
<td>(0.44)</td>
</tr>
<tr>
<td></td>
<td>4.5±0.1</td>
</tr>
<tr>
<td>Ø44.3 Max.</td>
<td>(Ø1.744 Max.)</td>
</tr>
<tr>
<td>Pin 1</td>
<td>JST S3B-PH-K-S(LF)(SN)</td>
</tr>
<tr>
<td>Depth</td>
<td>4.5±0.1</td>
</tr>
<tr>
<td>2-M3</td>
<td>(M10)</td>
</tr>
<tr>
<td>Ø44.3 Max.</td>
<td>(Ø1.744 Max.)</td>
</tr>
<tr>
<td>Pin 1</td>
<td>JST S3B-PH-K-S(LF)(SN)</td>
</tr>
</tbody>
</table>

## Mating Connector With Leads (order separately)

Dimensions: mm (in)

3 Lead Part Number 4634 1402 04496

- Housing: JST PHR-3
- Terminal: JST SPW-003T-P0.5S
- AWG26 UL3266

www.moonsindustries.com
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

www.moonsindustries.com
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
  - At Flat Center: 70 N (15.5 Lbs.)
- IP Rating: 40
- Approvals: RoHS
- Operating Temp.: -20°C to +50°C
- Insulation Class: B, 130°C
- Insulation Resistance: 100 MegOhms

**ML24HC 4 P 3 150 -E**

**Motor Technology**
- M: High Torque Step Motor
- P: PowerPlus Step Motor
- Basic Motor Length (Max):
  - 4: 45mm (1.77 in.) 1 Stack
  - 8: 55mm (2.17 in.)
  - A: 77mm (3.03 in.) 2 Stack

**Electrical Connection**
- L: Leads
- P: Plug-In Connector

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

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

**Number of Connections**
- 3: 3 Lead-Bipolar

**Dimensions: mm (in)**

- L Max
  - ML24HC4 = 45.5(1.79)
  - ML24HC8 = 55.5(2.17)
  - ML24HCA = 77.5(3.05)
- Ø6.35 ±0.012 (Ø0.250 ±0.0005)
- 4-Ø4.5 ±0.012 (4-Ø0.177 ±0.0005)
- 5.1 (0.20)
- 1.5 (0.06)
- 6 (0.24)
- 11.5 (0.45)
- 20.6 ±0.5 (0.811 ±0.020)
- 15 (0.591)
- 5.8 ±0.1 (0.228 ±0.004)
- Ø36 ±0.05 (Ø1.417 ±0.002)
- 0.635 ±0.013 (0.025 ±0.0005)
- 5 (2.00)

**Optional Rear Shaft Extension Includes Encoder Mounting:**
- 2-M2.5 on Ø19.05(0.75) Bolt Circle (In Rear Endbell)

**Electrical Connection**
- Pin 1: JST S7B-XH-A-1(LF)(SN)

**Technical**

- 2 Phase Step Motors
- 3 Phase Step Motors
- MOONS’ Technology

www.moonsindustries.com

MOONS’ moving in better ways
### ML24HC – 3 Phase

<table>
<thead>
<tr>
<th>Length</th>
<th>Model Number</th>
<th>Connect</th>
<th>Rated Current</th>
<th>Holding Torque</th>
<th>Winding Ohms</th>
<th>Detent Torque</th>
<th>Motor Inertia</th>
<th>Motor Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Single Shaft</td>
<td></td>
<td>P=Plug L=Leads</td>
<td>Amps (mounted)</td>
<td>Nm Typ.</td>
<td>oz-in Typ.</td>
<td>@20 °C Typ.</td>
<td>mNm</td>
</tr>
<tr>
<td>45 mm (1.77 in.)</td>
<td>PL24HC4P3150</td>
<td>P</td>
<td>1.5</td>
<td>0.72</td>
<td>100</td>
<td>4.8</td>
<td>7.9</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>PL24HC4P3230</td>
<td>P</td>
<td>2.3</td>
<td>0.72</td>
<td>100</td>
<td>2.1</td>
<td>3.4</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>PL24HC4L3410</td>
<td>L</td>
<td>4.1</td>
<td>0.72</td>
<td>100</td>
<td>0.67</td>
<td>1.05</td>
<td>45</td>
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<tr>
<td></td>
<td>PL24HC8P3150</td>
<td>P</td>
<td>1.5</td>
<td>0.97</td>
<td>140</td>
<td>6</td>
<td>15.1</td>
<td>45</td>
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<tr>
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<td>PL24HC8P3220</td>
<td>P</td>
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<td>0.97</td>
<td>140</td>
<td>2.7</td>
<td>5.5</td>
<td>21</td>
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<tr>
<td></td>
<td>PL24HC8L3350</td>
<td>L</td>
<td>3.5</td>
<td>0.97</td>
<td>140</td>
<td>1.15</td>
<td>2.7</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>PL24HC8L3550</td>
<td>L</td>
<td>5.5</td>
<td>0.97</td>
<td>140</td>
<td>0.51</td>
<td>1.05</td>
<td>21</td>
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</table>

### PL24HC - PowerPlus – 3 Phase

<table>
<thead>
<tr>
<th>Length</th>
<th>Model Number</th>
<th>Connect</th>
<th>Rated Current</th>
<th>Holding Torque</th>
<th>Winding Ohms</th>
<th>Detent Torque</th>
<th>Motor Inertia</th>
<th>Motor Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Single Shaft</td>
<td></td>
<td>P=Plug L=Leads</td>
<td>Amps (mounted)</td>
<td>Nm Typ.</td>
<td>oz-in Typ.</td>
<td>@20 °C Typ.</td>
<td>mNm</td>
</tr>
<tr>
<td>45 mm (1.77 in.)</td>
<td>PL24HC4P3150</td>
<td>P</td>
<td>1.5</td>
<td>0.87</td>
<td>120</td>
<td>4.8</td>
<td>7.9</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>PL24HC4P3230</td>
<td>P</td>
<td>2.3</td>
<td>0.87</td>
<td>120</td>
<td>2.1</td>
<td>3.4</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>PL24HC4L3410</td>
<td>L</td>
<td>4.1</td>
<td>0.87</td>
<td>120</td>
<td>0.67</td>
<td>1.05</td>
<td>55</td>
</tr>
<tr>
<td>55 mm (2.17 in.)</td>
<td>PL24HC8P3150</td>
<td>P</td>
<td>1.5</td>
<td>1.40</td>
<td>200</td>
<td>6</td>
<td>12.2</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>PL24HC8P3220</td>
<td>P</td>
<td>2.2</td>
<td>1.40</td>
<td>200</td>
<td>2.7</td>
<td>5.5</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>PL24HC8L3350</td>
<td>L</td>
<td>3.5</td>
<td>1.40</td>
<td>200</td>
<td>1.15</td>
<td>2.1</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>PL24HC8L3550</td>
<td>L</td>
<td>5.5</td>
<td>1.40</td>
<td>200</td>
<td>0.51</td>
<td>0.9</td>
<td>90</td>
</tr>
<tr>
<td>77 mm (3.03 in.)</td>
<td>PL24HCAP3150</td>
<td>P</td>
<td>1.5</td>
<td>2.30</td>
<td>330</td>
<td>7.3</td>
<td>15.7</td>
<td>150</td>
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<td>PL24HCAP3220</td>
<td>P</td>
<td>2.2</td>
<td>2.30</td>
<td>330</td>
<td>3.6</td>
<td>7.4</td>
<td>150</td>
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<tr>
<td></td>
<td>PL24HCAL3340</td>
<td>L</td>
<td>3.4</td>
<td>2.30</td>
<td>330</td>
<td>1.6</td>
<td>3</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td>PL24HCAL3550</td>
<td>L</td>
<td>5.5</td>
<td>2.30</td>
<td>330</td>
<td>0.64</td>
<td>1.15</td>
<td>150</td>
</tr>
</tbody>
</table>

^Preferred model

### Mating Connector With Leads (order separately)

Dimensions: mm (in)

<table>
<thead>
<tr>
<th>3 Lead Part Number 4634 1402 04485</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>300×10 (11.8×0.4)</td>
<td></td>
</tr>
<tr>
<td>HOUSING: JST XHP-7</td>
<td></td>
</tr>
<tr>
<td>TERMINAL: JST SXH-001T-P0.6</td>
<td></td>
</tr>
<tr>
<td>WHITE</td>
<td></td>
</tr>
<tr>
<td>RED</td>
<td></td>
</tr>
<tr>
<td>GREEN</td>
<td></td>
</tr>
</tbody>
</table>

www.moonsindustries.com
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
  - Radial: 155 N (35 Lbs.) Pull
  - At Flat Center: 220 N (50 Lbs.)
- IP Rating: 40
- Approvals: RoHS
- Operating Temp.: -20°C to +50°C
- Insulation Class: B, 130°C
- Insulation Resistance: 100 MegOhms

34HC - 3 Phase

<table>
<thead>
<tr>
<th>Length</th>
<th>Model Number</th>
<th>Connect</th>
<th>Rated Current</th>
<th>Holding Torque</th>
<th>Winding Ohms mH</th>
<th>Detent Torque</th>
<th>Rotor Inertia g cm² oz-in</th>
<th>Motor Weight kg Lbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>67 mm (2.64 in.)</td>
<td>^ 34HC0309</td>
<td>L</td>
<td>2</td>
<td>2.80</td>
<td>400</td>
<td>5</td>
<td>19.1</td>
<td>100 14</td>
</tr>
<tr>
<td>1 Stack</td>
<td>^ 34HC0310</td>
<td>L</td>
<td>3</td>
<td>2.80</td>
<td>400</td>
<td>2.3</td>
<td>8.4</td>
<td>0.54 1.95</td>
</tr>
<tr>
<td></td>
<td>^ 34HC0305</td>
<td>L</td>
<td>5.8</td>
<td>2.70</td>
<td>380</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>96.5 mm (3.8 in.)</td>
<td>^ 34HC1308</td>
<td>L</td>
<td>2</td>
<td>5.40</td>
<td>760</td>
<td>6</td>
<td>28</td>
<td>230 33</td>
</tr>
<tr>
<td>2 Stack</td>
<td>^ 34HC1309</td>
<td>L</td>
<td>3</td>
<td>5.30</td>
<td>750</td>
<td>2.5</td>
<td>12</td>
<td>0.62 2.7</td>
</tr>
<tr>
<td></td>
<td>^ 34HC1305</td>
<td>L</td>
<td>5.8</td>
<td>5.00</td>
<td>710</td>
<td>0</td>
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<td></td>
</tr>
<tr>
<td>126 mm (4.96 in.)</td>
<td>^ 34HC2310</td>
<td>L</td>
<td>2</td>
<td>6.70</td>
<td>950</td>
<td>6.8</td>
<td>36</td>
<td>350 50</td>
</tr>
<tr>
<td>3 Stack</td>
<td>^ 34HC2311</td>
<td>L</td>
<td>3</td>
<td>6.80</td>
<td>960</td>
<td>3.3</td>
<td>16.8</td>
<td>0.98 4.5</td>
</tr>
<tr>
<td></td>
<td>^ 34HC2306</td>
<td>L</td>
<td>5.8</td>
<td>6.80</td>
<td>960</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

^ Preferred model

Dimensions: mm (in)
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, conveyers, assembly, labeling
  - telecommunication: phase shift, Tuning, mobile antenna positioning
  - security: camera movement
  - automotive: fuel metering, steering control

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

• Performance Features of MOONS’ Stepping Motors
  • Accurate Position Control
    The number of control pulses defines the motor shaft position. Position error is very small (less than 1/10th of a degree), and non cumulative.

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

  • Forward & Reverse, Pause and Holding Function
    Motor torque and position control is effective throughout the entire speed range, including zero speed holding torque. The zero speed holding torque locks the shaft at the desired position to hold the load in place.

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

  • Long Life
    The brushless design of step motors leads to motors with a very long life. Step motor life is usually determined by the life of the bearings.
Step Motor Basics – Structure & Operation

• Basic Structure

- Front endbell
- Shaft
- Magnet
- Ball bearing
- Stator Laminations
- Spring Washer
- Ball bearing
- Rotor Laminations
- Winding Insulator
- Winding Insulator
- Rotor Laminations
- Stator Assembly
- Screw
- Rear Endbell
- Winding Insulator
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Load Calculations & Tips for Using Step Motors

**Load Calculations**

Torque load (Tf)
\[ T_f = G \times r \]
G: weight  
r: radius

Inertia load (TJ)
\[ T_J = J \times \frac{dw}{dt} \]
J = M * (R1^2 + R2^2) / 2 (Kg * cm)  
M: mass  
R1: outside radius  
R2: inside radius  
dw/dt: angular acceleration

**Speed-Torque Characteristics**

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

A. Working frequency point express the stepping motors rotational speed versus the drive pulse rate.
\[ n = q \times \frac{Hz}{360 \times D} \]
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 TL, it has to be accelerated from F0 to F1 in the shortest time (tr), what is the value of tr?
  (1). Generally TJ = 70%Tm
  (2). \( tr = 1.8 \times 10^{-5} \times J \times q \times (F1-F0)/(TJ-TL) \)
  (3). \( F(t) = (F1-F0) \times t/tr + F0, \; 0<t<tr \)

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

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

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

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

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

  C. Use 0.9° 2 phase step motor, or a three phase step motor.
Step Sequence & Schematic Diagrams

- **2 Phase Motors**

**Bipolar, Full Step**

<table>
<thead>
<tr>
<th>STEP</th>
<th>Phase 1</th>
<th>Phase 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>C</td>
</tr>
<tr>
<td>1</td>
<td>+</td>
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<tr>
<td>4</td>
<td>+</td>
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CW & CCW rotation when seen from flange side of the motor.

**Unipolar, Full step**

<table>
<thead>
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<th>Phase 1</th>
<th>Phase 2</th>
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</thead>
<tbody>
<tr>
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<td>C</td>
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<tr>
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<td>-</td>
<td>+</td>
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CW & CCW rotation when seen from flange side of the motor.

- **4 Lead (bipolar)**

<table>
<thead>
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<th>Connector Pin #</th>
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<tr>
<td>BLK 1</td>
<td>1 A</td>
</tr>
<tr>
<td>GRN 3</td>
<td>5 C</td>
</tr>
<tr>
<td>RED 4</td>
<td>7 B</td>
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<tr>
<td>BLU 6</td>
<td>11 D</td>
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- **6 Lead (unipolar)**

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<td>3 O</td>
</tr>
<tr>
<td>GRN 3</td>
<td>5 C</td>
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<tr>
<td>RED 4</td>
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<tr>
<td>WHT 5</td>
<td>9 M</td>
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<tr>
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<td>11 D</td>
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- **8 Lead**

**8 Lead Connection Options**

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<th>Unipolar</th>
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<tr>
<td>D</td>
<td>D</td>
<td>M</td>
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- **8 lead Motors**

<table>
<thead>
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<th>Connector Pin #</th>
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<tbody>
<tr>
<td>3 A</td>
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<tr>
<td>7 O</td>
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<tr>
<td>4 C</td>
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<tr>
<td>8 C</td>
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<td>6 B</td>
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<tr>
<td>5 M</td>
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<td>1 D</td>
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- **3 Phase Motors**

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<tbody>
<tr>
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<td>3</td>
<td>+</td>
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<tr>
<td>4</td>
<td>+</td>
</tr>
<tr>
<td>5</td>
<td>+</td>
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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 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.

![Bearing Life & Shaft Loading Graphs](image-url)
## Conversion Factors

### Length

<table>
<thead>
<tr>
<th>A</th>
<th>mm</th>
<th>cm</th>
<th>m</th>
<th>inch</th>
<th>feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>mm</td>
<td>--</td>
<td>0.1</td>
<td>0.001</td>
<td>0.03937</td>
<td>0.003281</td>
</tr>
<tr>
<td>cm</td>
<td>10</td>
<td>--</td>
<td>0.01</td>
<td>0.3937</td>
<td>0.03281</td>
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<tr>
<td>m</td>
<td>1,000</td>
<td>100</td>
<td>--</td>
<td>39.37</td>
<td>3.281</td>
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<tr>
<td>inch</td>
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<td>2.54</td>
<td>0.0254</td>
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<td>0.08333</td>
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<tr>
<td>feet</td>
<td>304.8</td>
<td>30.48</td>
<td>0.348</td>
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Multiply "A" units by conversion factor to obtain "B" units

### Force

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<thead>
<tr>
<th>A</th>
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<th>kgf</th>
<th>oz</th>
<th>lb</th>
<th>Newton</th>
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<tbody>
<tr>
<td>g</td>
<td>--</td>
<td>0.001</td>
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<td>kgf</td>
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<td>35.27</td>
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<tr>
<td>oz</td>
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<td>0.0625</td>
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<tr>
<td>Newton</td>
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<td>0.102</td>
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### Torque

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<th>Ncm</th>
<th>mNm</th>
<th>kgm*</th>
<th>kgcm*</th>
<th>gcm*</th>
<th>oz-in</th>
<th>lb-ft</th>
<th>lb-in</th>
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<tr>
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<td>Ncm</td>
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<td>102</td>
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<td>--</td>
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<td>0.00102</td>
<td>1.0102</td>
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<td>kgm*</td>
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<td>980.7</td>
<td>9807</td>
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<td>100</td>
<td>100,000</td>
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<td>kgcm*</td>
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<td>--</td>
<td>1,000</td>
<td>13.89</td>
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### Inertia

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<th>lb-in²</th>
<th>lb-ft²</th>
<th>lb-ft² (slug ft²)</th>
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