

# M2 / P2 Series Stepper Motors

## General Specifications

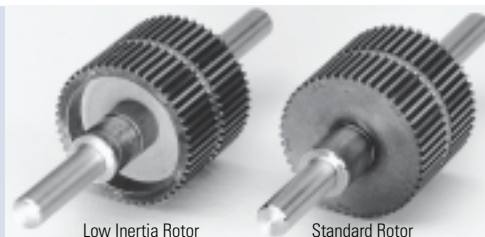


- NEMA Size 23
- Standard (P) and enhanced (M) using SIGMAX technology
- Standard laminated and low inertia “-J” rotors for maximum acceleration
- Standard NEMA mounting
- Oversized 30 mm bearings
- CE compliant
- Unipolar or Bipolar windings
- Features: integral electrical receptacle, smooth or flat shaft
- Options: leadwire connection, rear shaft extension, encoder mounting provisions, 500 or 512 ppr encoder
- Custom Motors

|   |                      |
|---|----------------------|
| Phases                                    | 2 and 4              |
| Full Steps per Revolution                 | 200                  |
| Step Angle                                | 1.8°                 |
| Step Accuracy (of one full step, no load) | ± 1.5 % M<br>± 3 % P |
| Operating Temperature                     | -20°C to +40°C       |
| Insulation Class                          | Class B, 130°C       |
| Insulation Voltage Rating                 | 340 Vdc              |
| Insulation Resistance                     | 100 Megohms          |

### Rotor Inertia Characteristics

Single and double stack motors are available with both standard and low inertia “-J” rotors. Choose low inertia to produce the highest acceleration rates possible. Low inertia motors are most effective for operation below 2,000 RPM. Choose standard to generate maximum torque.

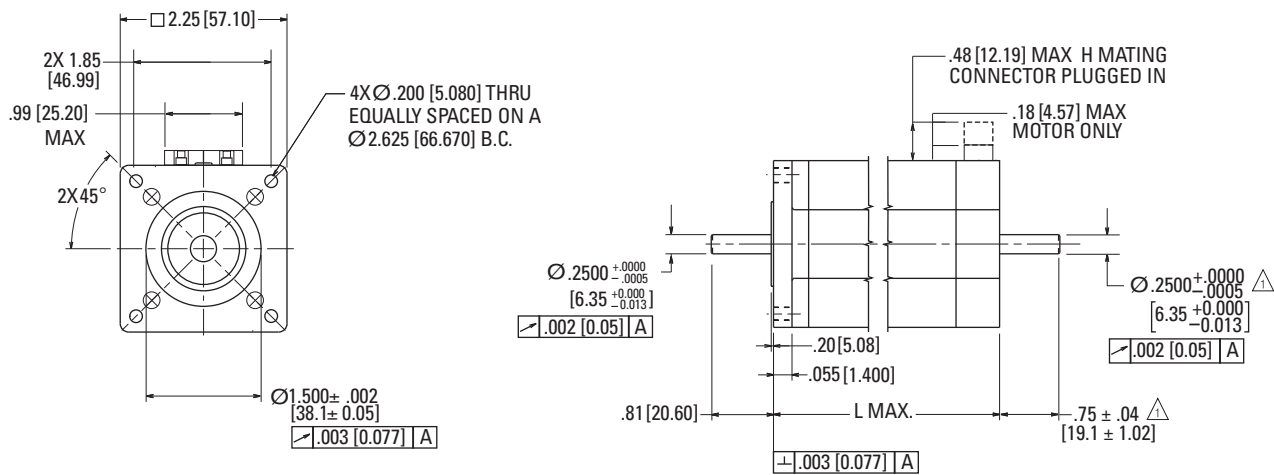


Low Inertia Rotor

Standard Rotor

## M2 / P2 Series Outline Drawings

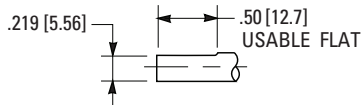
### M2 / P2 Regular Construction Hookup



| Motor Model | L Max.      |
|-------------|-------------|
| P2H         | 1.60 [40.7] |
| P or M21    | 2.06 [52.3] |
| P or M22    | 3.10 [78.7] |

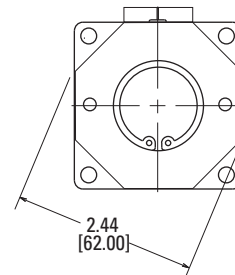
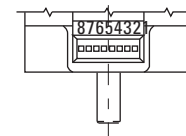
Dimensions in inches [mm]

### Standard Shaft Options

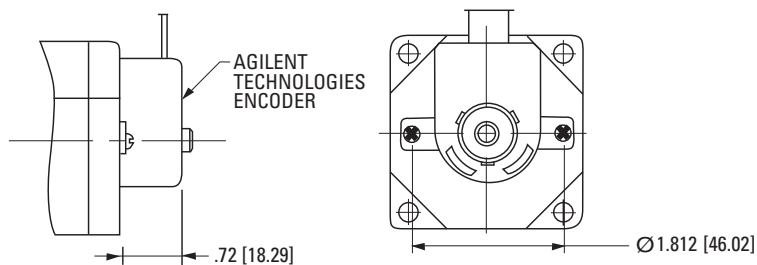


△ Optional rear shaft extension available as shown. Same diameter as front shaft extension.

1. Shaft modifications also available.
2. Optional flat available on front shaft as shown.



### Encoder Option



Dimensions in inches [mm]

# M2 / P2 Series Stepper Motors

## M2 / P2 Performance Data

|                  | Motor Model Number | Config.   |        |          | Holding Torque<br>(2 phases on)<br>oz-in (Nm)<br>+/-10% | Rated Current/<br>Phase<br>Amps DC | Phase Resistance<br>Ohms<br>+/-10% | Phase Inductance<br>mH<br>Typical | Detent Torque<br>oz-in<br>(Nm) | Thermal Resistance<br>Mounted<br>°C/Watt | Rotor Inertia<br>oz-in-s <sup>2</sup><br>(kg-m <sup>2</sup><br>x10 <sup>-3</sup> ) | Weight<br>lb<br>(kg) | Shaft Loading* |             |
|------------------|--------------------|-----------|--------|----------|---|------------------------------------|------------------------------------|-----------------------------------|--------------------------------|--|--|----------------------|----------------|-------------|
|                  |                    | Parallel  | Series | Unipolar |   |                                    |                                    |                                   |                                |  |  |                      | Radial Force   | Axial Force |
|                  |                    |           |        |          |   |                                    |                                    |                                   |                                |  |  | lb<br>(N)            | lb<br>(N)      |             |
| Short Stack      | P2HxxxH-L          | •         |        |          | 59 (0.42)   | 5.2                                | 0.22                               | 0.50                              | 2.5<br>(0.018)                 | 6.6                                      | 0.0010<br>(0.0071)   | 1.0<br>(0.45)        | 20<br>(89)     | 13<br>(58)  |
|                  | P2HxxxH-L          |           | •      |          |   | 2.6                                | 0.90                               | 1.9                               |                                |  |  |                      |                |             |
|                  | P2HxxxB-L          | •         |        |          |   | 2.6                                | 0.76                               | 1.9                               |                                |  |  |                      |                |             |
|                  | P2HxxxB-L          |           | •      |          | 59 (0.42)   | 1.3                                | 3.04                               | 7.6                               |                                |  |  |                      |                |             |
|                  | P2HxxxC-L          | •         |        |          |   | 2.5                                | 0.84                               | 2.3                               |                                |  |  |                      |                |             |
|                  | P2HxxxC-L          |           | •      |          |   | 1.25                               | 3.36                               | 9.2                               |                                |  |  |                      |                |             |
|                  | P2HxxxF-L          | •         |        |          | 60 (0.42)   | 1.61                               | 1.92                               | 5.1                               |                                |  |  |                      |                |             |
|                  | P2HxxxF-L          |           | •      |          |   | 0.8                                | 7.68                               | 20.4                              |                                |  |  |                      |                |             |
|                  | P2HxxxH-L          |           |        | •        |   | 3.68                               | 0.44                               | 0.50                              |                                |  |  |                      |                |             |
|                  | P2HxxxB-L          |           |        | •        | 42 (0.30)   | 1.84                               | 1.52                               | 1.9                               |                                |  |  |                      |                |             |
|                  | P2HxxxC-L          |           |        | •        |   | 1.77                               | 1.68                               | 2.3                               |                                |  |  |                      |                |             |
| P2HxxxF-L        |                    |           | •      | 1.1      |   | 3.84                               | 5.1                                |                                   |                                |  |  |                      |                |             |
| 1Stack           | P21xxxA-L          | •         |        |          | 114 (0.81)  | 5.6                                | 0.23                               | 0.80                              | 4.0<br>(0.028)                 | 5.5                                      | 0.0017<br>(0.012)  | 1.5<br>(0.68)        | 20<br>(89)     | 13<br>(58)  |
|                  | P21xxxA-L          |           | •      |          |   | 2.8                                | 0.92                               | 3.2                               |                                |  |  |                      |                |             |
|                  | P21xxxB-L          | •         |        |          | 111 (0.78)  | 4.6                                | 0.32                               | 1.1                               |                                |  |  |                      |                |             |
|                  | P21xxxB-L          |           | •      |          |   | 2.3                                | 1.28                               | 4.4                               |                                |  |  |                      |                |             |
|                  | P21xxxC-L          | •         |        |          | 116 (0.82)  | 3.5                                | 0.53                               | 2.3                               |                                |  |  |                      |                |             |
|                  | P21xxxC-L          |           | •      |          |   | 1.75                               | 2.12                               | 9.2                               |                                |  |  |                      |                |             |
|                  | P21xxxD-L          | •         |        |          | 109 (0.77)  | 1.51                               | 2.61                               | 10.3                              |                                |  |  |                      |                |             |
|                  | P21xxxD-L          |           | •      |          |   | 0.76                               | 10.4                               | 41.2                              |                                |  |  |                      |                |             |
|                  | P21xxxA-L          |           |        | •        | 81 (0.57)   | 4.0                                | 0.46                               | 0.80                              |                                |  |  |                      |                |             |
|                  | P21xxxB-L          |           |        | •        | 79 (0.56)   | 3.3                                | 0.64                               | 1.1                               |                                |  |  |                      |                |             |
|                  | P21xxxC-L          |           |        | •        | 82 (0.58)   | 2.5                                | 1.06                               | 2.3                               |                                |  |  |                      |                |             |
|                  | P21xxxD-L          |           |        | •        | 77 (0.54)   | 1.07                               | 5.22                               | 10.3                              |                                |  |  |                      |                |             |
|                  | Low Inertia        | P21xxxA-J | •      |          |   | 111 (0.78)                         | 5.6                                | 0.23                              |                                |  |  |                      |                |             |
| P21xxxA-J        |                    |           | •      |          | 2.8   |                                    | 0.92                               | 3.6                               |                                |  |  |                      |                |             |
| P21xxxA-J        |                    |           |        | •        | 79 (0.56)   |                                    | 4.0                                | 0.46                              | 0.90                           |  |  |                      |                |             |
| Enhanced 1 Stack | M21xxxA-L          | •         |        |          | 142 (1.00)  | 5.6                                | 0.23                               | 0.70                              | 9.4<br>(0.66)                  | 5.5                                      | 0.0017<br>(0.012)  | 1.5<br>(0.68)        | 20<br>(89)     | 13<br>(58)  |
|                  | M21xxxA-L          |           | •      |          |   | 2.8                                | 0.92                               | 2.8                               |                                |  |  |                      |                |             |
|                  | M21xxxB-L          | •         |        |          | 137 (0.97)  | 4.6                                | 0.32                               | 1.0                               |                                |  |  |                      |                |             |
|                  | M21xxxB-L          |           | •      |          |   | 2.3                                | 1.28                               | 4.0                               |                                |  |  |                      |                |             |
|                  | M21xxxC-L          | •         |        |          | 144 (1.02)  | 3.5                                | 0.53                               | 2.0                               |                                |  |  |                      |                |             |
|                  | M21xxxC-L          |           | •      |          |   | 1.75                               | 2.12                               | 8.0                               |                                |  |  |                      |                |             |
|                  | M21xxxD-L          | •         |        |          | 135 (0.95)  | 1.51                               | 2.61                               | 8.7                               |                                |  |  |                      |                |             |
|                  | M21xxxD-L          |           | •      |          |   | 0.76                               | 10.4                               | 34.8                              |                                |  |  |                      |                |             |
|                  | M21xxxA-L          |           |        | •        | 100 (0.71)  | 4.0                                | 0.46                               | 0.70                              |                                |  |  |                      |                |             |
|                  | M21xxxB-L          |           |        | •        | 97 (0.68)   | 3.3                                | 0.64                               | 1.0                               |                                |  |  |                      |                |             |
|                  | M21xxxC-L          |           |        | •        | 102 (0.72)  | 2.5                                | 1.06                               | 2.0                               |                                |  |  |                      |                |             |
|                  | M21xxxD-L          |           |        | •        | 95 (0.67)   | 1.07                               | 5.22                               | 8.7                               |                                |  |  |                      |                |             |
|                  | Low Inertia        | M21xxxA-J | •      |          |   | 140 (0.99)                         | 5.6                                | 0.23                              |                                |  |  |                      |                |             |
| M21xxxA-J        |                    |           | •      |          | 2.8   |                                    | 0.92                               | 2.8                               |                                |  |  |                      |                |             |
| M21xxxA-J        |                    |           |        | •        | 99 (0.70)   |                                    | 4.0                                | 0.46                              | 0.70                           |  |  |                      |                |             |

Note: \*Maximum shaft loading based on 20,000 hours of operation at 1500 rpm.

Continued on page 45.

### M2 / P2 Performance Data (continued)

|                  | Motor Model Number | Config.  |        |          | Holding Torque<br>(2 phases on) | Rated Current/<br>Phase | Phase Resistance | Phase Inductance | Detent Torque | Thermal Resistance | Rotor Inertia  | Weight        | Shaft Loading* |            |
|------------------|--------------------|----------|--------|----------|---------------------------------|-------------------------|------------------|------------------|---------------|--------------------|--|---------------|----------------|------------|
|                  |                    | Parallel | Series | Unipolar | oz-in<br>(Nm)<br>+/-10%         | Amps<br>DC              | Ohms<br>+/-10%   | mH<br>Typical    | oz-in<br>(Nm) | Mounted<br>°C/Watt | oz-in-s <sup>2</sup><br>(kg-m <sup>2</sup><br>x 10 <sup>-3</sup> ) | lb<br>(kg)    | lb<br>(N)      | lb<br>(N)  |
|                  |                    |          |        |          |                                 |                         |                  |                  |               |                    |  |               |                |            |
| 2 Stack          | P22xxxA-L          | •        |        |          | 197 (1.39)                      | 6.5                     | 0.21             | 0.80             | 17<br>(0.12)  | 4.5                | 0.0036<br>(0.025)  | 2.5<br>(1.13) | 20<br>(89)     | 13<br>(58) |
|                  | P22xxxA-L          |          | •      |          |                                 | 3.3                     | 0.84             | 3.2              |               |                    |  |               |                |            |
|                  | P22xxxB-L          | •        |        |          | 214 (1.51)                      | 4.6                     | 0.38             | 2.1              |               |                    |  |               |                |            |
|                  | P22xxxB-L          |          | •      |          |                                 | 2.3                     | 1.52             | 8.4              |               |                    |  |               |                |            |
|                  | P22xxxC-L          | •        |        |          | 203 (1.43)                      | 3.1                     | 0.78             | 3.9              |               |                    |  |               |                |            |
|                  | P22xxxC-L          |          | •      |          |                                 | 1.55                    | 3.12             | 15.6             |               |                    |  |               |                |            |
|                  | P22xxxD-L          | •        |        |          | 203 (1.43)                      | 2.5                     | 1.22             | 6.2              |               |                    |  |               |                |            |
|                  | P22xxxD-L          |          | •      |          |                                 | 1.25                    | 4.88             | 24.8             |               |                    |  |               |                |            |
|                  | P22xxxE-L          | •        |        |          | 195 (1.38)                      | 1.64                    | 2.7              | 12.6             |               |                    |  |               |                |            |
|                  | P22xxxE-L          |          | •      |          |                                 | 0.82                    | 10.8             | 50.4             |               |                    |  |               |                |            |
|                  | P22xxxA-L          |          |        | •        | 139 (0.98)                      | 4.6                     | 0.42             | 0.80             |               |                    |  |               |                |            |
|                  | P22xxxB-L          |          |        | •        | 151 (1.07)                      | 3.3                     | 0.76             | 2.1              |               |                    |  |               |                |            |
|                  | P22xxxC-L          |          |        | •        | 144 (1.01)                      | 2.2                     | 1.56             | 3.9              |               |                    |  |               |                |            |
|                  | P22xxxD-L          |          |        | •        | 144 (1.01)                      | 1.77                    | 2.44             | 6.2              |               |                    |  |               |                |            |
|                  | P22xxxE-L          |          |        | •        | 138 (0.97)                      | 1.16                    | 5.4              | 12.6             |               |                    |  |               |                |            |
| Low Inertia      | P22xxxB-J          | •        |        |          | 201 (1.42)                      | 4.6                     | 0.38             | 1.8              | 17<br>(0.12)  | 4.5                | 0.0026<br>(0.018)  | 2.5<br>(1.13) | 20<br>(89)     | 13<br>(58) |
|                  | P22xxxB-J          |          | •      |          |                                 | 2.3                     | 1.52             | 7.2              |               |                    |  |               |                |            |
|                  | P22xxxB-J          |          |        | •        | 142 (1.00)                      | 3.3                     | 0.76             | 1.8              |               |                    |  |               |                |            |
| Enhanced 2 Stack | M22xxxA-L          | •        |        |          | 230 (1.62)                      | 6.5                     | 0.21             | 0.70             | 17<br>(0.12)  | 4.5                | 0.0036<br>(0.025)  | 2.5<br>(1.13) | 20<br>(89)     | 13<br>(58) |
|                  | M22xxxA-L          |          | •      |          |                                 | 3.3                     | 0.84             | 2.8              |               |                    |  |               |                |            |
|                  | M22xxxB-L          | •        |        |          | 253 (1.79)                      | 4.6                     | 0.38             | 1.7              |               |                    |  |               |                |            |
|                  | M22xxxB-L          |          | •      |          |                                 | 2.3                     | 1.52             | 6.8              |               |                    |  |               |                |            |
|                  | M22xxxC-L          | •        |        |          | 238 (1.68)                      | 3.1                     | 0.78             | 3.1              |               |                    |  |               |                |            |
|                  | M22xxxC-L          |          | •      |          |                                 | 1.55                    | 3.12             | 12.4             |               |                    |  |               |                |            |
|                  | M22xxxD-L          | •        |        |          | 238 (1.68)                      | 2.5                     | 1.22             | 5.0              |               |                    |  |               |                |            |
|                  | M22xxxD-L          |          | •      |          |                                 | 1.25                    | 4.88             | 20               |               |                    |  |               |                |            |
|                  | M22xxxE-L          | •        |        |          | 227 (1.60)                      | 1.64                    | 2.71             | 10.1             |               |                    |  |               |                |            |
|                  | M22xxxE-L          |          | •      |          |                                 | 0.82                    | 10.8             | 40.4             |               |                    |  |               |                |            |
|                  | M22xxxA-L          |          |        | •        | 163 (1.15)                      | 4.6                     | 0.42             | 0.70             |               |                    |  |               |                |            |
|                  | M22xxxB-L          |          |        | •        | 179 (1.26)                      | 3.3                     | 0.76             | 1.7              |               |                    |  |               |                |            |
|                  | M22xxxC-L          |          |        | •        | 168 (1.19)                      | 2.2                     | 1.56             | 3.1              |               |                    |  |               |                |            |
|                  | M22xxxD-L          |          |        | •        | 168 (1.19)                      | 1.77                    | 2.44             | 5.0              |               |                    |  |               |                |            |
|                  | M22xxxE-L          |          |        | •        | 161 (1.14)                      | 1.16                    | 5.42             | 10.1             |               |                    |  |               |                |            |
| Low Inertia      | M22xxxB-J          | •        |        |          | 252 (1.78)                      | 4.6                     | 0.38             | 1.5              | 17<br>(0.12)  | 4.5                | 0.0026<br>(0.018)  | 2.5<br>(1.13) | 20<br>(89)     | 13<br>(58) |
|                  | M22xxxB-J          |          | •      |          |                                 | 2.3                     | 1.52             | 6.0              |               |                    |  |               |                |            |
|                  | M22xxxB-J          |          |        | •        | 178 (1.26)                      | 3.3                     | 0.76             | 1.5              |               |                    |  |               |                |            |

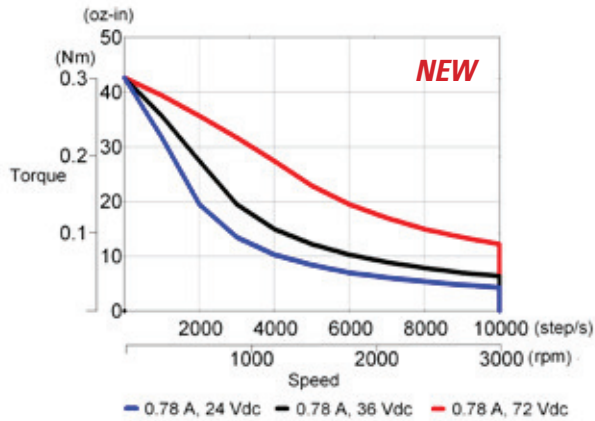
Note: \*Maximum shaft loading based on 20,000 hours of operation at 1500 rpm.  
See page 91 for M&P series connector diagrams and switching sequence.

# M2 / P2 Series Stepper Motors

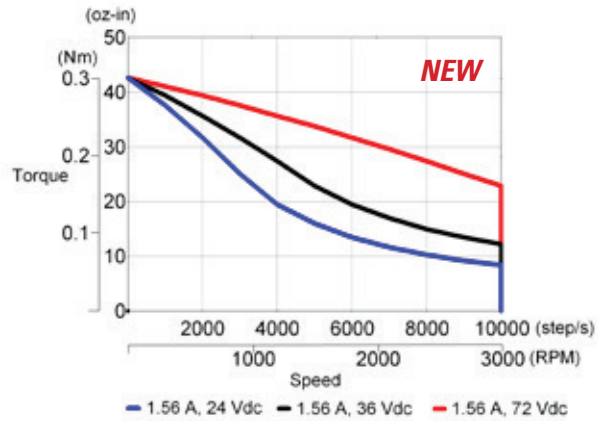
## M2 / P2 Performance Curves

M 2 / P 2 S E R I E S S T E P P E R M O T O R S

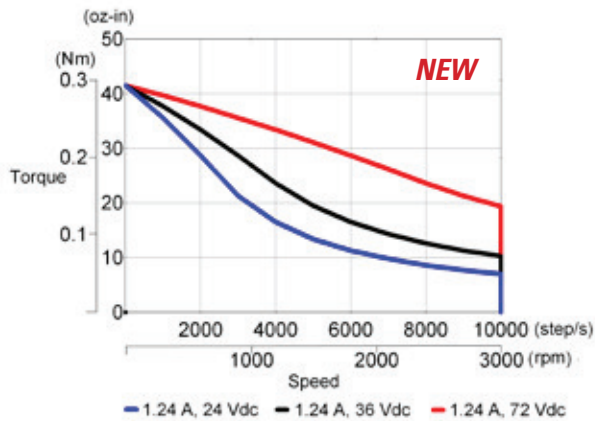
**P2HxxxF-L (S) w/ P5000**



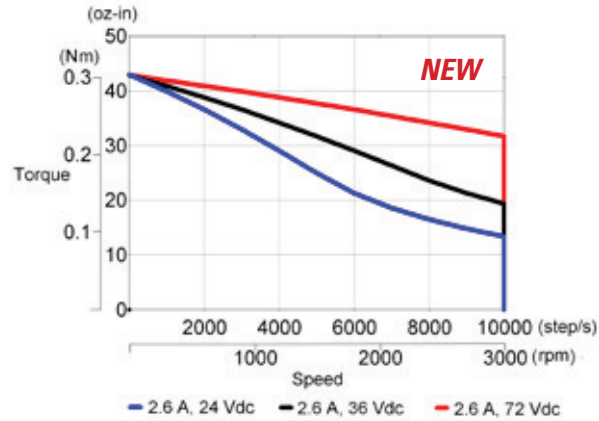
**P2HxxxF-L (P) w/ P5000**



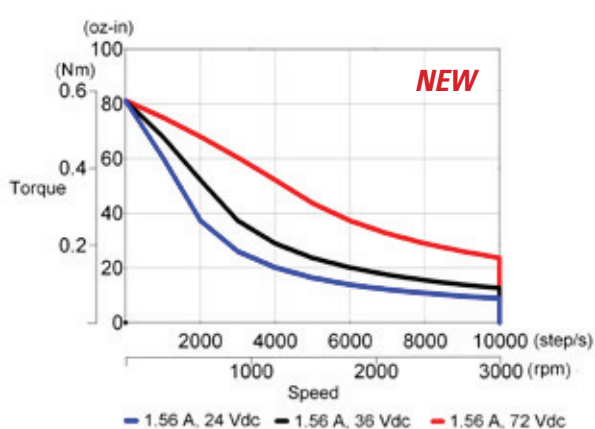
**P2HxxxB-L (S) w/ P5000**



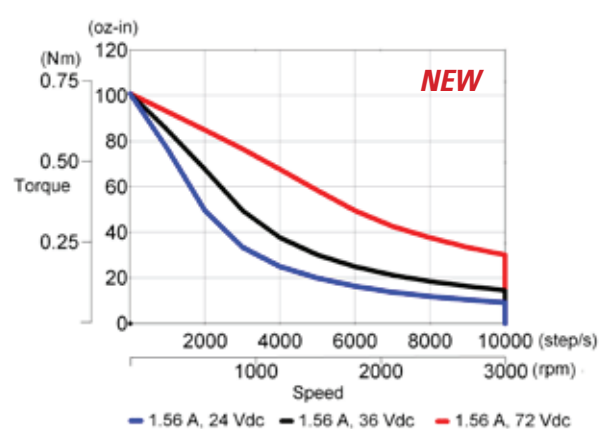
**P2HxxxB-L (P) w/ P5000**



**P21xxxD-L (P) w/ P5000**

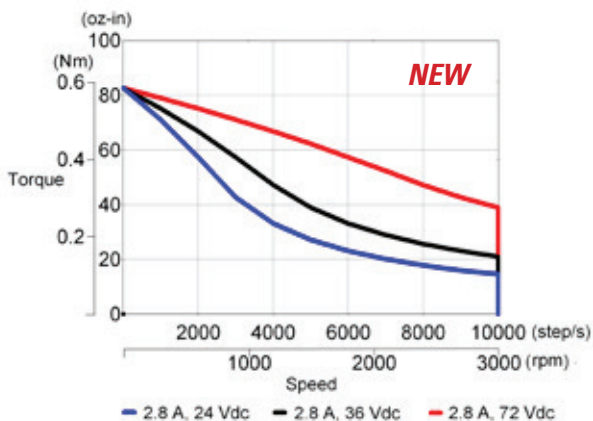


**M21xxxD-L (P) w/ P5000**

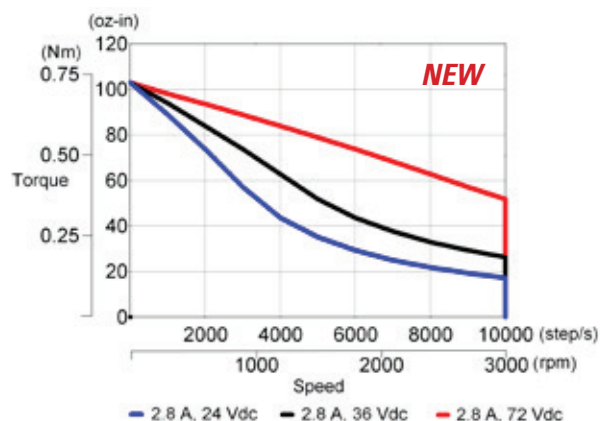


## M2 / P2 Performance Curves

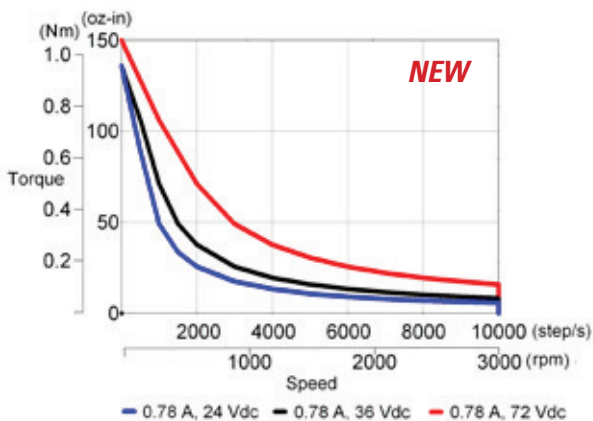
**P21xxxA-L (S) w/ P5000**



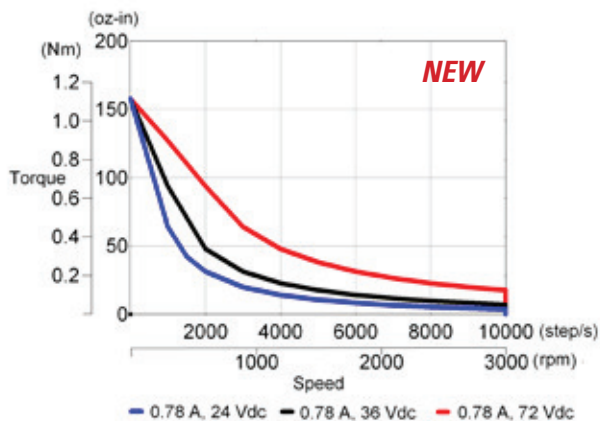
**M21xxxA-L (S) w/ P5000**



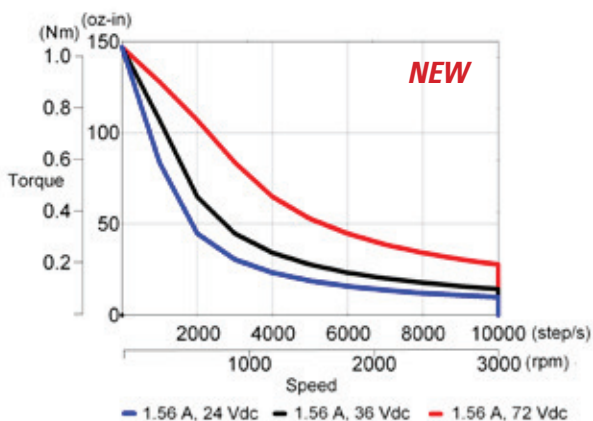
**P22xxxE-L (S) w/ P5000**



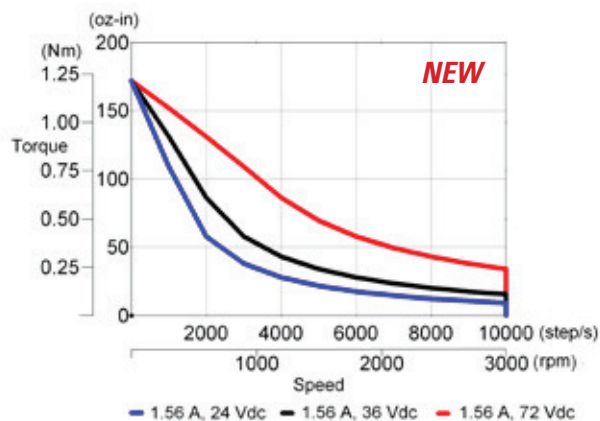
**M22xxxE-L (S) w/ P5000**



**P22xxxC-L (S) w/ P5000**



**M22xxxC-L (S) w/ P5000**



# M2 / P2 Series Stepper Motors

M 2 / P 2 S E R I E S S T E P P E R M O T O R S

## M2 / P2 Performance Curves

