Diverse selection of high performance motors with full consideration for safety and the environment

MEGATORQUE MOTOR™
PS Series (Complies with UL Standards and CE Mark)
PN Series (Complies with UL Standards and CE Mark)
PN Series with Brake
Z Series with High Environmental Resistance
(Dust-tight, Watertight)
The Megatorque Motor draws upon NSK’s combined strengths in manufacturing bearings, sensors and motors.

The NSK Megatorque Motor’s reliability effectively demonstrates NSK’s full manufacturing and design capabilities. Complete aftercare support is available through our many offices worldwide. The Megatorque Motor boosts productivity and achieves high performance in full compliance with the latest safety standards.

Comparison of major features

<table>
<thead>
<tr>
<th>PS Series</th>
<th>PN/Z Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outer rotor</td>
<td>Inner rotor</td>
</tr>
<tr>
<td>Small diameter</td>
<td>Low profile</td>
</tr>
<tr>
<td>Fixed from the bottom</td>
<td>Fixed from the top</td>
</tr>
<tr>
<td>High rotational speed</td>
<td>High rigidity</td>
</tr>
<tr>
<td>Small footprint</td>
<td>Low motor height</td>
</tr>
</tbody>
</table>

Compact, clean, high accuracy, hollow structure, minimum maintenance

For high-speed positioning of medium/light loads

1. Outer rotor
2. Small diameter
3. Fixed from the bottom

For positioning of heavy loads

1. Inner rotor
2. Low profile
3. Fixed from the top

Maximum output torque

- PS1 Motor: 6 [N·m]
- PS3 Motor: 10 [N·m]
- PS4 Motor: 30 [N·m]
- PN1 Motor: 50 [N·m]
- PN2 Motor: 6 [N·m]
- PN3 Motor: 15 [N·m]
- PN4 Motor: 45 [N·m]
- PNZ1 Motor: 40 [N·m]
- PNZ2 Motor: 90 [N·m]
- PNZ3 Motor: 125 [N·m]
- PNZ4 Motor: 130 [N·m]
A direct-drive motor with advanced features only available from NSK

With advanced features, including high torque, high resolution, maximum rotational speed of 10 [s⁻¹] (PS Series), high rigidity and compactness, the Megatorque Motor complies with CE mark (PS/PN Series), UL standards (PS/PN Series), and the EU RoHS directive. These innovative direct-drive motors are extremely accurate, light-weight, and boost the productivity of various devices.

High resolution
The Megatorque Motor’s absolute position sensor is capable of a high resolution of 2,621,440 [count/revolution] and repeatability of ±2 [arc-sec]. It requires no homing operations and facilitates the development of highly accurate devices.

Shortened positioning time
A new servo algorithm shortens settling time to less than one-fifth of conventional NSK motors. Shortened positioning time boosts the productivity of various devices.

High torque
The optimal magnetic field design gives it more than twice as much force density as conventional NSK motors. A maximum of 50% increase in motor torque increases productivity during high acceleration/deceleration drives.

Compact motor
NSK’s advanced design technology has produced two unique motor series: the low profile PN Series (height of PN2: 35 [mm] and the light and compact PS Series (outer diameter of PS1: φ100 [mm]).

Extensive lineup
The product lineup includes the PN Series with brake and the Z Series with High Environmental Resistance (dust-tight, watertight).

High accuracy and interchangeability
Interchangeable Motors and Driver Units can be randomly matched. Increased positioning accuracy of 90 [arc-sec] and interchangeably improve ease of use.

Intelligent
The EDC Driver Unit’s positioning controller function is provided as a standard feature. In addition, an electronic gear function is built in for setting the pulse train position command. The EDC Megatorm software is used to collect, edit, and monitor data.

Full consideration for people and the environment
Compliance with international safety standards (UL Standards, CE mark, EU RoHS Directive) assures worldwide applicability. The Megatorque Motor is environment friendly and complies with the EU RoHS Directive.

Courtesy of Steven Engineering, Inc. - 230 Ryan Way, South San Francisco, CA 94080-5370 - Main Office: (650) 588-9200 - Outside Local Area: (800) 258-9200 - www.stevenengineering.com
# Selection Guide

## PS Series (Outer Rotor Type)

<table>
<thead>
<tr>
<th>Series</th>
<th>PS Series</th>
<th>PN Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>PS1 Motor</td>
<td>PS3 Motor</td>
</tr>
<tr>
<td>Maximum output torque [N·m]</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>Motor outer diameter [mm]</td>
<td>100</td>
<td>150</td>
</tr>
<tr>
<td>Motor hollow diameter [mm]</td>
<td>35</td>
<td>56</td>
</tr>
<tr>
<td>Maximum rotational speed [s⁻¹]</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Resolution of position sensor [count/revolution]</td>
<td>2 621 440</td>
<td>2 621 440</td>
</tr>
<tr>
<td>Absolute positioning accuracy [arc-sec]</td>
<td>90 (Interchangeable type)</td>
<td>90 (Interchangeable type)</td>
</tr>
<tr>
<td>Driver unit model (Dimensions: W × D × H [mm])</td>
<td>EDC Driver Unit</td>
<td>EDC Driver Unit</td>
</tr>
<tr>
<td>Features</td>
<td>Shortened positioning time</td>
<td>Compact driver unit</td>
</tr>
</tbody>
</table>

## PN Series (Inner Rotor Type)

<table>
<thead>
<tr>
<th>Series</th>
<th>PN Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>PN2 Motor</td>
</tr>
<tr>
<td>Maximum output torque [N·m]</td>
<td>200</td>
</tr>
<tr>
<td>Motor outer diameter [mm]</td>
<td>170</td>
</tr>
<tr>
<td>Motor hollow diameter [mm]</td>
<td>36</td>
</tr>
<tr>
<td>Maximum rotational speed [s⁻¹]</td>
<td>2</td>
</tr>
<tr>
<td>Resolution of position sensor [count/revolution]</td>
<td>2 621 440</td>
</tr>
<tr>
<td>Absolute positioning accuracy [arc-sec]</td>
<td>90 (Interchangeable type)</td>
</tr>
<tr>
<td>Driver unit model (Dimensions: W × D × H [mm])</td>
<td>EDC Driver Unit</td>
</tr>
<tr>
<td>Reference page</td>
<td>Motor: 13–14</td>
</tr>
<tr>
<td>Features</td>
<td>Shortened positioning time</td>
</tr>
</tbody>
</table>

---

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### PN Series with Brake—Inner Rotor Type

<table>
<thead>
<tr>
<th>Series</th>
<th>PN3 Motor</th>
<th>PN4 Motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum output torque [N·m]</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>Motor height [mm]</td>
<td>18 (135)</td>
<td>135 (111)</td>
</tr>
<tr>
<td>Motor outer diameter [mm] (flange not included)</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td>Motor hollow diameter [mm]</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>Maximum rotational speed [%]</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Resolution of position sensor [count/revolution]</td>
<td>2 621 440</td>
<td>2 621 440</td>
</tr>
<tr>
<td>Absolute positioning accuracy [min/sec]</td>
<td>90 (Interchangeable type) (at ambient temperature of 25 ± 5 [°C])</td>
<td>90 (Interchangeable type) (at ambient temperature of 25 ± 5 [°C])</td>
</tr>
<tr>
<td>Driver unit model (Dimensions: W × D × H [mm])</td>
<td>EDC Driver Unit</td>
<td>EDC Driver Unit</td>
</tr>
<tr>
<td>Reference page</td>
<td>Motor: 15–16</td>
<td>Driver unit: 19–24</td>
</tr>
<tr>
<td>Features</td>
<td>Shortened positioning time</td>
<td>Compact driver unit</td>
</tr>
<tr>
<td></td>
<td>Flat with high rigidity</td>
<td>Certified with IP rating for dust and water ingress protection</td>
</tr>
<tr>
<td></td>
<td>Interchangeable, highly accurate absolute position sensor</td>
<td></td>
</tr>
</tbody>
</table>

### Z Series with High Environmental Resistance—Inner Rotor Type

<table>
<thead>
<tr>
<th>Series</th>
<th>Z Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td></td>
</tr>
<tr>
<td>Maximum output torque [N·m]</td>
<td>200</td>
</tr>
<tr>
<td>Motor height [mm]</td>
<td>100 (120)</td>
</tr>
<tr>
<td>Motor outer diameter [mm] (flange not included)</td>
<td>175 (137)</td>
</tr>
<tr>
<td>Motor hollow diameter [mm]</td>
<td>32</td>
</tr>
<tr>
<td>Maximum rotational speed [%]</td>
<td>3</td>
</tr>
<tr>
<td>Resolution of position sensor [count/revolution]</td>
<td>2 621 440</td>
</tr>
<tr>
<td>Absolute positioning accuracy [min/sec]</td>
<td>90 (Interchangeable type) (at ambient temperature of 25 ± 5 [°C])</td>
</tr>
<tr>
<td>Driver unit model (Dimensions: W × D × H [mm])</td>
<td>EDC Driver Unit</td>
</tr>
<tr>
<td>Reference page</td>
<td>Motor: 17–18</td>
</tr>
<tr>
<td>Features</td>
<td>Shortened positioning time</td>
</tr>
<tr>
<td></td>
<td>Flat with high rigidity</td>
</tr>
<tr>
<td></td>
<td>Interchangeable, highly accurate absolute position sensor</td>
</tr>
</tbody>
</table>

**Ingress Protection (IP) Classification Test under IEC Standards**

- Magatork Motor Z Series with High Environmental Resistance complies with IP66M under IEC standards certified by TÜV Rheinland Japan Ltd.

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The PN Series was certified with an IP rating after compliance testing under the following two standards:

1. IEC 60529 Degrees of protection provided by enclosures for electrical equipment (IP code)
2. IEC 60034-5 Rotating electrical machines—Part 5

The first characteristic numeral of the IP code stands for the degree of protection against ingress of solid foreign objects, such as dust, with “6” (IP6X) indicating completely dust-tight.

The second characteristic numeral of the IP code represents the degree of protection against ingress of water (waterproofness), with “6” (IPX6) indicating protection from high-pressure (100 l/min) water from any angle. A final “M” indicates the watertight test was conducted with a motor rotating.

---

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2 Motor Specifications

2.1 PS Series

2.1.1 Reference Number Coding of Motor

Example of Reference Number

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>M-PS1006</td>
<td>1000</td>
<td>6</td>
<td>85</td>
<td>φ35</td>
<td>10</td>
<td>2</td>
<td>5</td>
<td>2</td>
<td>2 621 440</td>
<td>90 (Interchangeable type) (at ambient temperature of 25 ± 5 [°C])</td>
<td>±2</td>
<td>1 000</td>
<td>820</td>
<td>28</td>
<td>0.0024</td>
<td>0.0031</td>
<td>0.0038</td>
<td>Ambient temperature 0 to 40 [°C]; humidity: 20 to 80 [%]; use indoors, free from dust, condensation and corrosive gas; IP30 or equivalent.</td>
</tr>
<tr>
<td>M-PS1012</td>
<td>1200</td>
<td>12</td>
<td>110</td>
<td>φ35</td>
<td>12</td>
<td>4</td>
<td>10</td>
<td>5</td>
<td>2 621 440</td>
<td>90 (Interchangeable type) (at ambient temperature of 25 ± 5 [°C])</td>
<td>±2</td>
<td>820</td>
<td>820</td>
<td>28</td>
<td>0.0024</td>
<td>0.0031</td>
<td>0.0038</td>
<td>Ambient temperature 0 to 40 [°C]; humidity: 20 to 80 [%]; use indoors, free from dust, condensation and corrosive gas; IP30 or equivalent.</td>
</tr>
<tr>
<td>M-PS1018</td>
<td>1800</td>
<td>18</td>
<td>135</td>
<td>φ35</td>
<td>18</td>
<td>6</td>
<td>5</td>
<td>5</td>
<td>2 621 440</td>
<td>90 (Interchangeable type) (at ambient temperature of 25 ± 5 [°C])</td>
<td>±2</td>
<td>820</td>
<td>820</td>
<td>28</td>
<td>0.0024</td>
<td>0.0031</td>
<td>0.0038</td>
<td>Ambient temperature 0 to 40 [°C]; humidity: 20 to 80 [%]; use indoors, free from dust, condensation and corrosive gas; IP30 or equivalent.</td>
</tr>
</tbody>
</table>

2.1.2 Specifications

- Please consult with NSK in case of a simultaneous application of axial load, radial load and moment load to a Motor.
- * Under no radial load
- ** Under no axial load
- · For an oscillating operation less than 45 [°], turn the Motor 90 [°] or more at least once a day.
- · Note 1: Absolute positioning accuracy of high-precision products (made to order) is 30 [arc-sec]. (Interchangeable type) (at ambient temperature of 25 ± 5 [°C])
- · Conditions outside the allowable range of inertia may be applicable, depending on operating conditions. Contact NSK for details.

2.1.3 Rotational Speed and Output Torque Characteristics

- Ambient temperature 0 to 40 [°C]; humidity: 20 to 80 [%]; use indoors, free from dust, condensation and corrosive gas; IP30 or equivalent.

2.1.4 Motor Dimensions

- Do not use the leads of the motor cable and the resolver cable with flexing motion.
- Do not add the stress (tension, vibration, etc.) to the joint of the leads and the connector. It causes the disconnection and the loose connection.
- Conditions outside the allowable range of inertia may be applicable, depending on operating conditions. Contact NSK for details.
2.1.5 Reference Number Coding of Motor

Example of Reference Number

Motor specifications

<table>
<thead>
<tr>
<th>M-PS 3 015 KN 002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design serial number</td>
</tr>
<tr>
<td>M: Motor series</td>
</tr>
<tr>
<td>PS: Standard</td>
</tr>
<tr>
<td>3: High-precision products (made to order)</td>
</tr>
<tr>
<td>015: Highly accurate upper surface finish (made to order)</td>
</tr>
</tbody>
</table>

2.1.6 Specifications

<table>
<thead>
<tr>
<th>Functional Item</th>
<th>Reference Number</th>
<th>M-PS3015KN002</th>
<th>M-PS3020KN002</th>
<th>M-PS3060KN002</th>
<th>M-PS3090KN002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor outer diameter [mm]</td>
<td>φ</td>
<td>150</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum output torque [N·m]</td>
<td>15</td>
<td>30</td>
<td>60</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>Rated output torque [N·m]</td>
<td>5</td>
<td>10</td>
<td>20</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Motor height [mm]</td>
<td>85</td>
<td>102</td>
<td>136</td>
<td>170</td>
<td></td>
</tr>
<tr>
<td>Motor hollow diameter [mm]</td>
<td>φ</td>
<td>66</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum rotational speed [s⁻¹]</td>
<td>10</td>
<td>8</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated rotational speed [s⁻¹]</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resolution of position sensor [count/revolution]</td>
<td>2 621 440</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Absolute positioning accuracy [arc-sec]</td>
<td>90 [Interchangeable type]</td>
<td>(at ambient temperature of 25 ± 5 °C)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repeatability [arc-sec]</td>
<td>±2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allowable axial load [N]</td>
<td>2000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allowable radial load [N]</td>
<td>700</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allowable moment load [N·m]</td>
<td>42</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rotor inertia [kg·m²]</td>
<td>0.010 for highly accurate upper surface runout type (design serial number: 701)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allowable range of inertia [kg·m²]</td>
<td>0 to 1.1</td>
<td>0 to 1.4</td>
<td>0.12 to 1.9</td>
<td>0.12 to 2.4</td>
<td></td>
</tr>
<tr>
<td>Mass [kg]</td>
<td>5.5</td>
<td>6.9</td>
<td>11.0</td>
<td>13.8</td>
<td></td>
</tr>
</tbody>
</table>

Environmental conditions

Ambient temperature 0 to 40 °C; humidity: 30 to 80 %; use indoors, free from dust, condensation and corrosive gas; IP30 or equivalent.

* Please consult with NSK in case of a simultaneous application of axial load, radial load and moment load to a Motor.
* 1. Under no radial load; 2. Under no axial load
* For an oscillating operation less than 45 °C, turn the Motor 90 °C or more at least once a day.
* Under no load.
* Absolute positioning accuracy of high-precision products (made to order) is 30 [arc-sec] ( interchangeable type) (at ambient temperature of 25 ± 5 °C)
* Cable length is up to 8 m.
* Conditions outside the allowable range of inertia may be applicable, depending on operating conditions. Contact NSK for details.

2.1.7 Rotational Speed and Output Torque Characteristics

2.1.8 Motor Dimensions
2.2 PN Series

2.2.1 Reference Number Coding of Motor

Example of Reference Number

<table>
<thead>
<tr>
<th>M-PN</th>
<th>045</th>
<th>KN</th>
<th>001</th>
</tr>
</thead>
</table>

- M: Magatorque Motor PN Series
- 045: Motor size code
- KN: Maximum output torque [N·m]
- 001: Design serial number

2.2.2 Specifications

<table>
<thead>
<tr>
<th>Functional Item</th>
<th>M-PN2012KN201</th>
<th>M-PN3045KN001</th>
<th>M-PN4135KN001</th>
<th>M-PN4180KN001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor outer diameter [mm]</td>
<td>φ170</td>
<td>φ210</td>
<td>φ280</td>
<td></td>
</tr>
<tr>
<td>Maximum output torque [N·m]</td>
<td>12</td>
<td>45</td>
<td>105</td>
<td>160</td>
</tr>
<tr>
<td>Rated output torque [N·m]</td>
<td>2</td>
<td>15</td>
<td>45</td>
<td>60</td>
</tr>
<tr>
<td>Motor height [mm]</td>
<td>35</td>
<td>86</td>
<td>95</td>
<td>112</td>
</tr>
<tr>
<td>Motor hollow diameter [mm]</td>
<td>φ36</td>
<td>φ56</td>
<td>φ50</td>
<td></td>
</tr>
<tr>
<td>Maximum rotational speed [s⁻¹]</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated rotational speed [s⁻¹]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resolution of position sensor [count/revolution]</td>
<td>2,621,440</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Absolute positioning accuracy [arc-sec]</td>
<td>90 (Interchangeable type) at ambient temperature of 25 ± 5 [°C]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repeatability [arc-sec]</td>
<td>±2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allowable axial load [N]</td>
<td>1,000</td>
<td>4,500</td>
<td>9,500</td>
<td></td>
</tr>
<tr>
<td>Allowable radial load [N]</td>
<td>500</td>
<td>4,500</td>
<td>9,500</td>
<td></td>
</tr>
<tr>
<td>Allowable moment load [N·m]</td>
<td>20</td>
<td>80</td>
<td>160</td>
<td>200</td>
</tr>
<tr>
<td>Rotor inertia [kg·m²]</td>
<td>0.0024</td>
<td>0.011</td>
<td>0.057</td>
<td>0.065</td>
</tr>
<tr>
<td>Allowable range of inertia [kg·m²]</td>
<td>0.02 to 0.24</td>
<td>0.11 to 0.77</td>
<td>0.57 to 3.99</td>
<td>0.65 to 4.55</td>
</tr>
<tr>
<td>Mass [kg]</td>
<td>3.7</td>
<td>13</td>
<td>26</td>
<td>31</td>
</tr>
</tbody>
</table>

Environmental conditions
- Ambient temperature: 0 to 40 [°C]; humidity: 20 to 80%; use indoors, free from dust, condensation and corrosive gas. IP30 or equivalent.

Additional notes:
- Please consult with NSK, in case of a simultaneous application of axial load, radial load and moment load to a Motor.
- *1 Under no radial load
- *2 Under no axial load
- For an oscillating operation less than 45 [°], turn the Motor 90 [°] or more at least once a day.
- See Note 1: Cable length for PN2012 is up to 8 [m].
- Conditions outside the allowable range of inertia (about 700 times the rotor’s inertia) may be applicable, depending on operating conditions. Contact NSK for details.
- M-PN3045KN001
- M-PN4135KN001
- M-PN4180KN001

2.2.3 Rotational Speed and Output Torque Characteristics

<table>
<thead>
<tr>
<th>PN2012</th>
<th>PN3045</th>
<th>PN4135</th>
<th>PN4180</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated</td>
<td>Maximum</td>
<td>Rated</td>
<td>Maximum</td>
</tr>
<tr>
<td>Rotational speed [s⁻¹]</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Output torque [N·m]</td>
<td>0</td>
<td>10</td>
<td>20</td>
</tr>
</tbody>
</table>

2.2.4 Motor Dimensions

- Dimensions marked with *1 require an extra 3 [mm] margin due to variations.
- *2 0.010 for highly accurate upper surface runout type (design serial number: 701).
- The bend radius of the motor cable lead (φ7) and the resolver cable lead (φ7) should be R30 [mm] or more.
- Do not use the leads of the motor cable and the resolver cable with flexing motion.
- Do not add stress (tension, vibration, etc.) to the joint of the leads and the connector. It causes disconnection and loose connection.
- Set clearance fit for the-inserting pin.
- Do not apply excessive load and/or impact to the motor when inserting the pin.
- Use the pinhole as a positioning purpose only. Do not use the pinhole to hold the load on rotor.

Note: See courtesy of Steven Engineering, Inc. - 230 Ryan Way, South San Francisco, CA 94080-5370 - Main Office: (650) 588-9200 - Outside Local Area: (800) 258-9200 - www.stevenengineering.com
2.3 PN Series with Brake

2.3.1 Reference Number Coding of Motor

Example of Reference Number

M-PN 3 045 KG 001

MegaTorque Motor PN Series
Motor size code
Maximum output torque [N·m]

2.3.2 Specifications

<table>
<thead>
<tr>
<th>Functional Item</th>
<th>Reference number</th>
<th>M-PN3045KG001</th>
<th>M-PN4135KG001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor outer diameter [mm]</td>
<td>φ210</td>
<td>φ280</td>
<td></td>
</tr>
<tr>
<td>Rated output torque [N·m]</td>
<td>45</td>
<td>135</td>
<td></td>
</tr>
<tr>
<td>Motor hollow diameter [mm]</td>
<td>φ32</td>
<td>φ32</td>
<td></td>
</tr>
<tr>
<td>Maximum rotational speed [s⁻¹]</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Rated rotational speed [s⁻¹]</td>
<td>±2</td>
<td>±2</td>
<td></td>
</tr>
<tr>
<td>Resolution of position sensor (count/revolution)</td>
<td>2 621 440</td>
<td>2 621 440</td>
<td></td>
</tr>
<tr>
<td>Absolute positioning accuracy [arc-sec]</td>
<td>20 (interchangeable type)</td>
<td>90 (at ambient temperature of 25 ± 5 °C)</td>
<td></td>
</tr>
<tr>
<td>Repeatability [arc-sec]</td>
<td>±2</td>
<td>±2</td>
<td></td>
</tr>
<tr>
<td>Allowable axial load [N]</td>
<td>4 500</td>
<td>9 500</td>
<td></td>
</tr>
<tr>
<td>Allowable radial load [N]</td>
<td>4 500</td>
<td>9 500</td>
<td></td>
</tr>
<tr>
<td>Allowable moment load [N·m]</td>
<td>80</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>Brake type</td>
<td>Negative actuation type holding brake without backlash</td>
<td></td>
<td></td>
</tr>
<tr>
<td>braking torque [N·m]</td>
<td>36</td>
<td>72</td>
<td></td>
</tr>
<tr>
<td>Brake power supply [VDC]</td>
<td>24</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>Brake power consumption [W]</td>
<td>28</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Rotor inertia [kg·m²]</td>
<td>0.016</td>
<td>0.080</td>
<td></td>
</tr>
<tr>
<td>Allowable range of inertia [kg·m²]</td>
<td>0.11 to 0.77</td>
<td>0.57 to 3.99</td>
<td></td>
</tr>
<tr>
<td>Mass [kg]</td>
<td>18</td>
<td>34</td>
<td></td>
</tr>
</tbody>
</table>

Environmental conditions
Ambient temperature 0 to 40 [°C]; humidity: 20 to 80%; use indoors, free from dust, condensation and corrosive gas, IP30 or equivalent.

*Please consult with NSK in case of a simultaneous application of axial load, radial load and moment load to a Motor.
*1 Under no radial load
*2 Under no axial load
*3 Positioning accuracy with brake released
*4 For an oscillating operation less than 45 [°], turn the Motor 90 [°] or more at least once a day.
*5 Positioning accuracy with brake released
*6 Conditions outside the allowable range of inertia (about 400 times the rotor inertia) may be applicable, depending on operating conditions. Contact NSK for details.

User’s manual and technical data are available for brake holding accuracy, operating time, and frequency of use. Contact NSK as necessary.

2.3.3 Rotational Speed and Output Torque Characteristics

2.3.4 Motor Dimensions

Note on compliance with UL Standards and CE Mark
PN Series with Brake
PN Series with brake does not comply with UL Standards or CE Mark.
EDC Driver Units
EDC Driver Units comply with UL Standards and CE Mark when used with a Standard PN Series Megatorque Motor (without brake). However, they do not comply with UL Standards or CE Mark when used with a PN Series Megatorque Motor with a brake.

PN3045

PN4135

Note on compliance with UL Standards and CE Mark
PN Series with Brake
PN Series with brake does not comply with UL Standards or CE Mark.
EDC Driver Units
EDC Driver Units comply with UL Standards and CE Mark when used with a Standard PN Series Megatorque Motor (without brake). However, they do not comply with UL Standards or CE Mark when used with a PN Series Megatorque Motor with a brake.

1. For the dimensions marked *, extra 3 [mm] margin is required due to their variations.
2. *1 indicates the minimum lead bend distance. When bending the lead, maintain a greater distance than specified regardless of bend direction. The bend radius of leads should be at least R15 [mm].
3. Be sure to keep iron powders or oil away from brake surfaces.
4. Iron materials near a brake may interrupt operation, therefore allow for at least 15 [mm] clearance around the brake during installation.
## Motor Specifications

### 2.4 Z Series with High Environmental Resistance

#### 2.4.1 Reference Number Coding of Motor

<table>
<thead>
<tr>
<th>Functional item</th>
<th>Reference number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor outer diameter (mm) (without flange)</td>
<td>M-PNZ3040KN001, M-PNZ4130KN001, M-PNZ4175KN001</td>
</tr>
<tr>
<td>Maximum output torque (N·m)</td>
<td>220</td>
</tr>
<tr>
<td>Rated output torque (N·m)</td>
<td>40</td>
</tr>
<tr>
<td>Motor height (mm)</td>
<td>100</td>
</tr>
<tr>
<td>Motor hollow diameter (mm)</td>
<td>0.44</td>
</tr>
<tr>
<td>Maximum rotational speed [s⁻¹]</td>
<td>3</td>
</tr>
<tr>
<td>Rated rotational speed [s⁻¹]</td>
<td>1</td>
</tr>
<tr>
<td>Resolution of position sensor (count/revolution)</td>
<td>90</td>
</tr>
<tr>
<td>Absolute positioning accuracy (arc-sec)</td>
<td>90</td>
</tr>
<tr>
<td>Repeatability (arc-sec)</td>
<td>2</td>
</tr>
<tr>
<td>Allowable axial load (N)</td>
<td>4,500</td>
</tr>
<tr>
<td>Allowable radial load (N)</td>
<td>9,500</td>
</tr>
<tr>
<td>Allowable moment load (N·m)</td>
<td>80</td>
</tr>
<tr>
<td>Rotor inertia (kg·m²)</td>
<td>0.028</td>
</tr>
<tr>
<td>Allowable range of inertia (kg·m²)</td>
<td>0.11 to 0.77</td>
</tr>
<tr>
<td>Mass (kg)</td>
<td>21</td>
</tr>
<tr>
<td>Ambient temperature (°C)</td>
<td>0 to 40</td>
</tr>
<tr>
<td>Degree of Protection</td>
<td>IP66M (IEC/EN 60529, IEC/EN 60034-5)</td>
</tr>
</tbody>
</table>

#### 2.4.2 Specifications

- Do not install in the upside-down position, as liquid will drop to the bottom of the rotating part.
- Maintain the required space (about 30 [mm]) around the connector part of the motor resolver for fitting. Be sure to install the protective cap (supplied with Motor) when the cable set is not connected, such as during maintenance or inspection.
- The outer layer sheath of the cable set uses heat resistant PVC, which is not resistant to all types of liquid or oil. Consult with NSK in advance if you are concerned about specific operating environment or liquids.
- Oil seals, O-rings, and gaskets are consumable parts. Periodic inspection of seal performance is strongly recommended to prevent motor failure or outage due to ingress of water. NSK replaces components, issues an overhaul evaluation report, and conducts performance inspections (excluding operations checking). Charges apply.
- Purge air out of the oil seal section to ensure protection from ingress of water.
- Though rust may occur on the motor outer surface, it does not affect the motor performance.

#### 2.4.3 Rotational Speed and Output Torque Characteristics

![Graphs showing allowable effective torque and rated torque vs. rotational speed for different models.]

Please refer to 6.7 Effective Torque Calculations to calculate allowable effective torque during positioning operation.

#### 2.4.4 Dimensions

![Dimensions diagrams for the motor models.]

**Note on compliance with UL Standards and CE Mark**
- Megatorque Motor Z Series with High Environmental Resistance complies with UL Standards and CE Mark.
- EDC Driver Units comply with UL Standards and CE Mark when used with a standard PN Series Megatorque Motor. However, they do not comply with UL Standards or CE Mark when used with a Megatorque Motor Z Series with High Environmental Resistance.

**Note on ABS and Bead Blasting**
- ABS and bead blasting are available for certain models. Please consult with NSK for details.
- ABS covers the surface of the motor to provide a more aesthetically pleasing appearance.
- Bead blasting is a process that uses a stream of small abrasive particles to remove material from a surface.
3 EDC Driver Unit

3.1 Features of EDC Driver Unit

• Adopts new servo algorithm (achieves settling time of 1 [ms])

The EDC Driver Unit adopts an original disturbance observer and preview-based feed-forward control, which significantly reduces the positioning time, especially the settling time (approaching time).

• Positioning controller function

Positioning operation can be controlled without complicated communication or upper controller.

• Compact Driver Unit

Combined with special electric components and advanced integration technology, the Driver Unit body is 65% smaller than conventional NSK units.

• Variety of control I/Os

Control input/output required for positioning is available, including an encoder output, servo control and program control; no additional sensor is required to monitor the status.

3.2 Components and functions of EDC Driver Unit

3.3 Control Technology and System Configuration of EDC Driver Unit

Control Technology and High-speed Positioning Example

• Control block diagram

Adopts new servo algorithm

Settling time: Less than 1 [ms]

• Comparison of 180° positioning

Positioning time = Command time + Settling time

<table>
<thead>
<tr>
<th>Conventional NSK motor (JS2014)</th>
<th>PS1012 Motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setting time</td>
<td>45 [ms]</td>
</tr>
<tr>
<td>Following error</td>
<td>20 500 pulses</td>
</tr>
<tr>
<td>Positioning time</td>
<td>330 [ms]</td>
</tr>
</tbody>
</table>

3.4 Example of Brake Sequence

For brake sequence details, refer to the User's Manual.
3.5 EDC Driver Unit Reference Number

Example of Reference Number

| M-EDC | PS1006 | A | B | 02 | -01 |

EDC Driver Unit

Motor model

Power supply:
A: 200-240 VAC (3-Phase)
B: 100-115 VAC (Single-Phase)

Position sensor type:
1: Absolute position sensor
2: Incremental position sensor

3.6 Dimensions of EDC Driver Unit (Standard Function)

Used for:
- PS1006 Motor, PS1012 Motor, PS1018 Motor, PS3015 Motor, PS3030 Motor, PN2012 Motor
- PS3060 Motor, PS3090 Motor, PN3045 Motor, PN4135 Motor, PN4180 Motor, PNZ3040 Motor, PNZ4130 Motor, PNZ4175 Motor

Accessories vary depending on the function.

Standard accessories:
(1) CN2 connector (user side)
   Connector: 54306-5019 (Molex), or equivalent
   Connector shell: 54331-0501 (Molex), or equivalent
(2) CN5 connector (user side)
   Connector: 231-305/026-000 (WAGO), or equivalent
   Wiring lever: 231-131 (WAGO), or equivalent
(3) Mounting bracket
(4) User’s Manual (English version)

Accessories for EDC Driver Unit (CC-Link Function):
(1) CN2 connector (user side)
   Connector: DHF-PDA10-3-A01-FA (DDK), or equivalent
(2) CN5 connector (user side)
   Connector: 231-305/026-000 (WAGO), or equivalent
   Wiring lever: 231-131 (WAGO), or equivalent
(3) CN6 connector (user side)
   Connector: MSTB, 5/5-STF-5, 08AU (Phoenix contact), or equivalent
(4) Mounting bracket
(5) User’s Manual (English version)
(6) User’s Manual for CC-Link (English version)

EDC Driver Unit for Z Series with High Environmental Resistance is the same unit used with the PN Series. Refer to Motor and EDC Driver Unit Combinations for details of applicable models.

Courtesy of Steven Engineering, Inc. - 230 Ryan Way, South San Francisco, CA 94080-5370 - Main Office: (650) 588-9200 - Outside Local Area: (800) 258-9200 - www.stevenengineering.com
3.7 General Specifications of EDC Driver Unit

3.8 Signal Specifications of CN2 (Control I/O)
4.1 Cable Set Reference Number

Example of Reference Number
- Cable set for Motor
- Cable length: 0.4m
- SCP: PS/SSS Series and PSN Series with brake

Refer to 9 Motor and EDC Driver Unit Combinations for correct length.
Cable length has to be less than 8m for combinations with PN2012 and high-precision products in PS series.

Example of Reference Number
- Cable set for Motor
- Cable length: 0.4m
- WCP: Cable set for Z Series with High Environmental Resistance

Refer to 9 Motor and EDC Driver Unit Combinations for correct length.

4.2 Dimension of Cable Set

Cable Set Dimensions for PS/SSS Series and PSN Series with Brake
- Motor cable length: 3.0m
- Resistor cable length: 0.5m

Cable Set Dimensions for Z Series with High Environmental Resistance
- Motor cable length: 3.0m
- Resistor cable length: 0.5m

Cable bend radius (for both motor cable and resolver cable)

<table>
<thead>
<tr>
<th>Stationary cable</th>
<th>Bend radius at fixed side</th>
<th>Bend radius at moving side</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexible cable</td>
<td>R43 or more</td>
<td>R80 or more</td>
</tr>
</tbody>
</table>

5.1 EDC Driver Unit with CC-Link Function

5.1.1 System Configuration

The EDC Driver Unit provides the field bus (CC-Link) compatibility.
- Monitoring communication status by LED, and terminating resistor can be switched on/off.
- The EDC Driver Units are fully compatible with CC-Link Ver. 1.10.

5.1.2 I/O Signal Specifications of CN2 (CC-Link Function)

<table>
<thead>
<tr>
<th>Signal Name</th>
<th>Pin-out</th>
<th>Input/Output Signal</th>
<th>Signal Code</th>
<th>Pin No.</th>
<th>Code Color and Pin Code Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC24</td>
<td>1</td>
<td>Signal name</td>
<td>24 (DC)</td>
<td>A0</td>
<td>External power supply</td>
</tr>
<tr>
<td>EMST</td>
<td>2</td>
<td>Yes</td>
<td>25</td>
<td>A0</td>
<td>Emergency stop</td>
</tr>
<tr>
<td>ACLR</td>
<td>3</td>
<td>Yes</td>
<td>25</td>
<td>A0</td>
<td>Clear warning</td>
</tr>
<tr>
<td>OTP</td>
<td>4</td>
<td>Yes</td>
<td>25</td>
<td>A0</td>
<td>Over travel limit (+ direction)</td>
</tr>
<tr>
<td>OTM</td>
<td>5</td>
<td>Yes</td>
<td>25</td>
<td>A0</td>
<td>Over travel limit (- direction)</td>
</tr>
<tr>
<td>DRDY</td>
<td>6-7</td>
<td>Do not connect</td>
<td></td>
<td></td>
<td>Driver Unit ready</td>
</tr>
<tr>
<td>COM</td>
<td>8-9</td>
<td>Do not connect</td>
<td></td>
<td></td>
<td>Common for output signal</td>
</tr>
</tbody>
</table>

Specifications of Driver Units, except CN2, are the same as standard products (refer to page 24).
5.1.3 Dimensions of EDC Driver Unit (CC-Link Function)

- Used for PS3060 Motor, PS3012 Motor, PS1018 Motor, PS3015 Motor, PS3030 Motor, PN2012 Motor
- Used for PS3060 Motor, PS3090 Motor, PN3045 Motor, PN4135 Motor, PN4180 Motor, PNZ3040 Motor, PNZ4030 Motor, PNZ4175 Motor

5.2 Optional Regeneration Resistor (M-E014DCKR1-100-101)

5.2.1 Dimensions and Schematics

- M-E014DCKR1-100
- M-E014DCKR1-101

5.2.2 Connection to EDC Driver Unit
5.3 Handy Terminal

Handy Terminal FHT21 is an easy-to-handle RS-232C communication terminal for inputting parameters and programs to the EDC Driver Unit. The device can also read and save (upload) driver unit parameters and channel programs, and transmit (download) them to other driver units.

- LCD screen: 20 letters × 4 lines, no external power source required, cable length: 3 [m]

Conventional model M-FHT11 is also supported by the EDC Driver Unit.

5.4 RS-232C Communication Cable

(Communication cable between EDC Driver Unit and PC)

6 Selection of Megatorque Motors

To select appropriate Megatorque Motors, examine the following data.

6.1 Loads on the Motor
(1) Load moment of inertia; (2) Axial load, radial load, and moment load; (3) Holding torque required during halts

Example 1

When the Megatorque Motor System is used, the size of the moment of inertia of the load mounted to the Motor rotor will significantly affect the acceleration/deceleration characteristics. Thus, calculation of the moment of inertia of the load J is required.

(2) Axial load, radial load, and moment load

Calculate the load on the Motor. The relationship between external force and load is represented in the following three patterns. Ensure the axial load/radial load and the moment load are set within the allowable axial, radial, and moment loads.

(Refer to 2. Motor Specifications in this catalog for allowable loads.)

6.2 Runout Accuracy

The measurement method for runout accuracy is shown at right.

6.3 Positioning Accuracy

The positioning accuracy of the Megatorque Motor System is considered by two respects as follows:

(1) Absolute positioning accuracy: 90 [arc-sec] (interchangeable)

(2) Repeatability: ±2 [arc-sec]
6 Selection of Megatorque Motors

[Example 1]
We examine the compatibility of the PS Series Motors, assuming a required repeatability of ±0.02 [mm] at 300 [mm] distance from the center.

From \[ \tan \theta = \frac{0.02}{300} \]
\[ \theta = \tan^{-1}(0.02 \div 30) \]
\[ \theta = 3.8 \times 10^{-1}[\text{'}] \]
\[ \theta = 14[\text{arc-sec}] \]

Therefore, \( s_{14} > s \)
Both PS1 and PS3 Models can be used in terms of positioning accuracy.

6.5 Selection of Optional Regeneration Resistor

(1) Obtain rotational energy of Megatorque Motor during deceleration

Calculate the rotational energy using the following equation:

\[
\text{Rotational energy} = \frac{1}{2} \times J \times \omega^2 [\text{J}] \\
J: \text{Rotor inertia [kg·m}^2]\]
\[J_m: \text{Moment of inertia of the load [kg·m}^2]\]
\[N: \text{Rotational speed [s}^{-1}\text{]}\]

(2) Regenerative energy capacity by internal capacitors

The regeneration energy that can be charged by the internal capacitors is 28 [J].

(3) Calculate energy consumed by optional regeneration resistor

Energy consumed by optional regeneration resistor \( J_r \) - Rotational energy \( J_m \) – 28 [J] (capacitor absorption energy)

When the difference is greater than zero, use the following procedure to obtain the required capacity for an optional regeneration resistor.

(4) Calculate required capacity for optional regeneration resistor

Required capacity for an optional regeneration resistor [W] = Energy consumed by optional regeneration resistor [J] / (Operation cycle [s] \( \times 0.25 \))

When the quotient is 7 or less, use optional regeneration resistor: M-E014DCKR1-100. (optional)

When the quotient is 120 or less, use optional regeneration resistor: M-E014DCKR1-101. (optional)

Please contact NSK when the quotient exceeds 120.

6.6 Effective Torque Calculations (Example 1)

When selecting a Megatorque Motor, it is necessary to consider the maximum required torque and the effective torque required for the actual operation.

Determine whether 90 [°] can be positioned in 0.24 [s], assuming the load moment of inertia is 0.05 [kg·m²]. Also calculate the effective torque when an operation cycle is 0.3 [s].

- Conditions:
  - Maximum rotational speed = 2.5 [s⁻¹]
  - Rotational acceleration = 25 [s⁻²]
  - Repeatability = ±15 [arc-sec]
  - Dwell time = 0.06 [s]
  - \( J_m \text{ (load moment of inertia)} = 0.05 [kg·m}^2\]
  - \( J_r \text{ (rotor moment of inertia)} = 0.019 [kg·m}^2\) (for PS3060)

- Since the rotational acceleration is 25 [s⁻²], calculate the approximate required torque using the following equation.

\[
\text{Equations:} T: \text{Torque at accelerating [N·m]} \\
\alpha: \text{Rotational acceleration [s}^{-2}\text{]} \\
\eta: \text{Safety coefficient} (\text{normally } 1.4-1.5)
\]

- Required torque at accelerating/decelerating

\[
T = (J_m + J_r) \times \alpha = (0.05 + 0.019) \times 25 = 0.13 \times 25 = 0.05 \times 0.019\times 10.8 [\text{N·m}]
\]

Therefore, the candidate selection is a motor with a maximum output torque of 15.2 [N·m] (obtained by multiplying required torque by a safety factor of 1.4) or larger. The PS1 Model (excluding PS1006 and PS1012), PS3 Model, PNS Model, or PN4 Model can be selected.

Note: Since the moment of inertia of the rotor of the motor varies depending on the motor, the required torque needs to be recalculated for each motor.

- The effective torque required for the actual operational pattern in use (see following diagram) needs to be examined.

Also determine whether the PS3060 meets the operational conditions.

\[
\text{Required effective torque} = \sqrt{\frac{T^2 \times \alpha \times 2}{t_4}} = 8.8 [\text{N·m}]
\]

Rotational energy = \( 1/2 \times (J_m + J_r) \times \omega^2 \times 2 \times \eta \)

An effective torque of 11.4 [N·m] is determined by multiplying the equation above by a temperature coefficient of 1.3, which is less than the PS3060’s rated output torque of 20 [N·m]. Therefore, the PS3060 sufficiently meets the operational conditions and no optional regeneration resistor is necessary.

- In case results do not meet rated torque ≥ effective torque, recalculation with revised conditions is required.
6.7 Effective Torque Calculations (Example 2) for Z Series with High Environmental Resistance

When selecting a Megatorque Motor, it is necessary to consider the maximum required torque and the allowable effective torque required for the actual operation.

Determine whether 90° can be positioned in 0.24 s, assuming the load moment of inertia is 0.05 [kg·m²]. Also calculate the effective torque when an operation cycle is 0.3 s.

Conditions:
- Maximum rotational speed = 2.5 [s⁻¹]
- Rotational acceleration = 25 [s⁻²]
- Repeatability = ±15 [arc-sec]
- Dwell time = 0.06 [s]
- J_m (load moment of inertia) = 0.05 [kg·m²]
- J_r (moment of inertia of the rotor) = 0.12 [kg·m²] (for PNZ4130)
- Ti = Internal load torque = 15 [N·m]

Since the rotational acceleration is 25 [s⁻²], calculate the approximate required torque using the following equations.

Equations:
- \( T = \frac{(J_m + J_r) \times \alpha}{\eta} \)

Required torque at accelerating/decelerating
\[ T = \frac{(J_m + J_r) \times \alpha}{\eta} = \frac{(0.05 + 0.12) \times 2\pi \times 25}{1.4} = 26.7 \text{ [N·m]} \]

Therefore, the candidate selection is a motor with a maximum output torque of 37.4 [N·m] (obtained by multiplying required torque by a safety factor of 1.4) or larger. The PNZ3 Model or PNZ4 Model can be selected.

The effective torque required for the actual operational pattern in use (see following diagram) needs to be examined. Also determine whether the PNZ4130 meets the operational conditions.

The effective torque for the actual operational pattern in use (see following diagram) needs to be examined.

Also determine whether the PNZ4130 meets the operational conditions.

The effective torque for the actual operational pattern in use (see following diagram) needs to be examined.

Also determine whether the PNZ4130 meets the operational conditions.

An effective torque of 32.5 [N·m] is determined by multiplying the equation above by a temperature coefficient of 1.3, which is less than the PNZ4130’s allowable effective torque of 45 [N·m]. Therefore, the PNZ4130 sufficiently meets the operational conditions and no optional regeneration resistor is necessary.

In case results do not meet allowable effective torque ≥ effective torque, recalculation with revised conditions is required.

---

7 Positioning Time Diagrams

The positioning time for Megatorque Motors is calculated in accordance with "6.3 Positioning time." When dwell time is relatively longer than accelerating/decelerating time (dwell time × accelerating/decelerating time x 10), rough positioning time can be determined using the following positioning time diagrams.

These diagrams only apply under the following conditions.

1. The motor is directly connected to the load (without gear reducer, belt, or couplings), and the rigidity of the load is sufficiently high (natural frequency: More than 100 [Hz]).
2. No load torque is applied to the motor.

The following conditions require additional considerations.

a. When the load’s moment of inertia exceeds the allowable moment load and is off the diagram:
   - Operation is possible, although much more time may be required than shown in the diagram, since rotational speed and acceleration are limited.

b. When there is no diagram for the relevant positioning angle:
   - An appropriate calculation is required. No calculation, however, is effective for very small angles.

Setting time of 0.001 [s] has been included. Add more setting time when higher repeatability is required.

Example: Motor: PN4180

Moment of inertia: 3.0 [kg·m²]
Index angle: 45°

Minimum positioning time of 0.3 [s] is determined according to the line in the following diagram.

---

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8.1 Installation of Motor

- Install and secure the Motor on a rigid base, otherwise mechanical vibrations may occur.
- Mount the motor using the tapped or through-holes.
- The Motor can be attached either horizontally or vertically. (For Z Series with High Environmental Resistance, do not install in the upside-down position.)
- Take care not to push up the underside cover when attaching the motor. (PS Series)
- Please see below figure for counterbore depth from base top. (PS Series)
- The bend radius of the motor cable lead and the resolver cable lead should be R30 [mm] or more. Do not use the leads of the motor cable and the resolver cable with flexing motion.

- The EDC Driver Unit must be fixed so that fins are in the vertical position for natural air-cooling.
- Ambient temperatures should be in a range from 0 to 50 [°C]. The Driver Unit cannot be used in excess of 50 [°C]. A sufficient space of at least 100 [mm] should be provided both above and below the Driver Unit in a control cabinet.
- Operate the Driver Unit in an environment in which internally generated heat can be dissipated. If heat is trapped above the Driver Unit, open the space above it to allow for the heat to dissipate (in this case, also take steps to prevent the entry of dust) or provide a forced-air cooling system.
- Use the Driver Unit in a control cabinet with IP54 or higher. Protect the Driver Unit from exposure to oil mist, cutting water, cutting dust, coating gas, etc., to prevent their entry into the Driver Unit through ventilation openings, which may cause circuit failure.
- When installing two or more Driver Units for multi-axis combinations, provide a 10 [mm] or more space between adjacent Driver Units.
- The Motor can be attached either horizontally or vertically. (For Z Series with High Environmental Resistance, do not install in the upside-down position.)
- Take care not to push up the underside cover when attaching the motor. (PS Series)
- Attach the load directly to the motor rotor.
- Mount the motor directly to the base.
- The mounting surface flatness should be less than 0.02 [mm].
- The Motor can be installed either horizontally or vertically. (For Z Series with High Environmental Resistance, do not install in the upside-down position.)
- When installing the PS Series connector through the bottom of the base, making a larger hole than is shown in this figure is recommended.

Note: If the motor is installed as indicated in the figure below, mechanical vibrations will be generated and the velocity loop proportional gain (VG) cannot be increased. It will occur overshoot and the motor cannot operate smoothly.

- Attach the load directly to the motor rotor.
- Mount the motor directly to the base.

8.2 Dummy Inertia

For the full use of the benefits of the direct drive motor system, it is essential to maximize the resonance frequency of the whole mechanism by increasing the rigidity of the load, as well as securely fastening the Motor to a highly rigid mechanical system. Therefore, adding a dummy load to the rotor directly may help in the following cases.

A. A key is used to fix the load to the rotor because the load cannot be directly attached to the rotor.
B. The load is directly fixed to the rotor. However, vibration occurs due to torsional deflection on the rotary axis of the load.
C. Inertia of the whole mechanism is very low when a thin shaft such as a ball screw shaft is attached.
D. There exists play because a sprocket chain or a gear train is used.
E. Vibration occurs because the rigidity of the structure is low, such as when the Motor is being used for driving a belt.

Inertia of a dummy load shall be approximately 20% of the load inertia. When a speed reducer mechanism is used, it shall be

\[ \frac{GD_1^2/r}{GD_2^2} \leq 5 \]

Where \(GD_1^2\) = inertia of indirectly connected load, \(GD_2^2\) = inertia of directly attached load, and \(r\) = reduction ratio.

8.3 Installation of Driver Unit

- The EDC Driver Unit must be fixed so that fins are in the vertical position for natural air-cooling.
- Ambient temperatures should be in a range from 0 to 50 [°C]. The Driver Unit cannot be used in excess of 50 [°C]. A sufficient space of at least 100 [mm] should be provided both above and below the Driver Unit in a control cabinet.
- Operate the Driver Unit in an environment in which internally generated heat can be dissipated. If heat is trapped above the Driver Unit, open the space above it to allow for the heat to dissipate (in this case, also take steps to prevent the entry of dust) or provide a forced-air cooling system.
- Use the Driver Unit in a control cabinet with IP54 or higher. Protect the Driver Unit from exposure to oil mist, cutting water, cutting dust, coating gas, etc., to prevent their entry into the Driver Unit through ventilation openings, which may cause circuit failure.
- When installing two or more Driver Units for multi-axis combinations, provide a 10 [mm] or more space between adjacent Driver Units.
- The Driver Unit can be attached to a panel using front mounting brackets (optional).
- The maximum power loss of the EDC Driver Unit is 55 [W].
### 9.1 PS Series and EDC Driver Unit Combinations

<table>
<thead>
<tr>
<th>Motor Outer Diameter</th>
<th>Reference Number Coding of Motor</th>
<th>EDC Driver Unit Reference Number (※ includes accessories specifications)</th>
<th>Power Voltage [VAC]</th>
<th>Cable Reference Number</th>
<th>Main Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>M-PS1006KN002</td>
<td>M-EDC-PN0640B02-**</td>
<td>200 to 230</td>
<td>M-C002RS03</td>
<td>256 program channels Pulse train input (Photocoupler)</td>
</tr>
<tr>
<td>150</td>
<td>M-PS1506KN002</td>
<td>M-EDC-PN0640B02-**</td>
<td>200 to 230</td>
<td>M-C002RS03</td>
<td>256 program channels Pulse train input (Photocoupler)</td>
</tr>
<tr>
<td>200</td>
<td>M-PS2006KN002</td>
<td>M-EDC-PN0640B02-**</td>
<td>200 to 230</td>
<td>M-C002RS03</td>
<td>256 program channels Pulse train input (Photocoupler)</td>
</tr>
</tbody>
</table>

### 9.2 PN Series and EDC Driver Unit Combinations

<table>
<thead>
<tr>
<th>Motor Outer Diameter</th>
<th>Reference Number Coding of Motor</th>
<th>EDC Driver Unit Reference Number (※ includes accessories specifications)</th>
<th>Power Voltage [VAC]</th>
<th>Cable Reference Number</th>
<th>Main Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>170</td>
<td>M-PN2012KN002</td>
<td>M-EDC-PN0435AB502-**</td>
<td>200 to 230</td>
<td>M-C002RS03</td>
<td>256 program channels Pulse train input (Photocoupler)</td>
</tr>
<tr>
<td>210</td>
<td>M-PN2012KN002</td>
<td>M-EDC-PN0435AB502-**</td>
<td>200 to 230</td>
<td>M-C002RS03</td>
<td>256 program channels Pulse train input (Photocoupler)</td>
</tr>
<tr>
<td>280</td>
<td>M-PN2012KN002</td>
<td>M-EDC-PN0435AB502-**</td>
<td>200 to 230</td>
<td>M-C002RS03</td>
<td>256 program channels Pulse train input (Photocoupler)</td>
</tr>
<tr>
<td>170</td>
<td>M-PN2012KN002</td>
<td>M-EDC-PN0435AB502-**</td>
<td>200 to 230</td>
<td>M-C002RS03</td>
<td>256 program channels Pulse train input (Photocoupler)</td>
</tr>
<tr>
<td>210</td>
<td>M-PN2012KN002</td>
<td>M-EDC-PN0435AB502-**</td>
<td>200 to 230</td>
<td>M-C002RS03</td>
<td>256 program channels Pulse train input (Photocoupler)</td>
</tr>
</tbody>
</table>

### 9.3 PN Series with Brake and EDC Driver Unit Combinations

<table>
<thead>
<tr>
<th>Motor Outer Diameter</th>
<th>Reference Number Coding of Motor</th>
<th>EDC Driver Unit Reference Number (※ includes accessories specifications)</th>
<th>Power Voltage [VAC]</th>
<th>Cable Reference Number</th>
<th>Main Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>210</td>
<td>M-PN3045KG001</td>
<td>M-EDC-PN0435AB502-**</td>
<td>200 to 230</td>
<td>M-C002RS03</td>
<td>256 program channels Pulse train input (Photocoupler)</td>
</tr>
<tr>
<td>280</td>
<td>M-PN3045KG001</td>
<td>M-EDC-PN0435AB502-**</td>
<td>200 to 230</td>
<td>M-C002RS03</td>
<td>256 program channels Pulse train input (Photocoupler)</td>
</tr>
<tr>
<td>210</td>
<td>M-PN3045KG001</td>
<td>M-EDC-PN0435AB502-**</td>
<td>200 to 230</td>
<td>M-C002RS03</td>
<td>256 program channels Pulse train input (Photocoupler)</td>
</tr>
</tbody>
</table>

### 9.4 Z Series with High Environmental Resistance and EDC Driver Unit Combinations

<table>
<thead>
<tr>
<th>Motor Outer Diameter</th>
<th>Reference Number Coding of Motor</th>
<th>EDC Driver Unit Reference Number (※ includes accessories specifications)</th>
<th>Power Voltage [VAC]</th>
<th>Cable Reference Number</th>
<th>Main Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>220</td>
<td>M-PNZ3040KN001</td>
<td>M-EDC-PN0435AB502-**</td>
<td>200 to 230</td>
<td>M-C002RS03</td>
<td>256 program channels Pulse train input (Photocoupler)</td>
</tr>
<tr>
<td>280</td>
<td>M-PNZ3040KN001</td>
<td>M-EDC-PN0435AB502-**</td>
<td>200 to 230</td>
<td>M-C002RS03</td>
<td>256 program channels Pulse train input (Photocoupler)</td>
</tr>
<tr>
<td>220</td>
<td>M-PNZ3040KN001</td>
<td>M-EDC-PN0435AB502-**</td>
<td>200 to 230</td>
<td>M-C002RS03</td>
<td>256 program channels Pulse train input (Photocoupler)</td>
</tr>
</tbody>
</table>

### 9.5 Options

<table>
<thead>
<tr>
<th>Item</th>
<th>Reference number</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connector</td>
<td>M-E014DCFS1-001</td>
<td>CN2 connector (user side) for standard function</td>
</tr>
<tr>
<td></td>
<td>M-E014DCFS1-006</td>
<td>CN2 connector (user side) for CC-Link function</td>
</tr>
<tr>
<td></td>
<td>M-E014DCFS1-002</td>
<td>CN5 connector (user side)</td>
</tr>
<tr>
<td></td>
<td>M-E014DCFS1-003</td>
<td>CN6 connector (user side)</td>
</tr>
<tr>
<td>Mounting bracket</td>
<td>M-E050DCKA1-001</td>
<td>Driver Unit mounting brackets</td>
</tr>
<tr>
<td></td>
<td></td>
<td>User's Manual (Japanese version)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>User's Manual (English version)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CC-Link option instruction manual (Japanese version)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CC-Link option instruction manual (English version)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Optional regeneration resistor (7 [W])</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Optional regeneration resistor (120 [W])</td>
</tr>
<tr>
<td>Accessory set</td>
<td>M-E014DCFS1-004</td>
<td>Set of M-E014DCFS1-001, M-E014DCFS1-002, and M-E050DCKA1-001</td>
</tr>
<tr>
<td>RS-232C Communication Cable</td>
<td>M-C053RFS3</td>
<td>Communication cable between PC and EDC driver unit (Cable length: 3 [m])</td>
</tr>
<tr>
<td>Cable with CN2 connector</td>
<td>M-E011DCCN1-001</td>
<td>Cable with CN2 connector for CC-Link function (Cable length: 3 [m])</td>
</tr>
<tr>
<td>Handy Terminal</td>
<td>M-RHT721</td>
<td>RS-232C interface terminal for inputting parameter/program into EDC driver unit (Cable length: 3 [m])</td>
</tr>
</tbody>
</table>
“EDC Megaterm” Application Software

Once installed on your computer, this software enables the editing, preparation and control of EDC Driver Unit programs and parameters. It also facilitates the allocation and monitoring of control input/output. And its oscilloscope function allows for easy confirmation of Motor operation.

EDC Megaterm can be downloaded for free from the NSK Web site (http://www.nsk.com/).

RS-232C communication cable is available (option).

Type: M-C003RS03 (cable length: 3 [m])

A USB port can be used on a PC without a COM port. In this case, use a commercial RS-232C/USB conversion adaptor for communication. We have confirmed the compatibility of the SRC06-USB, USB serial cable made by Arvel.

A USB port can be used on a PC without a COM port. In this case, use a commercial RS-232C/USB conversion adaptor for communication. We have confirmed the compatibility of the SRC06-USB, USB serial cable made by Arvel.

The RS-232C communication connector for the EDC Driver Unit has a different pin configuration than that for a PC.

RS-232C

EDC Megaterm

Windows 2000•XP•Vista

Personal computer

EDC Driver Unit

Functions

1. Oscilloscope function
2. Allocation and monitoring of control input/output
3. Parameter editing
4. Channel editing
5. Others:
   • Upload/download parameter and channel data
   • Terminal

Main Functions

1. Oscilloscope function
   • 4-channel oscilloscope, 10 [k sampling/s] maximum
   • Anything that can be monitored using the handy terminal can be displayed on the oscilloscope.
   • Monitor scales are adjustable.
   • Measured waveforms are output as bitmaps or CSV format.

2. Allocation and monitoring of control input/output
   • Allocation of control input/output by drag-and-drop editing
   • Monitoring of input/output signals
   • Report of allocation list

3. Parameter edits
   • Parameter edits take effect in real time (off-line editing is also supported)
   • Parameter-by-parameter reset to default
   • Help function for parameters
   • Report of parameter setting list

4. Channel edits
   • Drag-and-drop edits from command window
   • Direct input capability also supported (automatic insertion of comments)
   • Report of program list

5. Others:
   • Report of allocation list
   • Monitoring of input/output signals
   • Upload/download parameters

Special-purpose Applications

This product is intended for general industrial applications and is not designed or manufactured for use under dangerous conditions.

Contact NSK before using this product for any special-purpose applications, including nuclear power equipment and systems or aerospace, medical, and safety devices.

While this product is manufactured under strict quality controls, NSK recommends that an appropriate safety device be installed when used with equipment that could cause serious accidents or damage in the event of product failure.

Compliance with UL Standards (PS/PN Series only)

• Motor
   • UL Recognized Component
   • Compliant with UL1004-1 (File No.: E216970)

• Driver Unit
   • Compliant with UL508C (File No.: E216221)
   • Cable set
   • UL-compliant cables are used

Warranty Period

• The warranty period is either one year from delivery or 2 400 hours of operation, whichever comes first.

Limited Warranty

• The warranty is limited to the products supplied by NSK Ltd.
• The defective product will be repaired free of charge within the applicable warranty period.
• Repairs after the expiration of the applicable warranty period will be subject to payment.

Immunities

• The product is not warranted in one of the following cases even within the warranty period.
   • Failure of the unit due to modification or repair that is conducted by a person(s) or party (ies) other than the supplier.
   • Failure of the unit due to the causes other than those attributable to the supplier.
   • Failure of the unit due to modification or repair that is conducted by a person(s) or party (ies) other than the supplier.
   • Other types of failures due to natural disasters and accidents (causes not attributable to the responsibility of the supplier).
   • Damages induced by a failure of the supplied unit are not covered.

Services Fee

• Prices of goods do not include any applicable service charges, such as the dispatching of engineers.
• Startup or maintenance services that require the dispatching of engineers are subject to payment even during the applicable warranty period.
• Service charges will be invoiced in accordance with the supplier’s standard service charge list.

Discontinuation of Production and Maintenance Service Period

Any discontinuation of production will be announced one year in advance. The maintenance service period is five (5) years after discontinuation of production. Announcement will be released by the supplier or published on the NSK Web site.

Special-purpose Applications

This product is intended for general industrial applications and is not designed or manufactured for use under dangerous conditions.

Contact NSK before using this product for any special-purpose applications, including nuclear power equipment and systems or aerospace, medical, and safety devices.

While this product is manufactured under strict quality controls, NSK recommends that an appropriate safety device be installed when used with equipment that could cause serious accidents or damage in the event of product failure.
**Form for Requesting Megatorque Motor Selection**

NSK will assist in selecting the optimal Megatorque Motor. Please fill in the necessary items on the below form and send it by fax to the local NSK office. Items marked with "*" represent the important information required for selection. Please provide as much detail as possible.

---

### To

- **Company Name:**
- **Section:**
- **Contact:**

### Date (DD/MM/YYYY): / / 

### Application and equipment used

- Specify with as much detail as possible

### Motor installation position

- Upright position
- Horizontal position
- Upside-down position
- Others

### Load conditions

1. Geometry, dimensions, thickness, material (or mass) of table
2. Dimensions, mass, quantity of loads/ jigs
3. PCD (distance between the jigs/loads) (example of description)
   - (Example)

- Schematic drawing (an attached illustration showing outside dimensions is acceptable)
  - Please provide information on outside dimensions, dimensions from the center, material, etc.
  - Force is applied downward to a single point at 125 mm in radius from the center.

- **Attachment:** [ ] Yes [ ] No

### Motor size requested

**Positioning command system**

- Internal program system
- Pulse train input operation
- RS-232C operation
- CC-Link

**Index angle / Number of points**

- Settle at °, Number of points:

**Repeatability (a)**

- a seconds [ ] mm at mm from the motor center

**Cycle pattern**

- (desired positioning time) Specify setting time.

**Input power voltage**

- [ ] 100 to 115 [VAC] [ ] 200 to 230 [VAC] [ ] Others [ ] [VAC]

**Environmental conditions**

- Operating environment:
  - General environment (equivalent to IP50)
  - Oil, water and chemical
  - Chips and dust
- Clean

- Operating temperature:
  - 0°C to 40°C
  - Below 0°C
  - Above 40°C

- **Contact NSK for details.**

**Cable specification and length**

- Stationary cable
- Flexible cable
- Length: m

**Other request items**

- Please reply by January 12, 2010. (example)

---

### Example of completed form

To

- **Company Name:**
- **Section:**
- **Contact:**

Date (DD/MM/YYYY): / / 

**Application and equipment used**

- Specify with as much detail as possible

**Motor installation position**

- Upright position
- Horizontal position
- Upside-down position
- Others

**Load conditions**

1. Geometry, dimensions, thickness, material (or mass) of table
2. Dimensions, mass, quantity of loads/ jigs
3. PCD (distance between the jigs/loads) (example of description)
   - (Example)

- Schematic diagram (an attached illustration showing outside dimensions is acceptable)
  - Please provide information on outside dimensions, dimensions from the center, material, etc.

- **Attachment:** [ ] Yes [ ] No

**Motor size requested**

**Positioning command system**

- Internal program system
- Pulse train input operation
- RS-232C operation
- CC-Link

**Index angle / Number of points**

- Settle at °, Number of points:

**Repeatability (a)**

- a seconds [ ] mm at mm from the motor center

**Cycle pattern**

- (desired positioning time) Specify setting time.

**Input power voltage**

- [ ] 100 to 115 [VAC] [ ] 200 to 230 [VAC] [ ] Others [ ] [VAC]

**Environmental conditions**

- Operating environment:
  - General environment (equivalent to IP50)
  - Oil, water and chemical
  - Chips and dust
- Clean

- Operating temperature:
  - 0°C to 40°C
  - Below 0°C
  - Above 40°C

- **Contact NSK for details.**

**Cable specification and length**

- Stationary cable
- Flexible cable
- Length: m

**Other request items**

- Please reply by January 12, 2010. (example)
Diverse selection of high performance motors with full consideration for safety and the environment.