Compact design spring-actuated brakes

MODEL BXW
Compact design spring-actuated brakes

These are electromagnetic brakes that are actuated by the force of a spring when electricity is not flowing. They provide excellent performance in emergency braking when power goes out, holding stopped positions for long periods of time, preventing machinery from coasting down, and the like.

Four types are available: three types with the same dimensions but different load torques and one type with specifications and dimensions matched to compact servo motors. Select the one that best matches your application and life cycle.

Adapted to the RoHS

Three types with the same dimensions but different load torques and one type matched to compact servo motors

Optimum selection can be made according to usage and life cycle.

Optimum design by 3D-CAD and FEM

It was the best designed using a finite element method (FEM) for magnetic field analysis of the electromagnetic brake.
Compact design spring-actuated brakes

These are electromagnetic brakes that are actuated by the force of a spring when electricity is not flowing. They provide excellent performance in emergency braking when power goes out, holding stopped positions for long periods of time, preventing machinery from coasting down, and the like.

Four types are available: three types with the same dimensions but different load torques and one type matched to compact servo motors. Select the one that best matches your application and life cycle.

It corresponds to the diverse needs

The stator (a heat source) can be mounted facing either inwards or outwards.

The anti-noise spring reduces a clattering sound generated by fine vibration during rotations.

Option of enhancement

Manual release levers are available. (Made to order)

Dust covers are available. (Sold separately)
**SPRING-ACTUATED BRAKES**

**BXW (L) Model** Braking use

### Specifications

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<td>90 13.0</td>
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</table>

* Models with 12V and 180V voltage specifications are made to order.  * For the armature pull in time and the release time in the case of alternating-current side switching.

### Dimensions

**Size 01, 02**

**Size 03, 04, 05**

<table>
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<tr>
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<td>156</td>
<td>90 13.0</td>
<td>0.144</td>
<td>623</td>
</tr>
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</table>

### How to Place an Order

**BXW-01-10L-24V-5**

- **Size**
  - 10: Not included
  - 12: Included
- **Release lever**
  - 10: Not included
  - 12: Included
- **Voltage** (Refer to the specifications table)
- **Application**
  - L: Braking use
  - H: Holding and braking use
  - S: Holding use
- **Bore diameter** (Dimensional symbol d)
- **Length** (400mm)
**SPRING-ACTUATED BRAKES**

**BXW (H) Model**  Holding and braking use

### Specifications

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</table>

* Models with 12V and 180V voltage specifications are made to order. * For the armature pull in time and release time in the case of alternating current side switching.

### Dimensions

#### Size 01, 02

![Diagram](image1)

#### Size 03, 04, 05

![Diagram](image2)

### How to Place an Order

**BXW-01-10H-24V-5**

- **Size**: BXW-01-10H
- **Release lever**: 10: Not included, 12: Included
- **Voltage**: Refer to specifications table
- **Application**: L: Braking use, H: Holding and braking use, S: Holding use

**To download CAD data or product catalogs**

[www.mikipulley.co.jp](http://www.mikipulley.co.jp)
SPRING-ACTUATED BRAKES

BXW (S) Model Holding use

Specifications

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<td>0.025</td>
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<td>0.8</td>
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</table>

* For the armature pull in time and release time in the case of alternating-current side switching.

Dimensions

How to Place an Order

**BXW-01-10S-24V-5**

Size

Release lever

10: Not included
12: Included

Bore diameter (Dimensional symbol d)

Voltage (Refer to the specifications table)

Application
L: Braking use H: Holding and braking use S: Holding use
SPRING-ACTUATED BRAKES BXW (L/H/S) MODEL

Option & Sold separately

The BXW (L/H/S) model comes with a release lever which causes the brake to release when it is not energized. Also, it can be provided with a dust cover (must be purchased separately) which prevents ingress of foreign matter in a poor environment.

■ Release lever (Made to order)

How to Place an Order

BXW-02-12H-24V-7

Size 02

Release lever
12: Included
10: Not included

Bore diameter (Dimensional symbol d)

Voltage (Refer to the specifications table)

Application
L: Braking use
H: Holding and braking use
S: Holding use

■ Dust cover (Sold separately)

How to Place an Order

BXW-01-C02

Applicable brake size
01, 02, 03, 04, 05

Material
Ethylene propylene diene monomer (EPDM) rubber

Temperature range
-40°C to 140°C

Exterior color
Black

Applicable brake models
L type, H type, S type BXW models

Applicable specification voltage
12V DC, 24V DC, 48V DC, 90V DC, 180V DC

* This temperature range is for dust cover materials. The operating temperature for BXW models is -10°C to 40°C. * Cannot be mounted on BXW models with release levers or R type BXW models.
### Specifications

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* For the armature pull in time and release time in the case of alternating-current side switching.

### Dimensions

**Lead wire W**

Length: 200mm

* The lead wire exit for size 01 is located in the dashed area.

<table>
<thead>
<tr>
<th>Model</th>
<th>Size</th>
<th>Radial dimensions [mm]</th>
<th>Axial direction dimensions [mm]</th>
<th>Bore dim. [mm]</th>
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</tbody>
</table>

**How to Place an Order**

**BXW-01-10R-24V-8.5**

- **Size**
- **Bore diameter (Dimensional symbol d)**
- **Voltage (Refer to the specifications table)**
- **Application R: Servo motor use**
**SPRING-ACTUATED BRAKES**

**Items Checked for Design Purposes**

- **Precautions for handling**
  - Brakes
    Most electromagnetic braking systems are made using flexible materials. Be careful when handling such parts and materials as striking or dropping them or applying excessive force could cause them to become damaged or deformed.
  - Lead wires
    Be careful not to pull excessively on the brake lead wires, bend them at sharp angles, or allow them to hang too low.
  - Frictional surface
    Since these are dry brakes, they must be used with the frictional surface dry. Keep water and oil off of the frictional surfaces when handling the brakes.

- **Precautions for mounting**
  - Mounting orientation
    BXW models can be mounted with the stator facing inwards (stator mounted) or outwards (plate mounted). Select your mounting orientation as the application dictates. Be aware, however, that the BXW (R) type is only compatible with stator centering-mark mounting. Your understanding is appreciated.
  - Affixing the rotor hub
    Affix the rotor hub to the shaft with hex-socket-head set screws such that the rotor hub does not touch the armature or stator. If you are applying adhesive to the hex-socket-head set screws, be careful that the adhesive does not come out onto the rotor hub surface. Note also that since the BXW (R) type is constructed so that the rotor hub does not go through the stator, affix it by press-fitting it onto the shaft at a position that does not touch the armature (see dimension J) when they are assembled.
  - Bolts and screws
    Implement screw-locking measures such as use of an adhesive threadlocking compound to bolts and screws used to install brakes.
  - Shafts
    The shaft tolerance should be h7 class (JIS B 0401). Be aware that the harder the material used for the shaft, the lower the effect of the hex-socket-head set screws.
  - Accuracy of brake attachment surfaces
    Make sure that concentricity (X) and perpendicularity (Y) do not exceed the allowable values of the table below.

<table>
<thead>
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<th>Size</th>
<th>Concentricity (X) T.I.R. (mm)</th>
<th>Perpendicularity (Y) T.I.R. (mm)</th>
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<td>BXW-03, 04, 05</td>
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<td>0.02</td>
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</table>

- **Stator mounted**
  - Spigot joint

- **Precautions for use**
  - Environment
    These brake units are dry braking systems, meaning that the torque will drop if oil residue, moisture, or other liquids get onto friction surfaces. Attach the protective cover when working in areas with oil, moisture, dust, and other particles that could affect the braking system.
  - Operating temperature
    The operating temperature range is −10°C to 40°C. If you will use the product at other temperatures, consult MIKI PULLEY.
  - Power supply voltage fluctuations
    Full braking performance may not be guaranteed with extreme changes in power supply voltage. Make sure to keep power supply voltage to within ± 10% of the rated voltage value.
  - Air gap adjustment
    BXW models do not require air gap adjustment. The brake air gap is adjusted when the braking system is shipped from the factory.
  - Circuit protectors
    If using a power supply that is not equipped with a circuit protector for DC switching, make sure to connect the recommended circuit protector device in parallel with the brake.

### Recommended power supplies and circuit protectors

#### Recommended power supplies

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<tr>
<th>Input AC power</th>
<th>Brake voltage</th>
<th>Rectification method</th>
<th>Recommended power supply model</th>
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<td>AC 100V 50/60Hz</td>
<td>DC 24V</td>
<td>Single-phase, full-wave</td>
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<td>AC 100V 50/60Hz</td>
<td>DC 90V</td>
<td>Single-phase, full-wave</td>
<td>BEW-2R</td>
</tr>
<tr>
<td>AC 100V 50/60Hz</td>
<td>DC 180V</td>
<td>Single-phase, half-wave</td>
<td>BEW-4R</td>
</tr>
</tbody>
</table>

#### Recommended circuit protectors

<table>
<thead>
<tr>
<th>Input voltage</th>
<th>Brake voltage</th>
<th>Recommended circuit protector (varistor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC 24V</td>
<td>DC 24V</td>
<td>NVD07SCD082 or an equivalent</td>
</tr>
<tr>
<td>AC 100V 50/60Hz</td>
<td>DC 24V</td>
<td>NVD07SCD220 or an equivalent</td>
</tr>
<tr>
<td>AC 100V 50/60Hz</td>
<td>DC 48V</td>
<td>NVD07SCD220 or an equivalent</td>
</tr>
<tr>
<td>AC 100V 50/60Hz</td>
<td>DC 90V</td>
<td>NVD07SCD470 or an equivalent</td>
</tr>
<tr>
<td>AC 100V 50/60Hz</td>
<td>DC 180V</td>
<td>NVD14SCD082 or an equivalent</td>
</tr>
</tbody>
</table>
**SPRING-ACTUATED BRAKES**

### Items Checked for Design Purposes

#### ■ Operating characteristics

#### ■ Operating time

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Definition</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>ta</td>
<td>Armature release time</td>
<td>The time from when current shuts off until the armature returns to its position prior to being pulled in and torque begins to be generated</td>
</tr>
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<td>tar</td>
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</tr>
<tr>
<td>tab</td>
<td>Actual torque build-up time</td>
<td>The time from when torque first begins to be generated until it reaches 80% of rated torque</td>
</tr>
<tr>
<td>tp</td>
<td>Torque build-up time</td>
<td>The time from when current flow is shut off until torque reaches 80% of rated torque</td>
</tr>
<tr>
<td>ta</td>
<td>Armature pull in time</td>
<td>The time from when current flow first starts until the armature is pulled in and torque disappears</td>
</tr>
<tr>
<td>tid</td>
<td>Initial delay time</td>
<td>The time from start of command input to actuation input or release input to the main brake body</td>
</tr>
</tbody>
</table>

#### ■ Selection procedure for brakes for braking

1. **Consideration of required torque to brake loads**
   
   To select the appropriate brake size, you must find the torque required for braking, T, and then select a size of brake that delivers a greater torque than T.

2. **Consideration of cases when load conditions are not clearly known**
   
   When load conditions are clearly known, assuming that the motor has been selected correctly for the load, a guideline for torque can be obtained from motor output using the following equation.

   $$ T_M = \frac{9550 \times P}{n_r} \times \eta \ [N \cdot m] $$

   where:
   - P is Motor output [kW]
   - \( n_r \) is Brake shaft rotation speed \([\text{min}^{-1}]\)
   - \( \eta \) is Transmission efficiency from motor to brake

3. **Consideration when load conditions can be clearly ascertained**
   
   When load conditions can be clearly ascertained, the torque T required for braking can be found using the following equation.

   $$ T = \left( \frac{J \times n}{9.55 \times \eta} \pm T_\ell \right) \times K \ [N \cdot m] $$

   where:
   - J is Total moment of inertia of load side \([\text{kg} \cdot \text{m}^2]\)
   - n is Rotation speed \([\text{min}^{-1}]\)
   - \( T_\ell \) is Load torque \([N \cdot m]\)
   - K is Safety factor (see table below)

   The sign of load torque \( T_\ell \) is minus when the load works in the direction that hinders braking. The actual braking time tab is the time required from the start of braking torque generation until braking is complete. When this is not clearly known at the selection stage, a guideline value is used that factors in service life and the like.

   $$ \Delta \theta = \pm 0.15 \times \theta \ [\degree] $$

   where:
   - \( \Delta \theta \) is The angular displacement when the armature is released

   $$ \eta = \frac{9550 \times P}{n_r} \times \eta \ [N \cdot m] $$

   $$ J \times n^2 + J \times n + \eta = \frac{60 \times P b a \ell}{J} $$

   where:
   - \( P b a \ell \) is Energy required for one braking operation \([J]\)

   $$ S = \frac{J \times n^2}{182} \times T b + T_\ell $$

   where:
   - \( S \) is Total braking time \([\text{times/min}]\)

   - \( J \) is Total moment of inertia of load side \([\text{kg} \cdot \text{m}^2]\)

   - n is Rotation speed \([\text{min}^{-1}]\)

   - Tb is Brake torque \([N \cdot m]\)

   - T\ell is Load torque \([N \cdot m]\)

   - K is Safety factor (see table below)

   $$ EB = \frac{J \times n^2}{182} \times T b + T_\ell $$

   $$ EB \ll \frac{60 \times P b a \ell}{J} $$

   $$ T b > T \ (or \ T_M) \ [N \cdot m] $$

   where:
   - T is Brake torque \([N \cdot m]\)

   * For brake torque, treat T as equaling T\ell.

   $$ (T_\ell) \text{ Static friction torque from specifications table} $$

4. **Provisional size selection**

   A brake of a size for which torque T found from the equations above satisfies the following equation must be selected.

   $$ T b > T \ (or \ T_M) \ [N \cdot m] $$

   where:
   - T is Brake torque \([N \cdot m]\)

### Items Checked for Design Purposes

<table>
<thead>
<tr>
<th>Load state</th>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-inertia/low-frequency constant load</td>
<td>1.5</td>
</tr>
<tr>
<td>Ordinary use with normal inertia</td>
<td>2</td>
</tr>
<tr>
<td>High-inertia/high-frequency load fluctuation</td>
<td>3</td>
</tr>
</tbody>
</table>

* OC-side switching
Consideration of energy
When the load required for braking is sufficiently small, the size can be selected considering only torque \( T \) as described above. Given the effects of heat generated by braking, however, the following equation must be used to confirm that the operation frequency per unit time and the total number of operations (service life) meet the required specifications.

Use the following equation to find the energy \( E_b \) required for a single braking operation.

\[
E_b = \frac{J \times n^2}{182} \times \frac{T_b}{T_b \pm T_\ell} \ [J]
\]

The sign of load torque \( T_\ell \) is plus when the load works in the direction that assists braking and minus when it works in the direction that hinders braking.

Confirm the frequency \( S \) of operations that can be performed per minute

Find the frequency of operations that can be performed per minute using the equation at right to confirm that the desired operation frequency is sufficiently smaller than the value found.

\[
S = \frac{60 \times Pb_{\text{at}}}{E_b} \ [\text{times/min}]
\]

Here, actual braking time \( t_{tb} \) is the time from the start of braking torque generation to the completion of braking. Find it with the following equation.

\[
t_{tb} = \frac{J \times n}{9.55 \times (T_b \pm T_\ell)} \ [s]
\]

Consideration of stopping precision
To confirm stopping precision, find the stopping angle (rotation) using the following equation.

\[
\theta = 6 \times n \times (t_w + tar + \frac{1}{2}t_{tab}) \ [^\circ]
\]

The variation in stopping precision—i.e., stopping precision \( \Delta \theta \)—can be found empirically with the following equation and used as a guide.

\[
\Delta \theta = \pm 0.15 \times \theta \ [^\circ]
\]

### Selection procedure for brakes for holding

Consideration of required torque to hold loads

Use the following equation to find the torque \( T \) required to hold a load while stationary.

\[
T = T_{\text{max}} \times K \ [N \cdot m]
\]

- \( T_{\text{max}} \): Maximum load torque \( [N \cdot m] \)
- \( K \): Safety factor (refer to the table below)

<table>
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<tr>
<td>Hi inertia / large load fluctuations</td>
<td>3</td>
</tr>
</tbody>
</table>

Consideration of energy

When considering a brake with the objective of holding loads, braking is limited to emergency braking.

Use the following equation to find the braking energy \( E_b \) for a single operation required for emergency braking. You must confirm that this result is sufficiently smaller than the allowable braking energy \( E_{bal} \) of the selected brake.

\[
E_b = \frac{J \times n^2}{182} \times \frac{T_b}{T_b \pm T_{\text{max}}} \ [J]
\]

The sign of maximum load torque \( T_{\text{max}} \) is plus when the load works in the direction that assists braking and minus when it works in the direction that hinders braking.

\[
E_b < E_{bal} \ [J]
\]

When using brakes for both holding and braking and the specification is indicated by allowable braking energy rate \( Pb_{\text{at}} \), check under the following conditions.

\[
E_b < 60 \times Pb_{\text{at}} \ [J]
\]

Consideration of number of operations

The total number of braking operations (service life) when performing emergency braking \( L \) must be found using the following equation to confirm that required specifications are satisfied.

\[
L = \frac{E_l}{E_{b}} \ [\text{times}]
\]

\( E_l \): Total braking energy \([J]\)

Note that the frequency of emergency braking will also vary with operating environment; however, it should be about once per minute or better. When the braking energy of a single operation \( E_b \) is 70% or more of the allowable braking energy \( E_{bal} \), however, allow the brake to cool sufficiently after emergency braking before resuming use.