Spring-actuated brake and P.W.M. controller

MODEL BXR LE
A spring-actuated brake is a brake that is operated by the push force of a built-in spring in the event of a power failure or when the power is cut off in an emergency. In other words, when a machine is running it continuously consumes electric power in order to maintain the brake in a released condition. However, the necessary electrical energy consumed by a spring-actuated brake when the brake starts to release differs greatly from the energy required to maintain the brake in a released condition. Intrinsically, only a very small electrical energy was necessary to hold the brake in a released condition.

Accordingly, a variety of merits can be obtained by designing a spring-actuated brake based on the assumption that it will incorporate a dedicated controller to control the necessary electrical energy for overcoming the push force of the spring when the brake starts to release and also the necessary electrical energy for keeping the brake in a released condition.

A variety of merits

By incorporating a dedicated controller in the spring-actuated brake, a variety of merits can be obtained.

- **Compact design**
  - which reduces the thickness of the brake to 1/2

- **High torque design**
  - which doubles the torque

- **Long life design**
  - which doubles the life of the brake

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.
Accordingly, a variety of merits can be obtained by designing a spring-actuated brake based on the assumption that it will incorporate a dedicated controller to control the necessary electrical energy for overcoming the push force of the spring when the brake starts to release and also the necessary electrical energy for keeping the brake in a released condition.

**Ultra-compact design with 1/2 of thickness compared with the conventional company product**

Compared with BX series, which is the conventional company product, the thickness has been reduced to 1/2.

The lead wire that was taken from the outside diameter can be taken in the direction of the shaft of the reverse mounting surface. The limited space can be utilized as efficiently as possible.

**Thorough reduction of rotor weight**

High-intensity glass cloth has been adopted for the core material of the rotor to secure sufficient strength and to actualize overwhelming lighter weight.
SPRING-ACTUATED BRAKE & CONTROLLER

BXR LE Model  Holding use

■ Brake part

Specifications

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<thead>
<tr>
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■ Dimensions

[Diagram of brake part specifications]

■ Controller part

Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>Specifications</th>
<th>Functional Description</th>
<th>Function</th>
<th>Specification</th>
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<td>Yellow (+)</td>
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</table>

■ Structure

[Diagram of brake part structure]

■ Timing charts

[Diagram of timing charts]

* The brake output is controlled by the input power to the input read wire being toggled ON/OFF.
■ Specifications

- **Dimensions**
  - **Controller part**
  - **Brake part**

- **Controller part**
  - BXR LE Model Holding use
  - SPRING-ACTUATED BRAKE & CONTROLLER

- **Insulating resistance**
- **Ambient environment**
- **Dielectric strength voltage**
- **Max. output current**

- **Model**
  - BXR-040-10LE
  - BXR-035-10LE
  - BXR-020-10LE
  - BXR-015-10LE
  - BXR-050-10LE
  - BXR-035-10LE
  - BXR-020-10LE
  - BXR-015-10LE

- **Yellow**
- **Red**

- **Function**
  - Input voltage
  - Time rating
  - Smoothing power supplies

- **Output**
- **Input**
- **SP**
- **P.W.M. controller type**

- **Braking**
  - DC1.0A (at 20℃) ・ DC0.8A (at 60℃)

- **Lead wire (Yellow)**
- **Lead wire (Red)**

- **Connector for a brake** (Regardless of polarity)

- **Recommended mounting position**

- **Over excitation** DC24V (0.2s), Constant excitation DC7V (±10%) ・ PWM control

- **-20 to 60℃ 5 to 95%RH, With no condensation, freezing**

- **DC500V, 100MΩ with Megger (Between lead wire and case)**

- **AC1000V 50/60Hz 1min (Between lead wire and case)**

- **(Spigot joint depth:5)**

- **Unit [mm]**
  - **φD**
  - **φA**
  - **h9**
  - **L**
  - **D2**
  - **m**
  - **n**
  - **d**
  - **d max.**

- **How to Place an Order**

### Application

Example of mounting on the output shaft of a servo-motor

The photograph at right shows an example of an integrated construction in which an ultra-compact spring-actuated brake is installed on the output shaft of a servo motor and a rotor hub is machined onto the timing pulley. It is possible to make the total length shorter than the length of a built-in servo motor that has a brake, making a machine more compact.
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

■ Fixing the rotor hub
Use a design and fixing method that prevent the rotor hub from touching the armature or the stator. When employing a fixing method involving the use of a general hex socket head bolt and adhesive, take care that the adhesive does not get onto the surface of the rotor hub.

■ Bolts and screws
Implement screw-locking measures such as use of an adhesive thread locking compound to bolts used to install brakes.

■ Shafts
The shaft tolerance should be h7 class (JIS B 0401). When using an optional press-fitting type rotor hub, consider using the press-fitting tolerance.

■ 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>
<tr>
<th>Model</th>
<th>Size</th>
<th>Concentricity (X) T.I.R. [mm]</th>
<th>Perpendicularity (Y) T.I.R. [mm]</th>
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</table>

■ 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 of brake part is −10℃ to 40℃ and controller part is −20℃ to 60℃. 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
BXR LE models do not require air gap adjustment. The brake air gap is adjusted when the braking system is shipped from the factory.

■ Circuit protectors
A circuit protector is built into a dedicated controller, so do not connect another circuit protector to the controller.

■ Control using the controller
The control function operates as a result of the change in the ON/OFF status at the input side, so carry out switching at the input side of the dedicated controller.

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BXR-040-10LE BXR-035-10LE BXR-025-10LE BXR-020-10LE BXR-015-10LE

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Model  | Size | Concentricity (X) T.I.R. [mm] | Perpendicularity (Y) T.I.R. [mm] |
BXR-015-10LE | 015  | 0.05                         | 0.02                            |
BXR-020-10LE | 020  | 0.05                         | 0.02                            |
BXR-025-10LE | 025  | 0.05                         | 0.02                            |
BXR-035-10LE | 035  | 0.05                         | 0.02                            |
BXR-040-10LE | 040  | 0.10                         | 0.02                            |
BXR-050-10LE | 050  | 0.10                         | 0.02                            |
### Operating characteristics

#### Operating time

![Diagram of operating time]

**tar**: Armature release time

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.

**tap**: Actual torque build-up time

The time from when torque first begins to be generated until it reaches 80% of rated torque.

**tb**: Torque build-up time

The time from when current flow is shut off until torque reaches 80% of rated torque.

**ta**: Armature pull in time

The time from when current flow first starts until the armature is pulled in and torque disappears.

**tid**: Initial delay time

The time from start of command input to actuation input or release input to the main brake body.

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### Selection

#### 1. Consideration of required torque to hold loads

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

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

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

<table>
<thead>
<tr>
<th>Load state</th>
<th>Factor</th>
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<tbody>
<tr>
<td>Low inertia / small load fluctuations</td>
<td>1.5</td>
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<tr>
<td>Ordinary use with normal inertia</td>
<td>2</td>
</tr>
<tr>
<td>High inertia / large load fluctuations</td>
<td>3</td>
</tr>
</tbody>
</table>

#### 2. Provisional selection of size

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

\[
T_{\text{Ts}} > T \quad [\text{N} \cdot \text{m}]
\]

- \( T_{\text{Ts}} \): Static friction torque of brake \([\text{N} \cdot \text{m}]\)

#### 3. 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 \( E_{b\text{al}} \) of the selected brake.

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

- \( J \): Total moment of inertia on load side \([\text{kg} \cdot \text{m}^2]\)
- \( n \): Rotation speed \([\text{min}^{-1}]\)
- \( T_b \): Brake torque \([\text{N} \cdot \text{m}]\)
- \( T_{\text{max}} \): Maximum load torque \([\text{N} \cdot \text{m}]\)

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.

\[
E_b < E_{b\text{al}} \quad [\text{J}]
\]

#### 4. 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.

\[
L = \frac{E_T}{E_b} \quad \text{[times]}
\]

- \( E_T \): Total braking energy \([\text{J}]\)

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 \( E_{b\text{al}} \), however, allow the brake to cool sufficiently after emergency braking before resuming use.