CLUTCHES & BRAKES

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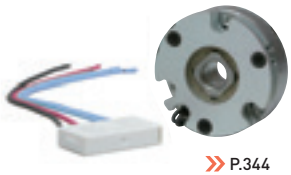
- BXR-LE —  » P.344
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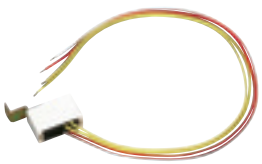
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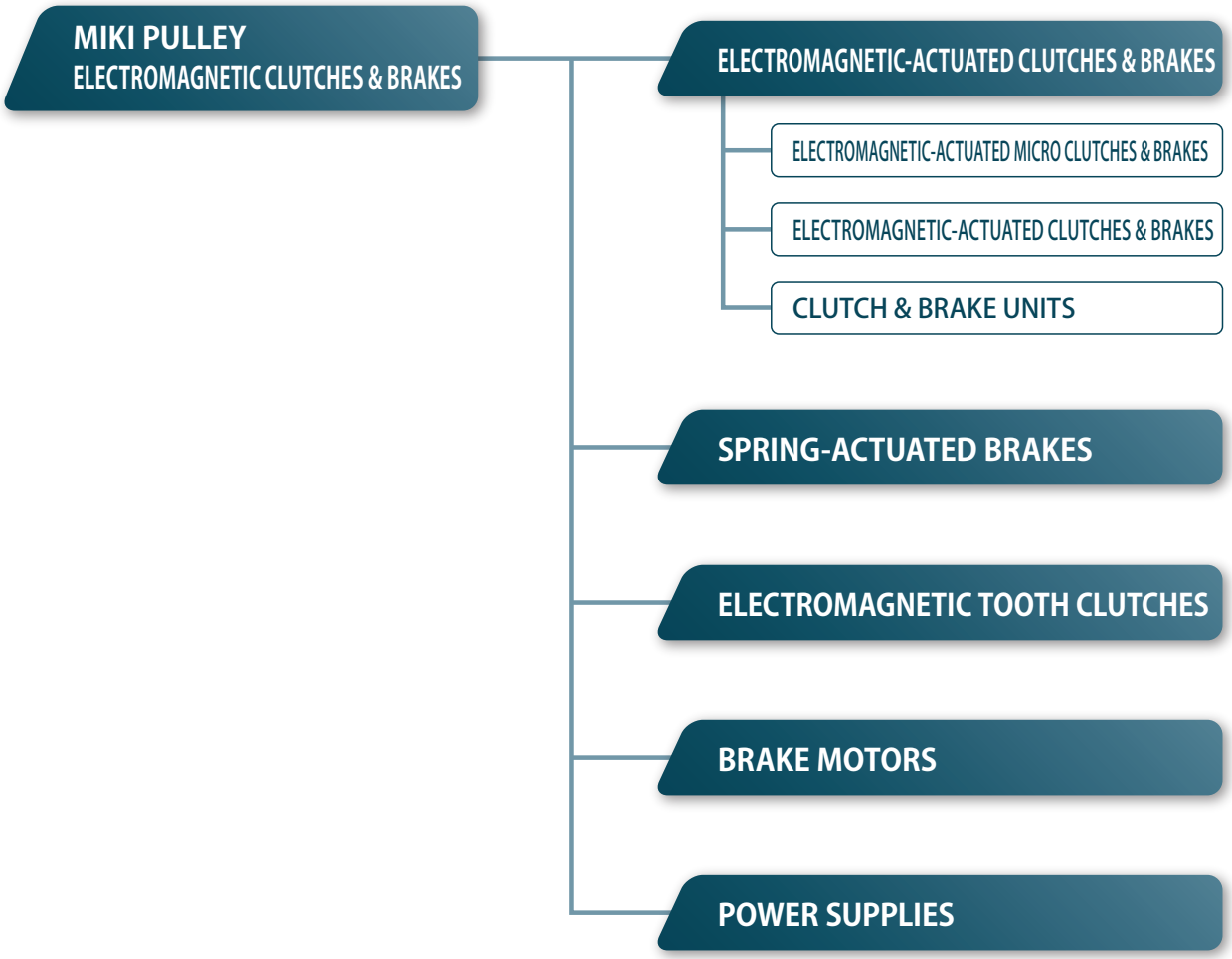
» A selection guide for electromagnetic clutches and brakes begins on the next page.

Selection Guide

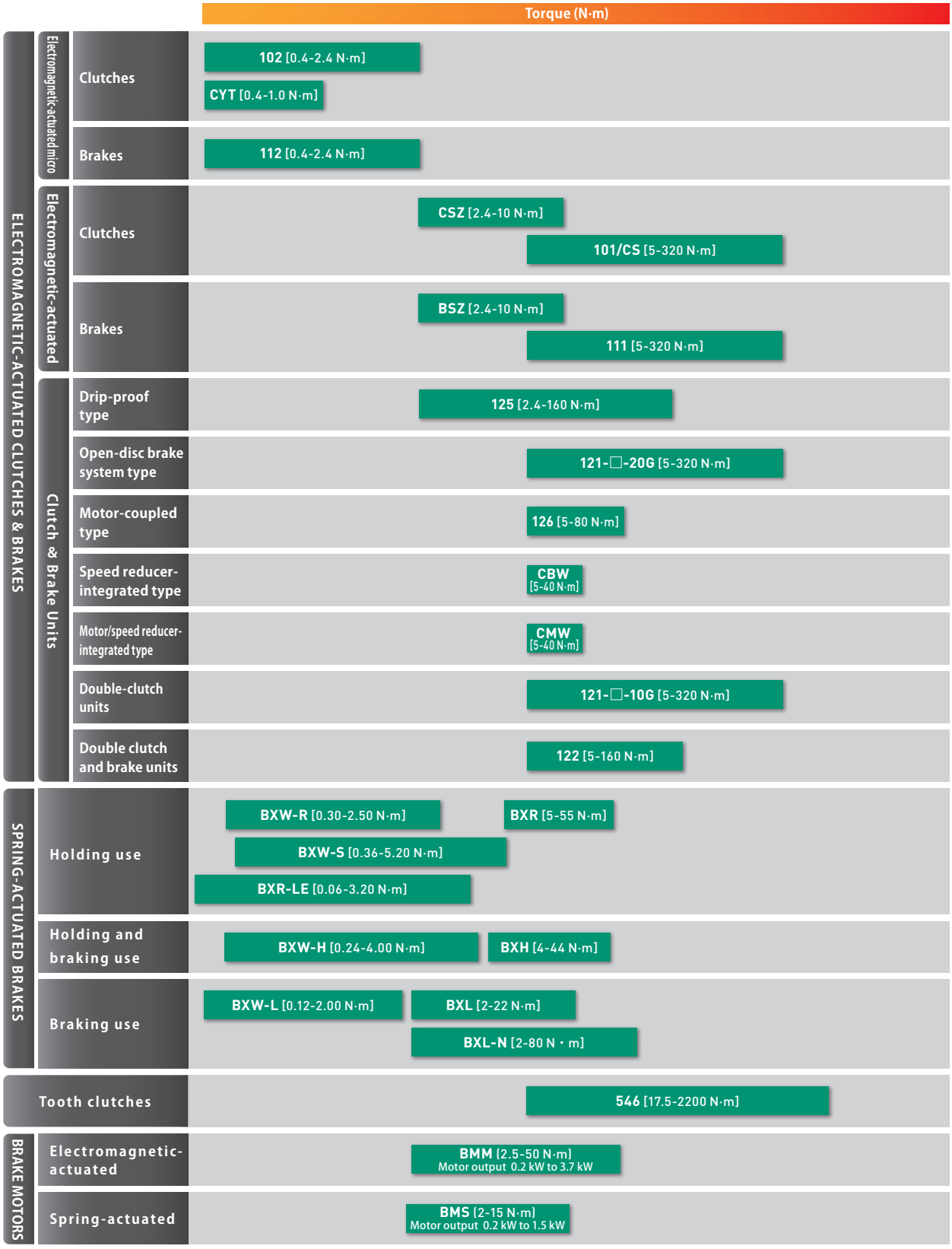
Miki Pulley divides its electromagnetic clutches & brakes into several major categories: electromagnetic-actuated clutches & brakes, spring-actuated clutches & brakes, electromagnetic tooth clutches, brake motors, and power supplies.

When selecting a product, have information handy on your application, required torque, performance, load properties, drive source and the like, and then use the diagram on the page at right as your guide. Selection details are described in the selection procedures given for each series.

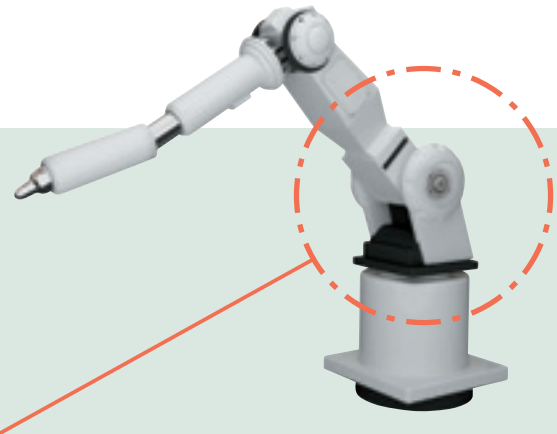
List of Products



Select by Product Characteristics



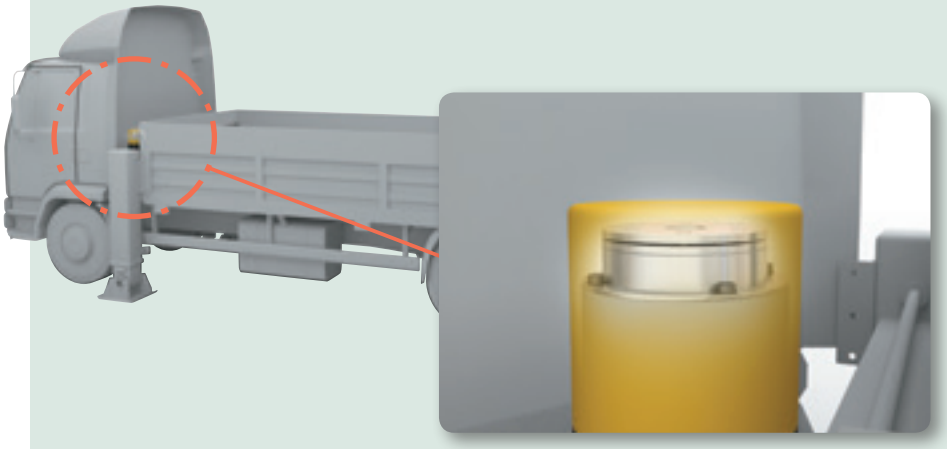
Applications



Product model BXR

Employed device Articulated Robot

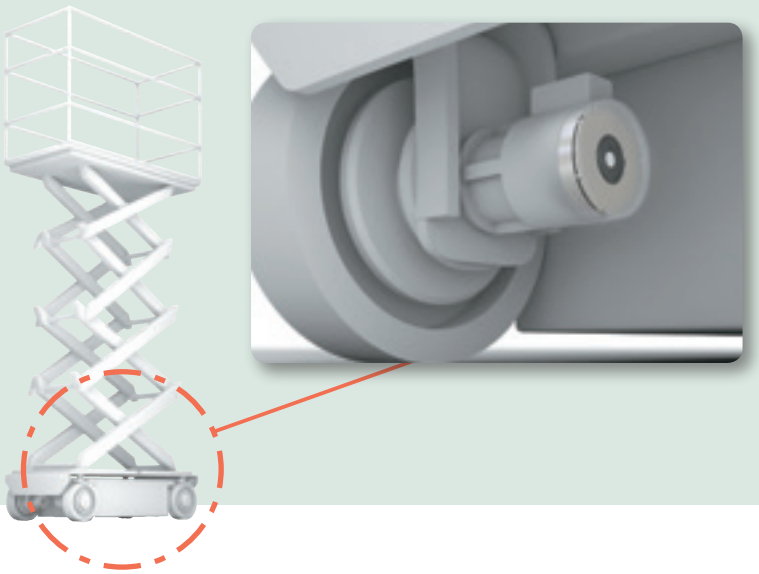
BXR spline type for holding arms.
Saves space with slim design and greatly reduces drag wear by using light rotor.



Product model 111

Employed device Special-purpose Vehicles

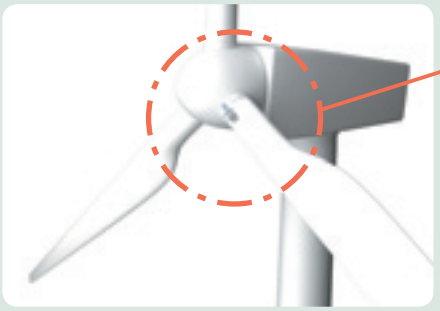
The Electromagnetic-actuated brake 111 model is used in the elevating device for the auxiliary leg.



Product model BXR

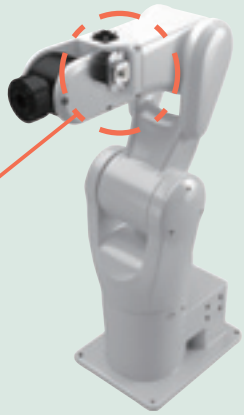
Employed device Aerial Vehicle

BXR model as the holding brake for drive motor. Slim design helps save space.



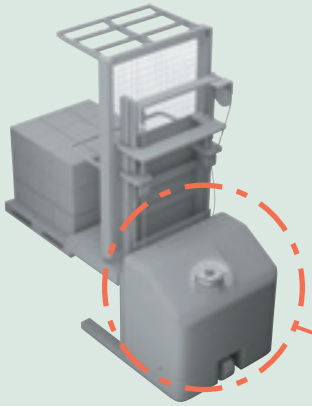
Product model BXW Large Size (Custom Product)
Employed device Wind Turbine Generator

Large BXW as the pitch drive device of a wind turbine generator.



Product model BXR-LE
Employed device Vertically Articulated Robots

The BXR-LE models owes its ultra-thin profile to a dedicated controller. Mounted on the output shaft, it is ideal for applications where space is limited. Its dedicated controller also saves energy.



Product model BXH
Employed device Forklifts

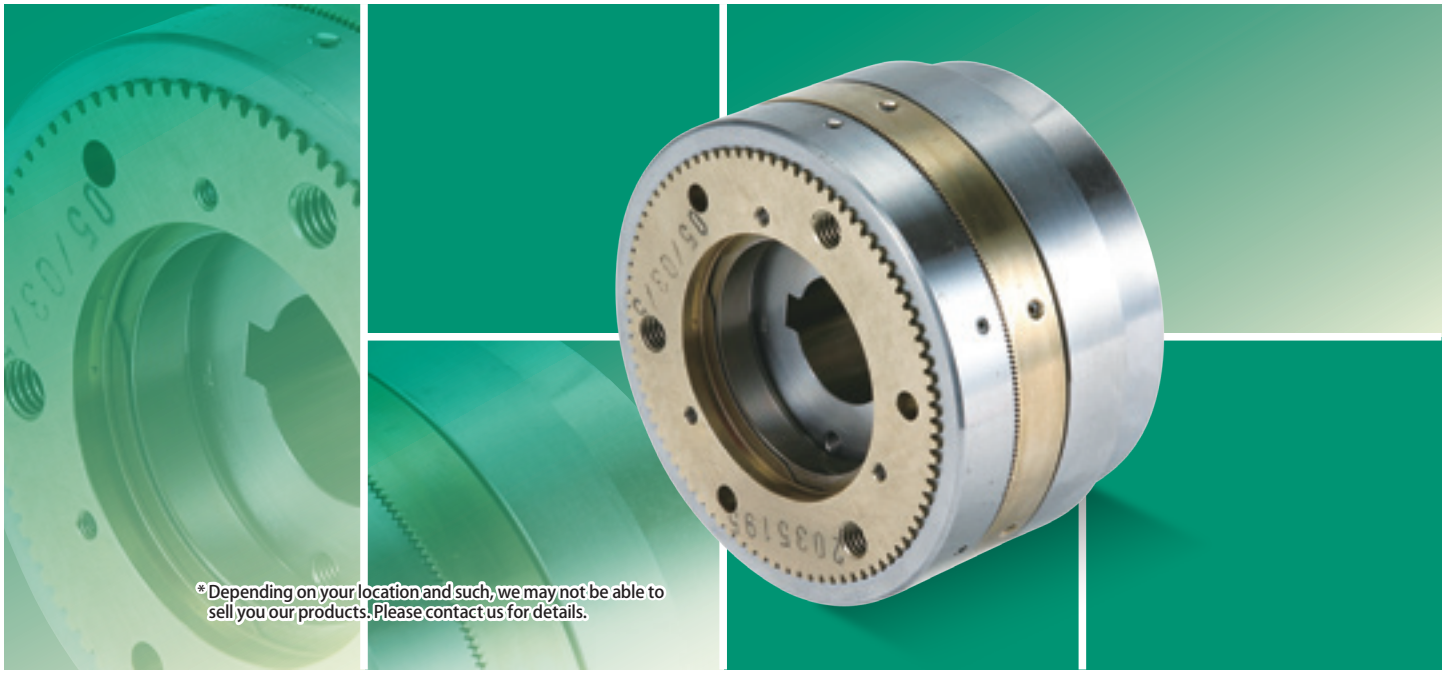
Spring-actuated brake BXH model for electric forklift. Compact, high torque design.

ELECTROMAGNETIC TOOTH CLUTCHES

Application	Printing machinery, wrapping machinery, filling machinery, food machinery, medical machinery

Meshing-type Electromagnetic-actuated Clutch Has High Torque and Reliable Transmission

These electromagnetic tooth clutches are electromagnetic-actuated clutches of the type that transmit torque by engaging tooth. Since torque is transmitted by engaging tooth, these clutches can transmit very high torque with a compact size (five to ten times our dry-type single discs). They may be either full position, which engage everywhere around their circumference, or single position, which engage at a set position, engaging in only one location per revolution. The shape of the tooth tip may be either symmetrical or sawtooth. Symmetrical tips can be used in any rotation direction, while sawtooth tips are faster than symmetrical tips and can engage at higher speeds.



* Depending on your location and such, we may not be able to sell you our products. Please contact us for details.

Compact, high torque
Since torque is transmitted by the meshing of the tooth, high torque transmission can be achieved with a compact form factor.

No drag torque
Since the tooth do not form a magnetic circuit, engagement and release can be faster, and there is no drag torque.

Easy mounting
Bearings are built in, so there is no centering of stator and rotor.

Can be used in oily environments
Can be used in oily environments under some usage conditions.

Special position engagement
Special tooth shapes can be made that mesh at multiple locations.

Available Models

Series	Tooth Shapes	Positions	Lineup
TOOTH CLUTCHES	Full-depth tooth	Full position	546-□-34-NF
		Single position	546-□-34-NS
	Sawtooth (right rotation)	Full position	546-□-34-RF
		Single position	546-□-34-RS
	Sawtooth (left rotation)	Full position	546-□-34-LF
		Single position	546-□-34-LS

Tooth Shape/Construction

Full-depth Tooth
By far the most common tooth shape, it can be used rotating in either direction.

Sawtooth
These have fewer tooth that the full-depth tooth type, and have a smaller angle of mesh insertion. They can thus engage at a relatively higher speed than full-depth tooth.

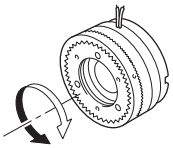
Full Position
A common tooth shape that can mesh anywhere around the full circumference.

Single Position
This tooth shape is for fixed position engagement, where only one location meshes per revolution.

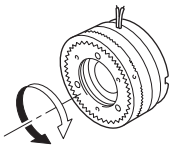
Name of tooth shape	NF	NS	RF	RS	LF	LS
Type of tooth shape	Full-depth tooth	Full-depth tooth	Sawtooth	Sawtooth	Sawtooth	Sawtooth
Position	Full	Single	Full	Single	Full	Single
Rotational direction	Both	Both	Right	Right	Left	Left

* The reference point for rotation direction (rotor) is the direction as seen from the adapter plate. With armature input, the rotation direction is as stated. Note that with shaft input, the direction is the opposite.
Example: To get right rotation at shaft input, use a left-rotating sawtooth (L).

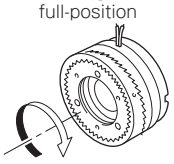
[NF] Full-depth tooth, full-position



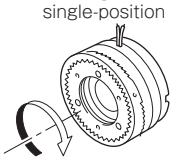
[NS] Full-depth tooth, single-position



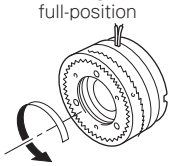
[RF] Right-handed rotating sawtooth, full-position



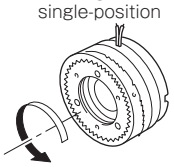
[RS] Right-handed rotating sawtooth, single-position



[LF] Left-handed rotating sawtooth, full-position



[LS] Left-handed rotating sawtooth, single-position



546 Models

Specifications

Model	Size	Torque [N·m]	Coil (at 20℃)				Heat resistance class	Allowable rotation speed of engagement [min⁻¹]			Max. rotation speed [min⁻¹]	Moment of inertia J [kg·m²]		Number of teeth		Armature pull-in time ta [s]	Armature release time tar [s]	Bearing number	Mass [kg]
			Exciting voltage [V]	Wattage [W]	Current [A]	Resistance [Ω]		NF	NS	Sawtooth		Rotor	Armature	Full-depth tooth, Full	Sawtooth, Full				
546-12-34	12	17.5	DC24	13.3	0.55	44.0	F	50	30	100	1500	6.6×10^{-5}	6.0×10^{-5}	200	25	0.035	0.040	6004	0.5
546-13-34	13	25	DC24	18.7	0.78	31.0	F	50	30	100	1500	1.5×10^{-4}	1.2×10^{-4}	220	30	0.040	0.050	6005	0.9
546-15-34	15	50	DC24	21.3	0.89	27.1	F	50	30	100	1500	3.7×10^{-4}	3.7×10^{-4}	260	36	0.060	0.060	6007	1.5
546-21-34	21	100	DC24	27.0	1.13	21.0	F	50	30	100	1500	8.7×10^{-4}	5.2×10^{-4}	290	36	0.080	0.070	6009	2.4
546-23-34	23	250	DC24	36.3	1.51	15.9	F	50	30	100	1500	2.06×10^{-3}	1.85×10^{-3}	280	38	0.090	0.080	6011	3.9
546-25-34	25	500	DC24	56.6	2.36	10.2	F	50	30	100	1500	4.88×10^{-3}	4.51×10^{-3}	250	40	0.100	0.090	6014	6.8
546-31-34	31	1000	DC24	79.7	3.32	7.2	F	50	30	100	1500	1.12×10^{-2}	1.28×10^{-2}	195	40	0.110	0.110	6017	11.1
546-32-34	32	2200	DC24	114.0	4.75	5.1	F	50	30	100	1500	2.87×10^{-2}	2.92×10^{-2}	186	40	0.120	0.130	6020	15.3

* The armature pull-in and release times are reference values under no load in a stationary state. They are generally longer depending on the size of the load and the operating state when engaged.
* The allowable rotation speeds of engagement NF and NS indicate, respectively, full-depth tooth/full position and full-depth tooth/single position.

Dimensions

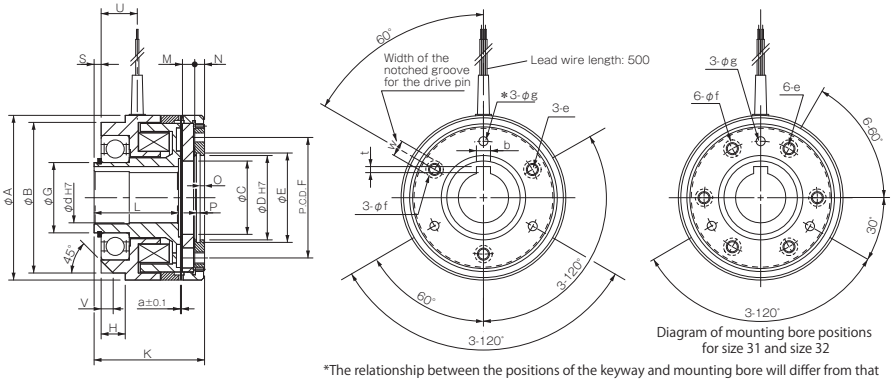


Diagram of mounting bore positions for size 31 and size 32

*The relationship between the positions of the keyway and mounting bore will differ from that shown in the diagram while the parts are fitted together.
*The dimension φg marked with [*] does not apply for size 12.

Unit [mm]

Size	Shaft bore dimensions				
	d H7	Models compliant with the new JIS standards		Models compliant with the old JIS standards	
		b P9	t +0.5 0	b E9	t +0.5 0
12	10	3 −0.006 −0.031	1.2	4 +0.05 +0.02	1.5
13	15	5 −0.012 −0.042	2	5 +0.05 +0.02	2
15	20	6 −0.012 −0.042	2.5	5 +0.05 +0.02	2
	25	8 −0.015 −0.051	3	7 +0.061 +0.025	3
21	25	8 −0.015 −0.051	3	7 +0.061 +0.025	3
	30	8 −0.015 −0.051	3	7 +0.061 +0.025	3
23	30	8 −0.015 −0.051	3	7 +0.061 +0.025	3
	40	12 −0.018 −0.061	3	10 +0.061 +0.025	3.5
25	40	12 −0.018 −0.061	3	10 +0.061 +0.025	3.5
	50	14 −0.018 −0.061	3.5	12 +0.075 +0.032	3.5
31	50	14 −0.018 −0.061	3.5	12 +0.075 +0.032	3.5
	60	18 −0.018 −0.061	4	15 +0.075 +0.032	5
32	60	18 −0.018 −0.061	4	15 +0.075 +0.032	5
	70	20 −0.022 −0.074	4.5	18 +0.075 +0.032	6

Unit [mm]

Model	Radial direction dimensions										Axial direction dimensions											
	A	B	C	D	E	F	G	e	f	g	H	K	L	M	N	O	P	S	U	V	W	a
546-12-34	57	52	22.5	26	27.2	36	20	M4	8.5	—	10	43	34	4.3	3.1	1.3	1.3	2.0	15	4.5	5	0.2
546-13-34	67	58	31	32	33.7	46	25	M5	8.5	4.5	11	49	39	4.9	3.5	1.4	1.3	2.5	16.5	5	6	0.3
546-15-34	82	75	36.5	42	44.5	60	35	M6	10	4.5	12	55	42	6.1	4.8	2.2	1.9	3.5	18	6	8	0.3
546-21-34	95	88	46	52	55	70	45	M8	12	5.5	14	63	45	8.7	6.0	2.8	2.2	3.0	20	6	10	0.4
546-23-34	114	105	55	62	65	80	55	M8	12	7.8	18	69	50	9.0	6.5	3.3	2.2	3.0	24	6	10	0.4
546-25-34	134	127	68	72	75	95	70	M12	15	9.5	20	83	61	11.0	8.4	4.3	2.7	3.0	26	8	10	0.4
546-31-34	166	152	80	90	93.5	120	85	M12	15	9.5	22	93.5	66	13.1	11.4	5.3	3.2	3.5	31	10	12	0.5
546-32-34	195	175	95	100	103.5	150	100	M12	19	11.5	24	110	80	14.0	11.7	6.3	3.2	4.0	38.5	10	12	0.5

How to Place an Order

546-12-34-NF 24V 10DIN

- Size
- Tooth shape
  - NF: Full-depth tooth, full-position
  - RF: Right-handed rotating sawtooth, full-position
  - LF: Left-handed rotating sawtooth, full-position
  - NS: Full-depth tooth, single-position
  - RS: Right-handed rotating sawtooth, single-position
  - LS: Left-handed rotating sawtooth, single-position
- Rotor bore diameter (dimensional symbol d)
- Keyway standards
  - DIN: Compliant with the new JIS standards
  - JIS: Compliant with the old JIS standards

*Depending on your location and such, we may not be able to sell you our products. Please contact us for details.

Selection

When Found from Motor Output

The clutch-shaft conversion of motor torque (T_M) is:

$$T_M = \frac{9550 \cdot P}{n_r} \cdot \eta \ [N \cdot m] \quad \cdots\cdots (1)$$

P: Motor output [kW]
n: Clutch-shaft conversion of rotation speed [min^{-1}]
η : Transmission efficiency from motor to clutch

The required torque (T) when the motor is correctly selected for the load is:

$$T = T_M \cdot K \ [N \cdot m] \quad \cdots\cdots (2)$$

K: Safety factor

When Load Rotation Starts After Engagement

The acceleration torque (TA) for starting up within n rotations is:

$$T_A = \frac{J \cdot n}{9.55 \cdot t_A} \ [N \cdot m] \quad \cdots\cdots (3)$$

J: Total moment of inertia on load side [$kg \cdot m^2$]
t_A: Acceleration time [s]

Therefore, the required torque (T) is:

$$T = (T_L + T_A)\ K \ [N \cdot m] \quad \cdots\cdots (4)$$

T_L: Load torque [N•m]

Select the clutch size by searching the specification table for the clutch whose value adequately satisfies the required torque (T).

Safety factor: K

Load state	Factor
Low rotation speed/small torque fluctuation	1.5
Ordinary load/small torque fluctuation	2
High rotation speed/large torque fluctuation	3

Recommended Power Supplies and Accessory Parts

Model	Recommended power supplies	Accessory parts	
		Circuit protector (Varistor), qty. 1	Shims (Inner diameter × Outer diameter × Thickness), qty. 5 [mm]
546-12-34-☐ 24V 10☐	BES-20-51・BEH-10G	NVD07SCD082 or an equivalent	10.3 × 13.7 × 0.1t
546-13-34-☐ 24V 15☐	BES-20-51・BEH-10G	NVD07SCD082 or an equivalent	15.3 × 20.7 × 0.1t
546-15-34-☐ 24V 20☐	BES-20-51・BEH-10G	NVD07SCD082 or an equivalent	20.3 × 27.7 × 0.1t
546-15-34-☐ 24V 25☐	BES-20-51・BEH-10G	NVD07SCD082 or an equivalent	25.3 × 34.7 × 0.1t
546-21-34-☐ 24V 25☐	BES-20-52・BEH-10G	NVD07SCD082 or an equivalent	25.3 × 34.7 × 0.1t
546-21-34-☐ 24V 30☐	BES-20-52・BEH-10G	NVD07SCD082 or an equivalent	30.3 × 41.7 × 0.1t
546-23-34-☐ 24V 30☐	BES-20-52・BEH-10G	NVD07SCD082 or an equivalent	30.3 × 41.7 × 0.1t
546-23-34-☐ 24V 40☐	BES-20-52・BEH-10G	NVD07SCD082 or an equivalent	40.3 × 51.7 × 0.1t
546-25-34-☐ 24V 40☐	BES-20-52・BEH-20G	NVD07SCD082 or an equivalent	40.3 × 51.7 × 0.1t
546-25-34-☐ 24V 50☐	BES-20-52・BEH-20G	NVD07SCD082 or an equivalent	50.3 × 61.7 × 0.1t
546-31-34-☐ 24V 50☐	BES-40-53・BEH-20G	NVD14SCD082 or an equivalent	50.3 × 61.7 × 0.1t
546-31-34-☐ 24V 60☐	BES-40-53・BEH-20G	NVD14SCD082 or an equivalent	60.3 × 71.1 × 0.1t
546-32-34-☐ 24V 60☐	BES-40-53・BEH-20G	NVD14SCD082 or an equivalent	60.3 × 71.1 × 0.1t
546-32-34-☐ 24V 70☐	BES-40-53・BEH-20G	NVD14SCD082 or an equivalent	70.3 × 79.7 × 0.1t

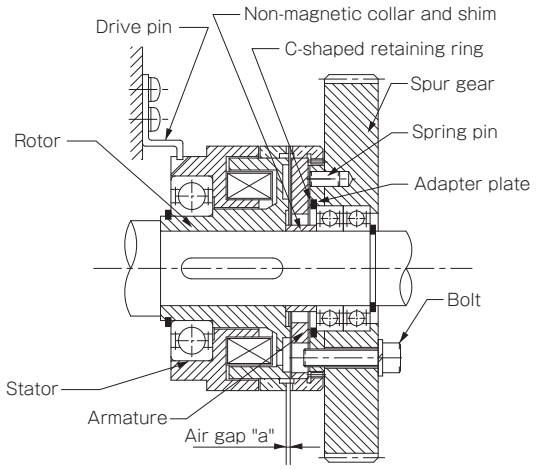
* NVD☐SCD☐ parts are manufactured by KOA Corporation.
* Varistors need not be used when a BES/BEH model recommended power supply is used. For details, refer to the section on power supplies.

546 Models

Items Checked for Design Purposes

Precautions for Mounting

This clutch is mounted for a through-shaft. The mounting example shown below is for mounting on an ordinary through-shaft.



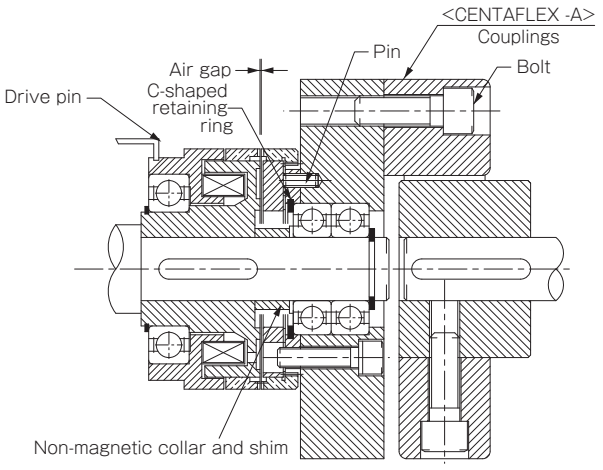
(1) Set the air gap between the teeth tips on the rotor and armature sides so that it is the value "a" in the dimensions table. Shims may be used to facilitate setting of the air gap.
(2) Use a collar made of a non-magnetic material (such as stainless steel or brass) to set the air gap. Use the reference values of the table below for the length of the collar when centering bearings relative to the adapter plate.

Collar lengths when using bearings to center

Size	Dimensions [mm]	Size	Dimensions [mm]
12	7.3	23	15.5
13	8.3	25	17.5
15	10.5	31	22.0
21	15.0	32	23.5

* Process the collar length to the negative tolerance and then make fine adjustments with shims.
* Five shims (0.1 mm in thickness) are provided for each shaft bore diameter.
* If not using the bearing to center, use a different collar design.

(3) When mounting, lock it securely in the axial direction so that there is no play (rattle) in the axial direction.
(4) We recommend a tolerance of h6 or j6 for the shaft when mounting.
(5) This clutch is for through-shafts; when using it on butt shafts, align one of the shafts with a bearing. Using a MIKI PULLEY CENTAFLEX coupling makes it relatively easy to find the centers. See the mounting examples below.



(6) The inner diameter of the adapter plate is the same as the outer diameter of the ball bearing, so the center is easy to find when designed to directly press in the ball bearings.

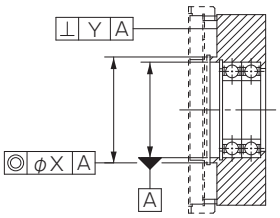
Recommended bearings when inner diameter of adapter plate is used as centering mark

Size	Bore diameter ød [mm]	Centering dimension øD [mm]	Bearing
12	10	26	6000
13	15	32	6002
15	20	42	6004
15	25	42	6905
21	25	52	6205
23	30	62	6206
23	40	62	6908
25	50	72	6910
31	50	90	6210
32	70	100	6914

Ball bearings cannot be used as centering points for combinations of the sizes and shaft diameters at right; in such cases, install centering positions on the flange (gear, sprocket, or the like) on which the adapter plate is mounted and then find the centers. Use the following as a reference for the precision of the mounting surface of the armature (adapter plate).

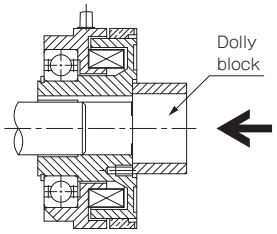
Size	Bore diameter ød [mm]	Centering dimension øD [mm]
21	30	52
25	40	72
31	60	90
32	60	100

Armature (adapter plate) mounting surface precision



Size	X [mm]	Y [mm]
12	0.04	0.03
13	0.05	0.04
15	0.05	0.04
21	0.06	0.05
23	0.07	0.05
25	0.08	0.06
31	0.08	0.07
32	0.10	0.08

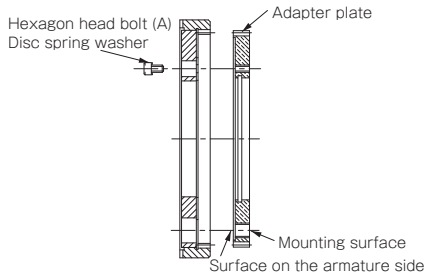
(7) Use two ball bearings in the flange (gear, sprocket, or the like) on which the armature (adapter plate) is mounted so that no vibration is generated in the armature.
(8) A pilot bore for mounting the spring pin has been drilled in the adapter plate. (This does not apply to size 12.) Although in some conditions its use can be omitted, we recommend that after the flange (gear, sprocket, or the like) that mounts on the adapter plate is mounted, additional processing gauged against actual objects be performed and spring pins be concurrently used. (Concurrent use of spring pins is not necessary for size 12.) For details, see the section on assembly of the armature part.
(9) Apply a small amount of adhesive to stop loosening to the bolt that mounts the adapter plate on the gear, sprocket, or the like.



(10) When inserting the stator side onto the shaft, damage can result from strong pounding with a hammer or pushing on the outer circumference part. Press a pipe-shaped dolly block near the shaft bore of the boss part and carefully insert it. The material is soft, so do not bend it as you insert.
(11) Hold the stator only in the direction of rotation, using the cut-out for stopping rotation. Be careful not to apply pressure on the cut-out in the shaft direction at this time.
(12) We recommend applying lubricant (molybdenum disulfide grease) to the teeth tips to improve the wear resistance of the teeth tips.
(13) Hold it so that no force is applied that might pull on or damage leads.

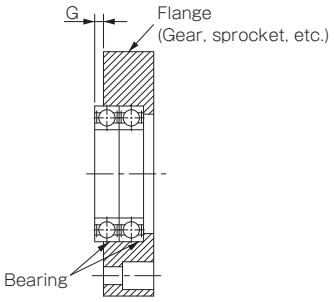
Assembly of Armature Components

(1) Remove the hexagon head bolt [A] previously fixed in place from the armature side and separate the armature and adapter plate. At this time, make fitting marks with a marker to show where the armature and adapter plate fit together to facilitate re-assembly.



(2) Press-fit the bearing onto the flange (gear, sprocket, etc.). If there are bearing centering marks, use a flange design that results in the bearing projection (dimension G) being the value in the table below.

Bearing projection

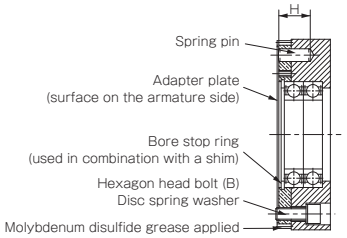


Unit [mm]

Size	Dimension G
12	1.3
13	1.4
15	2.2
21	2.8
23	3.3
25	4.3
31	5.3
32	6.3

* When press-fitting a bearing, apply bearing mount (adhesive) to the outer circumference of the bearing.
* Finish the depth of the bearing insertion bore to the positive tolerance (we recommend 0 to +0.1) and adjust with shims so there is no play (rattle) in the thrust direction.

(3) Snap the C-shaped snap ring in the C-shaped snap ring groove of the adapter plate. Use shims to adjust the air gap between the bearing and snap ring (for rattle).
(4) Mount the adapter plate on the flange and tighten the hexagon head bolt (B) to secure it.



* Pay attention to the orientation of the adapter plate.
* Apply a small amount of adhesive to the hexagon head bolt.
* See the table below for the hexagon head bolt tightening torque.

Adapter plate mounting bolt tightening torque

Size	Bolt	Tightening torque [N·m]	
		When spring pin is used	When no spring pin is used
		Bolt strength category 8.8 or higher	Bolt strength category 10.9 or higher
12	3-M4	—	3.4
13	3-M5	5.2	7.0
15	3-M6	8.8	11.8
21	3-M8	22.0	29.5
23	3-M8	22.0	29.5
25	3-M12	77.0	104.0
31	6-M12	77.0	104.0
32	6-M12	77.0	104.0

(5) Use the adapter plate's pilot bore for pins to simultaneously drill the spring pin bore. (Burr must be removed.) Consult the following table's recommended bore drilling dimensions for spring pin parts when drilling pin bores.

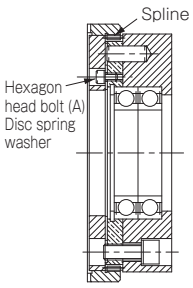
Recommended bore drilling dimensions for spring pin parts

Unit [mm]

Size	Bore drilling dimension	Recommended depth H	Spring pin
13	$5^{+0.12}_{0}$	13	5 × 10
15	$5^{+0.12}_{0}$	13	5 × 10
21	$6^{+0.12}_{0}$	15	6 × 12
23	$8^{+0.15}_{0}$	19	8 × 16
25	$10^{+0.15}_{0}$	21	10 × 18
31	$10^{+0.15}_{0}$	25	10 × 22
32	$13^{+0.2}_{0}$	25	13 × 22

* Recommended depth H includes the adapter plate drilling margin.

(6) Hammer a spring pin into the bore drilling site.
Hammer in the spring pin with the indexing direction facing the outer circumference (spline side). When doing so, be careful that the pin does not extend beyond the adapter plate surface. Have spring pins ready that meet the specifications of the table above.
(7) Completely remove any dust, powder or the like produced by bore drilling and wipe the spline part with molybdenum disulfide grease.
(8) Insert the adapter plate back onto the armature using the fitting marks previously drawn, and fasten with the hexagon head bolt [A] that you removed. (Do not use adhesives.) See the table below for the tightening torque.



Size	Bolt	Tightening torque [N·m]
12	M3 × 3	1.5
13	M3 × 4	1.5
15	M3 × 4	1.5
21	M4 × 6	3.4
23	M4 × 6	3.4
25	M4 × 8	3.4
31	M5 × 10	7.0
32	M6 × 10	11.8

Precautions for Use

(1) Tooth will not mesh together if the inertia on the driven side is too great. In such cases, we recommend lowering the rotation speed or also using a CENTAFLEX coupling to absorb shock.
(2) With single position tooth shapes, drag torque will be generated by contact between tooth tips until the tooth reach their engaging position after pull-in. Tooth clutches are structured, however, so the tooth do not form a magnetic circuit, meaning that drag torque is low and hardly ever a problem. When load torque is very small compared to clutch torque, however, drag turning may occur on the driven side. In such cases, a brake must also be used, to prevent drag turning.
(3) The keyway cannot be aligned with the adapter plate mounting holes in the engaging position. When alignment is necessary, adjust position with the paired side elements of the clutch.
(4) When used in stationary engagement, teeth may fail to engage and come into contact with other tooth tips when pull-in occurs. Rotation in this condition may result in teeth slipping rather than engaging, so adjust the acceleration speed of the drive side to engage.
(5) The operating temperature is 0° C to 40° C.
(6) The operating power supply of the clutch is DC 24 V. Keep fluctuations of the applied voltage within -10% to +5%. Since optimal BES model power supplies are available for the tooth clutch, we recommend one of these be used for both.
(7) Install a switch on the DC side to turn the clutch on and off. Operating times will be slower if it is installed on the AC side. A varistor to protect contacts should also be connected in parallel to the clutch.