



- 102 model (micro electromagnetic clutches)
- CYT model (customizable micro electromagnetic clutches)
- 112 model (micro electromagnetic brakes)

Clutch and brake torque [N·m]

	0	1	2	3
102 Model				
CYT Model				
112 Model				

Selection

Select the appropriate shape and size in accordance with the use condition and the intended use. The friction type clutches and brakes are useful since the performance is instantaneously exerted. If the clutch and brake is not properly selected the clutch or brake may have performance problems. Fully grasp the following matters when selecting.

1 Intended use (Requirement functions for clutches brakes)

Coupling • Uncoupling, Braking • Holding, Speed change, Forward reverse operation, High-frequency operation, Positioning • Dividing, Inching, etc.

2 Required performance

Torque, Response, frequency of use, Operating life, Accuracy, Work volume, etc.

3 Load characteristic

Load torque, Load moment of inertia J, Load change, Rotation speed to be applied, etc.

4 Driving side condition

Motor (three phase, single phase, alternating current, etc.), Engine, Hydraulic • Pneumatic pressure, etc.

◎...Excellence ●...Adjustment ○...Suitable depending on applications △...Customizing

Model list

Electromagnetic actuated type micro clutches and brakes											
Class	Micro-clutch						CYT		Micro-brake		
Model	102		11		102		CYT		112		11
Type	13	15	11	33	35	31	33M	33B	13	12	
Appearance											
Descriptive page	P11~16						P17~20		P21~24		
Adaptability	Rotational transmission	●	●	●	●	●	●	●	●	●	●
	Braking • Holding	●	●	●	●	●	●	●	●	●	●
	Wall mounting	●	●	●	●	●	●	●	●	●	●
	Shaft mounting	●	●	●	●	●	●	●	●	●	●
	High-velocity revol. (100min ⁻¹ ~)	●	●	●	●	●	●	●	●	●	●
	Parallel axis input/output	●	●	●	●	●	●	●	●	●	●
Characteristic	Shaft-to-shaft input/output	●	●	●	●	●	●	●	○	○	●
	Compact design	○	●	●	○	●	○	○	○	○	●
	Easy to mount and use	●	●	○	●	○	●	●	●	○	●
	One-touch mounting	●	●	●	●	●	△	△	●	●	●
Environmental responsiveness	●	●	●	●	●	●	●	●	●	●	●

■ Type • Model Selection

● Selection of clutches

There are two types of stators and three types of armature assemblies with different mounting methods, and six combinations of those. Select the appropriate type for the configuration of the mounting part.

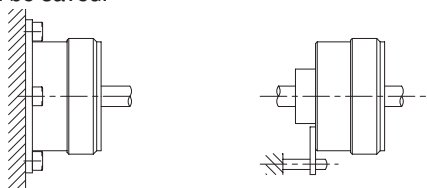
1 Select the place to mount (Selection of stators)

① Mount directly on the wall surface

A flange mounted type stator is used. This type is shorter to the axial direction. Mounting space can be saved.

② Mount on a shaft and apply a baffle

A bearing mounted type stator is used. This type is relatively easy to mount. The trouble of processing of the mounting portion can be saved.



(1) Mount directly on the wall surface

(2) Mount on a shaft

2 Select the shaft configuration to mount (Selection of armature assemblies)

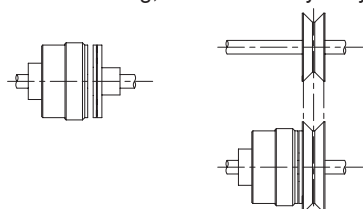
There are two types of connections between the driving side and the driven side.

① Couple a mating shaft

Use an armature assembly for mating shaft. Positioning such as centering may become complicated. A coupling flange or a flexible coupling may be required.

② Wrapping and gear connection of a parallel shaft

Use an armature assembly for through shaft. This method allows for rational mounting, and is relatively easy.



(1) Directly connect the mating shaft.

(2) Wrap the parallel shaft.

● Selection of brakes

Since a brake is used to brake and maintain the rotating body, the stator part must be properly fixed on the static part.

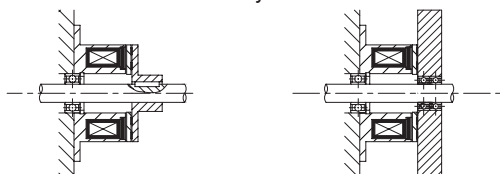
There are three ways to mount an armature assembly on the rotating body. Select the appropriate method in accordance with the configuration of the mounting part.

① Mount on the braking shaft

The point for selecting the mounting method from three types is that determining how to fix on the shaft effectively.

② Mount directly on the rotating body

Since the inertial body that is not fixed on the shaft will not stop when stopping the shaft, use an armature assembly that can be directly mounted on the inertial body.



(1) Mount directly on the wall surface

(2) Mount on a shaft

102model (micro clutches)

There are two types of stators; the flange mounted type that allows effective space use and the bearing mounted type that allows easy setting on a shaft. By combining with three types of armature assemblies with different mounting forms (direct mounting), six types can be selected according to the mounting conditions.



CYT model (customizable micro clutches)

The stator is a bearing mounted type that allows easy setting on a shaft. The dry-metal type or the ball-bearing type can be selected depending on the shaft rotation speed.

Various custom types such as assembling a pulley and gear in the armature type-3 or combing a shaft with it are available.



112model (micro brakes)

This model is a compact and high-performance brake with the same basic design with the micro clutches.

The optimum condition can be selected from the three types of armature assemblies with different mounting forms.



102 model

Micro electromagnetic clutches



Electromagnetic
actuated type
clutches and
brakes

Electromagnetic
actuated type
clutches and
brakes

Clutch
and brake
units

Nonexcited
operation type
brakes

Electromagnetic
torqued clutch

Brakemotor

Power supply
for clutches &
brakes

Ideal for use in small precision equipments such as business machine, communications equipment or automobile machinery that has a susceptibility to fluctuations of torque and responsiveness. Many different types are available in order to install in any place. Compact and lightweight, and easy to mount and use.

Various types

There are two types of stators; the flange mounted type that allows effective space use and the bearing mounted type that allows easy setting on a shaft. By combining with three type of armature assemblies with different mounting forms (direct mounting/shaft mounting type), six types can be selected according to the mounting terms.

Adapted to the RoHS

Adapted to the Restriction of Hazardous Substances that bans the use of 6 substances such as mercury or lead can be selected as option.

Clutch torque	[N · m]	0.4 ~ 2.4
Operational temperature	[°C]	-10 ~ +40
Backlash		Zero

6types

Stator · Rotor form

The flange mounted type is installed by combining a stator and rotor together. It allows effective wall space use. The bearing mounted type has integral structure of stator and rotor, and also has built-in oil retaining metal bearing. It allows easy setting at the optional position on a shaft.

With the armature type-3

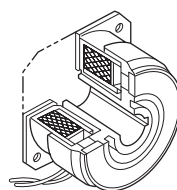
- Mainly used for through shaft.
- Ideal for wrapping and gear drive.
- The armature type-3 is the type of "direct mounting". Easy to install to a sprocket or a spur gear.
- The 102-□-13 uses a wall surface to fix.
- The 102-□-33 is fixed on a shaft.

With the armature type-5

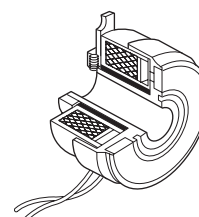
- Mainly used for through shaft.
- The armature type-5 is the type of "bearing mounting". Easy to install to a sprocket or a spur gear.
- The 102-□-15 uses a wall surface to fix.
- The 102-□-35 is fixed on a shaft.

With the armature type-1

- Mainly used for through shaft.
- The armature type-1 is the type of "shaft mounting".
- The 102-□-11 uses a wall surface to fix.
- The 102-□-31 is fixed on a shaft.



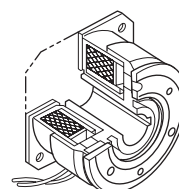
Flange mounted type



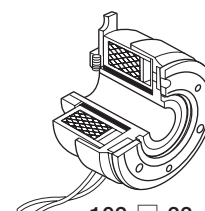
Bearing mounted type



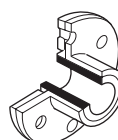
Armature type-3



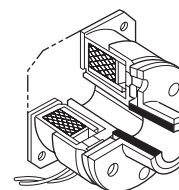
102-□-13



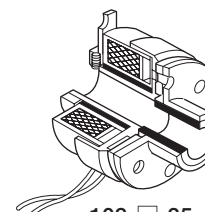
102-□-33



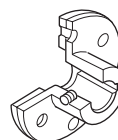
Armature type-5



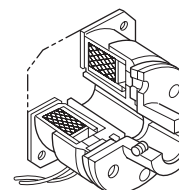
102-□-15



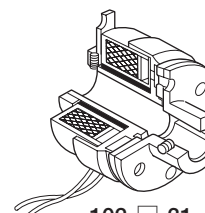
102-□-35



Armature type-1



102-□-11



102-□-31

■ Outline Structure

The micro clutch 102 model consists of the following three parts; the stator with built-in coil, rotor with lining material, and armature assembly. Each part is mutually combined in the correct physical relationship, and forms a magnetic circuit.

● Stator and Rotor

● Flange mounted type

The stator is directly fixed on the static part such as flange, by a mounting flange. The rotor is fixed against the rotating shaft by a key. When the coil is energized a magnetic circuit attracts the armature to the rotor. The stator and rotor are combined through a narrow air gap which becomes a part of the magnetic circuit, and forms magnetic poles.

● Bearing mounted type

The stator is integrated with the rotor through the bearing, and is maintained in the static part of the machine by an antirotation arm. The rotor is fixed on the rotating shaft by a setscrew. The stator and rotor form a magnetic pole through the bearing (iron oil-bearing metal).

● Armature assembly

The armature assembly is composed of armature, ring plate spring and armature hub. It is combined properly with keeping a certain amount of air gap [a] facing the rotor. The through-shaft armature assembly is fixed on the shaft by a bearing. The shaft-to-shaft type armature assembly is fixed on the opposed shaft by a key and set screw.

■ Stator • Rotor mounting

● Flange mounted type

● Centering

For the mounting shaft of the stator and rotor, centering is performed by "positioning fits" using the stator inside diameter or the flange outside diameter. Since the inside diameter is designed to fit into the nominal dimension for the outside diameter of the ball bearing, correct centering can be performed by directly using the bearing that supports the shaft.

● Setting of axial positional relationship (H measurement)

For the positional relationship between the stator and rotor, set the H measurement in order that it becomes its specified value. If centering is performed by using a ball bearing, use a retaining ring and strike the rotor edge to determine the H measurement.

● Bearing mounted type

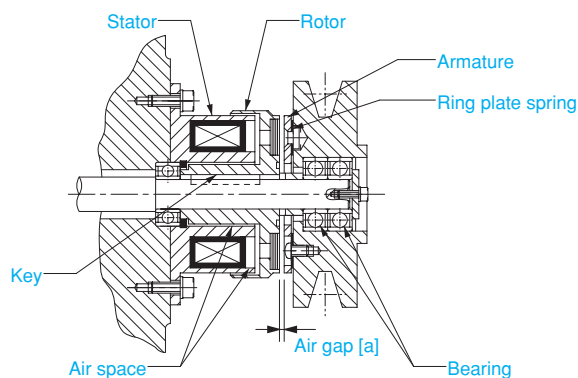
● Centering is not necessary.

● Fix on the shaft

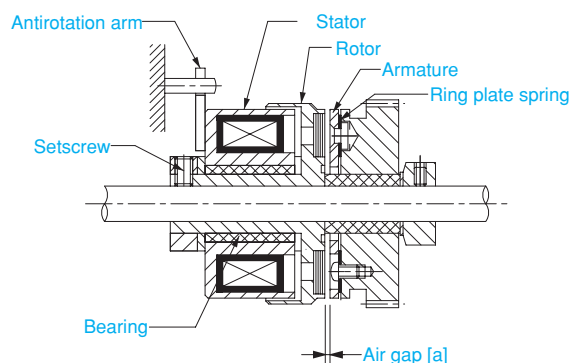
The stator and rotor can be easily fixed on the shaft by a fixing collar and a setscrew.

● Maintain the stator

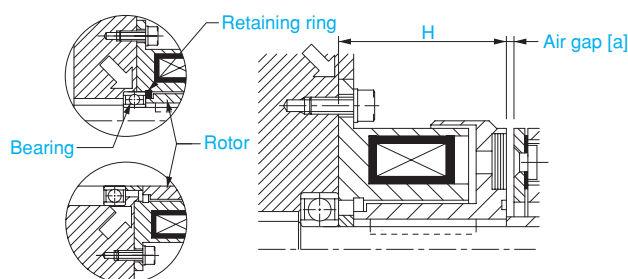
The force acting on the stator is a minimal amount of torque caused by the supporting bearing friction. To prevent free rotation of the stator, and to protect a lead wire, maintain an antirotation arm in the static part of the machine. An antirotation arm must be retained in the suitable form for not turning into the shaft direction.



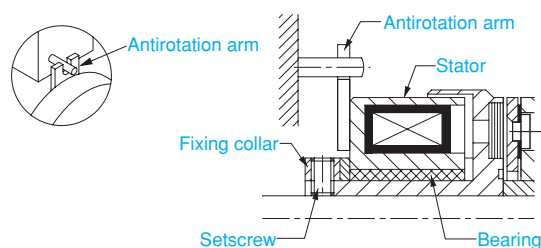
Structure of the flange mounted type



Structure of the bearing mounted type



Stator/Rotor mounting (flange mounted type)



Stator/Rotor mounting (bearing mounted type)

102-□-1□ type

Micro electromagnetic clutches
/Flange mounted type

Electromagnetic
actuated type
clutches and
brakes

Electromagnetic
actuated type
clutches and
brakes

Clutch
and brake
units

Nonexcited
operation type
brakes

Electromagnetic
toothed clutch

Brakemotor

Power supply
for clutches &
brakes

Specification

Model	Size	Dynamic friction torque T _d [N·m]	Coil (at20°C)				Heat- resistance class	Maximum rotation speed [min ⁻¹]	Rotating part moment of inertia J		Allowable coupling work E _{ea} [J]	Total amount of work before air gap readjustment E _T [J]	Armature suction time t _a [s]	orque risetime t _p [s]	Torque extinction time t _d [s]	Mass [kg]
			Voltage [V]	Wattage [W]	Amperage [A]	Resistance [Ω]			Armature [kg·m ²]	Rotor [kg·m ²]						
102-02-13	02	0.4	DC24	6	0.25	96	B	10000	6.75×10 ⁻⁷	2.45×10 ⁻⁶	1500	2×10 ⁶	0.009	0.019	0.017	0.075
102-02-15								500	1.00×10 ⁻⁶							0.081
102-02-11								10000	1.00×10 ⁻⁶							0.079
102-03-13	03	0.6	DC24	6	0.25	96	B	10000	1.30×10 ⁻⁶	3.25×10 ⁻⁶	2300	3×10 ⁶	0.009	0.022	0.020	0.096
102-03-15								500	1.95×10 ⁻⁶							0.105
102-03-11								10000	1.95×10 ⁻⁶							0.103
102-04-13	04	1.2	DC24	8	0.33	72	B	10000	4.38×10 ⁻⁶	1.41×10 ⁻⁵	4500	6×10 ⁶	0.011	0.028	0.030	0.178
102-04-15								500	6.15×10 ⁻⁶							0.195
102-04-11								10000	6.15×10 ⁻⁶							0.191
102-05-13	05	2.4	DC24	10	0.42	58	B	10000	9.08×10 ⁻⁶	3.15×10 ⁻⁵	9000	9×10 ⁶	0.012	0.031	0.040	0.310
102-05-15								500	1.38×10 ⁻⁵							0.335
102-05-11								10000	1.38×10 ⁻⁵							0.325

※Dynamic friction torque (T_d) indicates the value when relative velocity is (100min⁻¹).

※Rotating part moment of inertia and mass indicate the values of maximum bore diameter.

※Power supply voltage variation must be within ±10% of the coil voltage.

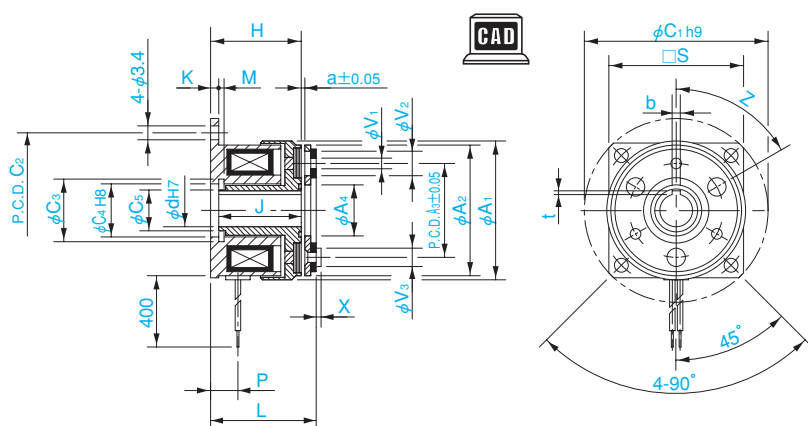
※The recommended power supply is the BE-05 type. However, do not apply over 80% of its current-carrying rate.

Dimensions

102-□-13

(For direct mounting)

Unit [mm]



Size	Shaft bore dimensions				
	d H7	New JIS standards correspondence		Previous edition of JIS standards correspondence	
		b P9	t	b E9	t
02	5	—	—	—	—
03	6	2 ^{-0.006 -0.031}	0.8 ^{+0.3 0}	—	—
04	8	2 ^{-0.006 -0.031}	0.8 ^{+0.3 0}	—	—
	10	3 ^{-0.006 -0.031}	1.2 ^{+0.3 0}	4 ^{+0.050 +0.020}	1.5 ^{+0.5 0}
05	10	3 ^{-0.006 -0.031}	1.2 ^{+0.3 0}	4 ^{+0.050 +0.020}	1.5 ^{+0.5 0}
	15	5 ^{-0.012 -0.042}	2 ^{+0.5 0}	5 ^{+0.050 +0.020}	2 ^{+0.5 0}

Unit [mm]

Size	Radial dimensions														Axial direction dimensions								CAD File No.
	A ₁	A ₂	A ₃	A ₄	C ₁	C ₂	C ₃	C ₄	C ₅	S	V ₁	V ₂	V ₃	Z	H	J	K	L	P	M	a	X	
02	31	28	19.5	10.5	39	33.5	11.4	11	8	—	2-2.1	2-5.3	2-4	4-90°	18	16.5	1.5	20.5	5	1.1	0.1	0.8	102-131
03	34	32	23	12.5	45	38	13.6	13	10	33	3-2.6	3-6	3-4.5	6-60°	22.2	20.2	2	24.5	6.7	1.3	0.15	1.2	102-132
04	43	40	30	18.5	54	47	20	19	15.5	41	3-3.1	3-6	3-5	6-60°	25.4	23.4	2	28.2	7	1.3	0.15	1.5	102-133
05	54	50	38	25.5	65	58	27.2	26	22	51	3-3.1	3-6.5	3-5.5	6-60°	28.1	26.1	2	31.3	8.2	1.5	0.2	1.5	102-134

※The size 02 has a round flange.

※There is no keyway on the rotor of the size 02. Fix on the shaft by press fitting.

Ordering information

102-03-13 24V 6 DIN

Size

Rotor bore diameter (Dimensional sign d)

Keyway standard

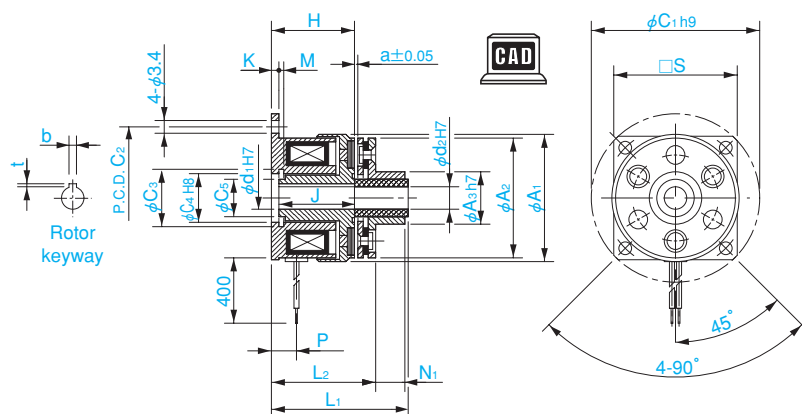
New JIS standards correspondence : DIN

Previous edition of JIS standards correspondence : JIS

※Unnecessary to enter the keyway standard if there is no description in the shaft-bore dimensions table.

Dimensions 102-□-15 (For through shaft)

Unit [mm]



Size	d1 H7	d2 H7	Shaft bore dimensions			
			New JIS standards correspondence		Previous edition of JIS standards correspondence	
			b P9	t	b E9	t
02	5	5	—	—	—	—
03	6	6	2 ^{-0.006} _{-0.031}	0.8 ^{+0.3} ₀	—	—
04	8	8	2 ^{-0.006} _{-0.031}	0.8 ^{+0.3} ₀	—	—
	10	10	3 ^{-0.006} _{-0.031}	1.2 ^{+0.3} ₀	4 ^{+0.050} _{+0.020}	1.5 ^{+0.5} ₀
05	10	10	3 ^{-0.006} _{-0.031}	1.2 ^{+0.3} ₀	4 ^{+0.050} _{+0.020}	1.5 ^{+0.5} ₀
	15	15	5 ^{-0.012} _{-0.042}	2 ^{+0.5} ₀	5 ^{+0.050} _{+0.020}	2 ^{+0.5} ₀

※The d2 of the 5-type armature is a straight bore.

Unit [mm]

Size	Radial dimensions									Axial direction dimensions									CAD File No.
	A1	A2	A3	C1	C2	C3	C4	C5	S	H	J	K	L1	L2	M	P	N1	a	
02	31	28	13	39	33.5	11.4	11	8	—	18	16.5	1.5	27.5	22.4	1.1	5	4.8	0.1	102-151
03	34	32	14	45	38	13.6	13	10	33	22.2	20.2	2	34.5	26.5	1.3	6.7	7.8	0.15	102-152
04	43	40	18	54	47	20	19	15.5	41	25.4	23.4	2	40.2	30.8	1.3	7	9.1	0.15	102-153
05	54	50	28	65	58	27.2	26	22	51	28.1	26.1	2	43.3	34.3	1.5	8.2	8.8	0.2	102-154

※The size 02 has a round flange.

※There is no keyway on the rotor of the size 02. Fix to the shaft by press fitting.

Ordering information

102-03-15 24V R6 DIN A6

Size

Rotor bore diameter (Dimensional sign d)

Armature bore diameter (Dimensional sign d2)

Keyway standard

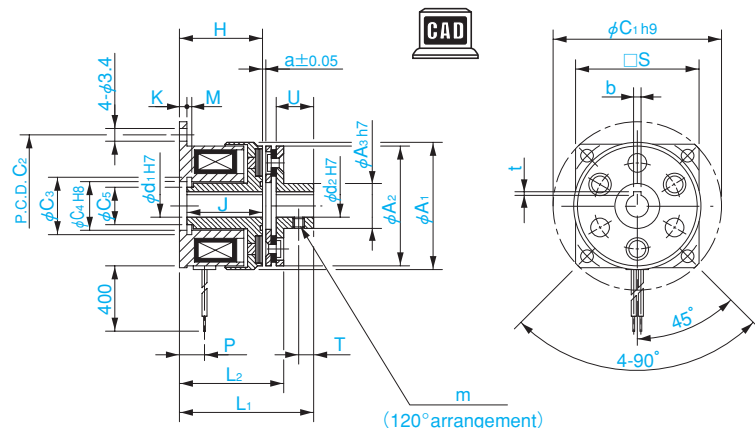
New JIS standards correspondence: DIN

Previous edition of JIS standards correspondence: JIS

※It is not necessary to enter the keyway standard if there is no description in the shaft-bore dimensions table.

Dimensions 102-□-11 (For shaft-to-shaft)

Unit [mm]



Size	d1 H7	d2 H7	Shaft bore dimensions			
			New JIS standards correspondence		Previous edition of JIS standards correspondence	
			b P9	t	b E9	t
02	5	5	—	—	—	—
03	6	6	2 ^{-0.006} _{-0.031}	0.8 ^{+0.3} ₀	—	—
04	8	8	2 ^{-0.006} _{-0.031}	0.8 ^{+0.3} ₀	—	—
	10	10	3 ^{-0.006} _{-0.031}	1.2 ^{+0.3} ₀	4 ^{+0.050} _{+0.020}	1.5 ^{+0.5} ₀
05	10	10	3 ^{-0.006} _{-0.031}	1.2 ^{+0.3} ₀	4 ^{+0.050} _{+0.020}	1.5 ^{+0.5} ₀
	15	15	5 ^{-0.012} _{-0.042}	2 ^{+0.5} ₀	5 ^{+0.050} _{+0.020}	2 ^{+0.5} ₀

Unit [mm]

Size	Radial dimensions										Axial direction dimensions										CAD File No.
	A ₁	A ₂	A ₃	C ₁	C ₂	C ₃	C ₄	C ₅	S	m	H	J	K	L ₁	L ₂	M	P	U	T	a	
02	31	28	9.5	39	33.5	11.4	11	8	—	M3	18	16.5	1.5	27.5	22.5	1.1	5	7	2.5	0.1	102-111
03	34	32	12	45	38	13.6	13	10	33	2-M3	22.2	20.2	2	34.5	26.5	1.3	6.7	10	4	0.15	102-112
04	43	40	17	54	47	20	19	15.5	41	2-M3	25.4	23.4	2	40.2	30.8	1.3	7	12	5	0.15	102-113
05	54	50	24	65	58	27.2	26	22	51	2-M4	28.1	26.1	2	43.3	34.3	1.5	8.2	12	5	0.2	102-114

※The size 02 has a round flange.

※There is no keyway on the rotor of the size 02. Fix on the shaft by press fitting.

Ordering information

102-03-11 24V R6 DIN A6 DIN

Size

Rotor bore diameter (Dimensional sign d₁)

Keyway standard

Armature bore diameter (Dimensional sign d₂)

Keyway standard

New JIS standards correspondence

Previous edition of JIS standards

※Unnecessary to enter the keyway standard if there is no description in the shaft-bore dimensions table.

New JIS standards correspondence: DIN

Previous edition of JIS standards correspondence: JIS

102-□-3□ type

Micro electromagnetic clutches
/Bearing mounted type

Electromagnetic
actuated type
clutches and
brakes

Electromagnetic
actuated type
clutches and
brakes

Clutch
and brake
units

Nonexcited
operation type
brakes

Electromagnetic
toothed clutch

Brakemotor

Power supply
for clutches &
brakes

Specification

Model	Size	Dynamic friction torque T_d [N·m]	Coil (at20°C)				Heat- resistance class	Maximum rotation speed [min ⁻¹]	Rotating part moment of inertia J		Allowable coupling work E_{ea} [J]	Total amount of work before air gap readjustment E_r [J]	Armature suction time t_a [s]	orque risetime t_p [s]	Torque extinction time t_d [s]	Mass [kg]
			Voltage [V]	Wattage [W]	Amperage [A]	Resistance [Ω]			Armature [kg·m ²]	Rotor [kg·m ²]						
102-02-33	02	0.4	DC24	6	0.25	96	B	500	6.75×10^{-7}	2.75×10^{-6}	1500	2×10^6	0.009	0.019	0.017	0.076
102-02-35									1.00×10^{-6}							0.082
102-02-31									1.00×10^{-6}							0.080
102-03-33	03	0.6	DC24	6	0.25	96	B	500	1.30×10^{-6}	4.08×10^{-6}	2300	3×10^6	0.009	0.022	0.020	0.101
102-03-35									1.95×10^{-6}							0.110
102-03-31									1.95×10^{-6}							0.108
102-04-33	04	1.2	DC24	8	0.33	72	B	500	4.38×10^{-6}	1.44×10^{-5}	4500	6×10^6	0.011	0.028	0.030	0.183
102-04-35									6.15×10^{-6}							0.200
102-04-31									6.15×10^{-6}							0.196
102-05-33	05	2.4	DC24	10	0.42	58	B	500	9.08×10^{-6}	2.90×10^{-5}	9000	9×10^6	0.012	0.031	0.040	0.321
102-05-35									1.38×10^{-5}							0.346
102-05-31									1.38×10^{-5}							0.336

※Dynamic friction torque (T_d) indicates the value when relative velocity is (100min⁻¹).

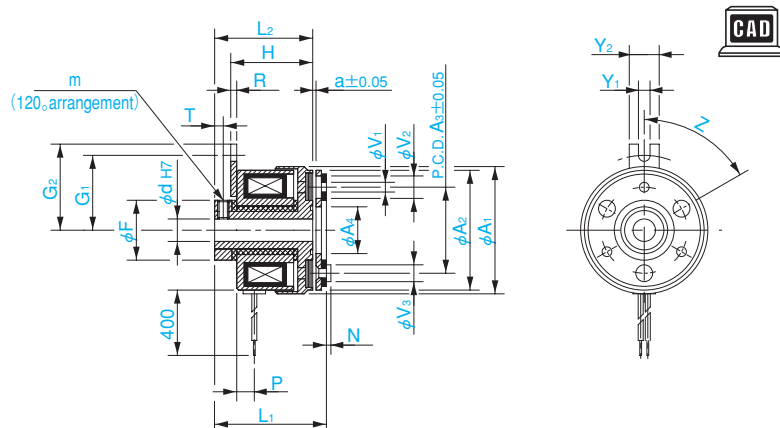
※Rotating part moment of inertia and mass indicate the values of maximum bore diameter.

※Power supply voltage variation must be within $\pm 10\%$ of the coil voltage.

※The recommended power supply is the BE-05 type. However, do not apply over 80% of its current-carrying rate.

Dimensions 102-□-33 (For direct mounting)

Unit [mm]



Size	Shaft bore dimensions	
	d H7	
02	5	
03	6	
04	8	
	10	
05	10	
	15	

Unit [mm]

Size	Radial dimensions														Axial direction dimensions								CAD File No.
	A ₁	A ₂	A ₃	A ₄	F	V ₁	V ₂	V ₃	G ₁	G ₂	Y ₁	Y ₂	Z	m	H	R	L ₁	L ₂	P	N	T	a	
02	31	28	19.5	10.5	14	2-2.1	2-5.3	2-4	16.8	20	3.1	8	4-90°	2-M3	19.5	1.6	25.9	23.5	5	0.8	2.5	0.1	102-331
03	34	32	23	12.5	16	3-2.6	3-6	3-4.5	20	23	3.1	8	6-60°	2-M3	21.9	1.6	28.5	26.2	4.7	1.2	2.3	0.15	102-332
04	43	40	30	18.5	22	3-3.1	3-6	3-5	23	26	3.1	8	6-60°	2-M4	25.1	1.6	33.2	30.4	5	1.5	2.8	0.15	102-333
05	54	50	38	25.5	30	3-3.1	3-6.5	3-5.5	28	31	3.1	8	6-60°	2-M5	27.9	1.6	37.3	34.1	6	1.5	3.3	0.2	102-334

Ordering information

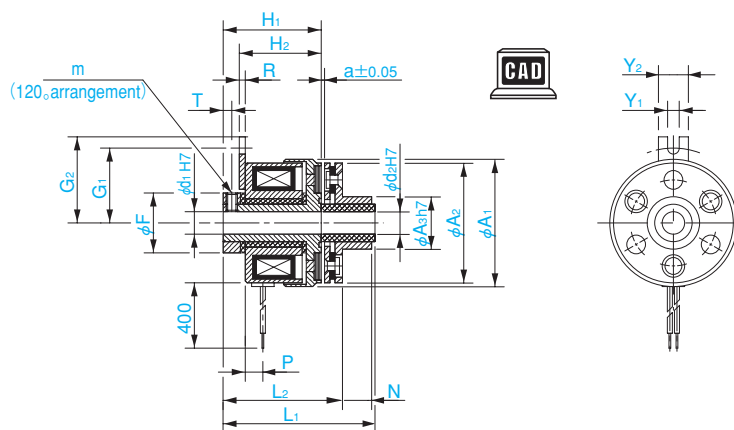
102-03-33 24V 6

Size

Rotor bore diameter (Dimensional sign d)

Dimensions 102-□-35 (For through shaft)

Unit [mm]



Size	Shaft bore dimensions	
	d_1 H7	d_2 H7
02	5	5
03	6	6
04	8	8
	10	10
05	10	10
	15	15

Unit [mm]

Size	Radial dimensions									Axial direction dimensions									CAD File No.
	A_1	A_2	A_3	F	G_1	G_2	Y_1	Y_2	m	H_1	H_2	R	L_1	L_2	P	N	T	a	
02	31	28	13	14	16.8	20	3.1	8	2-M3	23.5	19.5	1.6	33	27.9	5	4.8	2.5	0.1	102-351
03	34	32	14	16	20	23	3.1	8	2-M3	26.2	21.9	1.6	38.5	30.5	4.7	7.8	2.3	0.15	102-352
04	43	40	18	22	23	26	3.1	8	2-M4	30.4	25.1	1.6	45.2	35.8	5	9.1	2.8	0.15	102-353
05	54	50	28	30	28	31	3.1	8	2-M5	34.1	27.9	1.6	49.3	40.3	6	8.8	3.3	0.2	102-354

Ordering information

102-03-35 24V R6 A6

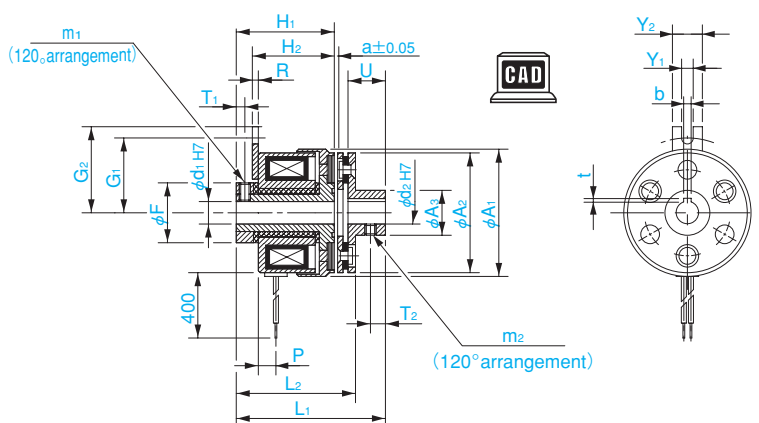
Size

Armature bore diameter (Dimensional sign d_2)

Rotor bore diameter (Dimensional sign d_1)

Dimensions 102-□-31 (For shaft-to-shaft)

Unit [mm]



Size	Shaft bore dimensions					
	d_1 H7	d_2 H7	New JIS standards correspondence		Previous edition of JIS standards correspondence	
			b P9	t	b E9	t
02	5	5	—	—	—	—
03	6	6	2 $\begin{smallmatrix} -0.006 \\ -0.031 \end{smallmatrix}$	0.8 $\begin{smallmatrix} +0.3 \\ 0 \end{smallmatrix}$	—	—
04	8	8	2 $\begin{smallmatrix} -0.006 \\ -0.031 \end{smallmatrix}$	0.8 $\begin{smallmatrix} +0.3 \\ 0 \end{smallmatrix}$	—	—
	10	10	3 $\begin{smallmatrix} -0.006 \\ -0.031 \end{smallmatrix}$	1.2 $\begin{smallmatrix} +0.3 \\ 0 \end{smallmatrix}$	4 $\begin{smallmatrix} +0.050 \\ +0.020 \end{smallmatrix}$	1.5 $\begin{smallmatrix} +0.5 \\ 0 \end{smallmatrix}$
05	10	10	3 $\begin{smallmatrix} -0.006 \\ -0.031 \end{smallmatrix}$	1.2 $\begin{smallmatrix} +0.3 \\ 0 \end{smallmatrix}$	4 $\begin{smallmatrix} +0.050 \\ +0.020 \end{smallmatrix}$	1.5 $\begin{smallmatrix} +0.5 \\ 0 \end{smallmatrix}$
	15	15	5 $\begin{smallmatrix} -0.012 \\ -0.042 \end{smallmatrix}$	2 $\begin{smallmatrix} +0.5 \\ 0 \end{smallmatrix}$	5 $\begin{smallmatrix} +0.050 \\ +0.020 \end{smallmatrix}$	2 $\begin{smallmatrix} +0.5 \\ 0 \end{smallmatrix}$

Unit [mm]

Size	Radial dimensions										Axial direction dimensions										CAD File No.
	A ₁	A ₂	A ₃	F	G ₁	G ₂	Y ₁	Y ₂	m ₁	m ₂	H ₁	H ₂	R	L ₁	L ₂	P	U	T ₁	T ₂	a	
02	31	28	9.5	14	16.8	20	3.1	8	2-M3	M3	23.5	19.5	1.6	33	27.9	5	7	2.5	2.5	0.1	102-311
03	34	32	12	16	20	23	3.1	8	2-M3	2-M3	26.2	21.9	1.6	38.5	30.5	4.7	10	2.3	4	0.15	102-312
04	43	40	17	22	23	26	3.1	8	2-M4	2-M3	30.4	25.1	1.6	45.2	35.8	5	12	2.8	5	0.15	102-313
05	54	50	24	30	28	31	3.1	8	2-M5	2-M4	34.1	27.9	1.6	49.3	40.3	6	12	3.3	5	0.2	102-314

Ordering information

102-03-31 24V R6 A6 DIN

Size

Keyway standard New JIS standards correspondence: DIN

Rotor bore diameter (Dimensional sign d_1)

Previous edition of JIS standards correspondence: JIS

Armature bore diameter (Dimensional sign d_2)

※ It is not necessary to enter the keyway standard if there is no description in the shaft-bore dimensions table.

CYT model

Micro electromagnetic clutches

Electromagnetic
actuated type
clutches and
brakes

Electromagnetic
actuated type
clutches and
brakes

Clutch
and brake
units

Nonexcited
operation type
brakes

Electromagnetic
torqued clutch

Brakemotor

Power supply
for clutches &
brakes



Excellent for use in small precision equipment such as business machines, communications equipment or automobile machinery. The CYT provides excellent stability of torque and quick response. Various custom types coupled with shafts are available. The compact design along with high torque capacity is also easy to mount and use.

Various custom types

The stator is a bearing mounted type that allows easy setting on a shaft. The dry-metal type or the ball-bearing type can be selected depending on the shaft rotation speed.

Various custom types such as assembling a pulley and a gear in the armature type-3 or combing a shaft are available.

Adapted to the RoHS

Adapted to the Restriction of Hazardous Substances that bans the use of 6 substances such as mercury or lead can be selected as option.

Clutch torque [N · m]	0.4 ~ 1.0
Operational temperature [°C]	-10 ~ +40
Backlash	Zero

Structure

The micro clutch CYT model consists of the following three parts; the stator with built-in coil, rotor with lining material, and armature assembly. The armature assembly is essentially formed of the armature hub and the constant-force plate spring. Only the armature is pulled and attached to the rotor by energization of a coil, and the torque is transferred from the driving side to the driven side through the plate spring. Each part is mutually combined in the correct physical relationship, and forms a magnetic circuit. The stator is a bearing mounted type that allows easy setting on a shaft. The dry-metal type or the ball-bearing type can be selected depending on the shaft rotation speed.

Stator and Rotor

● Bearing mounted type (Dry metal type)

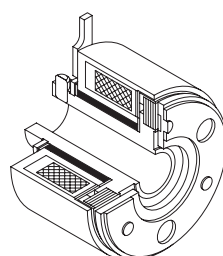
The stator is integrated with the rotor through the bearing, and is maintained in the static part of the machine by an antirotation arm. The rotor is fixed on the rotating shaft by a setscrew. The stator and rotor form a magnetic pole through the bearing (dry metal).

● Bearing mounted type (Ball bearing type)

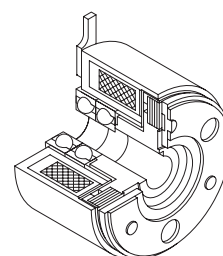
The stator is fixed on the shaft through the bearing, and is maintained in the static part of the machine by an antirotation arm. The stator and rotor are combined through a narrow air gap which becomes a part of the magnetic circuit, and forms magnetic poles.

Armature assembly

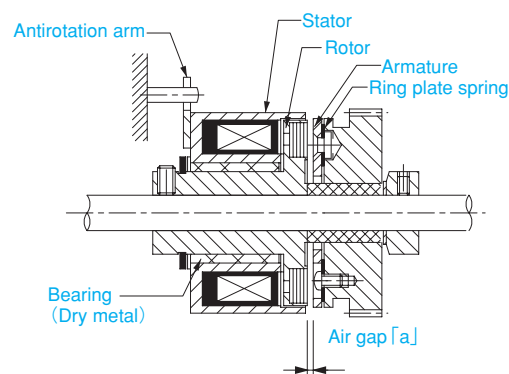
● The armature assembly is composed of armature and ring plate spring. It is combined properly with keeping a certain amount of air gap [a] facing the rotor, and is fixed on the through shaft by the bearing.



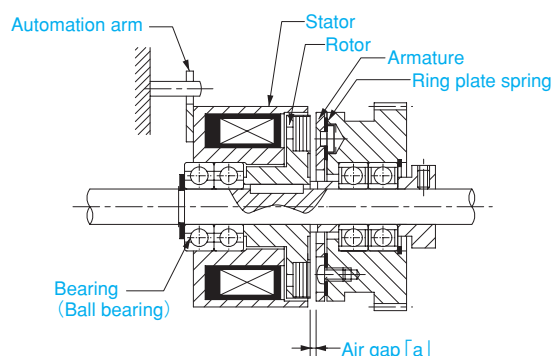
Bearing mounted type
(Dry metal type)



Bearing mounted type
(Ball bearing type)



Structure of the bearing mounted type (Dry metal type)



Structure of the bearing mounted type (Ball bearing type)

■ Stator • Rotor mounting

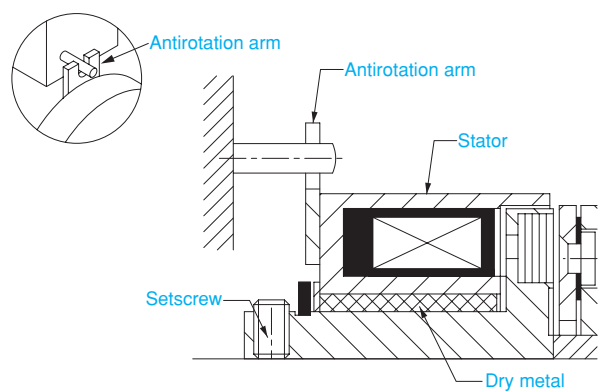
● Bearing mounted type (Dry metal type)

- Centering is not necessary.
- Fix on the shaft

The stator can be easily fixed on the shaft by a setscrew.

- Maintain the stator

The force acting on the stator is a minimal amount of torque caused by the supporting bearing friction. To prevent free rotation of the stator, and to protect a lead wire, maintain an antirotation arm in the static part of the machine. An antirotation arm must be retained in the suitable form for not turning into the shaft direction.



Stator/Rotor mounting (Dry metal type)

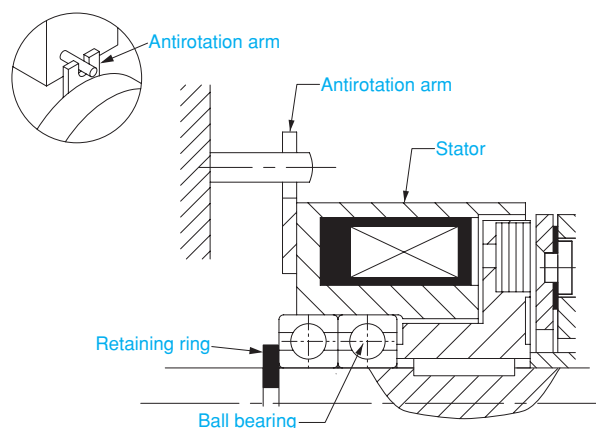
● Bearing mounted type (Ball bearing type)

- Centering is not necessary.
- Fix on the shaft

When mounting the stator, perform positioning for the shaft direction by a retaining ring and a fixing collar. The rotor can be easily fixed on the shaft by a setscrew or keyway.

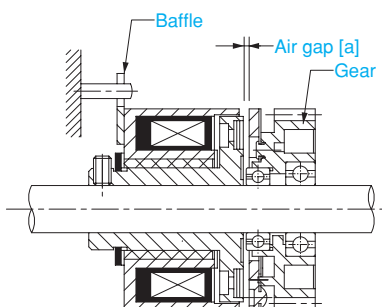
- Maintain the stator

The force acting on the stator is a minimal amount of torque caused by the supporting bearing friction. To prevent free rotation of the stator, and to protect a lead wire, maintain an antirotation arm in the static part of the machine. An antirotation arm must be retained in the suitable form for not turning into the shaft direction.

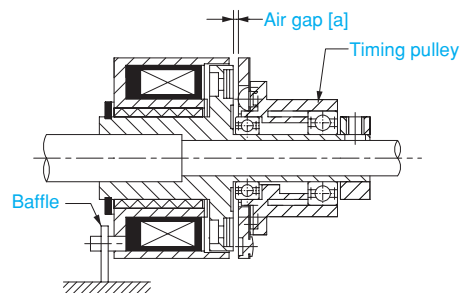


Stator/Rotor mounting (Ball bearing type)

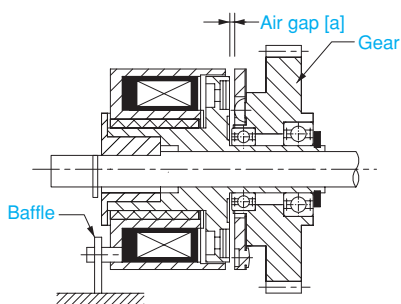
■ Custom examples



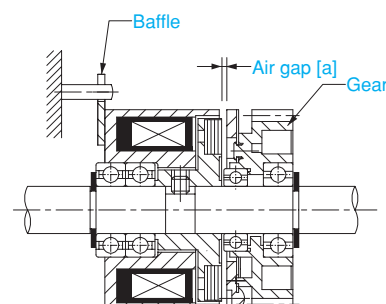
Bearing mounted type (Dry metal type) Mounting example



Bearing mounted type (Dry metal type) Mounting example
Built-in timing pulley



Bearing mounted type (Dry metal type) Mounting example
Built-in gear



Bearing mounted type (Ball bearing type) Mounting example

CYT model

Micro electromagnetic clutches
/Bearing mounted type

Electromagnetic
actuated type
clutches and
brakes

Electromagnetic
actuated type
clutches and
brakes

Clutch
and brake
units

Nonexcited
operation type
brakes

Electromagnetic
toothed clutch

Brakemotor

Power supply
for clutches &
brakes

Specification

Model	Size	Dynamic friction torque T_d [N·m]	Coil (at 20°C)				Heat- resistance class	Maximum rotation speed [min ⁻¹]	Rotating part moment of inertia J		Allowable coupling work E_{ea} [J]	Total amount of work before air gap readjustment E_T [J]	Armature suction time t_a [s]	Torque risetime t_p [s]	Torque extinction time t_d [s]	Mass [kg]
			Voltage [V]	Wattage [W]	Amperage [A]	Resistance [Ω]			Armature [kg·m ²]	Rotor [kg·m ²]						
CYT-025-33B	025	0.4	DC24	4.5	0.188	128	B	3600	1.00×10^{-6}	1.43×10^{-6}	800	1.0×10^6	0.014	0.028	0.030	0.07
CYT-03-33B	03	0.5	DC24	5.5	0.23	105	B	3600	1.30×10^{-6}	1.85×10^{-6}	900	1.5×10^6	0.015	0.030	0.040	0.13
CYT-03-33M								500		1.90×10^{-6}						0.11
CYT-04-33B	04	1.0	DC24	5.9	0.25	98	B	3600	5.15×10^{-6}	1.00×10^{-5}	1900	2.0×10^6	0.030	0.040	0.040	0.26
CYT-04-33M								500		1.05×10^{-5}						0.23

※Dynamic friction torque (T_d) indicates the value when relative velocity is (100min⁻¹).

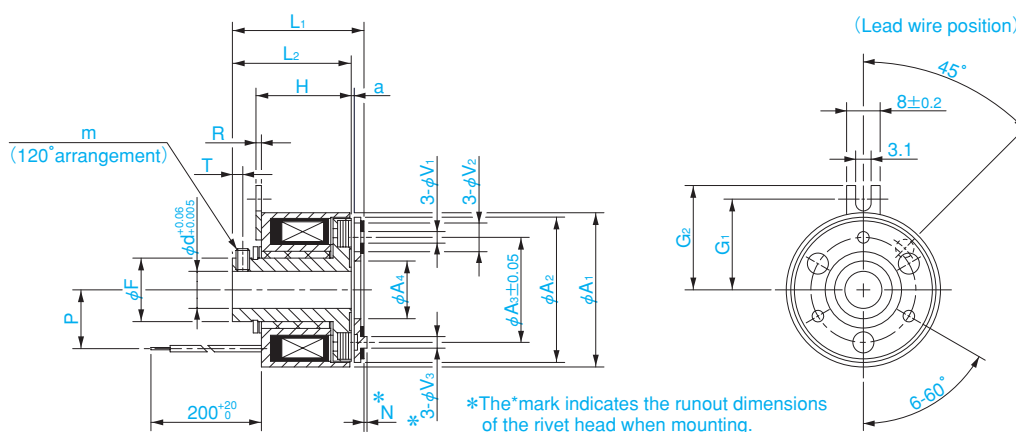
※Rotating part moment of inertia and mass indicate the values of maximum bore diameter.

※Power supply voltage variation must be within $\pm 10\%$ of the coil voltage.

※The recommended power supply is the BE-05 type. However, do not to apply over 50% of its current-carrying rate.

Dimensions

CYT-□-33M



Unit [mm]

Size	Radial dimensions												Axial direction dimensions								CAD File No.
	d	A ₁	A ₂	A ₃	A ₄	F	V ₁	V ₂	V ₃	G ₁	G ₂	m	H	R	L ₁	L ₂	P	N	T	a	
03	6	34	32	23	12.5	14	3-2.6	3-5.5	3-6	20	23	M3	21	1.2	28.6	26.2	13	3	2.3	0.2 ^{+0.05} _{-0.1}	—
	8																				—
04	8	45	42	30	18.5	18	3-3.1	3-6	3-6	25	27.5	M4	25.3	1.2	35.1	32.4	17.5	3.5	3	0.2 ^{+0.05} _{-0.1}	—
	10																				—

※The dimensional sign N and V3 indicate the runout dimensions of the rivet head when mounting.

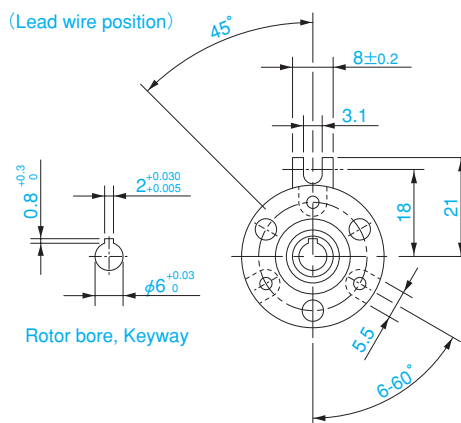
Ordering information

CYT-03-33M 24V 6

Size

Rotor bore diameter (Dimensional sign d)

CYT-025-33B



CYT-025-33B 24V 6

CYT-33B



Unit [mm]

Size	Nominal diameter	Radial dimensions										Axial direction dimensions										Shaft bore dimensions				CAD File No.
		A ₁	A ₂	A ₃	A ₄	F	V ₁	V ₂	V ₃	G ₁	G ₂	H	R	L ₁	L ₂	L ₃	L ₄	P	N	T	a	d ₂	d ₁	b	t	
03	6	34	32	23	12.5	15	3-2.6	3-5.5	3-6	20	23	21	1.2	22.2	19.8	10	11.3	13	3	1.5	0.2 ^{+0.05 -0.005}	6	6	2 ^{+0.030 -0.005}	0.8 ^{+0.3 0}	—
	8	34	32	23	12.5	16	3-2.6	3-5.5	3-6	20	23	21	1.2	22.2	19.8	10	11.3	13	3	1.5	0.2 ^{+0.05 -0.005}	8	8	2 ^{+0.030 -0.005}	0.8 ^{+0.3 0}	—
04	8	45	42	30	18.5	19	3-3.1	3-6	3-6	25	28	25.3	1.2	26.8	24.1	12	13	17.5	3.5	0.9	0.2 ^{+0.05 -0.1}	8	8	2 ^{+0.030 -0.005}	0.8 ^{+0.3 0}	—
	10	45	42	30	18.5	19	3-3.1	3-6	3-6	25	28	25.3	1.2	26.8	24.1	14	11	17.5	3.5	0.9	0.2 ^{+0.05 -0.1}	10	10	3 ^{+0.025 0}	1.2 ^{+0.3 0}	—

※The dimensional sign N and V3 indicate the runout dimensions of the rivet head when mounting.

CYT-03-33B 24V 6

Size _____ Nominal diameter _____

112 model

Micro electromagnetic brakes

Electromagnetic
actuated type
clutches and
brakes

Electromagnetic
actuated type
clutches and
brakes

Clutch
and brake
units

Nonexcited
operation type
brakes

Electromagnetic
torqued clutch

Brakemotor

Power supply
for clutches &
brakes



This model is a compact and high-performance brake with a similar basic design to the micro clutches.

It is excellent in breaking performance, and also ideal for high-precision positioning. Due to its design, it fits into many mounting positions of small precision equipment. It is lightweight and easy to use.

Three types

The optimum condition can be selected from the three types of armature assemblies with different mounting forms.

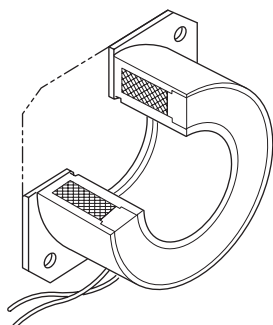
Adapted to the RoHS

Adapted to the Restriction of Hazardous Substances that bans the use of 6 substances such as mercury or lead can be selected as option.

Brake torque	[N · m]	0.4 ~ 2.4
Operational temperature	[°C]	-10 ~ +40
Backlash		Zero

Flange mounted type stator

The stator is a flange mounted type that allows easy setting on the wall. Use in combination with three types of assemblies.



Three types

With the armature type-3

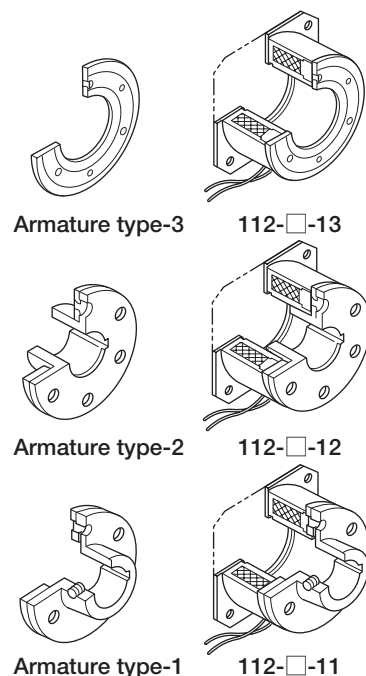
- Wide range of application
- Direct mounting type that is directly mounted on a pulley or spur gear.
- Suitable for braking and holding various types of rotating bodies.
- 112-□-13

With the armature type-2

- Unique slim type
- Shaft mounting type. The mounting portion fits into the inside stator.
- Shorter to the axial direction.
- 112-□-12

With the armature type-1

- Easy-to-use general type
- Shaft mounting type that allows easy setting on the braking shaft.
- 112-□-11



Structure

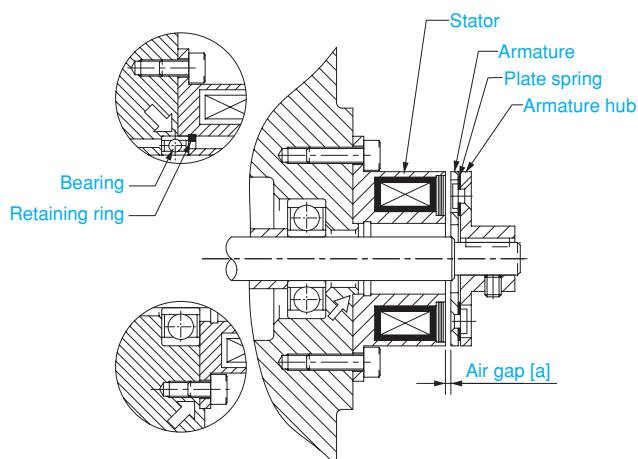
The micro brake consists of the stator with built-in coil, the rotor with lining material, and the armature assembly.

The stator is fixed on the firm and static portion such as machine frame, by a mounting flange.

The armature assembly is composed of armature, ring plate spring and armature hub. It is combined properly with keeping a certain amount of air gap [a] facing the stator, and is fixed on the braking shaft (rotating body).

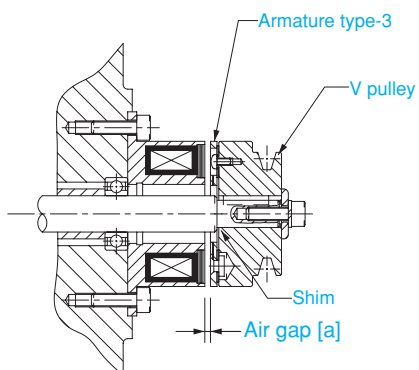
Stator mounting

Centering is performed by "positioning fits" using the stator inside diameter or the flange outside diameter. (See the arrow on the right figure) Since the inside diameter is designed to fit into the nominal dimension for the outside diameter of the ball bearing, correct centering can be performed by directly using the bearing that supports the armature assembly mounting shaft. In addition, there is a retaining-ring groove on the inside stator that the shaft-directional fixation of the bearing outer ring can be simultaneously performed.



■ Mounting Example

● Combination of the 112-□-13 and V pulley

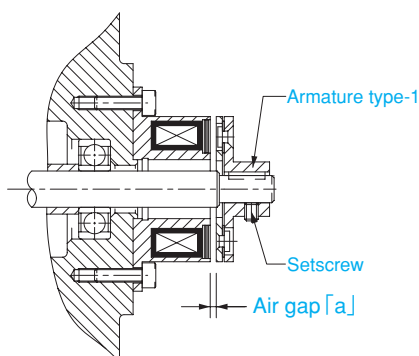


Use the armature type-3 by directly mounting on the transmission device such as V-belt pulley, or the rotating body to break the inertial force.

Shaft processing of the brake part is not necessary. Also, the shaft diameter can be optionally determined.

The air gap [a] can be easily set by a collar or shim. The corrections can also be performed simply by adding or reducing the number of shims.

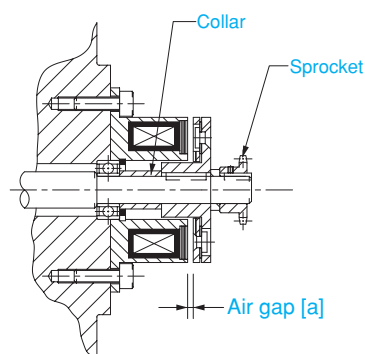
● Using the 112-□-11 at the shaft end



This model can be mounted on the shaft end of the existing machine with the simplest way.

The air gap [a] can be easily set by moving the armature type-1 and fixing with a setscrew.

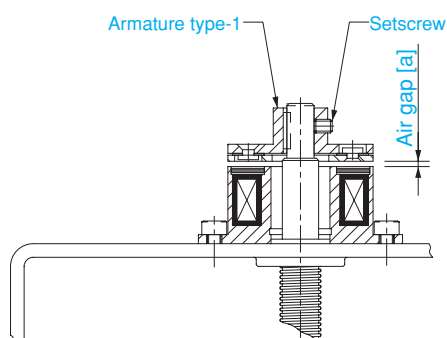
● Using the 112-□-12 at the shaft end



Since the necessary mounting space of the armature type-2 is smallest, the overhung load is no problem if mounting a sprocket on the brake end.

The air gap [a] can be easily set by a collar or shim. The corrections can also be performed simply by adding or reducing the number of shims.

● Using the 112-□-11 for the vertical shaft



Since there is no limit for the mounting direction, idling torque or abnormal friction will not occur when mounting on the vertical shaft.

The air gap [a] can be easily set by moving the armature type-1 and fixing with a setscrew.

112 model

Micro electromagnetic brakes
/Flange mounted type

Electromagnetic
actuated type
clutches and
brakes

Electromagnetic
actuated type
clutches and
brakes

Clutch
and brake
units

Nonexcited
operation type
brakes

Electromagnetic
toothed clutch

Brakemotor

Power supply
for clutches &
brakes

Specification

Model	Size	Dynamic friction torque T_d [N·m]	Coil (at20°C)				Heat- resistance class	Maximum rotation speed [min ⁻¹]	Armature moment of inertia J [kg·m ²]	Allowable coupling work E _{ea} [J]	Total amount of work before air gap readjustment E _T [J]	Armature suction time t _a [s]	Torque risetime t _p [s]	Torque extinction time t _d [s]	Mass [kg]
			Voltage [V]	Wattage [W]	Amperage [A]	Resistance [Ω]									
112-02-13	02	0.4	DC24	6	0.25	96	B	10000	6.75×10^{-7}	1500	2×10^6	0.004	0.010	0.010	0.053
112-02-12									1.00×10^{-6}						0.057
112-02-11									1.00×10^{-6}						0.057
112-03-13	03	0.6	DC24	6	0.25	96	B	10000	1.30×10^{-6}	2300	3×10^6	0.005	0.012	0.008	0.072
112-03-12									1.95×10^{-6}						0.079
112-03-11									1.95×10^{-6}						0.079
112-04-13	04	1.2	DC24	8	0.33	72	B	10000	4.38×10^{-6}	4500	6×10^6	0.007	0.016	0.010	0.118
112-04-12									6.15×10^{-6}						0.131
112-04-11									6.15×10^{-6}						0.131
112-05-13	05	2.4	DC24	10	0.42	58	B	10000	9.08×10^{-6}	9000	9×10^6	0.010	0.023	0.012	0.200
112-05-12									1.38×10^{-5}						0.215
112-05-11									1.38×10^{-5}						0.215

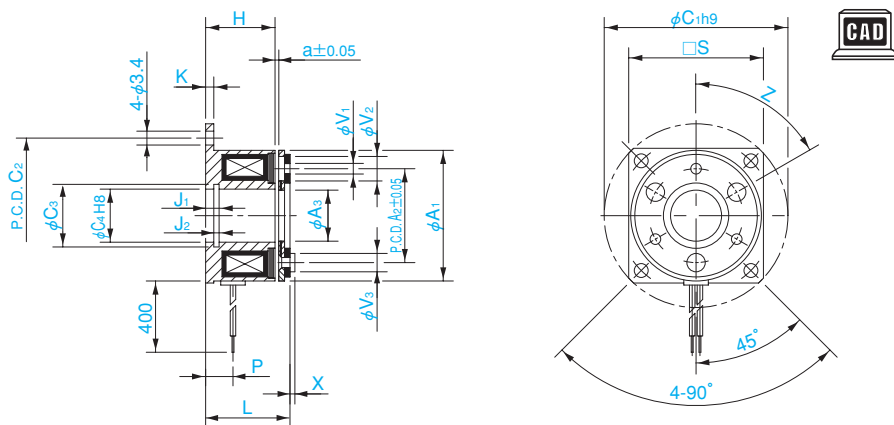
※Dynamic friction torque (Td) indicates the value when relative velocity is (100min⁻¹).

※Rotating part moment of inertia and mass indicate the values of maximum bore diameter.

※Power supply voltage variation must be within ±10% of the coil voltage.

※The recommended power supply is the BE-05 type. However, do not to apply over 80% of its current-carrying rate.

Dimensions 112-□-13



Unit [mm]

Size	Radial dimensions												Axial direction dimensions								CAD File No.
	A ₁	A ₂	A ₃	C ₁	C ₂	C ₃	C ₄	S	V ₁	V ₂	V ₃	Z	H	K	J ₁	J ₂	L	P	X	a	
02	28	19.5	10.5	39	33.5	11.4	11	—	2-2.1	2-5.3	2-4	4-90°	13.7	1.5	2.6	1.3	16.1	5	0.8	0.1	112-131
03	32	23	12.5	45	38	13.6	13	33	3-2.6	3-6	3-4.5	6-60°	17	2	3.3	1.3	19.3	6.7	1.2	0.15	112-132
04	40	30	18.5	54	47	20	19	41	3-3.1	3-6	3-5	6-60°	20	2	3.3	1.3	22.8	7	1.6	0.15	112-133
05	50	38	25.5	65	58	27.2	26	51	3-3.1	3-6.5	3-5.5	6-60°	22	2	3.5	1.5	25.2	8	1.6	0.2	112-134

※The size 02 has a round flange.

Ordering information

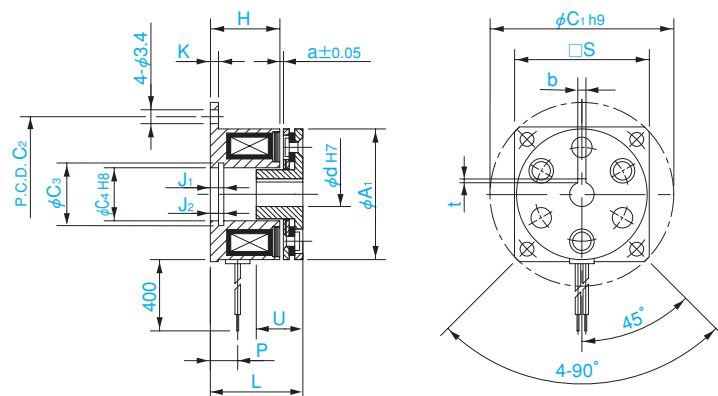
112-03-13 24V

Size

Dimensions

112-□-12

Unit [mm]



Size	Shaft bore dimensions				
	d H7	New JIS standards correspondence		Previous edition of JIS standards correspondence	
		b P9	t	b E9	t
02	5	—	—	—	—
03	6	2 ^{-0.006} _{-0.031}	0.8 ^{+0.3} ₀	—	—
04	8	2 ^{-0.006} _{-0.031}	0.8 ^{+0.3} ₀	—	—
	10	3 ^{-0.006} _{-0.031}	1.2 ^{+0.3} ₀	4 ^{+0.050} _{+0.020}	1.5 ^{+0.5} ₀
05	10	3 ^{-0.006} _{-0.031}	1.2 ^{+0.3} ₀	4 ^{+0.050} _{+0.020}	1.5 ^{+0.5} ₀
	15	5 ^{-0.012} _{-0.042}	2 ^{+0.5} ₀	5 ^{+0.050} _{+0.020}	2 ^{+0.5} ₀

Unit [mm]

Size	Radial dimensions						Axial direction dimensions								CAD File No.
	A ₁	C ₁	C ₂	C ₃	C ₄	S	H	K	J ₁	J ₂	L	P	U	a	
02	28	39	33.5	11.4	11	—	13.7	1.5	2.6	1.3	18.1	5	7	0.1	112-121
03	32	45	38	13.6	13	33	17	2	3.3	1.3	21.3	6.7	10	0.15	112-122
04	40	54	47	20	19	41	20	2	3.3	1.3	25.5	7	12	0.15	112-123
05	50	65	58	27.2	26	51	22	2	3.5	1.5	28.2	8	12	0.2	112-124

※ The size 02 has a round flange.

※ There is no keyway on the rotor of the size 02. Fix on the shaft by press fitting.

Ordering information

112-03-12 24V 6 DIN

Size

Keyway standard

New JIS standards correspondence : DIN

Previous edition of JIS standards correspondence : JIS

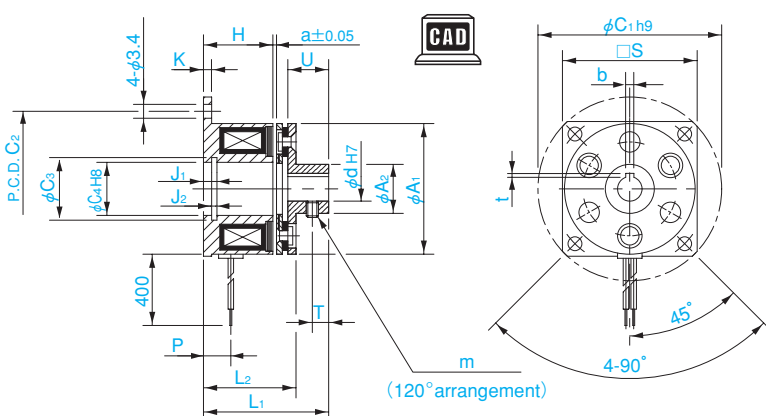
Armature bore diameter (Dimensional sign d)

※ It is not necessary to enter the keyway standard if there is no description in the shaft-bore dimensions table.

Dimensions

112-□-11

Unit [mm]



Size	Shaft bore dimensions				
	d H7	New JIS standards correspondence		Previous edition of JIS standards correspondence	
		b P9	t	b E9	t
02	5	—	—	—	—
03	6	2 ^{-0.006} _{-0.031}	0.8 ^{+0.3} ₀	—	—
04	8	2 ^{-0.006} _{-0.031}	0.8 ^{+0.3} ₀	—	—
	10	3 ^{-0.006} _{-0.031}	1.2 ^{+0.3} ₀	4 ^{+0.050} _{+0.020}	1.5 ^{+0.5} ₀
05	10	3 ^{-0.006} _{-0.031}	1.2 ^{+0.3} ₀	4 ^{+0.050} _{+0.020}	1.5 ^{+0.5} ₀
	15	5 ^{-0.012} _{-0.042}	2 ^{+0.5} ₀	5 ^{+0.050} _{+0.020}	2 ^{+0.5} ₀

Unit [mm]

Size	Radial dimensions								Axial direction dimensions									CAD File No.	
	A ₁	A ₂	C ₁	C ₂	C ₃	C ₄	S	m	H	K	J ₁	J ₂	L ₁	L ₂	P	U	T		a
02	28	9.5	39	33.5	11.4	11	—	M3	13.7	1.5	2.6	1.3	23.1	18.1	5	7	2.5	0.1	112-111
03	32	12	45	38	13.6	13	33	2-M3	17	2	3.3	1.3	29.3	21.3	6.7	10	4	0.15	112-112
04	40	17	54	47	20	19	41	2-M3	20	2	3.3	1.3	34.8	25.5	7	12	5	0.15	112-113
05	50	24	65	58	27.2	26	51	2-M4	22	2	3.5	1.5	37.2	28.2	8	12	5	0.2	112-114

※ The size 02 has a round flange.

Ordering information

112-03-11 24V 6 DIN

Size

Keyway standard

New JIS standards correspondence: DIN

Previous edition of JIS standards correspondence: JIS

Armature bore diameter (Dimensional sign d)

※ It is not necessary to enter the keyway standard if there is no description in the shaft-bore dimensions table.

Torque characteristics

Static friction torque and dynamic friction torque

Clutches and brakes transmit torque by sliding with a certain relative velocity in the process of coupling and braking. The relative velocity gradually becomes smaller, and they are completely connected. The transmittable torque when coupling and braking are completed is called "dynamic torque" of the relative velocity. The static friction torque becomes about the same value and the dynamic friction torque changes measurably with the relative velocity.

Dynamic friction torque characteristics

The relationship between relative sliding velocity and dynamic friction torque is indicated in the right diagram. As indicated in the diagram, the difference between the static friction torque and the dynamic friction torque is small, which indicates that the effect in actual use becomes small. The value shown in the specification is when the sliding velocity is 100min^{-1} .

Initial torque characteristics

For the friction type clutches and brakes, the friction surface does not sufficiently conform when initially used. It may not reach the rated torque, which is called initial torque condition. The value of initial torque is 60~70% of the indicated torque, however, it will reach the normal value by a short test operation. Please confirm if the indicated torque is needed from the beginning of use. It may take longer time for a test operation for use by light load or low revolution speed.

The duration time of the residual torque (remaining torque after current interruption) is very short due to the plate spring action so that a particular circuit such as reverse excitation is not necessary for normal use.

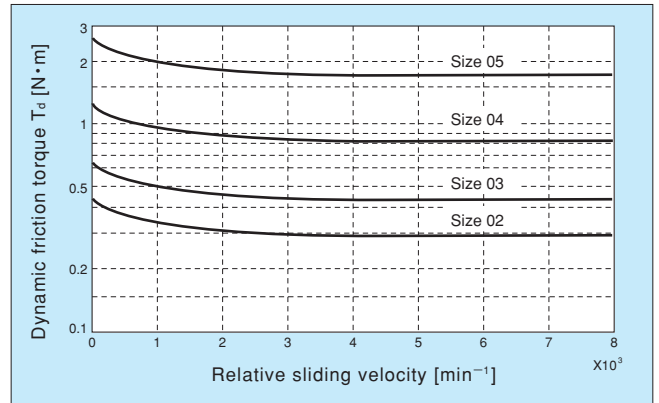
Torque current characteristics

Size of torque (magnitude of torque) is determined by the formula of $T = \mu$ (frictional factor) $\times r$ (mean radius of frictional surface) $\times P$ (suction power).

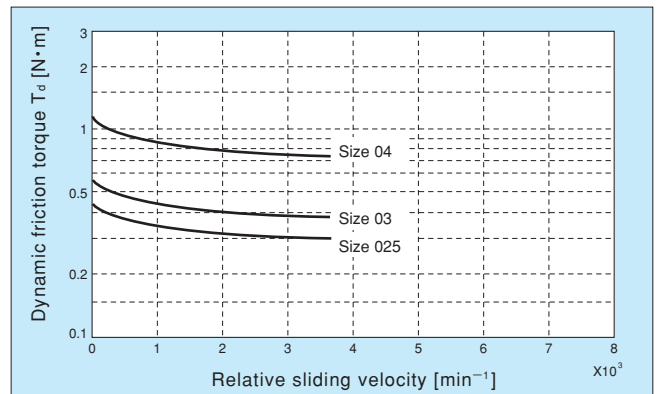
$$T = \mu \times r \times P$$

μ are determined at this time, but P changes depending on the current magnitude (amount of the current) to apply. A current is proportional to a voltage that the friction torque varies by changing the voltage applied to a coil. The relationship between friction torque and excitation current is indicated in the right diagram. Around the rated current value, torque increases and decreases in proportion to the current. As the current increases above the rated value, the magnetic flux density reaches a point of saturation in the magnetic circuit. There is no torque increment after then, and only the calorific power increases. On the other hand, torque decreases as the current decreases.

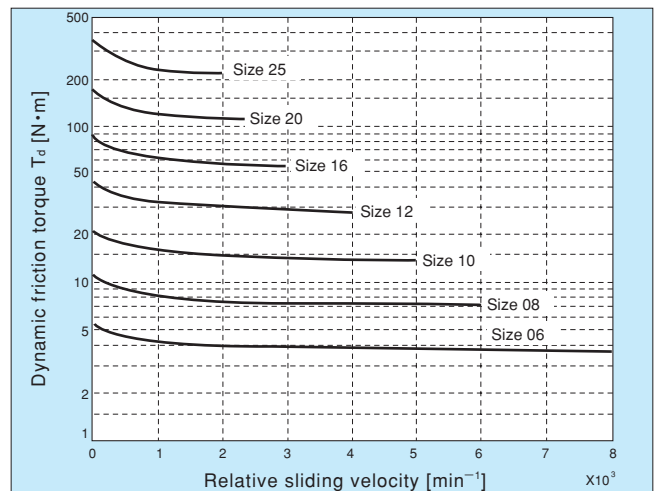
When it becomes closer to the minimum current value to draw the armature, torque becomes unstable. By decreasing more current, the armature becomes unable to draw and torque fades away. To generate torque below the suction current, some procedures are needed. Meanwhile, the diagram is for the specified air gap that the characteristic curve changes as the air gap value changes.



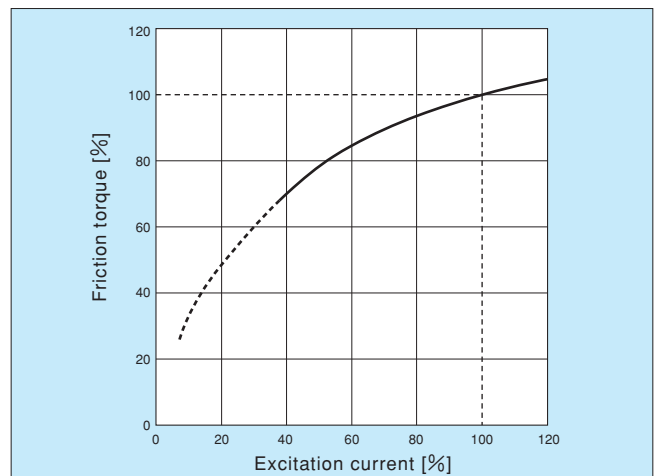
Dynamic friction torque characteristic Micro size 102 · 112 model



Dynamic friction torque characteristic Micro size CYT model



Dynamic friction torque characteristic Normal size 101 · 111 · CS model, etc.



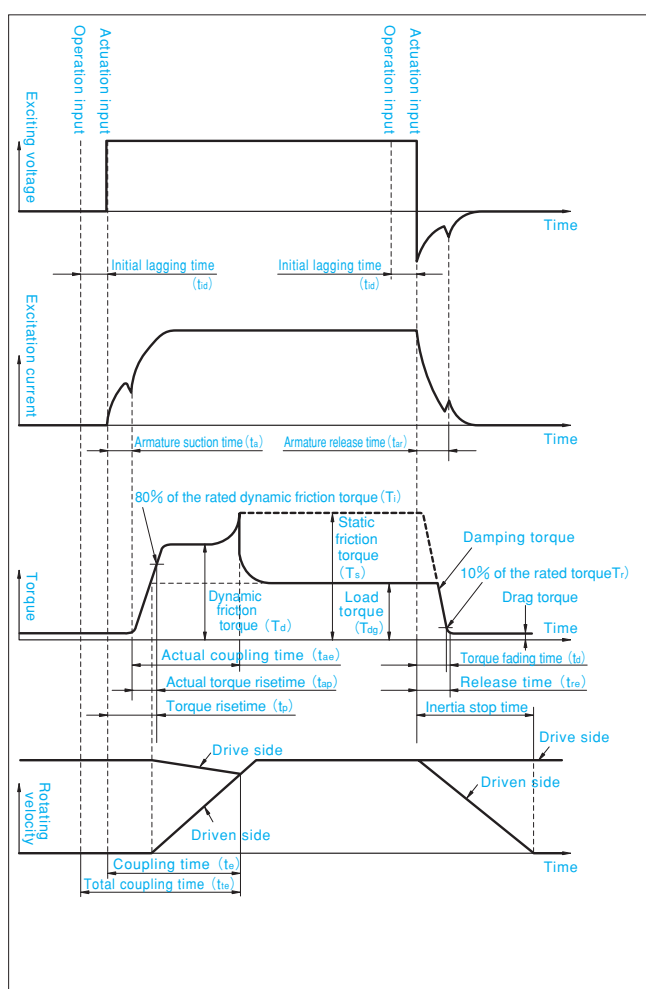
Torque current characteristic

Operating characteristics

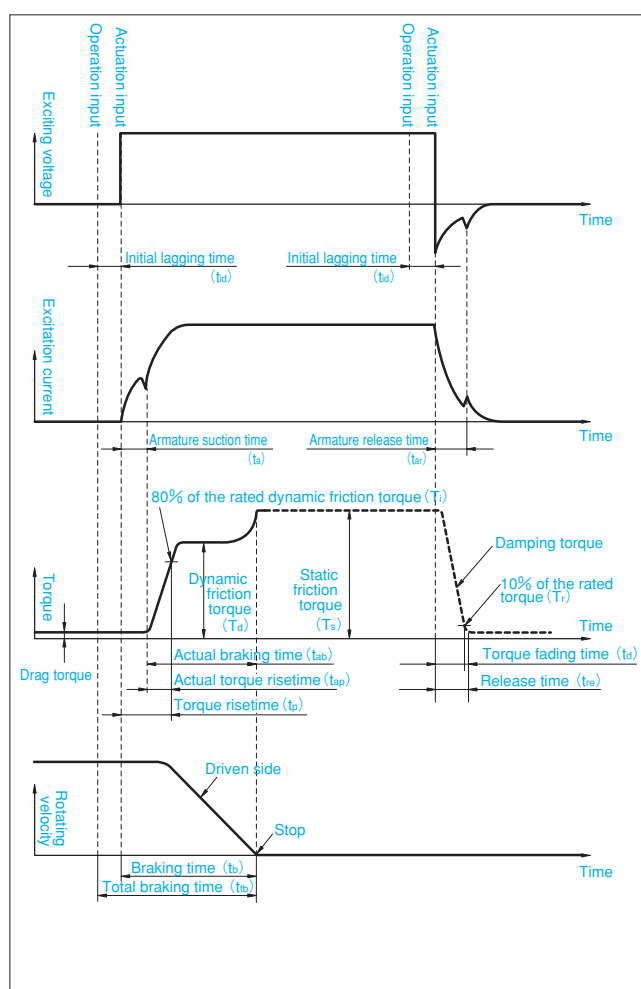
Transient characteristics of clutches and brakes in working condition

The following figure shows the transient phenomena of torque and current when the clutch and brake is connected (braking) and released. It is generally called operating characteristics. When applying a voltage through the clutch and brake, the current increases according to the time constant that is determined by the coil. When the current reaches a certain value, the armature is suctioned and the friction torque is generated. The frictional torque increases as the current increases, and reaches the rated value. As well as when releasing the clutch and brake, the armature starts separation by the releasing action of the plate spring as the current decreases, and torque fades away.

Clutch operating characteristics



Brake operating characteristics



T_a : Armature suction time: Time from when the current is applied till when the armature is suctioned and torque is generated.

T_{ap} : Actual torque rise time: Time from when torque is generated till when it becomes 80% of the rated torque.

T_p : Torque rise time: Time from when the current is applied till when it becomes 80% of the rated torque.

T_d : Torque fading time: Time from when the current is shut off till when it decreases to 10% of the rated torque.

T_{dl} : Initial lagging time: Time from when the operation input is on by the clutch and brake till when the actuating input or releasing input is on for the clutch or brake body.

T_{ae} : Actual coupling time: Time from when torque is generated by clutch till when connection is completed.

T_{ab} : Actual braking time: Time from when torque is generated by brake till when braking is completed.

Operating characteristics

Control circuit and operating time

The standard voltage is DC24V. If there is no DC source, use the direct current that is obtained by step-down and commutation (full-wave rectification) of alternating source. (Refer to the section of power supply.) The on-off operation is generally done on the direct-current side. The following table indicates the operating time at the time. The direct-current side operation allows a quick response, however extremely high surge voltage is generated when the current is shut off, which may cause burnout of the contact in the control circuit or a dielectric breakdown of the coil, therefore, a protective device for surge absorption is recommended. When switching operation is performed on the alternating-current side, torque fading time becomes long, which may cause interference with next operation. In such case, take a time lag. The torque rise time is the same as when operation is performed on the direct-current side.

Micro size

Clutch operating time (Applicable power supply type: BE, BER)

Clutch size	Operating time [s]			
	t _a	t _{ap}	t _p	t _d
102-02	0.009	0.010	0.019	0.017
102-03	0.009	0.013	0.022	0.020
102-04	0.011	0.017	0.028	0.030
102-05	0.012	0.019	0.031	0.040
CYT-025	0.014	0.014	0.028	0.030
CYT-03	0.015	0.015	0.030	0.040
CYT-04	0.030	0.010	0.040	0.040

Brake operating time (Applicable power supply type: BE, BER)

Brake size	Operating time [s]			
	t _a	t _{ap}	t _p	t _d
112-02	0.004	0.006	0.010	0.010
112-03	0.005	0.007	0.012	0.008
112-04	0.007	0.009	0.016	0.010
112-05	0.010	0.013	0.023	0.012

Standard size

Clutch operating time (Applicable power supply type: BE, BER)

Clutch size	Operating time [s]			
	t _a	t _{ap}	t _p	t _d
101-06	0.020	0.021	0.041	0.020
101-08	0.023	0.028	0.051	0.030
101-10	0.025	0.038	0.063	0.050
101-12	0.040	0.075	0.115	0.065
101-16	0.050	0.110	0.160	0.085
101-20	0.090	0.160	0.250	0.130
101-25	0.115	0.220	0.335	0.210

*The above values correspond to the CS, CSZ model and various clutch and brake units.

*Brake operating time (Applicable power supply type: BE, BER)

Brake size	Operating time [s]			
	t _a	t _{ap}	t _p	t _d
111-06	0.015	0.018	0.033	0.015
111-08	0.016	0.026	0.042	0.025
111-10	0.018	0.038	0.056	0.030
111-12	0.027	0.063	0.090	0.050
111-16	0.035	0.092	0.127	0.055
111-20	0.065	0.135	0.200	0.070
111-25	0.085	0.190	0.275	0.125

The above values correspond to the BSZ model and various clutch brake units.

Shorten the coupling • braking time

The current conforms to the specified time constant, but if especially fast rise is required, the operating characteristic can be changed by using an excitation method such as overexcitation. Overexcitation method is the means to quicken the rise by applying overvoltage to the coil. The following table indicates the operating time when overexcitation. Refer to the section of power supply for more detail.

Operating time in the case of clutch overexcitation
(Applicable power supply type: BEJ, BEH, BEJ, BEH)

Clutch size	Operating time [s]				
	BEJ-10, BEH-20N			BEJ-10	BEH-20N
	t _a	t _{ap}	t _p	t _d	t _d
101-06	0.008	0.005	0.013	0.025	0.005
101-08	0.009	0.008	0.017	0.033	0.008
101-10	0.010	0.010	0.020	0.053	0.011
101-12	0.013	0.012	0.025	0.070	0.018
101-16	0.018	0.016	0.034	0.090	0.023
101-20	0.027	0.020	0.047	—	0.037
101-25	0.045	0.026	0.071	—	0.045

*The above values correspond to the CS, CSZ model and various clutch and brake units.

Operating time in the case of brake overexcitation
(Applicable power supply type: BEJ, BEH)

Brake size	Operating time [s]				
	BEJ-10, BEH-20N			BEJ-10	BEH-20N
	t _a	t _{ap}	t _p	t _d	t _d
111-06	0.005	0.007	0.012	0.017	0.004
111-08	0.005	0.007	0.012	0.027	0.005
111-10	0.007	0.008	0.015	0.032	0.007
111-12	0.009	0.009	0.018	0.055	0.007
111-16	0.014	0.010	0.024	0.060	0.011
111-20	0.015	0.025	0.040	—	0.020
111-25	0.021	0.034	0.055	—	0.038

*The above values correspond to the BSZ model and various clutch and brake units.

- T_a- Armature suction time: Time from when the current is applied till when the armature is suctioned and torque is generated.
- T_{ap}- Actual torque rise time: Time from when torque is generated till when it becomes 80% of the rated torque.
- T_p- Torque rise time: Time from when the current is applied till when it becomes 80% of the rated torque.
- T_d- Torque fading time: Time from when the current is shut off till when it decreases to 10% of the rated torque.

Heat dissipation characteristics

Allowable work (E_{ea} or E_{ba})

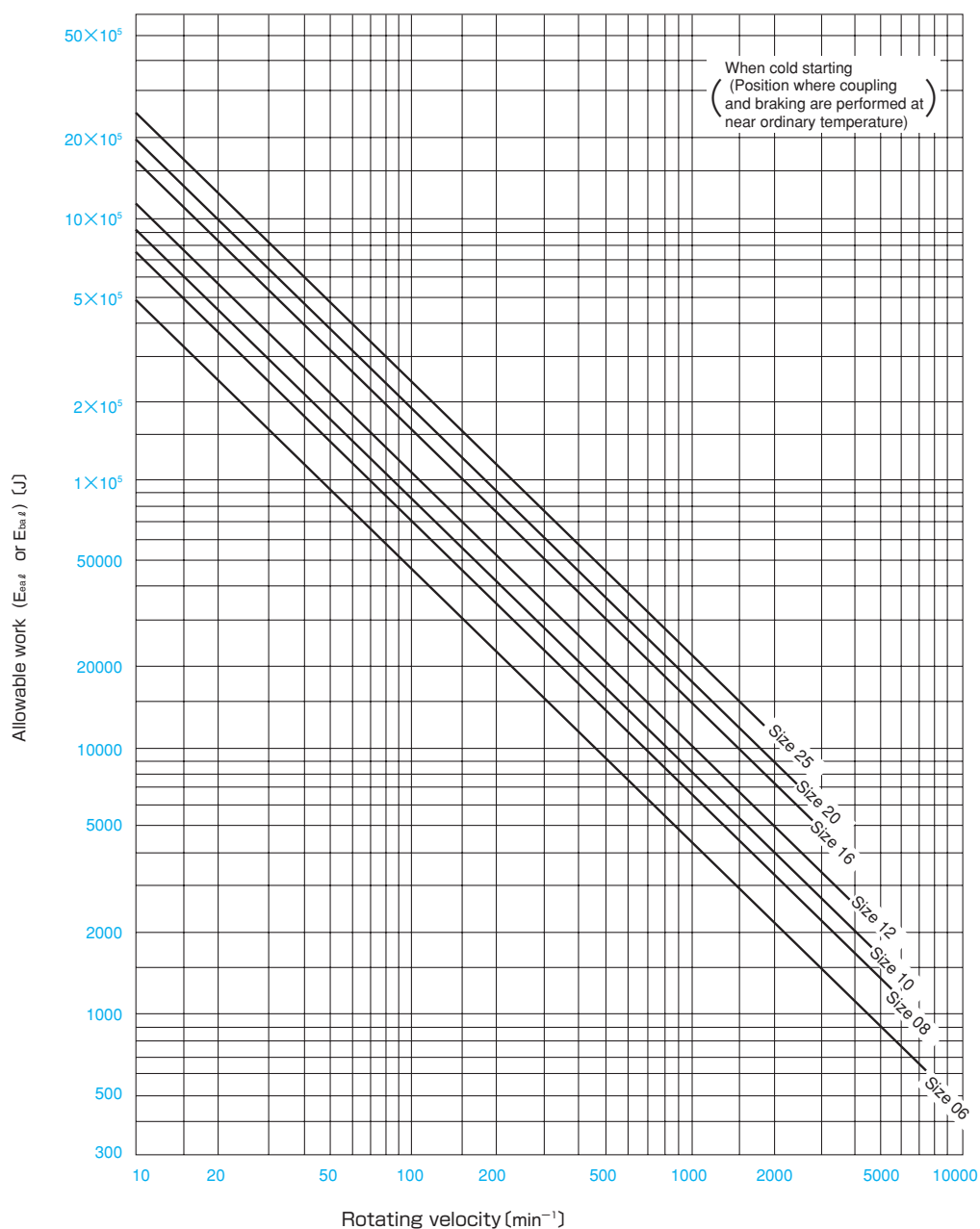
When accelerating or decelerating a load by clutch and brake, heat is generated by sliding friction. The amount of heat changes according to the use condition. A clutch and brake works best if the heat can be dissipated. However, if the core temperature exceeds the operational temperature limit, this may cause an operation trouble or damage. As stated above, the limit of frictional load by heat is called allowable work.

The tolerance is specified for each size. Heat dissipation depends on the mounting condition, rpm's and environment.

When accelerating or decelerating a large load, heat generation of the friction surface is greatly increased due to the intensive slippage. The friction material or armature could be damaged by single connection. The right table indicates the allowable work (allowable friction energy) for each size. Despite its operation frequency, if the work volume is large, apply the value much below the indicated value. For the standard size, apply below the limit line of the following diagram.

Allowable work of the micro clutch and brake s

Model size	Allowable work (coupling · braking) (E_{ea} or E_{ba}) [J]
102/112-02	1500
102/112-03	2300
102/112-04	4500
102/112-05	9000
CYT-025	800
CYT-03	900
CYT-04	1900

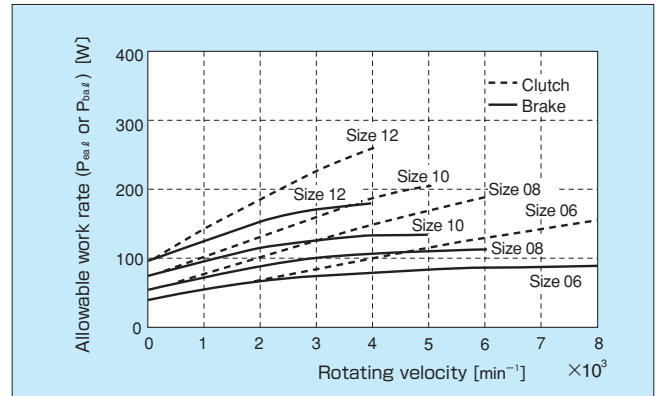


Heat dissipation characteristics

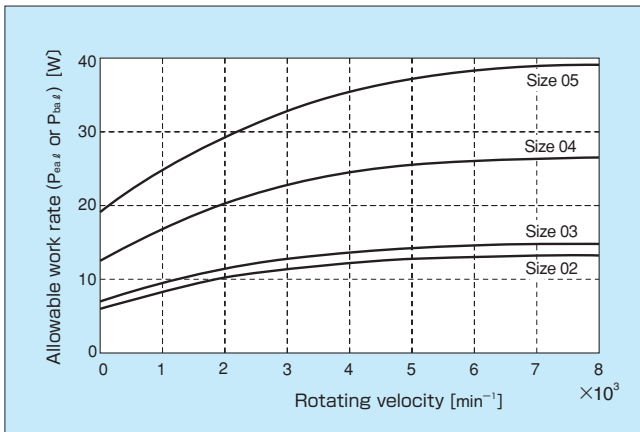
Allowable work rate (P_{eal} or P_{bal})

For high-frequency coupling and braking, the heat dissipation must be fully taken into account. The maximum amount of work per minute is called allowable work rate, and it is determined for each size as indicated in the diagram. For actual use, apply the value much below the permissible value in consideration of the changes of condition.

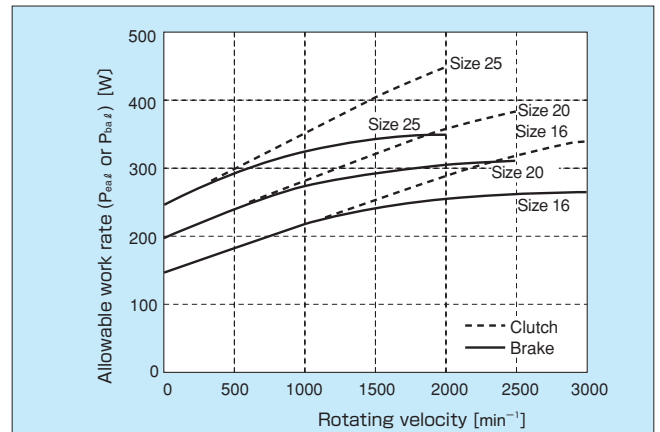
The diagram shows the value when wall mounting. When it is fixed on the shaft like bearing mounting, 80% of each diagram is equal to the permissible value.



Standard size



Micro size (Except CYT model)



Standard size

■ Structural instructions

When using a clutch and brake for machinery, how to maximize the performances and features in design. From the point of view of design, describe some useful factors to improve the liability of machinery.

● Mounting method of stator and rotor

1 Flange mounted type stator (Model: □-□-1□)

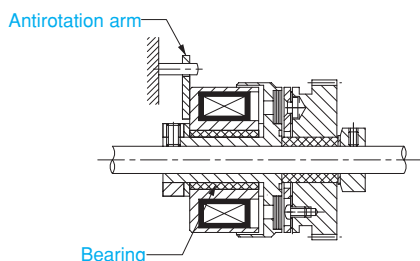
This stator must be fixed by an accurate positioning for the rotating shaft. For the inner and outer circumferences of the stator, class of fit (tolerance quality) is set for positioning. For the mounting surface, the concentricity and squareness of the positioning diameter must be below the permissible value to the rotating shaft.

Unit [mm]

Size	Concentricity (T.I.R.)	Squareness (T.I.R.)
02	0.05	0.03
03	0.05	0.04
04	0.06	0.04
05	0.06	0.05
06	0.08	0.05
08	0.08	0.05
10	0.1	0.05
12	0.1	0.07
16	0.12	0.08
20	0.12	0.13
25	0.14	0.13

2 Bearing mounted type stator (Model: □-□-3□)

This stator is subjected to a small amount of torque by a built-in bearing or sliding bearing. Therefore, maintain an antirotation arm in the static part of the machine to prevent corotation.



3 Magnetic shield of stator

When mounting a stator in combination with clutch and brake, the performance may become unstable by the effect of each other's magnetism. Also, if there is an instrument or equipment around the clutch and brake, it could cause a negative effect such as noise or error. In such a case, appropriate measures to shut off the magnetism should be taken. Generally, nonmagnetic material is used for the mounting surface or shaft.

4 Lead wire protection

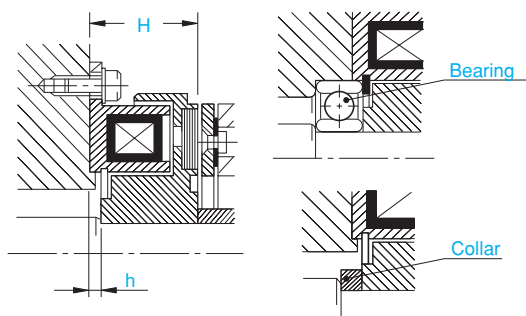
If the coated layer is damaged, it could become the source of troubles such as short circuit or burnout. Therefore, take into consideration the protection of the lead wire in the design phase.

5 Rotor mounting

The rotor is a part of the magnetic circuit. Any bore modifications may cause performance degradation. For rotor bore diameters other than the indicated standard bore diameters, contact us for further information.

6 Relationship between rotor and stator (Model: □-□-1□)

For the flange mounted type clutches, the positional relationship between the stator and rotor is very important. If the H measurement shown in the figure below is too small, the stator and rotor will come into contact with each other. If the H measurement shown is too big, the suction power decreases. The following table indicates the tolerance for each size. The design should be performed by not exceeding the value. As for the permissible value of h, follow the JIS standard tolerance.



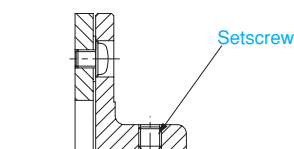
Unit [mm]

Clutch size	H		h
	Standard value	Tolerance	
102-02	18.0	±0.2	1.6
102-03	22.2		2.0
102-04	25.4		2.0
102-05	28.1		2.0
101-06	24.0		2.0
101-08	26.5	±0.3	2.5
101-10	30.0		3.0
101-12	33.5		3.5
101-16	37.5	±0.4	3.5
101-20	44.0		4.0
101-25	51.0		4.0

● Mounting method of armature

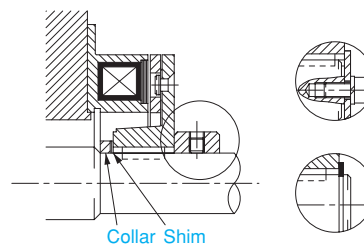
1 Installation of the armature type-1

Tighten completely with the attached hexagon socket bolt to fix. If it comes loose, apply an adhesive thread lock to the threaded part.



2 Installation of the armature type-2

It has a unique configuration that hides the boss in the inside stator. By using a C-shaped retaining ring or collar, fix completely as the figure below indicates.



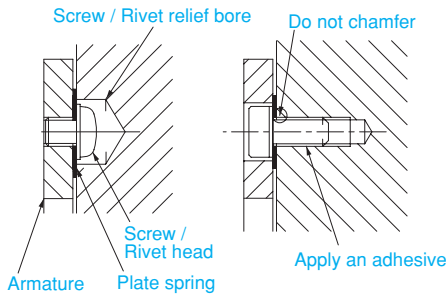
3 Installation of the armature type-5

Insert directly if the micro size is below 0.5. As well as the armature type-2, use a C-shaped retaining ring or collar to fix the end face.

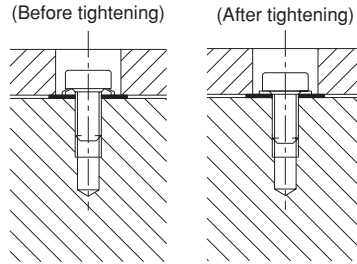
4 Installation of the armature type-3

Apply a bore processing to screw or a runout processing for the rivet head on the mounting surface. Mounting is performed with the attached special hexagon socket bolt and disc spring washer. For the thread part, apply a small amount of adhesive to prevent loosening. (Do not apply too much adhesive, which may disrupt the operation if it is attached to the plate spring.) For the mounting screw bore, chamfering is not necessary just remove the burr. The attached hexagon socket bolt is a special bolt with a low head. For the size below 0.4, the JIS standard cross-recessed pan head machine screw is attached. The disc spring washer must be used as the following figure. The tightening force decreases if it is used in reverse. For the armature type-3, the concentricity and squareness of the positioning diameter must be below the permissible value to the rotating shaft.

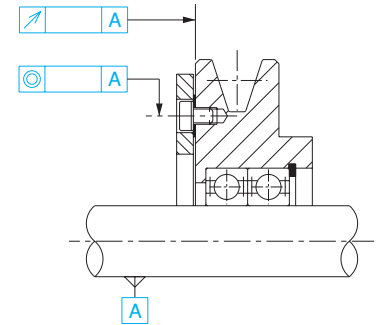
Size	Concentricity (T.I.R.)	Squareness (T.I.R.)
02	0.1	0.02
03	0.1	0.03
04	0.1	0.04
05	0.1	0.04
06	0.16	0.04
08	0.16	0.05
10	0.16	0.05
12	0.16	0.06
16	0.16	0.07
20	0.24	0.11
25	0.24	0.11



Armature type-3 mounting dimensions

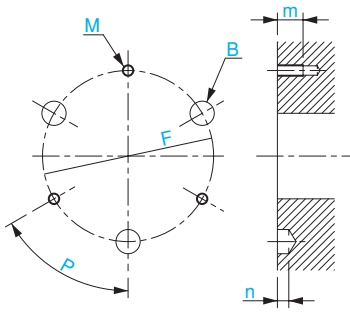


How to use washer



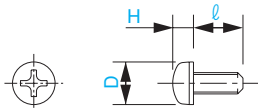
Mounting accuracy

Armature type-3 mounting dimensions

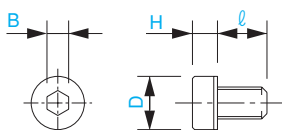


Clutch and brake size	Mounting pitch diameter		Mounting angle		Mounting screw bore			Screw / rivet relief bore	
	F (P.C.D)	Tolerance	P (degree)	Tolerance (min)	No. of bores X M (Nominal designation)	Pitch	Effective screw	No. of bores x Bore diameter	Depth of counterbore
02	19.5	±0.05	90	±5	2×M2	0.4	4	2×5	2.5
03	23		60		3×M2.5	0.45	5	3×6	3
04	30				3×M3	0.5	7	3×6	3.5
05	38							3×7	
06	46	±0.05	60		3×M3	0.5	7	3×7	3.5
08	60				3×M4	0.7	9	3×8.5	3.5
10	76				3×M5	0.8	11	3×10.5	4
12	95				3×M6	1.0	11	3×12.5	4
16	120				3×M8	1.25	16	3×15.5	4.5
20	158				3×M10	1.5	18	3×19	5.5
25	210	±0.1	45		4×M12	1.75	22	4×22	6

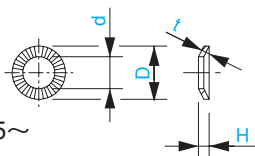
Armature type-3 mounting parts



Size 02~04



Size 05~



Size 05~

Clutch and brake size	Hexagon socket special bolt (cross-recessed pan head machine screw)						Disc spring washer			
	Nominal dimension x Pitch	φ D	H	B	ℓ		φ D	φ d	H	t
02	※M2×0.4	3.5	1.3		3	Disc spring washer is not used				
03	※M2.5×0.45	4.5	1.7		4					
04	※M3×0.5	5.5	2.0		6					
05	M3×0.5	5.5	2.0	2.0	6	6	3.2	0.55	0.36	
06										
08	M4×0.7	7	2.8	2.5	8	7	4.25	0.7	0.5	
10	M5×0.8	8.5	3.5	3.0	10	8.5	5.25	0.85	0.6	
12	M6×1.0	10	4.0	4.0	10	10	6.4	1.0	0.7	
16	M8×1.25	13	5.0	5.0	15	13	8.4	1.2	0.8	
20	M10×1.5	16	6.0	6.0	18	16	10.6	1.9	1.5	
25	M12×1.75	18	7.0	8.0	22	18	12.6	2.2	1.8	

● Air gap design and adjustment

Set the air gap [a] between the frictional surfaces (Figure below) in order that it becomes its specified value when released. At this time, adjustable layout should be done for further convenience. As a method of that, the layout with a combination of collar and shim as indicated in the figure below is recommended. (A shim is regularly stocked. Contact us if necessary.)

1 Set the air gap [a]

Prepare a slightly shorter collar than the required length ℓ to maintain the air gap [a], and adjust the remaining gap with a shim to obtain the specified value. At this time, the collar length is determined approximately by the following formula.

$$L \doteq \ell - 2a \text{ [mm]}$$

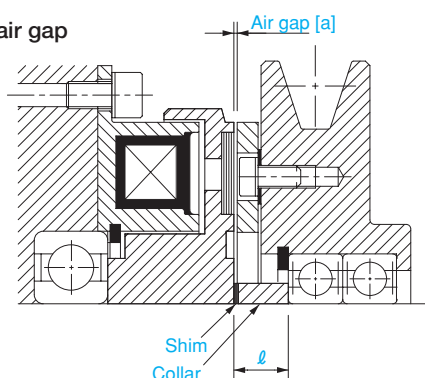
L: length of the collar

ℓ : required length to maintain the air gap

a: specified air gap value

Prepare the collar with appropriate length based on the estimated value. If the layout is done by the above method, the air gap adjustment after a long period of use can be performed simply by removing the required number of shims.

Setting of air gap

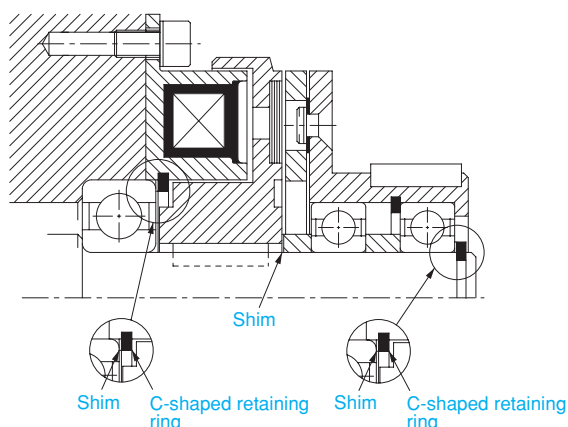


*Refer to the section of technical data for shim dimensions.

2 Remove the allowance of the shaft direction

For the clutch and brake also the parts used in combination, the performance degradation may occur if there is an allowance in the shaft direction after assembling. Therefore, reduce the allowance as much as possible. For controlling a little amount of allowance, various types of shims are available. They correspond to the often-used shaft diameter or bearing outside diameter. In addition, reliable fixing with a spring action can be performed when used in combination with a C-shaped retaining ring.

How to use shims

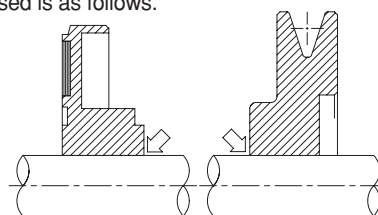


● Coupling tolerance

Clutches and brakes perform substantial work in a moment, but high accuracy control is also required at the same time. Therefore, the appropriate integration of each part is necessary for not generating a friction or vibration. For that purpose, the coupling tolerance is needed to determine in accordance with the use condition.

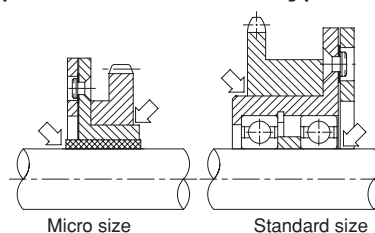
1 Coupling tolerance between rotor / armature type 1 & 2 / V-belt pulley and shaft

The standard bore tolerance is H7 class. For the CYT model, a special bore diameter tolerance is applied. The shaft dimensional tolerance used is as follows.



Load condition	Shaft tolerance		Remarks
Shaft below 10 ϕ	h6	h7	H5 for high accuracy
Light, normal and variable load	h6		h6 j6 for motor shaft Clutch and brake j6 for unit shaft
	js6	js7	
	j6	j7	
Heavy load and impact load	k6	k7	
	m6		

2 Coupling tolerance between armature type-5 and sprocket / armature type-5 and shaft



Clutch and brake size	Armature type-5		Bore tolerance of sprocket, etc.	Shaft tolerance	
	Boss part tolerance	Bore tolerance			
02~05	h7	H7	H7	h7	h8
06 or more	j6	Conforms to table below	H7	Conforms to table above	

3 Coupling tolerance between ball bearing and housing

Load condition	Bore tolerance	Remarks
Outer-ring rotational load	Heavy load	N7
	Normal load and variable load	M7
Unstable load in direction	Heavy impact load	
	Heavy load and normal load	
	Heavy load and normal load	
Inner-ring rotational load	Impact load	
	General load	

*Apply to the iron-steel or cast-iron housing. For light-alloy housing, tighter coupling is required.

● Environment of the mounting part

When selecting a clutches or brakes careful consideration of the operating environment must be taken.

1 Temperature

The heat-resistant class of clutch and brake is B type, and the allowable operating temperature is $-10^{\circ}\text{C} \sim 40^{\circ}\text{C}$. When the clutch or brake is used at high temperatures, the heat generated by actual clutching and braking operations does not dissipate, this may cause damage to the coil or friction part. Even if it is used below -10°C , there is no problem if the temperature becomes over -10°C by heat generation of the clutch and brake. However, if the water of crystalline frosts generated by a longtime stoppage or low-frequency operation is attached on the device, it may cause performance degradation.

2 Humidity and water drop

As in the case of temperature, if water drops are attached on the friction surface, the coefficient of friction decreases temporarily until it dries. Also, water contamination causes oxidation as well. Therefore, take appropriate measures such as using a cover.

3 Intorduction of foreign body such as dust or oil

The friction surface has a susceptibility to foreign body. If any oil is mixed, the coefficient of friction significantly decreases. Metal dust especially damages the friction surface or rotating part. In addition, an agent could also cause oxidation. For such environment, use of a protective cover is recommended.

4 Air ventilation

Since the clutch and brake converts the friction work into heat proper ventilation is required to dissipate the heat build up. Forced cooling is a effective way for increasing an allowable amount of work. Confirm the temperature if the device is used in the place with poor ventilation.

● Maximum rotation speed (RPM)

The maximum rotation speed (rpm) of clutches and brakes is indicated in the specification table. This value is determined by the peripheral velocity of the friction surface. If the speed exceeds the maximum rpm, this may cause premature wear and premature failure of the clutch or brake. Overspeed applications will not transmit rated torque.

● Ball bearing

A ball bearing is generally used in combination with clutches and brakes, and a deep-grooved ball bearing is the mos common. Since dry-type clutches and brakes have a susceptibility to oils and fats attached on the frictional surface, use a double sealed bearing which does not require lubrication. A double sealed bearing with contactless rubber seal is effective for preventing dust. For a compact bearing or rare bearing, a metallic double sealed type is also available.

● Mechanical strength

Due to the operating characteristics of clutches and brakes, coupling and braking of load can be immediately performed, thus impactive forces may be applied to each part of the machine, therefore to allow enough strength is important. (Undue safety design could cause a load torque increase, or affect the coupling and braking accuracy.)

● Vibration and backlash

Both clutch and brake assemblies are balanced to reduce vibration. However, if the device is applied impactive forces repeatedly, backlash could occur to generate vibration noises. Perform the layout with no backlash.

● Antirust

An antioxidation treatment is applied to the clutches and brakes. However, oxidation may be generated depending on the storage condition or environment. Please attempt to prevent oxidation. A small amount of oxidation is acceptable.

● Occurrence of sparks

During the use process of clutches and brakes, sparks may occur by the friction between the magnetic pole part of the frictional surface and the armature. Make sure not to use in a flammable environment.

● Structural design with maintability

Maintenance of clutches and brakes is not generally required for a long period of time.

By performing maintenance on a ball bearing, for instance, it can be used for a prolonged period. A structural design that can be easily disassembled and reassembled is recommended. Refer to the instruction manual for more detail.

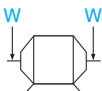
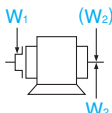
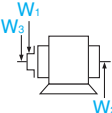
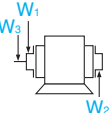
● Use of micro clutches

If a bearing mounted type micro clutch (oil retaining metal) is used, there is a possibility to be regulated by the current-carrying rate or temperature. Contact us for further information.

● Overhung load of the unit

he permissible value of the radial load applied on the shaft is indicated below. For the though shaft type unit, the permissible value slightly changes due to the direction of action of the input-output load. (The indicated value is when the most stringent condition is applied. The load point is the midpoint of the shaft.)

Unit: [N]

Size	125-□-12 126-□-4B	121-□-20		121-□-10 122-□-20
				
05	250	—	—	—
06	320	300 (320)	140	140
08	480	450 (500)	250	250
10	700	700 (800)	450	450
12	900	900 (1000)	700	700
16	1300	1400 (1600)	1000	1000
20	1800	2000 (2500)	1800	1800
25		2900 (3600)	2600	2600

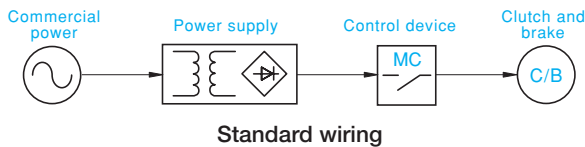
*() for load in both directions.

Control circuit

Basic configuration of a control circuit

When designing an electric circuit to control the clutch and brake, the selection of control method and control device is very important. The appropriate selection and circuit design stabilize the performance of the clutch and brake and strengthen the reliability of the machine.

To run the clutch and brake, DC24V (standard specification) power is required. There are two methods to run the clutch and brake. One is to use a direct current, and the other is to commutate an alternating current by stepping down the power. Various power supplies for exclusive use are available. Refer to the section of power supply for more details.



Selection of parts of power supply

1 Transformer

Adjust the primary side to the power supply voltage. For the secondary side, use a transformer that has enough capacity to apply the rated voltage to the clutch or brake coil. To get a rough idea, choose a transformer with a capacity of more than 1.25-times the rating capacity of the clutch in temperature of 20°C. In addition, the secondary side output voltage is generally required to be set in accordance with the voltage drop of the rectifier and the impedance of the transformer, however it can be evaluated simply by the formula below (Formula ① and ②).

$$V_2 = \frac{V + 1.4}{0.9} \quad (\text{V}) \quad \text{①}$$

Formula ① is a method of single-phase full-wave rectification.

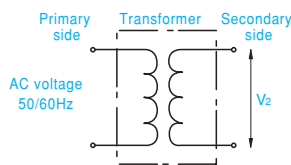
$$P \geq W_{CB} \times 1.25 \quad (\text{VA}) \quad \text{②}$$

V_2 : Transformer secondary side voltage [V]

V : Direct voltage [V]

P : Transformer capacity [VA]

W_{CB} : Clutch (brake) capacity [VA]



2 Rectifier

The "single-phase full-wave rectification (bridge method)" is adopted from various types of rectification methods. For the selection, the maximum rated value of the rectifiers must be followed. It can be evaluated simply by the formula below.

① Determination of the reverse withstand voltage VRM

$$VRM = V_L \cdot \sqrt{2} \cdot K \quad \text{③}$$

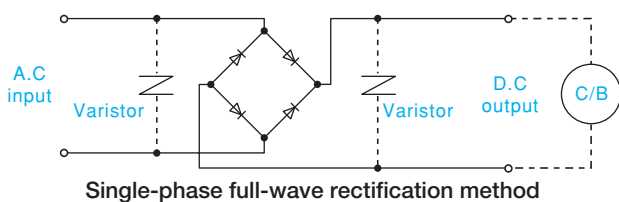
V_L : Current input voltage [V]

K : Factor of safety (take 2~3)

Protection of rectifier is required if there is a possibility of commingling of more than the withstand voltage of surge.

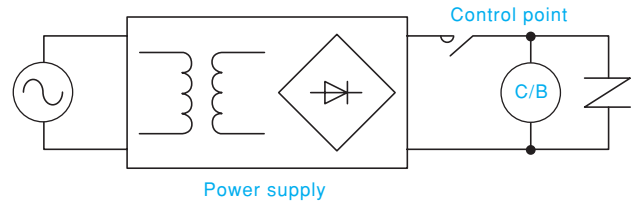
② Determination of the average rectified current

Select a rectifier that has more than 1.5-times the clutch or brake rated current. In the case of high current, temperature rise becomes a problem. Take measures to dissipate the heat and prevent the rise of temperature.



3 Relay (Control contact)

Since the electromagnetic clutches and brakes have a magnetic coil inside, they must be used within the conditions of the applied relay direct-current inductive load. This is because the contact erosion occurs by the surge voltage generated when the electromagnetic clutch and brake is controlled. In the case that the operating life or operation frequency is a problem in use, a static relay is required. For details, refer to the section of electromagnetic clutch and brake control for power supply.



4 Control circuit structural points to remember

① Control of clutch and brake

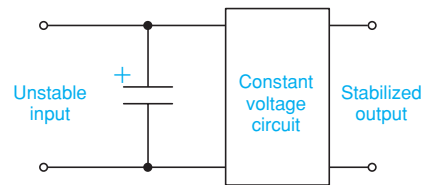
When the clutches and brakes are controlled on the alternating-current side, the armature release time becomes late and high-frequency operation becomes unable to perform. Therefore, set the control contact on the direct-current side.

② Power supply voltage of clutch and brake

Variation of the exciting voltage must be within $\pm 10\%$ of the clutch and brake rated voltage.

③ Smooth the exciting voltage

A single-phase full-wave rectification is generally used for a clutch and brake power supply. If high accuracy is required, a sufficient result can be obtained by smoothing.



Stabilized power supply circuit

④ Protection of the control contact

When a protection circuit is set for the clutch and brake, the control contact is also protected. In addition, if a CR absorber is applied between the contact points as below, the protection effect increases. C (condenser) and R (resistance) become approximately as below.

Condenser C [μF]: ratio to contact current is;

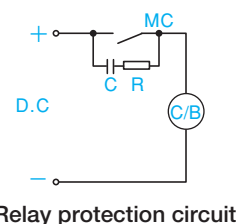
$$\frac{C [\mu\text{F}]}{I [\text{A}]} = \frac{0.5 \sim 1}{1}$$

Withstand pressure: 600 [V]

Resistance R [Ω]: ratio to contact current is;

$$\frac{R [\Omega]}{E [\text{V}]} = 1$$

Capacity: 1 [W]



Relay protection circuit

5 Discharge circuit

When a direct exciting current is applied to electromagnetic clutches and brakes, the energy is stored in the inside coil. When interrupting the current, surge energy is generated between the coil terminals by the stored energy. This surge energy could reach more than 1000V by the breaking speed or current, which may cause a dielectric breakdown of the coil or contact burnout of the switch. Therefore, to set an appropriate discharge circuit to prevent these troubles is required.

In addition, the effect to control the armature release time or surge voltage is different depending on the types of discharge circuits. For the characteristics of discharge circuits, refer to the table below. Each discharge circuit has both merits and demerits. We recommend using a varistor.

	Circuit diagram	Current decay	Characteristics
Varistor			It has a significant effect to reduce a surge voltage. There is no delay of the armature release time.
Resistance + diode			The power consumption of the power section can be reduced as well as its resistance capacitance. Since the armature release time becomes slow in a measure, caution is demanded for high-frequency use.
Diode			It is effective to reduce a surge voltage. However, the armature release time becomes slow, and there is a high possibility of occurrence of mutual interference of the clutch and brake. It is not suitable for high-frequency use.
Resistance + condenser			The armature release time becomes faster, but a condenser with high pressure tightness is required.

Applicable power supply specifications

Model	Rectification method	Frequency [Hz]	AC input voltage AC [V]	DC input voltage ^{*1} DC [V]	Capacity	Recommended protective device ^{*2} (Varistor)	Applicable clutch and brake size
BE-05	Single-phase full-wave	50/60	100/200	24	25	NVD07SCD082 or TNR7V820K	02~10
BE-10	Single-phase full-wave	50/60	100/200	24	50	NVD07SCD082 or TNR7V820K	12~16
BE-20	Single-phase full-wave	50/60	100/200	24	100	NVD07SCD082 or TNR7V820K	20~25
BER-05 Built-in relay	Single-phase full-wave	50/60	100/200	24	25	Not required	02~10
BER-10 Built-in relay	Single-phase full-wave	50/60	100/200	24	50	Not required	12~16
BER-20 Built-in relay	Single-phase full-wave	50/60	100/200	24	100	Not required	20~25

※ *1 indicates the value when applying current to the brake coil.

※ *2 The protective device NVD□SCD□ is manufactured by KOA, and TNR□V□K is manufactured by Nippon Chemi-Con Corporation.

※ Refer to the section of power supply for more detail.

Accessories

The attached components of clutches and brakes are different depending on the model and type. Refer to the accessory list below. Besides, information in this document is subjected to change without notice.

Micro size

Model	Varistor		Screw ^{*1}		Shim	
	Model	Qty	Specification	Qty	Inside dia. x outside dia. x thickness	Qty
102-02-□1,□5	NVD07SCD082 or equivalent	1	—	—	No accessories	—
102/112-02-□3		1	M2×3	2		—
112-02-□1,□2		1	—	—		—
102-03-□1,□5		1	—	—		—
102/112-03-□3		1	M2.5×4	3		—
112-03-□1,□2		1	—	—		—
102-04-□1,□5		1	—	—		—
102/112-04-□3		1	M3×6	3		—
112-04-□1,□2		1	—	—		—
102-05-□1,□5		1	—	—		—
102/112-05-□3		1	Low-head bolt M3×6	3		—
			Disc spring washer for M3	3		—
112-05-□1,□2		1	—	—		—
CYT-025-□ ϕ 6		1	M2.5×4	3	6.3×8.7×0.1t	3
CYT-03-□ ϕ 6		1			6.3×8.7×0.1t	3
CYT-03-□ ϕ 8		1			8.3×11.7×0.1t	3
CYT-04-□ ϕ 8		1	M3×6	3	8.3×11.7×0.1t	3
CYT-04-□ ϕ 10		1			10.3×13.7×0.1t	3
CSZ/BSZ-05-□		1	—	—	No accessories	—

*1 For the size 05, a hexagon socket special bolt is attached. For other sizes, a cross-recessed pan head machine screw is attached.

Standard size

Model	Varistor		Screw		Shim		Color	
	Model	Qty	Specification	Qty	Inside dia. x outside dia. x thickness	Qty	Inside dia. x outside dia. x thickness	Qty
101/CS-06-□1	NVD07SCD082 or equivalent	1	—	—	—	—	—	—
101/CS-06-□3 ϕ 12		1	Low-head bolt M3×6 Disc spring washer for M3	each 3	12.3×15.7×0.1t	3	—	—
101-06-13 ϕ 15		1		each 3	15.3×20.7×0.1t	3	—	—
101/CS-06-□5 ϕ 12		1	—	—	12.3×15.7×0.1t	5	12.2×18×5.5	1
					12.3×15.7×0.5t	1		
111-06-11 ϕ 12,15		1	—	—	—	—	—	—
111-06-12 ϕ 12		1	—	—	12.3×15.7×0.1t	3	—	—
111-06-12 ϕ 15		1	—	—	15.3×20.7×0.1t	3	—	—
111-06-13		1	Low-head bolt M3×6 Disc spring washer for M3	each 3	—	—	—	—
CSZ/BSZ-06-□		1	—	—	—	—	—	—
101/CS-08-□1	NVD07SCD082 or equivalent	1	—	—	—	—	—	—
101/CS-08-□3 ϕ 15		1	Low-head bolt M4×8 Disc spring washer for M4	each 3	15.3×20.7×0.1t	3	—	—
101-08-13 ϕ 20		1		each 3	20.3×27.7×0.1t	3	—	—
101/CS-08-□5 ϕ 15		1	—	—	15.3×20.7×0.1t	5	15.2×22×5.5	1
					15.3×20.7×0.5t	1		
111-08-11 ϕ 15,20		1	—	—	—	—	—	—
111-08-12 ϕ 15		1	—	—	15.3×20.7×0.1t	3	—	—
111-08-12 ϕ 20		1	—	—	20.3×27.7×0.1t	3	—	—
111-08-13		1	Low-head bolt M4×8 Disc spring washer for M4	each 3	—	—	—	—
CSZ/BSZ-08-□		1	—	—	—	—	—	—

Standard size

Model	Varistor		Screw		Shim		Color	
	Model	Qty	Specification	Qty	Inside dia. x outside dia. x thickness	Qty	Inside dia. x outside dia. x thickness	Qty
101/CS-10-□1	NVD07SCD082 or equivalent	1	—	—	—	—	—	—
101/CS-10-□3 ϕ 20		1	Low-head bolt M5×10	each 3	20.3×27.7×0.1t	3	—	—
101-10-13 ϕ 25		1	Disc spring washer for M5	each 3	25.3×34.7×0.1t	3	—	—
101/CS-10-□5 ϕ 20		1	—	—	20.3×27.7×0.1t	5	20.2×28×5.9	1
111-10-11 ϕ 20,25		1	—	—	20.3×27.7×0.5t	2		
111-10-12 ϕ 20		1	—	—	20.3×27.7×0.1t	3	—	—
111-10-12 ϕ 25		1	—	—	25.3×34.7×0.1t	3	—	—
111-10-13		1	Low-head bolt M5×10 Disc spring washer for M5	each 3	—	—	—	—
101/CS-12-□1	NVD07SCD082 or equivalent	1	—	—	—	—	—	—
101-12-13 ϕ 25		1	Low-head bolt M6×10 Disc spring washer for M6	each 3	25.3×34.7×0.1t	3	—	—
101-12-13 ϕ 30		1		each 3	30.3×39.7×0.1t	3	—	—
CS-12-33 ϕ 25		1		each 3	25.3×31.7×0.1t	3	—	—
101/CS-12-□5 ϕ 25		1	—	—	25.3×31.7×0.1t	5	25.2×32×7.5	1
111-12-11 ϕ 25,30		1	—	—	25.3×31.7×0.5t	2		
111-12-12 ϕ 25		1	—	—	—	—	—	—
111-12-12 ϕ 30		1	—	—	25.3×31.7×0.1t	3	—	—
111-12-12 ϕ 30		1	—	—	30.3×39.7×0.1t	3	—	—
111-12-13		1	Low-head bolt M6×10 Disc spring washer for M6	each 3	—	—	—	—
101/CS-16-□1	NVD07SCD082 or equivalent	1	—	—	—	—	—	—
101-16-13 ϕ 30		1	Low-head bolt M8×15 Disc spring washer for M8	each 3	30.3×41.7×0.1t	3	—	—
101-16-13 ϕ 40		1		each 3	40.3×51.7×0.1t	3	—	—
CS-16-33 ϕ 30		1		each 3	30.3×39.7×0.1t	3	—	—
101/CS-16-□5 ϕ 30		1	—	—	30.3×39.7×0.1t	5	30.2×40×11.2	1
111-16-11 ϕ 30,40		1	—	—	30.3×39.7×0.5t	2		
111-16-12 ϕ 30		1	—	—	—	—	—	—
111-16-12 ϕ 30		1	—	—	30.3×39.7×0.1t	3	—	—
111-16-12 ϕ 40		1	—	—	40.3×51.7×0.1t	3	—	—
111-16-13		1	Low-head bolt M8×15 Disc spring washer for M8	each 3	—	—	—	—
101-20-11	NVD07SCD082 or equivalent	1	—	—	—	—	—	—
101-20-13 ϕ 40		1	Low-head bolt M10×18 Disc spring washer for M10	each 3	40.3×51.7×0.1t	3	—	—
101-20-13 ϕ 50		1		each 3	50.3×67.7×0.1t	3	—	—
CS-20-33 ϕ 40		1		each 3	40.3×51.7×0.1t	5	—	—
101-20-15 ϕ 40		1	—	—	40.3×51.7×0.1t	5	40.2×50×11.7	1
111-20-11 ϕ 40,50		1	—	—	40.3×51.7×0.5t	2		
111-20-12 ϕ 40		1	—	—	—	—	—	—
111-20-12 ϕ 40		1	—	—	40.3×51.7×0.1t	3	—	—
111-20-12 ϕ 50		1	—	—	50.3×67.7×0.1t	3	—	—
111-20-13		1	Low-head bolt M10×18 Disc spring washer for M10	each 3	—	—	—	—
101-25-11	NVD07SCD082 or equivalent	1	—	—	—	—	—	—
101-25-13 ϕ 50		1	Low-head bolt M12×22 Disc spring washer for M12	each 4	50.3×67.7×0.1t	3	—	—
101-25-13 ϕ 60		1		each 4	60.3×84.7×0.1t	3	—	—
CS-25-33 ϕ 50		1		each 4	50.3×67.7×0.1t	5	—	—
101-25-15 ϕ 50		1	—	—	50.3×61.7×0.1t	5	50.2×60×12.2	1
111-25-11 ϕ 50,60		1	—	—	50.3×61.7×0.5t	2		
111-25-12 ϕ 50		1	—	—	—	—	—	—
111-25-12 ϕ 50		1	—	—	50.3×67.7×0.1t	3	—	—
111-25-12 ϕ 60		1	—	—	60.3×84.7×0.1t	3	—	—
111-25-13		1	Low-head bolt M12×22 Disc spring washer for M12	each 4	—	—	—	—

Selection

Points for selection

Due to the high controllability, clutches and brakes are used not only for on-off control but also complex operation. If the size is determined simply by its torque, an unexpected trouble may occur. When selecting the size, a careful examination from several points of view such as load characteristic or layout of the mechanism where the clutch and brake is assembled is required. This section describes the situational selection methods, calculation examples and required information.

1 Motor and clutch & brake

① Relationship between motor output and torque

Motor HP is indicated by output, but it is indicated by torque in clutches and brakes. The following relationship is formed between the torque and motor output.

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

P: Motor HP [kW]

n_r : RPM of the clutch and brake shaft [min^{-1}]

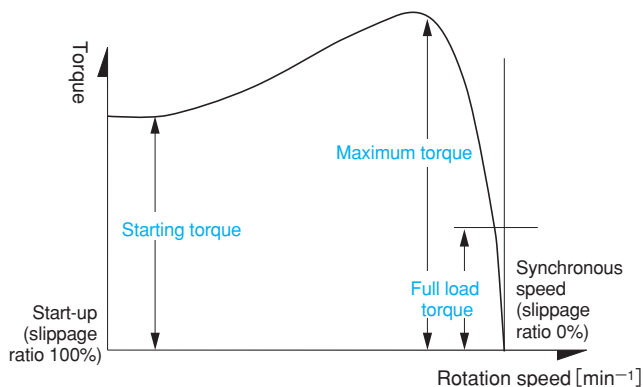
η : Transmission efficiency from the motor to clutch and brake

② Difference of characteristic

Motor and clutch & brake have different characteristics. Therefore, if a motor is used as a drive source and the start-and-stop control of load is performed by a clutch and brake, the selection must be done in consideration of respective characteristics.

A) Motor characteristics

A motor can generate over 200% of the full-load torque at start-up. After passing through the maximum torque while accelerating, it drives the load near the full-load torque until stable operation can be obtained. When the load increases while running the motor RPM will be reduced, the motor momentum will continue to drive the load and the motor will generate additional torque. The following diagram indicates the relationship between motor torque and rotating velocity characteristic.



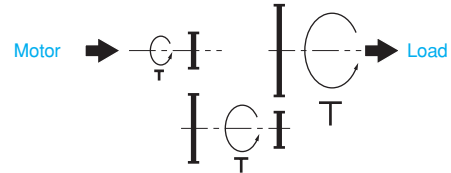
B) Clutch and brake characteristics

As described in the section of torque characteristics, the upper limit of coupling and braking torque is determined, and if more of the load torque is applied, it slips on the friction surface. An appropriate selection can be performed by confirming the difference of characteristic in advance. For a wide range of application, a clutch and brake with a torque value of 200~250% of the full load torque of the motor is recommended.

2 Relationship between torque and RPM

① Difference of characteristic

The shaft in the machine with a high RPM can be rotated by a small force, but the decelerated low-speed shaft needs a large force to rotate. That is, torque is inverse proportion to RPM. This is very important in selecting a clutch and brake. The size or operating life changes depending on the RPM of the shaft.



② Combination with a speed changer

Like a non-stage speed changer, when a clutch and brake is used in the mechanism that can change the RPM, the torque requirement during low speed and the responsiveness and operating life requirement during high speed must be considered in advance.

3 Understanding of load characteristics

The coupling time or wear life of clutch and brake varies depending on the coupling and braking load characteristics. Therefore, to understand the load characteristics is important to maintain a consistent operation. However, the load characteristics vary in definition and a complete understanding is difficult. As it is now, the size is often determined from an experimental point of view.

① Importance of safety factor

When the size of clutch and brake is determined, the required torque is evaluated by multiplying the factor empirically. If the driving part is already set, use the factor K empirically depending on the motor to be used. When the factor is too small, it could cause trouble such as slippage when worsening of the condition. Conversely, if the factor is too big, the motor load increases. An excessive load may lead to motor problems.

	Motor turbine	Gasoline engine	Diesel engine (1~2 cylinder gasoline engine)
K	2~2.5	2.5~2.8	2.8~3.4

② Load torque and moment of inertia

In load torque, there are resistance forces in machine and resistance forces added after coupling (such as cutting resistance). Since load torque is difficult to evaluate the size selection is sometimes calculated incorrectly, this may cause torque insufficiency in the case of clutch. The selection must be done with due caution. Moment of inertia is also called flywheel effect, which indicates the amount of power required to stop or start a rotating object. Overload of clutch and brake can be prevented by reducing the load on the clutch as much as possible. In the design phase apply a measurably larger load for brake. In addition this will minimize the inertia moment and improve responsiveness and operating life. Be sure include the inertia of clutch and brake in your inertia calculations.

Selection

Simplified selection graph

This selection graph is applied to a relatively light load and low frequency and when a motor is used as a drive source. The size of clutch and brake can be determined by a simplified way if the motor to be used is set appropriately to the load condition, and when there is no complicated mechanism or large inertial system to help the drive between the motor and clutch and brake. The safety factor K is 2.5 in this graph.

If other factors are required, use the value evaluated by multiplying the motor output by K/2.5 as kW of the vertical axis.

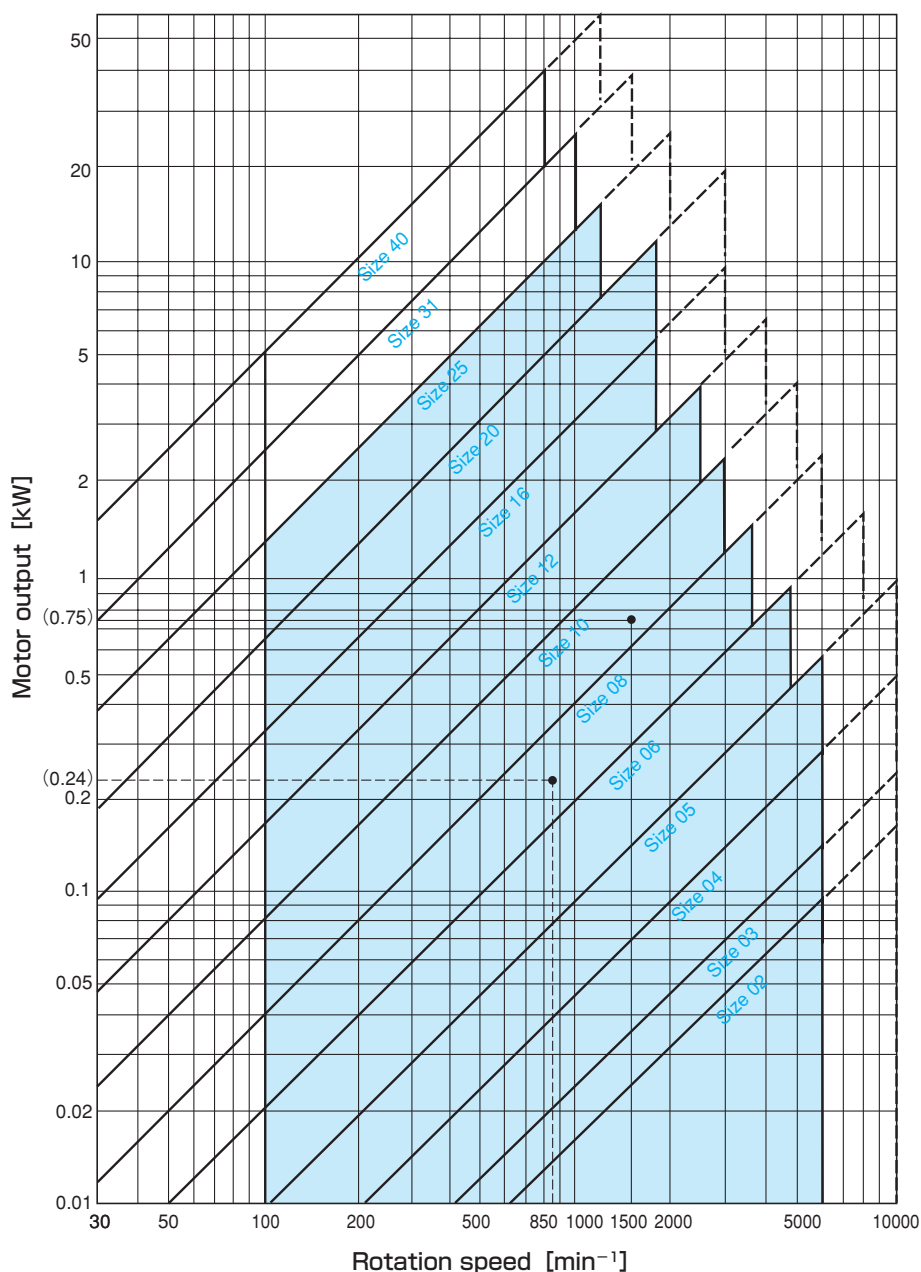
[Selection Example]

qWhen the motor output is 0.75 kW and the clutch and brake rotating velocity is 1500min⁻¹, select the size 10 where the intersecting point is.

wWhen the motor output is 1.4kW, the clutch and brake rotating velocity is 850min⁻¹, and the safety factor is 1.5,

$$0.4 \text{ [kW]} \times \frac{1.5}{2.5} = 0.24 \text{ [kW]}$$

evaluate the value as below. The point at intersection of 0.24 of the vertical axis and 850min⁻¹ is in the range of the size 08.



* Perform the selection within the range. If the intersecting point is in the dashed line, the amount of work, heat dissipation or wear could become below the specified level.

For the heavy-line frame of below 100min⁻¹, confirm the required torque by the formula.

*For the size 31 and 40, contact us for further information.

● Study of torque

1 Full load torque of motor (T_M)

The full load torque converted to the clutch and brake mounting shaft is;

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

P: Motor output [kW]

n_r : Rotating velocity of the clutch and brake shaft [min^{-1}]

η : Transmission efficiency from the motor to clutch and brake

2 Load torque (T_L)

Load torque is difficult to evaluate by a formula. Therefore, the value is estimated empirically or evaluated by measuring directly.

① Determine form the motor capacity

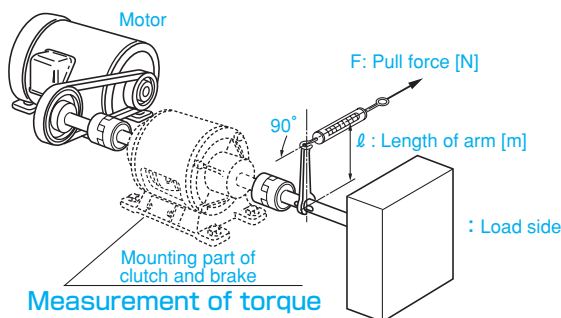
Assume that the motor is correctly selected for the load condition. Use the evaluated value T_M of ① as its load torque.

$$T_L = T_M \quad [\text{N} \cdot \text{m}] \quad \text{②}$$

② In a case of direct measurement

A correct T_L can be determined by actual measurement of load. For the measurement, use a torque wrench or rotate the shaft to mount the clutch and brake, and evaluate the product of F (force when the load starts to rotate) and ℓ (length of the arm).

$$T_L = \ell \cdot F \quad [\text{N} \cdot \text{m}] \quad \text{③}$$



③ Load torque sign

In the formula, the load torque is indicated by a plus-minus (+/-) sign. In a case of clutch, the load torque works on the direction of counteracting the rotation so that it is subtracted from the clutch torque T_a . In a case of brake, the load torque works on the direction of enhancing the braking so that it is added to the brake torque T_a . (It is relatively rare, but it may work the other way. In such a case, change the sign to calculate.) In the formula, it is indicated as $\pm T_L$.

3 Acceleration/deceleration torque (T_a)

① The required torque to accelerate the load is;

$$T_a = \frac{J \cdot n_r}{9.55 t_{ae}} \quad [\text{N} \cdot \text{m}] \quad \text{④}$$

t_{ae} : Actual coupling time of clutch (Acceleration time) [s]

J: Total amount of inertia moment coupled by clutch [$\text{kg} \cdot \text{m}^2$]

② The required torque to decelerate the load is;

$$T_a = \frac{J \cdot n_r}{9.55 t_{ab}} \quad [\text{N} \cdot \text{m}] \quad \text{⑤}$$

t_{ab} : Actual braking time of brake (Deceleration time) [s]

J: Total amount of inertia moment decelerated by brake [$\text{kg} \cdot \text{m}^2$]

4 Required torque (T)

The required torque to drive (brake) the load by condition is as follows.

① When J and T_L are applied when coupled

$$T = (T_a \pm T_L) K \quad [\text{N} \cdot \text{m}] \quad \text{⑥}$$

K is a factor by load condition. Refer to the table below and select the value empirically. In a case of clutch, the load torque works on the direction of counteracting the drive so that T_L is plus (+). In a case of brake, the load torque works on the direction of enhancing the braking so that T_L is minus (-).

② When T_L is mostly applied

$$T = T_L \cdot K \quad [\text{N} \cdot \text{m}] \quad \text{⑦}$$

③ When J is mostly applied

$$T = T_a \cdot K \quad [\text{N} \cdot \text{m}] \quad \text{⑧}$$

④ In a case of static coupling

If the clutch is coupled during stationary state and the load is accelerated by a motor, the required torque to prevent a slip of clutch during acceleration is;

$$T = \left\{ \frac{J_L}{J_d + J_L} (T_M - T_L) + T_L \right\} K \quad [\text{N} \cdot \text{m}] \quad \text{⑨}$$

J_d : Total amount of J on the driving side from the clutch [$\text{kg} \cdot \text{m}^2$]

J_L : Total amount of J on the loading side from the clutch [$\text{kg} \cdot \text{m}^2$]

Safety factor by load condition: K

Use condition		Factor K
Light load	Low-frequency use of a small inertial body	1.5
	High-frequency use of a relatively small inertial body	2~2.2
	General use of a standard inertial body	
	High-frequency use	
Standard load	Low-frequency use of a small inertial body	2~2.4
	General use of a standard inertial body	2.4~2.6
	Drive a large inertial body	2.7~3.2
	Operation that involved impact (Large load fluctuations)	3.5~4.5

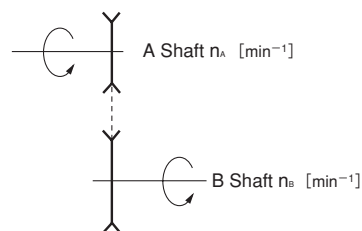
5 Conversion of torque to the other shaft

To convert the torque of B shaft to the A shaft

$$T_A = T_B \cdot \frac{n_B}{n_A} \quad [\text{N} \cdot \text{m}] \quad \text{⑩}$$

T_A : Torque of A shaft, T_B : torque of B shaft

n_A : Rotation speed of A shaft, n_B : Rotation speed of B shaft



● Study of work

1 Coupling or braking work (E_e , E_b)

The work volume of single coupling or braking by clutch and brake is;

① During acceleration, the coupling work E_e is;

$$E_e = \frac{J \cdot n_r^2}{182} \cdot \frac{T_d}{T_d - T_\ell} \quad [\text{J}] \quad \dots\dots\dots (11)$$

② During deceleration, the braking work E_b is;

$$E_b = \frac{J \cdot n_r^2}{182} \cdot \frac{T_d}{T_d + T_\ell} \quad [\text{J}] \quad \dots\dots\dots (12)$$

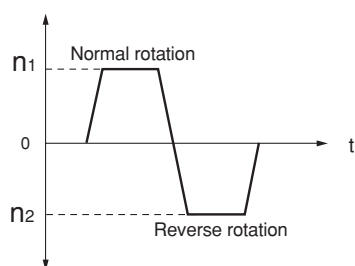
③ Normal/Reverse rotation

The clutch coupling work when the rotational direction is switched by clutch is;

$$E_e = \frac{J}{182} \left\{ (n_1^2 + 2 \cdot n_1 \cdot n_2) \frac{T_d}{T_d + T_\ell} + n_2^2 \frac{T_d}{T_d - T_\ell} \right\} [\text{J}] \quad \dots\dots\dots (13)$$

n_1 : Normal rotation velocity [min^{-1}]

n_2 : Reverse rotation velocity [min^{-1}]



④ Work during slip

$$E_e = \frac{2\pi}{60} \cdot n \cdot t \cdot T_d \quad [\text{J}] \quad \dots\dots\dots (14)$$

$$E_b = \frac{2\pi}{60} \cdot n \cdot t \cdot T_d \quad [\text{J}] \quad \dots\dots\dots (15)$$

t : Slipping time [s]

n : Rotating velocity to slip [min^{-1}]

T_d : Dynamic torque at n [min^{-1}] [$\text{N} \cdot \text{m}$]

When clutch and brake is used while slipping, an undesirable condition such as heat generation may occur.

⑤ Allowable work

The allowable work $E_{ea\ell}$ and $E_{ba\ell}$ are the values under and ideal condition that the values of E_e and E_b must be sufficiently smaller than them.

$$E_e \ll E_{ea\ell} \quad \dots\dots\dots (16)$$

$$E_b \ll E_{ba\ell} \quad \dots\dots\dots (17)$$

* For the values of $E_{ea\ell}$ and $E_{ba\ell}$, refer to the page of heat dissipation characteristics.

2 Work rate

A clutch and brake repeats an on-off operation with a high frequency that examination of capability of heat dissipation is important.

① Coupling work rate (P_e)

$$P_e = \frac{E_e \cdot S}{60} \ll P_{ea\ell} \quad [\text{W}] \quad \dots\dots\dots (18)$$

② Braking work rate (P_b)

$$P_b = \frac{E_b \cdot S}{60} \ll P_{ba\ell} \quad [\text{W}] \quad \dots\dots\dots (19)$$

S : Operation frequency [operations/min]

The allowable work rate $P_{ea\ell}$ and $P_{ba\ell}$ are the values under an ideal condition. Therefore, determine E_e and E_b and S in order that they become sufficiently smaller than them.

* For the values of $E_{ea\ell}$ and $E_{ba\ell}$, refer to the page of heat dissipation characteristics.

3 Coupling/braking frequency (S_a)

The allowable operation frequency determined by heat dissipation S_a is;

$$S_a \ll \frac{60 P_{ea\ell}}{E_e} \quad [\text{operation/min}] \quad \dots\dots\dots (20)$$

$$S_a \ll \frac{60 P_{ba\ell}}{E_b} \quad [\text{operation/min}] \quad \dots\dots\dots (21)$$

This allowable frequency is determined only by heat dissipation. For actual use, consider the operating time also.

● Study of operating time

1 Total coupling and total braking time (t_{te} , t_{tb})

The coupling and braking time of load by clutch and brake is the sum of the clutch and brake operating time itself and the accelerating and decelerating time of load.

① Total coupling time

$$t_{te} = t_{td} + t_a + t_{ae} \quad [\text{s}] \quad \dots\dots\dots (22)$$

t_{td} : Initial lagging time

t_a : Armature suction time [s]

T_{ab} : Clutch actual coupling time (Acceleration time) [s]

② Total braking time

$$t_{tb} = t_{td} + t_a + t_{ab} \quad [\text{s}] \quad \dots\dots\dots (23)$$

t_{td} : Initial lagging time

t_a : Armature suction time [s]

T_{ab} : Brake actual braking time [s]

T_{ae} and t_{ab} are evaluated by the formulas below by the condition.

③ During acceleration/deceleration

Actual coupling time is;

$$t_{ae} = \frac{J \cdot n_r}{9.55 (T_d - T_\ell)} \quad [\text{s}] \quad \dots\dots\dots (24)$$

Actual braking time is;

$$t_{ab} = \frac{J \cdot n_r}{9.55 (T_d + T_\ell)} \quad [\text{s}] \quad \dots\dots\dots (25)$$

④ During normal rotation

The actual coupling time (acceleration time) when switched the normal rotation into reverse rotation is;

$$t_{ae} = \frac{J}{9.55} \left(\frac{n_1}{T_d + T_\ell} + \frac{n_2}{T_d - T_\ell} \right) \quad [\text{s}] \quad \dots\dots\dots (26)$$

n_1 : Normal rotation velocity [min^{-1}]

n_2 : Reverse rotation velocity [min^{-1}]

2 The coupling/braking time when the coupling/braking is completed in the process of torque rise

In this case, the coupling/braking time is the sum of the armature suction time t_a and t_{ae} or t_a and t_{ab} .

① Total coupling time

$$t_{te} = t_{td} + t_a + t_{ae} \text{ [s]} \quad (27)$$

$$t_{ae}' = \sqrt{\frac{J \cdot n_r}{4.77} \cdot \frac{t_{ap}}{0.8 \cdot T_d}} \text{ [s]} \quad (28)$$

② Total braking time

$$t_{tb} = t_{td} + t_a + t_{ab}' \text{ [s]} \quad (29)$$

$$t_{ab}' = \sqrt{\frac{J \cdot n_r}{4.77} \cdot \frac{t_{ap}}{0.8 \cdot T_d}} \text{ [s]} \quad (30)$$

They are applied in the case of $T_L = 0$. Generally, the above formulas are used when the load torque (T_L) is small in full measure. Besides, if the calculated value becomes $t_{ae} > t_{ap}$, $t_{ab} > t_{ap}$, apply the formula (22) ~ (26).

● Study of operation number

The available amount of work of clutch and brake before air gap adjustment is determined. If more volume is required, the space adjustment is necessary.

The operable number before space adjustment is;

① In a case of clutch

$$L_e = \frac{E_T}{E_e} [\text{operation}] \quad (31)$$

E_T : Total amount of work before space readjustment [J]

② In a case of brake

$$L_b = \frac{E_T}{E_b} [\text{operation}] \quad (32)$$

● Study of stopping accuracy

To evaluate the stopping accuracy by a formula is difficult since the friction work or control system variation is involved. Generally, it is evaluated empirically by the formula below to use as a measure.

① Stopping angle (θ)

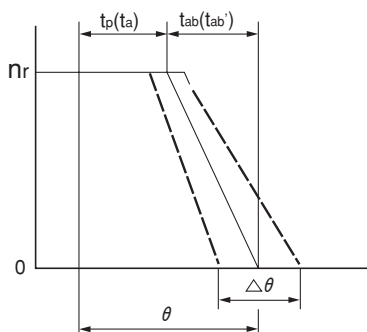
$$\theta = 6n_r \left(t_{td} + t_p + \frac{1}{2} t_{ab} \right) [^\circ] \quad (33)$$

$$\text{OR } \theta = 6n_r \left(t_{td} + t_a + \frac{2}{3} t_{ab}' \right) [^\circ] \quad (34)$$

② Stopping accuracy ($\Delta\theta$)

$$\Delta\theta = \pm 0.15\theta [^\circ] \quad (35)$$

If there is a factor to disturb the braking effect such as load fluctuation, change the constant of the formula (35) to 0.2 ~ 0.25. The system delay or variation caused by a backlash of chain or gear is not included in the stopping angle and accuracy.



Total amount of work before air gap readjustment E_T

Micro electromagnetic clutch and brake
102•112 model

Size	Total amount of work E_T [J]
02	2×10^6
03	3×10^6
04	6×10^6
05	9×10^6

CYT model

Size	Total amount of work E_T [J]
025	1×10^6
03	1.5×10^6
04	2×10^6

Micro electromagnetic clutch and brake (unit)
101•CS•111 model*

Size	Total amount of work E_T [J]
06	36×10^6
08	60×10^6
10	130×10^6
12	250×10^6
16	470×10^6
20	10×10^8
25	20×10^8

* Applicable to each model of the unit (except 180 model)

CSZ • BSZ model

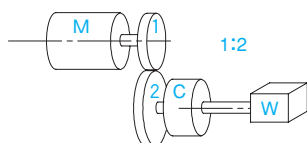
Size	Total amount of work E_T [J]
05	9×10^6
06	29×10^6
08	60×10^6

180 model

Size	Total amount of work E_T [J]
06	24×10^6
08	40×10^6
10	62×10^6
12	154×10^6
16	250×10^6

● Selection Example 1

Clutch used for a continued operation of load



The selection of clutches used for a continued operation of load as above figure is performed as follows.

Use conditions

Used motor output	P	0.4kW (Standard three-phase, 4P)
Clutch operation frequency	S	20 [operations/min]
Load moment of inertia	J_A	0.0208 [$\text{kg} \cdot \text{m}^2$]
Load torque	T_ℓ	Unknown [$\text{N} \cdot \text{m}$]
Rotating velocity of the clutch mounting shaft	n	750 [min^{-1}]
Transmission efficiency	η	90%

1 Study of torque

By the above use conditions, evaluate the torque required for coupling. Evaluate the load torque first. Assume that the motor is correctly selected. By the formula ①, the load torque T_x is;

$$T_\ell = \frac{9550 \times 0.4}{750} \times 0.9 = 4.58 \text{ [N} \cdot \text{m]}$$

Form the formula ④, the acceleration torque is;

$$T_a = \frac{0.0208 \times 750}{9.55 \times 0.5} = 3.27 \text{ [N} \cdot \text{m]}$$

The acceleration torque is given as a condition, but in the above formula, it is estimated from the operation frequency as $t_{ae} = 0.5$ [s]. Therefore, by the formula ⑥, the required torque is;

$$T = (4.58 + 3.27) \times 2 = 15.7 \text{ [N} \cdot \text{m]}$$

The sign of the load torque T_ℓ is plus (+). The factor K by load condition is empirically determined as $K = 2$ for general use of standard load. According to the above information, select the clutch size 10 (torque 20N · m) that has more than the required torque 15.7 [N · m].

2 Study of work

Determine the model and evaluate the total load moment of inertia by the self-moment of inertia J and load moment of inertia of the model. In the case of model 101-10-13, the rotating part moment of inertia J is 0.00678 [$\text{kg} \cdot \text{m}^2$].

Therefore, the total moment of inertia J is;

$$J_T' = 0.0208 + 0.000678 = 0.02148 \text{ [kg} \cdot \text{m}^2]$$

By the formula ⑪, evaluate the single coupling work E_e .

$$E_e = \frac{0.02148 \times 750^2}{182} \times \frac{20}{(20 - 4.58)} = 86.1 \text{ [J]}$$

The sign of the load torque T_ℓ is minus (-). The coupling work E_e is smaller than the allowable work $E_{ea\ell}$ in full measure.

$$E_e \ll E_{ea\ell}$$

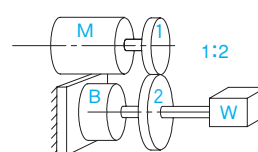
Then, evaluate the work rate by the formula ⑬.

$$P_e = \frac{86.1 \times 20}{60} = 28.7 \text{ [W]}$$

This value is smaller than the allowable work rate $P_{ea\ell}$ in full measure, which means that the clutch corresponds to the use condition, therefore select the model 101-10-13.

● Selection Example 2

Brake to stop the inertia when turning off a motor



The selection of clutches to stop the inertia when turning off a motor as above figure is performed as follows.

Use conditions

Used motor output	P	0.75kW (Standard three-phase, 4P)
Motor rotating velocity	n_1	1800 [min^{-1}]
Motor moment of inertia	J_M	0.00205 [$\text{kg} \cdot \text{m}^2$]
V-belt pulley (motor side) moment of inertia	J_1	0.00075 [$\text{kg} \cdot \text{m}^2$]
V-belt pulley (brake side) moment of inertia	J_2	0.00243 [$\text{kg} \cdot \text{m}^2$]
Load moment of inertia	J_A	0.05 [$\text{kg} \cdot \text{m}^2$]
Load torque	T_ℓ	5.0 [$\text{N} \cdot \text{m}$]
Rotating velocity of the brake mounting shaft	n	900 [min^{-1}]
Stop time	t	Within 0.5 [s]

1 Study of torque

By the above use conditions, evaluate the total moment of inertia of the brake shaft conversion.

$$J_T' = \left(\frac{1800}{900} \right)^2 \times (0.00205 + 0.00075) + 0.00243 + 0.05 = 0.06363 \text{ [kg} \cdot \text{m}^2]$$

Evaluate the deceleration torque. Since the operating time of the brake itself is included in the deceleration time, calculate as 1/2 of the given stop time.

By the formula ⑤

$$T_a = \frac{0.06363 \times 900}{9.55 \times 0.25} = 24.0 \text{ [N} \cdot \text{m]}$$

By the formula ⑥, the required torque is;

$$T = (24.0 - 5.0) \times 2.4 = 45.6 \text{ [N} \cdot \text{m]}$$

The sign of the load torque T_ℓ is minus (-). The factor K by load condition is determined empirically as $K = 2.4$ for general use of standard load. By the above information, temporally select the brake size 12 (torque 40N · m) that has brake torque equivalent to the required torque 45.6 [N · m].

2 Study of work

Determine the model and evaluate the total load moment of inertia by the self-moment of inertia J and load moment of inertia. In the case of model 111-12-11, the moment of inertia of the armature is 0.00181 [$\text{kg} \cdot \text{m}^2$].

Therefore, the total moment of inertia J_T' is;

$$J_T' = 0.06363 + 0.00181 = 0.06544 \text{ [kg} \cdot \text{m}^2]$$

By the formula ⑫, evaluate the single braking work E_b .

$$E_b = \frac{0.06544 \times 900^2}{182} \times \frac{40}{(40 + 5)} = 258.9 \text{ [J]}$$

The sign of the load torque T_ℓ is plus (+). The braking work E_b is smaller than the allowable work $E_{bea\ell}$ in full measure.

$$E_b \ll E_{bea\ell}$$

3 Study of operating time

By the formula ②⑤, evaluate the braking time.

$$t_{ab} = \frac{0.06544 \times 900}{9.55 \times (40+5)} = 0.137 \text{ [s]}$$

The sign of the load torque T_L is plus (+). And the armature suction time of the size 12 is 0.027 [s] by the specification table. And the initial lagging time is 0.05 [s].

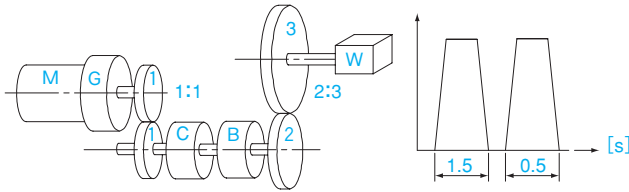
By the formula ②③,

$$t_{tb} = 0.05 + 0.027 + 0.137 = 0.214 \text{ [s]}$$

This value meets the requirement of below 0.5 [s], which means that the brake corresponds to the use conditions, therefore select the model 111-12-11.

● Selection Example 3

Clutch and brake to drive a load



The selection of clutches and brakes to drive a load as above figure is performed as follows.

Use conditions

Operation frequency	S	30 [operation/min]
Required operating life number ^{*1}	L	810×10 ⁴ [operation] or more
V-belt pulley A moment of inertia	J ₁	0.00195 [kg·m ²]
V-belt pulley B moment of inertia	J ₂	0.01668 [kg·m ²]
Load moment of inertia	J _A	0.5075 [kg·m ²]
Load torque	T _L	22.0 [N·m]
Rotating velocity of the clutch and brake mounting shaft	n	150 [min ⁻¹]
Rotating velocity of the load shaft	n ₂	100 [min ⁻¹]
Coupling time	t ₁	Within 0.3 [s]
Stop time	t ₂	Within 0.3 [s]

^{*}1 When it is used 15 hours a day with no adjustment over a year, L= 30 x 60 min x 15 hours x 300 days= 8,100,000 times

1 Study of torque

By the above conditions, convert the load torque into the clutch and brake shaft. Form the formula ⑩,

$$T_L = 22.0 \times \frac{2}{3} = 14.7 \text{ [N·m]}$$

Convert all the inertia moment of rotating part into the clutch and brake shaft.

$$\begin{aligned}
 J_T &= J_1 + (J_2 + J_A) \times \left(\frac{2}{3}\right)^2 \\
 &= 0.00195 + (0.01668 + 0.5075) \times \left(\frac{2}{3}\right)^2 \\
 &= 0.2349 \text{ [kg·m}^2\text{]}
 \end{aligned}$$

Since the operating time of the clutch and brake is included in the acceleration time, calculate as 1/2 of the given coupling time 0.3 [s].

By the formula ④,

$$T_a = \frac{0.2349 \times 150}{9.55 \times 0.15} = 24.6 \text{ [N·m]}$$

By the formula ⑥, the required torque T is;

$$T = (24.5 \pm 14.7) \times K \text{ [N·m]}$$

When the factor K by load condition is determined empirically as K= 2 for general use of standard load, the clutch is;

$$T = (24.5 + 14.7) \times 2 = 78.4 \text{ [N·m]}$$

The brake is;

$$T = (24.5 - 14.7) \times 2 = 19.6 \text{ [N·m]}$$

According to the above information select the clutch size 16 (torque 80N·m) and the brake size 10 (torque 20N·m).

2 Study of work

Determine the model and evaluate the total load moment of inertia by the self-moment of inertia J and load moment of inertia of the model. In the case of clutch model 101-16-15, the rotating part moment of inertia J is 0.0063 [kg·m²]. And in the case of brake model 111-10-11, the armature moment of inertia is 0.000663 [kg·m²].

Therefore, the total moment of inertia J_T is;

$$J_T' = 0.2349 + 0.0063 + 0.000663 = 0.2419 \text{ [kg·m}^2\text{]}$$

By the formula ⑪, evaluate the single coupling work of clutch E_c.

$$E_c = \frac{0.2419 \times 150^2}{182} \times \frac{80}{(80 - 14.7)} = 36.6 \text{ [J]}$$

By the formula ⑫, evaluate the single braking work of brake E_b.

$$E_b = \frac{0.2419 \times 150^2}{182} \times \frac{20}{(20 + 14.7)} = 17.2 \text{ [J]}$$

This value meets the requirements for the allowable work and the amount of work per minute of the selected model.

3 Study of operation number

Evaluate the number of operations next. By the specification table for each model, the total work of the size 16 is (470×10⁶) [J], and for the size 10 is (130×10⁶) [J]. Therefore, by the formula ③① and ③②, the clutch is;

$$L = \frac{470 \times 10^6}{36.6} = 1284 \times 10^4 \text{ [operations]}$$

The brake is;

$$L = \frac{130 \times 10^6}{17.2} = 756 \times 10^4 \text{ [operations]}$$

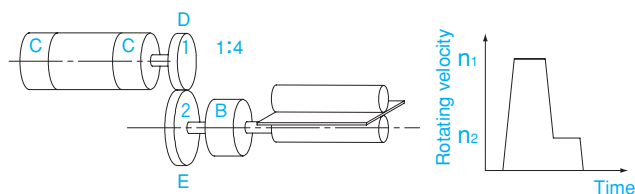
The required operating number is approximately 8,100,000 that the size 10 can't meet the requirement. When changing the model to 111-12-11 for a review, it becomes as below and meets the requirement. (The calculation process is omitted.)

$$L = \frac{250 \times 10^6}{22.0} = 1136 \times 10^4 \text{ [operations]}$$

Therefore, the appropriate clutch model is 101-16-15 and brake model is 111-12-11 for this example.

● Selection example 4

Clutch and brake used for two-stage speed change single-stop mechanism



The selection that includes the stopping accuracy of the clutch and brake to drive a load is performed as follows.

Use conditions

Maximum input rotating velocity	n_1	1500 [min ⁻¹]
Minimum input rotating velocity	n_2	200 [min ⁻¹]
Roll shaft rotating velocity	n_3	50 [min ⁻¹]
Operation frequency	S	12 [operations/min]
Required operating life number ^{*1}	L	130×10 ⁴ [operation] or more
Pulley D moment of inertia	J_1	0.000025 [kg·m ²]
Pulley E moment of inertia	J_2	0.005375 [kg·m ²]
Roll moment of inertia	J_A	0.0133 [kg·m ²]
Roll load torque	T_ℓ	8.0 [N·m]
Roll diameter	R	60 [mm]

※ *1 When it is used 6 hours a day with no adjustment over a year, L= 12 x 60 min x 300 days= 1,300,000 times

1 Study of brake

① Study of work

By the above conditions, evaluate the total moment of inertia for conversion of the feed roll shaft. Assuming that the inertia of rotating part of the clutch brake unit type 121-08-10 is 0.000475 [kg·m²], and the armature inertia moment of the brake model 111-12-12 is 0.00181 [kg·m²],

$$J_T = 0.0133 \times 2 + 0.00181 + 0.005375 + (0.000025 + 0.000475) \times \left(\frac{4}{1}\right)^2 = 0.04179 \text{ [kg} \cdot \text{m}^2\text{]}$$

By the formula ⑫, evaluate the single braking work E_b .

$$E_b = \frac{0.04179 \times 50^2}{182} \times \frac{40}{(40+8)} = 0.48 \text{ [J]}$$

The sign of the load torque T_ℓ is Plus (+). This value meets the requirements for the allowable work and the amount of work per minute of the selected model.

② Study of operation number

Evaluate the number of operations next. The total work of the size 12 is (250×10⁶) [J] that by the formula ⑳,

$$L = \frac{250 \times 10^6}{0.48} = 52083 \times 10^4 \text{ [operations]}$$

This value meets the requirement in full measure.

③ Study of operating time

Evaluate the braking time. Either the formula ㉕ or ㉙ is applied. In this case, apply the formula ㉙ to shorten the braking time. Assume that the torque increment time t_{ap} is 0.063 [s].

By the formula ㉙, the braking time $t_{ab'}$ is;

$$t_{ab'} = \sqrt{\frac{0.04179 \times 50}{4.77} \times \frac{0.063}{(0.8 \times 40)}} = 0.0294 \text{ [s]}$$

④ Study of stopping accuracy

Initial lagging time is 0.05 [s].

By the formula ㉚, the stopping angle is;

$$\theta = 6 \times 50 \times \left(0.05 + 0.027 + \frac{2}{3 \times 0.0294}\right) = 28.98 \text{ [°]}$$

Form the formula ㉛, the stopping accuracy is;

$$\Delta \theta = \pm 0.15 \times 28.98 = \pm 4.35 \text{ [°]}$$

When converting the roll diameter to the circumferential length, it becomes ±1.1 [mm].

2 Study of clutch

① Study of work

By the above conditions, evaluate the total moment of inertia converted to the clutch shaft.

$$J_T' = 0.000475 + 0.000025 + (0.00181 + 0.0133 \times 2 + 0.005375) \times \left(\frac{1}{4}\right)^2 = 0.0026 \text{ [kg} \cdot \text{m}^2\text{]}$$

By using the formula ⑩, convert the load torque to the clutch shaft.

$$T_\ell = 8.0 \times \frac{1}{4} = 2.0 \text{ [N} \cdot \text{m]}$$

By the formula ⑪, the single coupling work E_e of the high-speed side clutch is;

$$E_e = \frac{0.0026 \times 1500^2}{182} \times \frac{10}{(10-2)} = 40.2 \text{ [J]}$$

This value meets the requirement for the allowable work of the selected model. Evaluate the coupling work rate P_e next. By the formula ⑱,

$$P_e = \frac{40.2 \times 12}{60} = 8.04 \text{ [W]}$$

This value is smaller than the allowable work rate P_ℓ in full measure.

② Study of operation number

Evaluate the number of operations by the formula ㉑.

$$L = \frac{60 \times 10^6}{40.2} = 149 \times 10^4 \text{ [operations]}$$

The number of operations in one year is about 1,300,000, which satisfies the requirement.

By the formula ⑫, the single coupling work E_e of the low-speed side clutch is;

$$E_e = \frac{0.0026 \times (1500 - 200)^2}{182} \times \frac{10}{(10+2)} = 20.1 \text{ [J]}$$

This clutch decelerates the load from 1500 [min⁻¹] to 200 [min⁻¹], which is similar actions as brake. Therefore, the sign of the load torque is Plus (+).

Also, it is clear that the value meets the requirements of operating life number since it is smaller than the high-speed side clutch.

By the above information, both clutch and brake meet the requirements.