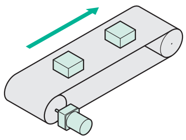
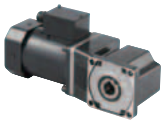
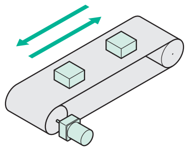
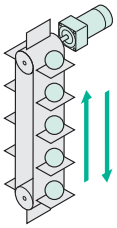
Standard AC Motors

Constant Speed Motors

Features and Types of Constant Speed Motors

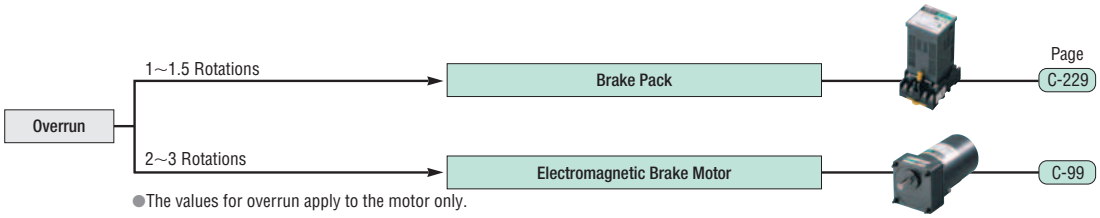
Constant speed motors come in various types as shown below. Select from a wide range of products depending on the application, required functions, output, etc.

Types	Features	Series		□60	□70	□80	□90			□104
			Frame Size (mm), Output Power	6 W	15 W	25 W	40 W	60 W	90 W	200 W
Induction Motors Page C-19	Suitable for applications where the motor is operated continuously in one direction. 	World **K** Series Conforms to safety standards and supports global power supply voltages to allow operation in many countries around the world. 		●	●	●	●	●	●	
			IP65 Terminal Box Type	●	●	●	●			
			2-Pole, High-Speed Type			● 40 W, 60 W		● 60 W, 90 W, 150 W		
		V Series Adopted High-Strength, Long Life, Low Noise gearheads. They also conform to major safety standards and support global power supply voltages. 		●	●	●	●	●	●	
		BH Series The **BH** Series achieves a high-output power of 200 W with a frame size of 104 mm. Conforms to safety standards and supports global power supply voltages. 								●
Reversible Motors Page C-73	Suitable for applications where the motor must frequently switch direction. 	World **K** Series Conforms to safety standards and supports global power supply voltages to allow operation in many countries around the world. 		●	●	●	●	●	●	
		V Series Adopted High-Strength, Long Life, Low Noise gearheads. They also conform to major safety standards and support global power supply voltages. 		●	●	●	●	●	●	

Types	Features	Series \ Frame Size (mm), Output Power	□60	□70	□80	□90			□104
			6 W	15 W	25 W	40 W	60 W	90 W	200 W
Electromagnetic Brake Motors	Suitable for applications in which the load must be held. 	**World K Series**  Conforms to safety standards and supports global power supply voltages to allow operation in many countries around the world.	●	●	●	●	●	●	
		V Series  Adopted High-Strength, Long Life, Low Noise gearheads. They also conform to major safety standards and support global power supply voltages.	●	●	●	●	●	●	
		BH Series  The **BH** Series achieves a high-output power of 200 W with a frame size of 104 mm. Conforms to safety standards and supports global power supply voltages.							●
Page C-99									

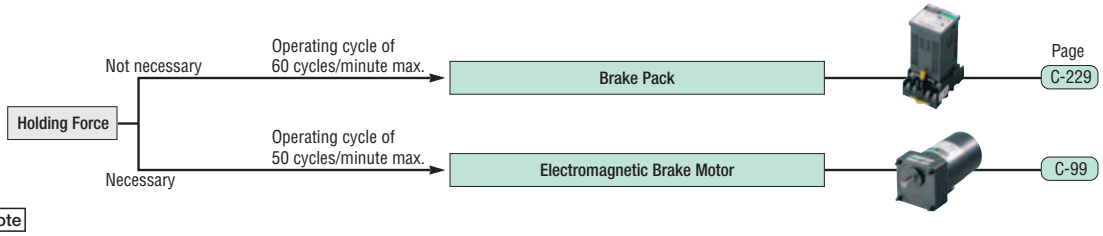
●How to Select a Brake Motor

◇Selecting Based on Stopping Accuracy



●The values for overrun apply to the motor only.

◇Selecting Based on Frequency of Use



Note

●The operating cycles are based merely on brake responsiveness. The value specified above is the maximum, so it may not be possible to repeat braking operation at this frequency. When actually using a motor, keep the surface temperature of the motor case at 90°C or less, considering a rise in motor temperature.

How to Read Specifications

When selecting a motor and gearhead, you should read the specifications to make sure that the motor you select meets the required specifications for your application.
Shown below is an explanation of how you should read the specifications on some important items.

How to Read Motor Specifications

Motor Specifications

Motor Specifications Table (Example)

Specifications – Continuous Rating ⑥

Product Name and Type Upper Product Name: Pinion Shaft Type Lower Product Name ( ): Round Shaft Type			① Output Power	Voltage	Frequency	② Current	③ Starting Torque	④ Rated Torque	⑤ Rated Speed	Capacitor
Lead Wire Type Dimensions ①	Terminal Box Type Dimensions ②	Terminal Box Type Dimensions ③	W	VAC	Hz	A	mN·m	mN·m	r/min	μF
TP **4IK25GN-CW2E** **(4IK25A-CW2E)**	TP **4IK25GN-CW2TE** **(4IK25A-CW2TE)**	–	25	Single-Phase 220	50	0.27	110	205	1200	1.5
					60	0.23		170	1450	
				Single-Phase 230	50	0.27	120	205	1200	
					60	0.23		170	1450	

①Output Power: The amount of work that can be performed in a given period of time by a motor. It can be used as a reference for motor capability.
②Current: The current value used by a motor when the motor is producing rated torque.
③Starting Torque: This term refers to the torque generated the instant a motor starts. If the motor is subjected to a frictional load smaller than this torque, it will start.
④Rated Torque: This is the torque generated when a motor is operating most efficiently. Although the maximum torque is far greater, the rated torque should be the highest torque from the standpoint of utility.
⑤Rated Speed: This is the speed of a motor when the motor is generating the rated torque.
⑥Rating: This is the time that a motor can operate continuously at rated output power (torque). With a continuous rating, a motor can operate continuously.

Electromagnetic Brake (Power off activated type)

Specifications Table (Example)

Motor Product Name	Voltage VAC	Frequency Hz	Current A	Input W	① Static Friction Torque mN·m
4RK25GN-CW2ME **4RK25A-CW2ME**	Single-Phase 220	60	0.05	7	100
	Single-Phase 230	50			
		60			

①Static Friction Torque: This refers to the static friction torque of an electromagnetic brake and express the amount of holding torque at the motor output shaft.

When a gearhead is attached, calculate the holding torque at the output shaft of the gearhead with the following formula.

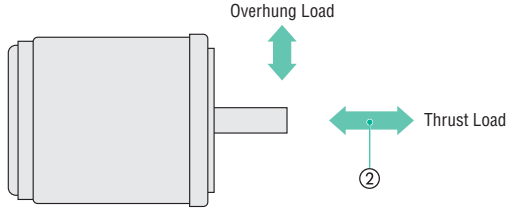
Holding torque at the gearhead output shaft $T_G = T_M \times i$

T_G : Holding torque at the gearhead output shaft
T_M : Holding torque at the motor output shaft
i : Gear ratio of gearhead

Permissible Overhung Load and Permissible Thrust Load of Motors

Specifications Table for Permissible Overhung Load (Example)

Motor			① Permissible Overhung Load N	
Frame Size □ (mm)	Output Shaft Diameter ϕ (mm)	Series Name	From the Shaft End 10 mm	From the Shaft End 20 mm
60	6	World **K**	50	110



①Permissible Overhung Load: The value for ① in the table above is the value for the permissible overhung load. As shown in the figure to the left, this term refers to the permissible value of the overhung load applied in a direction perpendicular to the motor shaft.
②Permissible Thrust Load: As shown in the figure to the left, this term refers to the permissible value of the thrust load applied in the axial direction to the motor shaft. The specification value is specified as half or less of the motor mass.

The calculating method of overhung load applied on the output shaft of the motor is the same as for an output shaft of the gearhead. Refer to the permissible overhung load and permissible thrust load of gearheads for details. Permissible overhung load and permissible thrust load of gearheads ➜ Page C-16

How to Read Gearhead Specifications

Some gearheads other than those for constant speed motors are listed.

Permissible Torque When Gearhead is Connected

Gearmotor – Torque Table (Example)

◇50 Hz

Unit = N·m

Product Name	Speed r/min	500 ①	417	300	250	200	167	120	100	83	60	50	42	30	25	20	17	15	12.5	10	8.3
Motor/ Gearhead	Gear Ratio	**3**	**3.6**	**5**	**6**	**7.5**	**9**	**12.5**	**15**	**18**	**25**	**30**	**36**	**50**	**60**	**75**	**90**	**100**	**120**	**150**	**180**
4IK25GN-CW2□E 4IK25GN-UW2□	**4GN□S**	0.50	0.60	0.83	1.0	1.2	1.5	2.1	2.5	3.0	3.7	4.5	5.4	6.8	8	8	8	8	8	8	8

①Permissible Torque: This refers to the value of the load torque driven by the gearhead's output shaft. Each value is shown for the corresponding gear ratio.

Permissible torque when a gearhead is attached can be calculated with the formula below.
Permissible torque for some models is omitted. In that case, use the formula below to calculate the permissible torque.

Permissible Torque $T_G = T_M \times i \times \eta$

T_G : Permissible torque of gearhead
T_M : Motor torque
i : Gear ratio of gearhead
η : Gearhead transmission efficiency

Gearhead Transmission Efficiency

Product Name \ Gear Ratio	3	3.6	5	6	7.5	9	12.5	15	18	25	30	36	50	60	75	90	100	120	150	180	250	300	360
2GN□S, 3GN□S, 4GN□S, 5GN□S	81%									73%			66%										
5GE□S, 5GU□KB	81%						73%			66%			59%										
BH6G2-□	90%						86%						81%										
GV2G□, GV3G□, GV4G□			90%							86%							81%						
GVH5G□			90%							86%							81%						
GVR5G□			90%							86%							81%						

- For **BH6G2-□RH** and **BH6G2-□RA**, the gearhead transmission efficiency of all gear ratios is 73% both at the rated and starting speed.
- The transmission efficiency of all the decimal gearhead models is 81%.
- For the transmission efficiency of right-angle gearheads, refer to the page for right-angle gearheads. Transmission efficiency of right-angle gearheads ➜ Page C-216

Product Name \ Gear Ratio	5	10	15	20	30	50	100	200
GFS2G□	90%				86%		81%	
GFS4G□	90%				86%		81%	
GFS5G□	90%				86%		81%	
GFS6G□	90%				86%		81%	

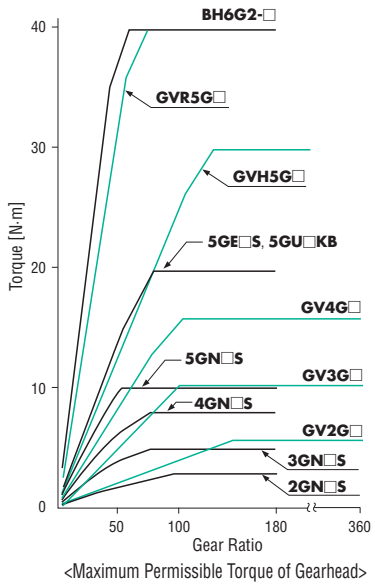
Product Name \ Gear Ratio	5	10	15	20	30	50	100	200
GFS2G□FR	80%	85%						
GFS4G□FR	85%							
GFS5G□FR	85%							
GFS6G□FR	85%							

Note

- The transmission efficiency in the table above is the value at room temperature. The transmission efficiency of the gear head varies according to the ambient temperature. Care should be taken when using in a low-temperature environment as the transmission efficiency will drop along with the output torque.

Maximum Permissible Torque

The gearhead output torque increases proportionally as the gear ratio increases. The load torque permissible to the gearhead is saturated at a certain gear ratio because of the gear materials and other conditions. This torque is called the maximum permissible torque.
The maximum permissible torque for typical gearheads is shown in the figure to the right.



<Maximum Permissible Torque of Gearhead>

- A code (**T** or **T2**) indicating the terminal box type is entered where the box □ is located within the product name.
  A number indicating the gear ratio is entered where the box □ is located within the product name.

●Speed and Rotation Direction
Gearmotor – Torque Table (Example)

◇50 Hz

Unit = N·m

Product Name	Speed r/min ①	500	417	300	250	200	167	120	100	83	60	50	42	30	25	20	17	15	12.5	10	8.3
Motor/ Gearhead	Gear Ratio	**3**	**3.6**	**5**	**6**	**7.5**	**9**	**12.5**	**15**	**18**	**25**	**30**	**36**	**50**	**60**	**75**	**90**	**100**	**120**	**150**	**180**
4IK25GN-CW2□E 4IK25GN-UW2□	**4GN□S**	0.50	0.60	0.83	1.0	1.2	1.5	2.1	2.5	3.0	3.7	4.5	5.4	6.8	8	8	8	8	8	8	8

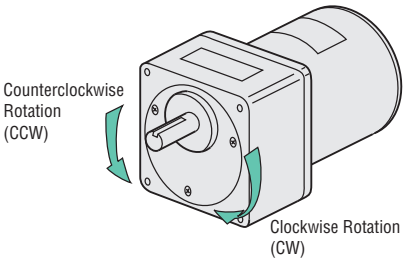
①Speed: This refers to the speed at the gearhead output shaft. The speeds at respective gear ratios are shown in the table showing the permissible torque when a gearhead is attached.
The speed is calculated by dividing the motor's synchronous speed by the gear ratio of the gearhead. The actual speed is 2 to 20% less than the displayed value depending on the load.

The speed is calculated with the following formula.

Speed $N_G = \frac{N_M}{i}$

N_G : Gearhead speed [r/min]
N_M : Motor speed [r/min]
i : Gear ratio of gearhead

②Rotation Direction: This refers to the rotation direction viewed from the output shaft. A colored background ▭ in the table below indicates gear shaft rotation in the same direction as the motor shaft, while the others rotate in the opposite direction. The rotation direction of the gearhead shaft may differ from the motor shaft rotation direction depending on the gear ratio of the gearhead. The gear ratio and rotation direction of each gearhead are shown in the table below.



◇Gear Ratio and Rotation Direction of Gearheads

▭: Same direction as the motor
▭: Opposite direction to the motor

Product Name \ Gear Ratio	3	3.6	5	6	7.5	9	12.5	15	18	25	30	36	50	60	75	90	100	120	150	180	250	300	360
2GN□S, 3GN□S, 4GN□S, 5GN□S	▭	▭	▭	▭	▭	▭	▭	▭	▭	□	□	□	▭	▭	▭	▭	▭	▭	▭	▭	□	□	□
5GE□S, 5GU□KB	▭	▭	▭	▭	▭	▭	□	□	□	▭	▭	▭	▭	▭	□	□	□	□	□	□	□	□	□
BH6G2-□	▭	▭	▭	▭	▭	▭	□	□	□	□	□	□	▭	▭	▭	▭	▭	▭	▭	▭	□	□	□
GV2G□, GV3G□, GV4G□	□	□	▭	▭	▭	▭	▭	▭	▭	▭	▭	▭	□	□	□	□	□	□	▭	▭	▭	▭	▭
GVH5G□	□	□	▭	▭	▭	▭	▭	▭	□	□	□	□	□	□	□	□	▭	▭	▭	▭	□	□	□
GVR5G□	□	□	▭	▭	▭	▭	□	□	□	□	□	□	▭	▭	▭	▭	▭	▭	▭	▭	□	□	□

Connection of a decimal gearhead to these gearheads reduces the speed by 1:10. The rotation direction is not affected.

Product Name \ Gear Ratio	5	10	15	20	30	50	100	200
GFS2G□	▭	▭	▭	▭	□	□	□	▭
GFS4G□	▭	▭	▭	▭	□	□	□	▭
GFS5G□	▭	▭	▭	▭	□	□	□	▭
GFS6G□	▭	▭	▭	▭	□	□	▭	▭

●A code (**T** or **T2**) indicating the terminal box type is entered where the box ▭ is located within the product name.
A number indicating the gear ratio is entered where the box □ is located within the product name.

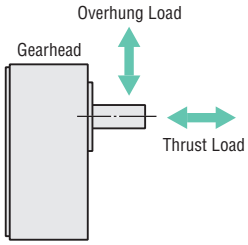
●Permissible Overhung Load and Permissible Thrust Load of Gearheads

Specifications Table for Permissible Overhung Load and Permissible Thrust Load (Example)

Product Name	Gear Ratio	Maximum Permissible Torque N·m	Permissible Overhung Load N		Permissible Thrust Load N
			10 mm from Shaft End ①	20 mm from Shaft End ②	
4GN□S	3~18	8.0	100	150	50
	25~180		200	300	

①Permissible Overhung Load: The value ① shown in the table above is the value for the permissible overhung load. As shown in the figure to the right, this term refers to the permissible value of the overhung load applied in a direction perpendicular to the gear shaft.

②Permissible Thrust Load: The value ② shown in the table above is the value for the permissible thrust load. As shown in the figure to the right, this term refers to the permissible value of the thrust load applied in the axial direction to the gear shaft.



When a chain, gear, belt, etc. is used as the transfer mechanism, the overhung load is always applied on the output shaft of the gearhead. The overhung load is calculated with the following formula.

Overhung load $W = \dfrac{K \times T \times f}{\gamma}$

W : Overhung load [N]
K : Load coefficient for drive system (right table)
T : Torque at gearhead output shaft [N·m]
f : Service factor
γ : Effective radius of gear or pulley, etc. [m]

◇Load Coefficient for Drive System (K)

Drive System	K
Chain and Synchronous Belt	1
Gear	1.25
V-belt	1.5
Flat Belt	2.5

◇Service Factor (f)

Load Type	Example	Factor f
Uniform Load	· Uni-directional Continuous Operation · For driving belt conveyors and film rollers that are subject to minimal load change	1.0
Slight Impact	· Frequent starting and stopping · Cam drive and positioning control of inertia body via stepping motor	1.5
Medium Impact	· Frequent instantaneous bi-directional operation, starting and stopping of reversible motors · Frequent instantaneous stopping of AC motors by brake pack · Frequent instantaneous starting and stopping of brushless motors, servo motors	2.0

●Permissible Load Inertia for Gearhead

This refers to the permissible value for the load inertia (J) at the gearhead shaft. Convert the permissible value at the motor shaft into the permissible value at the output shaft of the gearhead with the following formula.

Gear ratio of 1/3 to 1/50 $J_G = J_M \times i^2$
Gear ratio of 1/60 or more $J_G = J_M \times 2500$

J_G : Permissible load inertia at the gearhead output shaft J ($\times 10^{-4}$ kg·m^2)
J_M : Permissible load inertia at the motor shaft J ($\times 10^{-4}$ kg·m^2)
i : Gear ratio (Example: $i=3$ means a gear ratio of 1/3)

●Permissible Load Inertia at the Motor Shaft (Example)

Number of Phases	Frame Size	Output Power	Permissible Load Inertia at the Motor Shaft J ($\times 10^{-4}$ kg·m^2)
Single-Phase	80 mm Sq.	25 W	0.31

For some products such as combination types, the permissible load inertia at the gearhead output shaft is shown as a direct specifications value for each gear ratio.

●A number indicating the gear ratio is entered where the box □ is located within the product name.

General Specifications

Some specifications other than the constant speed motors are listed.

Permissible Overhung Load and Permissible Thrust Load of Motors

Permissible Overhung Load

Motor			Permissible Overhung Load N	
Frame Size □ (mm)	Output Shaft Diameter ϕ (mm)	Series Name	10 mm from Shaft End	20 mm from Shaft End
60	6	World **K**	50	110
70	6	World **K**	40	60
80	8	World **K**	90	140
90	10	World **K**	140	200
	12	World **K**	240	270
104	14	**BH**, **BHF**	320	350

Permissible Thrust Load

Permissible Thrust Load: Avoid thrust loads as much as possible. If thrust load is unavoidable, keep it to half or less of the motor mass.

Permissible Overhung Load and Permissible Thrust Load of Gearheads

Product Name	Gear Ratio	Maximum Permissible Torque N·m	Permissible Overhung Load N		Permissible Thrust Load N
			10 mm from Shaft End	20 mm from Shaft End	
2GN□S	**3~18**	3.0	50	80	30
	25~180		120	180	
3GN□S	**3~18**	5.0	80	120	40
	25~180		150	250	
4GN□S	**3~18**	8.0	100	150	50
	25~180		200	300	
5GN□S	**3~18**	10	250	350	100
	25~180		300	450	
5GE□S **5GU□KB**	**3~9**	20	400	500	150
	12.5~18		450	600	
	25~180		500	700	
GV2G□	**5~9**	6.0	100	150	40
	12.5~25		150	200	
	30~360		200	300	
GV3G□	**5~9**	10	150	200	80
	12.5~25		200	300	
	30~360		300	400	
GV4G□	**5~9**	16	200	250	100
	12.5~25		300	350	
	30~360		450	550	
GVH5G□	**5~9**	30	400	500	150
	12.5~18		450	600	
	25~300		500	700	
GVR5G□	**5~9**	40	400	500	150
	12.5~18		450	600	
	25~180		500	700	
BH6G2-□	**3~36**	40	550	800	200
	50~180		650	1000	
BH6G2-□RH	**5~36**	60	1200*	1100*	300
	50~180		2200*	2000*	
BH6G2-□RA	**5~36**	60	900	1000	300
	50~180		1700	1850	
FPW425□	**3~18**	8.0	100	150	50
	25~180		200	300	
FPW540□	**3~18**	10	250	350	100
	25~180		300	450	
FPW560□	**3~9**	15	400	500	150
	12.5~18		450	600	
	25~180		500	700	
FPW690□	**3~9**	30	550	800	200
	12.5~180		650	1000	

● For the permissible overhung load and permissible thrust load of right-angle gearheads, refer to the page where the products are listed. ➜ Page C-215

* With **BH6G2-□RH**, the permissible overhung load is for the distance measured from the flange-installation surface.
The permissible overhung load at each distance can also be calculated with a formula. ➜ Page C-17

● A number indicating the gear ratio is entered where the box □ is located within the product name.

◇Calculating the Permissible Overhung Load for the Hollow Shaft Type

When one end of the load shaft is not supported by a bearing unit as shown in the figure to the right, calculate the permissible overhung load using the following formula.
(This mechanism experiences the highest amount of overhung load.)

● BH6G2-□RH

•Gear Ratio of **5** to **36**

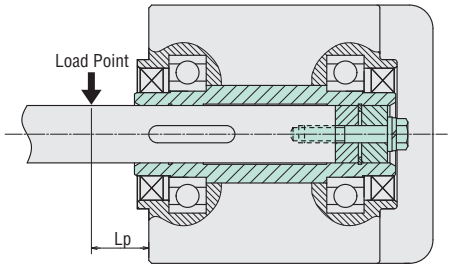
Permissible Overhung Load W [N] $= \dfrac{87.5}{87.5 + L_P} \times 1350$ [N]

1350 [N]: Permissible overhung load at the flange-installation surface

•Gear Ratio of **50** to **180**

Permissible Overhung Load W [N] $= \dfrac{87.5}{87.5 + L_P} \times 2450$ [N]

2450 [N]: Permissible overhung load at the flange-installation surface



Lp [mm]: Distance from flange-installation surface to overhung load point

■Permissible Load Inertia: J of Gearhead

When a high load inertia (J) is connected to a gearhead, high torque is exerted instantaneously on the gearhead during starting in frequent, intermittent operations (or during stopping by an electromagnetic brake or instantaneous stopping by a brake pack). Excessive impact shocks can cause damage to the gearhead or motor.
The table below gives values for the permissible load inertia at the motor shaft. Use the motor and gearhead within these parameters. The permissible load inertia for three-phase motors is the value when reversing after a stop.
The permissible load inertia (J) at the output shaft of the gearhead is calculated with the formula below.
The life of a gearhead when operating at the permissible load inertia with instantaneous stopping of electromagnetic brake motors, brake pack or speed control motors is approximately two million cycles.

●Permissible Load Inertia at the Gearhead Output Shaft

Gear ratio of 1/3 to 1/50 $J_G = J_M \times i^2$
Gear ratio of 1/60 or higher $J_G = J_M \times 2500$

J_G : Permissible load inertia at the gearhead output shaft J ($\times 10^{-4}$ kg·m^2)
J_M : Permissible load inertia at the motor shaft J ($\times 10^{-4}$ kg·m^2)
i : Gear ratio (Example: $i=3$ means a gear ratio of 1/3)

●Permissible Load Inertia at the Motor Shaft

Number of Phases	Frame Size	Output Power (W)	Permissible Load Inertia at the Motor Shaft J ($\times 10^{-4}$ kg·m^2)
Single-Phase	60 mm Sq.	6	0.062
	70 mm Sq.	15	0.14
	80 mm Sq.	25	0.31
	90 mm Sq.	40	0.75 (1.1)*
		60	1.1
		90	1.1
	104 mm Sq.	200	2
Three-Phase	60 mm Sq.	6	0.062
	70 mm Sq.	15	0.14
	80 mm Sq.	25	0.31
	90 mm Sq.	40	0.75 (1.1)*
		60	1.1
		90	1.1
	104 mm Sq.	200	2

*Values in the brackets are for the **V** Series.

●A number indicating the gear ratio is entered where the box □ is located within the product name.