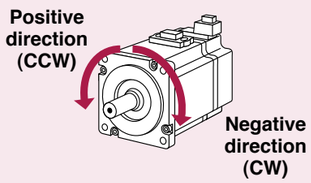
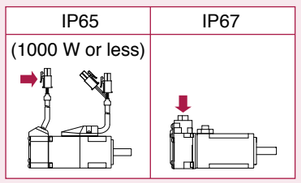
Environmental Conditions

Item		Conditions
Ambient temperature *1		0 ˚C to 40 ˚C (free from freezing)
Ambient humidity		20 % to 85 % RH (free from condensation)
Storage temperature *2		–20 ˚C to 65 ˚C (Max.temperature guarantee: 80 ˚C for 72 hours free from condensation*5)
Storage humidity		20 % to 85 % RH (free from condensation*5)
Vibration	Motor only	Lower than 49 m/s^2 (5 G) at running, 24.5 m/s^2 (2.5 G) at stall
Impact	Motor only	Lower than 98 m/s^2 (10 G)
Enclosure rating (Motor only)	IP65 *3	MSMF, MQMF, MHMF (except rotating portion of output shaft and leadwire end.) (MSMF, MQMF, MHMF In case of leadwire type.)
	IP67 *3*4	IP67 motor (except rotating portion of output shaft and connecting pin part of the motor connector and the encoder connector)
Altitude		Lower than 1000 m

*1 Ambient temperature to be measured at 5 cm away from the motor.
*2 Permissible temperature for short duration such as transportation.
*3 These motors conform to the test conditions specified in EN standards (EN60529, EN60034-5). Do not use these motors in application where water proof performance is required such as continuous wash-down operation.
*4 This condition is applied when the connector mounting screw are tightened to the recommended tightening torque.
*5 Air containing water vapor will become saturated with water vapor as the temperature falls, causing dew.

<Note>
Initial setup of rotational direction: positive = CCW and negative = CW. Pay an extra attention.





Notes on [Motor specification] page

Note) 1. **[At AC100 V of power voltage]**
Regenerative brake frequency represents the frequency of the motor's stops from the rated speed with deceleration without load.
- If the load is connected, frequency will be defines as 1/(m+1), where m=load moment of inertia/rotor moment of inertia.
- When the motor speed exceeds the rated speed, regenerative brake frequency is in inverse proportion to the square of (running speed/rated speed).
- Power supply voltage is AC115 V (at 100 V of the main voltage).
  If the supply voltage fluctuates, frequency is in inverse proportion to the square of (Running supply voltage/115) relative to the value in the table.
- When regeneration occurs continuously such cases as running speed frequently changes or vertical feeding, consult us or a dealer.

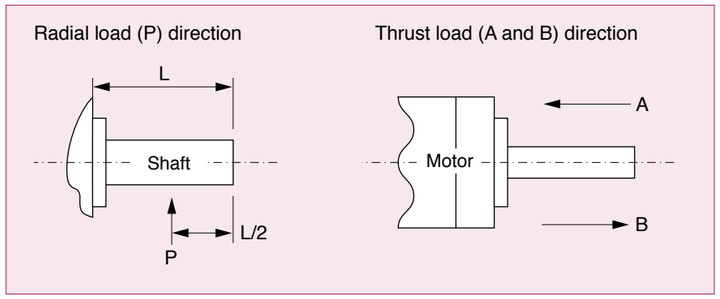
[At AC200 V of power voltage]
Regenerative brake frequency represents the frequency of the motor's stops from the rated speed with deceleration without load.
- If the load is connected, frequency will be defines as 1/(m+1), where m=load moment of inertia/rotor moment of inertia.
- When the motor speed exceeds the rated speed, regenerative brake frequency is in inverse proportion to the square of (running speed/rated speed).
- Power supply voltage is AC230 V (at 200 V of the main voltage).
  If the supply voltage fluctuates, frequency is in inverse proportion to the square of (Running supply voltage/230) relative to the value in the table.
- When regeneration occurs continuously such cases as running speed frequently changes or vertical feeding, consult us or a dealer.

Note) 2. If the effective torque is within the rated torque, there is no limit in generative brake.
Note) 3. Consult us or a dealer if the load moment of inertia exceeds the specified value.
Note) 4. Releasing time values represent the ones with DC-cutoff using a varistor.

Permissible Load at Output Shaft

The radial load is defined as a load applied to the output shaft in the right-angle direction. This load is generated when the gear head is coupled to the machine using a chain, belt, etc., but not when the gear head is directly connected to the coupling. As shown in the right figure, the permissible value is determined based on the load applied to the L/2 position of the output shaft. The thrust load is defined as a load applied to the output shaft in the axial direction.

Because the radial load and thrust load significantly affect the life of the bearing, take care not to allow the load during operation to exceed the permissible radial load and thrust load shown in the table below.



Built-in Holding Brake

In the applications where the motor drives the vertical axis, this brake would be used to hold and prevent the work (moving load) from falling by gravity while the power to the servo is shut off.

Use this built-in brake for "Holding" purpose only, that is to hold the stalling status. Never use this for "Brake" purpose to stop the load in motion.

- **Output Timing of BRK-OFF Signal**
  - For the brake release timing at power-on, or braking timing at Servo-OFF/Servo-Alarm while the motor is in motion, refer to the Operating Instructions (Overall).
  - With the parameter, Pr4.38 (Setup of mechanical brake action while the motor is in motion), you can set up a time between when the motor enters to a free-run from energized status and when BRK-OFF signal turns off (brake will be engaged), when the Servo-OFF or alarm occurs while the motor is in motion. For details, download a copy of the instruction manual from our website.

<Note>
1. The lining sound of the brake (chattering and etc.) might be generated while running the motor with built-in brake, however this does not affect any functionality.
2. Magnetic flux might be generated through the motor shaft while the brake coil is energized (brake is open). Pay an extra attention when magnetic sensors are used nearby the motor.

● Specifications of Built-in Holding Brake

Motor series	Motor output	Static friction torque N·m	Rotor inertia $\times 10^{-4}$ kg·m^2	Engaging time ms	Releasing time ms	Exciting current DC A (at cool-off)	Releasing voltage DC V / Exciting voltage DC V	Permissible work (J) per one braking	Permissible total work $\times 10^3$ J	Permissible angular acceleration rad/s^2
MSMF (80 mm sq. or less)	50 W,100 W	0.294 or more	0.002	35 or less	20 or less	0.30	1 or more / 24±1.2	39.2	4.9	30000
	200 W,400 W	1.27 or more	0.018	50 or less	15 or less	0.36		137	44.1	
	750 W	2.45 or more	0.075	70 or less	20 or less	0.42		196	147	
	1000 W	3.80 or more					1 or more / 24±2.4	185	80.0	
MSMF (100 mm sq. or more)	1.0 kW, 1.5 kW, 2.0 kW	8.0 or more	0.175	50 or less	15 or less	0.81 ±10 %	2 or more / 24±2.4	600	50	10000
	3.0 kW	12.0 or more		80 or less					900	
	4.0 kW	16.2 or more	1.12	110 or less	50 or less	0.90 ±10 %		1470	2160	
	5.0 kW	22.0 or more						1545	2000	
MQMF (80 mm sq. or less)	100 W	0.39 or more	0.018	15 or less	20 or less	0.30	1 or more / 24±2.4	105	44.1	30000
	200 W, 400 W	1.6 or more	0.075	70 or less		0.36		185	80	
MHMF (80 mm sq. or less)	50 W, 100 W	0.38 or more	0.002	35 or less	20 or less	0.30	1 or more / 24±2.4	39.2	4.9	30000
	200 W, 400 W	1.6 or more	0.018	50 or less		0.36		105	44.1	
	750 W, 1000 W	3.8 or more	0.075	70 or less		0.42		185	80	
MHMF (100 mm sq. or more)	1.0 kW, 1.5 kW	13.7 or more	1.12	100 or less	50 or less	0.79 ±10 %	2 or more / 24±2.4	1470	2160	10000
	2.0 kW, 3.0 kW, 4.0 kW	25.0 or more	4.7	80 or less	25 or less	1.29 ±10 %		1800	3000	5440
	5.0 kW	44.1 or more	4.1	150 or less	30 or less			1800	3100	5108
MDMF (100 mm sq. or more)	1.0 kW, 1.5 kW, 2.0 kW	13.7 or more	1.12	100 or less	50 or less	0.79 ±10 %	2 or more / 24±2.4	1470	2160	10000
	3.0 kW	22.0 or more		110 or less		0.90 ±10 %		1545	2000	
	4.0 kW	25.0 or more	4.7	80 or less	25 or less	1.29 ±10 %		1800	3000	5440
	5.0 kW	44.1 or more	4.1	150 or less	30 or less				3100	5108
MGMF (100 mm sq. or more)	0.85 kW, 1.3 kW, 1.8 kW	13.7 or more	1.12	100 or less	50 or less	0.79 ±10 %	2 or more / 24±2.4	1470	2160	10000
	2.9 kW	25.0 or more	4.7	80 or less	25 or less	1.29 ±10 %		1800	3000	5440
	4.4 kW	44.1 or more	3.93	150 or less	30 or less			1800	3100	5108

- Releasing time values represent the ones with DC-cutoff using a varistor.
- Above values (except static friction torque, releasing voltage and excitation current) represent typical values.
- Backlash of the built-in holding brake is kept ±1° or smaller at ex-factory point.
- Service life of the number of acceleration/deceleration with the above permissible angular acceleration is more than 10 million times. (Life end is defined as when the brake backlash drastically changes.)

Cable part No. Designation

Encoder Cable

1	2	3	4	5	6	7	8	9	10	11	12
M	F	E	C	A	0	0	5	0	M	J	D
Type classification					①				②	③	④

Type classification: MFECA: Encoder cable

① Cable length

0030	3 m
0050	5 m
0100	10 m
0200	20 m

② Cable type

E	PVC cable with shield by Oki Electric Cable Co., 0.20 mm^2 × 4P(8-wire), 3P(6-wire)
M	Hitachi Cable, Ltd. Highly bendable type
T	Hitachi Cable, Ltd. Standard bendable type

③ Cable end (Encoder side)

A	Tyco Electronics Japan G.K. connector
J	Japan Aviation Electronics Industry, Ltd. connector (Direction of motor shaft)
K	Japan Aviation Electronics Industry, Ltd. connector (Opposite direction of motor shaft)
P	Japan Aviation Electronics Industry, Ltd. plug connector
S	"S" shaped cannonplug
T	Japan Aviation Electronics Industry, Ltd. plug connector

④ Cable end (Driver side)

D	Connector (Without battery box)
E	Connector (With battery box)

Motor Cable, Brake Cable

1	2	3	4	5	6	7	8	9	10	11	12
M	F	M	C	A	0	0	5	2	N	J	D
AC servo motor cable				①	②			③	④	⑤	⑥

① Type classification

A	Standard
B	Special
⋮	Design order

② Cable length

003	3 m
005	5 m
010	10 m
020	20 m

③ Sectional area of cable core

0	0.75 mm^2
1	1.25 mm^2
2	2.0 mm^2
3	3.5 mm^2

④ Cable type

ROBO-TOP® is a trade mark of DYDEN CORPORATION

E	ROBO-TOP® 4-wire by DYDEN CORPORATION
F	ROBO-TOP® 6-wire by DYDEN CORPORATION
G	ROBO-TOP® 2-wire by DYDEN CORPORATION
N	4-wire by Hitachi Cable, Ltd. (Highly bendable type)
R	2-wire by Hitachi Cable, Ltd. (Highly bendable type)
P	4-wire by Hitachi Cable, Ltd. (Standard bendable type)
S	2-wire by Hitachi Cable, Ltd. (Standard bendable type)
U	4-wire for A6 series small motor* (Highly bendable type)
V	6-wire for A6 series small motor* (Highly bendable type)
W	4-wire for A6 series small motor* (Standard bendable type)
X	6-wire for A6 series small motor* (Standard bendable type)

* 80 mm sq. or less

⑤ Cable end at motor side

C	S type cannon plug
E	Tyco Electronics Japan G.K. connector
F	Japan Aviation Electronics Industry, Ltd. connector (Direction of motor shaft)
G	Japan Aviation Electronics Industry, Ltd. connector (Opposite direction of motor shaft)
J	Japan Aviation Electronics Industry, Ltd. connector (Direction of motor shaft)
K	Japan Aviation Electronics Industry, Ltd. connector (Opposite direction of motor shaft)
U	Japan Aviation Electronics Industry, Ltd. plug connector

⑥ Cable end at driver side

D	Rod terminal
T	Clamp terminal