

ORIENTAL MOTOR GENERAL CATALOG



LOW-SPEED SYNCHRONOUS MOTORS

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UPK	
UPK•W	
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Controllers	
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Low-Speed Synchronous Motors



The basic construction of low-speed synchronous motors is the same as that of stepping motors. Since they can be driven by **AC** power supplies, they are sometimes called **AC stepping motors**. Synchronous motors offer highly precise speed regulation and low-speed rotation.



■ FEATURES

1. Low-speed synchronous rotation is obtained without the use of a gearhead

The motor rotates at a speed proportional to and accurately synchronized with the frequency of the power supply. Motor speed is 72 r/min at 60Hz.

2. Superb starting, stopping and reversing characteristics

If operated within the permissible inertial load, the motor can start, stop and reverse within 1 cycle (1/60 sec. at 60Hz) of power supply frequency.

3. High-Precision Positioning

The motor can be stopped instantly by turning off the power supply. The stopping accuracy is $\pm 3.6^\circ$.

4. Holding Torque

Since a permanent-magnet multi-poled rotor is used, the motor has holding torque even when the motor is not excited energized. When a larger holding torque is required, a **DC** power supply can be connected as soon as the **AC** power supply is cut off.

5. High Torque

The **SMK** series provides much higher torque than conventional low speed synchronous motors. Their mounting base is the same size as other models, so switching to an **SMK** series motor is a simple way to get higher torque.

6. Low Vibration

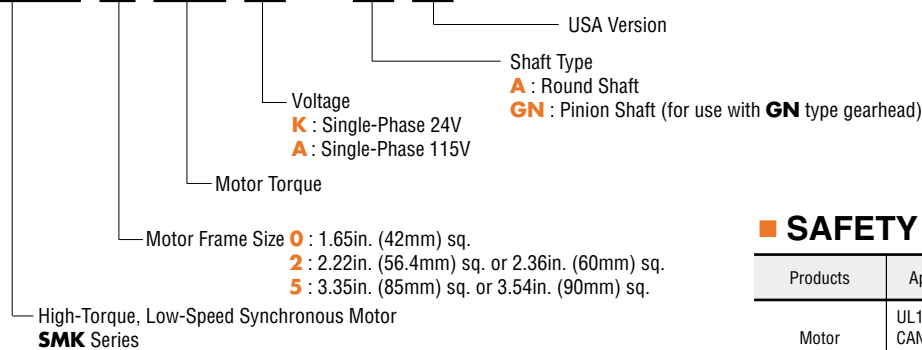
SMK series motors do more than provide high torque. They also employ a new design principle in the stator tooth shape and pitch to produce less vibration.

7. Pinion Shafts

Pinion shaft models are available that can be connected directly to standard Oriental Motor **GN** low-noise gearheads. The 20 gear ratios in the **GN** line combine to provide even lower speeds and higher torque.

■ PRODUCT NUMBER CODE

SMK 0 14 K - A A



■ SAFETY STANDARDS

Products	Applicable Standards	Authorizing Organization	File No.
Motor	UL1004, UL519 CAN/CSA C22.2 No.100 CAN/CSA C22.2 No.77	UL	E64199

■ SPECIFICATIONS

Model	Voltage Single phase VAC	Frequency Hz	Current A	Torque		Speed r/min	Residual Torque		Rotor Inertia GD ²		Capacitor μF	External Resistor		Safety standard
				oz-in	N·m		oz-in	mN·m	oz-in ²	kg·m ²		ohm	W	
SMK014K-AA	24	60	0.21	18	0.13	72	1.38	10	1.21	220×10 ⁻⁷	12	—	—	—
SMK237A-A	115	60	0.10	51.3	0.37	72	3.47	25	6.56	1200×10 ⁻⁷	1.2	—	—	
SMK216A-GN	115	60	0.10	22.2	0.16	72	2.08	15	2.63	480×10 ⁻⁷	1.2	—	—	
SMK5100A-AA	115	60	0.21	155	1.12	72	4.99	36	30.7	5600×10 ⁻⁷	2.5	400	30	
SMK5160A-AA	115	60	0.25	297	2.14	72	12.3	89	59.1	10800×10 ⁻⁷	2.5	400	30	
SMK550A-GN	115	60	0.07	70.8	0.51	72	4.99	36	30.7	5600×10 ⁻⁷	0.6	400	30	

■ PERMISSIBLE TORQUE WITH GEARHEAD ATTACHED

Motor/Gearhead	Gear Ratio	Permissible Torque																			
		lb-in N·m																			
		3	3.6	5	6	7.5	9	12.5	15	18	25	30	36	50	60	75	90	100	120	150	180
SMK216A-GN/2GN□KA	3.4	4.3	6	6.9	8.7	10	13	15	16	18	20	24	26	26	26	26	26	26	26	26	26
	0.4	0.5	0.7	0.8	1	1.2	1.5	1.8	1.9	2.1	2.4	2.8	3	3	3	3	3	3	3	3	3
SMK550A-GN/5GN□KA	12	14	19	24	30	37	39	43	52	65	78	78	86	86	86	86	86	86	86	86	86
	1.4	1.7	2.3	2.8	3.5	4.3	4.5	5	6	7.5	9	9	10	10	10	10	10	10	10	10	10

- Gearheads are sold separately.
- The box (□) represents the desired gear ratio, which becomes part of the product number for the gearhead.
- A white background indicates that the output shaft of the gearhead rotates in the same direction as the output shaft of the motor. A shaded background indicates rotation in the opposite direction.

■ GENERAL SPECIFICATIONS

Model	SMK014K-AA	SMK2□, SMK5□ type
Shaft Runout	0.002 inch (0.05mm) T.I.R.* ¹	
Concentricity	0.003 inch (0.075mm) T.I.R.* ¹	
Perpendicularity	0.003 inch (0.075mm) T.I.R.* ¹	
Shaft Radial Play * ²	0.001 inch (0.025mm) maximum at 1.1 lb (0.5kg)	
Shaft Axial Play * ³	0.003 inch (0.075mm) maximum at 2.2 lb (1kg)	
Step Accuracy	±3.6°	
Insulation Resistance	100M Ω or more when the megger reading between the windings and the case is DC 500V.	
Dielectric Strength	Sufficient to withstand 0.5kV at 60Hz applied between the windings and the case for one minute.	Sufficient to withstand 1.5kV at 60Hz applied between the windings and the case for one minute.
Temperature Rise	99°F (55°C) or less as measured by thermometer method after rated operation.	
Insulation Class	Class E [248°F (120°C)]	Class E [248°F (120°C)] *Recognized as Class A [221°F (105°C)] by UL and CSA standard
Ambient Temperature Range	+14°F ~ +104°F (-10°C ~ +40°C)	

*¹ T.I.R.(Total Indicator Reading): Total dial gage reading when the measurement section is rotated 1 revolution, centered on the reference axis center.

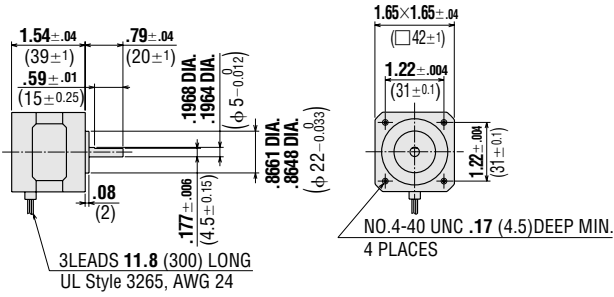
*² Radial Play: Displacement in shaft position in the radial direction when a 1.1lb. (0.5kg) load is applied to the motor shaft tip in a radial direction.

*³ Axial Play: Displacement in shaft position in the axial direction when a 2.2lb. (1kg) load is applied to the motor shaft in the axial direction.

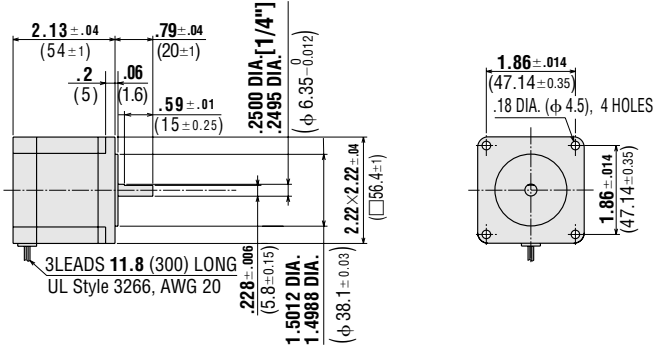
■ DIMENSIONS Scale 1/4, Unit = inch (mm)

● Motor

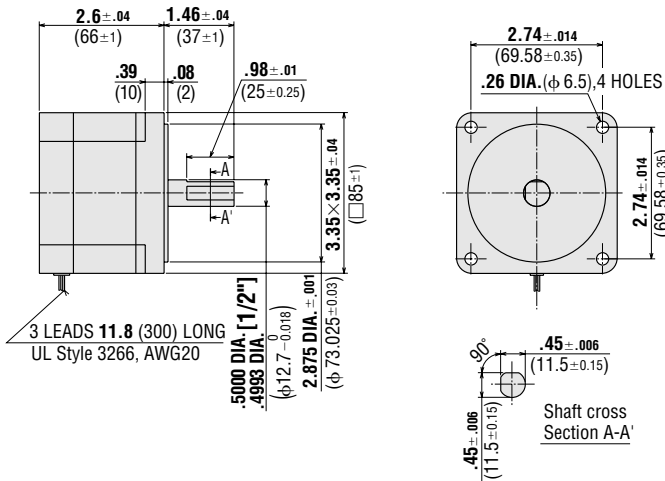
SMK014K-AA Weight 0.6lb. (Mass 0.27kg)



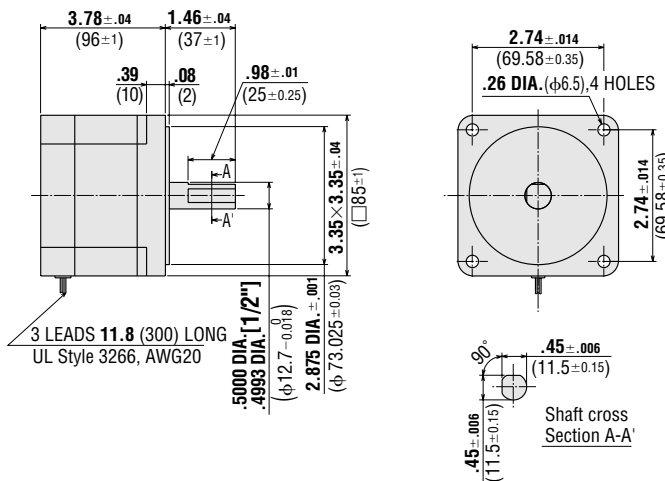
SMK237A-A Weight 1.55lb. (Mass 0.7kg)



SMK5100A-AA Weight 3.75lb. (Mass 1.7kg)

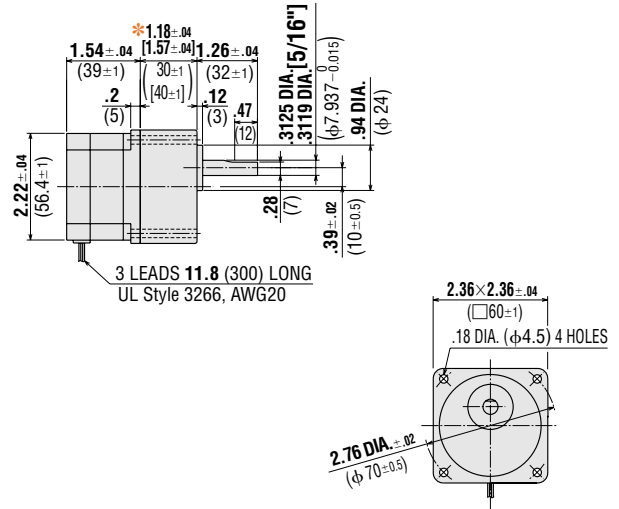


SMK5160A-AA Weight 6.18lb. (Mass 2.8kg)



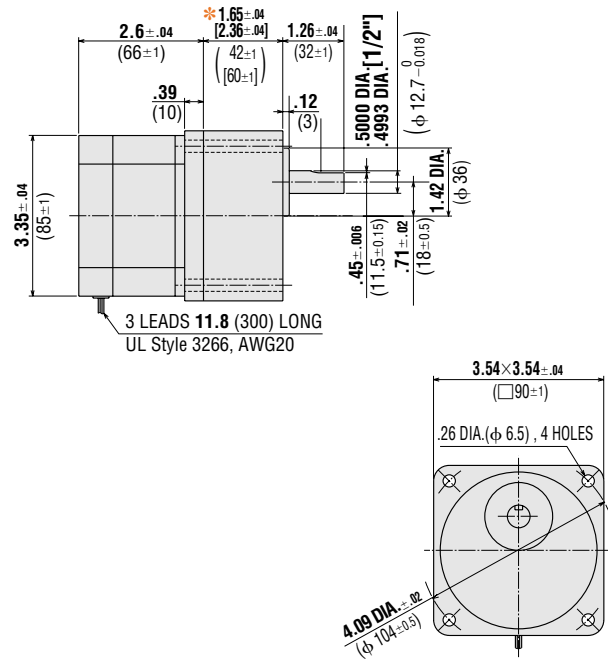
● Motor/Gearhead

SMK216A-GN/2GN□KA Weight 1.88lb. (Mass 0.85kg)



* Indicates dimensions of 2GN3KA~18KA, the figure in square brackets [] indicate dimensions of 2GN25KA~180KA.

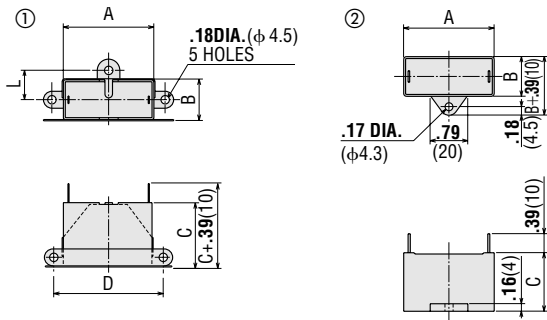
SMK550A-GN/5GN□KA Weight 7.06lb. (Mass 3.2kg)



* Indicates dimensions of 5GN3KA~18KA, the figure in square brackets [] indicate dimensions of 5GN25KA~180KA.

● See page B-36 for information on motor installation.

● **Capacitor** (included with the motor)

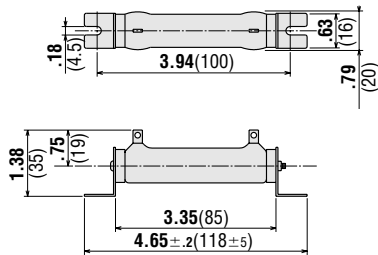


Motor Model	Capacitor Model	Capacitor Dimensions					Weight (Mass) oz(g)	Dimensions No.	Capacitor Cap Model
		A	B	C	D	E			
SMK014K-AA	CH120	1.89 (48)	0.83 (21)	1.32 (33.5)	2.28 (58)	0.61 (15.5)	2.12 (60)	①	CHC4821A
SMK237A-A SMK216A-GN	CH12UL	1.22 (31)	0.57 (14.5)	0.93 (23.5)	—	—	0.53 (15)	②	
SMK5100A-AA SMK5160A-AA	CH25UL	1.22 (31)	0.67 (17)	1.07 (27)	—	—	0.71 (20)	②	included
SMK550A-GN	CH06BUL	1.22 (31)	0.57 (14.5)	0.93 (23.5)	—	—	0.8 (25)	②	

● **External Resistor**

(included with **SMK5** type)

Weight 2.12oz (Mass 60g)

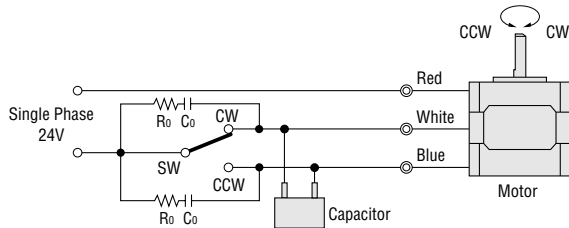


■ WIRING DIAGRAMS

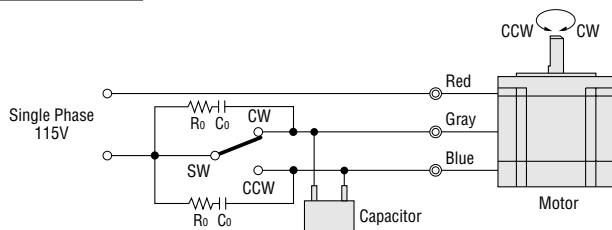
Flip the switch to CW to rotate in the clockwise direction and to CCW for counterclockwise rotation. When the power is cut, the motor stops within $\pm 3.6^\circ$. (The direction of motor rotation is as viewed from the shaft end of the motor.)

Capacitors and external resistors come with the motor, when necessary.

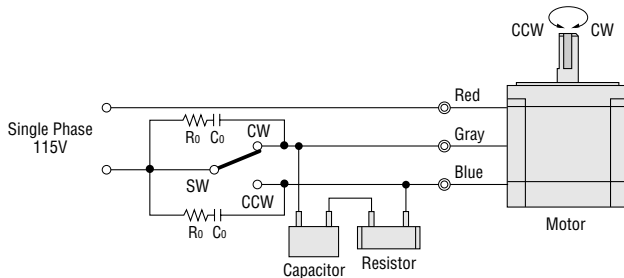
SMKO type



SMK2 type



SMK5 type



■ STARTING AND STOPPING CHARACTERISTICS

Operating with Inertial Loads

Starting, stopping and reversing characteristics vary according to the amount of inertial load directly coupled to the motor.

Permissible inertial load, therefore, refers to the upper limit of inertial load under which the motor can be operated normally when the load is connected directly to the motor shaft. It is recommended to use flexible couplings when connecting the load to the motor shaft.

Model	Permissible Inertial Load GD^2		Rotor Inertia GD^2	
	oz-in ²	kg·m ²	oz-in ²	kg·m ²
SMKO14K-AA	7.66	1.4×10^{-4}	1.16	220×10^{-7}
SMK237A-A	54.7	10×10^{-4}	6.56	1200×10^{-7}
SMK216A-GN	13.2	2.4×10^{-4}	2.63	480×10^{-7}
SMK5100A-AA SMK550A-GN	153	28×10^{-4}	30.7	5600×10^{-7}
SMK5160A-AA	263	48×10^{-4}	59.1	10800×10^{-7}

Starting Time

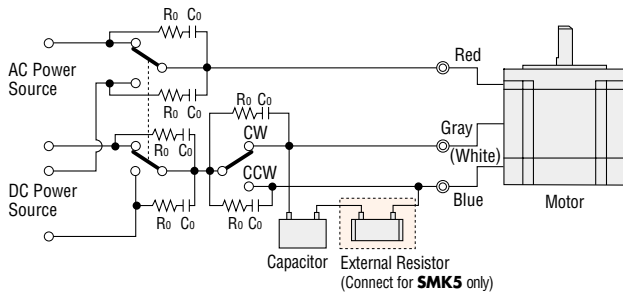
Low-speed synchronous motors offer superb starting, stopping and reversing characteristics. Provided that the motor is operating within permissible inertial load limits, it can be started, stopped or reversed within 1.5 cycles of the applied frequency. The motor will start and reach a steady speed in the time shown in the table below. As seen in this table, there is a certain amount of variation in the time required for the motor to reach the set speed. This is attributable to factors linked with the phase of the power source and the relative positions of the rotor and stator when the current is applied. One method of reducing these variations is to use a zero cross switch. Other possibilities include the use of special control circuits.

Model	Load GD^2		Starting Time (ms)		Stopping Time (ms)	
	oz-in ²	kg·m ²	Start Up	Setting	Start Up	Setting
SMKO14K-AA	0		2~15	19~37	3~5	7~23
	3.83	0.7×10^{-4}	3~16	25~38	4~7	11~27
	7.66	1.4×10^{-4}	6~22	14~48	5~9	23~32
SMK237A-A	0		2~15	19~37	3~5	7~23
	27.4	5×10^{-4}	3~16	25~38	4~7	11~27
	54.7	10×10^{-4}	6~22	14~48	5~9	23~32
SMK216A-GN	0		2~15	19~37	3~5	7~23
	6.56	1.2×10^{-4}	3~16	25~38	4~7	11~27
	13.2	2.4×10^{-4}	6~22	14~48	5~9	23~32
SMK5100A-AA SMK550A-GN	0		2~15	19~37	3~5	7~23
	76.6	14×10^{-4}	3~16	25~38	4~7	11~27
	153	28×10^{-4}	6~22	14~48	5~9	23~32
SMK5160A-AA	0		2~15	19~37	3~5	7~23
	132	24×10^{-4}	3~16	25~38	4~7	11~27
	263	48×10^{-4}	6~22	14~48	5~9	23~32

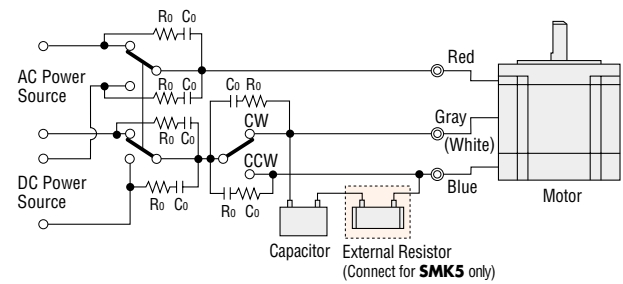
■ WIRING DIAGRAMS FOR DC EXCITATION

When a holding torque larger than the static holding torque of the stopped motor is required, apply a DC voltage simultaneously while turning the AC power supply off.

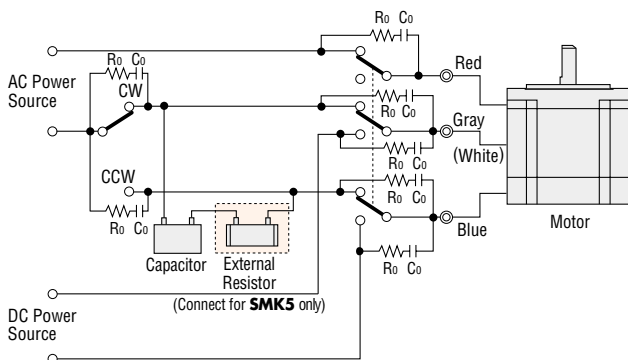
1-phase Excitation



2-phase Excitation (Serial)



2-phase Excitation (Parallel)

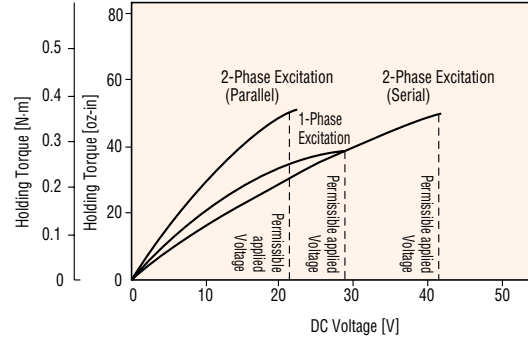


The white leads listed in parentheses are only for the **SMKO**. Connect the supplied external resistor to the capacitor in series for the **SMK5** model. External resistors are not needed for the **SMKO** and **SMK2** models.

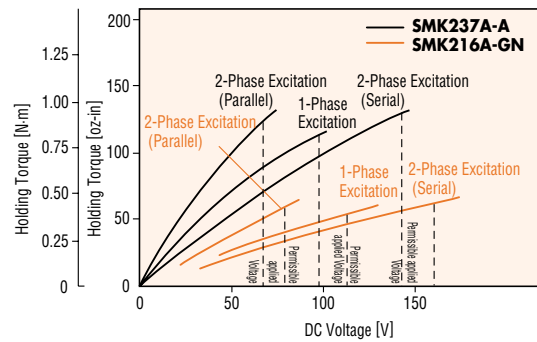
To prevent DC power supply damage caused by voltage surges, connect a surge suppressor circuit between the points of the relay switch. The **EPCR1201-2** surge suppressor circuit is available as an option.

■ CHARACTERISTICS FOR DC EXCITATION

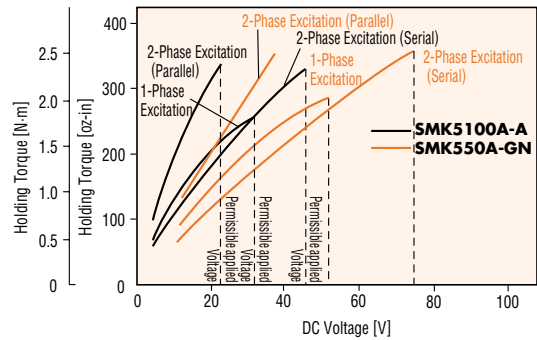
SMK014K-AA



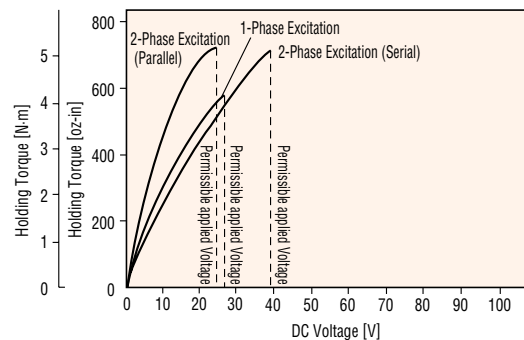
SMK237A-A, SMK216A-GN



SMK5100A-AA, SMK550A-GN



SMK5160A-AA



■ PRECAUTIONS

Do not lock the rotor

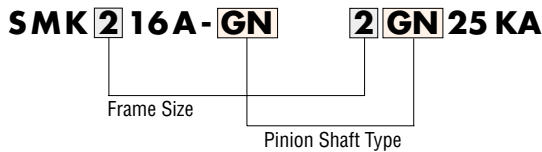
If the rotor is locked, a jarring vibration will result as the motor attempts to start. To avoid vibration, select the correct motor and avoid excessive loading.

Do not exceed the gearhead's permissible torque

The permissible torque is the limit of the gearhead's mechanical strength. Load torque must be kept at or below the permissible torque. Applying a torque in excess of the permissible torque will damage the gearhead.

Use with geared motors

Gearheads are sold separately. When combining motors and gearheads, be sure that the mounting frame size and shaft type both match.



■ ACCESSORIES

● Capacitor Caps

They are included with all **SMK** motor model, except for **SMK014-AA**. Use capacitor cap model **CHC4821A** for **SMK014-AA**.

Capacitor caps are used for insulation of capacitor terminals. These capacitor caps are sold ten to a package.

● Motor Mounting Brackets

The following mounting brackets are available for the low-speed synchronous motors.

Materials: Aluminum die cast



Mounting Bracket Model	Applicable Motor	Page
PAFOP	SMK014K-AA	B-298
PALOP		
PAL2P-2	SMK237A-AA	B-298
PAL4P-2	SMK5100□-AA, SMK5160A-AA	B-298
SOL2U8	SMK216A-GN / 2GN□KA	A-266
SOL5UA	SMK550□-GN / 5GN□KA	A-268

See page B-298, A-266 and A-268 for the details of the mounting brackets.

● Flexible Couplings

MC Coupling

This slit-type coupling is ideal for coupling a low-speed synchronous motor to the load shaft.

For details, see page B-301.



MCL Coupling

This clamping-type coupling is ideal for coupling a gearhead to the load shaft.

For details, see page B-303.



● CR Circuit for Surge Suppression

This product is used to protect the contacts of the relay and/or the switch used to control the motor direction.

Model : **EPCR1201-2**
AC250V (120 Ω, 0.1μF)

