E

TECHNICAL DATA

E TECHNICAL DATA

1. Reducer

The reducer portion of the CYCLO® GEARMOTOR is fundamentally different in principle and mechanism from the involute gearing mechanism of competitor's gearmotors. Our unique speed reducer part is an ingenious combination of the following two mechanisms:

- A combination of a planet gear and a fixed internal sun gear. In the CYCLO® GEARMOTOR, the planet gear has cycloidal-shaped teeth and the sun gear has circular pin teeth.
  The number of teeth in the planet gear is one or two less than the sun gear.
- A constant speed internal gearing mechanism.

See Fig.E-1
In equation 1 below, P identifies the number of the planet gear teeth, S that of the sun gear, and $\omega 2$ the angular velocity of the planet gear around its own axis. The velocity ratio of $\omega 2$ to $\omega 1$ is shown as follows:

$$\frac{\omega 2}{\omega 1} = 1 - \frac{S}{P} = -\frac{S-P}{P} \quad \cdots \text{Equation 1}$$

With S greater by one or two than P in this equation, the highest velocity ratio is obtainable.
That is, if S-P=1 is applied to Equation 1, the velocity ratio may be calculated from the following equation:

$$\frac{\omega 2}{\omega 1} = \frac{1}{P} \quad \cdots \text{Equation 2}$$

Or if S-P=2 is applied to Equation 1, the velocity ratio may be calculated from the following equation:

$$\frac{\omega 2}{\omega 1} = \frac{2}{P} \quad \cdots \text{Equation 3}$$

As the crankshaft rotates at the angular velocity $\omega 1$ around the axis of the sun gear, the planet gear rotates at the angular velocity:

$$-\frac{1\omega 1}{P} \text{ or } -\frac{2\omega 1}{P}$$

When P indicates the number of the teeth of the planet gear and the symbol '-' indicates that the rotation of the planet gear is in a reverse direction to that of the crankshaft.
In the CYCLO® GEARMOTOR, illustrated in Fig. E-2, circular teeth (pins) are adapted for the sun gear and epitrochoid curved teeth for the planet gear, thereby avoiding tooth top interference. The rotation of the planet gear around its own axis is taken out through a constant speed internal gearing mechanism as shown in Fig. E-3.
In this mechanism shown in Fig. E-4, the pins of the slow speed shaft are evenly spaced on a circle that is concentric to the axis of the sun gear. The pins transmit the rotation of the planet gear by rolling internally on the circumference of the bores of each planet gear or cycloid disc. The diameter of the bores minus the diameter of the slow speed shaft pins is equal to twice the eccentricity value of the crank shaft (eccentric). This mechanism smoothly transmits only the rotation of the planet gear around its own axis to the slow speed shaft.

Fig.E-1 Principle of Internal Planetary Gearing

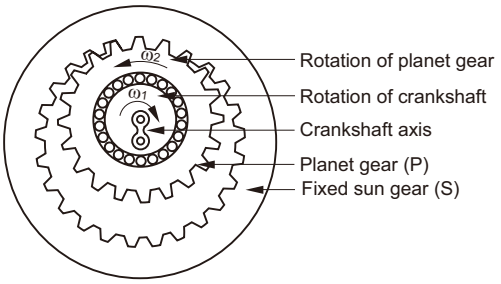


Fig.E-2 Epitrochoid Planet Gear-Circular (PIN) Tooth Sun Gear Combination

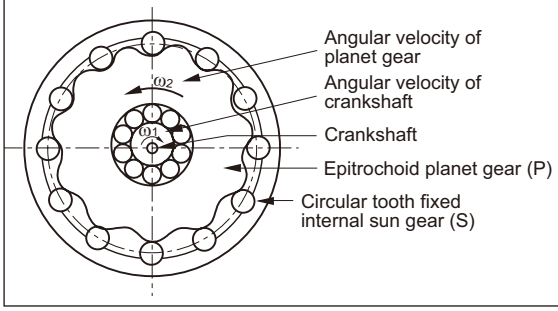


Fig.E-3 Constant Speed Internal Gearing

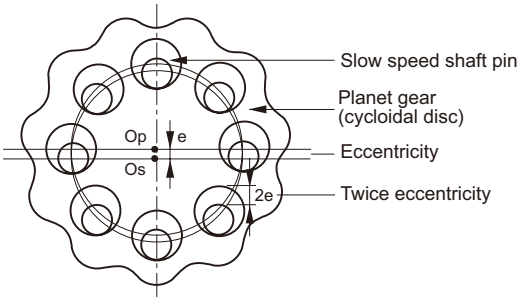
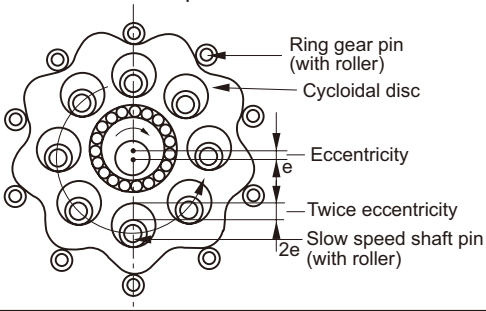


Fig.E-4 Combination of Planet-Sun Gears and Constant Speed Internal Gear



Lubrication

Lubrication Method

1. □ indicates 0, 5, or H (for certain frame size)

(1) Standard Type

Table E-1 Horizontal

a) 6000SK Series Horizontal

Frame Size \ Nominal Reduction Ratio	2.5	3	4	5	6	8	10
607□SK, 608□SK, 609□SK, 610□SK, 611□SK	Long-Life Type Grease (MF) *Indication necessary for mounting direction.						

b) 6000 Series Single Reduction Horizontal

Frame Size \ Ratio	6	8	11	13	15	17	21	25	29	35	43	51	59	71	87	119
606□	Long-Life Type Grease (MF)										43	59			87	
607□																
608□																
609□, 610□																
611□, 612□																
613□, 614□	Oil Bath (PB)															
616□, 617□																
618□, 619□																
6205, 6215																
6225, 6235																
6245, 6255																
6265																
6275																

c) 6000 Series Double Reduction Horizontal

Frame Size \ Ratio	104	121	143	165	195	231	273	319	377	473	599	649	731	841	1003	1015	1247	1479	1849	2065	2537	3045	3481	4437	5133	6177	7569
606□DA	Long-Life Type Grease (MF)																				2537				5133		
607□DA																											
609□DA, 610□DA																											
612□DA, 612□DB																											
613□DA, 613□DB	Grease (G)																										
613□DC																											
614□DA, 614□DB																											
614□DC																											
616□DA, 616□DB																											
617□DA, 617□DB																											
618□DA																											
616□DC	Oil Bath (PB)																										
617□DC																											
618□DB																											
619□DA, 619□DB																											
6205DA, 6205DB			165																								
6215DA, 6215DB		121																									
6225DA, 6225DB																											
6235DA, 6235DB																											
6245DA, 6245DB																											
6255DA, 6255DB																											
6265DA																											
6275DA			319																								

Note: 1. This table shows the standard lubrication method when the CYCLO® DRIVE is driven at the standard input speed.
2. Grease lubrication is possible for some models with oil lubrication as standards. Consult us in those cases, for performance may vary.
3. □ indicates 0 or 5, expressing the combination with reduction ratio.

Table E-2 Vertical

a) 6000SK Series Vertical

Frame Size \ Nominal Reduction Ratio	2.5	3	4	5	6	8	10
607□SK, 608□SK 609□SK, 610□SK 611□SK	Long-Life Type Grease (MF) *Indication necessary for mounting direction.						

b) 6000 Series Single Reduction Vertical

Frame Size \ Ratio	6	8	11	13	15	17	21	25	29	35	43	51	59	71	87	119
606□	Long-Life Type Grease (MF)										43					
607□													59			
608□															87	
609□, 610□																
611□, 612□																
613□, 614□	Oil Bath (PB)															
616□, 617□	Forced Oil Lubrication (P)															
618□, 619□																
6205, 6215																
6225, 6235																
6245, 6255																
6265																
6275									TP		TP		TP		TP	

TP: Postive Displacement Pump Lubrication (See Table F-3)

c) 6000 Series Double Reduction Vertical

Frame Size \ Ratio	104	121	143	165	195	231	273	319	377	473	599	649	731	841	1003	1015	1247	1479	1849	2065	2537	3045	3481	4437	5133	6177	7569
606□DA	Long-Life Type Grease (MF)																										
607□DA																					2537						
609□DA, 610□DA																									5133		
612□DA, 612□DB																											
613□DA, 613□DB	Grease (G)																										
613□DC																											
614□DA, 614□DB																											
614□DC																											
616□DA, 616□DB																											
617□DA, 617□DB																											
618□DA																											
616□DC										473																	
617□DC														841													
618□DB																1015											
619□DA, 619□DB																				2065							
6205DA, 6205DB				165															1849								
6215DA, 6215DB		121																			2537						
6225DA, 6225DB	Forced Oil Lubrication (P)																										
6235DA, 6235DB																											
6245DA, 6245DB																											
6255DA, 6255DB																											
6265DA																											
6275DA								319	Positive Displacement Pump Lubrication (TP) (See Table F-3)																		

Note: 1. This table shows the standard lubrication method when the CYCLO® DRIVE is driven at the standard input speed.
2. Grease lubrication is possible for some models with oil lubrication as standards. Consult us in those cases, for performance may vary.
3. □ indicates 0 or 5, expressing the combination with reduction ratio.

Lubrication

(2) Electric Pump (Electric Pump Type Forced Oil Lubrication Specification)

Table E-3 Electric Pump Specification

Trochoid pump type	TOP216HA-VB3 with release valve (3-phase induction motor: 0.75kW × 4P Type E)	TOP204HB-VB3 with release valve (3-phase induction motor: 0.4kW × 4P Type E)
Frame size/ reduction ratio	6275/29, 43, 59, 87	6275DA

Note: Although the CYCLO® SPEED REDUCER is capable for most uses with lubrication method in Table E-1 and 2, consult us when using in severe conditions, such as with harsh ambient temperature, input speed, or load condition.

2. Lubricant

(1) Grease Lubrication Models

Grease lubrication models in Table E-4 are packed with grease prior to shipment. They may be used without replenishment.

(i) Maintenance-Free Series

· 6000SK Series

Models in Table E-1 (a) and E-2 (a) are sealed with long-life grease (ALVANIA GREASE EPR000). Although replenishment is hardly necessary, replacement every 20,000 hours or 4~5 years will provide longer lifetime.

*Only designated mounting direction possible.

· 6000 Series

Models in section (MF) in Table E-1 (b) & (c) and E-2 (b) & (c) are sealed with long-life grease (BEN-10 No.2). Although replenishment is hardly necessary, replacement every 20,000 hours or 4~5 years will provide longer lifetime.

*Any mounting direction possible.

(ii) Grease Lubrication Models Other than Indicated in Section (i)

Replenish or replace grease following the Instruction Manual.

Table E-4 Standard Grease

Model	Ambient Temperature [°C]	Model/Part		Company	Brand
CYCLO® 6000SK Series	-10 ~ 40	(i) Maintenance-Free Type Grease Lubrication		Showa Shell	Alvania Grease EPR000
CYCLO® 6000 Series	-10 ~ 50	(i) Maintenance-Free Type Grease Lubrication		Nippeco	BEN-10 No.2
		(ii) Models other than (i)		Cosmo Oil	COSMO GREASE DYNAMAX SH No.2
Sumitomo Motor	-10 ~ 50	Sealed Bearings		Kyodo Yushi	MULTEMP SRL
		Open Bearings	Thermal Class: B	Exxon Mobil	UNIREX N2
			Thermal Class: F	Shell Oil	Stamina RL2

(iii) Consult us when the unit is stored for more than three years. Grease replacement may be necessary.

Note: 1. Do not use grease other than the ones indicated above.
2. Models (ii) in the Table E-4 are packed with COSMO GREASE DYNAMAX SH No.2 prior to shipment.
3. Grease for models (ii) in Table E-4 may be combined with no problem.
4. Consult us when the unit will be operated in temperatures exceeding 0~40°C.

(2) Oil Lubrication Models

Oil lubrication models are shipped without oil. Always fill with lubrication oil to the top red line on the oil gauge before operation.

Table E-5 Recommended Lubrication Oil (SP Type Industrial Extreme-Pressure Gear Oil) Equivalent to Type 2 Industrial Oil in JIS K2219.

Ambient temperature °C	Gulf Oil	Exxson Mobil		Shell Oil	Caltex Oil	BP Oil
-10~5	EP Lubricant HD 68	Spartan EP 68	Mobil gear 600XP 68	Shell Omala S2 G 68	-	Energol GR-XP 68
0 ~ 35	EP Lubricant HD 100 HD 150	Spartan EP 100 EP 150	Mobil gear 600XP 100, 150	Shell Omala S2 G 100, 150	Meropa 100, 150	Energol GR-XP 100 GR-XP 150
30 ~ 50	EP Lubricant HD 220 HD 320 HD 460	Spartan EP 220 EP 320 EP 460	Mobil gear 600XP 220, 320, 460	Shell Omala S2 G 220, 320 460	Meropa 220, 320 460	Energol GR-XP 220 GR-XP 320 GR-XP 460

Note: 1. Use oil with lower viscosity for operation in winter or relatively low ambient temperature, specified in the parenthesis.
2. Consult us for operation in ambient temperatures exceeding 0~40°C.

2. Volume of Oil

Table E-6 Volume of Lubrication Oil, Litres [L] (Approximate)

Single Reduction

Frame Size	613□	614□	616□	617□	618□	619□	6205	6215	6225	6235	6245	6255	6265	6275
Horizontal	0.7	0.7	1.4	1.9	2.5	4.0	5.5	8.5	10	15	16	21	29	56
Vertical	1.1	1.1	1.0	1.9	2.0	2.7	5.7	7.5	10	12	15	35	51	(60)

Double Reduction

Frame Size	616□	617□	618□	619□	619□	6205	6205	6215	6215	6225	6225	6235	6235	6245	6245	6255	6255	6265	6275
	DC	DC	DB	DA	DB	DA	DB	DA	DB	DA	DB	DA	DB	DA	DB	DA	DB	DA	DA
Horizontal	1.5	2.4	3.5	5.8	6.0	6.0	6.0	10	10	11	11	17	17	18	18	23	23	32	60
Vertical	1.0	1.9	2.0	2.7	2.7	11	11	14	14	18	18	23	23	29	29	42	42	51	(60)

Note: 1. □ indicates 0, 5, or H (for certain frame size).
2. ( ) with trochoid pump.

3. Cautions on Oil Seals

Oil seal has limited lifetime. Sealing effect may lower by natural degradation or abrasion by prolonged use. Seal life may vary depending on operation condition and ambient condition of the reducer. Oil seal change every 1~3 years is recommended for normal operation (uniform load, 10 hours/day, at normal temperature).

Nameplate

There are two types of nameplates, Type I and Type II. Refer to the relevant example of the typical plates shown below.

1. For Gearmotor

(1) Nameplate Type I: Gearmotor

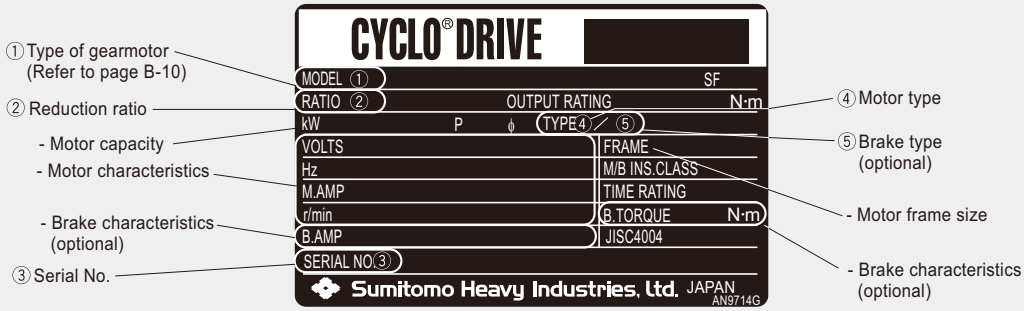
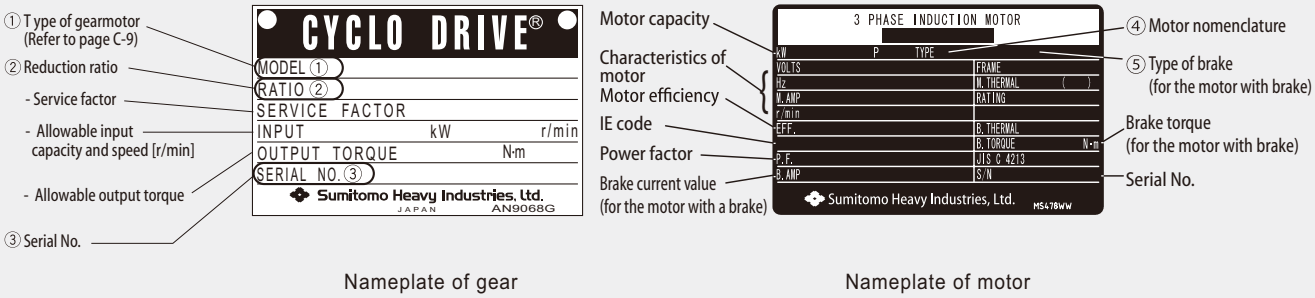


Fig. E-5 Nameplate of Gearmotor (Type I)

(2) Nameplate Type II: Reducer with Motor



Nameplate of gear

Nameplate of motor

Fig. E-6 Nameplates of Reducer with Motor (Type II)

2. For Reducer

(1) Nameplate Type I

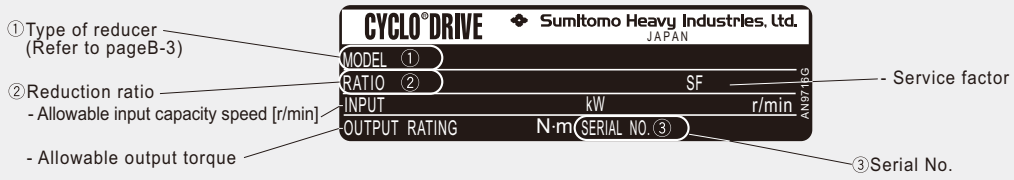


Fig. E-7 Nameplate of Reducer (Type I)

(2) Nameplate Type II

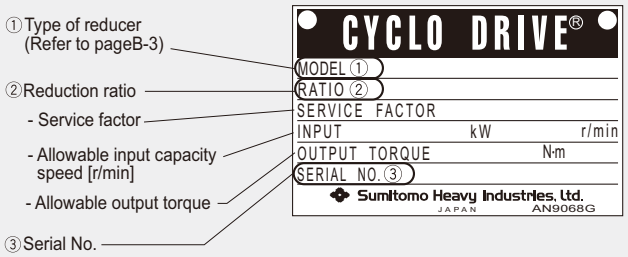


Fig. E-8 Nameplate of Reducer (Type II)

Allowable Radial and Axial Load

Use within the allowable range for the radial and axial load when a gear or a pulley is coupled with CYCLO® reducer.

1. Radial and Axial Load on the Slow Speed Shaft

Confirm the radial axial load on the slow speed shaft using the following formula:

1) Radial load Pr

$$Pr = \frac{T\ell}{R} \leq \frac{Pro}{Lf \cdot Cf \cdot Fs} \quad [N, kgf]$$

2) Axial load Pa

$$Pa \leq \frac{Pao}{Cf \cdot Fs} \quad [N, kgf]$$

3) When radial and axial load co-exist.

$$\left(\frac{Pr \cdot Lf}{Pro} + \frac{Pa}{Pao}\right) \cdot Cf \cdot Fs \leq 1$$

Pr: Actual radial load [N, kgf]
Tℓ: Actual transmitted torque [N·m, kgf·m] on slow speed shaft of the reducer.
R: Pitch circle radius [m] of sprocket, gear, pulley, etc.
Pro: Allowable radial load [N, kgf] (Refer to Selection Table)
Pa: Actual axial load [N, kgf]
Pao: Allowable axial load [N, kgf] (Table E-10)
Lf: Load location factor (Table E-9)
Cf: Coupling factor (Table E-7)
Fs: Shock factor (Table E-8)

- When the radial load exceeds the allowable values, a larger frame size may be selected, but depending upon the extent of the load, this may be avoided by using the heavy radial load type; please refer to Page E-13, 14.
- Consult us when using for application with extremely high startup frequency.

Table E-7 Coupling Factor Cf

Coupling Method	Cf
Chain	1
Gears	1.25
V-Belt	1.5

Table E-8 Shock Factor Fs

Degree of Shock	Fs
Practically no shock	1
Light shock	1~1.2
Severe shock	1.4~1.6

Calculate detailed intermediate values in Tables E-9, 10 according to the interpolation method.

Calculation Example by Interpolation Method

Load Location Factor

Frame size 6075 Load Location Factor for L=18mm is calculated below.

$$1.00 + \frac{1.29-1.00}{20-15} \times (18-15) = 1.17$$

Thrust Load Capacity

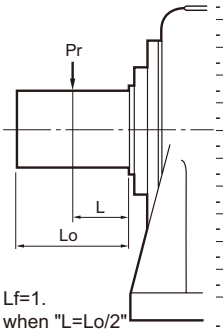
Frame size 6180 Thrust Load Capacity for output speed 130r/min is calculated bellow.

$$12500 + \frac{13100-12500}{150-125} \times (150-130) = 12980 \text{ [N]}$$

Allowable Radial and Axial Load

Table E-9 Load Location Factor (Slow Speed Shaft) Lf

Frame Size		Load Location L [mm]																								
Single Reduction	Double Reduction	~5	10	15	20	25	30	35	40	45	50	60	70	80	90	100	120	140	160	180	200	225	250	275	300
607□SK	-	0.83	0.92	1.00	1.08	1.17	1.25	-	-	-	-	-	-	-	-	-	-	-	-	-					
608□SK	-	0.83	0.90	0.97	1.03	1.10	1.17	1.24	-	-	-	-	-	-	-	-	-	-	-	-					
609□SK	-	0.87	0.92	0.97	1.03	1.08	1.13	1.19	-	-	-	-	-	-	-	-	-	-	-	-					
610□SK	-	0.87	0.92	0.97	1.03	1.08	1.13	1.19	-	-	-	-	-	-	-	-	-	-	-	-					
611□SK	-	0.83	0.88	0.93	0.98	1.02	1.07	1.12	1.17	1.22	-	-	-	-	-	-	-	-	-	-					
606□	606□DA	0.83	0.94	1.19	1.56	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					
607□	607□DA	0.82	0.91	1.00	1.29	1.59	1.88	-	-	-	-	-	-	-	-	-	-	-	-	-					
608□	-	0.81	0.87	0.94	1.03	1.28	1.54	1.80	-	-	-	-	-	-	-	-	-	-	-	-					
609□	609□DA	0.86	0.92	0.97	1.13	1.38	1.64	1.90	-	-	-	-	-	-	-	-	-	-	-	-					
610□	610□DA	0.86	0.92	0.97	1.13	1.38	1.64	1.90	-	-	-	-	-	-	-	-	-	-	-	-					
611□	-	0.78	0.84	0.90	0.96	1.02	1.08	1.19	1.36	1.53	-	-	-	-	-	-	-	-	-	-					
612□	612□DA 612□DB	-	0.82	0.87	0.92	0.97	1.08	1.25	1.42	1.59	1.76	-	-	-	-	-	-	-	-	-					
613□	613□DA 613□DB 613□DC	-	-	0.83	0.87	0.92	0.96	1.00	1.13	1.25	1.38	1.63	1.88	-	-	-	-	-	-	-	-	-	-	-	-
614□	614□DA 614□DB 614□DC	-	-	-	0.66	0.73	0.80	0.87	0.93	1.00	1.10	1.30	1.50	1.70	1.90	-	-	-	-	-	-	-	-	-	-
616□	616□DA 616□DB 616□DC	-	-	-	0.83	0.87	0.90	0.93	0.97	1.00	1.11	1.32	1.53	1.75	1.96	-	-	-	-	-	-	-	-	-	-
617□	617□DA 617□DB 617□DC	-	-	-	0.86	0.89	0.92	0.94	0.97	1.00	1.11	1.32	1.53	1.75	1.96	-	-	-	-	-	-	-	-	-	-
618□	618□DA 618□DB	-	-	-	-	0.85	0.87	0.90	0.93	0.95	0.98	1.09	1.26	1.43	1.60	1.78	-	-	-	-	-	-	-	-	-
619□	619□DA 619□DB	-	-	-	-	-	0.85	0.87	0.89	0.91	0.93	0.97	1.04	1.18	1.32	1.46	1.75	-	-	-	-	-	-	-	-
6205	6205DA 6205DB	-	-	-	-	-	-	-	0.70	0.74	0.77	0.84	0.91	0.98	1.05	1.12	1.26	1.40	1.54	-	-	-	-	-	-
6215	6215DA 6215DB	-	-	-	-	-	-	-	0.70	0.73	0.77	0.84	0.91	0.98	1.05	1.13	1.27	1.41	1.56	-	-	-	-	-	-
6225	6225DA 6225DB	-	-	-	-	-	-	-	0.86	0.88	0.90	0.93	0.96	0.99	1.02	1.06	1.12	1.19	1.25	-	-	-	-	-	-
6235	6235DA 6235DB	-	-	-	-	-	-	-	0.82	0.84	0.85	0.88	0.91	0.94	0.97	1.00	1.06	1.12	1.18	1.24	1.30	-	-	-	-
6245	6245DA 6245DB	-	-	-	-	-	-	-	0.83	0.84	0.86	0.89	0.92	0.94	0.97	1.00	1.06	1.11	1.17	1.23	1.29	-	-	-	-
6255	6255DA 6255DB	-	-	-	-	-	-	-	-	-	0.83	0.85	0.88	0.90	0.93	0.95	1.00	1.05	1.10	1.22	1.36	1.52	1.69	-	-
6265	6265DA	-	-	-	-	-	-	-	-	-	-	-	0.83	0.85	0.88	0.90	0.94	0.98	1.04	1.17	1.29	1.45	1.61	1.77	1.93
6275	6275DA	-	-	-	-	-	-	-	-	-	-	-	-	0.67	0.71	0.75	0.82	0.90	0.98	1.09	1.21	1.35	1.50	1.65	1.79
Single Reduction	Double Reduction	~5	10	15	20	25	30	35	40	45	50	60	70	80	90	100	120	140	160	180	200	225	250	275	300
Frame Size		Load Location L [mm]																							



Note: □ indicates 0 or 5, expressing combination with reduction ratio.

Allowable Radial and Axial Load

Table E-10 Axial Load Capacity (Slow Speed Shaft) Pao (Upper Row: N, Lower Row: kgf)

(When Cf, Lf, Fs=1)

Frame Size		Output Speed [r/min]																
Single Reduction	Double Reduction	~10	15	20	25	30	35	40	50	60	80	100	125	150	200	250	300	~700
607□SK	-	785	785	785	785	785	785	785	785	785	785	785	785	785	785	785	785	785
		80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
608□SK	-	981	981	981	981	981	981	981	981	981	981	981	981	981	981	981	981	981
		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
609□SK	-	981	981	981	981	981	981	981	981	981	981	981	981	981	981	981	981	981
		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
610□SK	-	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470
		150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
611□SK	-	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470
		150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
606□	606□DA	294	294	294	294	294	294	294	294	294	294	294	294	294	294	-	-	
		30	30	30	30	30	30	30	30	30	30	30	30	30	30	-	-	
607□	607□DA	785	785	785	785	785	785	785	785	785	785	785	785	785	785	785	785	
		80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	
608□	-	981	981	981	981	981	981	981	981	981	981	981	981	981	981	981	981	
		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	
609□	609□DA	981	981	981	981	981	981	981	981	981	981	981	981	981	981	981	981	
		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	
610□	610□DA	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	
		150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	
611□	-	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	
		150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	
612□	612□DA	2940	2940	2940	2940	2940	2940	2940	2940	2940	2940	2940	2940	2940	2770	2500	2390	
	612□DB	300	300	300	300	300	300	300	300	300	300	300	300	300	282	255	244	
613□	613□DA 613□DB 613□DC	3920 400	3920 400	3920 400	3920 400	3920 400	3920 400	3920 400	3920 400	3920 400	3920 400	3920 400	3920 400	3920 400	3920 400	3920 400	3920 400	
614□	614□DA 614□DB 614□DC	5400 550	5400 550	5400 550	5400 550	5400 550	5400 550	5400 550	5400 550	5400 550	5230 533	4860 495	4560 465	4370 445	3850 392	3670 374	3450 352	
616□	616□DA 616□DB 616□DC	6870 700	6870 700	6870 700	6870 700	6870 700	6870 700	6870 700	6870 700	6870 700	6870 700	6870 700	6870 700	6870 700	6300 642	5700 581	-	
617□	617□DA 617□DB 617□DC	9810 1000	9810 1000	9810 1000	9810 1000	9810 1000	9810 1000	9810 1000	9810 1000	9810 1000	9810 1000	9810 1000	9680 987	9020 919	8090 825	7330 747	6880 701	
618□	618□DA	13700	13700	13700	13700	13700	13700	13700	13700	13700	13700	13700	13100	12500	11000	-	-	
	618□DB	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400	1340	1270	1120	-	-	
619□	619□DA	19600	19600	19600	19600	19600	19600	19600	19600	19600	19600	19600	18500	17500	15400	-	-	
	619□DB	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1890	1780	1570	-	-	
6205	6205DA	26500	23500	21100	19600	18600	18100	17700	16700	15700	14200	13200	12800	12300	11300	-	-	
	6205DB	2700	2400	2150	2000	1900	1850	1800	1700	1600	1450	1350	1300	1250	1150	-	-	
6215	6215DA	27500	24500	22100	20600	19600	18600	18100	17200	16200	14700	13700	13200	12800	11800	-	-	
	6215DB	2800	2500	2250	2100	2000	1900	1850	1750	1650	1500	1400	1350	1300	1200	-	-	
6225	6225DA	29400	25600	23200	21700	20600	19600	18700	17600	16700	15300	14400	13600	13100	12100	-	-	
	6225DB	3000	2610	2360	2210	2100	2000	1910	1790	1700	1560	1470	1390	1340	1230	-	-	
6235	6235DA	35300	31400	28400	26500	25000	23500	22600	21100	20100	18600	17700	16700	-	-	-	-	
	6235DB	3600	3200	2900	2700	2550	2400	2300	2150	2050	1900	1800	1700	-	-	-	-	
6245	6245DA	37300	33800	30900	28800	27300	26100	25100	23500	22300	21000	19900	19100	-	-	-	-	
	6245DB	3800	3450	3150	2940	2780	2660	2560	2400	2270	2140	2030	1950	-	-	-	-	
6255	6255DA	48100	43100	39400	36900	35100	33600	32300	30400	28500	26800	25500	24200	-	-	-	-	
	6255DB	4900	4390	4020	3760	3580	3430	3290	3100	2910	2730	2600	2470	-	-	-	-	
6265	6265DA	52000	52000	51000	47500	44800	42800	41600	38900	37300	34800	33000	31100	-	-	-	-	
		5300	5300	5200	4840	4570	4360	4240	3970	3800	3550	3360	3170	-	-	-	-	
6275	6275DA	58900	58900	58900	58900	58900	58900	58900	58900	-	-	-	-	-	-	-	-	
		6000	6000	6000	6000	6000	6000	6000	6000	-	-	-	-	-	-	-	-	
Single Reduction	Double Reduction	~10	15	20	25	30	35	40	50	60	80	100	125	150	200	250	300	
Frame Size		Output Speed [r/min]																

Note: □ indicates 0 or 5, expressing combination with reduction ratio.

2. High Capacity Bearing Type (Iron/Ductile Iron) (Optional Items)

When the radial load of the slow speed shaft exceeds the allowable value of the standard CYCLO® reducer, a larger frame size may be selected, but depending upon the degree of the load, this may be avoided by using the heavy radial load type. Refer to Table E-11, 12 for allowable radial load on the slow speed shaft of the heavy radial load type.

Precautions for Selection and Use

1. High capacity bearing is indicated with the suffix "R1" or "R2" after the frame size.
   Example: CHHM5-6135-R2-B-29
2. □ indicates 0, 5, or H.
3. Consult us for the following conditions, which require special considerations:
   - When the shaft direction is vertical (Vertical type).
   - When thrust load is simultaneously exerted on the slow speed shaft.
4. Use JIS B1051 erection bolts, with strength in exceeding 8.8.

Table E-11 Allowable Radial Load Pro (Upper: N, Lower: kgf, Max) on the Slow Speed Shaft of the High Capacity Bearing (R1)

(When Cf, Lf, Fs=1)

Frame Size		Output Speed [r/min]											
Single Reduction	Double Reduction	~1	2	3	4	5	6	8	10	15	20	25	30
613□	613□DA	-	-	-	-	-	-	-	-	-	14700	14700	14700
	613□DB	-	-	-	-	-	-	-	-	-	1500	1500	1500
	613□DC												
616□	616□DA	-	-	-	-	-	-	-	-	-	-	22100	22100
	616□DB	-	-	-	-	-	-	-	-	-	-	2250	2250
	616□DC												
617□	617□DA	-	-	-	-	-	-	-	-	29500	29500	29500	29500
	617□DB	-	-	-	-	-	-	-	-	3010	3010	3010	3010
	617□DC												
618□	618□DA	-	-	-	-	-	-	-	-	41700	41700	41700	41700
	618□DB	-	-	-	-	-	-	-	-	4250	4250	4250	4250
619□	619□DA	-	-	-	-	-	-	-	-	59000	59000	59000	59000
	619□DB	-	-	-	-	-	-	-	-	6010	6010	6010	6010

Frame Size		Output Speed [r/min]										
Single Reduction	Double Reduction	35	40	50	60	80	100	125	150	200	250	300
613□	613□DA	14700	14700	14700	14700	14100	13500	12600	11900	10900	10200	9660
	613□DB	1500	1500	1500	1500	1440	1380	1280	1210	1110	1040	985
	613□DC											
616□	616□DA	22100	22100	22100	22100	22100	21600	20100	19000	17500	16300	15400
	616□DB	2250	2250	2250	2250	2250	2200	2050	1940	1780	1660	1570
	616□DC											
617□	617□DA	29500	29500	29500	29500	29500	29300	27400	25900	23800	22200	21100
	617□DB	3010	3010	3010	3010	3010	2990	2790	2640	2430	2260	2150
	617□DC											
618□	618□DA	41700	41700	41700	41700	41300	38600	36200	34200	31400	-	-
	618□DB	4250	4250	4250	4250	4210	3930	3690	3490	3200	-	-
619□	619□DA	59000	59000	55200	53000	47200	44000	41000	38300	34700	-	-
	619□DB	6010	6010	5630	5400	4810	4490	4180	3900	3540	-	-

Note: □ indicates 0 or 5, expressing combination with reduction ratio.

Allowable Radial and Axial Load

Table E-12 Allowable Radial Load Pro (Upper: N, Lower: kgf, Max) on the Slow Speed Shaft of High Capacity Bearing with Ductile Iron (R2)

(Cf, Lf, Fs=1)

Frame Size		Output Speed [r/min]											
Single Reduction	Double Reduction	~1	2	3	4	5	6	8	10	15	20	25	30
613□	613□DA	24000	24000	24000	24000	24000	24000	24000	24000	23800	21800	20400	19300
	613□DB	2450	2450	2450	2450	2450	2450	2450	2450	2430	2220	2080	1970
	613□DC												
616□	616□DA	33600	33600	33600	33600	33600	33600	33600	33600	33600	33600	33300	31500
	616□DB	3430	3430	3430	3430	3430	3430	3430	3430	3430	3430	3390	3210
	616□DC												
617□	617□DA	45900	45900	45900	45900	45900	45900	45900	45900	45900	45900	45300	42900
	617□DB	4680	4680	4680	4680	4680	4680	4680	4680	4680	4680	4620	4370
	617□DC												
618□	618□DA	55700	55700	55700	55700	55700	55700	55700	55700	55700	55700	55700	55700
	618□DB	5680	5680	5680	5680	5680	5680	5680	5680	5680	5680	5680	5680
619□	619□DA	71800	71800	71800	71800	71800	71800	71800	71800	71800	71800	71800	69300
	619□DB	7320	7320	7320	7320	7320	7320	7320	7320	7320	7320	7320	7060
6205	6205DA	97800	97800	97800	97800	97800	97800	97800	97800	89100	-	-	-
	6205DB	9970	9970	9970	9970	9970	9970	9970	9970	9080	-	-	-
6215	6215DA	132000	132000	132000	132000	126000	119000	109000	-	-	-	-	-
	6215DB	13500	13500	13500	13500	12800	12100	11100	-	-	-	-	-
6225	6225DA	161000	161000	161000	161000	156000	148000	135000	126000	112000	103000	96300	91100
	6225DB	16400	16400	16400	16400	15900	15100	13800	12800	11400	10500	9820	9290
6235	6235DA	183000	183000	183000	183000	183000	183000	170000	159000	141000	129000	121000	114000
	6235DB	18700	18700	18700	18700	18700	18700	17300	16200	14400	13100	12300	11600
6245	6245DA	223000	223000	223000	223000	209000	198000	181000	169000	150000	138000	129000	122000
	6245DB	22700	22700	22700	22700	21300	20200	18500	17200	15300	14100	13100	12400
6255	6255DA	274000	274000	274000	274000	258000	244000	224000	210000	185000	170000	159000	151000
	6255DB	27900	27900	27900	27900	26300	24900	22800	21400	18900	17300	16200	15400
6265	6265DA	283000	283000	283000	283000	283000	283000	270000	253000	224000	205000	191000	181000
		28800	28800	28800	28800	28800	28800	27500	25800	22800	20900	19500	18500
6275	6275DA	272000	272000	272000	272000	272000	272000	272000	272000	272000	272000	272000	272000
		27700	27700	27700	27700	27700	27700	27700	27700	27700	27700	27700	27700

Frame Size		Output Speed [r/min]										
Single Reduction	Double Reduction	35	40	50	60	80	100	125	150	200	250	300
613□	613□DA	18400	17800	16500	15600	14400	13500	12600	11900	10900	10200	9660
	613□DB	1880	1810	1680	1590	1470	1380	1280	1210	1110	1040	985
	613□DC											
616□	616□DA	30100	28900	27000	25600	23500	22000	20500	19400	17900	16600	15400
	616□DB	3070	2950	2750	2610	2400	2240	2090	1980	1820	1690	1570
	616□DC											
617□	617□DA	40900	39300	36800	34800	31900	29900	27900	26400	24300	22200	21100
	617□DB	4170	4010	3750	3550	3250	3050	2840	2690	2480	2260	2150
	617□DC											
618□	618□DA	54000	51900	48500	45900	42100	39400	36900	34900	32000	-	-
	618□DB	5500	5290	4940	4680	4290	4020	3760	3560	3260	-	-
619□	619□DA	66100	63500	59400	56300	51600	48300	45100	42800	39300	-	-
	619□DB	6740	6470	6060	5740	5260	4920	4600	4360	4010	-	-
6205	6205DA	-	-	-	-	-	-	-	-	-	-	-
	6205DB	-	-	-	-	-	-	-	-	-	-	-
6215	6215DA	-	-	-	-	-	-	-	-	-	-	-
	6215DB	-	-	-	-	-	-	-	-	-	-	-
6225	6225DA	87000	83500	78100	74000	67900	63500	59400	56300	51500	-	-
	6225DB	8870	8510	7960	7540	6920	6470	6060	5740	5250	-	-
6235	6235DA	109000	105000	98100	92900	85300	79800	74500	-	-	-	-
	6235DB	11100	10700	10000	9470	8700	8130	7590	-	-	-	-
6245	6245DA	116000	112000	105000	98900	90800	84900	79400	-	-	-	-
	6245DB	11800	11400	10700	10100	9260	8650	8090	-	-	-	-
6255	6255DA	144000	139000	129000	123000	112000	105000	98300	-	-	-	-
	6255DB	14700	14200	13100	12500	11400	10700	10000	-	-	-	-
6265	6265DA	174000	166000	156000	148000	135000	126000	118000	-	-	-	-
		17700	16900	15900	15100	13800	12800	12000	-	-	-	-
6275	6275DA	-	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	-	-

Note: □ indicates 0 or 5, expressing combination with reduction ratio.

Allowable Radial and Axial Load

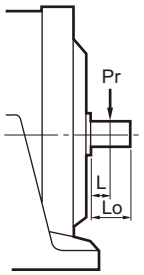
Confirm the radial load on the high speed shaft, following the formula below:

$$Pr \leq \frac{Pro}{Lf \cdot Cf \cdot Fs} \text{ [N, kgf]}$$

Pr: Actual radial load [N, kgf]
Pro: Allowable radial load [N, kgf]
Lf: Load location factor (Table E-11)
Cf: Coupling factor (Table E-5)
Fs: Shock factor (Table E-6)

Table E-13 Radial Load Location Factor (High Speed Shaft) Lf

Frame Size		Output Speed [r/min]																			
Single Reduction	Double Reduction	5	10	15	20	25	30	35	40	45	50	60	70	80	90	100	120	140	160	180	200
607□SK	-	0.72	0.91	1.09	1.28	1.46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
608□SK	-	0.90	0.97	1.03	1.10	1.16	-	-	-	-	-	-	-	-	-	-					-
609□SK	-	0.90	0.97	1.03	1.10	1.16	-	-	-	-	-	-	-	-	-	-					-
610□SK	-	0.75	0.92	1.08	1.25	1.42	-	-	-	-	-	-	-	-	-	-					-
611□SK	-	0.87	0.92	0.97	1.03	1.08	1.13	1.18	-	-	-	-	-	-	-	-					-
606□	606□DA, 607□DA	0.73	0.91	1.20	1.60	2.00	-	-	-	-	-	-	-	-	-	-					-
607□	609□DA, 610□DA, 612□DA 613□DA, 614□DA	0.73	0.91	1.20	1.60	2.00	-	-	-	-	-	-	-	-	-	-					-
608□	-	0.73	0.91	1.20	1.60	2.00	-	-	-	-	-	-	-	-	-	-					-
609□	612□DB, 613□DB, 614□DB 616□DA, 617□DA	0.88	0.96	1.20	1.59	2.00	2.38	-	-	-	-	-	-	-	-	-					-
610□	613□DC, 614□DC, 616□DB 617□DB, 618□DA	0.91	0.97	1.20	1.59	2.00	2.38	-	-	-	-	-	-	-	-	-					-
611□	-	0.91	0.97	1.20	1.59	2.00	2.38	-	-	-	-	-	-	-	-	-					-
612□	616□DC, 617□DC 619□DA, 6205DA	-	0.81	0.93	1.14	1.41	1.67	1.96	2.22	-	-	-	-	-	-	-	-	-	-	-	-
613□	618□DB, 619□DB, 6205DB 6215DA, 6225DA	-	0.78	0.89	1.00	1.23	1.45	1.69	1.92	2.13	-	-	-	-	-	-	-	-	-	-	-
614□	-	-	0.78	0.89	1.00	1.23	1.45	1.69	1.92	2.13	-	-	-	-	-	-	-	-	-	-	-
616□	6215DB, 6235DA, 6245DA	-	0.92	0.95	0.98	1.05	1.18	1.28	1.41	1.52	1.64	1.85	-	-	-	-	-	-	-	-	-
617□	6225DA, 6255DB	-	-	0.93	0.96	0.99	1.05	1.16	1.28	1.39	1.49	1.72	1.92	2.17	-	-	-	-	-	-	-
618□	6235DB, 6245DB	-	-	-	0.93	0.96	0.99	1.05	1.15	1.25	1.35	1.56	1.75	1.96	2.17	-	-	-	-	-	-
619□	6255DB, 6265DA, 6275DA	-	-	-	0.93	0.95	0.98	1.00	1.09	1.16	1.25	1.41	1.59	1.75	1.92	2.08	-	-	-	-	-
6205	-	-	-	-	-	0.93	0.95	0.97	1.00	1.04	1.10	1.22	1.33	1.45	1.56	1.68	1.91	-	-	-	-
6215	-	-	-	-	-	0.93	0.95	0.98	1.00	1.03	1.08	1.19	1.29	1.40	1.51	1.61	1.82	-	-	-	-
6225	-	-	-	-	-	0.94	0.96	0.98	1.00	1.02	1.04	1.08	1.14	1.24	1.33	1.42	1.60	-	-	-	-
6235	-	-	-	-	-	0.84	0.86	0.87	0.89	0.93	0.98	1.07	1.16	1.25	1.34	1.44	1.62	-	-	-	-
6245	-	-	-	-	-	0.91	0.92	0.94	0.96	0.98	0.99	1.07	1.15	1.24	1.33	1.42	1.59	-	-	-	-
6255	-	-	-	-	-	-	-	0.92	0.93	0.94	0.96	0.99	1.03	1.09	1.16	1.22	1.34	1.47	1.60	1.72	-
6265	-	-	-	-	-	-	-	0.92	0.93	0.94	0.96	0.99	1.03	1.09	1.16	1.22	1.34	1.47	1.60	1.72	-
6275	-	-	-	-	-	-	-	-	-	0.93	0.94	0.97	0.99	1.04	1.14	1.22	1.39	1.56	1.72	1.92	2.08
Single Reduction	Double Reduction	5	10	15	20	25	30	35	40	45	50	60	70	80	90	100	120	140	160	180	200
Frame Size		Output Speed [r/min]																			



Lf=1
when "L=Lo/2"

Note: □ indicates 0 or 5, expressing combination with reduction ratio.

Allowable Radial and Axial Load

Table E-14 Radial Load Capacity (High Speed Shaft) Pro (Upper row: N, Lower row: kgf)

(When Cf, Lf, Fs=1)

Frame Size		Reduction Ratio (Double Reduction: Input side)	Input Speed [r/min]						
Single Reduction	Double Reduction		1750	1450	1165	980	870	720	580
607□SK	-	2.5 - 10	196 20	147 15	147 15	196 20	196 20	196 20	196 20
608□SK	-	2.5 - 10	196 20	147 15	147 15	196 20	196 20	196 20	196 20
609□SK	-	2.5 - 10	294 30	294 30	294 30	294 30	294 30	294 30	294 30
610□SK	-	2.5 - 10	441 45	441 45	491 50	540 55	589 60	589 60	589 60
611□SK	-	2.5 - 10	441 45	343 35	441 45	491 50	491 50	540 55	589 60
606□	606□DA, 607□DA	6 - 17, 25 - 35	196 20	147 15	147 15	196 20	196 20	196 20	196 20
		21, 43	49.1 5	49.1 5	49.1 5	49.1 5	49.1 5	147 15	196 20
607□	609□DA, 610□DA, 612□DA 613□DA, 614□DA	6 - 17, 25 - 35, 51, 59	196 20	147 15	147 15	196 20	196 20	196 20	196 20
		21, 43	49.1 5	49.1 5	49.1 5	49.1 5	49.1 5	147 15	196 20
608□	-	6 - 15, 21 - 29, 43 - 59, 87	196 20	147 15	147 15	196 20	196 20	196 20	196 20
		17, 35, 71	49.1 5	49.1 5	49.1 5	49.1 5	49.1 5	147 15	196 20
609□	612□DB, 613□DB, 614□DB 616□DA, 617□DA	6 - 17, 25 - 71, 119	294 30	294 30	294 30	294 30	294 30	294 30	294 30
		21, 87	196 20	196 20	196 20	196 20	245 25	245 25	294 30
610□	613□DC, 614□DC, 616□DB 617□DB, 618VDA	6 - 11, 17 - 119	441 45	441 45	491 50	540 55	589 60	589 60	589 60
		13, 15	441 45	343 35	441 45	491 50	491 50	540 55	589 60
611□	-	6, 8, 21 - 87	441 45	343 35	441 45	491 50	491 50	540 55	589 60
		11 - 17	196 20	196 20	196 20	196 20	245 25	245 25	294 30
612□	616□DC, 617□DC 619□DA, 6205DA	6 - 17	590 60	690 70	740 75	780 80	880 90	880 90	880 90
		21 - 87	540 55	440 45	490 50	540 55	590 60	880 90	880 90
613□	618□DB, 619□DB, 6205DB 6215DA, 6225DA	6 - 17, 21	1370 140	1370 140	1370 140	1520 155	1620 165	1720 175	1860 190
		25 - 87	1280 130	1280 130	1280 130	1370 140	1470 150	1570 160	1770 180
614□	-	6, 8	1370 140	1370 140	1370 140	1520 155	1620 165	1720 175	1860 190
		11 - 21	1230 125	980 100	1080 110	1180 120	1230 125	1320 135	1470 150
		25	1080 110	1130 115	1180 120	1280 130	1320 135	1370 140	1470 150
		29 - 87	540 55	590 60	590 60	690 70	690 70	690 70	1080 110
616□	6215DB, 6235DA, 6245DA	8 - 25, 51, 59	1770 180	1770 180	1960 200	2060 210	2160 220	2160 220	2160 220
		29 - 43, 71, 87	1080 110	1180 120	1280 130	1370 140	1370 140	1570 160	1770 180
617□	6225DA, 6255DB	11 - 87	2060 210	2060 210	2260 230	2260 230	2350 240	2450 250	2650 270
618□	6235DB, 6245DB	11 - 87	2750 280	2550 260	2750 280	2940 300	3040 310	3340 340	3430 350
619□	6255DB, 6265DA, 6275DA	11 - 25	3040 310	3040 310	3240 330	3530 360	3630 370	3920 400	3920 400
		29 - 87	2650 270	2550 260	2840 290	2940 300	3140 320	3340 340	3630 370
6205	-	11 - 87	5400 550	4910 500	5400 550	5890 600	6080 620	6230 635	6180 630
6215	-	11 - 87	5740 585	5100 520	5440 555	6130 625	6330 645	6820 695	7260 740
6225	-	11 - 87	6620 675	5790 590	5980 610	6130 655	6620 675	6970 710	7500 765
6235	-	11 - 87	- -	- -	10000 1020	9520 970	9170 935	8980 915	8730 890
6245	-	11 - 87	- -	- -	11100 1130	10100 1030	10100 1030	10600 1080	11200 1140
6255	-	11 - 87	- -	- -	11800 1200	10800 1100	11300 1150	12300 1250	13100 1340
6265	-	11 - 87	- -	- -	11800 1200	10800 1100	11300 1150	12300 1250	13100 1340
6275	-	29 - 87	- -	- -	14700 1500	14700 1500	14700 1500	14700 1500	14700 1500
Single Reduction	Double Reduction	Reduction Ratio (Double Reduction: Input side)	1750	1450	1165	980	870	720	580
Frame Size			Input Speed [r/min]						

Note: □ indicates 0 or 5, expressing combination with reduction ratio.

1. Starting Time Moment of Inertia

For successful starting of a driven machine, the starting torque must be adequately larger than the load torque and even after start operation, the motor torque must consistently be greater than the load torque, until reaching full load speed.
The difference between the motor torque and the load torque-during the starting period is referred to as the accelerating torque. If the average accelerating torque is taken as $\overline{T}a$ [N·m, kgf·m], the starting time ts [s] up to the rotating speed n [r/min], is calculated according to the following formula:

$$ts = \frac{(J_M+J_C+J_L)\cdot n}{9.55\cdot \overline{T}a} \quad [S]$$

$$ts = \frac{(GD^2_M+GD^2_C+GD^2_L)\cdot n}{375\cdot \overline{T}a} \quad [S]$$

J_M: Motor moment of inertia (Including brake drum)
J_C: CYCLO® reducer moment of Inertia
J_L: Driven machine moment of Inertia (Including coupling and pulley) when converted to the motor shaft.
GD^2_M: GD^2 of motor (Including brake drum)
GD^2_C: GD^2 of CYCLO® reducer
GD^2_L: GD^2 of driven machine (Including coupling and pulley) when converted to the motor shaft.

Average Accelerating Torque $\overline{T}a$

Average accelerating torque refers to the average value of the difference between the motor torque and the load torque or the actual torque for accelerating the load, as shown in the right graph. For determining the starting time, the motor torque curve and load torque curve are necessary. However, since it is extremely difficult to determine the average accelerating torque by this method, the average accelerating torque at the actual load time is calculated according to the following formula:
When starting at full voltage, the rough average accelerating torque Ta [N·m kgf·m] may be calculated by the following formula:

$$\overline{T}a \div 0.8 \left(\frac{Ts+Tm}{2}\right) - \overline{T}_L \text{ [N·m, kgf·m]}$$

Furthermore, if the average load torque $\overline{T}_L$ [N·m, kgf·m] during the starting period is equivalent to the full load torque, rough $\overline{T}_L$ [N·m, kgf·m] of the motor may be close to the following:

In case of constant torque load $\overline{T}_L \div T_L$ [N·m, kgf·m]
In case of square of reduced torque load $\overline{T}_L \div 0.34T_L$[N·m, kgf·m]

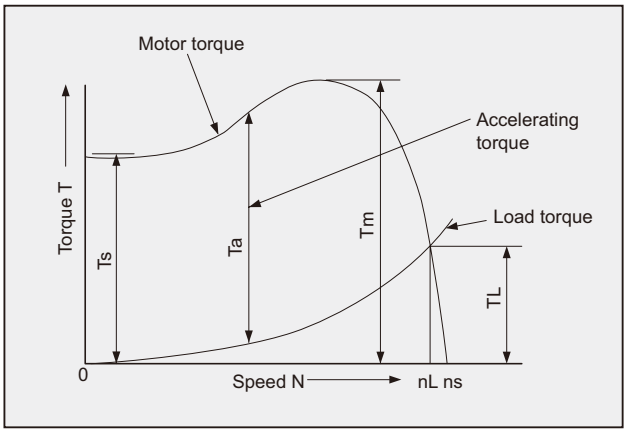


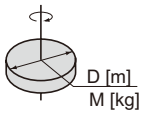
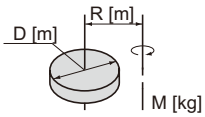
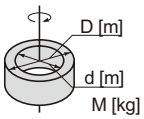
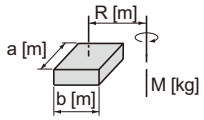
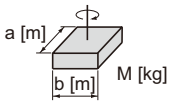
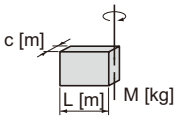
Fig E-9 Torque Curve

Ts: Starting torque
Tm: Maximum torque (Stalling torque)
Ta: Accelerating torque
TL: Full load torque
ns: Synchronous rotating speed
nL: Full load rotating speed

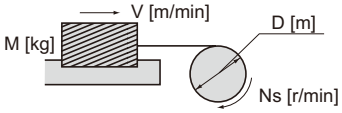
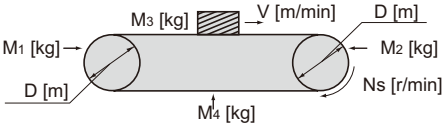
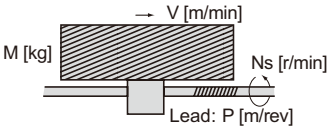
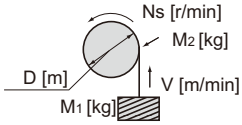
Introduction to Moment of Inertia · GD²

2. Calculation of Moment of Inertia

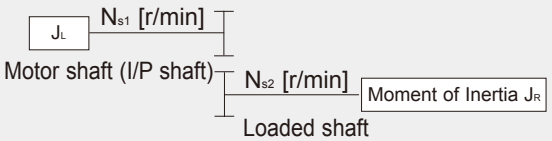
(1) Moment of Inertia of Rotating Motion

Rotating motion on the center of gravity		Rotating motion off the center of gravity	
	$J=\frac{1}{8}MD^2$ [kg·m²]		$J=\frac{M}{4}\left(\frac{1}{2}D^2+4R^2\right)$ [kg·m²]
	$J=\frac{1}{8}M(D^2+d^2)$ [kg·m²]		$J=\frac{M}{4}\left(\frac{a^2+b^2}{3}+4R^2\right)$ [kg·m²]
	$J=\frac{1}{12}M(a^2+b^2)$ [kg·m²]		$J=\frac{1}{12}M(4L^2+C^2)$ [kg·m²]

(2) Moment of Inertia of Rectilinear Motion (Loaded Shaft Side)

General application		$J=\frac{M}{4}\left(\frac{V}{\pi Ns}\right)^2=\frac{M}{4}D^2$ [kg·m²]
Horizontal motion by conveyor		$J=\frac{M}{4}\left(\frac{M_1+M_2}{2}+M_3+M_4\right)\times D^2$ [kg·m²]
Horizontal motion by lead screw		$J=\frac{M}{4}\left(\frac{V}{\pi Ns}\right)^2=\frac{M}{4}\left(\frac{P}{\pi}\right)^2$ [kg·m²]
Vertical motion by hoist		$J=\frac{M_1D^2}{4}+\frac{1}{8}M_2D^2$ [kg·m²]

(3) Calculation of Moment of Inertia at Different Rotating Speeds

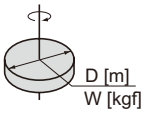
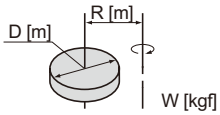
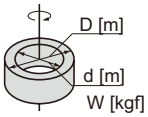
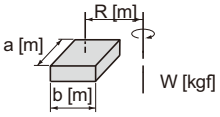
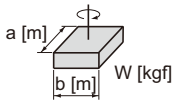
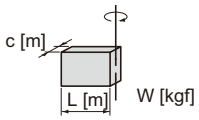


$J_L=\left(\frac{N_{s2}}{N_{s1}}\right)^2 J_R=\left(\frac{1}{Z}\right)^2 J_R$

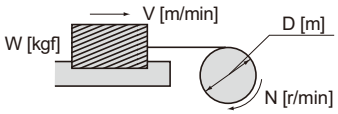
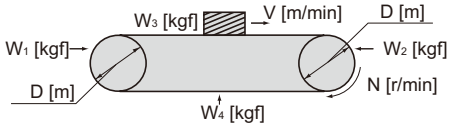
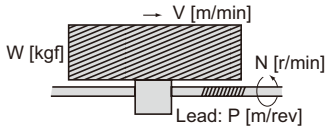
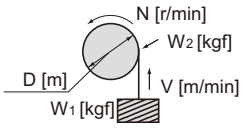
Z: Total ratio

3. Calculation of GD²

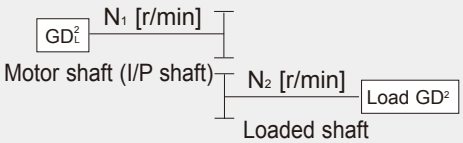
(1) GD² of Rotating Motion

Rotating motion on the center of gravity		Rotating motion off the center of gravity	
	$GD^2=\frac{1}{2}WD^2$ [kgf·m²]		$GD^2=W\left(\frac{1}{2}D^2+4R^2\right)$ [kgf·m²]
	$GD^2=\frac{1}{2}W(D^2+d^2)$ [kgf·m²]		$GD^2=W\left(\frac{a^2+b^2}{3}+4R^2\right)$ [kgf·m²]
	$GD^2=\frac{1}{3}W(a^2+b^2)$ [kgf·m²]		$GD^2=\frac{1}{3}W(4L^2+C^2)$ [kgf·m²]

(2) GD² of Rectilinear Motion (Loaded Shaft Side GD²)

General application		$GD^2=W\left(\frac{V}{\pi\cdot N}\right)^2=WD^2$	[kgf·m²]
Horizontal motion by conveyor		$GD^2=\left(\frac{W_1+W_2}{2}+W_3+W_4\right)\times D^2$	[kgf·m²]
Horizontal motion by lead screw		$GD^2=W\left(\frac{V}{\pi\cdot N}\right)^2=W\left(\frac{P}{\pi}\right)^2$	[kgf·m²]
Vertical motion by hoist		$GD^2=W_1D^2+\frac{1}{2}W_2D^2$	[kgf·m²]

(3) Calculation of Moment of Inertia at Different Rotating Speeds



$GD_L^2=\left(\frac{N_2}{N_1}\right)^2GD^2=\left(\frac{1}{Z}\right)^2GD^2$

Z: Total ratio

Introduction to Moment of Inertia · GD^2

Moment of Inertia · GD^2

Table E-15 Moment of Inertia, GD^2 on Motor Shaft of CYCLO® Gearmotor (Single Stage Reduction, CYCLO Part Only)

Unit: GD_C^2 ($\times 10^{-4}$kgf·m^2) J_C (Moment of inertia) ($\times 10^{-4}$kg·m^2)

Frame Size	Reduction Ratio															
	6		8		11		13		15		17		21		25	
	GD_C^2	J_C	GD_C^2	J_C	GD_C^2	J_C	GD_C^2	J_C	GD_C^2	J_C	GD_C^2	J_C	GD_C^2	J_C	GD_C^2	J_C
6060 6065	0.666	0.167	0.532	0.133	0.449	0.112	0.423	0.106	0.407	0.102	0.396	0.099	0.378	0.095	0.366	0.092
6070 6075	0.682	0.171	0.541	0.135	0.454	0.114	0.426	0.107	0.409	0.102	0.398	0.100	0.379	0.095	0.367	0.092
6080 6085	1.61	0.403	1.32	0.330	1.12	0.280	1.07	0.268	1.02	0.255	0.997	0.249	0.688	0.172	0.665	0.166
6090 6095	3.82	0.955	2.96	0.740	2.37	0.593	2.49	0.623	2.42	0.605	2.12	0.530	1.61	0.403	1.56	0.390
6100 6105	3.07	0.768	2.22	0.555	1.36	0.340	1.40	0.350	1.28	0.320	0.897	0.224	1.03	0.258	0.942	0.236
6110 6115	5.99	1.50	4.44	1.11	3.38	0.845	3.07	0.768	2.88	0.720	2.75	0.688	2.44	0.610	2.38	0.595
6120 6125	12.4	3.10	10.1	2.53	6.24	1.56	6.82	1.71	6.46	1.62	4.82	1.21	5.56	1.39	5.17	1.29
6130 6135	34.3	8.58	23.5	5.88	17.3	4.33	14.7	3.68	13.2	3.30	12.1	3.03	10.0	2.51	9.39	2.35
6140 6145	37.7	9.43	25.6	6.40	18.2	4.55	14.7	3.68	13.3	3.33	11.8	2.95	10.1	2.52	9.41	2.35
6160 6165	98.7	24.7	68.9	17.2	45.4	12.4	41.5	11.0	37.7	9.90	32.2	8.35	29.9	7.65	28.2	71.5
6170 6175	264	66.0	197	49.3	153	37.5	140	35.3	124	31.3	119	30.0	111	28.0	107	27.0
6180 6185	-	-	-	-	231	58.5	209	52.8	186	46.8	177	44.5	167	42.3	156	39.3
6190 6195	-	-	-	-	545	136	503	126	478	120	460	115	428	107	415	104
6205	-	-	-	-	646	162	-	-	565	141	-	-	517	129	-	-
6215	-	-	-	-	990	248	-	-	864	216	-	-	789	197	-	-
6225	-	-	-	-	1220	305	-	-	1030	258	-	-	927	232	-	-
6235	-	-	-	-	1990	498	-	-	1710	428	-	-	1530	383	-	-
6245	-	-	-	-	3610	903	-	-	3170	793	-	-	2890	723	-	-
6255	-	-	-	-	5870	1470	-	-	5120	1280	-	-	4630	1160	-	-
6265	-	-	-	-	8590	2150	-	-	7460	1870	-	-	6800	1700	-	-
6275	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Frame Size	Reduction Ratio															
	29		35		43		51		59		71		87		119	
	GD_C^2	J_C	GD_C^2	J_C	GD_C^2	J_C	GD_C^2	J_C	GD_C^2	J_C	GD_C^2	J_C	GD_C^2	J_C	GD_C^2	J_C
6060 6065	0.361	0.090	0.356	0.089	0.351	0.088	-	-	-	-	-	-	-	-	-	-
6070 6075	0.362	0.091	0.356	0.089	0.351	0.088	0.348	0.087	0.346	0.087	-	-	-	-	-	-
6080 6085	0.650	0.163	0.633	0.158	0.380	0.095	0.373	0.093	0.370	0.093	0.365	0.091	0.363	0.091	-	-
6090 6095	1.30	0.325	1.01	0.253	0.993	0.248	0.968	0.242	0.723	0.181	0.954	0.239	0.712	0.178	0.944	0.236
6100 6105	0.651	0.163	0.607	0.152	0.573	0.143	0.790	0.198	0.528	0.132	0.767	0.192	0.511	0.128	0.750	0.188
6110 6115	2.32	0.580	2.23	0.558	2.19	0.548	2.13	0.533	2.12	0.530	2.10	0.525	2.09	0.523	-	-
6120 6125	3.63	0.908	3.46	0.865	3.30	0.825	4.58	1.15	3.15	0.788	4.48	1.12	3.04	0.760	-	-
6130 6135	8.63	2.16	8.33	2.08	7.84	1.96	7.71	1.93	7.64	1.91	7.45	1.86	7.40	1.85	-	-
6140 6145	8.63	2.16	8.34	2.09	7.84	1.96	7.65	1.91	7.64	1.91	7.45	1.86	7.40	1.85	-	-
6160 6165	25.2	6.35	24.3	6.10	23.3	5.85	23.0	5.75	23.1	5.78	22.1	5.53	21.8	5.45	-	-
6170 6175	102	25.5	100	25.3	97.7	24.5	96.7	24.2	95.6	23.9	95.2	23.8	94.7	23.7	-	-
6180 6185	149	37.5	147	37.0	144	36.0	140	35.0	139	34.8	138	34.5	137	34.3	-	-
6190 6195	402	101	393	98.3	387	96.8	383	95.8	380	95.0	378	94.5	376	94.0	-	-
6205	482	121	-	-	460	115	-	-	451	113	-	-	446	117	-	-
6215	735	184	-	-	700	175	-	-	686	172	-	-	678	170	-	-
6225	840	210	-	-	788	197	-	-	766	192	-	-	753	188	-	-
6235	1410	353	-	-	1340	335	-	-	1300	325	-	-	1290	323	-	-
6245	2720	680	-	-	2600	650	-	-	2550	638	-	-	2530	633	-	-
6255	4320	1080	-	-	4140	1040	-	-	4060	1020	-	-	4010	1000	-	-
6265	6330	1580	-	-	6030	1510	-	-	5900	1480	-	-	5820	1460	-	-
6275	19600	4900	-	-	18900	4730	-	-	18600	4650	-	-	18400	4600	-	-

Note: 1. Table E-15 does not include GD^2 of motor.
Obtain the GD^2 of the single stage reduction gearmotor by adding the GD^2 of the motor Tables E-19, 20.
2. Calculate the GD^2 of the 2-Stage reduction model from the following formula:

$$GD^2 \text{ of the 2-stage reduction model} = GD^2 \text{ of 1st stage} + \frac{GD^2 \text{ (2nd stage)}}{(\text{Reduction ratio of 1st stage})^2}$$

Calculate the GD^2 of the 1st stage (input side)in the same manner as calculating the GD^2 of single stage reduction model.
For the GD^2 of the 2nd stage (output side), the values shown in Table E-15 may be used.

*The values in Table E-15 are subject to change without notice.

Table E-16 Moment of Inertia · GD² on High Speed Shaft of CYCLO® Reducer (Single Stage Reducer)

Unit: GD^2_C ($\times 10^{-4}$kgf·m²) J_C (Moment of inertia) ($\times 10^{-4}$kg·m²)

Frame Size	Reduction Ratio															
	6		8		11		13		15		17		21		25	
	GD^2_C	J_C	GD^2_C	J_C	GD^2_C	J_C	GD^2_C	J_C	GD^2_C	J_C	GD^2_C	J_C	GD^2_C	J_C	GD^2_C	J_C
6060 6065	0.764	0.191	0.630	0.158	0.547	0.137	0.521	0.130	0.505	0.126	0.494	0.124	0.476	0.119	0.464	0.116
6070 6075	0.780	0.195	0.639	0.160	0.552	0.138	0.524	0.131	0.507	0.127	0.496	0.124	0.477	0.119	0.465	0.116
6080 6085	1.70	0.425	1.41	0.353	1.22	0.305	1.16	0.290	1.11	0.278	1.09	0.273	0.782	0.196	0.759	0.190
6090 6095	4.06	1.015	2.73	0.683	2.60	0.650	2.25	0.563	2.18	0.545	2.36	0.590	1.380	0.345	1.330	0.333
6100 6105	3.32	0.830	1.98	0.495	1.60	0.400	1.15	0.288	1.03	0.259	1.18	0.295	0.783	0.196	0.695	0.174
6110 6115	6.23	1.56	4.68	1.17	3.62	0.905	3.31	0.828	3.12	0.780	2.99	0.748	2.68	0.670	2.62	0.655
6120 6125	13.8	3.45	8.68	2.17	7.64	1.91	5.42	1.36	5.06	1.27	6.22	1.56	4.17	1.04	3.77	0.943
6130 6135	36.8	9.20	26.0	6.50	19.8	4.95	17.2	4.30	15.8	3.95	14.6	3.65	12.6	3.15	18.9	4.73
6140 6145	41.7	10.4	28.9	7.23	21.2	5.30	17.3	4.33	15.8	3.95	14.5	3.63	12.6	3.15	12.0	3.00
6160 6165	146	36.5	116	29.0	92.6	23.2	88.7	22.2	84.9	21.2	79.4	19.9	77.1	19.3	75.4	18.9
6170 6175	315	78.8	248	62.0	204	51.0	191	47.8	175	43.8	170	42.5	161	40.3	158	39.5
6180 6185	-	-	-	-	292	73.0	271	67.8	247	61.8	239	59.8	228	57.0	217	54.3
6190 6195	-	-	-	-	678	169	636	159	611	152	594	148	561	140	548	137
6205	-	-	-	-	946	237	-	-	864	216	-	-	817	204	-	-
6215	-	-	-	-	1490	373	-	-	1360	340	-	-	1290	323	-	-
6225	-	-	-	-	1930	483	-	-	1750	438	-	-	1640	410	-	-
6235	-	-	-	-	3240	810	-	-	2960	740	-	-	2780	695	-	-
6245	-	-	-	-	4940	1240	-	-	4500	1130	-	-	4220	1060	-	-
6255	-	-	-	-	8910	2230	-	-	8160	2040	-	-	7670	1920	-	-
6265	-	-	-	-	11700	2930	-	-	10600	2650	-	-	9960	2490	-	-
6275	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Frame Size	Reduction Ratio																GD^2 of fan Moment of Inertia	
	29		35		43		51		59		71		87		119			
	GD^2_C	J_C	GD^2_C	J_C	GD^2_C	J_C	GD^2_C	J_C	GD^2_C	J_C	GD^2_C	J_C	GD^2_C	J_C	GD^2_C	J_C	GD^2_C	J_C
6060 6065	0.460	0.115	0.454	0.114	0.449	0.112	-	-	-	-	-	-	-	-	-	-	-	-
6070 6075	0.460	0.115	0.454	0.114	0.450	0.113	0.446	0.112	0.445	0.111	-	-	-	-	-	-	-	-
6080 6085	0.744	0.186	0.727	0.182	0.474	0.119	0.467	0.117	0.463	0.116	0.459	0.115	0.456	0.114	-	-		
6090 6095	1.54	0.385	1.25	0.313	1.23	0.308	0.731	0.183	0.960	0.240	0.717	0.179	0.949	0.237	0.707	0.177	-	-
6100 6105	0.899	0.225	0.854	0.214	0.820	0.205	0.543	0.136	0.776	0.194	0.520	0.130	0.758	0.190	0.503	0.126	-	-
6110 6115	2.56	0.64	2.47	0.618	2.43	0.608	2.37	0.593	2.36	0.590	2.34	0.585	2.33	0.583	-	-	-	-
6120 6125	5.03	1.26	4.86	1.22	4.70	1.18	3.19	0.798	4.55	1.14	3.08	0.770	4.44	1.11	-	-	-	-
6130 6135	11.2	2.80	10.9	2.73	10.3	2.58	10.2	2.55	10.2	2.55	9.97	2.49	9.93	2.48	-	-	-	-
6140 6145	11.2	2.80	10.9	2.73	10.3	2.58	10.2	2.55	10.2	2.55	9.99	2.50	9.93	2.48	-	-	-	-
6160 6165	72.4	18.1	71.5	17.9	70.5	17.6	70.2	17.6	70.3	17.6	69.3	17.3	69.0	17.3	-	-	35.4	8.85
6170 6175	153	38.3	151	37.8	148	37.0	147	36.8	146	36.5	146	36.5	145	36.3	-	-	33.3	8.33
6180 6185	211	52.8	209	52.3	206	51.5	202	50.5	200	50.0	199	49.8	198	49.5	-	-	32.7	8.18
6190 6195	535	133	527	131	520	130	516	129	513	128	511	127	509	127	-	-	83.6	20.9
6205	782	196	-	-	760	190	-	-	750	188	-	-	745	186	-	-	248	62.0
6215	1240	310	-	-	1200	300	-	-	1190	298	-	-	1180	295	-	-	419	105
6225	1550	388	-	-	1500	375	-	-	1480	370	-	-	1470	368	-	-	599	150
6235	2660	665	-	-	2580	645	-	-	2550	638	-	-	2530	633	-	-	1040	260
6245	4040	1010	-	-	3930	983	-	-	3880	970	-	-	3850	963	-	-	1040	260
6255	7360	1840	-	-	7180	1800	-	-	7100	1780	-	-	7060	1770	-	-	2370	593
6265	9480	2370	-	-	9180	2300	-	-	9050	2260	-	-	8980	2250	-	-	2370	593
6275	-	-	-	-	29900	7480	-	-	29600	7400	-	-	29400	7350	-	-	9540	2390

Note: 1. The value of the fan has been to the GD^2 of the Frame sizes of 6160~6275.

2. The GD^2 of the 2-stage reduction model is calculated by the following formula:

$$GD^2 \text{ of the 2-stage reduction model} = GD^2 \text{ of 1st stage} + \frac{GD^2 \text{ (2nd stage)}}{(\text{Reduction ratio of 1st stage})^2}$$

Use value in Table E-16 for GD^2 of 1st stage.

For the GD^2 of the 2nd stage, deduct the GD^2 of the fan from the value in Table E-16.

*The values in Table E-16 are subject to change without notice.

Moment of Inertia · GD^2

Table E-17 (6000SK Series, Gearmotor)

Unit: GD^2_C ($\times 10^{-4}$kgf·m^2) J_C (Moment of inertia) ($\times 10^{-4}$kgf·m^2)

Frame Size	Nominal Reduction Ratio													
	2.5		3		4		5		6		8		10	
	GD^2_C	J_C	GD^2_C	J_C	GD^2_C	J_C	GD^2_C	J_C	GD^2_C	J_C	GD^2_C	J_C	GD^2_C	J_C
6070SK 6075SK	1.71	0.428	1.36	0.340	0.865	0.216	1.47	0.368	1.18	0.295	0.769	0.192	0.750	0.187
6080SK 6085SK	4.47	1.12	4.15	1.04	1.04	0.261	0.767	0.192	2.05	0.512	1.67	0.419	1.62	0.406
6090SK 6095SK	10.3	2.57	8.06	2.01	7.05	1.76	6.61	1.65	4.69	1.17	2.76	0.691	2.65	0.663
6100SK 6105SK	10.3	2.57	8.05	2.01	7.04	1.76	6.60	1.65	4.68	1.17	2.75	0.688	2.64	0.661
6110SK 6115SK	23.9	5.98	21.9	5.48	20.0	4.99	15.7	3.93	11.4	2.84	8.24	2.06	7.82	1.96

Note: 1. Table E-17 does not include GD^2 of motor.
Obtain the GD^2 of the single stage reduction gearmotor by adding the GD^2 of the motor Tables E-19, 20.

*Values in the table are subject to change without notice.

Table E-18 (6000SK Series, Reducer)

Unit: GD^2_C ($\times 10^{-4}$kgf·m^2) J_C (Moment of inertia) ($\times 10^{-4}$kgf·m^2)

Frame Size	Nominal Reduction Ratio													
	2.5		3		4		5		6		8		10	
	GD^2_C	J_C	GD^2_C	J_C	GD^2_C	J_C	GD^2_C	J_C	GD^2_C	J_C	GD^2_C	J_C	GD^2_C	J_C
6070SK 6075SK	1.71	0.428	1.36	0.340	0.865	0.216	1.47	0.368	1.18	0.295	0.769	0.192	0.750	0.187
6080SK 6085SK	4.47	1.12	4.15	1.04	1.04	0.261	0.767	0.192	2.05	0.512	1.67	0.419	1.62	0.406
6090SK 6095SK	10.3	2.57	8.06	2.01	7.05	1.76	6.61	1.65	4.69	1.17	2.76	0.691	2.65	0.663
6100SK 6105SK	10.3	2.57	8.05	2.01	7.04	1.76	6.60	1.65	4.68	1.17	2.75	0.688	2.64	0.661
6110SK 6115SK	23.9	5.98	21.9	5.48	20.0	4.99	15.7	3.93	11.4	2.84	8.24	2.06	7.82	1.96

*Values in the table are subject to change without notice.

Table E-19 Moment of Inertia · GD² of Three Phase Motor

4P Motor

Unit: GD_M^2 [kgf·m²] J_M (Moment of inertia) [kg·m²]

kW × P	0.1kW × 4P		0.2kW × 4P		0.25kW × 4P		0.4kW × 4P		0.55kW × 4P		0.75kW × 4P	
	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M
Standard	0.0013	0.000325	0.0020	0.000500	0.0020	0.000500	0.0026	0.000650	0.0041	0.00101	0.0048	0.00120
With Brake	0.0014	0.000350	0.0022	0.000550	0.0022	0.000550	0.0027	0.000675	0.0045	0.00111	0.0052	0.00130

kW × P	1.1kW × 4P		1.5kW × 4P		2.2kW × 4P		3.0kW × 4P		3.7kW × 4P		5.5kW × 4P	
	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M
Standard	0.0074	0.00185	0.0085	0.00213	0.0133	0.00333	0.0281	0.00700	0.0339	0.00848	0.0457	0.0114
With Brake	0.0083	0.00208	0.0094	0.00235	0.0149	0.00373	0.0325	0.00810	0.0383	0.00958	0.0501	0.0125

kW × P	7.5kW × 4P		11kW × 4P		15kW × 4P		18.5kW × 4P		22kW × 4P		30W × 4P	
	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M
Standard	0.107	0.0268	0.150	0.0375	0.359	0.0898	0.900	0.225	0.900	0.225	1.00	0.250
With Brake	0.121	0.0303	0.164	0.0410	0.428	0.107	0.972	0.243	0.972	0.243	1.05	0.262

kW × P	37kW × 4P		45kW × 4P		55kW × 4P	
	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M
Standard	1.23	0.308	1.37	0.343	2.70	0.675
With Brake	1.28	0.321	-	-	-	-

6P Motor

kW × P	0.1kW × 6P		0.2kW × 6P		0.25kW × 6P		0.4kW × 6P		0.55kW × 6P		0.75kW × 6P	
	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M
Standard	0.0023	0.000575	0.0031	0.000775	0.0031	0.000775	0.0067	0.00168	0.0077	0.00193	0.0120	0.00300
With Brake	0.0025	0.000625	0.0032	0.000800	0.0032	0.000800	0.0071	0.00178	0.0081	0.00203	0.0129	0.00323

kW × P	1.1kW × 6P		1.5kW × 6P		2.2kW × 6P		3.0kW × 6P		3.7kW × 6P		5.5kW × 6P	
	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M
Standard	0.0145	0.00363	0.0212	0.00530	0.0527	0.0132	0.0657	0.0164	0.0740	0.0185	0.140	0.0350
With Brake	0.0154	0.00385	0.0228	0.00570	0.0571	0.0143	0.0701	0.0175	0.0784	0.0196	0.154	0.0385

kW × P	7.5kW × 6P		11kW × 6P		15kW × 6P		18.5kW × 6P		22kW × 6P		30W × 6P	
	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M
Standard	0.286	0.0715	0.359	0.0898	1.27	0.318	1.45	0.363	1.45	0.363	1.90	0.475
With Brake	0.355	0.0888	0.428	0.1070	-	-	-	-	-	-	-	-

kW × P	37kW × 6P		45kW × 6P		55kW × 6P	
	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M
Standard	2.40	0.600	4.00	1.00	4.70	1.18
With Brake	-	-	-	-	-	-

Table E-20 Moment of Inertia · GD² of Motor for Inverter

Unit: GD_M^2 [kgf·m²] J_M (Moment of inertia) [kg·m²]

kW × P	0.1kW × 4P		0.2kW × 4P		0.4kW × 4P		0.75kW × 4P		1.5kW × 4P		2.2kW × 4P	
	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M
Standard	0.0020	0.000500	0.0026	0.000650	0.0048	0.00120	0.0085	0.00213	0.0133	0.00333	0.0339	0.00848
With Brake	0.0022	0.000550	0.0027	0.000675	0.0052	0.00130	0.0094	0.00235	0.0149	0.00373	0.0383	0.00958

kW × P	3.7kW × 4P		5.5kW × 4P		7.5kW × 4P		11kW × 4P		15kW × 4P		18.5W × 4P	
	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M
Standard	0.0457	0.0114	0.107	0.0268	0.150	0.0375	0.359	0.0898	0.900	0.225	1.00	0.250
With Brake	0.0501	0.0125	0.121	0.0303	0.164	0.0410	0.428	0.1070	0.972	0.243	1.05	0.262

kW × P	22kW × 4P		30kW × 4P		37kW × 4P	
	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M
Standard	1.00	0.250	1.23	0.308	1.37	0.343
With Brake	1.05	0.262	1.28	0.321	-	-

Moment of Inertia · GD^2

Example 1: CNHM2-6115-29

(1) $J_M = 0.00213 kg \cdot m^2$
(Standard 1.5kW × 4-Pole motor in Table F-19)

(2) Frame size 6115 of CYCLO® reducer.
J_C: Reduction ratio of 29 = $0.580 \times 10^{-4} kg \cdot m^2$ (From the Table E-15)

(3) ΣJ_C of CNHM2-6115-29

ΣJ = Motor J_M + CYCLO® reducer J_C
= 0.00213 + 0.000058
= $0.002188 kg \cdot m^2$

Example 2: CVVM20-6215DA-165 (15 × 11)

(1) $J_M = 0.0898 kg \cdot m^2$ (Standard 15kW × 4-Pole motor in Table E-19)

(2) Combination of CYCLO® reducer, Frame size 6215 with ratio 15 + Frame size 6135 with ratio 11 (Refer to Page A-6)

(3) 1st stage of 6135 Ratio 11, $J_C = 4.33 \times 10^{-4} kg \cdot m^2$

(4) 2nd stage of 6215 Ratio 15, $J_C = 216 \times 10^{-4} kg \cdot m^2$
(Both (3) & (4) from Table F-15)

(5) CYCLO® reducer $J_C = 4.33 \times 10^{-4} + \dfrac{216 \times 10^{-4}}{11^2} = 0.0006 kg \cdot m^2$

(6) ΣJ of CVVM20-6215DA-165

ΣJ = Motor J_M + CYCLO® reducer J_C
= 0.0898 + 0.0006
= $0.0904 kg \cdot m^2$

1. Construction of 6000 Series

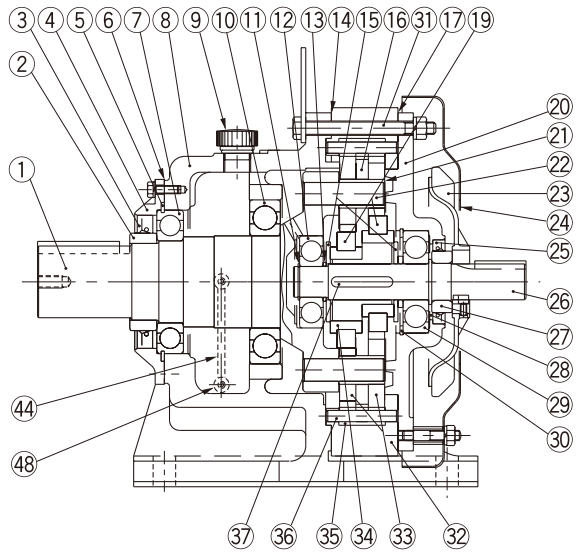


Fig E-10 Type CHH (Horizontal, Reducer) Single reduction
(Example: Frame size 6175)

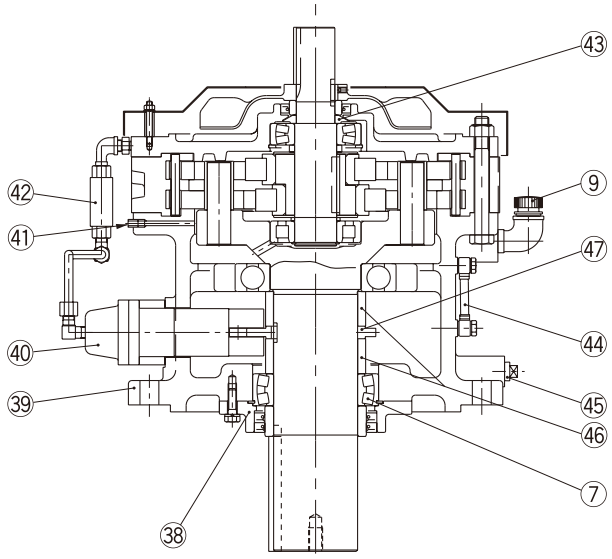


Fig E-11 Type CVV (Vertical, Reducer) Single reduction
(Example: Frame size 6225)

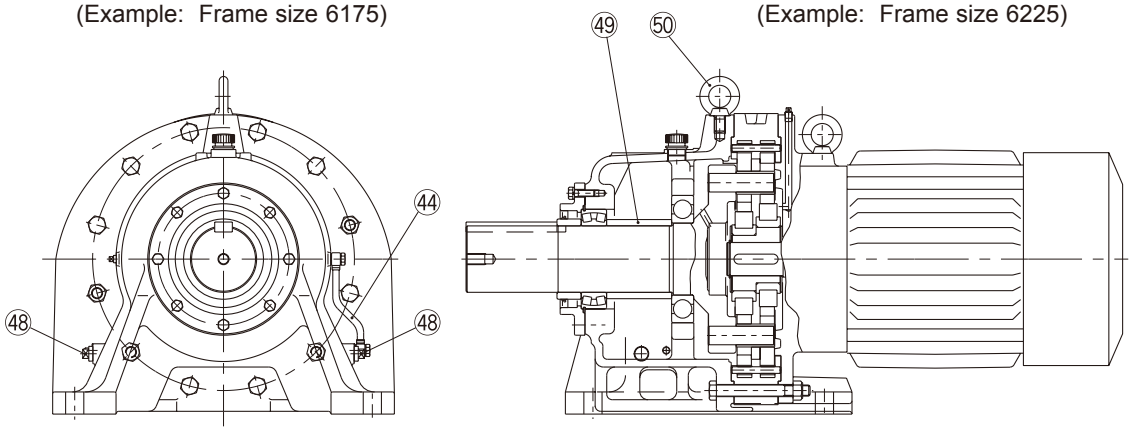


Fig E-12 Type CHHM (Horizontal, Gearmotor) Single reduction
(Example: Frame size 6225)

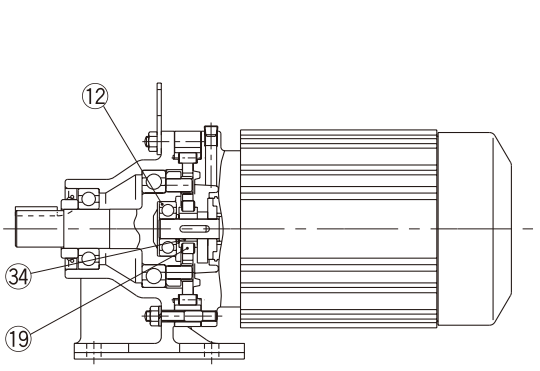


Fig E-13 Type CNHM (Horizontal, Gearmotor) Single reduction
(Example: Frame size 6095)

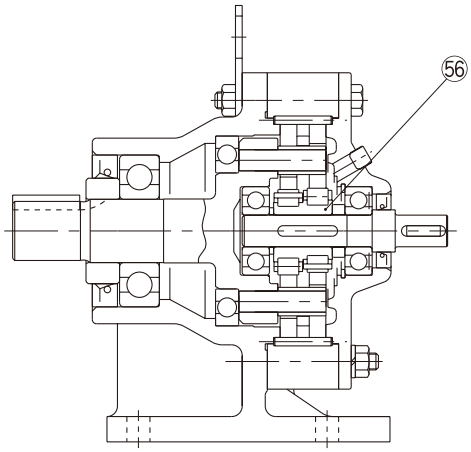


Fig E-14 Type CNH (Horizontal, Reducer) Single reduction
(Example: Frame size 6105)

Construction Drawing

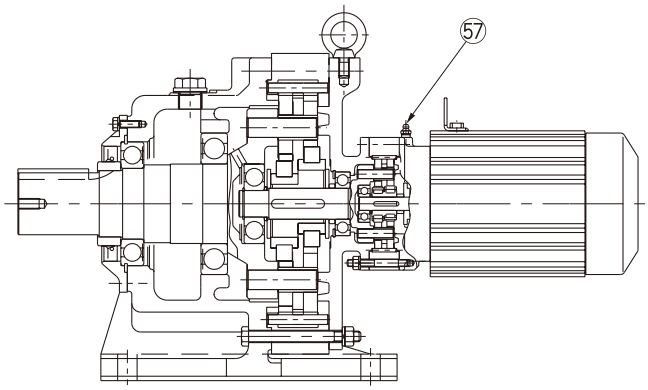


Fig E-15 Type CHHM (Horizontal, Gearmotor)
Double reduction
(Example: Frame size grease lubricated 6185DB)

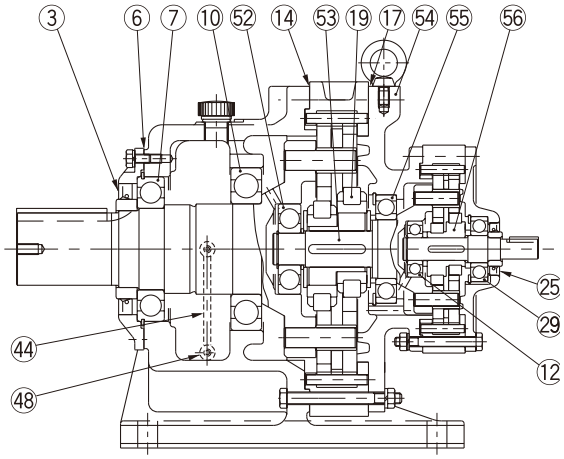


Fig E-16 Type CHH (Horizontal, Reducer)
Double reduction
(Example: Frame size 6185DB)

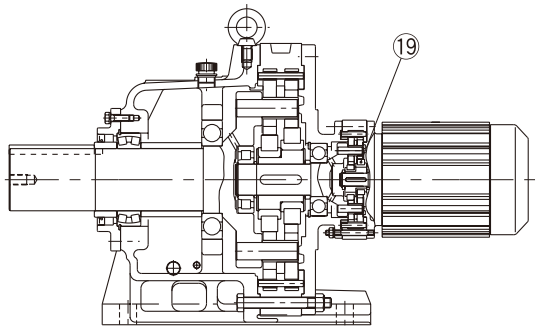


Fig E-17 Type CHHM (Horizontal, Gearmotor)
Double reduction
(Example: Frame size 6225DB)

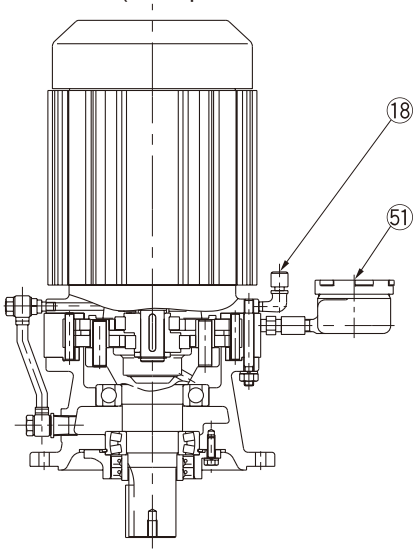


Fig E-18 Type CVVM
(Vertical, Gearmotor)
Single reduction
(Example: Frame size 6145)

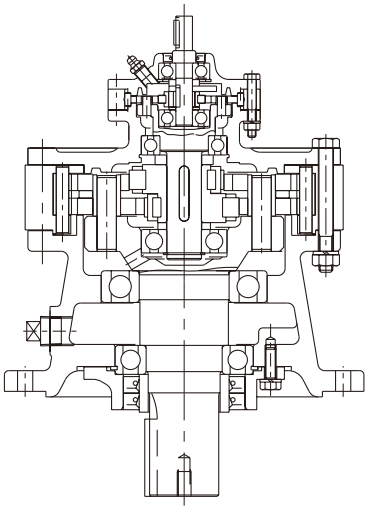


Fig E-19 Type CVV
(Vertica, Reducer)
Double reduction
(Example: Frame size 6135DA)

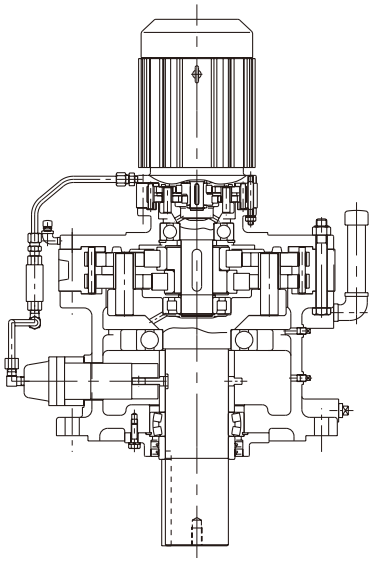


Fig E-20 Type CVVM
(Vertical, Gearmotor)
Double reduction
(Example: Frame size 6225DA)

Principal parts

No.	Part Name	No.	Part Name	No.	Part Name	No.	Part Name	No.	Part Name
1	Slow speed shaft	13	Spacer	25	Oil seal	37	Key	49	Spacer
2	Collar (Slow speed shaft)	14	Gasket B	26	High speed shaft	38	Gland	50	Eye bolt
3	Oil seal	15	End plate	27	Collar (High Speed Shaft)	39	Flanged casing	51	Oil filler
4	Slow speed end cap	16	Spacer ring	28	Spacer	40	Plunger pump	52	Intermediate shaft, bearing A
5	Retaining ring	17	Gasket C	29	High speed shaft, bearing B	41	Air vent plug	53	Intermediate shaft
6	Gasket A	18	Air vent plug	30	Retaining ring	42	Oil signal	54	Intermediate cover
7	Slow speed shaft, bearing A	19	Bearing for eccentric (High speed shaft section)	31	Bolt for ring gear housing	43	Oil slinger	55	Intermediate shaft, bearing B
8	Horizontal casing	20	High speed end shield	32	Ring gear housing	44	Oil level gauge	56	Eccentric bearing (Double)
9	Oil filler plug	21	Slow speed shaft roller	33	Cycloid disc	45	Plug (Oil drain)	57	Grease nipple
10	Slow speed shaft, bearing B	22	Slow speed shaft pin	34	Eccentric	46	Spacer		
11	Retaining ring	23	Cooling fan	35	Ring gear roller	47	Cam		
12	High speed shaft, bearing A	24	Fan cover	36	Ring gear pin	48	Plug (Oil drain)		

2. Construction of 6000SK Series

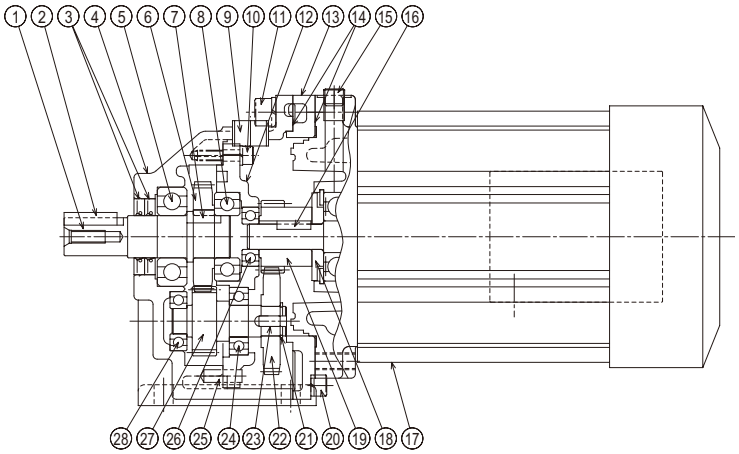


Fig E-21 Type CHHM
(6000SK Series Horizontal, Gearmotor)
(Example: Frame size 6075SK)

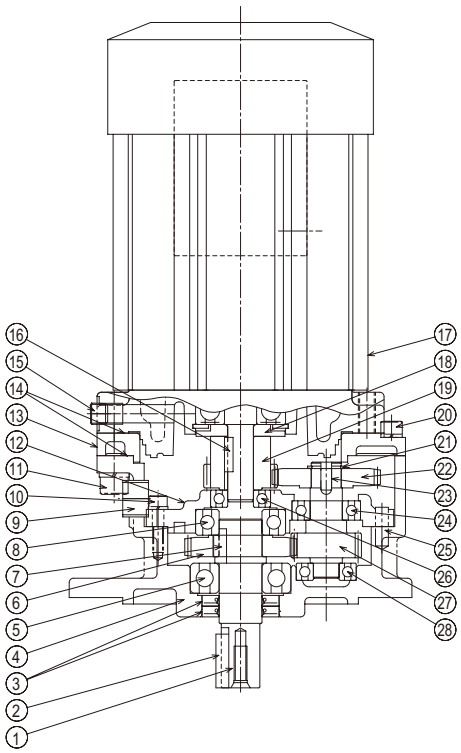


Fig E-22 Type CVVM
(6000SK Series Vertical, Gearmotor)
(Example: Frame size 6075SK)

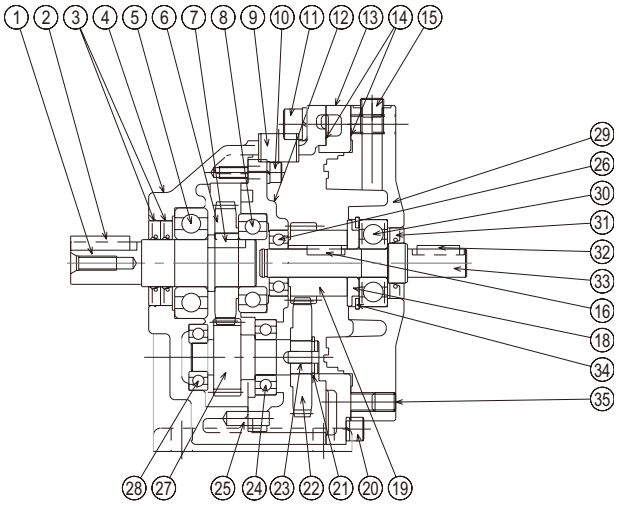
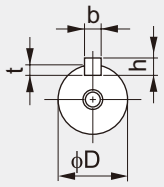


Fig E-23 Type CHH
(6000SK Series Horizontal, Reducer)
(Example: Frame size 6075SK)

Principal parts

No.	Part Name	No.	Part Name	No.	Part Name	No.	Part Name
1	Slow speed shaft (Output shaft)	11	Hexagon socket head cap screw	21	Snap ring	31	Oil seal
2	Key	12	Bearing plate	22	First gear	32	Key
3	Oil seal	13	Adapter plate	23	Key	33	High speed shaft
4	Horizontal casing	14	Liquid gasket	24	Bearing (B) for mid speed shaft	34	Snap ring
5	Bearing (A) for slow speed shaft	15	Plug	25	Pin	35	Hexagon socket head cap screw
6	Second gear	16	Key	26	Bearing (A) for high speed shaft		
7	Key	17	Motor	27	Second pinion (middle speed shaft)		
8	Bearing (B) for slow speed shaft	18	Oil slinger	28	Bearing (A) for middle speed shaft		
9	Plug	19	First pinion	29	High speed end shield		
10	Hexagon socket head cap screw	20	Hexagon socket head cap screw	30	Bearing (B) for high speed shaft		

Detailed Dimension of Slow Speed Shaft



View from A

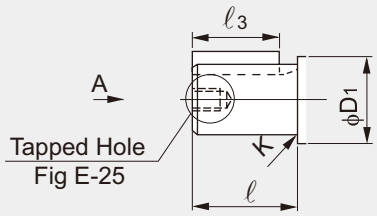


Fig E-24a

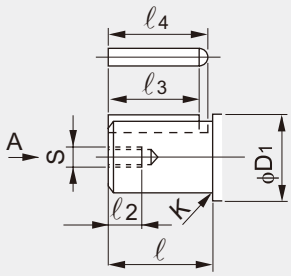


Fig E-24b

- Dimension of slow speed shaft end; Dimension tolerance in accordance with JIS B 0401-1976 "h6."
- Dimension of shaft end key; Parallel key in accordance with JIS B 1301-1996.

Table E-23 Dimension of Slow Speed Shaft

Frame Size			Slow Speed Shaft												
6000SK Series	6000Series Single	6000Series Double	Fig	D (h6)	Tolerance	D_1	ℓ	K (Roundness)	t	Tolerance	b(key) (h9)	Tolerance	h(key)	Tolerance	ℓ_3 (key)	ℓ_4
-	6060	6060DA	E-24b	14	0 -0.011	30	25	-	3	+0.1 0	5	0 -0.030	5	0 -0.030	20	22.5
-	6065	6065DA														
-	6070	6070DA	E-24b	18		30	30	-	3.5		6		6		25	-
-	6075	6075DA														
6070SK	-	-				20		0.6								28
6075SK	-	-														
-	6080	-	E-24b	22	0 -0.013	45	35	-	3.5		6		6		30	33
-	6085	-														
6080SK	-	-				25		0.6								33
6085SK	-	-														
-	6090	6090DA	E-24a	28		45	35	-	4		8		7		32	-
-	6095	6095DA														
6090SK	-	-	E-24b			30		0.5							27	32
6095SK	-	-														
-	6100	6100DA	E-24a	28		50	35	-	4	+0.2 0	8	0 -0.036	7	0 -0.090	32	-
-	6105	6105DA														
-	610H	-														
6100SK	-	-	E-24b			30		0.5							27	32
6105SK	-	-														
-	6110	-	E-24b	32	0 -0.016	55	45	-	5		10		8		37	42
-	6115	-														
6110SK	-	-	E-24b			35		1							37	40
6115SK	-	-														
-	6120	6120DA 6120DB	E-24a	38		65	55	-	5		10		8		50	-
-	6125	6125DA 6125DB														
-	612H	-														

Table E-24 Dimension of Tapped Hole

Frame Size			Tap	Depth	Center hole		
6000SK Series	6000 Series Single	6000 Series Double	M	A	ϕD1	ϕD2	B
-	6060	6060DA	M5	16	7	5.2	2.6
-	6065	6065DA	M5	16	7	5.2	2.6
6070SK	6070	6070DA	M6	16	9	6.2	3.4
6075SK	6075	6075DA	M6	16	9	6.2	3.4
6080SK	6080	-	M6	16	9	6.2	3.4
6085SK	6085	-	M6	16	9	6.2	3.4
6090SK	6090	6090DA	M8	20	11	8.2	3.6
6095SK	6095	6095DA	M8	20	11	8.2	3.6
6100SK	6100	6100DA	M8	20	11	8.2	3.6
6105SK	6105	6105DA	M8	20	11	8.2	3.6
-	610H	-	M8	20	11	8.2	3.6
6110SK	6110	-	M8	20	11	8.2	3.6
6115SK	6115	-	M8	20	11	8.2	3.6
-	6120	6120DA 6120DB	M8	20	11	8.2	3.6
-	6125	6125DA 6125DB	M8	20	11	8.2	3.6
-	612H	-	M8	20	11	8.2	3.6

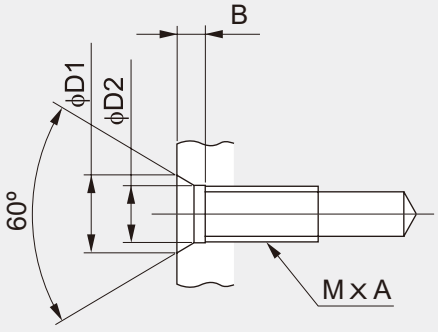
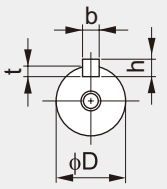


Fig E-25

Detailed Dimension of Slow Speed Shaft



View from A

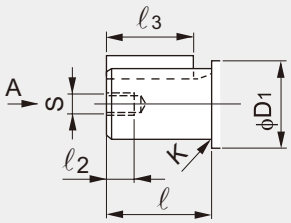


Fig E-26

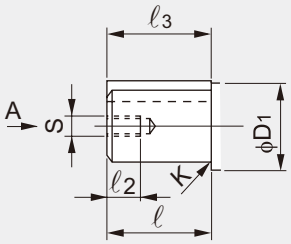


Fig E-27

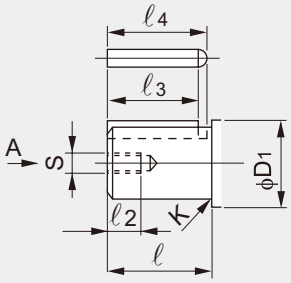


Fig E-28

Table E-25 Dimension of Slow Speed Shaft

Frame Size		Slow Speed Shaft															
		Fig	D		D_1	ℓ	K	s	ℓ_2	t		b(key)		h(key)		ℓ_3	ℓ_4
Single	Double		(h6)	Tolerance			(Roundness)				Tolerance	(h9)	Tolerance		Tolerance	(key)	
6130	6130DA 6130DB 6130DC	E-26	50	0 -0.016	65	70 (61)	-	M10	18	5.5	+0.2 0	14	0 -0.043	9	0 -0.090	56	
6135	6135DA 6135DB 6135DC	E-26															
6140	6140DA 6140DB 6140DC	E-26	50		65	90 (81)	-	M10	18	5.5		14		9		80	-
6145	6145DA 6145DB 6145DC	E-26															
614H	-	E-26															
6160	6160DA 6160DB 6160DC	E-26	60	0 -0.019	85	90 (80)	-	M10	18	7		18		11	0 -0.110	80	-
6165	6165DA 6165DB 6165DC	E-26															
616H	-	E-26															
6170	6170DA 6170DB 6170DC	E-26	70		95	90 (84)	-	M12	24	7.5		20	0 -0.052	12		80	-
6175	6175DA 6175DB 6175DC	E-26															
6180	6180DA 6180DB	E-26	80		110	110 (100)	-	M12	24	9		22		14		100	-
6185	6185DA 6185DB	E-26															
6190	6190DA 6190DB	E-28	95	0 -0.022	120	135 (125)	-	M20	34	9		25		14		125	137.5
6195	6195DA 6195DB	E-28															
6205	6205DA 6205DB	E-27	100		120	165	-	M20	34	10		28		16		165	-
6215	6215DA 6215DB	E-27	110		130	165	-	M20	34	10		28		16		165	-
6225	6225DA 6225DB	E-27	120		145	165	-	M20	34	11		32		18		165	-
6235	6235DA 6235DB	E-27	130	0 -0.025	160	200	-	M24	41	11	+0.3 0	32	0 -0.063	18	0 -0.130	200	-
6245	6245DA 6245DB	E-27	140		170	200	-	M24	41	12		36		20		200	-
6255	6255DA 6255DB	E-27	160		190	240	-	M30	49	13		40		22		240	-
6265	6265DA	E-27	170		200	300	-	M30	49	13		40		22		300	-
6275	6275DA	E-27	180		230	330 (320)	-	M30	52	15		45		25		330 (320)	-

Note: Dimensions in parentheses for ℓ and ℓ_3 are for models with vertical output shaft.

Detailed Dimension of High Speed Shaft

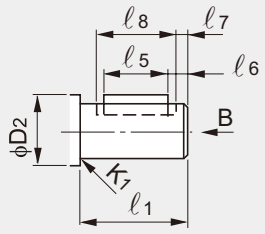
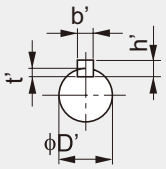


Fig E-29



View from B

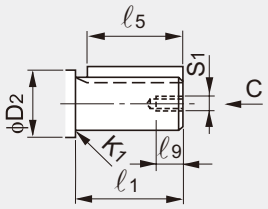


Fig E-30

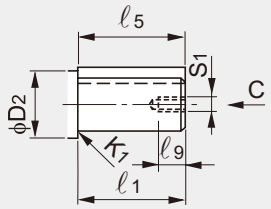
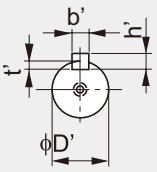


Fig E-31



View from C

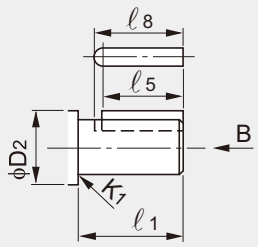


Fig E-32

- Dimension of high speed shaft end; Dimension tolerance in accordance with JIS B 0401-1976 "h6".
- Dimension of shaft end key; Parallel key in accordance with JIS B 1301-1996.
- *S1 & 9 Dimension Tap Hole is only for vertical (Type CVV, CVF) Single stage only

Table E-26 Dimension of High Speed Shaft

Frame Size			Slow Speed Shaft																	
6000SK Series	6000Series Single	6000Series Double	Fig	D' (h6)	Tolerance	D_2	ℓ_1	K_1 (Roundness)	t'	Tolerance	b' (key) (h9)	Tolerance	h' (key)	Tolerance	ℓ_5 (key)	ℓ_6	ℓ_7	ℓ_8	*S_1	*ℓ_9
-	6060	6060DA 6070DA	E-29	12	0 -0.011	17	25	0.5	2.5	+0.1 0	4	0 -0.030	4	0 -0.030	18	3	1	22	-	-
-	6065	6065DA 6075DA	E-29																	
-	6070	6090DA 6100DA 6120DA 6130DA 6140DA	E-29	12		17	25	0.5	2.5		4		4		18				-	-
-	6075	6095DA 6105DA 6125DA 6135DA 6145DA	E-29																	
6070SK	6080	-	E-29	12		17	25	0.5	2.5		4		4		18				-	-
6075SK	6085	-	E-29																	
6080SK	6090	6120DB 6130DB 6140DB 6160DA 6170DA	E-29	15		20	25	1	3		5		5		16	3.5		21	-	-
6085SK	6095	6125DB 6135DB 6145DB 6165DA 6175DA	E-29																	
6090SK	6100	6130DC 6140DC 6160DB 6170DB 6180DA	E-29			20	25	1	3		5		5		16				-	-
6095SK	6105	6135DC 6145DC 6165DB 6175DB 6185DA	E-29																	
-	610H	-	E-29																	
6100SK	6110	-	E-29	15		20	25	1	3		5		5		16	3.5	1		-	-
6105SK	6115	-	E-29																	
6110SK	6120	6160DC 6170DC 6190DA	E-32	18		32	35	-	3.5		6		6		25	-	-	28	-	-
6115SK	6125	6165DC 6175DC 6195DA 6205DA	E-32																	
-	612H	-	E-32																	
-	6130	6180DC 6190DB	E-32	22		38	40	-	3.5		6		6		32	-	-	35	-	-
-	6135	6185DB 6195DB 6205DB 6215DA 6255DA	E-32																	
-	6140	-	E-32	22		38	40	-	3.5		6		6		32				-	-
-	6145	-	E-32																	
-	614H	-	E-32																	
-	6160	6215DB	E-31	30	0 -0.013	70	45	-	4		8	0 -0.036	7		45	-	-	-	M10	20
-	6165	6215DB 6235DA 6245DA	E-31																	
-	616H	-	E-31																	
-	6170	-	E-32	35		70	55	-	5		10		8	0 -0.090	50	-	-	-	M12	25
-	6175	6255DB 6255DA	E-32																	
-	6180	-	E-32	40		70	65	-	5		12		8		63	-	-	-	M16	30
-	6185	6235DB 6245DB	E-32																	
-	6190	-	E-31	45		82	70	-	5.5	+0.2 0	14	0 -0.043	9		70	-	-	-	M16	30
-	6195	6255DB 6265DA 6275DA	E-31																	
-	6205	-	E-31	45		82	82	-	5.5		14		9		82	-	-	-	-	-
-	6215	-	E-31	50		82	82	-	5.5		14		9		82	-	-	-	-	-
-	6225	-	E-31	55	0 -0.019	90	82	-	6		16		10	0 -0.110	82	-	-	-	-	-
-	6235	-	E-31	60		110	105	-	7		18		11		105	-	-	-	-	-
-	6245	-	E-31	65		110	105	-	7		18		11		105	-	-	-	-	-
-	6255	-	E-31	80		130	130	-	9		22	0 -0.052	14		130	-	-	-	-	-
-	6265	-	E-31	80		130	130	-	9		22		14		140	-	-	-	-	-
-	6275	-	E-32	90	0 -0.022	140	150	-	9		25		14		140	-	-	152.5	-	-

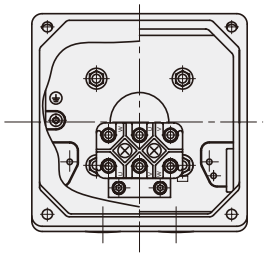
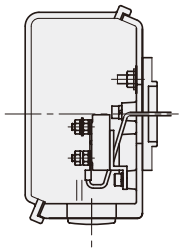
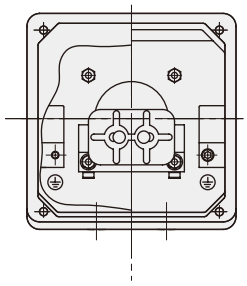
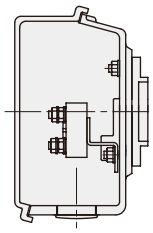
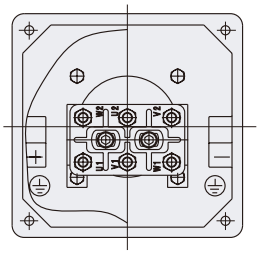
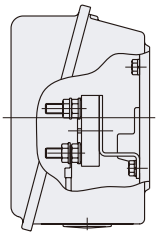
E TECHNICAL DATA

2. Motor

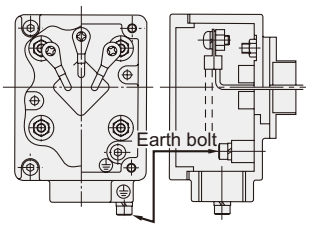
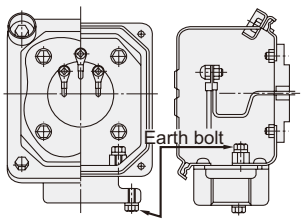
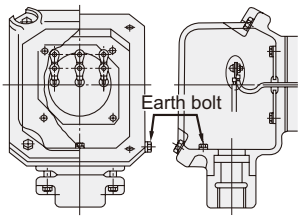
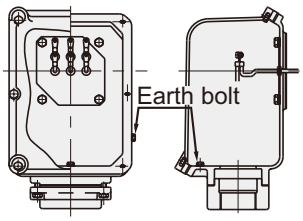
Terminal Box Specifications

1. Construction of Terminal Box

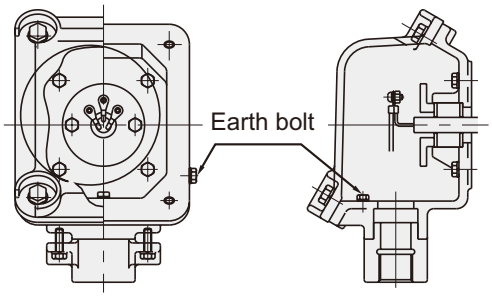
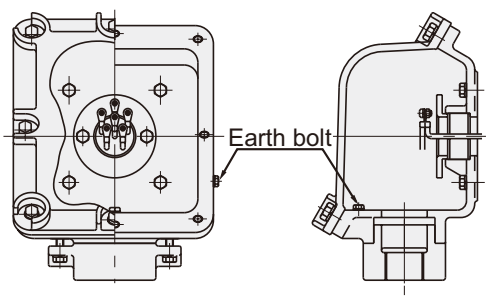
Standard Motors

3-Phase Motor AF Motor	0.1 ~ 5.5kW × 4P 0.1 ~ 3.7kW × 4P	3-Phase Motor AF Motor	7.5 ~ 15kW × 4P 5.5 ~ 11kW × 4P
			
3-Phase Motor AF Motor	18.5 ~ 55kW × 4P 15 ~ 55kW × 4P		
			

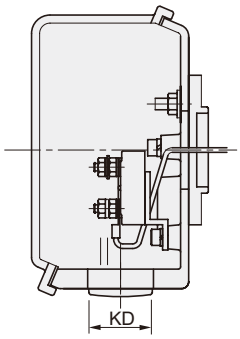
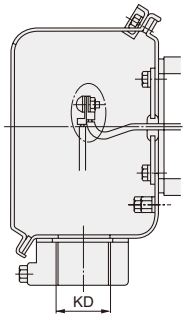
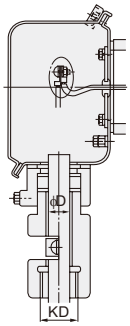
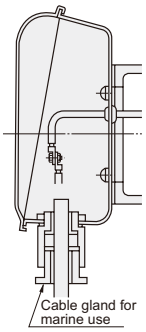
Increased Safety Motors

0.1 ~ 0.4kW × 4P	0.75 ~ 15kW × 4P	18.5 ~ 37kW × 4P 15 ~ 37kW × 6P	45 ~ 55kW × 4P 45 ~ 55kW × 6P
			

Flame Proof Motors

0.1 ~ 3.7kW × 4P	5.5 ~ 37kW × 4P 15 ~ 37kW × 6P
	

2. Methods for Drawing Lead Wire Outside of Terminal Box.

Standard model	Conduit tube type (Option)	Packing type with threaded conduit joint (Option)	Cable gland for marine use (Option)
			

Motor			Standard Model	Option							
				Conduit Tube Type		Packing Type with Thread Conduit Joint				Cable Gland for Marine Use	
Capacity [kW]		P				Standard Size		Available Size		Standard Size	
3-Phase Motor	AF Motor		KD	Standard Size KD	Available Size KD	Thread KD	Cable Dia. ϕD	Thread KD	Cable Dia. ϕD	Thread KD	Cable Dia. ϕD
0.1	-	4	M25	16 (PF1/2)	16 (PF1/2) 22 (PF3/4) 28 (PF1) 36 (PF1 1/4) Note:1)	22 (PF3/4)	12.5	22 (PF3/4)	10.0~16.5	20c	15a~c
0.2	0.1	4	M25					28 (PF1)	12.0~19.5		20a~c
0.25	-	4	M25					36 (PF1 1/4)	15.5~23.5		25a~c
0.4	0.2	4	M25								
0.55	-	4	M25	22 (PF3/4)		28 (PF1)	14.5				
0.75	0.4	4	M25								
1.1	-	4	M25								
1.5	0.75	4	M25								
2.2	1.5	4	M25								
3.0	-	4	M25								
3.7	2.2	4	M25								
5.5	3.7	4	M32	28 (PF1)						25c	
7.5	5.5	4	M32		22 (PF3/4) 28 (PF1) 36 (PF1 1/4) 42 (PF1 1/2)		17.5	22 (PF3/4) 28 (PF1) 36 (PF1 1/4) 42 (PF1 1/2)	12.0~16.5 12.0~18.7 15.5~22.7 17.5~27.0		20a~c 25a~c 30a~c
11	7.5	4	M32	36 (PF1 1/4)		36 (PF1 1/4)	19.5			30a	
15	11	4	M32			42 (PF1 1/2)	24				
15	-	6	M40		28 (PF1) 36 (PF1 1/4) 42 (PF1 1/2) 54 (PF2) 70 (PF2 1/2)			28 (PF1) 36 (PF1 1/4) 42 (PF1 1/2) 54 (PF2) 70 (PF2 1/2) Note:2)	13.5~19.0 16.0~23.0 19.5~28.0 23.0~35.7 29.0~45.0	35a	25a~c 30a~c 35a~c
18.5	-	4	M40								
18.5	-	6	M40								
22	15	4	M40								
22	15	6	M40								
30	22	4	M40	54 (PF2)		54 (PF2)	29				
30	22	6	M50								
37	30	4	M50				34				
37	30	6	M50								
45	37	4	M50	70 (PF2 1/2)		70 (PF2 1/2)	44	36 (PF1 1/4) 42 (PF1 1/2) 54 (PF2) 70 (PF2 1/2) 82 (PF3) 92 (PF3 1/2)	20.0~22.7 22.5~29.7 26.8~38.0 38.1~47.0 47.1~53.7 52.5~57.0	55a	35a~c 45a~c 55a~c
45	37	6	M50		36 (PF1 1/4) 42 (PF1 1/2) 54 (PF2) 70 (PF2 1/2) 82 (PF3) 92 (PF3 1/2)						
55	45	4	M50								
55	-	6	M63								

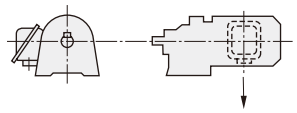
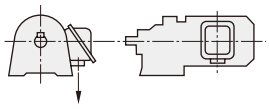
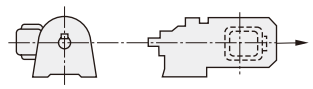
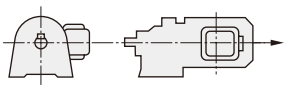
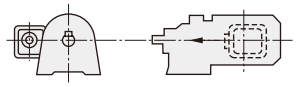
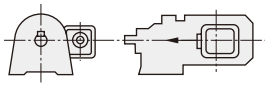
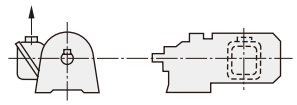
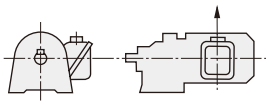
The size of the external lead wire opening of the standard Sumitomo motor has been listed.

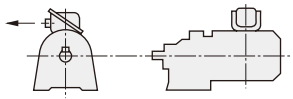
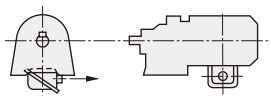
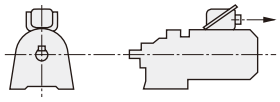
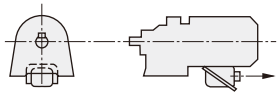
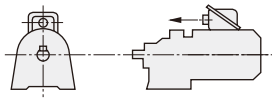
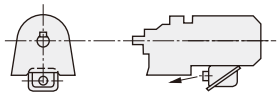
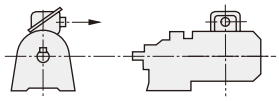
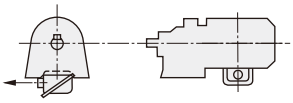
Note: 1. In case of 0.4kW × 4Pole below(0.2kW × 4Pole below when AF motor for Inverter), Except for STD KD(PF1/2), dimensions of a terminal box become special.
2. For the increased safety explosion-proof 45kwx4pole motor, the KD dimensions become PF11/4 (36) - PF31/2(92).
3. Unless otherwise specifically requested, the outdoor type, increased safety explosion-proof motor and for maritime use will be manufactured to the standard dimensions specified above.
4. Terminal Box below 0.4kW × 4P is plastic. Steel is also available. Please consult us.

Terminal Box Specifications

3. Mounting Direction of Terminal Box

● The terminal box mounting direction can be changed in units of 90°, but specify the direction according to the following table when placing an order.

Cable port direction	Terminal box mounting position (As viewed from output shaft with motor being horizontal)	
	Left side (N33)	Right side (N34)
Type A (N3A)		
Type B (N3B)		
Type C (N3C)		
Type D (N3D)		

Cable port direction	Terminal box mounting position (As viewed from output shaft with motor being horizontal)	
	Top (N35)	Down (N36)
Type A (N3A)		
Type B (N3B)		
Type C (N3C)		
Type D (N3D)		

Note: Arrow indicates direction of lead wires out of terminal box.

4. Standard Position of Terminal Box and Direction of Lead Wires.

	Horizontal type (Horizontal Slow Speed Shaft)				Vertical type (Vertical Slow Speed Shaft Down)	
	Standard Motor		Brake Motor		Standard Motor	Brake Motor
	3-Phase	AF Motor	3-Phase	AF Motor	3-Phase	AF Motor
Terminal Box Mounting Position	Left side	Left side	Left side	Left side	Left side	Left side
Cable port direction	A	A	A	A	A	A

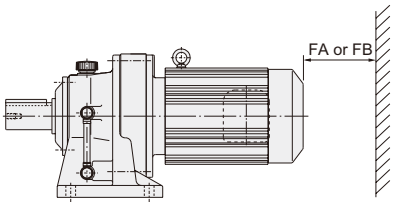
5. Details of Motor Fan Cover Mounting

Refer to the dimensions FA or FB shown below when designing a gearmotor mounting space.

(1) Dimensions FA:·····Dimensions necessary to remove the fan cover or brake cover without removing the motor from the equipment.

(2) Dimensions FB:·····Minimum space required for adequate ventilation

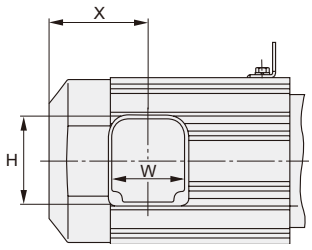
Note: 1. It is necessary to remove the gearmotor from the equipment when removing the fan or brake cover.
2. The minimum space when the wall at the back of the motor fan is closed tightly.
3. AF(Inverter) of 30kw or above are a differently ventilated type.



Dimension of FA and FB [mm]

Specification / Capacity	Without Brake				With Brake			
	3-Phase Motor		AF Motor		3-Phase Motor		AF Motor	
	FA	FB	FA	FB	FA	FB	FA	FB
0.1kW × 4P	-	-	48	20	49	-	61	20
0.2kW × 4P	48	20	48	20	61	20	61	20
0.25kW × 4P	48	20	-	-	61	20	-	-
0.4kW × 4P	48	20	49	20	61	20	93	20
0.55kW × 4P	49	20	-	-	93	20	-	-
0.75kW × 4P	49	20	52	20	93	20	115	20
1.1kW × 4P	52	20	-	-	115	20	-	-
1.5kW × 4P	52	20	56	20	115	20	121	20
2.2kW × 4P	56	20	60	20	121	20	132	20
3.0kW × 4P	60	20	-	-	132	20	-	-
3.7kW × 4P	60	20	60	20	132	20	132	20
5.5kW × 4P	60	20	75	25	132	20	170	25
7.5kW × 4P	75	25	75	25	170	25	170	25
11kW × 4P	75	25	130	30	170	25	220	30
15kW × 4P	130	30	155	30	220	30	367	30
18.5kW × 4P	155	30	170	30	367	30	370	30
22kW × 4P	155	30	170	30	367	30	370	30
30kW × 4P	170	30	140	30	370	30	295	30
37kW × 4P	230	30	140	30	445	30	295	30

6. Dimensions of Terminal Box Mounting Centers



[mm]

Specification / Capacity	Without Brake						With Brake					
	3-Phase Motor			AF Motor			3-Phase Motor			AF Motor		
	X	W	H	X	W	H	X	W	H	X	W	H
0.1kW × 4P	35	125	126	59	125	126	70	125	126	91	125	126
0.2kW × 4P	59	125	126	59	125	126	91	125	126	91	125	126
0.25kW × 4P	59	125	126	-	-	-	91	125	126	-	-	-
0.4kW × 4P	59	125	126	97	125	126	91	125	126	140	125	126
0.55kW × 4P	97	125	126	-	-	-	140	125	126	-	-	-
0.75kW × 4P	97	125	126	100	125	126	140	125	126	162	125	126
1.1kW × 4P	100	125	126	-	-	-	162	125	126	-	-	-
1.5kW × 4P	100	125	126	105	125	126	162	125	126	168	125	126
2.2kW × 4P	105	125	126	127	125	126	168	125	126	199	125	126
3.0kW × 4P	127	125	126	-	-	-	199	125	126	-	-	-
3.7kW × 4P	127	125	126	127	125	126	199	125	126	199	125	126
5.5kW × 4P	127	125	126	143	170	175	199	125	126	238	170	175
7.5kW × 4P	143	170	175	143	170	175	238	170	175	238	170	175
11kW × 4P	143	170	175	295	170	175	238	170	175	385	170	175
15kW × 4P	295	170	175	340	229	223	385	170	175	550	229	223
18.5kW × 4P	340	229	223	340	229	223	550	229	223	550	229	223
22kW × 4P	340	229	223	340	229	223	550	229	223	550	229	223
30kW × 4P	340	229	223	460	229	223	550	229	223	712	229	223
37kW × 4P	430	229	223	460	229	223	645	229	223	712	229	223
45kW × 4P	430	229	223	-	-	-	-	-	-	-	-	-
55kW × 4P	465	229	223	-	-	-	-	-	-	-	-	-

Characteristics for Global Motor

Table E-27 Characteristics of Non-Explosion Proof Motors

(1) 200V Class

Motor Frame Size	Pole	4P														
	Power	220V-50Hz					230V-50Hz					220V-60Hz				
	Output power [kW]	Rated Current	Torque max.[%]	Starting Torque [%]	Starting Current [A]	Speed [r/min]	Rated Current	Torque max.[%]	Starting Torque [%]	Starting Current [A]	Speed [r/min]	Rated Current	Torque max.[%]	Starting Torque [%]	Starting Current [A]	Speed [r/min]
V-63S	0.10	0.60	235	230	2.3	1420	0.62	261	261	2.3	1430	0.53	220	202	2.1	1700
V-63M	0.20	1.0	210	206	3.8	1410	1.0	231	236	4.0	1420	0.95	186	191	3.5	1690
V-63M	0.25	1.2	182	195	4.2	1380	1.2	202	222	4.4	1400	1.2	153	161	3.7	1640
V-71M	0.40	2.0	200	201	7.3	1410	2.1	221	229	7.8	1400	1.8	188	185	6.6	1680
V-80S	0.55	2.4	182	206	9.2	1410	2.4	200	225	9.6	1420	2.3	164	166	8.6	1680
V-80M	0.75	3.3	211	193	13.1	1420	3.3	217	212	13.8	1430	3.1	189	180	12.3	1720
V-90S	1.1	4.7	215	200	21.7	1420	4.6	236	223	22.8	1420	4.4	189	170	19.9	1690
V-90L	1.5	6.1	204	192	27.9	1420	6.0	226	212	28.9	1430	5.7	196	175	25.5	1700
V-100L	2.2	8.7	203	213	42.1	1420	8.3	231	255	45.0	1430	8.1	207	185	38.0	1690
V-112S	3.0	11.2	205	213	61	1420	11.1	224	237	64	1420	10.8	175	155	54	1720
V-112M	3.7	13.4	219	218	80	1410	17.8	308	340	114	1440	12.9	207	178	70	1700

(2) 400V Class

Motor Frame Size	Pole	4P														
	Power	380V-50Hz					400V-50Hz					415V-50Hz				
	Output power [kW]	Rated Current	Torque max.[%]	Starting Torque [%]	Starting Current [A]	Speed [r/min]	Rated Current	Torque max.[%]	Starting Torque [%]	Starting Current [A]	Speed [r/min]	Rated Current	Torque max.[%]	Starting Torque [%]	Starting Current [A]	Speed [r/min]
V-63S	0.10	0.34	235	230	1.3	1420	0.36	261	261	1.3	1430	0.37	281	286	1.4	1430
V-63M	0.20	0.61	210	206	2.2	1410	0.62	233	236	2.3	1420	0.63	251	260	2.4	1420
V-63M	0.25	0.70	182	195	2.4	1380	0.70	202	222	2.5	1380	0.70	220	242	2.3	1400
V-71M	0.40	1.2	200	201	4.2	1410	1.2	221	229	4.5	1420	1.3	236	250	4.7	1420
V-80S	0.55	1.4	182	206	5.3	1410	1.4	200	225	5.5	1420	1.4	218	248	5.8	1420
V-80M	0.75	1.9	211	193	7.6	1420	1.9	219	215	8.0	1430	2.0	237	232	8.4	1440
V-90S	1.1	2.7	215	200	12.5	1420	2.7	236	223	13.2	1420	2.7	256	243	14.3	1430
V-90L	1.5	3.5	204	192	16.1	1420	3.5	228	224	17.1	1430	3.6	242	236	17.8	1430
V-100L	2.2	5.0	203	213	24.3	1420	4.8	231	255	26.0	1430	5.0	240	263	26.8	1430
V-112S	3.0	6.5	205	213	35.1	1420	6.4	224	237	37.0	1420	6.2	241	255	35.7	1420
V-112M	3.7	7.8	219	218	45.9	1410	7.5	231	236	46.9	1420	7.7	259	269	51	1430
V-132S	5.5	11.3	215	227	69	1410	11.1	237	256	73	1420	11.0	256	281	76	1430
V-132M	7.5	15.0	228	232	93	1450	14.8	252	261	99	1450	14.8	270	284	103	1450
V-160M	11.0	21.5	231	250	139	1450	21.0	256	282	147	1450	20.8	274	308	154	1450
G-160L	15.0	27.7	241	235	170	1460	26.6	271	265	180	1470	26.0	294	289	188	1470
F-180MG	18.5	34.5	262	277	245	1450	33.1	293	312	261	1450	32.3	319	340	272	1460
F-180MG	22.0	40.8	252	269	280	1450	39.3	281	302	297	1450	38.9	304	328	310	1450
F-180L	30.0	56	218	236	325	1450	54	244	265	345	1450	54	264	286	361	1450
F-200L	37.0	70	256	285	479	1450	66	256	287	446	1460	65	277	311	467	1460
F-200L	45.0	84	251	286	564	1440	81	252	288	538	1450	80	271	310	559	1450

Motor Frame Size	Pole	4P				
	Power	440V-60Hz				
	Output power [kW]	Rated Current	Torque max.[%]	Starting Torque [%]	Starting Current [A]	Speed [r/min]
V-63S	0.10	0.32	300	289	1.4	1730
V-63M	0.20	0.54	268	266	2.4	1720
V-63M	0.25	0.60	232	251	2.6	1700
V-71M	0.40	1.0	256	262	4.6	1730
V-80S	0.55	1.2	224	240	5.9	1720
V-80M	0.75	1.7	247	242	8.4	1740
V-90S	1.1	2.3	257	260	13.6	1720
V-90L	1.5	3.0	250	243	17.5	1740
V-100L	2.2	4.2	248	260	26.2	1720
V-112S	3.0	5.5	238	225	37.0	1720
V-112M	3.7	6.6	246	238	46.4	1720
V-132S	5.5	9.6	254	263	73	1720
V-132M	7.5	12.8	267	271	98	1750
V-160M	11.0	18.4	270	296	145	1750
G-160L	15.0	23.8	275	280	175	1770
F-180MG	18.5	29.6	295	324	252	1750
F-180MG	22.0	38.8	199	216	225	1720
F-180L	30.0	47.8	249	280	334	1740
F-200L	37.0	59	259	306	429	1730
F-200L	45.0	72	255	311	516	1730

Note: 1. The characteristics of the 4-pole motor with built-in brake is the same as shown in Table E-27 (1) and (2).
2. For the electrical current of the brakes, refer to Table E-31 on Page E-40.
3. Consult us for confirmed values. Values in the above table are subject to change without notice.

Characteristics for Global Motor

Table E-28 Characteristics of AF Motor for Inverters

Motor Frame Size	Pole	4P							
	Power	220V-60Hz				380V-60Hz			
	Output [kW]	Frequency [Hz]	Voltage [V]	Rated Current	Speed [r/min]	Frequency [Hz]	Voltage [V]	Rated Current	Speed [r/min]
VA-63S	0.10	60	220	0.85	1765	60	380	0.38	1755
		6.0	34.0	0.75	120	6.0	68	0.37	125
VA-63M	0.20	60	220	1.6	1760	60	380	0.69	1750
		6.0	34.0	1.5	130	6.0	68	0.75	130
VA-71M	0.40	60	220	2.4	1745	60	380	1.1	1725
		6.0	35.0	2.2	115	6.0	70	1.1	115
VA-80M	0.75	60	220	4.0	1755	60	380	1.9	1735
		6.0	31.0	3.9	120	6.0	62	1.9	120
VA-90L	1.5	60	220	6.4	1735	60	380	3.3	1705
		6.0	33.0	6.5	105	6.0	66	3.2	110
VA-100L	2.2	60	220	9.1	1755	60	380	4.7	1740
		6.0	31.0	9.3	140	6.0	62	4.6	135
VA-112M	3.7	60	220	14.0	1750	60	380	7.7	1730
		6.0	30.0	14.8	125	6.0	60	7.4	120
VA-132S	5.5	60	220	20.2	1760	60	380	11.2	1745
		6.0	30.0	21.3	135	6.0	60	10.7	130
VA-132M	7.5	60	220	27.4	1765	60	380	15.2	1750
		6.0	30.0	28.2	145	6.0	60	14.1	145
G-160L	11.0	60	220	38.5	1770	60	380	21.7	1755
		6.0	32.0	39.6	155	6.0	64	19.7	155
F-180MG	15.0	60	220	53	1780	60	380	30.3	1770
		6.0	32.0	53	165	6.0	64	26.3	165
F-180L	22.0	60	220	77	1775	60	380	44.5	1765
		6.0	32.0	79	160	6.0	64	39.4	160
BF-200L	30.0	60	220	100	1780	60	380	58	1770
		6.0	32.0	101	165	6.0	64	51	165
BF-200L	37.0	60	220	123	1775	60	380	72	1765
		6.0	30.0	123	165	6.0	64	62	165

Motor Frame Size	Pole	4P			
	Power	415V-60Hz			
	Output [kW]	Frequency [Hz]	Voltage [V]	Rated Current	Speed [r/min]
VA-63S	0.10	60	415	0.40	1760
		6.0	68	0.37	125
VA-63M	0.20	60	415	0.75	1760
		6.0	68	0.75	130
VA-71M	0.40	60	415	1.1	1740
		6.0	70	1.1	115
VA-80M	0.75	60	415	1.9	1745
		6.0	62	1.9	120
VA-90L	1.5	60	415	3.1	1725
		6.0	66	3.2	110
VA-100L	2.2	60	415	4.4	1750
		6.0	62	4.6	135
VA-112M	3.7	60	415	7.2	1745
		6.0	60	7.4	120
VA-132S	5.5	60	415	10.5	1755
		6.0	60	10.7	130
VA-132M	7.5	60	415	14.2	1760
		6.0	60	14.1	145
G-160L	11.0	60	415	20.1	1765
		6.0	64	19.7	155
F-180MG	15.0	60	415	27.8	1775
		6.0	64	26.3	165
F-180L	22.0	60	415	40.7	1770
		6.0	64	39.4	160
BF-200L	30.0	60	415	53	1775
		6.0	64	51	165
BF-200L	37.0	60	415	65	1775
		6.0	64	62	165

Note: Consult us for confirmed values. Values in the above table are subject to change without notice.

Characteristics for Japan Standard Motor

Table E-29 Characteristics of 6P Motors

(1) 200V Class

Motor Frame Size	Pole	6P														
	Power	200V-50Hz					200V-60Hz					220V-60Hz				
	Output power [kW]	Rated Current	Torque max.[%]	Starting Torque [%]	Starting Current [A]	Speed [r/min]	Rated Current	Torque max.[%]	Starting Torque [%]	Starting Current [A]	Speed [r/min]	Rated Current	Torque max.[%]	Starting Torque [%]	Starting Current [A]	Speed [r/min]
F-180MG	15.0	55	271	232	358	980	55	222	195	308	1180	49.9	276	246	344	1180
F-180L	18.5	71	311	274	500	990	66	258	234	430	1180	62	321	293	480	1190
F-180L	22.0	83	261	230	500	990	79	216	196	430	1180	73	269	246	480	1180
F-200L	30.0	111	269	267	694	960	106	221	228	598	1180	98	275	287	668	1180
F-200L	37.0	137	289	293	912	980	130	237	251	784	1170	120	296	314	878	1170
F-225S	45.0	163	238	244	962	980	158	195	209	818	1170	144	242	262	914	1180
F-250S	55	198	231	242	1146	980	194	188	208	970	1170	176	234	260	1084	1180
F-250M	75	269	271	296	1830	980	261	221	255	1536	1170	239	274	320	1718	1180

(2) 400V Class

Motor Frame Size	Pole	6P														
	Power	400V-50Hz					400V-60Hz					440V-60Hz				
	Output power [kW]	Rated Current	Torque max.[%]	Starting Torque [%]	Starting Current [A]	Speed [r/min]	Rated Current	Torque max.[%]	Starting Torque [%]	Starting Current [A]	Speed [r/min]	Rated Current	Torque max.[%]	Starting Torque [%]	Starting Current [A]	Speed [r/min]
F-180MG	15.0	27.7	271	232	179	980	27.3	222	195	154	1180	25.0	276	246	172	1180
F-180L	18.5	35.6	311	274	250	990	33.2	258	234	215	1180	31.1	321	293	240	1190
F-180L	22.0	41.4	261	230	250	990	39.5	216	196	215	1180	36.3	269	246	240	1180
F-200L	30.0	56	269	267	347	960	53	221	228	299	1180	48.8	275	287	334	1180
F-200L	37.0	68	289	293	456	980	65	237	251	392	1170	60	296	314	439	1170
F-225S	45.0	82	238	244	481	980	79	195	209	409	1170	72	242	262	457	1180
F-250S	55	99	231	242	573	980	97	188	208	485	1170	88	234	260	542	1180
F-250M	75	135	271	296	915	980	131	221	255	768	1170	119	274	266	859	1180

Note: 1. Values in parenthesis in the above table is designed value. Consult us for detailed values.
2. Consult us for confirmed values. Values in the above table are subject to change without notice.

Characteristics for Japan Standard Motor

Table E-30 Characteristics of Increased Safety Motors

(1) 200V Class

Motor Frame Size	Pole	4P														
	Power	200V-50Hz					200V-60Hz					220V-60Hz				
	Output power [kW]	Rated Current	Torque max.[%]	Starting Torque [%]	Starting Current [A]	Speed [r/min]	Rated Current	Torque max.[%]	Starting Torque [%]	Starting Current [A]	Speed [r/min]	Rated Current	Torque max.[%]	Starting Torque [%]	Starting Current [A]	Speed [r/min]
V-63S	0.10	0.69	265	281	2.7	1420	0.60	236	245	2.5	1690	0.62	285	297	2.8	1720
V-63M	0.20	1.2	232	233	4.6	1410	1.1	210	207	4.2	1690	1.1	254	250	4.8	1710
V-71M	0.40	2.3	237	237	9.1	1380	2.0	210	210	8.3	1650	2.0	257	257	9.4	1680
V-80M	0.75	3.9	234	215	16.0	1420	3.4	211	190	15.1	1720	3.3	253	242	16.8	1740
V-90L	1.5	7.0	242	224	34.1	1430	6.3	205	192	31.2	1710	6.0	250	243	34.9	1730
V-100L	2.2	9.6	268	255	52	1430	8.8	229	204	46.9	1700	8.3	282	260	52	1720
F-112M	3.7	15.1	262	236	94	1430	14.2	216	188	83	1710	13.1	264	238	93	1730
F-132S	5.5	22.9	313	286	158	1420	21.1	264	229	139	1700	19.7	325	291	156	1720
F-132M	7.5	29.5	274	261	198	1450	27.4	240	224	175	1750	25.6	292	271	195	1760
F-160M	11.0	41.9	305	297	302	1450	39.5	263	247	265	1740	36.7	322	309	296	1750
G-160L	15.0	53	271	265	360	1460	52	220	222	313	1750	48	275	280	349	1760
F-180LG	18.5	66	293	312	522	1480	65	236	257	450	1780	59	295	324	504	1780
F-180LG	22.0	79	246	262	522	1480	78	199	216	450	1770	70	248	272	504	1780
F-200LG	30.0	105	245	281	706	1470	105	195	231	610	1760	94	245	292	684	1770
F-200L	37.0	128	245	289	857	1470	128	195	241	742	1750	115	245	305	832	1760
F-225S	45.0	154	243	228	985	1470	154	198	193	844	1770	139	246	241	943	1770
F-225S	55	186	267	261	1328	1470	186	217	225	1130	1770	168	269	280	1261	1770

Motor Frame Size	Pole	6P														
	Power	200V-50Hz					200V-60Hz					220V-60Hz				
	Output power [kW]	Rated Current	Torque max.[%]	Starting Torque [%]	Starting Current [A]	Speed [r/min]	Rated Current	Torque max.[%]	Starting Torque [%]	Starting Current [A]	Speed [r/min]	Rated Current	Torque max.[%]	Starting Torque [%]	Starting Current [A]	Speed [r/min]
F-180LG	15.0	56	271	232	358	980	55	222	195	308	1180	50	276	246	344	1180
F-180L	18.5	72	311	274	500	990	67	258	234	430	1180	63	321	293	480	1190
F-180L	22.0	84	261	230	500	990	79	216	196	430	1180	73	269	246	480	1180
F-200L	30.0	107	252	253	652	980	107	204	212	558	1170	97	256	287	668	1170
F-225S	37.0	136	239	241	793	980	132	196	206	678	1170	121	243	314	878	1180
F-225S	45.0	163	235	245	946	970	163	190	208	809	1170	146	237	262	914	1170
F-250S	55	199	242	257	1184	970	198	196	219	1011	1170	178	244	260	1084	1180

(2) 400V Class

Motor Frame Size	Pole	4P														
	Power	400V-50Hz					400V-60Hz					440V-60Hz				
	Output power [kW]	Rated Current	Torque max.[%]	Starting Torque [%]	Starting Current [A]	Speed [r/min]	Rated Current	Torque max.[%]	Starting Torque [%]	Starting Current [A]	Speed [r/min]	Rated Current	Torque max.[%]	Starting Torque [%]	Starting Current [A]	Speed [r/min]
V-63S	0.10	0.36	255	261	1.3	1420	0.31	233	224	1.2	1700	0.32	277	289	1.4	1720
V-63M	0.20	0.62	233	236	2.3	1410	0.54	212	202	2.1	1690	0.54	257	266	2.4	1710
V-71M	0.40	1.2	229	229	4.5	1390	1.0	205	201	4.1	1650	1.0	249	262	4.6	1680
V-80M	0.75	1.9	234	215	8.0	1420	1.7	211	190	7.6	1720	1.7	253	242	8.4	1740
V-90L	1.5	3.5	242	224	17.1	1430	3.1	205	192	15.6	1710	3.0	250	243	17.5	1730
V-100L	2.2	4.8	268	255	26.0	1430	4.4	229	204	23.5	1700	4.2	282	260	26.2	1720
F-112M	3.7	7.5	262	236	46.9	1430	7.1	216	188	41.4	1710	6.6	264	238	46.4	1730
F-132S	5.5	11.4	313	286	79	1420	10.5	264	229	70	1700	9.9	325	291	78	1720
F-132M	7.5	14.8	274	261	99	1450	13.7	240	224	88	1750	12.8	292	271	98	1760
F-160M	11.0	21.0	305	297	151	1450	19.7	263	247	133	1740	18.3	322	309	148	1750
G-160L	15.0	26.8	271	265	180	1460	26.1	220	222	157	1750	23.8	275	280	175	1760
F-180LG	18.5	33.1	293	312	261	1480	32.3	236	257	225	1780	29.6	295	324	252	1780
F-180LG	22.0	39.3	246	262	261	1480	38.8	199	216	225	1770	35.1	248	272	252	1780
F-200LG	30.0	52	245	281	353	1470	53	195	231	305	1760	47.2	245	292	342	1770
F-200L	37.0	64	245	289	429	1470	64	195	241	371	1750	58	245	305	416	1760
F-225S	45.0	77	243	222	492	1470	77	198	193	422	1770	70	246	241	471	1770
F-225S	55	93	267	261	664	1470	93	217	225	565	1770	84	269	280	630	1770

Motor Frame Size	Pole	6P														
	Power	400V-50Hz					400V-60Hz					440V-60Hz				
	Output power [kW]	Rated Current	Torque max.[%]	Starting Torque [%]	Starting Current [A]	Speed [r/min]	Rated Current	Torque max.[%]	Starting Torque [%]	Starting Current [A]	Speed [r/min]	Rated Current	Torque max.[%]	Starting Torque [%]	Starting Current [A]	Speed [r/min]
F-180LG	15.0	27.9	271	232	179	980	27.3	222	195	154	1180	25.0	276	246	172	1180
F-180L	18.5	36.0	311	274	250	990	33.4	258	234	215	1180	31.3	321	293	240	1190
F-180L	22.0	41.9	261	230	250	990	39.7	216	196	215	1180	36.5	269	246	240	1180
F-200L	30.0	54	252	253	326	980	53	204	212	279	1170	48.4	256	269	313	1170
F-225S	37.0	68	239	241	396	980	66	196	206	339	1170	60	243	258	379	1180
F-225S	45.0	81	235	245	473	970	81	190	208	404	1170	73	237	261	453	1170
F-250S	55	99	242	257	592	970	99	196	219	506	1170	89	244	275	566	1180

*Consult us for confirmed values. Values in the above table are subject to change without notice.

Specification and Constructions of Built-in Brake

Table E-31 Standard Brake Motor Specification

Brake Type	Motor Capacity				Brake Torque (Kinetic Friction) (N·m)	Motion Delay Time [sec]			Allowable Work E_0 (J/min)	Work up to Gap Adjustment ($\times 10^7$J)	Total Work E_1 ($\times 10^7$J)	Gap		Construction
	Three Phase Motor 4-Pole (kW)	Three Phase Motor 6-Pole (kW)	Inverter AF Motor 4-Pole (kW)	High-Efficiency Motor 4-Pole (kW)		Normal Brake Action (Simultaneous Shutoff Circuit) Three Phase Motor High-Efficiency Motor	Normal Brake Action (Separate Shutoff Circuit) AF Motor	Fast Brake Action				Default (Initial Value) (mm)	Limit Value (mm)	
FB-01A	0.1	-	-	-	1.0	0.15~0.2	-	0.015~0.02	1080	2.6	6.7	0.2~0.35	0.5	Fig.E-37
FB-02A	0.2 0.25	-	0.1	-	2.0		0.08~0.12							
FB-05A	0.4	-	0.2	0.2	4.0	0.1~0.15	0.03~0.07	0.01~0.015						
FB-1D	0.55 0.75	0.4	0.4	0.4	7.5	0.2~0.3	0.1~0.15		1620	7.0	33.1	0.3~0.4	0.6	Fig.E-38
FB-2D	1.1 1.5	-	0.75	0.75	15				2580	6.8	29.5			
FB-3D	2.2	0.75	1.5	1.1 1.5	22	0.3~0.4	0.15~0.2	0.01~0.02	3360	16.4	53.7		0.7	
FB-5B	3.0 3.7	1.5	2.2	2.2	37	0.4~0.5	0.2~0.25		6900	23.3	178.6	0.4~0.5	1.0	Fig.E-39
FB-8B	5.5	2.2	3.7	3.0 3.7	55	0.3~0.4	0.1~0.15							
FB-10B1	7.5	3.7	5.5	5.5	75	1.0~1.1	0.4~0.5	0.025~0.04	10800	94.3	356.3		1.2	Fig.E-40
FB-15B1	11	5.5	7.5	7.5	110	0.7~0.8	0.2~0.3							
FB-20	15	7.5 11	11	11 15	150	-	-	0.06~0.14	22440	191.6	1150	0.6~0.7	1.5	Fig.E-41
FB-30	18.5	-	-	-	190			0.03~0.11						Fig.E-42
	22	15 18.5 22	15	-	220									
	30	-	18.5 22	18.5 22	200									
ESB-250	37	-	30	30	250			0.065	30672	52.0	267	0.7	2.0	Fig.E-43
	45	30	37	37	300									
	-	37	-	-	370									

- This table summarizes the specifications for the standard brakes. The specifications for the special brakes may differ from those in this table.
- When the motor begins to be used, the predetermined brake torque may be unable to be reached due to the friction surface. In this case, perform lapping of the friction surface by turning on and off repeatedly with the possible lightest load.
- To improve the stopping accuracy or for the lifter, use a fast brake action.
- The lining friction sound may be generated because of the brake construction while the motor is in operation; however, the brake performance is all right.
- When the motor operates with inverter, the noise level from the brake section may increase for the reason of the brake construction; however, the brake performance is all right.
- When a motor with brake operates at a low speed for a long time, the temperature rise of the brake is larger because the cooling effect of the fan decreases. If you desire to use a motor in this manner, use an inverter motor.
- If the motor is used beyond the allowable work E_0, the brake may be failed (braking failure). By referring to Table B8 on page B14, make sure that the braking work is not larger than the allowable work E_0. (check this also when the motor needs emergency stop.)
- For ESB type brakes, the rectifier is mounted separately from the motor body. Use an HD-110M3. The rectifier is designed for indoor use, and must be installed in a place where it cannot be splashed with water.
- Any ESB type brake cannot be used in continuous operation when it is mounted in a vertical or inverse vertical position.

Why fast braking circuit shortens braking time.

See Fig.E-33 and Fig.E-34 for differences between standard braking circuit and fast braking circuit.
See Fig.E-35 and Fig.E-36 for current curves of standard braking and fast braking.

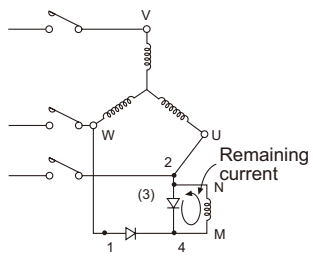


Fig. E-33 Standard Circuit

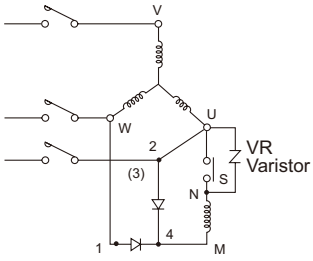


Fig. E-34 Quick Braking Circuit

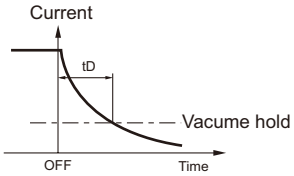


Fig. E-35 Current Curve of Standard Braking

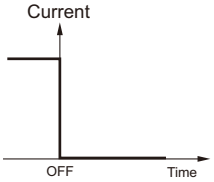
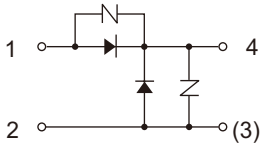


Fig. E-36 Current Curve of Quick Braking

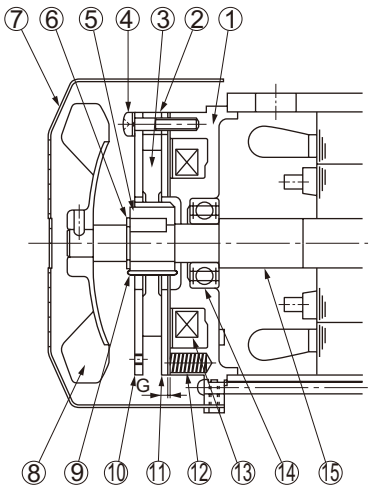
In the standard circuit Shown in Fig.E-33, some current remains after the power is turned off due to the saved energy in the inductance L of brake coil. The current curve is shown in the Fig.E-35.
When it is connected to fast braking circuit as Show in Fig.E-34 and S is released at the same time, no current remains as there is no closed circuit with the brake coil. (See the Fig.E-36)
Therefore, it shortens the braking time by tb in the Fig.E-35. Fast braking circuit is to release all current by ON/OFF of brake coil at the same time with power ON/OFF. (VR varistor must be used to protect the rectifier and connection S.)

Circuit in the rectifier



Specification and Constructions of Built-in Brake

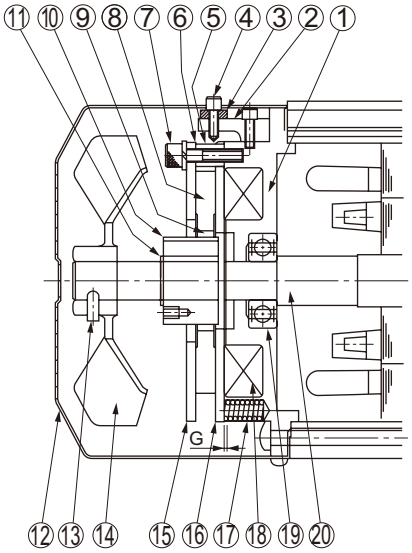
Fig. E-37 FB-01A, 02A, 05A
(FB-01A without Fan)



No.	Pats Name
1	Stationary core
2	Spacer
3	Brake lining
4	Assembling bolt
5	Boss
6	Shaft retaining C-ring
7	Cove
8	Fan (except for 0.1kW x 4 Poles)
9	Leaf spring
10	Fixed plate
11	Armature plate
12	Spring
13	Electromagnetic coil
14	Ball bearing
15	Motor shaft

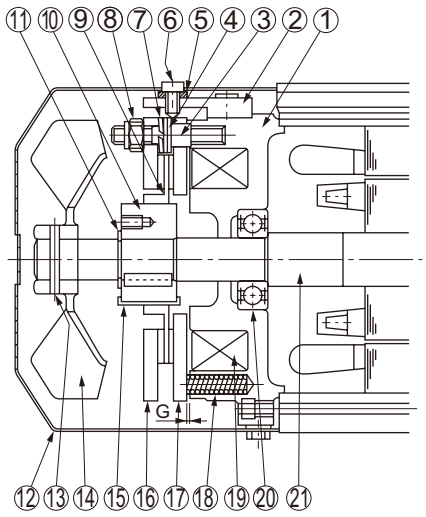
*Brake release unit is available by option.

Fig. E-38 FB-1D, 2D, 3D



No.	Pats Name
1	Stationary core
2	Release fitting
3	Manual release protection spacer
4	Brake release bolt
5	Spacer
6	Gap adjusting shim
7	Assembling bolt
8	Brake lining
9	Leaf spring
10	Boss
11	Shaft retaining C-ring
12	Cover
13	Fan set bolt
14	Fan
15	Fixed plate
16	Armature plate
17	Spring
18	Electromagnetic coil
19	Ball bearing
20	Motor shaft

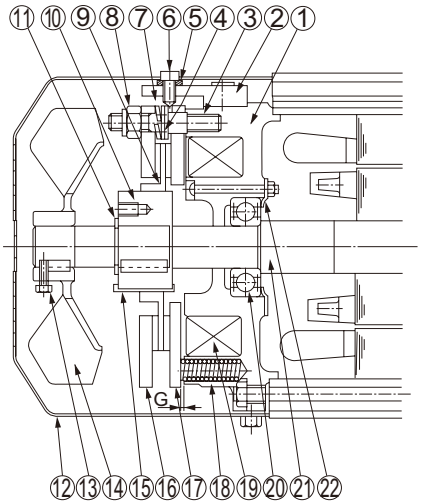
Fig. E-39 FB-5B, 8B



No.	Pats Name
1	Stationary core
2	Release fitting
3	Stud bolt
4	Adjusting washer
5	Manual release protection spacer
6	Brake release bolt
7	Spring washer
8	Gap adjusting nut
9	Brake lining
10	Boss
11	Shaft retaining C-ring
12	Cover
13	Spring pin
14	Fan
15	Leaf spring
16	Fixed plate
17	Armature plate
18	Spring
19	Electromagnetic coil
20	Ball bearing
21	Motor shaft

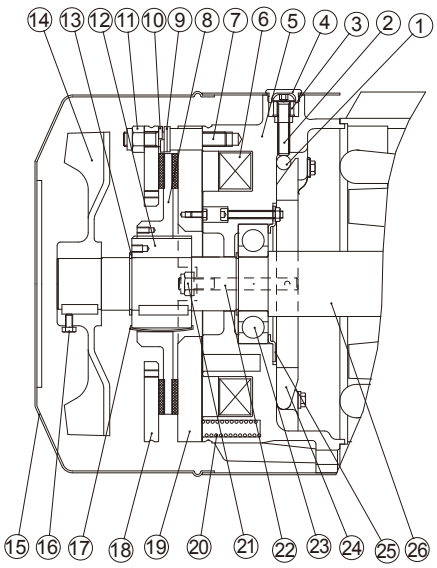
Specification and Constructions of Built-in Brake

Fig. E-40 FB-10B1, 15B1



No.	Pats Name
1	Stationary core
2	Release fitting
3	Stud bolt
4	Adjusting washer
5	Manual release protection spacer
6	Brake release bolt
7	Spring washer
8	Gap adjusting nut
9	Brake lining
10	Boss
11	Shaft retaining C-ring
12	Cover
13	Fan set bolt
14	Fan
15	Leaf spring
16	Fixed plate
17	Armature plate
18	Spring
19	Electromagnetic coil
20	Ball bearing
21	Motor shaft
22	Bearing cover

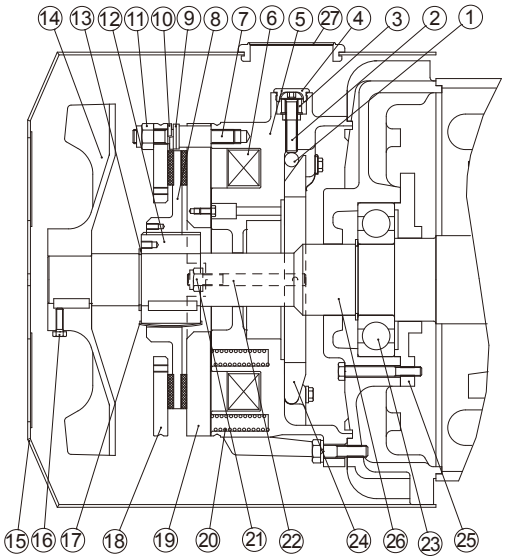
Fig. E-41 FB-20 (Indoor Type)



No.	Part Name
1	Roller
2	Brake release bolt
3	Manual release protection spacer
4	Plug
5	Stationary core
6	Solenoid coil
7	Stud bolt
8	Brake lining
9	Adjusting washer
10	Spring washer
11	Gap adjusting nut
12	Boss
13	C type retaining ring

No.	Part Name
14	Fan
15	Cover
16	Fan setting bolt
17	Leaf spring
18	Brake shoe
19	Armature plate
20	Spring
21	Nut
22	Tap-end stud
23	Bearing
24	Release lever
25	Bearing cover
26	Motor shaft

Fig. E-42 FB-30 (Indoor Type)

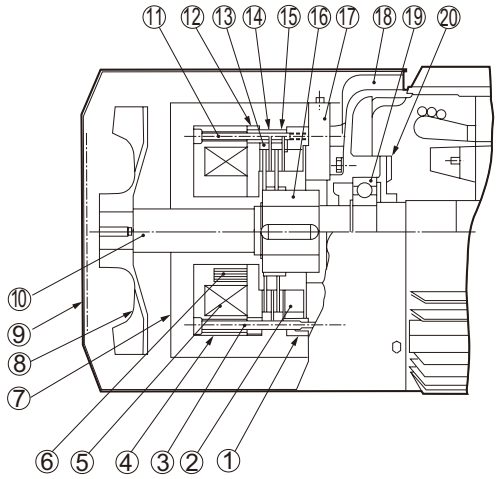


No.	Part Name
1	Roller
2	Brake release bolt
3	Manual release protection spacer
4	Plug
5	Stationary core
6	Solenoid coil
7	Stud bolt
8	Brake lining
9	Adjusting washer
10	Spring washer
11	Gap adjusting nut
12	Boss
13	C type retaining ring
14	Fan

No.	Part Name
15	Cover
16	Fan setting bolt
17	Leaf spring
18	Brake shoe
19	Armature plate
20	Spring
21	Nut
22	Tap-end stud
23	Bearing
24	Release lever
25	Bearing cover
26	Motor shaft
27	Grommet

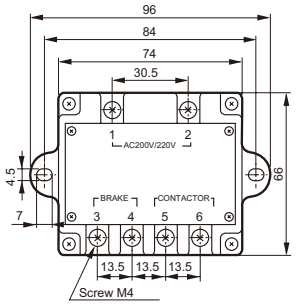
Specification and Constructions of Built-in Brake

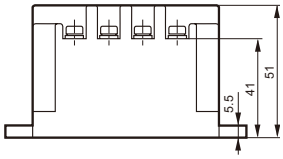
Fig. E-43. ESB250



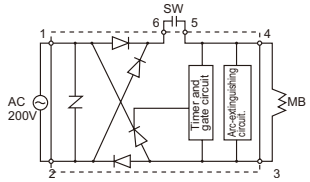
No.	Pats Name
1	Center ring
2	Gap adjusting screw
3	Assembling bolt
4	Field
5	Brake coil
6	Actuating spring
7	Brake cover (not provided for indoor type)
8	Fan
9	Fan cover
10	Shaft
11	Lock bolt
12	Armature
13	Inner disc
14	Outer disc
15	Spacer bushing
16	Hub
17	Brake adapter plate
18	Opposite drive end bracket
19	Opposite drive end bearing
20	Opposite drive end bearing cover

Power Module
Model HD-110M3





Circuit (Diagram)



Rated input voltage: AC200/220V 50/60Hz
Maximum input voltage: AC240V 50/60Hz
Minimum input voltage: AC170V 50/60Hz
Standard output voltage

Instantaneous voltage: DC180V with AC200V input
Steady voltage: DC90V
Maximum output current: DC1.8A (Steady output)

Overexcitation time: 0.4 to 1.2 s

Insulation resistance: At 100MΩ or larger
(When measured with 1000V megohmmeter)
Insulation with stand voltage: Application of AC2000V for over 1 time

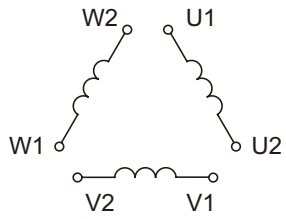
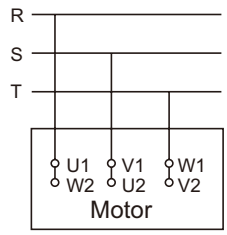
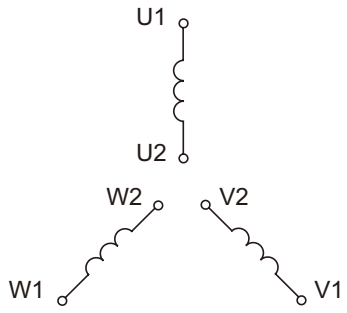
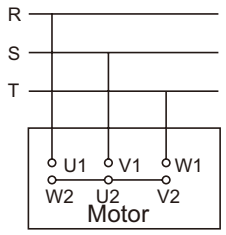
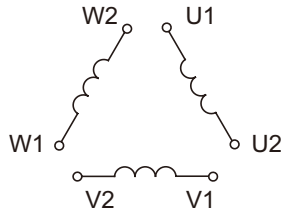
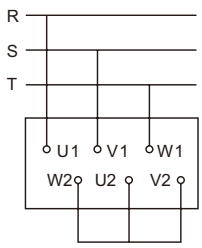
Maximum frequency

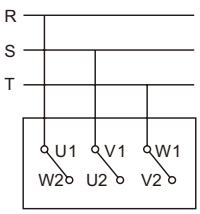
Inching (On-time 1.2 sec or less), 8 cycle/min
Constant (On-time over 1.2sec), 30 cycle/min
Ambient temperature: -20°C ~ +60°C

Note: 1. Take care to avoid dust and water.
2. Transformer is necessary for operation with 400V class power source.
The transformer should have 250 ~ 300VA rating and 200 ~ 220V secondary voltage.

Connection

3-Phase Induction Motor

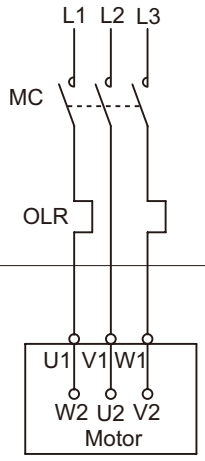
<table>
<tr><th></th><th>Wiring</th><th>Connection & Terminal code</th><th>Remarks</th></tr>
<tr><td rowspan="2">Direct Start-up</td><td> 
</td><td> 
</td><td>Standard motor under 0.1 - 3.7kW
200V Class 220 - 240V 50Hz
220V 60Hz</td></tr>
<tr><td> 
</td><td> 
</td><td>Standard motor 0.1 - 3.7kW
400V Class 380 - 420V 50Hz
440V 60Hz</td></tr>
<tr><td>人 - Start-up</td><td> 
</td><td>Start-up time
人 Connection
 

After full acceleration
Connection
 
</td><td>Standard Motor
(1) Capacity: 5.5kW and more
(2) Power Source
400V Class 380 - 420V 50Hz
400V 60Hz

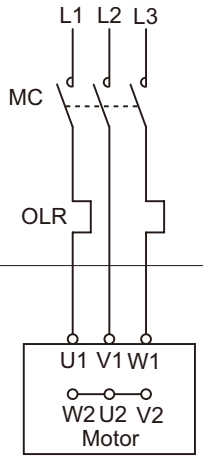
Note: If other than the above-mentioned voltages, please consult us.</td></tr>
</table>

a. 3-Phase Motor

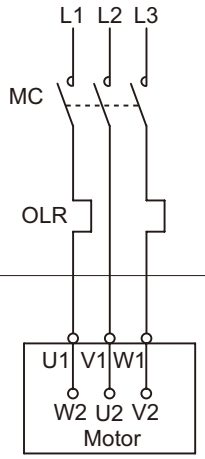
0.1-3.7kW x 4P 200V Class Direct Starting



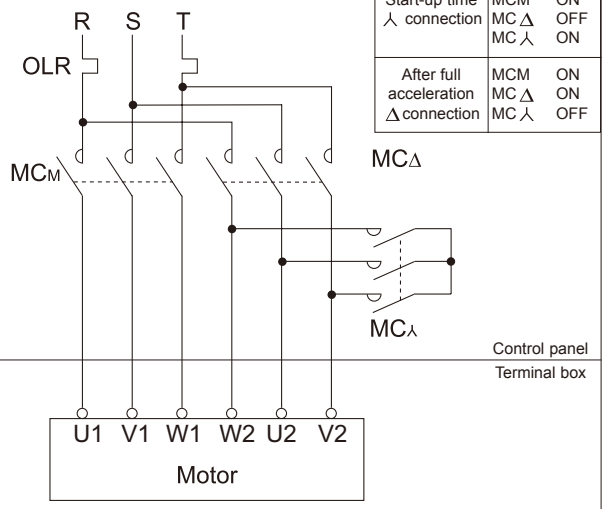
0.1-3.7kW x 4P 400V Class Direct Starting



5.5-45kW x 4P 400V Class Direct Starting



5.5-45kW x 4P 400V Class 人-△ Starting

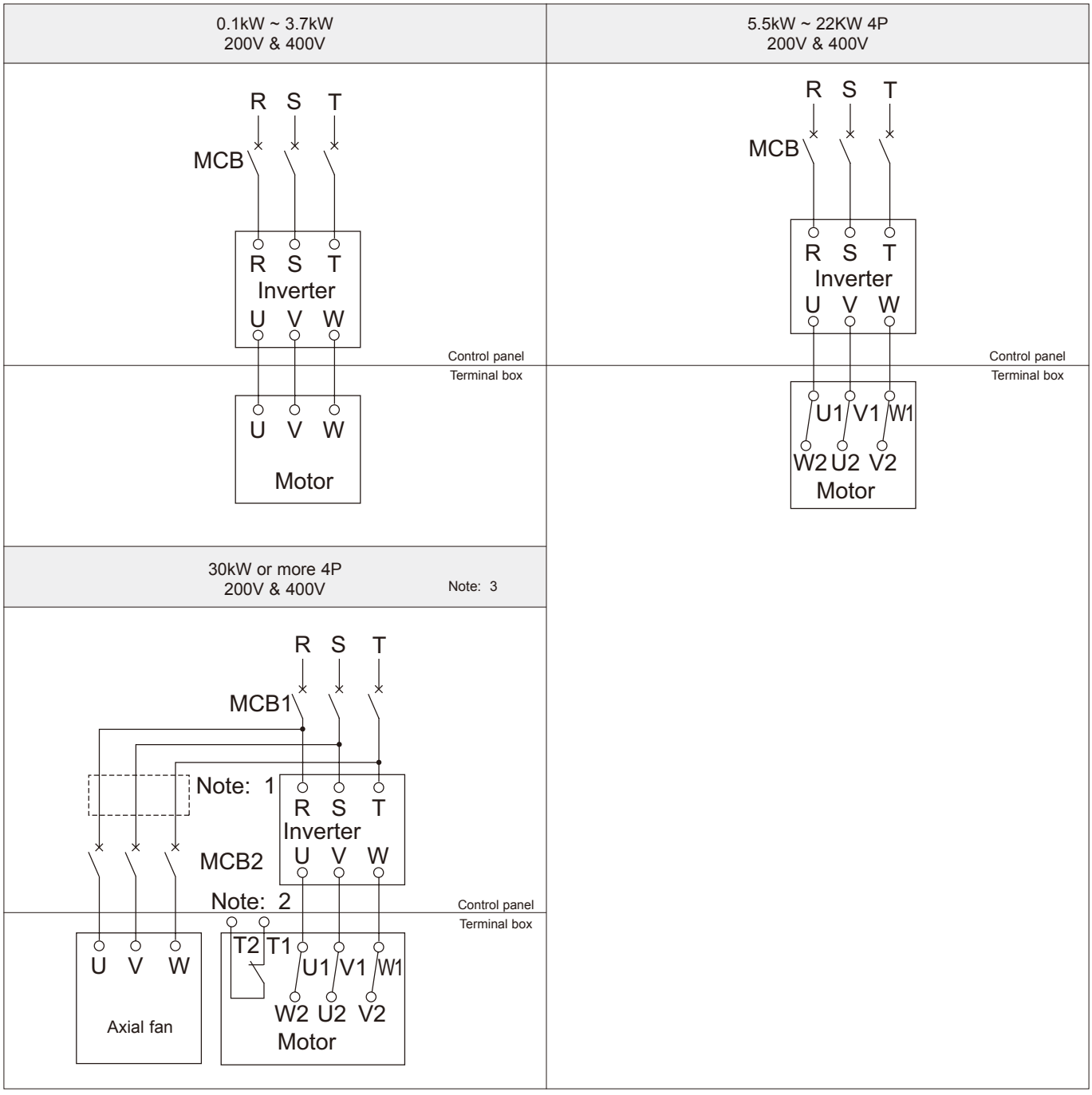


MC: Electromagnetic contactor
OLR: Overcurrent protection device
— To be prepared by customer.

Example of Connection

b. 3-Phase Motor

Example of connection for inverter-driving

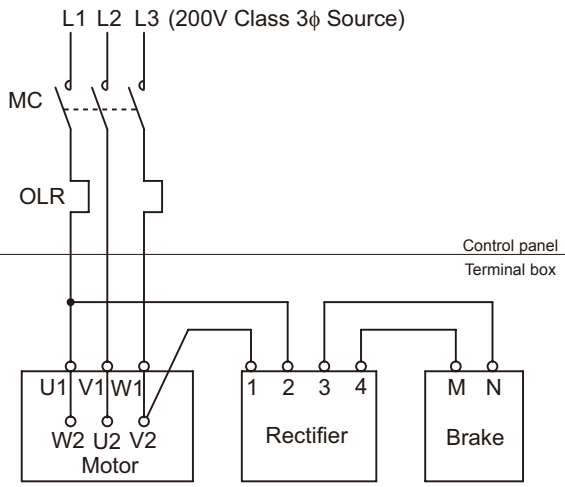
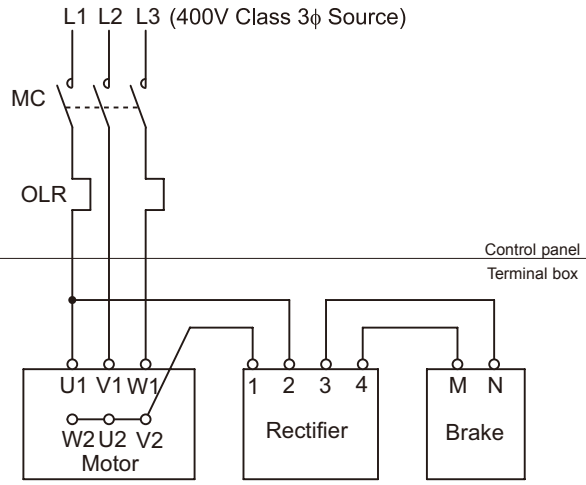
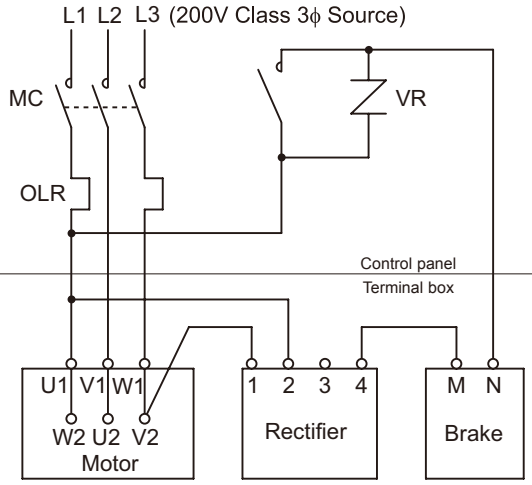
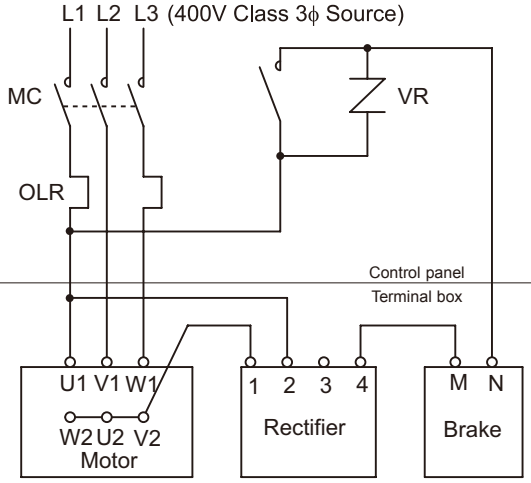


The AF motor is designed for inverter-driving. When the capacity is small, the ⅄ connection is adopted, and when it is intermediate or larger, the connection is adopted.
- ⅄- change-over operation by commercial power will also be possible.

• MCB: Circuit breaker – To be prepared by customer.

Note: 1. The standard voltage of the axial fan is 3 ,200V. Provide a 400/200V transformer for the 400V power supply. Contact us for inquiries about a 400V fan.
2. Thermostat specifications (For totally enclosed separate ventilation type)
Terminal code: T1 and T2 or P1 and P2
Operating temperature: 135°C (Type F insulation)
Operation: Normally closed (b contact point)
Max. current: 24VDC; 18A; 230VAC; 13A
3. General motor of standard specification type does not include axial fan or thermostat.

c. 3-Phase Motor with FB Brake for One Way Rotation (0.1-3.7kW)

	0.1-3.7kW x 4P 200V Class Direct Starting	0.1-3.7kW x 4P 400V Class Direct Starting
Normal Braking Action		
Fast Braking Action		

MC : Electromagnetic contactor
OLR : Overcurrent protection device
VR : Varistor (for protection of contact, rectifier, etc.)

To be prepared by customer.

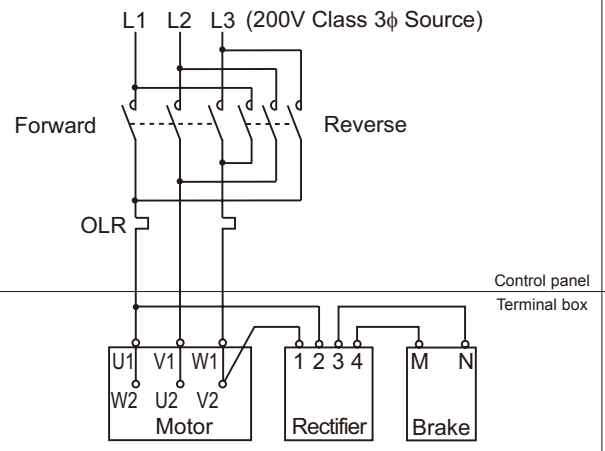
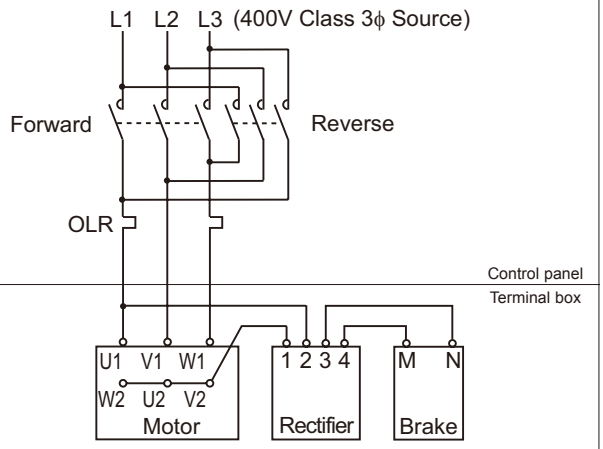
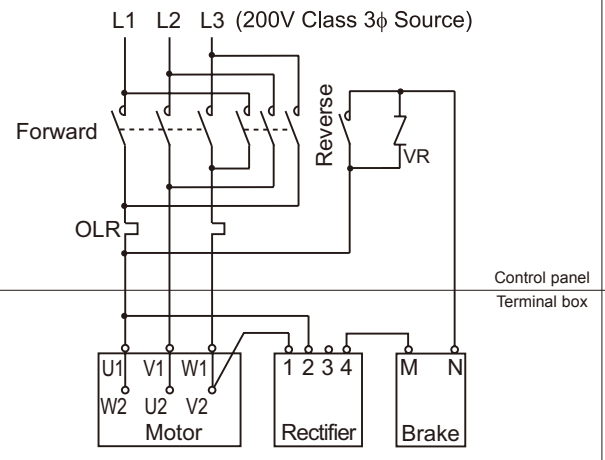
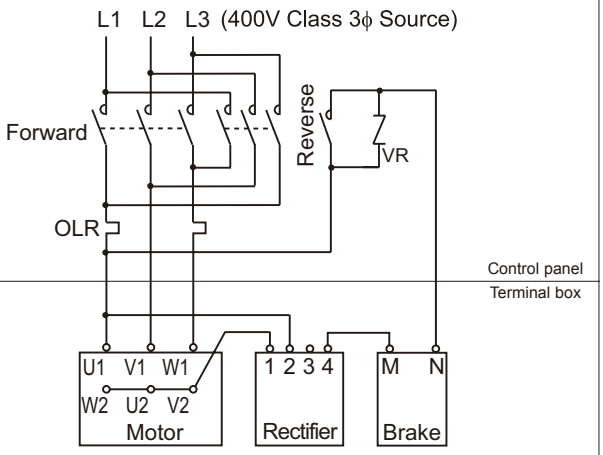
Varistor (VR) Capacity

Input power		AC200V–230V	AC380V–460V
Rated voltage of varistor		AC260V–300V	AC510V
Voltage of varistor		430V–470V	820V
Rated power of varistor	FB-01A1, 02A1, 05A1	0.25Watt or more	0.4Watt or more
	FB-1D	0.4Watt or more	0.6Watt or more
	FB-2D, 3D, 5B, 8B	0.6Watt or more	1.5Watt or more
	FB-10B1,15B1	1.0Watt or more	1.5Watt or more

- Use fast braking action for lifting devices or for better stopping accuracy.
- DC braking capacity (for DC coil loading) exceeding 5 times the braking current shown on the name plate is recommended for the fast braking action.

Example of Connection

d. 3-Phase Motor with FB Brake for Operating in Both Directions (0.1-3.7kW)

	0.1-3.7kW x 4P 200V Class Direct Starting	0.1-3.7kW x 4P 400V Class Direct Starting
Normal Braking Action		
Fast Braking Action		

Forward/reverse rotation electromagnetic contactor
OLR : Overcurrent protection device
VR : Varistor (for protection of contact, rectifier, etc.)

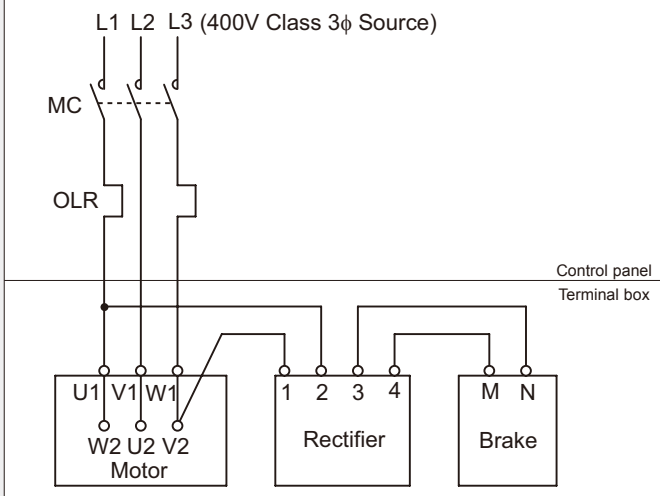
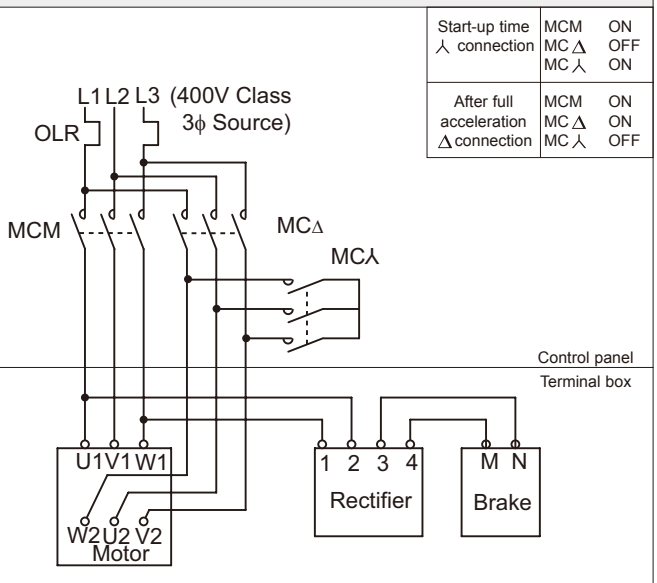
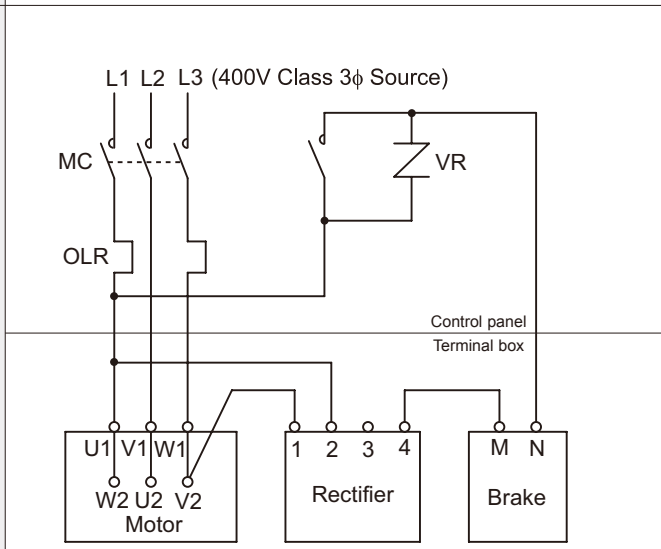
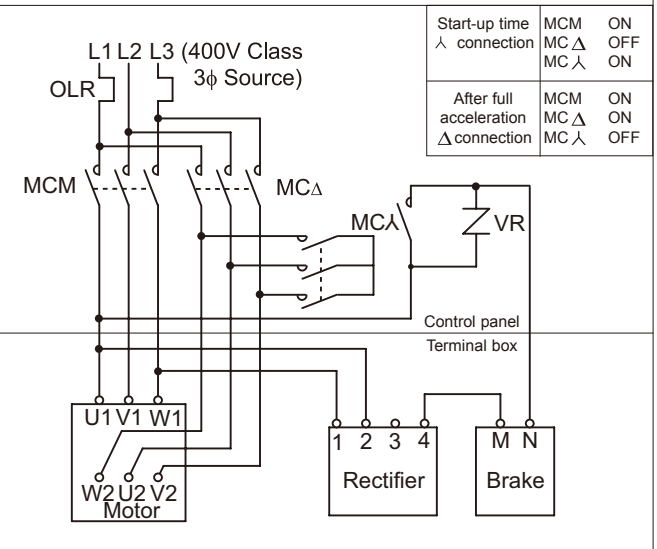
To be prepared by customer.

Varistor (VR) Capacity

Input power		AC200V–230V	AC380V–460V
Rated voltage of varistor		AC260V–300V	AC510V
Voltage of varistor		430V–470V	820V
Rated power of varistor	FB-01A1, 02A1, 05A1	0.25Watt or more	0.4Watt or more
	FB-1D	0.4Watt or more	0.6Watt or more
	FB-2D, 3D, 5B, 8B	0.6Watt or more	1.5Watt or more
	FB-10B1,15B1	1.0Watt or more	1.5Watt or more

- Use fast braking action for lifting devices or for better stopping accuracy.
- DC braking capacity (for DC coil loading) exceeding 5 times the braking current shown on the name plate is recommended for the fast braking action.

e. 3-Phase Motor with FB Brake for One Way Rotation (5.5-11kW)

	5.5-11kW x 4P 400V Class Direct Starting	5.5-11kW x 4P 400V Class 人-△ Starting
Normal Braking Action		
Fast Braking Action		

MC : Electromagnetic contactor
OLR : Overcurrent protection device
VR : Varistor (for protection of contact, rectifier, etc.)

To be prepared by customer.

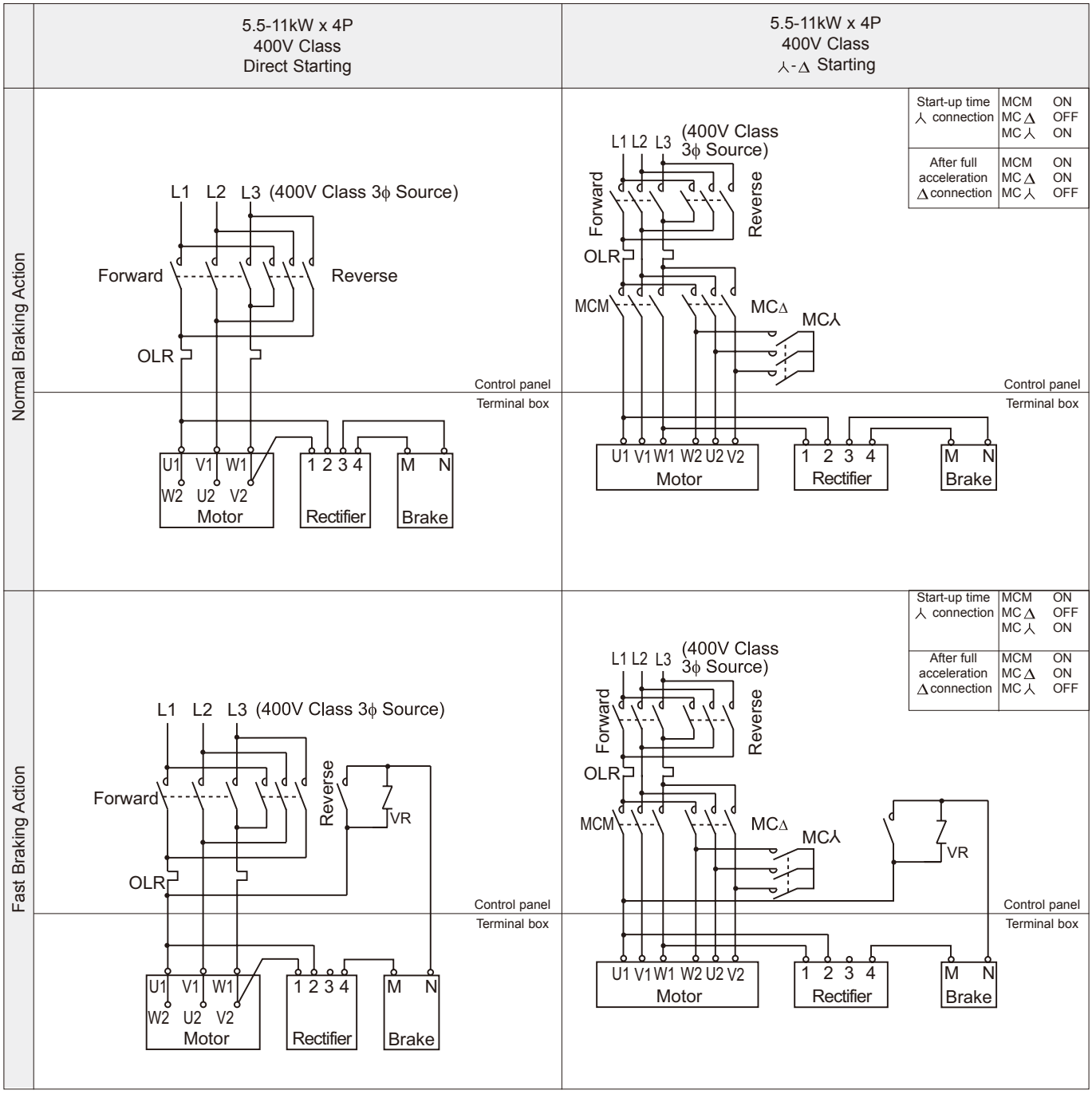
Varistor (VR) Capacity

Input power		AC200V–230V	AC380V–460V
Rated voltage of varistor		AC260V–300V	AC510V
Voltage of varistor		430V–470V	820V
Rated power of varistor	FB-01A1, 02A1, 05A1	0.25Watt or more	0.4Watt or more
	FB-1D	0.4Watt or more	0.6Watt or more
	FB-2D, 3D, 5B, 8B	0.6Watt or more	1.5Watt or more
	FB-10B1,15B1	1.0Watt or more	1.5Watt or more

- Use fast braking action for lifting devices or for better stopping accuracy.
- DC braking capacity (for DC coil loading) exceeding 5 times the braking current shown on the name plate is recommended for the fast braking action.

Example of Connection

f. 3-Phase Motor with FB Brake for Operating in Both Directions (5.5-11kW)



Forward/reverse operation electromagnetic contactor
MC : Electromagnetic contactor
OLR : Overcurrent protection device
VR : Varistor (for protection of contact, rectifier, etc.)

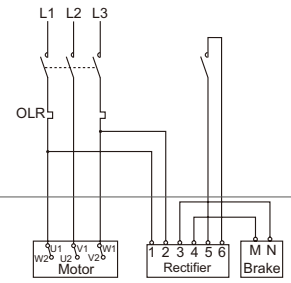
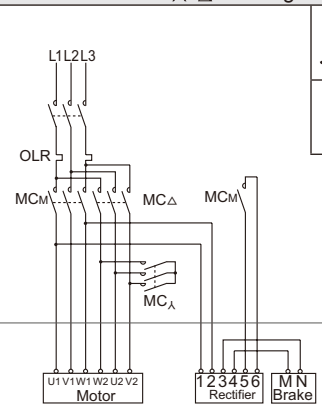
To be prepared by customer.

Varistor (VR) Capacity

Input power		AC200V–230V	AC380V–460V
Rated voltage of varistor		AC260V–300V	AC510V
Voltage of varistor		430V–470V	820V
Rated power of varistor	FB-01A1, 02A1, 05A1	0.25Watt or more	0.4Watt or more
	FB-1D	0.4Watt or more	0.6Watt or more
	FB-2D, 3D, 5B, 8B	0.6Watt or more	1.5Watt or more
	FB-10B1,15B1	1.0Watt or more	1.5Watt or more

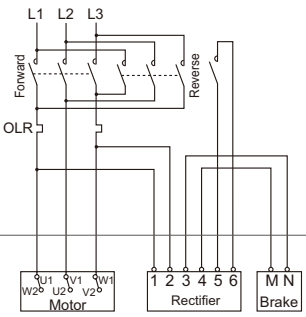
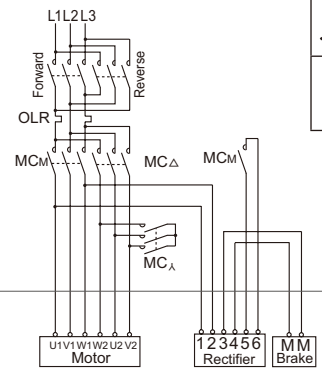
- Use fast braking action for lifting devices or for better stopping accuracy.
- DC braking capacity (for DC coil loading) exceeding 5 times the braking current shown on the name plate is recommended for the fast braking action.

g. 3-Phase Motor with FB Brake for One Way Rotation (15-30kW)

	15-30kW x 4P 400V Class Direct Starting	15-30kW x 4P 400V Class 人-△ Starting
Fast Brake Action		

Start-up time 人connection	MCM	ON
	MC△	OFF
	MC人	ON
After full acceleration △ connection	MCM	ON
	MC△	ON
	MC人	OFF

h. 3-Phase Motor with FB Brake for Operating in Both Directions (15-30kW)

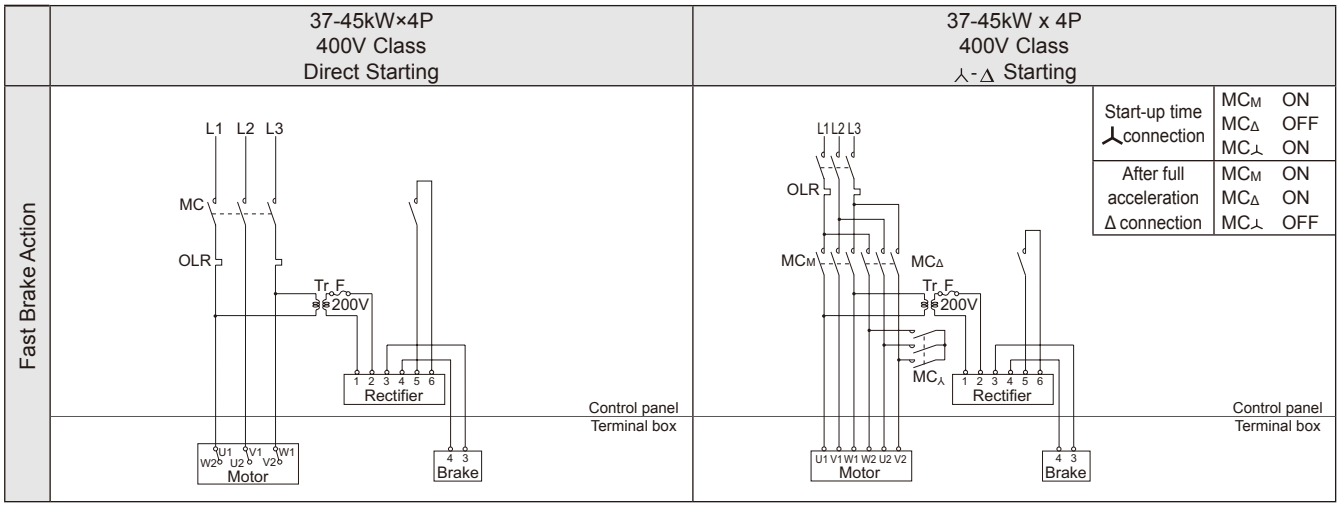
	15-30kW x 4P 400V Class Direct Starting	15-30kW x 4P 400V Class 人-△ Starting
Fast Brake Action		

Start-up time 人connection	MCM	ON
	MC△	OFF
	MC人	ON
After full acceleration △ connection	MCM	ON
	MC△	ON
	MC人	OFF

Forward/reverse operation electromagnetic contactor
MC : Electromagnetic contactor
OLR : Overcurrent protection device
— To be prepared by customer.

Example of Connection

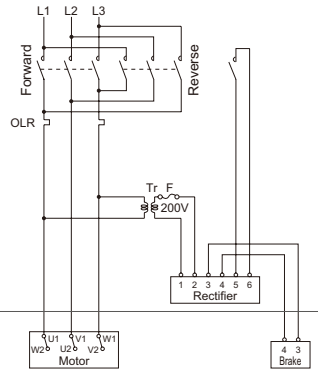
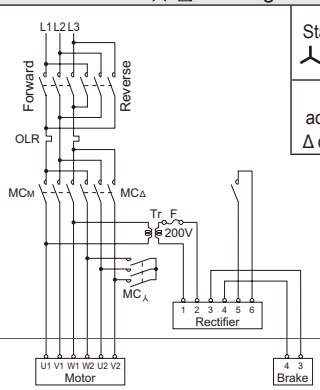
i. 3-Phase Motor with ESB Brake for One Way Rotation (37-45kW)



MC : Electromagnetic contactor
OLR : Overcurrent protection device
Tr : Transformer capacity 250~600VA, secondary voltage 200~220V
F : Fuse 3~5A

To be prepared by customer.

j. 3-Phase Motor with ESB Brake for Operating in Both Directions (37-45kW)

	37-45kW x 4P 400V Class Direct Starting	37-45kW x 4P 400V Class 人-△ Starting
Fast Brake Action		

Start-up time 人connection	MCM ON MC△ OFF MC人 ON
After full acceleration Δ connection	MCM ON MC△ ON MC人 OFF

Forward/reverse operation electromagnetic contactor
MC : Electromagnetic contactor
OLR : Overcurrent protection device
Tr : Transformer capacity 250~600VA, secondary voltage 200~220V
F : Fuse 3~5A

To be prepared by customer.

Protection and Cooling

No.1 Symbol: Type of protection of humans and solid foreign substances
No.2 Symbol: Type of protection against water permeation
} Classified according to combination (IEC34-1)

Protection Method of Motors

No.1 Symbol / No.2 Symbol	0 Non-protected type	2 Drip-proof type	3 Spray-proof type	4 Splash-proof type	5 Water-jet-proof type	6 Sea-wave-proof type	7 Immersion-proof type	8 Submersible type
0 (Non-protected type)	IP00			×	×	×	×	
1 (Semi-protected type)	IP10	IP12S			×	×	×	
2 (Protected type)	IP20	IP22S	IP23S	IP24	×	×	×	
4 (Totally enclosed type)	×			IP44	IP45			
5 (Dust-proof type)	×			IP54	IP55	IP56		

Note: 1. × denotes difficulty in forming the combination.
2. Outlined columns ▭ shows the range of standard models.
3. Please consult us if operating conditions include splashed water, or rain.

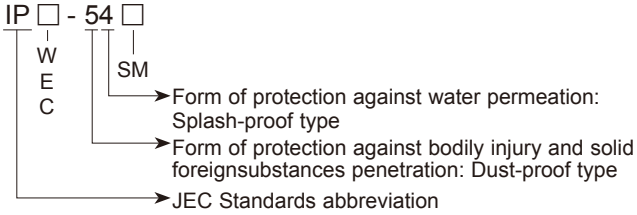
Class of No.1 Symbol

Type	Symbol	Description
Non-protected	0	Constructed without special protection against human contact and penetration of solid foreign substances.
Semi-protected	1	Constructed to prevent inadvertent contact with rotating and conductive parts inside the machine, by hand or other critical parts of human body. Constructed to prevent penetration of solid foreign substances over 50 mm in diameter.
Protected	2	Constructed to prevent contact with rotating and conductive parts inside the machine, by hand or other critical parts of the human body. Constructed to prevent penetration by solid substances over 12mm in diameter.
Totally enclosed	4	Constructed to prevent contact with the rotating and conductive parts inside the machine, by tools, electric wires, etc., with minimum width and thickness over 1mm. Constructed to prevent penetration of solid foreign substances over 1mm diameter. However, water drainage outlet and exhaust outlet may be of Symbol 2 construction.
Dust-proof type	5	Constructed to prevent contact with rotating and conductive parts inside the machine by any foreign object. Constructed for maximum protection against dust particles penetration, but such penetration will not interfere with normal operation.

Class of No.2 Symbol

Type	Symbol	Description
Non-protected	0	Constructed without special protection against water permeation.
Drip-proof	2	Constructed to prevent harmful effect from dripping water falling from within 15° direction from vertical.
Spray-proof	3	Constructed to prevent harmful effect from dripping water falling from within 60° direction from vertical.
Splash-proof	4	Constructed to prevent harmful effect from dripping water falling from any direction.
Water-jet-proof	5	Constructed to prevent harmful effect from spray from any direction.
Sea-wave-proof	6	Constructed to prevent harmful effect from strong spray from any direction.
Immersion-proof	7	Constructed for submersion into water of prescribed depth and time, without any harm even when water enter the unit.
Submersible	8	Constructed to assure normal operations under water.

Example: IP □ - 54 □



S: Test of form of protection against water permeation conducted when motor is stopped.
M: Test of form of protection against water permeation, conducted while motor is operating.
When S or M is not indicated:
Conduct test when motor is at stop and during operation.
W: Outdoor type (Only Non-protected)
E: Explosion-proof type
C: Form of protection against other harmful atmosphere.

Cooling

Enclosure Construction	IEC Standards
Totally enclosed, non-ventilated (TENV)	IC410
Totally enclosed, fan-cooled (TEFC)	IC411
Totally enclosed, Air over (TEAO)	IC416

International Standards and Compliance of Sumitomo Products

CCC Standards (China Compulsory Certification)

China had implemented the China Compulsory Certification (CCC) system since May 1, 2002 as becoming the full member of World Trade Organization (WTO). They have moved on to compulsory licensing on August 1, 2003.
Motor capacity 1.1kW and below are subject to this certification, and requires CCC Mark for sales in China. Below table is our motor with CCC.

Motor	Three Phase Motor	AF Motor	AF Motor (Foot Mount)
Capacity	0.1~1.1kW	0.1~0.75kW	0.4~0.75kW
Voltage	220 or 380V		
Frequency	50Hz		
Thermal class	F		
Usage	Indoor (IP44), Outdoor (IP55)		

AF motor: 3 Phase Motor for inverter

Difference with standard items
- CCC Mark as in the right is applied on the nameplate.
- Aluminum terminal box is the standard for three phase motor.
- Terminal block type (6 terminals, European system) is the standard for three phase motor.
- Rotational direction is the opposite from Japanese domestic specification (in CCW direction looking from the anti-load side).
- CCC correspondence motor coil is used.

China Compulsory Certificate

Remarks
- CCC Mark is necessary when exporting small size motor (or gear motor) units of 1.1kW or below to China.
- Subject service products and spare parts without certification may be permitted for import to China by applying for exemption. Consult us for any clarification.

GOST-R Standard (Russian Gosstandard)

GOST-R Standard is a national certification system determined by State Committee of Russian Federation for Standardization and Metrology.
Any product distributed in the Russian Federation requires certification. Especially products subject to compulsory certification are not allowed to export to Russian Federation without this certification.
Sumitomo offers motors conforming to GOST-R specification for export to Russia, because motors are subject to compulsory certification.
Our Certified Motor Specification (Range other than the below is the same as CE Marking of Europe.)

Motor	General motor				Inverter motor (AF motor)			
	Without brake	With brake	Without brake	With brake	Without brake	With brake	Without brake	With brake
Capacity x 4P	0.1~3.7kW	5.5kW	0.1~3.7kW	5.5kW~30kW	0.1~2.2kW	3.7kW	0.1~2.2kW	3.7kW~30kW
Motor voltage	220/380V	380V	220/380V	380V	220/380V	380V	220/380V	380V
Brake voltage	-	-	220V	380V	-	-	220V	380V
Frequency	50Hz				60Hz			
Thermal class	F				F			
Rating	S1 (continuous)				S1 (continuous)			
Construction	Indoor (IP44), Outdoor (IP55)				Indoor (IP44), Outdoor (IP55)			
Starting	Dual voltage inline	人-Δ	Dual voltage inline	人-Δ	-			

AF motor: 3-Phase Motor for inverter

Difference Compared to Standard Japanese Product
- Nameplate is marked with GOST-R Mark (as shown in the right).
- Standard terminal box is made of Aluminum
- The motor has terminal block (European type with 6 terminals).
- Rotation direction is counterclockwise viewed from fan cover side (opposite from Japanese specification).
- Motor coil is certified for GOST-R.

GOST-R Mark

Cautions
- Uncertified products cannot pass through customs when exported to Russia. (No specific certification is necessary when the unit is exported to Russia as a part of the machine.)
-A verified copy of the certification is necessary when exporting the individual unit for each case (each ship).
Let us know when ordering the units which are not included in an apparatus or not built into the exported aparatus.

International Standards and Compliance of Sumitomo Products

CE MARKING

The CE mark is to be affixed to products that conform to EC directives, in order to certify the quality and safety of products and ensure free distribution of products across borders within the region of the EU (European Union).

EC directives applicable to machine products and implementation period

The following three directives apply to ordinary machine products.

EC directives \ Details	Objects	Details of directive
Machinery directive	Aggregates of parts, which are movable (Industrial machines, primarily)	Essential matters related to safety of machines are stipulated. Machines that are electrically dangerous shall fulfill the requirements for low voltage.
Low Voltage Directive	Products driven by power of 50-1,000 VAC or 75-15,000 VDC	Products not conforming to standards cannot be put on the market.
EMC Directives Electromagnetic Compatibility Directive	All types of products that may cause jamming (electromagnetic radiation) or have their functions impeded by nearby radio waves	EMI : Not to cause external electromagnetic interference EMS : To withstand external electromagnetic interference

Standard Specifications of CE Marking Motors

Input power : 0.1kW~4kW 230/400V 50Hz Dual voltage direct starting
5.5kW or more 400V 50Hz 人-Δ Start
Thermal class : F
Rated time : Continuous
Characteristics : IEC34-1
Protection : IP55 (without brake), IP55 (with brake)
Terminal box : (Material) 5.5kW or less : Aluminum (PG16 bolts×2pcs or M25 bolts (P1.5)×2pcs)
7.5kW or more : cast iron (PG21 bolts×2pcs or M32 bolts (P1.5)×2pcs)
(specification) Terminal plate (six terminals European style)
with grounding terminal
Conduit tube of M thread
Shaft rotating direction : Rotating direction is reverse to Japanese standard direction.
Insulation : Distances between insulated surfaces and spaces in accordance with IEC standards.
External dimensions : Same as standard except for the terminal box Length might vary in some cases for models 90W or less.
T ÜV test report : Acquired for a representative model 0.75kW×4p, 230V/400V (Oct 1996)
CE marking motors are manufactured in accordance with the model.
Declaration of Conformity : Declaration of Conformity is available when necessary for CE marking

Manufacturing range of CE Marking motors

3-phase induction motor

	230/400V dual voltage								
Input power symbol	01	012	018	02	03	04	05	08	1
kW×4P	(0.1)	0.12	0.18	(0.2)	0.25	0.37	(0.4)	0.55	0.75
Frame	V63S		V63M			V71M		V80S	V80M

	230/400V dual voltage						400V		
Input power symbol	1H	2	3	4	5	6	8	10	15
kW×4P	1.1	1.5	2.2	3	(3.7)	4	5.5	7.5	11
Frame	V90S	V90L	V100L	V112S	V112M		V132S	V132M	V160M

· Motors of kWs without brackets ( ) in the above table are standard in Europe while motors of kWs with brackets ( ) are used only in Japan and other countries.
· European standard kW motors are recommended. Motors of kWs with brackets ( ) are also available.
3-phase 200V/50Hz, 200V/60Hz, 220V/60Hz 3-phase 400V/50Hz, 400V/60Hz, 440V/60Hz 3-phase 380V/50Hz, 3P 415V/50Hz
Contact us when motors of kW and voltage not shown in the above table are required.
· Consult us when M bolt (Metric bolt) is needed for conduit tube.

Measures to take for EC directives and CE marking related to gear motors

Among EC directives, the machinery directive (issued in January 1995) concerning induction motors and low voltage directive (issued in January 1997) are applicable.
The EMC directive (issued in January 1996) does not apply to induction motors.

CE marking logo shown on nameplates

CE

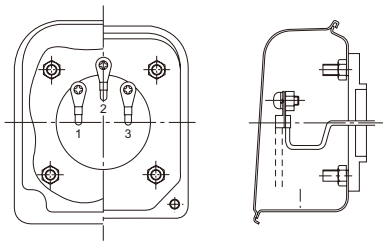
International Standards and Compliance of Sumitomo Products

UL Standards (Underwriters Laboratories)

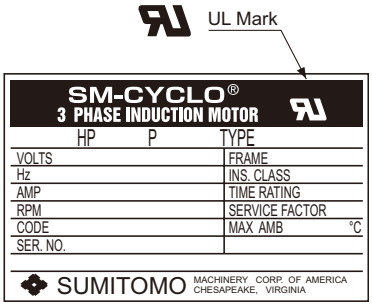
UL Standards are established by Underwriters Laboratories Inc. (UL), an independent, not-for-profit product-safety testing and certification organization in the USA. It conducts series of scientific study, research, and testing to prevent harmful effect to human life, fire, and disaster. Although there is no regulation by the Federal Government for manufacturers' compliance, some state and cities mandate them. Using Sumitomo product with UL Standard Certification will represent your reliability, which is highly appreciated in the USA.

Motor	Non-explosion proof 3-phase induction motor	3-phase induction motor with brake
Power	1/8~60HP × P	1/8~8HP × 4P
Voltage	208V, 230V, 460V, 575V	
Frequency	60Hz	
Thermal class	F	
Ambient conditions	Outdoor type	

*1 Contact us for manufacturing single-phase motor or motor with brake.



3-Phase indoor terminal box



UL Nameplate

Differences from Sumitomo standard models
- Terminal symbol: 1, 2, 3
- Name plate with UL mark and measurement expressed by units HP
- Opposite rotating direction from the Japanese domestic products
- Copper terminal box
- UL standard motor coil and brake coil

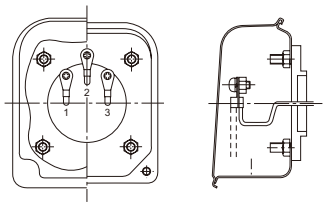
Remarks
- Motors must be manufactured, modified, and repaired at certified factories.
- Certified motor for inverter (AF Motor) may be manufactured for range 1/8~11HP.

CSA Standards (Canadian Standards Association)

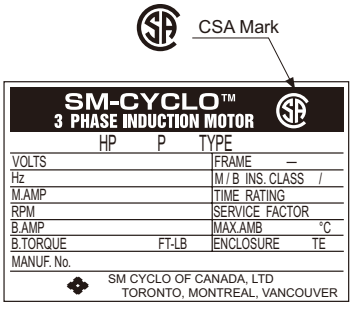
CSA Standards are established by the semiprivate Canadian Standards Association, a not-for-profit membership-based association. Most of the Canadian states requires this CSA certification for its domestically sold electric related products. Some American states evaluate CSA Standards comparable to UL Standards.

Motor	1-phase induction motor *1	3-phase induction motor	3-phase induction motor with brake	High efficiency 3-phase induction motor *1	High efficiency 3-phase induction motor with brake *1
Power	1/8~1HP × 4P	1/8~60HP × 4P	1/8~30HP × 4P	1.5~50HP × 4P	1.5~30HP × 4P
Voltage	115V, 230V	208V, 230V, 460V, 575V		230V, 460V, 575V	
Frequency	60Hz				
Thermal class	F				
Ambient conditions	Indoor type *2				

*1 Contact us for manufacturing of single-phase or high-efficiency motor with brake.
*2 Outdoor types are not available.



3-Phase indoor terminal box



CSA Nameplate

Differences from Sumitomo standard models
- Terminal symbol: 1, 2, 3 (with Brake type, T1, T2, T3)
- The frame size of a high-efficiency motors are different from standard types.
- Name plate with CSA mark and measurement in HP
- Opposite rotating direction
- Copper terminal box
- CSA standard motor coil

Remarks
- CSA certified motor is necessary for export to Canada. In addition, high-efficiency motor is necessary for 1 HP and above.
- Motors must be manufactured, modified, and repaired at certified factories.
- Because CSA does not certify motors for inverters, our AF Motors is not CSA certified and does not come with the CSA
- Mark although it complies with the CSA standard.
  NRCan established the energy efficiency act (EEACT) in 1992 and the energy efficiency regulations (EER) in 1995. Additional regulations were applied to gearmotors imported on November 27, 1999 and later. Gearmotor import which do not meet the efficiency standards are now banned under this law.(Subject capacity: 1~200HP, Subject frame: IEC frame size 90 and above, Subject voltage: 600V and below, constant speed motor)

International Standards and Compliance of Sumitomo Products

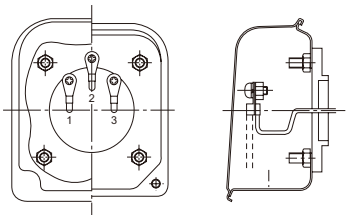
NEMA Standards (National Electrical Manufacturers Association)

NEMA Standards include numerous standards for electric products established by the National Electrical Manufacturers Association (NEMA) to eliminate misunderstandings between manufacturer and purchaser.

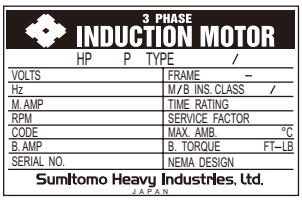
Differences from Sumitomo standard models
- · Terminal symbol: 1, 2, 3
- · Name plate marked with NEMA DESIGN and measurement in HP
- · Opposite rotating direction from the Japanese domestic products
- · Copper terminal box

NEMA standard motor coil

Remarks
- · No approval is required to state NEMA compliance
- · NEMA is also applicable for inverter motor (AF motor), but limited to terminal symbols, measurement in HP, rotating direction and terminal box.



3-Phase indoor terminal box



NEMA Nameplate

Other Standards

○: Sumitomo standards
△: Manufactured specially on customer's request

Application of International Standards (Example)

Country/Standards	Japan · JIS JEM JEC	International·IEC	UK · BS
Standard output	○	○	△: 4kW and below ○: 5.5kW and above
Applicable output frame size	○	-	△
Motor mounting dimension of each frame size	○ Note	○ Note	○ Note
Shaft end dimension	○ Note	○ Note	△ Note
Dimension tolerance of shaft end key and keyway	○ Note	○ Note	△ Note
Thermal class	○	○	○
Lead wire code	○	○	○
Standard rotation direction	○	△	△
Description on nameplate	○	△	△
Characteristic testing method	○	○	△
Standard voltage	200V, 220V 400V, 440V	△	415V
Standard frequency	50Hz, 60Hz	50Hz, 60Hz	50Hz

IEC- International Electrotechnical Commission.
BS- British Standards.

Note: CYCLO flange dimension is the standard. Consult us for flange dimension for your required compliance standards.

Major Japanese Standards

(1) General rotating electrical machines
- JIS C 4004 (1992): General rules for rotating electrical machines
- JEC-200 (1993): Rotating machinery in general
- JEM 1188 (1969): Rated output values of electric motors

(2) General 3-phase induction motors
- JIS C 4210 (1983): Low-voltage 3-phase squirrel cage induction motors for general purpose
- JIS C4212 (2000): High efficiency low-voltage 3-phase squirrel cage induction motors.
- JEC-37 (1979): Induction machines

(3) Methods of testing and calculating characteristics
- JEC-37 (1979): Induction machines
- JIS C 4207 (1995): Calculating method of 3-phase induction motors characteristics

(4) Dimensions
- JEM 1400 (1991): Dimension of low-voltage 3-phase squirrel cage induction motors for general purpose
- JEM 1401 (1991): Dimensions of flange-mounted low-voltage 3-phase squirrel cage induction motors for general purposes

(5) Explosion-proof construction
- JIS C 0903 (1983): Electrical apparatus for explosive atmospheres in general industries
- JIS C 0904 (1983): Test methods on electrical apparatus for explosive gas atmospheres in general industries
- JIS C 0905 (1983): Supplementary requirements for construction of electrical apparatus for explosive atmosphere in general industries

Recommended practices for explosion-protected electrical installations in general industries (1979)
Rules for authorization of explosion-proof construction of electrical machine tools (1981)

(6) Others
- JIS C 4003 (1977): Classification of materials for insulation of electrical machinery and apparatus
- JEC-147 (1960): Classification of materials for insulation of electrical machinery and apparatus
- JEM 1313 (1983): Noise levels for low-voltage 3-phase squirrel-cage induction motors for general purpose

Abbreviations:
- JEC Japanese Electrotechnical Committee Standards
- JIS Japanese Industrial Standard
- JEM Japan Electrical Manufacturers' Association

International Power Source Voltage and Conditions

Country / Area		Frequency	Voltage
Japan		50Hz / 60Hz	Single phase 100V / 200V, 3-phase 200V / 400V
North America	America	60Hz	Single phase 115V / 230V, 3-phase 230V
North America	Canada	60Hz	Single phase 120V / 347V, 3-phase 230V, 460V, 575V
South America	Brazil	60Hz	Single phase 110V / 220V, 3-phase 220V/380V
Asia	Bangladesh	50Hz	Single phase 230V, 3-phase 400V
Asia	China	50Hz	Single phase 220V, 3-phase 220V / 380V
Asia	China (Hong Kong)	50Hz	Single phase 200V / 220V, 3-phase 346V / 380V
Asia	India	50Hz	Single phase 240V, 3-phase 240V / 415V
Asia	Indonesia	50Hz	Single phase 220V, 3-phase 380V
Asia	Korea	60Hz	Single phase 110V / 220V, 3-phase 220V / 380V
Asia	Malaysia	50Hz	Single phase 240V, 3-phase 415V
Asia	Philippines	60Hz	Single phase 220V, 3-phase 220V / 440V
Asia	Singapore	50Hz	Single phase 230V, 3-phase 415V
Asia	Taiwan	60Hz	Single phase 110V / 220V, 3-phase 200V / 220V / 380V
Asia	Thailand	50Hz	Single phase 220V, 3-phase 220V / 380V
Asia	Vietnam	50Hz	Single Phase 120V/220V, 3-phase 380V
Oceania	Australia	50Hz	Single phase 240V, 3-phase 415V
Oceania	Guam	60Hz	Single phase 120V, 3-phase 240V / 480V
Oceania	New Zealand	50Hz	Single phase 230V, 3-phase 230V / 415V
Europe	Austria	50Hz	Single phase 230V, 3-phase 400V
Europe	Belgium	50Hz	Single phase 230V, 3-phase 400V
Europe	Bulgaria	50Hz	Single phase 220V, 3-phase 380V
Europe	Denmark	50Hz	Single phase 230V, 3-phase 400V
Europe	Finland	50Hz	Single phase 230V, 3-phase 400V
Europe	France	50Hz	Single phase 230V, 3-phase 400V
Europe	Germany	50Hz	Single phase 230V, 3-phase 400V
Europe	Greece	50Hz	Single phase 230V, 3-phase 400V
Europe	Hungary	50Hz	Single phase 220V, 3-phase 380V
Europe	Italy	50Hz	Single phase 220V, 3-phase 380V
Europe	Luxembourg	50Hz	Single phase 230V, 3-phase 400V
Europe	Netherlands	50Hz	Single phase 230V, 3-phase 400V
Europe	Norway	50Hz	Single phase 220V / 230V, 3-phase 380V
Europe	Poland	50Hz	Single phase 220V, 3-phase 380V
Europe	Portugal	50Hz	Single phase 230V, 3-phase 400V / 480V
Europe	Romania	50Hz	Single phase 220V, 3-phase 380V
Europe	Russia	50Hz	Single phase 220V, 3-phase 380V
Europe	Spain	50Hz	Single phase 127V / 220V, 3-phase 220V / 380V
Europe	Sweden	50Hz	Single phase 230V / 400V, 3-phase 400V / 690V
Europe	Switzerland	50Hz	Single phase 230V, 3-phase 400V
Europe	United Kingdom	50Hz	Single phase 230V, 3-phase 400V

*Voltage may differ from above in certain region or city, even in the same country.
*Single phase 120V indication is typical for USA and Canada, although their standard voltage is 115V.

M E M O

E TECHNICAL DATA

3. Common

Paint and Rustproof Coating

1. Coating Specifications

Treatment	Kind of painting		Additional leadtime [days]	Painting specifications			Applied paint	Weather resistance	Submersible	Oil-proof	Acid resistance	Alkal resistance	Heat resistance [°C]	Application
	Classification	Paint of finish coat		Type	Layers [μm]	Quality	Brand							
Cast Iron: Near White blast cleaning / Steel plate: Power tool cleaning	Standard	-	0	Under coating	1	Modified alkyd resin	UNIGROUND PTC PRIMER						100	Standard under coat
		Acrylic modified phthalic	0	Finish coating	1 (15~30)	Acrylic modified alkyd resin	NEORON #2000	○	×	△	◬	◬	100	Standard under coat
	Standard export painting	Acrylic modified phthalic	2	Under coating	2 (30~60)	Modified alkyd resin	UNIGROUND PTC PRIMER	○	×	△	◬	×	100	Models for export
				Finish coating	1 (15~30)	Acrylic modified alkyd resin	NEORON #2000							
	Special painting (including rust-proof and heat resisting painting) one layer of Uniground PTC Primer as the first primer	Modified epoxy	3	Under coating	1 (20~40)	Vinyl modified alkyd resin	NEO-GOSE #500 Red lead primer	◎	△	○	◬	◬	100	Moderate corrosive atomosphere, sea side, outdoor humid atomosphere, chemical plant area, etc.
				Finish coating	2 (30~60)	Acrylic modified alkyd resin	Acron #300							
		Phenol	7	Under coating	2 (40~70)	Lead rust preventive paint	SD MARINE PRIMER (rust)	○	×	△	○	◬	100	In-and-out door of acid treating plant or chemical plant, etc.
				Finish coating	2 (30~60)	Phenol resin enamel	NEW AKNON							
	Extra rust-proof painting	Epoxy	10	Under coating	1 (50~60)	Special permeability epoxy aluminum paint	CARBOMASTIC #15	◎	○	○	○	○	150	Chemical contact area, chemical plant, anticorrosion plant, etc.
				Finish coating	3 (30~90)	Polyamide epoxy	NEO-GOSE #200							
		Polyurethane	10	Under coating	1 (50~60)	Special permeability epoxy aluminum paint	CARBOMASTIC #15	◎	○	○	○	○	150	Nuclear power plant, etc.
				Finish coating	3 (45~90)	Polyisocianate urethane resin paint	NY POLIN K finish coat							
	Extra rustpreventive painting (sand blast undercoating)	Thick film epoxy	12		5 (250~350)	Thick film type modified epoxy resin paint	NEO-GOSE #2300 NTHB	◎	◎	○	○	○	100	Submersible equipment, marine structure, etc.

Note:
1. "Additional leadtime" refers to the number of days required for special coating in addition to standard painting.
2. Standard coating is 6.5PB 3.6/8.2. Coating specification may differ for special coating color.
3. Paint specified above is subject to replacement by comparable product.
4. "*" indicates coating which may fade with sunlight.
5. Consult us when ambient temperature exceeds heat resistance temperature indicated above.
   (Heat resistance temperature above is only for the paint, not for the CYCLO® DRIVE.)
6. Consult us when ambient temperature fluctuates between low and room temperature in short time period.
7. Thick film epoxy coating has limited color selections. Consult us for coating other than N1.0 or 10GY6/2.
   (Our standard coating 6.5PB3.6/8.2 may not be applied.)

◎○○◬: Appropriate
△: Caution necessary for selection
×: Inappropriate

2. Surface Conditioning

Treatment	Surface condition after treatment	Methods	Standards	
			SSPC	SIS
Class 1 Near white blast cleaning	Surface completely free of mill scales, rust, corrosives, dirt, and other foreign substances. Embedded residues (mill scales, rust, slight smears, or discoloration of oxide substances) are acceptable. However, minimum 95% of the surface area should be visibly clean of any residues. Remaining surface may contain slight discolorations, such as stains.	○Near white ○Blast cleaning ○Shot blast ○Sand blast, etc.	SP-10	Sa-2 1/2
Class 2 Power tool cleaning	Surface free of loose mill scales, rust, corrosives, dirt, and other foreign substances. Embedded residues (mill scales, rust, slight smears or discoloration of oxide substances) are acceptable. However, minimum 2/3 of the surface area should be visibly clean of any residues. Remaining surface may contain slight discolorations, such as stains, and residual rust, and coating peelings in pores, for surface with porous corrosion.	○Commercial Blast cleaning ○Power Tool Cleaning ○Disk sander ○Wire wheel ○Grinder, etc.	SP-6 (SP-3)	Sa-2 (St-3)
Class 3 Hand tool cleaning	Surface free of loose scales, rust, coating, oil & grease, dirt, and other foreign substances, with slight metallic luster. The surface should be cleaned with wire brush, scraper, etc.	○Hard Tool Cleaning ○Wire brush ○Scraper, etc.	SP-2	St-2

(U.S.A. Steel Structual Painting Councils) (SWEEDEN, SVENSK Standard, S.I.S. 055900)

Rustproof Treatment Standards

Our complete products are shipped with following rust proofing treatment.

1. Standard Rustproof Specification

(1) External Rustproof

Our assembled products are shipped with rust proofing oil applied. Check rustproof condition six months after shipment. Reapply rustproof treatment if necessary.

(2) Internal Rustproof

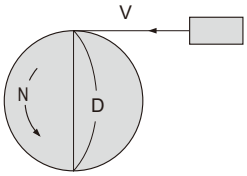
Lubrication	Grease lubricated models	Oil lubrication models
Rustproof period	1 year	6 months
Storage condition	Storage inside general shop or warehouse, with relatively low humidity, dust, extreme temperature fluctuation, corrosive gas, or such.	

2. Rustproof Specification for Export

Consult us when the item is exported or when more treatment is necessary than standard rustproof treatment. Export rustproof treatment is available.

Reference: Drive System Calculation Formulas

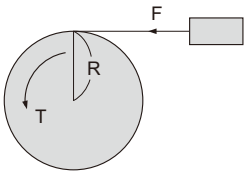
1. Speed N [r/min] and Velocity [m/s]



$$V = \pi \cdot D \cdot \frac{N}{60} \text{ [m/s]}$$

π: Circular constant ($\approx$3.14)
D: Wheel diameter

2. Torque T [N·m, kgf·m]

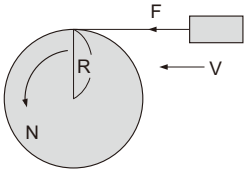


SI Units	Gravitational Units
$T = F \cdot R$ [N·m]	$T = F \cdot R$ [kgf·m]
F: Load [N]	F: Load [kgf]
R: Wheel radius [m]	R: Wheel radius [m]

3. Power P [kW]

SI Units	Gravitational Units
$P = \frac{F \cdot V}{1000}$	$T = \frac{F \cdot V}{102}$
F: Load [N]	F: Load [kgf]
V: Velocity [m/s]	V: Velocity [m/s]

4. Power P [kW], Torque T [N·m, kgf·m], Speed N [r/min]



SI Units

$$P = \frac{N \cdot T}{9550} \text{ [kW]} \qquad T = \frac{9550 \cdot P}{N} \text{ [N·m]}$$

$$P = \frac{F \cdot V}{1000} \text{ [kW]} \qquad V = \pi \cdot 2 \cdot R \cdot \frac{N}{60} \text{ [m/s]}$$

F: Load [N]

$$\therefore P = \frac{F \cdot \pi \cdot 2 \cdot R \cdot \frac{N}{60}}{1000} = \frac{2 \cdot \pi}{1000 \times 60} \cdot N \cdot F \cdot R \text{ [kW]}$$

$T = F \cdot R$

$$\therefore P = \frac{2 \cdot \pi}{1000 \times 60} \cdot N \cdot T = \frac{N \cdot T}{9550} \text{ [kW]}$$

Gravitational Units

$$P = \frac{N \cdot T}{975} \text{ [kW]} \qquad T = \frac{975 \cdot P}{N} \text{ [kgf·m]}$$

$$P = \frac{F \cdot V}{102} \text{ [kW]} \qquad V = \pi \cdot 2 \cdot R \cdot \frac{N}{60} \text{ [m/s]}$$

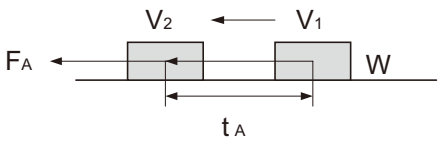
F: Load [kgf]

$$\therefore P = \frac{F \cdot \pi \cdot 2 \cdot R \cdot \frac{N}{60}}{102} = \frac{2 \cdot \pi}{102 \times 60} \cdot N \cdot F \cdot R \text{ [kW]}$$

$T = F \cdot R$

$$\therefore P = \frac{2 \cdot \pi}{102 \times 60} \cdot N \cdot T = \frac{N \cdot T}{975} \text{ [kW]}$$

5. Acceleration Force F_A [N, kgf]



SI Units

$$F_A = m \cdot \alpha = m \cdot \frac{V_2 - V_1\ [N]}{t_A}$$

$$\alpha = \frac{V_2 - V_1}{t_A}$$

m: Mass [kg]
α: Acceleration [m/s^2]
t_A: Acceleration Time [s]

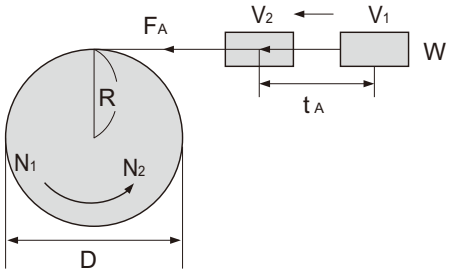
Gravitational Units

$$F_A = m \cdot \alpha = \frac{W}{g} \cdot \frac{V_2 - V_1}{t_A}\ [N]$$

$$\alpha = \frac{V_2 - V_1}{t_A}$$

W: Weight [kgf]
g: Acceleration of gravity ≈ 9.8 [m/s^2]
m: Mass [kgf·s^2/m]
α: Acceleration [m/s^2]
t_A: Acceleration Time [s]

6. Acceration Torque T_A [N·m, kgf·m]



SI Units

$$T_A = F_A \cdot R \qquad F_A = m \cdot \frac{V_2 - V_1}{t_A}$$

$$V_2 = \pi \cdot D \cdot \frac{N_2}{60} \qquad V_1 = \pi \cdot D \cdot \frac{N_1}{60}$$

$$D = 2 \cdot R$$

$$\therefore T_A = m \cdot \frac{\frac{\pi \cdot 2 \cdot R}{60} \cdot (N_2 - N_1)}{t_A} \cdot R$$

$$= \frac{2 \cdot \pi \cdot m \cdot R}{60} \cdot \frac{N_2 - N_1}{t_A} \cdot R$$

$$= \frac{m \cdot R^2}{9.55} \cdot \frac{N_2 - N_1}{t_A}\ [N \cdot m]$$

$m \cdot R^2 = J$ (moment of inertia [kgm^2])

$$\therefore T_A = \frac{J}{9.55} \cdot \frac{N_2 - N_1}{t_A}\ [N \cdot m]$$

Gravitational Units

$$T_A = F_A \cdot R \qquad F_A = \frac{W}{g} \cdot \frac{V_2 - V_1}{t_A}$$

$$V_2 = \pi \cdot D \cdot \frac{N_2}{60} \qquad V_1 = \pi \cdot D \cdot \frac{N_1}{60} \cdot R = \frac{D}{2}$$

$$\therefore T_A = \frac{W}{g} \cdot \frac{\frac{\pi \cdot D}{60} \cdot (N_2 - N_1)}{t_A} \cdot \frac{D}{2}$$

$$= \frac{\pi \cdot W \cdot D}{60 \cdot g} \cdot \frac{N_2 - N_1}{t_A} \cdot \frac{D}{2}$$

$$= \frac{W \cdot D^2}{375} \cdot \frac{N_2 - N_1}{t_A}\ [kgf \cdot m]$$

$W \cdot D^2 = GD^2$ (Flywheel effect [kgm^2])

$$\therefore T_A = \frac{GD^2}{375} \cdot \frac{N_2 - N_1}{t_A}\ [kgf \cdot m]$$

7. Synchronized Speed of AC Motor N_o [r/min]

$$N_0 = \frac{120 \cdot f}{P}\ [r/min]$$

f: Power supply frequency [Hz]
P: Number of motor poles

8. Rated Speed of AC Motor N [r/min]

$$N = N_0\ (1 - s)\ [r/min]$$

N_0: Synchronized speed [r/min]
s: Slippage

Lubrication