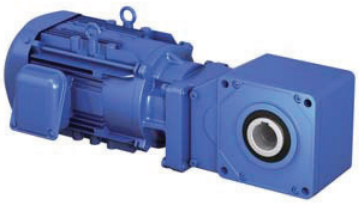
Sumitomo Drive Technologies



Bevel BUDDYBOX®

Bevel BUDDYBOX® Drive H Series

Introduction to the Premium Efficiency (IE3) Motor

Sumitomo Heavy Industries, Ltd.

No.C2050E-1

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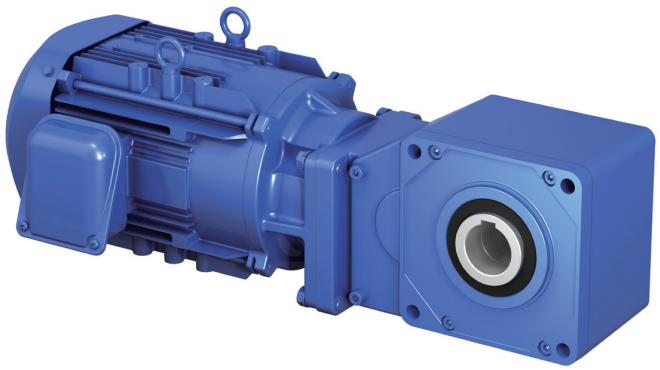
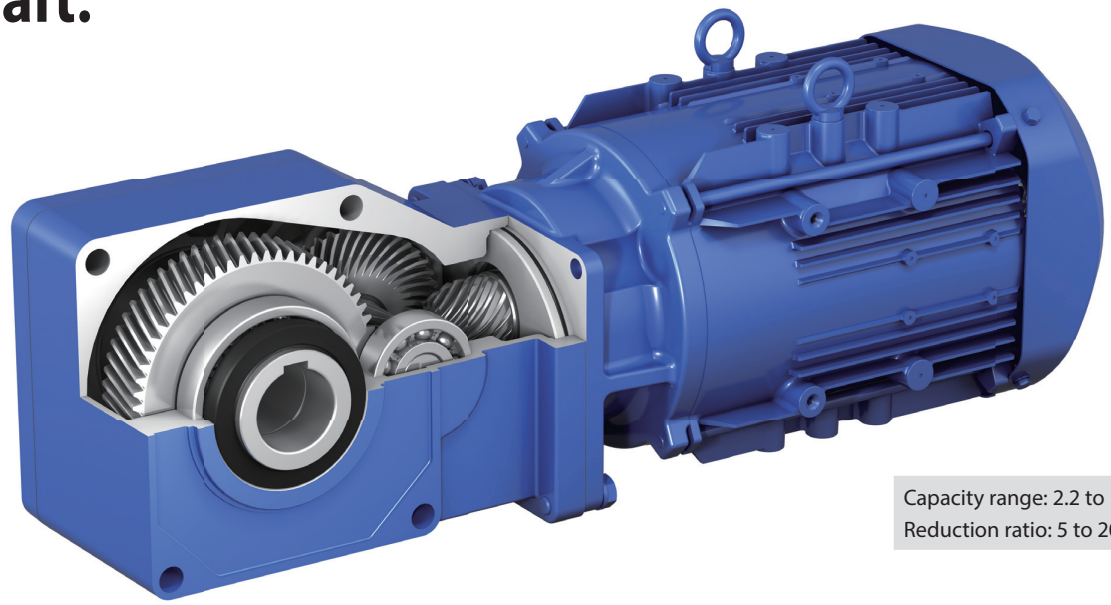


Introducing a compact right-angle-shaft gearmotor with low reduction rate and hollow shaft.



Capacity range: 2.2 to 11kW
Reduction ratio: 5 to 20

Features

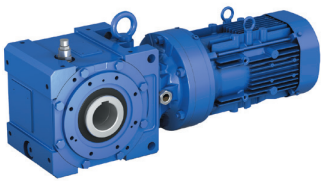
- **Bevel gear + helical gear high-efficiency reduction ratio mechanism**
  Realizes high efficiency thanks to a reduction mechanism optimized for low-reduction ratios.
- **Compact case for hollow shafts**
  With a case made especially for hollow shafts, it is more compact than standard gearmotors.
- **3600r/min motor speed makes high-speed operation possible**
  Can be operated at high speed (120Hz).
- **Can be lubricated with long-life grease**
  Saves time and effort compared with oil lubrication.

Related products

- **Bevel Buddybox® Drive 4 Series**

Has a high allowable radial load thanks to features such as its FCD gear case.
Solid shaft and foot mount also available

☞[Catalog No. C2020]

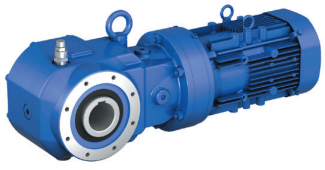


Capacity range: 0.1 to 55kW
Reduction ratio: 11 to 10658

- **Bevel Buddybox® Drive 5 Series**

High capacity range, right angle shaft gear motor specially designed for hollow shafts

☞ [Catalog No. C2030]

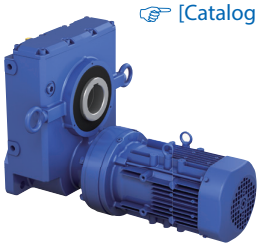


Capacity range: 0.1 to 37kW
Reduction ratio: 11 to 4365

- **Helical Buddybox® Drive**

Parallel shaft gearmotor that combines CYCLO® Drive and a helical gear with hollow shafts

☞ [Catalog No. C2019]



Capacity range: 0.1 to 30kW
Reduction ratio: 11 to 4365

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Precautions for the premium-efficiency motor

Commercial power source

The features of the premium-efficiency motor (top-runner motor) are different from a conventional standard efficiency motor.
Especially, at the time of replacement from the existing product, it is necessary to review the power and peripheral equipment.

Motor characteristics

[Example]

Motor capacity 2.2kW
Power source voltage
200V 60Hz

Standard-efficiency motor

Motor speed:	1700r/min	Starting torque:	204%
Rated current:	8.90A	Stall torque:	229%
Starting current value:	46.9A		

Premium-efficiency motor

Motor speed:	1740r/min	Starting torque:	297%
Rated current:	9.32A	Stall torque:	402%
Starting current value:	74.9A		

The premium-efficiency motor:

- reduces the occurrence loss so its speed is faster than that of the former standard-efficiency motor.
  For purposes for which the operation speed cannot be raised, it is necessary to reconsider the reduction ratio associated with an increase in the motor speed.
- If the load torque becomes equivalent or larger than that of the standard-efficiency motor due to an increase in the speed, the motor output will also increase.
  Depending on the load conditions, the power consumption may increase more than that of the standard-efficiency motor.
- To reduce copper loss, the winding resistance of the motor is lowered and the starting current, starting torque, and stall torque (maximum torque) is higher than those of the standard-efficiency motor.
- In some cases, it may be necessary to change peripheral equipment such as the breaker.

Starting and stopping frequency and load coefficient of the drive

Standard-efficiency motor

Starting and stopping frequency (times/hour)	Less than 10 hours a day			Less than 24 hours a day		
	I	II	III	I	II	III
10 or less	1.00	1.15	1.50	1.20	1.30	1.65
200 or less	1.10	1.35	1.65	1.30	1.50	1.85
500 or less	1.15	1.50	1.80	1.40	1.65	2.00

Premium-efficiency motor

Starting and stopping frequency (times/hour)	Less than 10 hours a day			Less than 24 hours a day		
	I	II	III	I	II	III
1 or less	1.00	1.15	1.50	1.20	1.30	1.65
3 or less	1.00	1.25	1.60	1.20	1.40	1.70
10 or less	1.00	1.35	1.70	1.20	1.50	1.80
60 or less	1.00	1.45	1.75	1.25	1.65	2.00

- Since the starting torque and stall torque (maximum torque) of the premium-efficiency motor are large, the selection procedure, start and stall frequencies, and drive load coefficient are different from those of a standard-efficiency motor. (For details see B10)

Inverter drive

Though it can be used in the same way as a standard-efficiency motor, the parameters (rated current, etc.) of the inverter are different.
If the existing product is replaced with a premium-efficiency motor and the existing inverter continues to be used, the parameters of the inverter must be changed.

Electronic thermal relay setting

- Since the rated current is higher than that of the standard-efficiency motor, it is necessary to change the setpoint of the electronic thermal relay.

During V/F control and fixed torque boost operation

- With the setpoint torque boost for the standard-efficiency motor, the current flow may be excessive during slow speed operation. If the current flow is too much, reduce the setpoint value.

During sensorless control operation

- After replacing the gearmotor, perform auto-tuning.

Motor brakes

The characteristics of the brake of the premium-efficiency motor differ from those of the conventional standard-efficiency motor and AF motor for inverter. For example, the operation delay time at the time of braking, and the standard brake torque are different.
The braking stop position may be misaligned, particularly in the case of replacement of the existing product. It may be necessary to review the braking circuit and the control signal timing of braking in the inverter-drive.

[Example] Motor capacity 2.2kW

Brake characteristics		Standard-efficiency motor		Premium-efficiency motor	
		3-phase motor	AF Motor for Inverter	Premium-Efficiency, 3-phase motor	Premium-efficiency, 3-phase motor for inverter
Brake type		FB-3D	FB-5B	FB-3E	
Brake torque (N·m)		22	37	22	
at the time of braking (sec)	Normal braking circuit (Simultaneous turn-off circuit)	0.3 - 0.4	-	0.75 - 0.95	-
	Normal braking circuitfor inverter (Separate turn-off circuit)	0.15 - 0.2	0.2 - 0.25	0.4 - 0.5	
	Quick-braking circuit	0.01 - 0.02	0.01 - 0.02	0.02 - 0.04	

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B Selection and Dimension Diagrams

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Gearmotor Standard Specification

Motor

Items		Specifications			
	Motor specifications	Standard Specification		Built-in brake standard specifications	
Premium-efficiency, 3-phase motor	Capacity range	2.2 to 11kW 4P		2.2 to 11kW 4P FB Brake	
	Protection type	Indoor type (IP44 Totally enclosed splash proof type, indoor) or outdoor type (IP44 Totally enclosed splash proof type, outdoor)		Indoor type (IP44 Totally enclosed splash proof type, indoor) or outdoor type (IP44 Totally enclosed splash proof type, outdoor)	
	Enclosure	Totally enclosed fan cooled type		Totally enclosed fan cooled type	
	Power source	200V 50/60Hz, 220V 60Hz, or 400V 50/60Hz, 440V 60Hz		200V 50/60Hz, 220V 60Hz, or 400V 50/60Hz, 440V 60Hz	
	Thermal class	155 (F)		Motor: 155 (F)/ FB brake: F	
	Time rating	S1 (continuous)		S1 (continuous)	
	Terminal box position and lead wire direction	See C25.		See C25.	
	Number of lead wires	3	2.2 to 3.7kW (direct on-line starting)	5	2.2 to 3.7kW (direct on-line starting)
		6	5.5 to 11kW(人–Δ startable)	8	5.5 to 11kW(人–Δ startable)
	Standard	JIS C 4034-1, efficiency value is compliant with JIS C 4034-30 and IEC60034-30 premium efficiency (IE3)		JIS C 4034-1, efficiency value is compliant with JIS C 4034-30 and IEC60034-30 premium efficiency (IE3)	
For inverters Premium-efficiency, 3-phase motor	Capacity range	2.2 to 11kW 4P		2.2 to 11kW 4P FB Brake	
	Protection type	Indoor type (IP44 Totally enclosed splash proof type, indoor) or outdoor type (IP44 Totally enclosed splash proof type, outdoor)		Indoor type (IP44 Totally enclosed splash proof type, indoor) or outdoor type (IP44 Totally enclosed splash proof type, outdoor)	
	Enclosure	Totally enclosed fan cooled type		Totally enclosed fan cooled type	
	Power source	200V 60Hz, 220V 60Hz or 400V 60Hz, 440V 60Hz		200V 60Hz, 220V 60Hz or 400V 60Hz, 440V 60Hz	
	Thermal class	155 (F)		Motor: 155 (F)/ Brake: F	
	Time rating	S1 (continuous)/6 to 60Hz constant torque characteristics		S1 (continuous)/6 to 60Hz constant torque characteristics	
	Terminal box position and lead wire direction	See C25.		See C25.	
	Number of lead wires	3	2.2 to 3.7kW	5	2.2 to 3.7kW
		6	5.5 to 11kW(人–Δ startable)	8	5.5 to 11kW(人–Δ startable)
	Standard	JIS C 4034-1, efficiency value is compliant with JIS C 4034-30 and EC60034-30 premium efficiency (IE3)		JIS C 4034-1, efficiency value is compliant with JIS C 4034-30 and IEC60034-30 premium efficiency (IE3)	

Note) Efficiency value conforms to Top Runner standard.

Drive part

Items	Specifications
Lubrication Method	Long life grease lubrication
Reduction method	Combination of a bevel gear and a helical gear
Output shaft rotational direction	See C9.

Common to the motor and drive

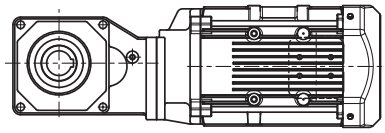
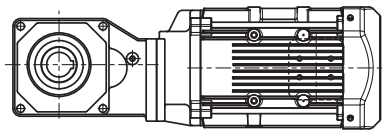
Items		Specifications
Ambient conditions	Installation location	Indoor type: Indoors (area with minimal dust, no contact with water) Outdoor type: Indoors and outdoors (places where standard but not heavy rain falls) 1 G or less of vibration
	Ambient Temperature	-10℃ to 40℃
	Ambient humidity	85% or less
	Altitude	Elevation of 1000m or lower
	Atmosphere	No corrosive or volatile gases, no steam, etc. Dust-free and well-ventilated area.
Installation Method		On-axis mounting and universal mounting
Connection method with driven machines		Direct coupling by a mechanical shaft and a hollow shaft
Paint		Coating: Phthalic acid-based Color: Munsell 6.5PB 3.6/8.2 reasonable approximation (Danube blue)

Outdoor (protection class IP44) specification

The specification allows use in areas not directly affected by heavy rain and wind, but where some rain may fall.
Installing a cover, or the rainstorm proof outdoor type (protection class IP55) is necessary in locations that are open-air environments and directly receive strong winds and rain.
Consult us for the specification details of the rainstorm proof outdoor type.
Further, since carbon steel is used for the shaft (or collar), there is the possibility of rust developing and progressing due to rainwater and condensation, leading to oil seal damage. Take periodic rust prevention measures.

Nomenclature

L	N	Y	M		3	–	HZ522	–	EP	–	B	–	10
[1]	[2]	[3]	[4]	[5]	[6]		[7]		[8]		[9]		[10]

[1] Model code	Bevel Buddybox drive	L
[2] Slow speed shaft direction	Universal mounting	N
[3] Mounting style	Hollow shaft/On-axis mounting type	Y
		
[4] Motor connection method	Motor directly connected	M
		

[5] Special specification	Standard Specification	Blank
	Special Specification	S

[6] Input capacity code	4P	Capacity symbol kW (HP)	3 2.2(3)	4 3.0(4)	5 3.7(5)	8 5.5(7.5)	10 7.5(10)	15 11(15)

[7] Frame size	See the selection table starting on page B12.

[8] Suffix	With Premium-efficiency, 3-phase motor	EP
	With Premium-efficiency, 3-phase motor for inverter	AP

[9] Brake status	Without brake	Blank
	With brake	B

[10] Reduction ratio	Nominal ratio (☞ refer to selection table for actual ratio)

Package no.

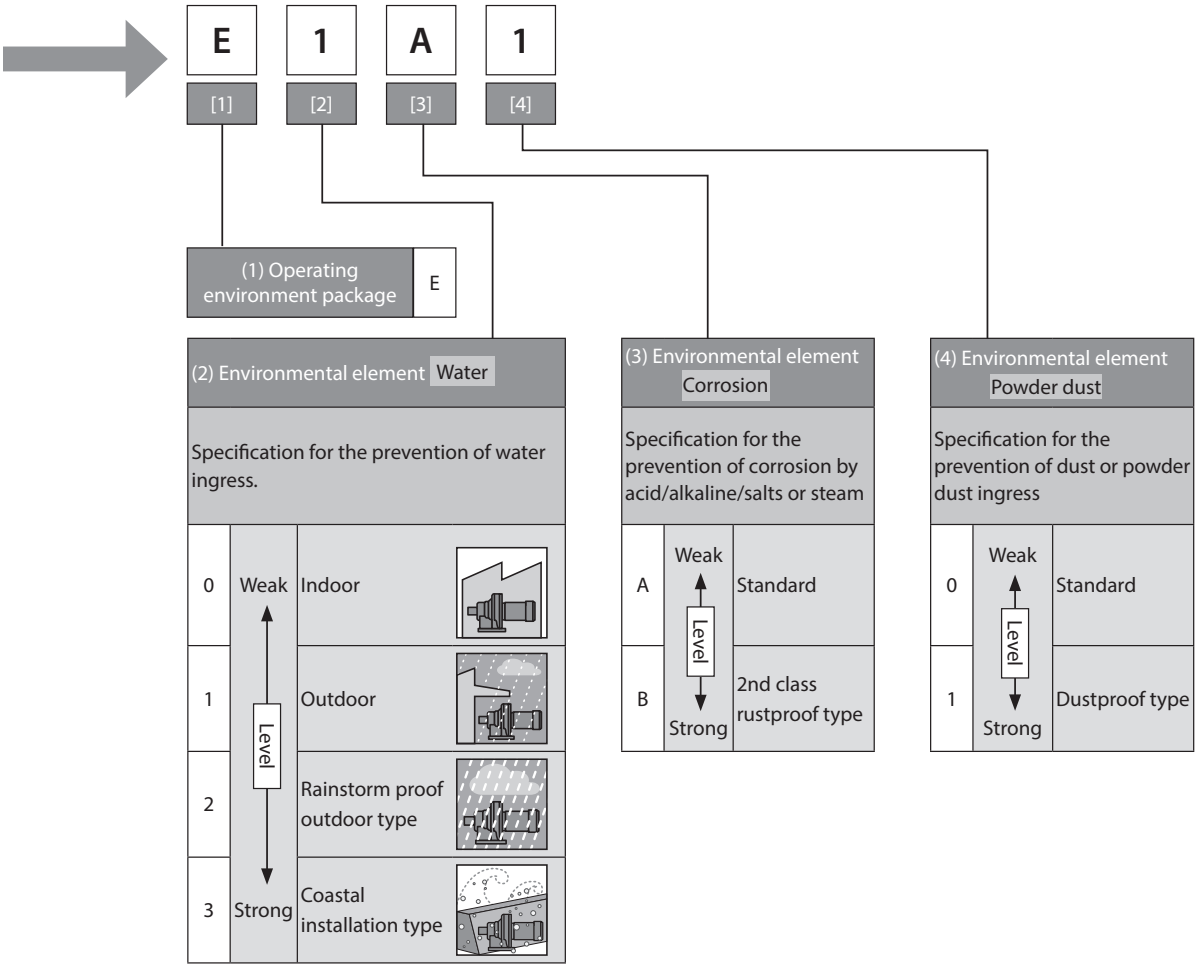
The following shows the operating environment options different from the main unit type

Operating Environment Packages

Gearmotors and Reducers have packaged specifications optimized for the usage environment.
Choose the specification simply by selecting the levels to prevent three environmental elements (water, corrosion and powder dust).

■ Package no.

Please specify the package no. when placing an order or requesting for quotation.



Notes: 1. Consult us for details of the specification.
2. The best paint for each specification must be specified as an option, as separate from the operating environment package. See C43.

Selection procedure

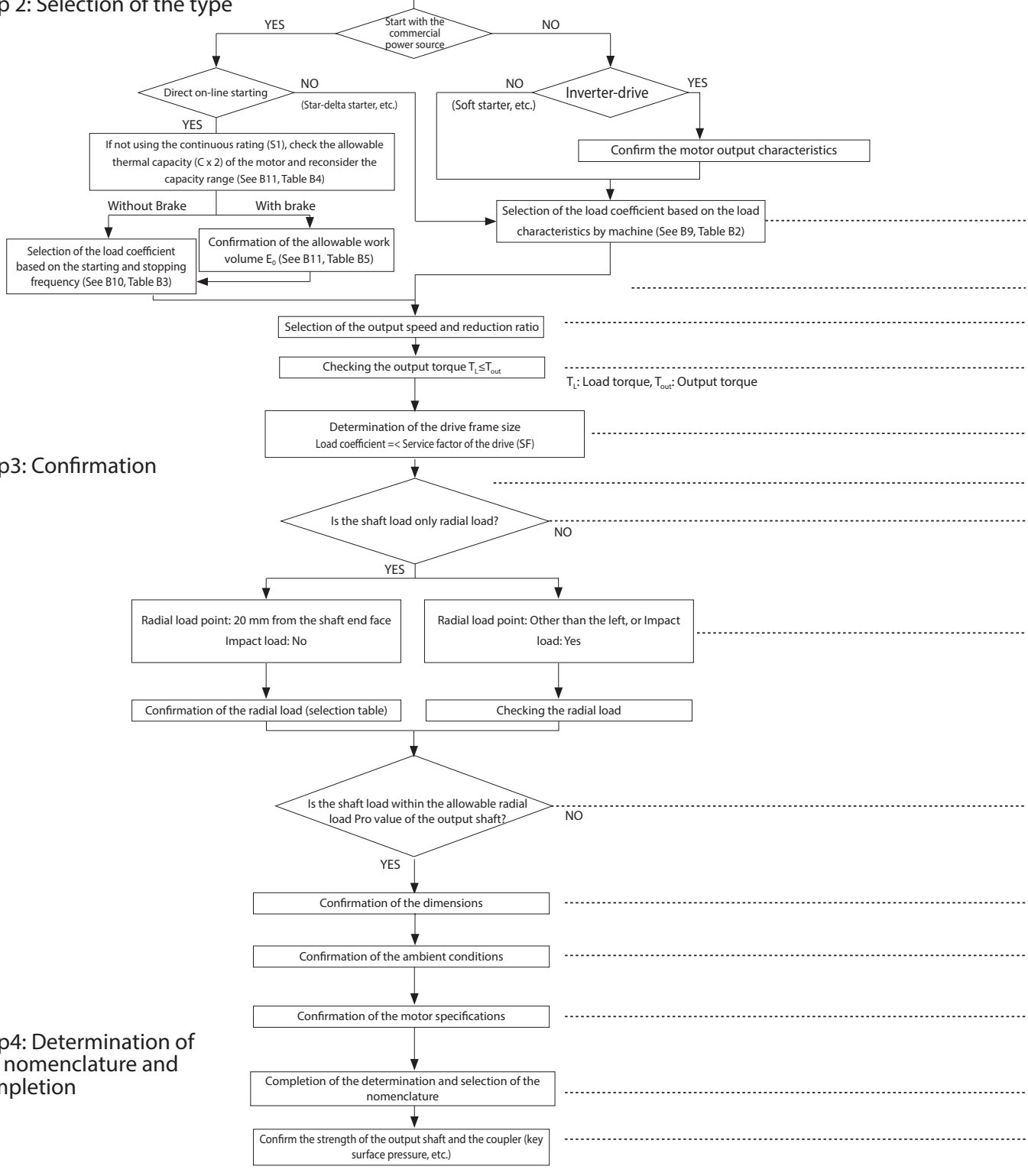
Select the type referring to the flow chart. If you are not sure of the selection method, please consult us.

Step1: Determination of the operation conditions

Before starting selection, determine the following conditions:

- Purpose
- Whether the product is operated continuously or started and stopped frequently
- Whether the power source is directly input, star delta starting or inverter driven
- Motor capacity (kW) and output speed or reduction ratio
- Radial load
- Operation time per day
- Degree of the impact load
- Mounting direction (output shaft direction)
- Specifications related to motors (power source frequency, voltage, existence of brake, etc.)
- Ambient conditions (operating environment)

Step 2: Selection of the type



Step3: Confirmation

Step4: Determination of the nomenclature and completion

Selection procedure

Descriptions of terms
- Service factor (SF) Value calculated by dividing the allowable input capacity of the drive by the motor capacity. - Operating environment package Package created to enable to determine the specifications just by selecting the levels to prevent three environmental elements (water, corrosion and powder dust) (See B5).

Description of the procedure
- Select the load factor suitable for the applications from page B9.
- In the case of an operation in which starting and stopping is repeated, check the starting and stopping frequency and the load coefficient of the drive on page B10, and the allowable heat capacity of the motor on page B11. - Further, if with a brake, confirm that the braking workload is equal to or less than the allowable workload E_0 on page B11.
- Confirm the brake torque on page C27.
- Open the page where your motor capacity is described in the selection table on page B12.
- Select the column where the values closest to the output speed or reduction ratio in use is described in the selection table.
- Confirm that the output torque meets your usage value. If the output torque is insufficient, use a one-class larger motor capacity.
- Select a combination with a larger service factor (SF) then the selected load coefficient from the selection table.
- Check whether the only load that is applied to the output shaft of the drive is radial load.
- Please use the Bevel Buddybox 4 series.
- Consult us.
- Please use the Bevel Buddybox 4 series.
- Confirm the dimensions. If it is not compatible with your operating conditions, please consult us.
- Confirm that the selected combination is suitable for conditions such as the surrounding environment using the "Standard Specifications" on pages B2 and B3. Also specify "Operating environment packages" as per B5.
- Confirm that the motor directly connected to the selected type is compatible with your operating conditions (power source, environment, thermal class, etc.).
- For the selected model, determine the nomenclature by referring to "Nomenclature" on page B4. The type selection is completed.
- Confirm with the maximum torque at starting and stopping.

Selection example

Select the type using an example according to the selection procedure on B6.

○ Operating conditions

- Use:	Chain conveyor	- Motor specifications	
- Operation pattern:	Continuous operation	Power source frequency:	50Hz
- Operation time per day:	24 hours/day	Voltage:	200V
- Load capacity:	6.5kW	Brake:	No
- Output speed:	145r/min		
- Connection with the other machines:	Hollow shaft on-axis mounting	Other:	Indoor type
	Torque arm fixing		
Load location:	20 mm from shaft end face	- Ambient conditions	
Radial load:	3000N	Ambient temperature 20℃	Indoor
- Level of impact load:	No impact		

Select the type based on the following conditions.

Usage conditions and selection and calculation results	Page in this catalog
○ Selection of the load coefficient Load characteristics of chain conveyor use → U (uniform load) Load coefficient = 1.25 (U, operating 24 hours/day)	Page B9 Table B2 Load characteristics table by machine, load coefficient Table B1 Load coefficient
○ Selection of the motor capacity Load capacity = 6.5kW → Motor capacity = 7.5kW	Page B14 Gearmotor selection table
○ Selection of the output speed Power source frequency 50Hz, output speed 145r/min -> 1450/145 = 10:1 ratio	Page B14 Gearmotor selection table
○ Confirmation of the output torque $T_L = \frac{9550 \times 6.5\ (kW)}{1450} \times 10 = 428N•m \leq 468N•m \rightarrow OK$ T_L: Load torque	Page B14 Gearmotor selection table
○ Determination of the drive frame size Load coefficient = 1.25 ≤ 1.46 Drive frame size and reduction ratio: 10-HZ524-EP-10	Page B14 Gearmotor selection table
○ Check of the radial load Pr ≤ Pro/Cf 3000 (N) ≤ 5450 (N)/1 = 5450 (N) → OK	Page B14 Gearmotor selection table
○ Confirmation of the dimensions Confirm with the dimension table	Page B17 Dimension table
○ Confirmation of the ambient conditions Ambient temperature 20°C → OK	Page B3 Standard Specification
○ Confirmation of the motor specifications 200V, 50Hz, indoor type → Standard specification is OK	Page B2 Standard Specification
◎ Determination of the nomenclature Determined nomenclature: LNYM10-HZ524-EP-10	Page B4 Nomenclature
Selection is completed.	

Load coefficient

The Bevel Buddybox Drive H series is designed for operating conditions of uniform load and 10 hours per day of use.
The following load coefficient must be anticipated in cases where daily machine use exceeds 10 hours per day, or depending on the load conditions of the machine in use.
The selection methods of the load coefficient are divided into (1) or (2) below:

(1) Selection based on the load characteristics by machine

[Classification of the load coefficient] U: Uniform load M: Light impact H: Heavy impact

Table B1, Load coefficient of the drive

Operation time	Up to 10 hours/day			Up to 24 hours/day		
	U	M	H	U	M	H
Load coefficient	1.00	1.25	1.75	1.25	1.50	2.00

Note) The load coefficient is different to that of the Bevel Buddybox 4 series and 5 series.

Table B2, Load characteristics by machine

Compressor and pump	
Compressor	
Reciprocating type Multi-cylinder	M
Single cylinder	H
Pump	
Centrifugal	U
Fin type	M
Reciprocating type	
Singe-acting 3-cylinder or more	M
Double-acting 2-cylinder or more	M
Rotary (gear type, etc.)	*
Transport and hoisting machine	
Elevator	
Bucket uniform load	U
Heavy load	M
Escalator	U
Flight	M
For passengers and workers	*
Water gate	*
Car dumper	H
Car puller	M
Crane hoist	
Main hoisting Medium load	M
Heavy load	H
Skip hoist	M
Girder traveling and trolley traverse	*
Conveyor (uniform load)	
Apron, assembly, Belt, bucket, chain, flight, oven, and screw	U
conveyor (heavy load and fluctuating feed)	
Apron, assembly, belt, and bucket, Chain, flight	M
oven, screw	
reciprocating, and shaker	H
Stoker	U
Dry dock crane	*
Feeder	
Disk	U
Apron, belt, and screw	M
Reciprocating	H
Mixing machine	
Agitator	
Pure liquid	U
Liquid (changing density)	M
Liquid and solid	M
Mixer	
Constant density	U
Changing density	M
Concrete mixer	M
Selection machine	
Classifier	M
Screen	
rotary (stone and gravel)	M
Air system	U
Traveling screen	U
Mill	
Crasher	
Ore and stone	H
Mill (rotary)	
Ball Bevel, Rod hammer	H
Kiln	M
Tumbler	H
Sand Muller	M
Printing machine	*
Washing machine	M
Machine tool	
Tapping machine	H
Punch press (gear driven)	H
Planar	H
Bending roll	M
General machine tools	
Rubber and plastic	
Extruder	
Rod, pipe, and tube	U
Blow molding machine	M
Pre-plasticizer	M
Others	*
Mixer	H
Rubber Calendar	M
Rubber mill (2 or more parallels)	M
Sheeter, refiner	M
Tuber, strainer	M
Cracker	H
Dryer	*
Dredger	
Cable reel, conveyor	M
Cutter head drive	H
Jig drive	H
Screen drive	H
Stacker, winch	M
Food	
Rice milling machine	U
Beet slicer	M
Dow mixer	M
Meat grinder	M
Dryer	*
Brewing and distilling	
Canning machine, bottling machine	U
Brew kettle (continuous)	U
Mash tub (continuous)	U
Cooker (continuous)	U
Scale hopper (frequent starting)	M
Paper making	
Aerator	*
Agitator	M
Barker auxiliary (Hydraulic type)	M
Mechanical barker	M
Drum barker	H
Beater, pulper	M
Bleaching machine	U
Conveyor	U
Conveyor (for logs)	H
Cutter, plater	H
Cylinder	M
Reel (for pulp)	M
Chest	M
Washer, thickener	M
Paper machine	
Couch	M
Suction roll	U
Press	U
Dryer	M
Calendar	M
Super calendar	H
Winder	U
Ironmaking	
Bridle roll drive	H
Slug pusher	M
Draw bench (truck, main drive)	H
Molding machine	H
Slitter	M
Table conveyor	*
Pinch dryer, scrubber roll	*
Wire drawing machine, rolling mill	M
Wire winder	M
Reel (for strip)	M
Sugar refining	
Cane knife	M
Crusher	M
Mill	H
Oil refining	
Chiller	M
Paraffin filter press	M
Rotary kiln	M
Cement	
Dryer, cooler	M
Cement kiln	*
Fiber and spinning and weaving	
Batcher, calendar, and card	
Dryer and dyeing machine	
Mangle, napper, pad	M
Slasher, soaper, and winder	
Spinning machine, stenter, and washer	
Cloth finishing machine	M
Washer, pad, stenter (dryer, calendar, etc.)	
Ship	
Barge tower	H
Windlass	*
Steering engine	M
Capstan and cargo winch	*
Mooring winch	*
Turning gear	*
Ceramics industry	
Brick press, briquetting machine	H
Pug mill	M
General ceramics machinery	M
Water treatment	
Clarifier	U
Bar screen	U
Chemical filter	U
Collector	U
Dehydration screen	M
Scum breaker	M
Mixer	M
Thickener	M
Vacuum filter	M
Aerator	*
Flocculator	M
Rotary screen	U
Wood industries	*

For machines with * symbol or not described in the table, please consult us.

Note) Since the names and machine characteristics in this table may differ from those of the machine to be used, please use the values in this table as a reference only.

Load coefficient

(2) Selection based on the starting and stopping frequency

If the machine is starting and stopping frequently during operation, select the product based on the starting and stopping frequency and the load coefficient of the drive (Table B3). At the same time, confirm the allowable heat capacity of the motor as shown in Table B4. Further, calculate the braking workload of for brakemotors by referencing page C27. Confirm that it is equal to or less than the allowable workload E_0 described in Table B5. (Also confirm it for emergency stopping.)

Table B3 Starting and stopping frequency and load coefficient of the drive

Premium-efficiency, 3-phase motor

Starting and stopping frequency	Less than 10 hours a day			Less than 24 hours a day		
(times/hour)	I	II	III	I	II	III
1 or less	1.00	1.15	1.50	1.20	1.30	1.65
3 or less	1.00	1.25	1.60	1.20	1.40	1.70
10 or less	1.00	1.35	1.70	1.20	1.50	1.80
60 or less	1.00	1.45	1.75	1.25	1.65	2.00

$$\text{Inertia moment } (GD^2) \text{ ratio} = \frac{\text{Inertia moment of the load converted to the motor shaft } (GD^2 \text{ of the load converted to the motor shaft})}{\text{Inertia moment of the motor } (GD^2 \text{ of the motor})}$$

Classification of the load coefficient

I: Allowable inertia moment (GD^2) ratio =< 0.3
II: Allowable inertia moment (GD^2) ratio =< 3
III: Allowable inertia moment (GD^2) ratio =< 10

Notes) 1. The load coefficient is different to that of the Bevel Buddybox 4 series and 5 series.
2. Include the number of times that braking by brake, clutch etc. occur in the starting/stopping count.
3. If the machine is started under torque and radial loads, please consult us because it may be necessary to consider other options.
4. If the ratio of the starting and stopping frequency to the inertia moment (GD^2) exceeds the above-mentioned value, please consult us.

Precautions

- With premium efficiency 3-phase motors, since the starting torque and stall torque (maximum torque) are large, selection procedures, starting and stopping frequencies, and the load coefficient of the drive are different from conventional motors.

Table B4 Allowable heat capacity of the motor (C x Z)

kW x 4P		Allowable C x Z				Moment of inertia of the motor kg·m²		Motor GD² kgf・m²	
		(35%ED or less)	(Over 35%ED to 50%ED or less)	(Over 50%ED to 80%ED or less)	(Over 80%ED to 100%ED or less)	Standard	With brake	Standard	With brake
3-phase motor, Premium-efficiency	2.2	1000	900	400	200	0.00880	0.00978	0.0352	0.0391
	3.0	1000	900	400	200	0.0100	0.0110	0.0400	0.0440
	3.7	800	800	800	700	0.0194	0.0209	0.0777	0.0835
	5.5	300	300	200	150	0.0291	0.0306	0.116	0.122
	7.5	400	350	300	300	0.0409	0.0450	0.164	0.180
	11	200	200	150	150	0.0561	0.0602	0.224	0.241

Check that C x Z calculated in (1) through (3) below is within the allowable CZ in the motor capacity-%ED corresponding to Table B4.

(1) You can calculate C from the following equation.

[SI unit] $C = \dfrac{J_M + J_L}{J_M}$ [Gravity unit] $C = \dfrac{GD_M^2 + GD_L^2}{GD_M^2}$

J_M; Moment of inertia of the motor (kg·m²)

J_L; Motor axis conversion, Total moments of inertia excluding the motor (kg·m²)

GD_M^2; Motor GD² (kgf·m²)

GD_L^2; Motor axis conversion, total GD excluding the motor² (kgf·m²)

(2) Calculate the number of times starting occurs per hour (times/hr).

(A) Assuming, of one cycle, the operation time to be t_a(s) and the pause time to be t_b(s), when starting n_r(times/cycle) during this period

$$Z_r = \frac{3600 n_r}{t_a + t_b} \text{ (times/hr)}$$

(B) Further, when including the number of times of inching n_i(times/cycle) during 1 cycle (t_a+t_b), this is converted to the number of times of starting, in which it is converted to the number of times of inching per hour Z_i.

$$Z_i = \frac{3600 n_i}{t_a + t_b} \text{(times/hr)}$$

(c) Calculate the number of times of starting per hour Z (times/hr) from (a) and (b).

$$Z = Z_r + \frac{1}{2} Z_i = \frac{3600}{t_a + t_b} \cdot \left(n_r + \frac{1}{2} n_i\right) \text{ (times/hr)}$$

(3) Calculate C x Z.

Calculate the product of C calculated in (1) and Z calculated in (2): C x Z.

(4) Load time rate %ED

$$\%ED = \frac{t_a}{t_a + t_b} \times 100$$

Table B5 Allowable work volume of the motor brake E_0 Unit: E_0 (J/min)

Brake type	FB-3E FB-4E	FB-5E FB-8E	FB-10E FB-15E
Allowable work volume E_0	5720	6900	10800

For brake types, see C28.

Selection table

2.2kW	Frequency Hz	50Hz	60Hz
	Number of motor poles P	4	
	Motor speed n_1 r/min	1450	1750

Suffix
EP: Premium-efficiency, 3-phase motor AP: Premium-efficiency, 3-phase motor for inverter

50Hz						60Hz						Nomenclature (see page B4)									Dimension diagrams (page)
Output speed n_2	Output torque Tout		Allowable radial load Pro of the output shaft		SF	Output speed	Output torque		Allowable radial load of the output shaft		SF	Capacity symbol		Frame size		Suffix		Reduction ratio			
r/min	N·m	kgf·m	N	kgf		r/min	N·m	kgf·m	N	kgf											
287	69.6	7.11	5950	607	2.50	346	57.7	5.89	5750	587	3.00	3	-	HZ522	-	EP AP	-	5			B16
207	96.4	9.84	6510	664	2.50	250	79.8	8.15	6300	643	3.00	3	-	HZ522	-	EP AP	-	7			
145	138	14.1	7100	724	2.50	175	114	11.6	6910	705	3.00	3	-	HZ522	-	EP AP	-	10			
119	168	17.2	7430	758	2.50	143	139	14.2	7250	740	3.00	3	-	HZ522	-	EP AP	-	12			
95.1	210	21.4	7740	790	2.50	115	174	17.8	7590	774	3.00	3	-	HZ522	-	EP AP	-	15			
74.8	267	27.2	7930	809	2.50	90.3	221	22.6	7840	800	3.00	3	-	HZ522	-	EP AP	-	20			

3.0kW	Frequency Hz	50Hz	60Hz
	Number of motor poles P	4	
	Motor speed n_1 r/min	1450	1750

Suffix
EP: Premium-efficiency, 3-phase motor

50Hz						60Hz						Nomenclature (see page B4)									Dimension diagrams (page)
Output speed n_2	Output torque Tout		Allowable radial load Pro of the output shaft		SF	Output speed	Output torque		Allowable radial load of the output shaft		SF	Capacity symbol		Frame size		Suffix		Reduction ratio			
r/min	N·m	kgf·m	N	kgf		r/min	N·m	kgf·m	N	kgf											
287	95.0	9.69	5950	607	1.83	346	78.7	8.03	5750	587	2.20	4	-	HZ522	-	EP	-	5			B16
207	131	13.4	6510	664	1.83	250	109	11.1	6300	643	2.20	4	-	HZ522	-	EP	-	7			
145	188	19.2	7100	724	1.83	175	156	15.9	6910	705	2.20	4	-	HZ522	-	EP	-	10			
119	229	23.4	7430	758	1.83	143	190	19.4	7250	740	2.20	4	-	HZ522	-	EP	-	12			
95.1	286	29.2	7740	790	1.83	115	237	24.2	7590	774	2.20	4	-	HZ522	-	EP	-	15			
74.8	364	37.1	7930	809	1.83	90.3	301	30.8	7840	800	2.20	4	-	HZ522	-	EP	-	20			

Actual reduction ratio

Frame size	Reduction ratio					
	5	7	10	12	15	20
HZ522	5.059	7	10	12.21	15.25	19.39

Note) 1. See page B4 for the nomenclature of the models listed in the selection table.
2. The allowable radial load Pro of the output shaft is the value at 20 mm from the shaft end face.
3. The motor speed n_1 described above is a representative value, and the output speed n_2 depends on this motor speed. See page C18 of the technical data for details on the motor speed.
4. The contents of this table may be changed without notice.

Selection table

3.7kW	Frequency Hz	50Hz	60Hz
	Number of motor poles P	4	
	Motor speed n_1 r/min	1450	1750

Suffix
EP: Premium-efficiency, 3-phase motor
AP: Premium-efficiency, 3-phase motor for inverter

50Hz						60Hz						Nomenclature (see page B4)							Dimension diagrams (page)
Output speed n_2	Output torque Tout		Allowable radial load Pro of the output shaft		SF	Output Speed	Output torque		Allowable radial load of the output shaft		SF	Capacity symbol		Frame size		Suffix		Reduction ratio	
r/min	N·m	kgf·m	N	kgf		r/min	N·m	kgf·m	N	kgf									
287	117	12.0	5950	607	1.49	346	97.0	9.91	5750	587	1.78	5	-	HZ522	-	EP AP	-	5	B16
207	162	16.5	6510	664	1.49	250	134	13.7	6300	643	1.78	5	-	HZ522	-	EP AP	-	7	
145	232	23.6	7100	724	1.49	175	192	19.6	6910	705	1.78	5	-	HZ522	-	EP AP	-	10	
119	283	28.9	7430	758	1.49	143	234	23.9	7250	740	1.78	5	-	HZ522	-	EP AP	-	12	
95.1	353	36.0	7740	790	1.49	115	293	29.9	7590	774	1.78	5	-	HZ522	-	EP AP	-	15	
74.8	449	45.8	7930	809	1.49	90.3	372	38.0	7840	800	1.78	5	-	HZ522	-	EP AP	-	20	

5.5kW	Frequency Hz	50Hz	60Hz
	Number of motor poles P	4	
	Motor speed n_1 r/min	1450	1750

Suffix
EP: Premium-efficiency, 3-phase motor
AP: Premium-efficiency, 3-phase motor for inverter

50Hz						60Hz						Nomenclature (see page B4)							Dimension diagrams (page)
Output speed n_2	Output torque Tout		Allowable radial load Pro of the output shaft		SF	Output speed	Output torque		Allowable radial load of the output shaft		SF	Capacity symbol		Frame size		Suffix		Reduction ratio	
r/min	N·m	kgf·m	N	kgf		r/min	N·m	kgf·m	N	kgf									
282	177	18.1	5580	569	1.36	340	147	15.0	5440	555	1.64	8	-	HZ523	-	EP AP	-	5	B16
206	242	24.7	5980	610	1.36	248	201	20.5	5870	599	1.64	8	-	HZ523	-	EP AP	-	7	
147	338	34.5	6320	645	1.36	178	280	28.6	6250	638	1.64	8	-	HZ523	-	EP AP	-	10	
119	420	42.9	6420	655	1.36	143	348	35.5	6410	654	1.64	8	-	HZ523	-	EP AP	-	12	
99.7	500	51.1	6480	661	1.36	120	415	42.3	6520	665	1.64	8	-	HZ523	-	EP AP	-	15	
71.1	701	71.6	12200	1240	2.00	85.9	581	59.3	12000	1220	2.40	8	-	HA635	-	EP AP	-	20	B18

Actual reduction ratio

Frame size	Reduction ratio					
	5	7	10	12	15	20
HZ522	5.059	7	10	12.21	15.25	19.39
HZ523	5.143	7.043	9.833	12.20	14.54	
HA635						20.38

Note)
1. See page B4 for the nomenclature of the models listed in the selection table.
2. The allowable radial load Pro of the output shaft is the value at 20 mm from the shaft end face.
3. The motor speed n_1 described above is a representative value, and the output speed n_2 depends on this motor speed. See page C18 of the technical data for details on the motor speed.
4. The contents of this table may be changed without notice.

Selection table

7.5kW	Frequency Hz	50Hz	60Hz
	Number of motor poles P	4	
	Motor speed n_1 r/min	1450	1750

Suffix
EP: Premium-efficiency, 3-phase motor
AP: Premium-efficiency, 3-phase motor for inverter

50Hz						60Hz						Nomenclature (see page B4)							Dimension diagrams (page)
Output speed n_2	Output torque Tout		Allowable radial load Pro of the output shaft		SF	Output Speed	Output torque		Allowable radial load of the output shaft		SF	Capacity symbol		Frame size		Suffix		Reduction ratio	
r/min	N·m	kgf·m	N	kgf		r/min	N·m	kgf·m	N	kgf									
292	233	23.8	5130	523	1.47	352	193	19.7	5060	516	1.76	10	-	HZ524	-	EP AP	-	5	
211	322	32.9	5380	549	1.47	255	267	27.3	5350	546	1.76	10	-	HZ524	-	EP AP	-	7	B17
146	468	47.7	5450	556	1.47	176	387	39.6	5530	564	1.76	10	-	HZ524	-	EP AP	-	10	
117	580	59.2	12000	1220	2.00	142	480	49.0	11700	1190	2.40	10	-	HA635	-	EP AP	-	12	
97.6	698	71.2	12500	1270	2.00	118	578	59.0	12200	1240	2.40	10	-	HA635	-	EP AP	-	15	B19
71.1	956	97.6	12200	1240	1.47	85.9	792	80.9	12000	1220	1.76	10	-	HA635	-	EP AP	-	20	

11kW	Frequency Hz	50Hz	60Hz
	Number of motor poles P	4	
	Motor speed n_1 r/min	1450	1750

Suffix
EP: Premium-efficiency, 3-phase motor
AP: Premium-efficiency, 3-phase motor for inverter

50Hz						60Hz						Nomenclature (see page B4)							Dimension diagrams (page)
Output speed n_2	Output torque Tout		Allowable radial load Pro of the output shaft		SF	Output speed	Output torque		Allowable radial load of the output shaft		SF	Capacity symbol		Frame size		Suffix		Reduction ratio	
r/min	N·m	kgf·m	N	kgf		r/min	N·m	kgf·m	N	kgf									
289	346	35.3	8740	892	1.68	349	286	29.2	8540	871	2.02	15	-	HA635	-	EP AP	-	5	
209	478	48.8	9690	989	1.68	252	396	40.5	9470	966	2.02	15	-	HA635	-	EP AP	-	7	
145	688	70.3	10200	1040	1.68	175	570	58.2	10100	1030	2.02	15	-	HA635	-	EP AP	-	10	B19
117	850	86.8	10300	1050	1.47	142	704	71.9	10300	1050	1.64	15	-	HA635	-	EP AP	-	12	
97.6	1020	104	10500	1070	1.47	118	848	86.5	10500	1070	1.64	15	-	HA635	-	EP AP	-	15	

Actual reduction ratio

Frame size	Reduction ratio					
	5	7	10	12	15	20
HZ524	4.969	6.868	9.964			
HA635	5.020	6.949	10	12.35	14.86	20.38

Note) 1. See page B4 for the nomenclature of the models listed in the selection table.
2. The allowable radial load Pro of the output shaft is the value at 20 mm from the shaft end face.
3. The motor speed n_1 described above is a representative value, and the output speed n_2 depends on this motor speed. See page C18 of the technical data for details on the motor speed.
4. The contents of this table may be changed without notice.

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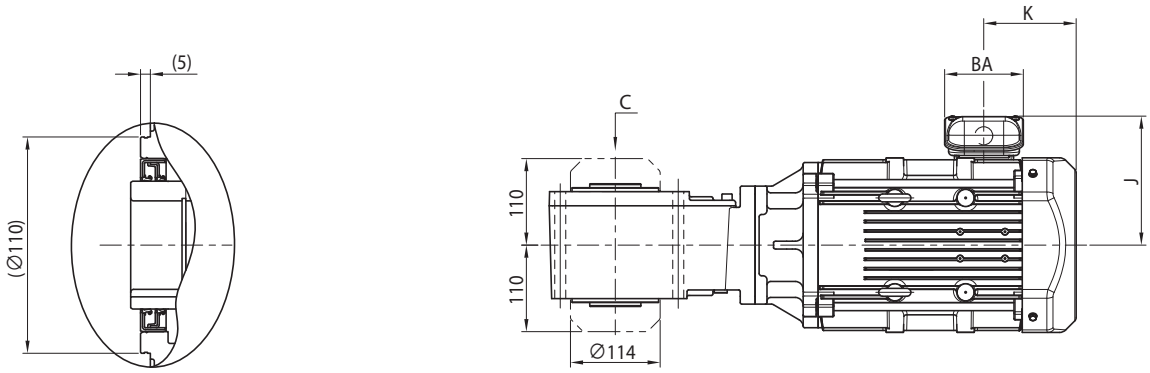
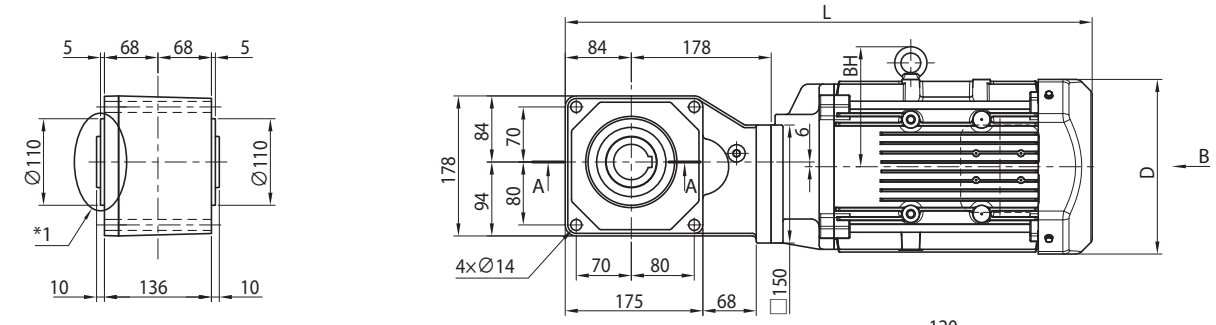
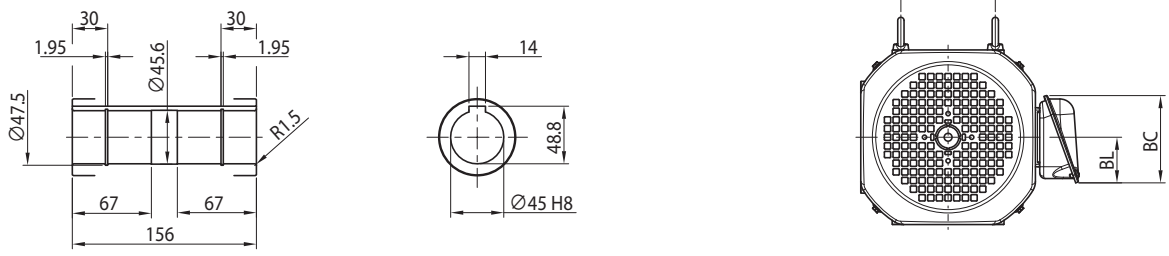
Dimension Diagrams

Premium-efficiency, 3-phase motor	LNYMΔ - HZ522 to HZ523 - EP(-B) - reduction ratio
Premium-efficiency, 3-phase motor for inverter	LNYMΔ - HZ522 to HZ523 - AP(-B) - reduction ratio



*1 Details on Part 1





A-A C B

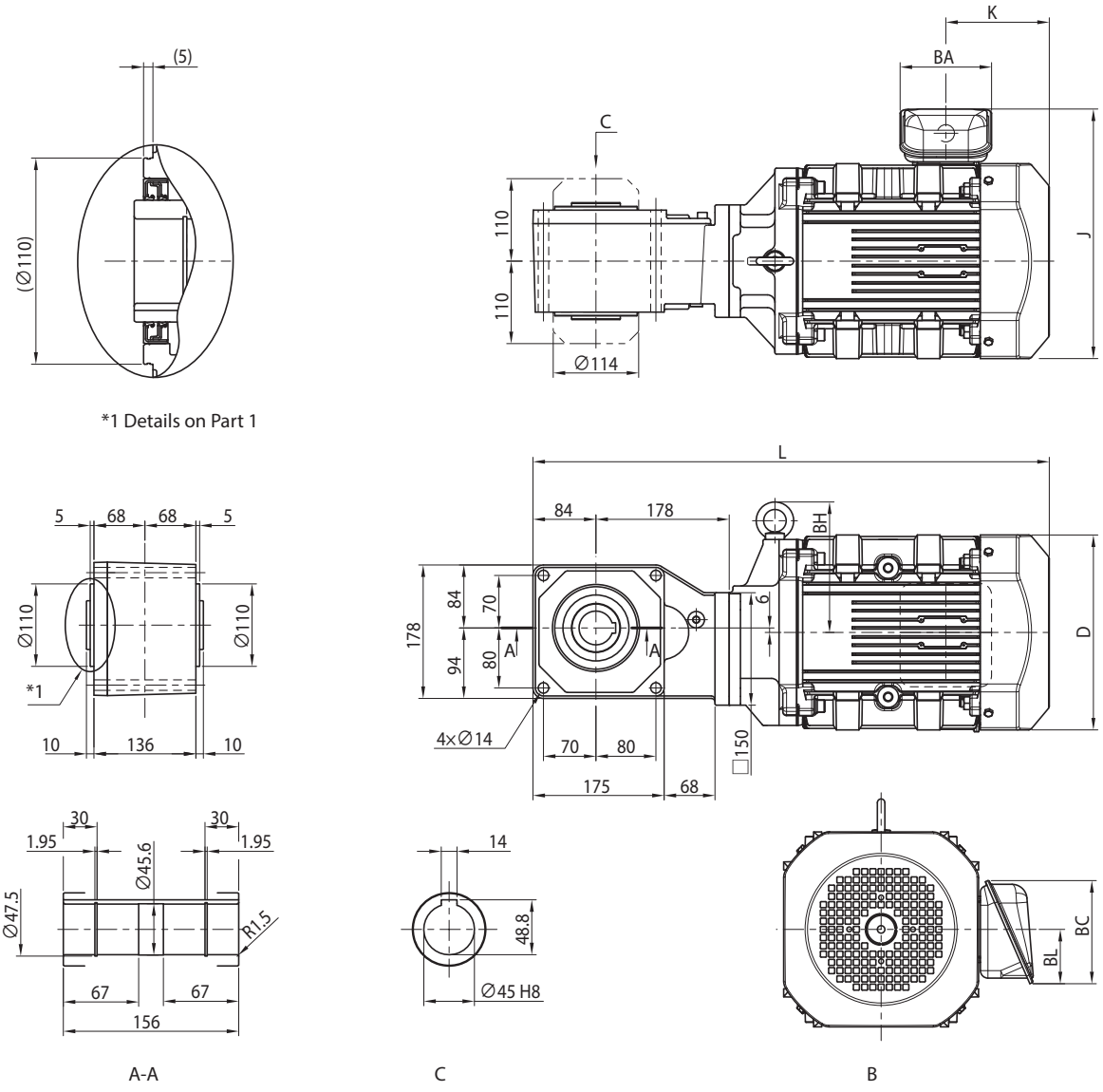
Frame size	Capacity kW x4P	Capacity symbol	BH	Indoor									Outdoor								Terminal box dimension
				J	Without brake				With brake (B)				J	Without brake				With brake (B)				
					K	D	L	Mass (kg)	K	D	L	Mass (kg)		K	D	L	Mass (kg)	K	D	L	Mass (kg)	
HZ522	2.2	3	125	150	115	□184	592	49	193	□184	670	56	183	115	□184	592	50	193	□184	670	57	a
	3.0	4	125	150	115	□184	606	51	193	□184	684	58	183	115	□184	606	52	193	□184	684	59	
	3.7	5	153	166	118	□222	627	60	208	□222	717	71	199	118	□222	627	61	208	□222	717	72	
HZ523	5.5	8	153	166	118	□222	670	72	208	□222	760	83	199	118	□222	670	73	208	□222	760	84	

Terminal box dimension	Indoor			Outdoor		
	BA	BC	BL	BA	BC	BL
a	100	111	58	123	151	87

Note) 1 A capacity symbol for the motor is entered in nomenclature Δ.
2 Output shaft bore diameter dimension: Dimension tolerance is JIS B 0401-1998 "H8."
3 Output shaft keyway dimension: Conforms to JIS B 1301-1996 (ISO) "Keys and their corresponding keyways (normal form)."
4 The dimensions and mass depicted in this dimension diagram may be changed without notice.

Dimension drawing

Premium-efficiency, 3-phase motor	LNYM10 - HZ524 - EP(-B) - reduction ratio
Premium-efficiency, 3-phase motor for inverter	LNYM10 - HZ524 - AP(-B) - reduction ratio



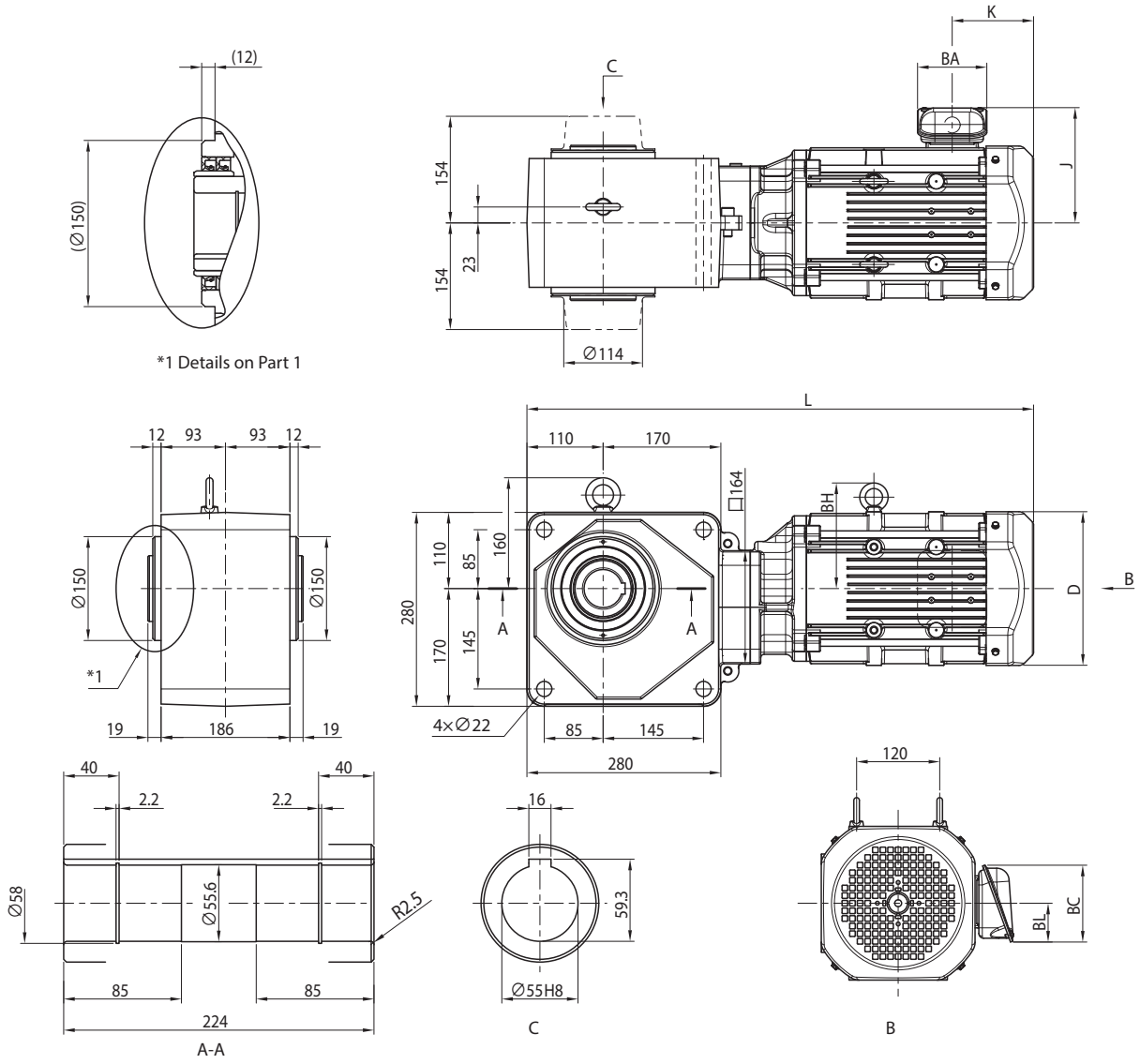
Frame size	Capacity kW x4P	Capacity symbol	BH	Indoor									Outdoor									Terminal box dimension
				J	Without brake				With brake (B)				J	Without brake				With brake (B)				
					K	D	L	Mass (kg)	K	D	L	Mass (kg)		K	D	L	Mass (kg)	K	D	L	Mass (kg)	
HZ524	7.5	10	174	203	138	□260	689	88	243	□260	794	108	235	138	□260	689	89	243	□260	794	109	b

Terminal box dimension	Indoor			Outdoor		
	BA	BC	BL	BA	BC	BL
b	122	138	72	154	184	105

Note) 1 Output shaft bore diameter dimension: Dimension tolerance is JIS B 0401-1998 "H8."
2 Output shaft keyway dimension: Conforms to JIS B 1301-1996 (ISO) "Keys and their corresponding keyways (normal form)."
3 The dimensions and mass depicted in this dimension diagram may be changed without notice.

Dimension Diagrams

Premium-efficiency, 3-phase motor	LNYM8 - HA635 - EP(-B) - reduction ratio
Premium-efficiency, 3-phase motor for inverter	LNYM8 - HA635 - AP(-B) - reduction ratio



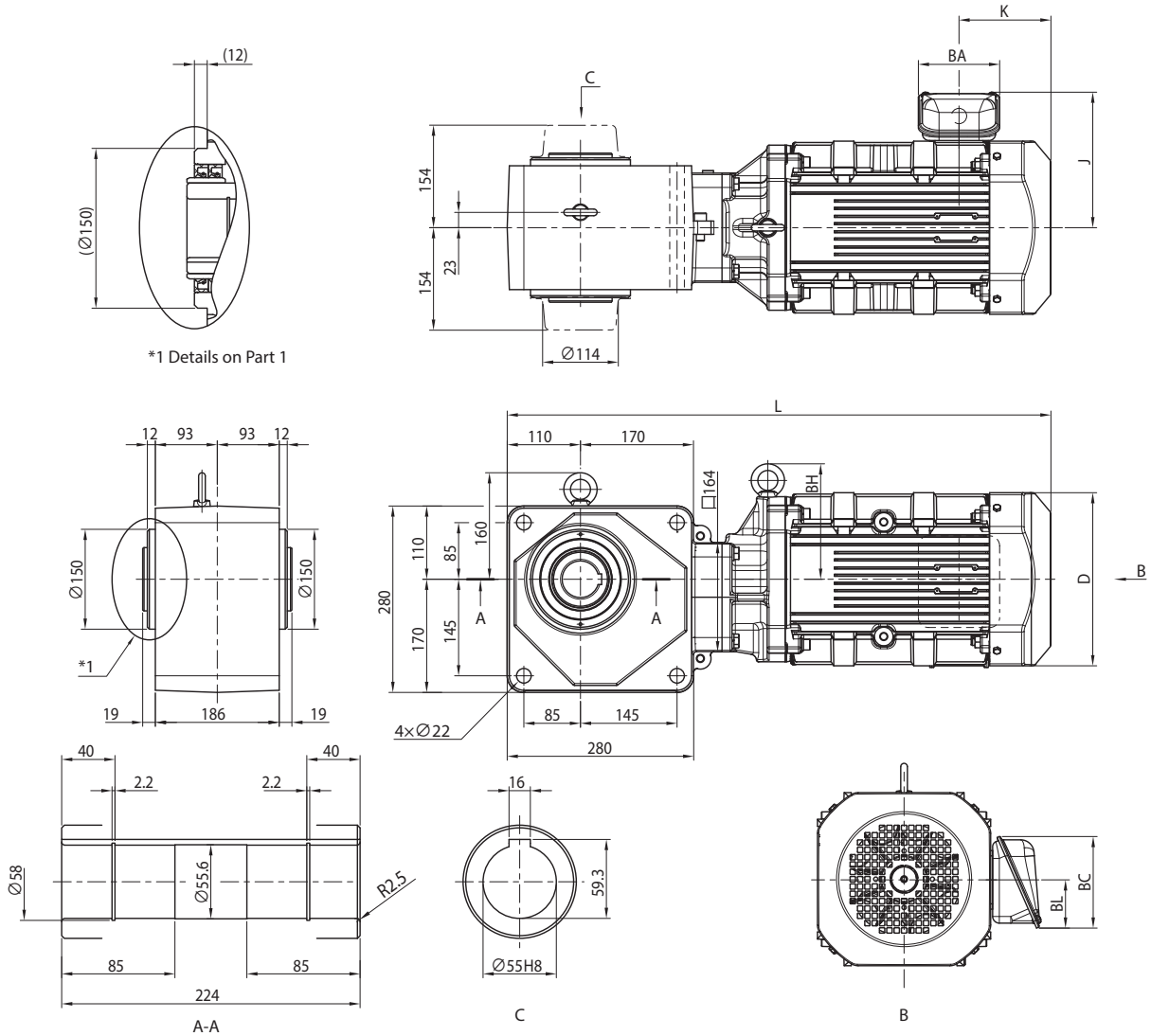
Frame size	Capacity kW x4P	Capacity symbol	BH	Indoor									Outdoor								Terminal box dimension
				J	Without brake				With brake (B)				J	Without brake				With brake (B)				
					K	D	L	Mass (kg)	K	D	L	Mass (kg)		K	D	L	Mass (kg)	K	D	L	Mass (kg)	
HA635	5.5	8	153	166	118	□222	732	95	208	□222	822	106	199	118	□222	732	96	208	□222	822	107	a

Terminal box dimension	Indoor			Outdoor		
	BA	BC	BL	BA	BC	BL
a	100	111	58	123	151	87

Note) 1 Output shaft bore diameter dimension: Dimension tolerance is JIS B 0401-1998 "H8."
2 Output shaft keyway dimension: Conforms to JIS B 1301-1996 (ISO) "Keys and their corresponding keyways (normal form)."
3 The dimensions and mass depicted in this dimension diagram may be changed without notice.

Dimension drawing

Premium-efficiency, 3-phase motor	LNYMΔ - HA635 - EP(-B) - reduction ratio
Premium-efficiency, 3-phase motor for inverter	LNYMΔ - HA635 - AP(-B) - reduction ratio



Frame size	Capacity kW x4P	Capacity symbol	BH	Indoor									Outdoor									Terminal box dimension
				J	Without brake				With brake (B)				J	Without brake				With brake (B)				
					K	D	L	Mass (kg)	K	D	L	Mass (kg)		K	D	L	Mass (kg)	K	D	L	Mass (kg)	
HA635	7.5	10	174	203	138	□260	755	111	243	□260	860	131	235	138	□260	755	112	243	□260	860	132	b
	11	15	174	203	138	□260	816	129	243	□260	921	149	235	138	□260	816	130	243	□260	921	150	

Terminal box dimension	Indoor			Outdoor		
	BA	BC	BL	BA	BC	BL
b	122	138	72	154	184	105

Note) 1 A capacity symbol for the motor is entered in nomenclature Δ.
2 Output shaft bore diameter dimension: Dimension tolerance is JIS B 0401-1998 "H8."
3 Output shaft keyway dimension: Conforms to JIS B 1301-1996 (ISO) "Keys and their corresponding keyways (normal form)."
4 The dimensions and mass depicted in this dimension diagram may be changed without notice.

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C Technical Data

Construction drawing

Construction

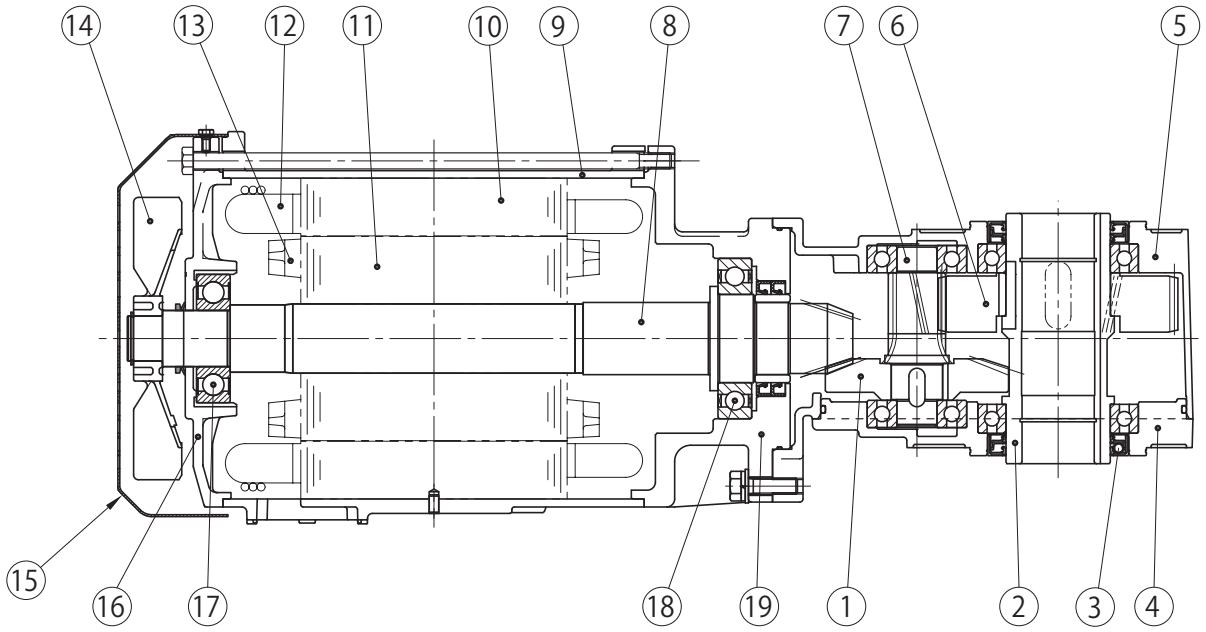


Figure C1 LNYM8-HZ523-EP

Table C1 Gearmotor main parts

Part number (PN)	Part Name	Part number (PN)	Part Name	Part number (PN)	Part Name
1	Bevel gear	8	Bevel pinion shaft	15	Fan cover
2	Output Shaft	9	Motor frame	16	Anti-load side cover
3	Oil seal	10	Stationary core	17	Bearing
4	Case (1)	11	Rotor core	18	Bearing
5	Case (2)	12	Stationary coil	19	Motor flange bracket
6	Gear	13	Rotor conductor		
7	Pinion shaft	14	Fan		

Gearmotor (motor directly connected)

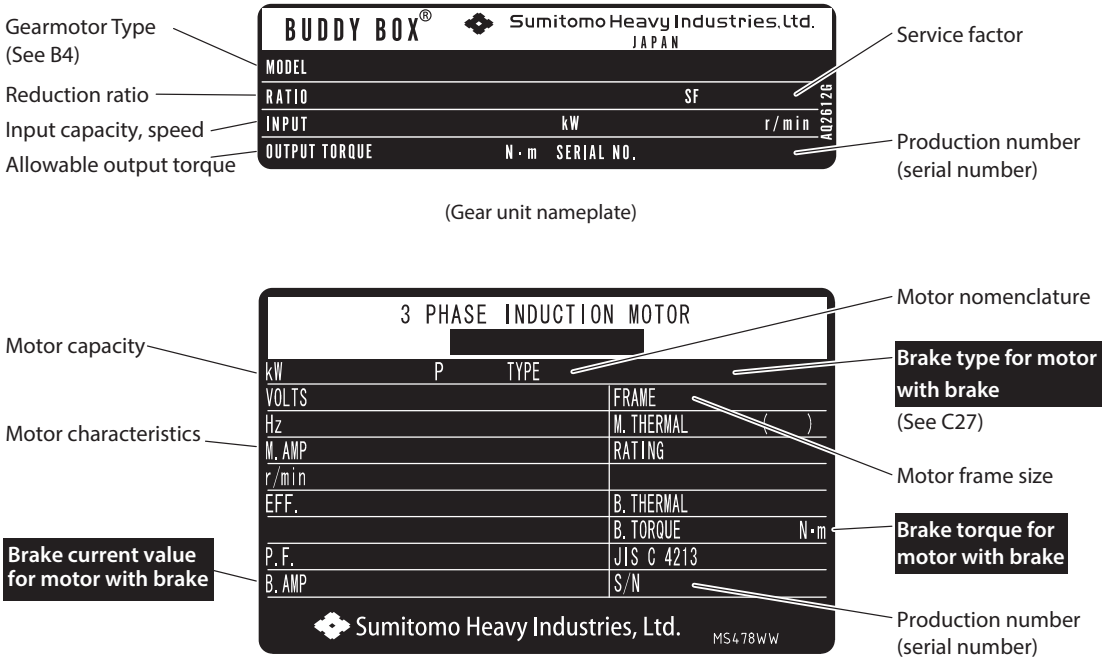
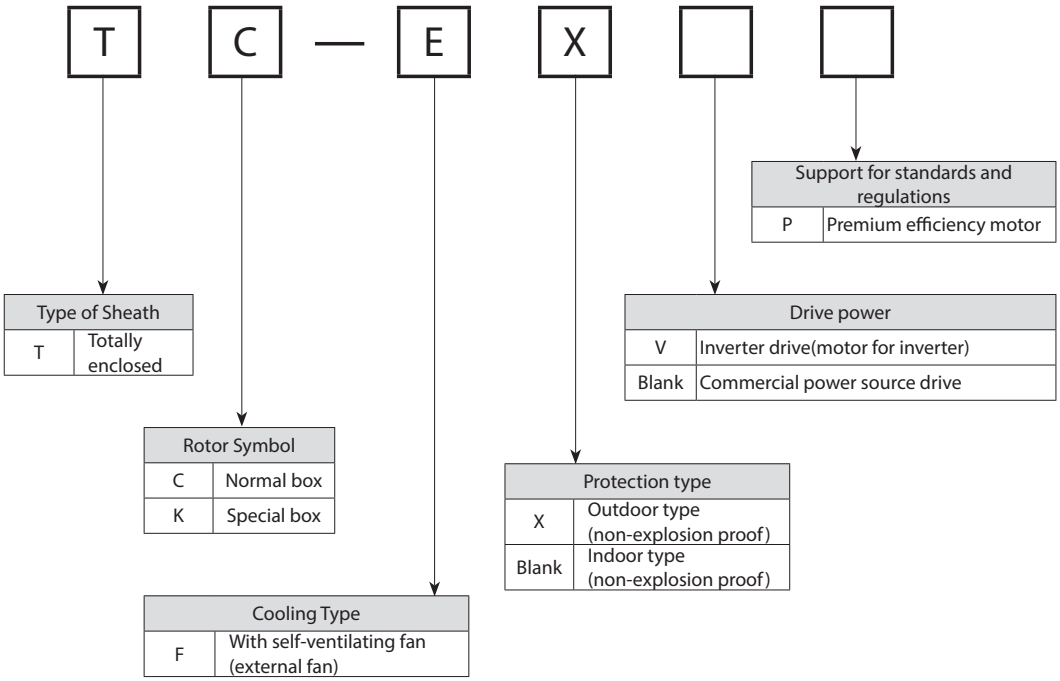


Figure C2 Gear unit nameplate

Motor nomenclature



Lubrication

Standard lubrication

- The gear part is filled with long-life grease, so long-term use is possible without replenishment. However, an even longer product life can be achieved by carrying out an overhaul at roughly 20,000 hours or 3 to 5 years.
- Overhauling of the gearmotor requires skill, so always carry it out at one of our authorized service stations.

Precautions for oil seal

- Oil seals have a service life, so the sealing effect may decrease over time due to natural deterioration and wear. The service life length will vary widely depending on the drive operating conditions and the surrounding environment. Given normal operation, (uniform load, running 10 hours per day, normal temperature) as a guideline it is recommended to change them every 1 to 3 years. Meanwhile, if rust is developing on the shaft (or collar) at that time, please have it replaced at the same time.
- Lubricating grease is applied to the oil seal. Oil from the grease described above may seep out during the early stages of operation. If oil seeps out, please wipe it off. If oil continues to seep out, replacement of the oil seal is recommended.

Inertia moment/GD² and starting time

To start the driven machine completely, the starting torque has to be sufficiently larger than the load torque and the motor torque has to exceed the load torque constantly from the start of operation to the achievement of the full-load speed.
The acceleration torque is the difference between the motor torque and the load torque during the starting period. Assuming the average acceleration torque to be $\overline{T}a$ (N·m, kgf·m), the starting time ts (s) until the rotation speed n (r/min) is calculated by the following formula using the moment of inertia or GD^2.

$$ts = \frac{(J_M+J_C+J_L)/n}{9.55\cdot\overline{T}a} \quad (S) \qquad ts = \frac{(GD_M^2+GD_C^2+GD^2)/n}{375\cdot\overline{T}a} \quad (S)$$

However, J_M: Inertia moment of the motor (including the brake drum) (kg-m²)
J_C: Inertia moment of CYCLO Drive (kg-m²)
J_L : The moment of inertia (kg·m²) of driven machines (including couplings and pulleys) converted to the motor shaft.

GD_M^2 : GD^2 of the motor (including brake drum) (kgf·m²)
GD_C^2 : GD^2 of the cyclo drive (kgf·m²)
GD_L^2 : GD^2 (kgf·m²) of driven machines (including couplings and pulleys) converted to the motor.

Average acceleration torque $\overline{T}a$

Here the average torque means the difference between the motor torque and load torque as shown in the right figure, which is the average value of the actual torque to accelerate the load. To calculate the starting time, the motor torque curve and load torque curve are required. However, in this method, it is very difficult to calculate the average acceleration torque, so the average acceleration torque with the actual load is calculated as follows:
In the case of full voltage starting, $\overline{T}a$ [N・m, kgf・m] of the average acceleration torque during the starting period is calculated approximately by the following formula.

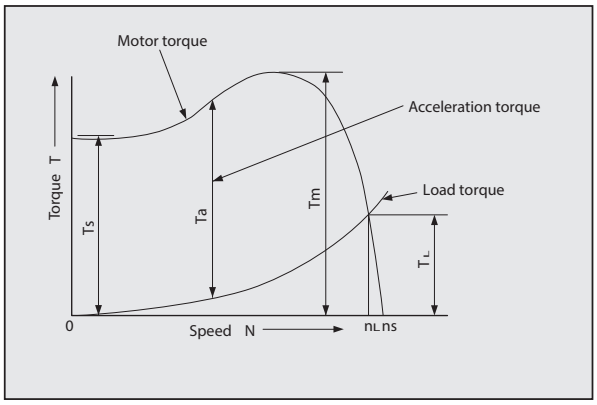


Figure C3 Torque diagram

Ts: Starting torque
Tm: Maximum torque (stall torque)
Ta: Acceleration torque
TL: Full-load torque
ns: Synchronization rotation speed
nL: Full-load rotation speed

$$\overline{T}a \fallingdotseq 0.8\left(\frac{Ts+Tm}{2}\right) - \overline{T}_L (N\cdot m, kgf\cdot m)$$

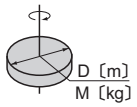
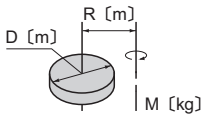
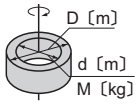
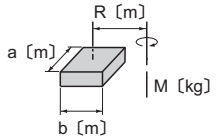
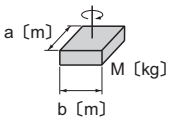
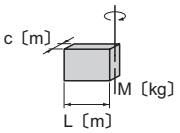
Also, the average load torque $\overline{T}L$ (N・m, kgf・m) during the starting period will be as follows if the motor full-load torque is TL:

In the case of constant load torque: $\overline{T}_L \fallingdotseq T_L$ (N・m, kgf・m)
In the case of double reduction torque: $\overline{T}_L \fallingdotseq 0.34T_L$ (N・m, kgf・m)

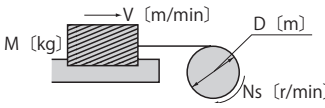
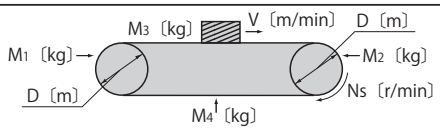
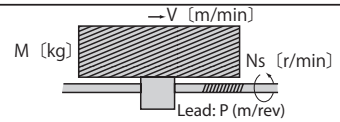
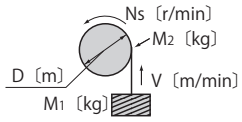
Inertia moment/GD^2

Calculation method of the moment of inertia J

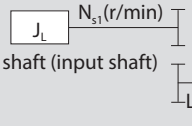
(1) Inertia moment of the rotor

If the rotation shaft passes through the center of gravity		If the rotation shaft does not pass through the center of gravity	
	$J=\frac{1}{8}MD^2$[kg·m^2]		$J=\frac{M}{4}\left(\frac{1}{2}D^2+4R^2\right)$ [kg·m^2]
	$J=\frac{1}{8}M(D^2+d^2)$[kg·m^2]		$J=\frac{M}{4}\left(\frac{a^2+b^2}{3}+4R^2\right)$ [kg·m^2]
	$J=\frac{1}{12}M(a^2+b^2)$[kg·m^2]		$J=\frac{1}{12}M(4L^2+C^2)$ [kg·m^2]

(2) Inertia moment of the linear motion (inertia moment in the load-side shaft)

General purpose		$J=\frac{M}{4}\left(\frac{V}{\pi\cdot Ns}\right)^2=\frac{M}{4}D^2$ [kg·m^2]
Horizontal movement by the conveyor		$J=\frac{1}{4}\left(\frac{M_1+M_2}{2}+M_3+M_4\right)\times D^2$ [kg·m^2]
Horizontal movement by the lead screw		$J=\frac{M}{4}\left(\frac{V}{\pi\cdot Ns}\right)^2=\frac{M}{4}\left(\frac{P}{\pi}\right)^2$ [kg·m^2]
Vertical movement by the hoisting machine		$J=\frac{M_1D^2}{4}+\frac{1}{8}M_2D^2$ [kg·m^2]

(3) Conversion to the motor shaft (input shaft)



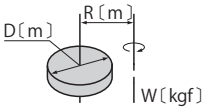
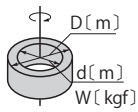
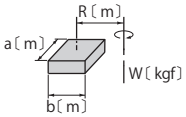
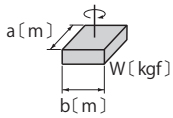
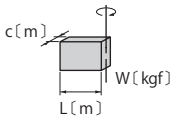
Inertia moment of the load J_R

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

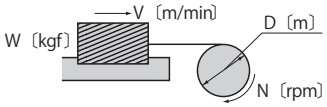
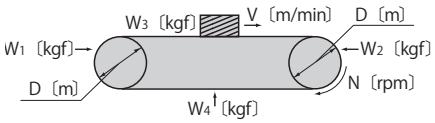
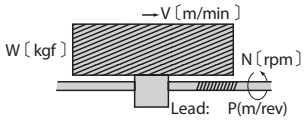
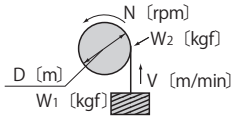
Z: Total reduction ratio

Calculation method of GD²

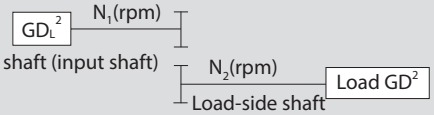
(1) GD² of the rotor

If the rotation shaft passes through the center of gravity		If the rotation shaft does not pass through 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 the linear motion (GD² in the load side)

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

(3) Conversion to the motor shaft (input shaft)



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

Z: Total reduction ratio

Inertia moment/GD^2

Moment of inertia / GD^2 of the Bevel Buddybox Drive H Series

Display the moment of inertia and GD^2 in the motor shaft of the Bevel Buddybox Drive H Series.

Table C2 The moment of inertia J and GD^2 in the motor shaft of the Bevel Buddybox Drive H Series

Premium-efficiency, 3-phase motor

Unit: J_M (Moment of inertia) [×kg·m^2]
GD^2_M [×kgf·m^2]

kW x P	2.2kW x 4P		3.0kW x 4P		3.7kW x 4P		5.5kW x 4P		7.5kW x 4P		11kW x 4P	
	J_M	GD^2_M	J_M	GD^2_M	J_M	GD^2_M	J_M	GD^2_M	J_M	GD^2_M	J_M	GD^2_M
Without brake	0.00880	0.0352	0.0100	0.0400	0.0194	0.0777	0.0291	0.116	0.0409	0.164	0.0561	0.224
With brake	0.00978	0.0391	0.0110	0.0440	0.0209	0.0835	0.0306	0.122	0.0450	0.180	0.0602	0.241

Premium-efficiency, 3-phase motor for inverter

Unit: J_M (Moment of inertia) [×kg·m^2]
GD^2_M [×kgf·m^2]

kW x P	2.2kW x 4P		3.0kW x 4P		3.7kW x 4P		5.5kW x 4P		7.5kW x 4P		11kW x 4P	
	J_M	GD^2_M	J_M	GD^2_M	J_M	GD^2_M	J_M	GD^2_M	J_M	GD^2_M	J_M	GD^2_M
Without brake	0.00880	0.0352	–	–	0.0194	0.0777	0.0291	0.116	0.0409	0.164	0.0561	0.224
With brake	0.00978	0.0391	–	–	0.0209	0.0835	0.0306	0.122	0.0450	0.180	0.0602	0.241

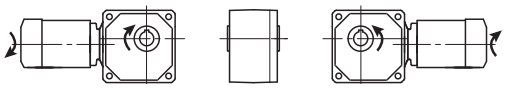
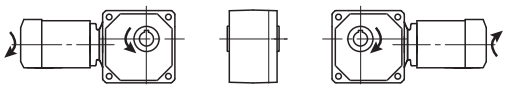
Notes: 1. The moment of inertia and GD^2 of the gear part and motor part are included in the values of the table.
2. The values in this table may be changed without notice.

Output shaft rotational direction/Output shaft bore diameter

Output shaft rotational direction

The motor shaft rotates to the right when viewed seen from the fan cover side, if connections are carried out according to the connection diagrams (during forward running) on pages C34 to C41.
The output shaft rotational direction at this time will be as follows.

Table C3 Output shaft rotational direction

Frame size	Reduction ratio	
HZ522	5, 7, 10, 12, 15, 20	-
HZ523	5, 7, 10, 12, 15	-
HZ524	5, 7, 10	-
HA635	5, 7, 10, 12, 15	20
Rotation direction		

Note) For reverse rotation, swap the Rs and Ts on pages C34 and C36-C39.

Output shaft bore diameter

The output shaft bore diameter can be made to an optional dimension, other than the standard dimension.

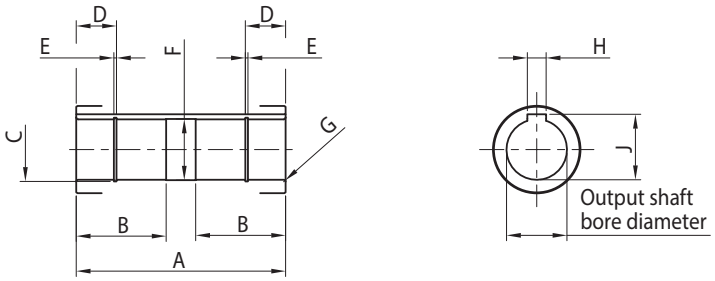


Figure C4 Output shaft bore diameter

Table C4 Output shaft bore diameter

Frame size	Output shaft bore diameter	A	B	C	D	E	F	G	H	J
HZ522, HZ523, HZ524	∅ 40 (Optional)	156	60	∅ 42.5	30	1.95	∅ 40.6	R1.5	12	43.3
	∅ 45 (Standard)		67	∅ 47.5			∅ 45.6		14	48.8
HA635	∅ 50 (Optional)	224	76	∅ 53	30	2.2	∅ 50.6	R1.5	14	53.8
	∅ 55 (Standard)		85	∅ 58	40		∅ 55.6	R2.5	16	59.3

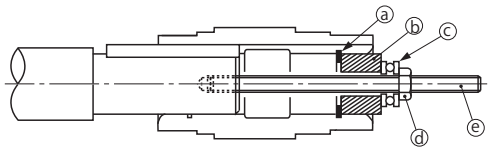
Notes: 1. Output shaft bore diameter dimension: Dimension tolerance is JIS B 0401-1998 "H8."
2. Output shaft keyway dimension: Conforms to JIS B 1301-1996 (ISO) "Keys and their corresponding keyways (normal form)."

Output shaft (hollow shaft) handling document

Attaching the output shaft (hollow shaft)

1. Attachment to the driven shaft

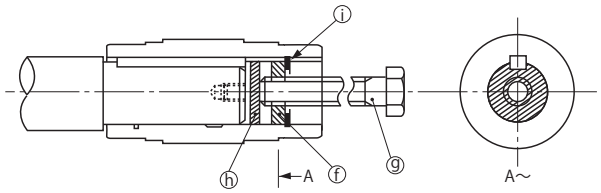
- Apply molybdenum disulfide grease to the surface of the driven shaft and the inner diameter of the output shaft (hollow shaft), and insert the drive into the driven shaft.
- If the fitting is tight, insert by lightly hitting the end face of the output shaft (hollow shaft) with a wooden hammer. Never hit the casing at this time. Additionally, as seen in the diagram, insertion can be done more smoothly by making and using jigs [a] to [e].
- The output shaft (hollow shaft) is made according to the JIS H8 tolerance. The recommended dimension tolerance of the driven shaft is as follows.
  When the load is uniform and a shock does not occur: JIS h6 or js6
  When there is an impact load or when the radial load is large: JIS js6 or k6
- The size of the snap ring is in accordance with the JIS B2804, C-type retaining ring.
- When making the driven shaft stepped, please check the shaft stress.



[a] Snap ring [b] Spacer [c] Thrust bearing
[d] Nut [e] Screw bolt

2. Removal from the driven shaft

Be careful not to apply excess force between the casing and the output shaft (hollow shaft).
Removal can be done more smoothly by using the jigs [f] to [i], as shown in the diagram.



[f]Spacer [g]Finished bolt [h]Discoid [i]Snap ring

3. The length of the driven shaft

The length L, for which the driven shaft is inserted, must be equal to or longer than the recommended length of the driven shaft.

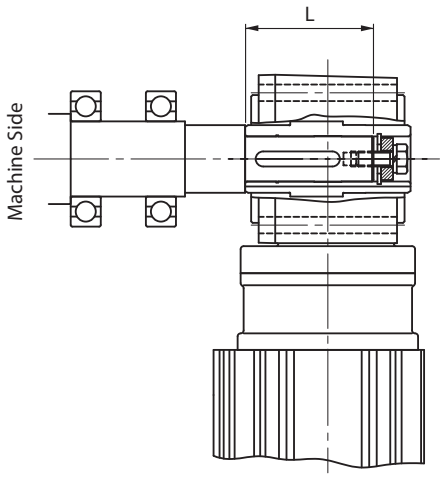


Figure C5 Driven shaft length

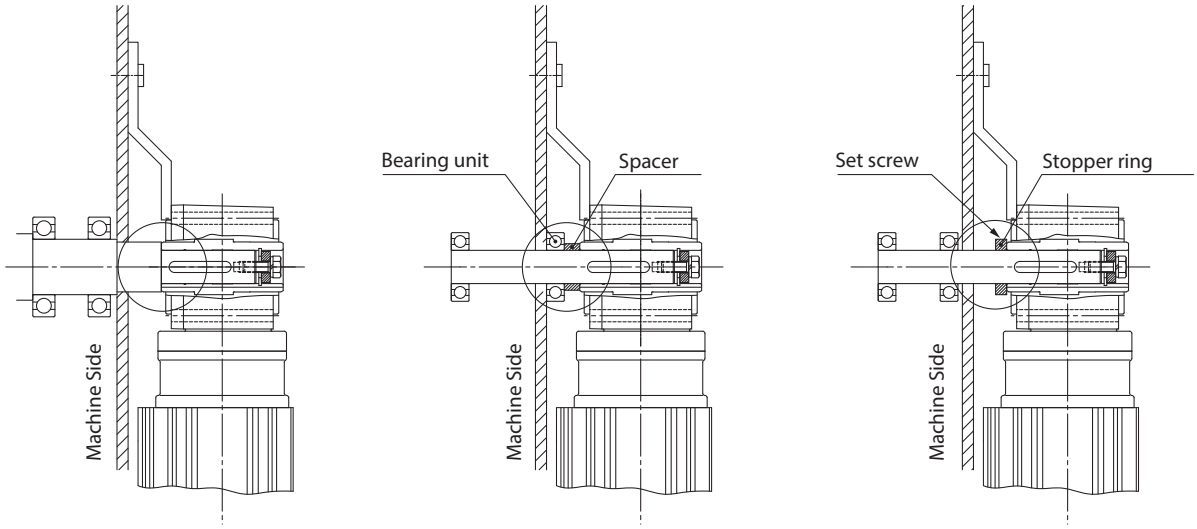
Table C5 Recommended length of driven shaft

Frame size	Output shaft bore diameter	Recommended length of driven shaft	Effective length of driven shaft key
HZ522, HZ523, HZ524	∅ 40	108	85
	∅ 45	104	70
HA635	∅ 50	169	110
	∅ 55	159	90

Output shaft (hollow shaft) handling document

4. Fixing to the driven shaft

When locking with a torque arm, always fix the drive to the driven shaft.

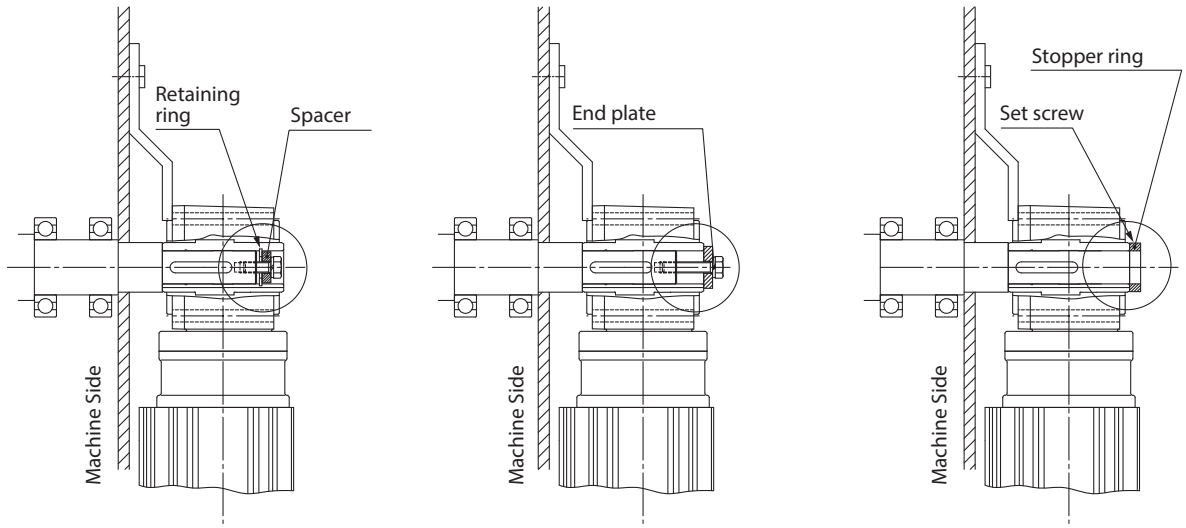


Fixing with a stepped shaft

Fixing with a spacer (driven shaft not stepped)

Fixing with a set screw and a stopper ring (driven shaft not stepped)

Figure C6 Fixing methods in which the present product does not move to the machine side.



Fixing with a spacer and a snap ring

Fixing with an end plate

Fixing with a set screw and a stopper ring

Figure C7 Fixing methods in which the present product does not move to the opposite of the machine.

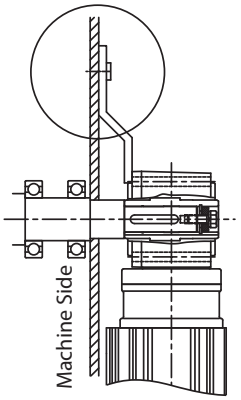
Output shaft (hollow shaft) handling document

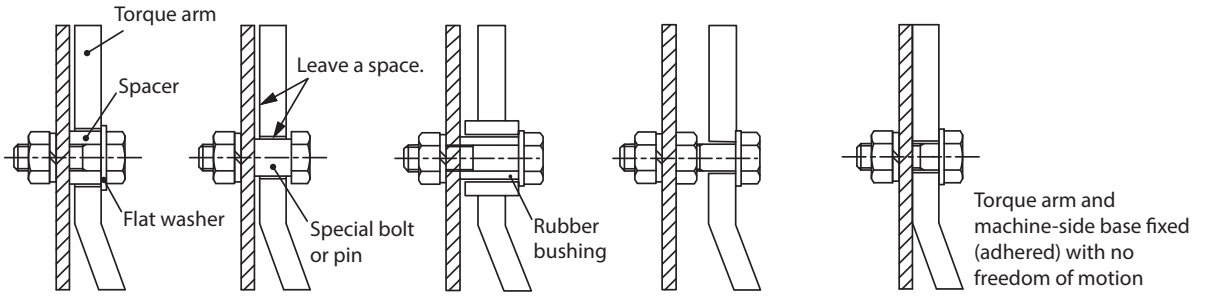
5. Locking the torque arm

[1] Attach the torque arm to the driven machine side of the case. Use a hexagon socket head bolt to mount on the case. (See Table C6 for size)

[2] Allow a degree of freedom to the locking part of the torque arm so that excess force is not applied between the product and the driven shaft. Never fix the torque arm using a retainer bolt.

[3] If starting and stopping frequency is high, and when repeating forward and reverse operations, etc., the impact can be mitigated by installing rubber bushing between the torque arm and the mounting bolt (or spacer).





Adjust the amount of the space to a size that does not result in excessive force or contact in accordance with the movement of the machine.

Good example

The retainer bolt, machine or the product may be damaged due to excessive force.

Bad example

Figure C8 Locking part installation example

Table C6 Hexagon socket head bolt size

Frame Size	Bolt size
HZ522, HZ523, HZ524	M12
HA635	M20

Output shaft (hollow shaft) handling document

Design example of the torque arm

The torque arm is prepared by the customer. The designing procedure of the torque arm is shown below. Meanwhile, for applications in which continuous operation and starting/stopping are infrequent, there is an optional torque arm.
See page C14 for details.

1. Calculation method of the strength check of the torque arm

Please refer to the following figures and formulas, and check the strength of the torque arm and driven shaft, and the service life of the bearing.

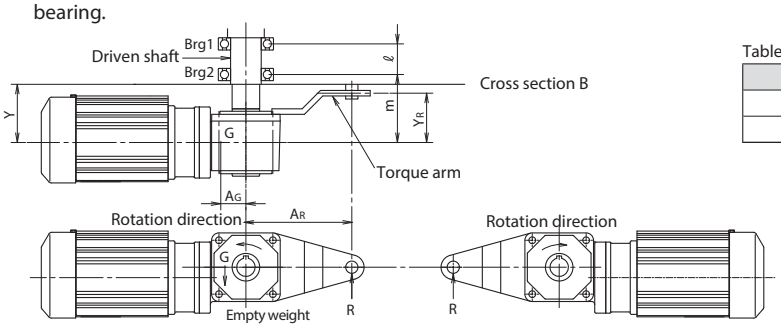


Figure C9: Example design

Table C7 (m)

Frame Size	A_G
HZ522, HZ523, HZ524	0.25
HA635	0.30

(Approximate values)

1. Torque arm load : $R = \frac{T+A_G \cdot G}{A_R}$
2. Brg. 1 load : $B1 = \frac{m(R-G)-Y_R \cdot R}{\ell}$
3. Brg. 2 load : $B2 = \frac{(\ell+m)(R-G)-Y_R \cdot R}{\ell}$
4. Bending moment for cross section B of the driven shaft
   : $M = Y_R \cdot R - Y(R-G)$ but $0 < Y \leqq m$

T : Output torque (N·m)
G : Empty weight of drive (N)
R : Torque arm load (N)
A_G : Distance from drive shaft center to gravitational center of drive (m)
A_R : Distance from drive shaft center to torque arm retainer (m)
Y_R : Distance from drive center to torque arm retainer (m)
m : Distance from drive center to Brg. 2 (m)
ℓ : Distance from Brg. 1 to Brg. 2 (m)
Y : Distance from drive center to cross section B (m)

Note: Change + to - if the rotation direction of the output torque is opposite from that shown above.

2. Recommended dimensions of the torque arm

Figure C10 Recommended dimensions

Table C8 Recommended dimensions

Frame size	Torque arm length	Torque arm bore diameter	Bore diameter of the torque arm locking part.	Torque arm mounting pitch			Torque arm mounting bore diameter	Torque arm plate thickness
	A_R	Ø H	Ø D	a	b	c	Ø d	
HZ522 HZ523 HZ524	150	112	22	80	70	–	14	9
HA635	280	152	22	145	85	–	22	12

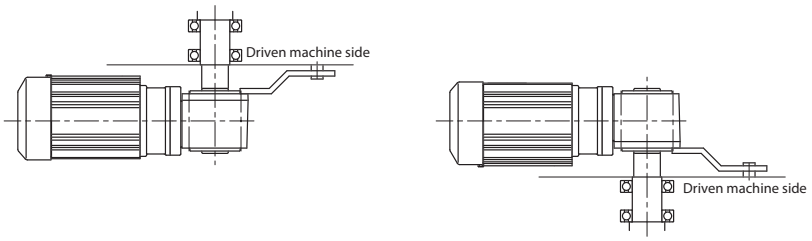


Figure C11 Installation method

Notes: 1. Attach the torque arm to the driven machine side.
2. The torque arm is mountable on either the left or right side of the case flange surface.
3. When mounting on the motor side, beware of interference with the motor.

Output shaft (hollow shaft) handling document

Torque arm option

- There is an optional torque arm. This can be used if continuous operation, and starting and stopping are infrequent.
- It cannot be mounted on the motor side from the output shaft (hollow shaft).
- When preparing the torque arm on your own, if starting and stopping is frequent, or if mounting the torque arm on the motor side, please refer to page C13 while carrying out the design.

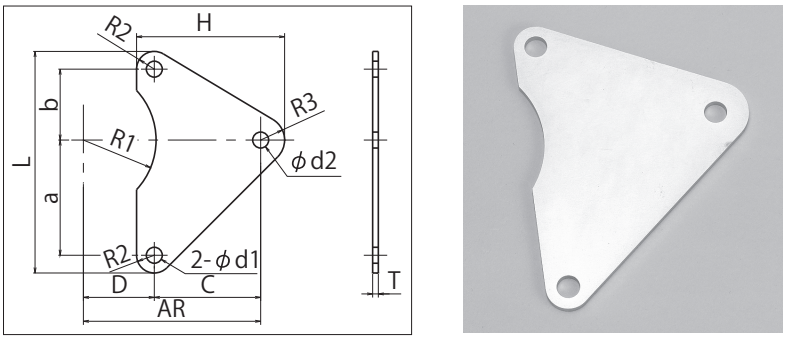


Figure C12 Torque arm

Table C9 Dimension table

Frame size	a	b	C	D	H	L	d1	d2	R1	R2	R3	T
HZ522 HZ523 HZ524	80	70	80	–	127	178	∅ 14	∅ 22	–	14	33	9
HA635	145	85	195	85	250	274	∅ 22	∅ 22	80	22	33	12

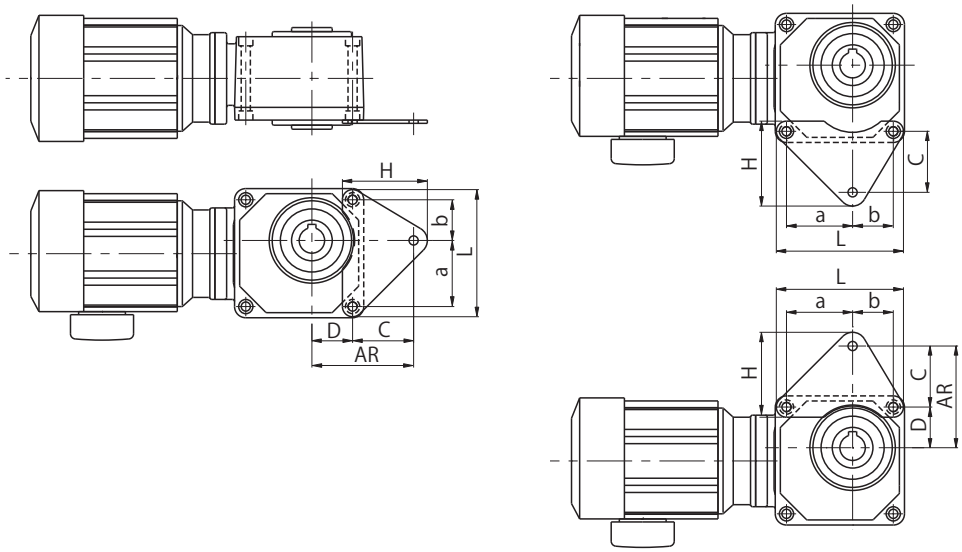


Figure C13 Installation example

Notes: 1. Please use the torque arm only for the locking function.
2. Please use the driven shaft to affix the drive in the axial direction.

Output shaft (hollow shaft) handling document

Safety cover of the output shaft

One safety cover made of resin is attached.
Mounting on either the left or right side is possible.

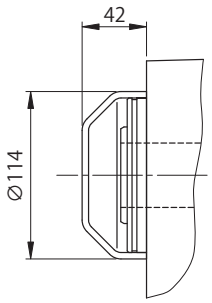


Figure C14 Safety cover (for HZ522, HZ523 and HZ524)

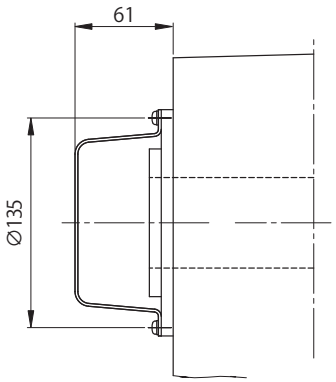


Figure C15 Safety cover (for HA635)

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Output shaft (hollow shaft) handling document

Shrink disk (optional)

Design recommendation example

1. Designing the driven shaft
   - When ordering the product, the mounting direction of the shrink disk must always be specified. (See Table C12)
     The mounting direction of the shrink disk cannot be changed after delivery.
   - Please design the driven shaft with reference to Dimension Table C10.

2. Installation of the shrink disk
   - Since the shrink disk is attached to the drive main unit, in a state in which grease is applied to the surface that tightens the boss when shipped, assembly can be carried out as is.
     Inserts that are stuffed between the two plates in transit can be removed by loosening all bolts.
     When removing the shrink disk that has been used so far and reusing it, first disassemble and wash it. Then, apply molybdenum disulfide grease to the surface that will come into contact with the sliding cone, tightening bolt, and its bolt head.

(1) Completely degrease the boss hole and the shaft that comes into contact with it.
(2) Slide the shrink disk onto the output shaft (hollow shaft). Do not tighten the tightening bolts until the driven shaft is inside the output shaft (hollow shaft).
(3) Slide the driven shaft or drive, then insert the driven shaft into the output shaft (hollow shaft).
(4) When tightening the bolts, ensure the surfaces of both plates are parallel. A spanner with a short handle is suitable for this task.
(5) After confirming that the shrink disk is properly set, start tightening the tightening bolts using a spanner with a suitable length.
Tighten the bolts clock-wise (not diagonally), uniformly, and in order, while keeping both plates parallel. Tightening each bolt 30 degrees at a time is recommended when doing this.
(6) Always check the shrink disk after tightening using a torque wrench. The specified torque is indicated on the nameplate of the shrink disk.
(7) Finally, check if both plates are parallel.

Note) Operate after installing the shrink disks by the procedure described above.
There is no lubrication on the contact portion of the output shaft (hollow shaft) and the drive shaft. Therefore, scratches and galling will occur on the shaft if it is rotated without being correctly installed.

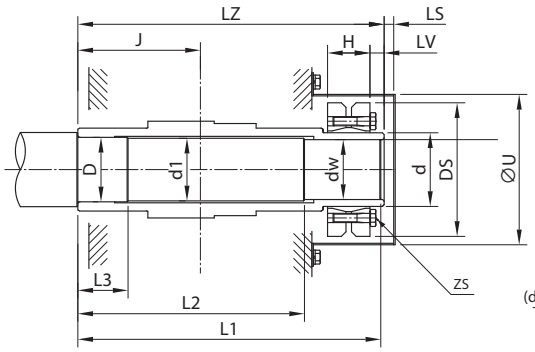


Figure C16 Shrink disk system
Output shaft (hollow shaft) dimensions

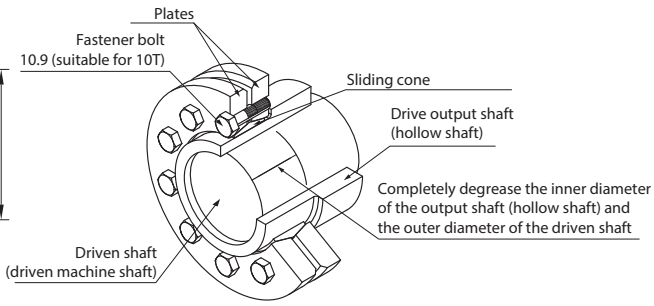


Figure C17 Shrink disk structure

3. Removing the shrink disk
   - Carry out the removal of the shrink disks in the opposite order of the installation procedure.
   - Loosen the bolts gradually and in order, so that the two plates do not tilt on the sliding cone.
   - Never remove the bolts if the two plates are not parallel. Both plates may suddenly fly out of the sliding cone and injury is possible. Accordingly, slightly loosen all bolts and insert wedges between the plates to achieve a parallel state.

Output shaft (hollow shaft) handling document

Table C10 Shrink disk design reference dimensions

Frame size	Shrink disk							Output shaft (hollow shaft)				
					Tightening bolt						Safety cover	
	Nomenclature	d	DS	H	ZS	Strength Classification	TA N·m	J	LZ	LV	LS	U
HZ522 HZ523 HZ524	S-45×55	55	100	30	M6	10.9	11.8	78	196	5	18	115
HA635	S-55×68	68	115	30	M6	10.9	11.8	112	264	5	31	152

Frame size	Driven shaft (Recommended design dimensions)					
	dw	d1	D	L1	L2	L3
HZ522 HZ523 HZ524	45h6	44.5	45h6	193	140	55
HA635	55h6	54.5	55h6	261	200	65

Table C11 Specified tightening torque of the tightening bolt

Strength class	JIS 10.9
Tightening torque (N·m)	11.8

Table C12 Shrink disk installation position specifying code

Shrink disk installation position		Specifying code
Seen from the motor side	Right	R61
	Left	R62

Motor characteristics table

Domestic specification motor

Table C13 Premium-efficiency, 3-phase motor (200V class)

Motor frame size	Number of Poles	4P																				
	Power source	200V-50Hz							200V-60Hz							220V-60Hz						
	Output (kW)	Rated current (A)	Efficiency (%)	IE code	Stall torque (%)	Starting torque (%)	Starting current (A)	Speed (r/min)	Rated current (A)	Efficiency (%)	IE code	Stall torque (%)	Starting torque (%)	Starting current (A)	Speed (r/min)	Rated current (A)	Efficiency (%)	IE code	Stall torque (%)	Starting torque (%)	Starting current (A)	Speed (r/min)
N-100L	2.2	10.4	88.7	IE3	465	382	83.0	1450	9.32	89.8	IE3	402	297	74.9	1740	9.08	90.2	IE3	500	380	83.6	1750
N-112S	3.0	13.6	87.9	IE3	419	352	98.9	1440	12.3	89.5	IE3	358	282	91.0	1730	11.8	89.7	IE3	452	368	101	1740
N-112M	3.7	16.6	89.0	IE3	420	294	127	1460	15.0	90.1	IE3	370	243	115	1750	14.5	90.6	IE3	452	300	126	1760
N-132S	5.5	24.4	90.6	IE3	524	351	229	1460	21.8	91.7	IE3	440	286	196	1760	21.2	91.9	IE3	542	355	217	1770
N-132M	7.5	33.5	91.2	IE3	350	236	206	1460	30.0	91.8	IE3	286	199	176	1760	29.0	92.0	IE3	356	244	195	1770
N-160M	11	49.8	91.5	IE3	378	257	316	1470	43.2	92.5	IE3	308	210	268	1760	42.4	92.6	IE3	387	262	299	1770

Table C14 Premium-efficiency, 3-phase motor (400V class)

Motor frame size	Number of Poles	4P																				
	Power source	400V-50Hz							400V-60Hz							440V-60Hz						
	Output (kW)	Rated current (A)	Efficiency (%)	IE code	Stall torque (%)	Starting torque (%)	Starting current (A)	Speed (r/min)	Rated current (A)	Efficiency (%)	IE code	Stall torque (%)	Starting torque (%)	Starting current (A)	Speed (r/min)	Rated current (A)	Efficiency (%)	IE code	Stall torque (%)	Starting torque (%)	Starting current (A)	Speed (r/min)
N-100L	2.2	5.20	88.7	IE3	465	382	41.5	1450	4.66	89.8	IE3	402	297	37.5	1740	4.54	90.2	IE3	500	380	41.8	1750
N-112S	3.0	6.80	87.9	IE3	419	352	49.5	1440	6.15	89.5	IE3	358	282	45.5	1730	5.90	89.7	IE3	452	368	50.7	1740
N-112M	3.7	8.30	89.0	IE3	420	294	63.6	1460	7.50	90.1	IE3	370	243	57.3	1750	7.25	90.6	IE3	452	300	63.0	1760
N-132S	5.5	12.2	90.6	IE3	524	351	114	1460	10.9	91.7	IE3	440	286	98.1	1760	10.6	91.9	IE3	542	355	109	1770
N-132M	7.5	16.8	91.2	IE3	350	236	103	1460	15.0	91.8	IE3	286	199	87.9	1760	14.5	92.0	IE3	356	244	97.7	1770
N-160M	11	24.9	91.5	IE3	378	257	158	1470	21.6	92.5	IE3	308	210	134	1760	21.2	92.6	IE3	387	262	149	1770

Note) 1. The characteristics of brakemotors are the same.
2. For brake characteristics, see page C27.
3. The figures of this table may be changed without notice.

Motor characteristics table

Table C15 Premium-efficiency, 3-phase motor for inverter (200V class)

Motor frame size	Number of Poles	4P											
	Power source	200V-60Hz						220V-60Hz					
	Output (kW)	Frequency (Hz)	Voltage (V)	Rated current (A)	Speed (r/min)	Efficiency (%)	IE Code	Frequency (Hz)	Voltage (V)	Rated current (A)	Speed (r/min)	Efficiency (%)	IE code
N-100L	2.2	60	200	8.96	1750	89.8	IE3	60	220	8.66	1760	90.2	IE3
		6	31	8.68	135	—	—	6	31	8.68	135	—	—
N-112M	3.7	60	200	14.3	1760	90.1	IE3	60	220	13.8	1770	90.6	IE3
		6	32	13.8	145	—	—	6	32	13.8	145	—	—
N-132S	5.5	60	200	20.9	1765	91.7	IE3	60	220	20.1	1775	91.9	IE3
		6	28	20.2	155	—	—	6	27	19.9	155	—	—
N-132M	7.5	60	200	28.8	1770	91.8	IE3	60	220	27.7	1775	92.0	IE3
		6	29	28.5	145	—	—	6	30	27.5	150	—	—
N-160M	11	60	200	42.0	1770	92.5	IE3	60	220	40.6	1775	92.6	IE3
		6	29	41.5	150	—	—	6	29	41.5	150	—	—

Table C16 Premium-efficiency, 3-phase motor for inverter (400V class)

Motor frame size	Number of Poles	4P											
	Power source	400V-60Hz						440V-60Hz					
	Output (kW)	Frequency (Hz)	Voltage (V)	Rated current (A)	Speed (r/min)	Efficiency (%)	IE Code	Frequency (Hz)	Voltage (V)	Rated current (A)	Speed (r/min)	Efficiency (%)	IE code
N-100L	2.2	60	400	4.48	1750	89.8	IE3	60	440	4.33	1760	90.2	IE3
		6	62	4.34	135	—	—	6	62	4.34	135	—	—
N-112M	3.7	60	400	7.16	1760	90.1	IE3	60	440	6.90	1770	90.6	IE3
		6	63	6.89	145	—	—	6	63	6.89	145	—	—
N-132S	5.5	60	400	10.4	1765	91.7	IE3	60	440	10.1	1775	91.9	IE3
		6	55	10.1	155	—	—	6	54	9.97	155	—	—
N-132M	7.5	60	400	14.4	1770	91.8	IE3	60	440	13.8	1775	92.0	IE3
		6	57	14.2	145	—	—	6	59	13.8	150	—	—
N-160M	11	60	400	21.0	1770	92.5	IE3	60	440	20.3	1775	92.6	IE3
		6	59	20.8	150	—	—	6	59	20.8	150	—	—

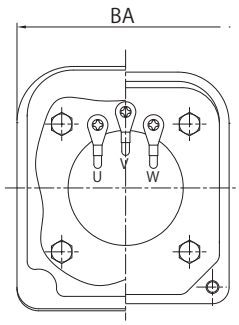
Notes: 1. For efficiency and IE codes, the characteristics when operating with a commercial power source are shown.
2. The characteristics of the motors with brake are the same.
3. For brake characteristics, see page C27.
4. The values in this table may be changed without notice.

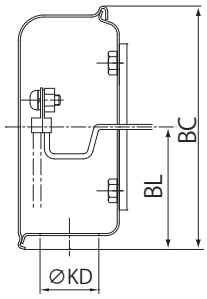
Terminal box specification

Indoor motor (without brake)

Made of Steel

	Motor type	Number of Poles	Motor capacity
Figure C18	Premium-efficiency, 3-phase motor	4P	2.2 to 3.7kW
	Premium-efficiency, 3-phase motor for inverter	4P	2.2 to 3.7kW





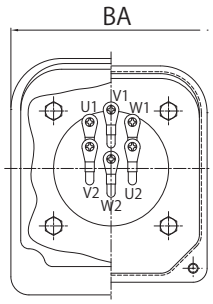
Reference image

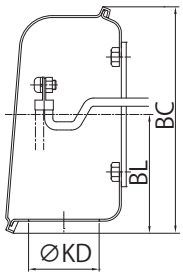
Unit: mm

kW	Premium-efficiency, 3-phase motor				Premium-efficiency, 3-phase motor for inverter			
	4P				4P			
	BA	BC	BL	KD	BA	BC	BL	KD
2.2	100	111	58	23	100	111	58	23
3.0					-	-	-	-
3.7					100	111	58	23

Made of Steel

	Motor type	Number of Poles	Motor capacity
Figure C19	Premium-efficiency, 3-phase motor	4P	5.5 to 11kW
	Premium-efficiency, 3-phase motor for inverter	4P	5.5 to 11kW





Reference image

Unit: mm

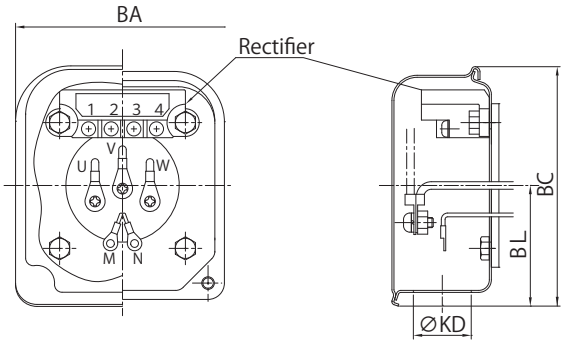
kW	Premium-efficiency, 3-phase motor				Premium-efficiency, 3-phase motor for inverter			
	4P				4P			
	BA	BC	BL	KD	BA	BC	BL	KD
5.5	100	111	58	23	100	111	58	23
7.5	122	138	72	43	122	138	72	43
11								

Note) The shape of the gasket depends on the size of the terminal box.

Indoor motor (with brake)

Made of Steel

	Motor type	Number of Poles	Motor capacity
Figure C20	Premium-efficiency, 3-phase motor	4P	2.2 to 3.7kW
	Premium-efficiency, 3-phase motor for inverter	4P	2.2 to 3.7kW



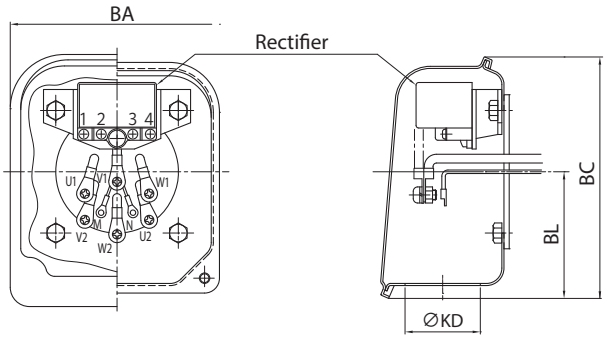
Reference image

Unit: mm

kW	Premium-efficiency, 3-phase motor				Premium-efficiency, 3-phase motor for inverter			
	4P				4P			
	BA	BC	BL	KD	BA	BC	BL	KD
2.2	100	111	58	23	100	111	58	23
3.0					-	-	-	-
3.7					100	111	58	23

Made of Steel

	Motor type	Number of Poles	Motor capacity
Figure C21	Premium-efficiency, 3-phase motor	4P	5.5 to 11kW
	Premium-efficiency, 3-phase motor for inverter	4P	5.5 to 11kW



Reference image

Unit: mm

kW	Premium-efficiency, 3-phase motor				Premium-efficiency, 3-phase motor for inverter			
	4P				4P			
	BA	BC	BL	KD	BA	BC	BL	KD
5.5	100	111	58	23	100	111	58	23
7.5	122	138	72	43	122	138	72	43
11								

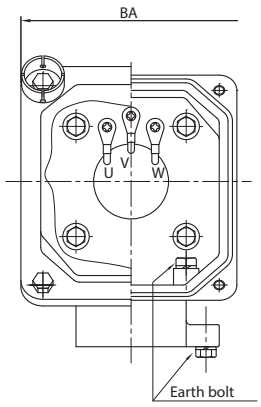
Note) The shape of the gasket depends on the size of the terminal box.

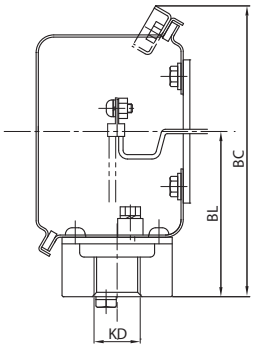
Terminal box specification

Outdoor motor (without brake)

Made of Steel

	Motor type	Number of Poles	Motor capacity
Figure C22	Premium-efficiency, 3-phase motor	4P	2.2 to 3.7kW
	Premium-efficiency, 3-phase motor for inverter	4P	2.2 to 3.7kW





Reference image

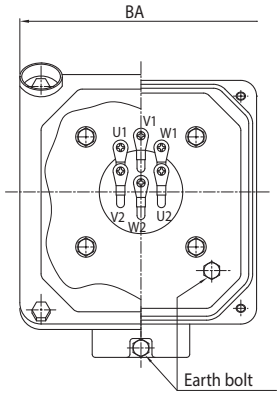
Unit: mm

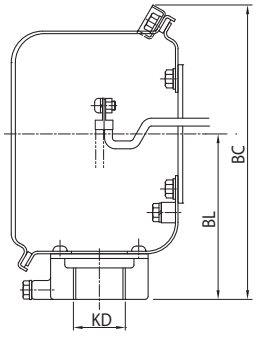
kW	Premium-efficiency, 3-phase motor				Premium-efficiency, 3-phase motor for inverter			
	4P				4P			
	BA	BC	BL	KD	BA	BC	BL	KD
2.2	123	151	87	22(G3/4)	123	151	87	22(G3/4)
3.0					-	-	-	-
3.7					123	151	87	22(G3/4)

Note) The conduit size can be changed. See page C24 for details.

Made of Steel

	Motor type	Number of Poles	Motor capacity
Figure C23	Premium-efficiency, 3-phase motor	4P	5.5 to 11kW
	Premium-efficiency, 3-phase motor for inverter	4P	5.5 to 11kW





Reference image

Unit: mm

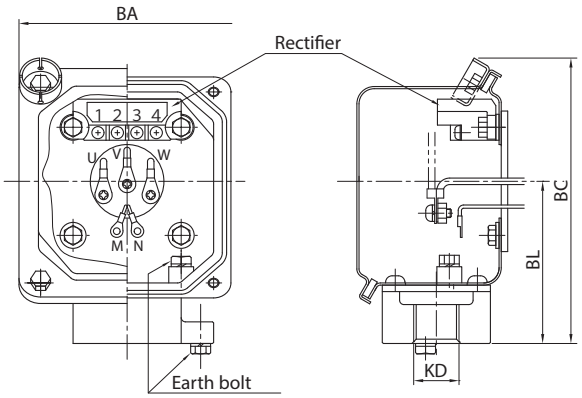
kW	Premium-efficiency, 3-phase motor				Premium-efficiency, 3-phase motor for inverter			
	4P				4P			
	BA	BC	BL	KD	BA	BC	BL	KD
5.5	123	151	87	28(G1)	123	151	87	28(G1)
7.5	154	184	105		154	184	105	
11				36(G1 1/4)				36(G1 1/4)

Note) 1. The shape of the packing and conduit and the position of the earth bolt vary according to the size of the terminal box.
2. You can change the conduit size. See page C24 for details.

Outdoor motor (with brake)

Made of Steel

	Motor type	Number of Poles	Motor capacity
Figure C24	Premium-efficiency, 3-phase motor	4P	2.2 to 3.7kW
	Premium-efficiency, 3-phase motor for inverter	4P	2.2 to 3.7kW



Reference image

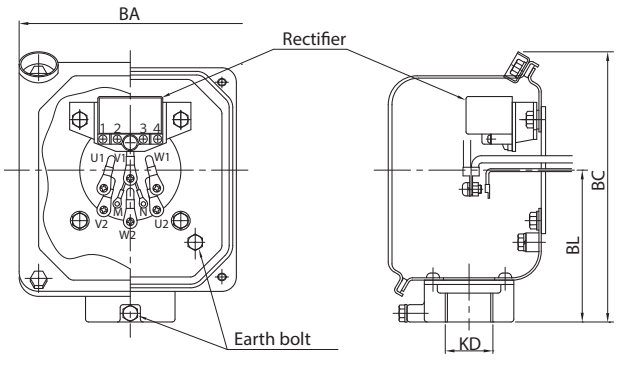
Unit: mm

kW	Premium-efficiency, 3-phase motor				Premium-efficiency, 3-phase motor for inverter			
	4P				4P			
	BA	BC	BL	KD	BA	BC	BL	KD
2.2	123	151	87	22(G3/4)	123	151	87	22(G3/4)
3.0					-	-	-	-
3.7					123	151	87	22(G3/4)

Note) The conduit size can be changed. See page C24 for details.

Made of Steel

	Motor type	Number of Poles	Motor capacity
Figure C25	Premium-efficiency, 3-phase motor	4P	5.5 to 11kW
	Premium-efficiency, 3-phase motor for inverter	4P	5.5 to 11kW



Reference image

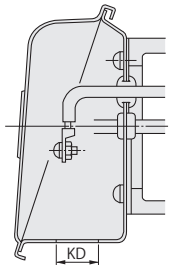
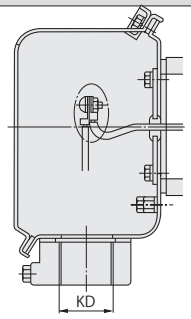
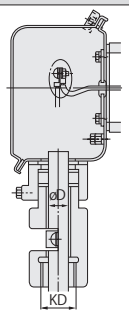
Unit: mm

kW	Premium-efficiency, 3-phase motor				Premium-efficiency, 3-phase motor for inverter			
	4P				4P			
	BA	BC	BL	KD	BA	BC	BL	KD
5.5	123	151	87	28(G1)	123	151	87	28(G1)
7.5	154	184	105		154	184	105	
11				36(G1 1/4)				36(G1 1/4)

Note) 1. The shape of the packing and conduit and the position of the earth bolt vary according to the size of the terminal box.
2. You can change the conduit size. See page C24 for details.

Terminal box specification

Terminal box port list

Indoor type (round hole type)	Conduit style	Conduit female screw packing style (Option)
		

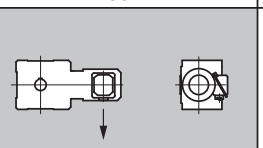
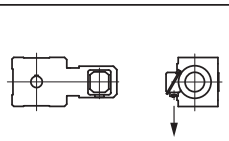
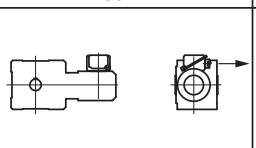
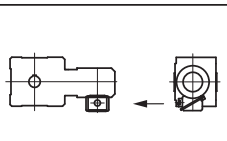
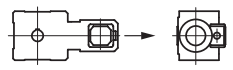
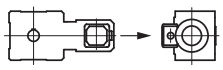
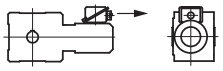
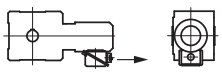
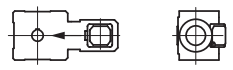
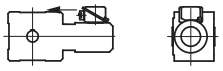
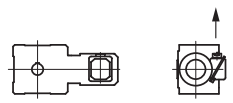
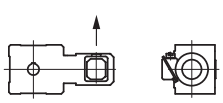
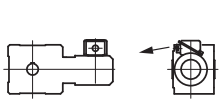
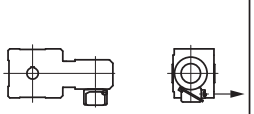
Motor Capacity (kW)		Indoor	Outdoor type, stormproof outdoor type, coastal installation type, 2-type anti-corrosion type, dust-proof type					
4P		Round hole type	Conduit style		Conduit female screw packing style (option)			
Premium-efficiency, 3-phase motor	Premium-efficiency, 3-phase motor for inverter	Cable port standard dimensions	Standard dimensions	Manufacturable range	Standard dimensions		Manufacturable range	
		KD	Conduit size KD	Conduit size KD	Conduit size KD	Cable diameter ØD	Conduit size KD	Cable diameter ØD
2.2	2.2	∅23	22(G3/4)	16(G1/2) 22(G3/4) 28(G1) 36(G1 1/4)	22(G3/4)	12.5	22(G3/4) 28(G1) 36(G1 1/4)	10.0-16.5 12.0-19.5 15.5-23.5
3.0	-				28(G1)	14.5		
3.7	3.7							
5.5	5.5		28(G1)					
7.5	7.5	∅43		22(G3/4) 28(G1) 36(G1 1/4) 42(G1 1/2)		17.5	22(G3/4) 28(G1) 36(G1 1/4) 42(G1 1/2)	12.0-16.5 12.0-18.7 15.5-22.7 17.5-27.0
11	11		36(G1 1/4)		36(G1 1/4)	19.5		

Note) When not specified, production will be carried out with standard dimensions.

Terminal box specification

Terminal box installation position, cable lead wire direction

The terminal box installation position of the motor and the cable lead wire direction can be selected in 90 degree pitches from the standard installation position and direction.
Specify at the time of ordering according to the diagram below.
(The terminal box installation position cannot be changed after shipment. Always specify at the time of ordering.)

Code		Terminal box mounting position (Seen from the side of the motor/output shaft side, keeping the motor horizontal)			
		N33	N34	N35	N36
Cable lead wire direction	N3A				
	N3B				
	N3C				
	N3D				

: Standard specification
↓ : Cable port

Dimensions of the terminal box installation position

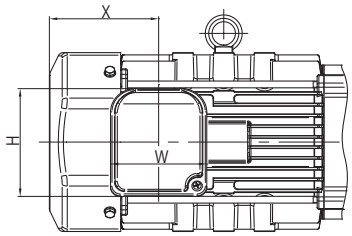


Table C17 List of dimensions of the terminal box installation position

Unit: mm

Motor (kW)	Premium-efficiency, 3-phase motor						Premium-efficiency, 3-phase motor for inverter					
	Indoor type without brake			Indoor type with brake			Indoor type without brake			Indoor type with brake		
4P	X	W	H	X	W	H	X	W	H	X	W	H
2.2	115	100	111	193	100	111	115	100	111	193	100	111
3.0	115	100	111	193	100	111	-	-	-	-	-	-
3.7	118	100	111	193	100	111	118	100	111	193	100	111
5.5	118	100	111	208	100	111	118	100	111	208	100	111
7.5	138	122	138	243	122	138	138	122	138	243	122	138
11	138	122	138	243	122	138	138	122	138	243	122	138

Motor fan cover

Details of motor fan cover installation

When designing the mounting space of the gear motor, consider the FA or FB dimensions of the following table.

(1) FA dimensions: Necessary dimensions in order to remove the fan cover or brake cover when attached to the device.

(2) FB dimensions: Minimum necessary space considering ventilation.

Notes: 1. When removing the fan or brake cover, the gearmotor must be removed from the device.
2. This is the minimum space with the back wall of the motor fan enclosed.

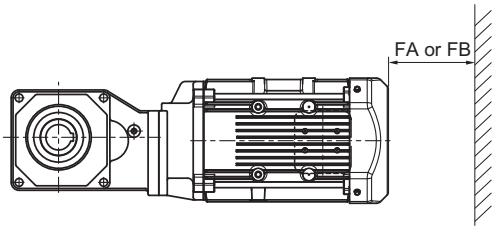


Table C18 FA and FB dimension list

Unit: mm

Motor (kW)	Premium-efficiency, 3-phase motor				Premium-efficiency, 3-phase motor for inverter			
	Indoor type without brake		Indoor type with brake		Indoor type without brake		Indoor type with brake	
4P	FA	FB	FA	FB	FA	FB	FA	FB
2.2	60	20	138	20	60	20	138	20
3.0	60	20	138	20	-	-	-	-
3.7	63	25	153	25	63	25	153	25
5.5	63	25	153	25	63	25	153	25
7.5	84	30	189	30	84	30	189	30
11	84	30	189	30	84	30	189	30

Motor brake specifications

Table C19 Electromagnetic brake specifications and applicable motors

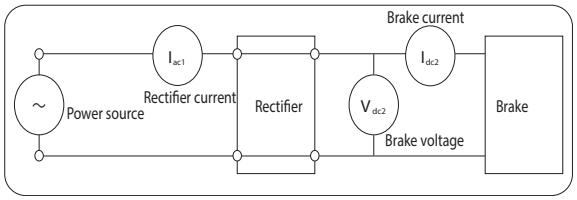
4-Pole motor

Brake type	Motor capacity		Brake Torque (Dynamic friction torque) (N·m)	Operating delay time when braking (s)			Allowable work volume E_0 (J/min)	Workload until gap modification (x 10^7J)	Total work volume E_1 (x 10^7J)	Gap		Construction drawing
	Premium efficiency, 3-phase motor (kW)	Premium efficiency, 3-phase motor for inverter (kW)		Normal braking circuit (Simultaneous turn-off circuit)	Normal braking circuit for inverter (Separate turn-off circuit)	Quick-braking circuit				Required value (original value) (mm)	Limit value (mm)	
FB-3E	2.2	2.2	22	0.75 - 0.95	0.4 - 0.5	0.02 - 0.04	5720	26.3	105.3	0.25 - 0.35	0.85	Figures C31 and C34
FB-4E	3.0	—	30	0.65 - 0.85	0.3 - 0.4							
FB-5E	3.7	3.7	40	1.1 - 1.3	0.4 - 0.5		6900	57.4	382.8	0.35 - 0.45	1.0	Figures C32 and C35
FB-8E	5.5	5.5	55	1.0 - 1.2	0.3 - 0.4							
FB-10E	7.5	7.5	80	1.8 - 2.0	0.6 - 0.7		10800	110.2	551.1		1.2	Figures C33 and C36
FB-15E	11	11	110	1.6 - 1.8	0.5 - 0.6							

- This table shows the case of a standard specification brake. The specification of the special specification brake may be different from this table.
- Please beware that the FB-E brake differs in operation delay time from brakes produced until now (FB-B, FB-B1, and FB-D brakes).
- Brake torque may not be at the prescribed level during initial operation due to the friction surface. In such a case turn the brake on and off under as light load as possible to contact the brake's friction surfaces.
- Use a quick-braking circuit to improve hoisting equipment and stopping precision.
- Use a quick braking circuit if you install a phase-advancing capacitor to a motor with brake which operates with 3-phase power source.
- Due to the brake structure, a rubbing sound of the lining may occur during motor operation, but there is no problem with the performance of the brake.
- Due to the brake structure, the noise from the brake may get bigger during inverter operation, but there is no problem with the performance of the brake.
- If the allowable work volume E_0 is exceeded, the brake may become unusable (braking defect). Upon referencing page B11, Table B5, confirm that the braking workload is equal to or less than the allowable workload E_0. (Also confirm it for emergency stopping.)

Table C20 Current value of the brake

Brake type	AC200V/50, 60Hz			AC220V/60Hz			AC400V/50, 60Hz			AC440V/60Hz		
	Brake voltage V_{dc2} (V)	Brake current I_{dc2} (A)	Rectifier current I_{ac1} (A)	Brake voltage V_{dc2} (V)	Brake current I_{dc2} (A)	Rectifier current I_{ac1} (A)	Brake voltage V_{dc2} (V)	Brake current I_{dc2} (A)	Rectifier current I_{ac1} (A)	Brake voltage V_{dc2} (V)	Brake current I_{dc2} (A)	Rectifier current I_{ac1} (A)
FB-3E	DC90	0.6	0.5	DC99	0.6	0.5	DC180	0.3	0.2	DC198	0.3	0.3
FB-4E												
FB-8E		0.9	0.7		1.0	0.8		0.5	0.4		0.5	0.4
FB-8E												
FB-10E		1.1	0.8		1.2	0.9		0.6	0.4		0.6	0.5
FB-15E												



Points to Note when Using a Quick Braking Circuit

When using brakes with quick braking circuits, take note of the following items.

- Connect a varistor (protection element) to protect the quick braking circuit contact points from surge voltage generated by the brake action.
- Wire the quick braking circuit contact points to the brake power source secondary side contacts. Contact points might not be protected.
- For information on using an alternating current (AC) electromagnetic contactor with contact points for quick braking circuits, see Table C21.

If multiple contact points are required, note the following issues.

- Connect electromagnetic contactor contact points in serial.
- Connect the varistor (VR) as close to the unit as possible.

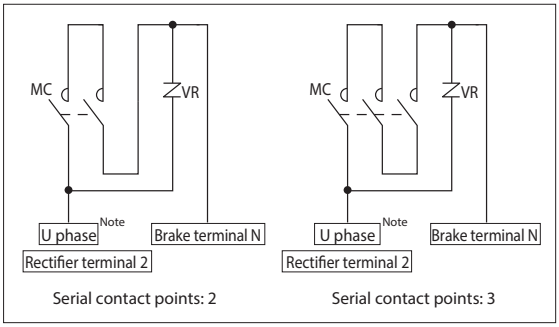
Table C21 Recommended part type when using a quick braking circuit (when using an AC electromagnetic contactor)

AC voltage	Brake type	Recommended contactor type				Recommended contactor contact point capacity (DC-13 class)		Recommended Varistor (For Protecting Contactor Contact Points)			
		Made by Fuji Electric FA Components & Systems Co., Ltd.		Made by Mitsubishi Electric Corporation				Varistor type	Maximum Allowable Circuit Voltage	Varistor voltage	Power rating
200V 220V	FB-3E	SC-05	Serial contact points: 2 (3.0A)	S-N11 or S-N12	Serial contact points: 2 (3.0A)	DC 110V	Minimum 1.5A	TND14V-471KB00AAA0	AC300V	470V (423–517V)	0.6W
	FB-4E										
	FB-5E	SC-05	Serial contact points: 3 (4.0A)	S-N18	Serial contact points: 3 (5.0A)		Minimum 3.0A				
	FB-8E										
	FB-10E	SC-5-1	Serial contact points: 3 (10A)	S-N20 or S-N21	Serial contact points: 3 (10A)		Minimum 5.5A	TND20V-471KB00AAA0			1.0W
	FB-15E										
400V 440V	FB-3E	SC-05	Serial contact points: 3 (2.0A)	S-N11 or S-N12	Serial contact points: 3 (2.0A)	DC 220V	Minimum 1.0A	TND20V-821KB00AAA0	AC510V	820V (738–902V)	1.0W
	FB-4E										
	FB-5E			S-N18	Serial contact points: 3 (2.0A)		Minimum 1.5A				
	FB-8E										
	FB-10E	-	-	S-N20 or S-N21	Serial contact points: 3 (4.0A)		Minimum 3.0A				
	FB-15E										

- The recommended contactor types are made by Fuji Electric Instrument Control Co., Ltd. and Mitsubishi Electric Corporation, or those by another company, as long as it has a similar capacity.
- A case in which the electrical opening and closing durability (lifetime) is 2 million times is shown as the recommended contactor contact point capacity.
- Among the recommended contactors, S-N11 made by Mitsubishi Electric Corporation has one auxiliary contact, and S-N18 has no auxiliary contact. This applies if, for inverter drive or other reasons, two or more auxiliary contact points are required. (The other contactors listed in Table C21 have two or more auxiliary contacts)

The recommended varistor type is made by Nippon Chemi-Con Corporation, or those by another company, as long as it has similar specifications.

Examples of Contact Point Connections with Quick-Braking Circuits



Note: For inverter drives, connect to the R phase.

Reason why the quick braking circuit shortens the braking time

The differences between a normal braking circuit (standard circuit) and a quick braking circuit are shown in Figures C26 and C27.
Figures C28 and C29 show the conditions of current decay in a normal braking circuit (standard circuit) and a quick braking circuit.

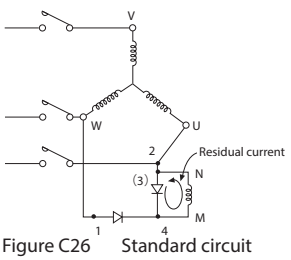


Figure C26 Standard circuit

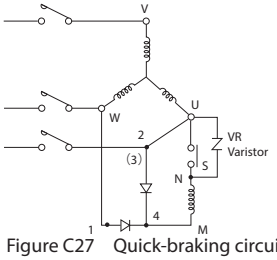


Figure C27 Quick-braking circuit

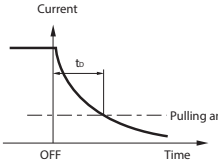


Figure C28 Current attenuation curve of a standard circuit

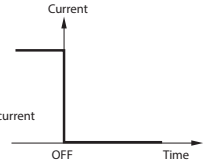
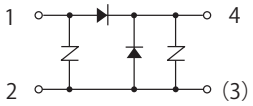


Figure C29 Current attenuation curve of a quick braking circuit

In the case of the standard circuit in Figure C26, since the brake coil is inductance L, residual current will flow even when the power set to OFF, due to the energy stored in L. The decay curve of this residual current is shown in Figure C28.
In the case of connection to the quick braking circuit in Figure C27, if S is opened when turning off the power, there will be no closed circuit for the brake coil, so the residual current will not flow, as shown in Figure C29.

Therefore, the braking time is shortened by t_D time, which realizes quick braking. In other words, the quick braking circuit is a circuit not to apply residual current by turning on and off the brake coil when turning on and off the power.
(Be sure to use the VR varistor to protect the rectifier and contact point S.)

Figure C30 (Reference) Rectifier internal circuit diagram



■ Calculation of the braking work volume and braking time

○ Braking work volume E_B (J , kgf·m)

The braking work volume by the brake varies greatly according to the speed of the motor and load conditions. The braking work volume can be calculated by the following formula

[SI unit system]

$$E_B = \frac{(J_L + J_M) \cdot N^2}{182} \times \frac{T_B}{T_B \pm T_R} \quad (J)$$

J_L : Total inertia moment other than the motor with brake [motor shaft conversion] (kg-m²)
J_M: Inertia moment of a motor with brake (kg-m²)
N : Motor speed at the time of braking (r/min)
T_B : Braking torque (N·m)
T_R : Resistance torque of the load (N·m)

[Gravity unit system]

$$E_B = \frac{(GD^2_L + GD^2_M) \cdot N^2}{7150} \times \frac{T_B}{T_B \pm T_R} \quad (kgf \cdot m)$$

GD^2_L: Total GD^2 other than the motor with brake [motor shaft conversion] (kgf·m²)
GD^2_M: GD^2 of a motor with brake (kgf·m²)
N : Motor speed at the time of braking (r/min)
T_B : Braking torque (kgf·m)
T_R : Resistance torque of the load (kgf·m)

T_R symbol +: If the load torque functions as brake when the power is turned off (+ load)
-: If the load torque does not function as brake when the power is turned off (- load)

Calculate the work volume per minute from the braking work volume E_B and number of times of braking per minute (supplementary) and confirm that it is below the allowable work volume E_0.
Also, if braking is applied by the brake after deceleration by the inverter, etc., consider the braking energy from high-speed rotation considering emergency stop due to outage, etc.

If the allowable work volume is exceeded, the brake may become unusable due to burn caused by abnormal heating of the brake friction surface, deformation and abnormal wear of the friction surface, reduction of the brake torque, damage of the lining, etc.

The allowable brake work volume is used for confirmation of temperature rise of the brake friction surface. Also consider the starting and stopping frequency of the gearmotor.
Supplementary information) If the braking frequency is once every several months to several hours, calculate the work volume assuming the frequency as once a minute.

○ Braking time t_B (s)

The stop time by the brake can be calculated with the following formula.

[SI unit system]

$$t_B = \frac{(J_L + J_M) \times N}{9.55 \times (T_B \pm T_R)} + t_D \quad (s)$$

J_L : Total inertia moment other than the motor with brake [motor shaft conversion] (kg-m²)
J_M: Inertia moment of a motor with brake (kg-m²)
N : Motor speed at the time of braking (r/min)
T_B : Braking torque (N·m)
T_R : Resistance torque of the load (N·m)
t_D : Operating delay time (s)

[Gravity unit system]

$$t_B = \frac{(GD^2_L + GD^2_M) \times N}{375 \times (T_B \pm T_R)} + t_D \quad (s)$$

GD^2_L: Total GD^2 other than the motor with brake [motor shaft conversion] (kgf·m²)
GD^2_M: GD^2 of a motor with brake (kgf·m²)
N : Motor speed at the time of braking (r/min)
T_B : Braking torque (kgf·m)
T_R : Resistance torque of the load (kgf·m)
t_D : Operating delay time (s)

Note) Symbol of TR +: If the load torque functions as brake (+ load) when turning the power OFF
-: If the load torque does not function as brake when the power is turned off (- load)

○ Lining life Z_L (number of times)

The lining of the brake wears while using it. The wear of the lining varies greatly according to the surface pressure, sliding speed, ambient conditions, temperature, etc. so it is difficult to calculate the life correctly, but an approximate life can be calculated by the following formula:

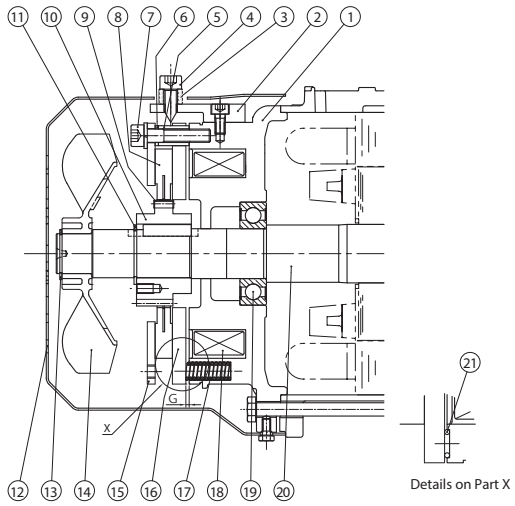
$$Z_L = \frac{E_t}{E_B} \text{(times)}$$

E_t: Total work volume (J)

Motor brake

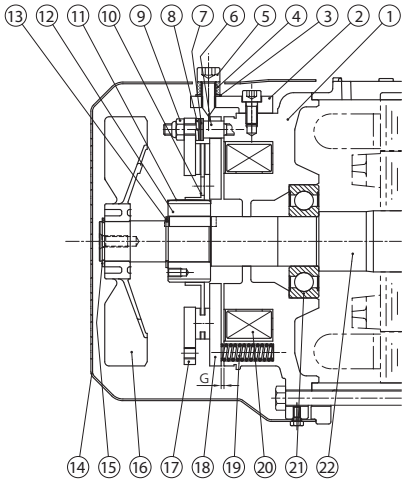
Motor brake structure

Figure C31 FB-3E, 4E (Indoor type)



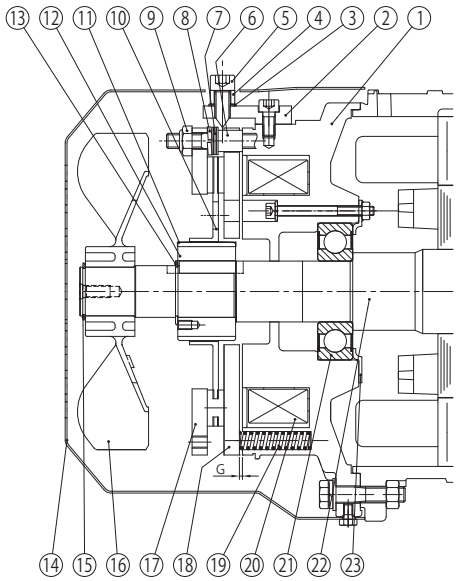
Part number (PN)	Part Name
1	Stationary core
2	Brake release
3	Manual release prevention spacer
4	Brake release bolt
5	Spacer
6	Gap adjusting shims
7	Attachment bolt
8	Brake Lining
9	Leaf spring
10	Boss
11	Shaft-retaining C-ring
12	Cover
13	Shaft-retaining C-ring
14	Fan
15	Fixed plate
16	Armature plate
17	Spring
18	Electromagnetic coil
19	Ball bearings
20	Motor shaft
21	Shock absorber

Figure C32 FB-5E, 8E (Indoor type)



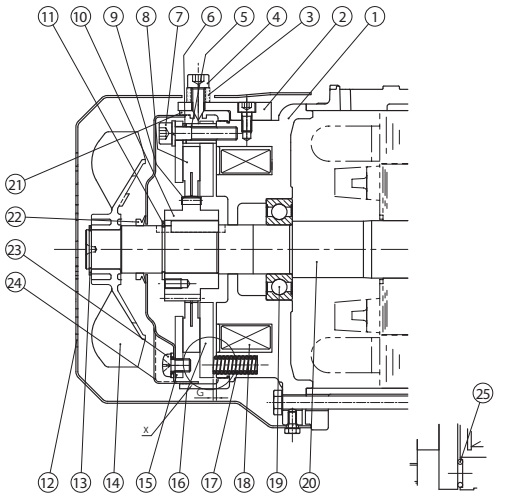
Part number (PN)	Part Name
1	Stationary core
2	Brake release
3	Seal washer
4	Manual release prevention spacer
5	Brake release bolt
6	Stud bolt
7	Adjusting washer
8	Spring washer
9	Gap adjusting nut
10	Brake Lining
11	Leaf spring
12	Boss
13	Shaft-retaining C-ring
14	Cover
15	Shaft-retaining C-ring
16	Fan
17	Fixed plate
18	Armature plate
19	Spring
20	Electromagnetic coil
21	Ball bearings
22	Motor shaft

Figure C33 FB-10E, 15E (Indoor type)



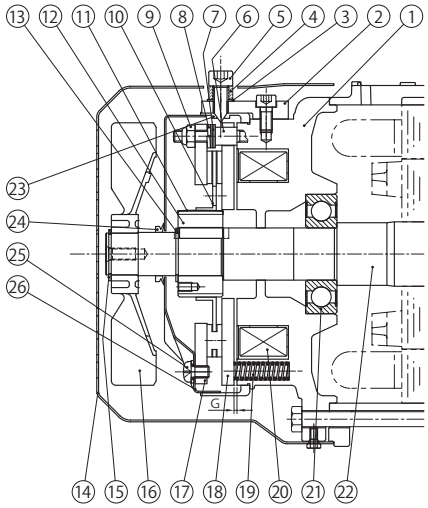
Part number (PN)	Part Name
1	Stationary core
2	Brake release
3	Seal washer
4	Manual release prevention spacer
5	Brake release bolt
6	Stud bolt
7	Adjusting washer
8	Spring washer
9	Gap adjusting shims
10	Brake Lining
11	Leaf spring
12	Boss
13	Shaft-retaining C-ring
14	Cover
15	Shaft-retaining C-ring
16	Fan
17	Fixed plate
18	Armature plate
19	Spring
20	Electromagnetic coil
21	Ball bearings
22	Motor shaft
23	Bearing cover

Figure C34 FB-3E, 4E (Outdoor type)



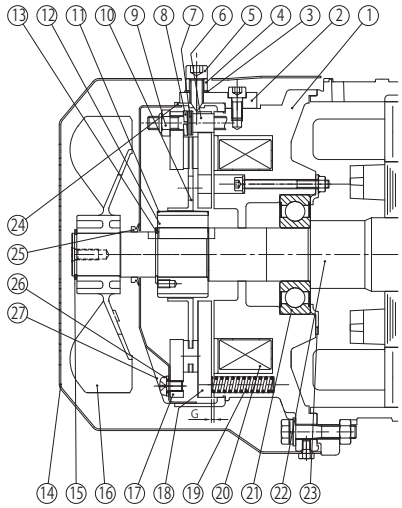
Part number (PN)	Parts Name
1	Stationary core
2	Brake release
3	Manual release prevention spacer
4	Brake release bolt
5	Spacer
6	Gap adjusting shims
7	Attachment bolt
8	Brake Lining
9	Leaf spring
10	Boss
11	Shaft-retaining C-ring
12	Cover
13	Shaft-retaining C-ring
14	Fan
15	Fixed plate
16	Armature plate
17	Spring
18	Electromagnetic coil
19	Ball bearings
20	Motor shaft
21	Waterproof seal
22	V-ring
23	Waterproof cover attachment bolts
24	Waterproof cover
25	Shock absorber

Figure C35 FB-5E, 8E (Outdoor type)



Part number (PN)	Parts Name
1	Stationary core
2	Brake release
3	Seal washer
4	Manual release prevention spacer
5	Brake release bolt
6	Stud bolt
7	Adjusting washer
8	Spring washer
9	Gap adjusting nut
10	Brake Lining
11	Leaf spring
12	Boss
13	Shaft-retaining C-ring
14	Cover
15	Shaft-retaining C-ring
16	Fan
17	Fixed plate
18	Armature plate
19	Spring
20	Electromagnetic coil
21	Ball bearings
22	Motor shaft
23	Waterproof seal
24	V-ring
25	Waterproof cover attachment bolts
26	Waterproof cover

Figure C36 FB-10E, 15E (Outdoor type)



Part number (PN)	Part Name
1	Stationary core
2	Brake release
3	Seal washer
4	Manual release prevention spacer
5	Brake release bolt
6	Stud bolt
7	Adjusting washer
8	Spring washer
9	Gap adjusting nut
10	Brake Lining
11	Leaf spring
12	Boss
13	Shaft-retaining C-ring
14	Cover
15	Shaft-retaining C-ring
16	Fan
17	Fixed plate
18	Armature plate
19	Spring
20	Electromagnetic coil
21	Ball bearings
22	Motor shaft
23	Bearing cover
24	Waterproof seal
25	V-ring
26	Waterproof cover attachment bolts
27	Waterproof cover

Motor brake

Brake release device

To release the brake manually without turning the power on, operate the brake release device as follows.

Release bolt method

(1) First remove the brake release bolts from the 2 opposing angles and remove the release prevention spacers. Reinsert the bolts and rotate with a hexagonal wrench to release the brake. Be careful not to over rotate the brake release bolts. (Rotate the brake release bolts while checking to see if the brake is released. (See Figures C37 and C38)

(2) When returning the brake to its original state after releasing it, for safety's sake return the manual release prevention spacers that were removed in (1) to their original positions. (See Figure C38)

(3) The size of the brake release bolt is as follows.

Brake type	Bolt size
FB-3E, 4E	M8
FB-5E, 8E, 10E, 15E	M10

Note: Indoor types do not come with waterproof seals or waterproof covers.

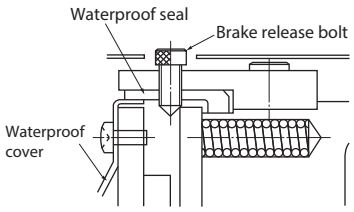


Figure C37

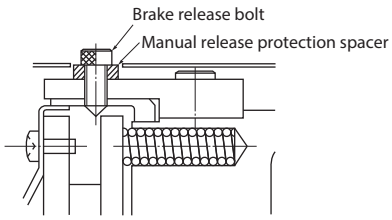


Figure C38

One touch release lever method (optional)

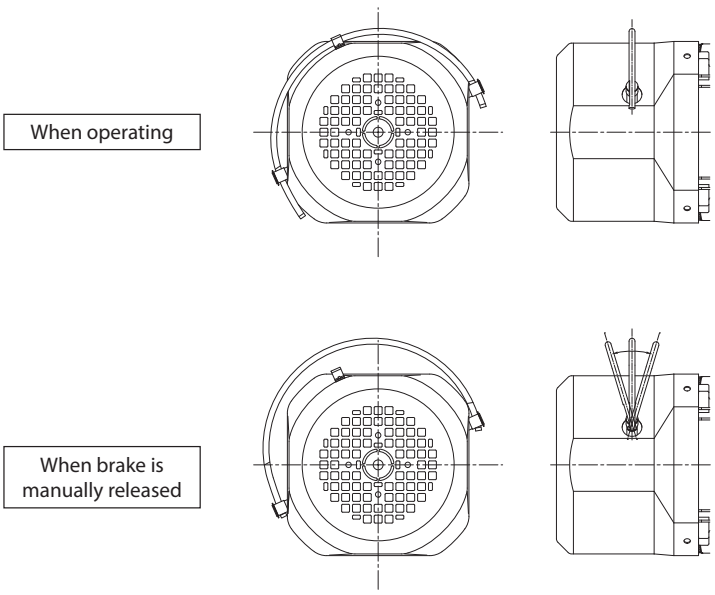
An optional brake releasing device can be installed for use with a one touch release lever method.
This cannot be installed after shipment.Be sure to specify it at the time of order.

(1) Pull up the release leverfrom the holder and push it toward the load side or the anti-load side to release the brake. (Some specifications do not allow pushing the release lever toward the load side.)

(2) Make sure not to push the release lever too far. Pushing the lever too far could damage the brake. (Push the release lever while checking to see if the brake is released.)

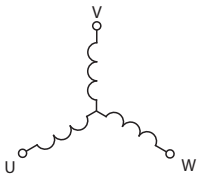
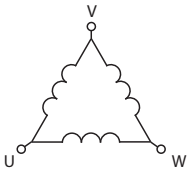
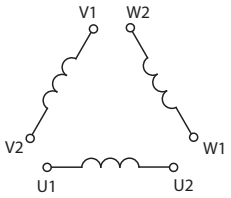
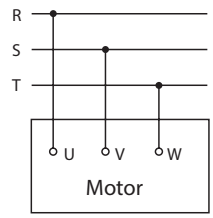
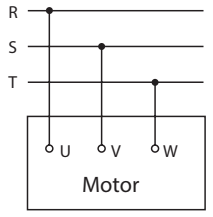
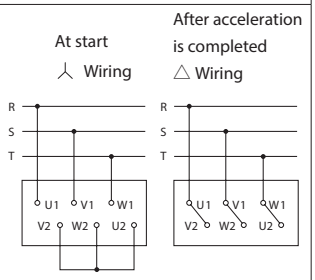
(3) When the motor is operating, always return the release lever to its original position, and set it to the holder.Check if the brake is reliably functioning before starting operation.

Note) The brake will be released while the lever is being pushed, but will be applied again when the lever is not being pushed.



Motor Wiring

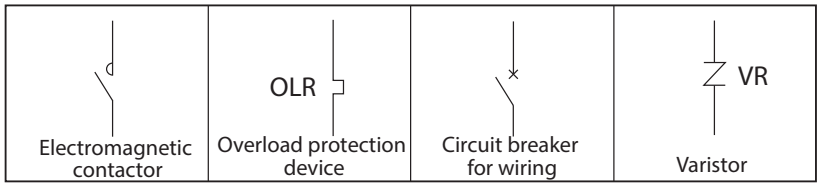
Motor type		Capacity	Wiring
Premium-efficiency, 3-phase motor	4P	2.2 to 3.7kW 5.5 to 11kW	⅄Wiring ⅄-Δ wiring
Premium-efficiency, 3-phase motor for inverter	4P	2.2 to 3.7kW 5.5 to 11kW	⅄Wiring Δ-wiring (⅄-Δ wiring)

	⅄Wiring	Δ wiring	⅄-Δ wiring
Winding			
Wiring diagram			

Note) 1. For details, see C34 to C41.
2. This figure is for motors with standard Japanese domestic specifications. Please consult with us for motors with overseas specifications.

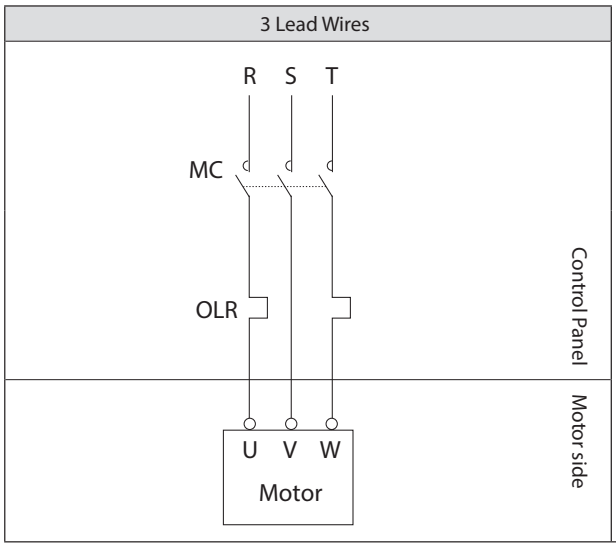
Wiring

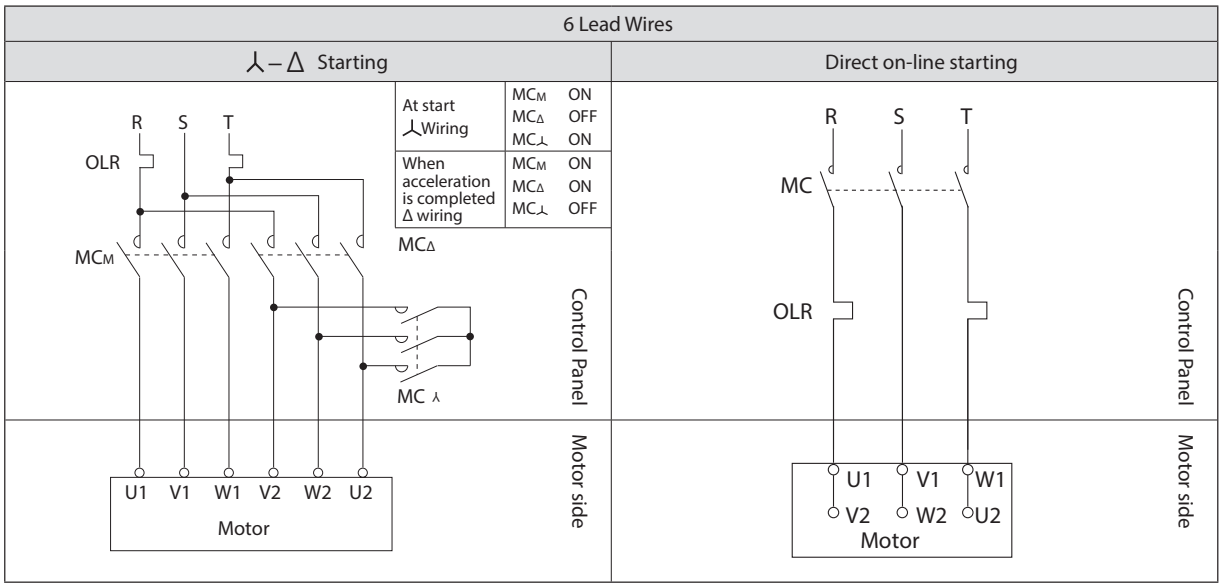
About wiring diagram symbols



Without brake. 3-phase power source

Premium-efficiency, 3-phase motor



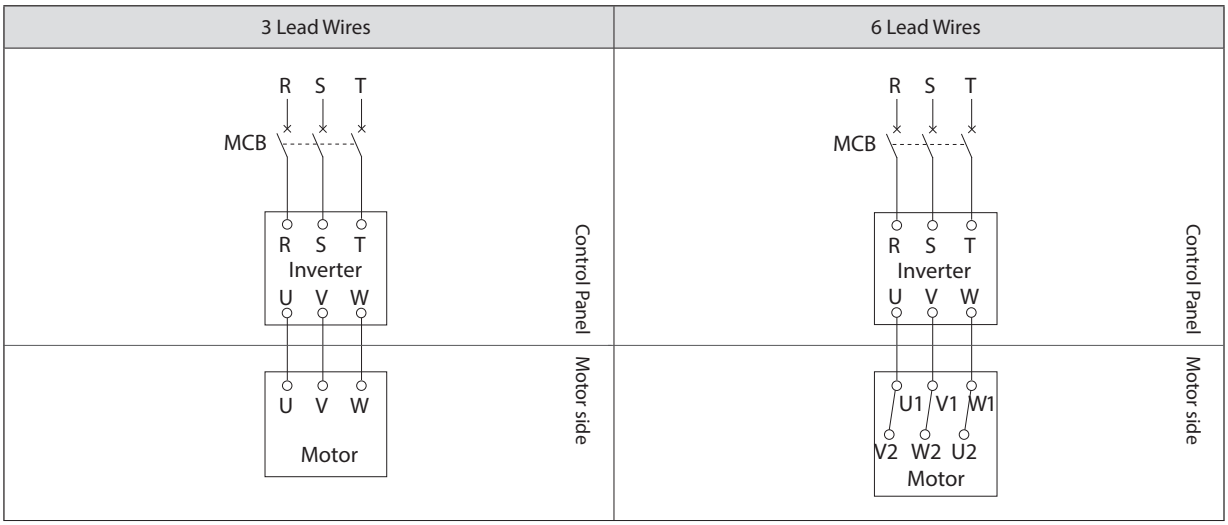


MC: Electromagnetic contactor
OLR: Overload protection device or electronic thermal relay
— Customer to prepare.

- This diagram shows motors with standard Japanese domestic specifications. Please consult with us for motors with overseas specifications.

Without brake. Inverter drive

Premium-efficiency, 3-phase motor
Premium-efficiency, 3-phase motor for inverter



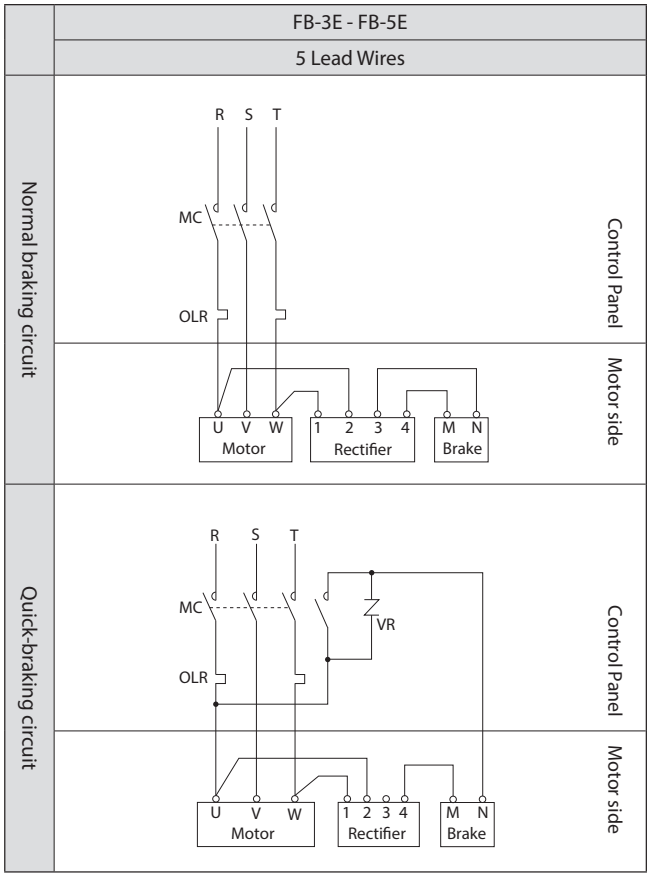
MCB: Circuit breaker for wiring –– To be prepared by the user.

- This diagram shows motors with standard Japanese domestic specifications. Please consult with us for motors with overseas specifications.

Wiring

With brake. 3-phase power source. Operates rotating in one direction.

Premium-efficiency, 3-phase motor

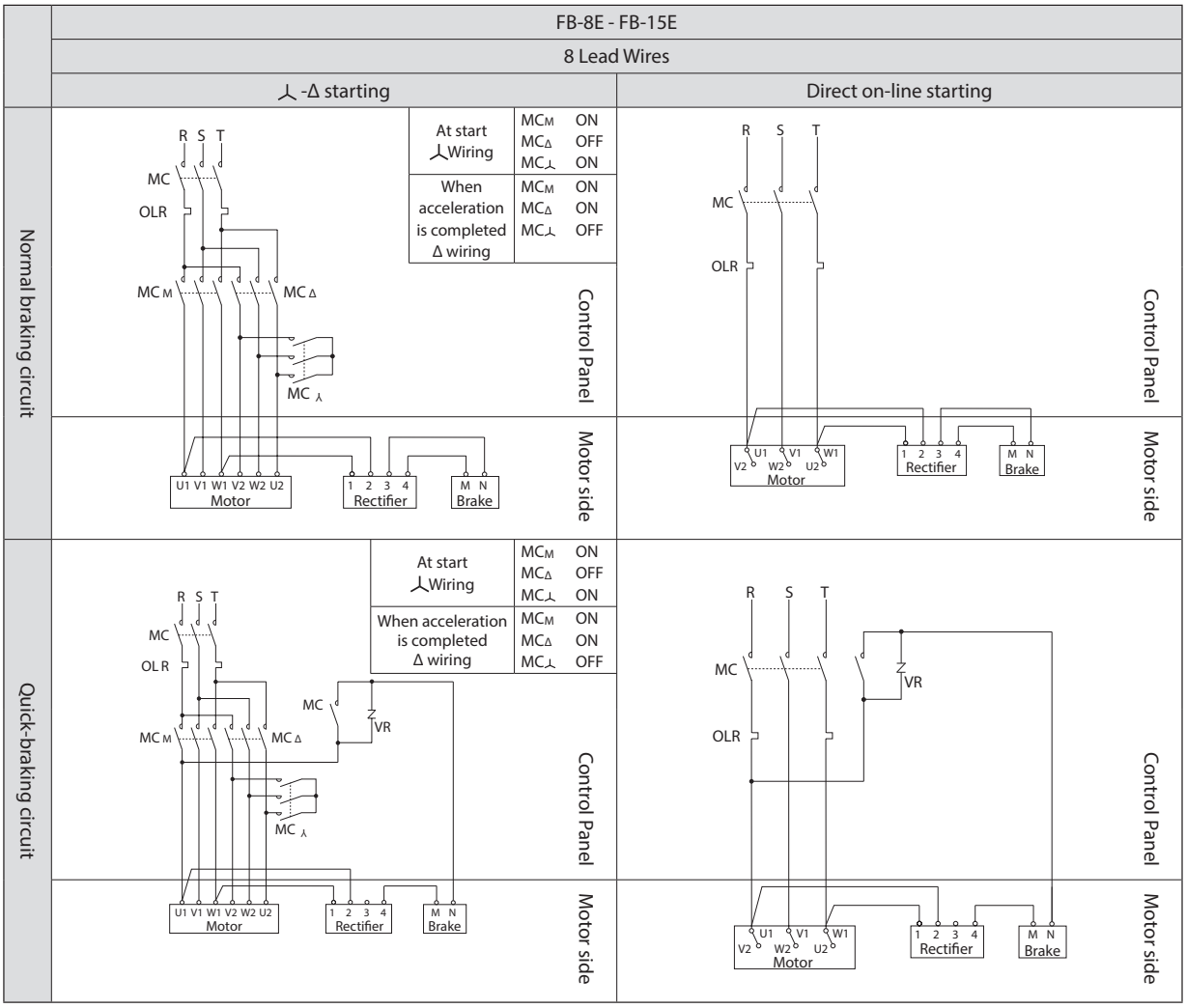


MC: Electromagnetic contactor
OLR: Overload protection device or electronic thermal relay
VR: Varistor (for protecting contact points, rectifier, etc.)
— Customer to prepare.

- This diagram shows motors with standard Japanese domestic specifications. Please consult with us for motors with overseas specifications.
- For brake types, see page C27, Table C17.
- Brake action delay time is different between normal and quick-braking circuits.
  Table C17 on page C27 shows the action delay period. Choose the circuit that matches the work requirements.
- Use a quick-braking circuit to improve hoisting equipment and stopping precision.
- Use a quick braking circuit if attaching a phase-advancing capacitor.
- For information on electromagnetic contactors and varistors for quick braking circuits, see Table C19 on page C28.
- For quick braking circuits, interlock the electromagnetic contactor of the brake circuit with the electromagnetic contactor of the motor.

With brake. 3-phase power source. Operates rotating in one direction.

Premium-efficiency, 3-phase motor



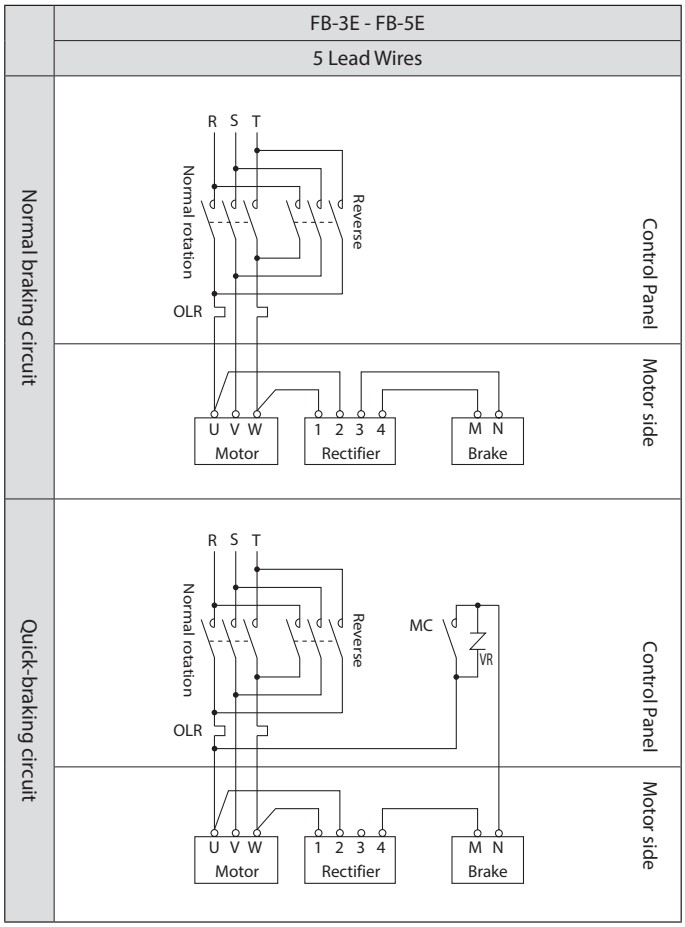
MC: Electromagnetic contactor
OLR: Overload protection device or electronic thermal relay
VR: Varistor (for protecting contact points, rectifier, etc.)
— Customer to prepare.

- This diagram shows motors with standard Japanese domestic specifications. Please consult with us for motors with overseas specifications.
- For brake types, see page C27, Table C17.
- Brake action delay time is different between normal and quick-braking circuits.
  Table C17 on page C27 shows the action delay period. Choose the circuit that matches the work requirements.
- Use a quick-braking circuit to improve hoisting equipment and stopping precision.
- Use a quick braking circuit if attaching a phase-advancing capacitor.
- For information on electromagnetic contactors and varistors for quick braking circuits, see Table C19 on page C28.
- For quick braking circuits, interlock the electromagnetic contactor of the brake circuit with the electromagnetic contactor of the motor.

Wiring

With brake. 3-phase power source. Plugging operation

Premium-efficiency, 3-phase motor



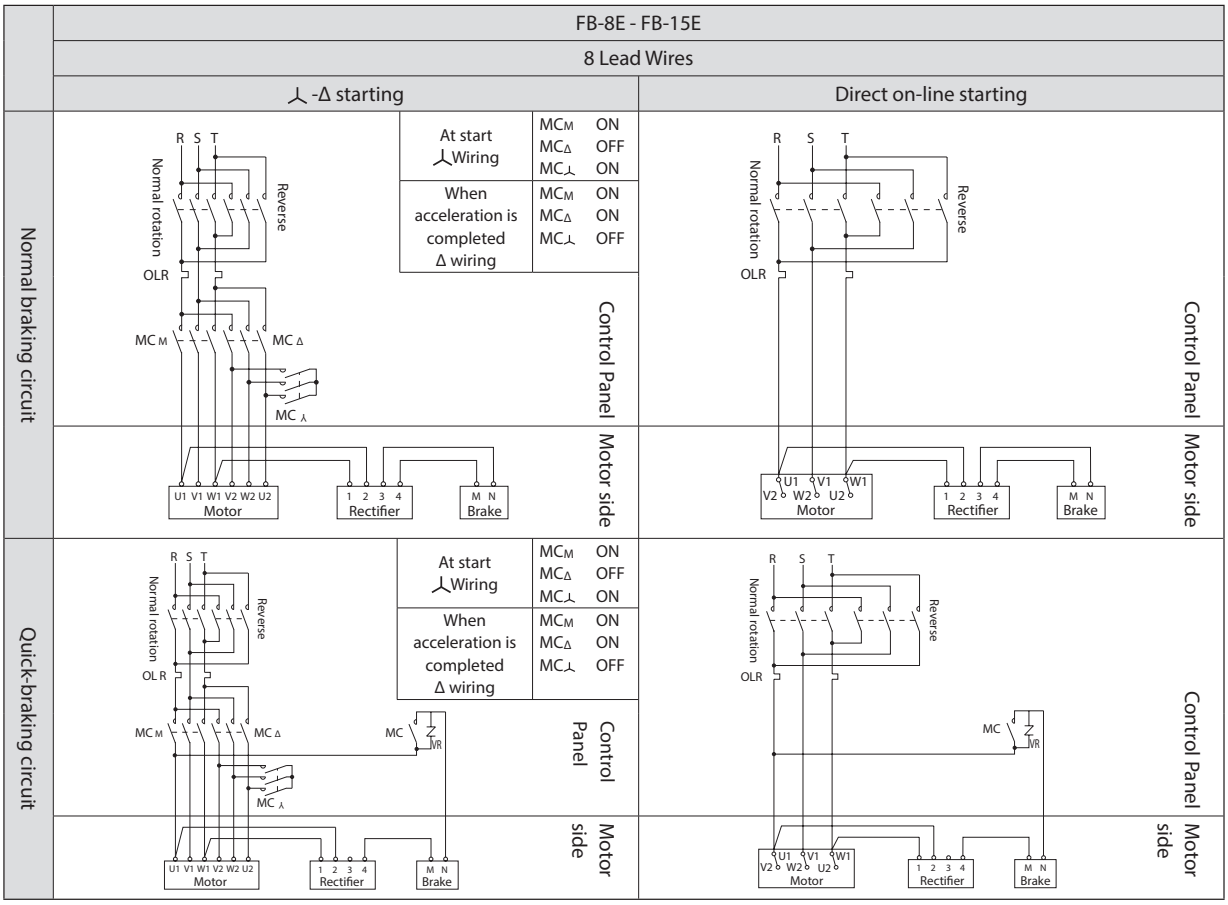
Electromagnetic contactor for normal and reverse rotation
MC: Electromagnetic contactor
OLR: Overload protection device or electronic thermal relay
VR: Varistor (for protecting contact points, rectifier, etc.)

— Customer to prepare.

- This diagram shows motors with standard Japanese domestic specifications. Please consult with us for motors with overseas specifications.
- For brake types, see page C27, Table C17.
- Brake action delay time is different between normal and quick-braking circuits.
  Table C17 on page C27 shows the action delay period. Choose the circuit that matches the work requirements.
- Use a quick-braking circuit to improve hoisting equipment and stopping precision.
- Use a quick braking circuit if attaching a phase-advancing capacitor.
- For information on electromagnetic contactors and varistors for quick braking circuits, see Table C19 on page C28.
- For plugging operations using a quick-braking circuit, gang the brake circuit's electromagnetic contactors to the motor's normal and reverse rotation electromagnetic contactors.

With brake. 3-phase power source. Both-direction operation

Premium-efficiency, 3-phase motor



Electromagnetic contactor for normal and reverse rotation
MC: Electromagnetic contactor
OLR: Overload protection device or electronic thermal relay
VR: Varistor (for protecting contact points, rectifier, etc.)

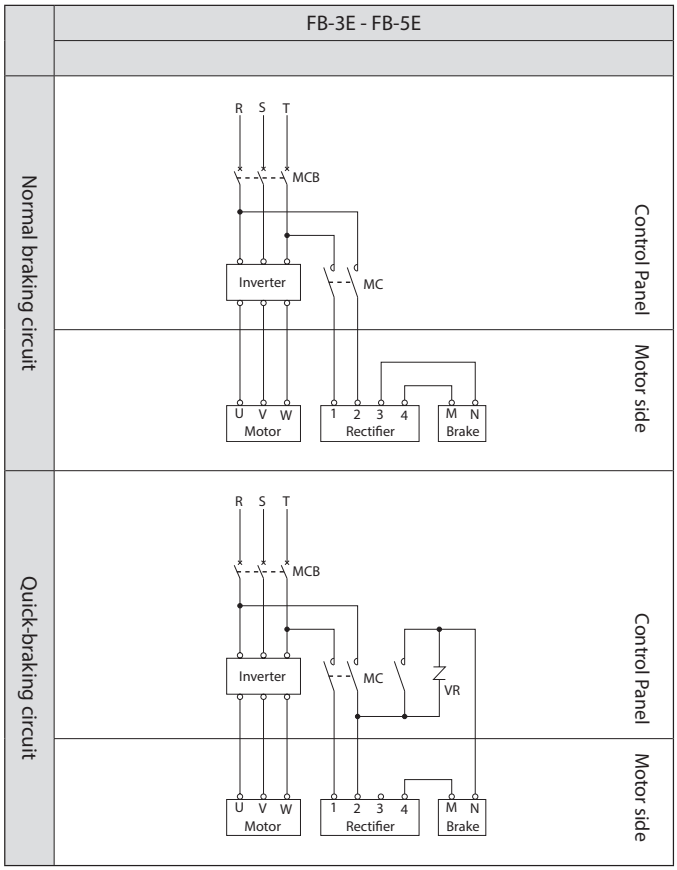
— Customer to prepare.

- This diagram shows motors with standard Japanese domestic specifications. Please consult with us for motors with overseas specifications.
- For brake types, see page C27, Table C17.
- Brake action delay time is different between normal and quick-braking circuits.
  Table C17 on page C27 shows the action delay period. Choose the circuit that matches the work requirements.
- Use a quick-braking circuit to improve hoisting equipment and stopping precision.
- Use a quick braking circuit if attaching a phase-advancing capacitor.
- For information on electromagnetic contactors and varistors for quick braking circuits, see Table C19 on page C28.
- For plugging operations using a quick-braking circuit, gang the brake circuit's electromagnetic contactors to the motor's normal and reverse rotation electromagnetic contactors.

Wiring

With Brake. Inverter Drive

Premium-efficiency, 3-phase motor
Premium-efficiency, 3-phase motor for inverter



MC: Electromagnetic contactor
MCB: Breaker for wiring
VR: Varistor (for protecting contact points, rectifier, etc.)

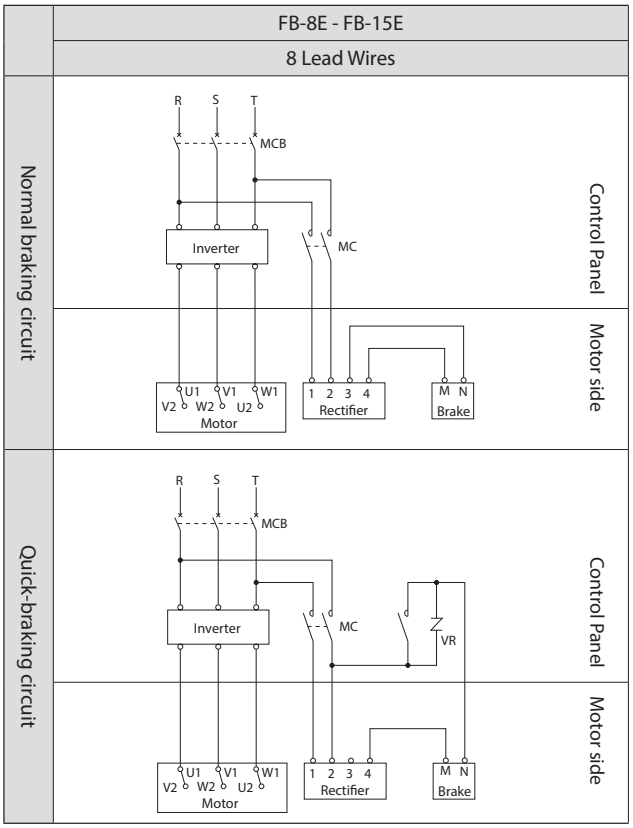
Customer to prepare.

- This diagram shows motors with standard Japanese domestic specifications. Please consult with us for motors with overseas specifications.
- For brake types, see page C27, Table C17.
- Brake action delay time is different between normal and quick-braking circuits.
  Table C17 on page C27 shows the action delay period. Choose the circuit that matches the work requirements.
- Use a quick-braking circuit to improve hoisting equipment and stopping precision.
- Use a quick braking circuit if attaching a phase-advancing capacitor.
- For information on electromagnetic contactors and varistors for quick braking circuits, see Table C19 on page C28.

- Always use the inverter's power source side for the brake power source.
- Sync the timing of the opening and closing of the electromagnetic contactor of the brake circuit with the controlling of the inverter.

With Brake. Inverter Drive

Premium-efficiency, 3-phase motor
Premium-efficiency, 3-phase motor for inverter



MC: Electromagnetic contactor
MCB: Breaker for wiring
VR: Varistor (for protecting contact points, rectifier, etc.)

} Customer to prepare.

- This diagram shows motors with standard Japanese domestic specifications. Please consult with us for motors with overseas specifications.
- For brake types, see page C27, Table C17.
- Brake action delay time is different between normal and quick-braking circuits.
  Table C17 on page C27 shows the action delay period. Choose the circuit that matches the work requirements.
- Use a quick-braking circuit to improve hoisting equipment and stopping precision.
- Use a quick braking circuit if attaching a phase-advancing capacitor.
- For information on electromagnetic contactors and varistors for quick braking circuits, see Table C19 on page C28.

- Always use the inverter's power source side for the brake power source.
- Sync the timing of the opening and closing of the electromagnetic contactor of the brake circuit with the controlling of the inverter.

Protection type and cooling type

First symbol - Protection type for human body and solid foreign materials
Second symbol - Classified by the combination of the protection type for water ingress. } (JIS C 4034)

Protection type of the electric machine and our support

First symbol / First type name — Second symbol / Second type name	0 Non-protection type	2 Drip proof type	3 Rainproof type	4 Splash proof type	5 Water-jet resistant type	6 Waveproof type	7 Watertight type	8 Submersible type
0 (Non-protection type)	IP00			×	×	×	×	
1 (Semi protection type)	IP10	IP12S			×	×	×	
2 (Protection type)	IP20	IP22S	IP23S	IP24	×	×	×	
4 (Totally enclosed)	×			IP44	IP45			
5 (Dust-proof type)	×			IP54	IP55	IP56		
6 (Complete dust-proof type)	×				IP65			

Note) 1. * indicates what is difficult to combine.
2. ☐ indicates the standard manufacturing range of Sumitomo.
3. In the case of direct exposure to strong wind and rain and frequent exposure to water, it may be necessary to consider the protection method, so please consult us.
4. The protection type on the standard motor, for both indoor and outdoor, is IP44. However, the structures differ between the indoor type and outdoor type, so please specify the outdoor type when installing outdoors.

Grade of the first symbol

Nomenclature	Symbol	Description
Non-protection type	0	Structure without special protection against contact with human body and intrusion of solid foreign materials.
Semi protection type	1	Structure to prevent large parts of human body such as hand from touching the rotation part or conductive part of the machine by mistake. Structure to prevent intrusion of solid foreign materials whose diameters exceeds 50mm.
Protection type	2	Structure to prevent fingers, etc. from touching the rotation part or conductive part of the machine. Structure to prevent intrusion of solid foreign materials over 12mm.
Totally enclosed	4	Structure to prevent objects whose minimum width or minimum depth is larger than 1mm such as tools and electric cables from touching the rotation part or conductive part of the machine. Structure to prevent intrusion of solid foreign materials over 1mm. However, the structures of drainage wells and inlets and outlets of the external fan can be that of symbol 2.
Dust-proof type	5	Structure to prevent any objects from touching the rotation part or conductive part of the machine. Structure to prevent intrusion of dust as mush as possible and prevent it from hindering the normal operation even in the event of intrusion.
Complete dust-proof type	6	Structure to prevent dust from intruding inside.

Grade of the second symbol

Nomenclature	Symbol	Description
Non-protection type	0	Structure without special protection against water ingress.
Drip proof type	2	Structure to prevent harmful effect of water droplets dropping at an angle from vertical to 15°.
Rainproof type	3	Structure to prevent harmful effect of water droplets dropping at an angle from vertical to 60°.
Splash proof type	4	Structure to prevent harmful influence of water droplets in any directions.
Water-jet resistant type	5	Structure to prevent harmful influence of jet in any directions.
Waveproof type	6	Structure to prevent harmful influence of strong jet in any directions.
Watertight type	7	Structure to prevent harmful effect even in the event of submersion in water at the specified water depth for the specified time and water ingress.
Submersible type	8	Structure to enable normal operation in water.

Example) IP☐ 54☐
W / E / C
SM
Protection type for water ingress: Splash proof type
Protection type for human body and solid foreign materials: Dust-proof
IEC - Abbreviation of the standard

S - If the protection type test for water ingress is performed while the motor is stopped.
M - Case that the protection type for water ingress is tested while the motor is in operation.
Without S or M indication - Conduct the test while the motor is stopped and in operation.
W - Outdoor type (used only for the outdoor open type)
E - Explosion proof
C - Protection type for other harmful air

Cooling Type

Enclosure	JIS standard	IEC standard
Totally enclosed, naturally air-cooling type (TENV)	IC410	IC410
Totally enclosed fan cooled type (TEFC)	IC411	IC411
Totally enclosed ventilated type (TEAO)	IC416	IC416

Coating

In addition to the standard specification, the coating can be changed to those shown in Table C22, depending on the application.

Table C22 Coating specification

Degree of surface preparation	Paint type		Number of days of paint	Painting specification			Weatherproof	Submersible water resistance	Oil resistance	Acid resistance	Alkaline resistance	Thermal stability ℃	Use
	Classification	Paint type		Paint	Frequency total thickness (Total μm)	General name							
Casting... Scraping Class 1 Steel plate/ Aluminum Scraping Class 2	Standard paint	Phthalic acid type	0	Undercoat	1 Note) 7 (0 to 40)	Modified epoxy resin	○	×	△	○	×	100	Standard applications
				Topcoat	1 (15 to 30)	Acrylic alkyd resin							
	Export standard paint	Phthalic acid type	2	Undercoat	2 (30 to 60)	Modified epoxy resin	○	×	△	○	×	100	Mainly for export
				Topcoat	1 (15 to 30)	Acrylic alkyd resin							
	Rustproof paint	Polyurethane	6	Undercoat	1 (20 to 40)	Modified epoxy resin	◎	△	○	○	○	100	Moderately corrosive environment Location in which there is steam
				Topcoat	2 (30 to 60)	Polyisocyanate-based urethane resin paint							
		Phenol	7	Undercoat	2 (40 to 70)	Rust preventive paint	○	×	△	○	○	100	Moderately corrosive environment Factories in which acid is used
				Topcoat	2 (30 to 60)	Phenol resin enamel							
	Heavy rustproof paint	Epoxy type	10	Undercoat	1 (50 to 60)	Special penetrating epoxy aluminum paint	* ○	◎	◎	◎	◎	150	Severely corrosive environment Factories in which acid is used
				Topcoat	3 (30 to 90)	Polyamide type epoxy resin							
		Polyurethane	10	Undercoat	1 (50 to 60)	Special penetrating epoxy aluminum paint	◎	◎	◎	◎	◎	150	Severely corrosive environment Location that is splashed with water Shore installation and shipboard installation Factories in which acid is used
				Topcoat	3 (45 to 90)	Polyisocyanate-based urethane resin paint							
Sandblast must be assigned.	Heavy rustproof paint	Thick epoxy type	16		5 (250 to 350)	Thick film type modified epoxy paint	◎	◎	◎	◎	◎	150	Submersible equipment Ocean structure

Note) 1. The number of paint days indicates the number of extra days for special paint compared with the standard paint.
2. In the case of a special paint color, the pain specification may be changed.
3. Note that those with * symbol may be discolored due to sun's rays.
4. About thermal stability: Needs to be considered if the above table is exceeded depending on the ambient temperature. (The heat resistance temperature shown in the above table is that with coating only and not that of the drive.)
5. Please consult us in the case of the operating conditions to repeat normal temperature and low temperature in short time.
6. Thick film epoxy, heavy duty anti-corrosion paint is limited in paint color. N1.0 and 7.5GY6/2 are fine, but please consult us for other paint colors. (Note that our standard paint color Danube Blue cannot be used for paint.)
7. Undercoat of the standard paint is omitted in some parts.
8. If you want long oil length phthalate ester type, specify an equivalent phenol type.
9. The types of paint are classified based on the type of topcoat paint type and we uniquely set undercoat and intermediate coat. There are customers that standardize different combinations using the same paint system name; these cases are handled as special paint.

Surface preparation is described in Table C23.

Table C23 Surface preparation

Degree of treatment	State of the treated surface	Treatment method	Reference standard	
			SSPC	SIS
Scraping Class 1	Surface with all mill scale, rust, corrosive substances, dirt, and other foreign substances. However, strong residual matters (mill scale, rust, minor stains of oxides, and discoloration) are not subject but at least 95% of the surface area has no clear residual matters and only minor discoloration, residual stain, etc. remain as shown above in the rest of the area.	Near White Blast Cleaning ○ Shot blast ○ Sandblast, etc.	SP-10	Sa-2 1/2
Scraping Class 2	Surface with mill scale and rust which do not adhere, corrosive substances, fat and oil, dirt, and other foreign substances retaining mill scale which does not adhere completely. However, strong residual matters (mill scale, rust, minor stains of oxides, and discoloration) are not subject but if there is pitting on the surface, residual matters of rust and coating will remain on the bottom. However, at least 2/3 of the surface area has no clear residual matters and only minor discoloration and residual stain remain as shown above in the rest of the area.	Commercial Blast Cleaning Power Tool Cleaning ○ Disk sander ○ Wire wheel ○ Grinder, etc.	SP-6 (SP-3)	Sa-2 (St-3)
Scraping Class 3	Remove the floating scale, rust, old coating, fat and oil, dirt, and other foreign matters with a wire brush, scraper, etc. The surface has a little metallic luster.	Hand Tool Cleaning ○ Wire brush ○ Scraper, etc.	SP-2	St-2

<Reference standard> SSPC Standard (U.S.A Steel Structual Painting Councils) SIS Standard (SWEDEN, SVENSK Standard, S.I.S 055900)

Paint and rust prevention

Paint color

The paint color of the standard specification is Donau Blue (Munsell 6.5PB 3.6/8.2).
The paint color can be changed according to your device design, so please consult us.

Rust prevention

Rust prevention measures are taken for complete products we assemble before shipment according to the following standards.

Standard rust prevention specifications

External rust prevention

- At the time of shipment from the factory, rust prevention oil is applied and shipped. After shipment, check the rust prevention status—whether rust is developing on the machined surface—every 6 months. Carry out rust prevention measures, such as re-application of rust prevention oil, as necessary.

Internal rust prevention

Lubrication	Grease Lubricated Machines
Rust prevention period	One year
Storage conditions	Store in an ordinary factory or warehouse in an environment free of moisture, dust, extreme temperature changes, corrosive gases, etc.

Special rust prevention specification (optional)

- For export goods, or when the storage period is one year or longer, the special rust prevention specification is necessary. Please consult us for details.

Warranty standard

Period	The warranty period applies only to new products and represents 18 months after the shipment or 12 months after the actual operation, whichever is shorter.
Description	If the product failed within the warranty period, during which despite a proper mounting, connection and maintenance & administration are followed according to the maintenance manual, and the product is properly run based on the specification on the catalog or under conditions agreed separately, we will repair or provide an alternative product at our discretion for free of charge, except the exclusions below. However, as far as the product is connected with customers' other devices, we will not indemnify those expenses on dismounting from/mounting on the devices, etc. and other associated construction expenses, transportation expenses and opportunity loss and operation loss the customers suffered from, and other indirect damages.
Exclusion from the warranty	The following items will be excluded from the warranty: 1. Breakdown caused by faulty mounting of the product, or faulty connection with other devices. 2. Breakdown due to insufficient maintenance management, or appropriate handling not being carried out. For example, if the product is not stored according to the procedures set forth in the storage instructions prescribed by our company. 3. Breakdown caused by operational and usage conditions that our company could not have known, such as operations that deviate from the specifications; or failure due to the use of a lubricating oil other than recommended by our company. 4. Breakdown caused by defects in devices that have been connected by the customer; or breakdown due to special specifications. 5. Breakdown caused by making modifications or structural changes to the product. 6. Breakdown arising from a defect in a part supplied or specified by the user. 7. Breakdown caused by an earthquake, fire, flood damage, salt damage, gas damage, lightning strike, or other force majeure. 8. Warranty related to expendable parts when the expendable parts such as bearings and oil seals are naturally consumed, worn down, or deteriorated, even with proper usage. 9. Breakdown due to a reason not attributable to the responsibility of our company, other than the above items.

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Safety Precautions

For customers of the gearmotor

⚠Safety Precautions

- Observe the safety rules necessary for the installation location and device in use.
  (Ordinance on Industrial Safety and Hygiene, electrical equipment technical standards,
  extension regulations, plant explosion proofing guide, Building Standards Act, etc.)
- Read the operation manual carefully before using the product, and always use it correctly.
  If the operation manual is required, please request one from a distributor or sales office.
  Be sure to keep the operation manual somewhere easily accessible to the operator of the product.
- Select a product suitable for your operating environment and application.
- If the product is to be used with devices for which a breakdown of the product could cause a loss of human life or a significant loss of equipment, such as human transport systems or hoisting equipment, install a protection device on the device side for safety.
- Use an explosion-proof motor in an explosive atmosphere. Also select an explosion proof motor whose specifications are suitable for dangerous places.
- When the unit is used in areas that are vulnerable to oil contamination, such as for food processing or cleanrooms, install an oil pan or other such device to cope with oil leakage due to breakdown or failure.

Precautions for operation of the motor for an inverter

Using a motor with brake

Use an independent power source for the brake, connect the brake power source to the power source side of the inverter, and shut off the inverter output while the brake is in operation (the motor is stopped). The lining may rattle at a low speed depending on the brake type.

Using an explosion-proof motor

The increased safety explosion-proof motors cannot be operated for an inverter. If it is necessary to drive an inverter with an explosion-proof motor, it must be combined with a flameproof motor, so please consult us.

Using with a 400V power source

If the wiring distance between the motor and inverter is long when driving an inverter with a 400V motor, contact us because it may be necessary to consider the dielectric voltage. (AF motors for inverter, premium-efficiency, 3-phase motors for inverter, and premium-efficiency, 3-phase motors feature insulation enhancements.)

Note: The numerical values in the specifications, dimension diagrams, and tables shown in this catalog, etc. may be changed without notice. Please contact us prior to designing just to be safe.

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