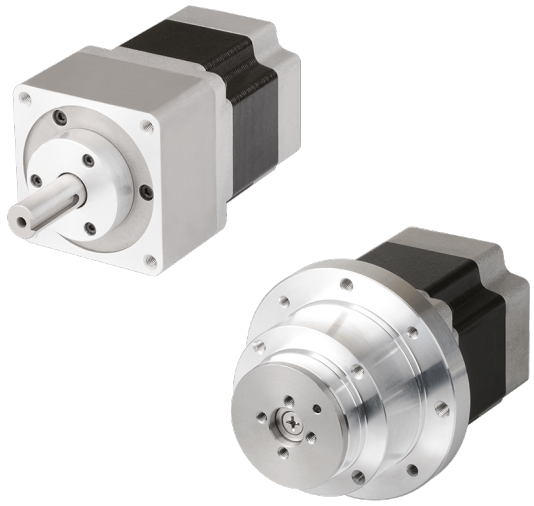
Built-in Gear / Rotary Actuator Type 5-phase Stepper Motor (□42 mm, □60 mm, □85 mm)



AK-G / AK-R Series

PRODUCT MANUAL

For your safety, read and follow the considerations written in the instruction manual, other manuals and Autonics website.

The specifications, dimensions, etc. are subject to change without notice for product improvement. Some models may be discontinued without notice.

Features

- Ideal for building compact sized system
- Low price for improved cost efficiency
- Backlash □42mm : ±35'(0.58), □60mm : ±20'(0.33), □85mm : ±15'(0.25)
- Brake releases when 24 VDC is applied on brake wire (AK-GB Series, AK-RB Series)
- Basic step angle 1:5 → 0.144 , 1:7.2 → 0.1 , 1:10 → 0.072
- Allowable speed 1:5 → 0 to 360 rpm, 1:7.2 → 0 to 250 rpm, 1:10 → 0 to 180 rpm

Safety Considerations

- Observe all 'Safety Considerations' for safe and proper operation to avoid hazards.
- ⚠ symbol indicates caution due to special circumstances in which hazards may occur.

⚠ Warning Failure to follow instructions may result in serious injury or death.

01. **Fail-safe device must be installed when using the unit with machinery that may cause serious injury or substantial economic loss. (e.g. nuclear power control, medical equipment, ships, vehicles, railways, aircraft, combustion apparatus, safety equipment, crime / disaster prevention devices, etc.)**
    Failure to follow this instruction may result in personal injury, economic loss or fire.
02. **Do not use the unit in the place where flammable / explosive / corrosive gas, high humidity, direct sunlight, radiant heat, vibration, impact or salinity may be present.**
    Failure to follow this instruction may result in explosion or fire.
03. **Do not use the brake for safety.**
    Failure to follow this instruction may result in personal injury or product and ambient equipment damage.
04. **Fix the unit on the metal plate.**
    Failure to follow this instruction may result in personal injury or product and ambient equipment damage.
05. **Do not connect, repair, or inspect the unit while connected to a power source.**
    Failure to follow this instruction may result in fire.
06. **Install the unit after considering counter plan against power failure.**
    Failure to follow this instruction may result in personal injury, economic loss or fire.
07. **Check 'Connections' before wiring.**
    Failure to follow this instruction may result in fire.
08. **Do not disassemble or modify the unit.**
    Failure to follow this instruction may result in fire or electric shock.
09. **Install the motor in the housing or ground it.**
    Failure to follow this instruction may result in personal injury, fire or electronic shock.
10. **Make sure to install covers on motor rotating components.**
    Failure to follow this instruction may result in personal injury
11. **Do not touch the unit during or after operation for a while.**
    Failure to follow this instruction may result in burn due to high temperature of the surface.
12. **Upon occurrence of an error, disconnect the power source.**
    Failure to follow this instruction may result in personal injury, fire or electronic shock.

⚠ Caution Failure to follow instructions may result in injury or product damage.

01. **Use the unit within the rated specifications.**
    Failure to follow this instruction may result in fire or product damage.
02. **Use a dry cloth to clean the unit, and do not use water or organic solvent.**
    Failure to follow this instruction may result in fire.
03. **The motor may overheat depending on the environment.**
    Install the unit at the well-ventilated environment and forced cooling with a cooling fan.
    Failure to follow this instruction may result in product damage or degradation by heat.
04. **Keep the product away from metal chip, dust, and wire residue which flow into the unit.**
    Failure to follow this instruction may result in fire or product damage.

Cautions during Use

- Follow instructions in 'Cautions during Use'.
  Otherwise, it may cause unexpected accidents.
- At low temperature, reducing the grease's consistency of ball-baring and etc. causes the friction torque increment.
  Start the motor gradually since motor's torque is in normal state.
- The clack sound may occur when power is ON or OFF on brake.
- Release the brake before motor drive by supplying power on brake.
  The product life cycle is shorten and the static friction torque reduces due to worn out brake pad.
- Be aware of backlash when positioning the motor in both CW/CCW directions.
  Built-in gear type motor achieves low backlash due to high accuracy gear for positioning, but the problem may occur when positioning the motor in both CW/CCW directions.
  In this case, the control is required to determine the position in either direction.

- Maintain and inspect regularly the following lists.
  - Unwinding bolts and connection parts for the unit installation and load connection
  - Abnormal sound from Ball-bearing of the unit
  - Damage and stress of lead cable of the unit
  - Connection error with driver
  - Inconsistency between the axis of motor output and the center, concentric (eccentric, declination) of the load, etc.
- This unit may be used in the following environments.
  - Indoors (in the environment condition rated in 'Specifications')
  - Altitude max. 2,000 m
  - Pollution degree 2
  - Installation category II

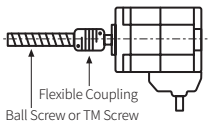
Cautions during Installation

- Follow instructions in 'Safety Considerations' and 'Cautions during Use'. Otherwise, it may cause unexpected accidents.
- Install the motor in a place that meets the certain conditions specified below. It may cause product damage if it is used out of following conditions.
  - Inside of the housing which is installed indoors (This unit is designed/manufactured for the purpose of attaching to equipment. Install a ventilation device.)
  - The place without contact with water, oil, or other liquid
  - The place without contact with strong alkali or acidity
  - The place with less electronic noise occurs by welding machine, motor, etc.
  - The place where no radioactive substances and magnetic fields exist. It shall be no vacuum status as well.
- Motor can be installed horizontally and vertically. Refer to 'Shaft Allowable Load along Installation Direction'.
- If a force (30 N) exceeding the specification is applied to the motor cable during installation, it may cause the contact failure and disconnection. If the excessive force or frequent cable movement is required, establish safety measures before use.
- In consideration of heat dissipation and vibration prevention, mount the motor as tight as possible against a metal panel with high thermal conductivity such as iron or aluminum.
- Refer to the product manual when mounting attachment on built-in rotary actuator motor.

Cautions during Connection with Load (AK-G Series)

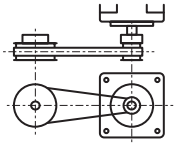
- Do not disassemble or modify the motor shaft to connect with the load.
- Tighten the screw not to be unscrewed when connecting with load.
- Refer to 'Shaft Allowable Load along Installation Direction' and take care of potential shock when connecting with load.
- Connect the motor shaft and the load shaft to be parallel.
- If the center with the load is not aligned with the shaft, it may cause unexpected accidents such as severe vibration, shorten life cycle of the shaft bearing and shaft damage.
- When attaching coupling or pulley with motor shaft, be aware of damage on motor shaft and shaft bearing.

■ Coupling



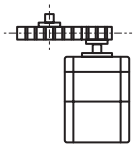
When connecting the load directly to the motor shaft, use a flexible coupling (ERB Series).

■ Pulley, Belt, Wire



Connect the motor shaft and the line which connects the center of two pulleys to be perpendicular.

■ Gear



Connect the motor shaft to the center of gear teeth to be interlocked.

Ordering Information

This is only for reference, the actual product does not support all combinations..
For selecting the specified model, follow the Autonics website.

A	❶	K	-	❷	5	❸	❹	❺	-	❻	❼

❶ Max. Allowable torque
Number: Max. allowable torque (unit: kgf cm)

❷ Rated current
S: 0.75 A / Phase
M: 1.4 A / Phase
G: 2.8 A / Phase

❸ Frame size
4: □ 42 mm
6: □ 60 mm
9: □ 85 mm

❹ Axial length
Number: Refer to 'Dimensions'

❺ Shaft type
No mark: Single shaft
W: Dual shaft

❻ Motor type
G: Built-in gear type
GB: Built-in gear + brake type
R: Built-in rotary actuator type
RB: Built-in rotary actuator + brake type

❼ Reduction ratio
5: 1:5
7.2: 1:7.2
10: 1:10

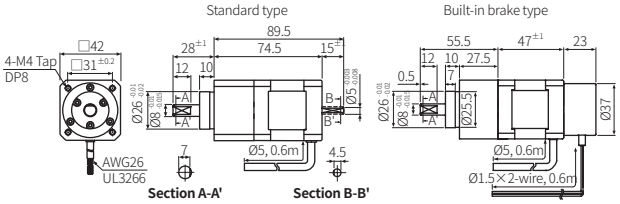
Product Components

Motor type	AK-G	AK-GB	AK-R	AK-RB
Product components	Product, instruction manual			
Parallel key	× 1 (□ 60 mm / □ 85 mm)		-	

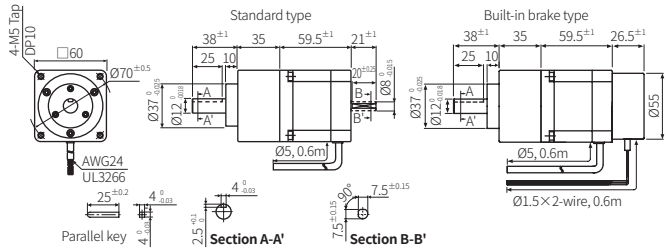
Dimensions

- Unit: mm, For the detailed drawings, follow the Autonics website.
- The dotted lines are included in dual shaft type.

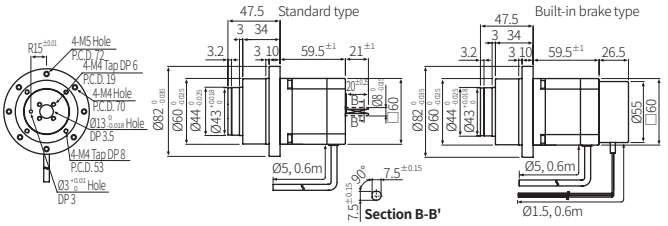
■ □ 42 mm Built-in gear type



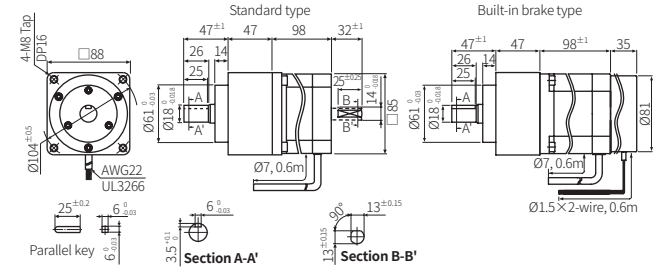
■ □ 60 mm Built-in gear type



■ □ 60 mm Built-in rotary actuator type

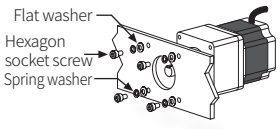


■ □ 85 mm Built-in gear type



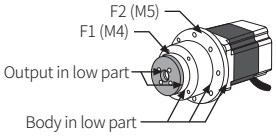
Installation Method

■ Built-in gear type



Frame size	Mounting plate Thickness	Applied bolt
□ 42 mm	≥ 5 mm	M4
□ 60 mm	≥ 8 mm	M5
□ 85 mm	≥ 12 mm	M8

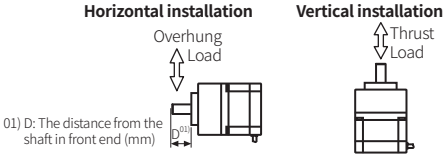
■ Built-in rotary actuator type



Frame size	Mounting plate Thickness	Applied bolt	Tightening torque
□ 60 mm	≥ 8 mm	M4	2 N m
		M5	4.4 N m

Shaft Allowable Load along Installation Direction

■ Built-in gear type



Frame size	Horizontal installation: Overhung Allowable load [N]					Vertical installation: Thrust Allowable load [N]
	D = 0	D = 5	D = 10	D = 15	D = 20	
□ 42 mm	72	82	98	121	-	Under load of motor
□ 60 mm	245	265	294	333	382	
□ 85 mm	471	530	588	667	775	

Specifications

Model	A10K-S545□-□5	A15K-S545□-□7.2	A15K-S545□-□10
Max. allowable torque	10 kgf cm (1.0 N m)	15 kgf cm (1.5 N m)	
Rotor inertia moment 01)	68×10^{-7} kg · m^2		
Rated current	0.75 A / Phase		
Basic step angle	0.144° / 0.072° (Full / Half step)	0.1° / 0.05° (Full / Half step)	0.072° / 0.036° (Full / Half step)
Allowable speed range	0 to 360 rpm	0 to 250 rpm	0 to 180 rpm
Backlash	± 35' (0.58°)		
Unit weight (packaged) 02)	≈ 0.58 kg (≈ 0.68 kg)		
	≈ 0.72 kg (≈ 0.78 kg)		

Model	A35K-M566□-□5	A40K-M566□-□7.2	A50K-M566□-□10
Max. allowable torque	35 kgf cm (3.5 N m)	40 kgf cm (4.0 N m)	50 kgf cm (5.0 N m)
Rotor inertia moment 01)	280×10^{-7} kg · m^2		
Rated current	1.4 A / Phase		
Basic step angle	0.144° / 0.072° (Full / Half step)	0.1° / 0.05° (Full / Half step)	0.072° / 0.036° (Full / Half step)
Allowable speed range	0 to 360 rpm	0 to 250 rpm	0 to 180 rpm
Backlash	± 20' (0.33°)		
Unit weight (packaged) 02)	Built-in gear type: ≈ 1.30 kg (≈ 1.57 kg) Built-in rotary actuator type: ≈ 1.30 kg (≈ 1.40 kg)		
	Built-in gear type: ≈ 0.95 kg (≈ 1.03 kg) Built-in rotary actuator type: ≈ 1.60 kg (≈ 1.70 kg)		

Model	A140K-□599□-□5	A200K-□599□-□7.2	A200K-□599□-□10
Max. allowable torque	140 kgf cm (14.0 N m)	200 kgf cm (20.0 N m)	
Rotor inertia moment 01)	2,700×10^{-7} kg · m^2		
Rated current	M: 1.4 A / Phase G: 2.8 A / Phase		
Basic step angle	0.144° / 0.072° (Full / Half step)	0.1° / 0.05° (Full / Half step)	0.072° / 0.036° (Full / Half step)
Allowable speed range	0 to 360 rpm	0 to 250 rpm	0 to 180 rpm
Backlash	± 15' (0.25°)		
Unit weight (packaged) 01)	≈ 4.40 kg (≈ 4.88 kg)		
	≈ 2.64 kg (≈ 2.74 kg)		

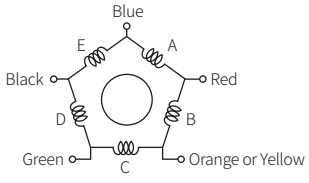
01) Listed in order of $\frac{\text{Standard type}}{\text{Built-in brake type}}$

Motor phase	5-phase
Insulation class	B type (130°C)
Insulation resistance	Between motor coil and case: ≥ 100 MΩ (500 VDC⎓ megger)
Dielectric strength 01)	Between motor coil and case: 1,000 VAC~ 50 / 60 Hz for 1 minute
Temperature rise 02)	≤ 80°C (5-phase excitation for rated current, while stop)
Ambient temp.	-10 to 50°C, storage: -25 to 85°C (no freezing or condensation)
Ambient humi.	35 to 85%RH, storage: 35 to 85%RH (no freezing or condensation)
Protection rating	IP30 (IEC34-5 standard)
Approval	CE EAC
Stop angle error 02)	± 3' (± 0.05°) (Full step, no load)
Absolut position error 03)	± 20' (± 0.33°)
Lost motion 03)	± 20' (± 0.33°)
Shaft vibration	0.05 mm T.I.R.
Radial movement 04)	≤ 0.025 mm T.I.R.
Axial movement 05)	≤ 0.075 mm T.I.R.
Shaft concentricity	0.075 mm T.I.R.
Shaft perpendicularity	0.075 mm T.I.R.

01) In case of rated current: 0.75 A / Phase, Between motor coil and case: 500 VAC~ 50 / 60 Hz for 1 minute
02) The corresponding value is only available in built-in gear type.
03) The corresponding value is only available in built-in rotary actuator type.
04) Amount of radial shaft displacement when applying radial load (5 N) to the end of the shaft.
05) Amount of axial shaft displacement when applying axial load (10 N) to the shaft.

Built-in brake type Frame size	□ 42 mm	□ 60 mm	□ 85 mm
Rated excitation voltage	24 VDC⎓ ±10%		
Rated excitation current	0.2 A	0.33 A	0.62 A
Static friction torque	≥ 0.18 N m	≥ 0.8 N m	≥ 4.0 N m
Rotation part inertia moment	3×10^{-7} kg · m^2	29×10^{-7} kg · m^2	153×10^{-7} kg · m^2
Insulation class	B type (130°C)		
B type brake	Brake is released when power ON, brake is locked when power OFF		
Operating time	≤ 25 ms	≤ 25 ms	≤ 60 ms
Releasing time	≤ 15 ms	≤ 20 ms	≤ 15 ms

Connection Diagram

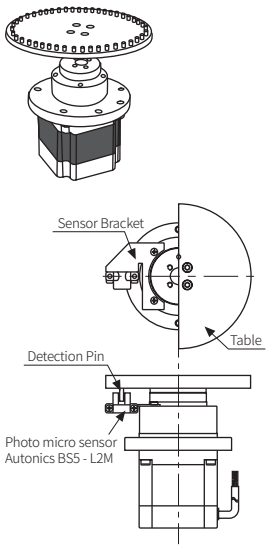


Cautions during Mounting (AK-R Series)

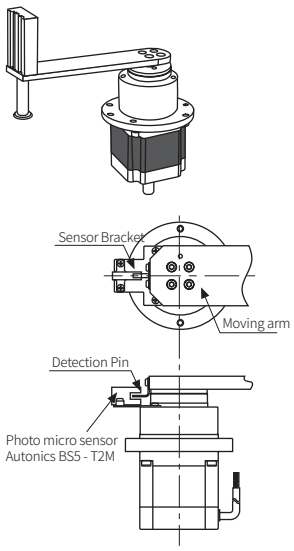
- Mount the accessory on the output shaft flange using M4 screw.
- Ø13 in low part is processed with C0.3. The accessories must be processed under C0.2.
- Place a positioning pin on the flange positioning hole and push it in. (Do not place the pin on he output flange.)
- Using a hammer to mount the accessory in low part may cause a product damage. Mount the accessory with hands gently.
- Make sure that the accessory is mounted on the output shaft firmly. Otherwise, it may cause an accident if an actuator is detached from the motor while driving.

Application of Built-in Rotary Actuator Type

■ Index table

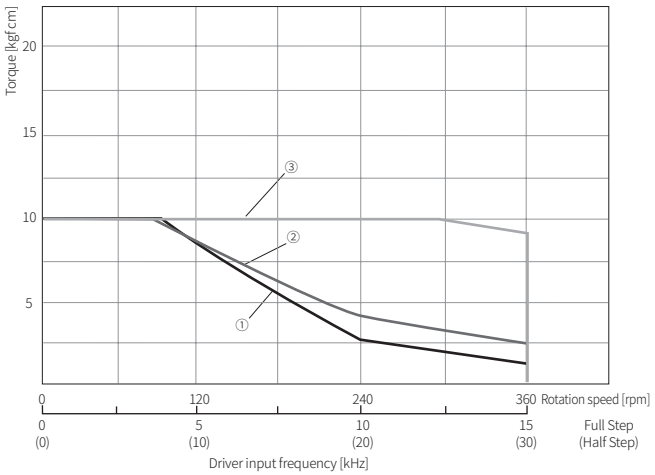


■ Moving arm



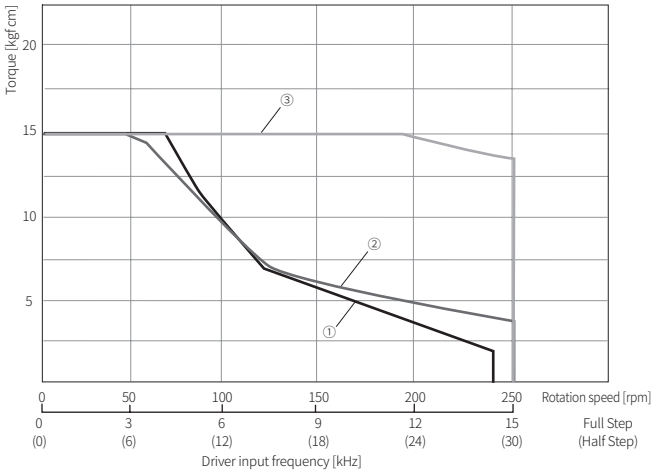
Motor Characteristics

■ A10K-S545(W)-G5



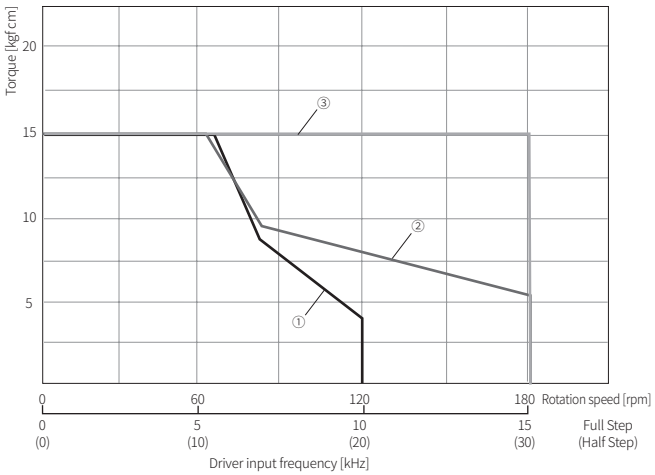
Index	Driver	Power supply	Setting current	Max. starting torque
①	MD5-ND14	24 VDC	1.4 A / Phase	3.1 kpps
②	MD5-HD14	24 VDC	1.4 A / Phase	3.2 kpps
③	MD5-HF14	220 VAC	1.4 A / Phase	3.2 kpps

■ A15K-S545(W)-G7.2



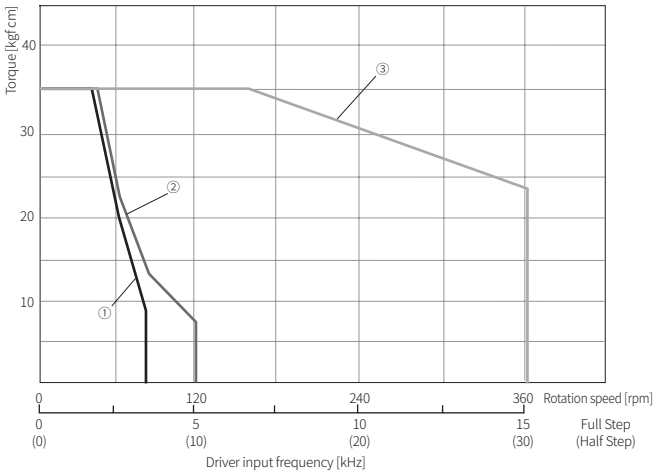
Index	Driver	Power supply	Setting current	Max. starting torque
①	MD5-ND14	24 VDC	1.4 A / Phase	3.2 kpps
②	MD5-HD14	24 VDC	1.4 A / Phase	3.3 kpps
③	MD5-HF14	220 VAC	1.4 A / Phase	3.4 kpps

■ A15K-S545(W)-G10



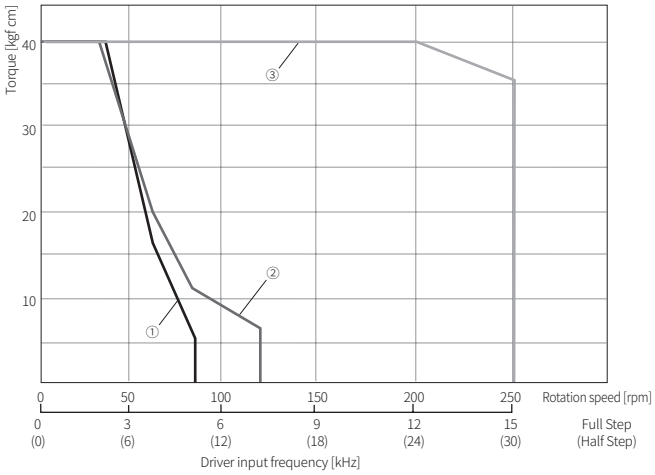
Index	Driver	Power supply	Setting current	Max. starting torque
①	MD5-ND14	24 VDC	1.4 A / Phase	3.3 kpps
②	MD5-HD14	24 VDC	1.4 A / Phase	3.3 kpps
③	MD5-HF14	220 VAC	1.4 A / Phase	3.4 kpps

■ A35K-M566(W)-□5



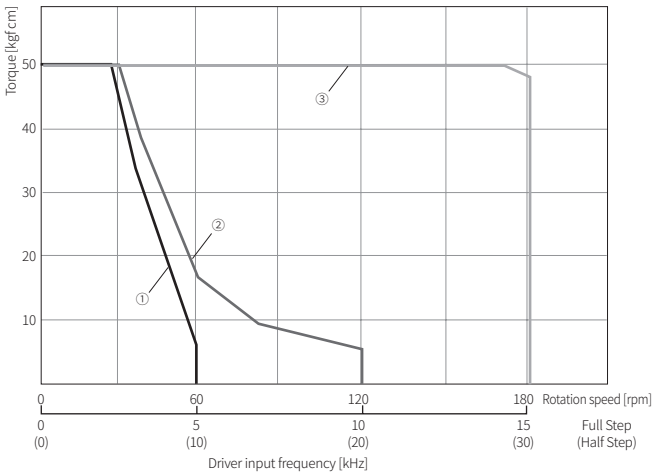
Index	Driver	Power supply	Setting current	Max. starting torque
①	MD5-ND14	24 VDC	1.4 A / Phase	2.3 kpps
②	MD5-HD14	24 VDC	1.4 A / Phase	2.3 kpps
③	MD5-HF14	220 VAC	1.4 A / Phase	2.6 kpps

■ A40K-M566(W)-□7.2



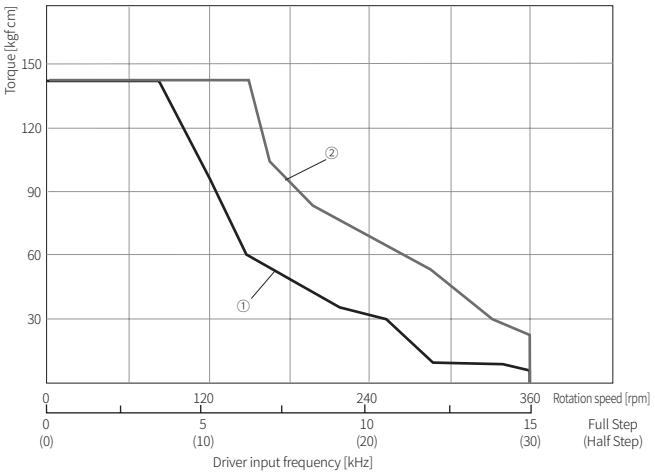
Index	Driver	Power supply	Setting current	Max. starting torque
①	MD5-ND14	24 VDC	1.4 A / Phase	2.2 kpps
②	MD5-HD14	24 VDC	1.4 A / Phase	2.3 kpps
③	MD5-HF14	220 VAC	1.4 A / Phase	2.6 kpps

■ A50K-M566(W)-□10



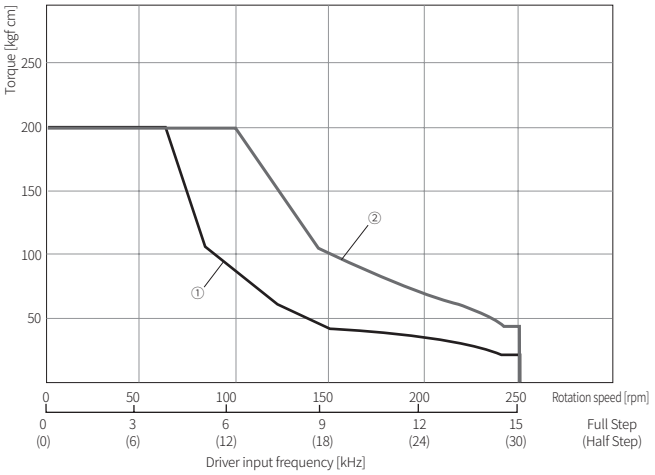
Index	Driver	Power supply	Setting current	Max. starting torque
①	MD5-ND14	24 VDC	1.4 A / Phase	2.3 kpps
②	MD5-HD14	24 VDC	1.4 A / Phase	2.3 kpps
③	MD5-HF14	220 VAC	1.4 A / Phase	2.8 kpps

■ A140K-□599(W)-G5



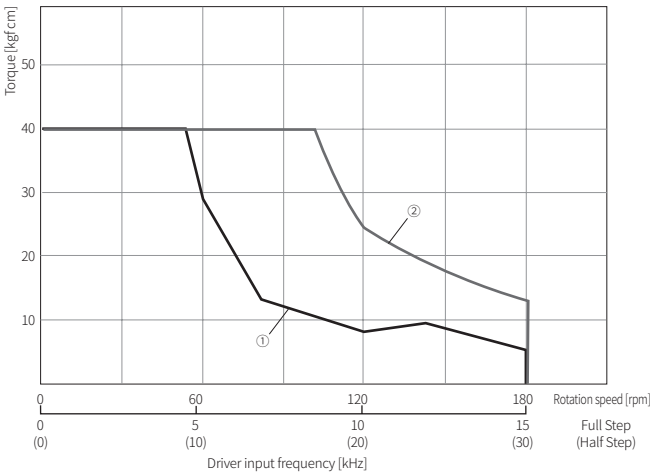
Index	Driver	Power supply	Setting current	Max. starting torque
①	MD5-HF14	220 VAC	1.4 A / Phase	1.8 kpps
②	MD5-HF28	220 VAC	2.8 A / Phase	2.1 kpps

■ A200K-□599(W)-G7.2



Index	Driver	Power supply	Setting current	Max. starting torque
①	MD5-HF14	220 VAC	1.4 A / Phase	1.8 kpps
②	MD5-HF28	220 VAC	2.8 A / Phase	2.1 kpps

■ A200K-□599(W)-G10



Index	Driver	Power supply	Setting current	Max. starting torque
①	MD5-HF14	220 VAC	1.4 A / Phase	1.9 kpps
②	MD5-HF28	220 VAC	2.8 A / Phase	2.1 kpps