Selecting a Stepping Motor

This section describes certain items that must be calculated to find the optimum stepping motor for a particular application. This section shows the selection procedure and gives examples.

Selection Procedure

1. Determining the drive mechanism component
Determine the mechanism and required specifications.

First, determine certain features of the design, such as mechanism, rough dimensions, distances moved, and positioning period.

↓

2. Calculate the required resolution
Find the resolution the motor requires.

From the required resolution, determine whether a motor only or a geared motor is to be used.

↓

3. Determine the operating pattern
Determine the operating pattern that fulfills the required specifications.

Find the acceleration (deceleration) period and operating pulse speed in order to calculate the acceleration torque.

↓

4. Calculate the required torque
Calculate load torque.
Calculate acceleration torque.
Calculate required torque.

Calculate the load torque and acceleration torque and find the required torque demanded by the motor.

↓

5. Select the motor
Make a provisional selection of a motor based on required torque. Determine the motor to be used from the speed-torque characteristics.

Select a motor whose speed-torque characteristics satisfy the requirement.

↓

6. Check the selected motor
Confirm the acceleration/deceleration rate and inertia ratio.

Check the acceleration/deceleration rate and inertia ratio in order to determine the suitability of the selection.

↓

Selection complete

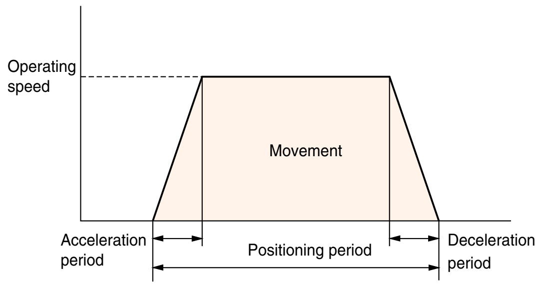
For technical questions about selection calculations, contact your nearest Oriental Motor office.

Approaches to Selection Calculations

This section describes in detail the key concerns in the selection procedure: the determination of the operating pattern, the calculation of the required torque and the confirmation of the selected motor.

1. Determining the Operating Pattern

The required changes in the movement of the drive mechanism are translated into motor movement, creating an operating pattern as shown in the figure below. Motor selection is based on the operating pattern.



Operating Pattern

(1) Finding the number of operating pulses A [pulses]

The number of operating pulses is expressed as the number of pulse signals that adds up to the angle that the motor must move to get the work from point A to point B.

$$\text{Operating pulses (A) [Pulses]} = \frac{\text{Distance per movement}}{\text{Distance per motor rotation}} \times \text{No. of pulses required for 1 motor rotation}$$

$$= \frac{l}{l_{rev}} \times \frac{360°}{\theta_s}$$

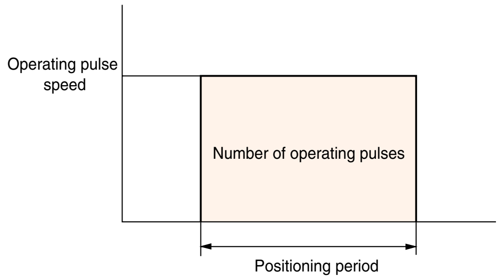
θ_s : Step angle

(2) Determining the operating pulse speed f_2 [Hz]

The operating pulse speed is the pulse speed required to rotate the motor the required number of operating pulses during the positioning period. The operating pulse speed can be found from the number of operating pulses, the positioning period and the acceleration (deceleration) period.

① For start-stop operation

Start-stop is a method of operation in which the operating pulse speed of a motor being used in a low-speed region is suddenly increased without an acceleration period. It is found by the following equation. Since rapid changes in speed are required, the acceleration torque is very large.

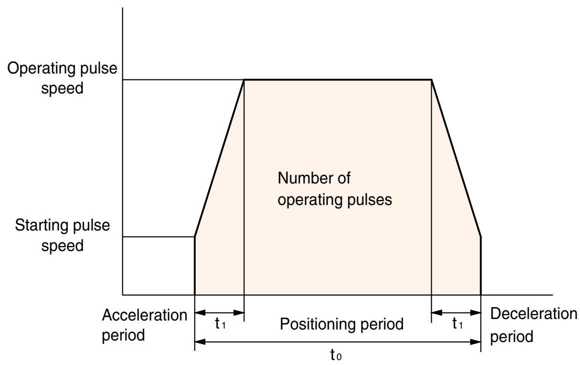


$$\text{Operating pulse speed } (f_2) \text{ [Hz]} = \frac{\text{Number of operating pulses [pulses]}}{\text{Positioning period [s]}}$$

$$= \frac{A}{t_0}$$

② For acceleration/deceleration operation

Acceleration/deceleration is a method of operation in which the operating pulses of a motor being used in a medium- or high-speed region are gradually changed. It is found by the following equation below. Usually, the acceleration (deceleration) period (t_1) is set as a proportion of acceleration torque at roughly 25% of the respective positioning periods. For gentle speed changes, the acceleration torque can be kept lower than in start-stop operations.



$$\text{Operating pulse speed } (f_2) \text{ [Hz]} = \frac{\text{Number of operating pulses [pulses]} - \text{Starting pulse speed [Hz]} \times \text{Acceleration (Deceleration) period [s]}}{\text{Positioning period [s]} - \text{Acceleration (deceleration) period [s]}}$$

$$= \frac{A - f_1 \cdot t_1}{t_0 - t_1}$$

2. Calculating the Required Torque T_M [N·m]

Calculate the required torque from the operating pattern by the following procedure.

(1) Calculate the load torque T_L [N·m]

Load torque is the frictional resistance produced by the parts of the drive mechanism that come into contact with each other. It is the torque constantly required when the motor is operating. Load torque varies greatly with the type of drive mechanism and the mass of the work. See page B-36 for methods of finding the load torque for different drive mechanisms.

(2) Calculate the acceleration torque Ta [N·m]

Acceleration torque is the torque only required in acceleration and deceleration operation of the motor. Find the acceleration torque using the equations below depending on what slope is used for acceleration (deceleration) of the drive mechanism's total inertia. See page B-37 for formulas that can be used to calculate the total inertia of the drive mechanism section.

① **For start-stop operation**

$$\text{Acceleration torque } (Ta)\ [\text{N·m}] = \left(\text{Inertia of rotor } [\text{kg·m}^2] + \text{Total inertia } [\text{kg·m}^2]\right) \times \frac{\pi \times \text{Step angle } [°] \times (\text{Operating pulse speed})^2\ [\text{Hz}]}{180° \times \text{Coefficient}}$$

$$= (J_0 + J_L) \times \frac{\pi \cdot \theta s \cdot f_2^2}{180° \cdot n} \qquad n{:}3.6°/\theta s$$

② **For acceleration/deceleration operation**

$$\text{Acceleration torque } (Ta)\ [\text{N·m}] = \left(\text{Inertia of rotor } [\text{kg·m}^2] + \text{Total inertia } [\text{kg·m}^2]\right) \times \frac{\pi \times \text{Step angle } [°]}{180°} \times \frac{\text{Operating pulse speed [Hz]} - \text{Starting pulse speed [Hz]}}{\text{Acceleration (deceleration) period [s]}}$$

$$= (J_0 + J_L) \times \frac{\pi \cdot \theta s}{180} \times \frac{f_2 - f_1}{t_1}$$

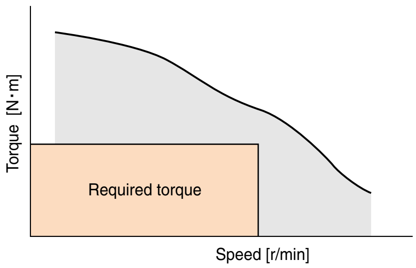
(3) Calculate the required torque T_M [N·m]

The required torque is the sum of the load torque required by the stepping motor and the acceleration torque.
The motor requires the most torque during the acceleration portion of the operating pattern. During acceleration, load torque from the frictional resistance and acceleration torque from the inertia are both required. To avoid problems when incorporating a stepping motor into a device, an additional safety factor needs to be estimated. The required torque can be found from the following equation.

$$\text{Required torque } (T_M)\ [\text{N·m}] = \left(\text{Load torque } [\text{N·m}] + \text{Acceleration torque } [\text{N·m}]\right) \times \text{Safety factor}$$

$$= (T_L + Ta) \times 2$$

Select a motor for which this required torque falls within the pull-out torque of the speed-torque characteristics.



3. Checking the Motor Selection

Check the following two items for the selected motor in order to ensure an optimal selection. (No need for αSTEP AS Series)

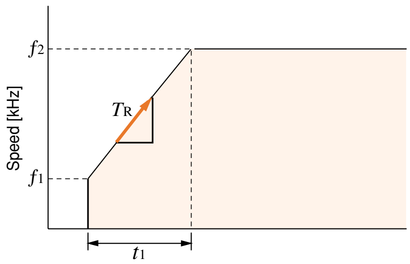
(1) Check the acceleration/deceleration rate

Most controllers, when set for acceleration or deceleration, adjust the pulse speed in steps. For that reason, operation may sometimes not be possible, even though it can be calculated.
The table below shows reference data for a stepping motor combined with our controller. Calculate the acceleration/deceleration rate from the following equation and check that the value is at or above the acceleration/deceleration rate in the table.

$$\text{Acceleration/deceleration rate } (T_R) \text{ [ms/kHz]} = \frac{\text{Acceleration (deceleration) period [s]}}{\text{Operating pulse speed [kHz]} - \text{Starting pulse speed [kHz]}}$$

$$= \frac{t_1}{f_2 - f_1}$$

* Calculate the pulse speed in full-step equivalents.



Acceleration Rate (Reference Values)

Motor Frame Size [mm]	Acceleration/deceleration rate T_R [ms/kHz]
28 42 60	20 minimum
85 90	30 minimum

If below the minimum value, change the operating pattern's acceleration (deceleration) period.

(2) Check the inertia ratio

Large inertia ratios (inertial loads) cause large overshooting and undershooting during starts and stops, which can affect startup times and settling times. Depending on the conditions of usage, operation may be impossible. Calculate the inertia ratio with the following equation and check that the values found are at or below the inertia ratios shown in the table.

$$\text{Inertia ratio} = \frac{\text{Total inertia of the machine [kg·m}^2\text{]}}{\text{Rotor inertia of the motor [kg·m}^2\text{]}}$$

$$= \frac{J_L}{J_0}$$

Inertia Ratio (Reference values)

Package	Inertia ratio
RK Series 5-Phase **CSK** Series **NanoStep RFK** 2-Phase **CSK** Series	10 maximum
PMC Series	5 maximum

* Except geared motor types.

When these values are exceeded, we recommend a geared motor. Using a geared motor can increase the drivable inertial load.

$$\text{Inertia ratio} = \frac{\text{Total inertia of the machine [kg·m}^2\text{]}}{\text{Rotor inertia of the motor [kg·m}^2\text{]} \times \text{(Gear ratio)}^2}$$

$$= \frac{J_L}{J_0 \cdot i^2}$$

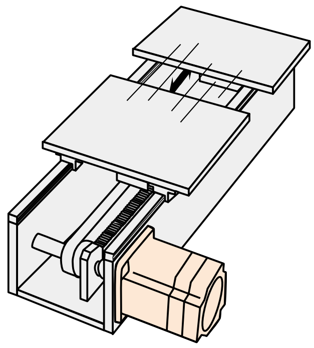
Note:
These values are estimates of common conditions.
Your application conditions may vary. If in doubt, contact your local Oriental Motor office for assistance.

Selecting Example

Example 1 Belt Drive

In this example, the *αSTEP* **AS** series is selected for a belt drive system.

1. Determine the Drive Mechanism



Total mass of the table and work:	m = 3kg
External force:	F_A = 0kg
Frictional coefficient of sliding surfaces:	μ = 0.05
Table tilt:	α = 0°
Belt and pulley efficiency:	η = 0.8
Pulley diameter:	D_P = 31.8mm
Length of pulley:	L_P = 20mm
Material of belt drive:	Aluminum [density 2.8×10^{-3} kg/m^3]
Resolution (feed per pulse):	Δl = 0.100
Feed:	l = 1000mm
Positioning period:	t_0 = 0.7 s
Acceleration and deceleration period:	t_0 = 0.2 s

2. Calculating the Required Resolution

(Refer to basic equations on page B-34)

$$\text{Required resolution } \theta s = \frac{360° \times \text{Demanded resolution}(\Delta l)}{\text{Pulley diameter (DP)} \times \pi}$$

$$= \frac{360° \times 0.1}{31.8 \times \pi} = 0.36\,[°]$$

3. Determine the Operating Pulse

(Refer to basic equations on pages B-25, 34 and 35)

(1) Finding the number of operating pulses (A) [pulses]

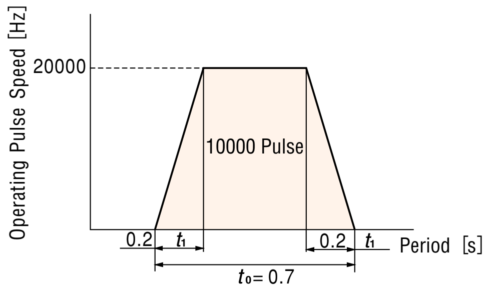
$$\text{Operating pulses (A)} = \frac{\text{Feed per unit } (l)}{\text{Pulley diameter (DP)} \times \pi} \times \frac{360°}{\text{Step angle}(\theta s)}$$

$$= \frac{1000}{31.8 \times \pi} \times \frac{360°}{0.36°} = 10000\,[\text{pulses}]$$

(2) Determining the operating pulse speed f_2 [Hz]

$$\text{Operating pulse speed } f_2 = \frac{\text{Number of operating pulses [A]} - \text{Starting pulses speed } [f_1] \times \text{Acceleration (deceleration) period } [t_1]}{\text{Positioning period } [t_0] - \text{Acceleration (deceleration) period } [t_1]}$$

$$= \frac{10000 - 0}{0.7 - 0.2} = 20000\,[\text{Hz}]$$



(3) Determining the operating speed N [r/min]

$$\text{Operating Speed} = f_2 \times \frac{\theta s}{360} \times 60$$

$$= 20000 \times \frac{0.36}{360} \times 60 = 1200\text{r/min}$$

4. Calculating the Required Torque T_M

(Refer to page B-26)

(1) Calculate the load torque T_L [N·m]

(Refer to page B-36 for basic equations)

$$\text{Load in shaft direction } F = F_A + mg(\sin\alpha + \mu\cos\alpha)$$

$$= 0 + 3\times9.8(\sin 0 + 0.05\cos 0)$$

$$= 1.47\,[\text{N}]$$

$$\text{Load torque } T_L = \frac{F \cdot D_P}{2\eta}$$

$$= \frac{1.47\times0.0318}{2\times0.8}$$

$$= 0.03\,[\text{N·m}]$$

(2) Calculate the acceleration torque Ta [N·m]

① Calculate the total inertial moment J_L [kg·m^2]

(See page B-37 for basic equations)

$$\text{Inertia of belt drive } J_P = \frac{\pi}{32}\cdot\rho\cdot L_P\cdot D_P^{\,4}$$

$$= \frac{\pi}{32}\, 2.8\times10^{3}\times0.02\times0.0318^{4}$$

$$= 5.6\times10^{-6}\,[\text{kg·m}^2]$$

Inertia of table and work $J_T = m\left(\frac{D_p}{2}\right)^2$

$$= 3 \times \left(\frac{0.0318}{2}\right)^2$$

$$= 7.59 \times 10^{-4}\ [kg \cdot m^2]$$

Total inertia $J_L = J_p \times 2 + J_T$

$$= 5.6 \times 10^{-6} \times 2 + 7.59 \times 10^{-4} = 7.7 \times 10^{-4}$$

② Calculate the acceleration torque T_a [N·m]

Acceleration torque $T_a = (J_0 + J_L) \times \frac{\pi \cdot \theta s}{180°} \times \frac{f_2 - f_1}{t_1}$

$$= (J_0 + 7.7 \times 10^{-4}) \times \frac{\pi \times 0.36}{180°} \times \frac{20000 - 0}{0.2}$$

$$= 628 J_0 + 0.48\ [N \cdot m]$$

(3) Calculate the required Torque T_M [N·m]

Required torque $T_M = (T_L + T_a) \times 1.5$

$$= \{0.03 + (628 J_0 + 0.48)\} \times 1.5$$

$$= 942 J_0 + 0.765\ [N \cdot m]$$

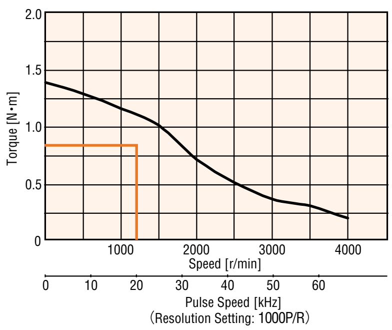
5. Selecting a Motor

(1) Provisional motor selection

Package Model	Rotor Inertia (kg·m²)	Required torque N·m
AS66AC	405×10^{-7}	0.8

(2) Determine the motor from the speed-torque characteristics

AS66AC

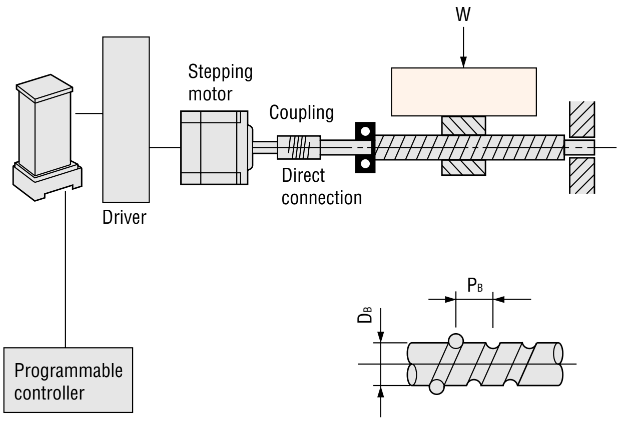


Select a motor for which the required torque falls within the pull-out torque of the speed-torque characteristics.

Example 2: Ball Screw

In these examples, 5-phase stepping motors and drivers in the **RK** series are selected for a ball screw system, an index table system and a belt drive.

1. Determine the Drive Mechanism



Total mass of the table and work:	m =40kg
Frictional coefficient of sliding surfaces:	μ =0.05
Ball screw efficiency:	η =0.9
Internal frictional coefficient of pilot pressure nut:	μ_0 =0.3
Ball screw shaft diameter:	D_B =15mm
Total length of ball screw:	L_B =600mm
Material of ball screw:	Iron (density ρ=7.9×10^{-3}kg/cm^3)
Pitch of ball screw:	P_B =15mm
Resolution (feed per pulse):	Δl =0.03mm/step
Feed:	l =180mm
Positioning period:	t_0 =0.8s or shorter

2. Calculating the Required Resolution

(Refer to basic equation on page B-34)

$$\text{Required resolution } (\theta s) = \frac{360° \times \text{Demanded resolution } (\Delta l)}{\text{Ball screw pitch } (P_B)}$$

$$= \frac{360° \times 0.03}{15} = 0.72\ [°]$$

A 5-phase stepping motor and driver in the **RK** series can be connected directly to the application.

3. Determine the Operating Pulse

(Refer to basic equations on pages B-25, 34 and 35)

(1) Finding the number of operating pulses (A) [pulses]

$$\text{Operating pulses (A)} = \frac{\text{Feed per unit } (l)}{\text{Ball screw pitch } (P_B)} \times \frac{360°}{\text{Step angle } (\theta s)}$$

$$= \frac{180}{15} \times \frac{360°}{0.72°} = 6000\ [\text{pulses}]$$

(2) Determining the acceleration (deceleration) period t_1 [sec]

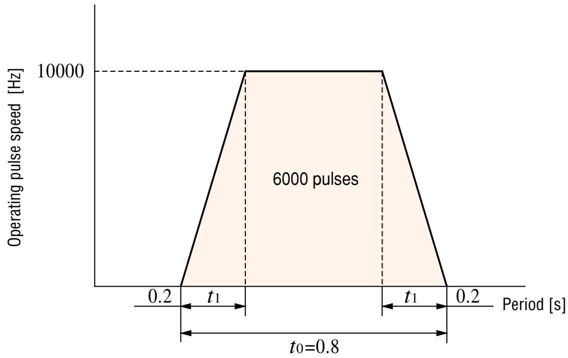
An acceleration (deceleration) period of 25% of the positioning period is appropriate.

Acceleration (deceleration) period (t_1) = 0.8 × 0.25 = 0.2 [s]

(3) Determining the operating pulse speed f_2 [Hz]

$$\text{Operating pulse speed } (f_2) = \frac{\text{Number of operating pulses (A)} - \text{Starting pulses speed } (f_1) \times \text{Acceleration (deceleration) period } (t_1)}{\text{Positioning period } (t_0) - \text{Acceleration (deceleration) period } (t_1)}$$

$$= \frac{6000 - 0}{0.8 - 0.2} = 10000\ [\text{Hz}]$$



4. Calculating the Required Torque T_M [N·m]

(Refer to page B-26)

(1) Calculate the load torque T_L [N·m]

(Refer to page B-36 for basic equations)

$$\text{Load in shaft direction } (F) = F_A + W{\cdot}g\,(\sin\alpha + \mu\cos\alpha)$$
$$= 0 + 40 \times 9.8\,(\sin 0 + 0.05\cos 0)$$
$$= 19.6\ [\text{N}]$$

$$\text{Pilot pressure load } (F_0) = \frac{F}{3} = \frac{19.6}{3} = 6.53\ [\text{N}]$$

$$\text{Load torque } (T_L) = \frac{F \cdot P_B}{2\pi\eta} + \frac{\mu_0 \cdot F_0 \cdot P_B}{2\pi}$$
$$= \frac{19.6 \times 0.015}{2\pi \times 0.9} + \frac{0.3 \times 6.53 \times 0.015}{2\pi}$$
$$= 0.057\ [\text{N·m}]$$

(2) Calculate the acceleration torque Ta [N·m]

① Calculate the total inertial moment J_L [kg·m^2]

(Refer to page B-37 for basic equations)

$$\text{Inertia of ball screw } (J_B) = \frac{\pi}{32} \cdot \rho \cdot L_B \cdot D_B^4$$
$$= \frac{\pi}{32} \times 7.9 \times 10^3 \times 0.6 \times 0.015^4$$
$$= 2.36 \times 10^{-5}\ [\text{kg·m}^2]$$

$$\text{Inertia of table and work } (J_T) = m\left(\frac{P_B}{2\pi}\right)^2$$
$$= 40 \times \left(\frac{0.015}{2\pi}\right)^2$$
$$= 2.28 \times 10^{-4}\ [\text{kg·m}^2]$$

$$\text{Total inertia } (J_L) = J_B + J_T$$
$$= 2.36 \times 10^{-5} + 2.28 \times 10^{-4}$$
$$= 2.52 \times 10^{-4}\ [\text{kg·m}^2]$$

② Calculate the acceleration torque Ta [N·m]

$$\text{Acceleration torque } (Ta) = (J_0 + J_L) \times \frac{\pi \cdot \theta s}{180°} \times \frac{f_2 - f_1}{t_1}$$

$$= (J_0 + 2.52 \times 10^{-4}) \times \frac{\pi \times 0.72}{180°} \times \frac{10000 - 0}{0.2}$$

$$= 628\, J_0 + 0.158 \text{ [N·m]}$$

(3) Calculate the required torque T_M [N·m]

$$\text{Required torque } (T_M) = (T_L + Ta) \times 2$$

$$= \{0.057 + (628\, J_0 + 0.158)\} \times 2$$

$$= 1256\, J_0 + 0.43 \text{ [N·m]}$$

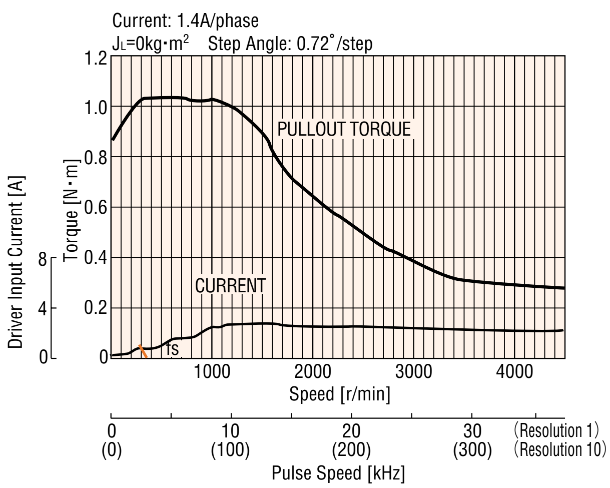
5. Selecting a Motor

(1) Provisional motor selection

Package Model	Rotor Inertia [kg·m^2]	Required torque [N·m]
RK566BC	280×10^{-7}	0.47
RK569BC	560×10^{-7}	0.5

(2) Determine the motor from the speed-torque characteristics

RK566BC



Select a motor for which the required torque falls within the pull-out torque of the speed-torque characteristics.

6. Checking the Motor Selection (See Page B-27)

(1) Check the acceleration/deceleration rate

$$\text{Acceleration/deceleration rate } (T_R) = \frac{\text{Acceleration (deceleration) period } (t_1)}{\text{Operating pulse speed } (f_2) - \text{Starting pulse speed } (f_2)}$$

$$= \frac{0.2 \text{ [s]}}{10 \text{ [kHz]} - 0} = 20 \text{ [ms/kHz]}$$

T_R = 48 [ms/kHz], so the motor can be used.

(2) Check the inertia ratio

$$\text{Inertia ratio} = \frac{\text{Total inertia } (J_L)}{\text{Rotor inertia of the motor } (J_0)}$$

$$= \frac{2.52 \times 10^{-4}}{280 \times 10^{-7}}$$

$$= 9 < 10$$

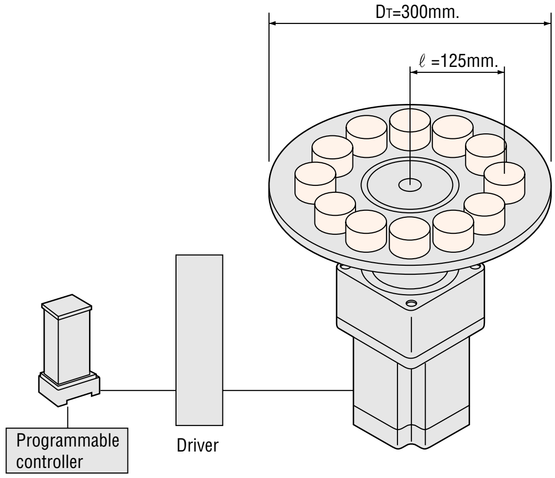
Therefore, the motor can be used

Based on the above, the selection for this application is the Standard **RK** series motor **RK566BC**.

Example 3: Index Table

Geared stepping motors are suitable for systems with high inertia, such as index tables.

1. Determine the Drive Mechanism



Diameter of index table:	D_T = 300mm
Index table thickness:	L_T = 10mm
Diameter of load:	D_W = 30mm
Thickness of load:	L_W = 40mm
Material of table and load:	Iron (density $\rho = 7.9\times10^3$ kg/m^3)
Number of load:	12 (one every 30˚)
Distance from center of index table to center of load:	l = 125mm
Positioning angle:	θ = 30˚
Resolution:	$\Delta\theta$ = 0.04˚
Positioning period:	t_0 = 0.4 s

2. Calculating the Required Resolution

Required resolution (θ s) = 0.04°

= 0.02° × 2 [pulses]

The **RK** Series **PN** geared type (gear ratio 1:36, 0.02°/step) can be used.

3. Determine the Operating Pulse

(see basic equations on pages B-25, 34 and 35)

(1) Finding the number of operating pulses (A) [pulses]

$$\text{Operating pulses (A)} = \frac{\text{Angle rotated per movement } (\theta)}{\text{Gear output shaft step angle } (\theta \text{ s})} = \frac{30°}{0.02°} = 1500 \text{ [pulses]}$$

(2) Determining the acceleration (deceleration) period t_1 [sec]

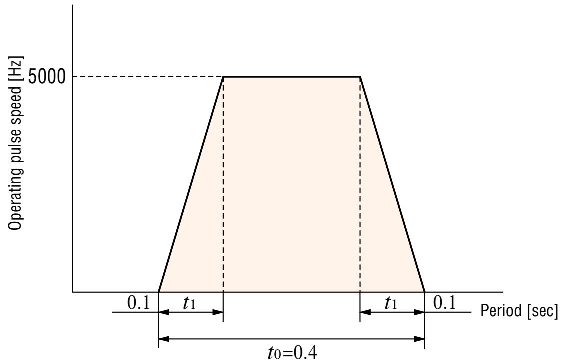
An acceleration (deceleration) period of 25% of the positioning period is appropriate.

Acceleration (deceleration) period (t_1) = 0.4 × 0.25 = 0.1 [sec]

(3) Determining the operating pulse speed f_2 [Hz]

$$\text{Operating pulse speed } (f2) = \frac{\text{Number of operating pulses (A)} - \text{Starting pulses speed } (f_1) \times \text{Acceleration (deceleration) period } (t_1)}{\text{Positioning period } (t_0) - \text{Acceleration (deceleration) period } (t_1)}$$

$$= \frac{1500 - 0}{0.4 - 0.1} = 5000 \text{ [Hz]}$$



4. Calculating the Required Torque T_M [N·m] (Refer to page B-26)

(1) Calculate the load torque T_L [N·m]

Frictional load is omitted because it is negligible. Load torque is considered 0.

(2) Calculate the acceleration torque Ta [N·m]

① Calculate the total inertia J_L [kg·m^2] (Refer to page B-37 for basic equations)

$$\text{Inertia of table } (J_T) = \frac{\pi}{32} \cdot \rho \cdot L_T \cdot D_T^4$$

$$= \frac{\pi}{32} \times 7.9 \times 10^3 \times 0.01 \times 0.3^4$$

$$= 6.28 \times 10^{-2} \text{ [kg·m}^2\text{]}$$

$$\text{Inertia of work } (J_W') = \frac{\pi}{32} \cdot \rho \cdot L_W \cdot D_W^4$$

$$= \frac{\pi}{32} \times 7.9 \times 10^3 \times 0.04 \times 0.03^4$$

$$= 2.51 \times 10^{-5} \text{ [kg·m}^2\text{]}$$

The center of the load is not on the center of rotation, so:

$$J_{W''} = J_{W'} \times m \cdot l^2$$
$$= 2.51 \times 10^{-5} + \{\pi \times \left(\frac{0.03}{2}\right)^2 \times 0.04 \times 7.9 \times 10^3\} \times 0.125^2$$
$$= 3.52 \times 10^{-3}\ [\text{kg}\cdot\text{m}^2]$$

Since there are 12 pieces of work:

$$J_W = 3.52 \times 10^{-3} \times 12$$
$$= 4.22 \times 10^{-2}\ [\text{kg}\cdot\text{m}^2]$$

$$\text{Total inertia } (J_L) = J_T + J_W$$
$$= 6.28 \times 10^{-2} + 4.22 \times 10^{-2}$$
$$= 0.11\ [\text{kg}\cdot\text{m}^2]$$

② Calculate the acceleration torque Ta [N·m]

$$\text{Acceleration torque } (Ta) = (J_0 \cdot i^2 + J_L) \times \frac{\pi \cdot \theta s}{180°} \times \frac{f_2 - f_1}{t_1}$$
$$= (J_0 \times 36^2 + 0.11) \times \frac{\pi \times 0.02}{180°} \times \frac{5000 - 0}{0.1}$$
$$= 22.619 \times 10^3 J_0 + 1.92\ [\text{N}\cdot\text{m}]$$

(3) Culculate the required Torque T_M [N·m]

$$\text{Required torque } (T_M) = (T_L + Ta) \times 2$$
$$= \{0 + (22.619 \times 10^3 J_0 + 1.92)\} \times 2$$
$$= 45.238 \times 10^3 J_0 + 3.84\ [\text{N}\cdot\text{m}]$$

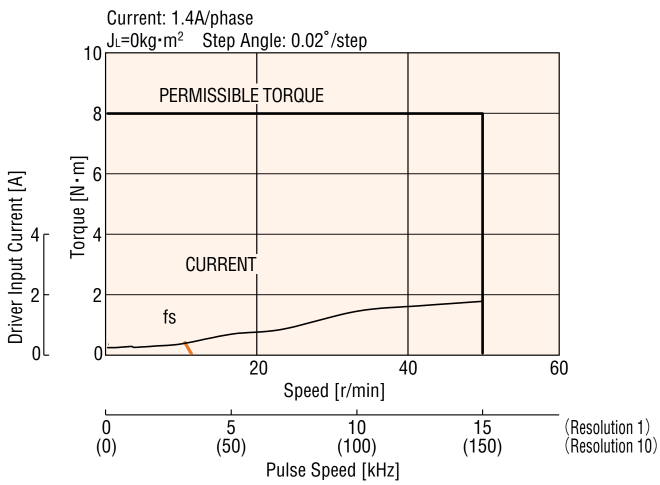
5. Selecting a Motor

(1) Provisional motor selection

Package Model	Rotor Inertia [kg·m²]	Required torque [N·m]
RK564BC-N36	175×10^{-7}	4.63
RK596BC-N36	1400×10^{-7}	10.17

(2) Determine the motor from the speed-torque characteristics

RK564BC-N36



Select a motor for which the required torque falls within the pull-out torque of the speed-torque characteristics.

6. Checking the Motor Selection (See Page B-27)

(1) Check the acceleration/deceleration rate

$$\text{Acceleration/deceleration rate } (T_R) = \frac{\text{Acceleration (deceleration) period } (t_1)}{\text{Operating pulse speed } (f_2) - \text{Starting pulse speed } (f_2)}$$
$$= \frac{0.1\ [\text{s}]}{5\ [\text{kHz}] - 0} = 20\ [\text{ms/kHz}]$$

T_R = 20 [ms/kHz], so the motor can be used.

(2) Check the inertia ratio

$$\text{Inertia ratio} = \frac{\text{Total inertia } (J_L)}{\text{Rotor inertia of the motor } (J_0) \times i^2}$$
$$= \frac{0.11}{175 \times 10^{-7} \times 36^2}$$
$$= 4.85 < 10$$

Therefore, the motor can be used

Based on the above, the selection for this application is the **RK** series **PN** geared motor **RK564BC-N36**.