

2-PHASE STEPPING SYSTEMS

# SANMOTION F2

## 2-Phase Stepping Systems

Ver. 10.2  
English



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#### **Basic Models**

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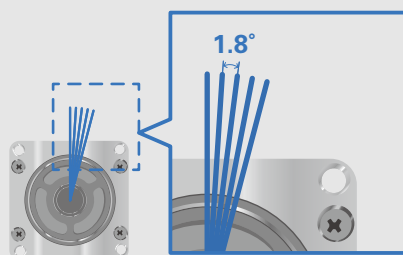
# Easy positioning control

by simple encoderless stepping systems



Stepping motors rotate precisely at a fixed angle (step angle) with each pulse the driver receives from a pulse generator.

SANMOTION F2 motors typically have a full step angle of  $1.8^\circ$ .



Full step angle  
 $1.8^\circ$

200  
steps

These use open-loop control without an encoder (position detection sensor), helping build simple and low-cost systems. Ease of use is a key point. In addition, they use holding force when stopped, and feature stable stopping without micro vibrations.



We hereby declare that the products listed in the catalog comply with the threshold values listed in Annex II, Directive (EU) 2015/863, which is an amendment to Directive 2011/65/EU of the European Parliament and of the Council of June 8, 2011 on the restriction of the use of certain hazardous substances (RoHS) in electrical and electronic equipment. However, the applications listed in ANNEX III of RoHS Directive 2011/65/EU are exempted from the restriction. Also, all models of the SANMOTION F2 drivers conform to CE/EN, UKCA, UL, and KC Mark as standard.

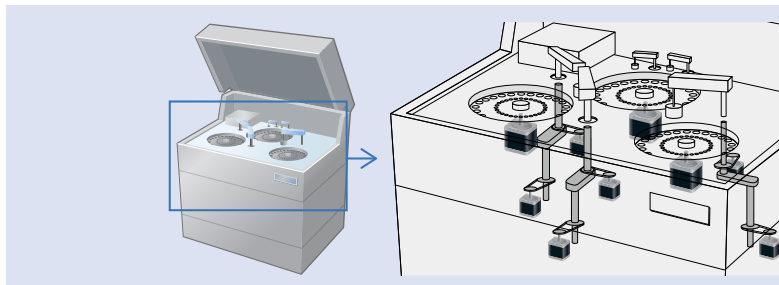


## Application Examples

The SANMOTION F2 can be used in a wide variety of applications, including fixed-speed drive synchronized with command pulses, accurate positioning, and stable stopping.

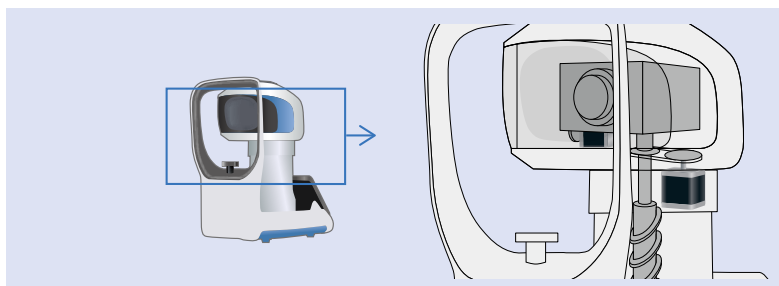
### Blood analyzer

For rotating the specimen tray and rotary table



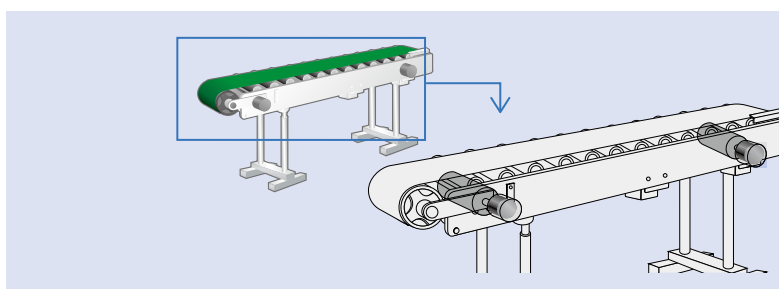
### Ophthalmology inspection equipment

For moving the camera vertically and horizontally



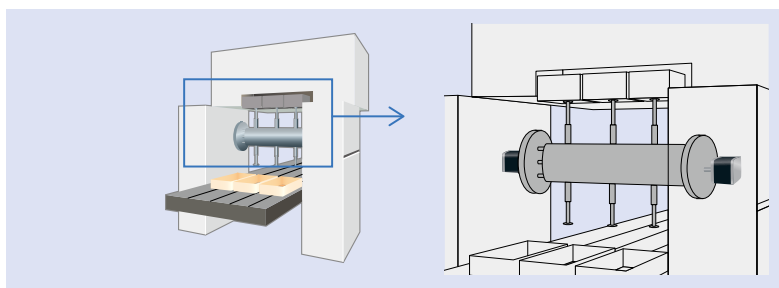
### Belt conveyor

For driving the belt and rollers



### Filling machine

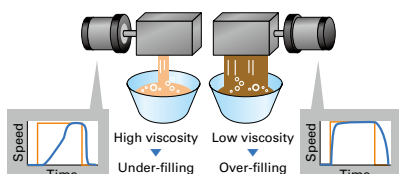
For filling liquids and pastes



## Induction motors and stepping motors

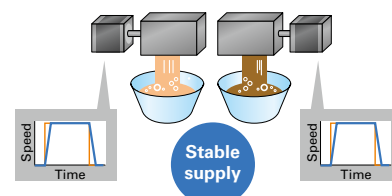
### With an induction motor

As the motor speed is affected by the viscosity of the filling material, the number of rotations must be adjusted by an inverter. Startup time is also slow.



### With a stepping motor

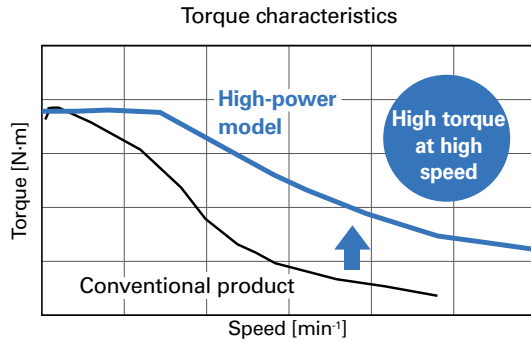
Stepping motors can stably dispense a constant amount because they simply rotate at a fixed angle regardless of the viscosity of the material. Startup time is also short.



# Features

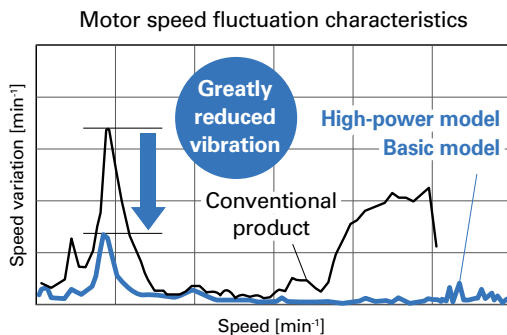
## High Torque

The high-power models achieve approximately 2 times higher torque at high speeds than our current models,<sup>(1)</sup> reducing the cycle time of your equipment and increasing productivity.



## Low Vibration

Motor vibration during operation has been reduced to one-third or less compared to the current models.<sup>(1)</sup> Thanks to their low vibration mode, SANMOTION F2 stepping drivers can smoothly operate stepping motors even at low resolution settings such as full-step and half-step modes. Vibrations can be suppressed regardless of the host controller.



## Microstepping Drive

The full step angle can be set to a resolution of up to 256 divisions in 16 levels. This realizes smooth operation with low vibration.

The high-power model drivers feature an electronic gear.

Used with setup software, the motor resolution can be set according to the ball screw pitch or gear reduction ratio.



Application: Surveillance camera  
Stable stopping and smooth operation reduce video shake

## Compact and Lightweight

The high-power models are newly designed to achieve a 12% reduction in volume and 33% reduction in mass compared to the current model.<sup>(2)</sup>

The basic models achieve a 7% reduction in volume and 39% reduction in mass while maintaining compatibility with the current models.<sup>(2)</sup>

## Various Useful Safety Functions

The high-power models are supported by setup software to adjust control parameters, analyze alarms, and monitor operating status from a PC.

Overcurrents and wire breakage caused by pinched motor power cables can be detected and notified with an alarm and motors can be stopped safely. Abnormal power supply voltage and heat generation can be notified even before the alarm goes off, ensuring the safety of your system.

## Easy Replacement

The basic models have mounting and interface compatibility with the current models<sup>(2)</sup> for easy replacement. Equipment performance can be improved by simply replacing your current stepping driver with a new model, with your current motor unchanged.

(1) Comparison with our current model: BS1D200P10 combined with SM2562C□0B11

(2) Comparison with our current model: BS1D200P10

## Setup Software

This setup software allows users to set control parameters and monitor the motor operating status from PCs. It also facilitates analyzing equipment status thanks to the optimal adjustment tailored to customer equipment. The software can be downloaded from Product Information on our website. <https://www.sanyodenki.com/>

### ■ Setup software name

SANMOTION MOTOR SETUP SOFTWARE

### ■ Supported operating systems

Windows 10/11

See our website for details on supported OS versions.

### ■ Main functions

Parameter settings (by group)

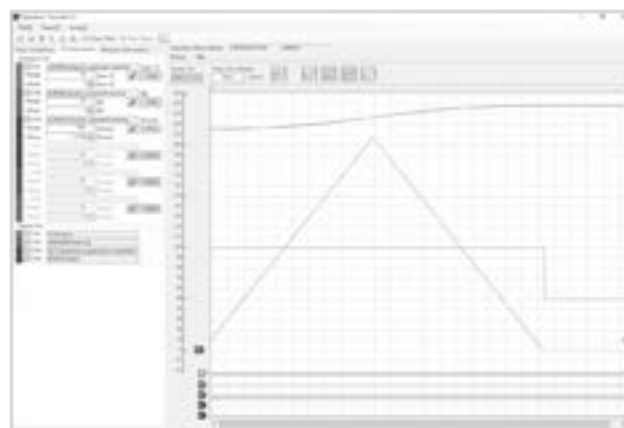
Diagnosis (alarm indicator, warning indicator, alarm cancellation)

Various measurement functions (operating waveform display)

A dedicated setup software connection unit is required to connect a driver to a PC.



Parameter setting screen



Operation tracing screen

| Alarm code | Alarm name | The state at the time of alarm | Alarm generating |
|------------|------------|--------------------------------|------------------|
| 0000       | No alarm   | 0000                           | 00:00:00         |

| Alarm code | Alarm name     | The state at the time of alarm | Alarm generating |
|------------|----------------|--------------------------------|------------------|
| 0001       | Over current   | 0001                           | 00:00:00         |
| 0002       | Over voltage   | 0002                           | 00:00:00         |
| 0003       | Position error | 0003                           | 00:00:00         |
| 0004       | Over current   | 0004                           | 00:00:00         |
| 0005       | Over voltage   | 0005                           | 00:00:00         |
| 0006       | Position error | 0006                           | 00:00:00         |

Alarm monitoring screen

# Lineup

## Drivers ▶ p. 11–

| Series                           | DC input<br>High-power models<br>High torque, high performance                         | DC input<br>Basic models                                                                                                                        |
|----------------------------------|----------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
|                                  |       |                                                              |
| Input voltage                    | 24 VDC                                                                                 | 24 VDC                                                                                                                                          |
| Microsteps                       | 2-phase mode: 1 to 256<br>5-phase mode: 2.5 to 625                                     | 2-phase mode: 1 to 256<br>5-phase mode: 2.5 to 625                                                                                              |
| Step angle                       | 2-phase mode:<br>1.8 to 0.00703125° /pulse<br>5-phase mode:<br>0.72 to 0.00288° /pulse | 2-phase mode:<br>0.9 to 0.003515625° /pulse<br>1.8 to 0.00703125° /pulse<br>5-phase mode:<br>0.36 to 0.00144° /pulse<br>0.72 to 0.00288° /pulse |
| Wiring of stepping motors        | Bipolar winding                                                                        | Bipolar winding                                                                                                                                 |
| Rated current of stepping motors | 3 A/phase, 4 A/phase                                                                   | 1 A/phase, 2 A/phase                                                                                                                            |
| Compatible motor size            | 56 mm sq./86 mm sq.                                                                    | 28 mm sq./42 mm sq./56 mm sq./60 mm sq./86 mm sq.                                                                                               |
| Control system                   | Pulse input, open loop                                                                 | Pulse input, open loop                                                                                                                          |
| Page                             | p. 11–                                                                                 | p. 23–                                                                                                                                          |

Note: A driver, motor, and optional motor cable and connector need to be purchased individually.

# Lineup

## Stepping Motors ▶ p. 42–

These stepping motors feature high torque. Select from among a broad lineup of products including an ultra-compact 14 mm sq. sized motor and a thin-profile motor with a 11.4 mm motor length.

Consult us regarding customization. ▶ p. 40



| Motor size                     | Full step angle | Holding torque [N·m]                                       | Model no.      | Page                                      |
|--------------------------------|-----------------|------------------------------------------------------------|----------------|-------------------------------------------|
|                                |                 |                                                            |                | Specifications/Characteristics/Dimensions |
| 14 mm sq. <b>Ultra-compact</b> | 1.8°            | 0.0065 to 0.01                                             | SH214□-5□□1    | p. 42                                     |
| 28 mm sq.                      | 1.8°            | 0.055 to 0.145                                             | SH228□-5□□1    | p. 43 to 44                               |
| 35 mm sq.                      | 1.8°            | 0.12 to 0.32                                               | SH35□□-1□□□0   | p. 45 to 46                               |
| 42 mm sq.                      | 0.9°            | 0.2 to 0.48                                                | SH142□-□□□1    | p. 47 to 48                               |
| 42 mm sq. <b>Thin-profile</b>  | 1.8°            | 0.083 to 0.186                                             | SS242□-50□□□   | p. 49                                     |
| 42 mm sq.                      | 1.8°            | 0.22 to 0.8                                                | SF242□-1□□□1   | p. 50 to 51                               |
| 50 mm sq.                      | 1.8°            | 0.28 to 0.53                                               | 103H670□-□□□0  | p. 52 to 54                               |
| 50 mm sq. <b>Thin-profile</b>  | 1.8°            | 0.1 to 0.215                                               | SS250□-80□□0   | p. 55                                     |
| 56 mm sq. (UL)                 | 1.8°            | 0.53 to 2.5                                                | SM256□C□0□□1   | p. 56 to 60                               |
| 56 mm sq. (CE/UKCA)            | 1.8°            | 0.39 to 1.27                                               | 103H712□-6□□0  | p. 69                                     |
| 60 mm sq.*                     | 1.8°            | It is recommended you use a 56 mm sq. motor (SM256□C□0□□1) |                | —                                         |
| 60 mm sq.                      | 0.9°            | 0.57 to 2.15                                               | SH160□-□□□0    | p. 62 to 63                               |
| 86 mm sq.                      | 1.8°            | 2.5 to 9                                                   | SH286□-□□□1    | p. 64 to 67                               |
| 86 mm sq. (CE/UKCA/UL)         | 1.8°            | 2.5 to 9                                                   | SM286□-□□□□    | p. 70 to 73                               |
| ø106 mm                        | 1.8°            | 10.8 to 19                                                 | 103H8922□-□□□1 | p. 68                                     |

• We provide motor customization services such as motors with an encoder, gear, and brake. For more information, see respective specifications and characteristics pages.

\* For 60 mm sq. size: It is recommended you use a 56 mm sq. motor (SM256□C□0□□1) that has equivalent torque as a conventional motor (103H782) in a smaller size. We also offer customization that makes the flange compatible with 60 mm sq. motors for easy replacement.

## IP65-Rated Stepping Motors Water/Dust protection ▶ p. 76–

These IP65-rated motors\* have superior water and dust resistance, and can be safely used in water-exposed environments such as in food processing machines.

\* Except for the shaft and cable ends.



| Motor size             | Full step angle | Holding torque [N·m] | Model no.   | Page                                      |
|------------------------|-----------------|----------------------|-------------|-------------------------------------------|
|                        |                 |                      |             | Specifications/Characteristics/Dimensions |
| 56 mm sq. (CE/UKCA/UL) | 1.8°            | 1 to 1.7             | SP256□-5□□0 | p. 77 to 78                               |
| 86 mm sq. (CE/UKCA/UL) | 1.8°            | 3.3 to 9             | SP286□-5□□0 | p. 79 to 80                               |

## In-Vacuum Stepping Motors Custom product ▶ p. 81–

We can customize motors for use in low to ultra-high vacuum environments to suit your system requirements.

| Motor size           |
|----------------------|
| 42 mm sq. to ø106 mm |



## Synchronous Motors Custom product ▶ p. 81–

Synchronous motors rotate at a constant speed in sync with the AC power frequency. Since they can be driven with AC power directly, a driver is not necessary.

| Motor size           |
|----------------------|
| 56 mm sq. to ø106 mm |



Note: A driver, motor, and optional motor cable and connector need to be purchased individually.

# Stepping Drivers/Motors

DC Input - High-Power Models

▶ p. 11

DC Input - Basic Models

▶ p. 23

# How to Read Specifications

**Bipolar** DC input driver (model: F2BFD400P100) and stepping motor

RoHS

| Motor size                           |                                              | 56 mm sq. (1.8° full step angle) |              |              |              | 56 mm sq. (1.8° full step angle) |
|--------------------------------------|----------------------------------------------|----------------------------------|--------------|--------------|--------------|----------------------------------|
| Motor length                         |                                              | 41.8 mm                          | 53.8 mm      | 75.8 mm      | 85.8 mm      | 41.8 mm                          |
| Single shaft                         | Motor model no.                              | SM2561C30B41                     | SM2562C30B41 | SM2563C30B41 | SM2564C30B41 | SM2561C40B41                     |
| Dual shaft                           | Motor model no.                              | SM2561C30B11                     | SM2562C30B11 | SM2563C30B11 | SM2564C30B11 | SM2561C40B11                     |
| Holding torque                       | N·m                                          | 0.75                             | 1.4          | 2.35         | 2.5          | 0.75                             |
| Rotor inertia                        | $\times 10^{-4} \text{ kg} \cdot \text{m}^2$ | 0.14                             | 0.28         | 0.5          | 0.6          | 0.14                             |
| Rated current                        | A/phase                                      | 3                                | 3            | 3            | 3            | 4                                |
| Motor mass <sup>(1)</sup>            | kg                                           | 0.49                             | 0.69         | 1.1          | 1.27         | 0.49                             |
| Allowable thrust load                | N                                            | 20                               | 20           | 20           | 20           | 20                               |
| Allowable radial load <sup>(2)</sup> | N                                            | 113                              | 102          | 78           | 70           | 113                              |

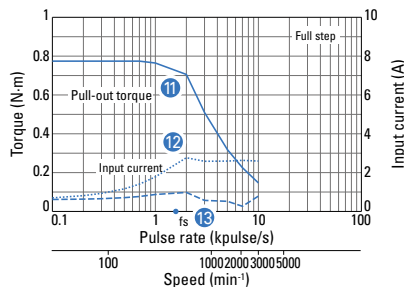
(1) For the driver mass, see ▶ p. 18

(2) Load is exerted to the shaft end.

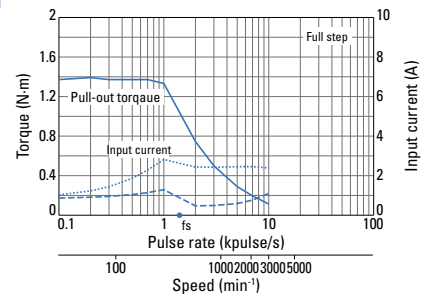
## Characteristics

With rubber coupling used   Pull-out torque —   Input current (with no load) - - -   Input current (with load) ·····   fs: Maximum starting frequency with no load

**SM2561C30B41** 24 VDC  
**SM2561C30B11**



**SM2562C30B41** 24 VDC  
**SM2562C30B11**



- 1 Model number of the driver.
- 2 This is the flange size and length of the stepping motor. The full step angle is the angle at which the motor rotates with each pulse in full step mode. In half step mode, the motor rotates by a half the full step angle with each pulse.
- 3 This is the model number of the stepping motor. The model number varies depending on whether the motor's shaft is single shaft or dual shaft.
- 4 This is the maximum torque that is generated when the stepping motor is rotated by exerting an external force on the shaft at 2-phase excitation at the rated current.
- 5 This is the moment of inertia of the rotor.
- 6 This is the rated current that flows to the motor winding.
- 7 This is the mass of the stepping motor.
- 8 This is the maximum allowable load to the shaft in the axial direction. Take care not to exceed this limit.
- 9 This is the maximum allowable load to the shaft in the direction perpendicular to the axial direction. Take care not to exceed this limit.
- 10 This graph shows the relationship between the pulse rate (frequency), motor speed, and torque. The driver's input current is shown in addition to the torque.

- 11 The pull-out torque is the maximum torque in which synchronized operation with command pulses can be maintained. If a torque that exceeds this value is applied to the stepping motor will be unable to synchronize with command pulses (step-out). Thus, when selecting a motor, you should allow for a torque margin of 1.4 to 2 times, in order to avoid step-out.
- 12 This graph shows the current value of the power supply powering the driver.
  - The blue dashed lines show the source current value when there is no load (motor by itself).
  - The blue dotted lines show the source current value when the maximum torque is applied to the stepping motor (with a load).

The required power supply capacity (W) is calculated from this graph.

- 13 The blue-colored dots in the lower part of the graph show the upper limit for the maximum starting frequency (fs) of the stepping motor by itself (with no load). The stepping motor will not operate normally if it is started using pulse rates that exceed these values. For this reason, it is necessary to start the stepping motor using pulse rates that are lower than these values. The maximum starting pulse rate with loads (fL) can be determined using the expression below.

$$f_L = \frac{f_s}{\sqrt{1 + \frac{J_L}{J_M}}}$$

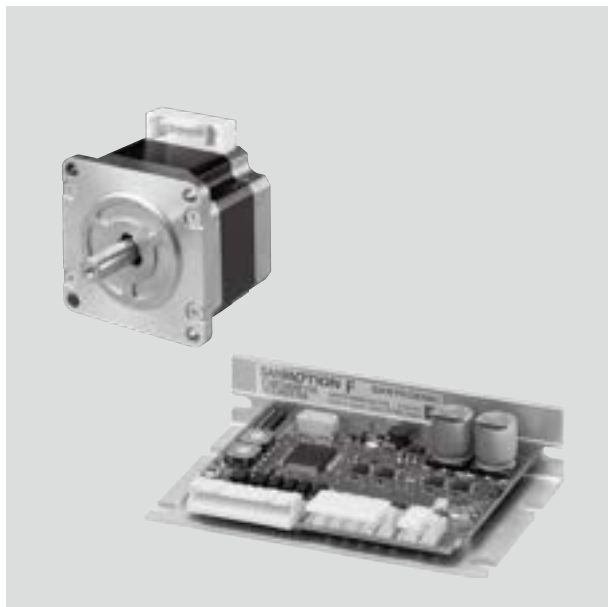
J<sub>M</sub>: Rotor inertia

J<sub>L</sub>: Load inertia

f<sub>s</sub>: Maximum starting pulse rate with no load

# DC Input Drivers/Motors

## High-power models



The high-power model is a high-output, high-performance driver. It can drive motors with high torque, contributing to shortening the cycle time of your equipment.

**Lineup** RoHS

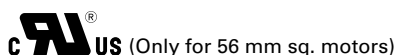
**Driver**



Bipolar Model no.: F2BFD400P100 Input voltage: 24 VDC

- The Instruction Manual is available for download from our website.

**Motor**



Motor sizes: 56 mm sq., 86 mm sq.

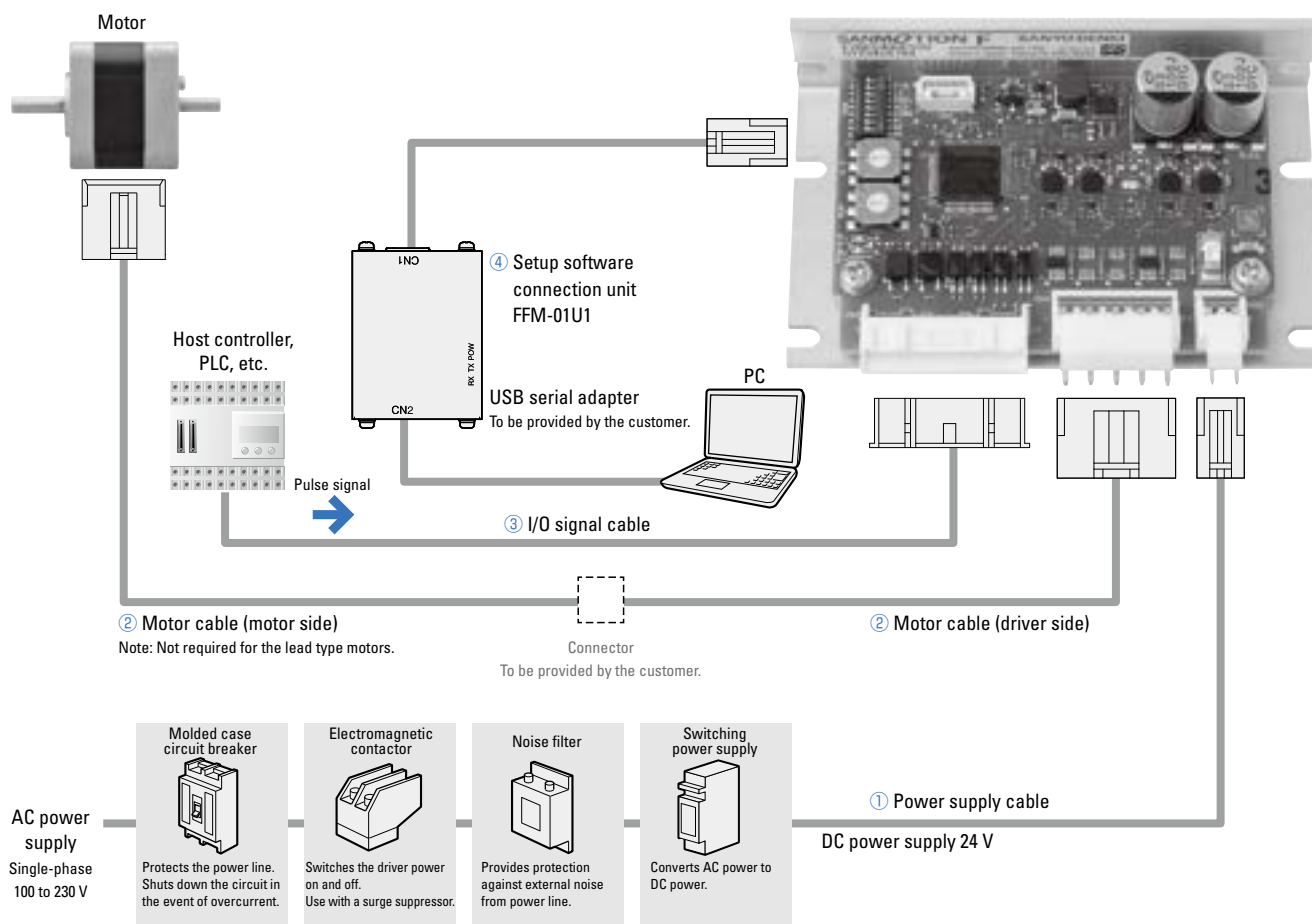
**Options**

Cable with connectors

Setup software connection unit

## System Configuration

- ① Power supply cable (option)
- ② Motor cable (option)
- ③ I/O signal cable (option)
- ④ Setup software connection unit (option)



# Combination Table

Motors marked with ① are lead-type motors. 300 mm or longer leads are attached to the motor.

Motors marked with ② are connector-type motors.

| Motor           |            |              |            |                |            |           | Driver |                    | Options     |                  |                                                                                       |           |          |
|-----------------|------------|--------------|------------|----------------|------------|-----------|--------|--------------------|-------------|------------------|---------------------------------------------------------------------------------------|-----------|----------|
| Model           | Motor size | Single shaft | Dual shaft | Page           |            | Model no. | Page   | Power supply cable | Motor cable | I/O signal cable | Connection unit                                                                       |           |          |
|                 |            |              |            | Specifications | Dimensions |           |        |                    |             |                  |                                                                                       |           |          |
| Standard models | 56 mm sq.  | SM2561C30B41 | C          | SM2561C30B11   | C          | p. 14, 17 | p. 16  | F2BFD400P100       | p. 18       | FC9P0010A        | FC9M0010A <sup>(1)</sup><br>(Driver side)<br>4837961-1 <sup>(2)</sup><br>(Motor side) | FC9S0010A | FFM-01U1 |
|                 |            | SM2562C30B41 | C          | SM2562C30B11   | C          | p. 14, 17 | p. 16  |                    |             |                  |                                                                                       |           |          |
|                 |            | SM2563C30B41 | C          | SM2563C30B11   | C          | p. 14, 17 | p. 16  |                    |             |                  |                                                                                       |           |          |
|                 |            | SM2564C30B41 | C          | SM2564C30B11   | C          | p. 14, 17 | p. 16  |                    |             |                  |                                                                                       |           |          |
|                 | 56 mm sq.  | SM2561C40B41 | C          | SM2561C40B11   | C          | p. 14, 17 | p. 16  | F2BFD400P100       | p. 18       | FC9P0010A        | FC9M0010A <sup>(1)</sup><br>(Driver side)<br>4837961-1 <sup>(2)</sup><br>(Motor side) | FC9S0010A | FFM-01U1 |
|                 |            | SM2562C40B41 | C          | SM2562C40B11   | C          | p. 15, 17 | p. 16  |                    |             |                  |                                                                                       |           |          |
|                 |            | SM2563C40B41 | C          | SM2563C40B11   | C          | p. 15, 17 | p. 16  |                    |             |                  |                                                                                       |           |          |
|                 |            | SM2564C40B41 | C          | SM2564C40B11   | C          | p. 15, 17 | p. 16  |                    |             |                  |                                                                                       |           |          |
|                 | 86 mm sq.  | SH2861-5141  | L          | SH2861-5111    | L          | p. 15, 17 | p. 16  | F2BFD400P100       | p. 18       | FC9P0010A        | FC9M0010A <sup>(1)</sup><br>(Driver side)                                             | FC9S0010A | FFM-01U1 |
|                 |            | SH2862-5141  | L          | SH2862-5111    | L          | p. 15, 17 | p. 16  |                    |             |                  |                                                                                       |           |          |

(1) Has a connector on the driver side. The motor-side connector/connection needs to be prepared by customers.

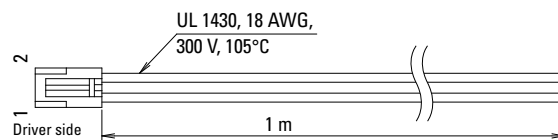
(2) Has a connector on the motor side. The cable relay connector/connection needs to be prepared by customers.

## Options

### ● Cable with connectors

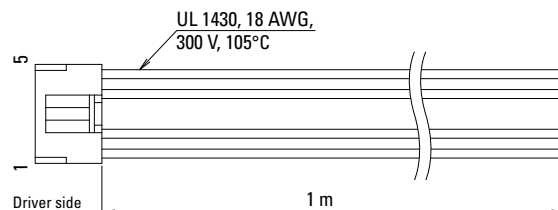
#### Power supply cable (Model no.: FC9P0010A)

| Pin no. | Color |
|---------|-------|
| 1       | White |
| 2       | Black |



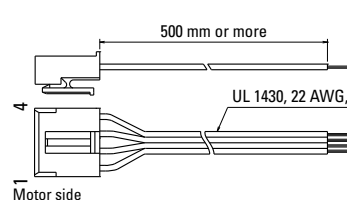
#### Motor cable Driver side (Model no.: FC9M0010A)

| Pin no. | Color  |
|---------|--------|
| 1       | Orange |
| 2       | Blue   |
| 3       | —      |
| 4       | Red    |
| 5       | Yellow |



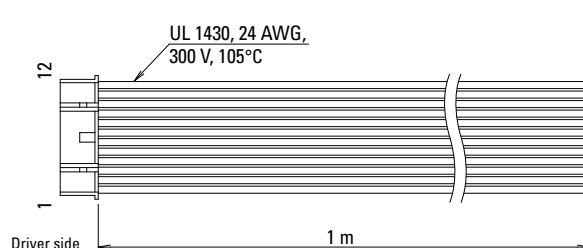
#### Motor cable Motor side (Model no.: 4837961-1)

| Pin no. | Color  |
|---------|--------|
| 1       | Orange |
| 2       | Blue   |
| 3       | Red    |
| 4       | Yellow |



#### I/O signal cable (Model no.: FC9S0010A)

| Pin no. | Color |
|---------|-------|
| 1       | Blue  |
| 2       |       |
| 3       |       |
| 4       |       |
| 5       |       |
| 6       |       |
| 7       |       |
| 8       |       |
| 9       |       |
| 10      |       |
| 11      |       |
| 12      |       |



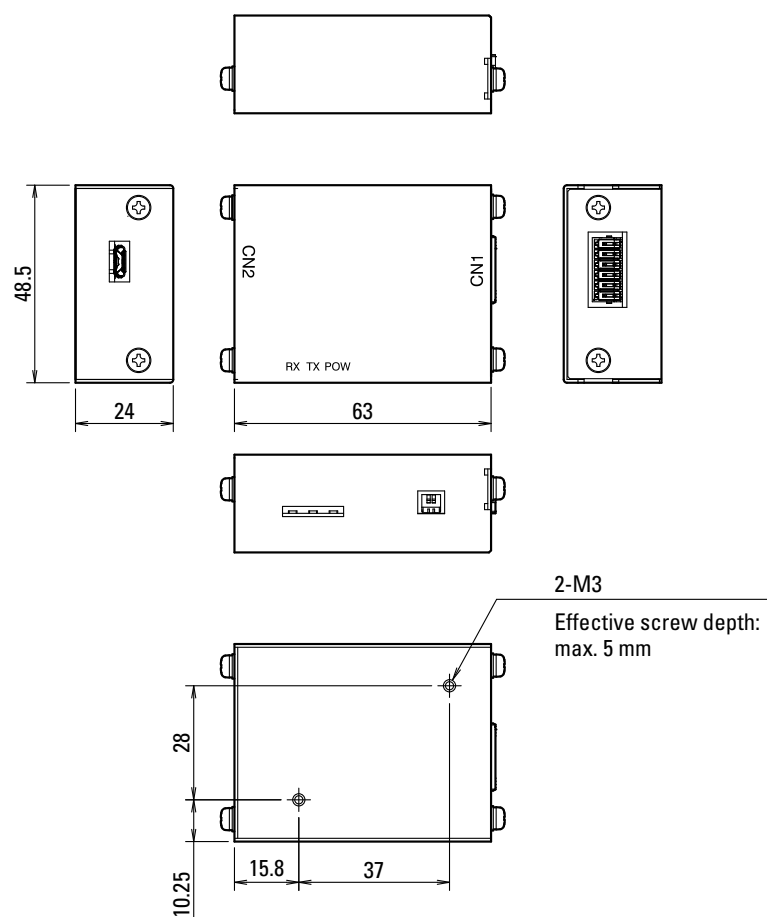
# Options

## ● Setup software connection unit (Model no.: FFM-01U1)

A set of a communication converter (FFM-01) and a communication cable (between converter and driver)

Note: The USB cable to connect the FFM-01 to a PC should be provided by the customer as shown in the table below.

| Interface        |                |
|------------------|----------------|
| PC side          | USB Type-A     |
| FFM-01 connector | USB 2.0 Type-B |



## Bipolar DC input driver (model: F2BFD400P100) and stepping motor

RoHS

| Motor size                           |                                      | 56 mm sq. (1.8° full step angle) |              |              |              | 56 mm sq. (1.8° full step angle) |
|--------------------------------------|--------------------------------------|----------------------------------|--------------|--------------|--------------|----------------------------------|
| Motor length                         |                                      | 41.8 mm                          | 53.8 mm      | 75.8 mm      | 85.8 mm      | 41.8 mm                          |
| Single shaft                         | Motor model no.                      | SM2561C30B41                     | SM2562C30B41 | SM2563C30B41 | SM2564C30B41 | SM2561C40B41                     |
| Dual shaft                           | Motor model no.                      | SM2561C30B11                     | SM2562C30B11 | SM2563C30B11 | SM2564C30B11 | SM2561C40B11                     |
| Holding torque                       | N·m                                  | 0.75                             | 1.4          | 2.35         | 2.5          | 0.75                             |
| Rotor inertia                        | × 10 <sup>-4</sup> kg·m <sup>2</sup> | 0.14                             | 0.28         | 0.5          | 0.6          | 0.14                             |
| Rated current                        | A/phase                              | 3                                | 3            | 3            | 3            | 4                                |
| Motor mass <sup>(1)</sup>            | kg                                   | 0.49                             | 0.69         | 1.1          | 1.27         | 0.49                             |
| Allowable thrust load                | N                                    | 20                               | 20           | 20           | 20           | 20                               |
| Allowable radial load <sup>(2)</sup> | N                                    | 113                              | 102          | 78           | 70           | 113                              |

(1) For the driver mass, see ▶ p. 18

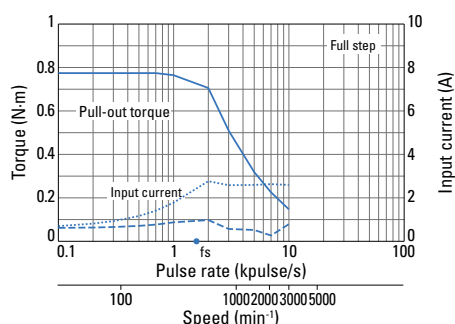
(2) Load is exerted to the shaft end.

## Characteristics

With rubber coupling used   Pull-out torque — Input current (with no load) - - - Input current (with load) ..... fs: Maximum starting frequency with no load ●

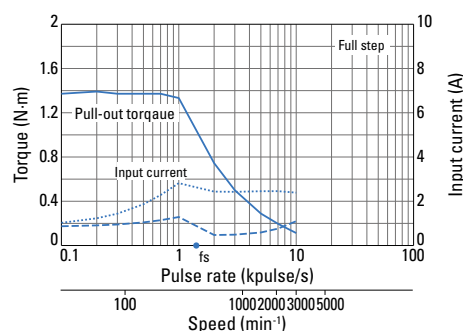
### SM2561C30B41 SM2561C30B11

24 VDC



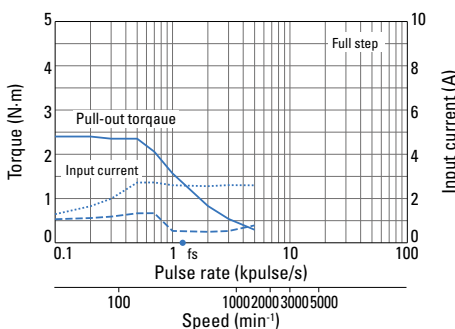
### SM2562C30B41 SM2562C30B11

24 VDC



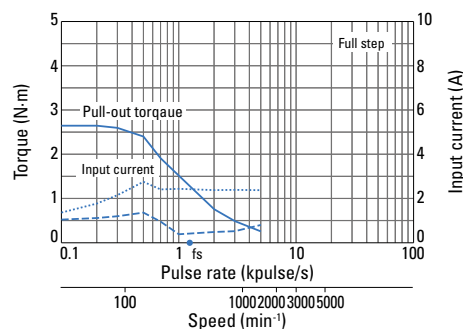
### SM2563C30B41 SM2563C30B11

24 VDC



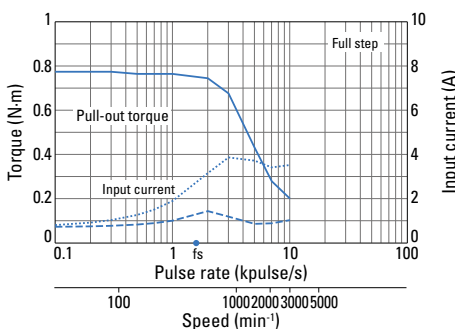
### SM2564C30B41 SM2564C30B11

24 VDC



### SM2561C40B41 SM2561C40B11

24 VDC



| Motor size                           |                                      | 56 mm sq. (1.8° full step angle) |              |              | 86 mm sq. (1.8° full step angle) |             |
|--------------------------------------|--------------------------------------|----------------------------------|--------------|--------------|----------------------------------|-------------|
| Motor length                         |                                      | 53.8 mm                          | 75.8 mm      | 85.8 mm      | 66 mm                            | 96.5 mm     |
| Single shaft                         | Motor model no.                      | SM2562C40B41                     | SM2563C40B41 | SM2564C40B41 | SH2861-5141                      | SH2862-5141 |
| Dual shaft                           | Motor model no.                      | SM2562C40B11                     | SM2563C40B11 | SM2564C40B11 | SH2861-5111                      | SH2862-5111 |
| Holding torque                       | N·m                                  | 1.4                              | 2.35         | 2.5          | 3.3                              | 6.4         |
| Rotor inertia                        | × 10 <sup>-4</sup> kg·m <sup>2</sup> | 0.28                             | 0.5          | 0.6          | 1.48                             | 3.0         |
| Rated current                        | A/phase                              | 4                                | 4            | 4            | 4                                | 4           |
| Motor mass <sup>(1)</sup>            | kg                                   | 0.69                             | 1.1          | 1.27         | 1.75                             | 2.9         |
| Allowable thrust load                | N                                    | 20                               | 20           | 20           | 60                               | 60          |
| Allowable radial load <sup>(2)</sup> | N                                    | 102                              | 78           | 70           | 200                              | 200         |

(1) For the driver mass, see ▶ p. 18

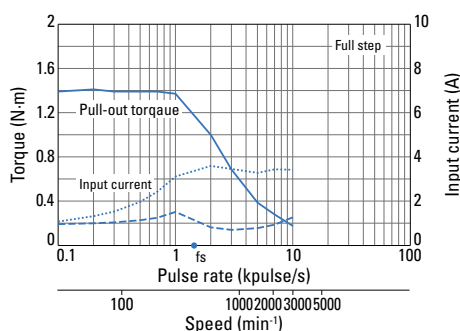
(2) Load is exerted to the shaft end.

## Characteristics

With rubber coupling used   Pull-out torque —   Input current (with no load) - - -   Input current (with load) ·····   fs: Maximum starting frequency with no load ●

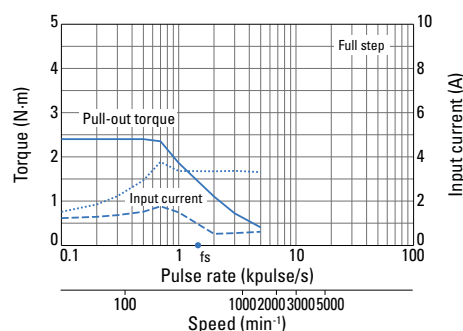
**SM2562C40B41**  
**SM2562C40B11**

24 VDC



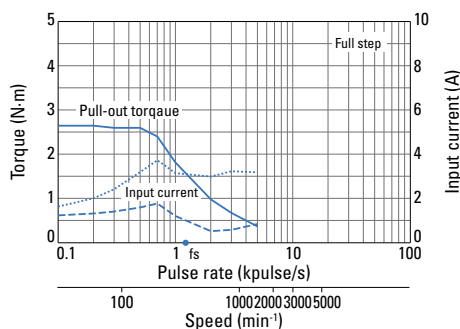
**SM2563C40B41**  
**SM2563C40B11**

24 VDC



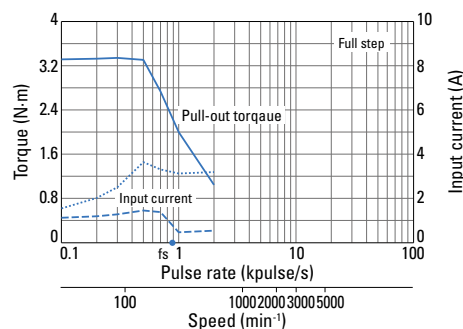
**SM2564C40B41**  
**SM2564C40B11**

24 VDC



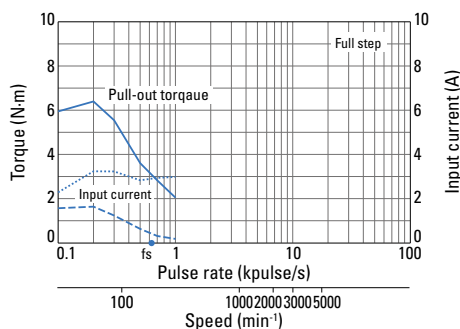
**SH2861-5141**  
**SH2861-5111**

24 VDC



**SH2862-5141**  
**SH2862-5111**

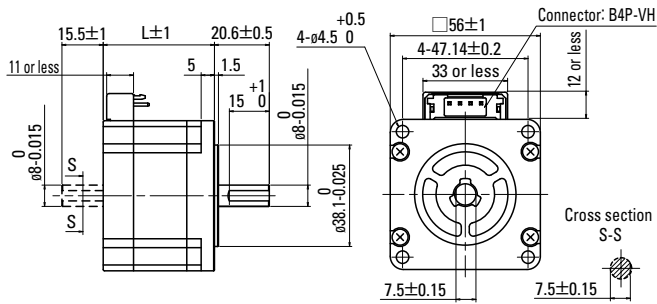
24 VDC



# Stepping Motor Dimensions

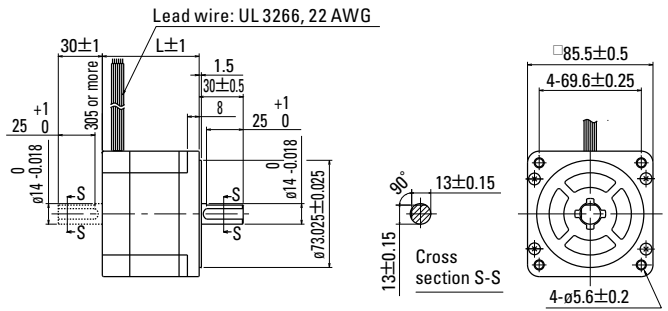
Unit: mm

## 56 mm sq.



| Motor model no. |              | Motor length (L) |
|-----------------|--------------|------------------|
| Single shaft    | Dual shaft   |                  |
| SM2561C30B41    | SM2561C30B11 | 41.8             |
| SM2562C30B41    | SM2562C30B11 | 53.8             |
| SM2563C30B41    | SM2563C30B11 | 75.8             |
| SM2564C30B41    | SM2564C30B11 | 85.8             |
| SM2561C40B41    | SM2561C40B11 | 41.8             |
| SM2562C40B41    | SM2562C40B11 | 53.8             |
| SM2563C40B41    | SM2563C40B11 | 75.8             |
| SM2564C40B41    | SM2564C40B11 | 85.8             |

## 86 mm sq.



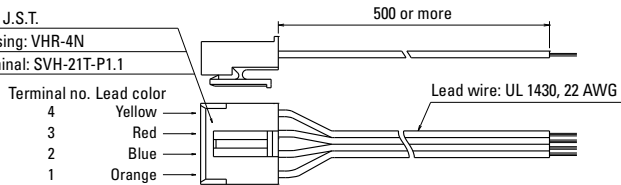
| Motor model no. |             | Motor length (L) |
|-----------------|-------------|------------------|
| Single shaft    | Dual shaft  |                  |
| SH2861-5141     | SH2861-5111 | 66               |
| SH2862-5141     | SH2862-5111 | 96.5             |

## Bipolar motor cable 4837961-1

Mfr.: J.S.T.

Housing: VHR-4N

Terminal: SVH-21T-P1.1



# Stepping Motor General Specifications

|                                                              |                                                                                                                                                                                                                             |                                                         |
|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|
| Motor model no.                                              | SM256□                                                                                                                                                                                                                      | SH286□                                                  |
| Operation type                                               | —                                                                                                                                                                                                                           |                                                         |
| Operating ambient temperature                                | -10 to +50°C                                                                                                                                                                                                                |                                                         |
| Storage temperature                                          | -20 to +65°C                                                                                                                                                                                                                |                                                         |
| Operating ambient humidity                                   | 20 to 90% RH (non-condensing)                                                                                                                                                                                               |                                                         |
| Storage humidity                                             | 5 to 95 % RH (non-condensing)                                                                                                                                                                                               |                                                         |
| Operating altitude                                           | Up to 1000 m above sea level                                                                                                                                                                                                |                                                         |
| Vibration resistance                                         | Frequency 10 to 500 Hz, amplitude 1.52 mm (10 to 70 Hz), vibration acceleration 150 m/s <sup>2</sup> (70 to 500 Hz), sweep time 15 min/cycle, a total of 12 tests in both opposite directions for each of X, Y, and Z axes. |                                                         |
| Shock resistance                                             | Acceleration 500 m/s <sup>2</sup> , duration 11 ms, half sine wave, tested 3 times in both directions for each X, Y, and Z axis for a total of 18 times                                                                     |                                                         |
| Thermal class                                                | B (+130°C)<br>(A for UL models)                                                                                                                                                                                             | B (+130°C)                                              |
| Dielectric strength                                          | 1120 VAC for 1 minute (between motor winding and frame)                                                                                                                                                                     | 1000 VAC for 1 minute (between motor winding and frame) |
| Insulation resistance                                        | 100 MΩ min. at 500 VDC (between motor winding and frame)                                                                                                                                                                    |                                                         |
| Protection rating                                            | —                                                                                                                                                                                                                           |                                                         |
| Winding temperature rise                                     | 80 K or less (based on our own standard)                                                                                                                                                                                    |                                                         |
| Positional accuracy tolerance                                | ±0.054°                                                                                                                                                                                                                     | ±0.09                                                   |
| Thrust play <sup>(1)</sup>                                   | 0.075 mm (With a 10 N load)                                                                                                                                                                                                 | 0.075 mm (With a 10 N load)                             |
| Radial play <sup>(2)</sup>                                   | 0.025 mm (With a 5 N load)                                                                                                                                                                                                  | 0.025 mm (With a 5 N load)                              |
| Shaft runout                                                 | 0.025 mm                                                                                                                                                                                                                    | 0.025 mm                                                |
| Concentricity of motor shaft and fitting part                | ø0.075 mm                                                                                                                                                                                                                   | ø0.075 mm                                               |
| Perpendicularity of mounting surface and motor shaft surface | 0.1 mm                                                                                                                                                                                                                      | 0.15 mm                                                 |
| Motor mounting orientation                                   | Can be installed vertically or horizontally.                                                                                                                                                                                |                                                         |

(1) Thrust play: Shaft position displacement when a load is exerted in a direction parallel to the motor shaft.

(2) Radial play: Maximum shaft position displacement when a load is exerted in a direction perpendicular to the motor shaft. Load is exerted on the point 1/3 the shaft length from the shaft end.

## Safety standards

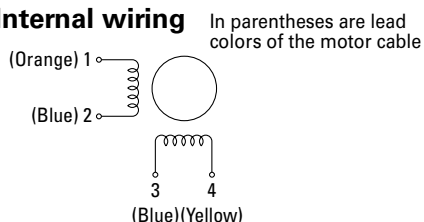
Model no.: SM256□ UL models

| UL | Classification      | Standards            | File no. |
|----|---------------------|----------------------|----------|
|    | UL                  | UL 1004-1, UL 1004-6 | E179832  |
|    | UL for Canada (cUL) | CSA C22.2 No. 100    |          |

# Internal Wiring and Rotational Directions

Connector type Model no.: SM256□

## Internal wiring



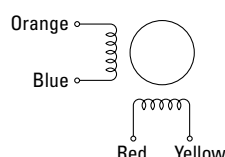
## Direction of motor rotation

When excited by a direct current in the order shown below, the direction of rotation is clockwise as viewed from the output shaft side.

|                     |   | Connector pin no. |   |   |   |
|---------------------|---|-------------------|---|---|---|
|                     |   | 3                 | 2 | 4 | 1 |
| Excitation sequence | 1 | —                 | — | + | + |
|                     | 2 | +                 | — | — | + |
|                     | 3 | +                 | + | — | — |
|                     | 4 | —                 | + | + | — |

Lead type Model no.: SH286□

## Internal wiring

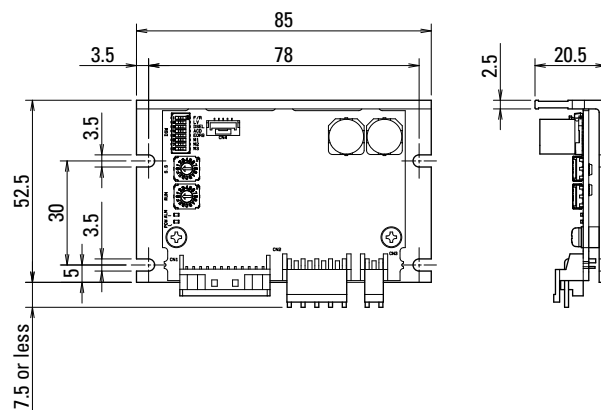


## Direction of motor rotation

When excited by a direct current in the order shown below, the direction of rotation is clockwise as viewed from the output shaft side.

|                     |   | Lead color |      |        |        |
|---------------------|---|------------|------|--------|--------|
|                     |   | Red        | Blue | Yellow | Orange |
| Excitation sequence | 1 | —          | —    | +      | +      |
|                     | 2 | +          | —    | —      | +      |
|                     | 3 | +          | +    | —      | —      |
|                     | 4 | —          | +    | +      | —      |

## Driver Dimensions Unit: mm



## Driver Specifications

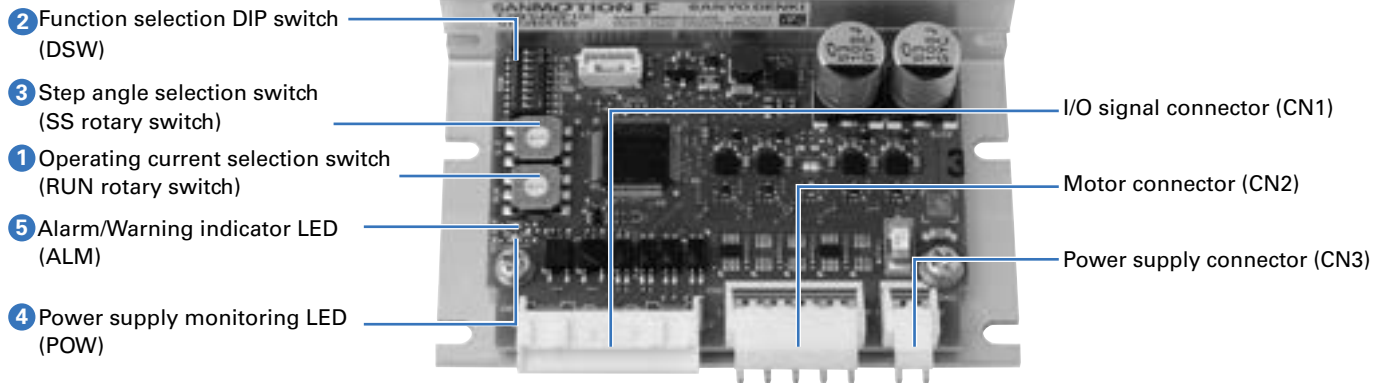
### General specifications

|                        |                                                     |                                                                                                                                                                                                                                                                             |
|------------------------|-----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Model no.              |                                                     | <b>F2BFD400P100</b>                                                                                                                                                                                                                                                         |
| General specifications | Input voltage                                       | 24 VDC $\pm 10\%$                                                                                                                                                                                                                                                           |
|                        | Input current                                       | 5 A                                                                                                                                                                                                                                                                         |
|                        | Protection class                                    | Class III                                                                                                                                                                                                                                                                   |
|                        | Operating environment                               | Installation category (Overvoltage category): I (CE), pollution level: 2                                                                                                                                                                                                    |
|                        | Operating ambient temperature                       | 0 to +50°C                                                                                                                                                                                                                                                                  |
|                        | Storage temperature                                 | -20 to +70°C                                                                                                                                                                                                                                                                |
|                        | Operating ambient humidity                          | Below 90% RH (non-condensing)                                                                                                                                                                                                                                               |
|                        | Storage humidity                                    | Below 90% RH (non-condensing)                                                                                                                                                                                                                                               |
|                        | Operating altitude                                  | Up to 1000 m above sea level                                                                                                                                                                                                                                                |
|                        | Vibration resistance                                | 5 m/s <sup>2</sup> , at frequency of 10 to 55 Hz in each X, Y, and Z direction for 2 hours                                                                                                                                                                                  |
|                        | Shock resistance                                    | 20 m/s <sup>2</sup>                                                                                                                                                                                                                                                         |
|                        | Dielectric strength                                 | 700 VDC for 1 minute (between power input terminal and chassis)                                                                                                                                                                                                             |
|                        | Insulation resistance                               | 10 M $\Omega$ min. at 500 VDC (between power input terminal and chassis)                                                                                                                                                                                                    |
| Mass                   |                                                     | 0.06 kg                                                                                                                                                                                                                                                                     |
| Functions              | Mode selection                                      | Pulse input mode (1-/2-input mode), low vibration mode (on/off), automatic current limiting (on/off), step division mode (2-/5-phase mode), initial excitation phase (excitation origin/excitation phase of last power off), motor selection, operating current, step angle |
|                        | Protection functions                                | Power supply voltage monitoring, overheat detection, overcurrent protection, non-volatile memory checksum error, hardware error, motor wire breakage detection, command speed error, limit reached                                                                          |
|                        | LED indicators                                      | Power supply monitoring, alarm status monitoring                                                                                                                                                                                                                            |
|                        | PC-based functions                                  | Parameter customization, operating status monitoring                                                                                                                                                                                                                        |
| I/O signal             | Command pulse input signal                          | Photocoupler input method; input resistance: 260 $\Omega$<br>High-level input signal voltage: 4.0 to 5.25 V, Low-level input signal voltage: 0 to 0.5 V<br>Between the high- and low-levels shall be 4.0 V or more. Maximum input frequency 400 kpulse/s                    |
|                        | Power down input signal                             | Photocoupler input method; input resistance: 480 $\Omega$<br>High-level input signal voltage: 4.0 to 5.25 V, Low-level input signal voltage: 0 to 0.5 V                                                                                                                     |
|                        | Step angle selection input signal                   | Photocoupler input method; input resistance: 480 $\Omega$<br>High-level input signal voltage: 4.0 to 5.25 V, Low-level input signal voltage: 0 to 0.5 V                                                                                                                     |
|                        | Phase origin monitor output/<br>Alarm output signal | Open-collector output through photocoupler, collector-to-emitter voltage: 30 VDC or less<br>Output current: 10 mA or less, Output saturation voltage: 1.0 V or less                                                                                                         |

### Safety standards

| Safety standards                                                   |                                                      | Standards                       |
|--------------------------------------------------------------------|------------------------------------------------------|---------------------------------|
| Directive                                                          | Directive                                            |                                 |
| UL/cUL standards                                                   | —                                                    | UL 61800-5-1 (File No. E179775) |
| KC Mark (Korea Certification Mark)                                 | —                                                    | KS C 9610-6-2, KS C 9610-6-4    |
| CE marking for EU Directive                                        | Low Voltage Directive (2014/35/EU)                   | EN 61800-5-1                    |
|                                                                    | Electromagnetic Compatibility Directive (2014/30/EU) | EN 61000-6-2<br>EN 61000-6-4    |
|                                                                    | RoHS Directive (2011/65/EU)                          | EN IEC 63000: 2018              |
| UKCA marking for Great Britain<br>(UK Conformity Assessed Marking) | Electrical Equipment (Safety) Regulations 2016       | EN 61800-5-1                    |
|                                                                    | Electromagnetic Compatibility Regulations 2016       | EN 61000-6-2<br>EN 61000-6-4    |
|                                                                    | RoHS Regulations 2012                                | EN IEC 63000: 2018              |

# Driver Part Names and Functions



## 1. Operating current selection switch (RUN rotary switch)

The value of the motor operating current can be set with a rotary switch.

| Dial              | 0   | 1   | 2   | 3   | 4   | 5   | 6   | 7   |
|-------------------|-----|-----|-----|-----|-----|-----|-----|-----|
| Motor current (A) | 4   | 3.8 | 3.6 | 3.4 | 3.2 | 3   | 2.8 | 2.6 |
| Dial              | 8   | 9   | A   | B   | C   | D   | E   | F   |
| Motor current (A) | 2.4 | 2.2 | 2   | 1.8 | 1.6 | 1.4 | 1.2 | 1   |

- The factory setting is F (1 A).  
Select the operating current after checking the rated current of the combination motor.
- If there are sufficient margins of motor torque, decreasing operating current value becomes effective for reduction in heat generation and vibration.
- Make sure to have sufficient operation margins before determining the motor current value to adjust operating current.

## 2. Function selection DIP switch (DSW)

Functions can be selected to suit your application.

Factory settings

|      | ON                       | OFF                      |                            |
|------|--------------------------|--------------------------|----------------------------|
| F/R  | <input type="checkbox"/> | <input type="checkbox"/> | Pulse input mode selection |
| LV   | <input type="checkbox"/> | <input type="checkbox"/> | Low-vibration mode         |
| DSEL | <input type="checkbox"/> | <input type="checkbox"/> | Step division mode         |
| ACD  | <input type="checkbox"/> | <input type="checkbox"/> | Auto-Current-Down          |
| EORG | <input type="checkbox"/> | <input type="checkbox"/> | Excitation selection       |
| M1   | <input type="checkbox"/> | <input type="checkbox"/> | Motor selection            |
| M2   | <input type="checkbox"/> | <input type="checkbox"/> |                            |
| M3   | <input type="checkbox"/> | <input type="checkbox"/> |                            |

- First, do the settings of the motor to be combined with the driver.
- Make sure to turn off the power supply of the driver when changing the settings of the function selection DIP switch.

## Combination motor settings

| M1  | M2  | M3  | Wiring current: 3 A/phase <sup>(1)</sup> |              | Wiring current: 4 A/phase |              |
|-----|-----|-----|------------------------------------------|--------------|---------------------------|--------------|
|     |     |     | Motor size                               | Model no.    | Motor size                | Model no.    |
| OFF | OFF | OFF | Reserved                                 |              | Reserved                  |              |
| ON  | OFF | OFF | Reserved                                 |              | 56 mm sq.                 | SM2561C40B□1 |
| OFF | ON  | OFF | 56 mm sq.                                | SM2561C30B□1 | 56 mm sq.                 | SM2562C40B□1 |
| ON  | ON  | OFF | Reserved                                 |              | 56 mm sq.                 | SM2563C40B□1 |
| OFF | OFF | ON  | 56 mm sq.                                | SM2562C30B□1 | 56 mm sq.                 | SM2564C40B□1 |
| ON  | OFF | ON  | 56 mm sq.                                | SM2563C30B□1 | 86 mm sq.                 | SH2861-51□1  |
| OFF | ON  | ON  | 56 mm sq.                                | SM2564C30B□1 | Reserved                  |              |
| ON  | ON  | ON  | Reserved                                 |              | 86 mm sq.                 | SH2862-51□1  |

(1)When using a 3 A/phase motor, be sure to set the operating current selection switch (RUN rotary switch) to 75% or less. Failure to follow this may cause the motor to overheat and burnout.

### 1. Pulse input mode selection (F/R)

Pulse input mode can be selected.

| F/R | Pulse input mode       |
|-----|------------------------|
| ON  | 1-input mode (CK, U/D) |
| OFF | 2-input mode (CW, CCW) |

### 2. Low-vibration mode selection (LV)

Motors can smoothly operate even at low-resolution settings such as full-step (1 subdivision) and half-step (2 subdivisions) modes.

| LV  | Operation mode              |
|-----|-----------------------------|
| ON  | Low-vibration mode enabled  |
| OFF | Low-vibration mode disabled |

### 3. Step division mode selection (DSEL)

Select the step angle selection switch (SS rotary switch) mode.

| DSEL | Resolution mode                                                                                      |
|------|------------------------------------------------------------------------------------------------------|
| OFF  | 2-phase mode: Operable as a normal 2-phase stepping system with a step angle of 1.8° to 0.00703125°. |
| ON   | 5-phase mode: Operable as a normal 5-phase stepping system with a step angle of 0.72° to 0.00288°.   |

## 4. Auto-Current-Down (ACD)

This function reduces the motor current at rest (200 ms after the last pulse is applied), which is effective in suppressing heat generation and reducing the current consumption of the motor and driver. The current and switching time when turned on can be changed by parameters.

| ACD | Current at rest         |
|-----|-------------------------|
| ON  | 50% of driving current  |
| OFF | 100% of driving current |

## 5. Excitation selection (EORG)

The excitation phase at the time of power-on is selected.

| EORG | The excitation phase at power-on  |
|------|-----------------------------------|
| ON   | The excitation phase at power-off |
| OFF  | Excitation origin                 |

## 3. Step angle selection switch (SS rotary switch)

The number of subdivisions for a full step can be set with the rotary switch.

After selecting 2- or 5-phase mode by setting the "3" (DSEL) of the DSW (function selection DIP switch), set the step angle selection switch for the desired step angle.

| 5-phase mode:<br>When the DSW's "3" (DSEL) is set to ON |            |            |            | 2-phase mode:<br>When the DSW's "3" (DSEL) is set to OFF |            |            |             |
|---------------------------------------------------------|------------|------------|------------|----------------------------------------------------------|------------|------------|-------------|
| SS                                                      | Microsteps | Resolution | Step angle | SS                                                       | Microsteps | Resolution | Step angle  |
| 0                                                       | 2.5        | 500        | 0.72°      | 0                                                        | 1          | 200        | 1.8°        |
| 1 (default setting)                                     | 5          | 1000       | 0.36°      | 1 (default setting)                                      | 2          | 400        | 0.9°        |
| 2                                                       | 6.25       | 1250       | 0.288°     | 2                                                        | 4          | 800        | 0.45°       |
| 3                                                       | 10         | 2000       | 0.18°      | 3                                                        | 5          | 1000       | 0.36°       |
| 4                                                       | 12.5       | 2500       | 0.144°     | 4                                                        | 8          | 1600       | 0.225°      |
| 5                                                       | 20         | 4000       | 0.09°      | 5                                                        | 10         | 2000       | 0.18°       |
| 6                                                       | 25         | 5000       | 0.072°     | 6                                                        | 16         | 3200       | 0.1125°     |
| 7                                                       | 50         | 10000      | 0.036°     | 7                                                        | 25         | 5000       | 0.072°      |
| 8                                                       | 62.5       | 12500      | 0.0288°    | 8                                                        | 32         | 6400       | 0.05625°    |
| 9                                                       | 100        | 20000      | 0.018°     | 9                                                        | 50         | 10000      | 0.036°      |
| A                                                       | 125        | 25000      | 0.0144°    | A                                                        | 64         | 12800      | 0.028125°   |
| B                                                       | 200        | 40000      | 0.009°     | B                                                        | 100        | 20000      | 0.018°      |
| C                                                       | 250        | 50000      | 0.0072°    | C                                                        | 125        | 25000      | 0.0144°     |
| D                                                       | 312.5      | 62500      | 0.00576°   | D                                                        | 128        | 25600      | 0.0140625°  |
| E                                                       | 500        | 100000     | 0.0036°    | E                                                        | 250        | 50000      | 0.0072°     |
| F                                                       | 625        | 125000     | 0.00288°   | F                                                        | 256        | 51200      | 0.00703125° |

## 4. Power supply monitoring LED (POW)

Lights up when the control and main circuit power supply are turned on.

## 5. Alarm/Warning indicator LED (ALM)

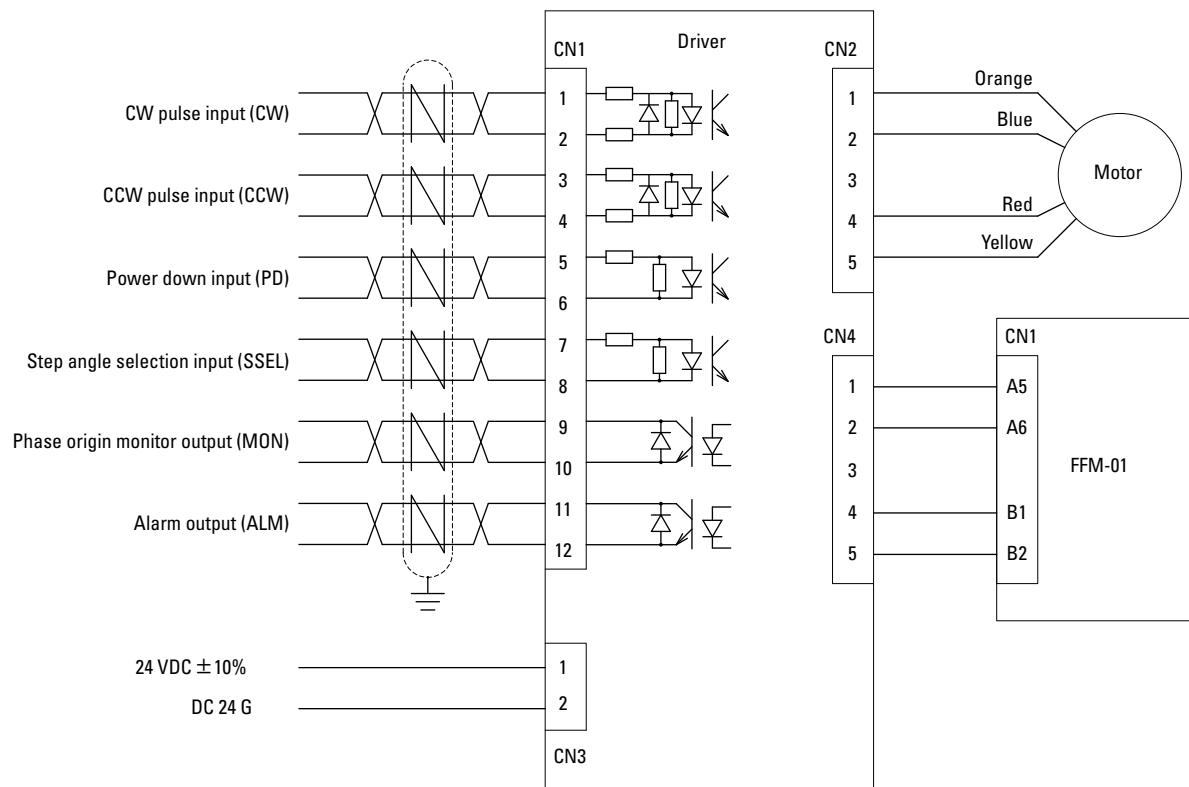
Flashes repeatedly when an alarm is generated.

| LED indicators                   | Status                             |
|----------------------------------|------------------------------------|
| "ALM" blinks once repeatedly     | Main power supply undervoltage     |
| "ALM" blinks 2 times repeatedly  | Main power supply overvoltage      |
| "ALM" blinks 3 times repeatedly  | Driver overheat                    |
| "ALM" blinks 4 times repeatedly  | Overcurrent                        |
| "ALM" blinks 5 times repeatedly  | Non-volatile memory checksum error |
| "ALM" blinks 6 times repeatedly  | Hardware error                     |
| "ALM" blinks 7 times repeatedly  | Motor wire breakage                |
| "ALM" blinks 8 times repeatedly  | Parameter error                    |
| "ALM" blinks 9 times repeatedly  | Command speed error                |
| "ALM" blinks 10 times repeatedly | Limit reached                      |

- When an alarm occurs, the "ALM" LED blinks and the winding current of the stepping motor is cut off and the status will shift to a "non-excitation" state. At the same time, an output signal is transmitted from the alarm output terminal of the I/O signal connector to the outside.
- In the event of an alarm, identify the cause of the alarm from the number of LED blinks, eliminate the cause, and turn on the power supply again.
- In the case of an alarm, the LED will be lit for about 1 second followed by blinks; in the case of a warning, the LED will only blink.

# Connections and Signals

## External wiring diagram



## Cable size

| Type                   | Applicable wire                                                 | Insulation diameter | Wire length |
|------------------------|-----------------------------------------------------------------|---------------------|-------------|
| Power cable (CN3)      | 20 AWG (0.5 mm <sup>2</sup> ) to 18 AWG (0.75 mm <sup>2</sup> ) | ø1.7 to ø3.0 mm     | Below 3 m   |
| I/O signal cable (CN1) | 24 AWG (0.2 mm <sup>2</sup> ) to 22 AWG (0.3 mm <sup>2</sup> )  | ø1.0 to ø1.5 mm     | Below 2 m   |
| Motor cable (CN2)      | 20 AWG (0.5 mm <sup>2</sup> ) to 18 AWG (0.75 mm <sup>2</sup> ) | ø1.7 to ø3.0 mm     | Below 10 m  |

Note: When bundling wire together or running wires through the duct, take the reduction rate of each wire allowable current into consideration.

When the ambient temperature is relatively high, the wire service life will be shortened due to thermal deterioration.

In this case, please use Heat-resistant Indoor PVC (HIV).

## Input/output signal specification overview

| Signal                                 | CN1 Pin no. | Function overview                                                                                                                                                                                           |
|----------------------------------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CW pulse input                         | 1<br>2      | When in 2-input mode, a CW-direction pulse is input.                                                                                                                                                        |
| Pulse train input                      | 1<br>2      | When in 1-input mode, a drive pulse train is input to rotate the motor.                                                                                                                                     |
| CCW pulse input                        | 3<br>4      | When in 2-input mode, a CCW-direction pulse is input.                                                                                                                                                       |
| Rotational direction input             | 3<br>4      | When in 1-input mode, a drive pulse is input to designate the rotational direction.<br>Internal photocoupler ON ... CW direction<br>Internal photocoupler OFF ... CCW direction                             |
| Power down input (Standard)            | 5<br>6      | Shuts down the motor current.<br>The terminal function can be selected in the setup software as a GPIO 1 signal.                                                                                            |
| Step angle selection input (Standard)  | 7<br>8      | Enables the number of step divisions set with the setup software.<br>The terminal function can be selected in the setup software as a GPIO 2 signal.                                                        |
| Phase origin monitor output (Standard) | 9<br>10     | Turned on when the excitation phase is at the origin. Output logic is the normally-open contact.<br>The terminal function can be selected in the setup software as a GPIO 1 signal.                         |
| Alarm output (Standard)                | 11<br>12    | Turned on when an alarm occurs. The motor shifts to a "non-excitation" state. Output logic is the normally-open contact.<br>The terminal function can be selected in the setup software as a GPIO 2 signal. |

Note: The CW direction refers to the clockwise direction when the motor is viewed from the output shaft side.

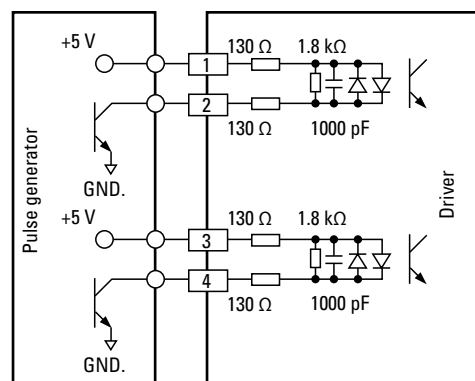
The CCW direction refers to the counter-clockwise direction when the , motor is viewed from the output shaft side.

# CW (CK) and CCW (U/D) Input Circuit Configuration

## Connection example

Pulse crest value

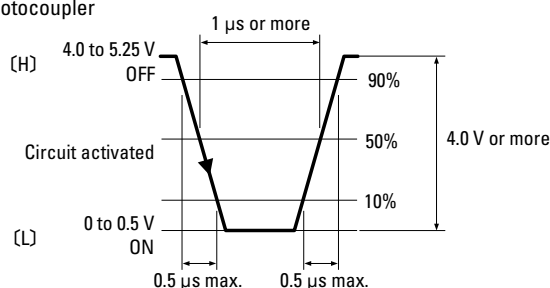
High-level: 4.0 to 5.25 V, low-level: 0 to 0.5 V, high-to-low: 4.0 V or more



- Ensure that the pulse duty is 50% or less.
- Maximum input frequency is 400 kpulse/s.
- If the peak voltage of the input signal exceeds 5.25 V, add an external current-limiting resistor R to limit the input current to around 10 mA. (Take the photocoupler forward voltage of 1.5 V into consideration.)

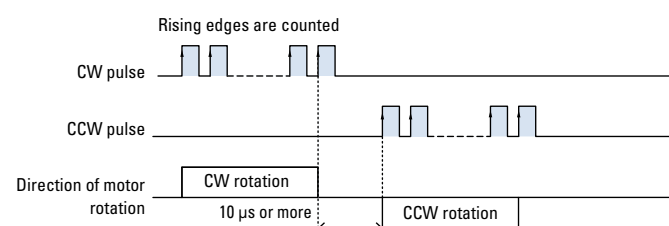
## Input signal specifications

Photocoupler



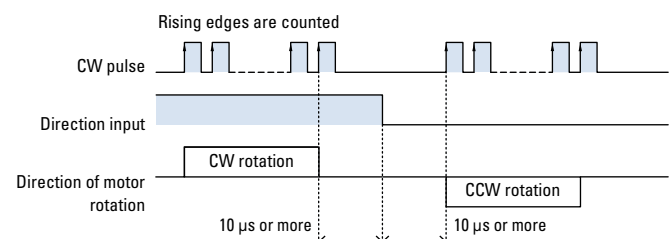
## Command pulse timing

### 2-input mode



- Shaded areas indicate that internal photocoupler is ON. Internal circuit (motor) starts operating at the rising edge of the photocoupler ON.
- When applying a pulse to CW, set the CCW-side internal photocoupler to OFF.
- When applying a pulse to CCW, set the CW-side internal photocoupler to OFF.
- The CW/CCW pulse switching time of "10 μs or more" is the operating time for the driver internal circuit, not the motor response time. Set a time in which the motor can respond for actual operations.
- 1- and 2-input modes can be switched by DIP switch (F/R) settings.

### 1-input mode



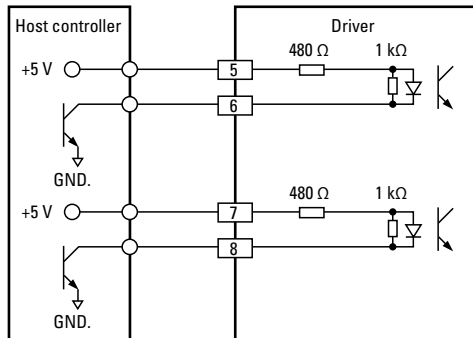
- Shaded areas indicate that internal photocoupler is ON. Internal circuit (motor) starts operating at the rising edge of the photocoupler ON.
- When applying a pulse to CW, set the CCW-side internal photocoupler to OFF.
- When applying a pulse to CCW, set the CW-side internal photocoupler to OFF.
- The CW/CCW pulse switching time of "10 μs or more" is the operating time for the driver internal circuit, not the motor response time. Set a time in which the motor can respond for actual operations.
- 1- and 2-input modes can be switched by DIP switch (F/R) settings.

## SSEL and PD Input Circuit Configuration

### Connection example

Pulse crest value

High-level: 4.0 to 5.25 V, low-level: 0 to 0.5 V

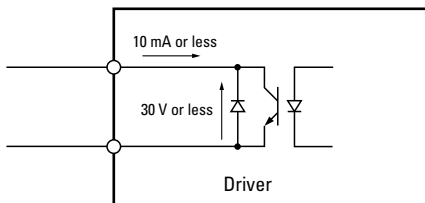


- If the peak voltage of the input signal exceeds 5.25 V, add an external current-limiting resistor R to limit the input current to around 6 mA. (Take the photocoupler forward voltage of 1.5 V into consideration.)

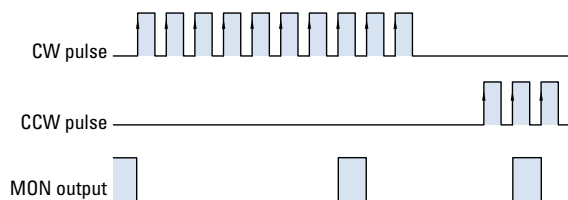
## MON and ALM Output Circuit Configuration

### Connection example

|                              |                |
|------------------------------|----------------|
| Collector-to-emitter voltage | 30 VDC or less |
| Output current               | 10 mA or less  |
| Output saturation voltage    | 1.0 V or less  |



### MON output

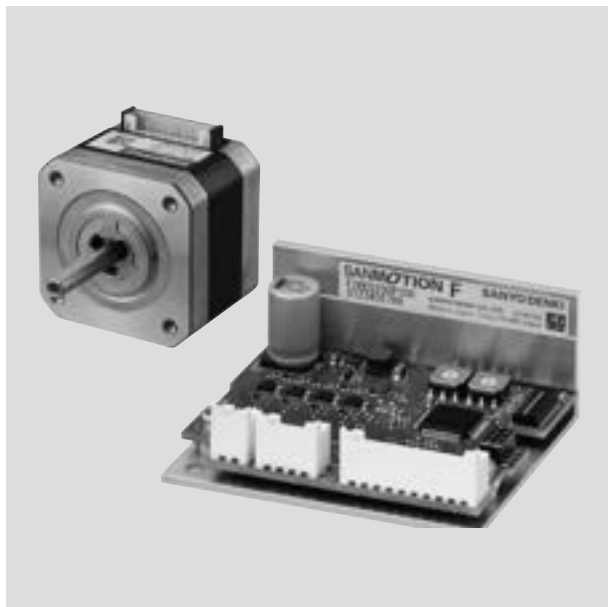


E.g., for 2-phase, 2-step (half-step) mode

- Photocoupler is turned on when the motor's excitation phase is at the origin.
- Inputting pulse turns on photocoupler every 7.2° of motor output axis from the phase origin (3.6° for a full step angle of 0.9°).
- Set command frequency to 30 kpulse/s or less when using the phase origin monitor.
- Perform switching of subdivisions via step angle selection input (SSEL) with phase origin monitor output turned on and motor being stopped.
- If the number of divisions is switched at a point other than the excitation origin, the phase origin monitor output may not be output correctly.

# DC Input Drivers/Motors

## Basic models



The small, lightweight basic models are compatible with the current models for easy replacement.

### Lineup RoHS

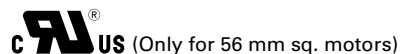
#### Driver



Bipolar Model no.: F2BED200P100 Input voltage: 24 VDC

- The Instruction Manual is available for download from our website.

#### Motor



(Only for 56 mm sq. motors)

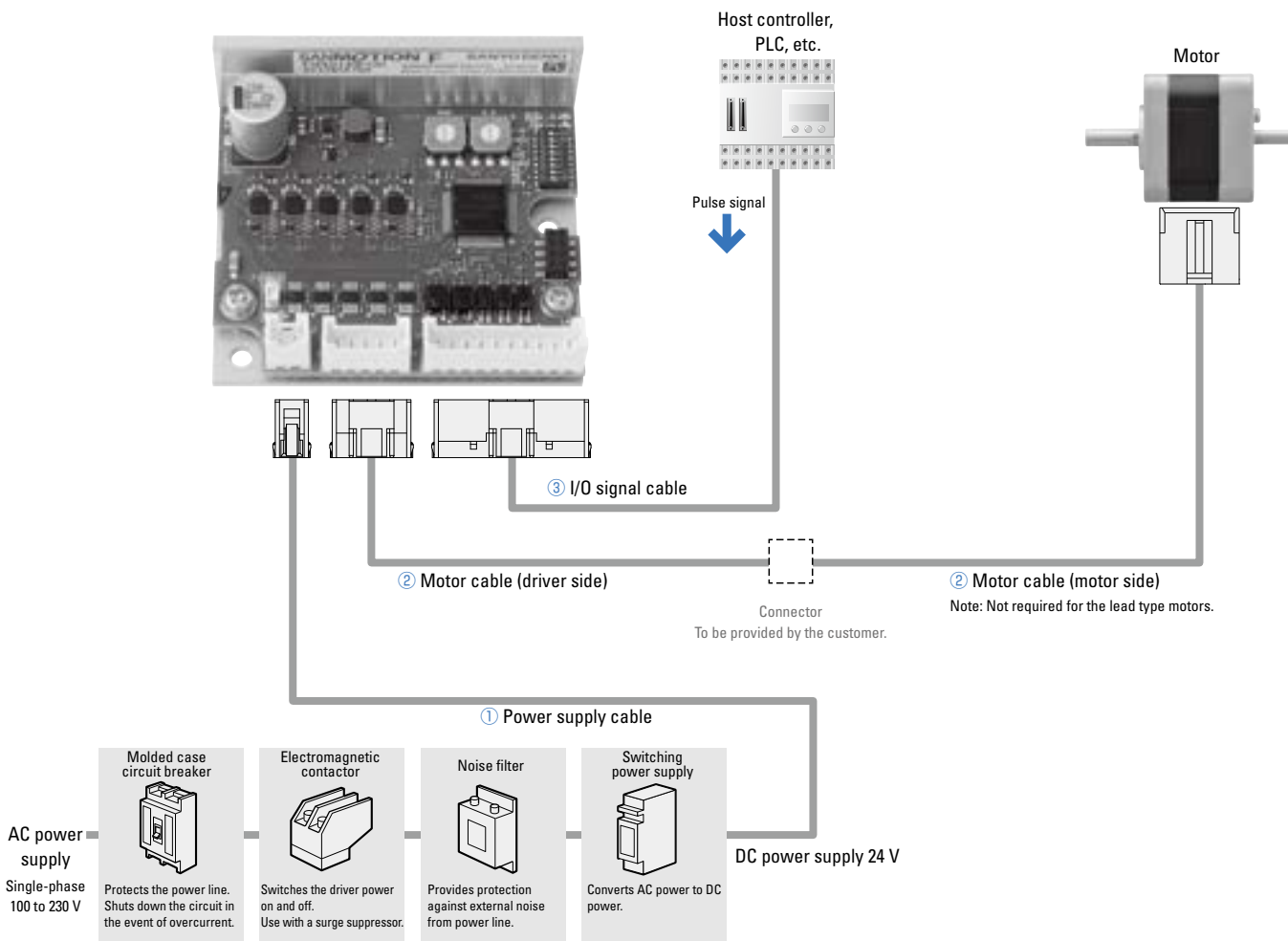
Motor size: 28 mm sq., 42 mm sq., 56 mm sq., 60 mm sq., 86 mm sq.

#### Options

Cable with connectors

## System Configuration

- ① Power supply cable (option)
- ② Motor cable (option)
- ③ I/O signal cable (option)



# Combination Table

Motors marked with ① are lead-type motors. 300 mm or longer leads are attached to the motor.  
Motors marked with ② are connector-type motors.

| Motor           |            |              |                |                |            |       | Driver       |       | Options            |                                                                                       |                  |
|-----------------|------------|--------------|----------------|----------------|------------|-------|--------------|-------|--------------------|---------------------------------------------------------------------------------------|------------------|
| Model           | Motor size | Single shaft | Dual shaft     | Page           |            |       | Model no.    | Page  | Power supply cable | Motor cable                                                                           | I/O signal cable |
|                 |            |              |                | Specifications | Dimensions |       |              |       |                    |                                                                                       |                  |
| Standard models | 28 mm sq.  | SH2281-5771  | L SH2281-5731  | L              | p. 25, 31  | p. 29 | F2BED200P100 | p. 32 | FC8P0010A          | FC8M0010A <sup>(1)</sup><br>(Driver side)                                             | FC8S0010A        |
|                 |            | SH2285-5771  | L SH2285-5731  | L              | p. 25, 31  | p. 29 |              |       |                    |                                                                                       |                  |
|                 | 42 mm sq.  | SH1421-5241  | L SH1421-5211  | L              | p. 25, 31  | p. 29 | F2BED200P100 | p. 32 | FC8P0010A          | FC8M0010A <sup>(1)</sup><br>(Driver side)                                             | FC8S0010A        |
|                 |            | SH1422-5241  | L SH1422-5211  | L              | p. 25, 31  | p. 29 |              |       |                    |                                                                                       |                  |
|                 |            | SH1424-5241  | L SH1424-5211  | L              | p. 25, 31  | p. 29 |              |       |                    |                                                                                       |                  |
|                 |            | SF2421-10B41 | C SF2421-10B11 | C              | p. 26, 31  | p. 29 |              |       |                    |                                                                                       |                  |
|                 |            | SF2422-10B41 | C SF2422-10B11 | C              | p. 26, 31  | p. 29 |              |       |                    |                                                                                       |                  |
|                 |            | SF2423-10B41 | C SF2423-10B11 | C              | p. 26, 31  | p. 29 |              |       |                    |                                                                                       |                  |
|                 | 56 mm sq.  | SF2424-10B41 | C SF2424-10B11 | C              | p. 26, 31  | p. 29 | F2BED200P100 | p. 32 | FC8P0010A          | FC8M0010A <sup>(1)</sup><br>(Driver side)<br>4835775-1 <sup>(2)</sup><br>(Motor side) | FC8S0010A        |
|                 |            | SM2561C20B41 | C SM2561C20B11 | C              | p. 27, 31  | p. 30 |              |       |                    |                                                                                       |                  |
|                 |            | SM2562C20B41 | C SM2562C20B11 | C              | p. 27, 31  | p. 30 |              |       |                    |                                                                                       |                  |
|                 |            | SM2563C20B41 | C SM2563C20B11 | C              | p. 27, 31  | p. 30 |              |       |                    |                                                                                       |                  |
|                 | 60 mm sq.  | SH1601-5240  | L SH1601-5210  | L              | p. 28, 31  | p. 30 | F2BED200P100 | p. 32 | FC8P0010A          | FC8M0010A <sup>(1)</sup><br>(Driver side)                                             | FC8S0010A        |
|                 |            | SH1602-5240  | L SH1602-5210  | L              | p. 28, 31  | p. 30 |              |       |                    |                                                                                       |                  |
|                 |            | SH1603-5240  | L SH1603-5210  | L              | p. 28, 31  | p. 30 |              |       |                    |                                                                                       |                  |
|                 | 86 mm sq.  | SH2861-5041  | L SH2861-5011  | L              | p. 28, 31  | p. 30 | F2BED200P100 | p. 32 | FC8P0010A          | FC8M0010A <sup>(1)</sup><br>(Driver side)                                             | FC8S0010A        |
|                 |            | SH2862-5041  | L SH2862-5011  | L              | p. 28, 31  | p. 30 |              |       |                    |                                                                                       |                  |

(1) Has a connector on the driver side. The motor-side connector/connection needs to be prepared by customers.

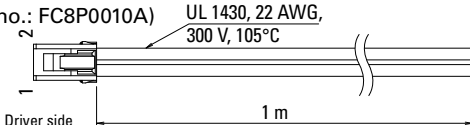
(2) Has a connector on the motor side. The cable relay connector/connection needs to be prepared by customers.

## Options

### ● Cable with connectors

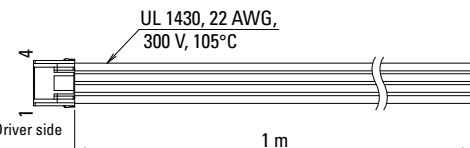
**Power supply cable** (Model no.: FC8P0010A)

| Pin no. | Color |
|---------|-------|
| 1       | White |
| 2       | Black |



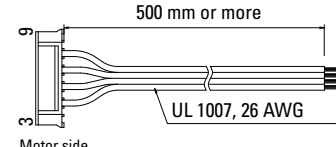
**Motor cable Driver side** (Model no.: FC8M0010A)

| Pin no. | Color  |
|---------|--------|
| 1       | Orange |
| 2       | Blue   |
| 3       | Red    |
| 4       | Yellow |



**Motor cable Motor side** (Model no.: 4835775-1)

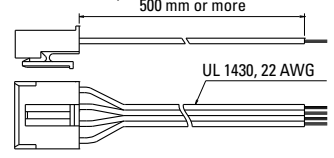
| Pin no. | Color  |
|---------|--------|
| 9       | Orange |
| 7       | Blue   |
| 5       | Yellow |
| 3       | Red    |



This is a motor-driver cable for use with SF242□-10B□1 motors.

**Motor cable Motor side** (Model no.: 4837961-1)

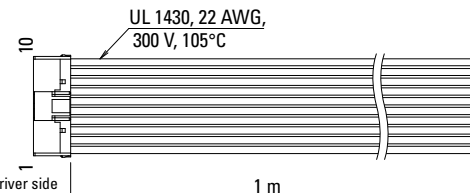
| Pin no. | Color  |
|---------|--------|
| 1       | Orange |
| 2       | Blue   |
| 3       | Red    |
| 4       | Yellow |



This is a motor-driver cable for use with SM256□C20B□1 motors.

**I/O signal cable** (Model no.: FC8S0010A)

| Pin no. | Color |
|---------|-------|
| 1       | Blue  |
| 2       |       |
| 3       |       |
| 4       |       |
| 5       |       |
| 6       |       |
| 7       |       |
| 8       |       |
| 9       |       |
| 10      |       |



| Motor size                           |                                      | 28 mm sq. (1.8° full step angle) |             | 42 mm sq. (0.9° full step angle) |             |             |
|--------------------------------------|--------------------------------------|----------------------------------|-------------|----------------------------------|-------------|-------------|
| Motor length                         |                                      | 32 mm                            | 51.5 mm     | 33 mm                            | 39 mm       | 48 mm       |
| Single shaft                         | Motor model no.                      | SH2281-5771                      | SH2285-5771 | SH1421-5241                      | SH1422-5241 | SH1424-5241 |
| Dual shaft                           | Motor model no.                      | SH2281-5731                      | SH2285-5731 | SH1421-5211                      | SH1422-5211 | SH1424-5211 |
| Holding torque                       | N·m                                  | 0.07                             | 0.145       | 0.23                             | 0.34        | 0.48        |
| Rotor inertia                        | ×10 <sup>-4</sup> ·kg·m <sup>2</sup> | 0.01                             | 0.022       | 0.044                            | 0.066       | 0.089       |
| Rated current                        | A/phase                              | 1                                | 1           | 2                                | 2           | 2           |
| Motor mass <sup>(1)</sup>            | kg                                   | 0.11                             | 0.2         | 0.24                             | 0.29        | 0.38        |
| Allowable thrust load                | N                                    | 3                                | 3           | 10                               | 10          | 10          |
| Allowable radial load <sup>(2)</sup> | N                                    | 42                               | 49          | 25                               | 24          | 20          |

(1) For the driver mass, see ▶ p. 32

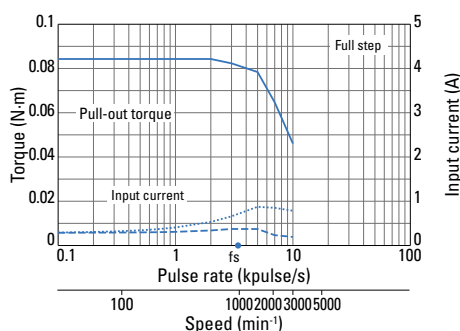
(2) Load is exerted to the shaft end.

## Characteristics

With rubber coupling used   Pull-out torque —   Input current (with no load) - - -   Input current (with load) ·····   fs: Maximum starting frequency with no load ●

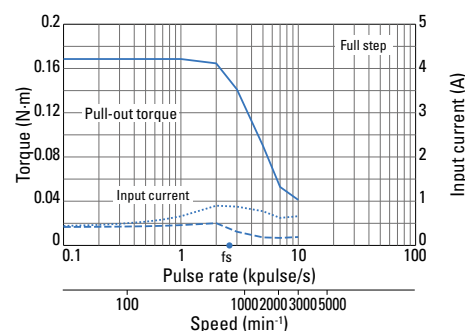
**SH2281-5771**  
**SH2281-5731**

24 VDC



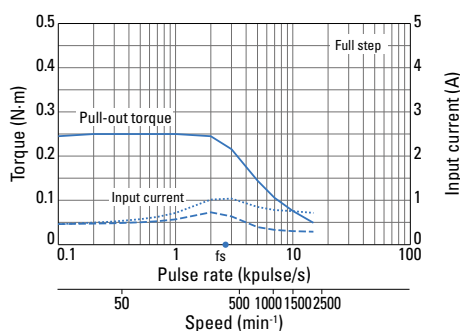
**SH2285-5771**  
**SH2285-5731**

24 VDC



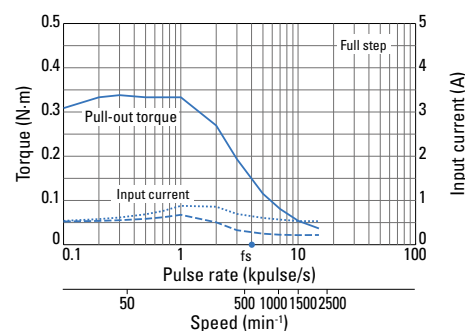
**SH1421-5241**  
**SH1421-5211**

24 VDC



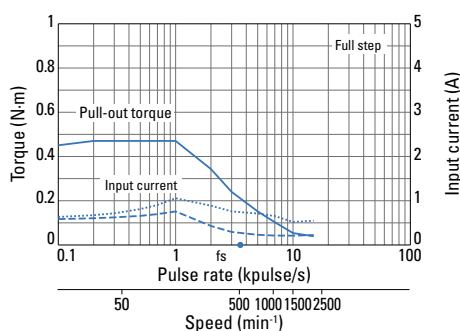
**SH1422-5241**  
**SH1422-5211**

24 VDC



**SH1424-5241**  
**SH1424-5211**

24 VDC



## Bipolar DC input driver (model: F2BED200P100) and stepping motor

RoHS

| Motor size                           |                                       | 42 mm sq. (1.8° full step angle) |              |              |              |
|--------------------------------------|---------------------------------------|----------------------------------|--------------|--------------|--------------|
| Motor length                         |                                       | 33 mm                            | 39 mm        | 48 mm        | 59.5 mm      |
| Single shaft                         | Motor model no.                       | SF2421-10B41                     | SF2422-10B41 | SF2423-10B41 | SF2424-10B41 |
| Dual shaft                           | Motor model no.                       | SF2421-10B11                     | SF2422-10B11 | SF2423-10B11 | SF2424-10B11 |
| Holding torque                       | N·m                                   | 0.29                             | 0.43         | 0.56         | 0.8          |
| Rotor inertia                        | × 10 <sup>-4</sup> ·kg·m <sup>2</sup> | 0.031                            | 0.046        | 0.063        | 0.094        |
| Rated current                        | A/phase                               | 1                                | 1            | 1            | 1            |
| Motor mass <sup>(1)</sup>            | kg                                    | 0.23                             | 0.3          | 0.38         | 0.51         |
| Allowable thrust load                | N                                     | 10                               | 10           | 10           | 10           |
| Allowable radial load <sup>(2)</sup> | N                                     | 38                               | 34           | 30           | 20           |

(1) For the driver mass, see ▶ p. 32

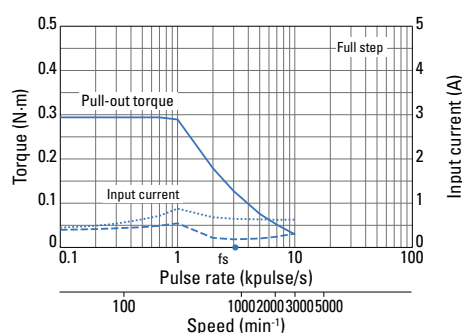
(2) Load is exerted to the shaft end.

## Characteristics

With rubber coupling used   Pull-out torque — Input current (with no load) - - - Input current (with load) ····· fs: Maximum starting frequency with no load ●

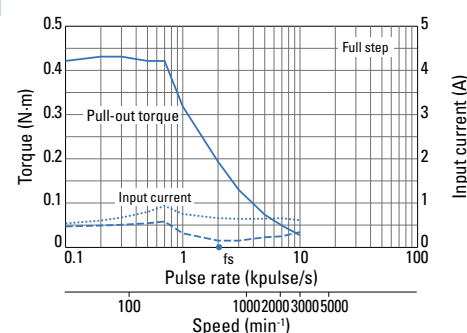
**SF2421-10B41**  
**SF2421-10B11**

24 VDC



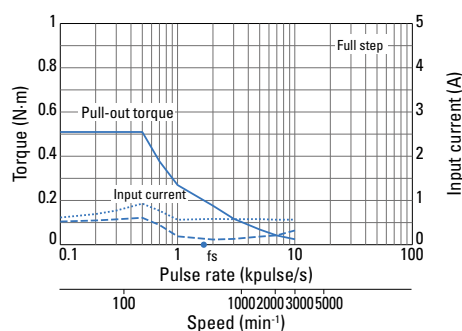
**SF2422-10B41**  
**SF2422-10B11**

24 VDC



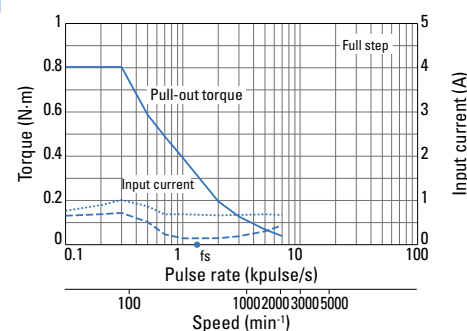
**SF2423-10B41**  
**SF2423-10B11**

24 VDC



**SF2424-10B41**  
**SF2424-10B11**

24 VDC



| Motor size                           |                                      | 56 mm sq. (1.8° full step angle) |              |              |              |
|--------------------------------------|--------------------------------------|----------------------------------|--------------|--------------|--------------|
| Motor length                         |                                      | 41.8 mm                          | 53.8 mm      | 75.8 mm      | 85.8 mm      |
| Single shaft                         | Motor model no.                      | SM2561C20B41                     | SM2562C20B41 | SM2563C20B41 | SM2564C20B41 |
| Dual shaft                           | Motor model no.                      | SM2561C20B11                     | SM2562C20B11 | SM2563C20B11 | SM2564C20B11 |
| Holding torque                       | N·m                                  | 0.75                             | 1.4          | 2.35         | 2.5          |
| Rotor inertia                        | × 10 <sup>-4</sup> kg·m <sup>2</sup> | 0.14                             | 0.28         | 0.5          | 0.6          |
| Rated current                        | A/phase                              | 2                                | 2            | 2            | 2            |
| Motor mass <sup>(1)</sup>            | kg                                   | 0.49                             | 0.69         | 1.1          | 1.27         |
| Allowable thrust load                | N                                    | 20                               | 20           | 20           | 20           |
| Allowable radial load <sup>(2)</sup> | N                                    | 113                              | 102          | 78           | 70           |

(1) For the driver mass, see ▶ p. 32

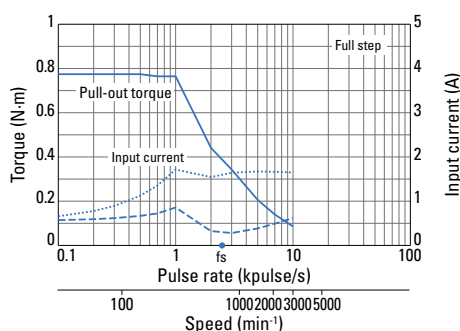
(2) Load is exerted to the shaft end.

## Characteristics

With rubber coupling used   Pull-out torque — Input current (with no load) - - - - Input current (with load) ····· fs: Maximum starting frequency with no load ●

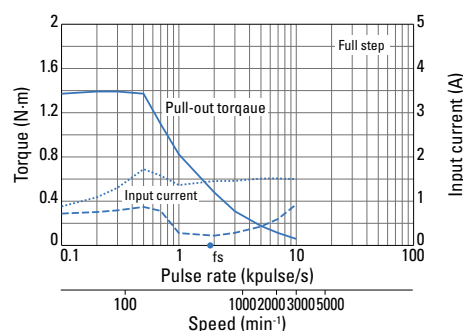
**SM2561C20B41**  
**SM2561C20B11**

24 VDC



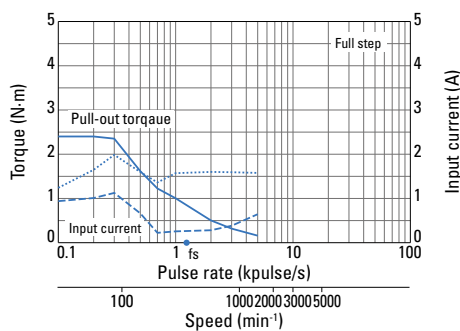
**SM2562C20B41**  
**SM2562C20B11**

24 VDC



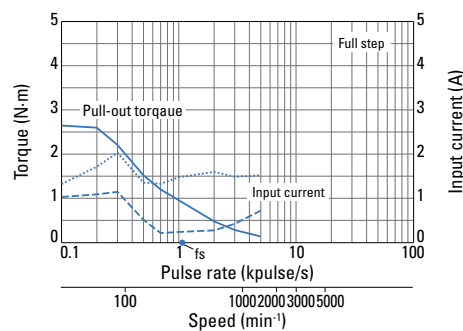
**SM2563C20B41**  
**SM2563C20B11**

24 VDC



**SM2564C20B41**  
**SM2564C20B11**

24 VDC



## Bipolar DC input driver (model: F2BED200P100) and stepping motor

RoHS

| Motor size                           |                                      | 60 mm sq. (0.9° full step angle) |             |             | 86 mm sq. (1.8° full step angle) |             |
|--------------------------------------|--------------------------------------|----------------------------------|-------------|-------------|----------------------------------|-------------|
| Motor length                         |                                      | 42 mm                            | 54 mm       | 76 mm       | 66 mm                            | 96.5 mm     |
| Single shaft                         | Motor model no.                      | SH1601-5240                      | SH1602-5240 | SH1603-5240 | SH2861-5041                      | SH2862-5041 |
| Dual shaft                           | Motor model no.                      | SH1601-5210                      | SH1602-5210 | SH1603-5210 | SH2861-5011                      | SH2862-5011 |
| Holding torque                       | N·m                                  | 0.69                             | 1.28        | 2.15        | 3.3                              | 6.4         |
| Rotor inertia                        | × 10 <sup>-4</sup> kg·m <sup>2</sup> | 0.24                             | 0.4         | 0.75        | 1.48                             | 3.0         |
| Rated current                        | A/phase                              | 2                                | 2           | 2           | 2                                | 2           |
| Motor mass <sup>(1)</sup>            | kg                                   | 0.55                             | 0.8         | 1.2         | 1.75                             | 2.9         |
| Allowable thrust load                | N                                    | 15                               | 15          | 15          | 60                               | 60          |
| Allowable radial load <sup>(2)</sup> | N                                    | 78                               | 65          | 83          | 200                              | 200         |

(1) For the driver mass, see ▶ p. 32

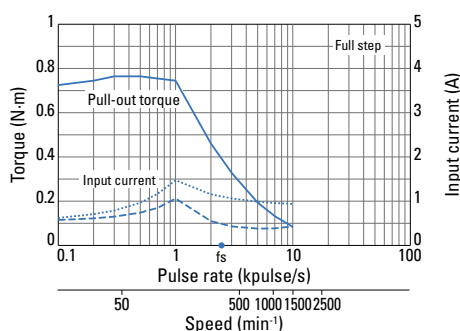
(2) Load is exerted to the shaft end.

## Characteristics

With rubber coupling used   Pull-out torque — Input current (with no load) - - - Input current (with load) ..... fs: Maximum starting frequency with no load ●

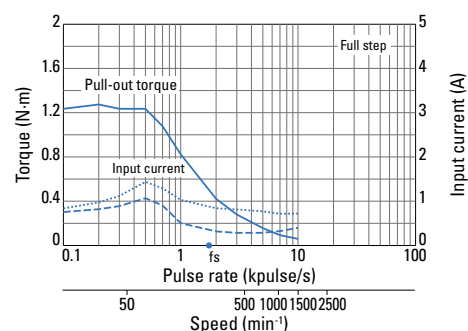
### SH1601-5240 SH1601-5210

24 VDC



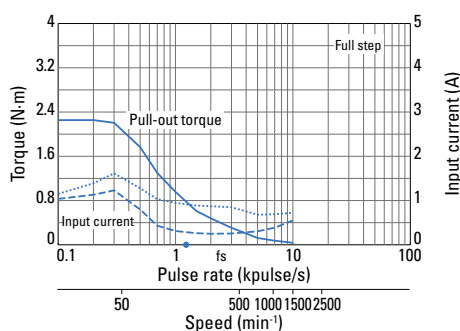
### SH1602-5240 SH1602-5210

24 VDC



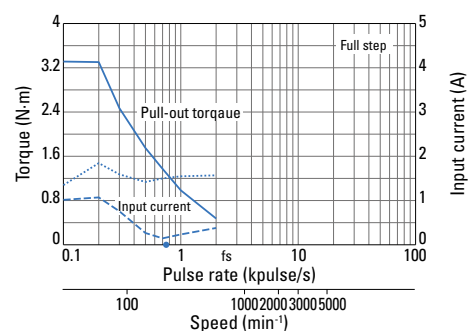
### SH1603-5240 SH1603-5210

24 VDC



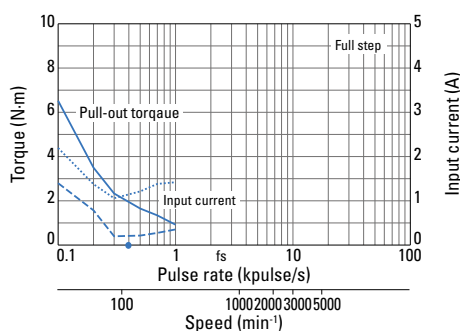
### SH2861-5041 SH2861-5011

24 VDC



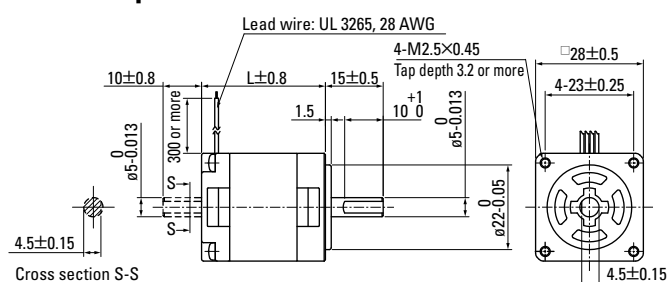
### SH2862-5041 SH2862-5011

24 VDC



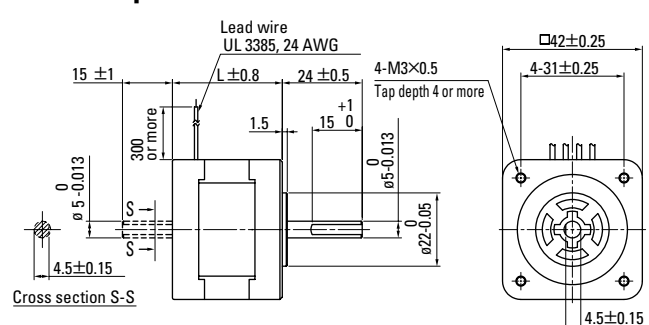
# Stepping Motor Dimensions Unit: mm

## 28 mm sq.



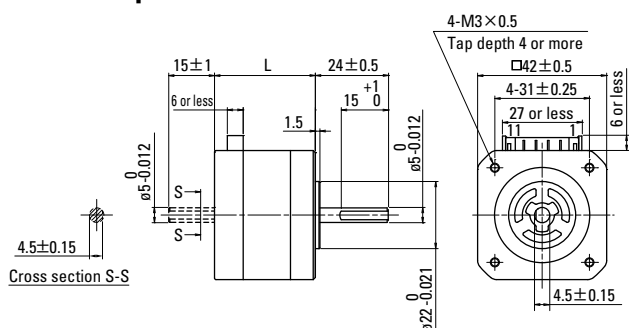
| Motor model no. |             | Motor length<br>(L) |
|-----------------|-------------|---------------------|
| Single shaft    | Dual shaft  |                     |
| SH2281-5771     | SH2281-5731 | 32                  |
| SH2285-5771     | SH2285-5731 | 51.5                |

## 42 mm sq.



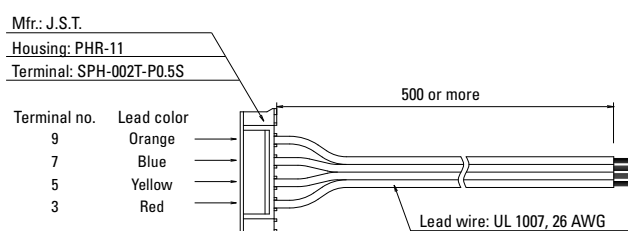
| Motor model no. |             | Motor length<br>(L) |
|-----------------|-------------|---------------------|
| Single shaft    | Dual shaft  |                     |
| SH1421-5241     | SH1421-5211 | 33                  |
| SH1422-5241     | SH1422-5211 | 39                  |
| SH1424-5241     | SH1424-5211 | 48                  |

## 42 mm sq.



| Motor model no. |              | Motor length<br>(L) |
|-----------------|--------------|---------------------|
| Single shaft    | Dual shaft   |                     |
| SF2421-10B41    | SF2421-10B11 | 33 ± 0.5            |
| SF2422-10B41    | SF2422-10B11 | 39 ± 0.5            |
| SF2423-10B41    | SF2423-10B11 | 48 ± 0.5            |
| SF2424-10B41    | SF2424-10B11 | 59.5 ± 1            |

## Bipolar motor cable 4835775-1



This is a motor-driver cable for use with SF242□-10B□1 motors.



# Stepping Motor General Specifications

|                                                              |                                                                                                                                                                                                                             |                                       |                               |                                                            |                                                            |                                |
|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|-------------------------------|------------------------------------------------------------|------------------------------------------------------------|--------------------------------|
| Motor model no.                                              | SH228□                                                                                                                                                                                                                      | SH142□                                | SF242□                        | SM256□                                                     | SH160□                                                     | SH286□                         |
| Operation type                                               | —                                                                                                                                                                                                                           |                                       |                               |                                                            |                                                            |                                |
| Operating ambient temperature                                | -10 to +50°C                                                                                                                                                                                                                |                                       |                               |                                                            |                                                            |                                |
| Storage temperature                                          | -20 to +65°C                                                                                                                                                                                                                |                                       |                               |                                                            |                                                            |                                |
| Operating ambient humidity                                   | 20 to 90%RH (non-condensing)                                                                                                                                                                                                |                                       |                               |                                                            |                                                            |                                |
| Storage humidity                                             | 5 to 95%RH (non-condensing)                                                                                                                                                                                                 |                                       |                               |                                                            |                                                            |                                |
| Operating altitude                                           | Up to 1000 m above sea level                                                                                                                                                                                                |                                       |                               |                                                            |                                                            |                                |
| Vibration resistance                                         | Frequency 10 to 500 Hz, amplitude 1.52 mm (10 to 70 Hz), vibration acceleration 150 m/s <sup>2</sup> (70 to 500 Hz), sweep time 15 min/cycle, a total of 12 tests in both opposite directions for each of X, Y, and Z axes. |                                       |                               |                                                            |                                                            |                                |
| Shock resistance                                             | Acceleration 500 m/s <sup>2</sup> , duration 11 ms, half sine wave, tested 3 times in both directions for each X, Y, and Z axis for a total of 18 times                                                                     |                                       |                               |                                                            |                                                            |                                |
| Thermal class                                                | B (+130°C)                                                                                                                                                                                                                  |                                       |                               | B (+130°C)<br>(A for UL models)                            | B (+130°C)                                                 |                                |
| Dielectric strength                                          | 500 VAC for 1 minute<br>(between motor winding and frame)                                                                                                                                                                   |                                       |                               | 1120 VAC for 1 minute<br>(between motor winding and frame) | 1000 VAC for 1 minute<br>(between motor winding and frame) |                                |
| Insulation resistance                                        | 100 MΩ min. at 500 VDC (between motor winding and frame)                                                                                                                                                                    |                                       |                               |                                                            |                                                            |                                |
| Protection rating                                            | —                                                                                                                                                                                                                           |                                       |                               |                                                            |                                                            |                                |
| Winding temperature rise                                     | 80 K or less (based on our own standard)                                                                                                                                                                                    |                                       |                               |                                                            |                                                            |                                |
| Positional accuracy tolerance                                | ±0.09°                                                                                                                                                                                                                      | ±0.054°                               | ±0.09°                        | ±0.054°                                                    | ±0.054°                                                    | ±0.09°                         |
| Thrust play <sup>(1)</sup>                                   | 0.075 mm or less<br>(With a 1.5 N load)                                                                                                                                                                                     | 0.075 mm or less<br>(With a 5 N load) | 0.075 mm<br>(With a 5 N load) | 0.075 mm<br>(With a 10 N load)                             | 0.075 mm<br>(With a 10 N load)                             | 0.075 mm<br>(With a 10 N load) |
| Radial play <sup>(2)</sup>                                   | 0.025 mm (With a 5 N load)                                                                                                                                                                                                  |                                       |                               |                                                            |                                                            |                                |
| Shaft runout                                                 | 0.025 mm                                                                                                                                                                                                                    |                                       |                               |                                                            |                                                            |                                |
| Concentricity of motor shaft and fitting part                | ø0.05 mm                                                                                                                                                                                                                    | ø0.05 mm                              | ø0.05 mm                      | ø0.075 mm                                                  | ø0.075 mm                                                  | ø0.075 mm                      |
| Perpendicularity of mounting surface and motor shaft surface | 0.1 mm                                                                                                                                                                                                                      | 0.1 mm                                | 0.1 mm                        | 0.1 mm                                                     | 0.1 mm                                                     | 0.15 mm                        |
| Motor mounting orientation                                   | Can be installed vertically or horizontally.                                                                                                                                                                                |                                       |                               |                                                            |                                                            |                                |

(1) Thrust play: Shaft position displacement when a load is exerted in a direction parallel to the motor shaft.

(2) Radial play: Maximum shaft position displacement when a load is exerted in a direction perpendicular to the motor shaft. Load is exerted on the point 1/3 the shaft length from the shaft end.

## Safety standards

Model no.: SM256□ UL models

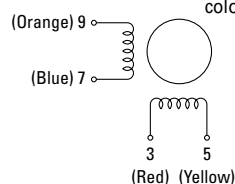
| UL | Classification      | Standards            | File no. |
|----|---------------------|----------------------|----------|
|    | UL                  | UL 1004-1, UL 1004-6 | E179832  |
|    | UL for Canada (cUL) | CSA C22.2 No. 100    |          |

# Internal Wiring and Rotational Directions

Connector type Model no.: SF242□

## Internal wiring

In parentheses are lead colors of the motor cable



## Direction of motor rotation

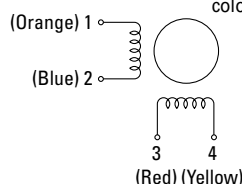
When excited by a direct current in the order shown below, the direction of rotation is clockwise as viewed from the output shaft side.

|                     |   | Connector pin no. |   |   |   |
|---------------------|---|-------------------|---|---|---|
|                     |   | 3                 | 7 | 5 | 9 |
| Excitation sequence | 1 | —                 | — | + | + |
|                     | 2 | +                 | — | — | + |
|                     | 3 | +                 | + | — | — |
|                     | 4 | —                 | + | + | — |

Connector type Model no.: SM256□

## Internal wiring

In parentheses are lead colors of the motor cable



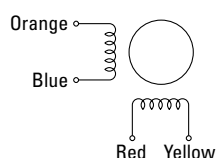
## Direction of motor rotation

When excited by a direct current in the order shown below, the direction of rotation is clockwise as viewed from the output shaft side.

|                     |   | Connector pin no. |   |   |   |
|---------------------|---|-------------------|---|---|---|
|                     |   | 3                 | 2 | 4 | 1 |
| Excitation sequence | 1 | —                 | — | + | + |
|                     | 2 | +                 | — | — | + |
|                     | 3 | +                 | + | — | — |
|                     | 4 | —                 | + | + | — |

Lead type

## Internal wiring

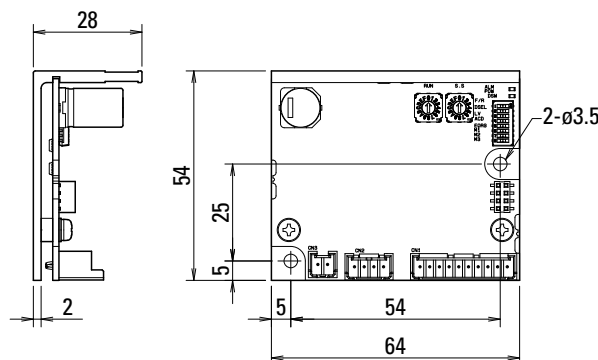


## Direction of motor rotation

When excited by a direct current in the order shown below, the direction of rotation is clockwise as viewed from the output shaft side.

|                     |   | Lead color |      |        |        |
|---------------------|---|------------|------|--------|--------|
|                     |   | Red        | Blue | Yellow | Orange |
| Excitation sequence | 1 | —          | —    | +      | +      |
|                     | 2 | +          | —    | —      | +      |
|                     | 3 | +          | +    | —      | —      |
|                     | 4 | —          | +    | +      | —      |

## Driver Dimensions Unit: mm



## Driver Specifications

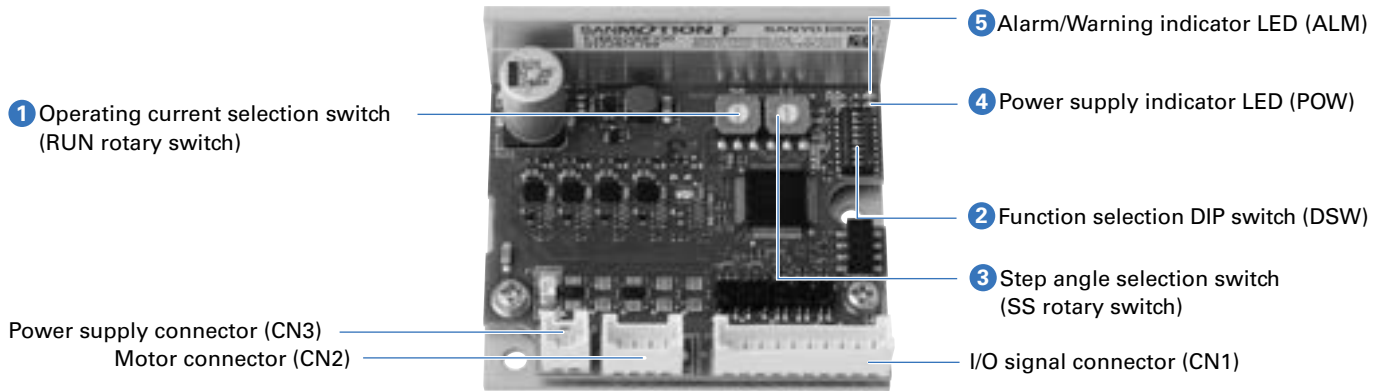
### General specifications

|                      |                                   |                                                                                                                                                                                                                                                                           |
|----------------------|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Model no.            |                                   | <b>F2BED200P100</b>                                                                                                                                                                                                                                                       |
| Basic specifications | Input voltage                     | 24 VDC $\pm 10\%$                                                                                                                                                                                                                                                         |
|                      | Input current                     | 3 A                                                                                                                                                                                                                                                                       |
|                      | Protection class                  | Class III                                                                                                                                                                                                                                                                 |
|                      | Operating environment             | Installation category (Overvoltage category): I (CE), pollution level: 2                                                                                                                                                                                                  |
|                      | Operating ambient temperature     | 0 to +50°C                                                                                                                                                                                                                                                                |
|                      | Storage temperature               | -20 to +70°C                                                                                                                                                                                                                                                              |
|                      | Operating ambient humidity        | Below 90% RH (non-condensing)                                                                                                                                                                                                                                             |
|                      | Storage humidity                  | Below 90% RH (non-condensing)                                                                                                                                                                                                                                             |
|                      | Operating altitude                | Up to 1000 m above sea level                                                                                                                                                                                                                                              |
|                      | Vibration resistance              | 5 m/s <sup>2</sup> , at frequency of 10 to 55 Hz in each X, Y, and Z direction for 2 hours                                                                                                                                                                                |
|                      | Shock resistance                  | 20 m/s <sup>2</sup>                                                                                                                                                                                                                                                       |
|                      | Dielectric strength               | 700 VDC for 1 minute (between power input terminal and chassis)                                                                                                                                                                                                           |
|                      | Insulation resistance             | 10 MΩ min. at 500 VDC (between power input terminal and chassis)                                                                                                                                                                                                          |
|                      | Mass                              | 0.06 kg                                                                                                                                                                                                                                                                   |
| Functions            | Mode selection                    | Pulse input mode (1-2-input mode), low vibration mode (on/off), automatic current limiting (on/off), step division mode (2-5-phase mode), initial excitation phase (excitation origin/excitation phase of last power off), motor selection, operating current, step angle |
|                      | Protection functions              | Power supply voltage monitoring, overheat detection, overcurrent protection, non-volatile memory checksum error, hardware error, motor wire breakage detection, command speed error                                                                                       |
|                      | LED indicators                    | Power supply, alarm/warning indicator                                                                                                                                                                                                                                     |
|                      | PC-based functions                | —                                                                                                                                                                                                                                                                         |
| I/O signal           | Command pulse input signal        | Photocoupler input method; input resistance: 260 Ω<br>High-level input signal voltage: 4.0 to 5.25 V, Low-level input signal voltage: 0 to 0.5 V<br>high-to-low voltage: 4.0 V or more. Maximum input frequency 400 kpulse/s                                              |
|                      | Power down input signal           | Photocoupler input method; input resistance: 480 Ω<br>High-level input signal voltage: 4.0 to 5.25 V, Low-level input signal voltage: 0 to 0.5 V                                                                                                                          |
|                      | Step angle selection input signal | —                                                                                                                                                                                                                                                                         |
|                      | Phase origin monitor output/      | Open-collector output through photocoupler, collector-to-emitter voltage: 30 VDC or less<br>Output current: 10 mA or less, Output saturation voltage: 1.0 V or less                                                                                                       |

### Safety standards

| Safety standards                                                   |                                                      | Standards                       |
|--------------------------------------------------------------------|------------------------------------------------------|---------------------------------|
| Directive                                                          | Directive                                            |                                 |
| UL/cUL standards                                                   | —                                                    | UL 61800-5-1 (File No. E179775) |
| KC Mark (Korea Certification Mark)                                 | —                                                    | KS C 9610-6-2, KS C 9610-6-4    |
| CE marking for EU Directive                                        | Low Voltage Directive (2014/35/EU)                   | EN 61800-5-1                    |
|                                                                    | Electromagnetic Compatibility Directive (2014/30/EU) | EN 61000-6-2<br>EN 61000-6-4    |
|                                                                    | RoHS Directive (2011/65/EU)                          | EN IEC 63000: 2018              |
| UKCA marking for Great Britain<br>(UK Conformity Assessed Marking) | Electrical Equipment (Safety) Regulations 2016       | EN 61800-5-1                    |
|                                                                    | Electromagnetic Compatibility Regulations 2016       | EN 61000-6-2<br>EN 61000-6-4    |
|                                                                    | RoHS Regulations 2012                                | EN IEC 63000: 2018              |

# Driver Part Names and Functions



## 1. Operating current selection switch (RUN rotary switch)

The value of the motor operating current can be set with a rotary switch.

| Dial              | 0   | 1   | 2   | 3   | 4   | 5   | 6   | 7   |
|-------------------|-----|-----|-----|-----|-----|-----|-----|-----|
| Motor current (A) | 2   | 1.9 | 1.8 | 1.7 | 1.6 | 1.5 | 1.4 | 1.3 |
| Dial              | 8   | 9   | A   | B   | C   | D   | E   | F   |
| Motor current (A) | 1.2 | 1.1 | 1.0 | 0.9 | 0.8 | 0.7 | 0.6 | 0.5 |

The factory setting is F (0.5 A). Select the operating current after checking the rated current of the combination motor.

## 2. Function selection DIP switch (DSW)

Functions can be selected to suit your application.

Factory settings

|      | 1   | 2  | 3   | 4  | 5   | 6  | 7   | 8  |
|------|-----|----|-----|----|-----|----|-----|----|
| F/R  | OFF | ON | OFF | ON | OFF | ON | OFF | ON |
| LV   | OFF | ON | OFF | ON | OFF | ON | OFF | ON |
| DSEL | OFF | ON | OFF | ON | OFF | ON | OFF | ON |
| ACD  | OFF | ON | OFF | ON | OFF | ON | OFF | ON |
| EORG | OFF | ON | OFF | ON | OFF | ON | OFF | ON |
| M1   | OFF | ON | OFF | ON | OFF | ON | OFF | ON |
| M2   | OFF | ON | OFF | ON | OFF | ON | OFF | ON |
| M3   | OFF | ON | OFF | ON | OFF | ON | OFF | ON |

- First, do the settings of the motor to be combined with the driver.
- Make sure to turn off the power supply of the driver when changing the settings of the function selection DIP switch.

## Combination motor settings

| M1  | M2  | M3  | Compatible motors |                          |
|-----|-----|-----|-------------------|--------------------------|
|     |     |     | Motor size        | Model no.                |
| OFF | OFF | OFF | —                 | Reserved                 |
| ON  | OFF | OFF | 42 mm sq.         | SH1421-52□1              |
|     |     |     | 42 mm sq.         | SH1422-52□1, SH1424-52□1 |
| OFF | ON  | OFF | 56 mm sq.         | SM2561C20B□1             |
|     |     |     | 60 mm sq.         | SH1601-52□0              |
| ON  | ON  | OFF | 56 mm sq.         | SM2562C20B□1             |
|     |     |     | 60 mm sq.         | SH1602-52□0              |
| OFF | OFF | ON  | 56 mm sq.         | SM2563C20B□1             |
|     |     |     | 60 mm sq.         | SH1603-52□0              |
| ON  | OFF | ON  | 56 mm sq.         | SM2564C20B□1             |
| OFF | ON  | ON  | 86 mm sq.         | SH2861-50□1              |
| ON  | ON  | ON  | 86 mm sq.         | SH2862-50□1              |

## 1. Pulse input mode selection (F/R)

Pulse input mode can be selected.

| F/R | Pulse input mode       |
|-----|------------------------|
| ON  | 1-input mode (CK, U/D) |
| OFF | 2-input mode (CW, CCW) |

## 2. Low-vibration mode selection (LV)

Motors can smoothly operate even at low-resolution settings such as full-step (1 subdivision) and half-step (2 subdivisions) modes.

| LV  | Operation mode              |
|-----|-----------------------------|
| ON  | Low-vibration mode enabled  |
| OFF | Low-vibration mode disabled |

## 3. Step division mode selection (DSEL)

Select the step angle selection switch (SS rotary switch) mode.

| DSEL | Resolution mode                                                                                                                                           |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| OFF  | 2-phase mode: Operable as a normal 2-phase stepping system with a step angle of 1.8° to 0.00703125° (0.9° to 0.003515625° for a full step angle of 0.9°). |
| ON   | 5-phase mode: Operable as a normal 5-phase stepping system with a step angle of 0.72° to 0.00288° (0.36° to 0.00144° for a full step angle of 0.9°).      |

## 4. Auto-Current-Down (ACD)

This function reduces the motor current at rest (200 ms after the last pulse is applied), which is effective in suppressing heat generation and reducing the current consumption of the motor and driver.

| ACD | Current at rest         |
|-----|-------------------------|
| ON  | 50% of driving current  |
| OFF | 100% of driving current |

## 5. Excitation selection (EORG)

The excitation phase at the time of power-on is selected.

| EORG | The excitation phase at power-on  |
|------|-----------------------------------|
| ON   | The excitation phase at power-off |
| OFF  | Excitation origin                 |

By turning on EORG, the excitation phase at the time of power-off will be saved. Therefore, there will be no shaft displacement when the power is turned on next time.

## 3. Step angle selection switch (SS rotary switch)

The number of subdivisions for a full step can be set with the rotary switch.

After selecting 2- or 5-phase mode by setting the "3" (DSEL) of the DSW (function selection DIP switch), set the step angle selection switch for the desired step angle.

| 5-phase mode: When the DSW's "3" (DSEL) is set to ON |            |            |            | 2-phase mode: When the DSW's "3" (DSEL) is set to OFF |            |            |             |
|------------------------------------------------------|------------|------------|------------|-------------------------------------------------------|------------|------------|-------------|
| SS                                                   | Microsteps | Resolution | Step angle | SS                                                    | Microsteps | Resolution | Step angle  |
| 0                                                    | 2.5        | 500        | 0.72°      | 0                                                     | 1          | 200        | 1.8°        |
| 1 (default setting)                                  | 5          | 1000       | 0.36°      | 1 (default setting)                                   | 2          | 400        | 0.9°        |
| 2                                                    | 6.25       | 1250       | 0.288°     | 2                                                     | 4          | 800        | 0.45°       |
| 3                                                    | 10         | 2000       | 0.18°      | 3                                                     | 5          | 1000       | 0.36°       |
| 4                                                    | 12.5       | 2500       | 0.144°     | 4                                                     | 8          | 1600       | 0.225°      |
| 5                                                    | 20         | 4000       | 0.09°      | 5                                                     | 10         | 2000       | 0.18°       |
| 6                                                    | 25         | 5000       | 0.072°     | 6                                                     | 16         | 3200       | 0.1125°     |
| 7                                                    | 50         | 10000      | 0.036°     | 7                                                     | 25         | 5000       | 0.072°      |
| 8                                                    | 62.5       | 12500      | 0.0288°    | 8                                                     | 32         | 6400       | 0.05625°    |
| 9                                                    | 100        | 20000      | 0.018°     | 9                                                     | 50         | 10000      | 0.036°      |
| A                                                    | 125        | 25000      | 0.0144°    | A                                                     | 64         | 12800      | 0.028125°   |
| B                                                    | 200        | 40000      | 0.009°     | B                                                     | 100        | 20000      | 0.018°      |
| C                                                    | 250        | 50000      | 0.0072°    | C                                                     | 125        | 25000      | 0.0144°     |
| D                                                    | 312.5      | 62500      | 0.00576°   | D                                                     | 128        | 25600      | 0.0140625°  |
| E                                                    | 500        | 100000     | 0.0036°    | E                                                     | 250        | 50000      | 0.0072°     |
| F                                                    | 625        | 125000     | 0.00288°   | F                                                     | 256        | 51200      | 0.00703125° |

## 4. Power supply monitoring LED (POW)

Lights up when the control and main circuit power supply are turned on.

## 5. Alarm/Warning indicator LED (ALM)

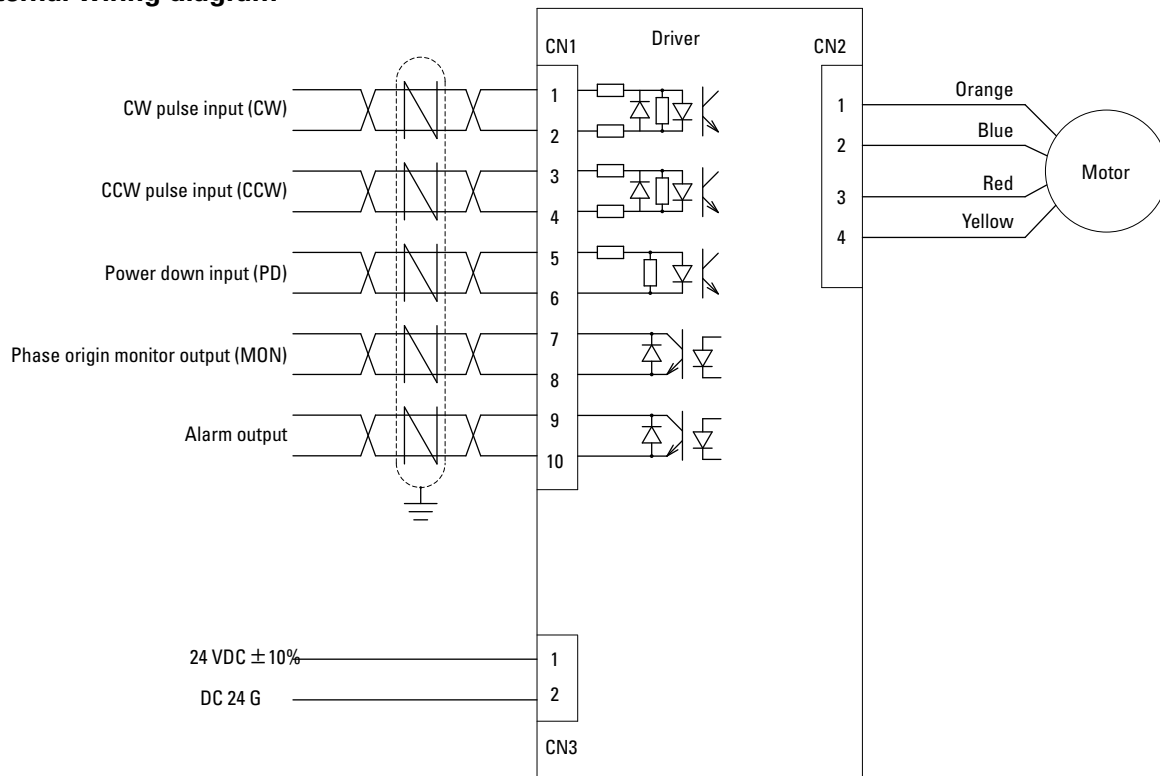
Flashes repeatedly when an alarm is generated.

| LED indicators                  | Status                             |
|---------------------------------|------------------------------------|
| "ALM" blinks once repeatedly    | Main power supply undervoltage     |
| "ALM" blinks 2 times repeatedly | Main power supply overvoltage      |
| "ALM" blinks 3 times repeatedly | Driver overheat                    |
| "ALM" blinks 4 times repeatedly | Overcurrent                        |
| "ALM" blinks 5 times repeatedly | Non-volatile memory checksum error |
| "ALM" blinks 6 times repeatedly | Hardware error                     |
| "ALM" blinks 7 times repeatedly | Motor wire breakage                |
| "ALM" blinks 9 times repeatedly | Command speed error                |

- When an alarm occurs, the "ALM" LED blinks and the winding current of the stepping motor is cut off and the status will shift to a "non-excitation" state. At the same time, an output signal is transmitted from the alarm output terminal of the I/O signal connector to the outside.
- In the event of an alarm, identify the cause of the alarm from the number of LED blinks, eliminate the cause, and turn on the power supply again.
- In the case of an alarm, the LED will be lit for about 1 second followed by blinks; in the case of a warning, the LED will only blink.

# Connections and Signals

## External wiring diagram



## Cable size

| Part                   | Cable size                    | Insulation diameter | Wire length |
|------------------------|-------------------------------|---------------------|-------------|
| Power cable (CN3)      | 22 AWG (0.3 mm <sup>2</sup> ) | ø1.15 to ø1.8 mm    | Below 3 m   |
| I/O signal cable (CN1) | 22 AWG (0.3 mm <sup>2</sup> ) | ø1.15 to ø1.8 mm    | Below 2 m   |
| Motor cable (CN2)      | 22 AWG (0.3 mm <sup>2</sup> ) | ø1.15 to ø1.8 mm    | Below 10 m  |

Note: When bundling wire together or running wires through the duct, take the reduction rate of each wire allowable current into consideration.

When the ambient temperature is relatively high, the wire service life will be shortened due to thermal deterioration.

In this case, please use Heat-resistant Indoor PVC (HIV).

When extending the motor wire, use the thickest wire possible.

## Input/output signal specification overview

| Signal                      | CN1 pin no. | Function overview                                                                                                                                                                                        |
|-----------------------------|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CW pulse input (Standard)   | 1<br>2      | When in 2-input mode, a CW-direction pulse is input.                                                                                                                                                     |
| Pulse train input           | 1<br>2      | When in 1-input mode, a drive pulse train is input to rotate the motor.                                                                                                                                  |
| CCW pulse input (Standard)  | 3<br>4      | When in 2-input mode, a CCW-direction pulse train is input.                                                                                                                                              |
| Rotational direction input  | 3<br>4      | When in 1-input mode, a drive pulse is input to designate the rotational direction.<br>Internal photocoupler ON ... CW direction<br>Internal photocoupler OFF ... CCW direction                          |
| Power down input            | 5<br>6      | A PD signal input will cut off (power off) the current flowing to the motor.<br>Internal photocoupler ON ... PD function is enabled.<br>Internal photocoupler OFF ... PD function is disabled            |
| Phase origin monitor output | 7<br>8      | Turned on when the excitation phase is at the origin (when power is turned on).<br>In full step mode, turned on once for 10 pulses. In half step mode, turned on once for 20 pulses.                     |
| Alarm output                | 9<br>10     | When the alarm circuit is activated inside the driver, an alarm signal is output to outside, which turns the stepping motor to non-excited state. The stepping motor shifts to a "non-excitation" state. |

Note: The CW direction refers to the clockwise direction when the motor is viewed from the output shaft side.

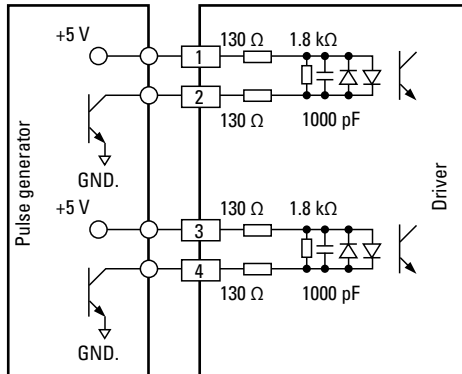
The CCW direction refers to the counter-clockwise direction when the motor is viewed from the output shaft side.

# CW (CK) and CCW (U/D) Input Circuit Configuration

## Connection example

Pulse crest value

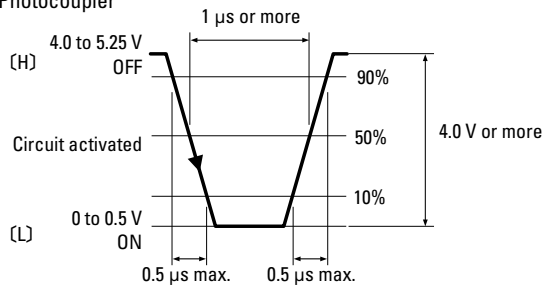
High-level: 4.0 to 5.25 V, low-level: 0 to 0.5 V, high-to-low: 4.0 V or more



- Ensure that the pulse duty is 50% or less.
- Maximum input frequency is 400 kpulse/s.
- If the peak voltage of the input signal exceeds 5.25 V, add an external current-limiting resistor R to limit the input current to around 10 mA. (Take the photocoupler forward voltage of 1.5 V into consideration.)

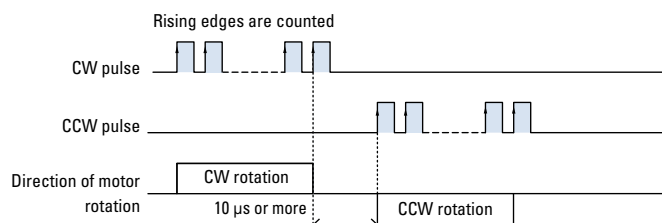
## Input signal specifications

Photocoupler



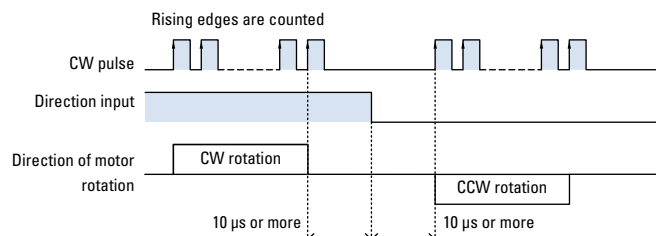
## Command pulse timing

2-input mode (CW, CCW)



- Shaded areas indicate that internal photocoupler is ON. Internal circuit (motor) starts operating at the rising edge of the photocoupler ON.
- When applying a pulse to CW, set the CCW-side internal photocoupler to OFF.
- When applying a pulse to CCW, set the CW-side internal photocoupler to OFF.
- The CW/CCW pulse switching time of "10 μs or more" is the operating time for the driver internal circuit, not the motor response time. Set a time in which the motor can respond for actual operations.
- 1- and 2-input modes can be switched by DIP switch (F/R) settings.

1-input mode (CK, U/D)



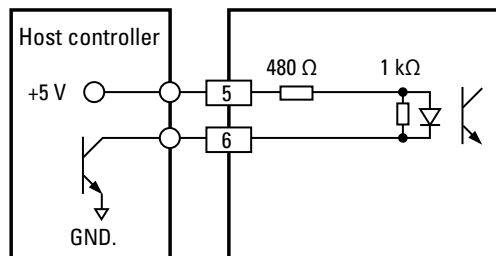
- Shaded areas indicate that internal photocoupler is ON. Internal circuit (motor) starts operating at the rising edge of the photocoupler ON.
- When applying a pulse to CW, set the CCW-side internal photocoupler to OFF.
- When applying a pulse to CCW, set the CW-side internal photocoupler to OFF.
- The CW/CCW pulse switching time of "10 μs or more" is the operating time for the driver internal circuit, not the motor response time. Set a time in which the motor can respond for actual operations.
- 1- and 2-input modes can be switched by DIP switch (F/R) settings.

## PD Input Circuit Configuration

### Connection example

Pulse crest value

High-level: 4.0 to 5.25 V, low-level: 0 to 0.5 V

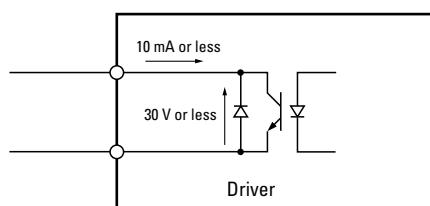


- If the peak voltage of the input signal exceeds 5.25 V, add an external current-limiting resistor R to limit the input current to around 6 mA. (Take the photocoupler forward voltage of 1.5 V into consideration.)

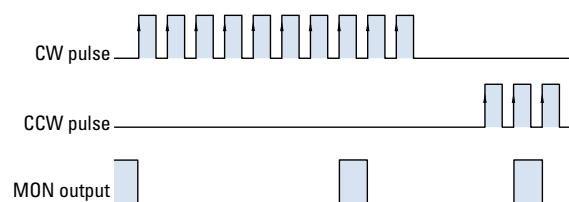
## MON and ALM Output Circuit Configuration

### Connection example

|                              |                |
|------------------------------|----------------|
| Collector-to-emitter voltage | 30 VDC or less |
| Output current               | 10 mA or less  |
| Output saturation voltage    | 1.0 V or less  |



### MON output



E.g., for 2-phase, 2-step (half-step) mode

- Photocoupler is turned on when the motor's excitation phase is at the origin.
- Inputting pulse turns on photocoupler every 7.2° of motor output axis from the phase origin (3.6° for a full step angle of 0.9°).
- Set command frequency to 30 kpulse/s or less when using the phase origin monitor.
- Perform switching of subdivisions via step angle selection input (SSEL) with phase origin monitor output turned on and motor being stopped.
- If the number of divisions is switched at a point other than the excitation origin, the phase origin monitor output may not be output correctly.

# Stepping Motors

Stepping Motors

► p. 42–

IP65-Rated Stepping Motors

Water/Dust protection

► p. 76–

In-Vacuum Stepping Motors

Custom product

► p. 81

Synchronous Motors

Custom product

► p. 81

## How to Read Specifications

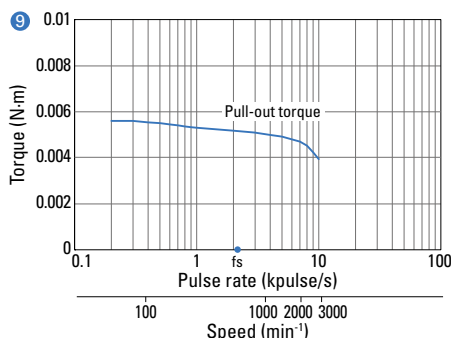
### Bipolar, lead type

| Bipolar, lead type |             | ②                                    | ③             | ④                  | ⑤                  | ⑥                                    | ⑦     | ⑧                |
|--------------------|-------------|--------------------------------------|---------------|--------------------|--------------------|--------------------------------------|-------|------------------|
| ① Model no.        |             | Holding torque at 2-phase excitation | Rated current | Winding resistance | Winding inductance | Rotor inertia                        | Mass  | Motor length (L) |
| Single shaft       | Dual shaft  | N·m or more                          | A/phase       | Ω/phase            | mH/phase           | × 10 <sup>-4</sup> kg·m <sup>2</sup> | kg    | mm               |
| SH2141-5541        | SH2141-5511 | 0.0065                               | 0.3           | 21                 | 4.2                | 0.00058                              | 0.03  | 30               |
| SH2145-5641        | SH2145-5611 | 0.01                                 | 0.4           | 19                 | 4                  | 0.0011                               | 0.042 | 43.8             |

### Characteristics

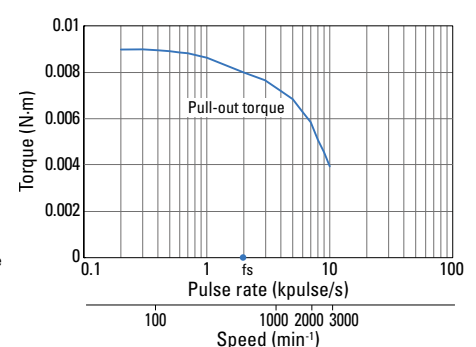
#### SH2141-5541 SH2141-5511

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 0.3 A/  
phase  
2-phase excitation (full  
step)  
Pull-out torque:  
 $J_L = 0.01 \times 10^{-4}\text{kg}\cdot\text{m}^2$   
(Pulley balancer method)  
 $f_s$ : Maximum starting pulse  
rate with no load



#### SH2145-5641 SH2145-5611

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 0.4 A/  
phase  
At 2-phase excitation (full  
step)  
Pull-out torque:  
 $J_L = 0.01 \times 10^{-4}\text{kg}\cdot\text{m}^2$   
(Pulley balancer method)  
 $f_s$ : Maximum starting pulse  
rate with no load



- This is the model number of the stepping motor.
- This is the maximum torque that is generated when the stepping motor is rotated by exerting an external force on the shaft at 2-phase excitation at the rated current.
- This is the rated current that flows to the motor winding. When current of this value flows through a motor, the torque generated will be the same as the holding torque.
- This is the resistance for one phase of stepping motor winding.

- This is the inductance for one phase of stepping motor winding.
- This is the moment of inertia of the rotor. This indicates the degree of ease with which the rotor accelerates or decelerates.
- This is the mass of the stepping motor.
- This is the length of the stepping motor.
- This graph shows the relationship between the pulse rate (frequency), motor speed, and pull-out torque in a full-step mode.

# Lineup

## Stepping Motors RoHS

These motors can be purchased as a single item.

| Motor size                                                                                                                                        | Full step angle | Holding torque [N·m]<br>Model no.                                                                                               | Custom options *                                                                                                    | Page        |
|---------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|---------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|-------------|
| 14 mm sq.  <span>Ultra-compact</span>                            | 1.8°            | 0.0065 to 0.01<br>SH214 <input type="checkbox"/> -5 <input type="checkbox"/> <input type="checkbox"/> 1                         | <span>Hollow shaft</span> <span>Custom shaft</span>                                                                 | p. 42       |
| 28 mm sq.                                                        | 1.8°            | 0.055 to 0.145<br>SH228 <input type="checkbox"/> -5 <input type="checkbox"/> <input type="checkbox"/> 1                         | <span>Hollow shaft</span> <span>Custom shaft</span><br><span>Gear</span> <span>Encoder</span>                       | p. 43 to 44 |
| 35 mm sq.                                                        | 1.8°            | 0.12 to 0.32<br>SH35 <input type="checkbox"/> <input type="checkbox"/> -1 <input type="checkbox"/> <input type="checkbox"/> 0   | <span>Hollow shaft</span> <span>Custom shaft</span>                                                                 | p. 45 to 46 |
| 42 mm sq.                                                        | 0.9°            | 0.2 to 0.48<br>SH142 <input type="checkbox"/> - <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> 1    | <span>Hollow shaft</span> <span>Custom shaft</span><br><span>Gear</span> <span>Encoder</span>                       | p. 47 to 48 |
| 42 mm sq.  <span>Thin-profile</span>                             | 1.8°            | 0.083 to 0.186<br>SS242 <input type="checkbox"/> -50 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | <span>Hollow shaft</span> <span>Custom shaft</span><br><span>Encoder</span>                                         | p. 49       |
| 42 mm sq.                                                       | 1.8°            | 0.22 to 0.8<br>SF242 <input type="checkbox"/> -1 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> 1   | <span>Hollow shaft</span> <span>Gear</span><br><span>Encoder</span> <span>Brake</span>                              | p. 50 to 51 |
| 50 mm sq.                                                      | 1.8°            | 0.28 to 0.53<br>103H670 <input type="checkbox"/> - <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> 0 | <span>Hollow shaft</span> <span>Custom shaft</span><br><span>Encoder</span>                                         | p. 52 to 54 |
| 50 mm sq.  <span>Thin-profile</span>                           | 1.8°            | 0.1 to 0.215<br>SS250 <input type="checkbox"/> -80 <input type="checkbox"/> <input type="checkbox"/> 0                          | <span>Hollow shaft</span> <span>Custom shaft</span>                                                                 | p. 55       |
| 56 mm sq.  <span>UL models</span>                              | 1.8°            | 0.53 to 2.5<br>SM256 <input type="checkbox"/> C <input type="checkbox"/> 0 <input type="checkbox"/> <input type="checkbox"/> 1  | <span>Hollow shaft</span> <span>Custom shaft</span><br><span>Gear</span> <span>Encoder</span><br><span>Brake</span> | p. 56 to 60 |
| 60 mm sq.<br>It is recommended you use a 56 mm sq. motor (SM256 <input type="checkbox"/> C <input type="checkbox"/> 0 <input type="checkbox"/> 1) | 1.8°            |                                                                                                                                 |                                                                                                                     | —           |
| 60 mm sq.                                                      | 0.9°            | 0.57 to 2.15<br>SH160 <input type="checkbox"/> - <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> 0   | <span>Hollow shaft</span> <span>Custom shaft</span><br><span>Gear</span> <span>Encoder</span>                       | p. 62 to 63 |
| 86 mm sq.                                                      | 1.8°            | 2.5 to 9<br>SH286 <input type="checkbox"/> - <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> 1       | <span>Hollow shaft</span> <span>Custom shaft</span><br><span>Encoder</span> <span>Brake</span>                      | p. 64 to 67 |

\*Custom options availability varies depending on the model number and requested quantity. Contact us for details.

| Motor size                                                                                                                          | Full step angle | Holding torque [N·m]<br>Model no.  | Custom options *                                                                   | Page        |
|-------------------------------------------------------------------------------------------------------------------------------------|-----------------|------------------------------------|------------------------------------------------------------------------------------|-------------|
| <br><b>ø106 mm</b>                                 | 1.8°            | 10.8 to 19<br>103H8922 □ - □ □ □ 1 | <a href="#">Hollow shaft</a> <a href="#">Custom shaft</a><br><a href="#">Brake</a> | p. 68       |
| <br><b>56 mm sq.</b><br><a href="#">CE/UKCA</a>    | 1.8°            | 0.39 to 1.27<br>103H712 □ -6 □ □ 0 | <a href="#">Hollow shaft</a> <a href="#">Custom shaft</a>                          | p. 69       |
| <br><b>86 mm sq.</b><br><a href="#">CE/UKCA/UL</a> | 1.8°            | 2.5 to 9<br>SM286 □ - □ □ □ □      | <a href="#">Hollow shaft</a> <a href="#">Custom shaft</a>                          | p. 70 to 73 |

\*Custom options availability varies depending on the model number and requested quantity. Contact us for details.

## IP65-Rated Stepping Motors

[Water/Dust protection](#)
[RoHS](#)

| Motor size                                                                                                                            | Full step angle | Holding torque [N·m]<br>Model no. | Custom options *             | Page        |
|---------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----------------------------------|------------------------------|-------------|
| <br><b>56 mm sq.</b><br><a href="#">CE/UKCA/UL</a> | 1.8°            | 1 to 1.7<br>SP256 □ -5 □ □ 0      | <a href="#">Custom shaft</a> | p. 77 to 78 |
| <br><b>86 mm sq.</b><br><a href="#">CE/UKCA/UL</a> | 1.8°            | 3.3 to 9<br>SP286 □ -5 □ □ 0      | <a href="#">Custom shaft</a> | p. 79 to 80 |

\*Custom options availability varies depending on the model number and requested quantity. Contact us for details.

## In-Vacuum Motors

[Custom product](#)

| Motor size                                                                                                         | Page  |
|--------------------------------------------------------------------------------------------------------------------|-------|
| <br><b>42 mm sq. to ø106 mm</b> | p. 81 |

## Synchronous Motors

[Custom product](#)

| Motor size                                                                                                         | Page  |
|--------------------------------------------------------------------------------------------------------------------|-------|
| <br><b>56 mm sq. to ø106 mm</b> | p. 81 |

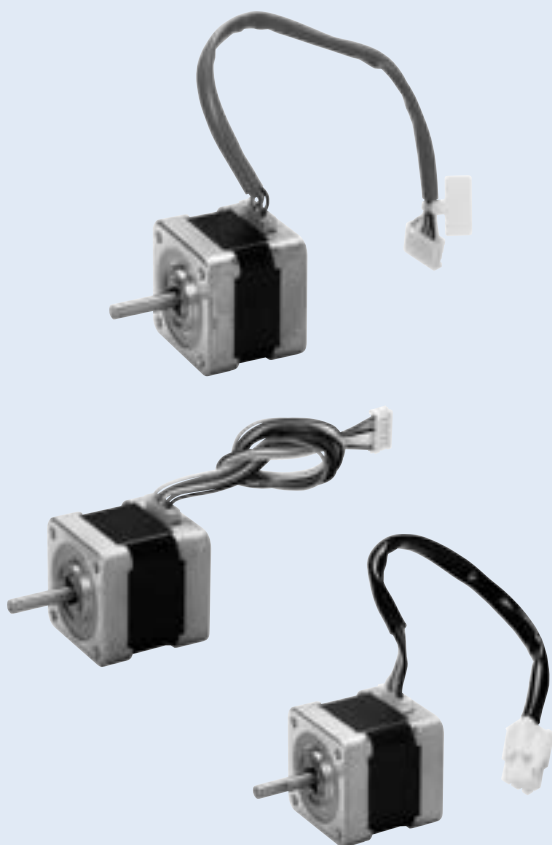
## Customization Services

Custom options availability varies depending on the requested customization and quantity. Contact us for details.

### Custom examples

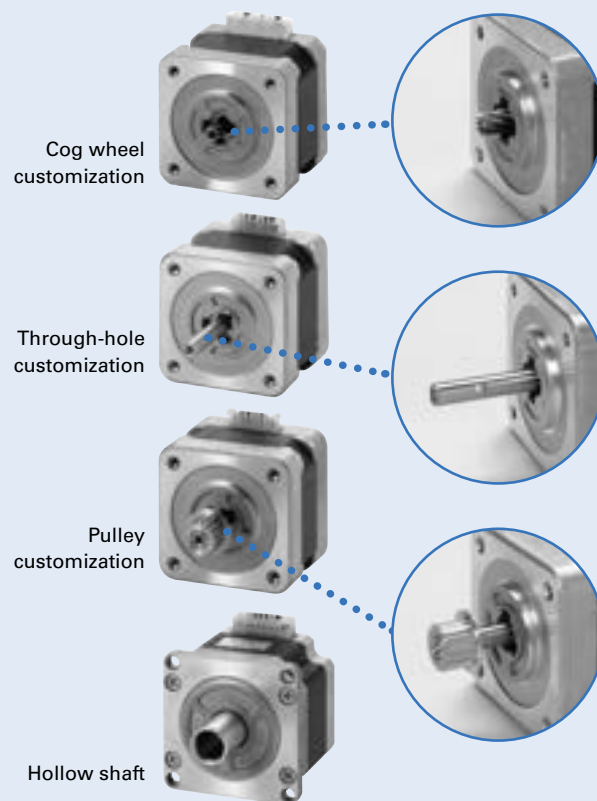
#### Custom harness

Connectors, cable ties, and plastic tubing can be added.



#### Custom shaft

We also offer custom options such as D-shaped shaft, addition of keyway and through-holes, and mounting of gear and pulley. The shaft can be made a hollow shaft for routing cables and air.



#### Rotary damper and surface mount damper

A damper can be added to reduce vibrations when rotating.



Rotary damper



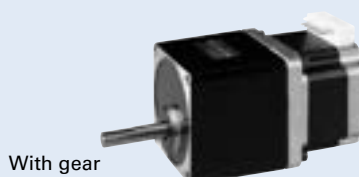
Surface mount damper

#### Gears, encoders, and brake

- A gear can be added for applications where a high load torque is exerted at low speeds.
- An encoder can be added for detecting motor position and speed.
- A brake can be added to hold the motor position at rest.



With encoder



With gear

## Geared models

Compatible motors: 56 mm sq. Model no.: S□2561

### Low-backlash gear models

These models feature low-backlash gear.

|                        |                   |       |       |      |      |      |      |
|------------------------|-------------------|-------|-------|------|------|------|------|
| Allowable torque       | N·m               | 1.25  | 2.5   | 3    | 3.5  | 4    | 4    |
| Gear ratio             | —                 | 1:3.6 | 1:7.2 | 1:10 | 1:20 | 1:30 | 1:36 |
| Backlash               | ° or less         | 0.55  | 0.25  | 0.25 | 0.17 | 0.17 | 0.17 |
| Allowable speed        | min <sup>-1</sup> | 500   | 250   | 180  | 90   | 60   | 50   |
| Allowable thrust load  | N                 | 30    | 30    | 30   | 30   | 30   | 30   |
| Allowable radial load* | N                 | 100   | 100   | 100  | 100  | 100  | 100  |

\* Load is exerted on the point 1/3 the shaft length from the shaft end.

• The motor and shaft rotate in the same direction for 1:3.6 and 1:7.2 gear ratios and in opposite directions for 1:10, 1:20, 1:30, 1:36 gear ratios.

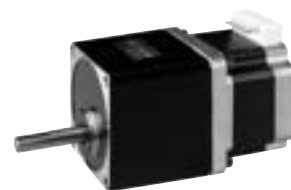
### Harmonic gear models

These models have extremely low backlash and superb positioning precision. The lineup has high gear ratios of up to 1:100 available.

|                        |                   |                         |                          |
|------------------------|-------------------|-------------------------|--------------------------|
| Allowable torque       | N·m               | 5.5                     | 8                        |
| Peak torque            | N·m               | 14                      | 20                       |
| Gear ratio             | —                 | 1:50                    | 1:100                    |
| Lost motion            | arcmin            | 0.4 to 3 (at ±0.28 N·m) | 0.4 to 1.5 (at ±0.4 N·m) |
| Allowable speed        | min <sup>-1</sup> | 70                      | 35                       |
| Maximum speed          | min <sup>-1</sup> | 100                     | 50                       |
| Allowable thrust load  | N                 | 400                     | 400                      |
| Allowable radial load* | N                 | 360                     | 360                      |

\* Load is exerted on the point 1/3 the shaft length from the shaft end.

• The motor shaft and the gear output shaft rotate in opposite directions.

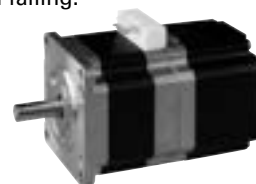


## EM brake models

Compatible motors: 56 mm sq. Model no. SF256□ Note: Non-UL certified

The non-excitation electromagnetic brake holds a workpiece while power is off, preventing it from falling.

|                        |             |                     |
|------------------------|-------------|---------------------|
| Brake activation type  | —           | Non-excitation type |
| Input voltage          | —           | 24 VDC ±5%          |
| Power consumption      | W           | 6 (at 75°C)         |
| Static friction torque | N·m or more | 0.8                 |
| Polarity               | —           | Red: +, black: -    |

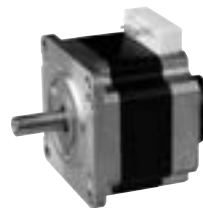


## Encoder-mounted models

Compatible motors: 56 mm sq. Model no. SM256

These models can detect vibration and step-out by monitoring the motor's operation status such as position and speed.

|                            |            |                    |         |         |
|----------------------------|------------|--------------------|---------|---------|
| Microsteps                 | P/R        | 1000               | 2000    | 4000    |
| Number of channels         | Ch         | 3                  | 3       | 3       |
| Output circuit             | —          | Line driver (CMOS) |         |         |
| Maximum response frequency | kHz        | 55                 | 110     | 220     |
| Input voltage              | —          | 5 V ±5%            | 5 V ±5% | 5 V ±5% |
| Current consumption        | mA or less | 100                | 100     | 100     |



Contact us for details of motors other than 56 mm sq. motors.



**14 mm sq.**

1.8°/step **Ultra-compact** **RoHS**

Bipolar, lead type



## Custom options

Hollow shaft Custom shaft

**Note:** Custom options availability varies depending on the model number and requested quantity. Contact us for details.

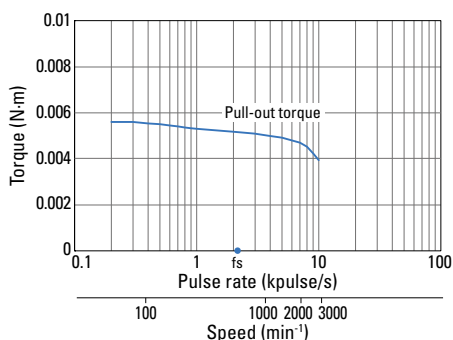
**Bipolar, lead type**

| Model no.          |                    | Holding torque at 2-phase excitation | Rated current | Winding resistance | Winding inductance | Rotor inertia                        | Allowable radial load | Allowable thrust load | Mass  | Motor length (L) |
|--------------------|--------------------|--------------------------------------|---------------|--------------------|--------------------|--------------------------------------|-----------------------|-----------------------|-------|------------------|
| Single shaft       | Dual shaft         | N·m or more                          | A/phase       | Ω/phase            | mH/phase           | × 10 <sup>-4</sup> kg·m <sup>2</sup> | N                     | N                     | kg    | mm               |
| <b>SH2141-5541</b> | <b>SH2141-5511</b> | 0.0065                               | 0.3           | 21                 | 4.2                | 0.00058                              | 10                    | 0.7                   | 0.03  | 30               |
| <b>SH2145-5641</b> | <b>SH2145-5611</b> | 0.01                                 | 0.4           | 19                 | 4                  | 0.0011                               | 10                    | 0.7                   | 0.042 | 43.8             |

## Characteristics

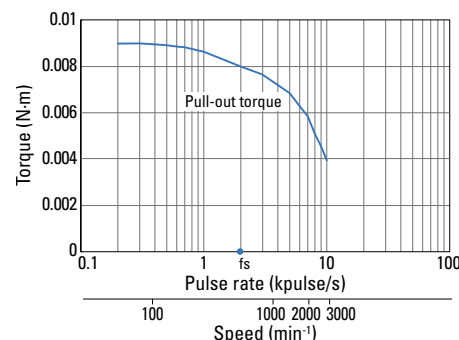
SH2141-5541  
SH2141-5511

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 0.3 A/phase  
2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.01 \times 10^{-4} \text{ kg} \cdot \text{m}^2$   
(Pulley balancer method)  
fs: Maximum starting pulse rate  
with no load

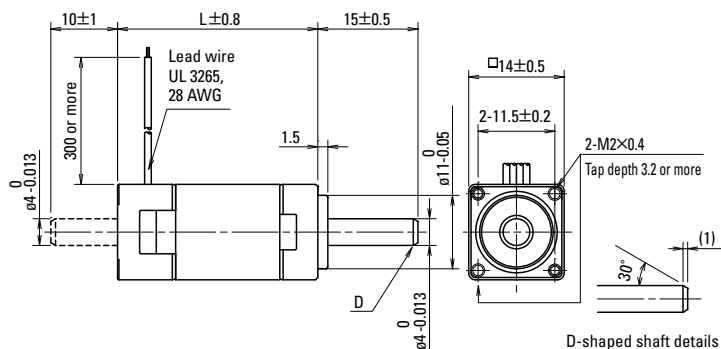


SH2145-5641  
SH2145-5611

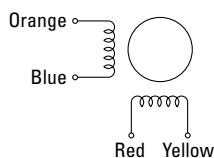
Constant current circuit  
Input voltage: 24 VDC  
Winding current: 0.4 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.01 \times 10^{-4} \text{ kg} \cdot \text{m}^2$   
(Pulley balancer method)  
fs: Maximum starting pulse rate  
with no load



### ■ Dimensions (Unit: mm)



## Internal winding



## Compatible drivers

A driver is to be provided by the customer.

Note: The characteristics shown above are calculated using our experimental circuit.



# 28 mm sq.

1.8°/step **RoHS**

Unipolar, lead type  
Bipolar, lead type ▶ p. 44



Custom options

Hollow shaft Custom shaft

Gear Encoder

Note: Custom options availability varies depending on the model number and requested quantity. Contact us for details.

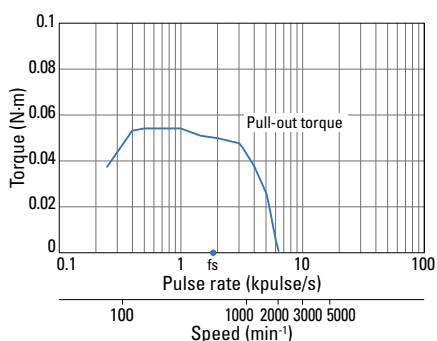
## Unipolar, lead type

| Model no.    |             | Holding torque at 2-phase excitation | Rated current | Winding resistance | Winding inductance | Rotor inertia                        | Allowable radial load | Allowable thrust load | Mass | Motor length (L) |
|--------------|-------------|--------------------------------------|---------------|--------------------|--------------------|--------------------------------------|-----------------------|-----------------------|------|------------------|
| Single shaft | Dual shaft  | N·m or more                          | A/phase       | Ω/phase            | mH/phase           | × 10 <sup>-4</sup> kg·m <sup>2</sup> | N                     | N                     | kg   | mm               |
| SH2281-5171  | SH2281-5131 | 0.055                                | 0.5           | 10.5               | 3.7                | 0.01                                 | 42                    | 3                     | 0.11 | 32               |
| SH2281-5271  | SH2281-5231 | 0.055                                | 1             | 2.85               | 1                  | 0.01                                 | 42                    | 3                     | 0.11 | 32               |
| SH2285-5171  | SH2285-5131 | 0.115                                | 0.5           | 17                 | 7                  | 0.022                                | 49                    | 3                     | 0.2  | 51.5             |
| SH2285-5271  | SH2285-5231 | 0.115                                | 1             | 4.1                | 1.9                | 0.022                                | 49                    | 3                     | 0.2  | 51.5             |

## Characteristics

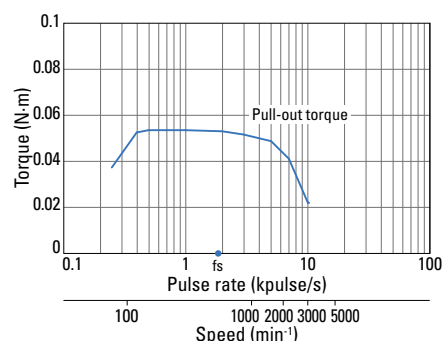
### SH2281-5171 SH2281-5131

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 0.5 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.01 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(Pulley balancer method)  
fs: Maximum starting pulse rate with no load



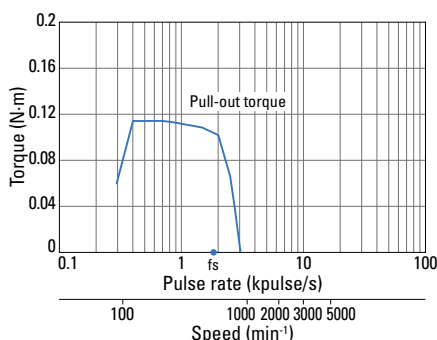
### SH2281-5271 SH2281-5231

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.01 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(Pulley balancer method)  
fs: Maximum starting pulse rate with no load



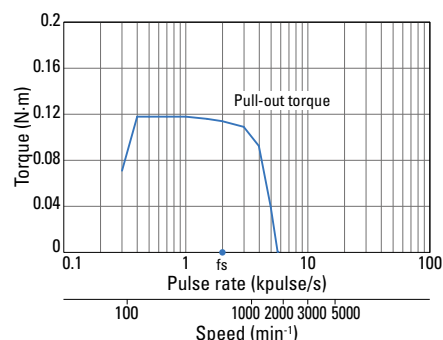
### SH2285-5171 SH2285-5131

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 0.5 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.01 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(Pulley balancer method)  
fs: Maximum starting pulse rate with no load

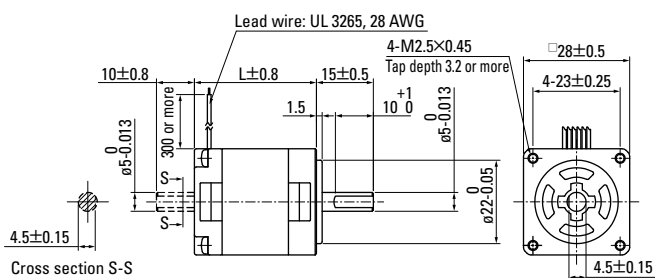


### SH2285-5271 SH2285-5231

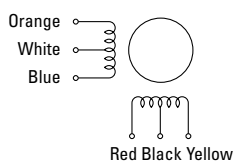
Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.01 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(Pulley balancer method)  
fs: Maximum starting pulse rate with no load



## Dimensions (Unit: mm)



## Internal winding



## Compatible drivers

A driver is to be provided by the customer.

Note: The characteristics shown above are calculated using our experimental circuit.



# 28 mm sq.

1.8°/step **RoHS**

Bipolar, lead type

Unipolar, lead type ▶ p. 43



Custom options

Hollow shaft Custom shaft

Gear Encoder

Note: Custom options availability varies depending on the model number and requested quantity. Contact us for details.

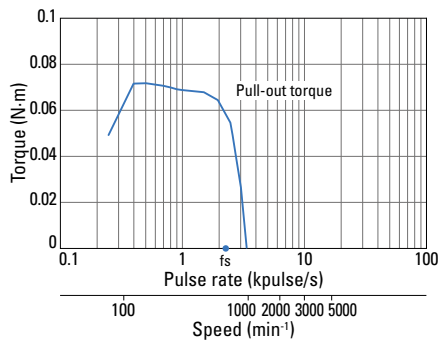
## Bipolar, lead type

| Model no.    |             | Holding torque at 2-phase excitation | Rated current | Winding resistance | Winding inductance | Rotor inertia                        | Allowable radial load | Allowable thrust load | Mass | Motor length (L) |
|--------------|-------------|--------------------------------------|---------------|--------------------|--------------------|--------------------------------------|-----------------------|-----------------------|------|------------------|
| Single shaft | Dual shaft  | N·m or more                          | A/phase       | Ω/phase            | mH/phase           | × 10 <sup>-4</sup> kg·m <sup>2</sup> | N                     | N                     | kg   | mm               |
| SH2281-5671  | SH2281-5631 | 0.07                                 | 0.5           | 10.5               | 7.2                | 0.01                                 | 42                    | 3                     | 0.11 | 32               |
| SH2281-5771  | SH2281-5731 | 0.07                                 | 1             | 2.6                | 1.85               | 0.01                                 | 42                    | 3                     | 0.11 | 32               |
| SH2285-5671  | SH2285-5631 | 0.145                                | 0.5           | 15                 | 13.5               | 0.022                                | 49                    | 3                     | 0.2  | 51.5             |
| SH2285-5771  | SH2285-5731 | 0.145                                | 1             | 3.75               | 3.4                | 0.022                                | 49                    | 3                     | 0.2  | 51.5             |

## Characteristics

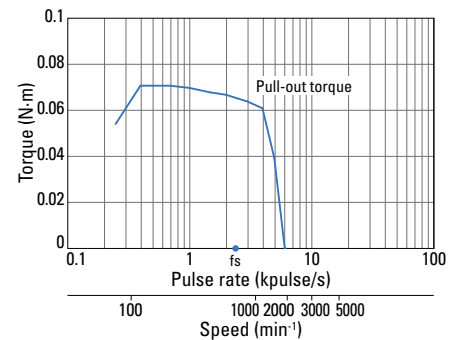
### SH2281-5671 SH2281-5631

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 0.5 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.01 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(Pulley balancer method)  
 $f_s$ : Maximum starting pulse rate with no load



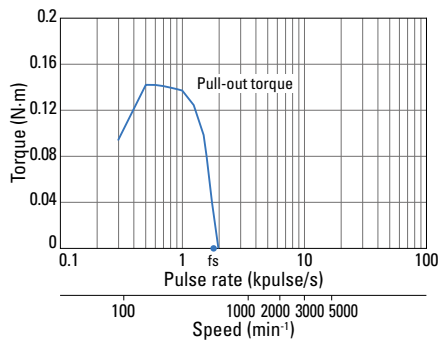
### SH2281-5771 SH2281-5731

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.01 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(Pulley balancer method)  
 $f_s$ : Maximum starting pulse rate with no load



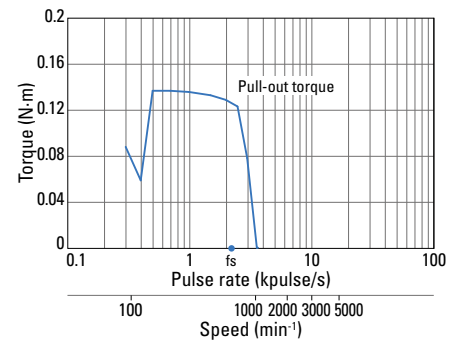
### SH2285-5671 SH2285-5631

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 0.5 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.01 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(Pulley balancer method)  
 $f_s$ : Maximum starting pulse rate with no load

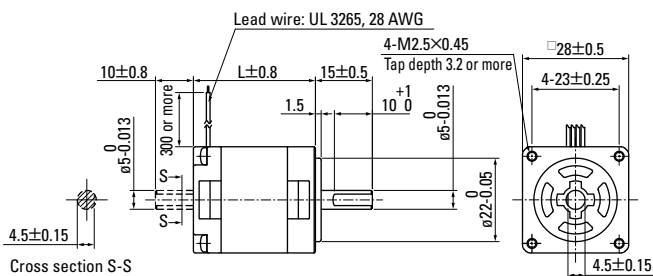


### SH2285-5771 SH2285-5731

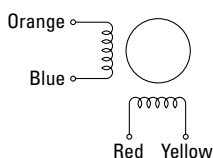
Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.01 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(Pulley balancer method)  
 $f_s$ : Maximum starting pulse rate with no load



## Dimensions (Unit: mm)



## Internal winding



## Compatible drivers

- For motors SH228□-57□1 (1 A/phase)...  
Model no.: F2BED200P100 (DC input)  
Operating current selection switch setting: A
- For motors other than above...  
A driver is to be provided by the customer.

Note: The characteristics shown above are calculated using our experimental circuit.



**35 mm sq.**

1.8°/step **RoHS**

Unipolar, lead type

## Custom options

Hollow shaft Custom shaft

**Note:** Custom options availability varies depending on the model number and requested quantity. Contact us for details.

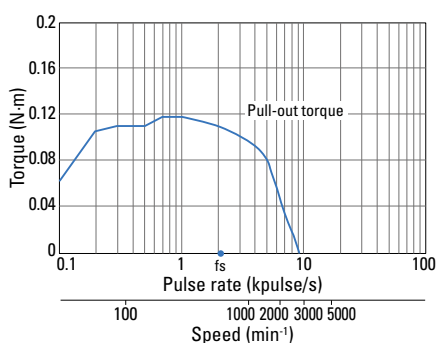
### Unipolar, lead type

| Model no.           |                     | Holding torque at<br>2-phase excitation | Rated<br>current | Winding<br>resistance | Winding<br>inductance | Rotor<br>inertia                     | Allowable<br>radial load | Allowable<br>thrust load | Mass | Motor<br>length (L) |
|---------------------|---------------------|-----------------------------------------|------------------|-----------------------|-----------------------|--------------------------------------|--------------------------|--------------------------|------|---------------------|
| Single shaft        | Dual shaft          | N·m or more                             | A/phase          | Ω/phase               | mH/phase              | × 10 <sup>-4</sup> kg·m <sup>2</sup> | N                        | N                        | kg   | mm                  |
| <b>SH3533-12U40</b> | <b>SH3533-12U10</b> | 0.12                                    | 1.2              | 2.4                   | 1.3                   | 0.02                                 | 46                       | 10                       | 0.17 | 33                  |
| <b>SH3537-12U40</b> | <b>SH3537-12U10</b> | 0.15                                    | 1.2              | 2.7                   | 2                     | 0.025                                | 41                       | 10                       | 0.2  | 37                  |
| <b>SH3552-12U40</b> | <b>SH3552-12U10</b> | 0.23                                    | 1.2              | 3.4                   | 2.8                   | 0.043                                | 40                       | 10                       | 0.3  | 52                  |

## Characteristics

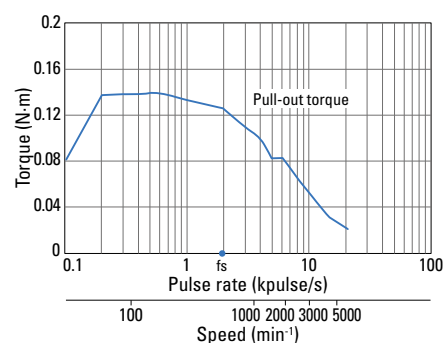
SH3533-12U40  
SH3533-12U10

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1.2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.33 \times 10^{-4} \text{ kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate  
with no load



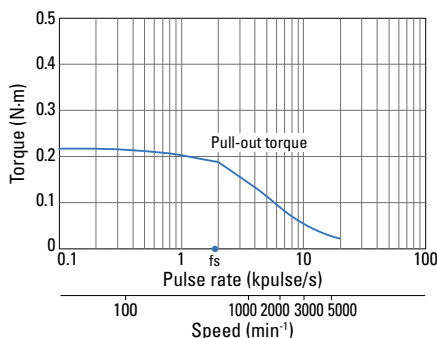
SH3537-12U40  
SH3537-12U10

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1.2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.33 \times 10^{-4} \text{ kg}\cdot\text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate  
with no load

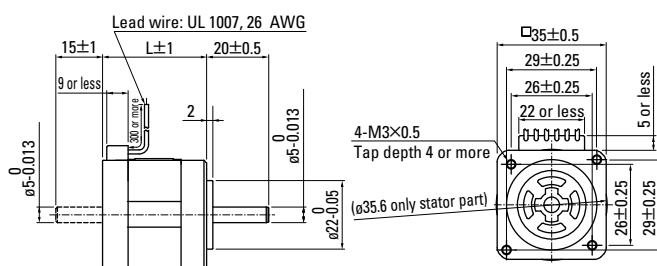


SH3552-12U40  
SH3552-12U10

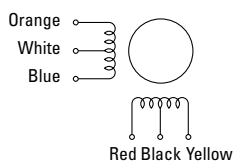
Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1.2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{ kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate  
with no load



### Dimensions (Unit: mm)



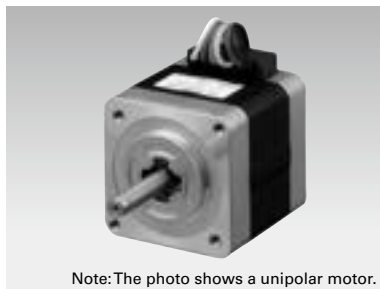
## Internal winding



## Compatible drivers

A driver is to be provided by the customer.

Note: The characteristics shown above are calculated using our experimental circuit.



Note: The photo shows a unipolar motor.

# 35 mm sq.

1.8°/step **RoHS**

Bipolar, lead type

Custom options

**Hollow shaft** **Custom shaft**

Note: Custom options availability varies depending on the model number and requested quantity. Contact us for details.

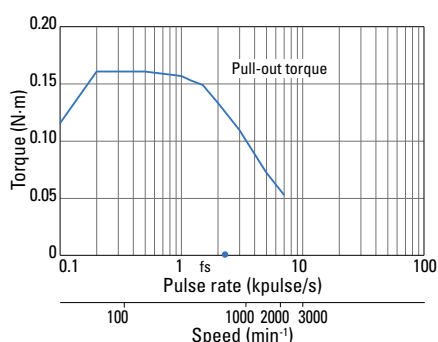
## Bipolar, lead type

| Model no.           |                     | Holding torque at 2-phase excitation | Rated current | Winding resistance | Winding inductance | Rotor inertia                        | Allowable radial load | Allowable thrust load | Mass | Motor length (L) |
|---------------------|---------------------|--------------------------------------|---------------|--------------------|--------------------|--------------------------------------|-----------------------|-----------------------|------|------------------|
| Single shaft        | Dual shaft          | N·m or more                          | A/phase       | Ω/phase            | mH/phase           | × 10 <sup>-4</sup> kg·m <sup>2</sup> | N                     | N                     | kg   | mm               |
| <b>SH3533-10B40</b> | <b>SH3533-10B10</b> | 0.155                                | 1             | 3.3                | 3.9                | 0.02                                 | 41                    | 10                    | 0.17 | 33               |
| <b>SH3537-10B40</b> | <b>SH3537-10B10</b> | 0.195                                | 1             | 3.9                | 5.5                | 0.025                                | 41                    | 10                    | 0.2  | 37               |
| <b>SH3552-10B40</b> | <b>SH3552-10B10</b> | 0.32                                 | 1             | 4.45               | 7                  | 0.043                                | 40                    | 10                    | 0.3  | 52               |

## Characteristics

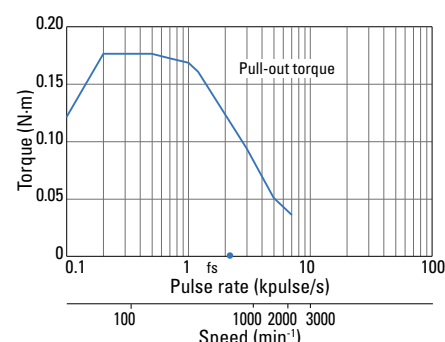
### SH3533-10B40 SH3533-10B10

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.33 \times 10^{-4} \text{kg·m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate with no load



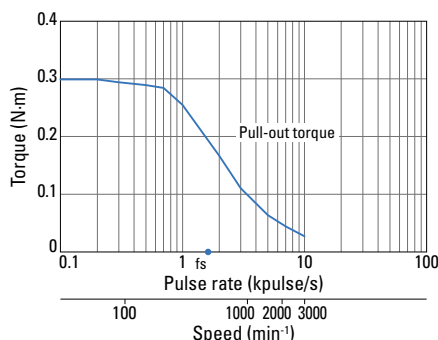
### SH3537-10B40 SH3537-10B10

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.33 \times 10^{-4} \text{kg·m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate with no load

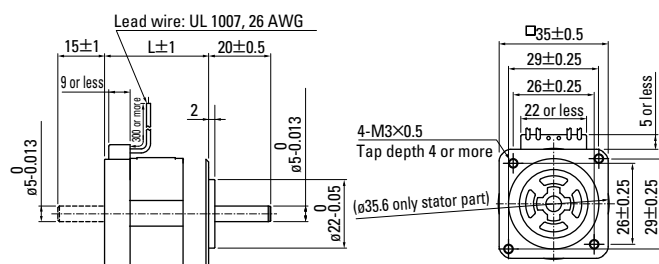


### SH3552-10B40 SH3552-10B10

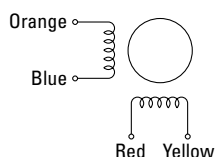
Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{kg·m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate with no load



## Dimensions (Unit: mm)



## Internal winding



## Compatible drivers

Model no.: BS1D200P10 (DC input)

Contact us for details on drivers.

Operating current selection switch setting: A

Note: The characteristics shown above are calculated using our experimental circuit.



# 42 mm sq.

0.9°/step **RoHS**

Unipolar, lead type



Custom options

Hollow shaft Custom shaft

Gear Encoder

Note: Custom options availability varies depending on the model number and requested quantity. Contact us for details.

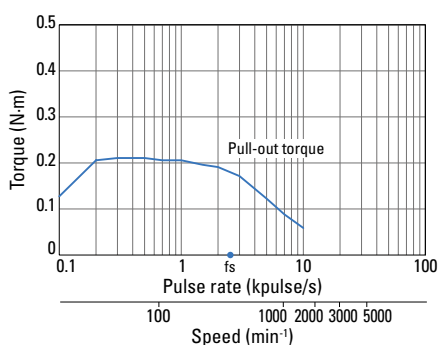
## Unipolar, lead type

| Model no.          |                    | Holding torque at 2-phase excitation | Rated current | Winding resistance | Winding inductance | Rotor inertia                      | Allowable radial load | Allowable thrust load | Mass | Motor length (L) |
|--------------------|--------------------|--------------------------------------|---------------|--------------------|--------------------|------------------------------------|-----------------------|-----------------------|------|------------------|
| Single shaft       | Dual shaft         | N·m or more                          | A/phase       | Ω/phase            | mH/phase           | $\times 10^{-4}$ kg·m <sup>2</sup> | N                     | N                     | kg   | mm               |
| <b>SH1421-0441</b> | <b>SH1421-0411</b> | 0.2                                  | 1.2           | 2.7                | 3.2                | 0.044                              | 25                    | 10                    | 0.24 | 33               |
| <b>SH1422-0441</b> | <b>SH1422-0411</b> | 0.29                                 | 1.2           | 3.1                | 5.3                | 0.066                              | 24                    | 10                    | 0.29 | 39               |
| <b>SH1424-0441</b> | <b>SH1424-0411</b> | 0.39                                 | 1.2           | 3.5                | 5.3                | 0.089                              | 20                    | 10                    | 0.38 | 48               |

## Characteristics

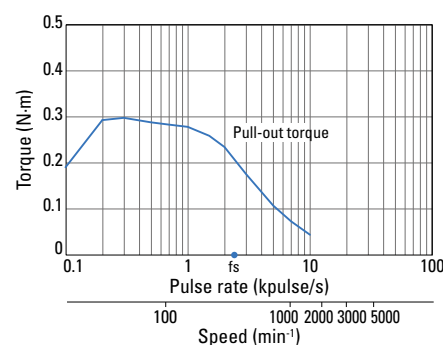
### SH1421-0441 SH1421-0411

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1.2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4}$  kg·m<sup>2</sup>  
(with rubber coupling used)  
fs: Maximum starting pulse rate with no load



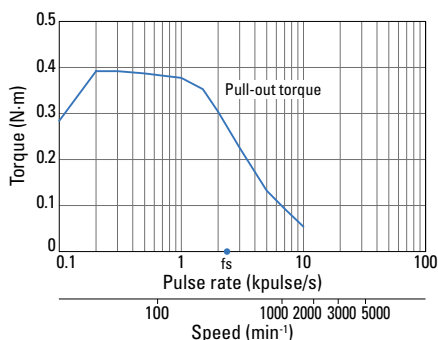
### SH1422-0441 SH1422-0411

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1.2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4}$  kg·m<sup>2</sup>  
(with rubber coupling used)  
fs: Maximum starting pulse rate with no load

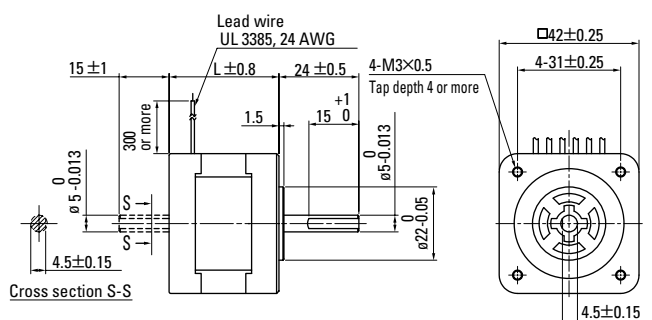


### SH1424-0441 SH1424-0411

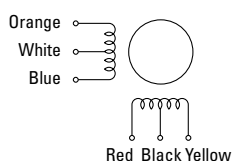
Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1.2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4}$  kg·m<sup>2</sup>  
(with rubber coupling used)  
fs: Maximum starting pulse rate with no load



## Dimensions (Unit: mm)



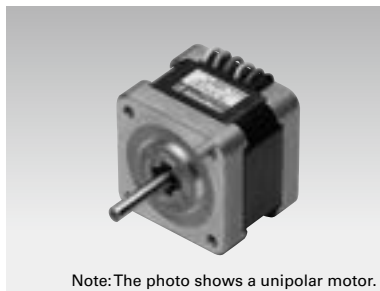
## Internal winding



## Compatible drivers

A driver is to be provided by the customer.

Note: The characteristics shown above are calculated using our experimental circuit.



Note: The photo shows a unipolar motor.

# 42 mm sq.

0.9°/step **RoHS**

Bipolar, lead type



Custom options

Hollow shaft Custom shaft

Gear Encoder

Note: Custom options availability varies depending on the model number and requested quantity. Contact us for details.

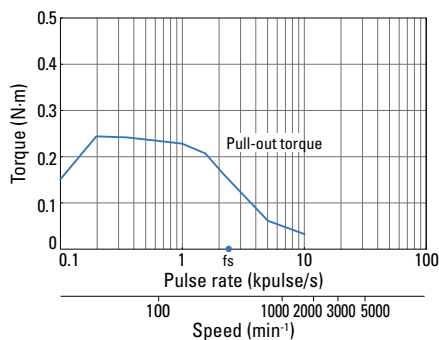
## Bipolar, lead type

| Model no.    |             | Holding torque at 2-phase excitation | Rated current | Winding resistance | Winding inductance | Rotor inertia                        | Allowable radial load | Allowable thrust load | Mass | Motor length (L) |
|--------------|-------------|--------------------------------------|---------------|--------------------|--------------------|--------------------------------------|-----------------------|-----------------------|------|------------------|
| Single shaft | Dual shaft  | N·m or more                          | A/phase       | Ω/phase            | mH/phase           | × 10 <sup>-4</sup> kg·m <sup>2</sup> | N                     | N                     | kg   | mm               |
| SH1421-5041  | SH1421-5011 | 0.23                                 | 1             | 3.3                | 8.0                | 0.044                                | 25                    | 10                    | 0.24 | 33               |
| SH1421-5241  | SH1421-5211 | 0.23                                 | 2             | 0.85               | 2.1                | 0.044                                | 25                    | 10                    | 0.24 | 33               |
| SH1422-5041  | SH1422-5011 | 0.34                                 | 1             | 4.0                | 14.0               | 0.066                                | 24                    | 10                    | 0.29 | 39               |
| SH1422-5241  | SH1422-5211 | 0.34                                 | 2             | 1.05               | 3.6                | 0.066                                | 24                    | 10                    | 0.29 | 39               |
| SH1424-5041  | SH1424-5011 | 0.48                                 | 1             | 4.7                | 15.0               | 0.089                                | 20                    | 10                    | 0.38 | 48               |
| SH1424-5241  | SH1424-5211 | 0.48                                 | 2             | 1.25               | 3.75               | 0.089                                | 20                    | 10                    | 0.38 | 48               |

## Characteristics

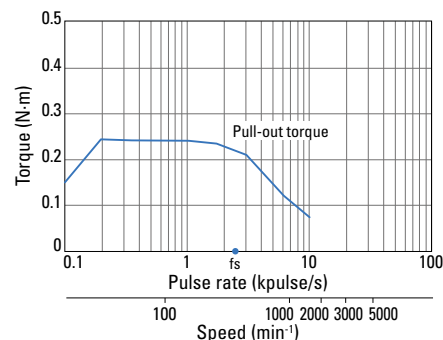
### SH1421-5041 SH1421-5011

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate with no load



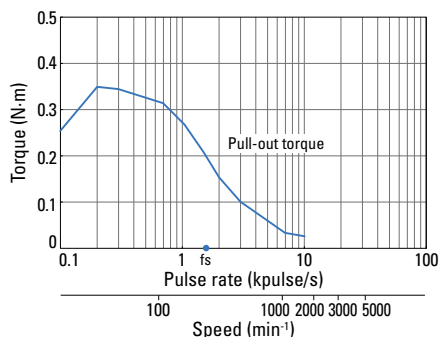
### SH1421-5241 SH1421-5211

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate with no load



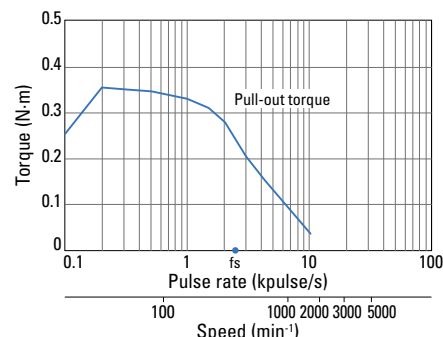
### SH1422-5041 SH1422-5011

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate with no load



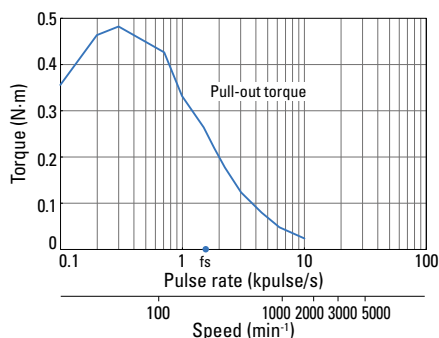
### SH1422-5241 SH1422-5211

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate with no load



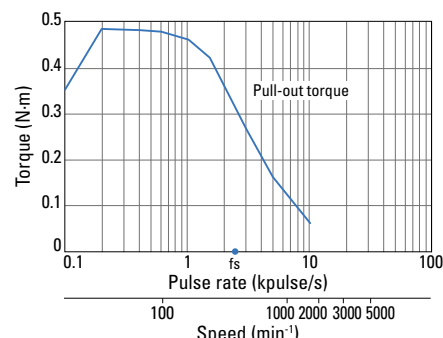
### SH1424-5041 SH1424-5011

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate with no load

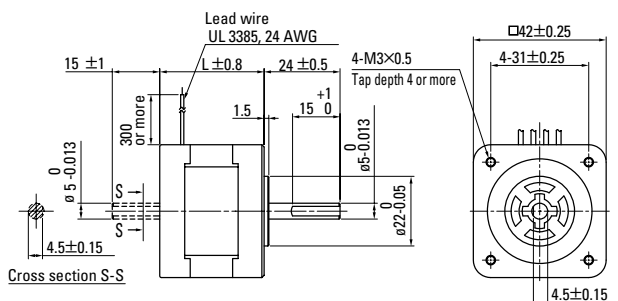


### SH1424-5241 SH1424-5211

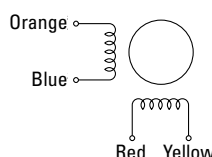
Constant current circuit  
Input voltage: 24 VDC  
Winding current: 2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate with no load



## Dimensions (Unit: mm)



## Internal winding



## Compatible drivers

- For motors SH142□-52□1 (2 A/phase)...  
Model no.: F2BED200P100 (DC input)  
Operating current selection switch setting: 0
- For motors SH142□-50□1 (1 A/phase)...  
Model no.: BS1D200P10 (DC input)  
Contact us for details on drivers.

Operating current selection switch setting: A  
Note: The characteristics shown above are calculated using our experimental circuit.

Internal Wiring and Rotational Directions... p. 74 General Specifications... p. 75  
Data is measured under our drive conditions. Drive torque may vary depending on the actual machine precision.



# 42 mm sq.

1.8°/step

Thin-profile RoHS

Bipolar, lead type



Custom options

Hollow shaft Custom shaft

Encoder

Note: Custom options availability varies depending on the model number and requested quantity. Contact us for details.

## Bipolar, lead type

| Model no.          |                    | Holding torque at 2-phase excitation | Rated current | Winding resistance | Winding inductance | Rotor inertia                        | Allowable radial load | Allowable thrust load | Mass | Motor length (L) |
|--------------------|--------------------|--------------------------------------|---------------|--------------------|--------------------|--------------------------------------|-----------------------|-----------------------|------|------------------|
| Single shaft       | Dual shaft         | N·m or more                          | A/phase       | Ω/phase            | mH/phase           | × 10 <sup>-4</sup> kg·m <sup>2</sup> | N                     | N                     | kg   | mm               |
| <b>SS2421-5041</b> | <b>SS2421-5011</b> | 0.083                                | 1             | 3.5                | 1.2                | 0.015                                | 10                    | 4.9                   | 0.07 | 11.6             |
| <b>SS2422-5041</b> | <b>SS2422-5011</b> | 0.186                                | 1             | 5.4                | 2.9                | 0.028                                | 10                    | 4.9                   | 0.14 | 18.6             |

## Bipolar, lead type Heavy duty

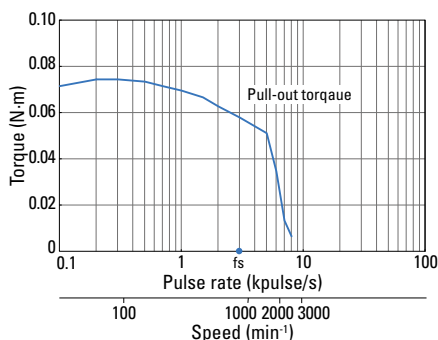
| Model no.           |                     | Holding torque at 2-phase excitation | Rated current | Winding resistance | Winding inductance | Rotor inertia                        | Allowable radial load | Allowable thrust load | Mass | Motor length (L) |
|---------------------|---------------------|--------------------------------------|---------------|--------------------|--------------------|--------------------------------------|-----------------------|-----------------------|------|------------------|
| Single shaft        | Dual shaft          | N·m or more                          | A/phase       | Ω/phase            | mH/phase           | × 10 <sup>-4</sup> kg·m <sup>2</sup> | N                     | N                     | kg   | mm               |
| <b>SS2421-50400</b> | <b>SS2421-50100</b> | 0.083                                | 1             | 3.5                | 1.2                | 0.015                                | 25                    | 4.9                   | 0.09 | 14.5             |
| <b>SS2422-50400</b> | <b>SS2422-50100</b> | 0.186                                | 1             | 5.4                | 2.9                | 0.028                                | 25                    | 4.9                   | 0.16 | 21.5             |

## Characteristics

**SS2421-5041**  
**SS2421-5011**

**SS2421-50400**  
**SS2421-50100**

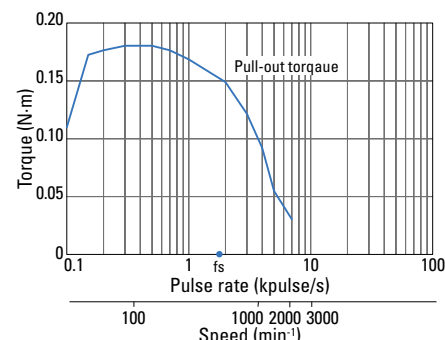
Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.33 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate  
with no load



**SS2422-5041**  
**SS2422-5011**

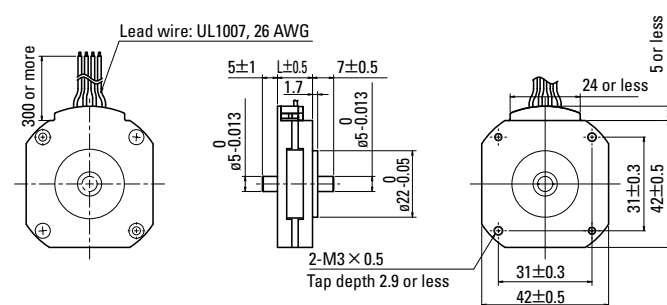
**SS2422-50400**  
**SS2422-50100**

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.33 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate  
with no load

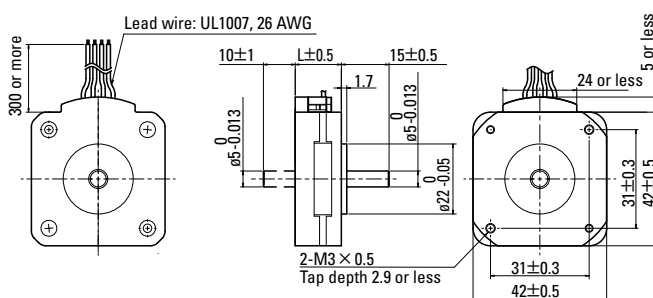


## Dimensions (Unit: mm)

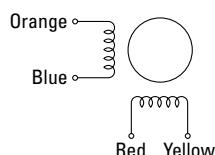
Model no.: SS242□-50□□



Model no.: SS242□-50□00



## Internal winding



## Compatible drivers

Model no.: BS1D200P10 (DC input)

Contact us for details on drivers.

Operating current selection switch setting: A

Note: The characteristics shown above are calculated using our experimental circuit.

Unipolar, connector type



|              |       |
|--------------|-------|
| Custom shaft | Gear  |
| Encoder      | Brake |

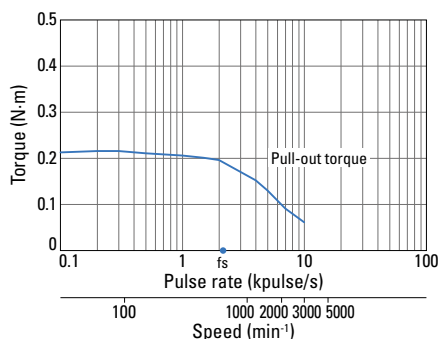
**Note:** Custom options availability varies depending on the model number and requested quantity. Contact us for details.

| Model no.           |                     | Holding torque at 2-phase excitation | Rated current | Winding resistance | Winding inductance | Rotor inertia                        | Allowable radial load | Allowable thrust load | Mass | Motor length (L) |
|---------------------|---------------------|--------------------------------------|---------------|--------------------|--------------------|--------------------------------------|-----------------------|-----------------------|------|------------------|
| Single shaft        | Dual shaft          | N·m or more                          | A/phase       | Ω/phase            | mH/phase           | × 10 <sup>-4</sup> kg·m <sup>2</sup> | N                     | N                     | kg   | mm               |
| <b>SF2421-12U41</b> | <b>SF2421-12U11</b> | 0.22                                 | 1.2           | 2.4                | 2.4                | 0.031                                | 39                    | 10                    | 0.23 | 33 ± 0.5         |
| <b>SF2422-12U41</b> | <b>SF2422-12U11</b> | 0.33                                 | 1.2           | 3                  | 3.3                | 0.046                                | 37                    | 10                    | 0.3  | 39 ± 0.5         |
| <b>SF2423-12U41</b> | <b>SF2423-12U11</b> | 0.4                                  | 1.2           | 3.4                | 3.9                | 0.063                                | 35                    | 10                    | 0.38 | 48 ± 0.5         |
| <b>SF2424-12U41</b> | <b>SF2424-12U11</b> | 0.58                                 | 1.2           | 4.4                | 5.4                | 0.094                                | 29                    | 10                    | 0.51 | 59.5 ± 1         |

Motor cable model no.: 4835774-1

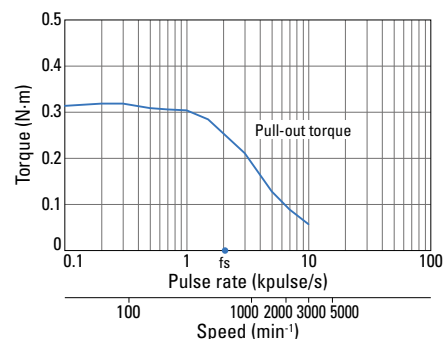
SF2421-12U41  
SF2421-12U11

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1.2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{ kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate  
with no load



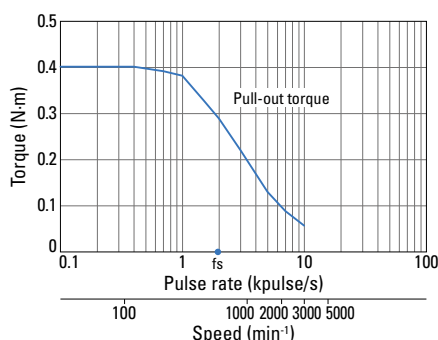
SF2422-12U41  
SF2422-12U11

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1.2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{ kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate  
with no load



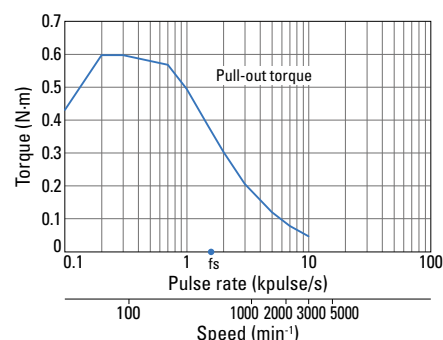
SF2423-12U41  
SF2423-12U11

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1.2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{ kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate  
with no load



SF2424-12U41  
SF2424-12U11

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1.2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{ kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate  
with no load



Technical drawing of a 1/2" NPT x 1/2" NPT female adapter. The drawing includes a side view, a cross-section S-S, and a top view.

**Side View Dimensions:**

- Total length:  $L$
- Left section length:  $15 \pm 1$
- Right section length:  $24 \pm 0.5$
- Step length on right section:  $15 \begin{smallmatrix} +0 \\ -0 \end{smallmatrix}$
- Outer diameter:  $\varnothing 5.0 \pm 0.012$
- Internal thread:  $4-M3 \times 0.5$
- Tap depth: 4 or more

**Cross section S-S:**

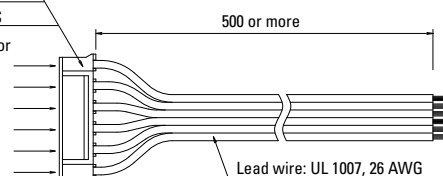
- Inner diameter:  $4.5 \pm 0.15$

**Top View Dimensions:**

- Outer square:  $42 \pm 0.5$
- Inner square:  $4.31 \pm 0.25$
- Dimension: 27 or less
- Dimension: 4.5 ± 0.15
- Dimension: 6 or less

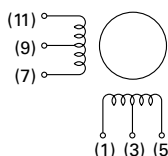
Separate option: Motor cable 4835774-1

is a motor cable for mo



This is a motor cable for model nos. SF242□-12U□1

In parentheses are connector pin nos.



A driver is to be provided by the customer.

Note: The characteristics shown above are calculated using our experimental circuit.

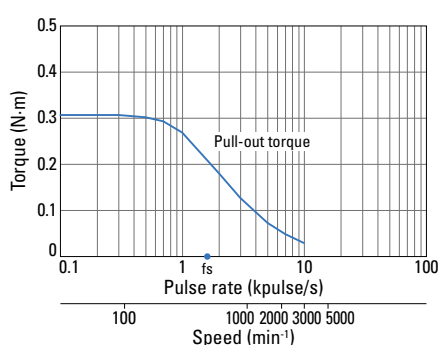
**Bipolar, connector type**

| Model no.    |              | Holding torque at 2-phase excitation | Rated current | Winding resistance | Winding inductance | Rotor inertia                               | Allowable radial load | Allowable thrust load | Mass | Motor length (L) |
|--------------|--------------|--------------------------------------|---------------|--------------------|--------------------|---------------------------------------------|-----------------------|-----------------------|------|------------------|
| Single shaft | Dual shaft   | N·m or more                          | A/phase       | Ω/phase            | mH/phase           | $\times 10^{-4} \text{kg} \cdot \text{m}^2$ | N                     | N                     | kg   | mm               |
| SF2421-10B41 | SF2421-10B11 | 0.29                                 | 1             | 3.6                | 7                  | 0.031                                       | 38                    | 10                    | 0.23 | 33 ± 0.5         |
| SF2422-10B41 | SF2422-10B11 | 0.43                                 | 1             | 4.6                | 9.6                | 0.046                                       | 34                    | 10                    | 0.3  | 39 ± 0.5         |
| SF2423-10B41 | SF2423-10B11 | 0.56                                 | 1             | 5.3                | 12.5               | 0.063                                       | 30                    | 10                    | 0.38 | 48 ± 0.5         |
| SF2424-10B41 | SF2424-10B11 | 0.8                                  | 1             | 6.5                | 16                 | 0.094                                       | 20                    | 10                    | 0.51 | 59.5 ± 1         |

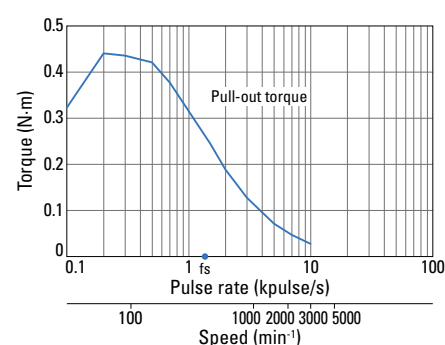
Motor cable model no.: 4835775-1

**Characteristics****SF2421-10B41  
SF2421-10B11**

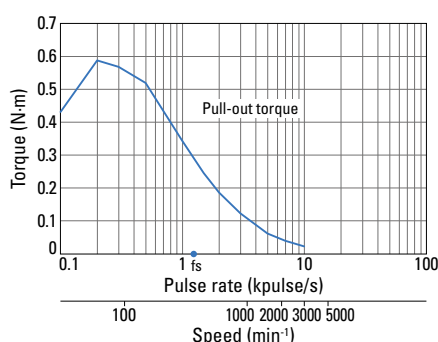
Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate  
with no load

**SF2422-10B41  
SF2422-10B11**

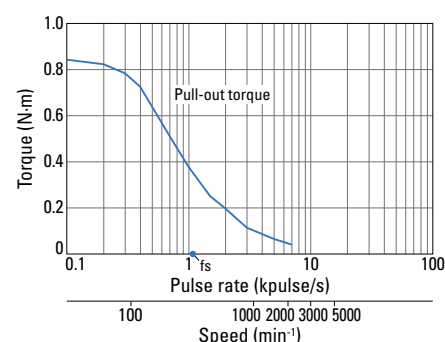
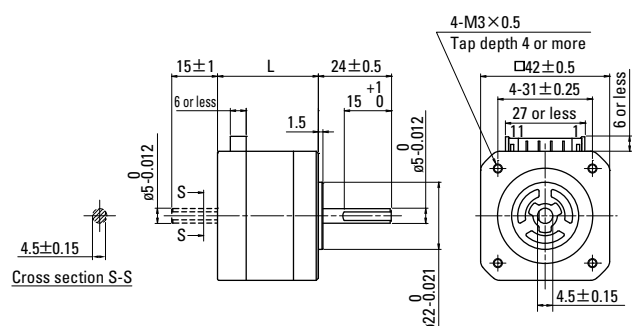
Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate  
with no load

**SF2423-10B41  
SF2423-10B11**

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate  
with no load

**SF2424-10B41  
SF2424-10B11**

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 2.6 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate  
with no load

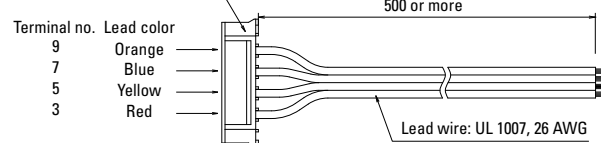
**Dimensions (Unit: mm)**

Separate option: Motor cable 4835775-1

Mfr.: J.S.T.

Housing: PHR-11

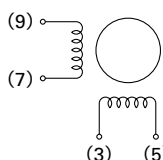
Terminal: SPH-002T-P0.5S



This is a motor cable for model nos. SF242□-10B□1

**Internal wiring**

In parentheses are connector pin nos.

**Compatible drivers**

Model no.: F2BED200P100 (DC input)

Operating current selection switch setting: A

Note: The characteristics shown above are calculated using our experimental circuit.



# 50 mm sq.

1.8°/step **RoHS**

Unipolar, lead type  
Bipolar, lead type ▶ p. 54

Custom options

Hollow shaft Custom shaft

Encoder

Note: Custom options availability varies depending on the model number and requested quantity. Contact us for details.

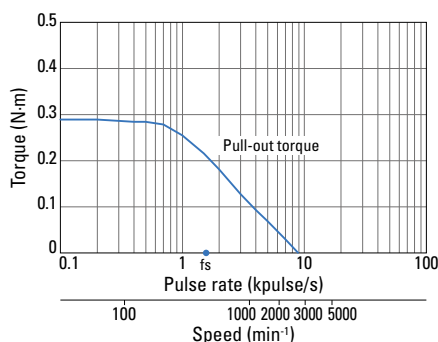
## Unipolar, lead type

| Model no.     |               | Holding torque at 2-phase excitation | Rated current | Winding resistance | Winding inductance | Rotor inertia                        | Allowable radial load | Allowable thrust load | Mass | Motor length (L) |
|---------------|---------------|--------------------------------------|---------------|--------------------|--------------------|--------------------------------------|-----------------------|-----------------------|------|------------------|
| Single shaft  | Dual shaft    | N·m or more                          | A/phase       | Ω/phase            | mH/phase           | × 10 <sup>-4</sup> kg·m <sup>2</sup> | N                     | N                     | kg   | mm               |
| 103H6701-0140 | 103H6701-0110 | 0.28                                 | 1             | 4.3                | 6.8                | 0.057                                | 79                    | 15                    | 0.35 | 39.8             |
| 103H6701-0440 | 103H6701-0410 | 0.28                                 | 2             | 1.1                | 1.6                | 0.057                                | 79                    | 15                    | 0.35 | 39.8             |
| 103H6701-0740 | 103H6701-0710 | 0.28                                 | 3             | 0.6                | 0.7                | 0.057                                | 79                    | 15                    | 0.35 | 39.8             |
| 103H6703-0140 | 103H6703-0110 | 0.49                                 | 1             | 6                  | 13                 | 0.118                                | 75                    | 15                    | 0.5  | 51.3             |
| 103H6703-0440 | 103H6703-0410 | 0.49                                 | 2             | 1.6                | 3.2                | 0.118                                | 75                    | 15                    | 0.5  | 51.3             |
| 103H6703-0740 | 103H6703-0710 | 0.49                                 | 3             | 0.83               | 1.4                | 0.118                                | 75                    | 15                    | 0.5  | 51.3             |
| 103H6704-0140 | 103H6704-0110 | 0.52                                 | 1             | 6.5                | 16.5               | 0.14                                 | 74                    | 15                    | 0.55 | 55.8             |
| 103H6704-0440 | 103H6704-0410 | 0.52                                 | 2             | 1.7                | 3.8                | 0.14                                 | 74                    | 15                    | 0.55 | 55.8             |
| 103H6704-0740 | 103H6704-0710 | 0.53                                 | 3             | 0.9                | 1.7                | 0.14                                 | 77                    | 15                    | 0.55 | 55.8             |

## Characteristics

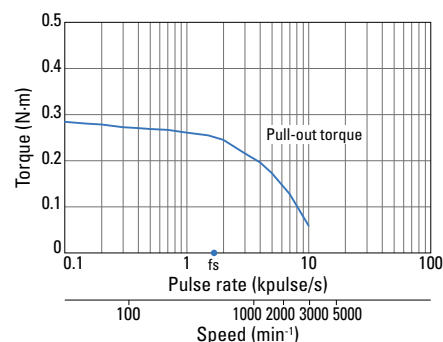
### 103H6701-0140 103H6701-0110

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate  
with no load



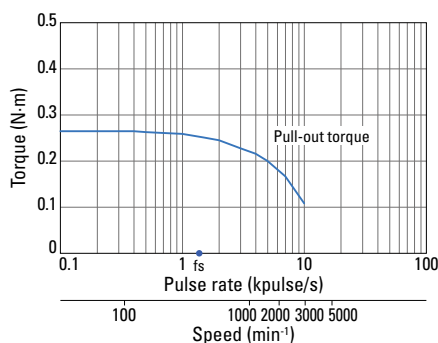
### 103H6701-0440 103H6701-0410

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate  
with no load



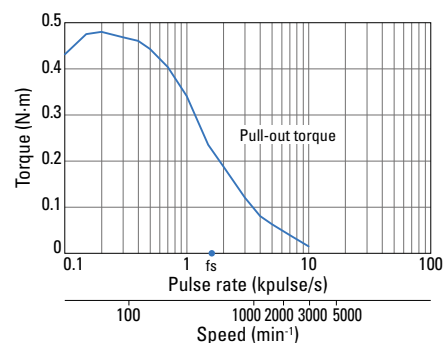
### 103H6701-0740 103H6701-0710

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 3 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate  
with no load



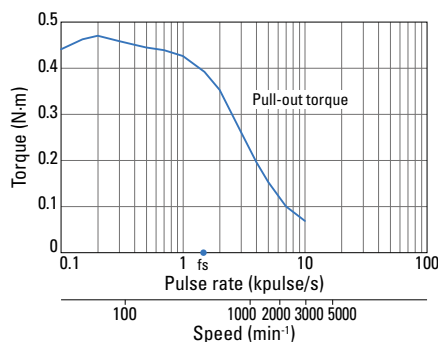
### 103H6703-0140 103H6703-0110

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate  
with no load



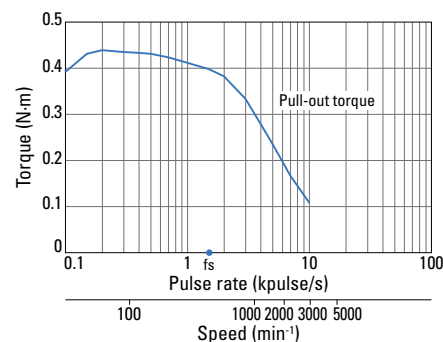
### 103H6703-0440 103H6703-0410

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate  
with no load



### 103H6703-0740 103H6703-0710

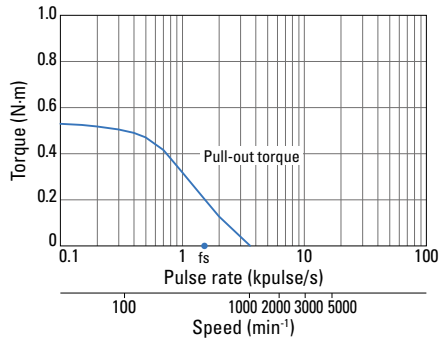
Constant current circuit  
Input voltage: 24 VDC  
Winding current: 3 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate  
with no load



Characteristics

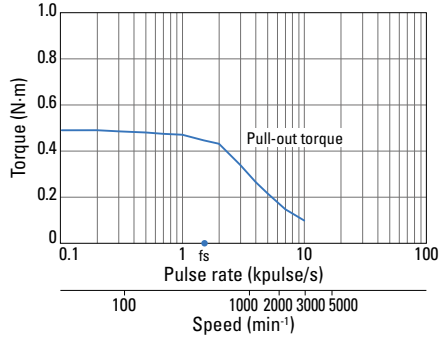
103H6704-0140  
103H6704-0110

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{ kg}\cdot\text{m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate  
with no load



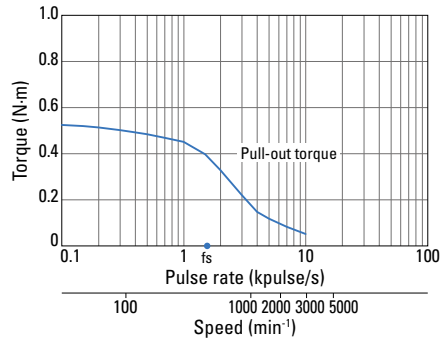
103H6704-0740  
103H6704-0710

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 3 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{ kg}\cdot\text{m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate  
with no load

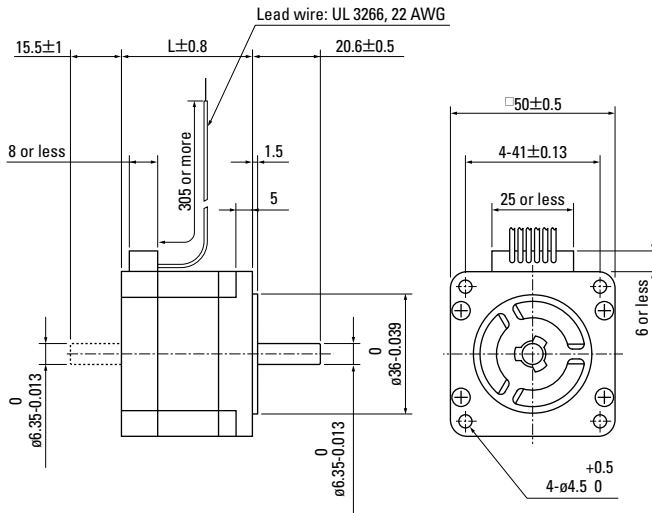


103H6704-0440  
103H6704-0410

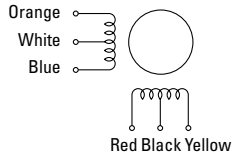
Constant current circuit  
Input voltage: 24 VDC  
Winding current: 2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{ kg}\cdot\text{m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate  
with no load



Dimensions (Unit: mm)



Internal winding



Compatible drivers

A driver is to be provided by the customer.  
Note: The characteristics shown above are calculated using our experimental circuit.

Bipolar, lead type

|              |              |
|--------------|--------------|
| Hollow shaft | Custom shaft |
| Encoder      |              |

**Note:** Custom options availability varies depending on the model number and requested quantity. Contact us for details.

| Model no.            |                      | Holding torque at 2-phase excitation | Rated current | Winding resistance | Winding inductance | Rotor inertia                         | Allowable radial load | Allowable thrust load | Mass | Motor length (L) |
|----------------------|----------------------|--------------------------------------|---------------|--------------------|--------------------|---------------------------------------|-----------------------|-----------------------|------|------------------|
| Single shaft         | Dual shaft           | N·m or more                          | A/phase       | Ω/phase            | mH/phase           | × 10 <sup>-4</sup> ·kg·m <sup>2</sup> | N                     | N                     | kg   | mm               |
| <b>103H6701-5040</b> | <b>103H6701-5010</b> | 0.28                                 | 2             | 0.6                | 1.6                | 0.057                                 | 79                    | 15                    | 0.35 | 39.8             |
| <b>103H6703-5040</b> | <b>103H6703-5010</b> | 0.49                                 | 2             | 0.8                | 3.2                | 0.118                                 | 75                    | 15                    | 0.5  | 51.3             |
| <b>103H6704-5040</b> | <b>103H6704-5010</b> | 0.52                                 | 2             | 0.9                | 3.8                | 0.14                                  | 74                    | 15                    | 0.55 | 55.8             |



# 50 mm sq.

1.8°/step

Thin-profile

RoHS

Bipolar, lead type

Custom options

Hollow shaft Custom shaft

Note: Custom options availability varies depending on the model number and requested quantity. Contact us for details.

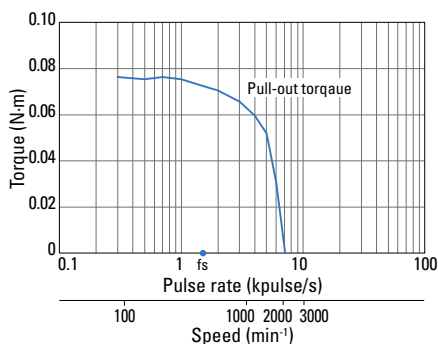
## Bipolar, lead type

| Model no.          |                    | Holding torque at 2-phase excitation | Rated current | Winding resistance | Winding inductance | Rotor inertia                      | Allowable radial load | Allowable thrust load | Mass | Motor length (L) |
|--------------------|--------------------|--------------------------------------|---------------|--------------------|--------------------|------------------------------------|-----------------------|-----------------------|------|------------------|
| Single shaft       | Dual shaft         | N·m or more                          | A/phase       | Ω/phase            | mH/phase           | $\times 10^{-4}$ kg·m <sup>2</sup> | N                     | N                     | kg   | mm               |
| <b>SS2501-8040</b> | <b>SS2501-8010</b> | 0.1                                  | 1             | 4.5                | 2                  | 0.026                              | 8.5                   | 4.9                   | 0.09 | 11.4             |
| <b>SS2502-8040</b> | <b>SS2502-8010</b> | 0.215                                | 1             | 5.9                | 3.2                | 0.049                              | 8.5                   | 4.9                   | 0.15 | 16.4             |

## Characteristics

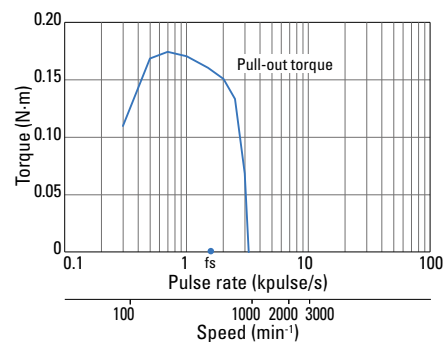
### SS2501-8040 SS2501-8010

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.01 \times 10^{-4}$  kg·m<sup>2</sup>  
(Pulley balancer method)  
 $f_s$ : Maximum starting pulse rate  
with no load

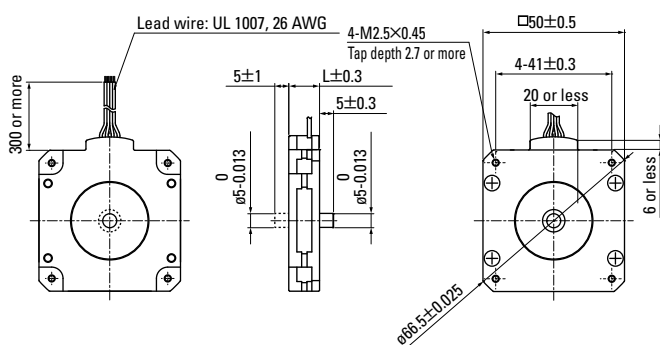


### SS2502-8040 SS2502-8010

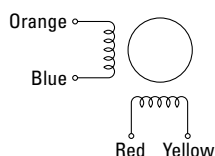
Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.01 \times 10^{-4}$  kg·m<sup>2</sup>  
(Pulley balancer method)  
 $f_s$ : Maximum starting pulse rate  
with no load



## Dimensions (Unit: mm)



## Internal winding



## Compatible drivers

Model no.: BS1D200P10 (DC input)

Contact us for details on drivers.

Operating current selection switch setting: A

Note: The characteristics shown above are calculated using our experimental circuit.



# 56 mm sq.

1.8°/step **RoHS**

Unipolar, connector type



Custom options

Hollow shaft Custom shaft

Gear Encoder

Brake

Note: Custom options availability varies depending on the model number and requested quantity. Contact us for details.

## Unipolar, connector type

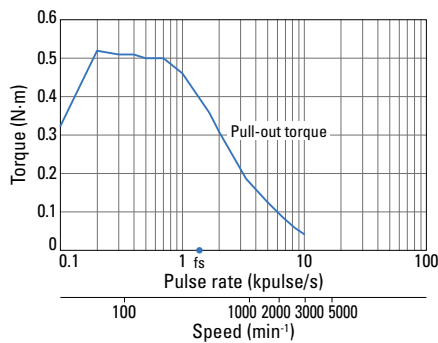
| Model no.           |                     | Holding torque at 2-phase excitation | Rated current | Winding resistance | Winding inductance | Rotor inertia                        | Allowable radial load | Allowable thrust load | Mass | Motor length (L) |
|---------------------|---------------------|--------------------------------------|---------------|--------------------|--------------------|--------------------------------------|-----------------------|-----------------------|------|------------------|
| Single shaft        | Dual shaft          | N·m or more                          | A/phase       | Ω/phase            | mH/phase           | × 10 <sup>-4</sup> kg·m <sup>2</sup> | N                     | N                     | kg   | mm               |
| <b>SM2561C10U41</b> | <b>SM2561C10U11</b> | 0.53                                 | 1             | 4.3                | 6.8                | 0.14                                 | 115                   | 20                    | 0.49 | 41.8             |
| <b>SM2561C20U41</b> | <b>SM2561C20U11</b> | 0.53                                 | 2             | 1.15               | 1.8                | 0.14                                 | 115                   | 20                    | 0.49 | 41.8             |
| <b>SM2561C30U41</b> | <b>SM2561C30U11</b> | 0.53                                 | 3             | 0.52               | 0.77               | 0.14                                 | 115                   | 20                    | 0.49 | 41.8             |
| <b>SM2562C10U41</b> | <b>SM2562C10U11</b> | 1.1                                  | 1             | 5.85               | 12.6               | 0.28                                 | 106                   | 20                    | 0.69 | 53.8             |
| <b>SM2562C20U41</b> | <b>SM2562C20U11</b> | 1.1                                  | 2             | 1.55               | 3.3                | 0.28                                 | 106                   | 20                    | 0.69 | 53.8             |
| <b>SM2562C30U41</b> | <b>SM2562C30U11</b> | 1.1                                  | 3             | 0.69               | 1.37               | 0.28                                 | 106                   | 20                    | 0.69 | 53.8             |
| <b>SM2563C10U41</b> | <b>SM2563C10U11</b> | 1.7                                  | 1             | 7.8                | 17                 | 0.5                                  | 93                    | 20                    | 1.1  | 75.8             |
| <b>SM2563C20U41</b> | <b>SM2563C20U11</b> | 1.7                                  | 2             | 1.87               | 4.2                | 0.5                                  | 93                    | 20                    | 1.1  | 75.8             |
| <b>SM2563C30U41</b> | <b>SM2563C30U11</b> | 1.7                                  | 3             | 0.74               | 1.75               | 0.5                                  | 93                    | 20                    | 1.1  | 75.8             |
| <b>SM2564C10U41</b> | <b>SM2564C10U11</b> | 1.75                                 | 1             | 9                  | 22                 | 0.6                                  | 86                    | 20                    | 1.27 | 85.8             |
| <b>SM2564C20U41</b> | <b>SM2564C20U11</b> | 1.75                                 | 2             | 2.1                | 5.4                | 0.6                                  | 86                    | 20                    | 1.27 | 85.8             |
| <b>SM2564C30U41</b> | <b>SM2564C30U11</b> | 1.75                                 | 3             | 0.84               | 2.2                | 0.6                                  | 86                    | 20                    | 1.27 | 85.8             |

Motor cable model no.: 4837798-1

## Characteristics

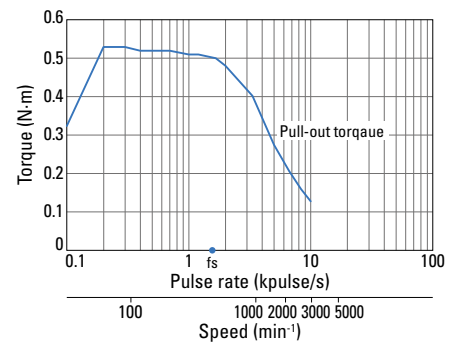
### SM2561C10U41 SM2561C10U11

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate with no load



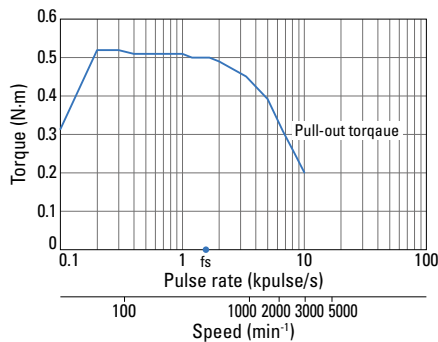
### SM2561C20U41 SM2561C20U11

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate with no load



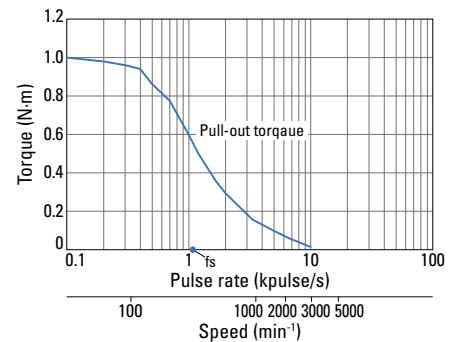
### SM2561C30U41 SM2561C30U11

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 3 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate with no load



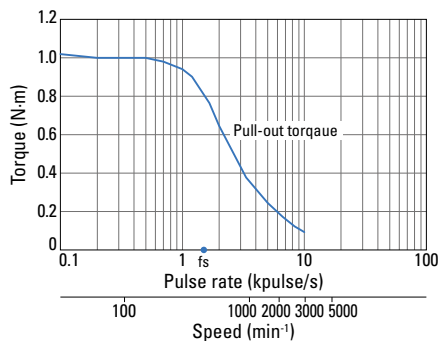
### SM2562C10U41 SM2562C10U11

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 2.6 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate with no load



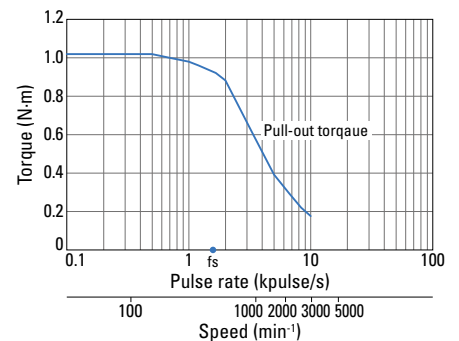
### SM2562C20U41 SM2562C20U11

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 2.6 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate with no load



### SM2562C30U41 SM2562C30U11

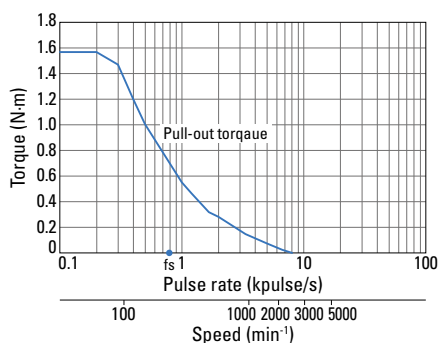
Constant current circuit  
Input voltage: 24 VDC  
Winding current: 3 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 2.6 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate with no load



## Characteristics

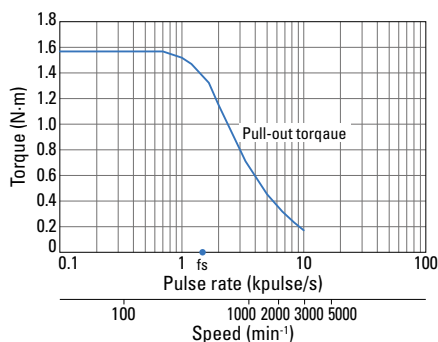
### SM2563C10U41 SM2563C10U11

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 7.4 \times 10^{-4} \text{ kg-m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate  
with no load



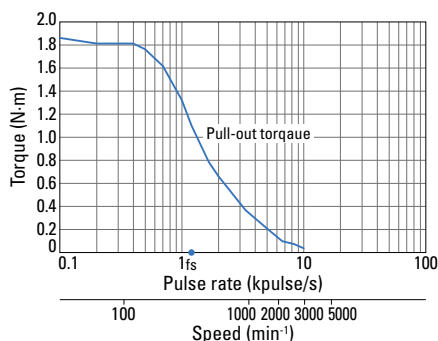
### SM2563C30U41 SM2563C30U11

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 3 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 7.4 \times 10^{-4} \text{ kg-m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate  
with no load



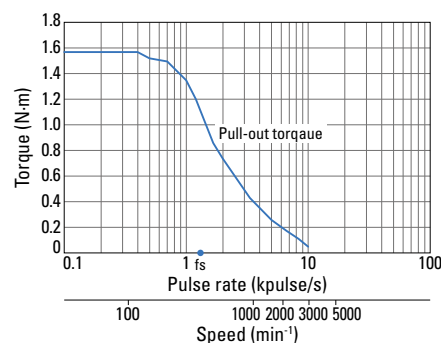
### SM2564C20U41 SM2564C20U11

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 7.4 \times 10^{-4} \text{ kg-m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate  
with no load



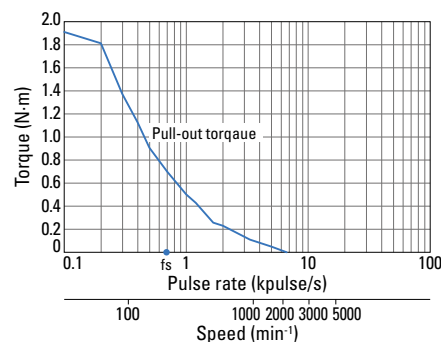
### SM2563C20U41 SM2563C20U11

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 7.4 \times 10^{-4} \text{ kg-m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate  
with no load



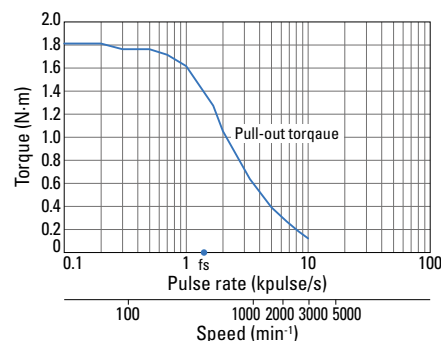
### SM2564C10U41 SM2564C10U11

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 7.4 \times 10^{-4} \text{ kg-m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate  
with no load

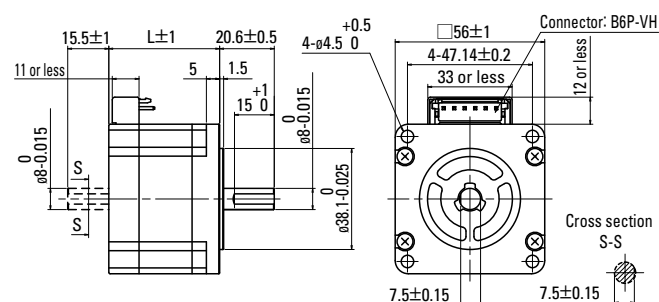


### SM2564C30U41 SM2564C30U11

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 3 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 7.4 \times 10^{-4} \text{ kg-m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate  
with no load



## Dimensions (Unit: mm)



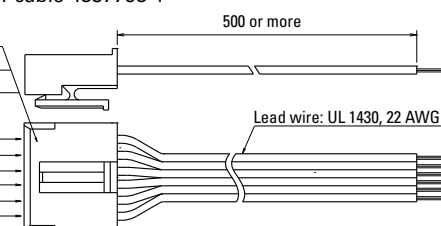
Separate option: Motor cable 4837798-1

Mfr.: J.S.T.

Housing: VHR-6N

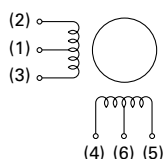
Terminal: SVH-21T-P1.1

| Terminal no. | Lead color |
|--------------|------------|
| 6            | Black      |
| 5            | Yellow     |
| 4            | Red        |
| 3            | Blue       |
| 2            | Orange     |
| 1            | White      |



## Internal wiring

In parentheses are connector pin nos.



## Compatible drivers

A driver is to be provided by the customer.

Note: The characteristics shown above are calculated using our experimental circuit.



# 56 mm sq.

1.8°/step **RoHS**  
Bipolar, connector type



Custom options

Hollow shaft Custom shaft

Gear Encoder

Brake

Note: Custom options availability varies depending on the model number and requested quantity. Contact us for details.

## Bipolar, connector type

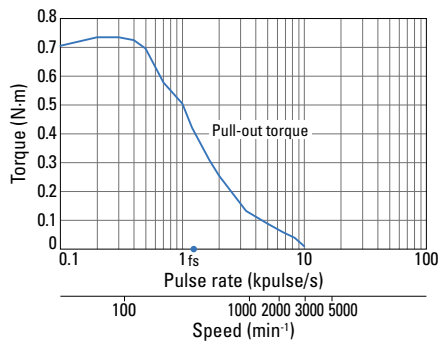
| Model no.           |                     | Holding torque at 2-phase excitation | Rated current | Winding resistance | Winding inductance | Rotor inertia                        | Allowable radial load | Allowable thrust load | Mass | Motor length (L) |
|---------------------|---------------------|--------------------------------------|---------------|--------------------|--------------------|--------------------------------------|-----------------------|-----------------------|------|------------------|
| Single shaft        | Dual shaft          | N·m or more                          | A/phase       | Ω/phase            | mH/phase           | × 10 <sup>-4</sup> kg·m <sup>2</sup> | N                     | N                     | kg   | mm               |
| <b>SM2561C10B41</b> | <b>SM2561C10B11</b> | 0.75                                 | 1             | 4.6                | 13.5               | 0.14                                 | 113                   | 20                    | 0.49 | 41.8             |
| <b>SM2561C20B41</b> | <b>SM2561C20B11</b> | 0.75                                 | 2             | 1.1                | 3.5                | 0.14                                 | 113                   | 20                    | 0.49 | 41.8             |
| <b>SM2561C30B41</b> | <b>SM2561C30B11</b> | 0.75                                 | 3             | 0.51               | 1.5                | 0.14                                 | 113                   | 20                    | 0.49 | 41.8             |
| <b>SM2561C40B41</b> | <b>SM2561C40B11</b> | 0.75                                 | 4             | 0.28               | 0.85               | 0.14                                 | 113                   | 20                    | 0.49 | 41.8             |
| <b>SM2561C60B41</b> | <b>SM2561C60B11</b> | 0.75                                 | 6             | 0.14               | 0.38               | 0.14                                 | 113                   | 20                    | 0.49 | 41.8             |
| <b>SM2562C10B41</b> | <b>SM2562C10B11</b> | 1.4                                  | 1             | 6.3                | 25.5               | 0.28                                 | 102                   | 20                    | 0.69 | 53.8             |
| <b>SM2562C20B41</b> | <b>SM2562C20B11</b> | 1.4                                  | 2             | 1.5                | 6.5                | 0.28                                 | 102                   | 20                    | 0.69 | 53.8             |
| <b>SM2562C30B41</b> | <b>SM2562C30B11</b> | 1.4                                  | 3             | 0.68               | 2.9                | 0.28                                 | 102                   | 20                    | 0.69 | 53.8             |
| <b>SM2562C40B41</b> | <b>SM2562C40B11</b> | 1.4                                  | 4             | 0.37               | 1.5                | 0.28                                 | 102                   | 20                    | 0.69 | 53.8             |
| <b>SM2562C60B41</b> | <b>SM2562C60B11</b> | 1.4                                  | 6             | 0.18               | 0.72               | 0.28                                 | 102                   | 20                    | 0.69 | 53.8             |
| <b>SM2563C10B41</b> | <b>SM2563C10B11</b> | 2.35                                 | 1             | 8.6                | 36                 | 0.5                                  | 78                    | 20                    | 1.1  | 75.8             |
| <b>SM2563C20B41</b> | <b>SM2563C20B11</b> | 2.35                                 | 2             | 2.1                | 9.5                | 0.5                                  | 78                    | 20                    | 1.1  | 75.8             |
| <b>SM2563C30B41</b> | <b>SM2563C30B11</b> | 2.35                                 | 3             | 0.95               | 4.2                | 0.5                                  | 78                    | 20                    | 1.1  | 75.8             |
| <b>SM2563C40B41</b> | <b>SM2563C40B11</b> | 2.35                                 | 4             | 0.52               | 2.4                | 0.5                                  | 78                    | 20                    | 1.1  | 75.8             |
| <b>SM2563C60B41</b> | <b>SM2563C60B11</b> | 2.35                                 | 6             | 0.25               | 1.05               | 0.5                                  | 78                    | 20                    | 1.1  | 75.8             |
| <b>SM2564C10B41</b> | <b>SM2564C10B11</b> | 2.5                                  | 1             | 9.4                | 41                 | 0.6                                  | 70                    | 20                    | 1.27 | 85.8             |
| <b>SM2564C20B41</b> | <b>SM2564C20B11</b> | 2.5                                  | 2             | 2.1                | 11                 | 0.6                                  | 70                    | 20                    | 1.27 | 85.8             |
| <b>SM2564C30B41</b> | <b>SM2564C30B11</b> | 2.5                                  | 3             | 0.95               | 4.9                | 0.6                                  | 70                    | 20                    | 1.27 | 85.8             |
| <b>SM2564C40B41</b> | <b>SM2564C40B11</b> | 2.5                                  | 4             | 0.59               | 2.8                | 0.6                                  | 70                    | 20                    | 1.27 | 85.8             |
| <b>SM2564C60B41</b> | <b>SM2564C60B11</b> | 2.5                                  | 6             | 0.27               | 1.15               | 0.6                                  | 70                    | 20                    | 1.27 | 85.8             |

Motor cable model no.: 4837961-1

## Characteristics

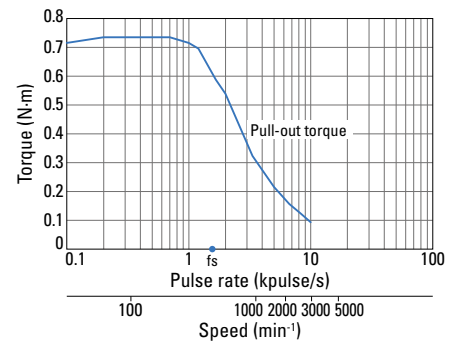
### SM2561C10B41 SM2561C10B11

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate  
with no load



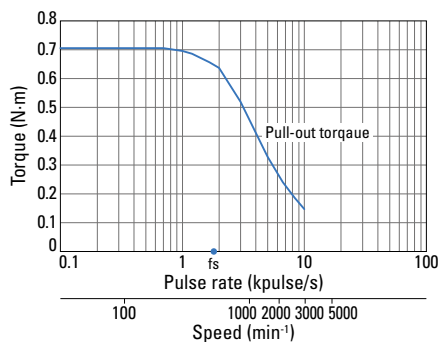
### SM2561C20B41 SM2561C20B11

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate  
with no load



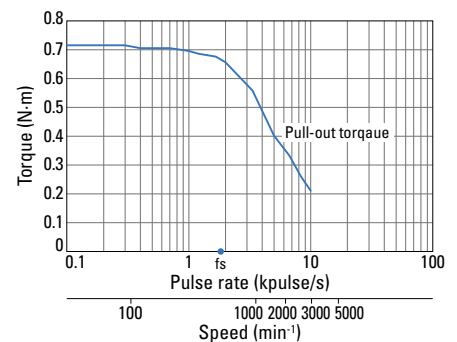
### SM2561C30B41 SM2561C30B11

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 3 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate  
with no load



### SM2561C40B41 SM2561C40B11

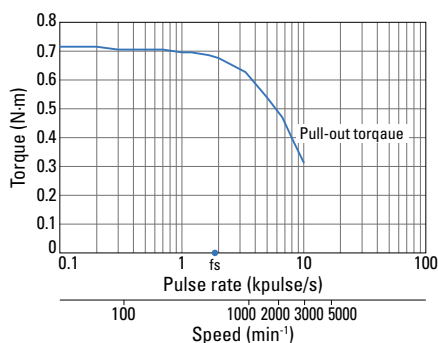
Constant current circuit  
Input voltage: 24 VDC  
Winding current: 4 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate  
with no load



## Characteristics

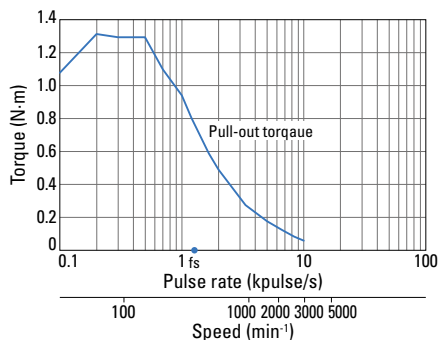
### SM2561C60B41 SM2561C60B11

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 6 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{ kg-m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate  
with no load



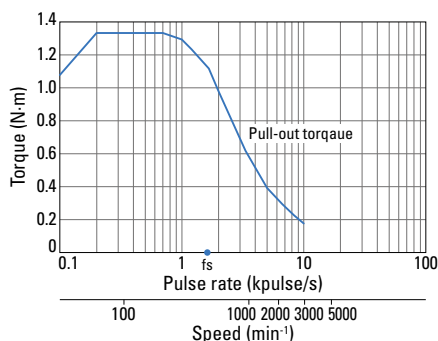
### SM2562C20B41 SM2562C20B11

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 2.6 \times 10^{-4} \text{ kg-m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate  
with no load



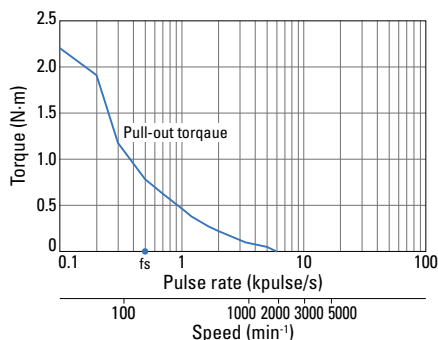
### SM2562C40B41 SM2562C40B11

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 4 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 2.6 \times 10^{-4} \text{ kg-m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate  
with no load



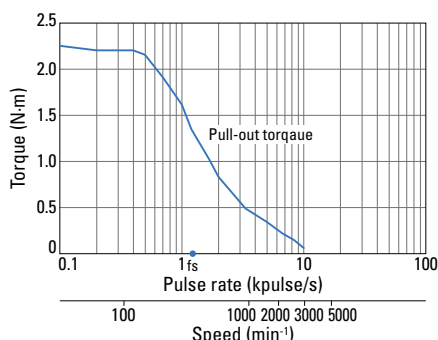
### SM2563C10B41 SM2563C10B11

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 7.4 \times 10^{-4} \text{ kg-m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate  
with no load



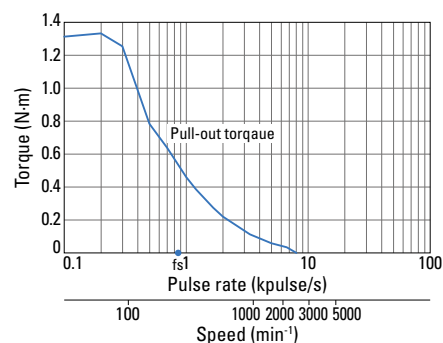
### SM2563C30B41 SM2563C30B11

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 3 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 7.4 \times 10^{-4} \text{ kg-m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate  
with no load



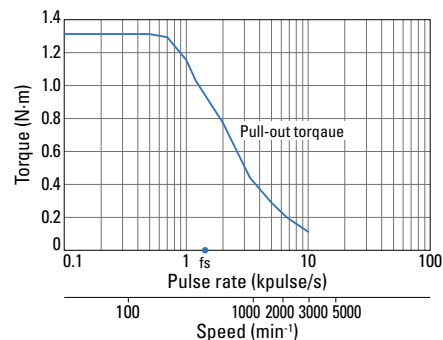
### SM2562C10B41 SM2562C10B11

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 2.6 \times 10^{-4} \text{ kg-m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate  
with no load



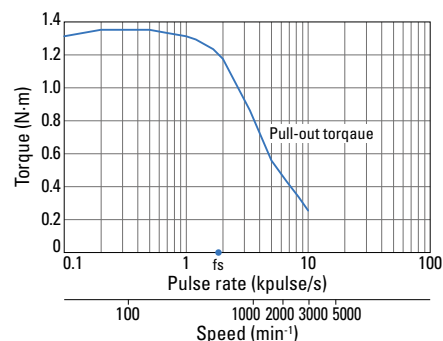
### SM2562C30B41 SM2562C30B11

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 3 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 2.6 \times 10^{-4} \text{ kg-m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate  
with no load



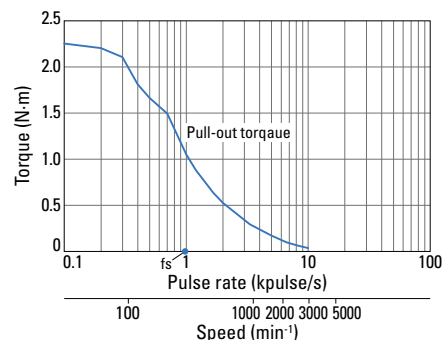
### SM2562C60B41 SM2562C60B11

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 6 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 2.6 \times 10^{-4} \text{ kg-m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate  
with no load



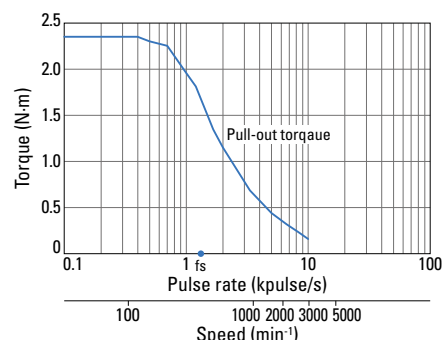
### SM2563C20B41 SM2563C20B11

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 7.4 \times 10^{-4} \text{ kg-m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate  
with no load



### SM2563C40B41 SM2563C40B11

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 4 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 7.4 \times 10^{-4} \text{ kg-m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate  
with no load



**SM2563C60B41**  
**SM2563C60B11**

SM2564C20B41  
SM2564C20B11

Figure 1 is a graph showing the pull-out torque of a synchronous motor as a function of pulse rate. The y-axis represents Torque (N·m) from 0 to 3.0. The x-axis represents Pulse rate (kpulse/s) on a logarithmic scale from 0.1 to 100, and Speed (min<sup>-1</sup>) from 100 to 5000. A blue curve labeled "Pull-out torque" starts at approximately 2.4 N·m at 0.1 kpulse/s and decreases to 0 at 10 kpulse/s. A point on the curve at 1 kpulse/s is marked with a blue arrow and labeled "fs".

SM2564C40B41  
SM2564C40B11

The graph illustrates the pull-out torque of a synchronous motor. The torque remains relatively constant at approximately 2.5 N·m for pulse rates up to about 0.5 kpulse/s. Beyond this point, the torque decreases as the pulse rate increases, reaching approximately 0.2 N·m at 10 kpulse/s. The synchronous speed  $f_s$  is indicated at a pulse rate of approximately 1.5 kpulse/s.

| Pulse rate (kpulse/s) | Speed ( $\text{min}^{-1}$ ) | Torque (N·m) |
|-----------------------|-----------------------------|--------------|
| 0.1                   | 100                         | 2.5          |
| 0.5                   | 500                         | 2.4          |
| 1.0                   | 1000                        | 2.0          |
| 1.5 ( $f_s$ )         | 1500                        | 1.5          |
| 2.0                   | 2000                        | 1.0          |
| 5.0                   | 5000                        | 0.5          |
| 10.0                  | 10000                       | 0.2          |

SM2564C10B41  
SM2564C10B11

Figure 1 is a graph showing the pull-out torque of a motor as a function of pulse rate. The y-axis represents Torque (N·m) from 0 to 3.0. The x-axis represents Pulse rate (kpulse/s) on a logarithmic scale from 0.1 to 100, and Speed (min<sup>-1</sup>) from 100 to 5000. A blue curve shows the pull-out torque decreasing as the pulse rate increases. A point labeled 'fs' is marked on the x-axis at 100 kpulse/s.

| Pulse rate (kpulse/s) | Speed (min <sup>-1</sup> ) | Torque (N·m) |
|-----------------------|----------------------------|--------------|
| 0.1                   | 100                        | 2.4          |
| 0.2                   | 200                        | 2.0          |
| 0.5                   | 500                        | 1.2          |
| 1.0                   | 1000                       | 0.8          |
| 2.0                   | 2000                       | 0.4          |
| 5.0                   | 5000                       | 0.1          |
| 10.0                  | 10000                      | 0.0          |

SM2564C30B41  
SM2564C30B11

The graph shows the relationship between Torque (N·m) and Pulse rate (kpulse/s) and Speed (min<sup>-1</sup>). The torque is constant at 2.5 N·m for pulse rates up to 0.5 kpulse/s. Beyond this, the torque decreases linearly with the logarithm of the pulse rate, reaching 0.5 N·m at 10 kpulse/s and 0.1 N·m at 30 kpulse/s. A point labeled 'fs' is marked at 1 kpulse/s on the pulse rate axis.

| Pulse rate (kpulse/s) | Speed (min <sup>-1</sup> ) | Torque (N·m) |
|-----------------------|----------------------------|--------------|
| 0.1                   | 100                        | 2.5          |
| 0.5                   | 300                        | 2.5          |
| 1                     | 600                        | 1.5          |
| 10                    | 6000                       | 0.5          |
| 30                    | 18000                      | 0.1          |

SM2564C60B41  
SM2564C60B11

The graph plots Torque (N·m) on the y-axis (0 to 3.0) against Pulse rate (kpulse/s) on the top x-axis (0.1 to 100) and Speed (min<sup>-1</sup>) on the bottom x-axis (100 to 5000). The curve starts at approximately 2.4 N·m for pulse rates up to 0.5 kpulse/s. Beyond 0.5 kpulse/s, the torque decreases linearly on the log-linear plot. A specific point on the curve at a pulse rate of 1.5 kpulse/s is marked with a blue dot and labeled 'fs'.

| Pulse rate (kpulse/s) | Speed (min <sup>-1</sup> ) | Torque (N·m) |
|-----------------------|----------------------------|--------------|
| 0.1                   | ~100                       | ~2.4         |
| 0.5                   | ~500                       | ~2.4         |
| 1.5 (fs)              | ~1500                      | ~1.5         |
| 10                    | ~10000                     | ~0.2         |

[illegible]

The diagram illustrates the SVH-21T-P1.1 terminal block. It features a housing labeled 'VHR-4N' and a terminal labeled 'SVH-21T-P1.1'. The terminal is shown with four leads, numbered 1 to 4, with corresponding lead colors: 1 (Orange), 2 (Blue), 3 (Red), and 4 (Yellow). The leads are connected to a lead wire labeled 'UL 1430, 22 AWG'. The terminal block is shown with a length of '500 or more' units.

Mfr.: J.S.T.  
Housing: VHR-4N  
Terminal: SVH-21T-P1.1

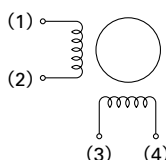
Terminal no. Lead color

|   |        |
|---|--------|
| 4 | Yellow |
| 3 | Red    |
| 2 | Blue   |
| 1 | Orange |

Lead wire: UL 1430, 22 AWG

500 or more

In parentheses are connector pin nos.



- For motors SM256□C20B□1 (2 A/phase)...  
Model no.: F2BED200P100 (DC input)  
Operating current selection switch setting: 0
- For motors SM256□C30B□1 (3 A/phase)...  
Model no.: F2BFD400P100 (DC input)  
Operating current selection switch setting: 5
- For motors SM256□C40B□1 (4 A/phase)...  
Model no.: F2BFD400P100 (DC input)  
Operating current selection switch setting: 0
- For motors other than above...  
A driver is to be provided by the customer.

Note: The characteristics shown above are calculated using our experimental circuit.



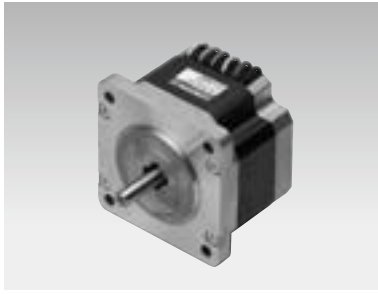
# 60 mm sq.

Our conventional 60 mm sq. motors (103H782□)

1.8°/step RoHS

It is recommended you use a 56 mm sq. motor (SM256□C□0□□1) that has equivalent torque in a smaller size.

We also offer customization that makes the flange compatible with 60 mm sq. motors for easy replacement.



# 60 mm sq.

0.9°/step **RoHS**

Unipolar, lead type  
Bipolar, lead type



Custom options

Hollow shaft Custom shaft

Gear Encoder

Note: Custom options availability varies depending on the model number and requested quantity. Contact us for details.

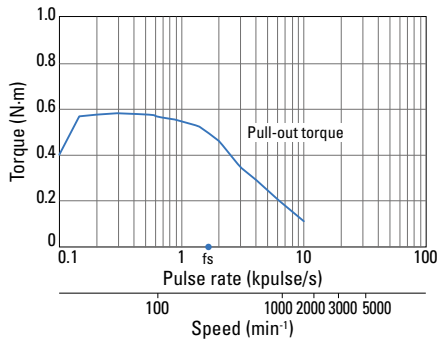
## Unipolar, lead type

| Model no.          |                    | Holding torque at 2-phase excitation | Rated current | Winding resistance | Winding inductance | Rotor inertia                        | Allowable radial load | Allowable thrust load | Mass | Motor length (L) | Shaft diameter (D) |
|--------------------|--------------------|--------------------------------------|---------------|--------------------|--------------------|--------------------------------------|-----------------------|-----------------------|------|------------------|--------------------|
| Single shaft       | Dual shaft         | N·m or more                          | A/phase       | Ω/phase            | mH/phase           | × 10 <sup>-4</sup> kg·m <sup>2</sup> | N                     | N                     | kg   | mm               | mm                 |
| <b>SH1601-0440</b> | <b>SH1601-0410</b> | 0.57                                 | 2             | 1.35               | 2                  | 0.24                                 | 80                    | 15                    | 0.55 | 42               | 0<br>ø6.35-0.013   |
| <b>SH1602-0440</b> | <b>SH1602-0410</b> | 1.1                                  | 2             | 1.8                | 3.5                | 0.4                                  | 70                    | 15                    | 0.8  | 54               | 0<br>ø6.35-0.013   |
| <b>SH1603-0440</b> | <b>SH1603-0410</b> | 1.7                                  | 2             | 2.3                | 4.5                | 0.75                                 | 90                    | 15                    | 1.2  | 76               | 0<br>ø8-0.015      |

## Characteristics

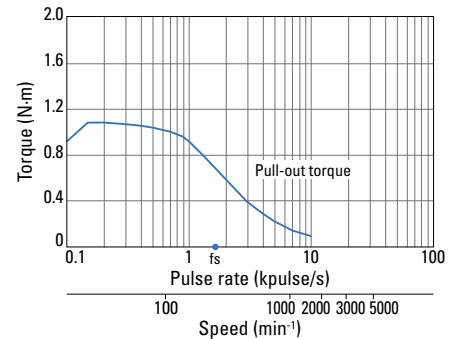
### SH1601-0440 SH1601-0410

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate with no load



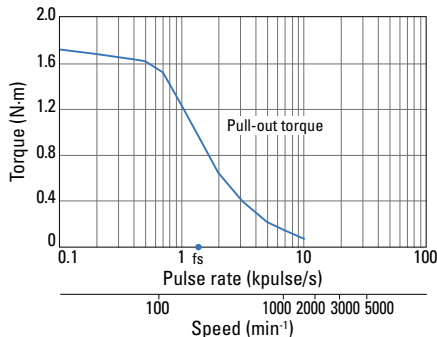
### SH1602-0440 SH1602-0410

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 2.6 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate with no load

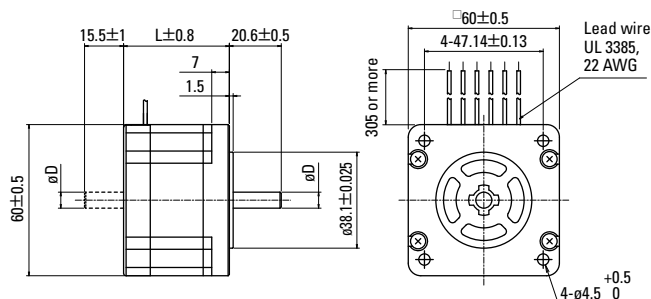


### SH1603-0440 SH1603-0410

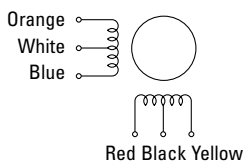
Constant current circuit  
Input voltage: 24 VDC  
Winding current: 2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 7.4 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate with no load



## Dimensions (Unit: mm)



## Internal winding



## Compatible drivers

A driver is to be provided by the customer.

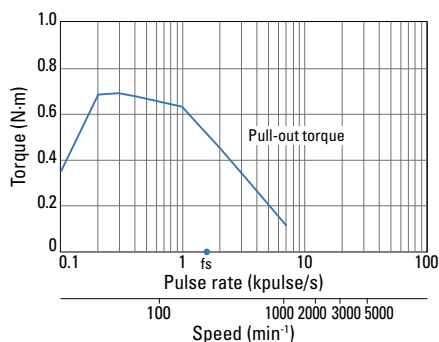
Note: The characteristics shown above are calculated using our experimental circuit.

**Bipolar, lead type**

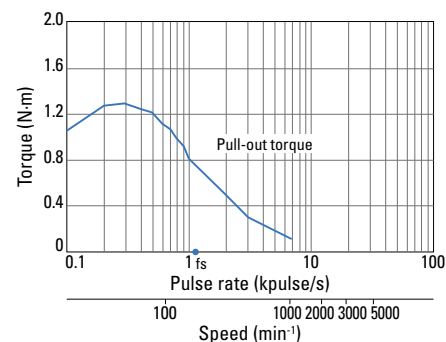
| Model no.    |             | Holding torque at 2-phase excitation | Rated current | Winding resistance | Winding inductance | Rotor inertia                        | Allowable radial load | Allowable thrust load | Mass | Motor length (L) | Shaft diameter (D) |
|--------------|-------------|--------------------------------------|---------------|--------------------|--------------------|--------------------------------------|-----------------------|-----------------------|------|------------------|--------------------|
| Single shaft | Dual shaft  | N·m or more                          | A/phase       | Ω/phase            | mH/phase           | × 10 <sup>-4</sup> kg·m <sup>2</sup> | N                     | N                     | kg   | mm               | mm                 |
| SH1601-5240  | SH1601-5210 | 0.69                                 | 2             | 1.2                | 3.5                | 0.24                                 | 78                    | 15                    | 0.55 | 42               | 0<br>ø6.35-0.013   |
| SH1602-5240  | SH1602-5210 | 1.28                                 | 2             | 1.65               | 6.1                | 0.4                                  | 65                    | 15                    | 0.8  | 54               | 0<br>ø6.35-0.013   |
| SH1603-5240  | SH1603-5210 | 2.15                                 | 2             | 2.3                | 8.8                | 0.75                                 | 83                    | 15                    | 1.2  | 76               | 0<br>ø8-0.015      |

**Characteristics****SH1601-5240  
SH1601-5210**

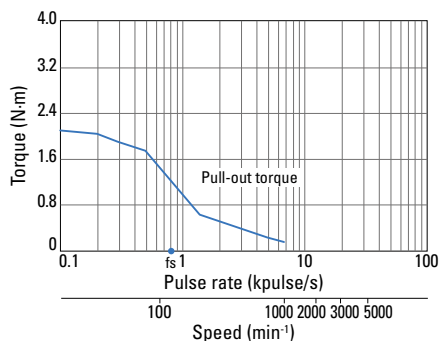
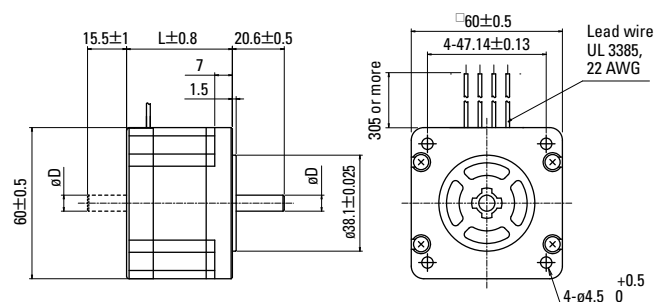
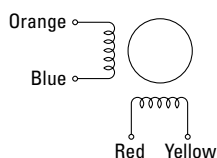
Constant current circuit  
Input voltage: 24 VDC  
Winding current: 2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate  
with no load

**SH1602-5240  
SH1602-5210**

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 2.6 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate  
with no load

**SH1603-5240  
SH1603-5210**

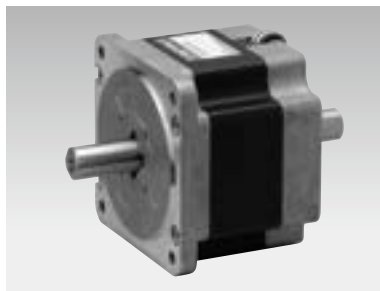
Constant current circuit  
Input voltage: 24 VDC  
Winding current: 2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 7.4 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate  
with no load

**Dimensions (Unit: mm)****Internal winding****Compatible drivers**

Model no.: F2BED200P100 (DC input)

Operating current selection switch setting: 0

Note: The characteristics shown above are calculated using our experimental circuit.



# 86 mm sq.

1.8°/step **RoHS**

Unipolar, lead type  
Bipolar, lead type ▶ p. 66



Custom options

Hollow shaft Custom shaft

Encoder Brake

Note: Custom options availability varies depending on the model number and requested quantity. Contact us for details.

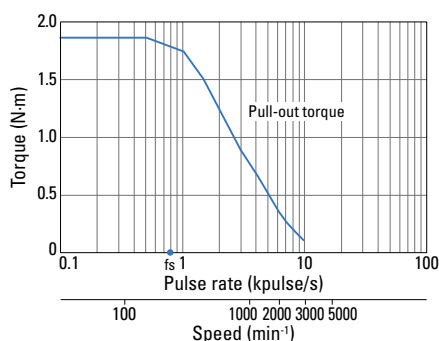
## Unipolar, lead type

| Model no.    |             | Holding torque at 2-phase excitation | Rated current | Winding resistance | Winding inductance | Rotor inertia                        | Allowable radial load | Allowable thrust load | Mass | Motor length (L) |
|--------------|-------------|--------------------------------------|---------------|--------------------|--------------------|--------------------------------------|-----------------------|-----------------------|------|------------------|
| Single shaft | Dual shaft  | N·m or more                          | A/phase       | Ω/phase            | mH/phase           | × 10 <sup>-4</sup> kg·m <sup>2</sup> | N                     | N                     | kg   | mm               |
| SH2861-0441  | SH2861-0411 | 2.5                                  | 2             | 2.3                | 8.0                | 1.48                                 | 200                   | 60                    | 1.75 | 66               |
| SH2861-0941  | SH2861-0911 | 2.5                                  | 4             | 0.6                | 2.0                | 1.48                                 | 200                   | 60                    | 1.75 | 66               |
| SH2862-0441  | SH2862-0411 | 4.7                                  | 2             | 3.2                | 13.0               | 3.0                                  | 200                   | 60                    | 2.9  | 96.5             |
| SH2862-0941  | SH2862-0911 | 4.7                                  | 4             | 0.85               | 3.4                | 3.0                                  | 200                   | 60                    | 2.9  | 96.5             |
| SH2863-0441  | SH2863-0411 | 6.7                                  | 2             | 4.0                | 17.0               | 4.5                                  | 200                   | 60                    | 4.0  | 127              |
| SH2863-0941  | SH2863-0911 | 6.7                                  | 4             | 0.9                | 4.2                | 4.5                                  | 200                   | 60                    | 4.0  | 127              |

## Characteristics

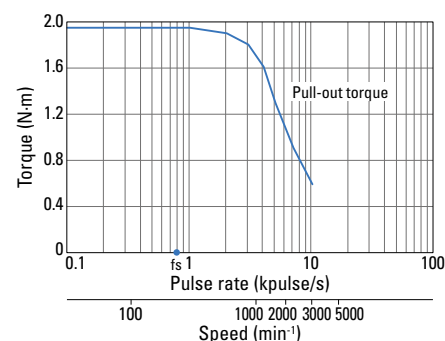
### SH2861-0441 SH2861-0411

Constant current circuit  
Input voltage: 100 VAC  
Winding current: 2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 7.4 \times 10^{-4} \text{kg·m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate with no load



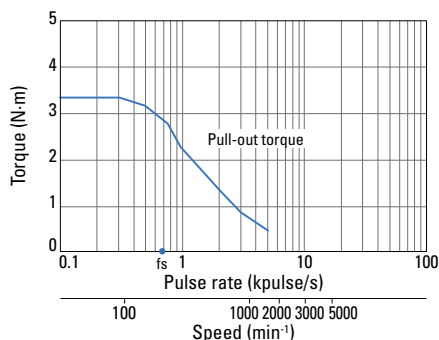
### SH2861-0941 SH2861-0911

Constant current circuit  
Input voltage: 100 VAC  
Winding current: 4 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 7.4 \times 10^{-4} \text{kg·m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate with no load



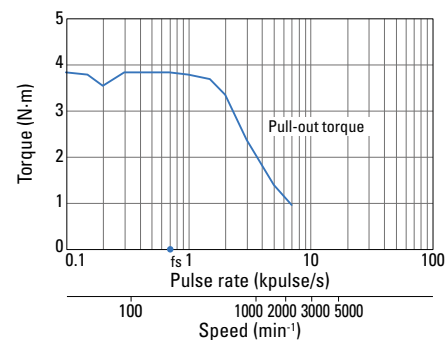
### SH2862-0441 SH2862-0411

Constant current circuit  
Input voltage: 100 VAC  
Winding current: 2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 15.3 \times 10^{-4} \text{kg·m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate with no load



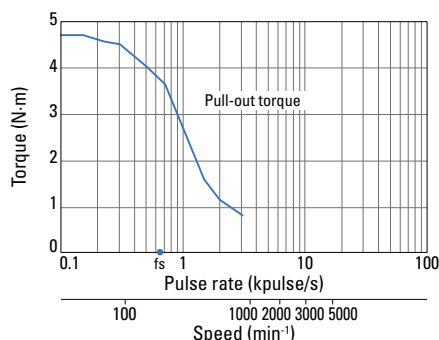
### SH2862-0941 SH2862-0911

Constant current circuit  
Input voltage: 100 VAC  
Winding current: 4 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 15.3 \times 10^{-4} \text{kg·m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate with no load



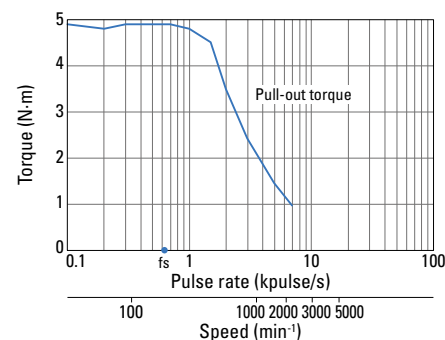
### SH2863-0441 SH2863-0411

Constant current circuit  
Input voltage: 100 VAC  
Winding current: 2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 15.3 \times 10^{-4} \text{kg·m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate with no load



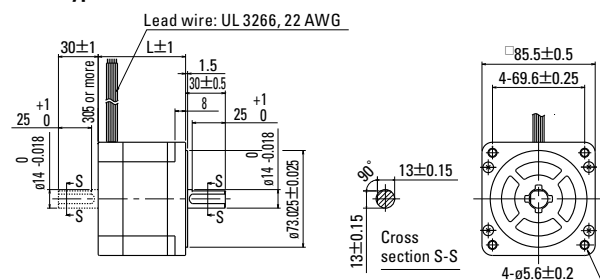
### SH2863-0941 SH2863-0911

Constant current circuit  
Input voltage: 100 VAC  
Winding current: 4 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 15.3 \times 10^{-4} \text{kg·m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate with no load

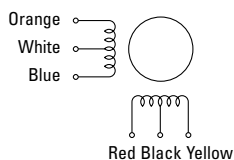


### ■ Dimensions (Unit: mm)

### Lead type



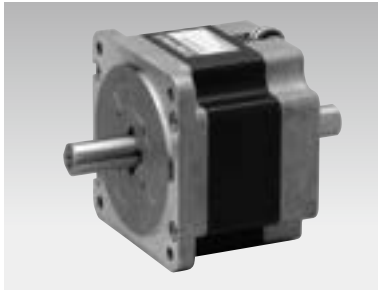
## Internal winding



## Compatible drivers

A driver is to be provided by the customer.

Note: The characteristics shown above are calculated using ,  
our experimental circuit.



# 86 mm sq.

1.8°/step **RoHS**

Bipolar, lead type

Unipolar, lead type ▶ p. 64



Custom options

Hollow shaft Custom shaft

Encoder Brake

Note: Custom options availability varies depending on the model number and requested quantity. Contact us for details.

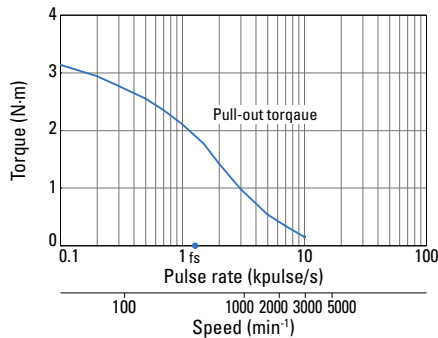
## Bipolar, lead type

| Model no.    |             | Holding torque at 2-phase excitation | Rated current | Winding resistance | Winding inductance | Rotor inertia                        | Allowable radial load | Allowable thrust load | Mass | Motor length (L) |
|--------------|-------------|--------------------------------------|---------------|--------------------|--------------------|--------------------------------------|-----------------------|-----------------------|------|------------------|
| Single shaft | Dual shaft  | N·m or more                          | A/phase       | Ω/phase            | mH/phase           | × 10 <sup>-4</sup> kg·m <sup>2</sup> | N                     | N                     | kg   | mm               |
| SH2861-5041  | SH2861-5011 | 3.3                                  | 2             | 2.2                | 15                 | 1.48                                 | 200                   | 60                    | 1.75 | 66               |
| SH2861-5141  | SH2861-5111 | 3.3                                  | 4             | 0.56               | 3.7                | 1.48                                 | 200                   | 60                    | 1.75 | 66               |
| SH2861-5241  | SH2861-5211 | 3.3                                  | 6             | 0.29               | 1.7                | 1.48                                 | 200                   | 60                    | 1.75 | 66               |
| SH2862-5041  | SH2862-5011 | 6.4                                  | 2             | 3.2                | 25                 | 3.0                                  | 200                   | 60                    | 2.9  | 96.5             |
| SH2862-5141  | SH2862-5111 | 6.4                                  | 4             | 0.83               | 6.4                | 3.0                                  | 200                   | 60                    | 2.9  | 96.5             |
| SH2862-5241  | SH2862-5211 | 6.4                                  | 6             | 0.36               | 2.8                | 3.0                                  | 200                   | 60                    | 2.9  | 96.5             |
| SH2863-5041  | SH2863-5011 | 9                                    | 2             | 4.0                | 32                 | 4.5                                  | 200                   | 60                    | 4.0  | 127              |
| SH2863-5141  | SH2863-5111 | 9                                    | 4             | 1.0                | 7.9                | 4.5                                  | 200                   | 60                    | 4.0  | 127              |
| SH2863-5241  | SH2863-5211 | 9                                    | 6             | 0.46               | 3.8                | 4.5                                  | 200                   | 60                    | 4.0  | 127              |

## Characteristics

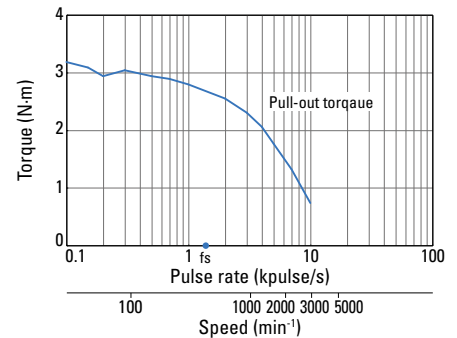
### SH2861-5041 SH2861-5011

Constant current circuit  
Input voltage: 100 VAC  
Winding current: 2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 15.3 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate with no load



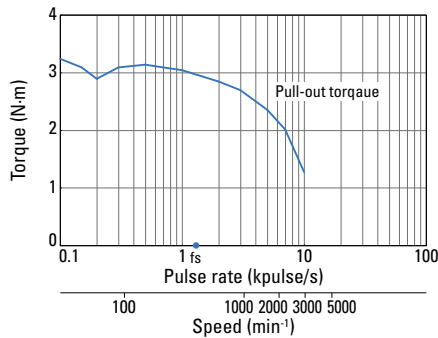
### SH2861-5141 SH2861-5111

Constant current circuit  
Input voltage: 100 VAC  
Winding current: 4 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 15.3 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate with no load



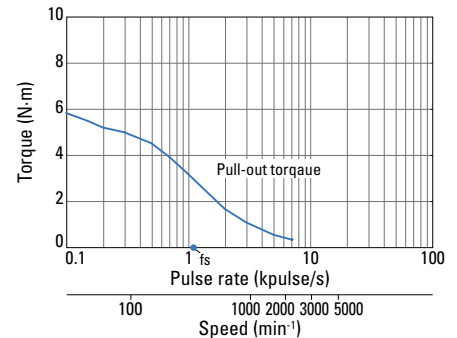
### SH2861-5241 SH2861-5211

Constant current circuit  
Input voltage: 100 VAC  
Winding current: 6 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 15.3 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate with no load



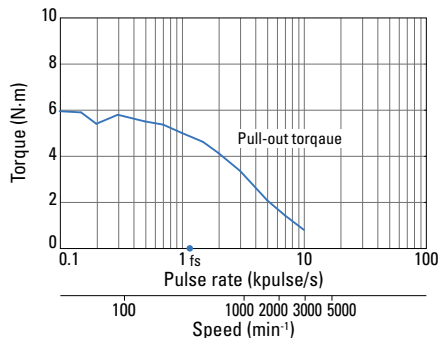
### SH2862-5041 SH2862-5011

Constant current circuit  
Input voltage: 100 VAC  
Winding current: 2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 15.3 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate with no load



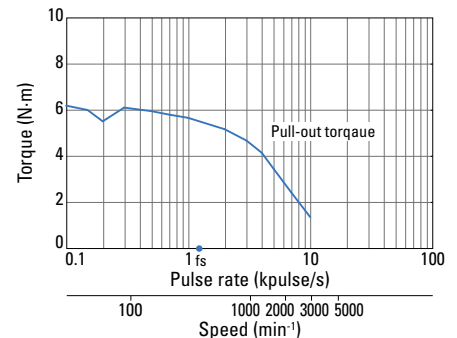
### SH2862-5141 SH2862-5111

Constant current circuit  
Input voltage: 100 VAC  
Winding current: 4 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 15.3 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate with no load



### SH2862-5241 SH2862-5211

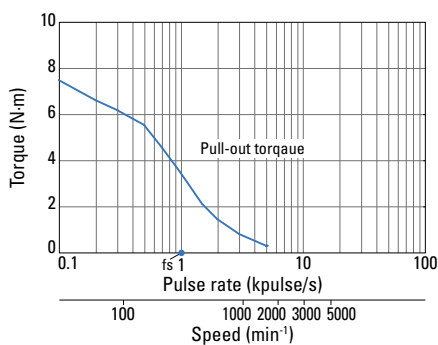
Constant current circuit  
Input voltage: 100 VAC  
Winding current: 6 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 15.3 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate with no load



## Characteristics

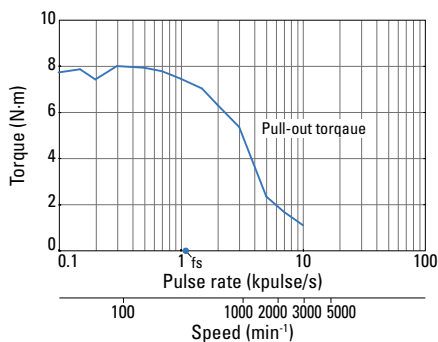
SH2863-5041  
SH2863-5011

Constant current circuit  
Input voltage: 100 VAC  
Winding current: 2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 44 \times 10^{-4} \text{ kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate  
with no load



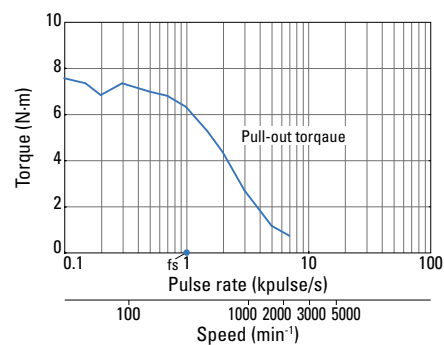
SH2863-5241  
SH2863-5211

Constant current circuit  
Input voltage: 100 VAC  
Winding current: 6 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 44 \times 10^{-4} \text{ kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate  
with no load

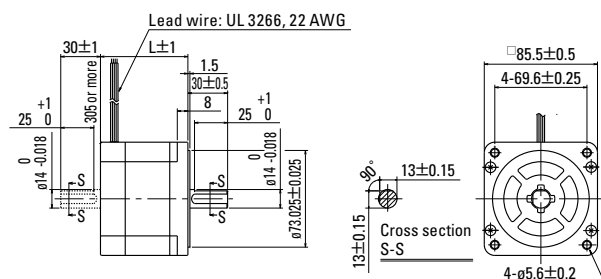


SH2863-5141  
SH2863-5111

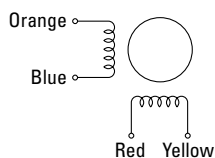
Constant current circuit  
Input voltage: 100 VAC  
Winding current: 4 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 44 \times 10^{-4} \text{ kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate  
with no load



### Dimensions (Unit: mm)



## Internal winding



## Compatible drivers

- For motors SH2861-50□□ (2 A/phase) or SH2862-50□□ (2 A/phase)...  
Model no.: F2BED200P100 (DC input)  
Operating current selection switch setting: 0
- For motors other than above...  
A driver is to be provided by the customer.

Note: The characteristics shown above are calculated using our experimental circuit.



# Ø106 mm

1.8°/step **RoHS**

Unipolar, lead type  
Bipolar, lead type

## Custom options

**Hollow shaft** **Custom shaft**

**Brake**

Note: Custom options availability varies depending on the model number and requested quantity. Contact us for details.

## Unipolar, lead type

| Model no.             |                       | Holding torque at 2-phase excitation | Rated current | Winding resistance | Winding inductance | Rotor inertia                        | Allowable radial load | Allowable thrust load | Mass | Motor length (L) |
|-----------------------|-----------------------|--------------------------------------|---------------|--------------------|--------------------|--------------------------------------|-----------------------|-----------------------|------|------------------|
| Single shaft          | Dual shaft            | N·m or more                          | A/phase       | Ω/phase            | mH/phase           | × 10 <sup>-4</sup> kg·m <sup>2</sup> | N                     | N                     | kg   | mm               |
| <b>103H89222-0941</b> | <b>103H89222-0911</b> | 10.8                                 | 4             | 0.98               | 6.3                | 14.6                                 | 350                   | 100                   | 7.5  | 163.3            |
| <b>103H89223-0941</b> | <b>103H89223-0911</b> | 15.5                                 | 4             | 1.4                | 9.7                | 22                                   | 340                   | 100                   | 10.5 | 221.3            |

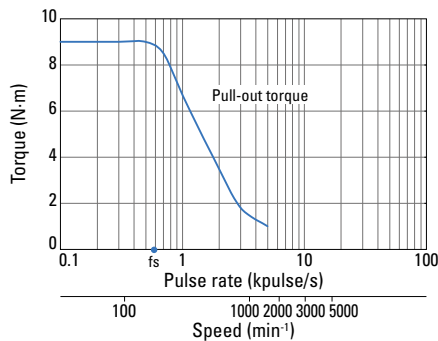
## Bipolar, lead type

| Model no.             |                       | Holding torque at 2-phase excitation | Rated current | Winding resistance | Winding inductance | Rotor inertia                        | Allowable radial load | Allowable thrust load | Mass | Motor length (L) |
|-----------------------|-----------------------|--------------------------------------|---------------|--------------------|--------------------|--------------------------------------|-----------------------|-----------------------|------|------------------|
| Single shaft          | Dual shaft            | N·m or more                          | A/phase       | Ω/phase            | mH/phase           | × 10 <sup>-4</sup> kg·m <sup>2</sup> | N                     | N                     | kg   | mm               |
| <b>103H89222-5241</b> | <b>103H89222-5211</b> | 13.2                                 | 6             | 0.45               | 5.4                | 14.6                                 | 340                   | 100                   | 7.5  | 163.3            |
| <b>103H89223-5241</b> | <b>103H89223-5211</b> | 19                                   | 6             | 0.63               | 8                  | 22                                   | 290                   | 100                   | 10.5 | 221.3            |

## Characteristics

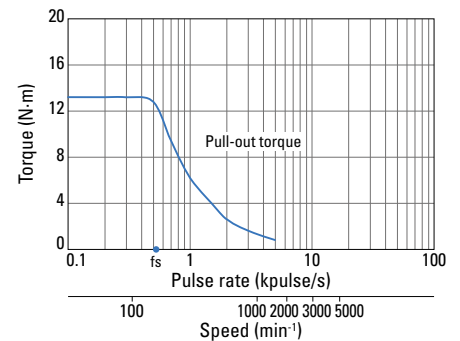
### 103H89222-0941 103H89222-0911

Constant current circuit  
Input voltage: 100 VAC  
Winding current: 4 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 44 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate with no load



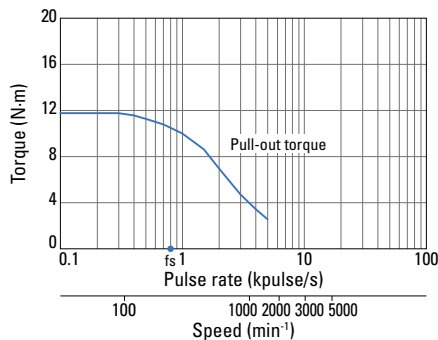
### 103H89223-0941 103H89223-0911

Constant current circuit  
Input voltage: 100 VAC  
Winding current: 4 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 44 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate with no load



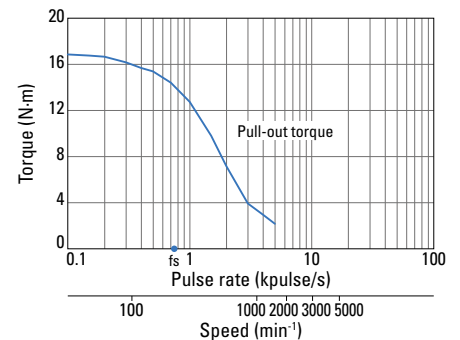
### 103H89222-5241 103H89222-5211

Constant current circuit  
Input voltage: 100 VAC  
Winding current: 6 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 44 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate with no load

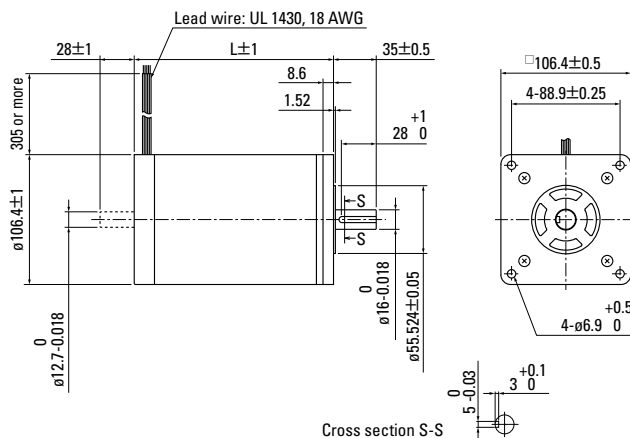


### 103H89223-5241 103H89223-5211

Constant current circuit  
Input voltage: 100 VAC  
Winding current: 6 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 44 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate with no load

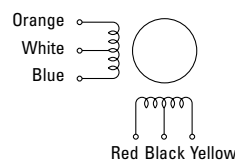


## Dimensions (Unit: mm)

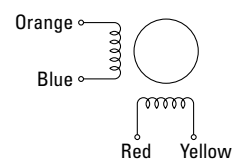


## Internal winding

### Unipolar



### Bipolar



## Compatible drivers

A driver is to be provided by the customer

Note: The characteristics shown above are calculated using our experimental circuit.



# 56 mm sq.

1.8°/step **RoHS**

Unipolar, lead-type, CE/UKCA models



Custom options

Hollow shaft Custom shaft

Note: Custom options availability varies depending on the model number and requested quantity. Contact us for details.

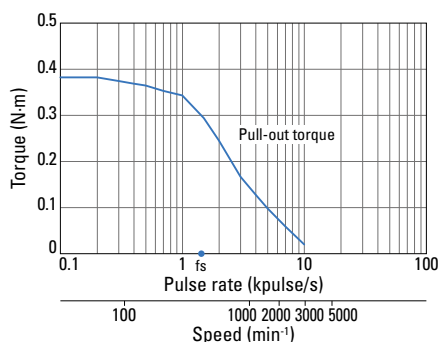
## Unipolar, lead-type, CE/UKCA models

| Model no.     |               | Holding torque at 2-phase excitation | Rated current | Winding resistance | Winding inductance | Rotor inertia                        | Allowable radial load | Allowable thrust load | Mass | Motor length (L) |
|---------------|---------------|--------------------------------------|---------------|--------------------|--------------------|--------------------------------------|-----------------------|-----------------------|------|------------------|
| Single shaft  | Dual shaft    | N·m or more                          | A/phase       | Ω/phase            | mH/phase           | × 10 <sup>-4</sup> kg·m <sup>2</sup> | N                     | N                     | kg   | mm               |
| 103H7121-6140 | 103H7121-6110 | 0.39                                 | 1             | 4.8                | 8                  | 0.1                                  | 78                    | 15                    | 0.47 | 41.8             |
| 103H7121-6740 | 103H7121-6710 | 0.39                                 | 3             | 0.6                | 0.8                | 0.1                                  | 78                    | 15                    | 0.47 | 41.8             |
| 103H7123-6140 | 103H7123-6110 | 0.83                                 | 1             | 6.7                | 15                 | 0.21                                 | 71                    | 15                    | 0.65 | 53.8             |
| 103H7123-6740 | 103H7123-6710 | 0.78                                 | 3             | 0.77               | 1.58               | 0.21                                 | 71                    | 15                    | 0.65 | 53.8             |
| 103H7126-6140 | 103H7126-6110 | 1.27                                 | 1             | 8.6                | 19                 | 0.36                                 | 62                    | 15                    | 0.98 | 75.8             |
| 103H7126-6740 | 103H7126-6710 | 1.27                                 | 3             | 0.9                | 2.2                | 0.36                                 | 62                    | 15                    | 0.98 | 75.8             |

## Characteristics

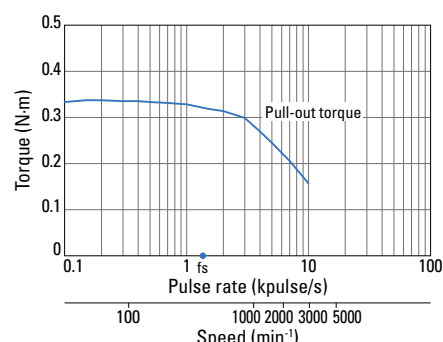
### 103H7121-6140 103H7121-6110

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{ kg·m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate with no load



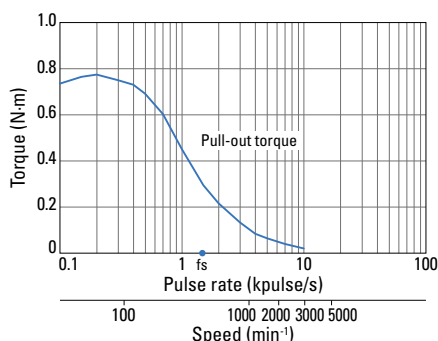
### 103H7121-6740 103H7121-6710

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 3 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{ kg·m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate with no load



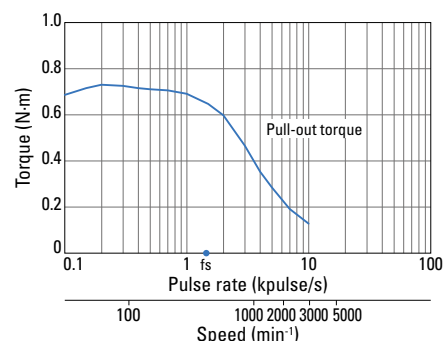
### 103H7123-6140 103H7123-6110

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{ kg·m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate with no load



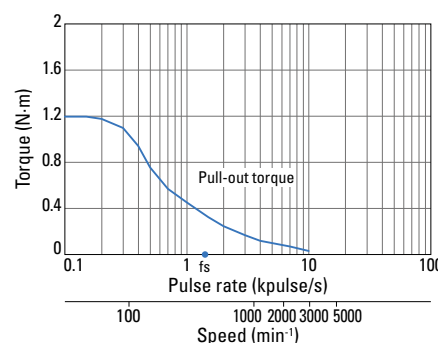
### 103H7123-6740 103H7123-6710

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 3 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 0.94 \times 10^{-4} \text{ kg·m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate with no load



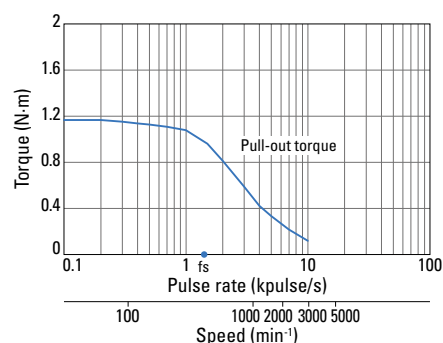
### 103H7126-6140 103H7126-6110

Constant current circuit  
Input voltage: 24 VDC  
Winding current: 1 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 2.6 \times 10^{-4} \text{ kg·m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate with no load

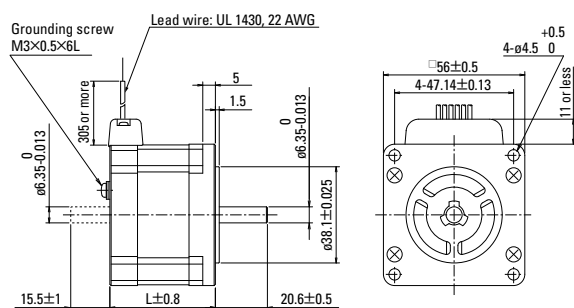


### 103H7126-6740 103H7126-6710

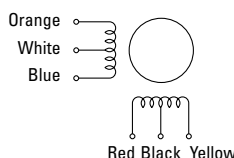
Constant current circuit  
Input voltage: 24 VDC  
Winding current: 3 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 2.6 \times 10^{-4} \text{ kg·m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate with no load



## Dimensions (Unit: mm)



## Internal winding



## Compatible drivers

A driver is to be provided by the customer.

Note: The characteristics shown above are calculated using our experimental circuit.



# 86 mm sq.

1.8°/step **RoHS**

Unipolar, lead-type, CE/UKCA/UL models

Bipolar, lead-type, CE/UKCA/UL models ▶ p. 72

Bipolar, terminal block-type, CE/UKCA/UL models ▶ p. 72



Custom options

Hollow shaft Custom shaft

Note: Custom options availability varies depending on the model number and requested quantity. Contact us for details.

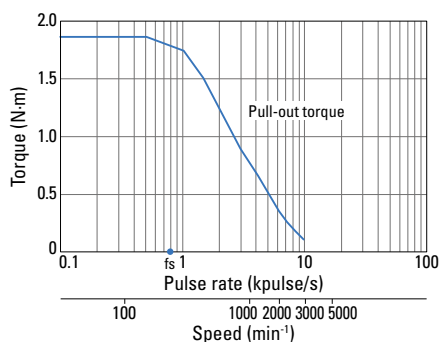
## Unipolar, lead-type, CE/UKCA/UL models

| Model no.          |                    | Holding torque at 2-phase excitation | Rated current | Winding resistance | Winding inductance | Rotor inertia                        | Allowable radial load | Allowable thrust load | Mass | Motor length (L) |
|--------------------|--------------------|--------------------------------------|---------------|--------------------|--------------------|--------------------------------------|-----------------------|-----------------------|------|------------------|
| Single shaft       | Dual shaft         | N·m or more                          | A/phase       | Ω/phase            | mH/phase           | × 10 <sup>-4</sup> kg·m <sup>2</sup> | N                     | N                     | kg   | mm               |
| <b>SM2861-0451</b> | <b>SM2861-0421</b> | 2.5                                  | 2             | 2.3                | 8.0                | 1.48                                 | 60                    | 200                   | 1.75 | 66               |
| <b>SM2861-0951</b> | <b>SM2861-0921</b> | 2.5                                  | 4             | 0.6                | 2.0                | 1.48                                 | 60                    | 200                   | 1.75 | 66               |
| <b>SM2862-0451</b> | <b>SM2862-0421</b> | 4.7                                  | 2             | 3.2                | 13.0               | 3.0                                  | 60                    | 200                   | 2.9  | 96.5             |
| <b>SM2862-0951</b> | <b>SM2862-0921</b> | 4.7                                  | 4             | 0.85               | 3.4                | 3.0                                  | 60                    | 200                   | 2.9  | 96.5             |
| <b>SM2863-0451</b> | <b>SM2863-0421</b> | 6.7                                  | 2             | 4.0                | 17.0               | 4.5                                  | 60                    | 200                   | 4.0  | 127              |
| <b>SM2863-0951</b> | <b>SM2863-0921</b> | 6.7                                  | 4             | 0.9                | 4.2                | 4.5                                  | 60                    | 200                   | 4.0  | 127              |

## Characteristics

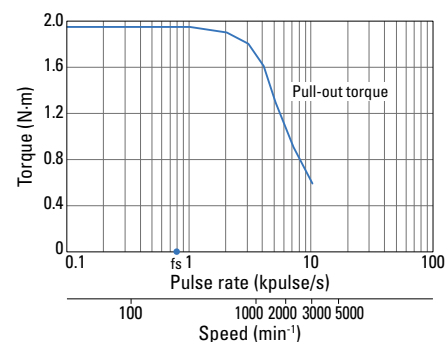
### SM2861-0451 SM2861-0421

Constant current circuit  
Input voltage: 100 VAC  
Winding current: 2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 7.4 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate with no load



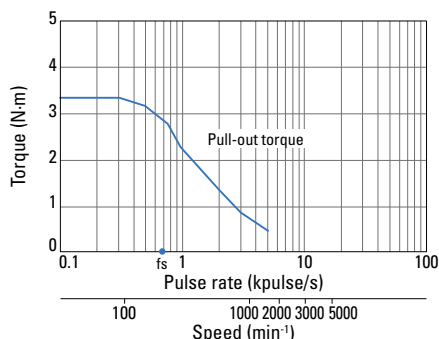
### SM2861-0951 SM2861-0921

Constant current circuit  
Input voltage: 100 VAC  
Winding current: 4 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 7.4 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate with no load



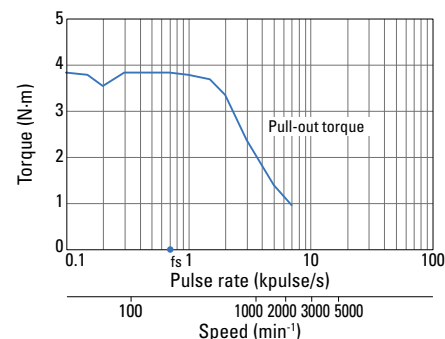
### SM2862-0451 SM2862-0421

Constant current circuit  
Input voltage: 100 VAC  
Winding current: 2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 15.3 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate with no load



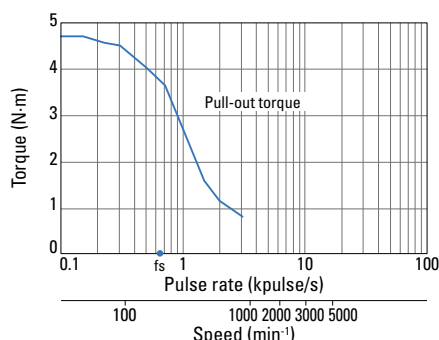
### SM2862-0951 SM2862-0921

Constant current circuit  
Input voltage: 100 VAC  
Winding current: 4 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 15.3 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate with no load



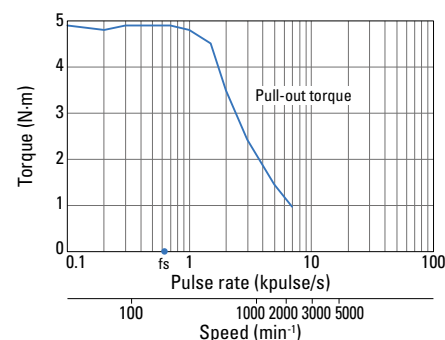
### SM2863-0451 SM2863-0421

Constant current circuit  
Input voltage: 100 VAC  
Winding current: 2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 15.3 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate with no load

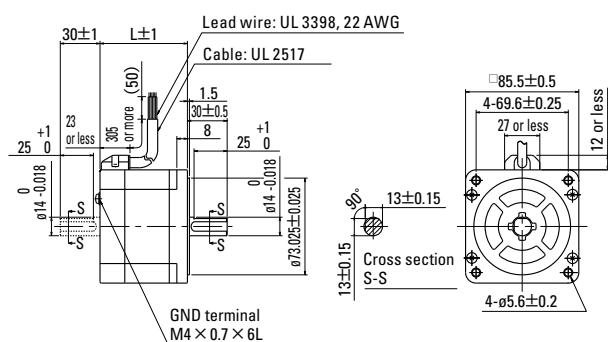


### SM2863-0951 SM2863-0921

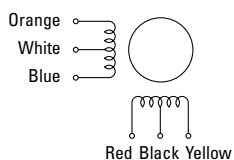
Constant current circuit  
Input voltage: 100 VAC  
Winding current: 4 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 15.3 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate with no load



### ■ Dimensions (Unit: mm)



## Internal winding



## Compatible drivers

A driver is to be provided by the customer.

Note: The characteristics shown above are calculated using our experimental circuit.



# 86 mm sq.

1.8°/step **RoHS**

Bipolar, lead-type, CE/UKCA/UL models

Bipolar, terminal block-type, CE/UKCA/UL models

Unipolar, lead-type, CE/UKCA/UL models ▶ p. 70



Custom options

Hollow shaft Custom shaft

Encoder

Note: Custom options availability varies depending on the model number and requested quantity. Contact us for details.

## Bipolar, lead-type, CE/UKCA/UL models

| Model no.          |                    | Holding torque at 2-phase excitation | Rated current | Winding resistance | Winding inductance | Rotor inertia                        | Allowable radial load | Allowable thrust load | Mass | Motor length (L) |
|--------------------|--------------------|--------------------------------------|---------------|--------------------|--------------------|--------------------------------------|-----------------------|-----------------------|------|------------------|
| Single shaft       | Dual shaft         | N·m or more                          | A/phase       | Ω/phase            | mH/phase           | × 10 <sup>-4</sup> kg·m <sup>2</sup> | N                     | N                     | kg   | mm               |
| <b>SM2861-5051</b> | <b>SM2861-5021</b> | 3.3                                  | 2             | 2.2                | 15                 | 1.48                                 | 200                   | 60                    | 1.75 | 66               |
| <b>SM2861-5151</b> | <b>SM2861-5121</b> | 3.3                                  | 4             | 0.56               | 3.7                | 1.48                                 | 200                   | 60                    | 1.75 | 66               |
| <b>SM2861-5251</b> | <b>SM2861-5221</b> | 3.3                                  | 6             | 0.29               | 1.7                | 1.48                                 | 200                   | 60                    | 1.75 | 66               |
| <b>SM2862-5051</b> | <b>SM2862-5021</b> | 6.4                                  | 2             | 3.2                | 25                 | 3.0                                  | 200                   | 60                    | 2.9  | 96.5             |
| <b>SM2862-5151</b> | <b>SM2862-5121</b> | 6.4                                  | 4             | 0.83               | 6.4                | 3.0                                  | 200                   | 60                    | 2.9  | 96.5             |
| <b>SM2862-5251</b> | <b>SM2862-5221</b> | 6.4                                  | 6             | 0.36               | 2.8                | 3.0                                  | 200                   | 60                    | 2.9  | 96.5             |
| <b>SM2863-5051</b> | <b>SM2863-5021</b> | 9                                    | 2             | 4.0                | 32                 | 4.5                                  | 200                   | 60                    | 4.0  | 127              |
| <b>SM2863-5151</b> | <b>SM2863-5121</b> | 9                                    | 4             | 1.0                | 7.9                | 4.5                                  | 200                   | 60                    | 4.0  | 127              |
| <b>SM2863-5251</b> | <b>SM2863-5221</b> | 9                                    | 6             | 0.46               | 3.8                | 4.5                                  | 200                   | 60                    | 4.0  | 127              |

## Bipolar, terminal block-type, CE/UKCA/UL models

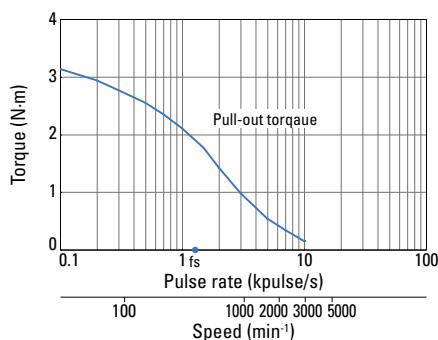
| Model no.          |  | Holding torque at 2-phase excitation | Rated current | Winding resistance | Winding inductance | Rotor inertia                        | Allowable radial load | Allowable thrust load | Mass | Motor length (L) |
|--------------------|--|--------------------------------------|---------------|--------------------|--------------------|--------------------------------------|-----------------------|-----------------------|------|------------------|
| Single shaft       |  | N·m or more                          | A/phase       | Ω/phase            | mH/phase           | × 10 <sup>-4</sup> kg·m <sup>2</sup> | N                     | N                     | kg   | mm               |
| <b>SM2861-5066</b> |  | 3.3                                  | 2             | 2.03               | 15                 | 1.48                                 | 200                   | 60                    | 1.9  | 97.9             |
| <b>SM2861-5166</b> |  | 3.3                                  | 4             | 0.52               | 3.7                | 1.48                                 | 200                   | 60                    | 1.9  | 97.9             |
| <b>SM2861-5266</b> |  | 3.3                                  | 6             | 0.27               | 1.7                | 1.48                                 | 200                   | 60                    | 1.9  | 97.9             |
| <b>SM2862-5066</b> |  | 6.4                                  | 2             | 3.08               | 25                 | 3.0                                  | 200                   | 60                    | 3.05 | 128.4            |
| <b>SM2862-5166</b> |  | 6.4                                  | 4             | 0.79               | 6.4                | 3.0                                  | 200                   | 60                    | 3.05 | 128.4            |
| <b>SM2862-5266</b> |  | 6.4                                  | 6             | 0.33               | 2.8                | 3.0                                  | 200                   | 60                    | 3.05 | 128.4            |
| <b>SM2863-5066</b> |  | 9                                    | 2             | 3.83               | 32                 | 4.5                                  | 200                   | 60                    | 4.15 | 158.8            |
| <b>SM2863-5166</b> |  | 9                                    | 4             | 0.96               | 7.9                | 4.5                                  | 200                   | 60                    | 4.15 | 158.8            |
| <b>SM2863-5266</b> |  | 9                                    | 6             | 0.48               | 3.8                | 4.5                                  | 200                   | 60                    | 4.15 | 158.8            |

## Characteristics

### SM2861-5051 SM2861-5021

### SM2861-5066

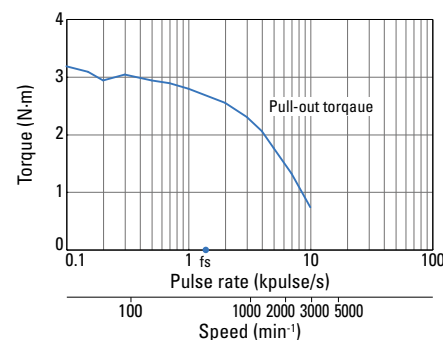
Constant current circuit  
Input voltage: 100 VAC  
Winding current: 2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 15.3 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate  
with no load



### SM2861-5151 SM2861-5121

### SM2861-5166

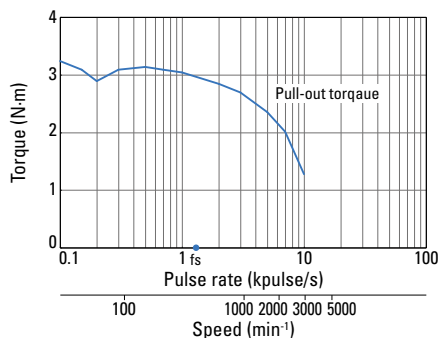
Constant current circuit  
Input voltage: 100 VAC  
Winding current: 4 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 15.3 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate  
with no load



### SM2861-5251 SM2861-5221

### SM2861-5266

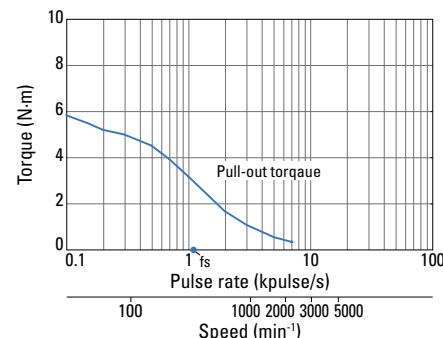
Constant current circuit  
Input voltage: 100 VAC  
Winding current: 6 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 15.3 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate  
with no load



### SM2862-5051 SM2862-5021

### SM2862-5066

Constant current circuit  
Input voltage: 100 VAC  
Winding current: 2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 15.3 \times 10^{-4} \text{kg} \cdot \text{m}^2$   
(with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate  
with no load

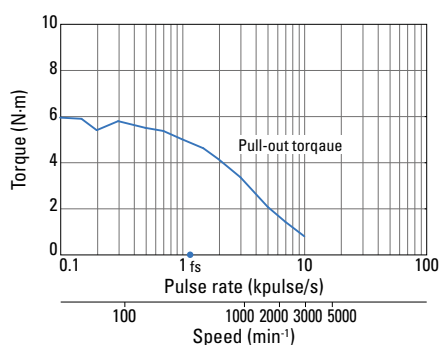


## Characteristics

**SM2862-5151**  
**SM2862-5121**

## SM2862-5166

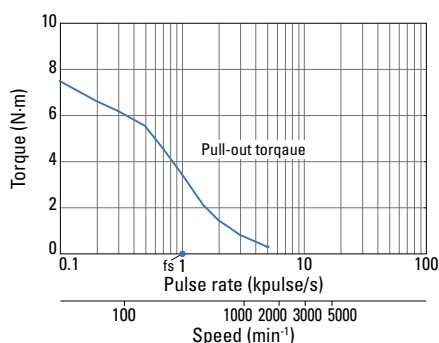
Constant current circuit  
Input voltage: 100 VAC  
Winding current: 4 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 15.3 \times 10^{-4} \text{ kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate  
with no load



**SM2863-5051**  
**SM2863-5021**

## SM2863-5066

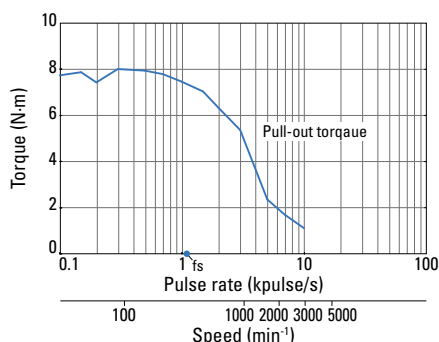
Constant current circuit  
Input voltage: 100 VAC  
Winding current: 2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 44 \times 10^{-4} \text{ kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate  
with no load



**SM2863-5251**  
**SM2863-5221**

## SM2863-5266

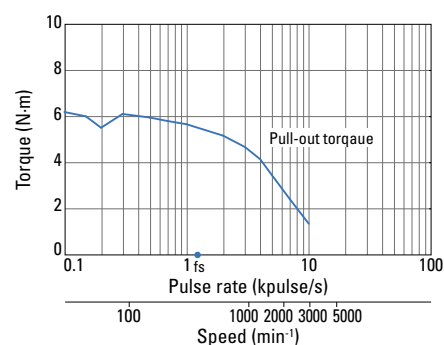
Constant current circuit  
Input voltage: 100 VAC  
Winding current: 6 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 44 \times 10^{-4} \text{ kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate  
with no load



SM2862-5251  
SM2862-5221

## SM2862-5066

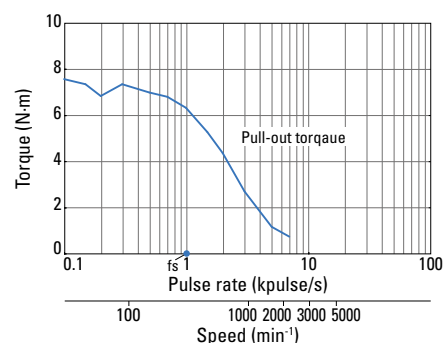
Constant current circuit  
Input voltage: 100 VAC  
Winding current: 6 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_L = 15.3 \times 10^{-4} \text{ kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate  
with no load



SM2863-5151  
SM2863-5121

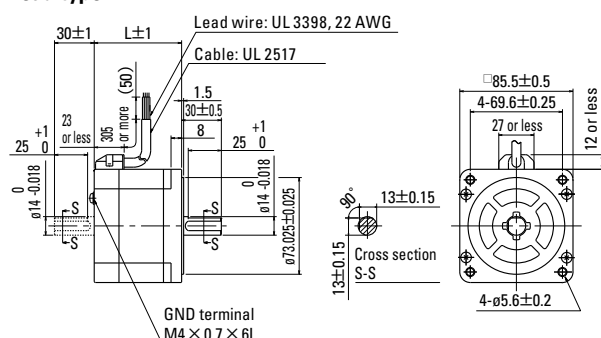
## SM2863-5166

Constant current circuit  
Input voltage: 100 VAC  
Winding current: 4 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  
 $J_e = 44 \times 10^{-4} \text{ kg} \cdot \text{m}^2$   
(with rubber coupling used)  
fs: Maximum starting pulse rate  
with no load

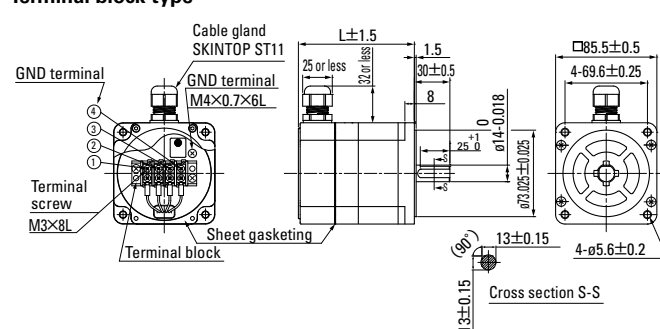


### Dimensions (Unit: mm)

### Lead type

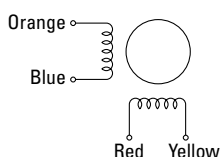


### Terminal block type



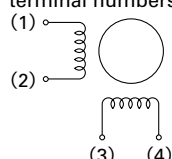
## Internal winding

### Lead type



### Terminal block type

Inside parentheses are terminal numbers



## Compatible drivers

A driver is to be provided by the customer.

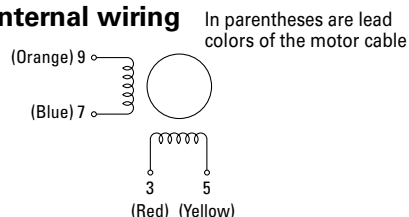
Note: The characteristics shown above are calculated using our experimental circuit.

# Internal Wiring and Rotational Directions

## Bipolar winding

Connector type, model no.: SF242□

### Internal wiring



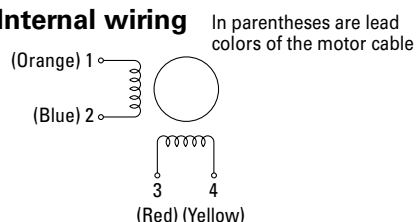
### Direction of motor rotation

When excited by a direct current in the order shown below, the direction of rotation is clockwise as viewed from the output shaft side.

|                     |   | Connector pin no. |   |   |   |
|---------------------|---|-------------------|---|---|---|
|                     |   | 3                 | 7 | 5 | 9 |
| Excitation sequence | 1 | —                 | — | + | + |
|                     | 2 | +                 | — | — | + |
|                     | 3 | +                 | + | — | — |
|                     | 4 | —                 | + | + | — |

Connector type, model no.: SM256□ (and 103H782□)

### Internal wiring



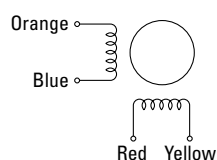
### Direction of motor rotation

When excited by a direct current in the order shown below, the direction of rotation is clockwise as viewed from the output shaft side.

|                     |   | Connector pin no. |   |   |   |
|---------------------|---|-------------------|---|---|---|
|                     |   | 3                 | 2 | 4 | 1 |
| Excitation sequence | 1 | —                 | — | + | + |
|                     | 2 | +                 | — | — | + |
|                     | 3 | +                 | + | — | — |
|                     | 4 | —                 | + | + | — |

Lead type

### Internal wiring



### Direction of motor rotation

When excited by a direct current in the order shown below, the direction of rotation is clockwise as viewed from the output shaft side.

|                     |   | Lead color |      |        |        |
|---------------------|---|------------|------|--------|--------|
|                     |   | Red        | Blue | Yellow | Orange |
| Excitation sequence | 1 | —          | —    | +      | +      |
|                     | 2 | +          | —    | —      | +      |
|                     | 3 | +          | +    | —      | —      |
|                     | 4 | —          | +    | +      | —      |

# General Specifications

|                                                              |                                                                                                                                                                                                                             |                                      |                                    |                                    |                                    |                            |                                    |                                                         |
|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|------------------------------------|------------------------------------|------------------------------------|----------------------------|------------------------------------|---------------------------------------------------------|
| Motor model no.                                              | SH214□                                                                                                                                                                                                                      | SH228□                               | SH353□                             | SS242□                             | SH142□                             | SF242□                     | SS250□                             | 103H670□                                                |
| Operation type                                               | —                                                                                                                                                                                                                           |                                      |                                    |                                    |                                    |                            |                                    |                                                         |
| Operating ambient temperature                                | -10 to +50°C                                                                                                                                                                                                                |                                      |                                    |                                    |                                    |                            |                                    |                                                         |
| Storage temperature                                          | -20 to +65°C                                                                                                                                                                                                                |                                      |                                    |                                    |                                    |                            |                                    |                                                         |
| Operating ambient humidity                                   | 20 to 90% RH (non-condensing)                                                                                                                                                                                               |                                      |                                    |                                    |                                    |                            |                                    |                                                         |
| Storage humidity                                             | 5 to 95 % RH (non-condensing)                                                                                                                                                                                               |                                      |                                    |                                    |                                    |                            |                                    |                                                         |
| Operating altitude                                           | Up to 1000 m above sea level                                                                                                                                                                                                |                                      |                                    |                                    |                                    |                            |                                    |                                                         |
| Vibration resistance                                         | Frequency 10 to 500 Hz, amplitude 1.52 mm (10 to 70 Hz), vibration acceleration 150 m/s <sup>2</sup> (70 to 500 Hz), sweep time 15 min/cycle, a total of 12 tests in both opposite directions for each of X, Y, and Z axes. |                                      |                                    |                                    |                                    |                            |                                    |                                                         |
| Shock resistance                                             | Acceleration 500 m/s <sup>2</sup> , duration 11 ms, half sine wave, tested 3 times in both directions for each X, Y, and Z axis for a total of 18 times                                                                     |                                      |                                    |                                    |                                    |                            |                                    |                                                         |
| Thermal class                                                | B (+130°C)                                                                                                                                                                                                                  |                                      |                                    |                                    |                                    |                            |                                    |                                                         |
| Dielectric strength                                          | 500 VAC for 1 minute (between motor winding and frame)                                                                                                                                                                      |                                      |                                    |                                    |                                    |                            |                                    | 1000 VAC for 1 minute (between motor winding and frame) |
| Insulation resistance                                        | 100 MΩ min. at 500 VDC (between motor winding and frame)                                                                                                                                                                    |                                      |                                    |                                    |                                    |                            |                                    |                                                         |
| Protection rating                                            | —                                                                                                                                                                                                                           |                                      |                                    |                                    |                                    |                            |                                    |                                                         |
| Winding temperature rise                                     | 80 K or less (based on our own standard)                                                                                                                                                                                    |                                      |                                    |                                    |                                    |                            |                                    |                                                         |
| Positional accuracy tolerance                                | ±0.09°                                                                                                                                                                                                                      |                                      |                                    |                                    | ±0.054°                            | ±0.09°                     |                                    |                                                         |
| Thrust play <sup>(1)</sup>                                   | 0.075 mm or less (With a 0.35 N load)                                                                                                                                                                                       | 0.075 mm or less (With a 1.5 N load) | 0.075 mm or less (With a 5 N load) | 0.075 mm or less (With a 4 N load) | 0.075 mm or less (With a 5 N load) | 0.075 mm (With a 5 N load) | 0.075 mm or less (With a 4 N load) | 0.075 mm (With a 10 N load)                             |
| Radial play <sup>(2)</sup>                                   | 0.025 mm (With a 5 N load)                                                                                                                                                                                                  |                                      |                                    |                                    |                                    |                            |                                    |                                                         |
| Shaft runout                                                 | 0.025 mm                                                                                                                                                                                                                    |                                      |                                    |                                    |                                    |                            |                                    |                                                         |
| Concentricity of motor shaft and fitting part                | ø0.05 mm                                                                                                                                                                                                                    | ø0.05 mm                             | ø0.075 mm                          | ø0.075 mm                          | ø0.05 mm                           | ø0.05 mm                   | ø0.075 mm                          | ø0.075 mm                                               |
| Perpendicularity of mounting surface and motor shaft surface | 0.1 mm                                                                                                                                                                                                                      | 0.1 mm                               | 0.1 mm                             | 0.1 mm                             | 0.1 mm                             | 0.1 mm                     | 0.1 mm                             | 0.1 mm                                                  |
| Motor mounting orientation                                   | Can be installed vertically or horizontally.                                                                                                                                                                                |                                      |                                    |                                    |                                    |                            |                                    |                                                         |

|                                                              |                                                                                                                                                                                                                             |        |                                                         |                            |                                                                                                           |                            |         |                            |
|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------------------------------------------------------|----------------------------|-----------------------------------------------------------------------------------------------------------|----------------------------|---------|----------------------------|
| Motor model no.                                              | SM256□<br>UL                                                                                                                                                                                                                | SH160□ | SH286□                                                  | 103H8922□                  | SM286□<br>CE/UKCA/UL                                                                                      | 103H712□-6□□0<br>CE/UKCA   |         |                            |
| Operation type                                               | —                                                                                                                                                                                                                           |        |                                                         |                            | Continuous operation (S1)                                                                                 |                            |         |                            |
| Operating ambient temperature                                | -10 to +50°C                                                                                                                                                                                                                |        |                                                         |                            | -10 to +40°C                                                                                              |                            |         |                            |
| Storage temperature                                          | -20 to +65°C                                                                                                                                                                                                                |        |                                                         |                            | -20 to +60°C                                                                                              |                            |         |                            |
| Operating ambient humidity                                   | 20 to 90% RH (non-condensing)                                                                                                                                                                                               |        |                                                         |                            | 95% RH or less: Below 40°C (non-condensing)                                                               |                            |         |                            |
| Storage humidity                                             | 5 to 95% RH (non-condensing)                                                                                                                                                                                                |        |                                                         |                            | 95% RH or less: Below 40°C,<br>57% RH or less: Below 50°C,<br>35% RH or less: Below 60°C (non-condensing) |                            |         |                            |
| Operating altitude                                           | Up to 1000 m above sea level                                                                                                                                                                                                |        |                                                         |                            |                                                                                                           |                            |         |                            |
| Vibration resistance                                         | Frequency 10 to 500 Hz, amplitude 1.52 mm (10 to 70 Hz), vibration acceleration 150 m/s <sup>2</sup> (70 to 500 Hz), sweep time 15 min/cycle, a total of 12 tests in both opposite directions for each of X, Y, and Z axes. |        |                                                         |                            |                                                                                                           |                            |         |                            |
| Shock resistance                                             | Acceleration 500 m/s <sup>2</sup> , duration 11 ms, half sine wave, tested 3 times in both directions for each X, Y, and Z axis for a total of 18 times                                                                     |        |                                                         |                            |                                                                                                           |                            |         |                            |
| Thermal class                                                | B (+130°C) (A for UL models)                                                                                                                                                                                                |        | B (+130°C)                                              |                            |                                                                                                           | F (+155°C)                 |         | B (+130°C)                 |
| Dielectric strength                                          | 1120 VAC for 1 minute (between motor winding and frame)                                                                                                                                                                     |        | 1000 VAC for 1 minute (between motor winding and frame) |                            | 1500 VAC for 1 minute (between motor winding and frame)                                                   |                            |         |                            |
| Insulation resistance                                        | 100 MΩ min. at 500 VDC (between motor winding and frame)                                                                                                                                                                    |        |                                                         |                            |                                                                                                           |                            |         |                            |
| Protection rating                                            | —                                                                                                                                                                                                                           |        |                                                         |                            | IP43                                                                                                      |                            |         |                            |
| Winding temperature rise                                     | 80 K or less (based on our own standard)                                                                                                                                                                                    |        |                                                         |                            |                                                                                                           |                            |         |                            |
| Positional accuracy tolerance                                | ±0.054°                                                                                                                                                                                                                     |        |                                                         | ±0.09°                     |                                                                                                           |                            | ±0.054° |                            |
| Thrust play <sup>(1)</sup>                                   | 0.075 mm (With a 10 N load)                                                                                                                                                                                                 |        |                                                         |                            |                                                                                                           |                            |         |                            |
| Radial play <sup>(2)</sup>                                   | 0.025 mm (With a 5 N load)                                                                                                                                                                                                  |        | 0.025 mm (With a 5 N load)                              | 0.025 mm (With a 5 N load) | 0.025 mm (With a 10 N load)                                                                               | 0.025 mm (With a 5 N load) |         | 0.025 mm (With a 5 N load) |
| Shaft runout                                                 | 0.025 mm                                                                                                                                                                                                                    |        |                                                         |                            |                                                                                                           |                            |         |                            |
| Concentricity of motor shaft and fitting part                | ø0.075 mm                                                                                                                                                                                                                   |        |                                                         |                            |                                                                                                           |                            |         |                            |
| Perpendicularity of mounting surface and motor shaft surface | 0.1 mm                                                                                                                                                                                                                      |        | 0.1 mm                                                  | 0.15 mm                    | 0.1 mm                                                                                                    | 0.15 mm                    |         | 0.1 mm                     |
| Motor mounting orientation                                   | Can be installed vertically or horizontally.                                                                                                                                                                                |        |                                                         |                            |                                                                                                           |                            |         |                            |

(1) Thrust play: Shaft position displacement when a load is exerted in a direction parallel to the motor shaft.

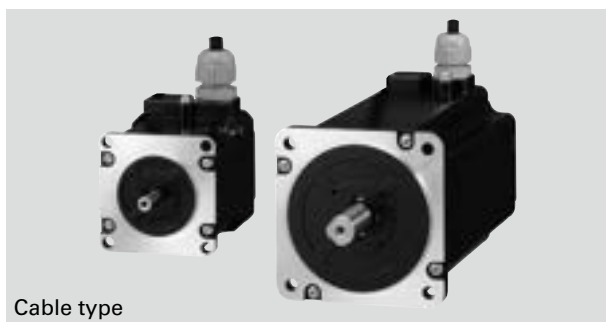
(2) Radial play: Maximum shaft position displacement when a load is exerted in a direction perpendicular to the motor shaft. Load is exerted on the point 1/3 the shaft length from the shaft end.

## Safety standards

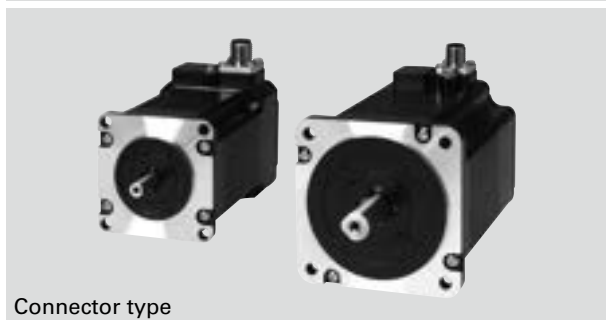
|                                                                    |                                                |                      |                          |
|--------------------------------------------------------------------|------------------------------------------------|----------------------|--------------------------|
| EU Directive<br>CE mark                                            | Directive                                      |                      | Standards                |
|                                                                    | Low Voltage Directive 2014/35/EU               |                      | IEC 60034-1, IEC 60034-5 |
|                                                                    | RoHS Directive 2011/65/EU                      |                      | EN IEC 63000: 2018       |
| UKCA marking for Great Britain<br>(UK Conformity Assessed Marking) | Electrical Equipment (Safety) Regulations 2016 |                      | IEC 60034-1, IEC 60034-5 |
|                                                                    | RoHS Regulations 2012                          |                      | EN IEC 63000: 2018       |
| UL                                                                 | Classification                                 | Standards            | File no.                 |
|                                                                    | UL                                             | UL 1004-1, UL 1004-6 | E179832                  |
|                                                                    | UL for Canada (cUL)                            | CSA C22.2 No. 100    |                          |

# IP65-Rated Stepping Motors

Water/Dust protection



Cable type



Connector type

## Features

- These IP65-rated motors\* have superior water and dust resistance, and can be safely used in water-exposed environments such as in food processing machines.

\* Except for the shaft and cable ends.

- Options such as a brake, encoder, and oil seal can be combined.

## Safety standards

In compliant with CE, UKCA, and UL safety standards.



## Specifications

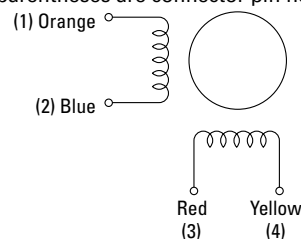
|                                                      | 56 mm sq.                                                                                                                                                                                                                   | 86 mm sq.    |
|------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| Motor model no.                                      | SP256□-5□□□0                                                                                                                                                                                                                | SP286□-5□□□0 |
| Operation type                                       | Continuous operation (S1)                                                                                                                                                                                                   |              |
| Operating ambient temperature                        | -10 to +40°C                                                                                                                                                                                                                |              |
| Storage temperature                                  | -20 to +60°C                                                                                                                                                                                                                |              |
| Operating ambient humidity                           | 95% RH or less: Below 40°C (non-condensing)                                                                                                                                                                                 |              |
| Storage humidity                                     | 95% RH or less: Below 40°C,<br>57% RH or less: Below 50°C,<br>35% RH or less: Below 60°C (non-condensing)                                                                                                                   |              |
| Operating altitude                                   | Up to 1000 m above sea level                                                                                                                                                                                                |              |
| Vibration resistance                                 | Frequency 10 to 500 Hz, amplitude 1.52 mm (10 to 70 Hz), vibration acceleration 150 m/s <sup>2</sup> (70 to 500 Hz), sweep time 15 min/cycle, a total of 12 tests in both opposite directions for each of X, Y, and Z axes. |              |
| Shock resistance                                     | Acceleration 500 m/s <sup>2</sup> , duration 11 ms, half sine wave, tested 3 times in both directions for each X, Y, and Z axis for a total of 18 times                                                                     |              |
| Thermal class                                        | F (+155°C)                                                                                                                                                                                                                  |              |
| Dielectric strength                                  | 1500 VAC for 1 minute (between motor winding and frame)                                                                                                                                                                     |              |
| Insulation resistance                                | 100 MΩ min. at 500 VDC (between motor winding and frame)                                                                                                                                                                    |              |
| Protection rating                                    | IP65 (excluding the hollow shaft part and cable ends)                                                                                                                                                                       |              |
| Winding temperature rise                             | 100 K or less (based on our own standard)                                                                                                                                                                                   |              |
| Positional accuracy                                  | ± 0.054°                                                                                                                                                                                                                    | ± 0.09°      |
| Thrust play                                          | 0.075 mm or less (With a 10 N load)                                                                                                                                                                                         |              |
| Radial play                                          | 0.025 mm or less (With a 5 N load)                                                                                                                                                                                          |              |
| Shaft runout                                         | 0.025 mm                                                                                                                                                                                                                    |              |
| Concentricity of motor shaft and fitting part        | ø0.075 mm                                                                                                                                                                                                                   |              |
| Perpendicularity of mounting surface and motor shaft | 0.1 mm                                                                                                                                                                                                                      | 0.15 mm      |
| Motor mounting orientation                           | Can be installed vertically or horizontally.                                                                                                                                                                                |              |

## Internal Wiring and Rotational Directions

Bipolar winding

### Internal wiring

In parentheses are connector pin nos.



### Rotational direction

When excited by a direct current in the order shown below, the direction of rotation is clockwise as viewed from the output shaft side.

| Lead color        | Red | Blue | Yellow | Orange |
|-------------------|-----|------|--------|--------|
| Connector pin no. | 3   | 2    | 4      | 1      |
| 1                 | —   | —    | +      | +      |
| 2                 | +   | —    | —      | +      |
| 3                 | +   | +    | —      | —      |
| 4                 | —   | +    | +      | —      |

## Safety standards

| EU Directive<br>CE mark                                            | Directive                                      |                      | Standards                |
|--------------------------------------------------------------------|------------------------------------------------|----------------------|--------------------------|
|                                                                    | Low Voltage Directive 2014/35/EU               |                      | IEC 60034-1, IEC 60034-5 |
| UKCA marking for Great Britain<br>(UK Conformity Assessed Marking) | RoHS Directive 2011/65/EU                      |                      | EN IEC 63000: 2018       |
|                                                                    | Electrical Equipment (Safety) Regulations 2016 |                      | IEC 60034-1, IEC 60034-5 |
| UL                                                                 | RoHS Regulations 2012                          |                      | EN IEC 63000: 2018       |
|                                                                    | Classification                                 | Standards            | File no.                 |
|                                                                    | UL                                             | UL 1004-1, UL 1004-6 | E179832                  |
|                                                                    | UL for Canada (cUL)                            | CSA C22.2 No. 100    |                          |

Models with brake or oil seal have different model nos.

Models with an encoder have different model nos. and vibration resistance.

# 56 mm sq.

1.8°/step

RoHS

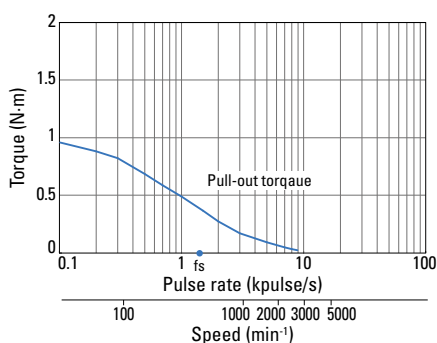
Bipolar

| Model no.   | Holding torque at 2-phase excitation | Rated current | Winding resistance | Winding inductance | Rotor inertia | Mass                                 | Allowable thrust load | Allowable radial load |
|-------------|--------------------------------------|---------------|--------------------|--------------------|---------------|--------------------------------------|-----------------------|-----------------------|
| Cable type  | Connector type                       | N·m or more   | A/phase            | Ω/phase            | mH/phase      | × 10 <sup>-4</sup> kg·m <sup>2</sup> | kg                    | N                     |
| SP2563-5060 | SP2563-5000                          | 1             | 1                  | 5.8                | 29            | 0.21                                 | 0.9                   | 15                    |
| SP2563-5160 | SP2563-5100                          | 1             | 2                  | 1.5                | 7.3           | 0.21                                 | 0.9                   | 15                    |
| SP2563-5260 | SP2563-5200                          | 1             | 3                  | 0.75               | 3.4           | 0.21                                 | 0.9                   | 15                    |
| SP2566-5060 | SP2566-5000                          | 1.7           | 1                  | 7.8                | 35.4          | 0.36                                 | 1.2                   | 15                    |
| SP2566-5160 | SP2566-5100                          | 1.7           | 2                  | 2                  | 9.2           | 0.36                                 | 1.2                   | 15                    |
| SP2566-5260 | SP2566-5200                          | 1.7           | 3                  | 1                  | 4.4           | 0.36                                 | 1.2                   | 15                    |

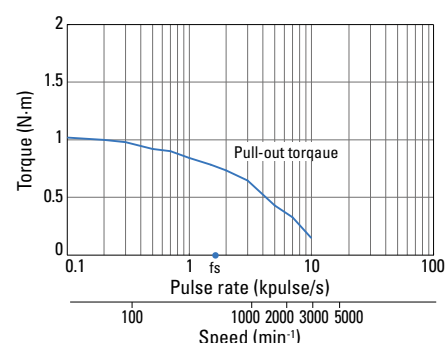
• Models with a brake, encoder, or oil seal have different model nos., rotor inertia, and mass.

## Characteristics

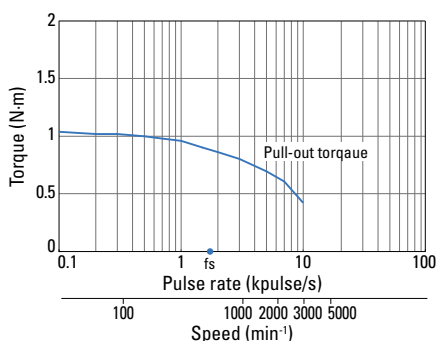
SP2563-5000  
SP2563-5060



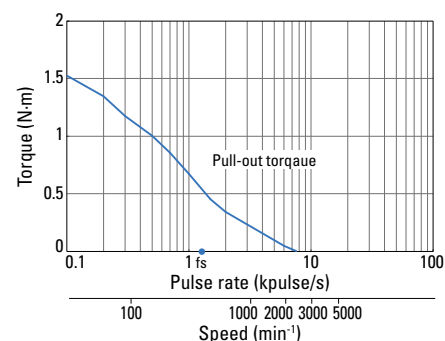
SP2563-5100  
SP2563-5160



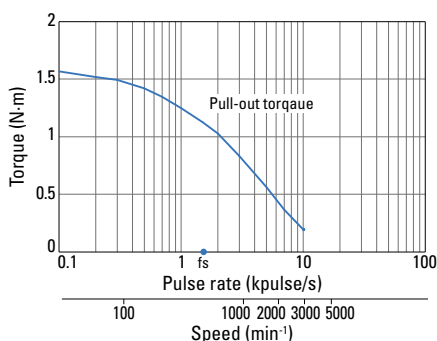
SP2563-5200  
SP2563-5260



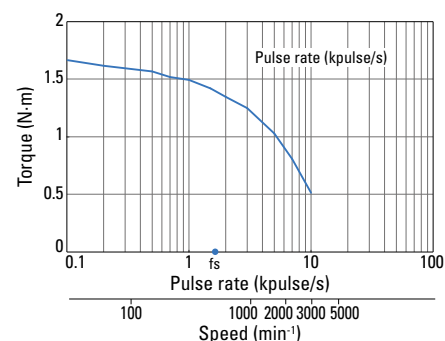
SP2566-5000  
SP2566-5060



SP2566-5100  
SP2566-5160



SP2566-5200  
SP2566-5260





# 86 mm sq.

1.8°/step

RoHS

Bipolar



Custom options

Custom shaft

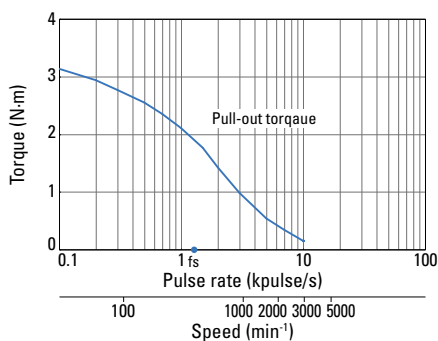
Note: Custom options availability varies depending on the model number and requested quantity. Contact us for details.

| Model no.   |                | Holding torque at 2-phase excitation | Rated current | Winding resistance |         | Winding inductance | Rotor inertia                        | Allowable thrust load | Allowable radial load | Mass |
|-------------|----------------|--------------------------------------|---------------|--------------------|---------|--------------------|--------------------------------------|-----------------------|-----------------------|------|
| Cable type  | Connector type | N·m or more                          | A/phase       | Ω/phase            | Ω/phase | mH/phase           | × 10 <sup>-4</sup> kg·m <sup>2</sup> | N                     | N                     | kg   |
| SP2861-5060 | SP2861-5000    | 3.3                                  | 2             | 2.1                | 2.05    | 15                 | 1.48                                 | 60                    | 200                   | 1.95 |
| SP2861-5160 | SP2861-5100    | 3.3                                  | 4             | 0.61               | 0.56    | 3.7                | 1.48                                 | 60                    | 200                   | 1.95 |
| SP2861-5260 | —              | 3.3                                  | 6             | 0.36               | —       | 1.7                | 1.48                                 | 60                    | 200                   | 1.95 |
| SP2862-5060 | SP2862-5000    | 6.4                                  | 2             | 3.2                | 3.2     | 25                 | 3                                    | 60                    | 200                   | 3.1  |
| SP2862-5160 | SP2862-5100    | 6.4                                  | 4             | 0.85               | 0.83    | 6.4                | 3                                    | 60                    | 200                   | 3.1  |
| SP2862-5260 | —              | 6.4                                  | 6             | 0.41               | —       | 2.8                | 3                                    | 60                    | 200                   | 3.1  |
| SP2863-5060 | SP2863-5000    | 9                                    | 2             | 4                  | 4       | 32                 | 4.5                                  | 60                    | 200                   | 4.2  |
| SP2863-5160 | SP2863-5100    | 9                                    | 4             | 1.05               | 1       | 7.9                | 4.5                                  | 60                    | 200                   | 4.2  |
| SP2863-5260 | —              | 9                                    | 6             | 0.53               | —       | 3.8                | 4.5                                  | 60                    | 200                   | 4.2  |

- Models with a brake, encoder, or oil seal have different model numbers, rotor inertia, and mass.
- Connector-type models are available for 4 A or lower rated voltages.

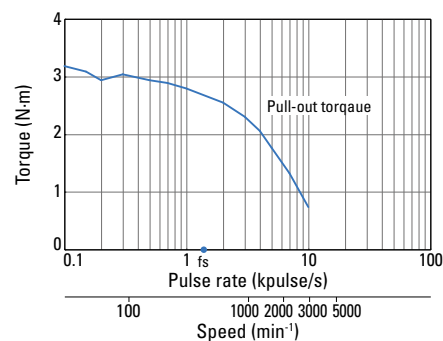
## Characteristics

SP2861-5000  
SP2861-5060



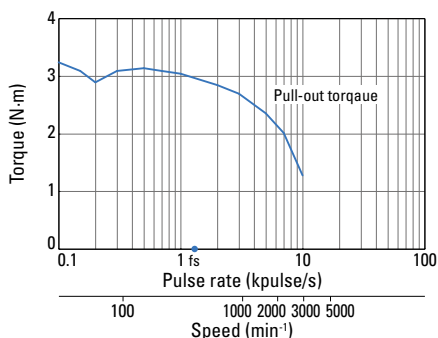
Constant current circuit  
Input voltage: 100 VAC, winding current: 2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  $J_L = 15.3 \times 10^{-4} \text{ kg} \cdot \text{m}^2$  (with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate with no load

SP2861-5100  
SP2861-5160



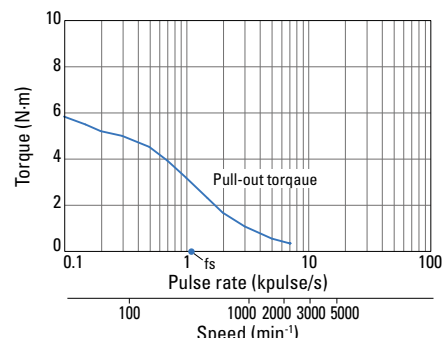
Constant current circuit  
Input voltage: 100 VAC, winding current: 4 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  $J_L = 15.3 \times 10^{-4} \text{ kg} \cdot \text{m}^2$  (with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate with no load

SP2861-5260



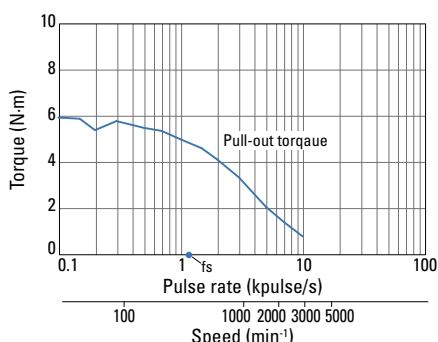
Constant current circuit  
Input voltage: 100 VAC, winding current: 6 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  $J_L = 15.3 \times 10^{-4} \text{ kg} \cdot \text{m}^2$  (with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate with no load

SP2862-5000  
SP2862-5060



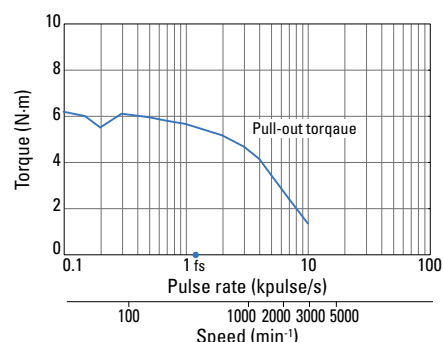
Constant current circuit  
Input voltage: 100 VAC, winding current: 2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  $J_L = 15.3 \times 10^{-4} \text{ kg} \cdot \text{m}^2$  (with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate with no load

SP2862-5100  
SP2862-5160



Constant current circuit  
Input voltage: 100 VAC, winding current: 4 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  $J_L = 15.3 \times 10^{-4} \text{ kg} \cdot \text{m}^2$  (with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate with no load

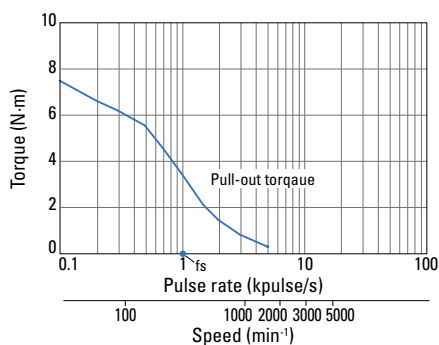
SP2862-5260



Constant current circuit  
Input voltage: 100 VAC, winding current: 6 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  $J_L = 15.3 \times 10^{-4} \text{ kg} \cdot \text{m}^2$  (with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate with no load

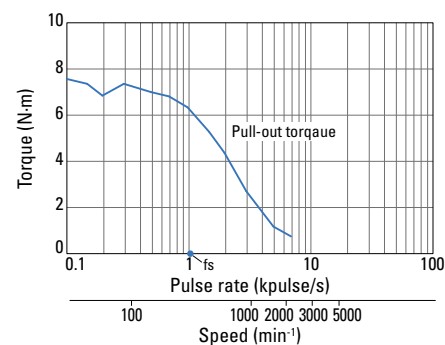
## Characteristics

**SP2863-5000**  
**SP2863-5060**



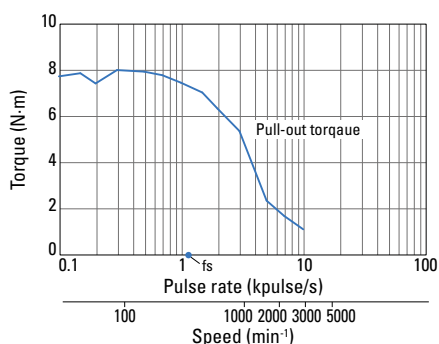
Constant current circuit  
Input voltage: 100 VAC, winding current: 2 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  $J_s=44 \times 10^{-4} \text{kg}\cdot\text{m}^2$  (with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate with no load

**SP2863-5100**  
**SP2863-5160**



Constant current circuit  
Input voltage: 100 VAC, winding current: 4 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  $J_s=44 \times 10^{-4} \text{kg}\cdot\text{m}^2$  (with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate with no load

**SP2863-5260**

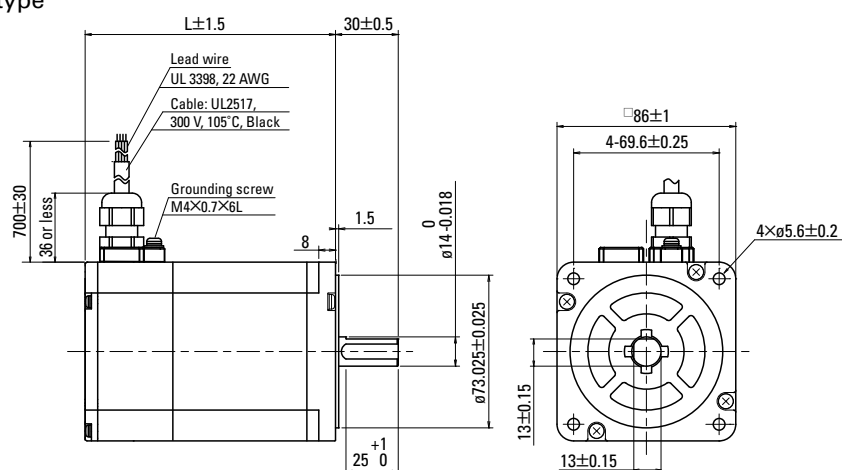


Constant current circuit  
Input voltage: 100 VAC, winding current: 6 A/phase  
At 2-phase excitation (full step)  
Pull-out torque:  $J_s=44 \times 10^{-4} \text{kg}\cdot\text{m}^2$  (with rubber coupling used)  
 $f_s$ : Maximum starting pulse rate with no load

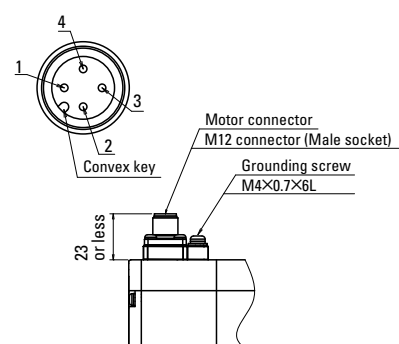
## Dimensions Unit: mm

**86 mm sq.**

Cable type



Connector type



| Model no.     |                | Motor length<br>(L) |
|---------------|----------------|---------------------|
| Cable type    | Connector type |                     |
| SP2861-5 □ 60 | SP2861-5 □ 00  | 89.5                |
| SP2862-5 □ 60 | SP2862-5 □ 00  | 120                 |
| SP2863-5 □ 60 | SP2863-5 □ 00  | 150                 |

## Compatible drivers

A driver is to be provided by the customer.

Note: The characteristics shown above are calculated using our experimental circuit.

# In-Vacuum Motors

Custom product



## Features

- These can be driven in vacuum environments without requiring a vacuum feedthrough. These stepping motors can be used as an actuator suitable for vacuum environments while maintaining the feature of a stepping motor—easy high-precision open-loop control.
- We also offer customization for use in a wide range of pressure environments from low vacuum to ultra-high vacuum.
- Baking at 200°C is possible.
- No significant size change from regular stepping motors.

## Operable pressure environments

| Low vacuum      |                 |                 | Medium vacuum   |                 |   | High vacuum      |                  |                  |                  | Ultra-high vacuum |                  |                  |                       |
|-----------------|-----------------|-----------------|-----------------|-----------------|---|------------------|------------------|------------------|------------------|-------------------|------------------|------------------|-----------------------|
| 10 <sup>5</sup> | 10 <sup>4</sup> | 10 <sup>3</sup> | 10 <sup>2</sup> | 10 <sup>1</sup> | 1 | 10 <sup>-1</sup> | 10 <sup>-2</sup> | 10 <sup>-3</sup> | 10 <sup>-4</sup> | 10 <sup>-5</sup>  | 10 <sup>-6</sup> | 10 <sup>-7</sup> | 10 <sup>-8</sup> [Pa] |

## Applications

Ideal for the following applications. Contact us to discuss your particular application environment needs.

- Semiconductor manufacturing equipment
- Satellite robots
- Electron microscopes
- Large-scale research facilities such as accelerators, synchrotron radiation analysis equipment, etc.

## Motor size

42 mm sq. to ø106 mm

# Synchronous Motors

Custom product



## Features

- Synchronous motors rotate at a constant speed in proportion to the AC power frequency without been affected by voltage or load level variations, preventing motor step-out.
- These motors can drive at ultra-low speeds with high torque without using gears.
- Since an AC power supply can be directly connected to the motor, a drive circuit is not required, simplifying your system.
- In addition to 2-phase motors, we also offer 3-phase motors, which don't require a phase shifter.
- Can be made compliant with safety standards.

## Applications

Ideal for the following applications. Contact us to discuss your particular application environment needs.

- Belt conveyors
- Printers
- Cryopumps
- Cryocoolers
- Switching devices

## Motor size

56 mm sq. to ø106 mm

# Safety Precautions

The products in this catalog are designed to be used with general industrial equipment. When using them, pay sufficient attention to the following points.

- Read the included Instruction Manual carefully before installing, assembling, and using the product for proper use.
- Do not modify or alter the product in any way.
- Contact us or your point of sale for installation or maintenance services of the product.
- Consult us when using the product for the following uses, as these require special considerations for operations, maintenance, and management such as redundancy and emergency power generators.
  - ❶ Use in medical equipment that may have an effect on human life or the human body
  - ❷ Use in transportation systems or transport-related equipment such as trains or elevators that may have an effect on human life or the human body
  - ❸ Use in computer systems that may have an impact on society or on the public
  - ❹ Use in other devices that have a major impact on human safety or on maintaining public operations
- In addition to the above, contact us or your point of sale for use in an environment where vibrations occur, such as in automobiles or transportation.
- For use in space, aviation, or nuclear power-related applications, contact us or your point of sale.
- The products listed in this catalog fall into the category 16 of Appended Table 1 of the Export Trade Control Order. To export these products as an individual part or to export a device into which they are assembled, the "Inform Requirements" and "Objective Requirements"—established by the Ministry of Economy, Trade and Industry of Japan based on the "Catch-all Controls"—must be studied for applicability. Accordingly, appropriate export formalities must be performed.

# Safety Precautions

## Warning Labels on Products

Either or all of the following symbols are labeled on products depending on the model of driver or stepping motor.



This label is attached in the vicinity of high-voltage portions such as charging or cover-protected parts, to indicate locations with risk of electric shock.



This label is attached in the vicinity of the grounding terminals of drivers to indicate that grounding is required.



This label is attached to the portion of drivers where a voltage of 42.4 VAC or 60 VDC or more is applied, drawing attention to the risk of electric shock.



Indicates that the stepping motor may get hot, resulting in burns.



Indicates that the stepping motor should be grounded.

## Safety Alert Symbols

The following safety symbols are used in the manual to indicate different hazardous situations and prohibited/required actions.



**DANGER** Indicates hazards that could cause severe bodily injury or death as a result of failure to follow the instructions.



**CAUTION** Indicates possible hazards that could cause moderate bodily injury or only property damage as a result of failure to follow the instructions.

Note that even items with a  CAUTION symbol could potentially lead to serious outcomes, depending on the situation. They all indicate important situations, so be sure to observe them.



**PROHIBITED** Indicates actions that must not be taken.



**COMPULSORY** Indicates actions that must be taken.

## DANGER

### General

- Do not use the product in an explosive, flammable or corrosive atmosphere, watery place or near a combustible material. Failure to follow this may cause injury or fire.
- Only technically qualified personnel should transport, install, wire, operate, or perform maintenance and inspection on the product. Failure to follow this may cause electric shock, injury, or fire.
- Do not work on wiring, maintenance servicing, or inspection with power on. Perform either of those five minutes after turning the power off. Failure to follow this may cause electrical shock.
- When the protective functions of the motor are activated, turn the power off immediately and eliminate the cause. If continuing the operation without eliminating the cause, the product may operate improperly and cause injury or a breakdown of the system devices.
- Stepping motors may step-out when running and stopping depending on the amount of the load. Put the product into use after sufficient trial test operation in the maximum planned load conditions to check that the product can handle the load. Doing otherwise may cause a breakdown of the system. (When used for upward/downward movements, loads may fall due to step-out.)
- Do not touch the internal parts of the driver. Failure to follow this may cause electric shock.

### Wiring

- Do not connect the stepping motor directly to a mains outlet. Failure to follow this may cause electric shock, injury, or fire. Stepping motors should be powered by stepping drivers (except for synchronous motors).
- Use an input voltage within the rated voltage range. Using otherwise may cause fire or an electric shock.
- Connect the driver and stepping motor to the ground. Failure to follow this may cause electric shock.
- Do not damage, apply excessive stresses, put heavy things on, or tuck down cables. Failure to follow this may cause electric shock.
- Perform wiring with the power cable as instructed by the wiring diagram or the Instruction Manual. Failure to follow this may cause electric shock or fire.
- Our stepping motor cables are for fixed-wiring use, so do not use products in applications where flex cables are required. Failure to follow this may cause electric shock, injury, or fire.

### Operation

- Never touch the rotating part of the stepping motor during its operation. Failure to follow this may cause injury.
- Do not reach or touch the electric terminals while electric power is on. Failure to follow this may cause electric shock.
- Never disconnect any of the connectors while electric power is on. Failure to follow this may cause electric shock or product damage.
- Do not operate products with live parts exposed. Failure to follow this may cause electric shock.
- If smoke, fire, unusual smells, or unusual sounds are produced from the driver or stepping motor, turn off the power and stop using them immediately. Failure to follow this may cause electric shock, injury, or fire.

## CAUTION

### General

- Prior to installation, operation, maintenance servicing or inspection, be sure to read the Instruction Manual and follow the instructions. Failure to follow this may cause electric shock, injury, or fire.
- Do not use the driver or the stepping motor in conditions that exceed the specification values. Failure to follow this may cause electric shock, injury, or fire.
- Do not insert a finger or an object into the opening of the motor. Failure to follow this may cause electric shock, injury, or fire.
- Do not use a damaged driver or stepping motor. Doing so may cause injury or fire.
- Use the driver and stepping motor in the designated combination. Failure to follow this may cause fire or product failures.
- Be careful when the temperature rises in the operating driver, stepping motor or peripheral devices. Failure to follow this may result in a burn.

- Never disassemble, repair, modify, or alter the motor. Failure to follow this may cause electric shock, injury, or fire.
- Do not remove the nameplate. Using motors with incorrect ratings may result in fire.
- Be careful that this product does not fall or tip over when handling, as this can be dangerous.

### Unpacking

- Unpack the box with the right side up. Failure to follow this may cause injury.
- Confirm that the product you received is the one that you have ordered. Installing an incorrect product may cause a breakdown.

### Wiring

- Do not measure the insulation resistance or dielectric strength of the motor by yourself. Failure to follow this may cause product damage. Contact us or your point of sale instead, if such a measurement is required.
- Perform wiring work according to local standards of electrical installations. Failure to follow this may cause motor burnout or fire.
- Perform wiring correctly and securely. Incorrect wiring may cause the stepping motor to run out of control, resulting in injury.
- Insulate the attached condenser and external resistance connection terminals. Failure to follow this may cause electric shock.

### Installation

- Do not stand on this product or place heavy objects on top of it. Failure to follow this may cause injury.
- Keep the air intake and exhaust vents free of obstructions and foreign matter. Failure to follow this may cause fire.
- Make sure to use the specified driver mounting direction. Failure to follow this may cause product failures.
- Keep a distance as instructed by the Instruction Manual for the driver from the inner surface of the control console or other devices. Failure to follow this may cause product failures.
- Install the motor with great care to avoid the risk of it falling or tipping over.
- Mount the motor to incombustible materials such as metals. Failure to do so may cause fire, injury, or device breakdown.
- Keep any combustible materials away from where the motor is installed. Failure to do so may result in fire or burns.
- Be sure to secure a ventilation path when installing the motor, and keep the intake and exhaust vents unblocked. Failure to do so may result in electric shock, fire, or device breakdown.
- Check the rotating direction of the motor before connecting it with equipment. Failure to follow this may cause injury or product damage.
- Do not touch the motor output spindle (including the keyway and gears) with your bare hand. Failure to follow this may cause injury.
- Do not apply loads to the motor shaft exceeding the specified allowable load.
- When attaching a pulley or coupling to the output shaft of a stepping motor, make sure that the motor unbalance is small enough. A large motor unbalance will increase vibration, which may result in shortened service life and premature damage.
- Make sure that the axial belt tension does not exceed the allowable load when operating the belt drive. The allowable load can be divided into the thrust (axial) load and radial load applied independently in the individual directions to the output shaft.
- Make sure that the output shaft of the motor and the mating machine are well aligned. Failure to follow this may increase vibration, which may result in shortened service life or premature damage.
- Fix the output shaft of the stepping motor to the mating machine around the entire shaft circumference to prevent fretting.

### Operation

- Stepping motors are not equipped with any protective device. Prepare an overvoltage protection device, earth leakage breaker, overheat protection device, and emergency stop device to ensure safe operation. Failure to follow this may cause injury or fire.
- Do not touch the product for a period after the power is on or has been turned off, since the driver and stepping motor remain at a high temperature. Failure to do so may cause burns. In particular, the temperature of the stepping motor rises considerably depending on the operating conditions. Do not allow the motor surface temperature to exceed the following:

- Thermal class F (+155°C) stepping motors: 125°C
- Thermal class B (+130°C) stepping motors: 100°C
- Regardless of thermal class, 85°C for encoder-equipped stepping motors, and 150°C for in-vacuum stepping motors.
- Immediately stop operation in case of anomaly. Failure to do so may cause an electric shock, injury or fire.
- Do not make extreme setting changes as doing so may result in unstable operations. Failure to follow this may cause injury.
- During trial operations, firmly stabilize the stepping motor, and confirm operations by disconnecting from the mechanical system before connecting with it. Failure to follow this may cause injury.
- Take safety measures such as covering the rotating parts of the stepping motor during operation to prevent them from being touched. Failure to follow this may cause injury.
- When an alarm is activated, remove the cause and ensure safety before resuming operations. Failure to follow this may cause injury.
- Stay away from equipment when power is restored after an outage because the system may restart suddenly. (Take measures to secure the safety even when it restarts on such occasions.) Failure to do so may cause injury.
- Use the right power supply for the motor. Failure to follow this may cause product failures.
- The electromagnetic brake is designed to hold the motor position in place. Do not use it as dynamic braking. Doing so may cause the breakdown of the system.
- Secure the key when operating the motor with a key. Failure to follow this may cause injury.
- For use in applications where varying loads are applied to the shaft, contact us in advance. Use in environments with varying loads might result in failure.

#### Maintenance

- Be careful when performing maintenance services or inspection as the driver and stepping motor frames get hot. Failure to follow this may result in a burn.
- It is recommended that the electrolytic condenser of the driver is replaced with a new one as preventive maintenance after using for 5 years (the expected life in an average operating environment of 40°C). The expected life of the fuse is 10 years in an average operating environment of 40°C. Thus, periodical replacement is recommended.
- Contact us or your point of sale for repair. If the product is disassembled by the user, it may become inoperable.
- Stepping motor's oil seals, electromagnetic brakes, bearings are life-limited parts. Determine when to replace them based on the results of the actual equipment evaluation.

#### Transportation

- Handle the product with care during transportation so as to prevent from dangers such as tumbling or overturning.
- Do not hold with the cable or the motor shaft when transporting. Failure to follow this may cause product damage or injury.

#### Disposal

- Dispose of stepping drivers and motors as industrial waste.

### PROHIBITED

#### Storage

- Avoid storing products in environments exposed to rain or water drops or with hazardous gas or liquid. Failure to follow this may cause failures.

#### Maintenance

- Do not disassemble or repair the product. Failure to follow this may cause fire or electric shock.

#### General

- Do not remove the nameplate. Using motors with incorrect ratings may result in fire.

### COMPULSORY

#### Storage

- Store the product out of direct sunlight within the specified temperature

and humidity ranges.

- If the driver has been stored for a long period (3 years or longer as a general guide), contact us. The capacitance of electrolytic capacitors can decrease through long-term storage, which may cause malfunctions.

#### Operation

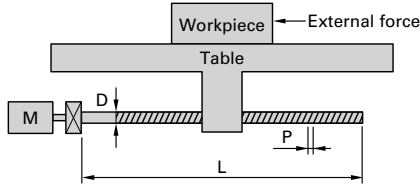
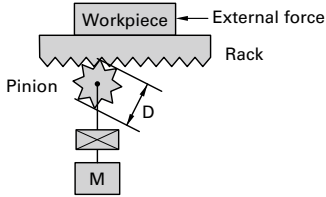
- Install an emergency stop circuit to the outside of equipment to turn the power off immediately whenever needed.
- Operate the motor within the specified ambient temperature and humidity ranges.

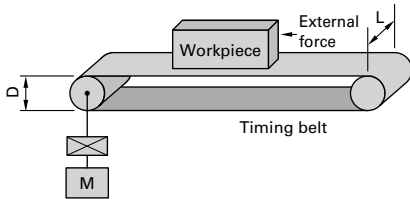
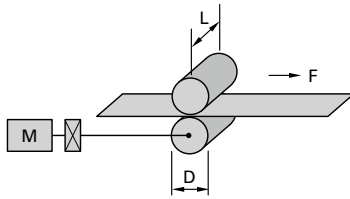
#### Transportation

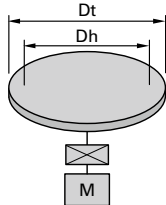
- Follow the instructions displayed on the package box and avoid excessively stacking boxes.

## ■ Selection Guide by Mechanism

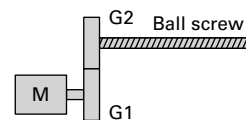
Typical mechanism examples and required selection criteria are shown below. Provide us with these information when consulting us for selection.

| Ball screw                                                                        |        |                                    | Rack & Pinion                                                                      |        |                                    |
|-----------------------------------------------------------------------------------|--------|------------------------------------|------------------------------------------------------------------------------------|--------|------------------------------------|
|  |        |                                    |  |        |                                    |
| External force                                                                    | F      | <input type="text" value="N"/>     | External force                                                                     | F      | <input type="text" value="N"/>     |
| Workpiece mass + table mass                                                       | W      | <input type="text" value="kg"/>    | Workpiece mass + rack mass                                                         | W      | <input type="text" value="kg"/>    |
| Ball screw diameter                                                               | D      | <input type="text" value="m"/>     | Pinion diameter                                                                    | D      | <input type="text" value="m"/>     |
| Ball screw length                                                                 | L      | <input type="text" value="m"/>     | Pinion thickness                                                                   | L      | <input type="text" value="m"/>     |
| Ball screw pitch                                                                  | P      | <input type="text" value="m"/>     | Pinion density                                                                     | $\rho$ | <input type="text" value="kg/m³"/> |
| Ball screw density                                                                | $\rho$ | <input type="text" value="kg/m³"/> | Friction coefficient                                                               | $\mu$  | <input type="text" value=""/>      |
| Friction coefficient                                                              | $\mu$  | <input type="text" value=""/>      | Gear ratio *                                                                       | G      | <input type="text" value=""/>      |
| Gear ratio *                                                                      | G      | <input type="text" value=""/>      | Mechanical efficiency                                                              | $\eta$ | <input type="text" value=""/>      |
| Mechanical efficiency                                                             | $\eta$ | <input type="text" value=""/>      |                                                                                    |        |                                    |

| Belt drive                                                                         |        |                                    | Roll feed                                                                           |        |                                    |
|------------------------------------------------------------------------------------|--------|------------------------------------|-------------------------------------------------------------------------------------|--------|------------------------------------|
|  |        |                                    |  |        |                                    |
| External force                                                                     | F      | <input type="text" value="N"/>     | Sheet tension                                                                       | F      | <input type="text" value="N"/>     |
| Workpiece mass + belt mass                                                         | W      | <input type="text" value="kg"/>    | Roll diameter                                                                       | D      | <input type="text" value="m"/>     |
| Pulley diameter                                                                    | D      | <input type="text" value="m"/>     | Roll width                                                                          | L      | <input type="text" value="m"/>     |
| Pulley width                                                                       | L      | <input type="text" value="m"/>     | Roll density                                                                        | $\rho$ | <input type="text" value="kg/m³"/> |
| Pulley density                                                                     | $\rho$ | <input type="text" value="kg/m³"/> | Gear ratio *                                                                        | G      | <input type="text" value=""/>      |
| Gear ratio *                                                                       | G      | <input type="text" value=""/>      | Mechanical efficiency                                                               | $\eta$ | <input type="text" value=""/>      |
| Mechanical efficiency                                                              | $\eta$ | <input type="text" value=""/>      |                                                                                     |        |                                    |

| Rotary indexing table                                                               |        |                                 |
|-------------------------------------------------------------------------------------|--------|---------------------------------|
|  |        |                                 |
| Table mass                                                                          | W      | <input type="text" value="kg"/> |
| Table diameter                                                                      | Dt     | <input type="text" value="m"/>  |
| Table support diameter                                                              | Dh     | <input type="text" value="m"/>  |
| Friction coefficient of table support                                               | $\mu$  | <input type="text" value=""/>   |
| Gear ratio *                                                                        | G      | <input type="text" value=""/>   |
| Mechanical efficiency                                                               | $\eta$ | <input type="text" value=""/>   |

\* Calculation of gear ratio (G)



$$G = \frac{\text{Number of screw threads (G2)}}{\text{Number of motor gear teeth (G1)}}$$







## ■ ECO PRODUCTS

ECO PRODUCTS are designed to reduce the environmental impacts throughout the product's life cycle. Ranging from design to manufacturing stages, the environmental impact of a product and its packaging materials is assessed against the eco-design requirements. Those products that satisfy the requirements are accredited as ECO PRODUCTS.

### Notes Before Purchase

- Read the accompanying Instruction Manual carefully prior to using the product.
- Do not use this product in an environment where vibration is present, such as in moving vehicles or shipping vessels.
- Do not modify or alter the product in any way.

Please contact us beforehand if you intend to use this product in the following applications.

- Medical equipment that may have an effect on human life
- Systems or equipment that may have a major impact on society or on the public
- Special applications related to aviation and space, nuclear power, electric power, submarine repeaters, etc.

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