

**SANMOTION**

**STEPPING SYSTEMS**

**F**

**TYPE P** (Pulse I/F)

F2BED200P1□□, F5PED140P1□□

**For Stepping Motor**

**Instruction Manual**

**SANYO DENKI**







# Safety Precautions

Please read this User Manual and its appendix carefully prior to installation, operation, maintenance or inspection and perform all tasks according to the instructions provided here. A good understanding of this equipment, its safety information as well as all Warnings / Cautions is also necessary before using.

Matters that require attention are ranked as “Danger” “Warning” and “Caution” in this document.



## ■ Warning Symbol

	Denotes immediate hazards that will probably cause severe bodily injury or death as a result of incorrect operation.
	Denotes immediate hazards which will probably cause severe bodily injury or death as a result of incorrect operation.
	Denotes hazards which could cause bodily injury and product or property damage as a result of incorrect operation.

 Even those hazards denoted by this symbol could lead to a serious accident.

Make sure to strictly follow these safety precautions.

## ■ Prohibited, Mandatory Symbols

	Indicates actions that must not be allowed to occur / prohibited actions.
	Indicates actions that must be carried out / mandatory actions.

# Safety Precautions

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## ■ Attention in use

### Warning

To avoid risk of electric shock or injury, be sure to observe the following precautions.

- ◆ Do not use this device in explosive environment.  
Injury or fire could otherwise result.
- ◆ Do not perform any wiring, maintenance or inspection when the device is hot-wired.  
After switching the power off, wait at least 1 minute before performing these tasks.  
Electric shock or damage could otherwise result.
- ◆ Be sure to connect the ground terminal of the motor to the grounding point of the equipment.  
Electric shock could otherwise result.
- ◆ Do not touch the inside of the driver.  
Electric shock could otherwise result.
- ◆ Do not damage the cable, do not apply unreasonable stress to it, do not place heavy items on it, and do not insert it in between objects.  
Electric shock could otherwise result.
- ◆ Do not touch the rotating part of the motor during operation.  
Bodily injury could otherwise result.
- ◆ When handling the driver, be sure to take measures against static electricity.  
Also, do not touch the electronic components and pin headers on the board.  
Damage could otherwise result.

### Caution

- ◆ Use the driver and motor together in the specified combination.  
Fire or damage to the device could otherwise result.
- ◆ Only technically qualified personnel should transport, install, wire, operate, or perform maintenance and inspection on this device.  
Electric shock, injury or fire could otherwise result.
- ◆ Do not expose the device to water, corrosive or flammable gases, or any flammable material.  
Fire or damage to the device could otherwise result.
- ◆ Be careful of the high temperatures generated by the driver/motor and the peripherals.  
Burn could otherwise result.
- ◆ Do not touch the radiation fin of the driver, or the motor while the device is powered up, or immediately after switching the power off, as these parts generate excessive heat.  
Burn could otherwise result.
- ◆ Please read the User Manual carefully before installation, operation, maintenance or inspection, and perform these tasks according to the instructions.  
Electric shock, injury or fire could otherwise result.
- ◆ Do not use the amplifier or the motor outside their specifications.  
Electric shock, injury or damage to the device could otherwise result.
- ◆ Use a DC power supply with reinforced insulation between the primary and secondary sides for the DC power supply connected to the driver.  
Electric shock could otherwise result.

# Safety Precautions

## ■ Storage

### Prohibited

- ◆ Do not store the device where it could be exposed to rain, water, toxic gases or other liquids.  
Damage to the device could otherwise result.

### Mandatory

- ◆ Store the products where it is not exposed to direct sunlight, and within the specified temperature and humidity ranges (non-condensing).  
For the driver: -20 to +70°C, below 90% RH  
For the motor: -20 to +65°C, 5 to 95% RH <sup>Note)</sup>  
Damage to the device could otherwise result.  
Note) Since there are slight differences between motors, please refer to the motor specifications for details.
- ◆ Please contact our office if the driver is to be stored for a period of 3 years or longer. The capacity of the electrolytic capacitors decreases during long-term storage, and could cause damage to the device.
- ◆ Please contact our office if the motor is to be stored for a period of 3 years or longer. Confirmations such as bearings and the brakes are necessary.

## ■ Transportation

### Caution

- ◆ When handling or moving this equipment, do not hold the device by the cables, the motor shaft or detector portion.  
Damage to the device or bodily injury could otherwise result.
- ◆ Keep in mind that it is dangerous at the time of conveyance if it falls and overturns.  
Bodily injury could otherwise result.
- ◆ When handling the driver, be sure to take measures against static electricity. Also, do not touch the electronic components and pin headers on the board.  
Damage could otherwise result.

### Mandatory

- ◆ Follow the directions written on the outside box. Excess stacking could result in collapse.  
Bodily injury could otherwise result.

# Safety Precautions

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## ■ Installation



## Caution

- ◆ Do not stand on the device or place heavy objects on top of it.  
Bodily injury could otherwise result.
- ◆ Make sure the mounting orientation is correct.  
Fire or damage to the device could otherwise result.
- ◆ Do not drop this device or subject it to excessive shock of any kind.  
Damage to the device could otherwise result.
- ◆ Do not obstruct the air intake and exhaust vents, and keep them free of debris and foreign matter.  
Fire could otherwise result.
- ◆ Do not allow foreign objects to adhere to the driver board.  
Fire could otherwise result.
- ◆ Consult the User Manual regarding the required distance inside the amplifier disposition.  
Fire or damage to the device could otherwise result.
- ◆ Open the box only after checking its top and bottom location.  
Bodily injury could otherwise result.
- ◆ Verify that the products correspond to the order sheet/packing list.  
Injury or damage could result.
- ◆ Take care of falling or overturning of the device during installation.  
Bodily injury could otherwise result.
- ◆ Install the device on a metal or other non-flammable support.  
Fire could otherwise result.
- ◆ Make the collision safety device strong enough to resist the maximum output of the system.  
Bodily injury could otherwise result.

## ■ Wiring



## Caution

- ◆ Wiring connections must be secure.  
Bodily injury could otherwise result.
- ◆ Wiring should be completed based on the Wiring Diagram or the User Manual.  
Electric shock or fire could otherwise result.
- ◆ Wiring should follow electric equipment technical standards and indoor wiring regulations.  
An electrical short or fire could otherwise result.
- ◆ Install a safety device such as a breaker to prevent external wiring short-circuits.  
Fire could otherwise result.
- ◆ Do not bind or band the power cable, input/output signal cable and/or encoder cable together or pass through the same duct or conduit.  
This action will cause faulty operation.

## Mandatory

- ◆ Install an external emergency stop circuit that can stop the device and cut off the power instantaneously. Install an external protective circuit to the amplifier to cut off the power from the main circuit in the case of an alarm.  
Motor runaway, bodily injury, burnout, fire and secondary damages could otherwise result.
- ◆ The motor is not equipped with a protection device. Use an overcurrent protection device, leakage current circuit breaker, overtemperature protection device, or emergency stop device to protect the motor.  
Bodily injury or fire could otherwise result.
- ◆ Use a power supply with reinforced insulation (double insulation) for the main circuit power supply, control circuit power supply, or I/O signal power supply.

### ■ Operation

## Caution

- ◆ Do not perform extensive adjustments to the device as they may result in unstable operation.  
Bodily injury could otherwise result.
- ◆ Trial runs should be performed with the motor in a fixed position, separated from the mechanism. After verifying successful operation, install the motor on the mechanism.  
Bodily injury could otherwise result.
- ◆ The holding brake is not to be used as a safety stop for the mechanism. Install a safety stop device on the mechanism.  
Bodily injury could otherwise result.
- ◆ In the case of an alarm, first remove the cause of the alarm, and then verify safety. Next, reset the alarm and restart the device.  
Bodily injury could otherwise result.
- ◆ Check that input power supply voltage (for main circuit/control) is keeping a specification range.  
Damage to the device could otherwise result.
- ◆ Avoid getting close to the device, as a momentary power outage could cause it to suddenly restart (although it is designed to be safe even in the case of a sudden restart).  
Bodily injury could otherwise result.
- ◆ Do not use motor or driver which is defective or failed and damaged by fire.  
Injury or fire could otherwise result.
- ◆ In the case of any irregular operation, stop the device immediately.  
Electric shock, injury or fire could otherwise result.
- ◆ When using the motor in vertical axis, provide safety devices to prevent falls during the work that will cause an alarm condition.  
Injury or damage could result.
- ◆ During motor rotation, the main circuit power supply voltage rises due to regeneration, which may affect the driver and other equipment connected to the same power supply. Please evaluate the system thoroughly in the operation pattern to be used.  
Damage could otherwise result.
- ◆ The motor may generate heat when driven by external force even when it is not energized.  
Burnout or burn could otherwise result.
- ◆ In the case of any irregular operation, stop the device immediately.  
Damage to the equipment could otherwise result.

# Safety Precautions

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## Prohibited

- ◆ The built-in brake is intended to secure the motor; do not use it for regular control.  
Damage to the brake could otherwise result.  
Damage to the device could otherwise result.
- ◆ Keep the motor's encoder cables away from static electricity and high voltage.  
Damage to the device could otherwise result.
- ◆ Do not rotate the motor continuously from the outside when the driver is not powered on.  
Fire, burn or damage to the device could otherwise result.
- ◆ Absolutely do not apply voltage more than the spec to the amplifier because over voltage will be cause of part failure.  
Damage to the device or bodily injury could otherwise result.
- ◆ Avoid frequent on and off power supply.  
Inner parts might get premature failure in case of repeating ON/OFF of power supply 30 times or more per day, otherwise 5 times or more per hour.

## Mandatory

- ◆ Install an external emergency stop circuit that can stop the device and cut off the power instantaneously. Install an external protective circuit to the amplifier to cut off the power from the main circuit in the case of an alarm.  
Motor runaway, bodily injury, burnout, fire and secondary damages could otherwise result.
- ◆ Operate within the specified temperature and humidity range.  
Driver  
Temperature 0 to +50°C  
Humidity below 90%RH (non-condensing)  
Motor  
Temperature -10 to +50°C (0 to +40°C for harmonic gear equipping motor)  
Humidity 20 to 90%RH (non-condensing) <sup>Note)</sup>  
Burnout or damage to the device could otherwise result.  
Note) Since there are slight differences between motors, please refer to the motor specifications for details.



# Safety Precautions

## ■ Maintenance, Inspection



### Caution

- ◆ Some parts of the driver (electrolytic capacitor, cooling fan, fuse, relay kinds) can deteriorate with long-term use. Please contact our offices for replacements.  
Damage to the device could otherwise result.
- ◆ Do not touch or get close to the terminal while the device is powered up.  
Electric shock could otherwise result.
- ◆ Be careful during maintenance and inspection, as the body of the driver becomes hot.  
Burn could otherwise result.
- ◆ Please contact your distributor or sales office if repairs are necessary.  
Disassembly could render the device inoperative.  
Damage to the device could otherwise result.
- ◆ When handling the driver, be sure to take measures against static electricity.  
Also, do not touch the electronic components and pin headers on the board.  
Damage could otherwise result.



### Prohibited

- ◆ Do not overhaul the device.  
Fire or electric shock could otherwise result.
- ◆ Do not measure the insulation resistance and the pressure resistance.  
Damage to the device could otherwise result.
- ◆ Absolutely do not unplug the connector while the device is powered up because hot plug will give damaged by surge to component.  
Electric shock or damage could otherwise result.
- ◆ Do not remove the nameplate cover attached to the device.

## ■ Disposal



### Mandatory

- ◆ If the driver or the motor is no longer in use, it should be discarded as industrial waste.

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# Preface

This chapter describes the features and configuration of the system, precautions when unpacking and using the system, and how to read the model number.

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# 1. Preface

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## 1.1 Introduction

Drivers and stepping motors are designed for use in general industrial equipment. Therefore, please pay close attention to the following points.

- Please read the "Instruction Manual" carefully before installation, assembly, and use.
- Do not modify or alter the product.
- For installation and maintenance work, consult your dealer or a specialist.
- In the following cases, special consideration should be given to operation, maintenance, and management, such as multiplexing of the system and installation of emergency power generation equipment, so please consult us.
  - Use for medical equipment, etc. that may cause loss of human life.
  - Use in trains, elevators, etc., which may cause damage to human life.
  - Use in computer systems, etc. that have a serious social or public impact.
  - Use in other equipment that may have a significant impact on human safety or the maintenance of public functions.
- Consult us for use in environments subject to vibration, such as for vehicle mounting, transportation, etc.

Before use (installation, operation, maintenance, inspection, etc.), be sure to read this instruction manual thoroughly and use the product correctly.

Please familiarize yourself with all knowledge of the equipment, safety information, and precautions before use.

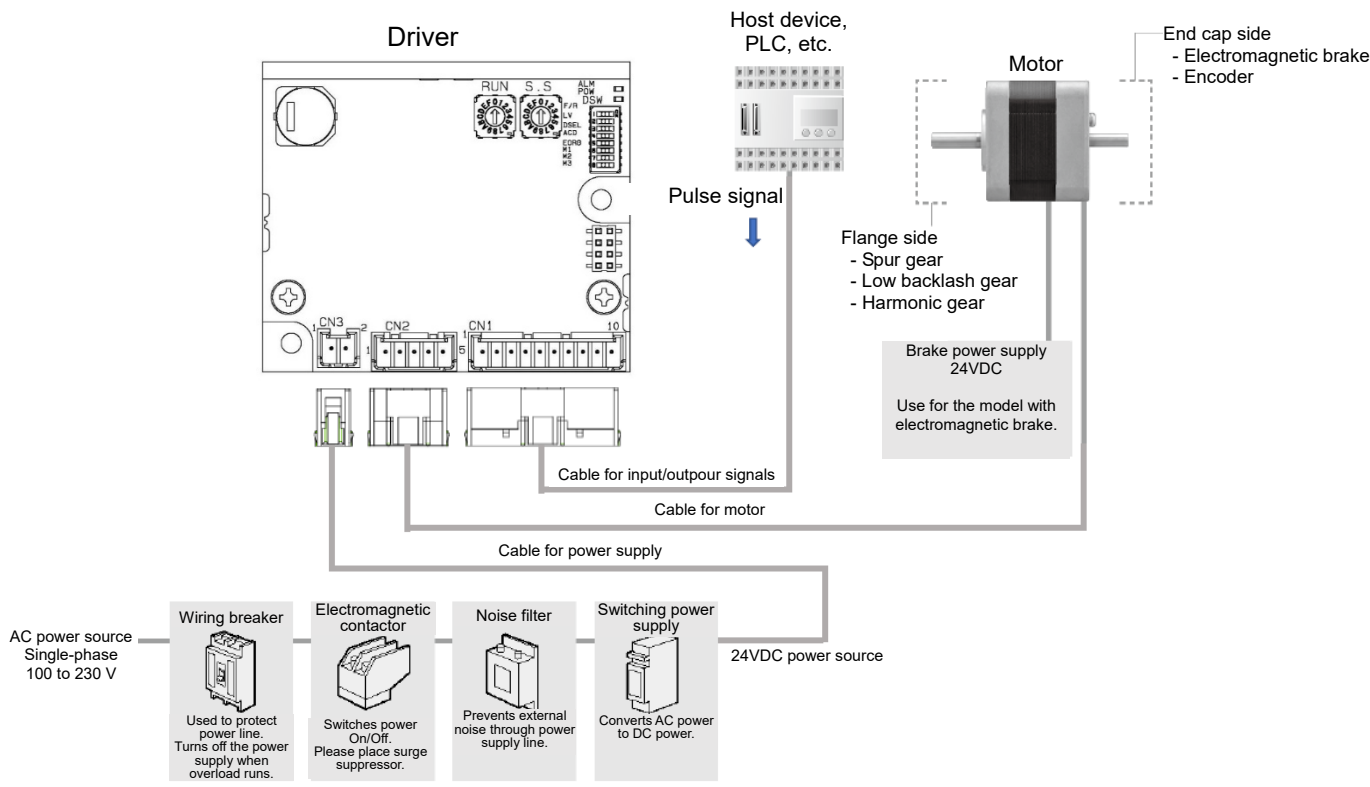
After reading the instruction manual, be sure to keep it in a place where the user can access it at any time.

## 1.2 Product Features

- Main built-in functions
  - Low vibration mode  
Smooth operation with low vibration is possible even with pulse trains equivalent to full-step and half-step.
  - Micro step function  
Micro step driving is possible with the resolution set by the rotary switch.
  - Operating current switching function  
Motor current during operation can be set by rotary switch.
  - Input pulse mode selection function  
1-input method or 2-input methods can be selected by DIP switches.
  - Auto current down function  
Motor current is reduced to 50% of the operating current when motor stop (200 ms after the last pulse is applied) to reduce heat generation in the motor and driver. This reduces heat generation in the motor and driver.

# 1.3 System Configuration

## 1.3 System Configuration

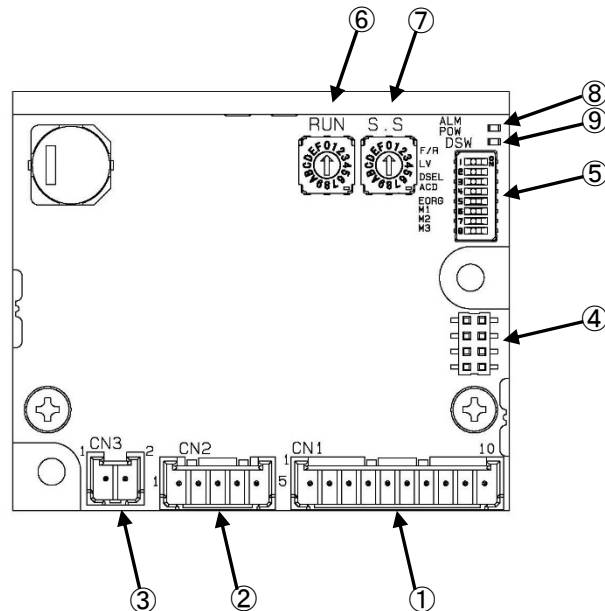


Note) For details on connectors and compatible wires, refer to "3.2 Connector Model Number, Applicable Wire".

Note) Refer to "8. Options" for details of optional products.

# 1. Preface

## 1.4 Product Part Names



Name	Description
① Input/output signal connector (CN1)	Connects input/output signals.
② Motor connection connector ※ (CN2)	Connects motor power lines.
③ Power supply connector (CN3)	Connects the power supply.
④ Connector for manufacturer's maintenance (CN4)	This connector is for our maintenance use. Do not wire.
⑤ Function selection DIP switch (DSW)	Selects the function according to the specifications.
⑥ Rotary switch for selecting operating current (RUN)	Selects the motor current during operation.
⑦ Step angle selection rotary switch (S.S)	Selects the number of stepping motor basic step angle divisions.
⑧ Alarm/warning indicator LED (ALM)	Lights up when an alarm or warning occurs. (Red)
⑨ Power indicator LED (POW)	Lights up when control power is established. (Green)

※ The motor connector (CN2) has 4 pins for F2BED200P1□□ and 5 pins for F5PED140P1□□ (shown above).



# 1.5 Precautions for Unpacking

## 1.5 Precautions for Unpacking

When purchasing this product, take it out of the box with the following precautions.

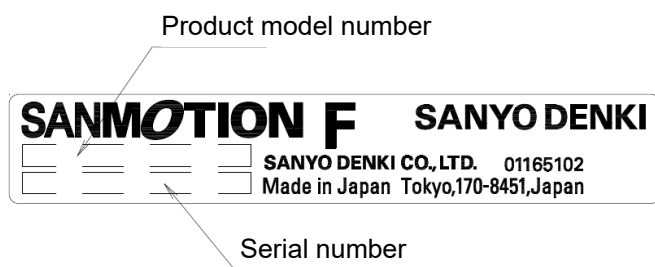
- Do not put your hand on the connector of the driver at removing it from the box.
- Do not touch the driver with charged hands when removing it from the box.

## 1.6 Product Confirmation

Check the following points about the product upon arrival. If any abnormality is found, please contact us.

- Check the model number of the motor and driver to make sure they are the same as the ordered ones.
- Check that there are no problems with the appearance of the motor and driver.
- Check if the screws of the motor and driver are not loose.

Driver main nameplate



※ Interpretation of the serial number

Production Month (2-digit) + Year (2-digit) + Day (2-digit) + Serial number (4-digit)  
+ Revision ("A" abbreviated)

# 1. Preface

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## 1.7 Precautions for Use

When using the product, pay attention to the following points.

- Do not give any impact to the motor or driver when installing this product.  
Doing so may cause malfunction.
- Check the model number of the driver to be used and use a main power supply of 24VDC $\pm$ 10%.  
Use of any other power supply may result in an accident.
- When turning the power supply ON/OFF for maintenance or inspection, please do so after thoroughly checking the load condition and other safety factors. Turning the power ON/OFF under load may cause accidents or malfunctions.
- Never use this product in the presence of corrosive (acid, alkali, etc.), flammable, or explosive liquids or gases, as they may deform or damage the product.
- It is very dangerous to use this product in the presence of flammable or explosive liquids or gases, as the liquids or gases may ignite. Never use this product.
- Use the product in an ambient temperature range of 0 to 50° C (-10 to 50° C for the motor) and an ambient humidity of 90%RH or less (20 to 90%RH for the motor).
- Avoid splashing water, cutting fluid, or rainwater on the motor and driver.  
Water, cutting fluid, or rainwater may cause electric leakage or electric shock.
- Never conduct withstand voltage tests or insulation resistance tests on the motor and driver.
- Be sure to refer to the section "3. Wiring" for proper wiring.  
Incorrect wiring may cause damage to the product.

# 1.8 How to Read Model Numbers

## 1.8 How to Read Model Numbers

### 1.8.1 Driver Model Number

F    2    B    E    D    200    P    1    00  
①    ②    ③    ④    ⑤    ⑥    ⑦    ⑧    ⑨

① Series name

F	F series
---	----------

② Phases of motor

2	2-phase
5	5-phase

③ Motor wiring method

B	Bipolar wiring
P	New pentagon wiring

④ Series generation

E	5th generation
---	----------------

⑤ Power source

D	24 VDC
---	--------

⑥ Maximum winding current

200	2 A/phase
140	1.4 A/phase

⑦ Interface

P	Pulse train input (photocoupler)
---	----------------------------------

⑧ Number of axes

1	1 axis
---	--------

⑨ Specification identification

00 to 19	Standard product
20 to 99	Standard compliant product

# 1. Preface

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## 1.8.2 Motor Model Number

◆ SM256□C20B□□ motor

S    M    2    56    □    C    20    B    □□  
①    ②    ③    ④    ⑤    ⑥    ⑦    ⑧    ⑨

① Series

S	Stepping motor
---	----------------

② Type

M	Type M (UL compliant)
---	-----------------------

③ Phases of motor and basic step angle

2	2-phase, 1.8° step
---	--------------------

④ Flange size

56	56 mm square
----	--------------

⑤ Motor total length

1	41.8 mm
2	53.8 mm
3	75.8 mm
4	85.8 mm

⑥ Lead outlet specification

C	Connector type
---	----------------

⑦ Rated current

20	2 A/phase
----	-----------

⑧ Motor wiring method

B	Bipolar wiring
---	----------------

⑨ Output shaft type, option

00 to 39	Dual shaft type
40 to 99	Single shaft type

# 1.8 How to Read Model Numbers

◆ Motors other than SM256□C20B□□



① Series

S	Stepping motor
---	----------------

② Type

F	Type F
H	Type H
M	Type M (CE/UL compliant)

③ Phases of motor and basic step angle

1	2-phase, 0.9° step
2	2-phase, 1.8° step
5	5-phase, 0.72° step

④ Flange size

28	28 mm square
42	42 mm square
60	60 mm square
86	86 mm square

⑤ Motor total length

1 to 4	Refer to motor outline drawing
--------	--------------------------------

⑥ Rated current

50, 52	2 A/phase (2-phase)
72	0.75 A/phase (5-phase)
82	1.4 A/phase (5-phase)

⑦ Output shaft type, option

00 to 39	Dual shaft type
40 to 99	Single shaft type

# 1. Preface

## 1.9 Standard combination

The following combinations of drivers and stepping motors are shown below.  
If the combination is different, normal operation will not be possible.

Standard combination motors for driver model number: F2BED200P1□□

Motor flange size	Motor model number		Motor rated current	Basic step angle
	Single shaft	Dual shaft		
42 mm sq.	SH1421-5241	SH1421-5211	2A/phase	0.9°
	SH1422-5241	SH1422-5211		
	SH1424-5241	SH1424-5211		
56 mm sq.	SM2561C20B41	SM2561C20B11	2A/phase	1.8°
	SM2562C20B41	SM2562C20B11		
	SM2563C20B41	SM2563C20B11		
	SM2564C20B41	SM2564C20B11		
60 mm sq.	SH1601-5240	SH1601-5210	2A/phase	0.9°
	SH1602-5240	SH1602-5210		
	SH1603-5240	SH1603-5210		
86 mm sq.	SH2861-5041	SH2861-5011	2A/phase	1.8°
	SH2862-5041	SH2862-5011		

Standard combination motors for driver model number: F5PED140P1□□

Motor flange size	Motor model number		Motor rated current	Basic step angle
	Single shaft	Dual shaft		
28 mm sq.	SH5281-7241	SH5281-7211	0.75A/phase	0.72°
	SH5285-7241	SH5285-7211		
42 mm sq.	SF5421-8241	SF5421-8211	1.4A/phase	0.72°
	SF5422-8241	SF5422-8211		
	SF5423-8241	SF5423-8211		
60 mm sq.	SM5601-8241	SM5601-8211	1.4A/phase	0.72°
	SM5602-8241	SM5602-8211		
	SM5603-8241	SM5603-8211		
86 mm sq.	SM5861-8241	SM5861-8211	1.4A/phase	0.72°
	SM5862-8241	SM5862-8211		

## Installation

In this chapter, installation of servo amplifier and servo motor are explained.

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## 2. Installation

### 2.1 Driver Installation

#### 2.1.1 Precautions for installation

Please note followings for driver installation place and method.

Case	Precautions
When installed in a cabinet	The temperature in the cabinet might be higher than the outside temperature depending on the power loss of built-in equipment and the dimensions of the cabinet. Be sure to keep the temperature around the driver at +50°C (+122°F) or lower by properly determining the dimensions of the cabinet, the cooling system and the arrangement. For a longer lifetime and higher reliability, recommends that operating the driver at an in-cabinet temperature of lower than +40°C (+104°F).
When there is a vibration source nearby	Install the driver to the base through a shock absorber so that vibration may not be transmitted directly to the driver.
When there is a heating element nearby	Even if there is a possibility that a temperature rise may be caused by convection or radiation, keep the temperature near the Driver lower than +50°C (+122°F).
When corrosive gas is present	If the driver is operated for a long time, contact failure will come to occur at contact parts (e.g., connectors). So, do not install the driver in corrosive gas atmosphere.
When explosive or combustible gases are present	Do not use the driver in explosive gas or combustible gas atmosphere. Relays and contactors, which generate arcs (sparks) inside cabinet, and such parts as regenerative resistor may become ignition sources, causing fires and explosion.
When dust or oil mist is present	Do not use the driver in such atmosphere containing dusts or oil mists. Dusts or oil mists adhered to or accumulated on the driver might lower insulation or cause leak between conductors of applicable parts, and might damage the driver.
When there is a large electrical noise source	Induction noise will be causing driver's malfunction by joining to input signals and/or the power supply circuit. When there is a possibility of joining noise, take proper measures such as inserting a noise filter, revising line wiring and preventing noise generation.



# 2.1 Driver Installation

## 2.1.2 Mounting direction and location

- Install the driver on a metal plate with high thermal conductivity and vibration resistance.
- Fix the driver horizontally or vertically with M3 screws using the mounting holes.
- Be sure to keep the ambient temperature of the driver below +50°C. To ensure long life and high reliability, it is recommended to use the driver at temperatures below +40°C.
- Regardless of the ambient temperature, the temperature of the heat sink (where the power element is mounted) should be kept below +70°C.  
If the temperature exceeds +70°C, take measures such as forced air cooling using a cooling fan.
- Keep the driver at least 25mm away from the cabinet and other devices horizontally and 50mm away vertically.
- When two or more units are installed side by side, keep them at least 25 mm apart horizontally and vertically.

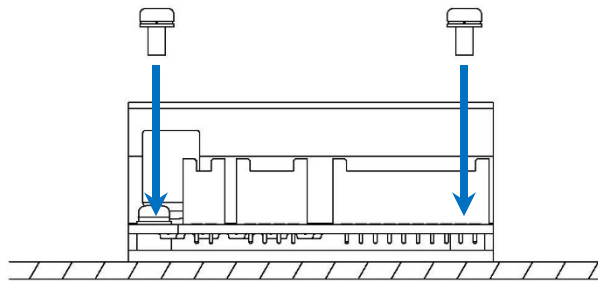


Figure 2.1 Horizontal installation

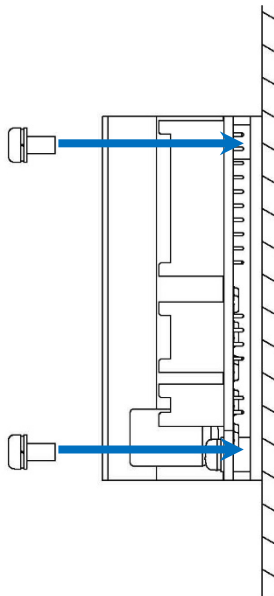


Figure 2.2 Vertical installation

# 2. Installation

## 2.2 Motor Installation

### 2.2.1 Mounting location

The motor should be installed indoors in the following environment.

- In use      Ambient temperature: -10 to +50 °C  
(0 to +40 °C for motors with harmonic gear, -10 to +40 °C for motors with encoder)  
Ambient humidity: 20 to 90% (non-condensing)
- In storage    Ambient temperature: -20 to +65°C  
Ambient humidity: 5 to 95%RH (non-condensing)
- Well-ventilated places without corrosive or explosive gases
- Places free from dust or debris
- Places easy to check and clean
- Do not use the product in applications where it is exposed to oil or splashed with water droplets, oil droplets, or cutting fluids.
- Never install the product in locations where corrosive (acids, alkalis, etc.), flammable, or explosive liquids or gases are present.

### 2.2.2 How to install

- Installation
  - ◆ The Stepping motor can be installed horizontally or on/under the end of a shaft.
  - ◆ Use the tapped holes, mounting holes, and mounting spigot joint on the mounting surface side for mounting.

Motor flange size	Screws	Recommended tightening torque [N·m]
28 mm sq.	M2.5, 4 pcs.	0.346±0.057
42 mm sq.	M3, 4 pcs.	0.62±0.1
56, 60 mm sq.	M4, 4 pcs.	1.43±0.24
86 mm sq.	M5, 4 pcs.	2.9±0.48

Note) For bolt strength grade 4.8 (JIS B1051)

- ◆ When setting vertically, make a cable trap to prevent oily water from going to the motor.

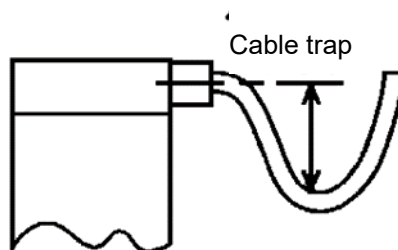


Figure 2.3 Cable trap

## 2.2 Motor Installation

### ■ Wet protection

The protection type of the motor alone meets the IEC standard. However, since this standard is a performance standard for a short period of time, actual use requires protection against wetting.

If the outer skin of the connector is bumped or damaged, the waterproof function may be impaired, so handle with care.

### ■ Coupling with mating machine

- ◆ Please make sure the centering of the motor shaft and the mating machine is correct. Especially when a rigid coupling is used, even a slight misalignment may result in damage to the output shaft.
- ◆ When mounting the motor on a machine, the mounting holes should be machined to a precision that allows smooth coupling of the motor mounting spigot joint. Also, ensure that the mounting surface is flat. Poor flatness may cause damage to the shaft or bearing.
- ◆ Gears, pulleys, couplings, etc. should be mounted in such a way that they are not subjected to impact.

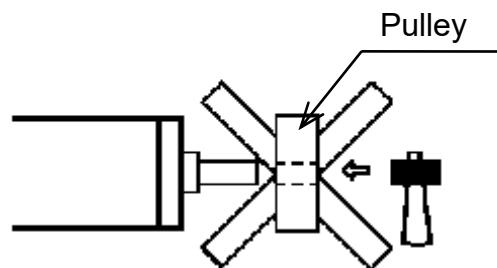


Figure 2.4 Installation of gear etc.

- ◆ When removing the gear, the pulley, etc, use a dedicated extracting tool.

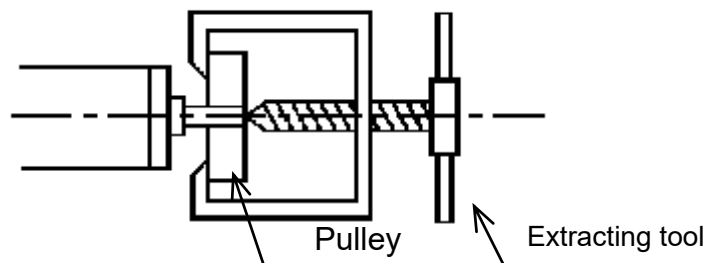


Figure 2.5 De-installation of gear etc.

## 2. Installation

---

- Allowable load of bearing

- ◆ Make sure that the load that can be applied to the motor, such as belt tension in the case of belt drive, does not exceed the allowable value.

Standard combination motor for driver model number: F2BED200P1□□

Motor model number	Allowable radial load [N]	Allowable thrust load [N]
SH1421-52□1	25	10
SH1422-52□1	24	10
SH1424-52□1	20	10
SM2561C20B□1	113	20
SM2562C20B□1	102	20
SM2563C20B□1	78	20
SM2564C20B□1	70	20
SH1601-52□0	78	15
SH1602-52□0	65	15
SH1603-52□0	83	15
SH286□-51□1	200	60

Standard combination motor for driver model number: F5PED140P1□□

Motor model number	Allowable radial load [N]	Allowable thrust load [N]
SH5281-72□1	42	3
SH5285-72□1	49	3
SF5421-82□1	56	10
SF5422-82□1	54	10
SF5423-82□1	52	10
SM5601-82□1	191	20
SM5602-82□1	183	20
SM5603-82□1	170	20
SM586□-82□1	200	60

Note) Do not apply an excessive thrust or radial load.

## 2.2 Motor Installation

**【Caution】** Thrust load and radial load are the allowable loads applied to the shaft independently. The allowable radial load is the maximum load that can be applied to the end of the output shaft. (See the figure below).

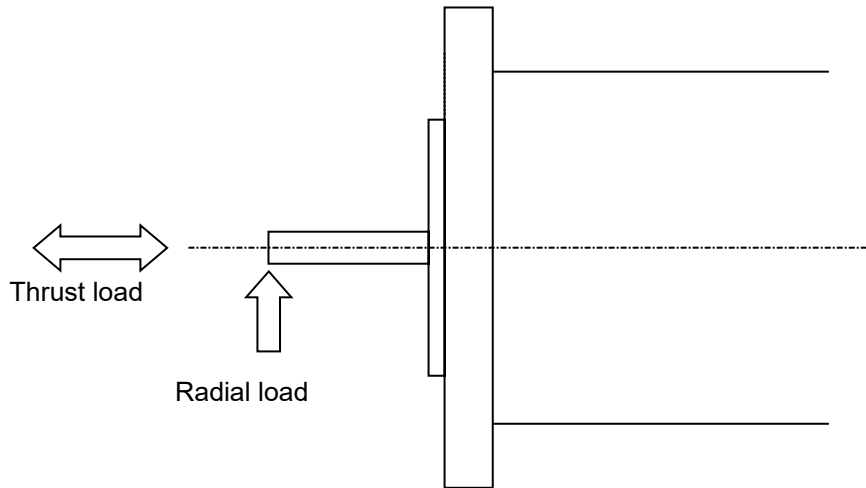


Figure 2.6 Position for the radial load

## 2. Installation

---

### 2.3 Cable Installation

- Be careful not to apply stress or damage to the cable.
- When installing a motor in a moving part, be careful not to apply excessive stress to the cable. A bending radius of at least 8 times the cable diameter is recommended.
- Pass the cable through a location where the outer sheath of the cable will not be damaged by sharp cutting debris.  
Also, make sure that the cable will not be placed in a location where it may come in contact with a corner of a machine or where a person or machine may step on the cable.
- Take measures such as clamp to machines so as not to apply flexion stress and own weight stress onto each connecting point of cables.
- When motor and cables need to be transferred with cableveyor (cable carrier), bending radius of cable shall be determined by referring required flexion life and wire type.
- Periodic replaceable structure for movable part of cable is recommended. Please contact us when you would like to use recommended cables for movable parts.

# Wiring

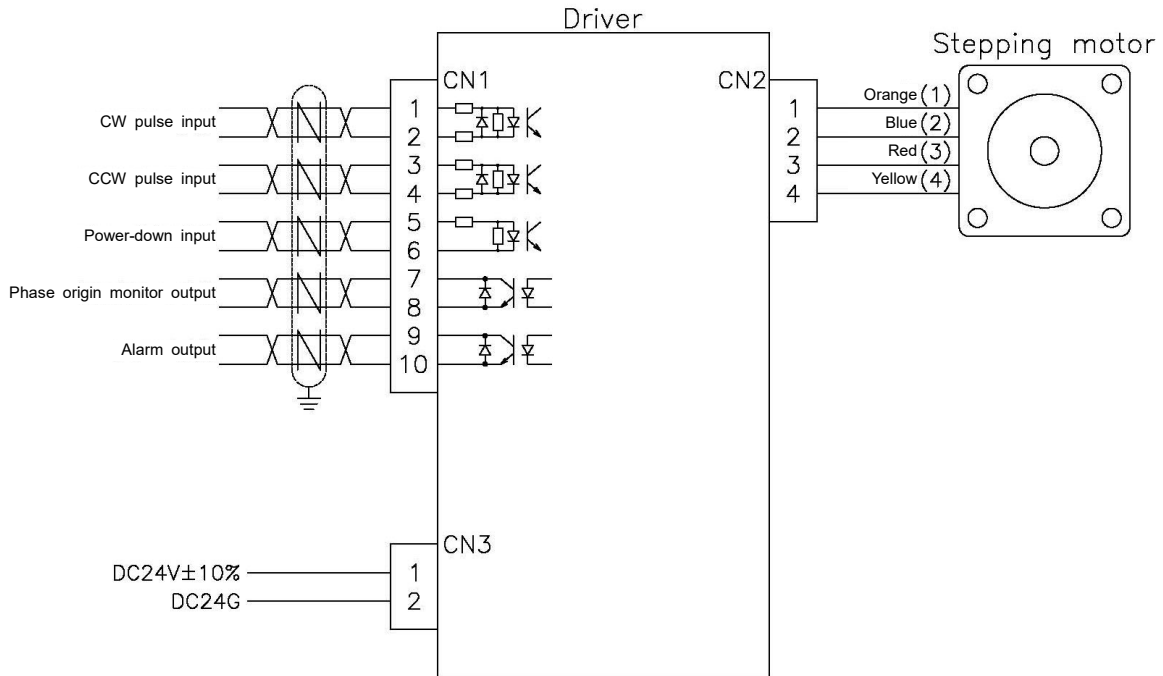
In this chapter, wiring between the driver, motor and peripherals are explained.

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<b>3.2 Connector Model Number, Applicable Wire .....</b>	<b>3-2</b>
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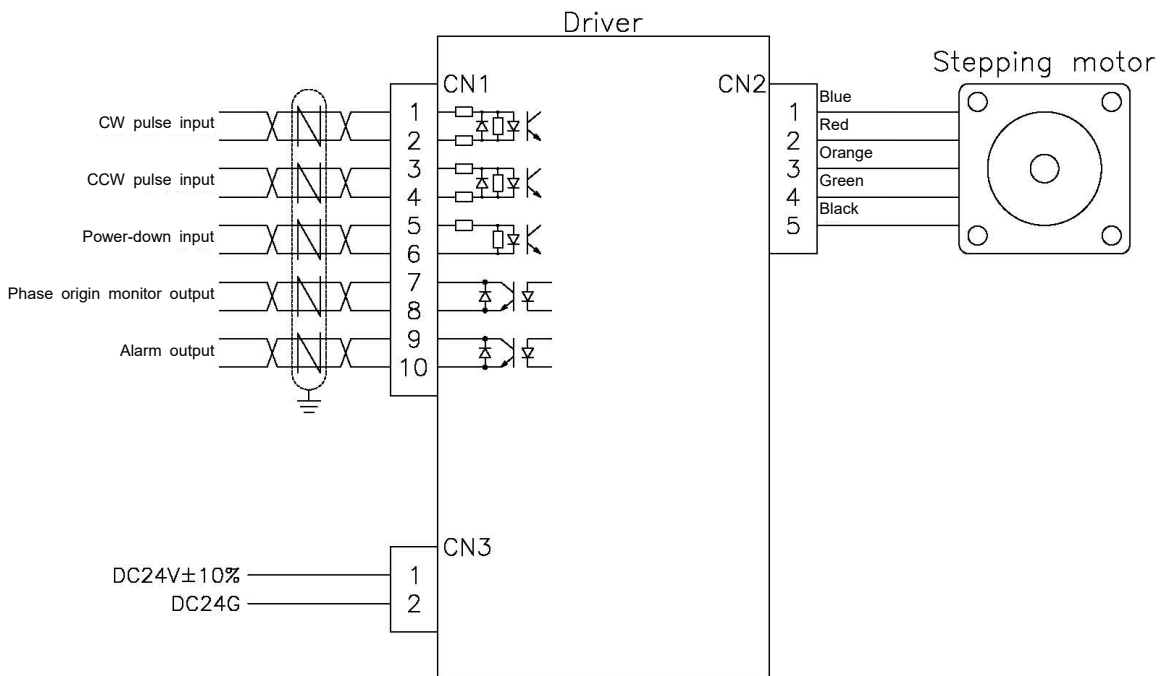
# 3. Wiring

## 3.1 External Wiring Diagram

- External wiring diagram of F2BED200P1□□



- External wiring diagram of F5PED140P1□□





## 3.2 Connector Model Number, Applicable Wire

### 3.2 Connector Model Number, Applicable Wire

Application	Symbol	Name	Model number	Applicable wire	Wiring length	Manufacturer
I/O	CN1	PCB header (Driver side)	533751010	In case ① is used AWG#22 to 24 Outer diameter 1.15 to 1.8 mm	2 m or less	Molex
		Housing ①	511031000			
		Contact ①	503518100	In case ② is used AWG#20 to 22 Outer diameter 1.5 to 1.8 mm		
		Housing ②	511631000			
		Contact ②	507528200			
Motor power	CN2	PCB header (Driver side)	533750410 (F2BED200P1□□) 533750510 (F5PED140P1□□)	In case ① is used AWG#22 Outer diameter 1.15 to 1.8 mm	10 m or less	Molex
		Housing ①	511030400 (F2BED200P1□□) 511030500 (F5PED140P1□□)			
		Contact ①	503518100	In case ② is used AWG#20 to 22 Outer diameter 1.5 to 1.8 mm		
		Housing ②	511630400 (F2BED200P1□□) 511630500 (F5PED140P1□□)			
		Contact ②	507528200			
Power supply	CN3	PCB header (Driver side)	533750210	In case ① is used AWG#22 Outer diameter 1.15 to 1.8 mm	3 m or less	Molex
		Housing ①	511030200			
		Contact ①	503518100	In case ② is used AWG#20 to 22 Outer diameter 1.5 to 1.8 mm		
		Housing ②	511630200			
		Contact ②	507528200			

- ✓ Refer to the manufacturer's catalog for connector specification details.
- ✓ Use the housing and contacts in a combination of ① or ②.

### 3.3 Connector Pin Assignments and Precautions

#### 3.3.1 Input/output signal connector (CN1)

Pin number	Symbol	Signal name
1	CW / CK	CW pulse input / Pulse train input
2		
3	CCW / U/D	CCW pulse input / Rotation direction input
4		
5	PD	Power-down input
6		
7	MON	Phase origin monitor output
8		
9	ALM	Alarm output
10		

## 3. Wiring

---

### 3.3.2 Connector for motor (CN2)

■ F2BED200P1□□

Pin number	Signal name
1	Phase A power (Orange)
2	Phase B power (Blue)
3	Phase C power (Red)
4	Phase D power (Yellow)

■ F5PED140P1□□

Pin number	Signal name
1	Phase A power (Blue)
2	Phase B power (Red)
3	Phase C power (Orange)
4	Phase D power (Green)
5	Phase E power (Black)

- ✓ Be sure to connect and disconnect power lines at least 1 minute after the power supply is cut off. If the power line is plugged or unplugged while the power is active, the driver may be damaged.

### 3.3.3 Connector for power supply (CN3)

Pin number	Signal name
1	DC24V
2	DC24G

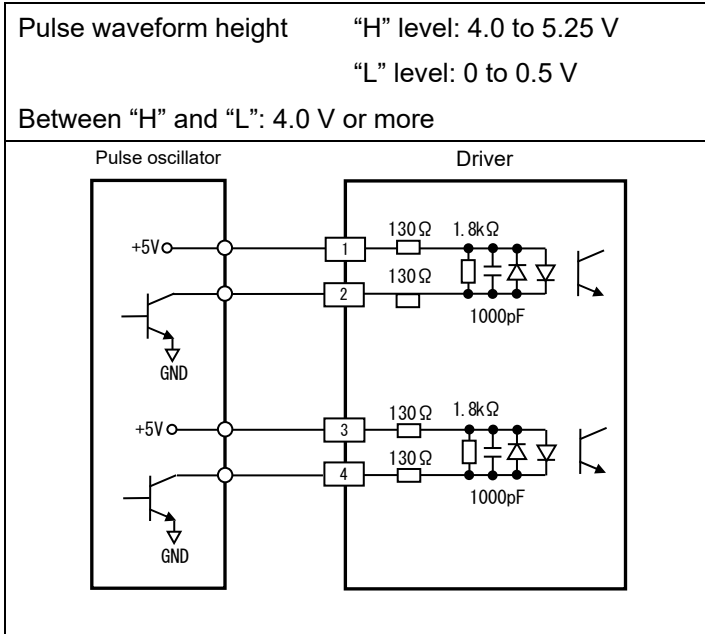
- ✓ Do not route power cables, motor power cables, and I/O cables in the same duct.
- ✓ Be sure to connect and disconnect power lines at least 1 minute after the power supply is cut off. If the power line is plugged or unplugged while the power is active, the driver may be damaged.

# 3.4 Input/output Signals

## 3.4 Input/output Signals

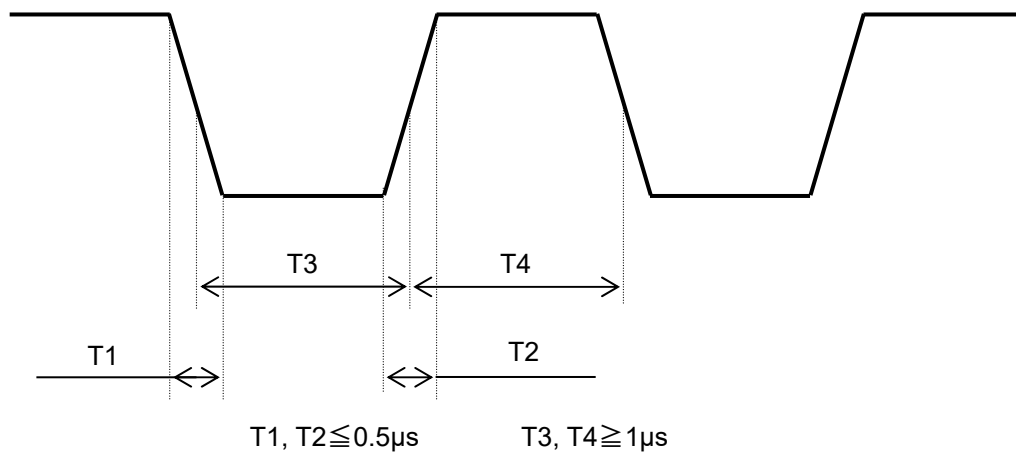
### 3.4.1 Command pulse input

■ Connection example



■ Pulse waveform

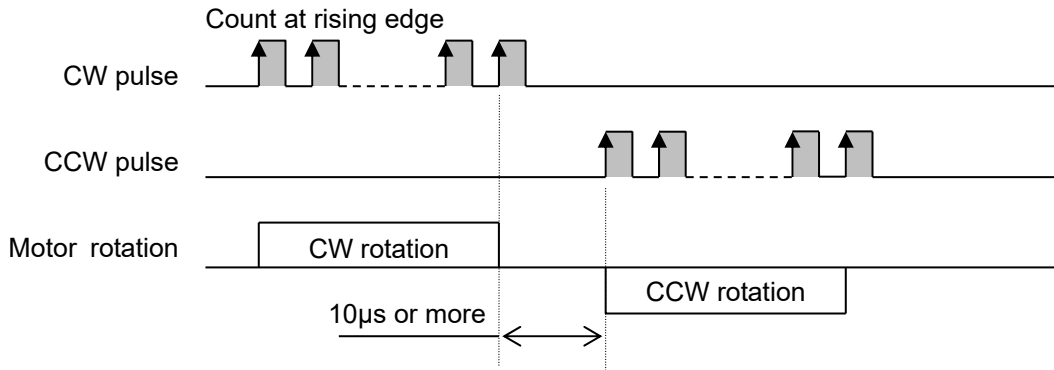
Maximum response frequency: 400kpulse/s



- ✓ Pulse duty should be 50% or less.
- ✓ Note that if the number of step divisions is high due to the limitation of the maximum response frequency, operation at the maximum rotation speed is not possible.

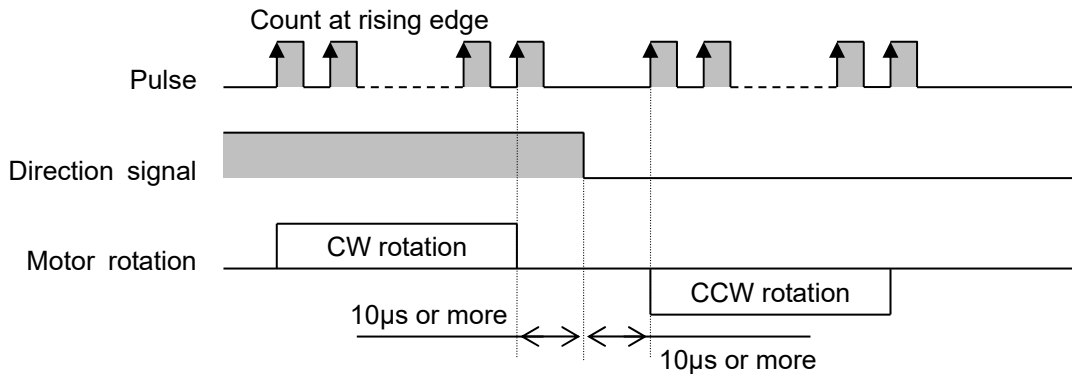
# 3. Wiring

- Timing chart
- ◆ 2-input mode



- ✓ indicates "photo coupler is ON".
- ✓ CW rotation is clockwise rotation viewed from the motor flange surface, and CCW rotation is counterclockwise rotation viewed from the motor flange surface.
- ✓ Do not input CW pulse and CCW pulse at the same time.
- ✓ Turn off the photocoupler on the side that does not input pulses.
- ✓ The switching time of CW pulse/CCW pulse "10µs or more" is the operation time of the internal circuit of the driver, not the time for the motor to respond. In actual operation, set the time when the motor can respond.
- ✓ Use DIP switch F/R to switch between 1-input and 2-input mode.

- ◆ 1-input mode (Rising edge operation)

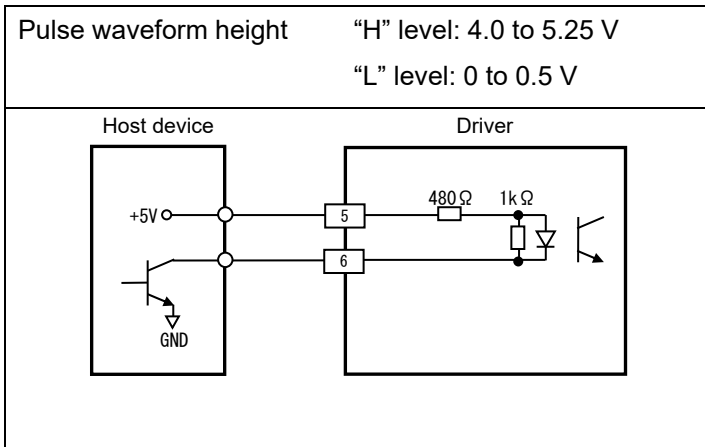


- ✓ indicates "photo coupler is ON".
- ✓ CW rotation is clockwise rotation viewed from the motor flange surface, and CCW rotation is counterclockwise rotation viewed from the motor flange surface.
- ✓ The switching time of CW pulse/CCW pulse "10µs or more" is the operation time of the internal circuit of the driver, not the time for the motor to respond. In actual operation, set the time when the motor can respond.
- ✓ Use DIP switch F/R to switch between 1-input and 2-input mode.

# 3.4 Input/output Signals

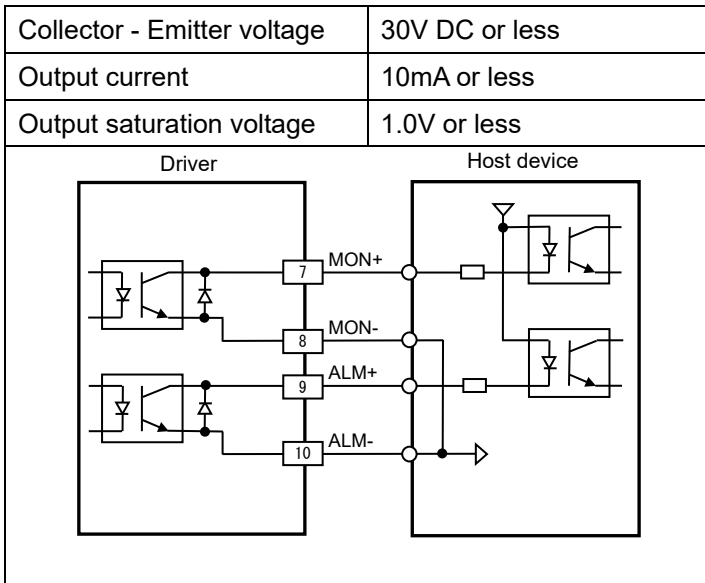
## 3.4.2 Input signals (PD)

■ Connection example



## 3.4.3 Output signals (MON, ALM)

■ Connection example



## 3. Wiring

### 3.4.4 I/O signals brief specification

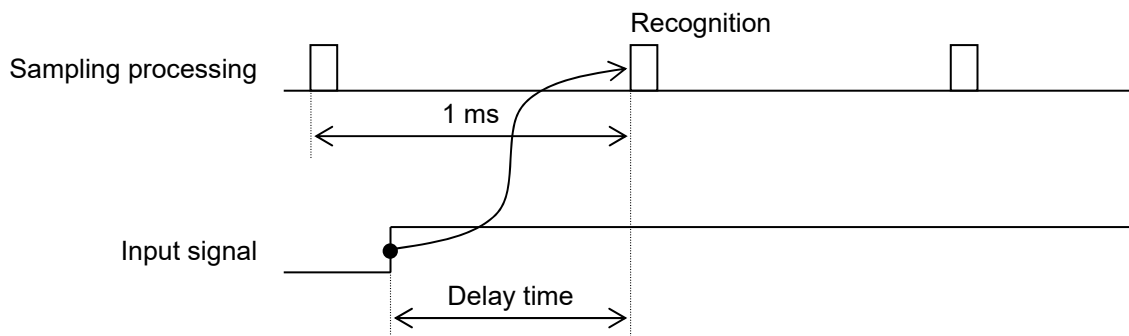
Pin number	Symbol	Signal name	Description
1 2	CW	CW pulse input (DSW-F/R: OFF)	2-input mode Inputs the pulse for CW rotation.
1 2	CK	Pulse train input (DSW-F/R: ON)	1-input mode Inputs the pulse train for motor rotation.
3 4	CCW	CCW pulse input (DSW-F/R: OFF)	2-input mode Inputs the pulse for CCW rotation.
3 4	U/D	Direction signal input (DSW-F/R: ON)	1-input mode Inputs the rotation direction signal of stepping motor. Photo coupler: ON ... CW direction Photo coupler: OFF ... CCW direction
5 6	PD	Power-down input	Shuts off the motor current.
7 8	MON	Phase origin monitor output	Turns ON when the excitation phase is at the origin.
9 10	ALM	Alarm output	Turns ON when an alarm occurs. In this case, the motor is de-energized.

## 3.5 Electronic Characteristics of I/O Signal Circuit

### 3.5 Electronic Characteristics of I/O Signal Circuit

#### 3.5.1 Delay time by sampling period

Each input signal is subject to a delay of up to 1 ms from the actual signal input until the driver recognizes it, depending on the sampling period of the driver. Determine the control timing, taking the delay time in advance.



### 3.6 Wiring Method

The driver is a control device that processes signals of several mV or less. Therefore, the following items should be observed in the wiring.

#### ■ Input signal line

Use twisted wires or multi-core twisted batch shielded wires for input signal lines.

Also, the following points should be taken into consideration when wiring.

- ✓ Perform shortest wiring distance.
- ✓ Separate the main circuit line from the signal circuit line.
- ✓ Do not route the main circuit line to the side of the driver or near other drivers.

#### ■ Processing to prevent malfunctions due to noise

To prevent malfunctions due to noise, the following points should be considered.

- ✓ Place noise filters, drivers, and host controllers at a short distance from each other.
- ✓ Must install surge absorbing circuits in the coils of relays, electromagnetic contactors, induction motors, brake solenoids, etc.
- ✓ Do not run main circuits and signal lines in the same duct or overlap them.
- ✓ When large noise sources such as electric welding machines, electric discharge machines, etc. are nearby, insert noise filters in the power supply and input circuits.
- ✓ Do not bundle the primary and secondary wiring of the noise filter.

## 3. Wiring

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### 3.7 Grounding

#### 3.7.1 Grounding the driver

- The frame of the driver must be grounded. When using an electric wire, use AWG16 (1.25 mm<sup>2</sup>) or more and single point grounding.

#### 3.7.2 Grounding the motor

- If the motor is grounded to ground through the frame on the machine side,  $C_f \times dv/dt$  current flows from the PWM control power section of the driver through the motor stray capacitance ( $C_f$ ). To prevent the effect of this current, mount the motor frame on a metal surface grounded to the power supply ground, or ground the motor ground terminal at a single point together with the driver ground.
- Use a motor ground wire of AWG18 (0.75mm<sup>2</sup>) or larger.
- If the motor wiring is in a metal conduit or metal box, be sure to ground the metal part. Grounding should be done at a single point.



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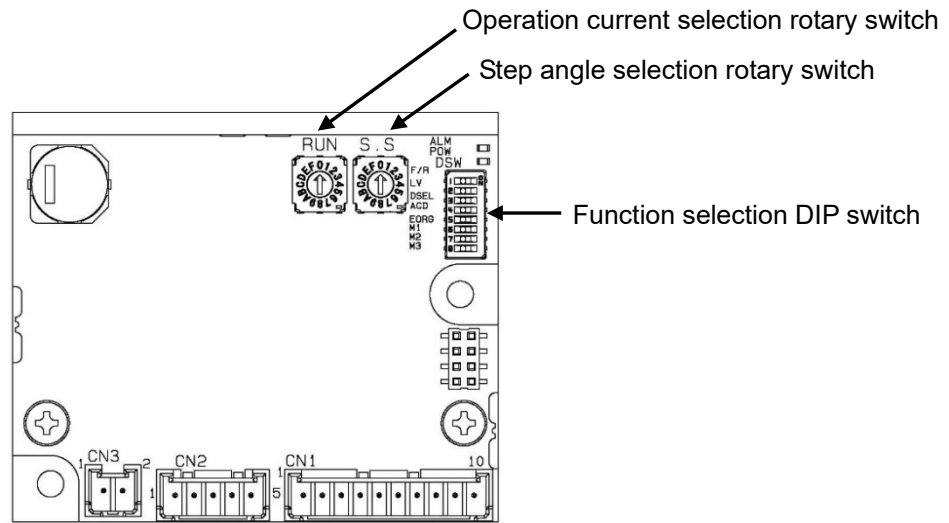
# Setting

In this chapter, switch settings are explained.

<b>4.1 Switch Setting</b> .....	<b>4-1</b>
4.1.1 Function selection DIP switch (DSW).....	4-1
4.1.2 Operation current selection rotary switch (RUN).....	4-4
4.1.3 Step angle selection rotary switch (S.S).....	4-4

# 4. Setting

## 4.1 Switch Setting



### 4.1.1 Function selection DIP switch (DSW)

Selects a function that matches the specifications of the equipment.

DIP switch settings must be made with the power off. Settings cannot be changed after the power is turned on.

SW No.	Symbol	Function	Initial setting
1	F/R	Pulse input method selection	OFF
2	LV	Low vibration mode selection	ON
3	DSEL	Step division number mode selection	OFF
4	ACD	Auto current down selection	ON
5	EORG	Excitation selection	OFF
6	M1	Motor selection	OFF
7	M2		OFF
8	M3		OFF

- Pulse input method selection

Selects the pulse input method.

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

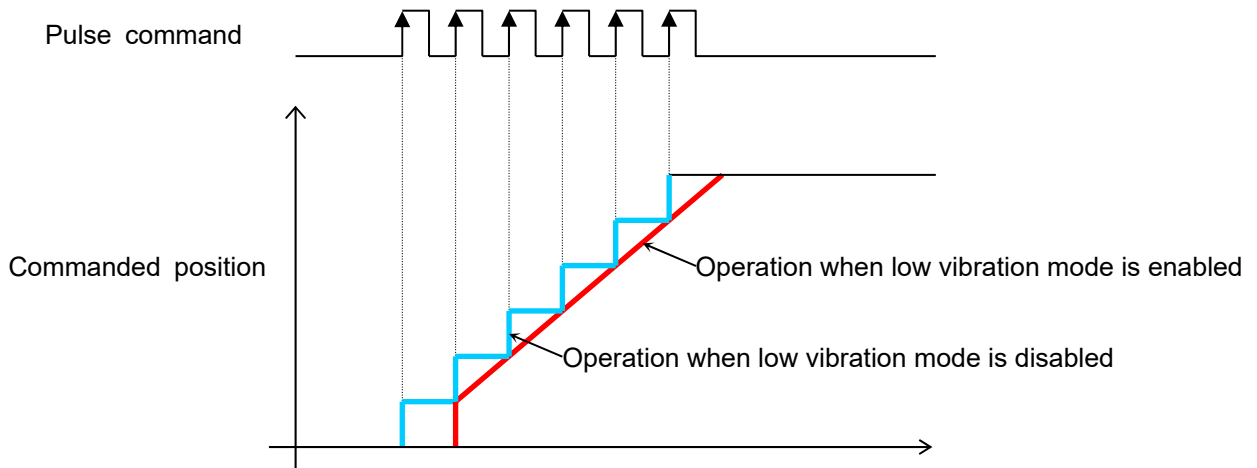
## 4.1 Switch Setting

### ■ Low vibration mode selection

When low vibration mode is selected, smooth operation with low vibration can be performed even with coarse step division settings.

LV	Description
OFF	Low vibration mode disabled
ON	Low vibration mode enabled

- ✓ In the low vibration mode, the driver performs arithmetic processing of drive pulses internally. Therefore, the motor movement is delayed by one pulse relative to the input pulse.



### ■ Step division number mode selection

Selects the mode for the number of step divisions.

DSEL	Mode		Description
	F2BED200P1□□	F5PED140P1□□	
OFF	2-phase mode	5-phase mode	2-phase mode: Available with 2-phase command resolution. Command resolution: 200 to 51,200 P/R Basic step angle: 1.8°
ON	5-phase mode	2-phase mode	5-phase mode: Available with 5-phase command resolution. Command resolution: 500 to 125,000 P/R Basic step angle: 0.72°

### ■ Auto current down selection

Selects the current at stop.

ACD	Current at stop
OFF	100% of operating current
ON	50% of operating current

### ◆ Auto current down function

This function reduces the motor current at standstill (200 ms after the last pulse is applied) to 50% of the operating current setting.

This function is effective in suppressing heat generation and reducing current consumption of the motor and driver.

## 4. Setting

### ■ Excitation selection

The excitation phase at power-on can be selected.

EORG	Excitation phase at power-on
OFF	Excitation origin
ON	Excitation phase at power-off

### ■ Motor selection

Selects the motor to be used in combination with the driver.

#### ◆ F2BED200P1□□

M1	M2	M3	Motor size	Motor model number
OFF	OFF	OFF	—	Reserved
ON	OFF	OFF	42 mm sq.	SH1421-52□1
OFF	ON	OFF	42 mm sq. 56 mm sq. 60 mm sq.	SH1422-52□1, SH1424-52□1 SM2561C20B□1 SH1601-52□0
ON	ON	OFF	56 mm sq. 60 mm sq.	SM2562C20B□1 SH1602-52□0
OFF	OFF	ON	56 mm sq. 60 mm sq.	SM2563C20B□1 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

#### ◆ F5PED140P1□□

M1	M2	M3	Winding rating 0.75A/phase motor (Note)		Winding rating 1.4A/phase motor	
			Motor size	Motor model number	Motor size	Motor model number
OFF	OFF	OFF	28 mm sq.	SH5281-72□1 SH5285-72□1	42 mm sq.	SF5421-82□1
ON	OFF	OFF	—	Reserved	42 mm sq.	SF5422-82□1
OFF	ON	OFF	—	Reserved	42 mm sq.	SF5423-82□1
ON	ON	OFF	—	Reserved	60 mm sq.	SM5601-82□1
OFF	OFF	ON	—	Reserved	60 mm sq.	SM5602-82□1
ON	OFF	ON	—	Reserved	60 mm sq. 86 mm sq.	SM5603-82□1 SM5861-82□1
OFF	ON	ON	—	Reserved	86 mm sq.	SM5862-82□1
ON	ON	ON	—	Reserved	—	Reserved

Note) When using a 0.75A/phase motor, be sure to set the operating current selection rotary switch (RUN) to 50% or less.

Use of a setting higher than 50% may cause the motor to overheat and burn out.

# 4.1 Switch Setting

## 4.1.2 Operation current selection rotary switch (RUN)

Selects a function that matches the specifications of the equipment.

Initial value: 0 (100%)

RUN set value	0	1	2	3	4	5	6	7
Motor current [%]	100	95	90	85	80	75	70	65
RUN set value	8	9	A	B	C	D	E	F
Motor current [%]	60	55	50	45	40	35	30	25

Note) F2BED200P1□□: 0 (100%) is 2A / phase setting.

F5PED140P1□□: 0 (100%) is 1.4A / phase setting.

If there is enough torque margin, lowering the operating current is effective in reducing heat generation and vibration of the motor.

The output torque of a motor is almost proportional to the current.

When adjusting the operating current, check the operating margin sufficiently before determining the motor current value.

## 4.1.3 Step angle selection rotary switch (S.S)

Sets the number of steps per motor revolution.

2-phase mode and 5-phase mode can be switched by the step division number mode selection of the function selection DIP switch (DSW). Refer to the section "4.1.1 Function Selection DIP Switch" for the step division number mode.

### ◆ Step division number mode: 2-phase mode setting

Initial value: 1 (400 P/R)

S.S set value	0	1	2	3	4	5	6	7
Resolution [P/R]	200 Full-step	400 Half-step	800	1,000	1,600	2,000	3,200	5,000
S.S set value	8	9	A	B	C	D	E	F
Resolution [P/R]	6,400	10,000	12,800	20,000	25,000	25,600	50,000	51,200

### ◆ Step division number mode: 5-phase mode setting

Initial value: 1 (1000 P/R)

S.S set value	0	1	2	3	4	5	6	7
Resolution [P/R]	500 Full-step	1,000 Half-step	1,250	2,000	2,500	4,000	5,000	10,000
S.S set value	8	9	A	B	C	D	E	F
Resolution [P/R]	12,500	20,000	25,000	40,000	50,000	62,500	100,000	125,000

Note) The resolution of a 2-phase motor with a basic step angle of 0.9° is twice that of a 2-phase motor with a basic step angle of 1.8°.

Example) Step division number mode: When 2-phase mode is set and S.S set value is 1, resolution of 2-phase motor with basic step angle of 0.9°:  $400 \times 2 = 800\text{P/R}$

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# Functions

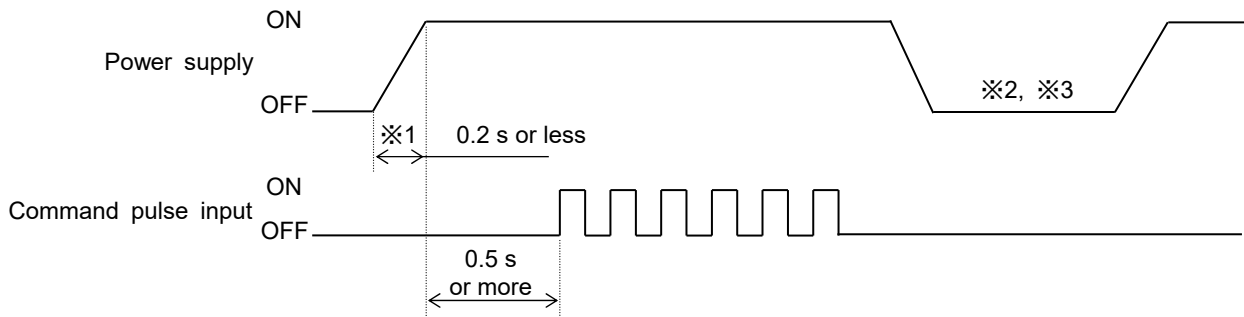
In this chapter, the operation sequence, I/O signal functions, and display functions are explained.

<b>5.1 Operation Sequence</b> .....	<b>5-1</b>
<b>5.2 Input Signal Function</b> .....	<b>5-2</b>
5.2.1 Power down input (PD) .....	5-2
<b>5.3 Output Signal Function</b> .....	<b>5-3</b>
5.3.1 Phase origin monitor output (MON).....	5-3
5.3.2 Alarm output (ALM) .....	5-3
<b>5.4 Display Functions</b> .....	<b>5-4</b>
5.4.1 Power supply display LED (POW).....	5-4
5.4.2 Alarm/warning display LED (ALM).....	5-4

# 5. Functions

## 5.1 Operation Sequence

### ■ Power On/Off



$\times 1$  The time until the power supply voltage is established should be within 0.2 seconds.

$\times 2$  Power should be turned on again at least 5 seconds after power is shut off.

$\times 3$  Power-on/off should be performed 5 times/h or less, 30 times/day or less.



## 5.2 Input Signal Function

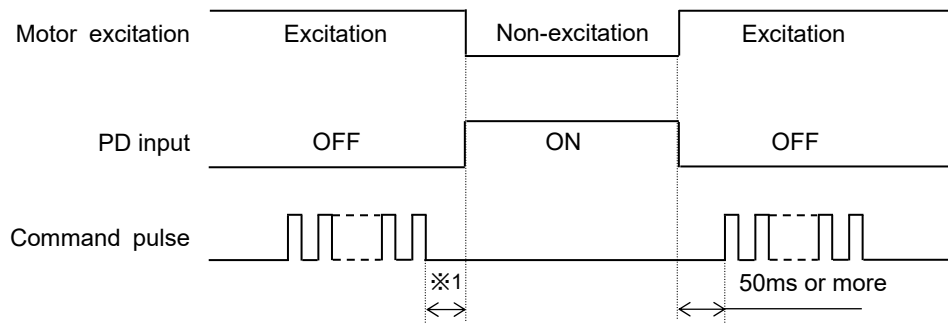
### 5.2 Input Signal Function

#### 5.2.1 Power down input (PD)

■ Function

Shuts off the motor current.

■ Timing chart (Power down)



※1 The PD signal should be input with the motor in a settled state.

# 5. Functions

## 5.3 Output Signal Function

### 5.3.1 Phase origin monitor output (MON)

■ Function

The excitation origin is output.

A signal of 50 P/R including the initial excitation position is output.

◆ Step division number mode: 2-phase mode

In full-step mode, the photocoupler turns ON once every 4 pulses.

In half-step mode, the photocoupler turns ON once every 8 pulses.

◆ Step division number mode: 5-phase mode

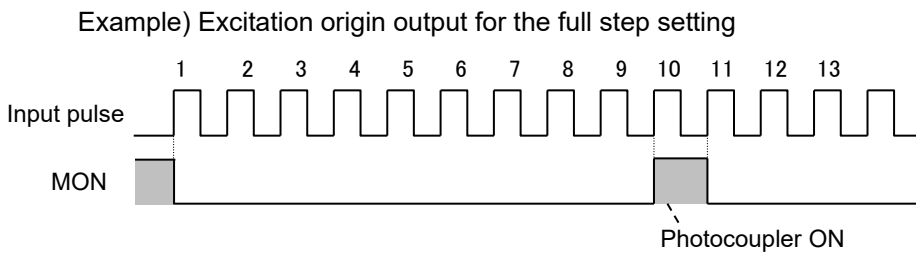
In full-step mode, the photocoupler turns ON once every 10 pulses.

In half-step mode, the photocoupler turns ON once every 20 pulses.

Note that if the motor rotation speed is  $60\text{min}^{-1}$  or higher, the signal width will be shortened and will not be output correctly.

(In the case of 5-phase:  $60\text{min}^{-1} = 500\text{pps}$  input pulse at full step 500P/R)

■ Timing chart



### 5.3.2 Alarm output (ALM)

■ Function

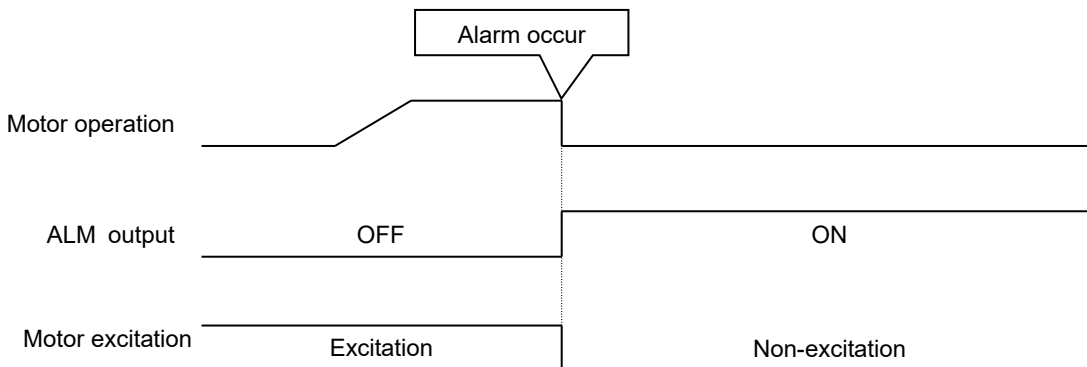
This signal indicates the alarm status. The photocoupler turns ON during an alarm. (Normally open)

When an alarm occurs, the motor is de-energized.

Identify the alarm from the number of times the alarm/warning display LED blinks, remove the cause, and then reconnect the power.

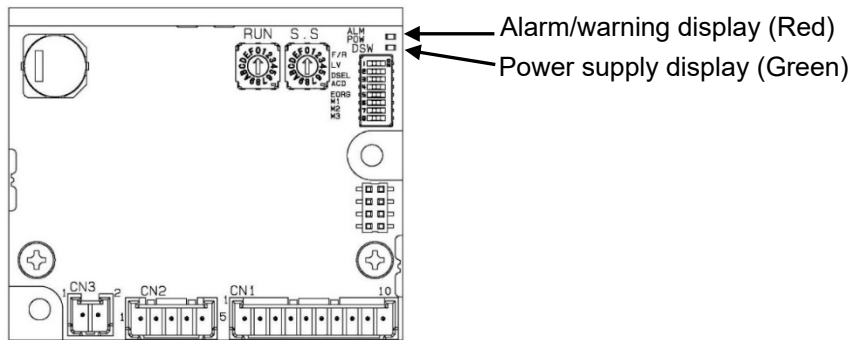
For details of the alarm, refer to "6.2 Troubleshooting in case of alarm".

■ Timing chart



# 5.4 Display Functions

## 5.4 Display Functions



### 5.4.1 Power supply display LED (POW)

■ Function

POW is lighting	Both main circuit power and internal control power are established. Motor excitation possible.
POW is not lighting	Main circuit power supply or internal control power supply not established. Motor excitation not possible.

### 5.4.2 Alarm/warning display LED (ALM)

■ Function

Flashes when an alarm or warning occurs.

In case of an alarm, the motor stops and becomes de-energized.

In case of a warning, there is no effect on motor operation.

For details, refer to "6.2 Troubleshooting in case of alarm".

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## Maintenance

In this chapter, troubleshooting and inspection are explained.

<b>6.1 Troubleshooting</b> .....	<b>6-1</b>
<b>6.2 Troubleshooting in Case of Alarm</b> .....	<b>6-2</b>
6.2.1 List of Alarms and Warnings.....	6-2
<b>6.3 Inspection</b> .....	<b>6-4</b>
<b>6.4 Maintenance parts</b> .....	<b>6-4</b>

# 6. Maintenance

## 6.1 Troubleshooting

If the motor cannot be operated properly without an alarm, refer to the following items to investigate the cause and corrective action. If an alarm is present, take the measures described in "6.2 Troubleshooting in case of alarm".

Table 6.1 Troubleshooting

Symptom	Check item	Action
Motor does not excite	Is the power ON? Check that the LED "POW" is lit.	Check the power supply line connections.
	Is the driver in alarm? Check if LED "ALM" is not blinking.	Identify the alarm from the number of flashes. (Refer the section "6.2 Troubleshooting in case of alarm".)
	Is there any mis-wiring?	Wire the unit correctly according to the external wiring diagram shown in the section 3.1.
	Is the power-down signal input?	Cancel the power-down signal of the host side.
Motor does not rotate	Are the input/output signal lines mis wired?	Wire the unit correctly according to the external wiring diagram shown in the section 3.1.
	Does the input command pulse conform to the specifications?	Check the section "3.4.1 Command pulse input".
	For the 2-input system, is the input signal logic correct?	
	For the 2-input system, are the CW and CCW signals input at the same time?	
	Does the pulse input method match the setting of the pulse input method selection switch?	Refer to the section "4.1.1 Function selection DIP switch" for correct setting.
	For motors with holding brake, is the brake released?	Check the holding brake specifications and release the brake.
Motor does not rotate in the correct direction	Are the motor power lines mis wired?	Wire the unit correctly according to the external wiring diagram shown in the section 3.1.
	For the 2-input system, are the CW and CCW signals connected in reverse?	
	For the 1-input system, is there any error in the logic of the motor rotation direction command?	Check the section "3.4.1 Command pulse input".
Motor does not run properly	Is the motor shaft centered with the load shaft?	Align the motor shaft with the load shaft.
	Is the travel-amount too small or too large?	Refer to the section "4.1.3 Step angle selection rotary switch" for correct setting.
Motor is out of step	Are you using the wrong combination motor?	Refer to the section "4.1.1 Function selection DIP switch" for correct setting.
	Is there an overload?	Check for any abnormality on the load side.
	Is the command pulse input correctly?	Check the command input on the host side.
	Is the appropriate acceleration/deceleration set?	Excessive rapid acceleration or deceleration may cause step out. Set an appropriate acceleration/deceleration.

# 6.2 Troubleshooting in Case of Alarm

## 6.2 Troubleshooting in Case of Alarm

If a system error occurs, it will be into alarm condition.

In the alarm state, the alarm/warning indicator LED (ALM) blinks, the motor winding current is cut off, and the motor becomes de-energized.

At the same time, an external signal is output from the alarm output terminal of the I/O signal connector (CN1).

If an alarm occurs, refer to the section "6.2.1 List of Alarms and Warnings" and take appropriate recovery measures.

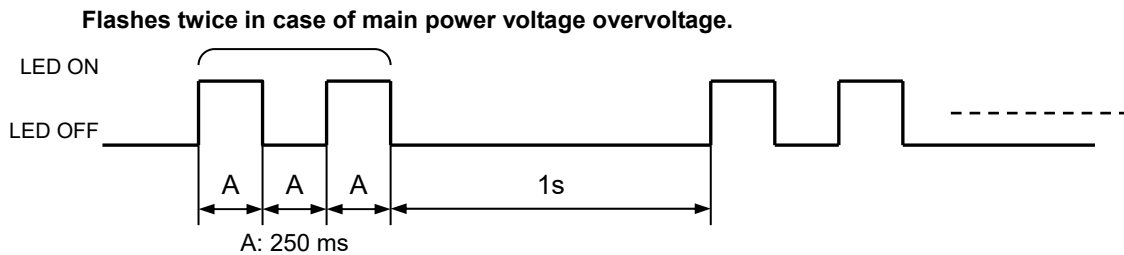
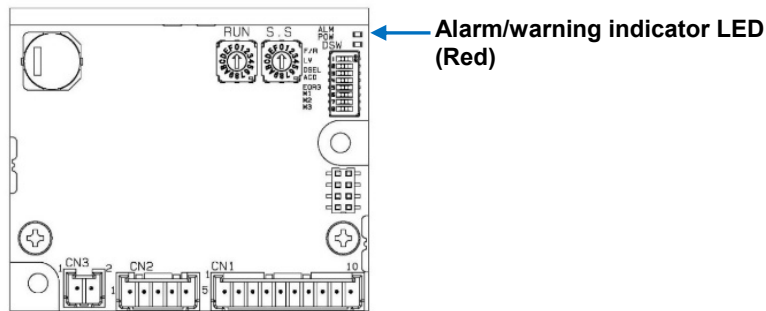
Also, it is possible to narrow down the cause of the alarm by confirming the occurrence status of the problem (during operation, when the power is turned on, etc.).

Be sure to check the occurrence status (driver status, I/O signal status) and the contents of the alarm or failure to identify the cause.

In the case of a warning condition, the LED will be turned ON, but it will not affect motor operation.

### 6.2.1 List of Alarms and Warnings

In the event of an alarm, identify the contents of the alarm from the number of times the alarm/warning indicator LED blinks, remove the cause, and then reconnect the power.



## 6. Maintenance

Table 6.2 Alarm list

ALM blink count	Alarm content	Cause and Action
1	Main power supply voltage sag	<p>【Cause】 Input power supply voltage below the allowable value.</p> <p>【Action】 Check the input power supply voltage.</p>
2	Main power supply overvoltage	<p>【Cause】 Input power supply voltage exceeded the allowable value.</p> <p>【Action】 Check the input power supply voltage.</p>
		<p>【Cause】 The inertial load is too large.</p> <p>【Action】 If the alarm occurs during operation, lighten the load or lengthen the acceleration/deceleration time.</p>
3	Driver overheat error	<p>【Cause】 The temperature inside the driver exceeded +80°C (warning: +75°C).</p> <p>【Action】 Review the driver installation method and ventilation conditions.</p> <p>If the temperature on the side of the heat sink exceeds +70°C, take measures such as forced air cooling using a cooling fan.</p>
4	Overcurrent error	<p>【Cause】 Excessive current flowed in the output circuit for the motor.</p> <p>【Action】 Check if the motor, cable, or driver is damaged.</p>
5	Nonvolatile memory checksum error	<p>【Cause】 Data error or access error of nonvolatile memory</p> <p>【Action】 Contact the dealer where you purchased the product.</p>
6	Hardware error	<p>【Cause】 Driver hardware error</p> <p>【Action】 Check that there are no problems with the power supply voltage or wiring, and contact the dealer where you purchased the product.</p>
7	Motor disconnection	<p>【Cause】 Motor power wire is disconnected.</p> <p>【Action】 Check the wiring of the motor power line.</p>
9	Command velocity error	<p>【Cause】 Excessive command velocity pulses were input.</p> <p>【Action】 Check the command profile or the wiring of command pulse input.</p>

Table 6.3 Warning list

ALM blink count	Warning content	Cause and Action
1	Main power supply voltage sag warning	<p>【Cause】 Input power supply voltage below the allowable value.</p> <p>【Action】 Check the input power supply voltage.</p>
2	Main power supply overvoltage warning	<p>【Cause】 Input power supply voltage exceeded the allowable value.</p> <p>【Action】 Check the input power supply voltage.</p>
		<p>【Cause】 The inertial load is too large.</p> <p>【Action】 If the alarm occurs during operation, lighten the load or lengthen the acceleration/deceleration time.</p>
3	Driver overheat error warning	<p>【Cause】 The temperature inside the driver exceeded +75°C.</p> <p>【Action】 Review the driver installation method and ventilation conditions.</p> <p>If the temperature on the side of the heat sink exceeds +70°C, take measures such as forced air cooling using a cooling fan.</p>



## 6.3 Inspection

### 6.3 Inspection

Since drivers and stepping motors do not use wear parts, simple daily inspections are sufficient for maintenance.

Perform the inspection with refer below.

Inspection location	Inspection conditions			Inspection Items	Inspection methods	Measures in case of abnormality
	Time	While operating	While stopping			
Stepping motor	Daily	✓		Vibration	Is the vibration louder than normal?	Please contact our company.
	Daily	✓		Sound	Is there any abnormal noise compared to normal?	
	Periodic		✓	Cleaning	Are there any dirt or dust on the exterior?	Clean with cloth or air blow. Note 1)
Driver	Periodic		✓	Cleaning	Are there any dust deposits on the equipped parts?	Clean with air blow. Note 1)
Temperature	Periodic	✓		Temperature measurement	Ambient temperature Motor frame temperature	Keep the ambient temperature within the specification range. Review the load conditions.

Note 1) Make sure that there is no oil, moisture, etc. in the air blow before cleaning.

### 6.4 Maintenance parts

Parts may deteriorate over time. Periodic inspections should be performed for preventive maintenance.

No.	Parts name	Standard replacement guideline	Corrective measures, usage conditions
1	Electrolytic capacitor	10 years	Must be replaced with a new one. Usage conditions: Average year-round temperature of 40°C
2	Fuse	10 years	Must be replaced with a new one.

#### ■ Electrolytic capacitor

- ◆ If the driver has been stored for more than 3 years, please contact us for inspection and maintenance.
- ◆ If the driver is used at an average temperature of 40°C or higher throughout the year, the capacitor should be replaced with a new one earlier than the standard replacement period of 10 years.
- ◆ If the driver is used in an application where the power is turned on and off more than 30 times/day or 5 times/hour, the electrolytic capacitor may be lowered in capacity and should be replaced with early timing.

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# Basic Specifications

In this chapter, basic specifications are explained.

<b>7.1 Basic Specifications</b> .....	<b>7-1</b>
7.1.1 Driver basic specifications .....	7-1
7.1.2 Motor basic specifications .....	7-2
<b>7.2 Outline Drawings</b> .....	<b>7-6</b>
7.2.1 Driver outline drawings .....	7-6
7.2.2 Motor outline drawings .....	7-7

# 7. Basic Specifications

## 7.1 Basic Specifications

### 7.1.1 Driver basic specifications

Driver model number		F2BED200P1□□ / F5PED140P1□□
Input power supply		Voltage: 24 VDC±10%, Current: 2 A
Environment	Protection class	Class III
	Operating environment	Installation category (Over-voltage category): I , Pollution level: 2
	Operating ambient temperature (Note)	0 to +50 °C
	Storage temperature	-20 to +70 °C
	Operating ambient humidity	90 %RH or less (non-condensing)
	Storage humidity	90 %RH or less (non-condensing)
	Operating elevation	Below 1,000m above sea level
	Vibration	5 m/s <sup>2</sup> , when tested X, Y and Z directions for 2 hours in the frequency range between 10 to 55Hz.
	Shock	20 m/s <sup>2</sup>
	Dielectric withstanding voltage	700 VDC, 1 minute (between power input terminal and housing)
	Insulation resistance	500 VDC, 10MΩ or more (between power input terminal and housing)
Mass		0.06 kg
Functions	Selective function	Pulse input method (1-input mode/2-input mode), Low vibration mode (enable/disable), Auto current down (enable/disable), Step division number mode (2-phase mode/5-phase mode), Initial excitation phase (excitation origin/excitation phase at last power off), Motor selection, Operating current (100 to 25%), Step angle (2-phase mode: 200 to 51200 P/R, 5-phase mode: 500 to 125000 P/R)
	Protective function	Power supply voltage error, Overheat detection, Overcurrent protection, Nonvolatile memory checksum error, Hardware error, Motor disconnection detection, Command velocity error
	LED display	Power supply display, Alarm/warning display
Input/output signals	Command pulse input signal	Photo coupler input type Input resistance 260 Ω, Input voltage "H" level:4.0 to 5.25 V, "L" level: 0 to 0.5 V ✓ Voltage between "H" level and "L" level is 4.0 V or more Maximum input frequency 400kpulse/s
	Power down signal	Photo coupler input type Input resistance 480 Ω Input voltage "H" level:4.0 to 5.25 V, "L" level: 0 to 0.5 V
	Phase origin monitor output signal, Alarm output signal	Open collector output with photocoupler Output signal standard :     Collector-emitter voltage: 30 VDC or less Output current: 10 mA or less Output saturation voltage: 1.0 V or less

Note) If the temperature of the heat sink exceeds +70°C, take measures such as forced air cooling using a cooling fan.

# 7.1 Basic Specifications

## 7.1.2 Motor basic specifications

### ■ 2-phase motor standard characteristics

Motor model number	Single shaft	SH1421-5241	SH1422-5241	SH1424-5241
	Dual shaft	SH1421-5211	SH1422-5211	SH1424-5211
Holding torque	N·m	0.23	0.34	0.48
Rotor inertia	$\times 10^{-4} \text{kg} \cdot \text{m}^2$	0.044	0.066	0.089
Motor mass	kg	0.24	0.29	0.38
Allowable thrust load	N	10	10	10
Allowable radial load	N	25	24	20

Motor model number	Single shaft	SM2561C20B41	SM2562C20B41	SM2563C20B41	SM2564C20B41
	Dual shaft	SM2561C20B11	SM2562C20B11	SM2563C20B11	SM2564C20B11
Holding torque	N·m	0.75	1.4	2.35	2.5
Rotor inertia	$\times 10^{-4} \text{kg} \cdot \text{m}^2$	0.14	0.28	0.5	0.6
Motor mass	kg	0.49	0.69	1.1	1.27
Allowable thrust load	N	20	20	20	20
Allowable radial load	N	113	102	78	70

Motor model number	Single shaft	SH1601-5240	SH1602-5240	SH1603-5240
	Dual shaft	SH1601-5210	SH1602-5210	SH1603-5210
Holding torque	N·m	0.69	1.28	2.15
Rotor inertia	$\times 10^{-4} \text{kg} \cdot \text{m}^2$	0.24	0.4	0.75
Motor mass	kg	0.55	0.8	1.2
Allowable thrust load	N	15	15	15
Allowable radial load	N	78	65	83

Motor model number	Single shaft	SH2861-5041	SH2862-5041
	Dual shaft	SH2861-5011	SH2862-5011
Holding torque	N·m	3.3	6.4
Rotor inertia	$\times 10^{-4} \text{kg} \cdot \text{m}^2$	1.48	3.0
Motor mass	kg	1.75	2.9
Allowable thrust load	N	60	60
Allowable radial load	N	200	200

# 7. Basic Specifications

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## ■ 5-phase motor standard characteristics

Motor model number	Single shaft	SH5281-7241	SH5285-7241
	Dual shaft	SH5281-7211	SH5285-7211
Holding torque	N·m	0.041	0.078
Rotor inertia	$\times 10^{-4} \text{kg}\cdot\text{m}^2$	0.01	0.022
Motor mass	kg	0.11	0.2
Allowable thrust load	N	3	3
Allowable radial load	N	42	49

Motor model number	Single shaft	SF5421-8241	SF5422-8241	SF5423-8241
	Dual shaft	SF5421-8211	SF5422-8211	SF5423-8211
Holding torque	N·m	0.125	0.185	0.245
Rotor inertia	$\times 10^{-4} \text{kg}\cdot\text{m}^2$	0.028	0.045	0.056
Motor mass	kg	0.24	0.31	0.38
Allowable thrust load	N	10	10	10
Allowable radial load	N	56	54	52

Motor model number	Single shaft	SM5601-8241	SM5602-8241	SM5603-8241
	Dual shaft	SM5601-8211	SM5602-8211	SM5603-8211
Holding torque	N·m	0.57	0.9	1.7
Rotor inertia	$\times 10^{-4} \text{kg}\cdot\text{m}^2$	0.2	0.31	0.6
Motor mass	kg	0.62	0.8	1.27
Allowable thrust load	N	20	20	20
Allowable radial load	N	191	183	170

Motor model number	Single shaft	SM5861-8241	SM5862-8241
	Dual shaft	SM5861-8211	SM5862-8211
Holding torque	N·m	2.3	4.4
Rotor inertia	$\times 10^{-4} \text{kg}\cdot\text{m}^2$	1.48	3
Motor mass	kg	1.75	2.9
Allowable thrust load	N	60	60
Allowable radial load	N	200	200

# 7.1 Basic Specifications

## ■ 2-phase motor common specifications

Motor model number	SH142□	SM256□	SH160□	SH286□
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 elevation	Below 1,000m above sea level			
Vibration resistance	Vibration frequency 10 to 500 Hz, total 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, 12 sweeps per X, Y, Z direction			
Shock resistance	Acceleration 500 m/s <sup>2</sup> , duration 11 ms, half-sine wave 3 times in each direction of X, Y and Z, total 18 times			
Heatproof class	B (+130 °C)	B (+130 °C) (A: UL certified)	B (+130 °C)	B (+130 °C)
Dielectric withstanding voltage	500 VAC, 1 minute (between motor winding and frame)	1120 VAC, 1 minute (between motor winding and frame)	1000 VAC, 1 minute (between motor winding and frame)	1000 VAC, 1 minute (between motor winding and frame)
Insulation resistance	500 VDC, 100 MΩ or more (between motor winding and frame)			
Protection grade	—			
Winding temperature rise Note 1)	80K or less (Condition depends on company standards)			
Static angle error	±0.054°	±0.054°	±0.054°	±0.09°
Thrust play Note 2)	0.075mm (Load 5N)	0.075mm (Load 10N)	0.075mm (Load 10N)	0.075mm (Load 10N)
Radial play Note 3)	0.025mm (Load 5N)			
Shaft run-out	0.025mm			
Concentricity of mounting spigot joint against the shaft	φ0.05mm	φ0.075mm	φ0.075mm	φ0.075mm
Squareness of mounting surface against the shaft	0.1mm	0.1mm	0.1mm	0.15mm
Motor mounting direction	Freely to horizontal or vertical etc.			

Note 1) Use the motor at a surface temperature of +100°C or less (+85°C or less for the motor with encoder).

Note 2) Thrust play: Shows the amount of displacement of the shaft position when an axial load is applied to the shaft.

Note 3) Radial play: Shows the amount of displacement of the shaft position when a radial load is applied to the shaft. The load point is 1/3 from the shaft tip.

## 7. Basic Specifications

### ■ 5-phase motor common specifications

Motor model number	SH528□	SF542□	SM560□	SM586□
Operating ambient temperature	-10 to +50 °C (0 to +40 °C with harmonic gear)		-10 to +40 °C (0 to +40 °C with harmonic gear)	
Storage temperature	-20 to +65 °C		-20 to +60 °C	
Operating ambient humidity	20 to 90 %RH (non-condensing)		95 %RH or less: less than 40 °C (non-condensing)	
Storage humidity	5 to 95 %RH (non-condensing)		95 %RH or less: less than 40 °C, 57 %RH or less: less than 50 °C, 35 %RH or less: less than 60 °C (non-condensing)	
Operating elevation	Below 1,000m above sea level			
Vibration resistance	Vibration frequency 10 to 500 Hz, total 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, 12 sweeps per X, Y, Z direction			
Shock resistance	Acceleration 500 m/s <sup>2</sup> , duration 11 ms, half-sine wave 3 times in each direction of X, Y and Z, total 18 times			
Heatproof class	B (+130 °C)		F (+155 °C)	
Dielectric withstanding voltage	500 VAC, 1 minute (between motor winding and frame)	1500 VAC, 1 minute (between motor winding and frame)		
Insulation resistance	500 VDC, 100 MΩ or more (between motor winding and frame)			
Protection grade	IP40			
Winding temperature rise Note 1)	80K or less (Condition depends on company standards)		85K or less (Condition depends on company standards)	
Static angle error	±0.09°			
Thrust play Note 2)	0.075mm (Load 1.5N)	0.075mm (Load 5N)	0.075mm (Load 10N)	0.075mm (Load 10N)
Radial play Note 3)	0.025mm (Load 5N)			
Shaft run-out	0.025mm			
Concentricity of mounting spigot joint against the shaft	φ0.05mm	φ0.05mm	φ0.075mm	φ0.075mm
Squareness of mounting surface against the shaft	0.1mm	0.1mm	0.1mm	0.15mm
Motor mounting direction	Freely to horizontal or vertical etc.			

Note 1) Use the motor at a surface temperature of +100°C or less (+85°C or less for the motor with encoder).

Note 2) Thrust play: Shows the amount of displacement of the shaft position when an axial load is applied to the shaft.

Note 3) Radial play: Shows the amount of displacement of the shaft position when a radial load is applied to the shaft. The load point is 1/3 from the shaft tip.



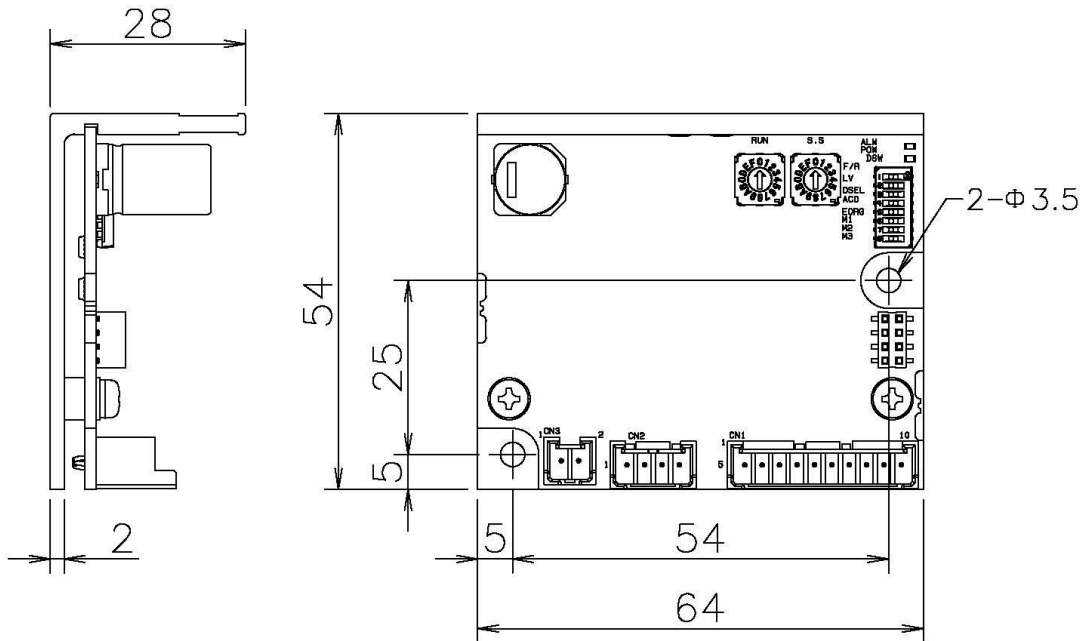
# 7.2 Outline Drawings

## 7.2 Outline Drawings

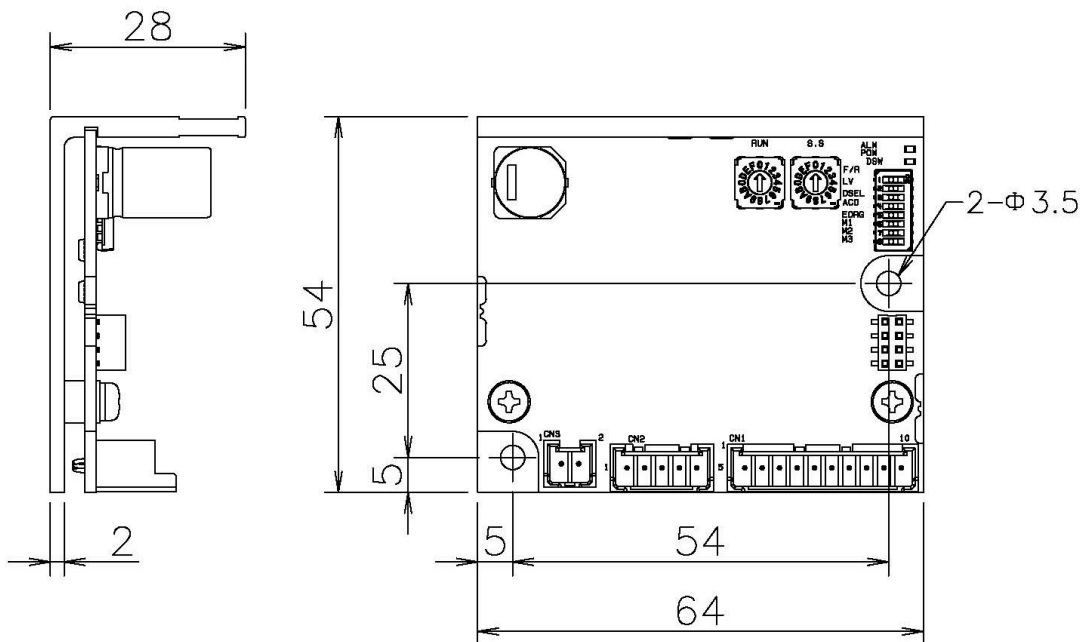
### 7.2.1 Driver outline drawings

- F2BED200P1□□

Unit: mm



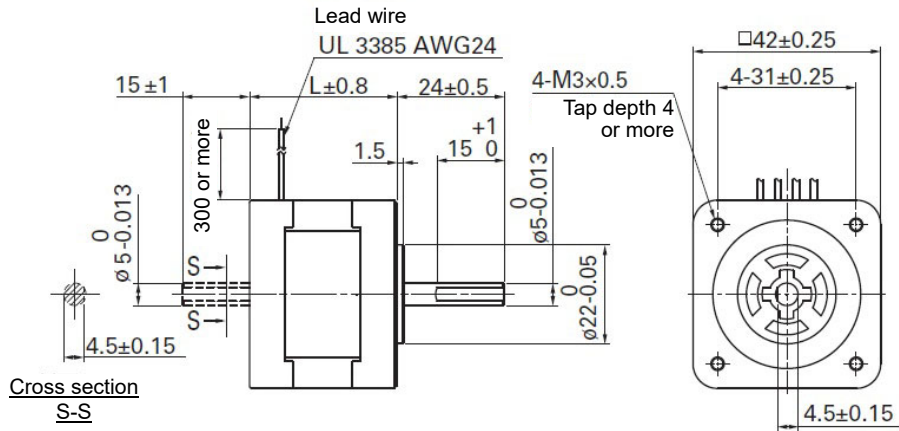
- F5PED140P1□□



# 7. Basic Specifications

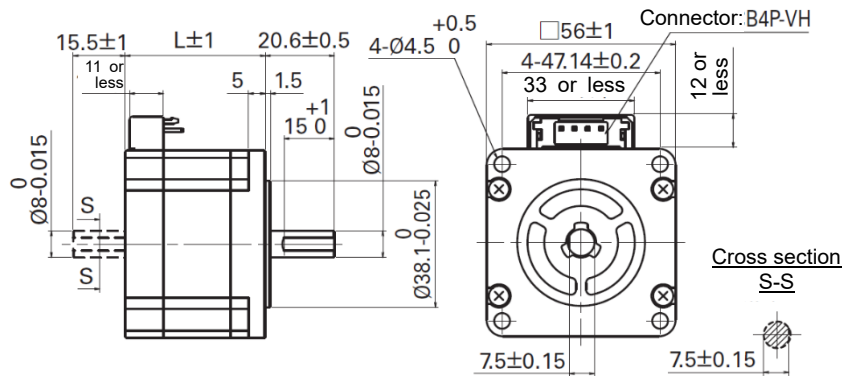
## 7.2.2 Motor outline drawings

### ■ SH142□ (2-phase, 42 mm sq.)



Model number	Motor length (L)
SH1421	33 mm
SH1422	39 mm
SH1424	48 mm

### ■ SM256□ (2-phase, 56 mm sq.)

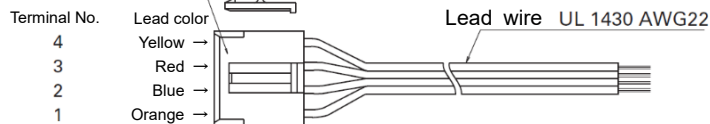


Option sold separately: Motor cable 4837961-1

Manufacturer: J. S. T.

Housing: VHR-4N

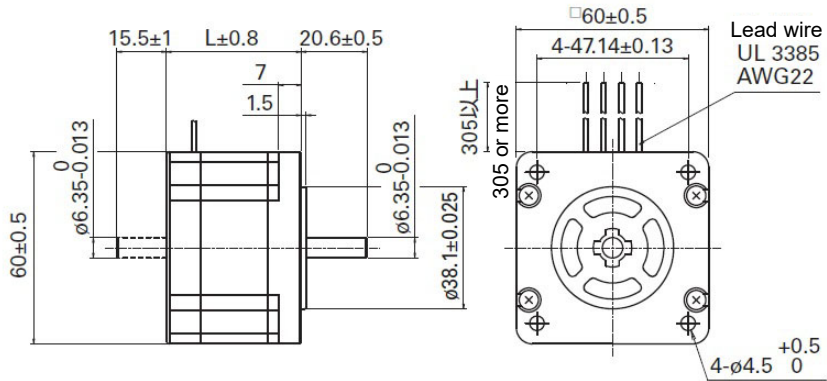
Terminal: SVH-21T-P1.1



Model number	Motor length (L)
SM2561	41.8 mm
SM2562	53.8 mm
SM2563	75.8 mm
SM2564	85.8 mm

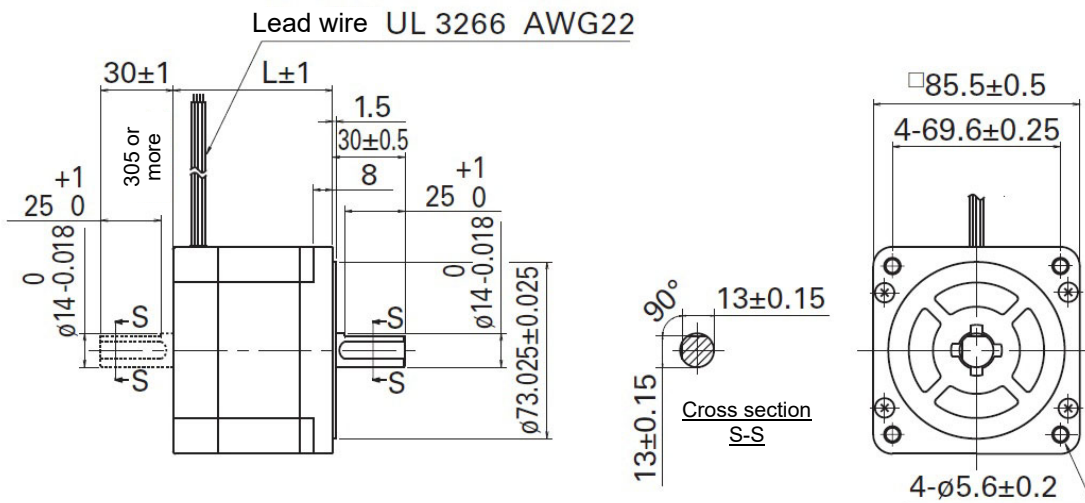
## 7.2 Outline Drawings

### ■ SH160□ (2-phase, 60 mm sq.)



Model number	Motor length (L)
SH1601	42 mm
SH1602	54 mm
SH1603	76 mm

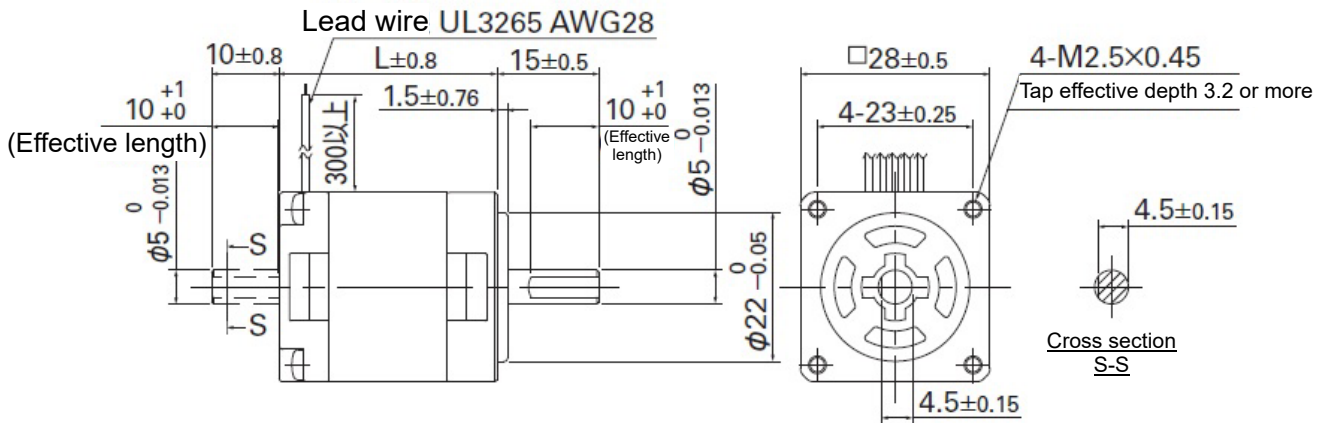
### ■ SH286□ (2-phase, 86 mm sq.)



Model number	Motor length (L)
SH2861	66 mm
SH2862	96.5 mm

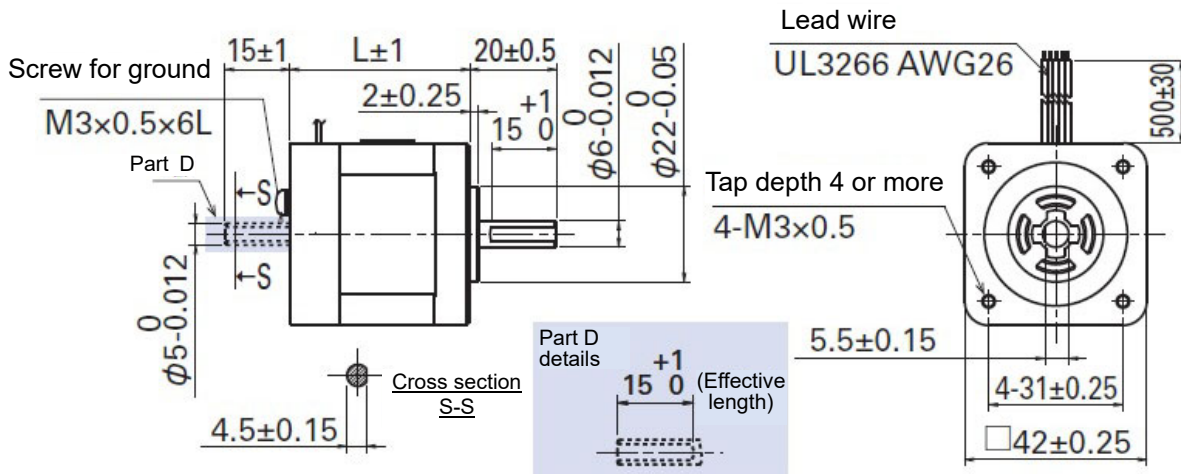
# 7. Basic Specifications

■ SH528□ (5-phase, 28 mm sq.)



Model number	Motor length (L)
SH5281	32 mm
SH5285	51.5 mm

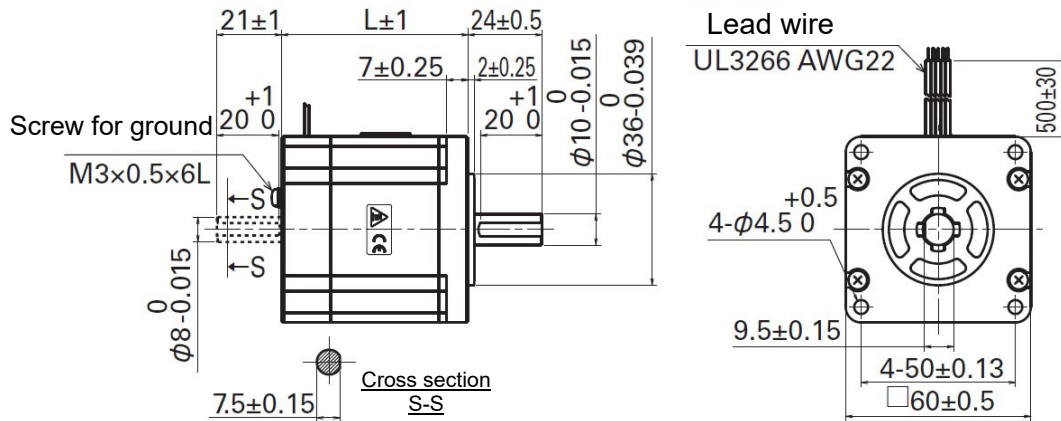
■ SF542□ (5-phase, 42 mm sq.)



Model number	Motor length (L)
SF5421	35 mm
SF5422	41 mm
SF5423	49 mm

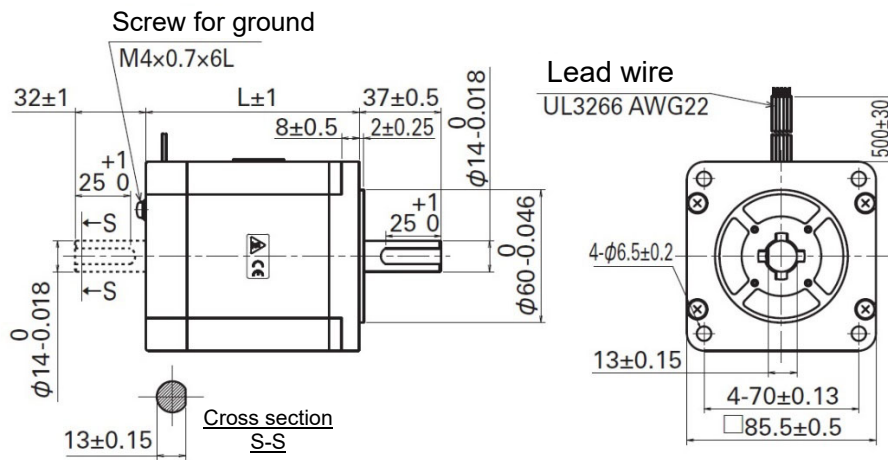
## 7.2 Outline Drawings

### ■ SM560□ (5-phase, 60 mm sq.)



Model number	Motor length (L)
SM5601	49 mm
SM5602	60 mm
SM5603	89 mm

### ■ SM586□ (5-phase, 86 mm sq.)



Model number	Motor length (L)
SM5861	66 mm
SM5862	96.5 mm

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## Options

In this chapter, options are explained.

<b>8.1 Option List.....</b>	<b>8-1</b>
<b>8.2 Cables.....</b>	<b>8-2</b>

## 8. Options

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### 8.1 Option List

Name	Model number	Length
Cable for input/output signals	FC8S0010A	1 m
Cable for motor	FC8M0010A (for F2BED200P1□□)	1 m
	FC8M0010B (for F5PED140P1□□)	1 m
Cable for power supply	FC8P0010A	1 m

- ◆ If you need a cable length other than the above, please contact us.
- ◆ If you need robot cables, please contact us.
- ◆ When assembling cables, dedicated crimping tools and IDC tools are required.  
For details, refer to the connector manufacturer's specifications.
- ◆ For connector models, compatible wires, and connector pin assignments, refer to the section 3.2 and 3.3.



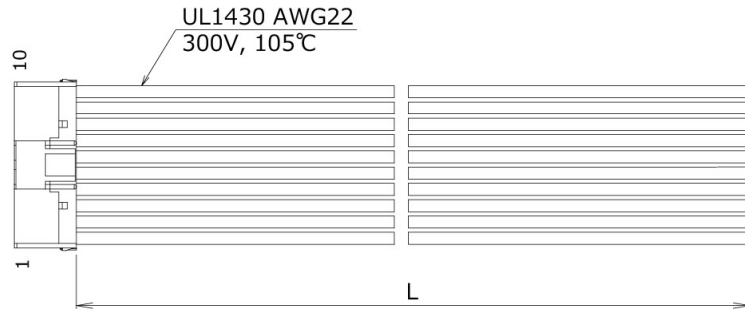
## 8.2 Cables

■ Cable for input/output signals

Model number: FC8S0010A

Pin No.	Color
1	Blue
2	
3	
4	
5	
6	
7	
8	
9	
10	

Length (L): 1 m

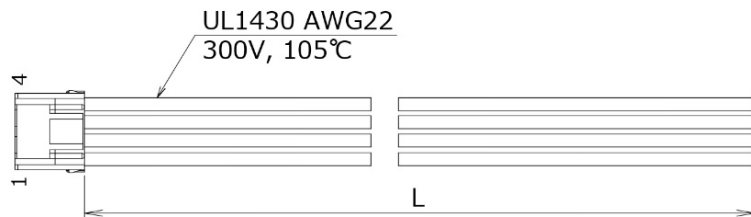


■ Cable for motor

Model number: FC8M0010A

Pin No.	Color
1	Orange
2	Blue
3	Red
4	Yellow

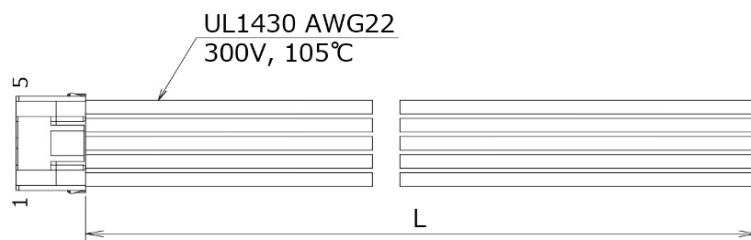
Length (L): 1 m



Model number: FC8M0010B

Pin No.	Color
1	Blue
2	Red
3	Orange
4	Green
5	Black

Length (L): 1 m

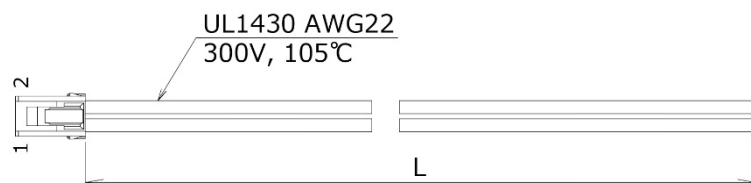


■ Cable for power supply

Model number: FC8P0010A

Pin No.	Color
1	White
2	Black

Length (L): 1 m



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#### ■ ECO PRODUCTS

Sanyo Denki's ECO PRODUCTS are designed with the concept of lessening impact on the environment in the process from product development to waste. The product units and packaging materials are designed for reduced environmental impact.

We have established our own assessment criteria on the environmental impacts applicable to all processes, ranging from design to manufacture.

#### ■ Precautions For Adoption

Failure to follow the precautions on the right may cause moderate injury and property damage, or in some circumstances, could lead to a serious accident.

Always follow all listed precautions.

#### Cautions

- Read the accompanying Instruction Manual carefully prior to using the product.
- If applying to medical devices and other equipment affecting people's lives please contact us beforehand and take appropriate safety measures.
- If applying to equipment that can have significant effects on society and the general public, please contact us beforehand.
- Do not use this product in an environment where vibration is present, such as in a moving vehicle or shipping vessel.
- Do not perform any retrofitting, re-engineering, or modification to this equipment.
- The Products presented in this Instruction Manual are meant to be used for general industrial applications. If using for special applications related to aviation and space, nuclear power, electric power, submarine repeaters, etc., please contact us beforehand.

\* For any question or inquiry regarding the above, contact our Sales Department.

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