M0020970

SANMOTION

STEPPING SYSTEMS

F

TYPE P (Pulse I/F)

F2BFD400P1□□, F5PFD280P1□□

For Stepping Motor

Instruction Manual

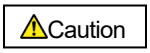
SANYO DENKI

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

■ 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.

■ 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℃, below 90% RH
For the motor: -20 to +65℃, 5 to 95% RH Note)
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

■ 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

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) Note)
  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.

■ 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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1 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.

1. Preface

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.

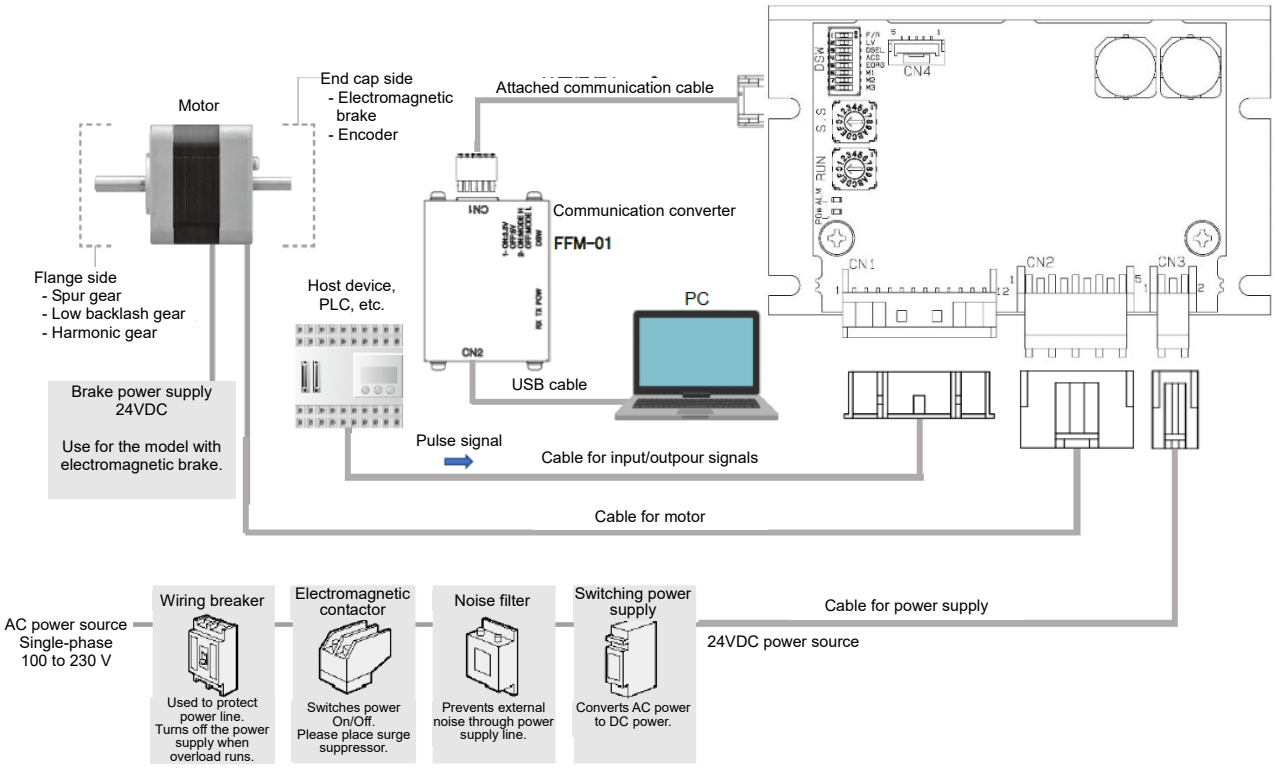
  - Input pulse mode selection function
    1-input method or 2-input methods can be selected by DIP switches.

  - 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.

- Features

  - PC interface
    Setup software can be used to change the input/output signal terminal function settings and other settings.

1.3 System Configuration

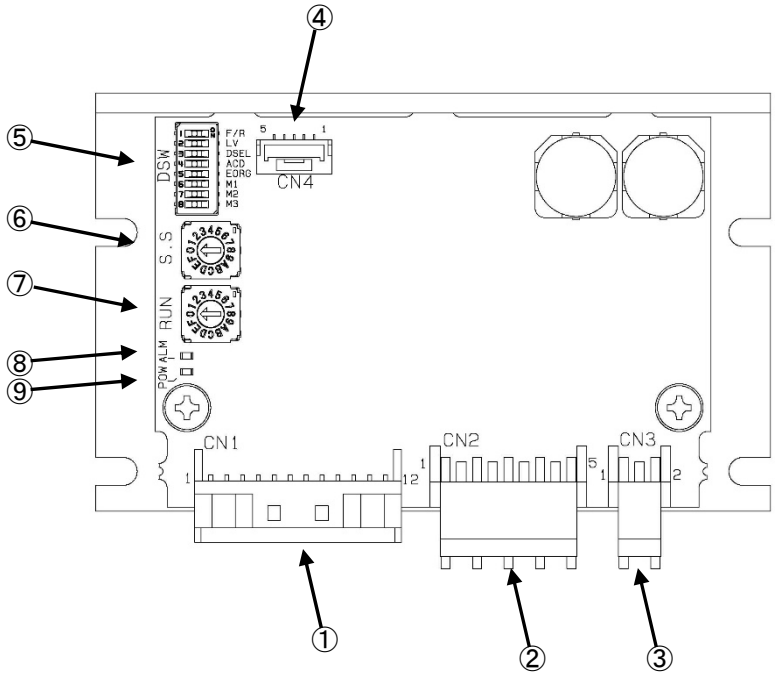


Note) For details on connectors and compatible wires, refer to "3.2 Connector Model Number, Applicable Wire ".

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 PC interface connection (CN4)	Connects the communication line for the PC.
⑤ Function selection DIP switch (DSW)	Selects the function according to the specifications.
⑥ Step angle selection rotary switch (S.S)	Selects the number of stepping motor basic step angle divisions.
⑦ Rotary switch for selecting operating current (RUN)	Selects the motor current during operation.
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)

1.5 Precautions for Unpacking

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

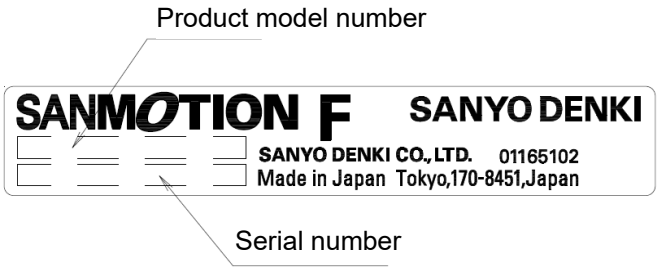
- Do not put your hand on the connector of the driver at removing it from the box.
- Do not touch the driver with charged hands when removing it from the box.

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

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±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

1.8.1 Driver Model Number

F	2	B	F	D	400	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

F	6th generation

⑤ Power source

D	24 VDC

⑥ Maximum winding current

400	4 A/phase
280	2.8 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

1.8.2 Motor Model Number

◆ SM256□C□□B□□ motor

S	M	2	5 6	□	C	□□	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

30	3 A/phase
40	4 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□C□□B□□

S	F	□	□□	□	–	□□	□□
①	②	③	④	⑤		⑥	⑦

① Series

S	Stepping motor

② Type

F	Type F
H	Type H

③ Phases of motor and basic step angle

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

④ Flange size

60	60 mm square
86	86 mm square

⑤ Motor total length

1 to 3	Refer to motor outline drawing

⑥ Rated current

51	4 A/phase
92	2.8 A/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: F2BFD400P1☐☐

Motor flange size	Motor model number		Motor rated current	Basic step angle
	Single shaft	Dual shaft		
56 mm sq.	SM2561C30B41	SM2561C30B11	3 A/phase	1.8°
	SM2562C30B41	SM2562C30B11		
	SM2563C30B41	SM2563C30B11		
	SM2564C30B41	SM2564C30B11		
	SM2561C40B41	SM2561C40B11	4 A/phase	1.8°
	SM2562C40B41	SM2562C40B11		
	SM2563C40B41	SM2563C40B11		
	SM2564C40B41	SM2564C40B11		
86 mm sq.	SH2861-5141	SH2861-5111	4 A/phase	1.8°
	SH2862-5141	SH2862-5111		

Standard combination motors for driver model number: F5PFD280P1☐☐

Motor flange size	Motor model number		Motor rated current	Basic step angle
	Single shaft	Dual shaft		
60 mm sq.	SF5601-9251	SF5601-9221	2.8 A/phase	0.72°
	SF5602-9251	SF5602-9221		
	SF5603-9251	SF5603-9221		

2 Installation

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

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.

2.1.2 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℃.
  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.

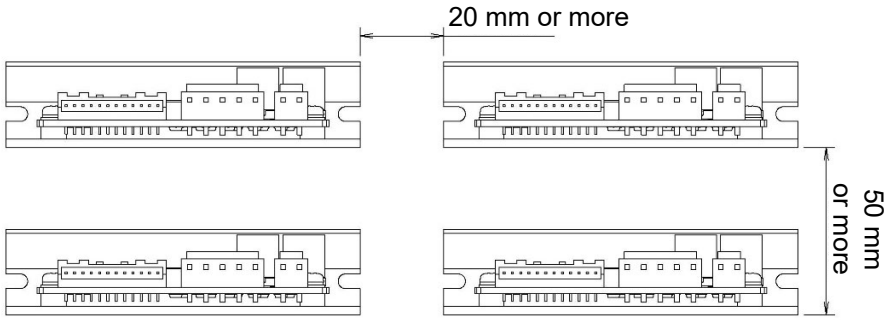


Figure 2.1 Arrange (Horizontal)

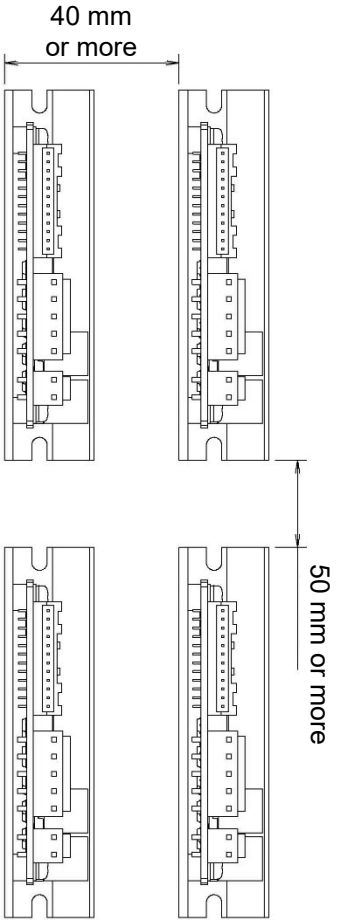


Figure 2.2 Arrange (Vertical)

2. Installation

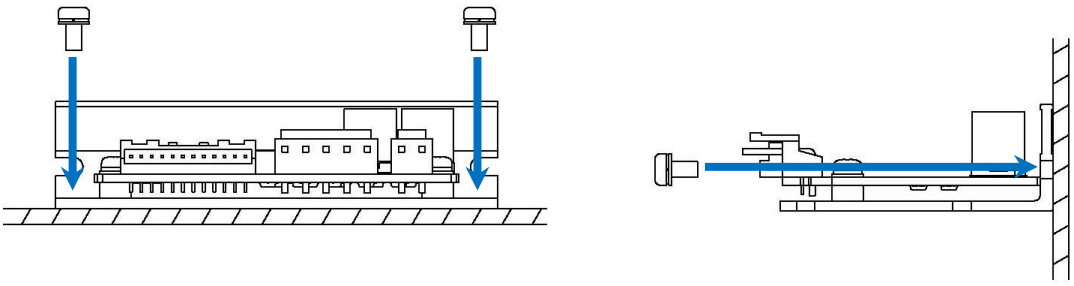


Figure 2.3 Horizontal installation

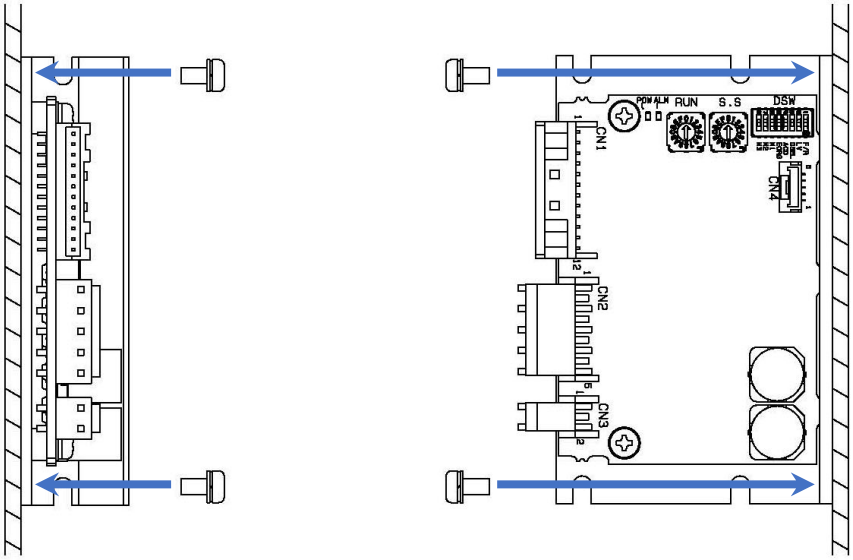


Figure 2.4 Vertical installation

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 ℃
  (0 to +40 ℃ for motors with harmonic gear, -10 to +40 ℃ for motors with encoder)
  Ambient humidity: 20 to 90%RH (non-condensing)
- In storage Ambient temperature: -20 to +65℃
  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]
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.

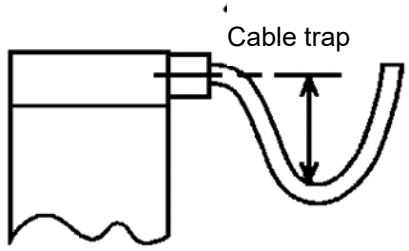


Figure 2.5 Cable trap

2. 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.

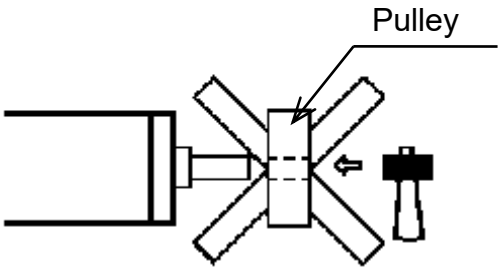


Figure 2.6 Installation of gear etc.

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

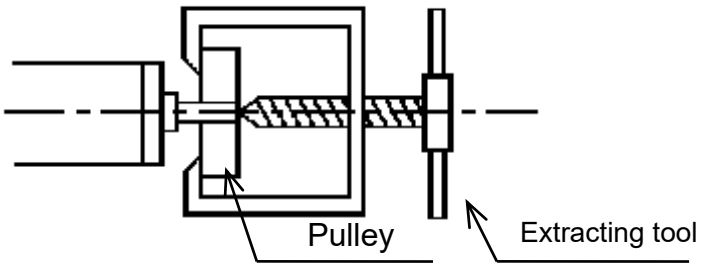


Figure 2.7 De-installation of gear etc.

■ 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: F2BFD400P1☐☐

Motor model number	Allowable radial load [N]	Allowable thrust load [N]
SM2561C30B☐1 SM2561C40B☐1	113	20
SM2562C30B☐1 SM2562C40B☐1	102	20
SM2563C30B☐1 SM2563C40B☐1	78	20
SM2564C30B☐1 SM2564C40B☐1	70	20
SH286☐-51☐1	200	60

Standard combination motor for driver model number: F5PFD280P1☐☐

Motor model number	Allowable radial load [N]	Allowable thrust load [N]
SF5601-92☐1	102	20
SF5602-92☐1	97	20
SF5603-92☐1	85	20

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

【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).

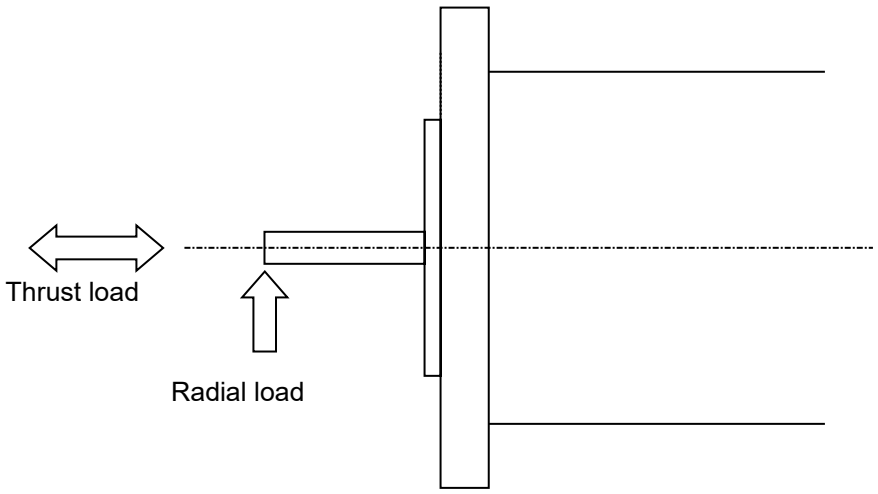


Figure 2.8 Position for the radial load

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.

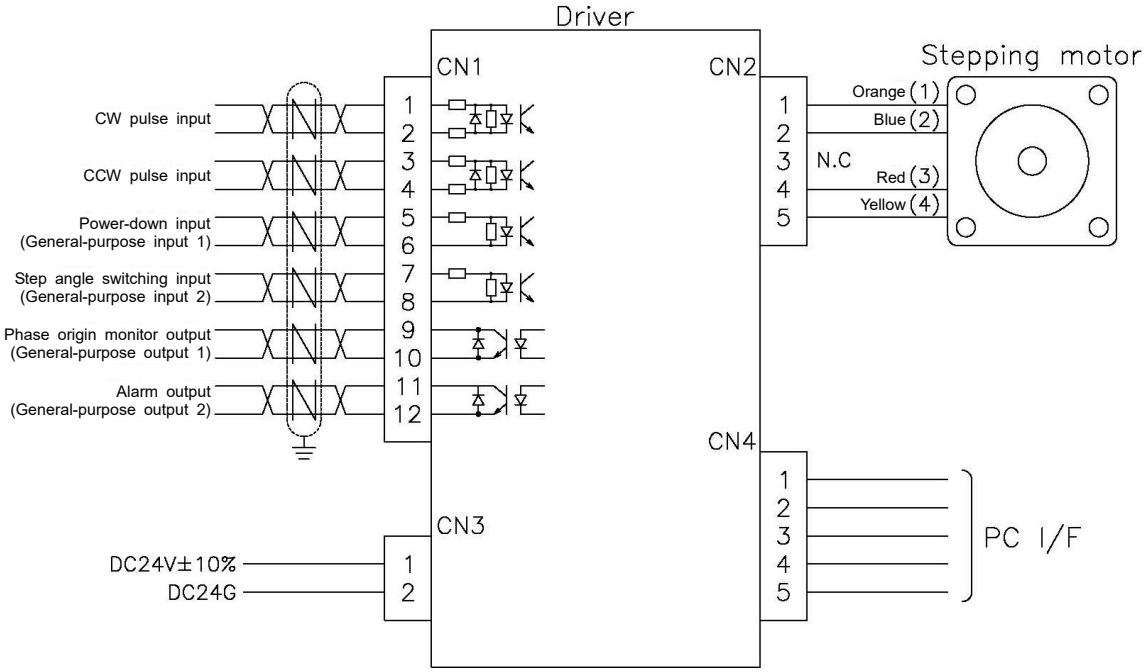
3 Wiring

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

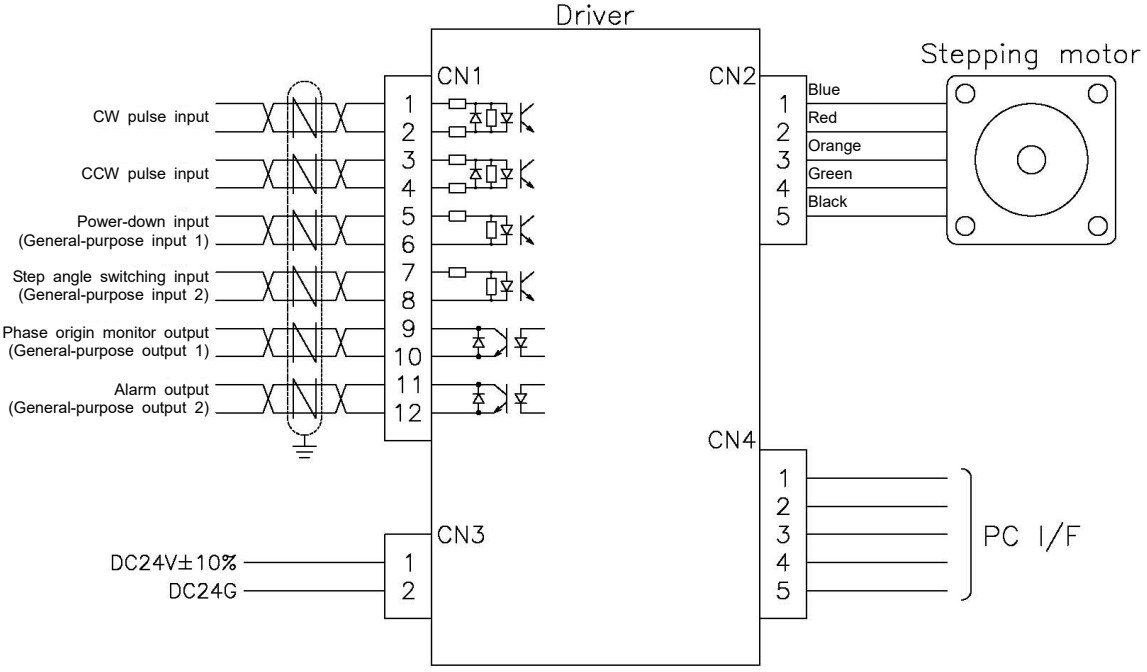
3. Wiring

3.1 External Wiring Diagram

■ External wiring diagram of F2BFD400P1☐☐



■ External wiring diagram of F5PFD280P1☐☐



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	Post with base (Driver side)	S12B-PASK-2(LF)(SN)	AWG#22 to 24 Outer diameter 1.0 to 1.5 mm	Less than 2 m	J.S.T. Mfg. Co., Ltd.
		Housing	PAP-12V-S			
		Contact	SPHD-001T-P0.5			
Motor power	CN2	Post with base (Driver side)	S5P-VH(LF)(SN)	AWG#18 to 20 Outer diameter 1.7 to 3.0 mm	10 m or less	J.S.T. Mfg. Co., Ltd.
		Housing	VHR-5N			
		Contact	SVH-21T-P1.1			
Power supply	CN3	Post with base (Driver side)	S2P-VH(LF)(SN)	AWG#18 to 20 Outer diameter 1.7 to 3.0 mm	Less than 3 m	J.S.T. Mfg. Co., Ltd.
		Housing	VHR-2N			
		Contact	SVH-21T-P1.1			
Communication	CN4	Base (Driver side)	BM05B-GHS-GB-TBT	AWG#26 Outer diameter 0.76 to 1.0 mm	Less than 0.5 m	J.S.T. Mfg. Co., Ltd.
		Housing	GHR-05V-S			
		Contact	SSHL-002GA1-P0.2			

✔ Refer to the manufacturer's catalog for connector specification details.
✔ When using PC I/F (CN4), connect the harness supplied with our communication converter.

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 (IN1)	Power-down input (General-purpose input 1)
6		
7	SSEL (IN2)	Step angle switching input (General-purpose input 2)
8		
9	MON (OUT1)	Phase origin monitor output (General-purpose output 1)
10		
11	ALM (OUT2)	Alarm output (General-purpose output 2)
12		

3.3.2 Connector for motor (CN2)

■ F2BFD400P1□□

Pin number	Signal name
1	Phase A power (Orange)
2	Phase $\overline{A}$ power (Blue)
3	N. C.
4	Phase B power (Red)
5	Phase $\overline{B}$ power (Yellow)

■ F5PFD280P1□□

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

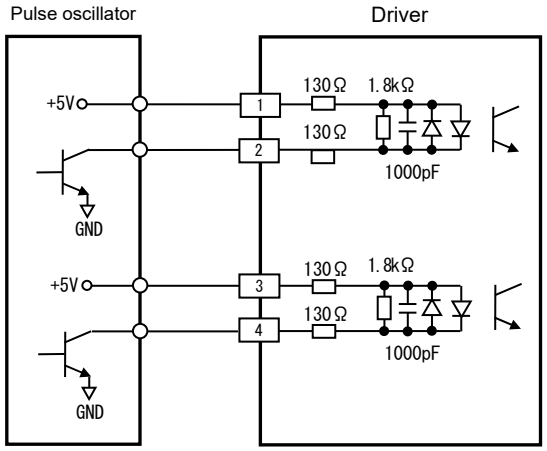
✔ Do not route power cables, motor power cables, and I/O cables in the same duct.
✔ Be sure to connect and disconnect power lines at least 1 minute after the power supply is cut off. If the power line is plugged or unplugged while the power is active, the driver may be damaged.

3.4 Input/output Signals

3.4.1 Command pulse input

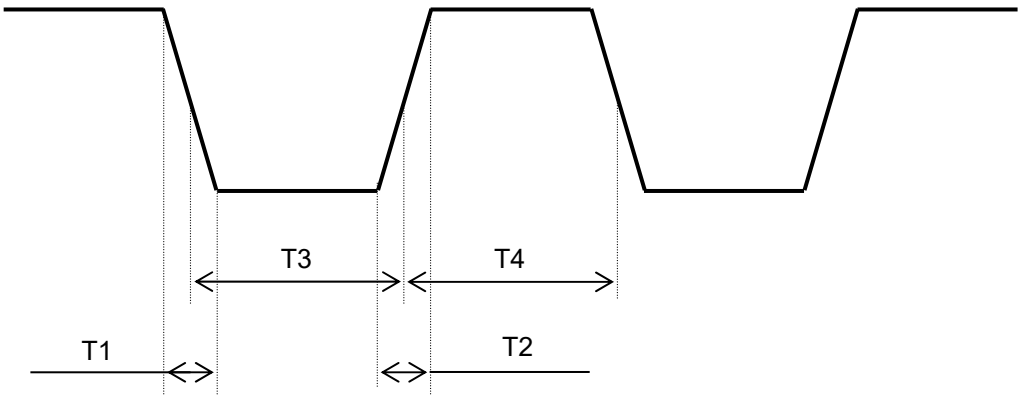
■ Connection example

Pulse waveform height “H” level: 4.0 to 5.25 V
“L” level: 0 to 0.5 V
Between “H” and “L”: 4.0 V or more



■ Pulse waveform

Maximum response frequency: 400kpulse/s



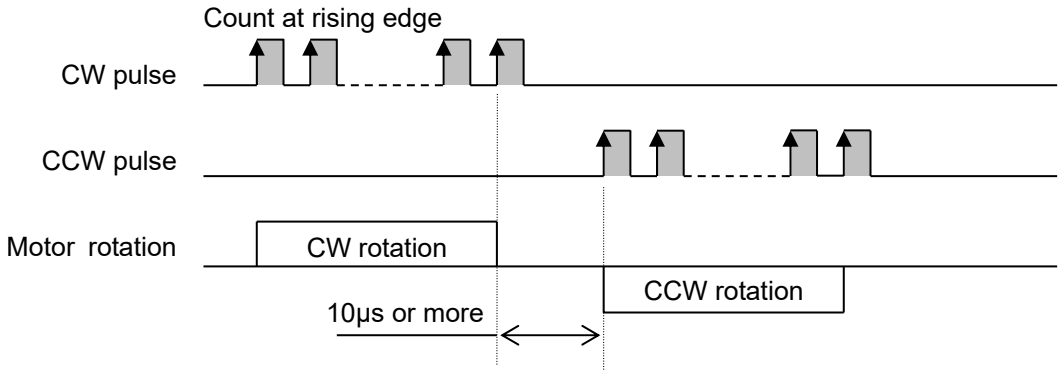
T1, T2≦0.5μs T3, T4≧1μs

✔ 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.

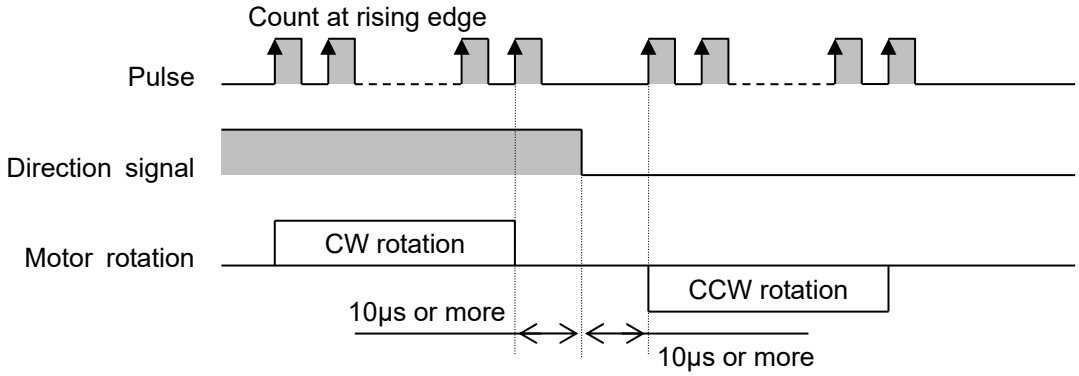
✔ Do not input CW pulse and CCW pulse at the same time.

✔ 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.

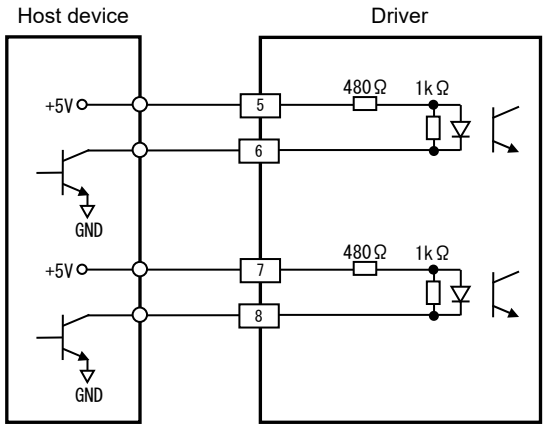
✔ The switching time of CW pulse/CCW pulse "10μs or more" is the operation time of the internal circuit of the driver, not the time for the motor to respond. In actual operation, set the time when the motor can respond.

✔ Use DIP switch F/R to switch between 1-input and 2-input mode.

3.4.2 Input signals (PD, SSEL)

■ Connection example

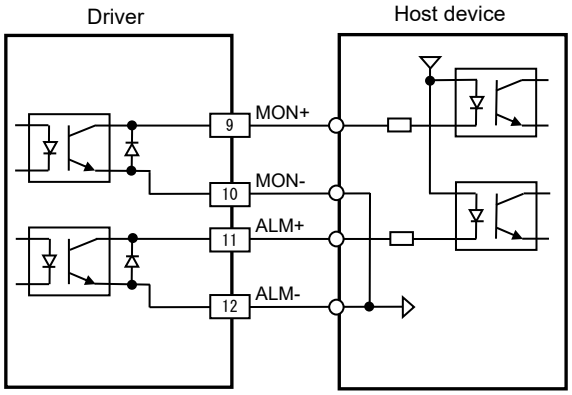
Pulse waveform height	“H” level: 4.0 to 5.25 V “L” level: 0 to 0.5 V



3.4.3 Output signals (MON, ALM)

■ Connection example

Collector - Emitter voltage	30V DC or less
Output current	10mA or less
Output saturation voltage	1.0V or less



3.4.4 I/O signals brief specification

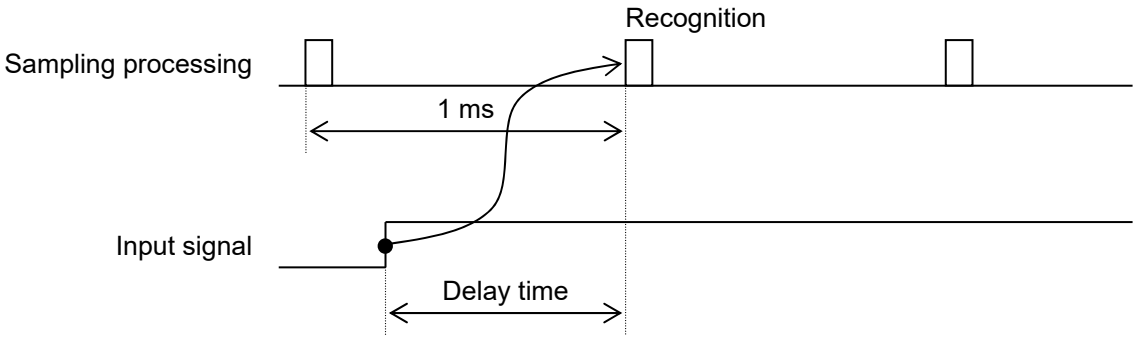
Pin number	Symbol	Signal name	Description
1 2	CW	CW pulse input (DSW-F/R: OFF)	2-input mode Inputs the pulse for CW rotation.
1 2	CK	Pulse train input (DSW-F/R: ON)	1-input mode Inputs the pulse train for motor rotation.
3 4	CCW	CCW pulse input (DSW-F/R: OFF)	2-input mode Inputs the pulse for CCW rotation.
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 (IN1)	Power-down input (General-purpose input 1)	Shuts off the motor current. (Standard setting) Terminal function can be selected in the setup software as a general-purpose input 1 signal. Refer the section "4.2 Setup Software".
7 8	SSEL (IN2)	Step angle switching input (General-purpose input 2)	Enables the number of divisions set by the setup software. (Standard setting) Terminal function can be selected in the setup software as general-purpose input 2 signal. Refer the section "4.2 Setup Software".
9 10	MON (OUT1)	Phase origin monitor output (General-purpose output 1)	Turns ON when the excitation phase is at the origin. Output logic is a-contact. (Standard setting) Terminal function can be selected in the setup software as a general-purpose output 1 signal. Refer the section "4.2 Setup Software".
11 12	ALM (OUT2)	Alarm output (General-purpose output 2)	Turns ON when an alarm occurs. The motor is de-energized at that time. Output logic is a-contact. (Standard setting) Terminal function can be selected in the setup software as general-purpose output 2 signal. Refer the section "4.2 Setup Software".

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

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^2) 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, Cf x dv/dt current flows from the PWM control power section of the driver through the motor stray capacitance (Cf). 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^2) or larger.

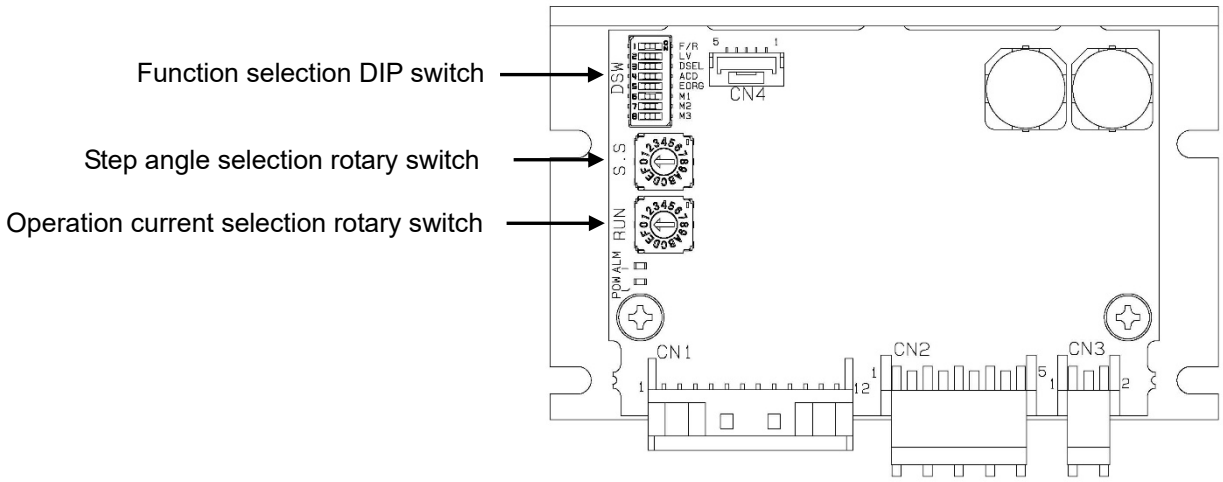
■ If the motor wiring is in a metal conduit or metal box, be sure to ground the metal part. Grounding should be done at a single point.

4 Setting

In this chapter, switch settings and how to use the setup software are explained.

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.

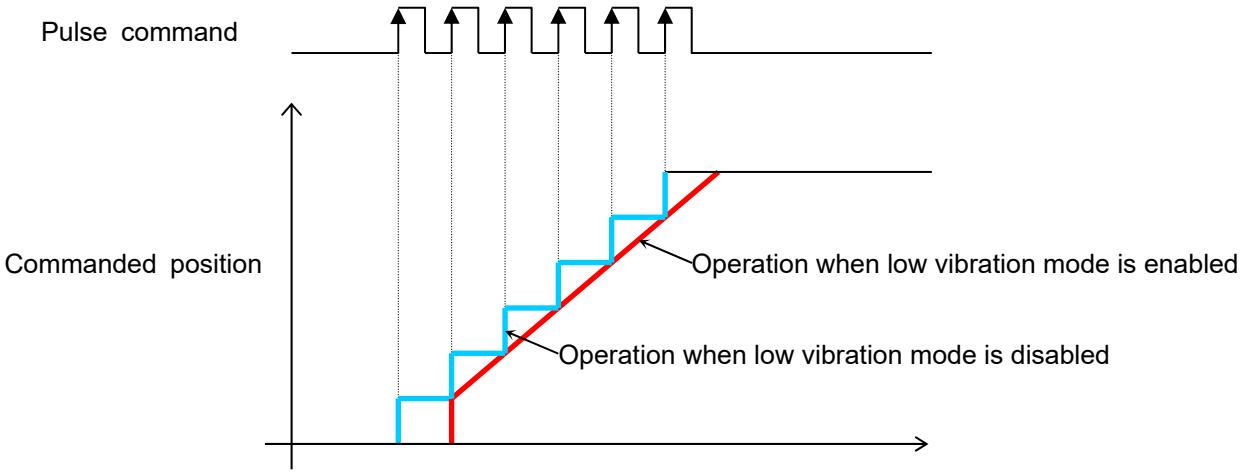
F/R	Pulse input method
OFF	2-input method (CW, CCW)
ON	1-input method (CK, U/D)

■ 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
	F2BFD400P1□□	F5PFD280P1□□	
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° 5-phase mode: Available with 5-phase command resolution. Command resolution: 500 to 125,000 P/R Basic step angle: 0.72°
ON	5-phase mode	2-phase mode	

■ Auto current down selection

This function reduces the motor current at standstill (200 ms (default setting) after the last pulse is applied).

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

The current and switching time when turned ON can be changed by parameters.

ACD	Current at stop
OFF	100% of operating current
ON	50% of operating current (Default setting)

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.

◆ F2BFD400P1□□

M1	M2	M3	Winding rating 3A/phase motor (※)		Winding rating 4A/phase motor	
			Motor size	Motor model number	Motor size	Motor model number
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

※ When using a 3A/phase motor, be sure to set the operating current selection rotary switch (RUN) to 75% or less.

Use of a setting higher than 75% may cause the motor to overheat and burn out.

◆ F5PED140P1□□

M1	M2	M3	Motor size	Motor model number
OFF	OFF	OFF	—	Reserved
ON	OFF	OFF	—	Reserved
OFF	ON	OFF	—	Reserved
ON	ON	OFF	60 mm sq.	SF5601-92□1
OFF	OFF	ON	60 mm sq.	SF5602-92□1
ON	OFF	ON	60 mm sq.	SF5603-92□1
OFF	ON	ON	—	Reserved
ON	ON	ON	—	Reserved

4.1.2 Operation current selection rotary switch (RUN)

Selects a function that matches the specifications of the equipment.

Initial value: F (25%)

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) F2BFD400P1☐☐: 0 (100%) is 4A / phase setting.
F5PFD280P1☐☐: 0 (100%) is 2.8A / 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 (Step number 1).

SSEL input selects whether step number 1 or step number 2 is enabled.

SSEL=OFF: Step number 1 (S.S rotary switch) is enabled.

SSEL=ON: Step number 2 (System: ID 00) is enabled.

When SSEL input is not used, step number 1 is always enabled. Refer to the section "4.2.3 Parameter details" for details on step number 2.

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.

When using the number of steps other than those listed below, set the electronic gear (Group 8: ID 03, 04). Refer to the section "4.2.3 Parameter details" for the electronic gear.

◆ 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 (1/4)	1,000 (1/5)	1,600 (1/8)	2,000 (1/10)	3,200 (1/16)	5,000 (1/25)
S.S set value	8	9	A	B	C	D	E	F
Resolution [P/R]	6,400 (1/32)	10,000 (1/50)	12,800 (1/64)	20,000 (1/100)	25,000 (1/125)	25,600 (1/128)	50,000 (1/250)	51,200 (1/256)

4. Setting

◆ Step division number mode: 5-phase mode setting Initial value: 1 (1000 P/R)

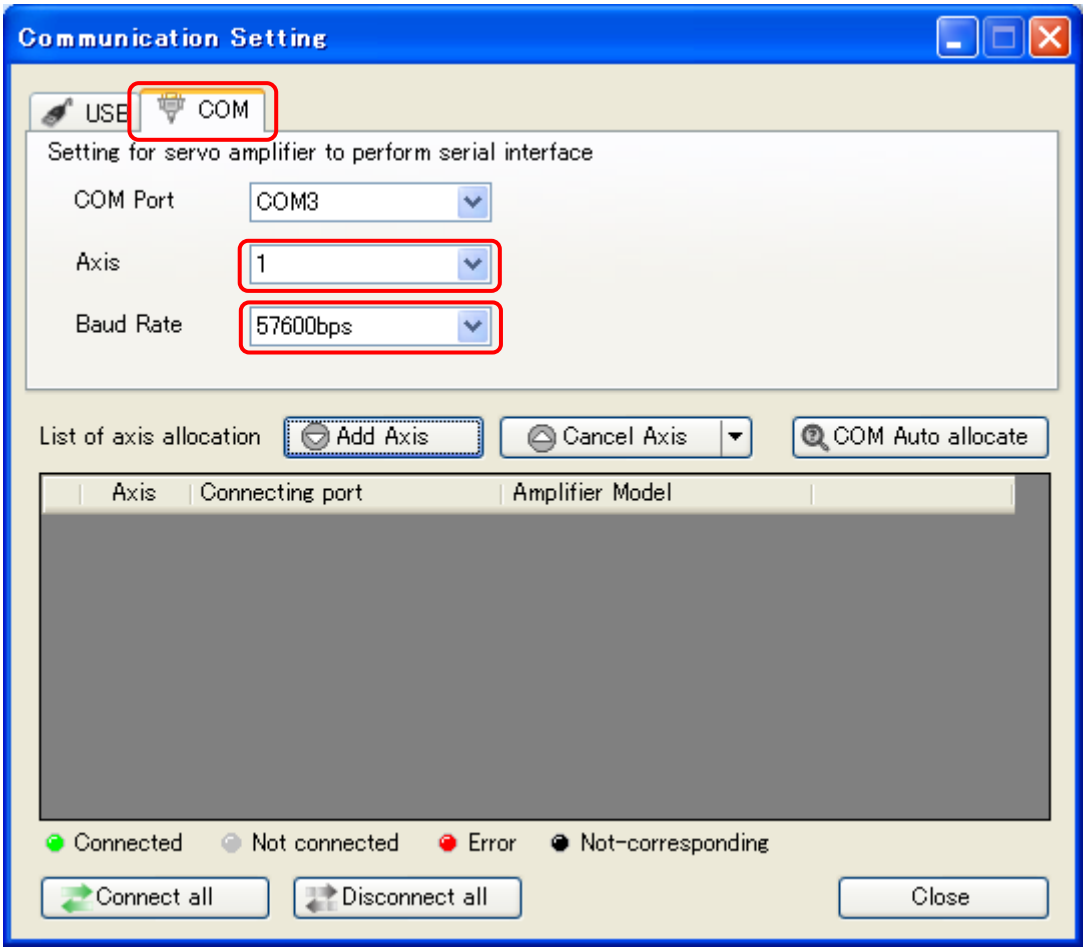
S.S set value	0	1	2	3	4	5	6	7
Resolution [P/R]	500 (Full-step)	1,000 (Half-step)	1250 (1/2.5)	2000 (1/4)	2500 (1/5)	4000 (1/8)	5000 (1/10)	10000 (1/20)
S.S set value	8	9	A	B	C	D	E	F
Resolution [P/R]	12,500 (1/25)	20,000 (1/40)	25,000 (1/50)	40,000 (1/80)	50,000 (1/100)	62,500 (1/125)	100,000 (1/200)	125,000 (1/250)

4.2 Setup Software

When connected to a PC using the setup software, the driver status can be checked, and advanced function settings can be configured.
The dedicated communication converter set FFM-01U1 and a USB cable are required for connection to a PC.
Refer to "Chapter 8 Options" for the options required for connection.

4.2.1 How to use the setup software

Download the setup software from our website and install it beforehand.
After wiring the driver to the PC, turn on the driver power.
When the setup software is started, the following screen is displayed.
Select the port number that matches the wiring and connect.
For details on how to operate the setup software, refer to the separate volume M0010842.



Open the [COM] tab and select axis number 1. Select 57600 bps for the baud rate.

Note that communication with the driver will not be possible if other settings are made.

4.2.2 Parameter list

Parameters can be set for function assignment of input/output signals, advanced settings related to operation, and preventive maintenance functions.
Parameter values are stored in the driver's nonvolatile memory, so the settings are reflected the next time the power is turned on.

■ System [System parameters]

ID	Symbol	Name	Standard set value	Unit	Detail page
00	SS2	Step number 2	0	-	4-8

■ Group 1 [Basic control parameters]

ID	Symbol	Name	Standard set value	Unit	Detail page
00	SMAFIL	Velocity command filter time constant	2	ms	4-9

■ Group 8 [Control systems]

ID	Symbol	Name	Standard set value	Unit	Detail page
00	POWLIMIT	Current limit value	100	%	4-9
01	ISTOP	Stop current	50	%	4-10
02	ACDTIME	Auto current down time	200	ms	4-11
03	EGN	Electronic gear numerator	1	-	4-11
04	EGD	Electronic gear denominator	1	-	4-11

■ Group A [Input/output ports]

ID	Symbol	Name	Standard set value	Unit	Detail page
00	INLOG	Input port logic	0000h	-	4-12
01	OUTLOG	Output port logic	0000h	-	4-12
02	IN1FUNC	IN1 signal function selection	0(PD)	-	4-13
03	IN2FUNC	IN2 signal function selection	1 (SSEL)	-	4-13
04	OUT1FUNC	OUT1 signal function selection	0 (MON)	-	4-14
05	OUT2FUNC	OUT2 signal function selection	1 (ALM)	-	4-14

■ Group B [Alarm/warning related]

ID	Symbol	Name	Standard set value	Unit	Detail page
00	ALMSK	Alarm mask bit	0 (no mask)	-	4-14
02	WAMSK	Warning mask bit	0 (no mask)	-	4-15
03	MHOUR	Maintenance warning time	0 (no warning)	h	4-15
04	MHOURCLR	Maintenance warning time reset	0	-	4-15
05	MTRIP	Maintenance warning distance	0 (no warning)	rotation	4-15
06	MTRIPCLR	Maintenance warning distance reset	0	-	4-16

4.2.3 Parameter details

■ System [System parameters]

ID:00	Step number 2		
SS2	Setting range	Standard set value	Setting unit
	0 to F	0	Same as step angle selection rotary switch (S.S) setting

Sets the number of steps 2.

If you want to change the number of steps for each operation, you can switch between step number 1 and step number 2 using the SSEL signal at the input port.

(Step number 1 is set by the step angle selection rotary switch (S.S.).)

The command resolution of step number 2 is determined by this parameter and the setting of DIP switch DSEL.

The relationship between this parameter setting and the command resolution is as follows.

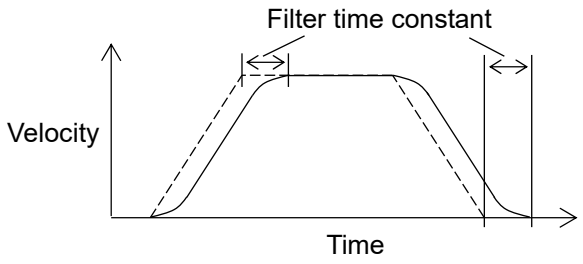
This parameter set value	Command resolution (Number of micro-step divisions)	
	When 2-phase mode is set (DSEL)	When 5-phase mode is set (DSEL)
0	200 P/R (Full-step)	500 P/R (Full-step)
1	400 P/R (Half-step)	1,000 P/R (Half-step)
2	800 P/R (1/4 micro-step)	1,250 P/R (1/2.5 micro-step)
3	1,000 P/R (1/5 micro-step)	2,000 P/R (1/4 micro-step)
4	1,600 P/R (1/8 micro-step)	2,500 P/R (1/5 micro-step)
5	2,000 P/R (1/10 micro-step)	4,000 P/R (1/8 micro-step)
6	3,200 P/R (1/16 micro-step)	5,000 P/R (1/10 micro-step)
7	5,000 P/R (1/25 micro-step)	1,0000 P/R (1/20 micro-step)
8	6,400 P/R (1/32 micro-step)	12,500 P/R (1/25 micro-step)
9	10,000 P/R (1/50 micro-step)	20,000 P/R (1/40 micro-step)
A	12,800 P/R (1/64 micro-step)	25,000 P/R (1/50 micro-step)
B	20,000 P/R (1/100 micro-step)	40,000 P/R (1/80 micro-step)
C	25,000 P/R (1/125 micro-step)	50,000 P/R (1/100 micro-step)
D	25,600 P/R (1/128 micro-step)	62,500 P/R (1/125 micro-step)
E	50,000 P/R (1/250 micro-step)	100,000 P/R (1/200 micro-step)
F	51,200 P/R (1/256 micro-step)	125,000 P/R (1/250 micro-step)

4. Setting

■ Group 1 [Basic control parameters]

ID:00	Velocity command filter time constant		
SMAFIL	Setting range	Standard set value	Setting unit
	0 to 10	2	ms

Set the time constant of the filter to smooth acceleration/deceleration.
The larger the set value, the smoother the operation, but the greater the delay relative to the command pulse.
Note that when using this parameter for applications that require synchronization to a command.
※ This parameter becomes effective after the power is turned on again.



■ Group 8 [Control systems]

ID:00	Current limit value		
POWLIMIT	Setting range	Standard set value	Setting unit
	0 to 100	100	Percentage against maximum output current of driver

When the current limit signal POWSAVE is ON, the operating current and the current at standstill are limited to the set value of this parameter or less.
Lowering the set value reduces motor heat generation and current consumption.
Note that lowering the set value too much may cause step-out during acceleration or under high load conditions such as external force.
For details on the function of the POWSAVE signal, refer to the section "5.2.3 Current limit input (POWSAVE)".

ID:01	Stop current		
ISTOP	Setting range	Standard set value	Setting unit
	0 to 100	50	Percentage against operating current

Sets the current value during auto current down.

The set value is a percentage against the operating current set by the operating current selection rotary switch (RUN).

Setting example) RUN set value 90% × Stop current set value 50% = Motor current at stop 45%.

Lowering the set value reduces the heat generated by the motor at standstill.

The torque at standstill and the current at standstill are almost proportional to each other.

When there is an unbalanced load such as a vertical axis, lowering the setpoint too much may cause the workpiece to fall.

※ The auto current down function reduces the motor current when the motor stops.

The time from the last pulse input until the auto current down function starts operating is set by the current down time (Group 8: ID 02).

When not using the auto current down function, set DIP switch ACD to OFF or set this parameter to "100".

ID:02	Auto current down time		
ACDTIME	Setting range	Standard set value	Setting unit
	0 to 10,000	200	ms
Sets the time required to switch from the running current (set by the RUN rotary switch) to the current at stop (Group8-ID01) after the last pulse command is input.			

ID:03	Electronic gear numerator		
ID:04	Electronic gear denominator		
EGN, EGD	Setting range	Standard set value	Setting unit
	$\frac{\text{1 to 32,768}}{\text{1 to 32,768}}$	$\frac{1}{1}$	—

The electronic gear can be used with any command resolution.

Electronic gear should be set to 2/1 or less.

※ Formula for electronic gear

Command resolution = Number of steps ÷ Electronic gear

(Example) When you want to use with 360P/R

Set the number of steps to 500 (S.S rotary switch = 0) and set the electronic gear to $\frac{25}{18}$.

If the electronic gear is set to a value other than $\frac{1}{1}$, the motor may not stop at the excitation origin.

※ This parameter becomes effective after the power is turned on again.

■ Group A [Input/output ports]

ID:00	Input port logic		
INLOG	Setting range	Standard set value	Setting unit
	0000 to FFFFh	0000h	Each bit 0: Input ON with photocoupler ON 1: Input ON with photocoupler OFF

Selects the logic for each input port.

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
—	—	—	—	—	—	—	—
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
—	—	—	—	—	—	IN2	IN1

ID:01	Output port logic		
OUTLOG	Setting range	Standard set value	Setting unit
	0000 to FFFFh	0000h	Each bit 0: Output ON with photocoupler ON 1: Output ON with photocoupler OFF

Selects the logic for each output port.

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
—	—	—	—	—	—	—	—
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
—	—	—	—	—	—	OUT2	OUT1

ID:02	IN1 signal function selection		
IN1FUNC	Setting range	Standard set value	Setting unit
	0 to 5	0	—

Sets the pin function of the general-purpose input 1 signal (CN1: pin 5/6).

Set value	Name	Function when signal ON
0	Power down (PD)	Interrupts the motor current.
1	Step angle switching (SSEL)	Step number 2 is enabled. Step number 2 is set by System: ID00.
2	Current limit (POWSAVE)	Limits the current and suppresses heat generation in the driver and motor. The current limit value is set by Group8: ID 00.
3	Alarm clear (ALMCLR)	If the alarm factor is eliminated, the driver returns from the alarm state. Clears the alarm on the edge from OFF to ON.
4	CW limit (CWLIMIT)	Inhibits the operation in the CW direction, to prevent overrun. If this signal is turned ON during CW rotation, the limit arrival alarm occurs.
5	CCW limit (CCWLIMIT)	Inhibits the operation in the CCW direction, to prevent overrun. If this signal is turned ON during CCW rotation, the limit arrival alarm occurs.

ID:03	IN2 signal function selection		
IN2FUNC	Setting range	Standard set value	Setting unit
	0 to 5	1	—

Sets the pin function of the general-purpose input 2 signal (CN1: pin 7/8).

The meaning of the set value is the same as for ID 02.

ID:04	OUT1 signal function selection		
OUT1FUNC	Setting range	Standard set value	Setting unit
	0 to 3	0	—

Sets the pin function of the general-purpose output 1 signal (CN1: pin 9/10).

Set value	Name	Function when signal ON
0	Phase origin monitor (MON)	The output turns ON while passing through the excitation origin or stopping at the excitation origin.
1	Alarm output (ALM)	The output turns ON during an alarm.
2	Warning output (WRN)	The output turns ON during a warning.
3	Alarm or warning (ALMWRN)	The output turns ON during an alarm or warning.

ID:05	OUT2 signal function selection		
OUT2FUNC	Setting range	Standard set value	Setting unit
	0 to 3	1	—

Sets the pin function of the general-purpose output 2 signal (CN1: pin 11/12).

The meaning of the set value is the same as for ID 04.

■ Group B [Alarm/warning related]

ID:00	Alarm mask bit		
ALMSK	Setting range	Standard set value	Setting unit
	0000 to FFFFh	0000h	Each bit 0: Alarm enabled 1: Alarm disabled

When bit is set to 1, no alarm is issued even if the corresponding alarm factor occurs.

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
—	MOT	—	—	—	—	—	—
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
—	—	UV	OSP	CWL	CCWL	—	—

MOT : Enable/Disable the motor disconnection alarm (80h).

UV : Enable/Disable setting of main power undervoltage (62h).

OSP : Enable/Disable command velocity error (C1h).

CWL : Enables/Disable CW limit reached (F0h).

CCWL : Enable/Disable CCW limit reached (F1h).

※ The alarm function is used to notify abnormal conditions and prevent damage. It should be disabled only for special purposes such as system debugging and should normally be used with alarm enabled.

ID:02	Warning mask bit		
WAMSK	Setting range	Standard set value	Setting unit
	0000 to FFFFh	0000h	Each bit 0: Warning enabled 1: Warning disabled

When bit is set to 1, no warning is issued even if the corresponding warning factor occurs.

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
—	—	—	—	—	—	—	—
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
OHW	OVW	UVW	OSPW	—	—	—	—

OHW : Enable/Disable driver overheat warning (56h).
OVW : Enables/disables the main power supply overvoltage warning (61h).
UVW : Enable/Disable main power undervoltage warning (62h).
OSPW : Enable/Disable command velocity warning (C1h).

ID:03	Maintenance warning time		
MHOUR	Setting range	Standard set value	Setting unit
	0 to 4,294,967,295	0 (no warning)	1 hour

When the accumulated operating time exceeds the value of this parameter, a warning is issued to alert the user that maintenance and inspection conditions have been reached.
The accumulated operating hours are counted in one-hour units.
When the power is shut off, the count value is retained, and the count is restarted the next time the power is turned on.
When this parameter is set to 0, no warning is issued when the maintenance and inspection conditions are reached based on the accumulated operating hours.

ID:04	Maintenance warning time reset		
MHOURCLR	Setting range	Standard set value	Setting unit
	0 to 1	0	—

Set to 1 to reset the accumulated operating hours for maintenance and inspection warnings to 0.
The setting value is not saved in this parameter. When read back, 0 is returned.

ID:05	Maintenance warning distance		
MTRIP	Setting range	Standard set value	Setting unit
	0 to 4,294,967,295	0 (no warning)	1 rotation

When the accumulated travel distance exceeds the value of this parameter, a warning is issued to alert the user that maintenance and inspection conditions have been reached.
The accumulated travel distance is counted in units of one revolution, regardless of the direction of rotation. (A half-turn reciprocating motion is counted as one rotation.)
When the power is shut off, the count value is retained, and the count is restarted the next time the power is turned on.
When this parameter is set to 0, no warning is issued when the maintenance and inspection conditions are reached based on the accumulated distance traveled.

ID:06	Maintenance warning distance reset		
MTRIPCLR	Setting range	Standard set value	Setting unit
	0 to 1	0	—
Set to 1 to reset the accumulated travel distance for maintenance and inspection warnings to 0. The setting value is not saved in this parameter. When read back, 0 is returned.			

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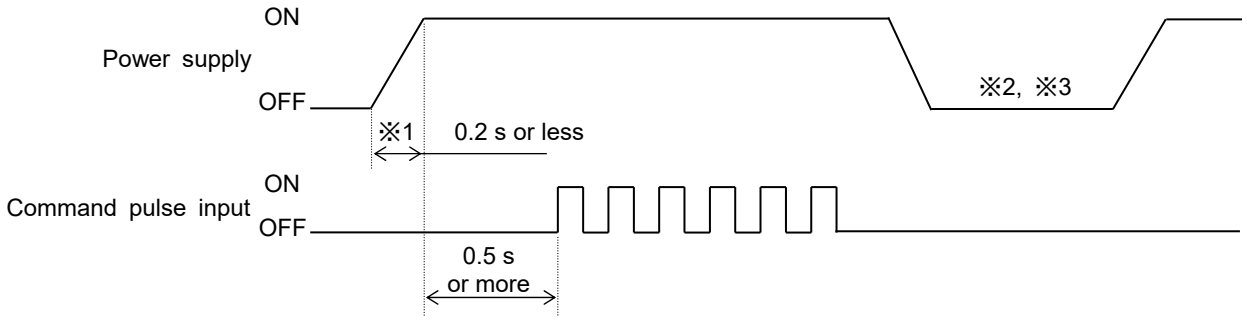
5 Functions

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

5. Functions

5.1 Operation Sequence

■ Power On/Off



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

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

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

5.2 Input Signal Function

This product allows customization of input signal functions and input logic.
The factory default settings are as follows.

- General-purpose input signal IN1: Power down input (PD), signal ON with photocoupler ON (normally open)
- General-purpose input signal IN2: Step angle switching input (SSEL), signal ON with photocoupler ON (normally open)

5.2.1 Power down input (PD)

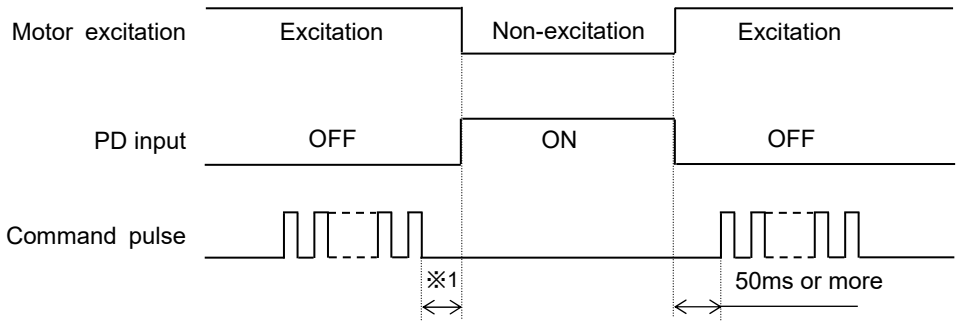
■ Function

Shuts off the motor current.

Before using this function, set the following parameters in the setup software.

- Assign the IN1 signal function selection (Group A: ID02) or IN2 signal function selection (Group A: ID03) to PD. (PD is assigned to the IN1 signal in the standard state at factory pickup.)

■ Timing chart (Power down)



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

5.2.2 Step angle switching input (SSEL)

■ Function

Used to switch the number of steps per motor revolution for each operation.

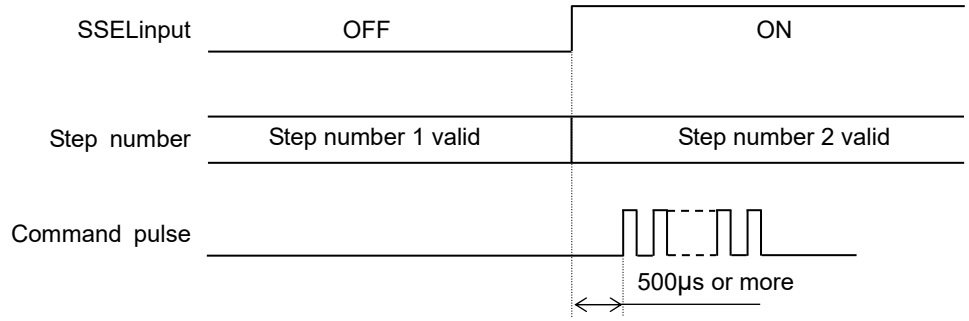
The number of steps includes step number 1, which is set by the step angle selection rotary switch (S.S), and step number 2 (System: ID 00), which is set by the setup software.

SSEL input switches between step number 1 and step number 2.

Before using this function, set the following parameters in the setup software.

- Assign the IN1 signal function selection (Group A: ID02) or IN2 signal function selection (Group A: ID03) to SSEL. (SSEL is assigned to the IN2 signal in the standard state at factory pickup.)

■ Timing chart (Step angle switching)



5.2.3 Current limit input (POWSAVE)

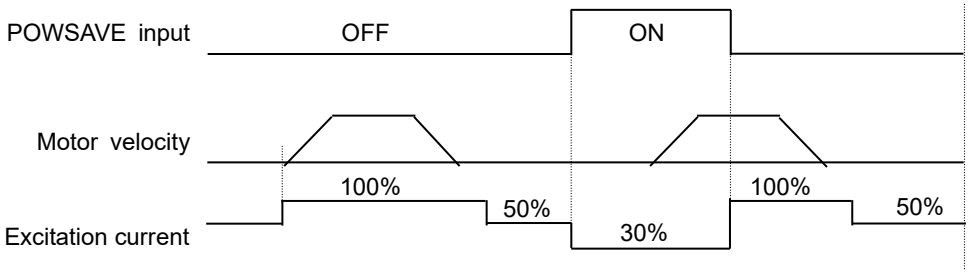
■ Function

Limits the output current to the motor when the signal is ON. Both the running current and the current at stop are limited.

Before using this function, set the following parameters in the setup software.

- Assign IN1 signal function selection (Group A: ID02) or IN2 signal function selection (Group A: ID03) to POWSAVE.
- Specify the limit value with the current limit value (Group 8: ID 00).

■ Timing chart (Example of 100% operating current, 50% current at standstill, 30% current limit)



5.2.4 Alarm clear input (ALMCLR)

■ Function

When the signal changes from OFF to ON, the alarm is cleared if the alarm factor has been removed.

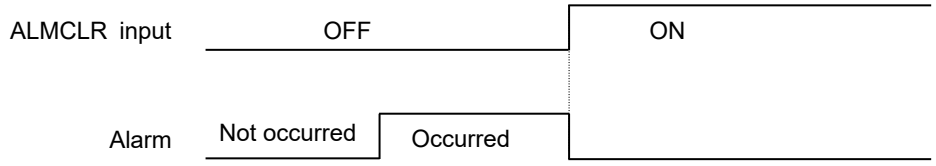
Refer the section 6.2.1 for alarms that can be cleared.

Warnings are not cleared by this signal. To clear a warning, remove the warning factor.

Before using this function, set the following parameters in the setup software.

- Assign the IN1 signal function selection (Group A: ID02) or IN2 signal function selection (Group A: ID03) to ALMCLR.

■ Timing chart



5.2.5 CW limit input (CWLIMIT), CCW limit input (CCWLIMIT)

■ Function

This is a limit sensor signal function to prevent motor overrun.

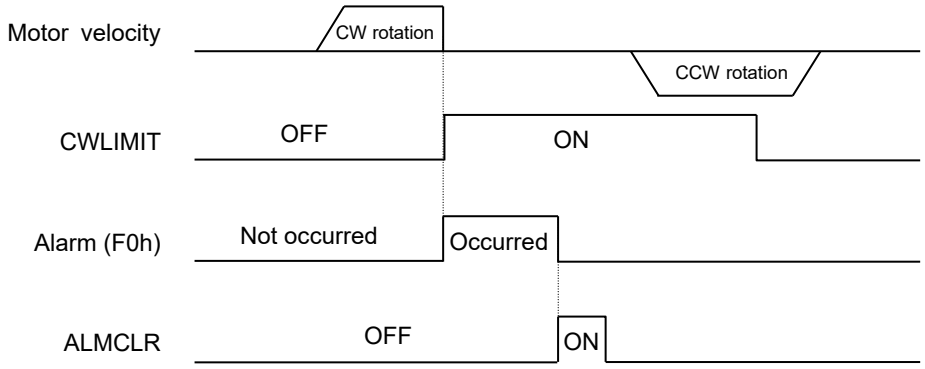
When CWLIMIT is ON, the CCW pulse input is accepted, but the CW pulse input causes a limit reached (F0h) alarm and the motor does not run. After clearing the alarm, move in the CCW direction to get out of the limit sensor range.

Similarly for CCWLIMIT, if CCW pulse is input while it is ON, the limit reached (F1h) alarm occurs.

Before using this function, set the following parameters in the setup software.

- Assign IN1 signal function selection (Group A: ID02) or IN2 signal function selection (Group A: ID03) to CWLIMIT or CCWLIMIT.

■ Timing chart (Example of CW rotation reaching the limit and then CCW rotation after clearing the alarm)



5. Functions

5.3 Output Signal Function

This product allows customization of output signal functions and output logic.
The factory default settings are as follows.

- General-purpose input signal OUT1: Phase origin monitor output (MON), signal ON with photocoupler ON (normally open)
- General-purpose input signal OUT2: Alarm output (ALM), signal ON with photocoupler ON (normally open)

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.

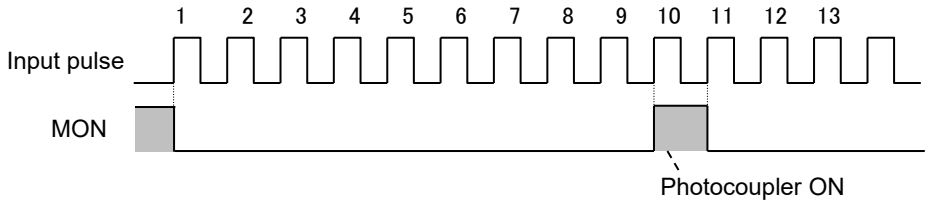
◆ Step division number mode: 5-phase mode

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 60min^{-1} or higher, the signal width will be shortened and will not be output correctly.
(In the case of 5-phase: 60min^{-1} = 500pps input pulse at full step 500P/R)

■ Timing chart

Example) Excitation origin output for the full step setting



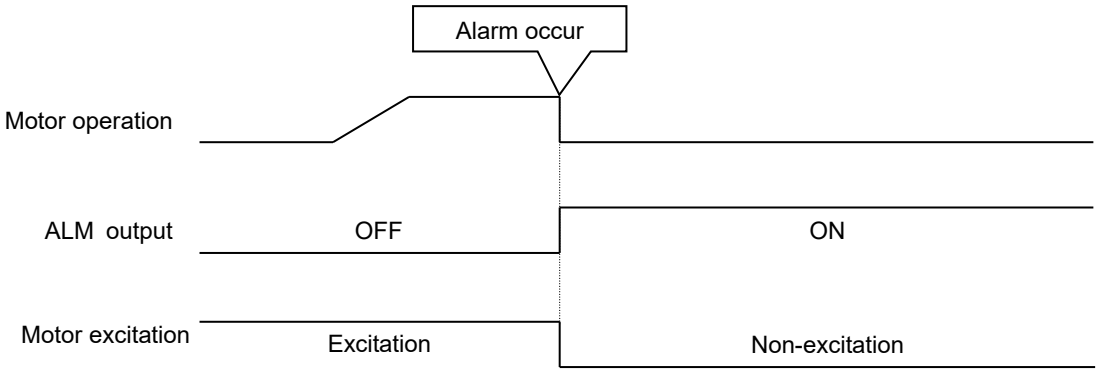
If the number of steps per revolution is switched at a location other than the excitation origin or if the electronic gear is set to a value other than 1/1, the machine may not stop at the excitation origin.

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



5.3.3 Warning output (WRN)

■ Function

This signal indicates the warning status. The photocoupler turns ON during a warning.
The warning does not affect motor operation.
Identify the warning from the number of times the alarm/warning indicator LED blinks and remove the cause. The warning will be removed when the cause disappears.
For details of the warning, refer to "6.2 Troubleshooting in case of alarm".

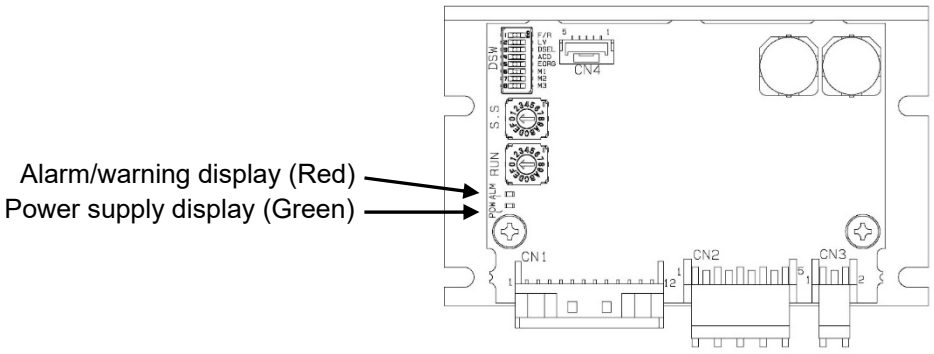
5.3.4 Alarm or warning output (ALMWRN)

■ Function

The photocoupler turns ON when either an alarm or warning occurs.
Identify the alarm/warning from the number of times the LED blinks and remove the cause.
For details of the alarm/warning, refer to "6.2 Troubleshooting in case of alarm".

5. Operation

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".

6 Maintenance

In this chapter, troubleshooting and inspection are explained.

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.

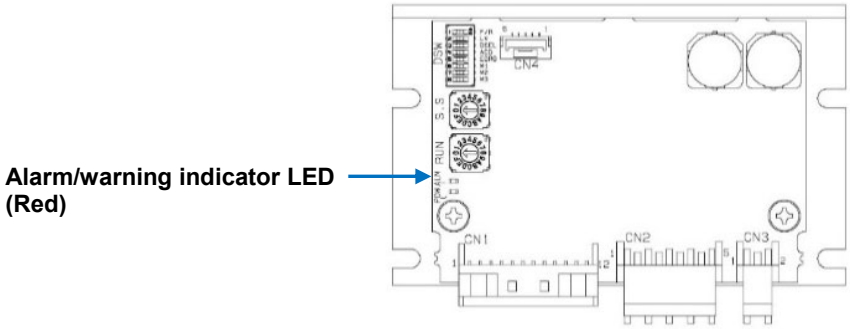
6.2 Troubleshooting in Case of Alarm

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.

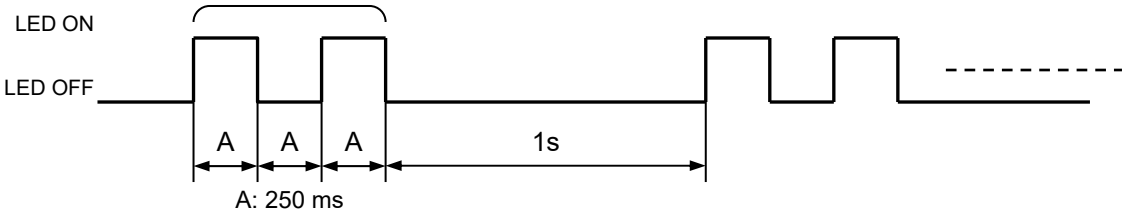
In the case of a warning condition, the LED will be turned ON, but it will not affect motor operation.

6.2.1 List of Alarms and Warnings

In the event of an alarm, identify the alarm from the number of times the alarm/warning indicator LED blinks, remove the cause, and then either turn the power back on or input the alarm clear signal (ALMCLR) to clear the alarm.



Flashes twice in case of main power voltage overvoltage.



6. Maintenance

Table 6.2 Alarm list

ALM blink count	Alarm code	Content	Cause and Action	Alarm clear
1	62h	Main power supply voltage sag	【Cause】 Input power supply voltage below the allowable value. 【Action】 Check the input power supply voltage.	Possible
2	61h	Main power supply overvoltage	【Cause】 Input power supply voltage exceeded the allowable value. 【Action】 Check the input power supply voltage. 【Cause】 The inertial load is too large. 【Action】 If the alarm occurs during operation, lighten the load or lengthen the acceleration/deceleration time.	Possible
3	56h	Driver overheat error	【Cause】 The temperature inside the driver exceeded +80°C (warning: +75°C). 【Action】 Review the driver installation method and ventilation conditions. If the temperature on the side of the heat sink exceeds +70°C, take measures such as forced air cooling using a cooling fan.	Possible
4	21h	Overcurrent error	【Cause】 Excessive current flowed in the output circuit for the motor. 【Action】 Check if the motor, cable, or driver is damaged.	Not possible
5	E2h	Nonvolatile memory checksum error	【Cause】 Data error or access error of nonvolatile memory 【Action】 Contact the dealer where you purchased the product.	Not possible
6	E8h	Hardware error	【Cause】 Driver hardware error 【Action】 Check that there are no problems with the power supply voltage or wiring, and contact the dealer where you purchased the product.	Not possible
7	80h	Motor disconnection	【Cause】 Motor power wire is disconnected. 【Action】 Check the wiring of the motor power line.	Not possible
8	F4h	Parameter error	【Cause】 An unworkable parameter value was set. 【Action】 Set the parameter to an appropriate value and reconnect the power.	Not possible
9	C1h	Command velocity error	【Cause】 Excessive command velocity pulses were input. 【Action】 Check the command profile or the wiring of command pulse input.	Not possible
10	F0h or F1h	Limit reached	【Cause】 The motor stopped due to a limit signal. 【Action】 Move to the position where the limit signal is released.	Possible

Table 6.3 Warning list

ALM blink count	Alarm code	Content	Cause and Action
1	62h	Main power supply voltage sag warning	【Cause】 Input power supply voltage below the allowable value. 【Action】 Check the input power supply voltage.
2	61h	Main power supply overvoltage warning	【Cause】 Input power supply voltage exceeded the allowable value. 【Action】 Check the input power supply voltage.
			【Cause】 The inertial load is too large. 【Action】 If the alarm occurs during operation, lighten the load or lengthen the acceleration/deceleration time.
3	56h	Driver overheat error warning	【Cause】 The temperature inside the driver exceeded +75°C. 【Action】 Review the driver installation method and ventilation conditions. If the temperature on the side of the heat sink exceeds +70°C, take measures such as forced air cooling using a cooling fan.
9	C1h	Command velocity warning	【Cause】 Excessive command velocity pulses were input. 【Action】 Review the drive profile and reduce the speed to prevent equipment damage due to back EMF.
11	FFh	Maintenance and inspection conditions-reached warning	【Cause】 The time or distance that requires maintenance and inspection has been reached. 【Action】 Consider replacing maintenance parts and performing inspections.

6. Maintenance

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.

7

Basic Specifications

In this chapter, basic specifications are explained.

7. Basic Specifications

7.1 Basic Specifications

7.1.1 Driver basic specifications

Driver model number		F2BFD400P1□□ / F5PFD280P1□□
Input power supply		Voltage: 24 VDC±10%, Current: 5 A
Environment	Protection class	Class Ⅲ
	Operating environment	Installation category (Over-voltage category): Ⅰ, Pollution level: 2
	Operating ambient temperature Note)	0 to +50 ℃
	Storage temperature	-20 to +70 ℃
	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^2, when tested X, Y and Z directions for 2 hours in the frequency range between 10 to 55Hz.
	Shock	20 m/s^2
	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, Parameter error, Command velocity error, Limit reached
	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

7.1.2 Motor basic specifications

■ 2-phase motor standard characteristics

Motor model number	Single shaft	SM2561C30B41	SM2562C30B41	SM2563C30B41	SM2564C30B41
	Dual shaft	SM2561C30B11	SM2562C30B11	SM2563C30B11	SM2564C30B11
Holding torque	N·m	0.75	1.4	2.35	2.5
Rotor inertia	$\times 10^{-4}$kg·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	SM2561C40B41	SM2562C40B41	SM2563C40B41	SM2564C40B41
	Dual shaft	SM2561C40B11	SM2562C40B11	SM2563C40B11	SM2564C40B11
Holding torque	N·m	0.75	1.4	2.35	2.5
Rotor inertia	$\times 10^{-4}$kg·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	SH2861-5141	SH2862-5141
	Dual shaft	SH2861-5111	SH2862-5111
Holding torque	N·m	3.3	6.4
Rotor inertia	$\times 10^{-4}$kg·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

■ 5-phase motor standard characteristics

Motor model number	Single shaft	SF5601-9251	SF5602-9251	SF5603-9251
	Dual shaft	SF5601-9221	SF5602-9221	SF5603-9221
Holding torque	N·m	0.5	0.83	1.55
Rotor inertia	$\times 10^{-4}$kg·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	102	97	85

7. Basic Specifications

■ Motor common specifications

Motor model number	SM256☐	SH286☐	SF560☐
Operating ambient temperature	-10 to +50 ℃	-10 to +50 ℃	-10 to +50 ℃ (0 to +40 ℃ for the motor with harmonic gear)
Storage temperature	-20 to +65 ℃		
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^2 (70 to 500 Hz), Sweep time 15 min/cycle, 12 sweeps per X, Y, Z direction		
Shock resistance	Acceleration 500 m/s^2, duration 11 ms, half-sine wave 3 times in each direction of X, Y and Z, total 18 times		
Heatproof class	B (+130℃) (A: UL certified)	B (+130℃)	B (+130℃)
Dielectric withstanding voltage	1120 VAC, 1 minute (between motor winding and frame)	1000 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	—		
Winding temperature rise Note 1)	80K or less (Condition depends on company standards)		
Static angle error	±0.054°	±0.09°	±0.09°
Thrust play Note 2)	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	ϕ0.075mm		
Squareness of mounting surface against the shaft	0.1mm	0.15mm	0.1mm
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).

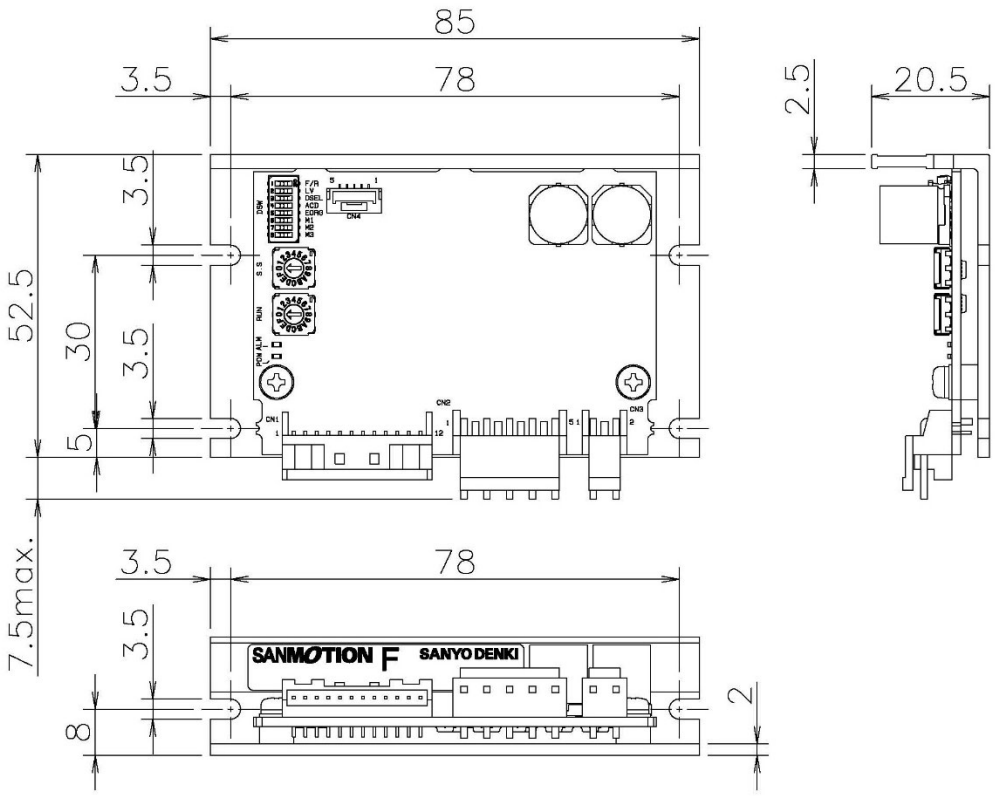
Note 2) Thrust play: Shows the amount of displacement of the shaft position when an axial load is applied to the shaft.

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

7.2.1 Driver outline drawings

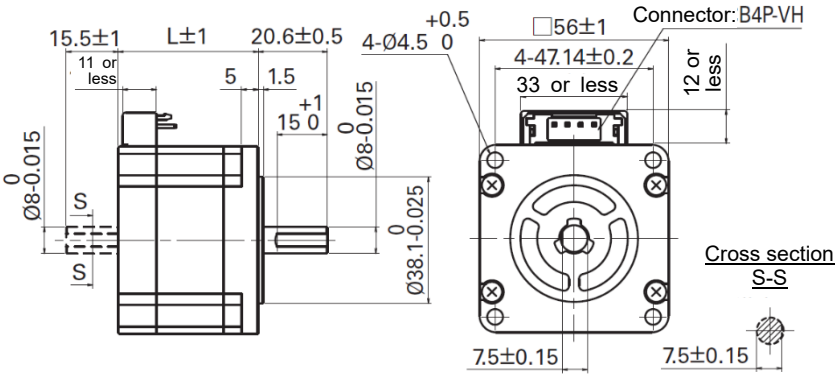
Unit: mm

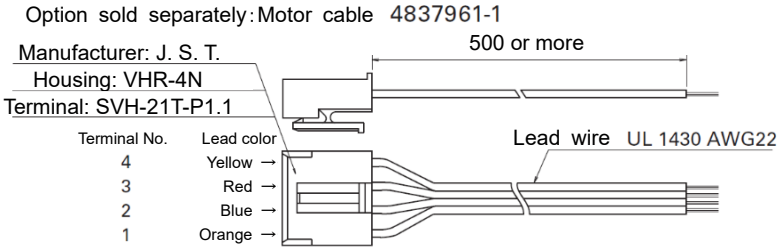


7. Basic Specifications

7.2.2 Motor outline drawings

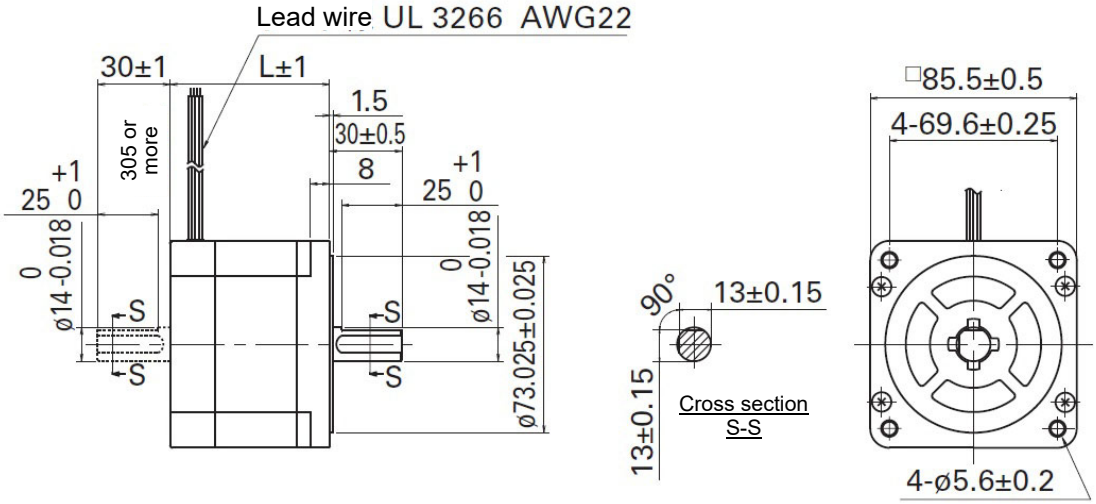
■ SM256☐ (2-phase, 56 mm sq.)





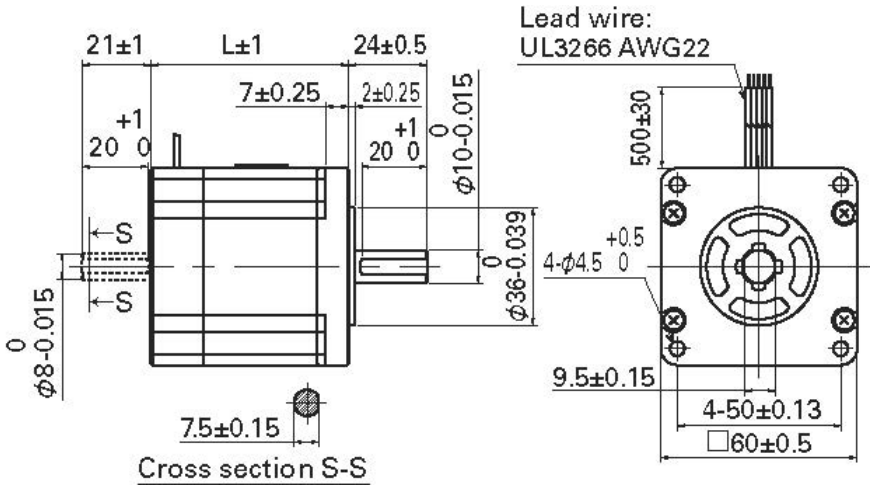
Model number	Motor length (L)
SM2561	41.8 mm
SM2562	53.8 mm
SM2563	75.8 mm
SM2564	85.8 mm

■ SH286☐ (2-phase, 86 mm sq.)



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

■ SF560□ (5-phase, 60 mm sq.)



Model number	Motor length (L)
SF5601	49 mm
SF5602	60 mm
SF5603	89 mm

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8 Options

In this chapter, options are explained.

8. Options

8.1 Option List

Name	Model number	Length
Cable for input/output signals	FC9S0010A	1 m
Cable for motor extension	FC9M0010A (for F2BFD400P1□□)	1 m
	FC9M0010B (for F5PFD280P1□□)	1 m
Cable for power supply	FC9P0010A	1 m
Setup software connection unit	FFM-01U1 (including USB/RS-485 converter FFM-01 and communication cable (between converter and driver)) ※The USB cable to connect the FFM-01 to the PC must be provided by the customer. PC side: USB Type-A FFM-01 side: Micro USB 2.0 Type-B	0.5 m
Setup software (free of charge)	SANMOTION MOTOR SETUP software	―

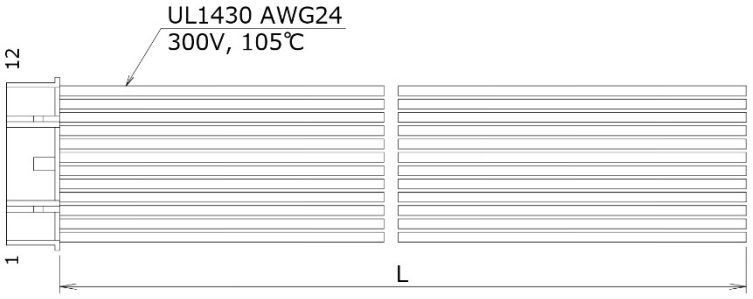
- ◆ If you need a cable length other than the above, please contact us.
- ◆ If you need robot cables, please contact us.
- ◆ For connector models, compatible wires, and connector pin assignments, refer to the section 3.2 and 3.3.

8.2 Cables

■ Cable for input/output signals

Model number: FC9S0010A

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

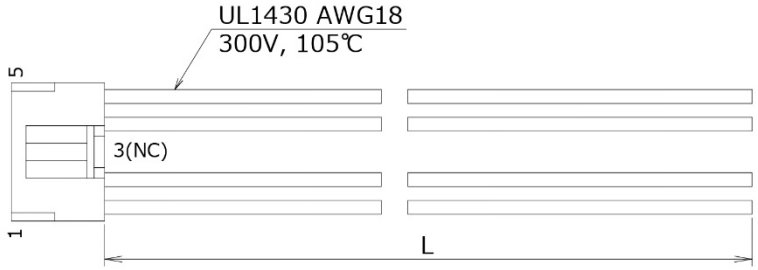


Length (L): 1 m

■ Cable for motor

Model number: FC9M0010A

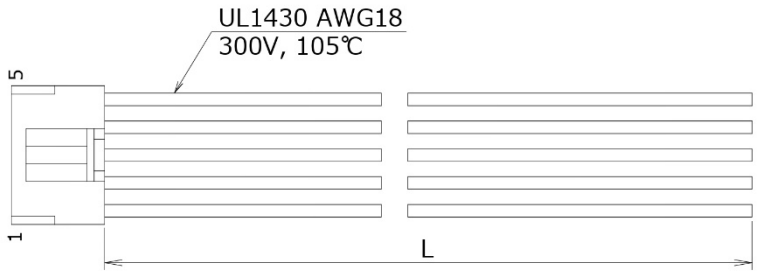
Pin No.	Color
1	Orange
2	Blue
3	(NC)
4	Red
5	Yellow



Length (L): 1 m

Model number: FC9M0010B

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

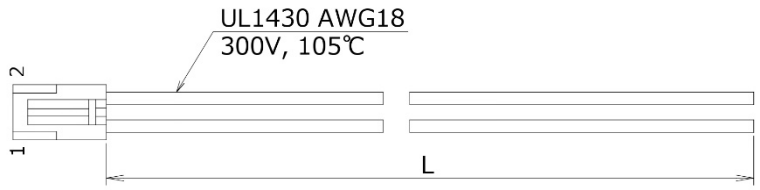


Length (L): 1 m

■ Cable for power supply

Model number: FC9P0010A

Pin No.	Color
1	White
2	Black



Length (L): 1 m

8. Options

8.3 Setup Software

■ SANMOTION MOTOR SETUP software

System environment

PC	IBM PC/AT-compatible
Memory	Space more than 512MB
Hard-disk space	More than 1GB (Including Microsoft .NET Framework 3.5)
Display	More than 1024×768 of resolution/ 32 color-bit
Applicable OS	Windows® 10 Windows® 11 ✔ There is no limit to the edition of operating software.
Required software	The following components are required to operate this software. If they have not been installed before installing this software, they will be automatically installed. ・Microsoft .Net Framework 3.5 ・Crystal Reports Basic Runtime for Visual Studio 2008 ・TDM-GCC ・MATLAB Runtime 9.0
Others	One or more USB ports

◆ Setup software can be downloaded from our website (http://www.sanyodenki.co.jp).

Release
Revision A Jun. 2023

ECO PRODUCTS

■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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