SANMOTION

STEPPING SYSTEMS

F

TYPE P

F5PA□035P100, F5PA□075P100

For Stepping Motor

Instruction Manual

SANYO DENKI

Table of contents

7. Maintenance

8. Specifications

9. Option

10. Safety Standard

No Text on This Page.

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[Safety Precautions]

0. Safety Precautions

0.1 Introduction

The driver and the stepping motor are designed to be used for general industrial equipment. Therefore, note the following precautions.

- To ensure proper operation, thoroughly read the Instruction Manual before installation, wiring and operation.
- Do not modify the product.
- For installation or maintenance, consult our dealer or authorized agency.
- When using the product for the following purposes, special measures, such as system multiplication or emergency power generator installation, should be taken regarding operation, maintenance and management of the product. In this case, consult us.
  - ・Use in medical equipment affecting people's lives.
  - ・Use in equipment that may be lead to physical injury, for example, trains or elevators.
  - ・Use in a computer system that may be socially or publicly influential.
  - ・Use in other equipment related to physical safety or equipment that may affect the functions of public facilities.
- For use in an environment subject to vibration, for example, on-vehicle use, consult us.

Make sure you read all parts of this manual before use (installation, operation, maintenance, inspection, etc.) to properly use the equipment and only start using it after completely understanding all aspects, safety information, and precautions relating to the equipment.
Keep this manual handy after reading it.

0.2 Product Guarantee

This product is guaranteed for 1 year after purchase.
However, the following cases fall outside the terms of the guarantee during the guarantee year and a repair fee must be paid.

- When a mistake is made during use or when caused by unauthorized repair or modifications
- When the fault is caused by something other than the product purchased
- When it is used outside the specification values
- Additionally, when it is caused by a natural disaster, a disaster, or a secondary disaster

In addition, this guarantee only covers damage done to this product and does not cover any damage caused by this product.

0. Safety Precautions

0.3 Meaning of Warning Indication

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.

⚠Caution 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.

0. Safety Precautions

0.4 Safety Precautions

■ Attention in use

⚠ Warning

- 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 10 minutes before performing these tasks.
  Electric shock or damage could otherwise result.
- The protective ground terminal (⏚) should always be grounded to the unit or control board.
  The ground terminal of the motor should always be connected to the protective ground terminal (⏚) of the driver.
  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.

⚠ 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.

0. Safety Precautions

■ Storage

Prohibited

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

Mandatory

◆ Store the products where it is not exposed to direct sunlight, and within the specified temperature and humidity ranges (non-condensing).
For the driver: - 20℃ to + 70℃, below 90% RH
For the motor: - 20℃ to + 60℃,
Less than 40℃, in the below of 95% RH
Less than 50℃, in the below of 57% RH
Less than 60℃, in the below of 35% RH
Damage to the device could otherwise result.

◆ 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.

Mandatory

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

0. 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.
- 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.

0. Safety Precautions

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.

■ 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 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.

0. 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.
- There is no safeguard on the motor. Use an over-voltage safeguard, short-circuit breaker, overheating safeguard, and emergency stop to ensure safe operation.
  Injury or fire could otherwise result.
- Operate within the specified temperature and humidity range.
  Driver
  Temperature 0 to +55℃
  Humidity below 90%RH (non-condensing)
  Stepping motor
  Temperature -10 to +40℃ (0 to +40℃ for harmonic gear equipping motor)
  Humidity below 95%RH (non-condensing)
  Burnout or damage to the device could otherwise result.

0. Safety Precautions

■ Maintenance, Inspection

⚠ Caution

- Some parts of the driver (electrolytic capacitor, cooling fan, fuse, relay kinds) can deteriorate with long-term use. Please contact our offices for replacements.
  Damage to the device could otherwise result.
- Do not touch or get close to the terminal while the device is powered up.
  Electric shock could otherwise result.
- Be careful during maintenance and inspection, as the body of the driver becomes hot.
  Burn could otherwise result.
- Please contact your distributor or sales office if repairs are necessary.
  Disassembly could render the device inoperative.
  Damage to the device could otherwise result.

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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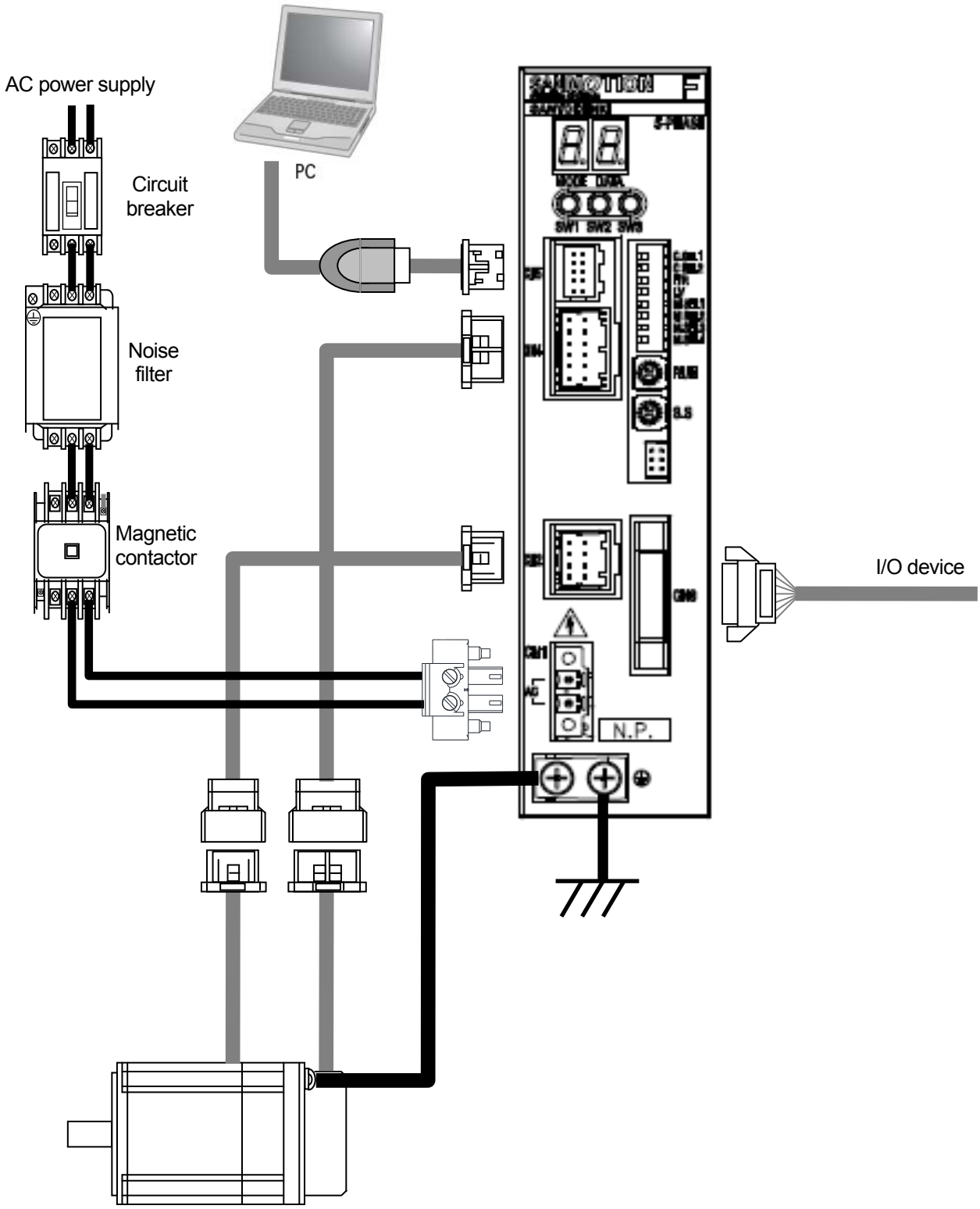
[Prior to use]

1. Prior to use

1.1 System configuration



※ See "3.2 Connector type, applicable wires", for the connectors and applicable wires.

※ See "9. Options", for detail of the options.

※ The setup software and the communication converter unit are needed for the setting of I/O signal functions, Waveform monitoring etc.
See another manual: M0010842 for detail.

1. Prior to use

1.2 Precaution for unpacking

Please note as follows and take out the product.

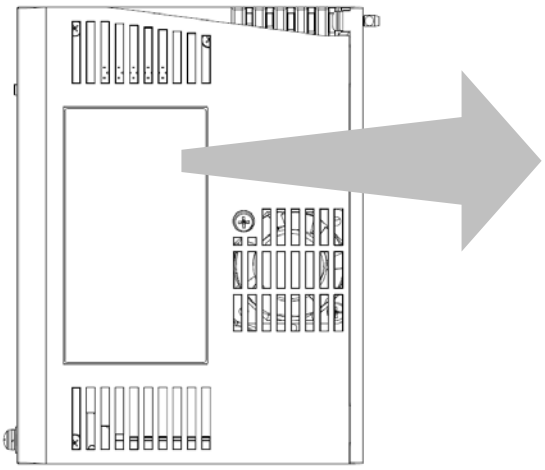
- ■ Please take out the product from box without laying a hand on the connector part of the driver.
- ■ Avoid touching with electrically-charged hand for taking out the driver.

1.3 Product confirmation

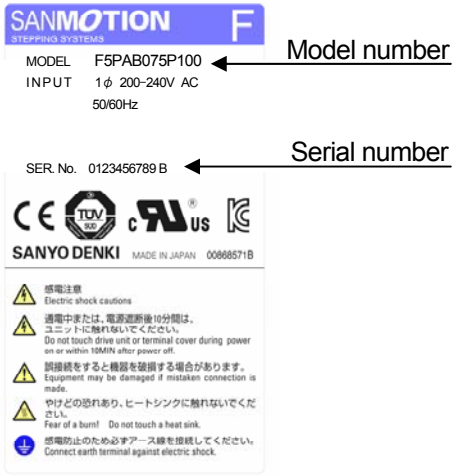
Verify the followings when the product arrives. If you find any discrepancy, contact your distributor or sales office.

- ■ Verify that the model number of the stepping motor or driver is the same as ordered. The model number is located on the main nameplate, following the word: “MODEL”.
- ■ Verify that there is no problem in the appearance of the stepping motor or driver.
- ■ Verify that there are no loose screws on the stepping motor or driver.

Driver



Sample of driver main nameplate



Interpretation of the serial number

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

1.3.1 Bundled item for the set product

Verify the following items are included, when getting the set product.

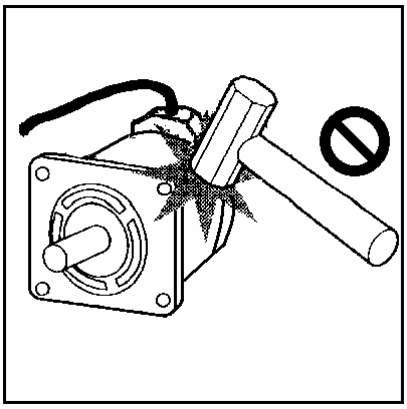
Item	Amount	Model number
Driver	1	F5PA□035P100 or F5PA□075P100
Stepping motor	1	See "1.5.2 Model number of stepping motor".
Power supply connector	1	FC6P0000A
I/O cable	1	FC5S0010A

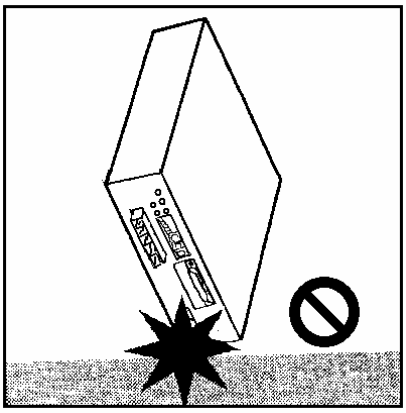
1. Prior to use

1.4 Precautions on Operation

Note the following in use.

■ At installation, do not give shocks to the Stepping motor and the Driver, or they may cause of break.



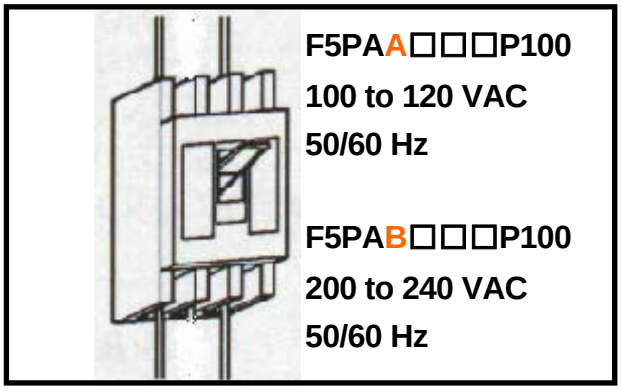


■ Check the model number of the driver, for confirming the power supply voltage.

F5PAA☐☐☐P100 ··· Please use from 100 to 120 VAC (+10% to -15%), 50/60 Hz power supply.

F5PAB☐☐☐P100 ··· Please use from 200 to 240 VAC (+10% to -15%), 50/60 Hz power supply.

If a power supply other than the above is used, an accident may result.



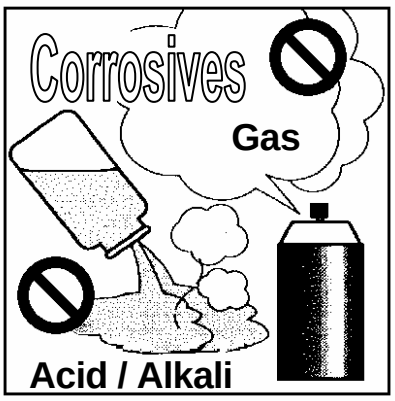
■ When a surge voltage is produced in the power supply, connect a surge absorber or others between the powers to absorb the voltage before operation. Otherwise malfunction or breakage may result.

■ Turn the power on and off during maintenance and inspection after safety (such as the situation of the load) is completely checked. If the power is turned on or off during the load is applied, an accident or breakage may result.

■ Never use this product where corrosive (acid, alkali, etc.), flammable or explosive liquid or gas exists to prevent it from deforming or breaking.

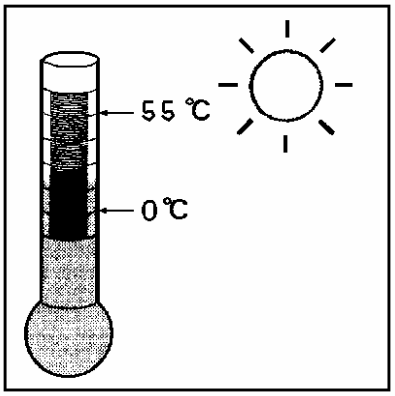
1. Prior to use

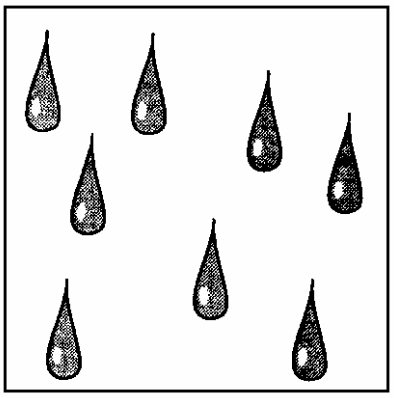
■ Never use this product where flammable or explosive liquid or gas exists since the liquid or the gas may be ignited, causing great danger.



■ Use the driver within the range of ambient temperature from 0 to 55°C (-10 to 40°C for stepping motor) and at an ambient humidity of 90% or less (95% or less for stepping motor).

■ Make sure to keep the stepping motor and driver away from water, cutting fluid, or rainwater. Getting water, cutting fluid or rainwater causes electrical leakage and electrical shock accident.

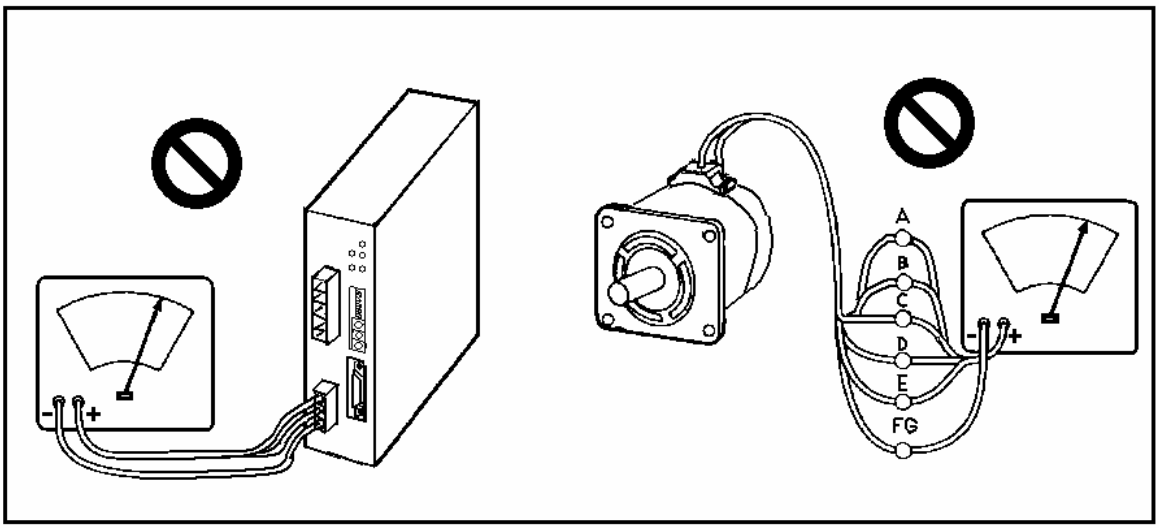




■ For the safety, be sure to confirm that the earth line of stepping motor and driver is grounded through resistance 100 ohm or less.

1. Prior to use

■ Absolutely, do not perform a withstand voltage or a megger test of the Stepping motor or the Driver.



■ Perform correct wiring by referring to the chapter "3. Wiring". Wrong wiring may cause breakage.

■ For safety operation, be sure to install a surge absorber on the relay, electromagnetic contactor, induction motor and brake solenoid coils.

1. Prior to use

1.5 How to Read Model Numbers

1.5.1 Model Number of Set Model

FA5	1	2	M	60	1	S	-	CX	10
①	②	③	④	⑤	⑥	⑦		⑧	⑨

①Power supply specification for the driver

FA5	100 VAC input
FB5	200 VAC input

②Series number

③Rated current specification

1	0.35 A per phase
2	0.75 A per phase

④Kinds of motor

M	UL/CE certificated

⑤Flange size of combination stepping motor

42	□42mm
60	□60mm
86	□86mm

⑥Length of combination stepping motor (Standard model)

Symbol	Motor size					
	□42mm		□60mm		□86mm	
	Model No.	Length	Model No.	Length	Model No.	Length
1	SM5421	35 mm	SM5601	49 mm	SM5861	66 mm
2	SM5422	41 mm	SM5602	60 mm	SM5862	96.5 mm
3	SM5423	49 mm	SM5603	89 mm	SM5863	127 mm

⑦Shaft specification of combination stepping motor

S	Single shaft
D	Dual shaft

⑧Option

XB	with electromagnetic brake
XE	with encoder
CX	with low backlash gear
HX	with harmonic gear

⑨Reduction gear ratio

3.6 to 100	1/3.6 to 1/100

1.5.2 Model Number of Stepping Motor

SM	5	60	1	-	72	40
①	②	③	④		⑤	⑥

①Motor series

SM	UL/CE certificated stepping motor

②Phases of motor

5	5-phase

③Flange size of stepping motor

42	□42mm
60	□60mm
86	□86mm

④Length of stepping motor

Symbol	Motor size					
	□42mm		□60mm		□86mm	
	Model No.	Length	Model No.	Length	Model No.	Length
1	SM5421	35 mm	SM5601	49 mm	SM5861	66 mm
2	SM5422	41 mm	SM5602	60 mm	SM5862	96.5 mm
3	SM5423	49 mm	SM5603	89 mm	SM5863	127 mm

⑤Winding wire specification

32	0.35 A per phase
72	0.75 A per phase

⑥Output shaft type, option

10	Dual shaft
40	Single shaft

※ Please refer "1.6 Standard combination" for the motor model number with encoder /brake.

1. Prior to use

1.5.3 Model Number of driver

F	5	P	A	B	075	P	1	00
①	②	③	④	⑤	⑥	⑦	⑧	⑨

①Series name

F	F series

②Phase

5	5-phase

③Flange size

P	Pentagon winding

④Generation of series

A	First generation

⑤Power supply specification

A	100 VAC input
B	200 VAC input

⑥Maximum current of winding

035	0.35 A per phase
075	0.75 A per phase

⑦Interface

P	Pulse train (photo coupler)

⑧axes

1	Single axis

⑨Individual specification

00	Standard

1. Prior to use

1.6 Standard combination

See below for combination of driver and stepping motor. Wrong combination is not able to operate correctly.

■ Standard model (□ ··· A: 100 VAC input type, B: 200 VAC input type)

Motor size	Shaft spec	Model number of set model	Model number of motor	Model number of driver
□42 mm	Single shaft	F□511M421S	SM5421-3240	F5PA□035P100
		F□511M422S	SM5422-3240	
		F□511M423S	SM5423-3240	
	Dual shaft	F□511M421D	SM5421-3210	
		F□511M422D	SM5422-3210	
		F□511M423D	SM5423-3210	
□60mm	Single shaft	F□512M601S	SM5601-7240	F5PA□075P100
		F□512M602S	SM5602-7240	
		F□512M603S	SM5603-7240	
	Dual shaft	F□512M601D	SM5601-7210	
		F□512M602D	SM5602-7210	
		F□512M603D	SM5603-7210	
□86mm	Single shaft	F□512M861S	SM5861-7240	
		F□512M862S	SM5862-7240	
		F□512M863S	SM5863-7240	
	Dual shaft	F□512M861D	SM5861-7210	
		F□512M862D	SM5862-7210	
		F□512M863D	SM5863-7210	

1. Prior to use

■ Model with electromagnetic brake (□ ··· A: 100 VAC input type, B: 200 VAC input type)

Motor size	Shaft spec	Model number of set model	Model number of motor	Model number of driver
□42 mm	Single shaft	F□511M421S-XB	SM5421-32XB40	F5PA□035P100
		F□511M422S-XB	SM5422-32XB40	
		F□511M423S-XB	SM5423-32XB40	
□60mm		F□512M601S-XB	SM5601-72XB40	F5PA□075P100
		F□512M602S-XB	SM5602-72XB40	
		F□512M603S-XB	SM5603-72XB40	
□86mm		F□512M861S-XB	SM5861-72XB40	
		F□512M862S-XB	SM5862-72XB40	
		F□512M863S-XB	SM5863-72XB40	

■ Model with encoder (□ ··· A: 100 VAC input type, B: 200 VAC input type)

Motor size	Shaft spec	Model number of set model	Model number of motor	Model number of driver
□42 mm	Single shaft	F□511M421S-XE	SM5421-32XE40	F5PA□035P100
		F□511M422S-XE	SM5422-32XE40	
		F□511M423S-XE	SM5423-32XE40	
□60mm		F□512M601S-XE	SM5601-72XE40	F5PA□075P100
		F□512M602S-XE	SM5602-72XE40	
		F□512M603S-XE	SM5603-72XE40	
□86mm		F□512M861S-XE	SM5861-72XE40	
		F□512M862S-XE	SM5862-72XE40	
		F□512M863S-XE	SM5863-72XE40	

1. Prior to use

■ Model with low backlash gear (□ ··· A: 100 VAC input type, B: 200 VAC input type)

Motor size	Shaft spec	Model number of set model	Model number of motor	Model number of driver
□42 mm	Single shaft	F□511M421S-CX3.6	SM5421-32CXA40	F5PA□035P100
		F□511M421S-CX7.2	SM5421-32CXB40	
		F□511M421S-CX10	SM5421-32CXE40	
		F□511M421S-CX20	SM5421-32CXG40	
		F□511M421S-CX30	SM5421-32CXJ40	
		F□511M421S-CX36	SM5421-32CXK40	
	Dual shaft	F□511M421D-CX3.6	SM5421-32CXA10	
		F□511M421D-CX7.2	SM5421-32CXB10	
		F□511M421D-CX10	SM5421-32CXE10	
		F□511M421D-CX20	SM5421-32CXG10	
		F□511M421D-CX30	SM5421-32CXJ10	
		F□511M421D-CX36	SM5421-32CXK10	
□60mm	Single shaft	F□512M601S-CX3.6	SM5601-72CXA40	F5PA□075P100
		F□512M601S-CX7.2	SM5601-72CXB40	
		F□512M601S-CX10	SM5601-72CXE40	
		F□512M601S-CX20	SM5601-72CXG40	
		F□512M601S-CX30	SM5601-72CXJ40	
		F□512M601S-CX36	SM5601-72CXK40	
	Dual shaft	F□512M601D-CX3.6	SM5601-72CXA10	
		F□512M601D-CX7.2	SM5601-72CXB10	
		F□512M601D-CX10	SM5601-72CXE10	
		F□512M601D-CX20	SM5601-72CXG10	
		F□512M601D-CX30	SM5601-72CXJ10	
		F□512M601D-CX36	SM5601-72CXK10	
□86mm	Single shaft	F□512M861S-CX3.6	SM5861-72CXA40	
		F□512M861S-CX7.2	SM5861-72CXB40	
		F□512M861S-CX10	SM5861-72CXE40	
		F□512M861S-CX20	SM5861-72CXG40	
		F□512M861S-CX30	SM5861-72CXJ40	
		F□512M861S-CX36	SM5861-72CXK40	
	Dual shaft	F□512M861D-CX3.6	SM5861-72CXA10	
		F□512M861D-CX7.2	SM5861-72CXB10	
		F□512M861D-CX10	SM5861-72CXE10	
		F□512M861D-CX20	SM5861-72CXG10	
		F□512M861D-CX30	SM5861-72CXJ10	
		F□512M861D-CX36	SM5861-72CXK10	

1. Prior to use

■ Model with harmonic gear (□ ⋯ A: 100 VAC input type, B: 200 VAC input type)

Motor size	Shaft spec	Model number of set model	Model number of motor	Model number of driver
□42 mm	Single shaft	F□511M421S-HX30	SM5421-32HXJ40	F5PA□035P100
		F□511M421S-HX50	SM5421-32HXL40	
		F□511M421S-HX100	SM5421-32HXM40	
	Dual shaft	F□511M421D-HX30	SM5421-32HXJ10	
		F□511M421D-HX50	SM5421-32HXL10	
		F□511M421D-HX100	SM5421-32HXM10	
□60mm	Single shaft	F□512M601S-HX50	SM5601-72HXL40	F5PA□075P100
		F□512M601S-HX100	SM5601-72HXM40	
	Dual shaft	F□512M601D-HX50	SM5601-72HXL10	
		F□512M601D-HX100	SM5601-72HXM10	
□86mm	Single shaft	F□512M861S-HX50	SM5861-72HXL40	
		F□512M861S-HX100	SM5861-72HXM40	
	Dual shaft	F□512M861D-HX50	SM5861-72HXL10	
		F□512M861D-HX100	SM5861-72HXM10	

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2

[Installation]

2. Installation

2.1 Driver Installation

2.1.1 Precaution for installation

Please note followings for driver installation place and method.

Case	Precautions
When installing in a box	The temperature in the box might be higher than the outside temperature depending on the power loss of built-in equipment and the dimensions of the box. Be sure to keep the temperature around the Driver at +55°C (+131°F) or lower by properly determining the dimensions of the box, the cooling system and the arrangement. For a longer lifetime and higher reliability, recommends that operating the Servo Amplifier at an in-box temperature of lower than +40°C(+104°F).
When there is a vibration source nearby	Install the Driver at the base through a shock absorber so that vibration may not be transmitted directly to the Driver.
When there is a heat generating source nearby	Even it there is a possibility that a temperature rise may be caused by convection or radiation, keep the temperature near the Driver lower than +55°C (+131°F).
When there is corrosive gas	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 there is explosive gas or combustible gas	Do not use the Driver in explosive gas or combustible gas atmosphere. Relays and contactors, which generate arcs (sparks) inside boxes, and such parts as regenerative resistor may become ignition sources, causing fires and explosion.
When there is dust or oil mist	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 noise source	Induction noise will 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. Installation

2.1.2 Install direction and part

- Install the driver vertically.
- Fix the upper side part by using attached dedicated screw.

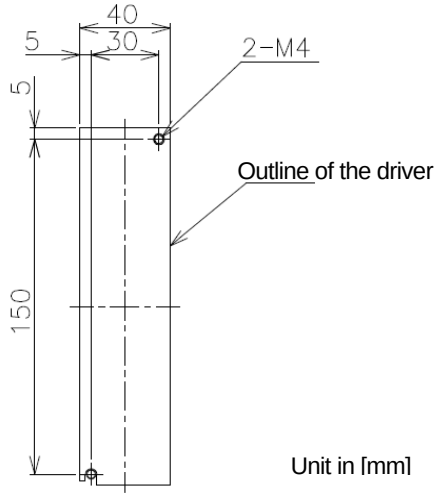

Figure 2.1 Driver installation

2.1.3 Board arrangement conditions

- Leave at least 50 mm space above and below the Driver to ensure unobstructed airflow from the inside of the servo amplifier and the radiator. If heat remains inside of the control box, install a fan to force air to flow.
- Make sure the temperature around the servo amplifier does not exceed +55°C. For longevity and reliability purposes it is recommended to keep the temperature below +40°C.
- Leave at least 10 mm space on both sides of the Driver to ensure unobstructed airflow from the heat sinks on the side and from the inside of the servo amplifier.
- A cooling fan is attached at the side of body. Therefore, it is recommended that the Driver be mounted in an arrangement as shown below.

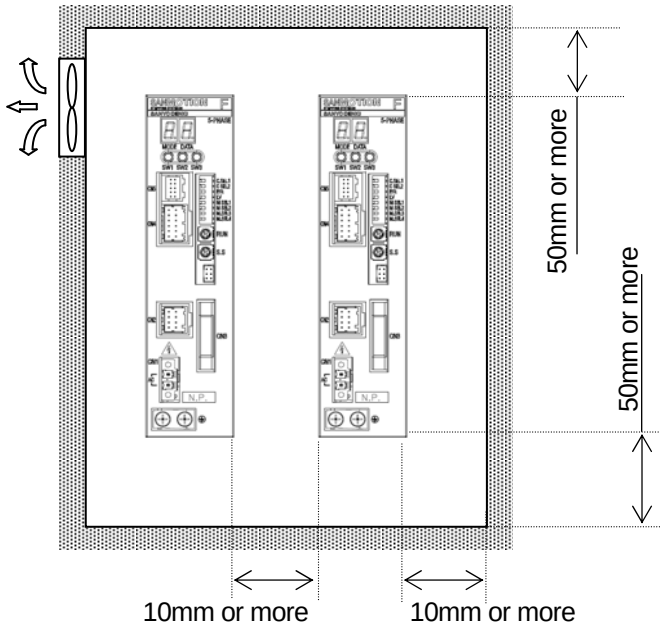

Figure 2.2 Arrangement in a control board

2. Installation

2.2 Stepping Motor Installation

2.2.1 Installation place

Install the stepping motor to indoor with conditions below.

■ In use	Ambient temperature	-10 to +40°C (+14 to +104°F) (0 to +40℃ for harmonic gear equipping motor)
		※Keep the temperature of encoder equipping motor surface to +85℃ or less.
	Ambient humidity	95%RH or less (non-condensing)
■ In storage	Ambient temperature	-20 to +60°C (-4 to +140°F)
	Ambient humidity	Less than 40℃, in the below of 95% RH (non-condensing)
		Less than 50℃, in the below of 57% RH (non-condensing)
		Less than 60℃, in the below of 35% RH (non-condensing)

■ Well-ventilated places without corrosive or explosive gas

■ Places free from dust or foreign materials

■ Places easy to check and clean

■ Always keep away from oil, water or cut liquid.

■ Avoid install to the place which has corrosive (acid, alkali etc), inflammability, explosive liquid or gas, absolutely.

2.2.2 How to install

■ Installation direction

◆ The Stepping motor can be installed horizontally or on/under the end of a shaft.

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

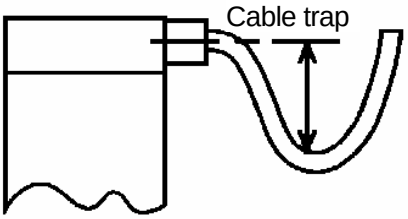

Figure 2.3 Cable trap

◆ Install with using tapped hall at mounting side or mounting hall, and mating part.

Motor flange size	Screws	Recommended tightening torque [N·m]
□42mm	M3 ×4	0.62±0.1
□60mm	M4 ×4	1.43±0.24
□86mm	M5 ×4	2.9±0.48

※ For bolt strength grade 4.8 (JIS B1051)

2. Installation

■ Prevention against Water

The motor protection, as a single unit, satisfies the IEC standard. However, this standard is intended to check performance over a short period of time. So, the following measures against wetting are required for actual usage.

Handle the system carefully, or the connector sheathes may be hit or damaged, deteriorating waterproof function.

■ Linkage to mating machine

- ◆ Perform centering accurately between the motor shaft and the mating machine. Note that when a rigid coupling is used, especially, a slight offset will lead to damage of the output shaft.
- ◆ When installing the motor to the machine, make a mating part precisely so that the motor linkage can be smoothly connected. Also, make the installing surface as flat as possible, or the shaft or the bearing may be damaged.
- ◆ When installing the gear, the pulley, the coupling etc, avoid giving shocks to them.

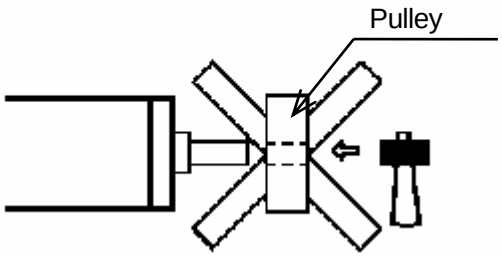

Figure 2.4 Installation of gear etc

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

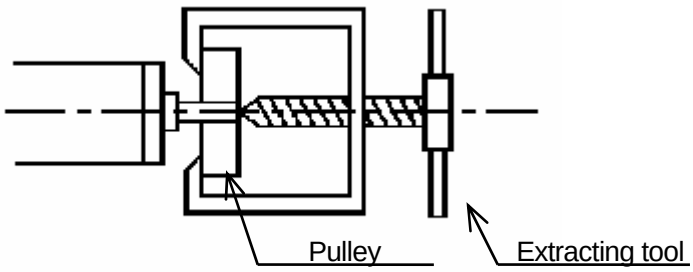

Figure2.5 De-installation of gear etc

2. Installation

■ Allowable Load of Bearing

◆ Please confirm that the load given to a stepping motor, as belt tension etc at belt driving does not exceed allowed value.

Motor Model Number	Allowable radial load [N]	Allowable thrust load [N]
SM5421	56	10
SM5422	54	10
SM5423	52	10
SM5601	191	20
SM5602	183	20
SM5603	170	20
SM5861	200	60
SM5862	200	60
SM5863	200	60

※ Do not apply an excessive thrust or radial load.

【Note】 The values of thrust load and radial load are the allowable value which is giving individually to a shaft. Allowable radial load is the maximum load which is able to give to the end of output shaft. (See the figure below.)

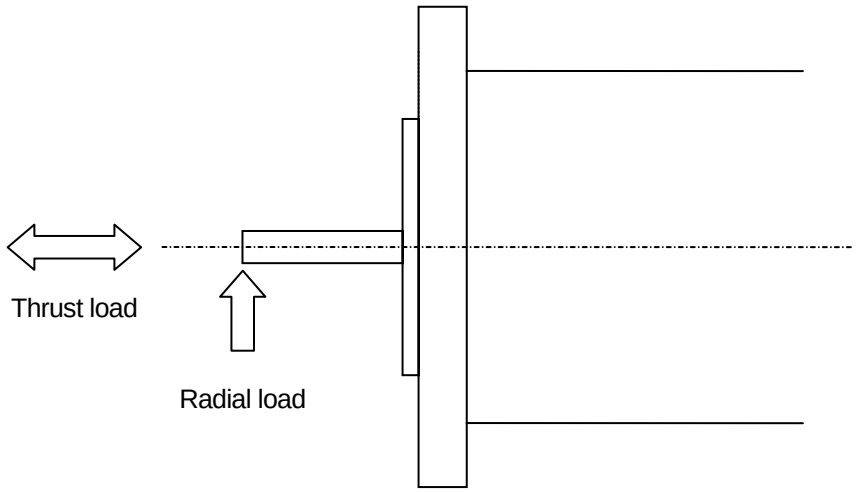

Figure 2.6 Position for the radial load

2. Installation

2.3 Lead Wire Installation

- Be careful not to give stress or damage to the lead wires/cables.
- If arranging lead wires/cables with bent, recommends making inflected radius beyond 8 times cable diameter.
- Do not use lead wires/cables with bending frequently. Please contact us if lead wires/cables are to be used to movable part.
- Arrange cables to the areas where cable insulators shall not be scratched by sharp cutting debris etc. Do not arrange cables to the areas having possibility that machine corner scrapes against cables, or personnel/machines may tread on cables.
- Take measures as clamping to machines, so as not to apply tension or stress.

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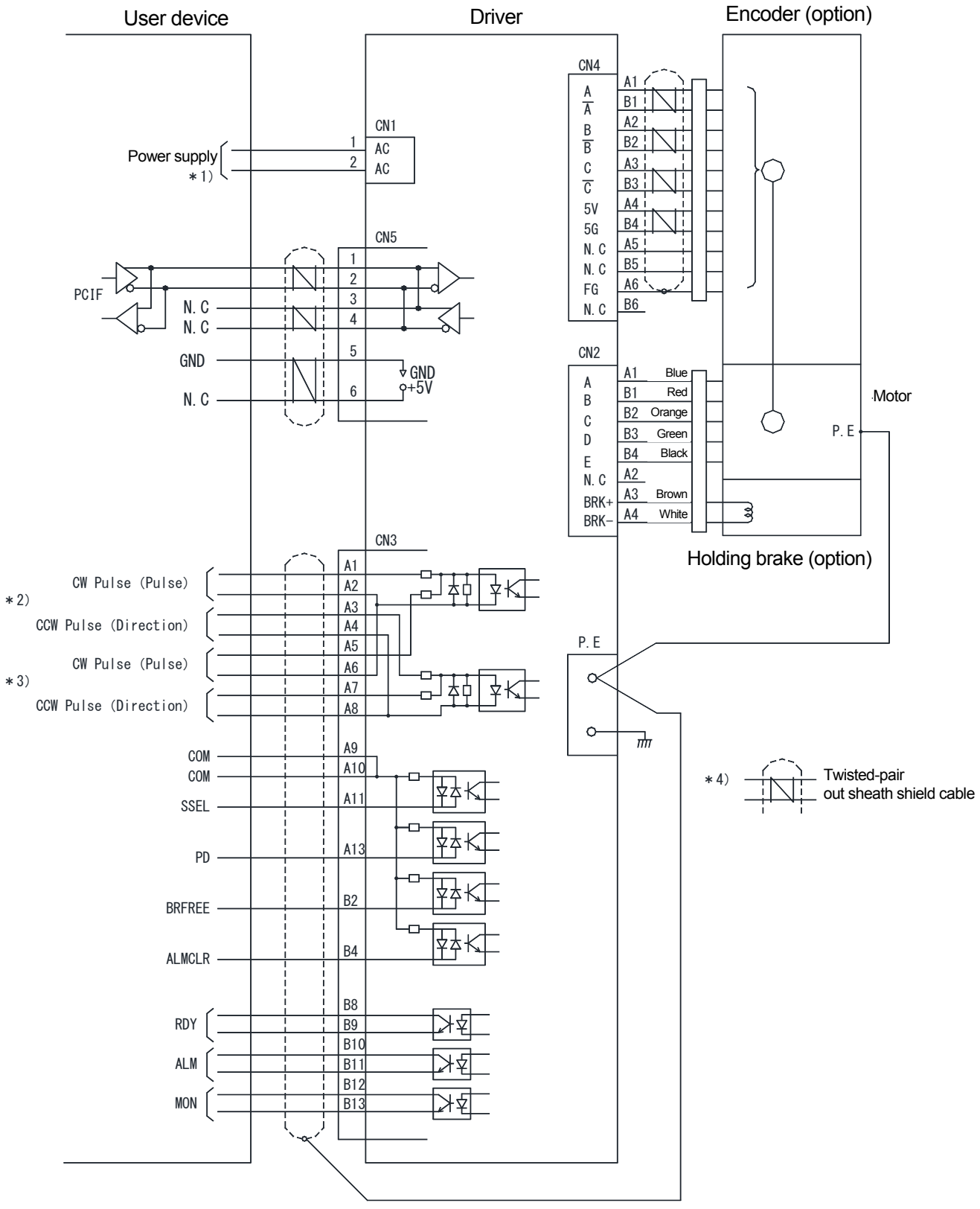
3

[Wiring]

3. Wiring

3.1 External Wiring Diagram



＊1) Refer to the name plate, about power input spec
＊2) Use if upper device is outputting through open-collector circuit
＊3) Use if upper device is outputting through line driver

3. Wiring

3.2 Connector model number, Applicable wire

Application	Symbol	Name	Model number	Applicable wire	Maximum length	Manufacturer
Power supply	CN1	Socket (Driver side)	MC1,5/2-GF-5,08	AWG18 Discrete wire	3m or less	PHOENIX CONTACT
		Plug	MC1,5/2-STF-5,08			
Motor power, Brake	CN2	Tab header (Driver side)	1-1827876-4	AWG18 to 22 Discrete wire	20m or less	Tyco Electronics Japan G.K.
		Plug	1-1827864-4			
		Receptacle contact	1827572-2			
I/O	CN3	Plug (Driver side)	8831E-026-170LD-F	AWG28 (7/0.127)	2m or less	KEL Corporation
		Receptacle	8822E-026-171D			
Encoder	CN4	Tab header (Driver side)	1-1827876-6	AWG22 to 28 Twisted-pair out sheath shield	20m or less	Tyco Electronics Japan G.K.
		Receptacle housing	1-1827864-6			
		Receptacle contact	1827570-2			
Communication	CN5	Shrouded header (Driver side)	S10B-PADSS-1GW	AWG28 to 24 Twisted-pair out sheath shield	2m or less	J.S.T. Mfg. Co.,Ltd.
		Housing	PADP-10V-1-S			
		Contact	SPH-002GW-P0.5S			

※ See manufacturer's catalog for specification detail of connector.

3. Wiring

3.3 Connector pin array and cautions

3.3.1 Connector for AC Power Supply (CN1)

Pin No.	Signal name
1	AC
2	AC

※ Do not wire a power supply cable to same duct along with the cable of motor, I/O and encoder.

※ Power supply connector should be removed after 10 minutes or more from power off. Hot plug might cause of driver damage.

※ For power supply current, inrush current and leakage current, see "8.2 power supply specifications", and prepare circuit breaker, magnetic contactor and noise filter.

3.3.2 Connector for Motor (CN2)

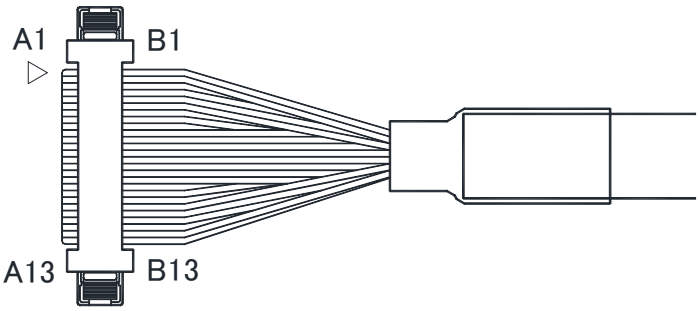
Pin No.	Signal name	Wire color
A1	Motor power, phase A	Blue
B1	Motor power, phase B	Red
A2	―	―
B2	Motor power, phase C	Orange
A3	Holding brake +	Brown
B3	Motor power, phase D	Green
A4	Holding brake -	White
B4	Motor power, phase E	Black

※ Wire color of holding brake is different depending on which polarity is there or not. Wire color of holding brake will be same if there is no polarity.

※ Power supply for holding brake is built into the driver. Also, holding brake is controlled by the driver automatically.

※ Motor power connector should be removed after 10 minute or more from power off. Hot plug might cause of driver damage.

3.3.3 I/O signal connector (CN3)

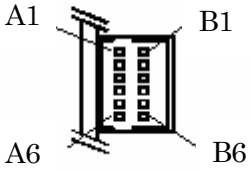


Pin No.	Signal name	Function	Wire color	Mark	Mark color
A1	CW Pulse / Pulse	CW Pulse / Pulse (for open-collector)	Orange		Red
A2					Black
A3	CCW Pulse / DIR	CCW Pulse / Direction (for open-collector)	Gray		Red
A4					Black
A5	CW Pulse / Pulse	CW Pulse / Pulse (for line driver)	White		Red
A6					Black
A7	CCW Pulse / DIR	CCW Pulse / Direction (for line driver)	Yellow		Red
A8					Black
A9	COM	Input common	Pink		Red
A10	COM				Black
A11	SSEL	Step angle selection input	Orange		Red
A12	-	-			Black
A13	PD	Power down input	Gray		Red
B1	-	-			Black
B2	BRFREE	Brake free input	White		Red
B3	-	-			Black
B4	ALMCLR	Alarm clear input	Yellow		Red
B5	-	-			Black
B6	-	-	Pink		Red
B7	-	-			Black
B8	RDY+	Operation preparation completion output	Orange		Red
B9	RDY-				Black
B10	ALM+	Alarm output	Gray		Red
B11	ALM-				Black
B12	MON+	Phase origin monitor output	White		Red
B13	MON-				Black

※ For setting of I/O signal logical and function, the setup software and the communication unit are required. See "4.3 Setup software" and prepare them.

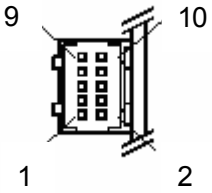
3.3.4 Encoder connector (CN4)

Pin No.	Signal name	Wire color
A1	Phase A+	Blue
B1	Phase A-	Brown
A2	Phase B+	Green
B2	Phase B-	Purple
A3	Phase C+	White
B3	Phase C-	Yellow
A4	VCC	Red
B4	GND	Black
A5	-	-
B5	-	-
A6	FG	Black
B6	-	-



3.3.5 Communication connector (CN5)

Pin No.	Signal name	Wire color
1	A	Yellow
2	B	White
3	(A)	-
4	(B)	-
5	GND	Black
6	(VCC)	-
7	-	-
8	-	-
9	-	-
10	-	-

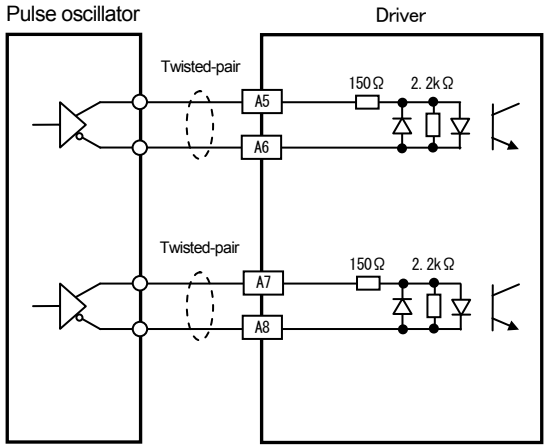
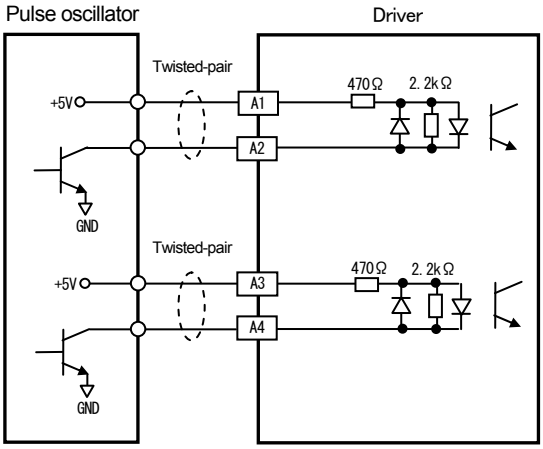


3. Wiring

3.4 I/O signal

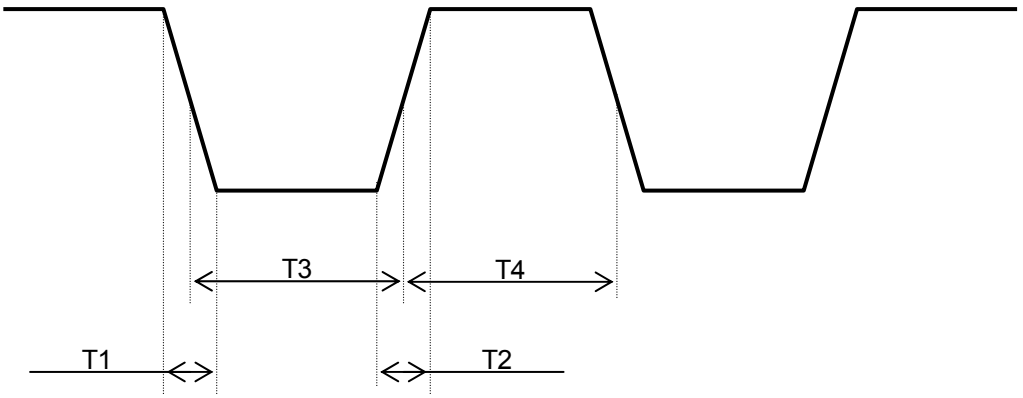
3.4.1 Input signals (CW, CCW)

■ Connection example

Connection with line driver output	Connection with open collector output
Pulse waveform height "H" level: 3 to 3.5 V "L" level: 0 to 0.5 V	Pulse waveform height "H" level: 4.5 to 5.5 V "L" level: 0 to 0.5 V
	

■ Pulse waveform

Maximum response frequency: 400kpulse/s



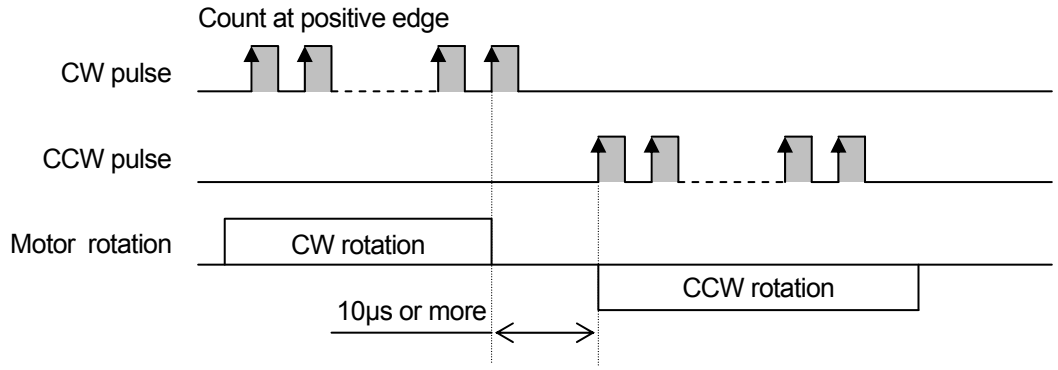
T1, T2≦0.1μs T3, T4≧1μs

※ As note, at higher step division setting, maximum rotation speed operation is not available by limit of the maximum response frequency.

3. Wiring

■ Timing chart

◆ 2 input mode



※ ▒ indicates “photo coupler is ON”.

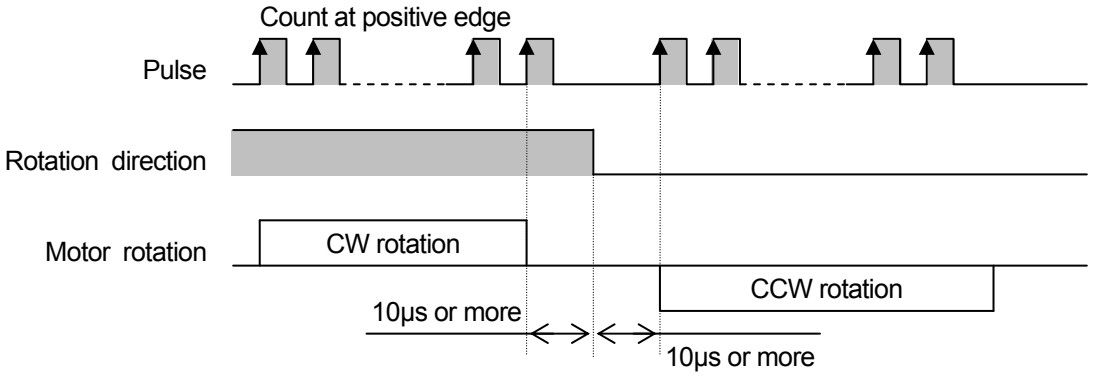
※ CW rotation is clockwise with seeing motor flange face. CCW rotation is counter clockwise with seeing motor flange face.

※ Avoid inputting of CW/CCW pulse at same timing.

※ Rotation direction change time "10μs or more" is the operation time on the internal circuit of driver, not the motor response time. Set it with allowable time of motor response at actual operation.

※ Perform switching of "1 input mode/2 input mode" by the dip switch: F/R.

◆ 1 input mode (Active high)



※ ▒ indicates “photo coupler is ON”.

※ CW rotation is clockwise with seeing motor flange face. CCW rotation is counter clockwise with seeing motor flange face.

※ Rotation direction change time "10μs or more" is the operation time on the internal circuit of driver, not the motor response time. Set it with allowable time of motor response at actual operation.

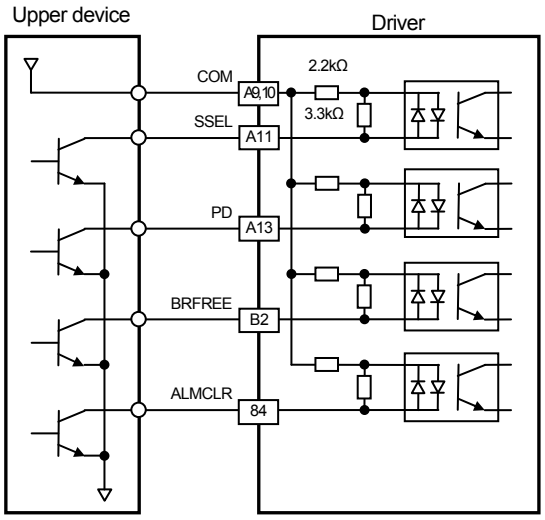
※ Perform switching of "1 input mode/2 input mode" by the dip switch: F/R.

3.4.2 Input signals (SSEL, PD, BRFREE, ALMCLR)

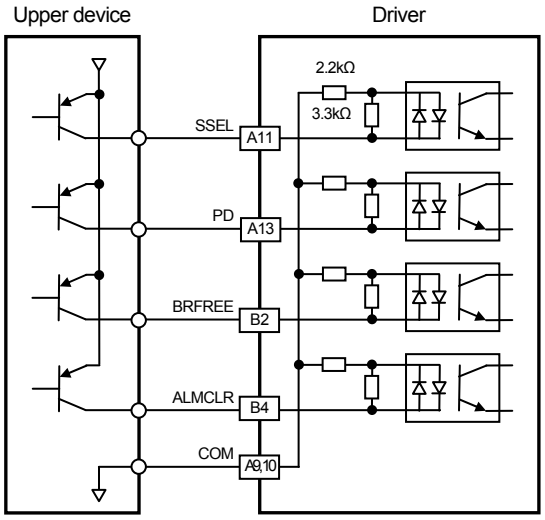
■ Connection example

Power supply voltage range	5 to 24VDC

For current sink output from upper device



For current source output from upper device

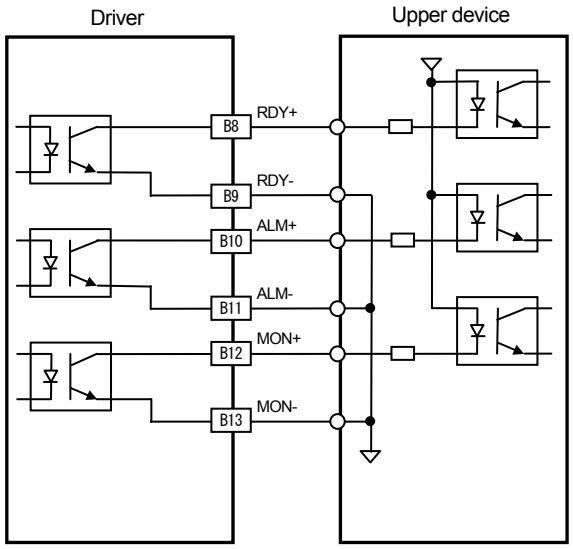


3.4.3 Output signals (RDY, ALM MON)

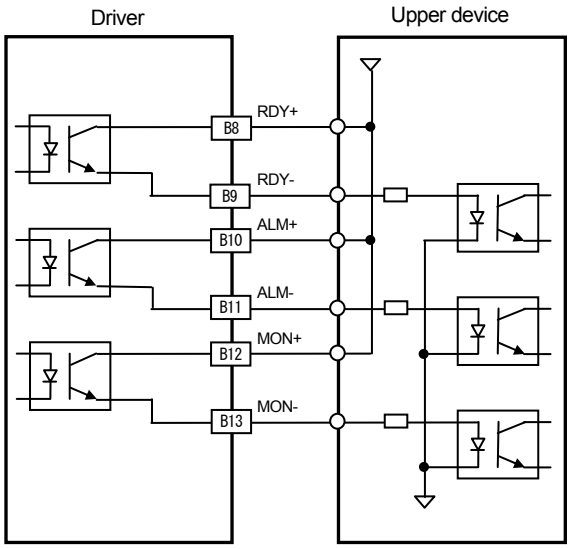
■ Connection example

Power supply voltage range	5 to 24VDC
Maximum current	10mA (Maximum saturation voltage 1.0V or less)

For sink output use



For source output use



3.4.4 I/O signals (CN3) brief specification

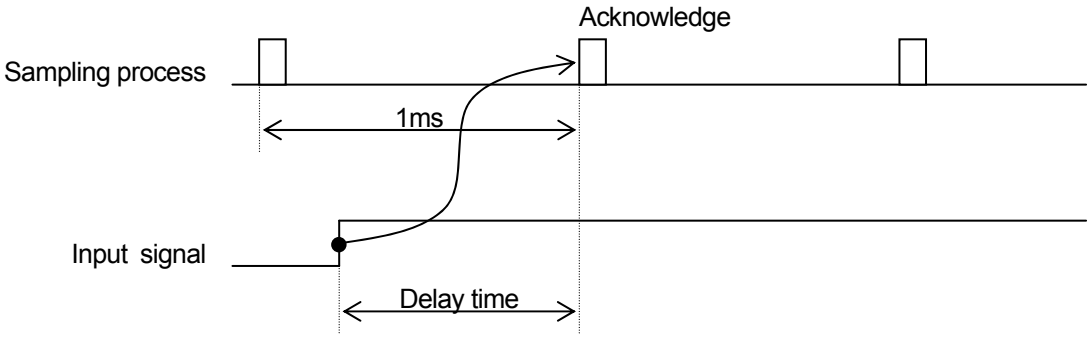
Pin No.	Symbol	Signal name	Description
A1	CW Pulse	CW pulse (for open-collector)	2 input mode Inputs the pulse for CW rotation.
A2			
A1	Pulse	Pulse (for open-collector)	1 input mode Inputs the pulse for motor rotation.
A2			
A3	CCW Pulse	CCW pulse (for open-collector)	2 input mode Inputs the pulse for CCW rotation.
A4			
A3	DIR	Direction (for open-collector)	1 input mode Inputs the rotation direction signal of motor. Internal photo coupler: ON ··· CW direction Internal photo coupler: OFF ··· CCW direction
A4			
A5	CW Pulse	CW pulse (for line driver)	2 input mode Inputs the pulse for CW rotation.
A6			
A5	Pulse	Pulse (for line driver)	1 input mode Inputs the pulse for motor rotation.
A6			
A7	CCW Pulse	CCW pulse (for line driver)	2 input mode Inputs the pulse for CCW rotation.
A8			
A7	DIR	Direction (for line driver)	1 input mode Inputs the rotation direction signal of motor. Internal photo coupler: ON ··· CW direction Internal photo coupler: OFF ··· CCW direction
A8			
A9	COM	Input common	Common for input signals.
A10	COM		
A11	SSEL	Step angle selection input	Enables the division number set by the digital operator or the setup software.
A12	—	—	No use
A13	PD	Power down input	Block the motor current. (Brake is kept.)
B1	—	—	No use
B2	BRFREE	Brake free input	Releasing brake during blocking the motor current.
B3	—	—	No use
B4	ALMCLR	Alarm clear input	Releasing alarm. (See troubleshooting)
B5	—	—	No use
B6	—	—	
B7	—	—	
B8	RDY+	Operation preparation completion output	Outputs the signal (perform the photo coupler-ON), at the status of operation preparation completion (command pulse reception available status).
B9	RDY-		
B10	ALM+	Alarm output	Outputs the signal, at the alarm by alarm circuit in the driver. Please set by the setup software, about output logic. (Initial value: a-contact (normal open))
B11	ALM-		
B12	MON+	Phase origin monitor output	Becomes ON when excitation phase is origin. Becomes ON one time per 10 pulses, at FULL STEP. Becomes ON one time per 20 pulses, at HALF STEP.
B13	MON-		

3. Wiring

3.5 Electronic characteristics of I/O signal circuit

3.5.1 Delay time by sampling cycle

Each input signals have delay time up to 1ms from inputting to knowing by the driver, caused by sampling cycle. Decide control timing considering the delay time.



3.6 Grounding

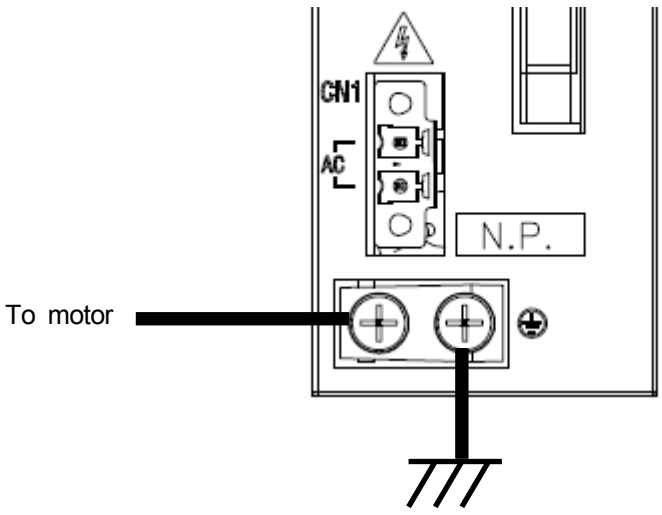
3.6.1 Grounding of driver

■ Must grounding the driver through its earth terminal. Use wire of AWG16 (1.25mm^2) or more, and perform single point ground.

3.6.2 Grounding of stepping motor

■ The current (Cf×dv/dt) flows to the ground through motor floating capacitance (Cf) from PWM control power part of driver when motor is grounded through frame at machine side. To eliminate impact by this current, motor frame must ground to earth terminal of driver. Use wire of AWG18 (0.75mm^2) or more, for motor grounding.

■ When motor wire is in a metal conduit or box, must ground the metal part. Perform ground process as single point ground.



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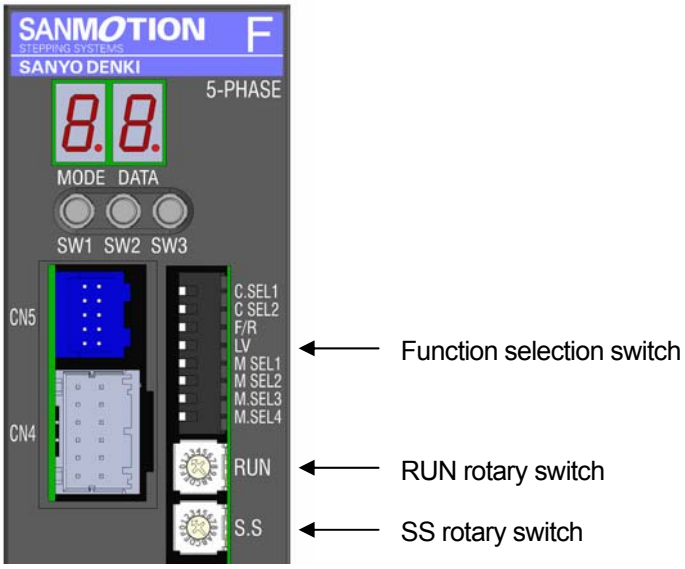
4

[Setting]

4. Setting

4.1 Switch setting



4.1.1 Function selection dip switch

Selects control mode, input pulse mode, low vibration mode and combination motor.

Perform dip switch setting at power off state. Change of dip switch setting is invalid after power on.

SW No.	Symbol	Function	Initial value
8	C.SEL1	Control mode selection	OFF
7	C.SEL2		OFF
6	F/R	Input pulse mode selection	OFF
5	LV	Low vibration mode selection	ON
4	M.SEL1	Combination motor selection	OFF
3	M.SEL2		OFF
2	M.SEL3		OFF
1	M.SEL4		OFF

■ Control mode selection

Selects control mode for stepping motor.

SW8	SW7	Control mode	
C.SEL1	C.SEL2		
OFF	OFF	Open loop control	(Initial value)
ON	OFF	Analysis mode	
OFF	ON	Reserved	
ON	ON	Reserved	

◆ Open loop control

Perform standard stepping motor control.

◆ Analysis mode

Perform same control as open loop control. Step-out detection, velocity monitor, present position monitor etc are available, by adding optional encoder.

4. Setting

■ Input pulse mode selection

Selects Input pulse mode.

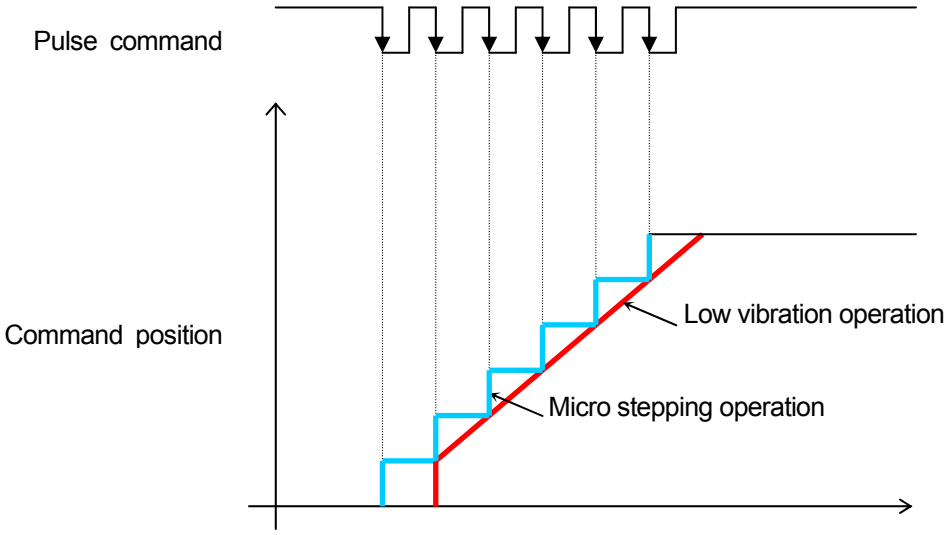
SW6 F/R	Input pulse mode	
OFF	2 input pulse mode (CW/CCW pulse)	(Initial value)
ON	1 input pulse mode (Pulse/Direction)	

■ Low vibration mode selection

Low vibration and smooth operation is able to perform even if setting a rough resolution.

SW5 LV	Operation	
OFF	Micro stepping operation	
ON	Low vibration operation	(Initial value)

※ In case of low vibration mode, operational process of driving pulse will be carried out inside the Driver. Therefore, the Motor movement is delayed the time of 1 pulse against input pulse.



4. Setting

■ Combination motor selection

Selects combination motor with driver.

◆ F5PA□075P1xx

SW4	SW3	SW2	SW1	Motor size	Motor model number
M.SEL1	M.SEL2	M.SEL3	M.SEL4		
OFF	OFF	OFF	OFF	—	Setting prohibition
ON	OFF	OFF	OFF	—	Setting prohibition
OFF	ON	OFF	OFF	—	Setting prohibition
ON	ON	OFF	OFF	—	Setting prohibition
OFF	OFF	ON	OFF	—	Setting prohibition
ON	OFF	ON	OFF	□60mm	SM5601-72xx (Initial value)
OFF	ON	ON	OFF	□60mm	SM5602-72xx
ON	ON	ON	OFF	□60mm	SM5603-72xx
OFF	OFF	OFF	ON	□86mm	SM5861-72xx
ON	OFF	OFF	ON	□86mm	SM5862-72xx
OFF	ON	OFF	ON	□86mm	SM5863-72xx
ON	ON	OFF	ON	—	Setting prohibition
OFF	OFF	ON	ON	—	Setting prohibition
ON	OFF	ON	ON	—	Setting prohibition
OFF	ON	ON	ON	—	Setting prohibition
ON	ON	ON	ON	—	Setting prohibition

◆ F5PA□035P1xx

SW4	SW3	SW2	SW1	Motor size	Motor model number
M.SEL1	M.SEL2	M.SEL3	M.SEL4		
OFF	OFF	OFF	OFF	□42mm	SM5421-32xx (Initial value)
ON	OFF	OFF	OFF	□42mm	SM5422-32xx
OFF	ON	OFF	OFF	□42mm	SM5423-32xx
ON	ON	OFF	OFF	—	Setting prohibition
OFF	OFF	ON	OFF	—	Setting prohibition
ON	OFF	ON	OFF	—	Setting prohibition
OFF	ON	ON	OFF	—	Setting prohibition
ON	ON	ON	OFF	—	Setting prohibition
OFF	OFF	OFF	ON	—	Setting prohibition
ON	OFF	OFF	ON	—	Setting prohibition
OFF	ON	OFF	ON	—	Setting prohibition
ON	ON	OFF	ON	—	Setting prohibition
OFF	OFF	ON	ON	—	Setting prohibition
ON	OFF	ON	ON	—	Setting prohibition
OFF	ON	ON	ON	—	Setting prohibition
ON	ON	ON	ON	—	Setting prohibition

※ If prohibition setting is performed, alarm will occur and correct operation is not available.

4.1.2 RUN rotary switch

Sets motor current. See "5.2 Adjustment" for detail of motor current.

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

4.1.3 SS rotary switch

Sets the step amount (Step division number 1) per a motor rotation.

Either step division number 1 or 2 are able to select which is valid, by SSEL input.

SSEL =Non-Active: Step division number 1 (SS rotary switch) is valid

SSEL =Active: Step division number 2 (System: ID 00) is valid

Step division number 1 will be always valid if SSEL is not used. See "4.3.3 Parameters detail" for step division number 2.

By the step division mode (System: ID 01), 2-phase system and 5-phase system are able to switch. See "4.3.3 Parameters detail" for step division mode.

Set electronic gear (Group8 ID02, 03), if division number which is not there in table below is desired. See "4.3.3 Parameters detail" for electronic gear.

Initial value: 5-phase system_1 (1000 P/R)

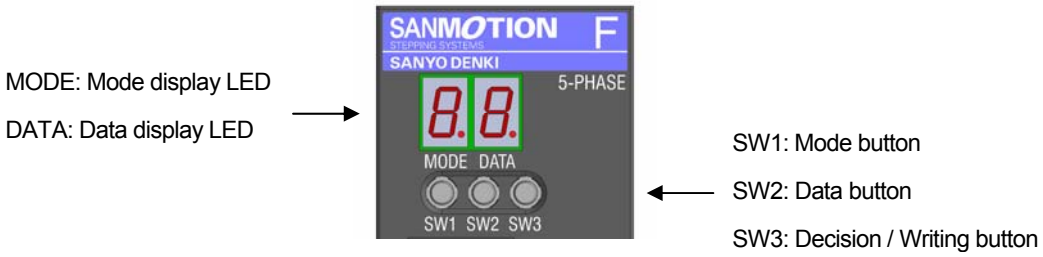
SS set value	0	1	2	3	4	5	6	7
2-phase system [P/R]	200	400	800	1000	1600	2000	3200	5000
5-phase system [P/R]	500	1000	1250	2000	2500	4000	5000	10000
SS set value	8	9	A	B	C	D	E	F
2-phase system [P/R]	6400	10000	12800	20000	25000	25600	50000	51200
5-phase system [P/R]	12500	20000	2500	40000	50000	62500	100000	125000

4. Setting

4.2 Digital operator

4.2.1 Names and functions of each part

The digital operator built into driver is able to setting of some parameters and doing JOG operation. Below shows names and functions of each part.



■ MODE (Mode display LED)

Indicates number of present mode.

Mode list

Mode	Function
0	Driver status display
1	Reserved
2	Reserved
3	Reserved
4	Current value setting at motor stop
5	Step division mode setting
6	Step division number 2 setting
7	Holding brake setting
8	JOG operation speed
9	JOG operation
A	Alarm code display
B	Settling-control parameter setting

■ DATA (Data display LED)

Indicates monitor value, parameter set value etc.

It will blink if present indicating parameter value differs from the set value.

4. Setting

■ SW1 (Mode button)

Mode will change alternately per single push of mode button. (0→1→2…B→0…)

However, unusable mode will be skipped.

When button has not operated during 1 minute, the mode will be transit to 0 (to A during alarming) automatically.

The mode will be transit to A automatically when alarm occurs.

■ SW2 (Data button)

The function of Data button will differ depending on the mode.

Mode	Function
0, A	Data button is invalid.
1 to 8, A	The data value will increment per single push. Next of maximum value is minimum value.
9	JOG operation is performed to CW direction with pushing button, and stops by releasing button.

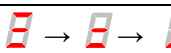
■ SW3 (Decision / Writing button)

The function of Decision button will differ depending on the mode.

Mode	Function
0, A	Decision / Writing button is invalid.
1 to 8, B	Decide present display value of the data LED as set value.
9	JOG operation is performed to CCW direction with pushing button, and stops by releasing button.

4.2.2 Modes detail

■ MODE 0

Driver status display	
Indicates present status of driver.	
Data LED	Driver status
	While driver initializing, or while alarm occurring
Continue drawing "8" character alternately.	Motor operation enabled status (Servo on)
	While emergency stopping (Servo off)

■ MODE 1

Reserved			
Setting range		Set unit	
Setup software-supported parameter			
MODE 1 will be reserved for future. Normally, do not change this parameter at customer side.			

■ MODE 2

Reserved			
Setting range		Set unit	
Setup software-supported parameter			
MODE 2 will be reserved for future. Normally, do not change this parameter at customer side.			

■ MODE 3

Reserved			
Setting range		Set unit	
Setup software-supported parameter			
MODE 2 will be reserved for future. Normally, do not change this parameter at customer side.			

■ MODE 4

Current value at motor stop			
Setting range	0 to F	Set unit	Same as RUN rotary switch setting
Setup software-supported parameter	Group 8: ID 01		Initial value: A (50% of RUN set value)

Sets the current value for auto-current-down.

Lower the value, reduce heat generation at motor stop.

Relation between torque (stall torque) and current value at motor stop will be near to proportional.

As note, when offset load like vertical axis is there, hunting may occur by lower value.

※Auto-current-down is the function that reduces motor current at motor stop.

After inputting last pulse, the time which is performed the auto-current-down function is set at "Current down time (Group8: ID05)". See "4.3.3 Parameters detail" for the current down time.

Set "0" when auto-current-down function is not used.

■ MODE 5

Step division mode			
Setting range	2 to 5	Set unit	2: 2-phase system
Setup software-supported parameter	SYSTEM: ID 01		5: 5-phase system Initial value: 5 (5-phase system)

Set the system of step division.

This series is 5-phase stepping system, but able to set the division number equivalent of 2-phase.

Power cycle is required if Step division mode is changed.

■ MODE 6

Step division number 2			
Setting range	0 to F	Set unit	Same as SS rotary switch setting
Setup software-supported parameter	SYSTEM: ID 00		Initial value: 0

Sets the step division number 2.

If the step division number is desired to change for each operation, step division number 1 and 2 are able to switch by EXT signal at the input port.

Power cycle is required if Step division number 2 is changed.

(Step division number 1 is set by SS rotary switch.)

■ MODE 7

Excitation selection			
Setting range	0 to 1	Set unit	0: Excitation origin 1: Excitation phase at shut off power Initial value: 0 (Excitation origin)
Setup software-supported parameter	Group B: ID 01		

Selects excitation phase at power on.

Name	Function
Excitation origin	At the driver power on, motor will rotate maximum 3.6 degree.
Excitation phase at shut off power	Excites at the position that was shut off power in previous time.

■ MODE 8

JOG operation speed			
Setting range	1 to F	Set unit	100 [min^{-1}/LSB] Initial value: 1 (100 min^{-1})
Setup software-supported parameter	-		

Sets the speed at JOG operation (MODE 9).

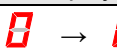
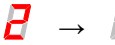
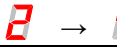
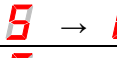
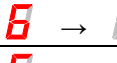
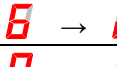
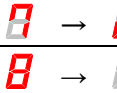
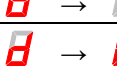
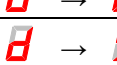
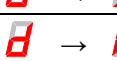
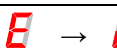
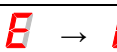
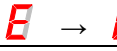
■ MODE 9

Jog operation
Able to operate motor without pulse command input. Operate with set speed at the JOG operation speed (MODE 8). (Data display LED shows the JOG operation speed). Accel/decel will be 200 [min^{-1}/s]. Rotates to CW during pushing SW2. Rotates to CCW during pushing SW3.

4. Setting

■ MODE A

Alarm code display
Indicates the alarm code.

Data display LED	Alarm code	Description
	00h	Normal state
	21h	Main circuit power device error
	27h	Fan stop
	56h	Driver internal overheat
	61h	Overvoltage
	62h	Main circuit voltage sag
	72h	Control power voltage error
	81h	Encoder connector disconnection
	D8h	Step-out
	D9h	Velocity deviation error
	DFh	Test mode completion
	E2h	Memory error
	E6h	System parameter error
	E8h	CPU and around circuit error

See "7.3 Troubleshooting at alarm occurrence" for detail of alarm.

■MODE B

Settling –control parameter			
Setting range	0 to F	Set unit	[ms]
Setup software-supported parameter			Initial value: 0

It is able to suppress overshoot/undershoot at motor starting/stopping.

Settling-control is not performed if parameter "0" is set.

Settling-control is valid if parameter "1" or more is set.

Larger the set value, increase effect of settling-control, but increase delay against command pulse.

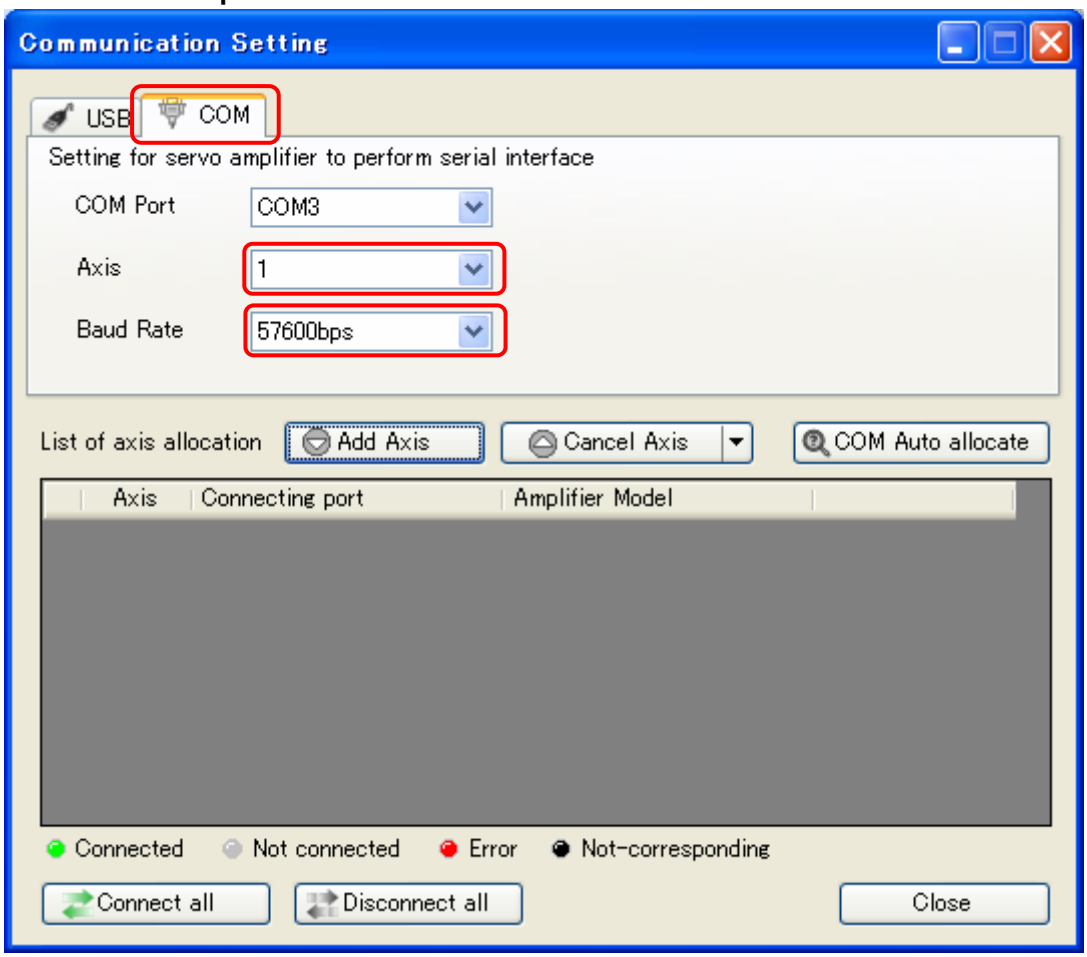
For this parameter change, perform without command pulse input.

Parameter change with command pulse input, will be cause of position gap.

4. Setting

4.3 Setup software

4.3.1 How to use the setup software



Focus to COM tab and select axis number 1. Select baud rate 57600bps. As note, the other settings except above are not able to communicate with the driver.

See another document: M0010842 for detail of how to use the setup software.

4.3.2 Parameter list

■ System parameter

ID	Symbol	Name	Standard setting	Unit	Referring page
00	SS2	Step division number 2	8	-	4-13
01	DSEL	Step division mode	5PH_MODE	-	4-13
02	ENRES	Encoder resolution	4000	P/R	4-13

■ Group 1 Basic control parameter

ID	Symbol	Name	Standard setting	Unit	Referring page
00	SMAFIL	Movement averaging filter size	0	-	4-14
01	FOLFIL	Settling-control parameter	0	ms	4-14

■ Group 8 Control system

ID	Symbol	Name	Standard setting	Unit	Referring page
00	ISTOP	Current value at motor stop	50%	-	4-15
01	EGN	Electronic gear numerator	1	-	4-15
02	EGD	Electronic gear denominator	1	-	4-15
03	PLSINSEL	Pulse command logic selection	L_ACTIVE	-	4-16
04	CDTIME	Current down time	100	ms	4-16

■ Group A I/O port

ID	Symbol	Name	Standard setting	Unit	Referring page
00	HMSEL	MON output selection	PHASE	-	4-17
01	INLOG	Input port logic	0	-	4-17
02	OUTLOG	Output port logic	0	-	4-17

■ Group B Sequence/ Alarm relations

ID	Symbol	Name	Standard setting	Unit	Referring page
00	SOTH	Step-out detection value	7.2	deg	4-18
01	EORG	Excitation selection	0	-	4-18
02	BONDLY	Holding brake wait time	100	ms	4-18
03	BOFFDLY	Releasing brake wait time	60	ms	4-18

4.3.3 Parameters detail

■ System parameter

ID:00	Step division number 2		
	Setting range	Std set value	Set unit
	0 to 15	0	Same as SS rotary switch setting
Sets the step division number 2. If the step division number is desired to change for each operation, step division number 1 and 2 are able to switch by SSEL signal at the input port. Power cycle is required if Step division number 2 is changed. (Step division number 1 is set by SS rotary switch.)			

ID:01	Step division mode		
	Setting range	Std set value	Set unit
	2, 5	5	2: 2-phase system 5: 5-phase system
Set the system of step division. This series is for 2-phase stepping motor, but step division of 5-phase equivalent is able to set. Power cycle is required if Step division mode is changed.			

ID:02	Encoder resolution		
	Setting range	Std set value	Set unit
	0 to 65535	4000	P/R
Sets the encoder resolution for feedback connected to the stepping motor. Power cycle is required if Encoder resolution is changed.			

4. Setting

■ Group 1 [Basic control parameter]

ID:00	Movement averaging filter size		
	Setting range	Std set value	Set unit
	0 to 3	0	0: without filter 1: fc = 9ms 2: fc = 18.75ms 3: fc = 37.5ms
Inputs the movement averaging filter against pulse command input. For this parameter change, perform without command pulse input. Parameter change with command pulse input, will be cause of position gap.			

ID:01	Settling –control parameter		
	Setting range	Std set value	Set unit
	0 to 15	0	
It is able to suppress overshoot/undershoot at motor starting/stopping. Settling-control is not performed if parameter "0" is set. Settling-control is valid if parameter "1" or more is set. Larger the set value, increase effect of settling-control, but increase delay against command pulse. For this parameter change, perform without command pulse input. Parameter change with command pulse input, will be cause of position gap.			

■ Group 8 [Control system]

ID:01	Current value at motor stop		
	Setting range	Std set value	Set unit
	0 to 15	10	Same as RUN rotary switch setting

Sets the current value for auto-current-down. See "4.1.2 RUN rotary switch", for the setting value.

Lower the value, reduce heat generation at motor stop.

Relation between torque (stall torque) and current value at motor stop will be near to proportional.

As note, when offset load like vertical axis is there, load may fall down by lower value.

※ Auto-current-down is the function that reduces motor current at motor stop.

After inputting last pulse, the time which is performed the auto-current-down function is set at "Current down time (Group8: ID05)". See "4.3.3 Parameters detail" for the current down time.

Set "0" when auto-current-down function is not used.

ID:01	Electronic gear numerator		
ID:02	Electronic gear denominator		
	Setting range	Std set value	Set unit
	1 to 32768 / 1 to 32768	1 / 1	-

If desired step resolution is not in the setting list, any resolution can use by electronic gear.

Desired resolution is able to set to range from 50 to 1,500,000 P/R. As note, alarm will occur when set value exceeds this range.

◆ Calculation for electronic gear

Step resolution = Desired resolution × Electronic gear

(Example) For 360P/R use

Set the step resolution 500(SS rotary switch = 0), and set the electronic gear 25/18.

Power cycle is necessary if Electronic gear setting is changed.

Excitation origin is not able to use if the other setting of electronic gear: 1/1 is set.

ID:04	Pulse command logic selection		
	Setting range	Std set value	Set unit
	0 to 1	0	0: Negative logic 1: Positive logic
Sets input logic of command pulse. Please set depending on pulse generator in use. Power cycle is necessary if Pulse command logic selection is changed.			

ID:07	Current down time		
	Setting range	Std set value	Set unit
	0 to 65535	100	ms
Sets the time of current value switching to current down (set by the Current value at motor stop) from last pulse entering (set by RUN rotary switch).			

4. Setting

■ Group A [I/O port]

ID:00	MON output selection		
	Setting range	Std set value	Set unit
	0 to 1	0	0: Excitation origin 1: Phase-C

Sets the signal output of MON (CN3-pin B12/B13).

Name	Function
Excitation origin	Outputs a 50P/R signal which includes initial excitation position.
Phase-C	Outputs a 1P/R signal.

Power cycle is necessary if ENC output selection is changed.

※ As note, in case of using as the excitation origin or Phase-C, signal width will be narrow and does not output correctly in the speed of exceeding 500pps at full step (200P/R).

※ As note, excitation origin is not able to use if the other setting of electronic gear: 1/1 is set.

ID:01	Input port logic		
	Setting range	Std set value	Set unit
	0 to 255	0	Each bit 0:Active-High 1:Active-Low

Selects the logic of each input port

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	ALMCLR	BRFREE	PD	SSEL

ID:02	Output port logic		
	Setting range	Std set value	Set unit
	0 to 255	0	Each bit 0:Active-High 1:Active-Low

Selects the logic of each output port

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	-	-	ALM	RDY

■ Group B [Sequence/ alarm relations]

ID:00	Step-out detection value		
	Setting range	Std set value	Set unit
	0.0 to 360.0	7.2	deg
Sets threshold of the step-out detection. Will be occurred step-out alarm when position deviation exceeds this value. Step-out detection is only available at the analysis mode.			

ID:01	Excitation selection		
	Setting range	Std set value	Set unit
	0 to 1	0	0: Excitation origin 1: Excitation phase at shut off power

Selects excitation phase at power on.

Name	Function
Excitation origin	At the driver power on, motor will rotate maximum 3.6 degree.
Excitation phase at shut off power	Excites at the position that was shut off power in previous time.

ID:02	Holding brake wait time		
	Setting range	Std set value	Set unit
	0 to 255	100	ms
For brake on at emergency stop or alarm state, motor excitation current is changed to zero after passing this time from brake on.			

ID:03	Releasing brake wait time		
	Setting range	Std set value	Set unit
	0 to 255	60	ms
For brake off at return from emergency stop or alarm state, brake will be off after passing this time from when motor excitation current is changed to the current value 100%. After releasing brake, motor current will be the value at motor stop.			

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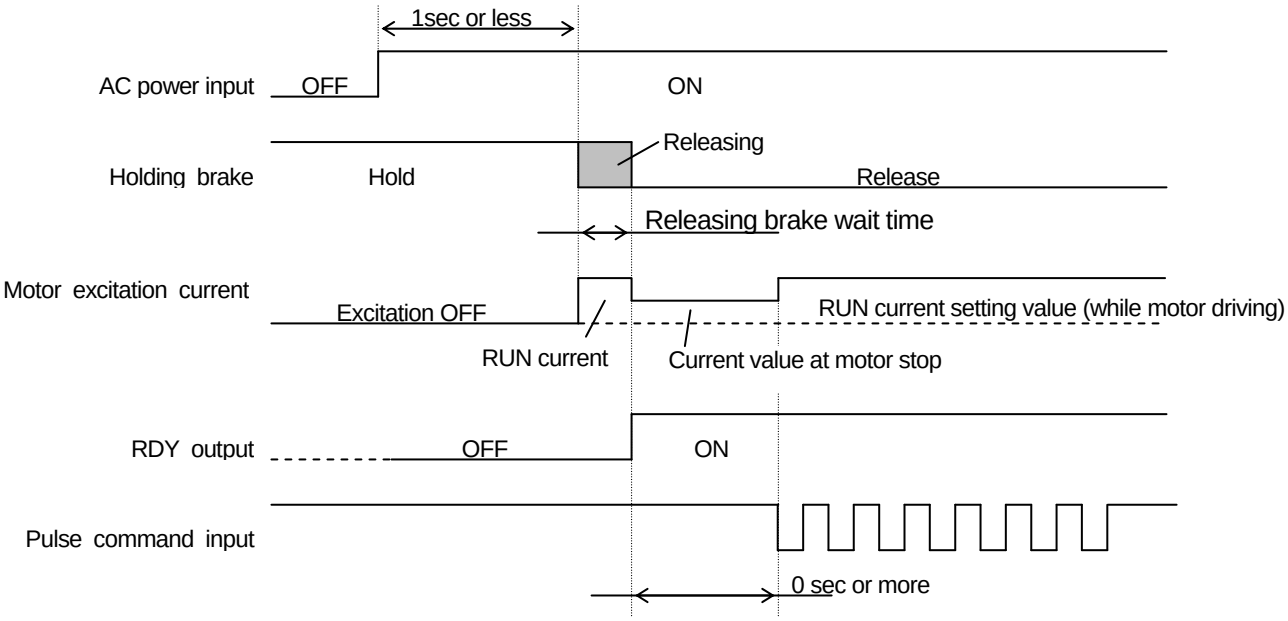
5

[Function]

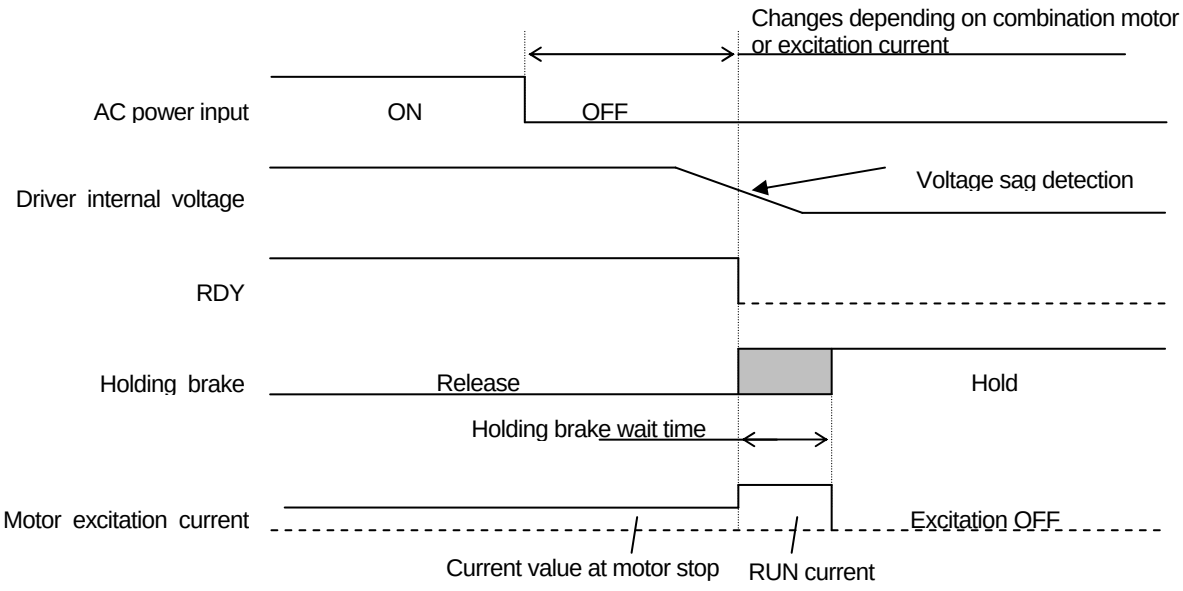
5. Function

5.1 Operation sequence

■ Power on



■ Power off



※ Keep 30 times or less per day for Power on/off.

※ For power cycle, keep power off period 1minute or more.

5. Function

5.2 Adjustment

■ Operation current

Able to select motor operation current by RUN rotary switch.

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

If torque margin is enough, less operation current gives less vibration effects.

Output torque of motor is almost proportional to current value.

For adjustment of operation current, confirm enough operation margins and decide motor current value.

■ Current value at motor stop (Group 8: ID 01)

Able to select the current value at motor stop.

When the auto current down is valid, automatically change to the current down current at motor stop.

Current down current = Operation current [%] × Current value at motor stop [%].

5. Function

5.3 Input signal function

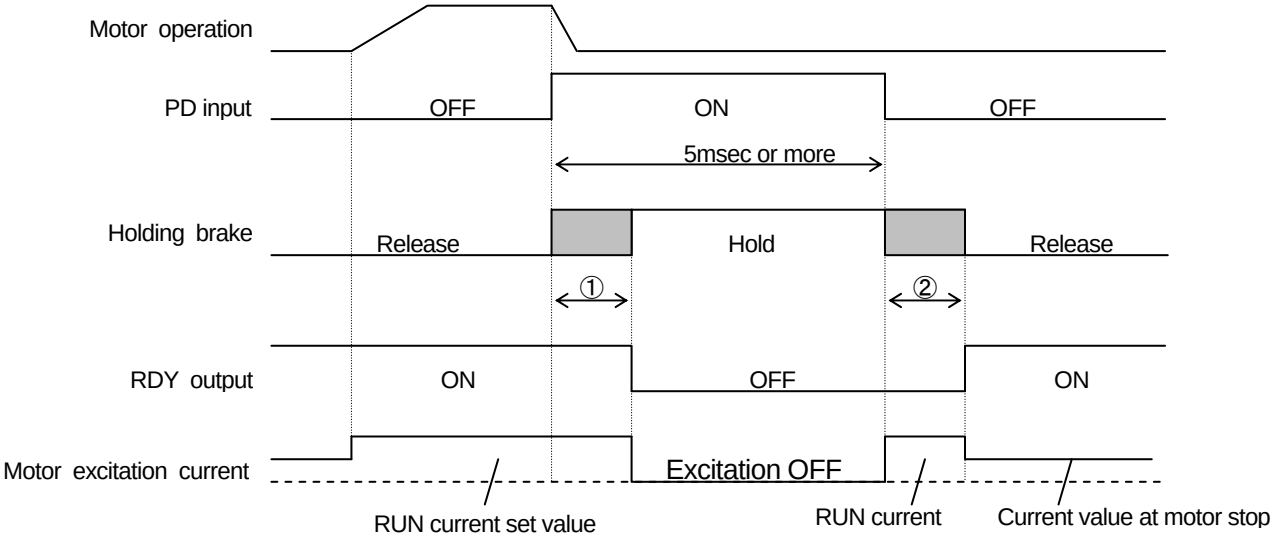
5.3.1 PD

■ Function

Transits to a power down state, and activating the holding brake.

During power down state, the main circuit voltage lack alarm is not detected.

■ Timing chart



① Holding brake wait time: Initial value 100ms

② Releasing brake wait time: Initial value 60ms

※ Holding brake has the Releasing brake wait time. After PD state released, do not input pulse command until RDY output will be Active.

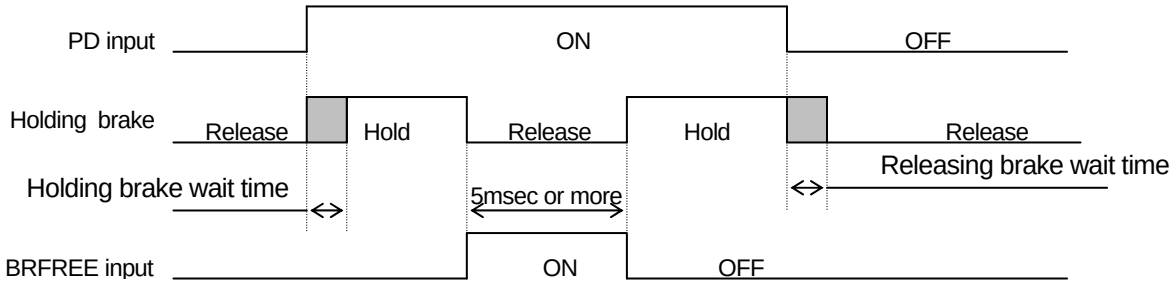
5.3.2 BRFREE

■ Function

The signal that performs holding/releasing operation for brake while motor excitation current is OFF.

This signal will be valid only when during a power down state or an alarm. In the other motor excitation state, brake will be a released state and this signal will be invalid.

■ Timing chart



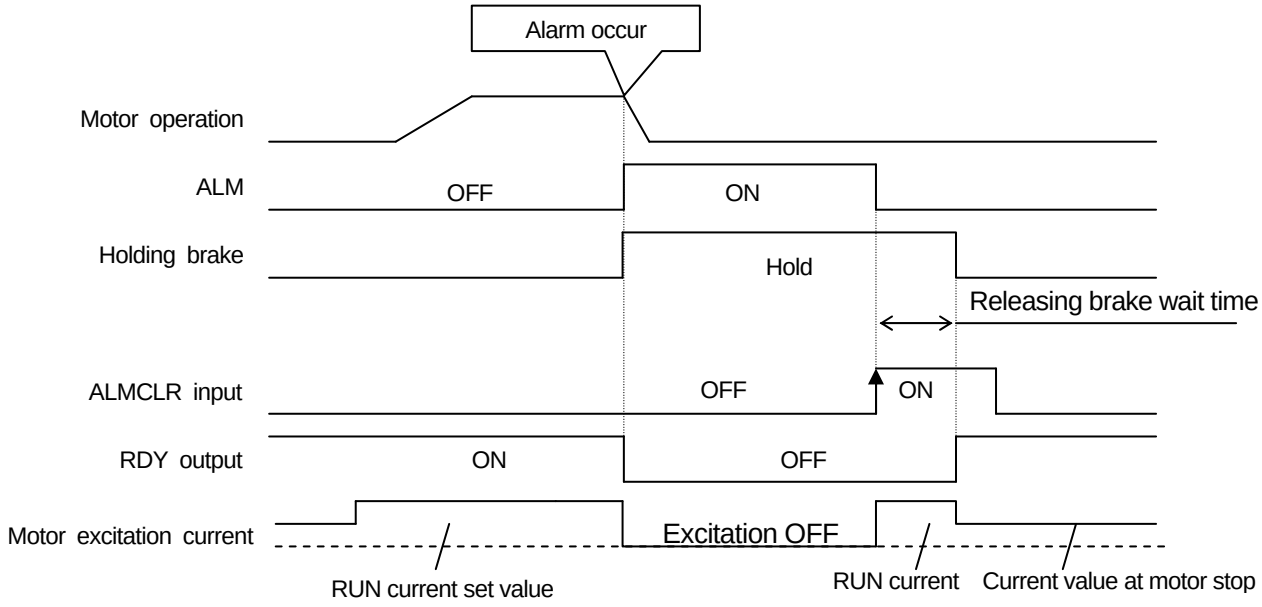
5.3.3 ALMCLR

■ Function

Alarm release signal at alarm occurrence. Release disabled alarm requires power cycle.

Alarm release is performed by edge recognition of OFF to ON.

■ Timing chart



※ Perform alarm release after avoiding alarm cause. Alarm occur again if alarm cause is not avoided.

※ Holding brake has the Releasing brake wait time. After alarm released, do not input pulse command until RDY output will be Active.

5.3.4 SSEL

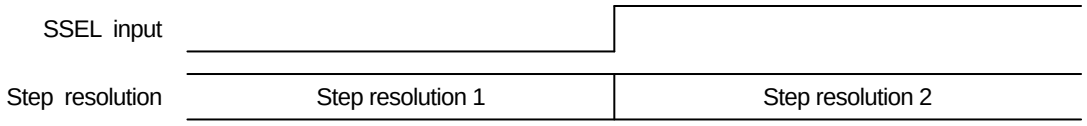
■ Function

Uses for switching the step resolution to each operation.

For the step resolution, there is the step resolution 1 which is set by SS rotary switching, and the step resolution 2 (System: ID 00) which is set by the digital operator or the setup software.

SSEL input performs switching of the step resolution 1 and the step resolution 2.

■ Timing chart



5. Function

5.4 Output signal function

5.4.1 ALM

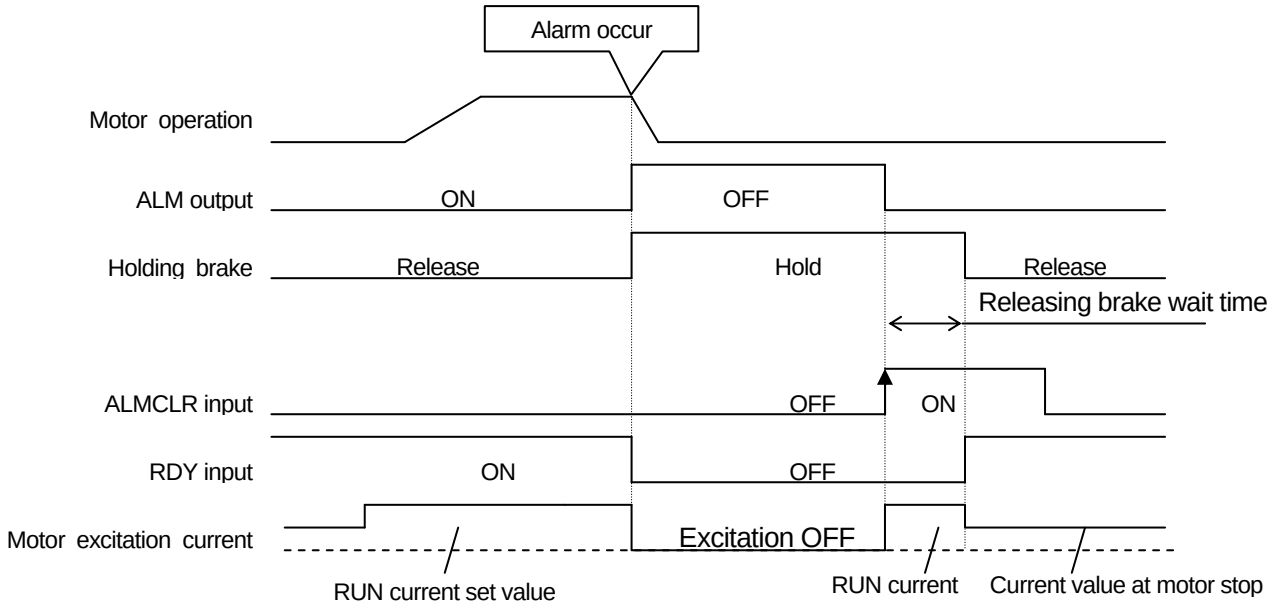
■ Function

This signal indicates the alarm state. Will be Active during alarm.

In case of resettable alarm, alarm is able to clear by edge input of ALMCLR input: OFF to ON.

Motor excitation will be OFF during alarm state.

■ Timing chart



5.4.2 RDY

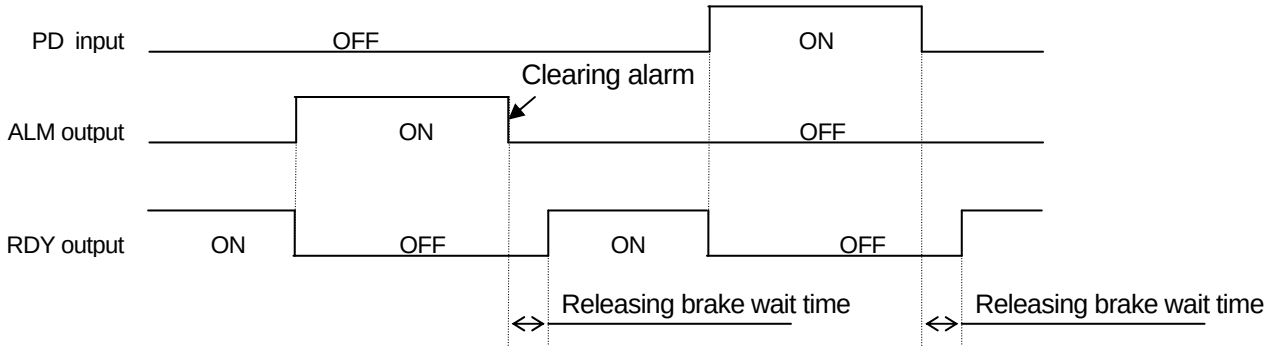
■ Function

This signal indicates the driving-available-state (Command pulse reception valid state).

Will be Active during the driving-available-state.

Pulse command is ignored while RDY is Non-Active.

■ Timing chart



5.4.3 MON

■ Function

Outputs the excitation origin or encoder phase-C signal.

See "4.3.3 Parameters detail", for output signal switching.

【For the excitation origin output】

Outputs a 50 P/R signal including initial excitation position.

Will be ON once per 10 pulses at the full step setting. Will be ON once per 20 pulses at the half step setting.

As note, excitation origin is not able to use if the other setting of electronic gear: 1/1 is set.

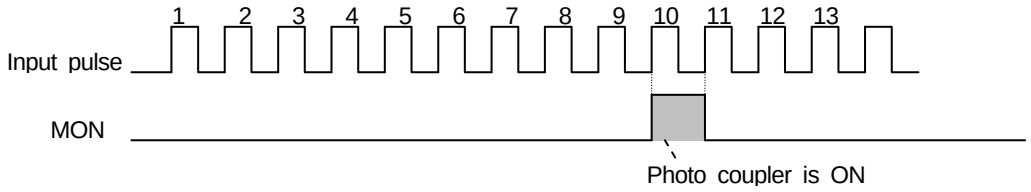
【For encoder phase-C signal output】

Outputs a 1 P/R signal.

As note, in case of output signal of either above, signal width will be narrow and does not output correctly in the speed of exceeding 60 min^{-1}. (60 min^{-1} = Input pulse 500pps at the full step setting: 500P/R)

■ Timing chart

For example) Excitation origin output, for the full step setting



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6

[Test operation]

6. Test operation

6.1 Test operation

6.1.1 Confirmation for Installation and wiring

Confirming Installation and wiring of driver and stepping motor.

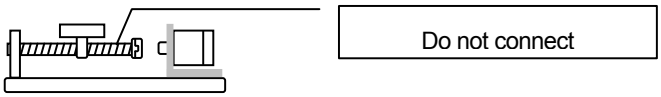
[Step 1: Setting]

■ Set each switches according to "4.1 Switch setting".

[Step 2: Installation]

■ Install a driver and stepping motor according to "2. Installation".

■ Motor shaft should be in disengaged state and should not connect to machine.



[Step 3: Wiring/ Connection → Power cycle]

■ Please wire the power supply, the stepping motor and the upper device, according to "3. Wiring".

■ Supply power. Please confirm that there is no alarm code indication on the display part of front upper of the driver. If the alarm is shown, perform corrective action according to "7.3 Troubleshooting when alarm activated".

6. Test operation

6.1.2 Operation confirmation

■ Perform JOG operation with no load state, with no connection of stepping motor shaft to machine.

■ Confirm that the stepping motor rotates to CW or CCW.

◆ Operating through the digital operator

[Step 1: JOG speed setting]

Sets the JOG speed at mode 8 of the digital operator.

JOG speed is set value times 100 min^{-1}.

For the first operation, recommends low speed operation like 100min^{-1}, to prepare for unexpected case.

[Step 2: JOG operation]

Set to mode 9 of the digital operator.

Rotates to CW while SW2 button is pushed, and stops by releasing button.

Rotates to CCW while SW3 button is pushed, and stops by releasing button.

Confirm at "4.2 Digital operator" for how to use the digital operator.

◆ Operating through the setup software

Select JOG operation from test operation menu. Confirm at "7.1 JOG operation" at another document: M0010842 for how to operate the setup software.

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7

[Maintenance]

7. Maintenance

7.1 Troubleshooting

When motor is not able to operate correctly without any alarm displayed, find causes and take corrective actions for them by referring the description below. If alarm occurs, take measures of “7.3 Troubleshooting when alarm occurs“.

■ Motor does not rotate

- ◆ Confirm the combination motor selection is proper. See "4.1 Switch setting".
- ◆ Confirm the input pulse mode is proper. See "4.1 Switch setting".
- ◆ Confirm I/O signal state like as power down signal is inputted etc.
- ◆ Confirm wiring of motor power line and holding brake line (if equipped).

■ Position gap

For encoder equipped motor, position gap is able to check through the command position monitor and current position monitor in the setup software.

[Case 1] Command position and current position are correct but load position is wrong.

Mechanical element as Looseness of coupling may cause.

[Case 2] Command position is wrong.

Superimposed noise of pulse command or wrong wiring/ command input method/ wrong pulse waveform etc may cause.

[Case 3] Command position is correct but current position is wrong.

Unintended signal like as power down input etc may input.

※ For offset load like as vertical axis, load may stop at the position which has gap from command position caused by offset load.

■ Motor doesn't make intended move.

When overshoot or undershoot is occurred, confirm the velocity waveform and the current command monitor, and perform a gain adjustment and a drive profile adjustment.

■ Communication with the setup software is impossible.

- ◆Check a port number setting on the setup software is correct.
- ◆Check the baud rate setting. (Set value is 57,600 bps)
- ◆Check the communication cable wiring is correct.
- ◆Check the grounding of driver and motor.

If communication is unstable, attach a ferrite core to motor power cable, considering to noise impact.

(Our ferrite core preparation - optional model number: AL-00113483-01)

7. Maintenance

7.2 Alarm list

Alarm code	Name of alarm	Alarm description	Alarm clear
21	Main circuit power device error	Overcurrent of drive module	Not available
27	Fan stop	Lowering of rotation speed of cooling fan	Available
56	Driver internal overheat	Overheat of drive module	Available
61	Overvoltage	Overvoltage of main circuit	Available
62	Main circuit voltage sag	Voltage sag of main circuit	Available
72	Control power voltage error	Power voltage abnormality for control circuit	Not available
81	Encoder connector disconnection	Disconnection of encoder signal line	Not available
D8	Step-out	Position deviation counter exceeds set value.	Available
DF	Test mode completion	Detect when exiting the test mode.	Available
E2	Memory error	Checksum error of all area of non-volatile memory.	Available
E6	System parameter error	Control mode or motor selection (switch setting) error.	Not available
E8	CPU and around circuit error	Detects alarm of GA. Electronic gear setting error.	Not available

7. Maintenance

7.3 Troubleshooting when alarm activated

Will be alarm state if error occurs on the system.

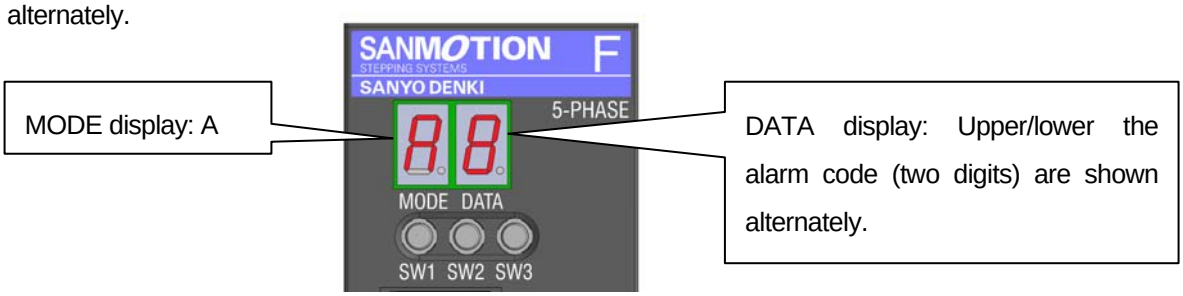
At an alarm state, alarm code is indicated and motor current is shut off, so it means no excitation state. At the same time, signal is output from alarm output terminal: ALM of I/O signal connector (CN3).

For alarm occurring, see troubleshooting, and perform proper corrective action.

Also, able to refine alarm cause by confirming error occurrence situation (while motor is rotating, at power on, etc). Please identify cause after confirming occurrence situation (driver status, I/O signal status), alarm content or error content, certainly.

7.3.1 Display when alarm activated

When alarm activated, MODE LED indicates "A" and DATA LED indicates alarm code (two digits) upper lower alternately.



7.3.2 Alarm coping process

■ Alarm code 21 (Main circuit power device error)

No.	Cause	Investigation and corrective actions
1	At motor side, phase-A and phase-B have short circuit or grounding.	・Replace the stepping motor. ・Confirm wiring
2	Fault of driver internal circuit.	Replace the driver.

■ Alarm code 27 (Fan stop)

No.	Cause	Investigation and corrective actions
1	Fault of driver internal circuit.	Replace the driver.
2	Life-span of cooling fan.	Replacement of cooling fan is necessary.

■ Alarm code 56 (Driver internal overheat)

No.	Cause	Investigation and corrective actions
1	Fault of driver internal circuit.	Replace the driver.
2	Ambient temperature is high.	Review the internal temperature of cabinet (ambient temperature of driver), and then renew the way of driver mounting and cabinet cooling, to keep ambient temperature to 55℃ or less.
3	Operated frequently.	Readjust an operation rate.

7. Maintenance

■ Alarm code 61 (Overvoltage)

No.	Cause	Investigation and corrective actions
1	Fault of driver internal circuit.	Replace the driver.
2	Power supply voltage is out of specification range.	Keep power supply voltage into specification range.
3	Load inertia moment is too large.	Reduce the load inertia moment. Make gentle the accel/decel.

■ Alarm code 62 (Main circuit voltage sag)

No.	Cause	Investigation and corrective actions
1	Fault of driver internal circuit.	Replace the driver.
2	Power supply voltage is below of specification range.	Keep power supply voltage into specification range.
3	Input power voltage sag occurred. Or, instantaneous voltage drop occurred.	Confirm power supply and rethink to avoid occurrence of voltage sag or instantaneous voltage drop.

■ Alarm code 81 (Encoder connector disconnection)

No.	Cause	Investigation and corrective actions
1	For motor encoder wiring, ◆ wiring is wrong. ◆ connector is not inserted. ◆ connector has contact failure. ◆ encoder cable is too long. ◆ encoder cable is too thin.	Confirm wiring, and correct it if problem is there. Confirm encoder voltage at the stepping motor side is 4.75V or more, and if not, correct it.
2	Fault of driver internal circuit.	Replace the driver.
3	Fault of motor encoder internal circuit.	Replace the stepping motor.

■ Alarm code D8 (Step-out)

No.	Cause	Investigation and corrective actions
1	Fault of driver internal circuit.	Replace the driver.
2	Fault of motor encoder internal circuit.	Replace the motor.
3	Used at out of specification range of allowable load.	Confirm load condition, and change load to fit in the specification range. Change motor capacity.
4	Wrong combination of driver and motor.	Confirm model numbers of driver and motor in use, and correct it if combination is wrong.
5	Holding brake of motor is not released.	Confirm the holding brake wiring, and correct it if problem is there.
6	Machine collision occurred.	Confirm operation condition.
7	Motor cable disconnection or contact failure.	Confirm wiring, and correct it if problem is there.

■ Alarm code DF (Test mode completion)

No.	Cause	Investigation and corrective actions
1	It is normal operation.	Return to normal operation by alarm reset. (After the Test mode, makes error because deviation is left in controller side.)

■ Alarm code E2 (Memory error)

No.	Cause	Investigation and corrective actions
1	Correct value did not load to CPU from non-volatile memory built in to driver.	Replace the driver.
2	At previous power off, writing to non-volatile memory was failed.	Please contact us for recovery process. As note, the parameter saved in non-volatile memory will be initial value by clearing this alarm.

■ Alarm code E6 (System parameter error)

No.	Cause	Investigation and corrective actions
1	Wrong control mode setting (switch setting).	Confirm the control mode setting (switch setting), and correct it if wrong.
2	Wrong combination motor setting (switch setting).	Confirm the combination motor setting (switch setting), and correct it if wrong.

■ Alarm code E8 (CPU and around circuit error)

No.	Cause	Investigation and corrective actions
1	Fault of driver internal circuit.	Replace the driver.
2	Pulse amount setting per motor rotation is out of specification range.	Rethink the electronic gear setting to be 50 to 1,500,000P/R of pulse amount setting per motor rotation.

7. Maintenance

7.4 Inspection

Maintenance is enough with daily simple inspection because driver and stepping motor does not have wear part. Perform the inspection with refer below.

Inspection location	Testing conditions			Inspection Items	Inspection Methods	Solution if abnormal
	Time	During operation	While stopping			
Stepping motor	Daily	✔		Vibration	Check for excessive vibration compared to normal.	Contact dealer/sales office.
	Daily	✔		Sound	Check for abnormal sound compared to normal.	
	Periodic		✔	Cleaning	Check for dirt and dust.	Clean with cloth or air. Note 1)
Driver	Periodic		✔	Cleaning	Check for dust accumulated in the accessories.	Clean with air. Note 1)
	Yearly		✔	Loose screws	Check for loose connections.	Fasten the screws properly.
Temperature	Periodic	✔		Temperature measurement	Ambient temperature Motor frame temperature	Set the ambient temperature within the specified range. Check the load condition.

Note 1) While cleaning with air, confirm that there is no oil content and/or moisture in the air.

7. Maintenance

7.5 Service parts

Parts will be aging deterioration. Perform periodic inspection for preventive maintenance.

No.	Part name	Standard replacement guideline	Corrective measures / usage conditions
1	Electrolytic capacitor for smoothing main circuit	5 years	Replacement with new parts is necessary. Usage condition: Average temp. 40°C year-round.
2	Electrolytic capacitor excepting for smoothing main circuit	5 years	Replacement with new parts is necessary. Usage condition: Average temp. 40°C year-round.
3	Fuse	10 years	Replacement with new parts is necessary.
4	Relay	Power activation count About 50,000 times	Replacement with new parts is necessary.
5	Cooling Fan motor	5 years	Replacement with new parts is necessary. Usage condition: Average temp. 40°C year-round.

■ Capacitor for smoothing the main circuit and relay kinds

- ◆ If the driver is stored for more than 3 years, contact the dealer or sales office for requiring inspection.
- ◆ When the capacitor is used with an average 40° C through out the year, it is necessary to replace the capacitor with a new one, earlier than standard cycle of 5 years.
- ◆ When used in an application where the power turn ON/OFF is repeated more than 30 times per day or 5 times per hour, it may cause of decrease the capacity of smoothing main circuit capacitor or early failure of relays, so it is necessary to replace the capacitor with a new one, earlier.

■ Cooling fan motor

- ◆ The F5PA driver is designed corresponding to the pollution level 2 (EN61800-5-1 or IEC 664-1). As it is not dust proof or oil proof, use it in an environment above Pollution Level 2 (i.e., Pollution Level 1,2).
- ◆ The F5PA driver has a cooling fan built-in, so be sure to maintain a space of 50mm on the upper and lower side of the driver for airflow. Narrower the space may cause damage due to a reduction in the static pressure of the cooling fan and/or degradation of electronic parts. Replacement is necessary if abnormal noise occurs, or oil or dust is observed on the parts. Also, at an average temperature of 40°C year-round, the life expectancy is 5 years.

8

[Specifications]

8. Specifications

8.1 Driver Basic Specifications

Model number		F5PAA035P100	F5PAA075P100	F5PAB035P100	F5PAB075P100
Input power supply		1Φ AC100 to 120V +10%, -15% 50/60Hz		1Φ AC200 to 240V +10%, -15% 50/60Hz	
Power current		2A	4A	1.5A	3A
Environment	Protection class	Class I			
	Operating environment	Installation category (Over-voltage category): II, Pollution level: 2			
	Operating ambient temperature	0 to 55℃			
	Storage temperature	-20 to 70℃			
	Operating ambient humidity	Below 90%RH (non-condensing)			
	Storage humidity	Below 90%RH (non-condensing)			
	Elevation	Below 1,000m above sea level			
	Vibration resistance	5m/s^2 when tested X,Y and Z directions for 2 hours in the frequency range between 10 to 55Hz.			
	Shock resistance	20m/s^2			
	Dielectric strength	No error when applying 1.5kVAC for a minute between power input terminal and chassis.			
	Insulation resistance	10MΩ or more with 500 VDC megger between power input terminal and chassis, over.			
Mass		0.65kg			
Dimensions		W40×H160×D120			
Function	Selective function	Control mode, Input pulse mode, Low vibration mode, Motor type, Step angle, Operational current			
	Protective function	Over-voltage protection, Low-voltage protection, Overheat protection, Over-current protection			
	LED display	Status display, Alarm display			
Input/Output signal	Command pulse input signal	Photo coupler input method For open-collector: Input resistance 470Ω Input voltage "H" level: 4.5 to 5.5V, "L" level: 0 to 0.5V For line receiver: Input resistance 150Ω Input voltage "H" level: 3 to 3.5V, "L" level: 0 to 0.5V Max. input frequency 400kpulse/s			
	Input signal	Photo coupler input method, input resistance 2.2kΩ Input signal voltage "H" level: 4.75 to 26.4V "L" level: 0 to 1.0V			
	Output signal	Open collector output by photo coupler Output signal standard Vceo: 4.75 to 26.4V Ic: 10mA or less Vce(sat): 1V or less			

8. Specifications

8.2 Power Supply Specifications

Model number	Power supply voltage	Inrush current	Leakage current
F5PAA035P100 F5PAA075P100	Single phase 100 to 120 VAC	50A or less	1mA
F5PAB035P100 F5PAB075P100	Single phase 200 to 240 VAC	50A or less	1mA

※ Inrush current value is at its maximum when 120/240VAC is supplied.

※ Since the F5 drives the motor by PWM control, a high-frequency electric current leakage can flow through the floating capacity of the motor winding, power cable or amplifier. This may cause a malfunction in the short circuit breaker and the protective relay installed in the power supply electric circuit Therefore, use the inverter as an electricity leakage breaker, as it provides a countermeasure operation.

※ Leakage current is per machine. Please be attentive that leakage current changes depending on grounding and wiring status.

8. Specifications

8.3 Motor Basic Specifications

■ Motor Standard Specifications

Model number	Single shaft	SM5421-3240	SM5422-3240	SM5423-3240
	Double shaft	SM5421-3210	SM5422-3210	SM5423-3210
Holding torque	N·m	0.13	0.185	0.245
Rotor inertia	$\times 10^{-4}$kg·m^2	0.028	0.045	0.056
Mass	kg	0.24	0.31	0.38
Allowable thrust load	N	10	10	10
Allowable radial load	N	56	54	52

Model number	Single shaft	SM5601-7240	SM5602-7240	SM5603-7240
	Double shaft	SM5601-7210	SM5602-7210	SM5603-7210
Holding torque	N·m	0.57	0.9	1.7
Rotor inertia	$\times 10^{-4}$kg·m^2	0.2	0.31	0.6
Mass	kg	0.62	0.8	1.27
Allowable thrust load	N	20	20	20
Allowable radial load	N	191	183	170

Model number	Single shaft	SM5861-7240	SM5862-7240	SM5863-7240
	Double shaft	SM5861-7210	SM5862-7210	SM5863-7210
Holding torque	N·m	2.3	4.4	6.8
Rotor inertia	$\times 10^{-4}$kg·m^2	1.48	3	4.5
Mass	kg	1.75	2.9	4
Allowable thrust load	N	60	60	60
Allowable radial load	N	200	200	200

8. Specifications

■ Motor Common Specifications

Model number	SM542□	SM560□	SM586□
Operating ambient temperature	-10 to 40°C		
Storage temperature	-20 to 60°C		
Operating ambient humidity	95%RH or less (non-condensing)		
Storage humidity	95%RH: less than 40°C, 57%RH: less than 50°C, 35%RH: less than 60°C (non-condensing)		
Elevation	Below 1,000m above sea level		
Vibration resistance	Frequency: 10 to 500Hz, Amplitude: 1.52mm (10 to 70 Hz), Acceleration: 150m/s^2 (70 to 500 Hz), Sweep time: 15 minutes per cycle along X, Y and Z axes for 12 times.		
Shock resistance	500m/s^2 of acceleration for 11ms with half-sine wave applying three times for X, Y and Z axes each, 18 times in total.		
Heatproof class	Class F		
Dielectric strength	No error when applying 1500VAC, 50/60Hz for a minute between motor winding and frame.		
Insulation resistance	100MΩ or more with 500VDC megger between motor winding and frame, over.		
Protection grade	IP40 EN60034-5		
Winding temperature rise	80K or less (Condition depends on company standards)		
Static angle error	±0.09°	±0.09°	±0.09°
Thrust play *1	0.075mm (Load 5N)	0.075mm (Load 10N)	0.075mm (Load 10N)
Radial play *2	0.025mm (Load 5N)	0.025mm (Load 5N)	0.025mm (Load 5N)
Shaft run-out	0.025mm	0.025mm	0.025mm
Concentricity of mounting spigot joint against the shaft	φ0.05mm	φ0.075mm	φ0.075mm
Squareness of mounting surface against the shaft	0.1mm	0.1mm	0.15mm
Motor mounting direction	Freely to horizontal or vertical etc.		

*1 Thrust play: This shows the shift amount of shaft which got a load of axial direction.

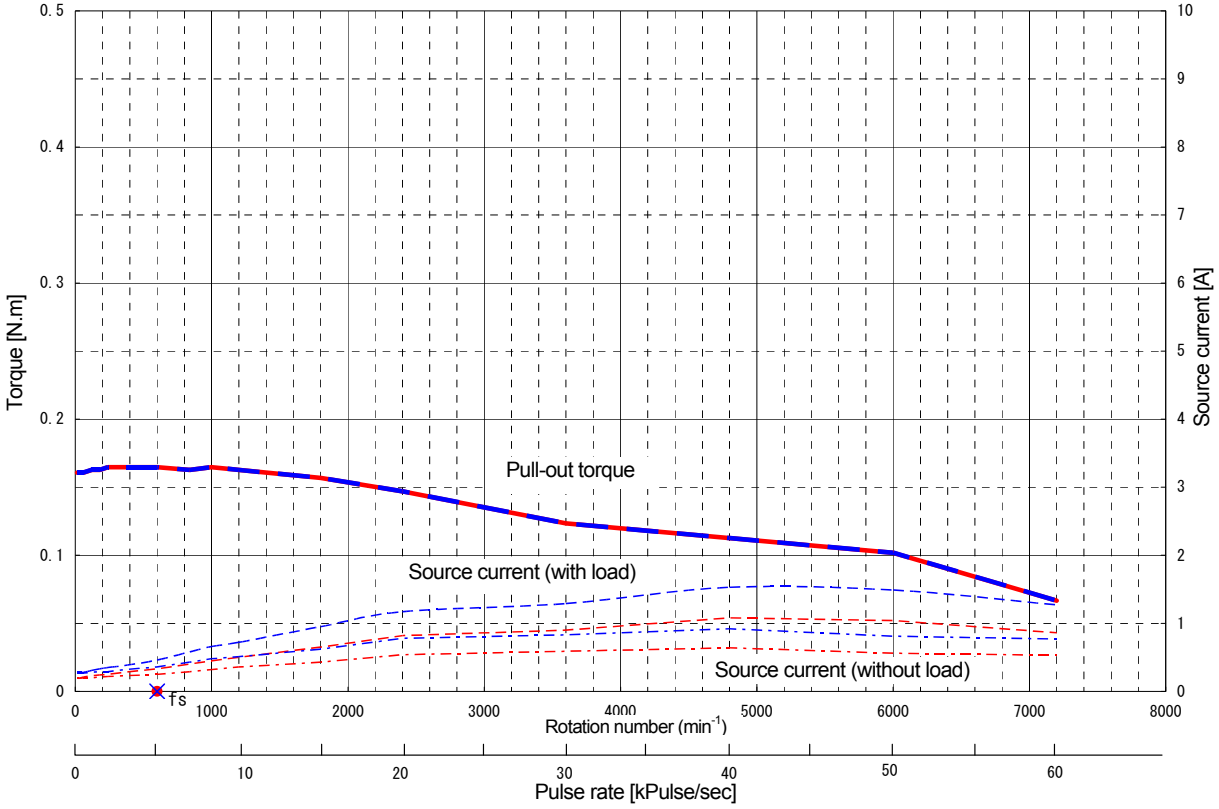
*2 Radial play: This shows the shift amount of shaft which got a load of radial direction. The load is applied to point of one-third from end of the shaft.

8. Specifications

8.4 Torque Characteristics

※ This clause mention data is typical value. Because there is unevenness of around ±10%, please be careful to motor torque.

■ SM5421-32xx (□42mm, 0.35A/Phase)

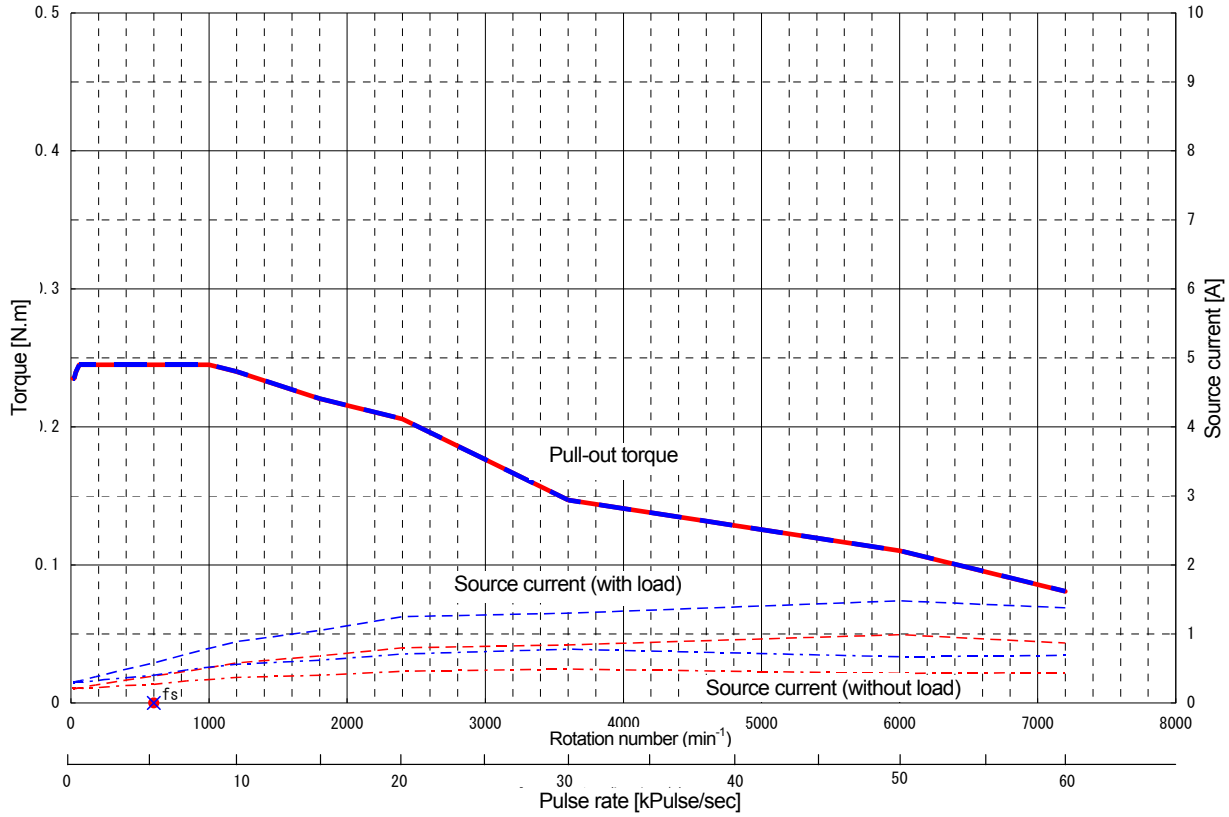


200VAC input	Pull-out torque	Source current (without load)	Source current (with load)	Self-start frequency (fs) ※1
100VAC input	Pull-out torque	Source current (without load)	Source current (with load)	Self-start frequency (fs) ※1

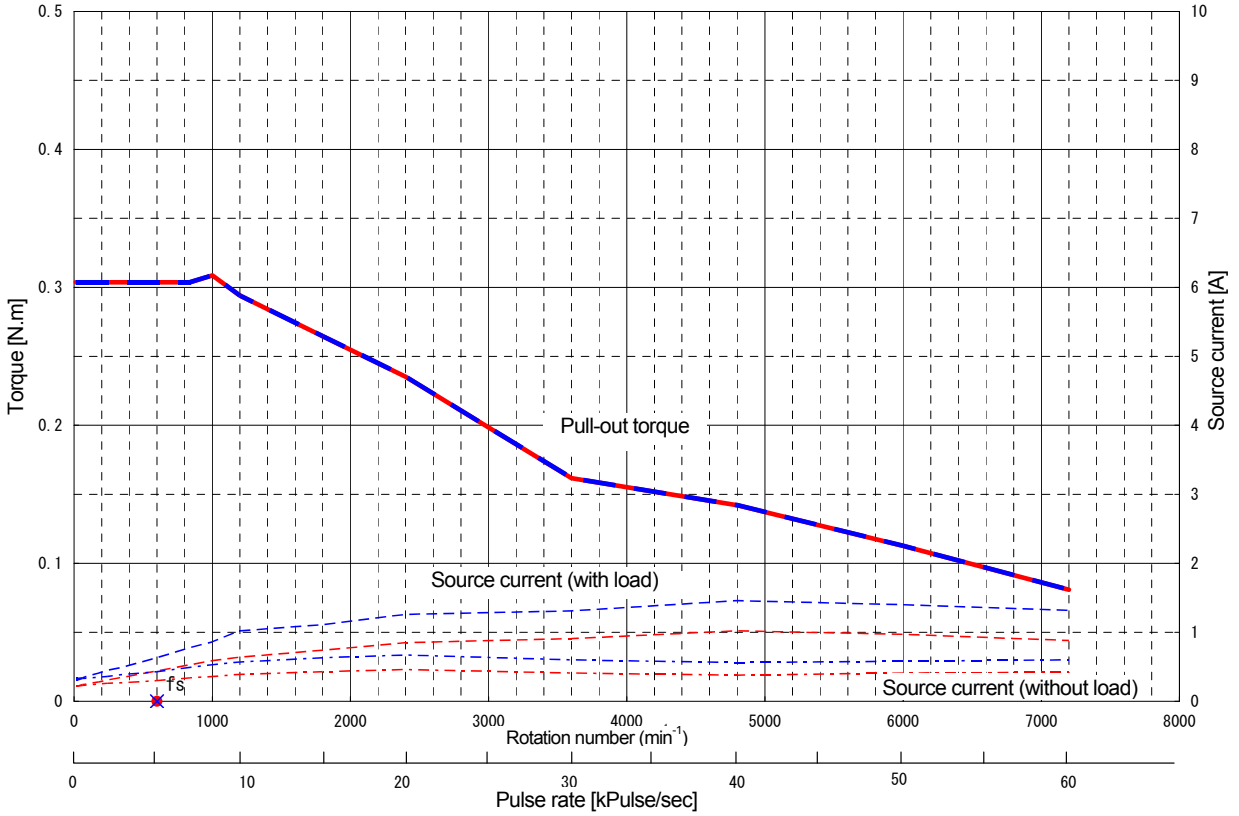
※1 Situation of "load": It means that 90% of rated torque is added.

8. Specifications

■ SM5422-32xx (□42mm, 0.35A/Phase)



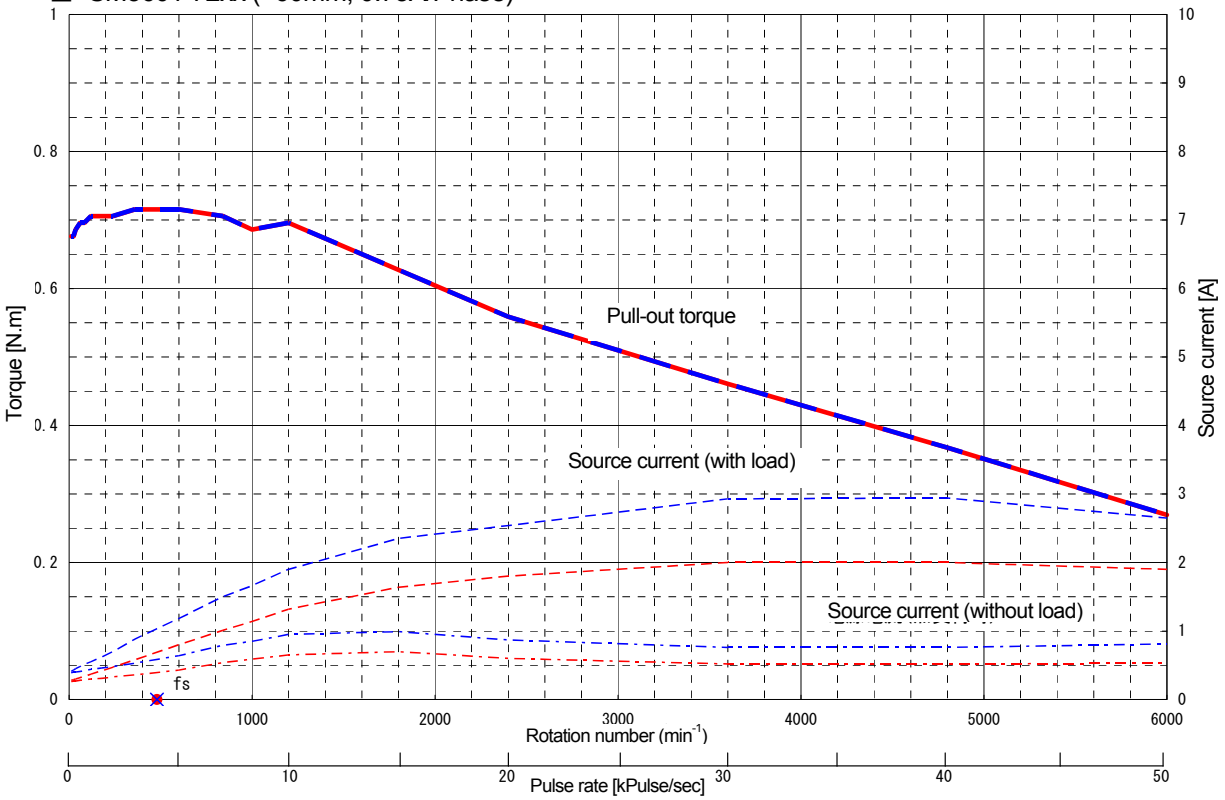
■ SM5423-32xx (□42mm, 0.35A/Phase)



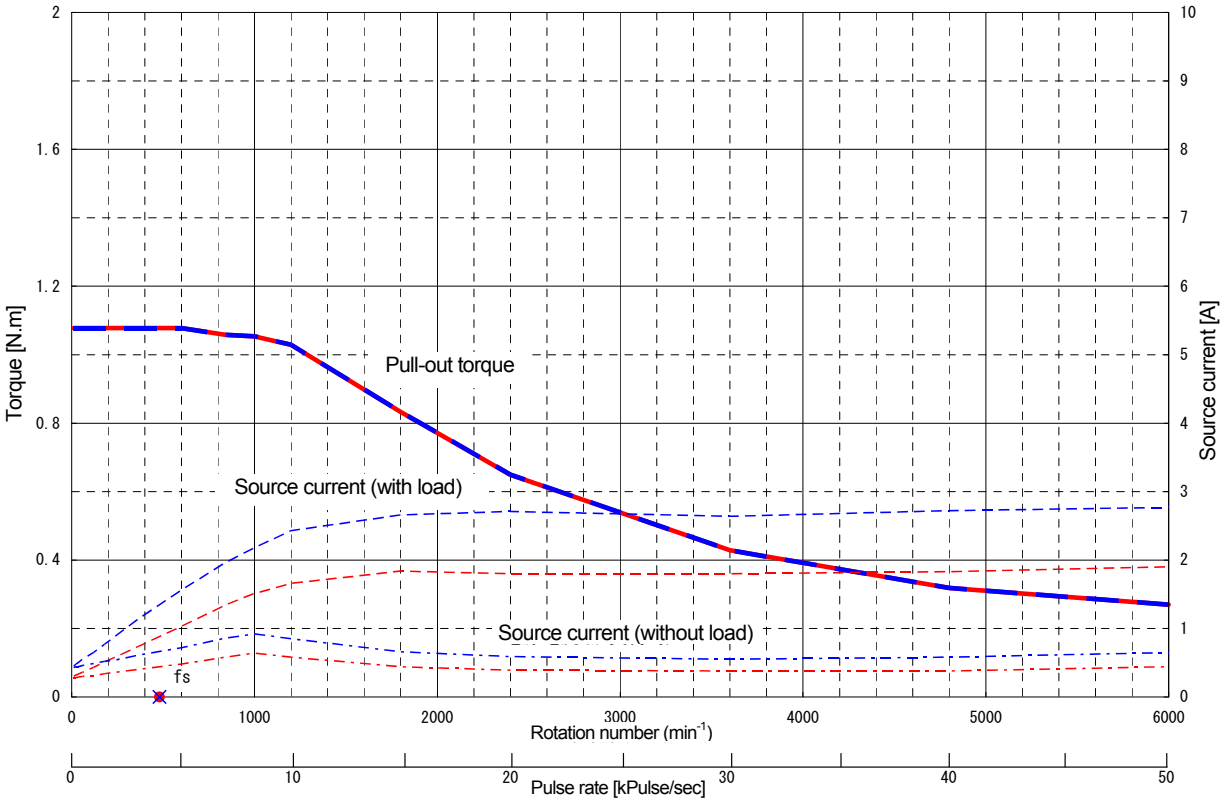
200VAC input	Pull-out torque	Source current (without load)	Source current (with load)	Self-start frequency (fs)
100VAC input	Pull-out torque	Source current (without load)	Source current (with load)	Self-start frequency (fs)

8. Specifications

■ SM5601-72xx (□60mm, 0.75A/Phase)



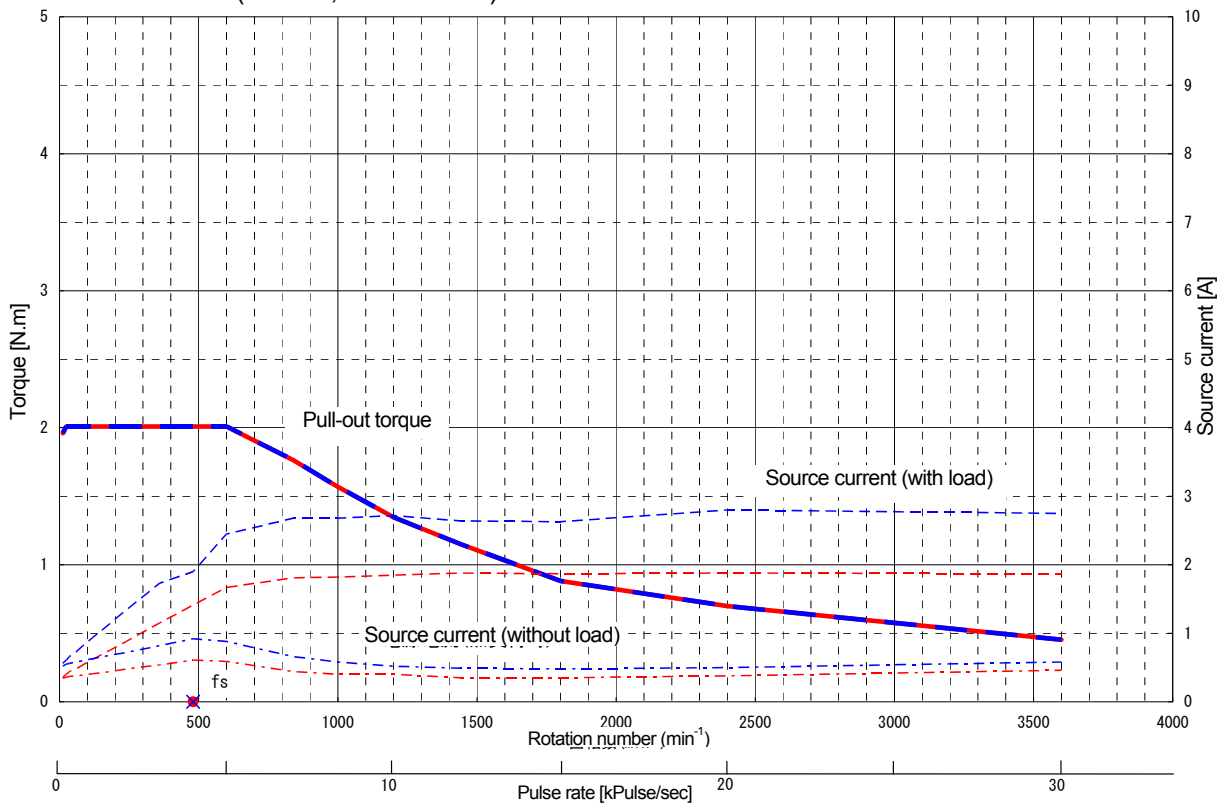
■ SM5602-72xx (□60mm, 0.75A/Phase)



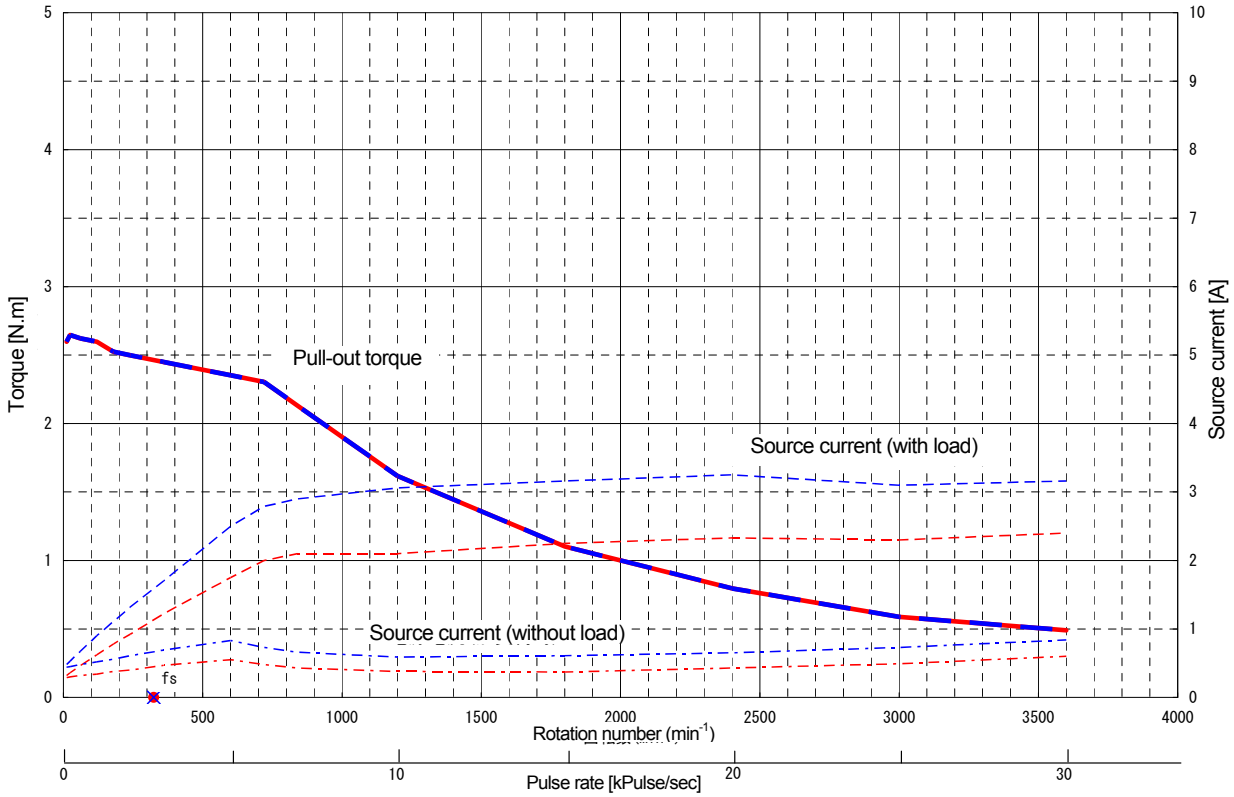
200VAC input	Pull-out torque	Source current (without load)	Source current (with load)	Self-start frequency (fs)
100VAC input	Pull-out torque	Source current (without load)	Source current (with load)	Self-start frequency (fs)

8. Specifications

■ SM5603-72xx (□60mm, 0.75A/Phase)



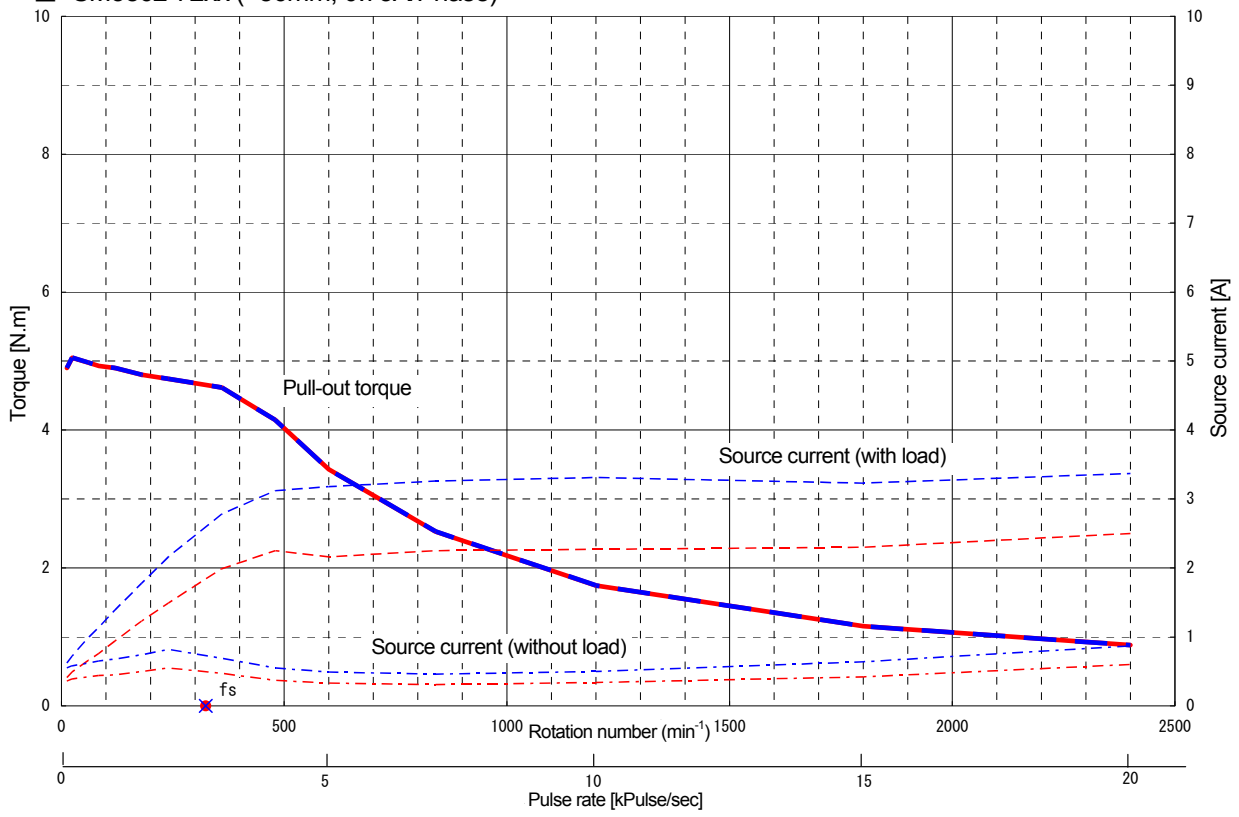
■ SM5861-72xx (□86mm, 0.75A/Phase)



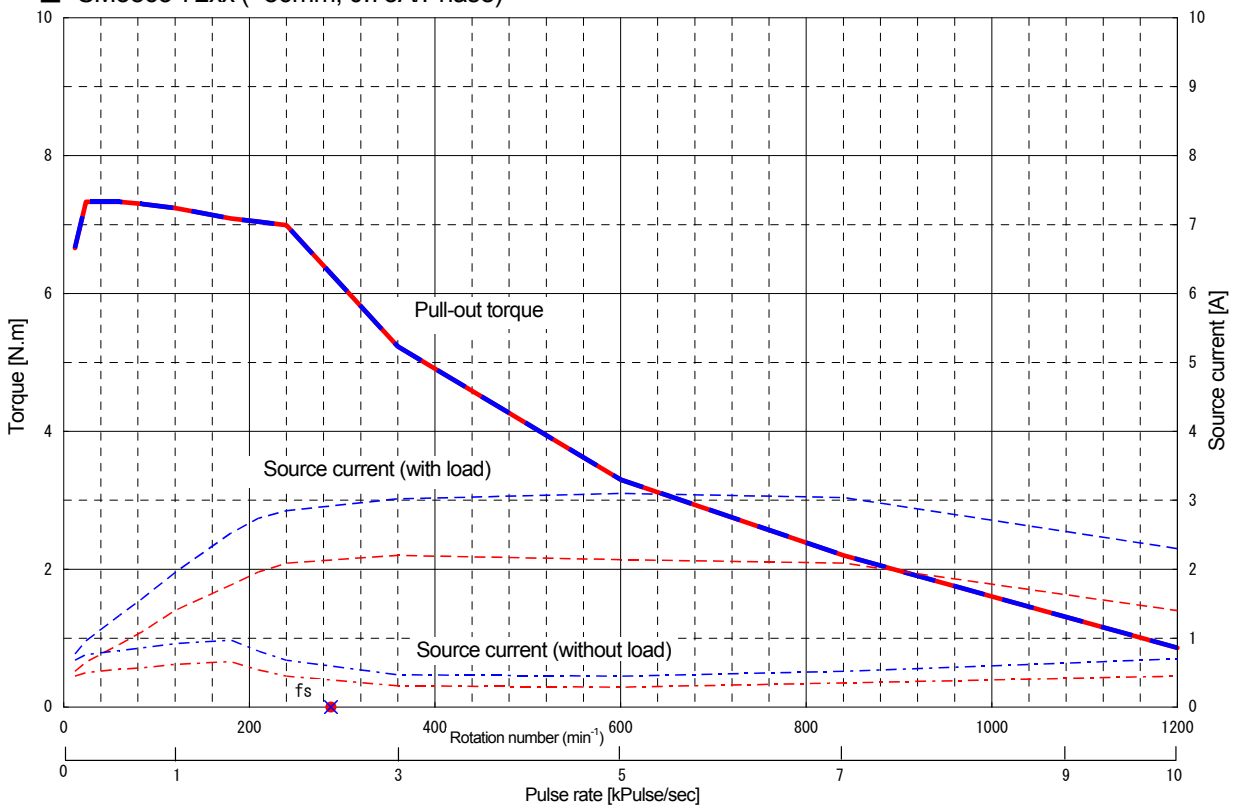
200VAC input	Pull-out torque	Source current (without load)	Source current (with load)	Self-start frequency (fs)
100VAC input	Pull-out torque	Source current (without load)	Source current (with load)	Self-start frequency (fs)

8. Specifications

■ SM5862-72xx (□86mm, 0.75A/Phase)



■ SM5863-72xx (□86mm, 0.75A/Phase)

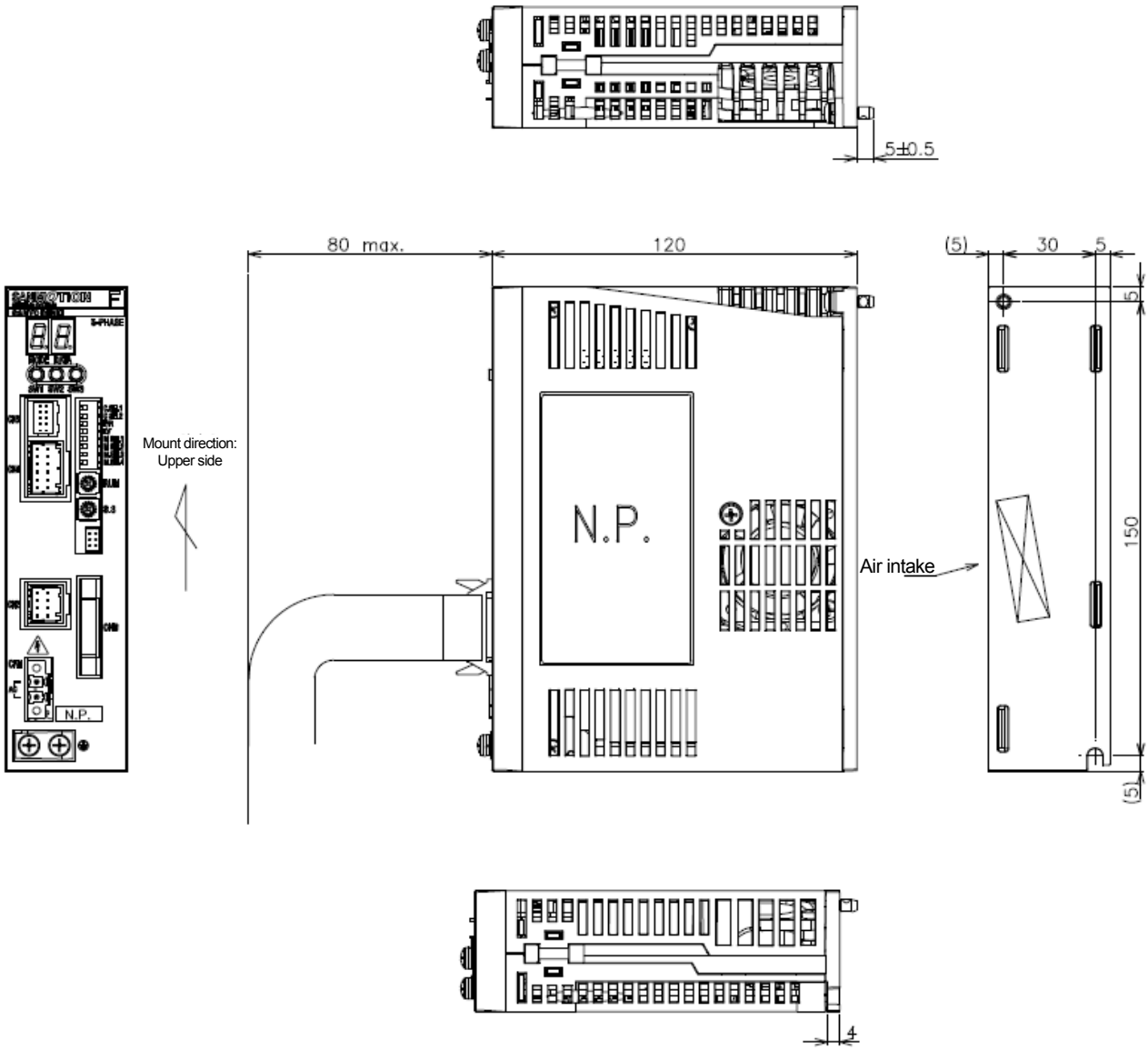


200VAC input	Pull-out torque	Source current (without load)	Source current (with load)	Self-start frequency (fs)
100VAC input	Pull-out torque	Source current (without load)	Source current (with load)	Self-start frequency (fs)

8. Specifications

8.5 Drawing

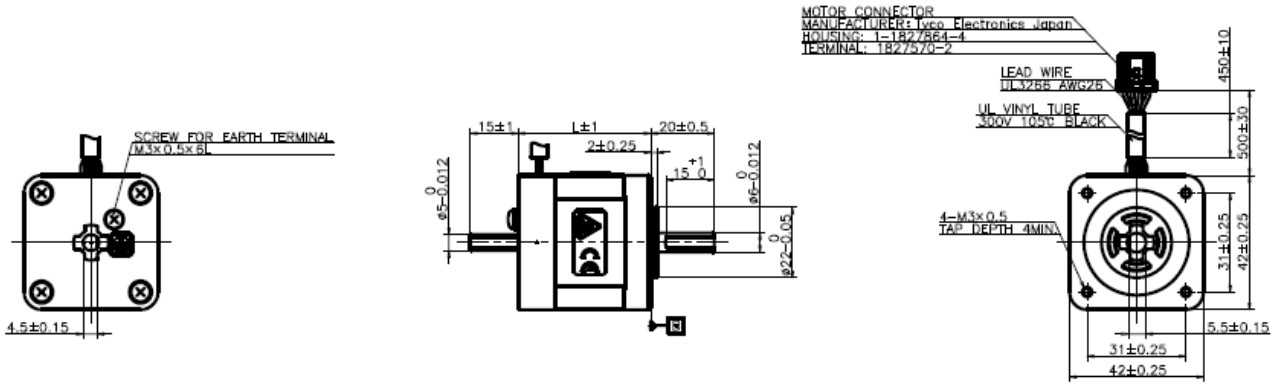
8.5.1 Driver Drawing



8. Specifications

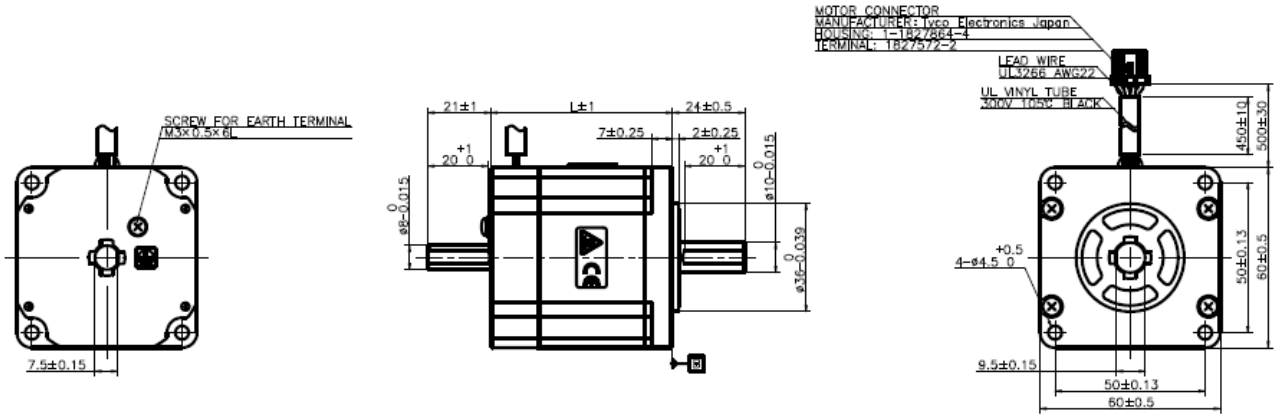
8.5.2 Motor Drawing

■ SM542□ (□42mm)



Model number	Motor length (L)
SM5421	35
SM5422	41
SM5423	49

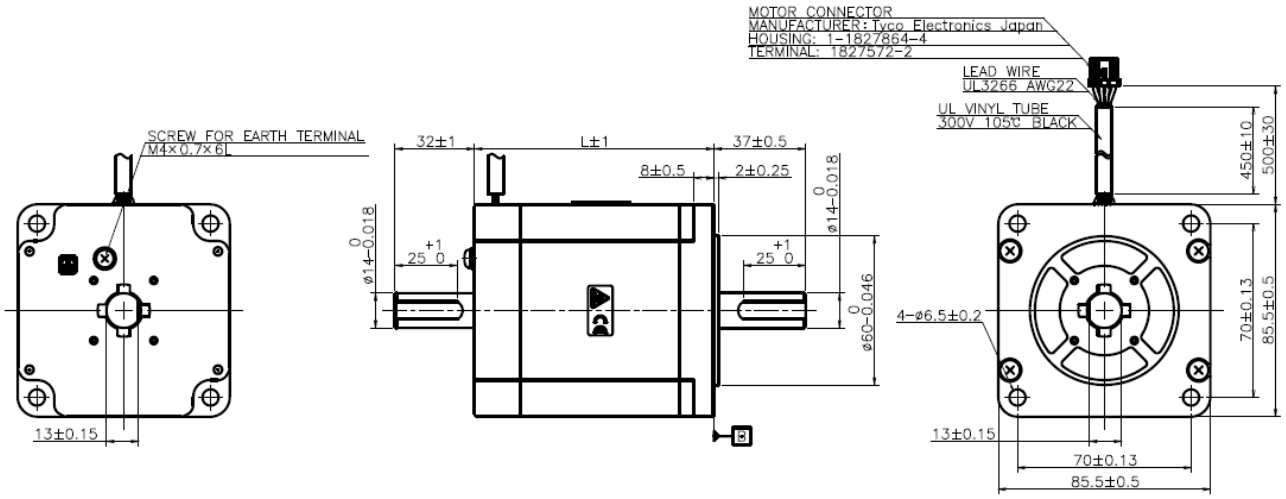
■ SM560□ (□60mm)



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

8. Specifications

■ SM586□ (□86mm)



Model number	Motor length (L)
SM5861	66
SM5862	96.5
SM5863	127

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9

[Option]

9. Option

9.1 Option list

Name	Model number	Length
Connector set for power supply	FC6P0000A	-
Extension connector set for motor	FC6M0000A	-
Extension cable for motor	FC6M0010A	1m
	FC6M0020A	2m
	FC6M0030A	3m
Extension connector set for encoder	FC5E0000A	-
Extension cable for encoder	FC5E0010A	1m
	FC5E0020A	2m
	FC5E0030A	3m
Connector for I/O signal	FC5S0000A	-
Cable for I/O signal	FC5S0010A	1m
	FC5S0020A	2m
Connection unit for the setup software	PBFM-U6	-
Setup software (charge-free)	SANMOTION MOTOR setup software	-

- ◆ Contact us if the other length above is required.
- ◆ Contact us if robot cables are required.
- ◆ For harness assembly, dedicated crimp tool or pressure welding tool is required. Please refer to specification of each connector manufacturer for detail.
- ◆ See 3.2 and 3.3, for applicable wire, model number detail and connector pin array.

9. Option

9.2 Connector, Cable

■ Connector set for power supply Model number: FC6P0000A

Manufacturer	Name	Manufacturer model number	Amount
PHOENIX CONTACT	Connector	MC1,5/2-STF-5,08	1

■ Extension connector set for motor Model number: FC6M0000A

Manufacturer	Name	Manufacturer model number	Amount
Tyco Electronics Japan G.K.	Receptacle housing	1-1827864-4	1
	Receptacle contact	1827572-2	7
	Tab housing	1-1903130-4	1
	Tab contact	1903114-2	7

■ Extension cable for motor

Model number	Cable length
FC6M0010A	1m
FC6M0020A	2m
FC6M0030A	3m

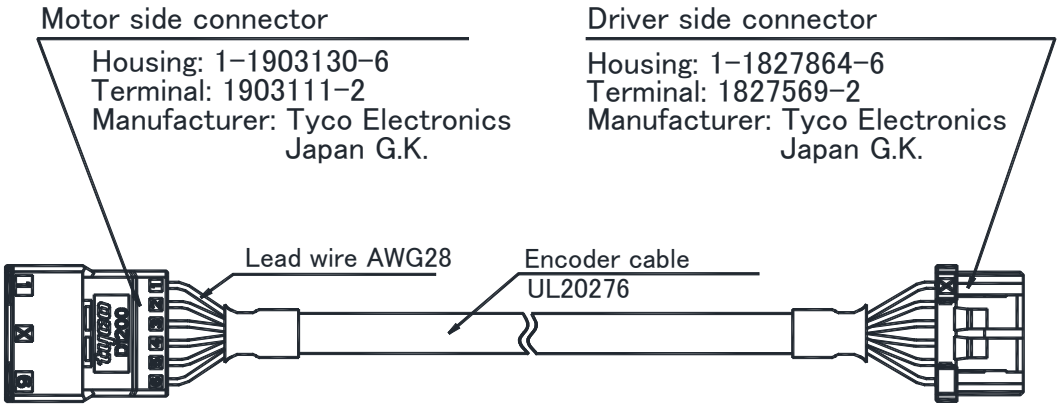
9. Option

■ Extension connector set for encoder Model number: FC5E0000A

Manufacturer	Name	Manufacturer model number	Amount
Tyco Electronics Japan G.K.	Receptacle housing	1-1827864-6	1
	Receptacle contact	1827570-2	10
	Tab housing	1-1903130-6	1
	Tab contact	1903112-2	10

■ Extension cable for encoder

Model number	Cable length
FC5E0010A	1m
FC5E0020A	2m
FC5E0030A	3m



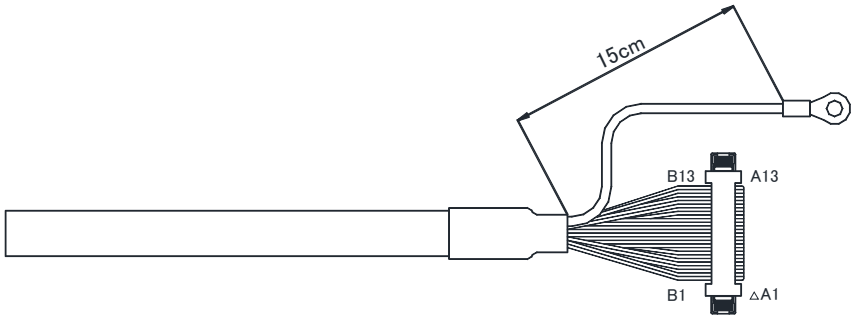
9. Option

■ Connector for I/O signal Model number: FC5S0000A

Manufacturer	Name	Manufacturer model number	Amount
KEL Corporation	Connector	8822E-026-171D-F	1

■ Cable for I/O signal

Model number	Cable length
FC5S0010A	1m
FC5S0020A	2m



9. Option

9.3 Setup software

■ Connection unit for the setup software　Model number: PBFM-U6

Name	Manufacturer model number	Amount
USB/RS-485 converter	Uport 1130 (MOXA)	1
Cable	PBC6T0005A (0.5m)	1

[Important]

◆ See the install manual of product bundle (CD-ROM) or the webpage for driver installation and detail of how to use of Uport 1130. (http://www.moxa.com/)

◆ For the problem caused by Uport 1130, our company assumes no responsibility.

■ SANMOTION MOTOR setup software

System environment

PC	IBM PC/AT-compatible
Memory	Space more than 512MB
Hard-disk space	More than 600MB (Including Microsoft .NET Framework 3.5)
Display	More than 1024×768 of resolution/ 32 color-bit
Applicable OS	Windows® XP Service Pack3-or equivalent performance Windows® Vista Windows® 7 ※There is no limit to the edition of operation 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

◆ The setup software is able to download from our company webpage. (http://www.sanyodenki.co.jp)

10

[Safety Standard]

10. Safety Standard

10.1 Standards conformity

For SANYO DENKI products, compatibility examinations of overseas standards are conducted by certificate authorities, and attestation markings are performed based on the published certificate of attestation.

10.1.1 Standards conformity

Mark	Applicable laws and regulations	Standard code	Certificate authorities
	UL/c-UL standard	UL508C	UL (Underwriters Laboratories inc.) UL File No. E179775
	Low Voltage Directive: LVD	EN61800-5-1	TÜV (TÜV SÜD Japan, Ltd.)
	EMC Directive: EMC	EN61800-3 EN61000-6-2 EN61000-6-4	
	KC standard	KN61000-6-2 KN61000-6-4	National Radio Research Agency Korea Communications Commission Republic of Korea

10.1.2 Over-voltage category, Protection grade, Pollution level

■ The "over-voltage category" of driver is "II" (EN61800-5-1). For use with over-voltage category III, please insert an isolation transformer which is EN or IEC compliant.
For the interface, use a DC power supply with reinforced and insulated input and outputs.

■ Make sure to install the driver in your control panel in an environment where the pollution level specified in EN61800-5-1 and IEC664 is no less than 2 (pollution level 1, 2). The protection grade of driver is IP20. The control panel installation configuration (under IP54) must exclude exposure to water, oil, carbon, dust, etc. Please close cabinet door which has this product, in use.

10. Safety Standard

10.2 Compliance with EN Directives

SANYO DENKI implements the conformity verification test of "Low Voltage Directive" and "an EMC command" in a certificate authority so that a user's CE Marking acquisition can be performed easily, and driver CE Marking is done based on the published certificate of attestation.

10.2.1 Conformity verification test

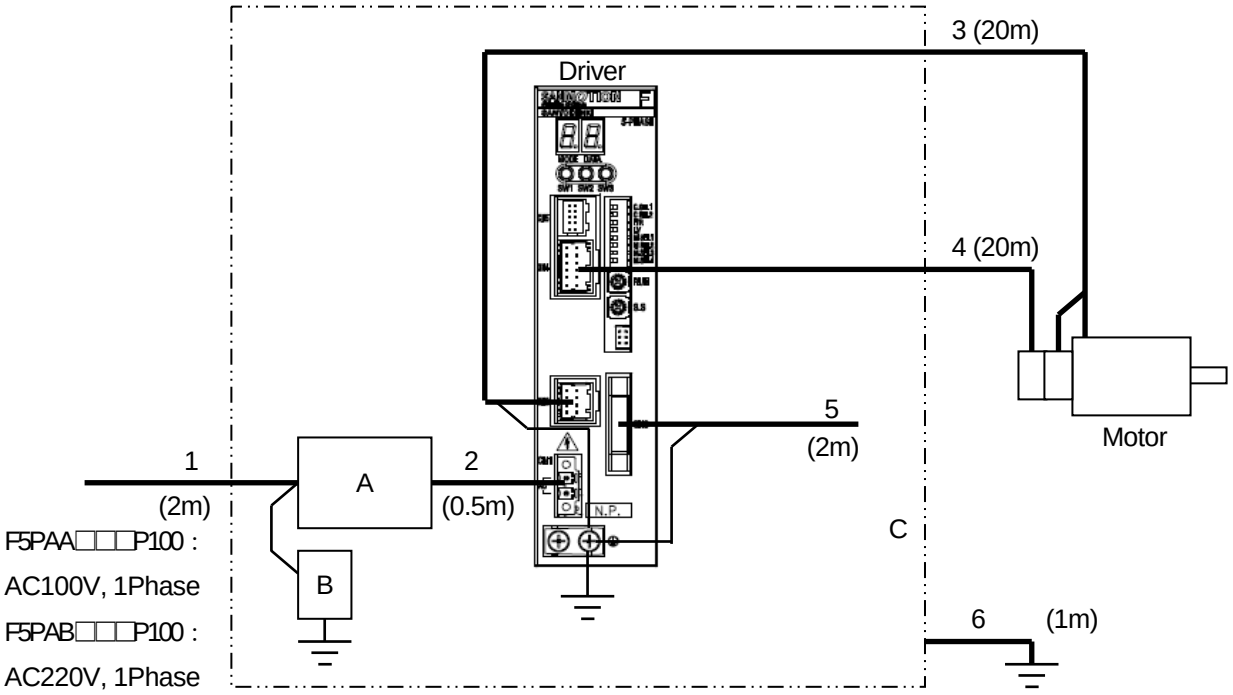
The following conformity verification tests are implemented.

Directive classification	Classification	Test standard
Low Voltage Directive	-	EN61800-5-1
EMC Directive	Emission	EN61000-6-4
		EN61800-3
	Immunity	EN61000-6-2
		EN61800-3

10. Safety Standard

10.2.2 EMC installation requirements

For the installation requirements, in our company the verification test is implemented by the following installations and measures methods, as machines and configurations differ depending on customers' needs. This driver has been authorized to display CE marking based on the recognition certificate issued by a certifying authority. Customers are instructed to perform the final conformity tests for all instruments and devices in use.



Mark	Name	Remarks
A	Noise filter	SUP-EL10-ER-6: OKAYA Electric Industries
B	Surge protector	LV275DI-Q4: OKAYA Electric Industries
C	Enclosure	NITTO KOGYO CORPORATION
1	Power cable 1	Not shielded
2	Power cable 2	Not shielded
3	Motor/Brake cable	Shielded
4	Encoder cable	Shielded
5	I/O cable	Shielded
6	FG cable	Not shielded

- Use metallic materials for enclosure.
- Make sure to ground frame of the noise filters.
- Shorten wiring length between secondary-circuit of noise filter to driver as much as possible.
- Make sure to separate noise filter wiring between primary-circuit and secondary-circuit.

Release
Revision A Mar. 2015

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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