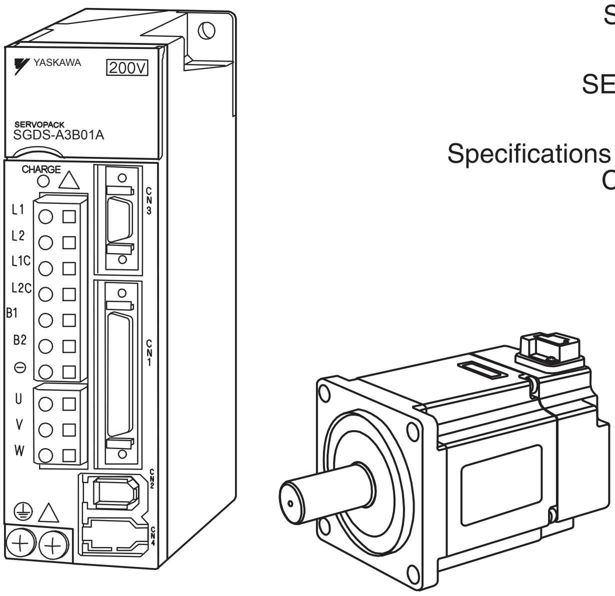
YASKAWA

AC Servo Drives
Σ-III Series
SGM□□/SGDS
USER'S MANUAL

SGMMJ/SGMAS/SGMPS/SGMSS/SGMCS/SGMGH Servomotors
SGDS SERVOPACK



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MANUAL NO. SIEP S800000 00G

About this Manual

■ Intended Audience

This manual is intended for the following users.

- Those selecting Σ-III Series servo drives or peripheral devices for Σ-III Series servo drives.
- Those wanting to know about the ratings and characteristics of Σ-III Series servo drives.
- Those designing Σ-III Series servo drive systems.
- Those installing or wiring Σ-III Series servo drives.
- Those performing trial operation or adjustments of Σ-III Series servo drives.
- Those maintaining or inspecting Σ-III Series servo drives.

■ Description of Technical Terms

The terms in this manual are defined as follows:

- Servomotor or motor = Σ-III Series SGMAS, SGMPS, SGMSS, SGMCS (direct drive) servomotors, Σ-II Series SGMGH servomotor, and Σ-mini Series SGMMJ servomotor.
- SERVOPACK = Σ-III Series SGDS SERVOPACK.
- Servo Drive = A set including a servomotor and servo amplifier.
- Servo System = A servo control system that includes the combination of a servo drive with a host computer and peripheral devices.
- Parameters = parameters set to the SERVOPACK.

■ Indication of Reverse Signals

In this manual, the names of reverse signals (ones that are valid when low level) are written with a forward slash (/) before the signal name, as shown in the following example:

- $\overline{\text{S-ON}}$ = /S-ON
- $\overline{\text{P-CON}}$ = /P-CON

■ Quick access to your required information

Read the chapters marked with ✓ to get the information required for your purpose.

Chapter	SERVOPACKs, Servomotors, and Peripheral Devices	Ratings and Character-istics	System Design	Panel Configura-tion and Wiring	Trial Operation and Servo Adjustment	Inspection and Maintenance	Fully-closed Control
Chapter 1 Outline	✓						
Chapter 2 Selections	✓						
Chapter 3 Servomotor Specifications and Dimensional Drawings	✓	✓	✓	✓			
Chapter 4 SERVOPACK Specifications and Dimensional Drawings	✓	✓	✓	✓			
Chapter 5 Specifications and Dimensional Drawings of Cables and Peripheral Devices	✓	✓	✓	✓			
Chapter 6 Wiring			✓	✓	✓		
Chapter 7 Panel Operator			✓		✓		
Chapter 8 Operation					✓		
Chapter 9 Adjustments						✓	
Chapter 10 Fully-closed Control							✓
Chapter 11 Inspection, Maintenance, and Troubleshooting						✓	
Chapter 12 Appendix	✓		✓		✓	✓	

■ Visual Aids

The following aids are used to indicate certain types of information for easier reference.

IMPORTANT

• Indicates important information that should be memorized, including precautions such as alarm displays to avoid damaging the devices.

INFO

• Indicates supplemental information.

◀ EXAMPLE ▶

• Indicates application examples.

TERMS

• Indicates definitions of difficult terms or terms that have not been previously explained in this manual.

Related Manuals

Refer to the following manuals as required.

Manual Name	Manual Number	Contents
Σ-III Series AC SERVOPACK SGDS Safety Precautions	TOBPS80000000	Describes the safety precautions of Σ-III series SERVOPACK.
Σ-III Series SGM□S/SGDS Digital Operator Operation Manual	TOBPS80000001	Provides detailed information on the operation of the JUSP-OP05A Digital Operator.

Safety Information

The following conventions are used to indicate precautions in this manual. Failure to heed precautions provided in this manual can result in serious or possibly even fatal injury or damage to the products or to related equipment and systems.

WARNING

Indicates precautions that, if not heeded, could possibly result in loss of life or serious injury.

CAUTION

Indicates precautions that, if not heeded, could result in relatively serious or minor injury, damage to the product, or faulty operation.

In some situations, the precautions indicated could have serious consequences if not heeded.

PROHIBITED

Indicates prohibited actions that must not be performed. For example, this symbol would be used to indicate that fire is prohibited as follows: .

MANDATORY

Indicates compulsory actions that must be performed. For example, this symbol would be used as follows to indicate that grounding is compulsory: .

The warning symbols for ISO and JIS standards are different, as shown below.

ISO	JIS
⚠	◇!

The ISO symbol is used in this manual.

Both of these symbols appear on warning labels on Yaskawa products. Please abide by these warning labels regardless of which symbol is used.

Notes for Safe Operation

Read this manual thoroughly before checking products on delivery, storage and transportation, installation, wiring, operation and inspection, and disposal of the AC servo drives.

⚠ WARNING

- Never touch any rotating motor parts while the motor is running.
  Failure to observe this warning may result in injury.
- Before starting operation with a machine connected, make sure that an emergency stop can be applied at any time.
  Failure to observe this warning may result in injury.
- Never touch the inside of the SERVOPACKs.
  Failure to observe this warning may result in electric shock.
- Do not touch terminals for five minutes after the power is turned OFF.
  Residual voltage may cause electric shock.
- Do not touch terminals for five minutes after voltage resistance test.
  Residual voltage may cause electric shock.
- Follow the procedures and instructions for trial operation precisely as described in this manual.
  Malfunctions that occur after the servomotor is connected to the equipment not only damage the equipment, but may also cause an accident resulting in death or injury.
- The output range of multi-turn data for Σ-III series absolute detection system differs from that for conventional systems (15-bit encoder and 12-bit encoder). Especially when “Infinite length positioning system” of conventional type is to be configured with Σ-III series, be sure to make the system modification.
- The multi-turn limit value must be changed only for special applications.
  Changing it inappropriately or unintentionally can be dangerous.
- If the Multi-turn Limit Disagreement alarm (A.CC0) occurs, check the setting of parameter Pn205 in the SERVOPACK to be sure that it is correct.
  If Fn013 is executed when an incorrect value is set in Pn205, an incorrect value will be set in the encoder. The alarm will disappear even if an incorrect value is set, but incorrect positions will be detected, resulting in a dangerous situation where the machine will move to unexpected positions.
- Do not remove the front cover, cables, connectors, or optional items while the power is ON.
  Failure to observe this warning may result in electric shock.
- Do not damage, press, exert excessive force or place heavy objects on the cables.
  Failure to observe this warning may result in electric shock, stopping operation of the product, or burning.
- Provide an appropriate stopping device on the machine side to ensure safety. A holding brake for a servomotor with brake is not a stopping device for ensuring safety.
  Failure to observe this warning may result in injury.
- Do not come close to the machine immediately after resetting momentary power loss to avoid an unexpected restart. Take appropriate measures to ensure safety against an unexpected restart.
  Failure to observe this warning may result in injury.
- Do not modify products.
  Failure to observe this warning may result in injury or damage to products.
- Connect the ground terminal to electrical codes (ground resistance: 100 Ω or less).
  Improper grounding may result in electric shock or fire.

⚠ WARNING

- Installation, disassembly, or repair must be performed only by authorized personnel.
  Failure to observe this warning may result in electric shock or injury.
- Do not modify the product.
  Failure to observe this warning may result in injury or damage to the product.

■ Checking on Delivery

⚠ CAUTION

- Always use the servomotor and SERVOPACK in one of the specified combinations.
  Failure to observe this caution may result in fire or malfunction.

■ Storage and Transportation

⚠ CAUTION

- Do not store or install the product in the following places.
  - Locations subject to direct sunlight.
  - Locations subject to temperatures outside the range specified in the storage or installation temperature conditions.
  - Locations subject to humidity outside the range specified in the storage or installation humidity conditions.
  - Locations subject to condensation as the result of extreme changes in temperature.
  - Locations subject to corrosive or flammable gases.
  - Locations subject to dust, salts, or iron dust.
  - Locations subject to exposure to water, oil, or chemicals.
  - Locations subject to shock or vibration.

  Failure to observe this caution may result in fire, electric shock, or damage to the product.
- Do not hold the product by the cables or motor shaft while transporting it.
  Failure to observe this caution may result in injury or malfunction.
- Do not place any load exceeding the limit specified on the packing box.
  Failure to observe this caution may result in injury or malfunction.
- If disinfectants or insecticides must be used to treat packing materials such as wooden frames, pallets, or plywood, the packing materials must be treated before the product is packaged, and methods other than fumigation must be used.
  Example: Heat treatment, where materials are kiln-dried to a core temperature of 56°C for 30 minutes or more.
  If the electronic products, which include stand-alone products and products installed in machines, are packed with fumigated wooden materials, the electrical components may be greatly damaged by the gases or fumes resulting from the fumigation process. In particular, disinfectants containing halogen, which includes chlorine, fluorine, bromine, or iodine can contribute to the erosion of the capacitors.

■ Installation

⚠ CAUTION
• Never use the products in an environment subject to water, corrosive gases, inflammable gases, or combustibles. Failure to observe this caution may result in electric shock or fire. • Do not step on or place a heavy object on the product. Failure to observe this caution may result in injury. • Do not cover the inlet or outlet ports and prevent any foreign objects from entering the product. Failure to observe this caution may cause internal elements to deteriorate resulting in malfunction or fire. • Be sure to install the product in the correct direction. Failure to observe this caution may result in malfunction. • Provide the specified clearances between the SERVOPACK and the control panel or with other devices. Failure to observe this caution may result in fire or malfunction. • Do not apply any strong impact. Failure to observe this caution may result in malfunction.

■ Wiring

⚠ CAUTION

- Do not connect a three-phase power supply to the U, V, or W output terminals.
  Failure to observe this caution may result in injury or fire.
- Securely connect the power supply terminal screws and motor output terminal screws.
  Failure to observe this caution may result in fire.
- Do not apply stress to connectors.
- Do not bundle or run power and signal lines together in the same duct. Keep power and signal lines separated by at least 30 cm.
- Use twisted-pair shielded wires or multi-core twisted pair shielded wires for signal and encoder (PG) feedback lines.
  The maximum length is 3 m for reference input lines and is 20 m for PG feedback lines.
- Do not touch the power terminals for five minutes after turning power OFF because high voltage may still remain in the SERVOPACK.
  Make sure the charge indicator is out first before starting an inspection.
- Avoid frequently turning power ON and OFF. Do not turn power ON or OFF more than once per minute.
  Since the SERVOPACK has a capacitor in the power supply, a high charging current flows for 0.2 seconds when power is turned ON. Frequently turning power ON and OFF causes main power devices like capacitors and fuses to deteriorate, resulting in unexpected problems.
- Observe the following precautions when wiring main circuit terminal blocks.
  - Remove the terminal block from the SERVOPACK prior to wiring.
  - Insert only one wire per terminal on the terminal block.
  - Make sure that the core wire is not electrically shorted to adjacent core wires.
- Use the products only with the specified power supply voltage.
  Failure to observe this warning may result in burning.
- Do not connect the SERVOPACK for 100 V and 200 V directly to a voltage of 400 V.
  The SERVOPACK will be destroyed.
- When using the products with an irregular or undependable power supply, make sure the power supply stays within the specified range of voltage changes.
  Failure to observe this warning may result in damage to the product.
- Connect the brake power supply properly, keeping in mind the difference of 90-V and 24-V power supplies.
- Install the battery at either the host controller or the battery case of the encoder.
  It is dangerous to install batteries at both simultaneously, because that sets up a loop circuit between the batteries.
- Be sure to wire correctly and securely.
  Failure to observe this caution may result in motor overrun, injury, or malfunction.
- Always use the specified power supply voltage.
  An incorrect voltage may result in burning.
- Take appropriate measures to ensure that the input power supply is supplied within the specified voltage fluctuation range. Be particularly careful in places where the power supply is unstable.
  An incorrect power supply may result in damage to the product.
- Install external breakers or other safety devices against short-circuiting in external wiring.
  Failure to observe this caution may result in fire.
- Do not modify connectors.

⚠ CAUTION

- Take appropriate and sufficient countermeasures for each when installing systems in the following locations.
  - Locations subject to static electricity or other forms of noise.
  - Locations subject to strong electromagnetic fields and magnetic fields.
  - Locations subject to possible exposure to radioactivity.
  - Locations close to power supplies.

  Failure to observe this caution may result in damage to the product.
- Do not reverse the polarity of the battery when connecting it.
  Failure to observe this caution may damage the battery or cause it to explode.

■ Operation

⚠ CAUTION

- Conduct trial operation on the servomotor alone with the motor shaft disconnected from machine to avoid any unexpected accidents.
  Failure to observe this caution may result in injury.
- Before starting operation with a machine connected, change the settings to match the parameters of the machine.
  Starting operation without matching the proper settings may cause the machine to run out of control or malfunction.
- Forward run prohibited (P-OT) and reverse run prohibited (N-OT) signals are not effective during zero point search mode using parameter Fn003.
- When using the servomotor for a vertical axis, install the safety devices to prevent workpieces to fall off due to occurrence of alarm or overtravel. Set the servomotor so that it will stop in the zero clamp state at occurrence of overtravel.
  Failure to observe this caution may cause workpieces to fall off due to overtravel.
- When not using the normal autotuning, set to the correct moment of inertia ratio.
  Setting to an incorrect moment of inertia ratio may cause vibration.
- Do not touch the SERVOPACK heatsinks, regenerative resistor, or servomotor while power is ON or soon after the power is turned OFF.
  Failure to observe this caution may result in burns due to high temperatures.
- Do not make any extreme adjustments or setting changes of parameters.
  Failure to observe this caution may result in injury due to unstable operation.
- When an alarm occurs, remove the cause, reset the alarm after confirming safety, and then resume operation.
  Failure to observe this caution may result in injury.
- Do not use the servo brake of the servomotor for ordinary braking.
  Failure to observe this caution may result in malfunction.

■ Maintenance and Inspection

⚠ CAUTION

- When replacing the SERVOPACK, resume operation only after transferring the previous SERVOPACK parameters to the new SERVOPACK.
  Failure to observe this caution may result in damage to the product.
- Do not attempt to change wiring while the power is ON.
  Failure to observe this caution may result in electric shock or injury.
- Do not disassemble the servomotor.
  Failure to observe this caution may result in electric shock or injury.

■ Disposal

⚠ CAUTION

- When disposing of the products, treat them as ordinary industrial waste.

■ General Precautions

Note the following to ensure safe application.

- The drawings presented in this manual are sometimes shown without covers or protective guards. Always replace the cover or protective guard as specified first, and then operate the products in accordance with the manual.
- The drawings presented in this manual are typical examples and may not match the product you received.
- This manual is subject to change due to product improvement, specification modification, and manual improvement. When this manual is revised, the manual code is updated and the new manual is published as a next edition.
- If the manual must be ordered due to loss or damage, inform your nearest Yaskawa representative or one of the offices listed on the back of this manual.
- Yaskawa will not take responsibility for the results of unauthorized modifications of this product. Yaskawa shall not be liable for any damages or troubles resulting from unauthorized modification.

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1.1 Checking Products

1.1.1 Check Items

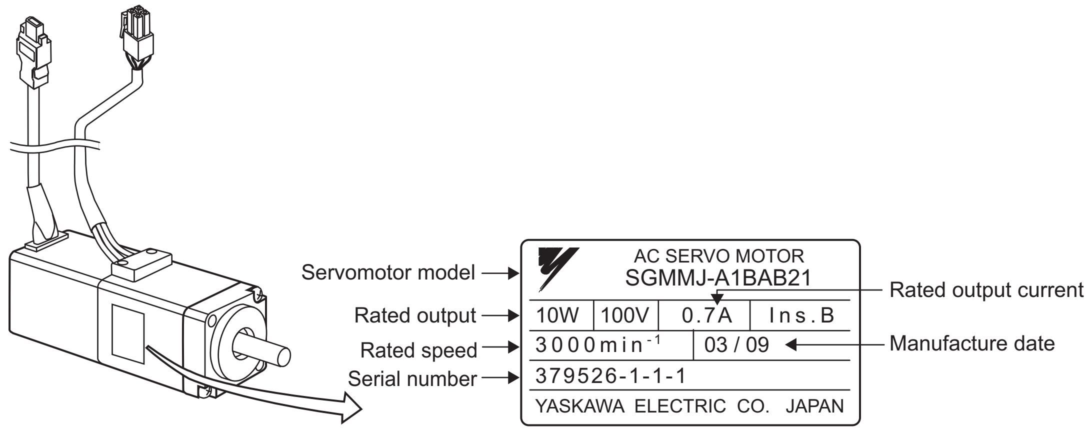
Check the following items when Σ-III Series products are delivered.

Check Items	Comments
Are the delivered products the ones that were ordered?	Check the model numbers marked on the nameplates on the servomotor and SERVOPACK. (Refer to the descriptions of model numbers in the following section.)
Does the servomotor shaft rotate smoothly?	The servomotor shaft is normal if it can be turned smoothly by hand. Servomotors with brakes, however, cannot be turned manually.
Is there any damage?	Check the overall appearance, and check for damage or scratches that may have occurred during shipping.

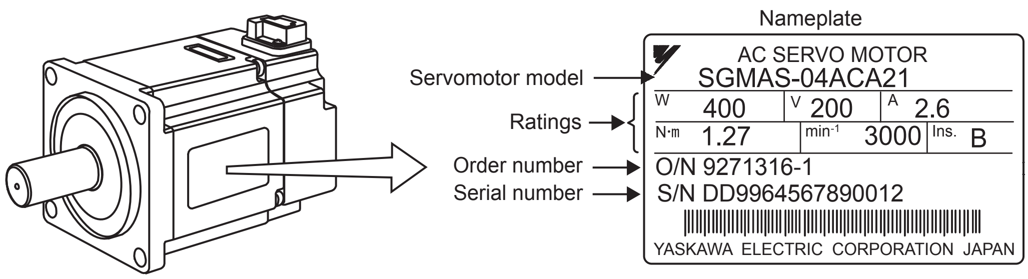
If any of the above items are faulty or incorrect, contact your Yaskawa representative or the dealer from whom you purchased the products.

1.1.2 Servomotors

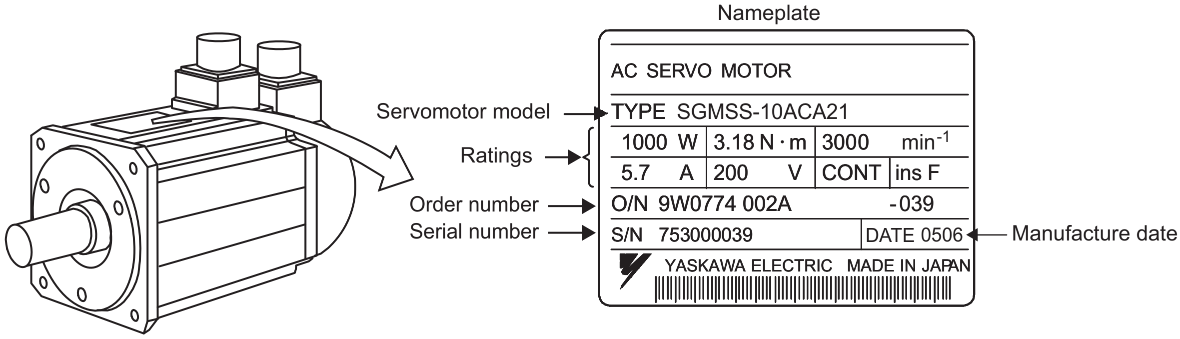
(1) Type SGMMJ



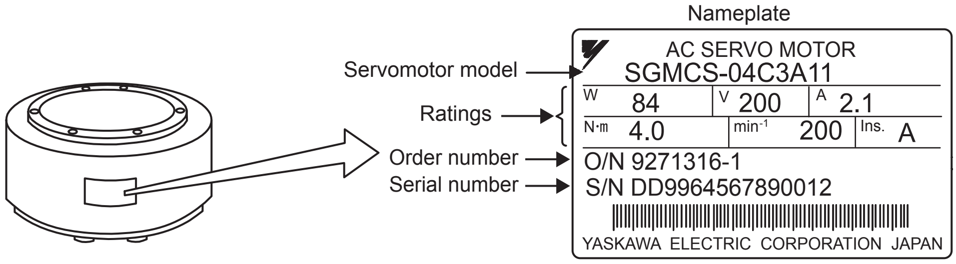
(2) Types SGMAS and SGMPS



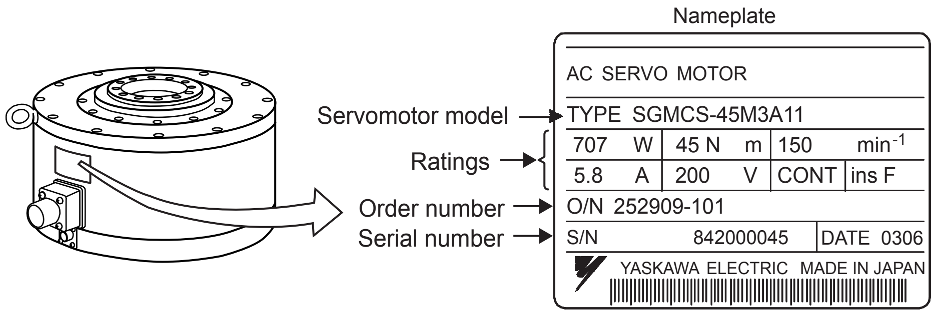
(3) Types SGMSS and SGMGH



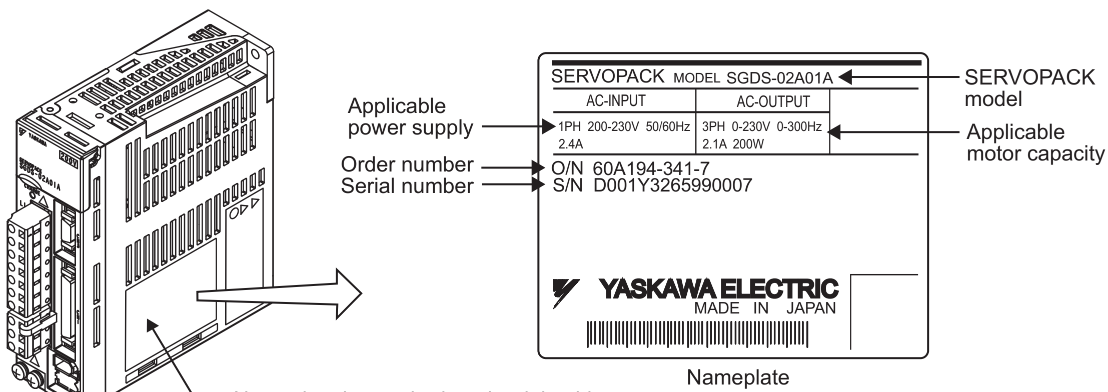
(4) Type SGMCS (Small-capacity series)



(5) Type SGMCS (Middle-capacity series)



1.1.3 SERVOPACKs

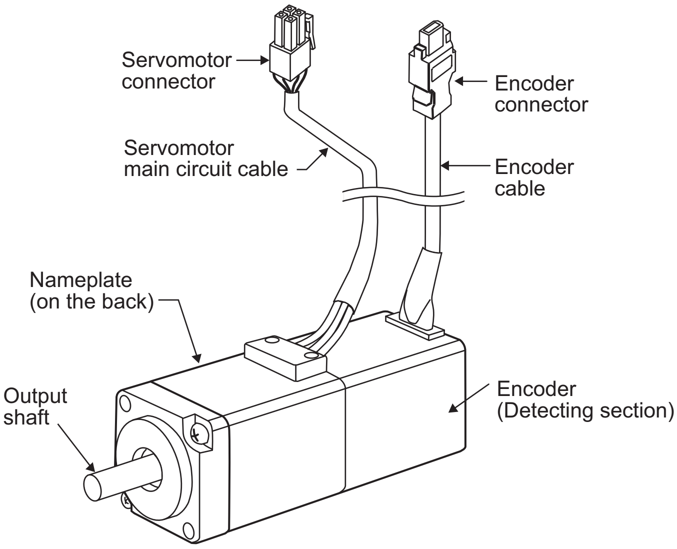


Nameplate is attached on the right side of the SERVOPACK. This illustration shows the SGDS-02A SERVOPACK.

1.2 Product Part Names

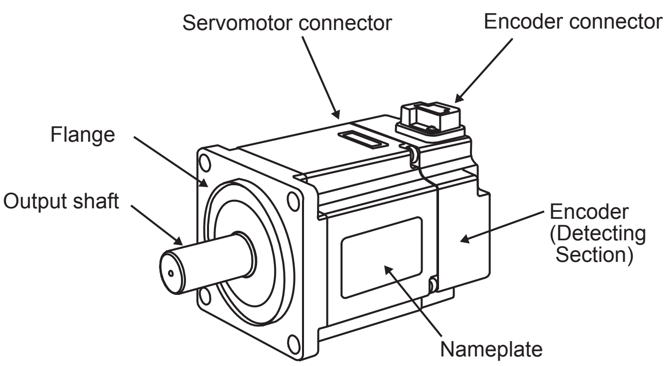
1.2.1 Servomotors

(1) Type SGMMJ without Gears and Brakes

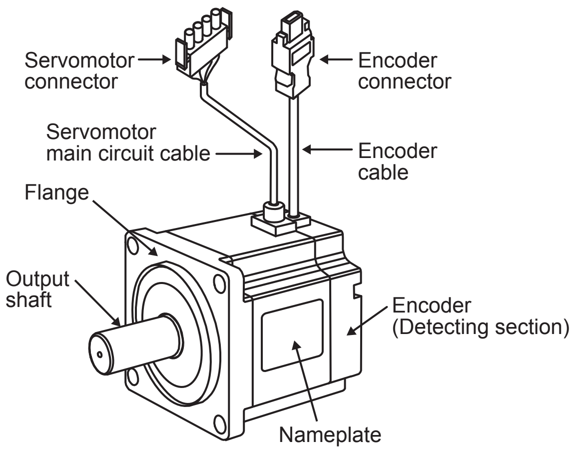


(2) Types SGMAS and SGMPS without Gears and Brakes

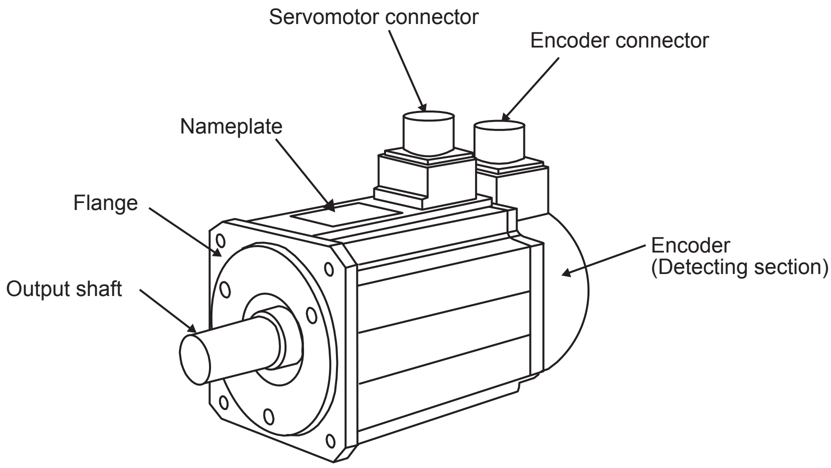
SGMAS or SGMPS-01 to 04 for 100 W to 400 W



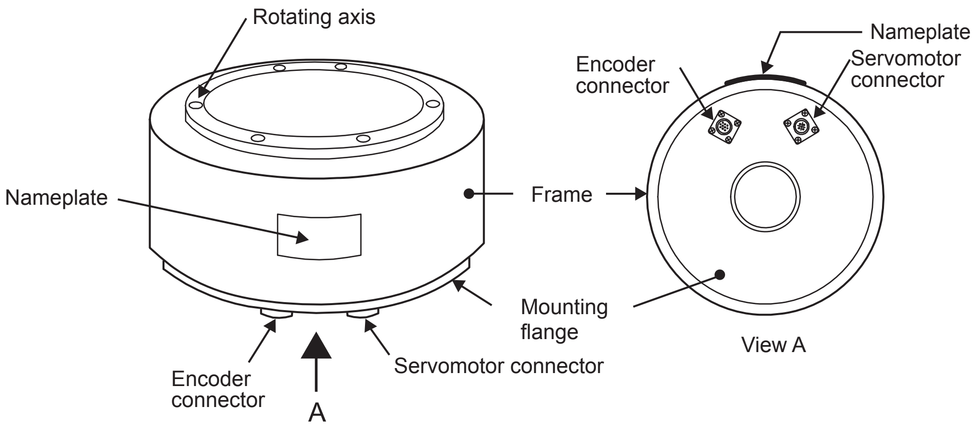
SGMPS-08, 15 for 750 W, 1.5 kW



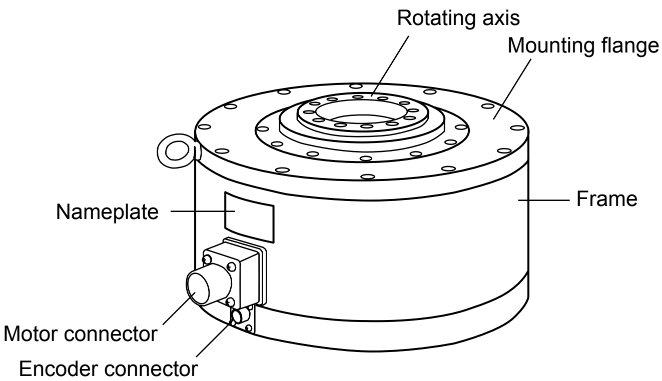
(3) Types SGMSS and SGMGH without Gears and Brakes



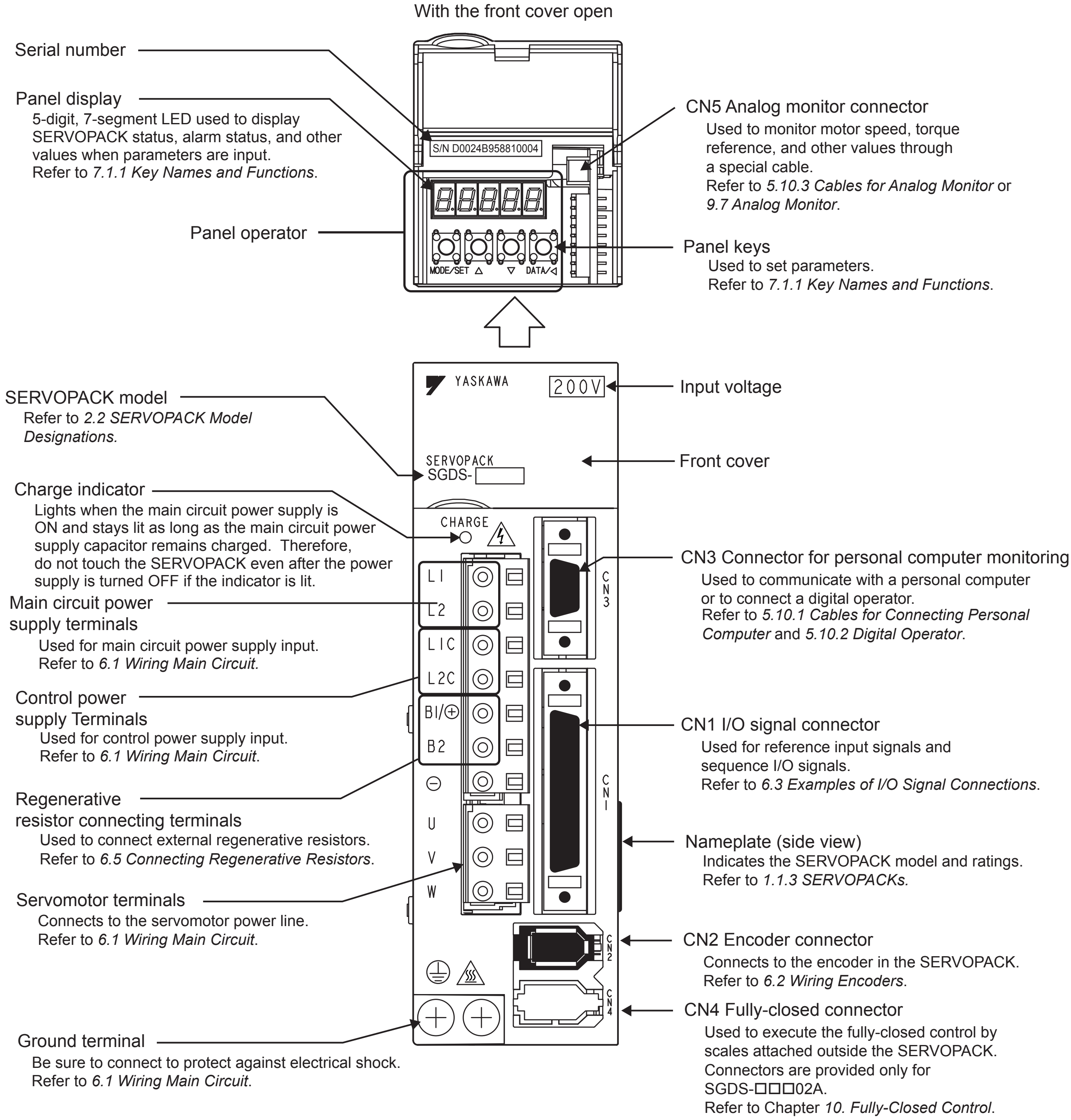
(4) Type SGMCS Direct-drive (Small-capacity series)



(5) Type SGMCS Direct-drive (Middle-capacity series)



1.2.2 SERVOPACKs



INFO

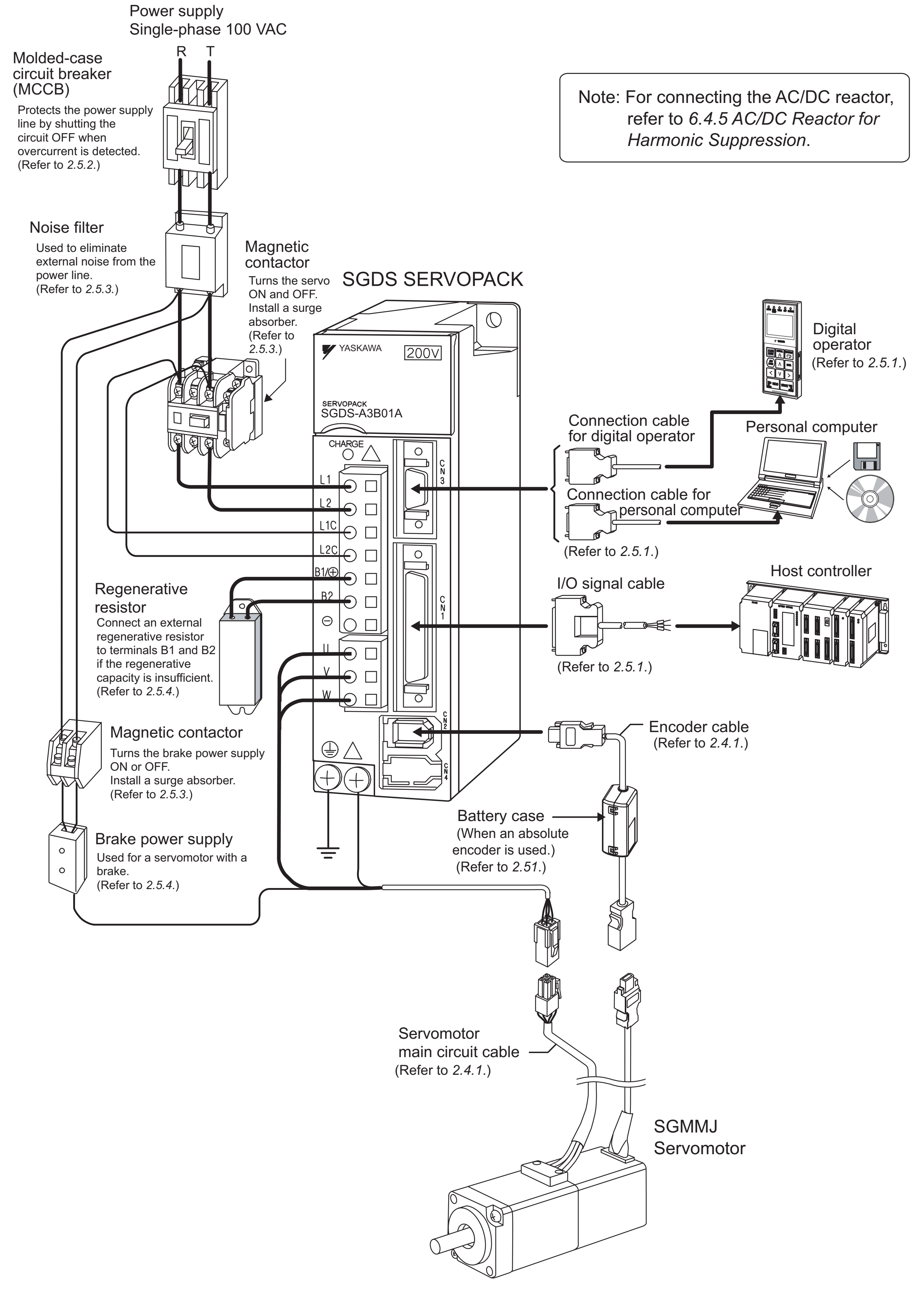
■ Connecting terminal

For connecting a reactor, refer to *6.4.5 AC/DC Reactor for Harmonic Suppression*.

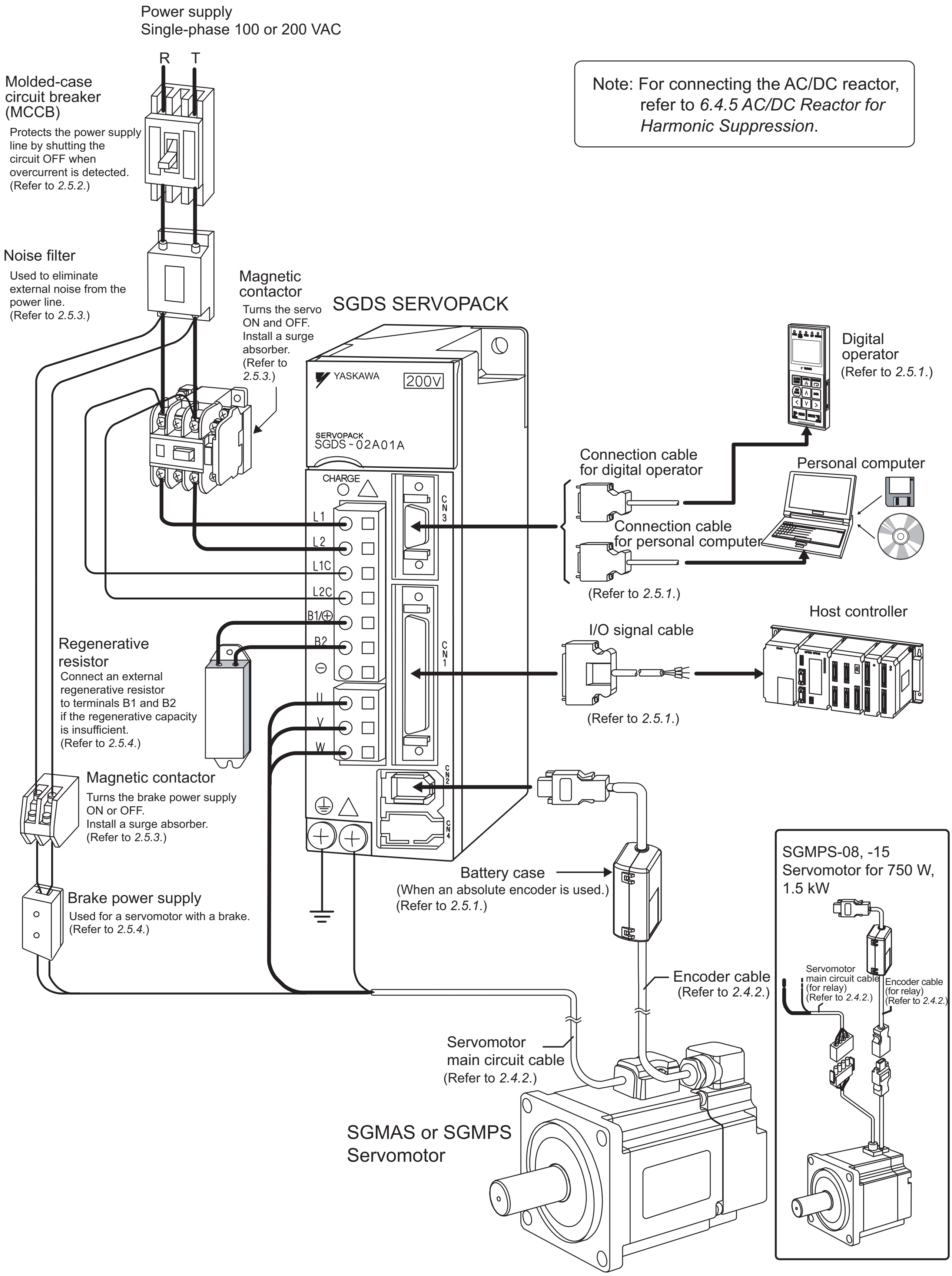
1.3 Examples of Servo System Configurations

This section describes examples of basic servo system configuration.

(1) Connecting to SGMMJ Servomotor



(2) Connecting to SGMAS and SGMPS Servomotors

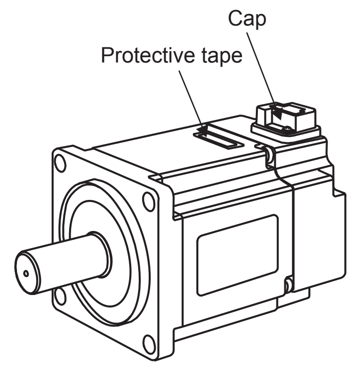


(3) Cable Connections to SGMAS and SGMPS Servomotors

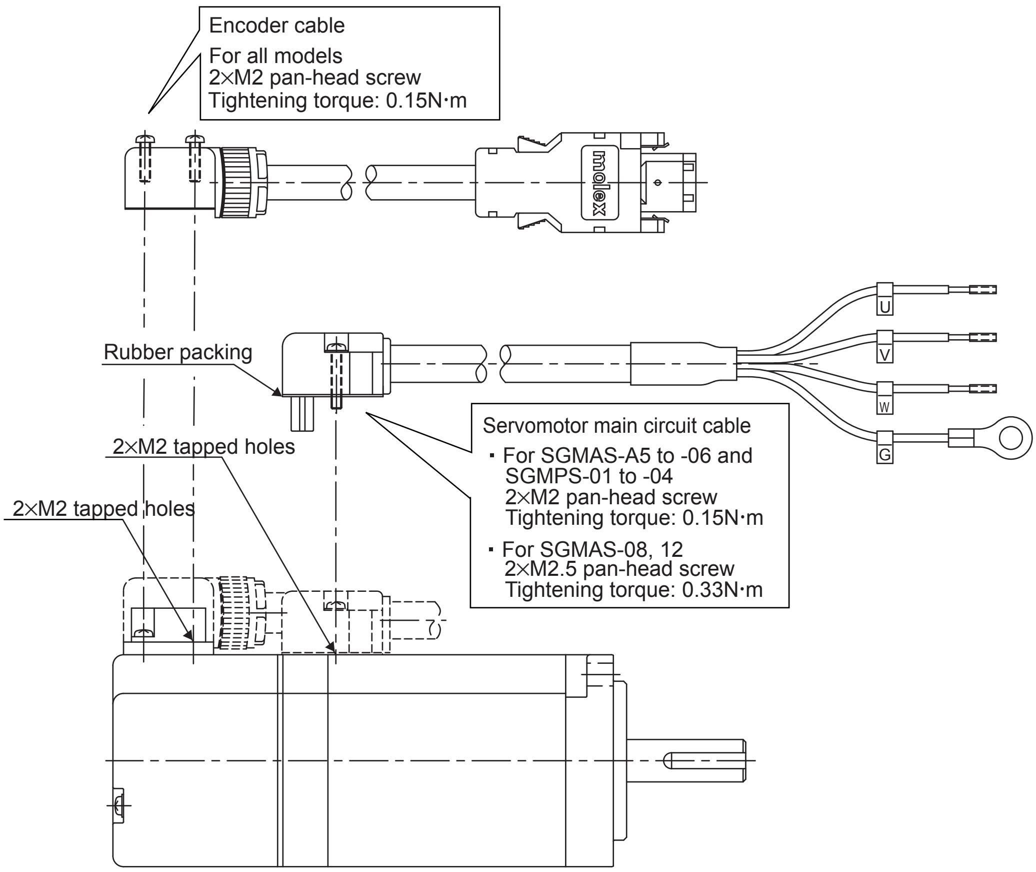
Connect the main circuit cable and encoder cable to SGMAS or SGMPS (100 W to 400 W) servomotor in the following manner.

IMPORTANT Do not directly touch the connector pins provided with the servomotor. Particularly, the encoder may be damaged by static electricity, etc.

1. Remove the protective tape and cap from the servomotor connector.



2. Mount the cable connector on the servomotor and fix it with screws as shown in the figure below.

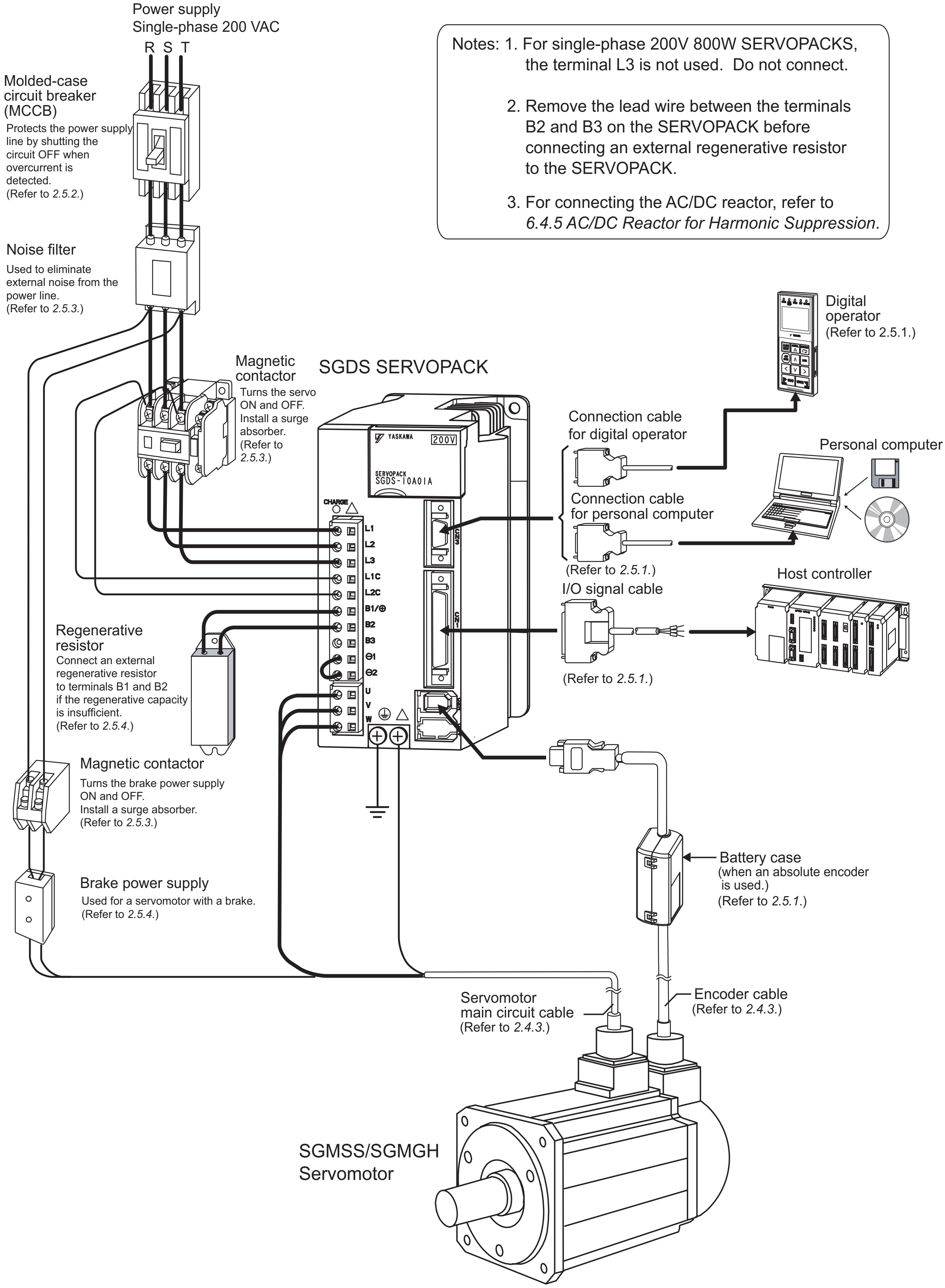


Note: Do not remove the rubber packing on the servomotor-end cable connector. Mount the connector so that the rubber packing is seated properly.
If the rubber packing is not seated properly, the requirements for the protective construction specifications may not be met.

Outline

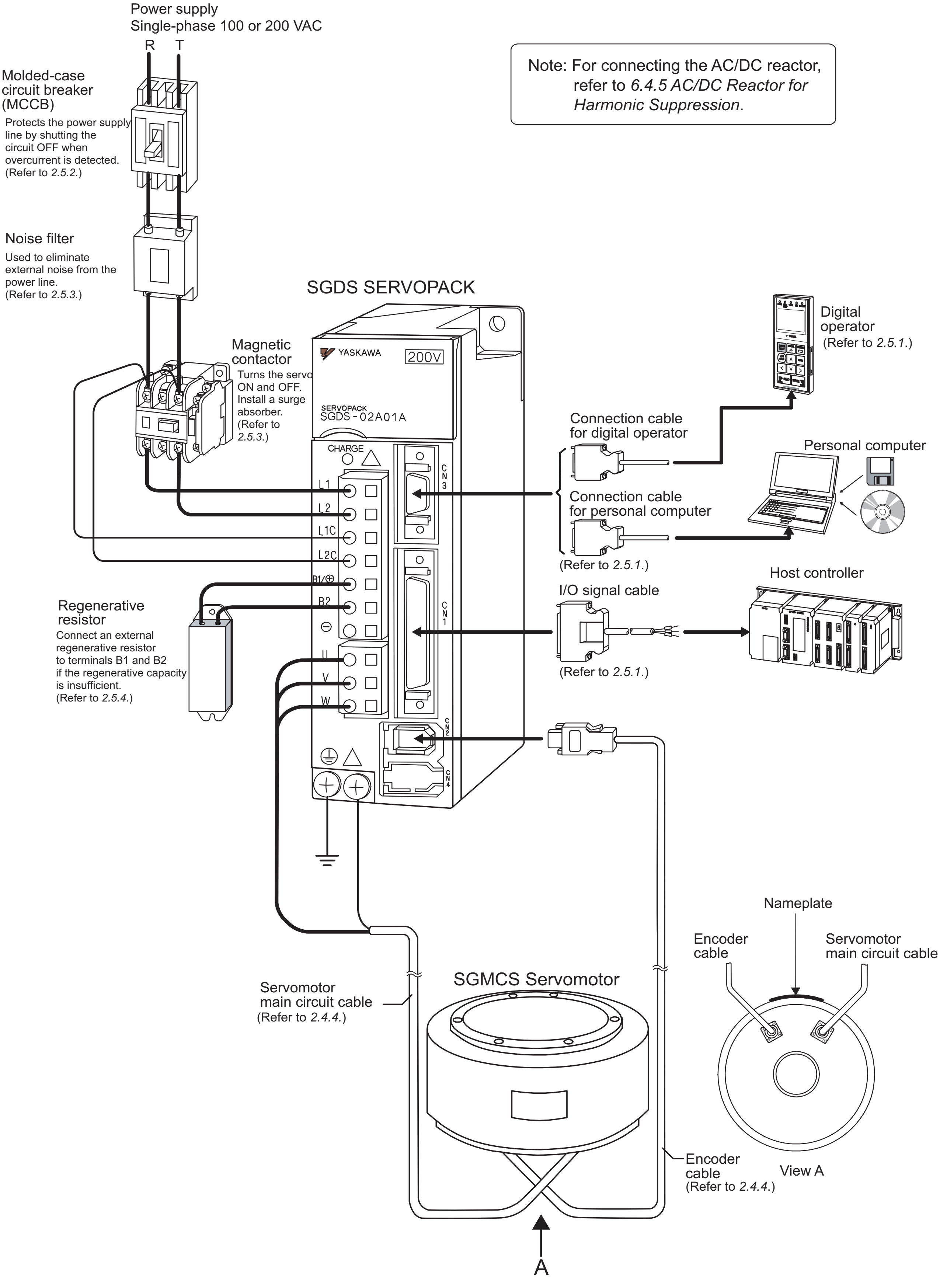
1

(4) Connecting to SGMSS/SGMGH Servomotors



(5) Connecting to SGMCS Servomotor

Note: For connecting the AC/DC reactor, refer to *6.4.5 AC/DC Reactor for Harmonic Suppression*.



Outline

1

1.4 Applicable Standards

1.4.1 North American Safety Standards (UL, CSA)

Model		UL*1 Standards (UL File No.)	CSA*2 Standards	Certification
SERVOPACK	• SGDS	UL508C(E147823)	CSA C22.2 No.14	UL
Servomotor	• SGMMJ • SGMAS • SGMPS • SGMSS • SGMGH	UL1004(E165827)	CSA C22.2 No.100	

* 1. Underwriters Laboratories Inc.
* 2. Canadian Standards Association.

1.4.2 CE Marking

Model		Low Voltage Directive	EMC Directive		Certification
			EMI	EMS	
SERVOPACK	• SGDS	EN50178	EN55011 class A group 1	EN61000-6-2	TÜV PS*
Servomotor	• SGMMJ • SGMAS • SGMPS • SGMSS • SGMGH	IEC60034-1 IEC60034-5 IEC60034-8 IEC60034-9			

* TÜV Product Services GmbH

Note: Because SERVOPACKs and servomotors are the built-in type, reconfirmation is required after being installed in the final product.

2

Selections

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2.1 Servomotor Model Designations

This section explains how to check the servomotor model and ratings.

2.1.1 Model SGMMJ

(1) Without Gears

	1st + 2nd digits	3rd digit	4th digit	5th digit	6th digit	7th digit	8th digit
SGMMJ –	A1	B	A	B	2	1	□

SGMMJ: Σ-mini series SGMMJ servomotor

1st + 2nd digits: Rated Output (W)	
Code	Rated Output
A1	10
A2	20
A3	30

3rd digit: Power Supply Voltage	
Code	Voltage
B	100VAC

4th digit: Serial Encoder		
Code	Specifications	Remarks
A	13-bit incremental encoder *1	Standard
2	17-bit absolute encoder *2	Standard

*1. The number of encoder pulses: 2048 P/Rev.
*2. The number of encoder pulses: 32768 P/Rev.

5th digit: Design Revision Order	
Code	Specifications
B	Standard (Applicable for SGDS SERVOPACK)

6th digit: Shaft End		
Code	Specifications	Remarks
2	Straight without flat	Standard
A	Straight with flat	Option

7th digit: Brake	
Code	Specifications
1	Without brakes
C	24-VDC brake

8th digit: Options	
Code	Specifications
None	Leads length 300mm
H	Leads length 500mm
J	Leads length 1000mm
K	Leads length 1500mm

(2) With Gears

1st + 2nd digits	3rd digit	4th digit	5th digit	6th digit	7th digit	8th digit	9th digit	10th digit
A1	C	A	A	J	1	2	1	□

SGMMJ – A1 C A A J 1 2 1 □

Σ-mini series SGMMJ servomotor

1st + 2nd digits: Rated Output (W)

Code	Rated Output
A1	10
A2	20
A3	30

3rd digit: Power Supply Voltage

Code	Voltage
B	100VAC

4th digit: Serial Encoder

Code	Specifications	Remarks
A	13-bit incremental encoder *1	Standard
2	17-bit absolute encoder *2	Standard

*1. The number of encoder pulses: 2048 P/Rev.
*2. The number of encoder pulses: 32768 P/Rev.

5th digit: Design Revision Order

Code	Specifications
B	Standard (Applicable for SGDS SERVOPACK)

6th digit: Gears

Code	Specifications
J	With gears

7th digit: Gear Ratio

Code	Specifications	Remarks
1	1/5	For SGMMJ-A3 (Gear ratio flange: □40)
2	1/16	
3	1/25	
A	1/5	For SGMMJ-A1 and A2 (Gear ratio flange: □25)
B	1/16	
C	1/25	

8th digit: Shaft End

Code	Specifications	Remarks
2	Straight without flat	Standard
6	Straight with key and tap	Option

9th digit: Brake

Code	Specifications
1	Without brakes
C	24-VDC brake

10th digit: Options

Code	Specifications
None	Leads length 300mm
H	Leads length 500mm
J	Leads length 1000mm
K	Leads length 1500mm

Selections

2

2.1.2 Model SGMAS/SGMPS/SGMSS

(1) Without Gears

	1st + 2nd digits	3rd digit	4th digit	5th digit	6th digit	7th digit
SGMAS –	01	A	C	A	2	1

Σ-III Series SGMAS, SGMPS and SGMSS servomotor

1st + 2nd digits: Rated Output (kW)			
Code	SGMAS	SGMPS	SGMSS
A5	0.05	–	–
01	0.10	0.10	–
C2	0.15	–	–
02	0.20	0.20	–
04	0.40	0.40	–
06	0.60	–	–
08	0.75	0.75	–
10	–	–	1.0
12	1.15	–	–
15	–	1.5	1.5
20	–	–	2.0
25	–	–	2.5
30	–	–	3.0
40	–	–	4.0
50	–	–	5.0
70	–	–	7.0

3rd digit: Power Supply Voltage	
Code	Voltage
A	200 VAC

Note: Servomotor is for 200 VAC also when SERVOPACK is for 100 VAC.

4th digit: Serial Encoder		
Code	Specifications	Remarks
2	17-bit absolute	Standard
C	17-bit incremental	

Note: The number of encoder pulse is 32768 P/Rev.

5th digit: Design Revision Order	
Code	Design Revision Order
A	SGMAS/SGMPS/SGMSS
E	SGMPS (IP67 specification)

<table>
<tr><th colspan="5">6th digit: Shaft End</th></tr>
<tr><th>Code</th><th>Specifications</th><th>SGMAS</th><th>SGMPS</th><th>SGMSS</th></tr>
<tr><td>2</td><td>Straight without key</td><td colspan="3">Standard</td></tr>
<tr><td>3</td><td>Taper 1/10, with key</td><td>–</td><td>–</td><td>Option</td></tr>
<tr><td>4</td><td>Straight with key</td><td colspan="2" rowspan="3">Option</td><td>–</td></tr>
<tr><td>6</td><td>Straight with key and tap</td><td>Option</td></tr>
<tr><td>8</td><td>Straight with tap</td><td>–</td></tr>
</table>

7th digit: Options	
Code	Specifications
1	Without options
B	With 90-VDC brake
C	With 24-VDC brake
D	With oil seal and 90-VDC brake
E	With oil seal and 24-VDC brake
S	With oil seal

Note: 4-kW, 5-kW and 7-kW SGMSS Servomotor do not have brakes.

(2) With Gears

1st + 2nd digits, 3rd digit, 4th digit, 5th digit, 6th digit, 7th digit, 8th digit, 9th digit

SGMAS – 01 A C A H 1 2 B

Σ-III Series SGMAS, SGMPS and SGMSS servomotor

9th digit: Brake	
1	Without brake
B	With 90-VDC brake
C	With 24-VDC brake

Note: 4 kW, 5 kW and 7 kW SGMSS Servomotors do not have brakes.

1st+2nd digits: Rated Output (kW)

Code	SGMAS	SGMPS	SGMSS
A5	0.05	–	–
01	0.10	0.10	–
C2	0.15	–	–
02	0.20	0.20	–
04	0.40	0.40	–
06	0.60	–	–
08	0.75	0.75	–
10	–	–	1.0
12	1.15	–	–
15	–	1.5	1.5
20	–	–	2.0
25	–	–	2.5
30	–	–	3.0
40	–	–	4.0
50	–	–	5.0

8th digit: Shaft End

Code	Specifications	SGMAS	SGMPS	SGMSS
0	Flange type (no shaft)	H	H	–
2	Straight without key	H, J	H, J	–
4	Straight with key	–	–	L
6	Straight with key and tap	H, J	H, J	–
8	Straight with tap	H	H	–

7th digit: Gear Ratio

Code	Gear Ratio	SGMAS	SGMPS	SGMSS -10A to -30A	SGMSS -40A	SGMSS -50A
B	1/11	H (-01A to -12A) J (only -12A)	H (-01A to -15A) J (only -15A)	–	–	–
C	1/21	H, J	H, J	–	–	–
1	1/5	H, J	H, J	L	L	L
2	1/9	H (only -A5A)	–	L	L	L
3	3/31	J (-A5A to -08A)	J (-01A to -08A)	–	–	–
5	1/20	–	–	L	L	L
7	1/29	–	–	L	L	–
	1/33	H, J	H, J	–	–	–
8	1/45	–	–	L	–	–

3rd: digit: Power Supply Voltage

Code	Voltage
A	200 VAC

Note: Servomotor is for 200 VAC also when SERVOPACK is for 100 VAC.

4th digit: Serial Encoder

Code	Specifications	Remarks
2	17-bit absolute	Standard
C	17-bit incremental	

Note: The number of encoder pulses is 32768 P/Rev.

6th digit: Gear Type

Code	Specifications
H	HDS planetary low-backlash gear (SGMAS/SGMPS)
J	Standard backlash gear (SGMAS/SGMPS)
L	Low-backlash gear (SGMSS)

5th digit: Design Revision Order

Code	Specifications
A	Standard
E	SGMPS (IP67 specification)

Note: SGMPS servomotors conform to IP67, but the gears do not.

2.1.3 Model SGMGH (1500 min^{-1})

(1) Without Gears

1st + 2nd digits | 3rd digit | 4th digit | 5th digit | 6th digit | 7th digit

SGMGH –13 A C A 2 1

1st+2nd digits Rated Output (kW)

Code	Rated Output
05	0.45
09	0.85
13	1.3
20	1.8
30	2.9
44	4.4
55	5.5
75	7.5

3rd digit: Power Supply Voltage

Code	Voltage
A	200VAC

4th digit: Serial Encoder

Code	Specifications	Remarks
2	17-bit absolute encoder *	Standard
C	17-bit incremental encoder *	

* The number of encoder pulses: 32768 P/Rev.

5th digit: Design Revision Order

Code	Specifications
A	Standard
C	For high-performance machine tool (4.4 kW or less)*

* Applicable only for models SGMGH-05 to 44.

6th digit: Shaft End

Code	Specifications	Remarks
2	Straight without key	Standard
3	Taper 1/10, with parallel key	Option
5	Taper 1/10, with woodruff key*	
6	Straight with key and tap	

* Applicable only for models SGMGH-05 and -09.

7th digit: Brake and Oil Seal

Code	Specifications
1	Without options
B	With 90-VDC brake
C	With 24-VDC brake
D	With oil seal and 90-VDC brake
E	With oil seal and 24-VDC brake
S	With oil seal

(2) With Grears

SGMGH –	20	A	C	A	L	1	4	B
	1st + 2nd digits	3rd digit	4th digit	5th digit	6th digit	7th digit	8th digit	9th digit

9th digit: Brake	
Code	Specifications
1	Without brake
B	With 90-VDC brake
C	With 24-VDC brake

8th digit: Shaft End		6th digit: Gear Type Code		
Code	Specifications	L	E	F
4	Straight with key	○	–	–
6	Straight with key and tap	–	○	○

○: Available

1st+2nd digits: Rated Output (kW)	
Code	Rated Output
05	0.45
09	0.85
13	1.3
20	1.8
30	2.9
44	4.4
55	5.5
75	7.5

3rd digit: Power Supply Voltage	
Code	Voltage
A*	200VAC

* With Standard backlash gears: P

6th digit: Gear Type	
Code	Specifications
L	Planetary low-backlash gear (Flange type)
E	Standard backlash gear (Foot mounting type)
F	Standard backlash gear (Flange type)

5th digit: Design Revision Order	
Code	Specifications
A	Standard
C	For high-performance machine tool*

* Applicable only for models SGMGH-05 to 44.

4th digit: Serial Encoder		
Code	Specifications	Remarks
2	17-bit absolute encoder*	Standard
C	17-bit incremental encoder*	

* The number of encoder pulses: 32768 P/Rev.

6th digit: Gear Type Code	7th digit: Gear Ratio		Code for 1st + 2nd + 3rd digits					
	Code	Specifications	05A	09A	13A	20A	30A	44A
L (Low-backlash)	1	1/5	○	○	○	○	○	○
	2	1/9	○	○	○	○	○	○
	5	1/20	○	○	○	○	○	–
	7	1/29	○	○	○	○	–	–
	8	1/45	○	○	○	–	–	–

○: Available

6th digit: Gear Type Code	7th digit: Gear Ratio		Code for 1st + 2nd + 3rd digits							
	Code	Specifications	05P	09P	13P	20P	30P	44P	55P	75P
E (Standard)	A	1/6	○	○	○	○	○	○	○	–
	B	1/11	○	○	○	○	○	○	○	○
	C	1/21	○	○	○	○	○	○	○	○
	7	1/29	○	○	○	○	○	○	○	○

○: Available

6th digit: Gear Type Code	7th digit: Gear Ratio		Code for 1st + 2nd + 3rd digits							
	Code	Specifications	05P	09P	13P	20P	30P	44P	55P	75P
F (Standard)	A	1/6	○	○	○	○	○	○	○	–
	B	1/11	○	○	○	○	○	○	○	○
	C	1/21	○	○	○	○	○	○	○	○
	7	1/29	○	○	○	○	○	○	○	○

○: Available

2.1.4 Model SGMGH (1000 min^{-1})

(1) Without Gears

1st + 2nd digits	3rd digit	4th digit	5th digit	6th digit	7th digit

SGMGH – 12 A C B 2 1

1st + 2nd digits: Rated Output (kW)	
Code	Rated Output
03	0.3
06	0.6
09	0.9
12	1.2
20	2.0
30	3.0
40	4.0
55	5.5

3rd digit : Power Supply Voltage	
Code	Voltage
A	200VAC

7th digit: Options	
Code	Specifications
1	Without options
B	With 90-VDC brake
C	With 24-VDC brake
D	With oil seal and 90-VDC brake
E	With oil seal and 24-VDC brake
S	With oil seal

6th digit: Shaft End		
Code	Specifications	Remarks
2	Straight without key	Standard
3	Taper 1/10, with parallel key	Option
5	Taper 1/10, with woodruff key*	
6	Straight with key and tap	

* Applicable only for models SGMGH-03 and -06.

4th digit: Serial Encoder		
Code	Specifications	Remarks
2	17-bit absolute encoder*	Standard
C	17-bit incremental encoder*	

* The number of encoder pulses: 32768 P/Rev.

5th digit: Design Revision Order	
Code	Specifications
B	Standard
D	For high-performance machine tool*

* Applicable only for models SGMGH-03 to 30.

(2) With Gears

1st + 2nd digits	3rd digit	4th digit	5th digit	6th digit	7th digit	8th digit	9th digit
SGMGH – 20	A	C	B	L	1	4	B

9th digit: Brake	
Code	Specifications
1	Without brake
B	With 90-VDC brake
C	With 24-VDC brake

8th digit: Shaft End		6th digit: Gear Type Code		
Code	Specifications	L	E	F
4	Straight with key	○	–	–
6	Straight with key and tap	–	○	○

○: Available

1st + 2nd digits: Rated Output (kW)	
Code	Rated Output
03	0.3
06	0.6
09	0.9
12	1.2
20	2.0
30	3.0
40	4.0
55	5.5

3rd digit : Power Supply Voltage	
Code	Voltage
A*	200VAC

* With standard backlash gears: P

6th digit: Gear Type	
Code	Specifications
L	Planetary low-backlash gear (Flange type)
E	Standard backlash gear (Foot mounting type)
F	Standard backlash gear (Flange type)

5th digit: Design Revision Order	
Code	Specifications
B	Standard
D	For high-performance machine tool*

* Applicable only for SGMGH-03 to -30.

4th digit: Serial Encoder		
Code	Specifications	Remarks
2	17-bit absolute encoder*	Standard
C	17-bit incremental encoder*	

* The number of encoder pulses: 32768 P/Rev.

6th digit: Gear Type Code	7th digit: Gear Ratio		Code for 1st + 2nd + 3rd digits							
	Code	Specifications	03A	06A	09A	12A	20A	30A	40A	55A
L (Low-backlash)	1	1/5	○	○	○	○	○	○	–	–
	2	1/9	○	○	○	○	○	○	–	–
	5	1/20	○	○	○	○	○	–	–	–
	7	1/29	○	○	○	○	–	–	–	–
	8	1/45	○	○	○	○	–	–	–	–

○: Available

6th digit: Gear Type Code	7th digit: Gear Ratio		Code for 1st + 2nd + 3rd digits							
	Code	Specifications	03P	06P	09P	12P	20P	30P	40P	55P
E (Standard)	A	1/6	○	○	○	○	○	○	○	–
	B	1/11	○	○	○	○	○	○	○	○
	C	1/21	○	○	○	○	○	○	○	○
	7	1/29	○	○	○	○	○	○	○	○

○: Available

6th digit: Gear Type Code	7th digit: Gear Ratio		Code for 1st + 2nd + 3rd digits							
	Code	Specifications	03P	06P	09P	12P	20P	30P	40P	55P
F (Standard)	A	1/6	○	○	○	○	○	○	○	–
	B	1/11	○	○	○	○	○	○	○	○
	C	1/21	○	○	○	○	○	○	○	○
	7	1/29	○	○	○	○	○	○	○	○

○: Available

2.1.5 Model SGMCS

	1st + 2nd digits	3rd digit	4th digit	5th digit	6th digit	7th digit
SGMCS –	02	B	3	C	1	1

SGMCS: Σ-III Series SGMCS servomotor

Rated Torque (N・m)		1st + 2nd + 3rd digits: Servomotor Outer Diameter (mm)					
Code	Specifications	B (ϕ135)	C (ϕ175)	D (ϕ230)	E (ϕ290)	M (ϕ280)	N (ϕ360)
02	2.0	○					
04	4.0		○				
05	5.0	○					
07	7.0	○					
08	8.0			○			
10	10.0		○				
14	14.0		○				
16	16.0				○		
17	17.0			○			
25	25.0			○			
35	35.0				○		
45	45.0					○	
80	80.0					○	○
1A	110.0					○	
1E	150.0						○
2Z	200.0						○

7th digit: Brake

Code	Specifications
1	Without brake

6th digit: Flange

Code	Specifications
1	C-face*1
3	C-face*2
4	C-face with cable on side*3

5th digit: Design Revision Order

Code	Specifications
A	Servomotor outer diameter M, N
B	Servomotor outer diameter E
C	Servomotor outer diameter B, C, D

4th digit: Serial Encoder

Code	Specifications	Remarks
3	20-bit absolute (without multiturn data)	Standard
D	20-bit incremental	Option

* 1. C-face on the opposite drive end
(servomotor outer diameter B, C, D, E)
C-face on the drive end
(servomotor outer diameter M, N)
* 2. C-face on the opposite drive end
(servomotor outer diameter M, N)
* 3. Only for servomotor outer diameter B, C, D, E

2.2 SERVOPACK Model Designations

Select the SERVOPACK according to the applied servomotor.

SGDS - 02 A 01 A *

- SGDS: Σ-III Series SGDS SERVOPACK
- 02: 1st + 2nd digits
- A: 3rd digit
- 01: 4th + 5th digits
- A: 6th digit
- *: 7th digit

1st + 2nd digits: Rated Output of Applicable Servomotor	
Code	Rated Output
A3	30 W
A5	50 W
01	100 W
02	200 W
04	400 W
05	500 W
08	750 W
10	1.0 kW
15	1.5 kW
20	2.0 kW
30	3.0 kW
50	5.0 kW
60	6.0 kW
75	7.5 kW

3rd digit: Power Supply Voltage	
Code	Voltage
A	200 VAC
F	100 VAC (100 V input, 200 V output: Doubled voltage)
B	100 VAC (100 V input, 100 V output: For SGMMJ servomotor)

4th + 5th digits: Interface Specifications	
Code	Specifications
01	Standard (analog, pulse-train)
02	Fully closed

6th digit: Design Revision Order
A,B ••• Start from A

7th digit: Mounting Method		
Code	Specifications	Applicable Model
–	Base-mounted as standard	7.5 kW or less
R	Rack-mounted	5.0 kW or less

2.3 Σ-III Series SERVOPACKs and Applicable Servomotors

Table 2.1 SERVOPACKs and Applicable Servomotors

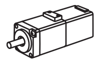
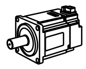
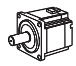
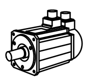
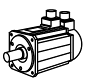
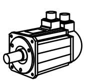
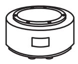
SGM☐S Servomotor		Σ-III Series SGDS SERVOPACK		
		Single-phase 100 VAC	Single-phase 200 VAC	Three-phase 200 VAC
SGMMJ (Σ-mini Series)  3000min^{-1} 3 models	SGMMJ-A1B (10 W)	SGDS-A3B	–	–
	SGMMJ-A2B (20 W)			
	SGMMJ-A3B (30 W)			
SGMAS (Super High Power Capacity)  3000min^{-1} 8 models	SGMAS-A5A (50 W)	SGDS-A5F	SGDS-A5A	–
	SGMAS-01A (100 W)	SGDS-01F	SGDS-01A	–
	SGMAS-C2A (150 W)	SGDS-02F	SGDS-02A	–
	SGMAS-02A (200 W)	SGDS-02F	SGDS-02A	–
	SGMAS-04A (400 W)	SGDS-04F	SGDS-04A	–
	SGMAS-06A (600 W)	–	SGDS-08A	–
	SGMAS-08A (750 W)	–	SGDS-08A	–
	SGMAS-12A (1.15 kW)	–	–	SGDS-15A
SGMPS (Flat Type)  3000min^{-1} 5 models	SGMPS-01A (100 W)	SGDS-01F	SGDS-01A	–
	SGMPS-02A (200 W)	SGDS-02F	SGDS-02A	–
	SGMPS-04A (400 W)	SGDS-04F	SGDS-04A	–
	SGMPS-08A (750 W)	–	SGDS-08A	–
	SGMPS-15A (1.5 kW)	–	–	SGDS-15A
SGMSS (Super High Power Capacity)  3000min^{-1} 8 models	SGMSS-10A (1.0 kW)	–	–	SGDS-10A
	SGMSS-15A (1.5 kW)	–	–	SGDS-15A
	SGMSS-20A (2.0 kW)	–	–	SGDS-20A
	SGMSS-25A (2.5 kW)	–	–	SGDS-30A
	SGMSS-30A (3.0 kW)	–	–	SGDS-30A
	SGMSS-40A (4.0 kW)			SGDS-50A
	SGMSS-50A (5.0 kW)			SGDS-50A
	SGMSS-70A (7.0 kW)	–	–	SGDS-75A
SGMGH (High-speed Feed Series)  1500min^{-1} 8 models	SGMGH-05A (450 W)	–	–	SGDS-05A
	SGMGH-09A (850 W)	–	–	SGDS-10A
	SGMGH-13A (1.3 kW)	–	–	SGDS-15A
	SGMGH-20A (1.8 kW)	–	–	SGDS-20A
	SGMGH-30A (2.9 kW)	–	–	SGDS-50A (SGDS-30A)*
	SGMGH-44A (4.4 kW)	–	–	SGDS-50A
	SGMGH-55A (5.5 kW)	–	–	SGDS-60A
	SGMGH-75A (7.5 kW)	–	–	SGDS-75A
SGMGH (High-speed Feed Series)  1000min^{-1} 8 models	SGMGH-03A (300 W)	–	–	SGDS-05A
	SGMGH-06A (600 W)	–	–	SGDS-10A
	SGMGH-09A (900 W)	–	–	SGDS-10A
	SGMGH-12A (1.2 kW)	–	–	SGDS-15A
	SGMGH-20A (2.0 kW)	–	–	SGDS-20A
	SGMGH-30A (3.0 kW)	–	–	SGDS-50A (SGDS-30A)*
	SGMGH-40A (4.0 kW)	–	–	SGDS-50A
	SGMGH-55A (5.5 kW)	–	–	SGDS-60A

Table 2.1 SERVOPACKs and Applicable Servomotors (cont'd)

SGM□S Servomotor		Σ-III Series SGDS SERVOPACK		
		Single-phase 100 VAC	Single-phase 200 VAC	Three-phase 200 VAC
SGMCS (Direct Drive)  $200 min^{-1}$ 9 models $150 min^{-1}$ 8 models:	SGMCS-02B	SGDS-02F	SGDS-02A	–
	SGMCS-05B	SGDS-02F	SGDS-02A	–
	SGMCS-07B	SGDS-02F	SGDS-02A	–
	SGMCS-04C	SGDS-04F	SGDS-04A	–
	SGMCS-08D	SGDS-04F	SGDS-04A	–
	SGMCS-10C	SGDS-04F	SGDS-04A	–
	SGMCS-14C	SGDS-04F	SGDS-04A	–
	SGMCS-17D	SGDS-04F	SGDS-04A	–
	SGMCS-25D	SGDS-04F	SGDS-04A	–
	SGMCS-16E	–	SGDS-08A	–
	SGMCS-35E	–	SGDS-08A	–
	SGMCS-45M	–	–	SGDS-10A
	SGMCS-80M	–	–	SGDS-15A
	SGMCS-1AM	–	–	SGDS-20A
	SGMCS-80N	–	–	SGDS-15A
	SGMCS-1EN	–	–	SGDS-30A
	SGMCS-2ZN	–	–	SGDS-30A

Note: Models with gears are available (excluding SGMCS).

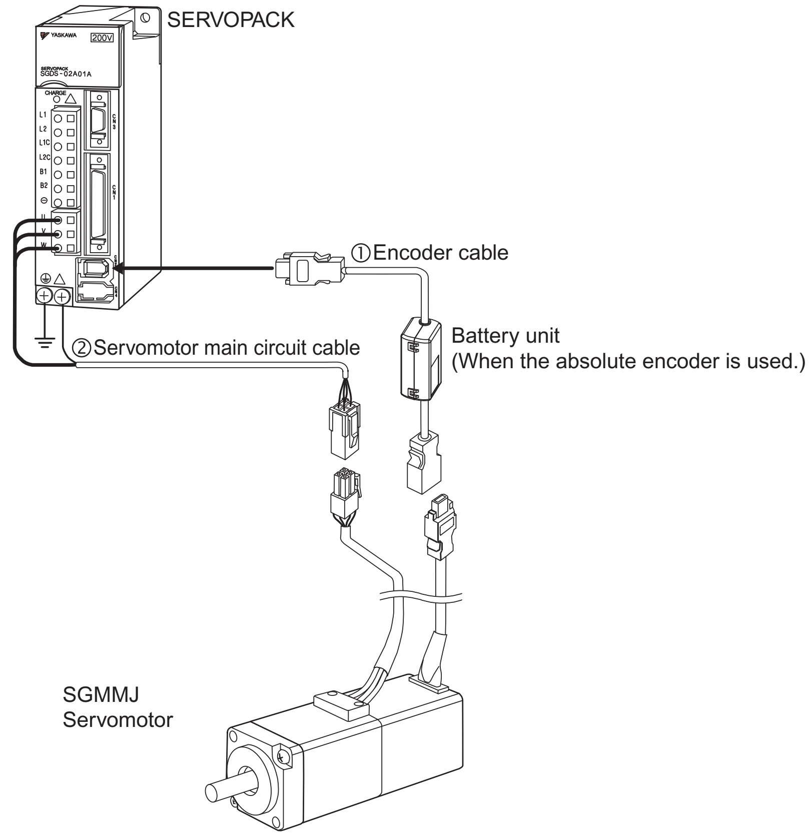
* When using the SGMGH-30 servomotor and the SGDS-30A servomotor together, the rated value of the servomotor will change. Use them considering the deratings of them shown in the following table.

Items	SGMGH-30A□A		SGMGH-30A□B	
	Deratings	Rated Value	Deratings	Rated Value
Rated Current (Arms)	18.9	23.8	18.9	24.8
Rated Torque (N·m)	14.8	18.6	21.6	28.4
Allowable load moment	3 times	5 times	5 times	
Rated Motor Speed (min^{-1})	1500		1000	

2.4 Selecting Cables

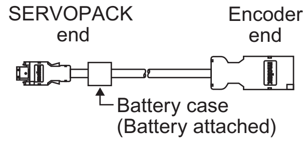
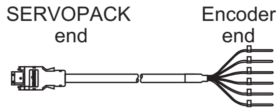
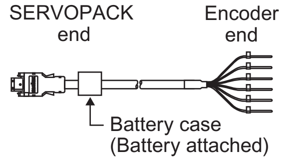
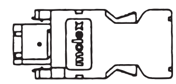
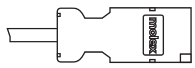
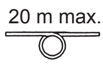
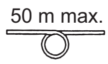
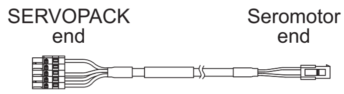
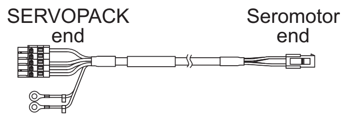
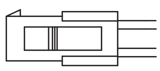
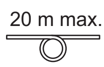
2.4.1 Cables for SGMMJ Servomotor

Contact Yaskawa Controls Co., Ltd.



Name		Length	Type		Specifications	Reference
			Standard Type	Flexible Type		
① CN4 Encoder Cable	Cable with connectors at both ends (For incremental encoder)	3 m	JZSP-CMP00-03	JZSP-CMP10-03	SERVOPACK end / Encoder end 	5.4.2
		5 m	JZSP-CMP00-05	JZSP-CMP10-05		
		10 m	JZSP-CMP00-10	JZSP-CMP10-10		
		15 m	JZSP-CMP00-15	JZSP-CMP10-15		
		20 m	JZSP-CMP00-20	JZSP-CMP10-20		

(cont'd)

Name		Length	Type: Standard Type	Type: Flexible Type	Specifications	Reference
① CN4 Encoder Cable	Cable with connectors at both ends (For absolute encoder: with battery case)	3 m	JZSP-CSP19-03	JZSP-CSP29-03		5.4.2
		5 m	JZSP-CSP19-05	JZSP-CSP29-03		
		10 m	JZSP-CSP19-10	JZSP-CSP29-05		
		15 m	JZSP-CSP19-15	JZSP-CSP29-10		
		20 m	JZSP-CSP19-20	JZSP-CSP29-15		
	Cable with loose wire at encoder end (For incremental encoder)	3 m	JZSP-CMP03-03	JZSP-CMP13-20		5.4.2
		5 m	JZSP-CMP03-05	JZSP-CMP13-05		
		10 m	JZSP-CMP03-10	JZSP-CMP13-10		
		15 m	JZSP-CMP03-15	JZSP-CMP13-15		
		20 m	JZSP-CMP03-20	JZSP-CMP13-20		
	Cable with loose wire at encoder end (For absolute encoder: with battery case)	3 m	JZSP-CSP04-03	JZSP-CSP24-03		5.4.2
		5 m	JZSP-CSP04-05	JZSP-CSP24-05		
		10 m	JZSP-CSP04-10	JZSP-CSP24-10		
		15 m	JZSP-CSP04-15	JZSP-CSP24-15		
		20 m	JZSP-CSP04-20	JZSP-CSP24-20		
	SERVOPACK end connector kit		JZSP-CMP9-1		Soldered 	5.5.1
	Encoder end connector kit		JZSP-CMP9-2		Soldered 	
	Cables	5 m	JZSP-CMP09-05	JZSP-CSP39-05		5.5.1
		10 m	JZSP-CMP09-10	JZSP-CSP39-10		
		15 m	JZSP-CMP09-15	JZSP-CSP39-15		
		20 m	JZSP-CMP09-20	JZSP-CSP39-20		
		30 m	JZSP-CMP19-30	–		
		40 m	JZSP-CMP19-40	–		
		50 m	JZSP-CMP19-50	–		
② Servomotor Main Circuit Cables and Connectors	SGMMJ Without brakes	3 m	JZSP-CDM03-03	JZSP-CDM23-03		5.1.2
		5 m	JZSP-CDM03-05	JZSP-CDM23-05		
		10 m	JZSP-CDM03-10	JZSP-CDM23-10		
		15 m	JZSP-CDM03-15	JZSP-CDM23-15		
		20 m	JZSP-CDM03-20	JZSP-CDM23-20		
	SGMMJ With brakes	3 m	JZSP-CDM33-03	JZSP-CDM43-03		
		5 m	JZSP-CDM33-05	JZSP-CDM43-05		
		10 m	JZSP-CDM33-10	JZSP-CDM43-10		
		15 m	JZSP-CDM33-15	JZSP-CDM43-15		
		20 m	JZSP-CDM33-20	JZSP-CDM43-03		
	Servomotor-end connector kit without brakes		JZSP-CFM9-2			5.2.2
	Servomotor-end connector kit with brakes		JZSP-CFM9-3			
	Cables	5 m	JZSP-CSM90-05	JZSP-CSM80-05		5.2.10
		10 m	JZSP-CSM90-10	JZSP-CSM80-10		
		15 m	JZSP-CSM90-15	JZSP-CSM80-15		
		20 m	JZSP-CSM90-20	JZSP-CSM80-20		

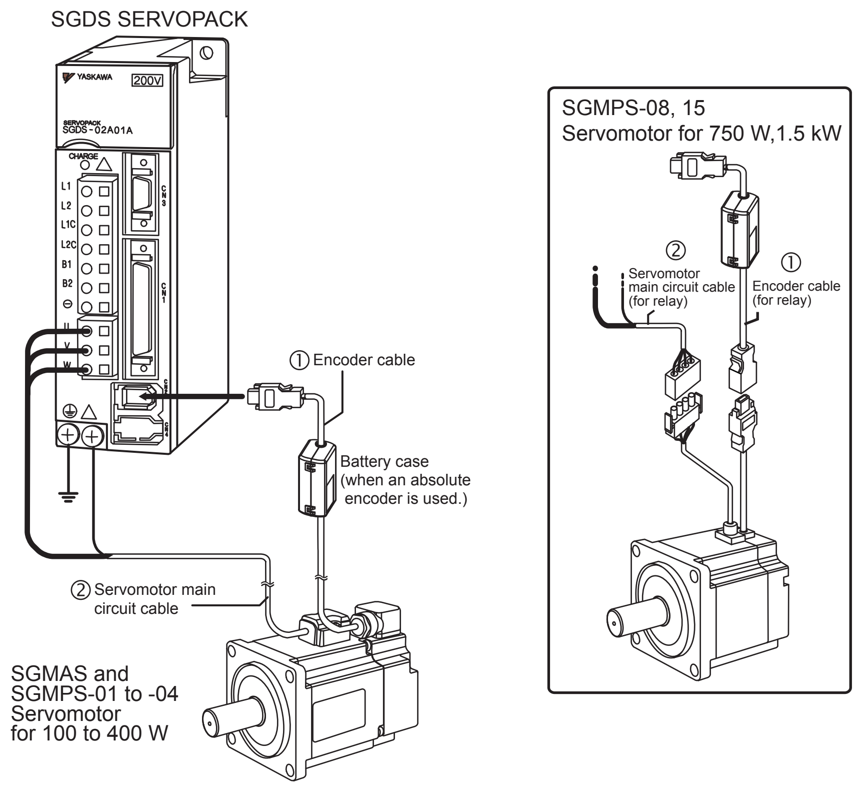
Note: For a flexible cable, contact your Yaskawa representative.

Selections

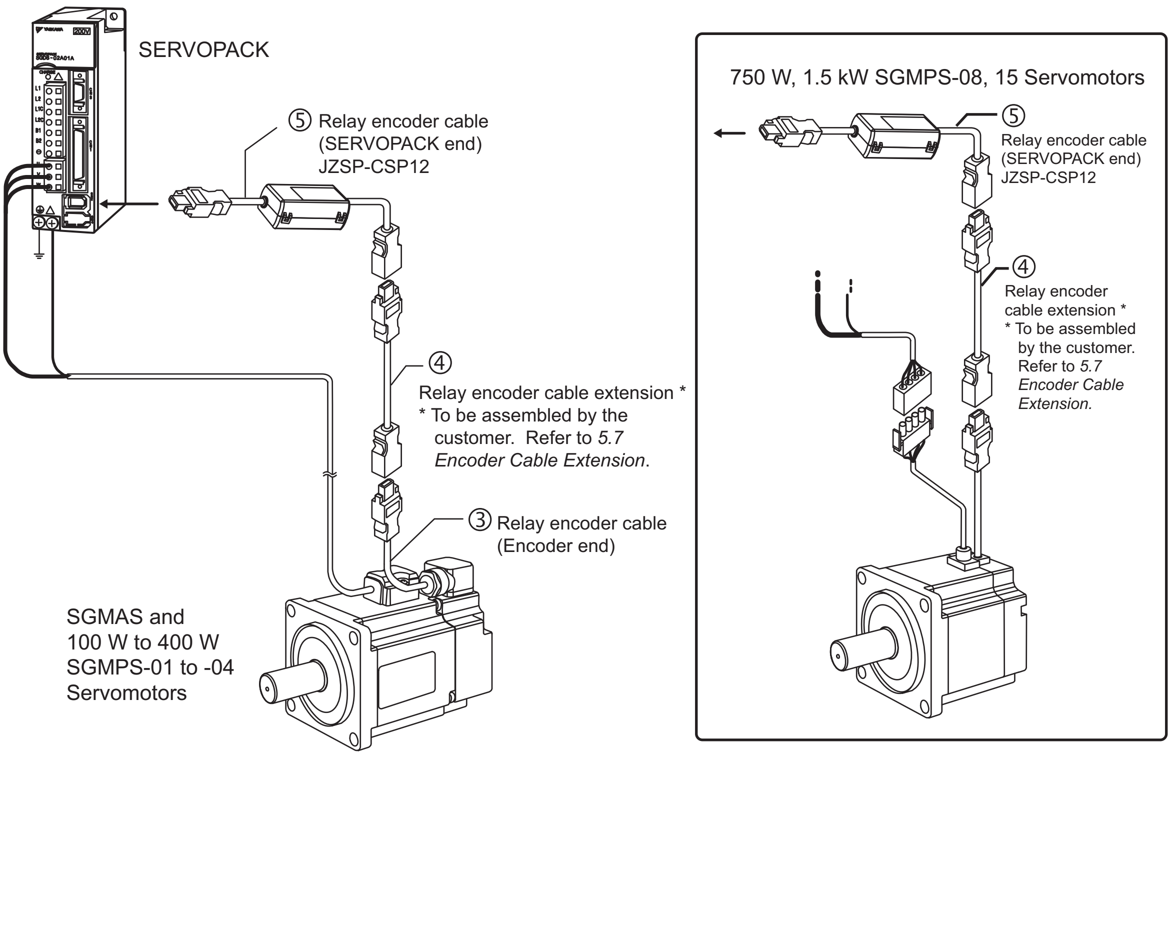
2

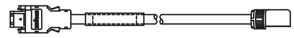
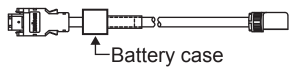
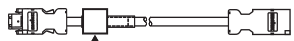
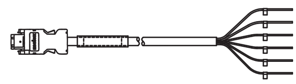
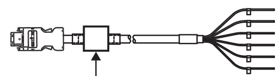
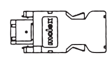
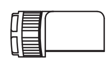
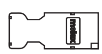
2.4.2 Cables for SGMAS and SGMPS Servomotors

Contact Yaskawa Controls Co., Ltd.



- Encoder cable extension from 20 m up to 50 m (Example)



Name		Servomotor Model	Length	Type: Standard Type	Type: Flexible Type	Specifications	Reference
① CN2 Encoder cable	Cable with connectors at both ends (For incremental encoder)	SGMAS for 50 to 1.15 kW, SGMPS for 100 to 400 W	3 m	JZSP-CSP01-03	JZSP-CSP21-03	SERVOPACK end Encoder end 	5.4.1
			5 m	JZSP-CSP01-05	JZSP-CSP21-05		
			10 m	JZSP-CSP01-10	JZSP-CSP21-10		
			15 m	JZSP-CSP01-15	JZSP-CSP21-15		
			20 m	JZSP-CSP01-20	JZSP-CSP21-20		
	Cable with connectors at both ends (For absolute encoder: with battery case)		3 m	JZSP-CSP05-03	JZSP-CSP25-03	SERVOPACK end Encoder end  Battery case (Battery attached)	
			5 m	JZSP-CSP05-05	JZSP-CSP25-05		
			10 m	JZSP-CSP05-10	JZSP-CSP25-10		
			15 m	JZSP-CSP05-15	JZSP-CSP25-15		
			20 m	JZSP-CSP05-20	JZSP-CSP25-20		
	Cable with connectors at both ends (For incremental encoder)	SGMPS for 750 W, 1.5 kW	3 m	JZSP-CMP00-03	JZSP-CMP10-03	SERVOPACK end Encoder end 	5.4.2
			5 m	JZSP-CMP00-05	JZSP-CMP10-05		
			10 m	JZSP-CMP00-10	JZSP-CMP10-10		
			15 m	JZSP-CMP00-15	JZSP-CMP10-15		
			20 m	JZSP-CMP00-20	JZSP-CMP10-20		
	Cable with connectors at both ends (For absolute encoder: with battery case)		3 m	JZSP-CSP19-03	JZSP-CSP29-03	SERVOPACK end Encoder end  Battery case (Battery attached)	
			5 m	JZSP-CSP19-05	JZSP-CSP29-05		
			10 m	JZSP-CSP19-10	JZSP-CSP29-10		
			15 m	JZSP-CSP19-15	JZSP-CSP29-15		
			20 m	JZSP-CSP19-20	JZSP-CSP29-20		
	Cable with loose wire at encoder end (For incremental encoder)	SGMAS 50 to 1.15 kW, SGMPS 100 to 1.5 kW	3 m	JZSP-CMP03-03	JZSP-CMP13-03	SERVOPACK end Encoder end 	5.4.1
			5 m	JZSP-CMP03-05	JZSP-CMP13-05		
			10 m	JZSP-CMP03-10	JZSP-CMP13-10		
			15 m	JZSP-CMP03-15	JZSP-CMP13-15		
			20 m	JZSP-CMP03-20	JZSP-CMP13-20		
	Cable with loose wire at encoder end (For absolute encoder: with battery case)	SGMAS 50 to 1.15 kW, SGMPS 100 to 1.5 kW	3 m	JZSP-CSP04-03	JZSP-CSP24-03	SERVOPACK end Encoder end  Battery case (Battery attached)	
			5 m	JZSP-CSP04-05	JZSP-CSP24-05		
			10 m	JZSP-CSP04-10	JZSP-CSP24-10		
			15 m	JZSP-CSP04-15	JZSP-CSP24-15		
			20 m	JZSP-CSP04-20	JZSP-CSP24-20		
	SERVOPACK end connector kit	SGMAS SGMPS		JZSP-CMP9-1		Soldered 	5.5.1
	Encoder end connector kit	SGMAS 50 to 1.15 kW, SGMPS 100 to 400 W		JZSP-CSP9-2		Caulking 	
		SGMPS 750 W, 1.5 kW		JZSP-CMP9-2		Soldered 	5.5.2
	Cables		5 m	JZSP-CMP09-05	JZSP-CSP39-05	20 m max. 	5.5.1
			10 m	JZSP-CMP09-10	JZSP-CSP39-10		
			15 m	JZSP-CMP09-15	JZSP-CSP39-15		
			20 m	JZSP-CMP09-20	JZSP-CSP39-20		

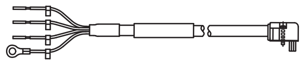
* Use flexible cables for movable sections such as robot arms. Refer to *5.6 Flexible Cables*.

Note: When the battery of the host controller is used for the absolute encoder, no battery case is required.
In this case, use a cable for the incremental encoder.

Selections

2

(cont'd)

<table>
<tr><th colspan="2" rowspan="2">Name</th><th rowspan="2">Servomotor Model</th><th rowspan="2">Length</th><th colspan="2">Type</th><th rowspan="2">Specifications</th><th rowspan="2">Reference</th></tr>
<tr><th>Standard Type</th><th>Flexible Type</th></tr>
<tr><td rowspan="30">② CN3 Servomotor Main Circuit Cables</td><td rowspan="30">Without brakes</td><td rowspan="5">SGMAS 50 to 150 W, SGMPS 100 W</td><td>3 m</td><td>JZSP-CSM01-03</td><td>JZSP-CSM21-03</td><td rowspan="15">SERVOPACK end Servomotor end
</td><td rowspan="5">5.1.2</td></tr>
<tr><td>5 m</td><td>JZSP-CSM01-05</td><td>JZSP-CSM21-05</td></tr>
<tr><td>10 m</td><td>JZSP-CSM01-10</td><td>JZSP-CSM21-10</td></tr>
<tr><td>15 m</td><td>JZSP-CSM01-15</td><td>JZSP-CSM21-15</td></tr>
<tr><td>20 m</td><td>JZSP-CSM01-20</td><td>JZSP-CSM21-20</td></tr>
<tr><td rowspan="5">SGMAS 200 to 600 W, SGMPS 200 to 400 W</td><td>3 m</td><td>JZSP-CSM02-03</td><td>JZSP-CSM22-03</td><td rowspan="5">5.1.3</td></tr>
<tr><td>5 m</td><td>JZSP-CSM02-05</td><td>JZSP-CSM22-05</td></tr>
<tr><td>10 m</td><td>JZSP-CSM02-10</td><td>JZSP-CSM22-10</td></tr>
<tr><td>15 m</td><td>JZSP-CSM02-15</td><td>JZSP-CSM22-15</td></tr>
<tr><td>20 m</td><td>JZSP-CSM02-20</td><td>JZSP-CSM22-20</td></tr>
<tr><td rowspan="5">SGMAS 750 W, 1.15 kW</td><td>3 m</td><td>JZSP-CSM03-03</td><td>JZSP-CSM23-03</td><td rowspan="5">5.1.4</td></tr>
<tr><td>5 m</td><td>JZSP-CSM03-05</td><td>JZSP-CSM23-05</td></tr>
<tr><td>10 m</td><td>JZSP-CSM03-10</td><td>JZSP-CSM23-10</td></tr>
<tr><td>15 m</td><td>JZSP-CSM03-15</td><td>JZSP-CSM23-15</td></tr>
<tr><td>20 m</td><td>JZSP-CSM03-20</td><td>JZSP-CSM23-20</td></tr>
<tr><td rowspan="5">SGMPS 750 W</td><td>3 m</td><td>JZSP-CMM00-03</td><td>JZSP-CMM01-03</td><td rowspan="5">SERVOPACK end Servomotor end
</td><td rowspan="5">5.1.5</td></tr>
<tr><td>5 m</td><td>JZSP-CMM00-05</td><td>JZSP-CMM01-05</td></tr>
<tr><td>10 m</td><td>JZSP-CMM00-10</td><td>JZSP-CMM01-10</td></tr>
<tr><td>15 m</td><td>JZSP-CMM00-15</td><td>JZSP-CMM01-15</td></tr>
<tr><td>20 m</td><td>JZSP-CMM00-20</td><td>JZSP-CMM01-20</td></tr>
<tr><td rowspan="5">SGMPS 1.5 kW</td><td>3 m</td><td>JZSP-CMM20-03</td><td>−</td><td rowspan="5">SERVOPACK end Servomotor end
</td><td rowspan="5">5.1.6</td></tr>
<tr><td>5 m</td><td>JZSP-CMM20-05</td><td>−</td></tr>
<tr><td>10 m</td><td>JZSP-CMM20-10</td><td>−</td></tr>
<tr><td>15 m</td><td>JZSP-CMM20-15</td><td>−</td></tr>
<tr><td>20 m</td><td>JZSP-CMM20-20</td><td>−</td></tr>
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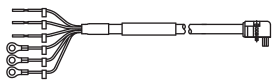
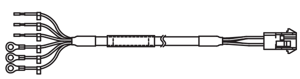
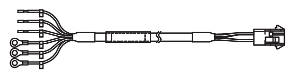
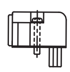
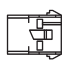
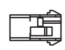
(cont'd)

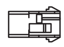
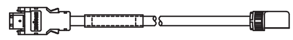
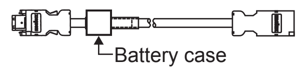
Name		Servomotor Model	Length	Type: Standard Type	Type: Flexible Type	Specifications	Reference
② CN3 Servomotor Main Circuit Cables (cont'd)	With brakes	SGMAS 50 to 150 W, SGMPS 100 W	3 m	JZSP-CSM11-03	JZSP-CSM31-03	SERVOPACK end Servomotor end 	5.1.2
			5 m	JZSP-CSM11-05	JZSP-CSM31-05		
			10 m	JZSP-CSM11-10	JZSP-CSM31-10		
			15 m	JZSP-CSM11-15	JZSP-CSM31-15		
			20 m	JZSP-CSM11-20	JZSP-CSM31-20		
		SGMAS 200 to 600 W, SGMPS 200 to 400 W	3 m	JZSP-CSM12-03	JZSP-CSM32-03		5.1.3
			5 m	JZSP-CSM12-05	JZSP-CSM32-05		
			10 m	JZSP-CSM12-10	JZSP-CSM32-10		
			15 m	JZSP-CSM12-15	JZSP-CSM32-15		
			20 m	JZSP-CSM12-20	JZSP-CSM32-20		
		SGMAS 750 W, 1.15 kW	3 m	JZSP-CSM13-03	JZSP-CSM33-03		5.1.4
			5 m	JZSP-CSM13-05	JZSP-CSM33-05		
			10 m	JZSP-CSM13-10	JZSP-CSM33-10		
			15 m	JZSP-CSM13-15	JZSP-CSM33-15		
			20 m	JZSP-CSM13-20	JZSP-CSM33-20		
		SGMPS 750 W	3 m	JZSP-CMM10-03	JZSP-CMM11-03	SERVOPACK end Servomotor end 	5.1.5
			5 m	JZSP-CMM10-05	JZSP-CMM11-05		
			10 m	JZSP-CMM10-10	JZSP-CMM11-10		
			15 m	JZSP-CMM10-15	JZSP-CMM11-15		
			20 m	JZSP-CMM10-20	JZSP-CMM11-20		
		SGMPS 1.5 kW	3 m	JZSP-CMM30-03	–	SERVOPACK end Servomotor end 	5.4.1
			5 m	JZSP-CMM30-05	–		
			10 m	JZSP-CMM30-10	–		
			15 m	JZSP-CMM3015	–		
			20 m	JZSP-CMM30-20	–		
	Servomotor end connector kit	SGMAS 50 to 150 W, SGMPS 100 W		JZSP-CSM9-1		Caulking 	5.2.2
		SGMAS 200 to 600 W, SGMPS 200 to 400 W		JZSP-CSM9-2			5.2.3
		SGMAS 750 W, 1.15 kW		JZSP-CSM9-3	JZSP-CSM9-4		5.2.4
		SGMPS 750 W (Without brakes)		JZSP-CMM9-1		Caulking 	5.2.5
		SGMPS 1.5 kW (Without brakes)		JZSP-CMM9-3		Caulking 	5.2.6
		SGMPS 750 W (With brakes)		JZSP-CMM9-2	JZSP-CSM9-5	Caulking 	5.2.5

* Use flexible cables for movable sections such as robot arms. Refer to *5.6 Flexible Cables*.

Selections

2

(cont'd)

<table>
<tr><th colspan="2" rowspan="2">Name</th><th rowspan="2">Servomotor Model</th><th rowspan="2">Length</th><th colspan="2">Type</th><th rowspan="2">Specifications</th><th rowspan="2">Reference</th></tr>
<tr><th>Standard Type</th><th>Flexible Type</th></tr>
<tr><td rowspan="9">②
CN3
Servomotor Main Circuit Cables (cont'd)</td><td>Servomotor end connector kit</td><td colspan="2">SGMPS
1.5 kW
(With brakes)</td><td>JZSP-CMM9-4</td><td>–</td><td>Caulking
</td><td>5.2.6</td></tr>
<tr><td rowspan="8">Cables</td><td rowspan="4">SGMAS
50 to 600 W
SGMPS
100 to 400 W</td><td>5 m</td><td>JZSP-CSM90-05</td><td>JZSP-CSM80-05</td><td rowspan="8">20 m max.
</td><td rowspan="4">5.2.7</td></tr>
<tr><td>10 m</td><td>JZSP-CSM90-10</td><td>JZSP-CSM80-10</td></tr>
<tr><td>15 m</td><td>JZSP-CSM90-15</td><td>JZSP-CSM80-15</td></tr>
<tr><td>20 m</td><td>JZSP-CSM90-20</td><td>JZSP-CSM80-20</td></tr>
<tr><td rowspan="4">SGMAS
750 W,
1.15 kW
SGMPS
750 W,
1.5 kW</td><td>5 m</td><td>JZSP-CSM91-05</td><td>JZSP-CSM81-05</td><td rowspan="4">5.2.8</td></tr>
<tr><td>10 m</td><td>JZSP-CSM91-10</td><td>JZSP-CSM81-10</td></tr>
<tr><td>15 m</td><td>JZSP-CSM91-15</td><td>JZSP-CSM81-15</td></tr>
<tr><td>20 m</td><td>JZSP-CSM91-20</td><td>JZSP-CSM81-20</td></tr>
<tr><td>③
Relay Encoder Cables</td><td>Encoder end
(Same for incremental and absolute encoders)</td><td>SGMAS
50 W to
1.15 kW
SGMPS
100 W to
400 W</td><td>0.3 m</td><td colspan="2">JZSP-CSP11</td><td></td><td rowspan="5">5.7</td></tr>
<tr><td rowspan="3">④
Wires and Connectors for Relay Encoder Cable Extensions</td><td colspan="2" rowspan="3">Wires and connectors for relay encoder cable extensions are available for assembly by the customer.</td><td>30 m</td><td colspan="2">JZSP-CMP19-30</td><td rowspan="3">50 m max.
</td></tr>
<tr><td>40 m</td><td colspan="2">JZSP-CMP19-40</td></tr>
<tr><td>50 m</td><td colspan="2">JZSP-CMP19-50</td></tr>
<tr><td>⑤
Relay Encoder Cables</td><td>SERVOPACK end
(For absolute encoders, with a battery case)</td><td>SGMAS
50 W to
1.15kW
SGMPS
100 W to
1.5 kW</td><td>0.3 m</td><td colspan="2">JZSP-CSP12[*2]</td><td></td></tr>
</table>

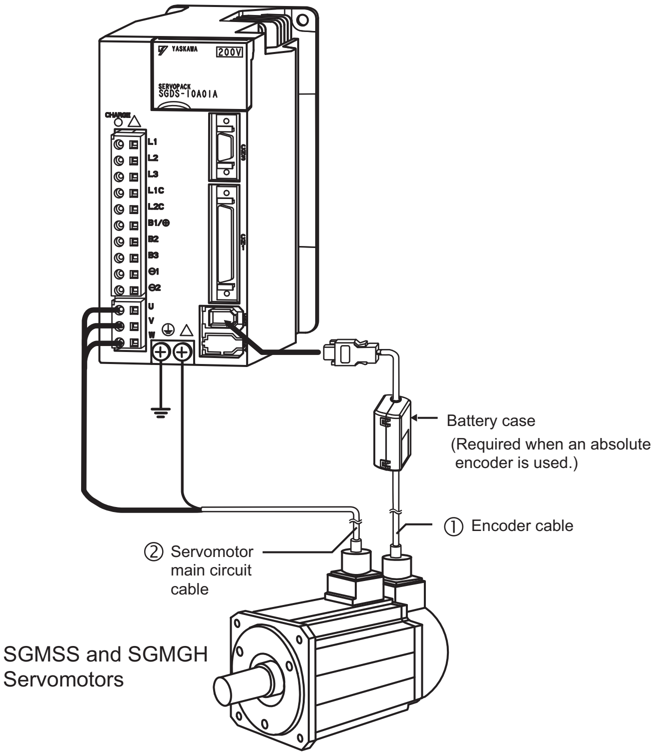
* 1. Use flexible cables for movable sections such as robot arms. For the precautions on handling flexible cables, refer to *5.6 Flexible Cables*.

* 2. When the battery of the host controller is used for the absolute encoder, no battery case is required. In this case, use a cable for the incremental encoder.

2.4.3 Cables for SGMSS and SGMGH Servomotors

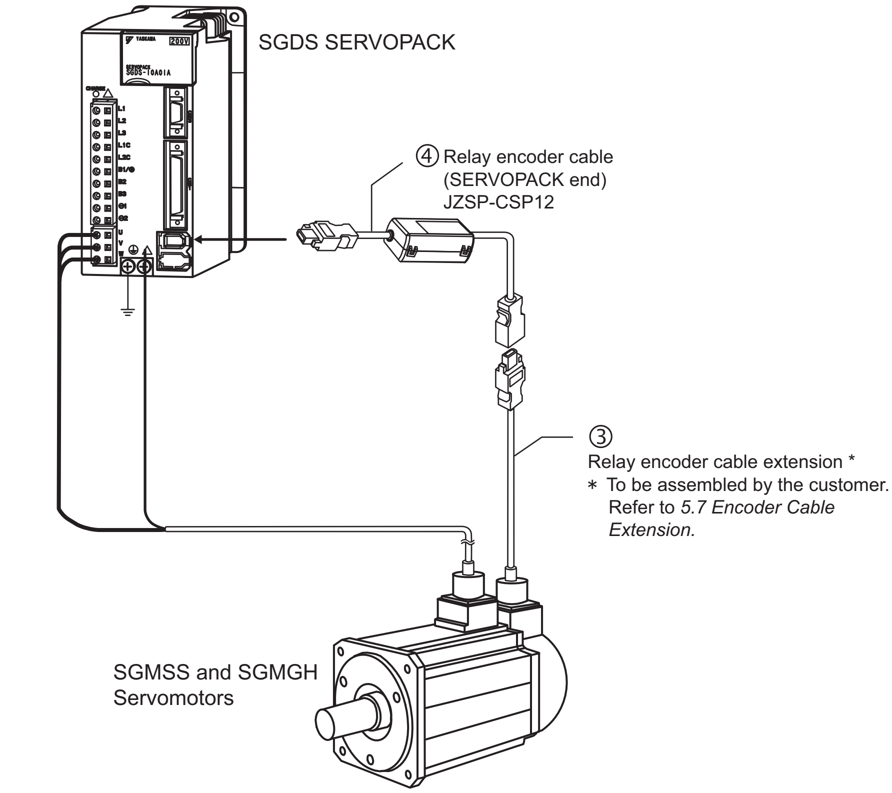
Contact Yaskawa Controls Co., Ltd.

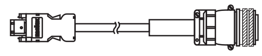
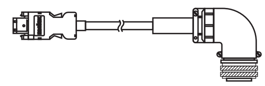
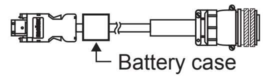
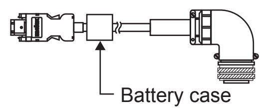
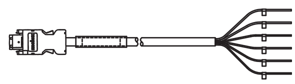
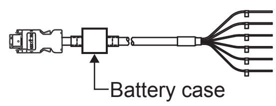
- Cable Connection for Standard Wiring Distance



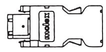
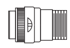
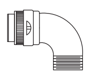
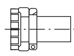
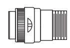
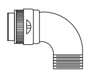
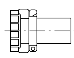
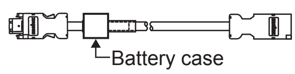
- Encoder Cable Extension from 20 m up to 50 m

(Example)



Name		Length	Type		Specifications	Reference
			Standard Type	Flexible Type[*1]		
① CN2 Encoder Cables	Cable with connectors at both ends (For incremental encoder)	3 m	JZSP-CMP01-03	JZSP-CMP11-03	With a straight plug SERVOPACK end Encoder end 	5.4.4
		5 m	JZSP-CMP01-05	JZSP-CMP11-05		
		10 m	JZSP-CMP01-10	JZSP-CMP11-10		
		15 m	JZSP-CMP01-15	JZSP-CMP11-15		
		20 m	JZSP-CMP01-20	JZSP-CMP11-20		
		3 m	JZSP-CMP02-03	JZSP-CMP12-03	With a L-shaped plug SERVOPACK end Encoder end 	
		5 m	JZSP-CMP02-05	JZSP-CMP12-05		
		10 m	JZSP-CMP02-10	JZSP-CMP12-10		
		15 m	JZSP-CMP02-15	JZSP-CMP12-15		
		20 m	JZSP-CMP02-20	JZSP-CMP12-20		
	Cable with connectors at both ends (For absolute encoder: with battery case)	3 m	JZSP-CSP06-03	JZSP-CSP26-03	With a straight plug SERVOPACK end Encoder end  Battery case (Battery attached)	
		5 m	JZSP-CSP06-05	JZSP-CSP26-05		
		10 m	JZSP-CSP06-10	JZSP-CSP26-10		
		15 m	JZSP-CSP06-15	JZSP-CSP26-15		
		20 m	JZSP-CSP06-20	JZSP-CSP26-20		
		3 m	JZSP-CSP07-03	JZSP-CSP27-03	With a L-shaped plug SERVOPACK end Encoder end  Battery case (Battery attached)	
		5 m	JZSP-CSP07-05	JZSP-CSP27-05		
		10 m	JZSP-CSP07-10	JZSP-CSP27-10		
		15 m	JZSP-CSP07-15	JZSP-CSP27-15		
		20 m	JZSP-CSP07-20	JZSP-CSP27-20		
	Cable with loose wires at encoder end (For incremental encoder)	3 m	JZSP-CMP03-03	JZSP-CMP13-03	SERVOPACK end Encoder end 	
		5 m	JZSP-CMP03-05	JZSP-CMP13-05		
		10 m	JZSP-CMP03-10	JZSP-CMP13-10		
		15 m	JZSP-CMP03-15	JZSP-CMP13-15		
		20 m	JZSP-CMP03-20	JZSP-CMP13-20		
	Cable with loose wires at encoder end (For absolute encoder: with battery case)	3 m	JZSP-CSP04-03	JZSP-CSP24-03	SERVOPACK end Encoder end  Battery case (Battery attached)	5.4.4
		5 m	JZSP-CSP04-05	JZSP-CSP24-05		
		10 m	JZSP-CSP04-10	JZSP-CSP24-10		
		15 m	JZSP-CSP04-15	JZSP-CSP24-15		
		20 m	JZSP-CSP04-20	JZSP-CSP24-20		

(cont'd)

Name		Length	Type: Standard Type	Type: Flexible Type*1	Specifications	Reference
① CN2 Encoder Cables (cont'd)	SERVOPACK end connector kit		JZSP-CMP9-1		Soldered 	5.5.3
	For standard environment Encoder end connector		MS3106B20-29S*2		Straight plug 	5.5.3
			MS3108B20-29S*2		L-shaped plug 	
			MS3057-12A*2		Cable clamp 	
	For IP67 specification Encoder end connector		JA06A-20-29S-J1-EB*2		Straight plug 	
			JA08A-20-29S-J1-EB*2		L-shaped plug 	
			JL04-2022CKE(09)*2 Cable diameter: ϕ6.5 to ϕ9.5 mm		Cable clamp 	
			JL04-2022CKE(12)*2 Cable diameter: ϕ9.5 to ϕ13 mm			
			JL04-2022CKE(14)*2 Cable diameter: ϕ12.9 to ϕ15.9 mm			
	Cables	5 m	JZSP-CMP09-05	JZSP-CSP39-05	20 m max. 	5.5.3
		10 m	JZSP-CMP09-10	JZSP-CSP39-10		
		15 m	JZSP-CMP09-15	JZSP-CSP39-15		
		20 m	JZSP-CMP09-20	JZSP-CSP39-20		
② Servomotor Main Circuit Cables and Connectors	Cable with connectors				These are not available. Refer to *chapter 5*.	5.2.12 to 5.2.20
	Cable wires and connectors					
③ Wires and Connectors for Relay Encoder Cable Extension	Wires and connectors for relay encoder cable extension are available to be assembled by the customer.	30 m	JZSP-CMP19-30		50 m max. 	5.7
		40 m	JZSP-CMP19-40			
		50 m	JZSP-CMP19-50			
④ Relay Encoder Cables	SERVOPACK end (For absolute encoder, with a battery case)	0.3 m	JZSP-CSP12*3		SERVOPACK end Encoder end  Battery case (Battery attached)	

* 1. Use flexible cables for movable sections such as robot arms. For the precautions on handling flexible cables, refer to *5.6 Flexible Cables*.

* 2. Contact Japan Aviation Electronics Industry, Ltd.

* 3. Not required when using an incremental encoder or using an absolute encoder with a battery conected to the host controller.

Note: When the battery of the host controller is used for the absolute encoder, no battery case is required. In this case, use a cable for the incremental encoder.

Selections

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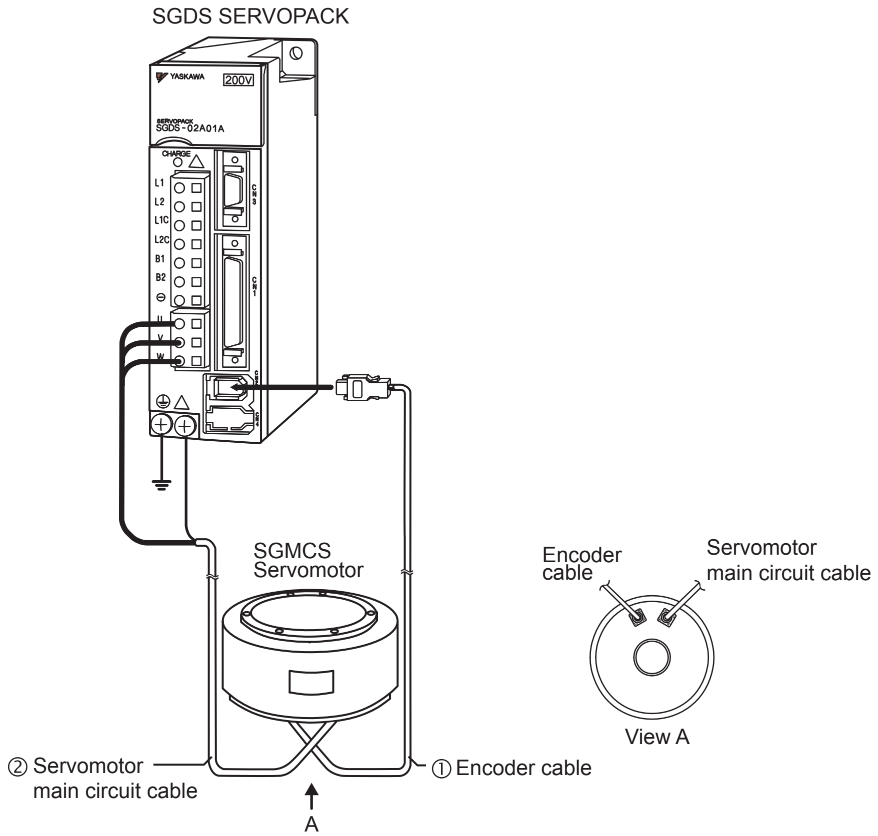
2.4.4 Cables for SGMCS Servomotor

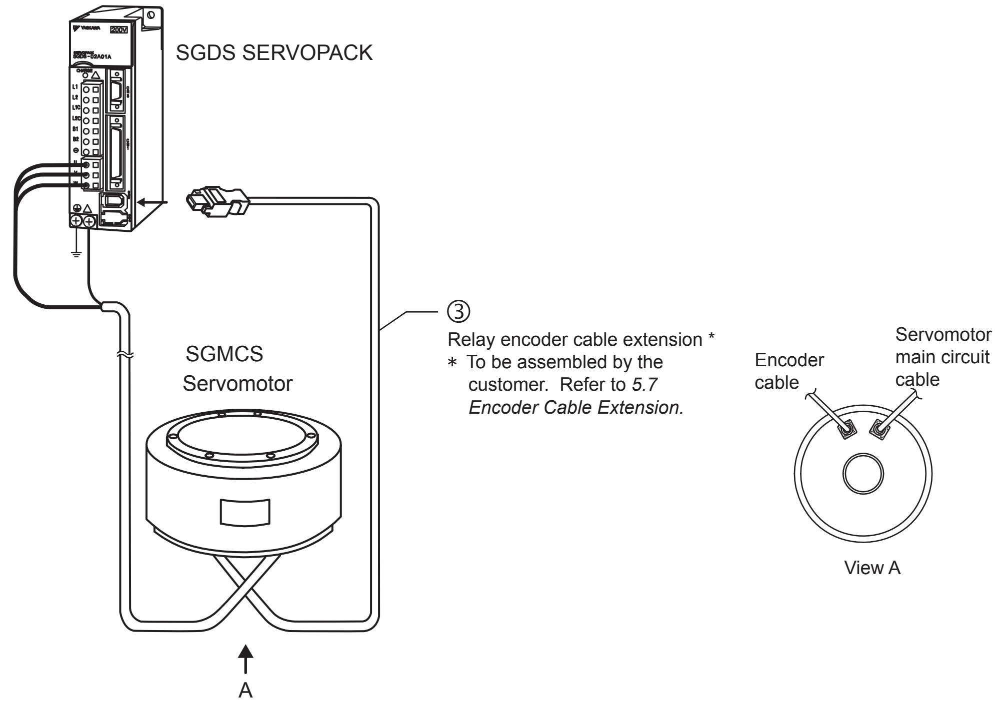
Contact Yaskawa Controls Co., Ltd.

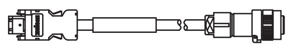
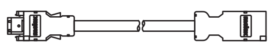
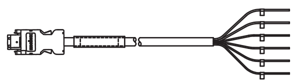
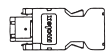
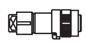
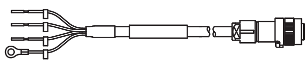
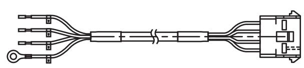
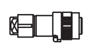
- Cable Connection for Standard Wiring Distance



- Encoder Cable Extension from 20 m up to 50 m

(Example)



Name			Length	Type: Standard Type	Type: Flexible Type *1	Specifications	Reference
① CN2 Encoder Cables	Cable with connectors at both ends (For incremental and absolute encoder)		3 m	JZSP-CMP60-03	JZSP-CSP60-03	Applicable flange*3:1, 3 SERVOPACK end Encoder end 	5.4.3
			5 m	JZSP-CMP60-05	JZSP-CSP60-05		
			10 m	JZSP-CMP60-10	JZSP-CSP60-10		
			15 m	JZSP-CMP60-15	JZSP-CSP60-15		
			20 m	JZSP-CMP60-20	JZSP-CSP60-20		
			3 m	JZSP-CMP00-03	JZSP-CMP10-03	Applicable flange*3: 4 SERVOPACK end Encoder end 	
			5 m	JZSP-CMP00-05	JZSP-CMP10-05		
			10 m	JZSP-CMP00-10	JZSP-CMP10-10		
			15 m	JZSP-CMP00-15	JZSP-CMP10-15		
			20 m	JZSP-CMP00-20	JZSP-CMP10-20		
	Cable with loose wires at encoder end (For incremental and absolute encoder)		3 m	JZSP-CMP03-03	JZSP-CMP13-03	SERVOPACK end Encoder end 	
			5 m	JZSP-CMP03-05	JZSP-CMP13-05		
			10 m	JZSP-CMP03-10	JZSP-CMP13-10		
			15 m	JZSP-CMP03-15	JZSP-CMP13-15		
			20 m	JZSP-CMP03-20	JZSP-CMP13-20		
	SERVOPACK end connector kit			JZSP-CMP9-1		Soldered 	5.5.4
	Connectors at encoder end (Straight plug)			JN1DS10SL1*2		Caulking 	
	Connectors at encoder end (Socket contact)			JN1-22-22S-PKG100*2			
	Cables		5 m	JZSP-CMP09-05	JZSP-CSP39-05	20 m max. 	
			10 m	JZSP-CMP09-10	JZSP-CSP39-10		
			15 m	JZSP-CMP09-15	JZSP-CSP39-15		
			20 m	JZSP-CMP09-20	JZSP-CSP39-20		
②Servomotor Main Circuit Cable Connectors	Without brakes (For small-capacity series)	SGMCS-□□B,C, D,E	3 m	JZSP-CMM60-03	JZSP-CSM60-03	Applicable flange*3: 1 SERVOPACK end Servomotor end 	5.1.7
			5 m	JZSP-CMM60-05	JZSP-CSM60-05		
			10 m	JZSP-CMM60-10	JZSP-CSM60-10		
			15 m	JZSP-CMM60-15	JZSP-CSM60-15		
			20 m	JZSP-CMM60-20	JZSP-CSM60-20		
			3 m	JZSP-CMM00-03	JZSP-CMM01-03	Applicable flange*3: 4 SERVOPACK end Servomotor end 	
			5 m	JZSP-CMM00-05	JZSP-CMM01-05		
			10 m	JZSP-CMM00-10	JZSP-CMM01-10		
			15 m	JZSP-CMM00-15	JZSP-CMM01-15		
			20 m	JZSP-CMM00-20	JZSP-CMM01-20		
	Without brakes (For middle-capacity series)	SGMCS-□□M,N				Cables with connectors, cables, and connectors are not provided by Yaskawa. For details, *5.2.14 Dimensional Drawings of Connectors for SGMSS Servomotors (Protective Structure IP67/European Safety Standards Conformed Type)*. Applicable flange*3: 1, 3	5.2.11
	Servomotor end connector			JN1DS04FK1*2		Soldered 	5.2.9
	Cables	For SGMCS-□□B, C, D, E	5 m	JZSP-CSM90-05	JZSP-CSM80-05	20 m max. 	5.2.10
			10 m	JZSP-CSM90-10	JZSP-CSM80-10		
			15 m	JZSP-CSM90-15	JZSP-CSM80-15		
			20 m	JZSP-CSM90-20	JZSP-CSM80-20		

* 1. Use flexible cables for movable sections such as robot arms. Refer to *5.6 Flexible Cables*.
* 2. Contact Japan Aviation Electronics Industry, Ltd.
* 3. For applicable flanges, refer to *2.1.5 Model SGMCS.*

Selections

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(cont'd)

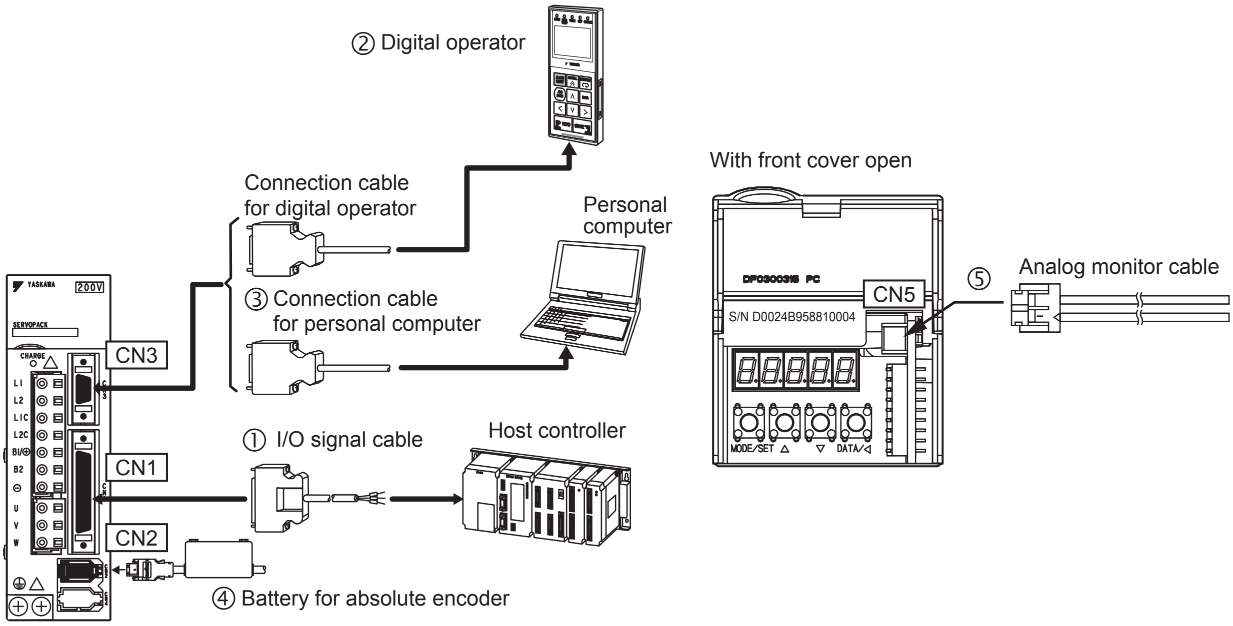
Name		Length	Type		Specifications	Refer-ence
			Standard Type	Flexible Type *1		
③ Wires and Connectors for Relay Encoder Cable Extensions	Wires and connectors for relay encoder cable extensions are available for assembly by the customer.	30 m	JZSP-CMP19-30		50 m max. 	5.7
		40 m	JZSP-CMP19-40			
		50 m	JZSP-CMP19-50			

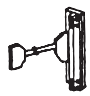
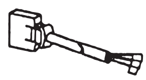
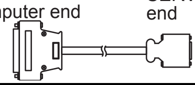
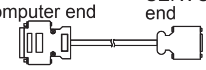
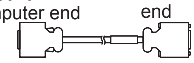
* 1. Use flexible cables for movable sections such as robot arms. Refer to *5.6 Flexible Cables*.

2.5 Selecting Peripheral Devices

Contact Yaskawa Controls Co., Ltd.

2.5.1 Special Options



Name		Length	Type	Specifications	Reference
① CN1 I/O Signal Cables	Connector terminal block converter unit		JUSP-TA50P	Terminal block and 0.5 m connection cable 	5.9
	Cable with loose wires at one end	1 m	JZSP-CSI01-1	Loose wires at customer end 	
		2 m	JZSP-CSI01-2		
		3 m	JZSP-CSI01-3		
② Digital Operator			JUSP-OP05A	Connection cable (1 m)	5.10.2
③ CN3 Connection Cable for Personal Computer		2 m	JZSP-CMS01	D-Sub 25-pin (For PC98) 	5.10.1
		2 m	JZSP-CMS02	D-Sub 9-pin 	
		2 m	JZSP-CMS03	Half-pitch 14-pin (For PC 98) 	

Selections

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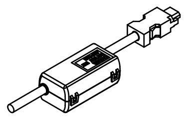
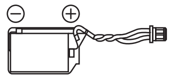
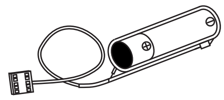
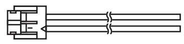
(cont'd)

Name	Length	Type	Specifications	Reference
④Battery for Absolute Encoder Note: No battery is mounted in the battery case. A battery must be purchased separately.		JUSP-BA01	Battery case 	5.10.8
		JZSP-BA01	(To mount in the battery case) 	
		ER6VC3N	To connect to a host computer (provided by a customer) 3.6 V 2000 mAh, manufactured by Toshiba Battery Co., Ltd. 	
⑤ CN5 Analog Monitor Cable	1 m	JZSP-CA01	SERVOPACK end 	5.10.3

2.5.2 Molded-case Circuit Breaker and Fuse Capacity

Main Circuit Power Supply	SERVOPACK Model		Power Supply Capacity per SERVOPACK (kVA)	Current Capacity of Molded-case Circuit Breaker or Fuse (A_{rms})*1, *2 (Refer to 5.10.9)		Inrush Current	
	Capacity (kW)	SGDS-		Main Circuit Power Supply (A_{rms})	Control Circuit (A_{rms})	Main Circuit Power Supply (A)	Control Circuit (A)
Single-phase 100 V	0.03	A3B	0.25	4	0.26	14	30
	0.05	A5F					
	0.10	01F	0.40				
	0.20	02F	0.60	6			
	0.40	04F	1.2	12			
Single-phase 200 V	0.05	A5A	0.25	4	0.13	28	60
	0.10	01A	0.40				
	0.20	02A	0.75				
	0.40	04A	1.2	8			
	0.80	08A	2.2	16			
Three-phase 200 V	0.5	05A	1.4	4	0.15	28	60
	1.0	10A	2.3	7			
	1.5	15A	3.2	10			28
	2.0	20A	4.3	13			
	3.0	30A	5.9	17			
	5.0	50A	7.5	28		57	
	6.0	60A	12.5	32	0.27	94	
	7.5	75A	15.5	41			

* 1. Nominal value at the rated load. The specified derating is required to select an appropriate fuse capacity.
* 2. Cutoff characteristics (25°C): 200% two seconds min. and 700% 0.01 seconds min.

Note: Do not use a fast-acting fuse. Because the SERVOPACK's power supply is a capacitor input type, a fast-acting fuse may blow when the power is turned ON.

IMPORTANT

The SGDS SERVOPACK does not include a protective grounding circuit. Install a ground-fault protector to protect the system against overload and short-circuit or protective grounding combined with the molded-case circuit breaker.

2.5.3 Noise Filters, Magnetic Contactors, Surge Absorbers and AC/DC Reactors

Main Circuit Power Supply	SERVOPACK Model		Recommended Noise Filter (Refer to 5.10.10)		Magnetic Contactor (Refer to 5.10.11)	Surge Absorber (Refer to 5.10.12, 5.10.13)		AC/DC Reactor (Refer to 5.10.14)
	Capacity (kW)	SGDS-	Type	Specifications				
Single-phase 100 V	0.03	A3B	FN2070-6/07	Single-phase 250 VAC, 6 A	HI-11J (20 A)	TU-25C120 (Surge Suppressor)	R·C·M -601BQZ-4 (Surge Protector)	X5052
	0.05	A5F						X5053
	0.10	01F						
	0.20	02F	FN2070-10/07	Single-phase 250 VAC, 10 A				X5054
	0.40	04F	FN2070-16/07	Single-phase 250 VAC, 16 A	HI-15J (35 A)			X5061
Single-phase 200 V	0.05	A5A	FN2070-6/07	Single-phase 250 VAC, 6 A	HI-11J (20 A)	TU-25C240 (Surge Suppressor)		X5052
	0.10	01A						
	0.20	02A						X5053
	0.40	04A	FN2070-10/07	Single-phase 250 VAC, 10 A				X5054
	0.80	08A	FN2070-16/07	Single-phase 250 VAC, 16 A	HI-15J (35 A)			X5056
Three-phase 200 V	0.5	05A	FN258L-7/07	Three-phase 480 VAC, 7 A	HI-11J (20 A)		R·C·M -601BUZ-4 (Surge Protector)	X5061
	1.0	10A	FN258L-16/07	Three-phase 480 VAC, 16 A	HI-15J (35 A)			
	1.5	15A						X5060
	2.0	20A			HI-20J (35 A)			
	3.0	30A	FN258L-30/07	Three-phase 480 VAC, 30 A				X5059
	5.0	50A	FMAC-0934-5010	Three-phase 480 VAC, 50 A	HI-25J (50 A)	TU-65C240 (Surge Suppressor)		X5068
	6.0	60A		Three-phase 440VAC, 50A				–
	7.5	75A	FMAC-0953-6410	Three-phase 440VAC, 64A	HI-35J (65A)			–

Note: 1. If some SERVOPACKs are wired at the same time, select the proper magnetic contactors according to the total capacity.

2. The following table shows the manufacturers of each device.

Peripheral Device	Manufacturer
Noise Filter	FN type: SCHAFFNER
	FMAC type: SCHURTER (formerly TIMONTA)
Magnetic Contactor	Yaskawa Controls Co., Ltd.
Surge Absorber	Yaskawa Controls Co., Ltd. (surge suppressor)
	Okaya Electric Industries Co., Ltd. (surge protector)
AC/DC Reactor	Yaskawa Controls Co., Ltd.

NOTE

■ Noise Filter Brake Power Supply

Use the following noise filter at the brake power input for 400 W or less servomotors with holding brakes.

MODEL: FN2070-6/07 (Manufactured by SCHAFFNER Electronic.)

2.5.4 Regenerative Resistors and Brake Power Supply Units

Main Circuit Power Supply	SERVOPACK Model		Regenerative Resistor (Refer to 5.10.6 and 6.5)			Brake Power Supply Unit (Refer to 5.10.5)
			Built-in		Externally connected	
	Capacity (kW)	SGDS-	Resistance (Ω)	Capacity (W)		
Single-phase 100 V	0.03	A3B	–	–	–	For 24VDC brakes[*3] Customers must provide.
	0.05	A5F				For 24VDC brakes[*3] Customers must provide. For 90 VDC brakes • LPDE-1H01 for 100 VAC input • LPSE-2H01 for 200 VAC input
	0.10	01F				
	0.20	02F				
	0.40	04F				
Single-phase 200 V	0.05	A5A	–	–	–	
	0.10	01A				
	0.20	02A				
	0.40	04A				
	0.80	08A	50	60		
Three-phase 200 V	0.5	05A	50	40	–	
	1.0	10A		60		
	1.5	15A	20	50		
	2.0	20A	12	80		
	3.0	30A				
	5.0	50A	8	180	-	
	6.0	60A	(6.25)[*1]	(880)[*1]	JUSP-RA04	
	7.5	75A	(3.13)[*2]	(1760)[*2]	JUSP-RA05	

* 1. For the optional JUSP-RA04 Regenerative Resistor Unit.
* 2. For the optional JUSP-RA05 Regenerative Resistor Unit.
* 3. Be careful when connecting the power supply for 24 VDC brake to the local power supply. The local power supply cannot apply the overvoltage such as surge to the output side, and the output side may be damaged even if the voltage is applied. Never fail to use the surge absorber.

Note: 1. If the SERVOPACK cannot process the regenerative power, an external regenerative resistor is required. Refer to *5.10.7 Regenerative Resistor Unit*, *5.10.8 Absolute Encoder Battery*, and *6.5 Connecting Regenerative Resistors*.

2. The following table shows the manufacturers of each device.

Peripheral Device	Manufacturer
External Regenerative Resistor	Iwaki Wireless Research Institute
External Regenerative Unit	Yaskawa Electric Corporation
Brake Power Supply Unit	Yaskawa Controls Co., Ltd.

3

Servomotor Specifications and Dimensional Drawings

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3.1 Ratings and Specifications of SGMMJ Servomotors

3.1.1 SGMMJ Servomotors Without Gears

(1) Ratings and Specifications

- Time Rating: Continuous
- Vibration Class: 15 μm or below
- Insulation Resistance: 500 VDC, 10 M Ω min.
- Ambient Temperature: 0 to 40°C
- Excitation: Permanent magnet
- Mounting: Flange method
- Thermal Class: B
- Withstand Voltage: 1000 VAC for one minute
- Ambient Humidity: 20% to 80% (no condensation)
- Drive Method: Direct drive

Voltage			100 V		
Servomotor Model SGMMJ-			A1B	A2B	A3B
Rated Output *1	W		10	20	30
Rated Torque *1,*2	N·m		0.0318	0.0638	0.0955
Instantaneous Peak Torque *1	N·m		0.0955	0.191	0.287
Rated Current *1	A_{rms}		0.70	0.66	0.98
Instantaneous Max. Current *1	A_{rms}		2.0	1.9	2.9
Rated Speed *1	min^{-1}		3000		
Max. Speed *1	min^{-1}		5000		
Torque Constant	$N·m/A_{rms}$		0.0516	0.107	0.107
Rotor Moment of Inertia J	Incremental	$x10^{-4}$ kg·m^2	0.00354	0.00548	0.00750
	Absolute	$x10^{-4}$ kg·m^2	(0.00272)	(0.00466)	(0.00668)
Rated Power Rate *1	kW/s		2.87	7.41	12.2
Rated Angular Acceleration *1	rad/s^2		90000	116000	127000

* 1. These items and torque-motor speed characteristics quoted in combination with SGDS SERVOPACK are at an armature winding temperature of 100°C. Other values quoted at 20°C. All values are typical.

* 2. Rated torques are continuous allowable torque values at 40°C with an aluminum plate (heat sink) attached.
A1 and A2: 150 × 150 × 3 (mm)
A3: 250 × 250 × 6 (mm)

Note: If the heating conditions are more severe than the *2 conditions above, continuous allowable torque decreases. Contact your Yaskawa representative.

(2) Holding Brake Moment of Inertia

The moment of inertia of the servomotor with holding brake is expressed using the following equation.

(The moment of inertia of the servomotor with holding brake) = (rotor moment of inertia) + (brake moment of inertia)

Servomotor Model SGMMJ-		A1□	A2□	A3□
Holding Brake Moment of Inertia J	$\times 10^{-4}$ kg·m^2	0.00125		

* These values are reference values.

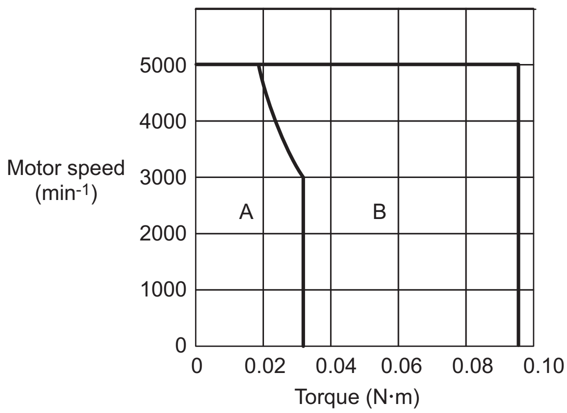
(3) Holding Brake Electrical Specifications

Holding Brake Rated Voltage	Servomotor Model	Servomotor Capacity W	Holding Brake Specifications			
			Capacity W	Holding Torque N·m	Coil Resistance Ω(at 20°C)	Rated Current A (at 20°C)
24 VDC	SGMMJ-A1B	10	2.0	0.0318	320	0.08
	SGMMJ-A2B	20	2.6	0.0638	222	0.11
	SGMMJ-A3B	30	2.6	0.0955	220	0.11

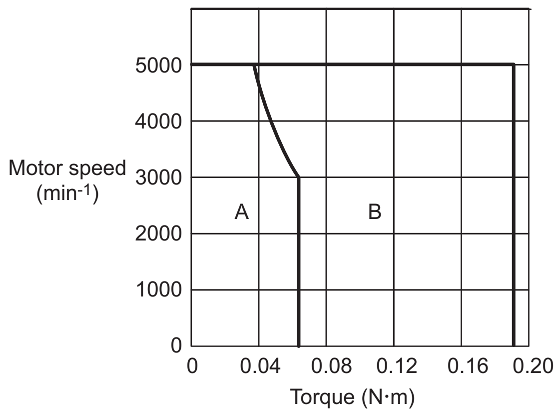
Note: The holding brake is only used to hold the load and cannot be used to stop the servomotor.

(4) Torque-motor Speed Characteristics

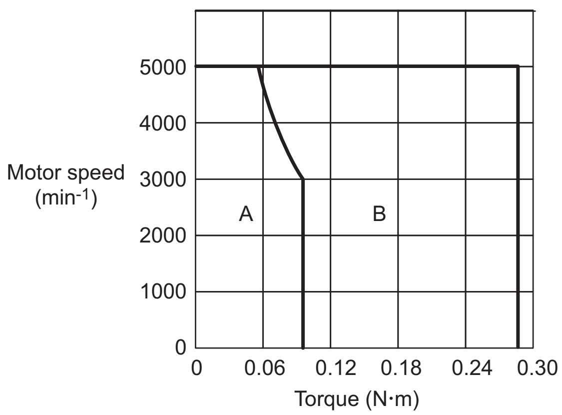
SGMMJ-A1B



SGMMJ-A2B



SGMMJ-A3B



A : Continuous Duty Zone
B : Intermittent Duty Zone

3.1.2 SGMMJ Servomotors With Standard Backlash Gears

- Time Rating: Continuous
- Withstand Voltage: 1000 VAC for one minute
- Insulation Resistance: 500 VDC, 10 MΩ min.
- Enclosure: Totally enclosed, self-cooled, IP55 (except for shaft opening)
- Ambient Temperature: 0 to 40°C
- Ambient Humidity: 20% to 80% (no condensation)
- Excitation: Permanent magnet
- Drive Method: Direct drive
- Mounting: Flange method
- Backlash: 15 to 20 min max.
- Gear Mechanism: Planetary gear mechanism
- Gear Rotation Direction: Same direction as servomotor
- Thermal Class: B

Servomotor Model SGMMJ-	Servomotor			Gear Output					Moment of Inertia J $\times 10^{-4}$ kg·m^2	
	Output W	Rated Speed min^{-1}	Rated Torque N·m	Gear Ratio	Rated Torque/ Efficiency*2 N·m/%	Instantaneous Peak Torque N·m	Rated Speed min^{-1}	Max. Speed *1 min^{-1}	Motor + Gears	Gears
A1B□BJA□□□	10	3000	0.0318	1/5	0.127/80	0.43	600	1000	0.00529	0.00175
A1B□BJB□□□				1/16	0.407/80	1.38	188	313	0.00454	0.00100
A1B□BJC□□□				1/25	0.636/80	2.15	120	200	0.00418	0.00064
A2B□BJA□□□	20	3000	0.0638	1/5	0.255/80	0.86	600	1000	0.00723	0.00175
A2B□BJB□□□				1/16	0.815/80	2.55*4	188	313	0.00648	0.00100
A2B□BJC□□□				1/25	1.27/80	2.26*4	120	200	0.00612	0.00064
A3B□BJ1□□□	30	3000	0.0955	1/5	0.382/80	1.29	600	1000	0.00917	0.00167
A3B□BJ2□□□				1/16	1.22/80	3.23*4	188	313	0.00842	0.00092
A3B□BJ3□□□				1/25	1.91/80	4.31*4	120	200	0.0806	0.0731

* 1. Gear output torque is expressed using the following equation.
(Gear output torque) = (servomotor output torque) × (gear) × (efficiency)

* 2. Maximum motor speed is up to 5000 min^{-1} at the shaft.

* 3. This brake is for holding (de-energization operation) and cannot be used to stop the servomotor.

* 4. The allowable torque is limited by gear.

3.2 Ratings and Specifications of SGMAS Servomotors

3.2.1 SGMAS Servomotors without Gears

(1) Ratings and Specifications

- Time Rating: Continuous
- Vibration Class: 15 µm or below
- Insulation Resistance: 500 VDC, 10 M Ω min.
- Ambient Temperature: 0 to 40°C
- Excitation: Permanent magnet
- Mounting: Flange method
- Thermal Class: B
- Withstand Voltage: 1500 VAC for one minute
- Enclosure: Totally enclosed, self-cooled, IP55 (except for shaft opening)
- Ambient Humidity: 20% to 80% (no condensation)
- Drive Method: Direct drive

Ratings and Specifications for SGMAS Servomotors without Gears

Voltage		200 V							
Servomotor Model SGMAS-		A5A	01A	C2A	02A	04A	06A	08A	12A
Rated Output*1	W	50	100	150	200	400	600	750	1150
Rated Torque*1, *2	N•m	0.159	0.318	0.477	0.637	1.27	1.91	2.39	3.66
Instantaneous Peak Torque*1	N•m	0.477	0.955	1.43	1.91	3.82	5.73	7.16	11.0
Rated Current*1	A_{rms}	0.66	0.91	1.8	1.9	2.6	4.3	5.4	8.5
Instantaneous Max. Current*1	A_{rms}	2.1	2.8	5.7	6.5	8.5	13.6	16.9	26.0
Rated Speed*1	min^{-1}	3000							
Max. Speed*1	min^{-1}	6000							
Torque Constant	$N{\cdot}m/A_{rms}$	0.265	0.375	0.284	0.375	0.527	0.496	0.487	0.467
Rotor Moment of Inertia	$kg{\cdot}m^2{\times}10^{-4}$	0.0242	0.0380	0.0531	0.116	0.190	0.326	0.769	1.20
Rated Power Rate*1	kW/s	10.4	26.6	42.8	35.0	84.9	112	74.1	112
Rated Angular Acceleration*1	rad/s^2	65800	83800	89900	54900	67000	58600	31000	30500
Applicable SERVOPACK	SGDS-	A5	01	02	02	04	08	08	15

* 1. These items and torque-motor speed characteristics quoted in combination with an SGDS SERVOPACK are at an armature winding temperature of 100°C. Other values quoted at 20°C.

* 2. Rated torques are continuous allowable torque values at 40°C with an aluminum heat sink of the following dimensions attached.
SGMAS-A5, -01, -C2, -02, -04 and -08: 250 mm × 250 mm × 6 mm
SGMAS-06: 300 mm × 300 mm × 12 mm
SGMAS-12: 350 mm × 350 mm × 12 mm

Note: If the heating conditions are more severe than the *2 conditions above, continuous allowable torque decreases. Contact your Yaskawa representative.

(2) Holding Brake Moment of Inertia

The moment of inertia of the servomotor with holding brake is that of the rotor + that of brakes.

Holding Brake Moment of Inertia

Servomotor Model SGMAS-		A5A	01A	C2A	02A	04A	06A	08A	12A
Holding Brake Moment of Inertia	kg·m^2×10^{-4}	0.00754			0.0642			0.171	0.244

(3) Derating Rate for Servomotor fitted with a Shaft Seal

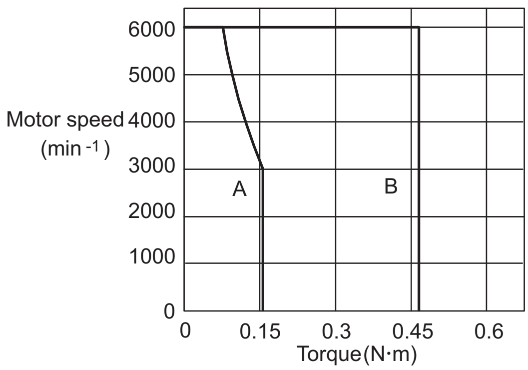
When a motor is fitted with a shaft seal, use the following reduction ratings because of the higher friction torque.

Derating Rate for Servomotor fitted with a Shaft Seal

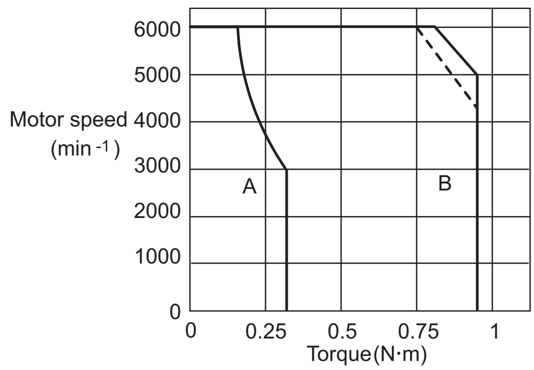
Servomotor Model SGMAS-	A5A	01A	C2A	02A	04A	06A	08A	12A
Derating Rate (%)	80	90			95			

(4) Torque-motor Speed Characteristics

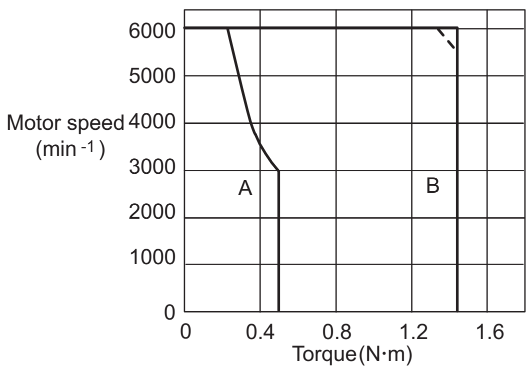
SGMAS-A5A



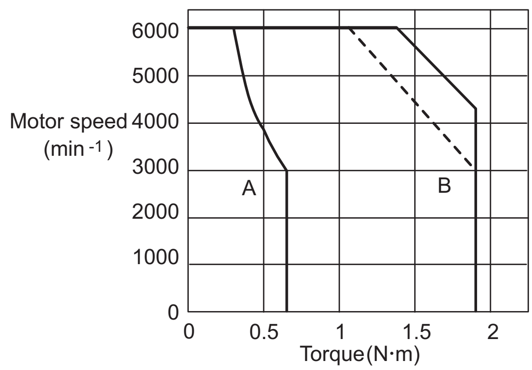
SGMAS-01A

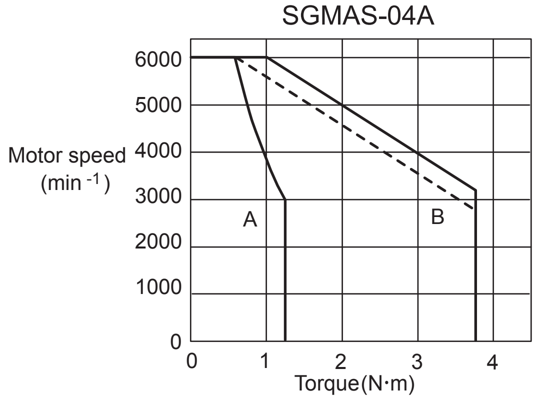


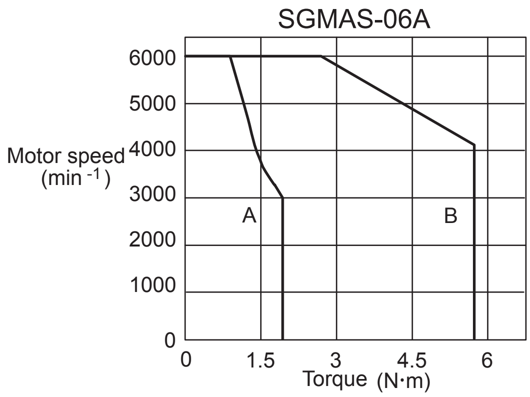
SGMAS-C2A

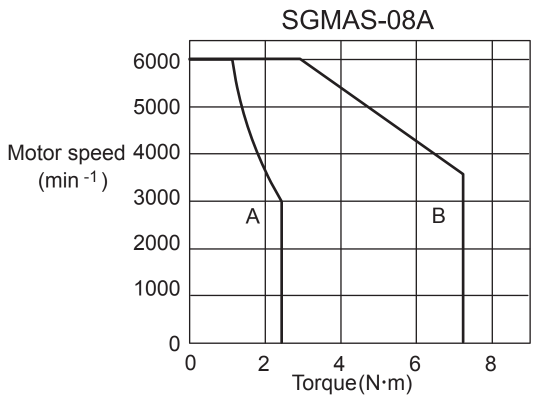


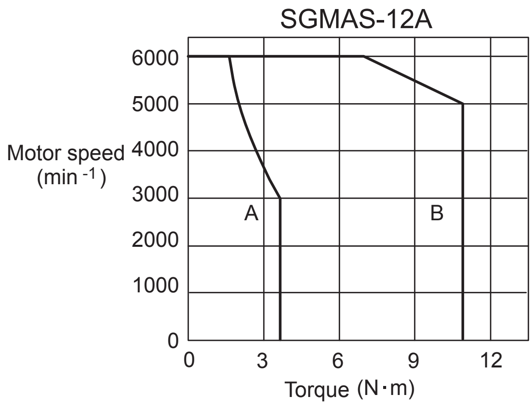
SGMAS-02A











A: Continuous Duty Zone
B: Intermittent Duty Zone

Note: The dotted line of intermittent duty zone indicates the characteristics when a servomotor runs in combination with a SERVOPACK for 100VAC.

(5) Holding Brake Electrical Specifications

Holding Brake Electrical Specifications

Holding Brake Rated Voltage	Servomotor Model	Servomotor Capacity (W)	Holding Brake Specifications			
			Capacity (W)	Holding Torque (N•m)	Coil Resistance Ω(at 20°C)	Rated Current A (at 20°C)
90 VDC	SGMAS-A5A	50	6	0.159	1350	0.066
	SGMAS-01A	100	6	0.318	1350	0.066
	SGMAS-C2A	150	6	0.477	1350	0.066
	SGMAS-02A	200	7.4	0.637	1095	0.082
	SGMAS-04A	400	7.4	1.27	1095	0.082
	SGMAS-06A	600	8.9	1.91	900	0.1
	SGMAS-08A	750	9	2.39	900	0.1
	SGMAS-12A	1150	8.4	3.66	964	0.09
24 VDC	SGMAS-A5A	50	6	0.159	96	0.25
	SGMAS-01A	100	6	0.318	96	0.25
	SGMAS-C2A	150	6	0.477	96	0.25
	SGMAS-02A	200	6.9	0.637	83	0.29
	SGMAS-04A	400	6.9	1.27	83	0.29
	SGMAS-06A	600	8.7	1.91	67	0.36
	SGMAS-08A	750	7.7	2.39	75	0.32
	SGMAS-12A	1150	7.7	3.66	75	0.32

Note: The holding brake is only used to hold the load and cannot be used to stop the servomotor.

3.2.2 SGMAS Servomotors with Standard Backlash Gears

- Time Rating: Continuous
- Vibration Class: 15 µm or below
- Insulation Resistance: 500 VDC, 10 MΩ min.
- Ambient Temperature: 0 to 40°C
- Excitation: Permanent magnet
- Mounting: Flange method
- Gear Mechanism: Planetary gear mechanism
- Thermal Class: B
- Withstand Voltage: 1500 VAC for one minute
- Enclosure: Totally enclosed, self cooled (except for shaft opening)
- Ambient Humidity: 20% to 80% (no condensation)
- Drive Method: Direct drive
- Backlash: 15 to 20 minutes max.

Ratings and Specifications for SGMAS Servomotors with Standard Backlash Gears

Servomotor Model SGMAS-	Servomotor			Gear					
	Output (W)	Rated Speed (min^{-1})	Rated Torque (N·m)	Gear Ratio	Lost Motion (arc-min)	Rated Torque /Efficiency*2 (N·m)/(%)	Instantaneous Peak Torque (N·m)	Rated Speed (min^{-1})	Max. Speed *1 (min^{-1})
A5A□AJ1□	50	3000	0.159	1/5	15	0.557/70	1.92	600	800
A5A□AJ3□				3/31		1.15/70	3.95	290	387
A5A□AJC□				1/21	20	2.67/80	9.07	143	190
A5A□AJ7□				1/33		4.20/80	14.3	91	121
01A□AJ1□	100	3000	0.318	1/5	15	1.27/80	4.32	600	800
01A□AJ3□				3/31		2.63/80	8.88	290	387
01A□AJC□				1/21		5.34/80	18.1	143	190
01A□AJ7□				1/33		8.40/80	28.4	91	121
C2A□AJ1□	150	3000	0.477	1/5	15	1.91/80	5.73	600	800
C2A□AJ3□				3/31		3.94/80	11.8	290	387
C2A□AJC□				1/21		8.01/80	24.0	143	190
C2A□AJ7□				1/33		12.6/80	37.8	91	121
02A□AJ1□	200	3000	0.637	1/5	15	2.55/80	8.60	600	800
02A□AJ3□				3/31		5.27/80	17.8	290	387
02A□AJC□				1/21		10.7/80	36.1	143	190
02A□AJ7□				1/33		16.8/80	56.7	91	121
04A□AJ1□	400	3000	1.27	1/5	15	5.08/80	17.2	600	800
04A□AJ3□				3/31		10.5/80	35.5	290	387
04A□AJC□				1/21		21.3/80	72.2	143	190
04A□AJ7□				1/33		33.5/80	113	91	121
06A□AJ1□	600	3000	1.91	1/5	15	7.60/80	22.8	600	800
06A□AJ3□				3/31		15.8/80	47.4	290	387
06A□AJC□				1/21		32.1/80	96.3	143	190
06A□AJ7□				1/33		50.4/80	151	91	121
08A□AJ1□	750	3000	2.39	1/5	15	9.56/80	32.0	600	800
08A□AJ3□				3/31		19.8/80	66.6	290	387
08A□AJC□				1/21		40.2/80	134	143	190
08A□AJ7□				1/33		63.1/80	212	91	121
12A□AJ1□	1150	3000	3.66	1/5	15	14.6/80	43.9	600	800
12A□AJB□				1/11		32.2/80	96.6	273	363
12A□AJC□				1/21		61.5/80	184	143	190
12A□AJ7□				1/33		96.6/80	290	91	121

Ratings and Specifications for SGMAS Servomotors with Standard Backlash Gears (Cont'd)

Servomotor Model SGMAS-	Moment of Inertia	
	Motor + Gear ($kg\cdot m^2 \times 10^{-4}$)	Gear ($kg\cdot m^2 \times 10^{-4}$)
A5A□AJ1□	0.052	0.028
A5A□AJ3□	0.042	0.018
A5A□AJC□	0.038	0.014
A5A□AJ7□	0.034	0.010
01A□AJ1□	0.101	0.063
01A□AJ3□	0.056	0.018
01A□AJC□	0.073	0.035
01A□AJ7□	0.059	0.021
C2A□AJ1□	0.116	0.063
C2A□AJ3□	0.084	0.031
C2A□AJC□	0.088	0.035
C2A□AJ7□	0.097	0.044
02A□AJ1□	0.309	0.193
02A□AJ3□	0.206	0.090
02A□AJC□	0.221	0.105
02A□AJ7□	0.191	0.075
04A□AJ1□	0.383	0.193
04A□AJ3□	0.370	0.180
04A□AJC□	0.420	0.230
04A□AJ7□	0.355	0.165
06A□AJ1□	0.519	0.193
06A□AJ3□	0.553	0.227
06A□AJC□	0.556	0.230
06A□AJ7□	0.609	0.283
08A□AJ1□	1.22	0.451
08A□AJ3□	1.20	0.425
08A□AJC□	1.24	0.475
08A□AJ7□	1.07	0.301
12A□AJ1□	1.65	0.450
12A□AJB□	2.24	1.04
12A□AJC□	1.68	0.475
12A□AJ7□	1.82	0.624

* 1. Maximum motor speed is up to 4000 min^{-1} at the motor shaft.
* 2. Gear output torque is expressed using the following equation.

$$(\text{Gear output torque}) = (\text{servomotor output torque}) \times \left(\frac{1}{\text{gear ratio}}\right) \times (\text{efficiency})$$

IMPORTANT

The no-load torque for a servomotor with gears is high immediately afer the servomotor starts, and it then decreases and becomes stable a few minutes later. This is a common phenomenon caused by grease being circulated in the gear and not by a faulty gear.
The speed control range of SERVOPACKs in the Σ-III series is 1:5000. When using servomotors at extremely low speeds (for example, 0.02 min^{-1} max. at the gear output shaft) or when using servomotors with one pulse feed reference for extended periods and in other situations that are less than optimum, the lubrication of the gear bearing may be insufficient. This may cause deterioration of the bearing or increase the load ratio.
Contact your Yaskawa representative if you are using your servomotor under such conditions.

3.2.3 SGMAS Servomotors with Low-backlash Gears

- Time Rating: Continuous
- Vibration Class: 15 µm or below
- Insulation Resistance: 500 VDC, 10 MΩ min.
- Ambient Temperature: 0 to 40°C
- Excitation: Permanent magnet
- Mounting: Flange method
- Gear Mechanism: Planetary gear mechanism
- Thermal Class: B
- Withstand Voltage: 1500 VAC for one minute
- Enclosure: Totally enclosed, self cooled (except for shaft opening)
- Ambient Humidity: 20% to 80% (no condensation)
- Drive Method: Direct drive
- Backlash: 3 minutes max.

Ratings and Specifications for SGMAS Servomotors with Low-backlash Gears

Servomotor Model SGMAS-	Servomotor			Gear					
	Output (W)	Rated Speed (min^{-1})	Rated Torque (N·m)	Gear Ratio	Lost Motion (arc-min)	Rated Torque /Efficiency*2 (N·m)/(%)	Instantaneous Peak Torque (N·m)	Rated Speed (min^{-1})	Max. Speed *1 (min^{-1})
A5A☐AH1☐	50	3000	0.159	1/5	3	0.557/70	1.67	600	800
A5A☐AH2☐				1/9		1.00/70	3.01	333	444
A5A☐AHC☐				1/21		2.67/80	8.02	143	190
A5A☐AH7☐				1/33		4.20/80	12.6	91	121
01A☐AH1☐	100	3000	0.318	1/5	3	1.27/80	3.82	600	800
01A☐AHB☐				1/11		2.80/80	8.41	273	363
01A☐AHC☐				1/21		5.34/80	18.2	143	190
01A☐AH7☐				1/33		8.40/80	28.7	91	121
C2A☐AH1☐	150	3000	0.477	1/5	3	1.91/80	5.73	600	800
C2A☐AHB☐				1/11		4.20/80	12.6	273	363
C2A☐AHC☐				1/21		8.01/80	24.0	143	190
C2A☐AH7☐				1/33		12.6/80	37.8	91	121
02A☐AH1☐	200	3000	0.637	1/5	3	2.55/80	8.4	600	800
02A☐AHB☐				1/11		5.96/85	19.3	273	363
02A☐AHC☐				1/21		11.4/85	37.3	143	190
02A☐AH7☐				1/33		17.9/85	58.6	91	121
04A☐AH1☐	400	3000	1.27	1/5	3	5.40/85	17.6	600	800
04A☐AHB☐				1/11		11.9/85	39.1	273	363
04A☐AHC☐				1/21		22.7/85	72.2	143	190
04A☐AH7☐				1/33		33.5/80	115	91	121
06A☐AH1☐	600	3000	1.91	1/5	3	8.12/85	24.3	600	800
06A☐AHB☐				1/11		17.9/85	53.7	273	363
06A☐AHC☐				1/21		34.1/85	102	143	190
06A☐AH7☐				1/33		50.4/80	151	91	121
08A☐AH1☐	750	3000	2.39	1/5	3	10.2/85	33.3	600	800
08A☐AHB☐				1/11		22.3/85	71.0	273	363
08A☐AHC☐				1/21		42.7/85	140	143	190
08A☐AH7☐				1/33		67.0/85	206	91	121
12A☐AH1☐	1150	3000	3.66	1/5	3	15.6/85	46.7	600	800
12A☐AHB☐				1/11		34.2/85	103	273	363
12A☐AHC☐				1/21		65.3/85	196	143	190
12A☐AH7☐				1/33		96.6/80	290	91	121

Ratings and Specifications for SGMAS Servomotors with Low-backlash Gears (cont'd)

Servomotor Model SGMAS-	Moment of Inertia	
	Motor + Gear ($kg·m^2 \times 10^{-4}$)	Gear ($kg·m^2 \times 10^{-4}$
A5A☐AH1☐	0.054	0.030
A5A☐AH2☐	0.052	0.028
A5A☐AHC☐	0.042	0.019
A5A☐AH7☐	0.037	0.013
01A☐AH1☐	0.116	0.078
01A☐AHB☐	0.086	0.048
01A☐AHC☐	0.081	0.043
01A☐AH7☐	0.071	0.033
C2A☐AH1☐	0.131	0.078
C2A☐AHB☐	0.124	0.071
C2A☐AHC☐	0.096	0.043
C2A☐AH7☐	0.085	0.032
02A☐AH1☐	0.451	0.335
02A☐AHB☐	0.201	0.085
02A☐AHC☐	0.226	0.110
02A☐AH7☐	0.181	0.065
04A☐AH1☐	0.525	0.335
04A☐AHB☐	0.385	0.195
04A☐AHC☐	0.385	0.195
04A☐AH7☐	0.363	0.173
06A☐AH1☐	0.661	0.335
06A☐AHB☐	0.518	0.192
06A☐AHC☐	0.904	0.578
06A☐AH7☐	0.501	0.173
08A☐AH1☐	1.35	0.583
08A☐AHB☐	1.30	0.528
08A☐AHC☐	1.36	0.593
08A☐AH7☐	1.03	0.263
12A☐AH1☐	1.78	0.583
12A☐AHB☐	2.30	1.10
12A☐AHC☐	1.79	0.593
12A☐AH7☐	6.14	4.94

* 1. Maximum motor speed is up to 4000 min^{-1} at the motor shaft.

* 2. Gear output torque is expressed using the following equation.

$$\text{(Gear output torque)} = \text{(servomotor output torque)} \times \left(\frac{1}{\text{gear ratio}}\right) \times \text{(efficiency)}$$

IMPORTANT

The no-load torque for a servomotor with gears is high immediately afer the servomotor starts, and it then decreases and becomes stable a few minutes later. This is a common phenomenon caused by grease being circulated in the gear and not by a faulty gear.

The speed control range of SERVOPACKs in the Σ-III series is 1:5000. When using servomotors at extremely low speeds (for example, 0.02 min^{-1} max. at the gear output shaft) or when using servomotors with one pulse feed reference for extended periods and in other situations that are less than optimum, the lubrication of the gear bearing may be insufficient. This may cause deterioration of the bearing or increase the load ratio.

Contact your Yaskawa representative if you are using your servomotor under such conditions.

3.2.4 SGMAS Flange-type Servomotors with Low-backlash Gears

- Time Rating: Continuous
- Vibration Class: 15 µm or below
- Insulation Resistance: 500 VDC, 10 MΩ min.
- Ambient Temperature: 0 to 40°
- Excitation: Permanent magnet
- Mounting: Flange method
- Gear Mechanism: Planetary gear mechanism
- Thermal Class: B
- Withstand Voltage: 1500 VAC for one minute
- Enclosure: Totally enclosed, self cooled (except for shaft opening)
- Ambient Humidity: 20% to 80% (no condensation)
- Drive Method: Direct drive
- Backlash: 3 minutes max.

Ratings and Specifications for SGMAS Flange-type Servomotors with Low-backlash Gears

Servomotor Model SGMAS-	Servomotor			Gear					
	Output (W)	Rated Speed (min^{-1})	Rated Torque (N·m)	Gear Ratio	Lost Motion (arc-min)	Rated Torque /Efficiency*2 (N·m)/(%)	Instantaneous Peak Torque (N·m)	Rated Speed (min^{-1})	Max. Speed *1 (min^{-1})
A5A☐AH10	50	3000	0.159	1/5	3	0.557/70	1.92	600	800
A5A☐AH20				1/9		1.00/70	3.89	333	444
A5A☐AHC0				1/21		2.67/80	9.07	143	190
A5A☐AH70				1/33		4.20/80	14.3	91	121
01A☐AH10	100	3000	0.318	1/5	3	1.27/80	4.32	600	800
01A☐AHB0				1/11		2.80/80	9.50	273	363
01A☐AHC0				1/21		5.34/80	18.1	143	190
01A☐AH70				1/33		8.40/80	27.0	91	121
C2A☐AH10	150	3000	0.477	1/5	3	1.91/80	5.73	600	800
C2A☐AHB0				1/11		4.20/80	12.6	273	363
C2A☐AHC0				1/21		8.01/80	24.0	143	190
C2A☐AH70				1/33		12.6/80	37.8	91	121
02A☐AH10	200	3000	0.637	1/5	3	2.55/80	8.60	600	800
02A☐AHB0				1/11		5.61/80	18.9	273	363
02A☐AHC0				1/21		10.7/80	36.1	143	190
02A☐AH70				1/33		16.8/80	48.0*3	91	121
04A☐AH10	400	3000	1.27	1/5	3	5.10/80	17.2	600	800
04A☐AHB0				1/11		11.2/80	35.0	273	363
04A☐AHC0				1/21		21.3/80	72.2	143	190
04A☐AH70				1/33		33.5/80	93.0*3	91	121
06A☐AH10	600	3000	1.91	1/5	3	7.64/80	22.9	600	800
06A☐AHB0				1/11		16.8/80	50.4	273	363
06A☐AHC0				1/21		32.1/80	96.3	143	190
06A☐AH70				1/33		50.4/80	151	91	121
08A☐AH10	750	3000	2.39	1/5	3	9.56/80	32.0	600	800
08A☐AHB0				1/11		21.0/80	56.0*3	273	363
08A☐AHC0				1/21		40.2/80	134	143	190
08A☐AH70				1/33		63.1/80	156*3	91	121
12A☐AH10	1150	3000	3.66	1/5	3	14.6/80	43.9	600	800
12A☐AHB0				1/11		32.2/80	96.6	273	363
12A☐AHC0				1/21		61.5/80	184	143	190
12A☐AH70				1/33		96.6/80	290	91	121

Ratings and Specifications for SGMAS Flange-type Servomotors with Low-backlash Gears (cont'd)

Servomotor Model SGMAS-	Moment of Inertia	
	Motor + Gear ($kg·m^2 \times 10^{-4}$)	Gear ($kg·m^2 \times 10^{-4}$)
A5A□AH10	0.059	0.035
A5A□AH20	0.056	0.032
A5A□AHC0	0.042	0.018
A5A□AH70	0.035	0.011
01A□AH10	0.123	0.085
01A□AHB0	0.079	0.041
01A□AHC0	0.081	0.043
01A□AH70	0.064	0.026
C2A□AH10	0.138	0.085
C2A□AHB0	0.137	0.084
C2A□AHC0	0.096	0.043
C2A□AH70	0.129	0.076
02A□AH10	0.396	0.280
02A□AHB0	0.217	0.101
02A□AHC0	0.204	0.088
02A□AH70	0.170	0.054
04A□AH10	0.470	0.280
04A□AHB0	0.417	0.227
04A□AHC0	0.409	0.219
04A□AH70	0.326	0.136
06A□AH10	0.606	0.280
06A□AHB0	0.843	0.517
06A□AHC0	0.891	0.565
06A□AH70	0.647	0.321
08A□AH10	1.39	0.616
08A□AHB0	1.32	0.552
08A□AHC0	1.32	0.552
08A□AH70	1.10	0.327
12A□AH10	3.66	2.46
12A□AHB0	2.53	1.33
12A□AHC0	3.41	2.21
12A□AH70	6.12	4.92

* 1. Maximum motor speed is up to 4000 min^{-1} at the shaft.
* 2. Gear output torque is expressed using the following equation.

  $$\text{(Gear output torque)} = \text{(servomotor output torque)} \times \left(\frac{1}{\text{gear ratio}}\right) \times \text{(efficiency)}$$

* 3. The instantaneous peak torque values are limited by the gear, so use the following servomotor instantaneous peak torque. In this case, set torque parameters Pn402 and 403 for the SERVOPACK at 250%.

IMPORTANT

The no-load torque for a servomotor with gears is high immediately afer the servomotor starts, and it then decreases and becomes stable a few minutes later. This is a common phenomenon caused by grease being circulated in the gear and not by a faulty gear.

The speed control range of SERVOPACKs in the Σ-III series is 1:5000. When using servomotors at extremely low speeds (for example, 0.02 min^{-1} max. at the gear output shaft) or when using servomotors with one pulse feed reference for extended periods and in other situations that are less than optimum, the lubrication of the gear bearing may be insufficient. This may cause deterioration of the bearing or increase the load ratio.

Contact your Yaskawa representative if you are using your servomotor under such conditions.

3.3 Ratings and Specifications of SGMPS Servomotors

3.3.1 SGMPS Servomotors without Gears

(1) Ratings and Specifications

- Time Rating: Continuous
- Vibration Class: 15 μm or below
- Insulation Resistance: 500 VDC, 10 MΩ min.
- Ambient Temperature: 0 to 40°C
- Excitation: Permanent magnet
- Mounting: Flange method
- Thermal Class: B
- Withstand Voltage: 1500 VAC for one minute
- Enclosure: Totally enclosed, self-cooled, IP55 (except for shaft opening)
- Ambient Humidity: 20% to 80% (no condensation)
- Drive Method: Direct drive

Ratings and Specifications for SGMPS Servomotors without Gears

Voltage		200 V				
Servomotor Model SGMPS-		01A	02A	04A	08A	15A
Rated Output*1	W	100	200	400	750	1500
Rated Torque*1, *2	N·m	0.318	0.637	1.27	2.39	4.77
Instantaneous Peak Torque*1	N·m	0.955	1.91	3.82	7.16	14.3
Rated Current *1	A_{rms}	0.86	2.0	2.6	5.4	9.2
Instantaneous Max. Current *1	A_{rms}	2.8	6.4	8.4	16.5	28.0
Rated Speed*1	min^{-1}	3000				
Max. Speed*1	min^{-1}	6000				
Torque Constant	$N·m/A_{rms}$	0.401	0.361	0.524	0.476	0.559
Rotor Moment of Inertia	$kg·m^2×10^{-4}$	0.0592	0.263	0.409	2.10	4.02
Rated Power Rate*1	kW/s	17.1	15.4	39.6	27.2	56.6
Rated Angular Acceleration *1	rad/s^2	53700	24200	31100	11400	11900
Applicable SERVOPACK	SGDS-	01	02	04	08	15

* 1. These items and torque-motor speed characteristics quoted in combination with a SGDS SERVOPACK are at an armature winding temperature of 100°C. Other values quoted at 20°C.

* 2. Rated torques are continuous allowable torque values at 40°C with the following aluminum head sink attached.
SGMPS-01, 02, 04: 250 mm × 250 mm × 6 mm
SGMPS-08, 15: 300 mm × 300 mm × 12 mm

Note: If the heating conditions are more severe than the *2 conditions above, continuous allowable torque decreases. Contact your Yaskawa representatives.

(2) Holding Brake Moment of Inertia

The moment of inertia of the servomotor with holding brake is that of the rotor + that of brakes.

Holding Brake Moment of Inertia

Servomotor Model SGMPS-		01A	02A	04A	08A	15A
Holding Brake Moment of Inertia	$(kg·m^2×10^{-4})$	0.0300	0.152		0.875	

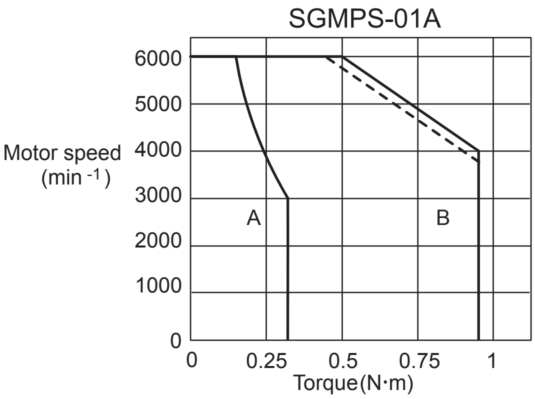
(3) Derating Ratio for Servomotor fitted with a Shaft Seal

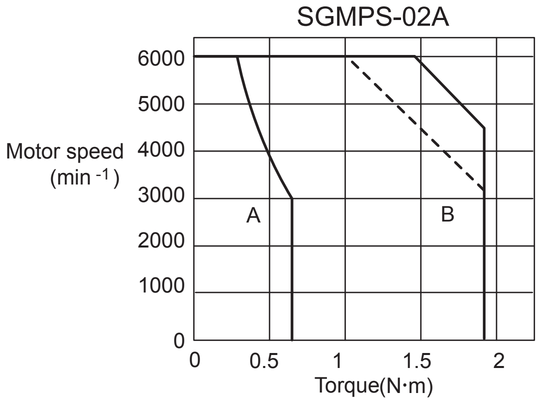
Use the following reduction ratings when a motor is fitted with a shaft seal because of the higher friction torque.

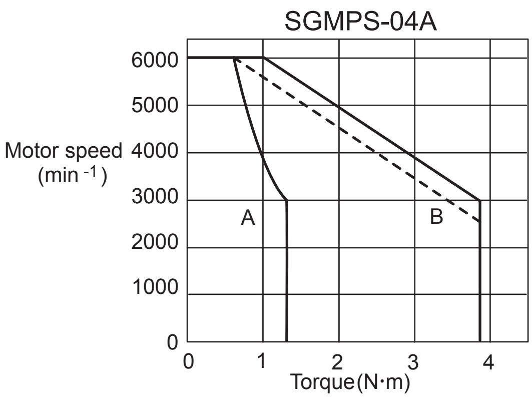
Derating Ratio for Servomotor fitted with a Shaft Seal

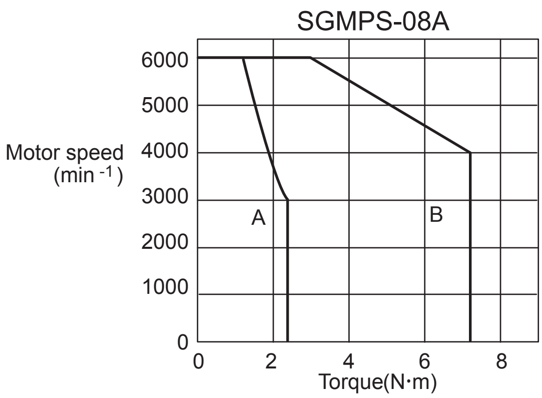
Servomotor Model SGMPS-	01A	02A	04A	08A	15A
Derating Ratio (%)	90		95		

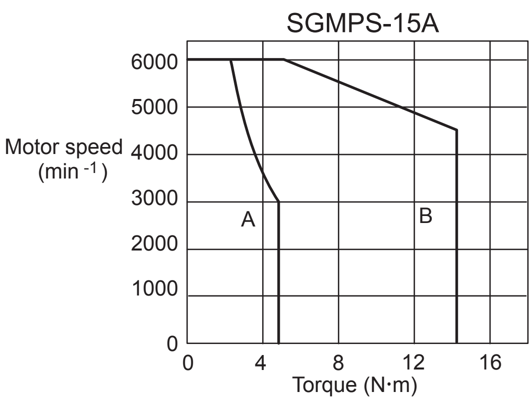
(4) Torque-motor Speed Characteristics











A : Continuous Duty Zone

B : Intermittent Duty Zone

Note: The dotted line of intermittent duty zone indicates the characteristics when a servomotor runs in combination with a SERVOPACK for 100VAC.

(5) Holding Brake Electrical Specifications

Holding Brake Electrical Specifications

Holding Brake Rated Voltage	Servomotor Model	Servomotor Capacity (W)	Holding Brake Specifications			
			Capacity (W)	Holding Torque (N·m)	Coil Resistance Ω(at 20°C)	Rated Current A (at 20°C)
90 VDC	SGMPS-01A	100	8.1	0.318	1000	0.09
	SGMPS-02A	200	7.6	0.637	1066	0.084
	SGMPS-04A	400	7.6	1.27	1066	0.084
	SGMPS-08A	750	7.5	2.39	1083	0.083
	SGMPS-15A	1500	10	4.77	832	0.108
24 VDC	SGMPS-01A	100	8.1	0.318	71	0.34
	SGMPS-02A	200	7.6	0.637	75.8	0.32
	SGMPS-04A	400	7.6	1.27	75.8	0.32
	SGMPS-08A	750	7.5	2.39	76.8	0.31
	SGMPS-15A	1500	10	4.77	57.6	0.31

Note: The holding brake is used only to hold the load and cannot be used to stop the servomotor.

3.3.2 SGMPS Servomotors with Standard Backlash Gears

- Time Rating: Continuous
- Vibration Class: 15 μm or below
- Insulation Resistance: 500 VDC, 10 MΩ min.
- Ambient Temperature: 0 to 40°C
- Excitation: Permanent magnet
- Mounting: Flange method
- Gear Mechanism: Planetary gear mechanism
- Thermal Class: B
- Withstand Voltage: 1500 VAC for one minute
- Enclosure: Totally enclosed, self-cooled (except for shaft opening)
- Ambient Humidity: 20% to 80% (no condensation)
- Drive Method: Direct drive
- Backlash: 15 minutes max.

Ratings and Specifications for SGMPS Servomotors with Standard backlash Gears

Servomotor Model SGMPS-	Servomotor			Gear					
	Output (W)	Rated Speed (min^{-1})	Rated Torque (N·m)	Gear Ratio	Lost Motion (arc-min)	Rated Torque /Efficiency*2 (N·m)/(%)	Instantaneous Peak Torque (N·m)	Rated Speed (min^{-1})	Max. Speed *1 (min^{-1})
01A□AJ1□	100	3000	0.318	1/5	15	1.27/80	4.32	600	800
01A□AJ3□				3/31		2.63/80	8.88	290	387
01A□AJC□				1/21		5.34/80	18.1	143	190
01A□AJ7□				1/33		8.40/80	28.4	91	121
02A□AJ1□	200	3000	0.637	1/5	15	2.55/80	8.60	600	800
02A□AJ3□				3/31		5.27/80	17.8	290	387
02A□AJC□				1/21		10.7/80	36.1	143	190
02A□AJ7□				1/33		16.8/80	56.7	91	121
04A□AJ1□	400	3000	1.27	1/5	15	5.08/80	17.2	600	800
04A□AJ3□				3/31		10.5/80	35.5	290	387
04A□AJC□				1/21		21.3/80	72.2	143	190
04A□AJ7□				1/33		33.5/80	113	91	121
08A□AJ1□	750	3000	2.39	1/5	15	9.56/80	32.0	600	800
08A□AJ3□				3/31		19.8/80	66.6	290	387
08A□AJC□				1/21		40.2/80	134	143	190
08A□AJ7□				1/33		63.1/80	213	91	121
15A□AJ1□	1500	3000	4.77	1/5	15	19.1/80	64.4	600	800
15A□AJB□				1/11		42.0/80	144	269	359
15A□AJC□				1/21		80.1/80	270	143	190
15A□AJ7□				1/33		126/80	425	91	121

Ratings and Specifications for SGMPS Servomotors with Standard backlash Gears (cont'd)

Servomotor Model SGMPS-	Moment of Inertia	
	Motor + Gear ($kg·m^2 \times 10^{-4}$)	Gear ($kg·m^2 \times 10^{-4}$)
01A□AJ1□	0.122	0.063
01A□AJ3□	0.077	0.018
01A□AJC□	0.094	0.035
01A□AJ7□	0.080	0.021
02A□AJ1□	0.456	0.193
02A□AJ3□	0.353	0.090
02A□AJC□	0.368	0.105
02A□AJ7□	0.338	0.075
04A□AJ1□	0.602	0.193
04A□AJ3□	0.589	0.180
04A□AJC□	0.639	0.230
04A□AJ7□	0.574	0.165
08A□AJ1□	2.55	0.450
08A□AJ3□	2.53	0.425
08A□AJC□	2.58	0.475
08A□AJ7□	2.40	0.300
15A□AJ1□	4.97	0.950
15A□AJB□	5.27	1.25
15A□AJC□	5.32	1.32
15A□AJ7□	4.82	0.800

* 1. Maximum motor speed is up to 4000 min^{-1} at the motor shaft.
* 2. Gear output torque is expressed using the following equation.

$$(\text{Gear output torque}) = (\text{servomotor output torque}) \times \left(\frac{1}{\text{gear ratio}}\right) \times (\text{efficiency})$$

IMPORTANT

The no-load torque for a servomotor with gears is high immediately afer the servomotor starts, and it then decreases and becomes stable a few minutes later. This is a common phenomenon caused by grease being circulated in the gear and not by a faulty gear.

The speed control range of SERVOPACKs in the Σ-III series is 1:5000. When using servomotors at extremely low speeds (for example, 0.02 min^{-1} max. at the gear output shaft) or when using servomotors with one pulse feed reference for extended periods and in other situations that are less than optimum, the lubrication of the gear bearing may be insufficient. This may cause deterioration of the bearing or increase the load ratio.

Contact your Yaskawa representative if you are using your servomotor under such conditions.

3.3.3 SGMPS Servomotors with Low-Backlash Gears

- Time Rating: Continuous
- Vibration Class: 15 μm or below
- Insulation Resistance: 500 VDC, 10 MΩ min.
- Ambient Temperature: 0 to 40°C
- Excitation: Permanent magnet
- Mounting: Flange method
- Gear Mechanism: Planetary gear mechanism
- Thermal Class: B
- Withstand Voltage:1500 VAC for one minute
- Enclosure: Totally enclosed, self-cooled (except for shaft opening)
- Ambient Humidity: 20% to 80% (no condensation)
- Drive Method: Direct drive
- Backlash: 3 minutes max.

Ratings and Specifications for SGMPS Servomotors with Low-backlash Gears

Servomotor Model SGMPS-	Servomotor			Gear					
	Output (W)	Rated Speed (min^{-1})	Rated Torque (N·m)	Gear Ratio	Lost Motion (arc-min)	Rated Torque /Efficiency *2 (N·m)/(%)	Instantaneous Peak Torque (N·m)	Rated Speed (min^{-1})	Max. Speed *1 (min^{-1})
01A□AH1□	100	3000	0.318	1/5	3	1.27/80	4.34	600	800
01A□AHB□				1/11		2.80/80	9.55	273	363
01A□AHC□				1/21		5.34/80	18.2	143	190
01A□AH7□				1/33		8.40/80	28.7	91	121
02A□AH1□	200	3000	0.637	1/5	3	2.55/80	8.40	600	800
02A□AHB□				1/11		5.96/85	19.3	273	363
02A□AHC□				1/21		11.4/85	37.3	143	190
02A□AH7□				1/33		17.9/85	58.6	91	121
04A□AH1□	400	3000	1.27	1/5	3	5.40/85	17.6	600	800
04A□AHB□				1/11		11.9/85	39.1	273	363
04A□AHC□				1/21		22.7/85	72.2	143	190
04A□AH7□				1/33		33.5/80	115	91	121
08A□AH1□	750	3000	2.39	1/5	3	10.2/85	33.3	600	800
08A□AHB□				1/11		22.3/85	71.0	273	363
08A□AHC□				1/21		42.7/85	140	143	190
08A□AH7□				1/33		67.0/85	206	91	121
15A□AH1□	1500	3000	4.77	1/5	3	20.3/85	65.9	600	800
15A□AHB□				1/11		44.6/85	148	273	363
15A□AHC□				1/21		80.1/80	270	143	190
15A□AH7□				1/33		126/80	353 *3	91	121

Ratings and Specifications for SGMPS Servomotors with Low-backlash Gears (cont'd)

Servomotor Model SGMPS-	Moment of Inertia	
	Motor + Gear ($kg \cdot m^2 \times 10^{-4}$)	Gear ($kg \cdot m^2 \times 10^{-4}$)
01A☐AH1☐	0.152	0.093
01A☐AHB☐	0.107	0.048
01A☐AHC☐	0.102	0.043
01A☐AH7☐	0.092	0.033
02A☐AH1☐	0.623	0.360
02A☐AHB☐	0.351	0.088
02A☐AHC☐	0.373	0.110
02A☐AH7☐	0.328	0.065
04A☐AH1☐	0.769	0.360
04A☐AHB☐	0.604	0.195
04A☐AHC☐	0.604	0.195
04A☐AH7☐	0.582	0.173
08A☐AH1☐	2.87	0.765
08A☐AHB☐	2.62	0.523
08A☐AHC☐	2.76	0.663
08A☐AH7☐	2.56	0.455
15A☐AH1☐	5.56	1.54
15A☐AHB☐	6.11	2.09
15A☐AHC☐	6.00	1.98
15A☐AH7☐	5.14	1.12

* 1. Maximum motor speed is up to 4000 min^{-1} at the motor shaft.
* 2. Gear output torque is expressed using the following equation.

$$\text{(Gear output torque)} = \text{(servomotor output torque)} \times \left(\frac{1}{\text{gear ratio}}\right) \times \text{(efficiency)}$$

* 3. The instantaneous peak torque values indicated with *3 are limited by the gear, so use the following servomotor instantaneous peak torque. In this case, set torque limit parameters Pn402 and 403 for the SERVOPACK at 250%.

IMPORTANT

The no-load torque for a servomotor with gears is high immediately afer the servomotor starts, and it then decreases and becomes stable a few minutes later. This is a common phenomenon caused by grease being circulated in the gear and not by a faulty gear.

The speed control range of SERVOPACKs in the Σ-III series is 1:5000. When using servomotors at extremely low speeds (for example, 0.02 min^{-1} max. at the gear output shaft) or when using servomotors with one pulse feed reference for extended periods and in other situations that are less than optimum, the lubrication of the gear bearing may be insufficient. This may cause deterioration of the bearing or increase the load ratio.

Contact your Yaskawa representative if you are using your servomotor under such conditions.

3.3.4 SGMPS Flange-type Servomotors with Low-backlash Gears

- Time Rating: Continuous
- Vibration Class: 15 µm or below
- Insulation Resistance: 500 VDC, 10 MΩ min.
- Ambient Temperature: 0 to 40°C
- Excitation: Permanent magnet
- Mounting: Flange method
- Gear Mechanism: Planetary gear mechanism
- Thermal Class: B
- Withstand Voltage: 1500 VAC for one minute
- Enclosure: Totally enclosed, self-cooled (except for shaft opening)
- Ambient Humidity: 20% to 80% (no condensation)
- Drive Method: Direct drive
- Backlash: 3 minutes max.

Ratings and Specifications for SGMPS Flange-type Servomotors with Low-backlash Gears

Servomotor Model SGMPS-	Servomotor			Gear					
	Output (W)	Rated Speed (min^{-1})	Rated Torque (N·m)	Gear Ratio	Lost Motion (arc-min)	Rated Torque /Efficiency*2 (N·m)/(%)	Instantaneous Peak Torque (N·m)	Rated Speed (min^{-1})	Max. Speed *1 (min^{-1})
01A☐AH10	100	3000	0.318	1/5	3	1.27/80	4.32	600	800
01A☐AHB0				1/11		2.80/80	9.50	273	363
01A☐AHC0				1/21		5.34/80	18.1	143	190
01A☐AH70				1/33		8.40/80	27.0	91	121
02A☐AH10	200	3000	0.637	1/5	3	2.55/80	8.60	600	800
02A☐AHB0				1/11		5.62/80	18.9	273	363
02A☐AHC0				1/21		10.7/80	36.1	143	190
02A☐AH70				1/33		16.8/80	48.0*3	91	121
04A☐AH10	400	3000	1.27	1/5	3	5.08/80	17.2	600	800
04A☐AHB0				1/11		11.2/80	35.0	273	363
04A☐AHC0				1/21		21.3/80	72.2	143	190
04A☐AH70				1/33		33.5/80	93.0*3	91	121
08A☐AH10	750	3000	2.39	1/5	3	9.56/80	32.0	600	800
08A☐AHB0				1/11		21.0/80	56.0*3	273	363
08A☐AHC0				1/21		40.2/80	134	143	190
08A☐AH70				1/33		63.1/80	156*3	91	121
15A☐AH10	1500	3000	4.77	1/5	3	19.1/80	64.4	600	800
15A☐AHB0				1/11		42.0/80	142	273	363
15A☐AHC0				1/21		80.1/80	270	143	190
15A☐AH70				1/33		126/80	353*3	91	121

Ratings and Specifications for SGMPS Flange-type Servomotors with Low-backlash Gears (cont'd)

Servomotor Model SGMPS-	Moment of Inertia	
	Motor + Gear ($kg·m^2 \times 10^{-4}$)	Gear ($kg·m^2 \times 10^{-4}$)
01A☐AH10	0.144	0.085
01A☐AHB0	0.100	0.041
01A☐AHC0	0.102	0.043
01A☐AH70	0.085	0.026
02A☐AH10	0.543	0.280
02A☐AHB0	0.364	0.101
02A☐AHC0	0.351	0.088
02A☐AH70	0.317	0.054
04A☐AH10	0.689	0.280
04A☐AHB0	0.636	0.227
04A☐AHC0	0.628	0.219
04A☐AH70	0.545	0.136
08A☐AH10	2.72	0.616
08A☐AHB0	2.65	0.552
08A☐AHC0	2.65	0.552
08A☐AH70	2.43	0.327
15A☐AH10	5.59	1.57
15A☐AHB0	5.58	1.56
15A☐AHC0	5.90	1.88
15A☐AH70	5.10	1.08

* 1. Maximum motor speed is up to 4000 (min^{-1}) at the motor shaft.
* 2. Gear output torque is expressed using the following equation.

$$(\text{Gear output torque}) = (\text{servomotor output torque}) \times \left(\frac{1}{\text{gear ratio}}\right) \times (\text{efficiency})$$

* 3. The instantaneous peak torque values are limited by the gear, so use the following servomotor instantaneous peak torque. In this case, set torque parameters Pn402 and 403 for the SERVOPACK at 250%.

IMPORTANT

The no-load torque for a servomotor with gears is high immediately afer the servomotor starts, and it then decreases and becomes stable a few minutes later. This is a common phenomenon caused by grease being circulated in the gear and not by a faulty gear.
The speed control range of SERVOPACKs in the Σ-III series is 1:5000. When using servomotors at extremely low speeds (for example, 0.02 min^{-1} max. at the gear output shaft) or when using servomotors with one pulse feed reference for extended periods and in other situations that are less than optimum, the lubrication of the gear bearing may be insufficient. This may cause deterioration of the bearing or increase the load ratio.
Contact your Yaskawa representative if you are using your servomotor under such conditions.

3.4 Ratings and Specifications of SGMSS Servomotors

3.4.1 SGMSS Servomotors without Gears

(1) Ratings and Specifications

- Time Rating: Continuous
- Vibration Class: 15 µm or below
- Insulation Resistance: 500 VDC, 10 MΩ min.
- Ambient Temperature: 0 to 40°C
- Excitation: Permanent magnet
- Mounting: Flange method
- Thermal Class: F
- Withstand Voltage: 1500 VAC for one minute
- Enclosure: Totally enclosed, self-cooled, IP67 (except for shaft opening) Note: IP22 for SGMSS-70
- Ambient Humidity: 20% to 80% (no condensation)
- Drive Method: Direct drive

Ratings and Specifications for SGMSS Servomotors without Gears

Voltage		200 V							
Servomotor Model SGMSS-		10A☐A	15A☐A	20A☐A	25A☐A	30A☐A	40A☐A	50A☐A	70A☐A
Rated Output*1	kW	1.0	1.5	2.0	2.5	3.0	4.0	5.0	7.0
Rated Torque*1, *2	N·m	3.18	4.90	6.36	7.96	9.80	12.6	15.8	22.3
Instantaneous Peak Torque *1	N·m	9.54	14.7	19.1	23.9	29.4	37.8	47.6	54
Rated Current*1	A_{rms}	5.7	9.3	12.1	13.8	17.9	25.4	27.6	38.3
Instantaneous Max. Current *1	A_{rms}	17	28	42	44.5	56	77	84	105
Rated Speed*1	min^{-1}	3000							
Max. Speed*1	min^{-1}	6000	5000						
Torque Constant	$N·m/A_{rms}$	0.636	0.590	0.561	0.610	0.581	0.520	0.600	0.600
Rotor Moment of Inertia	$kg·m^2×10^{-4}$	1.74	2.00	2.47	3.19	7.00	9.60	12.3	12.3
Rated Power Rate *1	kW/s	58.1	120	164	199	137	165	203	404
Rated Angular Acceleration*1	rad/s^2	18300	24500	25700	25000	14000	13100	12800	18100
Applicable SERVOPACK	SGDS-	10	15	20	30	30	50	50	75

* 1. These items and torque-motor speed characteristics quoted in combination with an SGDS SERVOPACK are at an armature winding temperature of 20°C.

* 2. These characteristics are values with the following aluminum plate (heat sink) attached for cooling.

- SGMSS-10, 15, 20, 25 :300 × 300 × 12 (mm)
- SGMSS-30, 40, 50, 70 :400 × 400 × 20 (mm)

Note: If the heating conditions are more severe than the *2 conditions above, continuous allowable torque decreases. Contact your Yaskawa representative.

(2) Holding Brake Moment of Inertia

The moment of inertia of the servomotor with holding brake is that of the rotor + that of brakes.

Holding Brake Moment of Inertia

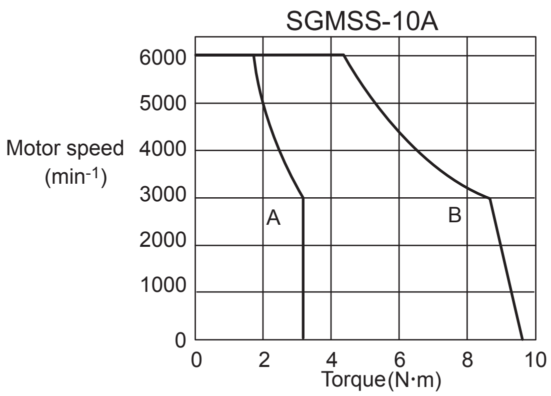
Servomotor Model SGMSS-		10A	15A	20A	25A	30A	40A	50A	70A
Holding Brake Moment of Inertia	$kg·m^2×10^{-4}$	0.250				2.1	SGMSS-40A to -70A servomotors do not have holding brakes.		

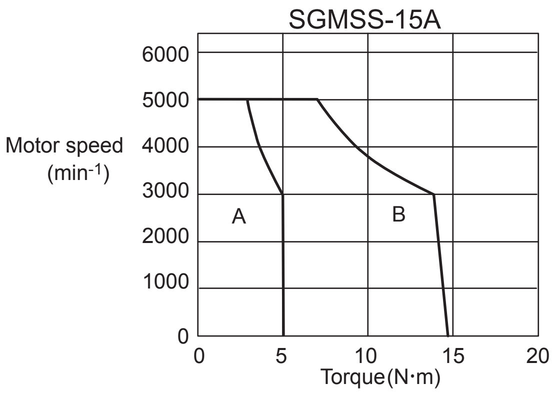
(3) Holding Brake Electrical Specifications

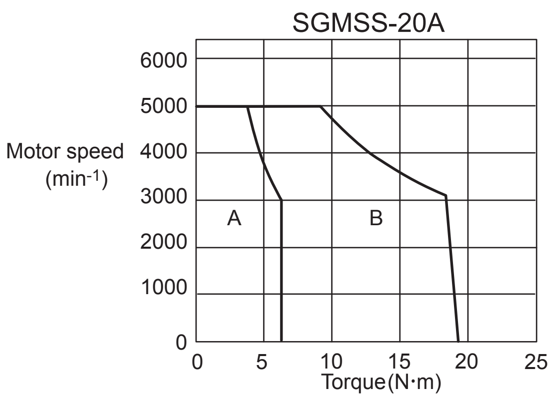
Holding Brake Raged Voltage	Servomotor Model	Servomotor Capacity (W)	Holding Brake Specifications			
			Capacity (W)	Holding Torque (N·m)	Coil Resistance Ω (at 20°C)	Rated Current A (at 20°C)
DC90 V	SGMSS−10	1000	7	4.3	1150	0.078
	SGMSS-15	1500	12	7.84	675	0.13
	SGMSS-20	2000	12	7.84	675	0.13
	SGMSS-25	2500	12	10	675	0.13
	SGMSS-30	3000	20	20	405	0.222
DC24 V	SGMSS−10	1000	7	4.3	82	0.29
	SGMSS-15	1500	12	7.84	48	0.5
	SGMSS-20	2000	12	7.84	48	0.5
	SGMSS-25	2500	12	10	48	0.5
	SGMSS-30	3000	20	20	28.8	0.833

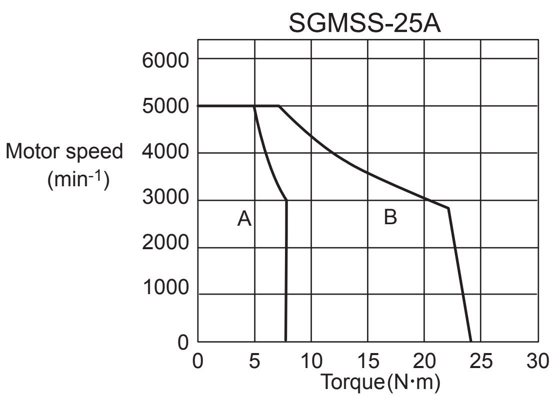
Note: The holding brake is only used to hold the load and cannot be used to stop the servomotor.

(4) Torque-motor Speed Characteristics



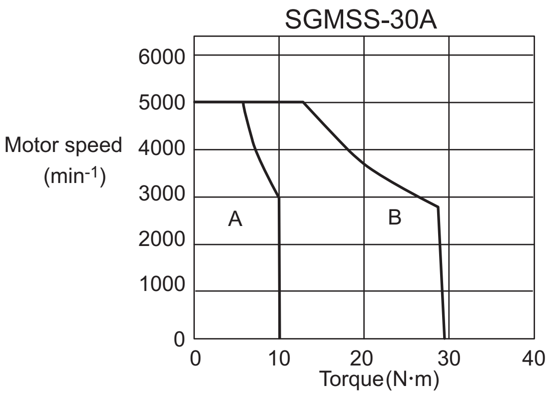


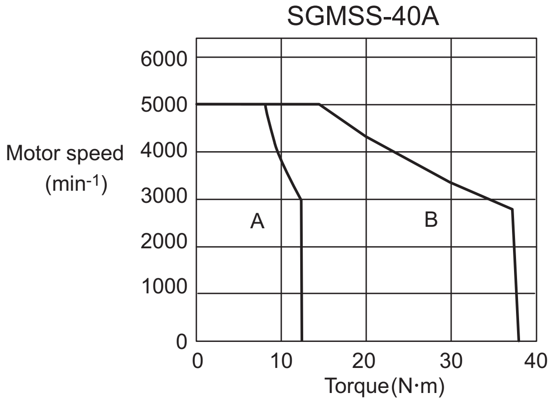


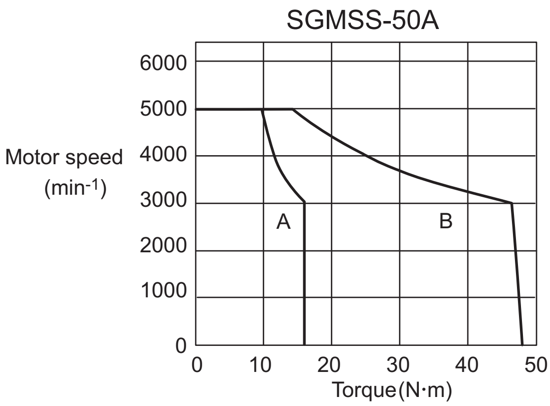


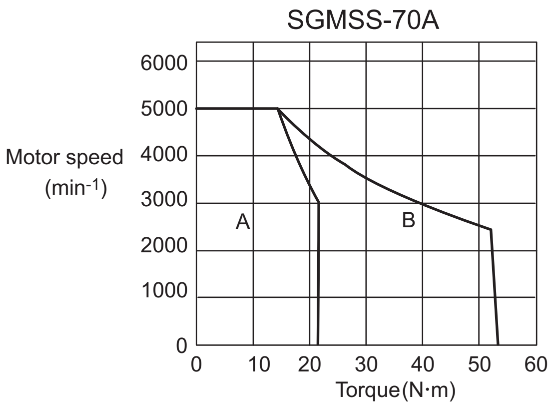
A : Continuous Duty Zone

B : Intermittent Duty Zone









A : Continuous Duty Zone

B : Intermittent Duty Zone

3.4.2 SGMSS Servomotors with Low-backlash Gears

- Time Rating: Continuous
- Vibration Class: 15 μm or below
- Insulation Resistance: 500 VDC, 10 MΩ min.
- Ambient Temperature: 0 to 40°C
- Excitation: Permanent magnet
- Mounting: Flange method
- Gear Mechanism: Planetary gear mechanism
- Thermal Class: F
- Withstand Voltage: 1500 VAC for one minute
- Enclosure: Totally enclosed, self-cooled, IP44 (except for shaft opening)
- Ambient Humidity: 20% to 80% (no condensation)
- Drive Method: Direct drive
- Backlash: 3 minutes max.
- Gear Lubricating Method: Grease

Ratings and Specifications for SGMSS Servomotors with Low-backlash Gears

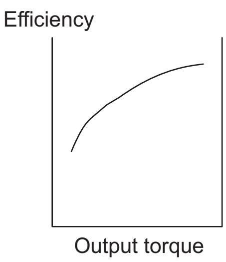
Servomotor Model SGMSS-	Servomotor			Gear				
	Output (kW)	Rated Speed (min^{-1})	Rated Torque (N·m)	Gear Ratio	Rated Torque /Efficiency*2 (N·m)/(%)	Instantaneous Peak Torque/ Efficiency (N·m)/(%)	Rated Speed (min^{-1})	Max. Speed * (min^{-1})
10A☐AL14	1.0	3000	3.18	1/5	12.7/80	38.2/80	600	800
10A☐AL24				1/9	22.9/80	68.7/80	333	444
10A☐AL54				1/20	50.9/80	153/80	150	200
10A☐AL74				1/29	73.8/80	221/80	103	138
10A☐AL84				1/45	115/80	343/80	66	89
15A☐AL14	1.5	3000	4.9	1/5	19.6/80	58.8/80	600	800
15A☐AL24				1/9	35.3/80	106/80	333	444
15A☐AL54				1/20	78.4/80	235/80	150	200
15A☐AL74				1/29	114/80	341/80	103	138
15A☐AL84				1/45	176/80	529/80	66	89
20A☐AL14	2.0	3000	6.36	1/5	25.6/80	76.4/80	600	800
20A☐AL24				1/9	46/80	138/80	333	444
20A☐AL54				1/20	102/80	306/80	150	200
20A☐AL74				1/29	148/80	443/80	103	138
20A☐AL84				1/45	230/80	688/80	66	89
25A☐AL14	2.5	3000	7.96	1/5	31.8/80	95.5/80	600	800
25A☐AL24				1/9	57.3/80	172/80	333	444
25A☐AL54				1/20	127/80	382/80	150	200
25A☐AL74				1/29	185/80	554/80	103	138
25A☐AL84				1/45	287/80	860/80	66	89
30A☐AL14	3.0	3000	9.8	1/5	39.2/80	118/80	600	800
30A☐AL24				1/9	70.5/80	212/80	333	444
30A☐AL54				1/20	157/80	470/80	150	200
30A☐AL74				1/29	227/80	682/80	103	138
30A☐AL84				1/45	353/80	1058/80	66	89
40A☐AL14	4.0		12.6	1/5	50.4/80	151/80	600	800
40A☐AL24				1/9	90.7/80	272/80	333	444
40A☐AL54				1/20	202/80	605/80	150	200
40A☐AL74				1/29	292/80	877/80	103	138
50A☐AL14	5.0		15.8	1/5	63.2/80	190/80	600	800
50A☐AL24				1/9	114/80	343/80	333	444
50A☐AL54				1/20	253/80	762/80	150	200

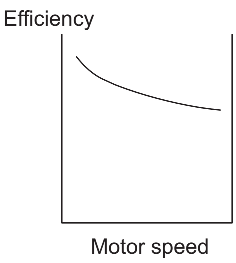
Ratings and Specifications for SGMSS Servomotors with Low-backlash Gears (cont'd)

Servomotor Model SGMSS-	Moment of Inertia	
	Motor + Gear ($kg·m^2 \times 10^{-4}$)	Gear ($kg·m^2 \times 10^{-4}$)
10A□AL14	5.18	3.44
10A□AL24	4.85	3.11
10A□AL54	8.53	6.79
10A□AL74	6.62	4.88
10A□AL84	5.66	3.92
15A□AL14	5.44	3.44
15A□AL24	6.77	4.77
15A□AL54	8.79	6.79
15A□AL74	6.88	4.88
15A□AL84	8.58	6.58
20A□AL14	5.91	3.44
20A□AL24	7.24	4.77
20A□AL54	9.26	6.79
20A□AL74	12.77	10.3
20A□AL84	9.05	6.58
25A□AL14	11.04	7.85
25A□AL24	7.96	4.77
25A□AL54	18.19	15.0
25A□AL74	13.49	10.3
25A□AL84	9.77	6.58
30A□AL14	17.2	10.2
30A□AL24	14.8	7.80
30A□AL54	27.2	20.2
30A□AL74	20.4	13.4
30A□AL84	16.7	9.70
40A□AL14	19.8	10.2
40A□AL24	22.1	12.5
40A□AL54	29.8	20.2
40A□AL74	23.0	13.4
50A□AL14	32.7	20.4
50A□AL24	24.8	12.5
50A□AL54	32.5	20.2

Notes: 1. For the shaft center allowable radial load, refer to the servomotor dimensional drawing.
2. The no-load torque for a servomotor with gears is high immediately after the servomotor starts, and it then decreases and becomes stable a few minutes later. This is a common phenomenon caused by grease being circulated in the gear and not by a faulty gear.

* 1. The maximum input motor speed of the gears is 4000 min^{-1}.
* 2. Output torque and motor speed produce the following trends in efficiency. Values in the table are at the rated motor speed.





Servomotor Specifications and Dimensional Drawings

3

3.5 Ratings and Specifications of SGMGH ($1500min^{-1}$)

3.5.1 SGMGH Servomotors ($1500min^{-1}$) Without Gears

(1) Ratings and Specifications

- Time Rating: Continuous
- Vibration Class: 15 μm or below
- Insulation Resistance: 500 VDC, 10 MΩ min.
- Ambient Temperature: 0 to 40°C
- Excitation: Permanent magnet
- Mounting: Flange method
- Thermal Class: F
- Withstand Voltage: 200 V Servomotors: 1500 VAC for one minute
- Enclosure: Totally enclosed, IP67 self-cooled (except for shaft opening)
- Ambient Humidity: 20% to 80% (no condensation)
- Drive Method: Direct drive

Voltage		200 V							
Servomotor Model SGMGH-		05A☐A	09A☐A	13A☐A	20A☐A	30A☐A	44A☐A	55A☐A	75A☐A
Rated Output *1	kW	0.45	0.85	1.3	1.8	2.9	4.4	5.5	7.5
Rated Torque *1	N·m	2.84	5.39	8.34	11.5	18.6 (14.8)*3	28.4	35.0	48.0
Instantaneous Peak Torque *1	N·m	8.92	13.8	23.3	28.7	45.1	71.1	87.6	119
Rated Current *1	A_{rms}	3.8	7.1	10.7	16.7	23.8 (18.9)*3	32.8	42.1	54.7
Instantaneous Max. Current *1	A_{rms}	11	17	28	42	56	84	110	130
Rated Speed *1	min^{-1}	1500							
Max. Speed *1	min^{-1}	3000							
Torque Constant	$N·m/A_{rms}$	0.82	0.83	0.84	0.73	0.83	0.91	0.88	0.93
Rotor Moment of Inertia J*2	$\times 10^{-4}$ $kg·m^2$	7.24	13.9	20.5	31.7	46.0	67.5	89.0	125
		(9.34)	(16.0)	(22.6)	(40.2)	(54.5)	(76.0)	(97.5)	(133.5)
Rated Power Rate *1	kW/s	11.2	20.9	33.8	41.5	75.3	120	137	184
Rated Angular Acceleration *1	rad/s^2	3930	3880	4060	3620	4050	4210	3930	3850

* 1. These items and torque-motor speed characteristics quoted in combination with an SGDS SERVOPACK are at an armature winding temperature of 20°C.

* 2. The values in the parentheses are those for motors with holding brakes.

* 3. If using the SGMGH-30A☐A servomotor and the SGDS-30 SERVOPACK together, take into consideration of the rated vaue in the parenthesesis.

Notes: 1. These characteristics are values with the following iron plate (heat sink) attached for cooling.
SGMGH-05, 09, and 13: 400 × 400 × 20 (mm)
SGMGH-20, 30, 44, 55, and 75: 550 × 550 × 30 (mm)

2. If the heating conditions are more severe than the conditions described in Note 1, continuous allowable torque decreases. Contact your Yaskawa representative.

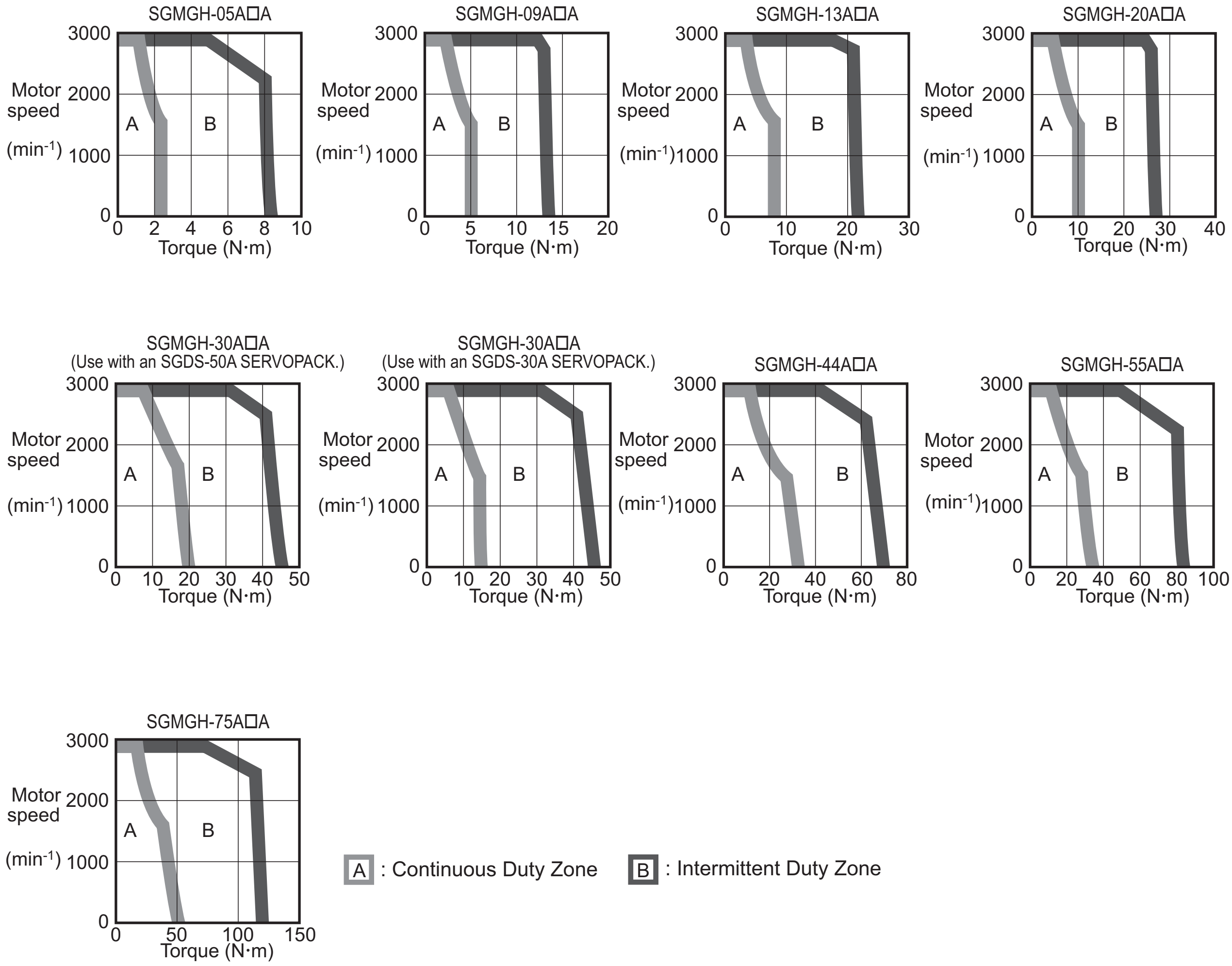
(2) Holding Brake Moment of Inertia

The moment of inertia of the servomotor with holding brake is expressed using the following equation.
(The moment of inertia of the servomotor with holding brake) =
(rotor moment of inertia) + (brake moment of inertia)

Servomotor Model SGMGH-		05A□A	09A□A	13A□A	20A□A	30A□A	44A□A	55A□A	75A□A
Holding Brake Moment of Inertia J	$\times10^{-4}$ kg·m^2	2.10			8.50				

* These values are reference values.

(3) Torque-motor Speed Characteristics



(4) Holding Brake Electrical Specifications

Holding Brake Rated Voltage	Servomotor Model	Servomotor Capacity W	Holding Brake Specifications			
			Capacity W	Holding Torque N·m	Coil Resistance Ω (at 20 °C)	Rated Current A (at 20 °C)
90 VDC	SGMGH-05	450	10.1	4.41	804	0.11
	SGMGH-09	850	10.1	12.7	804	0.11
	SGMGH-13	1300	10.1	12.7	804	0.11
	SGMGH-20	1800	18.5	43.1	438	0.21
	SGMGH-30	2900	18.5	43.1	438	0.21
	SGMGH-44	4400	18.5	43.1	438	0.21
	SGMGH-55	5500	23.5	72.6	327	0.28
	SGMGH-75	7500	23.5	72.6	327	0.28
24 VDC	SGMGH-05	450	9.85	4.41	58.7	0.41
	SGMGH-09	850	9.85	12.7	58.7	0.41
	SGMGH-13	1300	9.85	12.7	58.7	0.41
	SGMGH-20	1800	18.5	43.1	31.1	0.77
	SGMGH-30	2900	18.5	43.1	31.1	0.77
	SGMGH-44	4400	18.5	43.1	31.1	0.77
	SGMGH-55	5500	23.5	72.6	24.5	0.98
	SGMGH-75	7500	23.5	72.6	24.5	0.98

Note: The holding brake is only used to hold the load and cannot be used to stop the servomotor.

3.5.2 SGMGH Servomotors (1500 min^{-1}) With Standard Backlash Gears

- Time Rating: Continuous
- Vibration Class: 15 µm or below
- Insulation Resistance: 500 VDC, 10 MΩ min.
- Ambient Temperature: 0 to 40°C
- Excitation: Permanent magnet
- Mounting: Foot and flange-mounted
  Type 6090 to 6125: Omni-directional mounting
  Type 6130 to 6190: Horizontal mounting to shaft
- Gear Mechanism: Cyclo gear mechanism
- Thermal Class: F
- Withstand Voltage:
  200 V Servomotors: 1500 VAC for one minute
- Enclosure: Totally enclosed, IP44 self-cooled (or the equivalent)
- Ambient Humidity: 20% to 80% (no condensation)
- Drive Method: Direct drive
- Backlash: Roughly 0.6 to 2° at the gear output shaft
- Gear Rotation Direction: Reverse direction of servomotor
- Gear Lubricating Method:
  Type 6090 to 6125: Grease
  Type 6130 to 6190: Oil *

* For oil lubrication, the motor should be mounted horizontal to the shaft. Contact your Yaskawa representative about lubrication for angle mounting.

Note: Contact your Yaskawa representative regarding the use of servomotors in cases such as when the servomotor is frequently started and stopped, or when impact is generated on the gear output shaft by acceleration and deceleration.

Servomotor Model SGMGH-	Servomotor			Gear Output					Moment of Inertia J $\times 10^{-4}$ kg·m^2	
	Output kW	Rated Speed min^{-1}	Rated Torque N·m	Gear Ratio	Rated Torque/ Efficiency N·m/%	Instantaneous Peak Torque/ Effective N·m/%	Rated Speed min^{-1}	Max. Speed min^{-1}	Motor + Gears	Gears
05P☐A☐A6	0.45	1500	2.84	1/6	128/75	40.1/75	250	500	9.20	1.96
05P☐A☐B6				1/11	25.0/80	78.5/80	136	272	8.84	1.6
05P☐A☐C6				1/21	47.7/80	150/80	71	142	8.39	1.15
05P☐A☐76				1/29	65.9/80	207/80	51	103	8.41	1.17
09P☐A☐A6	0.85		5.39	1/6	25.9/80	66.2/80	250	500	15.7	1.78
09P☐A☐B6				1/11	47.4/80	121/80	136	272	15.3	1.35
09P☐A☐C6				1/21	90.6/80	232/80	71	142	15.9	1.97
09P☐A☐76				1/29	125/80	320/80	51	103	16.1	2.19
13P☐A☐A6	1.3		8.34	1/6	40.0/80	112/80	250	500	22.3	1.84
13P☐A☐B6				1/11	73.4/80	205/80	136	272	23.4	2.89
13P☐A☐C6				1/21	140/80	391/80	71	142	22.5	2.03
13P☐A☐76				1/29	206/85	574/85	51	103	24.2	3.67
20P☐A☐A6	1.8		11.5	1/6	58.7/85	146/85	250	500	38.0	6.3
20P☐A☐B6				1/11	108/85	268/85	136	272	36.5	4.76
20P☐A☐C6				1/21	205/85	512/85	71	142	37.6	5.93
20P☐A☐76				1/29	283/85	707/85	51	103	37.3	5.58
30P☐A☐A6	2.9		18.6	1/6	94.9/85	230/85	250	500	52.3	6.3
30P☐A☐B6				1/11	174/85	422/85	136	272	50.8	4.76
30P☐A☐C6				1/21	332/85	805/85	71	142	51.9	5.93
30P☐A☐76				1/29	458/85	1110/85	51	103	78.5	32.5
44P☐A☐A6	4.4		28.4	1/6	145/85	363/85	250	500	79.5	12.0
44P☐A☐B6				1/11	266/85	665/85	136	272	75.2	7.73
44P☐A☐C6				1/21	507/85	1270/85	71	142	101	33.6
44P☐A☐76				1/29	700/85	1750/85	51	103	121	53.3

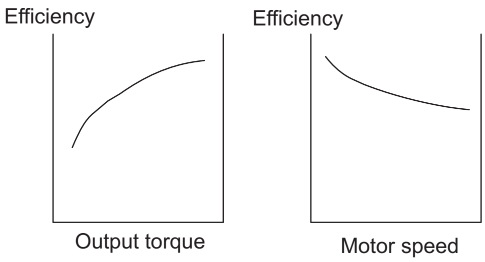
(cont'd)

Servomotor Model SGMGH-	Servomotor			Gear Output					Moment of Inertia J $\times 10^{-4}$ kg·m^2	
	Output kW	Rated Speed min^{-1}	Rated Torque N·m	Gear Ratio	Rated Torque/ Efficiency N·m/%	Instantaneous Peak Torque/ Effective N·m/%	Rated Speed min^{-1}	Max. Speed min^{-1}	Motor + Gears	Gears
55P□A□A6	5.5	1500	35.0	1/6	179/85	447/85	250	500	103	13.7
55P□A□B6				1/11	327/85	819/85	136	272	98.8	9.78
55P□A□C6				1/21	625/85	1560/85	71	142	157	68.0
55P□A□76				1/29	863/85	2160/85	51	103	155	66.0
75P□A□B6	7.5		48.0	1/11	449/85	1110/85	136	272	175	50.2
75P□A□C6				1/21	857/85	2120/85	71	142	193	68.0
75P□A□76				1/29	1180/85	2930/85	51	103	207	81.5

Notes: 1. For the shaft center allowable radial load, refer to the servomotor dimensional drawing.

2. Output torque and motor speed produce the following trends in efficiency. Values in the table are at the rated motor speed.

3. 15-kW servomotors do not equipped with gears.



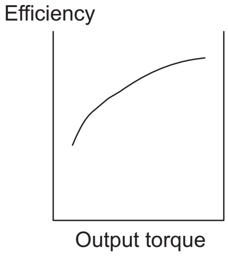
4. The no-load torque for a servomotor with gears is high immediately after the servomotor starts, and it then decreases and becomes stable a few minutes later. This is a common phenomenon caused by grease being circulated in the gear and not by a faulty gear.

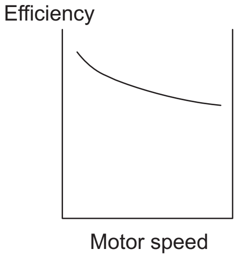
3.5.3 SGMGH Servomotors (1500 min^{-1}) With Low-backlash Gears

- Time Rating: Continuous
- Vibration Class: 15 μm or below
- Insulation Resistance: 500 VDC, 10 MΩ min.
- Ambient Temperature: 0 to 40°C
- Excitation: Permanent magnet
- Mounting: Flange-mounted (Omni-directional mounting)
- Gear Lubricating Method: Grease
- Gear Mechanism: Planetary gear mechanism
- Thermal Class: F
- Withstand Voltage:
  200 V Servomotors: 1500 VAC for one minute
- Enclosure: Totally enclosed, IP44 self-cooled (or the equivalent)
- Ambient Humidity: 20% to 80% (no condensation)
- Drive Method: Direct drive
- Backlash: 0.05° (3 min) at the gear output shaft
- Gear Rotation Direction: Same direction as servomotor

Servomotor Model SGMGH-	Servomotor			Gear Output					Moment of Inertia J $\times 10^{-4}$ kg·m^2	
	Output kW	Rated Speed min^{-1}	Rated Torque N·m	Gear Ratio	Rated Torque/ Efficiency * N·m/%	Instantaneous Peak Torque/ Effective N·m/%	Rated Speed min^{-1}	Max. Speed min^{-1}	Motor + Gears	Gears
05A□AL14	0.45	1500	2.84	1/5	11.4/80	35.7/80	300	600	8.50	1.26
05A□AL24				1/9	20.4/80	64.2/80	167	334	8.18	0.94
05A□AL54				1/20	45.4/80	143/80	75	150	11.9	4.66
05A□AL74				1/29	65.9/80	207/80	51	102	10.0	2.76
05A□AL84				1/45	102/80	321/80	33	66	9.05	1.81
09A□AL14	0.85		5.39	1/5	21.6/80	55.2/80	300	600	15.2	1.30
09A□AL24				1/9	38.8/80	99.4/80	167	334	14.8	0.90
09A□AL54				1/20	86.2/80	221/80	75	150	18.6	4.70
09A□AL74				1/29	125/80	320/80	51	102	16.7	2.80
09A□AL84				1/45	194/80	497/80	33	66	18.4	4.50
13A□AL14	1.3		8.34	1/5	33.4/80	93.2/80	300	600	27.7	7.20
13A□AL24				1/9	60.0/80	168/80	167	334	25.3	4.80
13A□AL54				1/20	133/80	373/80	75	150	27.4	6.90
13A□AL74				1/29	193/80	541/80	51	102	30.9	10.4
13A□AL84				1/45	300/80	839/80	33	66	27.2	6.70
20A□AL14	1.8		11.5	1/5	46.0/80	115/80	300	600	41.9	10.2
20A□AL24				1/9	82.8/80	207/80	167	334	39.5	7.80
20A□AL54				1/20	184/80	459/80	75	150	51.9	20.2
20A□AL74				1/29	267/80	666/80	51	102	45.1	13.4
30A□AL14	2.9		18.6	1/5	74.4/80	182/80	300	600	66.4	20.4
30A□AL24				1/9	134/80	328/80	167	334	58.5	12.5
30A□AL54				1/20	298/80	730/80	75	150	66.2	20.2
44A□AL14	4.4		28.4	1/5	114/80	284/80	300	600	87.9	20.4
44A□AL24				1/9	204/80	512/80	167	334	80.0	12.5

* Output torque and motor speed produce the following trends in efficiency. Values in the table are at the rated motor speed.





Notes: 1. For the shaft center allowable radial load, refer to the servomotor dimensional drawing.
2. The no-load torque for a servomotor with gears is high immediately after the servomotor starts, and it then decreases and becomes stable a few minutes later. This is a common phenomenon caused by grease being circulated in the gear and not by a faulty gear.

3.6 Ratings and Specifications of SGMGH (1000 min^{-1})

3.6.1 SGMGH Servomotors (1000 min^{-1}) Without Gears

(1) Ratings and Specifications

- Time Rating: Continuous
- Vibration Class: 15 µm or below
- Insulation Resistance: 500 VDC, 10 MΩ min.
- Ambient Temperature: 0 to 40°C
- Excitation: Permanent magnet
- Mounting: Flange method
- Thermal Class: F
- Withstand Voltage: 1500 VAC for one minute
- Enclosure: Totally enclosed, IP67 self-cooled (except for shaft opening)
- Ambient Humidity: 20% to 80% (no condensation)
- Drive Method: Direct drive

Voltage		200 V							
Servomotor Model SGMGH-		03A☐B	06A☐B	09A☐B	12A☐B	20A☐B	30A☐B	40A☐B	55A☐B
Rated Output *1	kW	0.3	0.6	0.9	1.2	2.0	3.0	4.0	5.5
Rated Torque *1	N·m	2.84	5.68	8.62	11.5	19.1	28.4 (21.6)*3	38.2	52.6
Instantaneous Peak Torque *1	N·m	7.17	14.1	19.3	28.0	44.0	63.7	107	136.9
Rated Current *1	A_{rms}	3.0	5.7	7.6	11.6	18.5	24.8 (18.9)*3	30	43.2
Instantaneous Max. Current *1	A_{rms}	7.3	13.9	16.6	28	42	56	84	110
Rated Speed *1	min^{-1}	1000							
Max. Speed *1	min^{-1}	2000							
Torque Constant	N·m/A_{rms}	1.03	1.06	1.21	1.03	1.07	1.19	1.34	1.26
Rotor Moment of Inertia J*2	x10^{-4} kg·m^2	7.24 (9.34)	13.9 (16.0)	20.5 (22.6)	31.7 (40.2)	46.0 (54.5)	67.5 (76.0)	89.0 (97.5)	125 (133.5)
Rated Power Rate *1	kW/s^2	11.2	23.2	36.3	41.5	79.4	120	164	221
Rated Anglar Acceleration *1	rad/s^2	3930	4080	4210	3620	4150	4210	4290	4200

* 1. These items and torque-motor speed characteristics quoted in combination with an SGDS SERVOPACK are at an armature winding temperature of 20°C.
* 2. The values in the parentheses are those for motors with holding brakes.
* 3. If using the SGMGH-30A☐B servomotor and the SGDS-30 SERVOPACK together, take into consideration of the rated vaue in the parentheses is.

Notes: 1. These characteristics are values with the following iron plate (heat sinks) attached for cooling.
SGMGH-03, 06, and 09: 400 × 400 × 20 (mm)
SGMGH-12, 20, 30, 40 and 55: 550 × 550 × 30 (mm)
2. If the heating conditions are more severe than the conditions described in Note 1, continuous allowable torque decreases. Contact your Yaskawa representative.

(2) Holding Brake Moment of Inertia

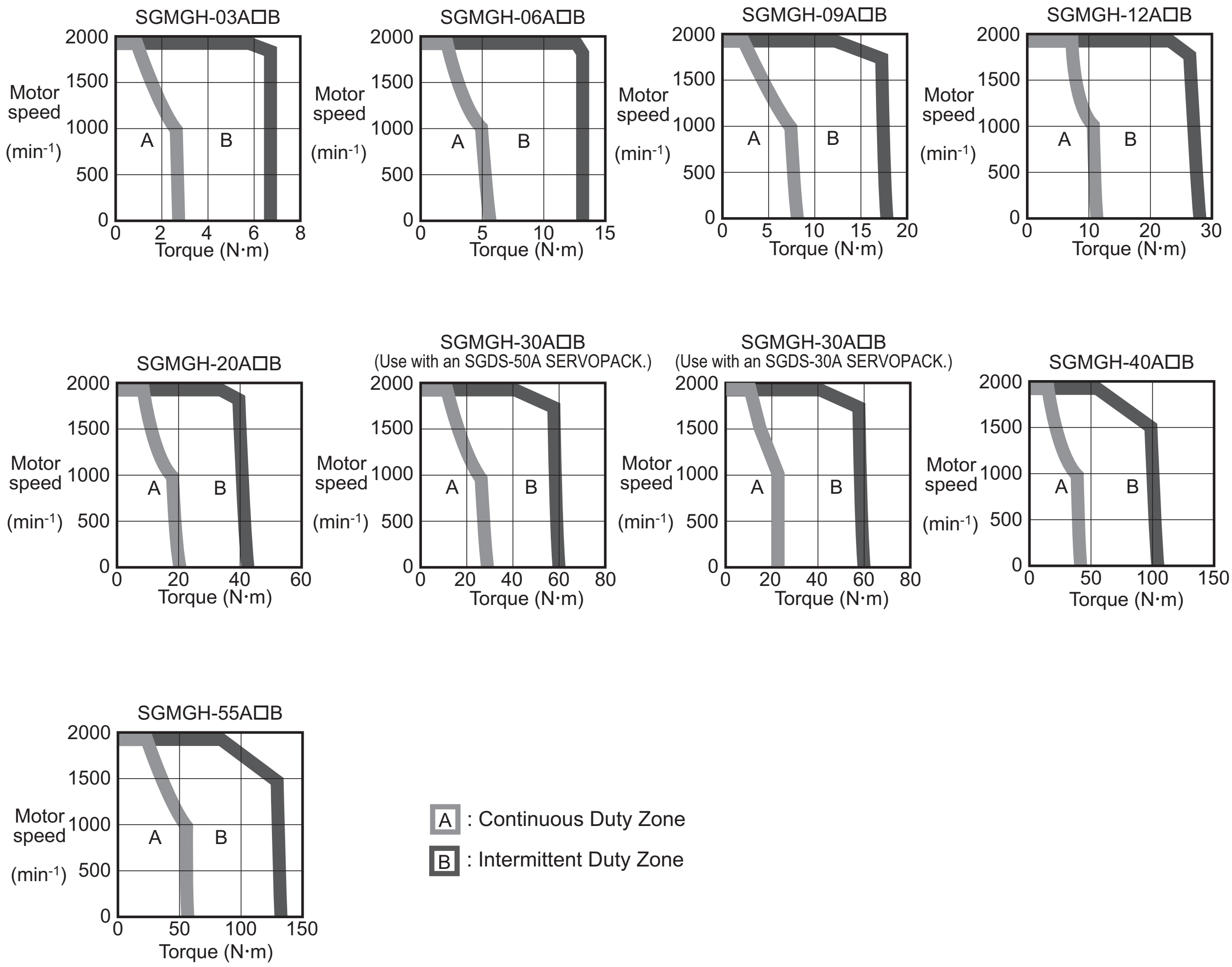
The moment of inertia of the servomotor with holding brake is expressed using the following equation.

(The moment of inertia of the servomotor with holding brake) =
(rotor moment of inertia) + (brake moment of inertia)

Servomotor Model SGMGH-		03A□B	06A□B	09A□B	12A□B	20A□B	30A□B	40A□B	55A□B
Holding Brake Moment of Inertia J	$\times 10^{-4}$ kg·m^2	2.10			8.50				

* These values are referece values.

(3) Torque-motor Speed Characteristics



(4) Holding Brake Electrical Specifications

Holding Brake Rated Voltage	Servomotor Model	Servomotor Capacity W	Holding Brake Specifications			
			Capacity W	Holding Torque N·m	Coil Resistance Ω (at 20 °C)	Rated Current A (at 20 °C)
90 VDC	SGMGH-03	300	10.1	4.41	804	0.11
	SGMGH-06	600	10.1	12.7	804	0.11
	SGMGH-09	900	10.1	12.7	804	0.11
	SGMGH-12	1200	18.5	43.1	438	0.21
	SGMGH-20	2000	18.5	43.1	438	0.21
	SGMGH-30	3000	18.5	43.1	438	0.21
	SGMGH-40	4000	23.5	72.6	327	0.28
	SGMGH-55	5500	23.5	72.6	327	0.28
24 VDC	SGMGH-03	300	9.85	4.41	58.7	0.41
	SGMGH-06	600	9.85	12.7	58.7	0.41
	SGMGH-09	900	9.85	12.7	58.7	0.41
	SGMGH-12	1200	18.5	43.1	31.1	0.77
	SGMGH-20	2000	18.5	43.1	31.1	0.77
	SGMGH-30	3000	18.5	43.1	31.1	0.77
	SGMGH-40	4000	23.5	72.6	22.8	1.05
	SGMGH-55	5500	23.5	72.6	22.8	1.05

Note: The holding brake cannot be used to stop the servomotor.

3.6.2 SGMGH servomotors (1000 min^{-1}) With Standard Backlash Gears

- Time Rating: Continuous
- Vibration Class: 15 μm or below
- Insulation Resistance: 500 VDC, 10 MΩ min.
- Ambient Temperature: 0 to 40°C
- Mounting: Foot and flange-mounted
  Type 6090 to 6125: Omni-directional mounting
  Type 6130 to 6190: Horizontal mounting to shaft
- Gear Lubricating Method:
  Type 6090 to 6125: Grease
  Type 6130 to 6190: Oil*
- Excitaton: Permanent magnet
- Thermal Class: F
- Withstand Voltage: 1500 VAC for one minute
- Enclosure: Totally enclosed, IP44 self-cooled (or the equivalent)
- Ambient Humidity: 20% to 80% (no condensation)
- Drive Method: Direct drive
- Backlash: Roughly 0.6 to 2° at gear output shaft
- Gear Rotation Direction: Reverse direction of servomotor
- Gear Mechanism: Cyclo gear mechanism

* For oil lubrication, the motor should be mounted horizontal to the shaft. Contact your Yaskawa representative about lubrication for angle mounting.

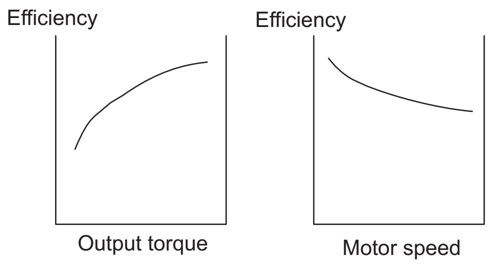
Note: Contact your Yaskawa representative regarding the use of servomotors in cases such as when the servomotor is frequently started and stopped, or when impact is generated on the gear output shaft by acceleration and deceleration.

Servomotor Model SGMGH-	Servomotor			Gear Output					Moment of Inertia J ×10^{-4} kg·m^2	
	Output kW	Rated Speed min^{-1}	Rated Torque N·m	Gear Ratio	Rated Torque/ Efficiency N·m/%	Instantaneous Peak Torque/ Effective N·m/%	Rated Speed min^{-1}	Max. Speed min^{-1}	Motor + Gears	Gears
03P□B□A6	0.3	1000	2.84	1/6	12.8/75	32.3/75	166	333	9.20	1.96
03P□B□B6				1/11	25.0/80	63.1/80	90	181	8.84	1.6
03P□B□C6				1/21	47.7/80	120/80	47	95	8.39	1.15
03P□B□76				1/29	65.9/80	166/80	34	68	8.41	1.17
06P□B□A6	0.6		5.68	1/6	27.3/80	67.7/80	166	333	15.7	1.78
06P□B□B6				1/11	50.0/80	124/80	90	181	15.3	1.35
06P□B□C6				1/21	95.4/80	237/80	47	95	15.9	1.97
06P□B□76				1/29	132/80	327/80	34	68	16.1	2.19
09P□B□A6	0.9		8.62	1/6	41.4/80	92.6/80	166	333	22.3	1.84
09P□B□B6				1/11	75.9/80	170/80	90	181	21.9	1.41
09P□B□C6				1/21	145/80	324/80	47	95	22.5	2.03
09P□B□76				1/29	200/80	448/80	34	68	22.7	2.24
12P□B□A6	1.2		11.5	1/6	58.7/85	143/85	166	333	38.0	6.3
12P□B□B6				1/11	108/85	262/85	90	181	36.5	4.76
12P□B□C6				1/21	205/85	500/85	47	95	37.6	5.93
12P□B□76				1/29	283/85	690/85	34	68	37.3	5.58
20P□B□A6	2.0		19.1	1/6	97.4/85	224/85	166	333	52.3	6.3
20P□B□B6				1/11	179/85	411/85	90	181	50.8	4.76
20P□B□C6				1/21	341/85	785/85	47	95	51.9	5.93
20P□B□76				1/29	471/85	1080/85	34	68	78.5	32.5

(cont'd)

Servomotor Model SGMGH-	Servomotor			Gear Output					Moment of Inertia J $\times 10^{-4}$ kg·m^2	
	Output kW	Rated Speed min^{-1}	Rated Torque N·m	Gear Ratio	Rated Torque/ Efficiency N·m/%	Instantaneous Peak Torque/ Effective N·m/%	Rated Speed min^{-1}	Max. Speed min^{-1}	Motor + Gears	Gears
30P□B□A6	3.0	1000	28.4	1/6	145/85	325/85	166	333	79.5	12.0
30P□B□B6				1/11	266/85	596/85	90	181	75.2	7.73
30P□B□C6				1/21	507/85	1140/85	47	95	101	33.6
30P□B□76				1/29	700/85	1570/85	34	68	121	53.3
40P□B□A6	4.0		38.2	1/6	195/85	546/85	166	333	103	13.7
40P□B□B6				1/11	357/85	1000/85	90	181	98.8	9.78
40P□B□C6				1/21	682/85	1910/85	47	95	157	68.0
40P□B□76				1/29	940/85	2640/85	34	68	155	66.0
55P□B□B6	5.5		52.6	1/11	492/85	1280/85	90	181	175	50.2
55P□B□C6				1/21	940/85	2450/85	47	95	193	68.0
55P□B□76				1/29	1297/85	3380/85	34	68	207	81.5

Notes: 1. Output torque and motor speed produce the following trends in efficiency. Values in the table are at the rated motor speed.



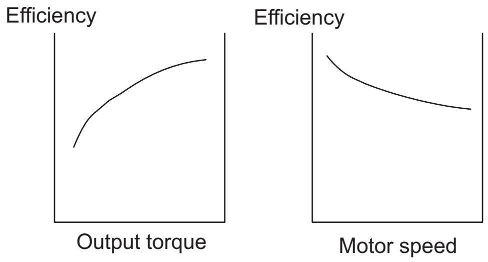
2. The no-load torque for a servomotor with gears is high immediately after the servomotor starts, and it then decreases and becomes stable a few minutes later. This is a common phenomenon caused by grease being circulated in the gear and not by a faulty gear.

3.6.3 SGMGH Servomotors (1000 min^{-1}) With Low-backlash Gears

- Time Rating: Continuous
- Vibration Class: 15 μm or below
- Insulation Resistance: 500 VDC, 10 MΩ min.
- Ambient Temperature: 0 to 40°C
- Excitation: Permanent magnet
- Mounting: Flange method (can be mounted in any direction)
- Gear Mechanism: Planetary gear mechanism
- Thermal Class: F
- Withstand Voltage: 1500 VAC for one minute
- Enclosure: Totally enclosed, IP44 self-cooled (or the equivalent)
- Ambient Humidity: 20% to 80% (no condensation)
- Drive Method: Direct drive
- Gear Lubricating Method: Grease
- Backlash: 0.05° (3 min) at the gear output shaft
- Gear Rotation Direction: Same direction as servomotor

Servomotor Model SGMGH-	Servomotor			Gear Output					Moment of Inertia J ×10^{-4} kg·m^2	
	Output kW	Rated Speed min^{-1}	Rated Torque N·m	Gear Ratio	Rated Torque/ Efficiency N·m/%	Instantaneous Peak Torque/ Effective N·m/%	Rated Speed min^{-1}	Max. Speed min^{-1}	Motor + Gears	Gears
03A□BL14	0.3	1000	2.84	1/5	11.4/80	28.7/80	200	400	8.50	1.26
03A□BL24				1/9	20.4/80	51.6/80	111	222	8.18	0.96
03A□BL54				1/20	45.4/80	115/80	50	100	8.64	1.40
03A□BL74				1/29	65.9/80	166/80	34	68	10.0	2.76
03A□BL84				1/45	102/80	258/80	22	44	9.05	1.81
06A□BL14	0.6		5.68	1/5	22.7/80	56.4/80	200	400	15.2	1.30
06A□BL24				1/9	40.9/80	101/80	111	222	14.8	0.90
06A□BL54				1/20	90.9/80	226/80	50	100	18.6	4.70
06A□BL74				1/29	132/80	327/80	34	68	16.7	2.80
06A□BL84				1/45	204/80	508/80	22	44	18.4	4.50
09A□BL14	0.9		8.62	1/5	34.5/80	77.2/80	200	400	23.9	3.40
09A□BL24				1/9	62.1/80	139/80	111	222	25.3	4.80
09A□BL54				1/20	138/80	309/80	50	100	27.4	6.90
09A□BL74				1/29	200/80	448/80	34	68	30.9	10.4
09A□BL84				1/45	310/80	695/80	22	44	27.2	6.70
12A□BL14	1.2		11.5	1/5	46/80	112/80	200	400	41.9	10.2
12A□BL24				1/9	82.8/80	202/80	111	222	39.5	7.80
12A□BL54				1/20	184/80	448/80	50	100	51.9	20.2
12A□BL74				1/29	267/80	650/80	34	68	45.1	13.4
12A□BL84				1/45	414/80	1010/80	22	44	41.4	9.70
20A□BL14	2.0		19.1	1/5	76.4/80	176/80	200	400	56.2	10.2
20A□BL24				1/9	138/80	317/80	111	222	53.8	7.80
20A□BL54				1/20	306/80	704/80	50	100	66.2	20.2
30A□BL14	3.0		28.4	1/5	114/80	255/80	200	400	87.9	20.4
30A□BL24				1/9	204/80	459/80	111	222	80.0	12.5

Notes: 1. Output torque and motor speed produce the following trends in efficiency. Values in the table are at the rated motor speed.



2. The no-load torque for a servomotor with gears is high immediately after the servomotor starts, and it then decreases and becomes stable a few minutes later. This is a common phenomenon caused by grease being circulated in the gear and not by a faulty gear.

3.7 Ratings and Specifications of SGMCS Servomotors

3.7.1 Small-capacity Series SGMCS Servomotors

(1) Ratings and Specifications

- Time Rating: Continuous
- Vibration Class: 15 μm or below
- Insulation Resistance: 500 VDC, 10 MΩ min.
- Ambient Temperature: 0 to 40°C
- Excitation: Permanent magnet
- Mounting: Flange method
- Thermal Class: A
- Withstand Voltage: 1500 VAC for one minute
- Enclosure: Totally enclosed, IP42 self-cooled (except for shaft opening)
- Ambient Humidity: 20% to 80% (no condensation)
- Drive Method: Direct drive

Ratings and Specifications for SGMCS Servomotor without Gears

Voltage		200 V					
Servomotor Model SGMCS-		02B□C	05B□C	07B□C	04C□C	10C□C	14C□C
Rated Output *1	W	42	105	147	84	209	293
Rated Torque *1, *2	N·m	2.0	5.0	7.0	4.0	10.0	14.0
Instantaneous Peak Torque *1	N·m	6.0	15.0	21.0	12.0	30.0	42.0
Stall torque *1	N·m	2.05	5.15	7.32	4.09	10.1	14.2
Rated Current *1	A_{rms}	1.8	1.7	1.4	2.2	2.2	2.8
Instantaneous Max. Current *1	A_{rms}	5.4	5.1	4.1	7.0	7.0	8.3
Rated Speed *1	min^{-1}	200			200		
Max. Speed *1	min^{-1}	500			500	400	300
Torque Constant	$N \cdot m/A_{rms}$	1.18	3.17	5.44	2.04	5.05	5.39
Rotor Moment of Inertia	$kg \cdot m^2 \times 10^{-4}$	28	51	77	77	140	220
Rated Power Rate *1	KW/s	1.4	4.9	6.4	2.1	7.1	8.9
Rated Angular Acceleration *1	rad/s^2	710	980	910	520	710	640
Absolute Accuracy	second	±15			±15		
Repeatability	second	±1.3			±1.3		
Applicable SERVOPACK	SGDS-	02			04		

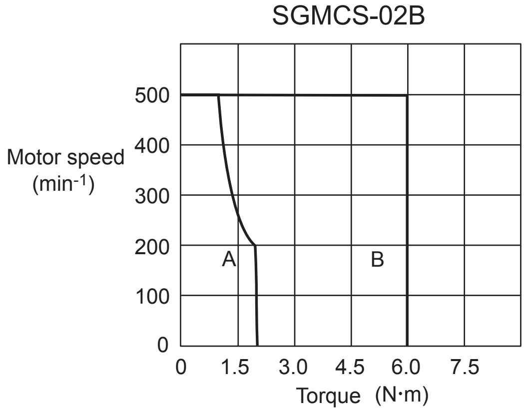
Voltage		200 V				
Servomotor Model SGMCS-		08D□C	17D□C	25D□C	16E□B	35E□B
Rated Output *1	W	168	356	393	335	550
Rated Torque *1, *2	N·m	8.0	17.0	25.0	16.0	35.0
Instantaneous Peak Torque *1	N·m	24.0	51.0	75.0	48.0	105
Stall torque *1	N·m	8.23	17.4	25.4	16.5	35.6
Rated Current *1	A_{rms}	1.9	2.5	2.6	3.3	3.5
Instantaneous Max. Current *1	A_{rms}	5.6	7.5	8.0	9.4	10.0
Rated Speed *1	min^{-1}	200		150	200	150
Max. Speed *1	min^{-1}	500	350	250	500	250
Torque Constant	$N \cdot m/A_{rms}$	5.1	7.8	10.8	5.58	11.1
Rotor Moment of Inertia	$kg \cdot m^2 \times 10^{-4}$	285	510	750	930	1430
Rated Power Rate *1	KW/s	2.2	5.7	8.3	2.75	8.57
Rated Angular Acceleration *1	rad/s^2	280	330	330	170	240
Absolute Accuracy	second	±15			±15	
Repeatability	second	±1.3			±1.3	
Applicable SERVOPACK	SGDS-	04			08	

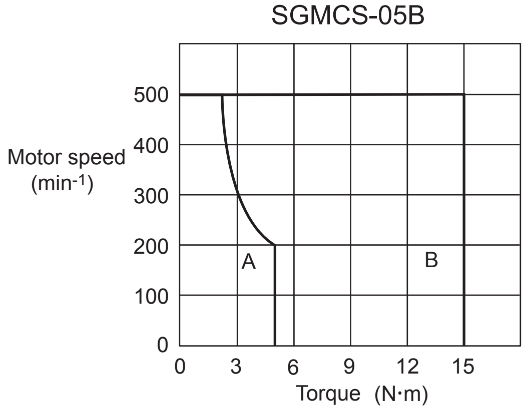
Notes: 1. SGMCS servomotor with holding brake is not available.
2. For the bearings used in SGMCS servomotors, loss varies according to the bearing temperature. At low temperatures, the amount of heat loss will be large.

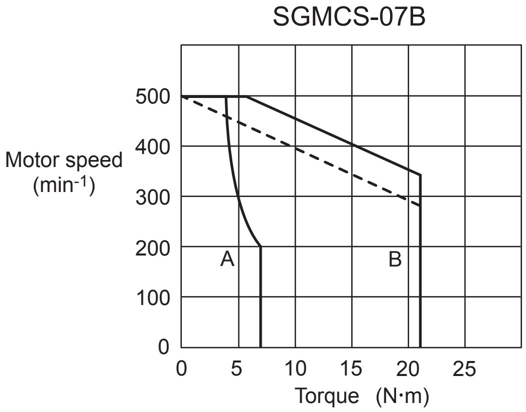
* 1. These items and torque-motor speed characteristics quoted in combination with an SGDS SERVOPACK are at an armature winding temperature of 100°C. Other values quoted at 20°C.
* 2. Rated torques are continuous allowable torque values at 40°C with a steel heat sink attached.

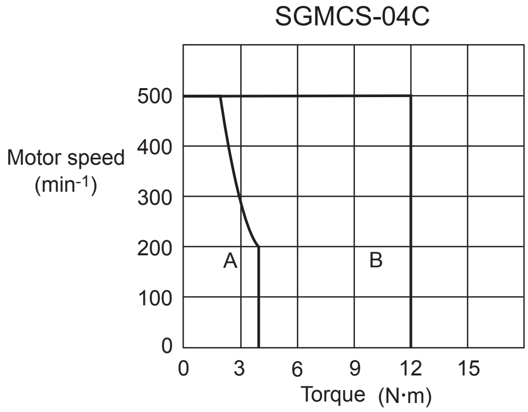
Servomotor Model SGMCS-	□□B	□□C	□□D	□□E
Heat Sink Units: mm	350 × 350 × 12	450 × 450 × 12	550 × 550 × 12	650 × 650 × 12

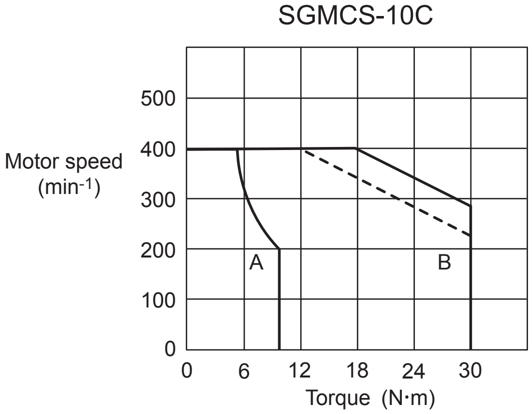
(2) Torque-motor Speed Characteristics





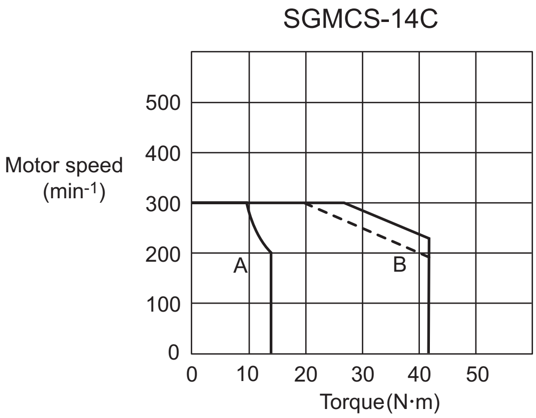


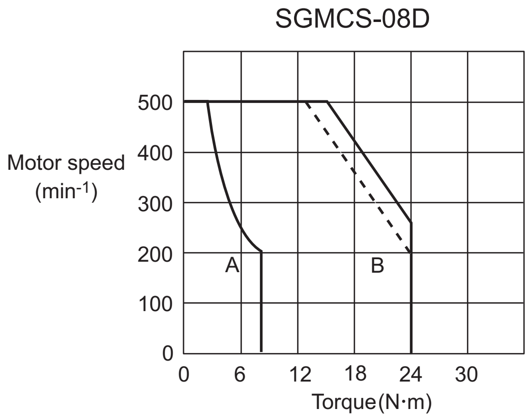


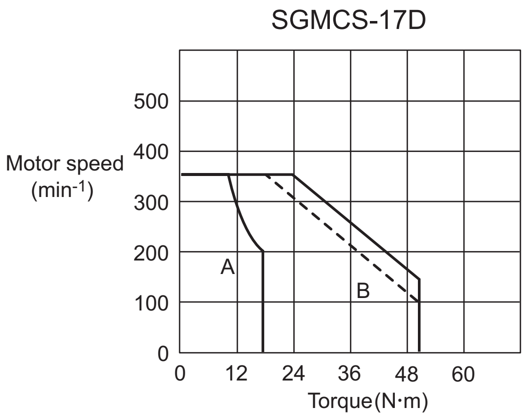


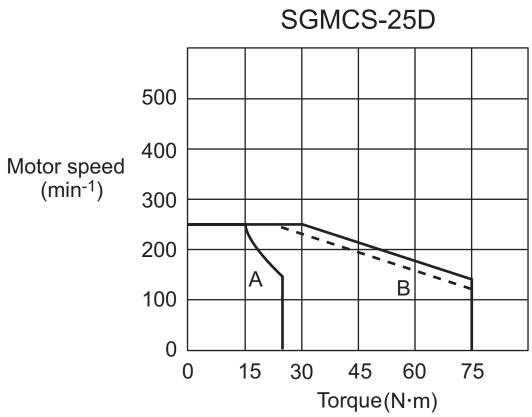
A : Continuous Duty Zone
B : Intermittent Duty Zone

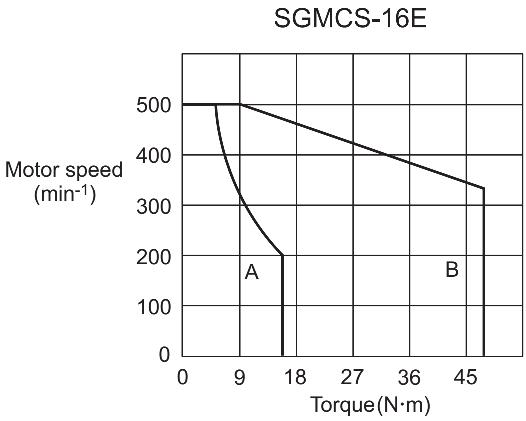
Note: The dotted line of intermittent duty zone indicates the characteristics when a servomotor runs in combination with a SERVOPACK for 100VAC.

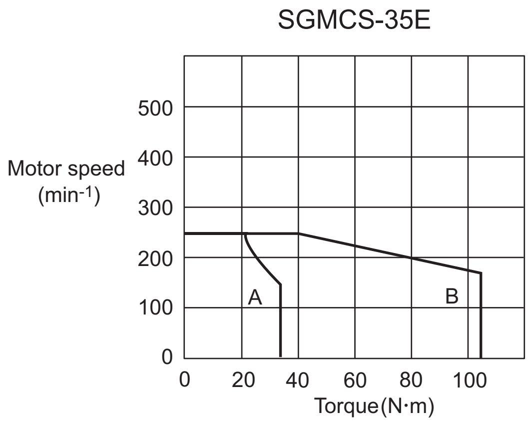












A: Continuous Duty Zone
B: Intermittent Duty Zone

Note: The dotted line of intermittent duty zone indicates the characteristics when a servomotor runs in combination with a SERVOPACK for 100VAC.

3.7.2 Middle-capacity Series SGMCS Servomotors

(1) Ratings and Specifications

- Time Rating: Continuous
- Vibration Class: 15 μm or below
- Insulation Resistance: 500 VDC, 10 MΩ min.
- Ambient Temperature: 0 to 40°C
- Excitation: Permanent magnet
- Mounting: Flange method
- Thermal Class: F
- Withstand Voltage: 1500 VAC for one minute
- Enclosure: Totally enclosed, IP44 self-cooled (except for shaft opening)
- Ambient Humidity: 20% to 80% (no condensation)
- Drive Method: Direct drive

Ratings and Specifications for SGMCS Servomotor without Gears

Voltage		200 V					
Servomotor Model SGMCS-		45M☐A	80M☐A	1AM☐A	80N☐A	1EN☐A	2ZN☐A
Rated Output*1	W	707	1260	1730	1260	2360	3140
Rated Torque*1, *2	N·m	45	80	110	80	150	200
Instantaneous Peak Torque *1	N·m	135	240	330	240	450	600
Stall torque*1	N·m	45	80	110	80	150	200
Rated Current*1	A_{rms}	5.80	9.74	13.4	9.35	17.4	18.9
Instantaneous Max. Current *1	A_{rms}	17	28	42	28	56	56
Rated Speed*1	min^{-1}	150					
Max. Speed*1	min^{-1}	300				250	
Torque Constant	$N{\cdot}m/A_{rms}$	8.39	8.91	8.45	9.08	9.05	11.5
Rotor Moment of Inertia	$kg{\cdot}m^2{\times}10^{-4}$	388	627	865	1360	2470	3060
Rated Power Rate*1	KW/s	52.2	102	140	47.1	91.1	131
Rated Angular Acceleration*1	rad/s^2	1160	1280	1270	588	607	654
Applicable SERVOPACK	SGDS-	10	15	20	15	30	30

Notes: 1. SGMCS servomotor with holding brake is not available.
2. For the bearings used in SGMCS servomotors, loss varies according to the bearing temperature. At low temperatures, the amount of heat loss will be large.

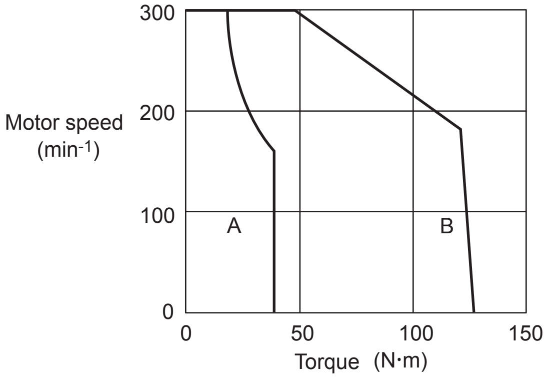
* 1. These items and torque-motor speed characteristics quoted in combination with an SGDS SERVOPACK are at an armature winding temperature of 20°C.

* 2. Rated torques are continuous allowable torque values at 40°C with a steel heat sink attached.

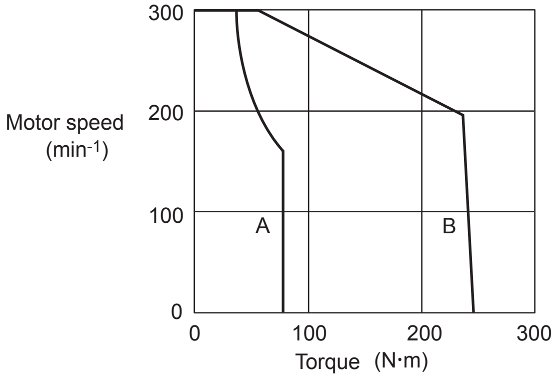
Servomotor Model SGMCS-	45M,80M,1AM,80N,1EN,2ZN
Heat Sink Units: mm	750 × 750 × 45

(2) Torque-motor Speed Characteristics

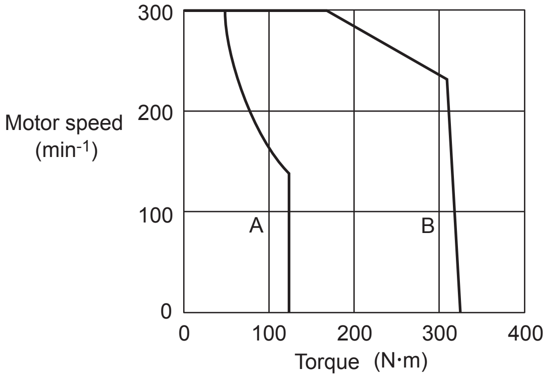
SGMCS-45M



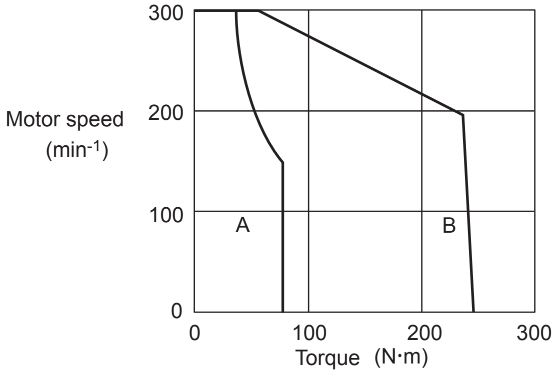
SGMCS-80M



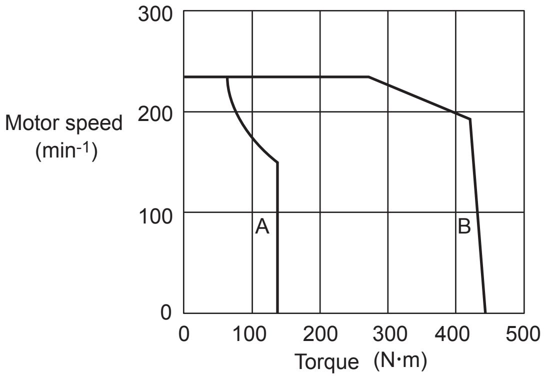
SGMCS-1AM



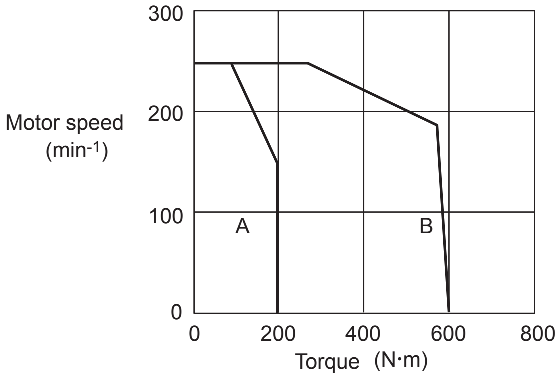
SGMCS-80N



SGMCS-1EN



SGMCS-2ZN



A : Continuous Duty Zone

B : Intermittent Duty Zone

3.8 Mechanical Specifications of SGMMJ, SGMAS, SGMPS, SGMSS, and SGMGH Servomotors

3.8.1 Precautions on Servomotor Installation

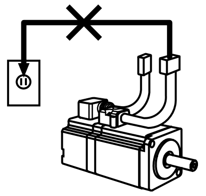
Servomotors can be installed either horizontally or vertically.

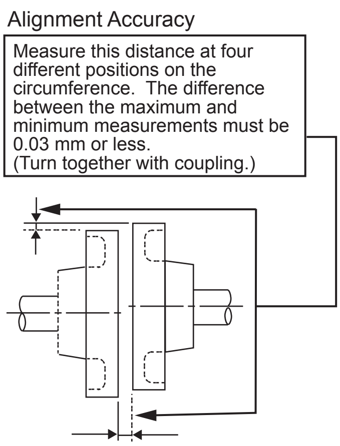
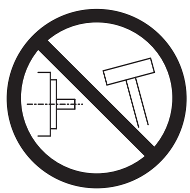
The service life of the servomotor will be shortened or unexpected problems will occur if the servomotor is installed incorrectly or in an inappropriate location. Always observe the following installation instructions.

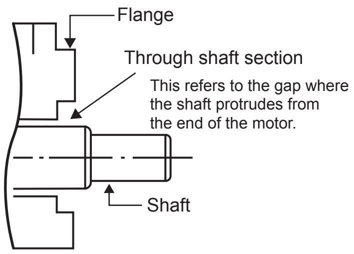
⚠ CAUTION

- Do not connect the servomotor directly to a commercial power line. This will damage the servomotor.

  The servomotor cannot operate without the proper SERVOPACK.



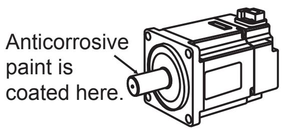
Storage Temperature	Store the servomotor within the following temperature range if it is stored with the power cable disconnected. Ambient temperature during storage: -20 to 60°C Ambient humidity during storage: 80%RH or less (with no condensation)
Installation Site	Servomotors are designed for indoor use. Install the servomotor in environments that satisfy the following conditions. • Free of corrosive or explosive gases. • Well-ventilated and free of dust and moisture. • Ambient temperature of 0 to 40°C • Relative humidity of 20% to 80% with no condensation. • Facilitates inspection and cleaning
Handling	Do not hold the product by cables or motors shaft while transporting it. Failure to observe this caution may result in injury or malfunciton.
Alignment	 Align the shaft of the servomotor with the shaft of the equipment, and then couple the shafts. Install the servomotor so that alignment accuracy falls within the following range. Vibration that will damage the bearings if the shafts are not properly aligned. Connect the servomotor to a machine in the way that prevents from generating concentric loads, or rotary unbalanced loads on the motor shaft.  When installing, do not hit the shafts with a hammer etc., as impacts may result in malfunction.
Orientation	Servomotors can be installed either horizontally or vertically.

Handling Oil and Water	 If the servomotor is used in a location that is subject to water drops, make sure of the servomotor protective specification (except for through shaft section). If the servomotor is used in a location that is subject to water or oil mist, use a servomotor with an oil seal to seal the through shaft section. Precautions on Using Servomotor with Oil Seal • Put the oil surface under the oil seal lip. • Use an oil seal in favorably lubricated condition. • When using a servomotor with its shaft upward direction, be sure that oil will not stay in the oil seal lips.
Cable Stress	Make sure there are no bends or tension on the power lines. Be especially careful to wire signal line cables so that they are not subject to stress because the core wires are very thin at only 0.2 to 0.3 mm.
Connectors	Observe the following precautions: • Make sure there is no foreign matters such as dust and metal chips in the connector before connecting. • When the connectors are connected to the motor, be sure to connect the end of servomotor main circuit cables before connecting the encoder cable’s end. If the encoder cable’s end is connected, the encoder may break because of the voltage differences between FG. • Make sure of the pin arrangement. • Do not apply shock to resin connectors. Otherwise, they may be damaged. • When handling a servomotor with its cables connected, hold the servomotor or the connectors and cables will be damaged. • Fix the connector to SGMAS (all the models) or SGMPS (excluding 750W and 1500W) with screws. Make sure that the connector is securely fixed with screws, referring to *1.3 (3) Cable Connections to SGMAS and SGMPS Servomotors*. If not, the protective construction specifications may not be satisfied. • When using flexible cables, be sure not to apply stress on the connector. The connector may be damaged by stress.

IMPORTANT

1. Prior to Installation

   The end of the motor shaft is coated with anticorrosive paint. Thoroughly remove the paint prior to installation.

2. Vibration from improper alignment of shafts will damage the bearings.
3. Do not allow direct impact to be applied to the shafts when installing the coupling as the encoder mounted on the opposite end of the shaft may be damaged.

3.8.2 Allowable Radial and Thrust Loads

Design the mechanical system so that thrust and radial loads applied to the servomotor shaft end during operation fall within the ranges shown in the table below. Note that loads are generated on the motor shafts in the following cases.

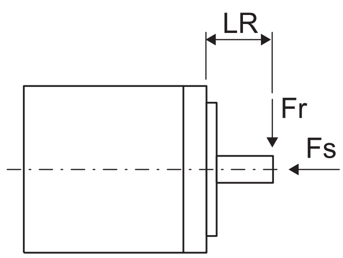
- Radial load is generated by:
  - Belt tension when the timing-belts are coupled
    - Concentric loads when installing couplings
- Thrust load is generated by:
    - The weight of parts on the shafts, when using the servomotor with a vertical output shaft
    - Driving a helical gear

When the loading point is larger than the dimension LR in the table below, the allowable radial load is reduced.

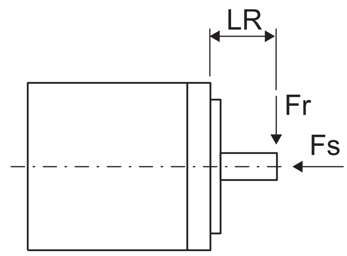
Contact your Yaskawa representative for more information.

(1) SGMMJ, SGMAS,SGMPS,SGMSS, and SGMGH Servomotors without Gears

Allowable Radial and Thrust Loads for Servomotors without Gears

Servomotor Model		Allowable Radial Load Fr (N)	Allowable Thrust Load Fs (N)	LR mm	Reference Diagram
SGMMJ-	A1B	34.3	14.7	16	
	A2B	44.1			
	A3B				
SGMAS-	A5A	68	54	20	
	01A	78			
	C2A				
	02A	245	74	25	
	04A				
	06A				
	08A	392	147	35	
	12A				
SGMPS-	01A	78	49	20	
	02A	245	68	25	
	04A				
	08A	392	147	35	
	15A	490			
SGMSS-	10A	686	196	45	
	15A				
	20A				
	25A				
	30A	980	392	63	
	40A	1176			
	50A				
	70A				
SGMGH- ($1500 min^{-1}$)	05A□A21	490	98	58	
	09A□A21	490	98	58	
	13A□A21	686	343	58	
	20A□A21	1176	490	79	
	30A□A21	1470	490	79	
	44A□A21	1470	490	79	
	55A□A21	1764	588	113	
	75A□A21	1764	588	113	

Allowable Radial and Thrust Loads for Servomotors without Gears (cont'd)

Servomotor Model		Allowable Radial Load Fr (N)	Allowable Thrust Load Fs (N)	LR mm	Reference Diagram
SGMGH- (1000min^{-1})	03A☐B21	490	98	58	
	06A☐B21	490	98	58	
	09A☐B21	686	343	58	
	12A☐B21	1176	490	79	
	20A☐B21	1470	490	79	
	30A☐B21	1470	490	79	
	40A☐B21	1764	588	113	
	55A☐B21	1764	588	113	

(2) SGMMJ Servomotors with Gears

Allowable Radial and Thrust Loads for SGMMJ Servomotor with Gears

Servomotor Model SGMMJ-	Keys	Tap × Depth	Allowable Radial Fr (N)	Allowable Thrust Load Fs (N)	LR mm
A1B☐BJA21	–	Without tap	52	47	18
A1B☐BJA61	Provided	M3 × 6L	76		
A1B☐BJB21	–	Without tap	89		
A2B☐BJB61	Provided	M3 × 6L	52		
A2B☐BJC21	–	Without tap	76		
A2B☐BJC61	Provided	M3 × 6L	89		
A3B☐BJ12	–	Without tap	69	59	
A3B☐BJ16	Provided	M3 × 6L			
A3B☐BJ22	–	Without tap	147		
A3B☐BJ26	Provided	M3 × 6L			
A3B☐BJ32	–	Without tap	186		
A3B☐BJ36	Provided	M3 × 6L			

(3) SGMAS Servomotors with Gears

Allowable Radial and Thrust Loads for SGMAS Servomotors with Gears

Servomotor Model SGMAS-	With Standard Backlash Gears			Servomotor Model SGMAS-	With Low-backlash Gears		
	Allowable Radial Load Fr (N)	Allowable Thrust Load Fs (N)	LR mm		Allowable Radial Load Fr (N)	Allowable Thrust Load Fs (N)	LR mm
A5A□AJ1□	145	125	50	A5A□AH1□	137	127	50
A5A□AJ3□	215	145	55	A5A□AH2□	206	147	55
A5A□AJC□	230			A5A□AHC□	235		
A5A□AJ7□	245			A5A□AH7□			
01A□AJ1□	175	145	55	01A□AH1□	167	147	55
01A□AJ3□	215			01A□AHB□	216		
01A□AJC□	455	235	69	01A□AHC□	392	235	69
01A□AJ7□	480			01A□AH7□	431		
C2A□AJ1□	175	145	55	C2A□AH1□	167	147	55
C2A□AJ3□	360	235	69	C2A□AHB□	323	235	69
C2A□AJC□	455			C2A□AHC□	392		
C2A□AJ7□	635	290	79	C2A□AH7□	608	294	79
02A□AJ1□	275	235	69	02A□AH1□	245	235	69
02A□AJ3□	360			02A□AHB□	323		
02A□AJC□	585	290	79	02A□AHC□	549	294	79
02A□AJ7□	635			02A□AH7□	608		
04A□AJ1□	275	235	69	04A□AH1□	245	235	69
04A□AJ3□	460	290	79	04A□AHB□	441	294	79
04A□AJC□	655	310	100	04A□AHC□	568	314	100
04A□AJ7□	755			04A□AH7□	657		
06A□AJ1□	275	235	69	06A□AH1□	245	235	69
06A□AJ3□	525	310	100	06A□AH2□	451	314	100
06A□AJC□	655			06A□AHC□	568		
06A□AJ7□	1205	490	102	06A□AH7□	921	490	137
08A□AJ1□	355	290	79	08A□AH1□	343	294	79
08A□AJ3□	525	310	100	08A□AHB□	451	314	100
08A□AJC□	1070	490	102	08A□AHC□	813	490	137
08A□AJ7□	1205			08A□AH7□	921		
12A□AJ1□	355	290	79	12A□AH1□	343	294	79
12A□AJB□	860	490	102	12A□AHB□	647	490	137
12A□AJC□	1070	490		12A□AHC□	813		
12A□AJ7□	1690	880	112	12A□AH7□	1247	882	151

(4) SGMGH Servomotor (1500 min^{-1}) with Standard Backlash Gears

Servomotor Model: SGMGH- (1500 min^{-1})		Allowable Radial Load for Shaft Center Fr (N)
Grease-lubricating Type • With foot • Flange type	05P□A□A6	2830
	05P□A□B6	3340
	05P□A□C6	5400
	05P□A□76	5400
	09P□A□A6	4110
	09P□A□B6	5220
	09P□A□C6	8240
	09P□A□76	8980
	13P□A□A6	4090
	13P□A□B6	6650
	13P□A□C6	8190
	20P□A□A6	5220
	20P□A□B6	6620
	30P□A□A6	5180
	30P□A□B6	6560
Oil-lubricating Type • With foot • Flange type	13P□A□76	10500
	20P□A□C6	9510
	20P□A□76	10400
	30P□A□C6	13900
	30P□A□76	17900
	44P□A□A6	6030
	44P□A□B6	7660
	44P□A□C6	16300
	44P□A□76	20100
	55P□A□A6	5990
	55P□A□B6	11500
	55P□A□C6	18300
	55P□A□76	20000
	75P□A□B6	13100
	75P□A□C6	18200
	75P□A□76	26600

Servomotor Specifications and Dimensional Drawings

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(5) SGMGH Servomotor (1500 min^{-1}) with Low-backlash Gears

Servomotor Model: SGMGH- (1500 min^{-1})		Allowable Radial Load for Shaft Center Fr (N)
Grease-lubricating Type • Flange type	05A☐AL14	833
	05A☐AL24	980
	09A☐AL14	833
	09A☐AL24	980
	05A☐AL54	2650
	05A☐AL74	2940
	05A☐AL84	3430
	09A☐AL54	2650
	09A☐AL74	2940
	09A☐AL84	8040
	13A☐AL14	1670
	13A☐AL24	1960
	13A☐AL54	2650
	13A☐AL74	6860
	13A☐AL84	8040
	20A☐AL14	1670
	20A☐AL24	1960
	20A☐AL54	6080
	20A☐AL74	6860
	30A☐AL14	3820
	30A☐AL24	4700
	30A☐AL54	6080
	44A☐AL14	3820
	44A☐AL24	4700

(6) SGMGH Servomotor (1000 min^{-1}) with Standard Backlash Gears

Servomotor Model: SGMGH- (1000 min^{-1})		Allowable Radial Load for Shaft Center Fr (N)
Grease-lubricating Type • With foot • Flange type	03P□B□A6	2840
	03P□B□B6	3340
	03P□B□C6	5400
	03P□B□76	5400
	06P□B□A6	4120
	06P□B□B6	5230
	06P□B□C6	8260
	06P□B□76	9810
	09P□B□A6	4110
	09P□B□B6	7600
	09P□B□C6	10900
	09P□B□76	11900
	12P□B□A6	5980
	12P□B□B6	7600
	20P□B□A6	5940
	20P□B□B6	7530
Oil-lubricating Type (for small capacity and large capacity) • With foot • Flange type	12P□B□C6	10900
	12P□B□76	11900
	20P□B□C6	15700
	20P□B□76	20500
	30P□B□A6	6920
	30P□B□B6	8790
	30P□B□C6	18600
	30P□B□76	23100
	40P□B□A6	6870
	40P□B□B6	13000
	40P□B□C6	21000
	40P□B□76	23000
	55P□B□B6	15000
	55P□B□C6	20900
	55P□B□76	30400

(7) SGMGH Servomotor (1000 min^{-1}) with Low-backlash Gears

Servomotor Model: SGMGH- (1000 min^{-1})		Allowable Radial Load for Shaft Center Fr (N)
Grease-lubricating Type (For small capacity) • Flange type	03A□BL14	833
	03A□BL24	980
	03A□BL54	1270
	06A□BL14	833
	06A□BL24	980
	09A□BL14	833
Grease-lubricating Type (For large capacity) • Flange type	03A□BL74	2940
	03A□BL84	3430
	06A□BL54	2650
	06A□BL74	2940
	06A□BL84	8040
	09A□BL24	1960
	09A□BL54	2650
	09A□BL74	6860
	09A□BL84	8040
	12A□BL14	1670
	12A□BL24	1960
	12A□BL54	6080
	12A□BL74	6860
	12A□BL84	8040
	20A□BL14	1670
	20A□BL24	1960
	20A□BL54	6080
	30A□BL14	3820
	30A□BL24	4700

(8) SGMPS Servomotors with Gears

Allowable Radial and Thrust Loads for SGMPS Servomotors with Gears

Servomotor Model SGMPS-	With Standard Backlash Gears: Allowable Radial Load Fr (N)	With Standard Backlash Gears: Allowable Thrust Load Fs (N)	With Standard Backlash Gears: LR mm	Servomotor Model SGMPS-	With Low-backlash Gears: Allowable Radial Load Fr (N)	With Low-backlash Gears: Allowable Thrust Load Fs (N)	With Low-backlash Gears: LR mm
01A□AJ1□	175	145	55	01A□AH1□	167	147	55
01A□AJ3□	215			01A□AHB□	216		
01A□AJC□	455	235	69	01A□AHC□	392	235	69
01A□AJ7□	480			01A□AH7□	431		
02A□AJ1□	275	235	69	02A□AH1□	245	235	69
02A□AJ3□	360			02A□AHB□	323		
02A□AJC□	585	290	79	02A□AHC□	549	294	79
02A□AJ7□	635			02A□AH7□	608		
04A□AJ1□	275	235	69	04A□AH1□	245	235	69
04A□AJ3□	460	290	79	04A□AHB□	441	294	79
04A□AJC□	655	310	100	04A□AHC□	568	314	100
04A□AJ7□	755			04A□AH7□	657		
08A□AJ1□	355	290	79	08A□AH1□	343	294	79
08A□AJ3□	525	310	100	08A□AHB□	451	314	100
08A□AJC□	1070	490	102	08A□AHC□	813	490	137
08A□AJ7□	1205			08A□AH7□	921		
15A□AJ1□	400	310	100	15A□AH1□	353	314	100
15A□AJB□	860	490	102	15A□AHB□	647	490	137
15A□AJC□	1690	880	112	15A□AHC□	1247	882	151
15A□AJ7□				15A□AH7□			

Servomotor Specifications and Dimensional Drawings

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(9) SGMSS Servomotors with Gears

Allowable Radial and Thrust Loads for SGMSS Servomotors with Gears

Servomotor Model SGMSS-	With Load-backlash Gears		
	Allowable Radial Load Fr (N)	Allowable Thrust Load Fs (N)	LR mm
10A☐AL1☐	833	0	72.5
	0	1280	–
10A☐AL2☐	980	0	72.5
	0	1570	–
10A☐AL5☐	2650	0	102.5
	0	4220	–
10A☐AL7☐	2940	0	102.5
	0	4900	–
10A☐AL8☐	3430	0	102.5
	0	5690	–
15A☐AL1☐	833	0	72.5
	0	1280	–
15A☐AL2☐	1960	0	102.5
	0	3000	–
15A☐AL5☐	2650	0	102.5
	0	4220	–
15A☐AL7☐	2940	0	102.5
	0	4900	–
15A☐AL8☐	8040	0	115
	0	8830	–
20A☐AL1☐	833	0	72.5
	0	1280	–
20A☐AL2☐	1960	0	102.5
	0	3000	–
20A☐AL5☐	2650	0	102.5
	0	4220	–
20A☐AL7☐	6860	0	115
	0	7350	–
20A☐AL8☐	8040	0	115
	0	8830	–
25A☐AL1☐	1670	0	102.5
	0	1960	–
25A☐AL2☐	1960	0	102.5
	0	3000	–
25A☐AL5☐	6080	0	115
	0	6370	–
25A☐AL7☐	6860	0	115
	0	7350	–
25A☐AL8☐	8040	0	115
	0	8830	–
30A☐AL1☐	1670	0	102.5
	0	1960	–
30A☐AL2☐	1960	0	102.5
	0	3000	–
30A☐AL5☐	6080	0	115
	0	6370	–

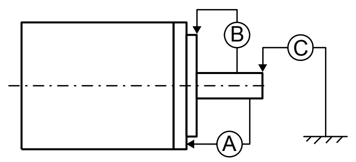
Allowable Radial and Thrust Loads for SGMSS Servomotors with Gears (cont'd)

Servomotor Model SGMSS-	With Load-backlash Gears		
	Allowable Radial Load Fr (N)	Allowable Thrust Load Fs (N)	LR mm
30A□AL7□	6860	0	115
	0	7350	–
30A□AL8□	8040	0	115
	0	8830	–
40A□AL1□	1670	0	102.5
	0	1960	–
40A□AL2□	4700	0	115
	0	4320	–
40A□AL5□	6080	0	115
	0	6370	–
40A□AL7□	6860	0	115
	0	7350	–
50A□AL1□	3820	0	115
	0	2940	–
50A□AL2□	4700	0	115
	0	4320	–
50A□AL5□	6080	0	115
	0	6370	–

3.8.3 Mechanical Tolerance

The following table shows tolerances for the servomotor's output shaft and installation area. For more details on tolerances, refer to the dimensional drawing of the individual servomotor.

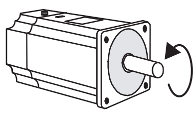
Mechanical Tolerance

Tolerance T. I. R. (Total Indicator Reading)		Reference Diagram
A	Perpendicularity between the flange face and output shaft: 0.04 mm	
B	Mating concentricity of the flange O.D.: 0.04 mm	
C	Run-out at the end of the shaft: 0.02 mm*	

* 5.5 kW and 7.5 kW SGMGH servomotors: 0.04 mm

3.8.4 Direction of Servomotor Rotation

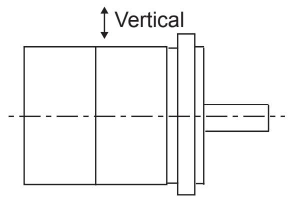
Positive rotation of the servomotor is counterclockwise when viewed from the load. (When the servomotor has a gear, the rotating direction of the gear output shaft will vary depending on the gear type.)



3.8.5 Impact Resistance

Mount the servomotor with the axis horizontal. The servomotor will withstand the following vertical impacts:

- Impact Acceleration: 490 m/s^2
- Impact occurrences: 2



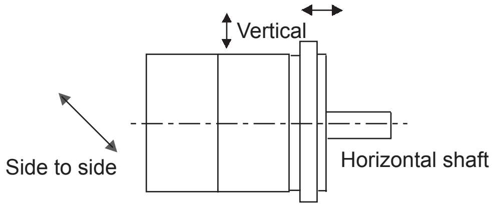
Impact applied to the servomotor

3.8.6 Vibration Resistance

Mount the servomotor with the axis horizontal. The servomotor will withstand the following vibration acceleration in three directions: Vertical, side to side, and front to back. The amount of vibration the servomotor endures will vary depending on the application. Check the vibration acceleration being applied to your servomotor for each application.

Vibration Acceleration

Servomotor Model	Vibration Acceleration at Flange
SGMMJ, SGMAS, SGMPS, SGMSS	49 m/s^2
SGMSS-70	14.7 m/s^2
SGMGH	24.5 m/s^2



Impact applied to the servomotor

3.8.7 Vibration Class

The vibration class for the servomotors at rated motor speed is as follows:

- Vibration Class: 15 μm or below

(A vibration class of 15 μm or below indicates a total vibration amplitude of 15 μm maximum on the servomotor during rated rotation.)

3.8.8 Protective Specifications

Servomotor Protective Specifications

Servomotor Model	SGMMJ	SGMAS	SGMPS	SGMSS	SGMGH
Standard	IP55	IP55	IP55*	IP67 (IP22 for only SGMSS-70)	IP67
Option	–	–	IP67*	–	–

Notes: 1. Except for shaft opening.

2. All models of SGMAS Servomotors and SGMPS Servomotors excluding 750 W and 1.5 kW satisfy the servomotor protective specifications when the specified cables are used. For the cable specifications, refer to *5.1 Servomotor Main Circuit Cables*.

* The connectors on SGMMJ, SGMPS-08, and -15 are excluded. Contact your Yaskawa representative for the connectors for IP67 specification.

3.8.9 Heating Conditions

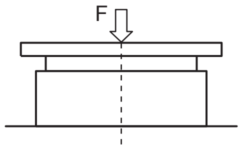
Note that when the flange face is smaller, continuous allowable torque is reduced.

Make sure there is no confined heat around the servomotors. (Do not use servomotors in a closed, unventilated space.)

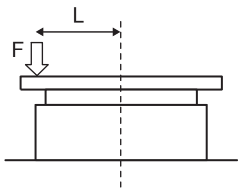
3.9 Mechanical Specifications of SGMCS Servomotors

3.9.1 Allowable Loads

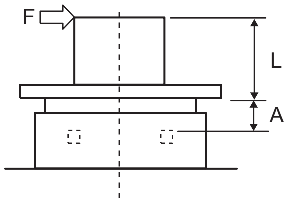
The loads applied while a servomotor is running are roughly classified in the following patterns. Design the machine so that the thrust load and moment load will not exceed the values in the table.



Where F is external force,
Thrust load: Fa = F + Load mass
Moment load: M=0



Where F is external force,
Thrust load: Fa = F + Load mass
Moment load: M = F × L



Where F is external force,
Thrust load: Fa = Load mass
Moment load: M = F × L
See the table below for the dimension A of each servomotor model.

Servomotor Model SGMCS-		02B	05B	07B	04C	10C	14C	08D	17D	25D
Dimensions A Units	mm	0			0			0		
Allowable Thrust Load Fa	(N)	1500			3300			4000		
Allowable Moment Load M	(N·m)	40	50	64	70	75	90	93	103	135

Servomotor Model SGMCS-		16E	35E	45M	80M	1AM	80N	1EN	2ZN
Dimensions A Units	mm	0		33			37.5		
Allowable Thrust Load Fa	(N)	11000		9000			16000		
Allowable Moment Load M	(N·m)	250	320	180			350		

Note: For small-capacity series SGMCS servomotors (02B to 35E), set dimensions A to 0 (zero).

3.9.2 Mechanical Tolerance

The following table shows tolerances for the servomotor's output shaft and installation area. See the dimensional drawing of the individual servomotor for more details on tolerances.

Mechanical Tolerance

Tolerance T. I. R. (Total Indicator Reading) Units: mm	Servomotor Model SGMCS-										
	02B	05B	07B	04C	10C	14C	08D	17D	25D	16E	35E
①Run-out of the surface of the shaft	0.02			0.02			0.02			0.02	
②Run-out at the end of the shaft	0.04			0.04			0.04			0.04	
③Perpendicularity between the flange face and output shaft	0.07			0.07			0.08			0.08	
④Coaxiality of output axis and mounting socket joint	0.07			0.07			0.08			0.08	
⑤Right angle between flange face and output shaft	–			–			–			–	
⑥Reference figure	Fig. 3.1			Fig. 3.1			Fig. 3.1			Fig. 3.1	

Tolerance T. I. R. (Total Indicator Reading) Units: mm	Servomotor Model SGMCS-					
	45M	80M	1AM	80N	1EN	2ZN
①Run-out of the surface of the shaft	0.02			0.02		
②Run-out at the end of the shaft	0.04			0.04		
③Perpendicularity between the flange face and output shaft	–			–		
④Coaxiality of output axis and mounting socket joint	0.08			0.08		
⑤Right angle between flange face and output shaft	0.08			0.08		
⑥Reference figure	Fig. 3.2			Fig. 3.2		

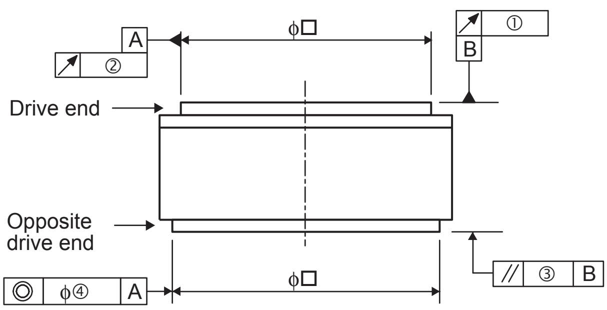


Fig. 3.1

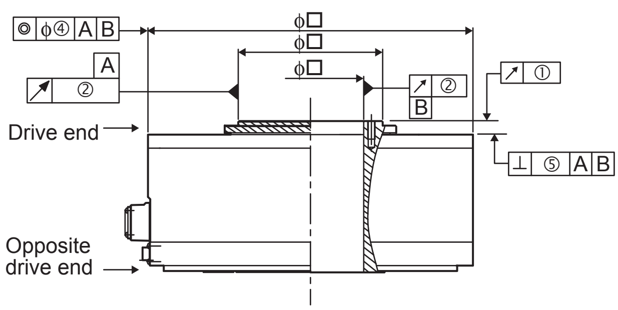
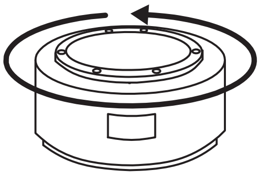


Fig. 3.2

3.9.3 Direction of Servomotor Rotation

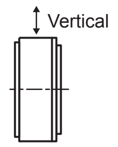
Positive rotation of the servomotor is counterclockwise when viewed from the load.



3.9.4 Impact Resistance

Mount the servomotor with the axis horizontal. The servomotor will withstand the following vertical impacts:

- Impact Acceleration: 490 m/s^2
- Number of Impacts: 2

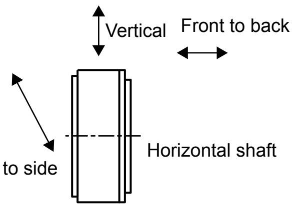


Impact applied to the servomotor

3.9.5 Vibration Resistance

Mount the servomotor with the axis horizontal. The servomotor will withstand the following vibration acceleration in three directions: Vertical, side to side, and front to back. The amount of vibration the servomotor endures will vary depending on the application. Check the vibration acceleration being applied to your servomotor for each application.

Motor Type	Vibration Acceleration at Flange
Small-capacity Series	49 m/s^2
Middle-capacity Series	24.5 m/s^2



Vibration applied to the servomotor

3.9.6 Vibration Class

The vibration class at rated motor speed is as follows:

- Vibration Class: 15 μm or below

(A vibration class of 15 μm or below indicates a total vibration amplitude of 15 μm maximum on the servomotor during rated rotation.)

3.9.7 Protective Specification

Motor Type	Protective Specification
Small-capacity Series	IP42*
Middle-capacity Series	IP44

* Excluding the shaft opening.

3.9.8 Heating Conditions

Note that when the flange face is smaller, the continuous allowable torque is reduced.

Make sure there is no confined heat around the servomotors. (Do not use servomotors in a closed, unventilated space.)

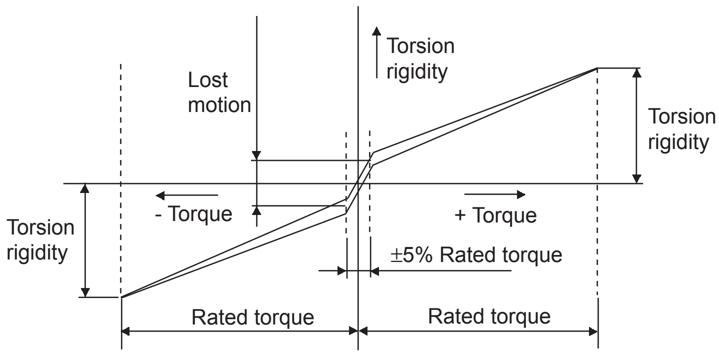
3.10 Terms for Servomotors with Gears

(1) Terms for Servomotors with Standard Backlash Gears and Low-backlash Gears

Terminology for Servomotors with Gears

Item	Measurement Method/Definition	Typical Value	
		Standard Backlash Gears	Low-back-lash Gears
Rated Torque (N·m)	The rated output torque of the motor is the gear input torque. The rated torque is this value multiplied by the inverse of the gear ratio and efficiency.	–	–
Lost Motion (arc-min)*	Angular difference in the screw with a ±5% rated torque load. (Maximum value at any four positions during output.)	20 max.	3 max.
Torsion Rigidity (arc-min)*	Highest torsion angle value on one side with a ± rated torque load	27 max.	10 max.
Angular Transmission Error Accuracy (arc-min)	Difference in absolute accuracy for one rotation under load and no-load conditions during output.	15 max.	6 max.

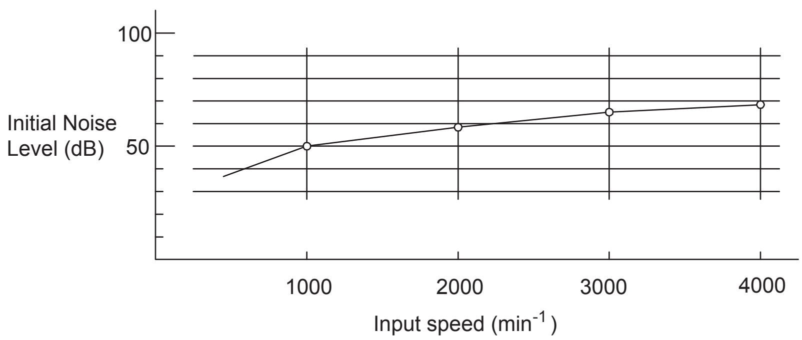
* See the following graph for lost motion and torsion rigidity.



(2) Noise Data

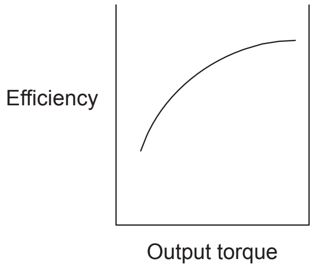
The following noise data for a servomotor with a gear is for reference only and may vary slightly with the capacity and gear ratio of the servomotor.

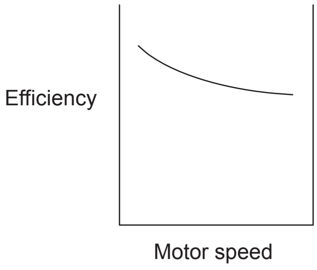
Measurement Conditions
- Scale A: 50 cm
- Ground Noise: 28 dB



(3) Efficiency

The output torque and motor speed produce the following trends in efficiency. The values in the tables, Ratings and Specifications of SGMSS, SGMGH servomotors with Gears are at the rated motor torque and rated motor speed.





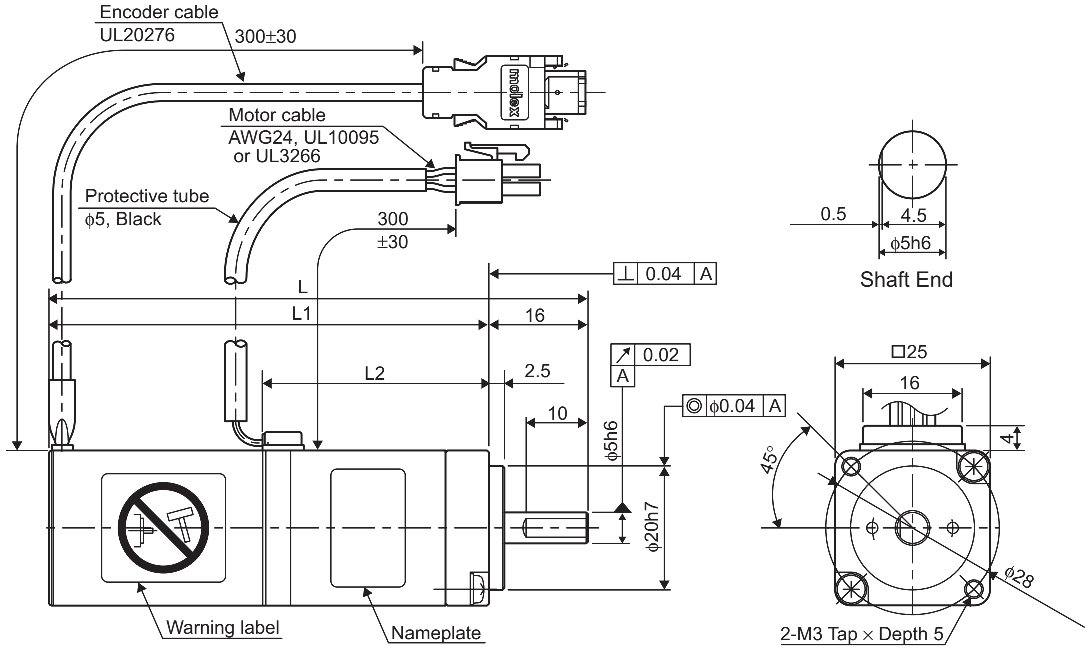
3.11 Servomotor Dimensional Drawings

Dimensional drawings for the SGM□H servomotors are broadly grouped using the following categories: With or without gears or brakes.

Series	Groups of Servomotor Dimensional Drawings	Reference
SGMMJ	Without gears	3.12.1
	With brakes	3.12.2
	With standard backlash gears	3.12.3
	With standard backlash gears and brakes	3.12.4
SGMAS	Without gears	3.13.1
	With brakes	3.13.2
	With standard backlash gears	3.13.3
	With standard backlash gears and brakes	3.13.4
	With low-backlash gears	3.13.5
	With low-backlash gears and brakes	3.13.6
	Flange-type with low-backlash gears	3.13.7
	Flange-type with low-backlash gears and brakes	3.13.8
SGMPS	Without gears	3.14.1
	With brakes	3.14.2
	With standard backlash gears	3.14.3
	With standard backlash gears and brakes	3.14.4
	With low-backlash gears	3.14.5
	With low-backlash gears and brakes	3.14.6
	Flange-type with low-backlash gears	3.14.7
	Flange-type with low-backlash gears and brakes	3.14.8
SGMSS	Without gears	3.16.1
	With brakes	3.15.2
	Flange-type with low-backlash gears	3.16.4
SGMGH (1500 min^{-1})	Without gears and brakes (Standard type)	3.18.1
	With brakes	3.18.1
	Foot-mounted type with standard backlash gears	3.18.3
	Flange-type with standard backlash gears	3.18.4
	Flange-type with low-backlash gears	3.18.5
SGMGH (1000 min^{-1})	Without gears and brakes	3.19.1
	With brakes	3.19.2
	Foot-mounted type with standard backlash gears	3.19.3
	Flange-type with standard backlash gears	3.19.4
	Flange-type with low-backlash gears	3.19.5
SGMCS	ϕ135 model	3.21.1
	ϕ175 model	3.21.2
	ϕ230 model	3.21.3
	ϕ290 model	3.21.4
	ϕ280 model	3.21.5
	ϕ360 model	3.21.6

3.12 Dimensional Drawings of SGMMJ Servomotors

3.12.1 SGMMJ Servomotors without Gears



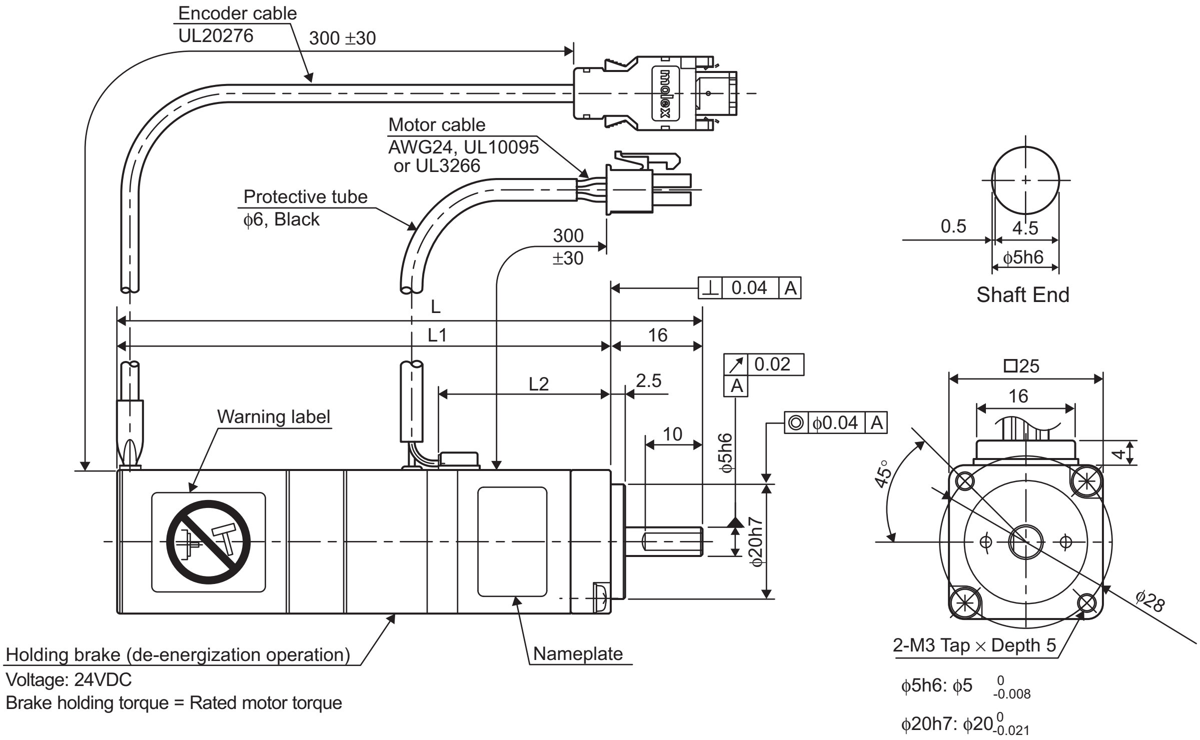
φ5h6: φ5 $^{0}_{-0.008}$

φ20h7: φ20 $^{0}_{-0.021}$

Units: mm

Model SGMMJ-	L	L1	L2	Flat	Approx. Mass g	Allowable Radial Load N	Allowable Thrust Load N
A1B□B21□	77	61	26.5	Not applied	130	34.3	14.7
A1B□BA1□				Applied			
A2B□B21□	87	71	36.5	Not applied	170	44.1	
A2B□BA1□				Applied			
A3B□B21□	97	81	46.5	Not applied	210		
A3B□BA1□				Applied			

3.12.2 SGMMJ Servomotors with Brakes



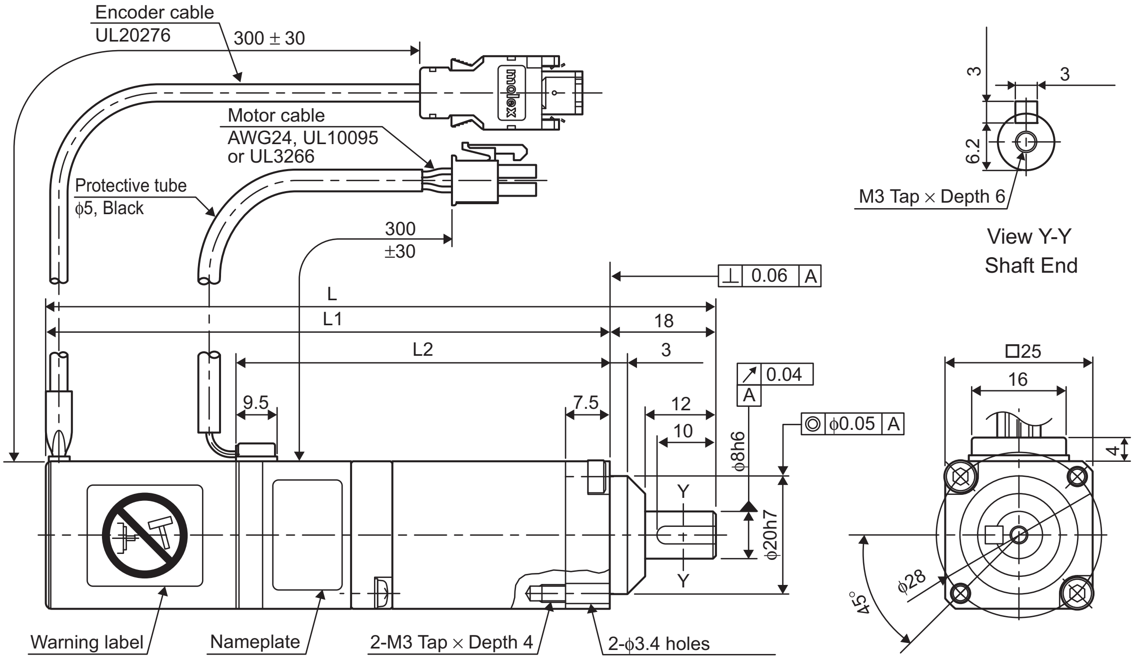
Units: mm

Model SGMMJ-	L	L1	L2	Flat	Approx. Mass g	Allowable Radial Load N	Allowable Thrust Load N
A1B□B2C□	101.5	85.5	26.5	Not applied	215	34.3	14.7
A1B□BAC□				Applied			
A2B□B2C□	115.5	99.5	36.5	Not applied	270	44.1	
A2B□BAC□				Applied			
A3B□B2C□	125.5	109.5	46.5	Not applied	310		
A3B□BAC□				Applied			

Note: The electromagnetic brake is only used to hold the position and cannot be used to stop the servomotor.

3.12.3 SGMMJ Servomotor with Standard Backlash Gears and without Brakes

(1) 10 W, 20 W



ϕ8h6: $\phi 8^{\ 0}_{-0.009}$

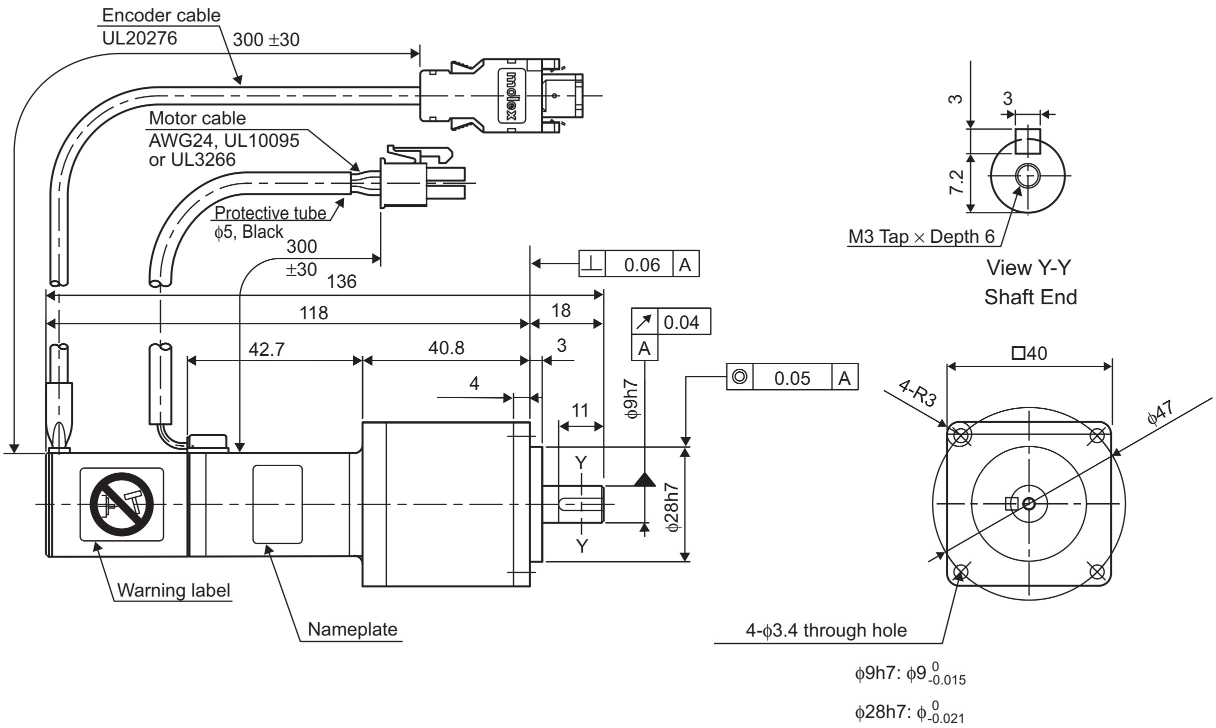
ϕ20h7: $\phi 20^{\ 0}_{-0.021}$

Units: mm

Model SGMMJ-	L	L1	L2	Key	Tap × Depth	Approx. Mass g	Allowable Radial Load N	Allowable Thrust Load N
A1B□BJA21□	113.5	95.5	61	None	No tap	240	52	47
A1B□BJA61□	124	106	71.5	Attached	M3 × 6L	275	76	
A1B□BJB21□				None	No tap	275	89	
A2B□BJB61□	123.5	105.5	71	Attached	M3 × 6L	280	52	
A2B□BJC21□	134	116	81.5	None	No tap	315	76	
A2B□BJC61□				Attached	M3 × 6L	315	89	

Note: The key slot conforms to the standard, JIS B 1301-1975 (fine class) and the parallel key is attached to it.

(2) 30 W



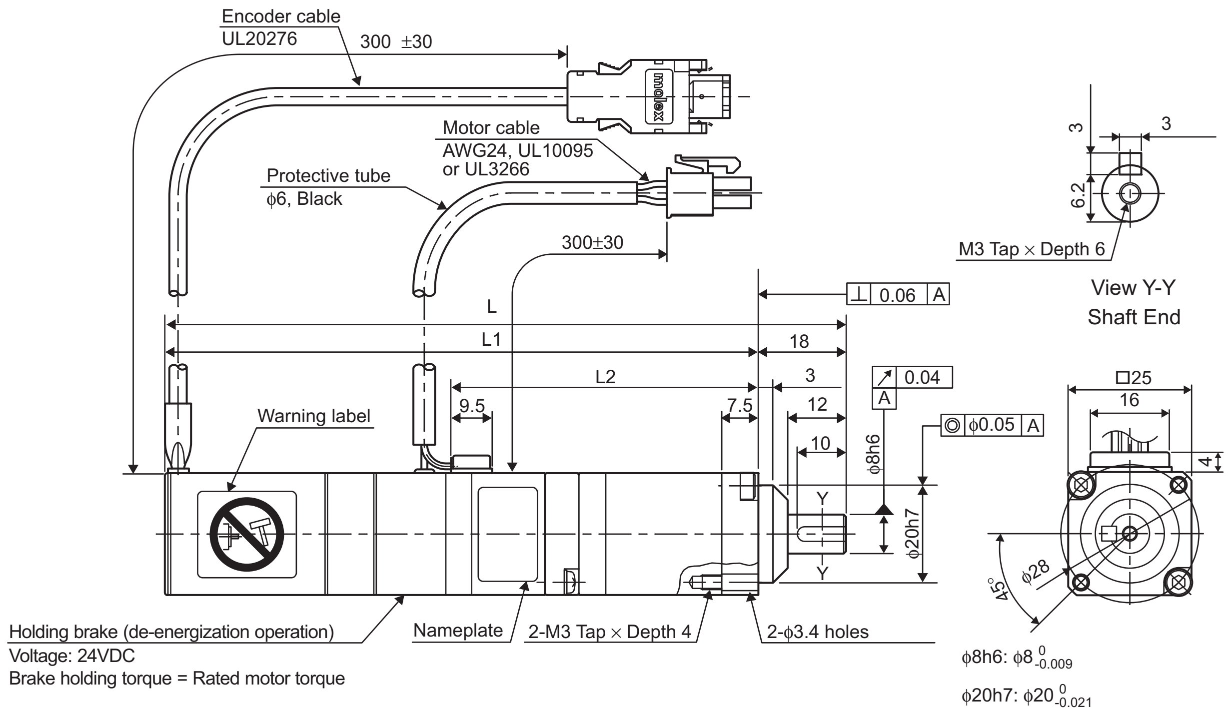
Units: mm

Model SGMMJ-	Key	Tap × Depth	Approx. Mass g	Allowable Radial Load N	Allowable Thrust Load N
A3B□BJ121□	None	No tap	410	69	59
A3B□BJ161□	Attached	M3 × 6L			
A3B□BJ221□	None	No tap		147	
A3B□BJ261□	Attached	M3 × 6L			
A3B□BJ321□	None	No tap		186	
A3B□BJ361□	Attached	M3 × 6L			

Note: The key slot conforms to the standard, JIS B 1301-1975 (fine class) and the parallel key is attached to it.

3.12.4 SGMMJ Servomotors with Standard Backlash Gears and Brakes

(1) 10 W, 20 W

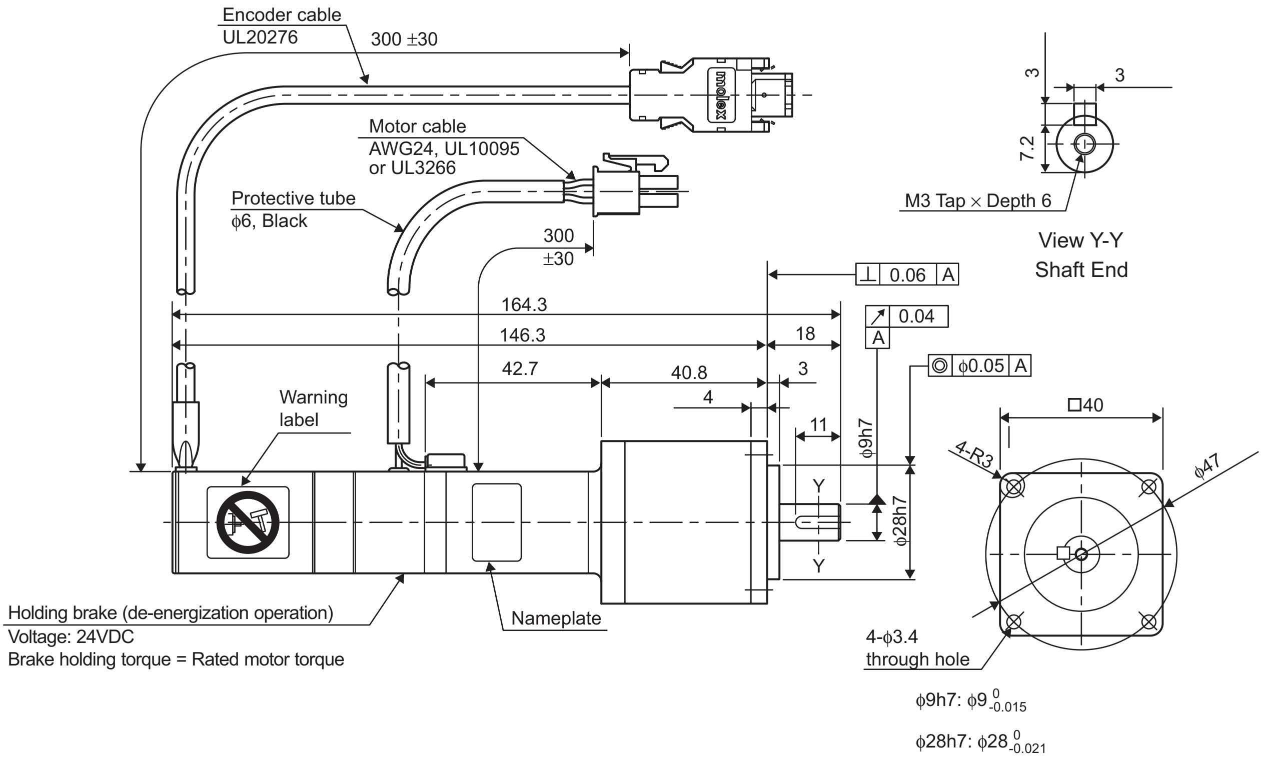


Units: mm

Model SGMMJ-	L	L1	L2	Key	Tap × Depth	Approx. Mass g	Allowable Radial Load N	Allowable Thrust Load N
A1B□BJA2C□	142	124	61	None	No tap	325	52	47
A1B□BJA6C□	152.5	134.5	71.5	Attached	M3 × 6L	360	76	
A1B□BJB2C□				None	No tap	360	89	
A2B□BJB6C□	152	134	71	Attached	M3 × 6L	380	52	
A2B□BJC2C□	162.5	144.5	81.5	None	No tap	415	76	
A2B□BJC6C□				Attached	M3 × 6L	415	89	

Note: The key slot conforms to the standard, JIS B 1301-1975 (fine class) and the parallel key is attached to it.

(2) 30 W



Units: mm

Model SGMMJ-	Tap × Depth	Approx. Mass g	Allowable Radial Load N	Allowable Thrust Load N
A3B□BJ12C□	No tap	555	69	59
A3B□BJ16C□	M3 × 6L			
A3B□BJ22C□	No tap		147	
A3B□BJ26C□	M3 × 6L			
A3B□BJ32C□	No tap		186	
A3B□BJ36C□	M3 × 6L			

Note: 1. The key slot conforms to the standard, JIS B 1301-1975 (fine class) and the parallel key is attached to it.
2. The electromagnetic brake is only used to hold the position and cannot be used to stop the servomotor.

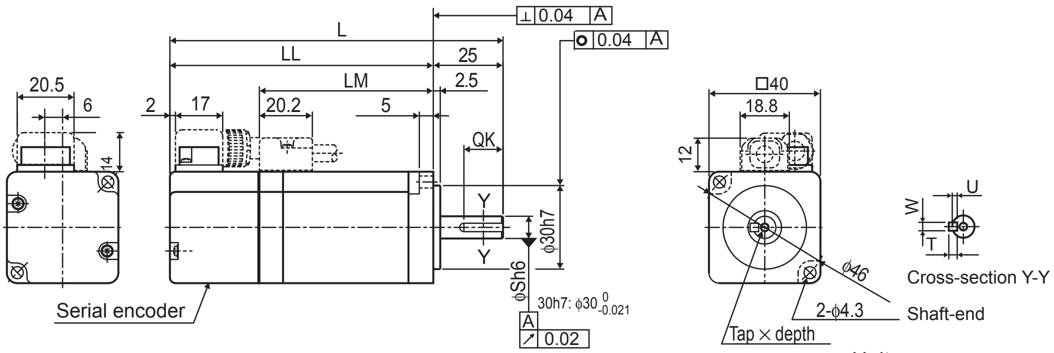
Servomotor Specifications and Dimensional Drawings

3

3.13 Dimensional Drawings of SGMAS Servomotors

3.13.1 SGMAS Servomotors without Gears

(1) 50 W, 100 W and 150 W



Units: mm

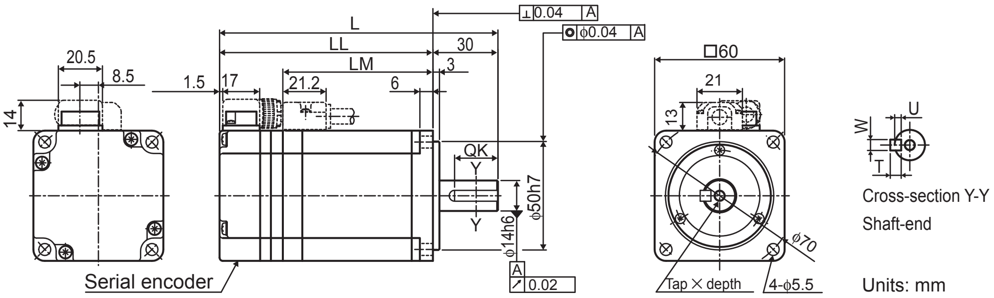
Model SGMAS-	L	LL	LM	S	Tap × Depth	QK	U	W	T	Approx. Mass kg
A5A□A21	95.5	70.5	38.5	6	No tap	No key				0.3
A5A□A41						14	1.2	2	2	
A5A□A61					M2.5 × 5L					
01A□A21	107.5	82.5	50.5	8	No tap	No key				0.4
01A□A41						14	1.8	3	3	
01A□A61					M3 × 6L					
C2A□A21	119.5	94.5	62.5	8	No tap	No key				0.5
C2A□A41						14	1.8	3	3	
C2A□A61					M3 × 6L					

- Dimensional Tolerances

Units: mm

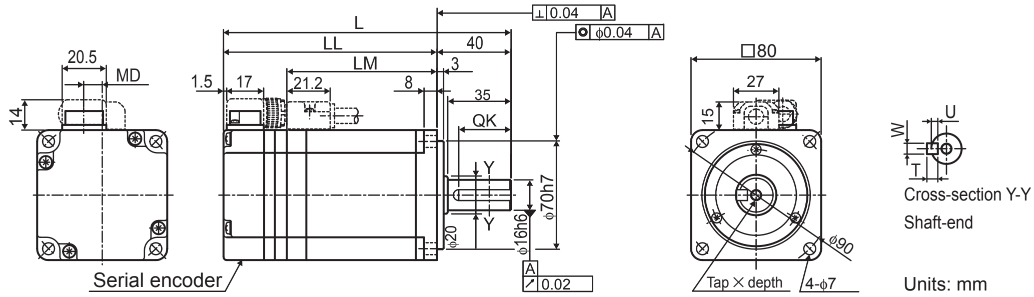
Model SGMAS-	Shaft-end Dimensions S
A5A□A21	$6^{\ 0}_{-0.008}$
A5A□A41	
A5A□A61	
01A□A21	$8^{\ 0}_{-0.009}$
01A□A41	
01A□A61	
C2A□A21	$8^{\ 0}_{-0.009}$
C2A□A41	
C2A□A61	

(2) 200 W, 400 W and 600 W



Model SGMAS-	L	LL	LM	Tap × Depth	QK	U	W	T	Approx. Mass kg
02A□A21	110	80	51	No tap	No key				0.9
02A□A41					20	3	5	5	
02A□A61				M5 × 8L					
04A□A21	128.5	98.5	69.5	No tap	No key				1.2
04A□A41					20	3	5	5	
04A□A61				M5 × 8L					
06A□A21	154.5	124.5	95.5	No tap	No key				1.7
06A□A41					20	3	5	5	
06A□A61				M5 × 8L					

(3) 750 W and 1150 W



Units: mm

Model SGMAS-	L	LL	LM	Tap × Depth	QK	U	W	T	Approx. Mass kg
08A□A21	155	115	85	No tap	No key				2.3
08A□A41					30	3	5	5	
08A□A61				M5 × 8L					
12A□A21	186.5	146.5	115	No tap	No key				3.6
12A□A41					30	3	5	5	
12A□A61				M5 × 8L					

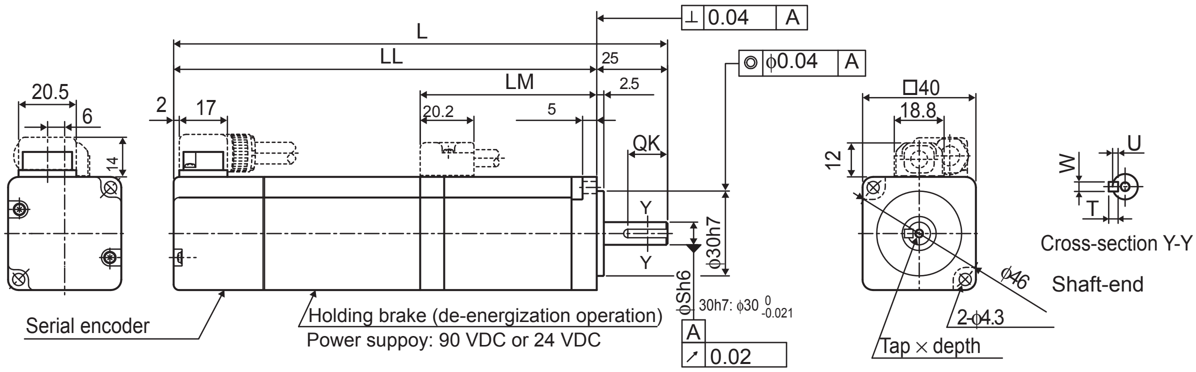
- Dimensional Tolerances

Units: mm

Model SGMAS-	Shaft-end Dimensions	Flange Face Dimensions
	S	LB
02A□A21	$14^{\ 0}_{-0.011}$	$50^{\ 0}_{-0.025}$
02A□A41		
02A□A61		
04A□A21		
04A□A41		
04A□A61		
06A□A21		
06A□A41		
06A□A61		
08A□A21	$16^{\ 0}_{-0.011}$	$70^{\ 0}_{-0.030}$
08A□A41		
08A□A61		
12A□A21		
12A□A41		
12A□A61		

3.13.2 SGMAS Servomotors with Brakes

(1) 50 W, 100 W and 150 W



Units: mm

Model SGMAS-	L	LL	LM	S	Tap × Depth	QK	U	W	T	Approx. Mass kg
A5A□A2□	140.5	115.5	38.5	6	No tap	No key				0.6
A5A□A4□						14	1.2	2	2	
A5A□A6□					M2.5 × 5L					
01A□A2□	152.5	127.5	50.5	8	No tap	No key				0.7
01A□A4□						14	1.8	3	3	
01A□A6□					M3 × 6L					
C2A□A2□	164.5	139.5	62.5	8	No tap	No key				0.8
C2A□A4□						14	1.8	3	3	
C2A□A6□					M3 × 6L					

- Dimensional Tolerances

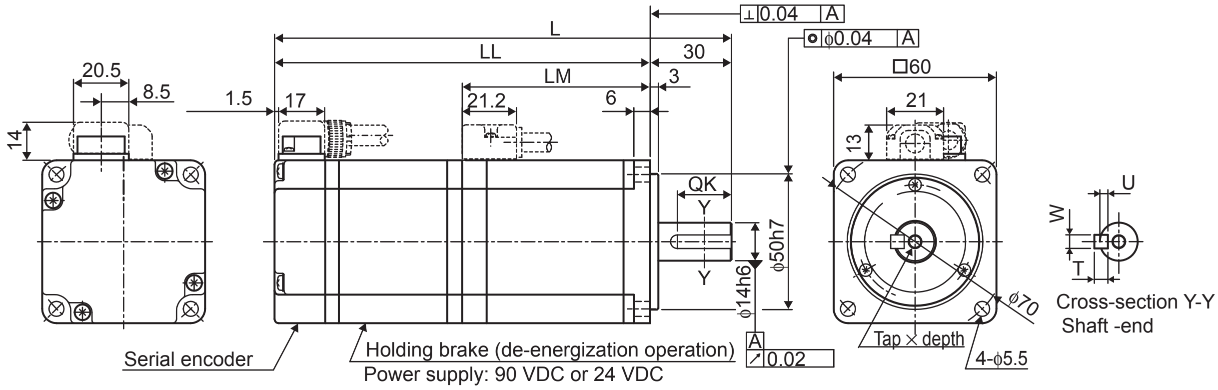
Units: mm

Model SGMAS-	Shaft-end Dimensions S
A5A□A2□	$6^{\ 0}_{-0.008}$
A5A□A4□	
A5A□A6□	
01A□A2□	$8^{\ 0}_{-0.009}$
01A□A4□	
01A□A6□	
C2A□A2□	$8^{\ 0}_{-0.009}$
C2A□A4□	
C2A□A6□	

Servomotor Specifications and Dimensional Drawings

3

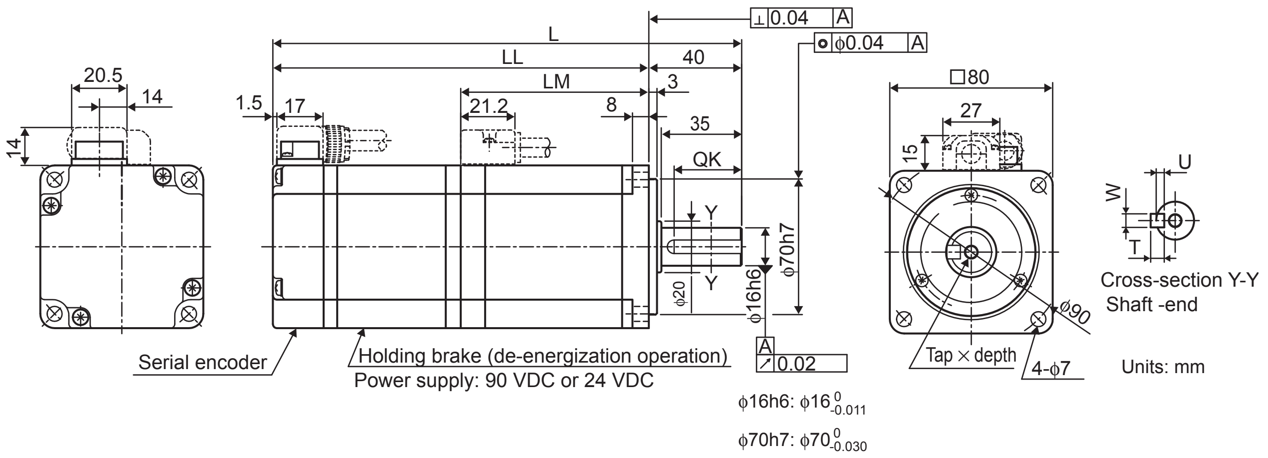
(2) 200 W, 400 W and 600 W



Units: mm

<table>
<tr><th>Model SGMAS-</th><th>L</th><th>LL</th><th>LM</th><th>Tap ×Depth</th><th>QK</th><th>U</th><th>W</th><th>T</th><th>Approx. Mass kg</th></tr>
<tr><td>02A□A2□</td><td rowspan="3">150</td><td rowspan="3">120</td><td rowspan="3">51</td><td rowspan="2">No tap</td><td colspan="4">No key</td><td rowspan="3">1.5</td></tr>
<tr><td>02A□A4□</td><td rowspan="2">20</td><td rowspan="2">3</td><td rowspan="2">5</td><td rowspan="2">5</td></tr>
<tr><td>02A□A6□</td><td>M5 × 8L</td></tr>
<tr><td>04A□A2□</td><td rowspan="3">168.5</td><td rowspan="3">138.5</td><td rowspan="3">69.5</td><td rowspan="2">No tap</td><td colspan="4">No key</td><td rowspan="3">1.8</td></tr>
<tr><td>04A□A4□</td><td rowspan="2">20</td><td rowspan="2">3</td><td rowspan="2">5</td><td rowspan="2">5</td></tr>
<tr><td>04A□A6□</td><td>M5 × 8L</td></tr>
<tr><td>06A□A2□</td><td rowspan="3">200.5</td><td rowspan="3">170.5</td><td rowspan="3">95.5</td><td rowspan="2">No tap</td><td colspan="4">No key</td><td rowspan="3">2.4</td></tr>
<tr><td>06A□A4□</td><td rowspan="2">20</td><td rowspan="2">3</td><td rowspan="2">5</td><td rowspan="2">5</td></tr>
<tr><td>06A□A6□</td><td>M5 × 8L</td></tr>
</table>

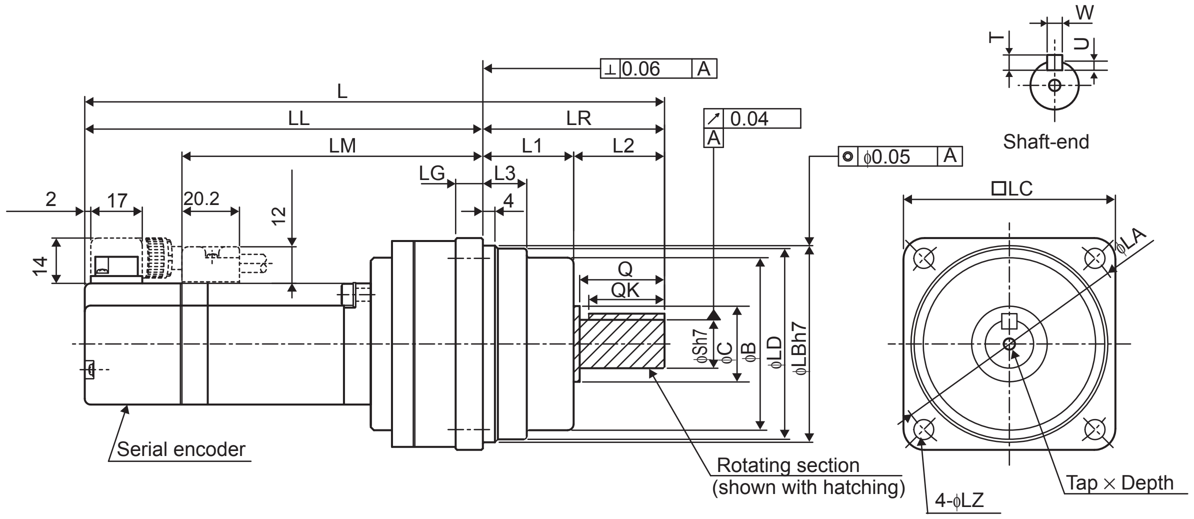
(3) 750 W and 1150 W



Model SGMAS-	L	LL	LM	Tap ×Depth	QK	U	W	T	Approx. Mass kg
08A□A2□	200	160	85	No tap	No key				3.2
08A□A4□					30	3	5	5	
08A□A6□				M5 × 8L					
12A□A2□	236.5	196.5	115	No tap	No key				4.5
12A□A4□					30	3	5	5	
12A□A6□				M5 × 8L					

3.13.3 SGMAS Servomotors with Standard Backlash Gears

(1) 50 W, 100 W and150 W



Units: mm

Model SGMAS-	Gear Ratio	L	LL	LM	LR	LG	B	LD	LB	LC	LA	LZ
A5A□AJ1□1	1/5	157.5	102.5	70.5	55	8	47	55.5	56	60	70	5.5
A5A□AJ3□1	3/31	167.5	107.5	75.5	60	9	57	63	65	70	80	6.6
A5A□AJC□1	1/21	184.5	124.5	92.5								
A5A□AJ7□1	1/33											
01A□AJ1□1	1/5	179.5	119.5	87.5	60	9	57	63	65	70	80	6.6
01A□AJ3□1	3/31											
01A□AJC□1	1/21	215	141	109	74	10	69	83	85	90	105	9
01A□AJ7□1	1/33											
C2A□AJ1□1	1/5	191.5	131.5	99.5	60	9	57	63	65	70	80	6.6
C2A□AJ3□1	3/31	210	136	104	74	10	69	83	85	90	105	9
C2A□AJC□1	1/21	227	153	121								
C2A□AJ7□1	1/33	247.5	163.5	131.5	84	12	82	98	100	105	120	

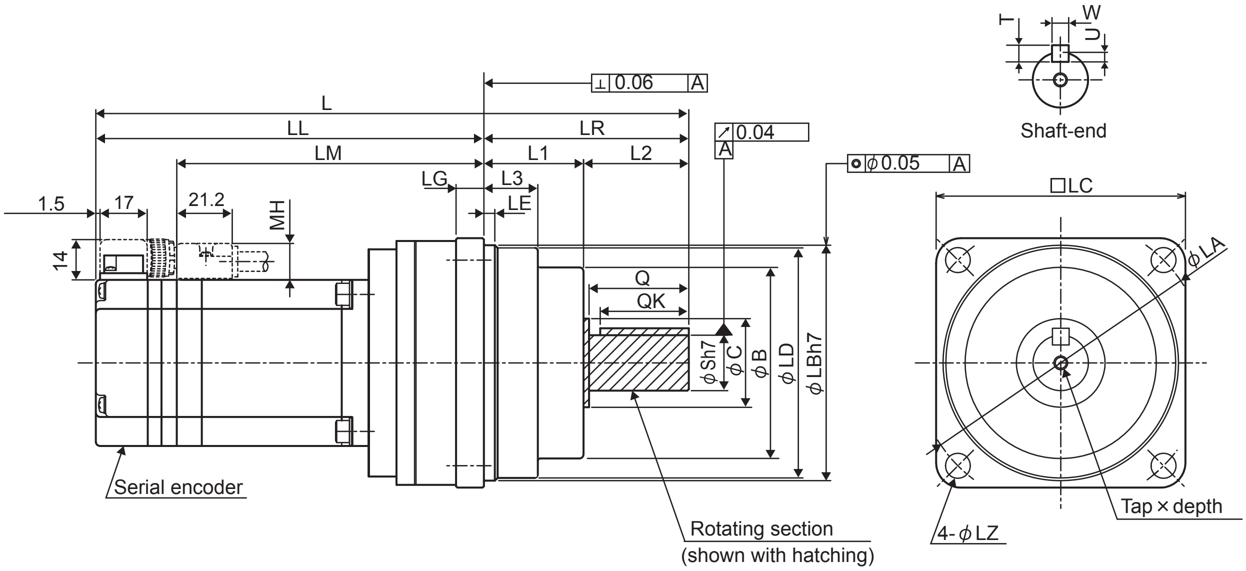
Model SGMAS-	L1	L2	L3	Q	C	S	Tap × Depth	QK	U	W	T	Approx. Mass kg
A5A□AJ1□1	28	27	17	25	20	14	M4 × 8L	20	3	5	5	0.9
A5A□AJ3□1	30	30	14.5	28	25	16		25				1.1
A5A□AJC□1												1.2
A5A□AJ7□1												
01A□AJ1□1	30	30	14.5	28	25	16	M4 × 8L	25	3	5	5	1.2
01A□AJ3□1												
01A□AJC□1	36	38	19.5	36	32	20	M5 × 10L	32	3.5	6	6	2.0
01A□AJ7□1												
C2A□AJ1□1	30	30	14.5	28	25	16	M4 × 8L	25	3	5	5	1.3
C2A□AJ3□1	36	38	19.5	36	32	20	M5 × 10L	32	3.5	6	6	1.8
C2A□AJC□1												2.1
C2A□AJ7□1	40	44	23	42	40	25	M6 × 12L	36	4	8	7	3.6

• Dimensional Tolerances

Units: mm

Model SGMAS-	Shaft-end Dimensions	Flange Face Dimensions
	S	LB
A5A□AJ1□1	$14^{\ 0}_{-0.018}$	$56^{\ 0}_{-0.030}$
A5A□AJ3□1	$16^{\ 0}_{-0.018}$	$65^{\ 0}_{-0.030}$
A5A□AJC□1		
A5A□AJ7□1		
01A□AJ1□1	$16^{\ 0}_{-0.018}$	$65^{\ 0}_{-0.030}$
01A□AJ3□1		
01A□AJC□1	$20^{\ 0}_{-0.021}$	$85^{\ 0}_{-0.035}$
01A□AJ7□1		
C2A□AJ1□1	$16^{\ 0}_{-0.018}$	$65^{\ 0}_{-0.030}$
C2A□AJ3□1	$20^{\ 0}_{-0.021}$	$85^{\ 0}_{-0.035}$
C2A□AJC□1		
C2A□AJ7□1	$25^{\ 0}_{-0.021}$	$100^{\ 0}_{-0.035}$

(2) 200 W, 400 W, 600 W, 750 W and 1150 W



Units: mm

Model SGMAS-	Gear Ratio	L	LL	LM	LR	LE	LG	B	LD	LB	LC	LA	LZ
02A□AJ1□1	1/5	195.5	121.5	92.5	74	4	10	69	83	85	90	105	9
02A□AJ3□1	3/31												
02A□AJC□1	1/21	233	149	120	84		12	82	98	100	105	120	
02A□AJ7□1	1/33												
04A□AJ1□1	1/5	214	140	111	74	4	10	69	83	85	90	105	9
04A□AJ3□1	3/31	230.5	146.5	117.5	84		12	82	98	100	105	120	
04A□AJC□1	1/21	279.5	174.5	145.5	105	5	13	93	112	115	120	135	11
04A□AJ7□1	1/33												
06A□AJ1□1	1/5	240	166	137	74	4	10	69	83	85	90	105	9
06A□AJ3□1	3/31	280.5	175.5	146.5	105	5	13	93	112	115	120	135	11
06A□AJC□1	1/21	305.5	200.5	171.5									
06A□AJ7□1	1/33	309.5	202.5	173.5	107	10	15	107	134	140	145	165	14
08A□AJ1□1	1/5	247	163	133	84	4	12	82	98	100	105	120	9
08A□AJ3□1	3/31	271	166	136	105	5	13	93	112	115	120	135	11
08A□AJC□1	1/21	300	193	163	107	10	15	107	134	140	145	165	14
08A□AJ7□1	1/33												
12A□AJ1□1	1/5	278.5	194.5	163	84	4	12	82	98	100	105	120	9
12A□AJB□1	1/11	334.5	227.5	227	107	10	15	107	134	140	145	165	14
12A□AJC□1	1/21	331.5	224.5	193									
12A□AJ7□1	1/33	352.5	235.5	204	117	17	16	135	163	165	170	190	

(cont'd)

<table>
<tr><th>Model SGMAS-</th><th>L1</th><th>L2</th><th>L3</th><th>Q</th><th>C</th><th>S</th><th>Tap × Depth</th><th>QK</th><th>U</th><th>W</th><th>T</th><th>MH</th><th>Approx. Mass kg</th></tr>
<tr><td>02A□AJ1□1</td><td rowspan="2">36</td><td rowspan="2">38</td><td rowspan="2">19.5</td><td rowspan="2">36</td><td rowspan="2">32</td><td rowspan="2">20</td><td rowspan="2">M5 × 10L</td><td rowspan="2">32</td><td rowspan="2">3.5</td><td rowspan="2">6</td><td rowspan="2">6</td><td rowspan="12">13</td><td rowspan="2">2.6</td></tr>
<tr><td>02A□AJ3□1</td></tr>
<tr><td>02A□AJC□1</td><td rowspan="2">40</td><td rowspan="2">44</td><td rowspan="2">23</td><td rowspan="2">42</td><td rowspan="2">40</td><td rowspan="2">25</td><td rowspan="2">M6 × 12L</td><td rowspan="2">36</td><td rowspan="2">4</td><td rowspan="2">8</td><td rowspan="2">7</td><td rowspan="2">4.0</td></tr>
<tr><td>02A□AJ7□1</td></tr>
<tr><td>04A□AJ1□1</td><td>36</td><td>38</td><td>19.5</td><td>36</td><td>32</td><td>20</td><td>M5 × 10L</td><td>32</td><td>3.5</td><td>6</td><td>6</td><td>2.9</td></tr>
<tr><td>04A□AJ3□1</td><td>40</td><td>44</td><td>23</td><td>42</td><td>40</td><td>25</td><td>M6 × 12L</td><td>36</td><td>4</td><td>8</td><td>7</td><td>3.8</td></tr>
<tr><td>04A□AJC□1</td><td rowspan="2">45</td><td rowspan="2">60</td><td rowspan="2">26.5</td><td rowspan="2">58</td><td rowspan="2">50</td><td rowspan="2">32</td><td rowspan="2">M8 × 16L</td><td rowspan="2">50</td><td rowspan="2">5</td><td rowspan="2">10</td><td rowspan="2">8</td><td rowspan="2">5.9</td></tr>
<tr><td>04A□AJ7□1</td></tr>
<tr><td>06A□AJ1□1</td><td>36</td><td>38</td><td>19.5</td><td>36</td><td>32</td><td>20</td><td>M5 × 10L</td><td>32</td><td>3.5</td><td>6</td><td>6</td><td>3.4</td></tr>
<tr><td>06A□AJ3□1</td><td rowspan="2">45</td><td rowspan="2">60</td><td rowspan="2">26.5</td><td rowspan="2">58</td><td rowspan="2">50</td><td rowspan="2">32</td><td rowspan="2">M8 × 16L</td><td rowspan="2">50</td><td rowspan="2">5</td><td rowspan="2">10</td><td rowspan="2">8</td><td>6</td></tr>
<tr><td>06A□AJC□1</td><td>6.4</td></tr>
<tr><td>06A□AJ7□1</td><td>44</td><td>63</td><td>42</td><td>60</td><td>46</td><td>40</td><td>M10 × 20L</td><td>45</td><td>5</td><td>12</td><td>8</td><td>11.5</td></tr>
<tr><td>08A□AJ1□1</td><td>40</td><td>44</td><td>23</td><td>42</td><td>40</td><td>25</td><td>M6 × 12L</td><td>36</td><td>4</td><td>8</td><td>7</td><td rowspan="4">15</td><td>4.9</td></tr>
<tr><td>08A□AJ3□1</td><td>45</td><td>60</td><td>26.5</td><td>58</td><td>50</td><td>32</td><td>M8 × 16L</td><td>50</td><td rowspan="3">5</td><td>10</td><td rowspan="3">8</td><td>6.5</td></tr>
<tr><td>08A□AJC□1</td><td rowspan="2">44</td><td rowspan="2">63</td><td rowspan="2">42</td><td rowspan="2">60</td><td rowspan="2">46</td><td rowspan="2">40</td><td rowspan="2">M10 × 20L</td><td rowspan="2">45</td><td rowspan="2">12</td><td rowspan="2">11.3</td></tr>
<tr><td>08A□AJ7□1</td></tr>
<tr><td>12A□AJ1□1</td><td>40</td><td>44</td><td>23</td><td>42</td><td>40</td><td>25</td><td>M6 × 12L</td><td>36</td><td>4</td><td>8</td><td>7</td><td rowspan="4">15</td><td>6.2</td></tr>
<tr><td>12A□AJB□1</td><td rowspan="2">44</td><td rowspan="2">63</td><td rowspan="2">42</td><td rowspan="3">60</td><td rowspan="2">46</td><td rowspan="2">40</td><td rowspan="3">M10 × 20L</td><td rowspan="3">45</td><td rowspan="2">5</td><td rowspan="2">12</td><td rowspan="2">8</td><td rowspan="2">12.6</td></tr>
<tr><td>12A□AJC□1</td></tr>
<tr><td>12A□AJ7□1</td><td>53</td><td>64</td><td>51</td><td>51</td><td>45</td><td>5.5</td><td>14</td><td>9</td><td>18.6</td></tr>
</table>

Servomotor Specifications and Dimensional Drawings

3

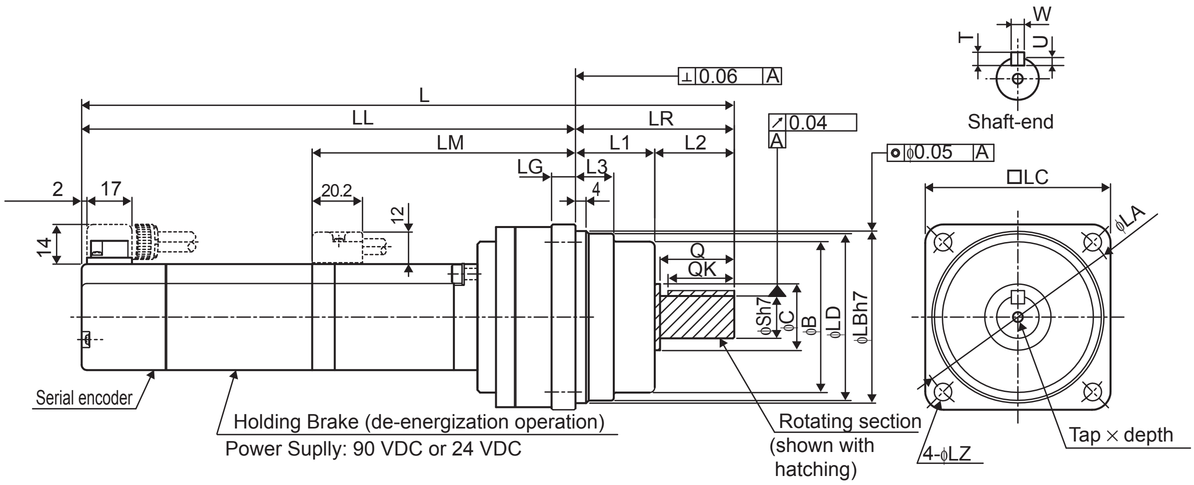
• Dimensional Tolerances

Units: mm

Model SGMAS-	Shaft-end Dimensions	Flange Face Dimensions
	S	LB
02A☐AJ1☐1	$20^{0}_{-0.021}$	$85^{0}_{-0.035}$
02A☐AJ3☐1		
02A☐AJC☐1	$25^{0}_{-0.021}$	$100^{0}_{-0.035}$
02A☐AJ7☐1		
04A☐AJ1☐1	$20^{0}_{-0.021}$	$85^{0}_{-0.035}$
04A☐AJ3☐1	$25^{0}_{-0.021}$	$100^{0}_{-0.035}$
04A☐AJC☐1	$32^{0}_{-0.025}$	$115^{0}_{-0.035}$
04A☐AJ7☐1		
06A☐AJ1☐1	$20^{0}_{-0.021}$	$85^{0}_{-0.035}$
06A☐AJ3☐1	$32^{0}_{-0.025}$	$115^{0}_{-0.035}$
06A☐AJC☐1		
06A☐AJ7☐1	$40^{0}_{-0.025}$	$140^{0}_{-0.040}$
08A☐AJ1☐1	$25^{0}_{-0.021}$	$100^{0}_{-0.035}$
08A☐AJ3☐1	$32^{0}_{-0.025}$	$115^{0}_{-0.035}$
08A☐AJC☐1	$40^{0}_{-0.025}$	$140^{0}_{-0.040}$
08A☐AJ7☐1		
12A☐AJ1☐1	$25^{0}_{-0.021}$	$100^{0}_{-0.035}$
12A☐AJB☐1	$40^{0}_{-0.025}$	$140^{0}_{-0.040}$
12A☐AJC☐1	$40^{0}_{-0.025}$	$140^{0}_{-0.040}$
12A☐AJ7☐1	$45^{0}_{-0.025}$	$165^{0}_{-0.040}$

3.13.4 SGMAS Servomotors with Standard Backlash Gears and Brakes

(1) 50 W, 100 W and 150 W



Units: mm

Model SGMAS-	Gear Ratio	L	LL	LM	LR	LG	B	LD	LB	LC	LA	LZ
A5A□AJ1□□	1/5	202.5	147.5	70.5	55	8	47	55.5	56	60	70	5.5
A5A□AJ3□□	3/31	212.5	152.5	75.5	60	9	57	63	65	70	80	6.6
A5A□AJC□□	1/21	229.5	169.5	92.5								
A5A□AJ7□□	1/33											
01A□AJ1□□	1/5	224.5	164.5	87.5	60	9	57	63	65	70	80	6.6
01A□AJ3□□	3/31											
01A□AJC□□	1/21	260	186	109	74	10	69	83	85	90	105	9
01A□AJ7□□	1/33											
C2A□AJ1□□	1/5	236.5	176.5	99.5	60	9	57	63	65	70	80	6.6
C2A□AJ3□□	3/31	255	181	104	74	10	69	83	85	90	105	9
C2A□AJC□□	1/21	272	198	121								
C2A□AJ7□□	1/33	292.5	208.5	131.5	84	12	82	98	100	105	120	

Servomotor Specifications and Dimensional Drawings

3

(cont'd)

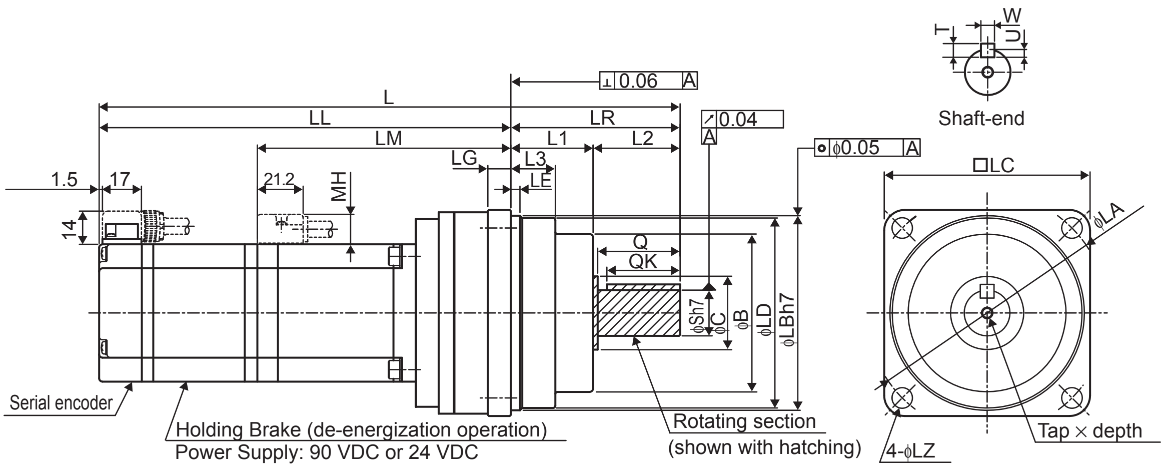
<table>
<tr><th>Model SGMAS-</th><th>L1</th><th>L2</th><th>L3</th><th>Q</th><th>C</th><th>S</th><th>Tap × Depth</th><th>QK</th><th>U</th><th>W</th><th>T</th><th>Approx. Mass kg</th></tr>
<tr><td>A5A□AJ1□□</td><td>28</td><td>27</td><td>17</td><td>25</td><td>20</td><td>14</td><td rowspan="4">M4 × 8L</td><td>20</td><td rowspan="4">3</td><td rowspan="4">5</td><td rowspan="4">5</td><td>1.2</td></tr>
<tr><td>A5A□AJ3□□</td><td rowspan="3">30</td><td rowspan="3">30</td><td rowspan="3">14.5</td><td rowspan="3">28</td><td rowspan="3">25</td><td rowspan="3">16</td><td rowspan="3">25</td><td>1.4</td></tr>
<tr><td>A5A□AJC□□</td><td rowspan="2">1.5</td></tr>
<tr><td>A5A□AJ7□□</td></tr>
<tr><td>01A□AJ1□□</td><td rowspan="2">30</td><td rowspan="2">30</td><td rowspan="2">14.5</td><td rowspan="2">28</td><td rowspan="2">25</td><td rowspan="2">16</td><td rowspan="2">M4 × 8L</td><td rowspan="2">25</td><td rowspan="2">3</td><td rowspan="2">5</td><td rowspan="2">5</td><td rowspan="2">1.5</td></tr>
<tr><td>01A□AJ3□□</td></tr>
<tr><td>01A□AJC□□</td><td rowspan="2">36</td><td rowspan="2">38</td><td rowspan="2">19.5</td><td rowspan="2">36</td><td rowspan="2">32</td><td rowspan="2">20</td><td rowspan="2">M5 × 10L</td><td rowspan="2">32</td><td rowspan="2">3.5</td><td rowspan="2">6</td><td rowspan="2">6</td><td rowspan="2">2.6</td></tr>
<tr><td>01A□AJ7□□</td></tr>
<tr><td>C2A□AJ1□□</td><td>30</td><td>30</td><td>14.5</td><td>28</td><td>25</td><td>16</td><td>M4 × 8L</td><td>25</td><td>3</td><td>5</td><td>5</td><td>1.6</td></tr>
<tr><td>C2A□AJ3□□</td><td rowspan="2">36</td><td rowspan="2">38</td><td rowspan="2">19.5</td><td rowspan="2">36</td><td rowspan="2">32</td><td rowspan="2">20</td><td rowspan="2">M5 × 10L</td><td rowspan="2">32</td><td rowspan="2">3.5</td><td rowspan="2">6</td><td rowspan="2">6</td><td>2.5</td></tr>
<tr><td>C2A□AJC□□</td><td>2.7</td></tr>
<tr><td>C2A□AJ7□□</td><td>40</td><td>44</td><td>23</td><td>42</td><td>40</td><td>25</td><td>M6 × 12L</td><td>36</td><td>4</td><td>8</td><td>7</td><td>3.9</td></tr>
</table>

- Dimensional Tolerances

Units: mm

<table>
<tr><th rowspan="2">Model SGMAS-</th><th>Shaft-end Dimensions</th><th>Flange Face Dimensions</th></tr>
<tr><th>S</th><th>LB</th></tr>
<tr><td>A5A□AJ1□□</td><td>$14^{\ 0}_{-0.018}$</td><td>$56^{\ 0}_{-0.030}$</td></tr>
<tr><td>A5A□AJ3□□</td><td rowspan="3">$16^{\ 0}_{-0.018}$</td><td rowspan="3">$65^{\ 0}_{-0.030}$</td></tr>
<tr><td>A5A□AJC□□</td></tr>
<tr><td>A5A□AJ7□□</td></tr>
<tr><td>01A□AJ1□□</td><td rowspan="2">$16^{\ 0}_{-0.018}$</td><td rowspan="2">$65^{\ 0}_{-0.030}$</td></tr>
<tr><td>01A□AJ3□□</td></tr>
<tr><td>01A□AJC□□</td><td rowspan="2">$20^{\ 0}_{-0.021}$</td><td rowspan="2">$85^{\ 0}_{-0.035}$</td></tr>
<tr><td>01A□AJ7□□</td></tr>
<tr><td>C2A□AJ1□□</td><td>$16^{\ 0}_{-0.018}$</td><td>$65^{\ 0}_{-0.030}$</td></tr>
<tr><td>C2A□AJ3□□</td><td rowspan="2">$20^{\ 0}_{-0.021}$</td><td rowspan="2">$85^{\ 0}_{-0.035}$</td></tr>
<tr><td>C2A□AJC□□</td></tr>
<tr><td>C2A□AJ7□□</td><td>$25^{\ 0}_{-0.021}$</td><td>$100^{\ 0}_{-0.035}$</td></tr>
</table>

(2) 200 W, 400 W, 600 W, 750 W and 1150 W



Units: mm

Model SGMAS-	Gear Ratio	L	LL	LM	LR	LE	LG	B	LD	LB	LC	LA	LZ
02A□AJ1□□	1/5	235.5	161.5	92.5	74	4	10	69	83	85	90	105	9
02A□AJ3□□	3/31												
02A□AJC□□	1/21	273	189	120	84		12	82	98	100	105	120	
02A□AJ7□□	1/33												
04A□AJ1□□	1/5	254	180	111	74	4	10	69	83	85	90	105	9
04A□AJ3□□	3/31	270.5	186.5	117.5	84		12	82	98	100	105	120	
04A□AJC□□	1/21	319.5	214.5	145.5	105	5	13	93	112	115	120	135	11
04A□AJ7□□	1/33												
06A□AJ1□□	1/5	287.5	213.5	137	74	4	10	69	83	85	90	105	9
06A□AJ3□□	3/31	328	223	146.5	84	5	13	93	112	115	120	135	11
06A□AJC□□	1/21	353	248	171.5	105								
06A□AJ7□□	1/33	357	250	173.5	107	10	15	107	134	140	145	165	14
08A□AJ1□□	1/5	292	208	133	84	4	12	82	98	100	105	120	9
08A□AJ3□□	3/31	316	211	136	105	5	13	93	112	115	120	135	11
08A□AJC□□	1/21	345	238	163	107	10	15	107	134	140	145	165	14
08A□AJ7□□	1/33												
12A□AJ1□□	1/5	328.5	244.5	163	84	4	12	82	98	100	105	120	9
12A□AJB□□	1/11	384.5	277.5	227	107	10	15	107	134	140	145	165	14
12A□AJC□□	1/21	381.5	274.5	193									
12A□AJ7□□	1/33	402.5	285.5	204	117	17	16	135	163	165	170	190	

(cont'd)

Model SGMAS-	L1	L2	L3	Q	C	S	Tap × Depth	QK	U	W	T	MH	Approx. Mass kg
02A□AJ1□□	36	38	19.5	36	32	20	M5 × 10L	32	3.5	6	6	13	3.2
02A□AJ3□□													
02A□AJC□□	40	44	23	42	40	25	M6 × 12L	36	4	8	7		4.6
02A□AJ7□□													
04A□AJ1□□	36	38	19.5	36	32	20	M5 × 10L	32	3.5	6	6		3.5
04A□AJ3□□	40	44	23	42	40	25	M6 × 12L	36	4	8	7		4.4
04A□AJC□□	45	60	26.5	58	50	32	M8 × 16L	50	5	10	8		6.5
04A□AJ7□□													
06A□AJ1□□	36	38	19.5	36	32	20	M5 × 10L	32	3.5	6	6		4.1
06A□AJ3□□	45	60	26.5	58	50	32	M8 × 16L	50	5	10	8		6.7
06A□AJC□□													7.1
06A□AJ7□□	44	63	42	60	46	40	M10 × 20L	45	5	12	8		12.2
08A□AJ1□□	40	44	23	42	40	25	M6 × 12L	36	4	8	7	15	5.8
08A□AJ3□□	45	60	26.5	58	50	32	M8 × 16L	50	5	10	8		7.3
08A□AJC□□	44	63	42	60	46	40	M10 × 20L	45		12			12.2
08A□AJ7□□													
12A□AJ1□□	40	44	23	42	40	25	M6 × 12L	36	4	8	7	15	7.1
12A□AJB□□	44	63	42	60	46	40	M10 × 20L	45	5	12	8		13.5
12A□AJC□□													
12A□AJ7□□	53	64	51		51	45			5.5	14	9		19.5

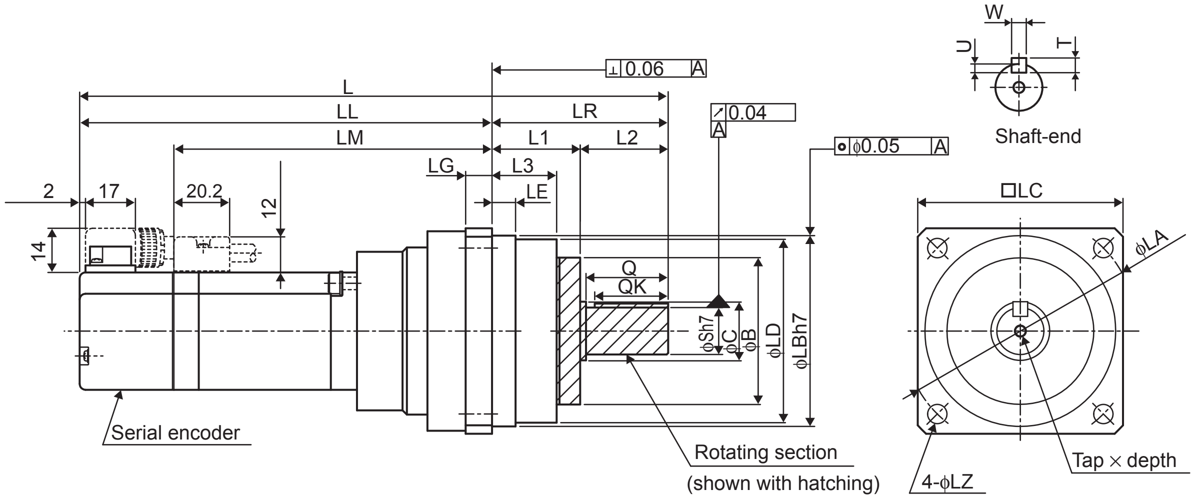
- Dimensional Tolerances

Units: mm

<table>
<tr><th rowspan="2">Model SGMAS-</th><th>Shaft-end Dimensions</th><th>Flange Face Dimensions</th></tr>
<tr><th>S</th><th>LB</th></tr>
<tr><td>02A□AJ1□□</td><td rowspan="2">$20^{\ 0}_{-0.021}$</td><td rowspan="2">$85^{\ 0}_{-0.035}$</td></tr>
<tr><td>02A□AJ3□□</td></tr>
<tr><td>02A□AJC□□</td><td rowspan="2">$25^{\ 0}_{-0.021}$</td><td rowspan="2">$100^{\ 0}_{-0.035}$</td></tr>
<tr><td>02A□AJ7□□</td></tr>
<tr><td>04A□AJ1□□</td><td>$20^{\ 0}_{-0.021}$</td><td>$85^{\ 0}_{-0.035}$</td></tr>
<tr><td>04A□AJ3□□</td><td>$25^{\ 0}_{-0.021}$</td><td>$100^{\ 0}_{-0.035}$</td></tr>
<tr><td>04A□AJC□□</td><td rowspan="2">$32^{\ 0}_{-0.025}$</td><td rowspan="2">$115^{\ 0}_{-0.035}$</td></tr>
<tr><td>04A□AJ7□□</td></tr>
<tr><td>06A□AJ1□□</td><td>$20^{\ 0}_{-0.021}$</td><td>$85^{\ 0}_{-0.035}$</td></tr>
<tr><td>06A□AJ3□□</td><td rowspan="2">$32^{\ 0}_{-0.025}$</td><td rowspan="2">$115^{\ 0}_{-0.035}$</td></tr>
<tr><td>06A□AJC□□</td></tr>
<tr><td>06A□AJ7□□</td><td>$40^{\ 0}_{-0.025}$</td><td>$140^{\ 0}_{-0.040}$</td></tr>
<tr><td>08A□AJ1□□</td><td>$25^{\ 0}_{-0.021}$</td><td>$100^{\ 0}_{-0.035}$</td></tr>
<tr><td>08A□AJ3□□</td><td>$32^{\ 0}_{-0.025}$</td><td>$115^{\ 0}_{-0.035}$</td></tr>
<tr><td>08A□AJC□□</td><td rowspan="2">$40^{\ 0}_{-0.025}$</td><td rowspan="2">$140^{\ 0}_{-0.040}$</td></tr>
<tr><td>08A□AJ7□□</td></tr>
<tr><td>12A□AJ1□□</td><td>$25^{\ 0}_{-0.021}$</td><td>$100^{\ 0}_{-0.035}$</td></tr>
<tr><td>12A□AJB□□</td><td>$40^{\ 0}_{-0.025}$</td><td>$140^{\ 0}_{-0.040}$</td></tr>
<tr><td>12A□AJC□□</td><td>$40^{\ 0}_{-0.025}$</td><td>$140^{\ 0}_{-0.040}$</td></tr>
<tr><td>12A□AJ7□□</td><td>$45^{\ 0}_{-0.025}$</td><td>$165^{\ 0}_{-0.040}$</td></tr>
</table>

3.13.5 SGMAS Servomotors with Low-backlash Gears

(1) 50 W, 100 W and 150 W



Units: mm

Model SGMAS-	Gear Ratio	L	LL	LM	LR	LE	LG	B	LD	LB	LC	LA	LZ
A5A□AH1□1	1/5	153.5	98.5	66.5	55	6	8	40	55.5	56	60	70	5.5
A5A□AH2□1	1/9	159.5	99.5	67.5	60	8	9	50	64.5	65	70	80	6.6
A5A□AHC□1	1/21	176.5	116.5	84.5				40					
A5A□AH7□1	1/33												
01A□AH1□1	1/5	171.5	111.5	79.5	60	8	9	40	64.5	65	70	80	6.6
01A□AHB□1	1/11	188.5	128.5	96.5									
01A□AHC□1	1/21	211.5	137.5	105.5	74	7.5	10	59	84	85	90	105	9
01A□AH7□1	1/33												
C2A□AH1□1	1/5	183.5	123.5	91.5	60	8	9	40	64.5	65	70	80	6.6
C2A□AHB□1	1/11	223.5	149.5	117.5	74	7.5	10	59	84	85	90	105	9
C2A□AHC□1	1/21												
C2A□AH7□1	1/33	229.5	145.5	113.5	84	12	12		96	100	105	120	

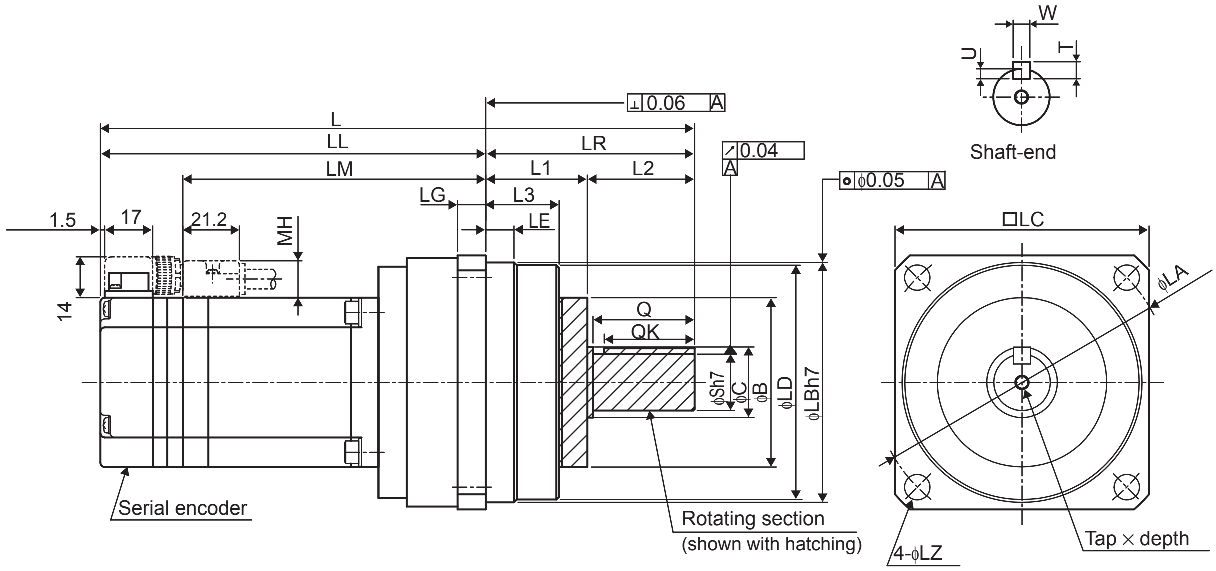
Model SGMAS-	L1	L2	L3	Q	C	S	Tap × Depth	QK	U	W	T	Approx. Mass kg
A5A□AH1□1	28	27	20	25	20	14	M4 × 8L	20	3	5	5	0.9
A5A□AH2□1	30	30	22	28		16		25				1.2
A5A□AHC□1												1.5
A5A□AH7□1												
01A□AH1□1	30	30	22	28	20	16	M4 × 8L	25	3	5	5	1.3
01A□AHB□1												1.6
01A□AHC□1	36	38	26	36	26	20	M5 × 10L	32	3.5	6	6	2.6
01A□AH7□1												
C2A□AH1□1	30	30	22	28	20	16	M4 × 8L	25	3	5	5	1.4
C2A□AHB□1	36	38	26	36	26	20	M5 × 10L	32	3.5	6	6	2.9
C2A□AHC□1												2.7
C2A□AH7□1	40	44	29	42	32	25	M6 × 12L	36	4	8	7	3.2

• Dimensional Tolerances

Units: mm

Model SGMAS-	Shaft-end Dimensions	Flange Face Dimensions
	S	LB
A5A☐AH1☐1	$14^{\ 0}_{-0.018}$	$56^{\ 0}_{-0.030}$
A5A☐AH2☐1	$16^{\ 0}_{-0.018}$	$65^{\ 0}_{-0.030}$
A5A☐AHC☐1		
A5A☐AH7☐1		
01A☐AH1☐1	$16^{\ 0}_{-0.018}$	$65^{\ 0}_{-0.030}$
01A☐AHB☐1		
01A☐AHC☐1	$20^{\ 0}_{-0.021}$	$85^{\ 0}_{-0.035}$
01A☐AH7☐1		
C2A☐AH1☐1	$16^{\ 0}_{-0.018}$	$65^{\ 0}_{-0.030}$
C2A☐AHB☐1	$20^{\ 0}_{-0.021}$	$85^{\ 0}_{-0.035}$
C2A☐AHC☐1		
C2A☐AH7☐1	$25^{\ 0}_{-0.021}$	$100^{\ 0}_{-0.035}$

(2) 200 W, 400 W, 600 W, 750 W and 1150 W



Units: mm

Model SGMAS-	Gear Ratio	L	LL	LM	LR	LE	LG	B	LD	LB	LC	LA	LZ
02A□AH1□1	1/5	192	118	89	74	7.5	10	59	84	85	90	105	9
02A□AHB□1	1/11	209	135	106									
02A□AHC□1	1/21	227	143	114	84	12	12		96	100	105	120	
02A□AH7□1	1/33												
04A□AH1□1	1/5	210.5	136.5	107.5	74	7.5	10	59	84	85	90	105	9
04A□AHB□1	1/11	245.5	161.5	132.5	84	12	12		96	100	105	120	
04A□AHC□1	1/21	274.5	169.5	140.5	105	14	13		112	115	120	135	11
04A□AH7□1	1/33					12.5		84	114				
06A□AH1□1	1/5	236.5	162.5	133.5	74	7.5	10	59	84	85	90	105	9
06A□AHB□1	1/11	288.5	183.5	154.5	105	14	13		112	115	120	135	11
06A□AHC□1	1/21	300.5	195.5	166.5		12.5		84	114				
06A□AH7□1	1/33	328.5	186.5	157.5	142	10	15		134	140	145	165	14
08A□AH1□1	1/5	241	157	127	84	12	12	59	96	100	105	120	9
08A□AHB□1	1/11	291	186	156	105	14	13		112	115	120	135	11
08A□AHC□1	1/21	335	193	163	142	10	15	84	134	140	145	165	14
08A□AH7□1	1/33												
12A□AH1□1	1/5	272.5	188.5	157	84	12	12	59	96	100	105	120	9
12A□AHB□1	1/11	366.5	224.5	193	142	10	15	84	134	140	145	165	14
12A□AHC□1	1/21												
12A□AH7□1	1/33	391.5	235.5	204	156	13	16	135	163	165	170	190	

(cont'd)

<table>
<tr><th>Model
SGMAS-</th><th>L1</th><th>L2</th><th>L3</th><th>Q</th><th>C</th><th>S</th><th>Tap × Depth</th><th>QK</th><th>U</th><th>W</th><th>T</th><th>MH</th><th>Approx.
Mass
kg</th></tr>
<tr><td>02A□AH1□1</td><td rowspan="2">36</td><td rowspan="2">38</td><td rowspan="2">26</td><td rowspan="2">36</td><td rowspan="2">26</td><td rowspan="2">20</td><td rowspan="2">M5 × 10L</td><td rowspan="2">32</td><td rowspan="2">3.5</td><td rowspan="2">6</td><td rowspan="2">6</td><td rowspan="12">13</td><td>2.8</td></tr>
<tr><td>02A□AHB□1</td><td>3.3</td></tr>
<tr><td>02A□AHC□1</td><td rowspan="2">40</td><td rowspan="2">44</td><td rowspan="2">30</td><td rowspan="2">42</td><td rowspan="2">32</td><td rowspan="2">25</td><td rowspan="2">M6 × 12L</td><td rowspan="2">36</td><td rowspan="2">4</td><td rowspan="2">8</td><td rowspan="2">7</td><td>3.5</td></tr>
<tr><td>02A□AH7□1</td><td>3.6</td></tr>
<tr><td>04A□AH1□1</td><td>36</td><td>38</td><td>26</td><td>36</td><td>26</td><td>20</td><td>M5 × 10L</td><td>32</td><td>3.5</td><td>6</td><td>6</td><td>3.1</td></tr>
<tr><td>04A□AHB□1</td><td>40</td><td>44</td><td>30</td><td>42</td><td>32</td><td>25</td><td>M6 × 12L</td><td>36</td><td>4</td><td>8</td><td>7</td><td>3.8</td></tr>
<tr><td>04A□AHC□1</td><td rowspan="2">45</td><td rowspan="2">60</td><td rowspan="2">33</td><td rowspan="2">58</td><td rowspan="2">40</td><td rowspan="2">32</td><td rowspan="2">M8 × 16L</td><td rowspan="2">50</td><td rowspan="2">5</td><td rowspan="2">10</td><td rowspan="2">8</td><td>4.2</td></tr>
<tr><td>04A□AH7□1</td><td>6.6</td></tr>
<tr><td>06A□AH1□1</td><td>36</td><td>38</td><td>26</td><td>36</td><td>26</td><td>20</td><td>M5 × 10L</td><td>32</td><td>3.5</td><td>6</td><td>6</td><td>3.6</td></tr>
<tr><td>06A□AHB□1</td><td rowspan="2">45</td><td rowspan="2">60</td><td rowspan="2">33</td><td rowspan="2">58</td><td rowspan="2">40</td><td rowspan="2">32</td><td rowspan="2">M8 × 16L</td><td rowspan="2">50</td><td rowspan="2">5</td><td rowspan="2">10</td><td rowspan="2">8</td><td>4.9</td></tr>
<tr><td>06A□AHC□1</td><td>6.7</td></tr>
<tr><td>06A□AH7□1</td><td>57</td><td>85</td><td>42</td><td>82</td><td>44</td><td>40</td><td>M10 × 20L</td><td>70</td><td>5</td><td>12</td><td>8</td><td>8.2</td></tr>
<tr><td>08A□AH1□1</td><td>40</td><td>44</td><td>30</td><td>42</td><td>32</td><td>25</td><td>M6 × 12L</td><td>36</td><td>4</td><td>8</td><td>7</td><td rowspan="4">15</td><td>4.7</td></tr>
<tr><td>08A□AHB□1</td><td>45</td><td>60</td><td>34</td><td>58</td><td>40</td><td>32</td><td></td><td>50</td><td rowspan="3">5</td><td>10</td><td rowspan="3">8</td><td>5.5</td></tr>
<tr><td>08A□AHC□1</td><td rowspan="2">57</td><td rowspan="2">85</td><td rowspan="2">42</td><td rowspan="2">82</td><td rowspan="2">44</td><td rowspan="2">40</td><td rowspan="2">M10 × 20L</td><td rowspan="2">70</td><td rowspan="2">12</td><td rowspan="2">8.8</td></tr>
<tr><td>08A□AH7□1</td></tr>
<tr><td>12A□AH1□1</td><td>40</td><td>44</td><td>30</td><td>42</td><td>32</td><td>25</td><td>M6 × 12L</td><td>36</td><td>4</td><td>8</td><td>7</td><td rowspan="4">15
(0.59)</td><td>6.0</td></tr>
<tr><td>12A□AHB□1</td><td rowspan="2">57</td><td rowspan="2">85</td><td rowspan="2">42</td><td rowspan="3">82</td><td rowspan="2">44</td><td rowspan="2">40</td><td rowspan="3">M10 × 20L</td><td rowspan="3">70</td><td rowspan="2">5</td><td rowspan="2">12</td><td rowspan="2">8</td><td>10.8</td></tr>
<tr><td>12A□AHC□1</td><td>10.1</td></tr>
<tr><td>12A□AH7□1</td><td>70</td><td>86</td><td>51</td><td>51</td><td>45</td><td>5.5</td><td>14</td><td>9</td><td>19.9</td></tr>
</table>

Servomotor Specifications and Dimensional Drawings

3

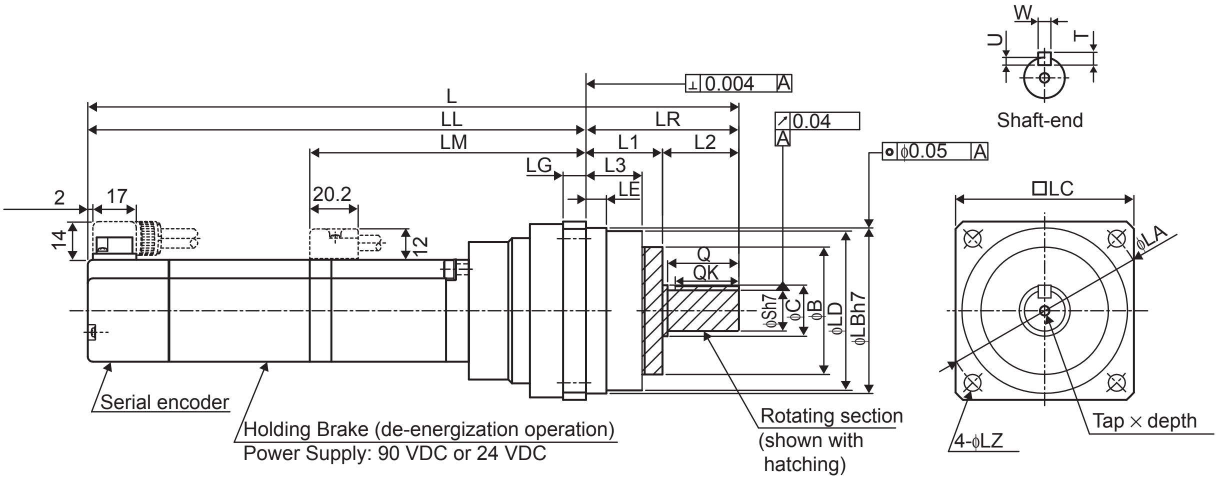
• Dimensional Tolerances

Units: mm

Model SGMAS-	Shaft-end Dimensions	Flange Face Dimensions
	S	LB
02A☐AH1☐1 02A☐AHB☐1	$20^{0}_{-0.021}$	$85^{0}_{-0.035}$
02A☐AHC☐1 02A☐AH7☐1	$25^{0}_{-0.021}$	$100^{0}_{-0.035}$
04A☐AH1☐1	$20^{0}_{-0.021}$	$85^{0}_{-0.035}$
04A☐AHB☐1	$25^{0}_{-0.021}$	$100^{0}_{-0.035}$
04A☐AHC☐1 04A☐AH7☐1	$32^{0}_{-0.025}$	$115^{0}_{-0.035}$
06A☐AH1☐1	$20^{0}_{-0.021}$	$85^{0}_{-0.035}$
06A☐AHB☐1 06A☐AHC☐1	$32^{0}_{-0.025}$	$115^{0}_{-0.035}$
06A☐AH7☐1	$40^{0}_{-0.025}$	$140^{0}_{-0.040}$
08A☐AH1☐1	$25^{0}_{-0.021}$	$100^{0}_{-0.035}$
08A☐AHB☐1	$32^{0}_{-0.025}$	$115^{0}_{-0.035}$
08A☐AHC☐1 08A☐AH7☐1	$40^{0}_{-0.025}$	$140^{0}_{-0.040}$
12A☐AH1☐1	$25^{0}_{-0.021}$	$100^{0}_{-0.035}$
12A☐AHB☐1	$40^{0}_{-0.025}$	$140^{0}_{-0.040}$
12A☐AHC☐1	$40^{0}_{-0.025}$	$140^{0}_{-0.040}$
12A☐AH7☐1	$45^{0}_{-0.025}$	$165^{0}_{-0.040}$

3.13.6 SGMAS Servomotors with Low-backlash Gears and Brakes

(1) 50 W, 100 W and 150 W



Units: mm

<table>
<tr><th>Model SGMAS-</th><th>Gear Ratio</th><th>L</th><th>LL</th><th>LM</th><th>LR</th><th>LE</th><th>LG</th><th>B</th><th>LD</th><th>LB</th><th>LC</th><th>LA</th><th>LZ</th></tr>
<tr><td>A5A□AH1□□</td><td>1/5</td><td>199.5</td><td>144.5</td><td>66.5</td><td>55</td><td>6</td><td>8</td><td>40</td><td>55.5</td><td>56</td><td>60</td><td>70</td><td>5.5</td></tr>
<tr><td>A5A□AH2□□</td><td>1/9</td><td>205.5</td><td>145.5</td><td>67.5</td><td rowspan="3">60</td><td rowspan="3">8</td><td rowspan="3">9</td><td>50</td><td rowspan="3">64.5</td><td rowspan="3">65</td><td rowspan="3">70</td><td rowspan="3">80</td><td rowspan="3">6.6</td></tr>
<tr><td>A5A□AHC□□</td><td>1/21</td><td rowspan="2">222.5</td><td rowspan="2">162.5</td><td rowspan="2">84.5</td><td rowspan="2">40</td></tr>
<tr><td>A5A□AH7□□</td><td>1/33</td></tr>
<tr><td>01A□AH1□□</td><td>1/5</td><td>217.5</td><td>157.5</td><td>79.5</td><td rowspan="2">60</td><td rowspan="2">8</td><td rowspan="2">9</td><td rowspan="2">40</td><td rowspan="2">64.5</td><td rowspan="2">65</td><td rowspan="2">70</td><td rowspan="2">80</td><td rowspan="2">6.6</td></tr>
<tr><td>01A□AHB□□</td><td>1/11</td><td>234.5</td><td>174.5</td><td>96.5</td></tr>
<tr><td>01A□AHC□□</td><td>1/21</td><td rowspan="2">257.5</td><td rowspan="2">183.5</td><td rowspan="2">105.5</td><td rowspan="2">74</td><td rowspan="2">7.5</td><td rowspan="2">10</td><td rowspan="2">59</td><td rowspan="2">84</td><td rowspan="2">85</td><td rowspan="2">90</td><td rowspan="2">105</td><td rowspan="2">9</td></tr>
<tr><td>01A□AH7□□</td><td>1/33</td></tr>
<tr><td>C2A□AH1□□</td><td>1/5</td><td>228.5</td><td>168.5</td><td>91.5</td><td>60</td><td>8</td><td>9</td><td>40</td><td>64.5</td><td>65</td><td>70</td><td>80</td><td>6.6</td></tr>
<tr><td>C2A□AHB□□</td><td>1/11</td><td rowspan="2">268.5</td><td rowspan="2">194.5</td><td rowspan="2">117.5</td><td rowspan="2">74</td><td rowspan="2">7.5</td><td rowspan="2">10</td><td rowspan="2">59</td><td rowspan="2">84</td><td rowspan="2">85</td><td rowspan="2">90</td><td rowspan="2">105</td><td rowspan="3">9</td></tr>
<tr><td>C2A□AHC□□</td><td>1/21</td></tr>
<tr><td>C2A□AH7□□</td><td>1/33</td><td>274.5</td><td>190.5</td><td>113.5</td><td>84</td><td>12</td><td>12</td><td>59</td><td>96</td><td>100</td><td>105</td><td>120</td></tr>
</table>

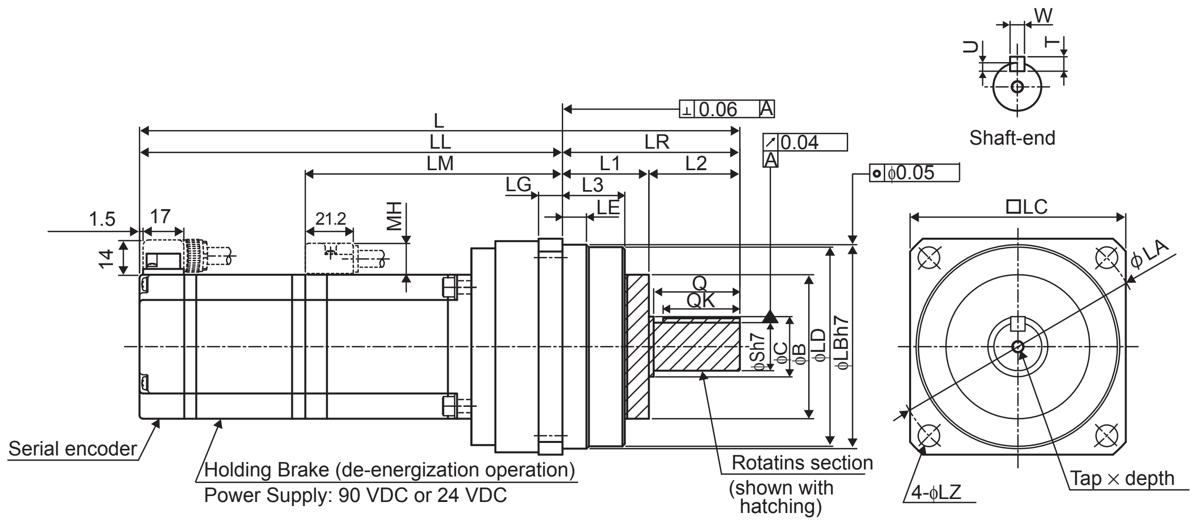
<table>
<tr><th>Model SGMAS-</th><th>L1</th><th>L2</th><th>L3</th><th>Q</th><th>C</th><th>S</th><th>Tap × Depth</th><th>QK</th><th>U</th><th>W</th><th>T</th><th>Approx. Mass kg</th></tr>
<tr><td>A5A□AH1□□</td><td>28</td><td>27</td><td>20</td><td>25</td><td rowspan="4">20</td><td>14</td><td rowspan="4">M4 × 8L</td><td>20</td><td rowspan="4">3</td><td rowspan="4">5</td><td rowspan="4">5</td><td>1.2</td></tr>
<tr><td>A5A□AH2□□</td><td rowspan="3">30</td><td rowspan="3">30</td><td rowspan="3">22</td><td rowspan="3">28</td><td rowspan="3">16</td><td rowspan="3">25</td><td>1.5</td></tr>
<tr><td>A5A□AHC□□</td><td rowspan="2">1.8</td></tr>
<tr><td>A5A□AH7□□</td></tr>
<tr><td>01A□AH1□□</td><td rowspan="2">30</td><td rowspan="2">30</td><td rowspan="2">22</td><td rowspan="2">28</td><td rowspan="2">20</td><td rowspan="2">16</td><td rowspan="2">M4 × 8L</td><td rowspan="2">25</td><td rowspan="2">3</td><td rowspan="2">5</td><td rowspan="2">5</td><td>1.6</td></tr>
<tr><td>01A□AHB□□</td><td>1.9</td></tr>
<tr><td>01A□AHC□□</td><td rowspan="2">36</td><td rowspan="2">38</td><td rowspan="2">26</td><td rowspan="2">36</td><td rowspan="2">26</td><td rowspan="2">20</td><td rowspan="2">M5 × 10L</td><td rowspan="2">32</td><td rowspan="2">3.5</td><td rowspan="2">6</td><td rowspan="2">6</td><td rowspan="2">2.9</td></tr>
<tr><td>01A□AH7□□</td></tr>
<tr><td>C2A□AH1□□</td><td>30</td><td>30</td><td>22</td><td>28</td><td>20</td><td>16</td><td>M4 × 8L</td><td>25</td><td>3</td><td>5</td><td>5</td><td>1.7</td></tr>
<tr><td>C2A□AHB□□</td><td rowspan="2">36</td><td rowspan="2">38</td><td rowspan="2">26</td><td rowspan="2">36</td><td rowspan="2">26</td><td rowspan="2">20</td><td rowspan="2">M5 × 10L</td><td rowspan="2">32</td><td rowspan="2">3.5</td><td rowspan="2">6</td><td rowspan="2">6</td><td>3.2</td></tr>
<tr><td>C2A□AHC□□</td><td>3.0</td></tr>
<tr><td>C2A□AH7□□</td><td>40</td><td>44</td><td>29</td><td>42</td><td>32</td><td>25</td><td>M6 × 12L</td><td>36</td><td>4</td><td>8</td><td>7</td><td>3.5</td></tr>
</table>

• Dimensional Tolerances

Units: mm

Model SGMAS-	Shaft-end Dimensions	Flange Face Dimensions
	S	LB
A5A□AH1□□	$14^{\ 0}_{-0.018}$	$56^{\ 0}_{-0.030}$
A5A□AH2□□	$16^{\ 0}_{-0.018}$	$65^{\ 0}_{-0.030}$
A5A□AHC□□		
A5A□AH7□□		
01A□AH1□□	$16^{\ 0}_{-0.018}$	$65^{\ 0}_{-0.030}$
01A□AHB□□		
01A□AHC□□	$20^{\ 0}_{-0.021}$	$85^{\ 0}_{-0.035}$
01A□AH7□□		
C2A□AH1□□	$16^{\ 0}_{-0.018}$	$65^{\ 0}_{-0.030}$
C2A□AHB□□	$20^{\ 0}_{-0.021}$	$85^{\ 0}_{-0.035}$
C2A□AHC□□		
C2A□AH7□□	$25^{\ 0}_{-0.021}$	$100^{\ 0}_{-0.035}$

(2) 200 W, 400 W, 600 W, 750 W and 1150 W



Units: mm

Model SGMAS-	Gear Ratio	L	LL	LM	LR	LE	LG	B	LD	LB	LC	LA	LZ
02A□AH1□□	1/5	232	158	89	74	7.5	10	59	84	85	90	105	9
02A□AHB□□	1/11	249	175	106									
02A□AHC□□	1/21	267	183	114	84	12	12		96	100	105	120	
02A□AH7□□	1/33												
04A□AH1□□	1/5	250.5	176.5	107.5	74	7.5	10	59	84	85	90	105	9
04A□AHB□□	1/11	285.5	201.5	132.5	84	12	12		96	100	105	120	
04A□AHC□□	1/21	314.5	209.5	140.5	105	14	13		112	115	120	135	11
04A□AH7□□	1/33					12.5		84	114				
06A□AH1□□	1/5	284	210	133.5	74	7.5	10	59	84	85	90	105	9
06A□AHB□□	1/11	334.5	229.5	154.5	105	14	13		112	115	120	135	11
06A□AHC□□	1/21	348	243	166.5		12.5		84	114				
06A□AH7□□	1/33	376	234	157.5	142	10	15	84	134	140	145	165	14
08A□AH1□□	1/5	286	202	127	84	12	12	59	96	100	105	120	9
08A□AHB□□	1/11	336	231	156	105	14	13		112	115	120	135	11
08A□AHC□□	1/21	380	238	163	142	10	15	84	134	140	145	165	14
08A□AH7□□	1/33												
12A□AH1□□	1/5	322.5	238.5	157	84	12	12	59	96	100	105	120	9
12A□AHB□□	1/11	416.5	274.5	193	142	10	15	84	134	140	145	165	14
12A□AHC□□	1/21												
12A□AH7□□	1/33	441.5	285.5	204	156	13	16	135	163	165	170	190	

(cont'd)

<table>
<tr><th>Model SGMAS-</th><th>L1</th><th>L2</th><th>L3</th><th>Q</th><th>C</th><th>S</th><th>Tap × Depth</th><th>QK</th><th>U</th><th>W</th><th>T</th><th>MH</th><th>Approx. Mass kg</th></tr>
<tr><td>02A□AH1□□</td><td rowspan="2">36</td><td rowspan="2">38</td><td rowspan="2">26</td><td rowspan="2">36</td><td rowspan="2">26</td><td rowspan="2">20</td><td rowspan="2">M5 × 10L</td><td rowspan="2">32</td><td rowspan="2">3.5</td><td rowspan="2">6</td><td rowspan="2">6</td><td rowspan="12">13</td><td>3.4</td></tr>
<tr><td>02A□AHB□□</td><td>3.9</td></tr>
<tr><td>02A□AHC□□</td><td rowspan="2">40</td><td rowspan="2">44</td><td rowspan="2">30</td><td rowspan="2">42</td><td rowspan="2">32</td><td rowspan="2">25</td><td rowspan="2">M6 × 12L</td><td rowspan="2">36</td><td rowspan="2">4</td><td rowspan="2">8</td><td rowspan="2">7</td><td>4.1</td></tr>
<tr><td>02A□AH7□□</td><td>4.2</td></tr>
<tr><td>04A□AH1□□</td><td>36</td><td>38</td><td>26</td><td>36</td><td>26</td><td>20</td><td>M5 × 10L</td><td>32</td><td>3.5</td><td>6</td><td>6</td><td>3.7</td></tr>
<tr><td>04A□AHB□□</td><td>40</td><td>44</td><td>30</td><td>42</td><td>32</td><td>25</td><td>M6 × 12L</td><td>36</td><td>4</td><td>8</td><td>7</td><td>4.4</td></tr>
<tr><td>04A□AHC□□</td><td rowspan="2">45</td><td rowspan="2">60</td><td rowspan="2">34</td><td rowspan="2">58</td><td rowspan="2">40</td><td rowspan="2">32</td><td rowspan="2">M8 × 16L</td><td rowspan="2">50</td><td rowspan="2">5</td><td rowspan="2">10</td><td rowspan="2">8</td><td>4.8</td></tr>
<tr><td>04A□AH7□□</td><td>7.2</td></tr>
<tr><td>06A□AH1□□</td><td>36</td><td>38</td><td>26</td><td>36</td><td>26</td><td>20</td><td>M5 × 10L</td><td>32</td><td>3.5</td><td>6</td><td>6</td><td>4.3</td></tr>
<tr><td>06A□AHB□□</td><td rowspan="2">45</td><td rowspan="2">60</td><td rowspan="2">33</td><td rowspan="2">58</td><td rowspan="2">40</td><td rowspan="2">32</td><td rowspan="2">M8 × 16L</td><td rowspan="2">50</td><td rowspan="3">5</td><td rowspan="2">10</td><td rowspan="3">8</td><td>5.6</td></tr>
<tr><td>06A□AHC□□</td><td>7.4</td></tr>
<tr><td>06A□AH7□□</td><td>57</td><td>85</td><td>46</td><td>82</td><td>44</td><td>40</td><td>M10 × 20L</td><td>70</td><td>12</td><td>8.9</td></tr>
<tr><td>08A□AH1□□</td><td>40</td><td>44</td><td>30</td><td>42</td><td>32</td><td>25</td><td>M6 × 12L</td><td>36</td><td>4</td><td>8</td><td>7</td><td rowspan="4">15</td><td>5.6</td></tr>
<tr><td>08A□AHB□□</td><td>45</td><td>60</td><td>34</td><td>58</td><td>40</td><td>32</td><td>M8 × 16L</td><td>50</td><td rowspan="3">5</td><td>10</td><td rowspan="3">8</td><td>6.4</td></tr>
<tr><td>08A□AHC□□</td><td rowspan="2">57</td><td rowspan="2">85</td><td rowspan="2">42</td><td rowspan="2">82</td><td rowspan="2">44</td><td rowspan="2">40</td><td rowspan="2">M10 × 20L</td><td rowspan="2">70</td><td rowspan="2">12</td><td rowspan="2">9.7</td></tr>
<tr><td>08A□AH7□□</td></tr>
<tr><td>12A□AH1□□</td><td>40</td><td>44</td><td>30</td><td>42</td><td>32</td><td>25</td><td>M6 × 12L</td><td>36</td><td>4</td><td>8</td><td>7</td><td rowspan="4">15</td><td>6.9</td></tr>
<tr><td>12A□AHB□□</td><td rowspan="2">57</td><td rowspan="2">85</td><td rowspan="2">42</td><td rowspan="3">82</td><td rowspan="2">44</td><td rowspan="2">40</td><td rowspan="3">M10 × 20L</td><td rowspan="3">70</td><td rowspan="2">5</td><td rowspan="2">12</td><td rowspan="2">8</td><td>11.7</td></tr>
<tr><td>12A□AHC□□</td><td>11</td></tr>
<tr><td>12A□AH7□□</td><td>70</td><td>86</td><td>51</td><td>51</td><td>45</td><td>5.5</td><td>14</td><td>9</td><td>20.8</td></tr>
</table>

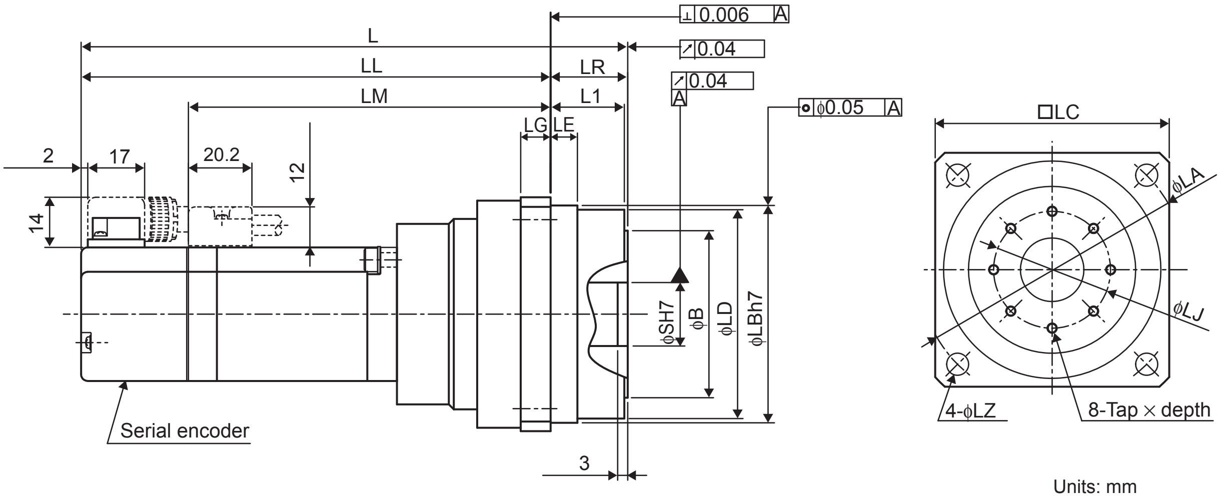
- Dimensional Tolerances

Units: mm

Model SGMAS-	Shaft-end Dimensions	Flange Face Dimensions
	S	LB
02A□AH1□□ 02A□AHB□□	$20^{0}_{-0.021}$	$85^{0}_{-0.035}$
02A□AHC□□ 02A□AH7□□	$25^{0}_{-0.021}$	$100^{0}_{-0.035}$
04A□AH1□□	$20^{0}_{-0.021}$	$85^{0}_{-0.035}$
04A□AHB□□	$25^{0}_{-0.021}$	$100^{0}_{-0.035}$
04A□AHC□□ 04A□AH7□□	$32^{0}_{-0.025}$	$115^{0}_{-0.035}$
06A□AH1□□	$20^{0}_{-0.021}$	$85^{0}_{-0.035}$
06A□AHB□□ 06A□AHC□□	$32^{0}_{-0.025}$	$115^{0}_{-0.035}$
06A□AH7□□	$40^{0}_{-0.025}$	$140^{0}_{-0.040}$
08A□AH1□□	$25^{0}_{-0.021}$	$100^{0}_{-0.035}$
08A□AHB□□	$32^{0}_{-0.025}$	$115^{0}_{-0.035}$
08A□AHC□□ 08A□AH7□□	$40^{0}_{-0.025}$	$140^{0}_{-0.040}$
12A□AH1□□	$25^{0}_{-0.021}$	$100^{0}_{-0.035}$
12A□AHB□□	$40^{0}_{-0.025}$	$140^{0}_{-0.040}$
12A□AHC□□	$40^{0}_{-0.025}$	$140^{0}_{-0.040}$
12A□AH7□□	$45^{0}_{-0.025}$	$165^{0}_{-0.040}$

3.13.7 SGMAS Flange-type Servomotors with Low-backlash Gears

(1) 50 W, 100 W and 150 W



Units: mm

Model SGMAS-	Gear Ratio	L	LL	LM	LR	LE	LG	B	LD	LB	LC	LA	LZ
A5A□AH101	1/5	119.5	98.5	66.5	21	6	8	40	55.5	56	60	70	5.5
A5A□AH201	1/9	122.5	99.5	67.5	23	8	9	50	64.5	65	70	80	6.6
A5A□AHC01	1/21	139.5	116.5	84.5									
A5A□AH701	1/33												
01A□AH101	1/5	134.5	111.5	79.5	23	8	9	50	64.5	65	70	80	6.6
01A□AHB01	1/11	151.5	128.5	96.5									
01A□AHC01	1/21	164.5	137.5	105.5	27	10	10	60	83	85	90	105	9
01A□AH701	1/33												
C2A□AH101	1/5	146.5	123.5	91.5	23	8	9	50	64.5	65	70	80	6.6
C2A□AHB01	1/11	176.5	149.5	117.5	27	10	10	60	83	85	90	105	9
C2A□AHC01	1/21												
C2A□AH701	1/33	188.5	157.5	125.5	31	12	12	70	96	100	105	120	

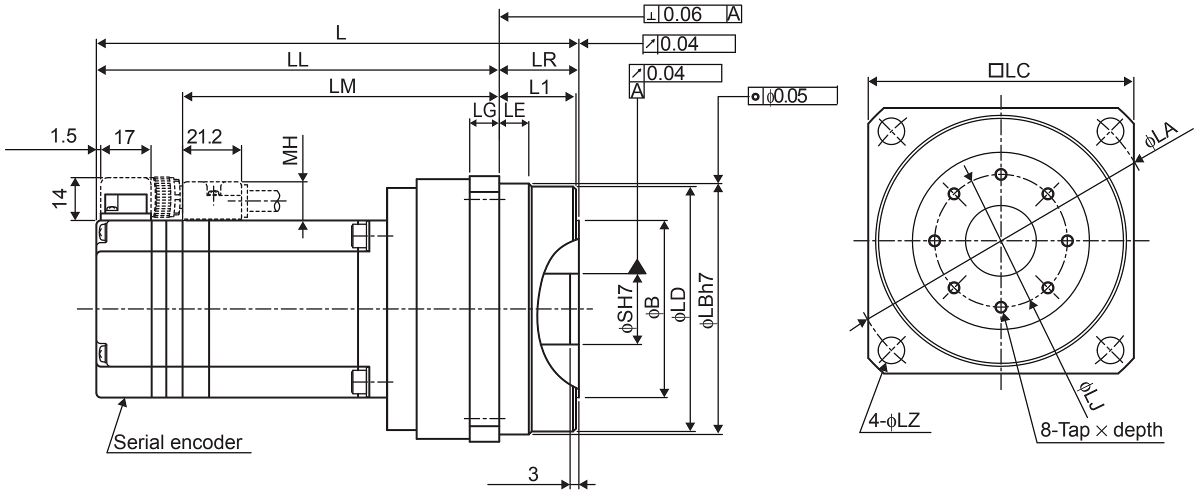
Model SGMAS-	L1	S	Tap × Depth	LJ	Approx. Mass kg
A5A□AH101	20	14	M3 × 6L	30	0.9
A5A□AH201	22	19		35	1.1
A5A□AHC01					1.2
A5A□AH701					
01A□AH101	22	19	M3 × 6L	35	1.2
01A□AHB01					1.3
01A□AHC01	26	24	M4 × 7L	45	2.3
01A□AH701					
C2A□AH101	22	19	M3 × 6L	35	1.3
C2A□AHB01	26	24	M4 × 7L	45	2.4
C2A□AHC01					
C2A□AH701	29	28	M5 × 8L	55	3.5

• Dimensional Tolerances

Units: mm

Model SGMAS-	Shaft-end Dimensions	Flange Face Dimensions
	S	LB
A5A□AH101	$14^{+0.018}_{0}$	$56^{0}_{-0.030}$
A5A□AH201	$19^{+0.021}_{0}$	$65^{0}_{-0.030}$
A5A□AHC01		
A5A□AH701		
01A□AH101	$19^{+0.021}_{0}$	$65^{0}_{-0.030}$
01A□AHB01		
01A□AHC01	$24^{+0.021}_{0}$	$85^{0}_{-0.035}$
01A□AH701		
C2A□AH101	$19^{+0.021}_{0}$	$65^{0}_{-0.030}$
C2A□AHB01	$24^{+0.021}_{0}$	$85^{0}_{-0.035}$
C2A□AHC01		
C2A□AH701	$28^{+0.021}_{0}$	$100^{0}_{-0.035}$

(2) 200 W, 400 W, 600 W, 750 W, and 1150 W



Units: mm

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<tr><th>Model SGMAS-</th><th>Gear Ratio</th><th>L</th><th>LL</th><th>LM</th><th>LR</th><th>LE</th><th>LG</th><th>B</th><th>LD</th><th>LB</th><th>LC</th><th>LA</th><th>LZ</th></tr>
<tr><td>02A□AH101</td><td>1/5</td><td>145</td><td>118</td><td>89</td><td rowspan="2">27</td><td rowspan="2">10</td><td rowspan="2">10</td><td rowspan="2">60</td><td rowspan="2">83</td><td rowspan="2">85</td><td rowspan="2">90</td><td rowspan="2">105</td><td rowspan="4">9</td></tr>
<tr><td>02A□AHB01</td><td>1/11</td><td>162</td><td>135</td><td>106</td></tr>
<tr><td>02A□AHC01</td><td>1/21</td><td rowspan="2">174</td><td rowspan="2">143</td><td rowspan="2">114</td><td rowspan="2">31</td><td rowspan="2">12</td><td rowspan="2">12</td><td rowspan="2">70</td><td rowspan="2">96</td><td rowspan="2">100</td><td rowspan="2">105</td><td rowspan="2">120</td></tr>
<tr><td>02A□AH701</td><td>1/33</td></tr>
<tr><td>04A□AH101</td><td>1/5</td><td>163.5</td><td>136.5</td><td>107.5</td><td>27</td><td>10</td><td>10</td><td>60</td><td>83</td><td>85</td><td>90</td><td>105</td><td rowspan="2">9</td></tr>
<tr><td>04A□AHB01</td><td>1/11</td><td>192.5</td><td>161.5</td><td>132.5</td><td>31</td><td>12</td><td>12</td><td>70</td><td>96</td><td>100</td><td>105</td><td>120</td></tr>
<tr><td>04A□AHC01</td><td>1/21</td><td rowspan="2">204.5</td><td rowspan="2">169.5</td><td rowspan="2">140.5</td><td rowspan="2">35</td><td rowspan="2">14</td><td rowspan="2">13</td><td rowspan="2">90</td><td rowspan="2">112</td><td rowspan="2">115</td><td rowspan="2">120</td><td rowspan="2">135</td><td rowspan="2">11</td></tr>
<tr><td>04A□AH701</td><td>1/33</td></tr>
<tr><td>06A□AH101</td><td>1/5</td><td>189.5</td><td>162.5</td><td>133.5</td><td>27</td><td>10</td><td>10</td><td>60</td><td>83</td><td>85</td><td>90</td><td>105</td><td>9</td></tr>
<tr><td>06A□AHB01</td><td>1/11</td><td rowspan="2">230.5</td><td rowspan="2">195.5</td><td rowspan="2">166.5</td><td rowspan="2">35</td><td rowspan="2">14</td><td rowspan="2">13</td><td rowspan="2">90</td><td rowspan="2">112</td><td rowspan="2">115</td><td rowspan="2">120</td><td rowspan="2">135</td><td rowspan="2">11</td></tr>
<tr><td>06A□AHC01</td><td>1/21</td></tr>
<tr><td>06A□AH701</td><td>1/33</td><td>246.5</td><td>202.5</td><td>173.5</td><td>44</td><td>10</td><td>15</td><td>107</td><td>134</td><td>140</td><td>145</td><td>165</td><td>14</td></tr>
<tr><td>08A□AH101</td><td>1/5</td><td>188</td><td>157</td><td>127</td><td>31</td><td>12</td><td>12</td><td>70</td><td>96</td><td>100</td><td>105</td><td>120</td><td>9</td></tr>
<tr><td>08A□AHB01</td><td>1/11</td><td>221</td><td>186</td><td>156</td><td>35</td><td>14</td><td>13</td><td>90</td><td>112</td><td>115</td><td>120</td><td>135</td><td>11</td></tr>
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<tr><td>12A□AH101</td><td>1/5</td><td>219.5</td><td>188.5</td><td>157</td><td>31</td><td>12</td><td>12</td><td>70</td><td>96</td><td>100</td><td>105</td><td>120</td><td>9</td></tr>
<tr><td>12A□AHB01</td><td>1/11</td><td>271.5</td><td>227.5</td><td>196</td><td rowspan="2">44</td><td>10</td><td rowspan="2">15</td><td rowspan="2">107</td><td rowspan="2">134</td><td rowspan="2">140</td><td rowspan="2">145</td><td rowspan="2">165</td><td rowspan="3">14</td></tr>
<tr><td>12A□AHC01</td><td>1/21</td><td>268.5</td><td>224.5</td><td>193</td><td rowspan="2">16</td></tr>
<tr><td>12A□AH701</td><td>1/33</td><td>288.5</td><td>235.5</td><td>204</td><td>53</td><td>16</td><td>135</td><td>163</td><td>165</td><td>170</td><td>190</td></tr>
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(cont'd)

Model SGMAS-	L1	S	Tap × Depth	LJ	MH	Approx. Mass kg
02A□AH101	26	24	M4 × 7L	45	13	2.7
02A□AHB01						2.8
02A□AHC01	29	28	M5 × 8L	55		3.9
02A□AH701						
04A□AH101	26	24	M4 × 7L	45		3.0
04A□AHB01	29	28	M5 × 8L	55		4.2
04A□AHC01	33	32		70		5.6
04A□AH701						
06A□AH101	26	24	M4 × 7L	45	13	3.5
06A□AHB01	33	32	M5 × 8L	70		5.9
06A□AHC01						5.9
06A□AH701	42	35	M6 × 10L	80		9.9
08A□AH101	29	28	M5 × 8L	55	15	5.0
08A□AHB01	33	32		70		6.7
08A□AHC01	42	35	M6 × 10L	80		10.3
08A□AH701						
12A□AH101	29	28	M5 × 8L	55	15	6.3
12A□AHB01	42	35	M6 × 10L	80		11.6
12A□AHC01						
12A□AH701	51	47	M8 × 12L	100		16.9

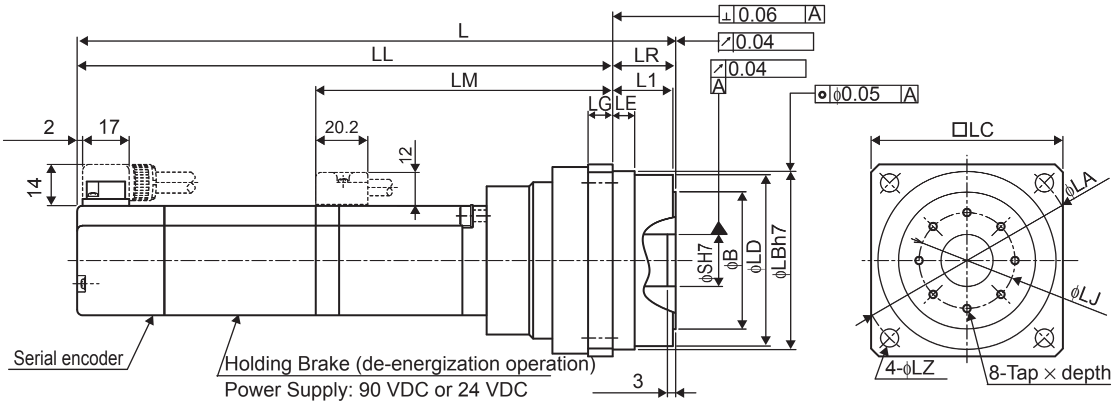
• Dimensional Tolerances

Units: mm

Model SGMAS-	Shaft-end Dimensions	Flange Face Dimensions
	S	LB
02A□AH101 02A□AHB01	$24^{+0.021}_{0}$	$85^{0}_{-0.035}$
02A□AHC01 02A□AH701	$28^{+0.021}_{0}$	$100^{0}_{-0.035}$
04A□AH101	$24^{+0.021}_{0}$	$85^{0}_{-0.035}$
04A□AHB01	$28^{+0.021}_{0}$	$100^{0}_{-0.035}$
04A□AHC01 04A□AH701	$32^{+0.025}_{0}$	$115^{0}_{-0.035}$
06A□AH101	$24^{+0.021}_{0}$	$85^{0}_{-0.035}$
06A□AHB01 06A□AHC01	$32^{+0.025}_{0}$	$115^{0}_{-0.035}$
06A□AH701	$35^{+0.025}_{0}$	$140^{0}_{-0.040}$
08A□AH101	$28^{+0.021}_{0}$	$100^{0}_{-0.035}$
08A□AHB01	$32^{+0.025}_{0}$	$115^{0}_{-0.035}$
08A□AHC01 08A□AH701	$35^{+0.025}_{0}$	$140^{0}_{-0.040}$
12A□AH101	$28^{+0.021}_{0}$	$100^{0}_{-0.035}$
12A□AHB01	$35^{+0.025}_{0}$	$140^{0}_{-0.040}$
12A□AHC01	$35^{+0.025}_{0}$	$140^{0}_{-0.040}$
12A□AH701	$47^{0}_{-0.025}$	$165^{0}_{-0.040}$

3.13.8 SGMAS Flange-type Servomotors with Low-backlash Gears and Brakes

(1) 50 W, 100 W and 150 W



Units: mm

Model SGMAS-	Gear Ratio	L	LL	LM	LR	LE	LG	B	LD	LB	LC	LA	LZ
A5A□AH10□	1/5	165.5	144.5	66.5	21	6	8	40	55.5	56	60	70	5.5
A5A□AH20□	1/9	168.5	145.5	67.5	23	8	9	50	64.5	65	70	80	6.6
A5A□AHC0□	1/21	185.5	162.5	84.5									
A5A□AH70□	1/33												
01A□AH10□	1/5	180.5	157.5	79.5	23	8	9	50	64.5	65	70	80	6.6
01A□AHB0□	1/11	197.5	174.5	96.5									
01A□AHC0□	1/21	210.5	183.5	105.5	27	10	10	60	83	85	90	105	9
01A□AH70□	1/33												
C2A□AH10□	1/5	203.5	168.5	91.5	23	8	9	50	64.5	65	70	80	6.6
C2A□AHB0□	1/11	233.5	194.5	117.5	27	10	10	60	83	85	90	105	9
C2A□AHC0□	1/21												
C2A□AH70□	1/33	245.5	190.5	113.5	31	12	12	76	96	100	105	120	

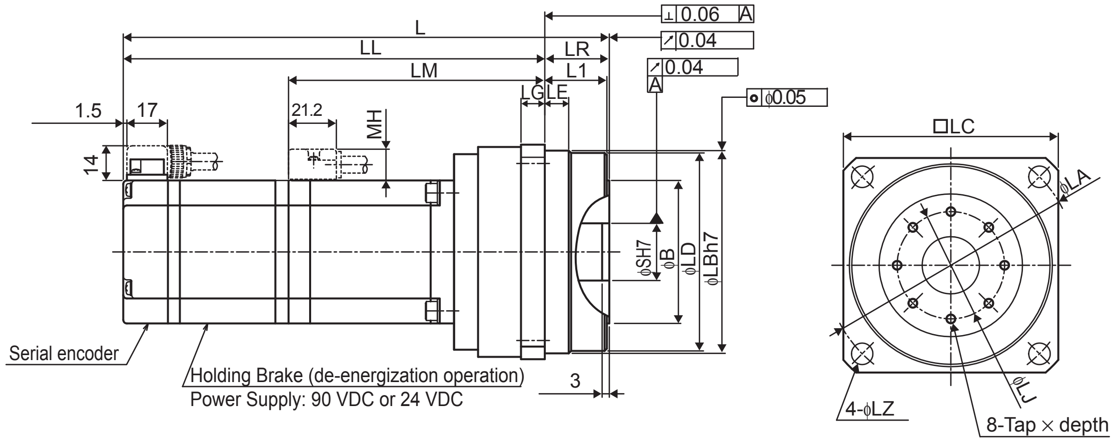
Model SGMAS-	L1	S	Tap × Depth	LJ	Approx. Mass kg
A5A□AH10□	20	14	M3 × 6L	30	1.2
A5A□AH20□	22	19		35	1.4
A5A□AHC0□					1.5
A5A□AH70□					
01A□AH10□	22	19	M3 × 6L	35	1.5
01A□AHB0□					1.6
01A□AHC0□	26	24	M4 × 7L	45	2.6
01A□AH70□					
C2A□AH10□	22	19	M3 × 6L	35	1.6
C2A□AHB0□	26	24	M4 × 7L	45	2.4
C2A□AHC0□					2.7
C2A□AH70□	29	28	M5 × 8L	55	3.5

- Dimensional Tolerances

Units: mm

Model SGMAS-	Shaft-end Dimensions	Flange Face Dimensions
	S	LB
A5A□AH10□	$14^{+0.018}_{0}$	$56^{0}_{-0.030}$
A5A□AH20□	$19^{+0.021}_{0}$	$65^{0}_{-0.030}$
A5A□AHC0□		
A5A□AH70□		
01A□AH10□	$19^{+0.021}_{0}$	$65^{0}_{-0.030}$
01A□AHB0□		
01A□AHC0□	$24^{+0.021}_{0}$	$85^{0}_{-0.035}$
01A□AH70□		
C2A□AH10□	$19^{+0.021}_{0}$	$65^{0}_{-0.030}$
C2A□AHB0□	$24^{+0.021}_{0}$	$85^{0}_{-0.035}$
C2A□AHC0□		
C2A□AH70□	$28^{+0.021}_{0}$	$100^{0}_{-0.035}$

(2) 200 W, 400 W, 600 W, 750 W and 1150 W



Units: mm

<table>
<tr><th>Model SGMAS-</th><th>Gear Ratio</th><th>L</th><th>LL</th><th>LM</th><th>LR</th><th>LE</th><th>LG</th><th>B</th><th>LD</th><th>LB</th><th>LC</th><th>LA</th><th>LZ</th></tr>
<tr><td>02A□AH10□</td><td>1/5</td><td>185</td><td>158</td><td>89</td><td rowspan="2">27</td><td rowspan="2">10</td><td rowspan="2">10</td><td rowspan="2">60</td><td rowspan="2">83</td><td rowspan="2">85</td><td rowspan="2">90</td><td rowspan="2">105</td><td rowspan="4">9</td></tr>
<tr><td>02A□AHB0□</td><td>1/11</td><td>202</td><td>175</td><td>106</td></tr>
<tr><td>02A□AHC0□</td><td>1/21</td><td rowspan="2">214</td><td rowspan="2">183</td><td rowspan="2">114</td><td rowspan="2">31</td><td rowspan="2">12</td><td rowspan="2">12</td><td rowspan="2">70</td><td rowspan="2">96</td><td rowspan="2">100</td><td rowspan="2">105</td><td rowspan="2">120</td></tr>
<tr><td>02A□AH70□</td><td>1/33</td></tr>
<tr><td>04A□AH10□</td><td>1/5</td><td>203.5</td><td>176.5</td><td>107.5</td><td>27</td><td>10</td><td>10</td><td>60</td><td>83</td><td>85</td><td>90</td><td>105</td><td rowspan="2">9</td></tr>
<tr><td>04A□AHB0□</td><td>1/11</td><td>232.5</td><td>201.5</td><td>132.5</td><td>31</td><td>12</td><td>12</td><td>70</td><td>96</td><td>100</td><td>105</td><td>120</td></tr>
<tr><td>04A□AHC0□</td><td>1/21</td><td rowspan="2">244.5</td><td rowspan="2">209.5</td><td rowspan="2">140.5</td><td rowspan="2">35</td><td rowspan="2">14</td><td rowspan="2">13</td><td rowspan="2">90</td><td rowspan="2">112</td><td rowspan="2">115</td><td rowspan="2">120</td><td rowspan="2">135</td><td rowspan="2">11</td></tr>
<tr><td>04A□AH70□</td><td>1/33</td></tr>
<tr><td>06A□AH10□</td><td>1/5</td><td>237</td><td>210</td><td>133.5</td><td>27</td><td>10</td><td>10</td><td>60</td><td>83</td><td>85</td><td>90</td><td>105</td><td>9</td></tr>
<tr><td>06A□AHB0□</td><td>1/11</td><td rowspan="2">278</td><td rowspan="2">243</td><td rowspan="2">166.5</td><td rowspan="2">35</td><td rowspan="2">12.5</td><td rowspan="2">13</td><td rowspan="2">84</td><td rowspan="2">114</td><td rowspan="2">115</td><td rowspan="2">120</td><td rowspan="2">135</td><td rowspan="2">11</td></tr>
<tr><td>06A□AHC0□</td><td>1/21</td></tr>
<tr><td>06A□AH70□</td><td>1/33</td><td>294</td><td>250</td><td>173.5</td><td>44</td><td>10</td><td>15</td><td>107</td><td>134</td><td>140</td><td>145</td><td>165</td><td>14</td></tr>
<tr><td>08A□AH10□</td><td>1/5</td><td>233</td><td>202</td><td>127</td><td>31</td><td>12</td><td>12</td><td>70</td><td>96</td><td>100</td><td>105</td><td>120</td><td>9</td></tr>
<tr><td>08A□AHB0□</td><td>1/11</td><td>266</td><td>231</td><td>156</td><td>35</td><td>14</td><td>13</td><td>90</td><td>112</td><td>115</td><td>120</td><td>135</td><td>11</td></tr>
<tr><td>08A□AHC0□</td><td>1/21</td><td rowspan="2">282</td><td rowspan="2">238</td><td rowspan="2">163</td><td rowspan="2">44</td><td rowspan="2">10</td><td rowspan="2">15</td><td rowspan="2">107</td><td rowspan="2">134</td><td rowspan="2">140</td><td rowspan="2">145</td><td rowspan="2">165</td><td rowspan="2">14</td></tr>
<tr><td>08A□AH70□</td><td>1/33</td></tr>
<tr><td>12A□AH10□</td><td>1/5</td><td>269.5</td><td>238.5</td><td>157</td><td>31</td><td>12</td><td>12</td><td>70</td><td>96</td><td>100</td><td>105</td><td>120</td><td>9</td></tr>
<tr><td>12A□AHB0□</td><td>1/11</td><td>321.5</td><td>277.5</td><td>196</td><td rowspan="2">44</td><td>10</td><td rowspan="2">15</td><td rowspan="2">107</td><td rowspan="2">134</td><td rowspan="2">140</td><td rowspan="2">145</td><td rowspan="2">165</td><td rowspan="3">14</td></tr>
<tr><td>12A□AHC0□</td><td>1/21</td><td>363.5</td><td>319.5</td><td>193</td><td rowspan="2">16</td></tr>
<tr><td>12A□AH70□</td><td>1/33</td><td>338.5</td><td>285.5</td><td>204</td><td>53</td><td>16</td><td>135</td><td>163</td><td>165</td><td>170</td><td>190</td></tr>
</table>

(cont'd)

Model SGMAS-	L1	S	Tap × Depth	LJ	MH	Approx. Mass kg
02A☐AH10☐	26	24	M4 × 7L	45	13	3.3
02A☐AHB0☐						3.4
02A☐AHC0☐	29	28	M5 × 8L	55		4.5
02A☐AH70☐						
04A☐AH10☐	26	24	M4 × 7L	45		3.6
04A☐AHB0☐	29	28	M5 × 8L	55		4.8
04A☐AHC0☐	33	32		70		6.2
04A☐AH70☐						
06A☐AH10☐	26	24	M4 × 7L	45		4.2
06A☐AHB0☐	33	32	M5 × 8L	70	13	7.0
06A☐AHC0☐					13	6.6
06A☐AH70☐	42	35	M6 × 10L	80	13	10.6
08A☐AH10☐	29	28	M5 × 8L	55	15	5.9
08A☐AHB0☐	33	32		70		7.6
08A☐AHC0☐	42	35	M6 × 10L	80		11.2
08A☐AH70☐						
12A☐AH10☐	29	28	M5 × 8L	55	15	7.2
12A☐AHB0☐	42	35	M6 × 10L	80		12.5
12A☐AHC0☐						
12A☐AH70☐	51	47	M8 × 12L	100		17.8

• Dimensional Tolerances

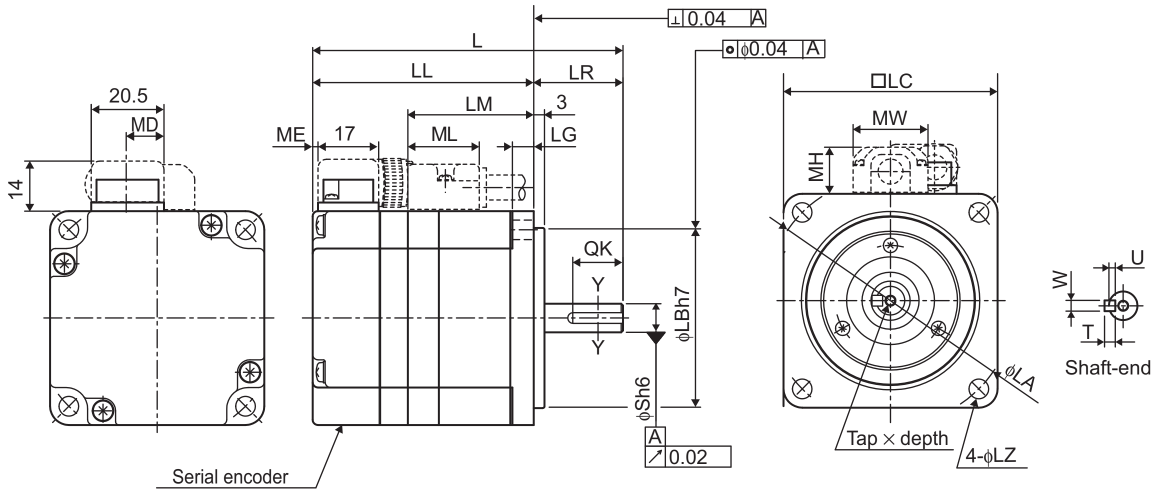
Units: mm

Model SGMAS-	Shaft-end Dimensions	Flange Face Dimensions
	S	LB
02A□AH10□ 02A□AHB0□	$24^{+0.021}_{0}$	$85^{0}_{-0.035}$
02A□AHC0□ 02A□AH70□	$28^{+0.021}_{0}$	$100^{0}_{-0.035}$
04A□AH10□	$24^{+0.021}_{0}$	$85^{0}_{-0.035}$
04A□AHB0□	$28^{+0.021}_{0}$	$100^{0}_{-0.035}$
04A□AHC0□ 04A□AH70□	$32^{+0.025}_{0}$	$115^{0}_{-0.035}$
06A□AH10□	$24^{+0.021}_{0}$	$85^{0}_{-0.035}$
06A□AHB0□ 06A□AHC0□	$32^{+0.025}_{0}$	$115^{0}_{-0.035}$
06A□AH70□	$35^{+0.025}_{0}$	$140^{0}_{-0.040}$
08A□AH10□	$28^{+0.021}_{0}$	$100^{0}_{-0.035}$
08A□AHB0□	$32^{+0.025}_{0}$	$115^{0}_{-0.035}$
08A□AHC0□ 08A□AH70□	$35^{+0.025}_{0}$	$140^{0}_{-0.040}$
12A□AH10□	$28^{+0.021}_{0}$	$100^{0}_{-0.035}$
12A□AHB0□	$35^{+0.025}_{0}$	$140^{0}_{-0.040}$
12A□AHC0□	$35^{+0.025}_{0}$	$140^{0}_{-0.040}$
12A□AH70□	$47^{0}_{-0.025}$	$165^{0}_{-0.040}$

3.14 Dimensional Drawings of SGMPS Servomotors

3.14.1 SGMPS Servomotors without Gears

(1) 100 W, 200 W and 400 W



Units: mm

<table>
<tr><th>Model SGMPS-</th><th>L</th><th>LL</th><th>LM</th><th>LR</th><th>LC</th><th>LA</th><th>LB</th><th>LZ</th><th>LG</th><th>S</th><th>Tap × Depth</th></tr>
<tr><td>01A□A21</td><td rowspan="3">87</td><td rowspan="3">62</td><td rowspan="3">36</td><td rowspan="3">25</td><td rowspan="3">60</td><td rowspan="3">70</td><td rowspan="3">50</td><td rowspan="3">5.5</td><td rowspan="3">6</td><td rowspan="3">8</td><td rowspan="2">No tap</td></tr>
<tr><td>01A□A41</td></tr>
<tr><td>01A□A61</td><td>M3 × 6L</td></tr>
<tr><td>02A□A21</td><td rowspan="3">97</td><td rowspan="3">67</td><td rowspan="3">43</td><td rowspan="3">30</td><td rowspan="3">80</td><td rowspan="3">90</td><td rowspan="3">70</td><td rowspan="3">7</td><td rowspan="3">8</td><td rowspan="3">14</td><td rowspan="2">No tap</td></tr>
<tr><td>02A□A41</td></tr>
<tr><td>02A□A61</td><td>M5 × 8L</td></tr>
<tr><td>04A□A21</td><td rowspan="3">107</td><td rowspan="3">77</td><td rowspan="3">53</td><td rowspan="3">30</td><td rowspan="3">80</td><td rowspan="3">90</td><td rowspan="3">70</td><td rowspan="3">7</td><td rowspan="3">8</td><td rowspan="3">14</td><td rowspan="2">No tap</td></tr>
<tr><td>04A□A41</td></tr>
<tr><td>04A□A61</td><td>M5 × 8L</td></tr>
</table>

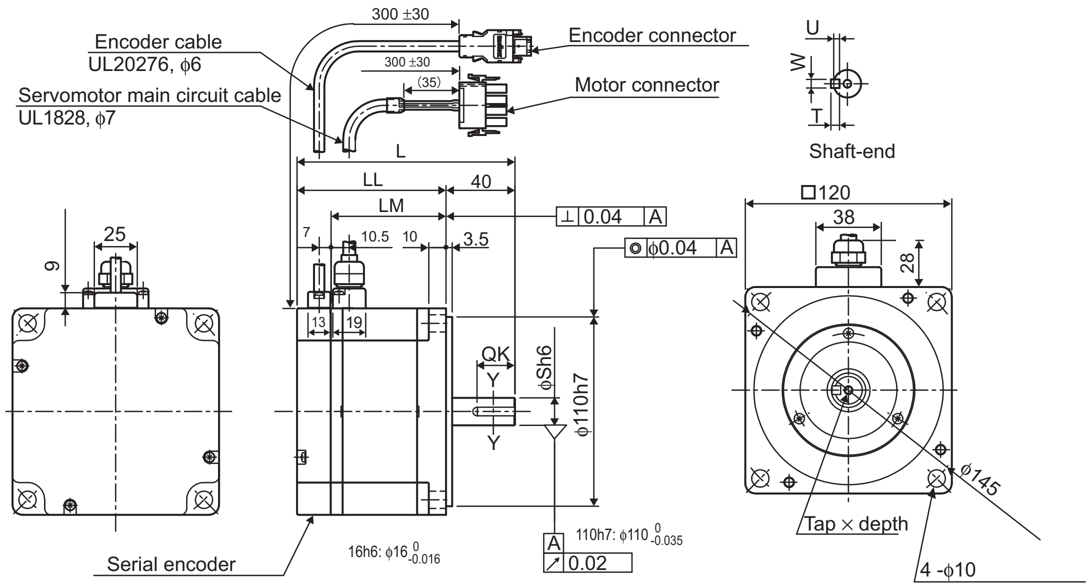
<table>
<tr><th>Model SGMPS-</th><th>QK</th><th>U</th><th>W</th><th>T</th><th>MD</th><th>ME</th><th>MH</th><th>ML</th><th>MW</th><th>Approx. Mass kg</th></tr>
<tr><td>01A□A21</td><td colspan="4">No key</td><td rowspan="3">9</td><td rowspan="3">1</td><td rowspan="3">12</td><td rowspan="3">20</td><td rowspan="3">19.8</td><td rowspan="3">0.5</td></tr>
<tr><td>01A□A41</td><td rowspan="2">14</td><td rowspan="2">1.8</td><td rowspan="2">3</td><td rowspan="2">3</td></tr>
<tr><td>01A□A61</td></tr>
<tr><td>02A□A21</td><td colspan="4">No key</td><td rowspan="6">14</td><td rowspan="6">1.5</td><td rowspan="6">13</td><td rowspan="6">21</td><td rowspan="6">21</td><td rowspan="3">1.1</td></tr>
<tr><td>02A□A41</td><td rowspan="2">16</td><td rowspan="2">3</td><td rowspan="2">5</td><td rowspan="2">5</td></tr>
<tr><td>02A□A61</td></tr>
<tr><td>04A□A21</td><td colspan="4">No key</td><td rowspan="3">1.4</td></tr>
<tr><td>04A□A41</td><td rowspan="2">16</td><td rowspan="2">3</td><td rowspan="2">5</td><td rowspan="2">5</td></tr>
<tr><td>04A□A61</td></tr>
</table>

• Dimensional Tolerances

Units: mm

Model SGMAS-	Shaft-end Dimensions S	Flange Face Dimensions LB
01A□A21	$8^{\ 0}_{-0.009}$	$50^{\ 0}_{-0.025}$
01A□A41		
01A□A61		
02A□A21	$14^{\ 0}_{-0.011}$	$70^{\ 0}_{-0.030}$
02A□A41		
02A□A61		
04A□A21	$14^{\ 0}_{-0.011}$	$70^{\ 0}_{-0.030}$
04A□A41		
04A□A61		

(2) 750 W and 1500 W

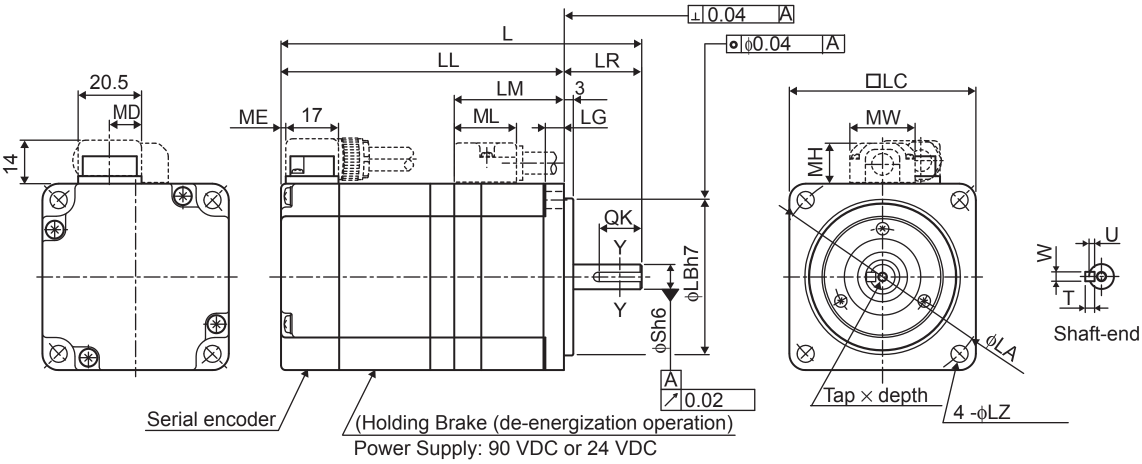


Units: mm

Model SGMPS-	L	LL	LM	S	Tap × Depth	QK	U	W	T	Approx. Mass kg
08A□A21	126.5	86.5	66.7	16	No tap	No key				4.2
08A□A41						22	3	5	5	
08A□A61					M5 × 8L					
15A□A21	154.5	114.5	94.7	19	No tap	No key				6.6
15A□A41						22	3.5	6	6	
15A□A61					M6 × 10L					

3.14.2 SGMPS Servomotors with Brakes

(1) 100 W, 200 W and 400 W



Units: mm

Model SGMPS-	L	LL	LM	LR	LC	LA	LB	LZ	LG	S	Tap ×Depth
01A□A2□	115	90	36	25	60	70	50	5.5	6	8	No tap
01A□A4□											
01A□A6□											M3 × 6L
02A□A2□	128.5	98.5	43	30	80	90	70	7	8	14	No tap
02A□A4□											
02A□A6□											M5 × 8L
04A□A2□	138.5	108.5	53	30	80	90	70	7	8	14	No tap
04A□A4□											
04A□A6□											M5 × 8L

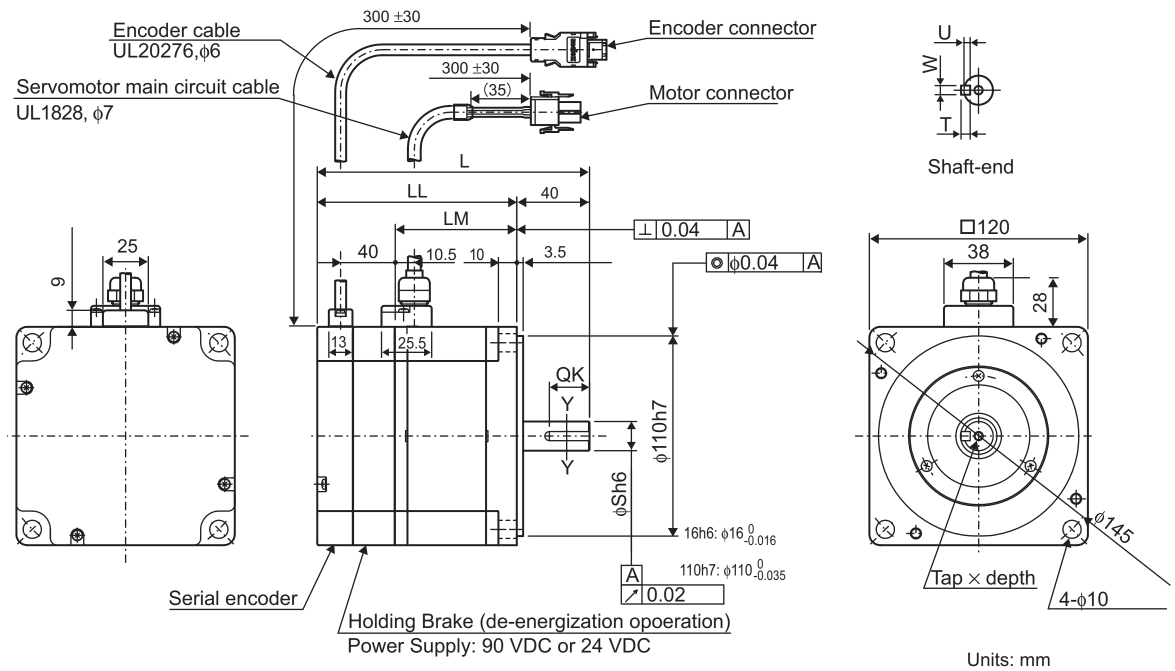
Model SGMPS-	QK	U	W	T	MD	ME	MH	ML	MW	Approx. Mass kg
01A□A2□	No key				9	1	12	20	19.8	0.7
01A□A4□	14	1.8	3	3						
01A□A6□										
02A□A2□	No key				14	1.5	13	21	21	1.6
02A□A4□	16	3	5	5						
02A□A6□										
04A□A2□	No key									1.9
04A□A4□	16	3	5	5						
04A□A6□										

- Dimensional Tolerances

Units: mm

Model SGMAS-	Shaft-end Dimensions S	Flange Face Dimensions LB
01A□A2□	$8^{\ 0}_{-0.009}$	$50^{\ 0}_{-0.025}$
01A□A4□		
01A□A6□		
02A□A2□	$14^{\ 0}_{-0.011}$	$70^{\ 0}_{-0.030}$
02A□A4□		
02A□A6□		
04A□A2□	$14^{\ 0}_{-0.011}$	$70^{\ 0}_{-0.030}$
04A□A4□		
04A□A6□		

(2) 750 W and 1500 W

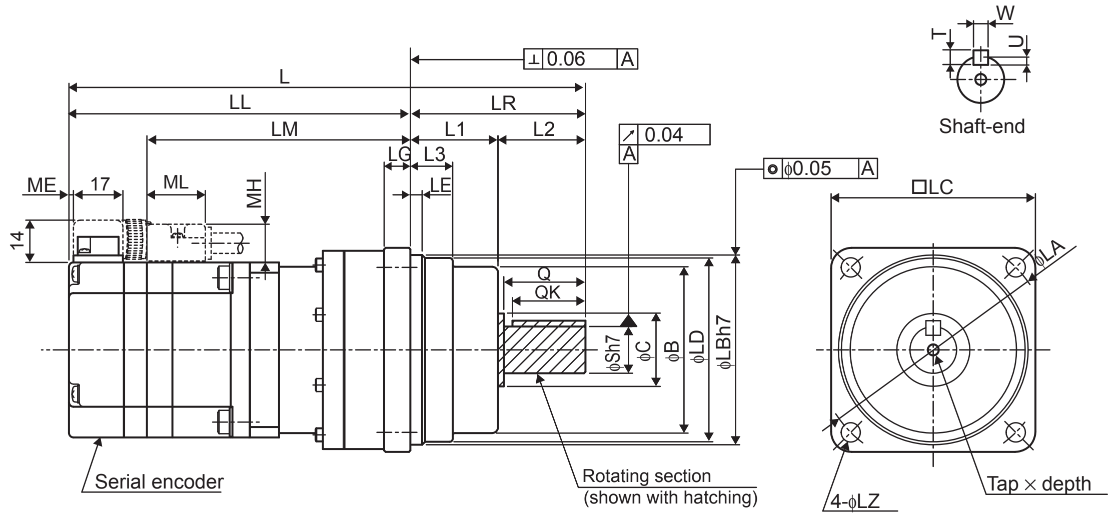


Units: mm

Model SGMPS-	L	LL	LM	S	Tap × Depth	QK	U	W	T	Approx. Mass kg
08A□A2□	160	120	66.7	16	No tap	No key				5.7
08A□A4□						22	3	5	5	
08A□A6□					M5 × 8L					
15A□A2□	187.5	147.5	94.7	19	No tap	No key				8.1
15A□A4□						22	3.5	6	6	
15A□A6□					M6 × 10L					

3.14.3 SGMPS Servomotors with Standard Backlash Gears

(1) 100 W, 200 W and 400 W



Units: mm

Model SGMPS-	Gear Ratio	L	LL	LM	LR	LE	LG	B	C	LD	LB	LC	LA	LZ
01A□AJ1□1	1/5	177	117	91	60	4	9	57	25	63	65	70	80	6.6
01A□AJ3□1	3/31													
01A□AJC□1	1/21	195.5	121.5	95.5	74		10	69	32	83	85	90	105	9
01A□AJ7□1	1/33													
02A□AJ1□1	1/5	200.5	126.5	102.5	74	4	10	69	32	83	85	90	105	9
02A□AJ3□1	3/31													
02A□AJC□1	1/21	221	137	113	84	4	12	82	40	98	100	105	120	
02A□AJ7□1	1/33													
04A□AJ1□1	1/5	210.5	136.5	112.5	74	4	10	69	32	83	85	90	105	9
04A□AJ3□1	3/31	231	147	123	84		12	82	40	98	100	105	120	
04A□AJC□1	1/21	259	154	130	105	5	13	93	50	112	115	120	135	11
04A□AJ7□1	1/33													

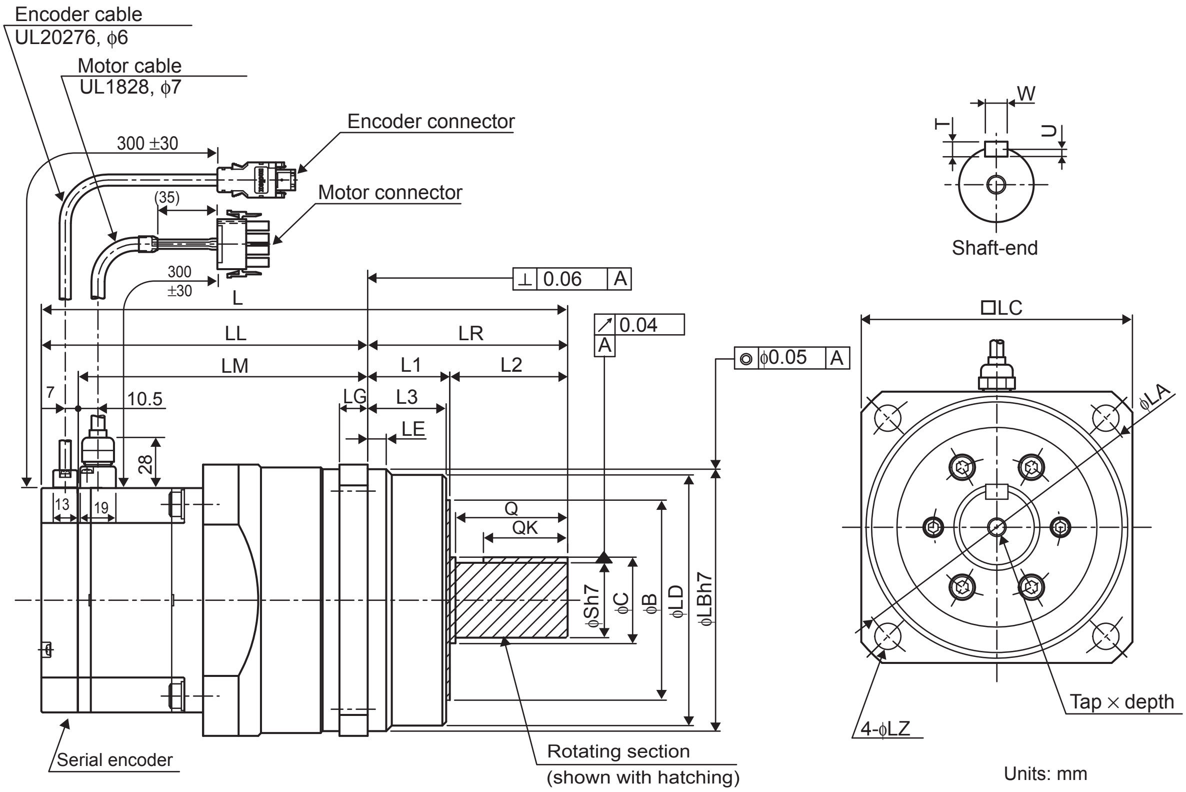
Model SGMPS-	L1	L2	L3	Q	S	Tap × Depth	QK	U	W	T	ME	MH	ML	Approx. Mass kg
01A□AJ1□1	30	30	14.5	28	16	M4 × 8L	25	3	5	5	1	12	20.2	1.3
01A□AJ3□1														
01A□AJC□1	36	38	19.5	36	20	M5 × 10L	32	3.5	6	6				2.4
01A□AJ7□1														
02A□AJ1□1	36	38	19.5	36	20	M5 × 10L	32	3.5	6	6	1.5	13	21.2	2.8
02A□AJ3□1														
02A□AJC□1	40	44	23	42	25	M6 × 12L	36	4	8	7				4.2
02A□AJ7□1														
04A□AJ1□1	36	38	19.5	36	20	M5 × 10L	32	3.5	6	6				3.1
04A□AJ3□1	40	44	23	42	25	M6 × 12L	36	4	8	7				4.0
04A□AJC□1	45	60	26.5	58	32	M8 × 16L	50	5	10	8				6.1
04A□AJ7□1														

• Dimensional Tolerances

Units: mm

<table>
<tr><th rowspan="2">Model
SGMAS-</th><th>Shaft-end Dimensions</th><th>Flange Face Dimensions</th></tr>
<tr><th>S</th><th>LB</th></tr>
<tr><td>01A□AJ1□1</td><td rowspan="2">$16^{\ 0}_{-0.018}$</td><td rowspan="2">$65^{\ 0}_{-0.030}$</td></tr>
<tr><td>01A□AJ3□1</td></tr>
<tr><td>01A□AJC□1</td><td rowspan="2">$20^{\ 0}_{-0.021}$</td><td rowspan="2">$85^{\ 0}_{-0.035}$</td></tr>
<tr><td>01A□AJ7□1</td></tr>
<tr><td>02A□AJ1□1</td><td rowspan="2">$20^{\ 0}_{-0.021}$</td><td rowspan="2">$85^{\ 0}_{-0.035}$</td></tr>
<tr><td>02A□AJ3□1</td></tr>
<tr><td>02A□AJC□1</td><td rowspan="2">$25^{\ 0}_{-0.021}$</td><td rowspan="2">$100^{\ 0}_{-0.035}$</td></tr>
<tr><td>02A□AJ7□1</td></tr>
<tr><td>04A□AJ1□1</td><td>$20^{\ 0}_{-0.021}$</td><td>$85^{\ 0}_{-0.035}$</td></tr>
<tr><td>04A□AJ3□1</td><td>$25^{\ 0}_{-0.021}$</td><td>$100^{\ 0}_{-0.035}$</td></tr>
<tr><td>04A□AJC□1</td><td rowspan="2">$32^{\ 0}_{-0.025}$</td><td rowspan="2">$115^{\ 0}_{-0.035}$</td></tr>
<tr><td>04A□AJ7□1</td></tr>
</table>

(2) 750 W and 1500 W



Model SGMPS-	Gear Ratio	L	LL	LM	LR	LE	LG	B	C	LD	LB	LC	LA	LZ
08A□AJ1□1	1/5	240.5	156.5	137	84	4	12	82	40	98	100	105	120	9
08A□AJ3□1	3/31	268.5	163.5	144	105	5	13	93	50	112	115	120	135	11
08A□AJC□1	1/21	281.5	174.5	155	107	10	15	107	46	134	140	145	165	14
08A□AJ7□1	1/33													
15A□AJ1□1	1/5	296.5	191.5	172	105	5	13	93	50	112	115	120	135	11
15A□AJB□1	1/11	309.5	202.5	183	107	10	15	107	46	134	140	145	165	14
15A□AJC□1	1/21	325.5	208.5	189	117	17	16	135	51	163	165	170	190	
15A□AJ7□1	1/33													

Model SGMPS-	L1	L2	L3	Q	S	Tap × Depth	QK	U	W	T	Approx. Mass kg
08A□AJ1□1	40	44	23	42	25	M6 × 12L	36	4	8	7	6.8
08A□AJ3□1	45	60	26.5	58	32	M8 × 16L	50	5	10	8	8.3
08A□AJC□1	44	63	42	60	40	M10 × 20L	45		12		13.2
08A□AJ7□1											
15A□AJ1□1	45	60	26.5	58	32	M8 × 16L	50	5	10	8	11.4
15A□AJB□1	44	63	42	60	40	M10 × 20L	45		12		16.6
15A□AJC□1	53	64	51		45			5.5	14	9	21.6
15A□AJ7□1											

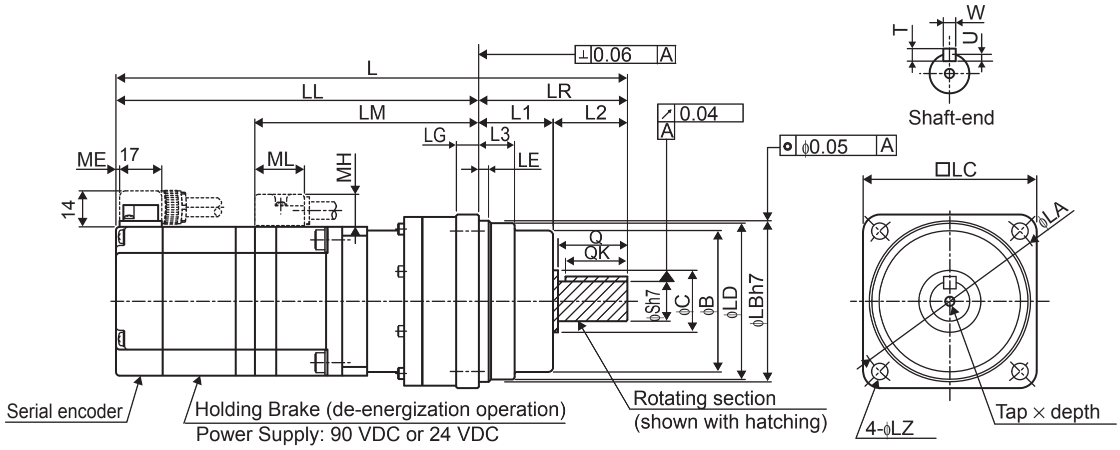
- Dimensional Tolerances

Units: mm

<table>
<tr><th rowspan="2">Model SGMAS-</th><th>Shaft-end Dimensions</th><th>Flange Face Dimensions</th></tr>
<tr><th>S</th><th>LB</th></tr>
<tr><td>08A□AJ1□1</td><td>$25^{\ 0}_{-0.021}$</td><td>$100^{\ 0}_{-0.035}$</td></tr>
<tr><td>08A□AJ3□1</td><td>$32^{\ 0}_{-0.025}$</td><td>$115^{\ 0}_{-0.035}$</td></tr>
<tr><td>08A□AJC□1</td><td rowspan="2">$40^{\ 0}_{-0.025}$</td><td rowspan="2">$140^{\ 0}_{-0.040}$</td></tr>
<tr><td>08A□AJ7□1</td></tr>
<tr><td>15A□AJ1□1</td><td>$32^{\ 0}_{-0.025}$</td><td>$115^{\ 0}_{-0.035}$</td></tr>
<tr><td>15A□AJB□1</td><td>$40^{\ 0}_{-0.025}$</td><td>$140^{\ 0}_{-0.040}$</td></tr>
<tr><td>15A□AJC□1</td><td>$45^{\ 0}_{-0.025}$</td><td>$165^{\ 0}_{-0.040}$</td></tr>
<tr><td>15A□AJ7□1</td><td>$45^{\ 0}_{-0.025}$</td><td>$165^{\ 0}_{-0.040}$</td></tr>
</table>

3.14.4 SGMPS Servomotors with Standard Backlash Gears and Brakes

(1) 100 W, 200 W and 400 W



Units: mm

Model SGMPS-	Gear Ratio	L	LL	LM	LR	LE	LG	B	C	LD	LB	LC	LA	LZ
01A□AJ1□□	1/5	205	145	91	60	4	9	57	25	63	65	70	80	6.6
01A□AJ3□□	3/31	205	145	91	60	4	9	57	25	63	65	70	80	6.6
01A□AJC□□	1/21	223.5	149.5	95.5	74	4	10	69	32	83	85	90	105	9
01A□AJ7□□	1/33	223.5	149.5	95.5	74	4	10	69	32	83	85	90	105	9
02A□AJ1□□	1/5	232	158	102.5	74	4	10	69	32	83	85	90	105	9
02A□AJ3□□	3/31	232	158	102.5	74	4	10	69	32	83	85	90	105	9
02A□AJC□□	1/21	252.5	168.5	113	84	4	12	82	40	98	100	105	120	9
02A□AJ7□□	1/33	252.5	168.5	113	84	4	12	82	40	98	100	105	120	9
04A□AJ1□□	1/5	242	168	112.5	74	4	10	69	32	83	85	90	105	9
04A□AJ3□□	3/31	262.5	178.5	123	84	4	12	82	40	98	100	105	120	9
04A□AJC□□	1/21	290.5	185.5	130	105	5	13	93	50	112	115	120	135	11
04A□AJ7□□	1/33	290.5	185.5	130	105	5	13	93	50	112	115	120	135	11

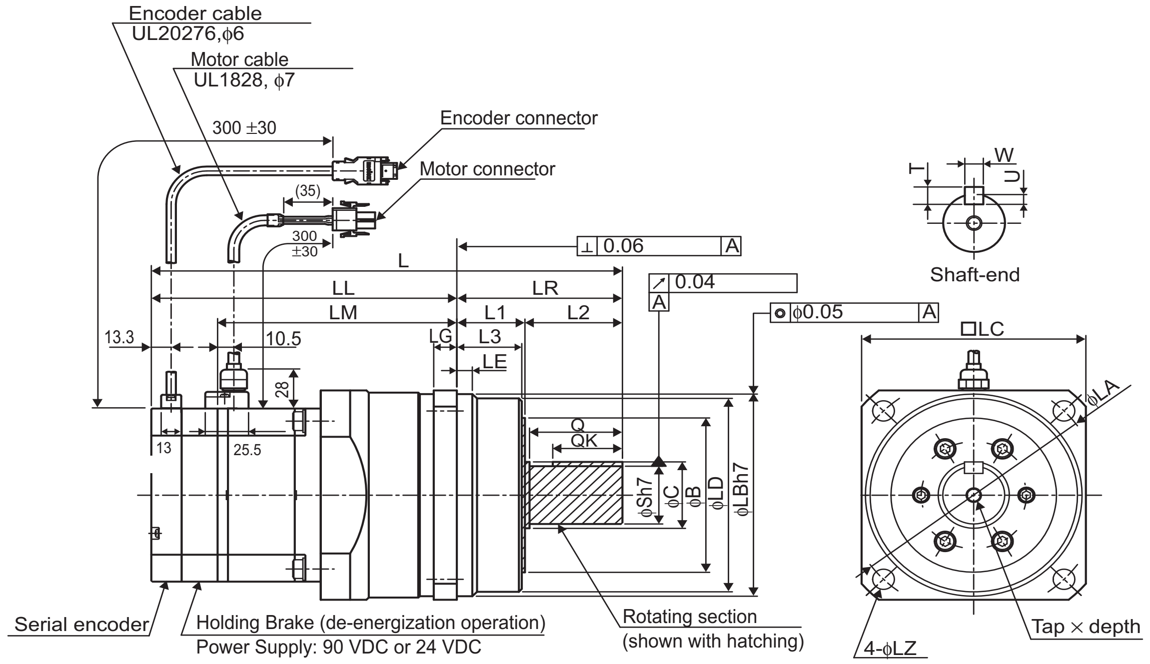
Model SGMPS-	L1	L2	L3	Q	S	Tap × Depth	QK	U	W	T	ME	MH	ML	Approx. Mass kg
01A□AJ1□□	30	30	14.5	28	16	M4 × 8L	25	3	5	5	1	12	20.2	1.5
01A□AJ3□□	30	30	14.5	28	16	M4 × 8L	25	3	5	5	1	12	20.2	1.5
01A□AJC□□	36	38	19.5	36	20	M5 × 10L	32	3.5	6	6	1	12	20.2	2.6
01A□AJ7□□	36	38	19.5	36	20	M5 × 10L	32	3.5	6	6	1	12	20.2	2.6
02A□AJ1□□	36	38	19.5	36	20	M5 × 10L	32	3.5	6	6	1.5	13	21.2	3.3
02A□AJ3□□	36	38	19.5	36	20	M5 × 10L	32	3.5	6	6	1.5	13	21.2	3.3
02A□AJC□□	40	44	23	42	25	M6 × 12L	36	4	8	7	1.5	13	21.2	4.7
02A□AJ7□□	40	44	23	42	25	M6 × 12L	36	4	8	7	1.5	13	21.2	4.7
04A□AJ1□□	36	38	19.5	36	20	M5 × 10L	32	3.5	6	6	1.5	13	21.2	3.6
04A□AJ3□□	40	44	23	42	25	M6 × 12L	36	4	8	7	1.5	13	21.2	4.5
04A□AJC□□	45	60	26.5	58	32	M8 × 16L	50	5	10	8	1.5	13	21.2	6.6
04A□AJ7□□	45	60	26.5	58	32	M8 × 16L	50	5	10	8	1.5	13	21.2	6.6

• Dimensional Tolerances

Units: mm

<table>
<tr><th rowspan="2">Model
SGMAS-</th><th>Shaft-end Dimensions</th><th>Flange Face Dimensions</th></tr>
<tr><th>S</th><th>LB</th></tr>
<tr><td>01A□AJ1□□</td><td rowspan="2">$16^{0}_{-0.018}$</td><td rowspan="2">$65^{0}_{-0.030}$</td></tr>
<tr><td>01A□AJ3□□</td></tr>
<tr><td>01A□AJC□□</td><td rowspan="2">$20^{0}_{-0.021}$</td><td rowspan="2">$85^{0}_{-0.035}$</td></tr>
<tr><td>01A□AJ7□□</td></tr>
<tr><td>02A□AJ1□□</td><td rowspan="2">$20^{0}_{-0.021}$</td><td rowspan="2">$85^{0}_{-0.035}$</td></tr>
<tr><td>02A□AJ3□□</td></tr>
<tr><td>02A□AJC□□</td><td rowspan="2">$25^{0}_{-0.021}$</td><td rowspan="2">$100^{0}_{-0.035}$</td></tr>
<tr><td>02A□AJ7□□</td></tr>
<tr><td>04A□AJ1□□</td><td>$20^{0}_{-0.021}$</td><td>$85^{0}_{-0.035}$</td></tr>
<tr><td>04A□AJ3□□</td><td>$25^{0}_{-0.021}$</td><td>$100^{0}_{-0.035}$</td></tr>
<tr><td>04A□AJC□□</td><td rowspan="2">$32^{0}_{-0.025}$</td><td rowspan="2">$115^{0}_{-0.035}$</td></tr>
<tr><td>04A□AJ7□□</td></tr>
</table>

(2) 750 W and 1500 W



Units: mm

Model SGMPS-	Gear Ratio	L	LL	LM	LR	LE	LG	B	C	LD	LB	LC	LA	LZ
08A□AJ1□□	1/5	274	190	137	84	4	12	82	40	98	100	105	120	9
08A□AJ3□□	3/31	302	197	144	105	5	13	93	50	112	115	120	135	11
08A□AJC□□	1/21	315	208	155	107	10	15	107	46	134	140	145	165	14
08A□AJ7□□	1/33													
15A□AJ1□□	1/5	330	225	172	105	5	13	93	50	112	115	120	135	11
15A□AJB□□	1/11	343	236	183	107	10	15	107	46	134	140	145	165	14
15A□AJC□□	1/21	359	242	189	117	17	16	135	51	163	165	170	190	
15A□AJ7□□	1/33													

Model SGMPS-	L1	L2	L3	Q	S	Tap × Depth	QK	U	W	T	Approx. Mass kg
08A□AJ1□□	40	44	23	42	25	M6 × 12L	36	4	8	7	8.3
08A□AJ3□□	45	60	26.5	58	32	M8 × 16L	50	5	10	8	9.8
08A□AJC□□	44	63	42	60	40	M10 × 20L	45	5	12	8	14.7
08A□AJ7□□											
15A□AJ1□□	45	60	26.5	58	32	M8 × 16L	50	5	10	8	12.9
15A□AJB□□	44	63	42	60	40	M10 × 20L	45		12		18.1
15A□AJC□□	53	64	51		45			5.5	14	9	23.1
15A□AJ7□□											

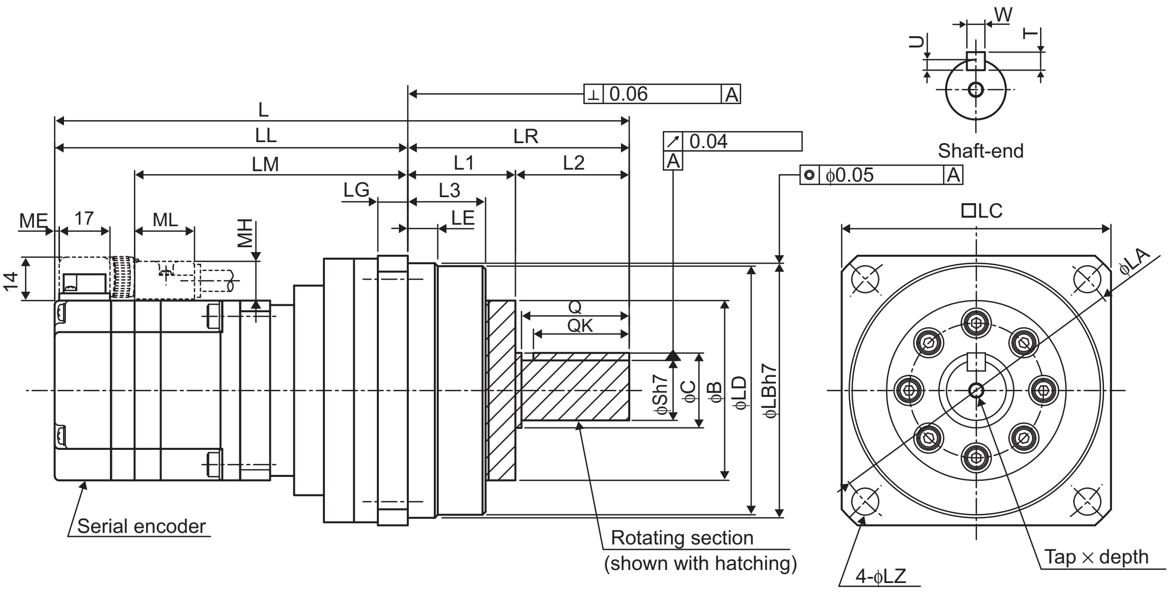
• Dimensional Tolerances

Units: mm

Model SGMAS-	Shaft-end Dimensions S	Flange Face Dimensions LB
08A□AJ1□□	$25^{\ 0}_{-0.021}$	$100^{\ 0}_{-0.035}$
08A□AJ3□□	$32^{\ 0}_{-0.025}$	$115^{\ 0}_{-0.035}$
08A□AJC□□ 08A□AJ7□□	$40^{\ 0}_{-0.025}$	$140^{\ 0}_{-0.040}$
15A□AJ1□□	$32^{\ 0}_{-0.025}$	$115^{\ 0}_{-0.035}$
15A□AJB□□	$40^{\ 0}_{-0.025}$	$140^{\ 0}_{-0.040}$
15A□AJC□□	$45^{\ 0}_{-0.025}$	$165^{\ 0}_{-0.040}$
15A□AJ7□□	$45^{\ 0}_{-0.025}$	$165^{\ 0}_{-0.040}$

3.14.5 SGMPS Servomotors with Low-backlash Gears

(1) 100 W, 200 W and 400 W



Units: mm

Model SGMPS-	Gear Ratio	L	LL	LM	LR	LE	LG	B	C	LD	LB	LC	LA	LZ
01A□AH1□1	1/5	168	108	82	60	8	9	40	20	64.5	65	70	80	6.6
01A□AHB□1	1/11													
01A□AHC□1	1/21	191	117	91	74	7.5	10	59	26	84	85	90	105	9
01A□AH7□1	1/33													
02A□AH1□1	1/5	197	123	99	74	7.5	10	59	26	84	85	90	105	9
02A□AHB□1	1/11													
02A□AHC□1	1/21	215	131	107	84	12	12	59	32	96	100	105	120	
02A□AH7□1	1/33													
04A□AH1□1	1/5	207	133	109	74	7.5	10	59	26	84	85	90	105	9
04A□AHB□1	1/11	225	141	117	84	12	12		32	96	100	105	120	
04A□AHC□1	1/21	253	148	124	105	14	13		40	112	115	120	135	11
04A□AH7□1	1/33	254	149	125		12.5		84	40	114				

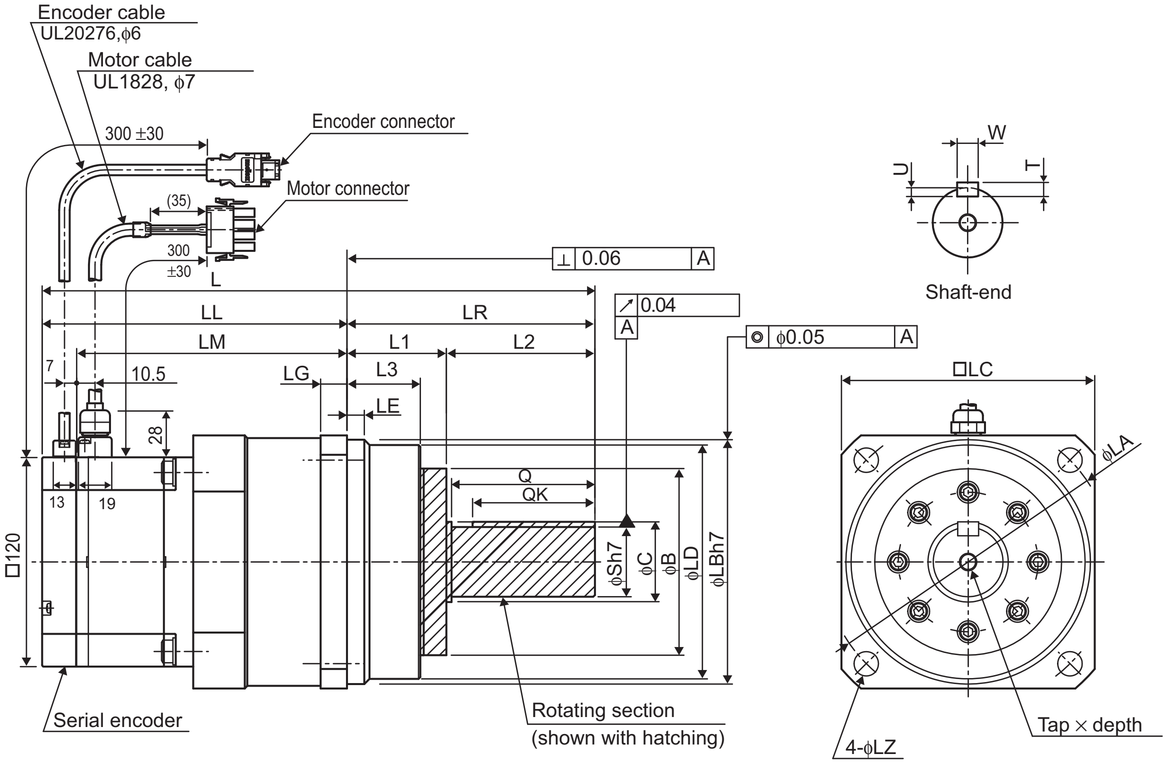
Model SGMPS-	L1	L2	L3	Q	S	Tap × Depth	QK	U	W	T	ME	MH	ML	Approx. Mass kg
01A□AH1□1	30	30	22	28	16	M4 × 8L	25	3	5	5	1	12	20.2	1.3
01A□AHB□1														
01A□AHC□1	36	38	26	36	20	M5 × 10L	32	3.5	6	6				2.8
01A□AH7□1														
02A□AH1□1	36	38	26	36	20	M5 × 10L	32	3.5	6	6	1.5	13	21.2	3.2
02A□AHB□1														3.5
02A□AHC□1	40	44	29	42	25	M6 × 12L	36	4	8	7				3.8
02A□AH7□1														
04A□AH1□1	36	38	26	36	20	M5 × 10L	32	3.5	6	6				3.5
04A□AHB□1	40	44	29	42	25	M6 × 12L	36	4	8	7				4.1
04A□AHC□1	45	60	33	58	32	M8 × 16L	50	5	10	8				4.5
04A□AH7□1														7.0

- Dimensional Tolerances

Units: mm

Model SGMAS-	Shaft-end Dimensions	Flange Face Dimensions
	S	LB
01A□AH1□1 01A□AHB□1	$16^{\,0}_{-0.018}$	$65^{\,0}_{-0.030}$
01A□AHC□1 01A□AH7□1	$20^{\,0}_{-0.021}$	$85^{\,0}_{-0.035}$
02A□AH1□1 02A□AHB□1	$20^{\,0}_{-0.021}$	$85^{\,0}_{-0.035}$
02A□AHC□1 02A□AH7□1	$25^{\,0}_{-0.021}$	$100^{\,0}_{-0.035}$
04A□AH1□1	$20^{\,0}_{-0.021}$	$85^{\,0}_{-0.035}$
04A□AHB□1	$25^{\,0}_{-0.021}$	$100^{\,0}_{-0.035}$
04A□AHC□1 04A□AH7□1	$32^{\,0}_{-0.025}$	$115^{\,0}_{-0.035}$

(2) 750 W and 1500 W



Units: mm

Model SGMPS-	Gear Ratio	L	LL	LM	LR	LE	LG	B	C	LD	LB	LC	LA	LZ
08A□AH1□1	1/5	234.5	150.5	131	84	12	12	59	32	96	100	105	120	9
08A□AHB□1	1/11	263.5	158.5	139	105	14	13	59	40	112	115	120	135	11
08A□AHC□1	1/21	316.5	174.5	155	142	10	15	84	44	134	140	145	165	14
08A□AH7□1	1/33													
15A□AH1□1	1/5	291.5	186.5	167	105	12.5	13	84	40	114	115	120	135	11
15A□AHB□1	1/11	344.5	202.5	183	142	10	15		44	134	140	145	165	14
15A□AHC□1	1/21	364.5	208.5	189	156	16	16	135	51	163	165	170	190	
15A□AH7□1	1/33													

Model SGMPS-	L1	L2	L3	Q	S	Tap × Depth	QK	U	W	T	Approx. Mass kg
08A□AH1□1	40	44	29	42	25	M6 × 12L	36	4	8	7	6.9
08A□AHB□1	45	60	33	58	32	M8 × 16L	50	5	10	8	8.0
08A□AHC□1	57	85	40	82	40	M10 × 20L	70	5	12	8	11.0
08A□AH7□1											
15A□AH1□1	45	60	33	58	32	M8 × 16L	50	5	10	8	13.1
15A□AHB□1	57	85	40	82	40	M10 × 20L	70		12		11.3
15A□AHC□1	70	86	51		45			5.5	14	9	23.6
15A□AH7□1											

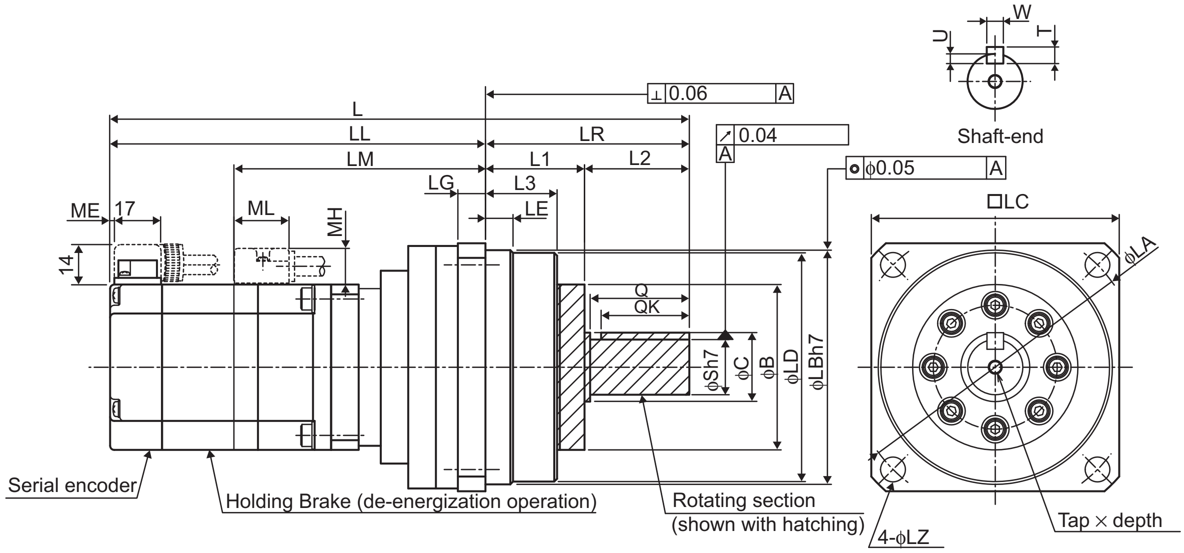
• Dimensional Tolerances

Units: mm

Model SGMAS-	Shaft-end Dimensions S	Flange Face Dimensions LB
08A□AH1□1	$25^{\ 0}_{-0.021}$	$100^{\ 0}_{-0.035}$
08A□AH3□1	$32^{\ 0}_{-0.025}$	$115^{\ 0}_{-0.035}$
08A□AHC□1 08A□AH7□1	$40^{\ 0}_{-0.025}$	$140^{\ 0}_{-0.040}$
15A□AH1□1	$32^{\ 0}_{-0.025}$	$115^{\ 0}_{-0.035}$
15A□AHB□1	$40^{\ 0}_{-0.025}$	$140^{\ 0}_{-0.040}$
15A□AHC□1	$45^{\ 0}_{-0.025}$	$165^{\ 0}_{-0.040}$
15A□AH7□1	$45^{\ 0}_{-0.025}$	$165^{\ 0}_{-0.040}$

3.14.6 SGMPS Servomotors with Low-backlash Gears and Brakes

(1) 100 W, 200 W and 400 W



Units: mm

Model SGMPS-	Gear Ratio	L	LL	LM	LR	LE	LG	B	C	LD	LB	LC	LA	LZ
01A□AH1□□	1/5	196	136	82	60	8	9	40	20	64.5	65	70	80	6.6
01A□AHB□□	1/11													
01A□AHC□□	1/21	219	145	91	74	7.5	10	59	26	84	85	90	105	9
01A□AH7□□	1/33													
02A□AH1□□	1/5	228.5	154.5	99	74	7.5	10	59	26	84	85	90	105	9
02A□AHB□□	1/11													
02A□AHC□□	1/21	246.5	162.5	107	84	12	12		32	96	100	105	120	
02A□AH7□□	1/33													
04A□AH1□□	1/5	238.5	164.5	109	74	7.5	10	59	26	84	85	90	105	9
04A□AHB□□	1/11	256.5	172.5	117	84	12	12		32	96	100	105	120	
04A□AHC□□	1/21	284.5	179.5	124	105	14	13		40	112	115	120	135	11
04A□AH7□□	1/33	285.5	180.5	125		12.5		84	40	114				

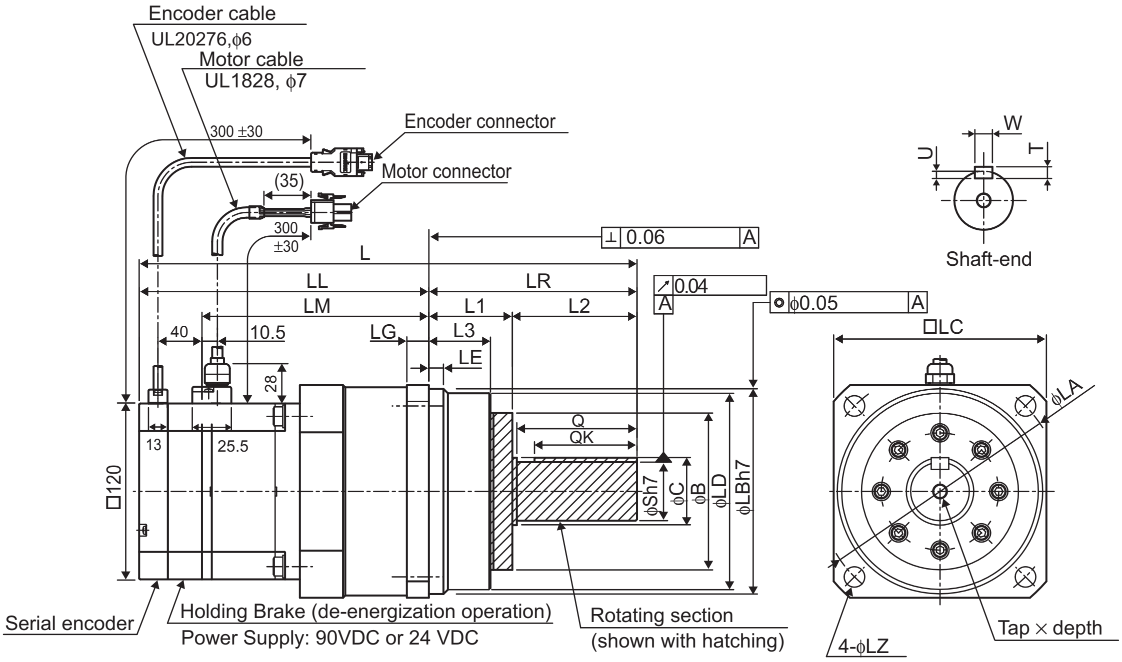
Model SGMPS-	L1	L2	L3	Q	S	Tap $\times$ Depth	QK	U	W	T	ME	MH	ML	Approx. Mass kg
01A□AH1□□	30	30	22	28	16	M4 $\times$ 8L	25	3	5	5	1	12	20.2	1.5
01A□AHB□□														
01A□AHC□□	36	38	26	36	20	M5 $\times$ 10L	32	3.5	6	6				3.0
01A□AH7□□														
02A□AH1□□	36	38	26	36	20	M5 $\times$ 10L	32	3.5	6	6	1.5	13	21.2	3.7
02A□AHB□□														4.0
02A□AHC□□	40	44	29	42	25	M6 $\times$ 12L	36	4	8	7				4.3
02A□AH7□□														
04A□AH1□□	36	38	26	36	20	M5 $\times$ 10L	32	3.5	6	6				4.0
04A□AHB□□	40	44	29	42	25	M6 $\times$ 12L	36	4	8	7				4.6
04A□AHC□□	45	60	33	58	32	M8 $\times$ 16L	50	5	10	8				5.0
04A□AH7□□														7.5

• Dimensional Tolerances

Units: mm

Model SGMAS-	Shaft-end Dimensions	Flange Face Dimensions
	S	LB
01A☐AH1☐☐	$16^{\ 0}_{-0.018}$	$65^{\ 0}_{-0.030}$
01A☐AHB☐☐		
01A☐AHC☐☐	$20^{\ 0}_{-0.021}$	$85^{\ 0}_{-0.035}$
01A☐AH7☐☐		
02A☐AH1☐☐	$20^{\ 0}_{-0.021}$	$85^{\ 0}_{-0.035}$
02A☐AHB☐☐		
02A☐AHC☐☐	$25^{\ 0}_{-0.021}$	$100^{\ 0}_{-0.035}$
02A☐AH7☐☐		
04A☐AH1☐☐	$20^{\ 0}_{-0.021}$	$85^{\ 0}_{-0.035}$
04A☐AHB☐☐	$25^{\ 0}_{-0.021}$	$100^{\ 0}_{-0.035}$
04A☐AHC☐☐	$32^{\ 0}_{-0.025}$	$115^{\ 0}_{-0.035}$
04A☐AH7☐☐		

(2) 750 W and 1500 W



Units: mm

Model SGMPS-	Gear Ratio	L	LL	LM	LR	LE	LG	B	C	LD	LB	LC	LA	LZ
08A□AH1□□	1/5	268	184	131	84	12	12	59	32	96	100	105	120	9
08A□AHB□□	1/11	297	192	139	105	14	13	59	40	112	115	120	135	11
08A□AHC□□	1/21	350	208	155	142	10	15	84	44	134	140	145	165	14
08A□AH7□□	1/33													
15A□AH1□□	1/5	325	220	167	105	12.5	13	84	40	114	115	120	135	11
15A□AHB□□	1/11	378	236	183	142	10	15		44	134	140	145	165	14
15A□AHC□□	1/21	398	242	189	156	16	16	135	51	163	165	170	190	
15A□AH7□□	1/33													

Model SGMPS-	L1	L2	L3	Q	S	Tap × Depth	QK	U	W	T	Approx. Mass kg
08A□AH1□□	40	44	29	42	25	M6 × 12L	36	4	8	7	8.4
08A□AHB□□	45	60	33	58	32	M8 × 16L	50	5	10	8	9.5
08A□AHC□□	57	85	40	82	40	M10 × 20L	70		12		12.5
08A□AH7□□											
15A□AH1□□	45	60	33	58	32	M8 × 16L	50	5	10	8	10.7
15A□AHB□□	57	85	40	82	40	M10 × 20L	70		12		12.8
15A□AHC□□	70	86	51		45			5.5	14	9	25.1
15A□AH7□□											

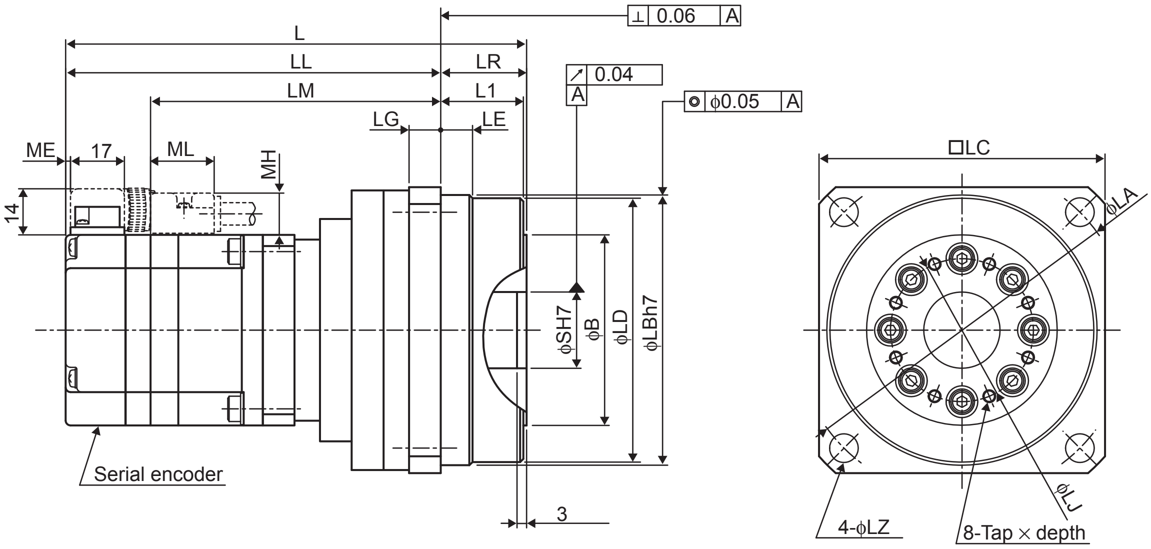
• Dimensional Tolerances

Units: mm

Model SGMAS-	Shaft-end Dimensions S	Flange Face Dimensions LB
08A□AH1□□	$25^{0}_{-0.021}$	$100^{0}_{-0.035}$
08A□AHB□□	$32^{0}_{-0.025}$	$115^{0}_{-0.035}$
08A□AHC□□ 08A□AH7□□	$40^{0}_{-0.025}$	$140^{0}_{-0.040}$
15A□AH1□□	$32^{0}_{-0.025}$	$115^{0}_{-0.035}$
15A□AHB□□	$40^{0}_{-0.025}$	$140^{0}_{-0.040}$
15A□AHC□□	$45^{0}_{-0.025}$	$165^{0}_{-0.040}$
15A□AH7□□	$45^{0}_{-0.025}$	$165^{0}_{-0.040}$

3.14.7 SGMPS Flange-type Servomotors with Low-backlash Gears

(1) 100 W, 200 W and 400 W



Units: mm

Model SGMPS-	Gear Ratio	L	LL	LM	LR	LE	LG	B	LD	LB	LC	LA	LZ
01A□AH101	1/5	132	109	83	23	8	9	50	64.5	65	70	80	6.6
01A□AHB01	1/11												
01A□AHC01	1/21	145	118	92	27	10	10	60	83	85	90	105	9
01A□AH701	1/33												
02A□AH101	1/5	150	123	99	27	10	10	60	83	85	90	105	9
02A□AHB01	1/11												
02A□AHC01	1/21	162	131	107	31	12	12	70	96	100	105	120	
02A□AH701	1/33												
04A□AH101	1/5	160	133	109	27	10	10	60	83	85	90	105	9
04A□AHB01	1/11	172	141	117	31	12	12	70	96	100	105	120	
04A□AHC01	1/21	184	149	125	35	14	13	90	112	115	120	135	11
04A□AH701	1/33												

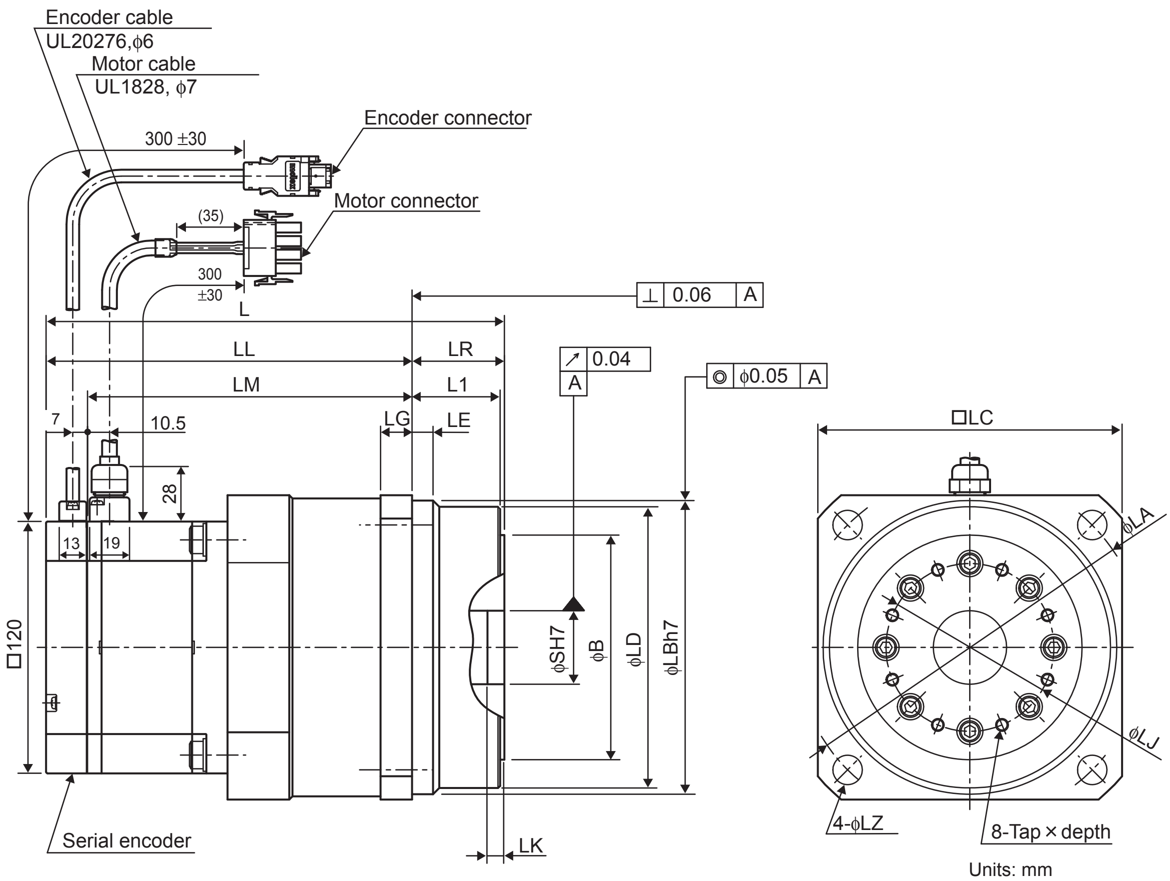
Model SGMPS-	L1	S	Tap ×Depth	LJ	ME	MH	ML	Approx. Mass kg
01A□AH101	22	19	M3 × 6L	35	1	12	20.2	1.3
01A□AHB01								1.4
01A□AHC01	26	24	M4 × 7L	45				2.4
01A□AH701								
02A□AH101	26	24	M4 × 7L	45	1.5	13	21.2	2.9
02A□AHB01								3.0
02A□AHC01	29	28	M5 × 8L	55				4.1
02A□AH701								
04A□AH101	26	24	M4 × 7L	45				3.2
04A□AHB01	29	28	M5 × 8L	55				4.4
04A□AHC01	33	32	M5 × 8L	70				5.8
04A□AH701								

• Dimensional Tolerances

Units: mm

Model SGMAS-	Shaft-end Dimensions S	Flange Face Dimensions LB
01A☐AH101 01A☐AHB01	$19^{+0.021}_{0}$	$65^{0}_{-0.030}$
01A☐AHC01 01A☐AH701	$24^{+0.021}_{0}$	$85^{0}_{-0.035}$
02A☐AH101 02A☐AHB01	$24^{+0.021}_{0}$	$85^{0}_{-0.035}$
02A☐AHC01 02A☐AH701	$24^{+0.021}_{0}$	$100^{0}_{-0.035}$
04A☐AH101	$24^{+0.021}_{0}$	$85^{0}_{-0.035}$
04A☐AHB01	$24^{+0.021}_{0}$	$100^{0}_{-0.035}$
04A☐AHC01 04A☐AH701	$24^{+0.021}_{0}$	$115^{0}_{-0.035}$

(2) 750 W and 1500 W



Units: mm

Model SGMPS-	Gear Ratio	L	LL	LM	LR	LE	LG	B	LD	LB	LC	LA	LZ
08A□AH101	1/5	181.5	150.5	131	31	12	12	70	96	100	105	120	9
08A□AHB01	1/11	193.5	158.5	139	35	14	13	90	112	115	120	135	11
08A□AHC01	1/21	218.5	174.5	155	44	10	15	107	134	140	145	165	14
08A□AH701	1/33												
15A□AH101	1/5	221.5	186.5	167	35	12.5	13	90	112	115	120	135	11
15A□AHB01	1/11	246.5	202.5	183	44	10	15	107	134	140	145	165	14
15A□AHC01	1/21	261.5	208.5	189	53	16	16	135	163	165	170	190	
15A□AH701	1/33												

Model SGMPS-	L1	LJ	LK	S	Tap × Depth	Approx. Mass kg
08A□AH101	29	55	3	28	M5 × 8L	6.9
08A□AHB01	33	70		32		8.6
08A□AHC01	42	80	4	35	M6 × 10L	12.2
08A□AH701						
15A□AH101	33	70	3	32	M5 × 8L	11.6
15A□AHB01	42	80	4	35	M6 × 10L	15.8
15A□AHC01	51	100	6	47	M8 × 12L	20.5
15A□AH701						

Note: For flange-type servomotors, the inner diameter of the rotating section and bolts etc. is not sealed.

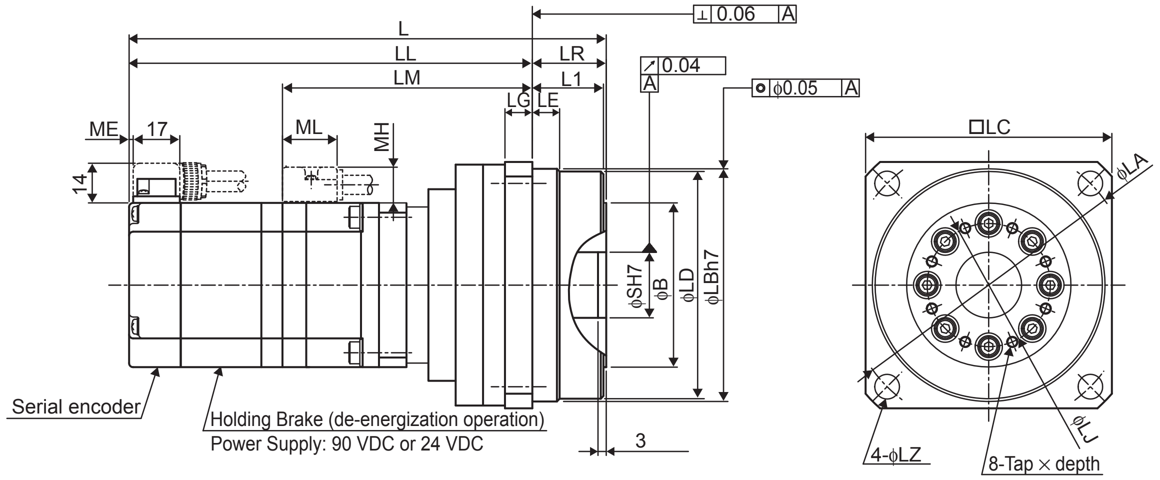
• Dimensional Tolerances

Units: mm

Model SGMAS-	Shaft-end Dimensions	Flange Face Dimensions
	S	LB
08A□AH101	$28^{+0.021}_{0}$	$100^{0}_{-0.035}$
08A□AHB01	$32^{+0.025}_{0}$	$115^{0}_{-0.035}$
08A□AHC01 08A□AH701	$35^{+0.025}_{0}$	$140^{0}_{-0.040}$
15A□AH101	$32^{+0.025}_{0}$	$115^{0}_{-0.035}$
15A□AHB01	$35^{+0.025}_{0}$	$140^{0}_{-0.040}$
15A□AHC01	$47^{0}_{-0.025}$	$165^{0}_{-0.040}$
15A□AH701	$47^{0}_{-0.025}$	$165^{0}_{-0.040}$

3.14.8 SGMPS Flange-type Servomotors with Low-backlash Gears and Brakes

(1) 100 W, 200 W and 400 W



Units: mm

Model SGMPS-	Gear Ratio	L	LL	LM	LR	LE	LG	B	LD	LB	LC	LA	LZ
01A□AH10□	1/5	160	137	83	23	8	9	50	64.5	65	70	80	6.6
01A□AHB0□	1/11												
01A□AHC0□	1/21	173	146	92	27	10	10	60	83	85	90	105	9
01A□AH70□	1/33												
02A□AH10□	1/5	181.5	154.5	99	27	10	10	60	83	85	90	105	9
02A□AHB0□	1/11												
02A□AHC0□	1/21	193.5	162.5	107	31	12	12	70	96	100	105	120	
02A□AH70□	1/33												
04A□AH10□	1/5	191.5	164.5	109	27	10	10	60	83	85	90	105	9
04A□AHB0□	1/11	203.5	172.5	117	31	12	12	70	96	100	105	120	
04A□AHC0□	1/21	215.5	180.5	125	35	14	13	90	112	115	120	135	11
04A□AH70□	1/33												

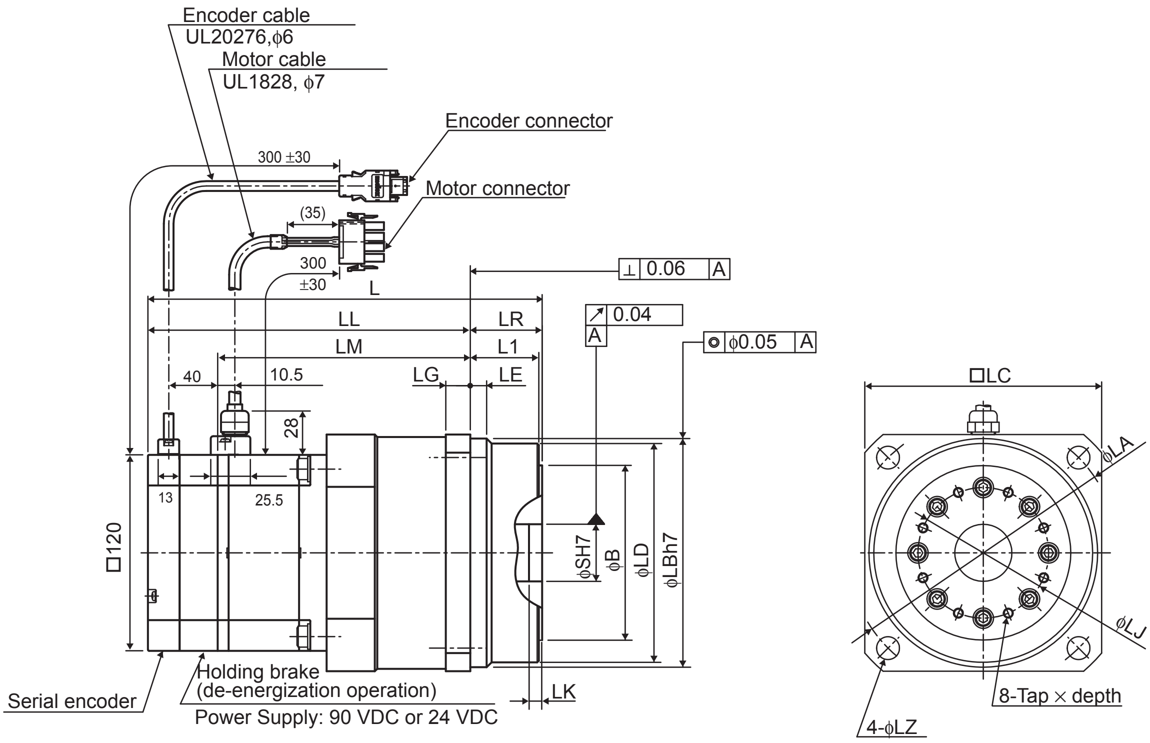
Model SGMPS-	L1	S	Tap × Depth	LJ	ME	MH	ML	Approx. Mass kg
01A□AH10□	22	19	M3 × 6L	35	1	12	20.2	1.5
01A□AHB0□								1.6
01A□AHC0□	26	24	M4 × 7L	45				2.6
01A□AH70□								
02A□AH10□	26	24	M4 × 7L	45	1.5	13	21.2	3.4
02A□AHB0□								3.5
02A□AHC0□	29	28	M5 × 8L	55				4.6
02A□AH70□								
04A□AH10□	26	24	M4 × 7L	45				3.7
04A□AHB0□	29	28	M5 × 8L	55				4.9
04A□AHC0□	33	32		70				6.3
04A□AH70□								

• Dimensional Tolerances

Units: mm

Model SGMAS-	Shaft-end Dimensions S	Flange Face Dimensions LB
01A□AH10□ 01A□AHB0□	$16^{\ 0}_{-0.018}$	$65^{\ 0}_{-0.030}$
01A□AHC0□ 01A□AH70□	$20^{\ 0}_{-0.021}$	$85^{\ 0}_{-0.035}$
02A□AH10□ 02A□AHB0□	$20^{\ 0}_{-0.021}$	$85^{\ 0}_{-0.035}$
02A□AHC0□ 02A□AH70□	$25^{\ 0}_{-0.021}$	$100^{\ 0}_{-0.035}$
04A□AH10□	$20^{\ 0}_{-0.021}$	$85^{\ 0}_{-0.035}$
04A□AHB0□	$25^{\ 0}_{-0.021}$	$100^{\ 0}_{-0.035}$
04A□AHC0□ 04A□AH70□	$32^{\ 0}_{-0.025}$	$115^{\ 0}_{-0.035}$

(2) 750 W and 1500 W



Units: mm

Model SGMPS-	Gear Ratio	L	LL	LM	LR	LE	LG	B	LD	LB	LC	LA	LZ
08A□AH10□	1/5	215	184	131	31	12	12	70	96	100	105	120	9
08A□AHB0□	1/11	227	192	139	35	14	13	90	112	115	120	135	11
08A□AHC0□	1/21	252	208	155	44	10	15	107	134	140	145	165	14
08A□AH70□	1/33												
15A□AH10□	1/5	255	220	167	35	12.5	13	90	112	115	120	135	11
15A□AHB0□	1/11	280	236	183	44	10	15	107	134	140	145	165	14
15A□AHC0□	1/21	295	242	189	53	16	16	135	163	165	170	190	
15A□AH70□	1/33												

Model SGMPS-	L1	LJ	LK	S	Tap × Depth	Approx. Mass kg
08A□AH10□	29	55	3	28	M5 × 8L	8.4
08A□AHB0□	33	70		32		10.1
08A□AHC0□	42	80	4	35	M6 × 10L	13.7
08A□AH70□						
15A□AH10□	33	70	3	32	M5 × 8L	13.1
15A□AHB0□	42	80	4	35	M6 × 10L	17.3
15A□AHC0□	51	100	6	47	M8 × 12L	22.0
15A□AH70□						

Note: For flange-type servomotors, the inner diameter of the rotating section and bolts etc. is not sealed.

• Dimensional Tolerances

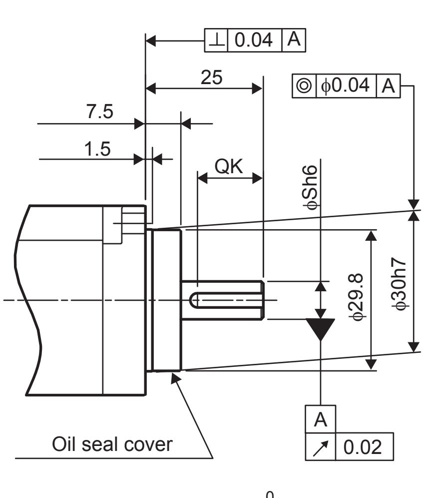
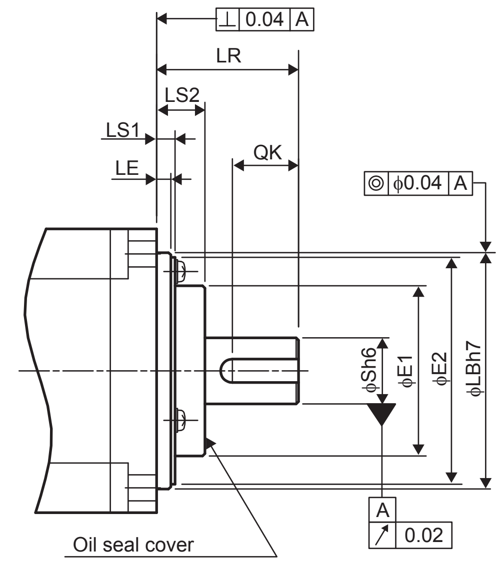
Units: mm

Model SGMAS-	Shaft-end Dimensions	Flange Face Dimensions
	S	LB
08A☐AH10☐	$28^{+0.021}_{0}$	$100^{0}_{-0.035}$
08A☐AHB0☐	$32^{+0.025}_{0}$	$115^{0}_{-0.035}$
08A☐AHC0☐ 08A☐AH70☐	$35^{+0.025}_{0}$	$140^{0}_{-0.040}$
15A☐AH10☐	$32^{+0.025}_{0}$	$115^{0}_{-0.035}$
15A☐AHB0☐	$35^{+0.025}_{0}$	$140^{0}_{-0.040}$
15A☐AHC0☐	$47^{0}_{-0.025}$	$165^{0}_{-0.040}$
15A☐AH70☐	$47^{0}_{-0.025}$	$165^{0}_{-0.040}$

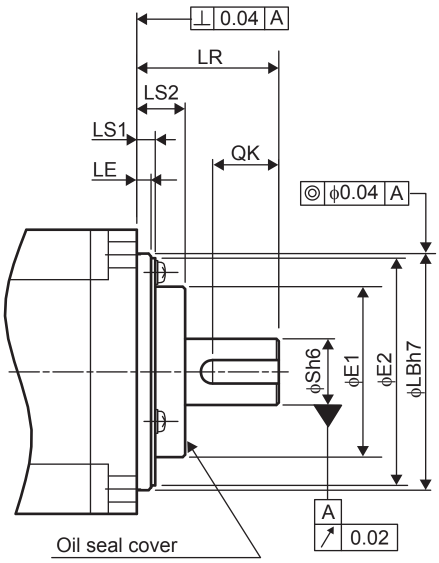
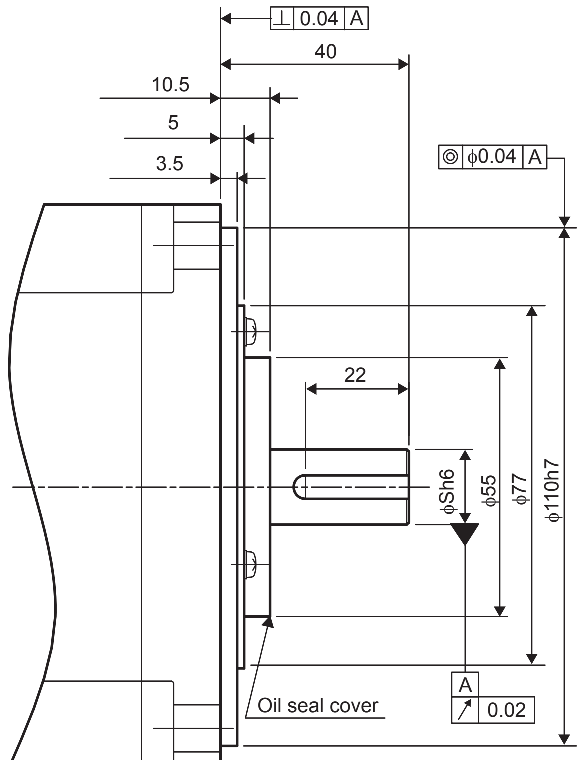
3.15 Output Shaft of SGMAS and SGMPS Servomotors with Oil Seal

The following table shows the external dimensions of the output shaft for SGMAS and SGMPS servomotors with oil seals. Note that the key length, QK, of the servomotors with oil seals, SGMAS-02 to -12, differs from that of the servomotors without oil seals.

3.15.1 SGMAS Servomotors

Model		SGMAS-A5, -01, and -C2		SGMAS-02, -04, and -06	SGMAS-08 and -12
Outer Dimensions in mm		□40		□60	□80
Capacity		50 W	100 W, 150 W	200 to 600 W	750 W, 1150 W
Output Shaft Dimensions in mm	φS	6	8	14	16
	φE1	–	–	36	49
	φE2	–	–	48	66
	φLB	–	–	50	70
	QK	14	14	14 (20 for servomotors without oil seals)	25 (20 for servomotors without oil seals)
	LE	–	–	3	3
	LS1	–	–	4	6
	LS2	–	–	10	11
	LR	–	–	30	40
Dimensional Drawing in mm		 $\phi30h7:\phi30^{0}_{-0.021}$			
Dimensional Tolerances in mm	S	$\phi6^{0}_{-0.008}$	$\phi8^{0}_{-0.009}$	$\phi14^{0}_{-0.011}$	$\phi16^{0}_{-0.011}$
	LB	–	–	$\phi50^{0}_{-0.025}$	$\phi70^{0}_{-0.03}$

3.15.2 SGMPS Servomotors

<table>
<tr><td colspan="2">Model</td><td>SGMPS-01</td><td>SGMPS-02, and -04</td><td>SGMPS-08</td><td>SGMPS-15</td></tr>
<tr><td colspan="2">Outer Dimensions in mm</td><td>□60</td><td>□80</td><td colspan="2">□120</td></tr>
<tr><td colspan="2">Capacity</td><td>100 W</td><td>200 W, 400 W</td><td>750 W</td><td>1500 W</td></tr>
<tr><td rowspan="9">Output Shaft Dimensions in mm</td><td>φS</td><td>8</td><td>14</td><td>16</td><td>19</td></tr>
<tr><td>φE1</td><td>22</td><td>35</td><td>–</td><td>–</td></tr>
<tr><td>φE2</td><td>39</td><td>49</td><td>–</td><td>–</td></tr>
<tr><td>φLB</td><td>50</td><td>70</td><td>–</td><td>–</td></tr>
<tr><td>QK</td><td>14</td><td>16</td><td>–</td><td>–</td></tr>
<tr><td>LE</td><td>3</td><td>3</td><td>–</td><td>–</td></tr>
<tr><td>LS1</td><td>3.5</td><td>6.5</td><td>–</td><td>–</td></tr>
<tr><td>LS2</td><td>7</td><td>10</td><td>–</td><td>–</td></tr>
<tr><td>LR</td><td>25</td><td>30</td><td>–</td><td>–</td></tr>
<tr><td colspan="2">Dimensional Drawing in mm</td><td colspan="2">
</td><td colspan="2">

φ16h6: $\phi 16^{0}_{-0.011}$
φ110h7: $\phi 110^{0}_{-0.035}$</td></tr>
<tr><td rowspan="2">Dimensional Tolerances in mm</td><td>S</td><td>$\phi 8^{0}_{-0.009}$</td><td>$\phi 14^{0}_{-0.011}$</td><td>–</td><td>–</td></tr>
<tr><td>LB</td><td>$\phi 50^{0}_{-0.025}$</td><td>$\phi 70^{0}_{-0.03}$</td><td>–</td><td>–</td></tr>
</table>

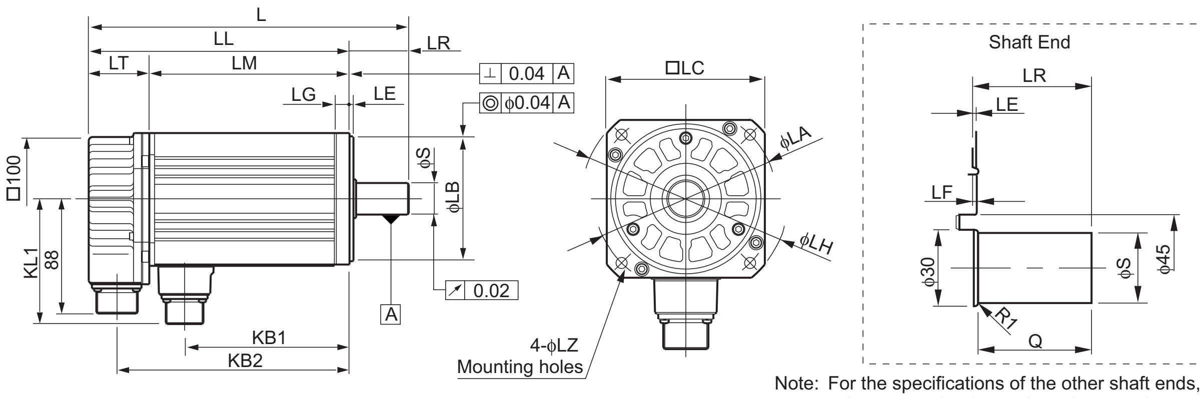
Servomotor Specifications and Dimensional Drawings

3

3.16 Dimensional Drawings of SGMSS Servomotors

3.16.1 1.0-kW to 5.0-kW SGMSS Servomotors without Gears

Models with oil seals are of the same configuration.



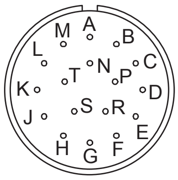
Note: For the specifications of the other shaft ends, refer to *3.17 Shaft End Specifications for SGMSS Servomotors*.

Units: mm

Models SGMSS-	L	LL	LM	LR	LT	KB1	KB2	KL1	Shaft-end Dimensions		Approx. Mass kg
									S	Q	
10A□A21	194	149	103	45	46	76	128	96	$24^{0}_{-0.013}$	40	4.6
15A□A21	205	160	116	45	44	87	139	96	$24^{0}_{-0.013}$	40	5.1
20A□A21	220	175	131	45	44	102	154	96	$24^{0}_{-0.013}$	40	5.8
25A□A21	249	204	154	45	50	125	183	96	$24^{0}_{-0.013}$	40	7.0
30A□A21	262	199	155	63	44	124	178	114	$28^{0}_{-0.013}$	55	11
40A□A21	299	236	192	63	44	161	215	114	$28^{0}_{-0.013}$	55	14
50A□A21	339	276	232	63	44	201	255	114	$28^{0}_{-0.013}$	55	17

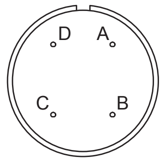
Models SGMSS-	Flange Face Dimensions mm							
	LA	LB	LC	LE	LF	LG	LH	LZ
10A□A21	115	$95^{0}_{-0.035}$	100	3	3	10	130	7
15A□A21	115	$95^{0}_{-0.035}$	100	3	3	10	130	7
20A□A21	115	$95^{0}_{-0.035}$	100	3	3	10	130	7
25A□A21	115	$95^{0}_{-0.035}$	100	3	3	10	130	7
30A□A21	145	$110^{0}_{-0.035}$	130	6	6	12	165	9
40A□A21	145	$110^{0}_{-0.035}$	130	6	6	12	165	9
50A□A21	145	$110^{0}_{-0.035}$	130	6	6	12	165	9

• Cable Specifications for Encoder End Connectors (17-bit Encoder)



Receptacle: MS3102A20-29P
Applicable plug (Purchased by the customer)
Plug: MS3108B20-29S
Cale clamp: MS3057-12A

• Cable Specifications for Servomotor Connectors



A	Phase U
B	Phase V
C	Phase W
D	FG (Frame ground)

With an Absolute Encoder

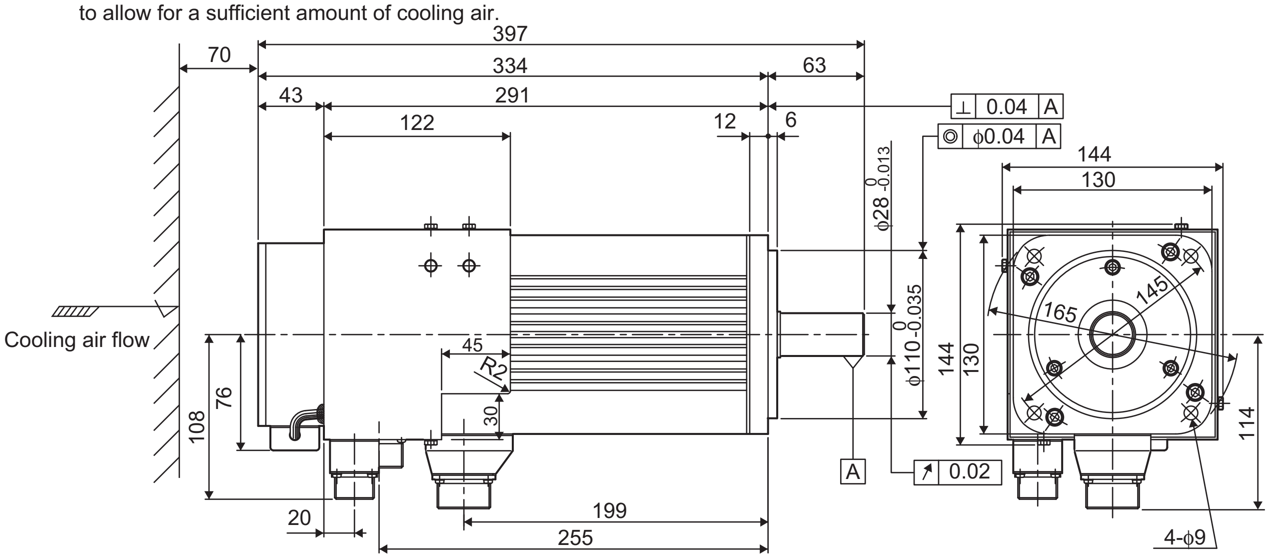
A	–	K	–
B	–	L	–
C	DATA+	M	–
D	DATA-	N	–
E	–	P	–
F	–	R	–
G	0V	S	BATT-
H	+5VDC	T	BATT+
J	FG(Frame ground)	–	–

With an Incremental Encoder

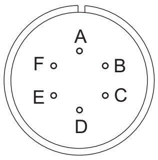
A	–	K	–
B	–	L	–
C	DATA+	M	–
D	DATA-	N	–
E	–	P	–
F	–	R	–
G	0V	S	–
H	+5VDC	T	–
J	FG(Frame ground)	–	–

3.16.2 7.0-kW SGMSS Servomotors without Gears

Leave a minimum space of 70 mm around the servomotor to allow for a sufficient amount of cooling air.



• Cable Specifications for Connectors on Fan End



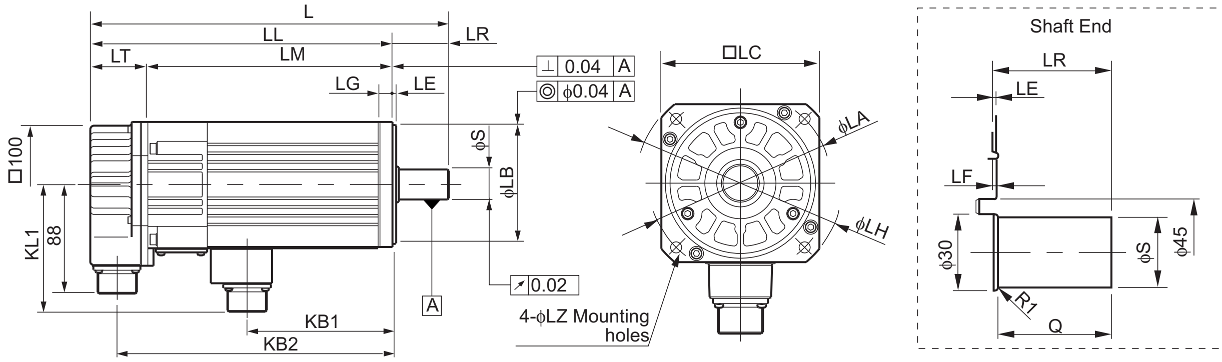
Receptacle: MS3102A14S-6P
Applicable plug to be prepared by customer
Plug: MS3108B14S-6S
Cable clamp: MS3057-6A

A	Fan motor
B	Fan motor
C	–
D	Alarm terminal
E	Alarm terminal
F	FG (Frame ground)

Note: The cable specifications of connectors on the encoder and servomotor ends are same as those for the SGMSS-30 to the SGMSS-50 servomotors without brakes.

3.16.3 SGMSS Servomotors without Gears and with Brakes

The servomotor with an oil seal has the same configuration.



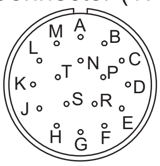
Note: For the specifications of the other shaft ends, refer to *3.20 Shaft End Specifications for SGMGH, SGMSH, and SGMDH Servomotors*.

Units: mm

Model SGMSS-	L	LL	LM	LR	LT	KB1	KB2	KL1	Shaft-end Dimensions		Approx. Mass kg
									S	Q	
10A□A2B	238	193	147	45	46	67	171	102	$24^{0}_{-0.013}$	40	6.0
15A□A2B	252	207	157	45	50	77	185	102	$24^{0}_{-0.013}$	40	6.8
20A□A2B	268	223	173	45	50	93	201	102	$24^{0}_{-0.013}$	40	7.5
25A□A2B	300	255	205	45	50	115	233	102	$24^{0}_{-0.013}$	40	10
30A□A2B	298	235	191	63	44	114	214	119	$28^{0}_{-0.013}$	55	13

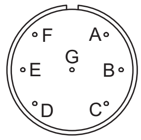
Model SGMSS-	Flange Face Dimensions							
	LA	LB	LC	LE	LF	LG	LH	LZ
10A□A2B	115	$95^{0}_{-0.035}$	100	3	3	10	130	7
15A□A2B	115	$95^{0}_{-0.035}$	100	3	3	10	130	7
20A□A2B	115	$95^{0}_{-0.035}$	100	3	3	10	130	7
25A□A2B	115	$95^{0}_{-0.035}$	100	3	3	10	130	7
30A□A2B	145	$110^{0}_{-0.035}$	130	6	6	12	165	9

- Cable Specifications for Encoder-end Connector (17-bit Encoder)



Receptacle: MS3102A20-29P
Applicable plug to be prepared by customer
Plug: MS3108B20-29S
Cable clamp: MS3057-12A

- Cable Specifications for Servomotor-end Connector



A	Phase U	E	Brake terminal
B	Phase V	F	Brake terminal
C	Phase W	G	–
D	FG (Frame ground)	–	–

For an absolute encoder

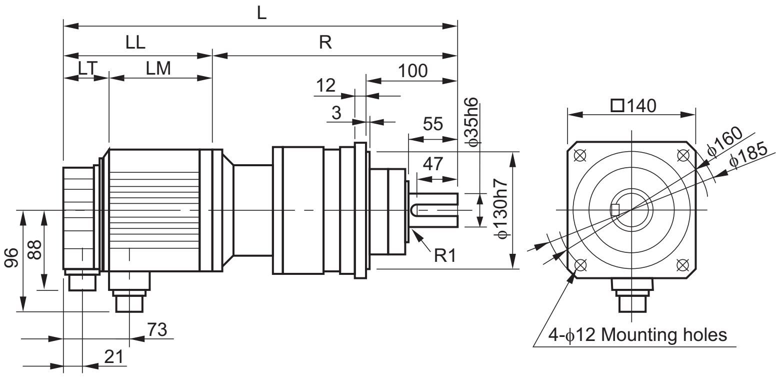
A	–	K	–
B	–	L	–
C	DATA+	M	–
D	DATA-	N	–
E	–	P	–
F	–	R	–
G	0V	S	BATT-
H	+5VDC	T	BATT+
J	FG (Frame ground)	–	–

For an incremental encoder

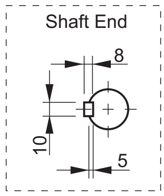
A	–	K	–
B	–	L	–
C	DATA+	M	–
D	DATA-	N	–
E	–	P	–
F	–	R	–
G	0V	S	–
H	+5VDC	T	–
J	FG (Frame ground)	–	–

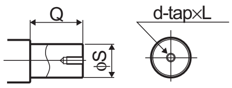
3.16.4 SGMSS Servomotors with Low-backlash Gears and Flange-mounted Type

(1) Small Grease Lubricating Type



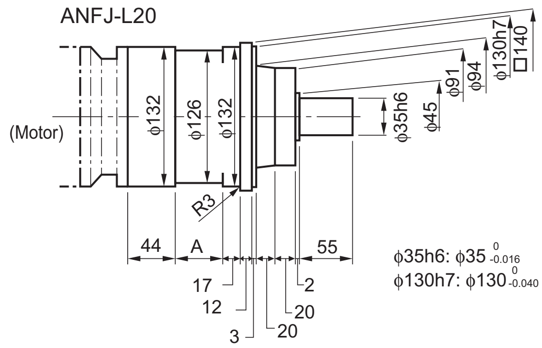
• Applied Specifications for Shaft-end Tap





Frame No.	Dia.S	Length Q	d × L mm
ANFJ-L20	35	55	M8 × 16
ANFJ-L30	50	75	M10 × 20
ANFJ-L40	60	90	M12 × 24

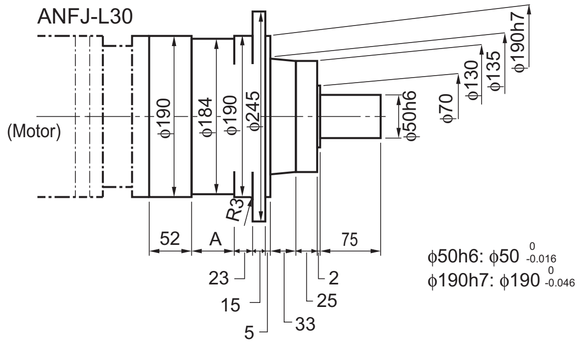
• Detailed Dimensions of IMT Gears



ϕ35h6: $\phi 35^{\,0}_{-0.016}$
ϕ130h7: $\phi 130^{\,0}_{-0.040}$

Units: mm

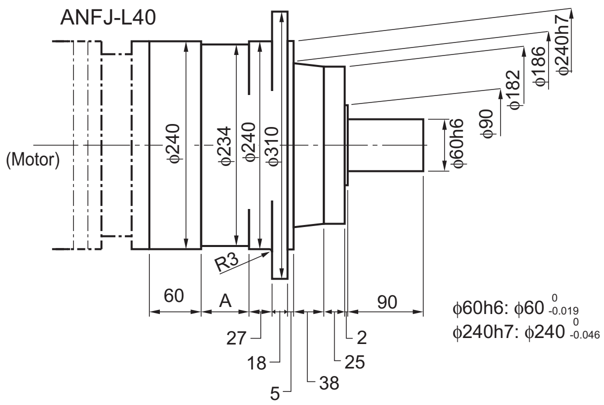
Gear Ratio	A
1/5	6
1/9	18
1/20, 1/29	37
1/45	47



ϕ50h6: $\phi 50^{\,0}_{-0.016}$
ϕ190h7: $\phi 190^{\,0}_{-0.046}$

Units: mm

Gear Ratio	A
1/5	11
1/9	38
1/20, 1/29	42
1/45	52



ϕ60h6: $\phi 60^{\,0}_{-0.019}$
ϕ240h7: $\phi 240^{\,0}_{-0.046}$

Units: mm

Gear Ratio	A
1/5	16
1/9	48
1/20, 1/29	48
1/45	58

Servomotor Specifications and Dimensional Drawings

3

Units: mm

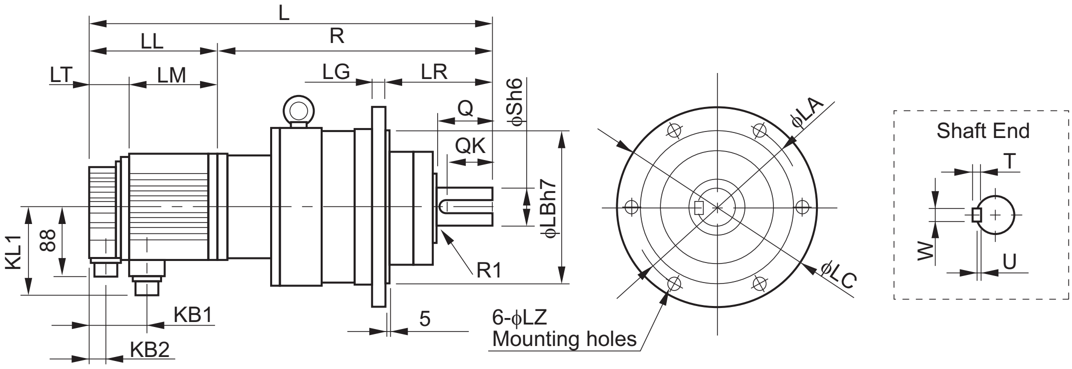
Model SGMSS-	Gear Model	Gear Ratio	L	LL	LM	LT	R	Approx. Mass kg
10A□AL14	ANFJ-L20	1/5	403	149	103	46	254	13
10A□AL24		1/9	415	149	103	46	266	13
15A□AL14		1/5	414	160	116	44	254	14
20A□AL14		1/5	429	175	131	44	254	15

INFO

■ Lubrication

- Since grease has been filled prior to shipment, the servomotors can be used without replenishing grease.

(2) Large Grease Lubricating Type



Units: mm

Model SGMSS-	Gear Model	Gear Ratio	L	LL	LM	LR	LT	KB1	KB2	KL1	R
10A□AL54	ANFJ-L30	1/20	496	149	103	140	46	73	21	96	347
10A□AL74		1/29	496	149	103	140	46	73	21	96	347
10A□AL84		1/45	506	149	103	140	46	73	21	96	357
15A□AL24		1/9	503	160	116	140	44	73	21	96	343
15A□AL54		1/20	507	160	116	140	44	73	21	96	347
15A□AL74		1/29	507	160	116	140	44	73	21	96	347
15A□AL84	ANFJ-L40	1/45	558	160	116	160	44	73	21	96	398
20A□AL24	ANFJ-L30	1/9	518	175	131	140	44	73	21	96	343
20A□AL54		1/20	522	175	131	140	44	73	21	96	347
20A□AL74	ANFJ-L40	1/29	563	175	131	160	44	73	21	96	388
20A□AL84		1/45	573	175	131	160	44	73	21	96	398
25A□AL14	ANFJ-L30	1/5	520	204	154	140	50	79	21	96	316
25A□AL24		1/9	547	204	154	140	50	79	21	96	343
25A□AL54	ANFJ-L40	1/20	592	204	154	160	50	79	21	96	388
25A□AL74		1/29	592	204	154	160	50	79	21	96	388
25A□AL84		1/45	602	204	154	160	50	79	21	96	398
30A□AL14	ANFJ-L30	1/5	540	199	155	140	44	75	21	114	341
30A□AL24		1/9	567	199	155	140	44	75	21	114	368
30A□AL54	ANFJ-L40	1/20	612	199	155	160	44	75	21	114	413
30A□AL74		1/29	612	199	155	160	44	75	21	114	413
30A□AL84		1/45	622	199	155	160	44	75	21	114	423
40A□AL14	ANFJ-L30	1/5	577	236	192	140	44	75	21	114	341
40A□AL24	ANFJ-L40	1/9	649	236	192	160	44	75	21	114	413
40A□AL54		1/20	649	236	192	160	44	75	21	114	413
40A□AL74		1/29	649	236	192	160	44	75	21	114	413
50A□AL14		1/5	657	276	232	160	44	75	21	114	381
50A□AL24		1/9	689	276	232	160	44	75	21	114	413
50A□AL54		1/20	689	276	232	160	44	75	21	114	413

(cont'd)

Model SGMSS-	Gear Ratio	Flange Face Dimensions mm					Shaft-end Dimensions mm						Approx. Mass kg
		LA	LB	LC	LG	LZ	Q	QK	S	T	U	W	
10A☐AL54	1/20	220	190	245	15	12	75	65	50	9	5.5	14	30
10A☐AL74	1/29	220	190	245	15	12	75	65	50	9	5.5	14	30
10A☐AL84	1/45	220	190	245	15	12	75	65	50	9	5.5	14	30
15A☐AL24	1/9	220	190	245	15	12	75	65	50	9	5.5	14	30.3
15A☐AL54	1/20	220	190	245	15	12	75	65	50	9	5.5	14	30.3
15A☐AL74	1/29	220	190	245	15	12	75	65	50	9	5.5	14	30.3
15A☐AL84	1/45	280	240	310	18	14	90	78	60	11	7	18	50.1
20A☐AL24	1/9	220	190	245	15	12	75	65	50	9	5.5	14	30.8
20A☐AL54	1/20	220	190	245	15	12	75	65	50	9	5.5	14	30.8
20A☐AL74	1/29	280	240	310	18	14	90	78	60	11	7	18	50.8
20A☐AL84	1/45	280	240	310	18	14	90	78	60	11	7	18	51.3
25A☐AL14	1/5	220	190	245	15	12	75	65	50	9	5.5	14	25
25A☐AL24	1/9	220	190	245	15	12	75	65	50	9	5.5	14	32
25A☐AL54	1/20	280	240	310	18	14	90	78	60	11	7	18	52
25A☐AL74	1/29	280	240	310	18	14	90	78	60	11	7	18	52
25A☐AL84	1/45	280	240	310	18	14	90	78	60	11	7	18	52.5
30A☐AL14	1/5	220	190	245	15	12	75	65	50	9	5.5	14	29
30A☐AL24	1/9	220	190	245	15	12	75	65	50	9	5.5	14	36
30A☐AL54	1/20	280	240	310	18	14	90	78	60	11	7	18	56
30A☐AL74	1/29	280	240	310	18	14	90	78	60	11	7	18	56
30A☐AL84	1/45	280	240	310	18	14	90	78	60	11	7	18	56
40A☐AL14	1/5	220	190	245	15	12	75	65	50	9	5.5	14	32
40A☐AL24	1/9	280	240	310	18	14	90	78	60	11	7	18	59
40A☐AL54	1/20	280	240	310	18	14	90	78	60	11	7	18	59
40A☐AL74	1/29	280	240	310	18	14	90	78	60	11	7	18	59
50A☐AL14	1/5	280	240	310	18	14	90	78	60	11	7	18	52
50A☐AL24	1/9	280	240	310	18	14	90	78	60	11	7	18	62
50A☐AL54	1/20	280	240	310	18	14	90	78	60	11	7	18	62

INFO

■ Lubrication

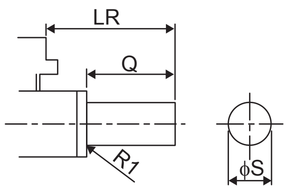
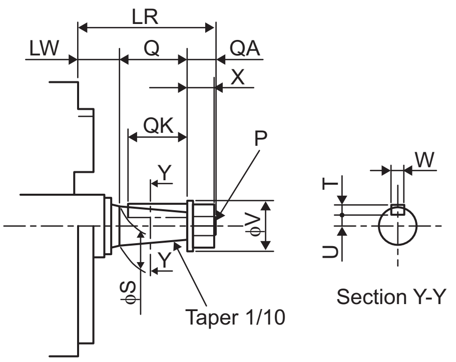
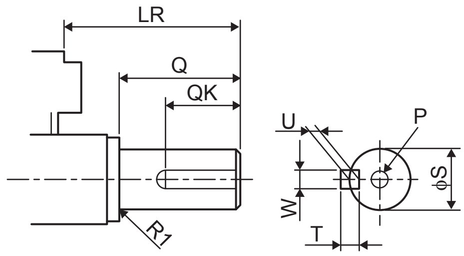
- Since grease has been filled prior to shipment, the servomotors can be used without replenishing grease.

3.17 Shaft End Specifications for SGMSS Servomotors

SGMSS - □□□□□□□

Symbol	Specifications	Remarks
2	Straight, without key	Standard
3	Taper 1/10, with parallel key (Key slot is JISB1301-1976 high precision.)	Option
6	Straight, with key and tap for one location (Key slot is JISB1301-1976 high precision.Key slot tolerance is JISB1301. Both key and tap are included.)	Option

Units: mm

Sym-bol	Specifications	Shaft End		SGMSS- 10, 15, 20, 25	SGMSS- 30, 40, 50, 70
2	Straight, without key		LR	45	63
			Q	40	55
			S	$24^{\ 0}_{-0.013}$	$28^{\ 0}_{-0.013}$
3	Taper 1/10 With parallel key		LR	70	80
			LW	20	
			Q	36	42
			QA	14	18
			QK	32	36
			X	12.5	16
			S	24	28
			V	24	30
			P	M12, P1.25	M16, P1.5
			W	8	
			T	7	
			U	7.1	8.95
6	Straight, With key and shaft end tap		LR	45	63
			Q	40	55
			QK	32	50
			S	$24^{\ 0}_{-0.013}$	$28^{\ 0}_{-0.013}$
			W	8	
			T	7	
			U	4	
			P	M8 screw, depth: 16	

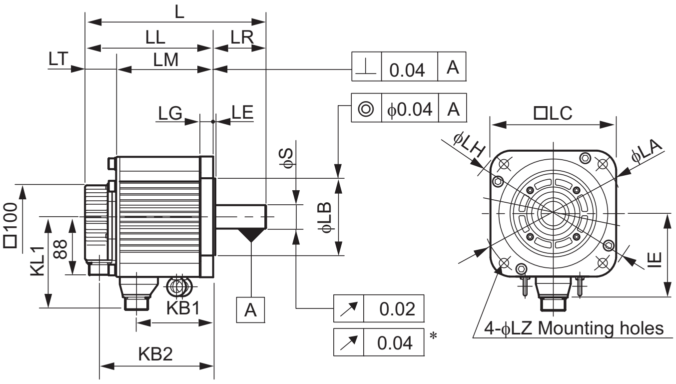
Servomotor Specifications and Dimensional Drawings

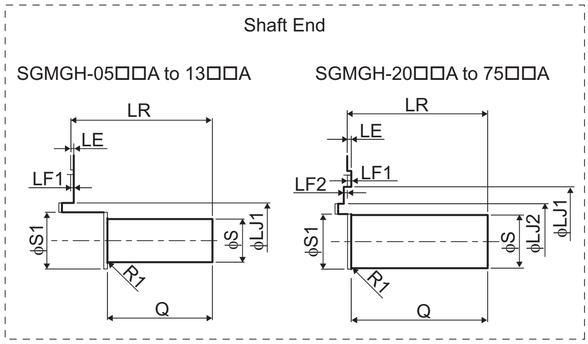
3

3.18 Dimensional Drawings of SGMGH Servomotors (1500 min^{-1})

3.18.1 SGMGH Servomotors (1500 min^{-1}) Without Gears and Brakes

Models with oil seals are of the same configuration.





* For 55□□A to 75□□A only

Note: For the specifications of the other shaft ends, refer to *3.20 Shaft End Specifications for SGMGH Servomotor*.

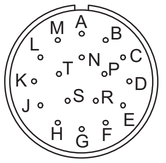
Units: mm

Model SGMGH-	L	LL	LM	LR	LT	KB1	KB2	IE	KL1	Shaft-end Dimensions			Approx. Mass kg	Allowable Radial Load N	Allowable Thrust Load N
										S	S1	Q			
05A□A21	196	138	92	58	46	65	117	–	109	$19^{0}_{-0.013}$	30	40	5.5	490	98
09A□A21	219	161	115	58	46	88	140	–	109	$19^{0}_{-0.013}$	30	40	7.6	490	98
13A□A21	243	185	139	58	46	112	164	–	109	$22^{0}_{-0.013}$	30	40	9.6	686	343
20A□A21	245	166	119	79	47	89	144	–	140	$35^{+0.01}_{0}$	45	76	14	1176	490
30A□A21	271	192	145	79	47	115	170	–	140	$35^{+0.01}_{0}$	45	76	18	1470	490
44A□A21	305	226	179	79	47	149	204	–	140	$35^{+0.01}_{0}$	45	76	23	1470	490
55A□A21	373	260	213	113	47	174	238	123	150	$42^{0}_{-0.016}$	45	110	30	1764	588
75A□A21	447	334	287	113	47	248	312	123	150	$42^{0}_{-0.016}$	45	110	40	1764	588

Units: mm

Model SGMGH-	Flange Face Dimensions									
	LA	LB	LC	LE	LF1	LF2	LG	LH	LJ1	LJ2	LZ
05A□A21	145	$110^{\ 0}_{-0.035}$	130	6	6	–	12	165	45	–	9
09A□A21	145	$110^{\ 0}_{-0.035}$	130	6	6	–	12	165	45	–	9
13A□A21	145	$110^{\ 0}_{-0.035}$	130	6	6	–	12	165	45	–	9
20A□A21	200	$114.3^{\ 0}_{-0.025}$	180	3.2	3	0.5	18	230	76	62	13.5
30A□A21	200	$114.3^{\ 0}_{-0.025}$	180	3.2	3	0.5	18	230	76	62	13.5
44A□A21	200	$114.3^{\ 0}_{-0.025}$	180	3.2	3	0.5	18	230	76	62	13.5
55A□A21	200	$114.3^{\ 0}_{-0.025}$	180	3.2	3	0.5	18	230	76	62	13.5
75A□A21	200	$114.3^{\ 0}_{-0.025}$	180	3.2	3	0.5	18	230	76	62	13.5

- Cable Specifications for Detector Connectors (17-bit Encoder)



Receptacle: MS3102A20-29P
Applicable plug (purchased by the customer)
Plug: MS3108B20-29S
Cable clamp: MS3057-12A

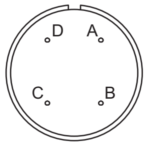
With an Absolute Encoder

A	–	K	–
B	–	L	–
C	DATA+	M	–
D	DATA-	N	–
E	–	P	–
F	–	R	–
G	0V	S	BATT-
H	+5VDC	T	BATT+
J	FG (Frame ground)	–	–

With an Incremental Encoder

A	–	K	–
B	–	L	–
C	DATA+	M	–
D	DATA-	N	–
E	–	P	–
F	–	R	–
G	0V	S	–
H	+5VDC	T	–
J	FG (Frame ground)	–	–

- Cable Specifications for Servomotor Connectors

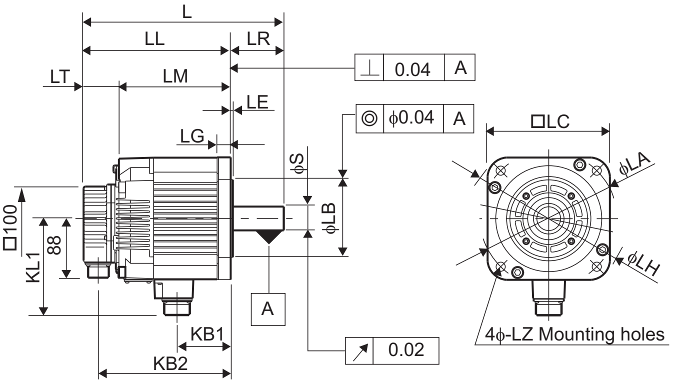


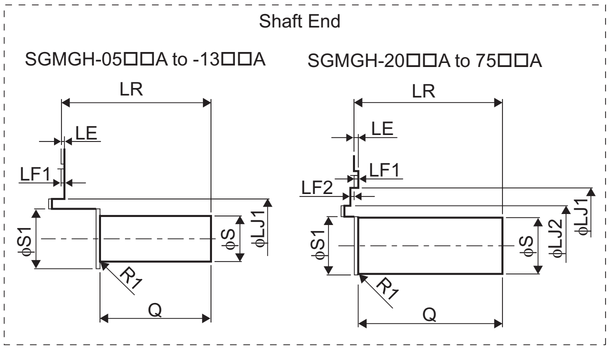
A	Phase U
B	Phase V
C	Phase W
D	FG (Frame ground)

3.18.2 SGMGH Servomotors (1500 min^{-1}) 200-V Specifications Without Gears and With Brakes

(1) 500 W to 4.4 kW

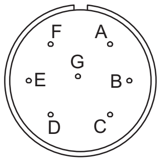
Models with oil seals are of the same configuration.





Note: For the specifications of the other shaft ends, refer to *3.20 Shaft End Specifications for SGMGH Servomotor*.

• Cable Specifications for Servomotor Connectors



A	Phase U	E	Brake terminal
B	Phase V	F	Brake terminal
C	Phase W	G	–
D	FG (Frame ground)	–	–

Units: mm

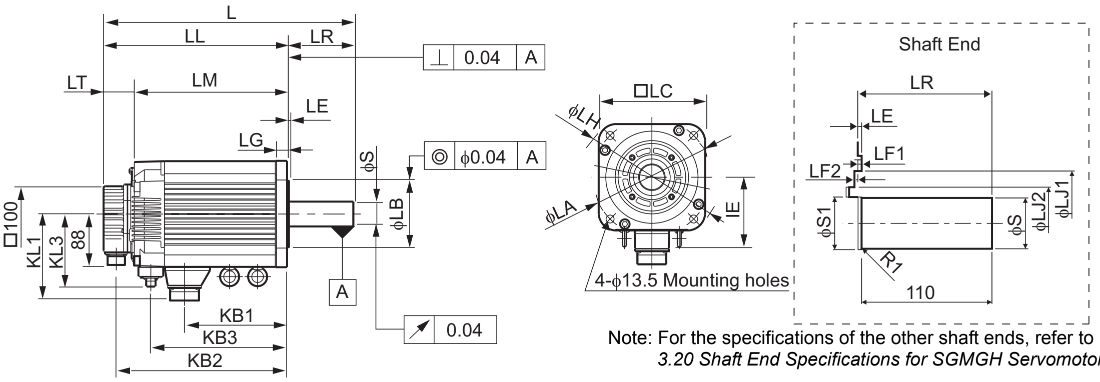
Model SGMGH-	L	LL	LM	LR	LT	KB 1	KB 2	KL1	Shaft-end Dimensions			Approx. Mass kg	Allowable Radial Load N	Allowable Thrust Load N
									S	S1	Q			
05A□A2□	234	176	130	58	46	56	154	120	$19^{\ 0}_{-0.013}$	30	40	7.5	490	98
09A□A2□	257	199	153	58	46	79	177	120	$19^{\ 0}_{-0.013}$	30	40	9.6	490	98
13A□A2□	281	223	177	58	46	103	201	120	$22^{\ 0}_{-0.013}$	30	40	12	686	343
20A□A2□	296	217	169	79	48	79	195	146	$35^{+0.01}_{\ 0}$	45	76	19	1176	490
30A□A2□	322	243	195	79	48	105	221	146	$35^{+0.01}_{\ 0}$	45	76	23.5	1470	490
44A□A2□	356	277	229	79	48	139	255	146	$35^{+0.01}_{\ 0}$	45	76	28.5	1470	490

Units: mm

Model SGMGH-	Flange Face Dimensions										
	LA	LB	LC	LE	LF1	LF2	LG	LH	LJ1	LJ2	LZ
05A☐A2☐	145	$110^{\ 0}_{-0.035}$	130	6	6	–	12	165	45	–	9
09A☐A2☐	145	$110^{\ 0}_{-0.035}$	130	6	6	–	12	165	45	–	9
13A☐A2☐	145	$110^{\ 0}_{-0.035}$	130	6	6	–	12	165	45	–	9
20A☐A2☐	200	$114.3^{\ 0}_{-0.025}$	180	3.2	3	0.5	18	230	76	62	13.5
30A☐A2☐	200	$114.3^{\ 0}_{-0.025}$	180	3.2	3	0.5	18	230	76	62	13.5
44A☐A2☐	200	$114.3^{\ 0}_{-0.025}$	180	3.2	3	0.5	18	230	76	62	13.5

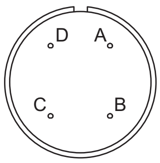
(2) 5.5 kW to 7.5 kW

Models with oil seals are of the same configuration.



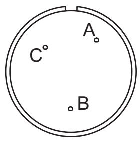
Note: For the specifications of the other shaft ends, refer to *3.20 Shaft End Specifications for SGMGH Servomotor*.

- Cable Specifications for Servomotor Connectors



A	Phase U
B	Phase V
C	Phase W
D	FG (Frame ground)

- Cable Specifications for Brake Connectors



A	Brake terminal
B	Brake terminal
C	–

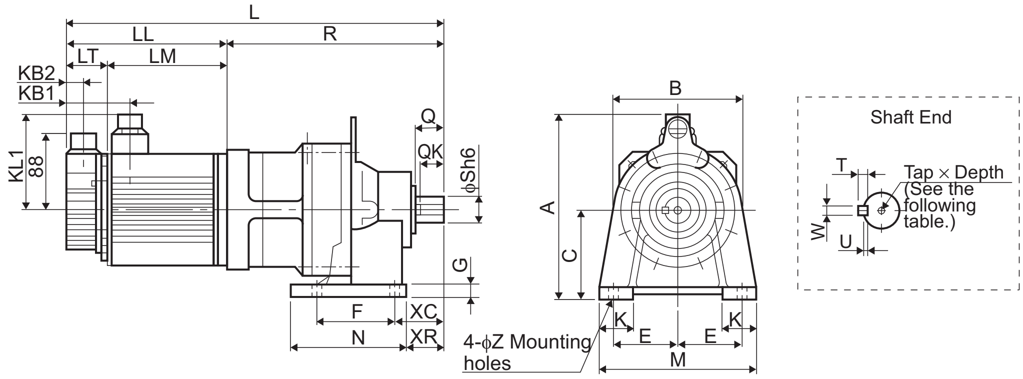
Units: mm

Model SGMGH-	L	LL	LM	LR	LT	KB1	KB2	KB3	IE	KL1	KL3	Shaft-end Dimensions		Approx. Mass kg
												S	S1	
55A□A2□	424	311	263	113	48	174	289	231	123	150	123	$42^{0}_{-0.016}$	45	35
75A□A2□	498	385	337	113	48	248	363	305	123	150	123	$42^{0}_{-0.016}$	45	45.5

Model SGMGH-	Flange Face Dimensions										Allowable Radial Load N	Allowable Thrust Load N
	LA	LB	LC	LE	LF1	LF2	LG	LH	LJ1	LJ2		
55A□A2□	200	$114.3^{0}_{-0.025}$	180	3.2	3	0.5	18	230	76	62	1764	588
75A□A2□	200	$114.3^{0}_{-0.025}$	180	3.2	3	0.5	18	230	76	62	1764	588

3.18.3 SGMGH Servomotors (1500 min^{-1}) With Standard Backlash Gears and Without Brakes (Foot-mounted Type)

(1) Grease Lubricating Type



Units: mm

Model SGMGH-	Gear Model	Gear Ratio	L	LL	LM	LT	KB1	KB2	KL1	R	A	B	C*	Shaft Center Allowable Radial Load N
05P☐AEA6	CNHX-6090	1/6	380	138	94	44	73	21	109	242	209	152	100	2830
05P☐AEB6	CNHX-6090	1/11	380	138	94	44	73	21	109	242	209	152	100	3340
05P☐AEC6	CNHX-6100	1/21	394	138	94	44	73	21	109	256	209	152	100	5400
05P☐AE76	CNHX-6100	1/29	394	138	94	44	73	21	109	256	209	152	100	5400
09P☐AEA6	CNHX-6100	1/6	417	161	117	44	73	21	109	256	209	152	100	4110
09P☐AEB6	CNHX-6100	1/11	417	161	117	44	73	21	109	256	209	152	100	5220
09P☐AEC6	CNHX-6120	1/21	449	161	117	44	73	21	109	288	257	204	120	8240
09P☐AE76	CNHX-6120	1/29	449	161	117	44	73	21	109	288	257	204	120	8980
13P☐AEA6	CNHX-6100	1/6	441	185	141	44	73	21	109	256	209	152	100	4090
13P☐AEB6	CNHX-6120	1/11	473	185	141	44	73	21	109	288	257	204	120	6650
13P☐AEC6	CNHX-6125	1/21	473	185	141	44	73	21	109	288	257	204	120	8190
20P☐AEA6	CNHX-6120	1/6	477	166	121	45	77	22	140	311	260	204	120	5220
20P☐AEB6	CNHX-6125	1/11	477	166	121	45	77	22	140	311	260	204	120	6620
30P☐AEA6	CNHX-6120	1/6	503	192	147	45	77	22	140	311	260	204	120	5180
30P☐AEB6	CNHX-6125	1/11	503	192	147	45	77	22	140	311	260	204	120	6560

* The tolerances for all models are $^{0}_{-0.5}$.

(cont'd)

Model SGMGH-	Gear Ratio	Foot-mounted Dimensions mm									Shaft-end Dimensions mm							Approx. Mass kg
		E	F	G	K	M	N	XR	XC	Z	Q	QK	S	T	U	W	Tap × Depth	
05P□AEA6	1/6	75	90	12	65	180	135	45	60	11	35	32	28	7	4	8	M8 × 20	20.7
05P□AEB6	1/11	75	90	12	65	180	135	45	60	11	35	32	28	7	4	8	M8 × 20	20.7
05P□AEC6	1/21	75	90	12	40	180	135	45	60	11	35	32	28	7	4	8	M8 × 20	22.7
05P□AE76	1/29	75	90	12	40	180	135	45	60	11	35	32	28	7	4	8	M8 ×20	22.7
09P□AEA6	1/6	75	90	12	40	180	135	45	60	11	35	32	28	7	4	8	M8 × 20	24.6
09P□AEB6	1/11	75	90	12	40	180	135	45	60	11	35	32	28	7	4	8	M8 × 20	24.6
09P□AEC6	1/21	95	115	15	55	230	155	62	82	14	55	50	38	8	5	10	M8 × 20	34.6
09P□AE76	1/29	95	115	15	55	230	155	62	82	14	55	50	38	8	5	10	M8 × 20	34.6
13P□AEA6	1/6	75	90	12	40	180	135	45	60	11	35	32	28	7	4	8	M8 × 20	26.6
13P□AEB6	1/11	95	115	15	55	230	155	62	82	14	55	50	38	8	5	10	M8 × 20	36.6
13P□AEC6	1/21	95	115	15	55	230	155	62	82	14	55	50	38	8	5	10	M8 × 20	36.6
20P□AEA6	1/6	95	115	15	55	230	155	62	82	14	55	50	38	8	5	10	M8 ×20	43
20P□AEB6	1/11	95	115	15	55	230	155	62	82	14	55	50	38	8	5	10	M8 ×20	43
30P□AEA6	1/6	95	115	15	55	230	155	62	82	14	55	50	38	8	5	10	M8 × 20	47
30P□AEB6	1/11	95	115	15	55	230	155	62	82	14	55	50	38	8	5	10	M8 × 20	47

- Dimensional Tolerances

Units: mm

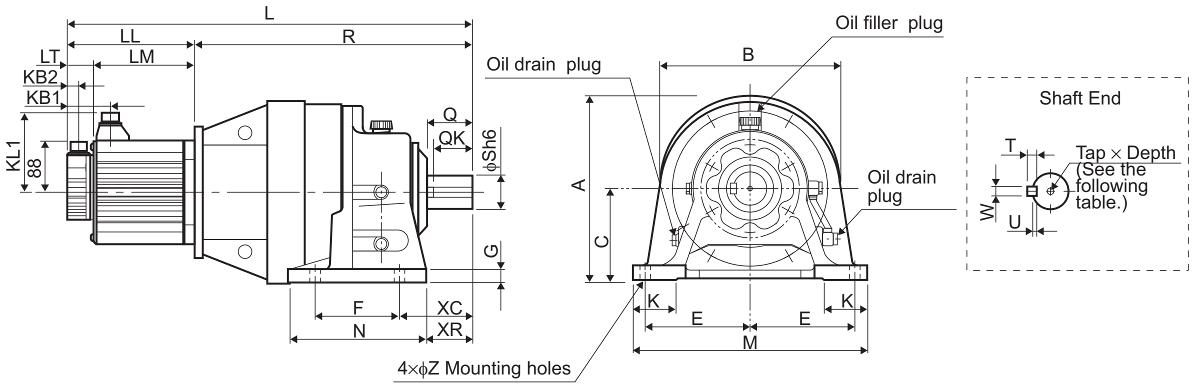
Model SGMGH-	Shaft-end Dimensions S
05P□AEA6	$28^{\ 0}_{-0.013}$
05P□AEB6	$28^{\ 0}_{-0.013}$
05P□AEC6	$28^{\ 0}_{-0.013}$
05P□AE76	$28^{\ 0}_{-0.013}$
09P□AEA6	$28^{\ 0}_{-0.013}$
09P□AEB6	$28^{\ 0}_{-0.013}$
09P□AEC6	$38^{\ 0}_{-0.016}$
09P□AE76	$38^{\ 0}_{-0.016}$
13P□AEA6	$28^{\ 0}_{-0.013}$
13P□AEB6	$38^{\ 0}_{-0.016}$
13P□AEC6	$38^{\ 0}_{-0.016}$
20P□AEA6	$38^{\ 0}_{-0.016}$
20P□AEB6	$38^{\ 0}_{-0.016}$
30P□AEA6	$38^{\ 0}_{-0.016}$
30P□AEB6	$38^{\ 0}_{-0.016}$

INFO

■ Lubrication

- Grease lubricating type (frame numbers: 6090 to 6125)
  Since grease has been filled prior to shipment, the servomotors can be used without replenishing grease.

(2) Oil Lubricating Type



Units: mm

Model SGMGH-	Gear Model	Gear Ratio	L	LL	LM	LT	KB1	KB2	KL1	R	A*1	B	C*2	Shaft Center Allowable Radial Load N
13P☐AE76	CHHX-6130	1/29	532	185	141	44	73	21	109	347	300	246	150	10500
20P☐AEC6	CHHX-6130	1/21	536	166	121	45	77	22	140	370	300	246	150	9510
20P☐AE76	CHHX-6135	1/29	536	166	121	45	77	22	140	370	300	246	150	10400
30P☐AEC6	CHHX-6140	1/21	582	192	147	45	77	22	140	390	300	246	150	13900
30P☐AE76	CHHJ-6160	1/29	687	192	147	45	77	22	140	495	367	318	160	17900
44P☐AEA6	CHHX-6130	1/6	596	226	181	45	77	22	140	370	300	246	150	6030
44P☐AEB6	CHHX-6135	1/11	596	226	181	45	77	22	140	370	300	246	150	7660
44P☐AEC6	CHHJ-6160	1/21	721	226	181	45	77	22	140	495	367	318	160	16300
44P☐AE76	CHHJ-6170	1/29	785	226	181	45	77	22	140	559	429	363	200	20100
55P☐AEA6	CHHX-6135	1/6	664	260	215	45	86	22	150	404	300	246	150	5990
55P☐AEB6	CHHX-6140	1/11	684	260	215	45	86	22	150	424	300	246	150	11500
55P☐AEC6	CHHJ-6170	1/21	853	260	215	45	86	22	150	593	429	363	200	18300
55P☐AE76	CHHJ-6175	1/29	853	260	215	45	86	22	150	593	429	363	200	20000
75P☐AEB6	CHHJ-6160	1/11	863	334	289	45	86	22	150	529	367	318	160	13100
75P☐AEC6	CHHJ-6175	1/21	927	334	289	45	86	22	150	593	429	363	200	18200
75P☐AE76	CHHJ-6180	1/29	977	334	289	45	86	22	150	643	467	393	220	26600

* 1. The dimension of the hook is included for some models.

* 2. The tolerances for all models are $^{0}_{-0.5}$.

Units: mm (cont'd)

Model SGMGH-	Gear Ratio	Foot-mounted Dimensions mm									Shaft-end Dimensions mm							Approx. Mass kg
		E	F	G	K	M	N	XR	XC	Z	Q	QK	S	T	U	W	Tap × Depth	
13P□AE76	1/29	145	145	22	65	330	195	75	100	18	70	56	50	9	5.5	14	M10 × 18	57.6
20P□AEC6	1/21	145	145	22	65	330	195	75	100	18	70	56	50	9	5.5	14	M10 × 18	67
20P□AE76	1/29	145	145	22	65	330	195	75	100	18	70	56	50	9	5.5	14	M10 × 18	67
30P□AEC6	1/21	145	145	22	65	330	195	95	120	18	90	80	50	9	5.5	14	M10 × 18	72
30P□AE76	1/29	185	150	25	75	410	238	95	139	18	90	80	60	11	7	18	M10 × 18	126
44P□AEA6	1/6	145	145	22	65	330	195	75	100	18	70	56	50	9	5.5	14	M10 × 18	76
44P□AEB6	1/11	145	145	22	65	330	195	75	100	18	70	56	50	9	5.5	14	M10 × 18	76
44P□AEC6	1/21	185	150	25	75	410	238	95	139	18	90	80	60	11	7	18	M10 × 18	131
44P□AE76	1/29	190	275	30	80	430	335	95	125	22	90	80	70	12	7.5	20	M12 × 24	176
55P□AEA6	1/6	145	145	22	65	330	195	75	100	18	70	56	50	9	5.5	14	M10 × 18	88
55P□AEB6	1/11	145	145	22	65	330	195	95	120	18	90	80	50	9	5.5	14	M10 × 18	89
55P□AEC6	1/21	190	275	30	80	430	335	95	125	22	90	80	70	12	7.5	20	M12 × 24	191
55P□AE76	1/29	190	275	30	80	430	335	95	125	22	90	80	70	12	7.5	20	M12 × 24	191
75P□AEB6	1/11	185	150	25	75	410	238	95	139	18	90	80	60	11	7	18	M10 × 18	155
75P□AEC6	1/21	190	275	30	80	430	335	95	125	22	90	80	70	12	7.5	20	M12 × 24	201
75P□AE76	1/29	210	320	30	85	470	380	115	145	22	110	100	80	14	9	22	M12 × 24	245

- Dimensional Tolerances

Units: mm

Model SGMGH-	Shaft-end Dimensions S
13P□AE76	$50^{\ 0}_{-0.016}$
20P□AEC6	$50^{\ 0}_{-0.016}$
20P□AE76	$50^{\ 0}_{-0.016}$
30P□AEC6	$50^{\ 0}_{-0.016}$
30P□AE76	$60^{\ 0}_{-0.019}$
44P□AEA6	$50^{\ 0}_{-0.016}$
44P□AEB6	$50^{\ 0}_{-0.016}$
44P□AEC6	$60^{\ 0}_{-0.019}$
44P□AE76	$70^{\ 0}_{-0.019}$
55P□AEA6	$50^{\ 0}_{-0.016}$
55P□AEB6	$50^{\ 0}_{-0.016}$
55P□AEC6	$70^{\ 0}_{-0.019}$
55P□AE76	$70^{\ 0}_{-0.019}$
75P□AEB6	$60^{\ 0}_{-0.019}$
75P□AEC6	$70^{\ 0}_{-0.019}$
75P□AE76	$80^{\ 0}_{-0.019}$

INFO

■ Lubrication

- Oil lubricating type (frame numbers: 6130 to 6190)

  Servomotors of this type have been shipped with oil removed. Be sure to supply oil until the red line at the upper side of the oil guage.

  Lubrication oil recommended is industrial-use extreme-pressure gear oil of SP-system, JIS K 2219 industrial-use gear oil or equivalent. Refer to the following table.

Ambient Tempera-ture	Manufacturer						
	COSMO Oil Co., Ltd.	Nippon Oil Corporation	Idemitsu Kosan Co., Ltd.	Showa Shell Sekiyu K.K.	Exxon Mobil Corporation		Japan Energy Corporation
0 to 35°C	COSMO Gear SE 100, 150	BON-NOCK M 100, 150	Daphne Super Gear Oil 100, 150	Shell Omala Oil 100, 150	Spartan EP 100, 150	Mobilgear 627, 629 (ISO VG100, 150)	JOMO Reductus 100, 150

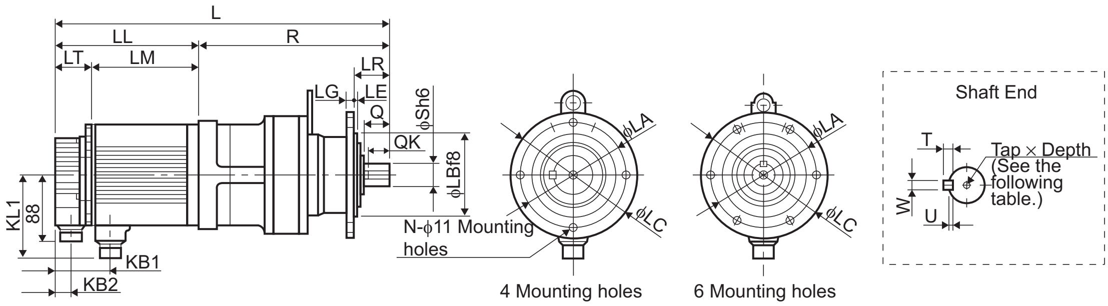
The following shows approximate oil amount to be supplied.

Units: liter

Frame No.	6130 6135	6140	6160	6170 6175	6180 6185	6190
Horizontal type	0.7	0.7	1.4	1.9	2.5	4.0

3.18.4 SGMGH Servomotors (1500 min^{-1}) With Standard Backlash Gears and Without Brakes (Flange-mounted Type)

(1) Grease Lubricating Type



Units: mm

Model SGMGH-	Gear Model	Gear Ratio	L	LL	LM	LT	KB1	KB2	KL1	R	Shaft Center Allowable Radial Load N
05P☐AFA6	CNVX-6090	1/6	380	138	94	44	73	21	109	242	2830
05P☐AFB6	CNVX-6090	1/11	380	138	94	44	73	21	109	242	3340
05P☐AFC6	CNVX-6100	1/21	394	138	94	44	73	21	109	256	5400
05P☐AF76	CNVX-6100	1/29	394	138	94	44	73	21	109	256	5400
09P☐AFA6	CNVX-6100	1/6	417	161	117	44	73	21	109	256	4110
09P☐AFB6	CNVX-6100	1/11	417	161	117	44	73	21	109	256	5220
09P☐AFC6	CNVX-6120	1/21	449	161	117	44	73	21	109	288	8240
09P☐AF76	CNVX-6120	1/29	449	161	117	44	73	21	109	288	8980
13P☐AFA6	CNVX-6100	1/6	441	185	141	44	73	21	109	256	4090
13P☐AFB6	CNVX-6120	1/11	473	185	141	44	73	21	109	288	6650
13P☐AFC6	CNVX-6125	1/21	473	185	141	44	73	21	109	288	8190
20P☐AFA6	CNVX-6120	1/6	477	166	121	45	77	22	140	311	5220
20P☐AFB6	CNVX-6125	1/11	477	166	121	45	77	22	140	311	6620
30P☐AFA6	CNVX-6120	1/6	503	192	147	45	77	22	140	311	5180
30P☐AFB6	CNVX-6125	1/11	503	192	147	45	77	22	140	311	6560

(cont'd)

Model SGMGH-	Gear Ratio	Flange Face Dimensions mm										Shaft-end Dimensions mm				Approx. Mass kg
		LA	LB	LC	LE	LG	LR	N	Q	QK	S	T	U	W	Tap × Depth	
05P□AFA6	1/6	134	110	160	3	9	48	4	35	32	28	7	4	8	M8 × 20	18.7
05P□AFB6	1/11	134	110	160	3	9	48	4	35	32	28	7	4	8	M8 × 20	18.7
05P□AFC6	1/21	134	110	160	3	9	48	4	35	32	28	7	4	8	M8 × 20	20.7
05P□AF76	1/29	134	110	160	3	9	48	4	35	32	28	7	4	8	M8 × 20	20.7
09P□AFA6	1/6	134	110	160	3	9	48	4	35	32	28	7	4	8	M8 × 20	22.6
09P□AFB6	1/11	134	110	160	3	9	48	4	35	32	28	7	4	8	M8 × 20	22.6
09P□AFC6	1/21	180	140	210	4	13	69	6	55	50	38	8	5	10	M8 × 20	33.6
09P□AF76	1/29	180	140	210	4	13	69	6	55	50	38	8	5	10	M8 × 20	33.6
13P□AFA6	1/6	134	110	160	3	9	48	4	35	32	28	7	4	8	M8 × 20	24.6
13P□AFB6	1/11	180	140	210	4	13	69	6	55	50	38	8	5	10	M8 × 20	35.6
13P□AFC6	1/21	180	140	210	4	13	69	6	55	50	38	8	5	10	M8 × 20	35.6
20P□AFA6	1/6	180	140	210	4	13	69	6	55	50	38	8	5	10	M8 × 20	42
20P□AFB6	1/11	180	140	210	4	13	69	6	55	50	38	8	5	10	M8 × 20	42
30P□AFA6	1/6	180	140	210	4	13	69	6	55	50	38	8	5	10	M8 × 20	46
30P□AFB6	1/11	180	140	210	4	13	69	6	55	50	38	8	5	10	M8 × 20	46

• Dimensional Tolerances

Units: mm

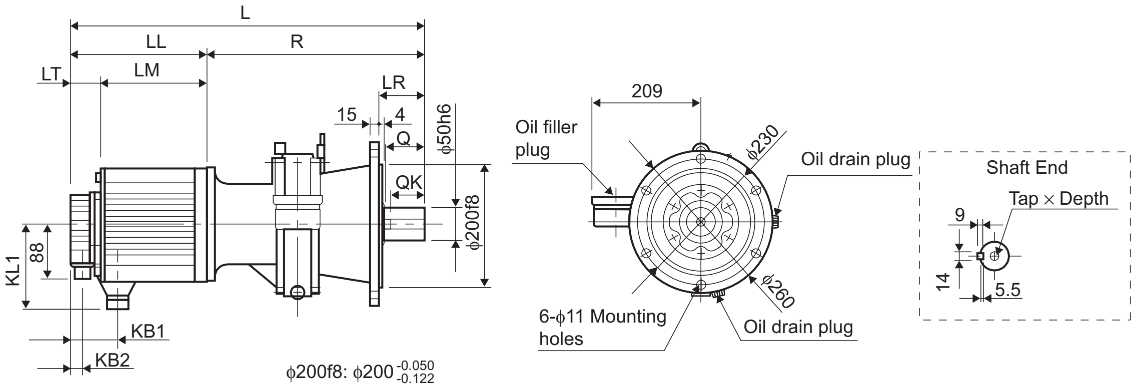
Model SGMGH-	Flange Face Dimensions	Shaft-end Dimensions
	LB	S
05P□AFA6	$110^{-0.036}_{-0.090}$	$28^{\ 0}_{-0.013}$
05P□AFB6	$110^{-0.036}_{-0.090}$	$28^{\ 0}_{-0.013}$
05P□AFC6	$110^{-0.036}_{-0.090}$	$28^{\ 0}_{-0.013}$
05P□AF76	$110^{-0.036}_{-0.090}$	$28^{\ 0}_{-0.013}$
09P□AFA6	$110^{-0.036}_{-0.090}$	$28^{\ 0}_{-0.013}$
09P□AFB6	$110^{-0.036}_{-0.090}$	$28^{\ 0}_{-0.013}$
09P□AFC6	$140^{-0.043}_{-0.106}$	$38^{\ 0}_{-0.016}$
09P□AF76	$140^{-0.043}_{-0.106}$	$38^{\ 0}_{-0.016}$
13P□AFA6	$110^{-0.036}_{-0.090}$	$28^{\ 0}_{-0.013}$
13P□AFB6	$140^{-0.043}_{-0.106}$	$38^{\ 0}_{-0.016}$
13P□AFC6	$140^{-0.043}_{-0.106}$	$38^{\ 0}_{-0.016}$
20P□AFA6	$140^{-0.043}_{-0.106}$	$38^{\ 0}_{-0.016}$
20P□AFB6	$140^{-0.043}_{-0.106}$	$38^{\ 0}_{-0.016}$
30P□AFA6	$140^{-0.043}_{-0.106}$	$38^{\ 0}_{-0.016}$
30P□AFB6	$140^{-0.043}_{-0.106}$	$38^{\ 0}_{-0.016}$

INFO

■ Lubrication

- Grease lubricating type (frame numbers: 6090 to 6125)
  Since grease has been filled prior to shipment, the servomotors can be used without replenishing grease.

(2) Small Oil Lubricating Type



ϕ200f8: $\phi 200^{-0.050}_{-0.122}$

ϕ50h6: $\phi 50^{0}_{-0.016}$

Units: mm

Model SGMGH-	Gear Model	Gear Ratio	L	LL	LM	LT	KB1	KB2	KL1	R	Shaft Center Allowable Radial Load N
13P☐AF76	CHVX-6130	1/29	532	185	141	44	73	21	109	347	10500
20P☐AFC6	CHVX-6130	1/21	536	166	121	45	77	22	140	370	9510
20P☐AF76	CHVX-6135	1/29	536	166	121	45	77	22	140	370	10400
30P☐AFC6	CHVX-6140	1/21	582	192	147	45	77	22	140	390	13900
44P☐AFA6	CHVX-6130	1/6	596	226	181	45	77	22	140	370	6030
44P☐AFB6	CHVX-6135	1/11	596	226	181	45	77	22	140	370	7660
55P☐AFA6	CHVX-6135	1/6	664	260	215	45	86	22	150	404	5990
55P☐AFB6	CHVX-6140	1/11	684	260	215	45	86	22	150	424	11500

Model SGMGH-	Gear Ratio	Flange Face Dimensions mm	Shaft-end Dimensions mm			Approx. Mass kg
		LR	Q	QK	Tap×Depth	
13P☐AF76	1/29	76	70	56	M10 × 18	56.6
20P☐AFC6	1/21	76	70	56	M10 × 18	66
20P☐AF76	1/29	76	70	56	M10 × 18	66
30P☐AFC6	1/21	96	90	80	M10 × 18	71
44P☐AFA6	1/6	76	70	56	M10 × 18	75
44P☐AFB6	1/11	76	70	56	M10 × 18	75
55P☐AFA6	1/6	76	70	56	M10 × 18	87
55P☐AFB6	1/11	96	90	80	M10 × 18	88

INFO

■ Lubrication

- Oil lubricating type (frame numbers: 6130 to 6190)
  Servomotors of this type have been shipped with oil removed. Be sure to supply oil until the red line at the upper side of the oil guage.
  Lubrication oil recommended is industrial-use extreme-pressure gear oil of SP-system, JIS K 2219 industrial-use gear oil or equivalent. Refer to the following table.

Ambient Tempera- ture	Manufacturer						
	COSMO Oil Co., Ltd.	Nippon Oil Corporation	Idemitsu Kosan Co., Ltd.	Showa Shell Sekiyu K.K.	Exxon Mobil Corporation		Japan Energy Corporation
0 to 35°C	COSMO Gear SE 100, 150	BON-NOCK M 100, 150	Daphne Super Gear Oil 100, 150	Shell Omala Oil 100, 150	Spartan EP 100, 150	Mobilgear 627, 629 (ISO VG100, 150)	JOMO Reductus 100, 150

The following shows approximate oil amount to be supplied.

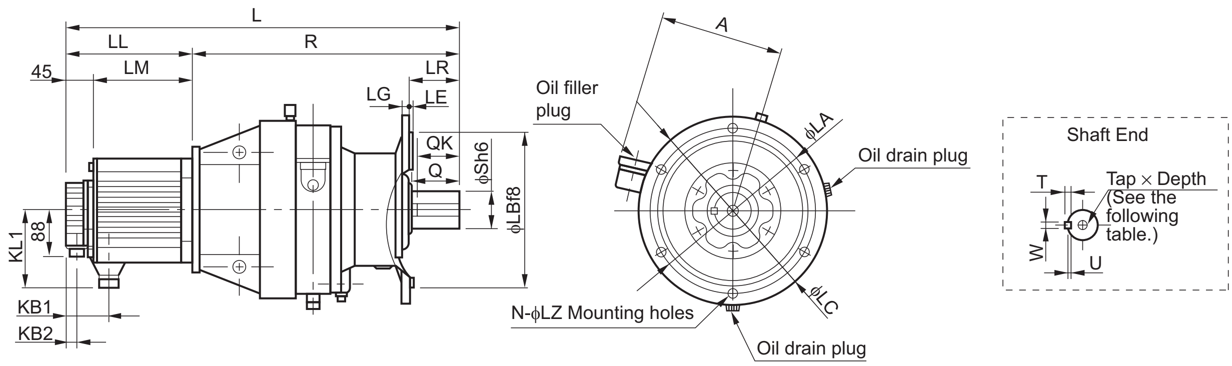
Units: liter

Frame No.	6130 6135	6140	6160	6170 6175	6180 6185	6190
Horizontal type	0.7	0.7	1.4	1.9	2.5	4.0

Servomotor Specifications and Dimensional Drawings

3

(3) Large Oil Lubricating Type



Units: mm

Model SGMGH-	Gear Model	Gear Ratio	L	LL	LM	KB1	KB2	KL1	R	A	Shaft Center Allowable Radial Load N
30P☐AF76	CHVJ-6160	1/29	687	192	147	77	22	140	495	228	17900
44P☐AFC6	CHVJ-6160	1/21	721	226	181	77	22	140	495	228	16300
44P☐AF76	CHVJ-6170	1/29	785	226	181	77	22	140	559	243	20100
55P☐AFC6	CHVJ-6170	1/21	853	260	215	86	22	150	593	243	18300
55P☐AF76	CHVJ-6175	1/29	853	260	215	86	22	150	593	243	20000
75P☐AFB6	CHVJ-6160	1/11	863	334	289	86	22	150	529	228	13100
75P☐AFC6	CHVJ-6175	1/21	927	334	289	86	22	150	593	243	18200
75P☐AF76	CHVJ-6180	1/29	977	334	289	86	22	150	643	258	26600

Model SGMGH-	Gear Ratio	Flange Face Dimensions mm								Shaft-end Dimensions mm							Approx. Mass kg
		LA	LB	LC	LE	LG	LR	N	LZ	Q	QK	S	T	U	W	Tap × Depth	
30P☐AF76	1/29	310	270	340	4	20	89	6	11	90	80	60	11	7	18	M10 × 18	121
44P☐AFC6	1/21	310	270	340	4	20	89	6	11	90	80	60	11	7	18	M10 × 18	126
44P☐AF76	1/29	360	316	400	5	22	94	8	14	90	80	70	12	7.5	20	M12 × 24	176
55P☐AFC6	1/21	360	316	400	5	22	94	8	14	90	80	70	12	7.5	20	M12 × 24	191
55P☐AF76	1/29	360	316	400	5	22	94	8	14	90	80	70	12	7.5	20	M12 × 24	191
75P☐AFB6	1/11	310	270	340	4	20	89	6	11	90	80	60	11	7	18	M10 × 18	150
75P☐AFC6	1/21	360	316	400	5	22	94	8	14	90	80	70	12	7.5	20	M12 × 24	201
75P☐AF76	1/29	390	345	430	5	22	110	8	18	110	100	80	14	9	22	M12 × 24	232

- Dimensional Tolerances

Units: mm

Model SGMGH-	Flange Face Dimensions	Shaft-end Dimensions
	LB	S
30P□AF76	$270^{-0.056}_{-0.137}$	$60^{\ 0}_{-0.019}$
44P□AFC6	$270^{-0.056}_{-0.137}$	$60^{\ 0}_{-0.019}$
44P□AF76	$316^{-0.062}_{-0.151}$	$70^{\ 0}_{-0.019}$
55P□AFC6	$316^{-0.062}_{-0.151}$	$70^{\ 0}_{-0.019}$
55P□AF76	$316^{-0.062}_{-0.151}$	$70^{\ 0}_{-0.019}$
75P□AFB6	$270^{-0.056}_{-0.137}$	$60^{\ 0}_{-0.019}$
75P□AFC6	$316^{-0.062}_{-0.151}$	$70^{\ 0}_{-0.019}$
75P□AF76	$345^{-0.062}_{-0.151}$	$80^{\ 0}_{-0.019}$

INFO

■ Lubrication

- Oil lubricating type (frame numbers: 6130 to 6190)

  Servomotors of this type have been shipped with oil removed. Be sure to supply oil until the red line at the upper side of the oil guage.

  Lubrication oil recommended is industrial-use extreme-pressure gear oil of SP-system, JIS K 2219 industrial-use gear oil or equivalent. Refer to the following table.

Ambient Tempera-ture	Manufacturer						
	COSMO Oil Co., Ltd.	Nippon Oil Corporation	Idemitsu Kosan Co., Ltd.	Showa Shell Sekiyu K.K.	Exxon Mobil Corporation		Japan Energy Corporation
0 to 35°C	COSMO Gear SE 100, 150	BON-NOCK M 100, 150	Daphne Super Gear Oil 100, 150	Shell Omala Oil 100, 150	Spartan EP 100, 150	Mobilgear 627, 629 (ISO VG100, 150)	JOMO Reductus 100, 150

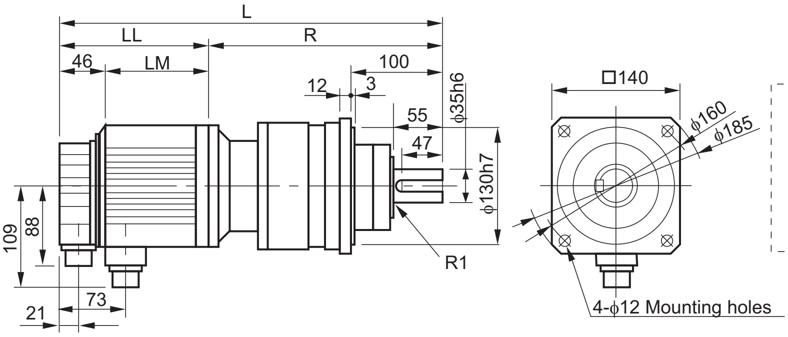
The following shows approximate oil amount to be supplied.

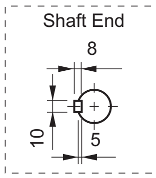
Units: liter

Frame No.	6130 6135	6140	6160	6170 6175	6180 6185	6190
Horizontal type	0.7	0.7	1.4	1.9	2.5	4.0

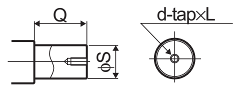
3.18.5 SGMGH Servomotors (1500 min^{-1}) With Low-backlash Gears and Without Brakes (Flange-mounted Type)

(1) Grease Lubricating Type for Small



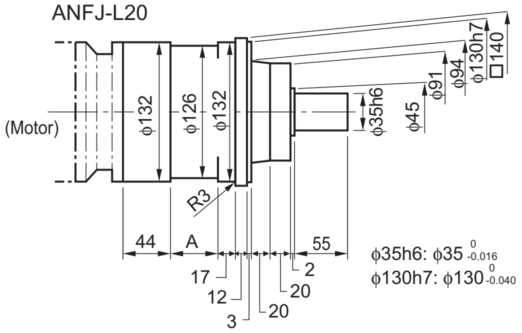


• Applied Specifications of Shaft-end Tap



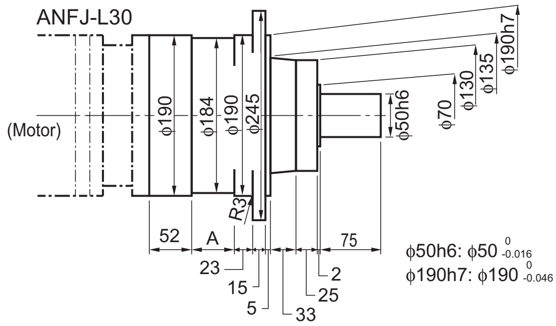
Frame No.	Dia.S	Length Q	d × L mm
ANFJ-L20	35	55	M8 × 16
ANFJ-L30	50	75	M10 × 20
ANFJ-L40	60	90	M12 × 24

• Detailed Dimensions of Gears



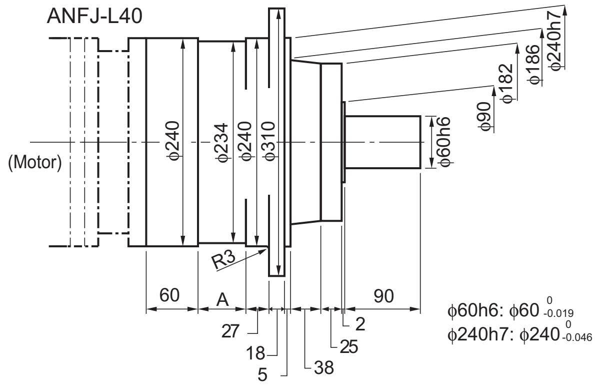
Units: mm

Gear Ratio	A
1/5	6
1/9	18
1/20, 1/29	37
1/45	47



Units: mm

Gear Ratio	A
1/5	11
1/9	38
1/20, 1/29	42
1/45	52



Units: mm

Gear Ratio	A
1/5	16
1/9	48
1/20, 1/29	48
1/45	58

Units: mm

Model SGMGH-	Gear Model	Gear Ratio	L	LL	LM	R	Shaft Center Allowable Radial Load N	Approx. Mass kg
05A☐AL14	ANFJ-L20	1/5	394	138	92	256	833	14
05A☐AL24		1/9	406	138	92	268	980	14
09A☐AL14		1/5	417	161	115	256	833	16
09A☐AL24		1/9	429	161	115	268	980	16

INFO

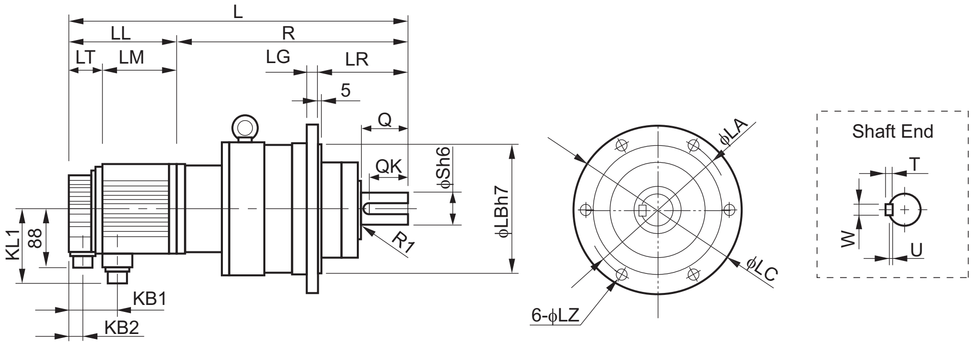
■ Lubrication

- Since grease has been filled prior to shipment, the servomotors can be used without replenishing grease.

Servomotor Specifications and Dimensional Drawings

3

(2) Large Grease Lubricating Type



Units: mm

Model SGMGH-	Gear Model	Gear Ratio	L	LL	LM	LR	LT	KB1	KB2	KL1	R	Shaft Center Allowable Radial Load N
05A□AL54		1/20	491	138	92	140	46	73	21	109	353	2650
05A□AL74		1/29	491	138	92	140	46	73	21	109	353	2940
05A□AL84	ANFJ-L30	1/45	501	138	92	140	46	73	21	109	363	3430
09A□AL54		1/20	514	161	115	140	46	73	21	109	353	2650
09A□AL74		1/29	514	161	115	140	46	73	21	109	353	2940
09A□AL84	ANFJ-L40	1/45	565	161	115	160	46	73	21	109	404	8040
13A□AL14		1/5	507	185	139	140	46	73	21	109	322	1670
13A□AL24	ANFJ-L30	1/9	534	185	139	140	46	73	21	109	349	1960
13A□AL54		1/20	538	185	139	140	46	73	21	109	353	2650
13A□AL74	ANFJ-L40	1/29	579	185	139	160	46	73	21	109	394	6860
13A□AL84		1/45	589	185	139	160	46	73	21	109	404	8040
20A□AL14	ANFJ-L30	1/5	509	166	119	140	47	77	22	140	343	1670
20A□AL24		1/9	536	166	119	140	47	77	22	140	370	1960
20A□AL54		1/20	581	166	119	160	47	77	22	140	415	6080
20A□AL74		1/29	581	166	119	160	47	77	22	140	415	6860
30A□AL14		1/5	575	192	145	160	47	77	22	140	383	3820
30A□AL24	ANFJ-L40	1/9	607	192	145	160	47	77	22	140	415	4700
30A□AL54		1/20	607	192	145	160	47	77	22	140	415	6080
44A□AL14		1/5	609	226	179	160	47	77	22	140	383	3820
44A□AL24		1/9	641	226	179	160	47	77	22	140	415	4700

(cont'd)

Model SGMGH-	Gear Ratio	Flange Face Dimensions mm					Shaft-end Dimensions mm						Approx. Mass kg
		LA	LB	LC	LG	LZ	Q	QK	S	T	U	W	
05A☐AL54	1/20	220	190	245	15	12	75	65	50	9	5.5	14	31
05A☐AL74	1/29	220	190	245	15	12	75	65	50	9	5.5	14	31
05A☐AL84	1/45	220	190	245	15	12	75	65	50	9	5.5	14	31
09A☐AL54	1/20	220	190	245	15	12	75	65	50	9	5.5	14	33
09A☐AL74	1/29	220	190	245	15	12	75	65	50	9	5.5	14	33
09A☐AL84	1/45	280	240	310	18	14	90	78	60	11	7	18	53
13A☐AL14	1/5	220	190	245	15	12	75	65	50	9	5.5	14	28
13A☐AL24	1/9	220	190	245	15	12	75	65	50	9	5.5	14	35
13A☐AL54	1/20	220	190	245	15	12	75	65	50	9	5.5	14	35
13A☐AL74	1/29	280	240	310	18	14	90	78	60	11	7	18	55
13A☐AL84	1/45	280	240	310	18	14	90	78	60	11	7	18	55
20A☐AL14	1/5	220	190	245	15	12	75	65	50	9	5.5	14	32
20A☐AL24	1/9	220	190	245	15	12	75	65	50	9	5.5	14	39
20A☐AL54	1/20	280	240	310	18	14	90	78	60	11	7	18	39
20A☐AL74	1/29	280	240	310	18	14	90	78	60	11	7	18	39
30A☐AL14	1/5	280	240	310	18	14	90	78	60	11	7	18	53
30A☐AL24	1/9	280	240	310	18	14	90	78	60	11	7	18	63
30A☐AL54	1/20	280	240	310	18	14	90	78	60	11	7	18	63
44A☐AL14	1/5	280	240	310	18	14	90	78	60	11	7	18	58
44A☐AL24	1/9	280	240	310	18	14	90	78	60	11	7	18	68

INFO

■ Lubrication

- Since grease has been filled prior to shipment, the servomotors can be used without replenishing grease.

- Dimensional Tolerances

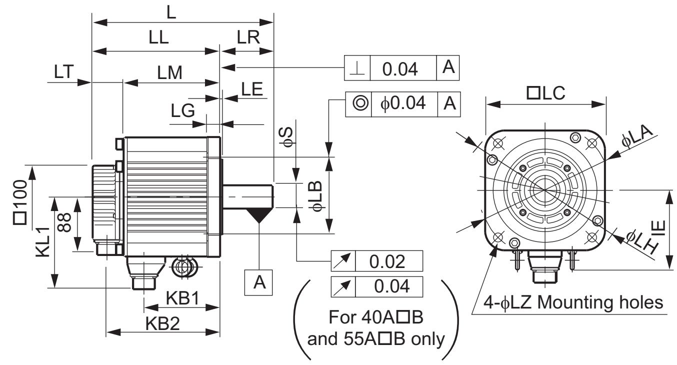
Units: mm

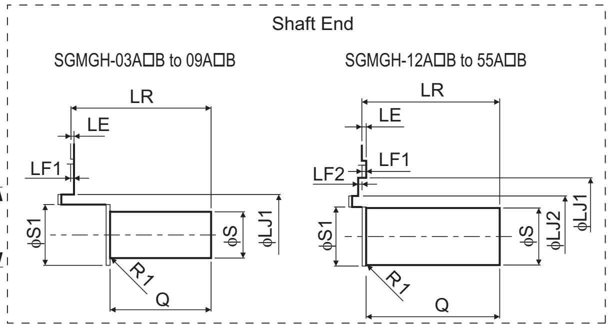
Model SGMGH-	Flange Face Dimensions	Shaft-end Dimensions
	LB	S
05A☐AL54	$190^{\ 0}_{-0.046}$	$50^{\ 0}_{-0.016}$
05A☐AL74	$190^{\ 0}_{-0.046}$	$50^{\ 0}_{-0.016}$
05A☐AL84	$190^{\ 0}_{-0.046}$	$50^{\ 0}_{-0.016}$
09A☐AL54	$190^{\ 0}_{-0.046}$	$50^{\ 0}_{-0.016}$
09A☐AL74	$190^{\ 0}_{-0.046}$	$50^{\ 0}_{-0.016}$
09A☐AL84	$240^{\ 0}_{-0.046}$	$60^{\ 0}_{-0.019}$
13A☐AL14	$190^{\ 0}_{-0.046}$	$50^{\ 0}_{-0.016}$
13A☐AL24	$190^{\ 0}_{-0.046}$	$50^{\ 0}_{-0.016}$
13A☐AL54	$190^{\ 0}_{-0.046}$	$50^{\ 0}_{-0.016}$
13A☐AL74	$240^{\ 0}_{-0.046}$	$60^{\ 0}_{-0.019}$
13A☐AL84	$240^{\ 0}_{-0.046}$	$60^{\ 0}_{-0.019}$
20A☐AL14	$190^{\ 0}_{-0.046}$	$50^{\ 0}_{-0.016}$
20A☐AL24	$190^{\ 0}_{-0.046}$	$50^{\ 0}_{-0.016}$
20A☐AL54	$240^{\ 0}_{-0.046}$	$60^{\ 0}_{-0.019}$
20A☐AL74	$240^{\ 0}_{-0.046}$	$60^{\ 0}_{-0.019}$
30A☐AL14	$240^{\ 0}_{-0.046}$	$60^{\ 0}_{-0.019}$
30A☐AL24	$240^{\ 0}_{-0.046}$	$60^{\ 0}_{-0.019}$
30A☐AL54	$240^{\ 0}_{-0.046}$	$60^{\ 0}_{-0.019}$
44A☐AL14	$240^{\ 0}_{-0.046}$	$60^{\ 0}_{-0.019}$
44A☐AL24	$240^{\ 0}_{-0.046}$	$60^{\ 0}_{-0.019}$

3.19 Dimensional Drawings of SGMGH Servomotors (1000 min^{-1})

3.19.1 SGMGH Servomotors (1000 min^{-1}) Without Gears and Brakes

Models with oil seals are of the same configuration.





Note: For the specifications of the other shaft ends, refer to *3.20 Shaft End Specifications for SGMGH, SGMSH and SGMDH Servomotors.*

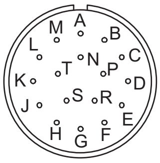
Units: mm

Model SGMGH-	L	LL	LM	LR	LT	KB1	KB2	IE	KL1	Shaft-end Dimensions			Approx. Mass kg
										S	S1	Q	
03A□B21	196	138	92	58	46	65	117	–	109	$19^{\ 0}_{-0.013}$	30	40	5.5
06A□B21	219	161	115	58	46	88	140	–	109	$19^{\ 0}_{-0.013}$	30	40	7.6
09A□B21	243	185	139	58	46	112	164	–	109	$22^{\ 0}_{-0.013}$	30	40	9.6
12A□B21	245	166	119	79	47	89	144	–	140	$35^{+0.01}_{\ 0}$	45	76	14
20A□B21	271	192	145	79	47	115	170	–	140	$35^{+0.01}_{\ 0}$	45	76	18
30A□B21	305	226	179	79	47	149	204	–	140	$35^{+0.01}_{\ 0}$	45	76	23
40A□B21	373	260	213	113	47	174	238	123	150	$42^{\ 0}_{-0.016}$	45	110	30
55A□B21	447	334	287	113	47	248	312	123	150	$42^{\ 0}_{-0.016}$	45	110	40

Units: mm

Model SGMGH-	Flange Face Dimensions mm											Allowable Radial Load N	Allowable Thrust Load N
	LA	LB	LC	LE	LF1	LF2	LG	LH	LJ1	LJ2	LZ		
03A□B21	145	$110^{\ 0}_{-0.035}$	130	6	6	–	12	165	45	–	9	490	98
06A□B21	145	$110^{\ 0}_{-0.035}$	130	6	6	–	12	165	45	–	9	490	98
09A□B21	145	$110^{\ 0}_{-0.035}$	130	6	6	–	12	165	45	–	9	686	343
12A□B21	200	$114.3^{\ 0}_{-0.025}$	180	3.2	3	0.5	18	230	76	62	13.5	1176	490
20A□B21	200	$114.3^{\ 0}_{-0.025}$	180	3.2	3	0.5	18	230	76	62	13.5	1470	490
30A□B21	200	$114.3^{\ 0}_{-0.025}$	180	3.2	3	0.5	18	230	76	62	13.5	1470	490
40A□B21	200	$114.3^{\ 0}_{-0.025}$	180	3.2	3	0.5	18	230	76	62	13.5	1764	588
55A□B21	200	$114.3^{\ 0}_{-0.025}$	180	3.2	3	0.5	18	230	76	62	13.5	1764	588

- Cable Specifications for Detector Connectors (17-bit Encoder)



Receptacle: MS3102A20-29P
Applicable plug (Purchased by the customer)
Plug: MS3108B20-29S
Cable clamp: MS3057-12A

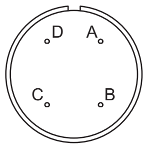
With an Absolute Encoder

A	–	K	–
B	–	L	–
C	DATA+	M	–
D	DATA-	N	–
E	–	P	–
F	–	R	–
G	0V	S	BATT-
H	+5VDC	T	BATT+
J	FG (Frame ground)	–	–

With an Incremental Encoder

A	–	K	–
B	–	L	–
C	DATA+	M	–
D	DATA-	N	–
E	–	P	–
F	–	R	–
G	0V	S	–
H	+5VDC	T	–
J	FG (Frame ground)	–	–

- Cable Specifications for Servomotor Connectors

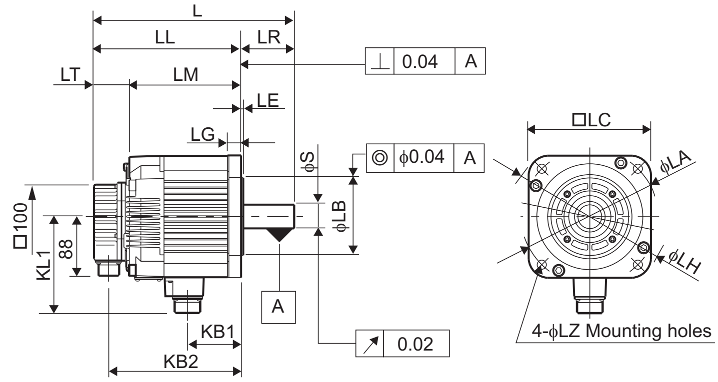


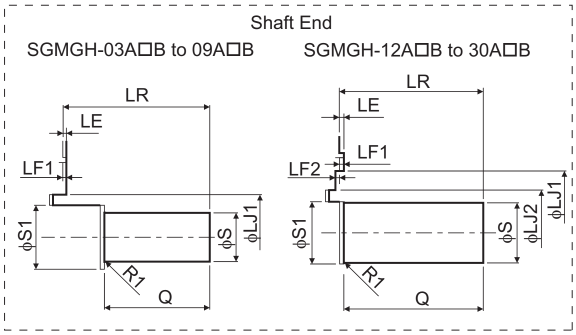
A	Phase U
B	Phase V
C	Phase W
D	FG (Frame ground)

3.19.2 SGMGH Servomotors (1000 min^{-1}) Without Gears and With Brakes

(1) 300W to 3.0kW

Models with oil seals are of the same configuration.





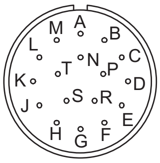
Note: For the specifications of the other shaft ends, refer to *3.20 Shaft End Specifications for SGMGH, SGMSH and SGMDH Servomotors*.

Units: mm

Model SGMGH-	L	LL	LM	LR	LT	KB1	KB2	KL1	Shaft-end Dimensions			Approx. Mass kg
									S	S1	Q	
03A□B2□	234	176	130	58	46	56	154	120	$19^{\ 0}_{-0.013}$	30	40	7.5
06A□B2□	257	199	153	58	46	79	177	120	$19^{\ 0}_{-0.013}$	30	40	9.6
09A□B2□	281	223	177	58	46	103	201	120	$22^{\ 0}_{-0.013}$	30	40	12
12A□B2□	296	217	169	79	48	79	195	146	$35^{+0.01}_{\ 0}$	45	76	19
20A□B2□	322	243	195	79	48	105	221	146	$35^{+0.01}_{\ 0}$	45	76	23.5
30A□B2□	356	277	229	79	48	139	255	146	$35^{+0.01}_{\ 0}$	45	76	28.5

Model SGMGH-	Flange Face Dimensions mm											Allowable Radial Load N	Allowable Thrust Load N
	LA	LB	LC	LE	LF1	LF2	LG	LH	LJ1	LJ2	LZ		
03A□B2□	145	$110^{\ 0}_{-0.035}$	130	6	6	–	12	165	45	–	9	490	98
06A□B2□	145	$110^{\ 0}_{-0.035}$	130	6	6	–	12	165	45	–	9	490	98
09A□B2□	145	$110^{\ 0}_{-0.035}$	130	6	6	–	12	165	45	–	9	686	343
12A□B2□	200	$114.3^{\ 0}_{-0.025}$	180	3.2	3	0.5	18	230	76	62	13.5	1176	490
20A□B2□	200	$114.3^{\ 0}_{-0.025}$	180	3.2	3	0.5	18	230	76	62	13.5	1470	490
30A□B2□	200	$114.3^{\ 0}_{-0.025}$	180	3.2	3	0.5	18	230	76	62	13.5	1470	490

- Cable Specifications for Detector Connectors (17-bit Encoder)



Receptacle: MS3102A20-29P
Applicable plug (Purchased by the customer)
Plug: MS3108B20-29S
Cable clamp: MS3057-12A

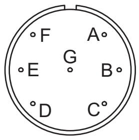
With an Absolute Encoder

A	–	K	–
B	–	L	–
C	DATA+	M	–
D	DATA-	N	–
E	–	P	–
F	–	R	–
G	0V	S	BATT-
H	+5VDC	T	BATT+
J	FG (Frame ground)	–	–

With an Incremental Encoder

A	–	K	–
B	–	L	–
C	DATA+	M	–
D	DATA-	N	–
E	–	P	–
F	–	R	–
G	0V	S	–
H	+5VDC	T	–
J	FG (Frame ground)	–	–

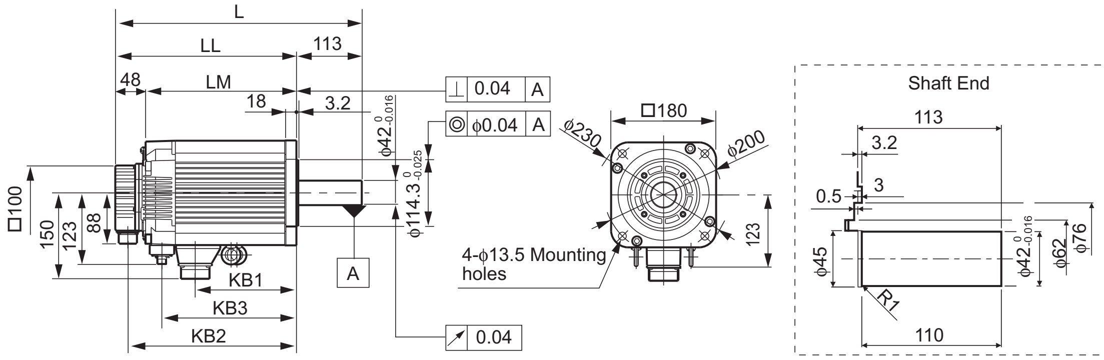
- Cable Specifications for Servomotor Connectors



A	Phase U	E	Brake terminal
B	Phase V	F	Brake terminal
C	Phase W	G	–
D	FG (Frame ground)	–	–

(2) 4.0 kW to 5.5 kW

Models with oil seals are of the same configuration.

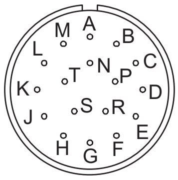


Note: For the specifications of the other shaft ends, refer to *3.20 Shaft End Specifications for SGMGH, SGMSH and SGMDH Servomotors*.

Units: mm

Model SGMGH-	L	LL	LM	KB1	KB2	KB3	Approx. Mass kg	Allowable Radial Load N	Allowable Thrust Load N
40A□B2□	424	311	263	174	289	231	35	1764	588
55A□B2□	498	385	337	248	363	305	45.5		

• Cable Specifications for Detector Connectors (17-bit Encoder)



Receptacle: MS3102A20-29P
Applicable plug (Purchased by the customer)
Plug: MS3108B20-29S
Cable clamp: MS3057-12A

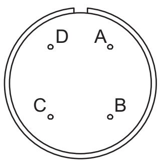
With an Absolute Encoder

A	–	K	–
B	–	L	–
C	DATA+	M	–
D	DATA-	N	–
E	–	P	–
F	–	R	–
G	0V	S	BATT-
H	+5VDC	T	BATT+
J	FG (Frame ground)	–	–

With an Incremental Encoder

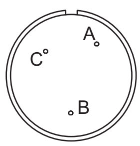
A	–	K	–
B	–	L	–
C	DATA+	M	–
D	DATA-	N	–
E	–	P	–
F	–	R	–
G	0V	S	–
H	+5VDC	T	–
J	FG (Frame ground)	–	–

• Cable Specifications for Servomotor Connectors



A	Phase U
B	Phase V
C	Phase W
D	FG (Frame ground)

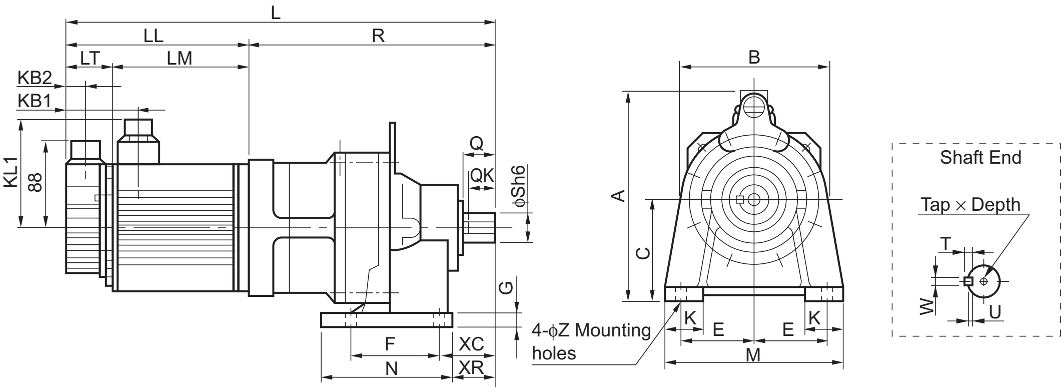
• Cable Specifications for Brake Connectors



A	Brake terminal
B	Brake terminal
C	–

3.19.3 SGMGH Servomotors (1000 min^{-1}) With Standard Backlash Gears and Without Brakes (Foot-mounted Type)

(1) Grease Lubricating Type



Units: mm

Model SGMGH-	Gear Model	Gear Ratio	L	LL	LM	LT	KB1	KB2	KL1	R	A	B	C*	Shaft Center Allowable Radial Load N
03P□BEA6	CNHX-6090	1/6	380	138	94	44	73	21	109	242	209	152	100	2840
03P□BEB6	CNHX-6090	1/11	380	138	94	44	73	21	109	242	209	152	100	3340
03P□BEC6	CNHX-6100	1/21	394	138	94	44	73	21	109	256	209	152	100	5400
03P□BE76	CNHX-6100	1/29	394	138	94	44	73	21	109	256	209	152	100	5400
06P□BEA6	CNHX-6100	1/6	417	161	117	44	73	21	109	256	209	152	100	4120
06P□BEB6	CNHX-6100	1/11	417	161	117	44	73	21	109	256	209	152	100	5230
06P□BEC6	CNHX-6120	1/21	449	161	117	44	73	21	109	288	257	204	120	8260
06P□BE76	CNHX-6120	1/29	449	161	117	44	73	21	109	288	257	204	120	9810
09P□BEA6	CNHX-6100	1/6	441	185	141	44	73	21	109	256	209	152	100	4110
09P□BEB6	CNHX-6105	1/11	441	185	141	44	73	21	109	256	209	152	100	7600
09P□BEC6	CNHX-6125	1/21	473	185	141	44	73	21	109	288	257	204	120	10900
09P□BE76	CNHX-6125	1/29	473	185	141	44	73	21	109	288	257	204	120	11900
12P□BEA6	CNHX-6120	1/6	477	166	121	45	77	22	140	311	260	204	120	5980
12P□BEB6	CNHX-6120	1/11	477	166	121	45	77	22	140	311	260	204	120	7600
20P□BEA6	CNHX-6120	1/6	503	192	147	45	77	22	140	311	260	204	120	5940
20P□BEB6	CNHX-6125	1/11	503	192	147	45	77	22	140	311	260	204	120	7530

* The tolerances for all models are $^{0}_{-0.5}$.

(cont'd)

Model SGMGH-	Gear Ratio	Foot-mounted Dimensions mm									Shaft-end Dimensions mm							Approx. Mass kg
		E	F	G	K	M	N	XR	XC	Z	Q	QK	S	T	U	W	Tap × Depth	
03P□BEA6	1/6	75	90	12	65	180	135	45	60	11	35	32	28	7	4	8	M8×20	20.7
03P□BEB6	1/11	75	90	12	65	180	135	45	60	11	35	32	28	7	4	8	M8×20	20.7
03P□BEC6	1/21	75	90	12	40	180	135	45	60	11	35	32	28	7	4	8	M8×20	22.7
03P□BE76	1/29	75	90	12	40	180	135	45	60	11	35	32	28	7	4	8	M8×20	22.7
06P□BEA6	1/6	75	90	12	40	180	135	45	60	11	35	32	28	7	4	8	M8×20	24.6
06P□BEB6	1/11	75	90	12	40	180	135	45	60	11	35	32	28	7	4	8	M8×20	24.6
06P□BEC6	1/21	95	115	15	55	230	155	62	82	14	55	50	38	8	5	10	M8×20	34.6
06P□BE76	1/29	95	115	15	55	230	155	62	82	14	55	50	38	8	5	10	M8×20	34.6
09P□BEA6	1/6	75	90	12	40	180	135	45	60	11	35	32	28	7	4	8	M8×20	26.6
09P□BEB6	1/11	75	90	12	40	180	135	45	60	11	35	32	28	7	4	8	M8×20	26.6
09P□BEC6	1/21	95	115	15	55	230	155	62	82	14	55	50	38	8	5	10	M8×20	36.6
09P□BE76	1/29	95	115	15	55	230	155	62	82	14	55	50	38	8	5	10	M8×20	36.6
12P□BEA6	1/6	95	115	15	55	230	155	62	82	14	55	50	38	8	5	10	M8×20	43
12P□BEB6	1/11	95	115	15	55	230	155	62	82	14	55	50	38	8	5	10	M8×20	43
20P□BEA6	1/6	95	115	15	55	230	155	62	82	14	55	50	38	8	5	10	M8×20	47
20P□BEB6	1/11	95	115	15	55	230	155	62	82	14	55	50	38	8	5	10	M8×20	47

• Dimensional Tolerances

Units: mm

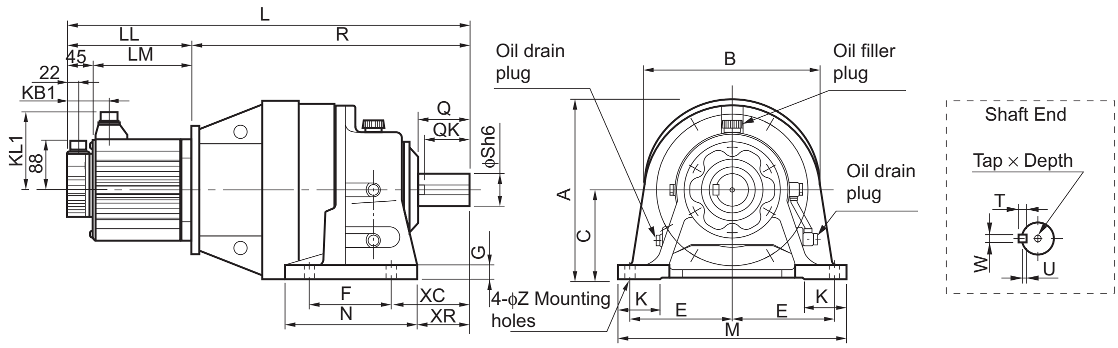
Model SGMGH-	Shaft-end Dimensions S
03P☐BEA6	$28^{\ 0}_{-0.013}$
03P☐BEB6	$28^{\ 0}_{-0.013}$
03P☐BEC6	$28^{\ 0}_{-0.013}$
03P☐BE76	$28^{\ 0}_{-0.013}$
06P☐BEA6	$28^{\ 0}_{-0.013}$
06P☐BEB6	$28^{\ 0}_{-0.013}$
06P☐BEC6	$38^{\ 0}_{-0.016}$
06P☐BE76	$38^{\ 0}_{-0.016}$
09P☐BEA6	$28^{\ 0}_{-0.013}$
09P☐BEB6	$28^{\ 0}_{-0.013}$
09P☐BEC6	$38^{\ 0}_{-0.016}$
09P☐BE76	$38^{\ 0}_{-0.016}$
12P☐BEA6	$38^{\ 0}_{-0.016}$
12P☐BEB6	$38^{\ 0}_{-0.016}$
20P☐BEA6	$38^{\ 0}_{-0.016}$
20P☐BEB6	$38^{\ 0}_{-0.016}$

INFO

■ Lubrication

• Since grease has been filled prior to shipment, the servomotors can be used without replenishing grease.

(2) Oil Lubricating Type



Units: mm

Model SGMGH-	Gear Model	Gear Ratio	L	LL	LM	KB1	KL1	R	A*1	B	C*2	Shaft Center Allowable Radial Load N
12P□BEC6	CHHX-6130	1/21	536	166	121	77	140	370	300	246	150	10900
12P□BE76	CHHX-6135	1/29	536	166	121	77	140	370	300	246	150	11900
20P□BEC6	CHHX-6140	1/21	582	192	147	77	140	390	300	246	150	15700
20P□BE76	CHHJ-6160	1/29	687	192	147	77	140	495	367	318	160	20500
30P□BEA6	CHHX-6130	1/6	596	226	181	77	140	370	300	246	150	6920
30P□BEB6	CHHX-6135	1/11	596	226	181	77	140	370	300	246	150	8790
30P□BEC6	CHHJ-6160	1/21	721	226	181	77	140	495	367	318	160	18600
30P□BE76	CHHJ-6170	1/29	785	226	181	77	140	559	429	363	200	23100
40P□BEA6	CHHX-6135	1/6	664	260	215	86	150	404	300	246	150	6870
40P□BEB6	CHHX-6145	1/11	684	260	215	86	150	424	300	246	150	13000
40P□BEC6	CHHJ-6170	1/21	853	260	215	86	150	593	429	363	200	21000
40P□BE76	CHHJ-6175	1/29	853	260	215	86	150	593	429	363	200	23000
55P□BEB6	CHHJ-6160	1/11	863	334	289	86	150	529	367	318	160	15000
55P□BEC6	CHHJ-6175	1/21	927	334	289	86	150	593	429	363	200	20900
55P□BE76	CHHJ-6185	1/29	977	334	289	86	150	643	467	393	220	30400

* 1. The dimension of the hook is included for some models.

* 2. The tolerances for all models are $^{0}_{-0.5}$.

3.19.3 SGMGH Servomotors (1000 min^{-1}) With Standard Backlash Gears and Without Brakes (Foot-mounted Type)

Model SGMGH-	Gear Ratio	Dimensions with Feet mm									Shaft-end Dimensions mm							Approx. Mass kg
		E	F	G	K	M	N	XR	XC	Z	Q	QK	S	T	U	W	Tap × Depth	
12P□BEC6	1/21	145	145	22	65	330	195	75	100	18	70	56	50	9	5.5	14	M10 × 18	67
12P□BE76	1/29	145	145	22	65	330	195	75	100	18	70	56	50	9	5.5	14	M10 × 18	67
20P□BEC6	1/21	145	145	22	65	330	195	95	120	18	90	80	50	9	5.5	14	M10 × 18	72
20P□BE76	1/29	185	150	25	75	410	238	95	139	18	90	80	60	11	7	18	M10 × 18	126
30P□BEA6	1/6	145	145	22	65	330	195	75	100	18	70	56	50	9	5.5	14	M10 × 18	76
30P□BEB6	1/11	145	145	22	65	330	195	75	100	18	70	56	50	9	5.5	14	M10 × 18	76
30P□BEC6	1/21	185	150	25	75	410	238	95	139	18	90	80	60	11	7	18	M10 × 18	131
30P□BE76	1/29	190	275	30	80	430	335	95	125	22	90	80	70	12	7.5	20	M12 × 24	176
40P□BEA6	1/6	145	145	22	65	330	195	75	100	18	70	56	50	9	5.5	14	M10 × 18	88
40P□BEB6	1/11	145	145	22	65	330	195	95	120	18	90	80	50	9	5.5	14	M10 × 18	89
40P□BEC6	1/21	190	275	30	80	430	335	95	125	22	90	80	70	12	7.5	20	M12 × 24	191
40P□BE76	1/29	190	275	30	80	430	335	95	125	22	90	80	70	12	7.5	20	M12 × 24	191
55P□BEB6	1/11	185	150	25	75	410	238	95	139	18	90	80	60	11	7	18	M10 × 18	155
55P□BEC6	1/21	190	275	30	80	430	335	95	125	22	90	80	70	12	7.5	20	M12 × 24	201
55P□BE76	1/29	210	320	30	85	470	380	115	145	22	110	100	80	14	9	22	M12 × 24	245

- Dimensional Tolerances

Units: mm

Model SGMGH-	Shaft-end Dimensions
	S
12P☐BEC6	$50^{\ 0}_{-0.016}$
12P☐BE76	$50^{\ 0}_{-0.016}$
20P☐BEC6	$50^{\ 0}_{-0.016}$
20P☐BE76	$60^{\ 0}_{-0.019}$
30P☐BEA6	$50^{\ 0}_{-0.016}$
30P☐BEB6	$50^{\ 0}_{-0.016}$
30P☐BEC6	$60^{\ 0}_{-0.019}$
30P☐BE76	$70^{\ 0}_{-0.019}$
40P☐BEA6	$50^{\ 0}_{-0.016}$
40P☐BEB6	$50^{\ 0}_{-0.016}$
40P☐BEC6	$70^{\ 0}_{-0.019}$
40P☐BE76	$70^{\ 0}_{-0.019}$
55P☐BEB6	$60^{\ 0}_{-0.019}$
55P☐BEC6	$70^{\ 0}_{-0.019}$
55P☐BE76	$80^{\ 0}_{-0.019}$

INFO

■ Lubrication

- Oil lubricating type (frame numbers: 6130 to 6190)
  Servomotors of this type have been shipped with oil removed. Be sure to supply oil until the red line at the upper side of the oil guage.
  Lubrication oil recommended is industrial-use extreme-pressure gear oil of SP-system, JIS K 2219 industrial-use gear oil or equivalent. Refer to the following table.

Ambient Tempera-ture	Manufacturer						
	COSMO Oil Co., Ltd.	Nippon Oil Corporation	Idemitsu Kosan Co., Ltd.	Showa Shell Sekiyu K.K.	Exxon Mobil Corporation		Japan Energy Corporation
0 to 35°C	COSMO Gear SE 100, 150	BON-NOCK M 100, 150	Daphne Super Gear Oil 100, 150	Shell Omala Oil 100, 150	Spartan EP 100, 150	Mobilgear 627, 629 (ISO VG100, 150)	JOMO Reductus 100, 150

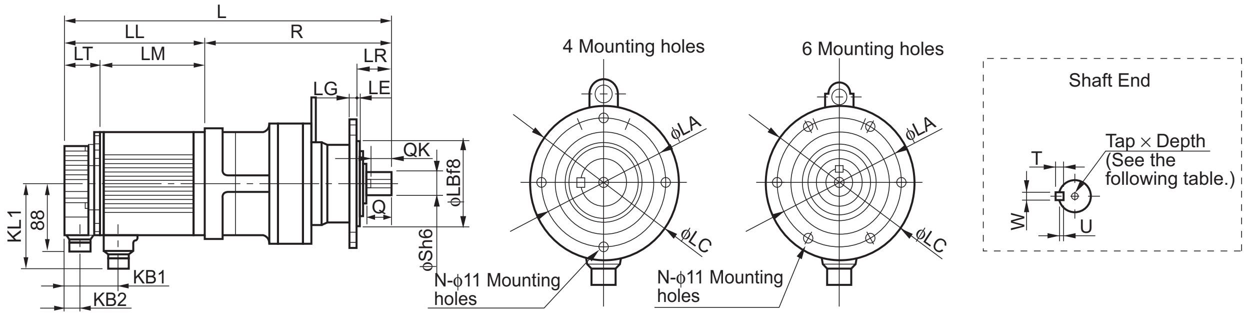
The following shows approximate oil amount to be supplied.

Units: liter

Frame No.	6130 6135	6140	6160	6170 6175	6180 6185	6190
Horizontal type	0.7	0.7	1.4	1.9	2.5	4.0

3.19.4 SGMGH Servomotors (1000 min^{-1}) With Standard Backlash Gears and Without Brakes (Flange-mounted Type)

(1) Grease Lubricating Type



Units: mm

Model SGMGH-	Gear Model	Gear Ratio	L	LL	LM	LT	KB1	KB2	KL1	R	Shaft Center Allowable Radial Load N
03P□BFA6	CNVX-6090	1/6	380	138	94	44	73	21	109	242	2840
03P□BFB6	CNVX-6090	1/11	380	138	94	44	73	21	109	242	3340
03P□BFC6	CNVX-6100	1/21	394	138	94	44	73	21	109	256	5400
03P□BF76	CNVX-6100	1/29	394	138	94	44	73	21	109	256	5400
06P□BFA6	CNVX-6100	1/6	417	161	117	44	73	21	109	256	4120
06P□BFB6	CNVX-6100	1/11	417	161	117	44	73	21	109	256	5230
06P□BFC6	CNVX-6120	1/21	449	161	117	44	73	21	109	288	8260
06P□BF76	CNVX-6120	1/29	449	161	117	44	73	21	109	288	9810
09P□BFA6	CNVX-6100	1/6	441	185	141	44	73	21	109	256	4110
09P□BFB6	CNVX-6105	1/11	441	185	141	44	73	21	109	256	7600
09P□BFC6	CNVX-6125	1/21	473	185	141	44	73	21	109	288	10900
09P□BF76	CNVX-6125	1/29	473	185	141	44	73	21	109	288	11900
12P□BFA6	CNVX-6120	1/6	477	166	121	45	77	22	140	311	5980
12P□BFB6	CNVX-6120	1/11	477	166	121	45	77	22	140	311	7600
20P□BFA6	CNVX-6120	1/6	503	192	147	45	77	22	140	311	5940
20P□BFB6	CNVX-6125	1/11	503	192	147	45	77	22	140	311	7530

Model SGMGH-	Flange Face Dimensions mm							Shaft-end Dimensions mm							Approx. Mass kg
	LA	LB	LC	LE	LG	LR	N	Q	QK	S	T	U	W	Tap × Depth	
03P□BFA6	134	110	160	3	9	48	4	35	32	28	7	4	8	M8 × 20	18.7
03P□BFB6	134	110	160	3	9	48	4	35	32	28	7	4	8	M8 × 20	18.7
03P□BFC6	134	110	160	3	9	48	4	35	32	28	7	4	8	M8 × 20	20.7
03P□BF76	134	110	160	3	9	48	4	35	32	28	7	4	8	M8 × 20	20.7
06P□BFA6	134	110	160	3	9	48	4	35	32	28	7	4	8	M8 × 20	22.6
06P□BTB6	134	110	160	3	9	48	4	35	32	28	7	4	8	M8 × 20	22.6
06P□BFC6	180	140	210	4	13	69	6	55	50	38	8	5	10	M8 × 20	33.6
06P□BF76	180	140	210	4	13	69	6	55	50	38	8	5	10	M8 × 20	33.6
09P□BFA6	134	110	160	3	9	48	4	35	32	28	7	4	8	M8 × 20	24.6
09P□BFB6	134	110	160	3	9	48	4	35	32	28	7	4	8	M8 × 20	24.6
09P□BFC6	180	140	210	4	13	69	6	55	50	38	8	5	10	M8 × 20	35.6
09P□BF76	180	140	210	4	13	69	6	55	50	38	8	5	10	M8 × 20	35.6

(cont'd)

Model SGMGH-	Flange Face Dimensions mm							Shaft-end Dimensions mm							Approx. Mass kg
	LA	LB	LC	LE	LG	LR	N	Q	QK	S	T	U	W	Tap × Depth	
12P☐BFA6	180	140	210	4	13	69	6	55	50	38	8	5	10	M8 × 20	42
12P☐BFB6	180	140	210	4	13	69	6	55	50	38	8	5	10	M8 × 20	42
20P☐BFA6	180	140	210	4	13	69	6	55	50	38	8	5	10	M8 × 20	46
20P☐BFB6	180	140	210	4	13	69	6	55	50	38	8	5	10	M8 × 20	46

• Dimensional Tolerances

Units: mm

Model SGMGH-	Flange Face Dimensions	Shaft-end Dimensions
	LB	S
03P☐BFA6	$110^{-0.036}_{-0.090}$	$28^{\ 0}_{-0.013}$
03P☐BFB6	$110^{-0.036}_{-0.090}$	$28^{\ 0}_{-0.013}$
03P☐BFC6	$110^{-0.036}_{-0.090}$	$28^{\ 0}_{-0.013}$
03P☐BF76	$110^{-0.036}_{-0.090}$	$28^{\ 0}_{-0.013}$
06P☐BFA6	$110^{-0.036}_{-0.090}$	$28^{\ 0}_{-0.013}$
06P☐BFB6	$110^{-0.036}_{-0.090}$	$28^{\ 0}_{-0.013}$
06P☐BFC6	$140^{-0.043}_{-0.106}$	$38^{\ 0}_{-0.016}$
06P☐BF76	$140^{-0.043}_{-0.106}$	$38^{\ 0}_{-0.016}$
09P☐BFA6	$110^{-0.036}_{-0.090}$	$28^{\ 0}_{-0.013}$
09P☐BFB6	$110^{-0.036}_{-0.090}$	$28^{\ 0}_{-0.013}$
09P☐BFC6	$140^{-0.043}_{-0.106}$	$38^{\ 0}_{-0.016}$
09P☐BF76	$140^{-0.043}_{-0.106}$	$38^{\ 0}_{-0.016}$
12P☐BFA6	$140^{-0.043}_{-0.106}$	$38^{\ 0}_{-0.016}$
12P☐BFB6	$140^{-0.043}_{-0.106}$	$38^{\ 0}_{-0.016}$
20P☐BFA6	$140^{-0.043}_{-0.106}$	$38^{\ 0}_{-0.016}$
20P☐BFB6	$140^{-0.043}_{-0.106}$	$38^{\ 0}_{-0.016}$

INFO

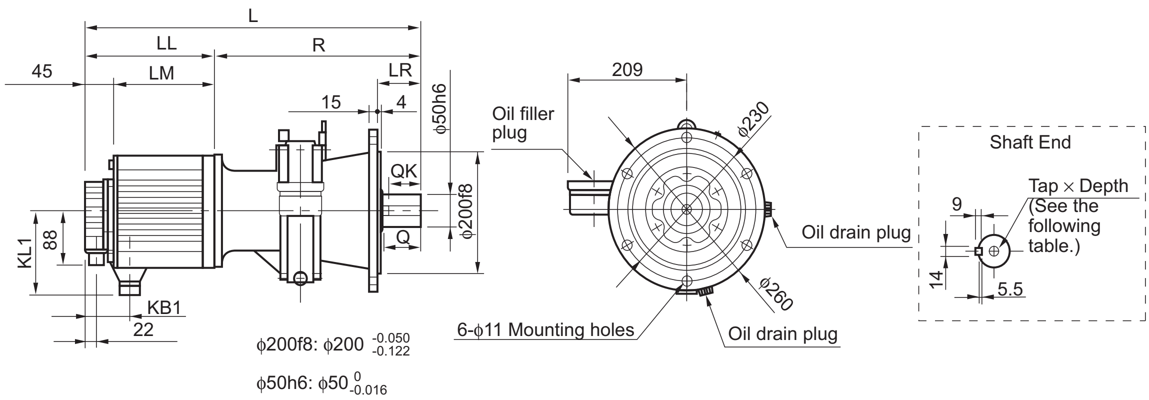
■ Lubrication

- Grease lubricating type (frame numbers: 6090 to 6125)
  Since grease has been filled prior to shipment, the servomotors can be used without replenishing grease.

Servomotor Specifications and Dimensional Drawings

3

(2) Small Oil Lubricating Type



Units: mm

Model SGMGH-	Gear Model	Gear Ratio	L	LL	LM	KB1	KL1	R	Shaft Center Allowable Radial Load N	Flange Face Dimensions	Shaft-end Dimensions			Approx. Mass kg
										LR	Q	QK	Tap × Depth	
12P☐BFC6	CHVX-6130	1/21	536	166	121	77	140	370	10900	76	70	56	M10×18	66
12P☐BF76	CHVX-6135	1/29	536	166	121	77	140	370	11900	76	70	56	M10×18	66
20P☐BFC6	CHVX-6140	1/21	582	192	147	77	140	390	15700	96	90	80	M10×18	71
30P☐BFA6	CHVX-6130	1/6	596	226	181	77	140	370	6920	76	70	56	M10×18	75
30P☐BFB6	CHVX-6135	1/11	596	226	181	77	140	370	8790	76	70	56	M10×18	75
40P☐BFA6	CHVX-6135	1/6	664	260	215	86	150	404	6870	76	70	56	M10×18	87
40P☐BFB6	CHVX-6145	1/11	684	260	215	86	150	424	13000	96	90	80	M10×18	88

INFO

■ Lubrication

- Oil lubricating type (frame numbers: 6130 to 6190)

  Servomotors of this type have been shipped with oil removed. Be sure to supply oil until the red line at the upper side of the oil guage.

  Lubrication oil recommended is industrial-use extreme-pressure gear oil of SP-system, JIS K 2219 industrial-use gear oil or equivalent. Refer to the following table.

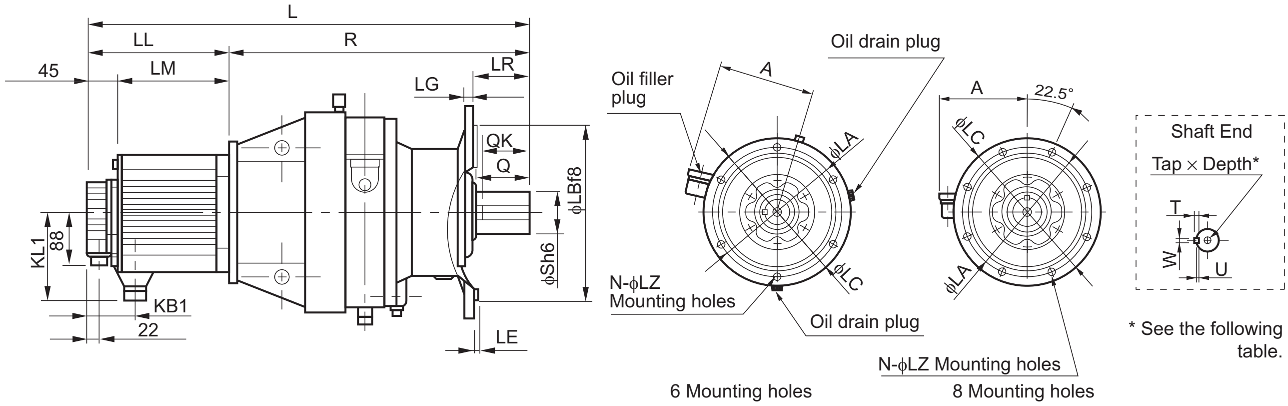
Ambient Tempera-ture	Manufacturer						
	COSMO Oil Co., Ltd.	Nippon Oil Corporation	Idemitsu Kosan Co., Ltd.	Showa Shell Sekiyu K.K.	Exxon Mobil Corporation		Japan Energy Corporation
0 to 35°C	COSMO Gear SE 100, 150	BON-NOCK M 100, 150	Daphne Super Gear Oil 100, 150	Shell Omala Oil 100, 150	Spartan EP 100, 150	Mobilgear 627, 629 (ISO VG100, 150)	JOMO Reductus 100, 150

The following shows approximate oil amount to be supplied.

Units: liter

Frame No.	6130 6135	6140	6160	6170 6175	6180 6185	6190
Horizontal type	0.7	0.7	1.4	1.9	2.5	4.0

(3) Large Oil Lubricating Type



Units: mm

Model SGMGH-	Gear Model	Gear Ratio	L	LL	LM	KB1	KL1	R	A	Shaft Center Allowable Radial Load N
20P□BF76	CHVJ-6160	1/29	687	192	147	77	140	495	228	20500
30P□BFC6	CHVJ-6160	1/21	721	226	181	77	140	495	228	18600
30P□BF76	CHVJ-6170	1/29	785	226	181	77	140	559	243	23100
40P□BFC6	CHVJ-6170	1/21	853	260	215	86	150	593	243	21000
40P□BF76	CHVJ-6175	1/29	853	260	215	86	150	593	243	23000
55P□BFB6	CHVJ-6160	1/11	863	334	289	86	150	529	228	15000
55P□BFC6	CHVJ-6175	1/21	927	334	289	86	150	593	243	20900
55P□BF76	CHVJ-6185	1/29	977	334	289	86	150	643	258	30400

Model SGMGH-	Gear Ratio	Flange Face Dimensions mm								Shaft-end Dimensions mm							Approx. Mass kg
		LA	LB	LC	LE	LG	LR	N	LZ	Q	QK	S	T	U	W	Tap × Depth	
20P□BF76	1/29	310	270	340	4	20	89	6	11	90	80	60	11	7	18	M10×18	121
30P□BFC6	1/21	310	270	340	4	20	89	6	11	90	80	60	11	7	18	M10×18	126
30P□BF76	1/29	360	316	400	5	22	94	8	14	90	80	70	12	7.5	20	M12×24	176
40P□BFC6	1/21	360	316	400	5	22	94	8	14	90	80	70	12	7.5	20	M12×24	191
40P□BF76	1/29	360	316	400	5	22	94	8	14	90	80	70	12	7.5	20	M12×24	191
55P□BFB6	1/11	310	270	340	4	20	89	6	11	90	80	60	11	7	18	M10×18	150
55P□BFC6	1/21	360	316	400	5	22	94	8	14	90	80	70	12	7.5	20	M12×24	201
55P□BF76	1/29	390	345	430	5	22	110	8	18	110	100	80	14	9	22	M12×24	232

- Dimensional Tolerances

Units: mm

Model SGMGH-	Flange Face Dimensions	Shaft-end Dimensions
	LB	S
20P☐BF76	$270^{-0.056}_{-0.137}$	$60^{\ \ 0}_{-0.019}$
30P☐BFC6	$270^{-0.056}_{-0.137}$	$60^{\ \ 0}_{-0.019}$
30P☐BF76	$316^{-0.062}_{-0.151}$	$70^{\ \ 0}_{-0.019}$
40P☐BFC6	$316^{-0.062}_{-0.151}$	$70^{\ \ 0}_{-0.019}$
40P☐BF76	$316^{-0.062}_{-0.151}$	$70^{\ \ 0}_{-0.019}$
55P☐BFB6	$270^{-0.056}_{-0.137}$	$60^{\ \ 0}_{-0.019}$
55P☐BFC6	$316^{-0.062}_{-0.151}$	$70^{\ \ 0}_{-0.019}$
55P☐BF76	$345^{-0.062}_{-0.151}$	$80^{\ \ 0}_{-0.019}$

INFO

■ Lubrication

- Oil lubricating type (frame numbers: 6130 to 6190)

  Servomotors of this type have been shipped with oil removed. Be sure to supply oil until the red line at the upper side of the oil guage.

  Lubrication oil recommended is industrial-use extreme-pressure gear oil of SP-system, JIS K 2219 industrial-use gear oil or equivalent. Refer to the following table.

Ambient Tempera-ture	Manufacturer						
	COSMO Oil Co., Ltd.	Nippon Oil Corporation	Idemitsu Kosan Co., Ltd.	Showa Shell Sekiyu K.K.	Exxon Mobil Corporation		Japan Energy Corporation
0 to 35°C	COSMO Gear SE 100, 150	BON-NOCK M 100, 150	Daphne Super Gear Oil 100, 150	Shell Omala Oil 100, 150	Spartan EP 100, 150	Mobilgear 627, 629 (ISO VG100, 150)	JOMO Reductus 100, 150

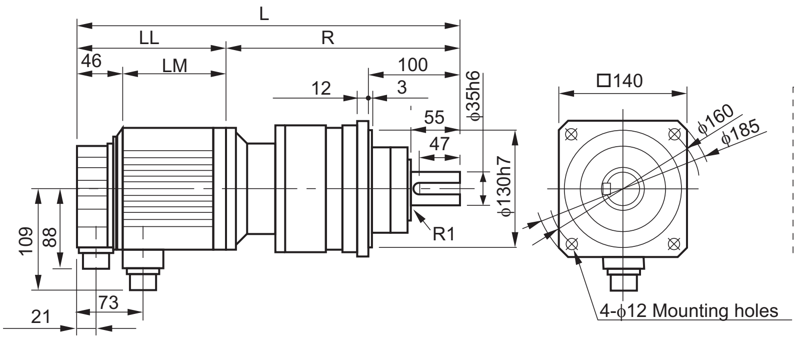
The following shows approximate oil amount to be supplied.

Units: liter

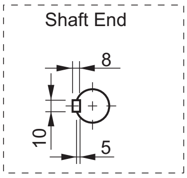
Frame No.	6130 6135	6140	6160	6170 6175	6180 6185	6190
Horizontal type	0.7	0.7	1.4	1.9	2.5	4.0

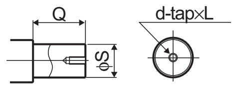
3.19.5 SGMGH Servomotors (1000 min^{-1}) With Low-backlash Gears and Without Brakes (Flange-mounted Type)

(1) Small Grease Lubricating Type



• Applied Specifications for Shaft-end Tap

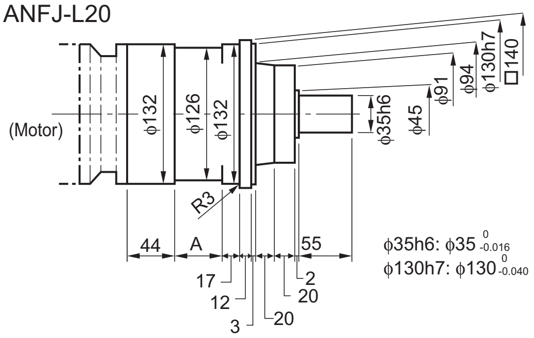




Frame No.	Dia.S	Length Q	d × L mm
ANFJ-L20	35	55	M8 × 16
ANFJ-L30	50	75	M10 × 20
ANFJ-L40	60	90	M12 × 24

• Detailed Dimensions of Gears

ANFJ-L20

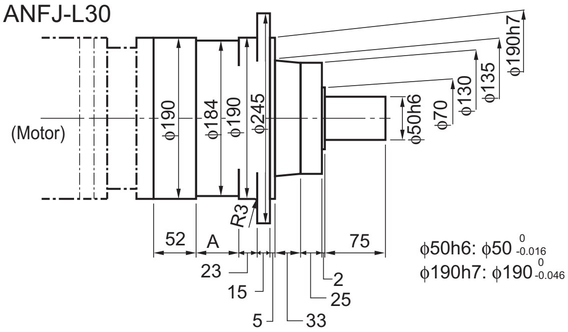


φ35h6: φ35 $^{0}_{-0.016}$
φ130h7: φ130 $^{0}_{-0.040}$

Units: mm

Gear Ratio	A
1/5	6
1/9	18
1/20, 1/29	37
1/45	47

ANFJ-L30

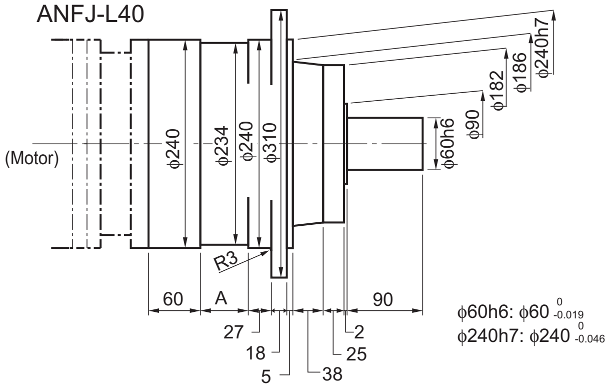


φ50h6: φ50 $^{0}_{-0.016}$
φ190h7: φ190 $^{0}_{-0.046}$

Units: mm

Gear Ratio	A
1/5	11
1/9	38
1/20, 1/29	42
1/45	52

ANFJ-L40



φ60h6: φ60 $^{0}_{-0.019}$
φ240h7: φ240 $^{0}_{-0.046}$

Units: mm

Gear Ratio	A
1/5	16
1/9	48
1/20, 1/29	48
1/45	58

Units: mm

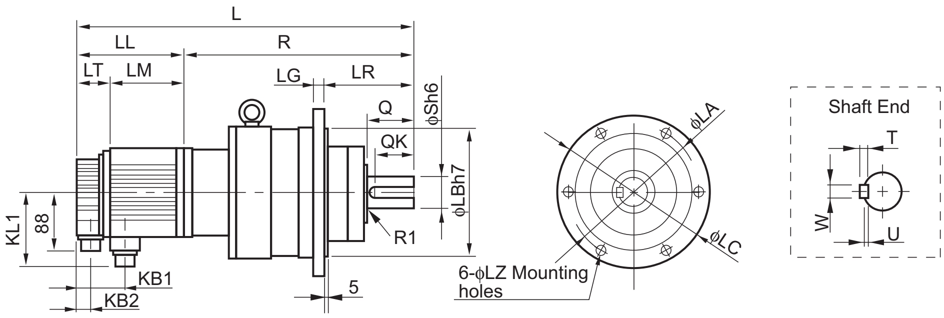
Model SGMGH-	Gear Type	Gear Ratio	L	LL	LM	R	Approx. Mass kg	Shaft Center Allowable Radial Load N
03A☐BL14	ANFJ-L20	1/5	394	138	92	256	14	833
03A☐BL24		1/9	406	138	92	268	14	980
03A☐BL54		1/20	425	138	92	287	16	1270
06A☐BL14		1/5	417	161	115	256	16	833
06A☐BL24		1/9	429	161	115	268	16	980
09A☐BL14		1/5	441	185	139	256	18	833

INFO

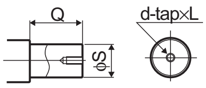
■ Lubrication

• Since grease has been filled prior to shipment, the servomotors can be used without replenishing grease.

(2) Large Grease Lubricating Type



• Applied Specifications of Shaft-end Tap



Frame No.	Dia.S	Length Q	d × L mm
ANFJ-L20	35	55	M8 × 16
ANFJ-L30	50	75	M10 × 20
ANFJ-L40	60	90	M12 × 24

Units: mm

Model SGMGH-	Gear Model	Gear Ratio	L	LL	LM	LR	LT	KB1	KB2	KL1	R	Shaft Center Allowable Radial Load N
03A☐BL74	ANFJ-L30	1/29	491	138	92	140	46	73	21	109	353	2940
03A☐BL84		1/45	501	138	92	140	46	73	21	109	363	3430
06A☐BL54		1/20	514	161	115	140	46	73	21	109	353	2650
06A☐BL74		1/29	514	161	115	140	46	73	21	109	353	2940
06A☐BL84	ANFJ-L40	1/45	565	161	115	160	46	73	21	109	404	8040
09A☐BL24	ANFJ-L30	1/9	534	185	139	140	46	73	21	109	349	1960
09A☐BL54		1/20	538	185	139	140	46	73	21	109	353	2650
09A☐BL74	ANFJ-L40	1/29	579	185	139	160	46	73	21	109	394	6860
09A☐BL84		1/45	589	185	139	160	46	73	21	109	404	8040
12A☐BL14	ANFJ-L30	1/5	509	166	119	140	47	77	22	140	343	1670
12A☐BL24		1/9	536	166	119	140	47	77	22	140	370	1960
12A☐BL54	ANFJ-L40	1/20	581	166	119	160	47	77	22	140	415	6080
12A☐BL74		1/29	581	166	119	160	47	77	22	140	415	6860
12A☐BL84		1/45	591	166	119	160	47	77	22	140	425	8040
20A☐BL14	ANFJ-L30	1/5	535	192	145	140	47	77	22	140	343	1670
20A☐BL24		1/9	562	192	145	140	47	77	22	140	370	1960
20A☐BL54	ANFJ-L40	1/20	607	192	145	160	47	77	22	140	415	6080
30A☐BL14		1/5	609	226	179	160	47	77	22	140	383	3820
30A☐BL24		1/9	641	226	179	160	47	77	22	140	415	4700

(cont'd)

Model SGMGH-	Gear Ratio	Flange Face Dimensions mm					Shaft-end Dimensions mm						Approx. Mass kg
		LA	LB	LC	LG	LZ	Q	QK	S	T	U	W	
03A☐BL74	1/29	220	190	245	15	12	75	65	50	9	5.5	14	31
03A☐BL84	1/45	220	190	245	15	12	75	65	50	9	5.5	14	31
06A☐BL54	1/20	220	190	245	15	12	75	65	50	9	5.5	14	33
06A☐BL74	1/29	220	190	245	15	12	75	65	50	9	5.5	14	33
06A☐BL84	1/45	280	240	310	18	14	90	78	60	11	7	18	53
09A☐BL24	1/9	220	190	245	15	12	75	65	50	9	5.5	14	35
09A☐BL54	1/20	220	190	245	15	12	75	65	50	9	5.5	14	35
09A☐BL74	1/29	280	240	310	18	14	90	78	60	11	7	18	55
09A☐BL84	1/45	280	240	310	18	14	90	78	60	11	7	18	55
12A☐BL14	1/5	220	190	245	15	12	75	65	50	9	5.5	14	32
12A☐BL24	1/9	220	190	245	15	12	75	65	50	9	5.5	14	39
12A☐BL54	1/20	280	240	310	18	14	90	78	60	11	7	18	59
12A☐BL74	1/29	280	240	310	18	14	90	78	60	11	7	18	59
12A☐BL84	1/45	280	240	310	18	14	90	78	60	11	7	18	59
20A☐BL14	1/5	220	190	245	15	12	75	65	50	9	5.5	14	36
20A☐BL24	1/9	220	190	245	15	12	75	65	50	9	5.5	14	43
20A☐BL54	1/20	280	240	310	18	14	90	78	60	11	7	18	63
30A☐BL14	1/5	280	240	310	18	14	90	78	60	11	7	18	58
30A☐BL24	1/9	280	240	310	18	14	90	78	60	11	7	18	68

INFO

■ Lubrication

- Since grease has been filled prior to shipment, the servomotors can be used without replenishing grease.

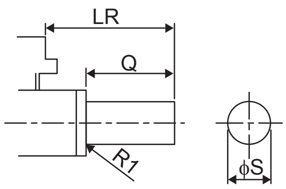
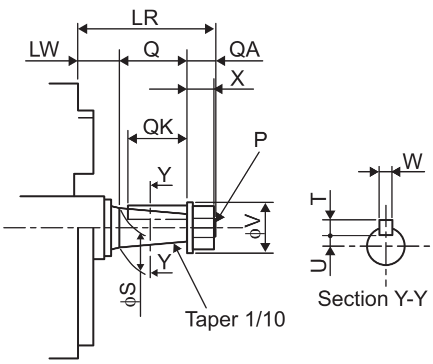
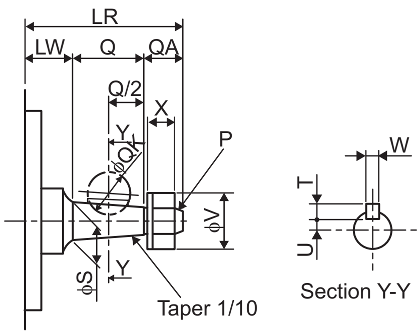
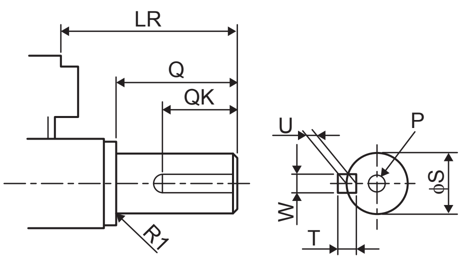
Servomotor Specifications and Dimensional Drawings

3

3.20 Shaft End Specifications for SGMGH Servomotor

SGMGH - □□□□□□□□

Symbol	Specifications	Remarks
2	Straight, without key	Standard
3	Taper 1/10, with parallel key (Key slot is JISB1301-1976 high precision. SGMGH series is interchangeable with USAGED series.)	Optional
5	Taper 1/10, woodruff key (Set only for SGMGH-05 and 09. Woodruff key is JISB1302.)	Optional
6	Straight, with key and tap for one location (Key slot is JISB1301-1976 high precision.Key slot tolerance is JISB1301. Both key and tap are included.)	Optional

Symbol	Specifications	Shaft End
2	Straight, without key	
3	Taper 1/10 With parallel key	
5	Taper 1/10, With woodruff key	
6	Straight, With key and tap	

Units: mm

<table>
<tr><th rowspan="4">Symbol</th><th rowspan="4">Specifications</th><th rowspan="4"></th><th colspan="8">Model</th></tr>
<tr><th colspan="8">SGMGH-</th></tr>
<tr><th>03A□B</th><th>06A□B</th><th>09A□B</th><th>12A□B</th><th>20A□B</th><th>30A□B</th><th>40A□B</th><th>55A□B</th></tr>
<tr><th>05A□A</th><th>09A□A</th><th>13A□A</th><th>20A□A</th><th>30A□A</th><th>44A□A</th><th>55A□A</th><th>75A□A</th></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Straight</td><td>LR</td><td colspan="3">58</td><td colspan="3">79</td><td colspan="2">113</td></tr>
<tr><td>Q</td><td colspan="3">40</td><td colspan="3">76</td><td colspan="2">110</td></tr>
<tr><td>S</td><td colspan="2">$19^{\ 0}_{-0.013}$</td><td>$22^{\ 0}_{-0.013}$</td><td colspan="3">$35^{+0.01}_{\ 0}$</td><td colspan="2">$42^{\ 0}_{-0.016}$</td></tr>
<tr><td rowspan="12">3</td><td rowspan="12">Taper 1/10, parallel key</td><td>LR</td><td colspan="3">58</td><td colspan="3">102</td><td colspan="2">132</td></tr>
<tr><td>LW</td><td colspan="3">18</td><td colspan="5">22</td></tr>
<tr><td>Q</td><td colspan="3">28</td><td colspan="3">58</td><td colspan="2">82</td></tr>
<tr><td>QA</td><td colspan="3">12</td><td colspan="3">22</td><td colspan="2">28</td></tr>
<tr><td>QK</td><td colspan="3">25*1</td><td colspan="3">50</td><td colspan="2">70</td></tr>
<tr><td>X</td><td colspan="3">10.3</td><td colspan="3">19.2</td><td colspan="2">23</td></tr>
<tr><td>S</td><td colspan="2">16</td><td>19</td><td colspan="3">32</td><td colspan="2">42</td></tr>
<tr><td>V</td><td colspan="3">21</td><td colspan="3">37</td><td colspan="2">44</td></tr>
<tr><td>P</td><td colspan="3">M10, P1.25</td><td colspan="3">M20, P1.5</td><td colspan="2">M24, P2.0</td></tr>
<tr><td>W</td><td colspan="3">5</td><td colspan="3">7</td><td colspan="2">10</td></tr>
<tr><td>T</td><td colspan="3">5*2</td><td colspan="3">7</td><td colspan="2">8</td></tr>
<tr><td>U</td><td colspan="2">4.3*3</td><td>5.8</td><td colspan="3">10.55</td><td colspan="2">13.95</td></tr>
<tr><td rowspan="12">5</td><td rowspan="12">Taper 1/10, wood-ruff key</td><td>LR</td><td colspan="2">58</td><td rowspan="12">–</td><td colspan="3" rowspan="12">–</td><td colspan="2" rowspan="12">–</td></tr>
<tr><td>LW</td><td colspan="2">18</td></tr>
<tr><td>Q</td><td colspan="2">28</td></tr>
<tr><td>QA</td><td colspan="2">12</td></tr>
<tr><td>QK</td><td colspan="2">16</td></tr>
<tr><td>X</td><td colspan="2">10.3</td></tr>
<tr><td>S</td><td colspan="2">16</td></tr>
<tr><td>V</td><td colspan="2">21</td></tr>
<tr><td>P</td><td colspan="2">M10, P1.25</td></tr>
<tr><td>W</td><td colspan="2">5</td></tr>
<tr><td>T</td><td colspan="2">2</td></tr>
<tr><td>U</td><td colspan="2">4.5</td></tr>
<tr><td rowspan="8">6</td><td rowspan="8">Straight, with key and tap</td><td>LR</td><td colspan="3">58</td><td colspan="3">79</td><td colspan="2">113</td></tr>
<tr><td>Q</td><td colspan="3">40</td><td colspan="3">76</td><td colspan="2">110</td></tr>
<tr><td>QK</td><td colspan="3">25</td><td colspan="3">60</td><td colspan="2">90</td></tr>
<tr><td>S</td><td colspan="2">$19^{\ 0}_{-0.013}$</td><td>$22^{\ 0}_{-0.013}$</td><td colspan="3">$35^{+0.01}_{\ 0}$</td><td colspan="2">$42^{\ 0}_{-0.016}$</td></tr>
<tr><td>W</td><td colspan="2">5</td><td>6</td><td colspan="3">10</td><td colspan="2">12</td></tr>
<tr><td>T</td><td colspan="2">5</td><td>6</td><td colspan="5">8</td></tr>
<tr><td>U</td><td colspan="2">3</td><td>3.5</td><td colspan="5">5</td></tr>
<tr><td>P</td><td colspan="3">M5 screw, depth: 12</td><td colspan="3">M12 screw, depth: 25</td><td colspan="2">M16 screw, depth: 32</td></tr>
</table>

* 1. If the SGMGH-05A□A, -09A□A, -03A□B, and -06A□B are not specified as the mounting interchangeable type, the value of the QK will be 16.

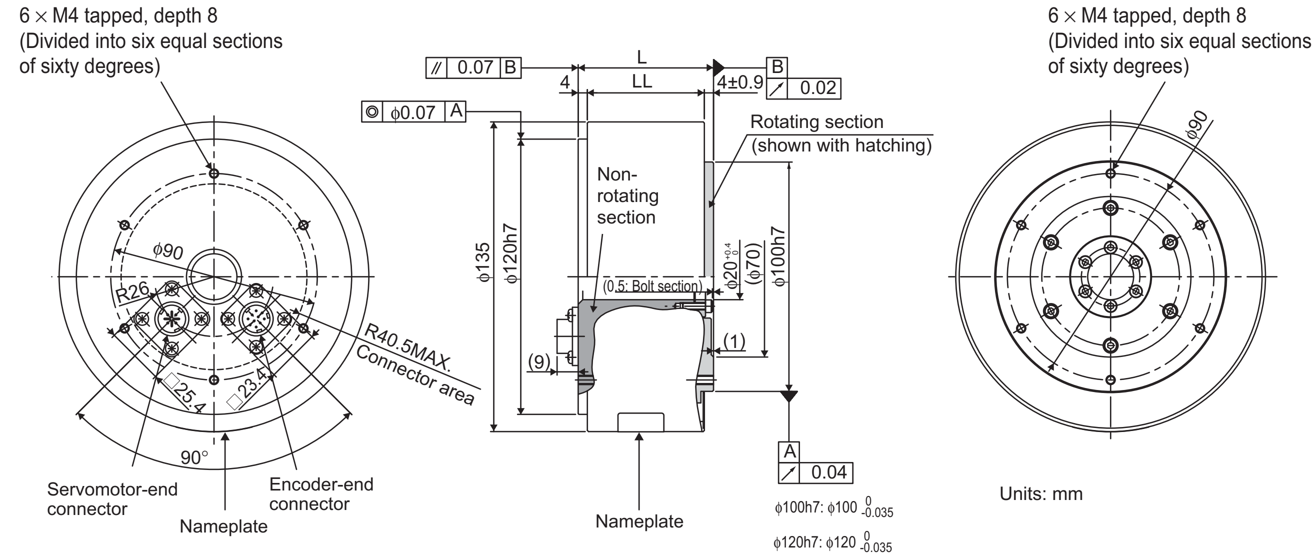
* 2. If the SGMGH-05A□A, -09A□A, -03A□B, and -06A□B are not specified as the mounting interchangeable type, the value of the T will be 2.

* 3. If the SGMGH-05A□A, -09A□A, -03A□B, and -06A□B are not specified as the mounting interchangeable type, the value of the U will be 4.5.

3.21 Dimensional Drawings of SGMCS Servomotors

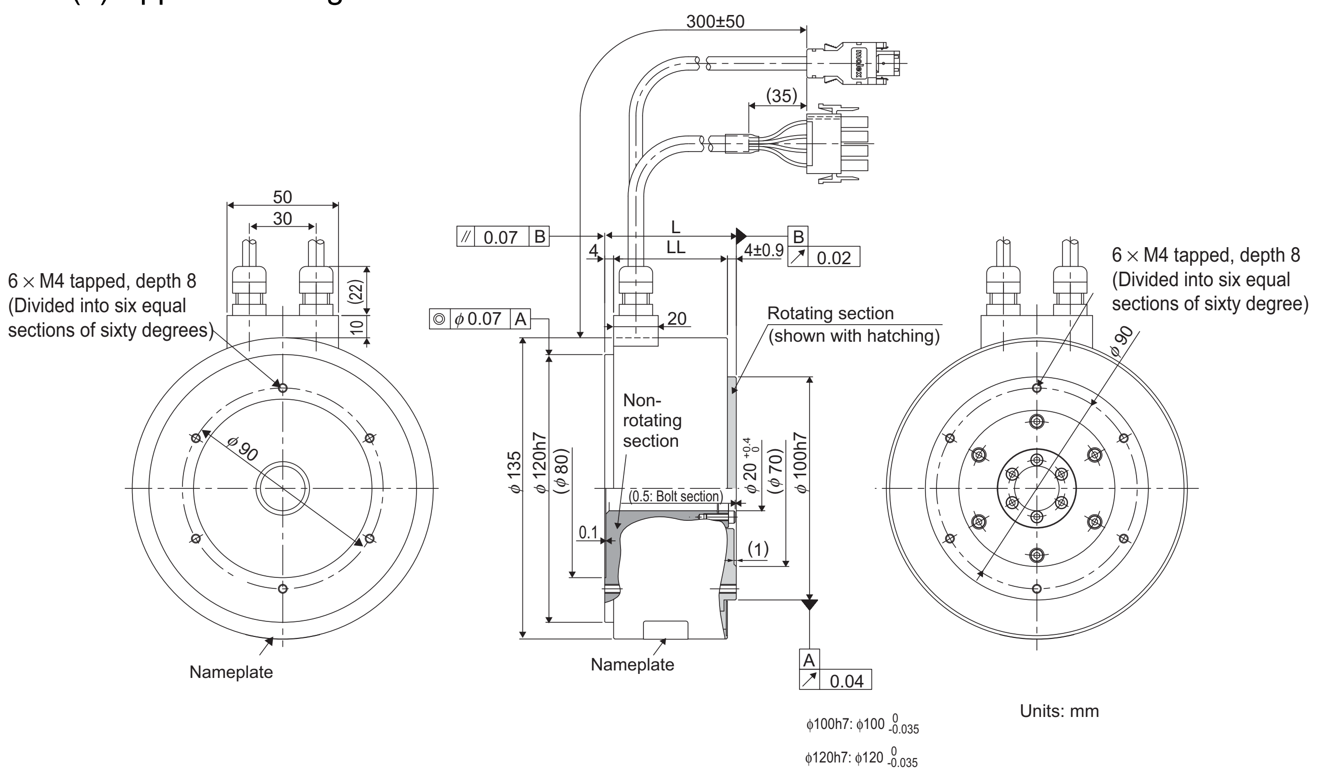
3.21.1 SGMCS Servomotors ϕ135 Mode

(1) Applicable flange: 1



Model SGMCS-	L	LL	Approx. Mass kg
02B□C11	59	51	4.8
05B□C11	88	80	5.8
07B□C11	128	120	8.2

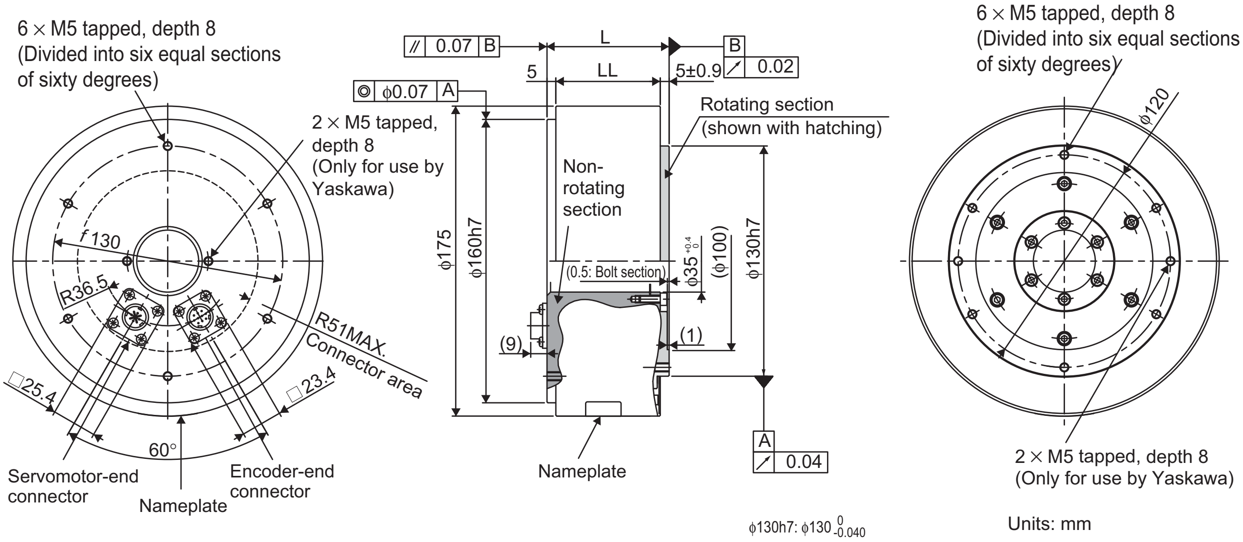
(2) Applicable flange: 4



Model SGMCS-	L	LL	Approx. Mass kg
02B□C41	59	51	4.8
05B□C41	88	80	5.8
07B□C41	128	120	8.2

3.21.2 SGMCS Servomotors ϕ175 Model

(1) Applicable flange: 1

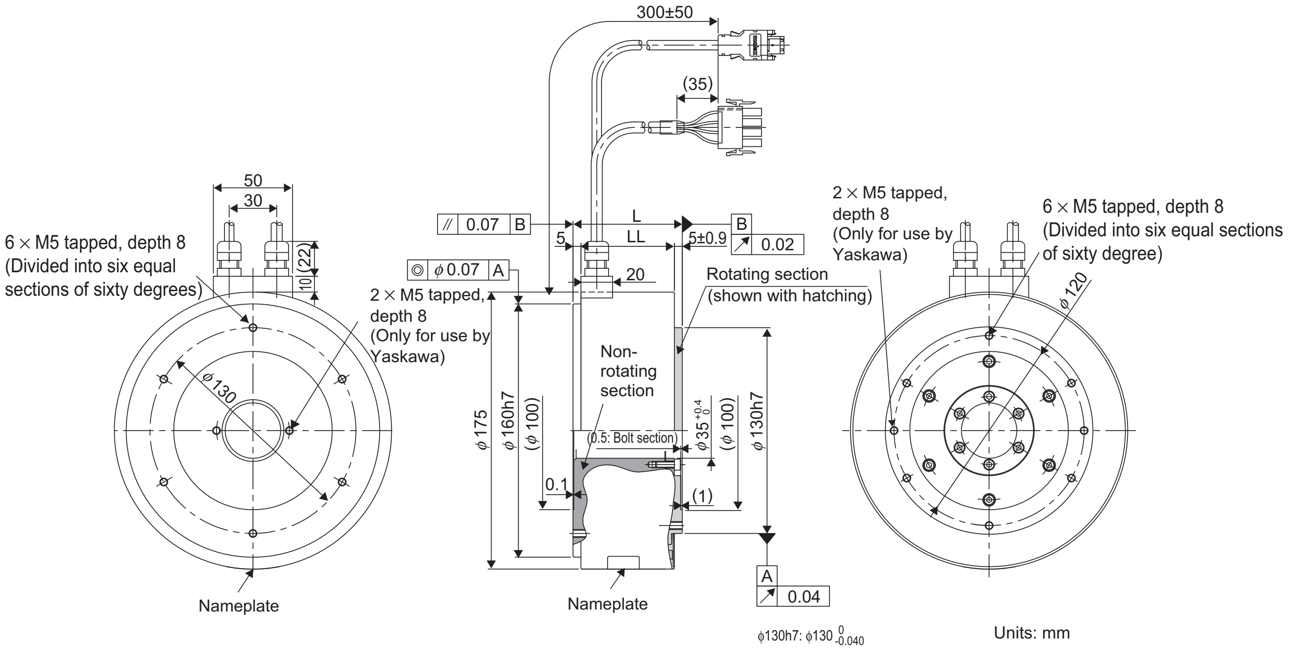


ϕ130h7: ϕ130 $^{0}_{-0.040}$

ϕ160h7: ϕ160 $^{0}_{-0.040}$

Model SGMCS-	L	LL	Approx. Mass kg
04C□C11	69	59	7.2
10C□C11	90	80	10.2
14C□C11	130	120	14.2

(2) Applicable flange: 4



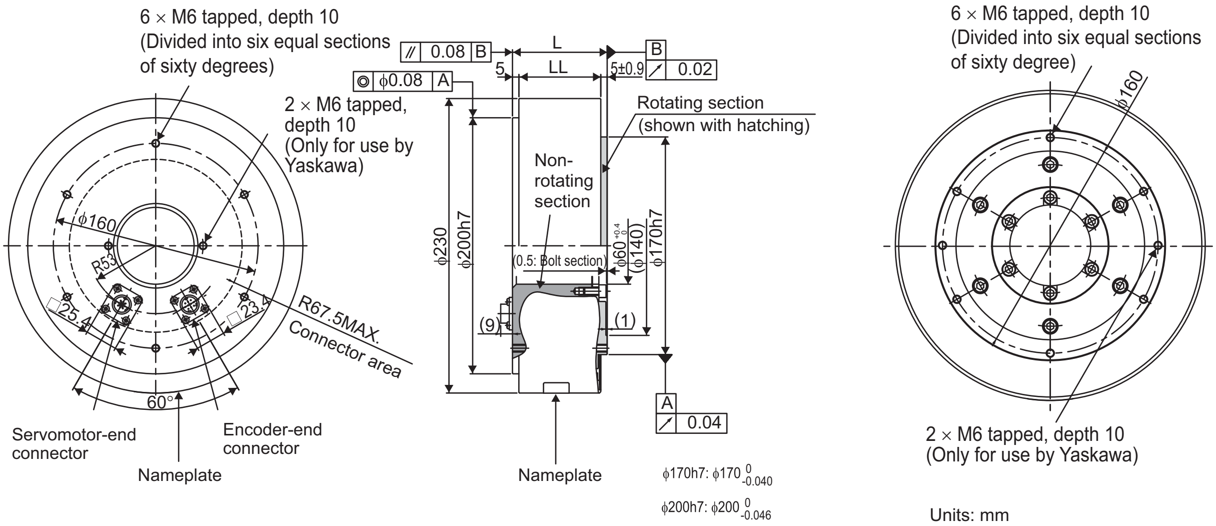
ϕ130h7: ϕ130 $^{0}_{-0.040}$

ϕ160h7: ϕ160 $^{0}_{-0.040}$

Model SGMCS-	L	LL	Approx. Mass kg
04C□C41	69	59	7.2
10C□C41	90	80	10.2
14C□C41	130	120	14.2

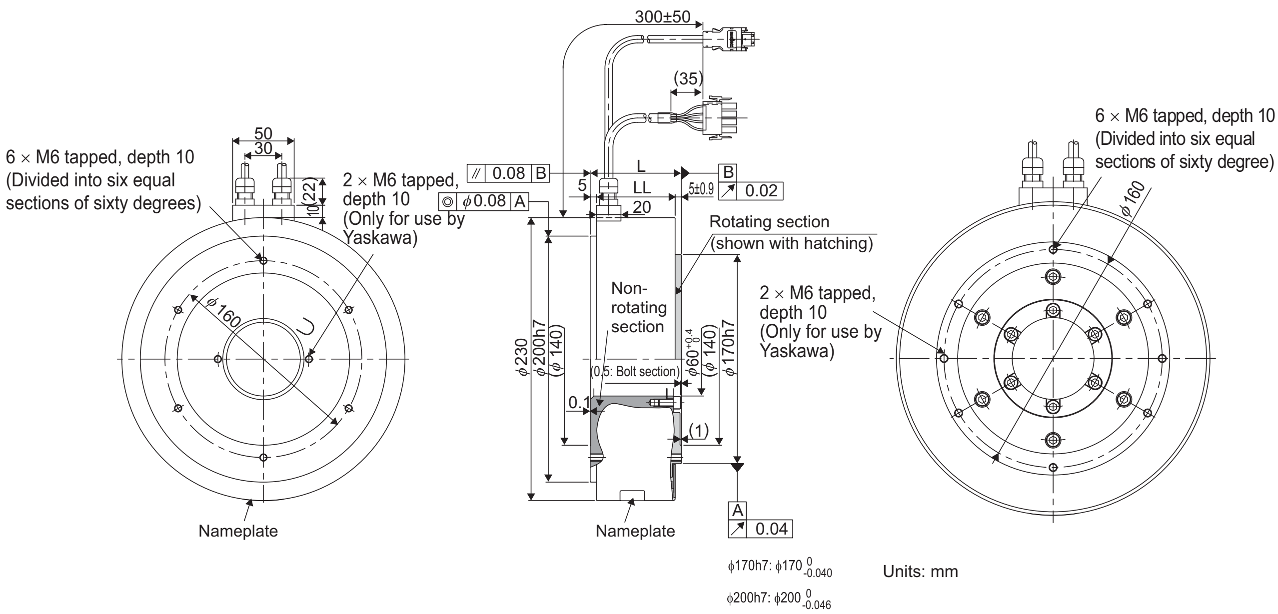
3.21.3 SGMCS Servomotors ϕ230 Model

(1) Applicable flange: 1



Model SGMCS-	L	LL	Approx. Mass kg
08D□C11	74	64	14.0
17D□C11	110	100	22.0
25D□C11	160	150	29.7

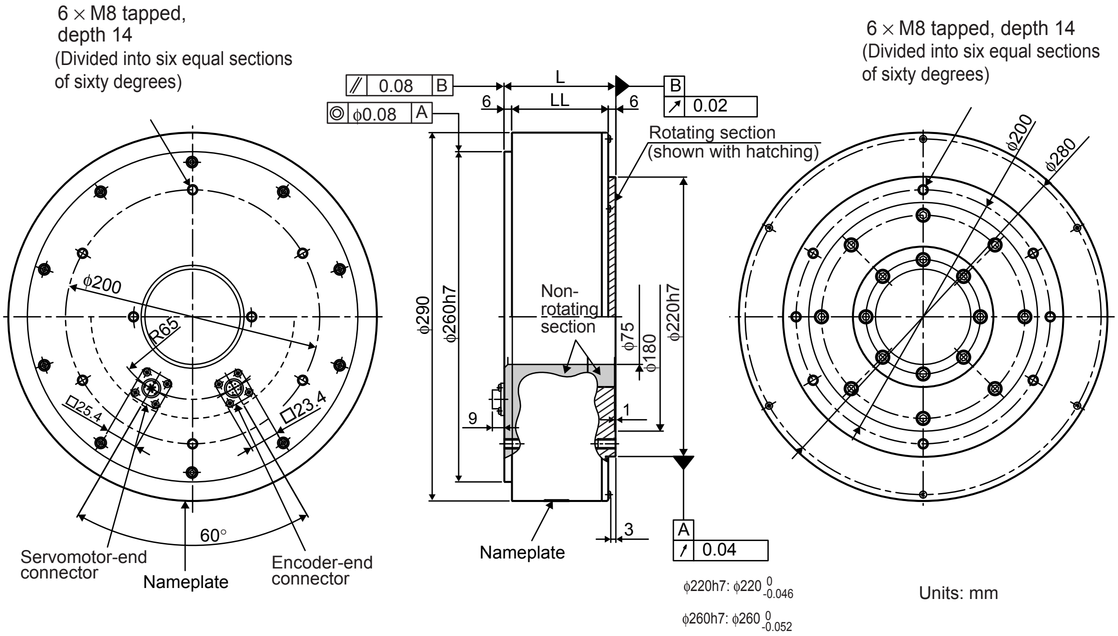
(2) Applicable flange: 4



Model SGMCS-	L	LL	Approx. Mass kg
08D□C41	74	64	14.0
17D□C41	110	100	22.0
25D□C41	160	150	29.7

3.21.4 SGMCS Servomotors ϕ290 Mode

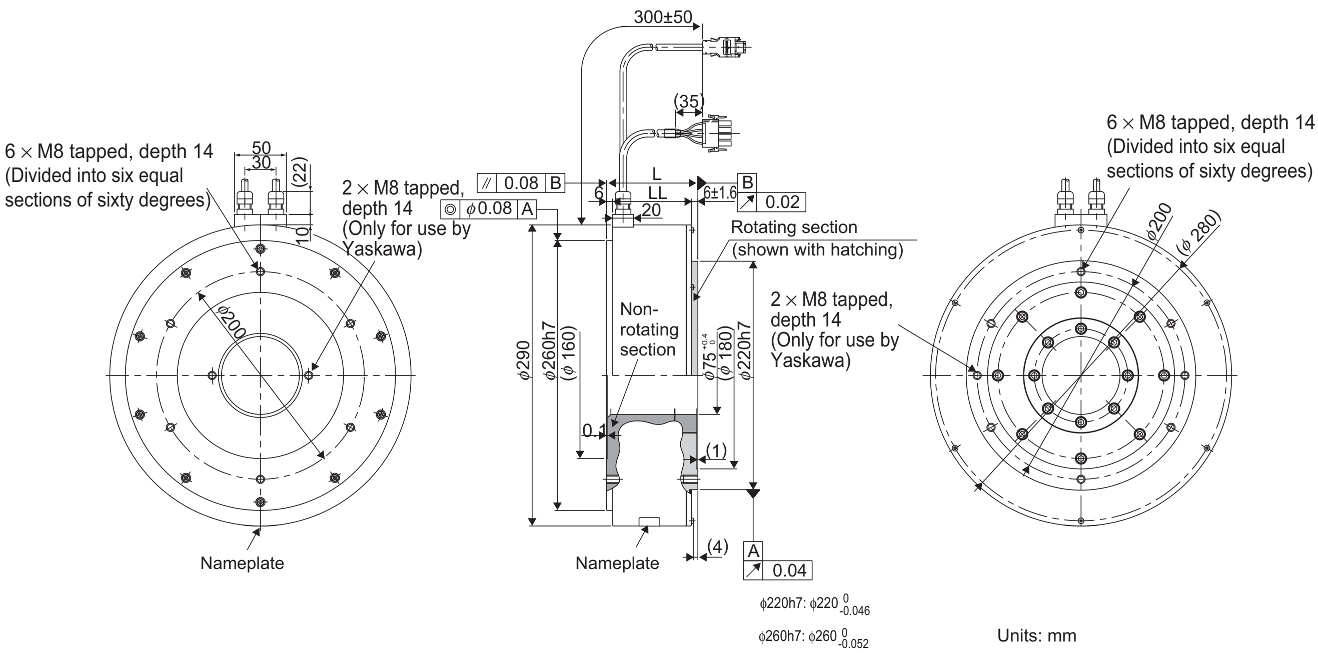
(1) Applicable flange: 1



Units: mm

Model SGMCS-	L	LL	Approx. Mass kg
16E□B11	88	76	26.0
35E□B11	112	100	34.0

(2) Applicable flange: 4

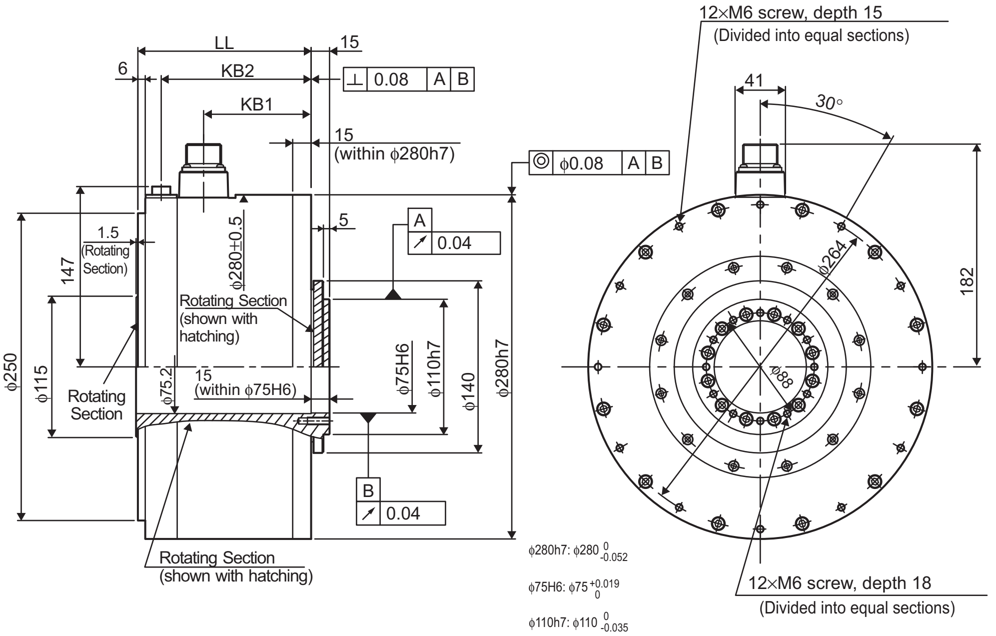


Units: mm

Model SGMCS-	L	LL	Approx. Mass kg
16E□B41	88	76	26.0
35E□B41	112	100	34.0

3.21.5 SGMCS Servomotors ϕ280 Model

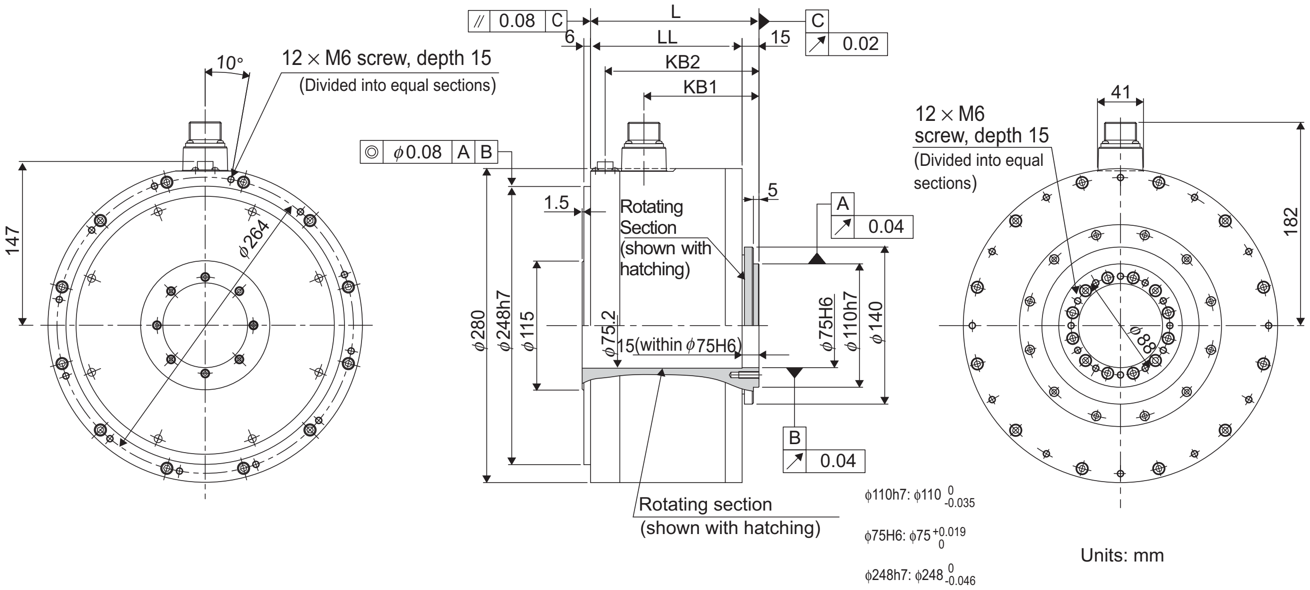
(1) Apllicable flange: 1



Units: mm

Model SGMCS-	LL	KB1	KB2	Approx. Mass kg
45M☐A11	141	87.5	122	38
80M☐A11	191	137.5	172	45
1AM☐A11	241	187.5	222	51

(2) Applicable flange: 3

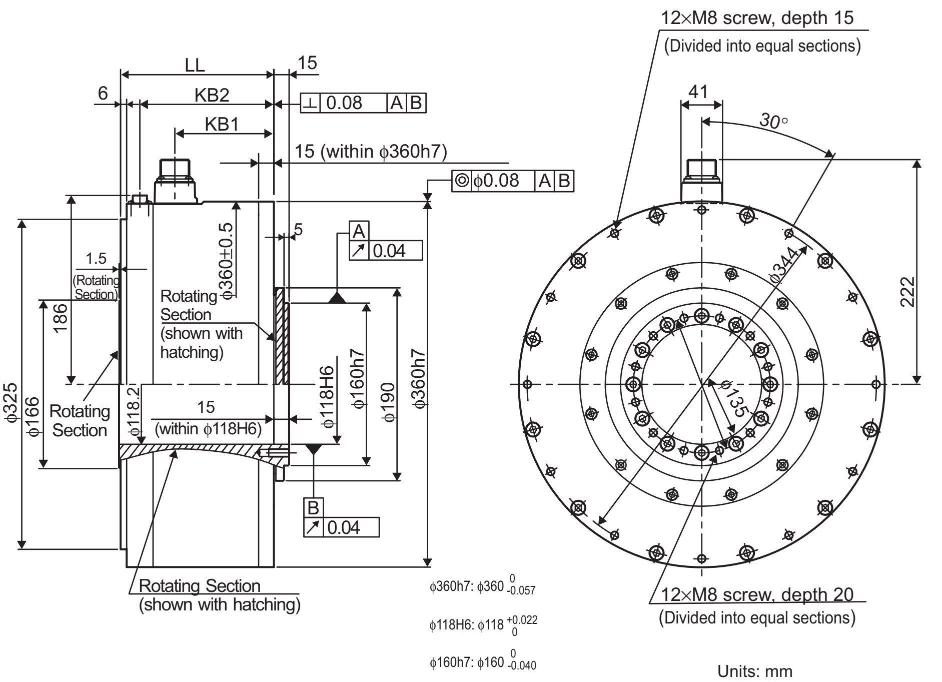


Units: mm

Model SGMCS-	L	LL	KB1	KB2	Approx. Mass kg
45M☐A31	150	135	102.5	137	38
80M☐A31	200	185	152.5	187	45
1AM☐A31	250	235	202.5	237	51

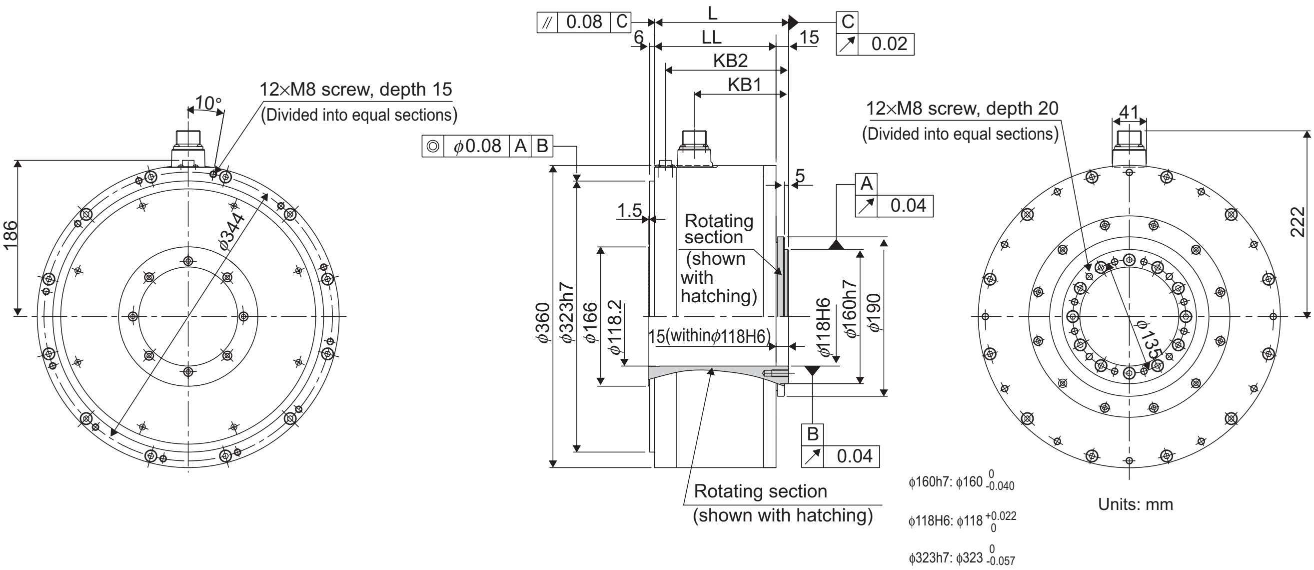
3.21.6 SGMCS Servomotors ϕ360 Model

(1) Applicable flange: 1



Model SGMCS-	LL	KB1	KB2	Approx. Mass kg
80N☐A11	151	98	132	50
1EN☐A11	201	148	182	68
2ZN☐A11	251	198	232	86

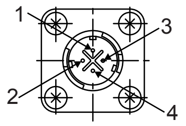
(2) Applicable flange: 3



Model SGMCS-	L	LL	KB1	KB2	Approx. Mass kg
80N☐A31	160	145	113	147	50
1EN☐A31	210	195	163	197	68
2ZN☐A31	260	245	213	247	86

- Servomotor Connector for Small-capacity Series Servomotors
  Applicable flange: 1, 3

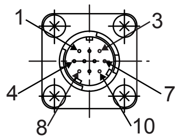
Servomotor-end Connector Cable Specifications
for small-capacity series, applicable flange: 1, 3



Model: JN1AS04MK2
Manufacturer: Japan Aviation Electronics Industry, Ltd.
Applicable plug: JN1DS04FK1
(Provided by the customer.)

1	Phase U
2	Phase V
3	Phase W
4	FG (Frame ground)

Encoder-end Connector Cable Specifications
for small-capacity series, applicable flange: 1, 3

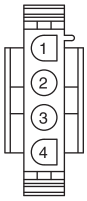


Model: JN1AS10ML1
Manufacturer: Japan Aviation Electronics Industry, Ltd.
Applicable plug: JN1DS10SL1
(Provided by the customer.)

1	PS
2	∗PS
3	–
4	PG5V
5	–
6	–
7	FG (Frame ground)
8	–
9	PG0V
10	–

• Servomotor-end Connector for small-capacity series, applicable flange: 4

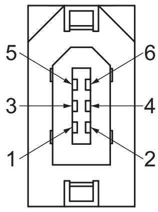
Servomotor-end Connector Cable Specifications
for small-capacity series, applicable flange: 4



Model
•Plug: 350779-1
•Pin: 350561-3 or 350690-3 (No.1 to 3)
•Ground pin: 350654-1 or 350669-1 (No.4)
Manufacturer: Tyco Electronics AMP K.K.
Applicable plug
•Cap: 350780-1
•Socket: 350570-3 or 350689-3

1	Phase U	Red
2	Phase V	White
3	Phase W	Blue
4	FG (Frame ground)	Green (yellow)

Encoder-end Connector Cable Specifications
for small-capacity series, applicable flange: 4



Model: 55102-0600
Manufacturer: Molex Japan Co., Ltd.
Applicable plug: 54280-0600

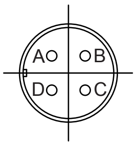
1	PG5V
2	PG0V
3	–
4	–
5	PS
6	/PS
Connector case	FG (Frame ground)

Servomotor Specifications and Dimensional Drawings

3

- Servomotor Connector for All Middle-capacity Series Servomotors

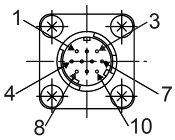
Servomotor-end Connector Cable Specifications



Model: CE05-2A18-10PD
Manufacturer: DDK Ltd.
Applicable plug and cable
- Plug: CE05-6A18-10SD-B-BSS
- Cable clamp: CE3057-10A-∗(D265)
  (Provided by the customer.)

A	Phase U
B	Phase V
C	Phase W
D	FG (Frame ground)

Encoder-end Connector Cable Specifications



Model: JN1AS10ML1
Manufacturer: Japan Aviation Electronics Industry, Ltd.
Applicable plug: JN1DS10SL1
(Provided by the customer.)

1	PS
2	∗PS
3	–
4	PG5V
5	–
6	–
7	FG (Frame ground)
8	–
9	PG0V
10	–

4

SERVOPACK Specifications and Dimensional Drawings

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4.1 SERVOPACK Ratings and Specifications

<table>
<tr><th colspan="4">SERVOPACK Model SGDS-</th><th>A3B</th><th>A5</th><th>01</th><th>02</th><th>04</th><th>05</th><th>08</th><th>10</th><th>15</th><th>20</th><th>30</th><th>50</th><th>60</th><th>75</th></tr>
<tr><td rowspan="25">Basic Specifications</td><td colspan="3">Max. Applicable Servomotor Capacity [kW]</td><td>0.03</td><td>0.05</td><td>0.1</td><td>0.2</td><td>0.4</td><td>0.5</td><td>0.75</td><td>1.0</td><td>1.5</td><td>2.0</td><td>3.0</td><td>5.0</td><td>6.0</td><td>7.5</td></tr>
<tr><td rowspan="2">100 V</td><td colspan="2">Continuous Output Current [Arms]</td><td>1.0</td><td>0.66</td><td>0.91</td><td>2.1</td><td>2.8</td><td colspan="9">–</td></tr>
<tr><td colspan="2">Max. Output Current [Arms]</td><td>2.9</td><td>2.1</td><td>2.8</td><td>6.5</td><td>8.5</td><td colspan="9">–</td></tr>
<tr><td rowspan="2">200 V</td><td colspan="2">Continuous Output Current [Arms]</td><td>–</td><td>0.66</td><td>0.91</td><td>2.1</td><td>2.8</td><td>3.8</td><td>5.5</td><td>7.6</td><td>11.6</td><td>18.5</td><td>18.9</td><td>32.9</td><td>46.9</td><td>54.7</td></tr>
<tr><td colspan="2">Max. Output Current [Arms]</td><td>–</td><td>2.1</td><td>2.8</td><td>6.5</td><td>8.5</td><td>11.0</td><td>16.9</td><td>17.0</td><td>28.0</td><td>42.0</td><td>56.0</td><td>84.0</td><td>110</td><td>130</td></tr>
<tr><td rowspan="7">Input Power Supply</td><td colspan="2" rowspan="3">SERVOPACK Capacity Range for 100/200 V</td><td colspan="5">Single-phase 100 VAC</td><td colspan="9">–</td></tr>
<tr><td>–</td><td colspan="4">Single-phase 200 VAC</td><td>–</td><td>Single-phase 200 VAC</td><td colspan="7">–</td></tr>
<tr><td colspan="5">–</td><td>Three-phase 200 VAC</td><td>–</td><td colspan="7">Three-phase 200 VAC</td></tr>
<tr><td rowspan="2">200 V</td><td>Main Circuit</td><td colspan="14">Three-phase (or single-phase) 200 to 230 VAC +10 to -15%, 50/60 Hz</td></tr>
<tr><td>Control Circuit</td><td colspan="14">Single-phase 200 to 230 VAC +10 to -15%, 50/60 Hz</td></tr>
<tr><td rowspan="2">100 V</td><td>Main Circuit</td><td colspan="14">Single-phase 100 to 115 VAC +10 to -15%, 50/60 Hz</td></tr>
<tr><td>Control Circuit</td><td colspan="14">Single-phase 100 to 115 VAC +10 to -15%, 50/60 Hz</td></tr>
<tr><td colspan="3">Control Method</td><td colspan="14">Single or three-phase full-wave rectification IGBT-PWM (sine-wave driven)
(Single-phase full-wave rectification for SGDS-A3B (100 V))</td></tr>
<tr><td colspan="3">Feedback</td><td colspan="14">Serial encoder: 17-bit (incremental/absolute)
Serial encoder: 20-bit (incremental/absolute)</td></tr>
<tr><td rowspan="3">Operating Conditions</td><td colspan="2">Ambient/Storage Temperature</td><td colspan="14">0 to +55°C/ -20 to +85°C</td></tr>
<tr><td colspan="2">Ambient/Storage Humidity</td><td colspan="14">90% RH or less (with no condensation)</td></tr>
<tr><td colspan="2">Vibration/Shock Resistance</td><td colspan="14">4.9 m/s^2 / 19.6 m/s^2</td></tr>
<tr><td colspan="3">Configuration</td><td colspan="14">Base-mounted (Rack mounting available as an option for SGDS-A3 to 50)</td></tr>
<tr><td rowspan="7">Performance</td><td colspan="2">Speed Control Range</td><td colspan="14">1:5000 (The lowest speed of the speed control range is the speed at which the servomotor will not stop with a rated torque load.)</td></tr>
<tr><td rowspan="3">Speed Regulation*</td><td>Load Regulation</td><td colspan="14">0 to 100% load: 0.01% max. (at rated speed)</td></tr>
<tr><td>Voltage Regulation</td><td colspan="14">Rated voltage ±10%: 0% (at rated speed)</td></tr>
<tr><td>Temperature Regulation</td><td colspan="14">25 ± 25 °C: ±0.1% max. (at rated speed)</td></tr>
<tr><td colspan="2">Frequency Characteristics</td><td colspan="14">600 Hz (at $J_L = J_M$)</td></tr>
<tr><td colspan="2">Torque Control Tolerance (Repeatability)</td><td colspan="14">±1%</td></tr>
<tr><td colspan="2">Soft Start Time Setting</td><td colspan="14">0 to 10 s (Can be set individually for acceleration and deceleration.)</td></tr>
</table>

(cont'd)

SERVOPACK Model SGDS-		A3B	A5	01	02	04	05	08	10	15	20	30	50	60	75
Built-in Functions	Dynamic Brake (DB)	Operated at main power OFF, servo alarm, servo OFF or overtravel													
	Regenerative Processing	External regenerative resistor					Built-in							External regenerative resistor	
	Overtravel Prevention (OT)	Dynamic brake stop at P-OT or N-OT, deceleration to a stop, or free run to a stop													
	Electronic Gear	$0.001 \leq B/A \leq 1000$													
	Protection	Overcurrent, overvoltage, insufficient voltage, overload, regeneration error, main circuit sensor error, heat sink overheat, power phase loss, position error pulse overflow, overspeed, encoder error, overrun detection, CPU error, parameter error, and so on.													
	LED Display	CHARGE, five 7-segment LEDs (built-in Digital Operator functions)													
	Others	Reverse connection, zero position search, automatic motor discrimination function													

* Speed regulation is defined as follows:

$$\text{Speed regulation} = \frac{\text{No-load motor speed} - \text{Total load motor speed}}{\text{Rated motor speed}} \times 100\%$$

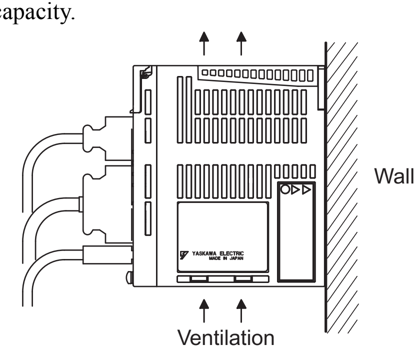
The motor speed may change due to voltage variations or amplifier drift and changes in processing resistance due to temperature variation. The ratio of speed changes to the rated speed represent speed regulation due to voltage and temperature variations.

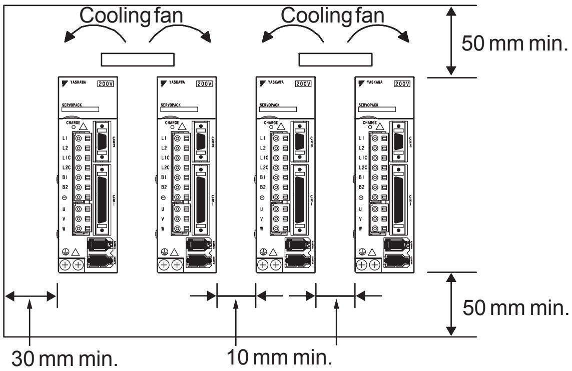
<table>
<tr><th colspan="4">Applicable SERVOPACK Model</th><th>SGDS-A3B and A5A to 75A All Capacities</th></tr>
<tr><td rowspan="15">Torque/Speed Position Control</td><td rowspan="3">Torque Control</td><td rowspan="3">Input Signals</td><td>Reference Voltage</td><td>±3 VDC (Variable setting range: ±1 to ±10 VDC) at rated torque (forward rotation with positive reference), input voltage: ±12 V (max.)</td></tr>
<tr><td>Input Impedance</td><td>About 14 kΩ minimum.</td></tr>
<tr><td>Circuit Time Constant</td><td>30 μs</td></tr>
<tr><td rowspan="6">Speed Control</td><td>Perfor-mance</td><td>Soft Start Time Set-ting</td><td>0 to 10 s (Can be set individually for acceleration and deceleration.)</td></tr>
<tr><td rowspan="3">Input Signals</td><td>Reference Voltage</td><td>±6 VDC (Variable setting range: ±2 to ±10 VDC) at rated torque (forward rotation with positive reference), input voltage: ±12 V (max.)</td></tr>
<tr><td>Input Impedance</td><td>About 14 kΩ minimum.</td></tr>
<tr><td>Circuit Time Constant</td><td>30 μs</td></tr>
<tr><td rowspan="2">Contact Speed Reference</td><td>Rotation Direction Selection</td><td>With P control signal</td></tr>
<tr><td>Speed Selection</td><td>With forward/reverse current limit signal (speed 1 to 3 selection), servomotor stops or another control method is used when both are OFF.</td></tr>
<tr><td rowspan="6">Position Control</td><td rowspan="3">Perfor-mance</td><td>Bias Setting</td><td>0 to 450 min^{-1} (setting resolution: 1 min^{-1})</td></tr>
<tr><td>Feed-forward Com-pensation</td><td>0 to 100% (setting resolution: 1%)</td></tr>
<tr><td>Positioning Complet-ed Width Setting</td><td>0 to 1073741824 reference units (setting resolution: 1 reference unit)</td></tr>
<tr><td rowspan="3">Input Signals</td><td>Reference Pulse: Type</td><td>Sign + pulse train, 90° phase difference 2-phase pulse (phase A + phase B), or CW + CCW pulse train</td></tr>
<tr><td>Reference Pulse: Form</td><td>Non-insulated line driver (+5 V level)</td></tr>
<tr><td>Reference Pulse: Frequency</td><td>1 Mpps max. (non-insulated line driver)</td></tr>
<tr><td></td><td></td><td></td><td>Control Signal</td><td>Clear Signal</td></tr>
<tr><td colspan="2" rowspan="6">I/O Signals</td><td rowspan="2">Position Output</td><td>Form</td><td>Phase-A, -B, -C line driver</td></tr>
<tr><td>Frequency Dividing Ratio</td><td>Any Setting Ratio</td></tr>
<tr><td>Sequence Input</td><td>Signal allocation can be modified.</td><td>Servo ON, P control (or Control Mode switching, forward/reverse motor rotation by internal speed setting, zero clamping, reference pulse inhibit), forward run prohib-ited (P-OT), reverse run prohibited (N-OT), alarm reset, forward external torque limit, reverse external torque limit (or internal set speed selection) and gain changeover</td></tr>
<tr><td rowspan="2">Sequence Output</td><td>Fixed Output</td><td>Servo alarm, 3-bit alarm codes</td></tr>
<tr><td>Signal allocation can be modified.</td><td>Select any three of the following signals: positioning completion (speed coinci-dence), rotation detection, servo ready, current limit, warning, positioning near, and brake signal.</td></tr>
<tr><td colspan="2" rowspan="3">Others</td><td colspan="2">Analog Monitor (CN5)</td><td>Output voltage: -8 VDC to +8 VDC
Analog monitor connector built in for monitoring speed, torque and other reference signals.
Speed: 1 V/1000 min^{-1}
Torque: 1 V/rated torque
Position error pulse: 0.05 V/reference unit</td></tr>
<tr><td rowspan="2">Communi-cations</td><td>Interface</td><td>Digital Operator (hand type)</td></tr>
<tr><td>Function</td><td>Status display, parameter setting, monitor display, alarm traceback display, JOG operation</td></tr>
</table>

4.2 SERVOPACK Installation

The SGDS SERVOPACKs can be mounted on a base or on a rack. Incorrect installation will cause problems. Always observe the following installation instructions.

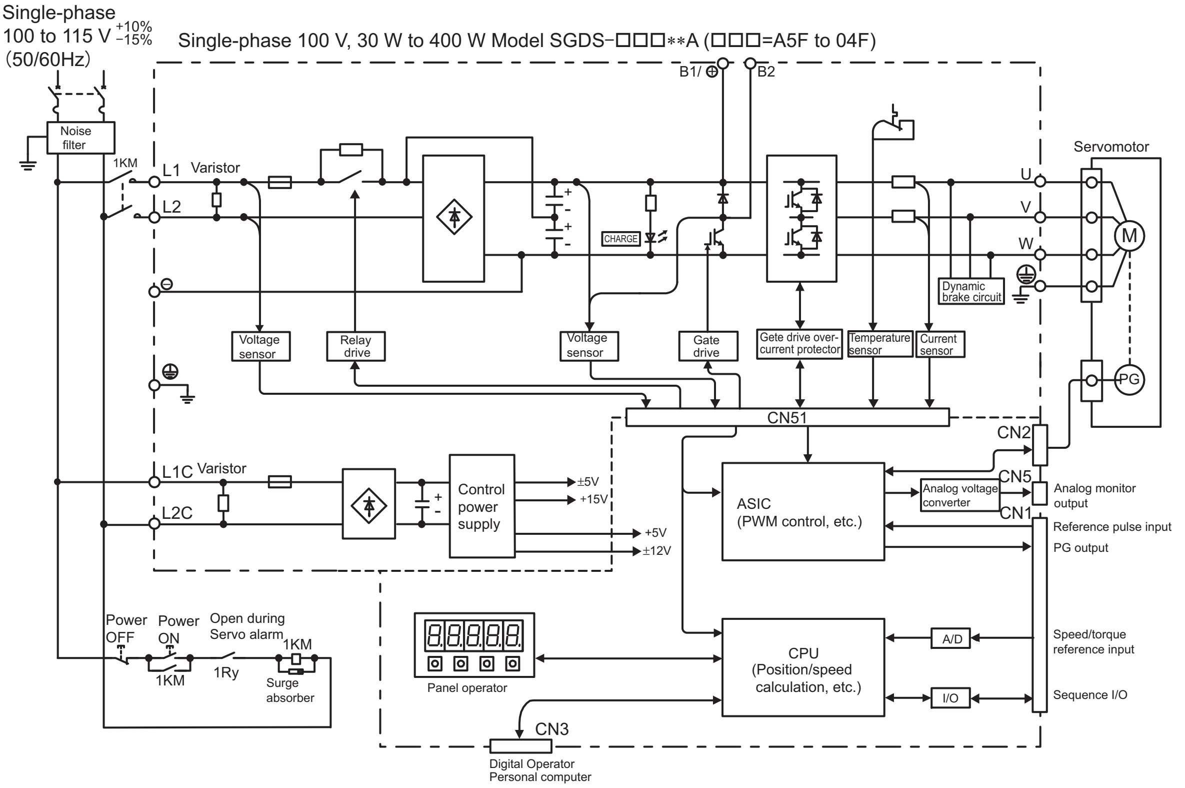
⚠ WARNING
• After voltage resistance test, wait at least five minutes before servicing the product. (Refer to “Voltage Resistance Test” on the next page.) Failure to observe this warning may result in electric shock. • Connect the main circuit wires, control wires, and main circuit cables of the motor correctly. Incorrect wiring will result in failure of the SERVOPACK.

Storage	Store the SERVOPACK within the following temperature range if it is stored with the power cable disconnected. Temperature: -20 to 85°C Humidity: 90%RH or less (with no condensation)
Operating Conditions	• Installation category (Overvoltage category) * : III • Pollution degree * : 2 • Protection class * : 1X • Altitude : 1000 m max. * Conforming to the following standards. • UL508C • CSA C22.2 No.14 • EN50178 • EN55011 group 1 class A • EN61000-6-2
Installation Site	Installation in a Control Panel Design the control panel size, unit layout, and cooling method so the temperature around the SERVOPACK does not exceed 55°C. Installation Near a Heating Unit Minimize the heat radiating from the heating unit as well as any temperature rise caused by natural convection so the temperature around the SERVOPACK does not exceed 55°C. Installation Near a Source of Vibration Install a vibration isolator beneath the SERVOPACK to avoid subjecting it to vibration. Installation at a Site Exposed to Corrosive Gas Corrosive gas does not have an immediate effect on the SERVOPACK but will eventually cause the electronic components and contactor-related devices to malfunction. Take appropriate action to avoid corrosive gas. Other Situations Do not install the SERVOPACK in hot, humid locations or locations subject to excessive dust or iron powder in the air.
Orientation	Install the SERVOPACK perpendicular to the wall as shown in the figure. The SERVOPACK must be oriented this way because it is designed to be cooled by natural convection or a cooling fan. Secure the SERVOPACK using two to four of the mounting holes. The number of holes depends on the capacity. 

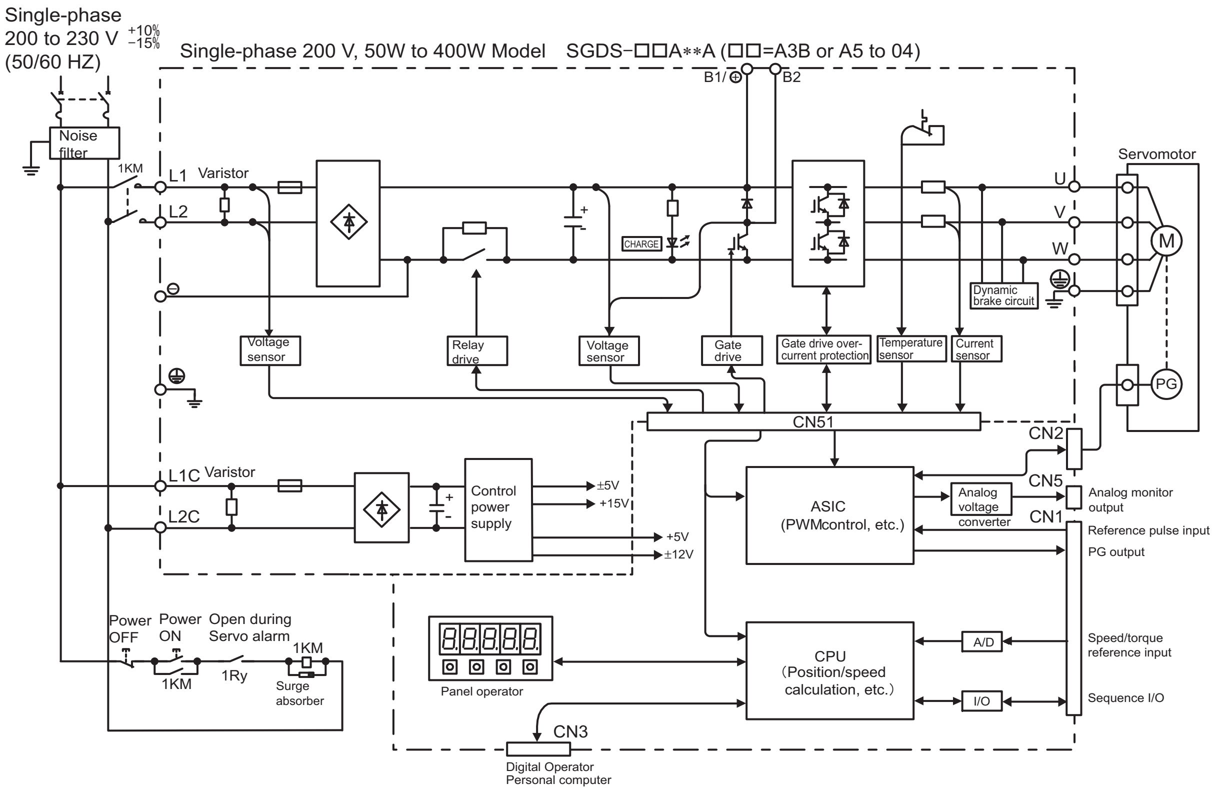
Installation	Follow the procedure below to install multiple SERVOPACKs side by side in a control panel.  SERVOPACK Orientation Install the SERVOPACK perpendicular to the wall so the front panel containing connectors faces outward. Cooling As shown in the figure above, allow sufficient space around each SERVOPACK for cooling by cooling fans or natural convection. Side-by-side Installation When installing SERVOPACKs side by side as shown in the figure above, allow at least 10 mm between and at least 50 mm above and below each SERVOPACK. Install cooling fans above the SERVOPACKs to avoid excessive temperature rise and to maintain even temperature inside the control panel. Environmental Conditions in the Control Panel Ambient Temperature:0 to 55°C Humidity: 90% RH or less Vibration: 0.5 G (4.9 m/s^2) Condensation and Freezing:None Ambient Temperature for Long-term Reliability: 45°C max.
Voltage Resistance Test	Conduct voltage resistance tests under the following conditions. • Voltage:1500 Vrms AC for one minute • Braking current:30 mA or more • Frequency:50 or 60 Hz • Voltage applied points For SGDS-□□A01A SERVOPACKs: Between the ground terminals and the point where the terminals L1, L2, (L3), L1C, L2C, U, V, and W are connected.

4.3 SERVOPACK Internal Block Diagrams

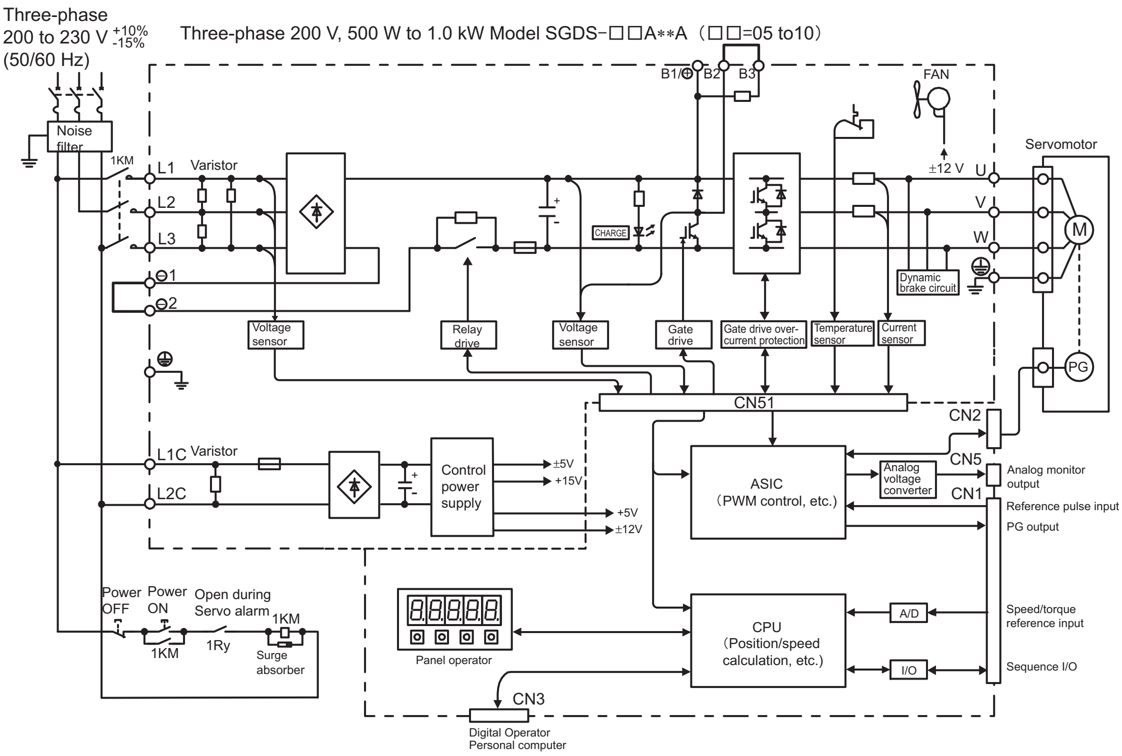
4.3.1 Single-phase 100 V, 50 W to 400 W Models



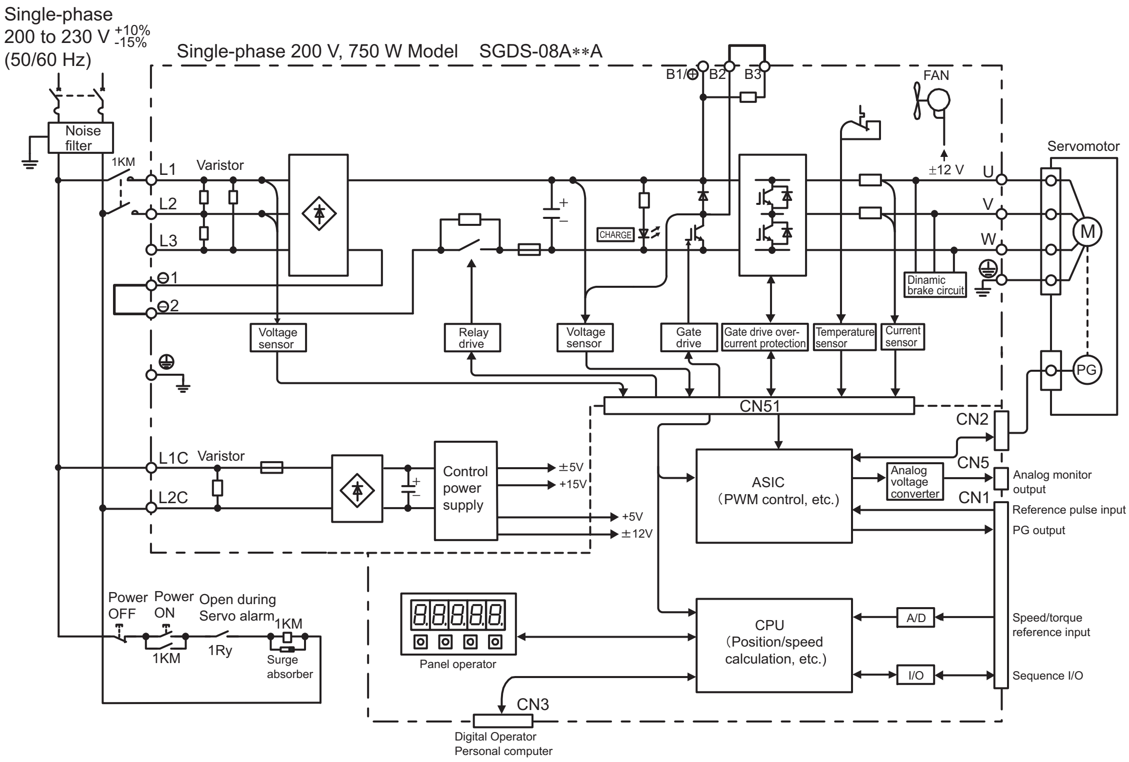
4.3.2 Single-phase 200V, 50 W to 400 W Models



4.3.3 Three-phase 200 V, 500 W to 1.0 kW Models



4.3.4 Single-phase 200 V, 750 W Model



Note: L3 terminal is not used. Do not connect.

SERVOPACK Specifications and Dimensional Drawings

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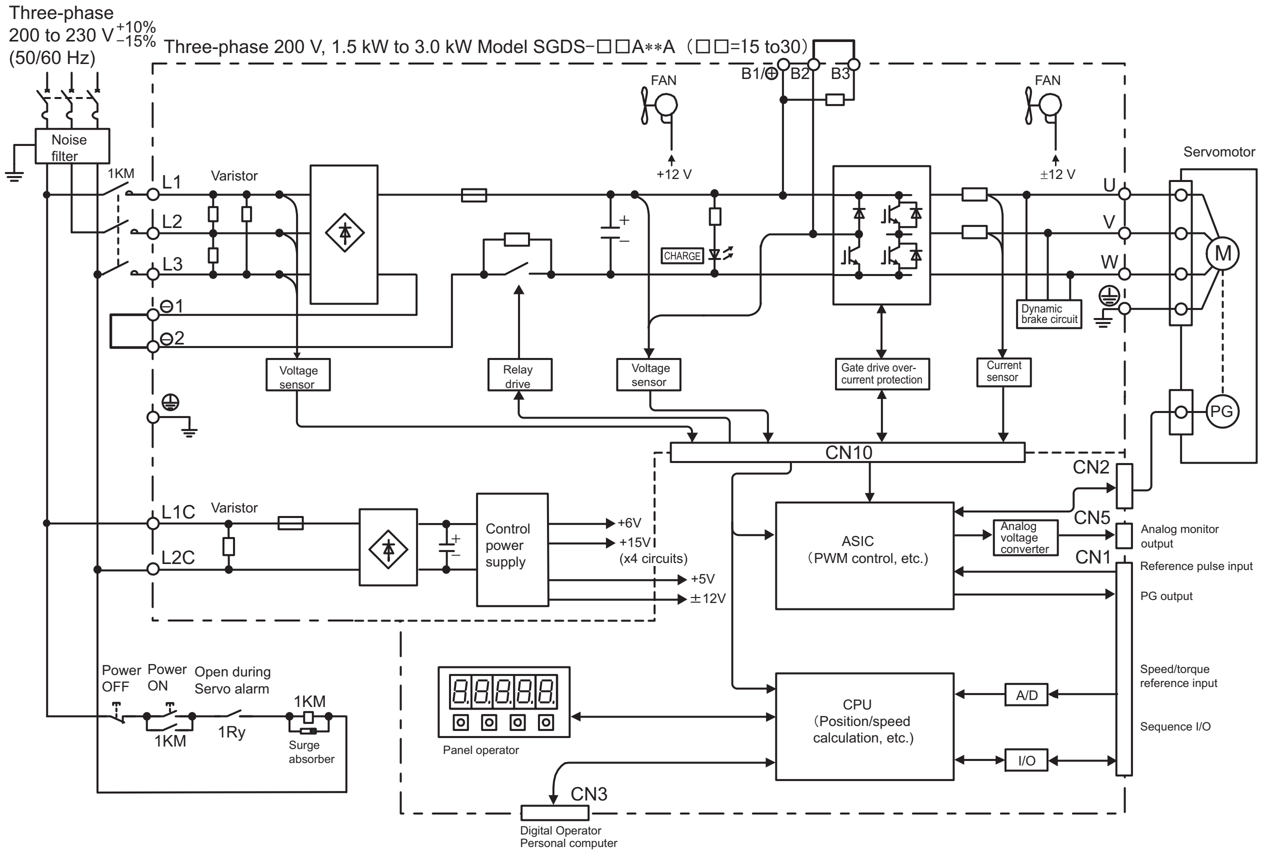
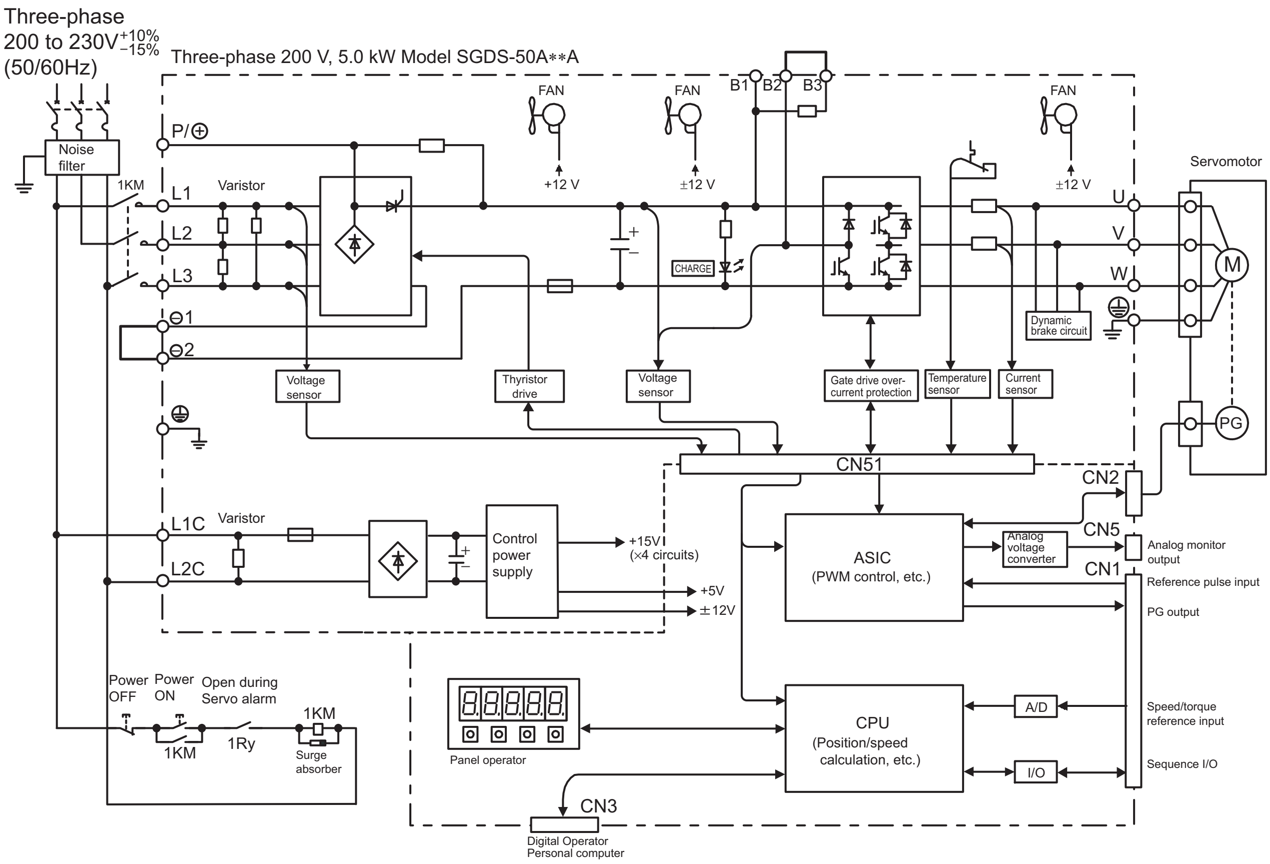
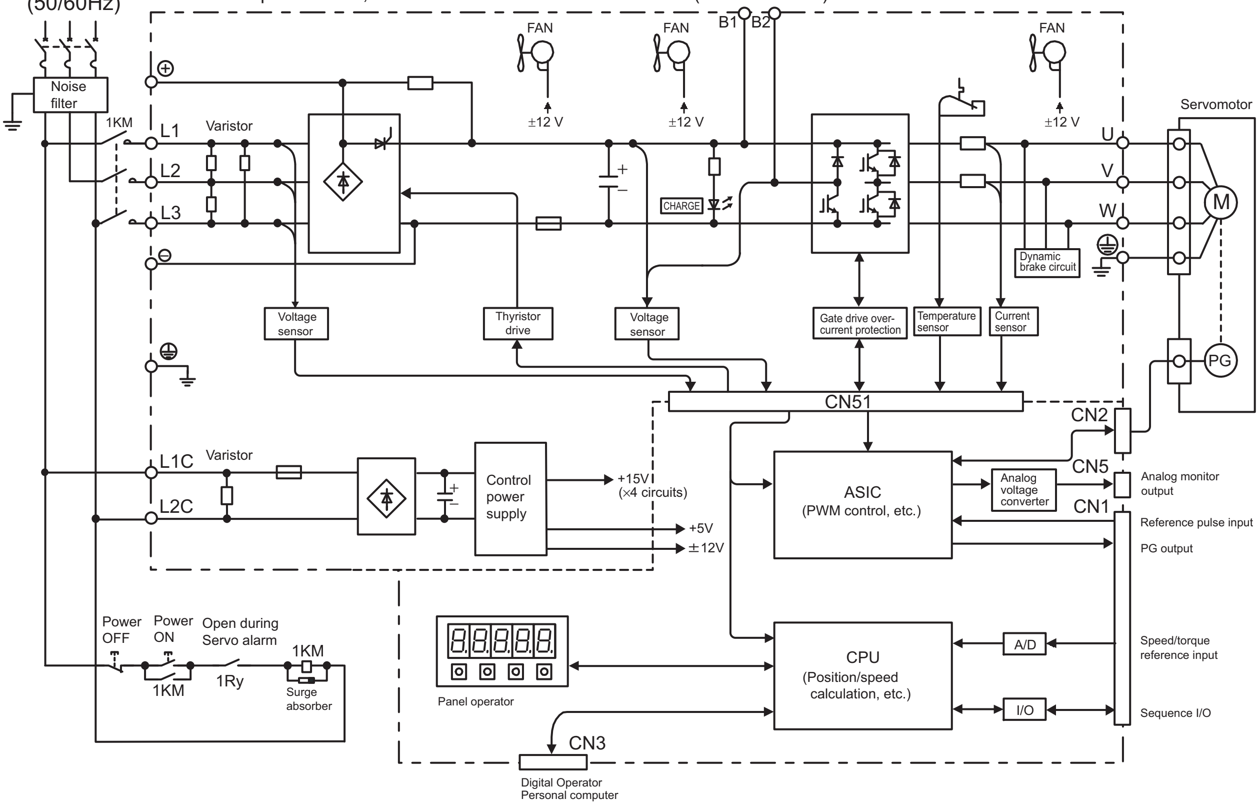
4.3.5 Three-phase 200 V, 1.5 kW to 3.0 kW Models



4.3.6 Three-phase 200 V, 5.0 kW Model



4.3.7 Three-phase 200 V, 6.0 kW, 7.5 kW Models



4.4 SERVOPACK's Power Supply Capacities and Power Losses

The following table shows SERVOPACK's power supply capacities and power losses at the rated output.

Table 4.1 SERVOPACK Power Losses at Rated Output

Main Circuit Power Supply	Maximum Applicable Servomotor Capacity kW	SERVOPACK Model SGDS-	Power Supply Capacity (kVA)	Output Current (Effective Value) A	Main Circuit Power Loss W	Regenerative Resistor Power Loss W	Control Circuit Power Loss W	Total Power Loss W
Single-phase 100V	0.03	A3B	0.25	1.0	5.2	–*1	13	19.2
	0.05	A5F	0.25	0.66	5.2			18.2
	0.10	01F	0.40	0.91	12			25
	0.20	02F	0.60	2.1	16.4			29.4
	0.40	04F	1.2	2.8	24			37
Single-phase 200V	0.05	A5A	0.25	0.66	4.6			17.6
	0.10	01A	0.40	0.91	6.7			19.7
	0.20	02A	0.75	2.1	13.3			26.3
	0.40	04A	1.2	2.8	20			33
	0.75	08A	2.2	5.5	47	12	15	74
Three-phase 200V	0.45	05A	1.4	3.8	27	8		54
	1.0	10A	2.3	7.6	55	12		82
	1.5	15A	3.2	11.6	92	10		117
	2.0	20A	4.3	18.5	120	16		151
	3.0	30A	5.9	18.9	155	16		186
	5.0	50A	7.5	32.8	255	36	19	310
	6.0	60A	12.5	46.9	360	–*3		379
	7.5	75A	15.5	54.7	455			474

* 1. SERVOPACKs with a capacity of 50 to 400 W do not have built-in regenerative resistors. If the regenerative energy exceeds the specified value, connect an external regenerative resistor. Refer to *12.1.3 Calculating the Required Capacity of Regenerative Resistors.*

* 2. Regenerative resistor power losses are allowable losses. Take the following action if this value is exceeded.

- Remove the lead from the internal regenerative resistor in the SERVOPACK.
- Install an external regenerative resistor.

* 3. Install an external regenerative register when using the SERVOPACK with capacity of 6.0 kW or more.
The following regenerative register can be used:

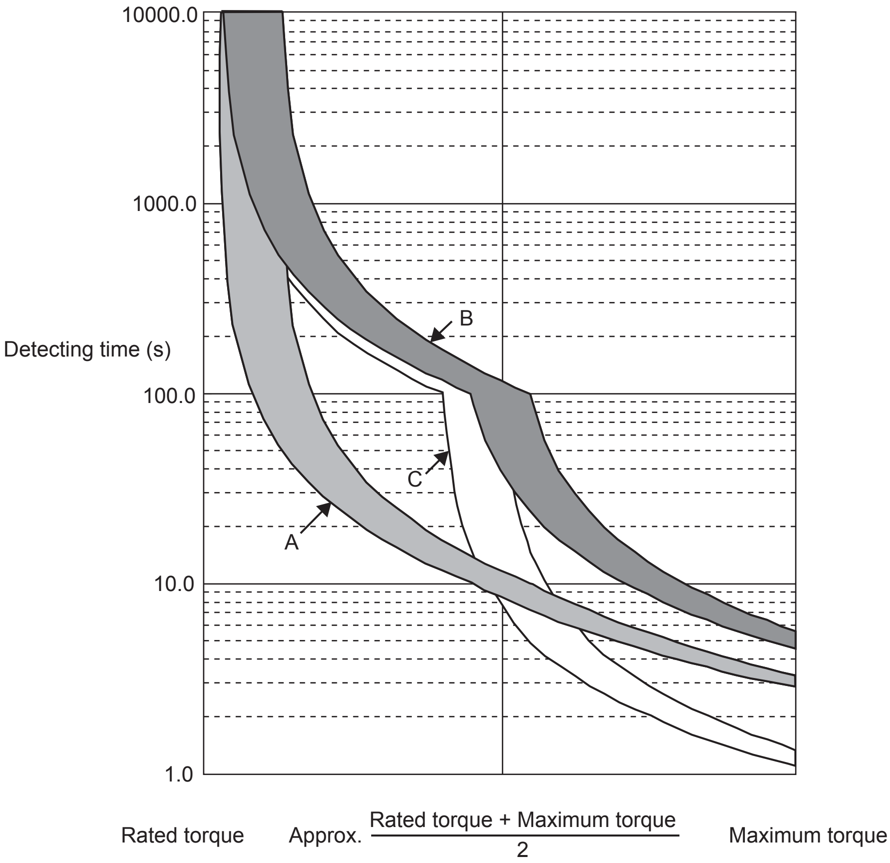
- Model JUSP-RA04: For SGDS-60A (Allowable power loss 180 W)
- Model JUSP-RA05: For SGDS-75A (Allowable power loss 350 W)

Note: External regenerative resistors are optional. Refer to *6.5 Connecting Regenerative Resistors* and *5.10.6 External Regenerative Resistor* for details.

4.5 SERVOPACK Overload Characteristics and Load Moment of Inertia

4.5.1 Overload Characteristics

The overload detection level is set under hot start conditions at a servomotor ambient temperature of 40°C.



Note: The overload protection characteristics of A, B and C in the figure are applicable when the SERVOPACK is combined with one of the following servomotors.

Graph Type	Motor Type					
	SGMMJ	SGMAS	SGMPS	SGMSS	SGMCS	SGMGH
A	-A1 to -A3	-A5 to -12	-01 to -15	–	-02 to -35	–
B	–	–	–	-10 to -50	-45 to -2Z	-03 to -30
C	–	–	–	-40 to -70	–	-40 to -75

4.5.2 Starting and Stopping Time

The servomotor starting time (tr) and stopping time (tf) under a constant load are calculated using the following formulas. Servomotor viscous torque and friction torque are ignored.

Starting time: $$tr = \frac{2\pi \cdot N_M(J_M + J_L)}{60 \cdot (T_{PM} - T_L)} \text{[s]}$$

Stopping time: $$tf = \frac{2\pi \cdot N_M(J_M + J_L)}{60 \cdot (T_{PM} + T_L)} \text{[s]}$$

N_M: Motor speed (min^{-1})

J_M: Motor rotor moment of inertia (kg·m^2)

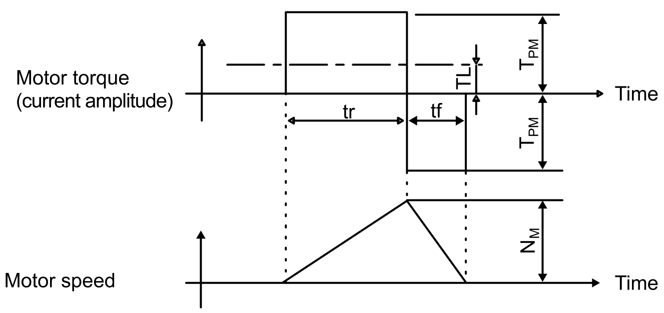
J_L: Load converted to shaft moment of inertia (kg·m^2)

T_{PM}: Instantaneous peak motor torque when combined with a SERVOPACK (N·m)

T_L: Load torque (N·m)

Calculate the torque from the motor current using servomotor torque constant × motor current (effective value).

The following figure shows the motor torque and motor speed timing chart.



4.5.3 Load Moment of Inertia

The larger the load moment of inertia, the worse the movement response of the load.
The size of the load moment of inertia (J_L) allowable when using a servomotor depends on motor capacity and is limited to within 5 to 30 times the moment of inertia of each servomotor (J_M). This value is provided strictly as a guideline and results may vary depending on servomotor drive conditions.

An overvoltage alarm (A.400) is likely to occur during deceleration if the load moment of inertia exceeds the allowable load moment of inertia. SERVOPACKs with a built-in regenerative resistor may generate a regeneration overload alarm (A.320). Take one of the following steps if this occurs.

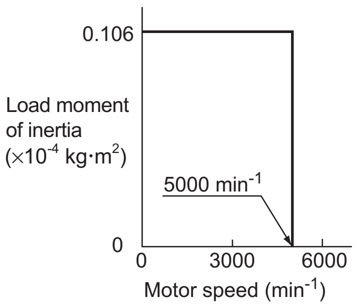
- Reduce the torque limit.
- Reduce the deceleration rate.
- Reduce the maximum motor speed.
- Install an externally mounted regenerative resistor if the alarm cannot be cleared. Contact your Yaskawa Application Engineering Department.

Regenerative resistors are not built into 200 V SERVOPACKs for 30 W to 400 W or 100 V SERVOPACKs for 50 W to 400 W. The following figures show the tentative relationship between the load moment of inertia and motor speed using an example with a load moment of inertia 10 to 30 times the load moment of inertia at the motor shaft.

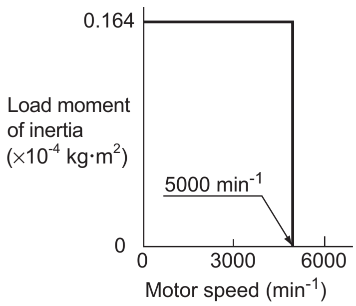
External regenerative resistors are required when this condition is exceeded or if the allowable loss capacity (W) of the built-in regenerative resistor is exceeded due to regenerative drive conditions when a regenerative resistor is already built in.

(1) Load Moment of Inertia and Motor Speed for SGMMJ Servomotors

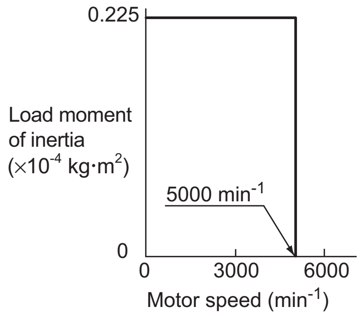
SGMMJ-A1(10W)



SGMMJ-A2(20W)

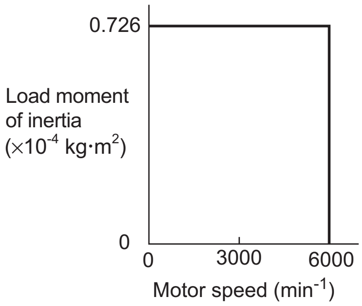


SGMMJ-A3(30W)

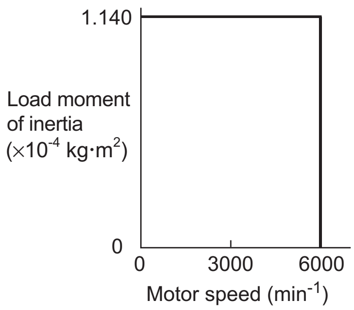


(2) Load Moment of Inertia and Motor Speed for SGMAS Servomotors

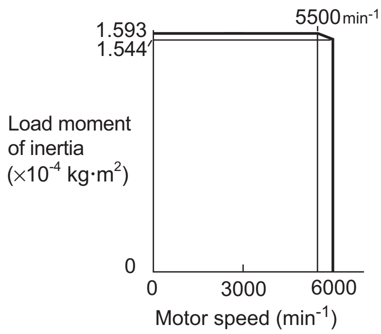
SGMAS-A5 (50W)



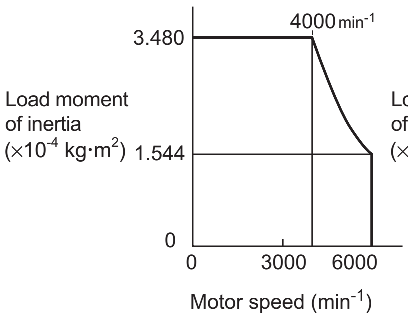
SGMAS-01 (100W)



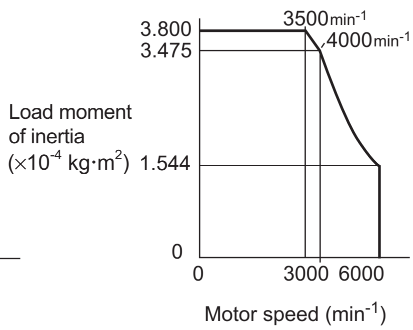
SGMAS-C2 (150W)



SGMAS-02 (200W)

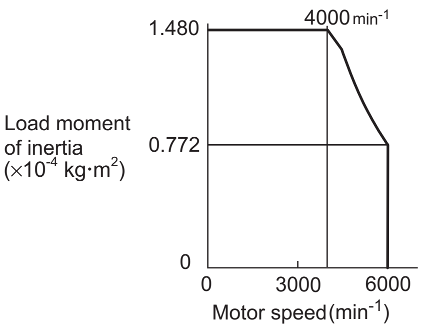


SGMAS-04 (400W)

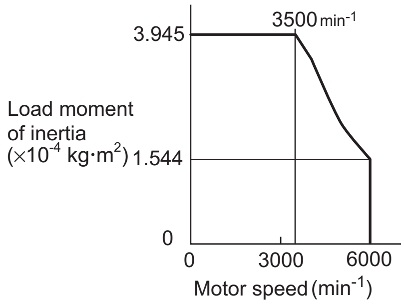


(3) Load Moment of Inertia and Motor Speed for SGMPS Servomotors

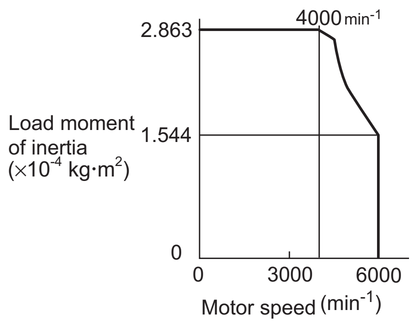
SGMPS-01 (100W)



SGMPS-02 (200W)

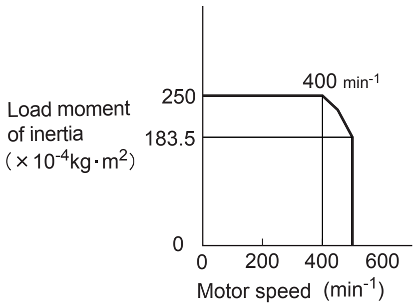


SGMPS-04 (400W)

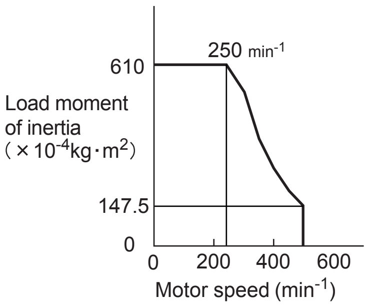


(4) Load Moment of Inertia and Motor Speed for SGMCS Servomotors

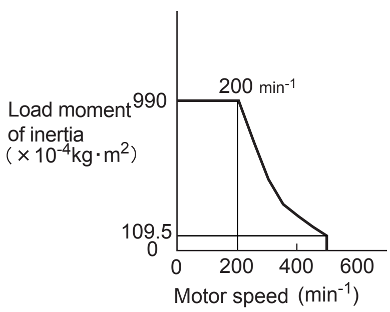
SGMCS-02B(42W)



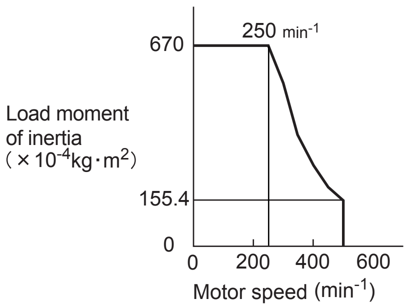
SGMCS-05B(105W)



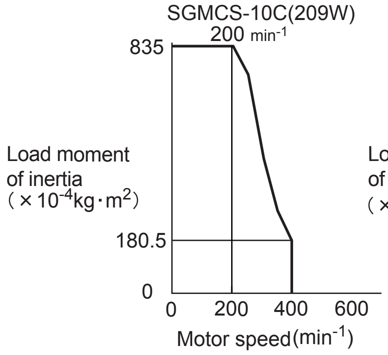
SGMCS-07B(147W)



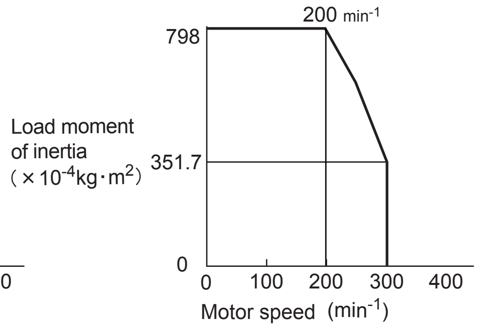
SGMCS-04C(84W)



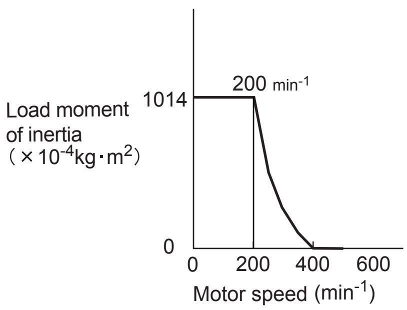
SGMCS-10C(209W)



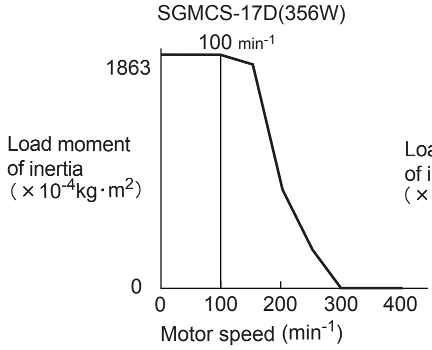
SGMCS-14C(293W)



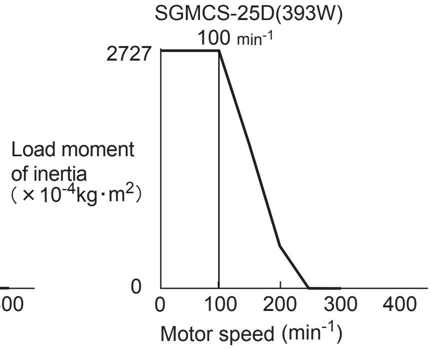
SGMCS-08C(168W)



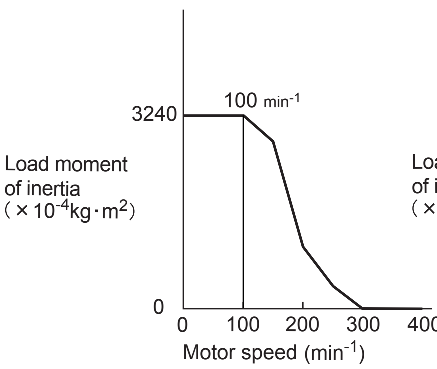
SGMCS-17D(356W)



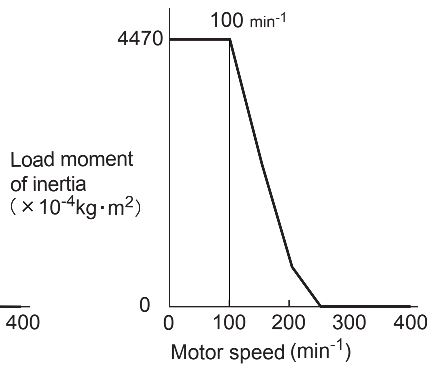
SGMCS-25D(393W)



SGMCS-16E(335W)



SGMCS-35E(550W)



(5) Allowable Load Moment of Inertia at the Motor Shaft

The rotor moment of inertia ratio is the value for a servomotor without a gear and a brake.

Servomotor Model	Capacity Range	Allowable Load Moment of Inertia (Rotor Moment of Inertia Ratio)
SGMMJ (100 V)	10 W to 30 W	× 30
SGMAS (200 V)	50 W to 200 W	× 30
	400 W to 750 W	× 20
	1.15 kW	× 10
SGMPS (200 V)	100 W	× 25
	200 W	× 15
	400 W	× 7
	750 W	× 5
	1.5 kW	× 5
SGMSS (200 V)	1.0 kW	× 5
	1.5 kW	× 5
	2.0 kW	× 5
	2.5 kW	× 5
	3.0 kW	× 5
	4.0 kW	× 5
	5.0 kW	× 5
	7.0 kW	× 5
SGMGH ($1500\ min^{-1}$) (200 V)	450 W to 7.5 kW	× 5*
SGMGH ($1000\ min^{-1}$) (200 V)	300 W to 5.5 kW	× 5

* The allowable load moment of inertia will be three times when the SGMGH-30A☐A servomotor and the SGDS-30 SERVOPACK is used together.

Servomotor Model	Rated Output (N·m)	Allowable Load Moment of Inertia (Rotor Moment of Inertia Ratio)
SGMCS (200 V)	2.0, 4.0, 5.0, 7.0	×10
	10.0	× 5
	8.0, 14.0, 16.0, 17.0, 25.0, 35.0	×3
	45.0	×3
	80.0	×3
	110.0	×3
	150.0	×3
	200.0	×3

(6) Overhanging Loads

A servomotor may not be operated with an overhanging load, which tends to continuously rotate the motor.

IMPORTANT

- Never operate servomotors with an overhanging load. Doing so will cause the SERVOPACKs' regenerative brake to be applied continuously and the regenerative energy of the load may exceed the allowable range causing damage to the SERVOPACK.
- The regenerative brake capacity of the SGDS SERVOPACKs is rated for short-term operation approximately equivalent to the time it takes to decelerate to a stop.

4.6 SERVOPACK Dimensional Drawings

SERVOPACK dimensional drawings are grouped according to the mounting method and capacity.

(1) Base-mounted Type

Supply Voltage		Capacity	Reference Section
Single-phase	100 V	30 W, 50 W, 100 W, 200 W	4.7.1
		400 W	4.7.2
	200 V	50 W, 100 W, 200 W	4.7.1
		400 W	4.7.3
		750 W	4.7.4
Three-phase	200 V	500 W, 1.0 kW	4.7.4
		1.5 kW	4.7.5
		2.0 kW / 3.0 kW	4.7.6
		6.0 kW, 7.5 kW	4.7.8

(2) Rack-mounted Type

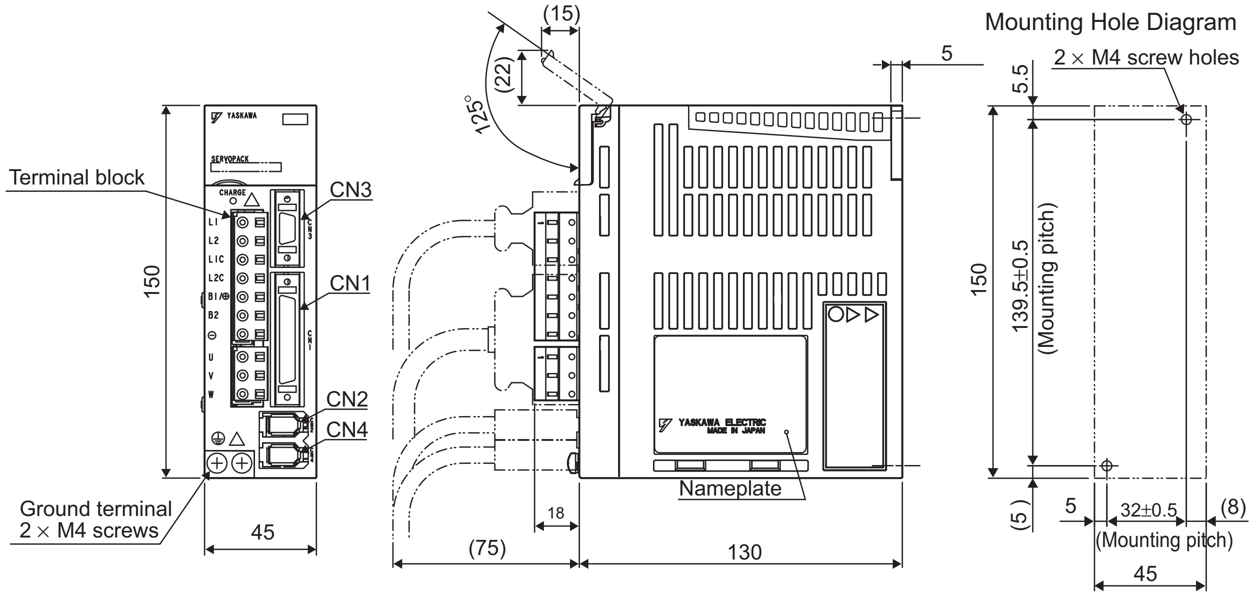
Supply Voltage		Capacity	Reference Section
Single-phase	100 V	30 W, 50 W, 100 W, 200 W	4.8.1
		400 W	4.8.2
	200 V	50 W, 100 W, 200 W	4.8.1
		400 W	4.8.3
		750 W	4.8.4
Three-phase	200 V	500 W, 1.0 kW	4.8.4
		1.5 kW	4.8.5
		2.0 kW, 3.0 kW	4.8.6
		5.0 kW	4.8.7

(3) Duct-ventilated Type

Supply Voltage		Capacity	Reference Section
Three-phase	200 V	6.0 kW/7.5 kW	4.9.1

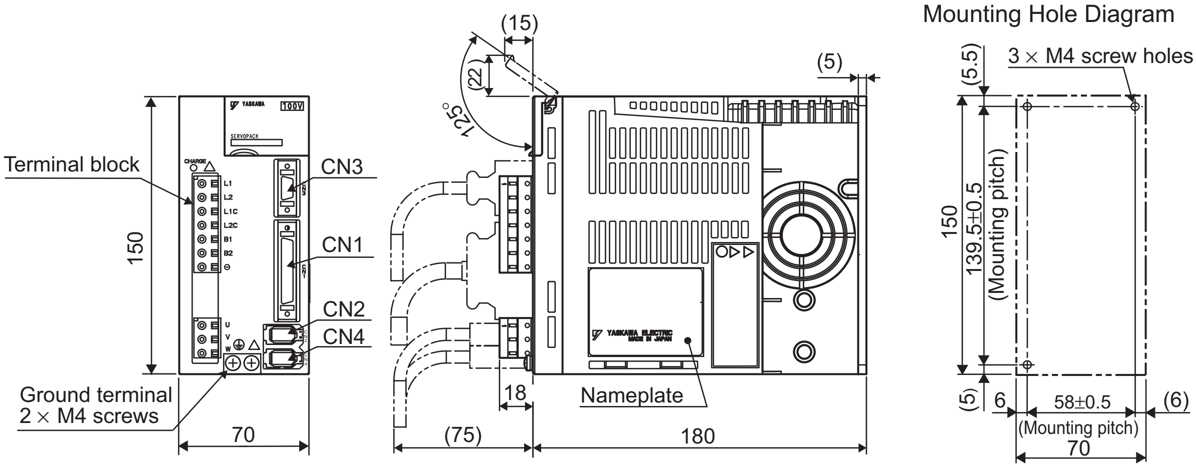
4.7 Dimensional Drawings of Base-mounted SERVOPACK Model SGDS-□□□01A/-□□□02A

4.7.1 Single-phase 100 VAC, 30 W Single-phase 100 V/200 V, 50 W/100 W/200 W



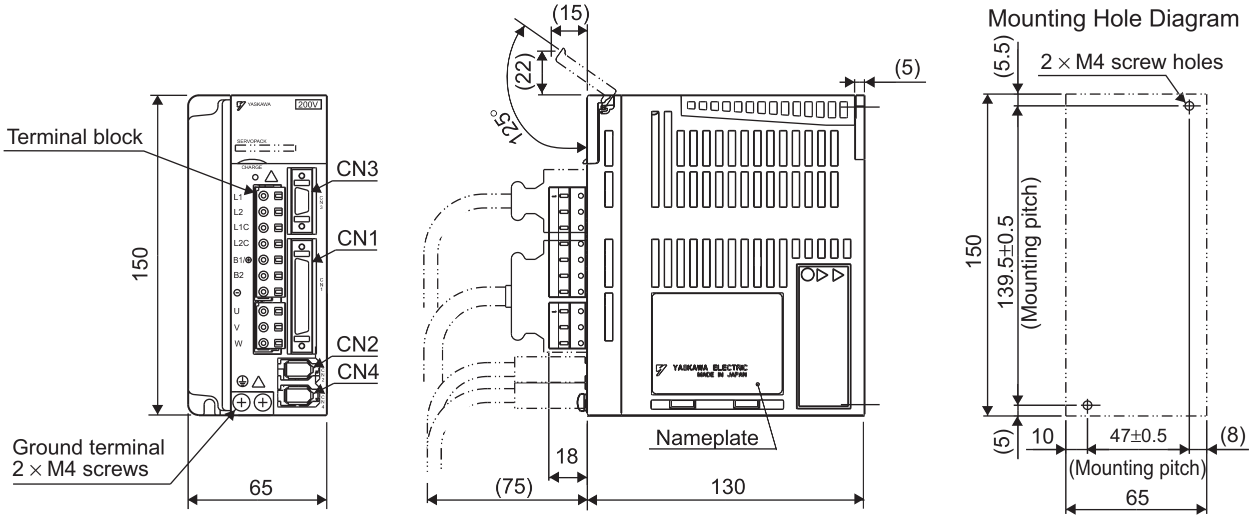
Units: mm
Approx. mass: 0.7 kg

4.7.2 Single-phase 100 V, 400 W



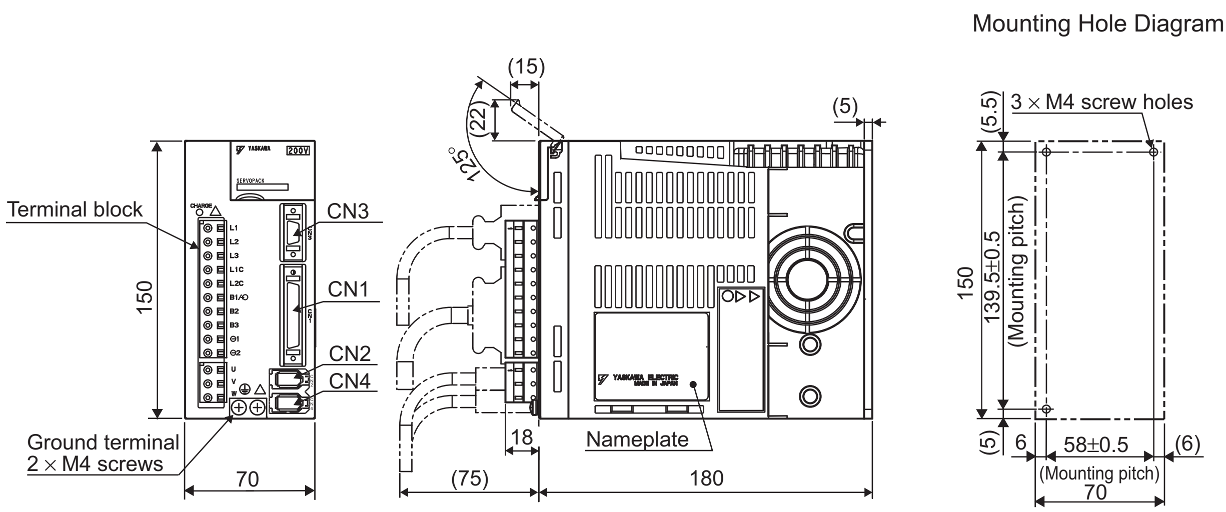
Units: mm
Approx. mass: 1.4 kg

4.7.3 Single-phase 200 V, 400 W



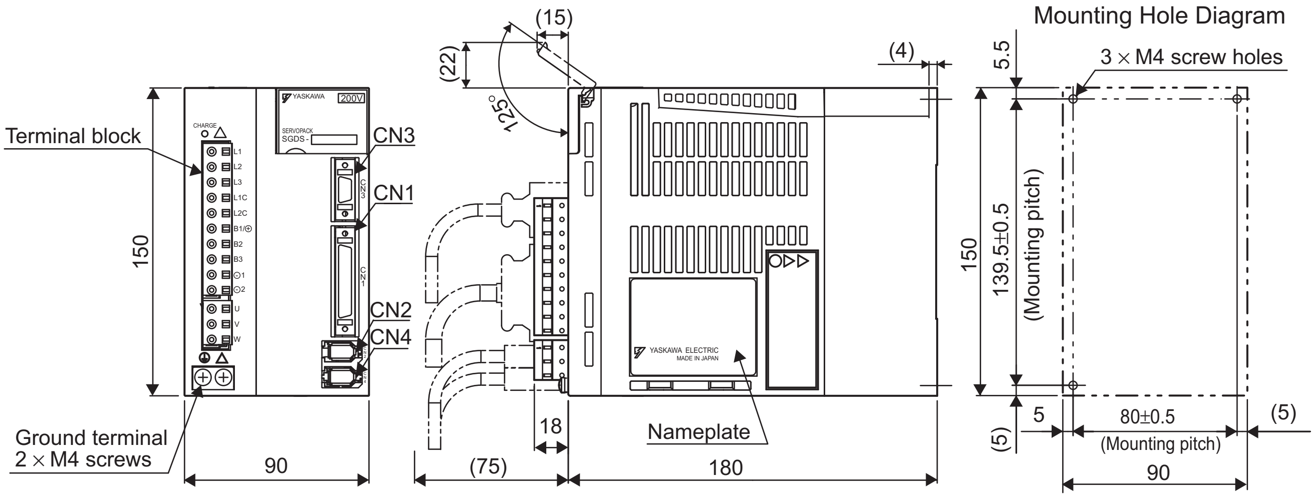
Units: mm
Approx mass: 0.9 kg

4.7.4 Single-phase 200 V, 750 W
Three-phase 200 V, 500 W / 1.0 kW



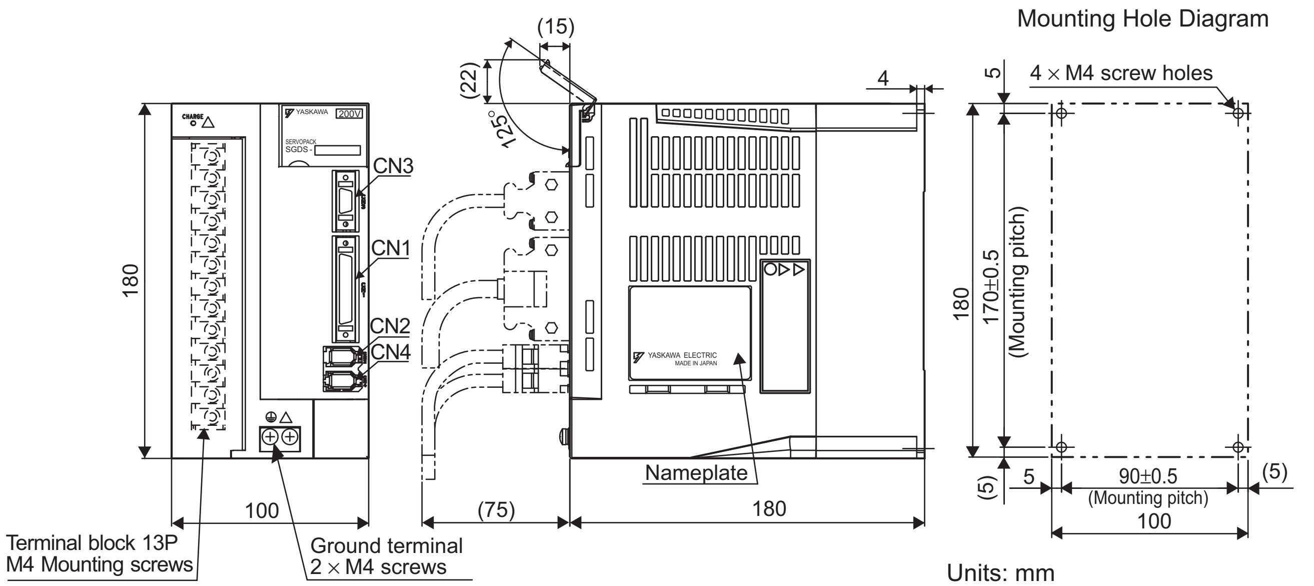
Units: mm
Approx. mass: 1.4 kg

4.7.5 Three-phase 200 V, 1.5 kW



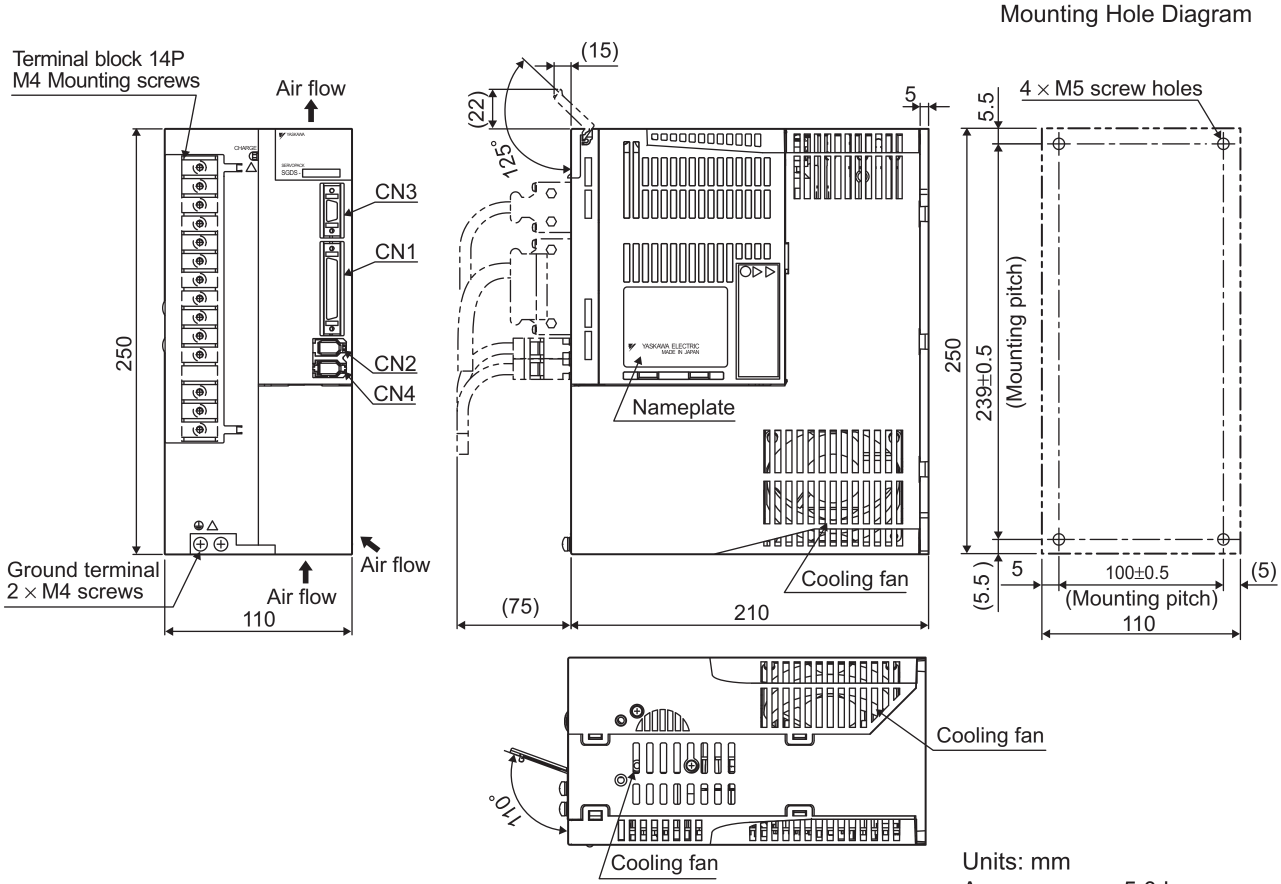
Units: mm
Approx. mass: 2.1 kg

4.7.6 Three-phase 200 V, 2.0 kW / 3.0 kW



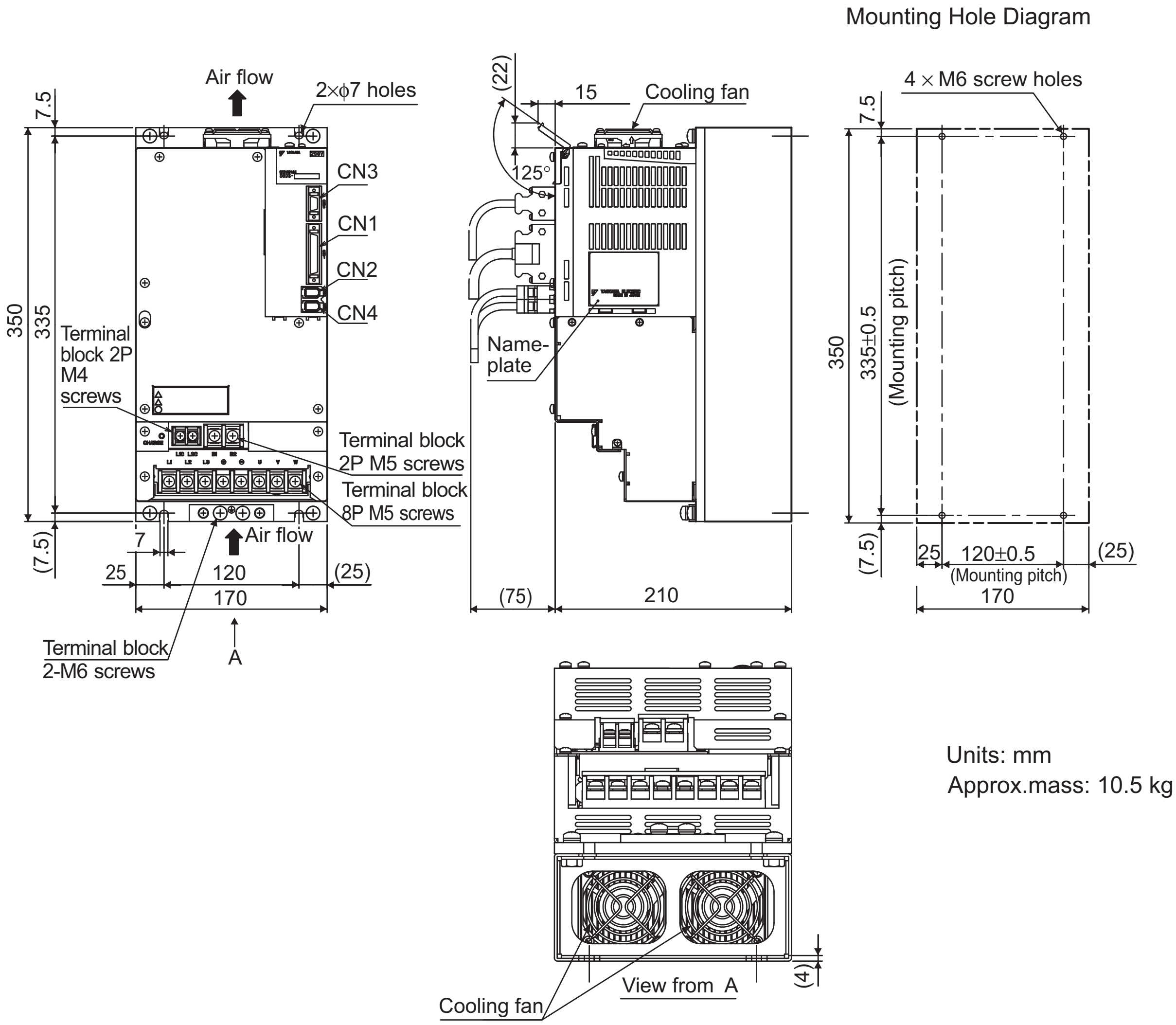
Units: mm
Approx. mass: 2.8 kg

4.7.7 Three-phase 200 V, 5.0 kW



Units: mm
Approx. mass: 5.0 kg

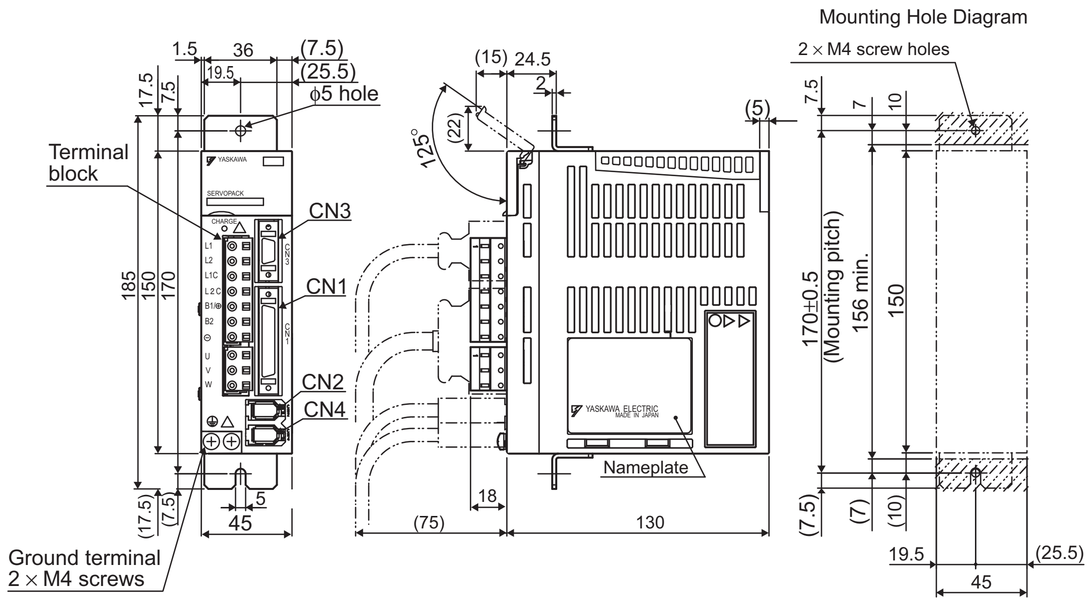
4.7.8 Three-phase 200 V, 6.0 kW, 7.5 kW



Units: mm
Approx.mass: 10.5 kg

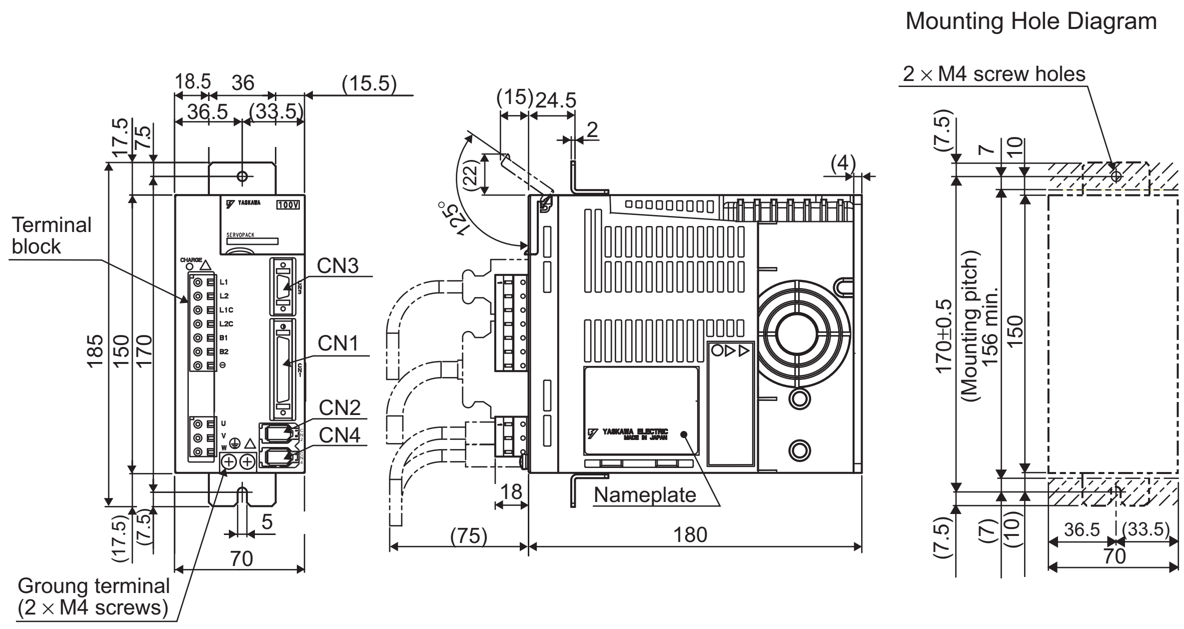
4.8 Dimensional Drawings of Rack-mounted SERVOPACK Model SGDS-□□□01AR/-□□□02AR

4.8.1 Single-phase 100 V / 200 V, 50 W / 100 W / 200 W



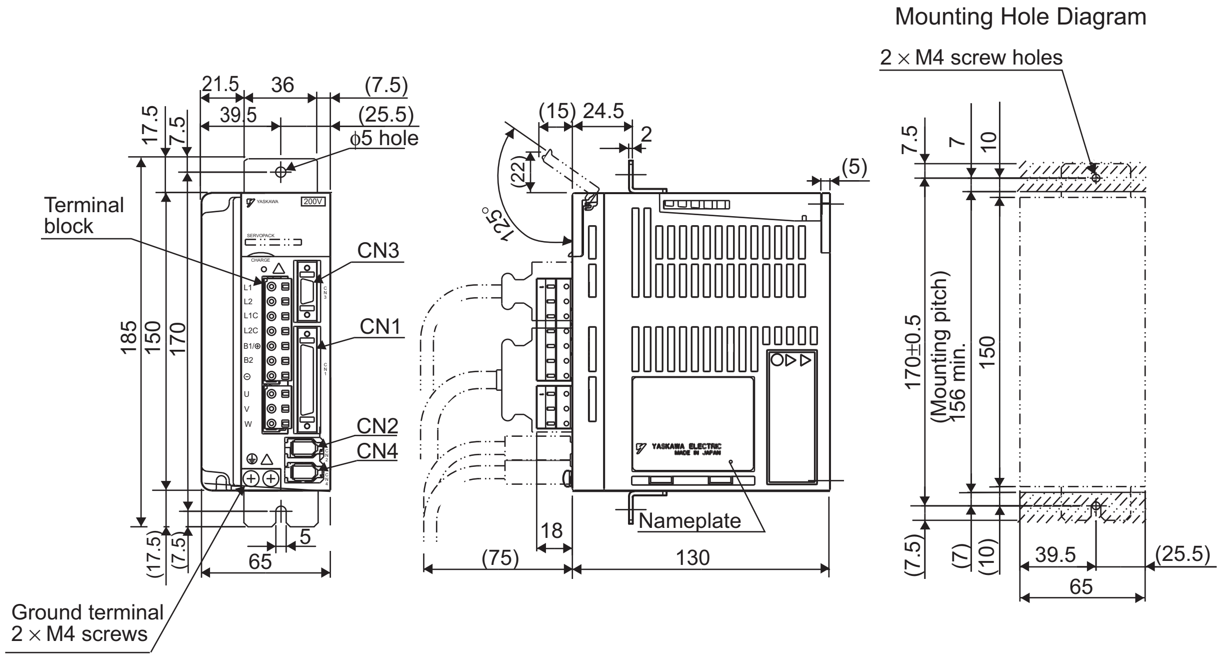
Units: mm
Approx. mass: 0.7 kg

4.8.2 Single-phase 100 V, 400 W



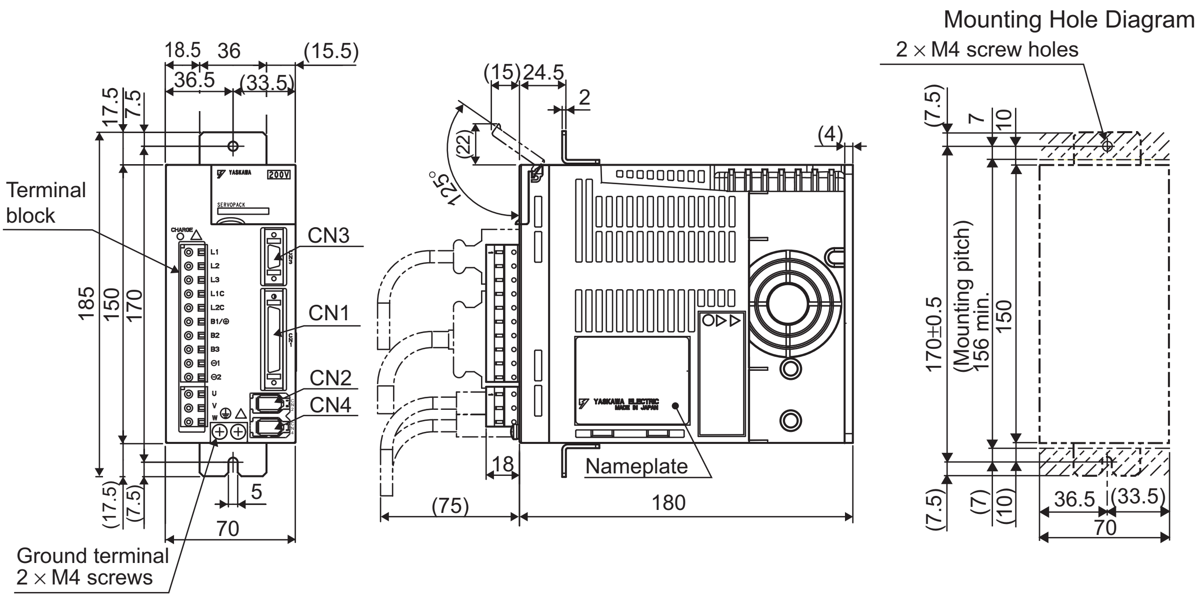
Units: mm
Approx.mass: 1.4 kg

4.8.3 Single-phase 200 V, 400 W



Units: mm
Approx. mass: 0.9 kg

4.8.4 Single-phase 200 V, 750 W
Three-phase 200 V, 500 W / 1.0 kW



Units: mm
Approx. mass: 1.4 kg

SERVOPACK Specifications and Dimensional Drawings

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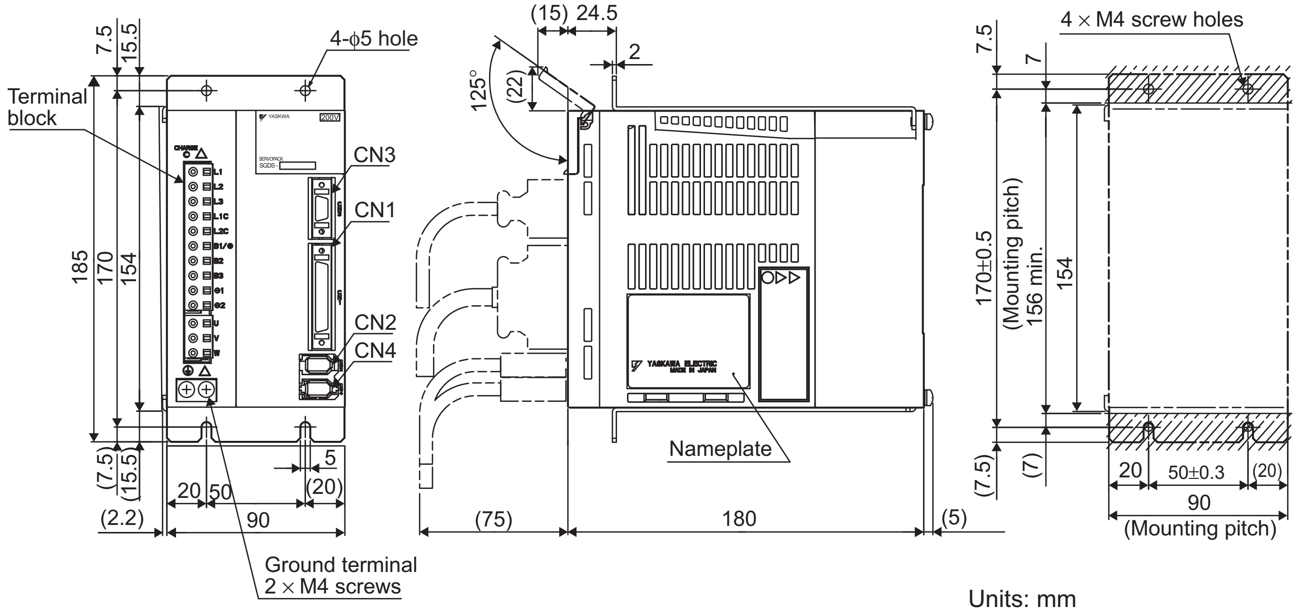
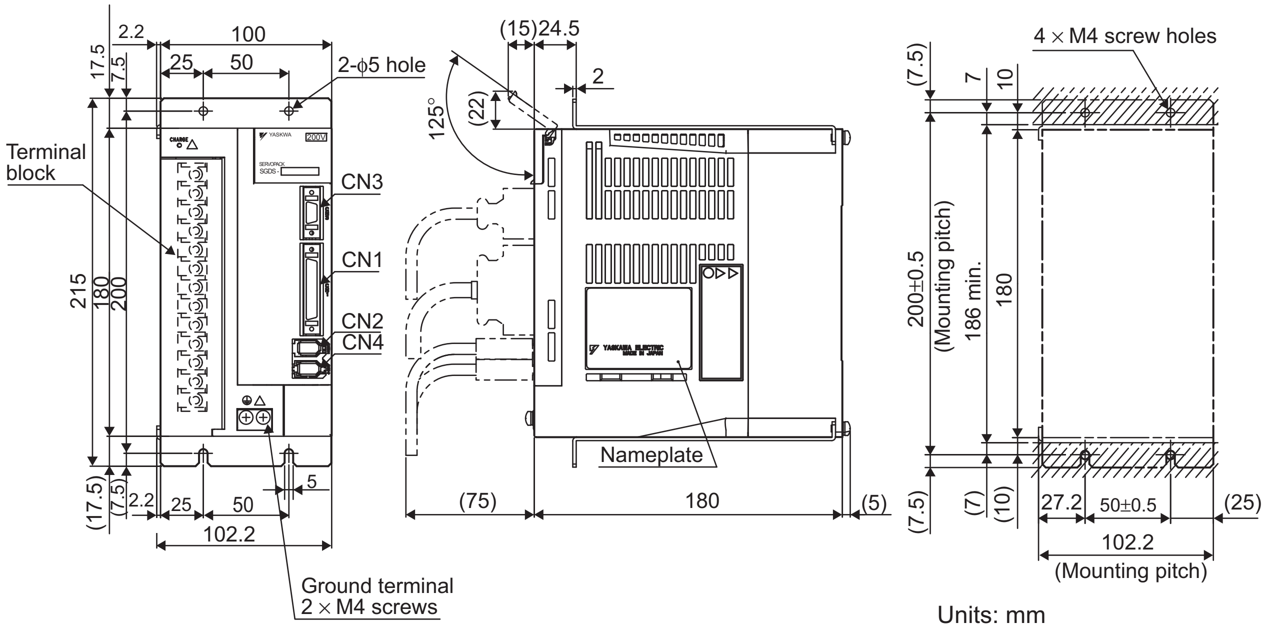
4.8.5 Three-phase 200 V, 1.5 kW



Units: mm
Approx. mass: 2.4 kg

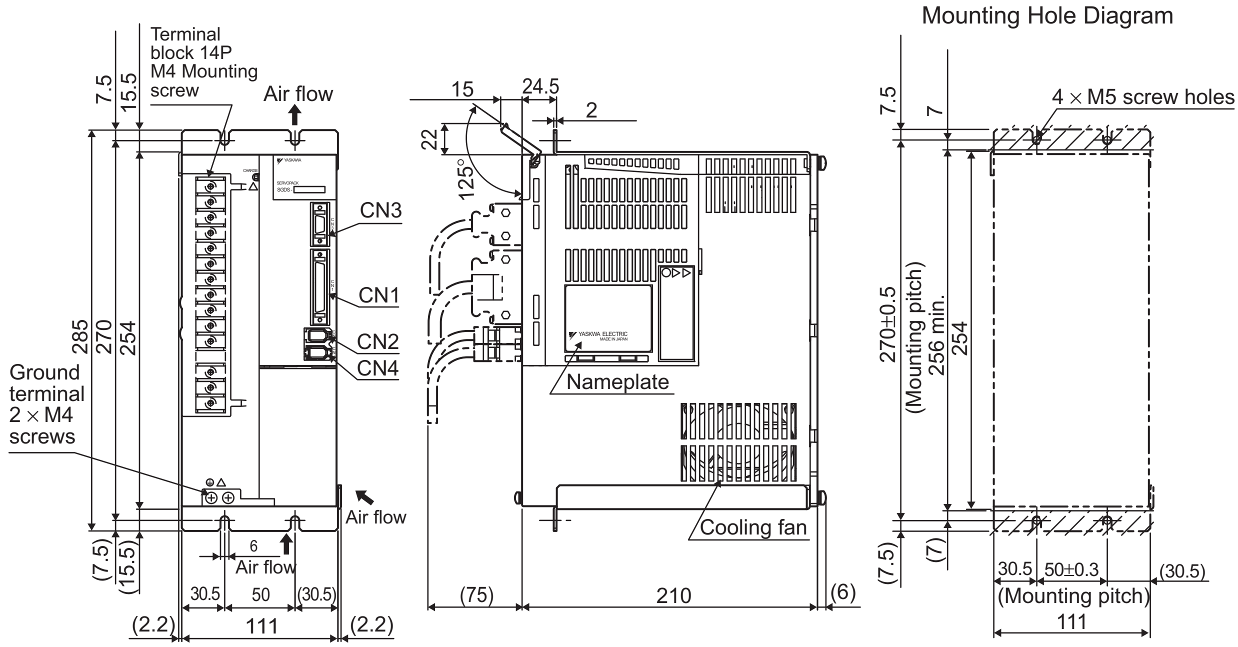
4.8.6 Three-phase 200 V, 2.0 kW, 3.0 kW

Mounting Hole Diagram



Units: mm
Approx. mass: 3.1 kg

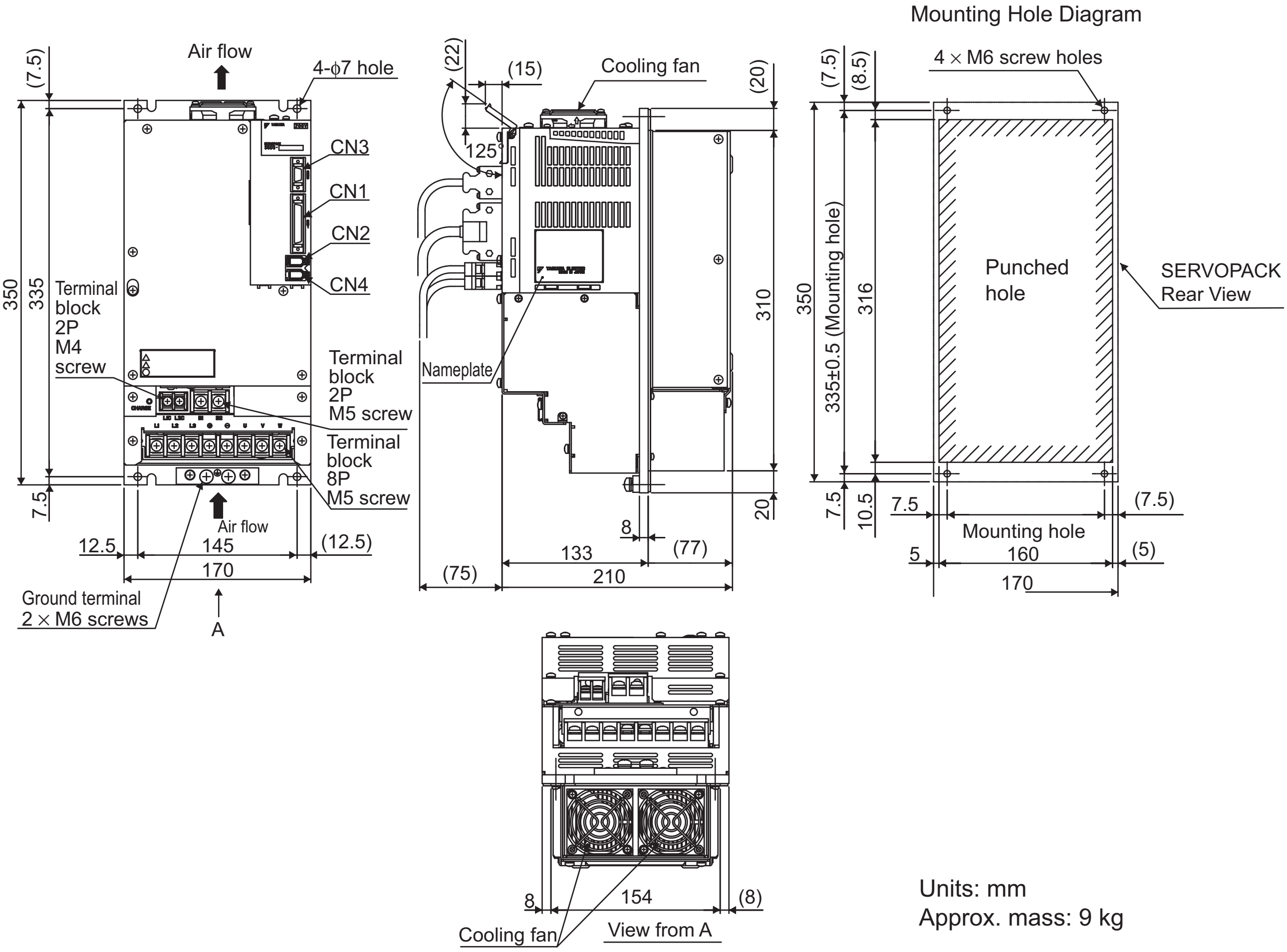
4.8.7 Three-phase 200 V, 5.0 kW



Units: mm
Approx. mass: 5.3 kg

4.9 Dimensional Drawings of Duct-ventilated SERVOPACK Model SGDS-60A□□AP/-75A□□AP

4.9.1 Three-phase 200 V 6.0 kW / 7.5 kW



Units: mm
Approx. mass: 9 kg

5

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5.1 Servomotor Main Circuit Cables

⚠ CAUTION

- Do not bundle or run power and signal lines together in the same duct. Keep power and signal lines separated by at least 30 cm. Wiring them too close may result in malfunction.

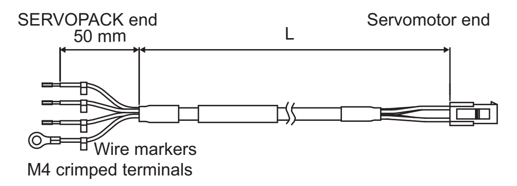
5.1.1 Main Circuit Cables for 10 W to 30 W SGMMJ Servomotors

(1) For Servomotors without Brakes

(a) Cable Type

Standard Type	Flexible Type	Length (L)
JZSP-CDM03-03	JZSP-CDM23-03	3 m
JZSP-CDM03-05	JZSP-CDM23-05	5 m
JZSP-CDM03-10	JZSP-CDM23-10	10 m
JZSP-CDM03-15	JZSP-CDM23-15	15 m
JZSP-CDM03-20	JZSP-CDM23-20	20 m

Dimensional Drawing



(b) Wiring Specifications

SERVOPACK-end Leads / Servomotor-end Connector

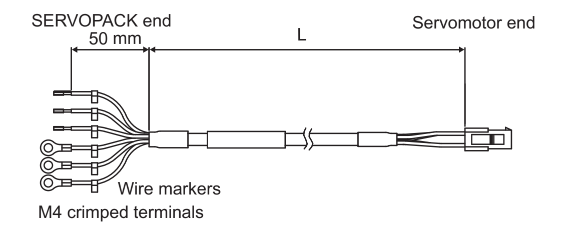
Wire Color	Signal	Signal	Pin No.
Red	Phase U	Phase U	1
White	Phase V	Phase V	2
Blue	Phase W	Phase W	3
Green/yellow	FG	FG	4

(2) For Servomotors with Brakes

(a) Cable Type

Standard Type	Flexible Type	Length (L)
JZSP-CDM33-03	JZSP-CDM43-03	3 m
JZSP-CDM33-05	JZSP-CDM43-05	5 m
JZSP-CDM33-10	JZSP-CDM43-10	10 m
JZSP-CDM33-15	JZSP-CDM43-15	15 m
JZSP-CDM33-20	JZSP-CDM43-20	20 m

Dimensional Drawing



(b) Wiring Specifications

SERVOPACK-end Leads / Servomotor-end Connector

Wire Color	Signal	Signal	Pin No.
Red	Phase U	Phase U	1
White	Phase V	Phase V	2
Blue	Phase W	Phase W	3
Green/yellow	FG	FG	4
Black	Brake	Brake	5
Balck	Brake	Brake	6

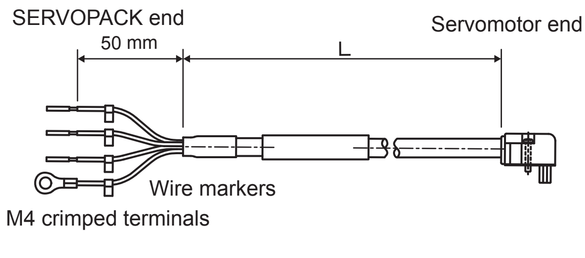
Note: No polarity for connection to a brake

5.1.2 Main Circuit Cables for 50 to 150 W SGMAS and 100 W SGMPS Servomotors

(1) For Servomotors without Brakes

(a) Cable Type

Standard Type	Flexible Type	Length (L)	Dimensional Drawing
JZSP-CSM01-03	JZSP-CSM21-03	3 m	
JZSP-CSM01-05	JZSP-CSM21-05	5 m	
JZSP-CSM01-10	JZSP-CSM21-10	10 m	
JZSP-CSM01-15	JZSP-CSM21-15	15 m	
JZSP-CSM01-20	JZSP-CSM21-20	20 m	



(b) Wiring Specifications

SERVOPACK-end Leads

Wire Color	Signal
Green/yellow	FG
Blue	Phase W
White	Phase V
Red	Phase U

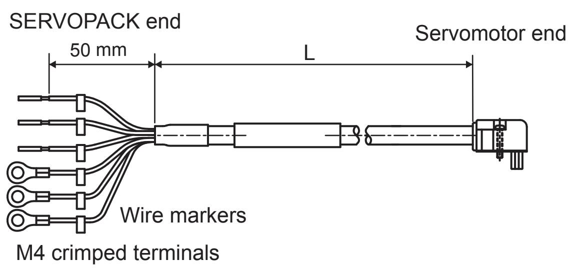
Servomotor-end Connector

Signal	Pin No.
FG	1
Phase W	2
Phase V	3
Phase U	4
—	5
—	6

(2) For Servomotors with Brakes

(a) Cable Type

Standard Type	Flexible Type	Length (L)	Dimensional Drawing
JZSP-CSM11-03	JZSP-CSM31-03	3 m	
JZSP-CSM11-05	JZSP-CSM31-05	5 m	
JZSP-CSM11-10	JZSP-CSM31-10	10 m	
JZSP-CSM11-15	JZSP-CSM31-15	15 m	
JZSP-CSM11-20	JZSP-CSM31-20	20 m	



(b) Wiring Specifications

SERVOPACK-end Leads

Wire Color	Signal
Green/yellow	FG
Blue	Phase W
White	Phase V
Red	Phase U
Black	Brake
Black	Brake

Servomotor-end Connector

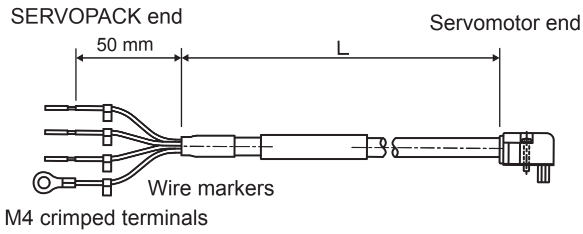
Signal	Pin No.
FG	1
Phase W	2
Phase V	3
Phase U	4
Brake	5
Brake	6

Note: No polarity for connection to a brake

5.1.3 Main Circuit Cables for 200 to 600 W SGMAS and 200 to 400 W SGMPS Servomotors

(1) For Servomotors without Brakes

(a) Cable Type

Standard Type	Flexible Type	Length (L)	Dimensional Drawing
JZSP-CSM02-03	JZSP-CSM22-03	3 m	
JZSP-CSM02-05	JZSP-CSM22-05	5 m	
JZSP-CSM02-10	JZSP-CSM22-10	10 m	
JZSP-CSM02-15	JZSP-CSM22-15	15 m	
JZSP-CSM02-20	JZSP-CSM22-20	20 m	

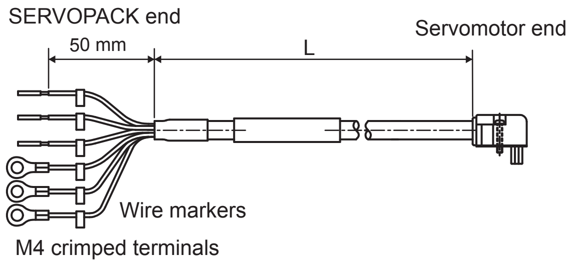
(b) Wiring Specifications

SERVOPACK-end Leads / Servomotor-end Connector

Wire Color	Signal	Signal	Pin No.
Green/yellow	FG	FG	1
Blue	Phase W	Phase W	2
White	Phase V	Phase V	3
Red	Phase U	Phase U	4
		—	5
		—	6

(2) For Servomotors with Brakes

(a) Cable Type

Standard Type	Flexible Type	Length (L)	Dimensional Drawing
JZSP-CSM12-03	JZSP-CSM32-03	3 m	
JZSP-CSM12-05	JZSP-CSM32-05	5 m	
JZSP-CSM12-10	JZSP-CSM32-10	10 m	
JZSP-CSM12-15	JZSP-CSM32-15	15 m	
JZSP-CSM12-20	JZSP-CSM32-20	20 m	

(b) Wiring Specifications

SERVOPACK-end Leads / Servomotor-end Connector

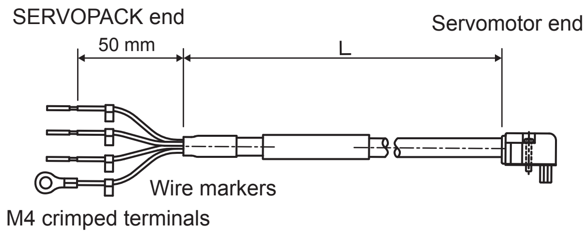
Wire Color	Signal	Signal	Pin No.
Green/yellow	FG	FG	1
Blue	Phase W	Phase W	2
White	Phase V	Phase V	3
Red	Phase U	Phase U	4
Black	Brake	Brake	5
Black	Brake	Brake	6

Note: No polarity for connection to a brake

5.1.4 Main Circuit Cables for 750 W and 1.15 kW SGMAS Servomotors

(1) For Servomotors without Brakes

(a) Cable Type

Standard Type	Flexible Type	Length (L)	Dimensional Drawing
JZSP-CSM03-03	JZSP-CSM23-03	3 m	
JZSP-CSM03-05	JZSP-CSM23-05	5 m	
JZSP-CSM03-10	JZSP-CSM23-10	10 m	
JZSP-CSM03-15	JZSP-CSM23-15	15 m	
JZSP-CSM03-20	JZSP-CSM23-20	20 m	

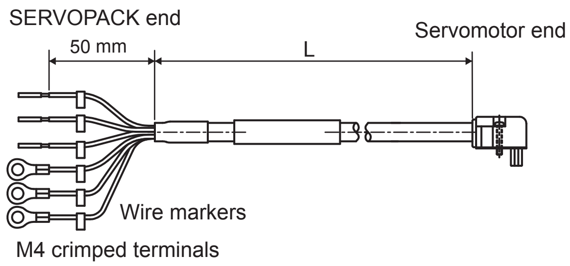
(b) Wiring Specifications

SERVOPACK-end Leads / Servomotor-end Connector

Wire Color	Signal	Signal	Pin No.
Green/yellow	FG	FG	1
Blue	Phase W	Phase W	2
White	Phase V	Phase V	3
Red	Phase U	Phase U	4
		–	5
		–	6

(2) For Servomotors with Brakes

(a) Cable Type

Standard Type	Flexible Type	Length (L)	Dimensional Drawing
JZSP-CSM13-03	JZSP-CSM33-03	3 m	
JZSP-CSM13-05	JZSP-CSM33-05	5 m	
JZSP-CSM13-10	JZSP-CSM33-10	10 m	
JZSP-CSM13-15	JZSP-CSM33-15	15 m	
JZSP-CSM13-20	JZSP-CSM33-20	20 m	

(b) Wiring Specifications

SERVOPACK-end Leads / Servomotor-end Connector

Wire Color	Signal	Signal	Pin No.
Green/yellow	FG	FG	1
Blue	Phase W	Phase W	2
White	Phase V	Phase V	3
Red	Phase U	Phase U	4
Black	Brake	Brake	5
Black	Brake	Brake	6

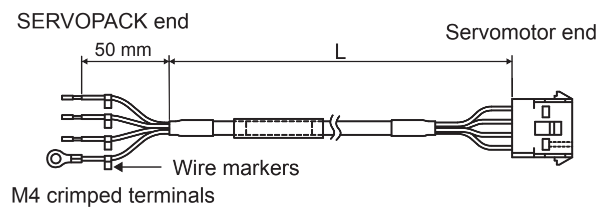
Note: No polarity for connection to a brake

5.1.5 Main Circuit Cables for 750 W SGMPS Servomotors

The 750 W SGMPS servomotor is provided with cables to connect servomotor and encoder cables.
The 750 W SGMPS servomotor cable is used to connect the connector on the servomotor cable tip to SERVOPACK.

(1) For Servomotors without Brakes

(a) Cable Type

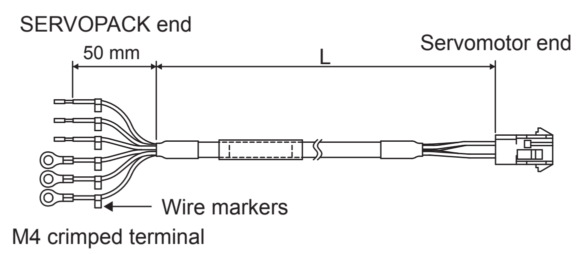
Standard Type	Flexible Type	Length (L)	Dimensional Drawing
JZSP-CMM00-03	JZSP-CMM01-03	3 m	
JZSP-CMM00-05	JZSP-CMM01-05	5 m	
JZSP-CMM00-10	JZSP-CMM01-10	10 m	
JZSP-CMM00-15	JZSP-CMM01-15	15 m	
JZSP-CMM00-20	JZSP-CMM01-20	20 m	

(b) Wiring Specifications

SERVOPACK-end leads		Servomotor-end connector	
Lead Color	Signal	Signal	Pin No.
Red	Phase U	Phase U	1
White	Phase V	Phase V	2
Blue	Phase W	Phase W	3
Green/yellow	FG	FG	4

(2) For Servomotors with Brakes

(a) Cable Type

Standard Type	Flexible Type	Length (L)	Dimensional Drawing
JZSP-CMM10-03	JZSP-CMM11-03	3 m	
JZSP-CMM10-05	JZSP-CMM11-05	5 m	
JZSP-CMM10-10	JZSP-CMM11-10	10 m	
JZSP-CMM10-15	JZSP-CMM11-15	15 m	
JZSP-CMM10-20	JZSP-CMM11-20	20 m	

(b) Wiring Specifications

SERVOPACK-end leads		Servomotor-end connector	
Lead Color	Signal	Signal	Pin No.
Red	Phase U	Phase U	1
White	Phase V	Phase V	2
Blue	Phase W	Phase W	3
Green/yellow	FG	FG	4
Black	Brake	Brake	5
Black	Brake	Brake	6

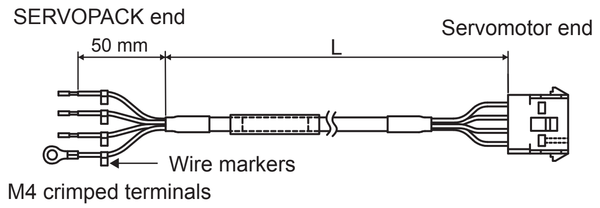
Note: No polarity for connection to the brake.

5.1.6 Main Circuit Cables for 1.5 kW SGMPS Servomotors

The 1.5 kW SGMPS servomotor is provided with cables to connect servomotor and encoder cables.
The 1.5 kW SGMPS servomotor cable is used to connect the connector on the servomotor cable tip to SERVOPACK.

(1) For Servomotors without Brakes

(a) Cable Type

Standard Type	Length (L)	Dimensional Drawing
JZSP-CMM20-03	3 m	
JZSP-CMM20-05	5 m	
JZSP-CMM20-10	10 m	
JZSP-CMM20-15	15 m	
JZSP-CMM20-20	20 m	

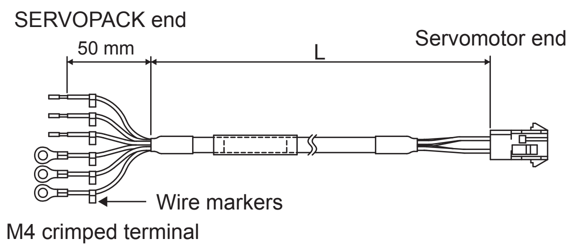
(b) Wiring Specifications

SERVOPACK-end leads / Servomotor-end connector

Lead Color	Signal	Signal	Pin No.
Red	Phase U	Phase U	1
White	Phase V	Phase V	2
Blue	Phase W	Phase W	3
Green/yellow	FG	FG	4

(2) For Servomotors with Brakes

(a) Cable Type

Standard Type	Length (L)	Dimensional Drawing
JZSP-CMM30-03	3 m	
JZSP-CMM30-05	5 m	
JZSP-CMM30-10	10 m	
JZSP-CMM30-15	15 m	
JZSP-CMM30-20	20 m	

(b) Wiring Specifications

SERVOPACK-end leads / Servomotor-end connector

Lead Color	Signal	Signal	Pin No.
Red	Phase U	Phase U	1
White	Phase V	Phase V	2
Blue	Phase W	Phase W	3
Green/yellow	FG	FG	4
Black	Brake	Brake	5
Black	Brake	Brake	6

Note: No polarity for connection to the brake.

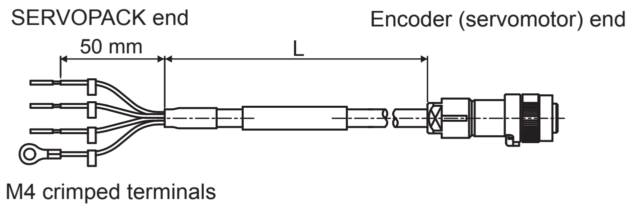
5.1.7 Main Circuit Cables for SGMCS-□□B, C, D, and E Servomotors

Yaskawa provides cables for SGMCS-□□B, C, D, and E servomotors. Cables for SGMCS-□□M and N servomotors must be provided by the customers. Refer to *5.2.11 Connectors for SGMCS-□□M and N Servomotors*.

(1) Cables for Applicable Flange 1, 3

For applicable flanges, refer to *2.1.5 Model SGMCS*

(a) Cable Type

Standard Type	Flexible Type	Length (L)	Dimensional Drawing
JZSP-CMM60-03	JZSP-CSM60-03	3 m	
JZSP-CMM60-05	JZSP-CSM60-05	5 m	
JZSP-CMM60-10	JZSP-CSM60-10	10 m	
JZSP-CMM60-15	JZSP-CSM60-15	15 m	
JZSP-CMM60-20	JZSP-CSM60-20	20 m	

(b) Wiring Specifications

SERVOPACK end

Lead Color	Signal
Red	Phase U
White	Phase V
Blue	Phase W
Green/(yellow)	FG

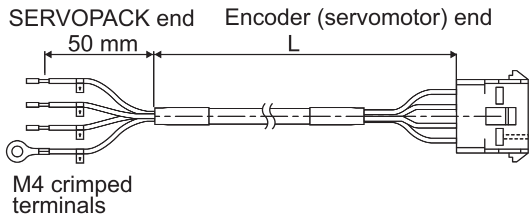
Servomotor end

Signal	Pin No.
Phase U	1
Phase V	2
Phase W	3
FG	4

(2) Cables for Applicable Flange 4

For applicable flanges, refer to *2.1.5 Model SGMCS*.

(a) Cable Type

Standard Type	Flexible Type	Length (L)	Dimensional Drawing
JZSP-CMM00-03	JZSP-CMM01-03	3 m	
JZSP-CMM00-05	JZSP-CMM01-05	5 m	
JZSP-CMM00-10	JZSP-CMM01-10	10 m	
JZSP-CMM00-15	JZSP-CMM01-15	15 m	
JZSP-CMM00-20	JZSP-CMM01-20	20 m	

(b) Wiring Specifications

SERVOPACK end

Lead Color	Signal
Red	Phase U
White	Phase V
Blue	Phase W
Green/(yellow)	FG

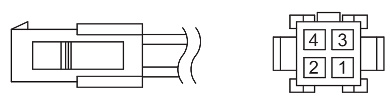
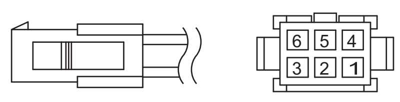
Servomotor end

Signal	Pin No.
Phase U	1
Phase V	2
Phase W	3
FG	4

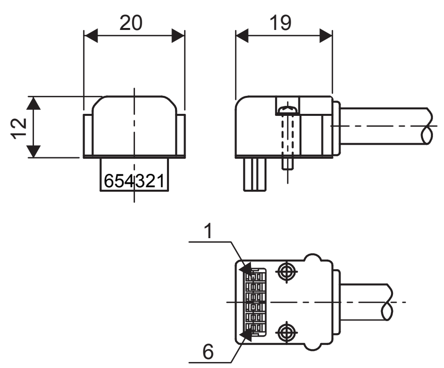
5.2 Servomotor Main Circuit Cables and Connectors

This section describes the specifications of servomotor main circuit cables and connectors to be assembled by the customers.

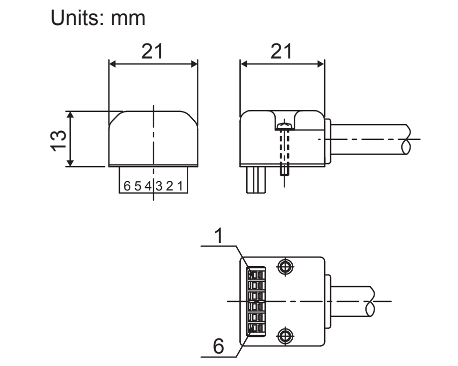
5.2.1 Connectors for 10 W to 30 W SGMMJ Servomotors

Items		Applicable Servomotors: SGMMJ-A1 to A3	
		Without Brakes (For standard cables)	With Brakes (For standard cables)
Manufacturer		Molex Japan Co., Ltd	
Plug		5559-04P-210	5559-06P-210
Pin		5558TL	
Applicable Wire Size		AWG18 to 24	
Caulk-ing Tool	Assembly required	Model: 5558□L Applicable crimp tool: 57026-5000 (For UL1007) 57027-5000 (For UL1015)	
	Assembly not required	Body: M15A or 57117-4000 Module crimp die: 57022-3000	
Dimensional Drawings			
Arranged Model		JZSP-CFM9-2	JZSP-CFM9-3

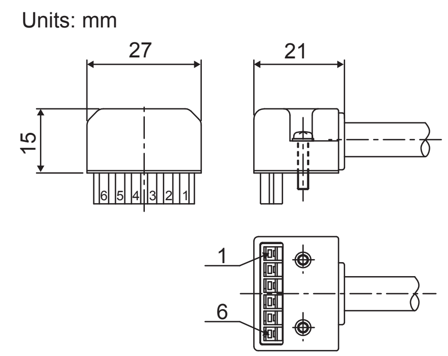
5.2.2 Connectors for 50 to 150 W SGMAS and 100 W SGMPS Servomotors

Items		Applicable Servomotors	Dimensional Drawings
SGMAS		SGMAS-A5 to C2	Units: mm 
SGMPS		SGMPS-01	
Manufacturer		J.S.T. Mfg. Co., Ltd.	
Receptacle		J17-06FMH-7KL-1	
Electrical Contact		SJ1F-01GF-P0.8	
Applicable Wire Size		AWG20 to 24	
Outer Diameter of Insulating Sheath in mm		ϕ1.11 to ϕ1.53	
Caulking Tool	Hand Tool	YRS-8841	
	Applicator	APLMK SJ1F/M-01-08	
Mounting Screw		M2 Pan-head screw	
Applicable Cable Outer Diameter in mm		$\phi 7 \pm 0.3$	
Arranged Model		JZSP-CSM9-1	

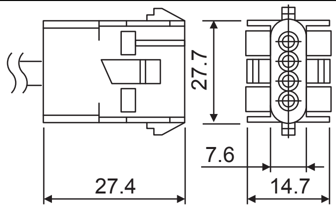
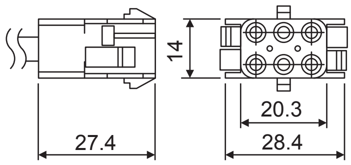
5.2.3 Connectors for 200 to 600 W SGMAS and 200 to 400 W SGMPS Servomotors

Items		Applicable Servomotor Model	Dimensional Drawing
SGMAS		SGMAS-02 to 06	
SGMPS		SGMPS-02 to 04	
Manufacturer		J.S.T. Mfg. Co., Ltd.	
Receptacle		J27-06FMH-7KL-1	
Electrical Contact		SJ2F-01GF-P1.0	
Applicable Wire Size		AWG20 to 24	
Outer Diameter of Insulating Sheath in mm		ϕ1.11 to ϕ1.53	
Caulking Tool	Hand tool	YRS-8861	
	Applicator	APLMK SJ2F/M-01-08	
Mounting Screw		M2 Pan-head screw	
Applicable Cable Outer Diameter in mm		ϕ7 ± 0.3	
Arranged Model		JZSP-CSM9-2	

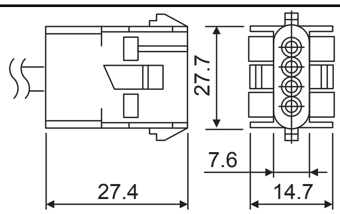
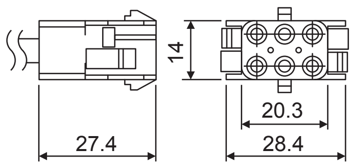
5.2.4 Connectors for 750 W and 1.15 kW SGMAS Servomotors

Items		Applicable Servomotor Models		Dimensional Drawings
SGMAS		SGMAS-08, -12		
SGMPS		–		
Manufacturer		J.S.T. Mfg. Co., Ltd.		
Receptacle		J37-06FMH-8KL-1		
Cable Type		Standard Type		
Electrical Contact		SJ3F-41GF-P1.8 (For power terminals)	SJ3F-01GF-P1.8 (For brake terminals)	
Applicable Wire Size		AWG16 to 20	AWG20 to 24	
Outer Diameter of Insulating Sheath in mm		ϕ1.53 to ϕ2.5	ϕ1.11 to ϕ1.86	
Caulking Tool	Hand tool	YRF-880	YRF-881	
	Applicator	APLMK SF3F/M-41-20	APLMK SF3F/M-01-20	
Mounting Screw		M2.5 Pan-head screw		
Applicable Cable Outer Diameter in mm		ϕ8 ± 0.3		
Arranged Model		JZSP-CSM9-3		

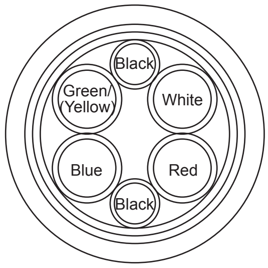
5.2.5 Connectors for 750 W SGMPS Servomotors

<table>
<tr><th colspan="2" rowspan="2">Items</th><th colspan="4">Applicable Servomotor Model SGMPS-08</th></tr>
<tr><th>Without a Brake</th><th>With a Brake
(For Standard Cables)</th><th colspan="2">With a Brake
(For Flexible Cables)</th></tr>
<tr><td colspan="2">Manufacturer</td><td colspan="4">Tyco Electronics AMP K.K.</td></tr>
<tr><td colspan="2">Cap</td><td>350780-1</td><td colspan="3">350781-1</td></tr>
<tr><td colspan="2">Socket</td><td colspan="2">350536-6 or 350689-3</td><td colspan="2">350536-6 or 350550-6
350570-3 or 350689-3
(For brake terminals)</td></tr>
<tr><td colspan="2">Applicable Wire Size</td><td colspan="2">AWG20 to 14</td><td>AWG20 to 14
(For power line)</td><td>AWG24 to 18
(For brake line)</td></tr>
<tr><td rowspan="2">Caulk-ing Tool</td><td>Hand Tool</td><td colspan="2">90296-2</td><td>90296-2</td><td>90300-2</td></tr>
<tr><td>Applicator</td><td colspan="2">637763-1, 687763-2</td><td>637763-1,
687763-2</td><td>466320-1,
466320-2</td></tr>
<tr><td colspan="2">Dimensional Drawings in mm</td><td>
</td><td colspan="3">
</td></tr>
<tr><td colspan="2">Arranged Model</td><td>JZSP-CMM9-1</td><td>JZSP-CMM9-2</td><td colspan="2">JZSP-CSM9-5</td></tr>
</table>

5.2.6 Connectors for 1.5 kW SGMPS Servomotors

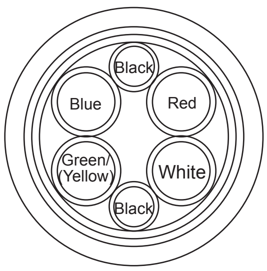
<table>
<tr><th colspan="2" rowspan="2">Items</th><th colspan="2">Applicable Servomotor Model SGMPS-15</th></tr>
<tr><th>Without a Brake</th><th>With a Brake
(For Standard Cables)</th></tr>
<tr><td colspan="2">Manufacturer</td><td colspan="2">Tyco Electronics AMP K.K.</td></tr>
<tr><td colspan="2">Cap</td><td>350780-1</td><td>350781-1</td></tr>
<tr><td colspan="2">Socket</td><td colspan="2">350536-6 or 350550-6</td></tr>
<tr><td colspan="2">Applicable Wire Size</td><td colspan="2">AWG20 to 14</td></tr>
<tr><td rowspan="2">Caulking Tool</td><td>Hand Tool</td><td colspan="2">90296-2</td></tr>
<tr><td>Applicator</td><td colspan="2">637763-1, 687763-2</td></tr>
<tr><td colspan="2">Dimensional Drawings in mm</td><td>
</td><td>
</td></tr>
<tr><td colspan="2">Arranged Model</td><td>JZSP-CMM9-3</td><td>JZSP-CMM9-4</td></tr>
</table>

5.2.7 Cables for 50 to 600 W SGMMJ, SGMAS, and 100 to 400 W SGMPS Servomotor

Items	Standard Cable	Flexible Cable
Cable Type Designation*	JZSP-CSM90-□□ (20 m max.)	JZSP-CSM80-□□ (20 m max.)
Specifications	UL2517 (Max. operating temperature: 105°C AWG20 × 6C For power line: AWG20 (0.52 mm^2) Outer diameter of insulating sheath: ϕ1.53 mm For brake line: AWG20 (0.52 mm^2) Outer diameter of insulating sheath: ϕ1.53 mm	UL2517 (Max. operating temperature: 105°C AWG22 × 6C For power line: AWG22 (0.33 mm^2) Outer diameter of insulating sheath: ϕ1.37 mm For brake line: AWG22 (0.33 mm^2) Outer diameter of insulating sheath: ϕ1.37 mm
Finished Dimensions	ϕ7 ± 0.3 mm	
Internal Configuration and Lead Color		
Yaskawa Standard Specifications (Standard Length)	5 m, 10 m, 15 m, 20 m	

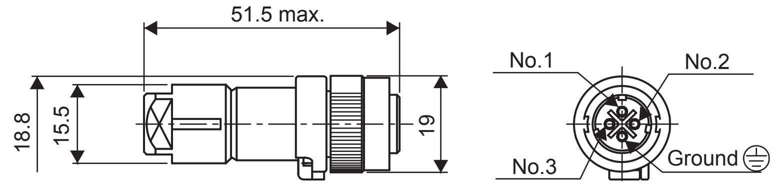
* Specify the cable length in □□ of cable type designation.
Example: JZSP-CSM91-15 (15 m)

5.2.8 Cables for 750 W and 1.15 kW SGMAS and 750 W SGMPS Servomotors

Items	Standard Cable	Flexible Cable
Cable Type Designation *	JZSP-CSM91-□□ (20 m max.)	JZSP-CSM81-□□ (20 m max.)
Specifications	UL2517 (Max. operating temperature: 105°C) AWG16 × 4C, AWG20 × 2C For power line: AWG16 (1.31 mm^2) Outer diameter of insulating sheath: ϕ2.15 mm For brake line: AWG20 (0.52 mm^2) Outer diameter of insulating sheath: ϕ1.6 mm	UL2517 (Max. operating temperature: 105°C) AWG16 × 4C, AWG22 × 2C For power line: AWG16 (1.31 mm^2) Outer diameter of insulating sheath: ϕ2.35 mm For brake line: AWG22 (0.33 mm^2) Outer diameter of insulating sheath: ϕ1.37 mm
Finished Dimension	ϕ8.0 ± 0.3 mm	
Internal Configuration and Lead Color		
Yaskawa Standard Specifications (Standard Length)	5 m, 10 m, 15 m, 20 m	

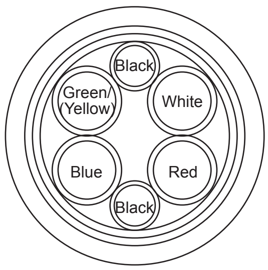
* Specify the cable length in □□ of cable type designation.
Example: JZSP-CSM91-15 (15 m)

5.2.9 Connectors for SGMCS-□□B, C, D, and E Servomotors

Items	Description
Manufacturer	Japan Aviation Electronics Industry, Ltd.
Plug	JN1DS04FK1(Soldered)
Applicable Cable Outer Diameter	ϕ5.7 mm to ϕ7.3 mm
Dimensional Drawings in mm	

Note: The mating connector type on servomotor: JN1AS04MK3

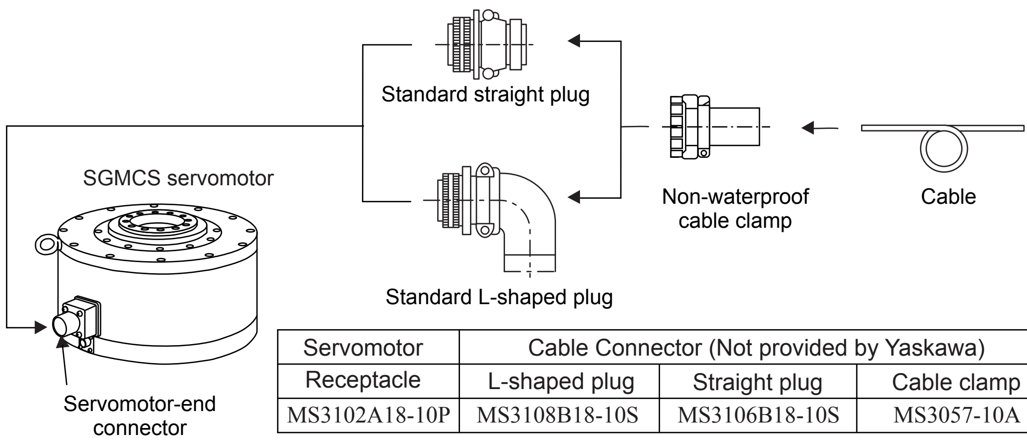
5.2.10 Cables for SGMCS-□□B, C, D, and E Servomotors

Items	Standard Cable	Flexible Cable
Cable Type Designation *	JZSP-CSM90-□□ (20 m max.)	JZSP-CSM80-□□ (20 m max.)
Specifications	UL2517 (Max. operating temperature: 105 °C) AWG20 × 6C For power line: AWG20 (0.52 mm^2) Outer diameter of insulating sheath: ϕ 1.53 mm For brake line: AWG20 (0.52 mm^2) Outer diameter of insulating sheath: ϕ 1.53 mm	UL2517 (Max. operating temperature: 105 °C) AWG22 × 6C For power line: AWG22 (0.33 mm^2) Outer diameter of insulating sheath: ϕ 1.37 mm For brake line: AWG22 (0.33 mm^2) Outer diameter of insulating sheath: ϕ 1.37 mm
Finished Dimension	ϕ 7 ± 0.3 mm	
Internal Configuration and Lead Color		
Yaskawa Standard Specifications (Standard Length)	5 m, 10 m, 15 m, 20 m	

* Specify the cable length in □□ of cable type designation
Example: JZSP-CSM90-15 (15 m)

5.2.11 Connectors for SGMCS-□□M and N Servomotors

(1) Connector Configuration Diagram

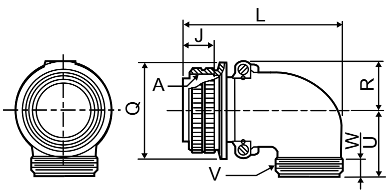


Servomotor	Cable Connector (Not provided by Yaskawa)		
Receptacle	L-shaped plug	Straight plug	Cable clamp
MS3102A18-10P	MS3108B18-10S	MS3106B18-10S	MS3057-10A

(2) Connector Dimensional Drawings

(a) MS3108B: L-shaped Plug Shell

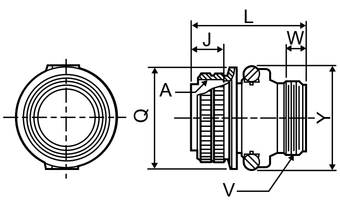
Units: mm



Shell Size	Joint Screw A	Length of Joint Portion J±0.12	Overall Length L max.	Outer Diameter of Joint Nut $\phi Q^{+0}_{-0.38}$	R ±0.5	U ±0.5	Cable Clamp Set Screw V	Effective Screw Length W min.
18	1 1/8 - 18UNEF	18.26	68.27	34.13	20.5	30.2	1-20UNEF	9.53

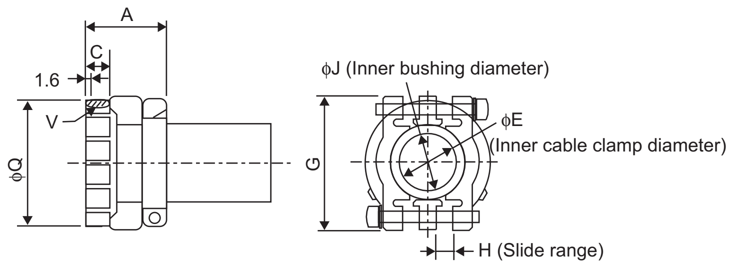
(b) MS3106B: Straight Plug Shell

Units: mm



Shell Size	Joint Screw A	Length of Joint Portion J±0.12	Overall Length L max.	Outer Diameter of Joint Nut $\phi Q^{+0}_{-0.38}$	Cable Clamp Set Screw V	Effective Screw Length W max	Maximum Width Y max.
18	1 1/8 - 18UNEF	18.26	52.37	34.13	1-20UNEF	9.53	42

(c) MS3057A-10A: Cable Clamp with Rubber Bushing



Units: mm

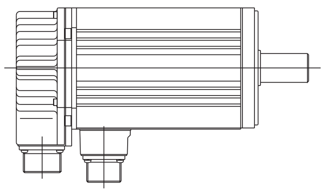
Cable Clamp Type	Applicable Connector Shell Size	Overall Length A±0.7	Effective Screw Length C	φE	G±0.7	H	φJ	Set Screw V	Outer Diameter φQ±0.7	Attached Bushing
MS3057-10A	18	23.8	10.3	15.9	31.7	3.2	14.3	1-20UNEF	30.1	AN3420-10

5.2.12 Cables and Connectors for SGMSS and SGMGH Servomotors

Customer must provide the servomotor main circuit cables for SGMSS servomotors.

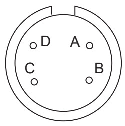
(1) Connector Pin Arrangement

(a) Servomotors without Holding Brakes



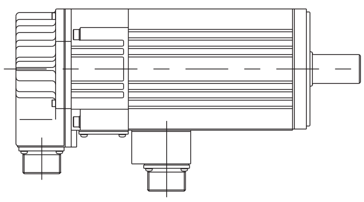
Servomotor-end connector

Servomotor-end Connector Pin Arrangement



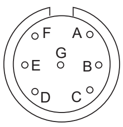
Pin No.	Signal
A	Phase U
B	Phase V
C	Phase W
D	FG (frame ground)

(b) Servomotors with Holding Brakes



Servomotor-end connector

Sevomotor-end Connector Pin Arrangement



Pin No.	Signal	Pin No.	Signal
A	Phase U	E*	Brake terminal
B	Phase V	F*	Brake terminal
C	Phase W	G	−
D	FG (frame ground)		

* No polarity

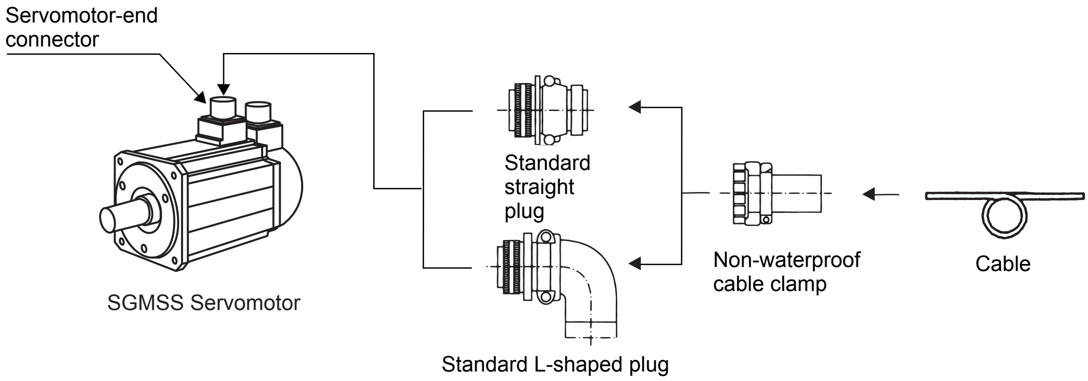
(2) Connector Configurations

The following two types of connectors are available for SGMSS and SGMGH servomotors. Select the appropriate type of connector according to the application. Refer to *5.2.13 Dimensional Drawings of Connectors for SGMSS Servomotors (Standard Environment Type)* and *5.2.14 Dimensional Drawings of Connectors for SGMSS Servomotors (Protective Structure IP67/European Safety Standards Conformed Type)* for the dimensional drawings.

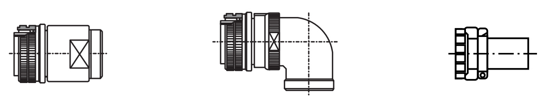
- Standard environmental connectors
- Protective Structure IP67/European Safety Standards conformed connectors

5.2.13 Dimensional Drawings of Connectors for SGMSS Servomotors (Standard Environment Type)

(1) Connector Configuration



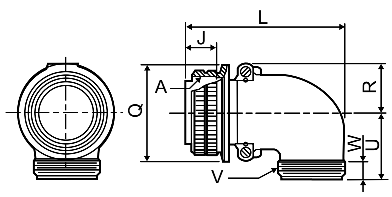
(2) Connector Combination List



Servomotor Type	Capacity (kW)	Servomotor end (Receptacle)	Cable end (Not provided by Yaskawa)		
			Straight plug	L-shaped plug	Cable clamp
Without brakes	1.0 1.5 2.0 2.5	MS3102A18-10P	MS3106B18-10S	MS3108B18-10S	MS3057-10A
	3.0 4.0 5.0 7.0	MS3102A22-22P	MS3106B22-22S	MS3108B22-22S	MS3057-12A
With brakes	1.0 1.5 2.0 2.5	MS3102A20-15P	MS3106B20-15S	MS3108B20-15S	MS3057-12A
	3.0	MS3102A24-10P	MS3106B24-10S	MS3108B24-10S	MS3057-16A

(3) Dimensional Drawings

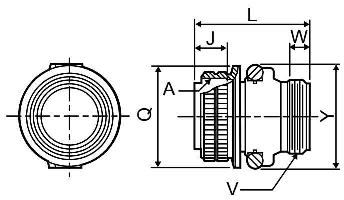
(a) MS3108B□□-□□S: L-shaped Plug Shell



Units: mm

Shell Size	Joint Screw A	Length of Joint Portion J±0.12)	Overall Length L max.	Outer Diameter of Joint Nut $\phi Q^{+0}_{-0.38}$	R ±0.5	U ±0.5	Cable Clamp Set Screw V	Effective Screw Length W min.
18	1 1/8 - 18UNEF	18.26	68.27	34.13	20.5	30.2	1- 20UNEF	9.53
20	1 1/4 - 18UNEF	18.26	76.98	37.28	22.5	33.3	1 3/16 - 18UNEF	9.53
22	1 3/8 - 18UNEF	18.26	76.98	40.48	24.1	33.3	1 3/16 - 18UNEF	9.53
24	1-1/2- 18UNEF	18.26	86.51	43.63	25.6	36.5	1-7/16- 18UNEF	9.53

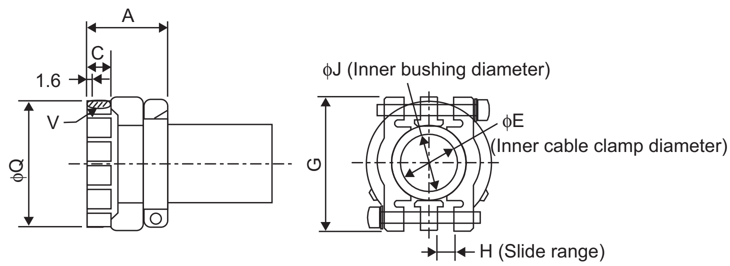
(b) MS3106B□□-□□S: Straight Plug Shell



Units: mm

Shell Size	Joint Screw A	Length of Joint Portion J±0.12	Overall Length L max.	Outer Diameter of Joint Nut $\phi Q^{+0}_{-0.38}$	Cable Clamp Set Screw V	Effective Screw Length W min.	Maxi-mum Width Y max.
18	1 1/8 - 18UNEF	18.26	52.37	34.13	1-20UNEF	9.53	42
20	1 1/4 - 18UNEF	18.26	55.57	37.28	1 3/16 - 18UNEF	9.53	47
22	1 3/8 - 18UNEF	18.26	55.57	40.48	1 3/16 - 18UNEF	9.53	50
24	1-1/2- 18UNEF	18.26	58.72	43.63	1-7/16- 18UNEF	9.53	53

(c) MS3057A-□□A: Cable Clamp with Rubber Bushing

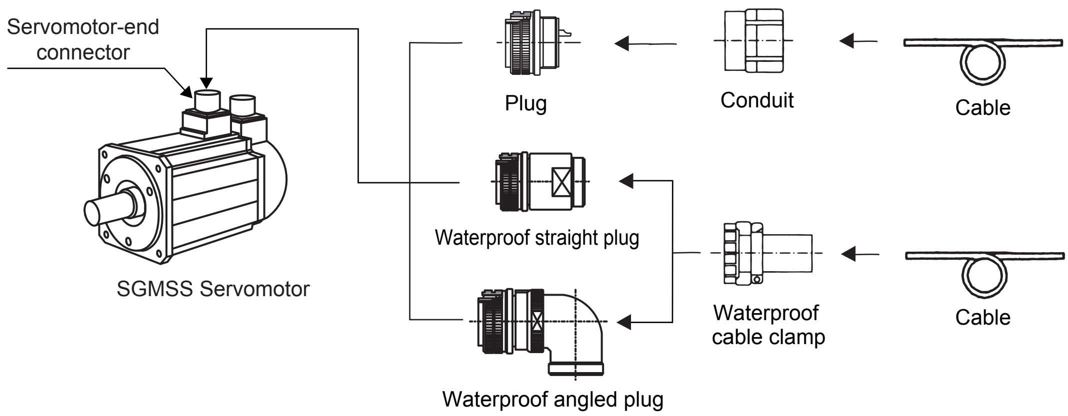


Units: mm

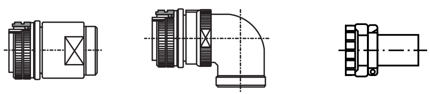
Cable Clamp Type	Applicable Connector Shell Size	Overall Length A±0.7	Effective Screw Length C	ϕE	G±0.7	H	ϕJ	Set Screw V	Outer Diameter ϕQ±0.7	Attached Bushing
MS3057-10A	18	23.8	10.3	15.9	31.7	3.2	14.3	1-20UNEF	30.1	AN3420-10
MS3057-12A	20, 22	23.8	10.3	19.0	37.3	4.0	15.9	1 3/16-18UNEF	35.0	AN3420-12
MS3057-16A	24	26.2	10.3	23.8	42.9	4.8	19.1	1-7/16-18UNEF	42.1	AN3420-16

5.2.14 Dimensional Drawings of Connectors for SGMSS Servomotors (Protective Structure IP67/European Safety Standards Conformed Type)

(1) Connector Configuration



(2) Connector Combination List



Servomotor Type	Capacity (kW)	Servomotor end (Receptacle)	Cable end (Not provided by Yaskawa): Plug	End Bell or Back Shell *1: Straight	End Bell or Back Shell *1: L-shaped (Angled)	Cable Clamp *2	Applicable Cable Range in mm (For reference)	Manufacturer
Without brakes	1.0 1.5 2.0 2.5	CE05-2A18-10PD-B	CE05-6A18-10SD-B	CE05-6A18-10SD-B-BSS	CE05-8A18-10SD-B-BAS	CE3057-10A-1	φ10.5 to φ14.1	DDK Ltd.
						CE3057-10A-2	φ 8.5 to φ11.0	
						CE3057-10A-3	φ 6.5 to φ 8.7	
	3.0 4.0 5.0 7.0	JL04HV-2E22-22PE-B	JL04V-6A22-22SE	JL04V-6A22-22SE-EB or JA06A-22-22S-J1-EB*3	JL04V-8A22-22SE-EB or JA08A-22-22S-J1-EB*3	JL04-2022CK(09)	φ 6.5 to φ 9.5	Japan Aviation Electronics Industry, Ltd.
						JL04-2022CK(12)	φ 9.5 to φ13.0	
						JL04-2022CK(14)	φ12.9 to φ15.9	
With brakes	1.0 1.5 2.0 2.5	JL04V-2E20-15PE-B	JL04V-6A20-15SE	JL04V-6A20-15SE-EB	JL04V-8A20-15SE-EB	JL04-2022CK(09)	φ 6.5 to φ 9.5	
						JL04-2022CK(12)	φ 9.5 to φ13.0	
						JL04-2022CK(14)	φ12.9 to φ15.9	
	3.0	JL04V-2E24-10PE-B	JL04V-6A24-10SE	JL04V-6A24-10SE-EB or JA06A-24-10S-J1-EB	JL04V-8A24-10SE-EB or JA08A-24-10S-J1-EB	JL04-2428CK(11)	φ 9.0 to φ 12.0	
						JL04-2428CK(14)	φ 12.0 to φ15.0	
						JL04-2428CK(17)	φ15.0 to φ18.0	
						JL04-2428CK(20)	φ18.0 to φ20.0	

* 1. End Bell is a product of Japan Aviation Electronics Industry, Ltd.
Back Shell is a product of DDK Ltd.

* 2. Select cable clamps according to the cable diameter.

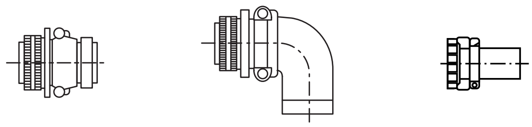
* 3. The following plugs conform to IP67 Protective Construction, but not conform to European Safety Standard.

- For 3.0, 4.0, 5.0 kW, and 7.0 kW servomotors without brakes
  Straight plug: JA06A-22-22S-J1-EB
  L-shaped plug: JA08A-22-22S-J1-EB
- For 3.0 kW servomotors with brakes
  Straight plug: JA06A-24-10S-J1-EB
  L-shaped plug: JA08A-24-10S-J1-EB

5.2.15 SGMGH Servomotor (1500 min^{-1}) Connectors for Standard Environments

(1) Without Holding Brakes

The specifications are same for both three-phase 200 V and 400 V servomotors.

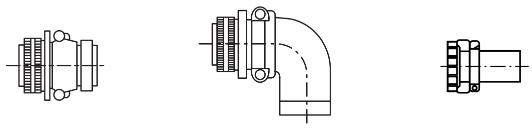


Capacity (kW)	Connector on Servomotor	Plug		Cable Clamp
		Straight	L-shaped	
0.45 0.85 1.3	MS3102A18-10P	MS3106B18-10S	MS3108B18-10S	MS3057-10A
1.8 2.9 4.4	MS3102A22-22P	MS3106B22-22S	MS3108B22-22S	MS3057-12A
5.5 7.5	MS3102A32-17P	MS3106B32-17S	MS3108B32-17S	MS3057-20A

(2) With Holding Brakes

The 5.5 to 7.5 kW servomotors require (a) servomotor-end connector and (b) brake power supply connector.

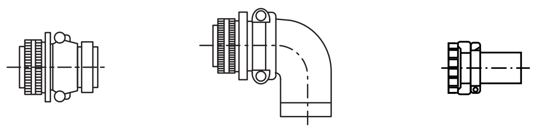
(a) Servomotor-end Connectors



Capacity (kW)	Connector on Servomotor	Plug		Cable Clamp
		Straight	L-shaped	
0.45 0.85 1.3	MS3102A20-15P	MS3106B20-15S	MS3108B20-15S	MS3057-12A
1.8 2.9 4.4	MS3102A24-10P	MS3106B24-10S	MS3108B24-10S	MS3057-16A
5.5 7.5	MS3102A32-17P	MS3106B32-17S	MS3108B32-17S	MS3057-20A

(b) Brake Power Supply Connectors

5.5 to 7.5 kW Servomotors

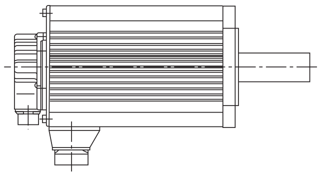


Capacity (kW)	Connector on Servomotor	Plug		Cable Clamp
Three-phase 200 V		Straight	L-shaped	
5.5 7.5	MS3102A10SL-3P	MS3106A10SL-3S	Use the connector conforming to protective structure IP67/European safety standard.	MS3057-4A

(3) SGMGH Servomotors (1500 min^{-1}) Main Circuit Connector Pin Arrangement

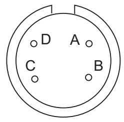
(a) Without Holding Brakes

0.45 to 7.5 kW



Servomotor-end connector

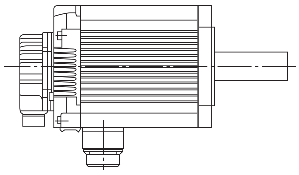
Servomotor Connector Pin Arrangement



Pin No.	Signal
A	Phase U
B	Phase V
C	Phase W
D	FG (Frame Ground)

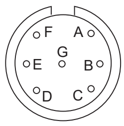
(b) With Holding Brakes

① 0.45 to 4.4 kW



Servomotor-end connector

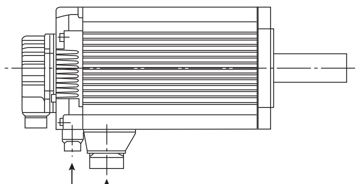
Servomotor Connector Pin Arrangement



Pin No.	Signal	Pin No.	Signal
A	Phase U	E *	Brake terminal
B	Phase V	F *	Brake terminal
C	Phase W	G	—
D	FG (Frame Ground)		

* No polarity

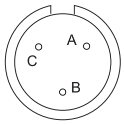
② 5.5 to 7.5 kW



Servomotor-end connector

Brake-end connector

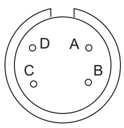
Brake Connector Pin Arrangement



Pin No.	Signal
A *	Brake terminal
B *	Brake terminal
C	—

* No polarity

Servomotor Connector Pin Arrangement



Pin No.	Signal
A	Phase U
B	Phase V
C	Phase W
D	FG (Frame Ground)

Specifications and Dimensional Drawings of Cables and Peripheral Devices

5

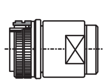
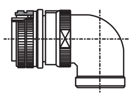
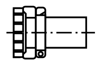
5.2.16 SGMGH Servomotor (1500 min^{-1}) Connectors Conforming to IP67 and European Safety Standards

(1) 0.45 to 4.4 kW Servomotors Without Holding Brakes

Select a cable clamp in accordance with the applied cable diameter.

INFO

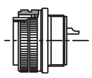
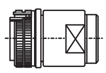
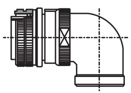
The straight plug type JA06A-22-22S-J1-EB and L-shaped plug type JA08A-22-22S-J1-EB conform to the IP67 Protective Construction Standard only.

Capacity (kW)	Connector on Servomotor	Plug		Cable Clamp	Applicable Cable Range in mm (For reference)
		Straight	L-shaped		
0.45 0.85 1.3	CE05-2A18-10PD-B	CE05-6A18-10SD-B-BSS	CE05-8A18-10SD-B-BAS	CE3057-10A-1	ϕ10.5 to ϕ14.1
				CE3057-10A-2	ϕ 8.5 to ϕ11.0
				CE3057-10A-3	ϕ 6.5 to ϕ 8.7
1.8 2.9 4.4	JL04HV-2E22-22PE-B	JL04V-6A22-22SE-EB or JA06A-22-22S-J1-EB	JL04V-8A22-22SE-EB or JA08A-22-22S-J1-EB	JL04-2022CK(09)	ϕ 6.5 to ϕ 9.5
				JL04-2022CK(12)	ϕ 9.5 to ϕ13.0
				JL04-2022CK(14)	ϕ12.9 to ϕ15.9

(2) 5.5 to 7.5 kW Servomotors Without Holding Brakes

Select a conduit in accordance with the applied cable diameter.

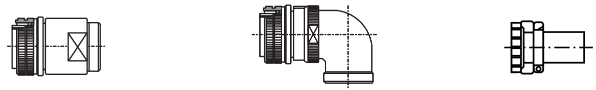




Capacity (kW)	Connector on Servomotor	Plug	Conduit		Applicable Cable Range in mm (For reference)
			Straight	L-shaped	
5.5 7.5	JL04V-2E32-17PE-B	JL04V-6A32-17SE	ACS-16RL-MS32F	ACA-16RL-MS32F	ϕ12.0 to ϕ16.0
			ACS-20RL-MS32F	ACA-20RL-MS32F	ϕ16.0 to ϕ20.0
			ACS-24RL-MS32F	ACA-24RL-MS32F	ϕ20.0 to ϕ24.0
			ACS-28RL-MS32F	ACA-28RL-MS32F	ϕ24.0 to ϕ28.0
			ACS-32RL-MS32F	ACA-32RL-MS32F	ϕ28.0 to ϕ32.0
			ACS-36RL-MS32F	ACA-36RL-MS32F	ϕ32.0 to ϕ36.0

(3) 0.45 to 4.4 kW Servomotors With Holding Brakes

Select a cable clamp in accordance with the applied cable diameter.

INFO The straight plug type JA06A-24-10S-J1-EB and L-shaped plug type JA08A-24-10S-J1-EB conform to IP67 Protective Construction Standard only.

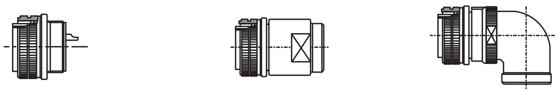


Capacity (kW)	Connector on Servomotor	Plug		Cable Clamp	Applicable Cable Range in mm (For reference)
		Straight	L-shaped		
0.45 0.85 1.3	JL04V-2E20-15PE-B	JL04V-6A20-15SE-EB	JL04V-8A20-15SE-EB	JL04-2022CK(09)	ϕ6.5 to ϕ9.5
				JL04-2022CK(12)	ϕ9.5 to ϕ13.0
				JL04-2022CK(14)	ϕ12.9 to ϕ15.9
1.8 2.9 4.4	JL04V-2E24-10PE-B	JL04V-6A24-10SE-EB or JA06A-24-10S-J1-EB	JL04V-8A24-10SE-EB or JA08A-24-10S-J1-EB	JL04-2428CK(11)	ϕ9.0 to ϕ12.0
				JL04-2428CK(14)	ϕ12.0 to ϕ15.0
				JL04-2428CK(17)	ϕ15.0 to ϕ18.0
				JL04-2428CK(20)	ϕ18.0 to ϕ20.0

(4) 5.5 to 7.5 kW Servomotors With Holding Brakes

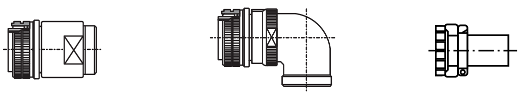
The servomotor end connector (a) and brake power supply connector (b) are required. Select a conduit in accordance with the applied cable diameter.

(a) Servomotor-end Connector



Capacity (kW)	Connector on Servomotor	Plug	Conduit		Applicable Cable Range in mm (For reference)
			Straight	L-shaped	
5.5 7.5	JL04V-2E32-17PE-B	JL04V-6A32-17SE	ACS-16RL-MS32F	ACA-16RL-MS32F	ϕ12.0 to ϕ16.0
			ACS-20RL-MS32F	ACA-20RL-MS32F	ϕ16.0 to ϕ20.0
			ACS-24RL-MS32F	ACA-24RL-MS32F	ϕ20.0 to ϕ24.0
			ACS-28RL-MS32F	ACA-28RL-MS32F	ϕ24.0 to ϕ28.0
			ACS-32RL-MS32F	ACA-32RL-MS32F	ϕ28.0 to ϕ32.0
			ACS-36RL-MS32F	ACA-36RL-MS32F	ϕ32.0 to ϕ36.0

(b) Brake Power Supply Connectors

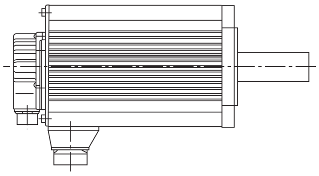


Capacity (kW)	Connector on Servomotor	Plug		Cable Clamp	Applicable Cable Range in mm (For reference)
		Straight	L-shaped		
5.5 7.5	CE05-2A10SL-3PC-B	CE05-6A10SL-3SC-B-BSS	CE05-8A10SL-3SC-B-BAS	CE3057-4A-1	ϕ 3.6 to ϕ5.6

(5) Servomotor Main Circuit Connector Pin Arrangement

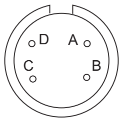
(a) Servomotors Without Holding Brakes

0.45 to 7.5 kW



Servomotor-end connector

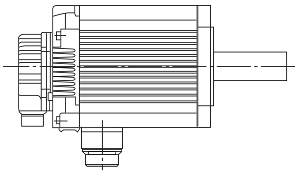
Servomotor Connector Pin Arrangement



Pin No.	Signal
A	Phase U
B	Phase V
C	Phase W
D	FG (Frame Ground)

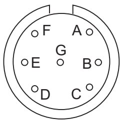
(b) Servomotors With Holding Brakes

① 0.45 to 4.4 kW



Servomotor-end connector

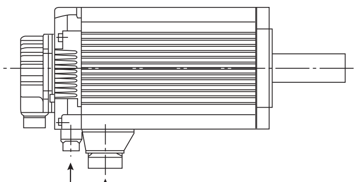
Servomotor Connector Pin Arrangement



Pin No.	Signal	Pin No.	Signal
A	Phase U	E *	Brake terminal
B	Phase V	F *	Brake terminal
C	Phase W	G	—
D	FG (Frame Ground)		

* No polarity

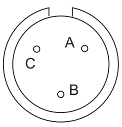
② 5.5 to 7.5 kW



Servomotor-end connector

Brake-end connector

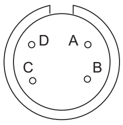
Brake Connector Pin Arrangement



Pin No.	Signal
A *	Brake terminal
B *	Brake terminal
C	—

* No polarity

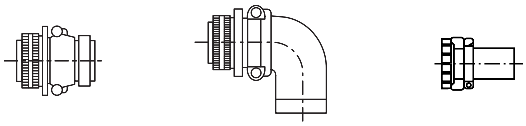
Servomotor Connector Pin Arrangement



Pin No.	Signal
A	Phase U
B	Phase V
C	Phase W
D	FG (Frame Ground)

5.2.17 SGMGH Servomotor (1000 min^{-1}) Connectors for Standard Environments

(1) Without Holding Brakes

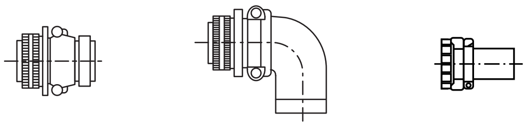


Capacity (kW)	Connector on Servomotor	Plug		Cable Clamp
		Straight	L-shaped	
0.3 0.6 0.9	MS3102A18-10P	MS3106B18-10S	MS3108B18-10S	MS3057-10A
1.2 2.0 3.0	MS3102A22-22P	MS3106B22-22S	MS3108B22-22S	MS3057-12A
4.0 5.5	MS3102A32-17P	MS3106B32-17S	MS3108B32-17S	MS3057-20A

(2) With Holding Brakes

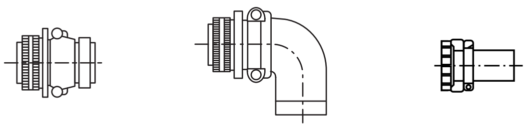
4.0 kW and 5.5 kW servomotors require (a) servomotor-end connector and (b) brake power supply connector.

(a) Servomotor-end Connectors



Capacity (kW)	Connector on Servomotor	Plug		Cable Clamp
		Straight	L-shaped	
0.3 0.6 0.9	MS3102A20-15P	MS3106B20-15S	MS3108B20-15S	MS3057-12A
1.2 2.0 3.0	MS3102A24-10P	MS3106B24-10S	MS3108B24-10S	MS3057-16A
4.0 5.5	MS3102A32-17P	MS3106B32-17S	MS3108B32-17S	MS3057-20A

(b) Brake Power Supply Connectors

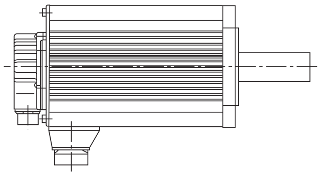


Capacity (kW)	Connector on Servomotor	Plug		Cable Clamp
		Straight	L-shaped	
4.0 5.5	MS3102A10SL-3P	MS3106A10SL-3S	Use the connector conforming to protective structure IP67/European safety standard.	MS3057-4A

(3) SGMGH (1000 min^{-1}) Servomotor Main Circuit Connector Pin Arrangement

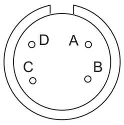
(a) Without Holding Brakes

0.3 to 5.5 kW



Servomotor-end connector

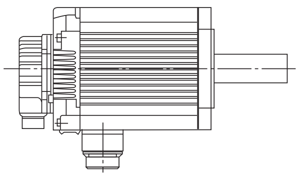
Servomotor Connector Pin Arrangement



Pin No.	Signal
A	Phase U
B	Phase V
C	Phase W
D	FG (Frame Ground)

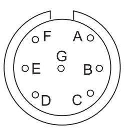
(b) With Holding Brakes

① 0.3 to 3.0 kW



Servomotor-end connector

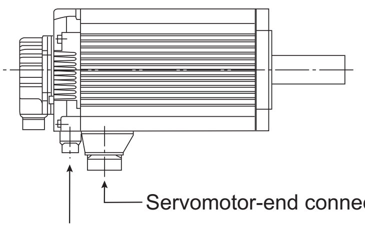
Servomotor Connector Pin Arrangement



Pin No.	Signal	Pin No.	Signal
A	Phase U	E *	Brake terminal
B	Phase V	F *	Brake terminal
C	Phase W	G	—
D	FG (Frame Ground)		

* No polarity

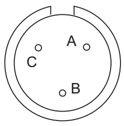
② 4.0 kW and 5.5 kW



Servomotor-end connector

Brake-end connector

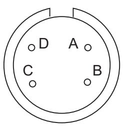
Brake Connector Pin Arrangement



Pin No.	Signal
A *	Brake terminal
B *	Brake terminal
C	—

* No polarity

Servomotor Connector Pin Arrangement



Pin No.	Signal
A	Phase U
B	Phase V
C	Phase W
D	FG (Frame Ground)

5.2.18 SGMGH Servomotor (1000 min^{-1}) Connectors Conforming to IP67 and European Safety Standards

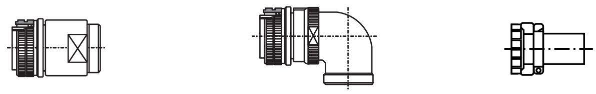
(1) Servomotors Without Holding Brakes

(a) For 0.3 to 3.0 kW Servomotors

Select a cable clamp in accordance with the applied cable diameter.

INFO

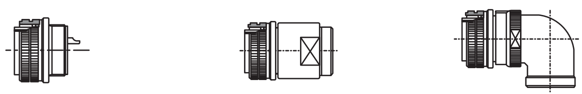
The straight plug type JA06A-22-22S-J1-EB and L-shaped plug type JA08A-22-22S-J1-EB conform to IP67 Protective Construction Standard only.



Capacity (kW)	Connector on Servomotor	Plug		Cable Clamp	Applicable Cable Range in mm (For reference)
		Straight	L-shaped		
0.3 0.6 0.9	CE05-2A18-10PD-B	CE05-6A18-10SD-B-BSS	CE05-8A18-10SD-B-BAS	CE3057-10A-1	ϕ10.5 to ϕ14.1
				CE3057-10A-2	ϕ 8.5 to ϕ11.0
				CE3057-10A-3	ϕ 6.5 to ϕ 8.7
1.2 2.0 3.0	JL04HV-2E22-22PE-B	JL04V-6A22-22SE-EB or JA06A-22-22S-J1-EB	JL04V-8A22-22SE-EB or JA08A-22-22S-J1-EB	JL04-2022CK(09)	ϕ 6.5 to ϕ 9.5
				JL04-2022CK(12)	ϕ 9.5 to ϕ13.0
				JL04-2022CK(14)	ϕ12.9 to ϕ15.9

(b) For 4.0 kW and 5.5 kW Servomotors

Select a conduit in accordance with the applied cable diameter.

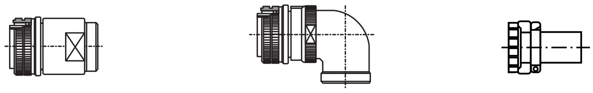


Capacity (kW)	Connector on Servomotor	Plug	Conduit		Applicable Cable Range in mm (For reference)
			Straight	L-shaped	
4.0 5.5	JL04V-2E32-17PE-B	JL04V-6A32-17SE	ACS-16RL-MS32F	ACA-16RL-MS32F	ϕ12.0to ϕ16.0
			ACS-20RL-MS32F	ACA-20RL-MS32F	ϕ16.0 to ϕ20.0
			ACS-24RL-MS32F	ACA-24RL-MS32F	ϕ20.0 to ϕ24.0
			ACS-28RL-MS32F	ACA-28RL-MS32F	ϕ24.0 to ϕ28.0
			ACS-32RL-MS32F	ACA-32RL-MS32F	ϕ28.0 to ϕ32.0
			ACS-36RL-MS32F	ACA-36RL-MS32F	ϕ32.0 to ϕ36.0

(2) 0.3 to 3.0 kW Servomotors With Holding Brakes

Select a cable clamp in accordance with the applied cable diameter.

INFO The straight plug type JA06A-24-10S-J1-EB and L-shaped plug type JA08A-24-10S-J1-EB conform to IP67 Protective Construction Standard only.



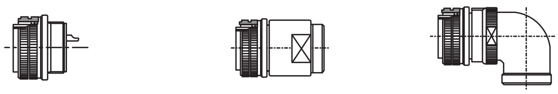
Capacity (kW)	Connector on Servomotor	Plug		Cable Clamp	Applicable Cable Range in mm (For reference)
		Straight	L-shaped		
0.3 0.6 0.9	JL04V-2E20-15PE-B	JL04V-6A20-15SE-EB	JL04V-8A20-15SE-EB	JL04-2022CK(09)	ϕ 6.5 to ϕ 9.5
				JL04-2022CK(12)	ϕ 9.5 to ϕ13.0
				JL04-2022CK(14)	ϕ12.9 to ϕ15.9
1.2 2.0 3.0	JL04V-2E24-10PE-B	JL04V-6A24-10SE-EB or JA06A-24-10S-J1-EB	JL04V-8A24-10SE-EB or JA08A-24-10S-J1-EB	JL04-2428CK(11)	ϕ9.0 to ϕ12.0
				JL04-2428CK(14)	ϕ12.0 to ϕ15.0
				JL04-2428CK(17)	ϕ15.0 to ϕ18.0
				JL04-2428CK(20)	ϕ18.0 to ϕ20.0

(3) 4.0 kW and 5.5 kW Servomotors With Holding Brakes

The servomotor end connector (a) and brake power supply connector (b) are required.

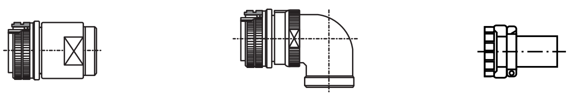
Select a conduit in accordance with the applied cable diameter.

(a) Servomotor-end Connector



Capacity (kW)	Connector on Servomotor	Plug	Conduit		Applicable Cable Range in mm (For reference)
			Straight	L-shaped	
4.0 5.5	JL04V-2E32-17PE-B	JL04V-6A32-17SE	ACS-16RL-MS32F	ACA-16RL-MS32F	ϕ12.0 to ϕ16.0
			ACS-20RL-MS32F	ACA-20RL-MS32F	ϕ16.0 to ϕ20.0
			ACS-24RL-MS32F	ACA-24RL-MS32F	ϕ20.0 to ϕ24.0
			ACS-28RL-MS32F	ACA-28RL-MS32F	ϕ24.0 to ϕ28.0
			ACS-32RL-MS32F	ACA-32RL-MS32F	ϕ28.0 to ϕ32.0
			ACS-36RL-MS32F	ACA-36RL-MS32F	ϕ32.0 to ϕ36.0

(b) Brake Power Supply Connector

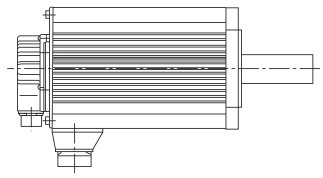


Capacity (kW)	Connector on Servomotor	Plug		Cable Clamp	Applicable Cable Range in mm (For reference)
		Straight	L-shaped		
4.0 5.5	CE05-2A10SL-3PC-B	CE05-6A10SL-3SC-B-BSS	CE05-8A10SL-3SC-B-BAS	CE3057-4A-1	ϕ 3.6 to ϕ 5.6

(4) Servomotor Main Circuit Connector Pin Arrangement

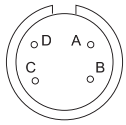
(a) Servomotors Without Holding Brakes

0.3 to 5.5 kW



Servomotor-end connector

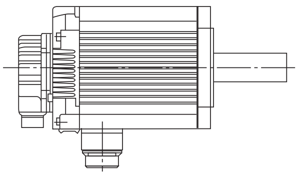
Servomotor Connector Pin Arrangement



Pin No.	Signal
A	Phase U
B	Phase V
C	Phase W
D	FG (Frame Ground)

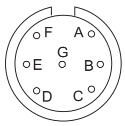
(b) Servomotors With Holding Brakes

① 0.3 to 3.0 kW



Servomotor-end connector

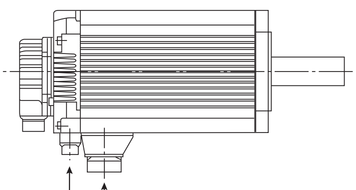
Servomotor Connector Pin Arrangement



Pin No.	Signal	Pin No.	Signal
A	Phase U	E *	Brake terminal
B	Phase V	F *	Brake terminal
C	Phase W	G	—
D	FG (Frame Ground)		

* No polarity

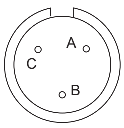
② 4.0 kW and 5.5 kW



Servomotor-end connector

Brake-end connector

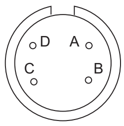
Brake Connector Pin Arrangement



Pin No.	Signal
A *	Brake terminal
B *	Brake terminal
C	—

* No polarity

Servomotor Connector Pin Arrangement



Pin No.	Signal
A	Phase U
B	Phase V
C	Phase W
D	FG (Frame Ground)

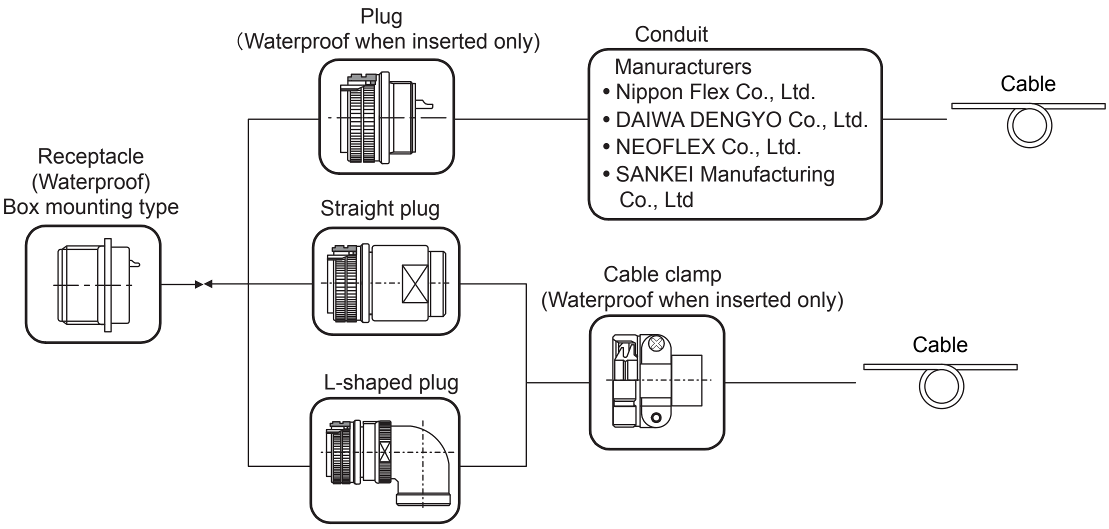
Specifications and Dimensional Drawings of Cables and Peripheral Devices

5

5.2.19 Connectors Manufactured by DDK Ltd.

Contact Yaskawa Controls Co., Ltd.

(1) Connector Configuration



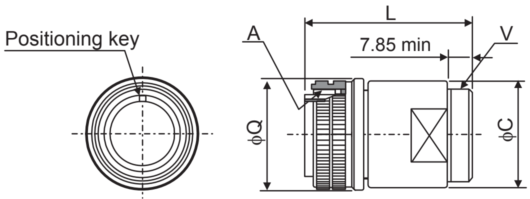
Note: Possible to connect with an MS connector.

(2) Products List

For more information, contact the manufacturer the conduit being used.

Servomotor Receptacle	Plug Type	Plug Model	Waterproof Cable Clamp	Reference
CE05-2A18-10PD-B	Solid Plug	CE05-6A18-10SD-B	Applicable with conduit	(5)
	Straight plug	CE05-6A18-10SD-B-BSS	CE3057-10A-□	(3), (6)
	L-shaped plug	CE05-8A18-10SD-B-BAS	(D265)	(4), (6)

(3) Straight Plug Dimensional Drawing

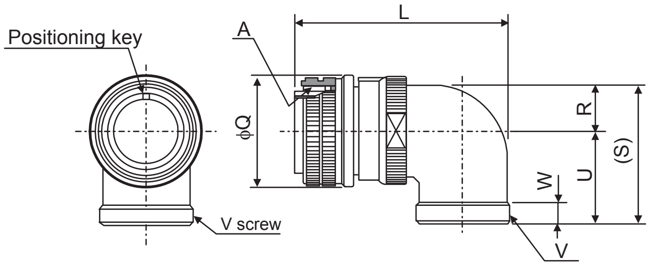


Units: mm

Model	Joint Screw A	Outer Diameter of Joint Nut $\phi Q^{+0}_{-0.38}$	ϕC±0.8	Overall Length L max.	Cable Clamp Set Screw V
CE05-6A18-10SD-B-BSS	1 1/8-18UNEF-2B	34.13	32.1	57	1-20UNEF-2A

Note: The plug CE05-6A□□-□□P□-B-BSS is pin inserting type. The mating receptacle is socket inserting type.

(4) L-shaped Plug Dimensional Drawing

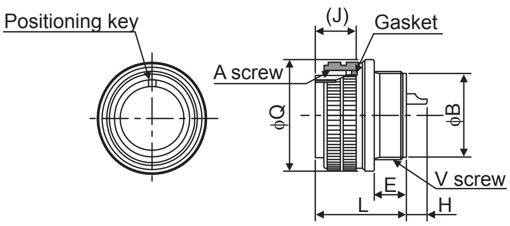


Units: mm

Model	Joint Screw A	Outer Diameter of Joint Nut $\phi Q^{+0}_{-0.38}$	Overall Length L max.	Cable Clamp Set Screw V	R±0.7	U±0.7	(S)±1	Effective Screw Length W
CE05-8A18-10SD-B-BAS	1 1/8-18UNEF-2B	34.13	69.5	1-20UNEF-2A	13.2	30.2	43.4	7.5

Note: The L-shaped plug model CE05-8A□□-□□P□-B-BAS is pin inserting type. The mating receptacle is socket inserting type.

(5) Plug Dimensional Drawing



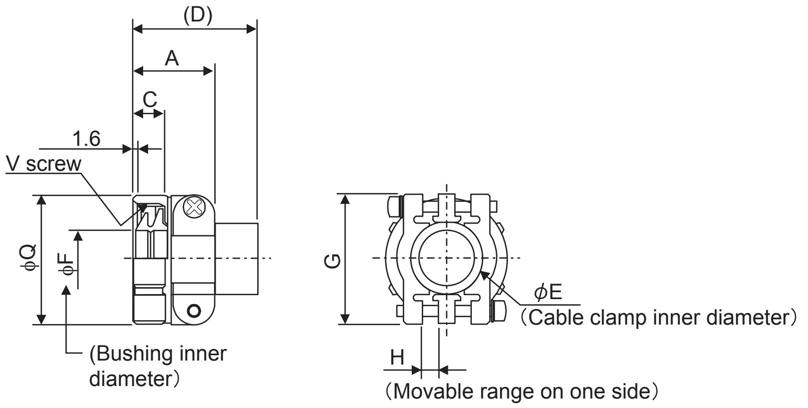
Units: mm

Model	Joint Screw A	Outer Diameter of Joint Nut $\phi Q^{+0}_{-0.38}$	Overall Length L±1	Conduit Set Screw V	E±0.5	$\phi B^{+0.05}_{-0.25}$	H±0.1	(J)
CE05-6A18-10SD-B	1 1/8-18UNEF-2B	34.13	33.7	1-20UNEF-2A	11.74	23.5	6.4	19.0

Note: 1. The plug CE05-6A□□-□□P□-B is pin inserting type. The mating receptacle is socket inserted type.

2. Consult the conduit manufacturer if a conduit is required.

(6) Waterproof Cable Clamp with Rubber Bushing Model CE3057-10A-□(D265)



Units: mm

Model	Applicable Shell Size	Overall Length A±0.7	Outer Diameter ϕQ±0.7	Effective Screw Length C	(D)	E	F	G±0.7 (±0.03)	H
CE3057-10A-1(D265)							14.1		
CE3057-10A-2(D265)	18	23.8	30.1	10.3	(41.3)	15.9	11	31.7	3.2
CE3057-10A-3(D265)							8.7		

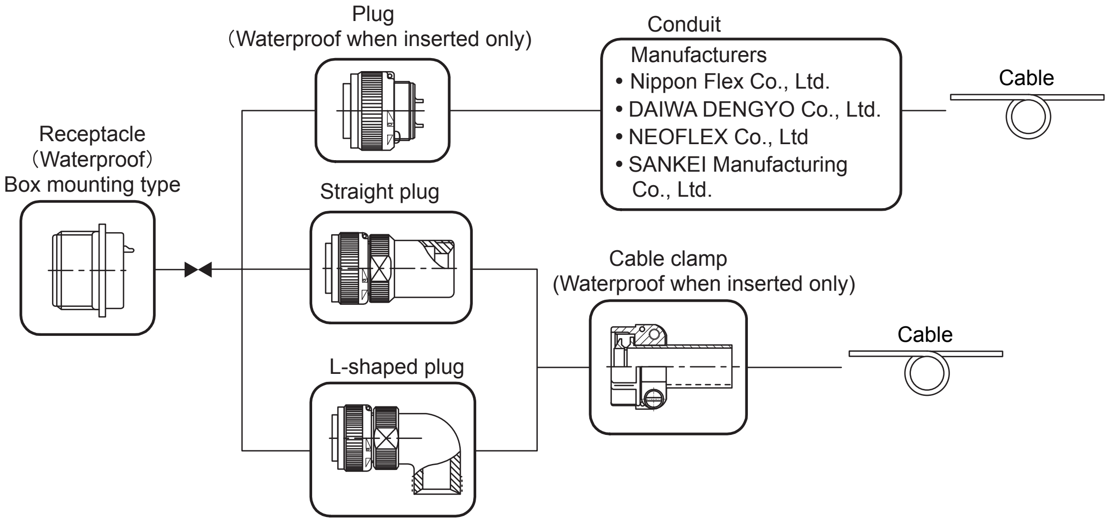
Model	Cable Clamp Set Screw V	Attached Bushing Model	Applicable Cable Range in mm (For reference)
CE3057-10A-1(D265)		CE3420-10-1	ϕ10.5 to ϕ14.1
CE3057-10A-2(D265)	1-20UNEF-2B	CE3420-10-2	ϕ8.5 to ϕ11.0
CE3057-10A-3(D265)		CE3420-10-3	ϕ6.5 to ϕ8.7

Note: The cable clamp CE3057-6A for the size 14 is not available. Use together with a conduit.

5.2.20 Connectors Manufactured by Japan Aviation Electronics Industry, Ltd.

Contact Yaskawa Controls Co., Ltd.

(1) Connector Configuration



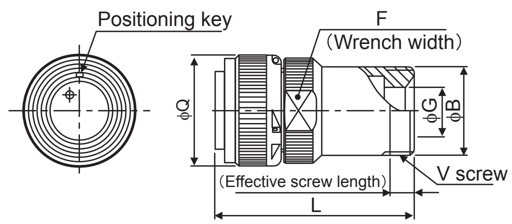
Note: Possible to connect with an MS connector.

(2) Products List

For more information, contact the manufacturer the conduit being used.

Type	Receptacle	Plug		Waterproof Cable Clamp	Reference
		Type	Model		
With brake	JL04V-2E20-15PE-B	Plug	JL04V-6A20-15SE	Conduit	(5)
		Straight plug	JL04V-6A20-15SE-EB	JL04-2022CK(14) or conduit	(3), (6)
		L-shaped plug	JL04V-8A20-15SE-EB		(4), (6)
Without brake	JL04HV-2E22-22PE-B	Plug	JL04V-6A22-22SE	Conduit	(5)
		Straight plug	JL04V-6A22-22SE-EB	JL04-2022CK(14) or conduit	(3), (6)
		L-shaped plug	JL04V-8A22-22SE-EB		(4), (6)

(3) Straight Plug Dimensional Drawing

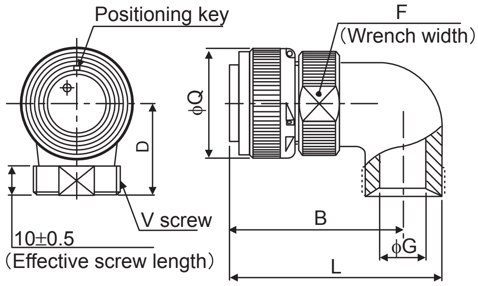


Units: mm

Model	Outer Diameter of Joint Nut φQ±0.8	φB±0.2	L±0.8	F±0.5	φG±0.5	Cable Clamp Set Screw V
JL04V-6A20-15SE-EB	37.3	29.72	58.5	33	17	1-3/16-18UNEF-2A
JL04V-6A22-22SE-EB	40.5	30.05	67.63	35	17	1-3/16-18UNEF-2A

Note: For the conduit grounding, contact manufacturer for the conduit being used.

(4) L-shaped Plug Dimensional Drawing

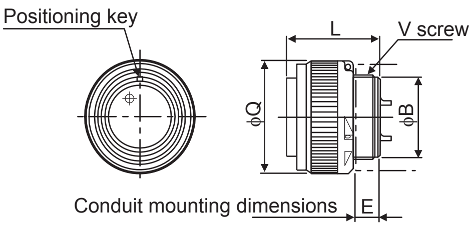


Units: mm

Model	Outer Diameter of Joint Nut $\phi Q^{+0}_{-0.38}$	B±0.8	L±0.8	D±0.8	F±0.5	φG±0.5	Cable Clamp Set Screw V
JL04V-8A20-15SE-EB	37.3	60.5	74.2	32	33	17	1-3/16-18UNEF-2A
JL04V-8A22-22SE-EB	40.5	60.23	73.93	32	35	17	1-3/16-18UNEF-2A

Note: For the conduit grounding, contact manufacturer of the conduit being used.

(5) Plug Dimensional Drawing

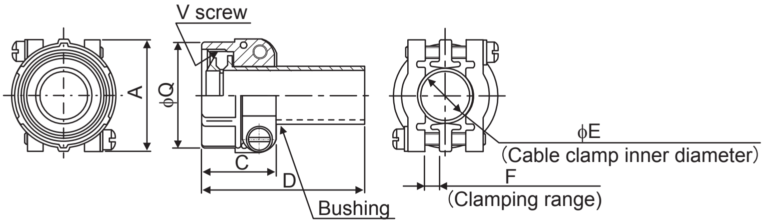


Units: mm

Model	Outer Diameter of Joint Nut φQ±0.8	φB±0.2	L±0.4	E max.	Conduit Set Screw V
JL04V-6A20-15SE	37.3	27.0	31.5	8	1-1/8-18UNEF-2A
JL04V-6A22-22SE	40.5	29.7	31.2	8	1-1/4-18UNEF-2A

Note: For the conduit grounding, contact manufacturer of the conduit being used.

(6) Waterproof Cable Clamps with Rubber Bushings



Units: mm

Model	Applicable Shell Size	A±0.8	φQ±0.8	C±0.8	D±0.8	φE±0.8	F±0.8	Set Screw V	Applicable Cable Range (For reference)
JL04-2022CK(09)	20, 22	37.3	34.9	24.3	53.8	9.5	4	1-3/16-18UNEF-2B	φ6.5 to φ9.5
JL04-2022CK(12)						13			φ9.5 to φ13
JL04-2022CK(14)						16			φ12.9 to φ16

5.3 SERVOPACK Main Circuit Wire Size

NOTE

1. Wire sizes are selected for three cables per bundle at 40°C ambient temperature with the rated current.
2. Use cable with withstand voltage of 600 V for main circuits.
3. If cables are bundled in PVC or metal ducts, consider the reduction ratio of the allowable current.
4. Use heat-resistant cable under high ambient or panel temperatures where normal vinyl cable will rapidly deteriorate.
5. Use cable within the allowable moment of inertia.
6. Do not use in continuous regenerating status.

5.3.1 Cable Types

Cable Types		Allowable Conductor Temperature °C
Symbol	Name	
PVC	Normal vinyl cable	−
IV	600-V vinyl cable	60
HIV	Temperature-resistant vinyl cable	75

The table shows the wire size and allowable currency for three cables. Use a cable whose specifications meet or are less than the values in the table.

- 600 V Heat-resistant Vinyl Cable (HIV)

AWG size	Nominal Cross Section Diameter (mm^2)	Configuration (number of wires/mm^2)	Conductive Resistance (Ω/km)	Allowable Currency at Ambient Temperatures (A)		
				30°C	40°C	50°C
20	0.5	19/0.18	39.5	6.6	5.6	4.5
−	0.75	30/0.18	26.0	8.8	7.0	5.5
18	0.9	37/0.18	24.4	9.0	7.7	6.0
16	1.25	50/0.18	15.6	12.0	11.0	8.5
14	2.0	7/0.6	9.53	23	20	16
12	3.5	7/0.8	5.41	33	29	24
10	5.5	7/1.0	3.47	43	38	31
8	8.0	7/1.2	2.41	55	49	40
6	14.0	7/1.6	1.35	79	70	57

Note: The values in the table are only for reference.

5.3.2 Single-phase for 100 V

External Terminal Name	Terminal Symbol	SERVOPACK Model SGDS-			
		A3B	A5F	01F	02F
Main circuit power input terminals	L1, L2	HIV1.25			HIV2.0
Servomotor connection terminals	U, V, W	HIV1.25			
Control power input terminals	L1C, L2C	HIV1.25			
External regenerative resistor connection terminals	B1/ , B2	HIV1.25			
Ground terminal	⏚	HIV2.0 min.			

5.3.3 Single-phase for 200 V

External Terminal Name	Terminal Symbol	SERVOPACK Model SGDS-				
		A5A	01A	02A	04A	08A
Main circuit power input terminals	L1, L2	HIV1.25			HIV2.0	
Servomotor connection terminals	U, V, W	HIV1.25				
Control power input terminals	L1C, L2C	HIV1.25				
External regenerative resistor connection terminal	B1/⊕, B2	HIV1.25				
Ground terminal	⏚	HIV2.0 min.				

5.3.4 Three-phase for 200 V

External Terminal Name	Terminal Symbol	SERVOPACK Model SGDS-					
		05A	10A	15A	20A	30A	50A
Main circuit power input terminals	L1, L2, L3	HIV2.0			HIV3.5		HIV5.5
Servomotor connection terminals	U, V, W	HIV2.0			HIV3.5	HIV5.5	HIV8
Control power input terminals	L1C, L2C	HIV1.25					
External regenerative resistor connection terminals	B1/⊕, B2	HIV1.25			HIV2.0	HIV3.5	HIV5.5
Ground terminal	⏚	HIV2.0 min.					

External Terminal Name	Terminal Symbol	SERVOPACK Model SGDS-	
		60A	75A
Main circuit power input terminals	L1, L2, L3	HIV8.0	HIV14
Servomotor connection terminals	U, V, W	HIV14	
Control power input terminals	L1C, L2C	HIV1.25	
External regenerative resistor connection terminals	B1, B2	HIV8.0	
Ground terminal	⏚	HIV2.0 min.	

5.4 Encoder Cables

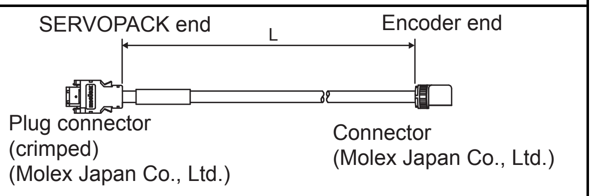
5.4.1 Encoder Cables for 50 to 1.15 kW SGMAS and 100 to 400 W SGMPS Servomotors

When using a cable with encoder loose leads or a cable assembled by the customer, be sure to connect the shield of encoder cable to the connector case (shell).

(1) Cable with Connectors (For Incremental Encoder)

(a) Cable Type

Standard Type	Flexible Type	Length (L)	Dimensional Drawing
JZSP-CSP01-03	JZSP-CSP21-03	3 m	
JZSP-CSP01-05	JZSP-CSP21-05	5 m	
JZSP-CSP01-10	JZSP-CSP21-10	10 m	
JZSP-CSP01-15	JZSP-CSP21-15	15 m	
JZSP-CSP01-20	JZSP-CSP21-20	20 m	



(b) Wiring Specifications

• Standard Type

SERVOPACK end Pin No.	Signal	Encoder (Servomotor) end Pin No.	Lead Color
6	/PS	5	Light blue/white
5	PS	4	Light blue
4	BAT(-)	8	Orange/white
3	BAT(+)	9	Orange
2	PG 0V	3	Black
1	PG 5V	6	Red
Shell	FG	Shell	FG

Shield wire

• Flexible Type

SERVOPACK end Pin No.	Signal	Encoder (Servomotor) end Pin No.	Lead Color
6	/PS	5	Black/pink
5	PS	4	Pink/red
4	BAT(-)	8	Black/ligint blue
3	BAT(+)	9	Red/light blue
2	PG 0V	3	Green
1	PG 5V	6	Orange
Shell	FG	Shell	FG

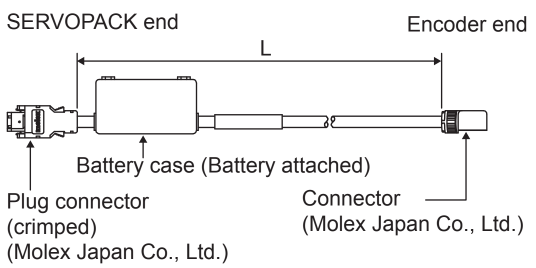
Shield wire

(2) Cable with Connectors (For Absolute Encoder, With a Battery Case)

When using an absolute encoder and connecting a battery to the host controller, no battery case is required. In this case, use a cable for incremental encoder.

(a) Cable Type

Standard Type	Flexible Type	Length (L)	Dimensional Drawing
JZSP-CSP05-03	JZSP-CSP25-03	3 m	
JZSP-CSP05-05	JZSP-CSP25-05	5 m	
JZSP-CSP05-10	JZSP-CSP25-10	10 m	
JZSP-CSP05-15	JZSP-CSP25-15	15 m	
JZSP-CSP05-20	JZSP-CSP25-20	20 m	



(b) Wiring Specifications

• Standard Type

SERVOPACK end

Pin No.	Signal
6	/PS
5	PS
4	BAT (-)
3	BAT (+)
2	PG0V
1	PG5V
Shell	FG

Encoder (Servomotor) end

Pin No.	Lead Color
5	Light blue/white
4	Light blue
8	White/orange
9	Orange
3	Black
6	Red
Shell	FG

Shield wire

Battery case

Pin No.	Signal
2	BAT (-)
1	BAT (+)

• Flexible Type

SERVOPACK end

Pin No.	Signal
6	/PS
5	PS
4	BAT(-)
3	BAT(+)
2	PG 0V
1	PG 5V
Shell	FG

Encoder (Servomotor) end

Pin No.	Lead Color
5	Black/pink
4	Pink/red
8	Black/light blue
9	Red/light blue
3	Green
6	Orange
Shell	FG

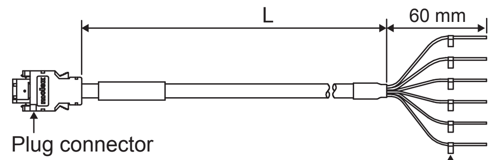
Shield wire

Battery case

Pin No.	Signal
2	BAT(-)
1	BAT(+)

(3) Cable With a SERVOPACK Connector and Encoder Loose Leads (For Incremental Encoder)

(a) Cable Type

Standard Type	Flexible Type	Length (L)	Dimensional Drawing
JZSP-CMP03-03	JZSP-CMP13-03	3 m	
JZSP-CMP03-05	JZSP-CMP13-05	5 m	
JZSP-CMP03-10	JZSP-CMP13-10	10 m	
JZSP-CMP03-15	JZSP-CMP13-15	15 m	
JZSP-CMP03-20	JZSP-CMP13-20	20 m	

(b) Wiring Specifications

• Standard Type

SERVOPACK end

Pin No.	Signal
6	/PS
5	PS
4	BAT (-)
3	BAT (+)
2	PG0V
1	PG5V
Shell	FG

Encoder (Servomotor) end

Lead Color	Marker
Light blue/white	6
Light blue	5
White/orange	4
Orange	3
Black	2
Red	1

Shield wire

• Flexible Type

SERVOPACK end

Pin No.	Signal
6	/PS
5	PS
4	BAT(-)
3	BAT(+)
2	PG 0V
1	PG 5V
Shell	FG

Encoder (Servomotor) end

Lead Color	Marker
Black/pink	6
Red/pink	5
Black/light blue	4
Red	3
Green	2
Orange	1

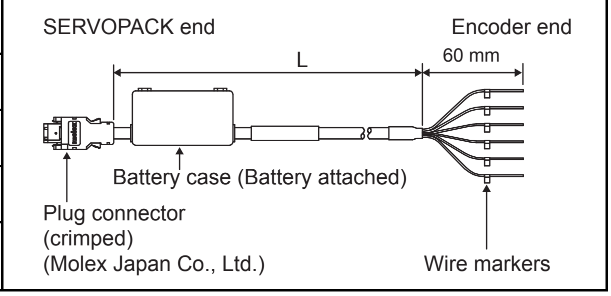
Shield wire

Notes: 1. The signals BAT (+) and BAT (-) are used when using an absolute encoder
2. Be sure to connect the shield wire of encoder cable to the connector case (shell).

(4) Cable with a SERVOPACK Connector and Encoder Loose Leads (For Absolute Encoder, With a Battery Case)

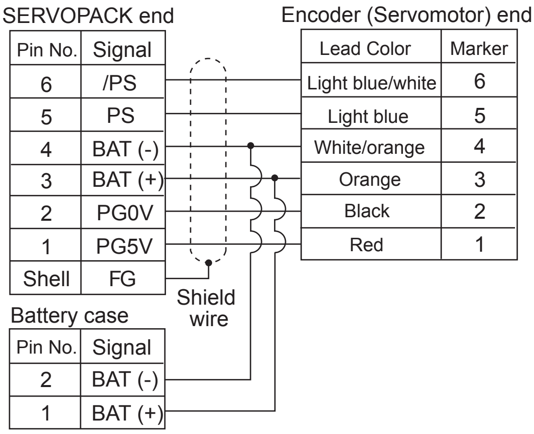
When using an absolute encoder and connecting a battery to the host controller, no battery case is required. In this case, use a cable for incremental encoder.

(a) Cable Type

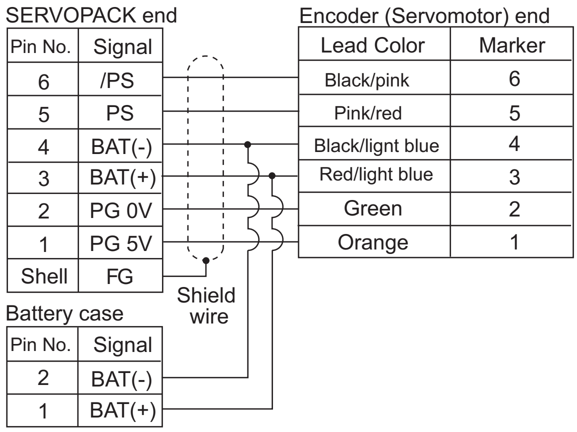
Standard Type	Flexible Type	Length (L)	Dimensional Drawing
JZSP-CSP04-03	JZSP-CSP24-03	3 m	
JZSP-CSP04-05	JZSP-CSP24-05	5 m	
JZSP-CSP04-10	JZSP-CSP24-10	10 m	
JZSP-CSP04-15	JZSP-CSP24-15	15 m	
JZSP-CSP04-20	JZSP-CSP24-20	20 m	

(b) Wiring Specifications

- Standard Type



- Flexible Type



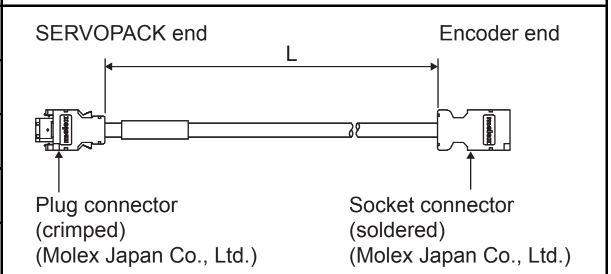
Note: Be sure to connect the shield wire of encoder cable to the connector case (shell).

5.4.2 Encoder Cables for 750W and 1.5 kW SGMMJ and SGMPS Servomotors

If you use cables with loose leads or assemble the cables, connect the shield wire of the encoder cable to the connector case (shell).

(1) Cable with Connectors (For Incremental Encoder)

(a) Cable Type

Standard Type	Flexible Type	Length (L)	Dimensional Drawing
JZSP-CMP00-03	JZSP-CMP10-03	3 m	
JZSP-CMP00-05	JZSP-CMP10-05	5 m	
JZSP-CMP00-10	JZSP-CMP10-10	10 m	
JZSP-CMP00-15	JZSP-CMP10-15	15 m	
JZSP-CMP00-20	JZSP-CMP10-20	20 m	

(b) Wiring Specifications

- Standard Type

SERVOPACK end Pin No.	Signal		Encoder (Servomotor) end Pin No.	Lead Color
6	/PS		6	Light blue/white
5	PS		5	Light blue
4	BAT(-)		4	White/orange
3	BAT(+)		3	Orange
2	PG0V		2	Black
1	PG5V		1	Red
Shell	FG	Shield wire	Shell	FG

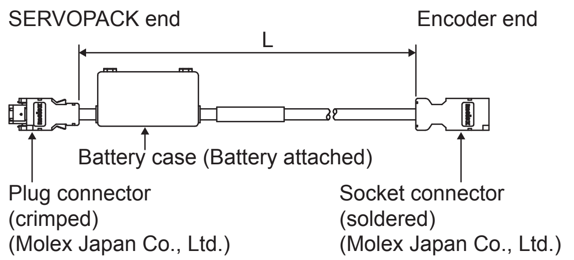
- Flexible Type

SERVOPACK end Pin No.	Signal		Encoder (Servomotor) end Pin No.	Lead Color
6	/PS		6	Black/pink
5	PS		5	Pink/red
4	BAT(-)		4	Black/lignt blue
3	BAT(+)		3	Red/light blue
2	PG 0V		2	Green
1	PG 5V		1	Orange
Shell	FG	Shield wire	Shell	FG

(2) Cable with Connectors (For Absolute Encoder, with a Battery Case)

When using an absolute encoder and connecting a battery to the host controller, no battery case is required. In this case, use a cable for incremental encoder.

(a) Cable Type

Standard Type	Flexible Type	Length (L)	Dimensional Drawing
JZSP-CSP19-03	JZSP-CSP29-03	3 m	
JZSP-CSP19-05	JZSP-CSP29-05	5 m	
JZSP-CSP19-10	JZSP-CSP29-10	10 m	
JZSP-CSP19-15	JZSP-CSP29-15	15 m	
JZSP-CSP19-20	JZSP-CSP29-20	20 m	

(b) Wiring Specifications

- Standard Type

SERVOPACK end Pin No.	Signal		Encoder (Servomotor) end Pin No.	Lead Color
6	/PS		6	Light blue/white
5	PS		5	Light blue
4	BAT(-)		4	White/orange
3	BAT(+)		3	Orange
2	PG0V		2	Black
1	PG5V		1	Red
Shell	FG	Shield wire	Shell	FG

Battery case

Pin No.	Signal
2	BAT(-)
1	BAT(+)

- Flexible Type

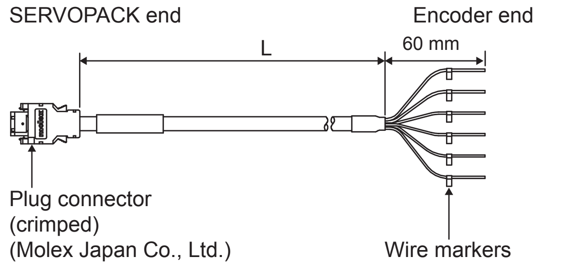
SERVOPACK end Pin No.	Signal		Encoder (Servomotor) end Pin No.	Lead Color
6	/PS		6	Black/pink
5	PS		5	Pink/red
4	BAT(-)		4	Black/lignt blue
3	BAT(+)		3	Red/light blue
2	PG 0V		2	Green
1	PG 5V		1	Orange
Shell	FG	Shield wire	Shell	FG

Battery case

Pin No	Signal
2	BAT(-)
1	BAT(+)

(3) Cable with a SERVOPACK Connector and Encoder Loose Leads (For Incremental Encoder)

(a) Cable Type

Standard Type	Flexible Type	Length (L)	Dimensional Drawing
JZSP-CMP03-03	JZSP-CMP13-03	3 m	
JZSP-CMP03-05	JZSP-CMP13-05	5 m	
JZSP-CMP03-10	JZSP-CMP13-10	10 m	
JZSP-CMP03-15	JZSP-CMP13-15	15 m	
JZSP-CMP03-20	JZSP-CMP13-20	20 m	

(b) Wiring Specifications

- Standard Type

SERVOPACK end / Encoder (Servomotor) end

Pin No.	Signal	Lead Color	Marker
6	/PS	Light blue/white	6
5	PS	Light blue	5
4	BAT(-)	White/orange	4
3	BAT(+)	Orange	3
2	PG0V	Black	2
1	PG5V	Red	1
Shell	FG	Shield wire	

- Flexible Type

SERVOPACK end / Encoder (Servomotor) end

Pin No.	Signal	Lead Color	Marker
6	/PS	Black/light blue	6
5	PS	Red/light blue	5
4	BAT(-)	Black/pink	4
3	BAT(+)	Red/pink	3
2	PG 0V	Green	2
1	PG 5V	Orange	1
Shell	FG	Shield wire	

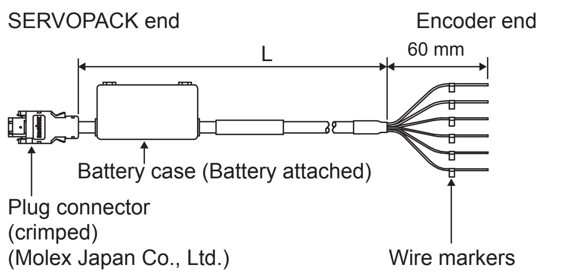
Note: 1. The signals BAT (+) and BAT (-) are used when using an absolute encoder

2. Be sure to connect the shield wire of encoder cable to the connector case (shell).

(4) Cable with a SERVOPACK Connector and Encoder Loose Leads (For Absolute Encoder, with a Battery Case)

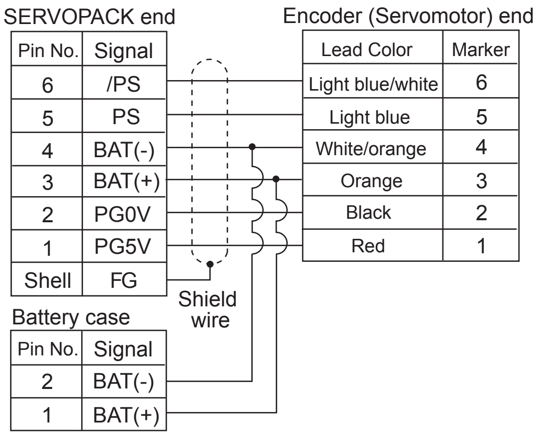
When using an absolute encoder and connecting a battery to the host controller, no battery case is required. In this case, use a cable for incremental encoder.

(a) Cable Type

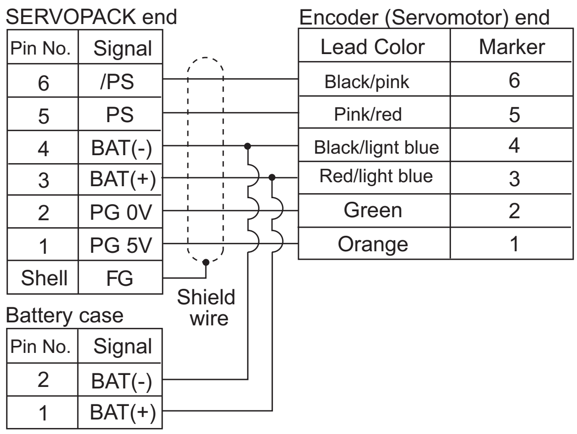
Standard Type	Flexible Type	Length (L)	Dimensional Drawing
JZSP-CSP04-03	JZSP-CSP24-03	3 m	
JZSP-CSP04-05	JZSP-CSP24-05	5 m	
JZSP-CSP04-10	JZSP-CSP24-10	10 m	
JZSP-CSP04-15	JZSP-CSP24-15	15 m	
JZSP-CSP04-20	JZSP-CSP24-20	20 m	

(b) Wiring Specifications

- Standard Type



- Flexible Type



Note: Be sure to connect the shield wire of encoder cable to the connector case (shell).

5.4.3 Encoder Cables for SGMCS Servomotors

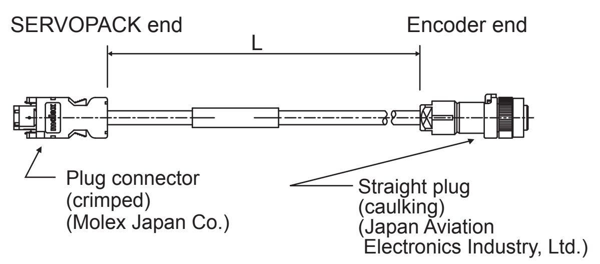
If you use cables with loose leads or assemble the cables, be sure to connect the shield wire of the encoder cable to the connector frame ground (FG).

(1) Cable With Connectors for Applicable Flange 1, 3

For applicable flanges, refer to *2.1.5 Model SGMCS.*

(a) Cable Type

Standard Type	Flexible Type	Length (L)	Dimensional Drawing
JZSP-CMP60-03	JZSP-CSP60-03	3 m	
JZSP-CMP60-05	JZSP-CSP60-05	5 m	
JZSP-CMP60-10	JZSP-CSP60-10	10 m	
JZSP-CMP60-15	JZSP-CSP60-15	15 m	
JZSP-CMP60-20	JZSP-CSP60-20	20 m	



(b) Wiring Specifications

- Standard Type

SERVOPACK end

Pin No.	Signal
1	PG5V
2	PG0V
5	PS
6	/PS
Shell	FG

Shield wire

Servomotor end

Pin No.	Lead Color
4	Red
9	Black
1	Light blue
2	Light blue/white
7	FG Shield wire

- Flexible Type

SERVOPACK end

Pin No.	Signal
1	PG 5V
2	PG 0V
5	PS
6	/PS
Shell	FG

Shield wire

Encoder (Servomotor) end

Pin No.	Lead Color
4	Orange
9	Green
1	Black/light blue
2	Red/light blue
7	FG Shield wire

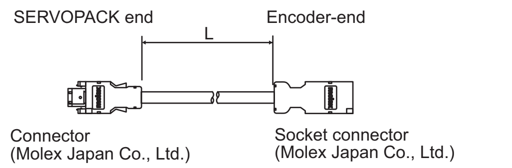
Note: Be sure to connect the shield wire of encoder cable to the connector case (shell).

(2) Cable with Connectors for Applicable Flange 4

For applicable flanges, refer to *2.1.5 Model SGMCS.*

(a) Cable Type

Standard Type	Flexible Type	Length (L)	Dimensional Drawing
JZSP-CMP00-03	JZSP-CMP10-03	3 m	
JZSP-CMP00-05	JZSP-CMP10-05	5 m	
JZSP-CMP00-10	JZSP-CMP10-10	10 m	
JZSP-CMP00-15	JZSP-CMP10-15	15 m	
JZSP-CMP00-20	JZSP-CMP10-20	20 m	



(b) Wiring Specifications

- Standard Type

SERVOPACK end

Pin No.	Signal
1	PG 5V
2	PG 0V
5	PS
6	/PS
Shell	FG

Shield wire

Encoder (Servomotor end)

Pin No.	Lead Color
1	Red
2	Black
5	Light blue
6	Light blue/white
Shell	FG Shield wire

- Flexible Type

SERVOPACK end

Pin No.	Signal
1	PG 5V
2	PG 0V
5	PS
6	/PS
Shell	FG

Shield wire

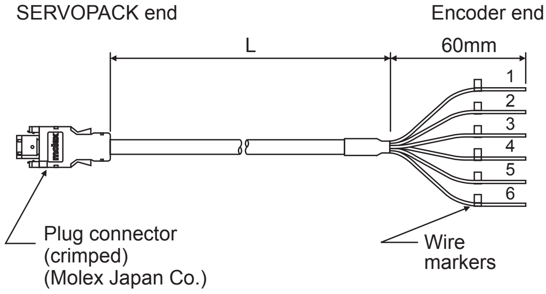
Encoder (Servomotor end)

Pin No.	Lead Color
1	Orange
2	Green
5	Black/light blue
6	Red/light blue
Shell	FG Shield wire

Note: Be sure to connect the shield wire of encoder cable to the connector case (shell).

(3) Cable with a SERVOPACK Connector and Encoder Loose Leads

(a) Cable Type

Standard Type	Flexible Type	Length (L)	Dimensional Drawing
JZSP-CMP03-03	JZSP-CMP13-03	3 m	
JZSP-CMP03-05	JZSP-CMP13-05	5 m	
JZSP-CMP03-10	JZSP-CMP13-10	10 m	
JZSP-CMP03-15	JZSP-CMP13-15	15 m	
JZSP-CMP03-20	JZSP-CMP13-20	20 m	

(b) Wiring Specifications

• Standard Type

SERVOPACK end Pin No.	SERVOPACK end Signal	Encoder (Servomotor) end Lead Color	Encoder (Servomotor) end Marker
6	/PS	Light blue/white	6
5	PS	Light blue	5
4	BAT(-)	White/orange	4
3	BAT(+)	Orange	3
2	PG0V	Black	2
1	PG5V	Red	1
Shell	FG	Shield wire	

• Flexible Type

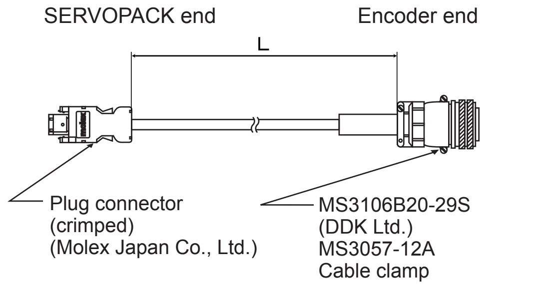
SERVOPACK end Pin No.	SERVOPACK end Signal	Encoder (Servomotor) end Lead Color	Encoder (Servomotor) end Marker
6	/PS	Black/light blue	6
5	PS	Red/light blue	5
4	BAT(-)	Black/pink	4
3	BAT(+)	Red/pink	3
2	PG 0V	Green	2
1	PG 5V	Orange	1
Shell	FG	Shield wire	

Notes: 1. The signals BAT (+) and BAT (-) are used when using an absolute encoder
2. Be sure to connect the shield wire of encoder cable to the connector case (shell).

5.4.4 Encoder Cables for SGMSS and SGMGH Servomotors

(1) Cable with a SERVOPACK Connector and Encoder Straight Plug (For Incremental Encoder)

(a) Cable Type

Standard Type	Flexible Type	Length (L)	Dimensional Drawing
JZSP-CMP01-03	JZSP-CMP11-03	3 m	
JZSP-CMP01-05	JZSP-CMP11-05	5 m	
JZSP-CMP01-10	JZSP-CMP11-10	10 m	
JZSP-CMP01-15	JZSP-CMP11-15	15 m	
JZSP-CMP01-20	JZSP-CMP11-20	20 m	

(b) Wiring Specifications

- Standard Type

SERVOPACK end Pin No.	Signal		Encoder (Servomotor) end Pin No.	Lead Color
5	PS		C	Light blue
6	/PS		D	Light blue/white
2	PG0V		G	Black
1	PG5V		H	Red
4	BAT(-)		S	White/orange
3	BAT(+)		T	Orange
Shell	FG	Shield wire	J	FG Shield wire

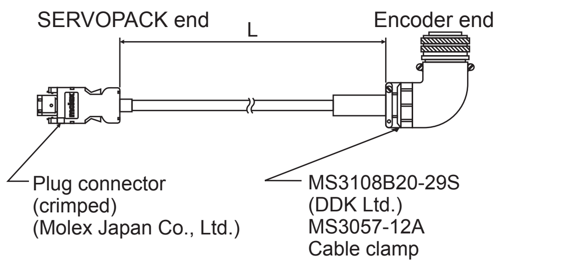
- Flexible Type

SERVOPACK end Pin No.	Signal		Encoder (Servomotor) end Pin No.	Lead Color
5	PS		C	Light blue
6	/PS		D	Light blue/white
2	PG 0V		G	Black
1	PG 5V		H	Red
4	BAT(-)		S	White/orange
3	BAT(+)		T	Orange
Shell	FG	Shield wire	J	FG Shield wire

Note: BAT(+) and BAT(-) are used when using an absolute encoder.

(2) Cable with a SERVOPACK Connector and Encoder L-shaped Plug (For Incremental Encoder)

(a) Cable Type

Standard Type	Flexible Type	Length (L)	Dimensional Drawing
JZSP-CMP02-03	JZSP-CMP12-03	3 m	
JZSP-CMP02-05	JZSP-CMP12-05	5 m	
JZSP-CMP02-10	JZSP-CMP12-10	10 m	
JZSP-CMP02-15	JZSP-CMP12-15	15 m	
JZSP-CMP02-20	JZSP-CMP12-20	20 m	

(b) Wiring Specifications

- Standard Type

SERVOPACK end Pin No.	Signal		Encoder (Servomotor) end Pin No.	Lead Color
5	PS		C	Light blue
6	/PS		D	Light blue/white
2	PG0V		G	Black
1	PG5V		H	Red
4	BAT(-)		S	White/orange
3	BAT(+)		T	Orange
Shell	FG	Shield wire	J	FG Shield wire

- Flexible Type

SERVOPACK end Pin No.	Signal		Encoder (Servomotor) end Pin No.	Lead Color
5	PS		C	Light blue
6	/PS		D	Light blue/white
2	PG 0V		G	Black
1	PG 5V		H	Red
4	BAT(-)		S	White/orange
3	BAT(+)		T	Orange
Shell	FG	Shield wire	J	FG Shield wire

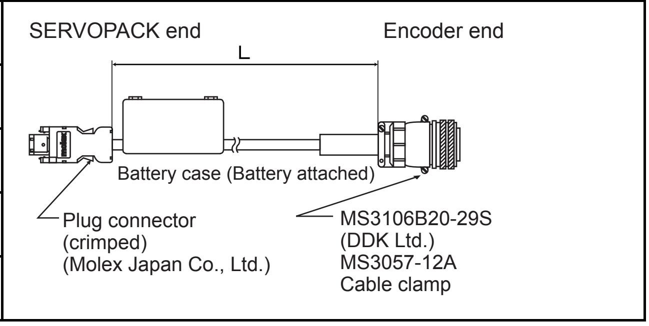
Note: BAT(+) and BAT(-) are used when using an absolute encoder.

(3) Cable with a SERVOPACK Connector and Encoder Straight Plug (For Absolute Encoder, with a Battery Case)

When using an absolute encoder and connecting a battery to the host controller, no battery case is required. In this case, use a cable for incremental encoder.

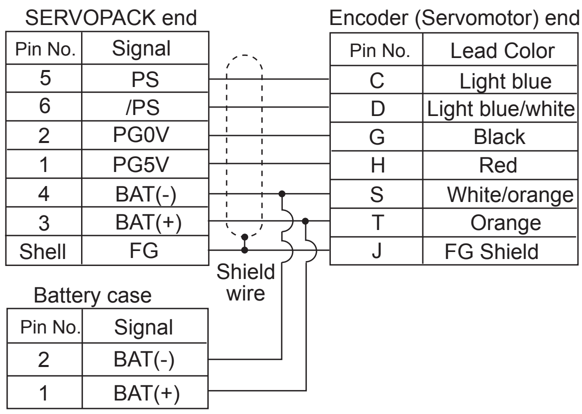
(a) Cable Type

Standard Type	Flexible Type	Length (L)	Dimensional Drawing
JZSP-CSP06-03	JZSP-CSP26-03	3 m	
JZSP-CSP06-05	JZSP-CSP26-05	5 m	
JZSP-CSP06-10	JZSP-CSP26-10	10 m	
JZSP-CSP06-15	JZSP-CSP26-15	15 m	
JZSP-CSP06-20	JZSP-CSP26-20	20 m	

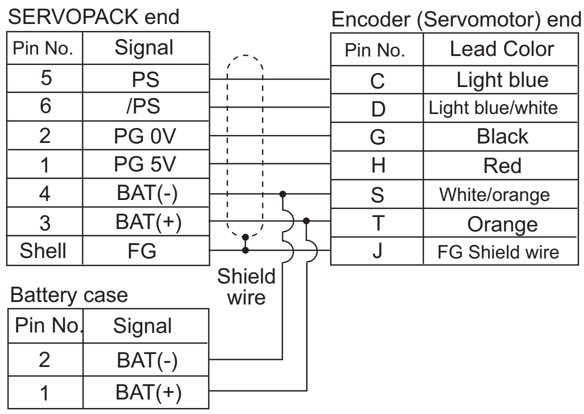


(b) Wiring Specifications

- Standard Type



- Flexible Type

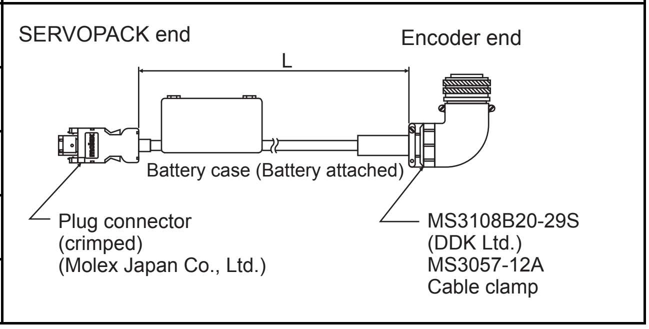


(4) Cable with a SERVOPACK Connector and Encoder L-shaped Plug (For Absolute Encoder, with a Battery Case)

When using an absolute encoder and connecting a battery to the host controller, no battery case is required. In this case, use a cable for incremental encoder.

(a) Cable Type

Standard Type	Flexible Type	Length (L)	Dimensional Drawing
JZSP-CSP07-03	JZSP-CSP27-03	3 m	
JZSP-CSP07-05	JZSP-CSP27-05	5 m	
JZSP-CSP07-10	JZSP-CSP27-10	10 m	
JZSP-CSP07-15	JZSP-CSP27-15	15 m	
JZSP-CSP07-20	JZSP-CSP27-20	20 m	



Specifications and Dimensional Drawings of Cables and Peripheral Devices

5

(b) Wiring Specifications

• Standard Type

SERVOPACK end

Pin No.	Signal
5	PS
6	/PS
2	PG0V
1	PG5V
4	BAT(-)
3	BAT(+)
Shell	FG

Shield wire

Encoder (Servomotor) end

Pin No.	Lead Color
C	Light blue
D	Light blue/white
G	Black
H	Red
S	White/orange
T	Orange
J	FG Shield

Battery case

Pin No.	Signal
2	BAT(-)
1	BAT(+)

• Flexible Type

SERVOPACK end

Pin No.	Signal
5	PS
6	/PS
2	PG 0V
1	PG 5V
4	BAT(-)
3	BAT(+)
Shell	FG

Shield wire

Encoder (Servomotor) end

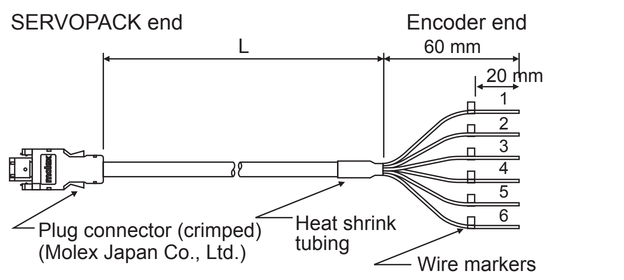
Pin No.	Lead Color
C	Light blue
D	Light blue/white
G	Black
H	Red
S	White/orange
T	Orange
J	FG Shield wire

Battery case

Pin No.	Signal
2	BAT(-)
1	BAT(+)

(5) Cable with a SERVOPACK Connector and Encoder Loose Leads (For Incremental Encoder)

(a) Cable Type

Standard Type	Flexible Type	Length (L)	Dimensional Drawing
JZSP-CMP03-03	JZSP-CMP13-03	3 m	
JZSP-CMP03-05	JZSP-CMP13-05	5 m	
JZSP-CMP03-10	JZSP-CMP13-10	10 m	
JZSP-CMP03-15	JZSP-CMP13-15	15 m	
JZSP-CMP03-20	JZSP-CMP13-20	20 m	

(b) Wiring Specifications

• Standard Type

SERVOPACK end

Pin No.	Signal
6	/PS
5	PS
4	BAT(-)
3	BAT(+)
2	PG0V
1	PG5V
Shell	FG

Shield wire

Encoder (Servomotor) end

Lead Color	Marker
Light blue/white	6
Light blue	5
White/orange	4
Orange	3
Black	2
Red	1

• Flexible Type

SERVOPACK end

Pin No.	Signal
6	/PS
5	PS
4	BAT(-)
3	BAT(+)
2	PG 0V
1	PG 5V
Shell	FG

Shield wire

Encoder (Servomotor) end

Lead Color	Marker
Light blue/white	6
Light blue	5
White/orange	4
Orange	3
Black	2
Red	1

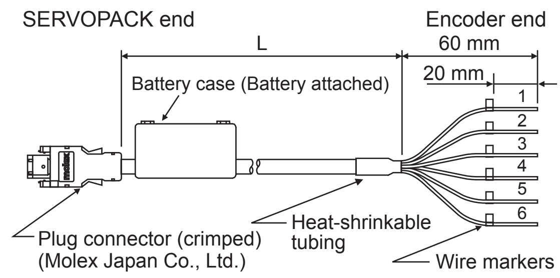
Notes: 1. The signals BAT (+) and BAT (-) are used when using an absolute encoder

2. Be sure to connect the shield wire of encoder cable to the connector case (shell).

(6) Cable with a SERVOPACK Connector and Encoder Loose Leads (For Absolute Encoder, and with a Battery Case)

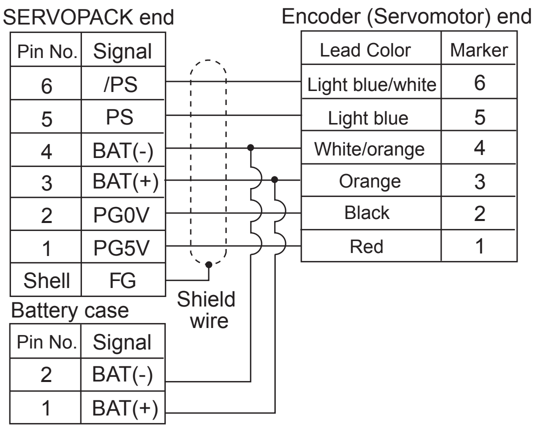
When using an absolute encoder and connecting a battery to the host controller, no battery case is required. In this case, use a cable for incremental encoder.

(a) Cable Type

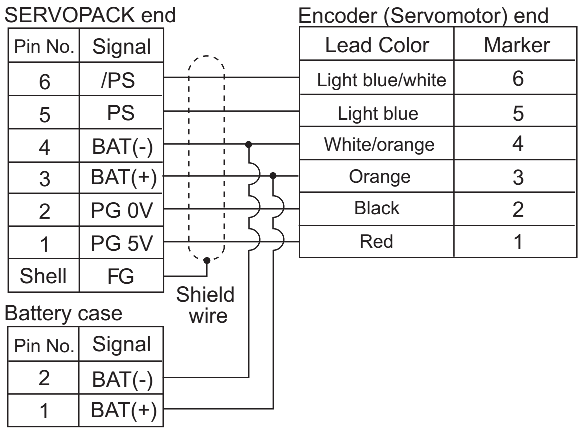
Standard Type	Flexible Type	Length (L)	Dimensional Drawing
JZSP-CSP04-03	JZSP-CSP24-03	3 m	
JZSP-CSP04-05	JZSP-CSP24-05	5 m	
JZSP-CSP04-10	JZSP-CSP24-10	10 m	
JZSP-CSP04-15	JZSP-CSP24-15	15 m	
JZSP-CSP04-20	JZSP-CSP24-20	20 m	

(b) Wiring Specifications

- Standard Type



- Flexible Type



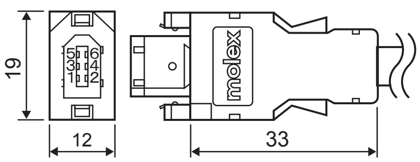
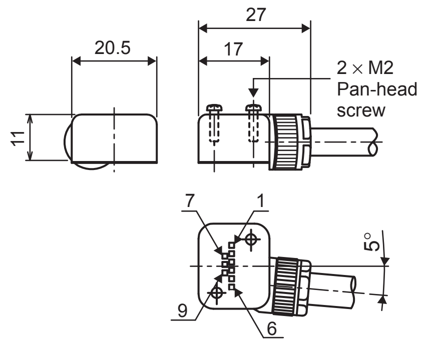
Note: Be sure to connect the shield wire of encoder cable to the connector case (shell).

5.5 Encoder Cables and Connectors

This section describes the specifications of encoder cables and connectors to be assembled by the customers.

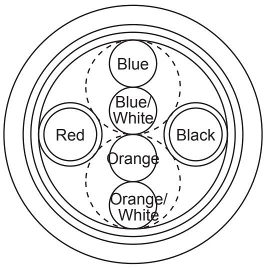
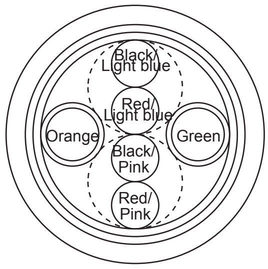
5.5.1 Encoder Cables and Connectors for SGMAS and 100 to 400 W SGMPS Servomotors

(1) Encoder Cable Connector Specifications

Items	SERVOPACK end	Servomotor (Encoder) end
Manufacturer	Molex Japan Co., Ltd.	Molex Japan Co., Ltd.
Incremental Encoder	55100-0600 (soldered) or	54346-0020 (caulking) * Mounting screw: M2 screws (×2) Applicable cable diameter: ϕ6.3 to ϕ7.7 Applicable wire size: AWG22 to 26 Outer diameter of insulating sheath: 1.05 to 1.4 m
Absolute Encoder	55102-0600 (caulking) 55100-0600 (soldered type) when using a connector kit	
External View (Dimensions in mm)		
Arranged Model	JZSP-CMP9-1	JZSP-CSP9-2

Note: The mating connector model on SERVOPACK: 53460-0611
The mating connector model on servomotor: 55833-0701
* A caulking tool is required.
The following caulking tools are applicable for the cables provided by Yaskawa. When using other wire sizes, contact the respective manufacturer for caulking tools.
Applicable caulking tool for Yaskawa's wire size: Hand Tool Model 57175-5000
Applicator Model 57175-3000

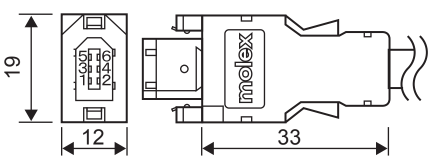
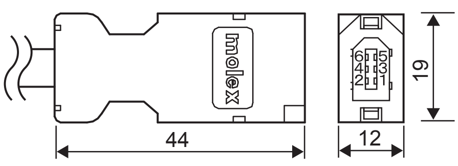
(2) Encoder Cables Specifications

Items	Standard Cable	Flexible Cable
Cable Type *	JZSP-CMP09-□□	JZSP-CSP39-□□
Cable Length	20 m max.	
Specifications	UL20276(Max. operating temperature: 80°C) AWG22 × 2C + AWG24 × 2P AWG22 (0.33 mm^2) Outer diameter of insulating sheath: ϕ1.15 mm AWG24 (0.20 mm^2) Outer diameter of insulating sheath: ϕ1.09 mm	UL20276 (Max. operating temperature: 80°C) AWG22 × 2C + AWG24 × 2P AWG22 (0.33 mm^2) Outer diameter of insulating sheath: ϕ1.35 mm AWG24 (0.20 mm^2) Outer diameter of insulating sheath: ϕ1.21 mm
Finished Dimensions	ϕ 6.5 mm	ϕ 6.8 mm
Internal Configuration and Lead Color		
Yaskawa Standards Specifications (Standard Lengths)	Cable length: 5 m, 10 m, 15 m, 20 m	

* Specify the cable length in □□ of cable type designation.
Example: JZSP-CSM09-05 (5 m)

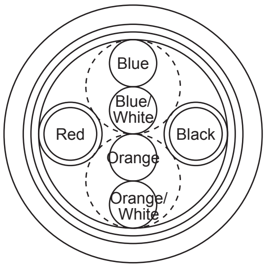
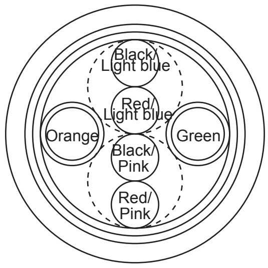
5.5.2 Encoder Cables and Connectors for 750 W and 1.5 kW SGMMJ and SGMPS Servomotors

(1) Encoder Cable Connector Specifications

Items	SERVOPACK end	Servomotor (Encoder) end
Manufacturer	Molex Japan Co., Ltd.	Molex Japan Co., Ltd.
Incremental Encoder	55100-0600 (Soldered) or 55102-0600 (Caulking)	54280-0600 (Soldered)
Absolute Encoder		
Appearance (Dimensions in mm)		
Type	JZSP-CMP9-1	JZSP-CMP9-2

Note: The mating connector model on SERVOPACK: 53460-0611
The mating connector model on servomotor: 55102-0600
* A caulking tool is required.
The following caulking tools are applicable for the cables provided by Yaskawa. When using other wire sizes, contact the respective manufacturer for caulking tools.
Applicable caulking tool for Yaskawa's wire size: Hand Tool Model 57175-5000
Applicator Model 57175-3000

(2) Encoder Cables Specifications

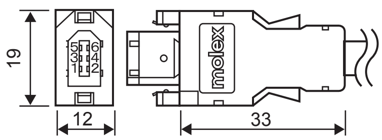
Items	Standard Type	Flexible Cable
Cable Type*	JZSP-CMP09-☐☐	JZSP-CSP39-☐☐
Cable Length	20 m max.	
Specifications	UL20276 (Max. operating temperature: 80°C) AWG22 × 2C + AWG24 × 2P AWG22 (0.33 mm^2) Outer diameter of insulating sheath: ϕ1.15 mm AWG24 (0.20 mm^2) Outer diameter of insulating sheath: ϕ1.09 mm	UL20276 (Max. operating temperature: 80°C) AWG22 × 2C + AWG24 × 2P AWG22 (0.33 mm^2) Outer diameter of insulating sheath: ϕ1.35 mm AWG24 (0.20 mm^2) Outer diameter of insulating sheath: ϕ1.21 mm
Finished Dimensions	ϕ6.5 mm	ϕ6.8 mm
Internal Configuration and Lead Colors		
Yaskawa Standard Specifications (Standard Length)	Cable length: 5 m, 10 m, 15 m, 20 m	

* Specify the cable length in ☐☐ of cable type designation.
Example: JZSP-CMP09-05 (5 m)

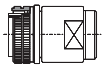
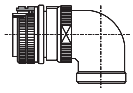
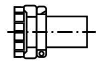
5.5.3 Encoder Cables and Connectors for SGMSS and SGMGH Servomotors

(1) Encoder Cable Connector Specifications

(a) SERVOPACK-end Connectors

Items	SERVOPACK end
Manufacturer	Molex Japan Co., Ltd.
Standard Environment Connector Type	55100-0600 (Soldered) or 55102-0600 (Caulking)
	The mating connector on SERVOPACK: 54280-0800
Appearance in mm	
Arranged Model	JZSP-CMP9-1

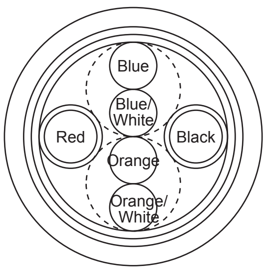
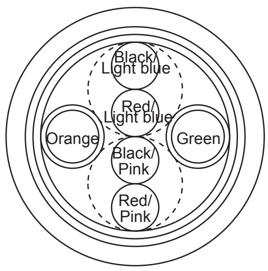
(b) Servomotor-end Connectors

Protection Type	Mating Connector on Servo-motor	Encoder-end Connector			
		Straight Plug	L-shaped Plug	Cable Clamp	Applicable Cable Diameter in mm
Standard environmental type	MS3102A 20-29P	MS3106B20-29S*1	MS3108B20-29S*1	MS3057-12A*1	–
Protective Structure IP67 / European Safety Standard conformed type	97F3102E 20-29P	JA06A-20-29S-J1-EB*2	JA08A-20-29S-J1-EB*2	JA04-2022CKE(09)*2	ϕ 6.5 to ϕ 9.5
				JA04-2022CKE(12)*2	ϕ 9.5 to ϕ 13
				JA04-2022CKE(14)*2	ϕ 12.9 to ϕ 15.9

* 1. Manufactured by DDK Ltd.
* 2. Manufactured by Japan Aviation Electronics Industry, Ltd.

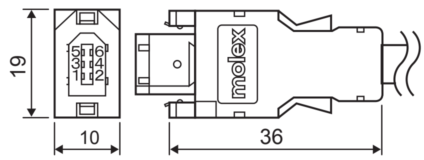
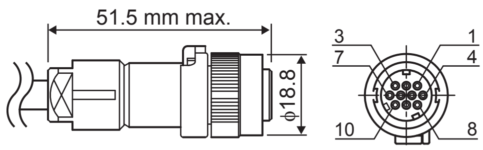
(2) Encoder Cables Specifications

Items	Standard Type	Flexible Cable
Cable Type *	JZSP-CMP09-□□	JZSP-CSP39-□□
Cable Length	20 m max.	
Specifications	UL20276 (Max. operating temperature: 80°C) AWG22 × 2C + AWG24 × 2P AWG22 (0.33 mm^2) Outer diameter of insulating sheath: ϕ 1.15 mm AWG24 (0.20 mm^2) Outer diameter of insulating sheath: ϕ 1.09 mm	UL20276 (Max. operating temperature: 80°C) AWG22 × 2C + AWG24 × 2P AWG22 (0.33 mm^2) Outer diameter of insulating sheath: ϕ 1.35 mm AWG24 (0.20 mm^2) Outer diameter of insulating sheath: ϕ 1.21 mm
Finished Dimensions	ϕ 6.5 mm	ϕ 6.8 mm
Internal Configuration and Lead Colors		
Yaskawa Standard Specifications (Standard Length)	Cable length: 5 m, 10 m, 15 m, 20 m	

* Specify the cable length in □□ of cable type designation.
Example: JZSP-CMP09-<u>05</u> (5 m)

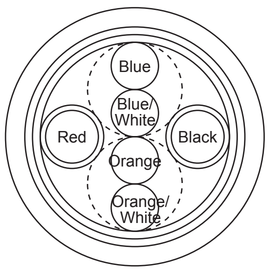
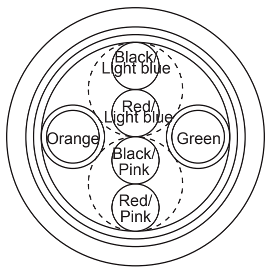
5.5.4 Encoder Cables and Connectors for SGMCS Servomotors

(1) Encoder Cable Connector Specifications

Items	SERVOPACK end	Servomotor end
Manufacturer	Molex Japan Co., Ltd.	Japan Aviation Electronics Industry, Ltd.
Connector Type	55100-0600 (Soldered type) or 55102-0600 (Caulking type) 55100-0600 (Soldered) when using a connector kit	Straight plug JN1DS10SL1 (Caulking type) Socket plug JN1-22-22S-PKG100 Applicable cable outer diameter in mm: ϕ5.7 to ϕ7.3 Applicable wire size: AWG21 to 25 Outer diameter of insulating sheath: 0.8 to 1.5 mm Caulking tool (Hand Tool) model: CT150-2-JN
Appearance		
Arranged Model	JZSP-CMP9-1	Order them from Japan Aviation Electronics Industry, Ltd.

Note: The mating connector type on servomotor: JN1AS10FL1

(2) Encoder Cable Specifications

Items	Standard Cable	Flexible Cable
Cable Type *	JZSP-CMP09-□□	JZSP-CSP39-□□
Cable Length	20 m max.	
Specifications	UL20276 (Max. operating temperature: 80°C) AWG22 × 2C + AWG24 × 2P AWG22 (0.33 mm^2) Outer diameter of insulating sheath: ϕ 1.15 mm AWG24 (0.20 mm^2) Outer diameter of insulating sheath: ϕ 1.09 mm	UL20276 (Max. operating temperature: 80°C) AWG22 × 2C + AWG24 × 2P AWG22 (0.33 mm^2) Outer diameter of insulating sheath: ϕ 1.35 mm AWG24 (0.20 mm^2) Outer diameter of insulating sheath: ϕ 1.21 mm
Finished Dimensions	ϕ 6.5 mm	ϕ 6.8 mm
Internal Configuration and Lead Colors		
Yaskawa Standard Specifications (Standard Length)	Cable length: 5 m, 10 m, 15 m, 20 m	

* Specify the cable length in □□ of cable type designation.
Example: JZSP-CMP09-05 (5 m)

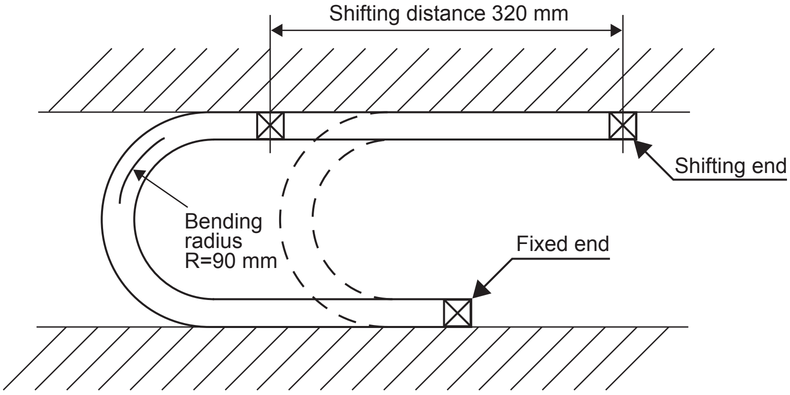
5.6 Flexible Cables

(1) Life of Flexible Cable

The flexible cable supports 10,000,000 or more operations of bending life with the recommended bending radius R = 90 mm under the following test conditions.

- Conditions

1. Repeat moving one end of the cable forward and backward for 320 mm using the test equipment shown in the following.
2. Connect the lead wires in parallel, and count the number of cable return motion times until a lead wire is disconnected. Note that one reciprocation is counted as one test.



Note: 1. The life of flexible cable differs largely depending on the amount of mechanical shocks, mounting to the cable, and fixing methods. The life of flexible cable is limited under the specified conditions.
2. The life of flexible cable indicates the number of bending times in which lead wires are electrically conducted and by which no cracks and damages that affects the performance of cable sheathing are caused. Disconnecting the shield wire is not taken into account.

(2) Wiring Precautions

Even if the recommended bending radius R is followed in the mechanical design, incorrect wiring may cause the early disconnection. Observe the following precautions when wiring.

(a) Cable twisting

Straighten the flexible cables wiring.

Twisted cables cause the early disconnection. Check the indication on the cable surface to make sure that the cable is not twisted.

(b) Fixing method

Do not fix the moving points of the flexible cable, or stress on the fixed points may cause early disconnection. Fix the cable at the minimum number of points.

Do not apply stress to connectors.

(c) Cable length

If the cable length is too long, it may result the cable sagging. If the cable length is too short, excessive tension on the fixed points will cause the early disconnection. Use a flexible cable with the optimum length.

(d) Interference between cables

Avoid interference between cables.

Interference limits the motion of flexible cable, which causes early disconnection. Keep enough distance between cables, or provide a partition when wiring.

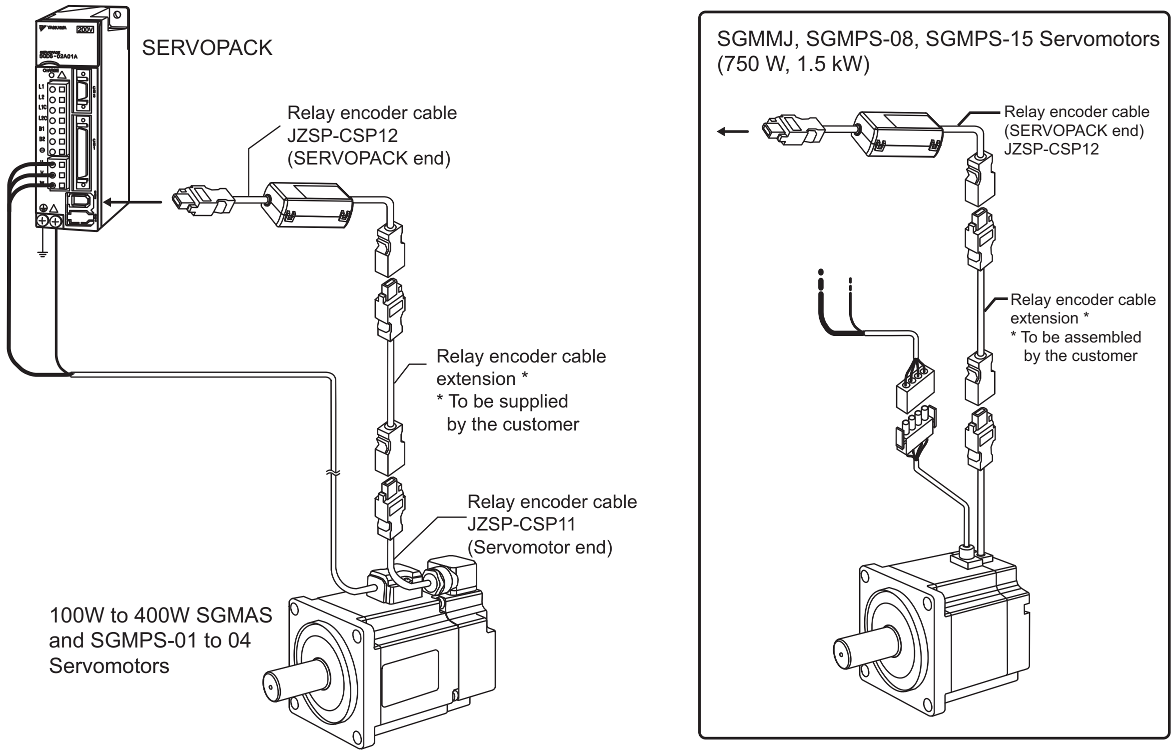
5.7 Encoder Cable Extension

The standard encoder cable length is 20 m maximum. To extend the wiring distance, use cable extensions to extend the wiring length to 50 m. The customer must provide cables and connectors to extend the relay encoder cable to 50 m.

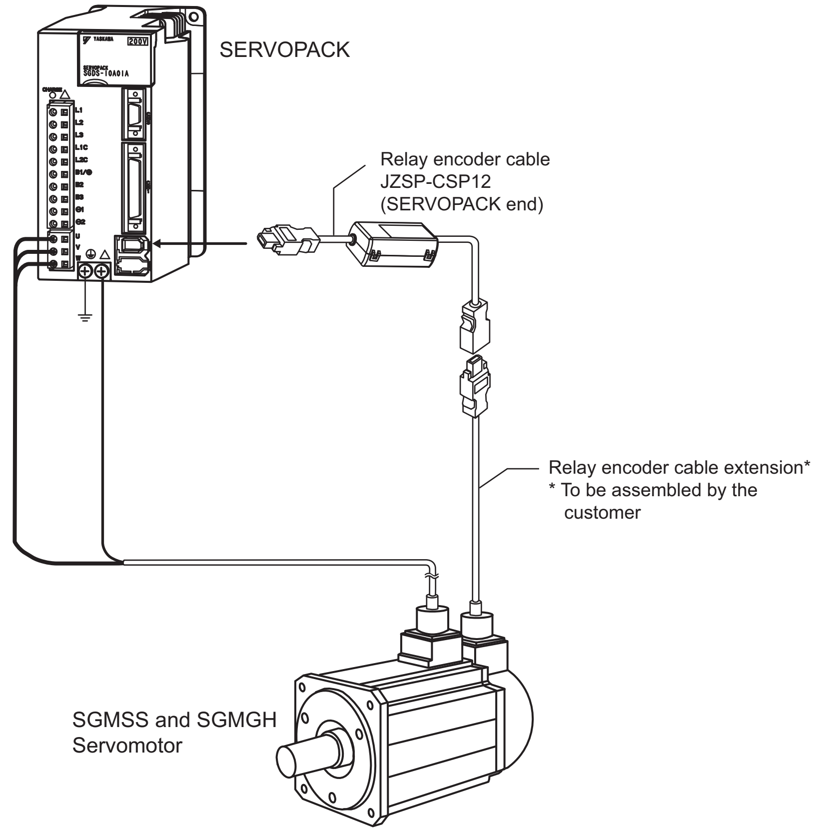
(1) Cable Connection Examples for Encoder Cable Extension

(a) For SGMAS and SGMPS Servomotors

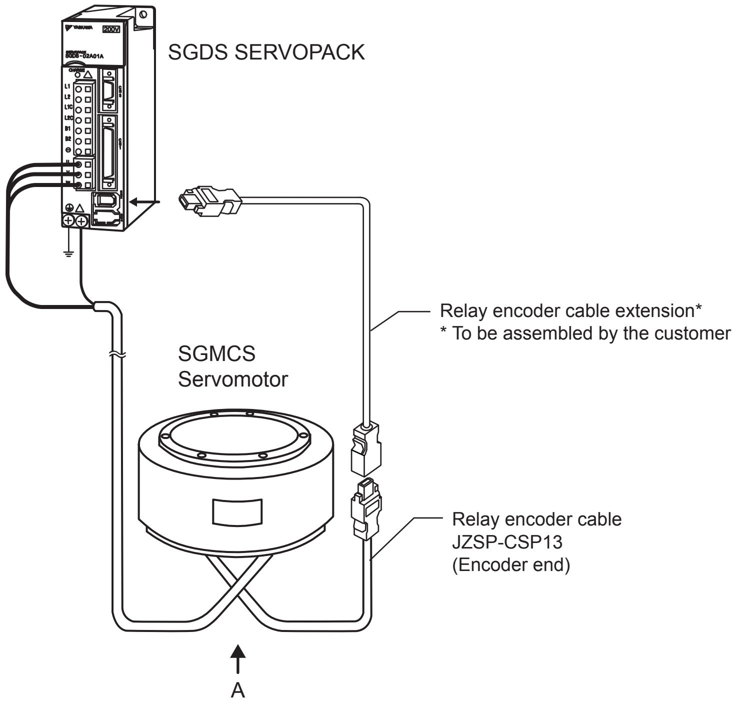
(Example)



(b) For SGMSS and SGMGH Servomotors



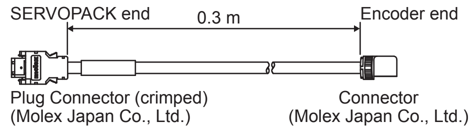
(c) For SGMCS Servomotors



(2) Relay Encoder Cable With Connectors

(a) For 50W to 750 W SGMAS and 100W to 400W SGMPS Servomotors

- Cable Type

Type	Length	Dimensional Drawing
JZSP-CSP11	0.3 m	

- Wiring Specifications

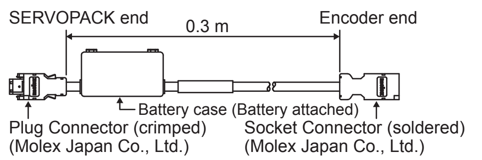
SERVOPACK end / Encoder (Servomotor) end

Pin No.	Signal	Pin No.	Lead Color
6	/PS	5	Light blue/white
5	PS	4	Light blue
4	BAT(-)	8	White/orange
3	BAT(+)	9	Orange
2	PG 0V	3	Black
1	PG 5V	6	Red
Shell	FG	Shell	FG

Shield wire

(b) For Absolute Encoder, with a Battery Case

- Cable Type

Type	Length	Dimensional Drawing
JZSP-CSP12	0.3 m	

- Wiring Specifications

SERVOPACK end / Encoder (Servomotor) end

Pin No.	Signal	Pin No.	Lead Color
6	/PS	6	Light blue/white
5	PS	5	Light blue
4	BAT(-)	4	White/orange
3	BAT(+)	3	Orange
2	PG0V	2	Black
1	PG5V	1	Red
Shell	FG	Shell	FG

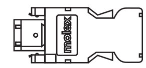
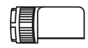
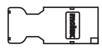
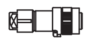
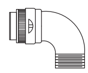
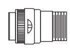
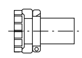
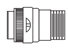
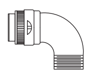
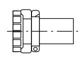
Shield wire

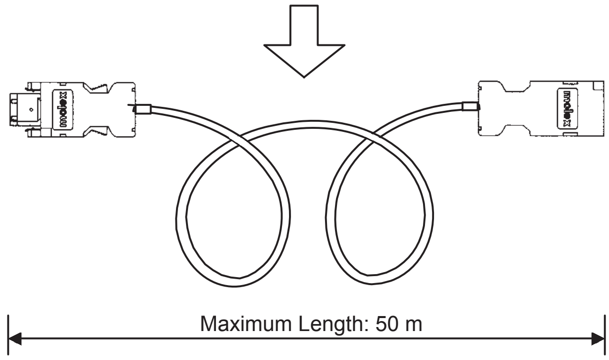
Battery case

Pin No.	Signal
2	BAT(-)
1	BAT(+)

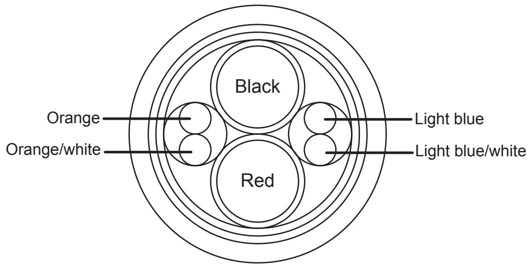
(3) Cables and Connectors for Encoder Cables

(a) Connectors and Connector Kit

Type			Model	Manufacturer	External View	Reference
SERVOPACK-end Connector Kits	SGMMJ SGMAS SGMPS SGMSS SGMGH SGMCS		JZSP-CMP9-1	Molex Japan Co., Ltd.		5.5
Servomotor-end Connector Kits	SGMAS 50 W to 1.15 kW SGMPS 100 W to 400 W		JZSP-CSP9-2	Molex Japan Co., Ltd.	Caulking type 	5.5.1
	SGMMJ SGMPS 750 W and 1.5kW		JZSP-CMP9-2	Molex Japan Co., Ltd.	Soldered type 	5.5.2
	SGMCS Servomotors		Straight plug JN1DS10SL1	Japan Aviation Electronics Industry, Ltd.	Caulking type 	5.5.4
			Socket contact JN1-22-22S-PKG100			
	SGMSS SGMGH	For standard environ-ment	MS3108B20-29S	DDK Ltd.	L-shaped plug 	5.5.3
			MS3106B20-29S	DDK Ltd.	Straight plug 	
			MS3057-12A	DDK Ltd.	Cable clamp 	
		For protective structure IP67	JA06A-20-29S-J1-EB	Japan Aviation Electronics Industry, Ltd.	Straight plug 	
			JA08A-20-29S-J1-EB		L-shaped plug 	
			JL04-2022CKE (09) Cable diameter ϕ6.5 to ϕ9.5 mm		Cable clamp 	
			JL04-2022CKE (12) Cable diameter ϕ9.5 to ϕ13 mm			
			JL04-2022CKE (14) Cable diameter ϕ12.9 to ϕ15.9 mm			
Cables			JZSP-CMP19-□	Yaskawa Electric Co., Ltd.	Max. wiring length: 50 m 	5.5.1



(b) Cable Specifications

Cable Type *	JZSP-CMP19-□□
Cable Length	50 m max.
Specifications	UL20276 (Max. operating temperature: 80 °C) AWG16 × 2C + AWG26 × 2P AWG16 (1.31 mm^2) Outer diameter of insulating sheath in mm: ϕ 2.0 AWG26 (0.13 mm^2) Outer diameter of insulating sheath in mm: ϕ 0.91
Finished Dimensions	ϕ6.8 mm
Internal Configuration and Lead Colors	
Yaskawa Standard Specifications (Standard Length)	Cable length: 30 m, 40 m , 50 m

* Specify the cable length in □□ of cable type designation.
Example: JZSP-CMP19-30 (30 m)

5.8 Connectors for Main Circuit, Control Power Supply, and Servomotor Cable

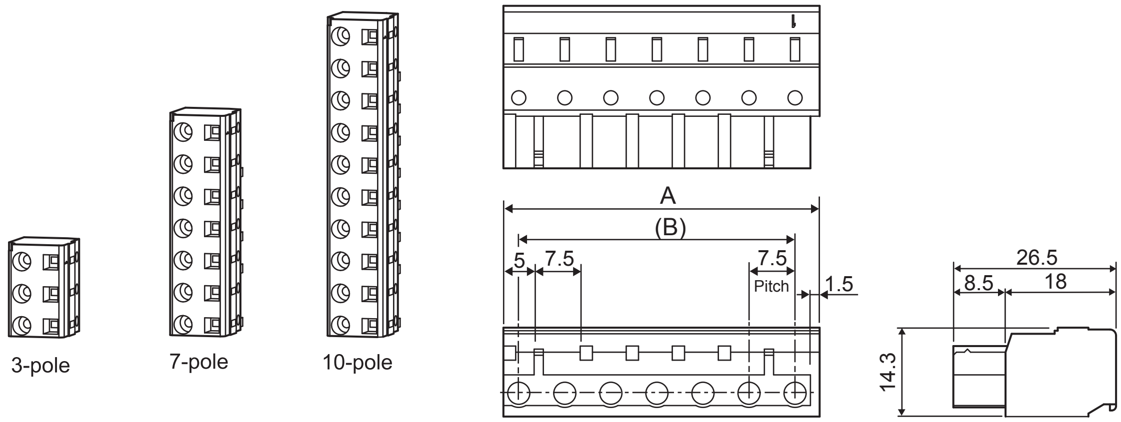
5.8.1 Spring Type (Standard)

Spring-type connectors are provided on SERVOPACK as standard.

(1) Connector Types

Appearance	Type	Manufacturer
3-pole (For servomotor main circuit cable connector at SERVOPACK end)	51446-0301	Molex Japan Co., Ltd.
7-pole (For 50 to 400 W SERVOPACKs)	51446-0701	
10-pole (For 0.5 to 1.5 kW SERVOPACKs)	51446-1001	
Connection lever	54932-0000	

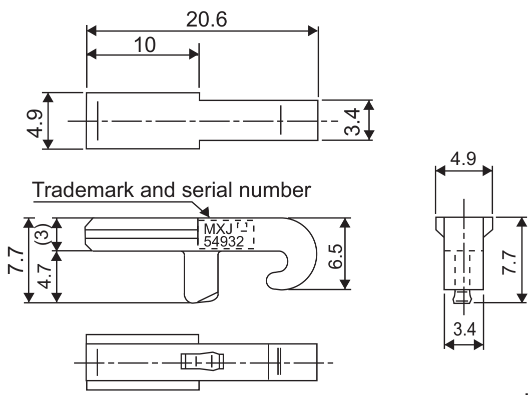
(2) External View and Dimensions



The number of Poles	Dimension A	Dimension B
3	21.5	15
7	51.5	45
10	74	67.5

Units: mm

(3) Connection Lever



Units: mm

Specifications and Dimensional Drawings of Cables and Peripheral Devices

5

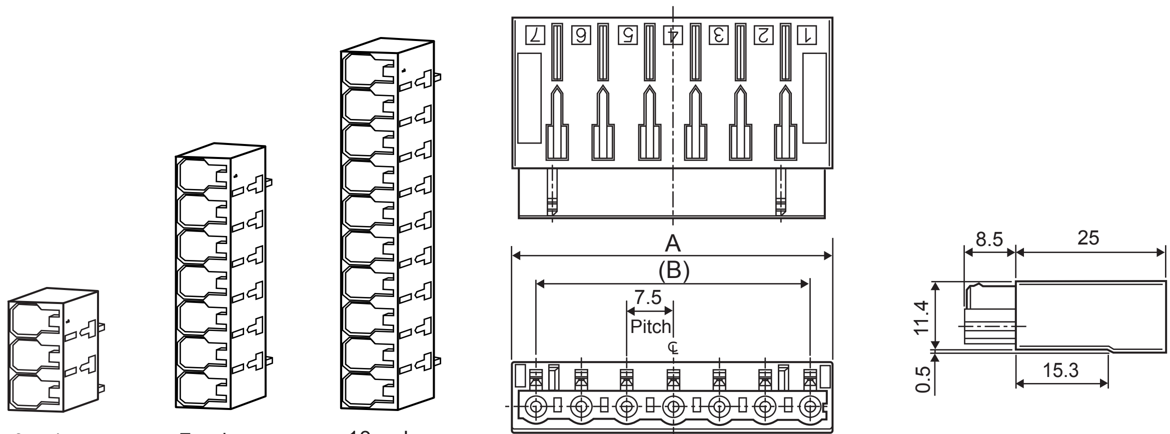
5.8.2 Crimp Type (Option)

The crimp type connectors are options. Contact the manufacturer for details.

(1) Connector Types

Appearance	Types	Manufacturer
3-pole (For servomotor main circuit cable connector at SERVOPACK end)	51241-0301	Molex Japan Co., Ltd.
7-pole (For 50 to 400 W SERVOPACKs)	51241-0701	
10-pole (For 0.5 to 1.5 kW SERVOPACKs)	51241-1001	
Plug (chained)	56125-0018	
Plug (detached)	56125-0118	
Manual tool	57349-5300	
Pull tool	57349-6000	

(2) External View and Dimensions

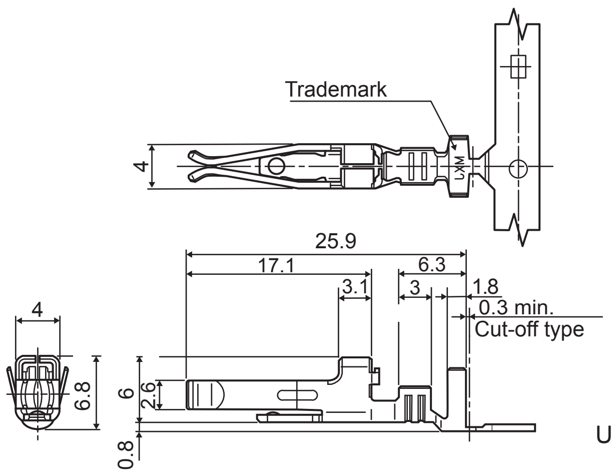


3-pole 7-pole 10-pole

The number of Poles	Dimension A	Dimension B
3	22.8	15
7	52.8	45
10	75.3	67.5

Units: mm

(3) Plugs (Chained/Detached)



Units: mm

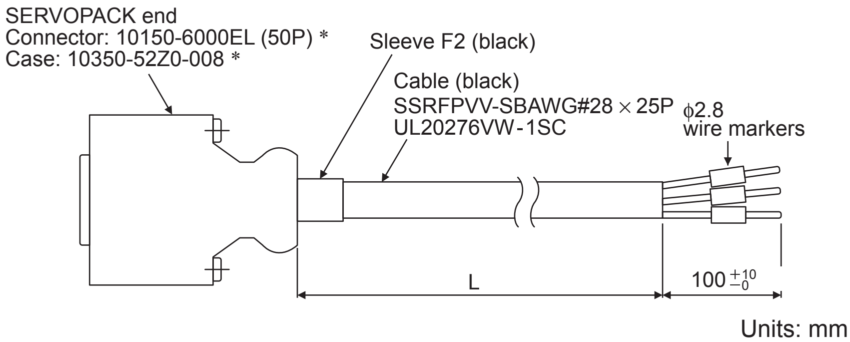
5.9 CN1 Cables for I/O Signals

5.9.1 Standard Cables

(1) Cable Types

Cable Types	Length (L)
JZSP-CSI01-1	1 m
JZSP-CSI01-2	2 m
JZSP-CSI01-3	3 m

(2) Dimensional Drawings



* Manufactured by Sumitomo 3M Ltd.

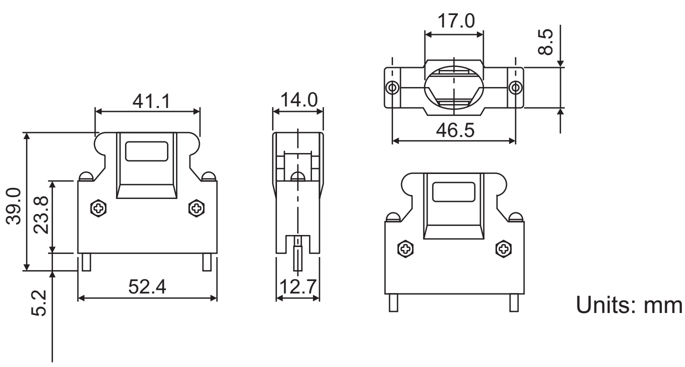
5.9.2 Connector Type and Cable Size

Use the following connector and wire when customers assemble the cable. The connector CN1 includes a set of case and a connector.

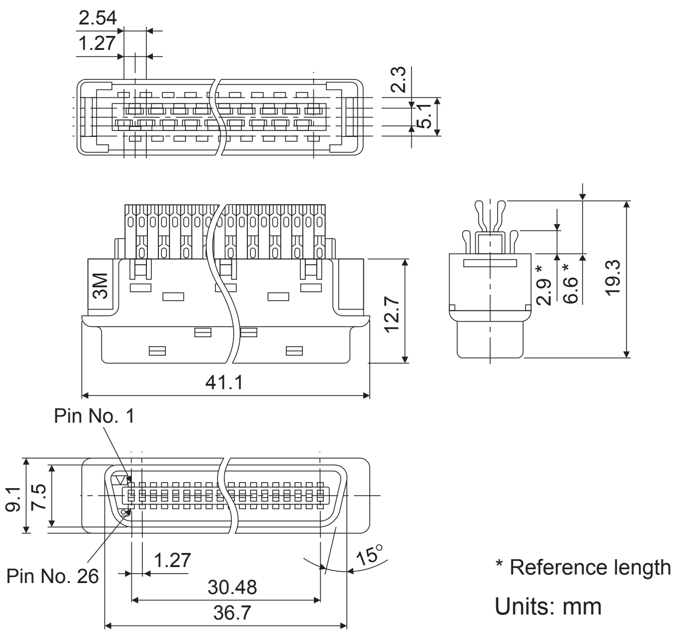
Connector Type	Case		Connector	
	Type	Qty	Type	Qty
JZSP-CSI9-1	10350-52Z0-008*	1 set	10150-3000VE* (Soldered)	1

* Manufactured by Sumitomo 3M Ltd.

(1) Dimensional Drawings of Case



(2) Dimensional Drawings of Connector



* Reference length

Units: mm

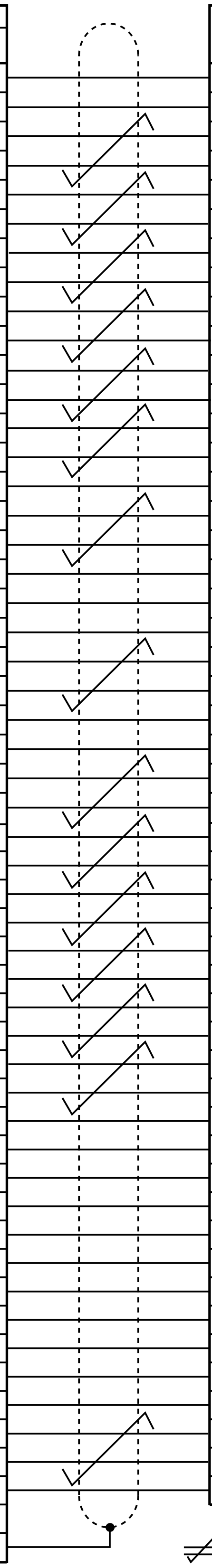
(3) Cable Size

Item	Specifications
Cable	Use twisted-pair or twisted-pair shielded wire.
Applicable wires	AWG24, 26, 28, 30
Cable Finished Diameter	ϕ16 mm max.

5.9.3 Connection Diagram for Standard I/O Cable JZSP-CSI01-☐

SERVOPACK end | Host controller end

Pin No.	Signal Name	Lead Color	Marking Color	Marking Dots	Host controller end Lead Marker
1	SG	Orange	Red	1	1
3	–	Orange	Black	1	3
2	SG	Gray	Red	1	2
4	SEN	Gray	Black	1	4
5	V-REF	White	Red	1	5
6	SG	White	Black	1	6
7	PULS	Yellow	Red	1	7
8	/PULS	Yellow	Black	1	8
9	T-REF	Pink	Red	1	9
10	SG	Pink	Black	1	10
11	SIGN	Orange	Red	2	11
12	/SIGN	Orange	Black	2	12
13	–	Gray	Red	2	13
14	/CLR	White	Red	2	14
15	CLR	White	Black	2	15
16	–	Gray	Black	2	16
17	–	Yellow	Red	2	17
18	–	Yellow	Black	2	18
19	PCO	Pink	Red	2	19
20	/PCO	Pink	Black	2	20
21	BAT (+)	Orange	Red	3	21
22	BAT (-)	Orange	Black	3	22
23	–	Gray	Red	3	23
24	–	Gray	Black	3	24
25	/V-CMP+	White	Red	3	25
26	/V-CMP-	White	Black	3	26
27	/TGON+	Yellow	Red	3	27
28	/T-GON-	Yellow	Black	3	28
29	/S-RDY+	Pink	Red	3	29
30	/S-RDY-	Pink	Black	3	30
31	ALM+	Orange	Red	4	31
32	ALM-	Orange	Black	4	32
33	PAO	Gray	Red	4	33
34	/PAO	Gray	Black	4	34
35	PBO	White	Red	4	35
36	/PBO	White	Black	4	36
37	ALO1	Yellow	Red	4	37
38	ALO2	Yellow	Black	4	38
39	ALO3	Pink	Red	4	39
40	/S-ON	Pink	Black	4	40
41	/P-CON	Orange	Red	5	41
42	P-OT	Orange	Black	5	42
43	N-OT	Gray	Red	5	43
44	/ALM-RST	Gray	Black	5	44
45	/P-CL	White	Red	5	45
46	/N-CL	White	Black	5	46
47	+24V-IN	Yellow	Red	5	47
48	–	Pink	Red	5	48
49	–	Pink	Black	5	49
50	–	Yellow	Black	5	50
Case	Shield				



: represents twisted-pair wires.

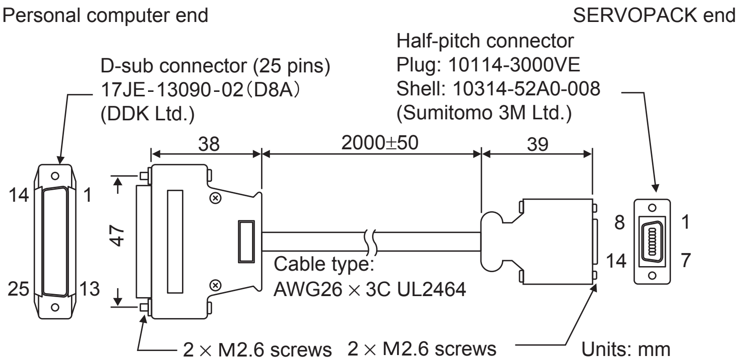
5.10 Peripheral Devices

5.10.1 Cables for Connecting Personal Computers

(1) For 25-pin Connector Cable for NEC PC-98 Series PC

(a) Cable Type: JZSP-CMS01

(b) Dimensional Drawings



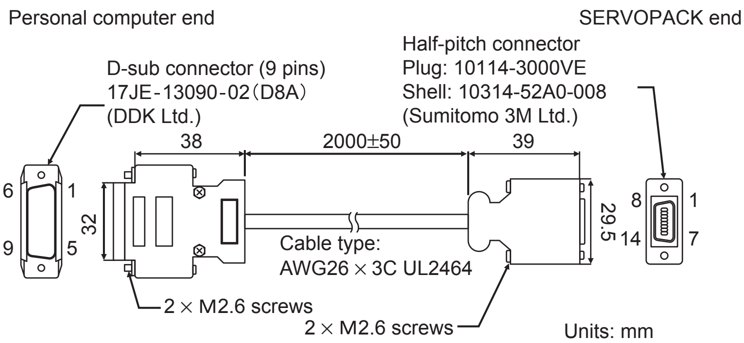
Personal computer end Signal	Pin No.	SERVOPACK end Pin No.	Signal
RXD	3	2	/TXD
TXD	2	4	/RXD
0V	7	14	0V
RTS	4	–	–
CTS	5	–	–
FG	1	Case	FG

Shield wire

(2) D-sub, 9-pin Connector Cable for IBM PC Compatible

(a) Cable Type: JZSP-CMS02

(b) Dimensional Drawings



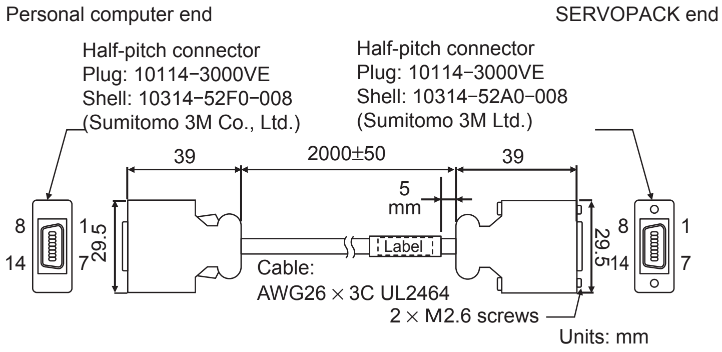
Personal computer end Signal	Pin No.	SERVOPACK end Pin No.	Signal
RXD	2	2	/TXD
TXD	3	4	/RXD
0V	5	14	0V
RTS	7	–	–
CTS	8	–	–
FG	Case	Case	FG

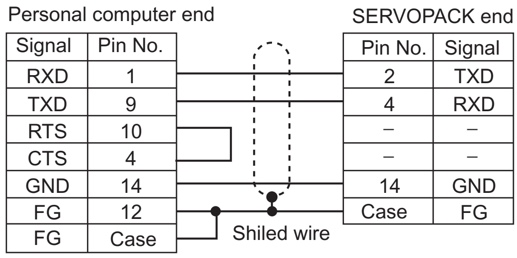
Shield wire

(3) For 14-pin Half-pitch Connector Cable for NEC PC-98 Series PC

(a) Cable Type: JZSP-CMS03

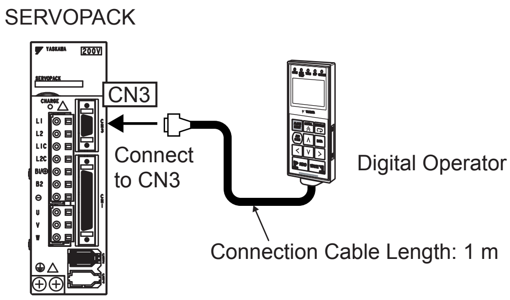
(b) Dimensional Drawings



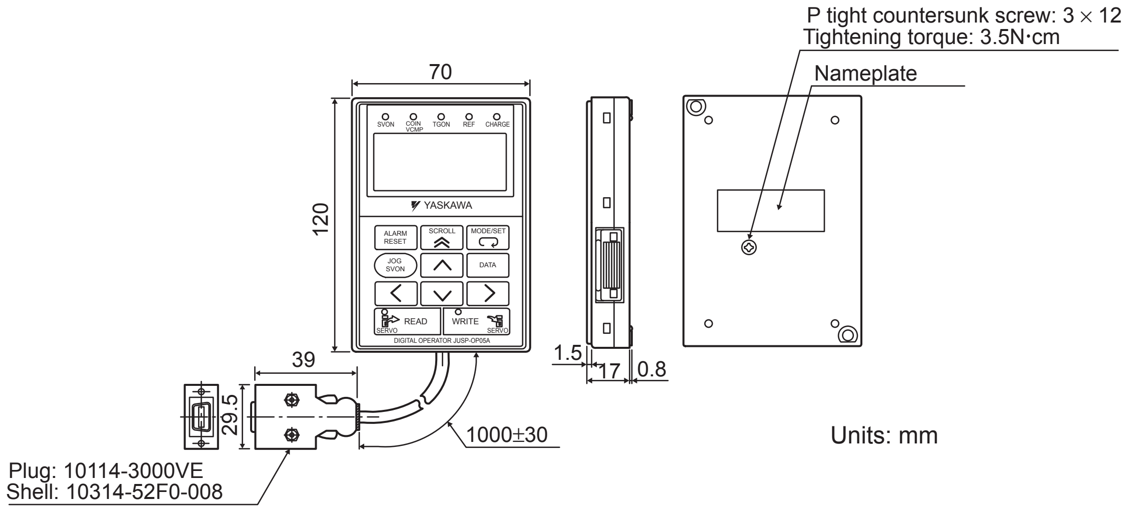


5.10.2 Digital Operator

(1) Model JUSP-OP05A with Connection Cable



(2) Dimensional Drawings

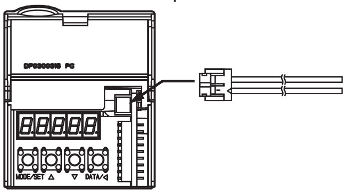


5.10.3 Cables for Analog Monitor

(1) Cable Type: JZSP-CA01

Connect the specified cables to CN5 connector for monitoring the analog monitor signals. For the details, refer to *9.7 Analog Monitor*.

With the front cover open



(2) Dimensional Drawings

* Manufactured by Hirose Electric Corporation.

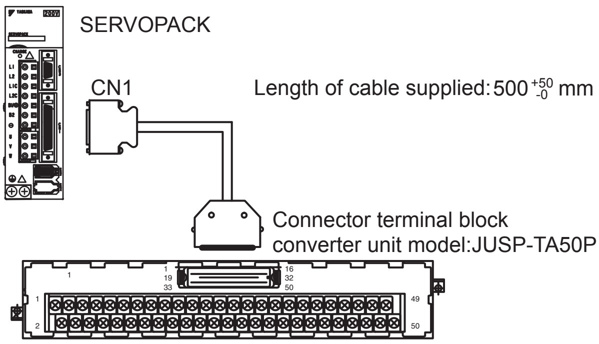
(3) Specifications

Cable Color	Signal Name	Explanation
White	Analog Monitor 1	Torque reference: 1 V / 100% rated torque
Red	Analog Monitor 2	Motor speed: 1 V / 1000 min^{-1}
Black (2 cables)	GND	GND Analog monitor: 0 V

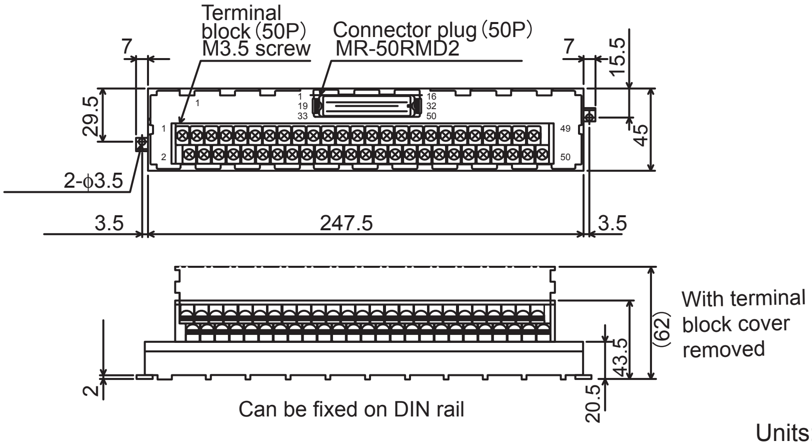
5.10.4 Connector Terminal Block Converter Unit

(1) Model: JUSP-TA50P

The connection diagram for the connector terminal block converter unit is shown below.

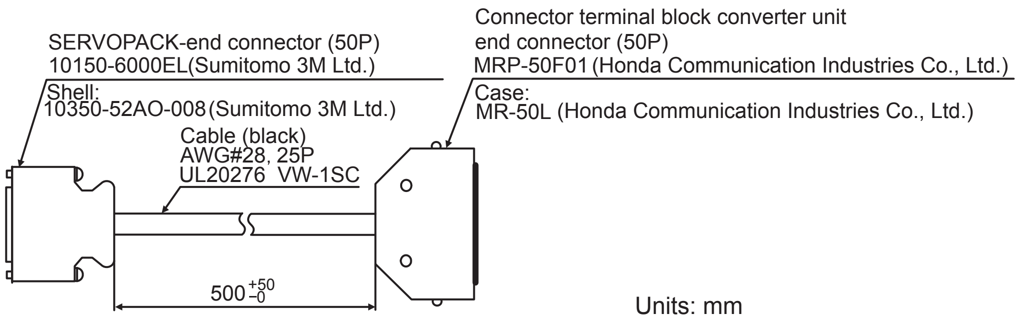


(2) Dimensional Drawings of Terminal Block



Units: mm

(3) Dimensional Drawings of Cable



Units: mm

Specifications and Dimensional Drawings of Cables and Peripheral Devices

5

5.10.5 Brake Power Supply Unit

(1) Model: LPSE-2H01, LPDE-1H01

Manufactured by Yaskawa Controls Co., Ltd.

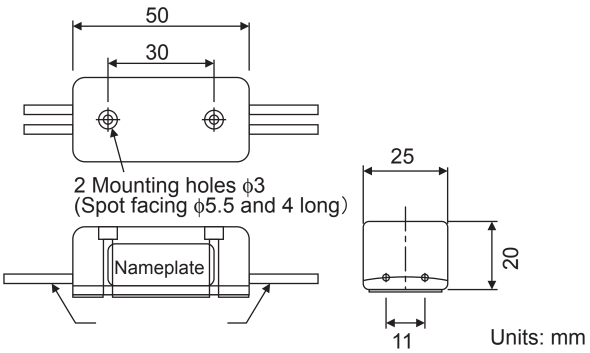
- 200 V input: LPSE-2H01
- 100 V input: LPDE-1H01

(2) Specifications

- Rated output voltage: 90 VDC
- Maximum output current: DC 1.0 A
- Lead wire length: 500 mm each
- Maximum ambient temperature: 60°C
- Lead wires: Color coded. Refer to the table below.

AC input		Brake end
100 V	200 V	
Blue/White	Yellow/White	Red/Blue

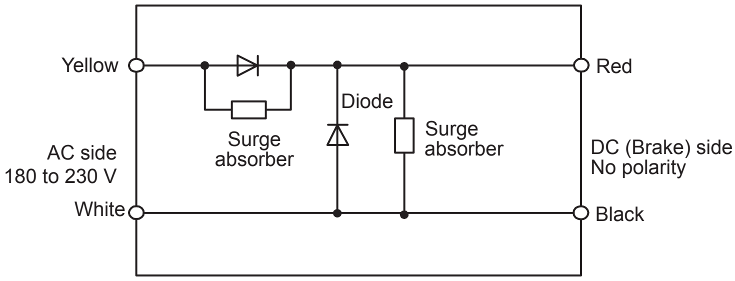
(3) Dimensional Drawings



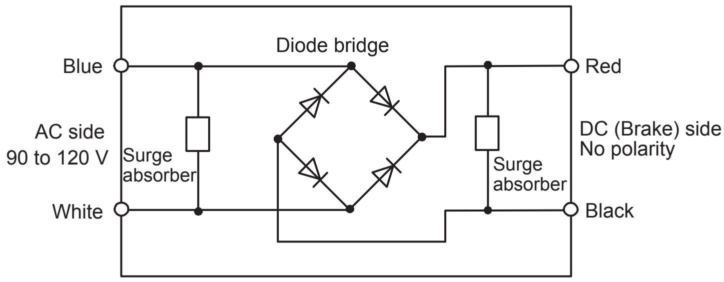
(4) Internal Circuits

Open or close the circuit for the brake's power supply so that switching occurs on the AC side of the brake power supply unit.
When switching on the DC side, install a surge absorber near the brake coil to prevent damage to the brake coil from voltage surges due to DC-side switching.

(a) Internal Circuit for 200 VAC Brake Power Supply Model: LPSE-2H01



(b) Internal Circuit for 100 VAC Brake Power Supply Model: LPDE-1H01



5.10.6 External Regenerative Resistor

When regenerative energy is so large that a SERVOPACK cannot process, install externally a regenerative resistor. The regenerative resistor must be purchased by customers. Refer to the table below for selecting the regenerative resistor. Refer to *6.5 Connecting Regenerative Resistors* for the connection.

(1) References for External Regenerative Resistor

Regenerative Resistor Model	Specifications	Manufacturer
RH120	70 W, 1 to 100 Ω	Iwaki Wireless Research Institute
RH150	90 W, 1 to 100 Ω	
RH220	120 W, 1 to 100 Ω	
RH300C	200 W, 1 to 10 kΩ	
RH500	300 W, 1 to 30 Ω	

(2) Model Designation

RH120 (N) 10Ω J

Model
N: Noninductive winding

Resistance

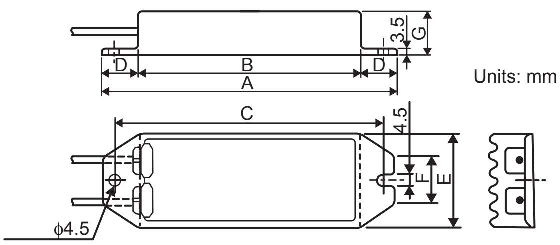
Tolerance	
Code	Tolerance
K	±10%
J	±5%
H	±3%

(3) Specifications

Resistance Tolerance	K: ± 10%, J: ± 5%, H: ± 3%
Temperature Resistance Characteristics	± 400 PPM / °C (20 Ω max.) , ± 260 PPM / °C (20 Ω min.)
Withstand Voltage	2000 VAC/min. ΔR: ± (0.1% + 0.05Ω)
Insulation Resistance	500 VDC, 20 MΩ minimum
Short-time Overload	When 10 times of rated power is applied for five seconds, ΔR: ±(2% + 0.05 Ω)
Life	1000 hours of repeating the operation ON for 90 minutes and OFF for 30 minutes, ΔR: ±(5% + 0.05 Ω)
Heat Resistance	Not ignite after having applied 10 times of rated electric power for one minute
Operating temperature	-25 to 150°C

(4) Dimensional Drawings

RH120/150/220

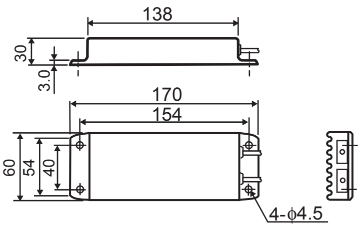


Lead wire length L: 300

Model	Rated Power	Resistance
RH120	70W	1 Ω to 100 Ω
RH150	90W	1 Ω to 100 Ω
RH220	120W	1 Ω to 100 Ω

Dimensions	A	B	C	D	E	F	G
RH120	182	150	172	16	42	22	20
RH150	212	180	202	16	44	24	30
RH220	230	200	220	15	60	24	20

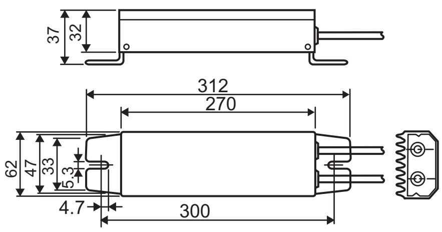
RH220B



Lead wire length L: 500
Rated power: 120 W
Resistance: 1 Ω to100 Ω

Units: mm

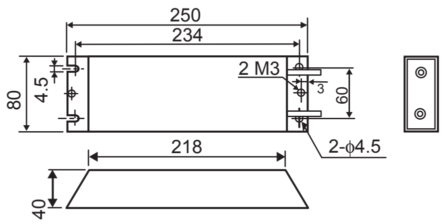
RH300C



Lead wire length L: 300
Rated power: 200 W
Resistance: 1 Ω to 10 kΩ

Units: mm

RH500



Lead wire length L: 450
Rated power: 300 W
Resistance: 1 Ω to 30 Ω

Units: mm

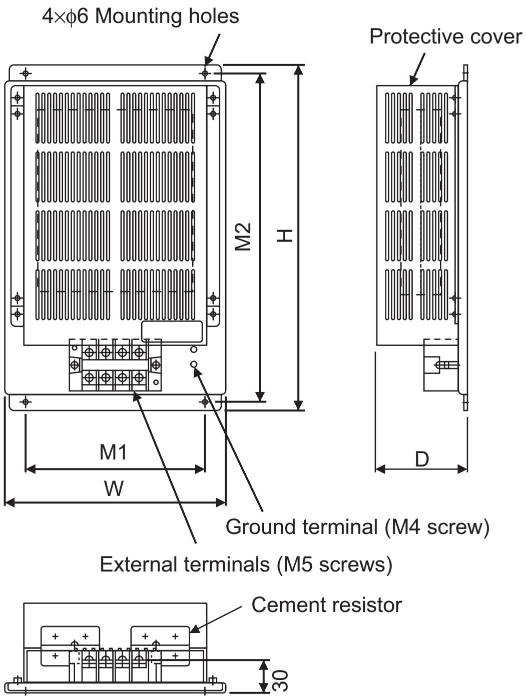
5.10.7 Regenerative Resistor Unit

(1) Models

The SERVOPACKs with a capacity of 6.0 kW or more do not have a built-in regenerative resistor.
The following regenerative resistor unit is required according to the SERVOPACK model.

SERVOPACK Model	Regenerative Resistor Unit Model	Specifications	Allowable Power Loss
SGDS-60A	JUSP-RA04	6.25 Ω, 880 W	180 W
SGDS-75A	JUSP-RA05	3.13 Ω, 1760 W	350 W

(2) Dimensional Drawings



Units: mm

Model	W	H	D	M1	M2	Approx. Mass kg
JUSP-RA04	220	350	92	180	335	4
JUSP-RA05	300	350	95	250	335	7

5.10.8 Absolute Encoder Battery

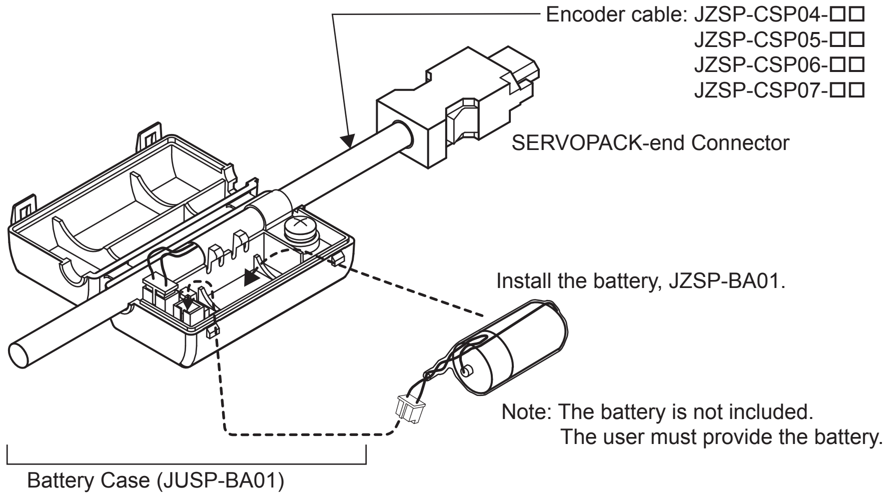
After the power supply was turned OFF, a backup battery is required to write the position of absolute encoder. Install one of the absolute encoder batteries below. For more information on the battery replacement, refer to *8.4.3 Handling Batteries*.

(1) Battery Case

Model: JUSP-BA01

IMPORTANT

1. A battery is not mounted in the battery case. A battery must be purchased separately.
   Battery Case Model: JZSP-BA01 (Refer to *(2) Battery Mounted in the Battery Case* on this page.)
2. Install the battery case where the ambient temperature is 0°C to 55°C.

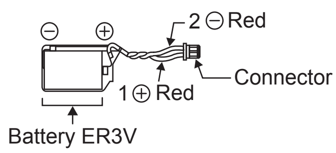


(2) Battery Mounted in the Battery Case

Model: JZSP-BA01 (lithium battery)

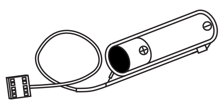
(Battery: ER3V battery made by Toshiba Battery Co., Ltd.)

3.6 V 1000 mAh



(3) Battery Installed on the Host Controller End

Use a battery that meets the specifications of the host controller. Use an ER6VC3N (3.6 V, 2000 mAh: by Toshiba Battery Co., Ltd.) or equivalent battery.



(4) Specifications

Location	Specification	Model Number	Manufacturer
Encoder cable	Lithium battery 3.6 V, 1000 mAh	ER3V	Toshiba Battery Co., Ltd.
Host controller	Lithium battery 3.6 V, 2000 mAh	ER6VC3N	Toshiba Battery Co., Ltd.

5.10.9 Molded-case Circuit Breaker (MCCB)

If selecting a molded-case circuit breaker, observe the following precautions.

IMPORTANT

■Ground Fault Detector

- Select ground fault detectors for inverters.
- High-frequency current leaks from the servomotor armature because of switching operation inside the SERVOPACK.

(1) Maximum Input Current

- The instantaneous maximum output of SERVOPACK is approximately 3 times of the rated output for maximum for 3 seconds. Accordingly, select a molded-case circuit breaker whose breaking time is 5 seconds or more at 300% of SERVOPACK rated current.
  The general-purpose low-speed acting molded-case circuit breakers are applicable.
- The power supply capacity per SERVOPACK when using a servomotor is described in *2.5.2 Molded-case Circuit Breaker and Fuse Capacity*. Select a molded-case circuit breaker with the capacity larger than the effective load current (when using more than multiple SERVOPACK) calculated from the total power supply capacity.
- The consumption of other controllers must be considered when selecting a molded-case circuit breaker.

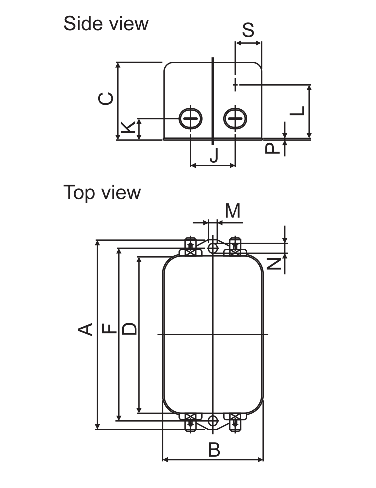
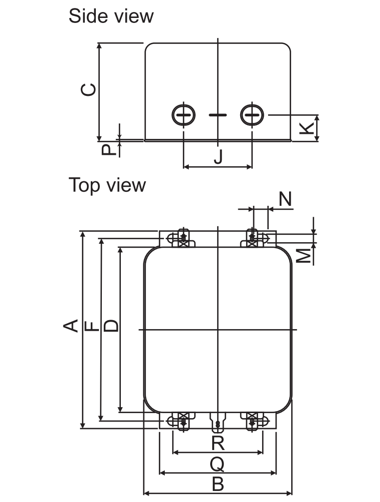
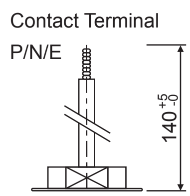
(2) Inrush Current

- Refer to *2.5.2 Molded-case Circuit Breaker and Fuse Capacity* for SERVOPACK inrush current.
- The allowable inrush current for a low-speed acting molded-case circuit breaker is approximately 10 times of the rated current for 0.02 seconds.
- When turning ON multiple SERVOPACK simultaneously, select a molded-case circuit breaker with the allowable current for 20 ms larger than the total inrush current shown in *2.5.2 Molded-case Circuit Breaker and Fuse Capacity*.

5.10.10 Noise Filter

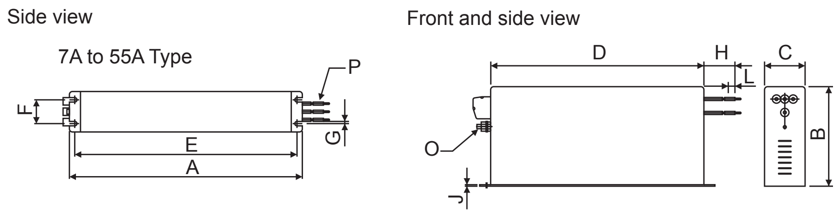
The recommended noise filter is manufactured by SCHAFFNER (FN type) and SCHURTER (formerly TIMONTA) (FMAC type). Contact Yaskawa Controls Co., Ltd. Select one of the following noise filters according to SERVOPACK capacity. For more details on selecting current capacity for a noise filter, refer to *2.5.3 Noise Filters, Magnetic Contactors, Surge Absorbers and AC/DC Reactors*. For connecting the noise filter, refer to *6.1.3 Typical Main Circuit Wiring Examples*

(1) Single-phase, 100/200 V

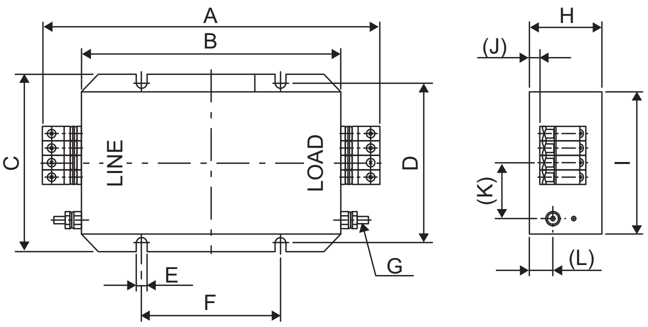
Model		FN2070-6/07	FN2070-10/07	FN2070-16/07
Dimensional Drawings (Units: mm)				
				
External Dimensions		Dimensions in mm		
	A	113.5 ± 1	156 ± 1	119 ± 0.5
	B	57.5 ± 1		85.5 ± 1
	C	45.4 ± 1.2		57.6 ± 1
	D	94 ± 1	130.5 ± 1	98.5 ± 1
	F	103 ± 0.3	143 ± 0.3	109 ± 0.3
	J	25 ± 0.2		40 ± 0.2
	K	8.4 ± 0.5		8.6 ± 0.5
	L	32.4 ± 0.5		–
	M	4.4 ± 0.1	5.3 ± 0.1	4.4 ± 0.1
	N	6 ± 0.1		7.4 ± 0.1
	P	0.9 ± 0.1		1.2 ± 0.1
	Q	–		66 ± 0.3
	R	–		51 ± 0.2 (2.01±0.0079)
	S	38 ± 0.5		–
Specifications		250 VAC, 6 A	250 VAC, 10 A	250 VAC, 16 A
Applicable SERVOPACK SGDS-	Single-phase 100 V	A5F 01F	02F	04F
	Single-phase 200 V	A5A 01A 02A	04A	08A
Manufacturer		SCHAFFNER		

(2) Three-phase, 200 V

(a) FN Type

Model		FN258L-7/07	FN258L-16/07	FN258L-30/07
Dimensional Drawings				
External Dimensions		Dimensions in mm		
	A	255 ± 1	305 ± 1	335 ± 1
	B	126 ± 0.8	142 ± 0.8	150 ± 1
	C	50 ± 0.6	55 ± 0.6	60 ± 0.6
	D	225 ± 0.8	275 ± 0.8	305 ± 1
	E	240 ± 0.5	290 ± 0.5	320 ± 0.5
	F	25 ± 0.3	30 ± 0.3	35 ± 0.3
	G	6.5 ± 0.2		
	H	300 ± 10		400 ± 10
	J	1 ± 0.1		
	L	9 ± 1		
	O	M5		
	P	AWG16	AWG14	AWG10
Specifications		480 VAC, 7 A	480 VAC, 16 A	480 VAC, 30 A
Applicable SERVOPACK SGDS-	Three-phase 200 V	05A	10A, 15A, 20A	30A
Manufacturer		SCHAFFNER		

(b) FMAC Type

Model		FMAC-0934-5010	FMAC-0953-6410
Dimensional Drawings			
External Dimensions	Symbol	Dimensions in mm	
	A	251	308
	B	201	231
	C	151	151
	D	135^{+0}_{-1}	135^{+0}_{-1}
	E	6.5±0.3	6.5±0.3
	F	115±0.3	115±0.3
	G	M6	M6
	H	66	66
	I	121	121
	J	(10)	(13)
	K	(41)	(45)
	L	(17)	(34)
Specifications		AC440V, 50A	AC440V, 64A
Applicable SERVOPACK SGDS-	Three-phase 200 V	50A 60A	75A
Manufacturer		SCHURTER (formerly TIMONTA)	

5.10.11 Magnetic Contactor

(1) Model: HI-□J

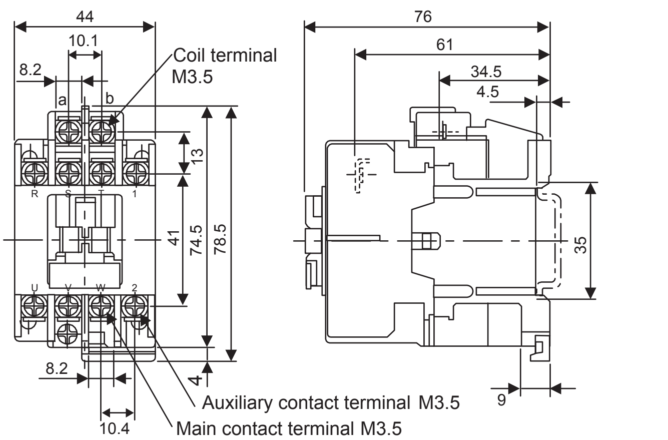
The magnetic contactor is manufactured by Yaskawa Controls Co., Ltd. Contact your Yaskawa representative for details.

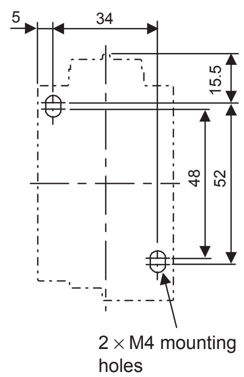
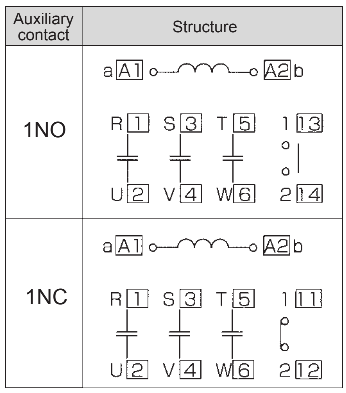
A magnetic contactor is required to make the AC power to SERVOPACK ON/OFF sequence externally. Be sure to attach a surge absorber to the excitation coil of the magnetic contactor. Refer to *5.10.13 Surge Absorber (for lightning surge)* for details of the surge absorber.

For selecting a magnetic contactor, refer to *2.5.3 Noise Filters, Magnetic Contactors, Surge Absorbers and AC/DC Reactors*.

(2) For Single-phase 100/200V and Three-phase 200 V SERVOPACKs

(a) Model: HI-11J

<table>
<tr><th>Dimensions in mm</th><th>Mounting Hole Dimensions in mm</th><th>Terminal Symbols</th></tr>
<tr><td>

Approx mass: 0.25 kg</td><td>
</td><td>
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(b) Model: HI-15J and HI-20J

<table>
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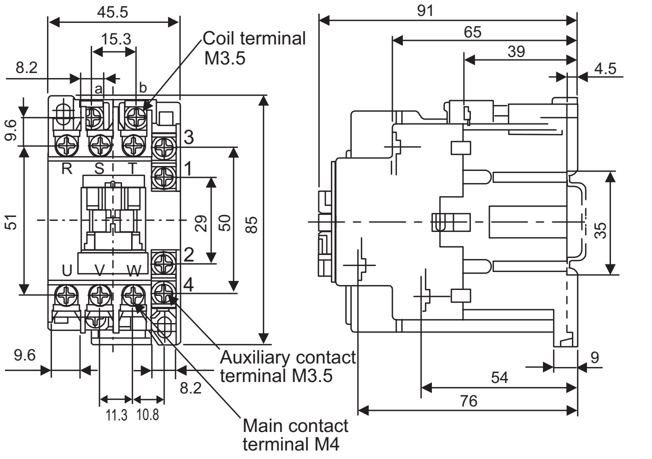
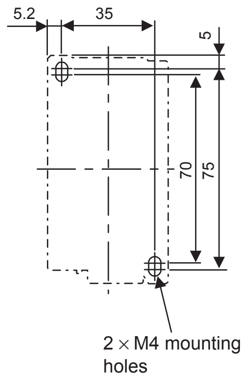
<td>

Approx. mass: 0.38 kg</td>
<td>
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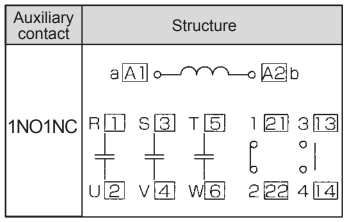
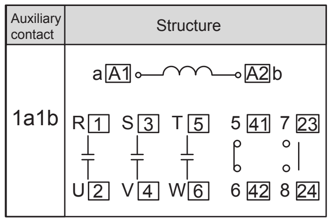
<td>HI-15J


HI-20J

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(c) Model: HI-25J and HI-35J

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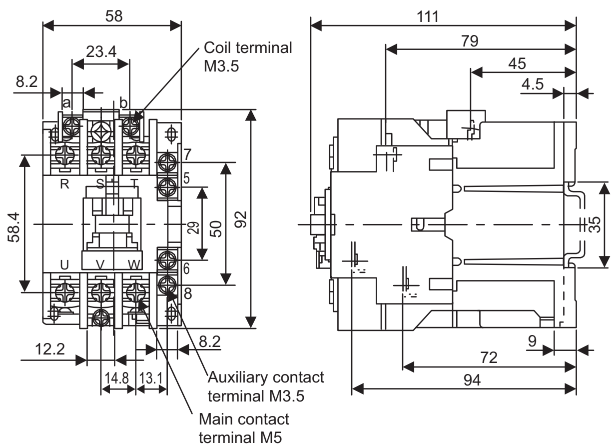
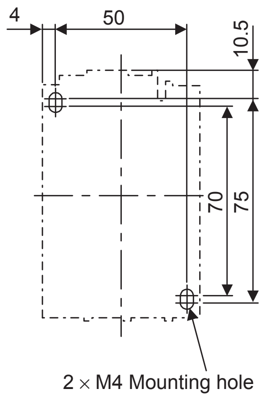
<td>

Approx. mass: 0.68 kg</td>
<td>
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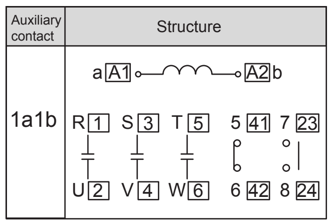
<td>
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5.10.12 Surge Absorber (for switching surge)

(1) Surge Absorber for Magnetic Contactor

Contact Yaskawa Controls Co., Ltd.

(a) Model: TU-25□, TU-65□

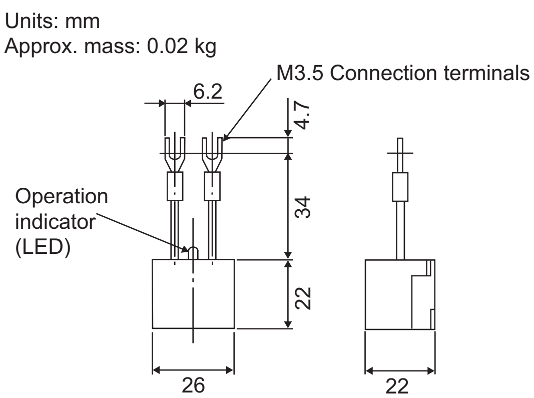
(b) Specifications

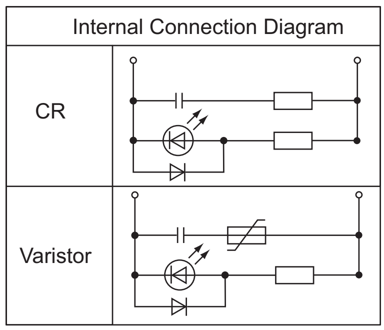
Model	Surge Absorption Method	Rated Insulation Voltage	Applicable Voltage Range for Operation Magnetic Coil AC 50/60Hz (50 V, 110 V, 127 V, 240 V, 380 V, 440 V)	Applicable Magnetic Contactor
TU-25C120	CR	150 VAC	50 V – 127 V	HI-11J HI-15J HI-20J
TU-25C240	CR	300 VAC	110 V – 240 V	
TU-25V440	Varistor	500 VAC	380 V – 440 V	
TU-65C120	CR	150 VAC	50 V – 127 V	HI-25J HI-35J HI-50J HI-65J
TU-65C240	CR	300 VAC	110 V – 240 V	
TU-65V440	Varistor	500 VAC	380 V – 440 V	

Note: ▬ : Applicable voltage range

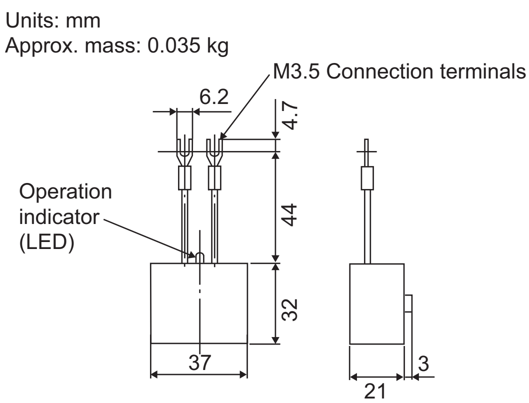
(c) Dimensional Drawings

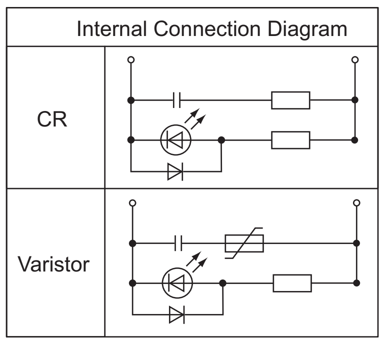
- Model TU-25□





- Model TU-65□



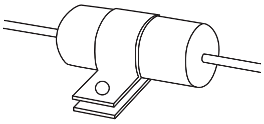


(2) Surge Absorber for Brake Power Supply

When using a servomotor with holding brake, install a surge absorber near the brake coil to prevent the power supply noises. The surge absorber handled by Okaya Electric Industries Co., Ltd. is recommended.

(a) Model: CR50500BL (Spark quencher)

(b) Specifications



Power supply: 250 VAC
Capacitance: 0.5 μF ± 20%
Resistance: 50 Ω(1/2 W) ± 30%

5.10.13 Surge Absorber (for lightning surge)

(1) Model: R·C·M-601BQZ-4 and R·C·M-601BUZ-4

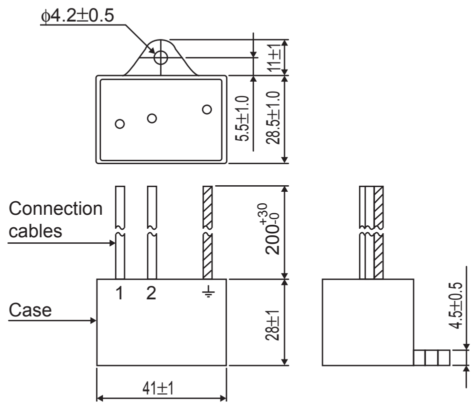
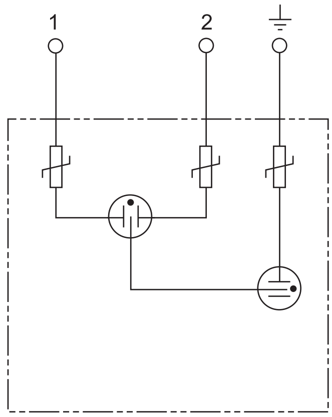
Manufactured by Okaya Electric Industries Co., Ltd.

The surge absorber absorbs lightning surge and prevents faulty operation in or damage to electronic circuits.

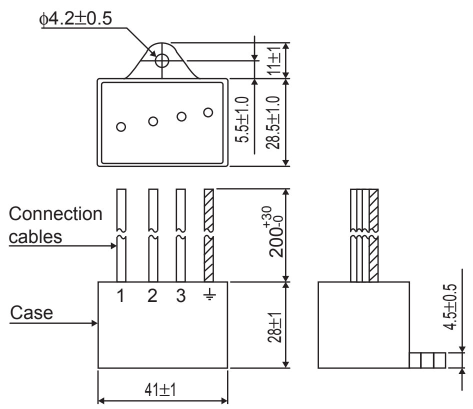
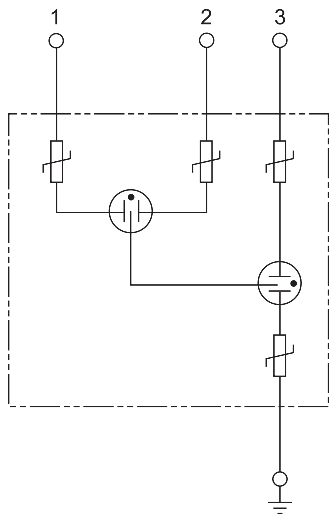
Recommended surge absorbers are listed below.

(2) Dimensional Drawings

(a) R·C·M-601BQZ-4

Dimensional Drawings	Internal Connection Diagram
 Units: mm	

(b) R·C·M-601BUZ-4

Dimensional Drawings	Internal Connection Diagram
 Units: mm	

5.10.14 AC/DC Reactors for Power Supply Harmonic Suppression

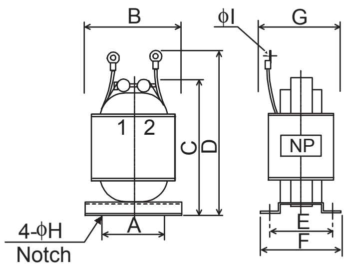
(1) Specifications

Manufactured by Yaskawa Controls Co., Ltd. Contact your Yaskawa representative for details.

If the power supply harmonic suppression is needed, connect an AC reactor to the AC line for the single-phase input, a DC reactor between the SERVOPACK main circuit terminals 1 and 2 for the three-phase input. Select a reactor that matches the ratings of the SERVOPACK. For wiring, refer to *6.4.5 AC/DC Reactor for Harmonic Suppression*.

Applicable SERVOPACK Model SGDS-		AC/DC Reactor Model	Reactor Specifications	
			Impedance (mH)	Rated Current (A)
Single-phase, 100 V	A3B	X5052	45.0	1.0
	A5F	X5053	20.0	2.0
	01F			
	02F	X5054	5.0	3.0
	04F	X5056	2.0	5.0
Single-phase, 200 V	A5A	X5052	45.0	1.0
	01A			
	02A	X5053	20.0	2.0
	04A	X5054	5.0	3.0
	08A	X5056	2.0	5.0
Three-phase, 200 V	05A	X5061	2.0	4.8
	10A			
	15A	X5060	1.5	8.8
	20A			
	30A	X5059	1.0	14.0
	50A	X5068	0.47	26.8
	60A	–	–	–
	75A			

(2) Dimensional Drawings



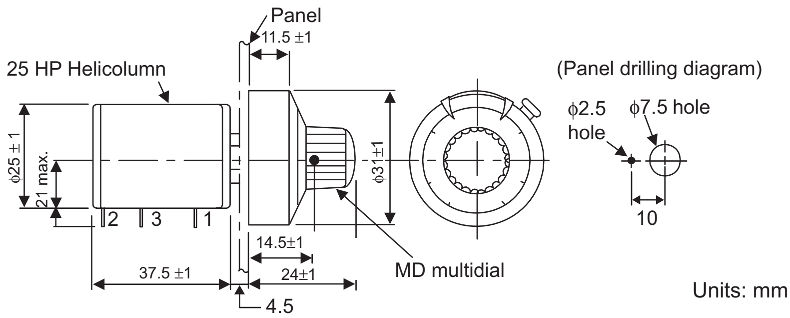
Reactor Model	Dimensions in mm									Approx. Mass kg
	A	B	C	D	E	F	G	ϕH	ϕI	
X5052	35	52	80	95	30	40	45	4	4.3	0.4
X5053	35	52	90	105	35	45	50	4	4.3	0.6
X5054	35	52	80	95	30	40	45	4	4.5	0.4
X5056	35	52	80	95	30	40	45	4	4.3	0.4
X5059	50	74	125	140	35	45	60	5	5.3	1.1
X5060	40	59	105	125	45	60	65	4	4.3	1.0
X5061	35	52	80	95	35	45	50	4	4.3	0.5
X5068	50	74	125	155	53	66	75	5	6.4	1.9

5.10.15 Variable Resistor for Speed and Torque Setting

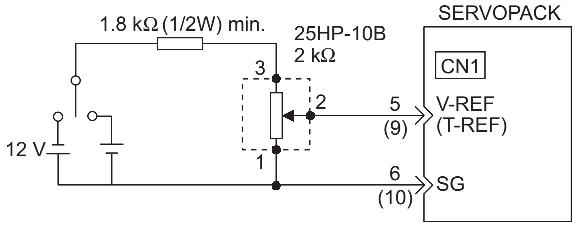
(1) Model: 25HP-10B

The multi-turn type winding variable resistors with dial MD10-30B4 are manufactured by Sakae Tsushin Kogyo Co., Ltd. Contact Yaskawa Controls Co., Ltd.

(2) Dimensional Drawings



(3) Connection Example to an External Power Supply



6

Wiring

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6.1 Wiring Main Circuit

This section describes typical examples of main circuit wiring, functions of main circuit terminals, and the power ON sequence.

⚠ CAUTION

- Do not bundle or run power and signal lines together in the same duct. Keep power and signal lines separated by at least 30 cm.
- Use twisted-pair wires or multi-core shielded-pair wires for signal and encoder (PG) feedback lines.
  The maximum length is 3 m for reference input lines and is 20 m for PG feedback lines.
- Do not touch the power terminals for five minutes after turning power OFF because high voltage may still remain in the SERVOPACK.
  Make sure the charge indicator is out first before starting an inspection.
- Avoid frequently turning the power ON and OFF. Do not turn the power ON or OFF more than once per minute.
  Because the SERVOPACK has a capacitor in the power supply, a high charging current flows for 0.2 seconds when the power is turned ON. Frequently turning the power ON and OFF causes main power devices like capacitors and fuses to deteriorate, resulting in unexpected problems.

6.1.1 Names and Descriptions of Main Circuit Terminals

Terminal Symbol	Name	Description	
L1, L2 or L1, L2, L3	Main circuit input terminal	50 W to 400 W	Single-phase 100 to 115 V $^{+10\%}$, $^{-15\%}$ (50/60 Hz)
		50 W to 400 W	Single-phase 200 to 230 V $^{+10\%}$, $^{-15\%}$ (50/60 Hz)
		800W	Single-phase 200 to 230 V $^{+10\%}$, $^{-15\%}$ (50/60 Hz) Note: Terminal L3 is not used. Do not connect.
		500 W, 1.0 kW to 7.5 kW	Three-phase 200 to 230 V $^{+10\%}$, $^{-15\%}$ (50/60 Hz)
U, V, W	Servomotor connection terminals	Connects to the servomotor.	
L1C, L2C	Control power input terminal	50 W to 400 W	Single-phase 100 to 115 V $^{+10\%}$, $^{-15\%}$ (50/60 Hz)
		50 W to 7.5 kW	Single-phase 200 to 230 V $^{+10\%}$, $^{-15\%}$ (50/60 Hz)
⏚	Ground terminals (×2)	Connects to the power supply ground terminals and servomotor ground terminal.	
B1/⊕, B2 or B1/⊕, B2, B3 or B1, B2, B3	External regenerative resistor terminal	50 W to 400 W	Normally not connected. Connect an external regenerative resistor (provided by customer) between B1/⊕ and B2 if the regenerative capacity is insufficient. Note: B3 terminal is not provided.
		500 W to 5.0 kW	Normally short B2 and B3 (for an internal regenerative resistor). Remove the wire between B2 and B3 and connect an external regenerative resistor between B1/⊕ and B2 or between B1 and B2 if the capacity of the internal regenerative resistor is insufficient. Customers must provide an external regenerative resistor terminal.
B1, B2		6.0 kW to 7.5 kW	Connect an external regenerative resistor (provided by customer) between B1 and B2. Refer to *6.5 Connecting Regenerative Resistors* for details.
⊖1, ⊖2	DC reactor connection terminal for power supply harmonic suppression	500 W to 5.0 kW	Normally short ⊖1- ⊖2 . If a countermeasure against power supply harmonic waves is needed, connect a DC reactor between ⊖1- ⊖2
B1/⊕, P/⊕ or ⊕	Main circuit plus terminal	50 W to 7.5 kW	Use when DC power supply input is used. Refer to *6.1.3 (4) DC Power Supply Input for SERVOPACK*.
⊖ or ⊖2	Main circuit minus terminal	50 W to 7.5 kW	

6.1.2 Wiring Main Circuit Terminal Block (Spring Type)

⚠ CAUTION

- Observe the following precautions when wiring main circuit terminal blocks.
  - Remove the terminal block from the SERVOPACK prior to wiring.
  - Insert only one wire per terminal on the terminal block.
  - Make sure that the core wire is not electrically shorted to adjacent core wires.

SERVOPACKs with a capacity below 1.5 kW have removable terminal blocks for the main circuit power supply terminal and the control power supply terminal. Use the following procedure when connecting to the terminal block.

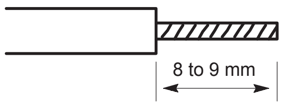
(1) Wire Size

Wire can be used simply by stripping back the outer coating. The following are applicable wire sizes.

- Single wire: ϕ0.5 to ϕ1.6 mm
- Braided wire: AWG28 to AWG12

(2) Connection Procedure

1. Strip the end of the wire.



2. Open the wire terminal on the terminal block housing (plug) with the tool using the procedure shown in Fig. A or B.
   - Press the lever and insert the wire into the wire terminal on the hook end of the tool as shown in Fig. A.
   - Use a standard flat-blade screwdriver (blade width of 3.0 to 3.5 mm). Put the blade into the slot, as shown in Fig. B, and press down firmly to open the wire terminal.

   Either the procedure shown in Fig. A or B can be used to open the wire insert opening.

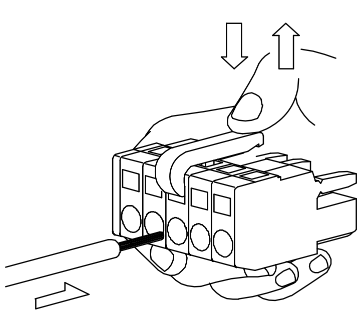


Fig. A

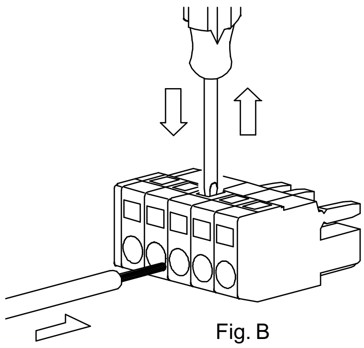
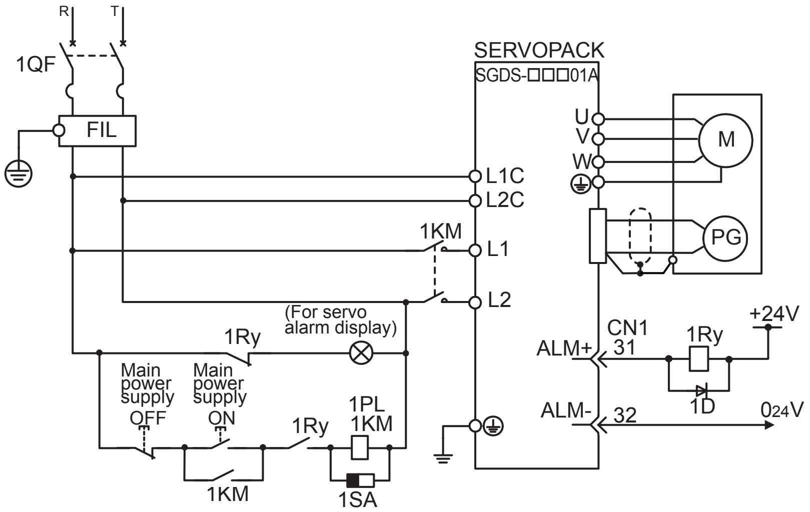


Fig. B

3. Insert the wire core into the opening and then close the opening by releasing the lever or removing the screwdriver.

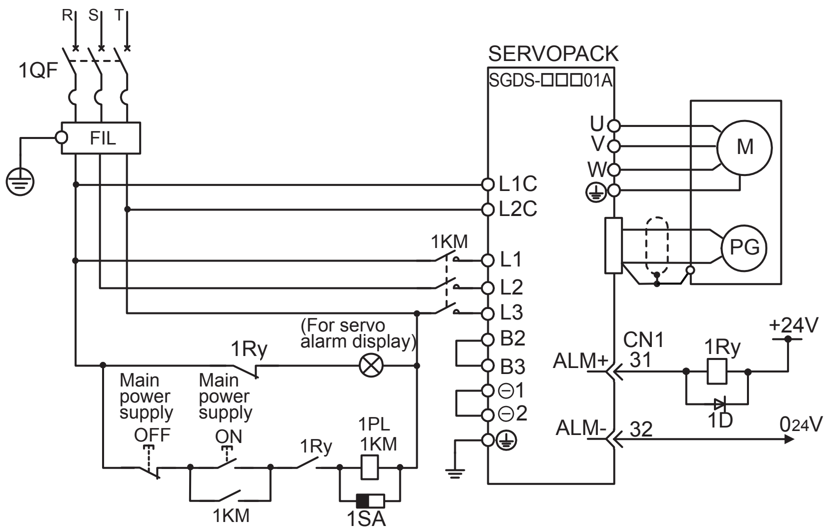
6.1.3 Typical Main Circuit Wiring Examples

(1) Single-phase, 100/200 V



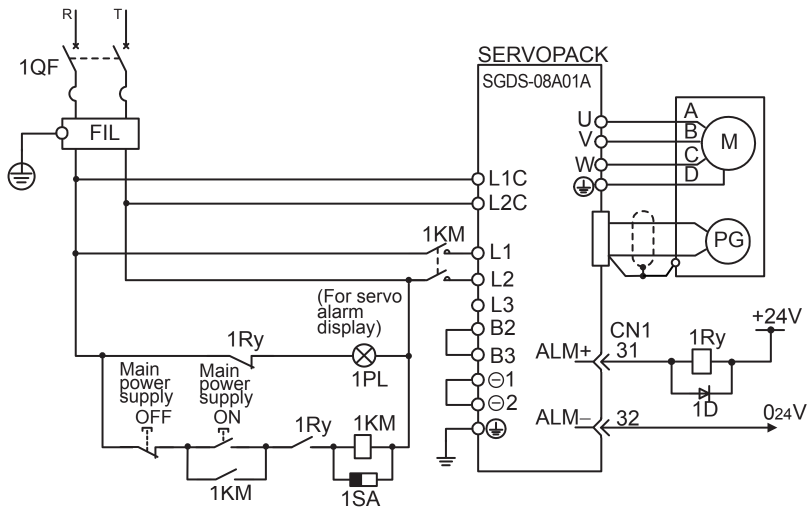
1QF : Molded-case circuit breaker
FIL : Noise filter
1KM : Magnetic contactor
1Ry : Relay
1PL : Indicator lamp
1SA : Surge absorber
1D : Flywhell diode

(2) Three-phase, 200 V



1QF : Molded-case circuit breaker
FIL : Noise filter
1KM : Magnetic contactor
1Ry : Relay
1PL : Indicator lamp
1SA : Surge absorber
1D : Flywheel diode

(3) 750 W, Single-phase 200V



1QF : Molded-case circuit breaker
FIL : Noise filter
1KM : Magnetic contactor
1Ry : Relay
1PL : Indicator lamp
1SA : Surge absorber
1D : Flywheel diode

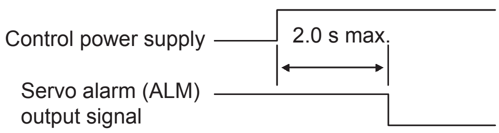
Note: Terminal L3 is not used for the single-phase 200 V, 750W SERVOPACKs. Do not connect.

IMPORTANT

■Designing a Power ON Sequence

Note the following points when designing the power ON sequence.

- Design the power ON sequence so that main power is turned OFF when a servo alarm signal is output. (See the circuit figure above.)
- The ALM signal is output for approximately two seconds when the power is turned ON. Take this into consideration when designing the power ON sequence. The ALM signal actuates the alarm detection relay 1Ry to stop main circuit power supply to the SERVOPACK.



- Select the power supply specifications for the parts in accordance with the input power supply.

■Power Supply Harmonic Suppression

If measures are needed to reject or suppress the harmonic waves near the power supply, insert the AC reactor into the AC power supply input of the SERVOPACK or insert the DC reactor into the internal DC main circuit. For more information on connecting the reactors, refer to *6.4.5 AC/DC Reactor for Harmonic Suppression.*

(4) DC Power Supply Input for SERVOPACK

⚠ CAUTION

- Do not use a DC power supply for the 100V SERVOPACK SGDS-□□F□□□ or SGDS-□□B□□□.
  A DC power will destroy the SERVOPACK and may cause a fatal accident or fire. Do not change the factory setting for Pn001 = n.□0□□ (DC power supply input not supported).
- The AC and DC power can be used with the 200V SERVOPACK SGDS-□□A□□.
  Before using DC power supply, Pn001 = n.□1□□ (DC power supply supported) must be selected. Failure to do so will cause the internal element of the SERVOPACK to burn out, and fire and damage to the devices may result.
  Check the parameter setting before using a DC power supply.

When using a DC power supply for the SERVOPACK SGDS-□□A□□, use the terminals listed in the following table and make sure that the parameter Pn001.2 is set to “1.” Also, observe the precautions given in IMPORTANT.

IMPORTANT

1. The servomotor returns the regenerated energy to the power supply. The SERVOPACK that can use a DC power supply is not capable of processing the regenerated energy. Provide measures to process the regenerated energy on the power supply.
2. With a SERVOPACK that is using DC power, a certain amount of time is required to discharge all remaining electricity after the main power supply is turned OFF. Note that high-voltage electricity remains in the SERVOPACK after the power supply is turned ON.

(a) DC Power Supply Input Terminals for the Main and Control Circuits

Terminal Symbols	Name	Description
B1/⊕, P/⊕, or ⊕	Main circuit positive polarity terminal	270 VDC to 320 VDC
⊖ or ⊖2	Main circuit negative polarity terminal	0V
L1C, L2C	Control power supply input terminal	270 VDC to 320 VDC (No polarity)

(b) Parameter Setting

Parameter		Meaning
Pn001	n.□0□□	DC power input not supported (AC power input to the L1, L2 or L3 terminals)
	n.□1□□	DC power input supported (Inputs DC power to B1/⊕, ⊖ or B1/⊕, ⊖2 or P/⊕, ⊖2, or ⊕ and ⊖.)
• Turn the power OFF and turn it ON again to validate the setting.		

Wiring

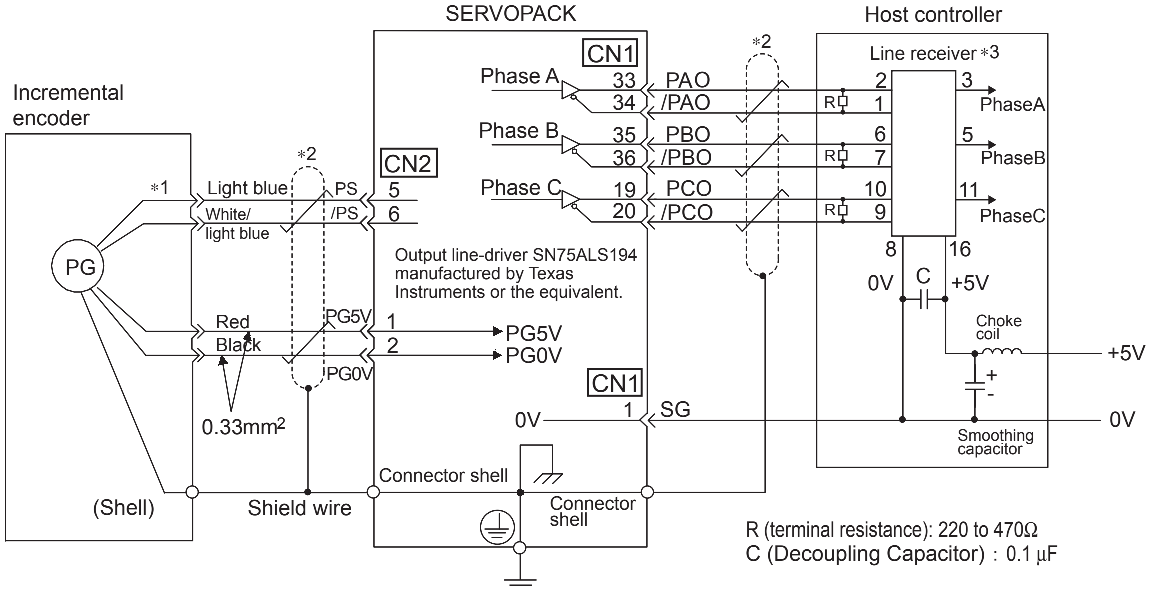
6

6.2 Wiring Encoders

The connection cables between encoder and SERVOPACK and wiring pin numbers differ depending on servomotor model. Refer to *5 Specifications and Dimensional Drawings of Cables and Peripheral Devices* for details.

6.2.1 Connecting an Encoder (CN2) and Output Signals from the SERVOPACK (CN1)

(1) Incremental Encoders

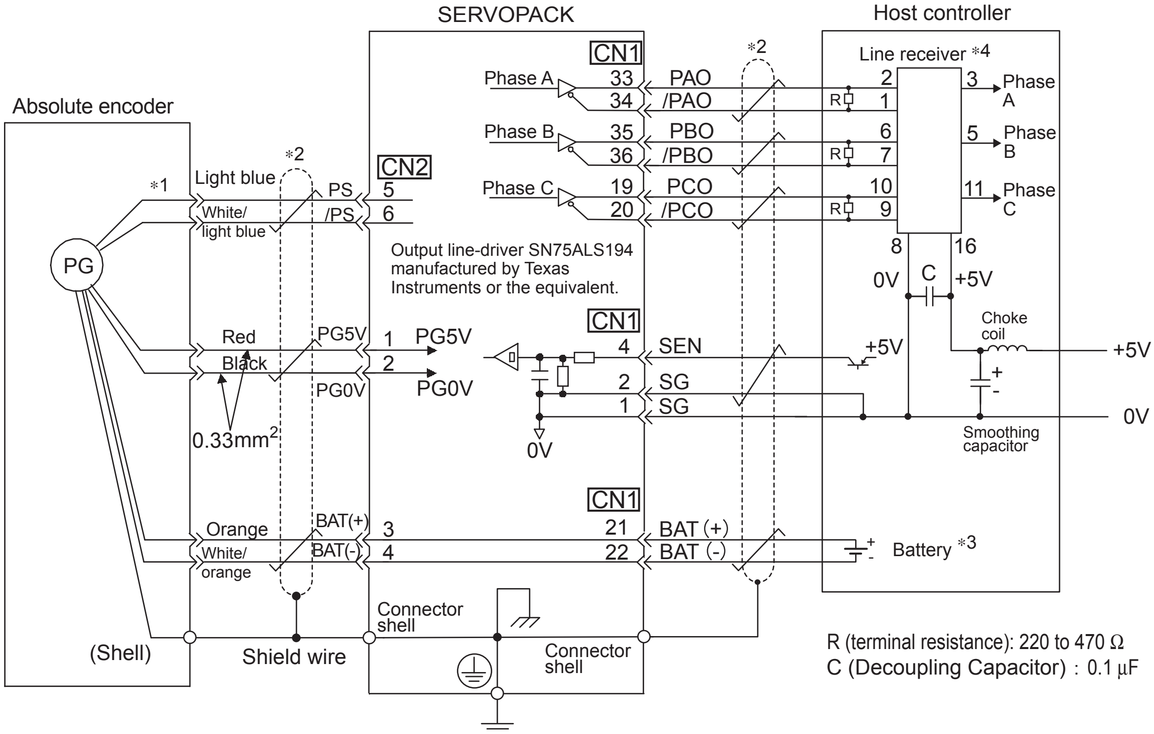


∗1 The pin numbers for the connector wiring differ depending on the servomotors.

∗2 : represents twisted-pair wires.

∗3 Applicable line receiver: SN75175 manufactured by Texas Instruments MC3486, or the equivalent

(2) Absolute Encoders



*1 The pin numbers for the connector wiring differ depending on the servomotors.

*2 : represents twisted-pair wires.

*3 When using an absolute encoder, install a battery in a battery case (JZSP-BA01) of encoder cable, or install a battery on the host controller side to supply power.

*4 Applicable line receiver: SN75175 manufactured by Texas Instruments MC3486, or the equivalent

6.2.2 CN2 Encoder Connector Terminal Layout

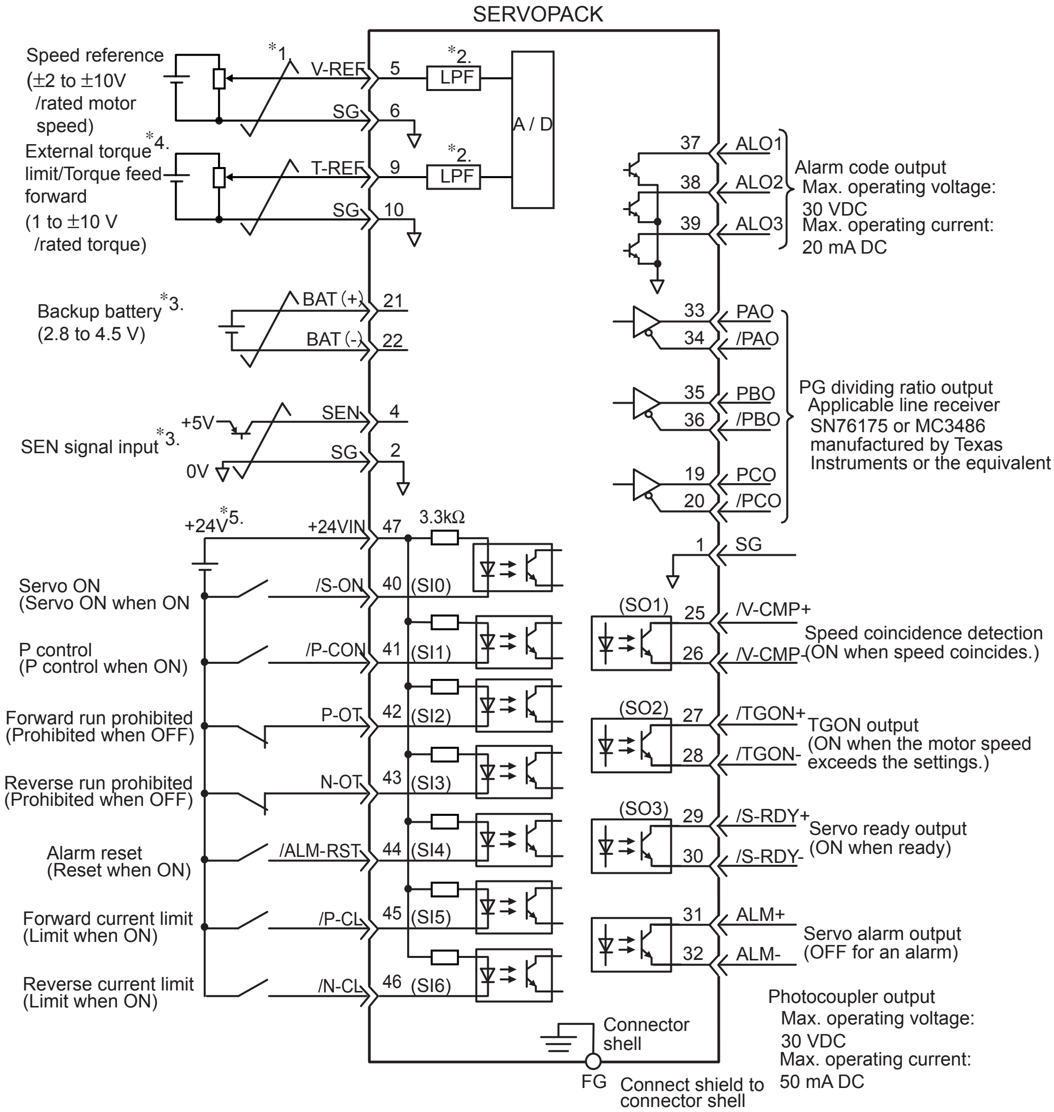
1	PG5V	PG power supply +5 V	2	PG 0 V	PG power supply 0 V
3	BAT (+)	Battery (+) (For an absolute encoder)	4	BAT (-)	Battery (-) (For an absolute encoder)
5	PS	PG serial signal input	6	/PS	PG serial signal input
SHELL	Shield	–	–	–	–

Wiring

6

6.3 Examples of I/O Signal Connections

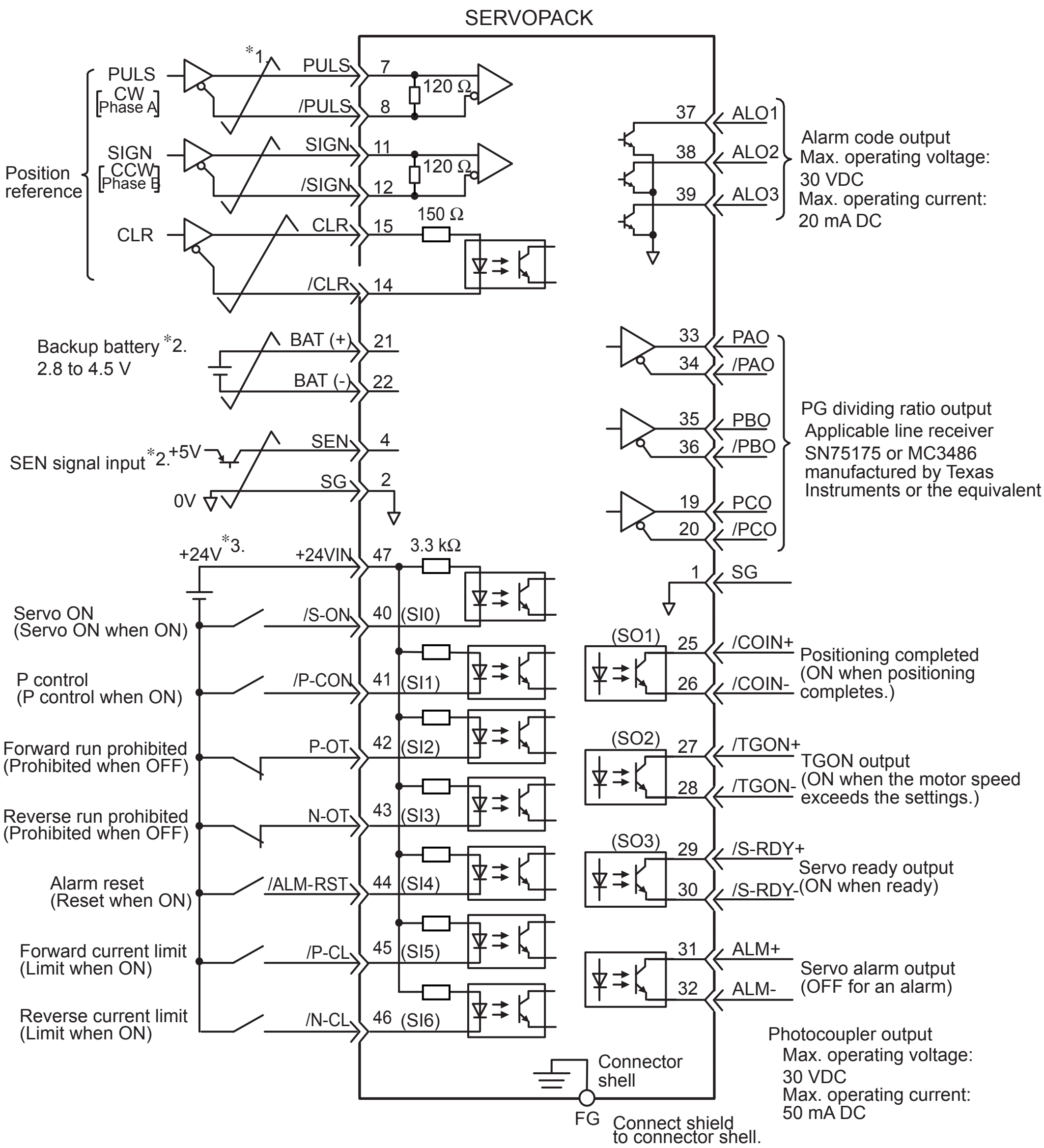
6.3.1 Speed Control Mode



* 1. represents twisted-pair wires.
* 2. The time constant for the primary filter is 30 μs.
* 3. Connect when using an absolute encoder. When the encoder cable for the battery case is connected, do not connect a backup battery.
* 4. Enabled by the parameter setting.
* 5. Customers must purchase a 24 VDC power supply with double-shielded enclosure.

Note: The functions allocated to the input signals SI0 to SI6 and the output signals SO1 to SO3 can be changed by using the parameters. Refer to *7.3.2 Input Circuit Signal Allocation* and *7.3.3 Output Circuit Signal Allocation*.

6.3.2 Position Control Mode



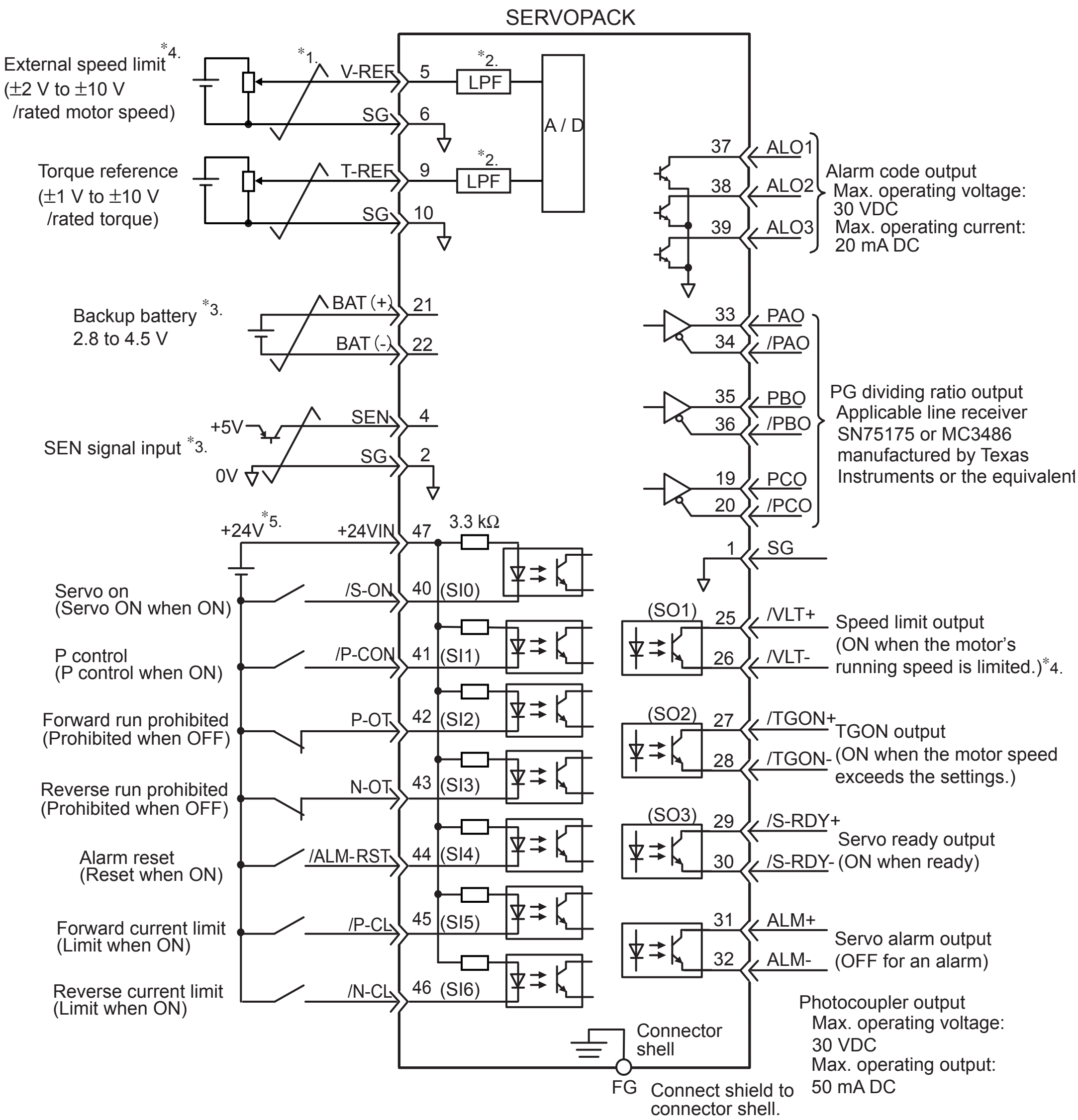
* 1. represents twisted-pair wires.

* 2. Connect when using an absolute encoder. When the encoder cable for the battery case is connected, do not connect a backup battery.

* 3. Customers must purchase a 24 VDC power supply with double-shielded enclosure.

Note: The functions allocated to the input signals SI0 to SI6 and the output signals SO1 to SO3 can be changed by using the parameters. Refer to *7.3.2 Input Circuit Signal Allocation* and *7.3.3 Output Circuit Signal Allocation*.

6.3.3 Torque Control Mode



* 1.  represents twisted-pair wires.

* 2. The time constant for the primary filter is 30 μs.

* 3. Connect when using an absolute encoder. When the encoder cable for the battery case is connected, do not connect a backup battery.

* 4. Enabled by the parameter setting.

* 5. Customers must purchase a 24 VDC power supply with double-shielded enclosure.

Note: The functions allocated to the input signals SI0 to SI6 and the output signals SO1 to SO3 can be changed by using the parameters. Refer to *7.3.2 Input Circuit Signal Allocation* and *7.3.3 Output Circuit Signal Allocation*.

6.3.4 I/O Signal Connector (CN1) Terminal Layout

2	SG	GND	1	SG	GND	27	/TGON+	TGON signal output	26	/V-CMP- (/COIN-)	Speed coincidence detection output
4	SEN	SEN signal input	3	–	–	29	/S-RDY+	Servo ready output	28	/TGON-	TGON signal output
6	SG	GND	5	V-REF	Speed reference input	31	ALM+	Servo alarm output	30	/S-RDY-	Servo ready output
8	/PULS	Reference pulse input	7	PULS	Reference pulse input	33	PAO	PG dividing pulse output Phase A	32	ALM-	Servo alarm output
10	SG	GND	9	T-REF	Torque reference input	35	PBO	PG dividing pulse output Phase B	34	/PAO	PG dividing pulse output Phase A
12	/SIGN	Reference sign input	11	SIGN	Reference sign input	37	ALO1	Alarm code output	36	/PBO	PG dividing pulse output Phase B
14	/CLR	Clear input	13	–	–	39	ALO3	Alarm code output	38	ALO2	Alarm code output
16	–	–	15	CLR	Clear input	41	/P-CON	P control input	40	/S-ON	Servo ON input
18	–	–	17	–	–	43	N-OT	Reverse run prohibit input	42	P-OT	Forward run prohibit input
20	/PCO	PG dividing pulse output Phase C	19	PCO	PG dividing pulse output Phase C	45	/P-CL	Forward external torque limit input	44	/ALM-RST	Alarm reset input
22	BAT (-)	Battery (-)	21	BAT (+)	Battery (+)	47	+24V IN	External input power supply	46	/N-CL	Reverse external torque limit input
24	–	–	23	–	–	49	–	–	48	–	–
			25	/V-CMP+ (/COIN+)	Speed coincidence detection output				50	–	–

Note: 1. Do not use unused terminals for relays.
2. Connect the shield of the I/O signal cable to the connector shell.
Connect to the FG (frame ground) at the SERVOPACK-end connector.
3. The functions allocated to the following input and output signals can be changed by using the parameters. Refer to *7.3.2 Input Circuit Signal Allocation* and *7.3.3 Output Circuit Signal Allocation.*
- Input signals: /S-ON, /P-CON, P-OT, N-OT, /ALM-RST, /P-CL, and /N-CL
- Output signals: /T-GON, /S-RDY, and /V-CMP (/COIN)

6.3.5 I/O Signal (CN1) Names and Functions

(1) Input Signals

Signal Name		Pin No.	Function		Reference Section
Common	/S-ON	40	Servo ON: Turns ON the servomotor when the gate block in the inverter is released.		8.3.1
	/P-CON	41	Function selected by parameter.		–
			Proportional control reference	Switches the speed control loop from PI (proportional/ integral) to P (proportional) control when ON.	8.5.2 9.6.4
			Direction reference	For the internal set speed selection: Switch the rotation direction.	8.8.2
			Control mode switching	Position ↔ speed Control ↔ torque Torque ↔ speed Enables control mode switching.	8.10.1 8.10.2
			Zero-clamp reference	Speed control with zero-clamp function: Reference speed is zero when ON.	8.5.6
			Reference pulse block	Position control with reference pulse stop: Stops reference pulse input when ON.	8.6.7
	P-OT N-OT	42 43	Forward Run prohibited Reverse Run prohibited	Overtravel prohibited: Stops servomotor when movable part travels beyond the allowable range of motion.	8.3.3
	/P-CL /N-CL	45 46	Function selected by parameter.		–
			Forward external torque limit ON Reverse external torque limit ON	Current limit function used when ON.	8.9.2 8.9.4
			Internal speed switching	With internal reference speed selected: Switches the internal speed settings.	8.8
	/ALM -RST	44	Alarm reset: Releases the servo alarm state.		8.11.1
	+24VIN	47	Control power supply input for sequence signals: Users must provide the +24-V power supply. Allowable voltage fluctuation range: 11 to 25 V		6.3.6
	SEN	4 (2)	Initial data request signal when using an absolute encoder.		8.4.1
	BAT (+) BAT (-)	21 22	Connecting pin for the absolute encoder backup battery. Do not connect when the encoder cable for the battery case is used.		8.4.1 6.2
Speed	V-REF	5 (6)	Speed reference speed input: ±2 to ±10 V/rated motor speed (Input gain can be modified using a parameter.)		8.5.2 8.7.4
Torque	T-REF	9 (10)	Torque reference input: ±1 to ±10 V/rated motor torque (Input gain can be modified using a parameter.)		8.7.2 8.9.3 8.9.4
Position Reference	PULS /PULS SIGN /SIGN	7 8 11 12	Reference pulse input for only line driver	Input modes: Set one of them. • Sign + pulse string • CCW/CW pulse • Two-phase pulse (90° phase differential)	8.6.1
	CLR /CLR	15 14	Position error pulse clear: Clears position error pulse during position control.		8.6.1

Note: 1. Pin numbers in parentheses () indicate signal grounds.
2. The functions allocated to /S-ON, /P-CON. P-OT, N-OT, /ALM-RST, /P-CL, and /N-CL input signals can be changed by using the parameters. Refer to *7.3.2 Input Circuit Signal Allocation*.
3. The voltage input range for speed and torque references is a maximum of ±12 V.

(2) Output Signals

<table>
<tr><th colspan="2">Signal Name</th><th>Pin No.</th><th colspan="2">Function</th><th>Reference Section</th></tr>
<tr><td rowspan="8">Common</td><td>ALM+
ALM-</td><td>31
32</td><td colspan="2">Servo alarm: Turns OFF when an error is detected.</td><td>8.11.1</td></tr>
<tr><td>/TGON+
/TGON-</td><td>27
28</td><td colspan="2">Detection during servomotor rotation: Detects whether the servomotor is rotating at a speed higher than the motor speed setting. Motor speed detection can be set by using the parameters.</td><td>8.11.3</td></tr>
<tr><td>/S-RDY+
/S-RDY-</td><td>29
30</td><td colspan="2">Servo ready: ON if there is no servo alarm when the control/main circuit power supply is turned ON.</td><td>8.11.4</td></tr>
<tr><td>PAO
/PAO</td><td>33 (1)
34</td><td>Phase-A signal</td><td rowspan="3">Converted two-phase pulse (phases A and B) encoder output signal and origin pulse (phase C) signal: RS-422 or the equivalent
(Proper line receiver is SN75175 by Texas Instruments or MC3486 or the equivalent.)</td><td rowspan="3">8.4.6
8.5.7</td></tr>
<tr><td>PBO
/PBO</td><td>35
36</td><td>Phase-B signal</td></tr>
<tr><td>PCO
/PCO</td><td>19
20</td><td>Phase-C signal</td></tr>
<tr><td>ALO1
ALO2
ALO3</td><td>37 (1)
38 (1)
39 (1)</td><td colspan="2">Alarm code output: Outputs 3-bit alarm codes.
Open-collector: 30 V and 20 mA rating maximum</td><td>8.11.1</td></tr>
<tr><td>FG</td><td>Shell</td><td colspan="2">Connected to frame ground if the shield wire of the I/O signal cable is connected to the connector shell.</td><td>–</td></tr>
<tr><td>Speed</td><td>/V-CMP+
/V-CMP-</td><td>25
26</td><td colspan="2">Speed coincidence (output in Speed Control Mode): Detects whether the motor speed is within the setting range and if it matches the reference speed value.</td><td>8.5.8</td></tr>
<tr><td>Position</td><td>/COIN+
/COIN-</td><td>25
26</td><td colspan="2">Positioning completed (output in Position Control Mode): Turns ON when the number of position error pulse reaches the value set. The setting is the number of position error pulse set in reference units (input pulse units defined by the electronic gear).</td><td>8.6.5</td></tr>
<tr><td rowspan="2">Reserved</td><td>/CLT
/VLT
/BK
/WARN
/NEAR</td><td>–</td><td colspan="2">Reserved terminals
The functions allocated to /TGON, /S-RDY, and /V-CMP (/COIN) can be changed by using the parameters. /CLT, /VLT, /BK, /WARN, and /NEAR signals can also be changed.</td><td>8.3.4
8.6.6
8.7.4
8.9.5
8.11.2</td></tr>
<tr><td>–</td><td>3
13
16
17
18
23
24
48
49
50</td><td colspan="2">Terminals not used
Do not connect relays to these terminals.</td><td>–</td></tr>
</table>

Note: 1. Pin numbers in parentheses () indicate signal grounds.

2. The functions allocated to /TGON, /S-RDY, and /V-CMP (/COIN) can be changed by using the parameters. /CLT, /VLT, /BK, /WARN, and /NEAR signals can also be changed. Refer to *7.3.3 Output Circuit Signal Allocation*.

6.3.6 Interface Circuit

This section shows examples of SERVOPACK I/O signal connection to the host controller.

(1) Interface for Reference Input Circuits

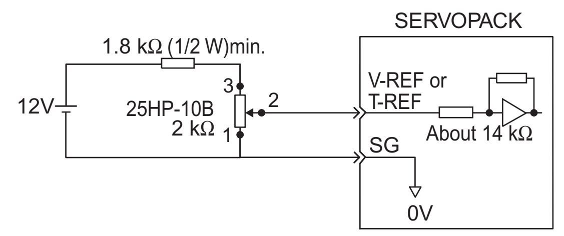
(a) Analog Input Circuit

CN1 connector terminals, 5-6 (speed reference input) and 9-10 (torque reference input) are explained below.
Analog signals are either speed or torque reference signals at the impedance below.

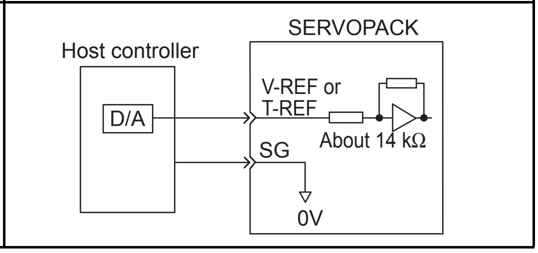
- Reference speed input: About 14 kΩ
- Reference torque input: About 14 kΩ

The maximum allowable voltages for input signals is ±12 V.

Analog voltage Input Circuit



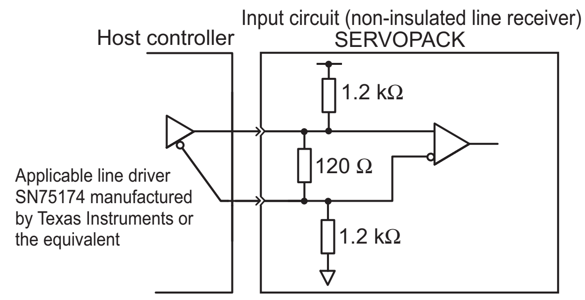
Analog Voltage Input Circuit (D/A)



(b) Position Reference Input Circuit

CN1 connector terminals, 7-8 (reference pulse input) and 11-12 (reference sign input) are explained below.
An input circuit for reference pulse and position error pulse signals is line receiver inputs.

Input Circuit (Non-insulated line receiver)



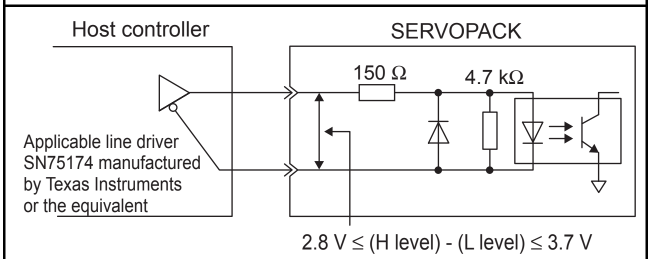
Note: Input circuit can not be connected to the host controller directory when the output circuit of the host controller is the voltage output or open-corrector output.

(c) Clear Input Circuit

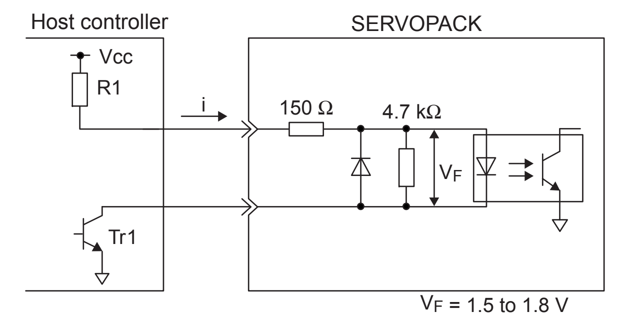
CN1 connector terminals, 15-14: Clear input is explained below.

An output circuit for the reference pulse and position error pulse clear signal at the host controller can be either line-driver or open-collector outputs. The following shows by type.

Line-driver Output Circuit



Open-collector Output, Example 1: Power Supply Provided by User



Use the examples below to set pull-up resistor R1 so the input current, i, falls between 7 mA and 15 mA.

Application Examples		
R1 = 2.2 kΩ with a Vcc of 24 V ±5%	R1 = 1 kΩ with a Vcc of 12 V ±5%	R1 = 180 Ω with a Vcc of 5 V ±5%

Wiring

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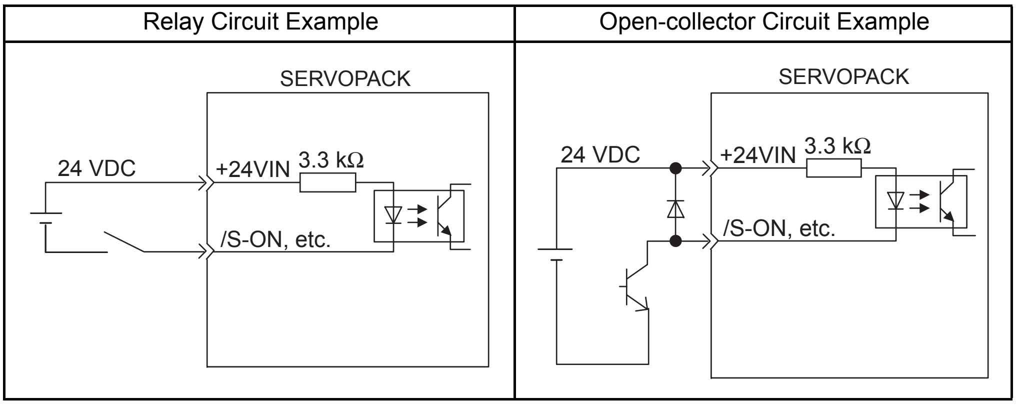
(2) Sequence Input Circuit Interface

CN1 connector terminals 40 to 47 is explained below.

The sequence input circuit interface connects through a relay or open-collector transistor circuit. Select a low-current relay otherwise a faulty contact will result.

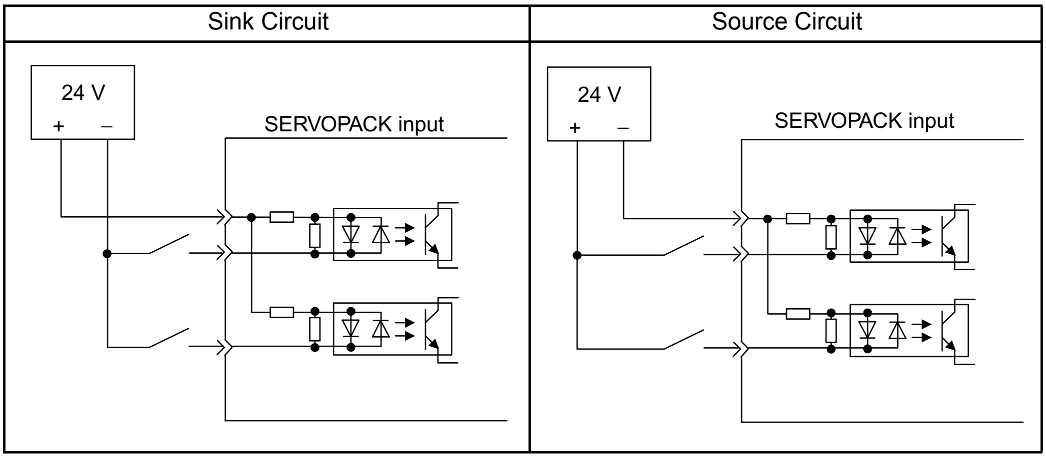


Note: The 24 VDC external power supply capacity must be 50 mA minimum.

INFO For SEN input signal circuit, refer to *8.4 Absolute Encoders*.

(3) Sink Circuit and Source Circuit

The SERVOPACK's I/O circuit uses bidirectional photocoupler. Select either the sink circuit or the source circuit according to the specifications required for each machine.



(4) Output Circuit Interface

There are three types of SERVOPACK output circuits:

(a) Line Driver Output Circuit

CN1 connector terminals, 33-34 (phase-A signal), 35-36 (phase-B signal), and 19-20 (phase-C signal) are explained below.

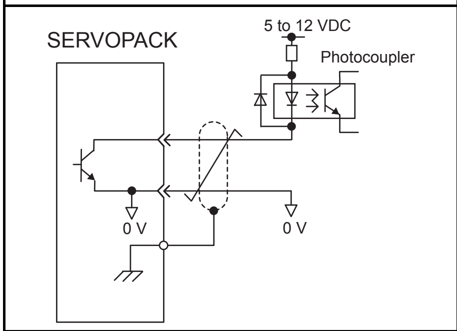
Encoder serial data converted to two-phase (phases A and B) pulse output signals (PAO, /PAO, PBO, /PBO) and origin pulse signals (PCO, /PCO) are output via line-driver output circuits. Normally, the SERVOPACK uses this output circuit in speed control to comprise the position control system at the host controller. Connect the line-driver output circuit through a line receiver circuit at the host controller.

(b) Open-collector Output Circuit

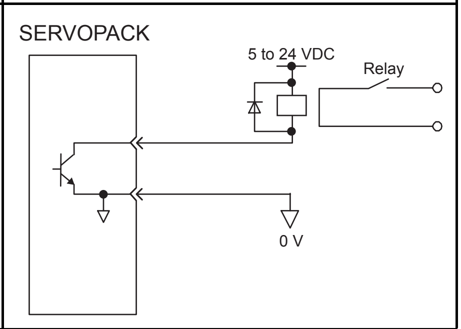
CN1 connector terminals 37 to 39 (alarm code output) are explained below.

Alarm code signals (ALO1, ALO2, ALO3) are output from open-collector transistor output circuits. Connect an open-collector output circuit through a photocoupler, relay or line receiver circuit.

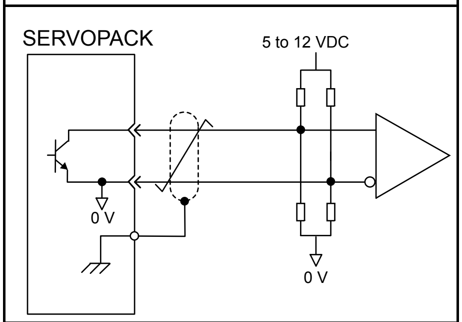
Photocoupler Circuit Example



Relay Circuit Example



Line Receiver Circuit Example



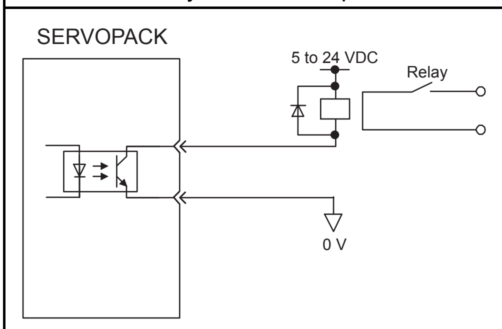
Note: The maximum allowable voltage and current capacities for open-collector output circuits are as follows.

- Voltage: 30 VDC
- Current: 20 mA DC

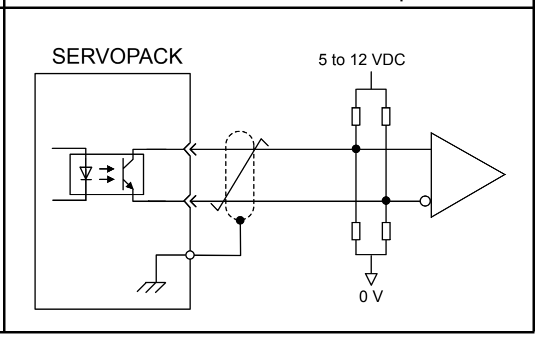
(c) Photocoupler Output Circuit

Photocoupler output circuits are used for servo alarm (ALM), servo ready (/S-RDY), and other sequence output signal circuits. Connect a photocoupler output circuit through a relay or line receiver circuit.

Relay Circuit Example



Line Receiver Circuit Example



Note: The maximum allowable voltage and current capacities for photocoupler output circuits are as follows.

- Voltage: 30 VDC
- Current: 50 mA DC

6.4 Others

6.4.1 Wiring Precautions

To ensure safe and stable operation, always observe the following wiring precautions.

IMPORTANT

1. For wiring for reference inputs and encoders, use the specified cables. Refer to *5 Specifications and Dimensional Drawings of Cables and Peripheral Devices* for details.
   Use cables that are as short as possible.
2. For a ground wire, use as thick a cable as possible (2.0 mm^2 or thicker).
   - At least class-3 ground (100 Ω max.) is recommended.
   - Ground to one point only.
   - If the servomotor is insulated from the machine, ground the servomotor directly.
3. Do not bend or apply tension to cables.
   The conductor of a signal cable is very thin (0.2 to 0.3 mm), so handle the cables carefully.
4. Use a noise filter to prevent noise interference.
   (For details, refer to *6.4.2 Wiring for Noise Control*.)
   - If the equipment is to be used near private houses or may receive noise interference, install a noise filter on the input side of the power supply line.
   - Because the SGDS SERVOPACK is designed as an industrial device, it provides no mechanism to prevent noise interference.
5. To prevent malfunction due to noise, take the following actions:
   - Position the input reference device and noise filter as close to the SERVOPACK as possible.
   - Always install a surge absorber in the relay, solenoid and electromagnetic contactor coils.
   - The distance between a power line (such as a power supply line or servomotor cable) and a signal line must be at least 30 cm. Do not put the power and signal lines in the same duct or bundle them together.
   - Do not share the power supply with an electric welder or electrical discharge machine. When the SERVOPACK is placed near a high-frequency generator, install a noise filter on the input side of the power supply line.
6. Use a molded-case circuit breaker (QF) or fuse to protect the power supply line from high voltage.
   - The SGDS SERVOPACK connects directly to a commercial power supply without a transformer, so always use an QF or fuse to protect the SERVOPACK from accidental high voltage.
7. The SGDS SERVOPACKs do not have built-in ground protection circuits. To configure a safer system, install an earth leakage breaker for protection again overloads and short-circuiting, or install an earth leakage breaker combined with a wiring circuit breaker for ground protection.

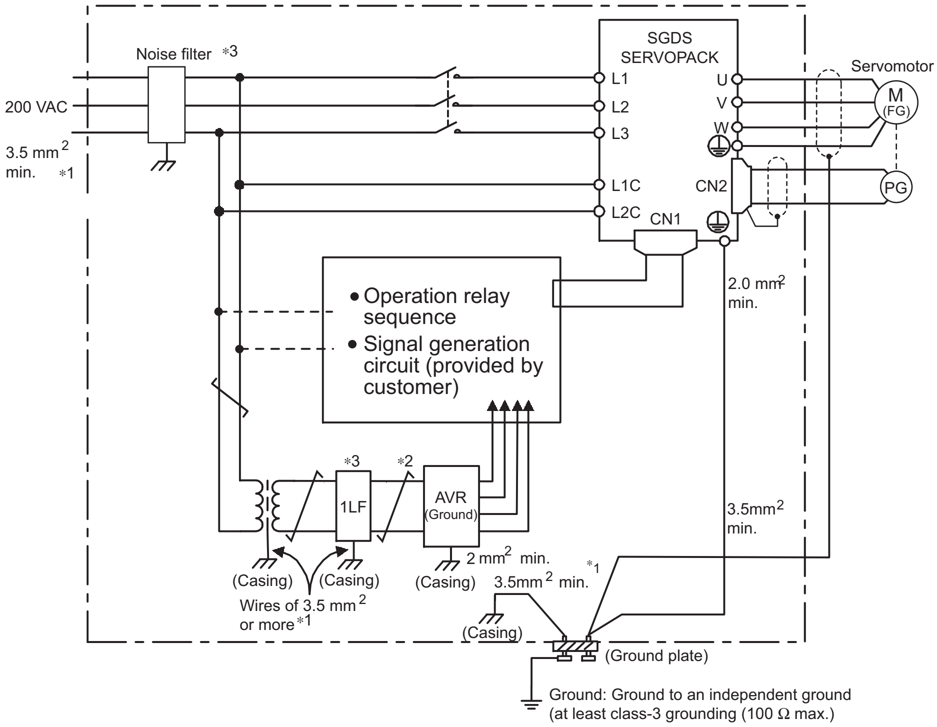
6.4.2 Wiring for Noise Control

(1) Wiring Example

The SGDS SERVOPACK uses high-speed switching elements in the main circuit. It may receive “switching noise” from these high-speed switching elements if wiring or grounding around the SERVOPACK is not appropriate. To prevent this, always wire and ground the SERVOPACK correctly.

The SGDS SERVOPACK has a built-in microprocessor (CPU), so protect it from external noise as much as possible by installing a noise filter in the appropriate place.

The following is an example of wiring for noise control.



∗1 For ground wires connected to the casing, use a thick wire with a thickness of at least 3.5 mm² (preferably, plain stitch cooper wire)

∗2 should be twisted-pair wires.

∗3 When using a noise filter, follow the precautions in *(3) Using Noise Filters.*

(2) Correct Grounding

(a) Grounding the Motor Frame

Always connect servomotor frame terminal FG to the SERVOPACK ground terminal ⏚. Also be sure to ground the ground terminal ⏚.

If the servomotor is grounded via the machine, a switching noise current will flow from the SERVOPACK power unit through servomotor stray capacitance. The above grounding is required to prevent the adverse effects of switching noise.

(b) Noise on the Reference Input Line

If the reference input line receives noise, ground the 0 V line (SG) of the reference input line. If the main circuit wiring for the motor is accommodated in a metal conduit, ground the conduit and its junction box. For all grounding, ground at one point only.

All grounds must be made to only one point in the system.

(3) Using Noise Filters

Use an inhibit type noise filter to prevent noise from the power supply line. The following table lists recommended noise filters for each SERVOPACK model.

Install a noise filter on the power supply line for peripheral equipment as necessary.

Main Circuit Power Supply	SERVOPACK Model		Recommended Noise Filters		Manufacturer
	Capacity (kW)	SGDS-	Model	Specification	
Single-phase 100 V	0.03	A3B	FN2070-6/07	Single-phase 250 VAC, 6 A	SCHAFFNER
	0.05	A5F			
	0.10	01F			
	0.20	02F	FN2070-10/07	Single-phase 250 VAC, 10 A	
	0.40	04F	FN2070-16/07	Single-phase 250 VAC, 16 A	
Single-phase 200 V	0.05	A5A	FN2070-6/07	Single-phase 250 VAC, 6 A	
	0.10	01A			
	0.20	02A			
	0.40	04A	FN2070-10/07	Single-phase 250 VAC, 10 A	
	0.75	08A	FN2070-16/07	Single-phase 250 VAC, 16 A	
Three-phase 200 V	0.5	05A	FN258L-7/07	Three-phase 480 VAC, 7 A	
	1.0	10A	FN258L-16/07	Three-phase 480 VAC, 16 A	
	1.5	15A			
	2.0	20A			
	3.0	30A	FN258L-30/07	Three-phase 480 VAC, 30 A	
	5.0	50A	FMAC-0934-5010	Three-phase 480 VAC, 50 A	SCHURTER (formerly TIMONTA)
	6.0	60A		Three-phase 440 VAC, 50 A	
	7.5	75A	FMAC-0953-6410	Three-phase 440 VAC, 64 A	

IMPORTANT

■Noise Filter Brake Power Supply

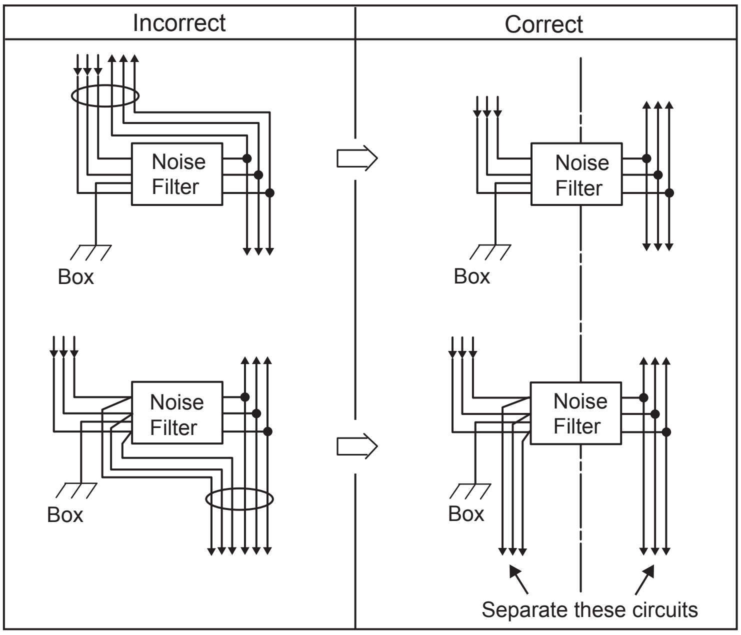
Use the following noise filter at the brake power input for 400 W or less servomotors with holding brakes.

MODEL: FN2070-6/07 (Manufactured by SCHAFFNER Electronic.)

■Precautions on Using Noise Filters

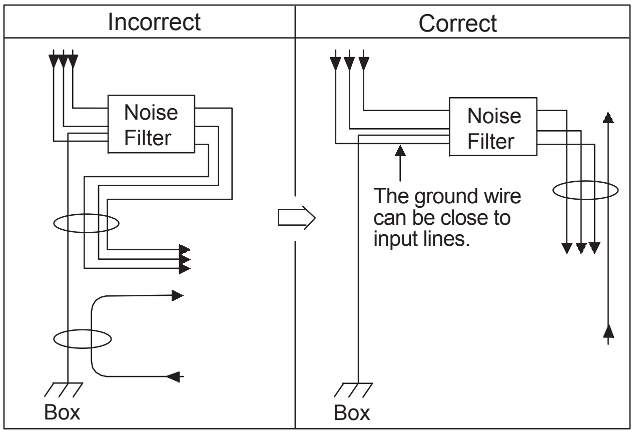
Always observe the following installation and wiring instructions. Incorrect use of a noise filter halves its benefits.

1. Do not put the input and output lines in the same duct or bundle them together.

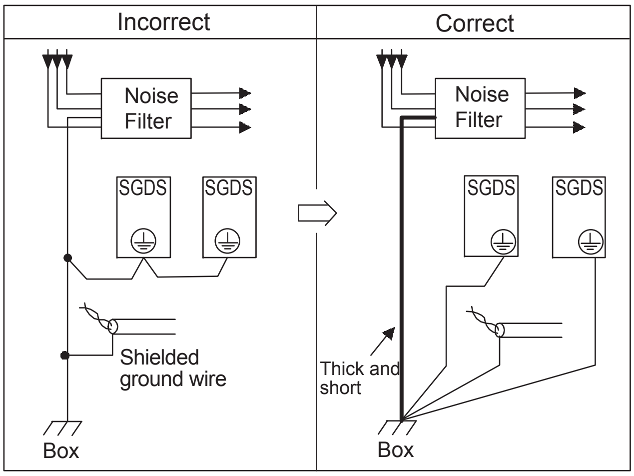


2. Separate the noise filter ground wire from the output lines.

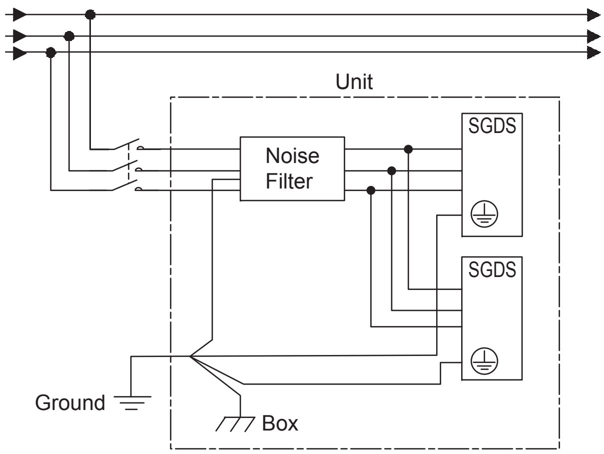
   Do not accommodate the noise filter ground wire, output lines and other signal lines in the same duct or bundle them together.



3. Connect the noise filter ground wire directly to the ground plate.
   Do not connect the noise filter ground wire to other ground wires.



4. When grounding a noise filter inside a unit.
   If a noise filter is located inside a unit, connect the noise filter ground wire and the ground wires from other devices inside the unit to the ground plate for the unit first, then ground these wires.



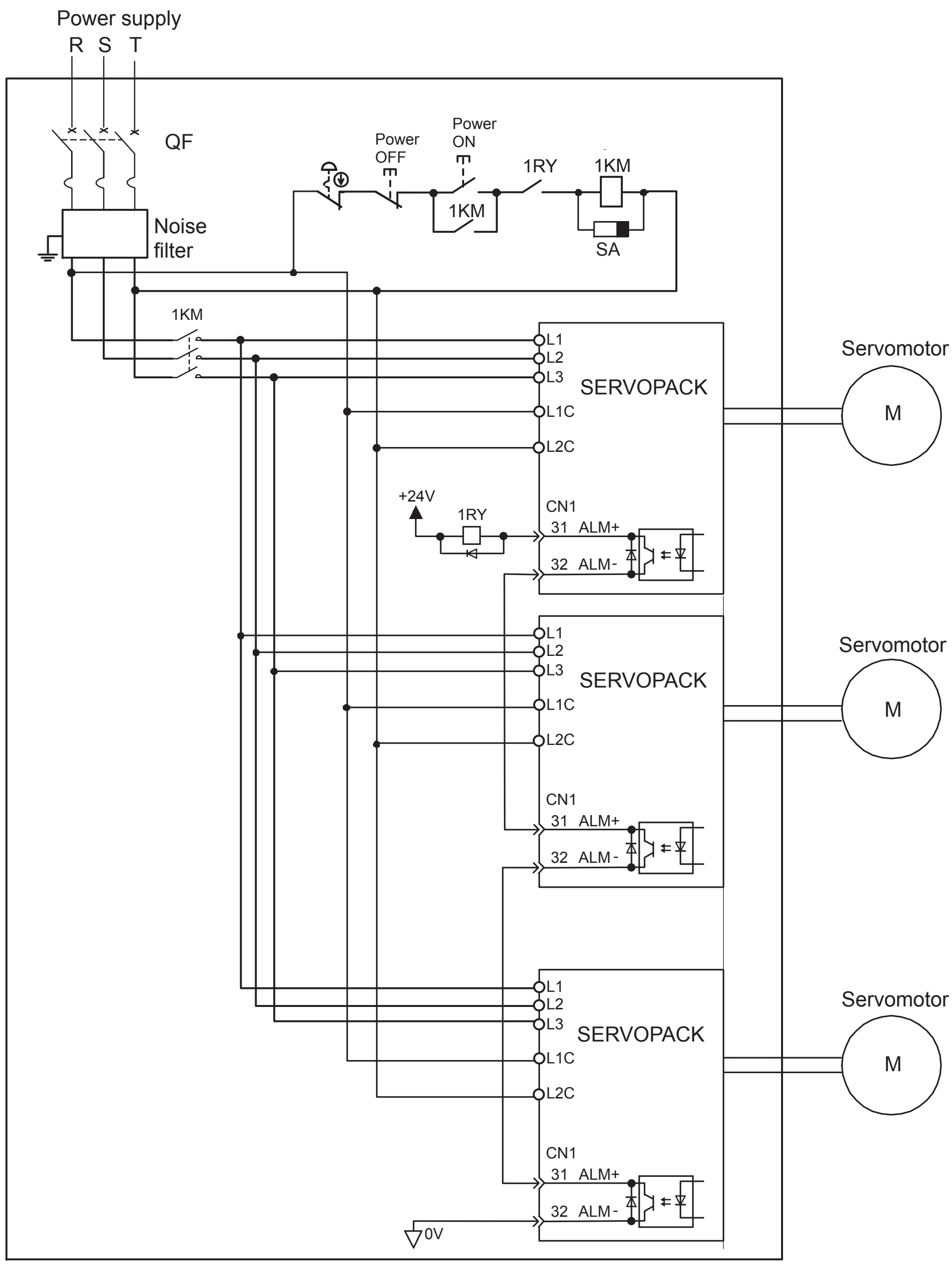
6.4.3 Using More Than One SERVOPACK

The following diagram is an example of the wiring when more than one SERVOPACK is used.

Connect the alarm output (ALM) terminals for the three SERVOPACKs in series to enable alarm detection relay 1RY to operate.

When the alarm occurs, the ALM output signal transistor is turned OFF.

Multiple servos can share a single molded-case circuit breaker (QF) or noise filter. Always select a QF or noise filter that has enough capacity for the total power capacity (load conditions) of those servos. For details, refer to *2.5.2 Molded-case Circuit Breaker and Fuse Capacity*.



Note: Wire the system so that the power supply's phase-S is the ground.

6.4.4 400-V Power Supply Voltage

⚠ CAUTION

- **Do not connect the SERVOPACK for 100 V and 200 V directly to a voltage of 400 V.**
  The SERVOPACK will be destroyed.
- **Control the AC power supply ON and OFF sequence at the primary side of voltage conversion transfer.**
  Voltage conversion transfer inductance will cause a surge voltage if the power is turned ON and OFF at the secondary, damaging the SERVOPACK.

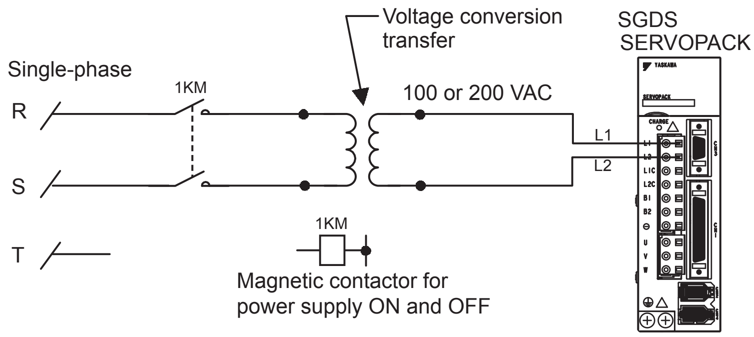
When using SERVOPACK with the three-phase 400-VAC class (380 V to 480 V), prepare the following voltage conversion transfers (single-phase or three-phase).

Primary Voltage		Secondary Voltage
380 to 480 VAC	→	200 VAC
380 to 480 VAC	→	100 VAC

When selecting a voltage conversion transfer, refer to the capacities shown in the following table.

Voltage	SERVOPACK Model	Voltage Capacity per SERVOPACK * (kVA)	Current Capacity of Circuit Breaker or Fuse (Arms)
Single-phase 100 V	SGDS-A3B	0.25	4
	SGDS-A5F	0.25	4
	SGDS-01F	0.40	4
	SGDS-02F	0.60	6
	SGDS-04F	1.20	8
Single-phase 200 V	SGDS-A5A	0.25	4
	SGDS-01A	0.40	4
	SGDS-02A	0.75	4
	SGDS-04A	1.2	8
	SGDS-08A	2.1	11
Three-phase 200 V	SGDS-05A	1.4	4
	SGDS-10A	2.3	7
	SGDS-15A	3.2	10
	SGDS-20A	4.3	13
	SGDS-30A	5.9	17
	SGDS-50A	7.5	28
	SGDS-60A	12.5	32
	SGDS-75A	15.5	41

* This is the net value at the rated load.



Single-phase Power Supply Connection Example

6.4.5 AC/DC Reactor for Harmonic Suppression

(1) Reactor Types

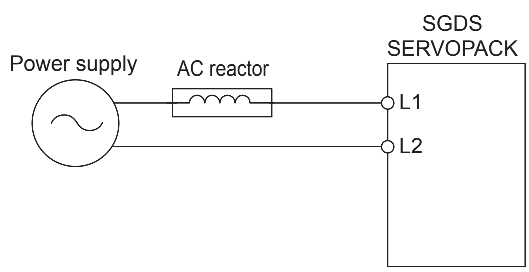
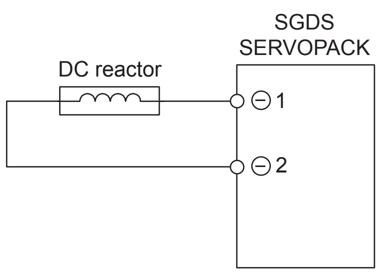
The SGDS SERVOPACK has reactor connection terminals for power supply harmonic suppression. The type of reactor to be connected differs depending on the SERVOPACK capacity. Refer to the following table.

Applicable SERVOPACK Model SGDS-		AC/DC Reactor Model	Reactor Specifications	
			Impedance (mH)	Rated Current (A)
Single-phase, 100 V	A3B	X5052	45.0	1.0
	A5F	X5053	20.0	2.0
	01F			
	02F	X5054	5.0	3.0
	04F	X5056	2.0	5.0
Single-phase, 200 V	A5A	X5052	45.0	1.0
	01A			
	02A	X5053	20.0	2.0
	04A	X5054	5.0	3.0
	08A	X5056	2.0	5.0
Three-phase, 200 V	05A	X5061	2.0	4.8
	10A			
	15A	X5060	1.5	8.8
	20A			
	30A	X5059	1.0	14.0
	50A	X5068	0.47	26.8
	60A	–	–	–
	75A	–	–	–

Note: Select a proper AC or DC reactor for the input current to the SERVOPACK.
Refer to *2.5.2 Molded-case Circuit Breaker and Fuse Capacity* for input current to each SERVOPACK. For the kind of reactor, refer to *5.10.14 AC/DC Reactors for Power Supply Harmonic Suppression.*

(2) Connecting a Reactor

Connect a reactor as shown in the following diagram.

AC Reactor	DC Reactor
Single-phase input	Three-phase input
	

Note: 1. The DC reactor's ⊖1 and ⊖2 terminals are short-circuited before shipment. Remove the lead wire between these two terminals and connect the DC reactor.
2. AC/DC reactor is an option.

Wiring

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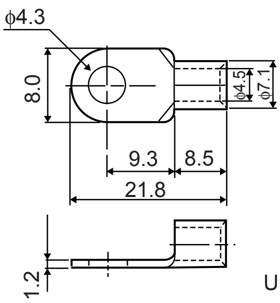
6.4.6 Installation Conditions of UL Standards

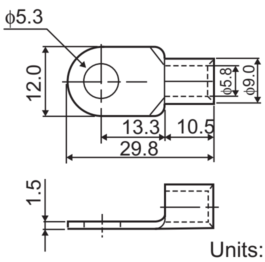
To adapt SERVOPACKs to UL Standards, use the following ring terminal kit for cables to connect the motor output terminals U,V, and W.

IMPORTANT Connecting exposed wires to the terminals in the table below is not allowed under UL standards.

<table>
<tr><th>SERVOPACK Model</th><th>Terminals</th><th>Terminal Kit Model, Recommended Crimp Terminal, and Sleeve Model</th></tr>
<tr><td>SGDS-50A12A
(5.0 kW)</td><td rowspan="2">U, V, W
(Motor output)</td><td>JZSP-CST9-50A
(Crimp terminals and Sleeves × 3 sets)

Dimensional Drawings
(Crimp terminal)


Units: mm</td></tr>
<tr><td>SGDS-75A12A
(7.5 kW)</td><td>■Terminal Kit Model
• JZSP-CST9-75A
(Crimp terminals and Sleeves × 3 sets)

Dimensional Drawings
(Crimp terminal)


Units: mm

■Recommended Crimp Terminal Model
R14-5 (by J.S.T. Mfg. Co., Ltd.)
or,
170730-1
(by Tyco Electronics AMP K.K.)

■Recommended Sleeve Model
TP-014 (by Tokyo Dip Co., Ltd.)</td></tr>
</table>

Note: Refer to *5.3 SERVOPACK Main Circuit Wire Size* in this manual or 10.3 SERVOPACK Main Circuit Wire Size in Σ-III Series AC SERVOPACK SGDS SAFETY PRECAUTIONS (manual no.: TOBPS80000000) for the wire size of each terminal.

6.5 Connecting Regenerative Resistors

6.5.1 Regenerative Power and Regenerative Resistance

The rotational energy of driven machine such as servomotor is returned to the SERVOPACK. This is called regenerative power. The regenerative power is absorbed by charging the smoothing capacitor, but when the chargeable energy is exceeded, the regenerative power is further consumed by the regenerative resistor.

The servomotor is driven in regeneration state in the following circumstances:

- While decelerating to a stop during acceleration and deceleration operation.
- Continuous operation on the vertical axis.
- During continuous operation with the servomotor rotated from the load side (negative load).
- Regenerative resistors are not installed in the 200 V, 50 W to 400 W and 100 V, 30 W to 400 W SERVOPACKs. Operations exceeding the motor speed characteristics shown in *4.5.3 Load Moment of Inertia* need the external regenerative resisters.

6.5.2 Connecting Externally Regenerative Resistors

(1) Necessity of External Regenerative Resistors

SERVOPACK Capacity	Necessity of External Regenerative Resistors	Necessity of External Regenerative Resistors
400 W or less	Not Required	No built-in regenerative resistor is provided, however, normally an external regenerative resistor is not required. Install external regenerative resistors when the smoothing capacitor in SERVOPACK cannot process all the regenerative power.
0.5 kW to 5.0 kW	Not Required	A built-in regenerative resistor is provided as standard. Install external regenerative resistors when the built-in regenerative resistor cannot process all the regenerative power.
6.0 kW to 7.5 kW	Required	No built-in regenerative resistor is provided, so the external regenerative resistor is required. If the external regenerative resistor is not connected with the SERVOPACK, the alarm30 is detected as a regeneration error alarm.

Wiring

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(2) Specifications of Built-in Regenerative Resistor

If the amount of regenerative energy exceeds the processing capacity of the SERVOPACK, then install an external regenerative resistor. The following table shows the specifications of the SERVOPACK's built-in resistor and the amount of regenerative power (average values) that it can process.

Main Circuit Power Supply	SERVOPACK Model		Specifications of Build-in Resistor		Regenerative Power Processed by Built-in Resistor * (W)	Minimum Allowable Resistance (Ω)
	Capacity (kW)	SGDS-	Resistance (Ω)	Capacity (W)		
Single-phase 100 V	0.03	A3B	–	–	–	40
	0.05	A5F				
	0.10	01F				
	0.20	02F				
	0.40	04F				
Single-phase 200 V	0.05	A5A	–	–	–	
	0.10	01A				
	0.20	02A				
	0.40	04A				
	0.80	08A	50	60	12	
Three-phase 200 V	0.5	05A		40	8	
	1.0	10A		60	12	
	1.5	15A	20	50	10	20
	2.0	20A	12	80	16	12
	3.0	30A				
	5.0	50A	8	180	36	8
	6.0	60A	(6.25)*2	(880)*2	(180)*2	5.8
	7.5	75A	(3.13)*3	(1760)*3	(350)*3	2.9

* 1. The average regenerative power that can be handled is 20% of the rated capacity of the regenerative resistor built into the SERVOPACK.
* 2. The values in parentheses are for the optional JUSP-RA04 Regenerative Resistor Unit.
* 3. The values in parentheses are for the optional JUSP-RA05 Regenerative Resistor Unit.

(3) Precautions on Selecting External Regenerative Resistors

- A built-in regenerative resistor is provided for 500 W to 3.0 kW SGDS SERVOPACKs as standard.

  When installing an external regenerative resistor to the SERVOPACK, make sure that the resistance is the same as that of the SERVOPACK's built-in resistor.
- If combining multiple small-capacity regenerative resistors to increase the regenerative resistor capacity (W), select resistors so that the resistance value including error is at least as high as the minimum allowable resistance shown in the preceding table.

  Connecting a regenerative resistor with the resistance smaller than the minimum allowable resistance may increase the current flow in the regeneration circuit, resulting in damage to the circuit.

(4) Parameter Setting

Pn600	Regenerative Resistor Capacity		Speed Position Torque	
	Setting Range	Unit	Factory Setting	Setting Validation
	0 to SERVOPACK capacity	10 W	0 W	Immediately

Be sure to set this parameter when installing an external regenerative resistor to the SERVOPACK.
When set to the factory setting of “0,” the SERVOPACK’s built-in resistor has been used.
Set the regenerative resistor capacity within tolerance value. When the set value is improper, alarm A.320 is not detected normally. Also, do not set other than 0 without connecting the regenerative resistor because alarm A.300 or A.330 may be detected.

The set value differs depending on the cooling method of external regenerative resistor:
- For natural air cooling method: Set the value maximum 20% of the actually installed regenerative resistor capacity (W).
- For forced air cooling method: Set the value maximum 50% of the actually installed regenerative resistor capacity (W).

Example: Set 20 W (100 W × 20%) for the 100 W external regenerative resistor with natural cooling method: Pn600 = 2 (units: 10 W)

IMPORTANT

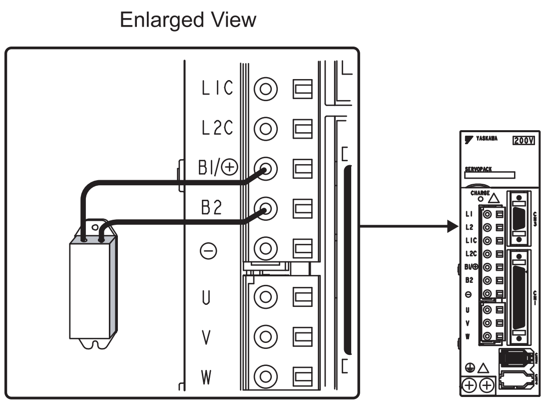
1. When regenerative resistors for power are used at the rated load ratio, the resistor temperature increases to between 200°C and 300°C. The resistors must be used at or below the rated values. Check with the manufacturer for the resistor’s load characteristics. Use resistors at no more than 20% of the rated load ratio with natural convection cooling, and no more than 50% of the rated load ratio with forced air cooling.
2. For safety, use the resistors with thermoswitches.

(5) Connecting Regenerative Resistors

(a) SERVOPACKs with Capacities of 400 W or Less

Connect an external regenerative resistor between B1/⊕ and B2 terminals.

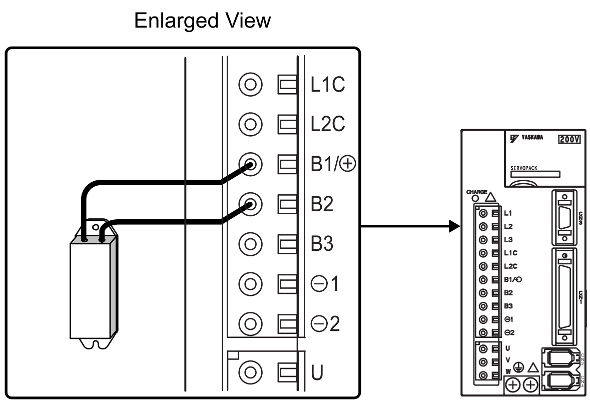
Note: The user must provide the regenerative resistor.



(b) SERVOPACKs with Capacities of 0.5 to 5.0 kW

Disconnect the wiring between the SERVOPACK’s B2 and B3 terminals and connect an external regenerative resistor between the B1/⊕ and B2 terminals or between the B1 and B2 terminals.
The user must provide the regenerative resistor.

Note: Be sure to take out the lead wire between the B2 and B3 terminals.

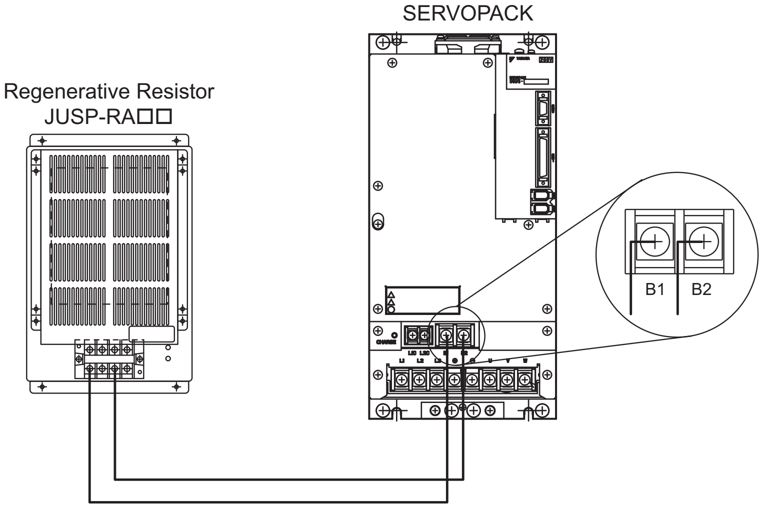


(c) SERVOPACKs with Capacities of 6.0 kW or more

The SERVOPACKs with 6.0 kW or more do not have built-in regenerative resistors. Connect the external regenerative resistor. The following regenerative resistors are available.

Main Circuit Power Supply	SERVOPACK Model SGDS-	Models of Applicable Regenerative Resistor	Resistance (Ω)	Specification
Three-phase 200 V	60A	JUSP-RA04	6.25	25 Ω (220 W) × 4, parallel connection
	75A	JUSP-RA05	3.13	25 Ω (220 W) × 8, parallel connection

The following illustration shows how to connect the regenerative resistor and a SERVOPACK.



Connect the regenerative resistors to the terminals between B1 and B2 of the SERVOAPCK. Customers must purchase regenerative resistors.

IMPORTANT

Do not touch the regenerative resistors because they reach high temperatures. Use heat-resistant, non-flammable wiring and make sure that the wiring does not touch the resistors. For connecting wire size when connecting an external regenerative resistor, refer to *5.3 SERVOPACK Main Circuit Wire Size.*

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Panel Operator

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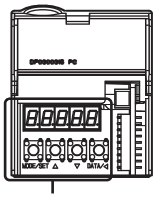
7.1 Functions on Panel Operator

This section describes the basic operations of the panel operator for setting the operating conditions.
Set parameters and JOG operation, and display status using the panel operator. For the operation of hand-held digital operator (Model: JUSP-OP05A), refer to the instructions of digital operator for SGM□S/SGDS (manual no.: TOBPS80000001) in the Σ-III series.

7.1.1 Key Names and Functions

The names and functions of the keys on the panel operator are as follows.



Keys on Panel Operator	Function
▲ + ▼ Press simultaneously	To reset the servo alarm. Notes: The servo alarm can be reset by /ALM-RST (CN1-44) input signal.
MODE/SET (MODE/SET Key)	To select a basic mode, such as the status display mode, utility function mode, parameter setting mode, or monitor mode.
▲ (UP Key)	Press UP Key to increase the set value. For JOG operation, this key is used as Forward Run Start Key.
▼ (DOWN Key)	Press DOWN Key to decrease the set value. For JOG operation, this key is used as Reserve Run Start Key.
DATA/◀ (DATA/SHIFT)	• Data setting key • To display parameter setting and set value. • To shift to the next digit on the left.

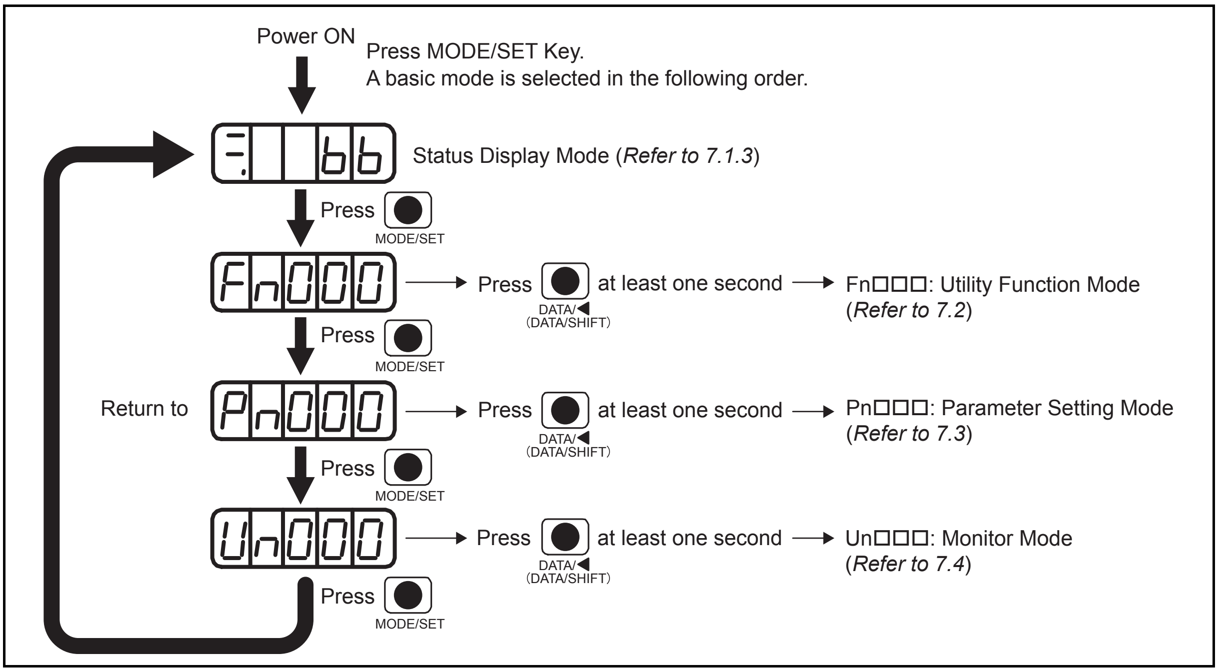
IMPORTANT

When an alarm occurs, remove the cause, and then reset the alarm. Refer to *11.1 Troubleshooting*.

7.1.2 Basic Mode Selection

The basic modes include: Status display mode, Utility Function Mode, Parameter Setting Mode, and Monitor Mode. Select a basic mode to display the operation status, set parameters and operation references.

Press MODE/SET Key to select a basic mode in the following order.



Press MODE/SET Key to select the utility function mode, parameter setting mode, or monitor mode.

Press DATA/SHIFT Key and UP or DOWN Key to select the desired parameter number. Then, press DATA/SHIFT Key for more than one second to display the contents of selected parameter number in the selected mode. (Refer to each operation instruction described later.)

Panel Operator

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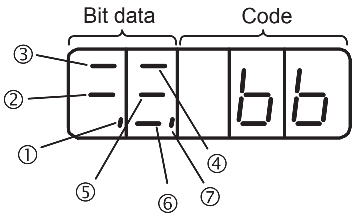
7.1.3 Status Display



(1) Bit Data and Meanings

Item	Speed or Torque Control Mode		Position Control Mode	
	Bit Data	Meaning	Bit Data	Meaning
①	Control Power ON	Lit when SERVOPACK control power is ON.	Control Power ON	Lit when SERVOPACK control power is ON.
②	Baseblock	Lit for baseblock. Not lit when servo is on.	Baseblock	Lit for baseblock. Not lit when servo is ON.
③	Speed Coincidence (/V-CMP)	Lit when the difference between the servomotor speed and reference speed is the same as or less than the value set in Pn503. (Factory setting: 10 min^{-1}.) ∗ Always lit in torque control mode.	Positioning Completion (/COIN)	Lit if error between position reference and actual motor position is below preset value. Not lit if error between position reference and actual motor position exceeds preset value. Preset value: Set in Pn522 (Factory setting is 7 pulses.)
④	Rotation Detection (/TGON)	Lit if motor speed exceeds preset value. Not lit if motor speed is below preset value. Preset value: Set in Pn502 (20 min^{-1} is factory setting)	Rotation Detection (/TGON)	Lit if motor speed exceeds preset value. Not lit if motor speed is below preset value. Preset value: Set in Pn502 (20 min^{-1} is standard setting.)
⑤	Speed Reference Input	Lit if input speed reference exceeds preset value. Not lit if input speed reference is below preset value. Preset value: Set in Pn502 (20 min^{-1} is factory setting.)	Reference Pulse Input	Lit if reference pulse is input Not lit if no reference pulse is input.
⑥	Torque Reference Input	Lit if input torque reference exceeds preset value. Not lit if input torque reference is below preset value. Preset value: 10% rated torque is standard setting.	Error Counter Clear Signal Input	Lit when error counter clear signal is input. Not lit when error counter clear signal is not input.
⑦	Power Ready	Lit when main power supply circuit is normal. Not lit when power is OFF.	Power Ready	Lit when main power supply circuit is normal. Not lit when power is OFF.

(2) Codes and Meanings

Code	Meaning
bb	Baseblock Servo OFF (servomotor power OFF)
run	Run Servo ON (servomotor power ON)
Pot	Forward Run Prohibited CN1-42 (P-OT) is OFF.
not	Reverse Run Prohibited CN1-43 (N-OT) is OFF.
020	Alarm Status Blinks the alarm number.
030 :	

7.2 Operation in Utility Function Mode (Fn□□□)

7.2.1 List of Utility Function Modes

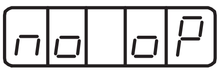
This section describes how to apply the basic operations using the panel operator to run and adjust the motor.

The following table shows the parameters in the utility function mode.

Parameter No.	Function	Remarks	Reference Section
Fn000	Alarm traceback data display		7.2.2
Fn001	Rigidity setting during normal autotuning	○	9.2.4
Fn002	JOG mode operation	○	8.1.1
Fn003	Origin search mode	○	7.2.3
Fn004	Program JOG operation	○	7.2.4
Fn005	Initialize parameter settings	○	7.2.5
Fn006	Clear alarm traceback data	○	7.2.6
Fn007	Save moment of inertia ratio data obtained from normal autotuning	○	9.2.7
Fn008	Absolute encoder multi-turn reset and encoder alarm reset	○	8.4.5
Fn009	Automatic tuning of analog (speed, torque) reference offset	○	8.5.3 8.7.3
Fn00A	Manual servo tuning of speed reference offset	○	8.5.3
Fn00B	Manual servo tuning of torque reference offset	○	8.7.3
Fn00C	Manual zero-adjustment of analog monitor output	○	–
Fn00D	Manual gain-adjustment of analog monitor output	○	–
Fn00E	Automatic offset-adjustment of motor current detection signal	○	7.2.7
Fn00F	Manual offset-adjustment of motor current detection signal	○	7.2.8
Fn010	Write prohibited setting		7.2.9
Fn011	Check servomotor models		7.2.10
Fn012	Software version display		7.2.11
Fn013	Multi-turn limit value setting change when a Multi-turn Limit Disagreement alarm occurs	○	8.4.8
Fn014	Fixed parameter	○	–
Fn015	One-parameter tuning with less deviation	○	9.6.9
Fn016	Fixed parameter		–
Fn017	Advanced tuning	○	9.3.2
Fn018	Online vibration monitor	○	7.2.12 7.2.13
Fn019	EasyFFT	○	7.2.12 7.2.14
Fn01A	One-parameter tuning	○	9.4.2
Fn01B	Initialize vibration detection level	○	7.2.15
Fn01E*	SERVOPACK and servomotor ID Display		–

* Fn01E can be operated only from the JUSP-OP05A digital operator.

Note: When the parameters marked with "○" in remarks column are set for Write Prohibited Setting (Fn010), the indication shown below appears and such parameters cannot be changed.



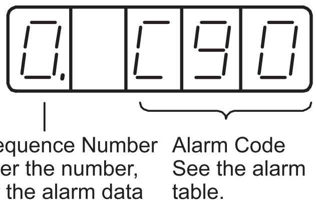
Blinks for one second

7.2.2 Alarm Traceback Data Display (Fn000)

The alarm traceback display can display up to ten previously occurred alarms with time stamp to indicate the total operation time at the moment of alarm occurrence, thus making it possible to check what kind of alarms have been generated.

The Time Stamp counts the main power supply ON time in units of 100 ms for 24 hours per day and 365 days. When the Time Stamp counts up to 4294967295 after approximately 13 years' operation, the Time Stamp ends counting. If the same alarm occurs more than one hour later, this alarm is also saved in the traceback.

Alarm data stored in the alarm traceback data is shown by Fn000. The data can be cleared using an utility function mode "Clear Alarm Traceback Data." For details, refer to *7.2.6 Clear Alarm Traceback Data (Fn006).*
The alarm traceback data is not cleared on alarm reset or when the SERVOPACK power is turned OFF. This does not adversely affect operation.



Refer to *11.1 Troubleshooting* for alarm number and contents.

INFO

1. Alarm traceback data will not be updated when the same alarm occurs repetitively.
2. The display "□.---" means no alarm occurs.

- Checking Alarms

Follow the procedure below to confirm alarms which have been generated.

Procedure	Display after Operation	Panel Operator	Description
1	Fn000	MODE/SET (MODE/SET Key)	Press MODE/SET Key to select “Alarm Traceback Data Display (Fn000).” If a number other than Fn000 is display, press UP Key or DOWN Key to set Fn000. *The enabled digit blinks.
2	0. 810	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT Key for more than one second. The latest alarm data is displayed.
3	1. C90	▼ (DOWN Key)	Press DOWN Key to display one older alarm data. (To display one newer alarm data, press UP Key.) *The height the leftmost digit, the older the alarm data.
4	_3456	DATA/◀ (DATA/SHIFT) (Less than one sec.)	Press DATA/SHIFT Key for less than one second. The lower four digits of Time Stamp are displayed.
5	-0012	DATA/◀ (DATA/SHIFT) (Less than one sec.)	Press DATA/SHIFT Key for less than one second. The middle four digits of Time Stamp are displayed.
6	‾ 00	DATA/◀ (DATA/SHIFT) (Less than one sec.)	Press DATA/SHIFT Key for less than one second. The higher two digits are displayed.
7	1. C90	DATA/◀ (DATA/SHIFT) (Less than one sec.)	Press DATA/SHIFT Key for less than one second. The alarm traceback data is displayed again.
8	Fn000	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT Key for more than one second. Fn000 is displayed again.

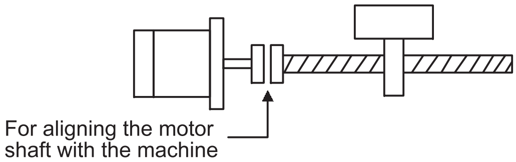
7.2.3 Origin Search Mode (Fn003)

⚠ CAUTION
• Forward run prohibited (P-OT) and reverse run prohibited (N-OT) signals are disabled during origin search mode operations using Fn003.

The origin search mode is designed to position the origin pulse position of the encoder and to clamp at the position.

This mode is used when the motor shaft needs to be aligned to the machine.

Execute the origin search without connecting the couplings.



The speed for executing the origin search is 60 min^{-1}.

The following conditions must be met to perform the origin search operation.

- If the Servo-ON input signal (/S-ON) is ON, turn it OFF.
- Release the Servo-ON signal mask if the parameter Pn 50A.1 is set to 7, and the Servo has been set to always be ON.

Follow the procedure below to execute the origin search.

Procedure	Display after Operation	Panel Operator	Description
1	Fn000	MODE/SET (MODE/SET Key)	Press MODE/SET Key to select the utility function mode.
2	Fn003	▲ ▼	Press UP or DOWN Key to select the Fn003. *The enabled digit blinks.
3	-. .CSr	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT Key for more than one second, and the display will be as shown on the left.
4	. .CSr	MODE/SET (MODE/SET Key)	Press MODE/SET Key. The servomotor is turned to Servo ON.
5	. .CSr	▲ ▼	When the parameter is set to Pn000.0 = 0 (default), pressing the UP Key will rotate the motor in the forward direction. Pressing the DOWN Key will rotate the motor in the reverse direction. When the parameter is set to Pn000.0 = 1, the rotation of the servomotor is reversed.
6	. .CSr	Display blinks.	When the servomotor origin search is completed, the display blinks. At this moment, the motor is servo-locked at the origin pulse position.
7	Fn003	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT Key for more than one second. Fn003 display appears again. The servomotor is turned to Servo OFF.

7.2.4 Program JOG Operation (Fn004)

The Program JOG Operation is a utility function, that allows continuous automatic operation determined by the preset operation pattern, movement distance, movement speed, acceleration/deceleration time, number of time of repetitive operations through the panel operator.
This function can be used to move the servomotor without it having to be connected to a host controller for the machine as a trial operation in JOG operation mode. Also, continuous repetitive operations can be carried out by using position control. Therefore, Program JOG Operation can be used to confirm the reference unit and electronic gears and for simple positioning operations.
The Program JOG Operation can be executed at the same time of processing for other functions. For example, setting the execution of normal autotuning while executing this function allow autotuning without connecting to a host controller.

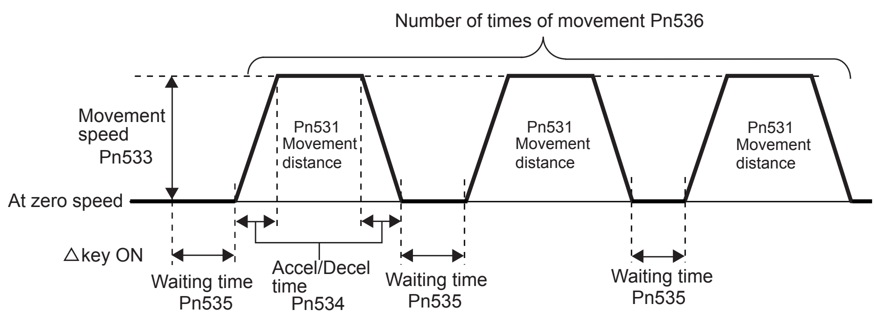
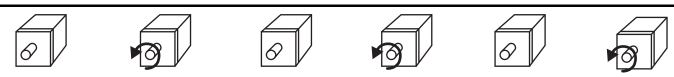
(1) Precautions

Observe the following restrictions during operation.

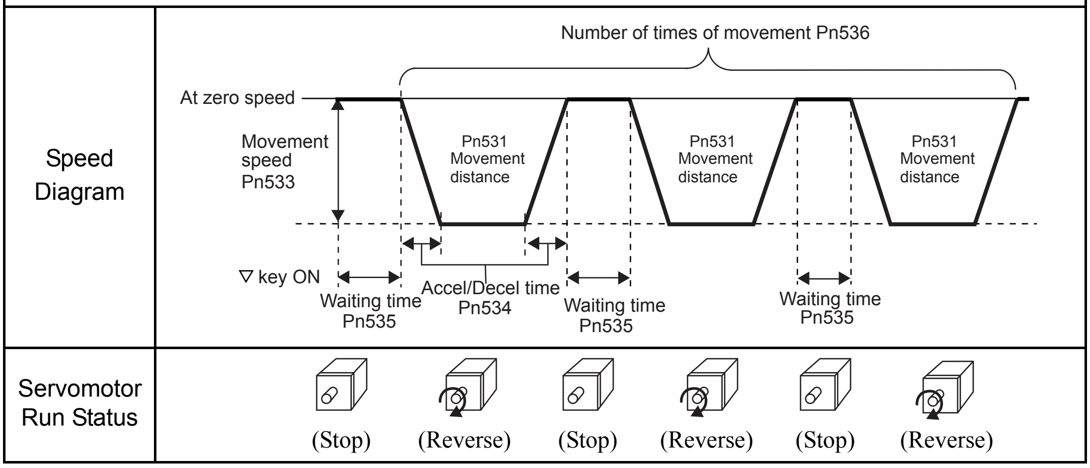
- Prior to setting this function, set correctly the machine operation range and safe operation speed in the parameters such as “program JOG operation movement distance” and “program JOG movement speed.”
- The SERVOPACK must be in Servo Ready status to execute this function. this function cannot be executed in Servo ON status.
- If the Servo-ON input signal (/S-ON) is ON, turn it OFF.
- Release the Servo-ON signal mask if the parameter Pn 50A.1 is set to 7, and the Servo has been set to always be ON.
- Control mode is position control mode during program JOG operation. However, the pulse reference input to the SERVOPACK is inhibited (in \INHIBIT status) and no pulse reference input is accepted.
- The overtravel function is enabled in this function. (Disables in JOG operation mode.)
- When an absolute encoder is used, SEN signal is always enabled.
- Other functions that are applicable for position control, such as position reference filter, can be used.

(2) Program Operation Patterns

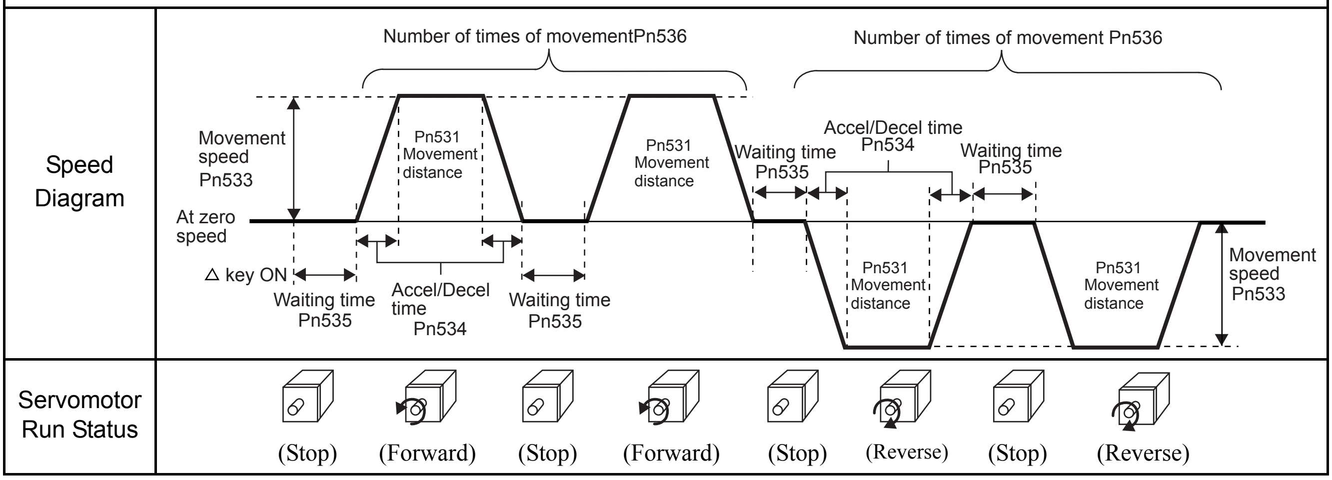
The following example is given when the rotating direction of the Servomotor is set as Pn000.0 = 1 (counterclockwise direction is regarded as the forward run).

Pn530.0 = 0 (Waiting time Pn535 → Forward movement Pn531) × No. of times of movement Pn536	
Speed Diagram	
Servomotor Run Status	 (Stop) (Forward) (Stop) (Forward) (Stop) (Forward)

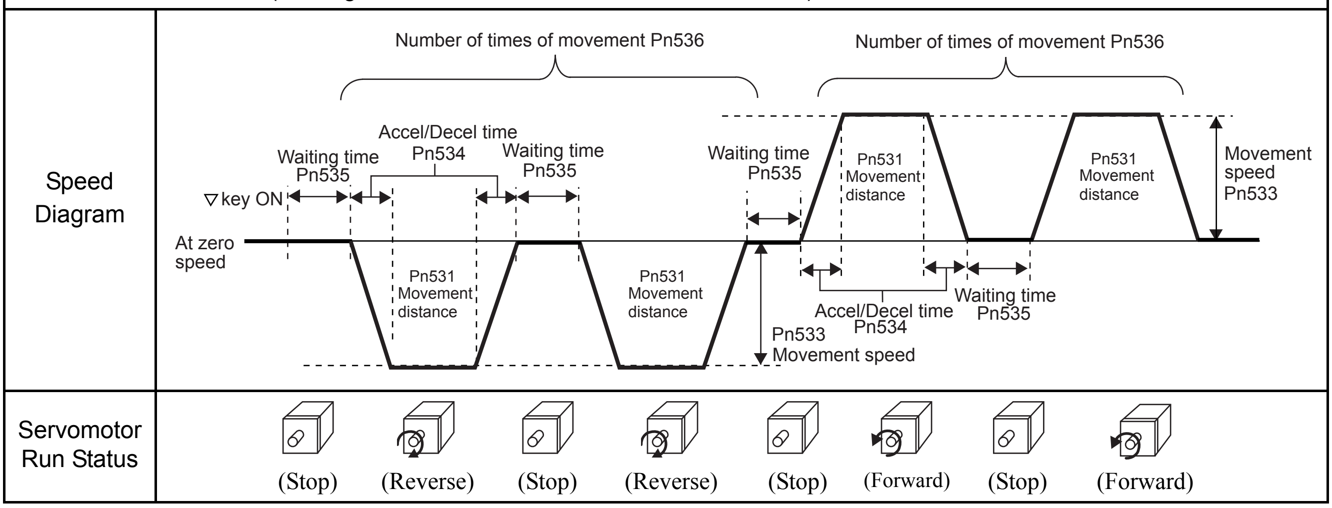
Pn530.0 = 1
(Waiting time Pn535 → Reverse movement Pn531) × No. of times of movement Pn536



Pn530.0 = 2 (Waiting time Pn535 → Forward movement Pn531) × No. of times of movement Pn536
(Waiting time Pn535 → Reverse movement Pn531) × No. of times of movement Pn536



Pn530.0 = 3 (Waiting time Pn535 → Reverse movement Pn531) × No. of times of movement Pn536
(Waiting time Pn535 → Forward movement Pn531) × No. of times of movement Pn536



Panel Operator

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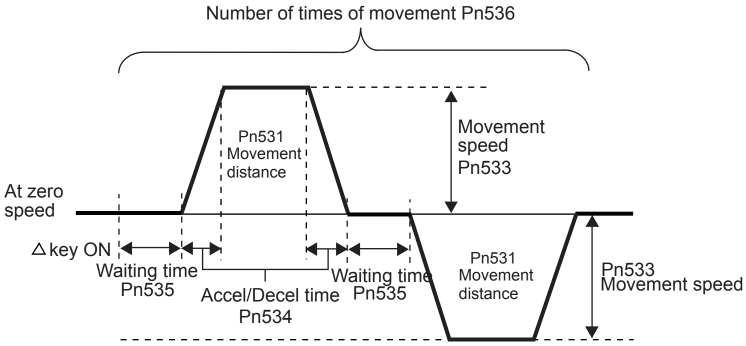
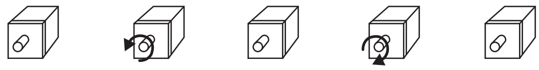
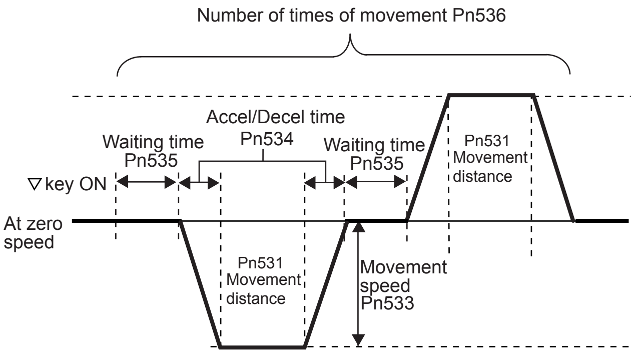
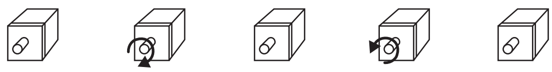
<table>
<tr><td colspan="2">Pn530.0 = 4
(Waiting time Pn535 → Forward movement Pn531 → Waiting time Pn535 → Reserve movement Pn531)
× No. of times of movement Pn536</td></tr>
<tr><td>Speed Diagram</td><td>
</td></tr>
<tr><td>Servomotor Run Status</td><td>
(Stop) (Forward) (Stop) (Reverse) (Stop)</td></tr>
</table>

<table>
<tr><td colspan="2">Pn530.0 = 5
(Waiting time Pn535 → Reverse movement Pn531 → Waiting time Pn535 → Forward movement Pn531)
× No. of times of movement Pn536</td></tr>
<tr><td>Speed Diagram</td><td>
</td></tr>
<tr><td>Servomotor Run Status</td><td>
(Stop) (Reverse) (Stop) (Forward) (Stop)</td></tr>
</table>

(3) Parameters

Pn530	Program JOG Operation Related Switch		Speed Position Torque
Setting Range	Unit	Factory Setting	Setting Validation
–	–	0000	Immediately

Pn531	Program JOG Movement Distance		Speed Position Torque
Setting Range	Unit	Factory Setting	Setting Validation
1 to 1073741824(2^{30}) reference units	1 Reference unit	32768	Immediately

Pn533	Program JOG Movement Speed		Speed Position Torque
Setting Range	Unit	Factory Setting	Setting Validation
1 to 10000	1min^{-1}	500	Immediately

Pn534	Program JOG Acceleration/Deceleration Time		Speed Position Torque
Setting Range	Unit	Factory Setting	Setting Validation
2 to 10000	1ms	100	Immediately

Pn535	Program JOG Waiting Time		Speed Position Torque
Setting Range	Unit	Factory Setting	Setting Validation
0 to 10000	1ms	100	Immediately

Pn536	Number of Times of Program JOG Movement		Speed Position Torque
Setting Range	Unit	Factory Setting	Setting Validation
1 to 1000	1 time	1	Immediately

Parameter		Contents	Factory Setting
Pn530	n.□□□0	(Waiting time Pn535 → Forward movement Pn531) × Number of times of movement Pn536	0
	n.□□□1	(Waiting time Pn535 → Reverse movement Pn531) × Number of times of movement Pn536	
	n.□□□2	(Waiting time Pn535 → Forward movement Pn531) × Number of times of movement Pn536 (Waiting time Pn535 → Reverse movement Pn531) × Number of times of movement Pn536	
	n.□□□3	(Waiting time Pn535 → Reverse movement Pn531) × Number of times of movement Pn536 (Waiting time Pn535 → Forward movement Pn531) × Number of times of movement Pn536	
	n.□□□4	(Waiting time Pn535 → Forward movement Pn531 → Waiting time Pn535 → Reverse movement Pn531) × Number of times of movement Pn536	
	n.□□□5	(Waiting time Pn535 → Reverse movement Pn531 → Waiting time Pn535 → Forward movement Pn531) × Number of times of movement Pn536	

(4) Operation

Procedure	Display after Operation	Panel Operator	Description
1	Fn000	MODE/SET (MODE/SET Key)	Press MODE/SET Key to select the utility function mode.
2	Fn004	▲ ▼	Press UP Key or DOWN Key to select Fn004.
3	=.PJOG	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT Key for more than one second. The display shown on the left appears.
4	‾.PJOG	MODE/SET (MODE/SET Key)	Press MODE/SET Key. The servo turns ON.
5	.PJOG	▲ ▼	Press UP Key or DOWN Key according to the first movement direction of the operation pattern. After the preset waiting time, the movement starts. * Press MODE/SET Key again during operation, and the servomotor will be in baseblock status and stop. Press DATA/ENTER Key for more than one second during operation, the servomotor stops and the utility function mode display Fn004 appears.
6	‾. .End (Blinking)	End of program JOG operation	“End” blinks when the program JOG operation movement completes, and the display of procedure 4 appears. Press MODE/SET Key, and the servomotor will be in baseblock status. Press DATA/ENTER Key for more than one second, and the utility function mode display Fn004 appears.

7.2.5 Initialize Parameter Settings (Fn005)

This function is used when returning to the factory settings after changing parameter settings.

Pressing MODE/SET Key during servo ON does not initialize the parameter settings.

After initialization, turn OFF the power supply and then turn ON again.

IMPORTANT

Initialize the parameter settings with the servo OFF.

Procedure	Display after Operation	Panel Operator	Description
1	Fn000	MODE/SET (MODE/SET Key)	Press MODE/SET Key to select the utility function mode.
2	Fn005	▲ ▼	Press UP or DOWN Key to select Fn005. *The enabled digit blinks.
3	P.Init	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT Key for more than one second, and the display will be as shown on the left.
4	P.Init	MODE/SET (MODE/SET Key)	Press MODE/SET Key. Then, the parameters will be initialized. During initialization, the display shown on the left blinks.
5	donE	End of initialization	When the initialization of parameter setting completes, the display shown on the left blinks for about one second.
6	P.Init	After about one second	The display changes from “donE” to the display shown on the left.
7	Fn005	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT Key for more than one second to return to the utility function mode display Fn005.

7.2.6 Clear Alarm Traceback Data (Fn006)

This function clears the alarm history, which stores the alarms generated in the SERVOPACK.
After having cleared data, "□.----" (No alarm) is set to all the alarm history data.

Procedure	Display after Operation	Panel Operator	Description
1	Fn000	MODE/SET (MODE/SET Key)	Press MODE/SET Key to select the utility function mode.
2	Fn006	▲ ▼	Press UP or DOWN Key to select Fn006. * The enabled digit blinks.
3	trCLr	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT Key for more than one second, and the display will be as shown on the left.
4	donE	MODE/SET (MODE/SET Key)	Press MODE/SET Key to clear the alarm traceback data. The display shown on the left blinks for about one second when the data is cleared.
5	trCLr	After about one second	The display changes from "donE" to the display shown on the left.
6	Fn006	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT Key for more than one second to return to the display the utility function mode Fn006.

7.2.7 Automatic Offset-Signal Adjustment of the Motor Current Detection (Fn00E)

Motor current detection offset adjustment has performed at Yaskawa before shipping. Basically, the user need not perform this adjustment.

Perform this adjustment only if highly accurate adjustment is required for reducing torque ripple caused by current offset. Automatic adjustment is possible only with power supplied to the main circuits power supply and with the servo OFF.

IMPORTANT

Execute the automatic offset adjustment if the torque ripple is too big when compared with that of other SERVOPACKs.

Procedure	Display after Operation	Panel Operator	Description
1	Fn000	MODE/SET (MODE/SET Key)	Press MODE/SET Key to select the utility function mode.
2	Fn00E	▲ ▼	Press UP or DOWN Key to select Fn00E. *The enabled digit blinks.
3	Cur_o	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press the DATA/SHIFT Key for more than one second, and the display will be as shown on the left.
4	donE	MODE/SET (MODE/SET Key)	Press MODE/SET Key. The offset will be automatically adjusted. When the adjustment completes, the display shown on the left blinks for about one second.
5	Cur_o	After about one second	The display changes from “donE” to the display shown on the left.
6	Fn00E	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press the DATA/SHIFT Key for more than one second to return to the utility function mode display Fn00E.

7.2.8 Manual Offset-Signal Adjustment of the Motor Current Detection (Fn00F)

The adjusting range of the motor current detection signal offset is -512 to +511.

To adjust the offset, perform the automatic adjustment (Fn00E) first.

And if the torque ripple is still big after the automatic adjustment, perform the manual servo tuning.

IMPORTANT

If this function, particularly manual servo tuning, is executed carelessly, it may worsen the characteristics.

When performing manual servo tuning, run the servomotor at a speed of approximately 100 min^{-1}, and adjust the operator until the torque monitor ripple is minimized. (Refer to *9.7 Analog Monitor*.) Adjust the phase-U and phase-V offsets alternately several times until these offsets are well balanced.

Procedure	Display after Operation	Panel Operator	Description
1	Fn000	MODE/SET (MODE/SET Key)	Press MODE/SET Key to select the utility function mode.
2	Fn00F	▲ ▼	Press UP or DOWN Key to select Fn00F. *The enabled digit blinks.
3	Cu1_o	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT Key for more than one second, and the display will be as shown on the left (phase U).
4	0000	DATA/◀ (DATA/SHIFT) (Less than one sec.)	Press DATA/SHIFT Key for less than one second to display the phase-U offset amount.
5	-0010	▲ ▼	Press UP or DOWN Key to adjust the offset. Carefully adjust the offset while monitoring the torque reference monitor signal.
6	Cu1_o	DATA/◀ (DATA/SHIFT) (Less than one sec.)	Press DATA/SHIFT Key for less than one second. The display shown on the left appears.
7	Cu2_o	MODE/SET (MODE/SET Key)	Press MODE/SET Key. The display shown on the left appears (phase V).
8	0000	DATA/◀ (DATA/SHIFT) (Less than one sec.)	Press DATA/SHIFT Key for less than one second to display the phase-V offset amount.
9	-0010	▲ ▼	Press UP or DOWN Key to adjust the offset. Carefully adjust the offset while monitoring the torque reference monitor signal.
10	Cu2_o	DATA/◀ (DATA/SHIFT) (Less than one sec.)	Press DATA/SHIFT Key for less than one second. The display shown on the left appears.
11	Fn00F	DATA◀ (DATA/SHIFT) (Press at least one sec.)	When the offset adjustment completes, press DATA/SHIFT Key for more than one second. The display returns to that of the utility function mode Fn00F.

7.2.9 Write Prohibited Setting (Fn010)

The write prohibited setting is used for preventing accidental changes of the parameter. All the parameters Pn□□□ and some of Fn□□□ become write prohibited by setting values. Refer to *7.2.1 List of Utility Function Modes* for details.

Setting values are as follows:

- “0000”: Write permitted (Releases write prohibited mode.)
- “0001”: Write prohibited (Parameters become write prohibited from the next power ON.)

Procedure	Display after Operation	Panel Operator	Description
1	Fn000	MODE/SET (MODE/SET Key)	Press MODE/SET Key to select the utility function mode.
2	Fn010	▲ ▼	Press the UP or DOWN Key to select Fn010. *The enabled digit blinks.
3	P.0000	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press the DATA/SHIFT Key for more than one second, and the display will be as shown on the left.
4	P.0001	▲ ▼	Press UP or DOWN Key to set a value: “0000”: Write permitted, “0001”: Write prohibited
5	donE	MODE/SET (MODE/SET Key)	Press MODE/SET Key to register the value. The write prohibited settings of parameters are executed. When the value is registered, the display shown on the left blinks for about one second. * If a value other than “0000” and “0001” is set, “Error” is displayed blinked for about one second, and the previous setting is displayed.
6	P.0001	After about one second	The display changes from “donE” to “P.000□.”
7	Fn010	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press the DATA/SHIFT Key for more than one second to return to the utility function mode display Fn010.

7.2.10 Servomotor Model Display (Fn011)

This function is used to check the servomotor model, voltage, capacity, encoder type, and encoder resolution. If the SERVOPACK has been custom-made, you can also check the specification codes of SERVOPACKs.

<table>
<tr><th>Procedure</th><th>Display after Operation</th><th>Panel Operator</th><th>Description</th></tr>
<tr><td>1</td><td>Fn000</td><td>MODE/SET
(MODE/SET Key)</td><td>Press MODE/SET Key to select the utility function mode.</td></tr>
<tr><td>2</td><td>Fn011</td><td>▲ ▼</td><td>Press UP or DOWN Key to select Fn011.
*The enabled digit blinks.</td></tr>
<tr><td>3</td><td>F.0100</td><td>DATA◀
(DATA/SHIFT)
(Press at least one sec.)</td><td>Press DATA/SHIFT Key for more than one second to display the servomotor model and voltage code.
F.0120
<table>
<tr><th colspan="2">Servomotor Voltage</th></tr>
<tr><th>Data</th><th>Type</th></tr>
<tr><td>00</td><td>100 VAC</td></tr>
<tr><td>01</td><td>200 VAC</td></tr>
</table>
<table>
<tr><th colspan="4">Servomotor Model</th></tr>
<tr><th>Data</th><th>Model</th><th>Data</th><th>Model</th></tr>
<tr><td>03</td><td>SGMGH (1500 min^{-1})</td><td>32</td><td>SGMCS-□□C</td></tr>
<tr><td>04</td><td>SGMGH (1000 min^{-1})</td><td>33</td><td>SGMCS-□□D</td></tr>
<tr><td>11</td><td>SGMMJ</td><td>34</td><td>SGMCS-□□B</td></tr>
<tr><td>20</td><td>SGMAS</td><td>35</td><td>SGMCS-□□E</td></tr>
<tr><td>21</td><td>SGMPS</td><td>37</td><td>SGMCS-□□M</td></tr>
<tr><td>22</td><td>SGMSS</td><td>38</td><td>SGMCS-□□N</td></tr>
</table></td></tr>
<tr><td>4</td><td>P.0010</td><td>MODE/SET
(MODE/SET Key)</td><td>Press MODE/SET Key to display the servomotor capacity.
P.0010
Servomotor capacity in units of 10 W
The above example indicates 100 W</td></tr>
<tr><td>5</td><td>E.0017</td><td>MODE/SET
(MODE/SET Key)</td><td>Press MODE/SET Key, and the encoder type and resolution code will be displayed.
E.0017
<table>
<tr><th colspan="2">Encoder Type</th></tr>
<tr><th>Data</th><th>Type</th></tr>
<tr><td>00</td><td>Incremental encoder</td></tr>
<tr><td>01</td><td>Multi-turn data absolute encoder</td></tr>
<tr><td>02</td><td>Single-turn data absolute encoder</td></tr>
</table>
<table>
<tr><th colspan="2">Encoder Resolution</th></tr>
<tr><th>Data</th><th>Resolution</th></tr>
<tr><td>13</td><td>13-bit</td></tr>
<tr><td>16</td><td>16-bit</td></tr>
<tr><td>17</td><td>17-bit</td></tr>
<tr><td>20</td><td>20-bit</td></tr>
</table></td></tr>
<tr><td>6</td><td>y.0010</td><td>MODE/SET
(MODE/SET Key)</td><td>Press MODE/SET Key to display the SERVOPACK's code for custom orders.
* The display "y.0000" means standard model.
y.0010
Code for custom orders</td></tr>
<tr><td>7</td><td>Fn011</td><td>DATA◀
(DATA/SHIFT)
(Press at least one sec.)</td><td>Press DATA/SHIFT Key for more than one second to return to the utility function mode display Fn011.</td></tr>
</table>

7.2.11 Software Version Display (Fn012)

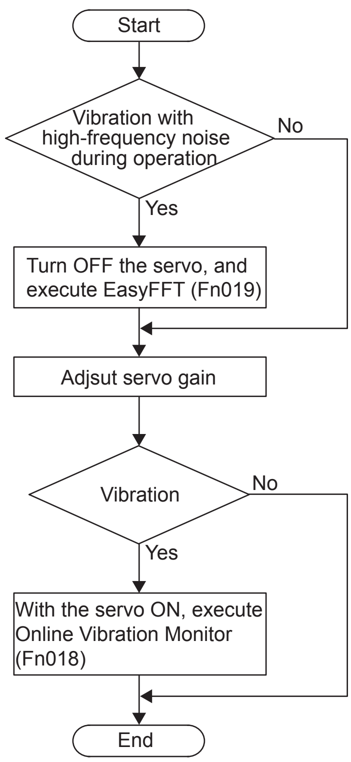
Set Fn012 to select the software-version check mode to check the SERVOPACK and encoder software version numbers.

Procedure	Display after Operation	Panel Operator	Description
1	Fn000	MODE/SET (MODE/SET Key)	Press MODE/SET Key to select the utility function mode.
2	Fn012	▲ ▼	Press UP or DOWN Key to select Fn012. ∗The enabled digit blinks.
3	r.0001	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT Key for more than one second to display the SERVOPACK software version number.
4	E.0001	MODE/SET (MODE/SET Key)	Press MODE/SET Key to display the encoder software version number.
5	Fn012	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT Key for more than one second to return to the utility function mode Fn012.

7.2.12 Online Vibration Monitor (Fn018) and EasyFFT (Fn019)

Both “Online Vibration Monitor” and “EasyFFT” functions are used to detect mechanical vibration and automatically set the notch filter. Refer to the following flowchart to decide which function to be used.

When using mainly for servo gain adjustment, etc.



7.2.13 Online Vibration Monitor (Fn018)

When the machine generates vibration, setting a notch filter or torque reference filter according to the vibration frequency may stop the vibration.

When vibration occurs while the power is supplied to the servomotor (“online” state), Online Vibration Monitor function detects the vibration elements and analyses the frequency to set a notch filter in the parameter.

When abnormal noise occurs due to machine resonance during operation, Online Vibration Monitor function detects the vibration frequencies and display three largest peak values in vibration frequency. And the function automatically selects a torque reference filter or notch filter frequency for one of the detected vibration frequencies and set in the parameter.

IMPORTANT

Use this function when Pn110=n.☐☐☐2 (normal autotuning is not used) is set.

Procedure	Display after Operation	Panel Operator	Description
1	Fn000	MODE/SET (MODE/SET Key)	Press MODE/SET Key to select the utility function mode.
2	Fn018	▲ ▼	Press UP or DOWN Key to select Fn018. ∗The enabled digit blinks.
3	F	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT Key for more than one second. The display shown on the left appears.
4	F	MODE/SET (MODE/SET Key)	Press MODE/SET Key to start vibration detection.
5	F (Blinks)	MODE/SET (MODE/SET Key) (Press at least one sec.)	“F” blinks during detection. Note that MODE/SET Key must be pressed about one second to start the detection. When “F” blinks, release MODE/SET Key. The vibration will be detected automatically.
6	F 1250 (Display of detection result)	MODE/SET (MODE/SET Key)	Press MODE/SET Key again. “F” stops blinking and the detection completes. If the detection ends successfully, the detection results is displayed. The vibration frequency with the biggest vibration amplitude peak value is detected and displayed.
	F---- (When fails to detect)		When there is a frequency with a peak value that cannot be detected, “F----” is displayed.
7	Fn018	DATA/◀ (DATA/SHIFT)	Press DATA/SHIFT Key to quit the vibration monitor and return to the basic function display. ∗If the detection process did not end normally, “no oPE” is displayed.
8	donE	MODE/SET (MODE/SET Key)	After the detection ends normally in Procedure 6, press MODE/SET Key to set optimum frequency (time constant) of notch filter frequency or torque reference filter time constant for the peak frequency F1250 automatically. When the setting is made normally, “donE” is displayed. And parameters is updated accordingly. Press DATA/SHIFT Key to return to the utility function mode display.

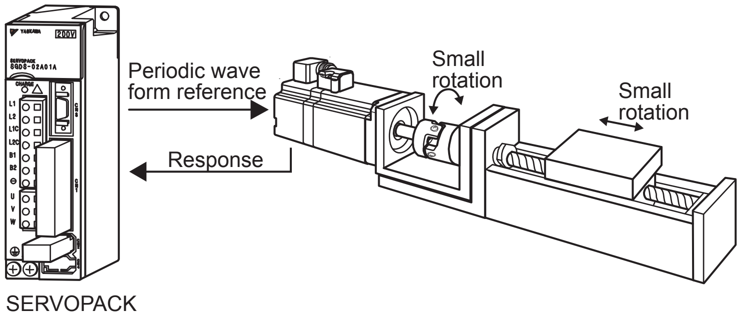
7.2.14 EasyFFT (Fn019)

⚠ WARNING
• **Do not touch the servomotor and machine during EasyFFT operation because the servomotor will run.** Failure to observe this warning may cause an injury.

When the machine generates vibration, setting a notch filter according to the vibration frequency may stop the vibration.

The EasyFFT function detects the frequency for setting the notch filter from the machine characteristics, and sets in the parameter.

The SERVOPACK outputs periodic wave form reference and slightly rotates the servomotor a few times for a set amount of time to cause the machine to vibrate. The EasyFFT function detects the resonant frequency from the vibration on the motor and sets the notch filter for the detected frequency. A notch filter is effective for removing high-frequency vibration and noise.

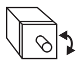


IMPORTANT

1. Starts EasyFFT (Fn019) with the servo OFF (the servomotor power OFF).
2. Do not input the reference from outside because EasyFFT outputs the special reference from the SERVOPACK.

Procedure	Display after Operation	Panel Operator	Description
1	Fn000	MODE/SET (MODE/SET Key)	Press MODE/SET Key to select the utility function mode.
2	Fn019	▲ ▼	Press UP or DOWN Key to select Fn019.
3	In. 15 (Setting reference amplitude)	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT for more than one second. The display shown on the left appears. The panel operator is in Fn019 utility setting execution mode.

(cont'd)

Procedure	Display after Operation	Panel Operator	Description
4	In. 16 Reference amplitude setting: 1 to 300) Note: The setting value of the reference amplitude setting is stored in Pn456, but set the setting value following the procedure the next time.	▲ ▼	Press UP or DOWN Key to set a reference amplitude. ∗At the initial execution of Fn019, do not change the reference amplitude setting, but starts from the initial value 15. Though increasing reference amplitude increases the detection accuracy, the vibration and noise occurring on the machine will increase momentarily. Increase an amplitude value little by little, observing the result.
5	F. (Run ready status)	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT Key for more than one second to enter the run ready status.
6	. .run	MODE/SET (MODE/SET Key)	Press MODE/SET Key to enter Servo ON status (the motor power ON) ∗Press DATA/SHIFT Key to turn the servo OFF. "F. " is displayed to indicate the run ready status. To end Fn019 function, proceed to Procedure 10.
7	E_FFt Blinks  Servomotor small movement	▲ ▼	In Servo ON status (the servomotor power ON), press UP Key (forward) or DOWN Key (reverse). The servomotor performs a few to-and-fro movements within 1/4 rotation in automatic operation. The motor performs such movements for approximately 1 to 45 seconds. During this operation, the display shown on the left blinks. * Do not enter the machine's working area, because the servomotor rotates. Some noise may result. * To stop EasyFFT while the servomotor rotates Press MODE/SET Key to stop the servomotor. No detection is executed. "F." is displayed to indicate the run ready status. To end Fn019, proceed to Procedure 10.
8	F1250 Detection result example	Detection result display	At normal completion of the detection, "E_FFt" stops blinking and the detected resonant frequency is displayed.
	F----		When failing to detect, the display shown on the left appears.

■ IMPORTANT

If the operation ended normally but it took two second or more, the detection accuracy may not be good. Set the reference amplitude little higher than 15 in Procedure 4 and re-execute the operation. More accurate resonance may be frequency detected.

Though increasing reference amplitude increases the detection accuracy, the vibration and noise occurring in the machine will increase momentarily. Increase an amplitude value little by little, observing the result.

Procedure	Display after Operation	Panel Operator	Description
9	. .run	DATA/◀ (DATA/SHIFT) (Less than one sec.)	To end the vibration monitor, press DATA/SHIFT Key for less than one second. The display returns to that for the servomotor power ON status in Procedure 6.
10	Fn019	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT Key for more than one second. The servo turns OFF (the servomotor power OFF) and the utility function mode display appears.

(cont'd)

Procedure	Display after Operation	Panel Operator	Description
11	donE (Blinks) Pn408=n.□□□1 Pn409=1375 (Hz) ↓ . .run	MODE/SET (MODE/SET Key)	After the detection completes normally, press MODE/SET Key. the optimum notch filter for the detected frequency "F1250" is automatically set. When the notch filter is set correctly (Pn408, Pn409), the display "donE" blinks. When the 1st notch filter frequency was already set (Pn408=n□□□1), sets 2nd notch filter frequency (Pn40C). When the 2nd notch filter frequency (Pn408=n.□1□□) was also set, the frequency setting of notch filter is unable. If the Detected frequency is not used, set the Pn408=n.□□□0.
12	F (Run ready status)	MODE/SET (MODE/SET Key)	Press MODE/SET Key to return to the display of run ready status.
13	Fn019	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT Key for more than one second to return to the utility function mode.

7.2.15 Vibration Detection Level Initialization (Fn01B)

This function detects vibration when servomotor is connected to a machine and automatically adjust the vibration detection level (Pn312) to output more exactly the vibration alarm (A.520) and warning (A.911).

Use this function if the vibration alarm (A.529) or warning (A.911) is not output correctly when a vibration above the factory setting vibration detection level (Pn312) is detected. In other cases, it is not necessary to use this function.

The vibration detection function detects vibration elements according to the motor speed, and if the vibration exceeds the detection level calculated by the following formula, outputs an alarm or warning depending on the setting of vibration detection switch (Pn310).

The vibration alarm or warning detection sensibility differs depending on the machine conditions. In this case, a detection sensibility fine adjustment can be set in the detection sensibility Pn311.

$$\text{Detection level} = \frac{\text{Vibration detection level} \times \text{Detection sensibility (Pn311[\%])}}{100}$$

IMPORTANT

1. The vibration may not be detected cause of improper servo gains. Also, not all kinds of vibrations can be detected. Use the detection result as a guideline.
2. Set the proper moment of inertia ratio (Pn103). Improper setting may result in the vibration alarm, warning misdetection, or non-detection.
3. When using this function, set parameter Pn110 to n.□□□2 so that normal auto tuning is not performed.
4. The references that are used to operate your system must be input to execute this function.
5. Execute this function under the operation condition for which the vibration detection level should be initialized. A vibration is detected immediately after the servo is turned ON if this function is executed while the servomotor runs at low speed. "Error" is displayed if this function is executed while the servomotor runs at less than 10% of the maximum motor speed.

(1) Parameters

Pn311	Vibration Detection Sensibility		Speed Position Torque	
	Setting Range	Unit	Factory Setting	Setting Validation
	50 to 500	1%	100	Immediately
Pn312	Vibration Detection Level		Speed Position Torque	
	Setting Range	Unit	Factory Setting	Setting Validation
	0 to 5000	1 min^{-1}	50	Immediately
This parameter is set by setting Fn01B, so the customer does not have to adjust it. The vibration detection sensibility can be set at Pn311.				

Parameter		Meaning
Pn310	n.□□□0	Does not detect vibration (Factory setting)
	n.□□□1	Outputs the warning (A.911) when vibration was detected.
	n.□□□2	Outputs the alarm (A.520) when vibration was detected.

Follow the procedure to initialize the parameter (Pn312).

Procedure	Display after Operation	Panel Operator	Description
1	Fn000	MODE/SET (MODE/SET Key)	Press MODE/SET Key to select the utility function mode.
2	Fn01b	▲ ▼	Press UP or DOWN Key to select Fn016.
3	d.init	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT Key at least one sec. The display shown on the left appears.
4	d.init (Blinks)	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press MODE/SET Key for more than one second. The display shown on the left appears and the vibration level is initialized. * Operate after inputting the reference that is used. * Error appears when the servomotor runs at 10% less than maximum rotation.
5	donE	DATA/◀ (DATA/SHIFT)	Press MODE/SET Key again to stop initializing the vibration level. The display shown on the left appears, and the standard vibration level in Pn312 is updated. * Error appears when the vibration detection level is not set correctly.
6	Fn01b	MODE/SET (MODE/SET Key)	Press DATA/SHIFT Key to return to the utility function mode.

7.3 Operation in Parameter Setting Mode (Pn□□□)

Functions can be selected or adjusted by setting parameters. There are two types of parameters. One type requires value setting and the other requires function selection. These two types use different setting methods.

With value setting, a parameter is set to a value within the specified range of the parameter. With function selection, the functions allocated to each digit of the panel operator can be selected. Refer to *12.3.2 Parameters*.

7.3.1 Setting Parameters

(1) Changing Settings

Specify the parameter data when the data-set type parameter is used. Before changing the data, check the permitted range of the parameter in *12.3.2 Parameters*.

◀EXAMPLE▶ The example below shows how to change parameter Pn100 (speed loop gain) from “40.0” to “100.0.”

Procedure	Display after Operation	Panel Operator	Description
1	Pn 100	MODE/SET (MODE/SET Key)	Press MODE/SET Key to select the parameter setting mode. If a parameter other than Pn100 is displayed, press UP or DOWN Key to select Pn100. ∗The enable digit blinks.
2	0040.0	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT Key for more than one second. The current data of Pn100 is displayed.
3	0040.0	DATA/◀ (DATA/SHIFT)	Press DATA/SHIFT Key to select the digit to be set.
4	0100.0	▲ ▼	Press UP or DOWN Key to change the data. Keep pressing UP or DOWN Key until “0100.0” is displayed.
5	0100.0	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT Key for more than one second. The value blinks and is saved.
6	Pn 100	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT Key for more than one second to return to the display of Pn100. The data for the speed loop gain (Pn100) is changed from “40.0” to “100.0.”

(2) Parameters over six digits

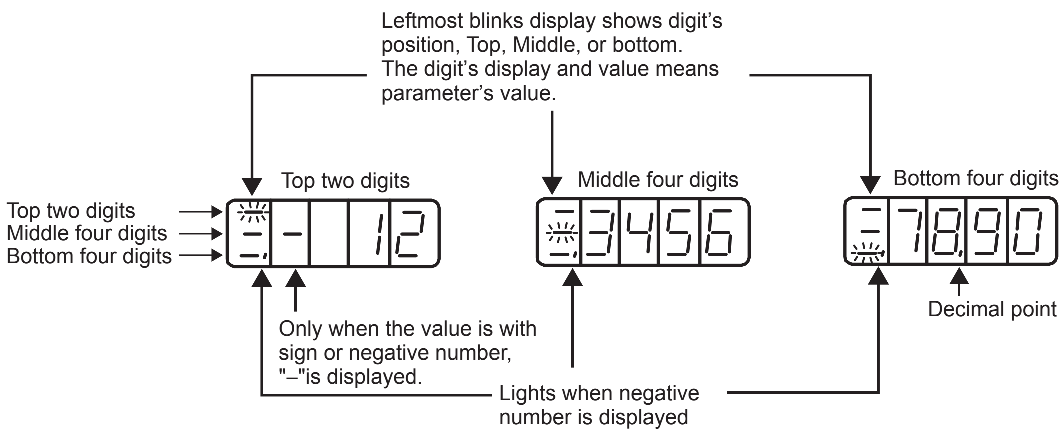
(a) Relevant Parameters

Following parameters have more than a six digit setting range.

Parame-ters	Name	Setting Range	Setting Unit	Factory Setting	Setting Validation
Pn20E	Electronic Gear Ratio (Numerator)	1 to 1073741824(2^{30})	–	4	After restart
Pn210	Electronic Gear Ratio (Denominator)	1 to 1073741824(2^{30})	–	1	After restart
Pn212	PG Dividing Ratio	16 to 1073741824(2^{30}) P/Rev	1 P/Rev	2048 P/Rev	After restart
Pn520	Positioning Error Alarm Level	1 to 1073741823(2^{30}-1) Reference units	1 Reference units	262144 Reference units	Immediately
Pn522	Positioning Completed Width	1 to 1073741824(2^{30}) Reference units	1 Reference units	7 Reference units	Immediately
Pn524	NEAR Signal Width	1 to 1073741824(2^{30}) Reference units	1 Reference units	1073741824 Reference units	Immediately
Pn526	Positioning Error Alarm Level When Servo is ON	1 to 1073741823(2^{30}-1) Reference units	1 Reference units	262144 Reference units	Immediately
Pn531	Program JOG Movement Distance	1 to 1073741824(2^{30}) Reference units	1 Reference units	32768 Reference units	Immediately
Fn017	Advance Autotuning (Setting movement distance)	-99990000 to 99990000 Reference units	1000 Reference units	300000 Reference units	Immediately

(b) Displays

Panel operator displays five digits. When the parameters have more than six digits, values are displayed and set as shown below.



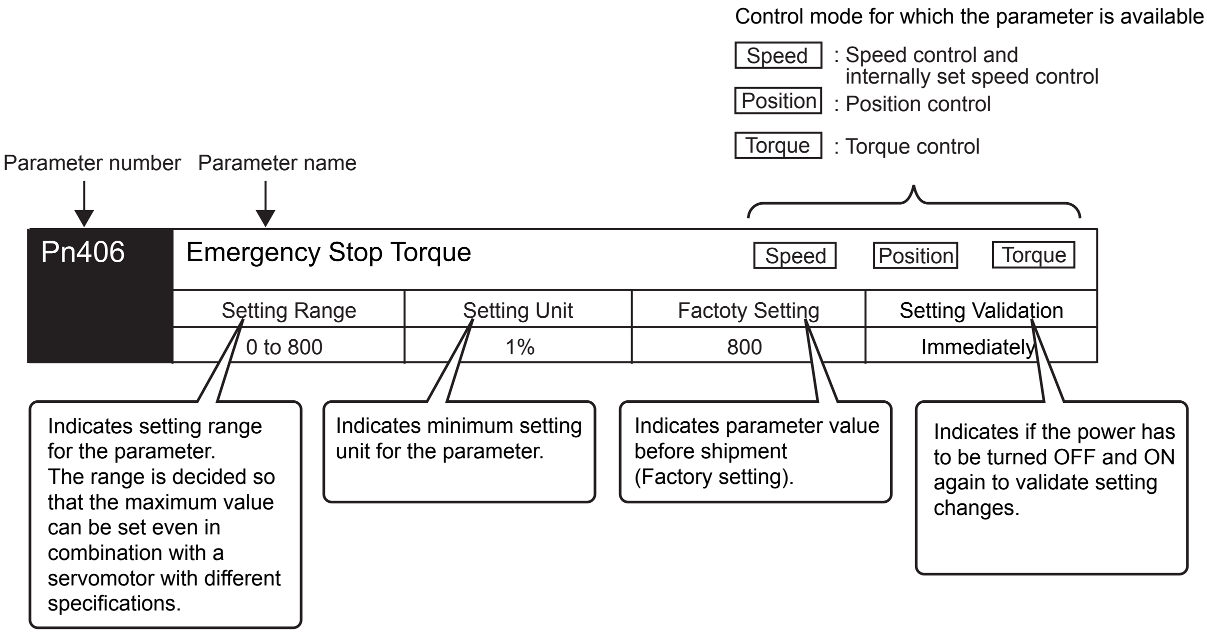
(c) Settings

Procedures for display and setting of “Pn20E = 1234567890” are shown below.

Procedure	Display after Operation	Panel Operator	Description
1	Pn20E	MODE/SET (MODE/SET Key)	Press MODE/SET key to select the parameter setting mode. If Pn20E is not displayed, select Pn20E by pressing UP key or DOWN key. *The digits that can be operated will blink.
2	Bottom four digits 7890	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT key at least one second. Then, the current data of Pn20E are displayed. The bottom four digits are displayed first, and rightmost digit’s value will blink and be selected. When move to other digits, press DATA/SHIFT key. Change the digit’s value by pressing UP/DOWN key. When DATA/SHIFT key is pressed on fourth digit “7,” middle four digits are displayed, and the fifth value “6” will blink.
3	Middle four digits 3456	DATA/◀ (DATA/SHIFT)	Each time DATA/SHIFT key is pressed, the value from fifth digits to eighth digits are selected. When DATA/SHIFT key is pressed on eighth digit “3,” the top two digits are displayed, and ninth value “2” is selected.
4	Top two digits 12	DATA/◀ (DATA/SHIFT)	If DATA/SHIFT key is pressed when tenth value “1” is selected, the bottom four digits are displayed again. You can move each one digit to left.

(d) How to Read a Parameter Explanation

In this manual, each parameter is explained using the following example.



Panel Operator

7

(3) Function Selection Parameters

(a) Types of Function Selection Parameters

IMPORTANT

If the parameters with "After restart" in "Setting Validation" column in the table are set, warning "A.941 Change of Parameter Requires Setting Validation" will occur. Turn OFF the main circuit and control power supply and ON again to validate new setting.

Category	Parameter No.	Name	Factory Setting	Setting Validation
Function Selection Parameter	Pn000	Function Selection Basic Switch 0	0000	After restart
	Pn001	Function Selection Basic Switch 1	0000	After restart
	Pn002	Function Selection Basic Switch 2	0000	After restart
	Pn006	Function Selection Basic Switch 6	0002	Immediately
	Pn007	Function Selection Basic Switch 7	0000	Immediately
	Pn008	Function Selection Basic Switch 8	0000	After restart
Servo Gain Related Parameter	Pn10B	Gain Related Application Switch	0000	After restart/ Immediately
	Pn110	Autotuning Switch	0010	After restart/ Immediately
	Pn139	Automatic Gain Changeover Related Switch 1	0000	After restart
	Pn13A	Automatic Gain Changeover Related Switch 2	0000	After restart
	Pn150	Predictive Control Selection Switch	0210	After restart
Position Control Related Parameter	Pn200	Position Control Reference Form Selection Switch	0000	After restart
	Pn207	Position Control Function Switch	0000	After restart
Speed Control Related Parameter	Pn310	Vibration Detection Switch	0000	Immediately
Torque Control Related Parameter	Pn408	Torque Related Function Switch	0000	After restart/ Immediately
Sequence Related Parameter (Input Signal Selection)	Pn50A	Input Signal Selection 1	2100	After restart
	Pn50B	Input Signal Selection 2	6543	After restart
	Pn50C	Input Signal Selection 3	8888	After restart
	Pn50D	Input Signal Selection 4	8888	After restart
	Pn515	Input Signal Selection 5	8888	After restart
Sequence Related Parameter (Output Signal Selection)	Pn50E	Output Signal Selection 1	3211	After restart
	Pn50F	Output Signal Selection 2	0000	After restart
	Pn510	Output Signal Selection 3	0000	After restart
	Pn512	Output Signal Reversal Setting	0000	After restart
	Pn530	Program JOG Operation Related Switch	0000	Immediately

The set value of parameters are displayed as follows.

Parameters for function selection	n.0000	Hexadecimal display for each digit
Parameters for value settings	00 100 or H.0000	Decimal or hexadecimal display in more than five digits

INFO Since each digit in the function selection parameters has a significant meaning, the value can only be changed for each individual digit. Each digit displays a value within its own setting range.

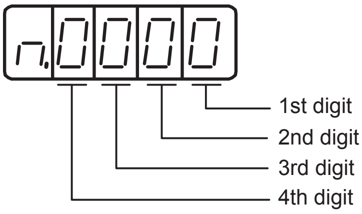
(b) Changing Function Selection Parameter Settings

EXAMPLE The procedure to change the setting of control method selection (Pn000.1) of the function selection basic switch Pn000 from speed control to position control is shown below.

Procedure	Display after Operation	Panel Operator	Description
1	Pn000	MODE/SET (MODE/SET Key)	Press MODE/SET Key to select the parameter setting mode. If a parameter other than Pn000 is displayed, press UP or DOWN Key to select to Pn000. *The enable digit blinks.
2	n.0000	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT Key for more than one second. The current data of Pn000 is displayed.
3	n.0000	DATA/◀ (DATA/SHIFT)	Press DATA/SHIFT Key once to select the first digit of current data.
4	n.0010	▲ ▼	Press UP Key once to change “n.0010.” (Set the control method to position control.)
5	n.0010	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT Key for more than one second. The value blinks and is saved.
6	Pn000	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT Key for more than one second to return to the display Pn000. The control method is changed to position control.
7	To enable the change in the setting of function selection basic switch Pn000, turn OFF the power and ON again.		

(c) Parameter Indications

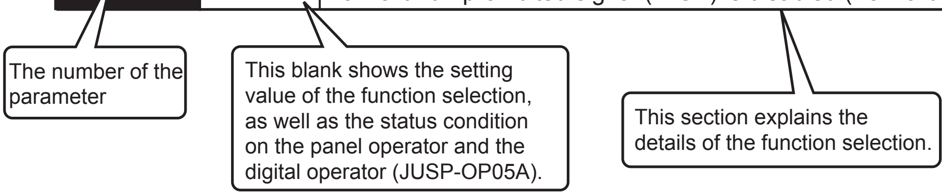
Each digit of the function selection parameters is defined as the hexadecimal display. The parameter display example shows how parameters are displayed in digits for set values.



- Pn000.0 or n.□□□x: Indicates the value for the 1st digit of parameter Pn000.
- Pn000.1 or n.□□x□: Indicates the value for the 2nd digit of parameter Pn000.
- Pn000.2 or n.□x□□: Indicates the value for the 3rd digit of parameter Pn000.
- Pn000.3 or n.x□□□: Indicates the value for the 4th digit of parameter Pn000.

For details on each digit of the parameter, refer to *12.3.2 Parameters.*

Parameter		Meaning
Pn50A	n.**2**□□□	Input the forward run prohibited signal (P-OT) from CN1-42 (Factory setting).
	n.**8**□□□	Forward run prohibited signal (P-OT) is disabled (Forward rotation allowed).

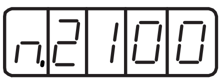


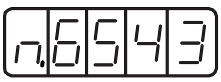
7.3.2 Input Circuit Signal Allocation

Each input signal is allocated to a pin of the input connector CN1 by setting the parameter. (The allocation table is shown in *7.3.2 (2) Changing the Allocation*.)

(1) Factory Setting (Pn50A.0 = 0)

The factory setting for a preset input signal (allocation) is shown in a box outlined with a bold line, ▭, a ▭, in the lists on the next page.

Pn50A: 

Pn50B: 

(2) Changing the Allocation (Set as Pn50A.0 = 1)

Set the parameter in accordance with the relation between the signal to be used and the input connector pin. After having changed the parameter, turn OFF the power and ON again to validate the new setting.

▭ means factory setting.

Signal Name / Parameter Setting Allocation	Validity Level	Input Signal	CN1 Pin Numbers							Connection Not required (SERVOPACK judges the connection)	
			40	41	42	43	44	45	46	Always ON	Always OFF
Servo ON Pn50A.1 = n.xx□x	L	/S-ON	0	1	2	3	4	5	6	7	8
	H	S-ON	9	A	B	C	D	E	F		
Proportional Operation Reference Pn50A.2 = n.x□xx	L	/P-CON	0	1	2	3	4	5	6	7	8
	H	P-CON	9	A	B	C	D	E	F		
Forward Run Prohibited Pn50A.3 = n.□xxx	H	P-OT	0	1	2	3	4	5	6	7	8
	L	/P-OT	9	A	B	C	D	E	F		
Reverse Run Prohibited Pn50B.0 = n.xxx□	H	N-OT	0	1	2	3	4	5	6	7	8
	L	/N-OT	9	A	B	C	D	E	F		
Alarm Reset Pn50B.1 = n.xx□x	L	/ARM-RST	0	1	2	3	4	5	6	–	8
	H	ARM-RST	9	A	B	C	D	E	F		
Forward External Torque Limit Pn50B.2 = n.x□xx	L	/P-CL	0	1	2	3	4	5	6	7	8
	H	P-CL	9	A	B	C	D	E	F		
Reserve External Torque Limit Pn50B.3 = n.□xxx	L	/N-CL	0	1	2	3	4	5	6	7	8
	H	N-CL	9	A	B	C	D	E	F		
Switching Servomotor Rotation Direction Pn50C.0 = n.xxx□	L	/SPD-D	0	1	2	3	4	5	6	7	8
	H	SPD-D	9	A	B	C	D	E	F		
Internal Set Speed Selection Pn50C.1 = n.xx□x	L	/SPD-A	0	1	2	3	4	5	6	7	8
	H	SPD-A	9	A	B	C	D	E	F		
Internal Set Speed Selection Pn50C.2 = n.x□xx	L	/SPD-B	0	1	2	3	4	5	6	7	8
	H	SPD-B	9	A	B	C	D	E	F		
Control Method Selection Pn50C.3 = n.□xxx	L	/C-SEL	0	1	2	3	4	5	6	7	8
	H	C-SEL	9	A	B	C	D	E	F		
Zero Clamp Pn50D.0 = n.xxx□	L	/ZCLAMP	0	1	2	3	4	5	6	7	8
	H	ZCLAMP	9	A	B	C	D	E	F		
Reference Pulse Inhibit Pn50D.1 = n.xx□x	L	/INHIBIT	0	1	2	3	4	5	6	7	8
	H	INHIBIT	9	A	B	C	D	E	F		
Gain Changeover 1 Pn50D.2 = n.x□xx	L	/G-SEL1	0	1	2	3	4	5	6	7	8
	H	G-SEL1	9	A	B	C	D	E	F		
Gain Changeover 22 Pn515.0 = n.xxx□	L	/G-SEL2	0	1	2	3	4	5	6	7	8
	H	G-SEL2	9	A	B	C	D	E	F		

IMPORTANT

1. When using Servo ON, Forward Run Prohibited, and Reverse Run Prohibited signals with the setting "Polarity Reversal," the machine may not move to the specified safe direction at occurrence of failure such as signal line disconnection. If such setting is absolutely necessary, confirm the operation and observe safety precautions.
2. When two or more signals are allocated to the same input circuit, input signal level is valid for all allocated signals.

(3) Example of Input Signal Allocation

◀EXAMPLE▶ The procedure to replace Servo ON (/S-ON) signal mapped on CN1-40 and Forward External Torque Limit (/P-CL) mapped on CN1-45 is shown below.

	Before		After
Pn50A:	n.2100	→	n.2151
Pn50B:	n.6543	→	n.6043

Procedure	Display after Operation	Panel Operator	Description
1	Pn50A	MODE/SET (MODE/SET Key)	Press MODE/SET Key to select the parameter setting mode. If a parameter other than Pn50A is displayed, press UP or DOWN Key to set Pn50A. *The enabled digit blinks.
2	n.2100	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT Key for more than one second to display the current data of Pn50A. (/S-ON is mapped on CN1-40.)
3	n.2101	▲ (UP Key)	Press UP key to set to "1." (Sequence input signals can be freely set.)
4	n.2151	DATA/◀ (DATA/SHIFT)	Press DATA/SHIFT Key to select the second digit from the right. Press UP key to set to "5." (Changes the mapping of /S-ON from CN1-40 to CN1-45.)
5	n.2151	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT Key for more than one second. The data blinks and saved.
6	Pn50A	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT Key for more than one second to return to the display Pn50A.
7	Pn50b	▲ (UP Key)	Press UP key to set Pn50B. *The enabled digit blinks.
8	n.6543	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT Key for more than one second to display the current data of Pn50b. (/P-CL is mapped on CN1-45.)
9	n.6043	DATA/◀ (DATA/SHIFT)	Press DATA/SHIFT Key to select the third digit from the right. Press DOWN Key to set "0." (Changes the mapping of /P-CL from CN1-45 to CN1-10.)

(cont'd)

Procedure	Display after Operation	Panel Operator	Description
10	n.6043	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT Key for more than one second. The value blinks and is saved.
11	Pn50b	DATA/◀ (DATA/SHIFT)	Press DATA/SHIFT Key for more than one second to return to the display Pn50B. /S-ON is mapped on CN1-45, and /P-CL is mapped on CN1-10.
12	Turn the power OFF and ON again to enable the change of input signal selections (Pn50A and Pn50B)		

INFO

■ Input signal polarities

Signal	Level	Voltage level	Contact
ON	Low (L) level	0 V	Close
OFF	High (H) level	24 V	Open

7.3.3 Output Circuit Signal Allocation

Functions can be allocated to the following sequence output signals. After having changed the parameter setting, turn the power OFF and ON again to enable the new setting.

▭ means factory setting.

CN1 Pin No.		25/(26)		27/(28)		29/(30)	
Parameter Setting Allocation		Signal Output Polarity Setting					
		Pn512=n.xxx□		Pn512=n.xx□x		Pn512=n.x□xx	
		0	1 (Reverse)	0	1 (Reverse)	0	1 (Reverse)
Positioning Completion (/COIN) Pn50E.0 = n.xxx□	0	Invalid					
	1	L	H				
	2			L	H		
	3					L	H
Speed Coincidence Detection (/V-CMP) Pn50E.1 = n.xx□x	0	Invalid					
	1	L	H				
	2			L	H		
	3					L	H
Rotation Detection (/TGON) Pn50E.2 = n.x□xx	0	Invalid					
	1	L	H				
	2			L	H		
	3					L	H
Servo Ready (/S-RDY) Pn50E.3 = n.□xxx	0	Invalid					
	1	L	H				
	2			L	H		
	3					L	H
Torque Limit Detection (/CLT) Pn50F.0 = n.xxx□	0	Invalid					
	1	L	H				
	2			L	H		
	3					L	H
Speed Limit Detection (/VLT) Pn50F.1 = n.xx□x	0	Invalid					
	1	L	H				
	2			L	H		
	3					L	H
Brake (/BK) Pn50F.2 = n.x□xx	0	Invalid					
	1	L	H				
	2			L	H		
	3					L	H
Warning (/WARN) Pn50F.3 = n.□xxx	0	Invalid					
	1	L	H				
	2			L	H		
	3					L	H
Near (/NEAR) Pn510.0 = n.xxx□	0	Invalid					
	1	L	H				
	2			L	H		
	3					L	H

Remark

L: Output signal is L level when the parameter is valid.

H: Output signal is H level when the parameter is valid.

Invalid
Not use the output signal.

■ Factory Setting

Pn50E: n.3211
Pn50F: n.0000
Pn510: n.0000
Pn512: n.0000

Note:
The output signals for Positioning Completion signal and Speed Coincidence Detection Signal differ depending on the control method.

IMPORTANT

1. When two or more signals are allocated to the same output circuit, a signal is output with OR logic circuit.
2. The signals not detected are considered as “Invalid.” For example, Positioning Completion (/COIN) signal in speed control mode is “Invalid.”

- Allocating Output Signals

The procedure to set Rotation Detection (/TGON) signal of factory setting to "Invalid" and map Brake Interlock (/BK) signal is shown below.

	Before		After
Pn50E:	n.3211	→	n.3011

Procedure	Display after Operation	Panel Operator	Description
1	Pn50E	MODE/SET (MODE/SET Key)	Press MODE/SET Key to select the parameter setting mode. If a parameter other than Pn50E is displayed, press UP or DOWN Key to select Pn50E. *The enabled digit blinks.
2	n.3211	DATA/◀ (DATA/SHIFT)	Press DATA/SHIFT Key for more than one second to display the current data of Pn50E. (/TGON is mapped on CN1-27 (28).)
3	n.3011	DATA/◀ (DATA/SHIFT)	Press DATA/SHIFT Key to select the third digit from the right. Press DOWN Key to set "0." (Sets /TGON "Invalid.")
4	n.3011	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT Key for more than one second. The data blinks and saved.
5	Pn50E	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT Key for more than one second to return to the display Pn50E.
6	Pn50F	▲ (UP Key)	Press UP Key to set Pn50F. *The enabled digit blinks.
7	n.0000	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT Key for more than one second to display the current data of Pn50F. (/BK is set to "Invalid".)
8	n.0200	DATA/◀ (DATA/SHIFT)	Press DATA/SHIFT Key to select the third digit from the right. Press UP Key to set "2." (Allocates /BK to CN1-27 (28).)
9	n.0200	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT Key for more than one second. The value blinks and is saved.
10	Pn50F	DATA/◀ (DATA/SHIFT)	Press DATA/SHIFT Key for more than one second to return to the display Pn50F. /TGON is set as "Invalid" and /BK is mapped on CN1-27 (28).
11	Turn OFF the power and ON again to enable the changes of output signal selection (Pn50E and Pn50F).		

7.4 Operation in Monitor Mode (Un□□□)

The monitor mode can be used for monitoring the reference values, I/O signal status, and SERVOPACK internal status.
The monitor mode can be selected during servomotor operation.

7.4.1 List of Monitor Modes

(1) Contents of Monitor Mode Display

Parameter No.	Content of Display	Unit
Un000	Motor speed	min^{-1}
Un001	Speed reference	min^{-1}
Un002	Internal torque reference (in percentage to the rated torque)	%
Un003	Rotation angle 1 (32-bit decimal code)	Number of pulses from the origin
Un004	Rotation angle 2 (Angle to the zero-point (electrical angle))	deg
Un005	Input signal monitor *1	–
Un006	Output signal monitor *1	–
Un007	Input reference pulse speed (valid only in position control mode)	min^{-1}
Un008	Error counter (position error amount) (valid only in position control mode)	reference unit
Un009	Accumulated load ratio (in percentage to the rated torque: effective torque in cycle of 10 seconds)	%
Un00A	Regenerative load ratio (in percentage to the processable regenerative power: regenerative power consumption in cycle of 10 seconds)	%
Un00B	Power consumed by DB resistance (in percentage to the processable power at DB activation: displayed in cycle of 10 seconds)	%
Un00C	Input reference pulse counter (32-bit decimal code) (valid only in position control mode) *2	pulse
Un00D	Feedback pulse counter (encoder pulses × 4 (multiplier): 32-bit decimal code) *2	pulse
Un00E	Fully-closed feedback pulse counter (Fully-closed feedback pulse × 4 (multiplier): 32-bit decimal code) *2	pulse
Un00F	Fully-closed feedback speed (Fully-closed feedback pulse × 4 (multiplier): 32-bit decimal code) *2	pulse/s

* 1. Refer to *7.4.2 Sequence I/O Signal Monitor Display* on the next page.
* 2. Refer to *7.4.4 Monitor Display of Reference Pulse Counter, Feedback Pulse Counter, Fully-closed Feedback Pulse Counter and Fully-closed Feedback Speed* on page 7-41.

7.4.2 Sequence I/O Signal Monitor Display

The following section describes the monitor display for sequence I/O signals.

(1) Input Signal Monitor Display

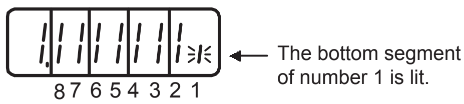
The status of input signal allocated to each input terminal is displayed:
When the input is in OFF (open) status, the top segment (LED) is lit.
when the input is in ON (short-circuited) status, the bottom segment (LED) is lit.

Refer to *7.3.2 Input Circuit Signal Allocation* for the relation between input terminals and signals.

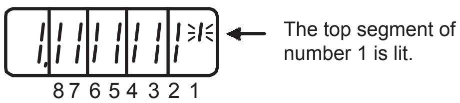
Display LED Number	Input Terminal Name	Factory Setting
1	CN1-40	/S-ON
2	CN1-41	/P-CON
3	CN1-42	P-OT
4	CN1-43	N-OT
5	CN1-44	/ALM-RST
6	CN1-45	/P-CL
7	CN1-46	/N-CL
8	CN1-4	SEN

◀EXAMPLE▶

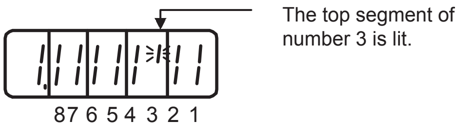
- When /S-ON signal is ON (Servo ON at L level)



- When /S-ON signal is OFF



- When P-OT signal operates (Operates at “H” level)



(2) Output Signal Monitor Display

The status of output signal allocated to each output terminal is displayed:
When the output is in OFF (open) status, the top segment (LED) is lit.
When the output is in ON (short circuit) status, the bottom segment is lit.

Refer to *7.3.3 Output Circuit Signal Allocation* for the relation between output terminals and signals.

Display LED Number	Output Terminal Name	Factory Setting
1	CN1-31, -32	ALM
2	CN1-25, -26	/COIN or /V-CMP
3	CN1-27, -28	/TGON
4	CN1-29, -30	/S-RDY
5	CN1-37	AL01
6	CN1-38	AL02
7	CN1-39	AL03

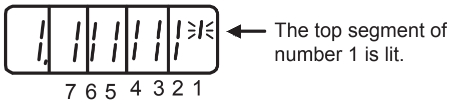
Note: Refer to *7.3.3 Output Circuit Signal Allocation* for the details on output terminals.

Seven segments in the top and bottom rows of an LED turn ON and OFF in different combinations to indicate various output signals.

These segments ON for “L” level and OFF for “H” level.

◀ EXAMPLE ▶

- When ALM signal operates (alarm at H level.)



7.4.3 Operation in Monitor Mode

The example below shows how to display, the contents of monitor number Un000 (when the servomotor rotates at 1500 min^{-1}).

Procedure	Display after Operation	Panel Operator	Description
1	Un000	MODE/SET (MODE/SET Key)	Press MODE/SET Key to select the monitor mode.
2	Un000	▲ ▼	Press the UP or DOWN Key to select the monitor number to be displayed.
3	1500	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT Key for more than one second to display the data of Un000.
4	Un000	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT Key for more than one second to return to the display of monitor number.

7.4.4 Monitor Display of Reference Pulse Counter, Feedback Pulse Counter, Fully-closed Feedback Pulse Counter and Fully-closed Feedback Speed

The monitor display of reference pulse counter and feedback pulse counter is expressed in 32-bit hexadecimal.

Procedure	Display after Operation	Panel Operator	Description
1	Un000	MODE/SET (MODE/SET Key)	Press MODE/SET Key to select the monitor mode.
2	Un00d	▲ ▼	Press the UP or DOWN Key to select “Un00C” or “Un00D.”
3	Lower 4 digits 7890	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT Key for more than one second to display the data of the selected monitor number. The lower 4 digits are displayed first.
4	Middle 4 digits 3456	DATA/◀ (DATA/SHIFT)	Press DATA/SHIFT Key to display the middle 4 digits.
5	Upper 2 digits 12	DATA/◀ (DATA/SHIFT)	Besides, press DATA/SHIFT Key to display the upper 2 digits. (Press DATA/SHIFT Key to display the lower 4 digits again.)
6	Un00d	DATA◀ (DATA/SHIFT) (Press at least one sec.)	Press DATA/SHIFT Key for more than one second to return to the display of monitor number.

When the control power supply is turned ON, reference pulse, feedback pulse, and fully-closed feedback counter will be “0.” The counter value increase by forward references, and decrease by reverse references. Displays the minus at the value less than 0. Displays the pulse number from -2,147,483,648 (-2^{31}) to 2,147,483,647 ($2^{31}-1$) in sequence. If one pulse is decreased from -2,147,483,648, displays 2,147,483,647 and then decreases from this pulse number. Also, if one pulse in increased from 2,147,483,647, displays -2,147,483,648 and increases from this pulse number. When the 17 bit encoder is used, the feedback pulse will be 131,072 pulse/rev, and when the 20 bit encoder is used, the feedback pulse will be 1048576 pulse/rev.

The equation between feedback pulse counter (Un00D) and fully-closed feedback counter (Un00E) is as follows.

- 17 bit encoder: Un00D × Pn20A (Number of external scale pitches) × 256 / 131072 = Un00E
- 20 bit encoder: Un00D × Pn20A (Number of external scale pitches) × 256 / 1048576 = Un00E

7.4.5 Monitor Display at Power ON

Pn52F	Monitor Display at Power ON		Speed Position Torque	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to FFF	–	FFF	Immediately

Pn52F is set to the same value as when it was in monitor mode (Un□□□), the data of Un□□□ that was specified in the panel operator is displayed when the power is turned ON. When the FFF is set (factory setting), the SERVOPACK becomes the status display mode (bb, run).

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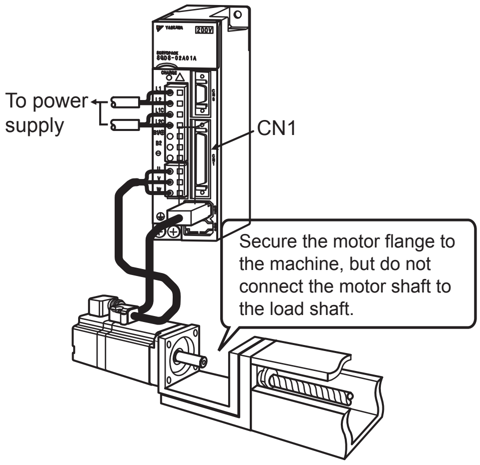
8.1 Trial Operation

Make sure that all wiring has been completed prior to trial operation.

Perform the following three types of trial operation in order. Instructions are given for speed control mode (standard setting) and position control mode. Unless otherwise specified, the standard parameters for speed control mode (factory setting) are used.

(1)Trial Operation for Servomotor without Load (Refer to 8.1.1.)

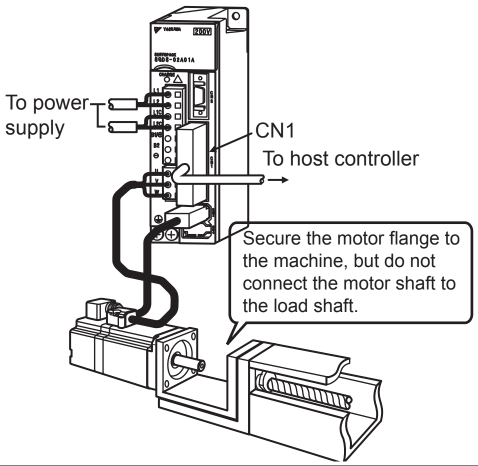


■ Purpose

The servomotor is operated without connecting the shaft to the machine in order to confirm that the following wiring is correct.

- Power supply circuit wiring
- Servomotor wiring
- Encoder wiring
- Motor's rotation direction and motor speed

(2)Trial Operation for Servomotor with Host Reference (Refer to 8.1.2.)

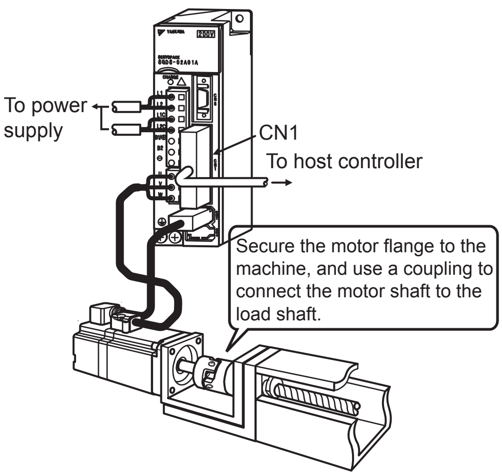


■ Purpose

The servomotor is operated without connecting the shaft to the machine in order to confirm that the following wiring is correct.

- I/O signal wiring between the SERVOPACK and the host controller.
- Check the operation of the brake, overtravel, and other protective functions.
- Motor's rotation direction, servomotor speed, and number of rotations

(3)Trial Operation for the Servomotor and Machine Combined (Refer to 8.1.3.)



■ Purpose

The servomotor is connected to the machine and trial operation is performed. The SERVOPACK is adjusted to match the machine characteristics.

- The servomotor's rotation direction, motor speed, and machine travel distance.
- Set the necessary parameters.

Step	Item	Description	Reference
1	Installation and mounting	Install the servomotor and SERVOPACK according to the installation conditions. (Do not connect the servomotor to the machine because the servomotor will be operated first under a no-load condition for checking.)	–
2	Wiring and connections	Connect the power supply circuit (L1 and L2 or L1, L2 and L3), servomotor wiring (U, V, W), I/O signal wiring (CN1), and encoder wiring (CN2). During *8.1.1 Trial Operation for Servomotor without Load*, however, disconnect the CN1 connector.	–
3	Turn ON the power.	Turn ON the power. Use the panel operator to check that the SERVOPACK is running normally. If using a servomotor equipped with an absolute encoder, perform the setup for the absolute encoder. (Refer to *8.4.5 Absolute Encoder Setup (Fn008)*.)	–
4	Execute jog mode operation.	Execute jog mode operation with the servomotor alone under a no-load condition.	Jog Operation
5	Connect input signals.	Connect the input signals (CN1) to the SERVOPACK that is necessary for trial operation.	–
6	Check input signals.	Use the internal monitor function to check the input signals. Turn ON the power, and check the brake, overtravel, and other protective functions for correct operation.	–
7	Input the servo ON signal.	Input the servo ON signal, and turn ON the servomotor.	Host Reference
8	Input reference.	Input the reference for the control mode being used, and check the servomotor for correct operation.	Host Reference
9	Check protective operation.	Turn OFF the power, and then connect the servomotor to the machine. If using a servomotor with an absolute encoder, set up the absolute encoder and make the initial settings for the host controller to match the machine's zero position.	–
10	Set necessary parameters.	Using the same procedure as you did to input a reference in step 8, operate the servomotor from the host controller and set the parameter so that the machine's travel direction, travel distance, and travel speed all correspond to the reference.	Host Reference
11	Operation	The servomotor can now be operated. Adjust the servo gain if necessary. Refer to *9.1 Servo Tuning Methods*. If a problem occurs, refer to *Chapter 11 Inspection, Maintenance, and Troubleshooting*.	Host Reference

8.1.1 Trial Operation for Servomotor without Load

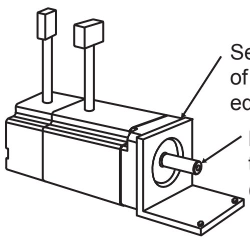
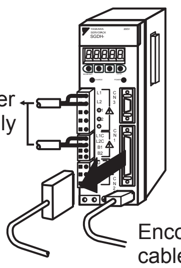
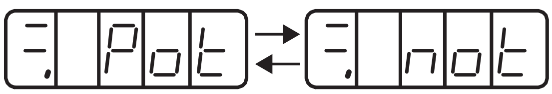
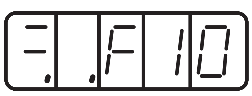
⚠ CAUTION

- Release the coupling between the servomotor and the machine, and secure only the servomotor without a load.
  To prevent accidents, initially perform step 1 where the trial operation is conducted under no-load conditions (with all couplings and belts disconnected).

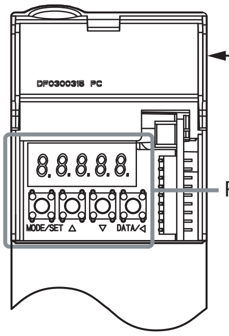
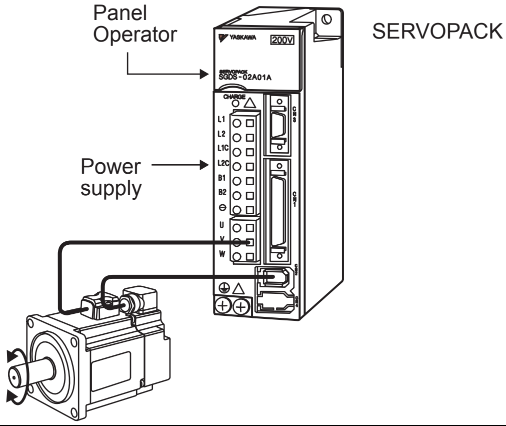
In this section, confirm the cable connections of the main circuit power supply, motor and encoder except the connection to host controller. Incorrect wiring is generally the reason why servomotors fail to operate properly during the trial operation.

Confirm the wiring, and then conduct the trial operation for servomotor without load.

JUSP-OP05A digital operator (option) can be operated and displayed the same as the panel operator.

Step	Description	Conformation and Supplement
1	Secure the servomotor.  	Secure the servomotor mounting plate to the equipment following *3.8.1 Precautions on Servomotor Installation*. Otherwise, the servomotor may turn over when it starts rotating. Do not connect anything to the servomotor shaft.
2	Check the power supply circuit, servomotor, and encoder wiring.  	With the CN1 connector not connected, check the power supply circuit and servomotor wiring. For an example of main circuit wiring, refer to *6.1 Wiring Main Circuit*. For the servomotor main circuit cable and encoder cable, refer to *2.4 Selecting Cables*. For installing the servomotor main circuit cable and encoder cable to the servomotor, *1.3 (3) Cable Connections to SGMAS and SGMPS Servomotors*.
3	Turn the control power and main circuit power ON. Normal display  Alternate display Example of alarm display 	If the power is correctly supplied, the panel operator display on the front panel of the SERVOPACK will appear as shown above. The display means forward run prohibited (P-OT) or reverse run prohibited (N-OT). Refer to *7.1.3 Status Display*. No power will be supplied to the servomotor at this point because the servo system is OFF. If an alarm display appears, the power supply circuit, servomotor wiring, or encoder wiring is incorrect. If an alarm is displayed, turn OFF the power, find the problem, and correct it. Refer to *11.1 Troubleshooting*.
4	If using a servomotor with a brake, release the brake prior to driving the motor. If an absolute encoder is used, encoder setup is needed before running the servomotor.	Refer to *8.3.4 Setting for Holding Brakes*. Refer to *8.4.5 Absolute Encoder Setup (Fn008)*. For a trial operation, set the parameter Pn002 = n.□1□□ (Use absolute encoder as incremental encoder) to omit Fn008 (absolute encoder Setup).

(cont'd)

Step	Description	Conformation and Supplement
5	Operate with the panel operator.  	Open the SERVOPACK's front cover, and execute the JOG mode operation (Fn002) using the panel operator. Press the Up Cursor Key for forward rotation and Down Cursor Key for reverse rotation to confirm that the servomotor rotates in the correct direction. If no alarm display message appears and the servomotor rotates according to the setting, end the trial operation for servomotor without load. Press the MODE/SET Key to turn OFF the power to the servomotor, and press the DATA/SHIFT Key to exit the JOG operation mode, following the instructions given in the JOG Mode Operation (Fn002). For operating the panel operator, refer to *7.1 Functions on Panel Operator*. Servomotor speed can be changed using the parameter Pn304 (JOG speed). The factory setting for JOG operation is 500 min^{-1}.

Operation

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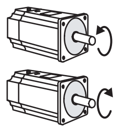
⚠ CAUTION

Pay attention that the Forward Run Prohibited (P-OT) and Reverse Run Prohibited (N-OT) signals are invalid during jog mode operation.

• JOG Mode Operation (Fn002)

Step	Display after Operation	Panel Operator	Description
1	Fn000	MODE/SET (MODE/SET Key)	Press the MODE/SET Key to select the utility function mode.
2	Fn002	▲ ▼	Press the Up or Down Cursor Key to select Fn002. *The digit that can be set will blink.
3	-. .JoG	DATA/◀ (DATA/SHIFT) (Press at least one sec.)	Press the DATA/SHIFT Key for a minimum of one second. The display shown at the right will appear, and the servomotor will enter jog operation mode. The servomotor can be operated with the panel operator in this condition.
4	. .JoG	MODE/SET (MODE/SET Key)	Press the MODE/SET Key. This will turn ON the power to the servomotor.
5		▲ ▼	Press the Up Cursor Key (forward) or Down Cursor Key (reverse). The servomotor will operate as long as the key is pressed.
6	-. .JoG	MODE/SET (MODE/SET Key)	Press the MODE/SET Key. This will turn OFF the power to the servomotor. The power will remain OFF even if the DATA/SHIFT Key is pressed for more than one second.
7	Fn002	DATA/◀ (DATA/SHIFT) (Press at least one sec.)	Press the DATA/SHIFT Key for a minimum of one second to return to the Fn002 display of the utility function mode.

INFO

The servomotor's rotation direction depends on the setting of parameter Pn000.0 (Direction Selection). The example above describes operation with Pn000.0 in the factory setting.

Pn304	JOG Speed		Speed Position Torque	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 10000	1 min^{-1}	500	Immediately
Sets the utility function Fn002 (Jog Mode Operation) to the reference value of motor speed.				

The motor can be operated using only the digital operator without reference from the host controller. The following conditions are required to perform jog mode operation.

1. The servo on (/S-ON) input signal is OFF (H level). Refer to *8.3.1 Setting the Servo ON Signal*.
2. Pn50A is not set to n.□□□7 (Sets signal ON) with the external input signal allocation. Refer to *7.3.2 Input Circuit Signal Allocation*.

8.1.2 Trial Operation for Servomotor without Load from Host Reference

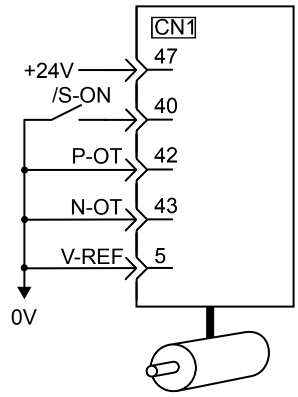
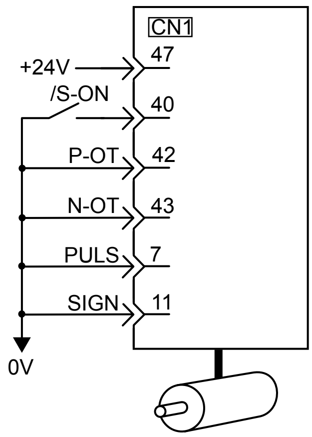
This section explains the items to be examined in a final check before connecting the servomotor to a machine and includes:

- Correct settings for servomotor commands, references, and I/O signals that are input from the host controller to the SERVOPACK
- Correct wiring and polarity between the host controller and the SERVOPACK
- Performance of the SERVOPACK

(1) Servo ON Reference from Host Reference

The following external input signal and equivalent signal circuits are required.

If using an absolute encoder, the SEN signal (CN1-4) must be set to H (high) level.

Speed Control (Standard Setting) (Pn000=n.□□0□)	Position Control (Pn000=n.□□1□)
	

Operation

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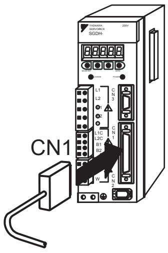
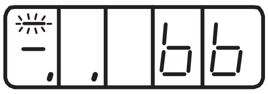
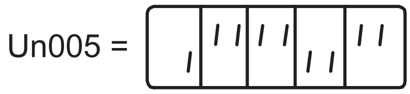
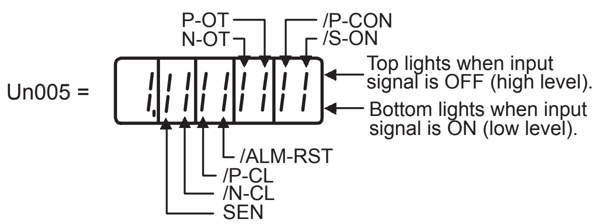
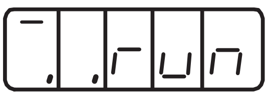
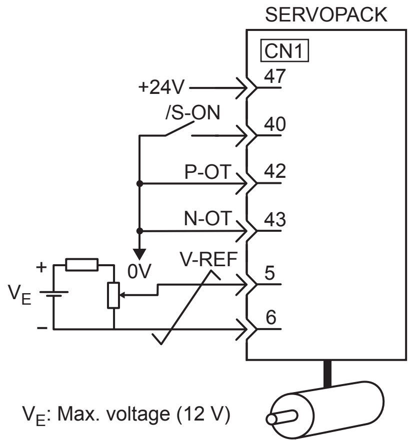
Step	Description	Check Method and Remarks
1	Configure an input signal circuit necessary for servo ON. Connect the I/O signal connectors (CN1) in the circuit on the previous page or equivalent to input the signal necessary for servo ON. Then turn OFF the power and connect the CN1 to the SERVOPACK. 	Satisfy the following conditions: 1. Servo ON (/S-ON) input signal can be input. 2. Forward Run Prohibited (P-OT) and Reverse Run Prohibited (N-OT) input signals are turned ON (L level). (Forward run and reverse run are prohibited.) 3. Reference input (0V reference or 0 pulse) is not input. To omit the external wiring, the input terminal function can be set to “Always ON” or “Always OFF” using the input signal allocation function of parameter. Refer to *7.3.2 Input Circuit Signal Allocation*. When the absolute encoder is used, Absolute Encoder Setup (Fn008) operation and the SEN signal wiring can be omitted when setting the Pn002 to n.□1□□ (Uses absolute encoder as an incremental encoder) only during trial operation.
2	Turn ON the power and make sure that the panel operator display is as shown below. 	The input signal setting is not correct if the display is not the same as on the left. Check the input signal using the Un005 (input signal monitor) from the panel operator.  Check input signal wiring in monitor mode using the digital operator or panel operator. Refer to *7.4.1 List of Monitor Modes*. Turn ON and OFF each signal line to see if the LED monitor bit display on the digital operator changes as shown below. Input signal LED display  If an absolute encoder is being used, the servo will not turn ON when the servo ON signal (/S-ON) is input unless the SEN signal is also ON. When the SEN signal is checked in monitor mode, the top of the LED will light because the SEN signal is high when ON.
3	Input the /S-ON signal, then make sure that the display of the panel operator is as shown below. 	If an alarm display appears, correct it according to *11.1 Troubleshooting*. If there is noise in the reference voltage during speed control, the horizontal line (–) at the far left edge of the panel operator display may blink. Also the servomotor may turn very slowly. Refer to *6.5 Connecting Regenerative Resistors* and take a preventive measure.

(2) Operating Procedure in Speed Control Mode (Pn000 = n.□□0□)

The following circuit is required: External input signal circuit or equivalent.



Step	Description	Check Method and Remarks
1	Check the power and input signal circuits again, and check that the speed reference input (voltage between the V-REF and SG) is 0 V.	Refer to the above figure for input signal circuit.
2	Turn ON the servo ON (/S-ON) input signal.	If the servomotor rotates at extremely slow speed, refer to *8.5.3 Adjusting Offset*, and use the reference voltage offset to keep the servomotor from moving.
3	Generally increase the speed reference input voltage between V-REF and SG from 0 V.	The factory setting is 6 V/rated rotation speed.
4	Check the speed reference input to the SERVO-PACK (Un000 [min-1]).	Refer to *7.1.2 Basic Mode Selection* for how it is displayed.
5	Check the Un000 (motor speed [min-1].	Refer to *7.1.2 Basic Mode Selection* for how it is displayed.
6	Check that the Un001 and Un000 values in steps 4 and 5 are equal.	Change the speed reference input voltage and check that Un001 and Un000 values are equal for multiple speed references.
7	Check the speed reference input gain and motor rotation direction.	Refer to the following equation to change the Pn300 (speed reference input gain). Un001=(voltage between V-REF) [V] × Pn300 [300 min-1/6V] To change the motor rotation direction without changing polarity for speed reference input gain, refer to *8.3.2 Switching the Servomotor Rotation Direction*. Perform the operation from step 2 again after the motor rotation direction is changed.
8	When the speed reference input is set to 0 V and servo OFF status enters, the trial operation for servomotor without load is completed.	–

Operation

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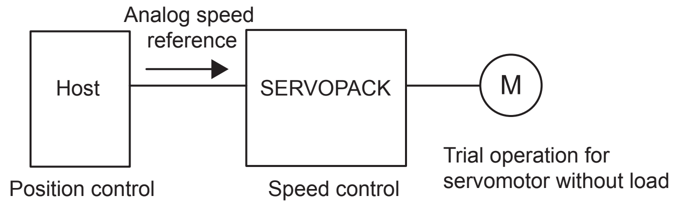
INFO

■ When Position Control is configured at the Host

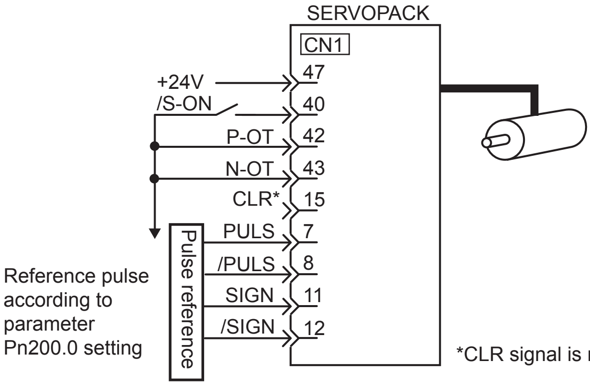


When the SERVOPACK conducts speed control and position control is conducted at the host controller, perform the operations below, following the operations in *(2) Operating Procedure in Speed Control Mode (Pn000 = n.□□0□)* on the previous page.

Step	Description	Check Method and Remarks
9	Check the input signal circuit again, and check that the speed reference input (voltage between the V-REF and SG) is 0 V.	Refer to the above figure for input signal circuit.
10	Turn ON the servo ON (/S-ON) input signal.	If the servomotor rotates at extremely slow speed, refer to *8.5.3 Adjusting Offset*, and use the reference voltage offset to keep the servomotor from moving.
11	Send the command for the number of motor rotation easy to check (for example, one motor revolution) from the host controller in advance, and check the sent number of rotation and actual number of rotation by visual inspection and the Un003 (rotation angle1)[pulse].	Un003 (rotation angle 1)[pulse]: the number of pulses from the zero point. Refer to *7.1.2 Basic Mode Selection* for how it is displayed.
12	If the sent number of rotation and actual number of rotation in step 11 are not equal, correctly set the Pn212 (PG divided ratio) outputting the encoder pulse from the SERVOPACK.	Refer to *8.5.7 Encoder Signal Output* for how to set. PG divider (Pn212 [P/Rev]): the number of encoder pulses per revolution
13	When the speed reference input is set to 0 V and servo OFF status enters, the trial operation for position control with the host controller is completed.	–

(3) Operating Procedure in Position Control Mode (Pn000 = n.□□1□)

The following circuit is required: External input signal circuit or equivalent.



*CLR signal is not connected.

Step	Description	Check Method and Remarks
1	Match the reference pulse form with the pulse output form from the host controller.	Set the reference pulse with Pn200=n.□□□×. Refer to *8.6.1 (2) Setting a Reference Pulse Form*.
2	Set the reference unit and electronic gear ratio so that it coincides with the host controller setting.	Set the electronic gear ratio with Pn20E/Pn210. Refer to *8.6.2 Setting the Electronic Gear*.
3	Turn ON the power and the servo ON (/S-ON) input signal.	–
4	Send the pulse reference for the number of motor rotation easy to check (for example, one motor revolution) and with slow speed from the host controller in advance.	Set the motor speed of several 100 min^{-1} for the reference pulse speed because such speed is safe.
5	Check the number of reference pulses input to the SERVOPACK by the changed amount before and after the Un00C (input reference pulse counter) [pulse] was executed.	Refer to *7.1.2 Basic Mode Selection* for how it is displayed. Un00C (input reference pulse counter) [pulse]
6	Check the actual number of motor rotation [pulse] by the changed amount before and after the reference was executed. Un00D (feedback pulse counter [pulse])	Refer to *7.1.2 Basic Mode Selection* for how it is displayed. Un00D (feedback pulse counter [pulse])
7	Check that steps 5 and 6 satisfy the following equation: Un00D=Un00C × (Pn20E/Pn210)	–
8	Check that the motor rotation direction is the same as the reference.	Check the input pulse polarity and input reference pulse form. Refer to *8.6.1 (2) Setting a Reference Pulse Form*.
9	Input the pulse reference with the large number of motor rotation from the host controller to obtain the constant speed.	Set the motor speed of several 100 min^{-1} for the reference pulse speed because such speed is safe.
10	Check the reference pulse speed input to the SERVOPACK using the Un007 (input reference pulse speed) [min^{-1}].	Refer to *7.1.2 Basic Mode Selection* for how it is displayed. Un007 (input reference pulse speed) [min^{-1}]
	The number of input reference pulses (Un007) can be obtained from the following equation for a servomotor with a 17-bit encoder. $\text{Un007(input reference pulse speed)} = \underbrace{\text{input reference pulse [pulses/S]} \times 60}_{\text{Reference input ppm}} \times \underbrace{\frac{\text{Pn20E}}{\text{Pn210}}}_{\text{Electronic gear ratio}} \times \underbrace{\frac{1}{2^{17}(131072)}}_{\text{Encoder pulse *}}$	

Operation

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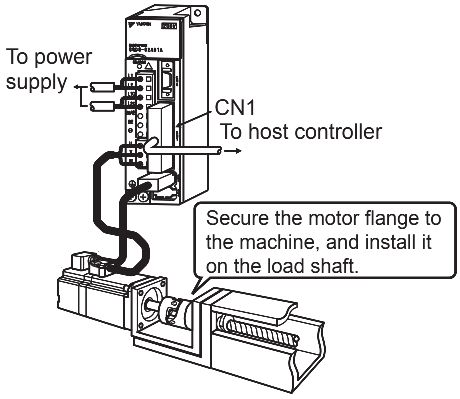
(cont'd)

Step	Description	Check Method and Remarks
11	Check the motor speed using the Un000 (motor speed) [min^{-1}].	Refer to *7.1.2 Basic Mode Selection* for how it is displayed. Un000 (motor speed) [min^{-1}]
12	Check that the Un007 and Un000 values in steps 9 and 10 are equal.	–
13	Check the motor rotation direction.	To change the motor rotation direction without changing input reference pulse form, refer to *8.3.2 Switching the Servomotor Rotation Direction*. Perform the operation from step 9 again after the motor rotation direction is changed.
14	When the pulse reference input is stopped and servo OFF status enters, the trial operation for servomotor without load and using position control with the host controller is completed.	–

8.1.3 Trial Operation with the Servomotor Connected to the Machine

> ⚠ **WARNING**
>
> • Follow the procedure below for trial operation precisely as given.
> Malfunctions that occur after the servomotor is connected to the machine not only damage the machine, but may also cause an accident resulting death or injury.

Follow the procedures below to perform the trial operation.



Step	Description	Check Method and Remarks
1	Turn ON the power and make the settings for mechanical configuration related to protective function such as overtravel and brake.	Refer to *8.3 Setting Common Basic Functions*. When a servomotor with brake is used, take advance measures to prevent vibration due to gravity acting on the machine or external forces before checking the brake operation. Check that both servomotor and brake operations are correct. For details, refer to *8.3.4 Setting for Holding Brakes*.
2	Set the necessary parameters for control mode used.	Refer to *8.5 Operating Using Speed Control with Analog Reference*, *8.6 Operating Using Position Control*, and *8.7 Operating Using Torque Control* for control mode used.
3	Connect the servomotor to the machine with coupling, etc., while the power is turned OFF.	Refer to *3.8.1 Precautions on Servomotor Installation*.
4	Check that the SERVOPACK is servo OFF status and then turn ON the power to the machine (host controller). Check again that the protective function in step 1 operates normally.	Refer to *8.3 Setting Common Basic Functions*. For steps 4 to 8, take advance measures for emergency stop so that the servomotor can stop safely when an error occurs during operation.
5	Perform trial operation with the servomotor connected to the machine, following each section in *8.1.2 Trial Operation for Servomotor without Load from Host Reference*.	Check that the trial operation is completed with as the trial operation for servomotor without load. Also check the settings for machine such as reference unit.
6	Check the settings of parameters for control mode used set in step 2 again.	Check that the servomotor rotates matching the machine operating specifications.
7	Adjust the servo gain and improve the servomotor response characteristics, if necessary.	Refer to *9.1 Servo Tuning Methods*. The servomotor will not be broken in completely during the trial operation. Therefore, let the system run for a sufficient amount of additional time to ensure that it is properly broken in.
8	Write the parameters set for maintenance in *12.4 Parameter Recording Table*. Then the trial operation with the servomotor connected to the machine is completed.	If the JUSP-OP05A digital operator is used, parameters can be saved. SigmaWin+, which is a tool for supporting the servo drive, can then manage the saved parameters in files.

8.1.4 Servomotor with Brakes

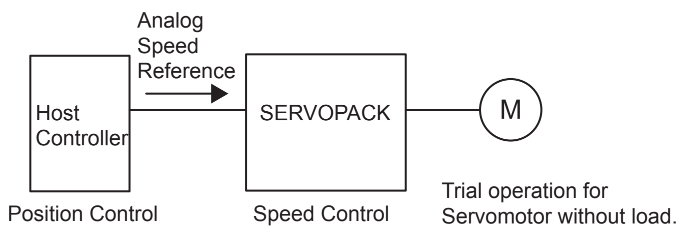
Holding brake operation of the servomotor with brake can be controlled the brake interlock output (/BK) signal of the SERVOPACK.

When checking the brake operation, take advance measures to prevent vibration due to gravity acting on the machine or external forces. Check the servomotor operation and holding brake operation with the servomotor separated from the machine. If both operations are correct, connect the servomotor and perform trial operation.

For wiring on a servomotor with brakes, and setting parameters, refer to *8.3.4 Setting for Holding Brakes*.

8.1.5 Position Control by Host Controller

As described above, be sure to separate the servomotor and machine before performing trial operation of the servomotor without a load. Refer to the following table, and check the servomotor operation and specifications in advance.



Reference from the Host Controller	Check Item	Check Method	Review Items	Reference Section
JOG Operation (Constant Reference Speed Input from Host Controller)	Motor Speed	Check motor speed as follows: • Use the servomotor speed monitor (Un000) on the panel operator. • Run the servomotor at low speed. Input a reference speed of 60 min^{-1} for example to check to see if the servomotor makes one revolution per second.	Check the parameter setting at Pn300 to see if reference speed gain is correct.	8.5.1
Simple Positioning	No. of motor rotation	Input a reference equivalent to one servomotor rotation and visually check to see if the shaft makes one revolution.	Check the parameter setting at Pn212 to see if the number of dividing pulses is correct.	8.5.7
Overtravel (P-OT and N-OT Used)	Whether the servomotor stops rotating when P-OT and N-OT signals are input	Check to see if the servomotor stops when P-OT and N-OT signals are input during continuous servomotor operation.	Review P-OT and N-OT wiring if the servomotor does not stop.	8.3.3

8.2 Control Mode Selection

The control modes supported by the SGDS SERVOPACK are described below.

Parameter		Control Mode	Reference Section
Pn000	**n.□□0□** (Factory setting)	Speed Control (Analog voltage speed reference) Controls servomotor speed by means of an analog voltage speed reference. Use in the following instances. • To control speed • For position control using the encoder feedback division output from the SERVOPACK to form a position loop in the host controller.	8.5
	n.□□1□	Position Control (Pulse train position reference) Controls the position of the machine by means of a pulse train position reference. Controls the position with the number of input pulses, and controls the speed with the input pulse frequency. Use when positioning is required.	8.6
	n.□□2□	Torque Control (Analog voltage speed reference) Controls the servomotor's output torque by means of an analog voltage torque reference. Use to output the required amount of torque for operations such as pressing.	8.7
	n.□□3□	Speed Control (Contact input speed control) Uses the three input signals /P-CON (/SPD-D), /P-CL (/SPD-A), and /N-CL (/SPD-B) to control the speed as set in advance in the SERVOPACK. Three operating speeds can be set in the SERVOPACK. (An analog reference is not necessary.)	8.8
	n.□□4□ · · · **n.□□B□**	These are switching modes for using the four control methods described above in combination. Select the control method switching mode that best suits the application.	8.10

8.3 Setting Common Basic Functions

8.3.1 Setting the Servo ON Signal

This sets the servo ON signal (/S-ON) that determines whether the servomotor power is ON or OFF.

(1) Servo ON signal (/S-ON)

Type	Name	Connector Pin Number	Setting	Meaning
Input	/S-ON	CN1-40 (Factory setting)	ON (low level)	Servomotor power ON. Servomotor can be operated.
			OFF (high level)	Servomotor power OFF. Servomotor cannot be operated.

■ IMPORTANT

Always input the servo ON signal before inputting the input reference to start or stop the servomotor. Do not input the input reference first and then use the /S-ON signal to start or stop. Doing so will degrade internal elements and lead to malfunction.

Note: A parameter can be used to re-allocate the input connector number for the /S-ON signal. Refer to *7.3.2 Input Circuit Signal Allocation.*

(2) Enabling/Disabling the Servo ON Signal

A parameter can be used to set a parameter servo ON condition. This eliminates the need to wire /S-ON, but care must be taken because the SERVOPACK can operate as soon as the power is turned ON.

Parameter		Meaning
Pn50A	n.□□0□	Inputs the /S-ON signal from the input terminal CN1-40. (Factory setting)
	n.□□7□	Constantly enables the /S-ON signal.

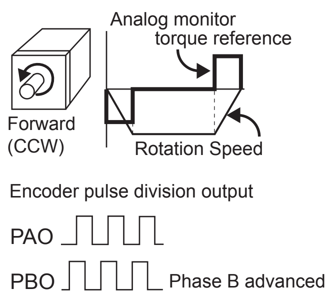
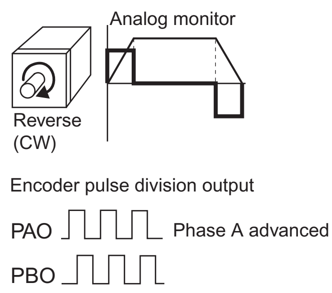
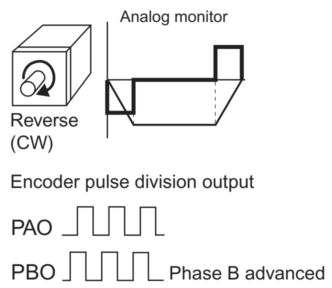
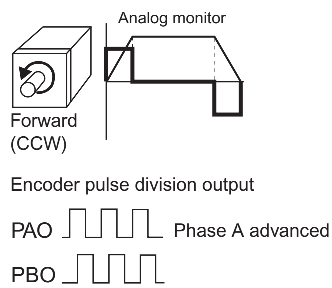
- After changing these parameters, turn OFF the main circuit and control power supplies and then turn them ON again to enable the new settings.
- When the parameter is set to constantly “enable” the signal, resetting following an alarm can only be done by turning the power OFF and ON. (Alarm reset is disabled.)

8.3.2 Switching the Servomotor Rotation Direction

Only the rotation direction of the servomotor can be switched without changing the reference pulse to the SERVOPACK or the reference voltage polarity.

This causes the travel direction (+, -) of the shaft reverse, but the encoder pulse output and analog monitor signal polarity do not change.

The standard setting for “forward rotation” is counterclockwise as viewed from the drive end.

Parameter		Name	Reference	
			Forward Reference	Reverse Reference
Pn000	**n.□□□0**	Standard setting (CCW = Forward) (Factory setting)		
	n.□□□1	Reverse Rotation Mode (CW = Reverse)		
The direction of P-OT and N-OT change. For Pn000 = n.□□□0 (standard setting), counterclockwise is P-OT. For Pn000 = n.□□□1 (Reverse Rotation Mode), clockwise is P-OT.				

8.3.3 Setting the Overtravel Limit Function

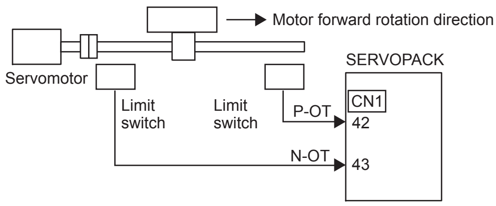
The overtravel limit function forces movable machine parts to stop if they exceed the allowable range of motion and turn ON a limit switch.

(1) Connecting the Overtravel Signal

To use the overtravel function, connect the following overtravel limit switch input signal terminals.

Type	Name	Connector Pin Number	Setting	Meaning
Input	P-OT	CN1-42	ON (low level)	Forward run allowed. Normal operation status.
			OFF (high level)	Forward run prohibited. Forward overtravel.
Input	N-OT	CN1-43	ON (low level)	Reverse run allowed. Normal operation status.
			OFF (high level)	Reverse run prohibited. Reverse overtravel.

Connect limit switches as shown below to prevent damage to the devices during linear motion.
Rotation in the opposite direction is possible during overtravel. For example, reverse rotation is possible during forward overtravel.



■ IMPORTANT
When the servomotor stops due to overtravel during position control, the position error pulses are held. A clear signal (CLR) input is required to clear the error pulses.

⚠ CAUTION

When using the servomotor on a vertical axis, the workpiece may fall in the overtravel condition.
To prevent this, always set the zero clamp after stopping with Pn001 = n.□□1□.
Refer to *(3) Selecting the Motor Stop Method When Overtravel is Used* in this section.

(2) Enabling/Disabling the Overtravel Signal

A parameter can be set to disable the overtravel signal. If the parameter is set, there is no need to wire the overtravel input signal.

Parameter		Meaning
Pn50A	**n.2□□□**	Inputs the Forward Run Prohibited (P-OT) signal from CN1-42. (Factory setting)
	n.8□□□	Disables the Forward Run Prohibited (P-OT) signal. (Allows constant forward rotation.)
Pn50B	**n.□□□3**	Inputs the Reverse Run Prohibited (N-OT) signal from CN1-43. (Factory setting)
	n.□□□8	Disables the Reverse Run Prohibited (N-OT) signal. (Allows constant reverse rotation.)

- Applicable control methods: Speed control, position control, and torque control
- After changing these parameters, turn OFF the main circuit and control power supplies and then turn them ON again to enable the new settings.

* A parameter can be used to re-allocate input connector number for the P-OT and N-OT signals. Refer to *7.3.2 Input Circuit Signal Allocation*.

(3) Selecting the Motor Stop Method When Overtravel is Used

This is used to set the stop method when an overtravel (P-OT, N-OT) signal is input while the servomotor is operating.

Parameter		Stop Mode	Mode After Stopping	Meaning
Pn001	**n.□□00**	Stop by dynamic brake	Coast	Immediately stops the servomotor by dynamic braking (DB), then places it into Coast (power OFF) Mode.
	n.□□01			
	n.□□02	Coast to a stop		Stops the servomotor by coast stop, then places it into Coast (power OFF) Mode.
	n.□□1□	Decelerate to stop	Zero Clamp	Decelerates the servomotor with emergency stop torque (Pn406), then places it into Zero Clamp (Servolock) Mode.
	n.□□2□		Coast	Decelerates the servomotor with emergency stop torque (Pn406), then places it into Coast (power OFF) Mode.

- During torque control stops by dynamic braking (DB) or coasts to a stop regardless of the Pn001.1 setting (the stopping method by Pn001.0).
- After it is stopped the servomotor enters Coast Mode.
- After changing these parameters, turn OFF the main circuit and control power supplies and then turn them ON again to enable the new settings.
- If the parameter for the Coast Mode is set to n.□□□2 during coasting, acceleration of the SERVOPACK can be resumed by using the servo ON signal.

■ TERMS
- Stop by dynamic brake: Stops by using the dynamic brake (with short-circuiting by a circuit of SERVOPACK).
- Coast to a stop: Stops naturally, with no brake, by using the friction resistance of the motor in operation.
- Decelerate to stop: Stops by using deceleration (braking) torque.
- Zero Clamp Mode: A mode forms a position loop by using the position reference zero.

* For details on stopping methods when the servo turns OFF or when an alarm occurs, refer to *8.3.5 Selecting the Stopping Method after Servo OFF*.

(4) Setting the Stop Torque for Overtravel

Pn406	Emergency Stop Torque		Speed	Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 800	1%	800	Immediately

- This sets the stop torque for when the overtravel signal (P-OT, N-OT) is input.
- The setting unit is a percentage of the rated torque (i.e., the rated torque is 100%).

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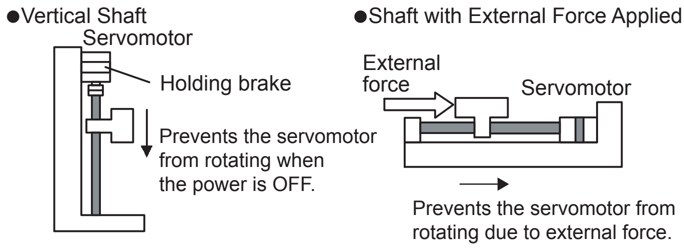
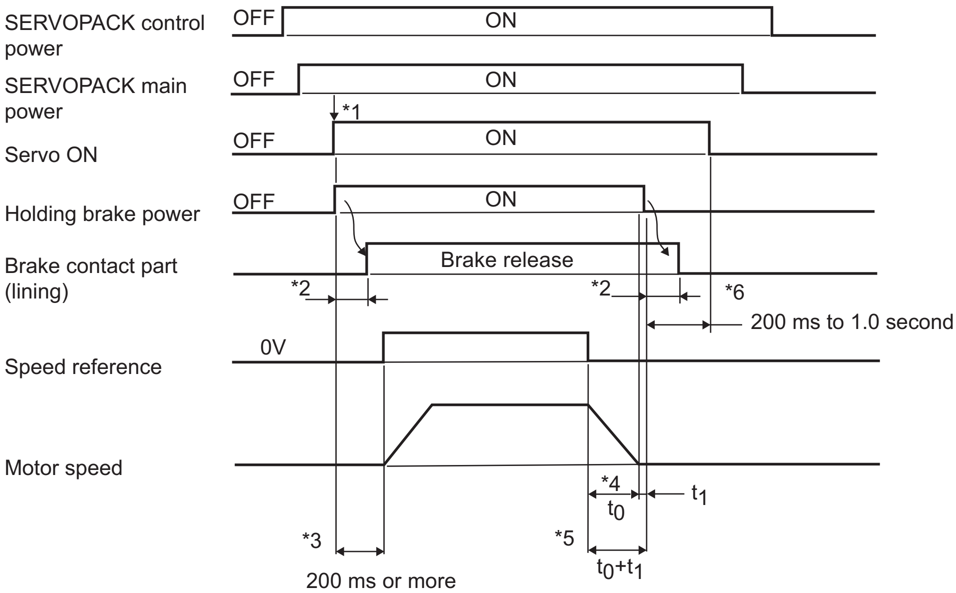
8.3.4 Setting for Holding Brakes

The holding brake is used when a SERVOPACK controls a vertical axis. A servomotor with brake prevents the movable part from shifting due to gravity when the power supply of the SERVOPACK turns OFF. Refer to 8.1.4 Servomotor with Brakes.



There is a delay in the braking operation. Set the following ON/OFF timing. The timing can be easily set using the brake interlock output signal.



* 1. The servo ON signal and holding brake power supply may be turned ON simultaneously.
* 2. The operation delay time of the brake depends on the model. For details, refer to *Table 8.1 Brake Operation Delay Time*.
* 3. Allow a period of 200 ms before the speed reference is input after the brake power supply is turned ON.
* 4. The servomotor stop time is shown by t_0. Refer to *Table 8.2 Calculation Method for Servomotor Stop Time* for the calculation of t_0.
* 5. Always turn OFF the brake power supply after the servomotor comes to a stop. Usually, set t_0+t_1 to 1 or 2 seconds.
* 6. Turn OFF the servo ON signal 0.2 to 1.0 second after the brake power supply is turned OFF.

Table 8.1 Brake Operation Delay Time

Model	Voltage	Brake Open Time (ms)	Brake Operation Time (ms)
SGMMJ-A1	24 V	60	200
SGMMJ-A2, A3	24 V	60	200
SGMAS-A5,01,C2	90 V	60	100
	24 V		
SGMAS-02,04	90 V	60	100
	24 V		
SGMAS-06	90 V	80	100
	24 V		
SGMAS-08,12	90 V	80	100
	24 V		
SGMPS-01	90 V	20	100
	24 V		
SGMPS-02,04	90 V	40	100
	24 V		
SGMPS-08,15	90 V	20	100
	24 V		
SGMSS-10, 15, 20, 25, 30	90 V	170	80
	24 V		
SGMGH-05 (1500 min^{-1})	90 V	100	80
SGMGH-03 (1000 min^{-1})	24 V		
SGMGH-09 (1500 min^{-1})	90 V	100	80
SGMGH-06 (1000 min^{-1})	24 V		
SGMGH-13 (1500 min^{-1})	90 V	100	80
SGMGH-09 (1000 min^{-1})	24 V		
SGMGH-20 (1500 min^{-1})	90 V	170	80
SGMGH-12 (1000 min^{-1})	24 V		100
SGMGH-30 (1500 min^{-1})	90 V	170	80
SGMGH-20 (1000 min^{-1})	24 V		100
SGMGH-44 (1500 min^{-1})	90 V	170	80
SGMGH-30 (1000 min^{-1})	24 V		100
SGMGH-55 (1500 min^{-1})	90 V	170	80
SGMGH-40 (1000 min^{-1})	24 V		
SGMGH-75 (1500 min^{-1})	90 V	170	80
SGMGH-55 (1000 min^{-1})	24 V		

Note: The above operation delay time is an example when the power supply is turned ON and OFF on the DC side.
Be sure to evaluate the above times on the actual equipment before using the application.

Table 8.2 Calculation Method for Servomotor Stop Time

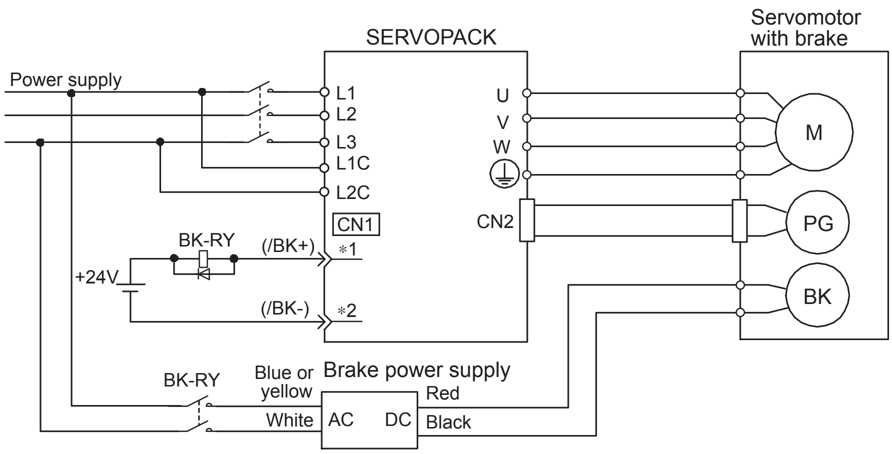
Using SI Units	Conventional Method
$t_0 = \dfrac{(J_M + J_L) \times N_M}{(T_P + T_L)} \times \dfrac{2\pi}{60}$ (sec)	$t_0 = \dfrac{(GD^2_M + GD^2_L) \times N_M}{375 \times (T_P + T_L)}$ (sec)
J_M : Rotor moment of inertia (kg·m^2)	GD^2_M : Motor GD^2 (kgf·m^2)
J_L : Load moment of inertia (kg·m^2)	GD^2_L : Load inertia GD^2 (kgf·m^2)
N_M : Motor rotational speed (min^{-1})	N_M : Motor rotational speed (r/min)
T_P : Motor deceleration torque (N·m)	T_P : Motor deceleration torque (kgf·m)
T_L : Load torque (N·m)	T_L : Load torque (kgf·m)

IMPORTANT

1. The brake built into the servomotor with brakes is a deenergization brake, which is used only to hold and cannot be used for braking. Use the holding brake only to hold a stopped motor. Brake torque is at least 120% of the rated motor torque.
2. When operating using only a speed loop, turn OFF the servo and set the input reference to 0 V when the brake is applied.
3. When forming a position loop, do not use a mechanical brake while stopped because the servomotor enters servolock status.

(1) Wiring Example

Use the SERVOPACK contact output signal /BK and the brake power supply to form a brake ON/OFF circuit. The following diagram shows a standard wiring example.



BK-RY: Brake control relay
Brake power supply Input voltage 200-V models: LPSE-2H01
Input voltage 100-V models: LPDE-1H01
*1 and *2 are the output terminals allocated with Pn50F.2.

(2) Brake Interlock Output

Type	Name	Connector Pin Number	Setting	Meaning
Output	/BK	Must be allocated	ON (low level)	Releases the brake.
			OFF (high level)	Applies the brake.

This output signal controls the brake and is used only for a servomotor with a brake. The output signal must be allocated (with Pn50F). It does not need to be connected for servomotors without a brake.

■ IMPORTANT

The /BK signal is not output during overtravel, or when there is no power to the servomotor.

(3) Allocating Brake Signals (/BK)

The brake signal (/BK) is not used with the factory settings. The output signal must be allocated.

Parameter		Connector Pin Number		Meaning
		+ Terminal	- Terminal	
Pn50F	n.□0□□	–	–	The /BK signal is not used. (Factory setting)
	n.□1□□	CN1-25	CN1-26	The /BK signal is output from output terminal CN1-25, 26.
	n.□2□□	CN1-27	CN1-28	The /BK signal is output from output terminal CN1-27, 28.
	n.□3□□	CN1-29	CN1-30	The /BK signal is output from output terminal CN1-29, 30.

■ IMPORTANT

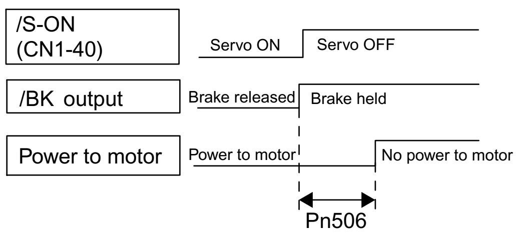
When set to the factory setting, the brake signal is invalid. When multiple signals are allocated to the same output terminal, the signals are output with OR logic. To output the /BK signal alone, disable the other output signals or set them to output terminals other than the one allocated to the /BK signal. Refer to *7.3.3 Output Circuit Signal Allocation*.

(4) Setting the Brake ON Timing after the Servomotor Stops

With the factory setting, the /BK signal is output at the same time as the servo is turned OFF. The servo OFF timing can be changed with a parameter.

Pn506	Delay Time from Brake Reference Until Servo OFF (Speed, Position, Torque)			
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 50 (0 to 500 ms)	10 ms	0	Immediately

- When using the servomotor to control a vertical axis, the machine movable part may shift slightly depending on the brake ON timing due to gravity or an external force. By using this parameter to delay turning the servo OFF, this slight shift can be eliminated.
- This parameter changes the brake ON timing while the servomotor is stopped.
  For details on brake operation while the servomotor is operating, refer to *(5) Setting the Brake ON Timing When Servomotor Running* in this section.



■ IMPORTANT

The servomotor will turn OFF immediately when an alarm occurs, regardless of the setting of this parameter.
The machine movable part may shift due to gravity or external force during the time until the brake operates.

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(5) Setting the Brake ON Timing When Servomotor Running

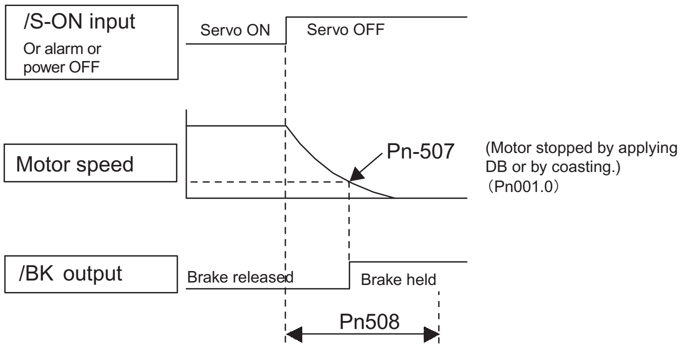
The following parameters can be used to change the /BK signal output conditions when a stop reference is output during servomotor operation due to the servomotor turning OFF or an alarm occurring.

Pn507	Brake Reference Output Speed Level		Speed Position Torque	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 1000	min^{-1}	100	Immediately
Pn508	Waiting Time for Brake Signal When Motor Running		Speed Position Torque	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	10 to 100 (100 to 1000 ms)	10 ms	50 (500 ms)	Immediately

/BK Signal Output Conditions When Servomotor Running

The /BK signal goes to high level (brake ON) when either of the following conditions is satisfied:

- When the motor speed falls below the level set in Pn507 after the power to the servomotor is turned OFF.
- When the time set in Pn508 is exceeded after the power to the servomotor is turned OFF.



■ IMPORTANT

- The servomotor will be limited to its maximum speed even if the value set in Pn507 is higher than the maximum speed.
- Allocate the /TGON signal and the /BK signal to different terminals.
- If the brake signal (/BK) and running output signal (/TGON) are allocated to the same output terminal, the /TGON signal will go to low level at the speed at which the movable part drops on the vertical axis, which means that the /BK signal will not go to high level even if the conditions of this parameter are met. (This is because signals are output with OR logic when multiple signals are allocated to the same output terminal.)

8.3.5 Selecting the Stopping Method after Servo OFF

The stopping method when the power to the SERVOPACK turns OFF can be selected.

Parameter		Stop Mode	Mode After Stopping	Meaning
Pn001	**n.□□□0**	Stop by dynamic brake	Dynamic Brake	Stops the servomotor by dynamic braking (DB), then holds it in Dynamic Brake Mode. (Factory setting)
	n.□□□1		Coast	Stops the servomotor by dynamic braking (DB), then places it into Coast (power OFF) Mode.
	n.□□□2	Coast to a stop	Coast	Stops the servomotor by coasting, then places it into Coast (power OFF) Mode.

These parameters are valid under the following conditions:

- When the /S-ON input signal is OFF (Servo OFF).
- When an alarm occurs in the torque control mode
- When an alarm to stop the motor using the dynamic brake
- When the main circuit power supply (L1, L2, or L3) is OFF; Some motors, depending on the model, are stopped by dynamic braking (DB). Refer to the following section labelled ■ IMPORTANT.

Similar to the Coast Mode, the n.□□□0 setting (which stops the servomotor by dynamic braking and then holds it in Dynamic Brake Mode) does not generate any braking force when the servomotor stops or when it rotates at very low speed.

■ TERMS

- Stop by dynamic brake: Stops by using the dynamic brake (with short-circuiting by a circuit of SERVOPACK).
- Coast to a stop: Stops naturally, with no brake, by using the friction resistance of the motor in operation.

■ IMPORTANT

The SERVOPACK is forced to stop by dynamic braking despite the above parameter settings when the main circuit power supply (L1, L2, L3) or control power supply (L1C, L2C) turns OFF.

- SGDS-A3B, A5F to 04F (30 W to 400 W for 100 V)
- SGDS-A5A to 75A (50 W to 7.5 kW for 200 V)

If the servomotor must be stopped by coasting rather than by dynamic braking when the main circuit power supply (L1, L2, L3) or the control power supply (L1C, L2C) turns OFF, arrange the sequence externally so the servomotor wiring (U, V, W) will be interrupted.

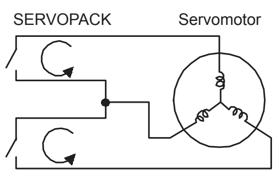
IMPORTANT

The dynamic brake (DB)[1] is an emergency stop function.
If the servomotor is frequently started and stopped by turning the power ON/OFF or using the servo ON signal (/S-ON), the DB circuit will also be repeatedly operated, degrading the SERVOPACK's internal elements. Use the speed input reference and position reference to control the starting and stopping of the servomotor.

TERMS

1 Dynamic brake (DB)

A common method for quickly stopping a servomotor. The servomotor is stopped by short-circuiting the servomotor circuit. This circuit is built into the SERVOPACK.



8.3.6 Power Loss Settings

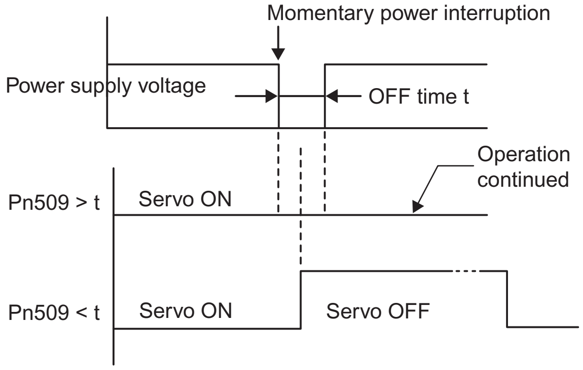
Determines whether to continue operation or turn the servo OFF when the power supply voltage is interrupted.

Pn509	Instantaneous Power Cut Hold Time	Speed Position Torque		
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	20 to 1000	1 ms	20	Immediately

In power loss detection, the status of the main circuit power supply is detected and OFF status is ignored so servomotor operation will continue if the servomotor turns back ON within the time set in parameter Pn509.

In the following instances, however, the parameter setting will be invalid.

- If an insufficient voltage alarm (A.410) occurs during a power loss with a large servomotor load.
- When control is lost (equivalent to normal power OFF operation) with loss of the control power supply.



■ IMPORTANT

The maximum setting for the hold time during a power loss is 1,000 ms, but the hold time for the SERVOPACK control power supply is about 100 ms. The hold time for the main circuit power supply depends on the SERVO-PACK output.

To continue SERVOPACK operation for a power loss that is longer than this, provide an uninterruptible power supply.

8.4 Absolute Encoders

⚠ WARNING

- The output range of multiturn data for the Σ-II and Σ-III series absolute detection system differs from that for conventional systems (15-bit encoder and 12-bit encoder). When an infinite length positioning system of the conventional type is to be configured with the Σ-II and Σ-III series, be sure to make the following system modification.

If a motor with an absolute encoder is used, a system to detect the absolute position can be made in the host controller. Consequently, operation can be performed without zero point return operation immediately after the power is turned ON.

SGMCS servomotor one-rotation absolute encoder of the multiturn data is 0.

SGMMJ/SGMAS/SGMPS/SGMSS/SGMGH-□□□2□ servomotors: With 17-bit absolute encoder

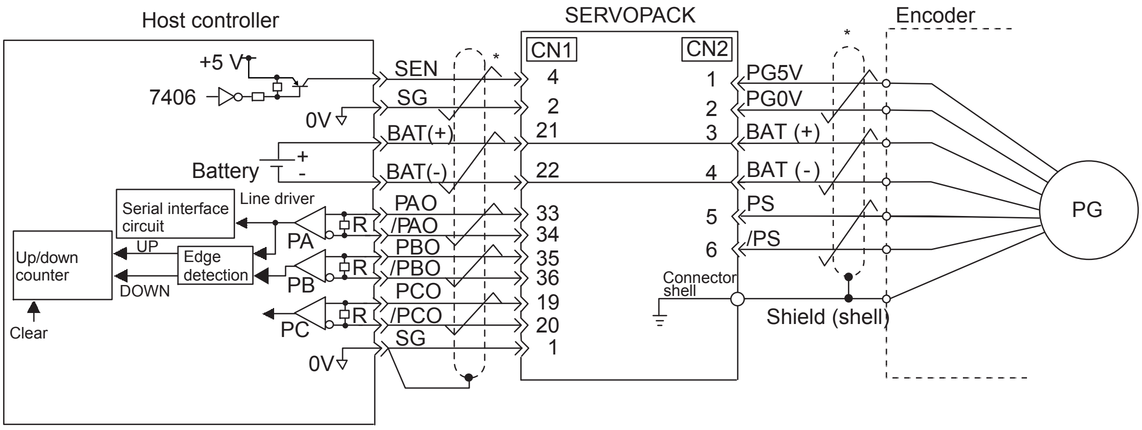
SGMCS-□□□3□□□ servomotor: With 20-bit absolute encoder (multiturn data is 0).

Absolute Encoder Type	Resolution	Output Range of Multiturn Data	Action when Limit Is Exceeded
Σ Series SGD SGDA SGDB	12-bit 15-bit	-99999 to + 99999	• When the upper limit (+99999) is exceeded in the forward direction, the multiturn data is 0. • When the lower limit (-99999) is exceeded in the reverse direction, the multiturn data is 0.
Σ-II, Σ-III Series SGDM SGDH SGDP SGDS	17-bit	-32768 to + 32767	• When the upper limit (+32767) is exceeded in the forward direction, the multiturn data is -32768.* • When the lower limit (-32767) is exceeded in the reverse direction, the multiturn data is +32768.*

* The action differs when the Multiturn Limit Setting (Pn205) is changed. Refer to *8.4.7 Multiturn Limit Setting*.

8.4.1 Interface Circuits

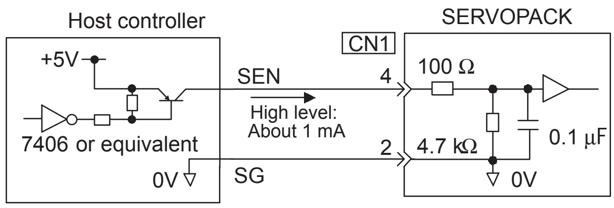
The following diagram shows the standard connections for a an absolute encoder mounted to a servomotor. The connection cable models and wiring pin numbers depend on the servomotor. For details, refer to *chapter 5 Specifications and Dimensional Drawings of Cables and Peripheral Devices*.

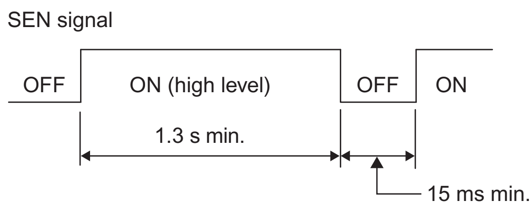


Applicable line driver:
Texas Instruments's SN75175 or KM3486
Terminating resistance R: 220 to 470 Ω

* : Represents twisted-pair wires.

• SEN Signal Connection

<table>
<tr><th>Type</th><th>Name</th><th>Connector Pin Number</th><th>Setting</th><th>Meaning</th></tr>
<tr><td rowspan="2">Input</td><td rowspan="2">SEN</td><td rowspan="2">CN1-4</td><td>OFF (low level)</td><td>Input when power is turned on</td></tr>
<tr><td>ON (high level)</td><td>Input at absolute data request</td></tr>
<tr><td colspan="5">This input signal is required to output absolute data from the SERVOPACK.
Let at least three seconds elapse after turning ON the power before rasing the SEN signal to high level.
When the SEN signal changes from low level to high level, the multiturn data and initial incremental pulses are output.
Until these operations have been completed, the motor cannot be operated regardless of the status of the servo ON signal (/S-ON). The panel operator display will also remain "bb."
Refer to 8.4.6 Absolute Encoder Reception Sequence.


We recommend a PNP transistor.
Signal levels
High: 4.0 V min., Low: 0.8 V max.</td></tr>
<tr><td colspan="5">■ IMPORTANT
Maintain the high level for at least 1.3 seconds when the SEN signal is turned OFF and then ON, as shown in the figure on the right.

</td></tr>
</table>

8.4.2 Selecting an Absolute Encoder

An absolute encoder can also be used as an incremental encoder.

Parameter		Meaning
Pn002	n.□0□□	Use the absolute encoder as an absolute encoder. (Factory setting)
	n.□1□□	Use the absolute encoder as an incremental encoder.
• The SEN signal and back-up battery are not required when using the absolute encoder as an incremental encoder. • After changing these parameters, turn OFF the main circuit and control power supplies and then turn them ON again to enable the new settings.		

8.4.3 Handling Batteries

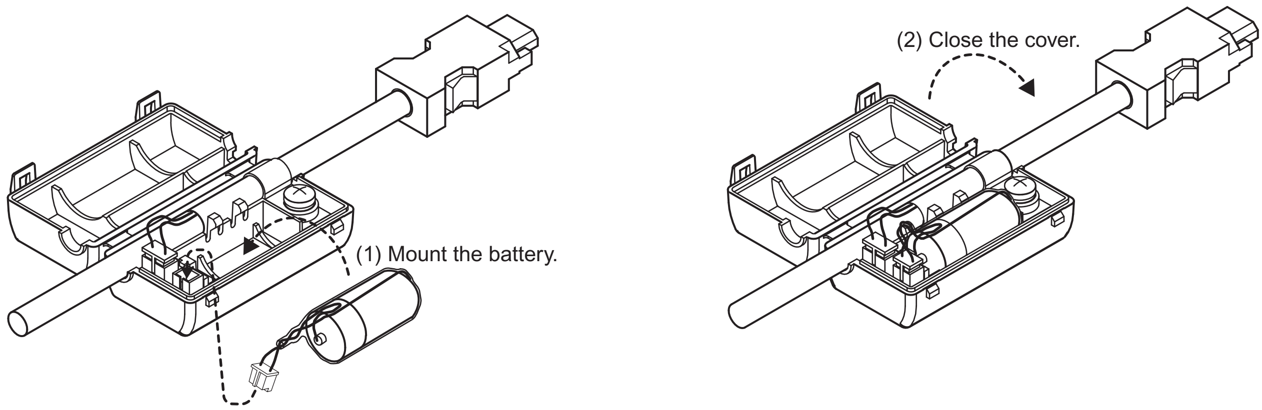
In order for the absolute encoder to retain position data when the power is turned OFF, the data must be backed up by a battery.

PROHIBITED

- Do not install the battery at either the host controller or the SERVOPACK.
  It is dangerous because a loop circuit between the batteries is set up. Install the battery in the host controller or SERVOPACK.

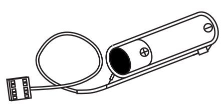
(1) Battery Provided for SERVOPACK

Use the following Battery Case (JUSP-BA01).



(2) Installing the Battery at the Host Controller

Prepare following the host controller specification. Use an ER6VC3 battery (3.6 V, 200 mAh: manufactured by Toshiba Battery Co., Ltd.) or an equivalent.



Operation

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8.4.4 Replacing Batteries

The SERVOPACK will generate an absolute encoder battery alarm (A.830) when the battery voltage drops below about 2.7 V. This alarm is output, however, only when a warning signal is received from the absolute encoder at the time the SERVOPACK power is turned ON. If the voltage drops while the SERVOPACK power is ON, the SERVOPACK will not generate the alarm.

The absolute encoder battery alarm A.830 can be changed to the warning A.930 by setting the parameter Pn008.

Parameter		Meaning
Pn008	n.□□□0	Generates the alarm A.830 when the battery voltage drops. (Factory setting)
	n.□□□1	Generates the warning A.930 when the battery voltage drops.

- Battery Replacement Procedure

1. Replace the battery with only the SERVOPACK control power supply turned ON.
2. After replacing the battery, turn OFF the SERVOPACK power to cancel the absolute encoder battery alarm (A.830).
3. Turn ON the SERVOPACK power back again. If it operates without any problems, the battery replacement has been completed.

IMPORTANT

If the SERVOPACK control power supply is turned OFF and the battery is disconnected (which includes disconnecting the encoder cable), **the absolute encoder data will be deleted**. The absolute encoder must be setup again. Refer to *8.4.5 Absolute Encoder Setup (Fn008)*.

8.4.5 Absolute Encoder Setup (Fn008)

Setting up the absolute encoder is necessary in the following cases.

- When starting the machine for the first time
- When an encoder backup error alarm (A.810) is generated
- When an encoder checksum error alarm (A.820) is generated
- When the data of the absolute encoder is to be set within the number of pulses of one rotation.

Use the panel operator to do the setup. (It can also be done with SigmaWin+, which is a tool for supporting the servo drive or a digital operator.)

IMPORTANT

1. Encoder setup operation is only possible when the servo is OFF.
2. If the following absolute encoder alarms are displayed, cancel the alarm by using the same method as the setup (initializing). They cannot be canceled with the SERVOPACK alarm reset input signal (/ALM-RST).
   - Encoder backup error alarm (A.810)
   - Encoder checksum error alarm (A.820)

   Any other alarms that monitor the inside of the encoder should be canceled by turning OFF the power, then canceling the alarm.
3. Multiturn data sometimes takes –1, 0, +1 when setup. (The values vary depending on the difference of motors (encoders) and the position when setup is executed.)
   When setup, make sure to read the multiturn data and the number of initial incremental pulse.

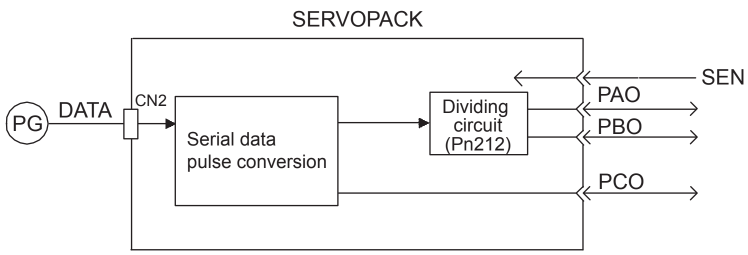
Procedure	Display after Operation	Panel Operator	Description
1	Alarm generated		
2	Fn000	MODE/SET (MODE/SET Key)	Press the MODE/SET Key to select the utility function mode.
3	Fn008	▲ ▼	Press the Up or Down Cursor Key to select parameter Fn008. *The digit that can be set will blink.
4	PGCL1	DATA/◀ (DATA/SHIFT) (Press at least one sec.)	Press the DATA/SHIFT Key for a minimum of one second. The display will be as shown at the left.
5	PGCL5	▲ ▼	Continue pressing the Up Cursor Key until PGCL5 is displayed. *If there is a mistake in the key operation, “nO_OP” will blink for about one second. The panel operator will return to the utility function mode.
6	donE	DATA/◀ (DATA/SHIFT) (Press at least one sec.)	Press the DATA/SHIFT Key for a minimum of one second. This will clear the multiturn data of the absolute encoder. When completed, “donE” will blink for about one second.
7	PGCL5	About one second later	After “donE” is displayed, “PGCL5” will be displayed again.
8	Fn008	DATA/◀ (DATA/SHIFT) (Press at least one sec.)	Press the DATA/SHIFT Key for a minimum of one second to return to the Fn008 display of the utility function mode.
9	Turn OFF the power, and then turn it ON again to make the setting valid.		

8.4.6 Absolute Encoder Reception Sequence

The sequence in which the SERVOPACK receives outputs from the absolute encoder and transmits them to host device is shown below.

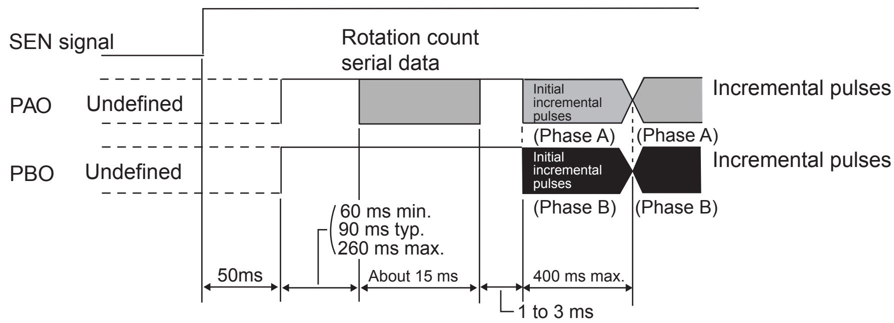
(1) Outline of Absolute Signals

The serial data, pulses, etc., of the absolute encoder that are output from the SERVOPACK are output from the PAO, PBO, and PCO signals as shown below.

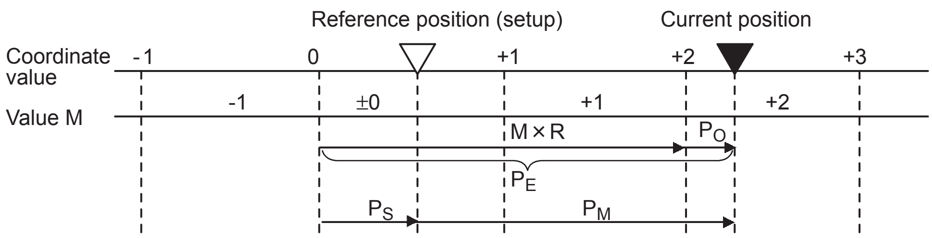


(2) Absolute Encoder Transmission Sequence and Contents

1. Set the SEN signal at high level.
2. After 100 ms, set the system to serial data reception-waiting-state. Clear the incremental pulse up/down counter to zero.
3. Receive eight bytes of serial data.
4. The system enters a normal incremental operation state about 400 ms after the last serial data is received.



- Serial data: Indicates how many turns the motor shaft has made from the reference position (position specified at setup).
- Initial incremental pulse: Outputs pulses at the same pulse rate as when the motor shaft rotates from the origin to the current position at about 1250 min^{-1} (for 17 bits when the dividing pulse is at the factory setting)



Final absolute data P_M is calculated by following formula.

$$P_E = M \times R + P_O$$
$$P_M = P_E - P_S$$

Use the following for reverse rotation mode (Pn000.0 = 1).

$$P_E = -M \times R + P_O$$
$$P_M = P_E - P_S$$

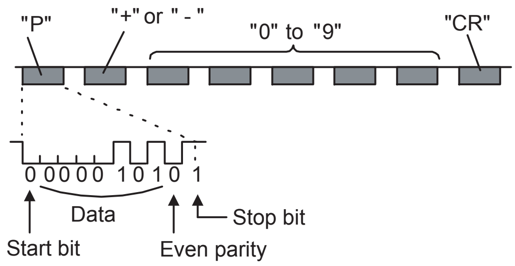
P_E	Current value read by encoder
M	Multiturn data (rotation count data)
P_O	Number of initial incremental pulses
P_S	Absolute data read at setup (This is saved and controlled by the host controller.) $P_S = M_S \times R + P_S'$
M_s	Multiturn data read at setup
P_S'	Number of initial incremental pulses read at setup
P_M	Current value required for the user's system.
R	Number of pulses per encoder revolution (pulse count after dividing, value of Pn212)

(3) Detailed Signal Specifications

(a) PAO Serial Data Specifications

The number of revolutions is output in five digits.

Data Transfer Method	Start-stop Synchronization (ASYNC)
Baud rate	9600 bps
Start bits	1 bit
Stop bits	1 bit
Parity	Even
Character coder	ASCII 7-bit coder
Data format	8 characters, as shown below.

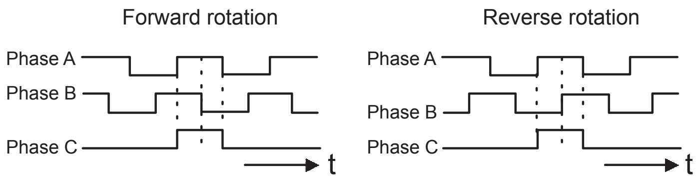


Note: 1. Data is “P+00000” (CR) or “P-00000” (CR) when the number of revolutions is zero.
2. The revolution range is “+32767” to “-32768.” When this range is exceeded, the data changes from “+32767” to “-32678” or from “-32678” to “+32767.” When changing multiturn limit, the range changes. For details, refer to *8.4.7 Multiturn Limit Setting*.

(b) Incremental Pulses and Origin Pulses

Just as with normal incremental pulses, initial incremental pulses which provide absolute data are first divided by the frequency divider inside the SERVOPACK and then output.

For details, refer to *8.5.7 Encoder Signal Output*.



Operation

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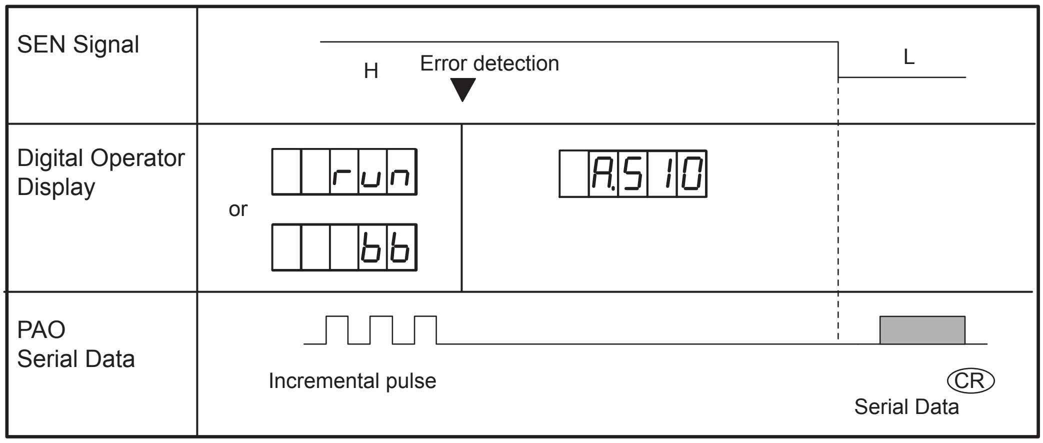
(4) Transferring Alarm Contents

When an absolute encoder is used, SEN signals can be utilized to transfer the alarm contents from PAO outputs to the host device as serial data. For the list of alarm contents, refer to *11.1.1 Alarm Display Table*.

Alarm Contents Output Example



8.4.7 Multiturn Limit Setting

⚠ WARNING

- The multiturn limit value must be changed only for special applications. Changing it inappropriately or unintentionally can be dangerous.
- If the Multiturn Limit Disagreement alarm (A.CC0) occurs, check the setting of parameter Pn205 to be sure that it is correct.
  If Fn013 is executed when an incorrect value is set in Pn205, an incorrect value will be set in the encoder. The alarm will disappear even if an incorrect value is set, but incorrect positions will be detected, resulting a dangerous situation where the machine will move to unexpected positions and machine break and personal accident will occur.

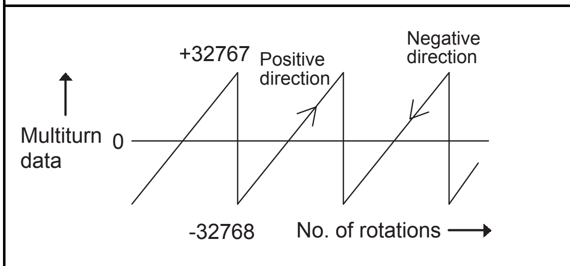
The parameter for the multiturn limit setting sets the upper limit for the multiturn data from the encoder into Pn002 = n□0□□ when using an absolute encoder. When the rotation amount exceeds this setting, the encoder rotation amount returns to 0.

Pn205	Multiturn Limit Setting	Speed	Position	Torque
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 65535	1 Rev	65535	After restart

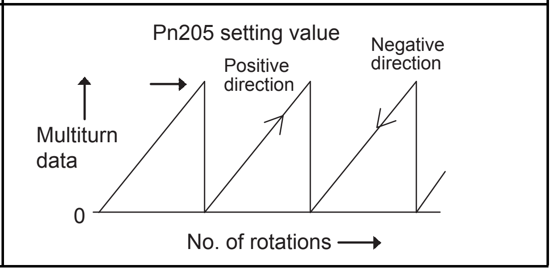
This parameter is valid when Pn002 = n□0□□ (when the absolute encoder is used).

The range of the multiturn data will vary when this parameter is set to anything other than the factory setting.

Factory Setting (=65535)



Without Factory Setting (≠65535)

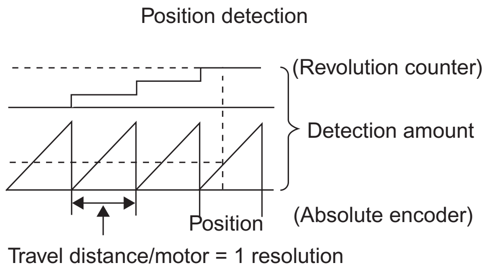


When Set to Anything Other than the Factory Setting (≠ 65535)

When the motor rotates in the reverse direction with the multiturn data at 0, the multiturn data will change to the setting of Pn205.

When the motor rotates in the forward direction with the multiturn data at the Pn205 setting, the multiturn data will change to 0.

SigmaWin, which is a tool for supporting the servo drive or a digital operator.



- Encoder Multiturn Limit Disagreement

If the Pn205 value is changed from the factory setting and the power is turned OFF then ON, an alarm will be displayed.

Alarm Display	Alarm Name	Alarm Code Outputs			Meaning
		ALO1	ALO2	ALO3	
A.CC0	Multiturn Limit Disagreement	ON (L)	OFF (H)	ON (L)	Different multiturn limits have been set in the encoder and SERVOPACK.

If this alarm is displayed, the multiturn limit value in the encoder must be changed.

8.4.8 Multiturn Limit Setting when the Multiturn Limit Disagreement alarm (A.CC0) Occurs

Use the panel operator and perform the operation described below. (This can also be done with SigmaWin+, the tool for supporting the servo drive, or digital operator.)

This operation is valid when the A.CC0 alarm occurs.

Procedure	Display after Operation	Panel Operator	Description
1	Fn000	MODE/SET (MODE/SET Key)	Press the MODE/SET Key to select the utility function mode.
2	Fn013	▲ ▼	Press the Up or Down Cursor Key to set the parameter Fn013. *The digit that can be set will blink.
3	PGSEt	DATA/◀ (DATA/SHIFT) (Press at least one sec.)	Press the DATA/SHIFT Key for at least one second. The left display will appear.
4	donE	MODE/SET (MODE/SET Key)	Press the MODE/SET Key. The multiturn limit setting in the absolute encoder will be changed. When the setting is completed, “donE” will blink for about one second.
5	PGSEt	About one second later	After “donE” is displayed, “PGSEt” will be displayed again.
6	Fn013	DATA/◀ (DATA/SHIFT) (Press at least one sec.)	Press the DATA/SHIFT Key for a minimum of one second to return to the Fn013 display of the utility function mode.
7	Turn OFF the power, and then turn it ON again to make the setting valid.		

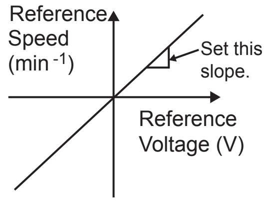
8.5 Operating Using Speed Control with Analog Reference

8.5.1 Setting Parameters

Parameter		Description
Pn000	n.□□**0**□	Control mode selection: Speed control (analog reference) (factory setting)

Pn300	Speed Reference Input Gain		Speed Position Torque	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	150 to 3000 (1.50 to 30.00 V/Rated speed)	0.01 V/Rated speed	600 (6.00 V/Rated speed)	Immediately

Sets the analog voltage level for the speed reference (V-REF) necessary to operate the servomotor at the rated speed.



■ EXAMPLE

Pn300=600 (6.00 V): 6-V input is equivalent to the rated speed of the servomotor (factory setting)

Pn300=1000 (10.00 V): 10-V input is equivalent to the rated speed of the servomotor

Pn300=200 (2.00 V): 2-V input is equivalent to the rated speed of the servomotor

8.5.2 Setting Input Signals

(1) Speed Reference Input

Input the speed reference to the SERVOPACK using the analog reference to control the servomotor speed in proportion to the input voltage.

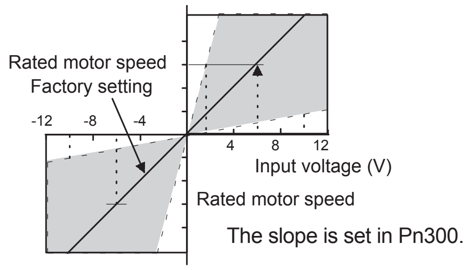
Type	Signal Name	Connector Pin Number	Name
Input	V-REF	CN1-5	Speed Reference Input
	SG	CN1-6	Signal Ground

The above inputs are used for speed control (analog reference). (Pn000.1 = 0, 4, 7, 9, or A)

Pn300 is used to set the speed reference input gain. Refer to *8.5.1 Setting Parameters*.

■ Input Specifications

- Input range: ±2 VDC to ±10 VDC/rated speed
- Maximum allowable input voltage: ±12 VDC



- Setting Example

Pn300 = 600: Rated speed at ±6 V

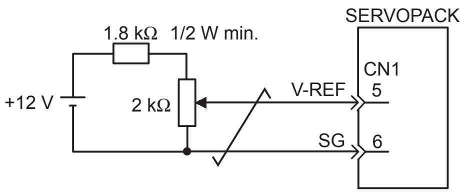
Actual examples are shown below.

Speed Reference Input	Rotation Direction	Motor Speed	SGMAS Servomotor
+6 V	Forward	Rated motor speed	3000 min^{-1}
+1 V	Forward	(1/6) rated motor speed	500 min^{-1}
-3 V	Reverse	(1/2) rated motor speed	1500 min^{-1}

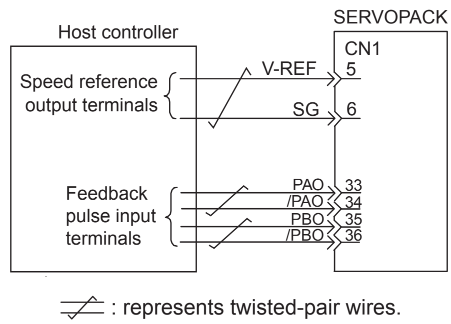
Parameter Pn300 can be used to change the voltage input range.

■ Input Circuit Example

- Always use twisted-pair cable to control noise.
- Recommended variable resistor: Model 25HP-10B manufactured by Sakae Tsushin Kogyo Co., Ltd.



Connect V-REF and SG to the speed reference output terminals on the host controller when using a host controller, such as a programmable controller, for position control.



Set the following signal and parameter according to the application.

(2) Proportional Control Reference (/P-CON)

Type	Signal Name	Connector Pin Number	Setting	Description
Input	/P-CON	CN1-41	ON (low level)	Operates the SERVOPACK with proportional control.
			OFF (high level)	Operates the SERVOPACK with proportional integral control.

This signal selects either the PI (proportional integral) or P (proportional) Speed Control Mode.

Switching to P control reduces servomotor rotation and minute vibrations due to speed reference input drift.

Input reference: At 0 V, the servomotor rotation due to drift will be reduced, but servomotor rigidity (holding force) drops when the servomotor is stopped.

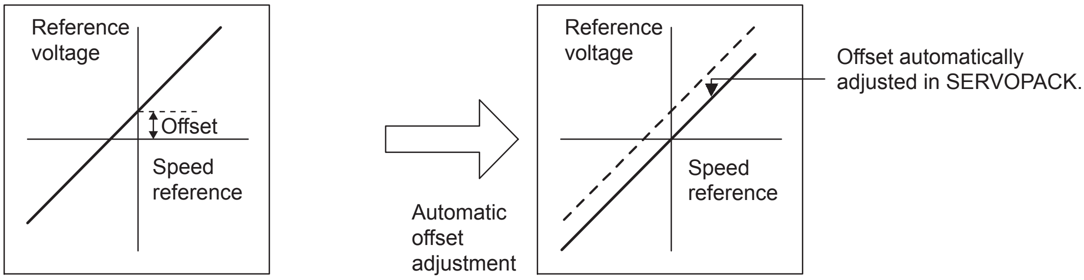
Note: A parameter can be used to reallocate the input connector number for the /P-CON signal. Refer to *7.3.2 Input Circuit Signal Allocation*.

8.5.3 Adjusting Offset

When using the speed control, the servomotor may rotate slowly even if 0 V is specified as the analog reference. This happens if the host controller or external circuit has a slight offset in the reference voltage. Adjustments can be done manually or automatically by using the panel operator or digital operator. Refer to *7.2 Operation in Utility Function Mode (Fn□□□)*.

The automatic adjustment of the analog (speed, torque) reference offset (Fn009) automatically measures the amount of the offset and adjusts the reference voltage.

If the offset occurs in the host controller or reference voltage of external circuit, SERVOPACK adjust offset automatically as follows.



After completion of the automatic adjustment, the amount of offset is stored in the SERVOPACK. The amount of offset can be checked in the speed reference offset manual servo tuning mode. There are two reference offset adjustment modes, as described next.

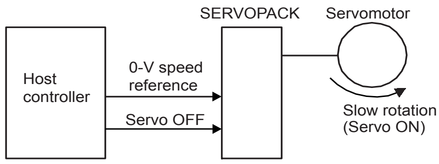
(1) Automatic Adjustment of the Speed Reference Offset

The automatic adjustment of analog (speed, torque) reference offset (Fn009) cannot be used when a position loop has been formed with a host controller. Use the speed reference offset adjustment manual mode described in the next section for a position loop.

The zero-clamp speed control function can be used to force the motor to stop while the zero speed reference is given. Refer to *8.5.6 Using the Zero Clamp Function*.

IMPORTANT	The speed reference offset must be automatically adjusted with the servo OFF.

Adjust the speed reference offset automatically using the following procedures.

Step	Display after Operation	Panel Operator	Description
1			Turn OFF the SERVOPACK, and input the 0-V reference voltage from the host controller or external circuit.
2	Fn000	MODE/SET (MODE/SET Key)	Press the MODE/SET Key to select the utility function mode.
3	Fn009	▲ ▼	Press the Up or Down Cursor Key to select parameter Fn009. *The digit that can be set will blink.
4	rEF_o	DATA/◀ (DATA/SHIFT) (Press at least one sec.)	Press the DATA/SHIFT Key for a minimum of one second. “rEF_o” will be displayed.
5	donE	MODE/SET (MODE/SET Key)	Press the MODE/SET Key. The reference offset will be automatically adjusted. When completed, “donE” will blink for about one second.
6	rEF_o	About one second later	After “donE” is displayed, “rEF_o” will be displayed again.
7	Fn009	DATA/◀ (DATA/SHIFT) (Press at least one sec.)	Press the DATA/SHIFT Key for a minimum of one second to return to the Fn009 display of the utility function mode.

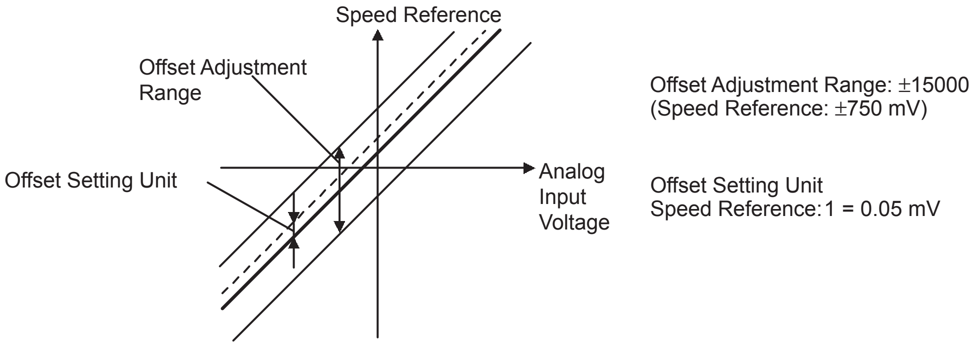
(2) Manual Servo Tuning of the Speed Reference Offset

Use the speed reference offset manual servo tuning (Fn00A) in the following situations:

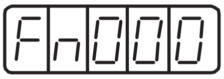
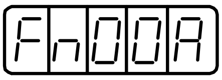
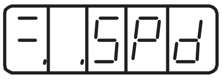
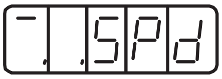
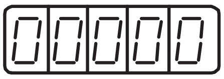
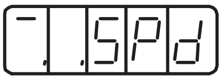
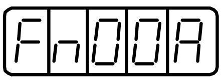
- If a loop is formed with the host controller and the error is zeroed when servolock is stopped.
- To deliberately set the offset to some value.
- To check the offset data set in the speed reference offset automatic adjustment mode.

This function operates in the same way as the reference offset automatic adjustment mode (Fn009), but the manual servo tuning (Fn 00A), adjust inputting the amount of offset.

The offset setting range and setting units are as follows:



Adjust the speed reference offset using following procedures.

Step	Display after Operation	Panel Operator	Description
1		MODE/SET (MODE/SET Key)	Press the MODE/SET Key to select the utility function mode.
2		▲ ▼	Press the Up or Down Cursor Key to select parameter Fn00A. *The digit that can be set will blink.
3		DATA/◀ (DATA/SHIFT) (Press at least one sec.)	Press the DATA/SHIFT Key for a minimum of one second. The display will be as shown at the left. The manual servo tuning mode for the speed reference offset will be entered.
4		Servo ON	Turn ON the servo ON (/S-ON) signal. The display will be as shown at the left.
5		DATA/◀ (DATA/SHIFT) (Less than one sec.)	Press the DATA/SHIFT Key for less than one second to display the speed reference offset amount.
6		▲ ▼	Press the Up or Down Cursor Key to adjust the amount of offset.
7		MODE/SET (MODE/SET Key) (Less than one sec.)	When the MODE/SET Key is pressed less than one second, the display on the left appears. Then “don E” blinks on the display, and offset amount is set. After setting, returns to the display on the left.
8		DATA/◀ (DATA/SHIFT) (Press at least one sec.)	Press the DATA/SHIFT Key for a minimum of one second to return to the Fn00A display of the utility function mode.

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8.5.4 Soft Start

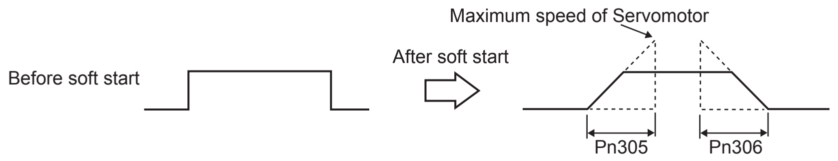
The soft start function converts the stepwise speed reference inside the SERVOPACK to a consistent rate of acceleration and deceleration.

Pn305	Soft Start Acceleration Time		Speed	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 10000	1 ms	0	Immediately
Pn306	Soft Start Deceleration Time		Speed	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 10000	1 ms	0	Immediately

The soft start function enables smooth speed control when inputting a stepwise speed reference or when selecting internally set speeds. Set both Pn305 and Pn306 to “0” for normal speed control.

Set these parameters as follows:

- Pn305: The time interval from the time the motor starts until the motor maximum speed is reached.
- Pn306: The time interval from the time the motor is operating at the motor maximum speed until it stops.



8.5.5 Speed Reference Filter

Pn307	Speed Reference Filter Time Constant		Speed	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 65535 (0.00 to 655.35 ms)	0.01 ms	40 (0.40 ms)	Immediately

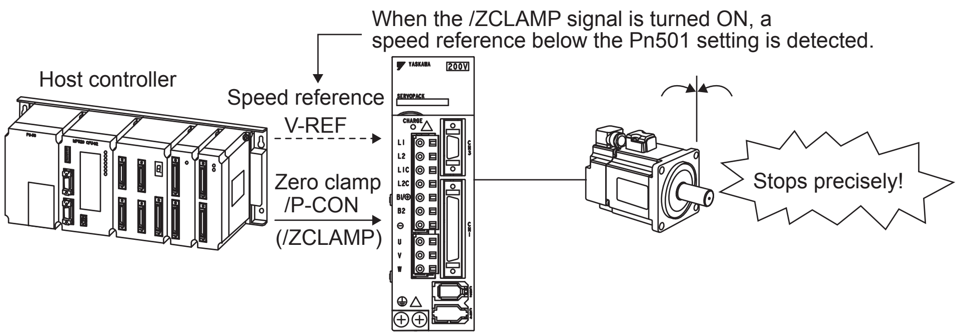
This smoothens the speed reference by applying a 1st-order delay filter to the analog speed reference (V-REF) input. A value that is too large, however, will slow down response.

8.5.6 Using the Zero Clamp Function

(1) Zero Clamp Function

The zero clamp function is used for systems where the host controller does not form a position loop for the speed reference input. When the zero clamp signal (/ZCLAMP) is ON, a position loop is formed inside the SERVOPACK as soon as the input voltage of the speed reference (V-REF) drops below the motor speed level that is set at Pn501 (Zero Clamp Level). The servomotor ignores the speed reference and then quickly stops and locks.

The servomotor is clamped within one pulse of when the zero clamp function is turned ON, and will still return to the zero clamp position even if it is forcibly rotated by external force.



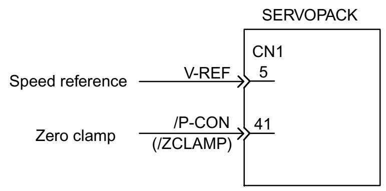
(2) Parameter Setting

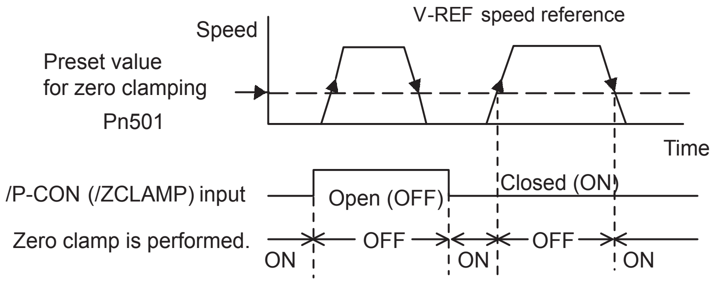
Parameter		Meaning
Pn000	n.□□A□	Control mode selection: Speed control (analog reference) ⇔ Zero clamp

Zero Clamp Conditions

Zero clamp is performed when Pn000 = n.□□A□ is set, and the following two conditions are satisfied:

- /P-CON (/ZCLAMP) is ON (low level).
- Speed reference (V-REF) drops below the setting of Pn501.





Pn501	Zero Clamp Level			Speed
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 10000	1 min^{-1}	10	Immediately

Sets the motor speed at which the zero clamp is performed if zero clamp speed control (Pn000 = n.□□A□) is selected. The maximum speed of the servomotor is set to above Pn501, the maximum speed will be used.

(3) Input Signal Setting

Type	Signal Name	Connector Pin Number	Setting	Meaning
Input	/P-CON	CN1-41	ON (low level)	Zero clamp function ON (enabled)
			OFF (high level)	Zero clamp function OFF (disabled)
	/ZCLAMP	Must be allocated	ON (low level)	Zero clamp function ON (enabled)
			OFF (high level)	Zero clamp function OFF (disabled)

This is the input signal for the zero clamp operation.

Either /P-CON or /ZCLAMP can be used to switch the zero clamp.

To use the /ZCLAMP signal, an input signal must be allocated. Refer to *7.3.2 Input Circuit Signal Allocation* for more details.

■ IMPORTANT

When the /ZCLAMP signal is allocated, the zero clamp operation will be used even for speed control Pn000 = n.□□0□.

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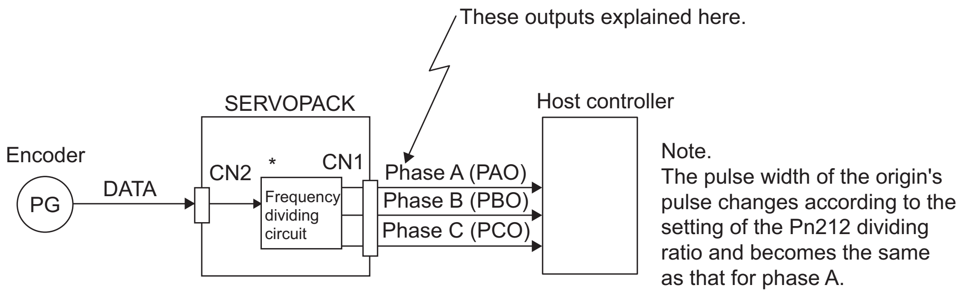
8.5.7 Encoder Signal Output

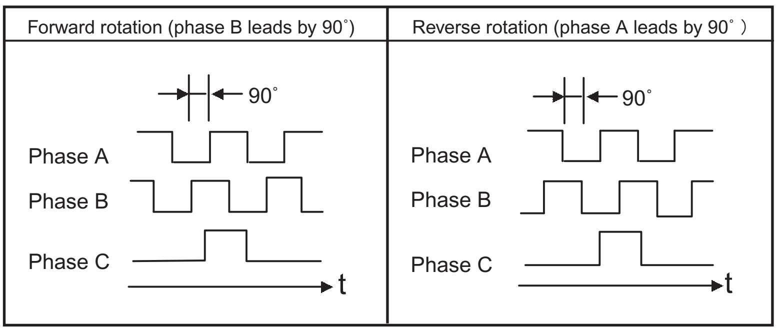
Encoder feedback pulses processed inside the SERVOPACK can be output externally.

Type	Signal Name	Connector Pin Number	Name
Output	PAO	CN1-33	Encoder output phase A
	/PAO	CN1-34	Encoder output phase /A
Output	PBO	CN1-35	Encoder output phase B
	/PBO	CN1-36	Encoder output phase /B
Output	PCO	CN1-19	Encoder output phase C (origin pulse)
	/PCO	CN1-20	Encoder output phase /C (origin pulse)



* Even in reverse rotation mode (Pn000.0 = 1), the output phase form is the same as that for the standard setting (Pn000.0 = 0).

■ Output Phase Form



The following signals are added when using an absolute encoder.

Type	Signal Name	Connector Pin Number	Name
Input	SEN	CN1-4	SEN Signal Input
	SG	CN1-2	Signal Ground
	BAT (+)	CN1-21	Battery (+)
	BAT (-)	CN1-22	Battery (-)
Output	SG*	CN1-1	Signal Ground

* SG (CN1-1, 2): Connect to 0 V on the host controller.

IMPORTANT

If using the SERVOPACK's phase-C pulse output for a zero point return, rotate the servomotor twice before starting a zero point return. If the configuration prevents the servomotor from returning to the zero point, perform a zero point return at a motor speed of 600 min^{-1} or below. If the motor speed is faster than 600 min^{-1}, the phase-C pulse output may not be output correctly.

- Pulse Dividing Ratio Setting

Pn212	PG Dividing Pulse Setting		Speed Position Torque	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	16 to 1073741824(2^{30})	1 P/Rev	2048	After restart

Set the number of pulses for PG output signals (PAO, /PAO, PBO, /PBO) externally output.

Feedback pulses from the encoder per revolution are divided inside the SERVOPACK by the number set in this parameter before being output. (Set according to the system specifications of the machine or host controller.)

The setting range varies with the encoder resolution for the servomotor used. The upper limit of the dividing pulse frequency the SERVOPACK can output is 1.6 Mpps. The servomotor speed is limited by the setting value of the number of the output pulse for Pn212 as shown in the following table.

For the servomotors with 17-bit (the number of encoder pulses 32768 P/Rev) encoder resolution or more, set the PG dividing pulse (Pn212) by the following setting unit.

Applied Encoder Resolution	PG Dividing Pulse Setting (Pn212) (P/Rev)	Pn212 Setting Unit	Upper Limit of Servomotor Speed (min^{-1})
13-bit or more	16 to 2048	1 pulse	6000
17-bit or more	16 to 16384	1 pulse	6000
	16386 to 32768	2 pulses	3000
18-bit or more	32772 to 65536	4 pulses	1500
19-bit or more	65544 to 131072	8 pulses	750
20-bit	131088 to 262144	16 pulses	375

A parameter setting error alarm (A.041) will occur if the setting is outside the allowable range or does not satisfy the setting conditions. An overspeed alarm (A.511) will occur if the rotational speed for the motor is excessively high.

■ Setting Example

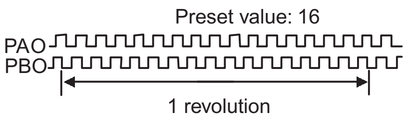
For the 17-bit resolution encoder,

Pn212=25000 (P/Rev) is accepted, but

Pn212=25001 (P/Rev) is not accepted. The alarm A.041 is output.

■ Setting Example

Pn212 = 16 (16-pulse output per one revolution)



8.5.8 Speed Coincidence Output

The speed coincidence (/V-CMP) output signal is output when the actual servomotor speed during speed control is the same as the speed reference input. The host controller uses the signal as an interlock.

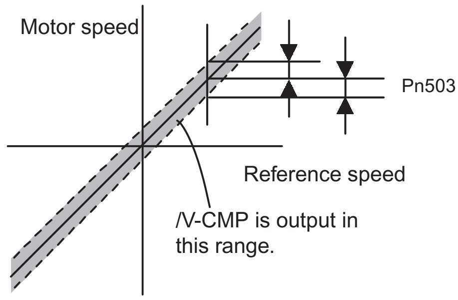
Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/V-CMP	CN1-25, 26 (Factory setting)	ON (low level)	Speed coincides.
			OFF (high level)	Speed does not coincide.
This output signal can be allocated to another output terminal with parameter Pn50E. Refer to *7.3.3 Output Circuit Signal Allocation* for details.				

Pn503	Speed Coincidence Signal Output Width $\boxed{\text{Speed}}$			
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 100	1 min^{-1}	10	Immediately

The /V-CMP signal is output when the difference between the speed reference and actual motor speed is below this setting.

■ EXAMPLE

The /V-CMP signal turns ON at 1900 to 2100 min^{-1} if the Pn503 parameter is set to 100 and the reference speed is 2000 min^{-1}



/V-CMP is a speed control output signal. With the factory setting without mapping output terminal in Pn50E, this signal is automatically used as the positioning completed signal /COIN for position control, and it is always OFF (high level) for torque control.

8.6 Operating Using Position Control

8.6.1 Setting Parameters

Set the following parameters for position control using pulse trains.

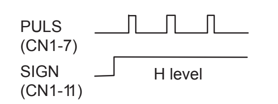
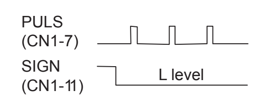
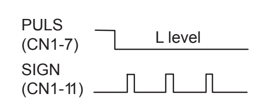
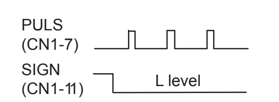
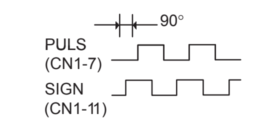
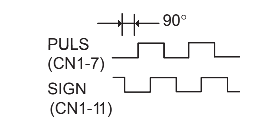
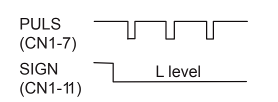
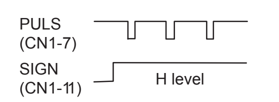
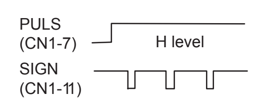
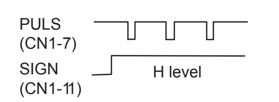
(1) Control Mode Selection

Parameter		Meaning
Pn000	n.□□1□	Control mode selection: Position control (pulse train reference)

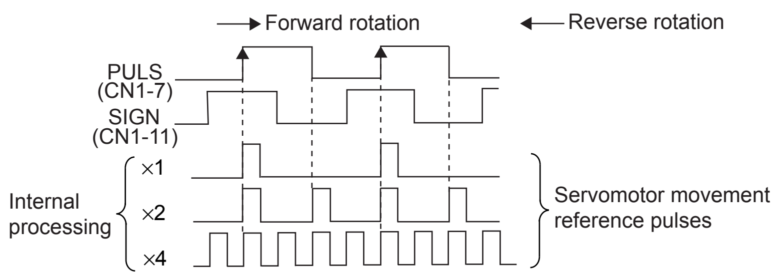
(2) Setting a Reference Pulse Form

Type	Signal Name	Connector Pin Number	Name
Input	PULS	CN1-7	Reference Pulse Input
	/PULS	CN1-8	Reference Pulse Input
	SIGN	CN1-11	Reference Code Input
	/SIGN	CN1-12	Reference Code Input

Set the input form for the SERVOPACK using parameter Pn200.0 according to the host controller specifications.

Parameter		Reference Pulse Form	Input Pulse Multiplier	Forward Rotation Reference	Reverse Rotation Reference
Pn200	n.□□□0	Sign + pulse train (Positive logic) (Factory setting)	–		
	n.□□□1	CW pulse + CCW pulse (Positive logic)	–		
	n.□□□2	Two-phase pulse train with 90° phase differential	×1		
	n.□□□3		×2		
	n.□□□4		×4		
	n.□□□5	Sign + pulse train (negative logic)	–		
	n.□□□6	CW pulse + CCW pulse (negative logic)	–		

The input pulse multiplier can be set for the 2-phase pulse train with 90° phase differential reference pulse form.



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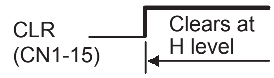
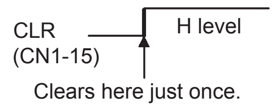
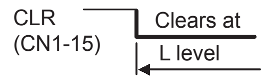
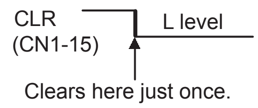
(3) Clear Signal Form Selection

Type	Signal Name	Connector Pin Number	Name
Input	CLR	CN1-15	Clear Input
	/CLR	CN1-14	Clear Input

The internal processing of the SERVOPACK for the clear signal can be set to either of four types by parameter Pn200.1. Select according to the specifications of the machine or host controller.

Parameter		Description	Timing
Pn200	n.□□0□	Clears at high level. Position error pulses do not accumulate while the signal is at high level. (Factory setting)	
	n.□□1□	Clears at the rising edge.	
	n.□□2□	Clears at low level. Position error pulses do not accumulate while the signal is at low level.	
	n.□□3□	Clears at the falling edge.	
The following are executed when the clear operation is enabled. • The SERVOPACK error counter is set to 0. • Position loop operation is disabled. ⇒ Holding the clear status may cause the servo clamp to stop functioning and the servomotor to rotate slowly due to drift in the speed loop. When the clear signal (CLR) is not wired, the signal is always at low level and the error pulse is not cleared.			

(4) Clear Operation Selection

This parameter determines when the error pulse should be cleared according to the condition of the SERVOPACK, in addition to the clearing operation of the clear signal (CLR). Either of three clearing modes can be selected with Pn200.2

Parameter		Description
Pn200	n.□0□□	Clear the error pulse during the baseblock (at the Servo OFF and alarm occurred). (Factory setting)
	n.□1□□	Do not clear the error pulse. Clear only with the /CLR signal.
	n.□2□□	Clear the error pulse when an alarm occurs.

8.6.2 Setting the Electronic Gear

(1) Number of Encoder Pulses

SGM□□-□□□□□□□ (Servomotor serial number)

Serial Encoder Specifications								
Symbol	Specification	SGMMJ	SGMAS	SGMPS	SGMSS	SGMGH	SGMCS	Number of Encoder Pulses (P/R)
A	13-bit incremental	Standard	–	–	–	–	–	2048
2	17-bit absolute	Standard	Standard	Standard	Standard	Standard		32768
C	17-bit incremental	–						
3	20-bit absolute (without multi-turn data)	–					Standard	262144
D	20-bit incremental							

Note: For details on reading servomotor model numbers, refer to *2.1 Servomotor Model Designations*.

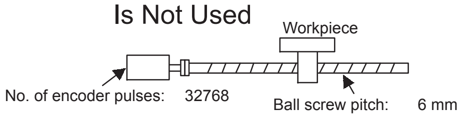
INFO

The number of bits representing the resolution of the applicable encoder is not the same as the number of encoder signal pulses (phase A and B). The number of bits representing the resolution is equal to the number of encoder pulses × 4 (multiplier).

(2) Electronic Gear

The electronic gear enables the workpiece travel distance per input reference pulse from the host controller to be set to any value. One reference pulse from the host controller, i.e., the minimum position data unit, is called a reference unit.

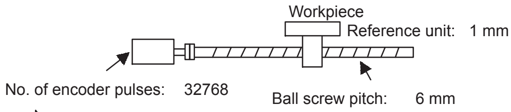
When the Electronic Gear Is Not Used



To move a workpiece 10 mm:

1 revolution is 6 mm. Therefore,
10 ÷ 6 = 1.6666 revolutions
32768 × 4 pulses is 1 revolution. Therefore,
1.6666 × 32768 × 4 = 218445 pulses
218445 pulses are input as reference pulses.
The equation must be calculated at the host controller.

When the Electronic Gear Is Used



To move a workpiece 10 mm using reference units:

The reference unit is 1 μm. Therefore,
to move the workpiece 10 mm (10000 μm),
1 pulse = 1 μm, so
10000/1=10000 pulses.
Input 10000 pulses as reference pulses.

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(3) Related Parameters

Pn20E	Electronic Gear Ratio (Numerator)			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 1073741824 (2^{30})	–	4	After restart
Pn210	Electronic Gear Ratio (Denominator)			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 1073741824 (2^{30})	–	1	After restart

If the deceleration ratio of the motor and the load shaft is given as n/m where m is the rotation of the motor and n is the rotation of the load shaft,

$$\text{Electronic gear ratio: } \frac{B}{A} = \frac{\text{Pn20E}}{\text{Pn210}} = \frac{\text{No. of encoder pulses} \times 4}{\text{Travel distance per load shaft revolution (reference units)}} \times \frac{m}{n}$$

* If the ratio is outside the setting range, reduce the fraction (both numerator and denominator) until you obtain integers within the range. Be careful not to change the electronic gear ratio (B/A).

■ IMPORTANT

Electronic gear ratio setting range: $0.001 \leq$ Electronic gear ratio (B/A) ≤ 1000

If the electronic gear ratio is outside this range, a parameter setting error (A.040) will be output, and the SERVOPACK will not operate properly. In this case, modify the load configuration or reference unit.

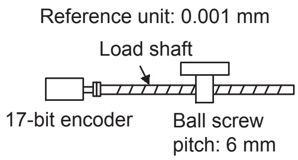
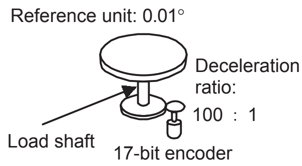
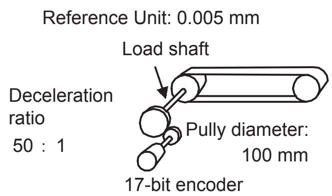
(4) Procedure for Setting the Electronic Gear Ratio

Use the following procedure to set the electronic gear ratio.

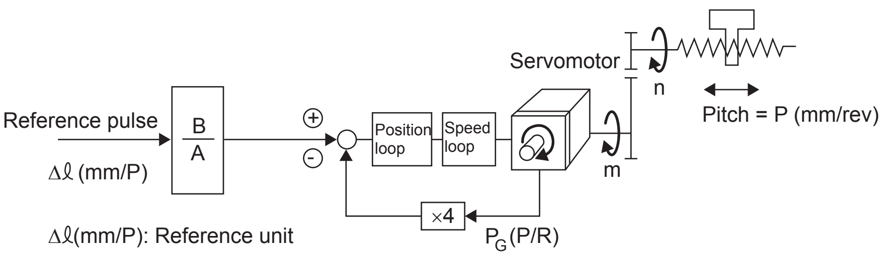
Step	Operation	Description
1	Check machine specifications.	Check the deceleration ratio, ball screw pitch, and pulley diameter.
2	Check the number of encoder pulses.	Check the number of encoder pulses for the servomotor used.
3	Determine the reference unit used.	Determine the reference unit from the host controller, considering the machine specifications and positioning accuracy.
4	Calculate the travel distance per load shaft revolution.	Calculate the number of reference units necessary to turn the load shaft one revolution based on the previously determined reference units.
5	Calculate the electronic gear ratio.	Use the electronic gear ratio equation to calculate the ratio (B/A).
6	Set parameters.	Set parameters using the calculated values.

(5) Electronic Gear Ratio Setting Examples

The following examples show electronic gear ratio settings for different load configurations.

Step	Operation	Load Configuration: Ball Screw	Load Configuration: Disc Table	Load Configuration: Belt and Pulley
				
1	Check machine specifications.	· Ball screw pitch: 6 mm · Deceleration ratio: 1/1	Rotation angle per revolution: 360° Deceleration ratio: 100/1	Pulley diameter: 100 mm (pulley circumference: 314 mm) · Deceleration ratio: 50/1
2	Check the number of encoder pulses.	17-bit: 32768 P/R	17-bit: 32768 P/R	17-bit: 32768 P/R
3	Determine the reference unit used.	Reference unit: 0.001 mm (1 μm)	Reference unit: 0.01°	Reference unit: 0.005 mm (5 μm)
4	Calculate the travel distance per load shaft revolution.	6 mm/0.001 mm=6000	360°/0.01°=36000	314 mm/0.005 mm=62800
5	Calculate the electronic gear ratio.	$\frac{B}{A}=\frac{32768\times4}{6000}\times\frac{1}{1}$	$\frac{B}{A}=\frac{32768\times4}{36000}\times\frac{100}{1}$	$\frac{B}{A}=\frac{32768\times4}{62800}\times\frac{50}{1}$
6	Set parameters.	Pn20E: 131072 Pn210: 6000	Pn20E: 13107200 Pn210: 36000	Pn20E: 6553600 Pn210: 62800

(6) Electronic Gear Ratio Equation



Δℓ(mm/P): Reference unit
P_G (P/R): Encoder pulses
P (mm/rev): Ball screw pitch
$\frac{m}{n}$: Deceleration ratio

$$\frac{n\times P}{\Delta\ell}\times\left(\frac{B}{A}\right)=4\times P_G\times m$$

$$\left(\frac{B}{A}\right)=\frac{4\times P_G\times m\times\Delta\ell}{n\times P}=\frac{4\times P_G}{\frac{P}{\Delta\ell}}\times\frac{m}{n}$$

Set A and B with the following parameters.

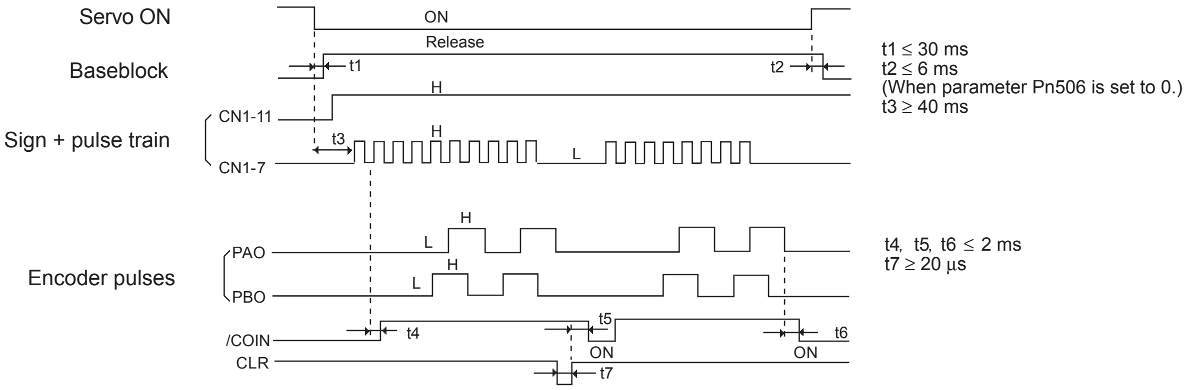
$\boxed{A}$: Pn210 $\boxed{B}$: Pn20E

8.6.3 Position Reference

The servomotor positioning is controlled by inputting a pulse train reference.

Line-driver output can be used as the pulse train output form from the host controller.

(1) Input/Output Signal Timing Example



Note: 1. The interval from the time the servo ON signal is turned ON until a reference pulse is input must be at least 40 ms, otherwise the reference pulse may not be received by the SERVOPACK.

2. The error counter clear signal must be ON for at least 20 µs.

(2) Reference Pulse Input Signal Timing

The reference pulse input signal timing differs from that when using a regular control or a less deviation control. Refer to Table 8.3 and Table 8.4 when using a regular control and a less deviation control.

Table 8.3 Reference Pulse Input Signal Timing (When using a regular control)

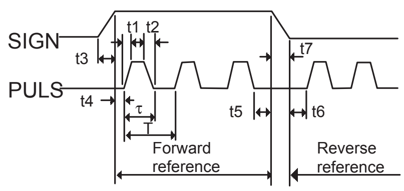
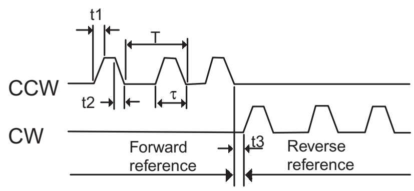
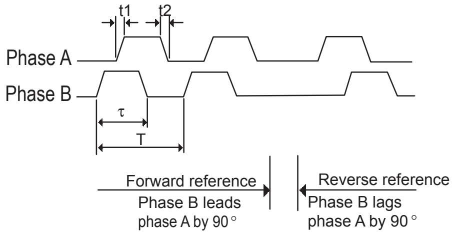
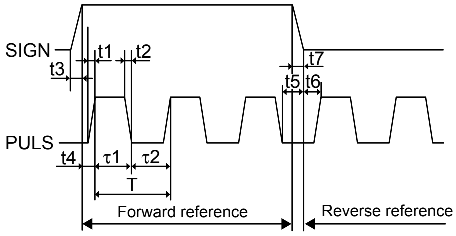
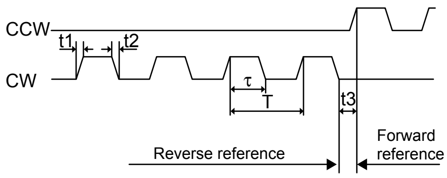
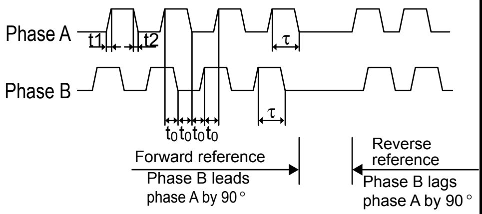
Reference Pulse Form	Electrical Specifications		Remarks
Sign and pulse train input (SIGN and PULS signal) Maximum reference frequency: 1 Mpps		t1, t2 ≤ 0.1 ms t3, t7 ≤ 0.1 ms t4, t5, t6 > 0.5 ms t ≥ 0.5 ms (τ/T) × 100 ≤ 50%	Sign (SIGN) H = Forward reference L = Reverse reference
CW pulse and CCW pulse Maximum reference frequency: 1 Mpps		t1, t2 ≤ 0.1 ms t3 > 0.5 ms τ ≥ 0.5 ms (τ/T) × 100 ≤ 50%	−
Two-phase pulse train with 90° phase differential (phase A and phase B) Maximum reference frequency ×1 input pulse multiplier: 1 Mpps ×2 input pulse multiplier: 1 Mpps ×4 input pulse multiplier: 1 Mpps		t1, t2 ≤ 0.1 ms τ ≥ 0.5 ms (τ/T) × 100 = 50%	Switching of the input pulse multiplier mode is done with parameter Pn200.0 setting.

Table 8.4 Reference Pulse Input Signal Timing (When using a less deviation control)

<table>
<tr><th>Reference Pulse Form</th><th>Electrical Specifications</th><th colspan="2">Conditions</th><th>Remarks</th></tr>
<tr><td rowspan="5">Sign and pulse train input (SIGN and PULS signal)
Maximum reference frequency:
1 Mpps</td><td rowspan="5">
</td><td>t1, t2, t3, t7</td><td>≤ 0.1µs</td><td>–</td></tr>
<tr><td>t4, t5, t6</td><td>> 0.5µs</td><td>–</td></tr>
<tr><td>τ1, τ2</td><td>> 1.1µs</td><td>–</td></tr>
<tr><td rowspan="2">T</td><td>> 2.2µs</td><td>When sending the reference at a constant frequency.
(Maximum reference frequency: 416kpps)</td></tr>
<tr><td>> 1.5µs</td><td>When sending the reference at a reference pulse with the acceleration/deceleration frequency.
(Maximum reference frequency: 667kpps)</td></tr>
<tr><td rowspan="5">CW pulse and CCW pulse
Maximum reference frequency:
1 Mpps</td><td rowspan="5">
</td><td>t1, t2</td><td>≤ 0.1µs</td><td>–</td></tr>
<tr><td>t3</td><td>> 0.5µs</td><td>–</td></tr>
<tr><td>τ</td><td>> 1.1µs</td><td>–</td></tr>
<tr><td rowspan="2">T</td><td>> 2.2µs</td><td>When sending the reference at a constant frequency.
(Maximum reference frequency: 416kpps)</td></tr>
<tr><td>> 1.5µs</td><td>When sending the reference at a reference pulse with the acceleration/deceleration frequency.
(Maximum reference frequency: 667kpps)</td></tr>
<tr><td rowspan="5">Two-phase pulse train with 90° phase differential (phase A and phase B)
Maximum reference frequency
×1 input pulse multiplier: 1 Mpps
×2 input pulse multiplier: 1 Mpps
×4 input pulse multiplier: 1 Mpps</td><td rowspan="5">
</td><td>t1, t2</td><td>≤ 0.1µs</td><td>–</td></tr>
<tr><td rowspan="2">τ</td><td>> 1.1µs</td><td>When sending the reference at a constant frequency.
(Maximum reference frequency: 416kpps)</td></tr>
<tr><td>> 0.5µs</td><td>When sending the reference at a reference pulse with the acceleration/deceleration frequency.
(Maximum reference frequency: 1Mpps)</td></tr>
<tr><td rowspan="2">t0</td><td>> 0.4µs</td><td>When sending the reference at a constant frequency.
(Maximum reference frequency: 416kpps)</td></tr>
<tr><td>> 0.2µs</td><td>When sending the reference at a reference pulse with the acceleration/deceleration frequency.
(Maximum reference frequency: 1Mpps)</td></tr>
</table>

Operation

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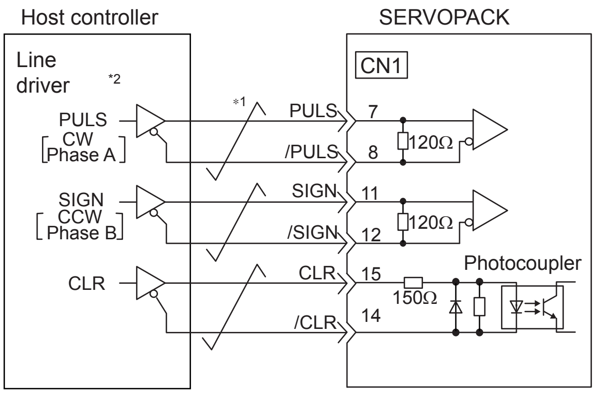
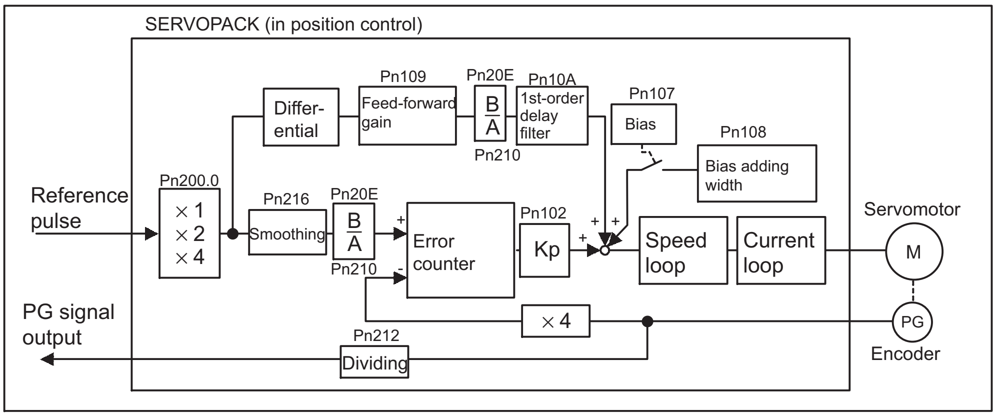
(3) Connection Example: Line-driver Output

Applicable line driver: SN75174 manufactured by Texas Instruments Inc., or MC3487 or equivalent



* 1. : Represents twisted-pair wires.
* 2. A line-driver output is the only pulse train output reference form from the host controller that can be received by the SERVOPACK.

A block diagram for position control is shown below.



8.6.4 Smoothing

A filter can be applied in the SERVOPACK to a constant-frequency reference pulse.

(1) Selecting a Position Reference Filter

Parameter		Description
Pn207	n.□□□**0**	Acceleration/deceleration filter
	n.□□□**1**	Average movement filter

* After resetting the parameter, turn OFF the power once and turn it ON again.

(2) Filter-related Parameters

Pn216	Position Reference Acceleration/Deceleration Time Constant			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 65535 (0.0 to 6553.5 ms)	0.1 ms	0 (0.0 ms)	Immediately
Pn209	Position Reference Acceleration/Deceleration Bias			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 65535	1 Reference units/s	0	Immediately
Pn217	Average Movement Time of Position Reference			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 10000 (0.0 to 1000.0 ms)	0.1 ms	0 (0.0 ms)	Immediately

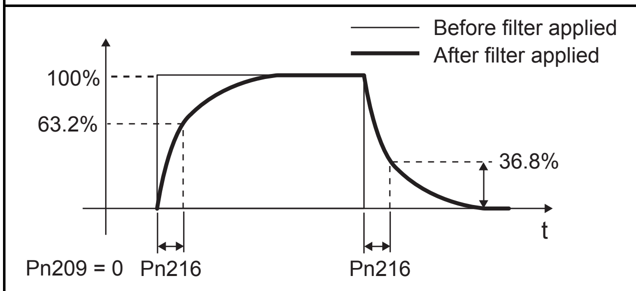
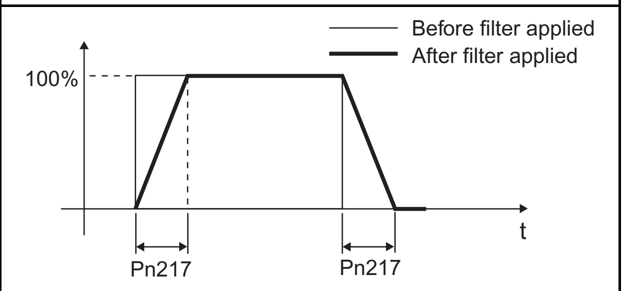
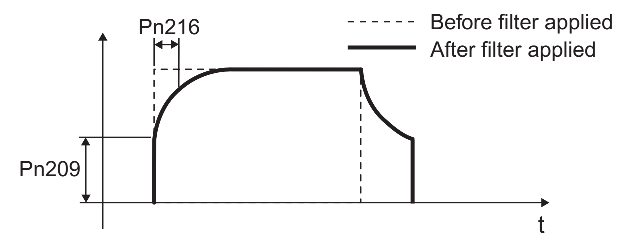
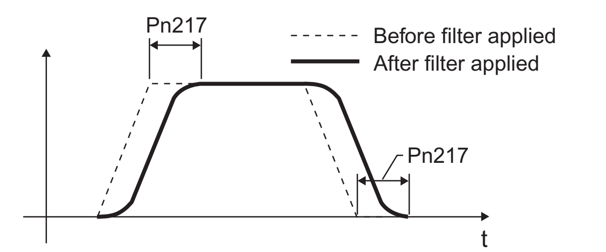
■ IMPORTANT

When the position reference acceleration/deceleration time constant (Pn216) is changed, a value with no reference pulse input and a position error of 0 will be enabled. To ensure that the setting value is correctly reflected, stop the reference pulse from the host controller and input the clear signal (/CLR), or turn the servo OFF to clear the error.

This function provides smooth servomotor operating in the following cases. The function does not affect the travel distance (i.e., the number of pulses).

- When the host controller that outputs a reference cannot perform acceleration/deceleration processing.
- When the reference pulse frequency is too low.
- When the reference electronic gear ratio is too high (i.e., 10x or more).

The difference between the position reference acceleration/deceleration time constant (Pn216) and the position reference movement averaging time (Pn217) is shown below.

Acceleration/Deceleration Filter	Average Movement Time Filter
Pn207=n.□□□0	Pn207=n.□□□1
 Response waveform for stepwise input	 Response waveform for stepwise input
 Using position reference acceleration/ deceleration bias	 Response waveform for ramp reference input

Operation

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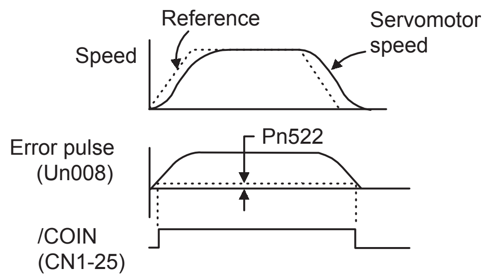
8.6.5 Positioning Completed Output Signal

This signal indicates that servomotor movement has been completed during position control. Use the signal as an interlock to confirm at the host controller that positioning has been completed.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/COIN	CN1-25, 26 (Factory setting)	ON (low level)	Positioning has been completed.
			OFF (high level)	Positioning is not completed.
This output signal can be allocated to an output terminal with parameter Pn50E. The factory setting is allocated to CN1-25, 26.				

Pn522	Positioning Completed Width			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 1073741824(2^{30})	1 Reference units	7	Immediately

The positioning completed (/COIN) signal is output when the difference (position error pulse) between the number of reference pulses output by the host controller and the travel distance of the servomotor is less than the value set in this parameter.



Set the number of error pulses in reference units (the number of input pulses defined using the electronic gear.)

Too large a value at this parameter may output only a small error during low-speed operation that will cause the /COIN signal to be output continuously.

If a servo gain is set that keeps the position error small even when the positioning completed width is large, use Pn207 = n.1□□□ to enable correct output timing for the COIN signal.

The positioning completed width setting has no effect on final positioning accuracy.

/COIN is a position control signal.

With the factory setting without mapping output terminal in Pn50E, this signal is used for the speed coincidence output /V-CMP for speed control, and it is always ON for torque control.

Parameter		Name	Description
Pn207	n.**0**□□□	/COIN Output Timing	When the absolute value of the position error is below the positioning completed width setting.
	n.**1**□□□		When the absolute value of the position error is below the positioning completed width setting, and the reference after applying the position reference filter is 0.

8.6.6 Positioning Near Signal

This signal indicates that the positioning of the servomotor is near to completion, and is generally used in combination with the positioning completed (/COIN) output signal.

The host controller receives the positioning near signal prior to confirming the positioning-completed signal, and performs the following operating sequence after positioning has been completed to shorten the time required for operation.

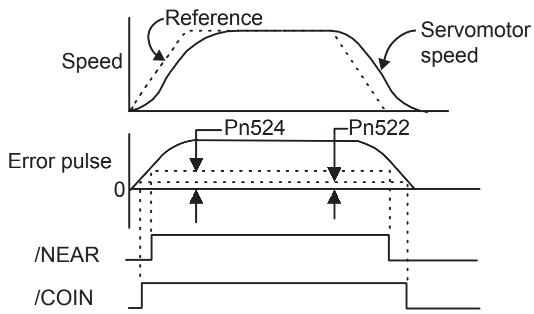
Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/NEAR	Must be allocated	ON (low level)	The servomotor has reached a point near to positioning completed.
			OFF (high level)	The servomotor has not reached a point near to positioning completed.
The output terminal must be allocated with parameter Pn510 in order to use Positioning Near signal. Refer to *7.3.3 Output Circuit Signal Allocation* for details.				

Pn524	NEAR Signal Width			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 1073741824(2^{30})	1 Reference units	1073741824	Immediately

The positioning near (/NEAR) signal is output when the difference (error) between the number of reference pulses output by the host controller and the travel distance of the servomotor is less than the value set in this parameter.

Set the number of error pulses in reference units (the number of input pulses defined using the electronic gear.)

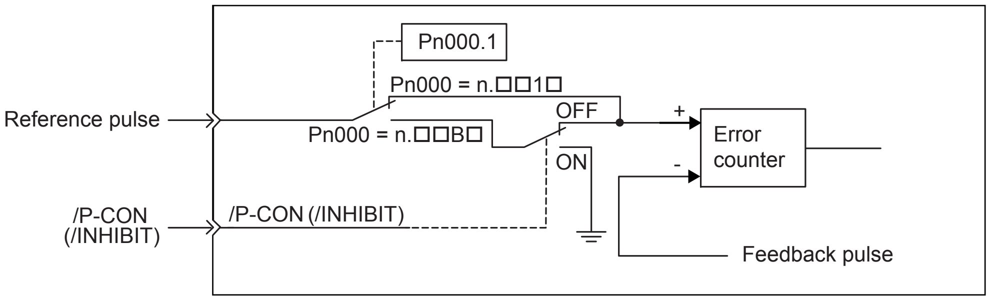
Normally, the setting should be larger than that for the positioning completed width (Pn522).



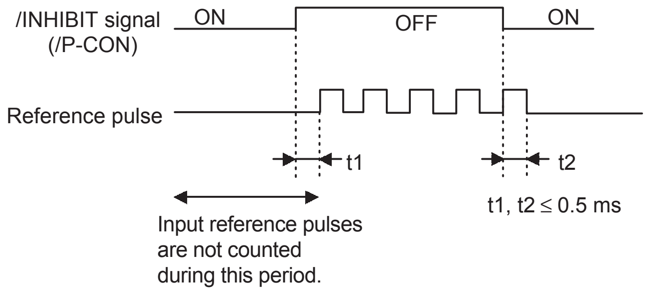
8.6.7 Reference Pulse Inhibit Function (INHIBIT)

(1) Description

This function inhibits the SERVOPACK from counting input pulses during position control. The servomotor remains locked (clamped) while pulse are inhibited.



(2) Setting Parameters

Parameter		Meaning
Pn000	n.□□B□	Control mode selection: Position control (pulse train reference) ⇔ Inhibit
■ Inhibit (INHIBIT) switching condition ・/P-CON (/INHIBIT) signal ON (low level)		

(3) Setting Input Signals

Type	Signal Name	Connector Pin Number	Setting	Meaning
Input	/P-CON	CN1-41 (Factory setting)	ON (low level)	Turns the INHIBIT function ON. (Inhibits the SERVOPACK from counting reference pulses.)
			OFF (high level)	Turns the INHIBIT function OFF. (Counts reference pulses.)
(Input)	(/INHIBIT)	Must be allocated CN1-□□	ON (low level)	Turns the INHIBIT function ON. (Inhibits the SERVOPACK from counting reference pulses.)
			OFF (high level)	Turns the INHIBIT function OFF. (Counts reference pulses.)
These input signals enable the inhibit function. Either the /P-CON signal or the /INHIBIT signal can be used to switch the inhibit signal. The input signal must be allocated in order to use the /INHIBIT signal. Refer to *7.3.2 Input Circuit Signal Allocation*.				

8.7 Operating Using Torque Control

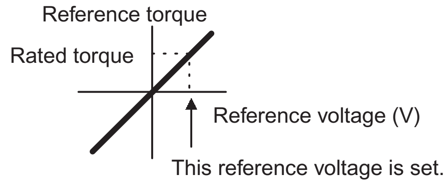
8.7.1 Setting Parameters

The following parameters must be set for torque control operation with analog voltage reference.

Parameter		Meaning
Pn000	n.□□2□	Control mode selection: Torque control (analog voltage reference)

Pn400	Torque Reference Input Gain			Speed / Position / Torque
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	10 to 100 (1.0 to 10.0V/rated torque)	0.1V/rated torque	30 (3.0V/rated torque)	Immediately

This sets the analog voltage level for the torque reference (T-REF) that is necessary to operate the servomotor at the rated torque.



■ EXAMPLE

Pn400 = 30 (3.0 V): The servomotor operates at the rated torque with 3-V input (factory setting).

Pn400 = 100 (10.0 V): The servomotor operates at the rated torque with 10-V input.

Pn400 = 20 (2.0 V): The servomotor operates at the rated torque with 2-V input.

8.7.2 Torque Reference Input

By applying a torque reference determined by the analog voltage reference to the SERVOPACK, the servomotor torque can be controlled in proportion with the input voltage.

Type	Signal Name	Connector Pin Number	Name
Input	T-REF	CN1-9	Torque Reference Input
	SG	CN1-10	Signal Ground for Torque Reference Input

Used during torque control (analog voltage reference). (Pn000.1 = 2, 6, 8, 9)

The torque reference gain is set in Pn400. For setting details, refer to *8.7.1 Setting Parameters*.

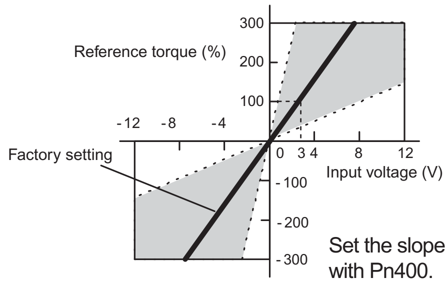
■ Input Specifications

- Input range: ±1 to ±10VDC/rated torque
- Max. allowable input voltage: ±12 VDC
- Factory setting

  Pn400 = 3.0: Rated torque at 3 V

  +3-V input: Rated torque in forward direction
  +9-V input: 300% rated torque in forward direction
  -0.3-V input: 10% rated torque in reverse direction

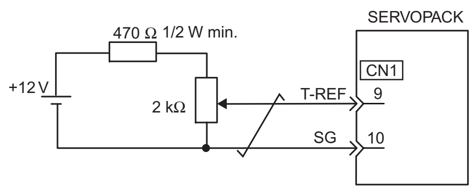
  The voltage input range can be changed with parameter Pn400.



■ Input Circuit Example

Use twisted-pair wires as a countermeasure against noise.

Variable resistor example: Model 25HP-10B manufactured by Sakae Tsushin Kogyo Co., Ltd.



INFO

■ Checking the Internal Torque Reference

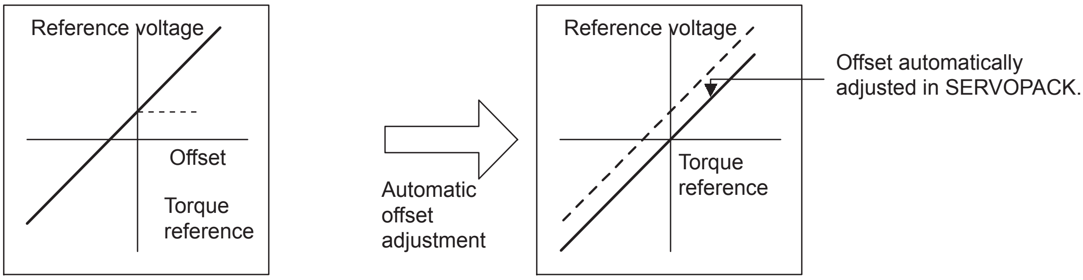
1. Checking the internal torque reference with the panel operator:
   Use the Monitor Mode (Un-002). Refer to *7.4 Operation in Monitor Mode (Un□□□)*.
2. Checking the internal torque reference with an analog monitor:
   The internal torque reference can also be checked with an analog monitor. Refer to *9.7 Analog Monitor*.

8.7.3 Adjusting the Reference Offset

When using torque control, the servomotor may rotate slowly even when 0 V is specified as the analog reference voltage. This occurs when the host controller or external circuit has a slight offset (measured in mV) in the reference voltage. In this case, the panel operator or digital operator adjusts the reference offset automatically or manually.

The automatic adjustment of analog reference offset (Fn009) automatically measures the offset and adjusts the reference voltage.

The SERVOPACK performs the following automatic adjustment when the host controller or external circuit has an offset in the reference voltage.



After completion of the automatic adjustment, the amount of offset is stored in the SERVOPACK. The amount of offset can be checked in the manual servo tuning of torque reference offset (Fn00B).

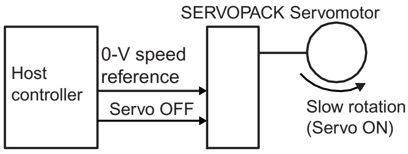
(1) Automatic Adjustment of the Torque Reference Offset

The automatic adjustment of analog reference offset (Fn009) cannot be used when a position loop has been formed with the host controller. In this case, use the manual servo tuning of torque reference offset (Fn00B).

IMPORTANT

Automatic adjustment of the analog reference offset must be performed with the servo OFF.

Use the following procedure for automatic adjustment of the torque reference offset.

Step	Display after Operation	Panel Operator	Description
1			Turn OFF the SERVOPACK, and input the 0-V reference voltage from the host controller or external circuit.
2	Fn000	MODE/SET (MODE/SET Key)	Press the MODE/SET Key to select the utility function mode.
3	Fn009	▲ ▼	Press the Up or Down Cursor Key to select parameter Fn009. *The digit that can be set will blink.
4	rEF_o	DATA/◀ (DATA/SHIFT) (Press at least one sec.)	Press the DATA/SHIFT Key for a minimum of one second. “rEF_o” will be displayed.
5	donE	MODE/SET (MODE/SET Key)	Press the MODE/SET Key. The reference offset will be automatically adjusted. When completed, “donE” will blink for about one second.
6	rEF_o	About one second later	After “donE” is displayed, “rEF_o” will be displayed again.
7	Fn009	DATA/◀ (DATA/SHIFT) (Press at least one sec.)	Press the DATA/SHIFT Key for a minimum of one second to return to the Fn009 display of the utility function mode.

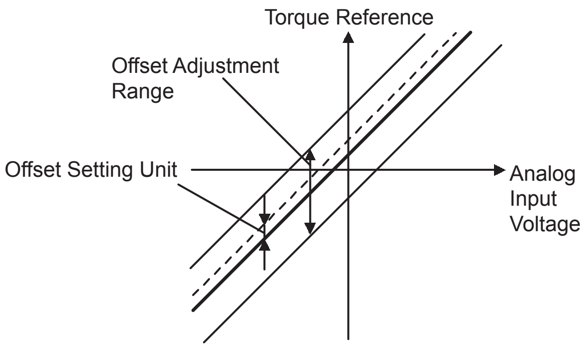
(2) Manual Servo Tuning of the Torque Reference Offset

Manual servo tuning of the torque reference offset (Fn00B) is used in the following cases.

- If a loop is formed with the host controller and the error is zeroed when servolock is stopped.
- To deliberately set the offset to some value.
- Use this mode to check the offset data that was set in the automatic adjustment mode of the torque reference offset.

This mode operates in the same way as the automatic adjustment mode (Fn009), but manual servo tuning of the torque reference (Fn00B) needs to be adjusted by inputting the amount of offset except that the amount of offset is directly input during the adjustment.

The offset adjustment range and setting units are as follows:



Offset Adjustment Range: -128 to +127
(Torque reference: -1881.6 mV to +1866.9 mV)

Offset Setting Unit
Torque reference: 1 = 14.7 mV

Operation

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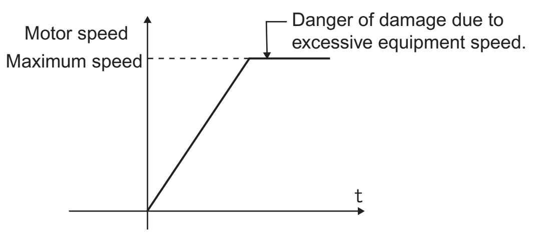
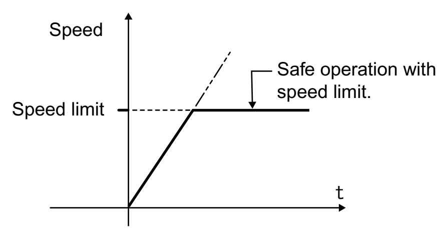
Use the following procedure to manually adjust the torque reference offset.

Step	Display after Operation	Panel Operator	Description
1	Fn000	MODE/SET (MODE/SET Key)	Press the MODE/SET Key to select the utility function mode.
2	Fn00b	▲ ▼	Press the Up or Down Cursor Key to select parameter Fn00B. *The digit that can be set will blink.
3	=. .tr9	DATA/◀ (DATA/SHIFT) (Press at least one sec.)	Press the DATA/SHIFT Key for a minimum of one second. The display will be as shown at the left. The manual servo tuning mode for the torque reference offset will be entered.
4	‾. .tr9	Servo ON	Turn ON the servo ON (/S-ON) signal. The display will be as shown at the left.
5	-0000	DATA/◀ (DATA/SHIFT) (Less than one sec.)	Press the DATA/SHIFT Key for less than one second to display the torque reference offset amount.
6		▲ ▼	Press the Up or Down Cursor Key to adjust the amount of offset.
7	‾. .tr9	DATA/◀ (DATA/SHIFT) (Less than one sec.)	Press the DATA/SHIFT Key for less than one second to return to the display shown on the left.
8	Fn00b	DATA/◀ (DATA/SHIFT) (Press at least one sec.)	Press the DATA/SHIFT Key for a minimum of one second to return to the Fn00B display of the utility function mode.

8.7.4 Speed Limit during Torque Control

During torque control, the servomotor is controlled to output the specified torque, which means that the servomotor speed is not controlled. Accordingly, when an excessive reference torque is set for the mechanical load torque, it will prevail over the mechanical load torque and the servomotor speed will greatly increase.

This function serves to limit the servomotor speed during torque control to protect the machine.

With No Speed Limit	With Speed Limit
	

(1) Speed Limit Mode Selection (Torque Limit Option)

Parameter		Description
Pn002	n.□□0□	Uses the value set in Pn407 as the speed limit (internal speed limit function).
	n.□□1□	Uses V-REF (CN1-5, 6) as an external speed limit input. Applies a speed limit using the input voltage of V-REF and the setting in Pn300 (external speed limit function).

(2) Internal Speed Limit Function

Pn407	Speed Limit During Torque Control (Torque)			
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 10000	1 min^{-1}	10000	Immediately

Sets the servomotor speed limit value during torque control.
The setting in this parameter is enabled when Pn002 = n.□□0□.
The servomotor's maximum speed will be used when the setting in this parameter exceeds the maximum speed of the servomotor used.

Parameter		Description
Pn408	n.□□0□	Use the maximum motor rotation number and the smaller value of Pn407 as speed limit value.
	n.□□1□	Use the excessive speed detection speed and smaller value of Pn407 as speed limit value.

(3) External Speed Limit Function

Type	Signal Name	Connector Pin Number	Name
Input	V-REF	CN1-5	External Speed Limit Input
	SG	CN1-6	Signal Ground

Inputs an analog voltage reference as the servomotor speed limit value during torque control.
The smaller value of the speed limit input from the V-REF on the Pn407 (Speed Limit during Torque Control) is enabled when Pn002 = n.□□1□.
The setting in Pn300 determines the voltage level to be input as the limit value. Polarity has no effect.

Pn300	Speed Reference Input Gain (Speed) (Position) (Torque)			
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	150 to 3000 (1.50 to 30.00 V/rated speed)	0.01 V/rated speed	600 (6.00 V/rated speed)	Immediately

Sets the voltage level for the motor speed that is to be externally limited during torque control.
With Pn300 = 6.00 (factory setting) and 6 V input from V-REF (CN1-5, 6), motor speed is limited to the rated speed of the servomotor used.

INFO

■ The Principle of Speed Limiting

When the speed is outside of the allowable range, a torque that is proportional to the difference between the actual speed and the speed limit is used as negative feedback to bring the speed back within the speed limit range. Accordingly, there is a margin generated by the load conditions in the actual servomotor speed limit value.

(4) Signals Output during Servomotor Speed Limit

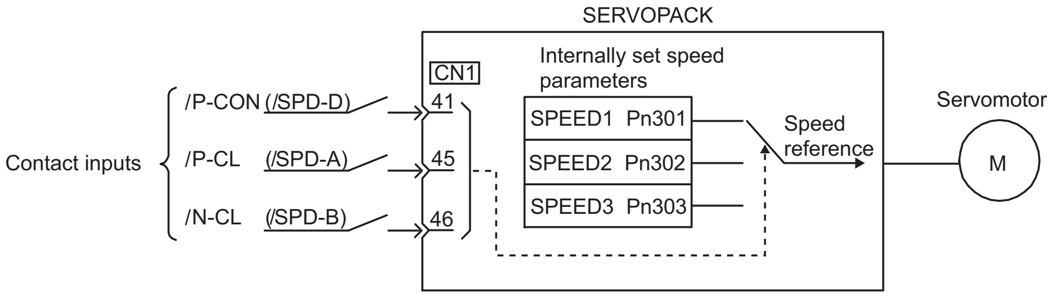
Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/VLT	Must be allocated CN1-□□	ON (low level)	Servomotor speed limit being applied.
			OFF (high level)	Servomotor speed limit not being applied.

This signal is output when the servomotor speed reaches the speed limit value set in Pn407 or set by the analog voltage reference.
For use, this output signal must be allocated with parameter Pn50F. For details, refer to *7.3.3 Output Circuit Signal Allocation*.

8.8 Operating Using Speed Control with an Internally Set Speed

- Internally Set Speed Selection

This function allows speed control operation by externally selecting an input signal from among three servomotor speed settings made in advance with parameters in the SERVOPACK. The speed control operations within the three settings are valid. There is no need for an external speed or pulse generator.



8.8.1 Setting Parameters

Parameter		Meaning
Pn000	n.□□3□	Control mode selection: Internally set speed control (contact reference)

Pn301	Internally set speed 1 (SPEED1) Speed			
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 10000	1 min^{-1}	100	Immediately
Pn302	Internally set speed 2 (SPEED2) Speed			
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 10000	1 min^{-1}	200	Immediately
Pn303	Internally set speed 3 (SPEED3) Speed			
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 10000	1 min^{-1}	300	Immediately

Note: The maximum speed of the servomotor is used whenever the value exceeds the maximum speed is set in the Pn301 to Pn303.

8.8.2 Input Signal Settings

The following input signals are used to switch the operating speed.

Type	Signal Name	Connector Pin Number	Meaning
Input	/P-CON	CN1-41	Switches the servomotor rotation direction
	(/SPD-D)	Must be allocated	
Input	/P-CL	CN1-45	Selects the internally set speed.
	(/SPD-A)	Must be allocated	
Input	/N-CL	CN1-46	Selects the internally set speed.
	(/SPD-B)	Must be allocated	

■ Input Signal Selection

The following two types of operation can be performed using the internally set speeds:

- Operation with the /P-CON, /P-CL, and /N-CL input signals (pins allocated in factory setting)
- Operation with the /SPD-D, /SPD-A, and /SPD-B input signals

When the /SPD-D, /SPD-A, and /SPD-B is used, the input signals must be allocated with parameter Pn50C. Refer to *7.3.2 Input Circuit Signal Allocation*.

8.8.3 Operating Using an Internally Set Speed

Use ON/OFF combinations of the following input signals to operate with the internally set speeds.

Input Signal			Motor Rotation Direction	Speed
/P-CON (/SPD-D)	/P-CL (/SPD-A)	/N-CL (/SPD-B)		
OFF (high)	OFF (high)	OFF (high)	Forward	Stop at 0 of the internally set speed
	OFF (high)	ON (low)		Pn301: Internally Set Speed 1 (SPEED1)
	ON (low)	ON (low)		Pn302: Internally Set Speed 2 (SPEED2)
	ON (low)	OFF (high)		Pn303: Internally Set Speed 3 (SPEED3)
ON (low)	OFF (high)	OFF (high)	Reverse	Stop at 0 of the internally set speed
	OFF (high)	ON (low)		Pn301: Internally Set Speed 1 (SPEED1)
	ON (low)	ON (low)		Pn302: Internally Set Speed 2 (SPEED2)
	ON (low)	OFF (high)		Pn303: Internally Set Speed 3 (SPEED3)

Note: Signal OFF = High level; Signal ON = Low level

IMPORTANT

■Control Mode Switching

When Pn000.1 = 4, 5, or 6, and either /P-CL (/SPD-A) or /N-CL (SPD-B) is OFF (high level), the control mode will switch.

Example:

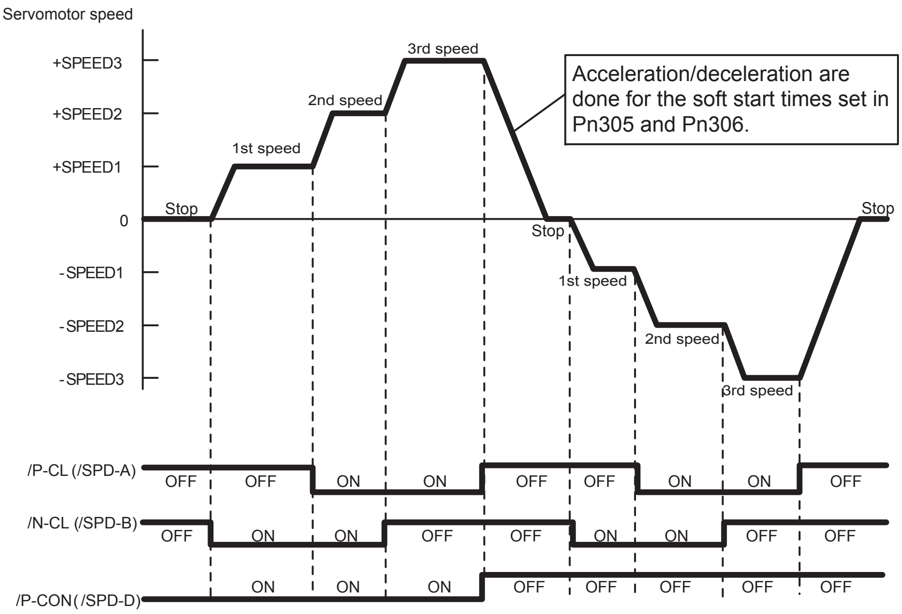
Pn000.1 = 5: Internally set speed selection ⇔ Position control (pulse train)

Input Signal		Speed
/P-CL (/SPD-A)	/N-CL (/SPD-B)	
OFF (high)	OFF (high)	Pulse train reference input (position control)
OFF (high)	ON (low)	Pn301: Internally Set Speed 1 (SPEED1)
ON (low)	ON (low)	Pn302: Internally Set Speed 2 (SPEED2)
ON (low)	OFF (high)	Pn303: Internally Set Speed 3 (SPEED3)

• Example of Operating with Internally Set Speed Selection

The shock that results when the speed is changed can be reduced by using the soft start function.
For details on the soft start function, refer to *8.5.4 Soft Start*.

Example: Operation with an Internally Set Speed and Soft Start

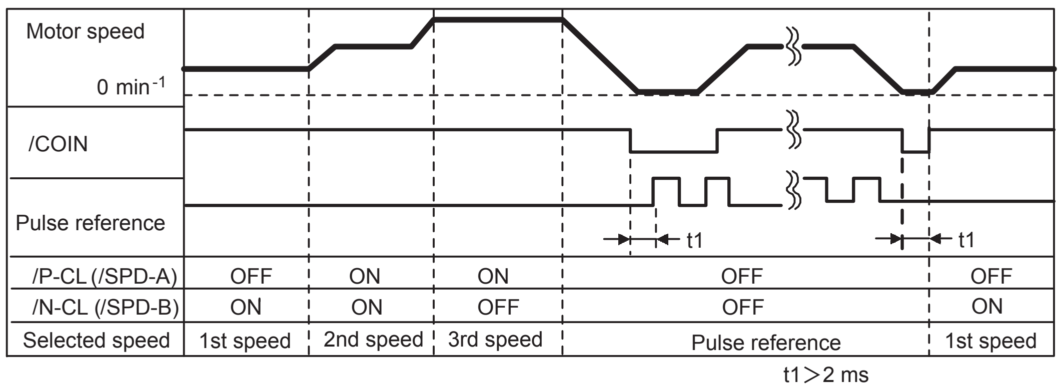


IMPORTANT

When Pn000.1 = 5 (Internally set speed control ⇔ Position control), the soft start function will operate only when selecting the internally set speed. The soft start function cannot be used with pulse reference input. When switching to pulse reference input during operation at either of the three speeds (1st speed to 3rd speed), the pulse reference will not be received by the SERVOPACK until after the positioning completed (/COIN) signal is output. Always begin the output of the pulse reference from the host controller after the positioning completed (/COIN) signal is output from the SERVOPACK.

Example: Operation with an Internally Set Speed and Soft Start ⇔ Position Control (Pulse Train Reference)

Signal Timing in Position Control



Note: 1. The soft start function is used in the above figure.
2. The t_1 value is not affected by whether the soft start function is used.
A maximum delay of 2 ms occurs in loading /P-CL (/SPD-A) and /N-CL (/SPD-B).

8.9 Limiting Torque

The SERVOPACK provides the following four methods for limiting output torque to protect the machine.

Setting Level	Limiting Method	Reference Section
1	Internal torque limit	8.9.1
2	External torque limit	8.9.2
3	Torque limiting by analog voltage reference	8.9.3
4	External torque limit + Torque limiting by analog voltage reference	8.9.4

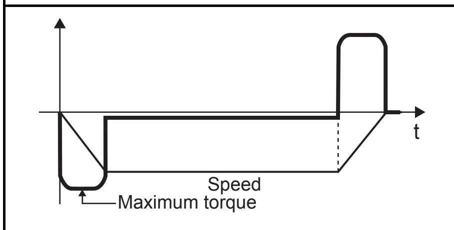
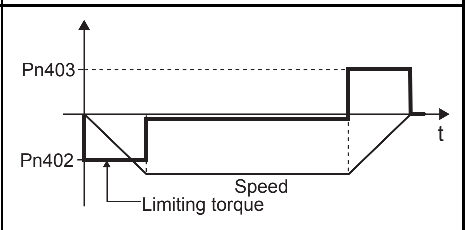
8.9.1 Internal Torque Limit (Limiting Maximum Output Torque)

This function always limits maximum output torque by setting values of following parameters.

Pn402	Forward Torque Limit Speed Position Torque			
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 800	1%	800	Immediately
Pn403	Reverse Torque Limit Speed Position Torque			
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 800	1%	800	Immediately

The settings in these parameters are constantly enabled. The setting unit is a percentage of rated torque.

The maximum torque of the servomotor is used whenever the value exceeds the maximum torque is set. (factory setting is 800%: maximum torque)

No Internal Torque Limit (Maximum Torque Can Be Output)	Internal Torque Limit
	

Too small a torque limit setting will result in insufficient torque during acceleration and deceleration.

Operation

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8.9.2 External Torque Limit (Output Torque Limiting by Input Signals)

Use this function to limit torque at specific times during machine operation, for example, during press stops and hold operations for robot workpieces.

An input signal is used to enable the torque limits previously set in parameters.

(1) Related Parameters

Pn404	Forward External Torque Limit Speed Position Torque			
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 800	1%	100	Immediately
Pn405	Reverse External Torque Limit Speed Position Torque			
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 800	1%	100	Immediately

Note: Setting unit is percentage to the servomotor rated torque. (Rated torque limits 100 %).

(2) Input Signals

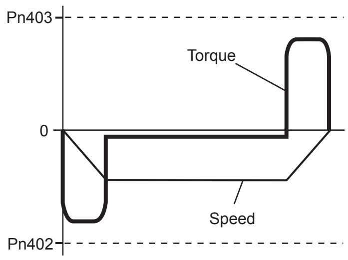
Type	Signal Name	Connector Pin Number	Setting	Meaning	Limit Value
Input	/P-CL	CN1-45 (Factory Setting)	ON (low level)	Forward external torque limit ON	The value set in Pn402 or Pn404 (whichever is smaller)
			OFF (high level)	Forward external torque limit OFF	Pn402
Input	/N-CL	CN1-46 (Factory Setting)	ON (low level)	Reverse external torque limit ON	The value set in Pn403 or Pn405 (whichever is smaller)
			OFF (high level)	Reverse external torque limit OFF	Pn403
When using external torque limit, make sure that there are no other signals allocated to the same terminals as /P-CL and /N-CL. When multiple signals are allocated to the same terminal, the signals are handled with OR logic, which affects the ON/OFF state of the other signals. Refer to *7.3.2 Input Circuit Signal Allocation*.					

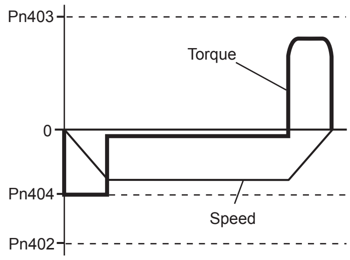
* The setting unit is a percentage of rated torque (i.e., the rated torque is 100%).

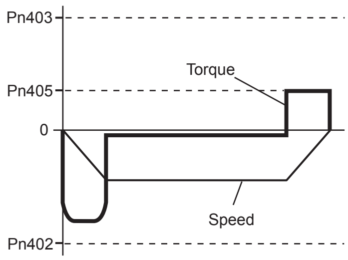
(3) Changes in Output Torque during External Torque Limiting

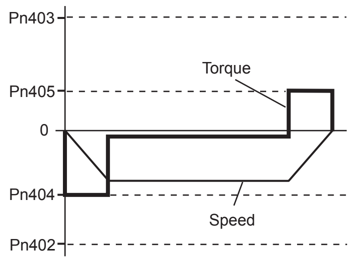
◀ EXAMPLE ▶

External torque limit (Pn402, Pn403) set to 800%

<table>
<tr><th colspan="2" rowspan="2"></th><th colspan="2">/P-CL (Forward external torque limit input)</th></tr>
<tr><th>High level</th><th>Low level</th></tr>
<tr><td rowspan="2">/N-CL (Reverse external torque limit input)</td><td>High level</td><td>


</td><td>


</td></tr>
<tr><td>Low level</td><td>


</td><td>


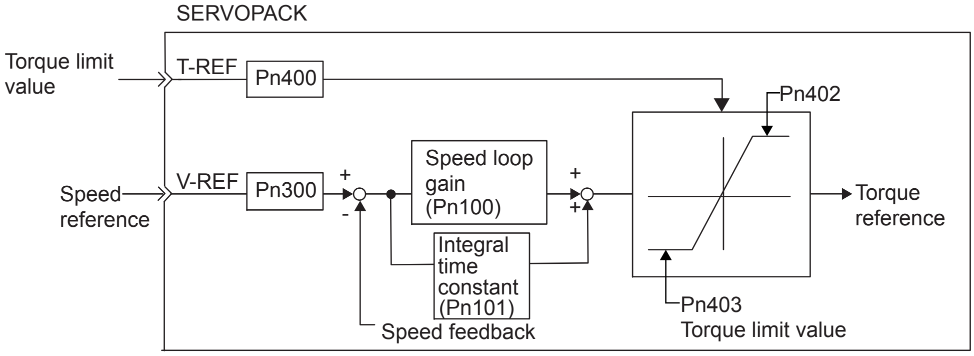
</td></tr>
</table>

Note: In this example, the servomotor rotation direction is Pn000 = n.□□□0 (standard setting, CCW = forward).

8.9.3 Torque Limiting Using an Analog Voltage Reference

Torque limiting by analog voltage reference limits torque by assigning a torque limit in an analog voltage to the T-REF terminals (CN1-9 and 10). This function can be used only during speed or position control, not during torque control.

The following chart shows when the torque limiting using an analog voltage reference in the speed control.



INFO

There is no polarity in the input voltage of the analog voltage reference for torque limiting. The absolute values of both + and - voltages are input, and a torque limit value corresponding to that absolute value is applied in the forward or reverse direction.

(1) Related Parameters

Parameter		Meaning
Pn002	n.□□□1	Speed control option: Uses the T-REF terminal to be used as an external torque limit input.
When n.□□□2 is set, T-REF terminal is used for torque feed-forward input, but the functions cannot be used together.		

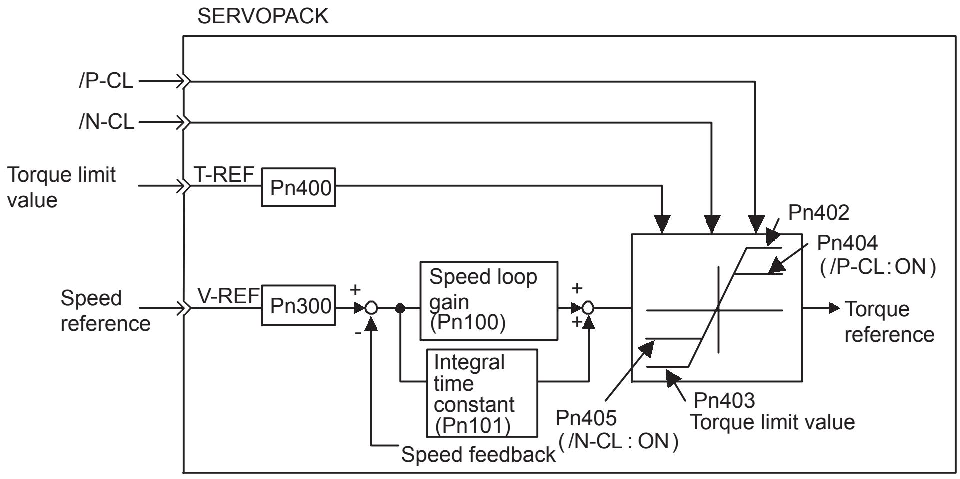
(2) Input Signals

Type	Signal Name	Connector Pin Number	Name
Input	T-REF	CN1-9	Torque reference input
	SG	CN1-10	Signal ground for torque reference input
The torque limit input gain is set at parameter Pn400. Refer to *8.7.1 Setting Parameters*. ■ Input Specifications • Input range: ±1 VDC to ±10 VDC/rated torque • Maximum allowable input voltage: ±12 VDC			

8.9.4 Torque Limiting Using an External Torque Limit and Analog Voltage Reference

This function can be used to combine torque limiting by an external input and by analog voltage reference. Because the torque limit by analog voltage reference is input from T-REF (CN1-9, 10), this function cannot be used during torque control. Use /P-CL (CN1-45) or /N-CL (CN1-46) for torque limiting by external input signal.

When /P-CL (or /N-CL) is ON, either the torque limit by analog voltage reference or the setting in Pn404 (or Pn405) will be applied as the torque limit, whichever is smaller.



(1) Related Parameters

Parameter		Meaning
Pn002	n.□□□3	Speed control option: When /P-CL or /N-CL is enabled, the T-REF terminal is used as the external torque limit input.
When n.□□□2 is set, T-REF is used for torque feed-forward input, but the functions cannot be used together.		

Pn404	Forward External Torque Limit	Speed	Position	Torque
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 800	1%	100	Immediately
Pn405	Reverse External Torque Limit			
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 800	1%	100	Immediately

* The setting unit is a percentage of rated torque (i.e., the rated torque is 100%).

Operation

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(2) Input Signals

Type	Signal Name	Connector Pin Number	Name
Input	T-REF	CN1-9	Torque reference input
	SG	CN1-10	Signal ground for torque reference input
The torque limit input gain is set in parameter Pn400. Refer to *8.7.1 Setting Parameters*. ■ Input Specifications • Input range: ±1 VDC to ±10 VDC/rated torque • Maximum allowable input voltage: ±12 VDC			

Type	Signal Name	Connector Pin Number	Setting	Meaning	Limit Value
Input	/P-CL	CN1-45 (Factory setting)	ON (low level)	Forward external torque limit ON	The analog voltage reference limit or the value set in Pn402 or Pn404 (whichever is smaller)
			OFF (high level)	Forward external torque limit OFF	Pn402
Input	/N-CL	CN1-46 (Factory setting)	ON (low level)	Reverse external torque limit ON	The analog voltage reference limit or the value set in Pn403 or Pn405 (whichever is smaller)
			OFF (high level)	Reverse external torque limit OFF	Pn403
When using the torque limit by external torque limit and analog voltage reference, make sure that there are no other signals allocated to the same terminals as /P-CL and /N-CL. When multiple signals are allocated to the same terminal, the signals are handled with OR logic, which affects the ON/OFF state of the other signals. Refer to *7.3.2 Input Circuit Signal Allocation*.					

8.9.5 Checking Output Torque Limiting during Operation

The following signal can be output to indicate that the servomotor output torque is being limited.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/CLT	Must be allocated	ON (low level)	Servomotor output torque is being limited.
			OFF (high level)	Torque is not being limited.
The output terminal must be allocated with parameter Pn50F to use the signal during servomotor output torque limit. Refer to *7.3.3 Output Circuit Signal Allocation* for details				

8.10 Control Mode Selection

The methods and conditions for switching SERVOPACK control modes are described below.

8.10.1 Setting Parameters

The following combinations of control modes can be selected according to the application at hand.

Parameter		Control Method
Pn000	n.□□4□	Internally set speed control (contact reference) ⇔ Speed control (analog voltage reference)
	n.□□5□	Internally set speed control (contact reference) ⇔ Position control (pulse train reference)
	n.□□6□	Internally set speed control (contact reference) ⇔ Torque control (analog voltage reference)
	n.□□7□	Position control (pulse train reference) ⇔ Speed control (analog voltage reference)
	n.□□8□	Position control (pulse train reference) ⇔ Torque control (analog voltage reference)
	n.□□9□	Torque control (analog voltage reference) ⇔ Speed control (analog voltage reference)
	n.□□A□	Speed control (analog voltage reference) ⇔ Zero clamp
	n.□□B□	Position control (pulse train reference) ⇔ Position control (inhibit)

8.10.2 Switching the Control Mode

(1) Switching Internally Set Speed Control (Pn000.1 = 4, 5, or 6)

With the sequence input signals in the factory setting (Pn50A = n.□□□0), the control mode will switch when both /P-CL (/SPD-A) and /N-CL (/SPD-B) signals are OFF (high level). When changing the sequence input signal from the factory setting (Pn50A = n.□□□1), allocate the /C-SEL to an input terminal and change modes with the /C-SEL signal. In this case, input a speed reference (analog voltage reference) for speed control, and a position reference (pulse train reference) for position control.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Input	/P-CL	CN1-45 (Factory setting)	OFF (high level)	Switches control mode.
	(/SPD-A)	Must be allocated		
Input	/N-CL	CN1-46 (Factory setting)	OFF (high level)	
	(/SPD-B)	Must be allocated		

■ Input Signal Selection

The following two types of control mode selection are available for switching from internally set speed control:

- Switching with the /P-CL and /N-CL input signals (pins allocated in factory setting)
- Switching with the /SPD-A and /SPD-B input signals

When using /SPD-A and /SPD-B, they must be allocated with parameter Pn50C. Refer to *7.3.2 Input Circuit Signal Allocation*.

(2) Switching Other Than Internally Set Speed Control (Pn000.1 = 7, 8, 9, A, or B)

Use the following signals to switch control modes. The control modes switch depending on the signal status as shown below.

<table>
<tr><th rowspan="2">Type</th><th rowspan="2">Signal Name</th><th rowspan="2">Connector Pin Number</th><th rowspan="2">Setting</th><th colspan="5">Pn000 Setting</th></tr>
<tr><th>n.□□7□</th><th>n.□□8□</th><th>n.□□9□</th><th>n.□□A□</th><th>n.□□B□</th></tr>
<tr><td rowspan="2">Input</td><td rowspan="2">/P-CON</td><td rowspan="2">CN1-41
(Factory setting)</td><td>ON (low level)</td><td>Speed</td><td>Torque</td><td>Speed</td><td>Zero clamp</td><td>Inhibit</td></tr>
<tr><td>OFF (high level)</td><td>Position</td><td>Position</td><td>Torque</td><td>Speed</td><td>Position</td></tr>
<tr><td rowspan="2">(Input)</td><td rowspan="2">(/C-SEL)</td><td rowspan="2">Must be allocated</td><td>ON (low level)</td><td>Speed</td><td>Torque</td><td>Speed</td><td>Zero clamp</td><td>Inhibit</td></tr>
<tr><td>OFF (high level)</td><td>Position</td><td>Position</td><td>Torque</td><td>Speed</td><td>Position</td></tr>
<tr><td colspan="9">The control mode can be switched with either /P-CON or /C-SEL.
When using the /C-SEL signal, the input signal must be allocated. Refer to 7.3.2 Input Circuit Signal Allocation.</td></tr>
</table>

8.11 Other Output Signals

The following output signals, which have no direct connection with the control modes, are used for machine protection.

8.11.1 Servo Alarm Output (ALM) and Alarm Code Output (ALO1, ALO2, ALO3)

(1) Servo Alarm Output (ALM)

This signal is output when an error is detected in the SERVOPACK.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	ALM	CN1-31, 32 (Factory setting)	ON (low level)	Normal SERVOPACK condition
			OFF (high level)	SERVOPACK alarm condition
■ IMPORTANT Always form an external circuit so this alarm output turns OFF the main circuit power supply to the SERVOPACK.				

(2) Alarm Reset

Type	Signal Name	Connector Pin Number	Name
Input	/ALM-RST	CN1-44	Alarm Reset
When a servo alarm (ALM) has occurred and the cause of the alarm has been eliminated, the alarm can be reset by turning this signal (/ALM-RST) from OFF (high level) to ON (low level). This signal can be allocated to other pin numbers with Pn50B. For details on the procedure, refer to *7.3.2 Input Circuit Signal Allocation*. This signal cannot be constantly enabled by the allocation of an external input signal. Reset the alarm by changing the signal from high level to low level. The alarm can also be reset from the panel operator or digital operator. Refer to *7.1.1 Key Names and Functions* for details.			

IMPORTANT

1. Some encoder-related alarms cannot be reset with the /ALM-RST signal input. To reset these alarms, turn OFF the control power supply.
2. When an alarm occurs, always eliminate the cause before resetting the alarm. The methods for troubleshooting alarms are described in *11.1.3 Troubleshooting of Alarm and Warning*.

(3) Alarm Code Output

Type	Signal Name	Connector Pin Number	Meaning
Output	ALO1	CN1-37	Alarm code output
Output	ALO2	CN1-38	Alarm code output
Output	ALO3	CN1-39	Alarm code output
Output	SG	CN1-1	Signal ground for Alarm code output
These open-collector signals output alarm codes. The ON/OFF combination of these output signals indicates the type of alarm detected by the servomotor. Use these signals to display alarm codes at the host controller. For details of the alarm code output, refer to *11.1.1 Alarm Display Table*.			

8.11.2 Warning Output (/WARN)

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/WARN	Must be allocated	ON (high level)	Normal state
			OFF (low level)	Warning state
This output signal displays warnings for overload (A.710) and regenerative overload (A.320) alarms. For use, this output signal must be allocated with parameter Pn50F. For details, refer to *7.3.3 Output Circuit Signal Allocation*.				

- Related Parameters

The following parameter is used to select the alarm code output.

Parameter		Description
Pn001	n.0□□□	Outputs alarm codes alone for alarm codes ALO1, ALO2, and ALO3.
	n.1□□□	Outputs both alarm and warning codes for alarm codes ALO1, ALO2, and ALO3, and outputs an alarm code when an alarm occurs.
• Refer to *8.11.1 Servo Alarm Output (ALM) and Alarm Code Output (ALO1, ALO2, ALO3)* for alarm code descriptions. • Refer to *11.1.2 Warning Displays* for the ON/OFF combinations of ALO1, ALO2, and ALO3 when a warning code is output.		

8.11.3 Rotation Detection Output Signal (/TGON)

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/TGON	CN1-27, 28 (Factory setting)	ON (low level)	Servomotor is operating (Motor speed is above the setting in Pn502).
			OFF (high level)	Servomotor is not operating (Motor speed is below the setting in Pn502).
This signal is output to indicate that the servomotor is currently operating above the setting in parameter Pn502. This output signal can be allocated to another output terminal with parameter Pn50E. For details, refer to *7.3.3 Output Circuit Signal Allocation*.				
■ IMPORTANT • If the brake signal (/BK) and running output signal (/TGON) are allocated to the same output terminal, the /TGON signal will go to low level at the speed at which the movable part drops on the vertical axis, which means that the /BK signal will not go to high level. (This is because signals are output with OR logic when multiple signals are allocated to the same output terminal.). Always allocate /TGON and /BK signals to different terminals.				

- Related Parameter

Pn502	Zero Speed Level (Speed, Position, Torque)			
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 10000	1 min^{-1}	20	Immediately
Set the range in which the running output signal (/TGON) is output in this parameter. When the servomotor speed is above the speed set in Pn502, it is judged to be operating and the running output signal (/TGON) is output. The rotation detection signal can also be checked on the panel operator or digital operator. For details, refer to *7.1.3 Status Display* and *7.4.1 List of Monitor Modes*.				

8.11.4 Servo Ready (/S-RDY) Output

<table>
<tr><th>Type</th><th>Signal Name</th><th>Connector Pin Number</th><th>Setting</th><th>Meaning</th></tr>
<tr><td rowspan="2">Output</td><td rowspan="2">/S-RDY</td><td rowspan="2">CN1-29, 30
(Factory setting)</td><td>ON (low level)</td><td>Servo is ready.</td></tr>
<tr><td>OFF (high level)</td><td>Servo is not ready.</td></tr>
<tr><td colspan="5">This signal indicates that the SERVOPACK received the servo ON signal and completed all preparations.
It is output when there are no servo alarms and the main circuit power supply is turned ON.
* An added condition with absolute encoder specifications is that the SEN signal is at high level, absolute data was output to the host controller.
The servo ready signal condition can also be checked on the panel operator or digital operator. For details, refer to 7.1.3 Status Display and 7.4.1 List of Monitor Modes.
/S-RDY signal can be allocated to another output terminal with parameter Pn50E. For details, refer to 7.3.3 Output Circuit Signal Allocation.</td></tr>
</table>

Operation

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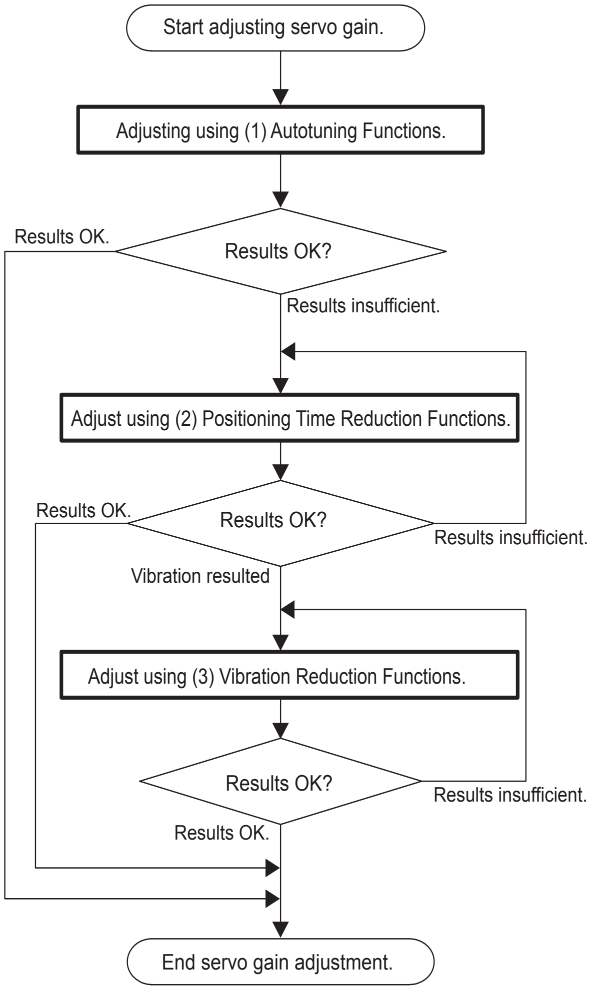
9.1 Servo Tuning Methods

9.1.1 Servo Gain Adjustment Methods

The SERVOPACK have a servo gains to determine the responsiveness of the servo. The servo gains are set by using the parameters. Increasing the servo gain of a machine with high rigidity can increase its responsiveness. A machine with low rigidity, however, will have a tendency to vibrate and may not be more responsive if the servo gain is increased.

As shown in *9.1.2 List of Servo Adjustment Functions*, the servo gain can be set by combining many parameters. Each parameter cannot be set to an arbitrary value. The setting of all of the parameters must be well balanced because they correlate to each other.

The servo gains in the SERVOPACK are factory-set to stable values, and responsiveness can be increased depending on the actual machine conditions. The following flowchart shows an overview procedure for adjusting the servo gains to reduce the positioning time for position control. Follow this flowchart to effectively adjust the servo gains. For functions in bold lines in the flowchart, select the adjustment method according to the client's intent using *9.1.2 List of Servo Adjustment Functions*.



If the desired responsiveness cannot be achieved adjusting according to the servo gain adjustment methods, consider the following possible causes.

- If autotuning does not suit the operating conditions, manually adjust the gain. Refer to *9.5 Manual Servo Tuning*.
- If the functions for reducing the positioning time and vibration are incompatible with the machine's characteristics or the operating conditions, the results will be inconsistent. Use another function to reduce the positioning time or vibrations.

9.1.2 List of Servo Adjustment Functions

(1) Autotuning Functions

In autotuning, algorithms are used to calculate the load moment of inertia, which determines the servo drive's responsiveness, automatically adjusts parameters, such as the Speed Loop Gain Kv (Pn100), Speed Loop Integral Time Constant Ti (Pn101), Position Loop Gain Kp (Pn102), and Torque Reference Filter Time Constant Tf (Pn401). Refer to the following table to select the appropriate autotuning function for your desired purpose and adjust the servo gains.

Function Name and Related Parameters	Description	Guidelines for Selection	Reference Section
Normal Autotuning Pn110.0 Fn001 Fn007	A new algorithm is used to increase the calculation accuracy of Σ-II autotuning calculation accuracy for the load moment of inertia, increase stability, and eliminate restrictions. Setting methods for the Machine Rigidity Setting (Fn001) have been reviewed to make the settings easier to use and provide more stable settings. The load moment of inertia is calculated during operation for a user reference, and the servo gains (Kv, Ti, Kp, and Tf) are set according to the Machine Rigidity Setting (Fn001).	Only the minimum number of parameters must be set for autotuning using a normal operation reference. This is the most basic autotuning function.	9.2
Advanced Autotuning Fn017	With advanced autotuning, the amounts that the gains can be increased for the SERVOPACK are determined automatically and a notch filter is automatically adjusted while detecting vibration to find servo gains suitable for the machine characteristics. This autotuning function is performed using utility function Fn017. Automatic round-trip operation is performed for the specified pattern and the load moment of inertia, servo gains (Kv, Ti, Kp, and Tf), and notch filter frequency are automatically set.	Advanced autotuning is used to improve characteristics when the results of normal autotuning are unsuitable. A motion stroke for the number of positioning reference units to perform the automatic operation must be confirmed. High-performance servo gain settings can be achieved by setting only the automatic operation.	9.3
One-parameter Tuning Fn01A	For one-parameter tuning, the load moment of inertia is not calculated and the four servo gains (Kv, Ti, Kp, and Tf) can be adjusted using a single parameter. This autotuning function is made to assist adjustments, and it is performed using utility function Fn01A. During operation with a user reference, the one parameter level is adjusted from 1 to 2,000 from the panel operator to simultaneous change and set the four servo gains. The four gains are set from the one parameter to satisfy a stable relationship between them.	One-parameter tuning is used when the user wants to adjust the servo gains while confirming the response of the servo or machine. One-parameter tuning can be used to eliminate the need to manually adjust parameters while quickly obtaining safe adjustments. The user must observe the response waveform on an external measuring instrument and determine the results of autotuning.	9.4

(2) Positioning Time Reduction Functions

Function Name and Related Parameters	Description	Features	Valid Control Modes	Reference Section
Feed-forward Pn109 Pn10A	Feed-forward compensation for the position reference is added to the speed reference.	Adjustment is easy. The system will be unstable if a large value is set, possibly resulting in overshooting or vibration.	Position	9.6.1
Torque feed-forward Pn002 Pn400	Inputs torque feed-forward to the torque reference input terminal and adds to the internal torque reference at the speed control.		Speed	9.6.2
Speed feed-forward Pn207 Pn300 Pn307	Inputs speed feed-forward to the speed reference input terminal and adds to the internal speed reference at the position control.		Position	9.6.3
Mode Switch (P/PI Switching) Pn10B Pn10C Pn10D Pn10E Pn10F	Switches from PI control to P control using the value of an internal servo variable in a parameter (torque, speed, acceleration, or position error) as a threshold value.	The setting for automatic switching between PI and P control is easy.	Position Speed	9.6.5
Speed Feedback Compensation Pn110 Pn111	Compensates the motor speed using an observer.	Adjustment is easy because the compensation can be set as a percentage. If the speed loop gain increases, the position loop gain also increases, however sometimes the servo rigidity decreases.	Position Speed	9.6.8
Gain Switching Pn100 Pn101 Pn102 . . .	Four parameters, speed loop gain (Kv), speed loop integral time constant (Ti), position loop gain (Kp), and torque reference filter time constant (Tf), are used as conditions for switching and switching is performed on an external signal.	Automatic gain switching is easily achieved using only servo parameter. The user must select the conditions for switching.	Position Speed	9.6.9
Predictive Control Pn150 Pn151 Pn152	Predictive control is performed to reduce following error for the position reference.	Adjustment is possible with only one or two parameters.	Position	9.6.10
Less Deviation Control Pn119 Pn11A Pn11E . . .	Minimizes the error during movement for position control to reduce settling time and to reduce locus tracking error.	Adjustment is easy using a single level with utility function Fn015.	Position	9.6.11

(3) Vibration Reduction Functions

Function Name and Related Parameters	Description	Features	Valid Control Modes	Reference Section
Soft Start Pn305 Pn306	Converts a stepwise speed reference to a constant acceleration or deceleration for the specified time interval.	Constant acceleration/deceleration is achieved for smoother operation. Use the maximum time setting to lengthen the operation time.	Speed	8.6.4
Acceleration/ Deceleration Filters Pn207 Pn209 Pn216	A 1st-order delay filter for the position reference input.	Enables smooth operation. The reference time increases by the filter delay time even after the reference input has been completed.	Position	8.6.4
Movement Average Filter Pn207 Pn217	A movement averaging filter for the position reference input.	Enables smooth operation. The reference time increases by the filter delay time even after the reference input has been completed.	Position	8.6.4
Speed Feedback Filter Pn308	A standard 1st-order delay filter for the speed feedback.	The feedback speed is smoother. The delay may be increased if a large value is set.	Position Speed	9.6.7
Speed Reference Filter Pn307	A 1st-order delay filter for the speed reference.	The speed reference is smoother. The delay may be increased if a large value is set.	Speed	8.5.5
Torque Reference Filters Pn401 Pn40F to Pn414	A series of three filter time constants, 1st-order, 2nd-order, and 1st-order, can be set in order for the torque reference.	These filters are effective in essentially all frequency bands. The delay may be increased if a large value (low frequency) is set.	Position Speed Torque	9.6.12
Vibration Suppression on Stopping Pn420 Pn421	A damping coefficient is applied to the change in the torque reference when stopping.	The variation in the torque is decreased when stopping. Disturbance characteristics are decreased.	Position	9.6.13
Notch Filters Pn408 to Pn40D	A series of two notch filters can be set for the torque reference. A notch width is possible for each.	Mainly effective for vibration between 500 and 2,000 Hz. Instability will result if the setting is not correct. For utility function of notch setting, there is a Online Vibration Monitor (Fn018) and EasyFFT (Fn019) to specify the frequency.	Position Speed Torque	9.6.12

9.2 Normal Autotuning

9.2.1 Normal Autotuning

Normal autotuning calculates the load moment of inertia during operation of the SERVOPACK and sets parameters so that the servo gains consistent with the Machine Rigidity Setting (Fn001) are achieved.

Normal autotuning may not be effective in the following cases.

- The load moment of inertia varies in less than 200 ms.
- The rotational speed is lower than 100 min^{-1}
- The rotational speed is not higher than 1000 min^{-1} and the acceleration time is longer than 100 ms.
- Load rigidity is low and mechanical vibration occurs easily or friction is high.
- The speed reference is a stepwise reference.

If the desired operation is not achieved for normal autotuning for these conditions, make adjustments using one of the following procedures.

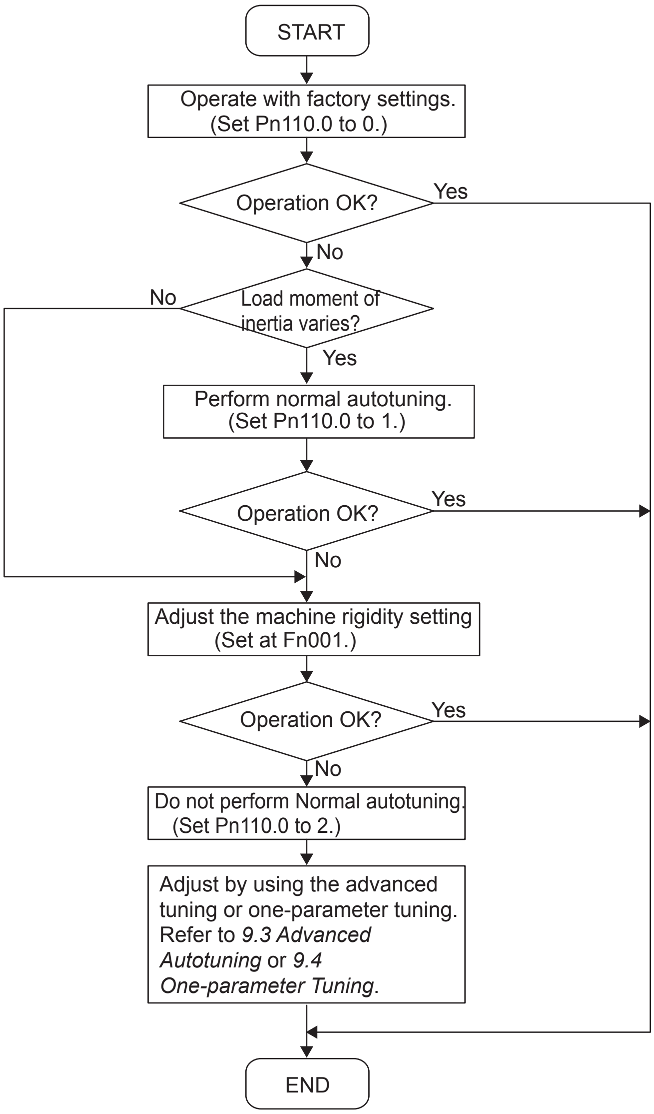
- Execute advanced autotuning.
- Execute one-parameter tuning or manual tuning after Pn103 (moment of inertia ratio) is set. Moment of inertia ratio is calculated using the machine specifications or by the moment of inertia detection function in SigmaWin+, a servo drive engineering tool from Yaskawa.

The following utility function is also available:

Fn007: Writes for the normal autotuning the load moment of inertia calculation result from the normal autotuning as the moment of inertia ratio to Pn103 and uses the result as the default value for the next calculation.

9.2.2 Normal Autotuning Procedure

⚠ WARNING
• Do not perform extreme adjustment or setting changes. Failure to observe this warning may result in damage to the machine and/or injury. • Adjust the gains slowly while confirming motor operation.



9.2.3 Selecting the Normal Autotuning Execution Method

There are three methods that can be used for normal autotuning: At start of operation, constantly, and none. The selection method is described next.

Pn110	Normal Autotuning Switches		Speed	Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	–	–	0010	Required

Parameter		Meaning
Pn110	**n.□□□0**	Normal autotuning is preformed only after the first time power is turned ON. (Factory Setting)
	n.□□□1	Normal autotuning (moment of inertia calculations) are performed continuously.
	n.□□□2	Normal autotuning is not performed.

The factory setting is n.□□□0. This setting is recommended for applications in which the load moment of inertia does not change much or if the load moment of inertia is not known. The moment of inertia calculated at the beginning of operation is used continuously. In this case, differences in machine status and operation references at the beginning of operation may cause minor differences in the calculation results of the load moment of inertia, causing differences in the SERVOPACK responsiveness each time the power supply is turned ON. If this occurs, overwrite Pn103 (Moment of Inertia Ratio) with the load moment of inertia in Fn007 (Save moment of inertia ratio data obtained from normal autotuning) and set Pn110 to n.□□□2 to disable normal autotuning.

The setting n.□□□1 is used when the load moment of inertia varies constantly. This setting enables a consistent responsiveness even when the load moment of inertia changes. If the load moment of inertia changes in less than 200 ms, however, the autotuning accuracy will deteriorate, in which case Pn110.0 should be set to 0 or 2.

The setting n.□□□2 is used when normal autotuning is not possible, when the load moment of inertia is known and the moment of inertia ratio is set in Pn103 to perform advanced autotuning with Fn017 or one-parameter tuning with Fn01A, when performing adjustments manually, or any other time the normal autotuning function is not going to be used.

9.2.4 Machine Rigidity Setting for Normal Autotuning

There are ten machine rigidity settings for normal autotuning. When the machine rigidity setting is selected, the servo gains (Position Loop Gain, Speed Loop Gain, Speed Loop Integral Time Constant, and Torque Reference Filter Time Constant) are determined automatically. The factory setting for the machine rigidity setting is 4. The speed loop is suitable for PI or I-P control. When the Position Loop Gain (Pn102) is changed, however, a value near the Position Loop Gain (Pn102) will be displayed for the Machine Rigidity Setting.

When parameter Pn10B.1 is 0, PI control will be used and when Pn10B.1 is 1, I-P control will be used. To switch the type of control, however, the power supply must be turned OFF and then back ON.

When a change is made, always set the machine rigidity setting.

(1) Speed Loop PI Control

Machine Rigidity Setting Fn001	Position Loop Gain [$0.1s^{-1}$] Pn102	Speed Loop Gain [0.1Hz] Pn100	Speed Loop Integral Time Constant [0.01 ms] Pn101	Torque Reference Filter Time Constant [0.01 ms] Pn401	Step Response Convergence Time [ms]*	
					Position Control	Speed Control
1	15.0	15.0	60.00	2.50	200	32
2	20.0	20.0	45.00	2.00	150	24
3	30.0	30.0	30.00	1.30	100	16
4	40.0	40.0	20.00	1.00	75	12
5	60.0	60.0	15.00	0.70	50	8
6	80.0	80.0	10.00	0.50	35	6
7	100.0	100.0	8.00	0.40	30	5
8	120.0	120.0	7.00	0.35	25	4
9	140.0	140.0	6.00	0.30	21	3
10	160.0	160.0	5.00	0.25	18	3

* Step Response Convergence Time: The time required to reach a 95% output for a step input.

(2) Speed Loop I-P Control

Machine Rigidity Setting Fn001	Position Loop Gain [$0.1s^{-1}$] Pn102	Speed Loop Gain [0.1Hz] Pn100	Speed Loop Integral Time Constant [0.01 ms] Pn101	Torque Reference Filter Time Constant [0.01 ms] Pn401	Step Response Convergence Time [ms]*	
					Position Control	Speed Control
1	15.0	15.0	18.00	2.50	200	32
2	20.0	20.0	14.00	2.00	150	24
3	30.0	30.0	9.00	1.30	100	16
4	40.0	40.0	7.00	1.00	75	12
5	60.0	60.0	4.50	0.70	50	8
6	80.0	80.0	3.50	0.50	38	6
7	100.0	100.0	3.00	0.40	30	5
8	120.0	120.0	2.50	0.35	25	4
9	140.0	140.0	2.00	0.30	13	3
10	160.0	160.0	2.00	0.25	15	3

* Step Response Convergence Time: The time required to reach a 95% output for a step input.

If the machine rigidity setting is changed greatly, the servo gain will increase and positioning time will decrease. If the setting is too large, however, vibration may result depending on the machine configuration. Set the machine rigidity starting at a low value and increasing it within the range where vibration does not occur.

The advanced autotuning function is provided to automatically determine the range in which vibration does not occur. Refer to *9.3 Advanced Autotuning*.

9.2.5 Method for Changing the Machine Rigidity Setting

The machine rigidity setting is changed in utility function mode using parameter Fn001. The procedure is given below.

Step	Display after Operation	Panel Operator	Description
1	Fn000	MODE/SET (MODE/SET Key)	Press the MODE/SET Key to select the utility function mode.
2	Fn001	▲ ▼	Press the Up or Down Cursor Key to select Fn001. *The digit that can be set will blink.
3	d0004	DATA/◀ (DATA/SHIFT) (More than one sec.)	Press the DATA/SHIFT Key for one second or more. The display shown at the left will appear and the rigidity for normal autotuning can be set.
4	d0004 UP ↓ ↑ DOWN d0005	▲ ▼	Press the Up or Down Cursor Key to select the machine rigidity setting.
5	donE	MODE/SET (MODE/SET Key)	Press the MODE/SET Key. The rigidity setting will be changed and “donE” will blink on the display for about one second.
6	d0005	About one second later	After “donE” is displayed, the setting will be displayed again.
7	Fn001	DATA/◀ (DATA/SHIFT) (More than one sec.)	Press the DATA/SHIFT Key for a minimum of one second to return to the Fn001 display of the utility function mode.

This completes changing the machine rigidity setting for normal autotuning.

9.2.6 Saving the Results of Normal Autotuning

⚠ CAUTION

- Always set the correct moment of inertia ratio when normal autotuning is not used.
  If the moment of inertia ratio is set incorrectly, vibration may occur.

For normal autotuning, the most recent load moment of inertia is calculated and the control parameters are adjusted to achieve response suitable for the machine rigidity setting. When normal autotuning is performed, the Position Loop Gain (Pn102), Speed Loop Gain (Pn100), and Speed Loop Integral Time Constant (Pn101) are saved. When the power supply to the SERVOPACK is turned OFF, however, the calculated load moment of inertia is lost and the factory setting is used as the default value to start autotuning the next time the power supply is turned ON.
To use the calculated load moment of inertia as the default value the next time the power supply is turned ON, the utility function mode parameter Fn007 (Save moment of inertia ratio data obtained from normal autotuning) can be used to save the most recent value in parameter Pn103 (Moment of Inertia Ratio). The moment of inertia ratio is given as the moment of inertia ratio (%) of the rotor moment of inertia of the servomotor.

Pn103	Moment of Inertia Ratio	Speed	Position	Torque
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 20000	1%	0	Immediately

$$\text{Moment of inertia ratio} = \frac{\text{Motor axis conversion load moment of inertia } (J_L)}{\text{Rotor moment of inertia } (J_M)}$$

The factory setting for the moment of inertia ratio is 0% (no-load condition for stand-alone servomotor).

9.2.7 Procedure for Saving the Results of Normal Autotuning

The following procedure is used to save the results of normal autotuning.

Step	Display after Operation	Panel Operator	Description
1	Fn000	MODE/SET (MODE/SET Key)	Press the MODE/SET Key to select the utility function mode.
2	Fn007	▲ ▼	Press the Up or Down Cursor Key to select parameter Fn007. *The digit that can be set will blink.
3	d0200	DATA/◀ (DATA/SHIFT) (More than one sec.)	Press the DATA/SHIFT Key for one second or more. The display at the left will appear for a moment of inertia ratio of 200%.
4	donE	MODE/SET (MODE/SET Key)	Press the MODE/SET Key. The moment of inertia ratio will be saved. When completed, “donE” will blink for about one second.
5	d0200	About one second later	After “donE” is displayed, the moment of inertia ratio will be displayed again.
6	Fn007	DATA/◀ (DATA/SHIFT) (More than one sec.)	Press the DATA/SHIFT Key for one second or more to return to the Fn007 display of the utility function mode.

This completes saving the default value for the moment of inertia ratio for normal autotuning. The next time the power supply is turned ON, the value that was saved for the Moment of Inertia Ratio (Pn103) will be used to start normal autotuning.

9.3 Advanced Autotuning

9.3.1 Advanced Autotuning

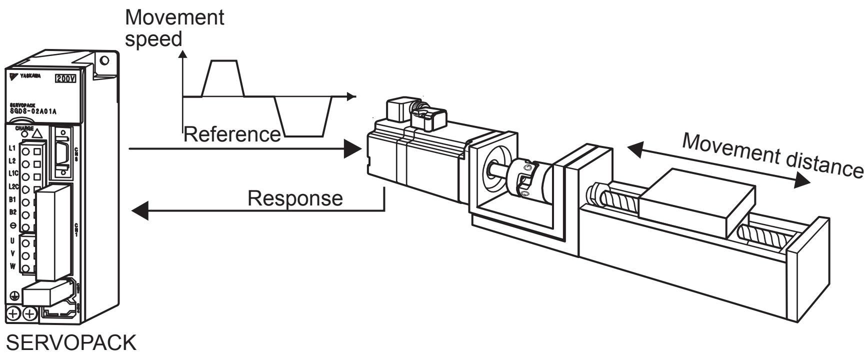
Advanced autotuning calculate the load moment of inertia and set the servo gain suitable for the machine charateristies. The gain is set as high as possible to avoid the vibration. Advanced autotuning is performing using utility function Fn017 (Advanced Autotuning). If vibration occurs during advanced autotuning, either set a notch filter or lower the servo gains, depending on circumstances.

The following parameter settings are changed by the advanced autotuning.

- Speed Loop Gain (Pn100)
- Speed Loop Integral Time Constant (Pn101)
- Position Loop Gain (Pn102)
- Torque Reference Filter Time Constant (Pn401)
- Moment of Inertia Ratio (Pn103)

The following parameter settings are changed if required.

- Torque Related Function Switch (Pn408.0 or Pn408.2)
- 1st Step Notch Filter Frequency (Pn409)
- 2nd Step Notch Filter Frequency (Pn40C)



Advanced Autotuning Operation Example

Advanced autotuning may not be effective in the following cases.

- The load moment of inertia varies in less than 200 ms.
- Load rigidity is low and mechanical vibration occurs easily or viscous friction is high.
- The movement range is too narrow, e.g., only a few rotations.
- There is movement in only one direction.
- When P control operation (proportional control) is used.

If the desired operation is not achieved for advanced autotuning in the above conditions, calculate values from machine specifications or use the load moment of inertia detection function of the SigmaWin+ (an AC servo drive support tool from Yaskawa) to set the load moment of inertia ratio in Pn103 and then perform one-parameter tuning or manual servo tuning.

If the vibration occurs when the power is supplied to the servomotor, use Fn018 (Online vibration monitor) and Fn019 (EasyFFT) to suppress the vibration. Then, the advanced autotuning may be effective.

IMPORTANT

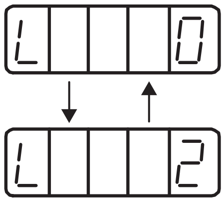
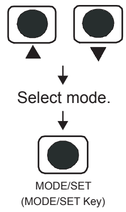
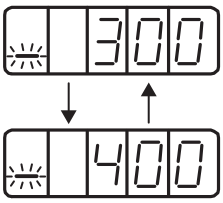
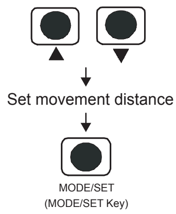
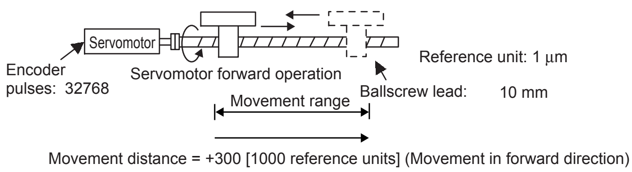
1. Advanced autotuning performs automatic operation accompanied by vibration. Ensure that an emergency stop is possible while advanced autotuning is being performed. Also, confirm the range and direction of motion and provide protective devices to ensure safety in the event of overtravel or other unexpected movement. Normally, set the level in step 5 to “normal” or less.
2. This function can select “Not estimates moment of inertia ratio (MODE:1),” but in this case, set the correct moment of inertia ratio in Pn103 before using this function.
3. Advanced autotuning set the servo gain according to the Positioning Completed Width (Pn522). Set the Positioning Completed Width to the value that will be used in normal operation.
4. Make sure that the following are properly set before starting the advanced autotuning.
   - The main circuit power is input.
   - The servo is OFF.
   - Overtravel does not occur in the servomotor. The forward run prohibited (P-OT) and reverse run prohibited (N-OT) signals are not input.
   - Pn110 = n.□□□2 (Performs manual tuning but not normal autotuning)
   - Pn10B = n.□0□□ (Less deviation control is not used.)
   - The Clear signal is at L (low) level (Not to clear).
   - Pn150 = n.□□□0 (Predictive control is not used.)

9.3.2 Advanced Autotuning Procedure

The following procedure is used for advanced autotuning.

Step	Display after Operation	Panel Operator	Description
1	Fn000	MODE/SET (MODE/SET Key)	Press the MODE/SET Key to select the utility function mode.
2	Fn017	▲ ▼	Press the Up or Down Cursor Key to select Fn017. *The digit that can be set will blink.
3	d 0	DATA/◀ (DATA/SHIFT) (Press at least one sec.)	Press the DATA/SHIFT Key for one second or more. The display shown at the left will appear.
4	d 0 ↓ ↑ d 1	▲ ▼ ↓ Select mode. ↓ MODE/SET (MODE/SET Key)	On the mode setting display, press the Up or Down Cursor Key to select the mode for the calculation of the load moment of inertia. *Mode (Load Moment of Inertia Calculation Switching) 0: Inertia calculated 1: Inertia not calculated If the moment of inertia ratio is known from the machine specifications, set it in Pn103, and then set the mode to 1 (inertia not calculated). Otherwise, use this function in mode 0 (inertia calculated).

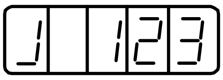
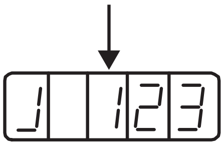
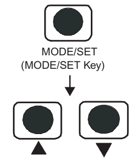
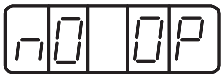
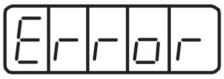
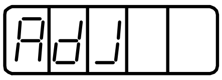
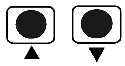
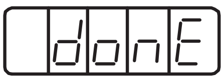
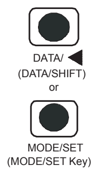
(cont'd)

Step	Display after Operation	Panel Operator	Description
5			On the level setting display, press the Up or Down Cursor Key to select the level of the gain setting and press the DATA/SHIFT Key for one second or more. Normally, use a setting of "normal" or less. 0: Loose = Gives priority to stability over response. (Setting will be 50% of the gain where vibration occurs or 50% of the gain limit (Pn540), Pn100 (Kv) = about 15.0 to 100.0 Hz and about one minute is required for completion.) 1: Normal = Sets both response and stability to medium-range values. (Setting will be 70% of the gain where vibration occurs or 70% of the gain limit (Pn540), Pn100 (Kv) = about 30.0 to 140.0 Hz and about three minutes are required for completion.) 2: Tight = Gives priority to response over stability. (Setting will be 80% of the gain where vibration occurs or 100% of the gain limit (Pn540), Pn100 (Kv) = about 40.0 to 200.0 Hz and about five minutes are required for completion.)
6			On the movement distance display, use the Up Cursor Key, Down Cursor Key, and DATA/SHIFT Key to set the movement distance in 1,000 reference units. Here, the movement distance is -99,990,000 to +99,990,000 in 1,000 reference units. Negative values are reverse rotation and positive values are forward. Set the movement distance from the current value from which advanced autotuning will be used. Use the Jog Mode Operation (Fn002) or other means to move to a location where a suitable range of movement is possible before executing advanced autotuning. The minimum distance of movement can be calculated by the following equation. $\text{Movement distance} \times \underbrace{\frac{\text{Pn20E}}{\text{Pn210}}}_{\text{(Electronic gear)}} \leq \text{one motor rotation}$ If the minimum distance of movement is less than the value calculated by this equation, an error will occur, and a new value must be input. Set the distance so it is as long as possible. Factory setting: 300,000 reference units (10 turns for a standard 17-bit encoder and a factory setting of the electronic gear ratio of 4/1) If 1 reference unit is 1 μm and the electronic gear ratio is set (electronic gear ratio B/A = 32768 × 4/10000, or 10 mm per motor rotation), 1 mm will be equivalent to 1,000 reference units. If the movement distance is to be set to 300 mm, as shown in the following diagram, then the setting is +300 (in units of 1,000 reference units).  The movement in the diagram will begin when the Up Cursor Key (forward direction drive) is pressed in step 7 or step 10. When the specified distances has been moved, the movement will be reversed and round-trip travel back to the starting position will be performed.

Adjustments

9

(cont'd)

Step	Display after Operation	Panel Operator	Description
7	 Blinks during calculations  (End)		Display the advanced autotuning display. Press the MODE/SET Key to turn ON the servo. In this status, press the key to the direction of movement specified on the movement distance setting display (Up Cursor Key to start forward rotation and Down Cursor Key to start reverse rotation) for one second or more to start calculating the inertia. Advanced autotuning will not start if the key that is pressed does not agree with the movement direction. To stop automatic operation, press the MODE/SET Key and return to step 2. During calculation of the inertia, the calculating value will be displayed as J □□□ with the calculating value blinking at J □□□. When calculations have been completed, the load moment of inertia will be displayed. If the moment of inertia is not calculated, the display will not blink and the current setting of the Moment of Inertia Ratio (Pn103) will be displayed (in which case, proceed to step 10).
8	 Blinks		If the autotuning operation set in step 7 cannot be started or the calculation process for inertia cannot be started, "nO OP" will blink on the display. End the operation by pressing the MODE/SET Key, remove the cause of the failure, and execute advanced autotuning again.
9	 Blinks		If the operation set in step 7 was completed normally, but the inertia could not be calculated because calculation conditions were insufficient, "Error" will blink on the display. End the operation by pressing the MODE/SET Key, change the settings, and execute advanced autotuning again.
10	 Blinks during adjustment		After the inertia has been calculated, press the Up or Down Cursor Key (press the same key as was pressed to start the operation) for one second or more. The moment of inertia ratio will be written to Pn103 and the operation will continue to set the notch filter, torque reference filter, and the gains. An automatic operation will then be performed to set the gains. "Adj" will blink on the display during autotuning. "Error" will be displayed if the gains cannot be set normally. 30 minutes may be required for completion if the gain setting level is "tight" or the Positioning Completed Width (Pn522) is exceptionally narrow. To end the processing before completion, press the MODE/SET Key and return to step 2. To end before completion, return to step 5, and reduce the gain level setting. Then, repeat this operation.
11	 Blinks for two seconds		If advanced autotuning ends successfully, "donE" will blink on the display for two seconds, and the Servo will turn OFF. Press the DATA/SHIFT Key to write the gains to the parameters, and return to step 2. Press the MODE/SET Key to return to step 2 without writing each gain. But only Pn103 (Moment of Inertia Ratio) that was written at step 10 is saved.

9.4 One-parameter Tuning

9.4.1 One-parameter Tuning

One-parameter tuning enables the four servo gains (Kv, Ti, Kp, and Tf) to be set to stable conditions merely by manipulating one autotuning level. One-parameter tuning is executed using utility function Fn01A (One-parameter Tuning).

The autotuning level is increased and decreased between 1 and 2,000 during operation to simultaneously change the Speed Loop Gain (Pn100: Kv), Speed Loop Integral Time Constant (Pn101: Ti), Position Loop Gain (Pn102: Kp), and Torque Reference Filter Time Constant (Pn401: Tf). These gains are changed to satisfy relationships determined by the autotuning mode. Vibration may occur during one-parameter tuning, so set vibration detection in Pn310 to an alarm (n.□□□2) or warning (n.□□□1). For details, refer to *7.2.15 Vibration Detection Level Initialization (Fn01B)*.

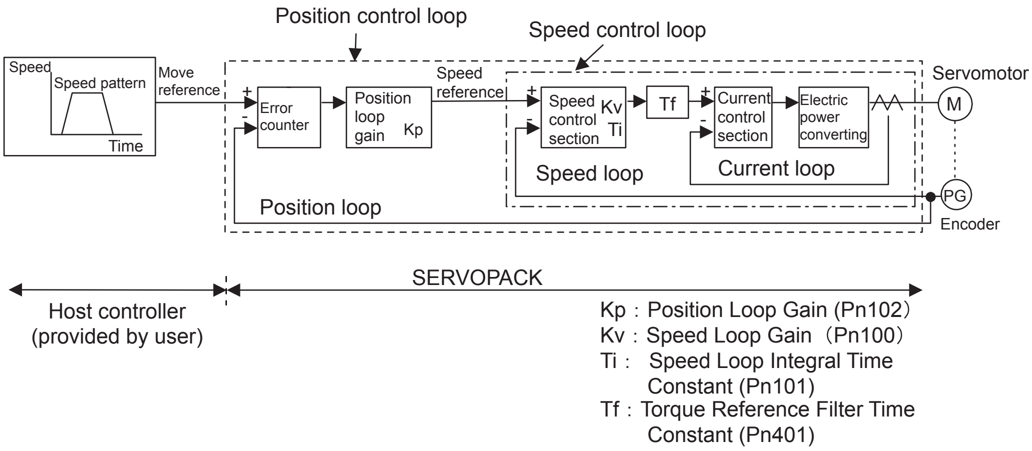
9.4.2 One-parameter Tuning Procedure

The following procedure is used for one-parameter tuning.

Step	Display after Operation	Panel Operator	Description
1	Fn000	MODE/SET (MODE/SET Key)	Press the MODE/SET Key to select the utility function mode.
2	Fn01A	▲ ▼	Press the Up or Down Cursor Key to select "Fn01A." *The digit that can be set will blink.
3	d 0	DATA/◀ (DATA/SHIFT) (More than one sec.)	Press the DATA/SHIFT Key for one second or more. The display shown at the left will appear, and the servomotor will enter one-parameter tuning mode.
4	d 0 ↓ ↑ d 1	▲ ▼	Press the Up or Down Cursor Key to select the one-parameter tuning mode. ∗Tuning Mode 0: Set servo gains with priority given to stability. 1:Set servo gains with priority given to response.
5	L0040	DATA/◀ (DATA/SHIFT)	Press the DATA/SHIFT Key. The tuning level change display shown at the left will appear.
6	L0055	▲ ▼	Press the Up Cursor Key and Down Cursor Key to change the tuning level value. The servo gains (Pn100, Pn101, Pn102, and Pn401) will also change simultaneously. One-parameter tuning is completed when the user had determined that the resulting response is acceptable.
7	donE Blinks during one sec.	MODE/SET (MODE/SET Key)	Press the MODE/SET Key to write the values of four gains to the parameters. If the values are saved normally, "donE" will blink on the display for one second. *Go to step 9 to end without saving the calculated gains.
8	L0055		"donE" will be displayed and the one-parameter gain display will return.
9	Fn01A	DATA/◀ (DATA/SHIFT) (More than one sec.)	Press the DATA/SHIFT Key for one second or more to return to the Fn01A display of the utility function mode.

9.5 Manual Servo Tuning

9.5.1 Explanation of Servo Gain



To adjust the servo gain manually, understand the configuration and characteristics of the SERVOPACK and adjust the servo gain parameters one by one. If one parameter is changed, it is almost always necessary to adjust the other parameters. It will also be necessary to make preparations such as setting up a measuring instrument to monitor the output waveform from the SERVOPACK.

The SERVOPACK has three feedback loops (i.e., position loop, speed loop, and current loop). The innermost loop must have the highest response and the middle loop must have higher response than the outermost. If this principle is not followed, it will result in vibration or responsiveness decreases.

The SERVOPACK is designed to ensure that the current loop has good response performance. The user need to adjust only position loop gain and speed loop gain.

9.5.2 Servo Gain Manual Tuning

The SERVOPACK has the following parameters for the servo gains. Setting the servo gains in the parameters can adjust the servo responsiveness.

- Pn100: Speed Loop Gain (Kv)
- Pn101: Speed Loop Integral Time Constant (Ti)
- Pn102: Position Loop Gain (Kp)
- Pn401: Torque Reference Filter Time Constant (Tf)

For the position and speed control, the adjustment in the following procedure can increase the responsiveness. The positioning time in position control can be reduced.

Perform the manual servo tuning in the following cases:

- If the advanced autotuning and one-parameter tuning did not give satisfactory results,
- To increase the servo gains by more than the values set by advanced autotuning or one-parameter tuning, or
- To determine the servo gains and moment of inertia ratio by the user.

Start manual servo tuning with the factory settings or the values which were set automatically when advanced autotuning or one-parameter tuning ended. Prepare measuring instruments such as memory recorder so that the signals can be observed from the analog monitor (CN5) such as “Torque Reference” and “Motor Speed,” and “Position Error Monitor” for the position control. (Refer to *9.7 Analog Monitor*.) The servo drive engineering tool “SigmaWin+” allows you to observe such signals. Prepare either of them.

Vibration may occur when the servo gains are being adjust. Select the vibration alarm, Pn310=n.□□□2 to detect vibration. For more information on vibration detection, refer to *7.2.15 Vibration Detection Level Initialization (Fn01B)*. The vibration alarm cannot detect all vibration. If an vibration alarm occurs, an emergency stopping device is needed to stop the machine. The customer has to provide the emergency stopping device, and use this device when vibration occurs.

- Servo Gain Manual Tuning

Step	Description
1	Increase the speed loop gain (Pn100) to within the range so that the machine does not vibrate. At the same time, decrease the speed loop integral time constant (Pn101).
2	Adjust the torque reference filter time constant (Pn401) so that no vibration occurs.
3	Repeat the steps 1 and 2. Then reduce the value for 10 to 20%.
4	For the position control, increase the position loop gain (Pn102) to within the range so that the machine does not vibrate.

9.5.3 Position Loop Gain

Pn102 Position Loop Gain (Kp) — Position

Setting Range	Setting Unit	Factory Setting	Setting Validation
10 to 20000 (1.0 to 2,000.0/s)	0.1/s	400 (40.0/s)	Immediately

The responsiveness of the position loop is determined by the position loop gain. The responsiveness increases and the positioning time decreases when the position loop gain is set to a higher value. In general, the position loop gain cannot be set higher than natural vibrating frequency of the mechanical system, so the mechanical system must be made more rigid to increase its natural vibrating frequency and allow the position loop gain to be set to a high value.

INFO

If the position loop gain (Pn102) can not be set high in the mechanical system, an overflow alarm may occur during high speed operation. In this case, increase the values in the following parameter to suppress detection of the overflow alarm.

Pn520 Excessive Position Error Alarm Level — Position

Setting Range	Setting Unit	Factory Setting	Setting Validation
1 to 1,073,741,823 (2^{30}-1)	1 Reference units	262,144	Immediately

This parameter's new setting must satisfy the following condition.

$$\text{Pn520} \geq \frac{\text{Max. feed speed (reference units/s)}}{\text{Pn102}} \times 2.0$$

When the position reference filter is used, transient error increases due to the filter time constant. Filter lag must be considered the setting.

9.5.4 Speed Loop Gain

Pn100 Speed Loop Gain (Kv) — Speed, Position, Torque

Setting Range	Setting Unit	Factory Setting	Setting Validation
10 to 20000 (1.0 to 2,000.0 Hz)	0.1 Hz	400 (40.0 Hz)	Immediately

This parameter determines the responsiveness of the speed loop. The responsiveness increases and the positioning time decreases when the position loop gain is set to a higher value. If the speed loop's responsiveness is too low, it will delay the outer position loop and cause overshooting and vibration of the speed reference. The SERVOPACK will be most stable and responsive when the speed loop gain is set as high as possible within the range that does not cause vibration in the mechanical system. The value of speed loop gain is the same as the set value of Pn100 if Pn103 (Moment of Inertia Ratio) has been set correctly.

Pn103 Moment of Inertia Ratio — Speed, Position, Torque

Setting Range	Setting Unit	Factory Setting	Setting Validation
0 to 20,000	1%	0	Immediately

$$\text{Pn103 set value} = \frac{\text{Motor axis conversion load moment of inertia } (J_L) \times 100(\%)}{\text{Servomotor rotor moment of inertia } (J_M)}$$

The factory setting is Pn103=0. Before adjusting the servo, determine the moment of inertia ratio with the equation above and set parameter Pn103.

9.5.5 Speed Loop Integral Time Constant

Pn101	Speed Loop Integral Time Constant (Ti) Speed Position			
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	15 to 51200 (0.15 to 512.00 ms)	0.01 ms	2000 (20.00 ms)	Immediately

The speed loop has an integral element so that the speed loop can respond to minute inputs. This integral element causes a delay in the SERVOPACK. If the time constant is set too long, overshooting will occur, which results in a longer positioning settling times or response decreases.
The estimated set value for Pn101 depends on the speed loop control method with Pn10B.1, as shown below.

(1) PI Control (Pn10B.1=0)

$$\text{Pn101 set value} = \frac{4000}{2\pi \times \text{Pn100 set value}}$$

Example: Pn100 = 40.0 (Hz);

$$\text{Pn101=15.92 (ms)} = \frac{4000}{2\pi \times 40.0\ \text{(Hz)}}$$

(2) IP Control (Pn10B.1=1)

$$\text{Pn101 set value} = \frac{2000}{2\pi \times \text{Pn100 set value}}$$

Example: Pn100 = 40.0 (Hz);

$$\text{Pn101=7.96 (ms)} = \frac{2000}{2\pi \times 40.0\ \text{(Hz)}}$$

In cases where the load moment of inertia is large and there are vibration elements in the mechanical system, vibrations may occur in the equipment unless Pn101 is set to a value somewhat higher than the estimated set value derived from the equation above.

INFO

■ Selecting the Speed Loop Control Method (PI Control or I-P Control)

Generally, I-P control is more effective in high-speed positioning or high-speed/precision manufacturing applications. The position loop gain is lower than it would be in PI control, so shorter positioning times and smaller arc radii can be achieved. On the other hand, PI control is generally used when switching to P control fairly often with a mode switch or other method.

9.5.6 Guidelines for Manual Tuning of Servo Gains

Throughly read the instructions given in the user's manual prior to manually tuning the parameters, and use the following guidelines to set the parameters to the optimum values. The parameter settings differ depending on the conditions of the connected machine. Run the machine, and then adjust the settings of parameters while checking the operation status displayed in SigmaWin, on the analog monitor, and so on. If a run command is executed, the operation may become unstable. Execute a run command, start the servomotor, and adjust the servo gains.

In this section, the guidelines for the manual tuning of servo gains are given using two setting ranges: the range for stable the operation and the setting range.

The parameters are regarded as well balanced when they are set to the values within the range for stable operation.

If the set value is within the allowable setting range but out of the range for stable operation, some interference may occur. Some machine conditions may cause overshooting or vibration and result in unstable operations. If the set value is out of the setting range, the operation may become so unstable as to cause the motor shaft to vibrate abnormally or more wildly. Never set a parameter to a value outside of the setting range.

If using a torque-reference filter, a second torque-reference filter, and a notch filter together, keep a sufficient margin between settings so a series of problems will not occur between each filter and the speed-loop gain.

IMPORTANT

The following guidelines are given under the condition that the parameter Pn103 (Moment of Inertia Ratio) is set correctly in accordance with the specifications of the machine that is connected.

(1) When Pn10B.1 = 0 (PI Control)

- Speed Loop Gain and Position Loop Gain

  Pn100 [Hz]   Pn102 [/s]

  Setting Range for Stable Operation: Pn102 [/s] $\leq 2\pi \times$ Pn100 / 4 [Hz]

  Allowable Setting Range: Pn102 [/s] $< 2\pi \times$ Pn100 [Hz]

- Speed Loop Gain and Speed Loop Integral Time Constant

  Pn100 [Hz]   Pn101 [ms]

  Setting Range for Stable Operation: Pn101 [ms] $\geq$ 4000 / ($2\pi \times$ Pn100 [Hz])

  Allowable Setting Range: Pn101[ms] > 1000 / ($2\pi \times$ Pn100[Hz])

- Speed Loop Gain and Torque Filter Time Constant

  Pn100 [Hz]   Pn401 [ms]

  Setting Range for Stable Operation: Pn401[ms] $\leq$ 1000 / ($2\pi \times$ Pn100 [Hz] $\times$ 4)

  Allowable Setting Range: Pn401 [ms] < 1000 / ($2\pi \times$ Pn100[Hz] $\times$ 1)

- Speed Loop Gain and Second Torque Reference Filter Frequency

  Pn100 [Hz]   Pn40F [Hz]

  Allowable Setting Range: Pn40F[Hz] > 4 $\times$ Pn100[Hz]

  Note: Set the parameter Pn410 (Second Torque Reference Filter Q Value) to 0.70.

- Speed Loop Gain and Notch Filter Frequency

  Pn100 [Hz]   Pn409 (or Pn40C) [Hz]

  Allowable Setting Range: Pn409[Hz] > 4 $\times$ Pn100[Hz]

- Speed Loop Gain and Speed Feedback Filter

  Pn100 [Hz]   Pn308 [ms]

  Setting Range for Stable Operation: Pn308 [ms] $\leq$ 1000 / ($2\pi \times$ Pn100 [Hz] $\times$ 4)

  Allowable Setting Range: Pn308[ms] < 1000 / ($2\pi \times$ Pn100 [Hz] $\times$ 1)

(2) When Pn10B.1 = 1 (IP Control)

The relation between the Speed Loop Integral Time Constant, the Speed Loop Gain, and the Position Loop Gain in the IP control mode is different from that in the PI control mode. The relation with other servo gain related parameters is the same as for PI control.

- Speed Loop Gain and Speed Loop Integral Time Constant

  Pn100 [Hz]   Pn101 [ms]

  Setting Range for Stable Operation: Pn100 [Hz] $\geq$ 320 / Pn101 [ms]

- Position Loop Gain and Speed Loop Integral Time Constant

  Pn102 [/s]   Pn101 [ms]

  Setting Range for Stable Operation: Pn102 [/s] $\leq$ 320 / Pn101[ms]

INFO

■ Parameters for Gain Switching Function

The relation with the following parameters must be taken into consideration as well.

Pn104, Pn105, Pn106, Pn412, Pn12B, Pn12C, Pn12D, Pn413, Pn12E, Pn12F, Pn130, and Pn414

■ Decimal Point in Parameter Setting

For SGDS SERVOPACKs, the parameter settings are shown with a decimal point on the digital operator and in the manuals. For example, the setting of Pn100 (Speed Loop Gain) is shown as Pn100 = 40.0. This means that the Pn100 is set to 40.0 Hz. The guidelines for the manual tuning of servo gains should be read as shown in the following example.

Example: Speed Loop Gain and Speed Loop Integral Time

Pn100 [Hz] Pn101 [ms]

Setting Range for Stable Operation: Pn101[ms] $\geq$ 4000 / ($2\pi \times$ Pn100 [Hz])

If Pn100 = 40.0 [Hz]

then Pn101 = 4000 / ($2\pi \times 40.0$) $\approx$ 15.92 [ms]

■ How to Adjust Servo Gains

After changing the setting of one of the servo gain related parameters, the settings of the other parameters must also be adjusted accordingly. Therefore, do not drastically change the setting of only one parameter. Gradually adjust the setting of each servo gain related parameter by approximately 5% of the given value each time. And, use the following procedure to adjust the parameters.

- To increase response speed
  1. Decrease the value of the Torque Reference Filter Time Constant.
  2. Increase the value of the Speed Loop Gain.
  3. Decrease the value of the Speed Loop Integral Time Constant.
  4. Increase the value of the Position Loop Gain.

- To decrease the response speed or to stop vibrations and overshooting
  1. Decrease the value of the Position Loop Gain
  2. Increase the value of the Speed Loop Integral Time Constant
  3. Decrease the value of the Speed Loop Gain.
  4. Increase the value of the Torque Filter Time Constant.

9.5.7 Safety Precautions on Adjustment of Servo Gains

⚠ CAUTION
• If adjusting the servo gains, observe the following precautions. • Do not touch the rotating section of the motor while power is being supplied to the motor. • Before starting the servomotor, make sure that the emergency-stop circuit works correctly. • Make sure that a trial run has been performed as described in *8.1 Trial Operation*. • Install a safety brake on the machine.

Yaskawa recommends that the following protective functions of the SERVOPACK are set to the correct settings before starting to adjust the servo gains.

- Enable the overtravel function.
- Set the torque limit.
- Set the excessive position error alarm level.
- Set the vibration detection function.
- Set the excessive position error alarm level for when the servo is turned ON.
- Set the excessive position error level between the motor and the load for fully-closed control.

(1) Overtravel Function

Yaskawa recommends the use of the overtravel function. For details on how to set the overtravel function, refer to *8.3.3 Setting the Overtravel Limit Function*.

(2) Torque Limit

Calculate the torque required to operate the machine. Set the torque limits so that the output torque will not be greater than requred. Setting the torque limits can reduce the amount of shock applied to the machine in collisions and other cases.

Use the following parameters to set the torque limits.

Pn402: Forward Torque Limit [%]

Pn403: Reverse Torque Limit [%]

(3) Excessive Position Error Alarm Level

When using a servo drive in position control mode, the Excessive position error level can be set. For the optimum setting, the servomotor will be stopped after the error occurs if the servomotor performs unpredictably after receiving a command.

The position error is the difference between the position reference and the actual position. The position error can be calculated from the position loop gain and the motor speed with the following equation.

- $$\text{Position Error} = \frac{\text{Motor Speed [min}^{-1}\text{]}}{60} \times \frac{\text{Number of Pulses per Motor Rotation [Reference unit]}}{\text{Pn102} \,/\, 10}$$

  Note: Pn102: Position Loop Gain [0.1/s]

- Excessive Position Error Alarm Level (Pn520 [reference unit])

$$\text{Pn520} > \frac{\text{Max. Motor Speed [min}^{-1}\text{]}}{60} \times \frac{\text{Number of Pulses per Motor Rotation [Reference unit]}}{\text{Pn102} \,/\, 10} \times (1.2 \text{ to } 2)$$

Set the level to a value that satisfies these equations, and no alarm will be generated during normal operation. The servomotor will be stopped, however, if the servomotor runs unpredictably after a command is input or if a position error in accordance with the value set in Pn520 occurs. At the end of the equation, a coefficient is shown as "× (1.2 to 2)." This coeffient is used to add a margin that prevents a faulty alarm from occurring in actual operation of the servomotor.

If the acceleration/deceleration of the position reference exceeds the capacity of the servomotor, the servomotor cannot perform at the requested speed, and the allowable level for position error will be increased as not to satisfy these equations. If so, lower the level of the acceleration/deceleration for the position reference so that the servomotor can perform at the requested speed or raise the allowable level of the position errors.

(4) Vibration Detection Function

Yaskawa recommends that the vibration detection function is set to an appropriate value. For details on how to set the vibration detection function, refer to *7.2.5 Initialize Parameter Settings (Fn005)*.

(5) Excessive Position Error Alarm Level at Servo ON

If Pn200.2 (Clear Operation) is set to value other than zero, the position error pulses will remain at the baseblock. If the servomotor is moved by an external force while it is being base-blocked, the servomotor will return to the original position so that the position error pulses are cleared and reset to zero after the servo is turned ON. This setting is used to limit such motions and to detect any errors.

The parameter Pn529 (Speed Limit Level at Servo ON) is used to limit the servomotor speed when returning to the original position to clear the accumulated position error pulses and reset the pulses to 0. The speed will be limited until the position error pulses are reset to 0.

An error will occur and the alarm A.d02 (Position Error Pulses Overflow Alarm by Speed Limit at Servo ON) will be generated if the number of position error pulses accumulated until the servo is turned ON is greater than the setting of Pn526 (Excessive Position Error Alarm Level at Servo ON).

(6) Excessive Error Level Between Servomotor and Load Positions

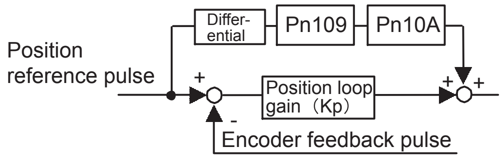
If using a SGDS-□□□02A servomotor with specifications for a fully-closed interface. Yaskawa recommends the use of the vibration detection function. For details, refer to *10.2 Serial Converter Unit*.

9.6 Advanced Manual Servo Tuning Functions

9.6.1 Feed-forward Reference

Parameter	Name			Control
Pn109	Feed Forward Gain			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 100	1%	0	Immediately
Pn10A	Feed Forward Filter Time Constant			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 6400 (0.00 to 64.00 ms)	0.01ms	0 (0.00ms)	Immediately

Applies feed-forward control[1] compensation in position control inside the SERVOPACK. Use this parameter to shorten positioning time. Too high value may cause the machine to vibrate. For ordinary machines, set 80% or less in this parameter.



TERMS

[1]Feed-forward Control

Feed-forward control is a control method that makes necessary control corrections in advance before the control system is affected by an external disturbance. Feed-forward control can increase the effective servo gain and improve the responsiveness of the system.

9.6.2 Torque Feed-forward

Parameter		Meaning
Pn002	n.□□□0	Disabled
	n.□□□2	Uses T-REF terminal for torque feed-forward input.

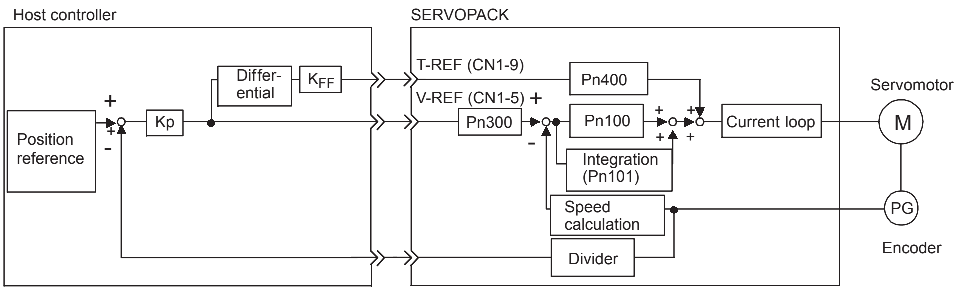
Pn400	Torque Reference Input Gain	Speed Position Torque		
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	10 to 100 (1.0 to 10.0V/Rated torque)	0.1V/Rated torque	30 (3.0 V/Rated torque)	Immediately

The torque feed-forward function is valid only in speed control and position control.

The torque feed-forward function shortens positioning time, differentiates a speed reference at the host controller to generate a torque feed-forward reference, and inputs the torque feed-forward reference together with the speed reference to the SERVOPACK.

Too high a torque feed-forward value will result in overshooting or undershooting. To prevent such troubles, set the optimum value while observing the system responsiveness.

Connect a speed reference signal line to V-REF (CN1-5 and -6) and a torque forward-feed reference to T-REF (CN1-9 and -10) from the host controller.



Kp: Position loop gain

K_{FF}: Feed-forward gain

Torque feed-forward is set using the parameter Pn400.

The factory setting is Pn400 = 30. If, for example, the torque feed-forward value is ±3V, then, the torque is limited to ±100% of the rated torque.

The torque feed-forward function cannot be used with torque limiting by analog voltage reference described in *8.9.3 Torque Limiting Using an Analog Voltage Reference*.

9.6.3 Speed Feed-forward

Parameter		Meaning
Pn207	n.□□0□	Disabled
	n.□□1□	Uses V-REF terminal for speed feed-forward input.

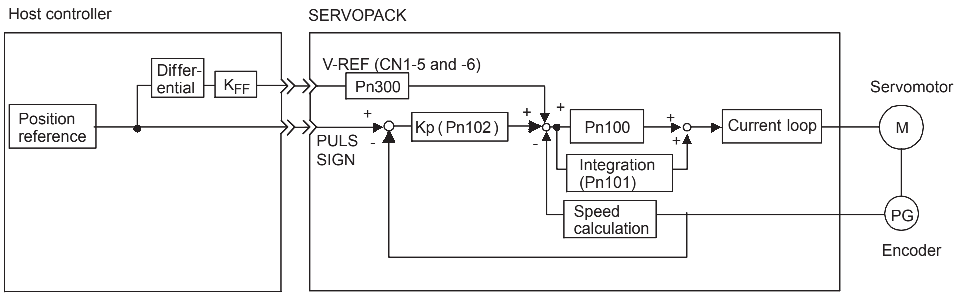
Pn300	Speed Reference Input Gain (Speed, Position, Torque)			
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	150 to 3,000 (1.50 to 30.00 V/Rated speed)	0.01 V/Rated speed	600 (6.00 V/Rated torque)	Immediately

The speed feed-forward function uses analog voltages and is valid only in position control.

The speed feed-forward function is used to shorten positioning time. The host controller differentiates the position reference to generate the feed-forward reference, and inputs the feed-forward reference together with the position reference to the SERVOPACK.

Too high a speed feed-forward value will result in overshooting or undershooting. To prevent such troubles, set the optimum value while observing the system responsiveness.

Connect a position reference signal line to PULS and SIGN (CN1-7, -8, -11, and -12) and a speed feed-forward reference signal line to V-REF (CN1-5 and -6) from the host controller.



Kp: Position loop gain

K_{FF}: Feed-forward gain

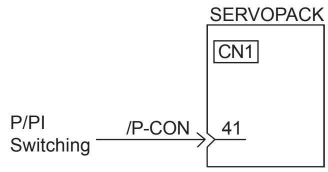
Speed feed-forward value is set using the parameter Pn300.

The factory setting is Pn300 = 6.00. If, for example, the speed feed-forward value is ±6V, then the speed is limited to the rated speed.

9.6.4 Proportional Control Operation (Proportional Operation Reference)

If parameter Pn000.1 is set to 0 or 1 as shown below, the /P-CON input signal serves as switch to change between PI control and P control.

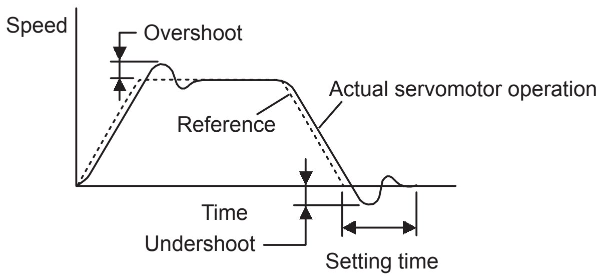
- PI control: Proportional/Integral control.
- P control: Proportional control

<table>
<tr><th colspan="2">Parameter</th><th colspan="3">Control Mode</th></tr>
<tr><td rowspan="2">Pn000</td><td>n.□□0□</td><td>Speed Control</td><td rowspan="2">Effective in speed control or position control.
Input signal /P-CON (CN1-41) is used to select PI control or P control.
<table><tr><td>CN1-41 is OFF (H level).</td><td>PI control</td></tr><tr><td>CN1-41 is ON (L level).</td><td>P control</td></tr></table></td><td rowspan="2"></td></tr>
<tr><td>n.□□1□</td><td>Position Control</td></tr>
<tr><td colspan="5">• When sending references from the host controller to the SERVOPACK, P control mode can be selected from the host controller for particular operating conditions. This mode switching method can be used to suppress overshooting and shorten the settling time. Refer to 9.6.5 Using the Mode Switch (P/PI Switching) for more details on inputting the /P-CON signal and switching the control mode for particular operating conditions.
• If PI control mode is being used and the speed reference has a reference offset, the motor may rotate very slowly and fail to stop even if 0 is specified as the speed reference. In this case, use P control mode to stop the motor.</td></tr>
</table>

9.6.5 Using the Mode Switch (P/PI Switching)

Use the mode switch (P/PI switching) function in the following cases:

- To suppress overshooting during acceleration or deceleration (for speed control)
- To suppress undershooting during positioning and reduce the settling time (for position control)



The mode switch function automatically switches the speed control mode from PI control mode to P control[1] mode based on a comparison between the servo's internal value and a user-set detection level.

TERMS

[1] From PI control to P control

PI control means proportional/integral control and P control means proportional control. In short, switching "from PI control to P control" reduces effective servo gain, making the SERVOPACK more stable.

Adjustments

9

IMPORTANT

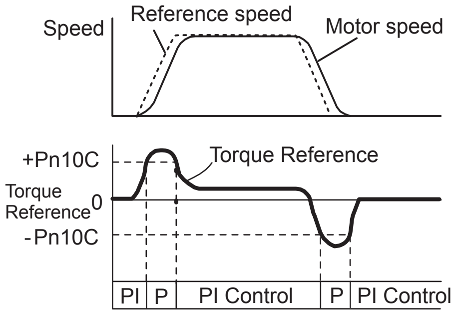
1. The mode switch function is used in very high-speed positioning when it is necessary to use the servo drive near the limits of its capabilities. The speed response waveform must be observed to adjust the mode switch.
2. For normal use, the speed loop gain and position loop gain set by autotuning provide sufficient speed/position control. Even if overshooting or undershooting occur, they can be suppressed by setting the host controller's acceleration/deceleration time constant, the SERVOPACK's Soft Start Time Constants (Pn305, Pn306), or Position Reference Acceleration/Deceleration Time Constant (Pn216).

(1) Selecting the Mode Switch Setting

The SERVOPACK provides the following four mode switch settings (0 to 3). Select the appropriate mode switch setting with parameter Pn10B.0.

Parameter		Mode Switch Selection	Parameter Containing Detection Point Setting	Setting Units
Pn10B	n.□□□0	Use a torque reference level for detection point. (Factory setting)	Pn10C	Percentage of rated torque: %
	n.□□□1	Use a speed reference level for detection point.	Pn10D	Motor speed: min^{-1}
	n.□□□2	Use an acceleration level for detection point.	Pn10E	Motor acceleration: 10 $(min^{-1})/s$
	n.□□□3	Use an position error pulse level for detection point.	Pn10F	Reference unit
	n.□□□4	Do not use mode switch function.	–	–
Select the conditions to switch modes (P or PI control switching). The settings are already valid, so the SERVOPACK does not have to be restarted.				

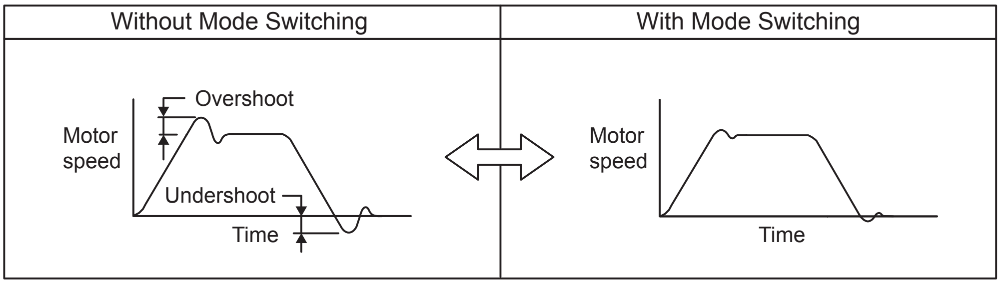
Using the Torque Reference Level to Switch Modes (Factory Setting)



With this setting, the speed loop is switched to P control when the value of torque reference input exceeds the torque set in parameter Pn10C. The factory default setting for the torque reference detection point is 200% of the rated torque (Pn10C = 200).

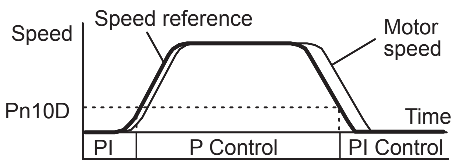
■ Operating Example

If the mode switch function is not being used and the SERVOPACK is always operated with PI control, the speed of the motor may overshoot or undershoot due to torque saturation during acceleration or deceleration. The mode switch function suppresses torque saturation and eliminates the overshooting or undershooting of the motor speed.



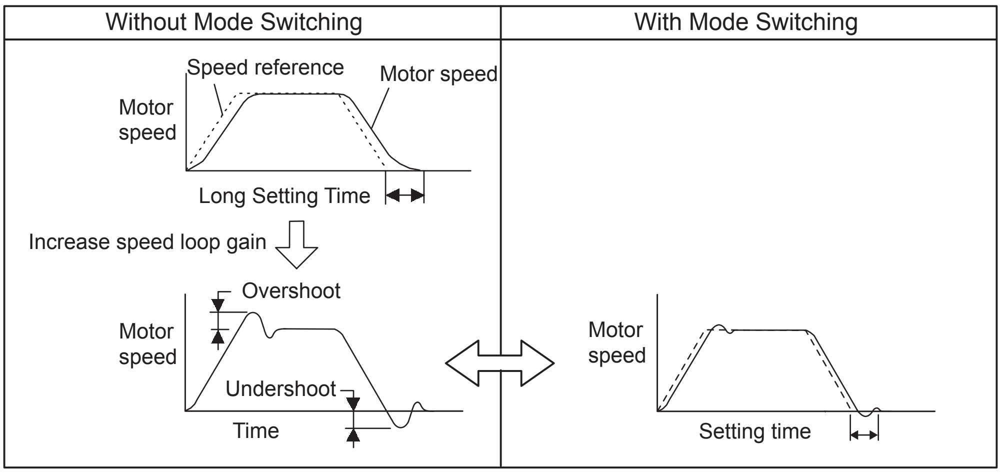
Using the Speed Reference Level to Switch Modes

With this setting, the speed loop is switched to P control when the value of speed reference input exceeds the speed set in parameter Pn10D.



■ Operating Example

In this example, the mode switch is used to reduce the settling time. It is necessary to increase the speed loop gain to reduce the settling time. Using the mode switch suppresses overshooting and undershooting when speed loop gain is increased.

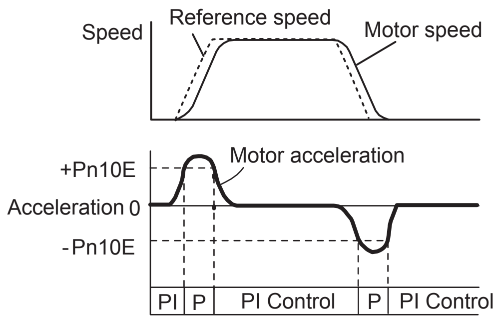


Adjustments

9

Using the Acceleration Level to Switch Modes

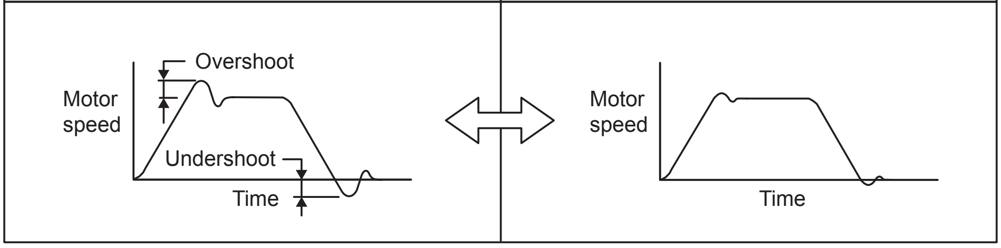
With this setting, the speed loop is switched to P control when the motor's acceleration rate exceeds the acceleration rate set in parameter Pn10E.



■ Operating Example

If the mode switch function is not being used and the SERVOPACK is always operated with PI control, the speed of the motor may overshoot or undershoot due to torque saturation during acceleration or deceleration. The mode switch function suppresses torque saturation and eliminates the overshooting or undershooting of the motor speed.

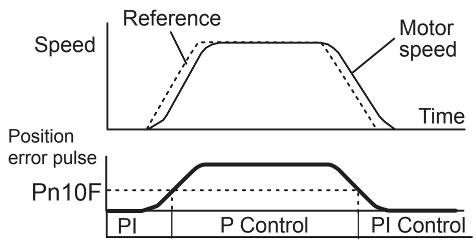
Without Mode Switching	With Mode Switching



Using the Error Pulse Level to Switch Modes

This setting is effective with position control only.

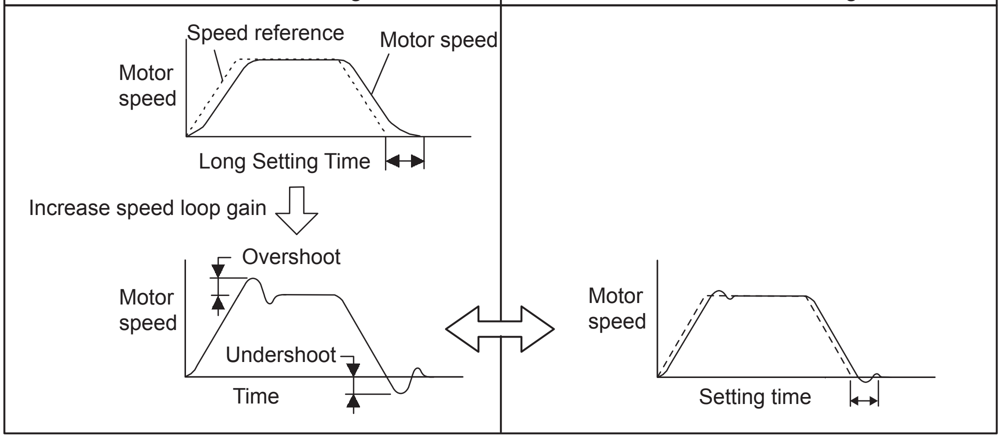
With this setting, the speed loop is switched to P control when the position error pulse exceeds the value set in parameter Pn10F.



■ Operating Example

In this example, the mode switch is used to reduce the settling time. It is necessary to increase the speed loop gain to reduce the settling time. Using the mode switch suppresses overshooting and undershooting when speed loop gain is increased.

Without Mode Switching	With Mode Switching



9.6.6 Setting the Speed Bias

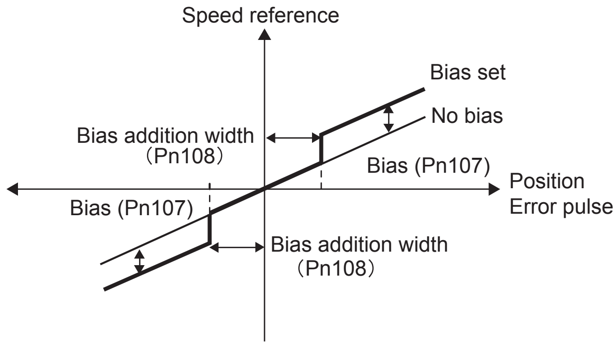
The settling time for positioning can be reduced by setting the following parameters to add bias in the speed reference block in the SERVOPACK.

Pn107	Bias			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 450	1 min^{-1}	0	Immediately

Pn108	Bias Addition Width			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 250	1 Reference units	7	Immediately

To reduce the positioning time, set these parameters based on the machine's characteristics.

The Bias Addition Width (Pn108) specifies when the Bias (Pn107) is added and the width is expressed in position error pulse units. The bias input will be added when the position error pulse value exceeds the width set in Pn108.



9.6.7 Speed Feedback Filter

Pn308	Speed Feedback Filter Time Constant		Speed	Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 65535 (0.00 to 655.35 ms)	0.01ms	0 (0.00ms)	Immediately
Sets the 1st-order filter for the speed loop's speed feedback. Makes the motor speed smoother and reduces vibration. If the set value is too high, it will introduce a delay in the loop and cause poor responsiveness.				

9.6.8 Speed Feedback Compensation

The speed feedback compensation can be used to reduce vibration and allow a higher speed loop gain to be set. In the end, the speed feedback compensation allows the positioning settling time to be reduced because the position loop gain can also be increased if the speed loop gain can be increased.

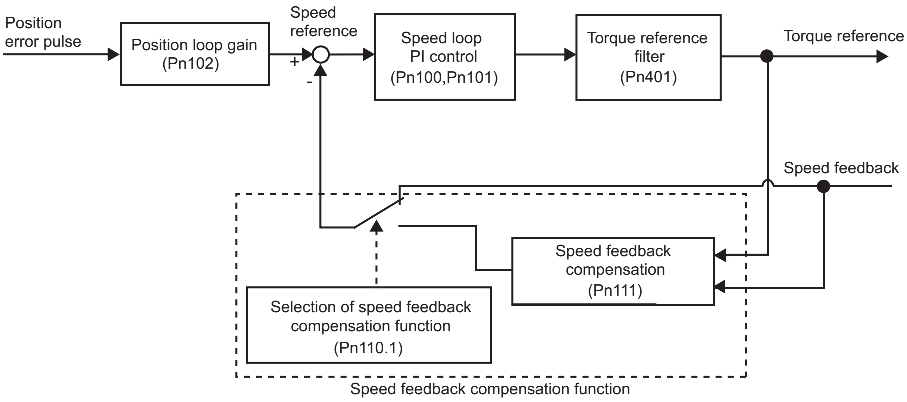
Pn110	Online Autotuning Switches		Speed	Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	–	–	0010	After restart

Pn111	Speed Feedback Compensation Gain		Speed	Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 500	1%	100	Immediately

Parameter		Function
Pn110	n.□□**0**□	Speed feedback compensation is used.
	n.□□**1**□	Speed feedback compensation is not used. (Standard speed feedback)

IMPORTANT

When this function is used, it is assumed that the moment of inertia ratio set in Pn103 is correct. Verify that the moment of inertia ratio has been set correctly.



(1) Adjustment Procedure

The following procedure explains how to adjust when the speed loop gain cannot be increased due to vibrations in the mechanical system. When adding a speed feedback compensation, observe the position error and torque reference with the analog monitor (Refer to *9.7 Analog Monitor*) while adjusting the servo gain.

1. Set parameter Pn110 to “0002,” to use the speed feedback compensation, and disable the normal autotuning function.
2. With PI control, gradually increase the Speed Loop Gain in Pn100 and reduce the Speed Loop Integral Time Constant Pn101, setting the Position Loop Gain in Pn102 to the same value as that of the Speed Loop Gain in Pn100.

   Use the result from the following equation as a initial estimate when setting the Speed Loop Integral Time Constant in Pn101.

   $$\text{Speed loop integral time constant (Pn101)} = \frac{4000}{2\pi \times \text{Pn100}}$$

   Speed loop gain units: 0.1 Hz

   Check the units when setting the Speed Loop Integral Time Constant in Pn101. The value in Pn101 is set in units of 0.01 ms.

   Set the same value for the speed loop gain and position loop gain even though the speed loop gain units (0.1 Hz) are different form the position loop gain units (0.1/s).
3. Repeat step 2 to increase the speed loop gain while monitoring the settling time with the analog monitor’s position error and checking whether vibration occurs in the torque reference. If there is any vibrating noise or noticeable vibration, gradually increase the Torque Reference Filter Time Constant in Pn401.
4. Gradually increase only the position loop gain. When it has been increased about as far as possible, then decrease the Speed Feedback Compensation in Pn111 from 100% to 90%. Then repeat steps 2 and 3.
5. Decrease the speed feedback compensation to a value lower than 90%. Then repeat steps 2 through 4 to shorten the settling time. If the speed feedback compensation is too low, however, the response waveform will oscillate.
6. Find the parameter settings that yield the shortest settling time without causing vibration or instability in the position error or torque reference waveform being observed with the analog monitor.
7. The servo gain adjustment procedure is complete when the positioning time cannot be reduced any more.

IMPORTANT	The speed feedback compensation usually makes it possible to increase the speed loop gain and position loop gain. Once the speed loop gain and position loop gain have been increased, the machinery may vibrate significantly and may even be damaged if the compensation value is changed significantly or Pn110.1 is set to “1” (i.e., speed feedback compensation disabled).

9.6.9 Switching Gain Settings

Two gain switching functions are available, manual switching and automatic switching. The manual switching function uses an external input signal to switch gains, and the automatic switching function switches gains automatically. The manual switching function uses the external input signals, /G-SEL1 and /G-SEL2, to switch between gain settings 1 through 4. The following tables list the gains and parameters to be switched.

(1) Gain Switch Settings

Parameter Settings	Switching Setting		Setting
	/G-SEL2	/G-SEL1	
Pn139=n.□□□0 Manual Gain Switching	OFF (H level)	OFF (H level)	Gain Setting 1
	OFF (H level)	ON (L level)	Gain Setting 2
	ON (L level)	OFF (H level)	Gain Setting 3
	ON (L level)	ON (L level)	Gain Setting 4

(2) Gain Combinations for Switching

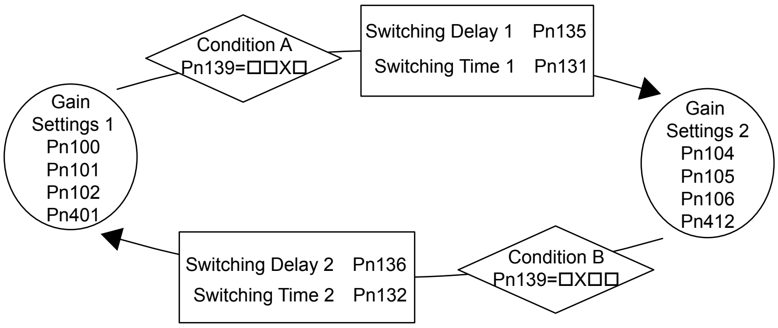
Setting	Speed Loop Gain	Speed Loop Integral Time Constant	Position Loop Gain	Torque Reference Filter
Gain Setting 1	Pn100 Speed Loop Gain	Pn101 Speed Loop Integral Time Constant	Pn102 Position Loop Gain	Pn401 Torque Reference Filter Time Constant
Gain Setting 2	Pn104 Speed Loop Gain #2	Pn105 Speed Loop Integral Time Constant #2	Pn106 Position Loop Gain #2	Pn412 Torque Reference Filter Time Constant #2
Gain Setting 3	Pn12B Speed Loop Gain #3	Pn12C Speed Loop Integral Time Constant #3	Pn12D Position Loop Gain #3	Pn413 Torque Reference Filter Time Constant #3
Gain Setting 4	Pn12E Speed Loop Gain #4	Pn12F Speed Loop Integral Time Constant #4	Pn130 Position Loop Gain #4	Pn414 Torque Reference Filter Time Constant #4

Automatic Gain Switching switches the setting between the gain settings 1 and 2 when the SERVOPACK status satisfies the switching conditions set in the parameter Pn139: From gain setting 1 to 2 when Condition A is met, and from gain setting 2 to 1 when Condition B is met.

The Switching Delay stays unchanged if the switching conditions are met. This function is effective when the switching conditions are not stable or precise timing is required. To minimize shocks when switching gains, set the Switching Time so that the gain can be changed smoothly in a linear pattern. The Switching Delay and the Switching Time can be set for switching from gain switching 1 to 2 and from 2 to 1 respectively as shown in the following figure.

(3) Automatic Gain Switch Pattern

Automatic switching pattern 1 (Pn139.0=1)

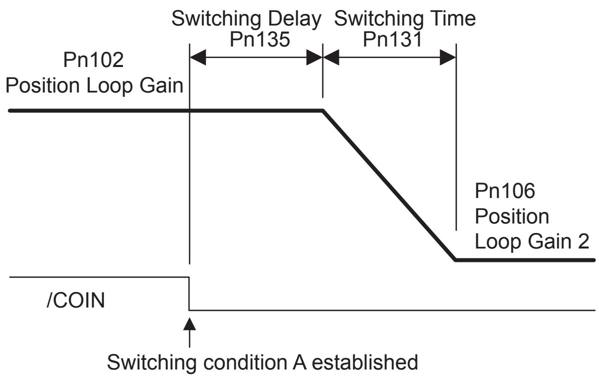


(4) Automatic Gain Switch Settings

Parameter Settings	Switching Setting	Setting	Switching Delay	Switching Time
Pn139=n.□□□1 (Automatic Switching Pattern 1)	Condition A established. Pn139=□□X□	Gain Settings 1 to Gain Settings 2	Switching Delay 1 Pn135	Switching Time 1 Pn131
	Condition B established. Pn139=□X□□	Gain Settings 2 to Gain Settings 1	Switching Delay2 Pn136	Switching Time 2 Pn132
When the control method switching function is used, changing position control into other control method results in "positioning completed signal (/COIN) ON", "NEAR signal (/NEAR) ON" and "position reference filter output = 0 and reference pulse input OFF". So, if the control method is changed from position control to another method, either one of the gains that correlates to the switching conditions set at Pn139, such as the positioning completed signal (/COIN) being ON, the NEAR signal (/NEAR) being ON or the position reference filter output being equal to 0 when the reference pulse input is OFF, is selected.				

(5) Gain Switching Delay and Switching Time

The following diagram shows the relationship between the gain switching delay and the switching time.
In this example, the "positioning completed signal (/COIN) ON" condition is set as condition A for automatic gain switching pattern 1. The position loop gain is switched from the value in Pn102 (Position Loop Gain) to the value in Pn106 (Position Loop Gain #2). When the /COIN signal goes ON, the switching operation begins after the delay set in Pn135. The switching operation changes the position loop gain linearly from Pn102 to Pn106 over the switching time interval set in Pn131.



Automatic gain switching is available in the standard PI and I-P controls and in the Less Deviation Control. The setting method for the Switching Setting Condition and the settings for the Switching Delay and the Switching Time are the same as those for the PI and I-P controls. For details on how to adjust the less deviation control, refer to *9.6.11 Less Deviation Control*.

(6) Switchable Gain Combinations for Less Deviation Control

Setting	Servo Rigidity	Speed Feedback Filter Time Constant	Integral Compensation Processing Pn1A7=n.□□□X			
			0	1	2	3
Gain Settings 1	Pn1A0 Servo Rigidity	Pn1A2 Speed Feedback Filter Time Constant	No integral compensation	Use integral compensation.	Use integral compensation.	No integral compensation
Gain Settings 2	Pn1A1 Servo Rigidity #2	Pn1A3 Speed Feedback Filter Time Constant #2	No integral compensation	Use integral compensation.	No integral compensation	Use integral compensation.

IMPORTANT

Observe the following precautions when using the gain switching function.

- The gain switching function is compatible with the PI control and the I-P control or the less deviation control.
- The primary gain settings (Gain Settings 1) will be set if the automatic switching operation is interrupted by a servo OFF signal or an alarm. If manual gain switching is interrupted, the gain settings specified by the input signals, /G-SEL1 and /G-SEL2, will be set.

(7) Related Parameters

Parameter		Function	
Pn139	n.□□□0	Manual gain switching	
	n.□□□1	Automatic switching pattern 1	
	n.□□0□	Switching condition A	Positioning completion signal (/COIN) ON
	n.□□1□		Positioning completion signal (/COIN) OFF
	n.□□2□		Positioning near signal (/NEAR) ON
	n.□□3□		Positioning near signal (/NEAR) OFF
	n.□□4□		No output for position reference filter and Reference pulse input OFF
	n.□□5□		Position reference pulse input ON
	n.□0□□ ⋮ n.□5□□	Switching condition B	Same as above.

Pn104	2nd Speed Loop Gain (Speed, Position)			
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	10 to 20000 (1.0 to 2,000.0 Hz)	0.1 Hz	400 (40.0 Hz)	Immediately
Pn105	2nd Speed Loop Integral Time Constant (Speed, Position)			
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	15 to 51200 (0.15 to 512.00 ms)	0.01 ms	2000 (20.00 ms)	Immediately
Pn106	2nd Position Loop Gain (Position)			
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	10 to 20000 (1.0 to 2,000.0/s)	0.1/s	400 (40.0/s)	Immediately
Pn412	1st Step 2nd Torque Reference Filter Time Constant (Speed, Position, Torque)			
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 65535 (0.00 to 655.35 ms)	0.01 ms	100 (1.00 ms)	Immediately

Adjustments

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Pn12B	3rd Speed Loop Gain		Speed	Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	10 to 20000 (1.0 to 2,000.0 Hz)	0.1 Hz	400 (40.0 Hz)	Immediately

Pn12C	3rd Speed Loop Integral Time Constant		Speed	Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	15 to 51200 (0.15 to 512.00 ms)	0.01 ms	20000 (20.00 ms)	Immediately

Pn12D	3rd Position Loop Gain			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	10 to 20000 (1.0 to 2,000.0/s)	0.1/s	400 (40.0/s)	Immediately

Pn413	1st Step 3rd Torque Reference Filter Time Constant		Speed	Position Torque
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 65535 (0.00 to 655.35 ms)	0.01 ms	100 (1.00 ms)	Immediately

Pn12E	4th Speed Loop Gain		Speed	Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	10 to 20000 (1.0 to 2,000.0 Hz)	0.1 Hz	400 (40.0 Hz)	Immediately

Pn12F	4th Speed Loop Integral Time Constant		Speed	Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	15 to 51200 (0.15 to 512.00 ms)	0.01 ms	20000 (20.00 ms)	Immediately

Pn130	4th Position Loop Gain			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	10 to 20000 (1.0 to 2,000.0/s)	0.1/s	400 (40.0/s)	Immediately

Pn414	1st Step 4th Torque Reference Filter Time Constant		Speed	Position Torque
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 65535 (0.00 to 655.35 ms)	0.01 ms	100 (1.00 ms)	Immediately

(8) Parameters for Automatic Gain Switching

Pn131	Gain Switching Time 1		Speed	Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 65,535	1 ms	0	Immediately

Pn132	Gain Switching Time 2		Speed	Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 65,535	1 ms	0	Immediately

Pn135	Gain Switching Watching Time 1		Speed	Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 65,535	1 ms	0	Immediately

Pn136	Gain Switching Watching Time 2		Speed	Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 65,535	1 ms	0	Immediately

(9) Parameters for Less Deviation Control

Pn1A0	Servo Rigidity			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 500	1%	60	Immediately

Pn1A1	Servo Rigidity 2			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 500	1%	60	Immediately

Pn1A2	Speed Feedback Filter Time Constant			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	30 to 3200 (0.30 to 32.00 ms)	0.01 ms	72 (0.72 ms)	Immediately

Pn1A3	Speed Feedback Filter Time Constant 2			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	30 to 3200 (0.30 to 32.00 ms)	0.01 ms	72 (0.72 ms)	Immediately

Pn1A7	Auxiliary Control Switches			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	–	–	1121	Immediately

Parameter		Function
Pn1A7	n.□□□0	Do not perform integral compensation processing.
	n.□□□1	Perform integral compensation processing. (Factory setting)
	n.□□□2	Use gain switching without position error. Perform integral compensation on Gain Settings 1. Do not perform integral compensation on Gain Settings 2.
	n.□□□3	Use gain switching without position error. Do not perform integral compensation on Gain Settings 1. Perform integral compensation on Gain Settings 2.

Adjustments

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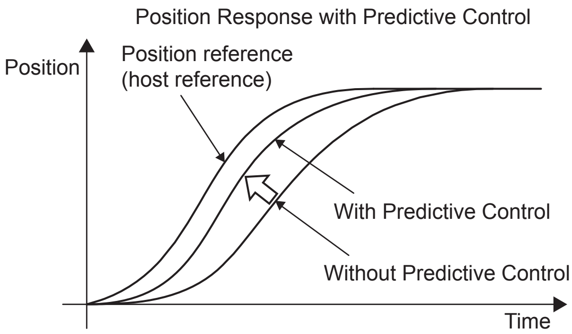
9.6.10 Predictive Control

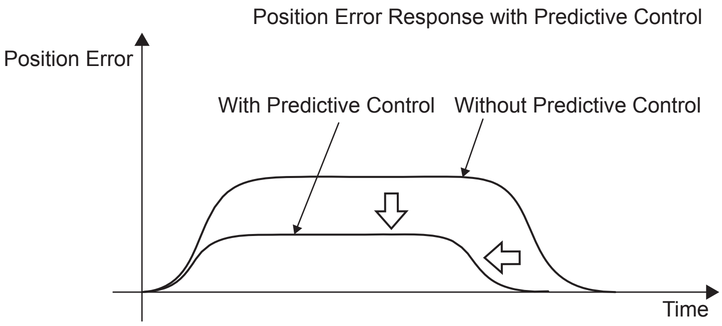
The Predictive Control function predicts the future error value using the future reference value and mechanical characteristics in the position control mode. There are two kinds Predictive Control in the SERVOPACK.

- Predictive Control for Positioning
  This control method is used to reduce the settling time.
- Predictive Control for Locus Tracking
  This control method is used to reduce the locus tracking error.

Predictive Control for Positioning operates by anticipating the future position reference in order to perform high-speed positioning. In contrast, Predictive Control for Locus Tracking follows the actual locus of the position reference being input.

The adjustment procedure is simple: just enable Predictive Control then the recommended values are calculated and set based on the position loop gain (Kp) that is set at that time. If necessary, the values can be fine-tuned with the parameters.





(1) Related Parameters

Pn150	Predictive Control Selection Switches			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	–	–	0210	After restart

Parameter		Name	Function
Pn150	n.□□□0	Predictive Control Enable	Do not use the Predictive Control function.
	n.□□□1		Use the Predictive Control function.
	n.□□0□	Predictive Control Method	Performs Predictive Control for Locus Tracking. This method is used for Locus Tracking Control and for positioning for low-rigidity machines. Reduces the tracking error by keeping the locus shape of the position reference.
	n.□□1□		Performs Predictive Control for Positioning. This method is used for positioning control. It operates by anticipating the future position reference. For low-rigidity machines, use the Predictive Control for Locus Tracking if the vibration increases when stopping with this method.
	n.□X□□	Reserved. (Do not change.)	
	n.X□□□	Reserved. (Do not change.)	

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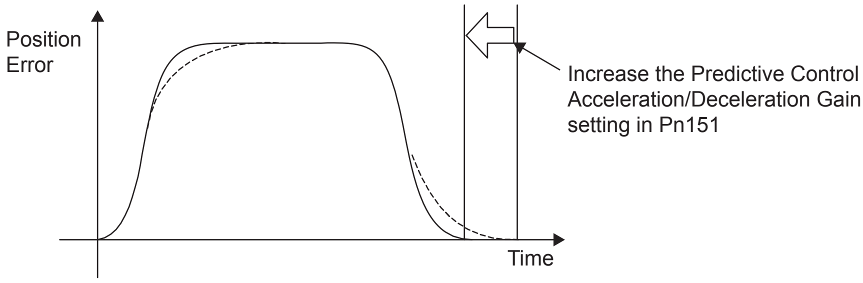
Pn151	Predictive Control Acceleration/Deceleration Gain Position			
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 300	1%	100	Immediately

Increasing the gain setting in Pn151 has the effect of shortening the settling time. The maximum position error is not changed significantly.

Overshooting will occur if the gain is set too high.

The following diagram shows the typical position error behavior when operating with a trapezoidal speed reference pattern. Increasing the Predictive Control Acceleration/Deceleration Gain changes the position error behavior from the dashed line to the solid line and shortens the settling time.

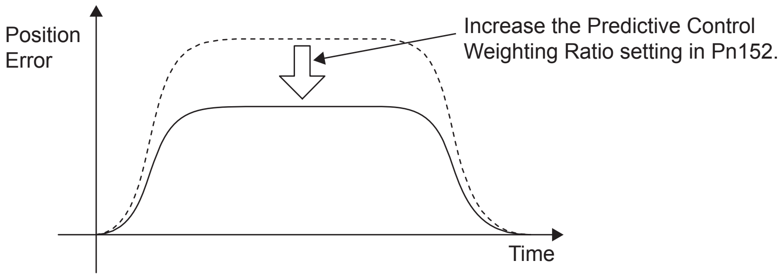


Pn152	Predictive Control Weighting Ratio Position			
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 300	1%	100	Immediately

Increasing the weighting ratio in Pn152 has the effect of reducing the tracking error. When the positioning completion width is large, increasing the weighting ratio will also have the benefit of reducing the settling time.

If the weighting ratio is set too high, the torque may become oscillating and overshooting may occur.

The following diagram shows the typical position error behavior when operating with a trapezoidal speed reference pattern. Increasing the Predictive Control Weighting Ratio changes the position error behavior from the dashed line to the solid line and reduces the tracking error.



(2) Predictive Control Method (Pn150=n.□□X□)

(a) Predictive Control for Locus Tracking (Pn150=n.□□0□)

The machine is controlled by following the locus of the position reference being input.

Use this control to keep the form of locus of position reference.

Note that the operation starts a few milliseconds after the command input. Therefore, the positioning time is longer than that by the predictive control for positioning.

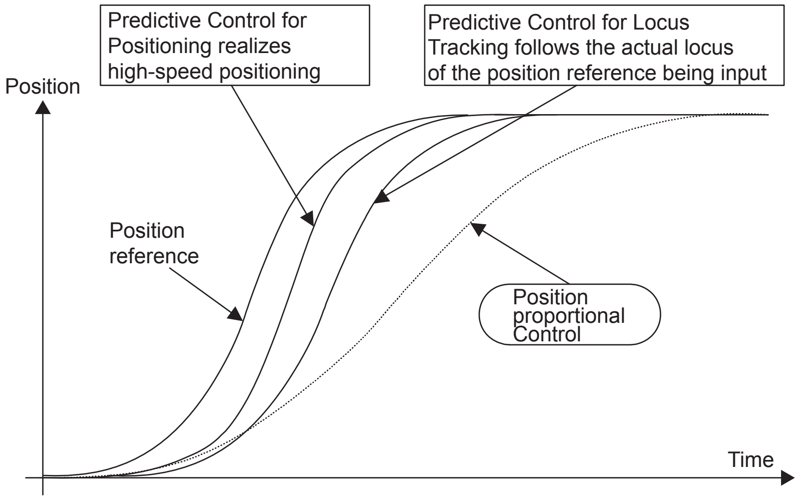
(b) Predictive Control for Positioning (Pn150=n.□□1□)

The machine is controlled by anticipating the position reference to be input.

The operation starts at the same time as the command input, which reduces the positioning time.

The locus differs from that of position reference.

For machines that easily vibrate, greater vibration may be caused upon stopping. In such case, use the predictive control for locus tracking instead of the predictive control for positioning.



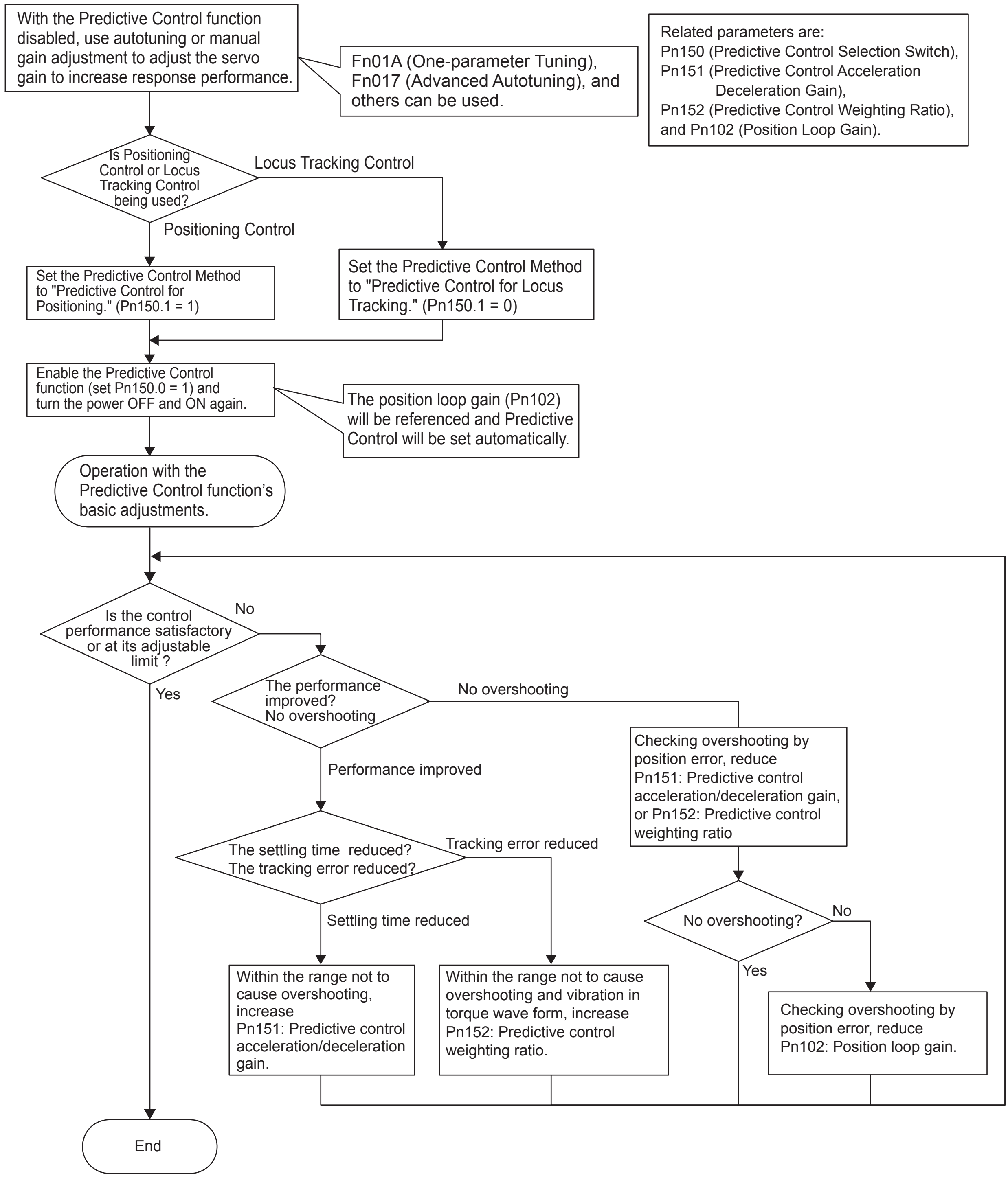
(3) Adjustment Procedure

Use the procedure shown in the following flowchart to adjust the Predictive Control function.

1. **Adjustment by normal control**
   Use the functions such as autotuning and one-parameter tuning.

2. **Predictive control selection switch setting**
   Set the predictive control selection switch to enable the predictive control. Turn OFF and ON the power to validate the setting.

3. **Adjustment of predictive control adjusting parameters**
   If necessary, adjust the predictive control related parameters, confirming the response.

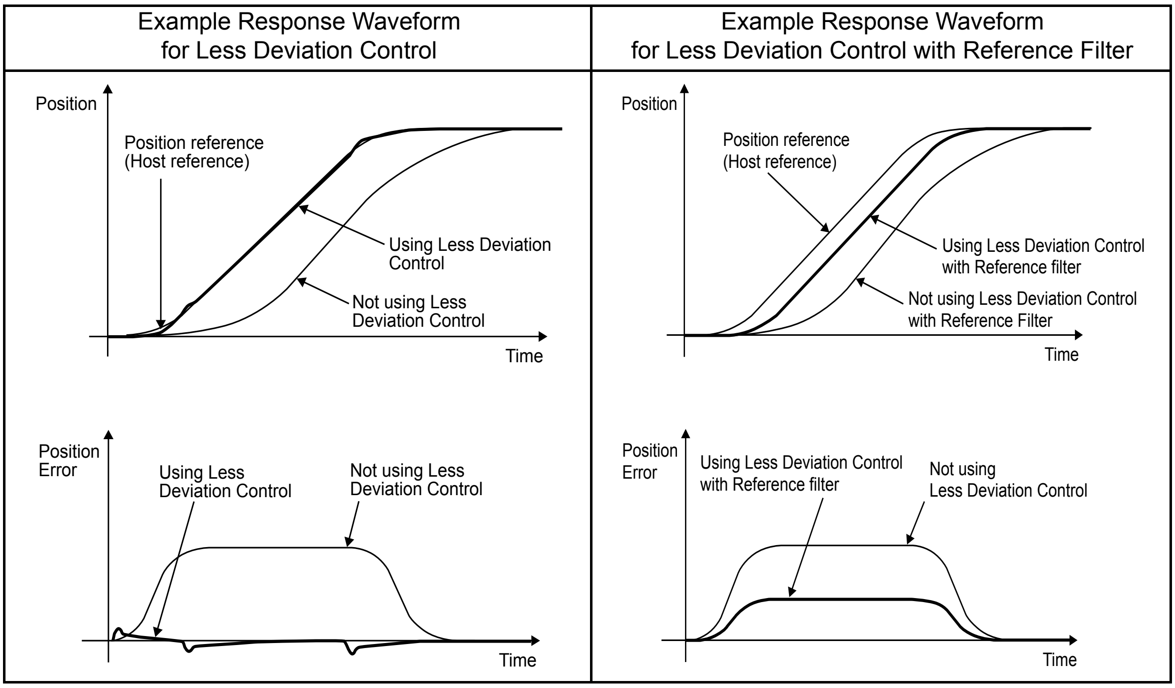


(4) Limitations

Fn017 (Advanced Autotuning) cannot be used while using the predictive control (Pn150.0=1).

9.6.11 Less Deviation Control

Less Deviation Control can provide shorter settling times and lower locus tracking errors by reducing the position error as much as possible for the position control mode. There are two kinds of Less deviation control: Basic Less deviation and Less Deviation control with reference filter. Operation can be adjusted easily with utility function Fn015 (One-parameter Tuning for Less Deviation Control.) If higher performance operation is required, the settings can be fine-tuned with the parameters.



Example Response Waveforms for Less Deviation Control

(1) Related Parameters

Pn119	Reference Filter Gain			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	10 to 20000 (1.0 to 2,000.0 /s)	0.1 /s	500 (50.0 /s)	Immediately

Pn11A	Reference Filter Gain Compensation			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	500 to 2000 (50.0% to 200.0%)	0.1%	1000 (100%)	Immediately

Pn11E	Reference Filter Bias (Forward)			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 10000 (0.0% to 1,000.0%)	0.1%	1000 (100%)	Immediately

Pn144	Reference Filter Bias (Reverse)			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 10000 (0.0% to 1,000.0%)	0.1%	1000 (100%)	Immediately

Pn1A0	Servo Rigidity			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 500	1%	60	Immediately

Pn1A1	Servo Rigidity #2			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 500	1%	60	Immediately

Pn1A2	Speed Feedback Filter Time Constant			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	30 to 3200 (0.30 to 32.00 ms)	0.01 ms	72 (0.72 ms)	Immediately

Pn1A3	Speed Feedback Filter Time Constant #2			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	30 to 3200 (0.30 to 32.00 ms)	0.01 ms	72 (0.72 ms)	Immediately

Pn1A4	Torque Reference Filter Time Constant			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 2500 (0.00 to 25.00 ms)	0.01 ms	36 (0.36 ms)	Immediately

Pn1A9	Auxiliary Integral Gain			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 500	1 Hz	37	Immediately

Pn1AA	Position Proportional Gain			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 500	1 Hz	60	Immediately

Pn1AB	Speed Integral Gain			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 500	1 Hz	0	Immediately

Pn1AC	Speed Proportional Gain			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 2,000	1 Hz	120	Immediately

Pn1B5	Gain Compensation Upper Limit 1			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	100 to 1000	1%	150	Immediately

Pn10B	Gain-related Application Switches			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	–	–	0000	After restart

Pn1A7	Auxiliary Control Switches			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	–	–	1121	Immediately

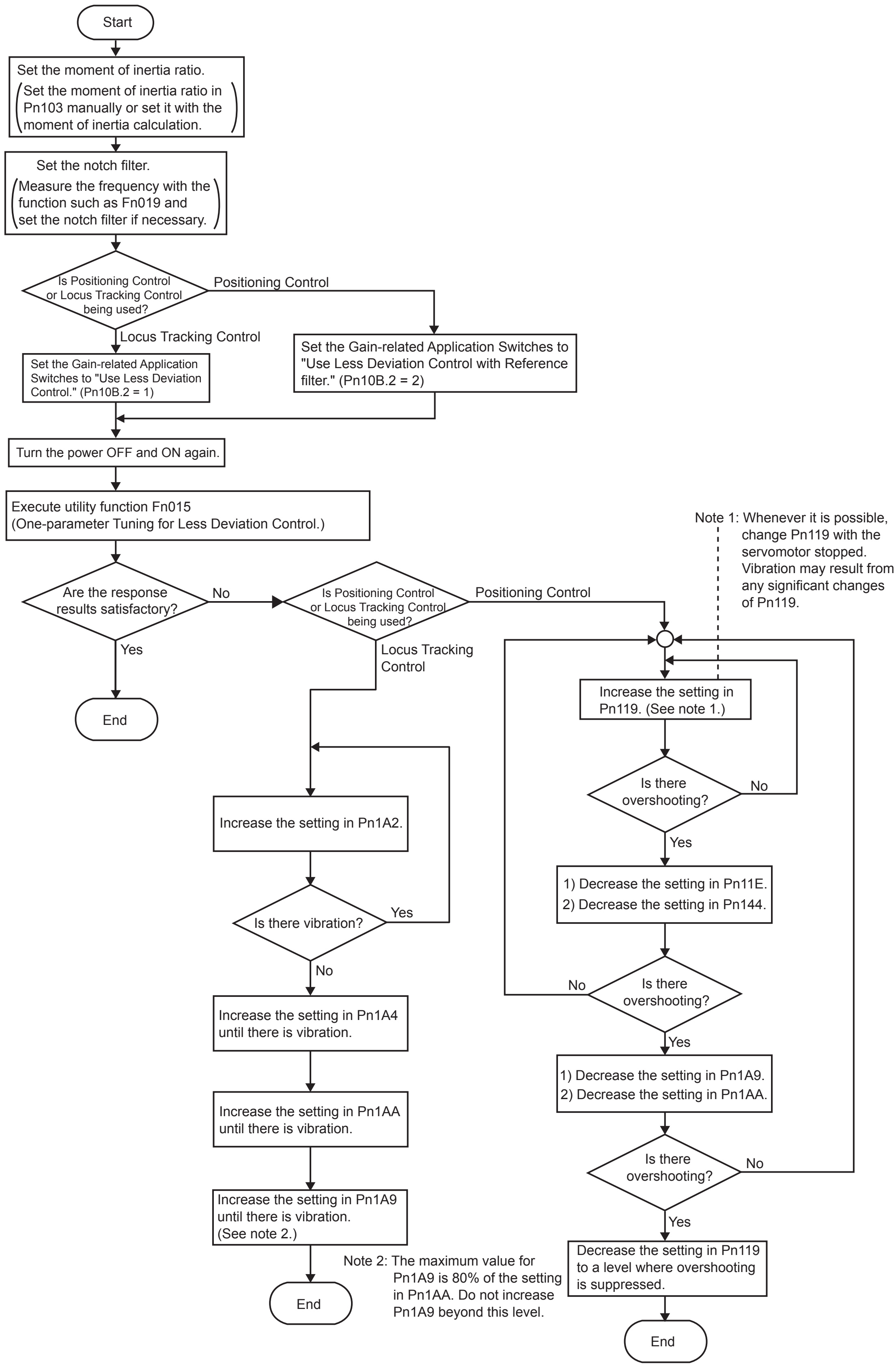
Parameter		Meaning
Pn10B	**n.□0□□**	Standard position control
	n.□1□□	Use Less Deviation Control.
	n.□2□□	Use Less Deviation Control with Reference filter.
	n.□3□□	Reserved. (Do not change.)
Pn1A7	**n.□□□0**	Do not perform integral compensation processing.
	n.□□□1	Perform integral compensation processing.
	n.□□□2	Use gain switching in Less Deviation Control. Perform integral compensation on Gain Settings 1. Do not perform integral compensation on Gain Settings 2.
	n.□□□3	Use gain switching in Less Deviation Control. Do not perform integral compensation on Gain Settings 1. Perform integral compensation on Gain Settings 2.

(2) Adjustment Procedure for Less Deviation Control

Use the procedure shown in the following flowchart when adjusting “Less Deviation Control.”

Always set the moment of inertia ratio. If necessary, set the notch filter. After making these settings, select Less Deviation Control and turn the power OFF and ON again.

Once Less Deviation Control has been selected, the normal autotuning function will be disabled regardless of the setting in Pn110 = n□□□x.


Start
Set the moment of inertia ratio.
(Set the moment of inertia ratio in Pn103 manually or set it with the moment of inertia calculation.)
Set the notch filter.
(Measure the frequency with the function such as Fn019 and set the notch filter if necessary.)
Is Positioning Control or Locus Tracking Control being used?
Positioning Control
Locus Tracking Control
Set the Gain-related Application Switches to "Use Less Deviation Control." (Pn10B.2 = 1)
Set the Gain-related Application Switches to "Use Less Deviation Control with Reference filter." (Pn10B.2 = 2)
Turn the power OFF and ON again.
Execute utility function Fn015 (One-parameter Tuning for Less Deviation Control.)
Are the response results satisfactory?
No
Yes
End
Is Positioning Control or Locus Tracking Control being used?
Positioning Control
Locus Tracking Control
Increase the setting in Pn1A2.
Is there vibration?
Yes
No
Increase the setting in Pn1A4 until there is vibration.
Increase the setting in Pn1AA until there is vibration.
Increase the setting in Pn1A9 until there is vibration. (See note 2.)
End
Note 2: The maximum value for Pn1A9 is 80% of the setting in Pn1AA. Do not increase Pn1A9 beyond this level.
Note 1: Whenever it is possible, change Pn119 with the servomotor stopped. Vibration may result from any significant changes of Pn119.
Increase the setting in Pn119. (See note 1.)
Is there overshooting?
No
Yes
1) Decrease the setting in Pn11E.
2) Decrease the setting in Pn144.
Is there overshooting?
No
Yes
1) Decrease the setting in Pn1A9.
2) Decrease the setting in Pn1AA.
Is there overshooting?
No
Yes
Decrease the setting in Pn119 to a level where overshooting is suppressed.
End

(3) One-parameter Tuning Procedure for Less Deviation Control

The following table shows the procedure for one-parameter tuning for less deviation control.

This function can be used while using the Less Deviation Control (Pn10B= n.□1□□ or n.□2□□).

Step	Display after Operation	Panel Operator	Explanation
1	Fn000	MODE/SET (MODE/SET Key)	Press the MODE/SET Key to select the utility function mode.
2	Fn015	▲ ▼	Press the Up or Down Cursor Key to select parameter Fn015. *The digit that can be set blinks.
3	L0060	DATA/◀ (DATA/SHIFT) (More than one sec.)	Press the DATA/SHIFT Key for one second or more. The one-parameter gain change display shown on the left will appear.
4	L0065	▲ ▼	Press the Up and Down Cursor Keys to change the one-parameter gain setting. The actual servo gain will be changed at the same time.
5	donE Blinking during one minute	MODE/SET (MODE/SET Key)	Press the MODE/SET Key. The 11 calculated gain values will be over written to the parameters. When the settings have been stored properly, “donE” will blink on the display for one second. To end function Fn015 without over writing the calculated values, do not press the MODE/SET Key and proceed to step 7.
6	L0065	About one second later	After “donE” is displayed, the one-parameter gain change display will return.
7	Fn015	DATA/◀ (DATA/SHIFT) (More than one sec.)	Press the DATA/SHIFT Key for a minimum of one second to return to the Fn015 display of the utility function mode.

(4) Gain Switching during Less Deviation Control

When using Less Deviation Control, refer to *9.6.9 (2) Gain Combinations for Switching* on page 9-35 for details on gain switching

(5) Function Limitations during Less Deviation Control

Some functions cannot be used together with the “Less Deviation Control” function.

(a) Utility Functions

The following utility functions will be disabled, even if they are selected.

- Rigidity setting during normal autotuning (Fn001)
- Save moment of inertia ratio data obtained from normal autotuning (Fn007)
- Advanced autotuning (Fn017)
- EasyFFT (Fn019)
- One-parameter tuning (Fn01A)

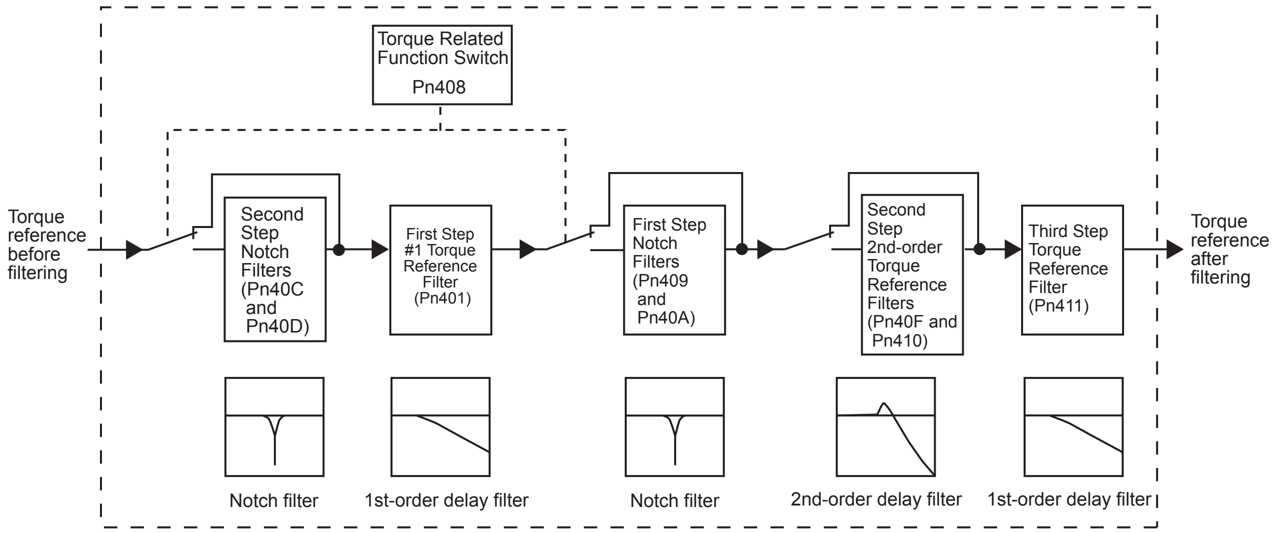
(b) Control Methods usable in Normal Position Control

The following control methods will not function.

- Feed-forward
- Mode Switch
- Speed Feedback Compensation
- Predictive Control
- Normal Autotuning
- Fully-closed control

9.6.12 Torque Reference Filter

As shown in the following diagram, the torque reference filter contains three torque reference filters and two notch filters arrayed in series, and each filter operates independently. The notch filters can be enabled and disabled with the parameters.



(1) Torque Reference Filter

If you suspect that machine vibration is being caused by the servo drive, try adjusting the filter time constants. This may stop the vibration. The lower the value, the better the speed control response will be, but there is a lower limit that depends on the machine conditions.

Pn401	Torque Reference Filter Time Constant			Speed Position Torque
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 65535 (0.00 to 655.35 ms)	0.01 ms	100 (1.00 ms)	Immediately
Pn40F	2nd Step 2nd Torque Reference Filter Frequency			Speed Position Torque
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	100 to 2,000	1 Hz	2,000	Immediately
Pn410	2nd Step 2nd Torque Reference Filter Q Value			Speed Position Torque
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	50 to 1000 (0.50 to 10.00 Hz)	0.01	70 (0.70 Hz)	Immediately
Pn411	3rd Step Torque Reference Filter Time Constant			Speed Position Torque
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 65,535	1 μs	0	Immediately

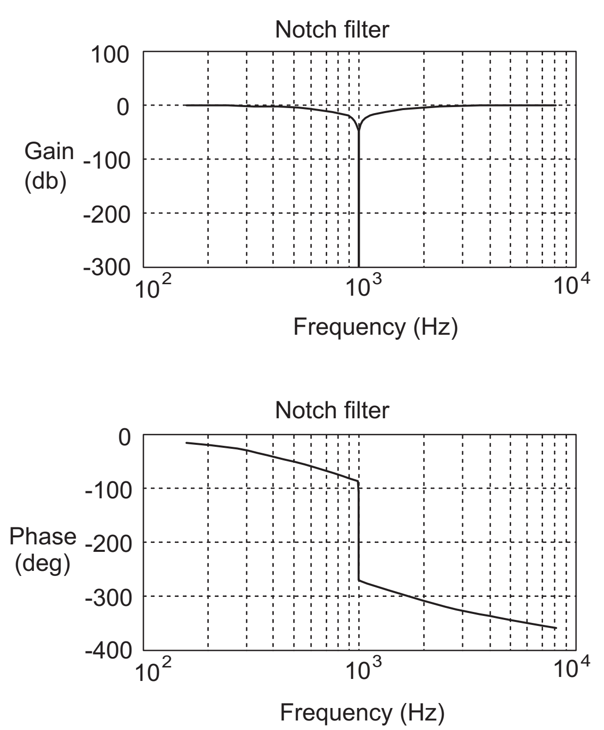
Note: 1. The setting units for the third step torque reference filter are different from the units for the first and second step filters.

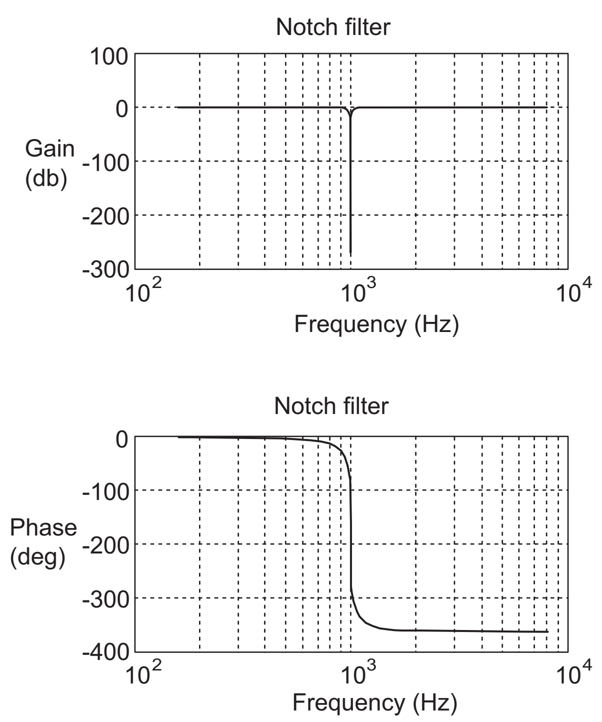
2. The 2nd step 2nd torque reference filter is disabled when parameter Pn40F (2nd Step 2nd Torque Reference Filter Frequency) is set to 2,000 Hz (factory setting).

(2) Notch Filter

The notch filter can eliminate specific frequency vibration generated by sources such as resonances of ball screw axes. The notch filter puts a notch in the gain curve at the specific vibration frequency. The frequency components near the notch frequency can be eliminated with this characteristic. A higher notch filter Q value produces a sharper notch and phase delay.

Q value = 0.7	Q value = 1.0





Parameter		Meaning
Pn408	n.□□□**0**	1st step notch filter disabled.
	n.□□□**1**	1st step notch filter is used.
	n.□**0**□□	2nd step notch filter disabled.
	n.□**1**□□	2nd step notch filter is used.
Used notch filters are enabled. (It isn't necessary to turn the power OFF and ON again.)		

Set the machine's vibration frequency in the parameter of a notch filter that is being used.

Pn409	1st Step Notch Filter Frequency	Speed	Position	Torque
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	50 to 2,000	1 Hz	2,000	Immediately

Pn40C	2nd Step Notch Filter Frequency	Speed	Position	Torque
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	50 to 2,000	1 Hz	2,000	Immediately

When the vibration is suppressed but overshooting occurs, increase the Q value and check whether the overshooting is corrected.

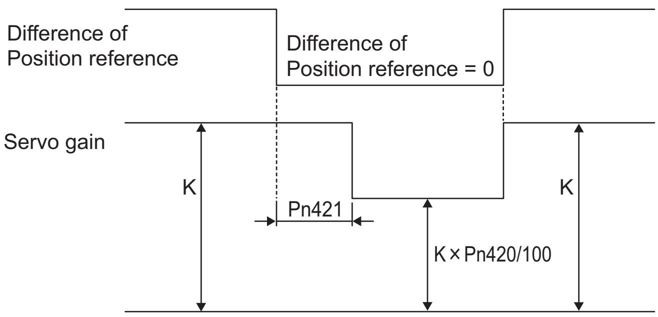
Pn40A	1st Step Notch Filter Q Value			Speed Position Torque
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	50 to 1000 (0.50 to 10.00)	0.01	70 (0.70)	Immediately
Pn40D	2nd Step Notch Filter Q Value			Speed Position Torque
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	50 to 1000 (0.50 to 10.00)	0.01	70 (0.70)	Immediately

IMPORTANT

1. Sufficient precautions must be taken when setting the notch frequencies. Do not set the notch frequencies (Pn409 or Pn40C) that is close to the speed loop's response frequency. Set the frequencies at least four times higher than the speed loop's response frequency. Setting the notch frequency too close to the response frequency may cause vibration and damage the machine. The speed loop response frequency is the value of the Speed Loop Gain (Pn100) when the Moment of Inertia Ratio (Pn103) is set to the correct value.
2. Change the Notch Filter Frequency (Pn409 or Pn40C) only when the motor is stopped. Vibration may occur if the notch filter frequency is changed when the motor is rotating.

9.6.13 Vibration Suppression on Stopping

When the servo gain has been increased, there may be vibration upon stopping (e.g., limit cycle) even though there is no vibration during operation. The function to suppress vibration on stopping, lowers the internal servo gain only when stopping. After the time specified for the Vibration Suppression Starting Time (Pn421) has elapsed from the time the difference of position reference becomes zero the internal servo gain is reduced at the rate specified for the Damping for Vibration Suppression on Stopping (Pn420).



Pn420	Damping for Vibration Suppression on Stopping			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	10 to 100	1%	100	Immediately
Pn421	Vibration Suppression Starting Time			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 65,535	1 ms	1,000	Immediately

IMPORTANT

Set the Damping for Vibration Suppression on stopping (Pn420) is 50% or higher, and the Vibration Suppression Starting Time (Pn421) to 10 ms or longer. If lower value are set, the response characteristic may become worse and vibration may occur.

9.6.14 Backlash Compensation

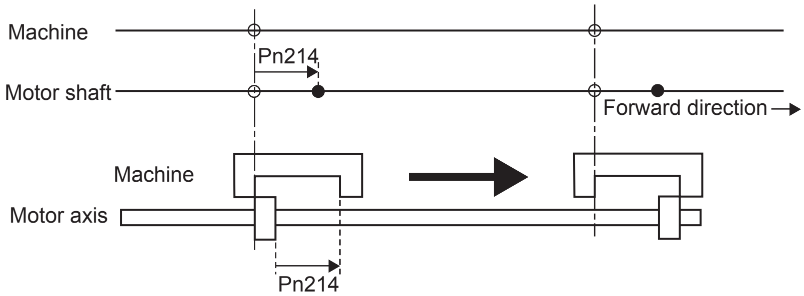
Pn214	Backlash Compensation Amount			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	-32767 to 3276	1 Reference unit	0	Immediately

Pn215	Backlash Compensation Time Constant			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 65535 (0.00 to 655.35 ms)	0.01 ms	0 (0.00 ms)	Immediately

Parameter		Meaning
Pn207	n.□0□□	Disabled. (Factory Setting)
	n.□1□□	Compensate in forward direction.
	n.□2□□	Compensate in reverse direction.

(1) Pn207=□1□□

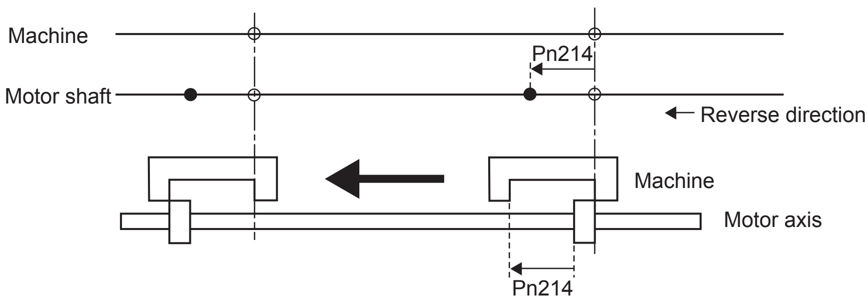
The Backlash Compensation Amount (Pn214) is added to the first forward reference after Servo ON. Set the positive value to Pn214.



(2) Pn207=□2□□

The Backlash Compensation Amount (Pn214) is added to the first reverse reference direction after Servo ON. Set the negative value to Pn214.

The actual position of the motor is shifted from the reference position for the backlash offset, because it is added to the backlash offset.



9.6.15 Position Integral Time Constant

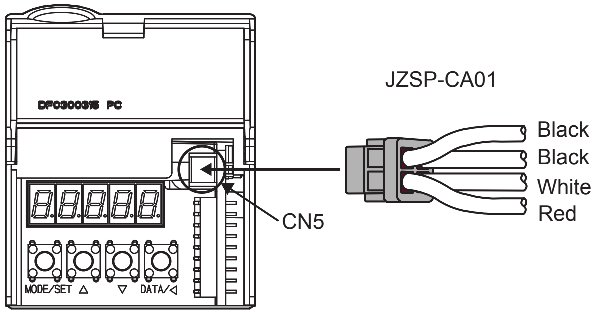
Pn11F	Position Integral Time Constant Position			
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 50000 (0.0 to 5000.0 ms)	0.1 ms	0 (0.0 ms)	Immediately

This function adds an integral control operation to the position loop. It is effective for electronic cam or electronic shaft applications. Refer to the examples in the user's manual for the MP9☐☐ or MP2☐☐☐ series of Controllers from Yaskawa for details.

9.7 Analog Monitor

Signals for analog voltage references can be monitored.

To monitor analog signals, connect the analog monitor cable (JZSP-CA01) to the connector CN5.



Line Color	Signal Name	Description
White	Analog monitor 1	Torque reference: 1 V/100% Rated torque
Red	Analog monitor 2	Motor speed: 1 V/1000 min^{-1}
Black (2 lines)	GND	Analog monitor GND: 0 V

The analog monitor signals can be selected by setting parameters Pn006.0,1 and Pn007.0,1.

The output voltages on analog monitor 1 and 2 are calculated by the following equations.

$$\text{Analog monitor 1 output voltage} = \{(-1) \times \underset{\text{Pn006}=\square\square\text{XX}}{\text{Signal selection}} \times \underset{\text{Pn006}=\square\text{X}\square\square}{\text{Signal multiplier}}\} + \underset{\text{Pn550}}{\text{Offset voltage [V]}}$$

$$\text{Analog monitor 2 output voltage} = \{(-1) \times \underset{\text{Pn007}=\square\square\text{XX}}{\text{Signal selection}} \times \underset{\text{Pn007}=\square\text{X}\square\square}{\text{Signal multiplier}}\} + \underset{\text{Pn551}}{\text{Offset voltage [V]}}$$

(1) Related Parameters

The following signals can be monitored.

(a) Pn006 and Pn007: Function Selections

Parameter		Description		
		Monitor Signal	Measurement Gain	Remarks
Pn006 Pn007	n.□□00	Motor speed	1 V/1000 min^{-1}	Pn007 Factory Setting
	n.□□01	Speed reference	1 V/1000 min^{-1}	
	n.□□02	Gravity Compensation Torque (Pn422) subtract from Torque reference	1 V/100% Rated torque	Pn006 Factory Setting
	n.□□03	Position error*	0.05 V/reference unit	–
	n.□□04	Position amp error*	0.05 V/reference unit	Position error after electronic gear conversion
	n.□□05	Position reference speed (speed calculation)	1 V/1000 min^{-1}	–
	n.□□06	Reversed	–	–
	n.□□07	Motor load position error	0.01 V/reference unit	–
	n.□□08	Positioning completed	Positioning completed: 5 V Positioning not completed: 0 V	–
	n.□□09	Speed feed-forward	1 V/1000min^{-1}	–
	n.□□0A	Torque feed-forward	1 V/100% Rated torque	–
	n.□□0B	Reserved	–	–
	n.□□0C			
	n.□□0D	Reserved	–	–
	n.□□0E	Reserved	–	–
	n.□□0F	Reserved	–	–

* When using speed control, the position error monitor signal is 0.

The monitor factor can be changed by setting parameters Pn006.2 and Pn007.2.

Parameter		Multiplier	Remarks
Pn006 **Pn007**	n.□**0**□□	× 1	Factory Setting
	n.□**1**□□	× 10	–
	n.□**2**□□	× 100	–
	n.□**3**□□	× 1/10	–
	n.□**4**□□	× 1/100	–

Pn550	Analog Monitor 1 Offset Voltage Speed Position Torque			
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	-10000 to 10000 (-1000.0 to 1000.0 V)	0.1 V	0 (0.0 V)	Immediately
Pn551	Analog Monitor 2 Offset Voltage Speed Position Torque			
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	-10000 to 10000 (-1000.0 to 1000.0 V)	0.1 V	0 (0.0 V)	Immediately

■ Example

If Pn006 = 0102, Pn422 = 10.0 [%], and Pn550 = 3.0 [V], then

Analog Monitor 1 = Torque reference

= {(-1) × (Torque reference[%]-10%) × 10} + 3[V]

If the torque is 2%,

$= \{(-1) \times (52\ [\%]-10\ [\%]) \times \frac{1\ [V]}{100\ [\%]} \times 10\} + 3\ [V] = -7.2\ [V]$ (Analog Monitor 1 output voltage)

INFO: The analog monitor output voltage is ±8 V (maximum). The output will be limited to ±8 V even if this value is exceeded in the above calculations.

10

Fully-closed Control

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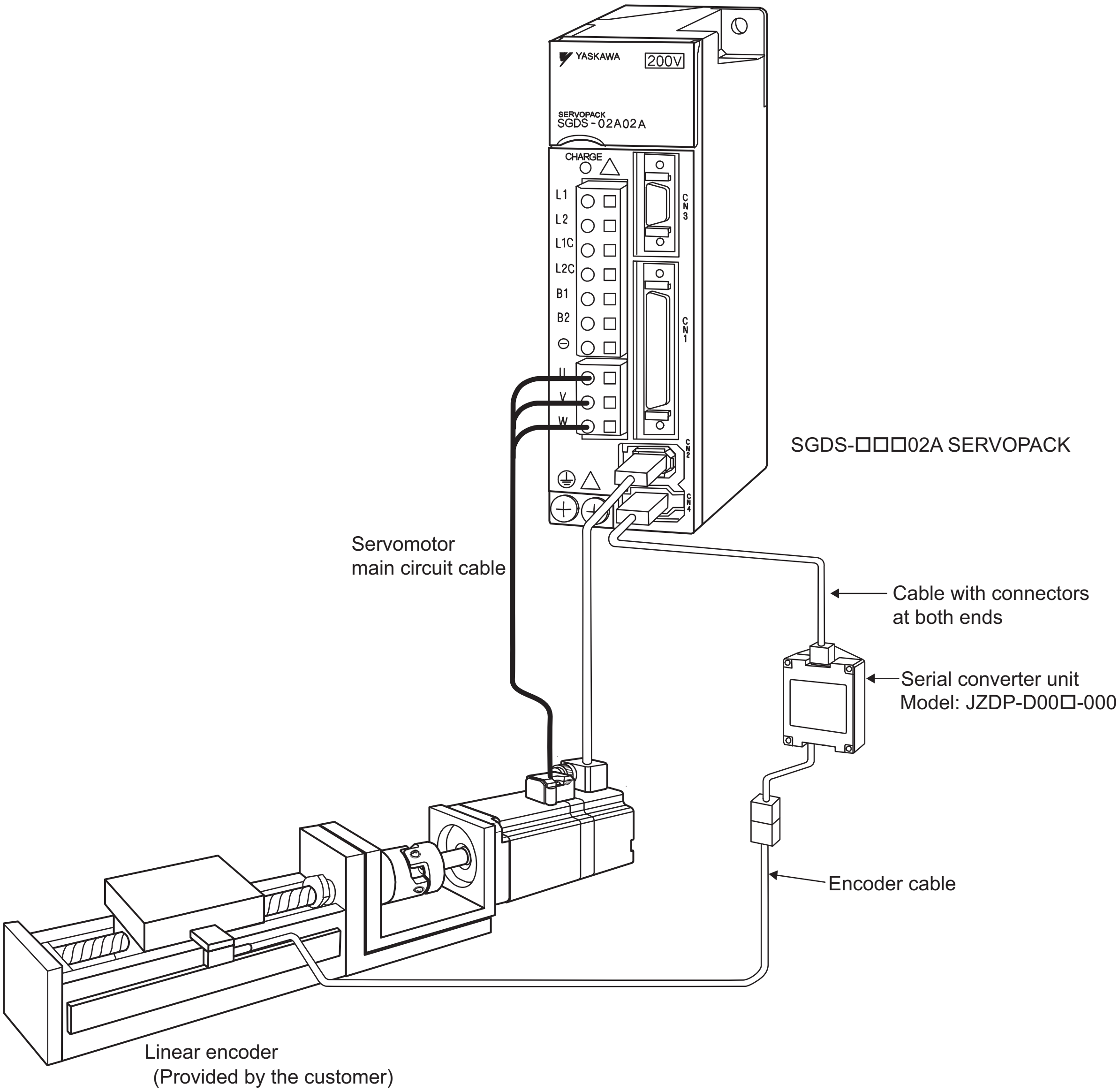
10.6 Encoder Output Signals from SERVOPACK with a Linear Scale
by Renishaw - 10-13

10.1 System Configuration for SERVOPACK with Fully-closed Control

The following figure shows the system configuration for fully-closed control.

The SERVOPACK model for fully-closed control is SGDS-□□□02A.



10.2 Serial Converter Unit

10.2.1 Specifications

(1) Model: JZDP-D00□-000

(2) Characteristics and Specifications

Items		Specifications
Electrical Characteristics	Power Supply Voltage	+5.0 V±5%, ripple content 5% max.
	Current Consumption *1	120 mA Typ. 350 mA Max.
	Signal Resolution	Input 2-phase sine wave: 1/256 pitch
	Max. Response Frequency	250 kHz
	Analog Input Signals *2 (cos, sin, Ref)	Differential input amplitude: 0.4 V to 1.2V Input signal level: 1.5 V to 3.5V
	Output signal *3	Position data, alarms
	Output method	Serial data communications (HDLC (High-level Data Link Control) protocol format with Manchester codes)
	Transmission cycle	62.5 μs
	Output circuit	Balanced type transceiver (SN75LBC176 or the equivalent), internal end resistor: 120 Ω
Mechanical Characteristics	Approx. mass	150 g
	Vibration Resistance	98 m/s^2 max. (10 to 2500) in three directions
	Shock Resistance	980 m/s^2, (11 ms) two times in three directions
Environmental Conditions	Operating temperature	0°C to 55°C
	Storage temperature	-20°C to +80°C
	Humidity	20% to 90%RH (without condensation)

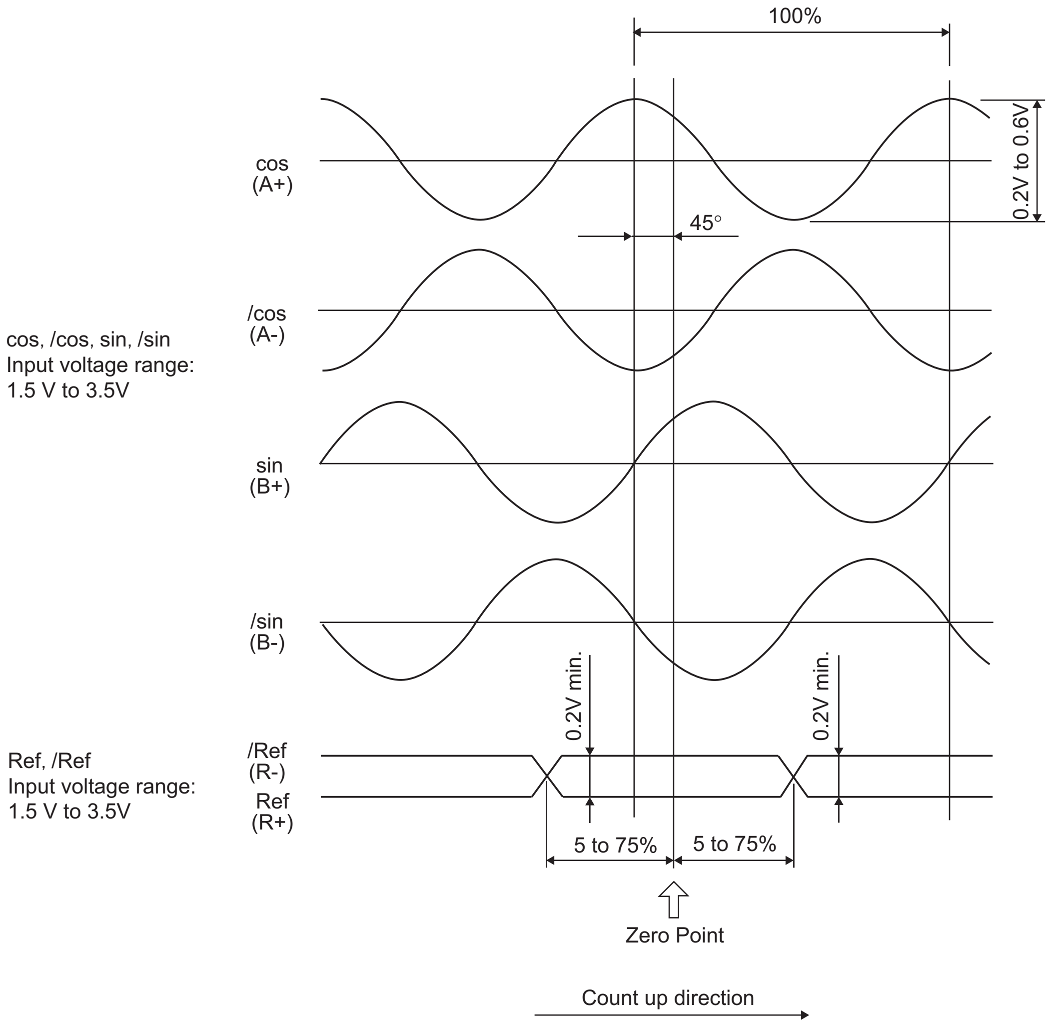
* 1. The current consumption of the linear scale is not included in this value.
The current consumption of the linear scale must be taken into consideration for the current capacity of host controller that supplies the power.
* 2. Input a value within the specified range. Otherwise, incorrect position information is output, and the device may be damaged.
* 3. The transmission is enabled 100 to 300 ms after the power turns ON.

10.2.2 Analog Signal Input Timing

The following figure shows the input timing of the analog signals.

When the cos and sin signals are shifted 180 degrees, the differential signals are the /cos and /sin signals. The specifications of the cos, /cos, sin, and /sin signals are identical except for the phase.

Input the signals Ref and /Ref so that they shall cross each other as shown in the figure because they are input into the converter. When they are crossed, the output data will be counted up.



IMPORTANT

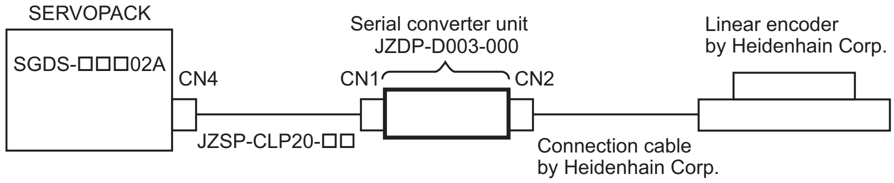
■Precautions

1. Never perform insulation resistance and withstand voltage tests.
2. When analog signals are input to the serial converter unit, noise influence on the analog signals affects the unit's ability to output correct position information. The analog cable must be as short as possible and shielded.
3. Do not connect or disconnect the unit while power is being supplied, or the unit may be damaged.
4. When using multiple axes, use a shield cable for each axis. Do not use a shield cable for multiple axes.

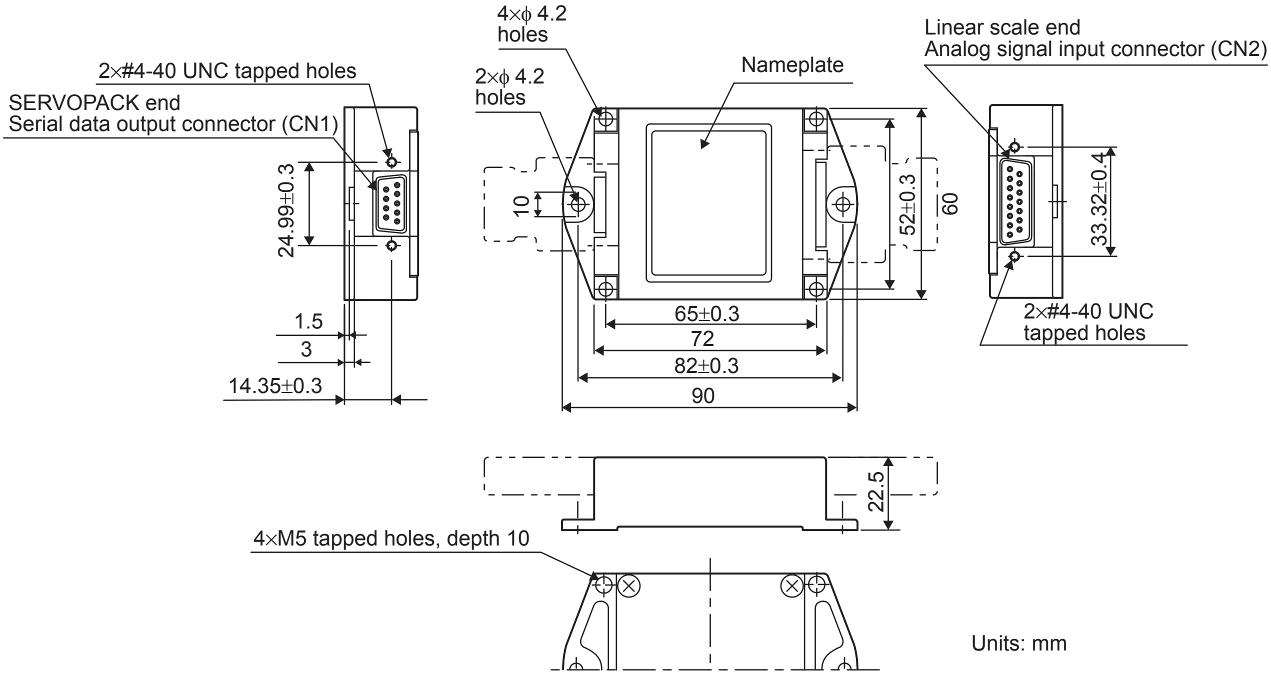
10.2.3 Connection Example of Linear Scale by Heidenhain

(1) Serial Converter Unit Model: JZDP-D003-000

(2) Connection Example



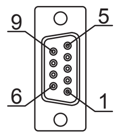
(3) Dimensional Drawing



Units: mm

CN1

SERVOPACK end
Serial data output

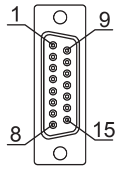


17-series connector model:
17LE-13090-27 (socket) by DDK Ltd.

Pin No.	Signal
1	+5V
2	S-phase output
3	Empty
4	Empty
5	0V
6	/S-phase output
7	Empty
8	Empty
9	Empty
Case	Shield

CN2

Linear encoder end
Analog signal input



17-series connector model:
17LE-13150-27 (socket) by DDK Ltd.

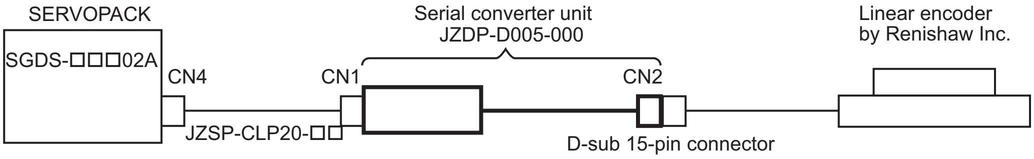
Pin No.	Signal
1	cos input (A+)
2	0V
3	sin input (B+)
4	+5V
5	Empty
6	Empty
7	/Ref input (R-)
8	Empty
9	/cos input (A-)
10	0V sensor
11	/sin input (B-)
12	5V sensor
13	Empty
14	Ref input (R+)
15	Empty
Case	Shield

Note: 1. Do not use the empty pins.
2. The linear scale (analog $1V_{p\text{-}p}$ output, D-sub 15-pin) manufactured by Heidenhain Corp. can be directly connected.

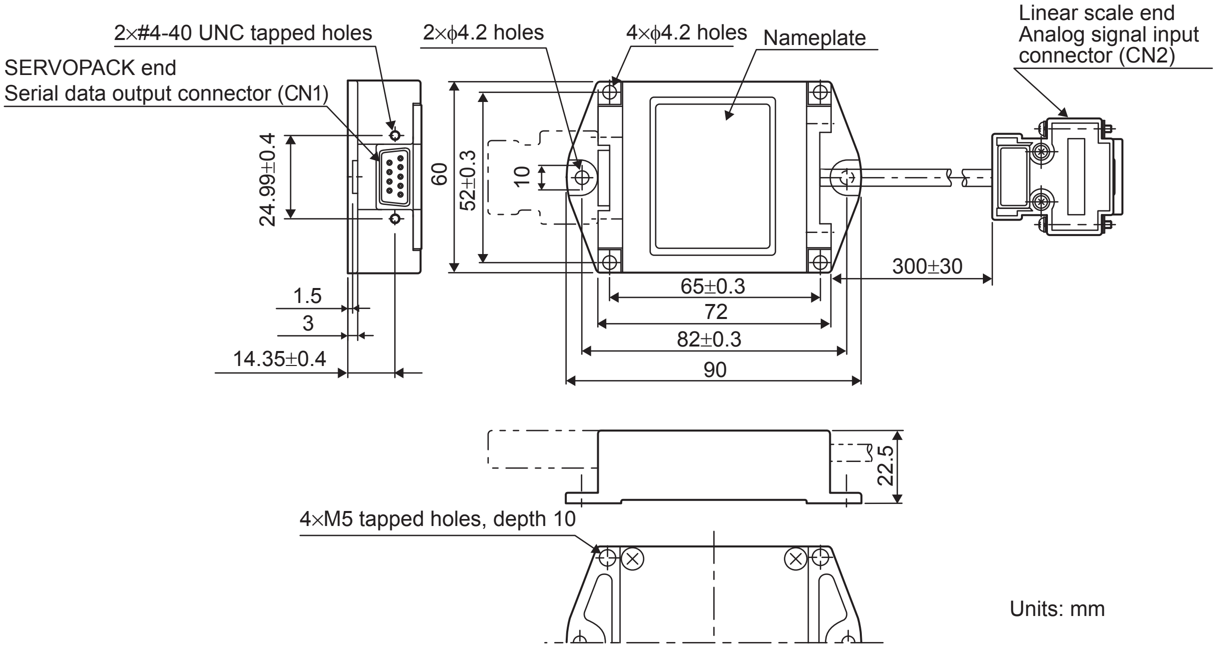
10.2.4 Connection Example of Linear Scale by Renishaw

(1) Serial Converter Unit Model: JZDP-D005-000

(2) Connection Example



(3) Dimensional Drawing

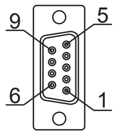


Pin No.	Signal
1	+5V
2	S-phase output
3	Empty
4	Empty
5	0V
6	/S-phase output
7	Empty
8	Empty
9	Empty
Case	Shield

SERVOPACK does not have the function to process Vq signals.

CN1

SERVOPACK end
Serial data output

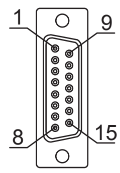


17-series connector model:
17LE-13090-27 (socket) by DDK Ltd.

Pin No.	Signal
1	/cos input (V1-)
2	/sin input (V2-)
3	Ref input (V0+)
4	+5V
5	5Vs
6	Empty
7	Empty
8	Empty
9	cos input (V1+)
10	sin input (V2+)
11	/Ref input (V0–)
12	0V
13	0Vs
14	Empty
15	Inner (0V)
Case	Shield

CN2

Linear encoder end
Analog signal input



17-series connector model:
17JE-13150-02 (D8C) (socket) by DDK Ltd.

Note: 1. Do not use empty pins.

2. The linear scale (analog 1Vp-p output, D-sub 15-pin) by Renishaw Inc. can be directly connected. However, the BID and DIR signals are not connected.

3. Use the linear scale end connector to change the home position specifications of the linear scale.

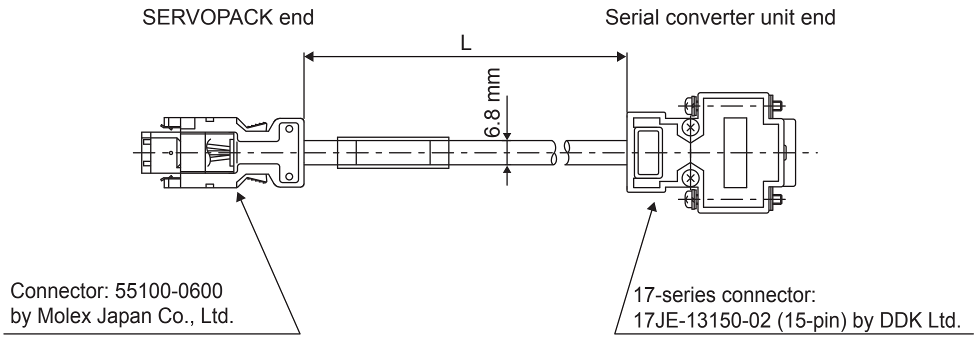
10.2.5 Connection Cable between SERVOPACK and Serial Converter Unit

(1) Recommended Cables

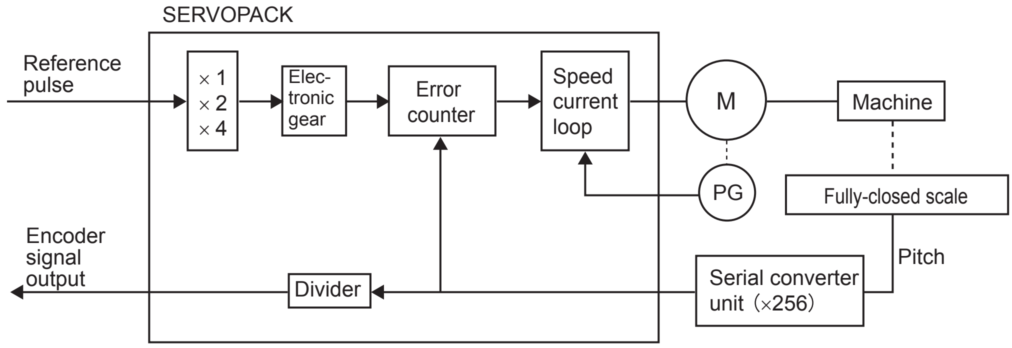
Name	Application	Type	Length (L)
Cable with connectors at both ends	Connection between SERVOPACK connector CN4 and serial converter unit	JZSP-CLP20-03	3 m
		JZSP-CLP20-05	5 m
		JZSP-CLP20-10	10 m
		JZSP-CLP20-15	15 m
		JZSP-CLP20-20	20 m

(2) Dimensional Drawing

- Cable with Connectors at Both Ends



10.3 Internal Configuration of Fully-closed Control



Note: Either an incremental or an absolute encoder can be used.
For control methods other than position control, this system operates in the same way as that using the SGDS-□□□01A SERVOPACK (standard interface specifications).

10.4 Related Parameters

(1) Parameters

The SGDS-□□□02A SERVOPACKs with fully-closed interface specifications have the following additional parameters that are the SGDS-□□□01A SERVOPACKs with standard interface specifications do not have.

Pn20A	Number of External Scale Pitches			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	100 to 1048576	1 pitch/Rev	32768	After restart

Sets the number of pitches (cycles) of the sine wave for the external scale.

Set the number of pitches between 100 to 1048576 (2^{20}) pulses. Any fractions cause differences on the speed monitor signals of the position loop gain (Pn102) and feed forward (Pn109), but do not cause position errors. Set the parameter to the number of pulses multiplied by 1.

- Example: How to calculate the parameter setting for Pn20A
  Number of scale pitch = Lead pitch (5 mm)/scale pitch (4 μm) = 1250
- Electronic gear ratio = (Number of scale pitch × 256)/Travel distance per load shaft revolution
  = (1250 × 256)/(5 mm/0.1 μm)
  = 320000/50000
  = 32 (Pn202)/5 (Pn203)

Pn281	Encoder Output Resolution			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 4096	1P/ (pitch × 4 multiplier)	20	After restart

Sets the number of output pulses of the PG output signal (PAO, PBO and PCO) from the SERVOPACK to an external device.

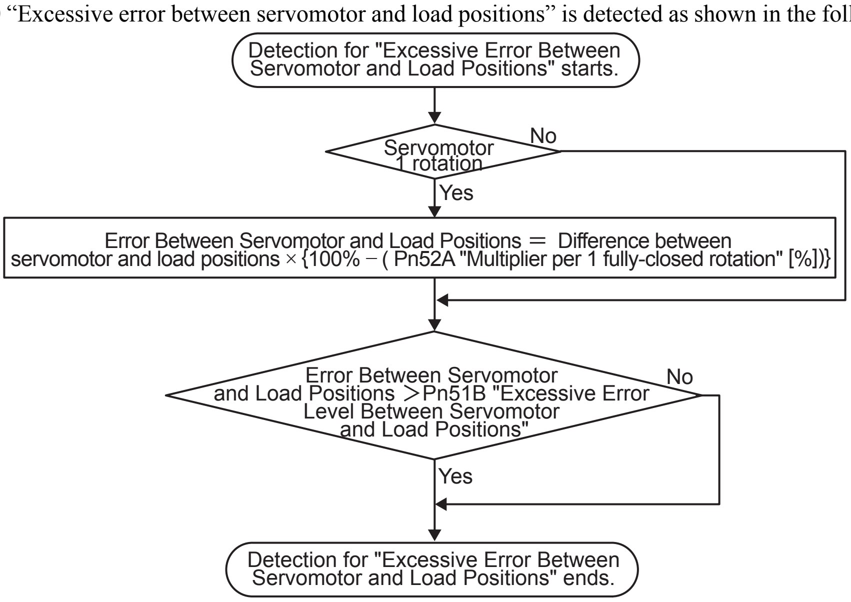
The position data from the external scale is divided by the number of pulses set in Pn281 and then output. Set the number of output pulses per pitch multiplied by 4.

Pn51B	Excessive Error Level Between Servomotor and Load Positions			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 1073741824(2^{30})	1 reference unit	1000	Immediately

Pn52A	Multiplier per One Fully-closed Rotation			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 100	1%	20	Immediately

If the detected difference between the external scale position and the encoder position is above the set level, the alarm A.d10 “Excessive error between servomotor and load positions” occurs. This function can be used to prevent runaway due to a damaged scale and to detect slip in the belt mechanism.

The alarm A.d10 “Excessive error between servomotor and load positions” is detected as shown in the following flowchart.



Note: When Pn51B is set to 0, “Excessive error between servomotor and load positions (A.d10)” is not detected.

(2) Switches

Parameter		Name	Meaning
Pn002	**n.0□□□**	Fully-closed Encoder Usage	Do not use. (Factory setting)
	n.1□□□		Use fully-closed encoder in forward rotation direction.
	n.2□□□		Reserved (Do not set).
	n.3□□□		Use fully-closed encoder in reversed rotation direction.
	n.4□□□		Reserved (Do not set).

Set parameter Pn002=n.0□□□ for semi-closed position control. Change accordingly the setting for electronic gear for semi-closed control and fully-closed control.

If performing the fully-closed control, two parameters must be set:
Pn000=n.□□□X for semi-closed control and
Pn002=n.X□□□ for fully-closed control
Change the settings according to your required specifications.
Refer to "*(3) Relation between Motor Rotating Direction and Fully-closed Pulse Direction*."

Incorrect settings may cause run away of the connected machine.
To change the rotation direction in a standard operation, change the settings of both Pn000.0 and Pn002.3.
If the connected machine runs away, change the setting of Pn000.0 or Pn002.3.

Parameter		Name	Meaning
Pn006	**n.□□07**	Analog Monitor 1 Signal Selection	Position error between servomotor and load [0.01V/1 reference unit] ∗ Factory setting: n.□□02
Pn007	**n.□□07**	Analog Monitor 2 Signal Selection	Position error between servomotor and load [0.01V/1 reference unit] ∗ Factory setting: n.□□00

(3) Relation between Motor Rotating Direction and Fully-closed Pulse Direction

			Pn002.3 (Using Method of Fully-closed Encoder)			
			1		3	
Pn000.0 (Motor rotating direction)	0	Reference direction	Forward run reference	Reverse run reference	Forward run reference	Reverse run reference
		Motor rotating direction	CCW	CW	CCW	CW
		External scale output	cos progression	sin progression	sin progression	cos progression
		Dividing pulse	Phase B progression	Phase A progression	Phase A progression	Phase B progression
	1	Reference direction	Forward run reference	Reverse run reference	Forward run reference	Reverse run reference
		Motor rotating direction	CW	CCW	CW	CCW
		External scale output	sin progression	cos progression	cos progression	sin progression
		Dividing pulse	Phase B progression	Phase A progression	Phase A progression	Phase B progression

- Set Pn000.0 after specifying the motor rotating direction for the reference direction.
- Set Pn002.3 to 1 if the output of the external scale is cos progression and the motor is turning counter-clockwise; set Pn002.3 to 3 if it is sin progression. When Pn000.0 is set to 0 and Pn002.3 to 1, manually turn the motor counterclockwise. If the Fully-closed Feedback Pulse Counter (Un00E) counts up, set Pn002.3 to 1. If the Un00E counts down, set Pn002.3 to 3.
- If Pn002.3 is set to 1, dividing output is phase B progression if the motor runs forward.
  If Pn002.3 is set to 3, it is phase A progression if the motor turns forward.

10.5 Related Alarms

The SGDS-□□□02A SERVOPACKs with fully-closed interface specifications have the following additional parameters that are the SGDS-□□□01A SERVOPACKs with standard interface specifications do not have.

10.5.1 Alarm List

If an alarm occurs, the servomotor can be stopped by doing either of the following operations.

- DB stop: Stops the servomotor immediately using the dynamic brake.
- Zero-speed stop: Stops the servomotor by setting the speed reference to “0.”

Alarm Display	Alarm Name	Meaning	Servomotor Stop Method	Alarm Reset	Alarm Code Output			Servo Alarm (ALM) Output
					ALO 1	ALO 2	ALO 3	
A.8A1	Fully-closed Serial Encoder Module Fault	An error occurred in the serial converter unit.	DB stop	Available	H	H	H	H
A.8A2	Fully-closed Serial Encoder Sensor Fault (Incremental)	An error occurred in the external scale.	DB stop	Available				H
A.CF1	Fully-closed Serial Encoder Communications Error (Receiving Failure)	The serial converter unit and the SERVOPACK can not communicate.	DB stop	N/A	L	H	L	H
A.CF2	Fully-closed Serial Encoder Communications Error (Timer stopped)	An error occurred in the timer for communications between the serial converter unit and the SERVOPACK.	DB stop	N/A				H
A.d10	Excessive Error Between Servomotor and Load Positions	The difference between the number of pulses for the servomotor encoder position and that for the external scale position is too large.	Zero-speed stop	Available	L	L	H	H

10.5.2 Alarm Display and Troubleshooting

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.8A1	Fully-closed Serial Encoder Module Fault	Occurred when the control power supply was turned ON or during operation.	Scale fault occurred.	Replace the scale.
			Serial converter unit fault occurred.	Replace the serial converter unit.
A.8A2	Fully-closed Serial Encoder Sensor Fault		Scale fault occurred.	Replace the scale.
A.CF1	Fully-closed Serial Encoder Communications Error (Receiving failure)		Incorrect wiring or contact fault in the scale or serial converter unit occurred.	Correct the wiring and connection.
			Noise influence, due to the incorrect specifications of the cable for the scale or serial converter unit occurred.	Use twisted pair wire, twisted pair shielded wire with a core of at least 0.12 mm^2, or annealed tinned copper twisted wire.
			Noise influence occurred because the wiring distance of the scale or serial converter unit cable is too long.	The max. wiring distance must be 20m.
A.CF2	Fully-closed Serial Encoder Communications Error (Timer stopped)		Noise influence occurred on the signals from the scale or serial converter unit.	Take measures to prevent noise for the scale or serial converter unit wiring.
			Excessive vibration or shock was applied on the scale or serial converter unit.	Reduce the machine vibration, or securely install the scale and serial converter unit.
			Serial converter unit fault occurred.	Replace the serial converter unit.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
A.d10	Excessive Error Between Servomotor and Load Positions	Occurred during operation or when the servo was turned ON.	Servomotor's rotation direction is not in accordance with the direction in which the scale is installed.	Reverse the installation direction of the scale, or reset the parameter Pn002.3 "Fully-closed Encoder Usage" to change the rotation direction.
			Loading position of the stage or mechanical connection of the scale is incorrect.	Correct the mechanical connection.

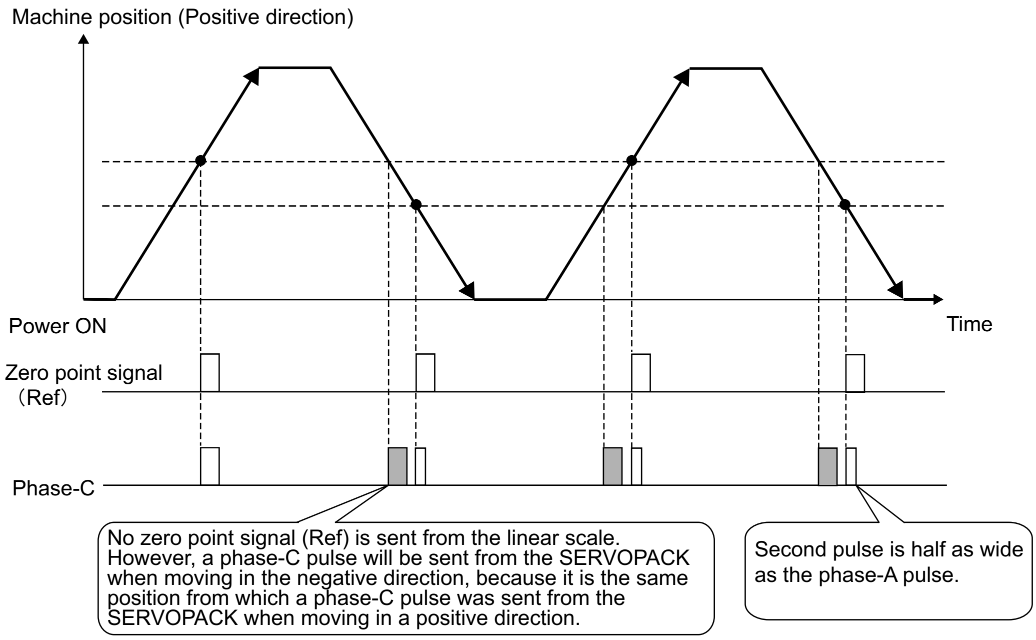
10.6 Encoder Output Signals from SERVOPACK with a Linear Scale by Renishaw

The output position of the zero point signal (Ref) may vary in some models of the linear scale made by Renishaw.

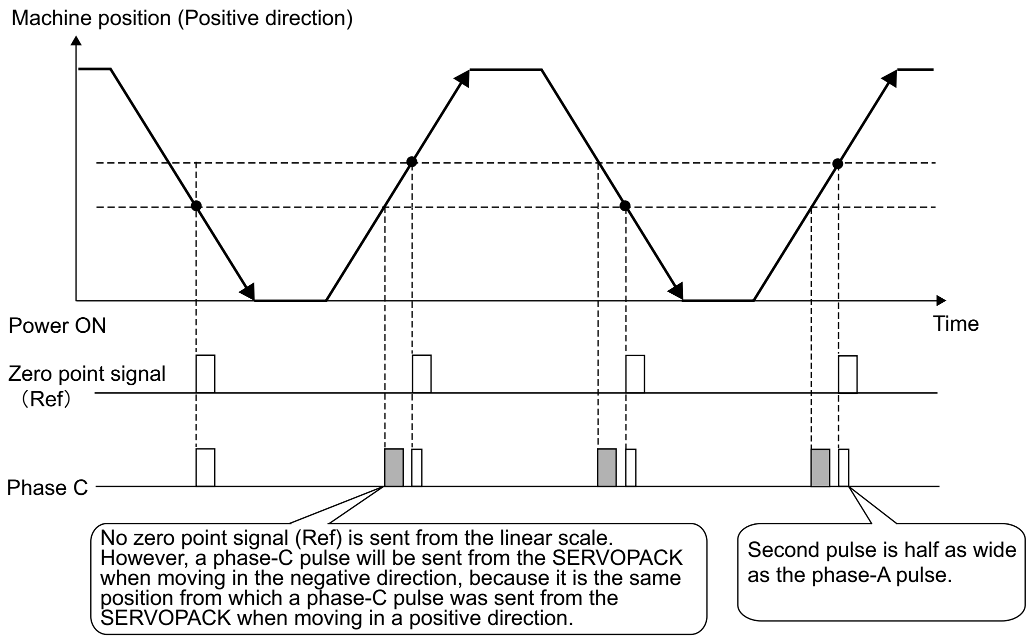
If using a Renishaw model, the phase-C pulses of the SERVOPACK are output at two positions.

For details on the specifications of the zero-point signals for a linear scale, refer to the manual for the Renishaw linear scale.

(1) When Passing the 1st Zero Point Signal (Ref) in Positive Direction after Power ON



(2) When Passing the 1st Zero Point Signal (Ref) in Negative Direction after Power ON



11

Inspection, Maintenance, and Troubleshooting

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11.1 Troubleshooting

11.1.1 Alarm Display Table

If an alarm occurs, the servomotor can be stopped by doing either of the following operations.

- DB stop: Stops the servomotor immediately using the dynamic brake.
- Zero-speed stop: Stops the servomotor by setting the speed reference to “0.” (The servomotor stops using the dynamic brake in the torque control mode.)

INFO

For alarms that relate to the fully-closed control, refer to *10.5 Related Alarms*.

Table 11.1 Alarm Display Table

<table>
<tr><th rowspan="2">Alarm Display</th><th rowspan="2">Alarm Name</th><th rowspan="2">Meaning</th><th rowspan="2">Servomotor Stop Method</th><th rowspan="2">Alarm Reset</th><th colspan="3">Alarm Code Output</th><th rowspan="2">Servo Alarm (ALM) Output</th></tr>
<tr><th>ALO1</th><th>ALO2</th><th>ALO3</th></tr>
<tr><td>A.020</td><td>Parameter Checksum Error</td><td>The data of the parameter in the SERVOPACK is incorrect.</td><td>DB stop</td><td>N/A</td><td rowspan="12">H</td><td rowspan="12">H</td><td rowspan="12">H</td><td rowspan="12">H</td></tr>
<tr><td>A.021</td><td>Parameter Format Error</td><td>The data of the parameter in the SERVOPACK is incorrect.</td><td>DB stop</td><td>N/A</td></tr>
<tr><td>A.022</td><td>System Checksum Error</td><td>The data of the parameter in the SERVOPACK is incorrect.</td><td>DB stop</td><td>N/A</td></tr>
<tr><td>A.023</td><td>Parameter Password Error</td><td>The data of the parameter in the SERVOPACK is incorrect.</td><td>DB stop</td><td>N/A</td></tr>
<tr><td>A.030</td><td>Main Circuit Detector Error</td><td>Detection data for power circuit is incorrect.</td><td>DB stop</td><td>Available</td></tr>
<tr><td>A.040</td><td>Parameter Setting Error</td><td>The parameter setting is outside the allowable setting range.</td><td>DB stop</td><td>N/A</td></tr>
<tr><td>A.041</td><td>Dividing Pulse Output Setting Error</td><td>The PG dividing pulse setting (Pn212) is outside the allowable setting range or not satisfies the setting conditions.</td><td>DB stop</td><td>N/A</td></tr>
<tr><td>A.042</td><td>Parameter Combination Error</td><td>Combination of some parameters exceeds the setting range.</td><td>DB stop</td><td>N/A</td></tr>
<tr><td>A.050</td><td>Combination Error</td><td>SERVOPACK and servomotor capacities do not match each other.</td><td>DB stop</td><td>Available</td></tr>
<tr><td>A.051</td><td>Unsupported Product Alarm</td><td>The serial converter unit unsupported was connected.</td><td>DB stop</td><td>N/A</td></tr>
<tr><td>A.0b0</td><td>Servo ON reference Invalid Alarm</td><td>The Host controller reference was sent to turn the Servo ON after the Servo ON function was used with the Digital Operator or SigmaWin+.</td><td>DB stop</td><td>Available</td></tr>
<tr><td>A.100</td><td>Overcurrent or Heat Sink Overheated</td><td>An overcurrent flowed through the IGBT.
Heat sink of SERVOPACK was overheated.</td><td>DB stop</td><td>N/A</td><td>L</td><td>H</td><td>H</td><td>H</td></tr>
<tr><td>A.300</td><td>Regeneration Error Detected</td><td>Regenerative circuit or regenerative resistor is faulty.</td><td>DB stop</td><td>Available</td><td rowspan="3">L</td><td rowspan="3">L</td><td rowspan="3">H</td><td rowspan="3">H</td></tr>
<tr><td>A.320</td><td>Regenerative Overload</td><td>Regenerative energy exceeds regenerative resistor capacity.</td><td>Zero speed stop</td><td>Available</td></tr>
<tr><td>A.330</td><td>Main Circuit Power Supply Wiring Error</td><td>The power supply to the main circuit does not match the parameter Pn001 setting.</td><td>DB stop</td><td>Available</td></tr>
<tr><td>A.400</td><td>Overvoltage</td><td>Main circuit DC voltage is excessively high.</td><td>DB stop</td><td>Available</td><td rowspan="2">H</td><td rowspan="2">H</td><td rowspan="2">L</td><td rowspan="2">H</td></tr>
<tr><td>A.410</td><td>Undervoltage</td><td>Main circuit DC voltage is excessively low.</td><td>Zero speed stop</td><td>Available</td></tr>
</table>

Table 11.1 Alarm Display Table (cont'd)

Alarm Display	Alarm Name	Meaning	Servomotor Stop Method	Alarm Reset	Alarm Code Output			Servo Alarm (ALM) Output
					ALO1	ALO2	ALO3	
A.510	Overspeed	The servomotor speed is excessively high.	DB stop	Available	L	H	L	H
A.511	Dividing Pulse Output Overspeed	The motor speed upper limit of the set PG dividing pulse (Pn212) is exceeded.	DB stop	Available				
A.520	Vibration Alarm	Vibration at the motor speed was detected.	DB stop	Available				
A.521	Autotuning Alarm	The moment of inertia ratio calculation error occurred.	DB stop	Available				
A.710	Overload: High Load	The motor was operating for several seconds to several tens of seconds under a torque largely exceeding ratings.	Zero speed stop	Available	L	L	L	H
A.720	Overload: Low Load	The motor was operating continuously under a torque largely exceeding ratings.	DB stop	Available				
A.730 A.731	Dynamic Brake Overload	When the dynamic brake was applied, rotational energy exceeded the capacity of dynamic brake resistor.	DB stop	Available				
A.740	Overload of Surge Current Limit Resistor	The main circuit power was frequently turned ON and OFF.	DB stop	Available				
A.7A0	Heat Sink Overheated	The heat sink of SERVOPACK overheated.	Zero speed stop	Available				
A.810	Encoder Backup Error	All the power supplies for the absolute encoder have failed and position data was cleared.	DB stop	N/A	H	H	H	H
A.820	Encoder Checksum Error	The checksum results of encoder memory is incorrect.	DB stop	N/A				
A.830	Absolute Encoder Battery Error	Battery voltage for the absolute encoder has dropped.	DB stop	Available				
A.840	Encoder Data Error	Data in the encoder is incorrect.	DB stop	N/A				
A.850	Encoder Overspeed	The encoder was rotating at high speed when the power was turned ON.	DB stop	N/A				
A.860	Encoder Overheated	The internal temperature of encoder is too high.	DB stop	N/A				
A.b10	Reference Speed Input Read Error	The A/D converter for reference speed input is faulty.	Zero speed stop	Available				
A.b11	Speed Reference A/D Data Error	A/D conversion data of speed reference is incorrect.	Zero speed stop	Available				
A.b20	Reference Torque Input Read Error	The A/D converter for reference torque input is faulty.	Zero speed stop	Available				
A.b31	Current Detection Error1	Phase-U current sensor is faulty.	DB stop	N/A				
A.b32	Current Detection Error 2	Phase-V current sensor is faulty.	DB stop	N/A				
A.b33	Current Detection Error 3	Phase-W current sensor is faulty.	DB stop	N/A				

Inspection, Maintenance, and Troubleshooting

11

Table 11.1 Alarm Display Table (cont’d)

<table>
<tr><th rowspan="2">Alarm Display</th><th rowspan="2">Alarm Name</th><th rowspan="2">Meaning</th><th rowspan="2">Servomotor Stop Method</th><th rowspan="2">Alarm Reset</th><th colspan="3">Alarm Code Output</th><th rowspan="2">Servo Alarm (ALM) Output</th></tr>
<tr><th>ALO1</th><th>ALO2</th><th>ALO3</th></tr>
<tr><td>A.bF0</td><td>System Alarm 0 (Internal program processing error)</td><td>“Internal program error 0” of SERVOPACK occurred.</td><td>DB stop</td><td>N/A</td><td rowspan="5">H</td><td rowspan="5">H</td><td rowspan="5">H</td><td rowspan="5">H</td></tr>
<tr><td>A.bF1</td><td>System Alarm 1 (Internal program error)</td><td>“Internal program error 1” of SERVOPACK occurred.</td><td>DB stop</td><td>N/A</td></tr>
<tr><td>A.bF2</td><td>System Alarm 2 (Current control processing program error)</td><td>“Internal program error 2” of SERVOPACK occurred.</td><td>DB stop</td><td>N/A</td></tr>
<tr><td>A.bF3</td><td>System Alarm 3 (Encoder interface processing error)</td><td>“Internal program error 3” of SERVOPACK occurred.</td><td>DB stop</td><td>N/A</td></tr>
<tr><td>A.bF4</td><td>System Alarm 4 (CPU watchdog timer error)</td><td>“Internal program error 4) of SERVOPACK occurred.</td><td>DB stop</td><td>N/A</td></tr>
<tr><td>A.C10</td><td>Servo Overrun Detected</td><td>The servomotor ran out of control.</td><td>DB stop</td><td>Available</td><td rowspan="8">L</td><td rowspan="8">H</td><td rowspan="8">L</td><td rowspan="8">H</td></tr>
<tr><td>A.C80</td><td>Absolute Encoder Clear Error and Multi-turn Limit Setting Error</td><td>The multi-turn for the absolute encoder was not properly cleared or set.</td><td>DB stop</td><td>N/A</td></tr>
<tr><td>A.C90</td><td>Encoder Communications Error</td><td>Communications between SERVOPACK and encoder is not possible.</td><td>DB stop</td><td>N/A</td></tr>
<tr><td>A.C91</td><td>Encoder Communications Position Data Error</td><td>An encoder position data calculation error occurred.</td><td>DB stop</td><td>N/A</td></tr>
<tr><td>A.C92</td><td>Encoder Communications Timer Error</td><td>An error occurs in the communications timer between the encoder and the SERVOPACK.</td><td>DB stop</td><td>N/A</td></tr>
<tr><td>A.CA0</td><td>Encoder Parameter Error</td><td>Encoder parameters are faulty.</td><td>DB stop</td><td>N/A</td></tr>
<tr><td>A.Cb0</td><td>Encoder Echoback Error</td><td>Contents of communications with encoder is incorrect.</td><td>DB stop</td><td>N/A</td></tr>
<tr><td>A.CC0</td><td>Multi-turn Limit Disagreement</td><td>Different multi-turn limits have been set in the encoder and SERVOPACK.</td><td>DB stop</td><td>N/A</td></tr>
<tr><td>A.d00</td><td>Position Error Pulse Overflow</td><td>Position error pulse exceeded parameter (Pn520).</td><td>DB stop</td><td>Available</td><td rowspan="3">L</td><td rowspan="3">L</td><td rowspan="3">H</td><td rowspan="3">H</td></tr>
<tr><td>A.d01</td><td>Position Error Pulse Overflow Alarm at Servo ON</td><td>When the servo turns ON, the position error pulses exceeded the parameter setting (Pn526).</td><td>DB stop</td><td>Available</td></tr>
<tr><td>A.d02</td><td>Position Error Pulse Overflow Alarm by Speed Limit at Servo ON</td><td>If the servo turns ON with position error pulses accumulated, the speed is limited by Pn529. In this state, the reference pulse was input without resetting the speed limit, and the position error pulses exceeds the value set for the parameter Pn520.</td><td>Zero speed stop</td><td>Available</td></tr>
<tr><td>A.F10</td><td>Power Line Open Phase</td><td>One phase is not connected in the main power supply.</td><td>Zero speed stop</td><td>Available</td><td>H</td><td>L</td><td>H</td><td>H</td></tr>
<tr><td>CPF00</td><td rowspan="2">Digital Operator Transmission Error</td><td rowspan="2">Digital operator (JUSP-OP05A) fails to communicate with SERVOPACK (e.g., CPU error).</td><td>–</td><td>N/A</td><td colspan="4" rowspan="2">Not decided</td></tr>
<tr><td>CPF01</td><td>–</td><td>N/A</td></tr>
<tr><td>A.– –</td><td>Not an error</td><td>Normal operation status</td><td>–</td><td>–</td><td>H</td><td>H</td><td>H</td><td>L</td></tr>
</table>

11.1.2 Warning Displays

The relation between warning displays and warning code outputs are shown in table 11.2.

Table 11.2 Warning Displays and Outputs

Warning Display	Warning Name	Meaning	Warning Code Output		
			ALO1	ALO2	ALO3
A.900	Position Error Pulse Overflow	Position error pulse exceeded the parameter settings (Pn520×Pn51E/100).	H	H	H
A.901	Position Error Pulse Overflow at Servo ON	When the servo turns ON, the position error pulses exceeded the parameter setting (Pn526×Pn528/100).	H	H	H
A.910	Overload	This warning occurs before the overload alarms (A.710 or A.720) occur. If the warning is ignored and operation continues, an overload alarm may occur.	L	H	H
A.911	Vibration	Abnormal vibration at the motor speed was detected. The detection level is the same as A.520. Set whether to output an alarm or warning by "Vibration Detection Switch" of Pn310.	L	H	H
A.920	Regenerative Overload	This warning occurs before the regenerative overload alarm (A.320) occurs. If the warning is ignored and operation continues, a regenerative overload alarm may occur.	H	L	H
A.921	DB Overload	This warning occurs before DB Overload (A.731) alarm occurs. If the warning is ignored and operation continues, a regenerative overload alarm may occur.	H	L	H
A.930	Absolute Encoder Battery Voltage Lowered	This warning occurs when the absolute encoder battery voltage is lowered.	L	L	H
A.941	Change of Parameters Requires Setting Validation	The change of the parameters can be validated only after turning the power ON from OFF.	L	H	H

Note: 1. Warning code is not outputted without setting Pn001 = n.1□□□ (Outputs both Alarm Codes and Warning Codes.)

2. If Pn008= n.□1□□ (Do not detect warning) is selected, all warnings will not be detected.

11.1.3 Troubleshooting of Alarm and Warning

When an error occurs in SERVOPACKs, an alarm display such as A.□□□ and CPF□□ or warning display such as A.9□□ appears on the panel operator. However, the display “A.--” is not an alarm. Refer to the following sections to identify the cause of an alarm and the action to be taken.

Contact your Yaskawa representative if the problem cannot be solved by the described corrective action.

INFO For alarms that relate to the fully-closed control, refer to *10.5 Related Alarms*.

(1) Alarm Display and Troubleshooting

Table 11.3 Alarm Display and Troubleshooting

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.020	Parameter Checksum Error (The data of the parameter in the SERVOPACK is incorrect.)	Occurred when the control power supply was turned ON.	The control power supply ranged from 30 VAC to 60 VAC.	Correct the power supply, and set Fn005 to initialize the parameter.
			The power supply was turned OFF while changing the parameter setting.	Set Fn005 to initialize the parameter and input the parameter again.
			The number of times that parameters were written exceeded the limit. For example, the parameter was changed every scan through the host controller.	Replace the SERVOPACK.
			The SERVOPACK EEPROM and the related circuit are faulty.	
A.021	Parameter Format Error (The data of the parameter is incorrect.)	Occurred when the power was turned ON again after writing the parameter with the parameter copy function of the digital operator (JUSP-OP05A) or with the servo drive engineering tool, SigmaWin.	The model number of the SERVOPACK in the software being used for the SERVOPACK is old and not compatible with the current parameters.	Replace the SERVOPACK.
				Change the parameter settings to be compatible with the model number in the software being used for the SERVOPACK.
A.022	System Checksum Error (The data of the parameter is incorrect.)	Occurred when the control power supply was turned ON.	The control power supply ranged from 30 VAC to 60 VAC.	Replace the SERVOPACK.
			The power supply was turned OFF while changing the parameter setting.	
			The SERVOPACK EEPROM and the related circuit are faulty.	
A.023	Parameter Password Error (The data of the parameter is incorrect.)	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
A.030	Main Circuit Detector Error	Occurred when the control power supply was turned ON or during operation	A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.040	Parameter Setting Error (The parameter setting was out of the allowable setting range.)	Occurred when the control power supply was turned ON.	The SERVOPACK and servomotor capacities do not match each other.	Select the proper combination of SERVOPACK and servomotor capacities.
			The SERVOPACK EEPROM and the related circuit are faulty.	Replace the SERVOPACK.
			The electronics gear ratio is out of the setting range.	Set 0.001 < Pn20E/Pn210 < 1000.
A.041	Dividing Pulse Output Setting Error	Occurred when the control power supply was turned ON.	The PG dividing pulse set for Pn212 is out of the setting range and does not satisfy the setting conditions.	Set Pn212 to the correct value.

Table 11.3 Alarm Display and Troubleshooting (cont'd)

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.042	Combination of parameters out of setting range	Occurred when the power was turned ON after having changed the electronic gear ratio (Pn20E/Pn210) or the servomotor to one with a different number of encoder pulses.	The speed set for Fn004 "Program JOG Operation" is below the allowable range because the electronic gear ratio (Pn20E/Pn210) or the servomotor was changed.	Reduce the electronic gear ratio (Pn20E/Pn210).
		Occurred after having changed the setting of Pn533 "Program JOG Movement Speed."	The speed set for Fn004 "Program JOG Operation" is below the allowable range because of the change in Pn533 "program JOG movement speed."	Increase the setting for Pn533 "Program JOG Movement Speed."
		Occurred when the power was turned ON to carry out advanced autotuning (Fn017) after having changed the electronic gear ratio (Pn20E/Pn210) or the servomotor to one with a different number of encoder pulses.	The movement speed for advanced autotuning is below the allowable range because the electronic gear ratio (Pn20E/Pn210) or the servomotor was changed.	Reduce the electronic gear ratio (Pn20E/Pn210).
A.050	Combination Error (The SERVOPACK and servomotor capacities do not correspond.)	Occurred when the control power supply was turned ON.	The SERVOPACK and servomotor capacities do not correspond to each other. Servomotor capacity / SERVOPACK capacity ≤ 1/4 or servomotor capacity / SERVOPACK capacity ≥ 4	Select the proper combination of SERVOPACK and servomotor capacities.
			The parameter that is written in the encoder is incorrect.	Replace the servomotor (encoder).
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
A.051	Unsupported Product Alarm	Occurred when the control power supply was turned ON.	The serial converter unit unsupported was connected.	Check and then correct the wiring.
A.0b0	Servo ON Reference Invalid Alarm	Occurred when the servo was ON after having used the following functions. JOG operation (Fn002), origin search (Fn003), program JOG operation (Fn004), advanced autotuning (Fn017) , EasyFFT(Fn019)	The servo ON reference was input just when occurring the servo ON reference invalid error.	Turn OFF the control power supply and then turn them ON again.

Table 11.3 Alarm Display and Troubleshooting (cont'd)

<table>
<tr><th>Alarm Display</th><th>Alarm Name</th><th>Situation at Alarm Occurrence</th><th>Cause</th><th>Corrective Actions</th></tr>
<tr><td rowspan="21">A.100</td><td rowspan="21">Overcurrent (An overcurrent flowed through the IGBT) or Heat Sink Overheated (Heat sink of SERVOPACK overheated.)</td><td rowspan="3">Occurred when the control power supply was turned ON.</td><td>The overload alarm has been reset by turning OFF the power too many times.</td><td>Change the method to reset the alarm.</td></tr>
<tr><td>The connection is faulty between the SERVOPACK board and the thermostat switch.</td><td rowspan="2">Replace the SERVOPACK.</td></tr>
<tr><td>The SERVOPACK board fault occurred.</td></tr>
<tr><td rowspan="18">Occurred when the main circuit power supply was turned ON or when an overcurrent occurred while the servomotor was running.</td><td>The connection between grounding and U, V, or W is incorrect.</td><td rowspan="2">Check and then correct the wiring.</td></tr>
<tr><td>The grounding line has contact with other terminals.</td></tr>
<tr><td>A short circuit occurred between the grounding and U, V, or W of the servomotor cable.</td><td rowspan="2">Repair or replace the servomotor main circuit cable.</td></tr>
<tr><td>A short circuit occurred between phase U, V, or W of the servomotor cable.</td></tr>
<tr><td>The wiring of the regenerative resistor is incorrect.</td><td>Check and then correct the wiring.</td></tr>
<tr><td>A short circuit occurred between the grounding and U, V, or W of the SERVOPACK.</td><td rowspan="2">Replace the SERVOPACK.</td></tr>
<tr><td>A SERVOPACK fault occurred (current feedback circuit, power transistor or board fault).</td></tr>
<tr><td>A short circuit occurred between phase U, V, and W of the servomotor.</td><td rowspan="2">Replace the servomotor.</td></tr>
<tr><td>A short circuit occurred between the grounding and U, V, W of the servomotor.</td></tr>
<tr><td>A fault occurred in the dynamic brake circuit.</td><td>Replace the SERVOPACK, and reduce the load, or reduce the number of rotations used.</td></tr>
<tr><td>The dynamic brake was activated too frequently, so a DB overload alarm occurred.</td><td>Replace the SERVOPACK, and reduce the DB operation frequency.</td></tr>
<tr><td>The overload alarm has been reset by turning OFF the power too many times.</td><td>Change the method to reset the alarm.</td></tr>
<tr><td>The overload or regenerative power exceeds the regenerative resistor's capacity.</td><td>Reconsider the load and operation conditions.</td></tr>
<tr><td>The direction or the distance of the SERVOPACK to other devices is incorrect.
Heat radiation of the panel or heat around the panel occurred.</td><td>The ambient temperature for the SERVOPACK must be 55°C or less.</td></tr>
<tr><td>A SERVOPACK fan fault occurred.</td><td rowspan="2">Replace the SERVOPACK.</td></tr>
<tr><td>A SERVOPACK fault occurred.</td></tr>
<tr><td rowspan="8">A.300</td><td rowspan="8">Regeneration Error Detected (Detected when the power to the main circuit was turned ON)</td><td>Occurred when the control power supply was turned ON</td><td>A SERVOPACK board fault occurred.</td><td>Replace the SERVOPACK.</td></tr>
<tr><td rowspan="3">Occurred when the main circuit power supply turned ON.</td><td>Pn600 is set to a value other than "0" for a servomotor of 400 W or less, and an external regenerative resistor is not connected.</td><td>Connect an external regenerative resistor, or set Pn600 to "0" if an external regenerative resistor is not connected.</td></tr>
<tr><td>Check for incorrect wiring or a disconnected wire in the regenerative resistor.</td><td>Correct the wiring for the external regenerative resistor.</td></tr>
<tr><td>A SERVOPACK fault occurred, such as regenerative transistor or a voltage sensor fault.</td><td>Replace the SERVOPACK.</td></tr>
<tr><td rowspan="4">Occurred during normal operation</td><td>Check for incorrect wiring and disconnection of the regenerative resistor.</td><td>Correct the wiring for the external regenerative resistor.</td></tr>
<tr><td>The jumper between B2 and B3 is removed for a servomotor of 500 W or more.</td><td>Correct the wiring.</td></tr>
<tr><td>The regenerative resistor is disconnected, so the regenerative energy became excessive.</td><td>Replace the regenerative resistor or replace the SERVOPACK. Reconsider the load and operation conditions.</td></tr>
<tr><td>A SERVOPACK fault, such as regenerative transistor and voltage sensor fault, occurred.</td><td>Replace the SERVOPACK.</td></tr>
</table>

Table 11.3 Alarm Display and Troubleshooting (cont'd)

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.320	Regenerative Overload (Detected when the power to the main circuit is turned ON)	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred when the main circuit power supply was turned ON	The power supply voltage is 270 V or more.	Correct the input voltage.
		Occurred during normal operation (large increase of regenerative resistor temperature)	The regenerative energy is excessive.	Select a proper regenerative resistance capacity, or reconsider the load and operation conditions.
			The regenerating state continued.	
		Occurred during normal operation (small increase of regenerative resistor temperature)	The setting of parameter Pn600 is smaller than the external regenerative resistor's capacity.	Correct the set value of parameter Pn600.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred at servomotor deceleration	The regenerative energy is excessive.	Select a proper regenerative resistance capacity, or reconsider the load and operation conditions.
A.330	Main Circuit Wiring Error (Detected when the power to the main circuit is turned ON)	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred when the main circuit power supply was turned ON.	In the DC power input mode, AC power is supplied through L1 and L2 or L1, L2, and L3.	For AC power input, Pn001.2=0. For DC power input, Pn001.2=1.
			In the AC power input mode, DC power is supplied through B1/⊕ and ⊖ terminals.	
			Pn600 is set to 0 if the regenerative resistance is disconnected.	Set Pn600 to 0.
A.400	Overvoltage (Detected when the SERVOPACK's main circuit DC voltage is 410 V or more) (Detected when the power to the main circuit is turned ON)	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred when the main circuit power supply was turned ON.	The AC power voltage is 290 V or more.	The AC power voltage must be within the specified range.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred during normal operation.	Check the AC power voltage (check if there is no excessive voltage change.)	The AC power voltage must be within the specified range.
			The motor speed is high and load moment of inertia is excessive, resulting in insufficient regenerative capacity.	Check the load moment of inertia and minus load specifications. Reconsider the load and operation conditions.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred at servomotor deceleration.	The motor speed is high, and the load moment of inertia is excessive.	Reconsider the load and operation conditions.
A.410	Undervoltage (Detected when the SERVOPACK's main circuit DC voltage is 170 V or less.) Detected when the power to the main circuit is turned ON. Detected 85 VDC or less when the SGDS-A3B☐☐A or A5B☐☐A is used.	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred when the main circuit power supply was turned ON.	The AC power supply voltage is 120 V or less. (60 VAC or less with SGDS-**B, **F☐☐A.)	The AC power supply voltage must be within the specified range.
			The fuse of the SERVOPACK is blown out.	Replace the SERVOPACK.
			The inrush current limit resistor is disconnected, and results in an abnormal power supply voltage or in an overload of the inrush current limit resistor.	Replace the SERVOPACK. Check the power supply voltage, and reduce the number of times that the main circuit is turned ON or OFF.)
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred during normal operation.	The AC power supply voltage was lowered, and large voltage drop occurred.	The AC power supply voltage must be within the specified range.
			A temporary power failure occurred.	Clear and reset the alarm, and restart the operation.
			The servomotor main circuit cable shorts to ground.	Repair or replace the servomotor main circuit cable.
			The servomotor shorts to ground.	Replace the servomotor.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.

Table 11.3 Alarm Display and Troubleshooting (cont'd)

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.510	Overspeed (Detected when the feedback speed is the maximum motor speed × 1.1 or more.)	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred when servomotor was ON.	The order of phases U, V, and W in the servomotor wiring is incorrect.	Correct the servomotor wiring.
			The encoder wiring is incorrect.	Correct the encoder wiring.
			Malfunction occurred due to noise interference in the encoder wiring.	Take measures against noise for the encoder wiring.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred when the servomotor started running or in a high speed run.	The order of phases U, V, and W in the servomotor wiring is incorrect.	Correct the servomotor wiring.
			The encoder wiring is incorrect.	Correct the encoder wiring.
			Malfunction occurred due to noise interference in the encoder wiring.	Take measures against noise for the encoder wiring.
			The position or speed reference input is too large.	Reduce the reference value.
			The setting of the reference input gain is incorrect.	Correct the reference input gain setting.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
A.511	Dividing Pulse Output Overspeed	Occurred while the servomotor was running.	The output frequency of the dividing pulse exceeds 1.6 MHz.	Lower the setting of the PG dividing pulse (Pn212).
				Reduce the servomotor speed.
A.520	Vibration Alarm	Occurred while the servomotor was running.	Abnormal vibration was detected.	Reduce the servomotor speed.
				Reduce the speed loop gain (Pn100).
A.521	Autotuning Alarm The moment of inertia ratio calculation error occurred.	Occurred during normal autotuning.	Vibration at the motor speed was detected during operation by input reference to the SERVOPACK.	Use the JOG mode operation (Fn002) or the program JOG operation (Fn004) and operate the servomotor by the trapezoidal reference when the speed reference or deceleration time is 20 ms and the number of the maximum rotation is 2000 min^{-1}.
				Execute advanced autotuning.
				Calculate the moment of inertia ratio with the machine specifications without using normal autotuning and set to Pn103.
		Occurred during advanced autotuning.	Vibration at the motor speed was detected during operation.	Calculate the moment of inertia ratio with the machine specifications without using advanced autotuning and set to Pn103.
A.710 A.720	Overload A.710: High load A.720: Low load	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred when the servo was turned ON.	The servomotor wiring is incorrect or the connection is faulty.	Correct the servomotor wiring.
		Occurred when the servo was turned ON.	The encoder wiring is incorrect or the connection is faulty.	Correct the encoder wiring.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred when the servomotor did not run by the reference input.	The servomotor wiring is incorrect or the connection is faulty.	Correct the servomotor wiring.
			The encoder wiring is incorrect or the connection is faulty.	Correct the encoder wiring.
			The starting torque exceeds the maximum torque.	Reconsider the load and operation conditions, or reconsider the servomotor capacity.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred during normal operation.	The actual torque exceeds the rated torque or the starting torque largely exceeds the rated torque.	Reconsider the load and operation conditions, or reconsider the servomotor capacity.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.

Table 11.3 Alarm Display and Troubleshooting (cont'd)

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.730 A.731	Dynamic Brake Overload (Detected with SERVOPACK of 500 W or more.)	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred when the servomotor was running and in a status other than servo OFF.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred when the servomotor was running in servo OFF status.	The rotating energy at a DB stop exceeds the DB resistance capacity.	①Reduce the servomotor speed, ②Reduce the load moment of inertia, or ③Reduce the number of times of the DB stop operation.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.740	Overload of Surge Current Limit Resistor (Detected when the number of times that the main circuit's power is turned ON or OFF more than 10 times/2 seconds.)	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred during operations other than the turning ON/OFF of the main circuit.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred at the main circuit power supply ON/OFF operation.	The inrush current limit resistor operation frequency at the main circuit power supply ON/OFF operation exceeds the allowable range.	Reduce the number of times that main circuit's power supply can be turned ON/OFF to 5 times/min. or less.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.7A0	Heat Sink Overheated (Detected when the heat sink temperature exceeds 100°C.)	Occurred when the control power supply was turned ON	A SERVOPACK fault occurred.	Replace the SERVOPACK.
			The overload alarm has been reset by turning OFF the power too many times.	Change the method to reset the alarm.
		Occurred when the main circuit power supply was turned ON or while the servomotor was running.	The load exceeds the rated load.	Reconsider the load and operation conditions, or reconsider the servomotor capacity.
			The SERVOPACK ambient temperature exceeds 55°C.	The ambient temperature must be 55°C or less.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
			The overload alarm has been reset by turning OFF the power too many times.	Change the method to reset the alarm.
			The connection of the SERVOPACK board and the thermostat switch is incorrect.	Replace the SERVOPACK.
			The overload or regenerative energy exceeds the resistor capacity.	Reconsider the load and operation conditions.
			The SERVOPACK (direction and distance to the peripheral devices) is mounted incorrectly. Heat radiation from the panel or heat around the SERVOPACK)	The ambient temperature for SERVOPACK must be 55°C or less.
			A SERVOPACK fan fault occurred.	Replace the SERVOPACK.
A.810	Encoder Backup Error (Detected on the encoder side) (Only when an absolute encoder is connected.)	Occurred when the control power supply was turned ON. (Setting: Pn002.2=1)	A SERVOPACK board fault occurred when an absolute encoder is used with the setting for incremental encoder.	Replace the SERVOPACK.
		Occurred when the control power supply was turned ON using an absolute encoder. (Setting: Pn002.2=0)	Alarm occurred when the power to the absolute encoder was initially turned ON.	Set up the encoder.
			The encoder cable had been disconnected once.	First confirm the connection and set up the encoder.
			The power from both the PG power supply (+5 V) and the battery power supply from the SERVOPACK is not being supplied.	Replace the battery or take similar measures to supply power to the encoder, and set up the encoder.
			An absolute encoder fault occurred.	If the alarm cannot be reset by setting up the encoder again, replace the encoder.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.

Table 11.3 Alarm Display and Troubleshooting (cont'd)

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.820	Encoder Checksum Error (Detected on the encoder side.)	Occurred when the control power supply was turned ON or during an operation	A fault occurred in the encoder and was detected by encoder self-diagnosis.	Set up the encoder. If this alarm occurs frequently, replace the servomotor.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.830	Absolute Encoder Battery Error (Detected when the battery voltage is lower than the specified value 2 to 4 seconds after the control power supply is turned ON.) (Only when an absolute encoder is connected.)	When the control power supply was turned ON. (Setting: Pn002.2=1)	When the absolute encoder was used as an incremental encoder, a SERVOPACK board fault occurred.	Replace the SERVOPACK.
		When the control power supply was turned ON using an absolute encoder. (Setting: Pn002.2=0)	The battery connection is incorrect.	Reconnect the battery.
			The battery voltage is lower than the specified value 2.7 V.	Replace the battery, and then turn the control power supply OFF and then ON again.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
A.840	Encoder Data Error (Detected on the encoder side)	Occurred when the control power supply was turned ON.	A malfunction occurred in the encoder.	Turn the control power supply OFF and then ON again. If this alarm occurs frequently, replace the servomotor.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred during operation.	A malfunction occurred in the encoder.	Correct the wiring around the encoder by separating the encoder cable from the power line, or by checking the grounding and other wiring.)
			An encoder fault occurred.	If this alarm occurs frequently, replace the servomotor.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
A.850	Encoder Overspeed (Detected when the control power supply was turned OFF and then ON again.) (Detected on the encoder side.)	Occurred when the control power supply was turned ON.	When the control power supply was turned OFF and then ON again, the servomotor runs at 200 min^{-1} or more.	Turn the control power supply OFF and then ON again when the servomotor runs at a speed less than 200 min^{-1}.
			An encoder fault occurred.	Replace the servomotor.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred during operation.	An encoder fault occurred.	Replace the servomotor.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
A.860	Encoder Overheated (Only when an absolute encoder is connected) (Detected on the encoder side.)	Occurred when the control power supply was turned ON.	An encoder fault occurred.	Replace the servomotor.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred during operation.	The ambient temperature around the servomotor is too high.	The ambient temperature must be 40°C or less.
			The servomotor load is greater than the rated load.	The servomotor load must be within the specified range.
			An encoder fault occurred.	Replace the servomotor.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
A.b10	Speed Reference Input Read Error (Detected when the Servo is turned ON.)	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred during operation.	A malfunction occurred in reading section of the speed reference input.	Clear and reset the alarm and restart the operation.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.

Table 11.3 Alarm Display and Troubleshooting (cont’d)

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.b11	Speed Reference A/D Data Error	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred when a speed reference greater than 0V was input when the servo was turned OFF.	A malfunction occurred when the detection section of the speed input A/D conversion data was detected.	After the alarm has been cleared and reset, restart the operation.
		Occurred during operation.	A malfunction occurred in the reading section of the speed reference input.	After the alarm reset is executed, restart the operation.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
A.b20	Torque Reference Input Read Error (Detected when the servo is ON.)	Occurred when the control power supply was turned ON or during operation.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
			A malfunction occurred in the reading section of the torque reference input.	Clear and reset the alarm and restart the operation.
A.b31	Current Detection Error 1		The current detection circuit for the Phase U is faulty.	Replace the SERVOPACK.
A.b32	Current Detection Error 2		The current detection circuit for the Phase V is faulty.	
A.b33	Current Detection Error 3	Occurred when the servo was ON.	The detection circuit for the current is faulty.	Replace the SERVOPACK.
			The servomotor main circuit cable is disconnected.	Check the motor wiring.
A.bF0	System Alarm 0 (Internal program processing error)	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
A.bF1	System Alarm 1 (Internal program error)			
A.bF2	System Alarm 2 (Current control processing program error)			
A.bF3	System Alarm 3 (Encoder interface processing error)			
A.bF4	System Alarm 4 (CPU watchdog timer error)			
A.C10	Servo Overrun Detected (Detected when the servo is ON.)	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred when the servo was ON or a reference was input.	The order of phase-U, -V, and -W in the servomotor wiring is incorrect.	Correct the servomotor wiring.
			An encoder fault occurred.	Replace the servomotor.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.C80	Absolute Encoder Clear Error and Multiturn Limit Setting Error	Occurred when the control power supply was turned ON.	An encoder fault occurred.	Replace the servomotor.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred when an encoder alarm was cleared and reset.	An encoder fault occurred.	Replace the servomotor.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.

Table 11.3 Alarm Display and Troubleshooting (cont'd)

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.C90	Encoder Communications Error	Occurred when the control power supply was turned ON or during operation.	The encoder wiring and the contact are incorrect.	Correct the encoder wiring.
			Noise interference occurred due to incorrect encoder cable specifications.	Use tinned annealed copper twisted-pair or twisted-pair shielded wire with a core of at least 0.12 mm^2.
			Noise interference occurred because the wiring distance for the encoder cable is too long.	The wiring distance must be 20m max.
A.C91	Encoder Communications Position Data Error		The noise interference occurred on the signal line because the encoder cable is bent and the sheath is damaged.	Correct the encoder cable layout.
			The encoder cable is bundled with a high-current line or near a high-current line.	Correct the encoder cable layout so that no surge is applied.
			The FG potential varies because of influence from machines on the servomotor side, such as the welder.	Make the grounding for the machine separately from PG side FG.
A.C92	Encoder Communications Timer Error		Noise interference occurred on the signal line from the encoder.	Take a measure against noise for the encoder wiring.
			Excessive vibration and shocks were applied to the encoder.	Reduce the machine vibration or mount the servomotor securely.
			An encoder fault occurred.	Replace the servomotor.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
A.CA0	Encoder Parameter Error	Occurred when the control power supply was turned ON.	An encoder fault occurred.	Replace the servomotor.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
A.Cb0	Encoder Echoback Error	Occurred when the control power supply was turned ON or during operation.	The encoder wiring and contact are incorrect.	Correct the encoder wiring.
			Noise interference occurred due to incorrect encoder cable specifications.	Use tinned annealed copper twisted-pair or twisted-pair shielded wire with a core of at least 0.12 mm^2.
			Noise interference occurred because the wiring distance for the encoder cable is too long.	The wiring distance must be 20m max.
			Noise interference occurred on the signal line, because the encoder cable is bent and the sheath is damaged.	Correct the encoder cable layout.
			The encoder cable is bundled with a high-current line or near a high-current line.	Correct the encoder cable layout so that no surge is applied.
			The FG potential varies because of influence from the servomotor side machines, such as the welder.	Ground the machine separately from PG side FG.
			Noise interference occurred on the signal line from the encoder.	Take measures against noise for the encoder wiring.
			Excessive vibration and shocks were applied to the encoder.	Reduce the machine vibration or mount the servomotor securely.
			An encoder fault occurred.	Replace the servomotor.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
A.CC0	Multi-turn Limit Disagreement	Occurred when the control power supply was turned ON.	The parameter settings for the SERVOPACK are incorrect.	Correct the setting of Pn205 (0 to 65535).
			The multiturn limit value for the encoder is not set or was changed.	Execute Fn013 at the occurrence of alarm.
		Occurred during operation.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.

Table 11.3 Alarm Display and Troubleshooting (cont'd)

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.d00	Position Error Pulse Overflow (In servo ON status, the position error pulses exceed the overflow level set in the parameter Pn520.)	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred at the servomotor high-speed operation.	The contact in the servomotor U, V, and W wirings is faulty.	Correct the servomotor wiring.
				Correct the encoder wiring.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		The servomotor did not run with position reference input.	Wirings of the servomotor U, V, and W are incorrect.	Correct the servomotor wiring.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Normal movement, but occurred with a long distance reference input.	The SERVOPACK gain adjustment is improper.	Increase the speed loop gain (Pn100) and position loop gain (Pn102).
			The position reference pulse frequency is too high.	Adjust slowly the position reference pulse frequency.
				Apply the smoothing function.
				Correct the electronic gear ratio.
			Setting of the parameter Pn520 (Position Error Pulse Overflow Alarm Level) is incorrect.	Set the parameter Pn520 to proper value.
			The servomotor specifications do not meet the load conditions such as torque and moment of inertia.	Reconsider and correct the load and servomotor capacity.
A.d01	Position Error Pulse Overflow Alarm at Servo ON	Occurred when the control power supply was turned ON.	• Excessive position error pulse accumulated while the servo is OFF • With the setting not to clear the position error pulse while the servo is OFF, the servomotor was running.	Do not run the servomotor in servo OFF status.
				Make the setting so that the position error pulse are cleared while the servo is OFF.
				Adjust the detection level.
A.d02	Position Error Pulse Overflow Alarm by Speed Limit at Servo ON	Occurred when the servomotor was running.	The servo turned ON with accumulated position error pulse, and reference pulse was input during operation at the speed limit, therefore, the position error pulse exceeded the Position Error Pulse Overflow Alarm Level (Pn520).	Do not run the servomotor in servo OFF status.
				Make the setting so that the position error pulse are cleared while the servo is OFF.
				Correct the detection level.
				Adjust the speed limit level (Pn529) when servo turns ON.
A.F10	Power Line Open Phase (In the main power supply ON status, the voltage stays low for 1 second or more at one of the phases R, S, and T.) (Detected when the main circuit power supply turns ON.)	Occurred when the control power supply was turned ON.	A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred when the main circuit power supply was turned ON.	The three-phase power supply wiring is incorrect.	Correct the power supply wiring.
			The three-phase power supply is unbalanced.	Balance the power supply by changing phases.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred when the servomotor was running.	The contact in three-phase power supply wiring is faulty.	Correct the power supply wiring.
			Three-phase power supply is unbalanced.	Balance the power supply.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
CPF00	Digital Operator Transmission Error 1 *1	Occurred when the power supply was turned ON with digital operator connected or when connecting digital operator with the power supply was turned ON.	The contact between the digital operator and the SERVOPACK is faulty.	Insert securely the connector, or replace the cable.
			The external noise interference occurred to the digital operator or cable. (The digital operator connection cable is near noise source)	Do not lay the cable near noise source.
				Install digital operator far from noise source.
CPF01	Digital Operator Transmission Error 2 *2		A digital operator fault occurred.	Replace the digital operator.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.

* 1. This alarm occurs when the communications is still disabled five seconds after digital operator power supply is ON.

* 2. This alarm occurs when digital operator received data error occurs consecutively five times, or when the state that digital operator receives no data from SERVOPACK for one second or more occurs consecutively three times.

(2) Warning Display and Troubleshooting

Table 11.4 Warning Display and Troubleshooting

Warning Display	Warning Name	Situation at Warning Occurrence	Cause	Corrective Actions
A.900	Position Error Pulse Overflow	Occurred during operation.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
			Wiring is incorrect or the contact of servomotor U, V, and W is faulty.	Correct the servomotor wiring.
				Correct the encoder wiring.
			The SERVOPACK gain adjustment is improper.	Increase the speed loop gain (Pn100) and position loop gain (Pn102).
			The position reference pulse frequency is too high.	Decrease slowly the position reference pulse frequency.
				Apply the smoothing function.
				Adjust the electronic gear ratio.
			Setting of the parameter Pn520 (Position Error Pulse Alarm Level) is improper.	Set the parameter Pn520 to a value other than “0”.
			The servomotor specifications do not meet the load conditions (torque, moment of inertia).	Reconsider and correct the load and servomotor capacity.
A.901	Position Error Pulse Overflow at Servo ON	Occurs when the servo was ON.	• Position error pulse accumulated excessively in servo OFF status • With the setting not to clear the position error pulse while the servo is OFF, the servomotor was running.	Do not run the servomotor in servo OFF status.
				Make the setting so that the position error pulse are cleared in servo OFF status.
				Adjust the detection level.
A.910	Overload: Before warning for the alarms A710 and A720 occurs In either of the following cases: 1. 20% of the overload detection level of A710 2. 20% of the overload detection level of A720.	Occurs when the servo was ON.	Wiring is incorrect and the contact in servomotor wiring is faulty.	Correct the servomotor wiring.
			Wiring is incorrect and the contact in encoder wiring is faulty.	Correct the encoder wiring.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		The servomotor did not run with a reference input.	Servomotor wiring is incorrect and the contact is faulty.	Correct the servomotor wiring.
			Encoder wiring is incorrect and the contact is faulty.	Correct the encoder wiring.
			The starting torque exceeds the maximum torque.	Reconsider the load and operation conditions. Or, check the servomotor capacity.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred during operation.	The effective torque exceeds the rated torque.	Reconsider the load and operation conditions. Or, check the servomotor capacity.
			Temperature in the SERVOPACK panel is high.	Reduce the in-panel temperature to 55°C or less.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.911	Vibration	Occurred during normal operation.	SERVOPACK gain is improper.	To adjust the gain, decrease the speed loop gain (Pn100) and position loop gain (Pn101), and increase the filter time constants such as torque reference filter (Pn401).
A.920	Regenerative Overload: Before warning for the alarm A320 occurs	Occurred when the control power supply was turned ON.	A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred during normal operation (Large increase of regenerative resistor temperature.)	Regenerative energy is excessive.	Check the regenerative resistor capacity, or reconsider the load and operation conditions.
			Regenerative status continues.	
		Occurred during normal operation (Small increase of regenerative resistor temperature).	The setting of parameter Pn600 is smaller than the external regenerative resistor capacity.	Correct the setting of parameter Pn600.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred at servomotor deceleration.	Regenerative energy is excessive.	Check the regenerative resistor capacity, or reconsider the load and operation conditions.

Table 11.4 Warning Display and Troubleshooting (cont'd)

Warning Display	Warning Name	Situation at Warning Occurrence	Cause	Corrective Actions
A.921	Regenerative Overload: Before warning for the alarm A731 occurs	Occurred when the control power supply was turned ON.	A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred when the servomotor was running in servo OFF status.	Rotational energy at a DB stop exceeds the DB resistor capacity.	① Reduce the motor speed, ② Reduce the load moment of inertia, or ③ Reduce the number of times of the DB stop operation.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.930	Absolute Encoder Battery Warning (The battery voltage stays below the specified value 4 seconds after the control power supply was turned ON.) (Only when an absolute encoder is connected.)	Occurred when the control power supply was turned ON (Setting: Pn002.2=1)	A SERVOPACK board fault occurred. (The absolute encoder is used in the incremental encoder setting.)	Replace the SERVOPACK.
		Occurred 4 seconds or more after the control power supply was turned ON (Setting: Pn002.2=0) When an absolute encoder was used	The battery connection is incorrect or faulty.	Connect correctly the battery.
			The battery voltage is lower than the specified value 2.7 V.	Replace the battery, and turn the control power supply OFF and then ON again.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
A.941	Change of Parameters Requires the Setting Validation	Occurred after having changed parameter setting.	To validate new setting of this parameter, turn OFF the power and ON again.	Turn OFF the power and ON again.

11.1.4 Troubleshooting for Malfunction without Alarm Display

The troubleshooting for the malfunctions that causes no alarm display is listed below.
Contact your Yaskawa representative if the problem cannot be solved by the described corrective actions.

Table 11.5 Troubleshooting for Malfunction without Alarm Display

Symptom	Cause	Inspection	Corrective Actions
		▒: Turn OFF the servo system before inspection.	
Servomotor Does Not Start	The control power supply is not ON.	Check voltage between power supply terminals.	Correct the power circuit.
	The main circuit power supply is not ON.	Check the voltage between power supply terminals.	Correct the power circuit.
	Wrong wiring or disconnection of I/O signal connector CN1	Check if the connector CN1 is properly inserted and connected.	Correct the connector CN1 connection.
	Servomotor or encoder wiring disconnected.	Check the wiring.	Correct the wiring.
	Overloaded	Run under no load.	Reduce load or replace with larger capacity servomotor.
	Speed/position references not input	Check reference input pins.	Input speed/position references correctly.
	Setting for Pn50A to Pn50D "Input Signal Selection" is incorrect.	Check settings of parameters Pn50A to Pn50D.	Correct the settings for Pn50A to Pn50D "Input Signal Selection."
	Encoder type differs from parameter setting.	Check incremental or absolute encoder.	Set parameter Pn002.2 to the encoder type being used.
	Servo ON (/S-ON) input signal stays OFF.	Check settings of parameters Pn50A.0 and Pn50A.1.	Correct the parameter setting, and turn the Servo ON (/S-ON) input signal ON.
	/P-CON input function setting is incorrect.	Check parameter Pn000.1.	Set parameters to match the application.
	SEN input is turned OFF.	When absolute encoder is used.	Turn SEN input signal ON.
	Reference pulse mode selection is incorrect.	Check the parameter setting for the reference pulse mode.	Correct setting of parameter Pn200.0.
	Speed control: Speed reference input is incorrect.	Check V-REF and SG to confirm if the control method and the input are agreed.	Correct the control mode selection parameter, or the input.
	Torque control: Torque reference input is incorrect.	Check V-REF and SG to confirm if the control method and the input are agreed.	Correct the control mode selection parameter, or the input.
	Position control: Reference pulse input is incorrect.	Check Pn200.0 reference pulse form or sign + pulse signal.	Correct the control mode selection parameter, or the input.
	Position error pulse clear (CLR) input is turned ON.	Check CLR or /CLR input pins (1CN-14 and -15).	Turn CLR or /CLR input signal OFF.
	The forward run prohibited (P-OT) and reverse run prohibited (N-OT) input signals are turned OFF.	Check P-OT or N-OT input signal.	Turn P-OT or N-OT input signal ON.
	A SERVOPACK fault occurred.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
Servomotor Moves Instantaneously, and then Stops	Servomotor wiring is incorrect.	Check the servomotor wiring.	Correct the servomotor wiring.
	Encoder wiring is incorrect.	Check the encoder wiring.	Correct the encoder wiring.
Servomotor Speed Unstable	Wiring connection to servomotor is defective	Check connection of power lead (phases-U, -V, and -W) and encoder connectors.	Tighten any loose terminals or connectors.
Servomotor Rotates Without Reference Input	Speed control: Speed reference input is incorrect.	Check V-REF and SG to confirm if the control method and the input are agreed.	Correct the control mode selection parameter, or the input signal.
	Torque control: Torque reference input is incorrect.	Check V-REF and SG to confirm if the control method and the input are agreed.	Correct the control mode selection parameter, or the input signal.
	Speed reference offset is error.	The SERVOPACK offset is adjusted incorrectly.	Adjust the SERVOPACK offset.
	Position control: Reference pulse input is incorrect.	Check Pn200.0 reference pulse form or reference pulse (PULS/SIGN) signal.	Correct the control mode selection parameter, or the input signal.
	A SERVOPACK fault occurred.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
DB (dynamic brake) Does Not Operate	Improper parameter setting	Check the setting of parameter Pn001.0.	Correct the parameter setting.
	DB resistor disconnected	Check if excessive moment of inertia, motor overspeed, or DB frequently activated occurred.	Replace the SERVOPACK, and reconsider the load.
	DB drive circuit fault	DB circuit parts are faulty.	Replace the SERVOPACK.

Table 11.5 Troubleshooting for Malfunction without Alarm Display (cont'd)

Symptom	Cause	Inspection	Corrective Actions
		: Turn OFF the servo system before inspection.	
Abnormal Noise from Servomotor	Mounting not secured	Check if there are any loosen mounting screws.	Tighten the mounting screws.
		Check if there are misalignment of couplings.	Align the couplings.
		Check if there are unbalanced couplings.	Balance the couplings.
	Defective bearings	Check for noise and vibration around the bearings.	If any problems, contact your Yaskawa representative.
	Vibration source on the driven machine.	Any foreign matter, damages, or deformation on the machine movable section.	Contact the machine manufacturer.
	Noise interference due to incorrect input signal wire specifications.	The specifications of input signal wires must be: Tinned annealed copper twisted-pair or twisted-pair shielded wires with core 0.12 mm^2 min.	Use the specified input signal wires.
	Noise interference due to length of input signal line	The wiring distance must be 3 m max. and the impedance a few hundreds ohm max.	Shorten the wiring distance for input signal line to the specified value.
	Noise interference due to incorrect encoder cable specifications.	The specifications of encoder cable must be: Tinned annealed copper twisted-pair or twisted-pair shielded wires with core 0.12 mm^2 min.	Use the specified encoder cable.
	Noise interference due to length of encoder cable wiring	The wiring distance must be 20 m max.	Shorten the encoder cable wiring distance to the specified value.
	Noise due to damaged encoder cable	Check if the encoder cable is not damaged or bent.	Modify the encoder cable layout.
	Excessive noise to the encoder cable	Check if the encoder cable is bundled with high-current line or near the high-current line.	Install a surge absorber to the encoder cable.
	FG potential varies because of influence of machines such as the welder on the servomotor side	Check if the machine is correctly grounded.	Ground the machine separately from PG side FG.
	SERVOPACK pulse counting error due to noise	Check if there is noise interference on the signal line from encoder.	Take measure against noise for the encoder wiring.
	Excessive vibration and shock to the encoder	Vibration from the machine occurred or servomotor installation is incorrect. (Mounting surface accuracy, fixing, alignment, etc.)	Reduce vibration from the machine, or secure the servomotor installation.
	Encoder fault	An encoder fault occurred.	Replace the servomotor.
Servomotor Vibrates at about 200 to 400 Hz	Speed loop gain value (Pn100) too high.	Factory setting: Kv=40.0 Hz Refer to the gain adjustment in User's Manual.	Reduce speed loop gain (Pn100) preset value.
	Position loop gain value (Pn102) too high	Factory setting: Kp=40.0/s Refer to the gain adjustment in User's Manual.	Reduce position loop gain (Pn102) preset value.
	Incorrect speed loop integral time constant Pn101 setting	Factory setting: Ti=20.00 ms Refer to the gain adjustment in User's Manual.	Correct the speed loop integral time constant Pn101 setting.
	When the autotuning is used: Incorrect machine rigidity setting	Check the machine rigidity setting Fn001.	Select a proper machine rigidity setting Fn001.
	When the autotuning is not used: Incorrect rotational moment of inertia ratio data	Check the rotational moment of inertia ratio data Pn103.	Correct the rotational moment of inertia ratio data Pn103.

Table 11.5 Troubleshooting for Malfunction without Alarm Display (cont'd)

<table>
<tr><th rowspan="2">Symptom</th><th rowspan="2">Cause</th><th>Inspection</th><th>Corrective Actions</th></tr>
<tr><th colspan="2">: Turn OFF the servo system before inspection.</th></tr>
<tr><td rowspan="6">High Rotation Speed Overshoot on Starting and Stopping.</td><td>Speed loop gain (Pn100) value too high</td><td>Factory setting: Kv=40.0 Hz
Refer to the gain adjustment in User's Manual.</td><td>Reduce the speed loop gain Pn100 preset value.</td></tr>
<tr><td>Position loop gain Pn102 value too big</td><td>Factory setting: Kp=40.0/s
Refer to the gain adjustment in User's Manual.</td><td>Reduce the position loop gain Pn102 preset value.</td></tr>
<tr><td>Incorrect speed loop integral time constant Pn101 setting</td><td>Factory setting: Ti=20.00 ms
Refer to the gain adjustment in User's Manual.</td><td>Correct the speed loop integral time constant Pn101 setting.</td></tr>
<tr><td>When the autotuning is used: Incorrect machine rigidity setting</td><td>Check the machine rigidity setting Fn001.</td><td>Select a proper machine rigidity setting Fn001.</td></tr>
<tr><td rowspan="2">When the autotuning is not used: Incorrect rotational moment of inertia ratio data</td><td rowspan="2">Check the rotational moment of inertia ratio data Pn103.</td><td>Correct the rotational moment of inertia ratio data Pn103.</td></tr>
<tr><td>Use the mode switch setting function.</td></tr>
<tr><td rowspan="12">Absolute Encoder Position Difference Error (The position saved in Host controller when the power turned OFF is different from the position when the power turned ON.)</td><td>Noise interference due to improper encoder cable specifications</td><td>The specifications of encoder cable must be:
Tinned annealed copper twisted-pair or twisted-pair shielded wires with core 0.12 mm² min.</td><td>Use encoder cable with the specified specifications.</td></tr>
<tr><td>Noise interference due to length of encoder cable.</td><td>The wiring distance must be 20 m max.</td><td>The encoder cable distance must be within the specified range.</td></tr>
<tr><td>Noise interference due to damaged encoder cable</td><td>Noise interference occurred to the signal line because the encoder cable is bent or its sheath damaged.</td><td>Correct the encoder cable layout.</td></tr>
<tr><td>Excessive noise to the encoder cable</td><td>Check if the encoder cable is bundled with a high-current line or near high-current line.</td><td>Change the encoder cable layout so that no surge is applied.</td></tr>
<tr><td>FG potential varies because of noise from machines such as the welder on the servomotor side</td><td>Check if the grounding for the machine is properly made.</td><td>Ground the machine separately from PG side FG.</td></tr>
<tr><td>SERVOPACK pulse counting error due to noise interference</td><td>Check if the signal line from the encoder receives influence from noise interference.</td><td>Take measures against noise for encoder wiring.</td></tr>
<tr><td>Excessive vibration and shock to the encoder</td><td>Vibration from machine occurred or servomotor mounting such as mounting surface precision, fixing, and alignment is incorrect.</td><td>Reduce vibration from machine or mount securely the servomotor.</td></tr>
<tr><td>Encoder fault</td><td>An encoder fault occurred. (no change in pulse count)</td><td>Replace the servomotor.</td></tr>
<tr><td>SERVOPACK fault</td><td>Check the multiturn data from SERVOPACK.</td><td>Replace the SERVOPACK.</td></tr>
<tr><td rowspan="3">Host controller multiturn data reading error</td><td>Check the error detection at the host controller.</td><td>Correct the error detection section of host controller.</td></tr>
<tr><td>Check if the host controller executes data parity check.</td><td>Execute the multiturn data parity check.</td></tr>
<tr><td>Check noise on the signal line between SERVOPACK and the host controller.</td><td>Noise influence at no parity check (as the above.)</td></tr>
</table>

Table 11.5 Troubleshooting for Malfunction without Alarm Display (cont'd)

Symptom	Cause	Inspection	Corrective Actions
		: Turn OFF the servo system before inspection.	
Overtravel (OT) (Movement over the zone specified by the host controller)	Forward or reverse run prohibited signal is output (P-OT (CN1-42) or N-OT (CN1-43) is at H level).	Check if the voltage of input signal external power supply (+24 V) is correct.	Connect to the external +24 V power supply.
		Check if the overtravel limit switch (SW) operates properly.	Correct the overtravel limit SW.
		Check if the overtravel limit switch (SW) is connected correctly.	Correct the overtravel limit SW wiring.
	Forward or reverse run prohibited signal does not operate normally (P-OT or N-OT signal sometimes changes).	Check the fluctuation of the input signal external power supply (+24 V) voltage.	Stabilize the external +24 V power supply voltage.
		Check if the overtravel limit switch (SW) activate correctly.	Adjust the overtravel limit SW so that it operates correctly.
		Check if the overtravel limit switch wiring is correct. (check for damaged cables or loosen screws.)	Correct the overtravel limit SW wiring.
	Incorrect forward or reverse run prohibited signal (P-OT/N-OT) selection	Check the P-OT signal selection Pn50A.3.	Correct the setting of P-OT signal selection Pn50A.3.
		Check the N-OT signal selection Pn50B.0.	Correct the setting of N-OT signal selection Pn50B.0.
	Incorrect servomotor stop method selection	Check if "coast to stop" in servo OFF status is selected.	Check Pn001.0 and Pn001.1.
		Check if "coast to stop" in torque control mode is selected.	Check Pn001.0 and Pn001.1.
	Improper overtravel position setting	The distance to the position of OT (overtravel) is too short considering the coasting distance.	Correct the OT position.
	Noise interference due to improper encoder cable specifications	The encoder cable specifications must be: Tinned annealed copper twisted-pair or twisted-pair shielded wire with core 0.12 mm^2 min.	Use encoder cable with the specified specifications.
	Noise interference because the encoder cable distance is too long.	The wiring distance must be 20 m max.	The encoder cable distance must be within the specified range.
	Noise influence due to damaged encoder cable	Check if the encoder cable is bent or its sheath is damaged.	Correct the encoder cable layout.
	Excessive noise interference to encoder cable	Check if the encoder cable is bundled with a high-current line or near high-current line.	Change the encoder cable layout so that no surge is applied.
	FG varies because machine such as welder installed on servomotor side.	Check if grounding of the machine is made correctly.	Ground the machine separately from PG side FG.
	SERVOPACK pulse count error due to noise	Check if the signal line from the encoder is influenced by noise.	Take a measure against noise for the encoder wiring.
	Excessive vibration and shock to the encoder	Machine vibration occurred or servomotor mounting such as mounting surface precision, fixing, alignment is incorrect.	Reduce the machine vibration or mount the servomotor securely.
	Encoder fault	An encoder fault occurred.	Replace the servomotor.
	SERVOPACK fault	A SERVOPACK fault occurred.	Replace the SERVOPACK.
Position error (without alarm)	Unsecured coupling between machine and servomotor	Check if a position error occurs at the coupling between machine and servomotor.	Secure the coupling between the machine and servomotor.
	Noise interference due to improper input signal cable specifications	The input signal cable specifications must be: Twisted-pair or twisted-pair shielded wire with core 0.12 mm^2 min. and tinned annealed copper twisted wire.	Use input signal cable with the specified specifications.
	Noise interference because the input signal cable distance is too long.	The wiring distance must be 3 m max. and the impedance several hundreds ohm max.	The input signal cable distance must be within the specified range.
	Encoder fault (pulse count does not change)	An encoder fault occurred. (pulse count does not change)	Replace the servomotor.
Servomotor Overheated	Ambient temperature too high	Measure servomotor ambient temperature.	Reduce ambient temperature to 40°C max.
	Servomotor surface dirty	Check visually.	Clean dust and oil from servomotor surface.
	Overloaded	Run under no load.	Reduce load or replace with larger capacity servomotor.

11.2 Inspection and Maintenance

11.2.1 Servomotor Inspection

The AC servomotors are brushless. Simple, daily inspection is sufficient. The inspection and maintenance frequencies in the table are only guidelines. Increase or decrease the frequency to suit the operating conditions and environment.

IMPORTANT

During inspection and maintenance, do not disassemble the servomotor. If disassembly of the servomotor is required, contact your Yaskawa representative.

Table 11.6 Servomotor Inspections

Item	Frequency	Procedure	Comments
Vibration and Noise	Daily	Touch and listen.	Levels higher than normal?
Exterior	According to degree of contamination	Clean with cloth or compressed air.	–
Insulation Resistance Measurement	At least once a year	Disconnect SERVOPACK and test insulation resistance at 500 V. Must exceed 10 MΩ .*	Contact your Yaskawa representative if the insulation resistance is below 10 MΩ .
Replacing Oil Seal	At least once every 5000 hours	Contact your Yaskawa representative.	Applies only to servomotors with oil seals.
Overhaul	At least once every 20000 hours or 5 years	Contact your Yaskawa representative.	–

* Measure across the servomotor FG and the phase-U, phase-V, or phase-W power line.

11.2.2 SERVOPACK Inspection

For inspection and maintenance of the SERVOPACK, follow the inspection procedures in the following table at least once every year. Other routine inspections are not required.

Table 11.7 SERVOPACK Inspections

Item	Frequency	Procedure	Comments
Exterior	At least once a year	Check for dust, dirt, and oil on the surfaces.	Clean with compressed air.
Loose Screws		Check for loose terminal block and connector screws.	Tighten any loose screws.

11.2.3 SERVOPACK's Parts Replacement Schedule

The following electric or electronic parts are subject to mechanical wear or deterioration over time. To avoid failure, replace these parts at the frequency indicated.

Refer to the standard replacement period in the following table, contact your Yaskawa representative. After an examination of the part in question, we will determine whether the parts should be replaced or not.

The parameters of any SERVOPACKs overhauled by Yaskawa are reset to the factory settings before shipping. Be sure to confirm that the parameters are properly set before starting operation.

Table 11.8 Periodical Part Replacement

Part	Standard Replacement Period	Operating Conditions
Cooling Fan	4 to 5 years	• Ambient Temperature: Annual average of 30°C • Load Factor: 80% max. • Operation Rate: 20 hours/day max.
Smoothing Capacitor	7 to 8 years	
Relays	–	
Fuses	10 years	
Aluminum Electrolytic Capacitor on Circuit Board	5 years	

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Appendix

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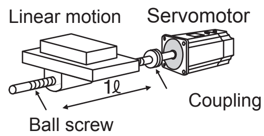
12.1 Servomotor Capacity Selection Examples

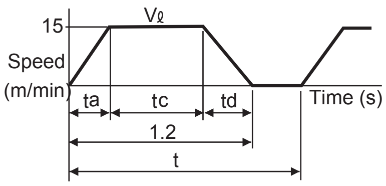
12.1.1 Selection Example for Speed Control

Mechanical Specifications



- Load speed: $V_\ell = 15$ m/min
- Linear motion section mass: M = 300 kg
- Ball screw length: $L_B = 1.0$ m
- Ball screw diameter: $D_B = 0.03$ m
- Ball screw lead: $P_B = 0.01$ m
- Coupling mass: $M_C = 1$ kg
- Coupling outer diameter: $D_C = 0.06$ m
- Feeding times: n=40times/min
- Feeding distance: $\ell = 0.275$ m
- Feeding time: tm = 1.2 s max.
- Friction coefficient: $\mu = 0.2$
- Mechanical efficiency: $\eta = 0.9$ (90%)

(1) Speed Diagram



$$t = \frac{60}{n} = \frac{60}{40} = 1.5(s)$$

where ta = td

$$tc = 1.2 - 0.1 \times 2 = 1.0(s)$$

(2) Rotation Speed

- Load axis rotation speed

$$N_\ell = \frac{V_\ell}{P_B} = \frac{15}{0.01} = 1500\ (\text{min}^{-1})$$

- Motor shaft rotation speed with the direct coupling: Gear ratio 1/R=1/1
  Therefore,

$$N_M = N_\ell \cdot R = 1500 \times 1 = 1500\ (\text{min}^{-1})$$

(3) Load torque

$$T_L = \frac{9.8\mu \cdot M \cdot P_B}{2\pi R \cdot \eta} = \frac{9.8 \times 0.2 \times 300 \times 0.01}{2\pi \times 1 \times 0.9} = 1.04\ (\text{N·m})$$

(4) Load Moment of Inertia

- Linear motion section

$$J_{L1} = M\left(\frac{P_B}{2\pi R}\right)^2 = 300 \times \left(\frac{0.01}{2\pi \times 1}\right)^2 = 7.6 \times 10^{-4}\ (\text{kg} \cdot \text{m}^2)$$

- Ball screw

$$J_B = \frac{\pi}{32}\rho \cdot L_B \cdot D_B^4 = \frac{\pi}{32} \times 7.87 \times 10^{+3} \times 1.0 \times (0.03)^4 = 6.3 \times 10^{-4}\ (\text{kg} \cdot \text{m}^2)$$

- Coupling

$$J_C = \frac{1}{8} M_C \cdot D_C^2 = \frac{1}{8} \times 1 \times (0.06)^2 = 4.5 \times 10^{-4}\ (\text{kg} \cdot \text{m}^2)$$

- Load moment of inertia at motor shaft

$$J_L = J_{L1} + J_B + J_C = 18.4 \times 10^{-4}\ (\text{kg} \cdot \text{m}^2)$$

(5) Load Moving Power

$$P_O = \frac{2\pi N_M \cdot T_L}{60} = \frac{2\pi \times 1500 \times 1.04}{60} = 163\ (\text{W})$$

(6) Load Acceleration Power

$$P_a = \left(\frac{2\pi}{60} N_M\right)^2 \frac{J_L}{ta} = \left(\frac{2\pi}{60} \times 1500\right)^2 \frac{18.4 \times 10^{-4}}{0.1} = 454 \text{ (W)}$$

(7) Servomotor Provisional Selection

(a) Selecting Conditions

- T_L ≤ Motor rated torque
- Pa + Po = (1 to 2) × Motor rated output
- N_M ≤ Motor rated speed
- J_L ≤ SERVOPACK allowable load moment of inertia

The followings satisfy the conditions.

- SGMAS-08A Servomotor
- SGDS-08A SERVOPACK

(b) Specifications of the Provisionally Selected Servomotor and SERVOPACK

- Rated output: 750 (W)
- Rated motor speed: 3000 (min^{-1})
- Rated torque: 2.39 (N·m)
- Instantaneous peak torque: 7.16 (N·m)
- Servomotor moment of inertia: 2.10×10^{-4} (kg·m^2)
- SERVOPACK allowable load moment of inertia: 31.5×10^{-4} (kg·m^2)

(8) Verification on the Provisionally Selected Servomotor

- Required starting torque

$$T_P = \frac{2\pi N_M (J_M + J_L)}{60ta} + T_L = \frac{2\pi \times 1500 \times (2.10 + 18.4) \times 10^{-4}}{60 \times 0.1} + 1.04$$

$\fallingdotseq$ 4.3 (N·m) < Instantaneous peak torque···Satisfactory

- Required braking torque

$$T_S = \frac{2\pi N_M (J_M + J_L)}{60td} - T_L = \frac{2\pi \times 1500 \times (2.10 + 18.4) \times 10^{-4}}{60 \times 0.1} - 1.04$$

$\fallingdotseq$ 2.2 (N·m) < Instantaneous peak torque···Satisfactory

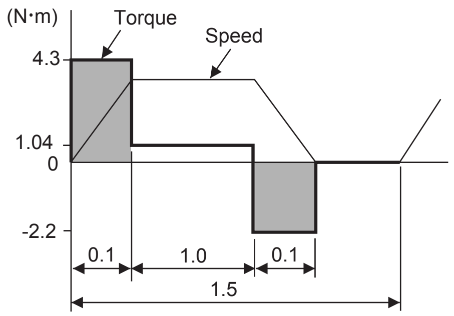
- Torque efficiency

$$T_{rms} = \sqrt{\frac{T_P{}^2 \cdot ta + T_L{}^2 \cdot tc + T_S{}^2 \cdot td}{t}} = \sqrt{\frac{(4.3)^2 \times 0.1 + (1.04)^2 \times 1.0 + (2.2)^2 \times 0.1}{1.5}}$$

$\fallingdotseq$ 1.51(N·m) < Rated torque···Satisfactory

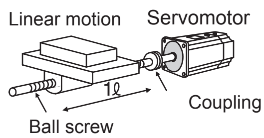
(9) Result

The provisionally selected servomotor and SERVOPACK are confirmed to be applicable.
The torque diagram is shown below.



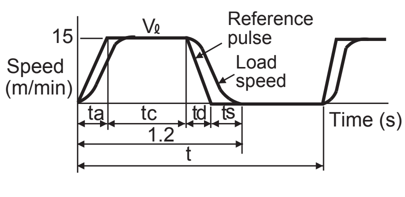
12.1.2 Selection Example for Position Control

Mechanical Specifications



- Load speed: $V_\ell = 15$ m/min
- Linear motion section mass: M = 80 kg
- Ball screw length: $L_B = 0.8$ m
- Ball screw diameter: $D_B = 0.016$ m
- Ball screw lead: $P_B = 0.005$ m
- Coupling mass: $M_C = 0.3$ kg
- Coupling outer diameter: D_C =0 .03 m
- Positioning times: n = 40 times/min
- Positioning distance: $\ell = 0.25$ m
- Positioning time: tm = Less than 1.2 s
- Electrical stop accuracy: $\delta = \pm 0.01$ mm
- Friction coefficient: $\mu = 0.2$
- Mechanical efficiency: η=0.9 (90%)

(1) Speed Diagram



$$t = \frac{60}{n} = \frac{60}{40} = 1.5(s)$$

Where ta = td, ts = 0.1 (s)

$$ta = tm - ts - \frac{60\ell}{V_\ell} = 1.2 - 0.1 - \frac{60 \times 0.25}{15} = 0.1\ (s)$$

$$tc = 1.2 - 0.1 - 0.1 \times 2 = 0.9(s)$$

(2) Rotation Speed

- Load axis rotation speed

$$N_\ell = \frac{V_\ell}{P_B} = \frac{15}{0.005} = 3000\ (\text{min}^{-1})$$

- Motor shaft rotation speed with direct coupling: Gear ratio 1/R=1/1
  Therefore,

$$N_M = N_\ell \cdot R = 3000 \times 1 = 3000\ (\text{min}^{-1})$$

(3) Load Torque

$$T_L = \frac{9.8\mu \cdot M \cdot P_B}{2\pi R \cdot \eta} = \frac{9.8 \times 0.2 \times 80 \times 0.005}{2\pi \times 1 \times 0.9} = 0.139\ (\text{N·m})$$

(4) Load Moment of Inertia

- Liner motion section

$$J_{L1} = M\left(\frac{P_B}{2\pi R}\right)^2 = 80 \times \left(\frac{0.005}{2\pi \times 1}\right)^2 = 0.507 \times 10^{-4}\ (\mathrm{kg \cdot m^2})$$

- Ball screw

$$J_B = \frac{\pi}{32}\rho \cdot L_B \cdot D_B^4 = \frac{\pi}{32} \times 7.87 \times 10^3 \times 0.8 \times (0.016)^4 = 0.405 \times 10^{-4}\ (\mathrm{kg \cdot m^2})$$

- Coupling

$$J_C = \frac{1}{8} M_C \cdot D_C^4 = \frac{1}{8} \times 0.3 \times (0.03)^2 = 0.338 \times 10^{-4}\ (\mathrm{kg \cdot m^2})$$

- Load moment of inertia at the motor shaft

$$J_L = J_{L1} \cdot J_B \cdot J_C = 1.25 \times 10^{-4}\ (\mathrm{kg \cdot m^2})$$

(5) Load Moving Power

$$P_O = \frac{2\pi N_M \cdot T_L}{60} = \frac{2\pi \times 3000 \times 0.139}{60} = 43.7\ (\mathrm{W})$$

(6) Load Acceleration Power

$$P_a = \left(\frac{2\pi}{60} N_M\right)^2 \frac{J_L}{ta} = \left(\frac{2\pi}{60} \times 3000\right)^2 \frac{1.25 \times 10^{-4}}{0.1} = 123.4\ (\mathrm{W})$$

(7) Provisionally Servomotor Selection

(a) Selecting Conditions

- $T_L \leq$ Motor rated torque
- Pa + Po = (1 to 2) × Motor rated output
- $N_M \leq$ Motor rated speed
- $J_L \leq$ SERVOPACK allowable load moment of inertia

The followings satisfy the conditions.

- SGMAS-02 Servomotor
- SGDS-02A01A SERVOPACK

(b) Specifications of Servomotor and SERVOPACK

- Rated output: 200 (W)
- Rated motor speed: 3000 (min^{-1})
- Rated torque: 0.637 (N·m)
- Instantaneous peak torque: 1.91 (N·m)
- Motor moment of inertia: 0.116×10^{-4} ($\mathrm{kg \cdot m^2}$)
- SERVOPACK allowable load moment of inertia: 3.48×10^{-4} ($\mathrm{kg \cdot m^2}$)
- Number of PG pulses: 32768 (P/R)

(8) Verification on Provisionally Selected Servomotor

- Required starting torque

$$T_P = \frac{2\pi N_M (J_M + J_L)}{60ta} + T_L = \frac{2\pi \times 3000 \times (0.209 + 1.25) \times 10^{-4}}{60 \times 0.1} + 0.139$$

$\fallingdotseq$ 0.597 (N·m) < Instantaneous peak torque···Satisfactory

- Required braking torque

$$T_S = \frac{2\pi N_M (J_M + J_L)}{60ta} - T_L = \frac{2\pi \times 3000 \times (0.209 + 1.25) \times 10^{-4}}{60 \times 0.1} - 0.139$$

$\fallingdotseq$ 0.319 (N·m) < Instantaneous peak torque···Satisfactory

- Effective torque

$$T_{rms} = \sqrt{\frac{T_P^2 \cdot ta + T_L^2 \cdot tc + T_S^2 \cdot td}{t}} = \sqrt{\frac{(0.597)^2 \times 0.1 + (0.139)^2 \times 0.9 + (0.319)^2 \times 0.1}{1.5}}$$

$\fallingdotseq$ 0.205 (N·m) < Rated torque···Satisfactory

The above confirms that the provisionally selected servomotor and SERVOPACK capacities are sufficient. In the next step, their performance in position control are checked.

(9) PG Feedback Pulse Dividing Ratio: Setting of Electronic Gear Ratio $(\frac{B}{A})$

As the electrical stop accuracy $\delta = \pm 0.01$mm, take the position detection unit $\Delta \ell = 0.01$mm/pulse.

$$\frac{P_B}{\Delta \ell} \times \left(\frac{B}{A}\right) = \frac{5}{0.01} \times \left(\frac{B}{A}\right) = 32768 \times 4$$

$$k = \frac{B}{A} = \frac{32768 \times 4}{500}$$

(10) Reference Pulse Frequency

$$vs = \frac{1000 V\ell}{60 \times \Delta \ell} = \frac{1000 \times 15}{60 \times 0.01} = 25{,}000 \text{ (pps)}$$

(11) Error Counter Pulses

Position loop gain Kp = 30 ($1/_S$)

$$\varepsilon = \frac{vs}{Kp} = \frac{25{,}000}{30} = 833 \text{ (pulse)}$$

(12) Electrical Stop Accuracy

$$-\Delta\varepsilon = -\frac{\varepsilon}{(\text{SERVOPACK control range}) \times \frac{N_M}{N_R}} = -\frac{833}{5000 \times \frac{3000}{3000}} \fallingdotseq -0.17 < -1 \text{ (pulse)} = -0.01 \text{ (pulse)}$$

The above results confirm that the selected SERVOPACK and servomotor are applicable for the position control.

12.1.3 Calculating the Required Capacity of Regenerative Resistors

(1) Simple Calculation

When driving a servomotor with the horizontal axis, check the external regenerative resistor requirements using the calculation method shown below.

(a) SERVOPACKs with Capacities of 400 W or Less

SERVOPACKs with capacities of 400 W or less do not have built-in regenerative resistors. The energy that can be charged with capacitors is shown in the following table. If the rotational energy in the servomotor exceeds these values, then connect a external regenerative resistor.

Voltage	Applicable SERVOPACKs	Regenerative Energy that Can be Processed (joules)	Remarks
100 V	SGDS-A3B	3.75	Value when main circuit input voltage is 100 VAC
	SGDS-A5F to -02F	28.6	
	SGDS-04F	39.0	
200 V	SGDS-A5A	15.2	Value when main circuit input voltage is 200 VAC
	SGDS-01A to -04A	30.5	

Calculate the rotational energy E_s in the servomotor from the following equation:

$$E_S = J \times (N_M)^2/182 \text{ (joules)}$$

- $J = J_M + J_L$
- J_M: Servomotor rotor moment of inertia ($kg{\cdot}m^2$)
- J_L: Load converted to shaft moment of inertia ($kg{\cdot}m^2$)
- N_M: Rotation speed used by servomotor (min^{-1})

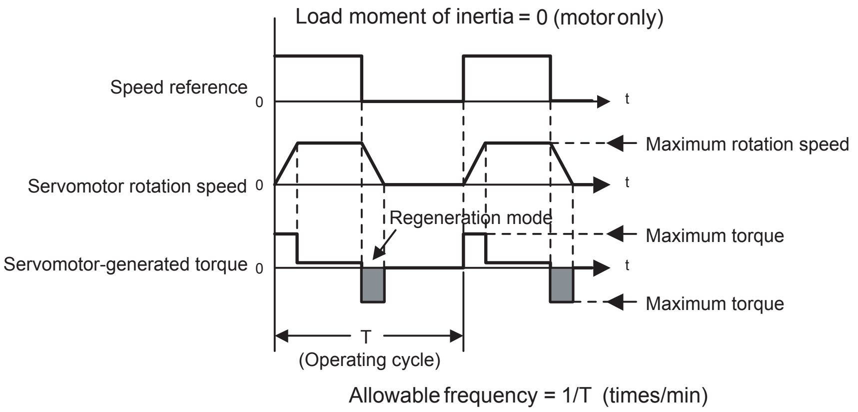
(b) SERVOPACKs with Capacities of 0.5 to 5.0 kW

Servomotors with capacities of 0.5 to 5.0 kW have built-in regenerative resistors. The allowable frequencies for just the servomotor in acceleration and deceleration operation, during the rotation speed cycle from 0 to the maximum rotation speed to 0, are summarized in the following table.

Convert the data into the values obtained with actual rotation speed and load moment of inertia to determine whether an external regenerative resistor is needed.

Voltage	Series	Allowable Frequencies in Regenerative Mode (times/min)												
	Capacity Symbol	05	06	08	10	12	13	15	20	25	30	40	44	50
200 V	SGMAS	–	110	46	–	45	–	–	–	–	–	–	–	–
	SGMPS	–	–	16	–	–	–	8	–	–	–	–	–	–
	SGMSS	–	–	–	19	–	–	36	77	42	12	22	–	16
	SGMGH-□□A□A	17	–	9	–	–	6	–	7	–	11*1	–	7	–
	SGMGH-□□A□B	–	36	16	–	10	–	–	12	–	20*2	14	–	–

* 1. Four times if using with the SGDS-30 (3.0 kW).
* 2. Seven times if using with the SGDS-30 (3.0 kW).



Operating Conditions for Allowable Regenerative Frequency Calculation

Use the following equation to calculate the allowable frequency for regeneration mode operation.

$$\text{Allowable frequency} = \frac{\text{Allowable frequency for Servomotor only}}{(1 + n)} \times \left(\frac{\text{Max. rotation speed}}{\text{Rotation speed}}\right)^2 \text{(times/min)}$$

- $n = J_L/J_M$
- J_M: Servomotor rotor moment of inertia ($kg\cdot m^2$)
- J_L: Load converted to shaft moment of inertia ($kg\cdot m^2$)

(c) SERVOPACKs with Capacities of 6.0 kW or More

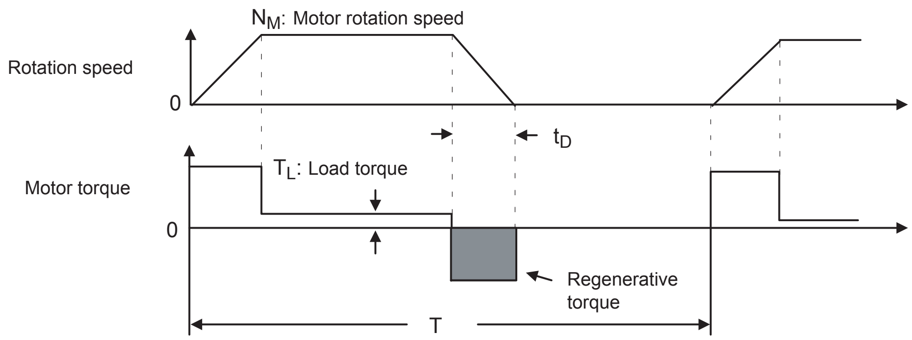
SERVOPACKs with capacities of 6.0 kW or more do not have built-in regenerative resistors. The following table shows the allowable regenerative frequencies when the JUSP-RA04 or JUSP-RA05 regenerative resistor is used together with an applicable SERVOPACK.

The servomotor driven conditions and the conversion equation of the allowable regenerative frequencies to the rotation speed and load moment of inertia are the same as the *(b) SERVOPACKs with Capacities of 0.5 to 5.0 kW*.

Voltage	Series / Capacity Symbol	Allowable Frequencies in Regenerative Mode (times/min)		
		55	70	75
200 V	SGMSS-□□A	–	192	–
	SGMGH-□□A□A	27	–	38
	SGMGH-□□A□B	47	–	–

(2) Calculating the Regenerative Energy

This section shows the procedure for calculating the regenerative resistor capacity when acceleration and deceleration operation is as shown in the following diagram.



• Calculation Procedure

The procedure for calculating the regenerative capacity is as follows:

Step	Item	Symbol	Equation
1	Find the rotational energy of the servomotor.	E_S	$E_S = JN_M^2/182$
2	Find the energy consumed by load loss during the deceleration period.	E_L	$E_L = (\pi/60)\ N_M T_L t_D$
3	Calculate the energy lost from servomotor winding resistance.	E_M	(Value calculated from “Servomotor Winding Resistance Loss” diagrams) $\times t_D$
4	Calculate the SERVOPACK energy that can be absorbed.	E_C	Calculate from the “Absorbable SERVOPACK Energy” diagrams.
5	Find the energy consumed by the regenerative resistor.	E_K	$E_K = E_S - (E_L+E_M+E_C)$
6	Calculate the required regenerative resistor capacity.	W_K	$W_K = E_K / (0.2 \times T)$

Note: 1. The “0.2” in the equation for calculating W_K is the value for when the regenerative resistor’s utilized load ratio is 20%.

2. The units for the various symbols are as follows:

E_S to E_K: Energy joules (J)
T_L:Load torque (N·m)
W_K:Regenerative resistor required capacity (W)
t_D: Deceleration stopping time (s)
J:(= $J_M + J_L$)(kg·m^2)
T: Servomotor repeat operation period (s)
N_M: Servomotor rotation speed (min^{-1})

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If the above calculation determines that the amount of regenerative power (Wk) processed by the built-in resistor is not exceeded, then an external regenerative resistor is not required.

If the amount of regenerative power that can be processed by the built-in resistor is exceeded, then install an external regenerative resistor for the capacity obtained from the above calculation.

If the energy consumed by load loss (in step 2 above) is unknown, then perform the calculation using $E_L = 0$.

When the operation period in regeneration mode is continuous, add the following items to the above calculation procedure in order to find the required capacity (W) for the regenerative resistor.

- Energy for continuous regeneration mode operation period: E_G (joules)
- Energy consumed by regenerative resistor: $E_K = E_S - (E_L + E_M + E_C) + E_G$
- Required capacity of regenerative resistor: $W_K = E_K / (0.2 \times T)$

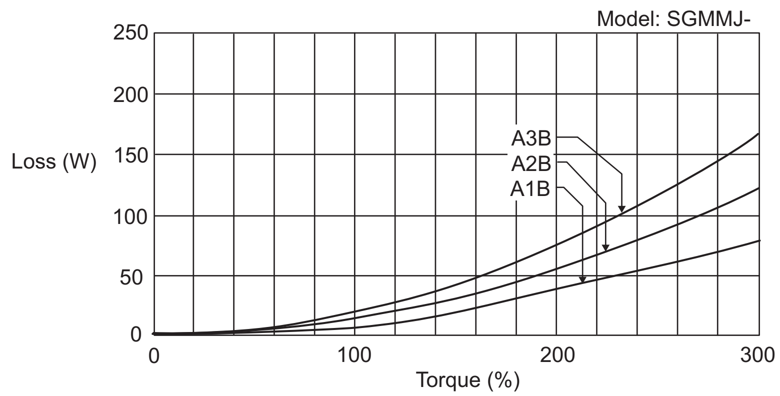
Here, $E_G = (2\pi/60)\ N_{MG} T_G t_G$

- T_G: Servomotor's generated torque (N·m) in continuous regeneration mode operation period
- N_{MG}:Servomotor rotation speed (min^{-1}) for same operation period as above
- t_G:Same operation period (s) as above

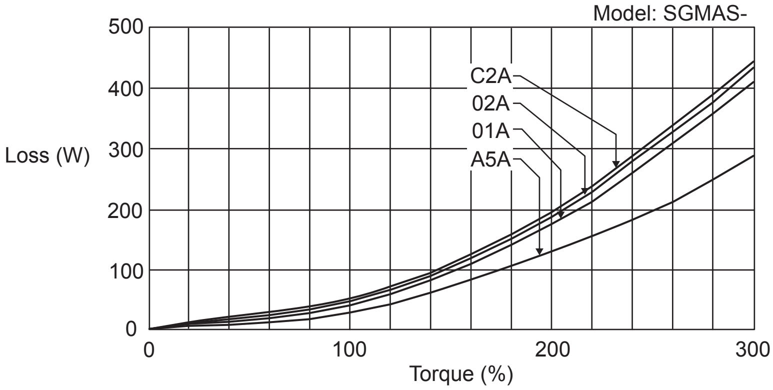
(3) Servomotor Winding Resistance Loss

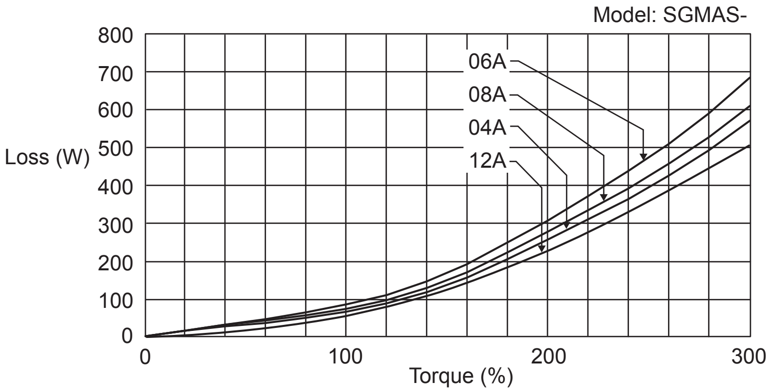
The following diagrams show the relationship, for each servomotor, between the servomotor's generated torque and the winding resistance loss.

(a) SGMMJ Servomotor

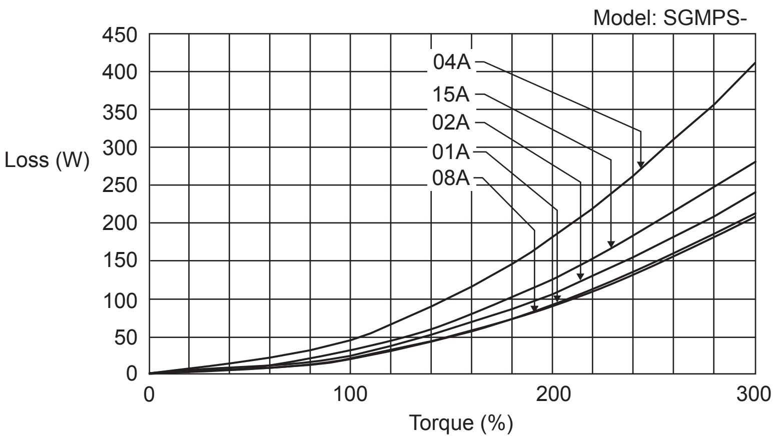


(b) SGMAS servomotor, 100/200V

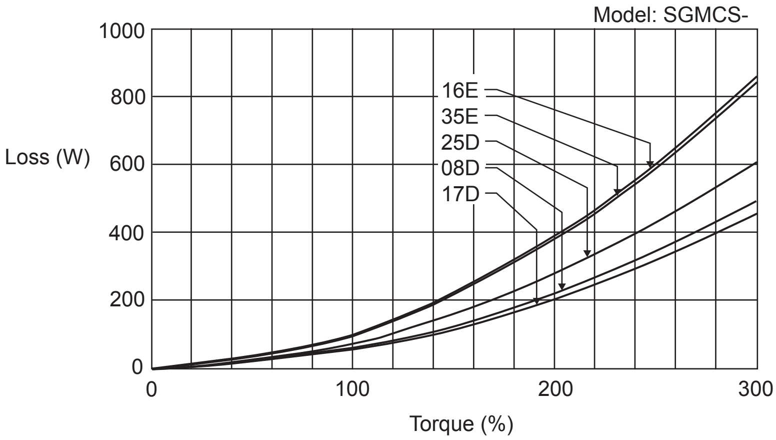


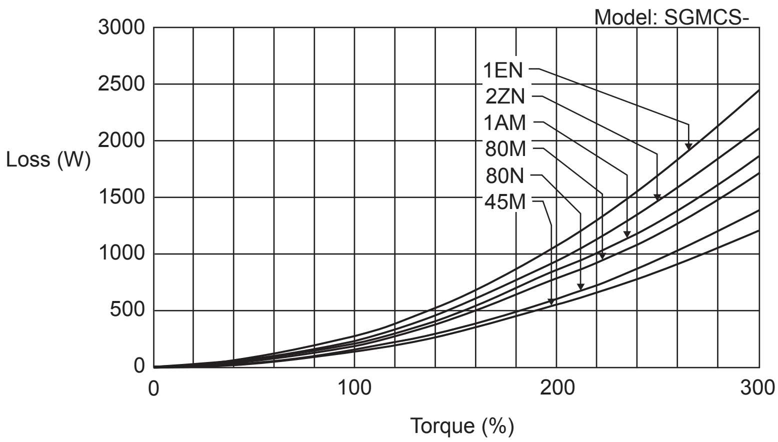


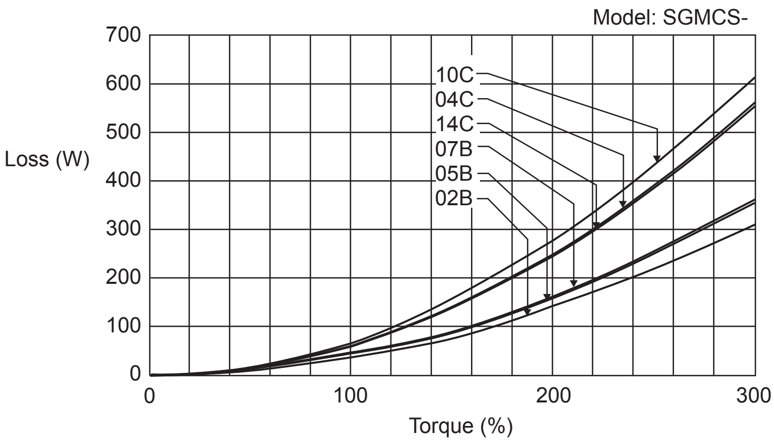
(c) SGMPS servomotor, 100/200 V



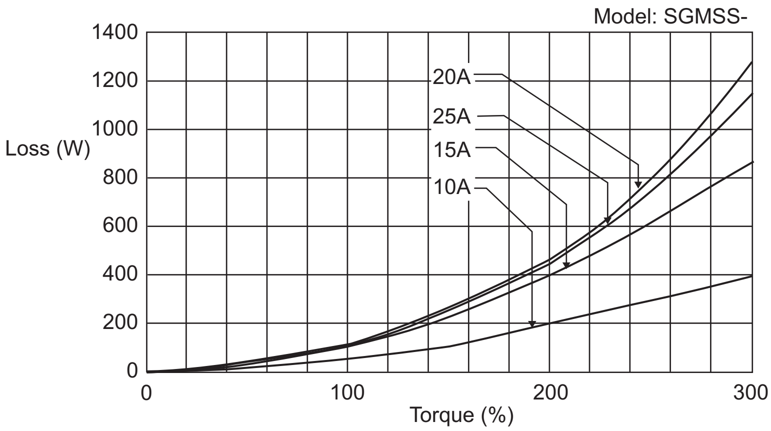
(d) SGMCS servomotor

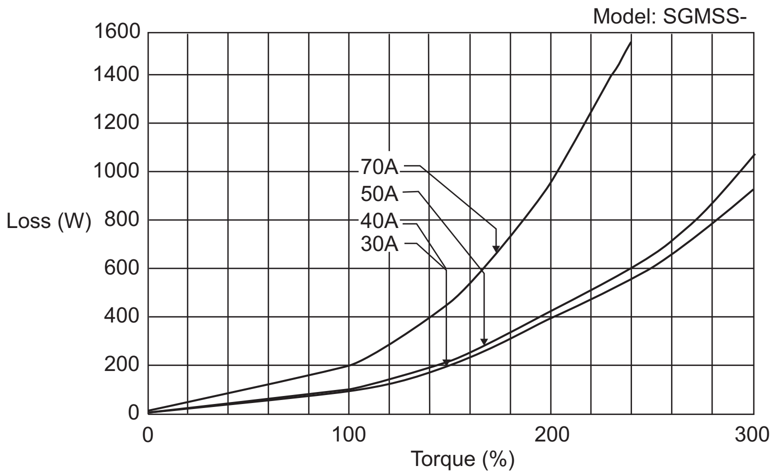






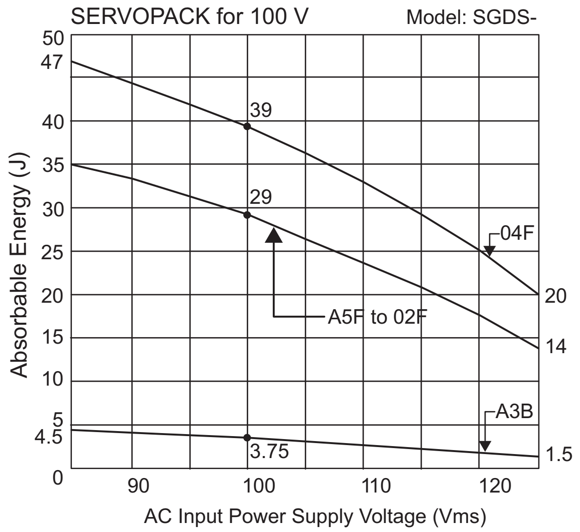
(e) SGMSS servomotor

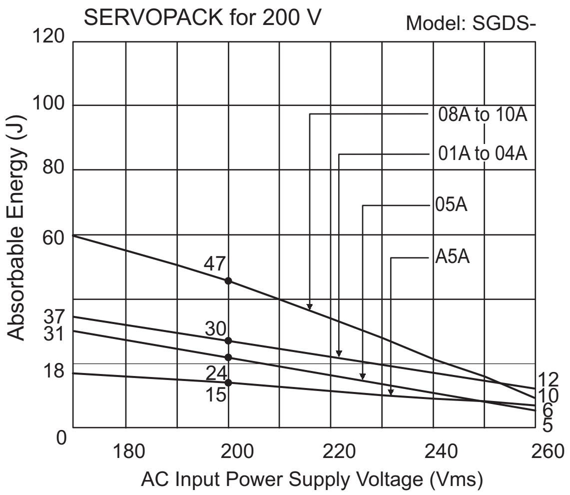


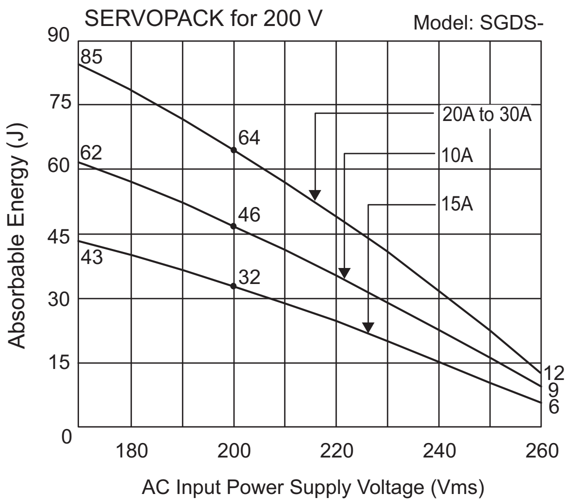


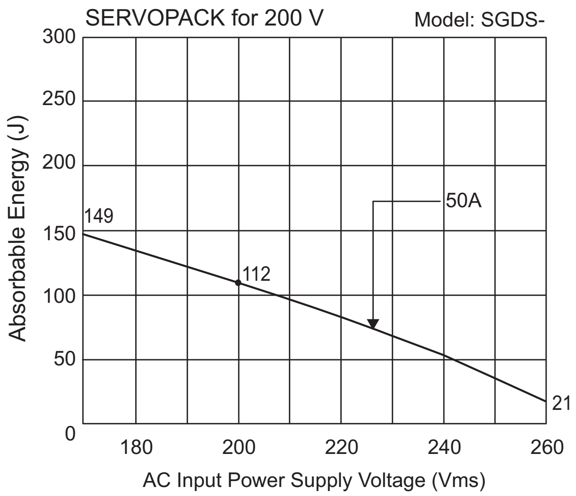
(4) SERVOPACK's Absorbable Energy

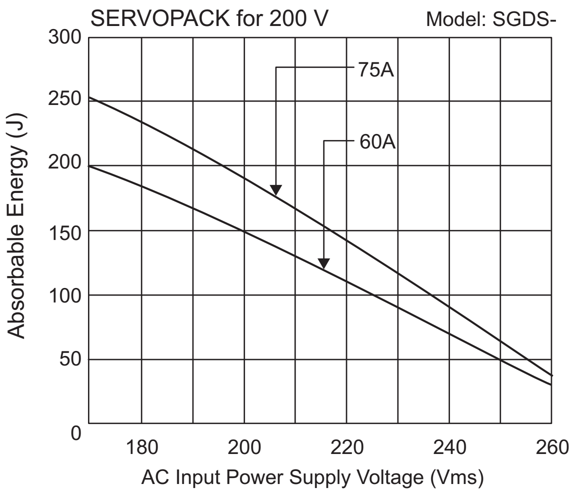
The following diagrams show the relationship between the SERVOPACK's input power supply voltage and its absorbable energy.





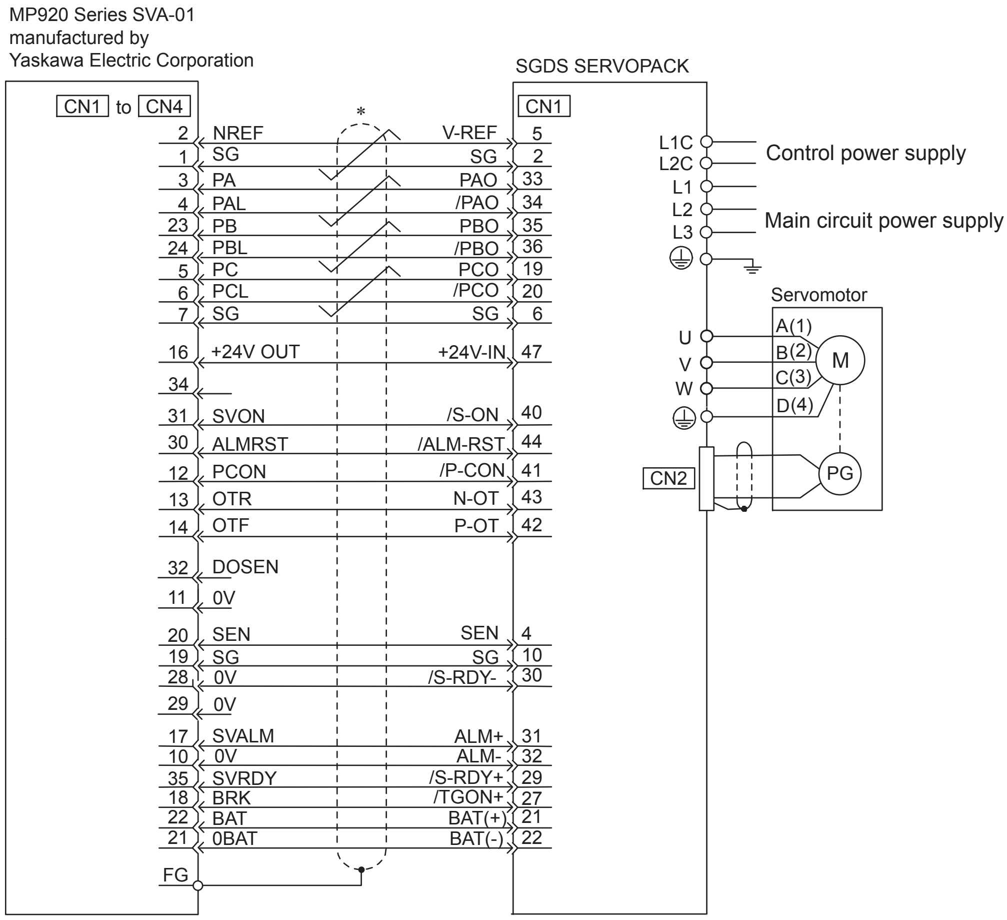






12.2 Connection to Host Controller

12.2.1 Example of Connection to MP920 4-axes Analog Module SVA-01



* represents twisted-pair wires.

Note: Connection cables (model: JEPMC-W6050-☐☐) to connect the SERVOPACK to the MP920 are provided by Yaskawa. For details, refer to *Machine Controller MP920 User's Manual design and maintenance (manual no. SIEZ-C887-2.1)*.

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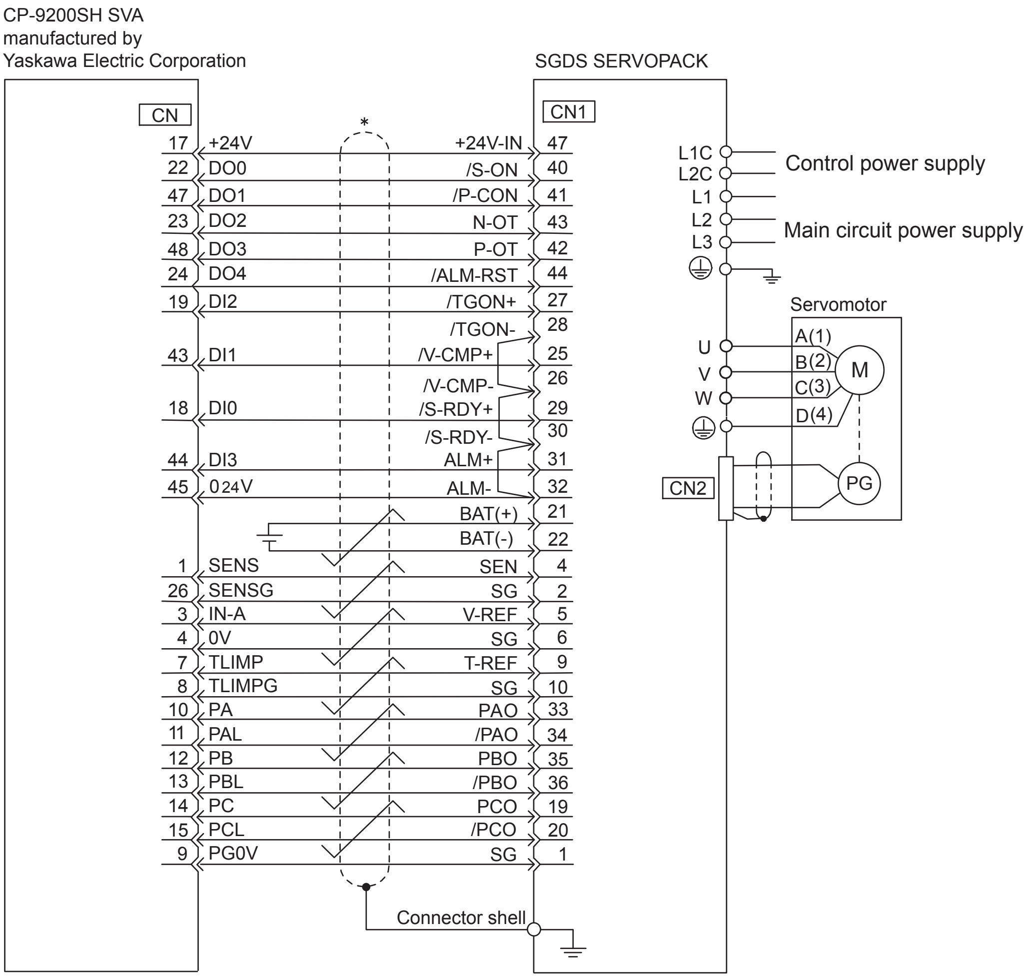
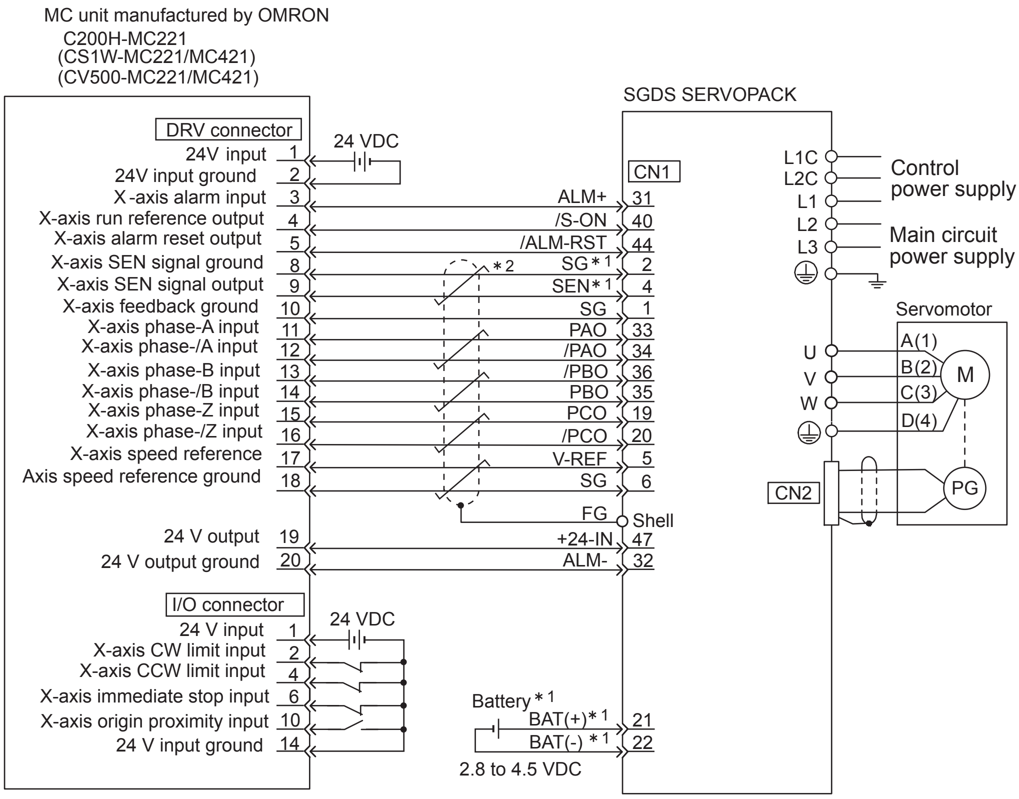
12.2.2 Example of Connection to CP-9200SH Servo Controller Module SVA (SERVOPACK in Speed Control Mode)



* represents twisted-pair wires.

12.2.3 Example of Connection to OMRON's Motion Control Unit



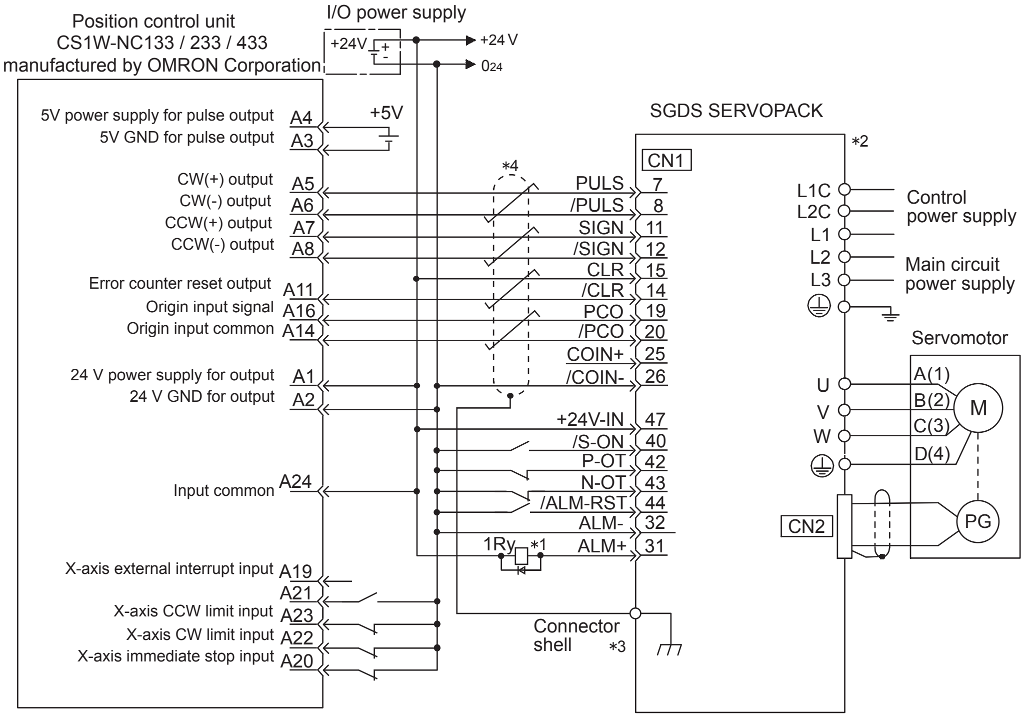
* 1. Connect when an absolute encoder is used.
When the encoder cables with a battery case JUSP-BA01 are used, no battery is required for CN1 (between 21 and 22).

- For CN1: ER6VC3N (3.6 V, 2000 mA)
- Battery case: JUSP-BA01 (3.6 V, 1000 mA)

* 2.  represents twisted-pair wires.

Note: 1. Only signals applicable to Yaskawa's SGDS SERVOPACK and OMRON's MC unit are shown in the diagram.
2. The main circuit power supply is a three-phase 200 VAC SERVOPACK input in the example. The power supply and wiring must be in accordance with the power supply specifications of the SERVOPACK to be used.
3. Note that incorrect signal connection will cause damage to the MC unit and SERVOPACK.
4. Open the signal lines not to be used.
5. The above connection diagram shows only X-axis connection. When using another axes, make connection to the SERVOPACK in the same way.
6. The normally closed (N.C.) input terminals not to be used at the motion control unit I/O connector section must be short-circuited at the connector.
7. Make the setting so that the servo can be turned ON/OFF by the Servo ON (/S-ON) signal.

12.2.4 Example of Connection to OMRON's Position Control Unit



* 1. The ALM signal is output for about two seconds after the control power is turned ON. Take this into consideration when designing the power ON sequence. The ALM signal actuates the alarm detection relay 1Ry to stop the main circuit power supply to the SERVOPACK.

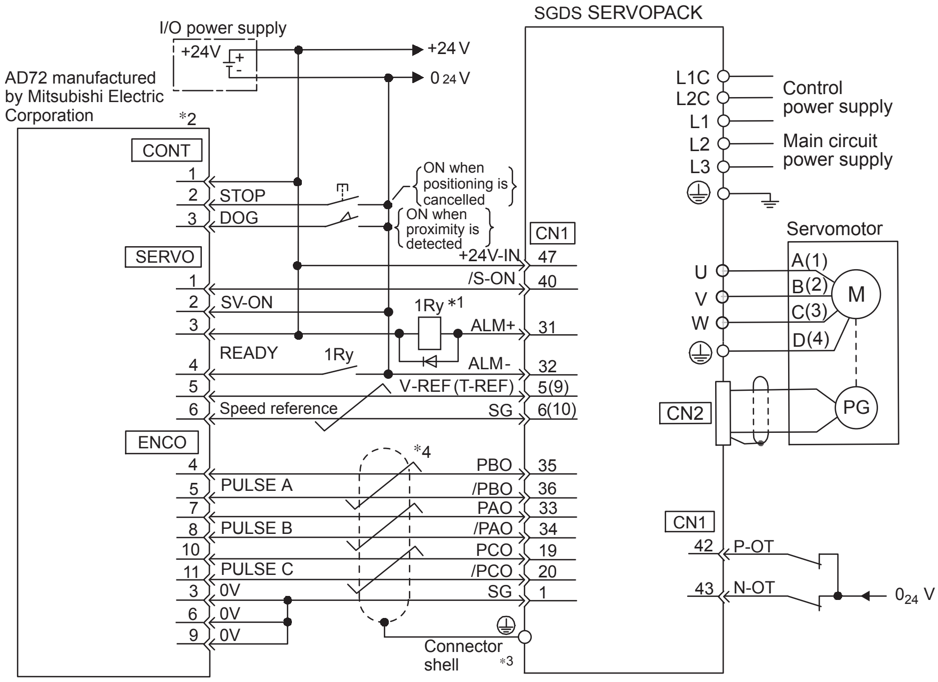
* 2. Set parameter Pn200.0 to "1."

* 3. Connect the shield wire to the connector shell.

* 4.  represents twisted-pair wires.

Note: Only signals applicable to Yaskawa's SGDS SERVOPACK and OMRON's MC unit (positioning unit) are shown in the diagram.

12.2.5 Connection to MITSUBISHI's A72 Positioning Unit (SERVOPACK in Speed Control Mode)



* 1. The ALM signal is output for about two seconds after the control power is turned ON. Take this into consideration when designing the power ON sequence. The ALM signal actuates the alarm detection relay 1Ry to stop the main circuit power supply to the SERVOPACK.

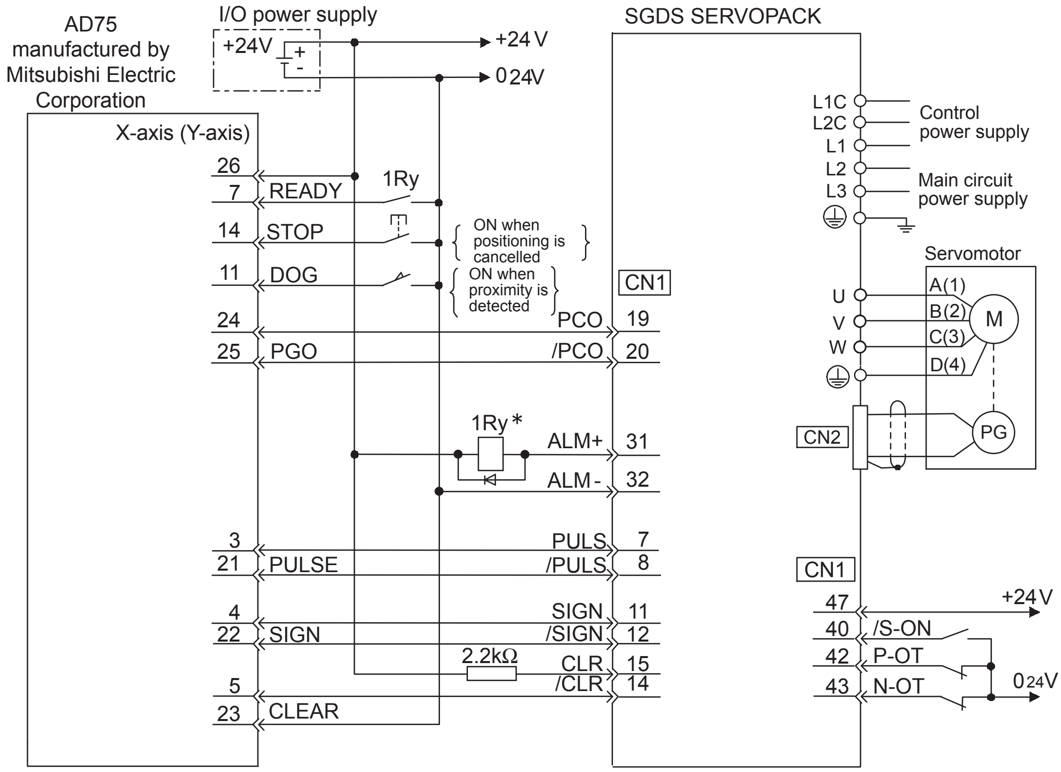
* 2. Pin numbers are the same both for X-axis and Y-axis.

* 3. Connect the connector wire to the connector shell.

* 4.  represents twisted-pair wires.

Note: Only signals applicable to Yaskawa's SGDS SERVOPACK and Mitsubishi's AD72 Positioning Unit are shown in the diagram.

12.2.6 Connection to MITSUBISHI's A75 Positioning Unit (SERVOPACK in Position Control Mode)



* The ALM signal is output for about two seconds when the control power is turned ON. Take this into consideration when designing the power ON sequence. The ALM signal actuates the alarm detection relay 1Ry to stop the main circuit power supply to the SERVOPACK.

Note: Only signals applicable to Yaskawa's SGDS SERVOPACK and Mitsubishi's AD75 Positioning Unit are shown in the diagram.

12.3 List of Parameters

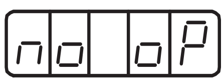
12.3.1 Utility Functions

The following list shows the available utility functions.

Parameter No.	Function	Remarks	Reference Section
Fn000	Alarm traceback data display		7.2.2
Fn001	Rigidity setting during normal autotuning	○	9.2.4
Fn002	JOG mode operation	○	8.1.1
Fn003	Origin search mode	○	7.2.3
Fn004	Program JOG operation	○	7.2.4
Fn005	Initialize parameter settings	○	7.2.5
Fn006	Clear alarm traceback data	○	7.2.6
Fn007	Save moment of inertia ratio data obtained from normal autotuning	○	9.2.7
Fn008	Absolute encoder multi-turn reset and encoder alarm reset	○	8.4.5
Fn009	Automatic tuning of analog (speed, torque) reference offset	○	8.5.3 8.7.3
Fn00A	Manual servo tuning of speed reference offset	○	8.5.3
Fn00B	Manual servo tuning of torque reference offset	○	8.7.3
Fn00C	Manual zero-adjustment of analog monitor output	○	–
Fn00D	Manual gain-adjustment of analog monitor output	○	–
Fn00E	Automatic offset-adjustment of motor current detection signal	○	7.2.7
Fn00F	Manual offset-adjustment of motor current detection signal	○	7.2.8
Fn010	Write prohibited setting		7.2.9
Fn011	Check servomotor models		7.2.10
Fn012	Software version display		7.2.11
Fn013	Multi-turn limit value setting change when a Multi-turn Limit Disagreement alarm occurs	○	8.4.8
Fn014	Fixed parameter	○	–
Fn015	One-parameter tuning for less deviation	○	9.6.9
Fn016	Reserved		–
Fn017	Advanced autotuning	○	9.3.2
Fn018	Online vibration monitor	○	7.2.12 7.2.13
Fn019	EasyFFT	○	7.2.12 7.2.14
Fn01A	One-parameter tuning	○	9.4.2
Fn01B	Initialize vibration detection level	○	7.2.15
Fn01E*	SERVOPACK and servomotor ID Display		–

* Fn01E can be operated only from the JUSP-OP05A digital operator.

Note: When the parameters marked with "○" in remarks column are set for Write Prohibited Setting (Fn010), the indication shown below appears and such parameters cannot be changed.



Blinks for
one second

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12.3.2 Parameters

Parameter No.	Name	Setting Range	Units	Factory Setting	Setting Validation	Reference Section
Pn000	Function Selection Basic Switch 0	–	–	0000	After restart	–

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Direction Selection
(Refer to "8.3.2 Switching the Servomotor Rotation Direction.")

0	Sets CCW as forward direction.
1	Sets CW as forward direction (Reverse Rotation Mode)
2 to 3	Reserved (Do not use.)

2nd digit: Control Method Selection
(Refer to "8.10 Control Mode Selection.")

0	Speed control (analog reference)
1	Position control (pulse train reference)
2	Torque control (analog reference)
3	Internal set speed control (contact reference)
4	Internal set speed control (contact reference) ⇔ Speed control (analog reference)
5	Internal set speed control (contact reference) ⇔ Position control (pulse train reference)
6	Internal set speed control (contact reference) ⇔ Torque control (analog reference)
7	Position control (pulse train reference) ⇔ Speed control (analog reference)
8	Position control (pulse train reference) ⇔ Torque control (analog reference)
9	Torque control (analog reference) ⇔ Speed control (analog reference)
A	Speed control (analog reference) ⇔ Zero clamp
B	Position control (pulse train reference) ⇔ Position control (Inhibit)

3rd digit: Axis Address

0 to F	Sets SERVOPACK axis address (Function supported by the servodrive support tool SigmaWin+)

4th digit: Reserved (Do not change)

Parameter No.	Name	Setting Range	Units	Factory Setting	Setting Validation	Reference Section
Pn001	Function Selection Application Switch 1	–	–	0000	After restart	–

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Servo OFF or Alarm Stop Mode *1
(Refer to "8.3.5 Selecting the Stopping Method after Servo OFF.")

0	Stops the motor by applying DB (dynamic brake).
1	Stops the motor by applying dynamic brake (DB) and then releases DB.
2	Makes the motor coast to a stop state without using the dynamic brake (DB).

2nd digit: Overtravel (OT) Stop Mode *2
(Refer to "8.3.3 Setting the Overtravel Limit Function.")

0	Same setting as Pn001.0 (Stops the motor by applying DB or by coasting).
1	Sets the torque of Pn406 to the maximum value, decelerate the motor to a stop, and then sets it to servolock state.
2	Sets the torque of Pn406 to the maximum value, decelerates the motor to a stop, and then sets it to coasting state.

3rd digit: AC/DC Power Input Selection
(Refer to "6.1.3 Typical Main Circuit Wiring Examples.")

0	Not applicable to DC power input: Input AC power supply through L1, L2 (, and L3) terminals.
1	Applicable to DC power input: Input DC power supply between B1/⊕and ⊖, or input DC power supply between B1/⊕and ⊖1.

4th digit: Warning Code Output Selection
(Refer to "8.11.2 Warning Output (/WARN).")

0	ALO1, ALO2, and ALO3 output only alarm codes.
1	ALO1, ALO2, and ALO3 output both alarm codes and warning codes. While warning codes are output, ALM signal output remains ON (normal state).

* 1. Used if alarm occurs in the torque control mode.
Used if alarm occurs when the motor is stopped by the dynamic brake.

* 2. The motor is stopped by the dynamic brake or by coasting regardless of the setting in the torque control mode.

Parameter No.	Name	Setting Range	Units	Factory Setting	Setting Validation	Reference Section
Pn002	Function Selection Application Switch 2	–	–	0000	After restart	–

n. □□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Speed Control Option (T-REF Terminal Allocation)

0	N/A	
1	Uses T-REF as an external torque limit input.	(Refer to 8.9.3.)
2	Uses T-REF as a torque feed forward input.	(Refer to 9.6.2.)
3	Uses T-REF as an external torque limit input when P-CL and N-CL are ON.	(Refer to 8.9.4.)

2nd digit: Torque Control Option (V-REF Terminal Allocation)
(Refer to "8.7.4 Speed Limit during Torque Control.")

0	N/A
1	Uses V-REF as an external speed limit input.

3rd digit: Absolute Encoder Usage
(Refer to "8.4.2 Selecting an Absolute Encoder.")

0	Uses absolute encoder as an absolute encoder.
1	Uses absolute encoder as an incremental encoder.

4th digit: Fully-closed Encoder Usage
(Refer to "10.4 Related Parameters.")

0	Do not use fully-closed encoder.
1	Uses fully-closed encoder in forward rotation direction.
2	Reserved (Do not set.)
3	Uses fully-closed encoder in reversed rotation direction.
4	Reserved (Do not set.)

Parameter No.	Name	Setting Range	Units	Factory Setting	Setting Validation	Reference Section
Pn006	Function Selection Application Switch 6	–	–	0002	After restart	–

4th digit 3rd digit 2nd digit 1st digit

n. □ □ □ □

Analog Monitor 1 Signal Selection (Refer to "9.7 Analog Monitor.") (2nd and 1st digits)

00	Motor speed (1 V/1000 min^{-1})
01	Speed reference (1 V/1000 min^{-1})
02	Torque reference - Gravity compensation torque (Pn422) (1 V/100%)*
03	Position error (0.05 V/1 reference unit)
04	Position amplifier error (after electronic gears) (0.05 V/ 1 encoder pulse unit)
05	Position reference speed (1 V/1000 min^{-1})
06	Reserved (Do not use.)
07	Motor load position error (0.01 V/one reference unit)
08	Positioning completion signal (positioning completed: 5 V, positioning not completed: 0 V)
09	Speed feed forward (1 V/1000 min^{-1})
0A	Torque feed forward (1 V/100%)

Analog Monitor 1 Signal Multiplication Selection (Refer to "9.7 Analog Monitor.") (3rd digit)

0	× 1
1	× 10
2	× 100
3	× 1/10
4	× 1/100

Reserved (Do not change) (4th digit)

Analog monitor 1 output voltage
= [(−1) × Signal selection (Pn006.0) × Signal multiplication (Pn006.2)] + Offset voltage (Pn550)

*The torque reference outputs a value "Torque reference value output from SERVOPACK− Gravity compensation (Pn422)" for monitor.

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Parameter No.	Name	Setting Range	Units	Factory Setting	Setting Validation	Reference Section
Pn007	Function Selection Application Switch 7	–	–	0000	After restart	–

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st and 2nd digits: Analog Monitor 2 Signal Selection (Refer to "9.7 Analog Monitor.")

00	Motor speed (1 V/1000 min^{-1})
01	Speed reference (1 V/1000 min^{-1})
02	Torque reference − Gravity compensation torque (Pn422) (1V/100%) *
03	Position error (0.05 V/1 reference unit)
04	Position amplifier error (after electronic gears) (0.05 V/1 encoder pulse unit)
05	Position reference speed (1 V/1000 min^{-1})
06	Reserved (Do not use.)
07	Motor load position error (0.01 V/one reference unit)
08	Positioning completion signal (positioning completed: 5V, positioning not completed: 0V)
09	Speed feed forward (1 V/1000 min^{-1})
0A	Torque feed forward (1 V/100%)

3rd digit: Analog Monitor 2 Signal Multiplication Selection (Refer to "9.7 Analog Monitor.")

0	× 1
1	× 10
2	× 100
3	× 1/10
4	× 1/100

4th digit: Reserved (Do not change)

Analog monitor 2 output voltage = [(−1) × Signal selection (Pn007.0) × Signal multiplication (Pn007.2)] + Offset voltage (Pn551)

*The torque reference outputs a value "Torque reference value output from SERVOPACK − Gravity compensation (Pn422)" for monitor.

Parameter No.	Name	Setting Range	Units	Factory Setting	Setting Validation	Reference Section
Pn008	Function Selection Application Switch 8	–	–	0000	After restart	–

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Lowered Battery Voltage Alarm/Warning Selection (Refer to "8.4.4 Replacing Batteries.")

0	Outputs alarm (A.830) for lowered battery voltage.
1	Outputs warning (A.930) for lowered battery voltage.

2nd digit: Reserved (Do not change)

3rd digit: Warning Detection Selection (Refer to "11.1.2 Warning Displays.")

0	Detects warning.
1	Does not detect warning.

4th digit: Reserved (Do not change)

Parameter No.	Name	Setting Range	Units	Factory Setting	Setting Validation	Reference Section
Pn100	Speed Loop Gain	10 to 20000	0.1 Hz	400	Immediately	9.5.4

Parameter No.	Name	Setting Range	Units	Factory Setting	Setting Validation	Reference Section
Pn101	Speed Loop Integral Time Constant	15 to 51200	0.01 ms	2000	Immediately	9.5.5
Pn102	Position Loop Gain	10 to 20000	0.1/s	400	Immediately	9.5.3
Pn103	Moment of Inertia Ratio	0 to 20000	1%	0	Immediately	9.2.6 9.5.4
Pn104	2nd Speed Loop Gain	10 to 20000	0.1 Hz	400	Immediately	9.6.9
Pn105	2nd Speed Loop Integral Time Constant	15 to 51200	0.01 ms	2000	Immediately	9.6.9
Pn106	2nd Position Loop Gain	10 to 20000	0.1/s	400	Immediately	9.6.9
Pn107	Bias	0 to 450	1 min^{-1}	0	Immediately	9.6.6
Pn108	Bias Addition Width	0 to 250	Reference unit	7	Immediately	9.6.6
Pn109	Feed Forward Gain	0 to 100	1%	0	Immediately	9.6.1
Pn10A	Feed Forward Filter Time Constant	0 to 6400	0.01 ms	0	Immediately	9.6.1
Pn10B	Gain-related Application Switch	–	–	0000	Immediately/After restart	–

n. □□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Mode Switch Selection
(Refer to "9.6.5 Using the Mode Switch (P/PI Switching).")

		Setting Validation
0	Uses internal torque reference as the condition (Level setting: Pn10C)	Immediately
1	Uses speed reference as the condition (Level setting: Pn10D)	
2	Uses acceleration as the condition (Level setting: Pn10E)	
3	Uses position error pulse as the condition (Level setting: Pn10F)	
4	No mode switch function available	

2nd digit: Speed Loop Control Method
(Refer to "9.6.4 Proportional Control Operation (Proportional Operation Reference).")

		Setting Validation
0	PI control	After restart
1	I-P control	
2 and 3	Reserved (Do not use)	

3rd digit: Position Loop Control Method
(Refer to "9.6.11 Less Deviation Control.")

		Setting Validation
0	Standard Position Control	After restart
1	Less Deviation Control	
2	Less Deviation Control with reference filter	

4th digit: Reserved (Do not change)

Parameter No.	Name	Setting Range	Units	Factory Setting	Setting Validation	Reference Section
Pn10C	Mode Switch (torque reference)	0 to 800	1%	200	Immediately	9.6.5
Pn10D	Mode Switch (speed reference)	0 to 10000	1 min^{-1}	0	Immediately	9.6.5
Pn10E	Mode Switch (acceleration)	0 to 30000	1 min^{-1}/ s	0	Immediately	9.6.5

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Parameter No.	Name	Setting Range	Units	Factory Setting	Setting Validation	Reference Section
Pn10F	Mode Switch (position error pulse)	0 to 10000	1 reference unit	0	Immedi-ately	9.6.5
Pn110	Online Autotuning Switches	–	–	0010	After restart	–

Pn110: n. □□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: **Autotuning Selection**
(Refer to "9.2.3 Selecting the Normal Autotuning Execution Method.")

0	Performs normal autotuning only when power turns ON.
1	Performs normal autotuning.
2	Performs manual tuning but not normal autotuning.

2nd digit: **Speed Feedback Compensation Selection**
(Refer to "9.6.8 Speed Feedback Compensation.")

0	Available.
1	N/A (standard speed feedback.)
2 and 3	Reserved (Do not use)

3rd digit: **Reserved (Do not change)**

4th digit: **Reserved (Do not change)**

Parameter No.	Name	Setting Range	Units	Factory Setting	Setting Validation	Reference Section
Pn111	Speed Feedback Compensation Gain *	1 to 500	1%	100	Immedi-ately	9.6.8
Pn119	Reference Filter Gain	10 to 20000	0.1 /s	500	Immedi-ately	9.6.11
Pn11A	Reference Filter Gain Compensation	500 to 2000	0.1%	1000	Immedi-ately	9.6.11
Pn11E	Reference Filter Bias (Forward)	0 to 10000	0.1%	1000	Immedi-ately	9.6.11
Pn11F	Position Integral Time Constant	00 to 50000	0.1 ms	0	Immedi-ately	9.6.15
Pn12B	3rd Speed Loop Gain	10 to 20000	0.1 Hz	400	Immedi-ately	9.6.9
Pn12C	3rd Speed Loop Integral Time Constant	15 to 51200	0.01 ms	2000	Immedi-ately	9.6.9
Pn12D	3rd Position Loop Gain	10 to 20000	0.1 /s	400	Immedi-ately	9.6.9
Pn12E	4th Speed Loop Gain	10 to 20000	0.1 Hz	400	Immedi-ately	9.6.9
Pn12F	4th Speed Loop Integral Time Constant	15 to 51200	0.01 ms	2000	Immedi-ately	9.6.9
Pn130	4th Position Loop Gain	10 to 20000	0.1 /s	400	Immedi-ately	9.6.9
Pn131	Gain Switching Time 1	0 to 65535	1 ms	0	Immedi-ately	9.6.9

* The parameter Pn111 setting is enabled only when the parameter Pn110.1 is set to "0."

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn132	Gain Switching Time 2	0 to 65535	1 ms	0	Immedi-ately	9.6.9
Pn135	Gain Switching Waiting Time 1	0 to 65535	1 ms	0	Immedi-ately	9.6.9
Pn136	Gain Switching Waiting Time 2	0 to 65535	1 ms	0	Immedi-ately	9.6.9
Pn139	Automatic Gain Changeover Related Switch 1	–	–	0000	After restart	–

4th digit 3rd digit 2nd digit 1st digit

n. □ □ □ □

1st digit: **Gain Switching Selection Switch**
(Refer to "9.6.9 Switching Gain Settings.")

0	Manual gain switching Changes gain manually using external input signals (/G-SEL1, /G-SEL2)
1	Automatic gain switching pattern 1 Changes automatically 1st gain to 2nd gain when the switching condition A is satisfied. Changes automatically 2nd gain to 1st gain when the switching condition B is satisfied.

2nd digit: **Gain Switching Condition A**
(Refer to "9.6.9 Switching Gain Settings.")

0	Positioning completion signal (/COIN) ON
1	Positioning completion signal (/COIN) OFF
2	NEAR signal (/NEAR) ON
3	NEAR signal (/NEAR) OFF
4	Position reference filter output = 0 and reference pulse input OFF
5	Position reference pulse input ON

3rd digit: **Gain Switching Condition B**
(Refer to "9.6.9 Switching Gain Settings.")

0 to 5	Same as Condition A

4th digit: **Reserved (Do not change)**

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn144	Reference Filter Bias (Reverse)	0 to 10000	0.1%	1000	Immedi-ately	9.6.11

<table>
<tr><th>Parameter No.</th><th>Name</th><th>Setting Range</th><th>Unit</th><th>Factory Setting</th><th>Setting Validation</th><th>Reference Section</th></tr>
<tr><td rowspan="2">Pn150</td><td>Predictive Control Selection Switches</td><td>–</td><td>–</td><td>0210</td><td>After restart</td><td>–</td></tr>
<tr><td colspan="6">4th digit 3rd digit 2nd digit 1st digit
n. □ □ □ □

1st digit: Predictive Control Selection
(Refer to "9.6.10 Predictive Control.")
0 Do not perform predictive control selection.
1 Perform predictive control selection.
2 Reserved (Do not use).

2nd digit: Reversed Control Type
(Refer to "9.6.10 Predictive Control.")
0 Perform predictive control for locus tracking.
1 Perform predictive control for positioning.

3rd digit: Reserved (Do not change)
0 to 4 Reserved (Do not use).

4th digit: Reserved (Do not change)</td></tr>
<tr><td>Pn151</td><td>Predictive Control Acceleration/Deceleration Gain</td><td>0 to 300</td><td>1%</td><td>100</td><td>Immediately</td><td>9.6.10</td></tr>
<tr><td>Pn152</td><td>Predictive Control Weighting Ratio</td><td>0 to 300</td><td>1%</td><td>100</td><td>Immediately</td><td>9.6.10</td></tr>
<tr><td>Pn1A0</td><td>Servo Rigidity</td><td>1 to 500</td><td>1%</td><td>60</td><td>Immediately</td><td>9.6.9
9.6.11</td></tr>
<tr><td>Pn1A1</td><td>Servo Rigidity 2</td><td>1 to 500</td><td>1%</td><td>60</td><td>Immediately</td><td>9.6.9
9.6.11</td></tr>
<tr><td>Pn1A2</td><td>Speed Feedback Filter Time Constant</td><td>30 to 3200</td><td>0.01 ms</td><td>72</td><td>Immediately</td><td>9.6.9
9.6.11</td></tr>
<tr><td>Pn1A3</td><td>Speed Feedback Filter Time Constant 2</td><td>30 to 3200</td><td>0.01 ms</td><td>72</td><td>Immediately</td><td>9.6.9
9.6.11</td></tr>
<tr><td>Pn1A4</td><td>Torque Reference Filter Time Constant</td><td>0 to 2500</td><td>0.01 ms</td><td>30</td><td>Immediately</td><td>9.6.11</td></tr>
</table>

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn1A7	Auxiliary Control Switch	–	–	1121	Immediately	–

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Integral Compensation pro
(Refer to "9.6.9 Switching Gain Settings and 9.6.11 Less Deviation Control.")

0	Do not perform integral compensation processing.
1	Perform integral compensation processing. (Factory setting)
2	Use gain switching for less deviation. Perform integral compensation on Gain Settings 1. Do not perform integral compensation on Gain Settings 2.
3	Use gain switching for less deviation. Do not perform integral compensation on Gain Settings 1. Perform integral compensation on Gain Setting 2.

2nd digit: Reserved (Do not change)

3rd digit: Reserved (Do not change)

4th digit: Reserved (Do not change)

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn1A9	Auxiliary Integral Gain	0 to 500	1 Hz	37	Immediately	9.6.11
Pn1AA	Position Proportional Gain	0 to 500	1 Hz	60	Immediately	9.6.11
Pn1AB	Speed Integral Gain	0 to 500	1 Hz	0	Immediately	9.6.11
Pn1AC	Speed Proportional Gain	0 to 2000	1 Hz	120	Immediately	9.6.11
Pn1B5	Gain Compensation Upper Limit 1	100 to 1000	1%	150	Immediately	9.6.11

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn200	Position Control Reference Form Selection Switch	–	–	0000	After restart	–

4th digit 3rd digit 2nd digit 1st digit

n. □ □ □ □

1st digit:

Reference Pulse Form (Refer to "8.6.1 Setting Parameters.")	
0	Sign + Pulse, positive logic
1	CW + CCW, positive logic
2	Phase A + Phase B (×1), positive logic
3	Phase A + Phase B (×2), positive logic
4	Phase A + Phase B (×4), positive logic
5	Sign + Pulse, negative logic
6	CW + CCW, negative logic

2nd digit:

Clear Signal Form (Refer to "8.6.1 Setting Parameters.")	
0	Clears position error pulse when the signal is at H level.
1	Clears position error pulse at the rising edge of the signal.
2	Clears position error pulse when the signal is at L level.
3	Clears position error pulse at the falling edge of the signal.

3rd digit:

Clear Operation (Refer to "8.6.1 Setting Parameters.")	
0	Clears position error pulse at the baseblock (Servo OFF or alarm occurred).
1	Does not clear position error pulse (Possible to clear error counter only with CLR signal)
2	Clears position error pulse when an alarm occurs.

4th digit: Reserved (Do not change)

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn205	Multiturn Limit Setting *	0 to 65535	1 rev	65535	After restart	8.4.7

* The multiturn limit must be changed only for special applications. Changing this limit inappropriate or unintentionally can be dangerous.

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn207	Position Control Function Switch	–	–	0000	After restart	–

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Position Reference Filter Selection
(Refer to "8.6.4 Smoothing.")

0	Position reference acceleration/deceleration filter
1	Position reference average movement filter
2	Reserved (Do not use)

2nd digit: Position Control Option
(Refer to "9.6.3 Speed Feed-forward.")

0	N/A
1	Uses V-REF as a speed feed forward input.

3rd digit: Backlash Compensation Selection
(Refer to "9.6.14 Backlash Compensation.")

0	N/A
1	Compensates in forward direction.
2	Compensates in reverse direction.

4th digit: /COIN Output Timing
(Refer to "8.6.5 Positioning Completed Output Signal.")

0	Outputs when the position error absolute value is the same or less than the positioning completion width (Pn522).
1	Outputs when the position error absolute value is the position completion width (Pn522) or less and the reference after position reference filtering is 0.
2	When the absolute value of the position error is below the positioning completed width setting (Pn522), and the position reference input is 0.

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn209	Position Reference Acceleration/Deceleration Bias	0 to 65535	1 reference unit/s	0	Immediately	8.6.4
Pn20A	Number of External Scale Pitch	100 to 1048576	1 pitch/Rev	32768	After restart	10.4
Pn20E	Electronic Gear Ratio (Numerator)	1 to 1073741824(2^{30})	–	4	After restart	8.6.2
Pn210	Electronic Gear Ratio (Denominator)	1 to 1073741824(2^{30})	–	1	After restart	8.6.2
Pn212	PG Dividing Pulse (pulse unit)	16 to 1073741824(2^{30})	1 P/ Rev	2048	After restart	8.4.6 8.5.7
Pn214	Backlash Compensation Amount	-32767 to 32767	1 reference unit	0	Immediately	9.6.14
Pn215	Backlash Compensation Time Constant	0 to 65535	0.01 ms	0	Immediately	9.6.14
Pn216	Position Reference Acceleration/Deceleration Time Constant	0 to 65535	0.1 ms	0	Immediately	8.6.4
Pn217	Average Movement Time of Position Reference	0 to 10000	0.1 ms	0	Immediately	8.6.4
Pn281	Encoder Output Resolution	1 to 4096	1 P/(4 multiplier pitch)	20	After restart	10.4

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn300	Speed Reference Input Gain	150 to 3000	0.01V / rated speed	600	Immedi-ately	8.5.1 8.7.4 9.6.3
Pn301	Internal Set Speed 1	0 to 10000	1 min^{-1}	100	Immedi-ately	8.8.1
Pn302	Internal Set Speed 2	0 to 10000	1 min^{-1}	200	Immedi-ately	8.8.1
Pn303	Internal Set Speed 3	0 to 10000	1 min^{-1}	300	Immedi-ately	8.8.1
Pn304	JOG Speed	0 to 10000	1 min^{-1}	500	Immedi-ately	8.1.1
Pn305	Soft Start Acceleration Time	0 to 10000	1 ms	0	Immedi-ately	8.5.4
Pn306	Soft Start Deceleration Time	0 to 10000	1 ms	0	Immedi-ately	8.5.4
Pn307	Speed Reference Filter Time Constant	0 to 65535	0.01 ms	40	Immedi-ately	8.5.5
Pn308	Speed Feedback Filter Time Constant	0 to 65535	0.01 ms	0	Immedi-ately	9.6.7
Pn310	Vibration Detection Switch	–	–	0000	Immedi-ately	–

n. □□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: **Vibration Detection Selection**
(Refer to "7.2.15 Vibration Detection Level Initialization (Fn01B).")

0	No detection.
1	Outputs warning (A.911) when vibration is detected.
2	Outputs alarm (A.520) when vibration is detected.

2nd digit: **Reserved (Do not change)**

3rd digit: **Reserved (Do not change)**

4th digit: **Reserved (Do not change)**

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn311	Vibration Detection Sensibility	50 to 500	1%	100	Immedi-ately	7.2.15
Pn312	Vibration Detection Level	0 to 5000	1 min^{-1}	50	Immedi-ately	7.2.15
Pn400	Torque Reference Input Gain	10 to100	0.1 V/rated torque	30	Immedi-ately	8.7.1 8.9.3 8.9.4 9.6.2
Pn401	Torque Reference Filter Time Constant	0 to 65535	0.01 ms	100	Immedi-ately	9.6.12
Pn402	Forward Torque Limit	0 to 800	1%	800	Immedi-ately	8.9.1
Pn403	Reverse Torque Limit	0 to 800	1%	800	Immedi-ately	8.9.1
Pn404	Forward External Torque Limit	0 to 800	1%	100	Immedi-ately	8.9.2 8.9.4
Pn405	Reverse External Torque Limit	0 to 800	1%	100	Immedi-ately	8.9.2 8.9.4
Pn406	Emergency Stop Torque	0 to 800	1%	800	Immedi-ately	8.3.3

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn407	Speed Limit during Torque Control	0 to 10000	1 min^{-1}	10000	Immediately	8.7.4
Pn408	Torque Related Function Switch	–	–	0000	Immediately/After restart	–

4th digit 3rd digit 2nd digit 1st digit

n. □ □ □ □

1st digit

1st Step Notch Filter Selection (Refer to "9.6.12 Torque Reference Filter.")		Setting Validation
0	N/A	Immediately
1	Uses 1st step notch filter for torque reference.	

2nd digit

Speed Limit Selection (Refer to "8.7.4 Speed Limit during Torque Control.")		Setting Validation
0	Uses the smaller value between motor max. speed and parameter Pn407 as speed limit value.	After restart
1	Uses the smaller value between overspeed detection speed and parameter Pn407 as speed limit value.	

3rd digit

2nd Step Notch Filter Selection (Refer to "9.6.12 Torque Reference Filter.")		Setting Validation
0	N/A	Immediately
1	Uses 2nd step notch filter for torque reference.	

4th digit

Reserved (Do not change).

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn409	1st Step Notch Filter Frequency	50 to 2000	1 Hz	2000	Immediately	9.6.12
Pn40A	1st Step Notch Filter Q Value	50 to 1000	0.01	70	Immediately	9.6.12
Pn40C	2nd Step Notch Filter Frequency	50 to 2000	1 Hz	2000	Immediately	9.6.12
Pn40D	2nd Step Notch Filter Q Value	50 to 1000	0.01	70	Immediately	9.6.12
Pn40F	2nd Step 2nd Torque Reference Filter Frequency	100 to 2000	1 Hz	2000	Immediately	9.6.12
Pn410	2nd Step 2nd Torque Reference Filter Q Value	50 to 1000	0.01	70	Immediately	9.6.12
Pn411	3rd Step Torque Reference Filter Time Constant	0 to 65535	1 µs	0	Immediately	9.6.12
Pn412	1st Step 2nd Torque Reference Filter Time Constant	0 to 65535	0.01 ms	100	Immediately	9.6.9
Pn413	1st Step 3rd Torque Reference Filter Time Constant	0 to 65535	0.01 ms	100	Immediately	9.6.9
Pn414	1st Step 4th Torque Reference Filter Time Constant	0 to 65535	0.01 ms	100	Immediately	9.6.9
Pn420	Damping for Vibration Suppression on Stopping	10 to 100	1%	100	Immediately	9.6.13
Pn421	Vibration Suppression Starting Time	0 to 65535	1 ms	1000	Immediately	9.6.13
Pn422	Gravity Compensation Torque	-20000 to 20000	0.01 %	0	Immediately	9.7
Pn456	Sweep Torque Reference Amplitude	1 to 800	1%	15	Immediately	7.2.14

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn501	Zero Clamp Level	0 to 10000	1 min^{-1}	10	Immedi-ately	8.5.6
Pn502	Zero Speed Level	1 to 10000	1 min^{-1}	20	Immedi-ately	8.11.3
Pn503	Speed Coincidence Signal Output Width	0 to 100	1 min^{-1}	10	Immedi-ately	8.5.8
Pn506	Brake Reference - Servo OFF Delay Time	0 to 50	10 ms	0	Immedi-ately	8.3.4
Pn507	Brake Reference Output Speed Level	0 to 10000	1 min^{-1}	100	Immedi-ately	8.3.4
Pn508	Waiting Time for Brake Signal When Motor Running	10 to 100	10 ms	50	Immedi-ately	8.3.4
Pn509	Instantaneous Power Cut Hold time	20 to 1000	1 ms	20	Immedi-ately	8.3.6

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn50A	Input Signal Selection 1	–	–	2100	After restart	–

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Input Signal Allocation Mode
(Refer to "7.3.2 Input Circuit Signal Allocation.")

0	Uses the sequence input signal terminals with standard allocation.
1	Changes the sequence input signal allocation for each signal.

2nd digit: /S-ON Signal Mapping
Signal Polarity: Normal; Servo ON when ON (L-level)
Signal Polarity: Reverse; Servo ON when OFF (H-level)
(Refer to "8.3.1 Setting the Servo ON Signal.")

0	ON when CN1-40 input signal is ON (L-level)
1	ON when CN1-41 input signal is ON (L-level)
2	ON when CN1-42 input signal is ON (L-level)
3	ON when CN1-43 input signal is ON (L-level)
4	ON when CN1-44 input signal is ON (L-level)
5	ON when CN1-45 input signal is ON (L-level)
6	ON when CN1-46 input signal is ON (L-level)
7	Sets signal ON
8	Sets signal OFF
9	OFF when CN1-40 input signal is OFF (H-level)
A	OFF when CN1-41 input signal is OFF (H-level)
B	OFF when CN1-42 input signal is OFF (H-level)
C	OFF when CN1-43 input signal is OFF (H-level)
D	OFF when CN1-44 input signal is OFF (H-level)
E	OFF when CN1-45 input signal is OFF (H-level)
F	OFF when CN1-46 input signal is OFF (H-level)

3rd digit: /P-CON Signal Mapping (P control when ON (L-level))
(Refer to "9.6.4 Proportional Control Operation (Proportional Operation Reference).")

0 to F	Same as /S-ON

4th digit: P-OT Signal Mapping (Overtravel when OFF (H-level))
(Refer to "8.3.3 Switching the Servomotor Rotation Direction.")

0	Forward run allowed when CN1-40 input signal is ON (L-level)
1	Forward run allowed when CN1-41 input signal is ON (L-level)
2	Forward run allowed when CN1-42 input signal is ON (L-level)
3	Forward run allowed when CN1-43 input signal is ON (L-level)
4	Forward run allowed when CN1-44 input signal is ON (L-level)
5	Forward run allowed when CN1-45 input signal is ON (L-level)
6	Forward run allowed when CN1-46 input signal is ON (L-level)
7	Forward run prohibited
8	Forward run allowed
9	Forward run allowed when CN1-40 input signal is OFF (H-level)
A	Forward run allowed when CN1-41 input signal is OFF (H-level)
B	Forward run allowed when CN1-42 input signal is OFF (H-level)
C	Forward run allowed when CN1-43 input signal is OFF (H-level)
D	Forward run allowed when CN1-44 input signal is OFF (H-level)
E	Forward run allowed when CN1-45 input signal is OFF (H-level)
F	Forward run allowed when CN1-46 input signal is OFF (H-level)

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn50B	Input Signal Selection 2	–	–	6543	After restart	–

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: N-OT Signal Mapping (Overtravel when OFF (H-level))
(Refer to "8.3.3 Setting the Overtravel Limit Function.")

0	Reverse run allowed when S10 (CN1-40) input signal is ON (L-level)
1	Reverse run allowed when S11 (CN1-41) input signal is ON (L-level)
2	Reverse run allowed when S12 (CN1-42) input signal is ON (L-level)
3	Reverse run allowed when S13 (CN1-43) input signal is ON (L-level)
4	Reverse run allowed when S14 (CN1-44) input signal is ON (L-level)
5	Reverse run allowed when S15 (CN1-45) input signal is ON (L-level)
6	Reverse run allowed when S16 (CN1-46) input signal is ON (L-level)
7	Reverse run prohibited
8	Reverse run allowed
9	Reverse run allowed when S10 (CN1-40) input signal is OFF (H-level)
A	Reverse run allowed when S11 (CN1-41) input signal is OFF (H-level)
B	Reverse run allowed when S12 (CN1-42) input signal is OFF (H-level)
C	Reverse run allowed when S13 (CN1-43) input signal is OFF (H-level)
D	Reverse run allowed when S14 (CN1-44) input signal is OFF (H-level)
E	Reverse run allowed when S15 (CN1-45) input signal is OFF (H-level)
F	Reverse run allowed when S16 (CN1-46) input signal is OFF (H-level)

2nd digit: /ALM-RST Signal Mapping (Alarm Reset when ON (L-level))
(Refer to "8.11.1 Servo Alarm Output (ALM) and Alarm Code Output (ALO1, ALO2, ALO3).")

0 to 6	Same as N-OT
7	Reserved (Do not use)
8 to F	Same as N-OT

3rd digit: /P-CL Signal Mapping (Torque Limit when ON (L-level))
(Refer to "8.9.2 External Torque Limit (Output Torque Limiting by Input Signals).")

0 to F	Same as /S-ON, the setting of 1st digit of Pn50A

4th digit: /N-CL Signal Mapping (Torque Limit when ON (L-level))
(Refer to "8.9.2 External Torque Limit (Output Torque Limiting by Input Signals).")

0 to F	Same as N-OT

INFO

■ Input signal polarities

Signal	Level	Voltage level	Contact
ON	Low (L) level	0 V	Close
OFF	High (H) level	24 V	Open

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn50C	Input Signal Selection 3	–	–	8888	After restart	–

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: /SPD-D Signal Mapping (See the internal set speed control function.) (Refer to "8.8.2 Input Signal Settings.")

0	ON when S10 (CN1-40) input signal is ON (L-level).
1	ON when S11 (CN1-41) input signal is ON (L-level).
2	ON when S12 (CN1-42) input signal is ON (L-level).
3	ON when S13 (CN1-43) input signal is ON (L-level).
4	ON when S14 (CN1-44) input signal is ON (L-level).
5	ON when S15 (CN1-45) input signal is ON (L-level).
6	ON when S16 (CN1-46) input signal is ON (L-level).
7	Sets signal ON.
8	Sets signal OFF
9	ON when S10 (CN1-40) input signal is OFF (H-level).
A	ON when S11 (CN1-41) input signal is OFF (H-level).
B	ON when S12 (CN1-42) input signal is OFF (H-level).
C	ON when S13 (CN1-43) input signal is OFF (H-level).
D	ON when S14 (CN1-44) input signal is OFF (H-level).
E	ON when S15 (CN1-45) input signal is OFF (H-level).
F	ON when S16 (CN1-46) input signal is OFF (H-level).

2nd digit: /SPD-A Signal Mapping (Refer to "8.8 Operating Using Speed Control with an Internally Set Speed and 8.8.2 Input Signal Settings.")

0 to F	Same as /SPD-D

3rd digit: /SPD-B Signal Mapping (Refer to "8.8 Operating Using Speed Control with an Internally Set Speed and 8.8.2 Input Signal Settings.")

0 to F	Same as /SPD-D

4th digit: /C-SEL Signal Mapping (Control mode change when ON (L-level)) (Refer to "8.10.2 Switching the Control Mode.")

0 to F	Same as /SPD-D

Appendix

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Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn50D	Input Signal Selection 4	–	–	8888	After restart	–

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: **/ZCLAMP Signal Mapping (Zero clamp when ON (L-level))**
(Refer to "8.5.6 Using the Zero Clamp Function.")

0	ON when S10 (CN1-40) input signal is ON (L-level).
1	ON when S11 (CN1-41) input signal is ON (L-level).
2	ON when S12 (CN1-42) input signal is ON (L-level).
3	ON when S13 (CN1-43) input signal is ON (L-level).
4	ON when S14 (CN1-44) input signal is ON (L-level).
5	ON when S15 (CN1-45) input signal is ON (L-level).
6	ON when S16 (CN1-46) input signal is ON (L-level).
7	Sets signal ON.
8	Sets signal OFF.
9	ON when S10 (CN1-40) input signal is OFF (H-level).
A	ON when S11 (CN1-41) input signal is OFF (H-level).
B	ON when S12 (CN1-42) input signal is OFF (H-level).
C	ON when S13 (CN1-43) input signal is OFF (H-level).
D	ON when S14 (CN1-44) input signal is OFF (H-level).
E	ON when S15 (CN1-45) input signal is OFF (H-level).
F	ON when S16 (CN1-46) input signal is OFF (H-level).

2nd digit: **/INHIBIT Signal Mapping (Reference pulse inhibit when ON (L-level))**
(Refer to "8.6.7 Reference Pulse Inhibit Function (INHIBIT).")

0 to F	Same as /ZCLAMP

3rd digit: **/G-SEL1 Signal Mapping (Gain change when ON (L-level))**
(Refer to "9.6.9 Switching Gain Settings.")

0 to F	Same as /ZCLAMP

4th digit: **Reserved (Do not change)**

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn50E	Output Signal Selection 1	–	–	3211	After restart	–

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: **Positioning Completion Signal Mapping (/COIN)**
(Refer to "8.6.5 Positioning Completed Output Signal.")

0	Disabled (the above signal is not used.)
1	Outputs the signal from SO1 (CN1-25, 26) output terminal.
2	Outputs the signal from SO2 (CN1-27, 28) output terminal.
3	Outputs the signal from SO3 (CN1-29, 30) output terminal.

2nd digit: **Speed Coincidence Detection Signal Mapping (/V-CMP)**
(Refer to "8.5.8 Speed Coincidence Output.")

0 to 3	Same as /COIN

3rd digit: **Servomotor Rotation Detection Signal Mapping (/TGON)**
(Refer to "8.11.3 Rotation Detection Output Signal (/TGON).")

0 to 3	Same as /COIN

4th digit: **Servo Ready Signal Mapping (/S-RDY)**
(Refer to "8.11.4 Servo Ready (/S-RDY) Output.")

0 to 3	Same as /COIN

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn50F	Output Signal Selection 2	–	–	0000	After restart	7.3.3 8.3.4

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: **Torque Limit Detection Signal Mapping (/CLT)**
(Refer to "8.9.5 Checking Output Torque Limiting during Operation.")

0	Disabled (the above signal is not used.)
1	Outputs the signal from SO1 (CN1-25, -26) output terminal.
2	Outputs the signal from SO2 (CN1-27, -28) output terminal.
3	Outputs the signal from SO3 (CN1-29, -30) output terminal.

2nd digit: **Speed Limit Detection Signal Mapping (/VLT)**
(Refer to "8.7.4 Speed Limit during Torque Control.")

0 to 3	Same as /CLT

3rd digit: **Brake Interlock Signal Mapping (/BK)**
(Refer to "8.3.4 Setting for Holding Brakes.")

0 to 3	Same as /CLT

4th digit: **Warning Signal Mapping (/WARN)**
(Refer to "8.11.2 Warning Output (/WARN).")

0 to 3	Same as /CLT

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn510	Output Signal Selection 3	–	–	0000	After restart	7.3.3
Pn512	Output Signal Reversal Setting	–	–	0000	After restart	7.3.3

Pn510

n. □□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Near Signal Mapping (/NEAR)
(Refer to "8.6.6 Positioning Near Signal.")

0	Disabled (the above signal is not used.)
1	Outputs the signal from CN1-25 or -26 terminals.
2	Outputs the signal from CN1-27 or -28 terminals.
3	Outputs the signal from CN1-29 or -30 terminals.

2nd digit: Reserved (Do not change)

3rd digit: Reserved (Do not change)

4th digit: Reserved (Do not change)

Pn512

n. □□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Output Signal Reversal for CN1-25 or -26 Terminals
(Refer to "7.3.3 Output Circuit Signal Allocation.")

0	Output signal is not reversed.
1	Output signal is reversed.

2nd digit: Output Signal Reversal for CN1-27 or -28 Terminals
(Refer to "7.3.3 Output Circuit Signal Allocation.")

0	Output signal is not reversed.
1	Output signal is reversed.

3rd digit: Output Signal Reversal for CN1-29 or -30 Terminals
(Refer to "7.3.3 Output Circuit Signal Allocation.")

0	Output signal is not reversed.
1	Output signal is reversed.

4th digit: Reserved (Do not change)

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn515	Input Signal Selection 5	–	–	8888	After restart	7.3.2

n. □□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: /G-SEL2 Signal Mapping (Gain Change when ON (L-level))
(Refer to "7.3.2 Input Circuit Signal Allocation.")

0	ON when SI0 (CN1-40) input signal is ON (L-level)
1	ON when SI1 (CN1-41) input signal is ON (L-level)
2	ON when SI2 (CN1-42) input signal is ON (L-level)
3	ON when SI3 (CN1-43) input signal is ON (L-level)
4	ON when SI4 (CN1-44) input signal is ON (L-level)
5	ON when SI5 (CN1-45) input signal is ON (L-level)
6	ON when SI6 (CN1-46) input signal is ON (L-level)
7	Sets signal ON.
8	Sets signal OFF.
9	ON when SI0 (CN1-40) input signal is OFF (H-level)
A	ON when SI1 (CN1-41) input signal is OFF (H-level)
B	ON when SI2 (CN1-42) input signal is OFF (H-level)
C	ON when SI3 (CN1-43) input signal is OFF (H-level)
D	ON when SI4 (CN1-44) input signal is OFF (H-level)
E	ON when SI5 (CN1-45) input signal is OFF (H-level)
F	ON when SI6 (CN1-46) input signal is OFF (H-level)

2nd digit: Reserved (Do not change)

3rd digit: Reserved (Do not change)

4th digit: Reserved (Do not change)

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn51B	Excessive Error Level Between Servomotor and Load Positions	1 to 1073741824 (2^{30})	1 reference unit	1000	Immediately	10.4
Pn51E	Excessive Position Error Warning Level	10 to 100	1%	100	Immediately	11.1.2
Pn520	Excessive Position Error Alarm Level	0 to 1073741823 (2^{30}-1)	1 reference unit	262144	Immediately	9.5.3 11.1.1
Pn522	Positioning Completed Width	1 to 1073741824(2^{30})	1 reference unit	7	Immediately	8.6.5
Pn524	NEAR Signal Width	1 to 1073741824(2^{30})	1 reference unit	1073741824	Immediately	8.6.6
Pn526	Excessive Position Error Alarm Level at Servo ON	1 to 1073741823 (2^{30}-1)	1 reference unit	262144	Immediately	11.1.1
Pn528	Excessive Position Error Warning Level at Servo ON	10 to 100	1%	100	Immediately	11.1.2
Pn529	Speed Limit Level at Servo ON	0 to 10000	1 min^{-1}	10000	Immediately	11.1.1
Pn52A	Multiplier per One Fully-closed Rotation	0 to 100	1%	20	Immediately	10.4
Pn52F	Monitor Display at Power ON	0 to FFF	–	FFF	Immediately	7.4.1

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn530	Program JOG Operation Related Switch	–	–	0000	Immedi-ately	7.2.4

n. □□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: **Program JOG Operation Related Switch**
(Refer to "7.2.4 Program JOG Operation (Fn004).")

0	(Waiting time Pn535 → Forward movement Pn531) × Number of times of movement Pn536
1	(Waiting time Pn535 → Reverse movement Pn531) × Number of times of movements Pn536
2	(Waiting time Pn535 → Forward movement Pn531) × Number of times of movements Pn536 (Waiting time Pn535 → Reverse movement Pn531) × Number of times of movements Pn536
3	(Waiting time Pn535 → Reverse movement Pn531) × Number of times of movements Pn536 (Waiting time Pn535 → Forward movement Pn531) × Number of times of movements Pn536
4	(Waiting time Pn535 → Forward movement Pn531 → Waiting time Pn535 → Reverse movement Pn531) × Number of times of movement Pn536
5	(Waiting time Pn535 → Reverse movement Pn531 → Waiting time Pn535 → Forward movement Pn531) × Number of times of movement Pn536

2nd digit: **Reserved (Do not change)**

3rd digit: **Reserved (Do not change)**

4th digit: **Reserved (Do not change)**

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn531	Program JOG Movement Distance	1 to 1073741824(2^{30})	1 reference unit	32768	Immedi-ately	7.2.4
Pn533	Program JOG Movement Speed	1 to 10000	1 min^{-1}	500	Immedi-ately	7.2.4
Pn534	Program JOG Acceleration/Deceleration Time	2 to 10000	1 ms	100	Immedi-ately	7.2.4
Pn535	Program JOG Waiting Time	0 to 10000	1 ms	100	Immedi-ately	7.2.4
Pn536	Number of Times of Program JOG Move-ment	1 to 1000	1 time	1	Immedi-ately	7.2.4
Pn540	Gain Limit	10 to 20000	0.1 Hz	2000	Immedi-ately	9.3.2
Pn550	Analog Monitor 1 Offset Voltage	-10000 to 10000	0.1 V	0	Immedi-ately	9.7
Pn551	Analog Monitor 2 Offset Voltage	-10000 to 10000	0.1 V	0	Immedi-ately	9.7
Pn600	Regenerative Resistor Capacity *1	Depends on SERVO-PACK Capacity *2	10 W	0	Immedi-ately	6.5

* 1. Normally set to “0.” When using an external regenerative resistor, set the capacity (W) of the regenerative resistor.
* 2. The upper limit is the maximum output capacity (W) of the SERVOPACK.

12.3.3 Monitor Modes

The following list shows monitor modes available.

Parameter No.	Content of Display	Unit
Un000	Motor speed	min^{-1}
Un001	Speed reference (displayed only in speed control mode)	min^{-1}
Un002	Internal torque reference (in percentage to the rated torque)	%
Un003	Rotation angle 1 (32-bit decimal code)	pulse
Un004	Rotation angle 2 (Angle to the zero-point (electrical angle))	deg
Un005	Input signal monitor	–
Un006	Output signal monitor	–
Un007	Input reference pulse speed (displayed only in position control mode)	min^{-1}
Un008	Error counter (position error amount) (displayed only in position control mode)	reference unit
Un009	Accumulated load ratio (in percentage to the rated torque: effective torque in cycle of 10 seconds)	%
Un00A	Regenerative load ratio (in percentage to the processable regenerative power: regenerative power consumption in cycle of 10 seconds)	%
Un00B	Power consumed by DB resistance (in percentage to the processable power at DB activation: display in cycle of 10 seconds)	%
Un00C	Input reference pulse counter (32-bit decimal code) (displayed only in position control mode)	pulse
Un00D	Feedback pulse counter (32-bit decimal code)	pulse
Un00E	Fully-closed Feedback Pulse Counter (32-bit decimal code)	pulse
Un00F	Fully-closed Feedback Speed (32-bit decimal code)	pulse/s

12.4 Parameter Recording Table

Use the following table for recording parameters.

Note: Pn10B, Pn110, and Pn408 have the digit which does not need the setting validation after changing the settings. The underlined digits of the factory setting in the following table show the digit which needs the setting validation.

Parame-ter	Factory Setting						Name	Setting Validation
Pn000	0000						Function Selection Basic Switch 0	After restart
Pn001	0000						Function Selection Application Switch 1	After restart
Pn002	0000						Function Selection Application Switch 2	After restart
Pn006	0002						Function Selection Application Switch 6	Immediately
Pn007	0000						Function Selection Application Switch 7	Immediately
Pn008	0000						Function Selection Application Switch 8	After restart
Pn100	40.0 Hz						Speed Loop Gain	Immediately
Pn101	20.00 ms						Speed Loop Integral Time Constant	Immediately
Pn102	40.0/s						Position Loop Gain	Immediately
Pn103	0 %						Moment of Inertia Ratio	Immediately
Pn104	40.0 Hz						2nd Speed Loop Gain	Immediately
Pn105	20.00 ms						2nd Speed Loop Integral Time Constant	Immediately
Pn106	40.0/s						2nd Position Loop Gain	Immediately
Pn107	0 min^{-1}						Bias	Immediately
Pn108	7 reference unit						Bias Addition Width	Immediately
Pn109	0 %						Feed Forward Gain	Immediately
Pn10A	0.00 ms						Feed Forward Filter Time Constant	Immediately
Pn10B	0000						Gain-related Application Switch	After restart
Pn10C	200 %						Mode Switch (torque reference)	Immediately
Pn10D	0 min^{-1}						Mode Switch (speed reference)	Immediately
Pn10E	0 min^{-1}/s						Mode Switch (acceleration)	Immediately
Pn10F	0 reference unit						Mode Switch (position error pulse)	Immediately
Pn110	0010						Online Autotuning Switches	After restart
Pn111	100 %						Speed Feedback Compensation Gain	Immediately
Pn119	50.0/s						Reference Filter Gain	Immediately
Pn11A	100.0 %						Reference Filter Gain Compensation	Immediately
Pn11E	100.0 %						Reference Filter Bias (Forward)	Immediately
Pn11F	0.0 ms						Position Integral Time Constant	Immediately
Pn12B	40.0 Hz						3rd Speed Loop Gain	Immediately
Pn12C	20.00 ms						3rd Speed Loop Integral Time Constant	Immediately
Pn12D	40.0/s						3rd Position Loop Gain	Immediately
Pn12E	40.0 Hz						4th Speed Loop Gain	Immediately
Pn12F	20.00 ms						4th Speed Loop Integral Time Constant	Immediately
Pn130	40.0/s						4th Position Loop Gain	Immediately
Pn131	0 ms						Gain Switching Time 1	Immediately
Pn132	0 ms						Gain Switching Time 2	Immediately
Pn135	0 ms						Gain Switching Waiting Time 1	Immediately
Pn136	0 ms						Gain Switching Waiting Time 2	Immediately
Pn139	0000						Automatic Gain Changeover Related Switch 1	After restart
Pn144	100.0 %						Reference Filter Bias (Reverse)	Immediately
Pn150	0210						Predictive Control Selection Switches	After restart
Pn151	100 %						Predictive Control Acceleration/Deceleration Gain	Immediately
Pn152	100 %						Predictive Control Weighting Ratio	Immediately

(cont'd)

Parameter	Factory Setting						Name	Setting Validation
Pn1A0	60 %						Servo Rigidity	Immediately
Pn1A1	60 %						Servo Rigidity 2	Immediately
Pn1A2	0.72 ms						Speed Feedback Filter Time Constant	Immediately
Pn1A3	0.72 ms						Speed Feedback Filter Time Constant 2	Immediately
Pn1A4	0.36 ms						Torque Reference Filter Time Constant	Immediately
Pn1A7	1121						Auxiliary Control Switch	Immediately
Pn1A9	37 Hz						Auxiliary Integral Gain	Immediately
Pn1AA	60 Hz						Position Proportional Gain	Immediately
Pn1AB	0 Hz						Speed Integral Gain	Immediately
Pn1AC	120 Hz						Speed Proportional Gain	Immediately
Pn1B5	150%						Gain Compensation Upper Limit 1	Immediately
Pn200	0000						Position Control Reference Form Selection Switch	After restart
Pn205	65535 Rev						Multiturn Limit Setting	After restart
Pn207	0000						Position Control Function Switch	After restart
Pn209	0						Position Reference Acceleration/Deceleration Bias	Immediately
Pn20A	32768 Pitch/Rev						Number of External Scale Pitch	After restart
Pn20E	4						Electronic Gear Ratio (Numerator)	After restart
Pn210	1						Electronic Gear Ratio (Denominator)	After restart
Pn212	2048 P/Rev						PG Dividing Pulse (pulse unit)	After restart
Pn214	0						Backlash Compensation Amount	Immediately
Pn215	0.00ms						Backlash Compensation Time Constant	Immediately
Pn216	0.0ms						Position Reference Acceleration/Deceleration Time Constant	Immediately
Pn217	0.0ms						Average Movement Time of Position Reference	Immediately
Pn281	20 P/(4-multiplier pitch)						Encoder Output Resolution	After restart
Pn300	6.00 V /Rated speed						Speed Reference Input Gain	Immediately
Pn301	100 min^{-1}						Internal Set Speed 1	Immediately
Pn302	200 min^{-1}						Internal Set Speed 2	Immediately
Pn303	300 min^{-1}						Internal Set Speed 3	Immediately
Pn304	500 min^{-1}						JOG Speed	Immediately
Pn305	0 ms						Soft Start Acceleration Time	Immediately
Pn306	0 ms						Soft Start Deceleration Time	Immediately
Pn307	0.40 ms						Speed Reference Filter Time Constant	Immediately
Pn308	0.00 ms						Speed Feedback Filter Time Constant	Immediately
Pn310	0000						Vibration Detection Switch	Immediately
Pn311	100 %						Vibration Detection Sensibility	Immediately
Pn312	50 min^{-1}						Vibration Detection Level	Immediately
Pn400	3.0 V/Rated torque						Torque Reference Input Gain	Immediately
Pn401	1.00 ms						Torque Reference Filter Time Constant	Immediately
Pn402	800 %						Forward Torque Limit	Immediately
Pn403	800 %						Reverse Torque Limit	Immediately
Pn404	100 %						Forward External Torque Limit	Immediately
Pn405	100 %						Reverse External Torque Limit	Immediately
Pn406	800 %						Emergency Stop Torque	Immediately
Pn407	10000 min^{-1}						Speed Limit during Torque Control	Immediately
Pn408	0000						Torque Related Function Switch	After restart
Pn409	2000 Hz						1st Step Notch Filter Frequency	Immediately
Pn40A	0.70						1st Step Notch Filter Q Value	Immediately
Pn40C	2000 Hz						2nd Step Notch Filter Frequency	Immediately

(cont'd)

Parame-ter	Factory Setting						Name	Setting Validation
Pn40D	0.70						2nd Step Notch Filter Q Value	Immediately
Pn40F	2000 Hz						2nd Step 2nd Torque Reference Filter Frequency	Immediately
Pn410	0.70						2nd Step 2nd Torque Reference Filter Q Value	Immediately
Pn411	0 μ						3rd Step Torque Reference Filter Time Constant	Immediately
Pn412	1.00 ms						1st Step 2nd Torque Reference Filter Time Constant	Immediately
Pn413	1.00 ms						1st Step 3rd Torque Reference Filter Time Constant	Immediately
Pn414	1.00 ms						1st Step 4th Torque Reference Filter Time Constant	Immediately
Pn420	100 %						Damping for Vibration Suppression on Stopping	Immediately
Pn421	1000 ms						Vibration Suppression Starting Time	Immediately
Pn422	0.00 %						Gravity Compensation Torque	Immediately
Pn456	15 %						Sweep Torque Reference Amplitude	Immediately
Pn501	10 min^{-1}						Zero Clamp Level	Immediately
Pn502	20 min^{-1}						Zero Speed Level	Immediately
Pn503	10 min^{-1}						Speed Coincidence Signal Output Width	Immediately
Pn506	0 ms						Brake Reference - Servo OFF Delay Time	Immediately
Pn507	100 min^{-1}						Brake Reference Output Speed Level	Immediately
Pn508	500 ms						Waiting Time for Brake Signal When Motor Running	Immediately
Pn509	20 ms						Instantaneous Power Cut Hold time	Immediately
Pn50A	2100						Input Signal Selection 1	After restart
Pn50B	6543						Input Signal Selection 2	After restart
Pn50C	8888						Input Signal Selection 3	After restart
Pn50D	8888						Input Signal Selection 4	After restart
Pn50E	3211						Output Signal Selection 1	After restart
Pn50F	0000						Output Signal Selection 2	After restart
Pn510	0000						Output Signal Selection 3	After restart
Pn512	0000						Output Signal Reversal Setting	After restart
Pn515	8888						Input Signal Selection 5	After restart
Pn51B	1000 reference unit						Excessive Error Level Between Servo-motor and Load Positions	Immediately
Pn51E	100%						Excessive Position Error Warning Level	Immediately
Pn520	262144 reference unit						Excessive Position Error Alarm Level	Immediately
Pn522	7 reference unit						Positioning Completed Width	Immediately
Pn524	1073741824 reference unit						NEAR Signal Width	Immediately
Pn526	262144 reference unit						Excessive Position Error Alarm Level at Servo ON	Immediately
Pn528	100 %						Excessive Position Error Warning Level at Servo ON	Immediately
Pn529	10000 min^{-1}						Speed Limit Level at Servo ON	Immediately
Pn52A	20 %						Multiplier per One Full-closed Rotation	Immediately
Pn52F	FFF						Monitor Display at Power ON	Immediately
Pn530	0000						Program JOG Operation Related Switch	Immediately
Pn531	32768 reference unit						Program JOG Movement Distance	Immediately
Pn533	500 min^{-1}						Program JOG Movement Speed	Immediately
Pn534	100 ms						Program JOG Acceleration/Deceleration Time	Immediately
Pn535	100 ms						Program JOG Waiting Time	Immediately

(cont'd)

Parame-ter	Factory Setting						Name	Setting Validation
Pn536	once						Number of Times of Program JOG Movement	Immediately
Pn540	200.0 Hz						Gain Limit	Immediately
Pn550	0.0 V						Analog Monitor 1 Offset Voltage	Immediately
Pn551	0.0 V						Analog Monitor 2 Offset Voltage	Immediately
Pn600	0 w						Regenerative Resistor Capacity	Immediately

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			6.4.5 (2)	Revision: Diagram
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			11.2	Revision: Inspection and Maintenance
November 2004	4	–	All chapters	Addition: SGMSS-40 and -50 servomotors Addition: SGDS-50 SERVOPACK
			2.5.2	Revision: Encoder cable for SGMSS servomotor Connector type at encoder end conforming to the protective structure IP67
			3.4.1	Revision: Stall torque of SGMCS servomotors (small-capacity series)
			4.1	Revision: Frequency characteristics of SGDS-15 to -30 SERVOPACKs
			4.3	Revision: SERVOPACK internal block diagrams
			4.5	Revision: Overload characteristics
			4.8	Addition: Dimensional drawings of rack-mounted SERVOPACK model SGDS-15 to -30
			6.4.6	Addition: UL installation conditions
			Chapter 8	Completely revised
			Chapter 9	Completely revised
			Chapter 10	Revision: Type of serial converter unit A00☐ to D00
			Chapter 11	Addition: Alarm A.731 and A.921
			12.3.2	Revision: Pn001, Pn110, Pn1A7, Pn40A, and Pn40D Addition: Pn1B5
December 2004	5	0	6.4.6	Addition: Inch notation
March 2005		1	11.1.3	Revision: Alarm A.100, A.710, and A.720
September 2005	6	0	All chapters	Addition: Servomotor models SGMMJ-A1B to A3B, SGMSS-70A, SGMGH (1500 min^{-1}), and SGMGH (1000 min^{-1}) SERVOPACK models SGDS-A3B, SGDS-60A, and SGDS-75A
			5.10.7	Addition: Description of regenerative resistor unit
			9.5.6, 9.5.7	Addition: Guidelines for manual tuning of servo gains and safety precautions on adjustment of servo gains
			Back cover	Revision: Address

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			All chapters	Deletion: Non-metric units of measurement, including Fahrenheit.
			Back cover	Revision: Address

AC Servo Drives

Σ-III Series

SGM□□/SGDS

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