YASKAWA

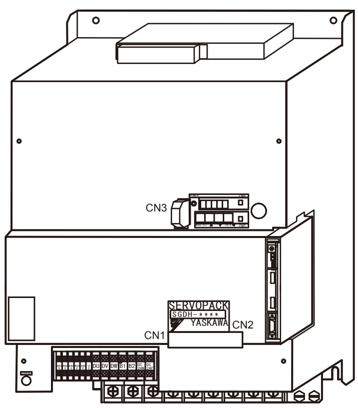
AC Servo Drives

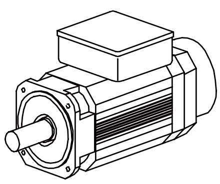
Σ-II Series

SGMVH/SGDM/SGDH

USER'S MANUAL

SGMVH Servomotor
SGDM/SGDH SERVOPACKs





MANUAL NO. SIEP S800000 59A

About this Manual

■ Intended Audience

This manual is intended for the following users.

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

■ Description of Technical Terms

The terms in this manual are defined as follows:

- Servomotor or motor = Σ-II Series SGMVH servomotor.
- SERVOPACK = Σ-II Series SGDM/SGDH amplifier.
- 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 controller and peripheral devices.
- Parameter number = Numbers that the user inputs toward the SERVOPACK.

■ 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
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 Digital Operator/Panel Operator			✓		✓	
Chapter 8 Operation					✓	
Chapter 9 Adjustments						✓
Chapter 10 Inspection, Maintenance, and Troubleshooting						✓
Chapter 11 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.

■ Indication of Reverse Signals

In this manual, the names of reverse signals (ones that are valid when low) 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

■ Related Manuals

Refer to the following manuals as required.

Manual Name	Manual Number	Contents
Σ-II Series SGM□H/SGDH Digital Operator Operation Manual	TOE-S800-34	Provides detailed information on the operating method of JUSP-OP02A-2 type Digital Operator (option device).
Σ-II Series SERVOPACKs Personal Computer Monitoring Software Operation Manual	SIE-S800-35	Describes the using and the operating methods on software that changes the local personal computer into the monitor equipment for the Σ-II Series servomotor.
Σ-II Series SGDH Fully Closed Interface Unit User's Manual Type: JUSP-FC100	SIE-C718-5	Provides detailed information on the fully closed control of the JUSP-FC100 interface unit.
Σ-II Series SGDH MECHATROLINK Application Module User's Manual Type: JUSP-NS100	SIE-C718-4	Provides detailed information on MECHATROLINK communications.
Σ-II Series SGDH MECHATROLINK-II Application Module User's Manual Type: JUSP-NS115	SIEPC71080001	Provides detailed information on MECHATROLINK-II communications.
Σ-II Series SGDH DeviceNet Application Module User's Manual Type: JUSP-NS300	SIE-C718-6	Provides detailed information on DeviceNet communications.
Σ-II Series SGDH PROFIBUS-DP Application Module User's Manual Type: JUSP-NS500	SIE-C718-8	Provides detailed information on PROFIBUS-DP communications.

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 as follows to indicate that fire is prohibited: .

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

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 drive.

⚠ 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 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.CC) 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.
- 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 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.

■ 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 parts 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.

■ Installation（cont’d）

⚠ CAUTION

- 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.

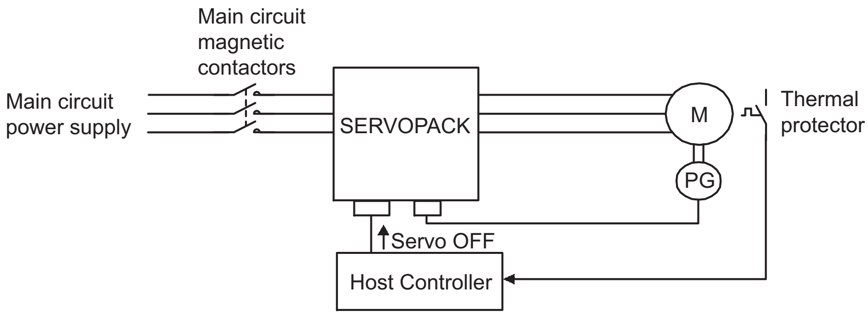
■ Wiring

⚠ WARNING

- Connect the ground terminal ⏚ to electrical codes (ground resistance: 100 Ω or less).
  Improper grounding may result in electric shock or fire.
- Use the thermal protector built into the servomotor according to either of the two following methods.
  SGMVH servomotors are cooled by a fan. If the fan is defective or power to the fan is disconnected, heat from the motor may result in burns or fire.

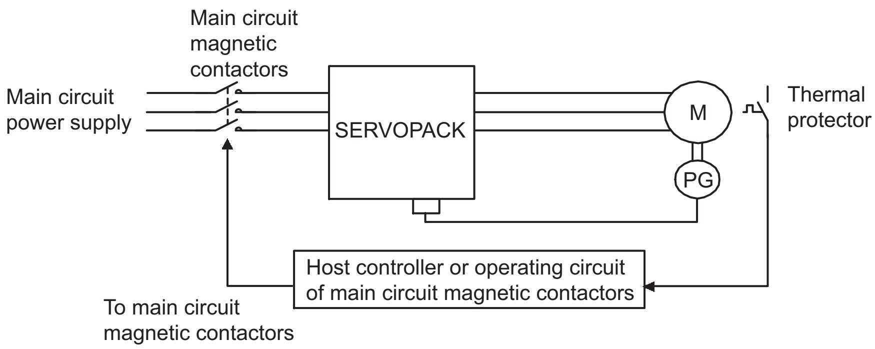
Method 1:

- Wire the output from the thermal protector to the host controller and turn OFF the servo when the thermal protector operates.



Method 2:

- Wire the thermal protector to the operating circuit of the main circuit magnetic contactors or the host controller and turn OFF the main circuit magnetic contactor when the thermal protector operates.



⚠ 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 terminals and motor output terminals.
  Failure to observe this caution may result in fire.
- 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 turned OFF first before starting an inspection.
- Avoid frequently turning power ON and OFF.
  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 such as capacitors and fuses to deteriorate, resulting in unexpected problems.
- Install the battery at either the host controller or the SERVOPACK.
  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.
- 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 including power supply lines.

  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.
- 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.
- Do not turn the Servo ON or OFF unless necessary.
  Failure to observe this caution may cause internal parts to deteriorate.

■ Maintenance and Inspection

⚠ CAUTION
• When replacing the SERVOPACK, transfer the previous SERVOPACK parameters to the new SERVOPACK before resuming operation. 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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7 Digital Operator/Panel Operator

8 Operation

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1

Outline

1.1 Checking Products

The following procedure is used to check the AC servo drives of Σ-II Series products on delivery.

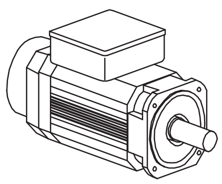
1.1.1 Check Items

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

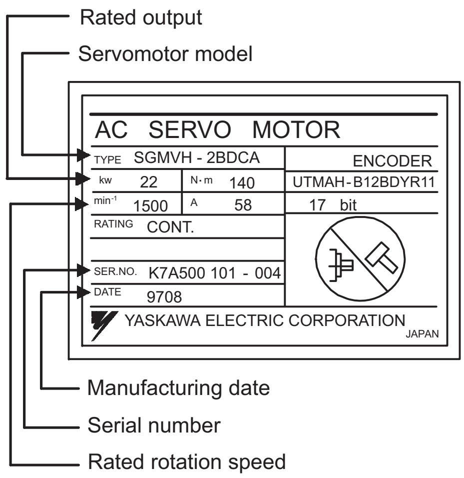
Check Items	Comments
Are the delivered products the ones that were ordered?	Check the model numbers marked on the nameplates on the servomotor and SERVOPACK. (Refer to the descriptions of model numbers in the following section.)
Does the servomotor shaft rotate smoothly?	The servomotor shaft is normal 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.

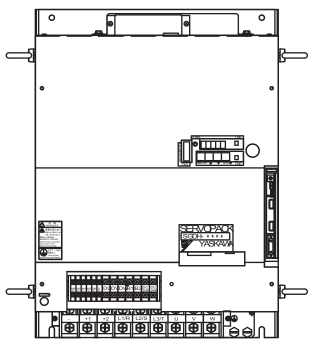
1.1.2 Servomotors



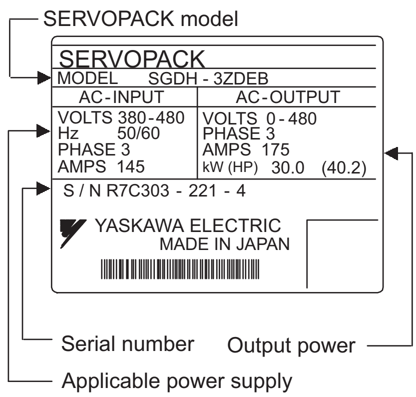
SGMVH servomotor



1.1.3 SERVOPACKs



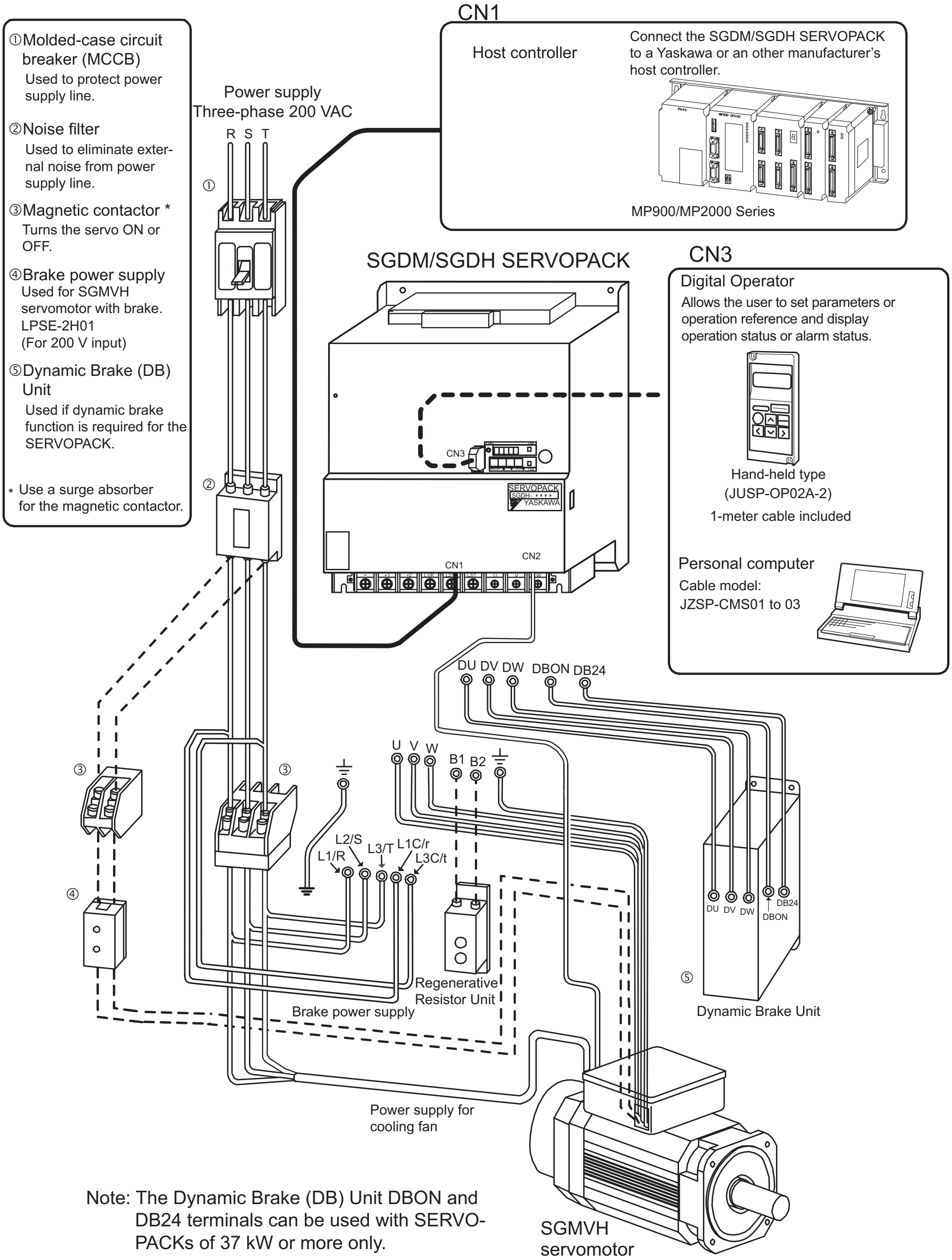
Σ-II Series SGDM and SGDH SERVOPACKs



1.2 Examples of Servo System Configurations

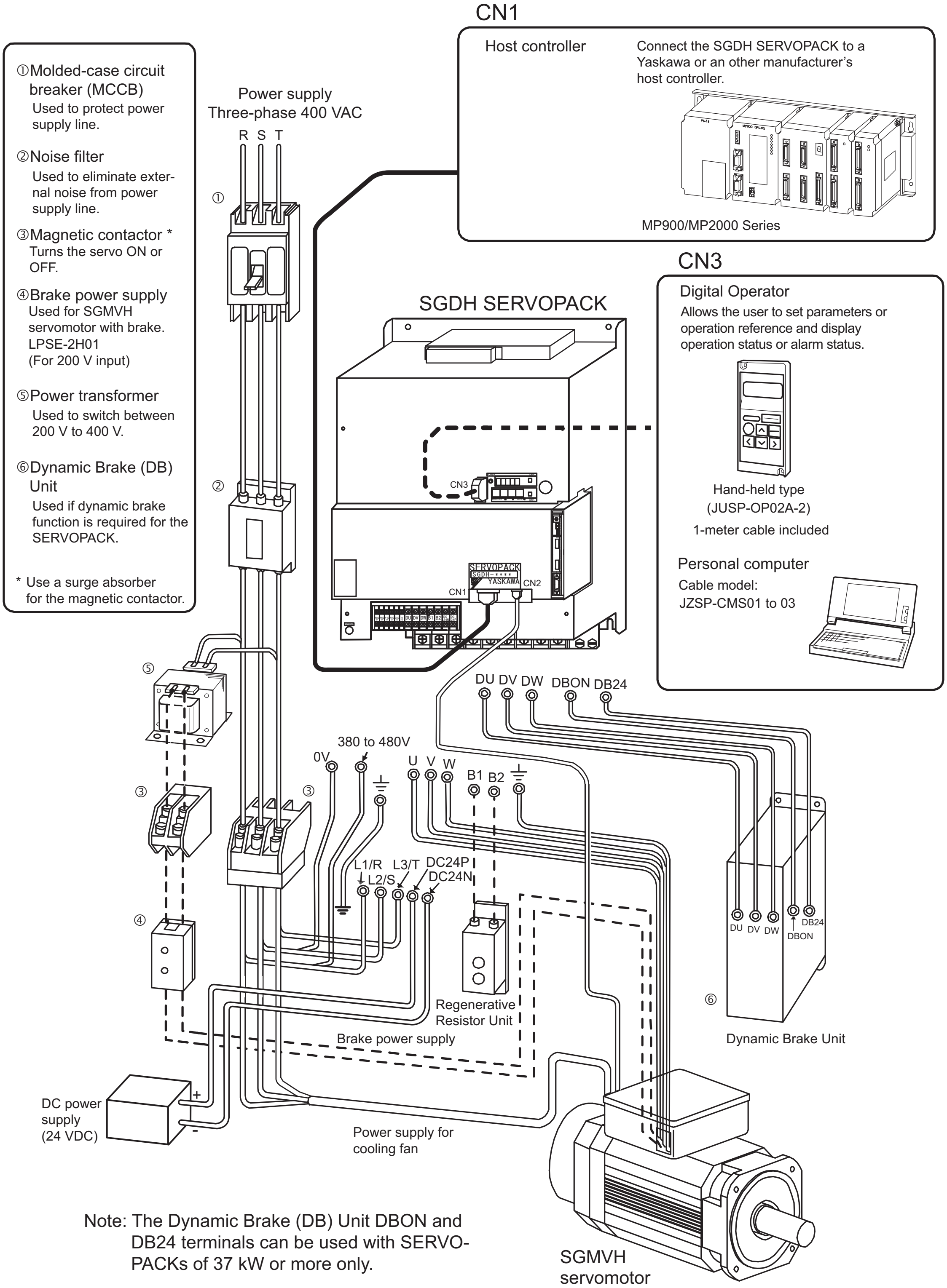
This section describes examples of basic servo system configuration.

1.2.1 Three-phase, 200 V Series



Note: The Dynamic Brake (DB) Unit DBON and DB24 terminals can be used with SERVOPACKs of 37 kW or more only.

1.2.2 Three-phase, 400 V Series



Note: The Dynamic Brake (DB) Unit DBON and DB24 terminals can be used with SERVOPACKs of 37 kW or more only.

1.3 Applicable Standards

1.3.1 North American Safety Standards (UL)

Model		Voltage*1	Capacity*2	UL*3 Standards (UL File No.)
SERVOPACK	SGDH	400 V	22 kW to 55 kW	UL508C(E147823)
Servomotor	SGMVH	400 V	22 kW to 55 kW	UL1004(E165827)

* 1. 200 V SERVOPACKs and servomotors have not obtained certification showing compliance with UL standards.
* 2. 75 kW SERVOPACKs and servomotors have not obtained certification showing compliance with UL standards.
* 3. Underwriters Laboratories Inc.

1.3.2 CE Marking

The SGDH SERVOPACK and SGMVH servomotor have not obtained certification showing compliance with CE marking, but, the following models comply with its standards.

Model		Voltage*	Capacity*	Low Voltage Directive (compliant)	EMC Directive (compliant)	
					EMI	EMS
SERVOPACK	SGDH	400 V	22 kW to 55 kW	EN50178	EN55011 class A group 1	EN50082-2 or EN61000-6-2
Servomotor	SGMVH	400 V	22 kW to 55 kW	–*	EN55011 class A group 1	EN50082-2 or EN61000-6-2

* A low voltage directive-compliant model is in development.

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

2

Selections

2.1 Servomotor Model Designations

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

SGMVH – 2B A 2 B 2 N

1st + 2nd digits: Rated Output (kW)		3rd digit: Voltage A:200V,D:400V	
Code	Rated Output	A	D
2B	22	✓	✓
3Z	30	✓	✓
3G	37	✓	✓
4E	45	–	✓
5E	55	–	✓
7E	75	–	✓

✓: Available
–: Not available

4th digit: Serial Encoder

Code	Specifications	Remarks
2	17-bit absolute encoder	Standard
3	20-bit absolute encoder	Option
C	17-bit incremental encoder	Standard

5th digit: Rated Speed

Code	Specifications
B	1500 min^{-1}
D	800 min^{-1}

6th digit: Shaft End, Mounting Method

Code	Specifications	Remarks
2	Flange-mounted, straight without key	Standard
6	Flange-mounted, straight with key and shaft end tap (×1)	Option
K	Foot-mounted, straight without key	
L	Foot-mounted, straight with key and shaft end tap (×1)	

7th digit: Brake and Oil Seal

Code	Specifications
N	Standard (without options)
1	With dust seal
S	With oil seal
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
F	With dust seal and 90-VDC brake
G	With dust seal and 24-VDC brake

(1) Available Models

1st + 2nd digits: Rated Output (kW)		5th digit: Rated Speed B: 1500 min^{-1}, D: 800 min^{-1}		Mounting Method		With Oil Seal and Dust Seal	With Brake
Code	Rated Output	B	D	Flange-mounted	Foot-mounted		Foot-mounted
2B	22	✓	✓	✓	✓	✓	✓
3Z	30	✓	✓	✓	✓	✓	✓
3G	37	✓	✓	✓	✓	✓	✓
4E	45	✓	✓	✓	✓	✓	✓
5E	55	✓	–	✓	✓	✓	✓
7E	75	✓	–	✓	✓	✓	✓

✓: Available
–: Not available

Rated Speed (min^{-1})	Rated Output (kW)	With Brake Flange-mounted
1500	22	✓
	30	✓
	37	✓
	45	✓
	55	–
	75	–
800	22	✓
	30	–
	37	–
	45	–

2.2 SERVOPACK Model Designations

Select the SERVOPACK according to the applied servomotor.

	1st + 2nd digits	3rd digit	4th digit	5th digit
SGDM -	2B	A	D	B

1st + 2nd digits (kW)

Code	Rated Output
2B	22
3Z	30
3G	37

3rd digit: Power Supply Voltage A: 200 V

Code	A
2B	✓
3Z	✓
3G	✓

✓: Available

4th digit: Model

Code	Specificatioins
D	For torque, speed and position control

5th digit: Applicable Servomotor Model

Code	Specificatioins
B	SGMVH Servomotor

	1st + 2nd digits	3rd digit	4th digit	5th digit
SGDH -	2B	A	E	B

1st + 2nd digits (kW)

Code	Rated Output
2B	22
3Z	30
3G	37
4E	45
5E	55
9Z	75

3rd digit: Power Supply Voltage A: 200 V, D: 400 V

Code	A	D
2B	✓	Δ
3Z	✓	Δ
3G	✓	Δ
4E	−	✓
5E	−	✓
9Z	−	✓

✓: Available
Δ: Option
−: Not available

4th digit: Model

Code	Specificatioins
E	For torque, speed and position control

5th digit: Applicable Servomotor Model

Code	Specificatioins
B	SGMVH Servomotor

Selections

2

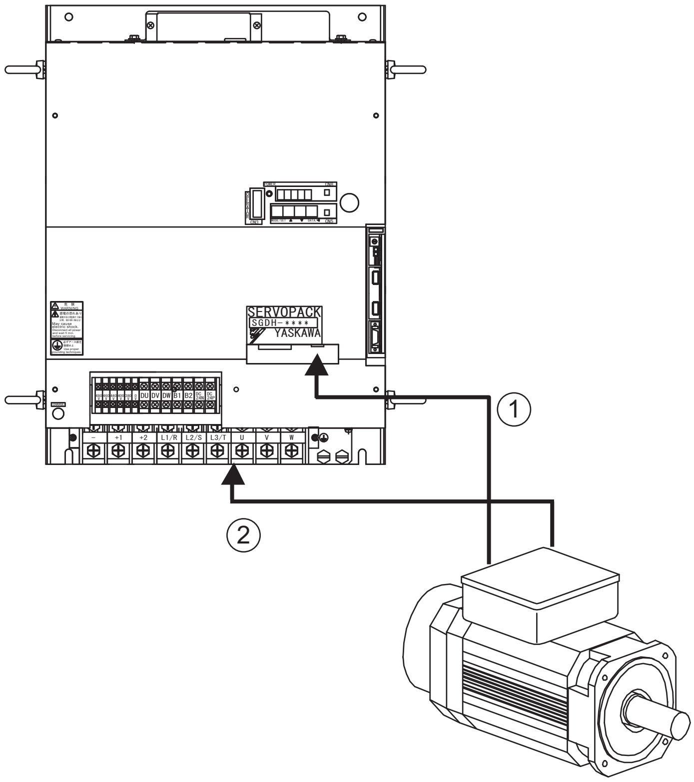
2.3 Σ-II Series SERVOPACKs and Applicable Servomotor

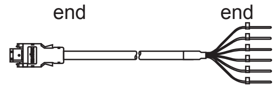
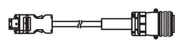
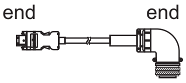
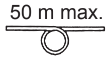
Servomotor SGMVH-		SERVOPACK		
		SGDM-	SGDH-	
		200 V	200 V	400 V
1500 min^{-1}	2B☐	2BADB	2BAEB	2BDEB
	3Z☐	3ZADB	3ZAEB	3ZDEB
	3G☐	3GADB	3GAEB	3GDEB
	4ED	–	–	4EDEB
	5ED	–	–	5EDEB
	7ED	–	–	9ZDEB
800 min^{-1}	2B☐	2BADB	2BAEB	2BDEB
	3Z☐	3ZADB	3ZAEB	3ZDEB
	3G☐	3GADB	3GAEB	3GDEB
	4ED	–	–	4EDEB

Note: ☐=A: 200 V, D: 400 V
Be sure to match the voltage ratio on the servomotor and the SERVOPACK.

2.4 Selecting Cables

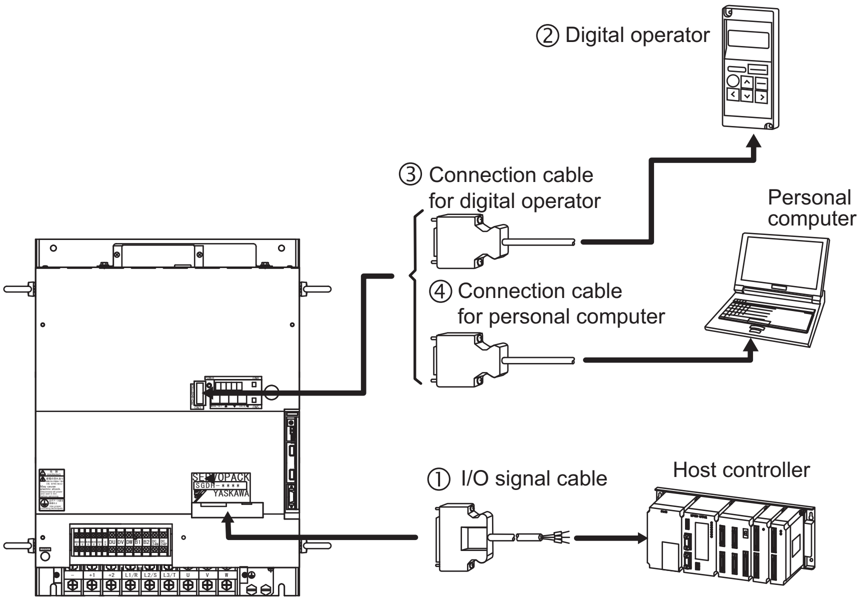
2.4.1 Cables for SGMVH Servomotor

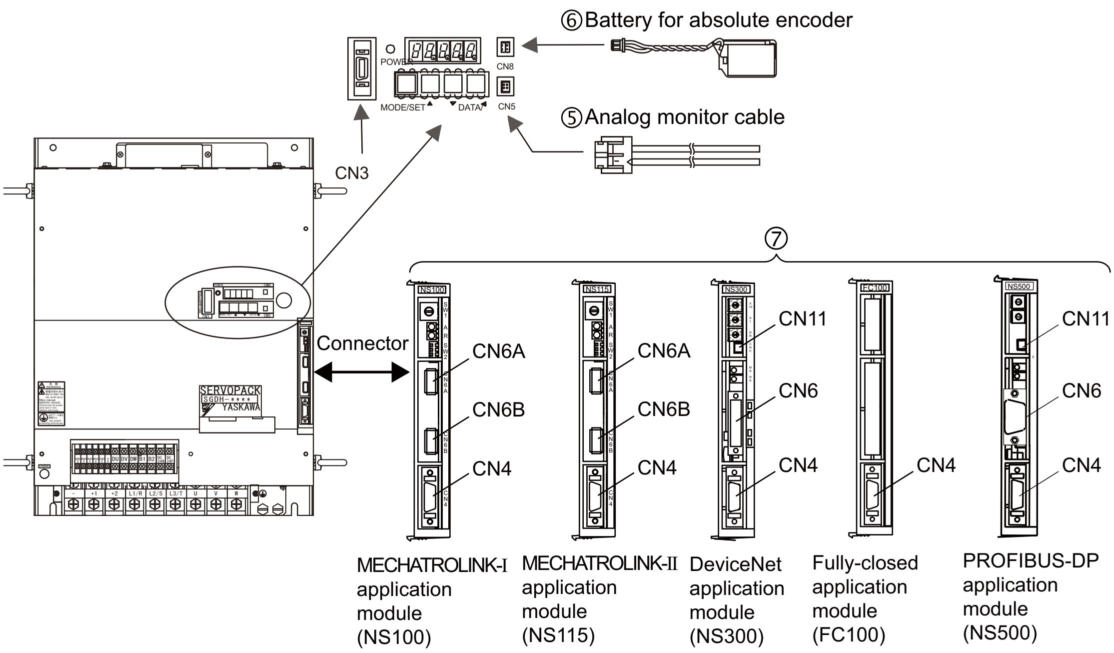


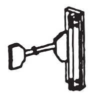
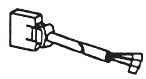
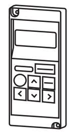
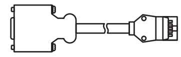
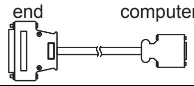
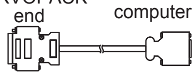
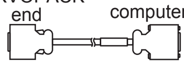
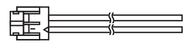
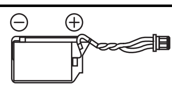
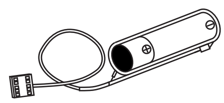
Name		Length	Type	Specifications	Reference
① CN2 Encoder Cable	Cable with loose wire at encoder end	3 m	JZSP-CMP23-03	SERVOPACK end / Encoder end 	5.2.2
		5 m	JZSP-CMP23-05		
		10 m	JZSP-CMP23-10		
		15 m	JZSP-CMP23-15		
		20 m	JZSP-CMP23-20		
	Cable with a straight plug	3 m	JZSP-CMP21-03	SERVOPACK end / Encoder end 	5.2.1
		5 m	JZSP-CMP21-05		
		10 m	JZSP-CMP21-10		
		15 m	JZSP-CMP21-15		
		20 m	JZSP-CMP21-20		
	Cable with an L-shaped plug	3 m	JZSP-CMP22-03	SERVOPACK end / Encoder end 	5.2.1
		5 m	JZSP-CMP22-05		
		10 m	JZSP-CMP22-10		
		15 m	JZSP-CMP22-15		
		20 m	JZSP-CMP22-20		
	Cables	5 m	JZSP-CMP29-05	50 m max. 	5.3
		10 m	JZSP-CMP29-10		
		15 m	JZSP-CMP29-15		
		20 m	JZSP-CMP29-20		
		30 m	JZSP-CMP29-30		
		40 m	JZSP-CMP29-40		
		50 m	JZSP-CMP29-50		
② Main Circuit Cable	Cables			Not available. For details, refer to chapter 5.	–

2.5 Selecting Peripheral Devices

2.5.1 Special Options





Name		Length	Type	Specifications	Reference
① CN1 I/O Signal Cables	Connector terminal block converter unit		JUSP-TA50PG	Terminal block and 0.5 m connection cable 	5.5.4
	Cable with loose wires at one end	1 m	JZSP-CKI01-1	Loose wires at host controller end 	5.4.1
		2 m	JZSP-CKI01-2		
		3 m	JZSP-CKI01-3		
② Digital Operator			JUSP-OP02A-2	With connection cable (1 m) 	5.5.2
③ CN3 Connection Cable for Digital Operator		1m	JZSP-CMS00-1	Required only when the digital operator model: JUSP-OP02A-1 for Σ-I series is used. 	
		1.5m	JZSP-CMS00-2		
		2 m	JZSP-CMS00-3		
④ CN3 Connection Cable for Personal Computer		2 m	JZSP-CMS01	D-Sub 25-pin (For PC98) 	5.5.1
		2 m	JZSP-CMS02	D-Sub 9-pin (For DOS/V) 	
		2 m	JZSP-CMS03	Half-pitch 14-pin (For PC 98) 	
⑤ CN5 Analog Monitor Cable		1 m	JZSP-CA01 or DE9404559		5.5.3
⑥ CN8 Battery for Absolute Encoder			JZSP-BA01-1		5.5.6
			ER6VC3	To connect to a host controller, 3.6 V, 2000 mAh, manufactured by Toshiba Battery Co., Ltd. 	
⑦ Application Module *			JUSP-NS100	MECHATROLINK-I application module (NS100)	5.5.15
			JUSP-NS115	MECHATROLINK-II application module (NS115)	5.5.15
			JUSP-NS300	DeviceNet application module (NS300)	5.5.16
			JUSP-FC100	Fully-closed application module (FC100)	5.5.18
			JUSP-NS500	PROFIBUS-DP application module (NS500)	5.5.17

* For details, refer to the manuals of each application module.

Selections

2

2.5.2 Molded-case Circuit Breaker and Fuse Capacity

Select a input fuse or molded-case circuit breaker that comply with UL standard.

SERVOPACK Model	Power Supply Capacity per SERVOPACK (kVA)*1	Current Capacity of the Molded-case Circuit Breaker and the Fuse (A)*2	Inrush Current (A)	
			Main Circuit Power Supply	Control Circuit Power Supply
SGDM-2BADB SGDH-2BAEB	36.7	150	300	30
SGDM-3ZADB SGDH-3ZAEB	50.1	200	300	30
SGDM-3GADB SGDH-3GAEB	61.8	225	600	30
SGDH-2BDEB	36.7	100	140	(10)*3
SGDH-3ZDEB	50.1	150	565	
SGDH-3GDEB	61.8	150	565	
SGDH-4EDEB	75.2	225	1130	
SGDH-5EDEB	91.9	225	1130	
SGDH-9ZDEB	125.3	300	170	

* 1. Nominal value at the rated load.
* 2. Cutoff characteristics (25°C): 200% for two seconds min. and 700% for 0.01 seconds min.
* 3. The values will vary, depending on the 24 VDC control power supply used.

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.

2.5.3 Noise Filters, Magnetic Contactors, and Brake Power Supply Units

SERVOPACK Model	Recommended Noise Filter	Magnetic Contactor	Brake Power Supply Unit
SGDM-2BADB SGDH-2BAEB	FN258L-130-35	SC-N6 (125A)	①24 VDC brake (provided by a customer) ②90 VDC brake • LPDE-1H01 for 100 VAC input • LPSE-2H01 for 200 VAC input
SGDM-3ZADB SGDH-3ZAEB	FN258L-180-07	SC-N8 (180A)	
SGDM-3GADB SGDH-3GAEB	FN359P-250-99	SC-N10 (220A)	
SGDH-2BDEB	FN258L-180-07	SC-N6 (125A)	
SGDH-3ZDEB	FN258L-180-07	SC-N8 (180A)	
SGDH-3GDEB	FN258L-180-07	SC-N8 (180A)	
SGDH-4EDEB	FN359P-250-99	SC-N10 (220A)	
SGDH-5EDEB	FN359P-250-99	SC-N10 (220A)	
SGDH-9ZDEB	FN359P-300-99	SC-N11 (300A)	

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	Schaffner Electronic
Magnetic Contactor	Fuji Electric Co., Ltd.
Brake Power Supply Unit	Yaskawa Controls Co., Ltd.

2.5.4 Regenerative Resistor Units

SERVOPACK Model	SGDM-	2BADB	3ZADB	3GADB	–					
	SGDH-	2BAEB	3ZAEB	3GAEB	2BDEB	3ZDEB	3GDEB	4EDEB	5EDEB	9ZDEB
Regenerative Resistor Unit Model	JUSP-	RA08	RA09	RA11	RA12	RA13	RA14	RA15	RA16	RA25
Resistance (Ω)		2.4	1.8	1.6	9	6.7	5	4	3.8	2.1
Resistance Capacity (W)		2400	4800	4800	3600	3600	4800	6000	7200	16800
Allowable Load Moment of Inertia ($\times 10^{-4} kg \cdot m^2$)		1830	2490	2875	1830	2490	2875	5355	6450	9020
Allowable Duty		2% ED at maximum speed and torque deceleration.								

2.5.5 Dynamic Brake (DB) Units

Externally attach a dynamic brake resistor to the SERVOPACK to dissipate regenerative energy when using the dynamic brake function. The dynamic brake resistor does not need to be installed if the dynamic brake function is not required.

Dynamic Brake (DB) Unit Model	SERVOPACK Model		Resistance Specifications (Star Wiring ⅄)	DB Contactor and Surge Absorption Unit
	SGDM-	SGDH-		
JUSP–DB01	2BADB, 3ZADB	2BAEB, 3ZAEB	180 W, 0.3 Ω	Built into the SERVOPACK
JUSP–DB02	3GADB	3GAEB	180 W, 0.3 Ω	Built into Dynamic Brake Unit
JUSP–DB03	–	2BDEB, 3ZDEB	180 W, 0.8 Ω	Built into the SERVOPACK
JUSP–DB04	–	3GDEB	180 W, 0.8 Ω	Built into Dynamic Brake Unit
JUSP–DB05	–	4EDEB	180 W, 0.8 Ω	Built into Dynamic Brake Unit
JUSP–DB06	–	5EDEB	300 W, 0.8 Ω	Built into Dynamic Brake Unit
JUSP–DB12	–	9ZDEB	600 W, 0.9 Ω	Built into Dynamic Brake Unit

Use the dynamic brake unit under the following conditions. Contact your Yaskawa representative before using the unit under conditions more severe than those specified below.

- Allowable load moment of inertia: 5 times the load moment of inertia
- Allowable duty: Less than one DB stop per hour at maximum rotation speed

2.5.6 Thermal Relays

Dynamic Brake (DB) Unit and Regenerative Resistor Unit Model	Thermal Relay Model	Thermal Relay Current Range	Thermal Relay Current	Manufacturer
JUSP-DB01 JUSP-DB02	TR-N3H/3 9 A	9 to 13 A	10 A	Fuji Electric Co., Ltd.
JUSP-DB03 JUSP-DB04 JUSP-DB05	TR-N3H/3 7 A	7 to 11 A	7 A	
JUSP-DB06	TR-N3H/3 7 A	7 to 11 A	9 A	
JUSP-DB12	TR-N3H/3 9 A	9 to 13 A	12 A	
JUSP-RA08	TR-N3H/3 12 A	12 to 18 A	14 A	
JUSP-RA09	TR-N3H/3 18 A	18 to 26 A	23 A	
JUSP-RA11	TR-N3H/3 18 A	18 to 26 A	24 A	
JUSP-RA12	TR-N3H/3 7 A	7 to 11 A	9 A	
JUSP-RA13	TR-N3H/3 9 A	9 to 13 A	10 A	
JUSP-RA14	TR-N3H/3 12 A	12 to 18 A	14 A	
JUSP-RA15	TR-N3H/3 12 A	12 to 18 A	17 A	
JUSP-RA16	TR-N3H/3 18 A	18 to 26 A	19 A	
JUSP-RA25	TR-N3H/3 34 A	34 to 50 A	40 A	

3

Servomotor Specifications and Dimensional Drawings

3.1 Ratings and Specifications of SGMVH (1500 min^{-1})

(1) Ratings and Specifications

- Time Rating: Continuous
- Vibration Class: V15
- Insulation Resistance: 500 VDC, 10 MΩ min.
- Surrounding Air Temperature: 0 to 40°C
- Excitation: Permanent magnet
- Mounting: Flange-mounted (standard)
  Foot-mounted (semi-standard)
- Thermal Class: F
- Withstand Voltage:
  200 V Servomotors: 1500 VAC for one minute
  400 V Servomotors: 1800 VAC for one minute
- Enclosure: Totally enclosed, cooled separately, IP44
- Ambient Humidity: 20% to 80% (no condensation)
- Drive Method: Timing belt or coupling

(a) 200 V Class

Voltage Class		200 V		
Servomotor Model SGMVH-		2BA☐B	3ZA☐B	3GA☐B
Rated Output *	kW	22	30	37
Rated Torque *	N·m	140	191	236
Stall Torque *	N·m	140	191	236
Instantaneous Peak Torque *	N·m	350	478	589
Rated Current *	Arms	88	120	152
Instantaneous Max. Current *	Arms	240	350	460
Rated Speed *	min^{-1}	1500		
Max. Speed *	min^{-1}	2000		
Torque Constant	N·m/Arms	1.72	1.72	1.68
Rotor Moment of Inertia J	$\times 10^{-4}$ kg·m^2	366	498	595
Rated Power Rate *	kW/s	536	733	933
Rated Angular Acceleration *	rad/s^2	3827	3536	3960

Note: Refer to the next page for the notes.

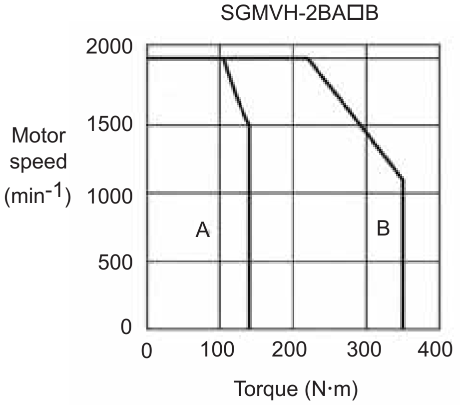
(b) 400 V Class

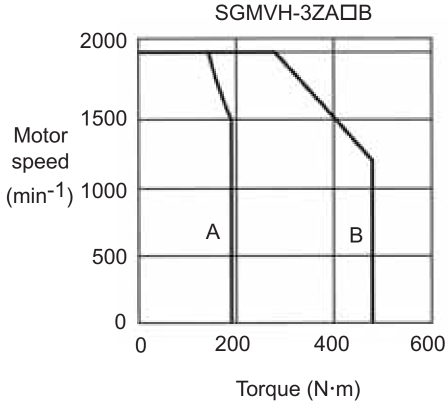
Voltage Class		400 V					
Servomotor Model SGMVH-		2BD□B	3ZD□B	3GD□B	4ED□B	5ED□B	7ED□B
Rated Output *	kW	22	30	37	45	55	75
Rated Torque *	N·m	140	191	236	286	350	477
Stall Torque *	N·m	140	191	236	286	350	477
Instantaneous Peak Torque *	N·m	350	478	589	715	875	1193
Rated Current *	Arms	44	60	76	102	117	150
Instantaneous Max. Current *	Arms	120	170	230	280	340	450
Rated Speed *	min^{-1}	1500					
Max. Speed *	min^{-1}	2000					
Torque Constant	N·m/Arms	3.44	3.44	3.36	3.09	3.15	3.35
Rotor Moment of Inertia J	$\times 10^{-4}$ kg·m^2	366	498	595	1071	1290	1804
Rated Power Rate *	kW/s	536	733	933	767	950	1265
Rated Angular Acceleration *	rad/s^2	3827	3536	3960	2675	2715	2645

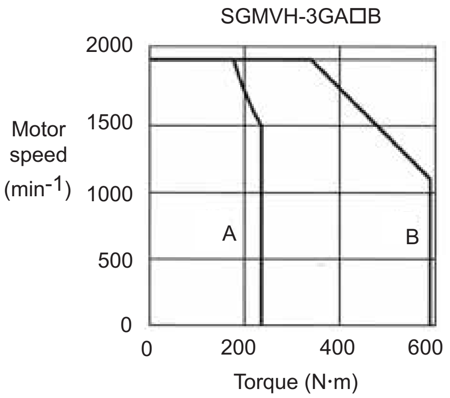
* These items and torque-motor speed characteristics quoted in combination with SGDM/SGDH SERVOPACK are at an armature winding temperature of 20°C.

Note: These characteristics are values with the following iron plate (heat sink) attached for cooling.
SGMVH-2B, 3Z and 3G: 650 × 650 × 35 mm
SGMVH-4E, 5E and 7E: 740 × 520 × 27 mm

(2) Torque-Motor Speed Characteristics (200 V class)



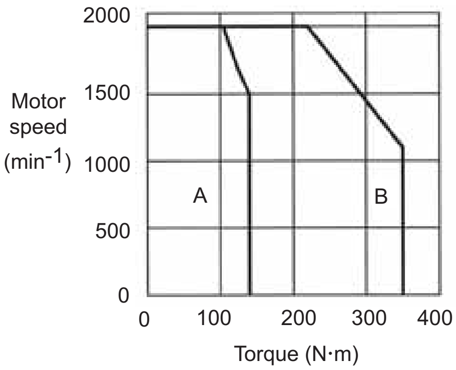




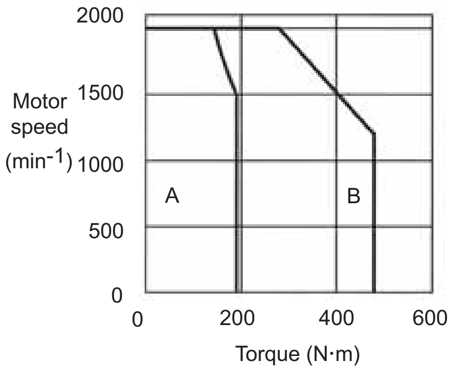
A: Continuous Duty Zone B: Intermittent Duty Zone

(3) Torque-Motor Speed Characteristics (400 V class)

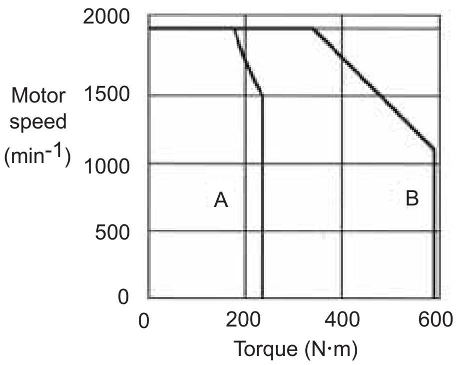
SGMVH-2BD□B



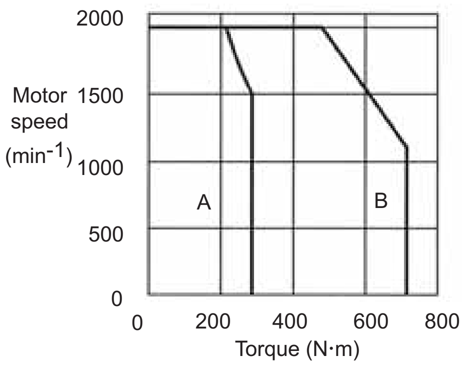
SGMVH-3ZD□B



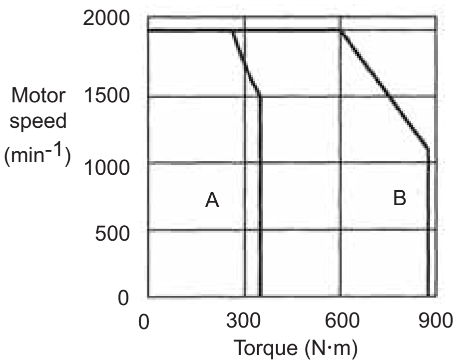
SGMVH-3GD□B



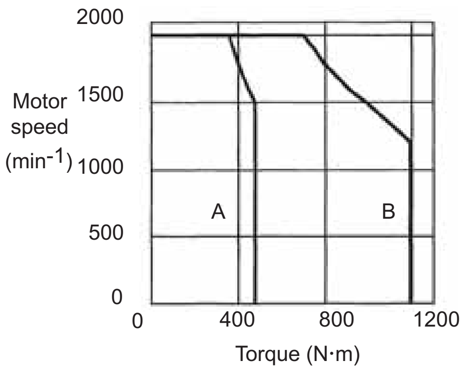
SGMVH-4ED□B



SGMVH-5ED□B



SGMVH-7ED□B



A: Continuous Duty Zone
B: Intermittent Duty Zone

3.2 Ratings and Specifications of SGMVH (800 min^{-1})

(1) Ratings and Specifications

- Time Rating: Continuous
- Vibration Class: V15
- Insulation Resistance: 500 VDC, 10 MΩ min.
- Surrounding Air Temperature: 0 to 40°C
- Excitation: Permanent magnet
- Mounting: Flange-mounted (standard)
  Foot-mounted (semi-standard)
- Thermal Class: F
- Withstand Voltage:
  200 V Servomotors: 1500 VAC for one minute
  400 V Servomotors: 1800 VAC for one minute
- Enclosure: Totally enclosed, cooled separately, IP44
- Ambient Humidity: 20% to 80% (no condensation)
- Drive Method: Timing belt or coupling

(a) 200 V Class

Voltage Class		200 V		
Servomotor Model SGMVH-		2BA□D	3ZA□D	3GA□D
Rated Output *	kW	22	30	37
Rated Torque *	N·m	262	358	442
Stall Torque *	N·m	262	358	442
Instantaneous Peak Torque *	N·m	526	752	930
Rated Current *	Arms	104	150	195
Instantaneous Max. Current *	Arms	240	340	460
Rated Speed *	min^{-1}	800		
Max. Speed *	min^{-1}	1300		
Torque Constant	N·m/Arms	2.73	2.50	2.34
Rotor Moment of Inertia J	$x10^{-4}$ $kg{\cdot}m^2$	705	1290	1564
Rated Power Rate *	kW/s	979	994	1248
Rated Angular Acceleration *	rad/s^2	3726	2777	2824

Note: Refer to the next page for the notes.

(b) 400 V Class

Voltage Class		400 V			
Servomotor Model SGMVH-		2BD□□D	3ZD□□D	3GD□□D	4ED□□D
Rated Output *	kW	22	30	37	45
Rated Torque *	N·m	262	358	442	537
Stall Torque *	N·m	262	358	442	537
Instantaneous Peak Torque *	N·m	526	752	930	1182
Rated Current *	Arms	52	75	98	110
Instantaneous Max. Current *	Arms	120	170	230	280
Rated Speed *	min^{-1}	800			
Max. Speed *	min^{-1}	1300			
Torque Constant	N·m/Arms	5.46	5.00	4.68	5.21
Rotor Moment of Inertia J	$x10^{-4}$ kg·m^2	705	1290	1564	1804
Rated Power Rate *	kW/s	979	994	1248	1600
Rated Angular Acceleration *	rad/s^2	3726	2777	2824	2978

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

Note: These characteristics are values with the following iron plates (heat sinks) attached for cooling.
SGMVH-2B: 650 × 650 × 35 mm
SGMVH-3Z, 3G and 4E: 740 × 520 × 27 mm

Servomotor Specifications and Dimensional Drawings

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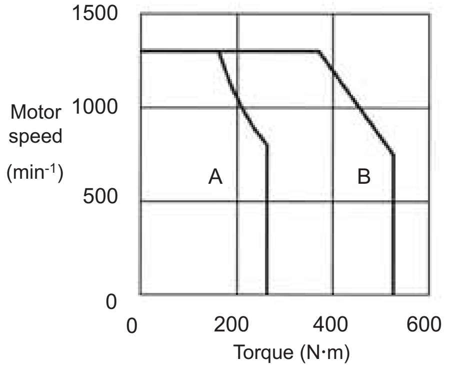
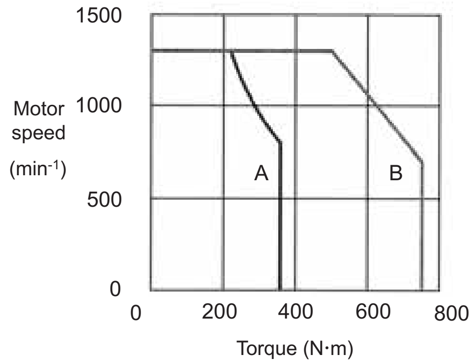
(2) Torque-Motor Speed Characteristics (200 V class)

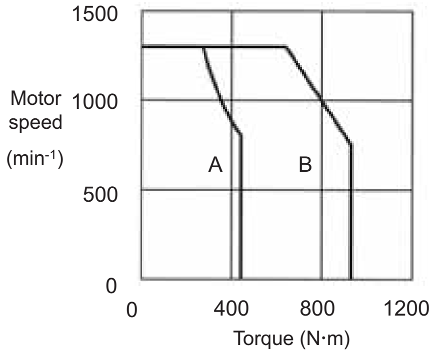
SGMVH-2BA☐D



SGMVH-3ZA☐D



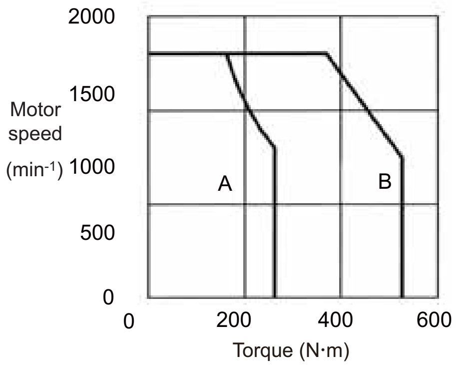
SGMVH-3GA☐D



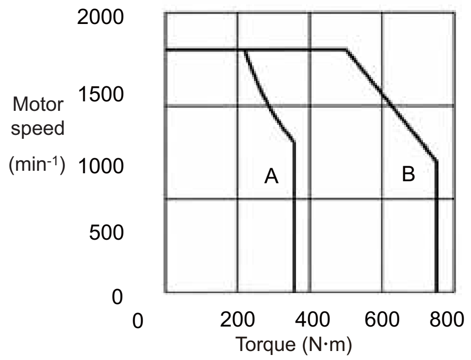
A: Continuous Duty Zone
B: Intermittent Duty Zone

(3) Torque-Motor Speed Characteristics (400 V class)

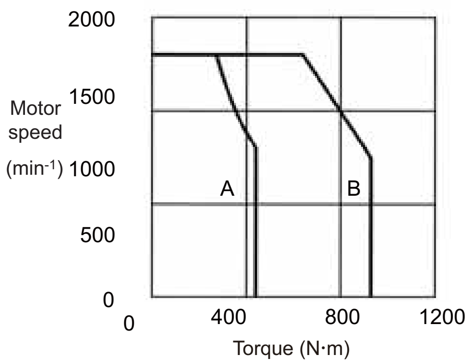
SGMVH-2BD☐☐D



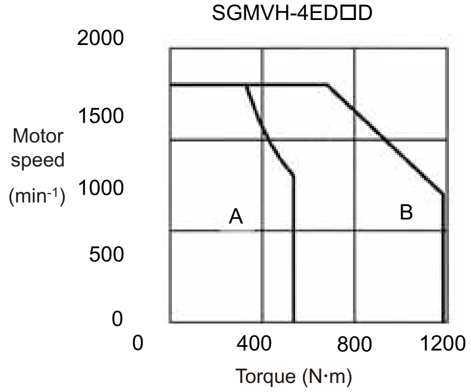
SGMVH-3ZD☐☐D



SGMVH-3GD☐☐D



SGMVH-4ED☐☐D



A: Continuous Duty Zone
B: Intermittent Duty Zone

3.3 Mechanical Specifications of Servomotors

3.3.1 Precautions on Servomotor Installation

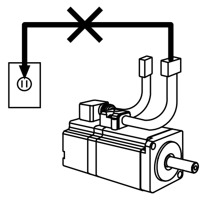
Servomotors can be installed either horizontally or vertically.

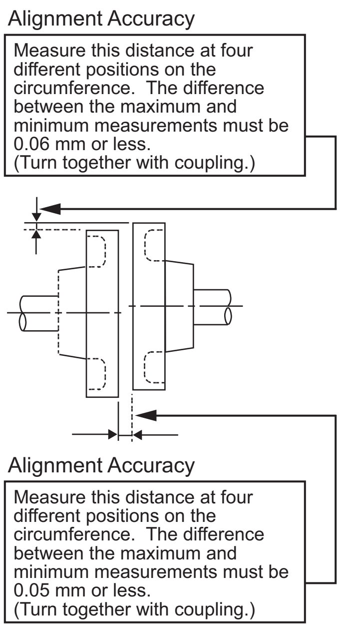
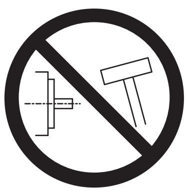
The service life of the servomotor will be shortened or unexpected problems will occur if the servomotor is installed incorrectly or in an inappropriate location. Always observe the following installation instructions.

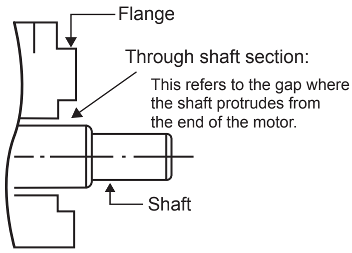
⚠ CAUTION

- Do not connect the servomotor directly to a commercial power line. This will damage the servomotor.
  The servomotor cannot operate without the proper SERVOPACK.

Do not connect



Storage Temperature and Humidity	Store the servomotor within the following temperature range if it is stored with the power cable disconnected. Surrounding air 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. • Surrounding air temperature of 0 to 40°C • Relative humidity of 20% to 80% with no condensation. • Facilitates inspection and cleaning
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 range described on the left. Vibration may occur and damage the bearings and the encoder if the shafts are not correctly aligned. Connect the servomotor to a machine in a way that prevents the application of 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.

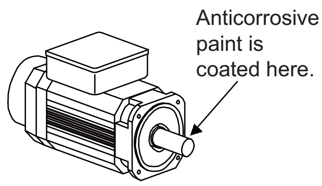
<table>
<tr><td>Handling Oil and Water</td><td>

If the servomotor is used in a location that is subject to water drops, make sure of the servomotor protective specifications (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
• The oil surface must be under the oil seal lip.
• Use an oil seal in favorably lubricated condition.
• When using a servomotor with its shaft pointed upward, be sure that oil will not stay in the oil seal lips.</td></tr>
<tr><td>Cable Stress</td><td>Make sure there are no bends or tension on the power lines.
Especially be 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.</td></tr>
<tr><td>Connectors</td><td>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 first, the encoder may be damaged because of the voltage differences between frame grounds.
• 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. Otherwise, the cables will be damaged.
• When bending cables are used, wiring must be performed so that excessive stress will not be applied to the connector section. Failure to observe this caution may damage the connector.</td></tr>
</table>

IMPORTANT

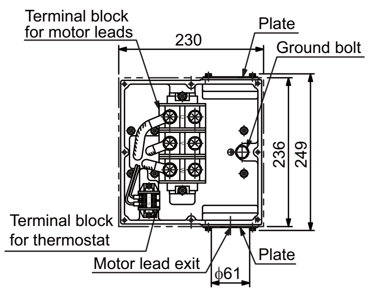
1. Before starting installation, thoroughly remove the anticorrosive paint that coats the end of the motor shaft.



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.

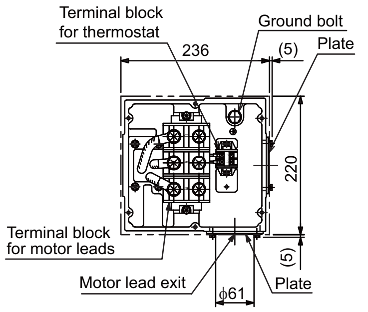
Wring the Motor Terminal Box

- Connect the servomotor power lines (U, V, and W) to the servomotor terminal block (M10) in the servomotor terminal box. Connect the ground wire to the ground bolt (M10) in the terminal box.
- The servomotor has a built-in thermostat. Wire the thermostat leads (l, lb) to the terminal block (M4) in the servomotor's terminal box.
- Terminal Box
  - 22 kW to 37 kW (1500 min^{-1})
  - 22 kW (800 min^{-1})



Symbol	Terminal	Terminal Screw
U,V,W	Motor	M10
⏚	Ground	M10
1,1b	Thermostat	M4

  - 45 kW to 75 kW (1500 min^{-1})
  - 30 kW to 45 kW (800 min^{-1})

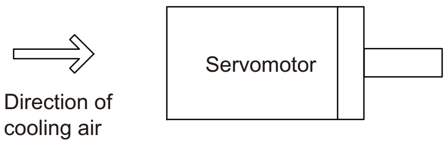


Symbol	Terminal	Terminal Screw
U,V,W	Motor	M10
⏚	Ground	M10
1,1b	Thermostat	M4

Units：mm

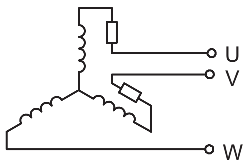
Wiring the Servomotor Fan

Wire the servomotor fan leads U(A), V(B), and W(C) so that the direction of air flows according to the following diagram. If the air flows in the opposite direction, change the wiring of any of the two phases U, V, and W.



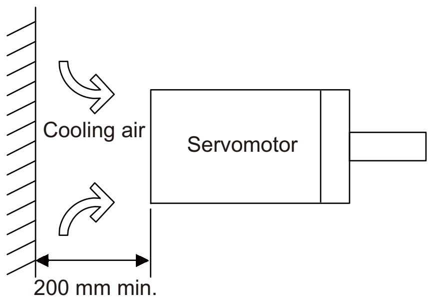
Protecting the Servomotor Fan

The servomotor fan has a built-in thermal protector, as shown in the following diagram, that operates at 140°C ±5%. To protect the servomotor fan from overcurrent, use with a 2-A no-fuse breaker.



Installing the Servomotor Fan

To maximize the cooling capacity of the servomotor fan, install the fan at least 200 mm from the inlet side of the servomotor as shown in the following diagram.

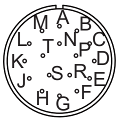


Servomotor Specifications and Dimensional Drawings

3

Encoder-end Connector Specifications

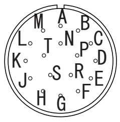
Absolute Encoder



Receptacle: 97F3102E20-29P
Applicable plug（purchased by a customer.）
Plug: JA06A-20-29S-J1-EB
Cable clamp: JL04-2022CKE（□□）

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）		

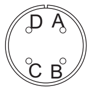
Incremental Encoder



Receptacle: 97F3102E20-29P
Applicable plug（purchased by a customer.）
Plug: JA06A-20-29S-J1-EB
Cable clamp: JL04-2022CKE（□□）

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

Fan Connector Specifications



A	Fan terminal（U）
B	Fan terminal（V）
C	Fan terminal（W）
D	

Receptacle: CE05-2A18-10PD-B
Applicable plug（purchased by a customer.）
Plug: CE05-6A18-10SD-B-BSS
Cable clamp: CE3057-10A-□（D265）

3.3.2 Allowable Radial and Thrust Loads

The following table shows the allowable loads applied to the SGMVH servomotor shaft end.

Design the mechanical system so radial and thrust loads applied to the servomotor shaft end during operation falls within the ranges shown in the following table.

Note that even when using a servomotor below the allowable radial load, the following imbalance or the loads may damage the bearings.

- The imbalance of parts that are connected to the shaft end
- Rotating loads generated by unmatched concentricity, when the bearing is attached to the extended shaft end.

(1) 1500 min^{-1} Series

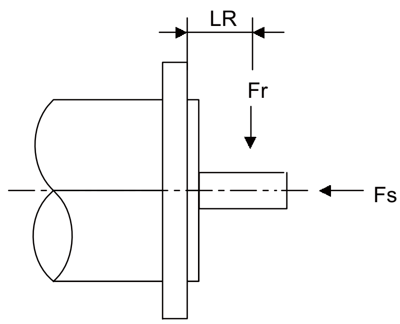
Servomotor Model SGMVH-	Allowable Radial Load Fr [N]	Allowable Thrust Load Fs [N]	LR [mm]
2BA☐B, 2BD☐B	5880	2156	100
3ZA☐B, 3ZD☐B	6272	2156	100
3GA☐B, 3GD☐B	7448	2156	100
4ED☐B	7840	2156	100
5ED☐B	8428	2156	110
7ED☐B	10100	2156	120

Note: Allowable radial and thrust loads shown above are the maximum values that could be applied to the shaft end from motor torque or other loads.

(2) 800 min^{-1} Series

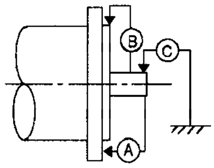
Servomotor Model SGMVH-	Allowable Radial Load Fr [N]	Allowable Thrust Load Fs [N]	LR [mm]
2BA☐D, 2BD☐D	7448	2156	100
3ZA☐D, 3ZD☐D	8428	2156	110
3GA☐D, 3GD☐D	8428	2156	110
4ED☐D	10100	2156	120

Note: Allowable radial and thrust loads shown above are the maximum values that could be applied to the shaft end from motor torque or other loads.



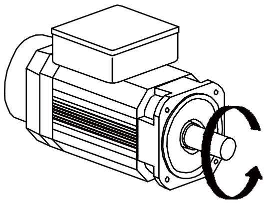
3.3.3 Mechanical Tolerance

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.

	Tolerance T. I. R. (Total Indicator Reading)	Reference Diagram
A	Perpendicularity between the flange face and output shaft Ⓐ: 0.05	
B	Mating concentricity of the flange O.D. Ⓑ: 0.025	
C	Run-out at the end of the shaft Ⓒ: 0.03	

3.3.4 Direction of Servomotor Rotation

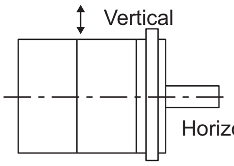
Positive rotation of the servomotor is counterclockwise when viewed from the load.



3.3.5 Impact Resistance

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

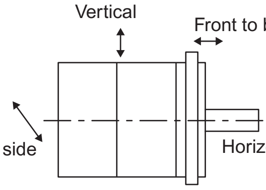
- Impact acceleration: 490 m/s^2
- Impact occurrences: 2



3.3.6 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.

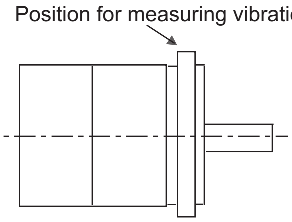
- Vibration acceleration: 24.5 m/s^2



3.3.7 Vibration Class

The vibration class [1] for the servomotors at rated motor speed is as follows.

- Vibration class: V15



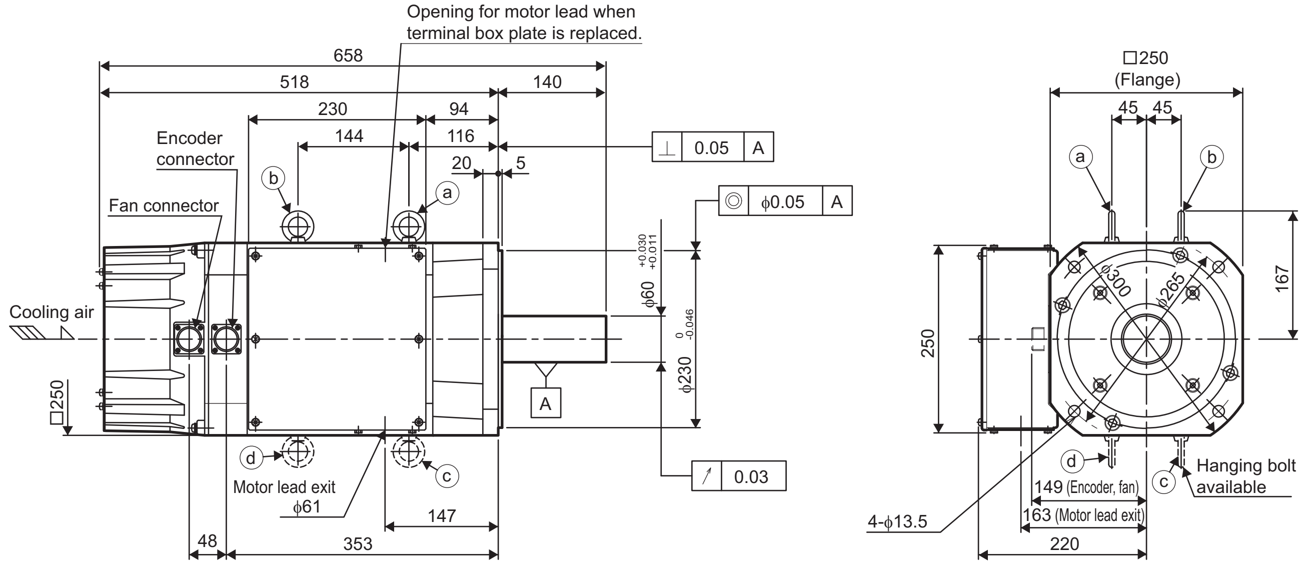
TERMS

1 Vibration Class

A vibration class of V15 indicates a total vibration amplitude of 15 μm maximum on the servomotor during rated rotation.

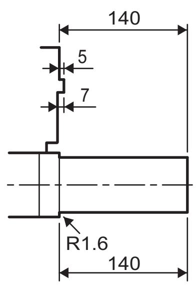
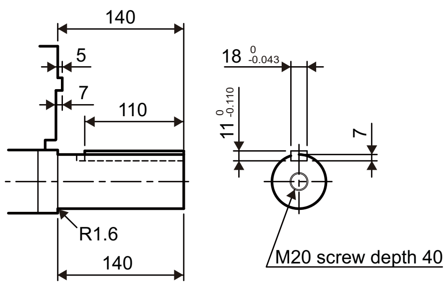
3.4 Dimensional Drawings of SGMVH Servomotors (1500 min^{-1})

(1) 22 kW (-2BA□B, -2BD□B)



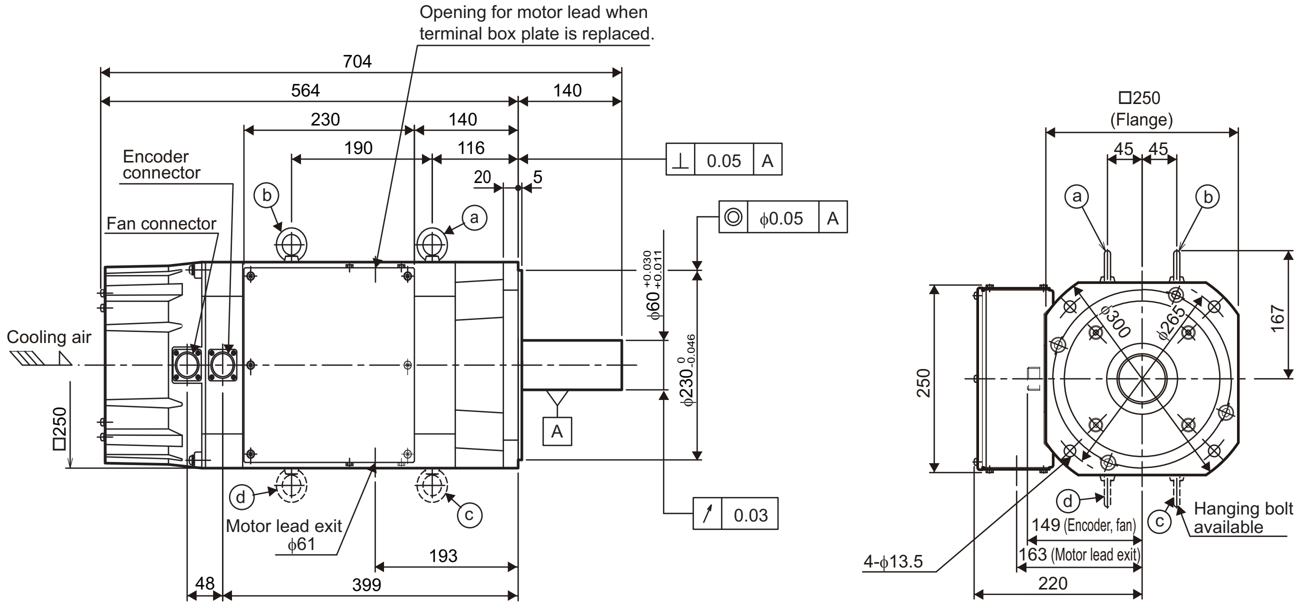
Units: mm
Approx. mass: 95 kg

- Shaft End Specifications

Specifications	Shaft End
Straight, without key	
Straight, with key and tap *	

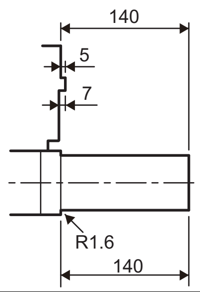
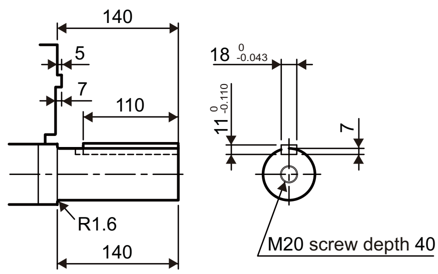
* Shaft end key is a JIS B 1301-1996 horizontal key (key slot tightening type).

(2) 30 kW (-3ZA□B, -3ZD□B)



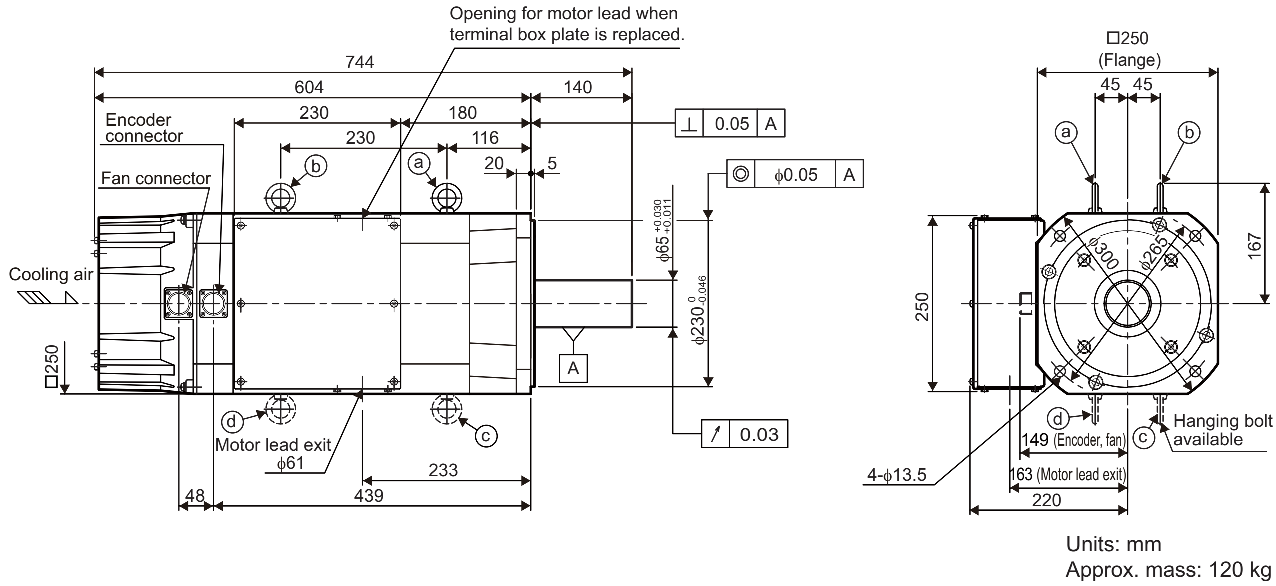
Units: mm
Approx. mass: 110 kg

- Shaft End Specifications

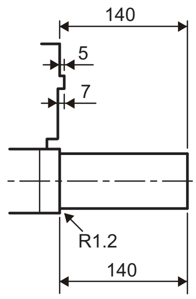
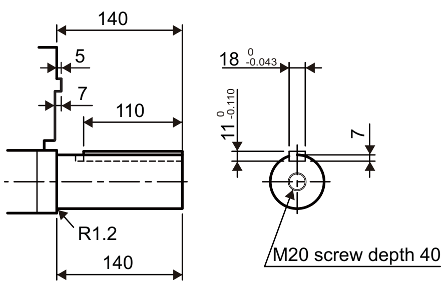
Specifications	Shaft End
Straight, without key	
Straight, with key and tap *	

* Shaft end key is a JIS B 1301-1996 horizontal key (key slot tightening type).

(3) 37 kW (-3GA☐B, -3GD☐B)

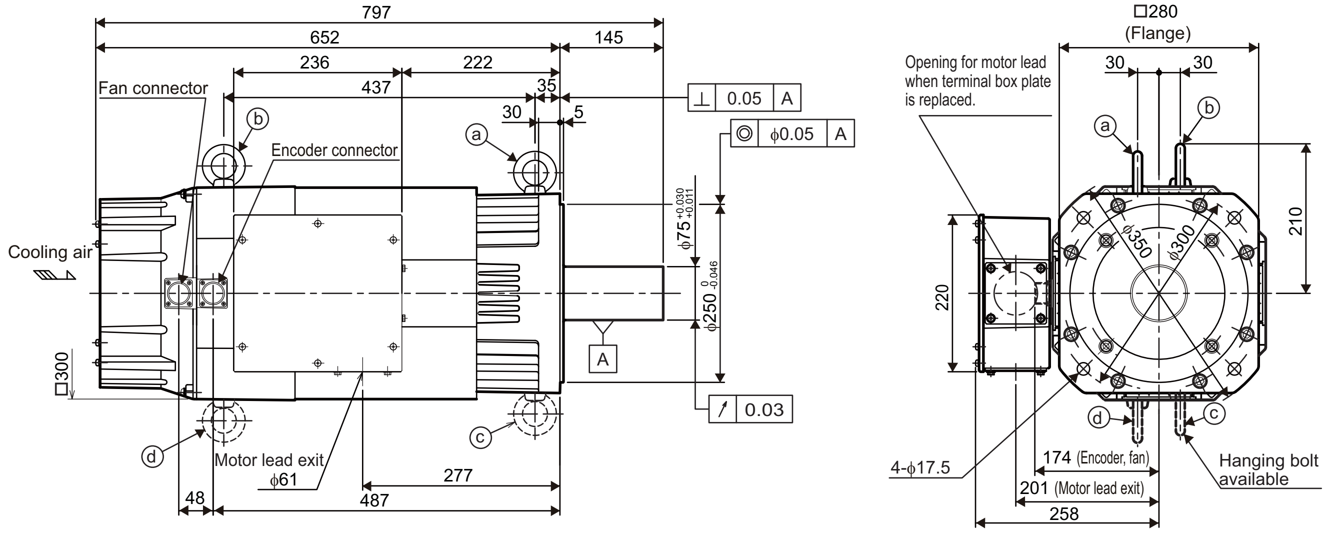


- Shaft End Specifications

Specifications	Shaft End
Straight, without key	
Straight, with key and tap *	

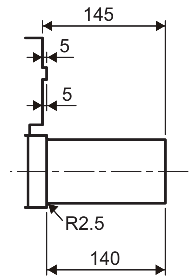
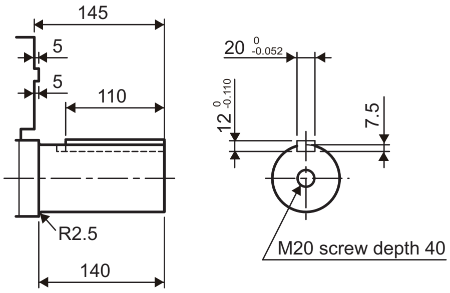
* Shaft end key is a JIS B 1301-1996 horizontal key (key slot tightening type).

(4) 45 kW (-4ED☐B)



Units: mm
Approx. mass: 165 kg

- Shaft End Specifications

Specifications	Shaft End
Straight, without key	
Straight, with key and tap *	

* Shaft end key is a JIS B 1301-1996 horizontal key (key slot tightening type).

Servomotor Specifications and Dimensional Drawings

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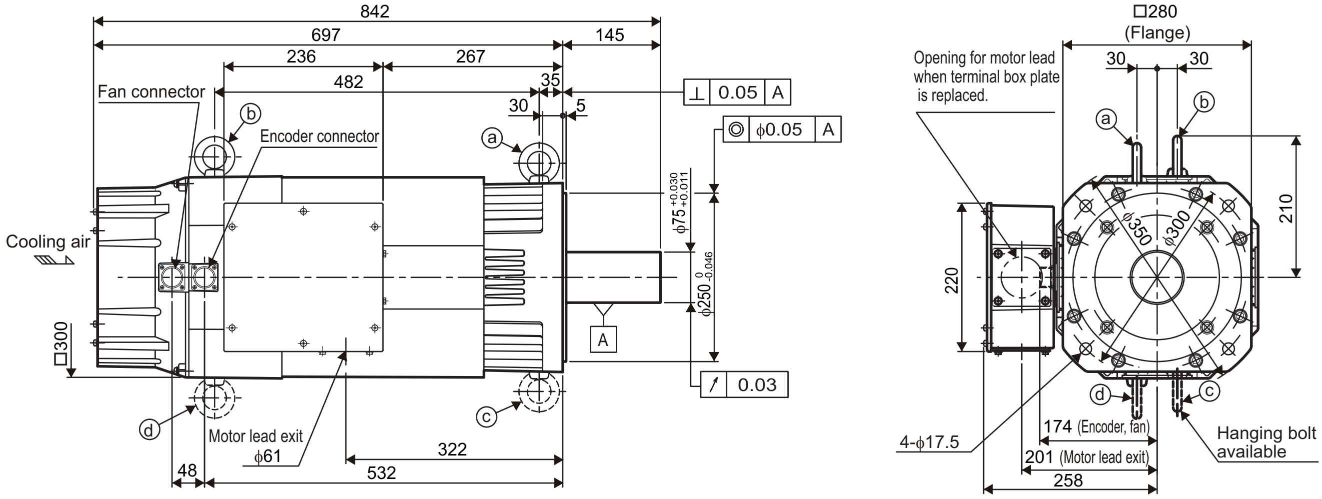
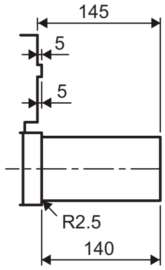
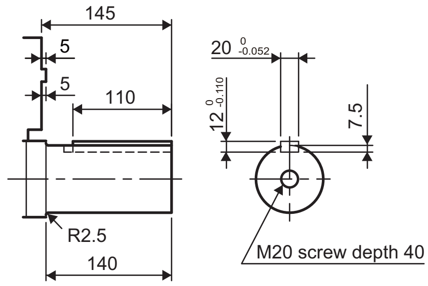
(5) 55 kW (-5ED□B)



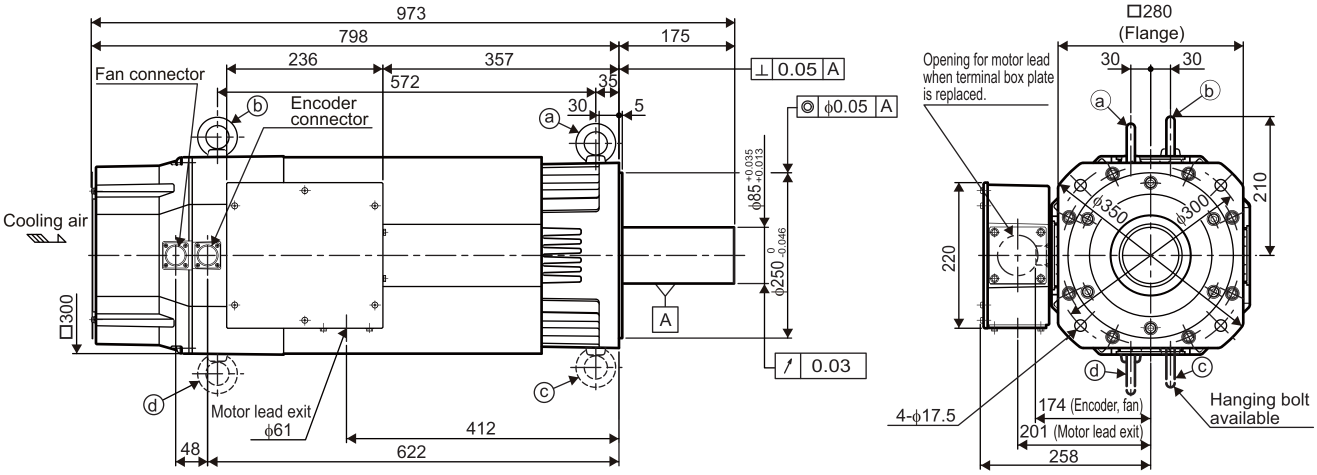
Units: mm
Approx. mass: 185 kg

- Shaft End Specifications

Specifications	Shaft End
Straight, without key	
Straight, with key and tap *	

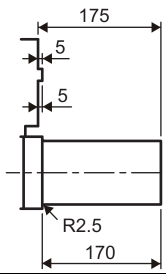
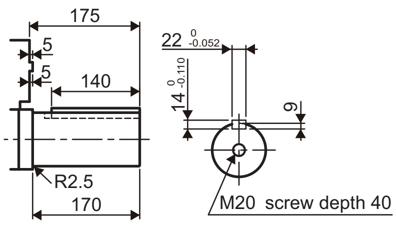
* Shaft end key is a JIS B 1301-1996 horizontal key (key slot tightening type).

(6) 75 kW (-7ED□B)



Units: mm
Approx. mass: 225 kg

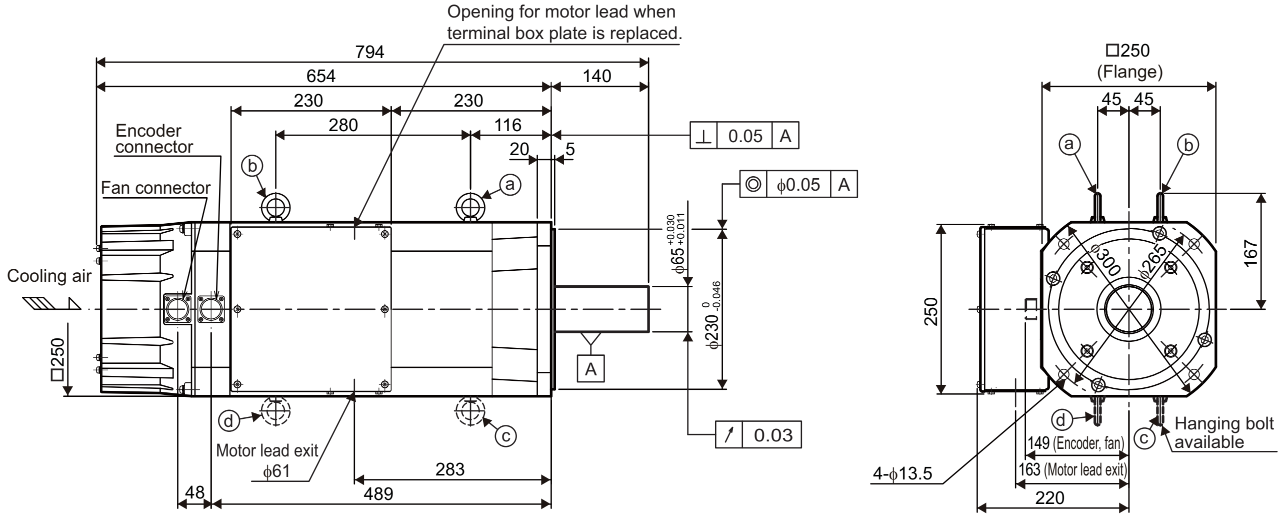
• Shaft End Specifications

Specifications	Shaft End
Straight, without key	
Straight, with key and tap *	

* Shaft end key is a JIS B 1301-1996 horizontal key (key slot tightening type).

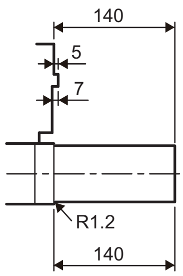
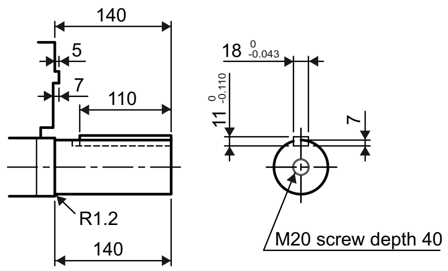
3.5 Dimensional Drawings of SGMVH Servomotors (800 min^{-1})

(1) 22 kW (-2BA□D, -2BD□D)



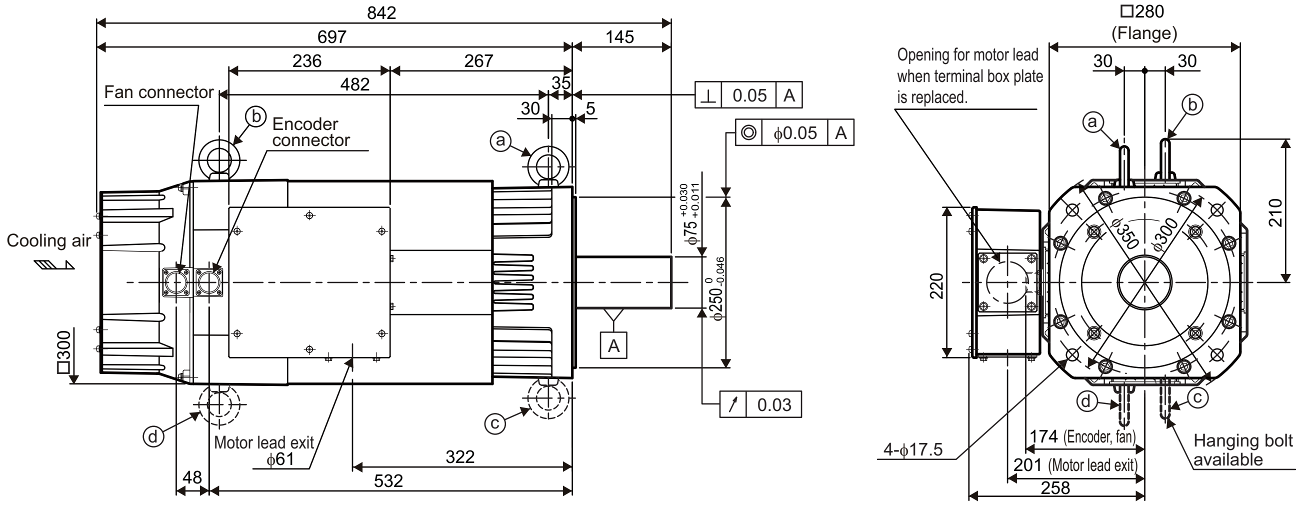
Units: mm
Approx. mass: 135 kg

- Shaft End Specifications

Specifications	Shaft End
Straight, without key	
Straight, with key and tap *	

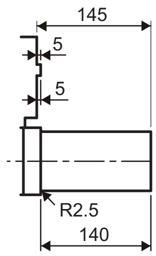
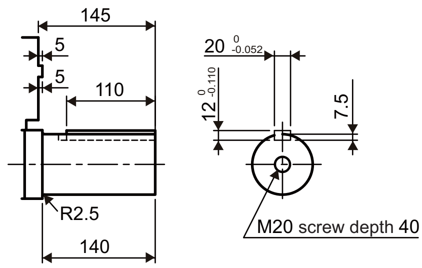
* Shaft end key is a JIS B 1301-1996 horizontal key (key slot tightening type).

(2) 30 kW (-3ZA□D, -3ZD□D)



Units: mm
Approx. mass: 185 kg

- Shaft End Specifications

Specifications	Shaft End
Straight, without key	
Straight, with key and tap *	

* Shaft end key is a JIS B 1301-1996 horizontal key (key slot tightening type).

Servomotor Specifications and Dimensional Drawings

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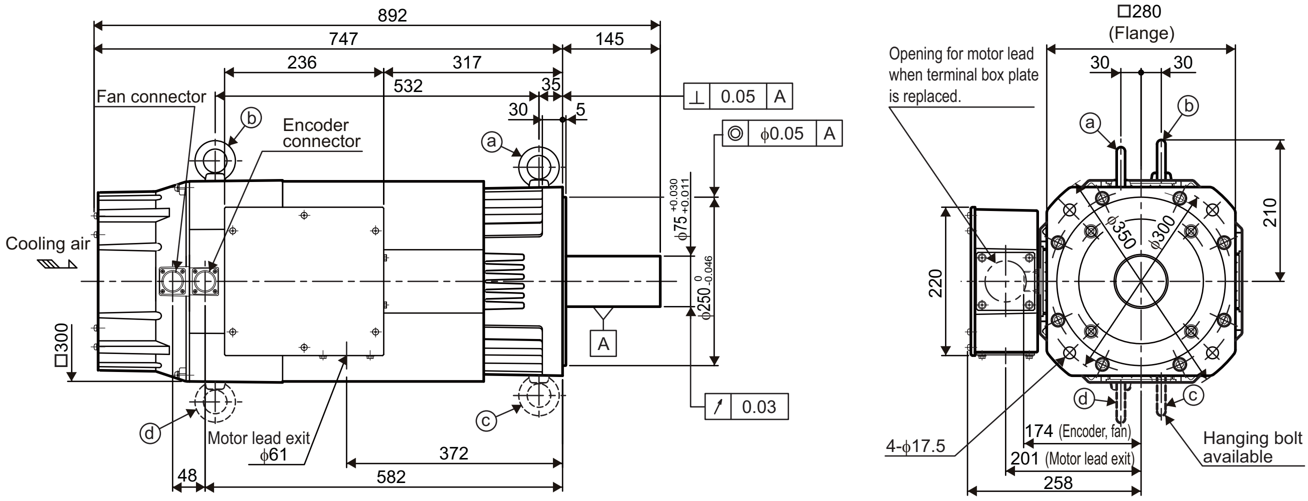
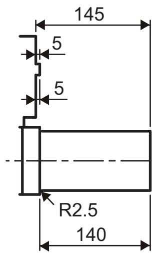
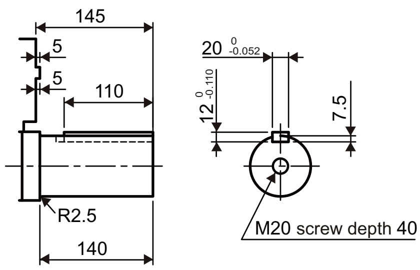
(3) 37 kW (-3GA☐D, -3GD☐D)



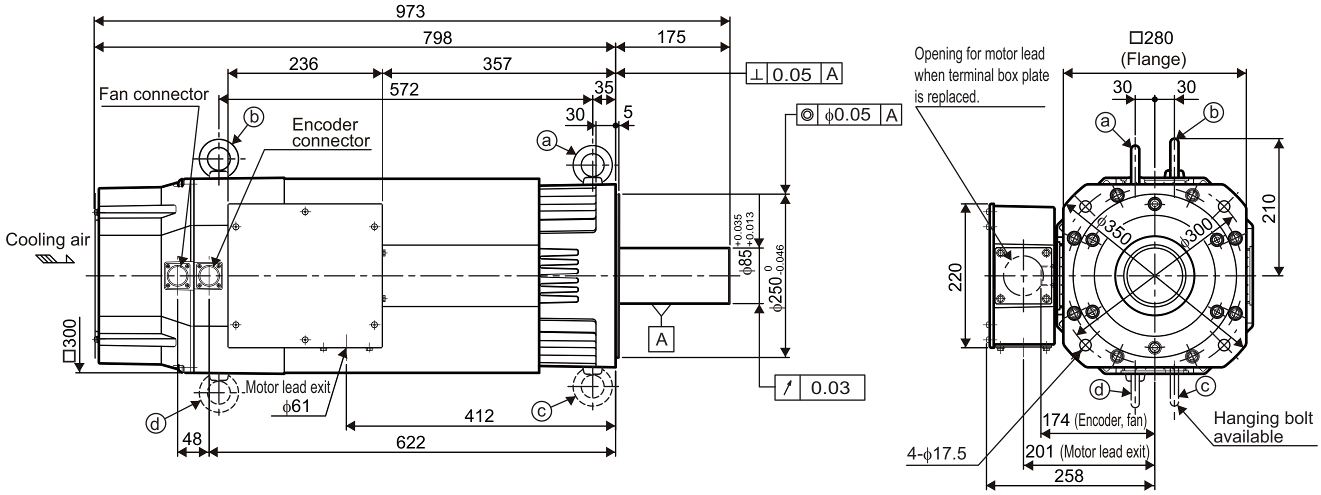
Units: mm
Approx. mass: 205 kg

- Shaft End Specifications

Specifications	Shaft End
Straight, without key	
Straight, with key and tap *	

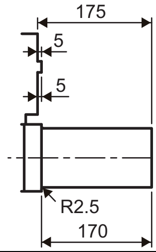
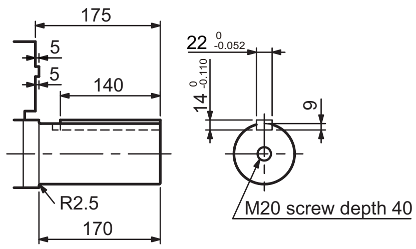
* Shaft end key is a JIS B 1301-1996 horizontal key (key slot tightening type).

(4) 45 kW (-4ED□D)



Units: mm
Approx. mass: 225 kg

- Shaft End Specifications

Specifications	Shaft End
Straight, without key	
Straight, with key and tap *	

* Shaft end key is a JIS B 1301-1996 horizontal key (key slot tightening type).

4

SERVOPACK Specifications and Dimensional Drawings

4.1 SERVOPACK Ratings and Specifications

⚠ CAUTION

- Take appropriate measures to ensure that the input power supply is supplied within the specified voltage range.
  An incorrect input power supply may result in damage to the SERVOPACK. If the voltage exceeds these values, use a step-down transformer so that the voltage will be within the specified range.

4.1.1 Three-phase 200 V

The value of the input power supply voltage is maximum 253 Vrms.

SERVOPACK Model		SGDM-	2BADB	3ZADB	3GADB
		SGDH-	2BAEB	3ZAEB	3GAEB
Max. Applicable Servomotor Capacity (kW)			22	30	37
Continuous Output Current (Arms)			110	148	195
Max. Output Current (Arms)			240	340	460
Input Power Supply	Main Circuit		Three-phase 200 to 230 VAC +10% to -15%, 50/60 Hz		
	Control Circuit		Single-phase 200 to 220 VAC +10% to -15%, 50 Hz Single-phase 200 to 230 VAC +10% to -15%, 60 Hz		
Configuration			Base-mounted		

4.1.2 Three-phase 400 V

The value of the input power supply voltage is maximum 528 Vrms.

SERVOPACK Model SGDH-		2BDEB	3ZDEB	3GDEB	4EDEB	5EDEB	9ZDEB
Max. Applicable Servomotor Capacity (kW)		22	30	37	45	55	75
Continuous Output Current (Arms)		52.2	75	98	127	150	210
Max. Output Current (Arms)		120	170	230	280	340	580
Input Power Supply	Main Circuit	Three-phase 380 to 480 VAC +10% to -15%, 50/60 Hz					
	Control Circuit	24 VDC ±15%					
	For Control Actuator	Single-phase 380 to 480 VAC, 50/60 Hz, 150 VA					
Configuration		Base-mounted					

4.1.3 SERVOPACK Ratings and Specifications

Basic Specifications	Control Method			Three-phase full-wave rectification IGBT-PWM (sine-wave driven)
	Feedback			Serial encoder: 17-bit (incremental/absolute)
	Conditions	Ambient/Storage Temperature *1		0 to +55°C/-20 to +85°C
		Ambient/Storage Humidity		90% RH or less (with no condensation)
		Vibration/Shock Resistance		4.9 m/s^2/19.6 m/s^2
Speed and Torque Control Modes	Performance	Speed Control Range		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.)
		Speed Regulation *2	Load Regulation	0 to 100% load: ±0.01% or less (at rated speed)
			Voltage Regulation	Rated voltage ±10%: 0% (at rated speed)
			Temperature Regulation	25 ± 25°C: ±0.1% or less (at rated speed)
		Frequency Characteristics		100 Hz (at $J_L = J_M$)
		Torque Control Tolerance (Repeatability)		±2%
		Soft Start Time Setting		0 to 10 s (Can be set individually for acceleration and deceleration.)
	Input Signals	Speed Reference Input	Reference Voltage *3	±6 VDC (Variable setting range: ±2 to ±10 VDC) at rated speed, input voltage: maximum ±12 V (servomotor forward rotation with positive reference)
			Input Impedance	About 14 kΩ
			Circuit Time Constant	About 47 µs
		Torque Reference Input	Reference Voltage *3	±3 VDC (Variable setting range: ±1 to ±10 VDC) at rated torque, input voltage: maximum ±12 V (positive torque reference with positive reference)
			Input Impedance	About 14 kΩ
			Circuit Time Constant	About 47 µs
		Contact Speed Reference	Rotation Direction Selection	With P control signal
			Speed Selection	With forward/reverse external torque limit signal (speed 1 to 3 selection), servomotor stops or another control method is used when both are OFF.
Position Control Modes	Performance	Bias Setting		0 to 450 min^{-1} (setting resolution: 1 min^{-1})
		Feed Forward Compensation		0 to 100% (setting resolution: 1%)
		Positioning Completed Width Setting		0 to 250 reference units (setting resolution: 1 reference unit)
	Input Signals	Reference Pulse	Type	Sign + pulse train, 90° phase difference 2-phase pulse train (phase A + phase B), or CCW + CW pulse train
			Form	Line driver (+5 V level), open collector (+5 V or +12 V level)
			Frequency	Maximum 500/200 kpps (line driver/open collector)
		Control Signal		Clear signal (input pulse form identical to reference pulse)
		Built-in Open Collector Power Supply *4		+12 V (1kΩ resistor built in)
I/O Signals	Position Output		Form	Phase-A, -B, -C line driver Phase-S line driver (only with an absolute encoder)
			Frequency Dividing Ratio	Any
	Sequence Input		Signal allocation can be modified.	Servo ON, P control (or Control mode switching, forward/reverse motor rotation by internal speed setting, zero clamping, reference pulse prohibited), forward run prohibited (P-OT), reverse run prohibited (N-OT), alarm reset, forward external torque limit, and reverse external torque limit (or internal speed selection)
	Sequence Output		Fixed Output	Servo alarm, 3-bit alarm codes
			Signal allocation can be modified.	Select three signals from the following: Positioning completed (speed coincidence), servomotor rotation detection, servo ready, torque limit, speed limit, brake interlock, warning, NEAR signal.

SERVOPACK Specifications and Dimensional Drawings

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Internal Functions	Dynamic Brake		Operated at main power OFF, servo alarm, servo OFF or overtravel.
	Overtravel Stop		Dynamic brake stop at P-OT or N-OT, deceleration to a stop, or coast to a stop
	Electronic Gear		$0.01 \leq B/A \leq 100$
	Protection		Overcurrent, overvoltage, low voltage, overload, regeneration error, main circuit detection section error, heat sink overheated, no power supply, overflow, overspeed, encoder error, overrun, CPU error, parameter error
	LED Display		Charge, Power, five 7-segment LEDs × 5 digits (built-in Digital Operator functions)
	CN5Analog Monitoring		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 pulses: 0.05 V/1 reference units or 0.05 V/100 reference units
	Communications	Connected Devices	Digital Operator (hand-held model), RS-422A port such as for a personal computer (RS-232C ports under certain conditions)
		1:N Communications	Up to N = 14 for RS-422A ports
		Axis Address Setting	Set with parameters.
		Functions	Status display, parameter setting, monitor display, alarm trace-back display, JOG operations, speed/torque reference signal and other drawing functions
	Others		Reverse rotation connection, zero-point search, automatic servomotor ID, DC reactor connection terminal for harmonic suppressions

* 1. Use the SERVOPACK within the surrounding air temperature range. When enclosed in a control panel, internal temperatures must not exceed the ambient temperature range.

* 2. Speed regulation is defined as follows:

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

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.

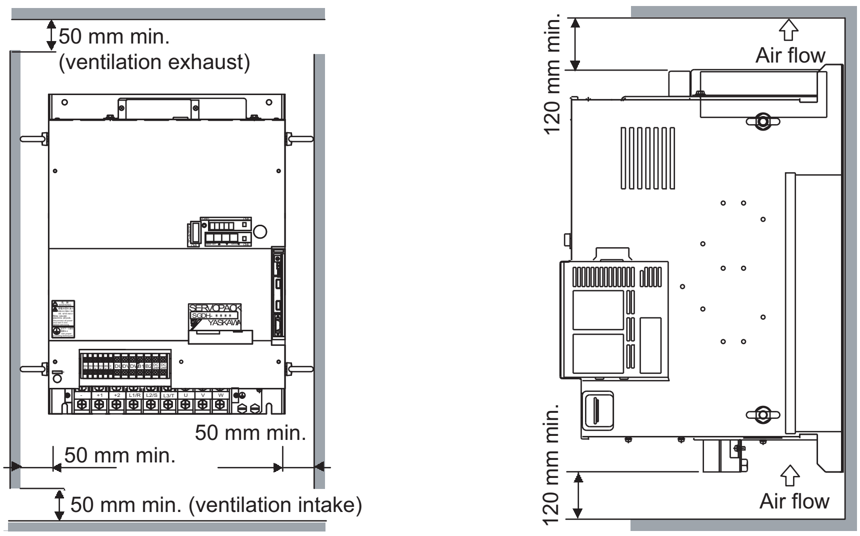
* 3. Forward is clockwise viewed from the non-load side of the servomotor. (Counterclockwise viewed from the load and shaft end)

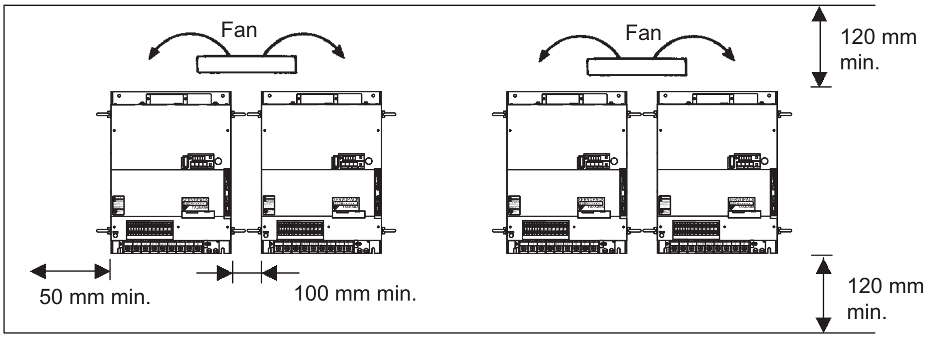
* 4. The built-in open collector power supply is not electrically insulated from the control circuit in the SERVOPACK.

4.2 SERVOPACK Installation

The SGDM/SGDH SERVOPACKs can be mounted on a base. 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 following 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.

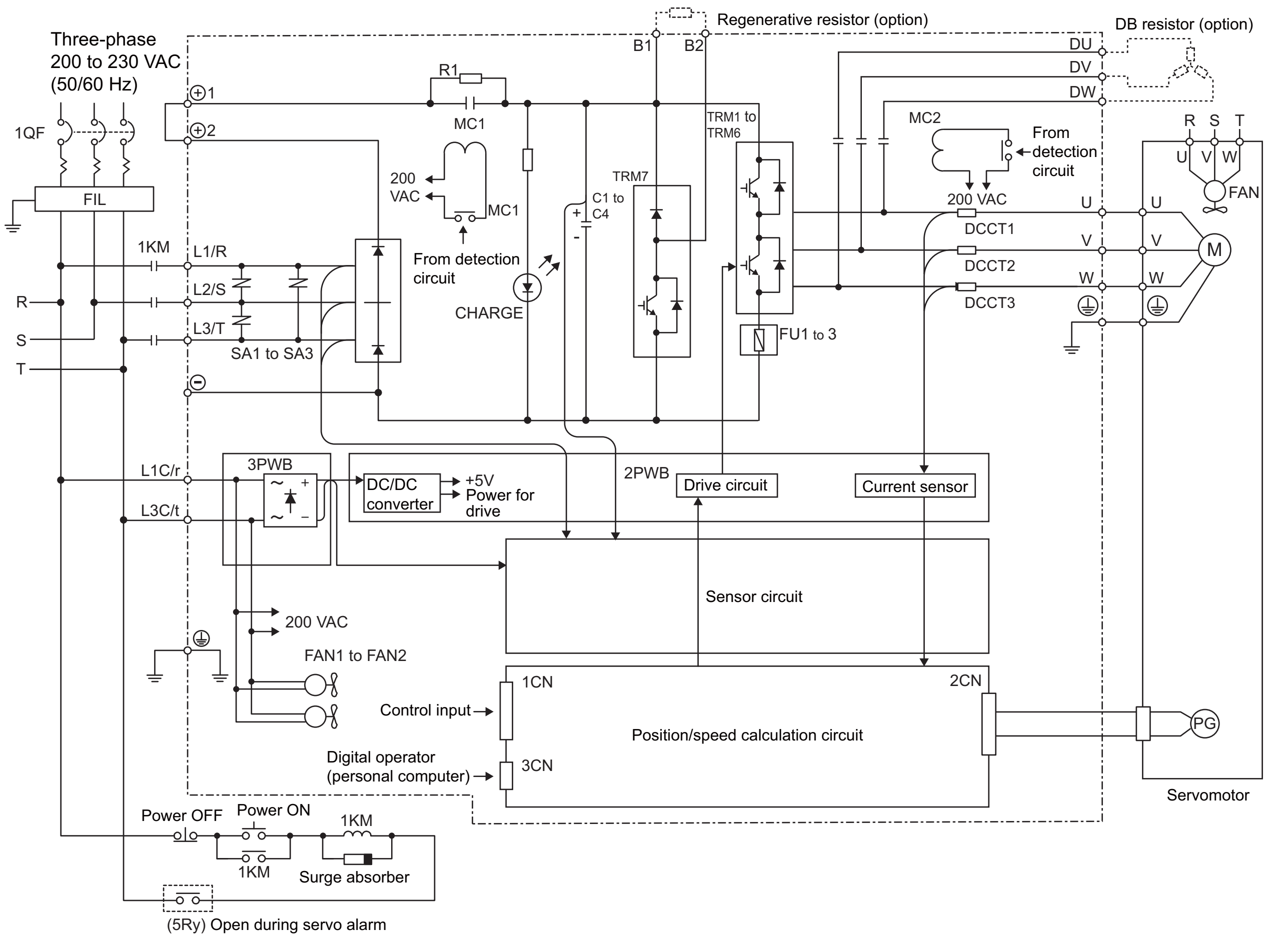
Storage	Store the SERVOPACK within the following temperature range if it is stored with the power cable disconnected. Temperature: -20 to 85°C Humidity: 90% RH or less (with no condensation)
Installation Site	Installation in a Control Panel Design the control panel size, unit layout, and cooling method 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 on 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 water, cutting oil, excessive dust, iron powder, and radioactivity in the air.
Orientation	Install the SERVOPACK perpendicular to the wall as shown in the figure. 

<table>
<tr><td>Installation</td><td>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 100 mm between and at least 120 mm above and below each SERVOPACK. Allow the space for eyebolts on both sides of the SERVOPACK.
Environmental Conditions in the Control Panel
Surrounding Air Temperature:0 to 55°C
Humidity: 90% RH or less
Vibration: 4.9 m/s^2
Condensation and Freezing: None
Surrounding Air Temperature for Long-term Reliability: 45°C or less</td></tr>
<tr><td>Voltage Resistance Test</td><td>Conduct voltage resistance tests under the following conditions.
• Voltage: 1500 Vrms AC for one minute
• Braking current: 100 mA
• Frequency: 50 or 60 Hz
• Voltage applied points
200 V series: Between the ground terminals and the point where terminals L1C/r, L3C/t, L1/R, L2/S, L3/T are connected.
400 V series: Between the ground terminals and the point where terminals 480 V, 460 V, 440 V, 400 V, 380 V, 0 V, L1/R, L2/S, L3/T are connected.</td></tr>
</table>

4.3 SERVOPACK Internal Block Diagrams

4.3.1 Three-phase 200 V, 22 kW, 30 kW Models



SERVOPACK Specifications and Dimensional Drawings

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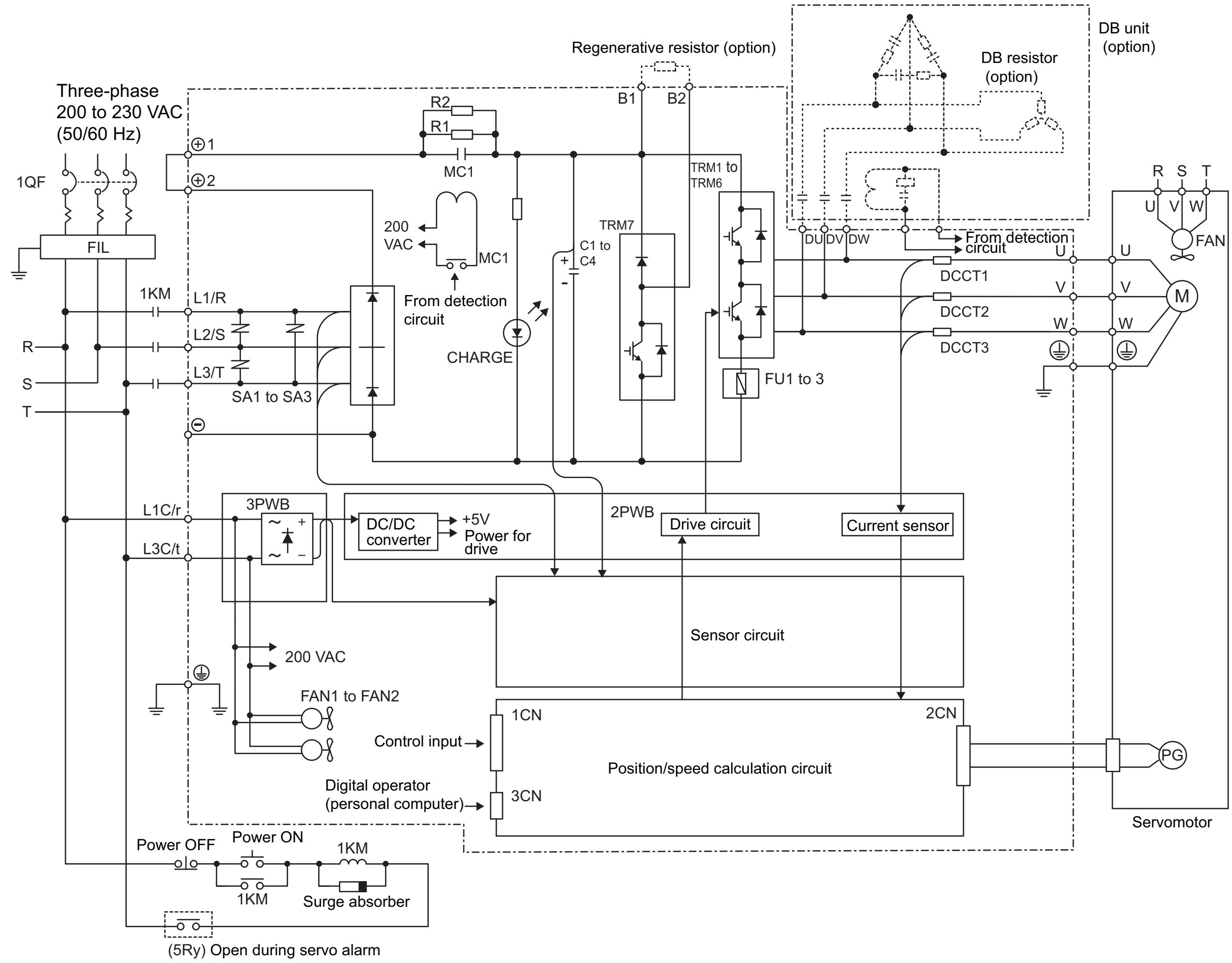
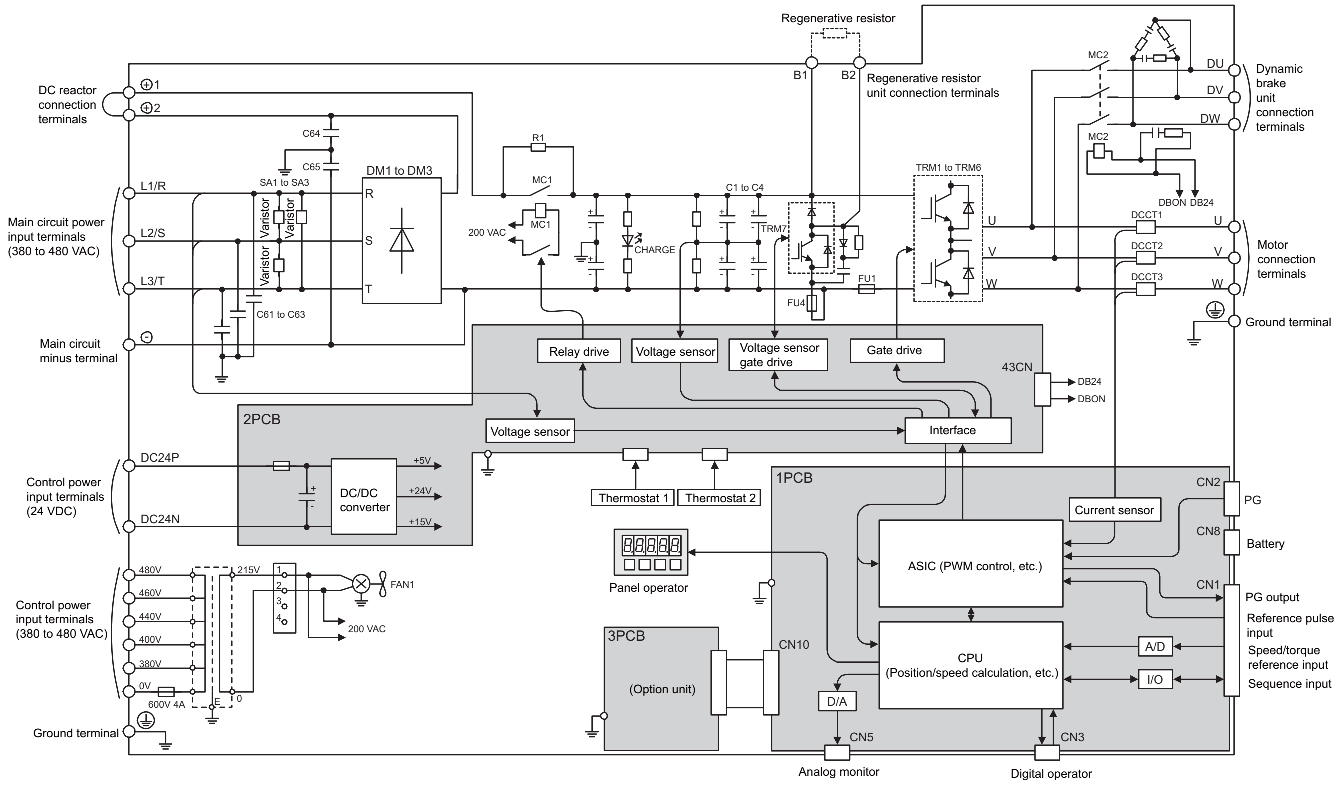
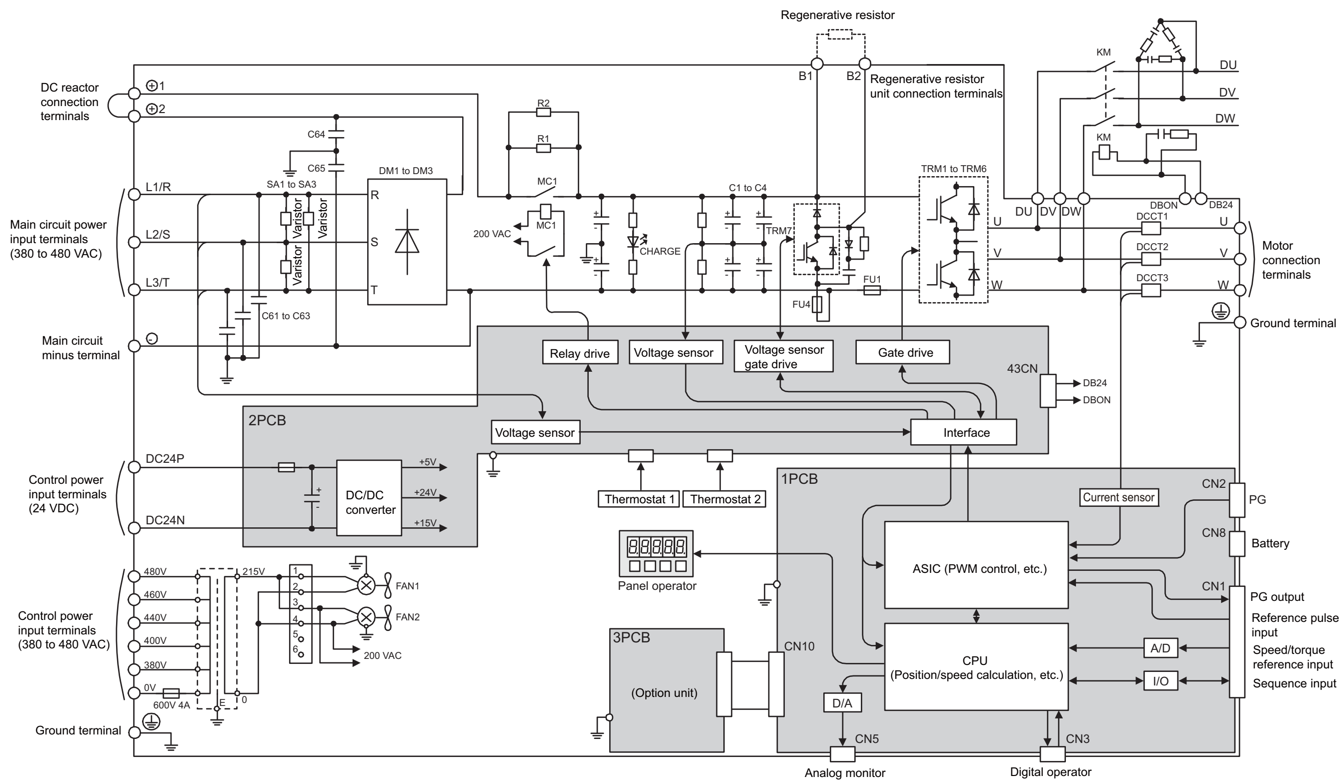
4.3.2 Three-phase 200 V, 37 kW Model



4.3.3 Three-phase 400 V, 22 kW, 30 kW Models



4.3.4 Three-phase 400 V, 37 kW Model



SERVOPACK Specifications and Dimensional Drawings

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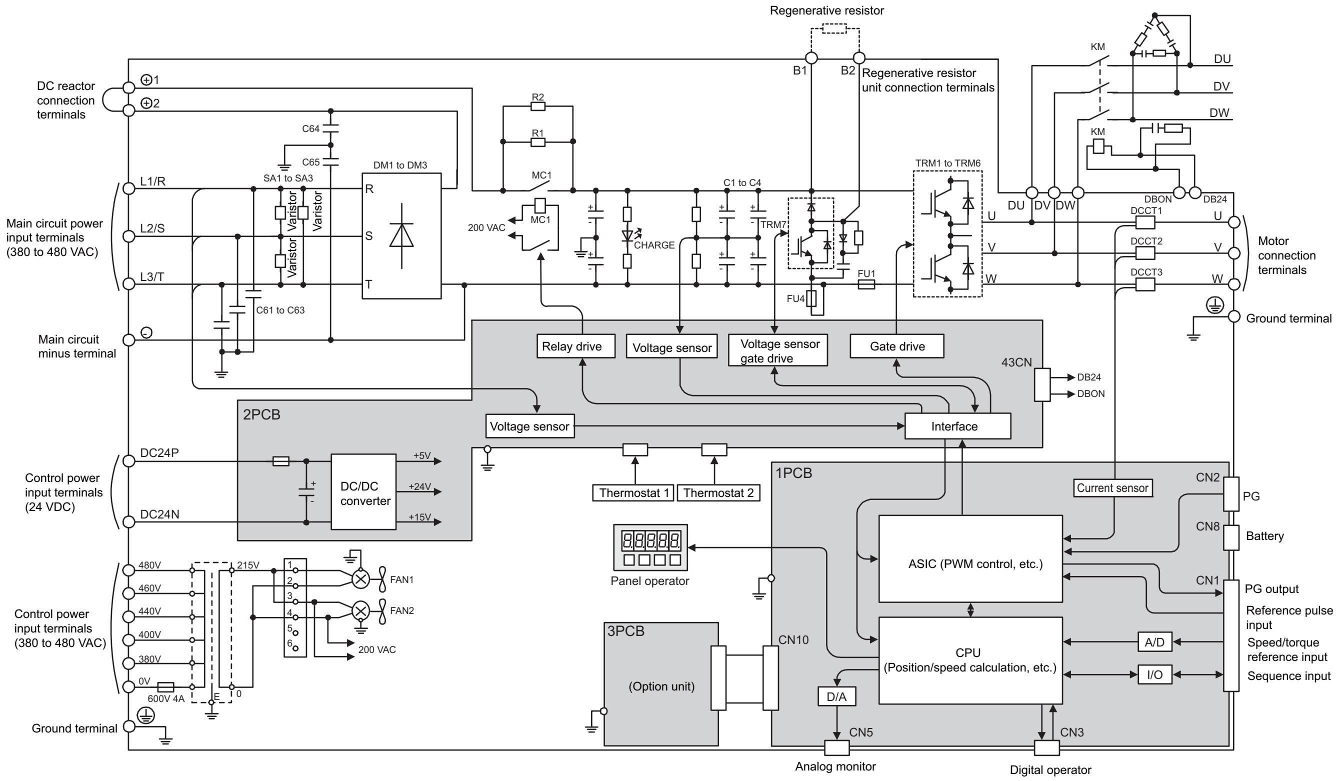
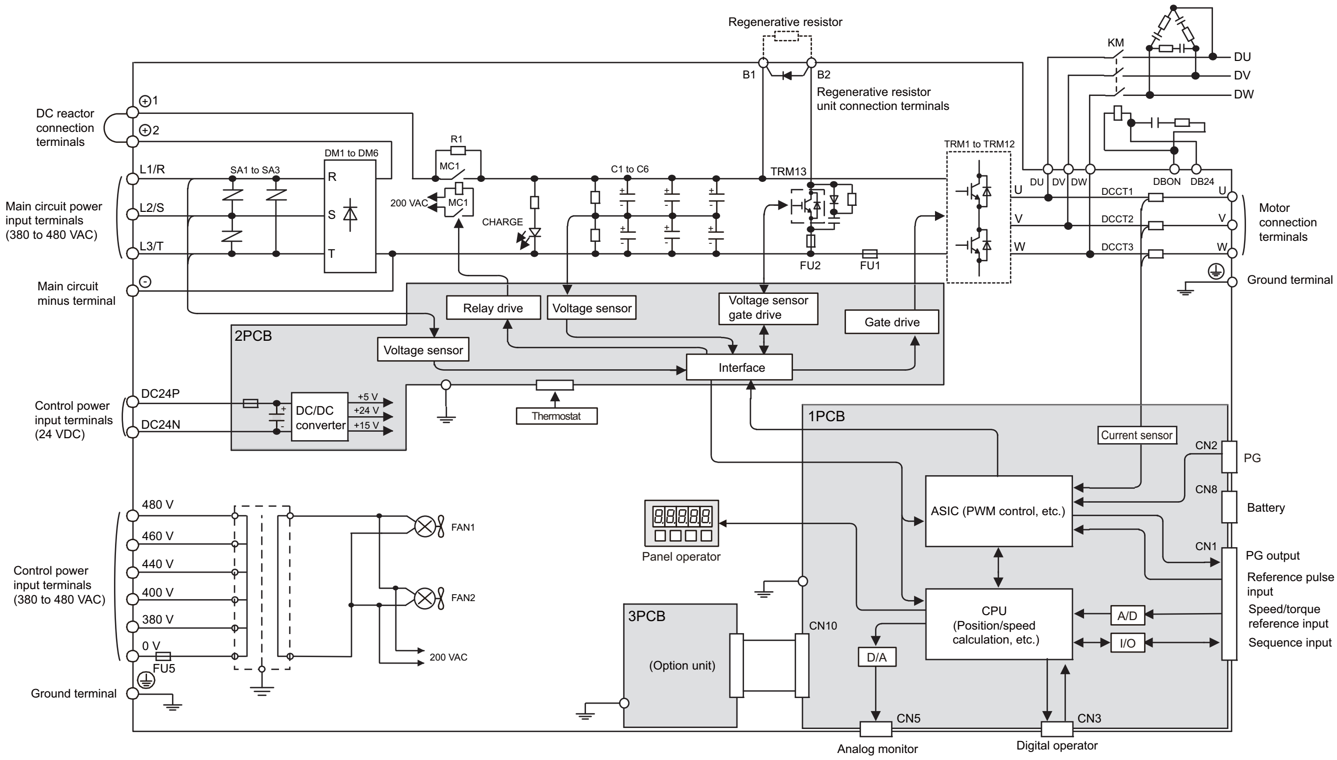
4.3.5 Three-phase 400 V, 45 kW, 55 kW Models



4.3.6 Three-phase 400 V, 90 kW Model



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.

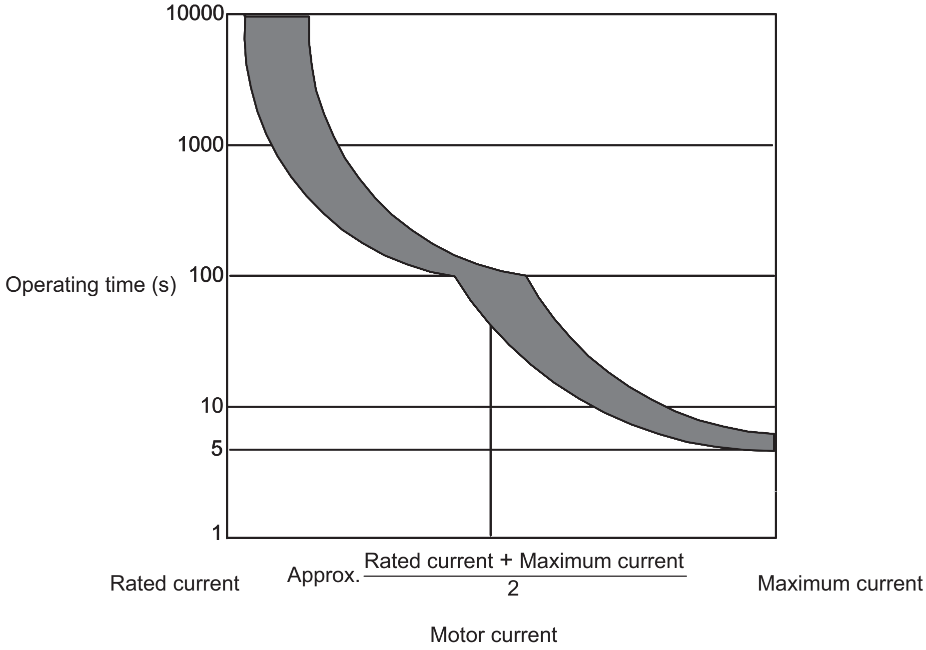
Main Circuit Power Supply	SERVOPACK Model	Output Current (Effective Value) A	Main Circuit Power Loss W	Control Circuit Power Loss W	Total Power Loss W
Three-phase 200 VAC	SGDM-2BADB	110	670	72	742
	SGDM-3ZADB	148	980		1052
	SGDM-3GADB	195	1700	120	1820
	SGDH-2BAEB	110	670	72	742
	SGDH-3ZAEB	148	980		1052
	SGDH-3GAEB	195	1700	120	1820
Three-phase 400 VAC	SGDH-2BDEB	52.2	650	120	770
	SGDH-3ZDEB	72	970		1090
	SGDH-3GDEB	90	1140		1260
	SGDH-4EDEB	127	1440		1560
	SGDH-5EDEB	150	1720		1840
	SGDH-9ZDEB	210	2500		2620

4.5 SERVOPACK Overload Characteristics and Allowable Load Moment of Inertia

4.5.1 Overload Characteristics

SERVOPACKs have a built-in overload protective function that protects the SERVOPACKs and servomotors from overload. Allowable power for the SERVOPACKs is limited by the overload protective function as shown in the figure below.

The overload detection level is set under hot start[1] conditions at a servomotor surrounding air temperature of 40°C.



TERMS

1 Hot Start

A hot start indicates that both the SERVOPACK and the servomotor have run long enough at the rated load to be thermally saturated.

4.5.2 Starting and Stopping Time

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

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

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

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

J_M: Motor rotor moment of inertia ($kg \cdot m^2$)

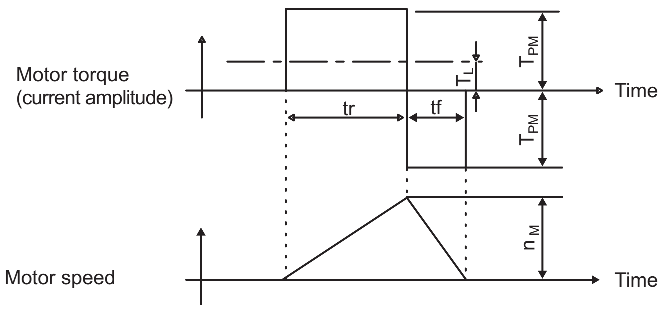
J_L: Load converted to shaft moment of inertia ($kg \cdot m^2$)

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 is limited to within 5 times the moment of inertia of each servomotor (J_M).

An overvoltage alarm is likely to occur during deceleration if the load moment of inertia exceeds the 5 times of load moment of inertia. Take one of the following steps if this occurs.

- Reduce the torque limit.
- Reduce the deceleration rate.
- Reduce the maximum motor speed.

If the alarm cannot be cleared, contact your Yaskawa Application Engineering Department.

(1) Allowable Load Moment of Inertia at the Motor Shaft

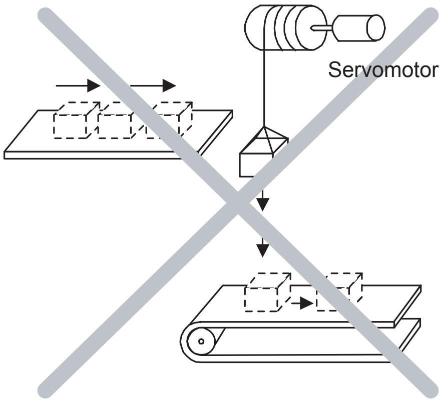
The rotor moment of inertia ratio is the value for a servomotor without a gear and a brake.

Servomotor Model		Allowable Load Moment of Inertia ($\times 10^{-4}$ kg·m^2)
1500 min^{-1} Series	SGMVH-2BA☐B	1830
	SGMVH-3ZA☐B	2490
	SGMVH-3GA☐B	2975
	SGMVH-2BD☐B	1830
	SGMVH-3ZD☐B	2490
	SGMVH-3GD☐B	2975
	SGMVH-4ED☐B	5355
	SGMVH-5ED☐B	6450
	SGMVH-7ED☐B	9020
800 min^{-1} Series	SGMVH-2BA☐D	3525
	SGMVH-3ZA☐D	6450
	SGMVH-3GA☐D	7820
	SGMVH-2BD☐D	3525
	SGMVH-3ZD☐D	6450
	SGMVH-3GD☐D	7820
	SGMVH-4ED☐D	9020

(2) Overhanging Loads

A servomotor may not be operated with an overhanging load, which tends to continuously rotate the motor. *Fig. 4.1* shows a typical example of such a load.

- DO NOT use the servomotor with the Vertical Axis Motor Drive without Counterweight



- DO NOT use the servomotor with the Feeding Motor Drive

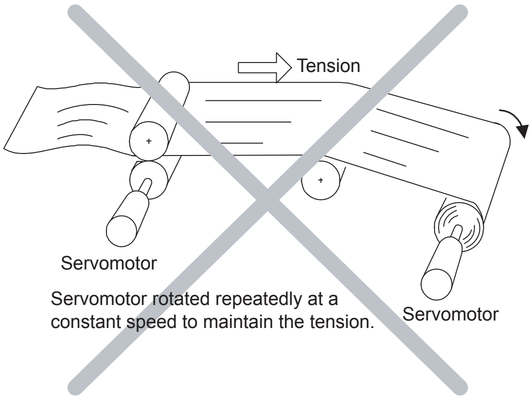


Fig. 4.1 Examples of Overhanging Loads

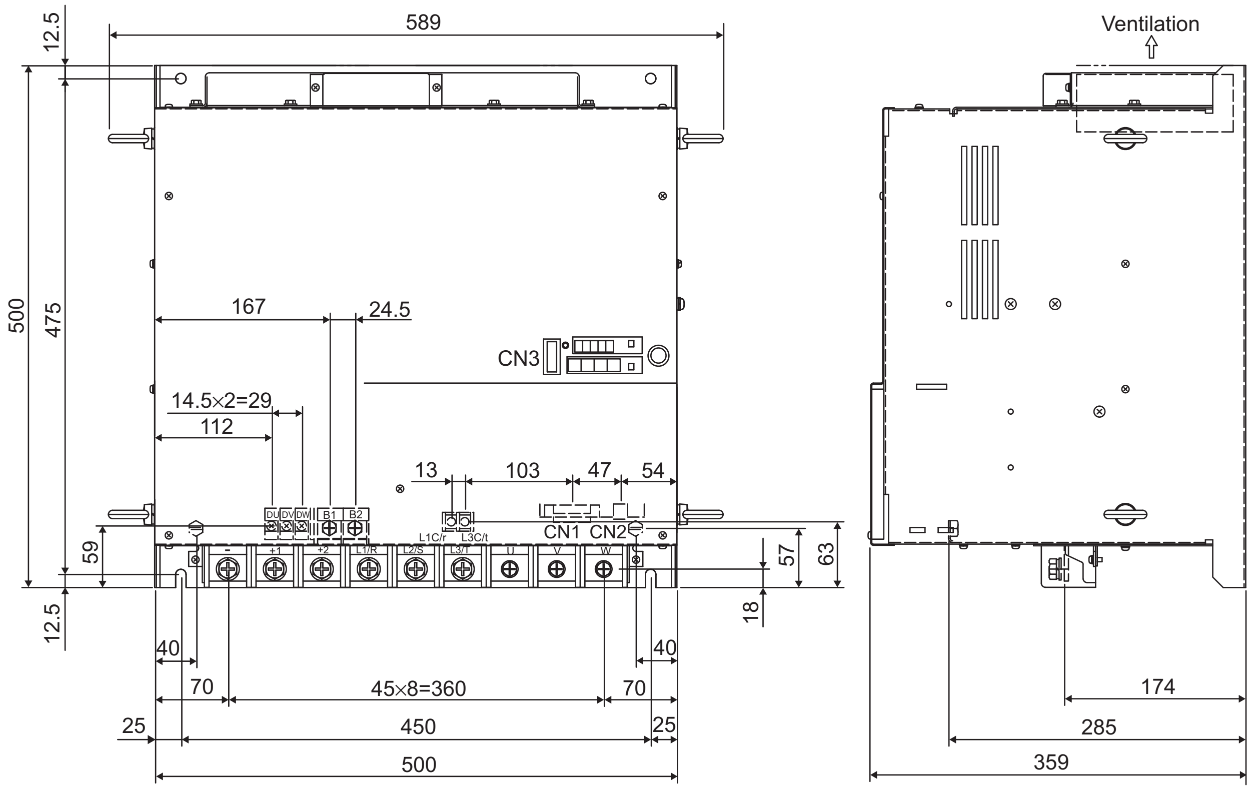
IMPORTANT

- 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 SGDH SERVOPACKs is rated for short-term operation approximately equivalent to the time it takes to decelerate to a stop.

4.6 SERVOPACK Dimensional Drawings

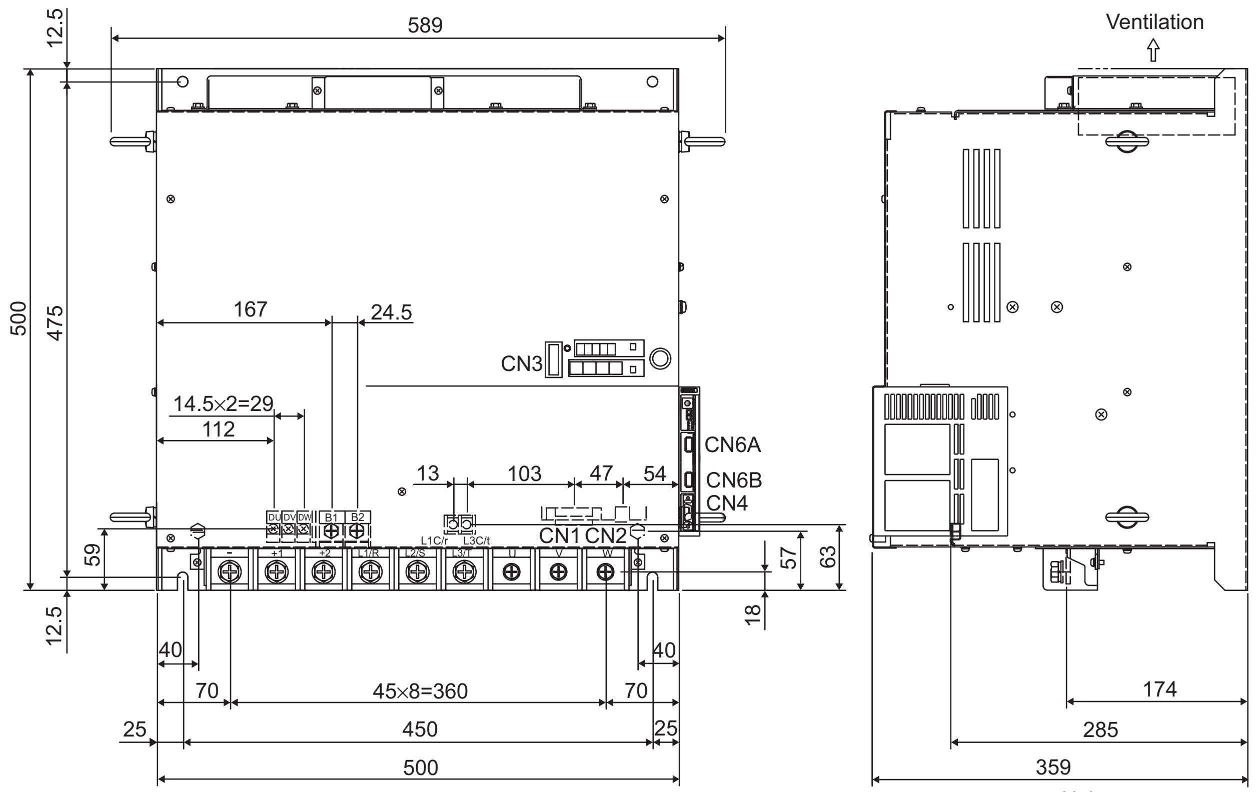
4.6.1 Three-phase 200 V, 22 kW, 30 kW Models

(1) SGDM-2BADB, -3ZADB



Units: mm
Approx.mass: 55 kg

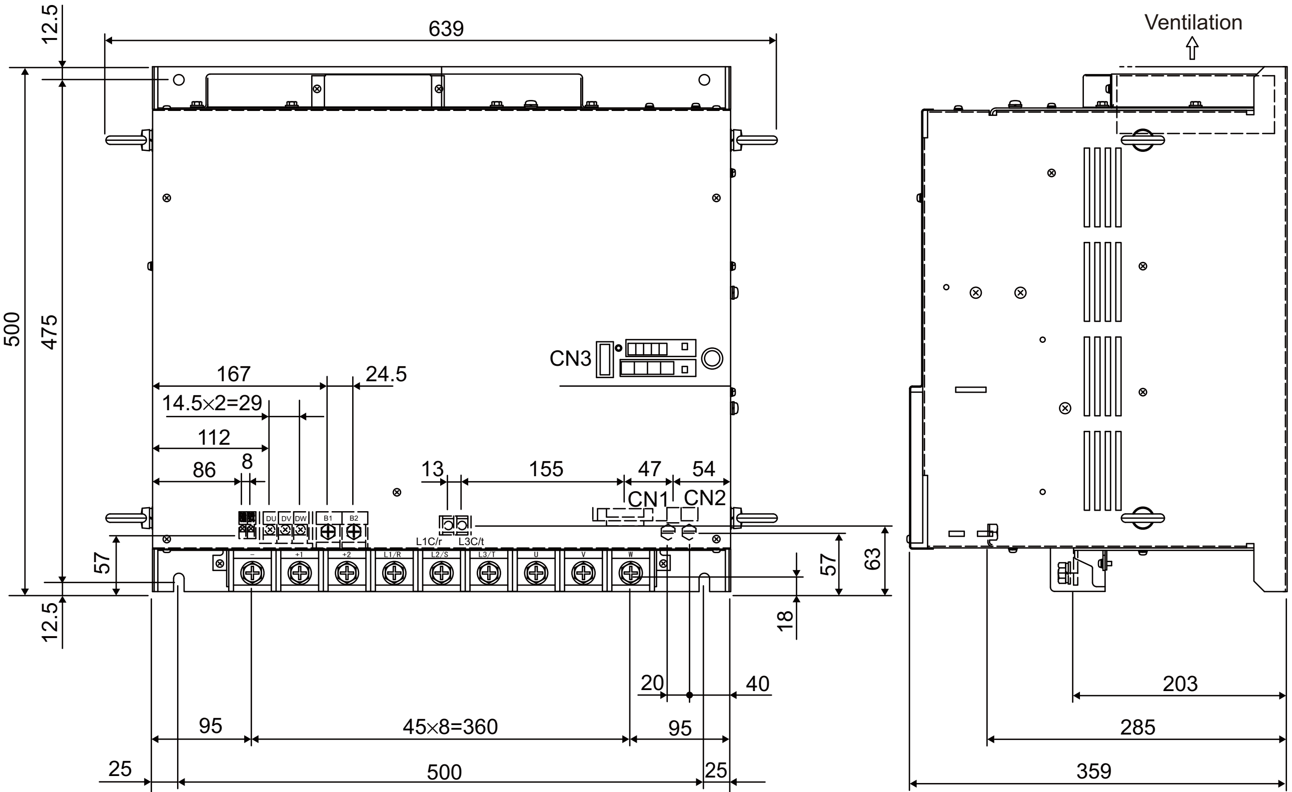
(2) SGDH-2BAEB, -3ZAEB



Units: mm
Approx.mass: 55 kg

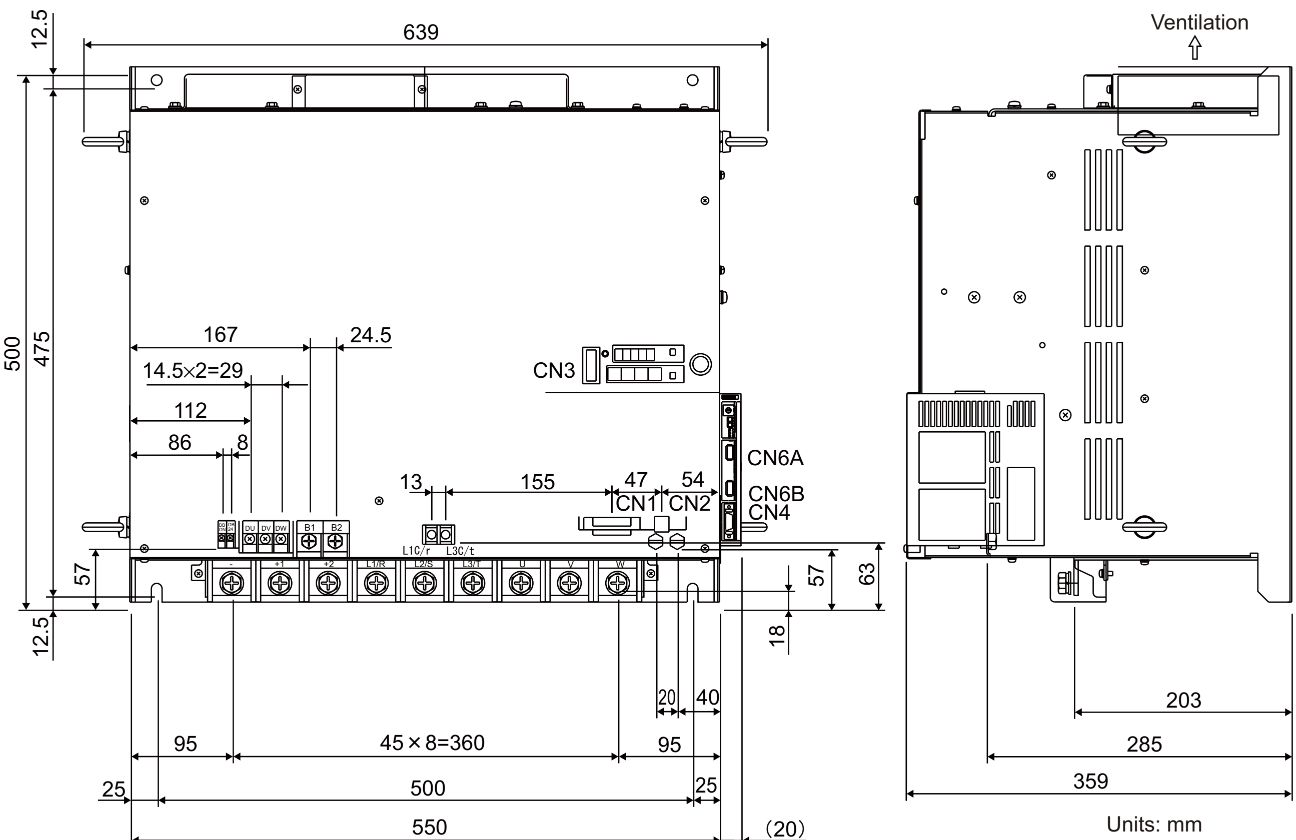
4.6.2 Three-phase 200 V, 37 kW Model

(1) SGDM-3GADB



Units: mm
Approx.mass: 60 kg

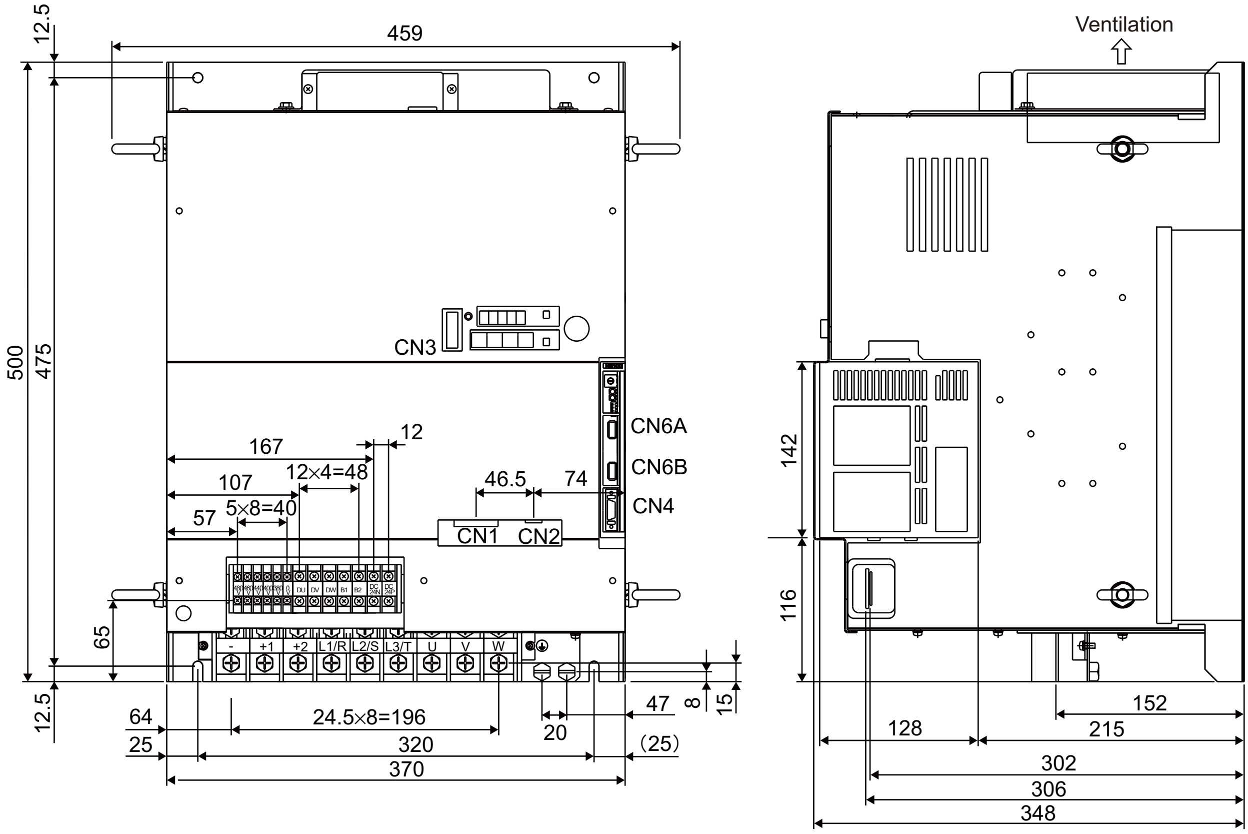
(2) SGDH-3GAEB



Units: mm
Approx.mass: 60 kg

4.6.3 Three-phase 400 V, 22 kW Model

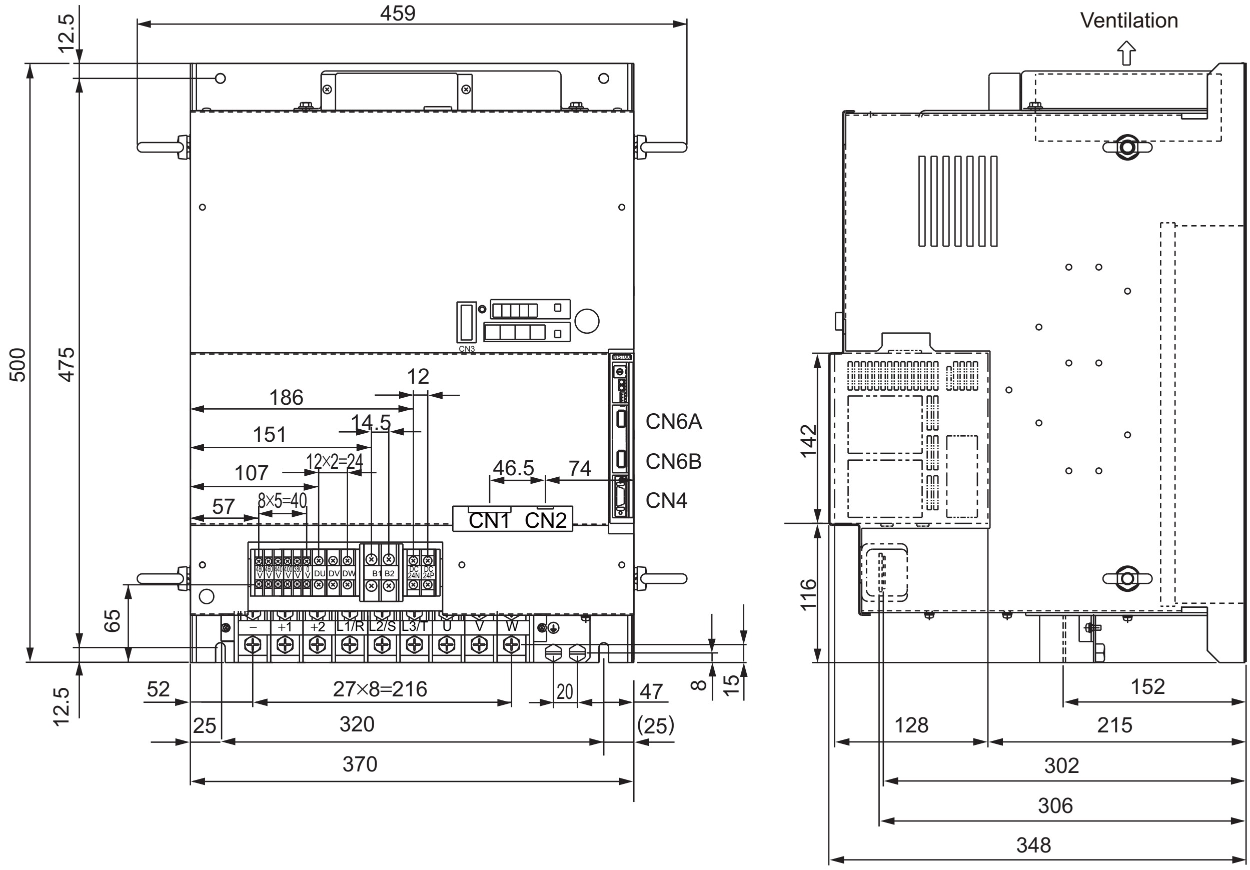
(1) SGDH-2BDEB



Units: mm
Approx.mass: 40 kg

4.6.4 Three-phase 400 V, 30 kW Model

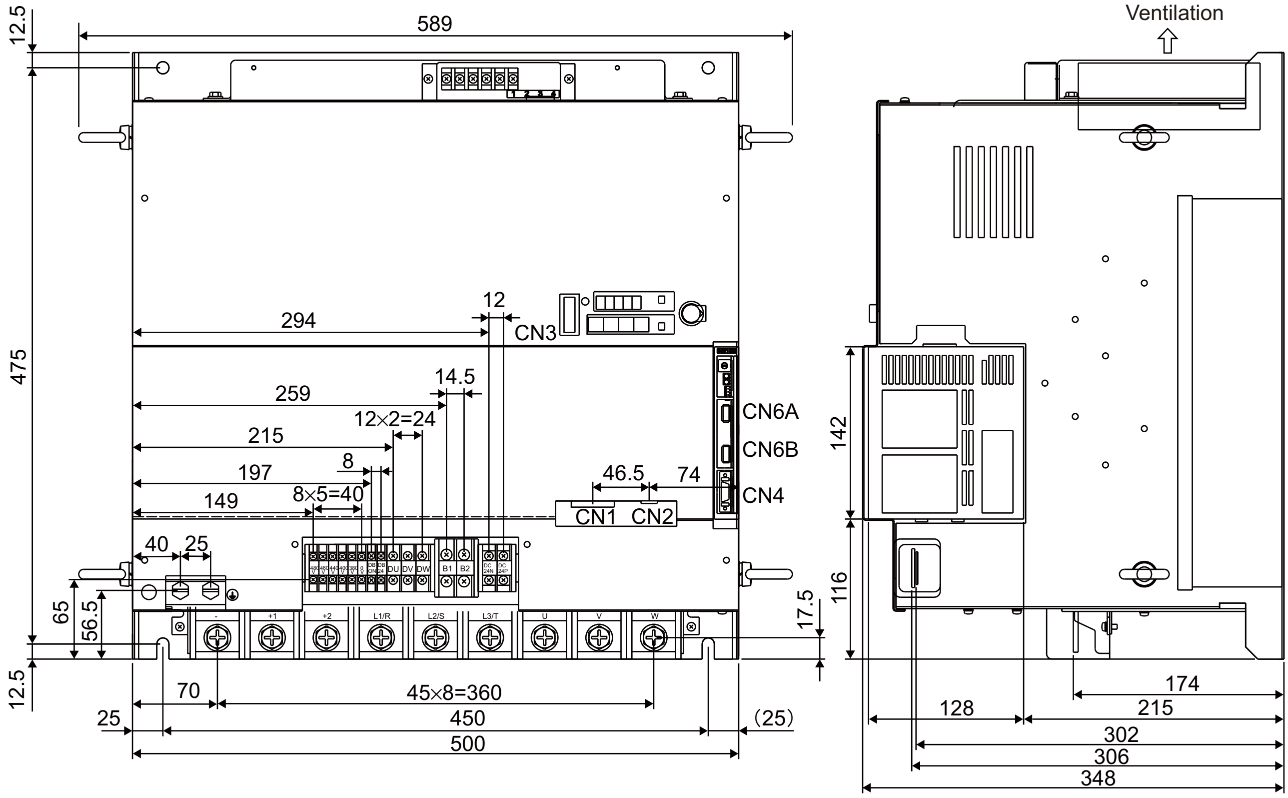
(1) SGDH-3ZDEB



Units: mm
Approx.mass: 40 kg

4.6.5 Three-phase 400 V, 37 kW Model

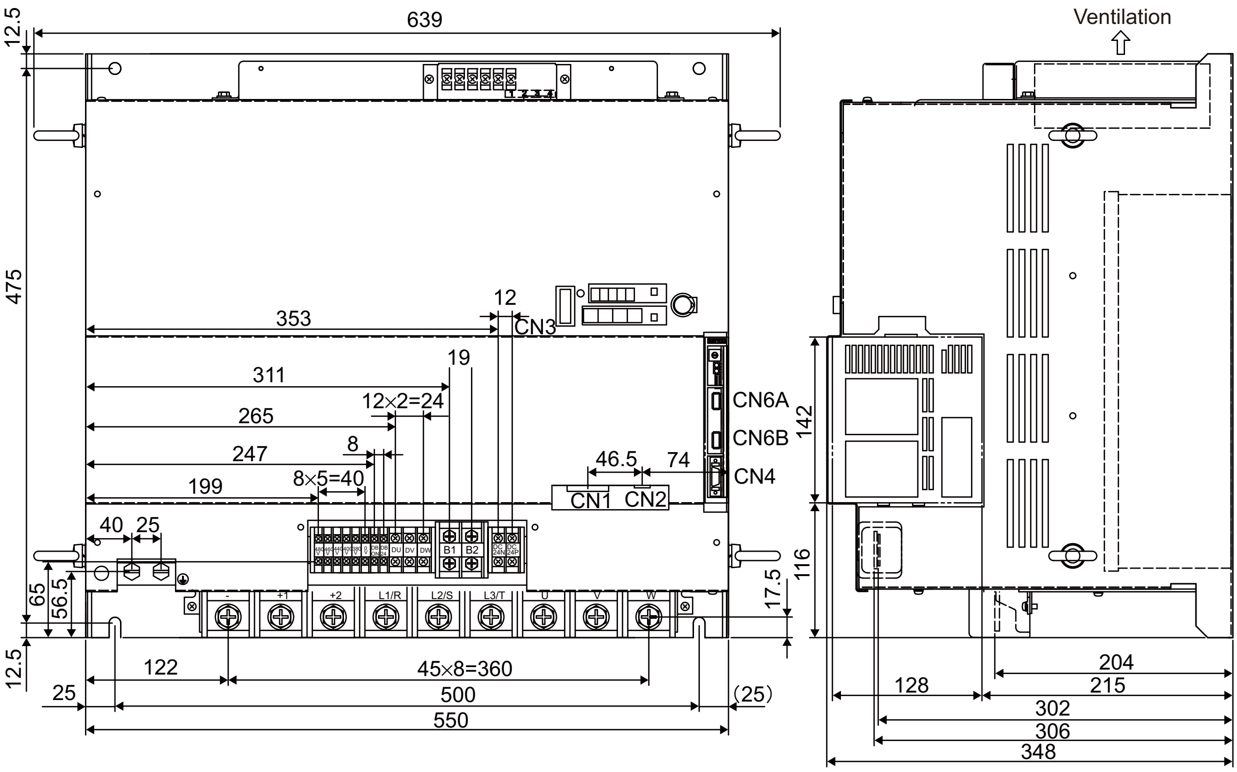
(1) SGDH-3GDEB



Units: mm
Approx.mass: 60 kg

4.6.6 Three-phase 400 V, 45 kW, 55 kW Models

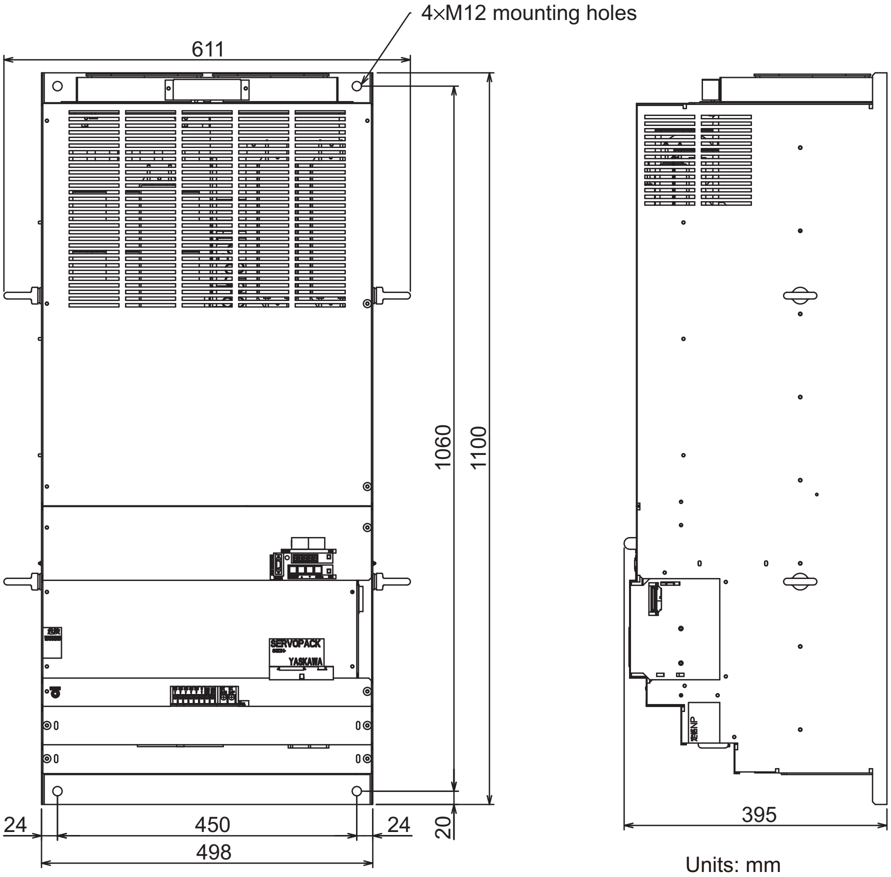
(1) SGDH-4EDEB, -5EDEB



Units: mm
Approx.mass: 65 kg

4.6.7 Three-phase 400 V, 90 kW Model

(1) SGDH-9ZDEB



Units: mm
Approx.mass: 130 kg

5

Specifications and Dimensional Drawings of Cables and Peripheral Devices

5.1 SERVOPACK Main Circuit Wire Size

IMPORTANT

1. Wire sizes were selected for three cables per bundle at 40°C surrounding air temperature with the rated current.
2. Use cable with a minimum 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 cables under high surrounding air or panel temperatures where normal vinyl cables will rapidly deteriorate.
5. Use cables within the allowable moment of inertia.
6. Do not use cables under continuous regenerative state.

5.1.1 Wiring Cables to Main Circuit Terminals

Use the following UL-certified copper cables (rated 75°C, 600 V) and round crimped terminals (UL standard compliant) when connecting cables to main circuit terminals. Crimp the terminal with the recommended crimping tool. Yaskawa recommends the crimped terminals manufactured by J.S.T. Mfg. Co., Ltd.

Cable Size mm^2 (AWG)	Terminal Screw Size	Crimped Terminal Type	Tightening Torque N·m
1.25 (16)	M3.5	R1.25-3.5	0.8 to 0.88
	M4	R1.25-4	1.2 to 1.5
2 (14)	M4	R2-4	1.2 to 1.5
	M5	R2-5	2.0 to 2.5
3.5/5.5 (12/10)	M4	R5.5-4	1.2 to 1.5
	M5	R5.5-5	2.0 to 2.5
	M6	R5.5-6	4.0 to 4.6
8 (8)	M4	8-4	1.2 to 1.5
	M5	R8-5	2.0 to 2.5
14 (6)	M5	R14-5	2.0 to 2.5
	M8	R14-8	9.0 to 11.0
22 (4)	M6	R22-6	4.0 to 4.6
	M8	R22-8	9.0 to 11.0
	M10	R22-10	17.5 to 20.5
30/38 (3/2)	M6	38-6	4.0 to 4.6
	M8	R38-8	9.0 to 11.0
	M10	R38-10	17.5 to 20.5
50/60 (1/0/2/0)	M8	R60-8	9.0 to 11.0
	M10	R60-10	17.5 to 20.5
80 (3/0)	M10	R80-10	17.5 to 20.5

5.1.2 Three-phase 200 V

SERVOPACK Model SGDM-☐☐ADB SGDH-☐☐AEB	Terminal Symbol	Terminal Screw Size	Tightening Torque N·m	Applicable Cable Range mm^2 (AWG)	Recommended Cable Size mm^2 (AWG)
2B	L1/R, L2/S, L3/T -, +1, +2	M10	17.5 to 20.5	30 to 80 (3 to 3/0)	30 (3)
	U, V, W	M8	9.0 to 11.0	30 to 60 (3 to 2/0)	38 (2)
	L1C/r, L3C/t	M4	1.2 to 1.5	0.75 to 2 (18 to 14)	1.25 (16)
	B1, B2	M8	9.0 to 11.0	14 to 38 (6 to 2)	14 (6)
	DU, DV, DW	M5	2.0 to 2.5	3.5 to 8 (12 to 8)	3.5 (12)
	⏚	M8	9.0 to 11.0	30 to 60 (3 to 2/0)	38 (2)
3Z	L1/R, L2/S, L3/T -, +1, +2	M10	17.5 to 20.5	30 to 80 (3 to 3/0)	50 (1/0)
	U, V, W	M8	9.0 to 11.0	30 to 60 (3 to 2/0)	60 (2/0)
	L1C/r, L3C/t	M4	1.2 to 1.5	0.75 to 2 (18 to 14)	1.25 (16)
	B1, B2	M8	9.0 to 11.0	14 to 38 (6 to 2)	14 (6)
	DU, DV, DW	M5	2.0 to 2.5	3.5 to 8 (12 to 8)	3.5 (12)
	⏚	M8	9.0 to 11.0	30 to 60 (3 to 2/0)	60 (2/0)
3G	L1/R, L2/S, L3/T -, +1, +2	M10	17.5 to 20.5	30 to 80 (3 to 3/0)	60 (2/0)
	U, V, W	M10	17.5 to 20.5	30 to 80 (3 to 3/0)	80 (3/0)
	L1C/r, L3C/t	M4	1.2 to 1.5	0.75 to 2 (18 to 14)	1.25 (16)
	B1, B2	M8	9.0 to 11.0	14 to 38 (6 to 2)	22 (4)
	DU, DV, DW	M5	2.0 to 2.5	3.5 to 8 (12 to 8)	5.5 (10)
	DBON, DB24	M3.5	0.8 to 0.88	0.75 to 2 (18 to 14)	1.25 (16)
	⏚	M8	9.0 to 11.0	30 to 60 (3 to 2/0)	60 (2/0)

5.1.3 Three-phase 400 V

SERVOPACK Model SGDH-□□DEB	Terminal Symbol	Terminal Screw Size	Tightening Torque N·m	Applicable Cable Range mm^2 (AWG)	Recommended Cable Size mm^2 (AWG)
2B	L1/R, L2/S, L3/T -, +1, +2	M8	9.0 to 11.0	14 to 38 (6 to 2)	14 (6)
	U, V, W	M8	9.0 to 11.0	14 to 38 (6 to 2)	14 (6)
	DC24P, DC24N	M4	1.2 to 1.5	0.75 to 2 (18 to 14)	1.25 (16)
	B1, B2	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	5.5 (10)
	0 V, 380 V, 400 V 440 V, 460 V, 480 V	M3.5	0.8 to 0.88	0.75 to 2 (18 to 14)	1.25 (16)
	DU, DV, DW	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)
	⏚	M8	9.0 to 11.0	14 to 38 (6 to 2)	14 (6)
3Z	L1/R, L2/S, L3/T -, +1, +2	M8	9.0 to 11.0	14 to 38 (6 to 2)	14 (6)
	U, V, W	M8	9.0 to 11.0	14 to 38 (6 to 2)	22 (4)
	DC24P, DC24N	M4	1.2 to 1.5	0.75 to 2 (18 to 14)	1.25 (16)
	B1, B2	M5	2.0 to 2.5	8 to 14 (8 to 6)	8 (8)
	0 V, 380 V, 400 V 440 V, 460 V, 480 V	M3.5	0.8 to 0.88	0.75 to 2 (18 to 14)	1.25 (16)
	DU, DV, DW	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)
	⏚	M8	9.0 to 11.0	22 to 38 (4 to 2)	22 (4)
3G	L1/R, L2/S, L3/T -, +1, +2	M10	17.5 to 20.5	22 to 80 (4 to 3/0)	22 (4)
	U, V, W	M10	17.5 to 20.5	30 to 80 (3 to 3/0)	30 (3)
	DC24P, DC24N	M4	1.2 to 1.5	0.75 to 2 (18 to 14)	1.25 (16)
	B1, B2	M5	2.0 to 2.5	8 to 14 (8 to 6)	8 (8)
	0 V, 380 V, 400 V 440 V, 460 V, 480 V	M3.5	0.8 to 0.88	0.75 to 2 (18 to 14)	1.25 (16)
	DU, DV, DW	M5	1.2 to 1.5	0.75 to 5.5 (18 to 10)	3.5 (12)
	DBON, DB24	M3.5	0.8 to 0.88	0.75 to 2 (18 to 14)	1.25 (16)
	⏚	M8	9.0 to 11.0	30 to 38 (3 to 2)	30 (3)

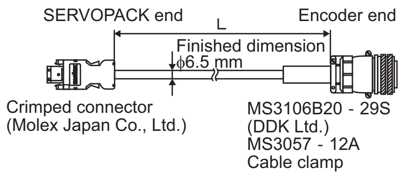
SERVOPACK Model SGDH-□□DEB	Terminal Symbol	Terminal Screw Size	Tightening Torque N·m	Applicable Cable Range mm^2 (AWG)	Recommended Cable Size mm^2 (AWG)
4E	L1/R, L2/S, L3/T -, +1, +2	M10	17.5 to 20.5	30 to 80 (3 to 3/0)	30 (3)
	U, V, W	M10	17.5 to 20.5	30 to 80 (3 to 3/0)	38 (2)
	DC24P, DC24N	M4	1.2 to 1.5	0.75 to 2 (18 to 14)	1.25 (16)
	B1, B2	M6	4.0 to 4.6	14 to 22 (6 to 4)	14 (6)
	0 V, 380 V, 400 V 440 V, 460 V, 480 V	M3.5	0.8 to 0.88	0.75 to 2 (18 to 14)	1.25 (16)
	DU, DV, DW	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	3.5 (12)
	DBON, DV24	M3.5	0.8 to 0.88	0.75 to 2 (18 to 14)	1.25 (16)
	⏚	M8	9.0 to 11.0	38 to 50 (2 to 1/0)	38 (2)
5E	L1/R, L2/S, L3/T -, +1, +2	M10	17.5 to 20.5	30 to 80 (3 to 3/0)	38 (2)
	U, V, W	M10	17.5 to 20.5	30 to 80 (3 to 3/0)	50 (1/0)
	DC24P, DC24N	M4	1.2 to 1.5	0.75 to 2 (18 to 14)	1.25 (16)
	B1, B2	M6	4.0 to 4.6	14 to 22 (6 to 4)	14 (6)
	0 V, 380 V, 400 V 440 V, 460 V, 480 V	M3.5	0.8 to 0.88	0.75 to 2 (18 to 14)	1.25 (16)
	DU, DV, DW	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	3.5 (12)
	DBON, DB24	M3.5	0.8 to 0.88	0.75 to 2 (18 to 14)	1.25 (16)
	⏚	M8	9.0 to 11.0	50 to 60 (1/0 to 2/0)	50 (1/0)
9Z	L1/R, L2/S, L3/T -, +1, +2	M10	17.5 to 20.5	30 to 80 (6 to 3/0)	80 (3/0)
	U, V, W	M10	17.5 to 20.5	30 to 80 (6 to 3/0)	50 (1/0)
	DC24P, DC24N	M4	1.2 to 1.5	0.75 to 2 (18 to 14)	1.25 (16)
	B1, B2	M8	9.0 to 11.0	30 to 50 (3 to 1/0)	30 (3)
	0 V, 380 V, 400 V 440 V, 460 V, 480 V	M3.5	0.8 to 0.88	0.75 to 2 (18 to 14)	1.25 (16)
	DU, DV, DW	M6	4.0 to 4.6	5.5 to 14 (10 to 6)	5.5 (10)
	DBON, DB24	M3.5	0.8 to 0.88	0.75 to 2 (18 to 14)	1.25 (16)
	⏚	M8	9.0 to 11.0	50 to 60 (1/0 to 2/0)	50 (1/0)

5.2 Encoder Cables for CN2 Connector

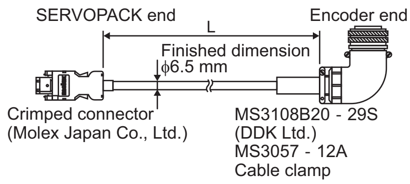
When assembling the encoder cable, refer to *5.3 Connectors and Cables for Encoder Signals.*

5.2.1 Encoder Cable with Connectors on Both Ends

(1) Cable With a SERVOPACK Connector and Encoder Straight Plug

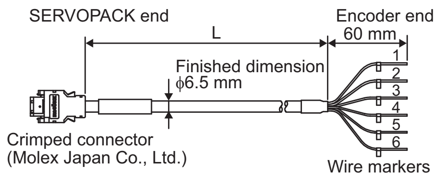
Cable Type	Cable Length (L)	Dimensional Drawing
JZSP-CMP21-03	3 m	
JZSP-CMP21-05	5 m	
JZSP-CMP21-10	10 m	
JZSP-CMP21-15	15 m	
JZSP-CMP21-20	20 m	

(2) Cable With a SERVOPACK Connector and Encoder L-shaped Plug

Cable Type	Cable Length (L)	Dimensional Drawing
JZSP-CMP22-03	3 m	
JZSP-CMP22-05	5 m	
JZSP-CMP22-10	10 m	
JZSP-CMP22-15	15 m	
JZSP-CMP22-20	20 m	

5.2.2 Cable with Loose Wire at Encoder End

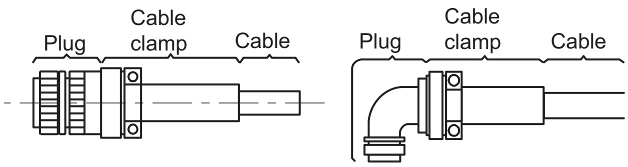
(1) Cable Type

Cable Type	Cable Length (L)	Dimensional Drawing
JZSP-CMP23-03	3 m	
JZSP-CMP23-05	5 m	
JZSP-CMP23-10	10 m	
JZSP-CMP23-15	15 m	
JZSP-CMP23-20	20 m	

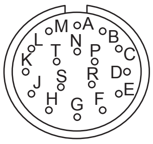
(2) Encoder-end Connector

Contact Yaskawa Controls Co., Ltd.

Connector on Servomotor	Plug (Manufactured by DDK Ltd.)		Cable Clamp (Manufactured by DDK Ltd.)
	Type	Model	
MS3102A20-29P	Straight	MS3106B20-29S	MS3057-12A
	L-shaped	MS3108B20-29S	



(3) Encoder Plug Connector Pin Arrangement



Absolute Encoder Connection Specifications

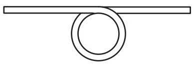
Pin No.	Signal	Lead Color
A	–	–
B	–	–
C	PS	Blue
D	/PS	White/blue
E	–	–
F	–	–
G	PG0V	Inner shield
H	PG5V	Red
J	FG (Frame ground)	Outer shield
K	–	–
L	–	–
M	–	–
N	–	–
P	–	–
R	–	–
S	BAT(–)	White/orange
T	BAT(+)	Orange

Incremental Encoder Connection Specifications

Pin No.	Signal	Lead Color
A	–	–
B	–	–
C	PS	Blue
D	/PS	White/blue
E	–	–
F	–	–
G	PG0V	Inner shield
H	PG5V	Red
J	FG (Frame ground)	Outer shield
K	–	–
L	–	–
M	–	–
N	–	–
P	–	–
R	–	–
S	–	–
T	–	–

5.3 Connectors and Cables for Encoder Signals

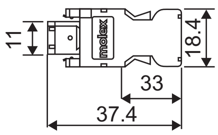
(1) Cable Type



Cable Type	Cable Length
JZSP-CMP29-05	5 m
JZSP-CMP29-10	10 m
JZSP-CMP29-15	15 m
JZSP-CMP29-20	20 m
JZSP-CMP29-30	30 m
JZSP-CMP29-40	40 m
JZSP-CMP29-50	50 m

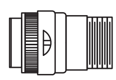
(2) SERVOPACK-end Connector for CN2

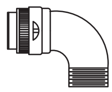
Units: mm

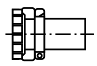
Model	Manufacturer	Dimensional Drawing
JZSP-CMP9-1	Molex Japan Co., Ltd.	Plug connector (Soldered) 

(3) Encoder-end Connector

Connector on Servomotor	Encoder-end Connector Type		
	Straight Plug *	L-shaped Plug *	Cable Clamp *
MS3102A20-29P	MS3106B20-29S	MS3108B20-29S	MS3057-12A

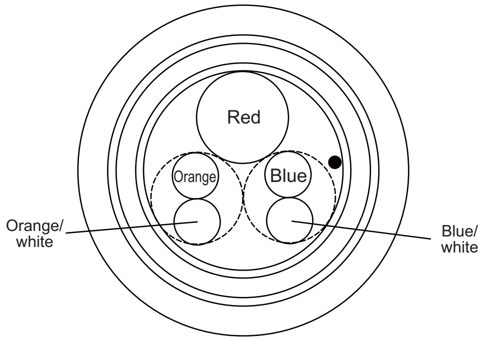




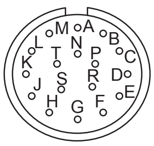


* Manufactured by DDK Ltd.

(4) Encoder Cable Specifications

Cable Type	JZSP-CMP29-□□
Basic Specifications	T/20276-SP (SP) AWG26 × 2P, AWG16 × 1P
Finished Dimension	ϕ7.0 mm
Internal Configuration and Lead Colors	
Yaskawa Standard Specifications (Standard Length)	5 m, 10 m, 15 m, 20 m, 30 m, 40 m, 50 m

(5) Encoder Plug Connector Pin Arrangement



Absolute Encoder Connection Specifications

Pin No.	Signal	Lead Color
A	–	–
B	–	–
C	PS	Blue
D	/PS	White/blue
E	–	–
F	–	–
G	PG0V	Inner shield
H	PG5V	Red
J	FG (Frame ground)	Outer shield
K	–	–
L	–	–
M	–	–
N	–	–
P	–	–
R	–	–
S	BAT(–)	White/orange
T	BAT(+)	Orange

Incremental Encoder Connection Specifications

Pin No.	Signal	Lead Color
A	–	–
B	–	–
C	PS	Blue
D	/PS	White/blue
E	–	–
F	–	–
G	PG0V	Inner shield
H	PG5V	Red
J	FG (Frame ground)	Outer shield
K	–	–
L	–	–
M	–	–
N	–	–
P	–	–
R	–	–
S	–	–
T	–	–

5.4 I/O Signal Cables for CN1 Connector

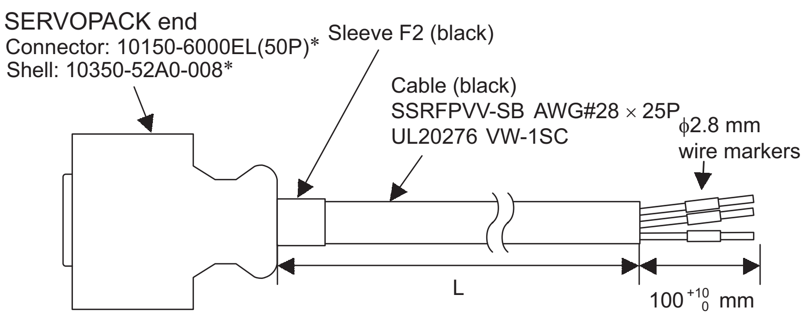
5.4.1 Standard Cables

For the connection diagram, refer to *5.4.3 Connection Diagram*.

(1) Cable Types

Cable Type	Cable Length (L)
JZSP-CKI01-1	1 m
JZSP-CKI01-2	2 m
JZSP-CKI01-3	3 m

(2) Dimensional Drawing



* Manufactured by Sumitomo 3M Ltd.

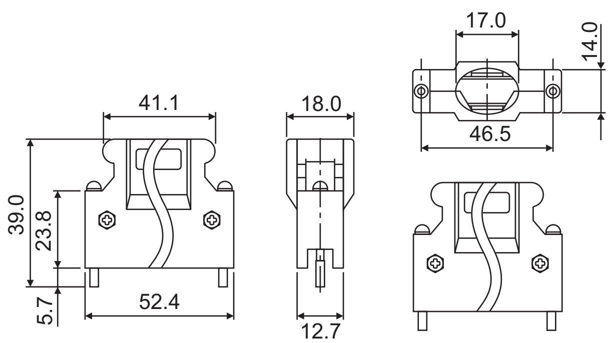
5.4.2 Connector Type and Cable Size

Use the following connector and wire when assembling the cable. The CN1 connector includes a set of case and a connector.

Connector Type	Case		Connector	
	Type	Qty	Type	Qty
JZSP-CKI9	10350-52A0-008*	1 set	10150-3000VE*	1

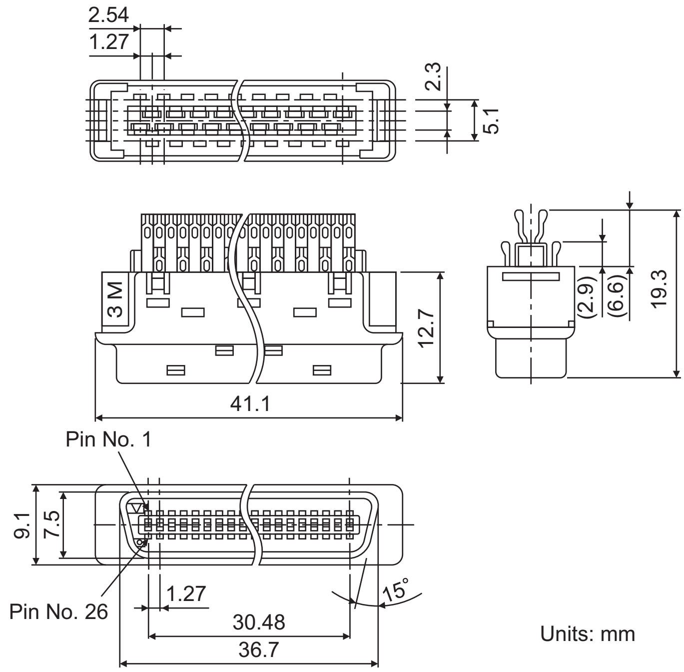
* Manufactured by Sumitomo 3M Ltd.

(1) Dimensional Drawing of Case



Units: mm

(2) Dimensional Drawing of Connector



Units: mm

(3) Cable Size

Item	Specifications
Cable	Use twisted-pair or twisted-pair shielded wire.
Applicable Wires	AWG24, 26, 28, 30
Finished Dimension	ϕ16 mm or less

Specifications and Dimensional Drawings of Cables and Peripheral Devices

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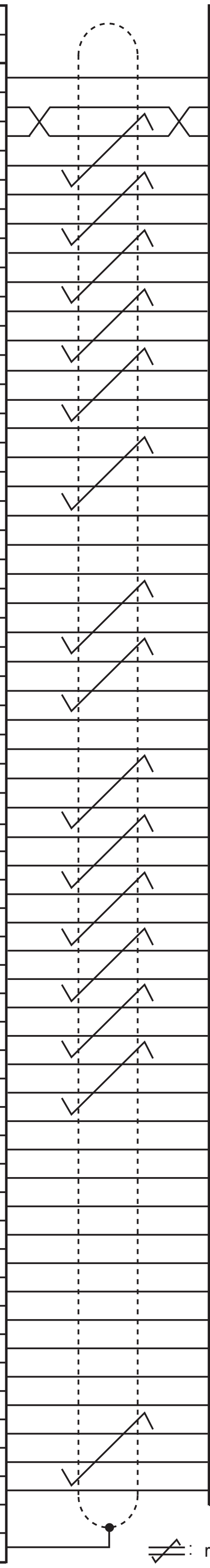
5.4.3 Connection Diagram

SERVOPACK end | Host controller end

Pin No.	Signal	Lead Color	Marking Color	Marking Dots	Host controller end: Lead Marker No.
1	SG	Orange	Red	1	1
2	SG	Gray	Red	1	2
3	PL1	Orange	Black	1	3
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	PL2	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	PL3	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	/TGON-	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	+24VIN	Yellow	Red	5	47
48	PSO	Pink	Red	5	48
49	/PSO	Pink	Black	5	49
50	–	Yellow	Black	5	50
Case	Shield				



: represents twisted-pair wires.

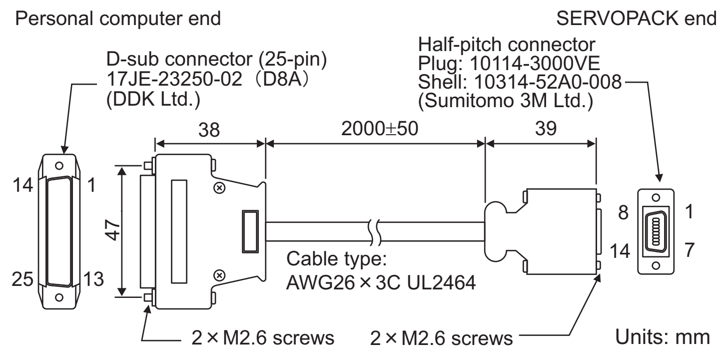
5.5 Peripheral Devices

5.5.1 Cables for Connecting Personal Computers

(1) For 25-pin Connector Cable for NEC PC-98 Series PC

(a) Cable Type: JZSP-CMS01

(b) Dimensional Drawing



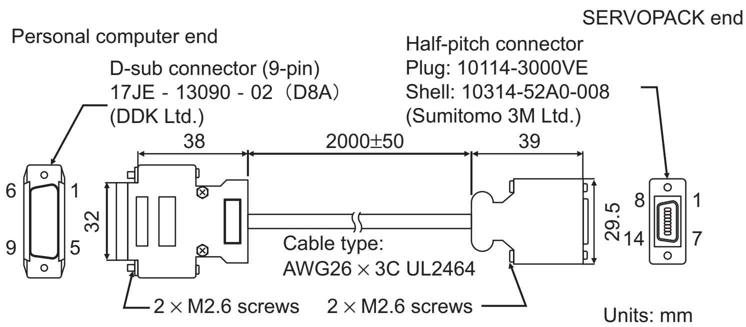
Personal computer end Signal	Pin No.	SERVOPACK end Pin No.	Signal
RXD	3	2	/TXD
TXD	2	4	/RXD
0 V	7	14	0 V
RTS	4	–	–
CTS	5	–	–
FG	1	Case	FG

Shield wire

(2) D-sub, 9-pin Connector Cable for IBM PC Compatible

(a) Cable Type: JZSP-CMS02

(b) Dimensional Drawing



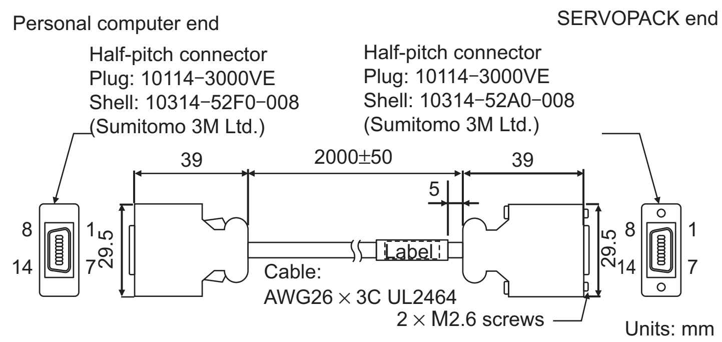
Personal computer end Signal	Pin No.	SERVOPACK end Pin No.	Signal
RXD	2	2	/TXD
TXD	3	4	/RXD
0 V	5	14	0 V
RTS	7	–	–
CTS	8	–	–
FG	Case	Case	FG

Shield wire

(3) 14-pin Half-pitch Connector Cable for NEC PC-98 Series PC

(a) Cable Type: JZSP-CMS03

(b) Dimensional Drawing



Personal computer end Signal	Pin No.	SERVOPACK end Pin No.	Signal
RXD	1	2	/TXD
TXD	9	4	/RXD
RTS	10	–	–
CTS	4	–	–
GND	14	14	0 V
FG	12	Case	FG
FG	Case		

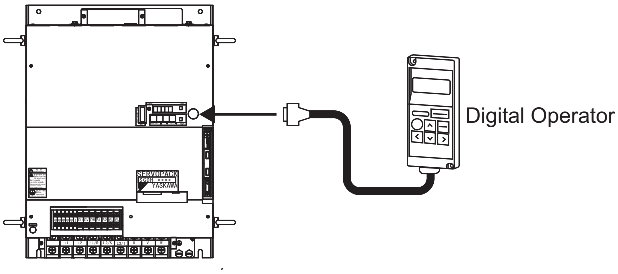
Shield wire

Specifications and Dimensional Drawings of Cables and Peripheral Devices

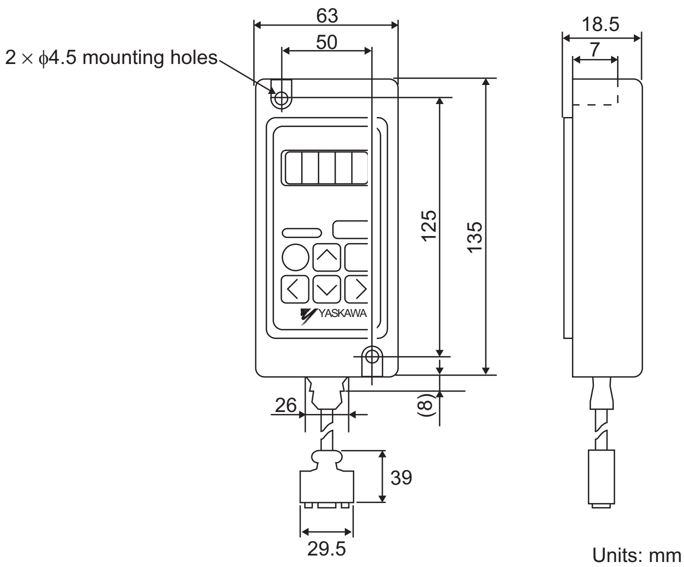
5

5.5.2 Digital Operator

(1) Model JUSP-OP02A-2 with a 1m-connection Cable



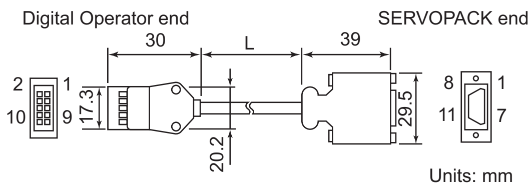
(2) Dimensional Drawing



(3) Other Types of the Applicable Connection Cables: JZSP-CMS00-□

* Order your cable from Yaskawa Controls Co., Ltd. in the following cases.

- When you need a longer cable than the cable supplied with the digital operator.
- When you need additional cables.

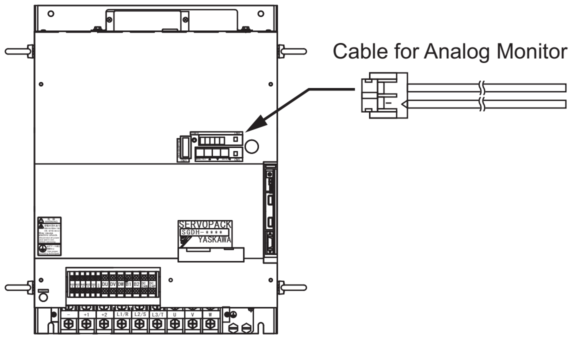


Cable Type	Cable Length (L)
JZSP-CMS00-1	1 m
JZSP-CMS00-2	1.5 m
JZSP-CMS00-3	2 m

5.5.3 Cables for Analog Monitor

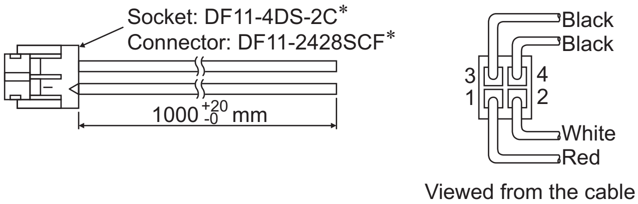
(1) Cable Type: JZSP-CA01 (DE9404559)

Connect the specified cables to CN5 connector for monitoring the analog monitor signals. For details, refer to *9.5 Analog Monitor*.



Note: Specify the cable type either JZSP-CA01 or DE9404559 when ordering the cable for analog monitor.

(2) Dimensional Drawing



* Manufactured by Hirose Electric Corporation.

(3) Specifications

Pin No.	Cable Color	Signal	Monitoring Item
1	Red	Analog Monitor 2	Motor speed: 1V/1000 min^{-1}
2	White	Analog Monitor 1	Torque reference: 1V/100% rated torque
3 and 4	Black (2 cables)	GND (0 V)	–

Note: The above monitoring items are the factory settings. The monitoring items can be changed by setting the parameter Pn003. Refer to *9.5 Analog Monitor.*

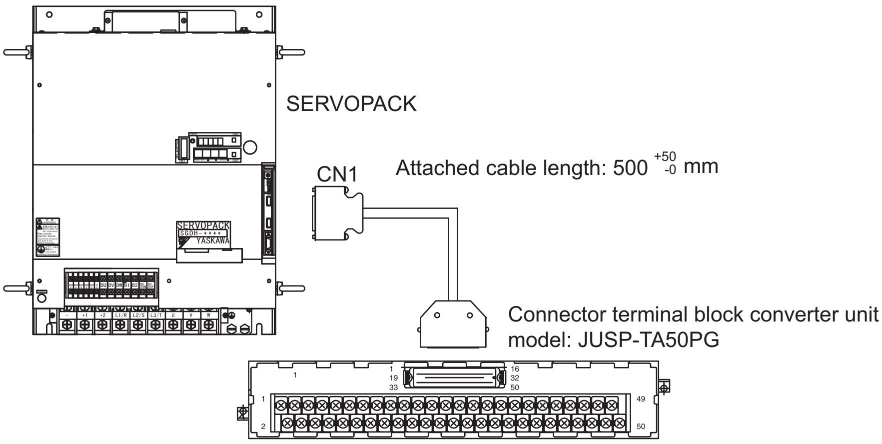
Specifications and Dimensional Drawings of Cables and Peripheral Devices

5

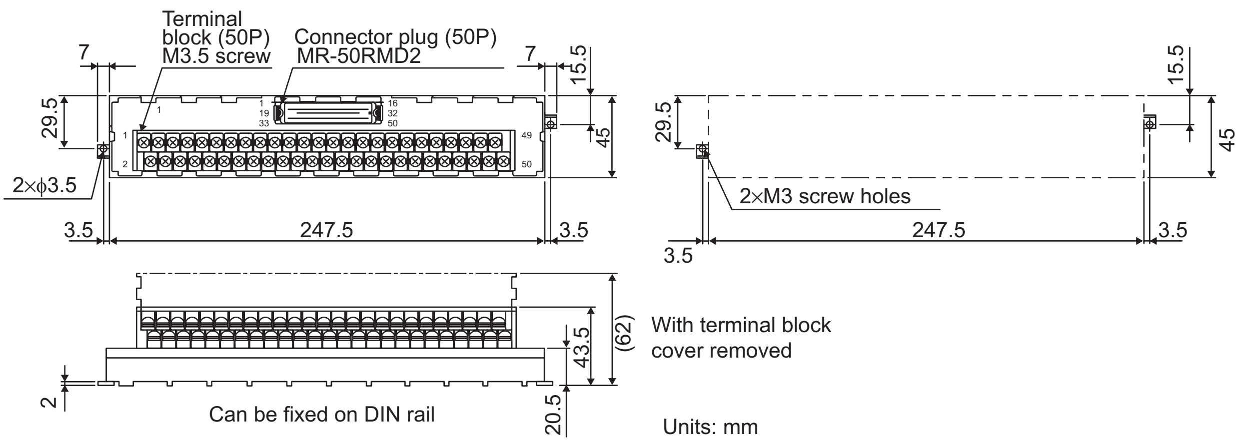
5.5.4 Connector Terminal Block Converter Unit

(1) Model: JUSP-TA50PG

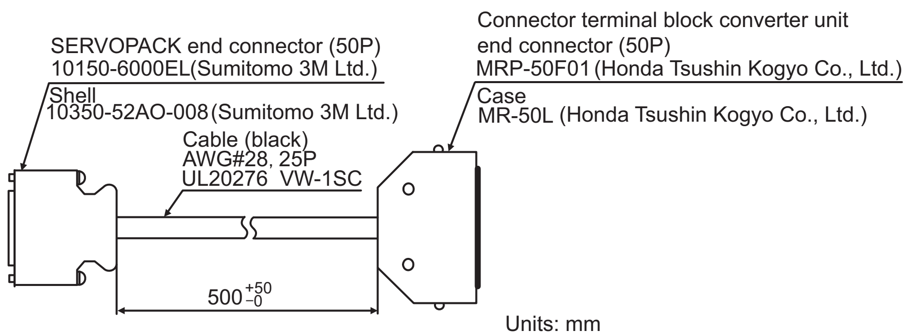
The connection between the connector terminal block converter and the SERVOPACK is shown below.



(2) Dimensional Drawings of Terminal Block



(3) Dimensional Drawing of Cable



5.5.5 Brake Power Supply Unit

(1) Model: LPSE-2H01, LPDE-1H01

Contact Yaskawa Controls Co., Ltd.

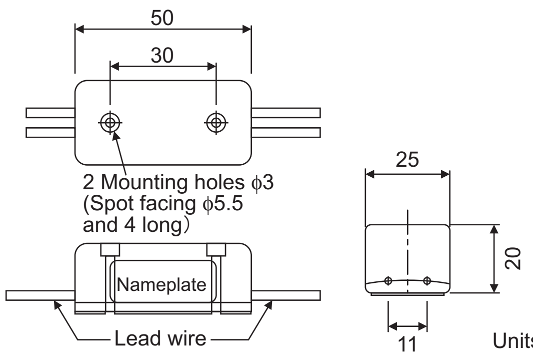
- 200 V input: LPSE-2H01
- 100 V input: LPDE-1H01

(2) Specifications

- Rated output voltage: 90 VDC
- Maximum output current: 1.0 ADC
- Lead wire length: 500 mm each
- Maximum surrounding air temperature: 60°C
- Lead wires: Color coded. Refer to the table below.

AC Input End		Brake End
100 V	200 V	
Blue/White	Yellow/White	Red/Blue

(3) Dimensional Drawing

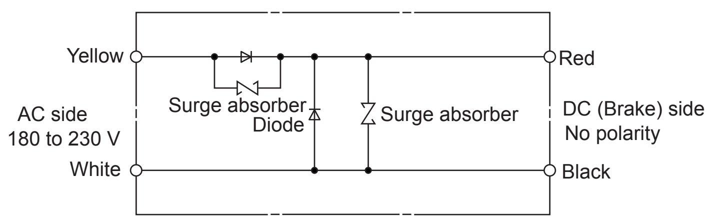


Units: mm

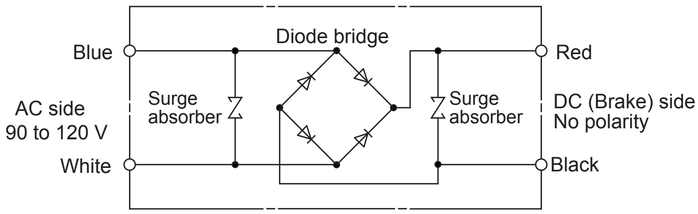
(4) Internal Circuits

The brake power supply circuit can be opened and closed either on AC or DC side. However, if the wiring distance on DC side is too long, the brake circuit may not operate normally due to the influence of switching noises. When switching the circuit on AC side, install a surge absorber model CR50500BL (sold as spark quencher) for the brake power supply near the brake coil to reduce the influence of switching noises.
When switching the circuit on DC side, the influence of the switching noise is minimal, even without installing a surge absorber. However, the surge voltage at switching may damage the brake coil. Install a surge absorber near the brake coil to prevent the damage to the brake coil in addition to the built-in surge absorber.

(a) Internal Circuit for 200 VAC Brake Power Supply Model: LPSE-2H01



(b) Internal Circuit for 100 VAC Brake Power Supply Model: LPDE-1H01



■ Brake Power Supply Unit for the 24 VDC

The brake power supply unit for the 24 VDC is not provided by Yaskawa. When using the servomotor with a 24-VDC brake, the brake power supply unit is to be provided by the customer.

5.5.6 Absolute Encoder Battery

When using an absolute encoder, a backup battery is required to prevent the position data from being lost at power OFF. Install one of the following absolute encoder batteries.
There are two types of battery: Battery to be mounted on the SERVOPACK and battery to be connected to the host controller.

PROHIBITED

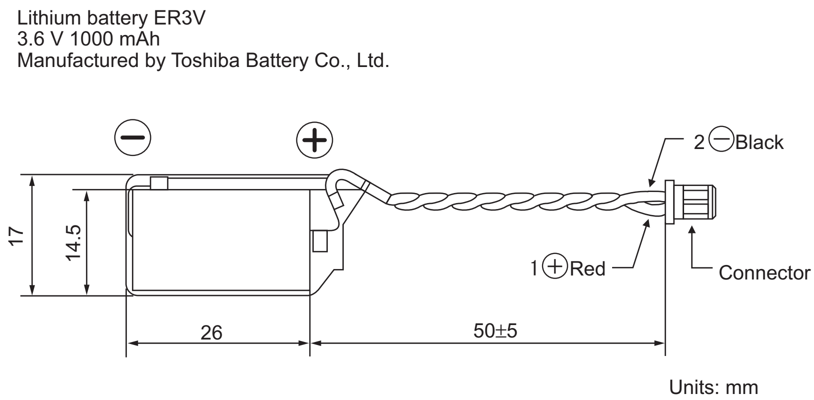
- Install the absolute encoder battery on either the SERVOPACK or the host controller.
  Installing the batteries both on the SERVOPACK and host controller configures a loop in the circuit between two batteries, which damages the circuit.

(1) Battery Mounted on SERVOPACK

(a) Model

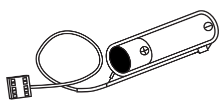
JZSP-BA01-1

(b) Dimensional Drawing



(2) Battery Connected to the Host Controller

When connecting the battery to the host controller, select the battery in accordance with the specifications of the host controller.
Use the battery ER6 VC3 or the equivalent:
3.6 V, 2000 mAh manufactured by Toshiba Battery Co., Ltd.



5.5.7 Molded-case Circuit Breaker (MCCB)

If selecting a molded-case circuit breaker, observe the following precautions.

IMPORTANT

■ Circuit Breakers

- Select a breaker for inverters.
- High-frequency current leaks from the servomotor armature because of switching operations inside the SERVOPACK.

(1) Maximum Input Current

- The instantaneous maximum output of SERVOPACK is 3 times of the rated output for maximum 3 seconds. Accordingly, select a circuit breaker whose operating time is 5 seconds or more at 300% of SERVOPACK rated current.
  The general-purpose and low-speed acting molded-case circuit breakers are applicable.
- The power supply capacity per SERVOPACK when using a servomotor is described in *2.6.2 Molded-case Circuit Breaker and Fuse Capacity.* Select a circuit breaker with the capacity larger than the effective load current (when using multiple SERVOPACKs) calculated from the total power supply capacity.
- The power consumption of other controllers must be considered when selecting a circuit breaker.

(2) Inrush Current

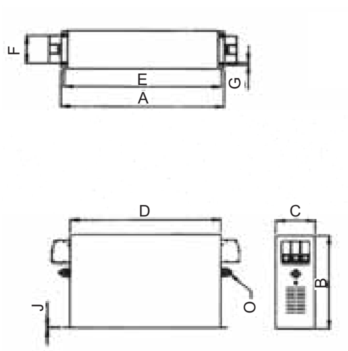
- Refer to *2.6.2 Molded-case Circuit Breaker and Fuse Capacity* for SERVOPACK inrush current.
- The allowable inrush current for a low-speed acting circuit breaker is approximately 10 times of the rated current for 0.02 seconds.
- When turning ON multiple SERVOPACKs simultaneously, select a molded-case circuit breaker with the allowable current for 20 ms larger than the total inrush current shown in *2.6.2 Molded-case Circuit Breaker and Fuse Capacity.*

5.5.8 Noise Filter

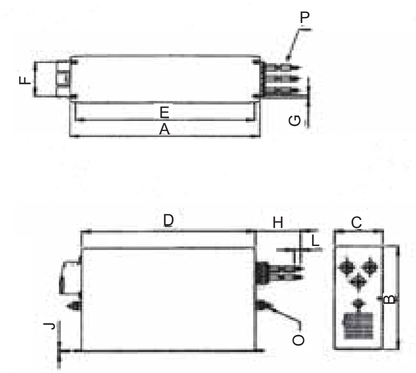
The noise filters model FN manufactured by Schaffner Electronic are recommended. Contact Yaskawa Controls Co., Ltd.
Select one of the following noise filters according to SERVOPACK capacity. For more details, refer to *2.5.3 Noise Filters, Magnetic Contactors, and Brake Power Supply Units*.

Refer to *6.1.2 Typical Main Circuit Wiring Examples* for the connection method.

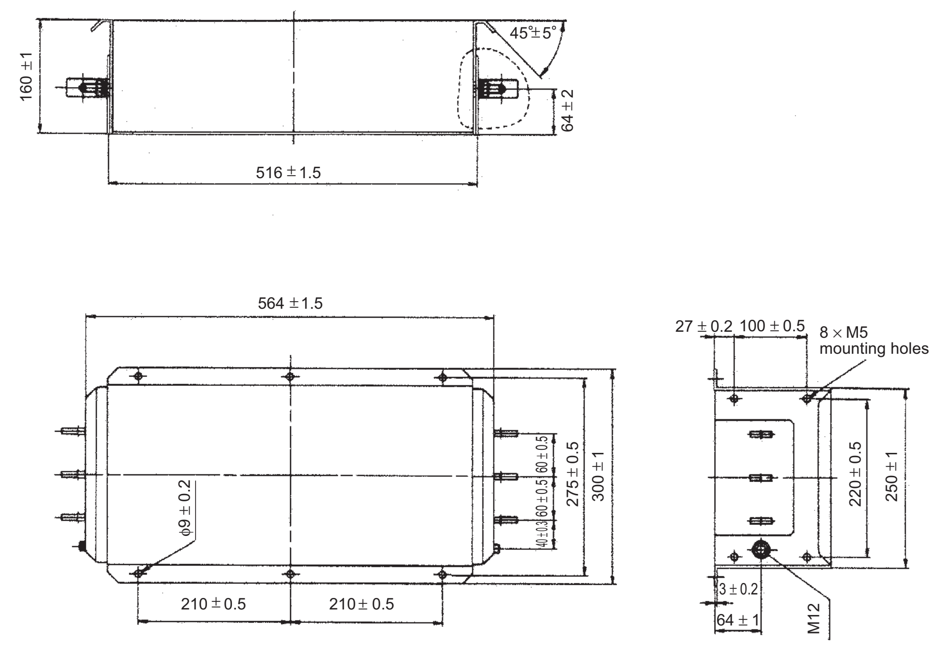
(1) Model: FN258L-130-35

Dimensional Drawings		
External Dimensions (mm)	A	439 ± 1.5
	B	240
	C	110 ± 0.8
	D	400 ± 1.2
	E	414
	F	80
	G	6.5
	J	3
	O	M10
Specifications		480 VAC, 130 A
Applicable SERVOPACK	Three-phase 200 V	SGDM-2BADB SGDH-2BAEB

(2) Model: FN258L-180-07

<table>
<tr><td colspan="2">Dimensional Drawings</td><td></td></tr>
<tr><td rowspan="12">External Dimensions (mm)</td><td>A</td><td>438±1.5</td></tr>
<tr><td>B</td><td>240</td></tr>
<tr><td>C</td><td>110±0.8</td></tr>
<tr><td>D</td><td>400±1.2</td></tr>
<tr><td>E</td><td>413</td></tr>
<tr><td>F</td><td>80</td></tr>
<tr><td>G</td><td>6.5</td></tr>
<tr><td>H</td><td>500</td></tr>
<tr><td>J</td><td>4</td></tr>
<tr><td>L</td><td>15</td></tr>
<tr><td>O</td><td>M10</td></tr>
<tr><td>P</td><td>50 (mm^2)</td></tr>
<tr><td colspan="2">Specifications</td><td>480 VAC, 180 A</td></tr>
<tr><td rowspan="2">Applicable SERVOPACK</td><td>Three-phase 200 V</td><td>SGDM-3ZADB
SGDH-3ZAEB</td></tr>
<tr><td>Three-phase 400 V</td><td>SGDH-2BDEB
SGDH-3ZDEB
SGDH-3GDEB</td></tr>
</table>

(3) Model: FN359P-250-99, FN359P-300-99

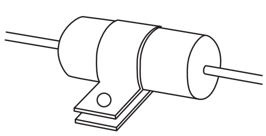
<table>
<tr><td colspan="2">External Dimensions
(mm)</td><td colspan="2">
</td></tr>
<tr><td colspan="2">Model</td><td>FN359P-250-99</td><td>FN359P-300-99</td></tr>
<tr><td colspan="2">Specifications</td><td>AC480 V, 250 A</td><td>AC480 V, 300 A</td></tr>
<tr><td rowspan="2">Applicable SERVOPACK</td><td>Three-phase 200 V</td><td>SGDM-3GADB
SGDH-3GAEB</td><td>–</td></tr>
<tr><td>Three-phase 400 V</td><td>SGDH-4EDEB
SGDH-5EDEB</td><td>SGDH-9ZDEB</td></tr>
</table>

5.5.9 Surge Absorber

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 (sold as Spark Quencher)

(b) Specifications



Power supply: 250 VAC
Capacitance: 0.5 μF ± 20%
Resistance: 50 Ω(1/2 W) ± 30%

5.5.10 Regenerative Resistor Unit

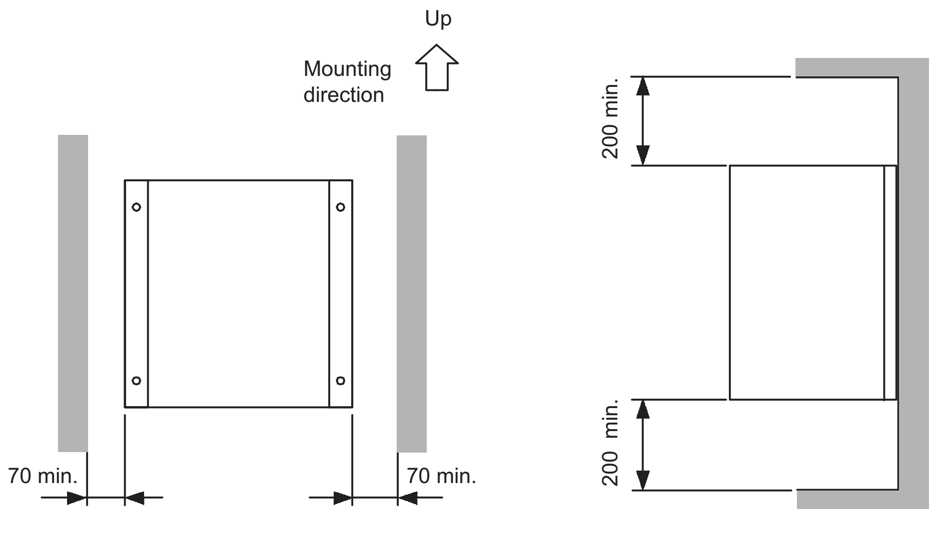
(1) Model

Refer to the following table to install the regenerative resistor unit according to the SERVOPACK model requirements.

SERVOPACK Model	Regenerative Resistor Unit			Allowable Power Loss (W)
	Model	Resistance (Ω)	Resistance Capacity (W)	
SGDM-2BADB SGDH-2BAEB	JUSP-RA08	2.4	2400	480
SGDM-3ZADB SGDH-3ZAEB	JUSP-RA09	1.8	4800	960
SGDM-3GADB SGDH-3GAEB	JUSP-RA11	1.6	4800	960
SGDH-2BDEB	JUSP-RA12	9	3600	720
SGDH-3ZDEB	JUSP-RA13	6.7	3600	720
SGDH-3GDEB	JUSP-RA14	5	4800	960
SGDH-4EDEB	JUSP-RA15	4	6000	1200
SGDH-5EDEB	JUSP-RA16	3.8	7200	1440
SGDH-9ZDEB	JUSP-RA25	2.1	16800	3360

(2) Mounting

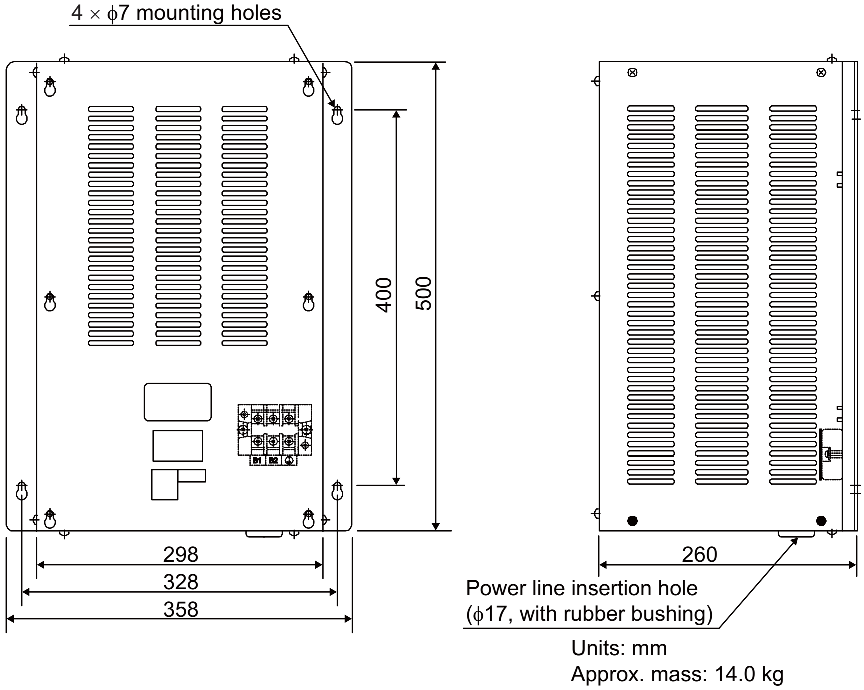
To cool the regenerative resistor by fan or natural convection, provide at least 70 mm of space on each side and at least 200 mm of space both above and below.



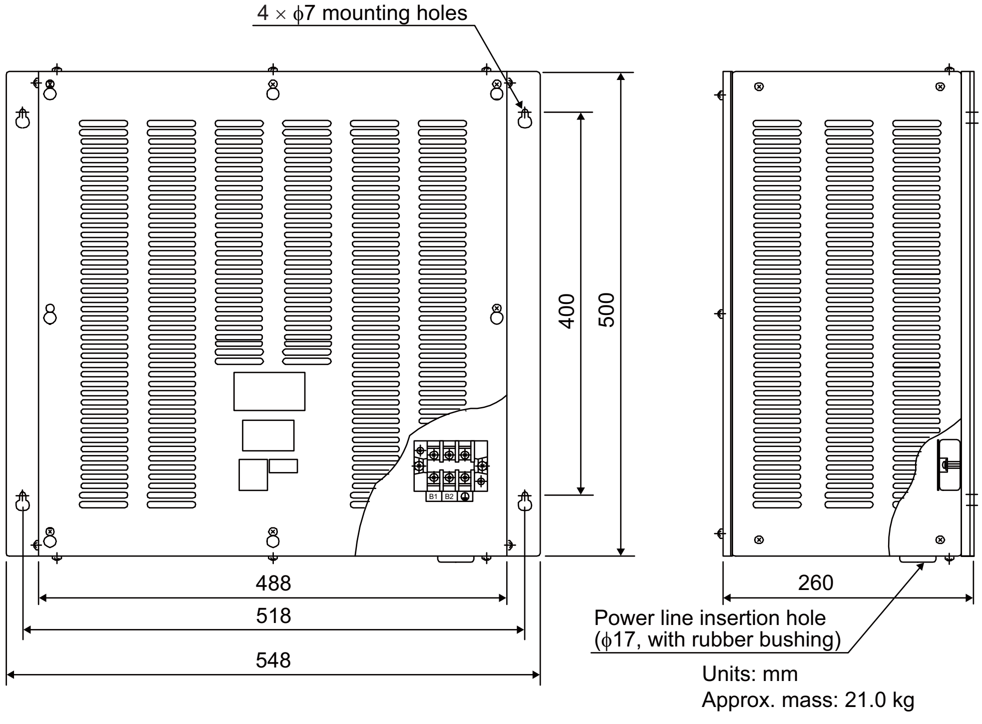
Units: mm

(3) Dimensional Drawings

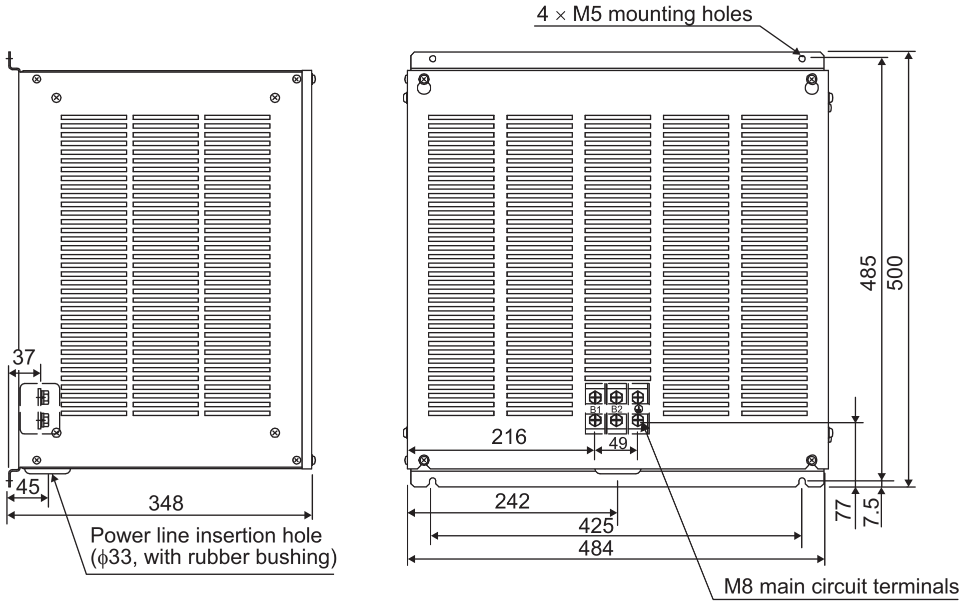
(a) JUSP-RA08 Regenerative Resistor Unit



(b) JUSP-RA09 Regenerative Resistor Unit

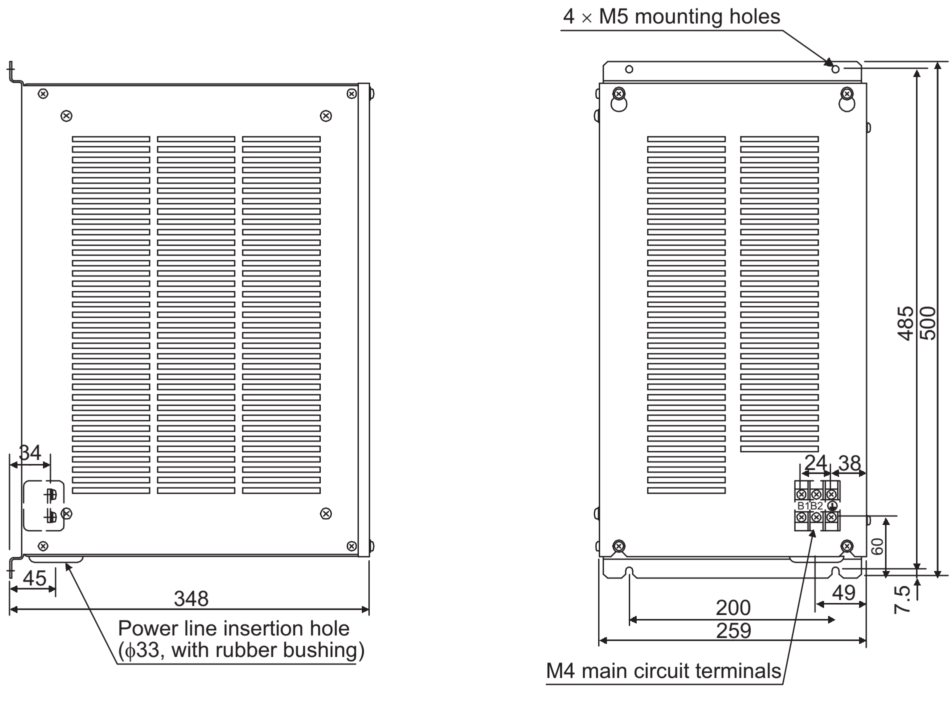


(c) JUSP-RA11 Regenerative Resistor Unit



Units: mm
Approx. mass: 20.5 kg

(d) JUSP-RA12 Regenerative Resistor Unit

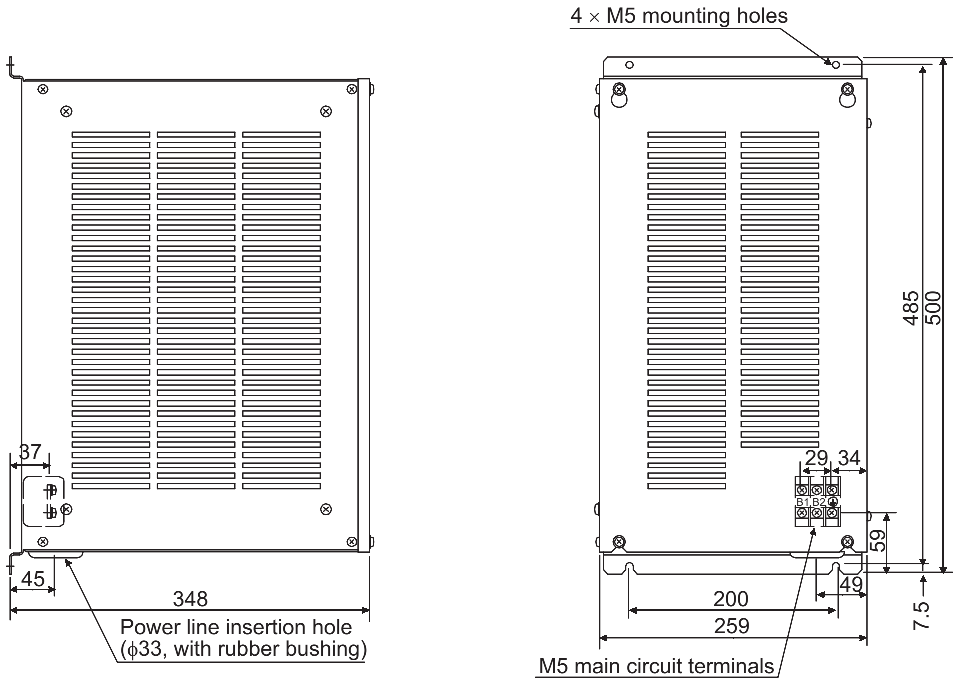


Units: mm
Approx. mass: 14 kg

Specifications and Dimensional Drawings of Cables and Peripheral Devices

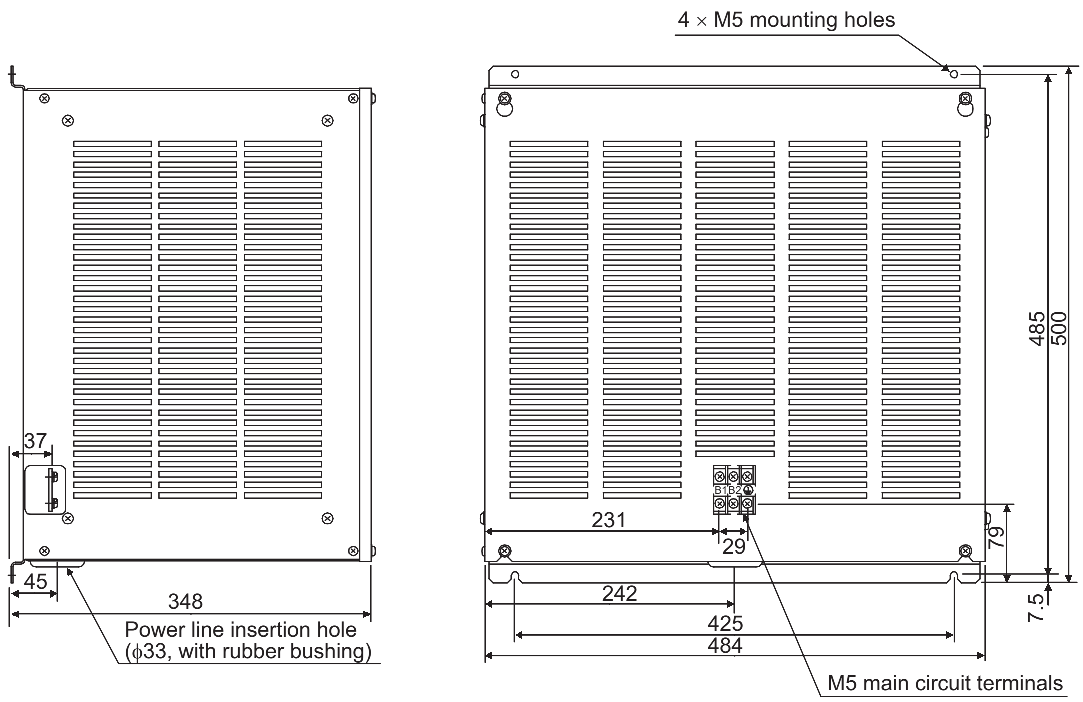
5

(e) JUSP-RA13 Regenerative Resistor Unit



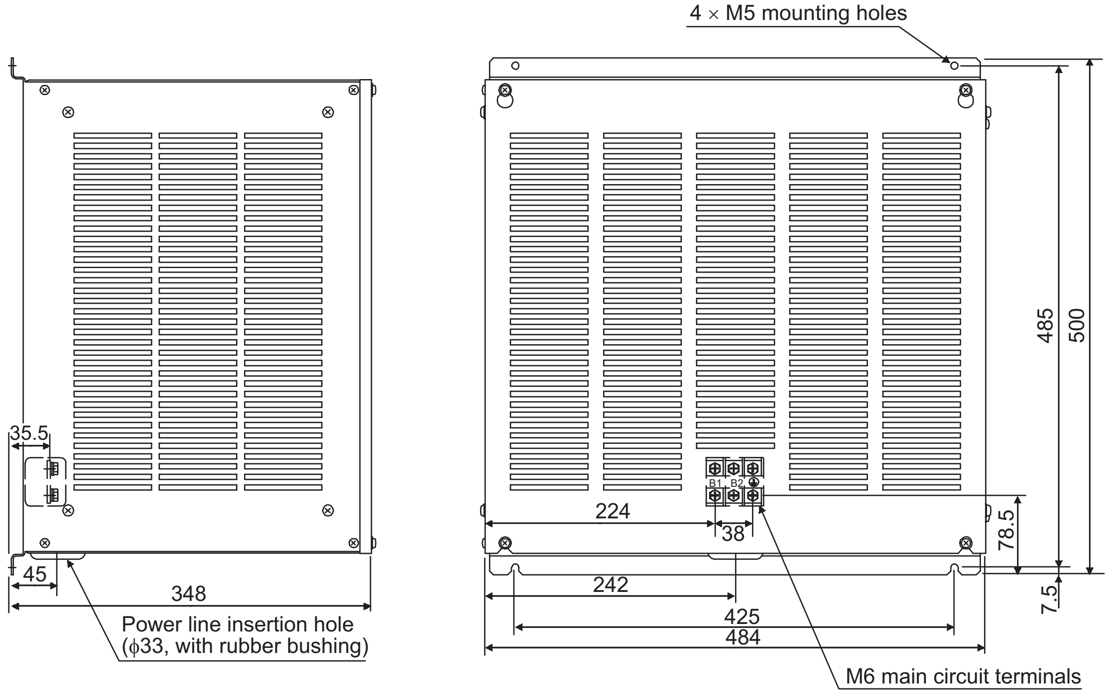
Units: mm
Approx. mass: 14 kg

(f) JUSP-RA14 Regenerative Resistor Unit



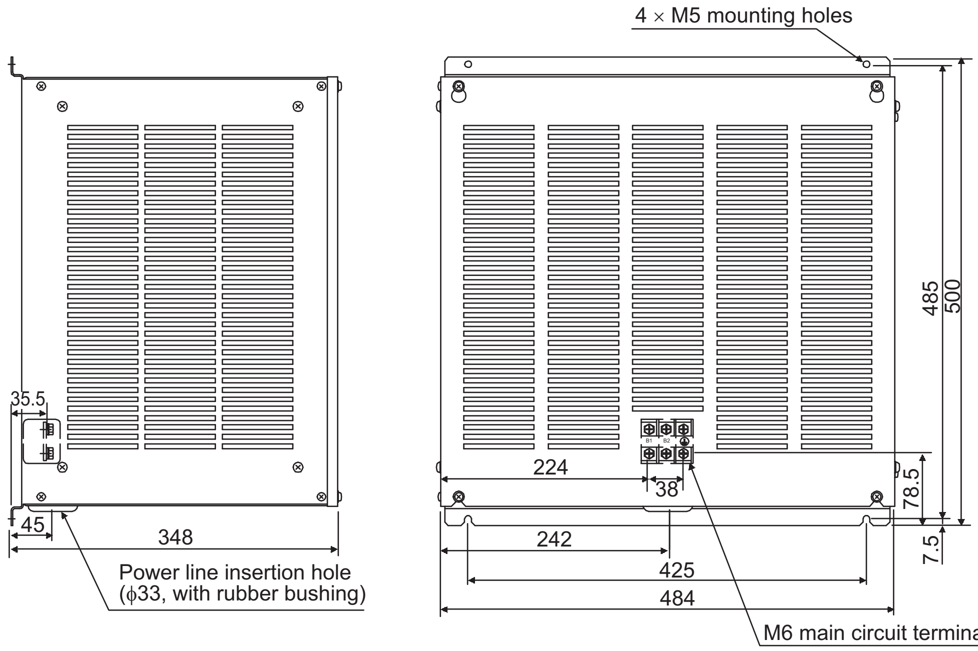
Units: mm
Approx. mass: 20 kg

(g) JUSP-RA15 Regenerative Resistor Unit



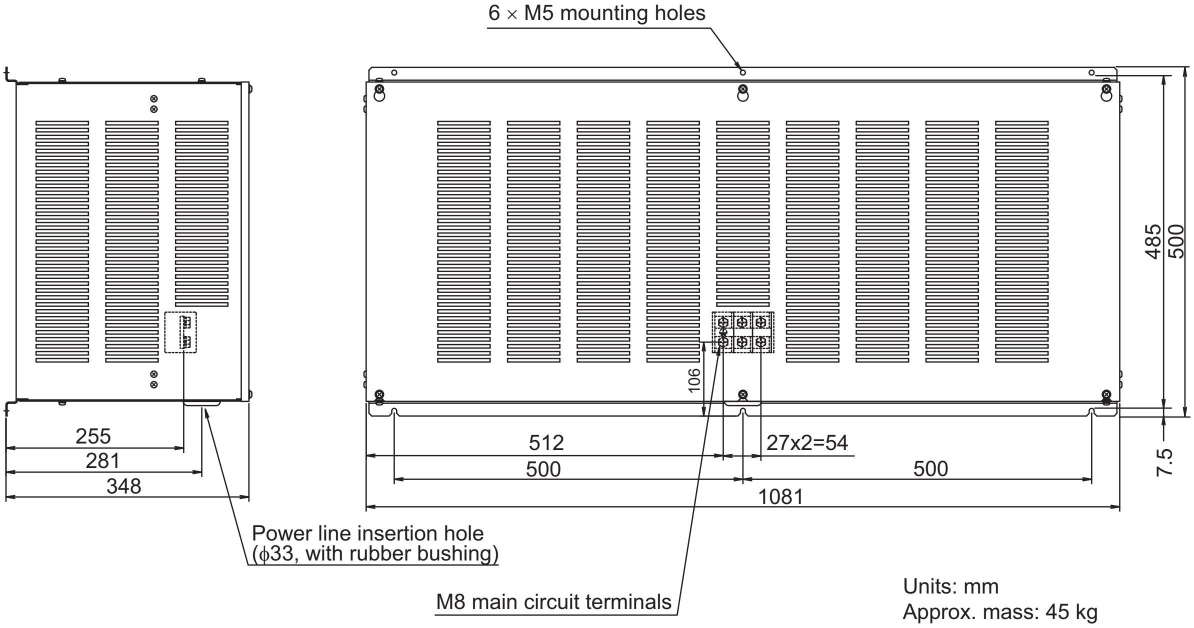
Units: mm
Approx. mass: 21.5 kg

(h) JUSP-RA16 Regenerative Resistor Unit



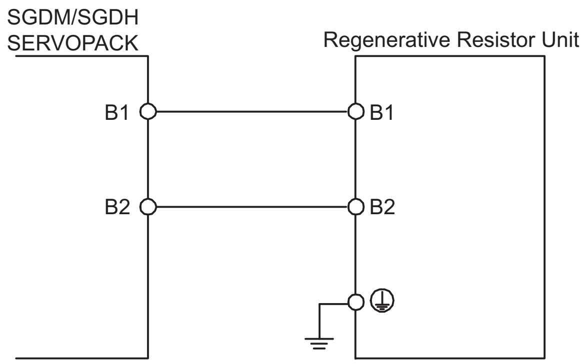
Units: mm
Approx. mass: 23.5 kg

(i) JUSP-RA25 Regenerative Resistor Unit



(4) Connections

Connect the Regenerative Resister Unit to the SGDM/SGDH SERVOPACKs as shown in the following diagram.



5.5.11 Dynamic Brake (DB) Unit

Externally attach a dynamic brake resistor to the SERVOPACK to dissipate regenerative energy when using the dynamic brake function. The dynamic brake resistor does not need to be installed if the dynamic brake function is not required.

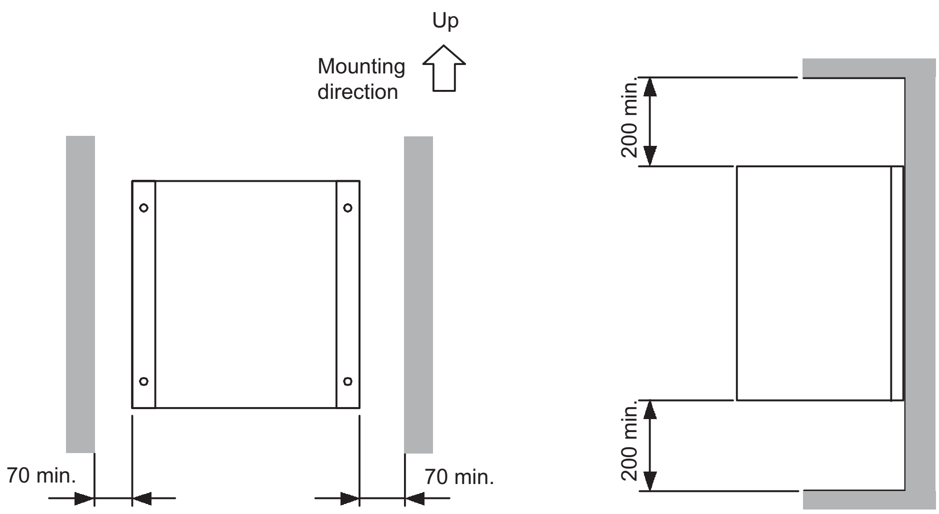
(1) Specifications

The following Dynamic Brake Units are required according to the SERVOPACK model.

Dynamic Brake (DB) Unit Model	SERVOPACK Model		Resistance Specifications (Star Wiring ⅄)	DB Contactor and Surge Absorption Unit
	SGDM-	SGDH-		
JUSP-DB01	2BADB, 3ZADB	2BAEB, 3ZAEB	180 W, 0.3 Ω	Built into the SERVOPACK
JUSP-DB02	3GADB	3GAEB	180 W, 0.3 Ω	Built into Dynamic Brake Unit
JUSP-DB03	–	2BDEB, 3ZDEB	180 W, 0.8 Ω	Built into the SERVOPACK
JUSP-DB04	–	3GDEB	180 W, 0.8 Ω	Built into Dynamic Brake Unit
JUSP-DB05	–	4EDEB	180 W, 0.8 Ω	Built into Dynamic Brake Unit
JUSP-DB06	–	5EDEB	300 W, 0.8 Ω	Built into Dynamic Brake Unit
JUSP-DB12	–	9ZDEB	600 W, 0.9 Ω	Built into Dynamic Brake Unit

(2) Mounting

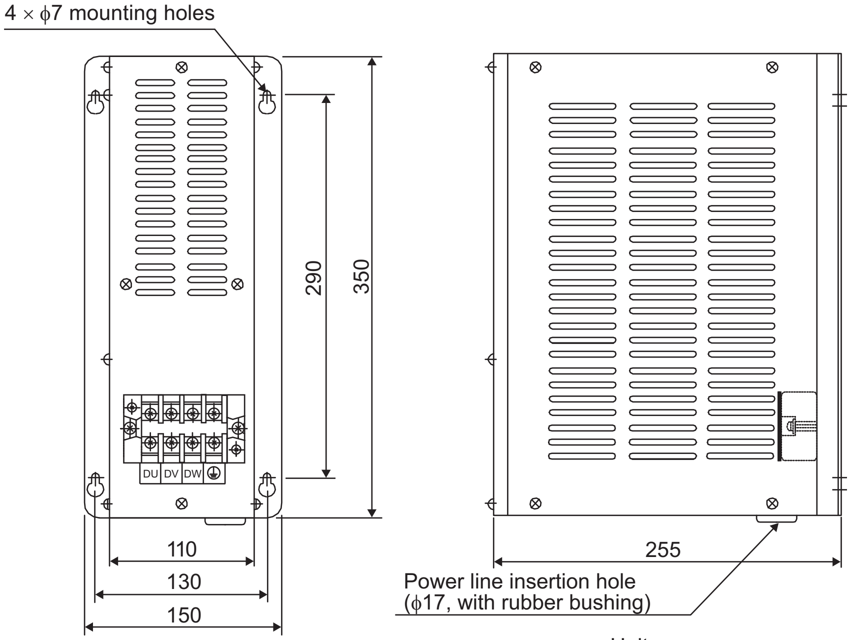
To cool the regenerative resistor by fan or natural convection, provide at least 70 mm of space on each side and at least 200 mm of space both above and below.



Units: mm

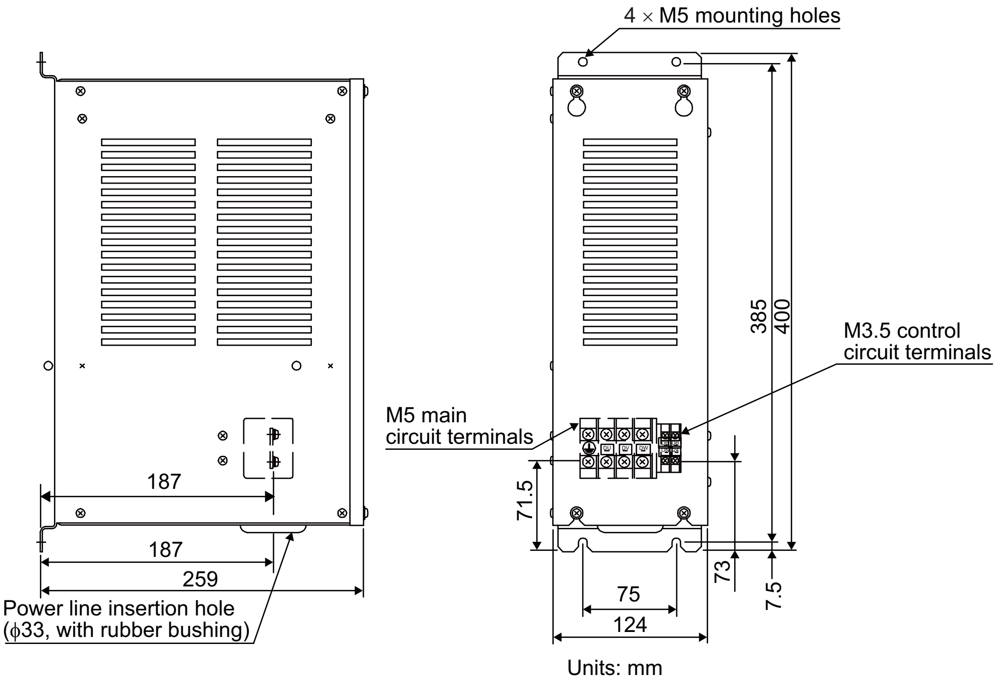
(3) Dimensional Drawings

(a) JUSP-DB01 Dynamic Brake Unit



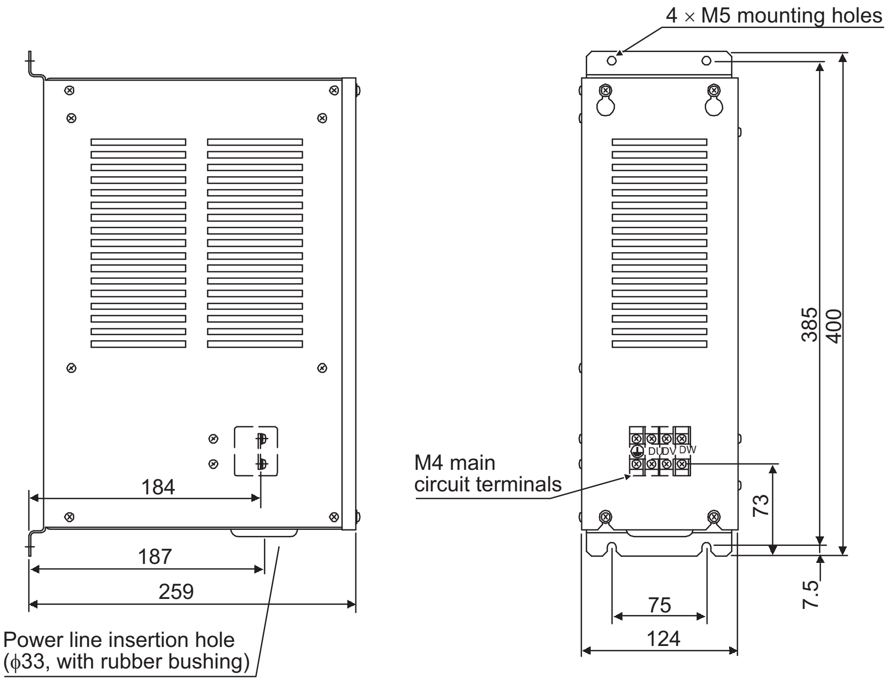
Units: mm
Approx. mass: 5.0 kg

(b) JUSP-DB02 Dynamic Brake Unit



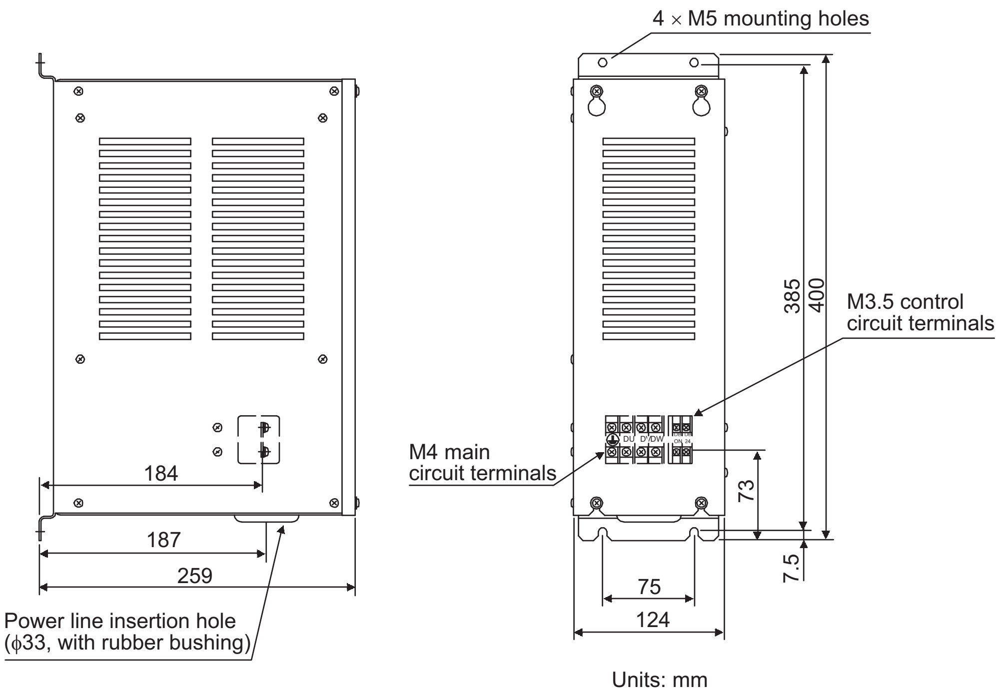
Units: mm
Approx. mass: 6.0 kg

(c) JUSP-DB03 Dynamic Brake Unit



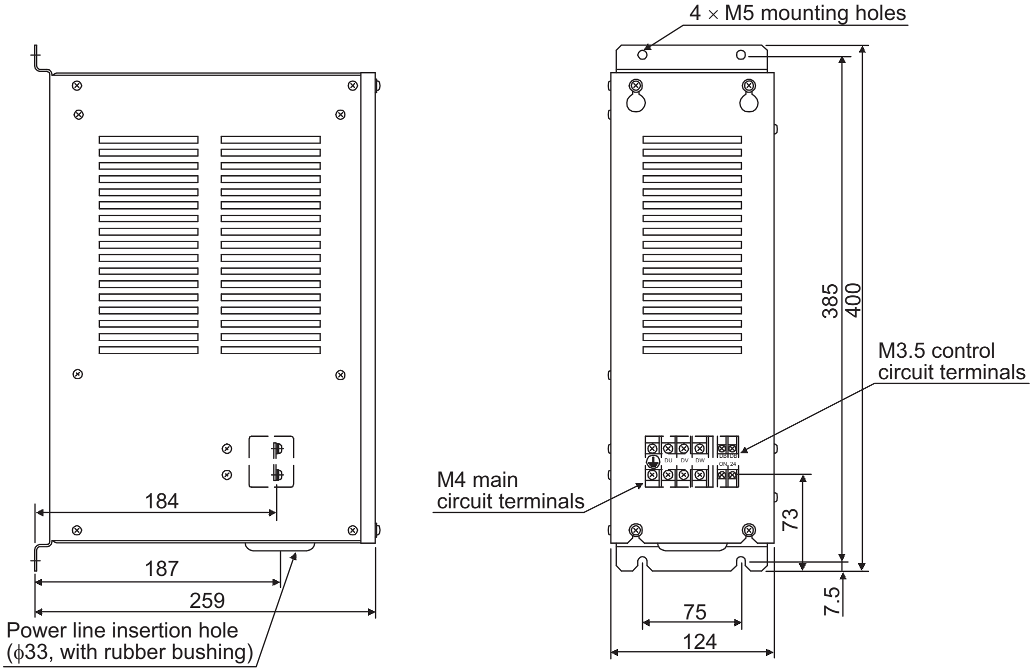
Units: mm
Approx. mass: 5.0 kg

(d) JUSP-DB04 Dynamic Brake Unit



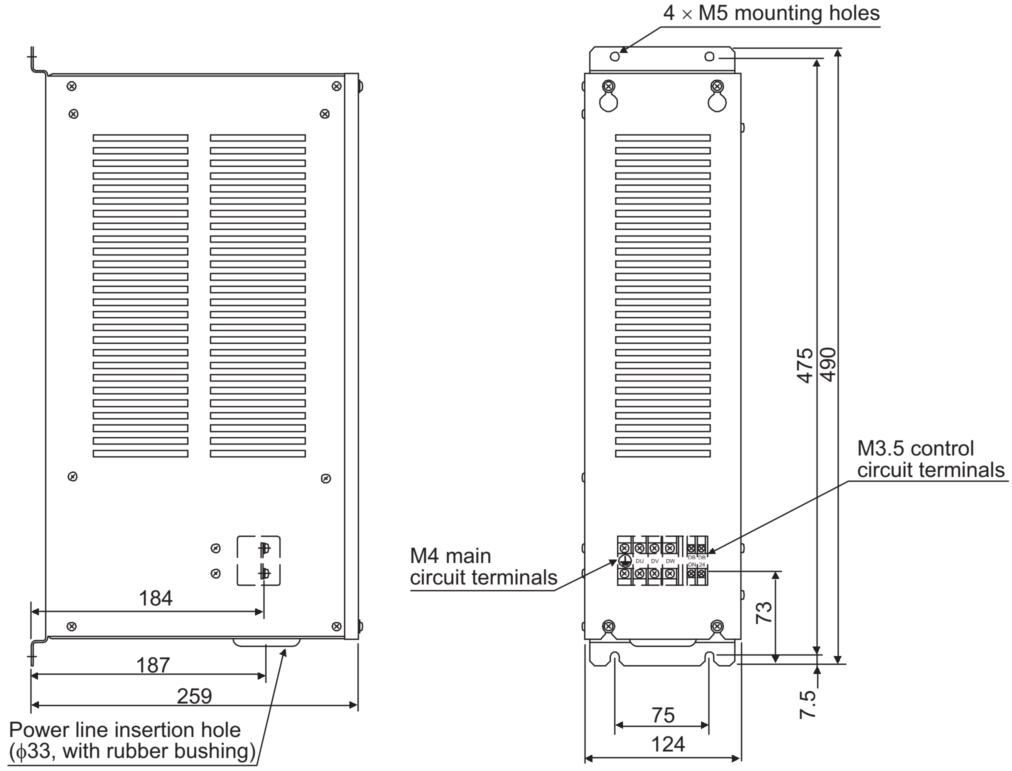
Units: mm
Approx. mass: 6.0 kg

(e) JUSP-DB05 Dynamic Brake Unit



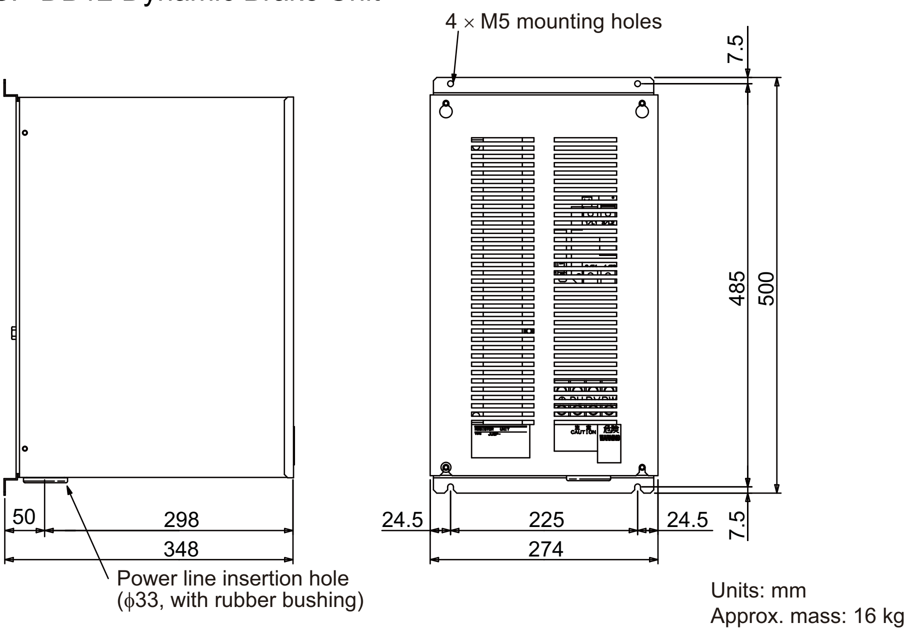
Units: mm
Approx. mass: 6.0 kg

(f) JUSP-DB06 Dynamic Brake Unit



Units: mm
Approx. mass: 7.0 kg

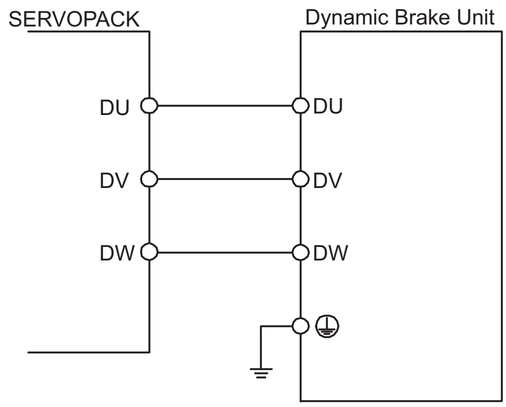
(g) JUSP-DB12 Dynamic Brake Unit



(4) Connections

(a) Using a Yaskawa Dynamic Brake Unit

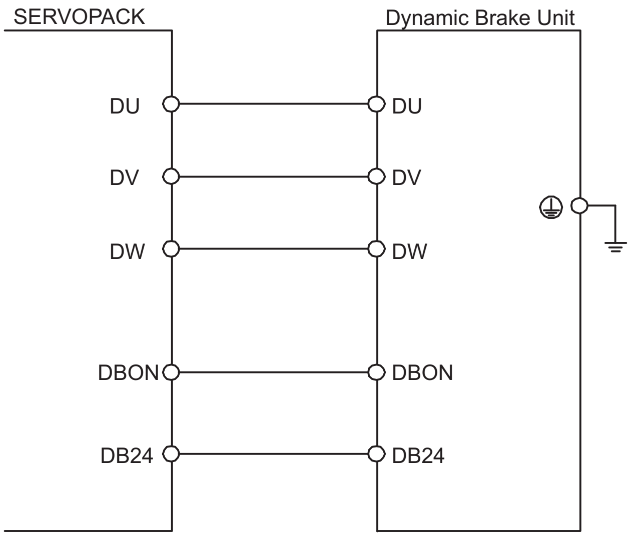
- SGDM-2BADB, -3ZADB SERVOPACKs
  SGDH-2BAEB, -3ZAEB SERVOPACKs
  SGDH-2BDEB, -3ZDEB SERVOPACKs
  The dynamic brake contactor and surge absorption unit are built into the SERVOPACK. Connect the DU, DV, and DW terminals and the Frame Ground (⏚) on the dynamic brake unit, as sown in the following diagram.



- SGDM-3GADB SERVOPACK
  SGDH-3GAEB, SERVOPACK
  SGDH-3GDEB, -4EDEB , -5EDEB , -9ZDEB SERVOPACKs

  The dynamic brake contactor and surge absorption unit are not built into the SERVOPACK.

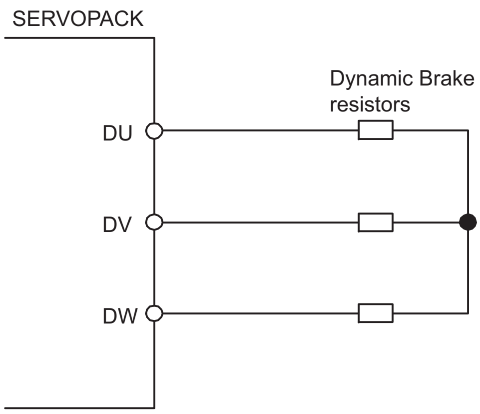
  The dynamic brake contactor and surge absorption unit are built into the dynamic brake unit. Connect the DU, DV, and DW terminals and the frame ground (⏚) on the dynamic brake unit, and also connect the terminals DBON and DB24 for dynamic brake contactor control, as shown in the following diagram.



(b) Using Dynamic Brake Resistors Prepared by the Customer

- SGDM-2BADB, -3ZADB SERVOPACKs
  SGDH-2BAEB, 3ZAEB, SERVOPACKs
  SGDH-2BDEB, -3ZDEB, SERVOPACKs

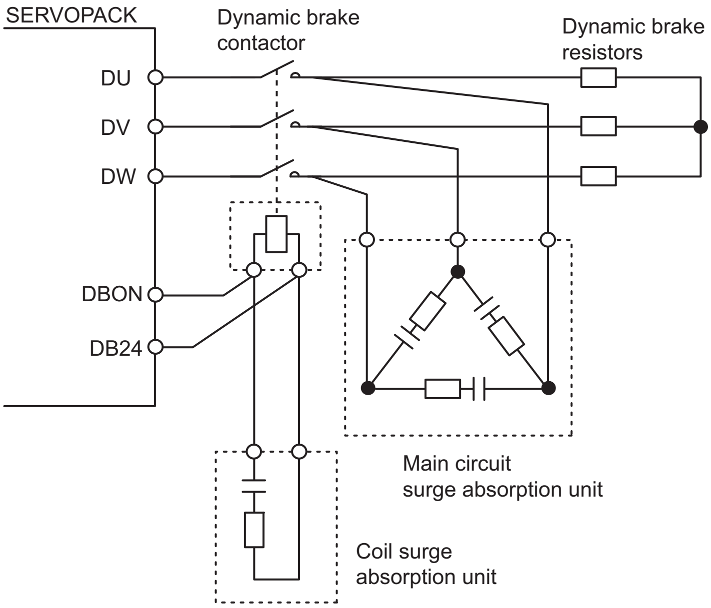
  The dynamic brake contactor and surge absorption unit are built into the SERVOPACK. Connect the dynamic brake resistors only, as shown in the following diagram.



Note: Connect dynamic brake resistors with the following resistance specifications.
200-V SERVOPACKs: Higher than 0.3 Ω
400-V SERVOPACKs: Higher than 0.8 Ω

- SGDM-3GADB SERVOPACK
  SGDH-3GAEB SERVOPACK
  SGDH-3GDEB, -4EDEB, -5EDEB, -9ZDEB SERVOPACKs

  Connect a dynamic brake contactor and surge absorption unit, as shown in the following diagram.



Note: Connect dynamic brake resistors with the following resistance specifications.

Voltage	SERVOPACK Model	Dynamic Brake Resistors
200 V	SGDM-3GADB, SGDH-3GAEB	Higher than 0.3 Ω
400 V	SGDH-3GDEB, 4EDEB, 5EDEB	Higher than 0.8 Ω
	SGDH-9ZDEB	Higher than 0.9 Ω

Use the following dynamic brake contactor and surge absorption unit.

SERVOPACK Model	Name		Model	Manufacturer
SGDM-3GADB SGDH-3GAEB SGDH-3GDEB SGDH-4EDEB SGDH-5EDEB	Contactor		SC-4-1/G 24-VDC coil	Fuji Electric Co., Ltd.
	Main Circuit Surge Absorption Unit*	Front Connection	SZ-ZM1	
		Side Connection	SZ-ZM2	
	Coil Surge Absorption Unit		SZ-Z4	
SGDH-9ZDEB	Contactor		SD-N50 24-VDC coil	Mitsubishi Electric Co., Ltd.
	Main Circuit Surge Absorption Unit*		UN-SA33	
	Coil Surge Absorption Unit		UN-SA721	

* The main circuit surge absorption unit is available as a front-connection type or a side-connection type.

5.5.12 Thermal Relays

Connect a thermal relay to the SERVOPACK to protect the regenerative resistor and dynamic brake resistor from heat damage when operating under extreme conditions.

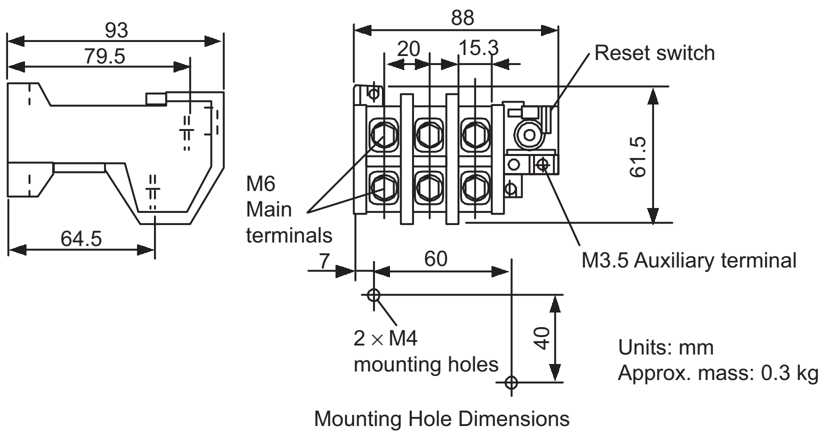
(1) Models

Select the appropriate thermal relay from the following list according to regenerative resistor unit and dynamic brake unit model.

Dynamic Brake (DB) Unit and Regenerative Resistor Unit Model	Thermal Relay Model	Thermal Relay Current Range	Thermal Relay Current	Manufacturer
JUSP-DB01 JUSP-DB02	TR-3N/3 9 A	9 to 13 A	10 A	Fuji Electric Co., Ltd.
JUSP-DB03 JUSP-DB04 JUSP-DB05	TR-3N/3 7 A	7 to 11 A	7 A	
JUSP-DB06	TR-3N/3 7 A	7 to 11 A	9 A	
JUSP-DB12	TR-3N/3 9 A	9 to 13 A	12 A	
JUSP-RA08	TR-3N/3 12 A	12 to 18 A	14 A	
JUSP-RA09	TR-3N/3 18 A	18 to 26 A	23 A	
JUSP-RA11	TR-3N/3 18 A	18 to 26 A	24 A	
JUSP-RA12	TR-3N/3 7 A	7 to 11 A	9 A	
JUSP-RA13	TR-3N/3 9 A	9 to 13 A	10 A	
JUSP-RA14	TR-3N/3 12 A	12 to 18 A	14 A	
JUSP-RA15	TR-3N/3 12 A	12 to 18 A	17 A	
JUSP-RA16	TR-3N/3 18 A	18 to 26 A	19 A	
JUSP-RA25	TR-3N/3 34A	34 to 50 A	40 A	

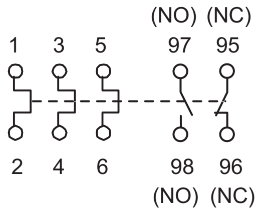
(2) Dimensional Drawings

The following dimensional drawings are for a TR-3N thermal relay.



(3) Internal Connection Diagram

The following connection diagram is for a TR-3N thermal relay.

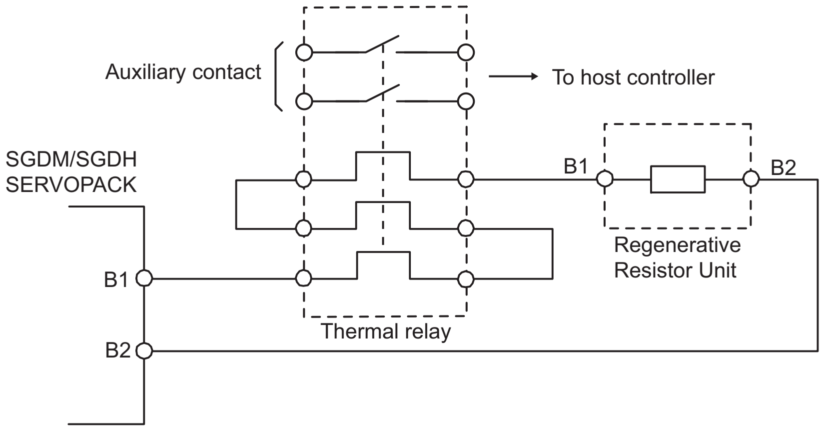


(4) Connections

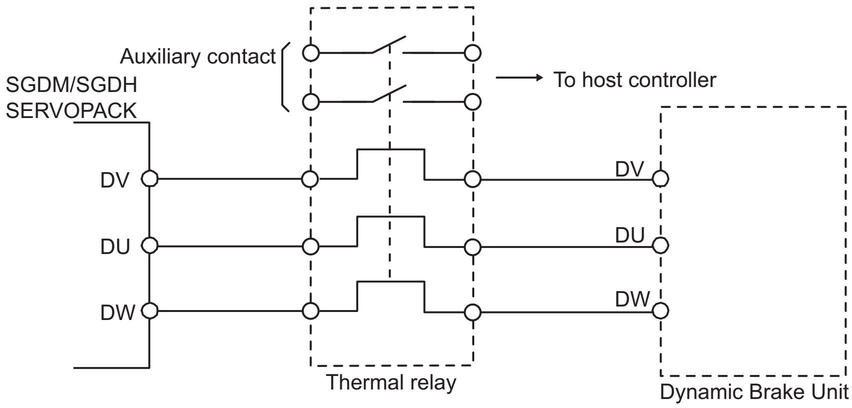
Connect the thermal relay as shown in the following diagram.

When the thermal relay operates, the auxiliary contact turns OFF or ON. Therefore, configure a sequence so that the main power supply or the servomotor turns OFF when the auxiliary contact turns OFF or ON.

(a) Connecting to a Regenerative Resistor Unit



(b) Connecting to a Dynamic Brake Unit



Specifications and Dimensional Drawings of Cables and Peripheral Devices

5

(5) Selecting a Thermal Relay

When preparing the dynamic brake resistor and regenerative resistor separately, select a thermal relay by calculating the setting current of the thermal relay according to the value and capacity of the resistor being used, as shown in the following equation.

$$\text{Setting current} = \sqrt{\frac{\text{Resistance capacity (W)} \times 0.2}{\text{Resistance value } (\Omega)}}$$

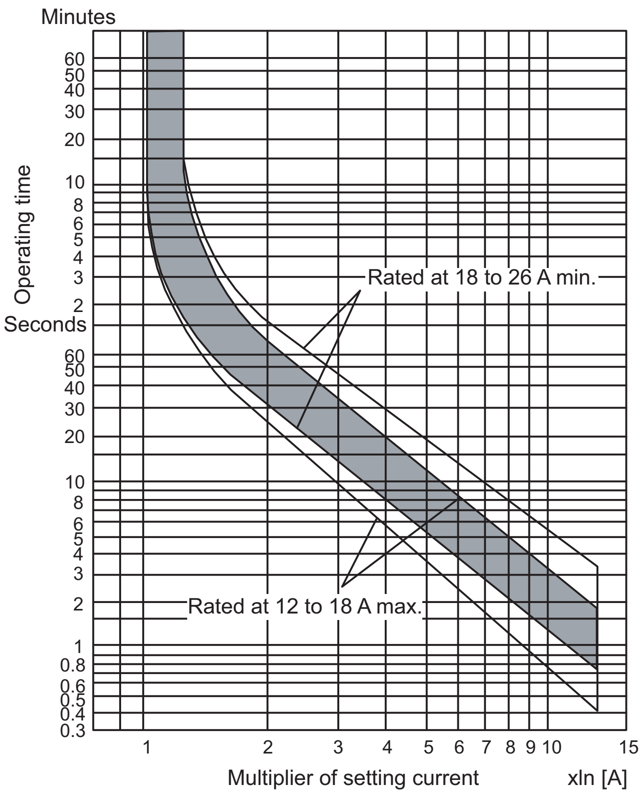
Example for a JUSP-RA08

$$\text{Setting current} = \sqrt{\frac{2000\text{ (W)} \times 0.2}{2.4\ (\Omega)}} \fallingdotseq 14\text{ A}$$

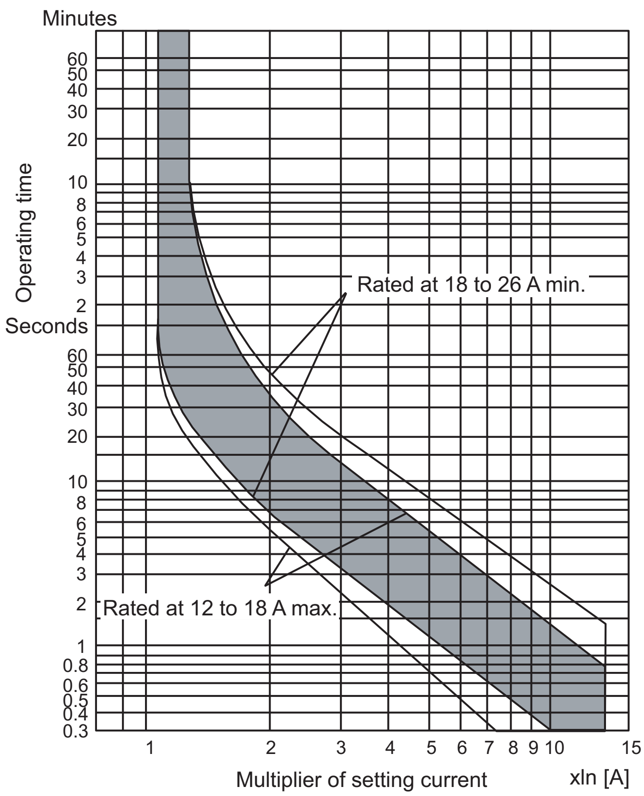
Select a thermal relay that has operating characteristics equivalent to those of the recommended product.

Refer to the following diagrams for the operating characteristics of the recommended thermal relays.

Cold Start Characteristics (Ambient Temperature of 20°C)



Hot Start Characteristics (Ambient Temperature of 20°C)

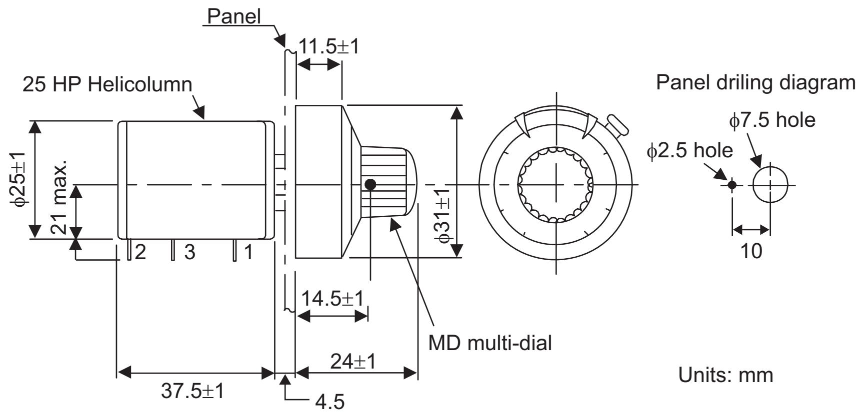


5.5.13 Variable Resistor for Speed and Torque Setting

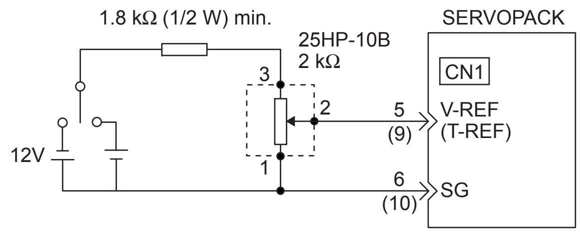
(1) Model: 25HP-10B

The multiturn 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) Example of Connection to an External Power Supply



5.5.14 Encoder Signal Converter Unit

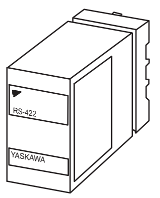
The encoder signal converter unit (the trade name “Receiver Unit”) converts encoder signal output from the line driver to open-collector or voltage-pulse output.

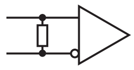
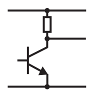
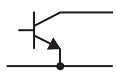
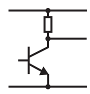
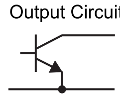
A socket model 11PFA is required to use a Receiver Unit.

(1) Model: LRX-01 / A□

Contact Yaskawa Controls Co., Ltd.

(2) Specifications

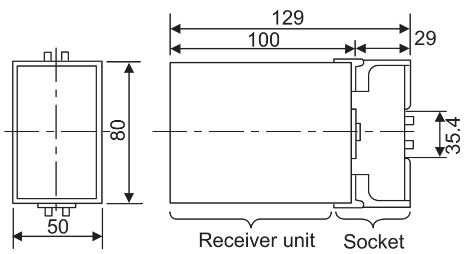


Specifications	Receiver Unit			
	LRX-01/A1	LRX-01/A2	LRX-01/A3	LRX-01/A4
Power Supply	12 VDC ±10 %, 100 mA		5 VDC ±5 %, 100 mA	
Input Signals	Balanced line driver input (RS-422) Input Circuit 			
Output Signals	Voltage pulse output Output Circuit 	Open collector output Output Circuit 	Voltage pulse output Output Circuit 	Open collector output Output Circuit 
Input Signal Level	Differential voltage ≥ 0.3 V, built-in terminator 100 Ω			
Output Signal Level	H: 10 V min. (1 mA) L: 0.5 V max. (30 mA)	L: 0.5 V min. (30 mA) Withstand voltage: 50 V	H: 3 V min. (1 mA) L: 0.5 V max. (30 mA)	L: 0.5 V min. (30 mA) Withstand voltage: 50 V
Surrounding Air Temperature	0 to + 60°C			
IC Used	Receiver IC: AM26LS32C or the equivalent			
Response Frequency	100 kHz			

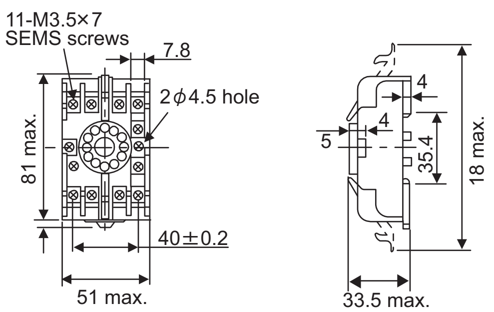
(3) Dimensional Drawings

The socket is optional.

Receiver unit and socket



Socket Type 11PFA



Units: mm

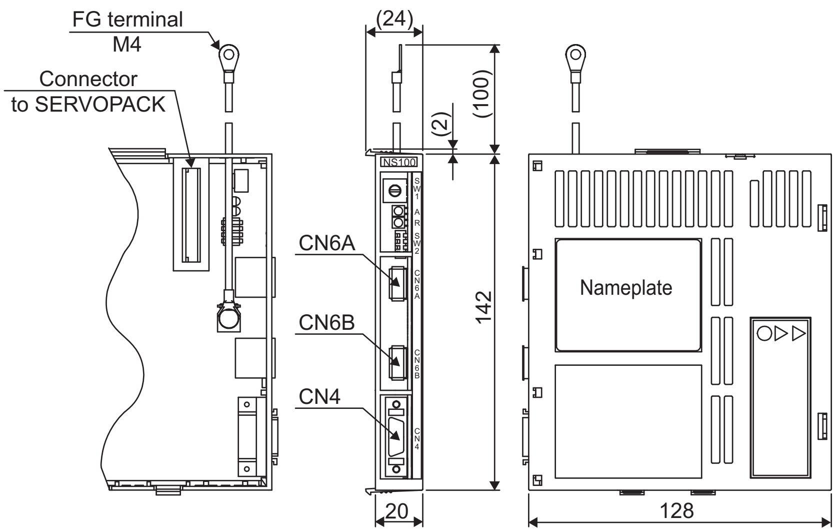
5.5.15 MECHATROLINK Application Module

(1) Model : JUSP-NS100 (for MECHATROLINK-I communications)
: JUSP-NS115 (for MECHATROLINK-I/II communications)

(2) Specifications

Item		Details	
		JUSP-NS100	JUSP-NS115
Applicable SERVOPACK		All SGDH-□□□EB models	SGDH-□□□EB models (except for 90 kW model)
Installation Method		Mounted on the SGDH SERVOPACK side: CN10.	
Basic Specifications	Power Supply Method	Supplied from the SERVOPACK control power supply.	
	Power Consumption	2 W	
MECHA-TROLINK Com-munications	Baud Rate/ Transmission Cycle	4 Mbps / 2 ms	10Mbps/500μs or more (4Mbps/2ms when using MECHATROLINK-I)
Command Format	Operation Specification	Positioning using MECHA-TROLINK-I communications.	Positioning using MECHA-TROLINK-I/II communications.
	Reference Input	MECHATROLINK-I communications Commands: Motion commands (position, speed), Interpolation commands, Parameter read/write, Monitor output	MECHATROLINK-I/II communications Commands: Motion commands (position, speed), Interpolation commands, Parameter read/write, Monitor output
Position Control Functions	Acceleration/ Deceleration Method	Linear first/second-step, asymmetric, exponential, S-curve	
	Fully-closed Control	Impossible	
Input Signals	Signal Allocation Changes Possible	Forward/reverse run prohibited, Zero point return deceleration LS External latch signals 1, 2, 3 Forward/reverse external torque limit	
Internal Functions	Position Data Latch Function	Position data latching is possible using phase C, and external signals 1, 2, 3	
	Protection	Parameters damage, Parameter setting errors, Communications errors, WDT errors	
	LED Indicators	A: Alarm R: MECHATROLINK-I Communicating	A: Alarm R: MECHATROLINK-I/II Communicating

(3) Dimensional Drawings (JUSP-NS100/NS115)



Units: mm
Approx. mass: 0.2 kg

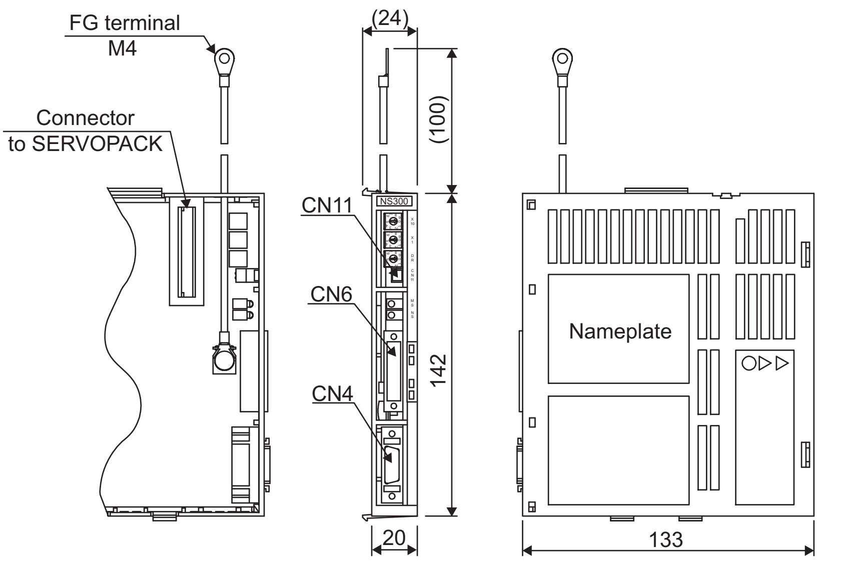
5.5.16 DeviceNet Application Module

(1) Model: JUSP-NS300

(2) Specifications

Item		Details
Applicable SERVOPACK		All SGDH-□□□EB models
Installation Method		Mounted on the SGDH SERVOPACK side: CN10.
Basic Specifications	Power Supply Method	Supplied from the SERVOPACK control power supply.
	Power Consumption	1.3 W
DeviceNet Communications	Baud Rate Setting	Select from 125 kbps, 250 kbps, or 500 kbps using a rotary switch.
	Node Address Setting	Select the address from 0 to 63 using the rotary switches.
Command Format	Operation Specifications	Positioning using DeviceNet communications.
	Reference Input	DeviceNet communications Commands: Motion commands (position, speed), and Parameter read/write
Position Control Functions	Acceleration/ Deceleration Method	Linear first/second-step, asymmetric, exponential, S-curve
	Fully Closed Control	Possible
Input Signals	Fixed Allocation to SERVOPACK CN1 Connector	Forward/reverse run prohibited, Zero point signal, External positioning signal, Zero point return deceleration limit switch
Internal Functions	Position Data Latch Function	Position data latching is possible using phase C, zero point signals, and external signals.
	Protection	Parameters damage, Parameter setting errors, Communications error, etc.
	LED Indicators	MS: Module Status NS: Network Status

(3) Dimensional Drawings



Units: mm
Approx. mass: 0.2 kg

5.5.17 PROFIBUS-DP Application Module

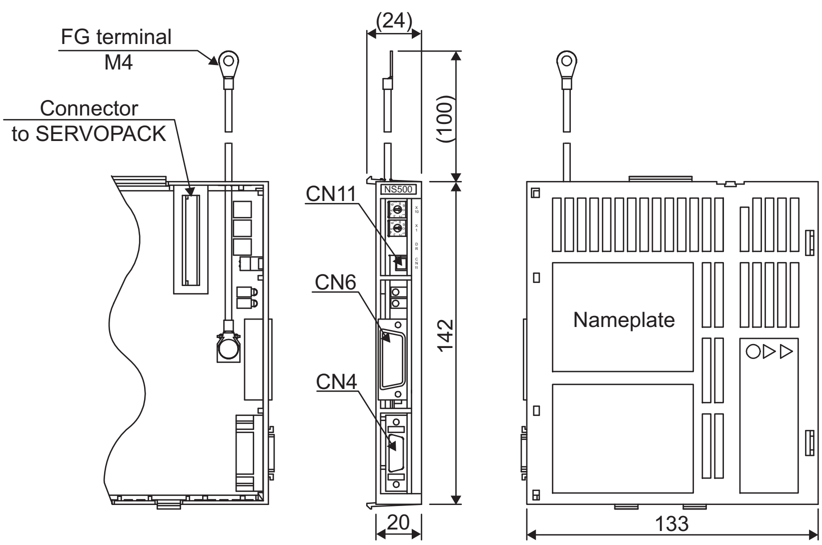
(1) Model: JUSP-NS500

(2) Specifications

Item		Details
Applicable SERVOPACk		All SGDH-□□□EB models
Installation Method		Mounted on the SGDH SERVOPACK side: CN10.
Basic Specifications	Power Supply Method	Supplied from the SERVOPACK control power supply.
	Power Consumption	1.3 W
PROFIBUS-DP Communications	Baud Rate Setting	The baud rate is automatically set by the Master between 9.6 kbps and 12 Mbps.
	Station Address Setting	Select the address from 0 to 7D (0 to 125) using the rotary switches.
Command Format	Operation Specifications	Positioning using PROFIBUS-DP communications
	Reference Input	PROFIBUS-DP communications Commands: Motion commands (position, speed), Parameter read/write
Position Control Functions	Acceleration/ Deceleration Method	Linear first/second-step, asymmetric, exponential, S-curve
	Fully Closed Control	Possible
Input Signals	Fixed Allocation to SERVOPACK CN1 Connector	Forward/reverse run prohibited, Zero point return deceleration LS, Zero point signal, External positioning signal
	NS500 Module	Emergency stop signal
Output Signals	SERVOPACK CN1 Connector*	Servo alarm, Brake interlock, Servo ready, Positioning completion
	NS500 Module	Notch 1, notch 2
Internal Functions	Position Data Latch Function	Position data latching is possible using phase C, zero point signals, and external signals.
	Protection	Parameters damage, Parameter setting errors, Communications errors, etc.
	LED Indicators	ERR: Module Error COMM: Communications Status

* The allocation of the output signals for brake interlock, servo ready, or positioning completion can be changed using parameter settings.

(3) Dimensional Drawings



Units: mm
Approx. mass: 0.2 kg

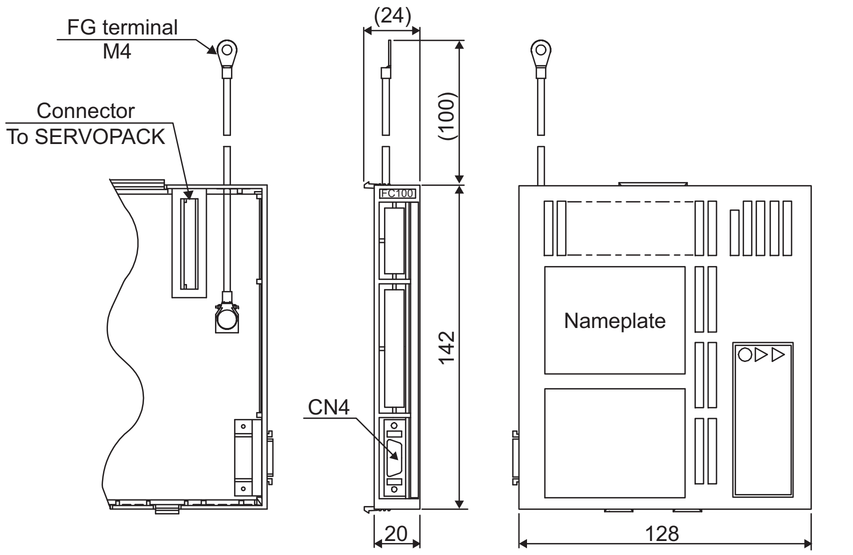
5.5.18 Fully-closed Application Module

(1) Model: JUSP-FC100

(2) Specifications

Item		Details
Applicable SERVOPACK		All SGDH-□□□EB models
Installation Method		Mounted on the SGDH SERVOPACK side: CN10.
Basic Specifications	Power Supply Method	Supplied from the SERVOPACK control power supply.
	Power Consumption	0.5 W or less
Fully Closed System Specifications	Fully-closed Encoder Pulse Output Form	5 V differential line-driver output (complies with EIA Standard RS-422A)
	Fully-closed Encoder Pulse Signal Form	90° Phase difference 2-phase differential pulse (phase A, phase B)
	Maximum Receivable Frequency for SERVOPACK	1 Mbps
	Power Supply for Fully-closed Encoder	To be prepared by customer.
Internal Functions	Protection	Detecting fully-closed encoder disconnection
	LED Indicators	Setting with the parameters

(3) Dimensional Drawings



Units: mm
Approx. mass: 0.2 kg

6

Wiring

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 300 mm.
  Failure to observe this caution may result in malfunction.
- 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.
- 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 turned OFF first before starting an inspection.
- Avoid frequently turning power ON and OFF.
  Since 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 such as capacitors and fuses to deteriorate, resulting in unexpected problems.

6.1.1 Names and Functions of Main Circuit Terminals

(1) SERVOPACK main circuit terminal functions and descriptions

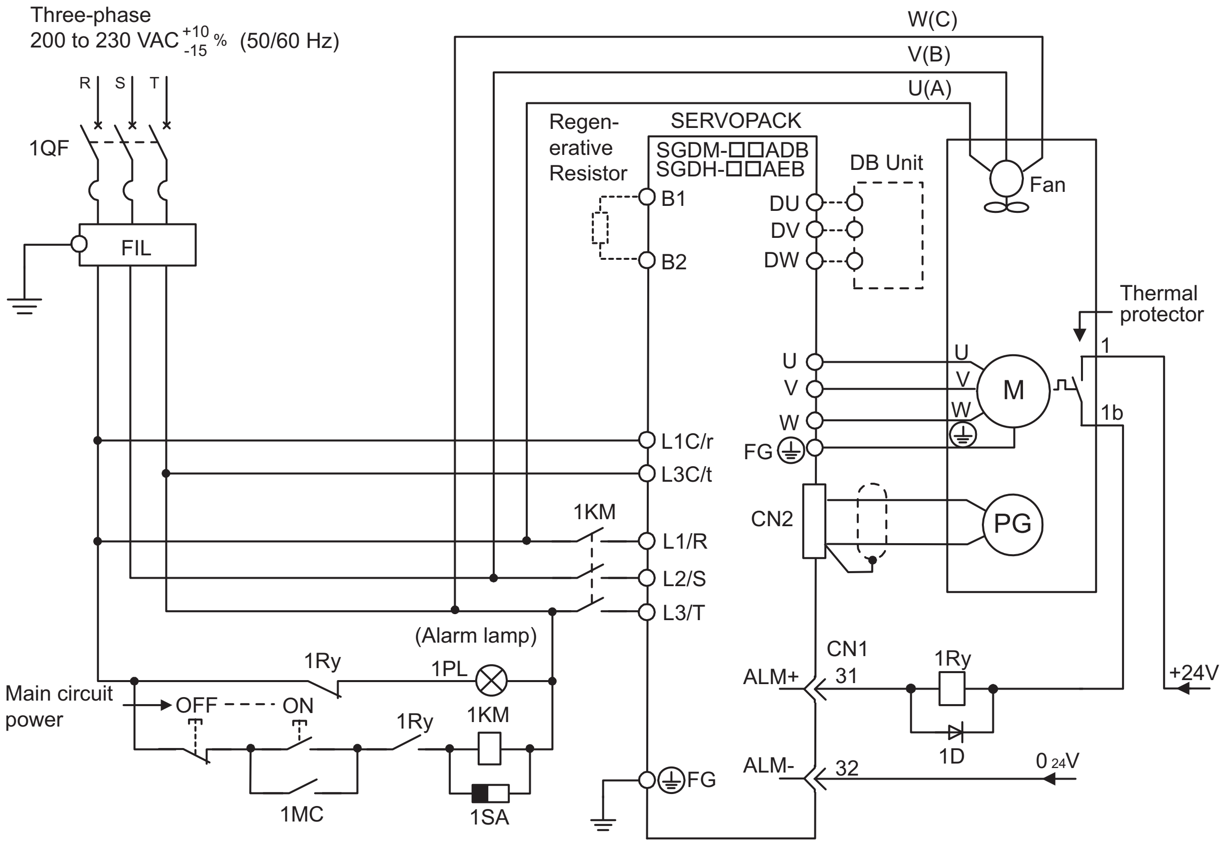
Terminal Symbol	External Terminal Name	Main Circuit Voltage (V)	Functions
L1/R, L2/S, L3/T	Main circuit power supply input terminal	200	Three-phase 200 to 230 VAC$^{+10\%, -15\%}$ (50/60 Hz)
		400	Three-phase 380 to 480 VAC$^{+10\%,-15\%}$ (50/60 Hz)
U, V, W	Servomotor connection terminals	–	Connects to the servomotor.
L1C/r, L3C/t	Control circuit power supply input terminal	200	Single-phase 200 to 220 VAC$^{+10\%, -15\%}$ (50 Hz) Single-phase 200 to 230 VAC$^{+10\%, -15\%}$ (60 Hz)
DC24P, DC24N		400	24 VDC (±15%)
⏚	Ground terminals	–	Connects to the power supply ground terminals and servomotor ground terminal.
B1, B2	Regenerative resistor connection terminal	–	Connects to the regenerative resistor.
0 V, 380 V, 400 V, 440 V, 460 V, 480 V	Input terminal for actuator control	400	Single-phase 380 to 480 VAC (50/60 Hz) Power input terminals for the fan or contactor.
DU, DV, DW	Dynamic brake unit connection terminal	–	Connects the dynamic brake unit.
DBON, DB24	Dynamic brake unit connection terminal	–	Connects to the DBON and DB24 terminals of the dynamic brake unit (only when using 37 kW or more SERVOPACK).

(2) Servomotor terminal names and description

Terminal Symbol	External Terminal Name	Main Circuit Voltage (V)	Functions
U, V, W	SERVOPACK connection terminal	−	Connects to the U, V and W terminals of the SERVOPACK.
U (A), V (B), W (C)	Fan terminal	200	Three-phase 200 to 230 VAC$^{+10\%,\ -15\%}$ (50/60 Hz)
		400	Three-phase 380 to 480 VAC$^{+10\%,-15\%}$ (50/60 Hz)
A, B	Brake power supply connection terminal (only when using servomotors with brakes)	−	Connects the brake power supply.
1, 1b	Thermal protector terminal	−	Used to detect overheating of the servomotor and to open the thermal protector circuit. Use a sequence that turns the SERVOPACK's main circuit power supply OFF or the servo OFF when the thermal protector circuit opens.

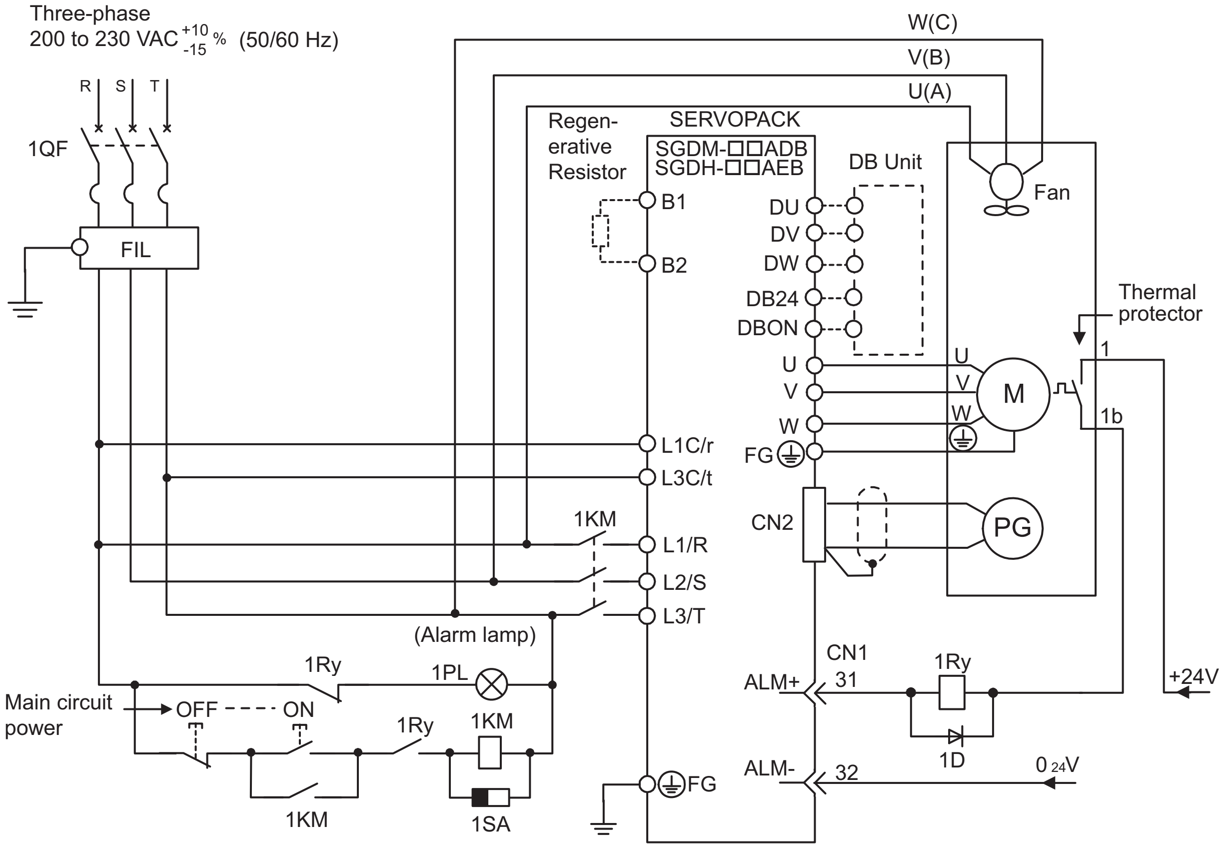
6.1.2 Typical Main Circuit Wiring Examples

(1) Three-phase 200 V, 22 kW and 30 kW SERVOPACKs



1QF	: Circuit breaker (for inverters)	1PL	: Lamp for display
FIL	: Noise filter	1SA	: Surge absorber
1KM	: Contactor	1D	: Flywheel diode
1Ry	: Relay		

(2) Three-phase 200 V, 37 kW SERVOPACK

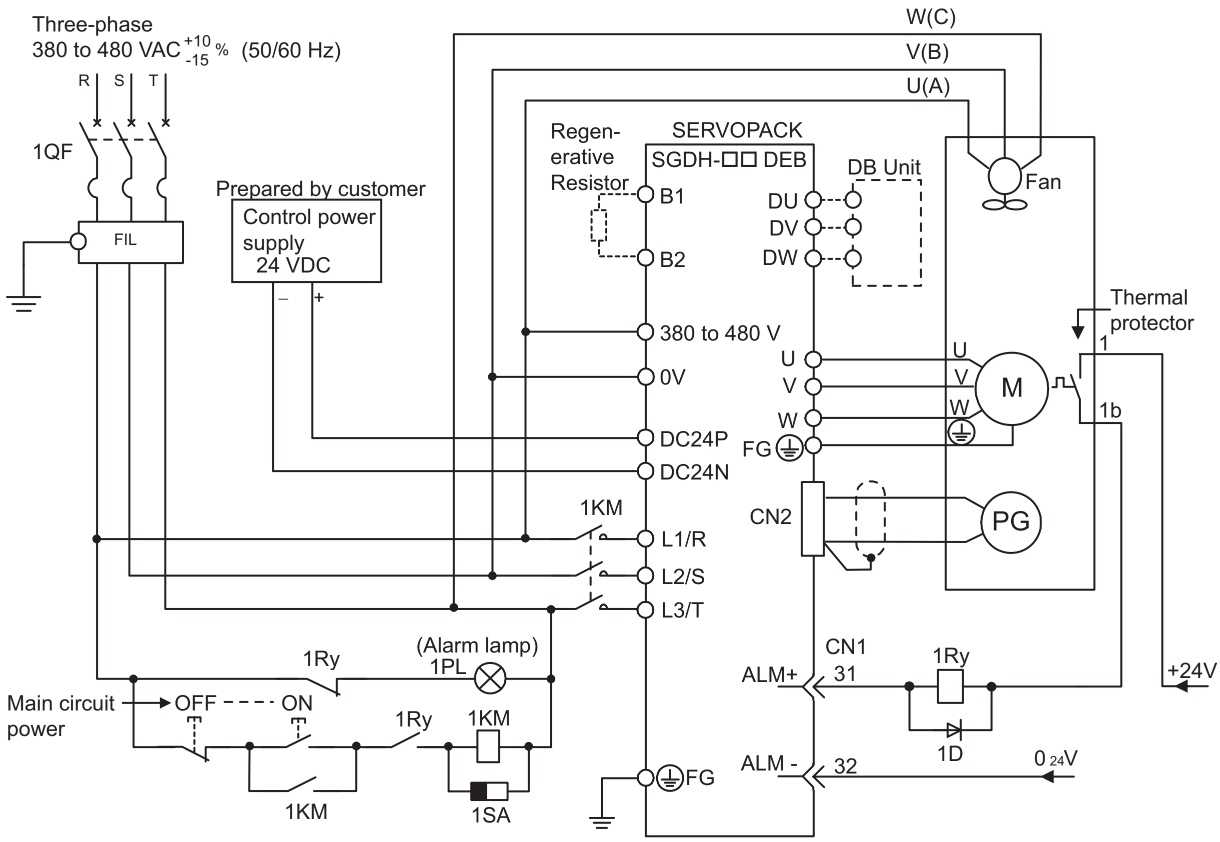


1QF	: Circuit breaker (for inverters)	1PL	: Lamp for display
FIL	: Noise filter	1SA	: Surge absorber
1KM	: Contactor	1D	: Flywheel diode
1Ry	: Relay		

Wiring

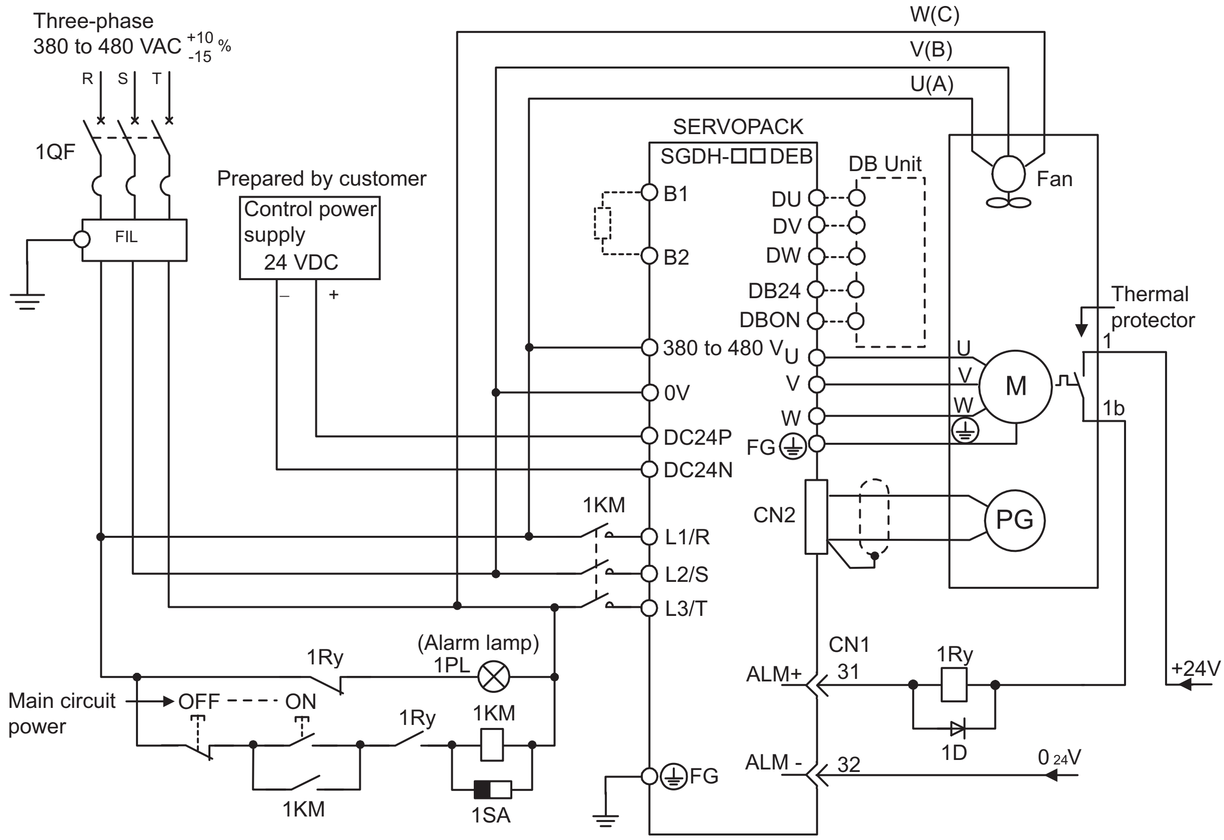
6

(3) Three-phase 400 V, 22 kW and 30 kW SERVOPACKs



1QF	: Circuit breaker (for inverters)	1PL	: Lamp for display
FIL	: Noise filter	1SA	: Surge absorber
1KM	: Contactor	1D	: Flywheel diode
1Ry	: Relay		

(4) Three-phase 400 V, 37 kW to 90 kW SERVOPACKs



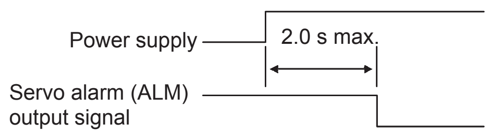
1QF	: Circuit breaker (for inverters)	1PL	: Lamp for display
FIL	: Noise filter	1SA	: Surge absorber
1KM	: Contactor	1D	: Flywheel diode
1Ry	: Relay		

IMPORTANT

■Designing a Power ON Sequence

Note the following points when designing the power ON sequence.

- Design the power ON sequence so that main circuit power supply is turned OFF when a servo alarm signal is output. See the previous circuit figure.
- Hold the power ON button for at least two seconds. The SERVOPACK will output (1Ry is OFF) a servo alarm signal for two seconds or less when power is turned ON. This is required in order to initialize the SERVOPACK.



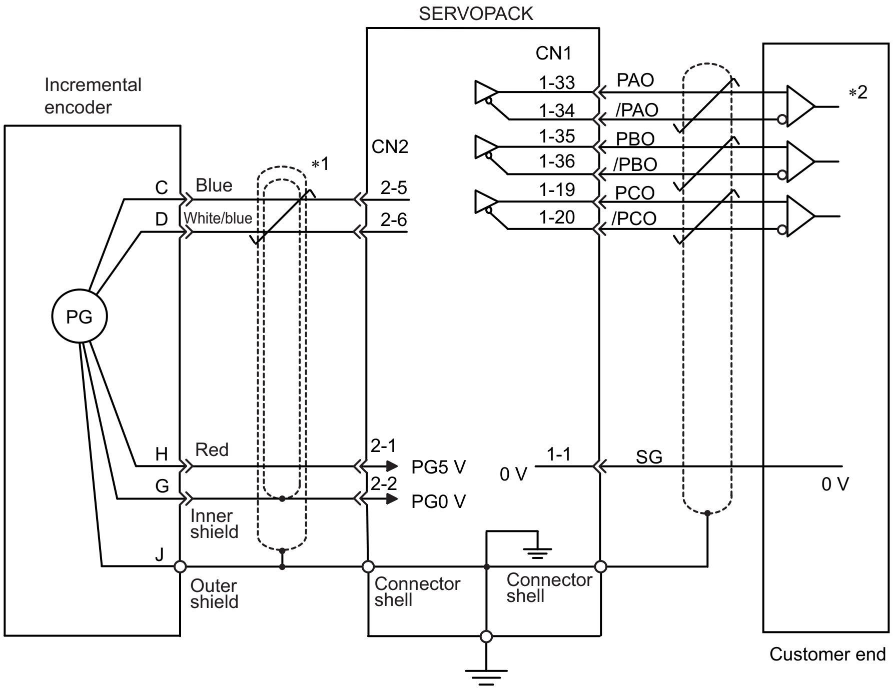
- Select the power supply specifications for the parts in accordance with the input power supply.

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)

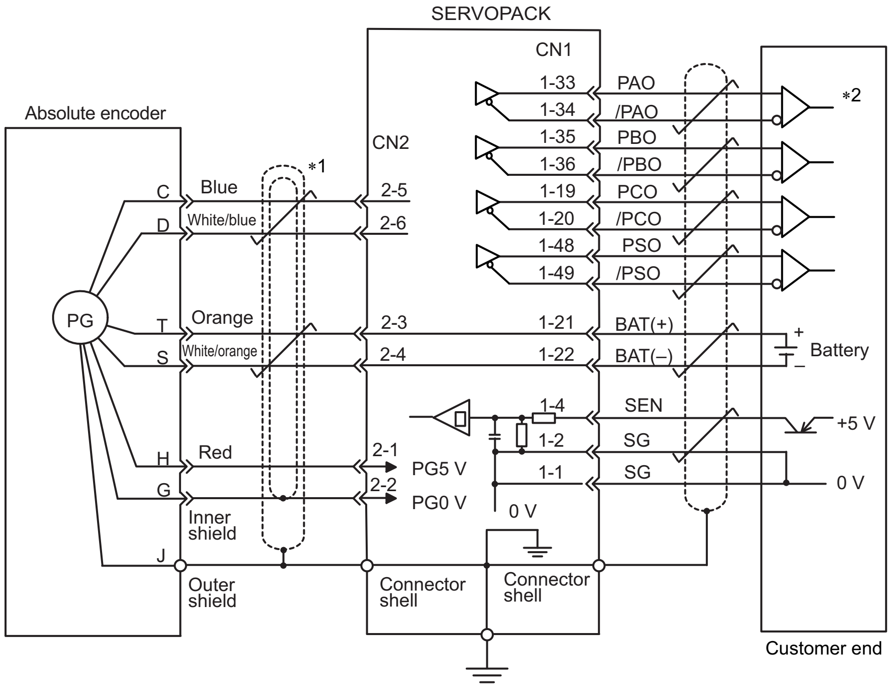
(1) Incremental Encoders

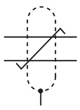


* 1. : represents twisted-pair wires.

* 2. Applicable line receiver: SN75175 manufactured by Texas Instruments or the equivalent.

(2) Absolute Encoders



* 1.  : represents twisted-pair wires.

* 2. Applicable line receiver: SN75175 manufactured by Texas Instruments or the equivalent.

6.2.2 Encoder Connector (CN2) 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

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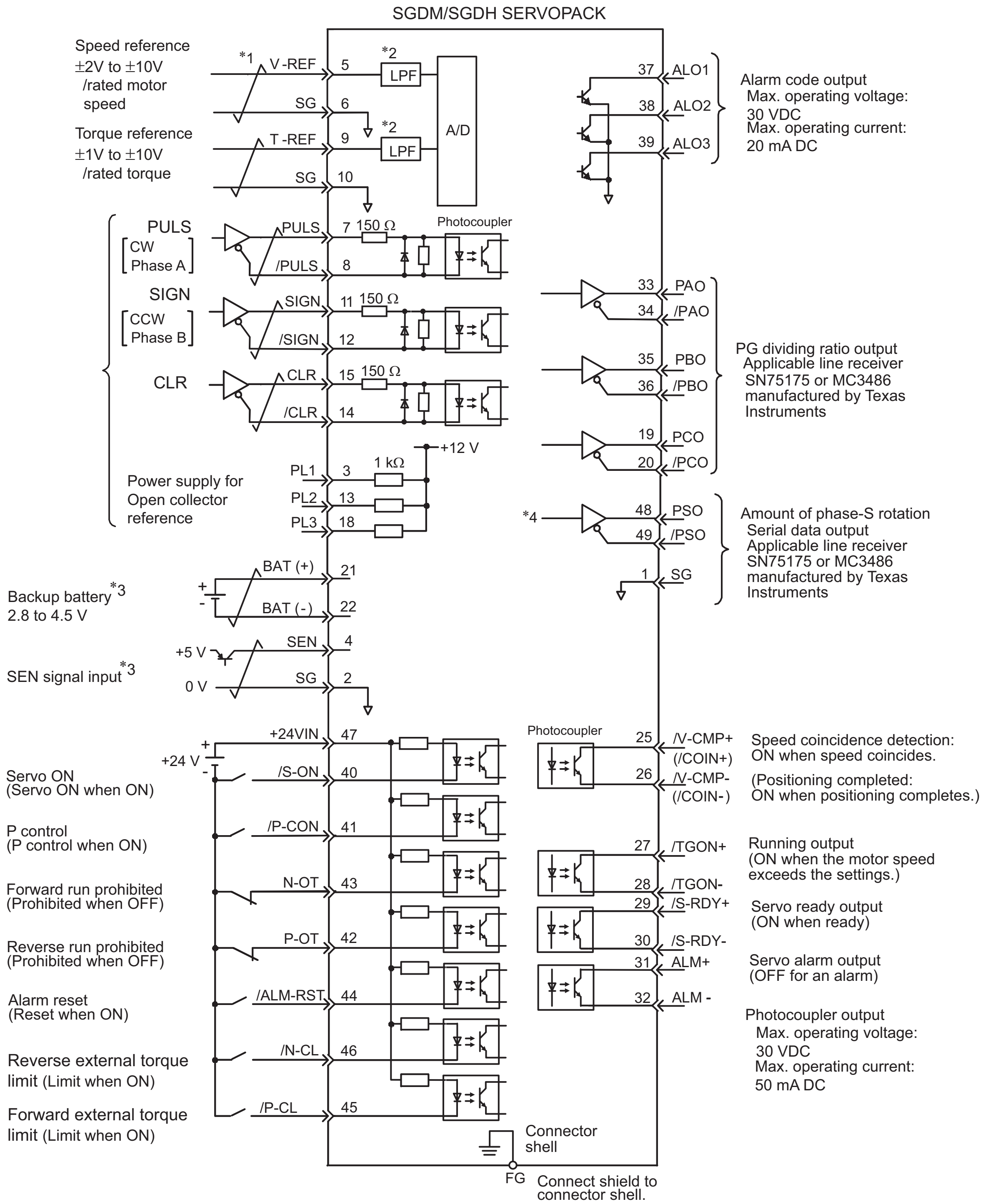
6.3 I/O Signal Connections

6.3.1 Example of I/O Signal Connection



* 1. represents twisted-pair wires.

* 2. The time constant for the primary filter is 47 μs.

* 3. Connect a backup battery when using an absolute encoder.

* 4. Enabled when using the absolute encoder.

6.3.2 I/O Signal Connector (CN1) Terminal Layout

The following diagram shows the terminal layout and the signals that are preset before shipping.

Pin Number	Signal Name	Function	Pin Number	Signal Name	Function	Pin Number	Signal Name	Function	Pin Number	Signal Name	Function
2	SG	GND	1	SG	GND	27	/TGON+	Running signal output	26	/V-CMP- (/COIN-)	Speed coincidence detection output
4	SEN	SEN signal input	3	PL1	Open-collector reference power supply	29	/S-RDY+	Servo ready output	28	/TGON-	Running 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	PL2	Open-collector reference power supply	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	PL3	Open-collector reference power supply	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	/PSO	Phase-S signal output	48	PSO	Phase-S signal output
			25	/V-CMP+ (/COIN+)	Speed coincidence detection output				50	–	–

Notes: 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.
- Input signals: /S-ON, /P-CON, P-OT, N-OT, /ALM-RST, /P-CL, and /N-CL
- Output signals: /TGON, /S-RDY, and /V-CMP (/COIN)
- The above output signals can be changed to /CLT, /VLT, /BK, /WARN, and /NEAR.

6.3.3 I/O Signal (CN1) Names and Functions

(1) Input Signals

Signal Name		Pin No.	Function		Reference
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 9.4.4
			Direction reference	With the internally set speed selection: Switch the rotation direction.	8.8.2
			Control mode switching	Position ↔ speed Position ↔ torque Torque ↔ speed Enables control mode switching.	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	External torque limit function enabled when ON.	8.9.2
			Internal speed switching	With the internally set speed selection: Switches the internal speed settings.	8.8.2 8.10.2
	/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		6.3.4
	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 a battery is connected to the host controller.		6.2.1 8.4.3
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
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
Position	PULS /PULS SIGN /SIGN	7 8 11 12	Reference pulse input for line driver and open collector	Input mode is set from the following pulses. • Sign + pulse string • CCW/CW pulse • Two-phase pulse (90° phase differential)	8.6.1
	CLR /CLR	15 14	Positional error pulse clear input: Clears the positional error pulse during position control.		8.6.1
	PL1 PL2 PL3	3 13 18	+12 V pull-up power is supplied when PULS, SIGN, and CLR reference signals are open-collector outputs (+12 V power supply is built into the SERVOPACK).		6.3.4 8.6.3

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

Signal Name		Pin No.	Function		Reference
Common	ALM+ ALM-	31 32	Servo alarm: Turns OFF when an error is detected.		8.11.1
	/TGON+ /TGON-	27 28	Detection during servomotor rotation: Detects when the servomotor is rotating at a speed higher than the motor speed setting. Detection speed can be set by using the parameters.		8.11.3
	/S-RDY+ /S-RDY-	29 30	Servo ready: ON if there is no servo alarm when the control/main circuit power supply is turned ON.		8.11.4
	PAO /PAO	33 (1) 34	Phase-A signal	Converted two-phase pulse (phases A and B) encoder output signal and zero-point pulse (phase C) signal: RS-422 or the equivalent (Proper line receiver is SN75175 manufactured by Texas Instruments or the equivalent corresponding to MC3486.)	8.4.6 8.5.7
	PBO /PBO	35 36	Phase-B signal		
	PCO /PCO	19 20	Phase-C signal		
	PSO /PSO	48 49	Phase-S signal	With an absolute encoder: Outputs serial data corresponding to the number of revolutions (RS-422 or the equivalent)	
	ALO1 ALO2 ALO3	37 38 39 (1)	Alarm code output: Outputs 3-bit alarm codes. Open-collector: 30 V and 20 mA rating maximum		8.11.1
	FG	Shell	Connected to frame ground if the shield wire of the I/O signal cable is connected to the connector shell.		–
Speed	/V-CMP+ /V-CMP-	25 26	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.		8.5.8
Position	/COIN+ /COIN-	25 26	Positioning completed (output in Position Control Mode): Turns ON when the number of positional error pulses reaches the value set. The setting is the number of positional error pulses set in reference units (input pulse units defined by the electronic gear).		8.6.5
Reserved	/CLT /VLT /BK /WARN /NEAR	–	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.		8.3.4 8.6.6 8.7.4 8.9.5 8.11.2
	–	16 17 23 24 50	Terminals not used Do not connect relays to these terminals.		–

Notes: 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.

6.3.4 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

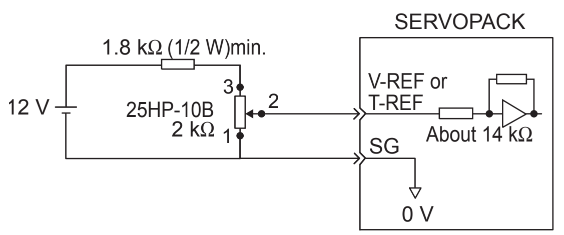
CN1 connector terminals, 5-6: Speed reference input and 9-10: Torque reference input are explained below.

Analog signals are either speed or torque reference signals at the impedance below.

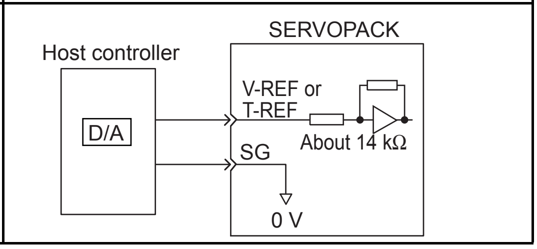
- Reference speed input: About 14 kΩ
- Reference torque input: About 14 kΩ

The maximum allowable voltages for input signals is ±12 V.

Analog Voltage Input Circuit



Analog Voltage Input Circuit (D/A)

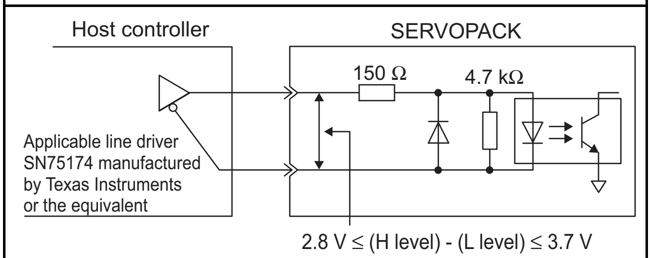


(b) Position Reference Input Circuit

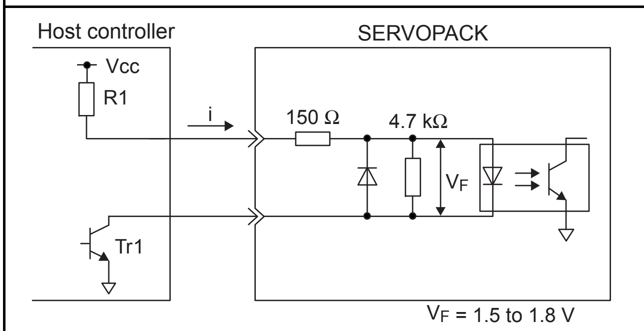
CN1 connector terminals, 7-8: Reference pulse input, 11-12: Reference code input and 15-14: Clear input are explained below.

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



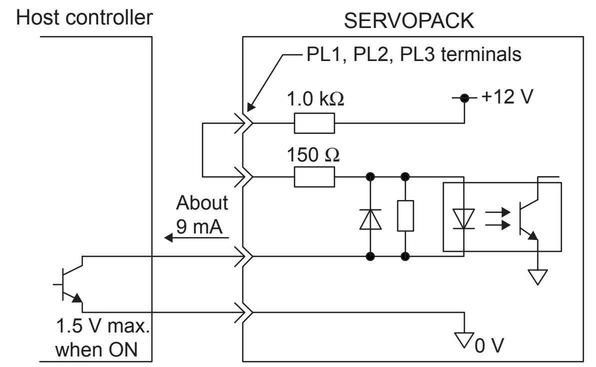
Open-collector Output, Example 1:
Power Supply Provided by User



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%

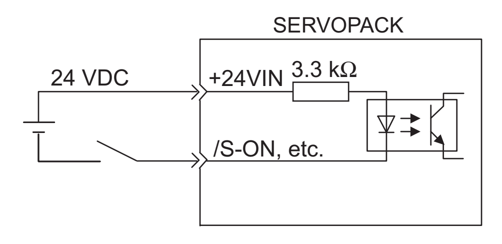
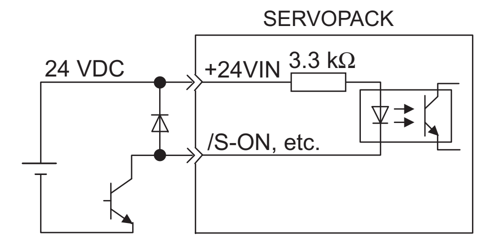
Open-collector Output, Example 2:
Using 12-V Power Supply Built into SERVOPACK,
Non-insulated Input



(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.

Relay Circuit Example	Open-collector Circuit Example
	

Note: The 24 VDC external power supply capacity must be 50 mA minimum.

(3) 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), zero-point pulse signals (PCO, /PCO), and the amount of phase-S rotation signal 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.

Wiring

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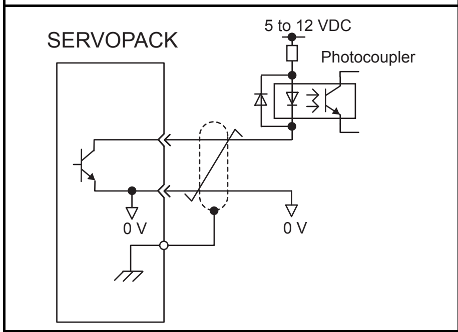
(b) Open-collector Output Circuit

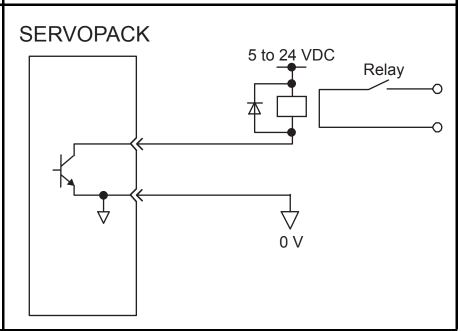
CN1 connector terminals 37 to 39: Alarm code output are explained below.

Alarm code signals (ALO1, ALO2, ALO3) are output from open-collector transistor output circuits. Connect an open-collector output circuit through a photocoupler, relay circuit, or line receiver circuit.

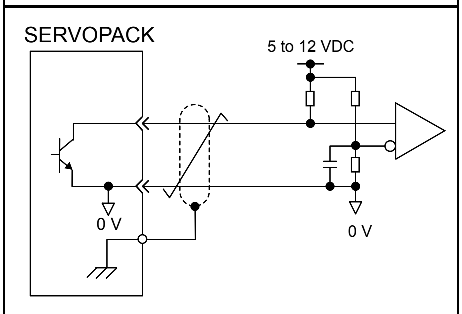
Photocoupler Circuit Example



Relay Circuit Example



Line Receiver Circuit Example



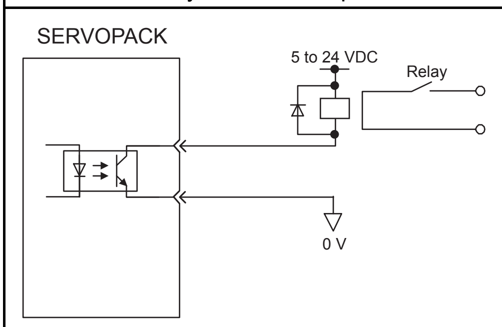
Note: The maximum allowable voltage and current capacities for open-collector output circuits are as follows:

- Voltage: 30 VDC
- Current: 20 mA DC

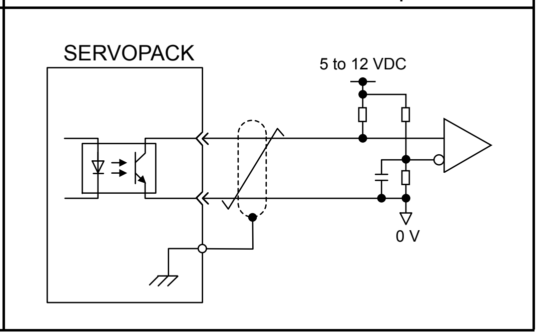
(c) Photocoupler Output Circuit

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 circuit 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 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 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 magnetic 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 300 mm. 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 SERVOPACK connects directly to a commercial power supply without a transformer, so always use a QF or fuse to protect the SERVOPACK from accidental high voltage.
7. The SERVOPACKs do not have built-in ground protection circuits. To configure a safer system, install an earth leakage breaker for protection against 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

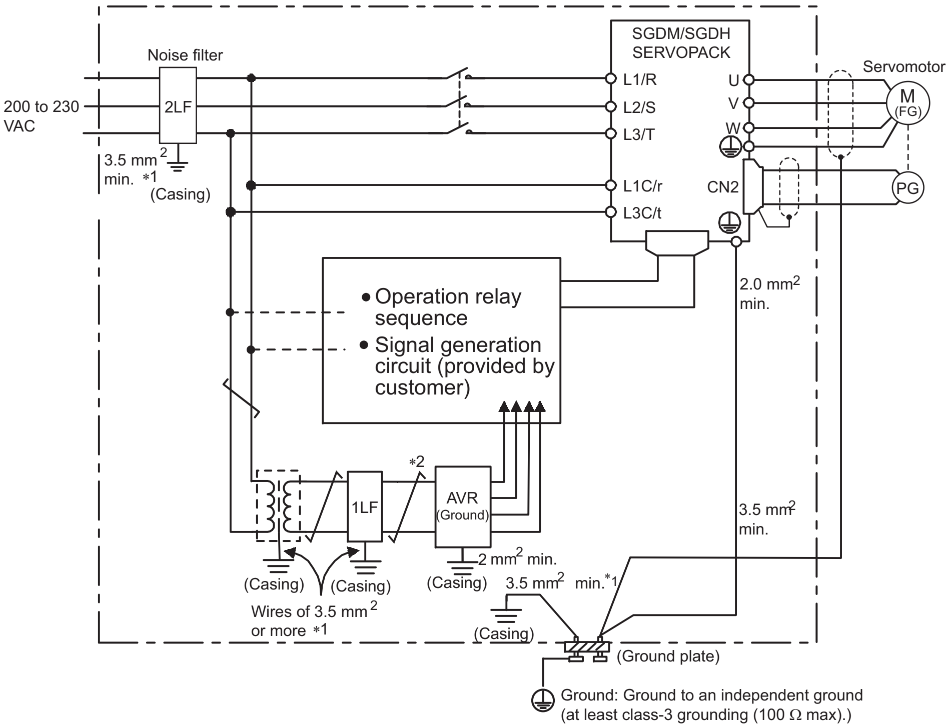
(1) Wiring Example

The SERVOPACK uses high-speed switching elements in the main circuit. It may receive “switching noise” from these high-speed switching elements if the processing of wiring or grounding around the SERVOPACK is not appropriate. To prevent this, always wire and ground the SERVOPACK correctly.

The SGDH 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.

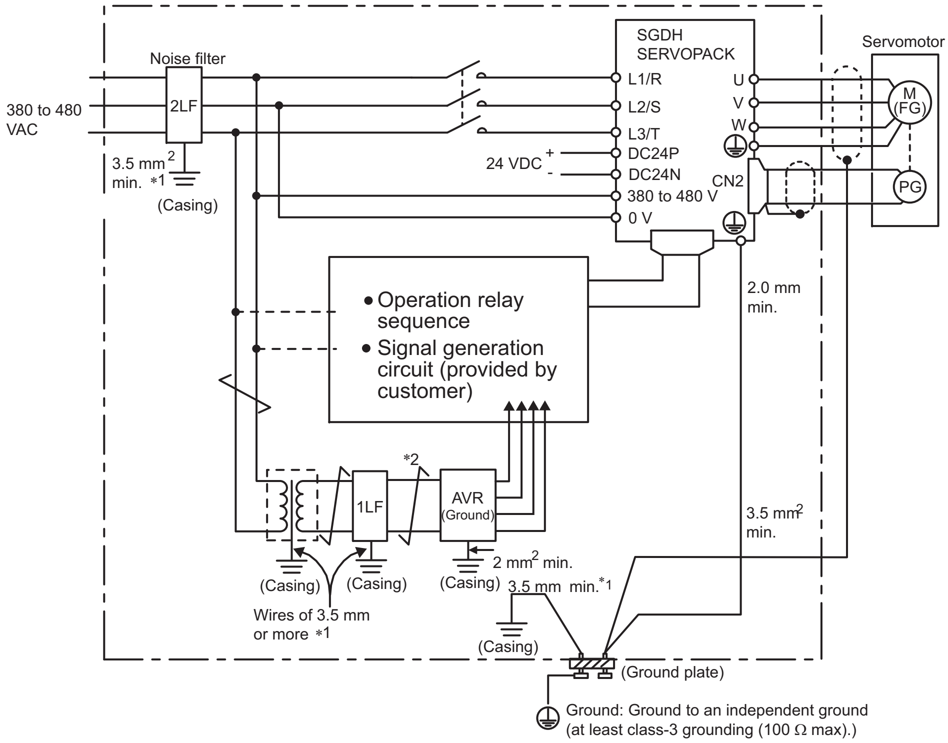
The following is an example of wiring for noise control.

When using a noise filter, follow the precautions in *(3) Using Noise Filters.*



* 1. For ground wires connected to the casing, use a thick wire with a thickness of at least 3.5 mm (preferably, plain stitch copper wire).

* 2. : represents twisted-pair wires.



* 1. For ground wires connected to the casing, use a thick wire with a thickness of at least 3.5 mm (preferably, plain stitch copper wire).

* 2. : represents twisted-pair wires.

(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.

Wiring

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(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.

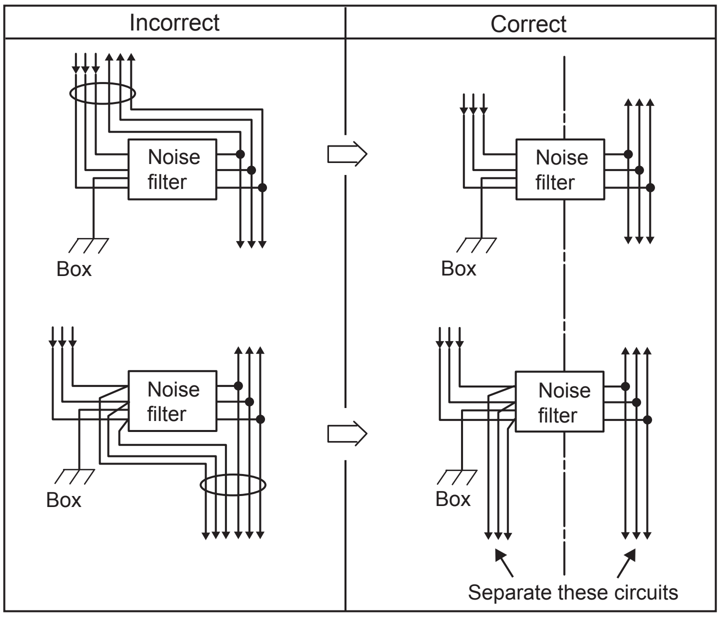
Voltage	SERVOPACK Model	Recommended Noise Filters		
		Model	Specifications	Manufacturer
Three-phase 200 V	SGDM-2BADB SGDH-2BAEB	FN258L-130-35	480 VAC, 130 A	Schaffner
	SGDM-3ZADB SGDH-3ZAEB	FN258L-180-07	480 VAC, 180 A	
	SGDM-3GADB SGDH-3GAEB	FN359P-250-99	480 VAC, 250 A	
Three-phase 400 V	SGDH-2BDEB	FN258L-180-07	480 VAC, 180 A	
	SGDH-3ZDEB	FN258L-180-07	480 VAC, 180 A	
	SGDH-3GDEB	FN258L-180-07	480 VAC, 180 A	
	SGDH-4EDEB	FN359P-250-99	480 VAC, 250 A	
	SGDH-5EDEB	FN359P-250-99	480 VAC, 250 A	
	SGDH-9ZDEB	FN359P-300-99	A480 VAC, 300 A	

IMPORTANT

■Precautions when using noise filter

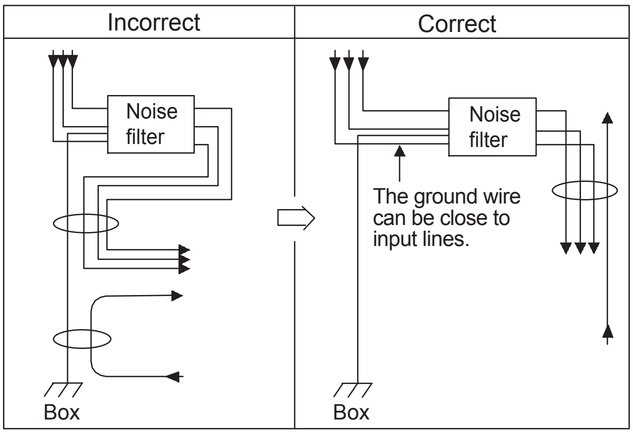
Always observe the following installation and wiring instructions. Incorrect use of a noise filter halves its benefits.

1. Do not put the input and output lines in the same duct or bundle them together.



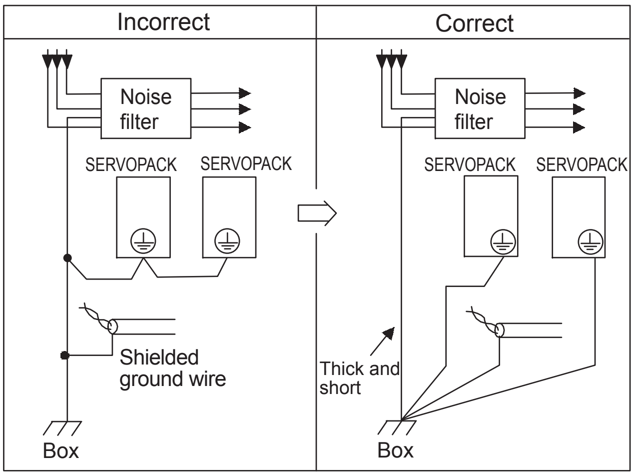
2. Separate the noise filter ground wire from the output lines.

   Do not accommodate the noise filter ground wire, output lines, and other signal lines in the same duct or bundle them together.



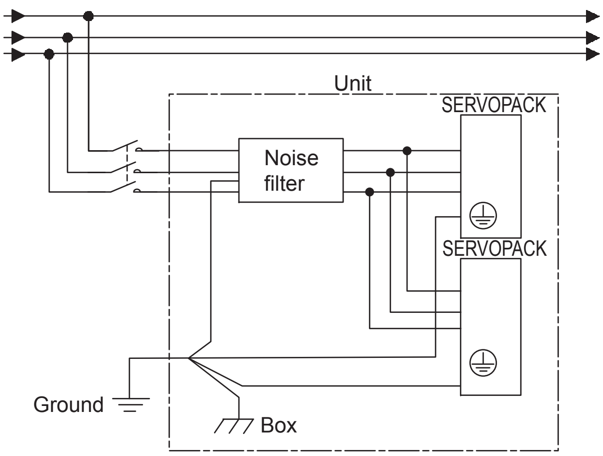
3. Connect the noise filter ground wire directly to the ground plate.

   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.



Wiring

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6.4.3 Using More Than One SERVOPACK

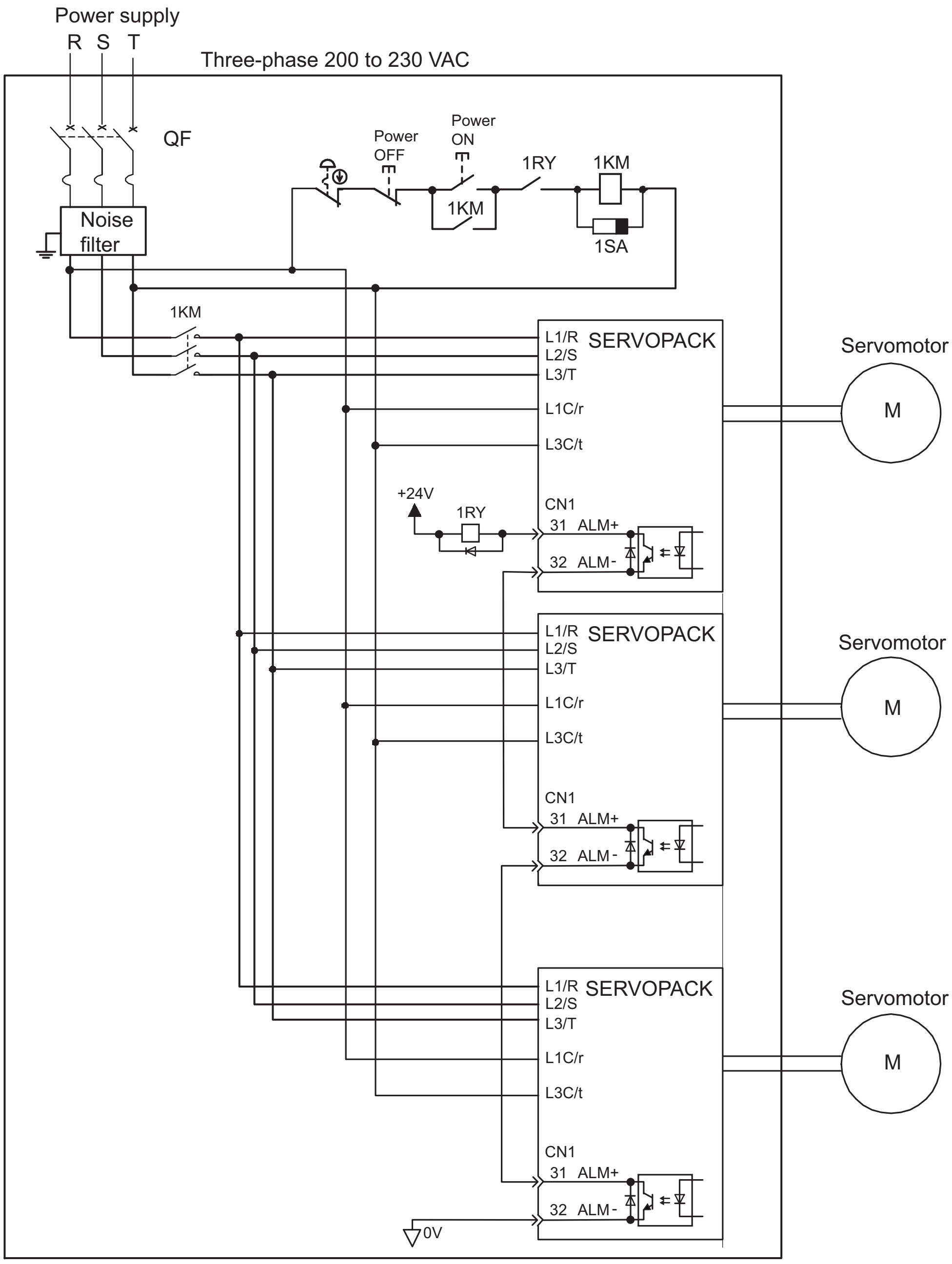
The following diagram is an example of the wiring when more than one SERVOPACK is used.

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.

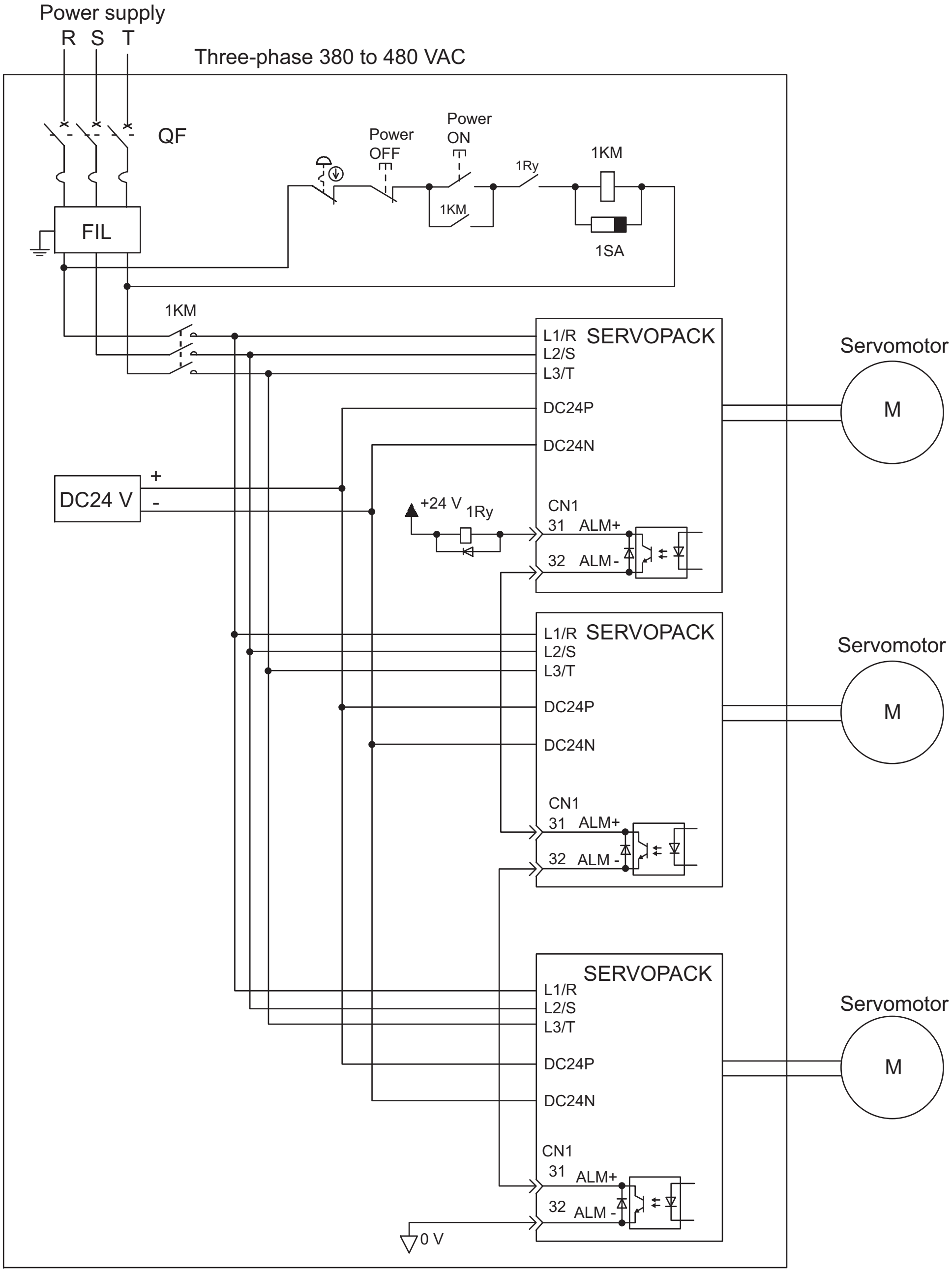
Multiple servos can share a single molded-case circuit breaker (QF) or noise filter. Always select a QF or noise filter that has enough capacity for the total power capacity (load conditions) of those servos. For details, refer to *2.5.2 Molded-case Circuit Breaker and Fuse Capacity*.

(1) Three-phase 200 VAC: SGDM-□□ADB/SGDH-□□AEB



Note: Wire the system, so that the phase-S power supply will be the ground phase.

(2) Three-phase 400 VAC: SGDH-☐☐DEB

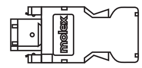
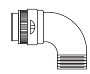
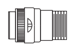
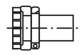


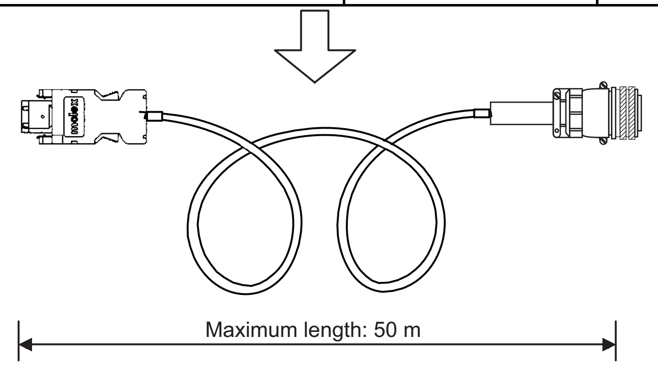
Note: Wire the system, so that the phase-S power supply will be the ground phase.

6.4.4 Extending Encoder Cables

Standard encoder cables have a maximum length of 20 m. If a longer cable is required, prepare an extension cable as described below. The maximum allowable cable length is 50 m.

For the encoder cable specifications, refer to *5.3 Connectors and Cables for Encoder Signals*.

Name		Type	Specifications
SERVOPACK-end connector kit	Plug for encoder connector (CN2)	JZSP-CMP9-1	
Servomotor-end connector kit	Encoder connector	MS3108B20-29S	L-shaped plug 
		MS3106B20-29S	Straight plug 
		MS3057-12A	Cable clamp 
Cables		JZSP-CMP29-30 JZSP-CMP29-40 JZSP-CMP29-50	50 m max. 



7

Digital Operator/Panel Operator

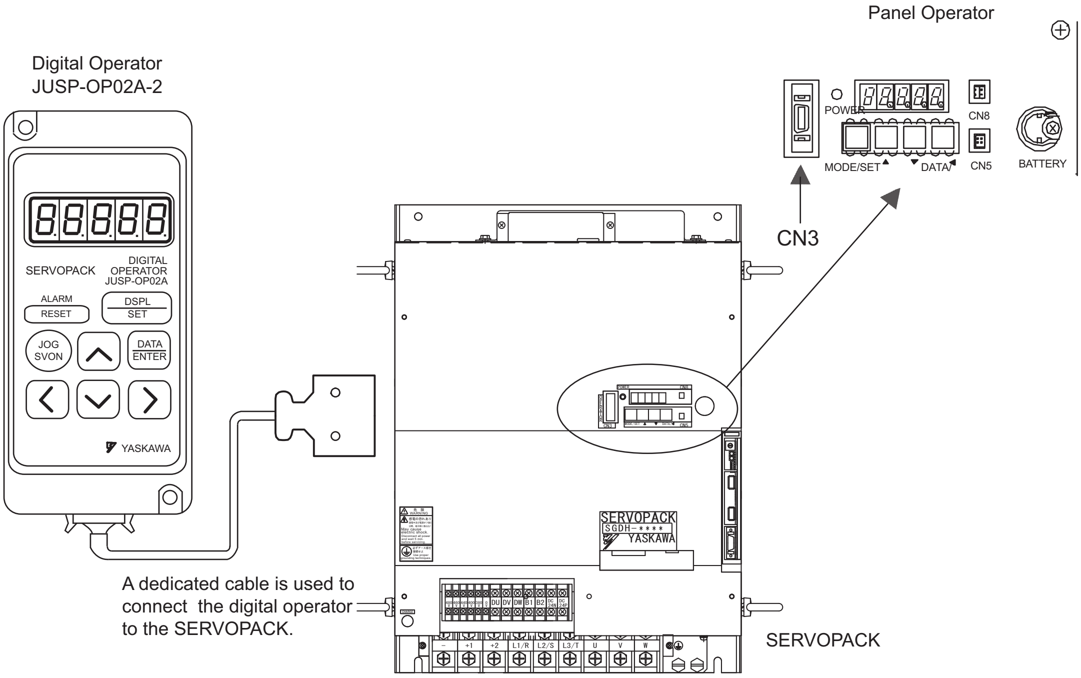
7.1 Functions on Digital Operator/Panel Operator

This section describes the basic operations of the digital operator (hereinafter called the digital operator) and the panel operator (hereinafter called the panel operator) for setting the operating conditions. Set parameters and JOG operation, and display status using these operators. For the operation of the digital operator (model: JUSP-OP02A-2), refer to Σ-II Series SGM☐H/SGDH Digital Operator Operation Manual (TOE-S800-34).

7.1.1 Connecting the Digital Operator

Two types of digital operators are available. One is a built-in operator that has a panel indicator and switches located on the front panel of the SERVOPACK. This type of digital operator is also called a panel operator. The other one is a hand-held operator (JUSP-OP02A-2 digital operator), which can be connected to the SERVOPACK with connector CN3 of the SERVOPACK.

There is no need to turn OFF the SERVOPACK to connect this hand-held operator to the SERVOPACK. Refer to the following illustrations to connect the digital operator to the SERVOPACK.



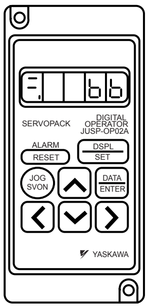
IMPORTANT	If the digital operator is connected to the SERVOPACK, the panel operator does not display anything.

7.1.2 Key Names and Functions

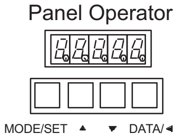
Key names and functions for the digital operator and the panel operator are explained below.

Set parameters and JOG operation, and display status using the panel operator.

Digital Operator



Panel Operator



Key		Function
Digital Operator	Panel Operator	
ALARM RESET (RESET Key)	▲ + ▼ Press simultaneously	To reset the servo alarm. Note 1. The servo alarm can be reset by /ALM-RST (CN1-44) input signal. 2. The servo alarm need not be reset if the control power supply is turned OFF.
DSPL SET (DSPL/SET Key)	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. Can be also used to set the data.
DATA ENTER (DATA/ENTER Key)	DATA/◀ (DATA/SHIFT Key)	To display parameter setting and set value.
(UP Key)	▲ (UP Key)	Press the UP Key to increase the set value. For JOG operation, this key is used as Forward Run Start Key.
(DOWN Key)	▼ (DOWN Key)	Press the DOWN Key to decrease the set value. For JOG operation, this key is used as Reverse Run Start Key.
(RIGHT Key)	–	Press the RIGHT Key to shift to the next digit on the right.
(LEFT Key)	DATA/◀ (DATA/SHIFT Key)	Press the LEFT or DATA/SHIFT Key to shift to the next digit on the left.
JOG SVON (SVON Key)	MODE/SET (MODE/SET Key)	Press the SVON or MODE/SET Key to perform servo ON/OFF in the JOG operation with the operator.

IMPORTANT

When an alarm occurs, remove the cause, and then reset the alarm. Refer to *10.1 Troubleshooting*.

Digital Operator/Panel Operator

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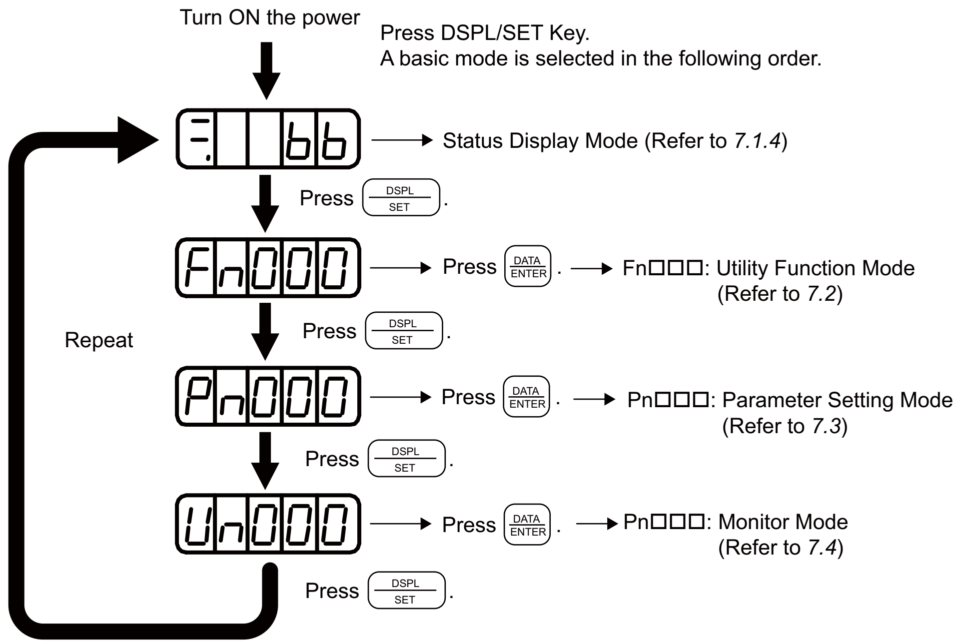
7.1.3 Basic Mode Selection and Operation

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.

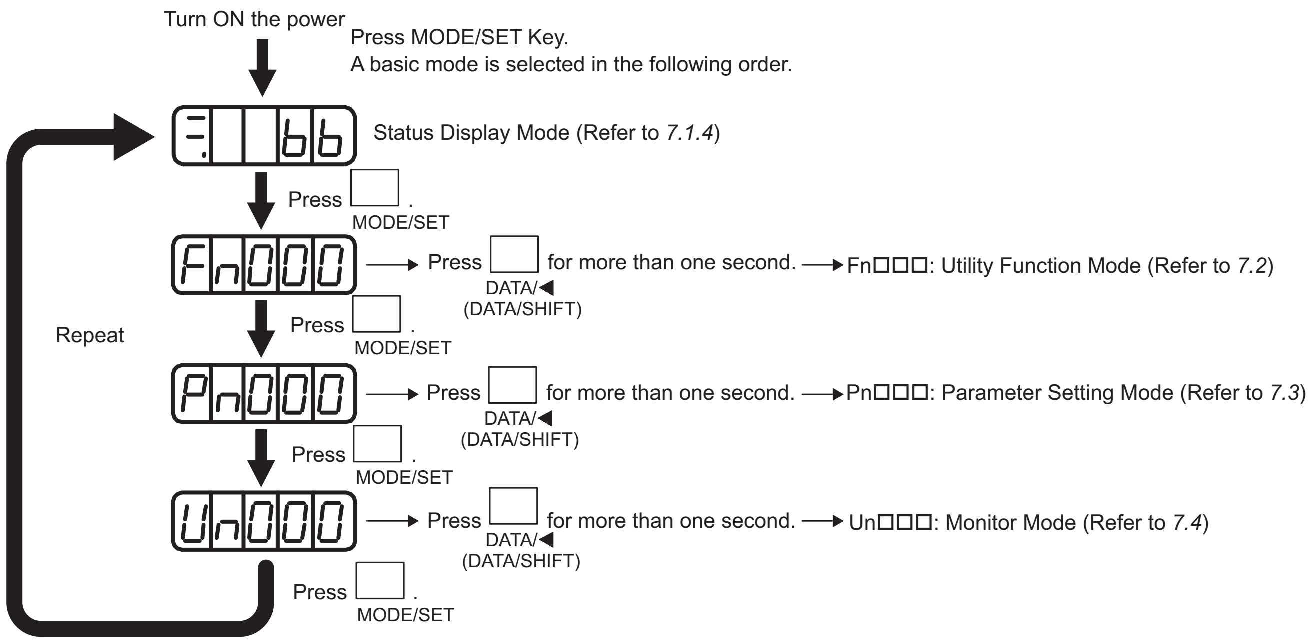
The basic mode is selected in the following order.

(1) Using the Digital Operator



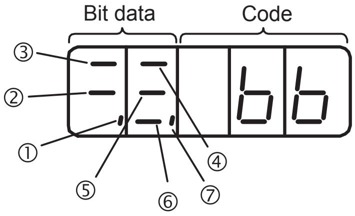
Press DATA/ENTER Key and UP or DOWN Key to select the desired parameter number.
Then, press DATA/ENTER Key to display the contents of selected parameter number in the selected mode. (Refer to each operation instruction described later.)

(2) Using the Panel Operator



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.)

7.1.4 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 supply 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 motor speed and reference speed is the same as or less than the value set in Pn503. (Factory setting is 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 Pn500 (Factory setting is 7 reference units.)
④	Servomotor Rotation Detection (/TGON)	Lit if motor speed exceeds preset value. Not lit if motor speed is below preset value. Preset value: Set in Pn502 (Factory setting is 20 min^{-1}.)	Servomotor Rotation Detection (/TGON)	Lit if motor speed exceeds preset value. Not lit if motor speed is below preset value. Preset value: Set in Pn502 (Factory setting is 20 min^{-1}.)
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 (Factory setting is 20 min^{-1}.)	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% of rated torque	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 circuit power supply is ON and normal. Not lit when main circuit power supply power is OFF.	Power Ready	Lit when main circuit power supply is ON and normal. Not lit when main circuit power supply power is OFF.

Digital Operator/Panel Operator

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(2) Codes and Meanings

Code	Meaning
bb	Baseblock Servo OFF (motor power OFF)
run	Run Servo ON (motor power ON)
Pot	Forward Run Prohibited CN1-42 (P-OT) is OFF.
not	Reverse Run Prohibited CN1-43 (N-OT) is OFF.
A.02	Alarm Status Displays the alarm number.
A.03 :	

7.2 Operation in Utility Function Mode (Fn□□□)

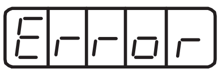
7.2.1 List of Utility Function Modes

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
Fn000	Alarm traceback data display	–
Fn001	Not used for the SERVOPACKs of 22 kW or more.	√
Fn002	JOG mode operation	–
Fn003	Zero-point search mode	–
Fn004	Reserved	–
Fn005	Parameter setting initialization	√
Fn006	Alarm traceback data clear	√
Fn007	Not used for the SERVOPACKs of 22 kW or more.	–
Fn008	Absolute encoder multiturn reset and encoder alarm reset	√
Fn009	Automatic tuning of speed and torque reference offset	√
Fn00A	Manual adjustment of speed reference offset	√
Fn00B	Manual adjustment of torque reference offset	√
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	√
Fn00F	Manual offset-adjustment of motor current detection signal	√
Fn010	Password setting (protects parameters from being changed)	–
Fn011	Motor models display	–
Fn012	Software version display	–
Fn013	Multiturn limit setting change when a Multiturn Limit Disagreement Alarm (A.CC) occurs	√
Fn014	Application module detection results clear	–

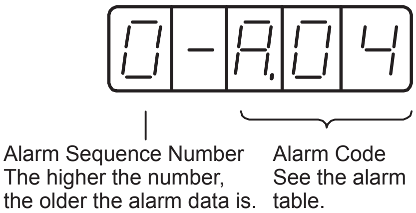
Note: When the parameters marked with "√" in remarks column or in Pn□□□ are set for Password Setting (Fn010), the indication shown below appears and such parameters cannot be changed.



Blinks for one second

7.2.2 Alarm Traceback Data Display (Fn000)

The alarm traceback display can display up to 10 previously occurred alarms. The alarm data is displayed on Fn000, which is stocked in the alarm traceback data. The data can be cleared using an utility function mode "Alarm Traceback Data Clear." For details, refer to *7.2.5 Alarm Traceback Data Clear (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.



The following alarm are operator-related alarms which are not recorded in the traceback data.

Display	Description
CPF00	Digital operator transmission error 1
CPF01	Digital operator transmission error 2

Refer to *10.1 Troubleshooting* for alarm number and contents.

INFO

1. Alarm traceback data will not be updated when the same alarm occurs repetitively.
2. The display "A.--" means no alarm occurs.

Follow the procedure below to confirm alarms which have been generated.

Step	Display after Operation	Digital Operator	Panel Operator	Description
1	Fn000	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select "Alarm Traceback Data Display (Fn000)." If a number other than Fn000 is displayed, press UP Key or DOWN Key to set Fn000. Note: The enabled digit blinks.
2	0-A.40	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. The latest alarm data is displayed.
3	1-A.71	(UP Key)	▲ (UP Key)	Press the UP Key to display the data for a previous alarm. (To display one newer alarm data, press DOWN Key.) Note: The higher the digit on the far left, the older the alarm data is.
4	2-A.--	(UP Key)	▲ (UP Key)	Press the UP Key to display value in order. Note: "A.--" means no alarm occurs.
5	Fn000	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. The display will return to Fn000.

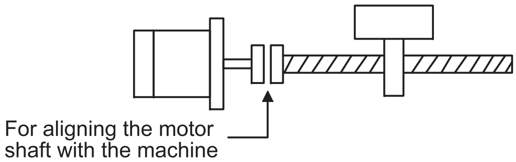
7.2.3 Zero-point Search Mode (Fn003)

⚠ CAUTION
• Forward run prohibited (P-OT) and reverse run prohibited (N-OT) signals are disabled during zero-point search mode operations using Fn003.

The zero-point search mode is designed to perform positioning to the zero-point pulse (phase-C) 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 zero-point search without connecting the motor shaft with the machine.



The speed for executing the zero-point search is 60 min^{-1}.

The following conditions must be met to perform the zero-point 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 zero-point search.

Step	Display after Operation	Digital Operator	Panel Operator	Description
1	Fn000	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
2	Fn003	∧ ∨	▲ ▼	Press the UP or DOWN Key to select the Fn003. Note: The enabled digit blinks.
3	-. .CSr	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second, and the display will be as shown on the left.
4	.‾.CSr	JOG SVON (SVON Key)	MODE/SET (MODE/SET Key)	Press the SVON or MODE/SET Key. The servo turns 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 direction of the motor is reversed.
6	.‾.CSr	Display blinks.		When the motor zero-point search is completed, the display blinks. At this moment, the motor is servo-locked at the zero-point pulse position.
7	Fn003	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. Fn003 display appears again. The motor will be servo OFF status.

INFO Forward run prohibited (P-OT) and reverse run prohibited (N-OT) signals cannot be input during the zero-point search operation.

7.2.4 Parameter Settings Initialization (Fn005)

This function is used when returning to the factory settings after changing parameter settings.

Pressing the DSPL/SET or 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.

Step	Display after Operation	Digital Operator	Panel Operator	Description
1	Fn000	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
2	Fn005	∧ ∨	▲ ▼	Press the UP or DOWN Key to select Fn005. Note: The enabled digit blinks.
3	P.InIt	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second, and the display will be as shown on the left.
4	P.InIt	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or 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 ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to return to the utility function mode display Fn005.

7.2.5 Alarm Traceback Data Clear (Fn006)

This function clears the alarm traceback data, which stores the alarms generated in the SERVOPACK.

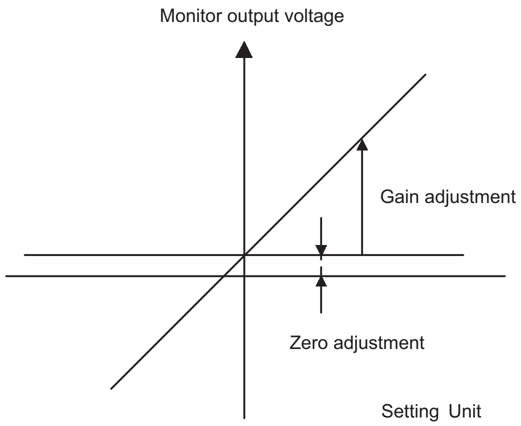
After having cleared data, “A.--” (No alarm) is set to all the alarm traceback data.

Step	Display after Operation	Digital Operator	Panel Operator	Description
1	Fn000	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
2	Fn006	▲ ▼	▲ ▼	Press the UP or DOWN Key to select Fn006. Note: The enabled digit blinks.
3	trCLr	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second, and the display will be as shown on the left.
4	donE	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or 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 ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to return to the utility function mode display Fn006.

7.2.6 Manual Zero Adjustment and Gain Adjustment of Analog Monitor Output (Fn00C, Fn00D)

Motor speed, torque reference, and position error can be monitored through the analog monitor output. Refer to *9.5 Analog Monitor*.

Use the manual zero adjustment function to compensate for the output voltage drift or the zero point drift caused by noise entering the monitor system. The gain adjustment function can be changed to match the sensitivity of the measuring system.



Zero Setting Range: ± 2V → 17 mV/LSB
Gain Setting Range: 50% to 150% → 0.4 %/LSB

INFO The output voltage of the analog monitor is ±8 V max. The output voltage will be limited to ±8 V if ±8 V is exceeded.

(1) Manual Zero adjustment of Analog Monitor Output (Fn00C)

Step	Display after Operation	Digital Operator	Panel Operator	Description
1	Fn000	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
2	Fn00C	∧ ∨	▲ ▼	Press the UP or DOWN Key to select Fn00C. Note: The enabled digit blinks.
3	Ch1_o	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second, and the display shown on the left appears.
4	0000	< >	DATA◀ (DATA/SHIFT Key) (Press less than 1 s.)	Press the LEFT or RIGHT or DATA/SHIFT Key for less than one second to display the output data of analog monitor.
5	-0001	∧ ∨	▲ ▼	Press the UP or DOWN Key to perform the zero adjustment of analog monitor.
6	Ch1_o	< >	DATA◀ (DATA/SHIFT Key) (Press less than 1 s.)	Press the LEFT or RIGHT or DATA/SHIFT Key for less than one second. The display shown on the left appears.
7	Ch2_o	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key. The display shown on the left appears.
8	0000	< >	DATA◀ (DATA/SHIFT Key) (Press less than 1 s.)	Press the LEFT or RIGHT or DATA/SHIFT Key for less than one second to display the output data of analog monitor.
9	-0001	∧ ∨	▲ ▼	Press the UP or DOWN Key to perform the zero adjustment of analog monitor.
10	Ch2_o	< >	DATA◀ (DATA/SHIFT Key) (Press less than 1 s.)	Press the LEFT or RIGHT Key or DATA/SHIFT Key for less than one second. The display shown on the left appears.
11	Fn00C	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	When the zero adjustment of analog monitor output completes, press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. The display returns to the utility function mode display Fn00C.

(2) Manual Gain adjustment of Analog Monitor Output (Fn00D)

Step	Display after Operation	Digital Operator	Panel Operator	Description
1	Fn000	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
2	Fn00d	∧ ∨	▲ ▼	Press the UP or DOWN Key to select Fn00D. Note: The enabled digit blinks.
3	Ch1_G	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second, and the display shown on the left appears.
4	0000	< >	DATA◀ (DATA/SHIFT Key) (Press less than 1 s.)	Press the LEFT or RIGHT or DATA/SHIFT Key for less than one second to display the gain coefficient of analog monitor.
5	0001	∧ ∨	▲ ▼	Press the UP or DOWN Key to adjust the gain coefficient of analog monitor.
6	Ch1_G	< >	DATA◀ (DATA/SHIFT Key) (Press less than 1 s.)	Press the LEFT or RIGHT or DATA/SHIFT Key for less than one second. The display shown on the left appears.
7	Ch2_G	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key. The display shown on the left appears.
8	0000	< >	DATA◀ (DATA/SHIFT Key) (Press less than 1 s.)	Press the LEFT or RIGHT or DATA/SHIFT Key for less than one second to display the gain coefficient of analog monitor.
9	0001	∧ ∨	▲ ▼	Press the UP or DOWN Key to adjust the gain coefficient of analog monitor.
10	Ch2_G	< >	DATA◀ (DATA/SHIFT Key) (Press less than 1 s.)	Press the LEFT or RIGHT Key or DATA/SHIFT Key for less than one second. The display shown on the left appears.
11	Fn00d	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	When the gain coefficient of analog monitor adjustment completes, press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. The display returns to the utility function mode display Fn00D.

7.2.7 Offset Adjustment of Motor Current Detection Signal (Fn00E, Fn00F)

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. This section explains automatic offset-adjustment and manual offset adjustment.

(1) Automatic Offset Adjustment of Motor Current Detection Signal (Fn00E)

IMPORTANT

1. Execute the automatic offset adjustment if the torque ripple is too big when compared with that of other SERVOPACKs.
2. Automatic adjustment is possible only while power is supplied to the main circuit and the servo is OFF.

Step	Display after Operation	Digital Operator	Panel Operator	Description
1	Fn000	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
2	Fn00E	∧ ∨	▲ ▼	Press the UP or DOWN Key to select Fn00E. Note: The enabled digit blinks.
3	Cur_o	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second, and the display will be as shown on the left.
4	donE	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or 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 ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to return to the utility function mode display Fn00E.

(2) Manual Offset Adjustment of Motor Current Detection Signal (Fn00F)

The adjusting range of the motor current detection 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 adjustment.

IMPORTANT

If this function, particularly manual adjustment, is executed carelessly, it may worsen the characteristics.

When performing manual adjustments, run the motor at a speed of approximately 100 min^{-1}, and adjust the operator until the torque monitor ripple is minimized. (Refer to *9.5 Analog Monitor*.) Adjust the phase-U and phase-V offsets alternately several times until these offsets are well balanced.

Step	Display after Operation	Digital Operator	Panel Operator	Description
1	Fn000	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
2	Fn00F	∧ ∨	▲ ▼	Press the UP or DOWN Key to select Fn00F. Note: The enabled digit blinks.
3	Cu1_o	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or 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 Key) (Press less than 1 s.)	Press the LEFT or RIGHT or DATA/SHIFT Key for less than one second to display the phase-U offset amount.
5	-0010	∧ ∨	▲ ▼	Press the 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 Key) (Press less than 1 s.)	Press the LEFT or RIGHT or DATA/SHIFT Key for less than one second. The display shown on the left appears.
7	Cu2_o	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key. The display shown on the left appears (phase V).
8	0000	< >	DATA◀ (DATA/SHIFT Key) (Press less than 1 s.)	Press the LEFT or RIGHT or DATA/SHIFT Key for less than one second to display the phase-V offset amount.
9	-0010	∧ ∨	▲ ▼	Press the 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 Key) (Press less than 1 s.)	Press the LEFT or RIGHT Key or DATA/SHIFT Key for less than one second. The display shown on the left appears.
11	Fn00F	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	When the offset adjustment completes, press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. The display returns to the utility function mode display Fn00F.

7.2.8 Password Setting (Protects Parameters from Being Changed) (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.)

Step	Display after Operation	Digital Operator	Panel Operator	Description
1	Fn000	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
2	Fn010	∧ ∨	▲ ▼	Press the UP or DOWN Key to select Fn010. Note: The enabled digit blinks.
3	P.0000	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second, and the display will be as shown on the left.
4	P.0001	∧ ∨	▲ ▼	Press the UP or DOWN Key to set a value: “0000”: Write permitted, “0001”: Write prohibited
5	donE	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to register the value. When the value is registered, the display shown on the left blinks for about one second. Note: If a value other than “0000” and “0001” is set, “Error” blinks 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 ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to return to the utility function mode display Fn010.

7.2.9 Motor Models Display (Fn011)

This mode is used for motor maintenance such as checking the connected servomotor model, voltage, capacity, encoder type, or encoder resolution. Set the parameter Fn011 to select the motor model check mode. If the SERVOPACK has been custom-made, you can also check the specification codes of SERVOPACKs.

<table>
<tr><th>Step</th><th>Display after Operation</th><th>Digital Operator</th><th>Panel Operator</th><th>Description</th></tr>
<tr><td>1</td><td>Fn000</td><td>DSPL SET
(DSPL/SET Key)</td><td>MODE/SET
(MODE/SET Key)</td><td>Press the DSPL/SET or MODE/SET Key to select the utility function mode.</td></tr>
<tr><td>2</td><td>Fn011</td><td>∧ ∨</td><td>▲ ▼</td><td>Press the UP or DOWN Key to select Fn011.
Note: The enabled digit blinks.</td></tr>
<tr><td>3</td><td>F.0100</td><td>DATA ENTER
(DATA/ENTER Key)</td><td>DATA◀
(DATA/SHIFT Key)
(Press at least 1 s.)</td><td>Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to display the servomotor model and voltage code.
F.0100
<table><tr><th colspan="2">Motor Voltage</th></tr><tr><th>Data</th><th>Model</th></tr><tr><td>00</td><td>100VAC, 140VDC</td></tr><tr><td>01</td><td>200VAC, 280VDC</td></tr><tr><td>02</td><td>400VAC, 560VDC</td></tr></table>
<table><tr><th colspan="2">Motor Type</th></tr><tr><th>Data</th><th>Model</th></tr><tr><td>17</td><td>SGMVH (1500 min⁻¹)</td></tr><tr><td>19</td><td>SGMVH (800 min⁻¹)</td></tr></table></td></tr>
<tr><td>4</td><td>P.0010</td><td>DSPL SET
(DSPL/SET Key)</td><td>MODE/SET
(MODE/SET Key)</td><td>Press the DSPL/SET or MODE/SET Key to display the servomotor capacity.
P.0010
Motor capacity in units of 10 W
The above example indicates 100 W.</td></tr>
<tr><td>5</td><td>E.0017</td><td>DSPL SET
(DSPL/SET Key)</td><td>MODE/SET
(MODE/SET Key)</td><td>Press the DSPL/SET or MODE/SET Key, and the encoder type and resolution code will be displayed.
E.0013
<table><tr><th colspan="2">Encoder Type</th></tr><tr><th>Data</th><th>Type</th></tr><tr><td>00</td><td>Incremental</td></tr><tr><td>01</td><td>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>Reserved</td></tr></table></td></tr>
<tr><td>6</td><td>y.0010</td><td>DSPL SET
(DSPL/SET Key)</td><td>MODE/SET
(MODE/SET Key)</td><td>Press the DSPL/SET or MODE/SET Key to display the SERVOPACK's code for custom orders.
Note: The display "y.0000" means standard model.
y.0010
Code for custom orders</td></tr>
<tr><td>7</td><td>Fn011</td><td>DATA ENTER
(DATA/ENTER Key)</td><td>DATA◀
(DATA/SHIFT Key)
(Press at least 1 s.)</td><td>Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to return to the utility function mode display Fn011.</td></tr>
</table>

7.2.10 Software Version Display (Fn012)

Set the Fn012 to select the software-version check mode to check the SERVOPACK and encoder software version.

Step	Display after Operation	Digital Operator	Panel Operator	Description
1	Fn000	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
2	Fn012	∧ ∨	▲ ▼	Press the UP or DOWN Key to select Fn012. Note: The enabled digit blinks.
3	r.0001	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to display the SERVOPACK software version.
4	E.0001	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to display the encoder software version.
5	Fn012	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to return to the utility function mode Fn012.

7.2.11 Application Module Detection Results Clear (Fn014)

The alarm A.E7 (application module detection error) occurs when turning ON the power for the first time when the SERVOPACK is used without application module after the SERVOPACK has been used with application module.

Clearing application module detection results is performed as using the SERVOPACK individually without operating the application module detection.

Restarting again after performing the following operation will clear and reset the alarm A.E7. Then, the operation of SERVOPACK without application module is enabled.

IMPORTANT

Because the parameter is set for the SERVOPACK with an application module, change the setting or initialize the parameter value (Fn005 of utility function mode) as required.

Step	Display after Operation	Digital Operator	Panel Operator	Description
1	Fn000	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
2	Fn014	▲ ▼	▲ ▼	Press the UP or DOWN Key to select the Fn014. Note: The enabled digit blinks.
3	o.Init	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second, and the display will be as shown on the left.
4	o.Init Blinks ↓ donE	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key, and the display will be as shown on the left to clear the application module detection.
5	o.Init	After about one second		The display changes from “donE” to the display shown on the left.
6	Fn014	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second 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 seven-segment LED panel indicator (five digits) can be selected.

7.3.1 Setting Parameters

(1) Value Setting Parameters

(a) Types of Value Setting Parameters

Refer to *11.3.2 List of Parameters*.

(b) Example of Changing Value Setting Parameter

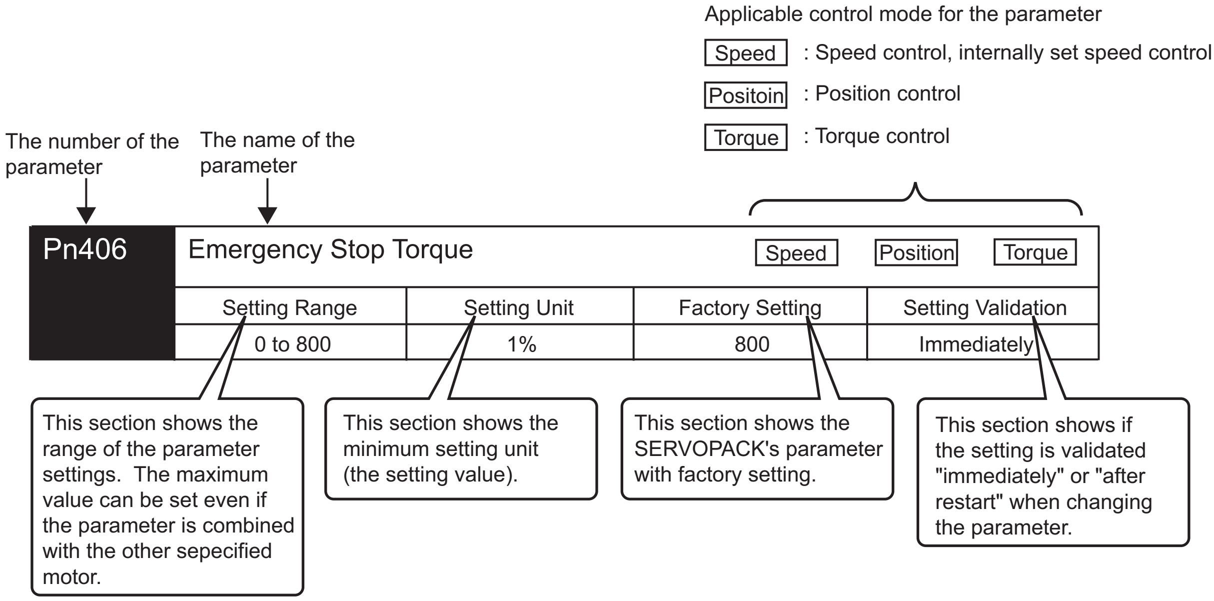
The parameter settings can be used for changing parameter data. Before changing the data, check the permitted range of the parameter.

◀ EXAMPLE ▶ The example below shows how to change parameter Pn100 (speed loop gain) from “40” to “100.”

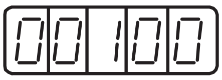
Step	Display after Operation	Digital Operator	Panel Operator	Description
1	Pn100	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the parameter setting mode. If a parameter other than Pn100 is displayed, press the UP or DOWN Key to select Pn100. Note: The enabled digit blinks.
2	00040	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. The current data of Pn100 is displayed.
3	00040	< >	DATA/◀ (DATA/SHIFT Key)	Press the LEFT or RIGHT Key or DATA/SHIFT Key to select the digit to be set.
4	00100	∧ ∨	▲ ▼	Press the UP or DOWN Key to change the data. Keep pressing UP or DOWN Key until “00100” is displayed.
5	00100	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. The value blinks and is saved.
6	Pn100	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or 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” to “100.”

(c) Parameter Indications

In this manual, the parameter is explained with using the following format.



The following alarm shows the setting value of the parameter.



Decimal display in five digits

(2) Function Selection Parameters

(a) Types of Function Selection Parameters

Refer to *11.3.2 List of Parameters.*

IMPORTANT

If the parameters with “After restart” in “Setting Validation” column in the table are changed, turn OFF the main circuit and control power supply and ON again to validate new setting.
- Pn10B.1 requires the power to be reset as mentioned above.

Category	Parameter No.	Name	Factory Setting	Setting Validation
Function Selection Parameter	Pn000	Function Selection Basic Switches	0000	After restart
	Pn001	Function Selection Application Switches	0000	After restart
	Pn002	Function Selection Application Switches	0000	After restart
	Pn003	Function Selection Application Switches	0002	Immediately
Servo Gain Related Parameter	Pn10B	Gain Application Switches	0000	After restart/ Immediately
Position Control Related Parameter	Pn200	Position Control References Selection Switches	0000	After restart
	Pn207	Position Control Function Switches	0000	After restart
Sequence Related Parameter (Input Signal Selection)	Pn50A	Input Signal Selections	2100	After restart
	Pn50B	Input Signal Selections	6543	After restart
	Pn50C	Input Signal Selections	8888	After restart
	Pn50D	Input Signal Selections	8888	After restart
Sequence Related Parameter (Output Signal Selection)	Pn50E	Output Signal Selections	3211	After restart
	Pn50F	Output Signal Selections	0000	After restart
	Pn510	Output Signal Selections	0000	After restart
	Pn512	Output Signal Reversal Setting	0000	After restart

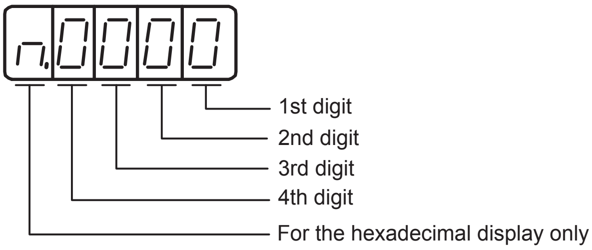
(b) Example of Changing Function Selection

The procedure to change the setting of control method selection (Pn000.1) of the function selection basic switches (Pn000) from speed control to position control is shown below.

Step	Display after Operation	Digital Operator	Panel Operator	Description
1	Pn000	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the parameter setting mode. If a parameter other than Pn000 is displayed, press the UP or DOWN Key to select the Pn100. Note: The enable digit blinks.
2	n.0000	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. The current data of Pn000 is displayed.
3	n.0000	< >	DATA/◀ (DATA/SHIFT Key)	Press the LEFT or RIGHT or DATA/SHIFT Key to select the first digit of current data.
4	n.0010	^ (UP Key)	▲ (UP Key)	Press the UP Key once to change to “n.0010.” (Set the control method to position control.)
5	n.0010	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. The value blinks and is saved.
6	Pn000	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or 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 switches (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.xxx□: Indicates the value for the 1st digit of parameter Pn000.
- Pn000.1 or n.xx□x: Indicates the value for the 2nd digit of parameter Pn000.
- Pn000.2 or n.x□xx: Indicates the value for the 3rd digit of parameter Pn000.
- Pn000.3 or n.□xxx: Indicates the value for the 4th digit of parameter Pn000.

For details on each digit of the parameter, see *11.3.2 List of 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).

The number of the parameter

This blank shows the setting value of the function selection, as well as the state condition on the panel operator and the digital operator (JUSP-OP02A-2).

This section explains the details of the function selection.

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 following table shows detailed allocation.

(1) Factory Setting (Pn50A.0 = 0)

The factory setting for the input signal allocation is as follows.

□ means factory setting.

Pn50A: n.2100

Pn50B: n.6543

(2) Changing the Allocation (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 enable the parameters.

□ means factory setting.

Signal Name / Parameter Setting Allocation	Validity Level	Input Signal	CN1 Input Pin Allocation 40	41	42	43	44	45	46	Connection Not Required (SERVOPACK judges the connection) 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	/ALM-RST	0	1	2	3	4	5	6	–	8
	H	ALM-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		
Internally Set Speed Selection 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		
Internally 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		
Internally 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 Pn50D.2 = n.x□xx	L	/G-SEL	0	1	2	3	4	5	6	7	8
	H	G-SEL	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, the input signal level will be applied to all the allocated signal.

(3) Allocating Input Signals

◀ EXAMPLE ▶ The procedure to replace Servo ON (/S-ON) signal allocated to CN1-40 and Forward External Torque Limit (/P-CL) allocated to CN1-45 is shown below.

	Before		After
Pn50A:	n.2100	→	n.2151
Pn50B:	n.6543	→	n.6043

Step	Display after Operation	Digital Operator	Panel Operator	Description
1	Pn50A	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the “value setting parameter” mode. If a parameter other than Pn50A is displayed, press the UP or DOWN Key to set Pn50A. Note: The enabled digit blinks.
2	n.2100	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to display the current data of Pn50A. (/S-ON is allocated to CN1-40.)
3	n.2101	(UP Key)	▲ (UP Key)	Press the UP Key to set to “1.” (Sequence input signals can be freely set.)
4	n.2151	< >	DATA/◀ (DATA/SHIFT Key)	Press the LEFT or RIGHT Key or DATA/SHIFT Key to select the second digit from the right. Press the UP key to set to “5.” (Changes the allocation of /S-ON from CN1-40 to CN1-45.)
5	n.2151	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. The value blinks and is saved. At the moment, the CN1-45 operates with OR logic for /S-ON and /P-CL.
6	Pn50A	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to return to the display Pn50A.
7	Pn50b	(UP Key)	▲ (UP Key)	Press the UP Key to set Pn50B. Note: The enabled digit blinks.
8	n.6543	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to display the current data of Pn50B. (/P-CL is allocated to CN1-45.)
9	n.6043	< >	DATA/◀ (DATA/SHIFT Key)	Press the LEFT or RIGHT Key or DATA/SHIFT Key to select the third digit from the right. Press the DOWN Key to set to “0.” (Changes the allocation of /P-CL from CN1-45 to CN1-40.)
10	n.6043	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. The value blinks and is saved.
11	Pn50b	DATA ENTER (DATA/ENTER Key)	DATA/◀ (DATA/SHIFT Key)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to return to the display Pn50B. /S-ON is allocation to CN1-45, and /P-CL is allocated to CN1-40.
12	Turn the power OFF and ON again to enable the change of input signal selections (Pn50A and Pn50B).			

7.3.3 Output Circuit Signal Allocation

Functions can be allocated to the following sequence output signals. After having changed the parameter, turn OFF the power and ON again to enable the parameters.

☐ means factory setting.

CN1 Pin No.		25/(26)		27/(28)		29/(30)	
Parameter Setting Allocation		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	$\boxed{L}$	H				
	2			L	H		
	3					L	H
Speed Coincidence Detection (/V-CMP) Pn50E.1 = n.xx□x	0	Invalid					
	1	$\boxed{L}$	H				
	2			L	H		
	3					L	H
Servomotor Rotation Detection (/TGON) Pn50E.2 = n.x□xx	0	Invalid					
	1	L	H				
	2			$\boxed{L}$	H		
	3					L	H
Servo Ready (/S-RDY) Pn50E.3 = n.□xxx	0	Invalid					
	1	L	H				
	2			L	H		
	3					$\boxed{L}$	H
Torque Limit Detection (/CLT) Pn50F.0 = n.xxx□	0	$\boxed{\text{Invalid}}$					
	1	L	H				
	2			L	H		
	3					L	H
Speed Limit Detection (/VLT) Pn50F.1 = n.xx□x	0	$\boxed{\text{Invalid}}$					
	1	L	H				
	2			L	H		
	3					L	H
Brake Interlock (/BK) Pn50F.2 = n.x□xx	0	$\boxed{\text{Invalid}}$					
	1	L	H				
	2			L	H		
	3					L	H
Warning (/WARN) Pn50F.3 = n.□xxx	0	$\boxed{\text{Invalid}}$					
	1	L	H				
	2			L	H		
	3					L	H
Near (/NEAR) Pn510.0 = n.xxx□	0	$\boxed{\text{Invalid}}$					
	1	L	H				
	2			L	H		
	3					L	H

Remark

L:
Valid output signal: Low level
H:
Valid output signal: High level
Invalid:
Do 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.
2. The signals not detected are considered as “Invalid.” For example, Positioning Completion (/COIN) Signal in speed control mode is “Invalid.”

• Allocating Output Signals

◀ EXAMPLE ▶ The procedure to replace Servomotor Rotation Detection (/TGON) signal allocated to CN1-27 (28) with factory setting to "Invalid" and allocate Brake Interlock (/BK) signal to CN1-27 (28) is shown below.

	Before		After
Pn50E:	n.3211	→	n.3011
Pn50F:	n.0000	→	n.0200

Step	Display after Operation	Digital Operator	Panel Operator	Description
1	Pn50E	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the "value setting parameter" mode. If a parameter other than Pn50E is displayed, press the UP or DOWN Key to select Pn50E. Note: The enabled digit blinks.
2	n.3211	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to display the current data of Pn50E. (/TGON is allocated to CN1-27 (28).)
3	n.3011	< >	DATA/◀ (DATA/SHIFT Key)	Press the LEFT Key or RIGHT or DATA/SHIFT Key to select the third digit from the right. Press the DOWN Key to set "0." (Sets /TGON "Invalid.")
4	n.3011	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. The value blinks and is saved.
5	Pn50E	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to return to the display Pn50E.
6	Pn50F	^ (UP Key)	▲ (UP Key)	Press the UP Key to set Pn50F. Note: The enabled digit blinks.
7	n.0000	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or 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 Key)	Press the LEFT or RIHGT Key or DATA/SHIFT Key to select the third digit from the right. Press the UP Key to set "2." (Allocates /BK to CN1-27 (28).)
9	n.0200	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. The value blinks and is saved.
10	Pn50F	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to return to the display Pn50F. /TGON is set as "Invalid" and /BK is allocated to 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 motor operation.

7.4.1 List of Monitor Modes

(1) Contents of Monitor Mode Display

Parameter No.	Content of Display	Unit
Un000	Actual motor speed	min^{-1}
Un001	Input speed reference (Valid only in speed control mode)	min^{-1}
Un002	Internal torque reference (in percentage to the rated torque)	%
Un003	Rotation angle 1 (16-bit decimal code)	Number of pulses from the zero-point
Un004	Rotation angle 2 (Angle from 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 value (amount of position error) (valid only in position control mode)	reference unit
Un009	Accumulated load rate (value for the rated torque as 100 %. Displays effective torque in 10-s cycle.)	%
Un00A	Regenerative load rate (value for the processable regenerative power as 100 %. Displays regenerative power consumption in 10-s cycle.)	%
Un00B	Power consumed by DB resistance (Value for the processable power when dynamic brake is applied as 100 %. Displays power consumed by DB resistance in 10-s cycle.)	%
Un00C	Input reference pulse counter (32-bit hexadecimal code) (valid only in position control mode) *2	–
Un00D	Feedback pulse counter (Data as four times of the encoder pulse number: 32-bit hexadecimal code) *2	–

* 1. Refer to *(2) Sequence I/O Signal Monitor Display*.
* 2. Refer to *(4) Monitor Display of Reference Pulse Counter and Feedback Pulse Counter*.

(2) Sequence I/O Signal Monitor Display

The following section describes the monitor display for sequence I/O signals.

(a) Input Signal Monitor Display

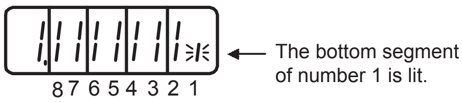
The status of input signal allocated to each input terminal is displayed:
When the input is in OFF (open) status, the top segment (LED) is lit.
when the input is in ON (short-circuited) status, the bottom segment (LED) is lit.

Refer to *7.3.2 Input Circuit Signal Allocation* for the relation between input terminals and signals.

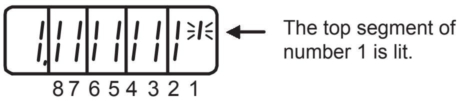
Display LED Number	Input Terminal Name	Factory Setting
1	CN1-40	/S-ON
2	CN1-41	/P-CON
3	CN1-42	P-OT
4	CN1-43	N-OT
5	CN1-44	/ALM-RST
6	CN1-45	/P-CL
7	CN1-46	/N-CL
8	CN1-4	SEN

◀ EXAMPLE ▶

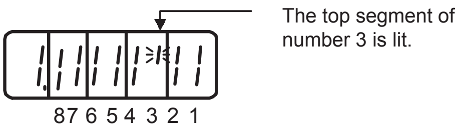
- When /S-ON signal is ON (Servo ON at L level)



- When /S-ON signal is OFF



- When P-OT signal operates (Operates at H level)



(b) 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-circuited) 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	ALO1
6	CN1-38	ALO2
7	CN1-39	ALO3

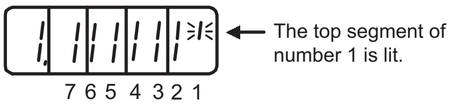
Note: For the detail of output terminals, refer to *7.3.3 Output Circuit Signal Allocation.*

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.

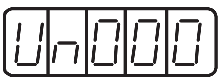
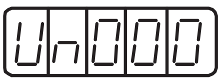
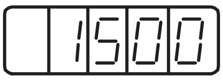
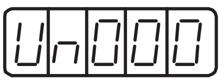
◀ EXAMPLE ▶

• When ALM signal operates (alarm at H level.)



(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}.

Step	Display after Operation	Digital Operator	Panel Operator	Description
1		DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the monitor mode.
2		∧ ∨	▲ ▼	Press the UP or DOWN Key to select the monitor number to be displayed. The display shows the example of the data of Un000.
3		DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to display the data of Un000.
4		DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to return to the display of monitor number.

(4) Monitor Display of Reference Pulse Counter and Feedback Pulse Counter

The monitor display of reference pulse counter and feedback pulse counter is expressed in 32-bit hexadecimal.

Step	Display after Operation	Digital Operator	Panel Operator	Description
1	Un000	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the monitor mode.
2	Un00d	∧ ∨	▲ ▼	Press the UP or DOWN Key to select “Un00C” or “Un00D.”
3	H.1111 The upper 16-bit data	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/ SHIFT Key for more than one second to display the data of the selected monitor number.
4	L.1111 The lower 16-bit data	∧ ∨	▲ ▼	Press the UP or DOWN Key to display the lower 16-bit data.
5	L.0000	∧ ∨ (Press simultaneouly)	▲ + ▼ Press simultaneously	Press both UP and DOWN Keys simultaneously while the display on the left appears to clear the 32-bit counter data. (The display shown on the left is of the lower 16-bit data.)
6	Un00d	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or 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 and feedback pulse will be “0.” The counter value increases by forward references, and decreases by reverse references.

Displays the pulse number from 0 to 4294967295 in sequence. If one pulse is decreased from 0, the digital operator and the panel operator display 4294967295 and then decrease from this pulse number. Also, if one pulse in increased from 4294967295, the digital operator and the panel operator display 0 and increase from this pulse number.

The feedback pulse will be 65536 pulse/rev, when using the 16-bit encoder. The feedback pulse will be 131071 pulse/rev, when using the 17-bit encoder.

8

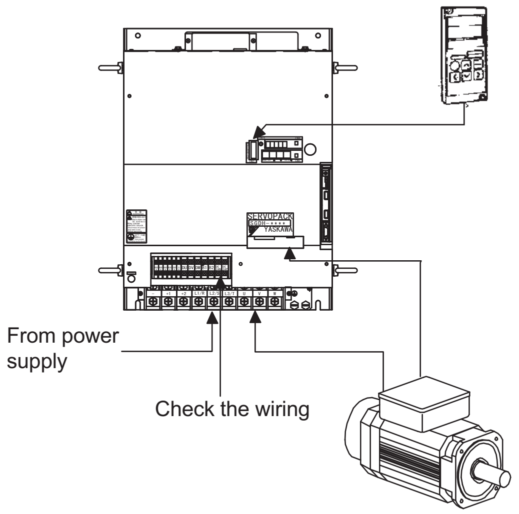
Operation

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.)

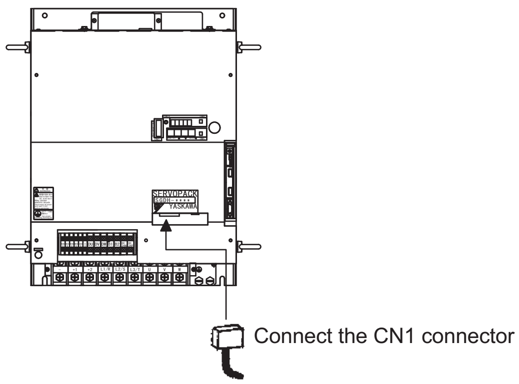


■ Purpose

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
- Servomotor’s rotation direction and motor speed

(2)Trial Operation for Servomotor with Host Reference (Refer to 8.1.2.)

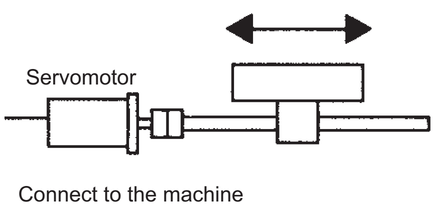


■ Purpose

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.
- Servomotor’s rotation direction, motor speed, and number of rotations
- Operation of the brake, overtravel, and other protective functions.

(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 (refer to *6.1.2*), servomotor wiring (U, V, W), I/O signal wiring (CN1), and encoder wiring (CN2). During *(1) Trial Operation for Servomotor without Load*, however, disconnect the CN1 connector (refer to *8.1.1*).	–
3	Turn ON the power.	Turn ON the power. Check the panel operator to make sure 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*.).	–
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) 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 emergency stop, 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 Autotuning*. If a problem occurs, refer to *10 Inspection, Maintenance, and Troubleshooting*.	Host Reference

8.1.1 Trial Operation for Servomotor without Load

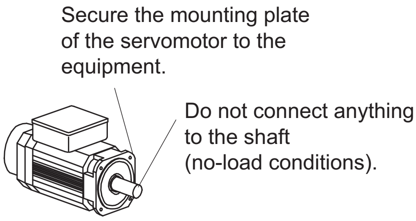
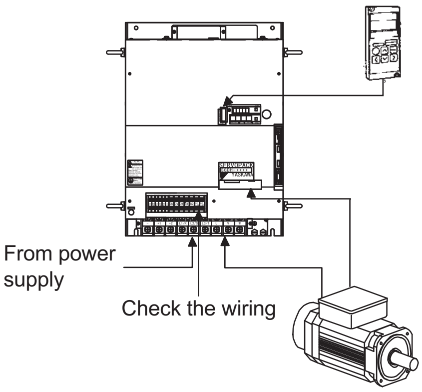
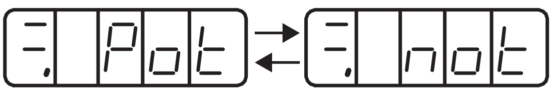
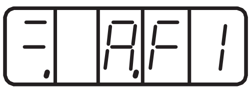
⚠ CAUTION

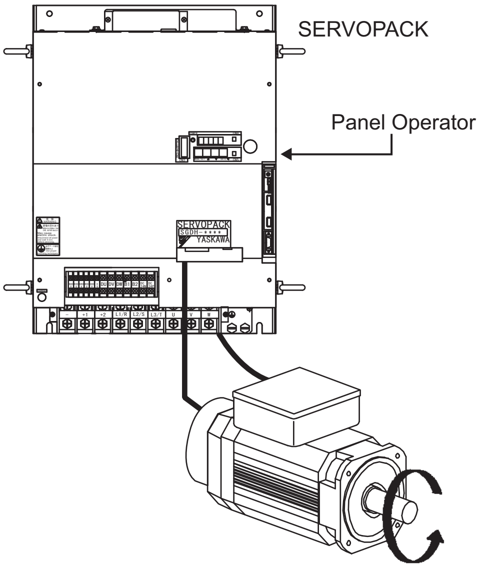
- Release the coupling between the servomotor and the machine, and secure only the servomotor without a load.
  To prevent accidents, initially perform the trial operation for servomotor under no-load conditions (with all couplings and belts disconnected).

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.

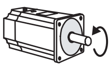
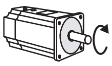
Confirm the wiring, and then conduct the trial operation for servomotor without load.

The operation and the display are the same both for the panel operator and optional digital operator (JUSP-OP02A-2).

Step	Description	Check Method and Remarks
1	Secure the servomotor. 	Follow *3.3.1 Precautions on Servomotor Installation* and secure the servomotor mounting plate to the machine in order to prevent the servomotor from moving during operation. Do not connect the servomotor shaft to the machine. The servomotor may tip over during rotation.
2	Check the power supply circuit, servomotor, and encoder wiring. 	With the CN1 connector not connected, check the power supply circuit and servomotor wiring. Refer to *6.1 Wiring Main Circuit* for wiring example of main circuit. Refer *to 2.4 Selecting Cables* for motor and encoder cables.
3	Turn ON the control power supply and main circuit power supply. Normal 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 on the left. The display on the left indicates that Forward Run Prohibited (P-OT) and Reverse Run Prohibited (N-OT). For details, refer to *7.1.4 Status Display*. 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 *10.1 Troubleshooting*.
4	Release the brake before driving the servomotor when a servomotor with brake is used. When using an absolute encoder, encoder setup is required before running the servomotor.	Refer to *8.3.4 Setting for Holding Brakes* and *8.4.5 Absolute Encoder Setup (Fn008)*. Absolute Encoder Setup (Fn008) operation can be omitted when setting the Pn002 to n.□1□□ (uses absolute encoder as an incremental encoder) only during trial operation.

Step	Description	Check Method and Remarks
5	Operate with the panel operator. 	Use the panel operator to operate the servomotor with utility function Fn002 (Jog Mode Operation). Check that the servomotor rotates in the forward direction by UP key, and reverse direction by DOWN key. The operation is completed when the operation is performed as described below and the alarm display does not appear. Complete the Fn002 (Jog Mode Operation) and turn OFF the power. For operation method of the digital operator and the panel operator, refer to *7.1 Functions on Digital Operator/Panel Operator*. The servomotor speed can be changed using the Pn304 (JOG Speed). The factory setting for jog speed is 500 min^{-1}.

• JOG Mode Operation (Fn002)

Step	Display after Operation	Digital Operator	Panel Operator	Description
1	Fn000	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
2	Fn002	▲ ▼	▲ ▼	Press the UP or DOWN Key to select Fn002. Note: The digit that can be set will blink.
3	JoG	DATA ENTER (DATA/ENTER Key)	DATA/◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. The display shown at the left will appear, and the servomotor will enter JOG operation mode. The servomotor can be operated with the panel operator in this condition.
4	JoG	JOG SVON (SVON Key)	MODE/SET (MODE/SET Key)	Press the SVON or MODE/SET Key. This will turn ON the power to the servomotor.
5	 Forward running  Reverse running	▲ ▼	▲ ▼	Press the UP Key (forward) or DOWN Key (reverse). The servomotor will operate as long as the key is pressed.
6	JoG	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key. This will turn OFF the power to the servomotor. The power will remain OFF even if the SVON or DATA/SHIFT Key is pressed for more than one second.
7	Fn002	DATA ENTER (DATA/ENTER Key)	DATA/◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than 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 on the previous page describes operation with Pn000.0 in the factory setting.

Pn304	JOG Speed		Speed	
	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*.

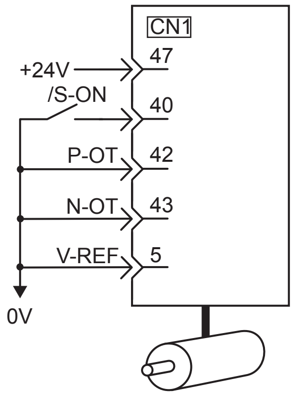
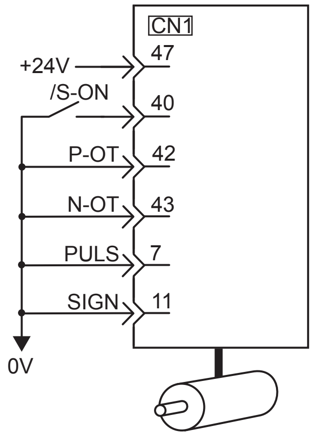
Pay attention that the Forward Run Prohibited (P-OT) and Reverse Run Prohibited (N-OT) signals are invalid during jog mode operation. For the jog mode operation procedures, refer to *pages 8-6* and *8-7*.

8.1.2 Trial Operation for Servomotor without Load from Host Reference

Check that the servomotor move reference or I/O signals are correctly set from the host controller to the SERVOPACK. Also check that the wiring and polarity between the host controller and SERVOPACK, and the SERVOPACK operation settings are correct. This is final check before connecting the servomotor to the machine.

(1) Servo ON Command from the Host

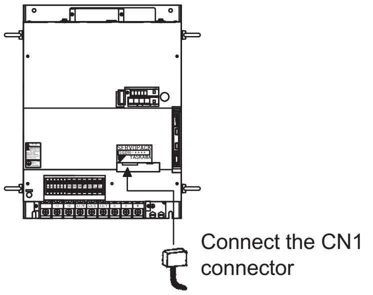
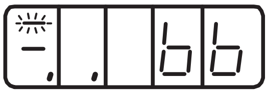
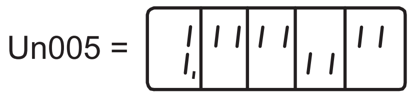
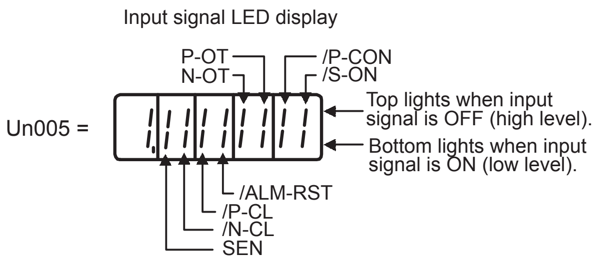
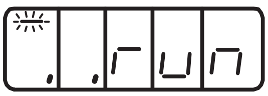
The following circuits are required: External input signal circuit or equivalent.

Speed Control (Standard Setting) [Pn000=n.□□0□]	Position Control [Pn000=n.□□1□]
	

Change the SEN signal (CN1-4) to the H level when an absolute encoder is used.

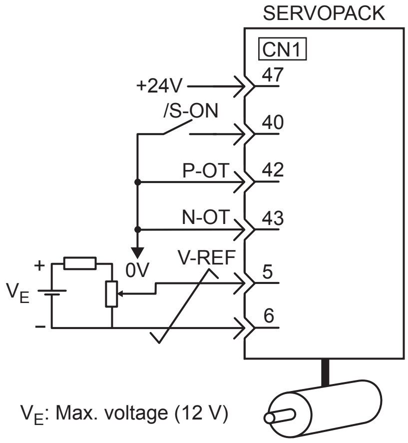
Operation

8

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, Fn008 (Absolute Encoder Setup) 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. 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.  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 *10.1 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 *6.4 Others* and take a preventive measure.

(2) Operating Procedure in Speed Control Mode (Pn000 = n.□□0□)

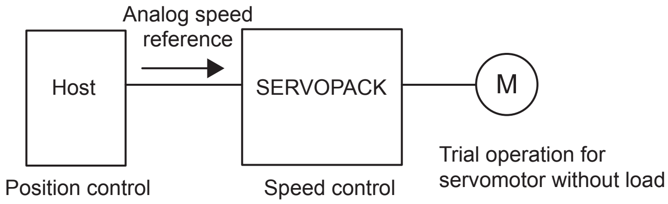
The following circuit is required: External input signal circuit or equivalent.



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 SERVOPACK (Un000 [min^{-1}]).	Refer to *7.1.3 Basic Mode Selection and Operation* for how it is displayed.
5	Check the servomotor speed value (Un000 [min^{-1}]).	Refer to *7.1.3 Basic Mode Selection and Operation* 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 [3000 min^{-1}/6V] To change the motor rotation direction without changing polarity for speed reference input voltage, 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.	–

INFO

■ When Position Control is configured at the Host

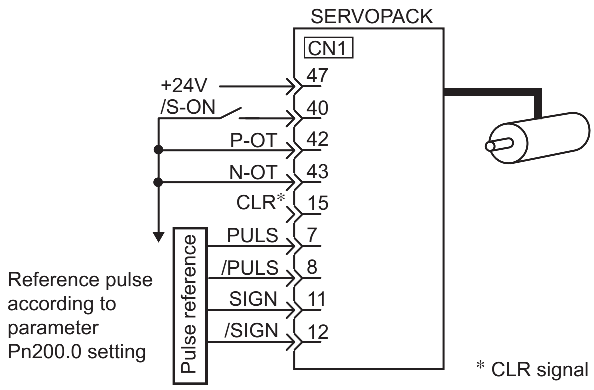


When the SERVOPACK conducts speed control and position control is conducted at the host controller, perform the operations below, following the operations in *(2) Operating Procedure in Speed Control Mode (Pn000 = n.□□0□)* on the previous page.

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].	Refer to *7.1.3 Basic Mode Selection and Operation* for how it is displayed. Un003 (rotation angle 1)[pulse]: The number of pulses from the zero point.
12	If the sent number of rotation and actual number of rotation in step 11 are not equal, correctly set the Pn201 (PG divided ratio) outputting the encoder pulse from the SERVOPACK.	Refer to *8.5.7 Encoder Signal Output* for how to set. Pn201 (PG divider) [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 ration so that it coincides with the host controller setting.	Set the electronic gear ratio with Pn202/Pn203. 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 *7.1.3 Basic Mode Selection and Operation* 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 Un003 (rotation angle 1) [pulse] was executed.	Refer to *7.1.3 Basic Mode Selection and Operation* for how it is displayed. Un003 (rotation angle 1) [pulse]
7	Check that steps 5 and 6 satisfy the following equation: Un003=Un00C × (Pn202/Pn203)	–
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 *7.1.3 Basic Mode Selection and Operation* for how it is displayed. Un007 (input reference pulse speed) [min^{-1}]
	The number of Un007 (input reference pulses) can be obtained from the following equation. $\text{Un007(input reference pulse speed)} = \underbrace{\text{input reference pulse [pulses/S]} \times 60}_{\text{Reference input ppm}} \times \underbrace{\frac{\text{Pn202}}{\text{Pn203}}}_{\text{Electronic gear ratio}} \times \underbrace{\frac{1}{2^{13}(8192)}}_{\text{Encoder pulse*}}$ * The encoder pulse differs depending on the model of the servomotor used.	
11	Check the motor speed using the Un000 (motor speed) [min^{-1}].	Refer to *7.1.3 Basic Mode Selection and Operation* for how it is displayed. Un000 (motor speed) [min^{-1}]

Step	Description	Check Method and Remarks
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 functions 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 *3.3.1 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 Autotuning*. 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 *11.4 Parameter Recording Table*. Then the trial operation with the servomotor connected to the machine is completed.	–

8.1.4 Servomotor with Brakes

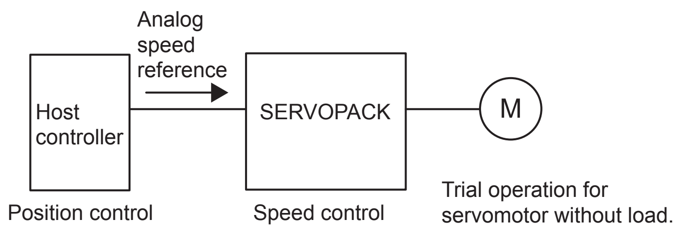
Holding brake operation of the servomotor with brake can be controlled with the brake interlock output (/BK) signal of the SERVOPACK.

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 parameter settings, 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 motor 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 motor rotation and visually check to see if the shaft makes one revolution.	Check the parameter setting at Pn201 to see if the number of PG 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 SGDM/SGDH SERVOPACKs 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 reference) Controls the position of the servomotor 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 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 (Internally set speed selection) 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. (In this case, 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.

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 always 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.

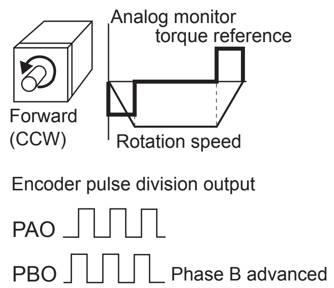
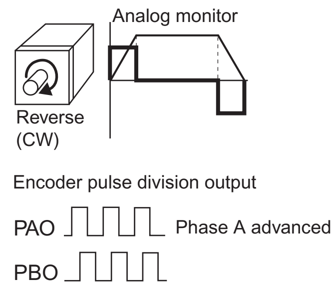
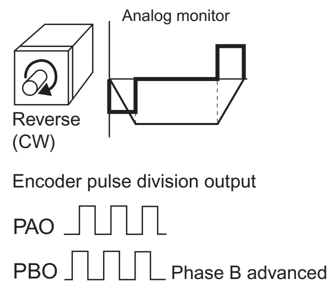
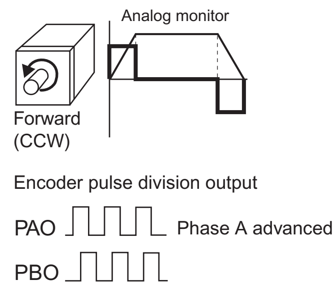
- After changing these parameters, turn OFF the main circuit and control power supplies and then turn them ON again to enable the new settings.
- When the parameter is set to constantly “enable” the signal, resetting an alarm can only be done by turning the power OFF and ON. (Alarm reset is disabled.)

8.3.2 Switching the Servomotor Rotation Direction

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. The output signal polarity such as encoder pulse output and analog monitor signal from the SERVOPACK does 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 = Forward)		
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.

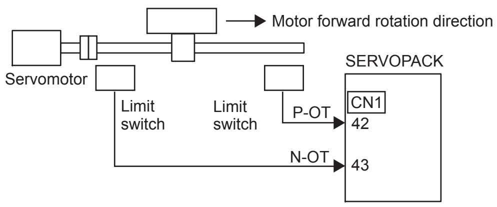
(1) Connecting the Overtravel Signal

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 (Factory setting)	ON (low level)	Forward rotation allowed. Normal operation status.
			OFF (high level)	Forward rotation prohibited. Forward overtravel.
Input	N-OT	CN1-43 (Factory setting)	ON (low level)	Reverse rotation allowed. Normal operation status.
			OFF (high level)	Reverse rotation 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 motor is operating.

Parameter		Stop Mode	Mode After Stopping	Meaning
Pn001	n.□□00	Stop by dynamic brake	Holding Dynamic Brake Mode	Rapidly stops the servomotor by using dynamic braking (DB), then keeps it in Dynamic Brake Mode after the servomotor stops.
	n.□□01		Coast	Rapidly stops the servomotor by using dynamic braking (DB), then puts it into Coast (power OFF) Mode.
	n.□□02	Coast to a stop		Coasts to a 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.

- In each setting, only the servomotor stopping method can be selected during torque control. After the servomotor stops, it maintains the coasting to a stop status regardless of the setting.
- After changing these parameters, turn OFF the main circuit and control power supplies and then turn them ON again to enable the new settings.
- During n.□□02 Coast Mode, SERVOPACK can be resumed using the servo ON signal.

■ TERMS
- Stop by dynamic brake: Stops by using the dynamic brake.
- 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*.

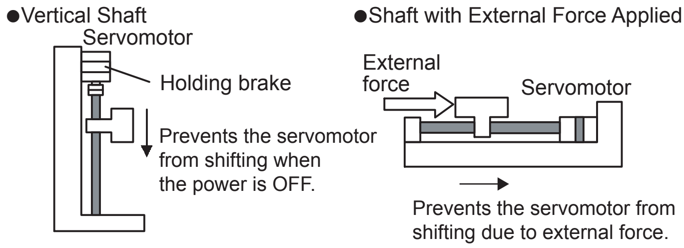
(4) Setting the Stop Torque for Overtravel

Pn406	Emergency Stop Torque	Speed	Position	Torque
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 800	%	800	Immediately

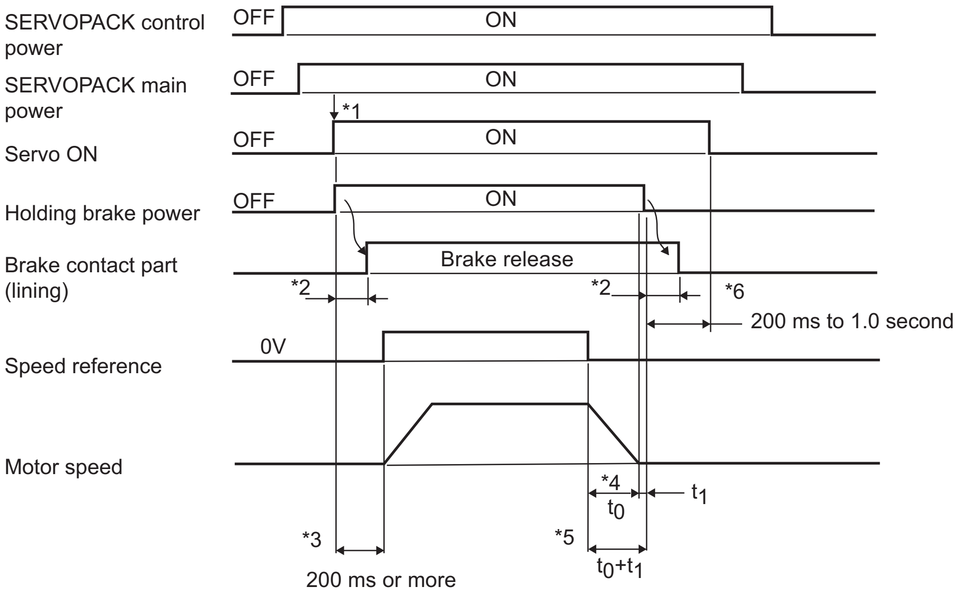
- This sets the stop torque for when the overtravel signal (P-OT, N-OT) is input.
- The setting unit is a percentage of the rated torque (the rated torque is 100%).
- The value large enough to be the motor maximum torque, 800% is set as the factory setting for emergency stop torque. However, the actual output emergency stop torque is determined by motor ratings.

8.3.4 Setting for Holding Brakes

The holding brake is used when a SERVOPACK controls a vertical axis. In other words, a servomotor with brake prevents the movable part from shifting due to gravity when the SERVOPACK power goes 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)
1500 min^{-1}	800 min^{-1}			
SGMVH-2B, 3Z	–	90V	500 max.	150 max.
		24V		
SGMVH-3G	SGMVH-2B	90V	500 max.	150 max.
		24V		
SGMVH-4E, 5E	SGMVH-3Z	90V	550 max.	320 max.
		24V		
SGMVH-7E	SGMVH-3G	90V	700 max.	320 max.
		24V		

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

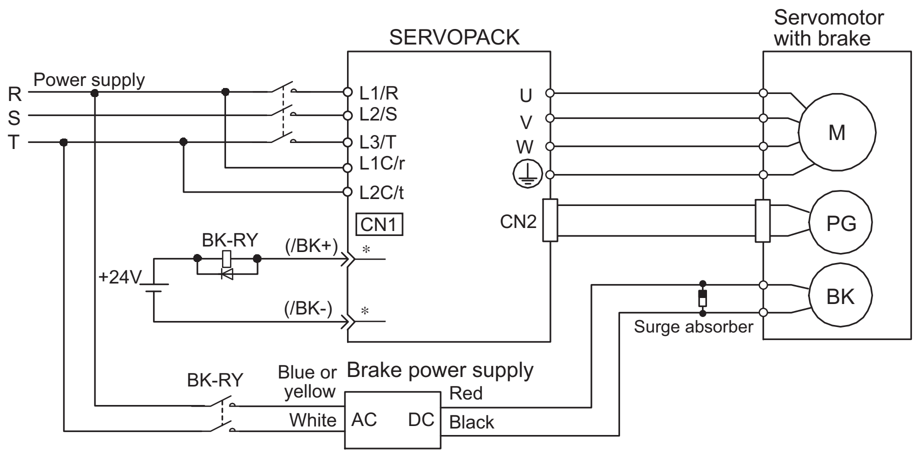
Using SI Units	Conventional Method
$t_0 = \dfrac{(J_M + J_L) \times N_M}{(T_P + T_L)} \times \dfrac{2\pi}{60}$ (sec)	$t_0 = \dfrac{(GD^2_M + GD^2_L) \times N_M}{375 \times (T_P + T_L)}$ (sec)
J_M : Rotor moment of inertia (kg·m^2)	GD^2_M : Motor GD^2 (kgf·m^2)
J_L : Load moment of inertia (kg·m^2)	GD^2_L : 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 the servomotor is 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-R Y: Brake control relay

Brake power supply Input voltage 200-V models: LPSE-2H01
Input voltage 100-V models: LPDE-1H01

Surge absorber model: CR50500BL (sold as Spark Quencher manufactured by Okaya Electric Industries Co., Ltd.)

* are the output terminals allocated with Pn50F.2.

(2) Brake Interlock Output (/BK)

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. This output signal is not used with the factory settings. 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 Interlock Output Signals (/BK)

The brake interlock output 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

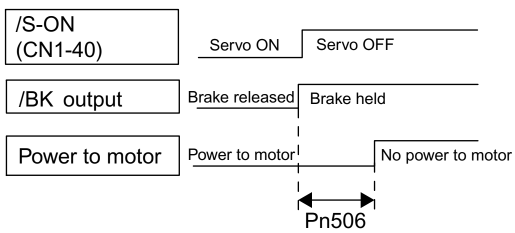
When set to the factory setting, the brake interlock output signal (/BK) is invalid. When multiple signals are allocated to the same output terminal, the signals are output with OR logic. To output the /BK output signal alone, disable the other output signals or set them to output terminals other than the one allocated to the /BK output signal. For the allocation of SERVOPACK output signals other than /BK output signal, refer to *7.3.3 Output Circuit Signal Allocation*.

(4) Setting the Brake ON Timing after the Servomotor Stops

With the standard 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.

(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 servo OFF or an alarm occurring.

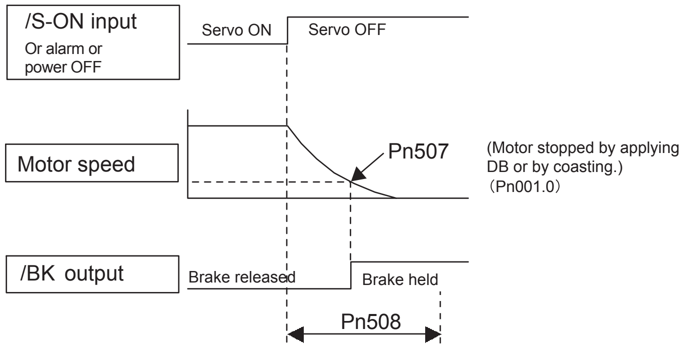
Pn507	Brake Reference Output Speed Level			Speed Position Torque
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 10000	1 min^{-1}	100	Immediately

Pn508	Timing for Brake Reference Output during Motor Operation			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 Servo-motor Running

The /BK output 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 servo OFF.
- When the time set in Pn508 is exceeded after the servo 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 running output signal (/TGON) and the brake interlock output signal (/BK) to different terminals.
- If the brake interlock output 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 output 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.) For output signal allocations, refer to *7.3.3 Output Circuit Signal Allocation.*

Operation

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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.
- When main circuit power supply is OFF.

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.
- 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, regardless of the settings of this parameter**, when the main circuit power supply or control power supply turns OFF.

If the servomotor must be stopped by coasting rather than by dynamic braking when the main circuit power supply or the control power supply turns OFF, arrange the sequence externally so the servomotor wiring will be interrupted.

IMPORTANT

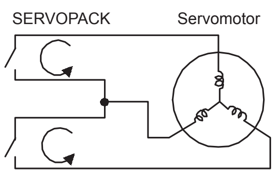
The dynamic brake (DB)[1] is an emergency stop function.

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 function is built into the SERVOPACK.



8.3.6 Instantaneous Power Loss Settings

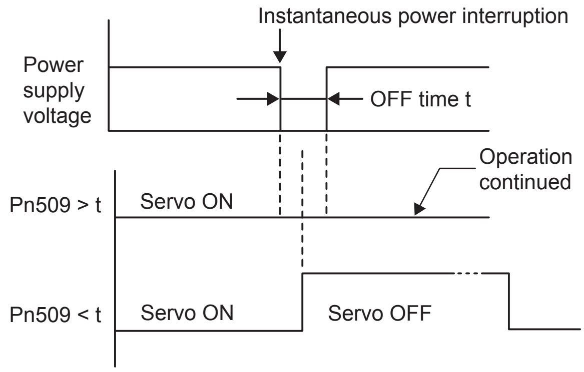
Determines whether to continue operation or turn the servo OFF when the power supply voltage to the SERVOPACK main circuit is instantaneously interrupted.

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.41) 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 SERVOPACK output.

To continue SERVOPACK operation for a power loss that is longer than this, provide an uninterruptible power supply.

Operation

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8.4 Absolute Encoders

⚠ WARNING

- The output range of multiturn data for the Σ-II 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 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.

SGMVH-□□□2□ servomotor: With 17-bit absolute encoder

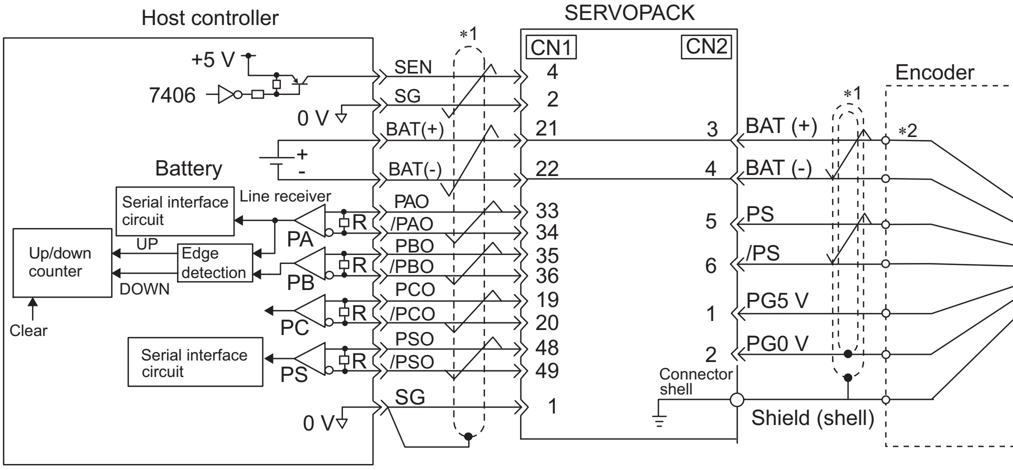
SGMVH-□□□3□ servomotor: With 20-bit absolute encoder (optional)

Absolute Encoder Type	Resolution	Output Range of Multiturn Data	Action when Limit Is Exceeded
Σ-I Series	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 Series	16-bit 17-bit 20-bit	-32768 to + 32767	• When the upper limit (+32767) is exceeded in the forward direction, the multiturn data is -32768.* • When the lower limit (-32768) is exceeded in the reverse direction, the multiturn data is +32767.*

* 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 cables 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 receiver: Texas Instruments's SN75175 or the equivalent
Terminating resistance R: 220 to 470 Ω

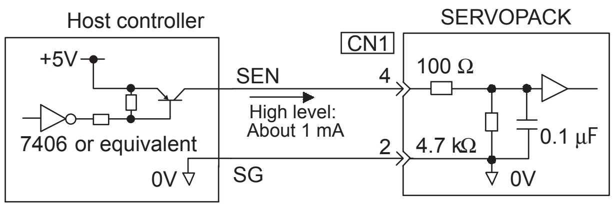
* 1. : Represents twisted-pair wires.

* 2. For wiring pin numbers, refer to *5 Specifications and Dimensional Drawings of Cables and Peripheral Devices*.

- SEN Signal Connection

Type	Name	Connector Pin Number	Setting	Meaning
Input	SEN	CN1-4	OFF (low level)	Input when power is turned ON
			ON (high level)	Input at absolute data request

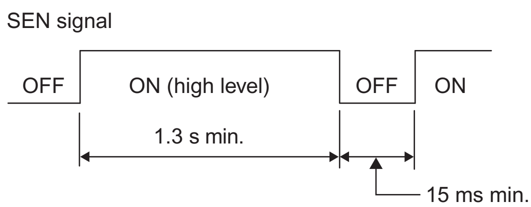
- This input signal is required to output absolute data from the SERVOPACK.
- When the SERVOPACK main circuit power supply turns OFF, input the SEN signal at a low level.
- Let at least three seconds elapse after turning ON the power before changing the SEN signal to high level.
- When the SEN signal changes from low level to high level, the multiturn data and initial incremental pulses are output.
  Until these operations have been completed, the servomotor cannot be turned ON regardless of the status of the servo ON signal (/S-ON).
- The panel operator display will also remain "b.b".
  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.

■ 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.



Operation

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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.

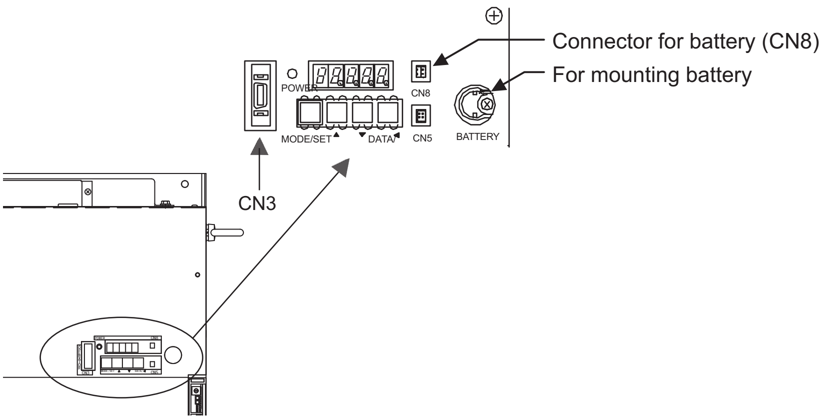
PROHIBITED

- Install the battery at either the host controller or the SERVOPACK.
  It is dangerous to install batteries at both simultaneously, because that sets up a loop circuit between the batteries.

Battery Installation Location	Yaskawa Model*	Manufacturer Model	Specifications	Manufacturer
Host controller	–	ER6VC3	Lithium battery 3.6 V, 2000 mAh	Toshiba Battery Co., Ltd.
SERVOPACK	JZSP-BA01-1	ER3V	Lithium battery 3.6 V, 1000 mAh	Toshiba Battery Co., Ltd.

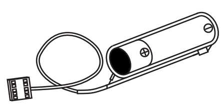
* For Yaskawa model, a connector is included with a battery.

(1) Battery Provided for SERVOPACK



(2) Installing the Battery at the Host Controller

Prepare the battery according to the specifications of the host controller. Use the battery with the model number ER6VC3 (3.6 V, 2000 mAh made by Toshiba Battery Co., Ltd.) or the equivalent.



8.4.4 Replacing Batteries

The SERVOPACK will generate an absolute encoder battery alarm (A.83) when the battery voltage drops below about 2.7 V. This alarm is output, however, only when the SERVOPACK power is turned ON. If the voltage drops while the SERVOPACK power is ON, the SERVOPACK will not generate the alarm.

- 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.83).
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 (initializing) the absolute encoder is necessary in the following cases.

- When starting the machine for the first time
- When an encoder backup error alarm (A.81) is generated
- When an encoder checksum error alarm (A.82) is generated
- When the multiturn data of the absolute encoder is to be 0.

Use a built-in type digital operator in the SERVOPACK or a digital operator for setup.

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.81)
   - Encoder checksum error alarm (A.82)

   Any other alarms that monitor the inside of the encoder should be canceled by turning OFF the power.

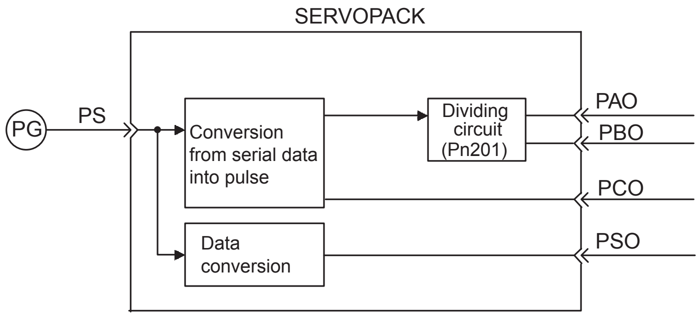
Step	Display after Operation	Digital Operator	Panel Operator	Description
1	Alarm generated			
2	Fn000	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
3	Fn008	▲ ▼	▲ ▼	Press the UP or DOWN Key to select parameter Fn008. Note: The digit that can be set will blink.
4	PGCL1	DATA ENTER (DATA/ENTER Key)	DATA/◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. The display will be as shown at the left.
5	PGCL5	▲ ▼	▲ ▼	Continue pressing the UP Key until PGCL5 is displayed. Note: If there is a mistake in the key operation, “nO_OP” will blink for about one second. The panel operator or digital operator will return to the utility function mode.
6	donE	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key. 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 ENTER (DATA/ENTER Key)	DATA/◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than 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 controller is shown below.

(1) Outline of Absolute Signals

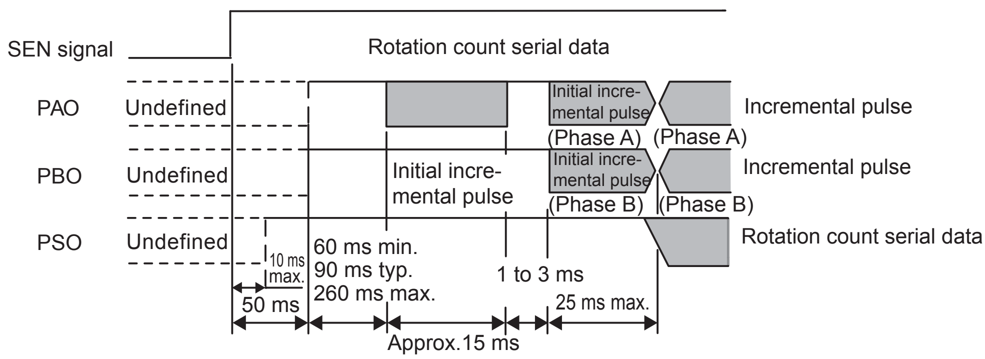
The serial data, pulses, etc., of the absolute encoder that are output from the SERVOPACK are output from the PAO, PBO, PCO, and PSO signals as shown below.



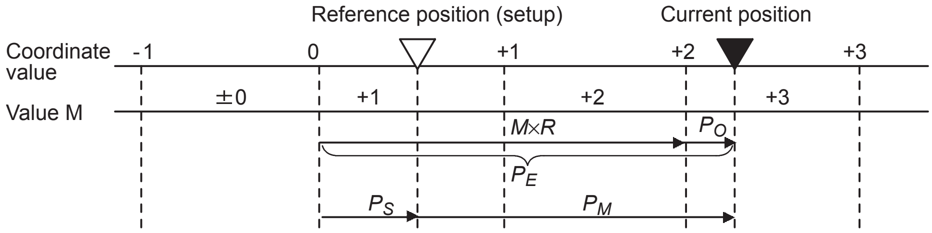
Signal Name	Status	Meaning
PAO	At initial status	Serial data Initial incremental pulse
	At normal status	Incremental pulse
PBO	At initial status	Initial incremental pulse
	At normal status	Incremental pulse
PCO	Always	Zero point pulse
PSO	Always	Rotation count serial data

(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 25 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).

$$P_E = -M \times R + P_O$$
$$P_M = P_E - P_S$$

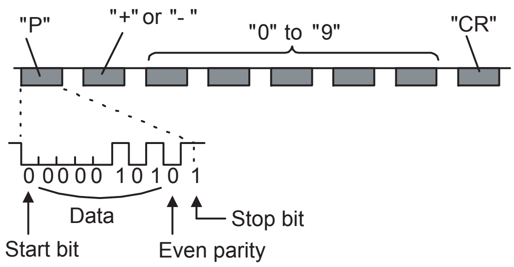
P_E	Current value read by encoder
M	Multiturn data (rotation count data)
P_O	Number of initial incremental pulses
P_S	Absolute data read at setup (This is saved and controlled by the host controller.) $P_S = M_S \times R + P_S'$
M_s	Multiturn data read at setup
P_S'	Number of initial incremental pulses 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 Pn201)

(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 code	ASCII 7-bit code
Data format	8 characters, as shown below.



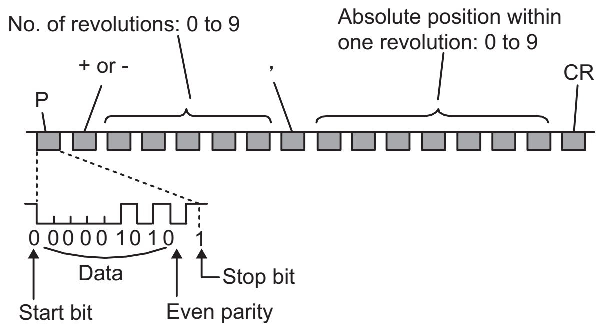
Notes: 1. Data is "P+00000" (CR) or "P-00000" (CR) when the number of revolutions is zero.

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) PSO Serial Data Specifications

The number of revolutions is always output in five digits and seven digits (absolute position within one revolution).

Data Transfer Method	Start-stop Synchronization (ASYNC)
Baud rate	9600 bps
Start bits	1 bit
Stop bits	1 bit
Parity	Even
Character code	ASCII 7-bit code
Data format	13 characters, as shown below.

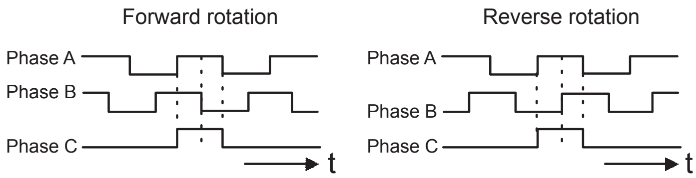


Note: 1. The absolute position data within one revolution is the value before divided.
2. The absolute position data increases during forward rotation. (The reverse rotation mode is invalid.)

(c) Incremental Pulses and Zero-Point Pulses

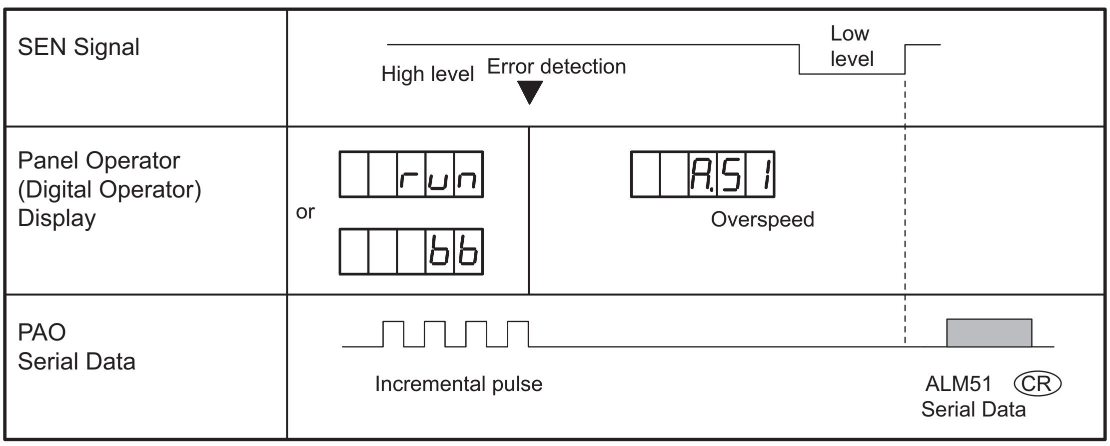
Just as with normal incremental pulses, initial incremental pulses which provide absolute data are first divided by the frequency divider inside the SERVOPACK and then output.

For details, refer to *8.5.7 Encoder Signal Output.*



(4) Transferring Alarm Contents

When an absolute encoder is used, SEN signals can be utilized to transfer the alarm detection contents from PAO outputs to the host controller as serial data.
For alarm list, refer to *10.1.1 Alarm Display Table.*



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.CC) occurs, check the setting of parameter Pn205 to be sure that it is correct.

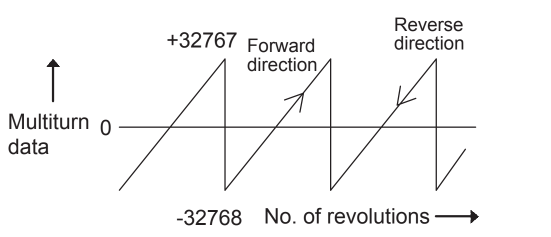
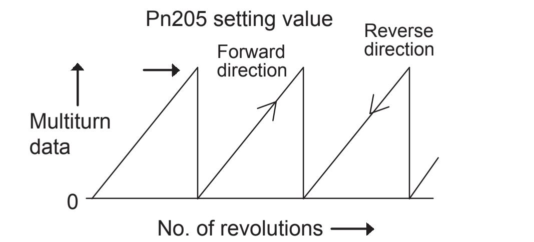
  If Fn013 is executed when an incorrect value is set in Pn205, an incorrect value will be set in the encoder. The alarm will disappear even if an incorrect value is set, but incorrect positions will be detected, resulting a dangerous situation where the machine will move to unexpected positions and machine 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.

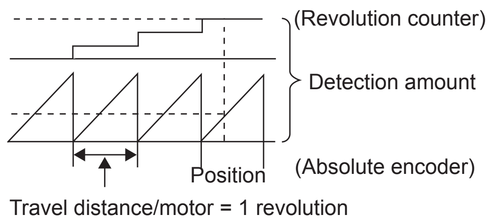
Factory Setting (=65535)	Without Factory Setting (≠65535)
	

■ 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.

Set the Pn205 to (the desired multiturn data -1).



- 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
A.CC	Multiturn Limit Disagreement	ALO1	ALO2	ALO3	Different multiturn limits have been set in the encoder and SERVOPACK.
		ON (L)	OFF (H)	ON (L)	

When the alarm is displayed, be sure to change the multiturn limit value within the encoder.

8.4.8 Multiturn Limit Setting When Multiturn Limit Disagreement (A.CC) Occurred

Perform the following operation using the digital operator or panel operator.

This operation can only be done when the A.CC alarm is generated.

Step	Display after Operation	Digital Operator	Panel Operator	Description
1	Fn000	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
2	Fn013		▲ ▼	Press the LEFT/RIGHT or UP/DOWN Key or the UP or DOWN Key to set the parameter Fn013. *The digit that can be set will blink.
3	PGSEt	DATA ENTER (DATA/ENTER Key)	DATA/◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. The display on the left will appear.
4	donE	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or 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 ENTER (DATA/ENTER Key)	DATA/◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than 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.			

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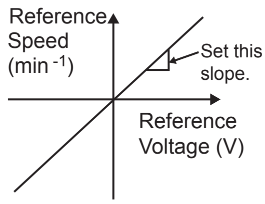
8.5 Operating Using Speed Control with Analog Reference

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
	1.50 to 3000 (150 to 30.00 V/rated speed)	0.01 V/Rated speed	600 (6 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-V input is equivalent to the rated speed of the servomotor (factory setting).

Pn300=1000: 10-V input is equivalent to the rated speed of the servomotor.

Pn300=200: 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 voltage reference to control the servomotor speed in proportion to the input voltage.

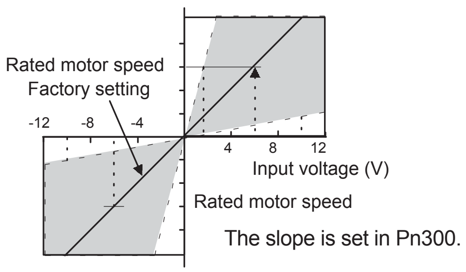
Type	Signal Name	Connector Pin Number	Name
Input	V-REF	CN1-5	Speed Reference Input
	SG	CN1-6	Signal Ground for Speed Reference Input

The above inputs are used for speed control (analog voltage 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

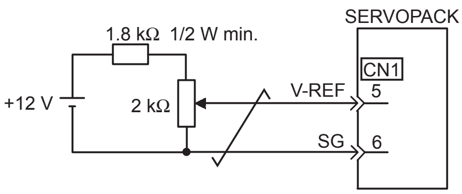
  Actual examples are shown below.

Speed Reference Input	Rotation Direction	Motor Speed
+6 V	Forward	Rated motor speed
+1 V	Forward	1/6 rated motor speed
-3 V	Reverse	1/2 rated motor speed

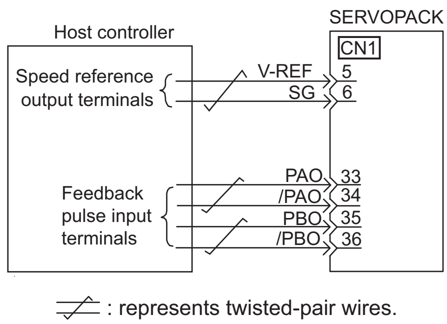
Parameter Pn300 can be used to change the voltage input range.

■ Input Circuit Example

- Always use twisted-pair wire 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.



(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.

/P-CON 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*.

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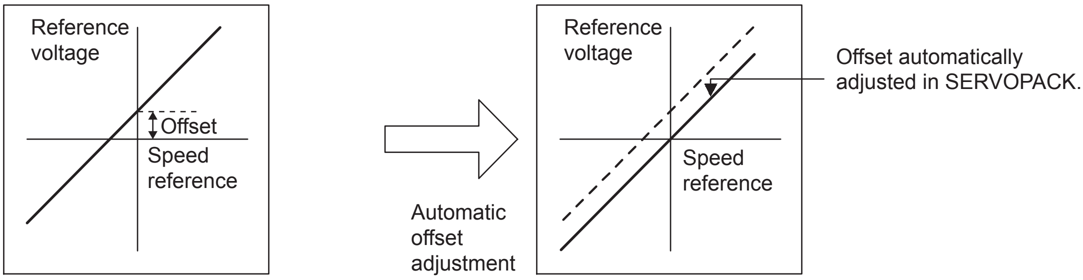
8.5.3 Adjusting Offset

When using the speed control, the servomotor may rotate slowly even if 0 V is specified as the analog voltage reference. This happens if the host controller or external circuit has a slight offset (in the units of mV) 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.

The SERVOPACK automatically adjusts the offset when the host controller or external circuit has the 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 speed reference offset manual adjustment mode (Fn00A). Refer to *8.5.3 (2) Manual Adjustment of the Speed Reference Offset*.

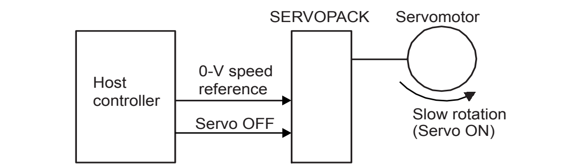
(1) Automatic Adjustment of the Speed Reference Offset

The automatic adjustment of reference offset (Fn009) cannot be used when a position loop has been formed with a host controller and the error pulse is changed to zero at the servomotor stop due to servolock. Use the speed reference offset manual adjustment (Fn00A) 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 in the following procedure.

Step	Display after Operation	Digital Operator	Panel Operator	Description
1				Turn OFF the SERVOPACK, and input the 0-V reference voltage from the host controller or external circuit.
2	Fn000	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
3	Fn009		▲ ▼	Press the LEFT/RIGHT or UP/DOWN Key, or UP or DOWN Key to select parameter Fn009. *The digit that can be set will blink.
4	rEF_o	DATA ENTER (DATA/ENTER Key)	DATA/◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. "rEF_o" will be displayed.
5	donE	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or 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 ENTER (DATA/ENTER Key)	DATA/◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to return to the Fn009 display of the utility function mode.

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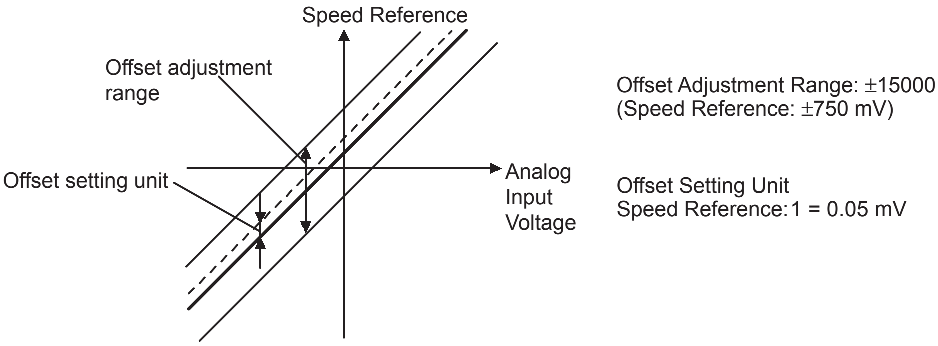
(2) Manual Adjustment of the Speed Reference Offset

Use the speed reference offset manual adjustment (Fn00A) in the following situations:

- If a loop is formed with the host controller and the position error pulse is to be zero 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), except that the amount of offset is directly input during the adjustment.

The offset setting range and setting units are as follows:



Adjust the speed reference offset manually in the following procedure.

Step	Display after Operation	Digital Operator	Panel Operator	Description
1	Fn000	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
2	Fn00A	▲ ▼	▲ ▼	Press the UP or DOWN Key to select parameter Fn00A. *The digit that can be set will blink.
3	. .SPd	DATA ENTER (DATA/ENTER Key)	DATA/◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. The display will be as shown at the left. The manual adjustment mode for the speed reference offset will be entered.
4	. .SPd	Servo ON		Turn ON the servo ON (/S-ON) signal. The display will be as shown at the left.
5	00000	◀ ▶	DATA/◀ (DATA/SHIFT Key) (Press less than 1 s.)	Press the LEFT or RIGHT Key or DATA/SHIFT Key for less than one second to display the speed reference offset amount.
6		▲ ▼	▲ ▼	Press the UP or DOWN Key to adjust the amount of offset.
7	. .SPd	◀ ▶	MODE/SET (MODE/SET Key) (Press less than 1 s.)	Press the LEFT or RIGHT Key or MODE/SET Key for less than one second. The display will appear momentarily as shown at the left, and “donE” will blink and the offset will be set. After the setting is completed, the display will return to the display as shown at the left.
8	Fn00A	DATA ENTER (DATA/ENTER Key)	DATA/◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to return to the Fn00A display of the utility function mode.

8.5.4 Soft Start

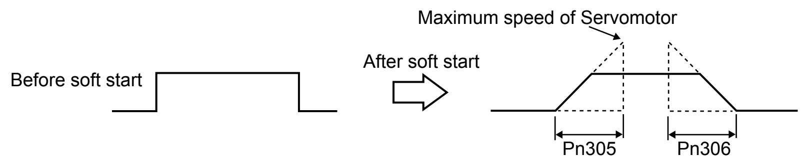
The soft start function converts the stepwise speed reference inside the SERVOPACK to a consistent rate of acceleration and deceleration.

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	0.01 ms	40	Immediately

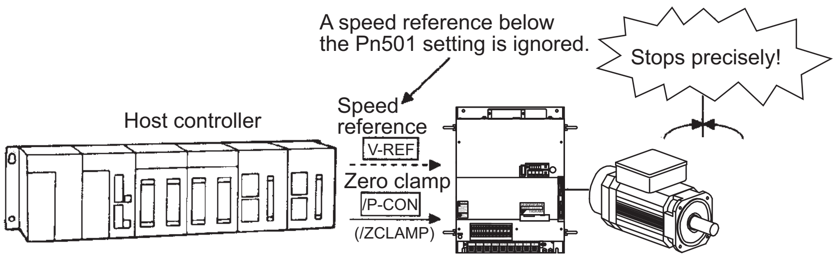
This smoothens the speed reference by applying a 1st-order delay filter to the analog speed reference (V-REF) input. A value that is too large, however, will slow down response.

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 in the zero clamp level (Pn501). The servomotor ignores the speed reference and then quickly stops and locks the servomotor.

The servomotor is clamped within ±1 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.

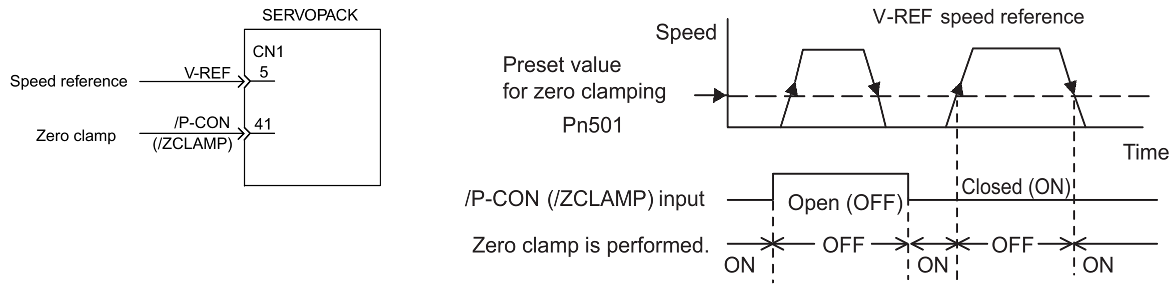


(2) Parameter Setting

Parameter		Meaning
Pn000	n.□□A□	Control mode selection: Speed control (analog voltage reference) ⇔ Zero clamp

Zero Clamp Conditions
Zero clamp is performed with Pn000 = n.□□A□ when 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.
Even if this value is set higher than the maximum speed of the servomotor, 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)

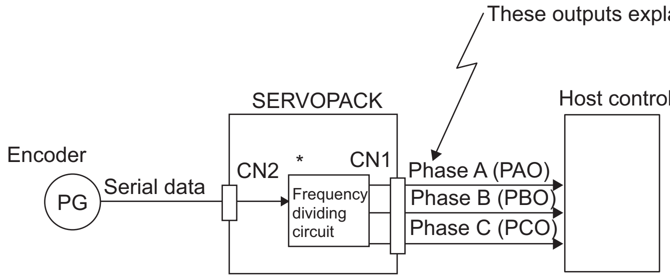
This is the input signal for the zero clamp operation.
Either /P-CON or /ZCLAMP can be used to switch the zero clamp.
To use the /ZCLAMP signal, allocation of the input signal is required.
Refer to *7.3.2 Input Circuit Signal Allocation* for more details.

■ IMPORTANT
When the /ZCLAMP signal is allocated, the zero clamp operation will be used even for speed control Pn000 = n.□□0□.

8.5.7 Encoder Signal Output

Encoder feedback pulses processed inside the SERVOPACK can be output externally.

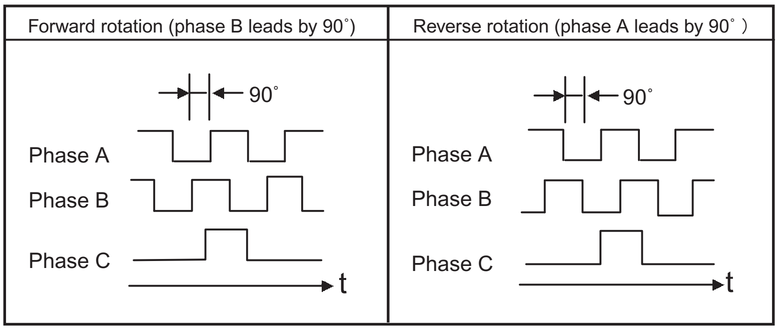
Type	Signal Name	Connector Pin Number	Name
Output	PAO	CN1-33	Encoder output phase A
	/PAO	CN1-34	Encoder output phase /A
Output	PBO	CN1-35	Encoder output phase B
	/PBO	CN1-36	Encoder output phase /B
Output	PCO	CN1-19	Encoder output phase C (zero-point pulse)
	/PCO	CN1-20	Encoder output phase /C (zero-point pulse)



Note: The width of the zero-point pulse varies depending on the setting of the dividing ratio (Pn201). The width of zero-point pulse and phase A are identical.

* Even in reverse rotation mode (Pn000.0 = 1), the dividing[1] 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 or more before starting a zero point return. If the configuration prevents the servomotor from rotating the servomotor or more, 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.

TERMS

1 Dividing

The dividing means that the divider converts data into the number of pulses based on the pulses of the encoder installed on the servomotor, and outputs it. The setting unit is the number of pulses/revolution.

• Pulse Dividing Ratio Setting

The upper limit of PG dividing ratio (Pn201) is 16384 [P/R] that is decided for 16-bit encoder. However, SGMVH servomotors are equipped with 17-bit encoder as standard and 20-bit encoder as an option. Therefore, the parameter Pn212 is added to adapt the dividing pulse setting for 20-bit encoder.

For the PG dividing ratio setting, either the existing Pn210 or the newly added Pn212 can be used.

Select Pn201 or Pn212 by the switch for parameters. The factory setting is Pn201.

- Dividing pulse is set in the resolution 16-bit or less, use Pn201.
- Dividing pulse is set in the resolution 17-bit or more, use Pn212.

For the setting method of dividing ratio for 17-bit or more resolution, refer to *(2) Setting PG dividing ratio of 5-digit or more*.

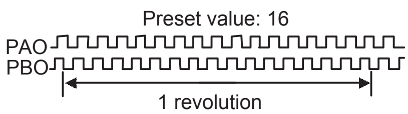
(1) Related Parameters

Parameter		Description
Pn207	n.□**0**□□	Uses the parameter Pn201 (For 16-bit or less) as the dividing ratio (Factory setting).
	n.□**1**□□	Uses the parameter Pn212 (For 17-bit or more) as the dividing ratio.

Pn201	PG Dividing Ratio (For 16-bit or less) Speed Position Torque			
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	16 to 16384	1 P/rev	16384	After restart
Pn212	PG Dividing Ratio (For 17-bit or more) Speed Position Torque			
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	16 to 1073741824	1 P/rev	2048	After restart

■ Output Example

Pn201=16 (when 16 pulses are output per revolution)



The setting range of Pn212 differs depending on the encoder used.

The upper limit of dividing output frequency is 1.4 Mpps because of the restrictions on the hardware. Therefore, setting a high number of pulses limits the motor speed.

The following table shows the setting conditions when Pn212 is used.

Encoder Resolution (Bits)	Number of Encoder Pulses per Revolution (P/R)	Setting Range (P/R)
17	32768	16 to 32768
20	262144	16 to 262144

For settings higher than 16384 P/R, pulses must be set in the following increments.

PG Dividing Ratio Setting (P/R)	Increments (P/R)	Motor Speed Upper Limit (min^{-1})
16 to 16384	1-pulse	No limit
16386 to 32768	2-pulse	82×10^6/set value
32772 to 65536	4-pulse	
65544 to 131072	8-pulse	
131088 to 262144	16-pulse	

The setting error alarm A.09 (dividing ratio setting error) will occur if the setting is outside the allowable range or does not satisfy the setting conditions. The overspeed alarm A.51 will occur if the motor speed exceeds the upper limit.

When setting the pulse dividing ratio using a digital operator or panel operator, the display of the number of pulses is skipped to not increment by 2 to 16 pulses and the upper limit will not increment above the resolution of mounted encoder.

When Pn212 is set without connecting a servomotor to the SERVOPACK, the upper limit is automatically set to 2^{30} (=1073741824: the maximum output value of the SERVOPACK) since the encoder resolution of the servomotor is unknown.

Therefore, it is recommended to set Pn212 after connecting a servomotor.

(2) Setting PG dividing ratio of 5-digit or more

The following table shows a procedure to set Pn212 by a digital operator or a panel operator.

Procedure	Display After Operation	Hand-held digital operator	Panel Operator	Description
1	Pn000	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press DSPL/SET or MODE/SET Key to select the utility function mode.
2	Pn212	∧ ∨ < >	▲ ▼	Press Up or Down Cursor Key to select the parameter Pn212. Press Left or Right Cursor Key to select the digit. The enabled digit blinks. Press Up or Down Cursor Key to change the value.
3	02048	DATA ENTER (DATA/ENTER Key)	DATA/◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press DATA/ENTER Key or DATA/SHIFT key for more than one second to display the lower 5 digits of the current PG dividing ratio setting value.
4	02048 ↓ 00000	∧ ∨ < >	▲ ▼ DATA/◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press Left or Right Cursor Key once, or DATA/SHIFT Key for more than one second to select the digit. The enable digit blinks. Press Up or Down Cursor Key to change the value. Pressing Left or Right Cursor Key or DATA SHIFT Key when the left-end or right-end digit is blinking displays another 5 digits.
5	00000 ↓ 02048	∧ ∨ < >	▲ ▼ DATA/◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press Left or Right Cursor Key or DATA/SHIFT Key for more then one second to select the digit. The enabled digit blinks. Press Up or Down Cursor Key to change the value. Pressing Left or Right Cursor Key or DATA/SHIFT Key when the left-end or right-end digit is blinking displays another 5 digits. Repeat the steps 4 and 5 to change the data.
6	Pn212	DATA ENTER (DATA/ENTER Key)	DATA/◀ (DATA/SHIFT Key) (Press at least 1 s.)	DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. The display returns to Pn212.

INFO

When the password setting (write prohibited setting) is enabled, the setting can be read only by pressing Left or Right Cursor Key or DATA/SHIFT Key.

8.5.8 Speed Coincidence Output

The speed coincidence (/V-CMP) output signal is output when the actual motor speed during speed control is the same as the speed reference input. The host controller uses the signal as an interlock.

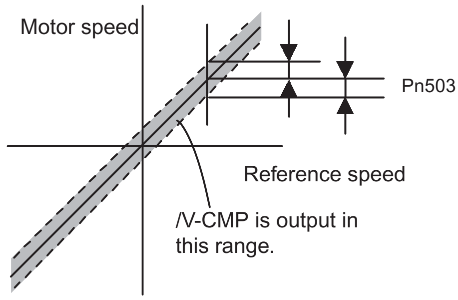
Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/V-CMP	CN1-25, 26 (Factory setting)	ON (low level)	Speed coincides.
			OFF (high level)	Speed does not coincide.
This output signal can be allocated to another output terminal with parameter Pn50E. Refer to *7.3.3 Output Circuit Signal Allocation* for details.				

Pn503	Speed Coincidence Signal Output Width	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 the same as the pn503 setting or less.

■ 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. When the factory setting is used and the output terminal allocation is not performed with the 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)

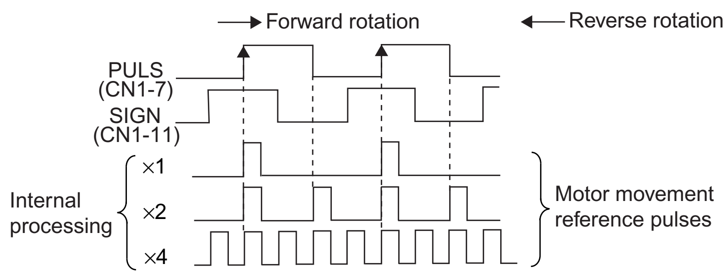
(2) Setting a Reference Pulse Form

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)	–	PULS (CN1-7) SIGN (CN1-11) H	PULS (CN1-7) SIGN (CN1-11) L
	n.□□□1	CW pulse + CCW pulse (Positive logic)	–	PULS (CN1-7) L SIGN (CN1-11)	PULS (CN1-7) SIGN (CN1-11) L
	n.□□□2	Two-phase pulse train with 90° phase differential (Positive logic)	×1	90° PULS (CN1-7) SIGN (CN1-11)	90° PULS (CN1-7) SIGN (CN1-11)
	n.□□□3		×2		
	n.□□□4		×4		
	n.□□□5	Sign + pulse train (Negative logic)	–	PULS (CN1-7) SIGN (CN1-11) L	PULS (CN1-7) SIGN (CN1-11) H
	n.□□□6	CW pulse + CCW pulse (Negative logic)	–	PULS (CN1-7) H SIGN (CN1-11)	PULS (CN1-7) SIGN (CN1-11) H
	n.□□□7	Two-phase pulse train with 90° phase differential (Negative logic)	×1	90° PULS (CN1-7) SIGN (CN1-11)	90° PULS (CN1-7) SIGN (CN1-11)
	n.□□□8		×2		
	n.□□□9		×4		

The input pulse multiplier can be set for the 2-phase pulse train with 90° phase differential reference pulse form.



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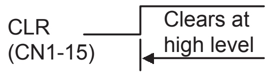
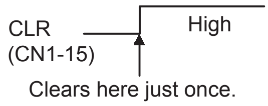
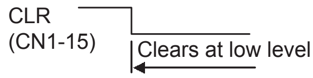
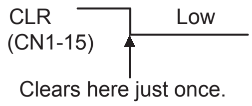
(3) Clear Signal Form Selection

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.

If the clear signal (CLR) is not wired and Pn200 is set to n.□□2□, the position-error pulse is always cleared.
So, if a pulse-train reference is input, the servomotor will not operate.

(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 at the CLR signal input during the baseblock. (Factory setting) "During the baseblock" means when the /S-ON signal or the main circuit power supply is OFF, or an alarm occurs.
	n.□1□□	Do not clear the error pulse. Clear only with the CLR signal.
	n.□2□□	Clear the error pulse when an alarm occurs or the CLR signal is input.

8.6.2 Setting the Electronic Gear

(1) Number of Encoder Pulses

SGMVH-□□□□□□□ (Servomotor model)

Motor Model Encoder Specifications	Encoder Type	No. of Encoder Pulses (P/Rev)	
C	Incremental encoder	17 bits	32768
2	Absolute encoder	17 bits	32768
3		20 bits	262144

Note: For details on reading servomotor model numbers, refer to *2.1 Servomotor Model Designations*.

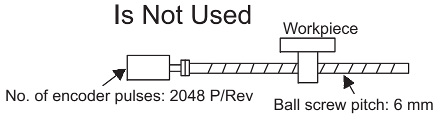
INFO

The number of bits representing the resolution of the applicable encoder is not the same as the number of encoder signal pulses (phases 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.

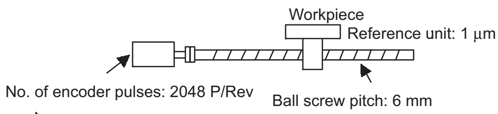
When the Electronic Gear Is Not Used



To move a workpiece 10 mm:

1 revolution is 6 mm. Therefore,
10 ÷ 6 = 1.6666 revolutions
2048 × 4 pulses is 1 revolution. Therefore,
1.6666 × 2048 × 4 = 13653 pulses
13653 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 per 10 mm of workpiece movement.

(3) Related Parameters

Pn202	Electronic Gear Ratio (Numerator)			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 65535	–	4	After restart
Pn203	Electronic Gear Ratio (Denominator)			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 65535	–	1	After restart

If the deceleration ratio of the servomotor and the load shaft is given as n/m where m is the rotation of the servomotor and n is the rotation of the load shaft,

$$\text{Electronic gear ratio: } \frac{B}{A} = \frac{\text{Pn202}}{\text{Pn203}} = \frac{\text{No. of encoder pulses} \times 4}{\text{Travel distance per load shaft revolution (reference units)}} \times \frac{m}{n}$$

* 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: $0.01 \leq$ Electronic gear ratio (B/A) ≤ 100

If the electronic gear ratio is outside this range, the SERVOPACK will not operate properly. In this case, modify the load configuration or reference unit.

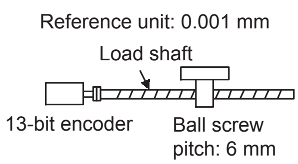
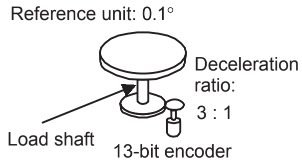
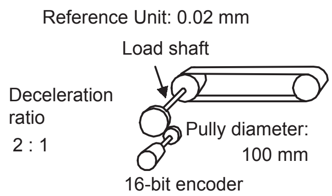
(4) Procedure for Setting the Electronic Gear Ratio

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.

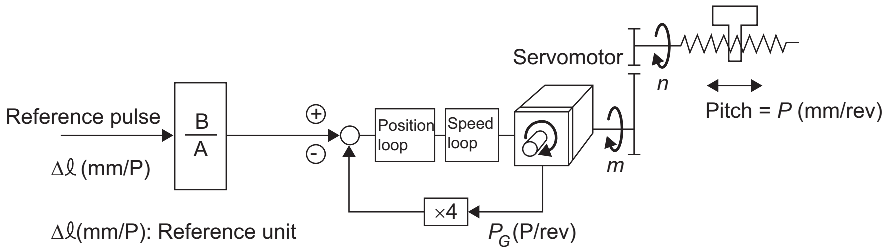
(5) Electronic Gear Ratio Setting Examples

The following examples show electronic gear ratio settings for different load configurations.

Step	Operation	Load Configuration					
		Ball Screw		Disc Table		Belt and Pulley	
							
1	Check machine specifications.	· Ball screw pitch: 6 mm · Deceleration ratio: 1/1		Rotation angle per revolution: 360° Deceleration ratio: 3/1		Pulley diameter: 100 mm (pulley circumference: 314 mm) · Deceleration ratio: 2/1	
2	Check the number of encoder pulses.	13-bit: 2048 P/Rev		13-bit: 2048 P/Rev		16-bit: 16384 P/Rev	
3	Determine the reference unit used.	1 Reference unit: 0.001 mm (1 μm)		1 Reference unit: 0.1°		1 Reference unit: 0.02 mm	
4	Calculate the travel distance per load shaft revolution.	6 mm/0.001 mm=6000		360°/0.1°=3600		314 mm/0.02 mm=15700	
5	Calculate the electronic gear ratio.	$\frac{B}{A}=\frac{2048\times 4}{6000}\times\frac{1}{1}$		$\frac{B}{A}=\frac{2048\times 4}{3600}\times\frac{3}{1}$		$\frac{B}{A}=\frac{16384\times 4}{15700}\times\frac{2}{1}$	
6	Set parameters.	Pn202	8192	Pn202	24576	Pn202	131072*
		Pn203	6000	Pn203	3600	Pn203	15700

Reduce the fraction (both numerator and denominator) since the calculated result will not be within the setting range. For example, reduce the numerator and denominator by four to obtain Pn201=32768, Pn203=3925 and complete the settings.

(6) Electronic Gear Ratio Equation



Δℓ(mm/P): Reference unit

P_G(P/Rev): 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.

$\boxed{A}$: Pn203 $\boxed{B}$: Pn202

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8.6.3 Position Reference

The servomotor positioning is controlled by inputting a pulse train reference.

The pulse train output form from the host controller corresponds to the following:

- Line-driver Output
- +24V Open-collector output
- +12V Open-collector output
- +5V Open-collector output

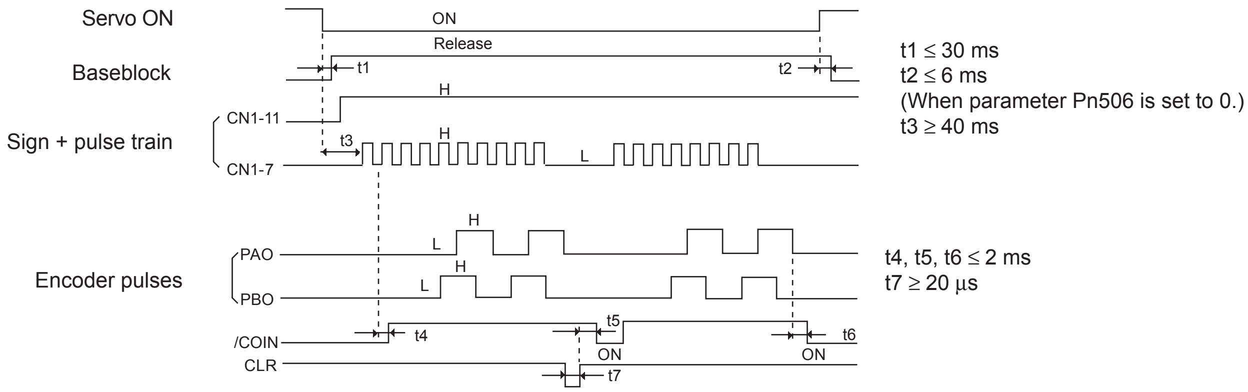
IMPORTANT

■Precautions for Open-collector Output

When the open-collector output is used, input signal noise margin lowers. When a position error caused by the noise occurs, change the parameter as follows:

Parameter		Description
Pn200	n.1□□□	Reference input filter for open-collector signal

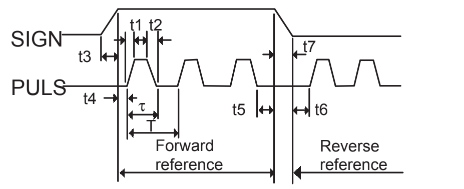
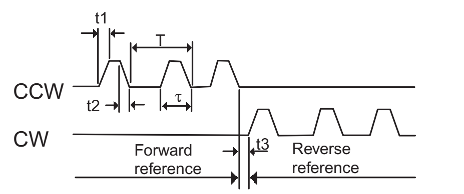
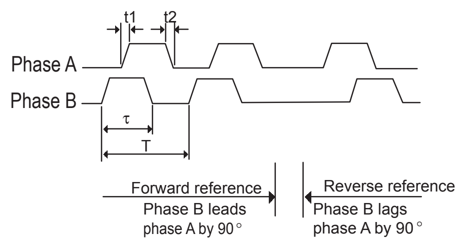
(1) Input/Output Signal Timing Example



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.

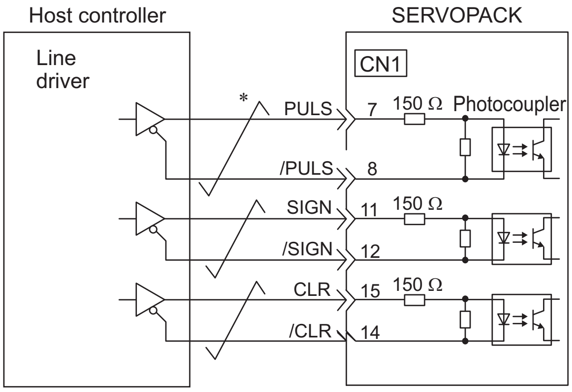
Table 8.3 Reference Pulse Input Signal Timing

Reference Pulse Signal Form	Electrical Specifications		Remarks
Sign and pulse train input (SIGN and PULS signal) Maximum reference frequency: 500 kpps (For open-collector output: 200 kpps)		t1, t2 ≤ 0.1 µs t3, t7 ≤ 0.1 µs t4, t5, t6 > 3 µs τ ≥ 1.0 µs (τ/T) × 100 ≤ 50%	Sign (SIGN) H = Forward reference L = Reverse reference
CW pulse and CCW pulse Maximum reference frequency: 500 kpps (For open-collector output: 200 kpps)		t1, t2 ≤ 0.1 µs t3 > 3 µs τ ≥ 1.0 µs (τ/T) × 100 ≤ 50%	–
Two-phase pulse train with 90° phase differential (phase A and phase B) Maximum reference frequency ×1 input pulse multiplier: 500 kpps ×2 input pulse multiplier: 400 kpps ×4 input pulse multiplier: 200 kpps		t1, t2 ≤ 0.1 µs τ ≥ 1.0 µs (τ/T) × 100 = 50%	Switching of the input pulse multiplier mode is done with parameter Pn200.0 setting.

(2) Connection Example

(a) Connection Example for Line-driver Output

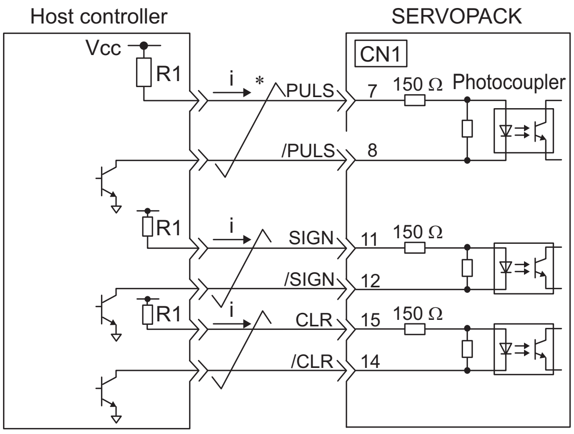
Applicable line driver: SN75174 manufactured by Texas Instruments Inc., or MC3487 or the equivalent



* : Represents twisted-pair wires.

(b) Connection Example for Open-collector Output

Select the limit resistance R1 value so that the input current *i* will be within 7 to 15 mA.



■Example

- When Vcc is +24V: R1=2.2 kΩ
- When Vcc is +12V: R1=1 kΩ
- When Vcc is +5V: R1=180 Ω

Note: When the open-collector output is used, the signal logic is as follows:

When Tr1 is ON	High level input or the equivalent
When Tr1 is OFF	Low level input or the equivalent

* : Represents twisted-pair wires.

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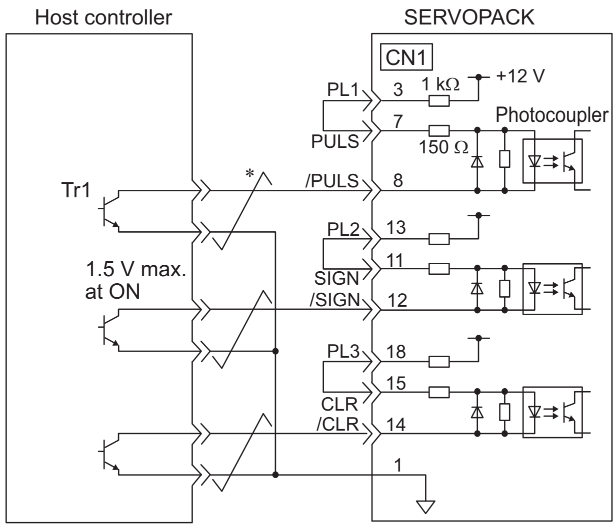
The SERVOPACK internal power supply can be used.
In this case, the circuit will not be isolated.



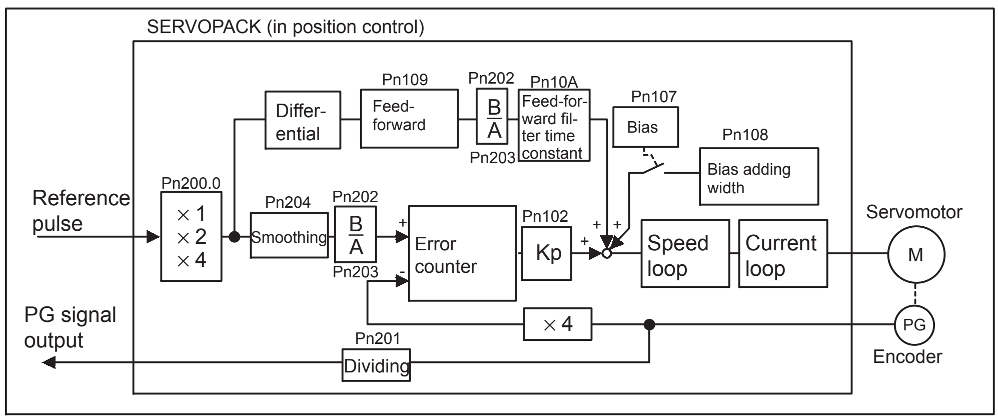
* : Represents twisted-pair wires.

IMPORTANT

When the open-collector output is used, input signal noise margin lowers. When a position error caused by the noise occurs, set the parameter Pn200.3 to 1.

(3) Position Control Block Diagram

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

Pn204	Position Reference Acceleration/Deceleration Time Constant			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 6400	0.01 ms	0	Immediately

Pn208	Average Movement Time of Position Reference			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 6400	0.01 ms	0	Immediately

■ IMPORTANT

When the position reference acceleration/deceleration time constant (Pn204) 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.

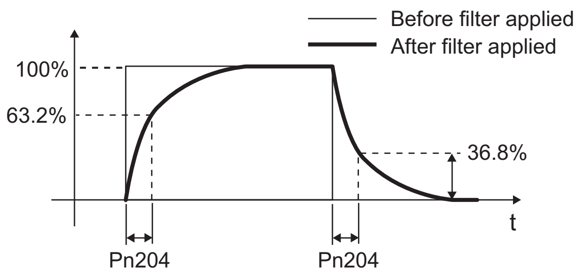
This function provides smooth motor operating in the following cases. The function does not affect the travel distance (i.e., the number of pulses).

- 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., 10× or more).

The difference between the position reference acceleration/deceleration time constant (Pn204) and the position reference movement averaging time (Pn208) is shown below.

Acceleration/Deceleration Filter

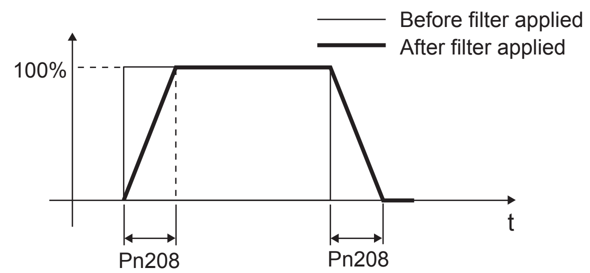
Pn207=n.□□□0



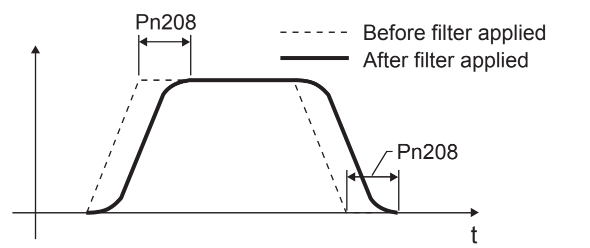
Response waveform for stepwise input

Average Movement Time Filter

Pn207=n.□□□1



Response waveform for stepwise input



Response waveform for ramp reference input

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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. Refer to *7.3.3 Output Circuit Signal Allocation*. The factory setting is allocated to CN1-25, 26.				

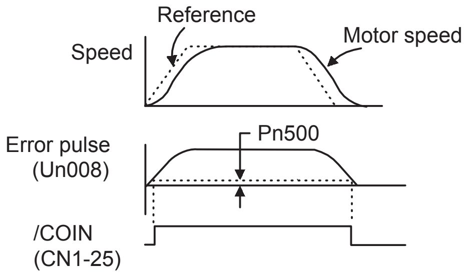
Pn500	Positioning Completed Width			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 250	1 reference unit	7	Immediately

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.

The positioning completed width setting has no effect on final positioning accuracy.



/COIN is a position control signal.

When the factory setting is used and the output terminal allocation is not performed with the Pn50E, this signal is used for the speed coincidence output /V-CMP for speed control, and it is always OFF (high level) for torque control.

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.

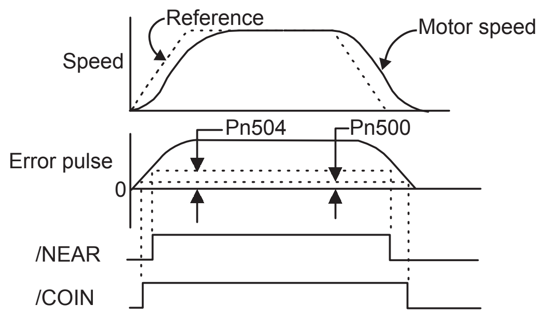
Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/NEAR	Must be allocated	ON (low level)	The servomotor has reached a point near to positioning completed.
			OFF (high level)	The servomotor has not reached a point near to positioning completed.
The output terminal must be allocated with parameter Pn510 in order to use positioning near signal. Refer to *7.3.3 Output Circuit Signal Allocation* for details.				

Pn504	NEAR Signal Width			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 250	1 reference unit	7	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 Pn504.

Set the number of error pulses in reference units (the number of input pulses defined using the electronic gear.)

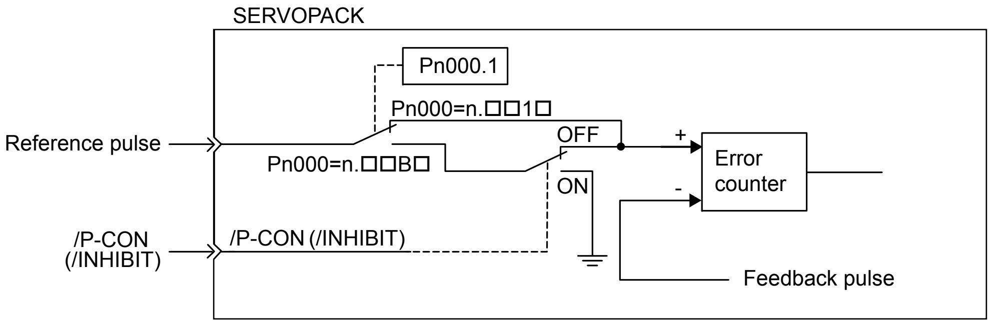
Normally, the setting should be larger than that for the positioning completed width (Pn500).



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.

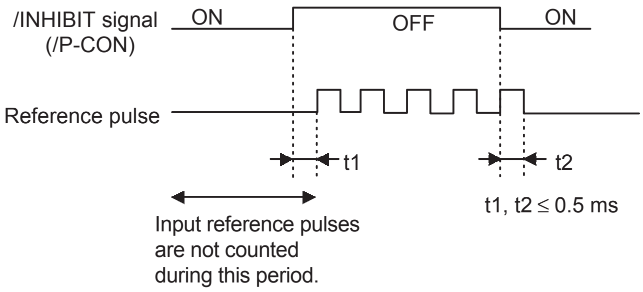


(2) Setting Parameters

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 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*.				

8.6.8 Reference Pulse Input Multiplication Switching Function

If the /PSEL signal for switching the multiplication of the position reference pulse input turns ON or OFF, the multiplication factor can be switched from 1 to n (n = 1 to 99). And the status of this signal indicates whether the position multiplication is switched to 1 or n.

Set Pn218.0 = 1 to enable this function, and set the multiplication in Pn217.

To change the reference pulse multiplication, the position reference pulse must be set to 0. Otherwise, the operation cannot be guaranteed.

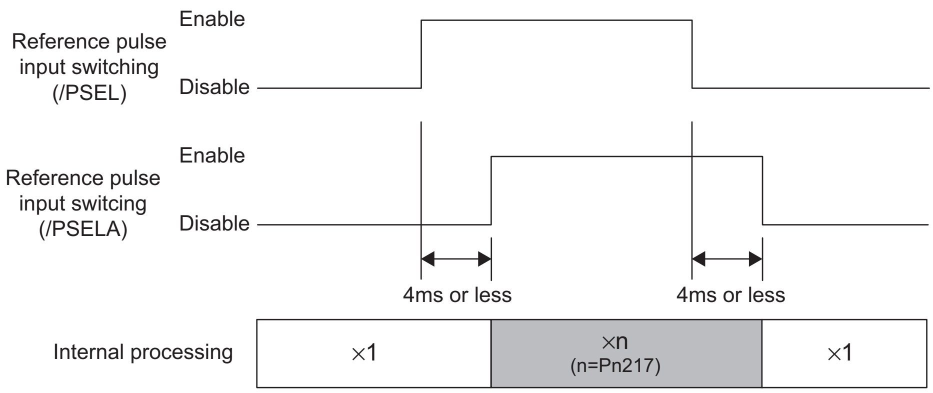
(1) Related Parameters

Parameters		Description
Pn218	n.□□□**0**	Reference pulse input multiplication switching function: Disabled (Factory setting)
	n.□□□**1**	Reference pulse input multiplication switching function: Enabled

Note: After changing the setting, turn OFF the power and ON again to enable the new setting.

Pn217	Reference Pulse Input Multiplication			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 99	×1	1	Immediately

(2) Timing Chart for Reference Pulse Input Multiplication Switching



(3) Input Signal Selection

Signal Name	Connector Pin Number	Setting	Meaning
/PSEL	Signal allocation not required	ON (low level)	Enabled when the /PSEL signal turns ON.
		OFF (high level)	Disabled when the /PSEL signal turns OFF.
The /PSEL signal is the input signal that switches the multiplication factor of the reference pulse input to the value set in Pn217. This signal must be allocated in parameter Pn513.0 as shown in the following table. Refer to *7.3.2 Input Circuit Signal Allocation* for more information on how to allocate input signals. After setting Pn217, turn OFF the power supplies for the main circuit and the control and then turn ON again.			

Parameter		Description
Pn513	n.□□□0	Input signal from CN1-40 is ON (high level): Enabled
	n.□□□1	Input signal from CN1-41 is ON (high level): Enabled
	n.□□□2	Input signal from CN1-42 is ON (high level): Enabled
	n.□□□3	Input signal from CN1-43 is ON (high level): Enabled
	n.□□□4	Input signal from CN1-44 is ON (high level): Enabled
	n.□□□5	Input signal from CN1-45 is ON (high level): Enabled
	n.□□□6	Input signal from CN1-46 is ON (high level): Enabled
	n.□□□7	Sets the signal ON.
	n.□□□8	Sets the signal OFF. (Factory setting)
	n.□□□9	Input signal from CN1-40 is OFF (low level): Enabled
	n.□□□A	Input signal from CN1-41 is OFF (low level): Enabled
	n.□□□B	Input signal from CN1-42 is OFF (low level): Enabled
	n.□□□C	Input signal from CN1-43 is OFF (low level): Enabled
	n.□□□D	Input signal from CN1-44 is OFF (low level): Enabled
	n.□□□E	Input signal from CN1-45 is OFF (low level): Enabled
	n.□□□F	Input signal from CN1-46 is OFF (low level): Enabled

Note: After changing the setting, turn OFF the power and ON again to enable the new setting.

(4) Output Signal Selection

The /PSELA signal is the output signal that indicates if switching for reference pulse input multiplication is enabled by /PSEL signal or not.

Signal Name	Connector Pin Number	Setting	Meaning
/PSELA	Signal allocation not required	ON (low level)	Enabled when the /PSEL signal turns ON.
		OFF (high level)	Disabled when the /PSEL signal turns OFF.

The /PSELA signal can’t be used with the factory setting. Allocate the /PSELA output signal.

Parameter		Meaning
Pn510	n.□0□□	Disabled (/PSELA output signal is not used.)
	n.□1□□	Outputs the /PSELA signal from the CN1-25, 26 output terminal.
	n.□2□□	Outputs the /PSELA signal from the CN1-27, 28 output terminal
	n.□3□□	Outputs the /PSELA signal from the CN1-29, 30 output terminal.
For the factory settings, the pins CN1-25 to CN1-30 are allocated for other output signals. If multiple signals are allocated to the same output terminal, signals are output with OR logic. To enable only the /PSELA output signal, allocate the other signals to other output terminals or disable the other signals. Refer to *7.3.3 Output Circuit Signal Allocation* for the allocation of output signals.		

Note: After changing the setting, turn OFF the power and ON again to enable the new setting.

8.7 Operating Using Torque Control

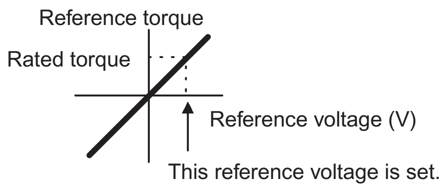
8.7.1 Setting Parameters

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 10.0 V/rated torque)	0.1V/rated torque	30	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: The servomotor operates at the rated torque with 3-V input (factory setting).

Pn400 = 100: The servomotor operates at the rated torque with 10-V input.

Pn400 = 20: 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)

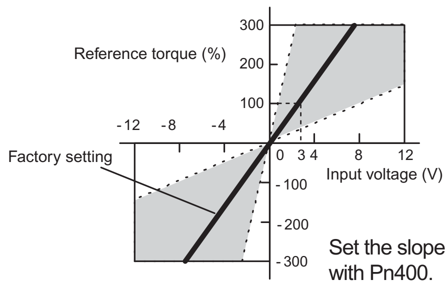
The torque reference gain is set in Pn400. For setting details, refer to *8.7.1 Setting Parameters*.

■ Input Specifications

- Input range: ±1 to ±10VDC/rated torque
- Max. allowable input voltage: ±12 VDC
- Factory setting

  Pn400 = 30: Rated torque at 3 V

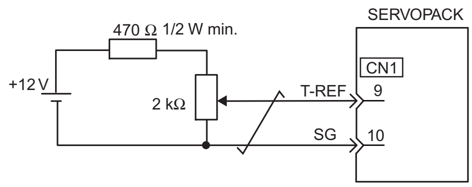
  +3-V input: Rated torque in forward direction
  +9-V input: 300% rated torque in forward direction
  -0.3-V input: 10% rated torque in reverse direction
  The voltage input range can be changed with parameter Pn400.



■ 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 (Un002). 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 *9.5 Analog Monitor*.

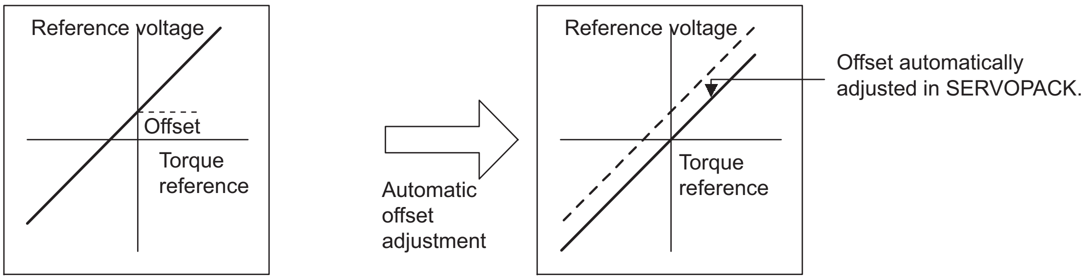
8.7.3 Adjusting the Reference Offset

(1) Automatic Adjustment of the Torque 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 reference offset can be adjusted automatically and manually using the panel operator or digital operator.

The automatic adjustment of analog (speed, torque) 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.



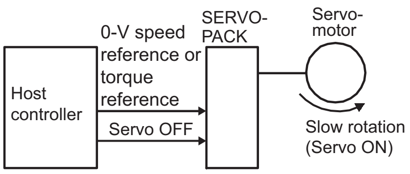
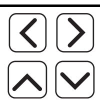
After completion of the automatic adjustment, the amount of offset is stored in the SERVOPACK. The amount of offset can be checked in the manual adjustment of torque reference offset (Fn00B).

The automatic adjustment of analog reference offset (Fn009) cannot be used when a position loop has been formed with the host controller and the error pulse is changed to zero at the servomotor stop due to servolock. Use the torque reference offset manual adjustment (Fn00B).

IMPORTANT

The analog reference offset must be automatically adjusted with the servo OFF.

Use the following procedure for automatic adjustment of the torque reference offset.

Step	Display after Operation	Digital Operator	Panel Operator	Description
1				Turn OFF the SERVOPACK, and input the 0-V reference voltage from the host controller or external circuit.
2	Fn000	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
3	Fn009		▲ ▼	Press the LEFT/RIGHT or UP/DOWN Key, or UP or DOWN Key to select parameter Fn009. *The digit that can be set will blink.
4	rEF_o	DATA ENTER (DATA/ENTER Key)	DATA/◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. "rEF_o" will be displayed.
5	donE	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or 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 ENTER (DATA/ENTER Key)	DATA/◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to return to the Fn009 display of the utility function mode.

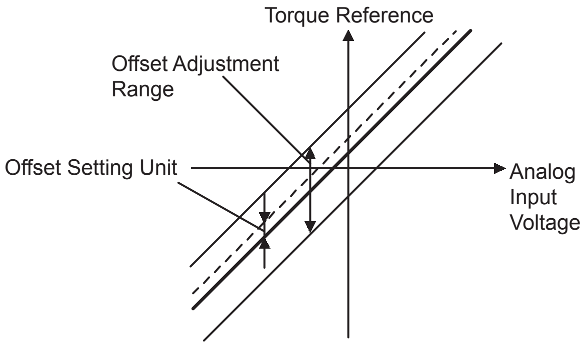
(2) Manual Adjustment of the Torque Reference Offset

Manual adjustment of the torque reference offset (Fn00B) is used in the following cases.

- If a position 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), 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

Use the following procedure to manually adjust the torque reference offset.

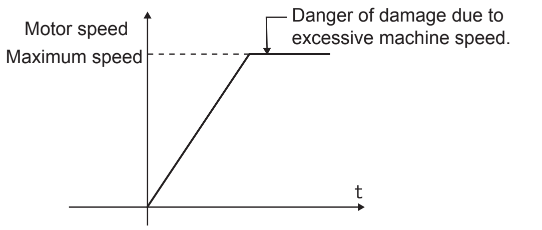
Step	Display after Operation	Digital Operator	Panel Operator	Description
1	Fn000	DSPL/SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
2	Fn00b	< > ∧ ∨	▲ ▼	Press the LEFT/RIGHT or UP/DOWN Key or UP or DOWN Key to select parameter Fn00B. *The digit that can be set will blink.
3	=. .tr9	DATA ENTER (DATA/ENTER Key)	DATA/◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. The display will be as shown at the left. The manual adjustment 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 Key) (Less than 1 s.)	Press the LEFT or RIGHT Key or DATA/SHIFT Key for less than one second to display the torque reference offset amount.
6		∧ ∨	▲ ▼	Press the UP or DOWN Key to adjust the amount of offset.
7	¯. .tr9	< >	DATA/◀ (DATA/SHIFT Key) (Less than 1 s.)	Press the LEFT or RIGHT Key or DATA/SHIFT Key for less than one second to return to the display shown on the left.
8	Fn00b	DATA ENTER (DATA/ENTER Key)	DATA/◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to return to the Fn00B display of the utility function mode.

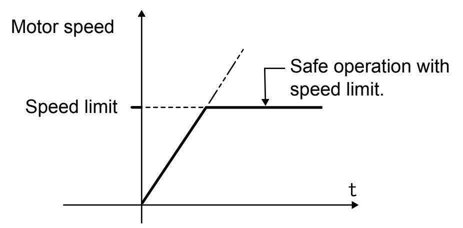
8.7.4 Limiting Servomotor Speed during Torque Control

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.

(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 is enabled, the speed limit input from V-REF or the Pn407 (Speed Limit during Torque Control) 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 30.0 V/rated speed)	0.01 V/rated speed	600	Immediately

Sets the voltage level for the speed that is to be externally limited during torque control.
With Pn300 = 600 (factory setting) and 6 V input from V-REF (CN1-5, 6), the actual 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 motor speed limit value.

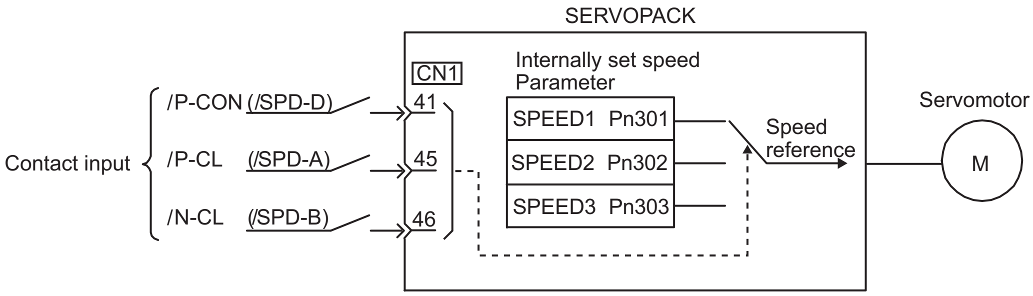
(4) Signals Output during Servomotor Speed Limit

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)

Parameter	Setting Range	Setting Unit	Factory Setting	Setting Validation
Pn301	Internally Set Speed 1	Speed		
	0 to 10000	1 min^{-1}	100	Immediately
Pn302	Internally Set Speed 2	Speed		
	0 to 10000	1 min^{-1}	200	Immediately
Pn303	Internally Set Speed 3	Speed		
	0 to 10000	1 min^{-1}	300	Immediately

Note: The maximum speed of servomotor is used whenever a speed settings for the Pn301 to Pn303 exceed the maximum speed.

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

/SPD-D, /SPD-A, and /SPD-B 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:

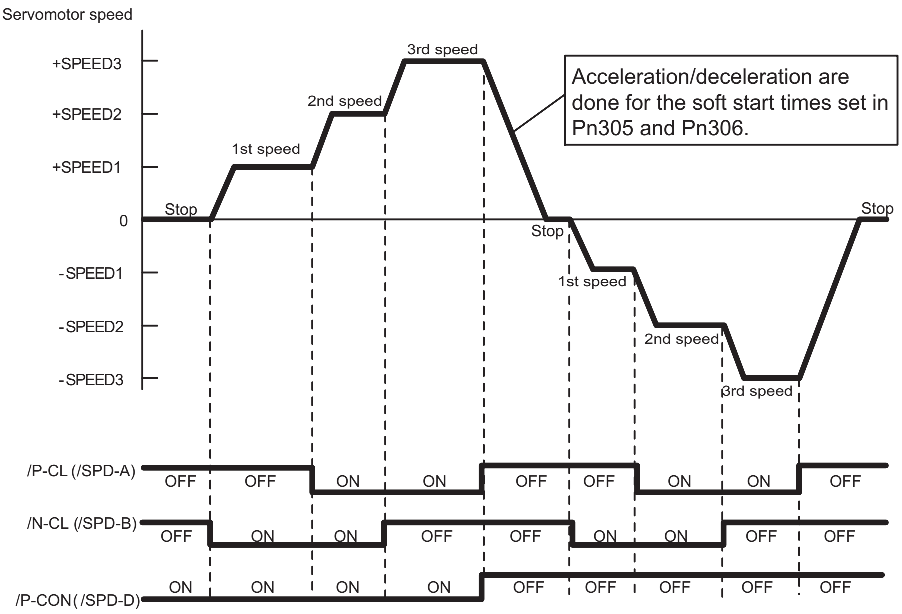
When Pn000.1=5: Internally set speed selection ⇔ Position control (pulse train)

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

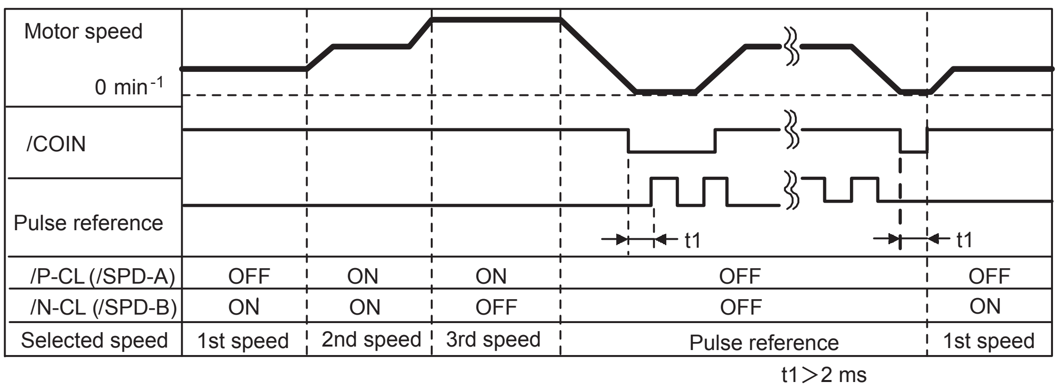


IMPORTANT

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

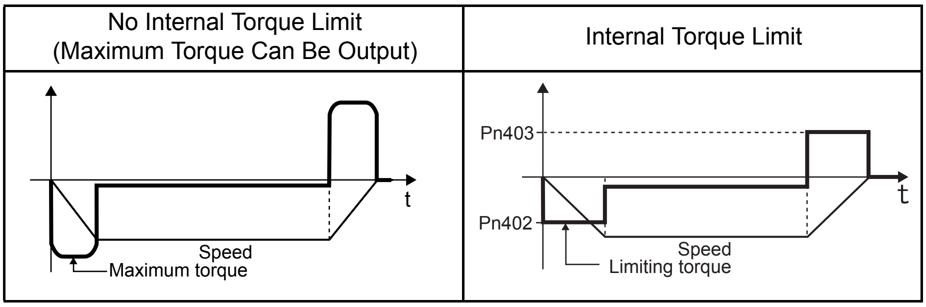
8.9.1 Internal Torque Limit (Limiting Maximum Output Torque)

Maximum torque is always limited to the values set in the 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.

If the torque limit is set higher than the maximum torque of the servomotor, the maximum torque of the servomotor is used (as is the case with the 800% factory setting).



Too small a torque limit setting will result in insufficient torque during acceleration and deceleration.

8.9.2 External Torque Limit (Output Torque Limiting by Input Signals)

This function allows the torque to be limited 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

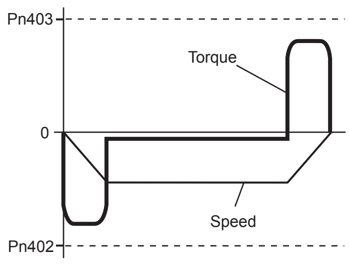
Note: The setting unit is a percentage of rated torque (i.e., the rated torque is 100%).

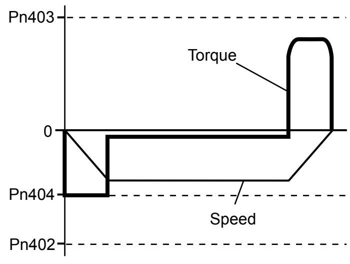
(2) Input Signals

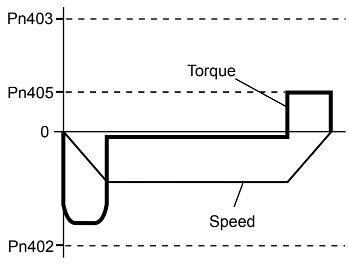
Type	Signal Name	Connector Pin Number	Setting	Meaning	Limit Value
Input	/P-CL	CN1-45 (Factory Setting)	ON (low level)	Forward external torque limit ON	The value set in Pn402 or Pn404 (whichever is smaller)
			OFF (high level)	Forward external torque limit OFF	Pn402
Input	/N-CL	CN1-46 (Factory Setting)	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 this function, 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*.					

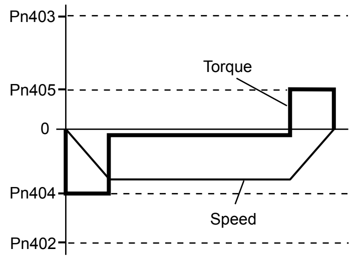
(3) Changes in Output Torque during External Torque Limiting

Example: External torque limit (Pn402, Pn403) set to 800%

<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="2">/P-CL (Forward External Torque Limit Input)</td></tr>
<tr><td>High level</td><td>Low level</td></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>


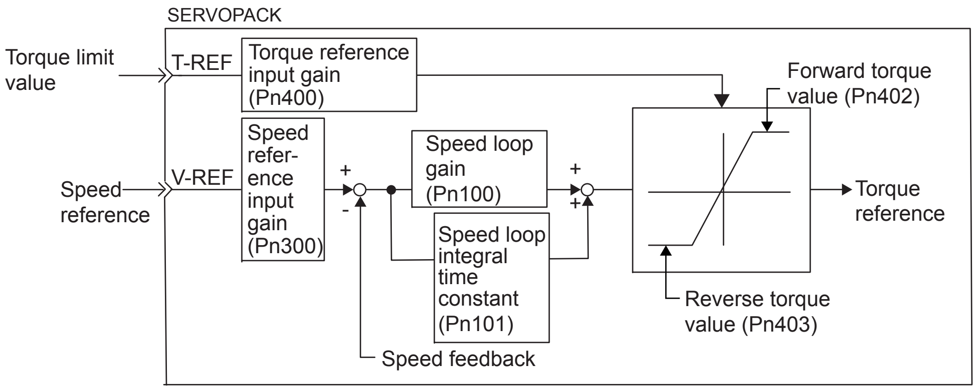
</td></tr>
</table>

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.

Refer to the following block diagram when the torque limit with an analog voltage reference is used for 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, the 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

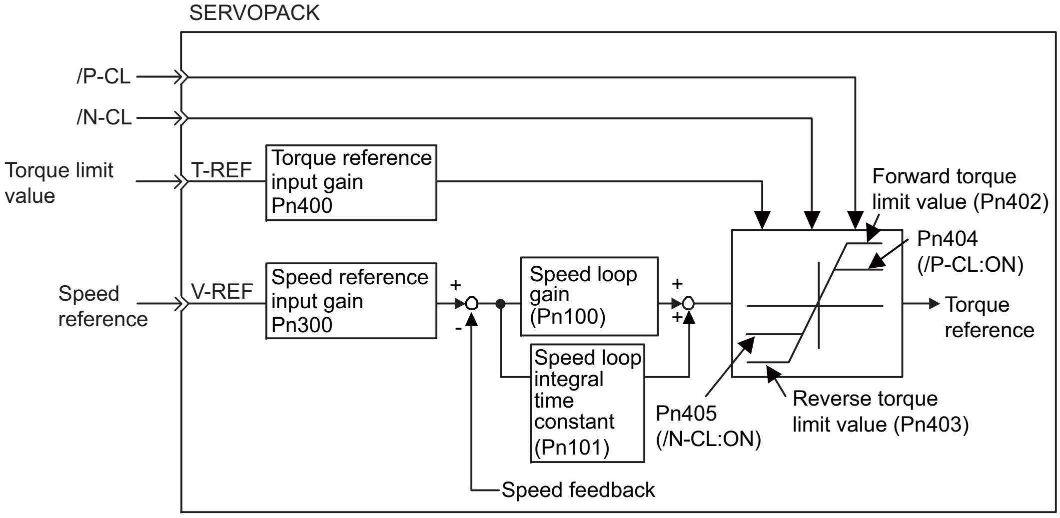
Operation

8

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 signal 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%).

(2) Input Signals

<table>
<tr><th>Type</th><th>Signal Name</th><th>Connector Pin Number</th><th>Name</th></tr>
<tr><td rowspan="2">Input</td><td>T-REF</td><td>CN1-9</td><td>Torque reference input</td></tr>
<tr><td>SG</td><td>CN1-10</td><td>Signal ground for torque reference input</td></tr>
<tr><td colspan="4">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</td></tr>
</table>

<table>
<tr><th>Type</th><th>Signal Name</th><th>Connector Pin Number</th><th>Setting</th><th>Meaning</th><th>Limit Value</th></tr>
<tr><td rowspan="2">Input</td><td rowspan="2">/P-CL</td><td rowspan="2">CN1-45
(Factory setting)</td><td>ON (low level)</td><td>Forward external torque limit ON</td><td>The analog voltage reference limit or the value set in Pn402 or Pn404 (whichever is smaller)</td></tr>
<tr><td>OFF (high level)</td><td>Forward external torque limit OFF</td><td>Pn402</td></tr>
<tr><td rowspan="2">Input</td><td rowspan="2">/N-CL</td><td rowspan="2">CN1-46
(Factory setting)</td><td>ON (low level)</td><td>Reverse external torque limit ON</td><td>The analog voltage reference limit or the value set in Pn403 or Pn405 (whichever is smaller)</td></tr>
<tr><td>OFF (high level)</td><td>Reverse external torque limit OFF</td><td>Pn403</td></tr>
<tr><td colspan="6">When using the torque limiting with the 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.</td></tr>
</table>

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.

<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">/CLT</td><td rowspan="2">Must be allocated</td><td>ON (low level)</td><td>Servomotor output torque is being limited.</td></tr>
<tr><td>OFF (high level)</td><td>Torque is not being limited.</td></tr>
<tr><td colspan="5">The output terminal must be allocated with parameter Pn50F to use this output signal. Refer to 7.3.3 Output Circuit Signal Allocation for details.</td></tr>
</table>

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).

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 as shown below for each of the signal states indicated.

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	Pn000 Setting				
				n.□□7□	n.□□8□	n.□□9□	n.□□A□	n.□□B□
Input	/P-CON	CN1-41 (Factory setting)	ON (low level)	Speed	Torque	Speed	Zero clamp	Inhibit
			OFF (high level)	Position	Position	Torque	Speed	Position
Input	/C-SEL	Must be allocated	ON (low level)	Speed	Torque	Speed	Zero clamp	Inhibit
			OFF (high level)	Position	Position	Torque	Speed	Position

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*.

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*. The /ALM-RST 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 *7.1.2 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 *10.1.5 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. Refer to *10.1.1 Alarm Display Table* for details on alarm code output.			

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 before an overload (A.71) or regenerative overload (A.32) alarm is output.
For use, the /WARN 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 *10.1.2 Warning Display* for the ON/OFF combinations of ALO1, ALO2, and ALO3 when a warning code is output.

8.11.3 Servomotor running 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.
The /TGON 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 interlock signal (/BK) and servomotor 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	Servomotor Rotation Detection 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 servomotor running output signal (/TGON) is output in this parameter.
When the servomotor rotation speed is above the value set in the Pn502, it is judged to be servomotor rotating and the servomotor running output signal (/TGON) is output. The servomotor running detection signal (/TGON) can also be checked on the digital operator. For details, refer to *7.1.4 Status Display* and *7.4.1 List of Monitor Modes*.

8.11.4 Servo Ready (/S-RDY) Output

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/S-RDY	CN1-29, 30 (Factory setting)	ON (low level)	Servo is ready.
			OFF (high level)	Servo is not ready.

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 when 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 digital operator. For details, refer to *7.1.4 Status Display* and *7.4.1 List of Monitor Modes*.
The /S-RDY signal can be allocated to another output terminal with parameter Pn50E. For details, refer to *7.3.3 Output Circuit Signal Allocation*.

9

Adjustments

9.1 Autotuning

9.1.1 Servo Gain Adjustment Methods

The SERVOPACK has the servo gains to determine the servo response characteristics. The servo gains are set in the parameters. The parameters are designated for each function as shown in *9.1.2 List of Servo Adjustment Functions*.

The servo gains are factory-set to stable values, and responsiveness can be increased depending on the actual machine conditions. Select the adjustment method according to the client's intent using *9.1.2 List of Servo Adjustment Functions*.

9.1.2 List of Servo Adjustment Functions

(1) Online Autotuning Functions

Online autotuning functions cannot be used for SERVOPACKs of 22 kW or more.

(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	9.4.1
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	9.4.2
Speed feed-forward Pn207 Pn300	Inputs speed feed-forward to the speed reference input terminal and adds to the internal speed reference at the position control.		Position	9.4.3
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	9.4.5
Speed Feedback Compensation Pn110 Pn111	This function cannot be used for SERVOPACKs of 22 kW or more.	–	–	9.4.8
Gain Switching Pn100 Pn101 Pn102 Pn104 Pn105 Pn106	Automatically switches each parameter for speed loop gain (Kv), speed loop integral time constant (Ti), and position loop gain (Kp) by external signal or according to condition: Whether position reference is specified or not, or Position error level, or AND logic of the above two determined conditions.	–	Position Speed	9.4.9

(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.	A constant acceleration/deceleration is achieved for smoother operation. The operation time is increased for the specified time.	Speed	8.5.4
Acceleration/ Deceleration Filters Pn204 Pn207	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 Pn208	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 response is delayed if a large value is set.	Position Speed	9.4.7
Speed Reference Filter Pn307	A 1st-order delay filter for the speed reference.	The speed reference is smoother. The response is delayed if a large value is set.	Speed	8.5.5
Torque Reference Filter Pn401	A 1st-order filter time constant can be set for the torque reference.	The lower the value, the better the speed control response will be, but there is a lower limit that depends on the machine conditions.	Position Speed Torque	9.4.10
Notch Filter Pn408 Pn409 Pn40A Pn40B Pn40C	Notch filters can be set for the torque reference. The performances of first stage notch filter and second stage notch filter are identical.	Mainly effective for vibration between 500 and 2,000 Hz. Instability will result if the setting is not correct.	Position Speed Torque	9.4.10

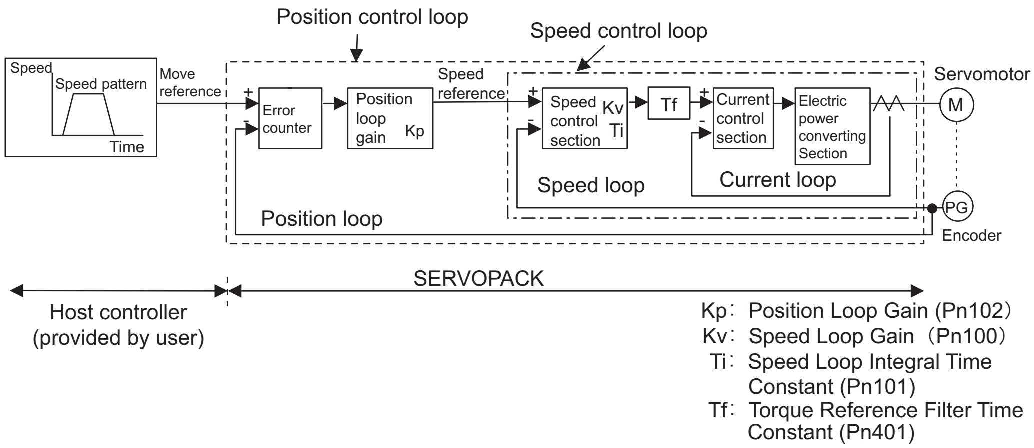
9.2 Online Autotuning

Online autotuning functions cannot be used for SERVOPACKs of 22 kW or more.

9.3 Manual Tuning

9.3.1 Explanation of Servo Gain

The block diagram for position control is as follows:



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 analog monitor.

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.

9.3.2 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.

Step	Explanation
1	Set correctly the moment of inertia ratio (Pn103).
2	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).
3	Adjust the torque reference filter time constant (Pn401) so that no vibration occurs.
4	Repeat the steps 1 and 2. Then reduce the value for 10 to 20%.
5	For the position control, increase the position loop gain (Pn102) to within the range so that the machine does not vibrate.

Start the manual tuning from the factory setting. 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 *9.5 Analog Monitor*.) The servo drive supporting tool “SigmaWin+” allows you to observe such signals. Prepare either of them.

9.3.3 Position Loop Gain

Pn102	Position Loop Gain (Kp)			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 2,000	1/s	40	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) cannot 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.

Pn505	Overflow Level			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 32,767	256 reference units	1,024	Immediately

This parameter’s new setting must satisfy the following condition.

$$\text{Pn505} \geq \frac{\text{Max. feed speed (reference units/s)}}{\text{Pn102}} \times 2.0$$

9.3.4 Speed Loop Gain

Pn100	Speed Loop Gain (Kv) Speed Position			
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 2,000	1 Hz	40	Immediately

This parameter determines the responsiveness of the speed loop. 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 the moment of inertia ratio in Pn103 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

$$\text{Pn103setvalue} = \frac{\text{Motor axis conversion load moment of inertia } (J_L)}{\text{Servomotor rotor moment of inertia } (J_M)} \times 100(\%)$$

The factory setting is Pn103=0. Before adjusting the servo, determine the moment of inertia ratio with the equation above and set parameter Pn103.

9.3.5 Speed Loop Integral Time Constant

Pn101	Speed Loop Integral Time Constant (Ti) Speed Position			
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	15 to 51,200 (0.15 to 512.00 ms)	0.01 ms	2,000 (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 time or responsiveness decreases.
The estimated set value for Pn101 depends on the speed loop control method with Pn10B.1, as shown below.

INFO

■ Selecting the Speed Loop Control Method (PI Control or I-P Control)

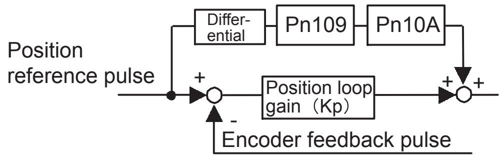
Generally, I-P control is more effective in high-speed positioning or high-speed/precision manufacturing applications. The position loop gain is lower than it would be in PI control, so shorter positioning times and smaller arc radii can be achieved. On the other hand, PI control is generally used when switching to P control fairly often with a mode switch or other method.

9.4 Servo Gain Adjustment Functions

9.4.1 Feed-forward Reference

Pn109	Feed-forward			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 6,400 (0.00 to 64.00 ms)	0.01ms	0	Immediately

Applies feed-forward 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.



9.4.2 Torque Feed-forward

Parameter		Meaning
Pn002	n.□□□**0**	Disabled
	n.□□□**2**	Uses T-REF terminal for torque feed-forward input.

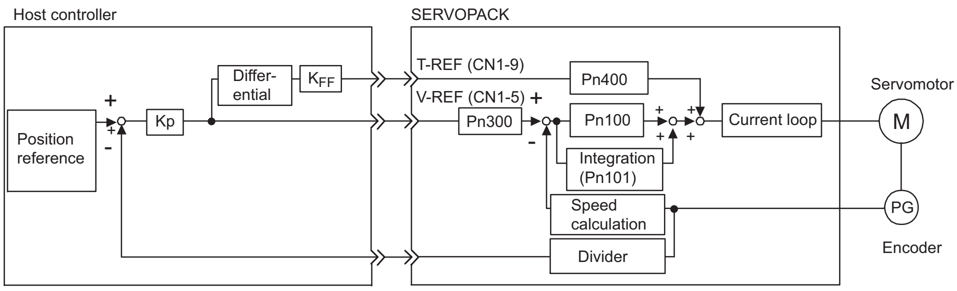
Pn400	Torque Reference Input Gain		Speed Position Torque	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	10 to 100 (1.0 to 10.0 V/rated torque)	0.1 V/rated torque	30	Immediately

The torque feed-forward function is valid only in speed control (analog reference).

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.*

9.4.3 Speed Feed-forward

Parameter		Meaning
Pn207	n.□□0□	Disabled
	n.□□1□	Uses V-REF terminal for speed feed-forward input.

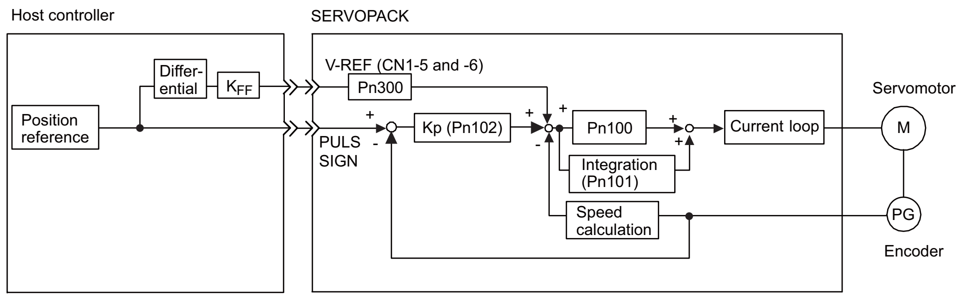
Pn300	Speed Reference Input Gain		Speed Position Torque	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	150 to 3,000 (1.50 to 30.00 V/rated speed)	0.01 V/rated speed	600	Immediately

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

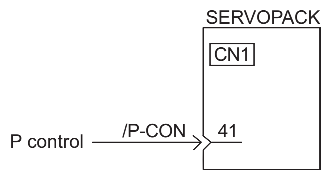
Speed feed-forward value is set using the parameter Pn300.

The factory setting is Pn300 = 600. If, for example, the speed feed-forward value is ±6V, then the speed is limited to the rated speed.

9.4.4 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.

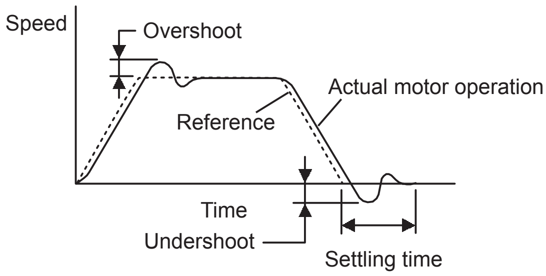
- PI control: Proportional/Integral control
- P control: Proportional control

<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 9.4.5 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 servomotor 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 servomotor.</td></tr>
</table>

9.4.5 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.

IMPORTANT

1. The mode switch function is used in very high-speed positioning when it is necessary to use the servodrive 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 Acceleration/Deceleration Time (Pn305, Pn306), or Position Reference Acceleration/Deceleration Time Constant (Pn204).

(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 Unit
Pn10B	n.□□□0	Use a torque reference level for detection point. (Factory Setting)	Pn10C	Percentage to the rated torque
	n.□□□1	Use a speed reference level for detection point.	Pn10D	Servomotor speed: min^{-1}
	n.□□□2	Use an acceleration level for detection point.	Pn10E	Servomotor acceleration: 10 min^{-1}/s
	n.□□□3	Use a position error pulse for detection point.	Pn10F	Reference unit
	n.□□□4	Do not use the mode switch function.	–	–
Select a condition to execute the mode switch (P/PI switching). (Setting is validated immediately.)				

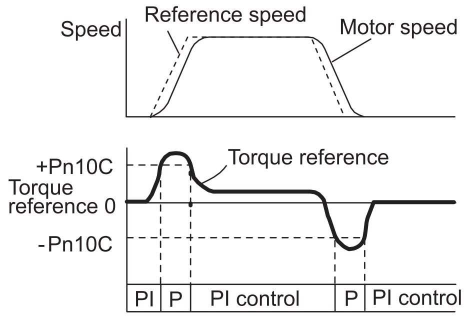
TERMS

[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.

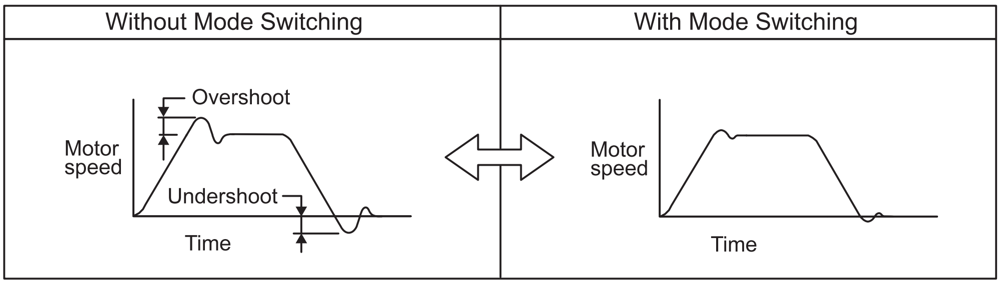
Using the Torque Reference Level to Switch Modes (Factory Setting)

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).



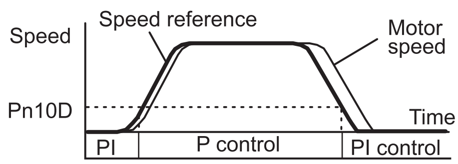
■ Operating Example

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.



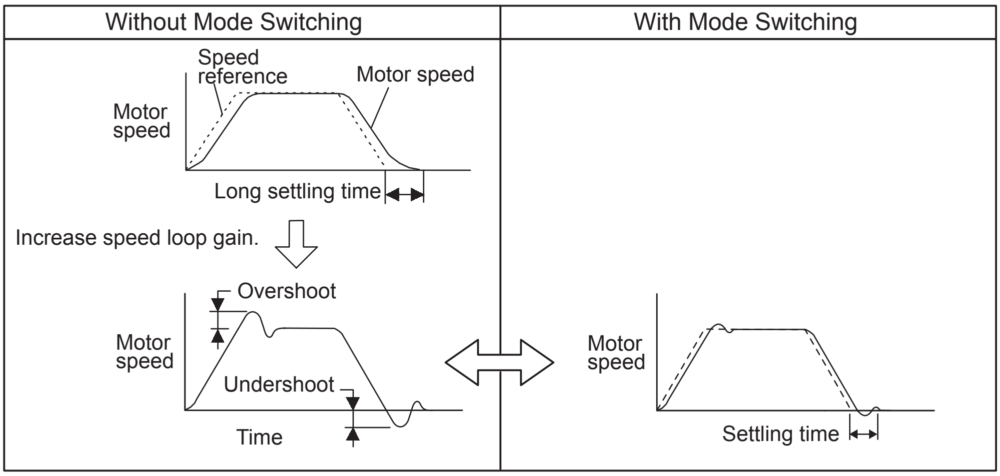
Using the Speed Reference Level to Switch Modes

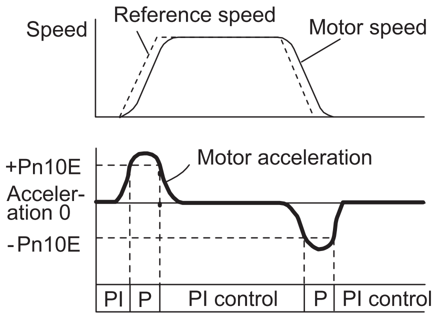
With this setting, the speed loop is switched to P control when the value of speed reference input exceeds the speed set in parameter Pn10D.



■ Operating Example

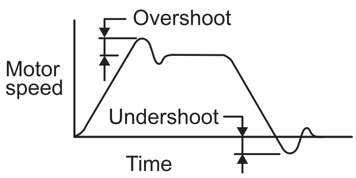
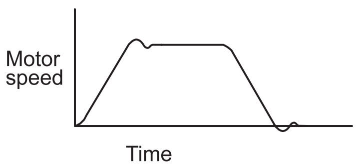
In this example, the mode switch is used to reduce the settling time. It is necessary to increase the speed loop gain to reduce the settling time. Using the mode switch suppresses overshooting and undershooting when speed loop gain is increased.

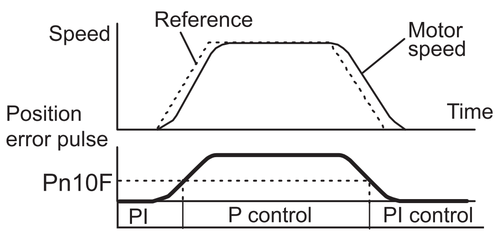


Using the Acceleration Level to Switch Modes	
With this setting, the speed loop is switched to P control when the motor's acceleration rate exceeds the acceleration rate set in parameter Pn10E.	

■ Operating Example

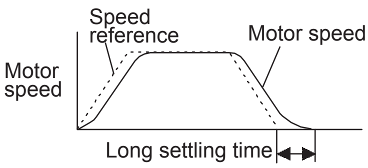
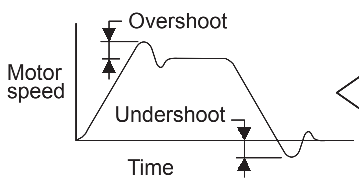
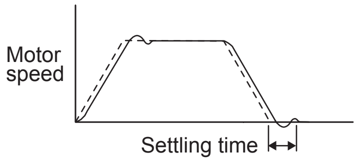
If the mode switch function is not being used and the SERVOPACK is always operated with PI control, the speed of the motor may overshoot or undershoot due to torque saturation during acceleration or deceleration. The mode switch function suppresses torque saturation and eliminates the overshooting or 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 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
 Increase speed loop gain. 	

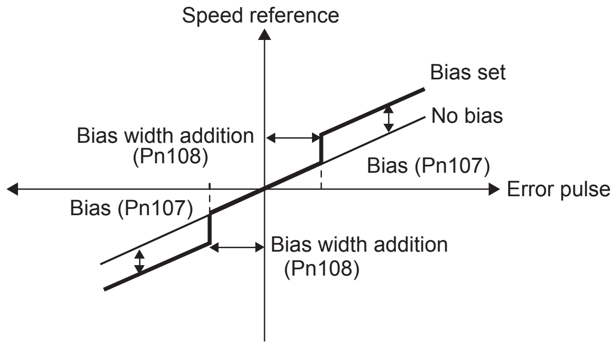
9.4.6 Setting the Speed Bias

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 Width Addition			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 250	1 Reference unit	7	Immediately

To reduce the positioning time, set these parameters based on the machine's characteristics.

The Bias Width Addition (Pn108) specifies when the Bias (Pn107) is added and the width is expressed in error pulse units. The bias input will be added when the error pulse value exceeds the width set in Pn108.



9.4.7 Speed Feedback Filter

Pn308	Speed Feedback Filter Time Constant		Speed	Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 65,535 (0.00 to 655.35 ms)	0.01 ms	0	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.				

9.4.8 Speed Feedback Compensation

Speed feedback compensation cannot be used for SERVOPACKs of 22 kW or more.

9.4.9 Switching Gain Settings

Gain switching functions by the external signal, or by using automatic gain switching that is enabled only at position control, are built into the SGDM/SGDH SERVOPACK. For example, to use different gains while the servomotor is running or stopped, set two values in the gain settings 1 and 2 and switch the gains.

(1) Gain Switching Function Using an External Input Signal

(a) Gain Switching Input Signal

Type	Signal	Connector Pin No.	Setting	Meaning
Input	/G-SEL	Signal allocation required	OFF: H (high) level	Gain settings 1
			ON: L (low) level	Gain settings 2
To use the input signal, the input signal must be allocated in the parameter Pn50D. Refer to *7.3.2 Input Circuit Signal Allocation*.				

(b) Switchable Gain Combinations

Turning ON and OFF the gain switching signal /G-SEL switches the gains as follows.

Gain Switching Signal (/G-SEL)	OFF (H Level)	ON (L Level)
Speed loop gain	Pn100	Pn104
Speed loop integral time constant	Pn101	Pn105
Position loop gain	Pn102	Pn106

(c) Related Parameters

Parameter		Function
Pn50A	n.□□□1	Enables the input signal allocation for the sequence.
Set to allocate the gain switching signal (/G-SEL) to an input terminal.		

Pn100	Speed Loop Gain		Speed Position Torque	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 2,000	Hz	40	Immediately
Pn101	Speed Loop Integral Time Constant		Speed Position Torque	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	15 to 51,200	0.01 ms	2,000	Immediately
Pn102	Position Loop Gain		Speed Position Torque	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 2,000	1/s	40	Immediately
Pn104	2nd Speed Loop Gain		Speed Position Torque	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 2,000	Hz	40	Immediately
Pn105	2nd Speed Loop Integral Time Constant		Speed Position Torque	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	15 to 51,200	0.01 ms	2,000	Immediately
Pn106	2nd Position Loop Gain		Speed Position Torque	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 2,000	1/s	40	Immediately

(2) Automatic Gain Switching Function

The automatic gain switching function switches the gain setting between the gain setting 1 and 2 according to the condition:

Whether position reference is specified or not, or

Position error level, or

AND logic of the above two determined conditions

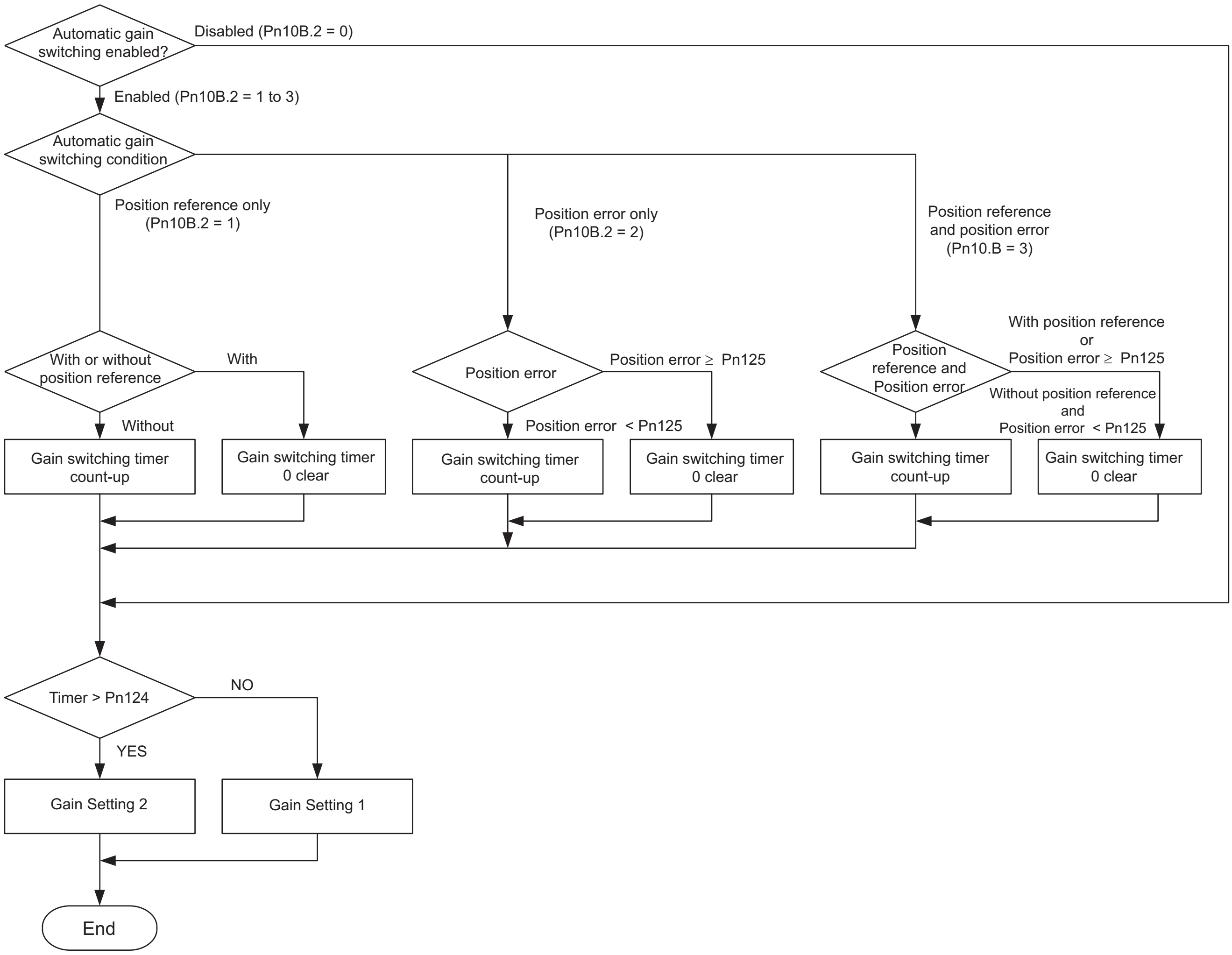
The position reference of the automatic gain switching condition indicates the reference pulses from CN1.

Note that the automatic gain switching function is disabled for the control modes other than position control.

The existing gain switching function by /G-SEL signal is also available. However, it cannot be used with the gain switching function.

When the automatic gain switching is enabled by setting 1 to 3 of Pn10B.2, the gain switching function by /G-SEL signal is disabled.

The following flowchart shows the automatic gain switching.



(1) Related Parameters

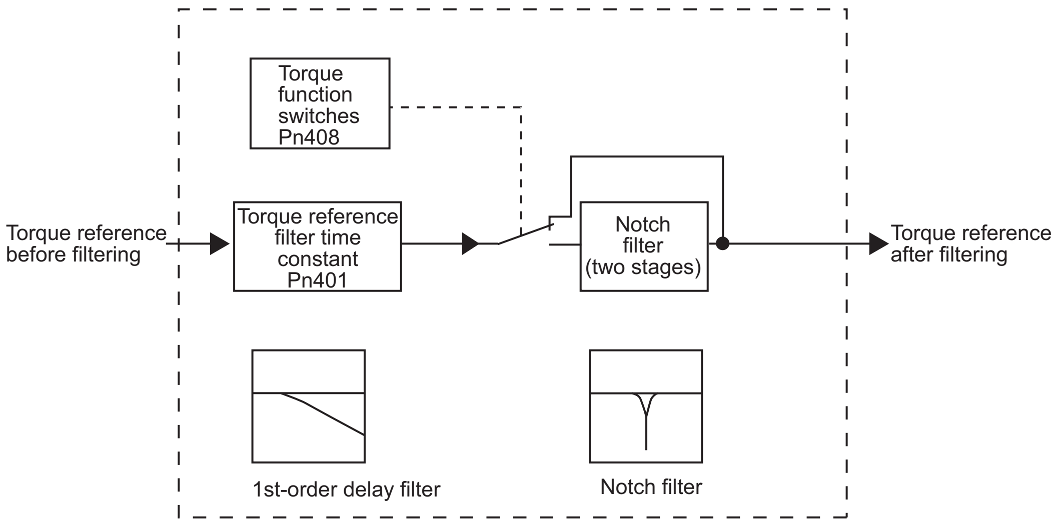
Parameter		Meaning
Pn10B	n.□0□□	Automatic gain switching disabled (Factory setting)
	n.□1□□	Switches the gain according to the position reference condition only.
	n.□2□□	Switches the gain according to the position error condition only.
	n.□3□□	Switches the gain according to the position reference and position error condition only.

Note: After changing the setting, turn OFF the power and ON again to enable the new setting.

Pn124	Automatic Gain Switching Timer			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 10000	1 ms	100	immediately
Pn125	Automatic Gain Switching Width			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 250	1 Reference units	7	immediately

9.4.10 Torque Reference Filter

As shown in the following diagram, the torque reference filter contains torque reference filter time constant (Pn401) and notch filter (two stages) arrayed in series. The notch filter can be enabled and disabled using the parameters.



(1) Torque Reference Filter

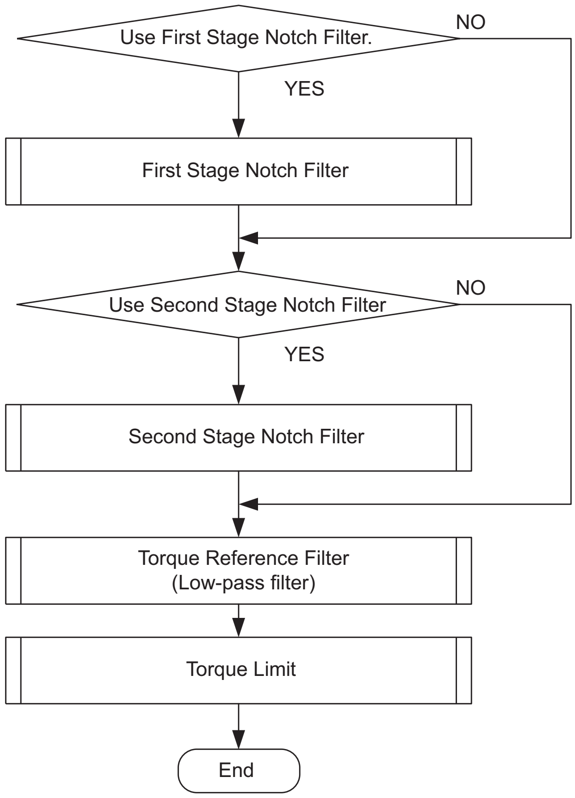
If you suspect that machine vibration is being caused by the servodrive, try adjusting the filter time constant. This may stop the vibration. The lower the value, the better the speed control response will be, but there is a lower limit that depends on the machine conditions.

Pn401	Torque Reference Filter Time Constant		Speed Position	Torque
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 65,535 (0.00 to 655.35 ms)	0.01 ms	100	Immediately

(2) Notch Filter

Using the notch filter in accordance with the components of specific vibration frequency such as resonances of ball screw can eliminate the frequency components to stop the vibration.

The performances of first stage notch filter and second stage notch filter are identical.



Adjustments

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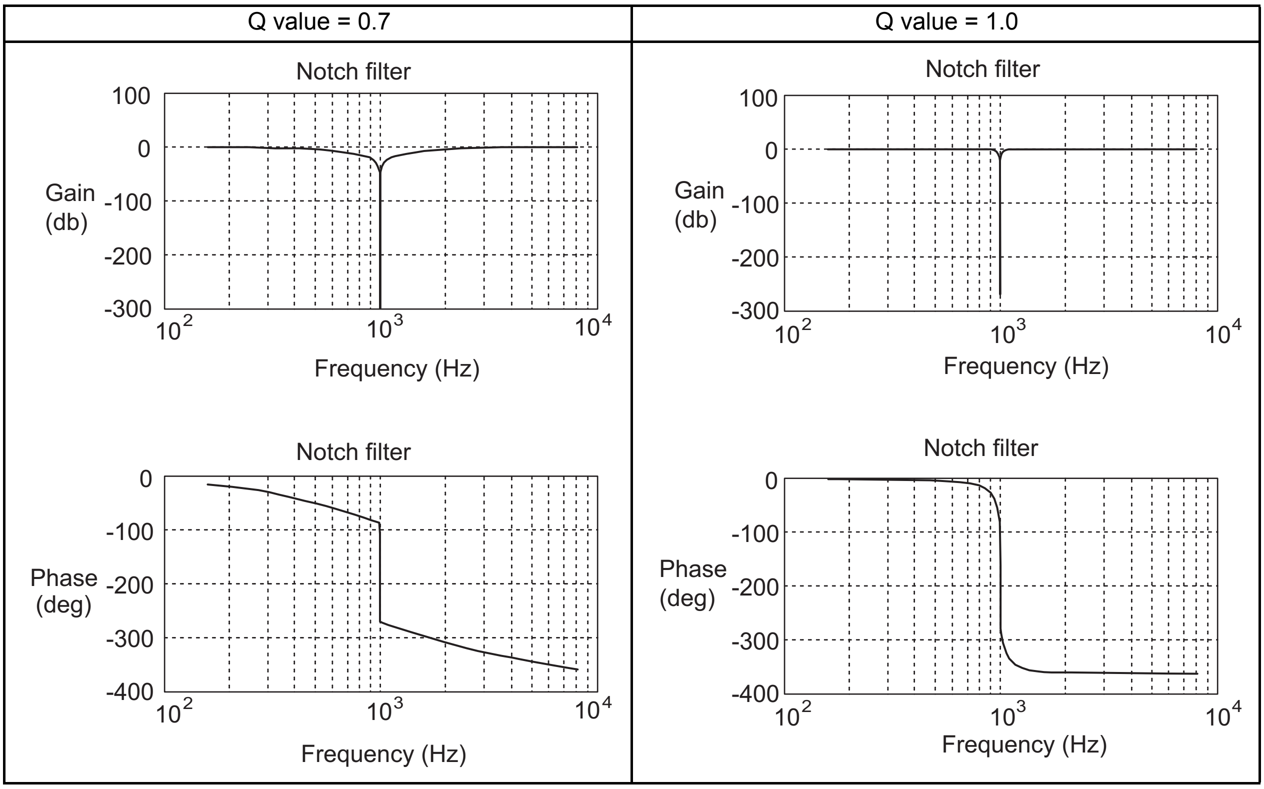
(a) Notch Filter

The notch filter can decrease the set frequency responsiveness. 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.



(b) Related Parameters

Parameter		Meaning
Pn408	n.□□□**0**	First notch filter disabled (Factory setting)
	n.□□□**1**	Use first notch filter.
	n.□**0**□□	Second notch filter disabled (Factory setting)
	n.□**1**□□	Use second notch filter.

Pn409	First Stage Notch Filter Frequency			Speed Position Torque
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	50 to 2000	1 Hz	2000	Immediately
Pn40A	First Stage Notch Filter Q Value			Speed Position Torque
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	50 to 400	× 0.01	70	Immediately
Pn40B	Second Stage Notch Filter Frequency			Speed Position Torque
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	50 to 2000	1 Hz	2000	Immediately
Pn40C	Second Stage Notch Filter Q Value			Speed Position Torque
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	50 to 400	× 0.01	70	Immediately

IMPORTANT

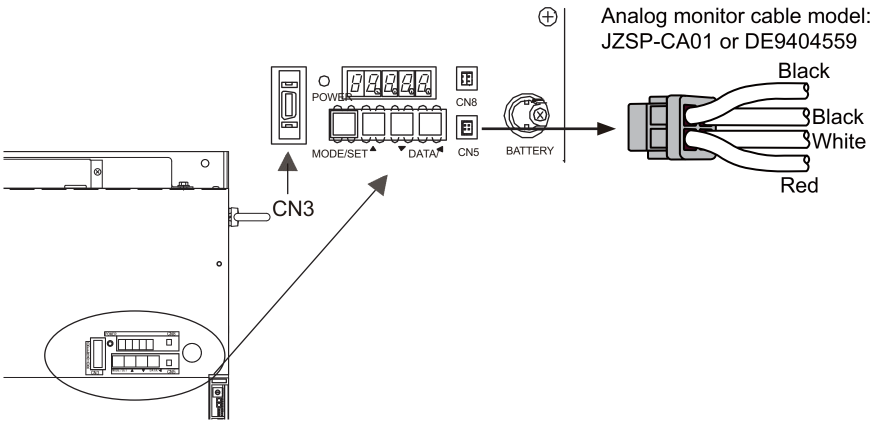
1. Sufficient precautions must be taken when setting the notch frequency. Do not set the notch filter frequency (Pn409, Pn40B) that is close to the speed loop's response frequency. Set the frequency at least four times higher than the speed loop's response frequency. Setting the notch filter frequency 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, Pn40B) only when the servomotor is stopped. Vibration may occur if the notch filter frequency is changed when the servomotor is rotating.

9.5 Analog Monitor

Signals for analog voltage references can be monitored.

To monitor analog signals, connect the analog monitor cable (JZSP-CA01 or DE9404559) to the connector CN5.

The analog monitor signals can be selected by setting parameters Pn003.0 and Pn003.1.



Pin Number	Line Color	Signal Name	Monitoring Item with Factory Setting
1	Red	Analog monitor 2	Motor speed: 1 V/1000 min^{-1}
2	White	Analog monitor 1	Torque reference: 1 V/100% rated torque
3, 4	Black (2 lines)	GND (0 V)	–

(1) Related Parameters

The following signals can be monitored.

(a) Pn003: Function Selections

	Parameter		Function		
	Monitor 1	Monitor 2	Monitor Signal	Observation Gain	Remarks
Pn003	n.□□□**0**	n.□□**0**□	Motor speed	1 V / 1000 min^{-1}	Factory setting for Monitor 1
	n.□□□**1**	n.□□**1**□	Speed reference	1 V / 1000 min^{-1}	–
	n.□□□**2**	n.□□**2**□	Internal torque reference	1 V / 100% rated torque	Factory setting for Monitor 2
	n.□□□**3**	n.□□**3**□	Position error *	0.05 V / 1 reference unit	–
	n.□□□**4**	n.□□**4**□	Position error *	0.05 V / 100 reference units	–
	n.□□□**5**	n.□□**5**□	Position reference speed (converted to motor speed)	1 V / 1000 min^{-1}	–
	n.□□□**6**	n.□□**6**□	Motor speed	1 V / 250 min^{-1}	–
	n.□□□**7**	n.□□**7**□	Motor speed	1 V / 125 min^{-1}	–
	n.□□□**8**	n.□□**8**□	Reserved. Do not set.	–	–
	n.□□□**9**	n.□□**9**□			–
	n.□□□**A**	n.□□**A**□			–
	n.□□□**B**	n.□□**B**□			–
	n.□□□**C**	n.□□**C**□			–
	n.□□□**D**	n.□□**D**□			–
	n.□□□**E**	n.□□**E**□			–
	n.□□□**F**	n.□□**F**□			–

* When using speed control or torque control, the position error monitor signal is not specified.

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.

Adjustments

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10

Inspection, Maintenance, and Troubleshooting

10.1 Troubleshooting

10.1.1 Alarm Display Table

The relation between alarm displays and alarm code outputs is shown in Table 10.1.
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.
- COAST TO A STOP: Stops naturally, with no brake, by using the friction resistance of the motor in operation.

Table 10.1 Alarm Displays and Outputs

Alarm Display	Alarm Name	Meaning	Alarm Reset	Alarm Code Output			Servo Alarm (ALM) Output
				ALO1	ALO2	ALO3	
A.02	Parameter Breakdown	EEPROM data of SERVOPACK is abnormal.	N/A	H	H	H	H
A.03	Main Circuit Encoder Error	Detection data for power circuit is abnormal.	Available				
A.04	Parameter Setting Error	The parameter setting is outside the allowable setting range.	N/A				
A.05	Combination Error	SERVOPACK and servomotor capacities do not match each other.	Available				
A.09	Dividing Ratio Setting Error	The setting of dividing ratio (Pn212) is not acceptable (out of fixed increments), or exceeds the value for the connected, encoder resolution.	N/A				
A.0A	Encoder Model Unmatched	The mounted serial encoder is not supported by Σ-II series SERVOPACK.	N/A				
A.10	Overcurrent or Heat Sink Overheated	An overcurrent flowed through the IGBT. Heat sink of SERVOPACK was overheated.	N/A	L	H	H	H
A.30	Regeneration Error Detected	Regenerative transistor or regenerative resistor is faulty.	Available	L	L	H	H
A.32	Regenerative Overload	Regenerative energy exceeds regenerative resistor capacity.	Available				
A.33	Main Circuit Power Supply Wiring Error	The power supply to the main circuit does not match the parameter Pn001 setting.	Available				
A.40	Overvoltage *	Main circuit DC voltage is excessively high.	Available	H	H	L	H
	Undervoltage*	Main circuit DC voltage is excessively low.	Available				
A.51	Overspeed	The motor speed is excessively high.	Available	L	H	L	H
A.71	Overload: High Load	The motor was operating for several seconds to several tens of seconds under a torque largely exceeding ratings.	Available	L	L	L	H
A.72	Overload: Low Load	The motor was operating continuously under a torque largely exceeding ratings.	Available				
A.73	Dynamic Brake Overload	When the dynamic brake was applied, rotational energy exceeded the capacity of dynamic brake resistor.	Available				
A.74	Overload of Surge Current Limit Resistor	The main circuit power was frequently turned ON and OFF.	Available				
A.7A	Heat Sink Overheated	The heat sink of SERVOPACK overheated.	Available				

Table 10.1 Alarm Displays and Outputs (cont'd)

Alarm Display	Alarm Name	Meaning	Alarm Reset	Alarm Code Output ALO1	Alarm Code Output ALO2	Alarm Code Output ALO3	Servo Alarm (ALM) Output
A.81	Encoder Backup Error	All the power supplies for the absolute encoder have failed and position data was cleared.	N/A				
A.82	Encoder Checksum Error	The checksum results of encoder memory is abnormal.	N/A				
A.83	Absolute Encoder Battery Error	Backup battery voltage for the absolute encoder has dropped.	Available				
A.84	Encoder Data Error	Data in the encoder is abnormal.	N/A				
A.85	Encoder Overspeed	The encoder was rotating at high speed when the power was turned ON.	N/A	H	H	H	H
A.86	Encoder Overheated	The internal temperature of encoder is too high.	N/A				
A.b1	Reference Speed Input Read Error	The A/D converter for reference speed input is faulty.	Available				
A.b2	Reference Torque Input Read Error	The A/D converter for reference torque input is faulty.	Available				
A.b3	Current Detection Error	The current sensor is faulty, or the servomotor is disconnected.	Available				
A.bF	System Alarm	A system error occurred in the SERVOPACK.	N/A				
A.C1	Servo Overrun Detected	The servomotor ran out of control.	Available				
A.C8	Absolute Encoder Clear Error and Multiturn Limit Setting Error	The multiturn for the absolute encoder was not properly cleared or set.	N/A				
A.C9	Encoder Communications Error	Communications between SERVOPACK and encoder is not possible.	N/A	L	H	L	H
A.CA	Encoder Parameter Error	Encoder parameters are faulty.	N/A				
A.Cb	Encoder Echoback Error	Contents of communications with encoder is incorrect.	N/A				
A.CC	Multiturn Limit Disagreement	Different multiturn limits have been set in the encoder and SERVOPACK.	N/A				
A.d0	Position Error Pulse Overflow	Position error pulse exceeded parameter (Pn505).	Available	L	L	H	H
A.F1	Power Line Open Phase	One phase is not connected in the main power supply.	Available				
A.F4	Main circuit MC Error	The magnetic contactor of main circuit is faulty.	Available	H	L	H	H
A.F5 A.F6	Servomotor Disconnection Alarm	The servomotor will not operate, or the power is not being supplied to the servomotor, though the Servo ON command was input and the command to the SERVOPACK was valid.	Available				
CPF00 CPF01	Digital Operator Transmission Error	Digital operator (JUSP-OP02A-2) fails to communicate with SERVOPACK (e.g., CPU error).	N/A N/A	Not decided			
A.– –	Not an error	Normal operation status	-	H	H	H	L

* For the SERVOPACK with a capacity of 22 kW or more, alarm A.40 indicates detecting excessively high/low voltage in the main circuit.

10.1.2 Warning Display

The relation between warning displays and warning code outputs is shown in table 10.2.

Table 10.2 Warning Displays and Outputs

Warning Display	Warning Name	Meaning	Warning Code Output		
			ALO1	ALO2	ALO3
A.90	Excessive Position Error Warning	The position errors exceed the setting in Pn51E.	H	H	H
A.91	Overload	This warning occurs before the overload alarms (A.71 or A.72) occur. If the warning is ignored and operation continues, an overload alarm may occur.	L	H	H
A.92	Regenerative Overload	This warning occurs before the regenerative overload alarm (A.32) occurs. If the warning is ignored and operation continues, a regenerative overload alarm may occur.	H	L	H
A.93	Absolute Encoder Battery Voltage Lowered	This warning occurs when the absolute encoder battery voltage is lowered. If the warning is ignored and operation continues, an overload alarm may occur.	L	L	H

Note: Warning code is not output without setting Pn001 = n.1□□□ (Outputs both Alarm Codes and Warning Codes.)

10.1.3 Alarm Display Table when the Application Module is Used

The following special alarms will occur when the SGDH SERVOPACK and an application module are used together. The relation between alarm displays and alarm code outputs is shown in Table 10.3.

Table 10.3 Alarm Displays and Outputs when the SERVOPACK and an Application Module Are Used Together

Alarm Display	Application Module which Detects Alarms					Alarm Name	Meaning	Alarm Code Output			Servo Alarm (ALM) Output
	NS 100	NS 115	NS 300	NS 500	FC 100			ALO 1	ALO 2	ALO 3	
A.C6	○	○	○	○	○	Fully Closed Encoder Phase A/B Disconnection Alarm	The phase A/B of the fully closed encoder was disconnected.	L	H	L	H
A.C7	○	○	○	○	○	Fully Closed Encoder Phase C Disconnection Alarm	The phase C of the fully closed encoder was disconnected.				
A.d1	○	○	○	○	○	Motor-Load Position Error Over	The motor-load position error over level (Pn51A) was exceeded.	L	L	H	H
A.E0	○	○	○	○	–	No Application Module	No application module installed.	H	L	L	H
A.E1	○	○	○	○	–	Application Module Time-out	No response from the application module.				
A.E2	○	○	○	○	–	Watchdog Counter Error of Application Module	WDC error in the application module				
A.E4	–	○	–	–	–	MECHATROLINK-II Transmission Cycle Setting Error	Transmission cycle setting of MECHATROLINK-II is incorrect.				
A.E5	○	○	–	–	–	Watchdog Timer Error	MECHATROLINK-I/II synchronization error				
A.E6	○	○	○	–	–	NS100/NS115 Communications Error	MECHATROLINK-I/II communications error				
						NS300 Duplicate MAC ID Error	Same node address already exists on the DeviceNet network.				
A.E7	○	○	○	○	–	Application Module Detection Error	No application module was detected.				
A.E9	–	–	○	–	–	BUS-OFF Error	Fatal communications error has occurred in DeviceNet communications.				
A.EA	○	○	○	○	–	SERVOPACK Malfunction	SERVOPACK is defective.				
A.EB	○	○	○	○	–	SERVOPACK Initial Access Error	Initial processing failed.				
A.EC	○	○	○	○	–	SERVOPACK WDC Error	SERVOPACK watchdog counter error				
A.ED	○	○	○	○	–	Command Execution Incomplete	Command was interrupted.				

Note: 1. The following types of application modules are available:
NS100 (JUSP-NS100): MECHATROLINK-I application module
NS115 (JUSP-NS115): MECHATROLINK-II I/F application module
NS300 (JUSP-NS300): DeviceNet application module
NS500 (JUSP-NS500): PROFIBUS-DP application module
FC100 (JUSP-FC100): Fully-closed application module

2. For troubleshooting application module alarms, refer to relevant application module manual. Manual numbers are described in *About this Manual*.

3. When mounting the NS115 module, observe the following restrictions on use. If the NS115 module is connected to the hand-held digital operator or communications are being sent to or from SigmaWin+ and another device (a personal computer) during execution of the following MECHATROLINK-II commands, an A.ED alarm (Command execution incomplete) occurs and the commands are not successfully sent.
PRM_RD, PRM_WR, PPRM_WR, CONFIG, ALM_RD, ALM_CLR, SENS_ON, ADJ, ID_RD

10.1.4 Warning Display Table when the Application Module is Used

The following special warnings will occur when the SGDH SERVOPACK and an application module are used together. The relation between warning displays and warning code outputs is shown in Table 10.4.

Table 10.4 Warning Displays and Outputs when the SERVOPACK and an Application Module Are Used Together

Warning Display	Application Module which Detects Warnings					Warning Name	Meaning	Warning Code Output			Servo Alarm (ALM) Output
	NS 100	NS 115	NS 300	NS 500	FC 100			ALO 1	ALO 2	ALO 3	
A.94	○	○	○	○	–	Data Setting Warning	A value outside the setting range was set using communications.	L	L	H	L
A.95	○	○	○	○	–	Command Warning	A command not supported in the product specifications was issued. The command reception conditions were not met.	H	L	H	L
A.96	○	○	○	–	–	Communications Warning	A communications error occurred (once).	L	H	H	L
A.98	–	–	○	○	–	Main Power OFF	The main power supply is not being supplied.	L	L	L	L
A.9A	–	–	○	○	–	Not Completed within the Set Time	Positioning was not completed within the set time.	L	H	L	L

Note: 1. The following types of application modules are available:
NS100 (JUSP-NS100): MECHATROLINK-I application module
NS115 (JUSP-NS115): MECHATROLINK-II application module
NS300 (JUSP-NS300): DeviceNet application module
NS500 (JUSP-NS500): PROFIBUS-DP application module
FC100 (JUSP-FC100): Fully closed application module

2. For troubleshooting application module alarms, refer to relevant application module manual. Manual numbers are described in *About this Manual* on *page v*.
3. When mounting the NS115 module, observe the following restrictions on use. If the hand-held digital operator is connected or the communications are being sent or from SigmaWin+ and another device (a personal computer), the following MECHATROLINK-II commands can not be carried out unconditionally (command warning: A.95) and the commands are not successfully sent.
PRM_RD, PRM_WR, PPRM_WR, CONFIG, ALM_RD, ALM_CLR,
SENS_ON, ADJ, ID_RD

10.1.5 Troubleshooting of Alarm and Warning

When an error occurs in servodrive, 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.

(1) Alarm Display and Troubleshooting

Table 10.5 Alarm Display and Troubleshooting

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.02	Parameter Breakdown (The EEPROM data storing the parameter is incorrect.)	Occurred when the control power supply was turned ON.	The power supply was turned OFF while changing the parameter setting. The power supply was turned OFF while an alarm was being written.	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. (Recheck the parameter writing method.)
			The SERVOPACK EEPROM and the related circuit are faulty.	Replace the SERVOPACK.
A.03	Main Circuit Encoder Error	Occurred when the control power supply was turned ON or during operation	A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.04	Parameter Setting Error (The parameter setting was out of the allowable setting range.)	Occurred when the control power supply was turned ON.	The incorrect parameter was being loaded. (The incorrect value was rejected as an error at the digital operator.)	Set Fn005 to initialize the parameter.
			The SERVOPACK EEPROM and the related circuit are faulty.	Replace the SERVOPACK.
A.05	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.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.09	Dividing Ratio Setting Error	Occurred when the control power supply was turned ON.	At Pn207.2 = 1, the setting of dividing ratio (Pn212) is not acceptable (out of fixed increments), or exceeds the value for the connected encoder resolution.	Correct the setting of Pn212, and turn OFF the control power and turn it ON again.
			The SERVOPACK EEPROM and the related circuit are faulty.	Replace the SERVOPACK.
A.0A	Encoder Model Unmatched	Occurred when the control power supply was turned ON.	The connected serial encoder is not supported by Σ-II series servo drives.	Replace the servomotor with Σ-II series SERVOPACK supported model.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.10	Overcurrent (An overcurrent flowed through the IGBT) or Heat Sink Overheated	Occurred when the control power supply was turned ON.	The overload alarm has been reset by turning OFF the power too many times.	Change the method to reset the alarm.
			The connection is faulty between the SERVOPACK board and the thermostat switch.	Replace the SERVOPACK.
			The SERVOPACK fault occurred.	
		Occurred when the main circuit power supply was turned ON or while the servomotor was running.	The connection between grounding and U, V, or W is incorrect.	Check and then correct the wiring.
			The grounding line has contact with other terminals.	
			A short circuit occurred between the grounding and U, V, or W of the servomotor cable.	Repair or replace the servomotor main circuit cable.
			A short circuit occurred between phases U, V, and W of the servomotor.	
			A short circuit occurred between the grounding and U, V, or W of the SERVOPACK.	Replace the SERVOPACK.
			A SERVOPACK fault occurred (current feedback circuit, power transistor or board fault).	

Table 10.5 Alarm Display and Troubleshooting (cont'd)

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.10	Overcurrent (An overcurrent flowed through the IGBT) or Heat Sink Overheated (cont'd)	Occurred when the main circuit power supply was turned ON or while the servomotor was running.	A short circuit occurred between the grounding and U, V, W of the servomotor.	Replace the servomotor.
			A short circuit occurred between phases U, V, and W of the servomotor.	
			Load moment of inertia was large and DB circuit fault occurred when a dynamic brake is applied during high-speed motor running.	Reduce the load. Reduce the motor speed at dynamic brake or replace the SERVOPACK.
			The dynamic brake was activated too frequently, so a DB overload alarm occurred.	Reduce the DB operation frequency or 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 overload or regenerative power exceeds the regenerative resistor's capacity.	Reconsider the load and operation conditions.
			The direction or the distance of the SERVOPACK to other devices is incorrect.	The surrounding air temperature for the SERVOPACK must be 55°C or less.
			A SERVOPACK fan fault occurred.	Replace the SERVOPACK.
			A SERVOPACK fault occurred.	
A.30	Regeneration Error Detected	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.	A regenerative resistor is not connected.	Check the wiring of the regenerative resistor.
			A regenerative resistor is disconnected.	Replace the regenerative resistor.
			A SERVOPACK fault occurred, such as regenerative transistor fault.	Replace the SERVOPACK.
		Occurred during normal operation.	Check for incorrect wiring and disconnection of the regenerative resistor.	Correct the wiring for the regenerative resistor.
			The regenerative resistor is disconnected.	Reconsider the load and operation conditions and check if the regenerative energy become excessive, or replace the regenerative resistor.
			A SERVOPACK fault, such as regenerative transistor fault, occurred.	Replace the SERVOPACK.
A.32	Regenerative Overload	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).	The regenerative energy exceeds the allowable value.	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 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.33	Main Circuit Wiring Error	Occurred when the control power supply was turned ON.	A SERVOPACK fault occurred.	Replace the SERVOPACK.
			Residual voltage exists in the main circuit.	Reconsider the resistance value of the regenerative resistor.
		Occurred when the main circuit power supply was turned ON.	In the DC power input mode, AC power is supplied through 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 ⊕1 and ⊖ terminals.	

Table 10.5 Alarm Display and Troubleshooting (cont'd)

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.40	Overvoltage	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 AC power voltage is too high.	Check the AC power voltage.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred during normal operation.	Check the AC power voltage (check if there is no excessive voltage change.)	Check the AC power voltage.
			The motor speed is high and load moment of inertia is excessive, resulting in insufficient regenerative capacity.	Reconsider the load and operation conditions. Check the load moment of inertia and minus load specifications.
			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.40	Undervoltage	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 AC power supply voltage is low.	Check the AC power supply voltage.
			The fuse of the SERVOPACK is blown out.	Replace the SERVOPACK.
			The inrush current limit resistor is disconnected, resulting in an overload of the inrush current limit resistor.	Reduce the number of times that the main circuit is turned ON or OFF, or replace the SERVOPACK.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred during normal operation.	The AC power supply voltage was lowered, and large voltage drop occurred.	Check the AC power supply voltage.
			A temporary power failure occurred.	Check the AC power supply voltage.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.51	Overspeed	Occurred when the control power supply was turned ON.	A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred when servo 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 rotation.	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.	Check the setting of the parameter.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.

Table 10.5 Alarm Display and Troubleshooting (cont'd)

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.71 A.72	Overload A.71: Instantaneous Peak Load A.72: Continuous Peak Load	Occurred when the control power supply was turned ON.	A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred when the servo was ON.	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, or check if the connector is inserted securely.
			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, or check if the connector is inserted securely.
			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.	Reconsider the load and operation conditions, or reconsider the servomotor capacity.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.73	Dynamic Brake Overload	Occurred when the control power supply was turned ON.	A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred when the servomotor was running and in a status other than servo OFF.	A SERVOPACK 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 motor 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.74	Overload of Inrush Current Limit Resistor	Occurred when the control power supply was turned ON.	A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred during operations other than the turning ON/OFF of the main circuit.	A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred at the main circuit power supply ON/OFF operation.	The main circuit power supply ON/OFF operation is repeated frequently.	Reduce the number of times that main circuit's power supply ON/OFF operation .
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.7A	Heat Sink Overheated	Occurred when the control power supply was turned ON.	A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred during normal operation.	The load exceeds the rated load.	Reconsider the load and operation conditions, or reconsider the servomotor capacity.
			The SERVOPACK surrounding air temperature exceeds 55°C.	The surrounding air temperature must be 55°C or less.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
			Cooling is not sufficient by natural convection or fun.	Reconsider the installation according to the SERVOPACK mounting instructions.

Table 10.5 Alarm Display and Troubleshooting (cont'd)

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.81	Encoder Backup Error	Occurred when the control power supply was turned ON. (Setting: Pn002.2=1)	A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred when the control power supply was turned ON. (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 servomotor.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.82	Encoder Checksum Error	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.
		Occurred when the SEN signal turned ON.	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.83	Absolute Encoder Battery Error	When the control power supply was turned ON. (Setting: Pn002.2=1)	A SERVOPACK fault occurred.	Replace the SERVOPACK.
		When the control power supply was turned ON. (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 ON the power to the encoder.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.84	Encoder Data Error	Occurred when the control power supply was turned ON.	A malfunction occurred in the encoder.	Turn the encoder power supply OFF and then ON again. If this alarm occurs frequently, replace the servomotor.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred during normal operation.	A malfunction occurred in the encoder due to external noise.	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 fault occurred.	Replace the SERVOPACK.
A.85	Encoder Overspeed	Occurred when the control power supply was turned ON.	When the encoder power supply turns ON, the servomotor runs at 200 min^{-1} or more.	Turn ON the encoder power supply when the servomotor stops.
			An encoder fault occurred.	Replace the servomotor.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred during normal operation.	An encoder fault occurred.	Replace the servomotor.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.86	Encoder Overheated	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 normal operation.	The surrounding air temperature around the servomotor is too high.	The surrounding air 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.b1	Reference Speed Input Read Error	Occurred when the control power supply was turned ON.	A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred during normal operation.	A malfunction occurred in reading section of the speed reference input.	Clear and reset the alarm and restart the operation.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.

Table 10.5 Alarm Display and Troubleshooting (cont'd)

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.b2	Reference Torque Input Read Error	Occurred when the control power supply was turned ON.	A SERVOPACK 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.
		Occurred during normal operation.	A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.b3	Current Detection Error	Occurred when the control power supply was turned ON.	A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred when the servo was ON.	A SERVOPACK fault occurred.	Replace the SERVOPACK.
			The Servo ON command was input while the servomotor was operating.	Check to be sure the servomotor has stopped, and then input the Servo ON command.
			The servomotor is disconnected.	Correct the servomotor wiring.
		Occurred during normal operation.	A SERVOPACK fault occurred.	Replace the SERVOPACK.
			The servomotor was disconnected.	Correct the servomotor wiring.
A.bF	System Alarm (Program error)	Occurred when the control power supply was turned ON.	A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred during normal operation.	A program is incorrect.	Replace the SERVOPACK.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.C1	Servo Overrun Detected	Occurred when the control power supply was turned ON.	A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred when the servo was ON or during normal operation.	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.C8	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 fault occurred.	Replace the SERVOPACK.
		Occurred when an encoder alarm was cleared and reset.	An encoder fault occurred.	Replace the servomotor.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.C9	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.
			Encoder cable specification is incorrect.	Use the recommended cable for the encoder cable.
			The wiring distance for the encoder cable is too long.	The wiring distance must be 20m max.
			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 power line.	Separate the encoder cable from the power line.
			The FG electrical potential varies because of the influence from such machines on the servomotor side as welders.	Ground the machine separately from PG side FG.
			Noise interference occurred on the signal line from the encoder.	Take a measure against noise for the encoder wiring.
			An encoder fault occurred.	Replace the servomotor.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.CA	Encoder Parameter Error	Occurred when the control power supply was turned ON.	An encoder fault occurred.	Replace the servomotor.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.

Table 10.5 Alarm Display and Troubleshooting (cont'd)

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.Cb	Encoder Echo-back Error	Occurred when the control power supply was turned ON or during normal operation.	The encoder wiring and contact are incorrect.	Correct the encoder wiring.
			Encoder cable specifications is incorrect.	Use the recommended cable for the encoder cable.
			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 power line or near a high-current line.	Separate the encoder cable from the power line.
			The FG electrical potential varies because of the influence from such machines on the servomotor side as welders.	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.
			An encoder fault occurred.	Replace the servomotor.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.CC	Multiturn 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 normal operation.	A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.d0	Position Error Pulse Overflow	Occurred when the control power supply was turned ON.	The overflow level (Pn505) is incorrect.	Make the value set in the Pn505 to other than 0.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred at the servomotor high-speed rotation.	The contact in the servomotor U, V, and W wirings is faulty.	Correct the servomotor wiring.
			A SERVOPACK 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 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 position error pulse overflow alarm level (Pn505) is incorrect.	Set the parameter Pn505 to proper value.
			The load exceeds the rated load.	Reconsider and correct the load/operation conditions and servomotor capacity.
A.F1	Power Line Open Phase	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.	Check the power supply voltage.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred during normal operation.	The contact in three-phase power supply wiring is faulty.	Correct the power supply wiring.
			Three-phase power supply is unbalanced.	Check the power supply voltage.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.F4	Main Circuit MC Error	Occurred when the control/main circuit power supply was turned ON.	A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred when servo was ON.	Incorrect wiring of control power supply input terminals 380 to 480 VAC (only for 400V models)	Correct the power supply wiring.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred during normal operation	A SERVOPACK fault occurred.	Replace the SERVOPACK.

Table 10.5 Alarm Display and Troubleshooting (cont'd)

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.F5	Servomotor Disconnection Alarm	Occurred when the control power supply was turned ON.	A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.F6		Occurred when the servo was ON.	The servomotor power cable (U, V, W) was disconnect.	Correct the servomotor wiring.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
CPF00	Digital Operator Transmission Error 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 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		A digital operator fault occurred.	Replace the digital operator.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.

(2) Warning Display and Troubleshooting

Table 10.6 Warning Display and Troubleshooting

Warning Display	Warning Name	Situation at Warning Occurrence	Cause	Corrective Actions
A.90	Excessive Position Error Warning: Warning for the alarm A.d0	Occurred at the servomotor high-speed rotation.	The contact in the servomotor U, V, and W wirings is faulty.	Correct the servomotor wiring.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		The servomotor did not run with position reference input.	The contact in the servomotor U, V, and W wirings is faulty.	Correct the servomotor wiring.
			A SERVOPACK 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 position error pulse over flow warning level (Pn51E) is incorrect.	Set the parameter Pn51E to proper value.
			The servomotor specifications do not meet the load conditions.	Reconsider and correct the load/operation conditions and servomotor capacity.
A.91	Overload: Warning for the alarms A71 and A72	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 or confirm that the connector is inserted securely.
			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 normal operation.	The effective torque exceeds the rated torque.	Reconsider the load and operation conditions. Or, check the servomotor capacity.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.92	Regenerative Overload: Warning for the alarm A320	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 exceeds the allowable value.	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.
A.93	Absolute Encoder Battery Warning	Occurred when the control power supply was turned ON (Setting: Pn002.2=1).	A SERVOPACK fault occurred.	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 OFF the encoder power supply and ON again.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.

10.1.6 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 10.7 Troubleshooting for Malfunction without Alarm Display

Symptom	Cause	Inspection	Corrective Actions
		■: Turn OFF the servo system before executing operations.	
Servomotor Does Not Start	The power supply is not ON.	Check 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.	Connect 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.
	/S-ON input signal stays OFF.	Check settings of parameters Pn50A.0 and Pn50A.1.	Correct the parameter setting and turn ON /S-ON input signal.
	/P-CON input function setting is incorrect.	Check parameter Pn000.1.	Set parameters to match the application.
	SEN input is turned OFF.	Check the SEN signal input (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.
	The error clear counter (CLR) input is turned ON.	Check CLR input pins.	Turn CLR input signal OFF.
	The forward run prohibited (P-OT) or reverse run prohibited (N-OT) input signal is turned OFF.	Check P-OT or N-OT input signal.	Turn P-OT or N-OT input signal ON.
	A SERVOPACK 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 Suddenly Stops during Operation and will Not Restart	An alarm occurred while alarm reset signal (/ALM-RST) was turned ON.	Check /ALM-RST signal.	Remove the cause of alarm. Turn alarm reset signal (/ALM-RST) from ON to OFF.
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 correctly.
	Torque control: Torque reference input is incorrect.	Check T-REF and SG to confirm if the control method and the input are agreed.	Correct the control mode selection parameter, or the input correctly.
	Speed reference offset is error.	–	Adjust the SERVOPACK offset correctly.
	Position control: Reference pulse input is incorrect.	Set the parameter and cheek the reference pulse form.	Correct the control mode selection parameter, or the input correctly.
	A SERVOPACK 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	–	Replace the SERVOPACK.

Table 10.7 Troubleshooting for Malfunction without Alarm Display (cont'd)

Symptom	Cause	Inspection	Corrective Actions
		■: Turn OFF the servo system before executing operations.	
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	Check if the cable meets the recommended specification.	Use the specified input signal wires.
	Noise interference due to long distance 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	Check if the cable meets the recommended specification.	Use the specified encoder cable.
	Noise interference due to long encoder cable wiring distance	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.	Install a surge suppressor to the encoder cable.
	FG electrical potential varies by influence of such machines on the servomotor side as welders.	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.
	Encoder fault	–	Replace the servomotor.
Servomotor Vibrates at about 200 to 400 Hz	Speed loop gain value (Pn100) too high.	Factory setting: Kv=40.0 Hz*	Reduce speed loop gain (Pn100) preset value.
	Position loop gain value (Pn102) too high	Factory setting: Kp=40.0/s*	Reduce position loop gain (Pn102) preset value.
	Incorrect speed loop integral time constant (Pn101) setting	Factory setting: Ti=20.00 ms*	Correct the speed loop integral time constant (Pn101) setting.
	When the autotuning is not used: Incorrect rotational moment of inertia ratio data	–	Correct the rotational moment of inertia ratio data (Pn103).
High Rotation Speed Overshoot on Starting and Stopping.	Speed loop gain value (Pn100) too high	Factory setting: Kv=40.0 Hz*	Reduce the speed loop gain (Pn100) preset value.
	Position loop gain value (Pn102) too high	Factory setting: Kp=40.0/s*	Reduce the position loop gain (Pn102) preset value.
	Incorrect speed loop integral time constant (Pn101) setting	Factory setting: Ti=20.00 ms*	Correct the speed loop integral time constant (Pn101) setting.
	Incorrect moment of inertia ratio (Pn103) setting	–	Correct the rotational moment of inertia ratio data (Pn103).

* Refer to *9.3.2 Servo Gain Manual Tuning*.

Table 10.7 Troubleshooting for Malfunction without Alarm Display (cont'd)

Symptom	Cause	Inspection	Corrective Actions
		: Turn OFF the servo system before executing operations.	
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.)	Noise interference due to improper encoder cable specifications	Check if the cable meets recommended specification.	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 interference due to damaged encoder cable	Noise interference occurred to the signal line because the encoder cable is bent or its sheath damaged.	Correct the encoder cable layout.
	Excessive noise to the encoder cable	Check if the encoder cable is bundled with a high-current line.	Change the encoder cable layout so that no surge is applied.
	FG electrical potential varies by influence of such machines on the servomotor side as welder.	Check if the machine is correctly grounded.	Ground the machine separately from PG side FG.
	SERVOPACK pulse counting error due to noise interference	Check if the signal line from the encoder receives influence from noise interference.	Take measures against noise for encoder wiring.
	Excessive vibration and shock to the encoder	Vibration from machine occurred or servomotor mounting such as mounting surface precision, fixing, and alignment is incorrect.	Reduce vibration from machine or mount securely the servomotor.
	Encoder fault	–	Replace the servomotor.
	SERVOPACK fault	Check the multiturn data from SERVOPACK.	Replace the SERVOPACK.
	Host controller multiturn data reading error	Check the error detection at the host controller.	Correct the error detection section of host controller.
		Check if the host controller executes data parity check.	Execute the multiturn data parity check.
		Check noise on the signal line between SERVOPACK and the host controller.	
Overtravel (OT) (Movement over the zone specified by the host controller)	An overtravel signal is output (P-OT (CN1-42) or N-OT (CN1-43)) is at H.	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.
	The overtravel 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, etc.)	Correct the overtravel limit SW wiring.
	Incorrect P-OT/N-OT signal 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.
	Improper encoder cable specifications	Check if the cable meets the recommended specifications.	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.	Change the encoder cable layout so that no surge is applied.
	FG electrical potential varies by influence of such machines on the servomotor side as welders.	Check if the machine is correctly grounded.	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.

Table 10.7 Troubleshooting for Malfunction without Alarm Display (cont'd)

Symptom	Cause	Inspection	Corrective Actions
		: Turn OFF the servo system before executing operations.	
Overtravel (OT) (Movement over the zone specified by the host controller) (cont'd)	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	–	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	Check if the cable meets the recommended specifications.	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)	–	Replace the servomotor.
Servomotor Overheated	Surrounding air temperature too high	Measure servomotor surrounding air temperature.	Reduce surrounding air temperature to 40°C max.
	Servomotor surface dirty	Check visually.	Clean dust and oil from servomotor surface.
	Overloaded	Run under no load.	Reconsider load and operation conditions or replace with larger capacity servomotor.

10.2 Inspection and Maintenance

10.2.1 Servomotor Inspection

The AC servomotors are brushless. Simple, daily inspection is sufficient. The inspection and maintenance frequencies in Table 10.8 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 10.8 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 5,000 hours	Contact your Yaskawa representative.	Applies only to servomotors with oil seals.
Overhaul	At least once every 20,000 hours or 5 years	Contact your Yaskawa representative.	–

* Measure across the servomotor FG and the phase-U, phase-V, or phase-W power line.

10.2.2 SERVOPACK Inspection

For inspection and maintenance of the SERVOPACK, follow the inspection procedures in Table 10.9 at least once every year. Other routine inspections are not required.

Table 10.9 SERVOPACK Inspections

Item	Frequency	Procedure	Comments
Check the Appearance	At least once a year	Check for dust, dirt, and oil on the surfaces.	Clean with cloth or compressed air.
Loose Screws		Check for loose terminal block and connector screws.	Tighten any loose screws.

10.2.3 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 10.10 Periodical Part Replacement

Part	Standard Replacement Period	Operating Conditions
Cooling Fan	4 to 5 years	• Surrounding Air 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	

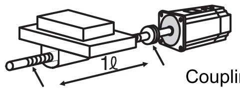
11

Appendix

11.1 Servomotor Capacity Selection Examples

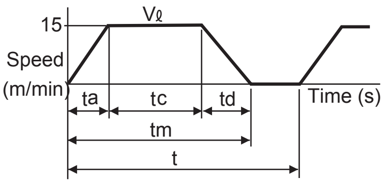
11.1.1 Selection Example for Speed Control

Mechanical Specifications



- Load speed: $V\ell$ = 15 m/min
- Linear motion section mass: M = 500 kg
- Ball screw length: L_B = 1.4 m
- Ball screw diameter: D_B = 0.04 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 = 40 times/min
- Feeding distance: ℓ = 0.275 m
- Feeding time: tm = 1.2 s max.
- Friction coefficient: μ = 0.2
- Mechanical efficiency: η = 0.9 (90%)

(1) Speed Diagram



$$t = \frac{60}{n} = \frac{60}{40} = 1.5 \text{ (s)}$$

where ta = td

$$ta = tm - \frac{60 \times \ell}{V\ell} = 1.2 - \frac{60 \times 0.275}{15} = 0.1 \text{ (s)}$$

$$tc = 1.2 - 0.1 \times 2 = 1.0 \text{ (s)}$$

(2) Rotation Speed

- Load axis rotation speed

$$N_\ell = \frac{V_\ell}{P_B} = \frac{15}{0.01} = 1500 \text{ (min}^{-1}\text{)}$$

- Motor shaft rotation speed with the direct coupling: Gear ratio 1/R = 1/1
  Therefore,

$$N_M = N_\ell \cdot R = 1500 \times 1 = 1500 \text{ (min}^{-1}\text{)}$$

(3) Load torque

$$T_L = \frac{9.8\mu \cdot M \cdot P_B}{2\pi R \cdot \eta} = \frac{9.8 \times 0.2 \times 500 \times 0.01}{2\pi \times 1 \times 0.9} = 1.73 \text{ (N·m)}$$

(4) Load Moment of Inertia

- Linear motion section

$$J_{L1} = M\left(\frac{P_B}{2\pi R}\right)^2 = 500 \times \left(\frac{0.01}{2\pi \times 1}\right)^2 = 12.7 \times 10^{-4} \text{ (kg} \cdot \text{m}^2\text{)}$$

- Ball screw

$$J_B = \frac{\pi}{32}\rho \cdot L_B \cdot D_B^4 = \frac{\pi}{32} \times 7.87 \times 10^{-3} \times 1.4 \times (0.04)^4 = 27.7 \times 10^{-4} \text{ (kg} \cdot \text{m}^2\text{)}$$

- Coupling

$$J_C = \frac{1}{8}M_C \cdot D_C^2 = \frac{1}{8} \times 1 \times (0.06)^2 = 4.5 \times 10^{-4} \text{ (kg} \cdot \text{m}^2\text{)}$$

- Load moment of inertia at motor shaft

$$J_L = J_{L1} + J_B + J_C = 44.9 \times 10^{-4} \text{ (kg} \cdot \text{m}^2\text{)}$$

(5) Load Moving Power

$$P_O = \frac{2\pi N_M \cdot T_L}{60} = \frac{2\pi \times 1500 \times 1.73}{60} = 272 \text{ (W)}$$

(6) Load Acceleration Power

$$P_a = \left(\frac{2\pi}{60} N_M\right)^2 \frac{J_L}{ta} = \left(\frac{2\pi}{60} \times 1500\right)^2 \frac{44.9 \times 10^{-4}}{0.1} = 1108 \text{ (W)}$$

(7) Servomotor Provisional 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.

- SGMGH-09A2A21 servomotor
- SGDH-10AE SERVOPACK

(b) Specifications of the Provisionally Selected Servomotor and SERVOPACK

- Rated output: 850 (W)
- Rated motor speed: 1500 (min^{-1})
- Rated torque: 5.39 (N·m)
- Instantaneous peak torque: 13.8 (N·m)
- Servomotor moment of inertia: 13.9×10^{-4} (kg·m^2)
- SERVOPACK allowable load moment of inertia: 69.58×10^{-4} (kg·m^2)

(8) Verification on the Provisionally Selected Servomotor

- Required starting torque

$$T_P = \frac{2\pi N_M (J_M + J_L)}{60ta} + T_L = \frac{2\pi \times 1500 \times (13.9 + 44.9) \times 10^{-4}}{60 \times 0.1} + 1.73$$

≒ 11 (N·m) < Instantaneous peak torque···Satisfactory

- Required braking torque

$$T_S = \frac{2\pi N_M (J_M + J_L)}{60td} - T_L = \frac{2\pi \times 1500 \times (13.9 + 44.9) \times 10^{-4}}{60 \times 0.1} - 1.73$$

≒ 7.5 (N·m) < Instantaneous peak torque···Satisfactory

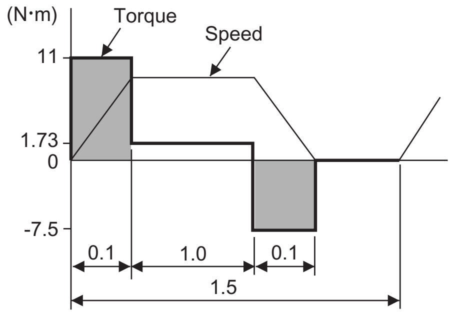
- Torque efficiency

$$T_{rms} = \sqrt{\frac{T_P{}^2 \cdot ta + T_L{}^2 \cdot tc + T_S{}^2 \cdot td}{t}} = \sqrt{\frac{(11)^2 \times 0.1 + (1.73)^2 \times 1.0 + (7.5)^2 \times 0.1}{1.5}}$$

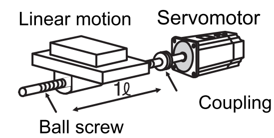
≒ 3.72 (N·m) < Rated torque···Satisfactory

(9) Result

The provisionally selected servomotor and SERVOPACK are confirmed to be applicable.
The torque diagram is shown below.

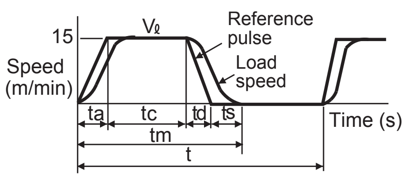


11.1.2 Selection Example for Position Control



- Load speed: V_ℓ = 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: ℓ = 0.25 m
- Positioning time: tm = Less than 1.2 s
- Electrical stop accuracy: $\delta = \pm$ 0.01 mm
- Friction coefficient: μ = 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

$$N_\ell = \frac{V_\ell}{P_B} = \frac{15}{0.005} = 3000\ (min^{-1})$$

- Motor shaft rotation speed with direct coupling: Gear ratio 1/R = 1/1
  Therefore,

$$N_M = N_\ell \cdot R = 3000 \times 1 = 3000\ (min^{-1})$$

(3) Load Torque

$$T_L = \frac{9.8\mu \cdot M \cdot P_B}{2\pi R \cdot \eta} = \frac{9.8 \times 0.2 \times 80 \times 0.005}{2\pi \times 1 \times 0.9} = 0.139\ (N{\cdot}m)$$

(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.

- SGMPH-02AAA21 servomotor
- SGDH-02AE SERVOPACK

(b) Specifications of Servomotor and SERVOPACK

- Rated output: 200 (W)
- Rated motor speed: 3000 ($\mathrm{min^{-1}}$)
- Rated torque: 0.637 (N·m)
- Instantaneous peak torque: 1.91 (N·m)
- Servomotor rotor moment of inertia: 0.209×10^{-4} ($\mathrm{kg \cdot m^2}$)
- SERVOPACK allowable load moment of inertia: 3.69×10^{-4} ($\mathrm{kg \cdot m^2}$)
- Number of encoder pulses: 2048 (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 $\left(\frac{B}{A}\right)$

As the electrical stop accuracy $\delta = \pm 0.01$ mm, take the position detection unit $\Delta\ell = 0.01$ mm/pulse.

$$\frac{P_B}{\Delta\ell} \times \left(\frac{B}{A}\right) = \frac{5}{0.01} \times \left(\frac{B}{A}\right) = 2048 \times 4$$

$$k = \frac{B}{A} = \frac{2048 \times 4}{500}$$

(10) Reference Pulse Frequency

$$vs = \frac{1000V\ell}{60 \times \Delta\ell} = \frac{1000 \times 15}{60 \times 0.01} = 25{,}000 \text{ (pps)}$$

(11) Error Counter Pulses

Position loop gain Kp = 30 ($1/S$)

$$\varepsilon = \frac{vs}{Kp} = \frac{25{,}000}{30} = 833 \text{ (pulse)}$$

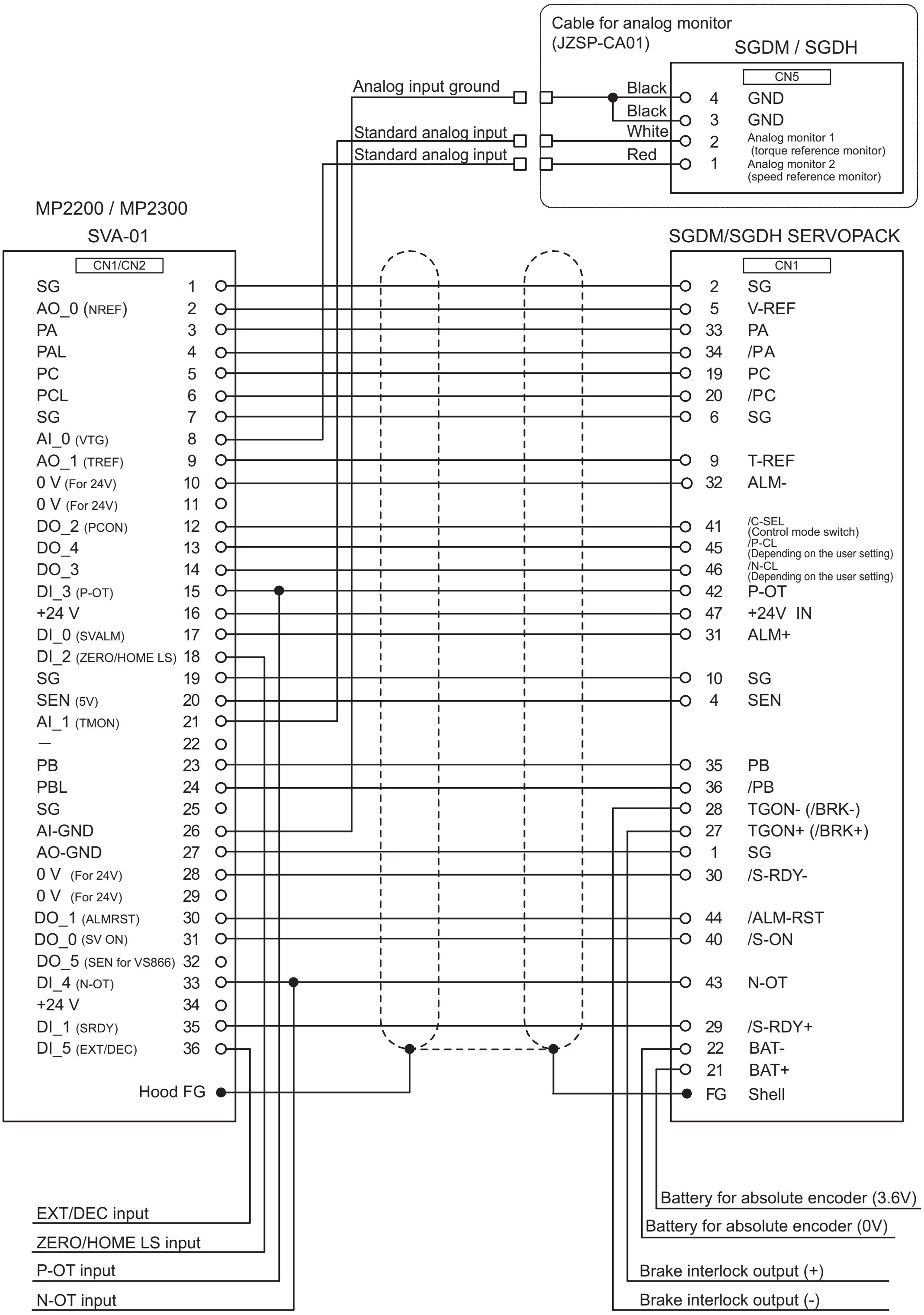
(12) Electrical Stop Accuracy

$$\pm\Delta\varepsilon = \pm \frac{\varepsilon}{\text{(SERVOPACK control range)} \times \frac{N_M}{N_R}} = \pm \frac{833}{5000 \times \frac{3000}{3000}} \fallingdotseq \pm 0.17 < \pm 1 \text{ (pulse)} = \pm 0.01 \text{ (pulse)}$$

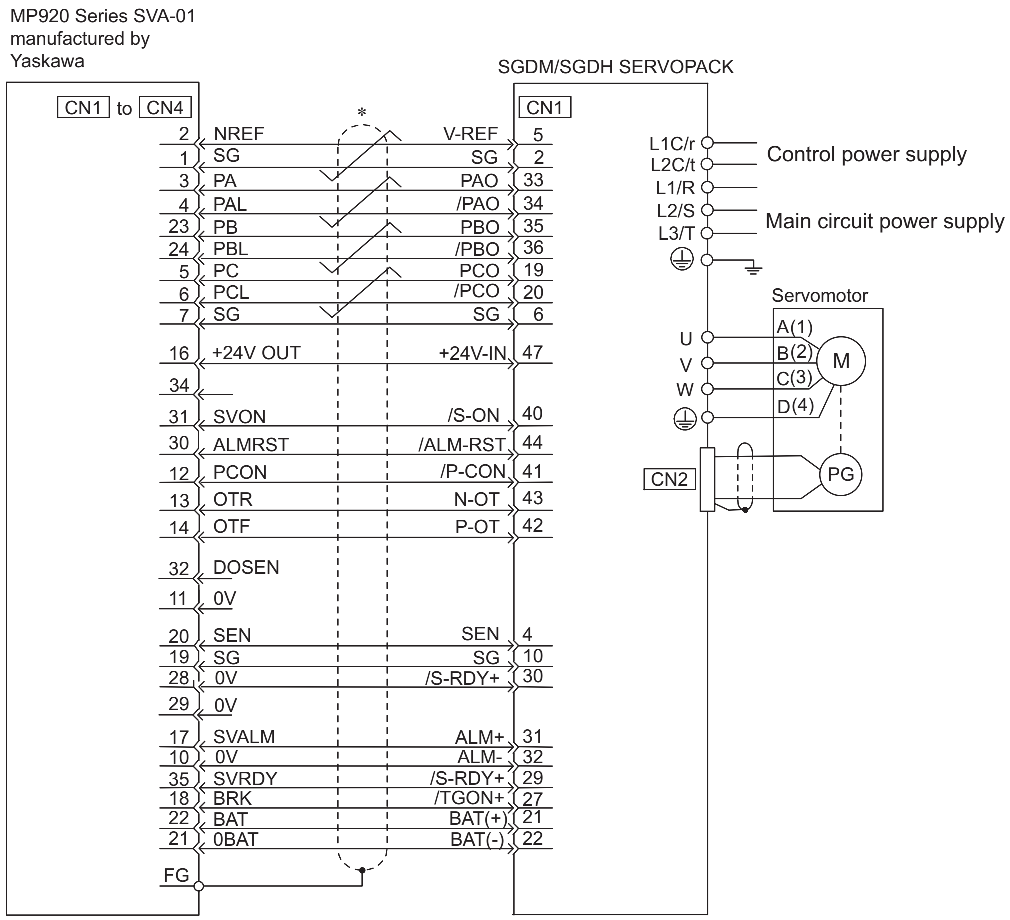
The above results confirm that the selected SERVOPACK and servomotor are applicable for the position control.

11.2 Connection to Host Controller

11.2.1 Example of Connection to MP2200/MP2300 Motion Module SVA-01

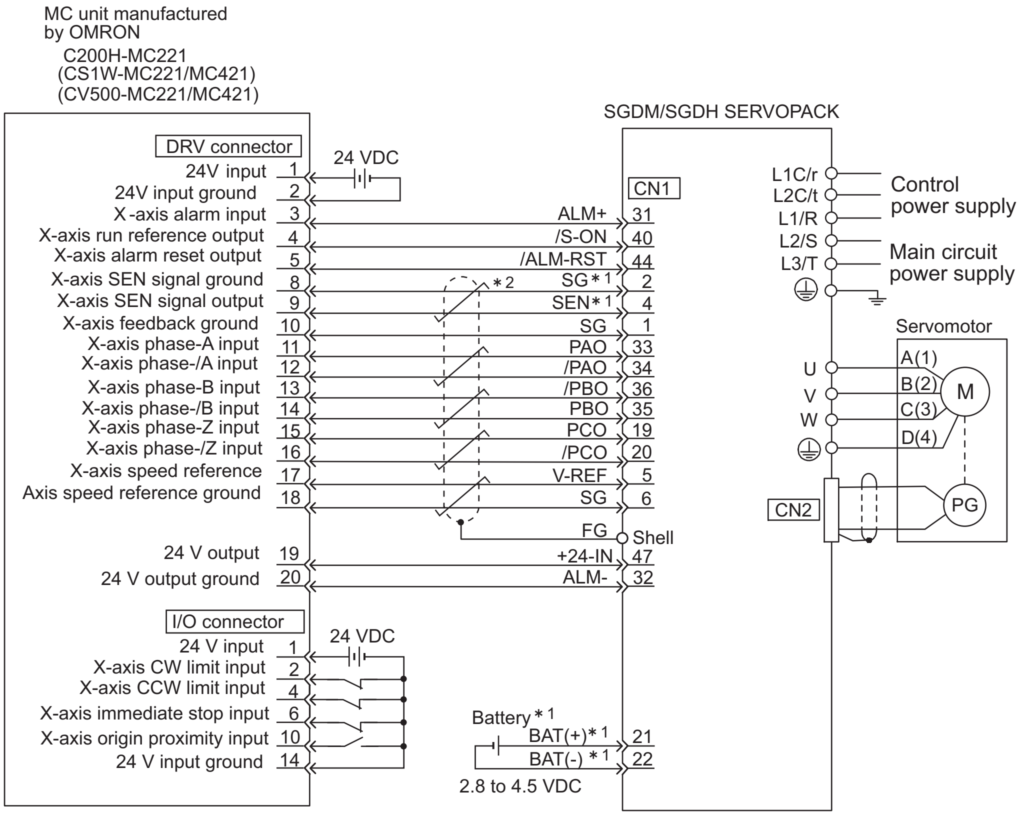


11.2.2 Example of Connection to MP920 4-axes Analog Module SVA-01



* represents twisted-pair wires.

11.2.3 Example of Connection to OMRON's Motion Control Unit

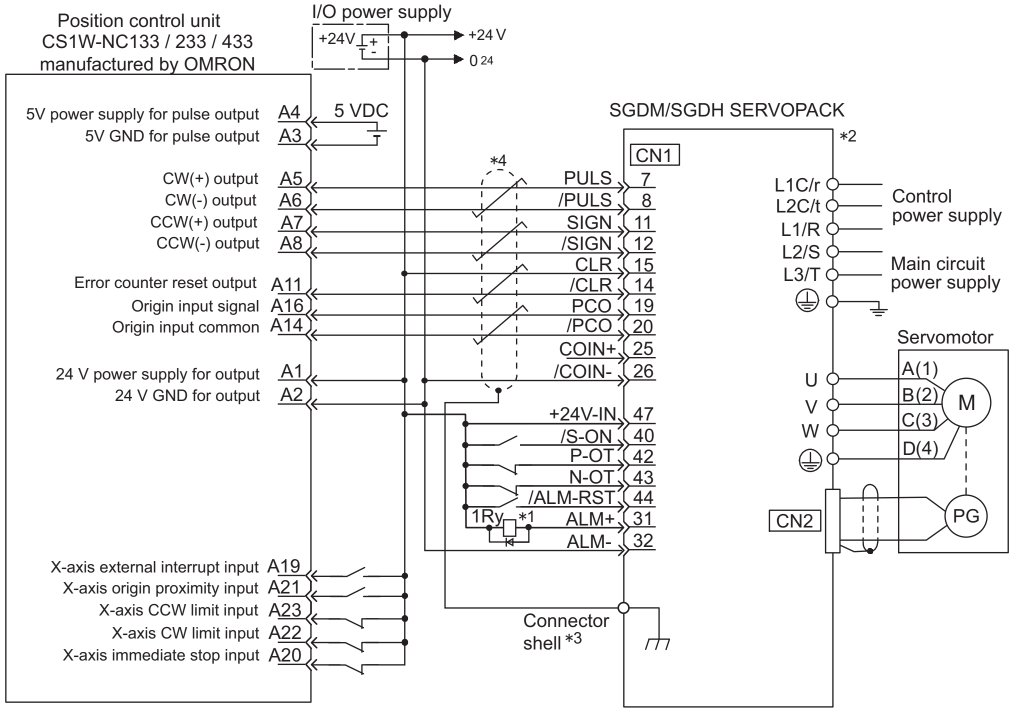


* 1. Connect when an absolute encoder is used.
When a battery is installed in the SERVOPACK, no battery is required for CN1 (between 21 and 22).
- Battery for CN1: ER6VC3 (3.6 V, 2000 mAh)
- Battery installed in the SERVOPACK: JZSP-BA01-1 (3.6 V, 1000 mAh)

* 2. represents twisted-pair wires.

Note:
1. Only signals applicable to OMRON's MC unit and Yaskawa's SGDM/SGDH SERVOPACK 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 /S-ON signal.

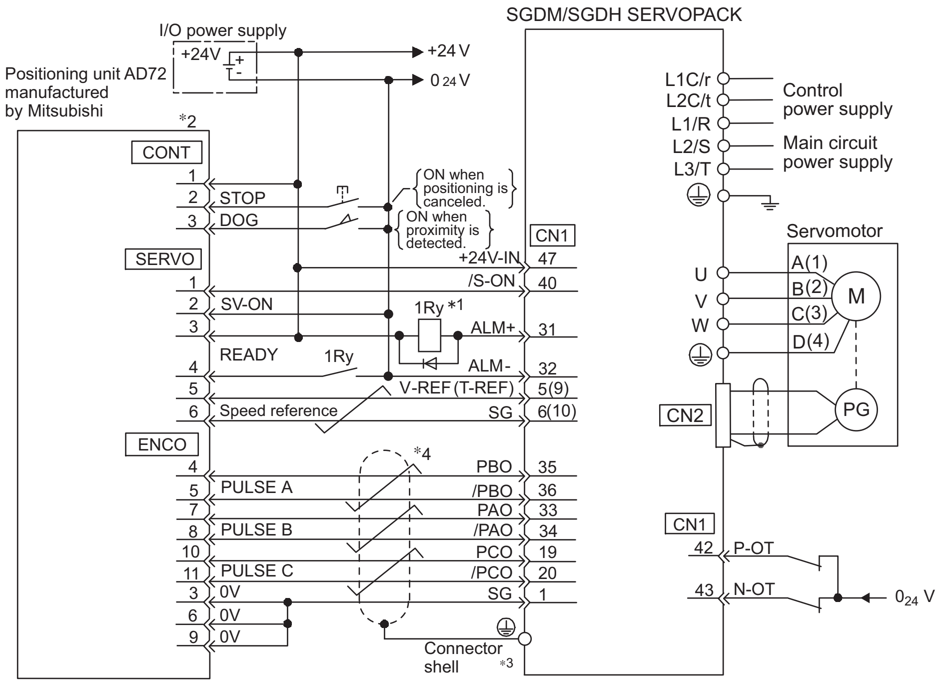
11.2.4 Example of Connection to OMRON's Position Control Unit



* 1. The ALM signal is output for about two seconds after 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 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 OMRON's MC unit (positioning unit) and Yaskawa's SGDM/SGDH SERVOPACK are shown in the diagram.

11.2.5 Example of Connection to MITSUBISHI's AD72 Positioning Unit (SERVOPACK in Speed Control Mode)



* 1. The ALM signal is output for about two seconds after 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 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.

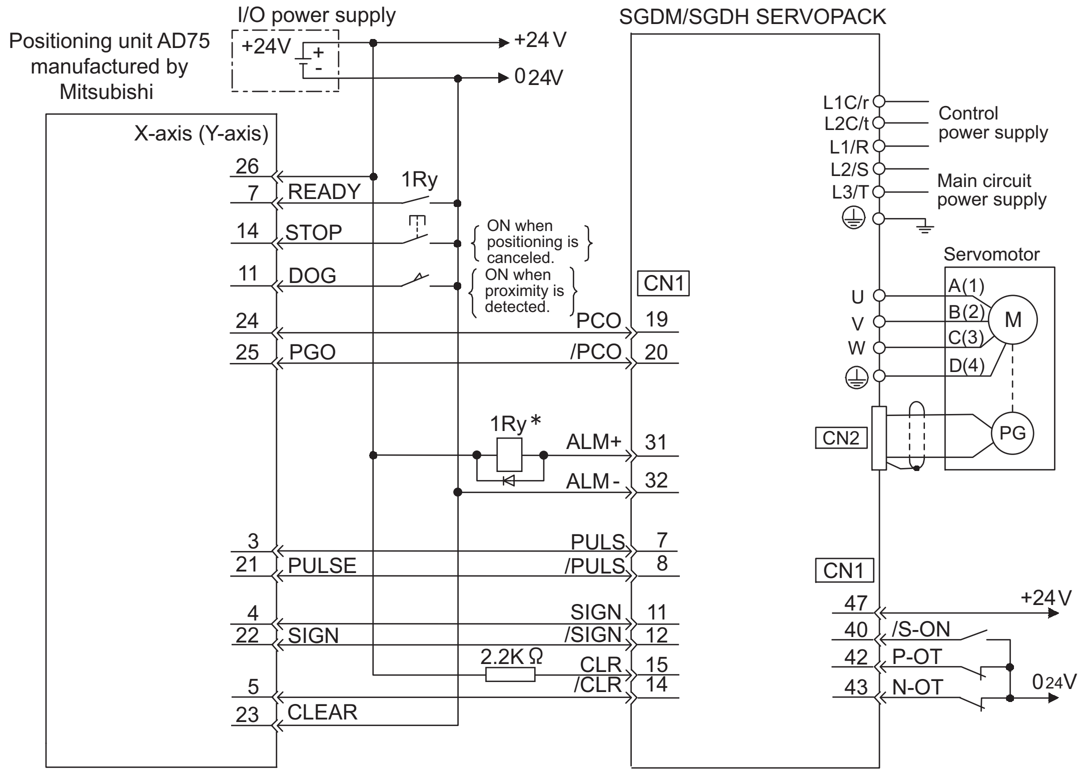
* 4. represents twisted-pair wires.

Note: Only signals applicable to Mitsubishi's AD72 Positioning Unit and Yaskawa's SGDM/SGDH SERVOPACK are shown in the diagram.

Appendix

11

11.2.6 Example of Connection to MITSUBISHI's AD75 Positioning Unit (SERVOPACK in Position Control Mode)



* The ALM signal is output for about 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 the main circuit power supply to the SERVOPACK.

Note: Only signals applicable to Mitsubishi's AD75 Positioning Unit and Yaskawa's SGDM/SGDH SERVOPACK are shown in the diagram.

11.3 List of Parameters

11.3.1 Utility Functions List

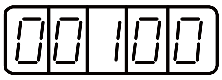
The following list shows the available utility functions.

Parameter No.	Function
Fn000	Alarm traceback data display
Fn001	Not used for the SERVOPACKs of 22 kW or more.
Fn002	JOG mode operation
Fn003	Zero-point search mode
Fn004	Reserved (Do not change.)
Fn005	Parameter setting initialization
Fn006	Alarm traceback data clear
Fn007	Not used for the SERVOPACKs of 22 kW or more.
Fn008	Absolute encoder multiturn reset and encoder alarm reset
Fn009	Automatic tuning of analog (speed, torque) reference offset
Fn00A	Manual adjustment of speed reference offset
Fn00B	Manual adjustment of torque reference offset
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
Fn00F	Manual offset-adjustment of motor current detection signal
Fn010	Password setting (protects parameters from being changed.)
Fn011	Motor models display
Fn012	Software version display
Fn013	Multiturn limit value setting change when a Multiturn Limit Disagreement alarm (A.CC) occurs
Fn014	Application module detection results clear

11.3.2 List of Parameters

(1) Parameter Display

Parameter settings are displayed as shown below.



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.

(2) Definition of Display for Function Selection Parameters

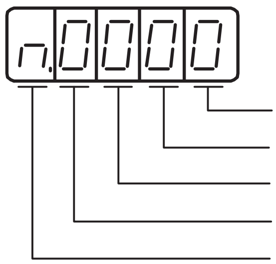
Each digit of the function selection parameters has a meaning.

For example, the rightmost digit of parameter Pn000 is expressed as “Pn000.0.”

IMPORTANT

1. Each digit of the function selection parameters is defined as shown below. The following explains the purpose of each digit of a parameter.

- Pn000.0 or n.×××□: Indicates the value for the 1st digit of parameter Pn000.
- Pn000.1 or n.××□×: Indicates the value for the 2nd digit of parameter Pn000.
- Pn000.2 or n.×□××: Indicates the value for the 3rd digit of parameter Pn000.
- Pn000.3 or n.□×××: Indicates the value for the 4th digit of parameter Pn000.



How to Display Parameters

2. After changing the parameters with “After restart” mentioned in “Setting Validation” column in the table on the following pages, turn OFF the main circuit and control power supplies and then turn them ON again to enable the new settings.

Parameter No.	Name	Setting Range	Units	Factory Setting	Setting Validation
Pn000	Function Selection Basic Switches	–	–	0000	After restart

4th digit 3rd digit 2nd digit 1st digit

n. □ □ □ □

1st digit: Direction Selection

Direction Selection	
0	Sets CCW as forward direction.
1	Sets CW as forward direction (Reverse Rotation Mode).
2 and 3	Reserved (Do not change.)

2nd digit: Control Method Selection

Control Method Selection	
0	Speed control (analog reference)
1	Position control (pulse train reference)
2	Torque control (analog reference)
3	Internally set speed control (contact reference)
4	Internally set speed control (contact reference) ⇔ Speed control (analog reference)
5	Internally set speed control (contact reference) ⇔ Position control (pulse train reference)
6	Internally 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

Axis Address	
0 to F	Sets SERVOPACK axis address.

4th digit: Reserved (Do not change)

Parameter No.	Name	Setting Range	Units	Factory Setting	Setting Validation
Pn001	Function Selection Application Switches 1	–	–	0000	After restart

n. □□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit:

Servo OFF or Alarm Stop Mode	
0	Stops the motor by applying dynamic brake (DB).
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	
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	
0	Not applicable to main circuit DC power input: Input AC power supply through L1, L2, and L3 terminals.
1	Applicable to main circuit DC power input: Input DC power supply between ⊕1 and ⊖.

4th digit:

Warning Code Output Selection	
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).

Parameter No.	Name	Setting Range	Units	Factory Setting	Setting Validation
Pn002	Function Selection Application Switches 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 Torque Limiting Using an Analog Voltage Reference.")
2	Uses T-REF as a torque feed forward input. (Refer to "9.4.2 Torque Feed-forward.")
3	Uses T-REF as an external torque limit input when P-CL and N-CL are ON. (Refer to "8.9.4 Torque Limiting Using an External Torque Limit and Analog Voltage Reference.")

2nd digit:

Torque Control Option (V-REF Terminal Allocation)	
0	N/A
1	Uses V-REF as an external speed limit input.

3rd digit:

Absolute Encoder Usage	
0	Uses absolute encoder as an absolute encoder.
1	Uses absolute encoder as an incremental encoder.

4th digit:

Reserved (Do not change)

Parameter No.	Name	Setting Range	Units	Factory Setting	Setting Validation
Pn003	Function Selection Application Switches 3	–	–	0002	After restart

4th digit 3rd digit 2nd digit 1st digit

n. □ □ □ □

Analog Monitor 1 Torque Reference Monitor	
0	Motor speed: 1 V/1000 min^{-1}
1	Speed reference: 1 V/1000 min^{-1}
2	Internal torque reference: 1 V/100%
3	Position error: 0.05 V/1 reference unit
4	Position error: 0.05 V/100 reference units
5	Reference pulse frequency (converted to min^{-1}): 1 V/1000 min^{-1}
6	Motor speed × 4: 1 V/250 min^{-1}
7	Motor speed × 8: 1 V/125 min^{-1}
8 to F	Reserved (Do not change)

Analog Monitor 2 Speed Reference Monitor	
0 to F	Same as Analog Monitor 1 Torque Reference Monitor

Reserved (Do not change)

Reserved (Do not change)

Parameter No.	Name	Setting Range	Units	Factory Setting	Setting Validation
Pn004	Reserved (Do not change)	–	–	0000	–
Pn005	Reserved (Do not change)	–	–	0000	–
Pn100	Speed Loop Gain	1 to 2000	1 Hz	40	Immediately
Pn101	Speed Loop Integral Time Constant	15 to 51200	0.01 ms	2000	Immediately
Pn102	Position Loop Gain	1 to 2000	1/s	40	Immediately
Pn103	Moment of Inertia Ratio	0 to 20000	1%	0	Immediately
Pn104	2nd Speed Loop Gain	1 to 2000	1 Hz	40	Immediately
Pn105	2nd Speed Loop Integral Time Constant	15 to 51200	0.01 ms	2000	Immediately
Pn106	2nd Position Loop Gain	1 to 2000	1/s	40	Immediately
Pn107	Bias	0 to 450	1 min^{-1}	0	Immediately
Pn108	Bias Width Addition	0 to 250	1 reference unit	7	Immediately
Pn109	Feed-forward	0 to 100	1%	0	Immediately

Parameter No.	Name	Setting Range	Units	Factory Setting	Setting Validation
Pn10A	Feed-forward Filter Time Constant	0 to 6400	0.01 ms	0	Immediately
Pn10B	Gain-related Application Switches	0000 to 2314	–	0000	After restart/ Immediately

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit:

Mode Switch Selection		Setting Validation
0	Uses internal torque reference as the condition (Level setting: Pn10C)	Immediately
1	Uses speed reference as the condition (Level setting: Pn10D)	Immediately
2	Uses acceleration as the condition (Level setting: Pn10E)	Immediately
3	Uses position error pulse as the condition (Level setting: Pn10F)	Immediately
4	No mode switch function available	Immediately

2nd digit:

Speed Loop Control Method		Setting Validation
0	PI control	After restart
1	IP control	After restart
2 and 3	Reserved (Do not change)	After restart

3rd digit:

Automatic Gain Switching Condition Selection		Setting Validation
0	Automatic gain switching disabled (Factory setting)	After restart
1	Switches the gain according to the position reference condition only.	After restart
2	Switches the gain according to the position error condition only.	After restart
3	Switches the gain according to the position reference and position error condition only.	After restart

4th digit: Reserved (Do not change)

Parameter No.	Name	Setting Range	Units	Factory Setting	Setting Validation
Pn10C	Mode Switch Torque Reference	0 to 800	1%	200	Immediately
Pn10D	Mode Switch Speed Reference	0 to 10000	1 min^{-1}	0	Immediately
Pn10E	Mode Switch Acceleration	0 to 3000	1 min^{-1}/s	0	Immediately
Pn10F	Mode Switch Error Pulse	0 to 10000	1 reference unit	0	Immediately

Parameter No.	Name	Setting Range	Units	Factory Setting	Setting Validation
Pn110	Online Autotuning Switches *1*2	–	–	0012	–
Pn111	Speed Feedback Compensation *1*2	1 to 500	1%	100	Immediately
Pn112	Reserved (Do not change)	–	–	100	–
Pn113				1000	
Pn114				200	
Pn115				32	
Pn116				16	
Pn117				100	
Pn118				100	
Pn119				50	
Pn11A				1000	
Pn11B				50	
Pn11C				70	
Pn11D				100	
Pn11E				100	
Pn11F				0	
Pn120				0	
Pn121				50	
Pn122				0	
Pn123				0	
Pn124	Automatic Gain Switching Timer	1 to 10000	1 ms	100	Immediately
Pn125	Automatic Gain Switching Width	1 to 250	1 reference unit	7	Immediately

* 1. The parameters Pn110 and Pn111 settings are disabled.
* 2. Not used for the SERVOPACKs of 22 kW or more.

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation
Pn200	Position Control References Selection Switches	–	–	0000	After restart

4th digit 3rd digit 2nd digit 1st digit

n. □ □ □ □

1st digit:

Reference Pulse Form	
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
7	Phase A + Phase B (×1), negative logic
8	Phase A + Phase B (×2), negative logic
9	Phase A + Phase B (×4), negative logic

2nd digit:

Error Counter Clear Signal From	
0	Clears error counter when the signal is at H level.
1	Clears error counter at the rising edge of the signal.
2	Clears error counter when the signal is at L level.
3	Clears error counter at the falling edge of the signal.

3rd digit:

Clear Operation	
0	Clears error counter at the baseblock.
1	Does not clear error counter (Possible to clear error counter only with CLR signal).
2	Clears error counter when an alarm occurs.

4th digit:

Filter Selection	
0	Reference input filter for line driver signals
1	Reference input filter for open collector signals

Pn201	PG Dividing Ratio (For 16-bit or less)	16 to 16384	1 P/rev	16384	After restart
Pn202	Electronic Gear Ratio (Numerator)	1 to 65535	–	4	After restart
Pn203	Electronic Gear Ratio (Denominator)	1 to 65535	–	1	After restart
Pn204	Position Reference Accel/Decel Time Constant	0 to 6400	0.01 ms	0	Immediately
Pn205	Multiturn Limit Setting *	0 to 65535	1 rev	65535	After restart
Pn206	Reserved (Do not change)	–	–	16384	–

* This setting must be changed only for special applications. Do not change this limit inappropriately or unintentionally.

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation
Pn207	Position Control Function Switches	0000 to 1111	–	0000	After restart

n. □□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: **Position Reference Filter Selection**

0	Acceleration/deceleration filter
1	Average movement filter

2nd digit: **Position Control Option**

0	N/A
1	Uses V-REF as a speed feed-forward input.

3rd digit: **Dividing Output Range Selection**

0	Uses the parameter Pn201 (For 16-bit or less) as the dividing ratio (Factory setting).
1	Uses the parameter Pn212 (For 17-bit or more) as the dividing ratio.

4th digit: **Reserved (Do not change)**

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation
Pn208	Position Reference Movement Averaging Time	0 to 6400	0.01 ms	0	After restart
Pn212	PG Dividing Ratio (For 17-bit or more)	16 to 1073741824	1 P/rev	2048	After restart
Pn217	Reference Pulse Input Multiplication	1 to 99	×1	1	Immediately
Pn218	Reference Pulse Multiplication Range Switching Function	0000 to 0001	–	0000	After restart

n. □□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: **Reference Pulse Input Multiplication Range Switching Function**

0	Disabled (Factory setting)
1	Enabled

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
Pn300	Speed Reference Input Gain	150 to 3000	0.01V / rated speed	600	Immediately
Pn301	Internal Set Speed 1	0 to 10000	1 min^{-1}	100	Immediately
Pn302	Internal Set Speed 2	0 to 10000	1 min^{-1}	200	Immediately
Pn303	Internal Set Speed 3	0 to 10000	1 min^{-1}	300	Immediately

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation
Pn304	JOG Speed	0 to 10000	1 min^{-1}	500	Immediately
Pn305	Soft Start Acceleration Time	0 to 10000	1 ms	0	Immediately
Pn306	Soft Start Deceleration Time	0 to 10000	1 ms	0	Immediately
Pn307	Speed Reference Filter Time Constant	0 to 65535	0.01 ms	40	Immediately
Pn308	Speed Feedback Filter Time Constant	0 to 65535	0.01 ms	0	Immediately
Pn309	Reserved (Do not change)	–	–	60	–
Pn400	Torque Reference Input Gain	10 to 100	0.1 V/rated torque	30	Immediately
Pn401	Torque Reference Filter Time Constant	0 to 65535	0.01 ms	100	Immediately
Pn402	Forward Torque Limit	0 to 800	1%	800	Immediately
Pn403	Reverse Torque Limit	0 to 800	1%	800	Immediately
Pn404	Forward External Torque Limit	0 to 800	1%	100	Immediately
Pn405	Reverse External Torque Limit	0 to 800	1%	100	Immediately
Pn406	Emergency Stop Torque	0 to 800	1%	800	Immediately
Pn407	Speed Limit during Torque Control	0 to 10000	1 min^{-1}	10000	Immediately
Pn408	Torque Function Switches	0000 to 0101	–	0000	Immediately

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: **Notch Filter Selection**

0	First notch filter disabled.
1	Uses first notch filter.

2nd digit: **Reserved (Do not change)**

3rd digit: **Notch Filter Function 2**

0	Second notch filter disabled.
1	Uses second notch filter.

4th digit: **Reserved (Do not change)**

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation
Pn409	First Stage Notch Filter Frequency	50 to 2000	1 Hz	2000	Immediately
Pn40A	First Stage Notch Filter Q Value	50 to 400	×0.01	70	Immediately
Pn40B	Second Stage Notch Filter Frequency	50 to 2000	1 Hz	2000	Immediately
Pn40C	Second Stage Notch Filter Q Value	50 to 400	×0.01	70	Immediately
Pn500	Positioning Completed Width	0 to 250	1 reference unit	7	Immediately
Pn501	Zero Clamp Level	0 to 10000	1 min^{-1}	10	Immediately
Pn502	Rotation Detection Level	1 to 10000	1 min^{-1}	20	Immediately
Pn503	Speed Coincidence Signal Output Width	0 to 100	1 min^{-1}	10	Immediately
Pn504	NEAR Signal Width	1 to 250	1 reference unit	7	Immediately
Pn505	Overflow Level	1 to 32767	256 reference units	1024	Immediately
Pn506	Brake Reference - Servo OFF Delay Time	0 to 50	10 ms	0	Immediately
Pn507	Brake Reference Output Speed Level	0 to 10000	1 min^{-1}	100	Immediately
Pn508	Timing for Brake Reference Output during Motor Operation	0 to 100	10 ms	50	Immediately
Pn509	Momentary Hold time	20 to 1000	1 ms	20	Immediately

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation
Pn50A	Input Signal Selections 1	–	–	2100	After restart

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit:

Input Signal Allocation Mode	
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)	
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))	
0 to F	Same as /S-ON

4th digit:

P-OT Signal Mapping (Overtravel when OFF (H-level))	
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).

* When Pn50A.0 is set to 0 for the input signal standard allocation mode, the following modes are compatible: Pn50A.1 = 7, Pn50A.3 = 8, and Pn50B.0 = 8.

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation
Pn50B	Input Signal Selections 2	–	–	6543	After restart

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit:

N-OT Signal Mapping (Overtravel when OFF (H-level))	
0	Reverse run allowed when CN1-40 input signal is ON (L-level).
1	Reverse run allowed when CN1-41 input signal is ON (L-level).
2	Reverse run allowed when CN1-42 input signal is ON (L-level).
3	Reverse run allowed when CN1-43 input signal is ON (L-level).
4	Reverse run allowed when CN1-44 input signal is ON (L-level).
5	Reverse run allowed when CN1-45 input signal is ON (L-level).
6	Reverse run allowed when CN1-46 input signal is ON (L-level).
7	Reverse run prohibited.
8	Reverse run allowed.
9	Reverse run allowed when CN1-40 input signal is OFF (H-level).
A	Reverse run allowed when CN1-41 input signal is OFF (H-level).
B	Reverse run allowed when CN1-42 input signal is OFF (H-level).
C	Reverse run allowed when CN1-43 input signal is OFF (H-level).
D	Reverse run allowed when CN1-44 input signal is OFF (H-level).
E	Reverse run allowed when CN1-45 input signal is OFF (H-level).
F	Reverse run allowed when CN1-46 input signal is OFF (H-level).

2nd digit:

/ALM-RST Signal Mapping (Alarm Reset when ON (L-level))	
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	ON when CN1-40 input signal is OFF (H-level).
A	ON when CN1-41 input signal is OFF (H-level).
B	ON when CN1-42 input signal is OFF (H-level).
C	ON when CN1-43 input signal is OFF (H-level).
D	ON when CN1-44 input signal is OFF (H-level).
E	ON when CN1-45 input signal is OFF (H-level).
F	ON when CN1-46 input signal is OFF (H-level).

3rd digit:

/P-CL Signal Mapping (Forward Torque Limit when ON (L-level))	
0 to F	Same as above

4th digit:

/N-CL Signal Mapping (Reverse Torque Limit when ON (L-level))	
0 to F	Same as above

INFO

■ Input signal polarities

Signal	Effective 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
Pn50C	Input Signal Selections 3	–	–	8888	After restart

n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: /SPD-D Signal Mapping

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	ON when CN1-40 input signal is OFF (H-level).
A	ON when CN1-41 input signal is OFF (H-level).
B	ON when CN1-42 input signal is OFF (H-level).
C	ON when CN1-43 input signal is OFF (H-level).
D	ON when CN1-44 input signal is OFF (H-level).
E	ON when CN1-45 input signal is OFF (H-level).
F	ON when CN1-46 input signal is OFF (H-level).

2nd digit: /SPD-A Signal Mapping

0 to F	Same as /SPD-D

3rd digit: /SPD-B Signal Mapping

0 to F	Same as /SPD-D

4th digit: /C-SEL Signal Mapping (Control mode change when ON (L-level))

0 to F	Same as /SPD-D

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation
Pn50D	Input Signal Selections 4	–	–	8888	After restart
Pn50E	Output Signal Selections 1	–	–	3211	After restart

Pn50D

n. □□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: /ZCLAMP Signal Mapping (Zero clamp when ON (L-level))

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	ON when CN1-40 input signal is OFF (H-level).
A	ON when CN1-41 input signal is OFF (H-level).
B	ON when CN1-42 input signal is OFF (H-level).
C	ON when CN1-43 input signal is OFF (H-level).
D	ON when CN1-44 input signal is OFF (H-level).
E	ON when CN1-45 input signal is OFF (H-level).
F	ON when CN1-46 input signal is OFF (H-level).

2nd digit: /INHIBIT Signal Mapping (Reference pulse inhibit when ON (L-level))

0 to F	Same as /ZCLAMP

3rd digit: /G-SEL Signal Mapping (Gain change when ON (L-level))

0 to F	Same as /ZCLAMP

4th digit: Reserved (Do not change)

Pn50E

n. □□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Positioning Completion Signal Mapping (/COIN)

0	Disabled (the above signal is not used.)
1	Outputs the signal from CN1-25, 26 output terminal.
2	Outputs the signal from CN1-27, 28 output terminal.
3	Outputs the signal from CN1-29, 30 output terminal.

2nd digit: Speed Coincidence Detection Signal Mapping (/V-CMP)

0 to 3	Same as /COIN

3rd digit: Rotation Detection Signal Mapping (/TGON)

0 to 3	Same as /COIN

4th digit: Servo Ready Signal Mapping (/S-RDY)

0 to 3	Same as /COIN

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation
Pn50F	Output Signal Selections 2	–	–	0000	After restart

n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Torque Limit Detection Signal Mapping (/CLT)

0	Disabled (the above signal is not used.)
1	Outputs the signal from CN1-25, -26 output terminal.
2	Outputs the signal from CN1-27, -28 output terminal.
3	Outputs the signal from CN1-29, -30 output terminal.

2nd digit: Speed Limit Detection Signal Mapping (/VLT)

0 to 3	Same as /CLT

3rd digit: Brake Interlock Signal Mapping (/BK)

0 to 3	Same as /CLT

4th digit: Warning Signal Mapping (/WARN)

0 to 3	Same as /CLT

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation
Pn510	Output Signal Selections 3	–	–	0000	After restart

n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Near Signal Mapping (/NEAR)

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: Reference Pulse Input Multiplication Change Output Signal Mapping (/PSELA)

0 to 3	Same as /NEAR

4th digit: Reserved (Do not change)

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation
Pn511	Reserved (Do not change)	–	–	8888	Immediately
Pn512	Output Signal Reversal Settings	–	–	0000	After restart

n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Output Signal Reversal for CN1-25 or -26 Terminals

0	Output signal is not reversed.
1	Output signal is reversed.

2nd digit: Output Signal Reversal for CN1-27 or -28 Terminals

0	Output signal is not reversed.
1	Output signal is reversed.

3rd digit: Output Signal Reversal for CN1-29 or -30 Terminals

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
Pn513	Input Signal Selections 5	–	–	0088	After restart
	n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit) 1st digit: Reference Pulse Input Mulitiplication Change 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. (Factory setting) 9: ON when CN1-40 input signal is OFF (H-level). A: ON when CN1-41 input signal is OFF (H-level). B: ON when CN1-42 input signal is OFF (H-level). C: ON when CN1-43 input signal is OFF (H-level). D: ON when CN1-44 input signal is OFF (H-level). E: ON when CN1-45 input signal is OFF (H-level). F: ON when 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)				
Pn51A	Position Error Level Between Motor and Load	0 to 32767	1 reference unit	0	Immediately
Pn51B	Reserved (Do not change)	–	–	100	–
Pn51C	Reserved (Do not change)	–	–	450	–
Pn51E	Excessive Position Error Warning Level	0 to 100	1 %	0	Immediately
Pn600	Regenerative Resistor Capacity *1	Depends on SERVOPACK Capacity *2	10 W	0	After restart
Pn601	Reserved (Do not change)	–	–	0	–

* 1. Normally set to “0.” When using an external regenerative resistor, set the allowable power loss (W) of the regenerative resistor.
* 2. The upper limit is the maximum output capacity (W) of the SERVOPACK.

11.4 Parameter Recording Table

Use the following table for recording parameters.

Note: Setting validation (“immediately” or “after restart”) for Pn10B differs depending on the digit. The digits validated after restart are underlined in “Factory Setting” column.

Parameter No.	Factory Setting						Name	Setting Validation
Pn000	0000						Function Selection Basic Switches	After restart
Pn001	0000						Function Selection Application Switches 1	After restart
Pn002	0000						Function Selection Application Switches 2	After restart
Pn003	0002						Function Selection Application Switches 3	After restart
Pn004	0000						Reserved (Do not change)	Immediately
Pn005	0000						Reserved (Do not change)	Immediately
Pn100	40 Hz						Speed Loop Gain	Immediately
Pn101	20.00 ms						Speed Loop Integral Time Constant	Immediately
Pn102	40 /s						Position Loop Gain	Immediately
Pn103	0%						Moment of Inertia Ratio	Immediately
Pn104	40 Hz						2nd Speed Loop Gain	Immediately
Pn105	20.00 ms						2nd Loop Integral Time Constant	Immediately
Pn106	40 /s						2nd Position Loop Gain	Immediately
Pn107	0 min^{-1}						Bias	Immediately
Pn108	7 reference units						Bias Width Addition	Immediately
Pn109	0%						Feed-forward	Immediately
Pn10A	0.00 ms						Feed-forward Filter Time Constant	Immediately
Pn10B	0000						Gain-related Application Switches	After restart /Immediately
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 units						Mode Switch Error Pulse	Immediately
Pn110	0012						Online Autotuning Switches	After restart
Pn111	100						Speed Feedback Compensation	Immediately
Pn112	100%						Reserved (Do not change)	Immediately
Pn113	1000						Reserved (Do not change)	Immediately
Pn114	200						Reserved (Do not change)	Immediately
Pn115	32						Reserved (Do not change)	Immediately
Pn116	16						Reserved (Do not change)	Immediately
Pn117	100%						Reserved (Do not change)	Immediately
Pn118	100%						Reserved (Do not change)	Immediately
Pn119	50 /s						Reserved (Do not change)	Immediately
Pn11A	1000%						Reserved (Do not change)	Immediately
Pn11B	50 Hz						Reserved (Do not change)	Immediately
Pn11C	70 Hz						Reserved (Do not change)	Immediately
Pn11D	100%						Reserved (Do not change)	Immediately
Pn11E	100%						Reserved (Do not change)	Immediately
Pn11F	0 ms						Reserved (Do not change)	Immediately
Pn120	0 ms						Reserved (Do not change)	Immediately
Pn121	50 Hz						Reserved (Do not change)	Immediately

Parameter No.	Factory Setting						Name	Setting Validation
Pn122	0 Hz						Reserved (Do not change)	Immediately
Pn123	0%						Reserved (Do not change)	Immediately
Pn124	100 ms						Automatic Gain Switching Timer	Immediately
Pn125	7 reference units						Automatic Gain Switching Width	Immediately
Pn200	0000						Position Control References Selection Switches	After restart
Pn201	16384 P/rev						PG Dividing Ratio (For 16-bit or less)	After restart
Pn202	4						Electronic Gear Ratio (Numerator)	After restart
Pn203	1						Electronic Gear Ratio (Denominator)	After restart
Pn204	0.00 ms						Position Reference Accel/Decel Time Constant	Immediately
Pn205	65535 rev						Multiturn Limit Setting	After restart
Pn206	16384 P/rev						Reserved (Do not change)	–
Pn207	0000						Position Control Function Switches	After restart
Pn208	0.00 ms						Position Reference Movement Averaging Time	After restart
Pn212	2048 P/rev						PG Dividing Ratio (For 17-bit or more)	After restart
Pn217	×1						Reference Pulse Input Multiplication	Immediately
Pn218	0000						Reference Pulse Multiplication Range Switching Function	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
Pn309	60 min^{-1}						Reserved (Do not change)	Immediately
Pn400	3.0 V/ rated speed						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 Function Switches	Immediately
Pn409	2000 Hz						First Stage Notch Filter Frequency	Immediately
Pn40A	0.70						First Stage Notch Filter Q Value	Immediately
Pn40B	2000 Hz						Second Stage Notch Filter Frequency	Immediately
Pn40C	0.70						Second Stage Notch Filter Q Value	Immediately
Pn500	7 reference units						Positioning Completed Width	Immediately
Pn501	10 min^{-1}						Zero Clamp Level	Immediately

Parameter No.	Factory Setting						Name	Setting Validation
Pn502	20 min^{-1}						Rotation Detection Level	Immediately
Pn503	10 min^{-1}						Speed Coincidence Signal Output Width	Immediately
Pn504	7 reference units						NEAR Signal Width	Immediately
Pn505	1024 reference units						Overflow Level	Immediately
Pn506	0 ms						Brake Reference-Servo OFF Delay Time	Immediately
Pn507	100 min^{-1}						Brake Reference Output Speed Level	Immediately
Pn508	500 ms						Timing for Brake Reference Output during Motor Operation	Immediately
Pn509	20 ms						Momentary Hold Time	Immediately
Pn50A	2100						Input Signal Selections 1	After restart
Pn50B	6543						Input Signal Selections 2	After restart
Pn50C	8888						Input Signal Selections 3	After restart
Pn50D	8888						Input Signal Selections 4	After restart
Pn50E	3211						Output Signal Selections 1	After restart
Pn50F	0000						Output Signal Selections 2	After restart
Pn510	0000						Output Signal Selections 3	After restart
Pn511	8888						Reserved (Do not change)	Immediately
Pn512	0000						Output Signal Reversal Settings	After restart
Pn513	0088						Input Signal Selections	After restart
Pn51A	0 reference units						Position Error Level Between Motor and Load	Immediately
Pn51B	100 reference units						Reserved (Do not change)	Immediately
Pn51C	450 min^{-1}						Reserved (Do not change)	Immediately
Pn51D	0%						Excessive Position Error Warning Level	Immediately
Pn600	0 W						Regenerative Resistor Capacity	After restart
Pn601	0 W						Reserved (Do not change)	After restart

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Revision History

The revision dates and numbers of the revised manuals are given on the bottom of the back cover.

MANUAL NO. SIEP S800000 59A

Published in Japan August 2008 08-8

Date of publication

Date of original publication

Date of Publication	Rev. No.	Section	Revised Content
August 2008	–		First edition

AC Servo Drives
Σ-II Series
SGMVH/SGDM/SGDH
USER'S MANUAL

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Specifications are subject to change without notice for ongoing product modifications and improvements.

MANUAL NO. SIEP S800000 59A

Published in Japan August 2008 08-8
08-5-3