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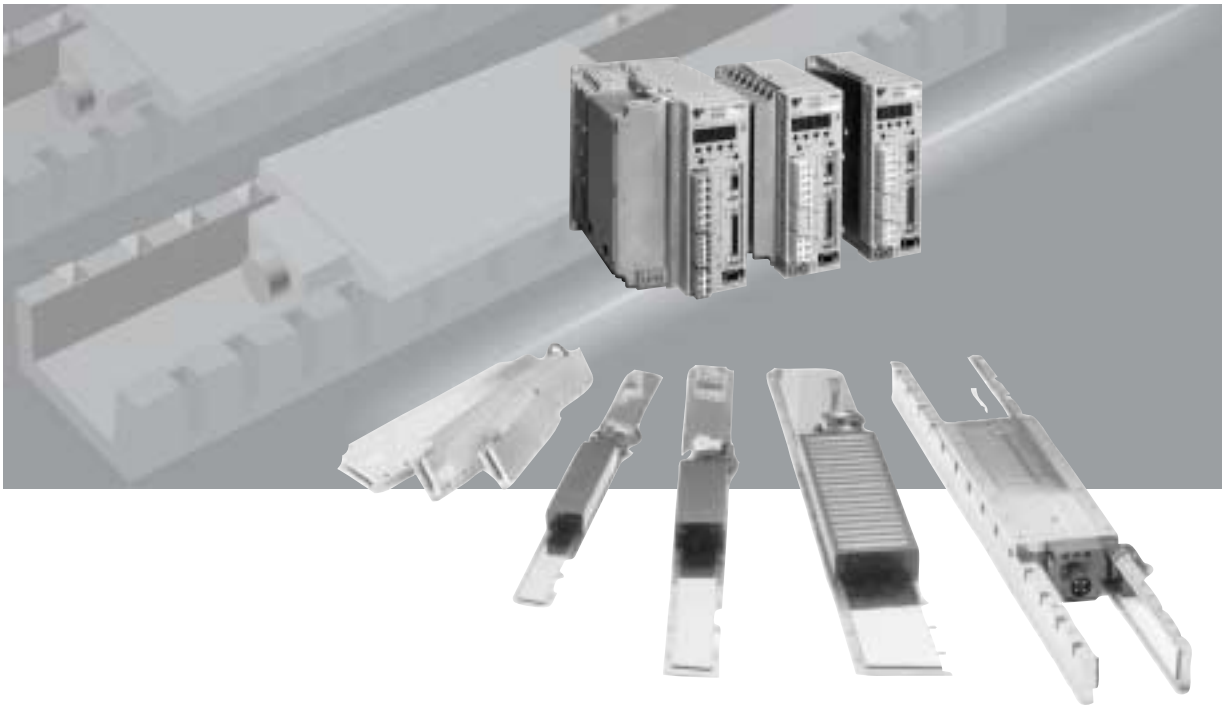
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Linear Σ Series SGL□□/SGDH
USER'S MANUAL

SGLGW/SGLFW/SGLTW Linear Servomotors
SGDH SERVOPACK



YASKAWA

MANUAL NO. SIEP S800000 19C

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About this Manual

■ Intended Audience

This manual is intended for the following users.

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

■ Description of Technical Terms

The terms in this manual are defined as follows:

- Servomotor or motor = Linear Σ Series SGLGW, SGLFW and SGLTW linear servomotor
- SERVOPACK = Σ-II Series SGDH amplifier.
- Servodrive = A set including a servomotor and servo amplifier.
- Servo System = A servo control system that includes the combination of a servodrive with a host computer and peripheral devices.
- Parameter number = Numbers that the user inputs toward the SERVOPACK.

■ 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

■ Quick access to your required information

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

Chapter	SERVOPACKs, Linear Servomotors, and Peripheral Devices	Ratings and Characteristics	System Design	Panel Configuration and Wiring	Trial Operation and Servo Adjustment	Inspection and Maintenance
Chapter 1 Outline	✓					
Chapter 2 Selections	✓					
Chapter 3 Linear Servomotor Specifications and Dimensional Drawings	✓	✓	✓	✓		
Chapter 4 SERVOPACK Specifications and Dimensional Drawings	✓	✓	✓	✓		
Chapter 5 Serial Converter Unit Specifications and Drawings	✓	✓	✓	✓		
Chapter 6 Specifications and Drawings of Cables and Peripheral Devices	✓	✓	✓	✓		
Chapter 7 Installation and Wiring			✓	✓	✓	
Chapter 8 Panel Operator			✓		✓	
Chapter 9 Operation					✓	
Chapter 10 Adjustment						✓
Chapter 11 Inspection, Maintenance, and Troubleshooting						✓
Chapter 12 Appendix	✓		✓		✓	✓

■ Visual Aids

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

IMPORTANT

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



- Indicates supplemental information.

◀ EXAMPLE ▶

- Indicates application examples.



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

Related Manuals

Refer to the following manuals as required.

Manual Name	Manual Number	Contents
Σ-II Series AC SERVOPACK SGDH/SGDM SAFETY PRECAUTIONS	TOBPS80000004	Describes the safety precautions on using a SERVOPACK in the Σ-II Series.
Σ-II Series SGM□H/SGDM Digital Operator Operation Manual	TOE-S800-34	Provides detailed information on the operating method of the JUSP-OP02A-2 digital operator (option).
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 MECHATROLINK Interface Unit User's Manual Model: JUSP-NS100	SIE-C718-4	Provides detailed information on MECHATROLINK communications.
Σ-II Series SGDH MECHATROLINK-II Application Module User's Manual Model: JUSP-NS115	SIEPC71080001	Provides detailed information on MECHATROLINK-II communications.
Σ-II Series SGDH DeviceNet Interface Unit User's Manual Model: JUSP-NS300	SIE-C718-6	Describes the DeviceNet communications.
Σ-II Series SGDH PROFIBUS-DP IF UNIT User's Manual Model: JUSP-NS500	SIE-C718-8	Describes the PROFIBUS-DP communications.
Σ-II Series Indexer Application Module User's Manual Model: JUSP-NS600	SIE-C718-9	Provides detailed information on positioning by communications and the contact points.

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:  .

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

ISO	JIS
	

The ISO symbol is used in this manual.

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

Notes for Safe Operation

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

⚠ WARNING

- If you have a pacemaker or any other electronic medical device, do not go near the magnetic way of the linear servomotor.
  Failure to observe this warning may result in the malfunction of the medical device.
- Be sure to use nonmagnetic tools when installing or working close to the linear servomotor. (Example: a beryllium-copper alloy hexagonal wrench set, made by NGK Insulators, Ltd.)
- If starting an operation with the linear servomotor in a machine, set the linear servomotor to always allow emergency stops.
  Failure to observe this warning may result in injury.
- Never touch the linear servomotor or machinery during operation.
  Failure to observe this warning may result in injury.
- Before wiring, install the SERVOPACK and the linear servomotor.
  Failure to observe this warning may result in electric shock.
- Do not operate switches with wet hands.
  Failure to observe this warning may result in electric shock.
- 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.
- Make sure that the main circuit power cable, the control power cable, and the linear servomotor main circuit cable are wired correctly.
  Failure to observe this warning may result in damage to the SERVOPACK.
- 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 SGDH SERVOPACK supports both AC and DC power. If DC power is supplied to the SERVOPACK without setting Pn001=n.□1□□ (DC power input), the internal components of the SERVOPACK will burn and may result in fire or serious damage.
  Before using a DC power supply, be sure to check the parameter Pn001 setting.
- Do not remove the front cover, cables, connectors, or optional items while the power is ON.
  Failure to observe this warning may result in electric shock.
- Do not damage, press, exert excessive force or place heavy objects on the cables.
  Failure to observe this warning may result in electric shock, stopping operation of the product, or burning.

⚠ WARNING

- Provide an appropriate stopping device on the machine side to ensure 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.



- Connect the ground terminal to electrical codes (ground resistance: 100 Ω or less).
  Improper grounding may result in electric shock or fire.



- Installation, disassembly, or repair must be performed only by authorized personnel.
  Failure to observe this warning may result in electric shock or injury.



- Do not modify the product.
  Failure to observe this warning may result in injury or damage to the product.

■ Checking on Delivery

⚠ CAUTION

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

■ Storage and Transportation

⚠ CAUTION

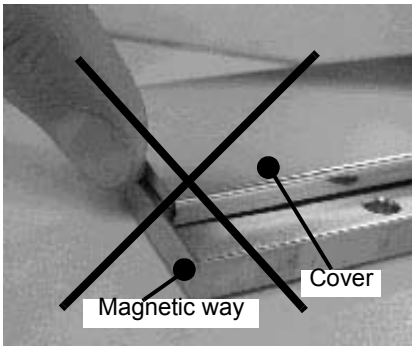
- Be sure to store the magnetic way of the linear servomotor in the same way as it was originally packaged.
- Do not store or install the product in the following places.
  - Locations subject to direct sunlight.
  - Locations subject to temperatures outside the range specified in the storage or installation 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 carry the linear servomotor by its cables.
  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.

■ Installation

⚠ CAUTION

- When unpacking and installing magnetic way, check that no metal fragments or magnetized objects near the stator because they may be affected by the magnetic attraction of the magnetic way.
  Failure to observe this caution may result in injury or damage to the magnetic way's magnets.
- Do not use the magnetic way near metal or other magnetized objects.
  Failure to observe this caution may result in injury.
- Do not place clocks, magnetic cards, floppy disks, or measuring instruments close to the magnetic way.
  Failure to observe this caution may result in malfunction or damage to these items by the magnetic force.
- Securely mount the linear servomotor on to the machine.
  If the linear servomotor is not mounted securely, it may loosen during operation.
- Do not carry the magnetic way by its antimagnetic cover.
  Failure to observe this caution may result in injury by the cover's edge or the shape of the cover may become distorted.



- Install SERVOPACKs, linear servomotors, and regenerative resistors on nonflammable objects.
  Mounting directly onto or near flammable objects may result in fire.
- 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.
- Provide the specified clearances between the SERVOPACK and the control panel or with other devices.
  Failure to observe this caution may result in fire or malfunction.
- Do not apply any strong impact.
  Failure to observe this caution may result in malfunction.

■ Wiring

⚠ CAUTION

- Securely tighten the cable connector screws and securing mechanism.
  If the connector screws and securing mechanism are not secure, they may loosen during operation.
- Use power lines and cables with a radius, heat resistance, and flexibility suitable for the system.
- If the SERVOPACK malfunctions, turn OFF the main circuit's power supply of the SERVOPACK.
  The continuous flow of a large current may cause fire.
- Use a noise filter to minimize the effects of electromagnetic damage.
  Failure to observe this caution may result in electromagnetic damage to electronic devices used near the SERVOPACK.
- 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 (11.81 in).
  Failure to observe this caution may result in malfunction.
- Use shielded twisted-pair wire or shielded multi-core twisted-pair wire for the signal lines and feedback lines of the serial converter unit (SC).
  The maximum wiring length is 3 m for the reference input line and 20 m for the SC feedback line.
- 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. Do not turn power ON or OFF more than once per minute.
  Since the SERVOPACK has a capacitor in the power supply, a high charging current flows for 0.2 seconds when power is turned ON. Frequently turning power ON and OFF causes main power devices such as capacitors and fuses to deteriorate, resulting in unexpected problems.
- Observe the following precautions when wiring main circuit terminal blocks.
  - Remove the terminal block from the SERVOPACK prior to wiring.
  - Insert only one wire per terminal on the terminal block.
  - Make sure that the core wire is not electrically shorted to adjacent core wires.
- Do not connect the SERVOPACK for 100 V and 200 V directly to a voltage of 400 V.
  The SERVOPACK will be destroyed.
- 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.
- Make sure that the polarity is correct.
  Incorrect polarity may cause ruptures or damage.
- 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.

⚠ CAUTION

- 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.

■ Operation

⚠ CAUTION

- Do not stand within the machine's range of motion during operation.
  Failure to observe this caution may result in injury.
- Before operation, install a limit switch or stopper on the end of the slider to prevent unexpected movement.
  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.
- If using the linear servomotor on a vertical axis, install a safety device such as a counterbalance so that the workpiece does not fall if an alarm or overtravel occurs. Set the linear servomotor so that it will stop in the zero clamp state at occurrence of overtravel.
  The workpiece may fall during overtraveling.
- When not using the online autotuning, set to the correct mass ratio.
  Setting to an incorrect moment of inertia ratio may cause vibration.
- Do not touch the SERVOPACK heatsinks, regenerative resistor, or servomotor while power is ON or soon after the power is turned OFF.
  Failure to observe this caution may result in burns due to high temperatures.
- Do not make any extreme adjustments or setting changes of parameters.
  Failure to observe this caution may result in injury due to unstable operation.
- When an alarm occurs, remove the cause, reset the alarm after confirming safety, and then resume operation.
  Failure to observe this caution may result in injury.

■ 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 linear 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.
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1.1 Checking Products

1.1.1 Check Items

Check the following items when the products are delivered.

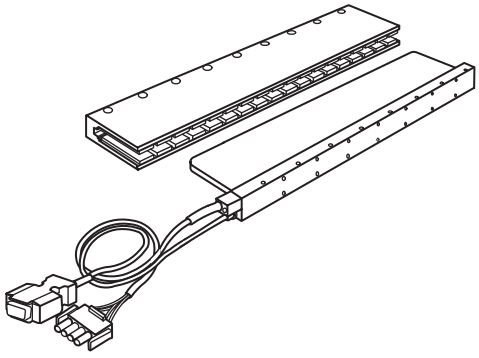
Check Items	Comments
Are the delivered products the ones that were ordered?	Check the model numbers marked on the nameplates on the linear servomotor and SERVOPACK. (Refer to the descriptions of model numbers in the following section.)
Is there any damage?	Check the overall appearance, and check for 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.

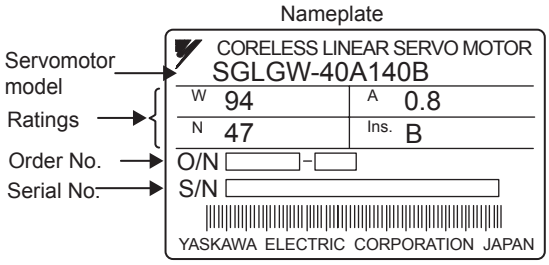
1.1.2 Linear Servomotors

The location of the nameplate varies depending on the model of the linear servomotor. The nameplate is affixed on both the coil assembly and the magnetic way.

(1) Coreless SGLGW and SGLGM Linear Servomotors

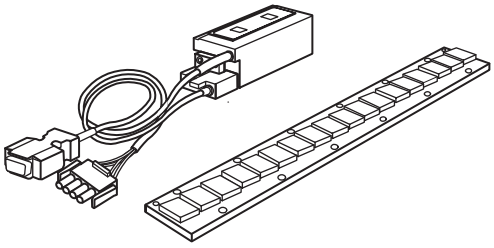


• Coil assembly and Magnetic way



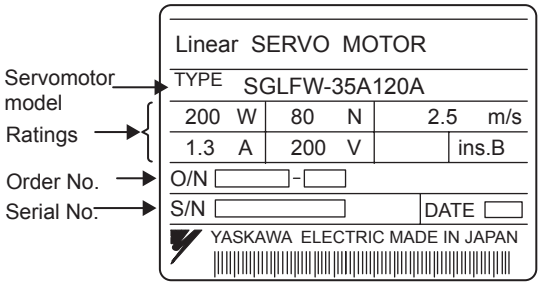
(2) SGLFW and SGLFM Linear Servomotors with F-type Iron Core and SGLTW and SGLTM Linear Servomotors with T-type Iron Core

• SGLFW and SGLFM

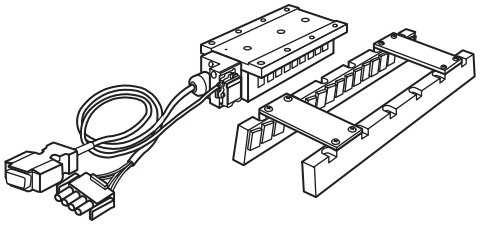


• Coil assembly

Nameplate

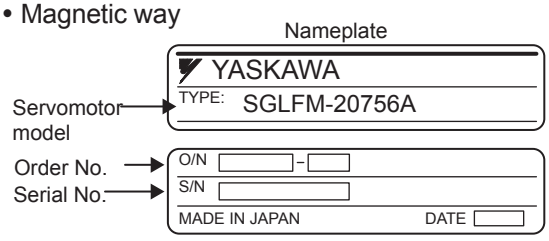


• SGLTW and SGLTM



• Magnetic way

Nameplate

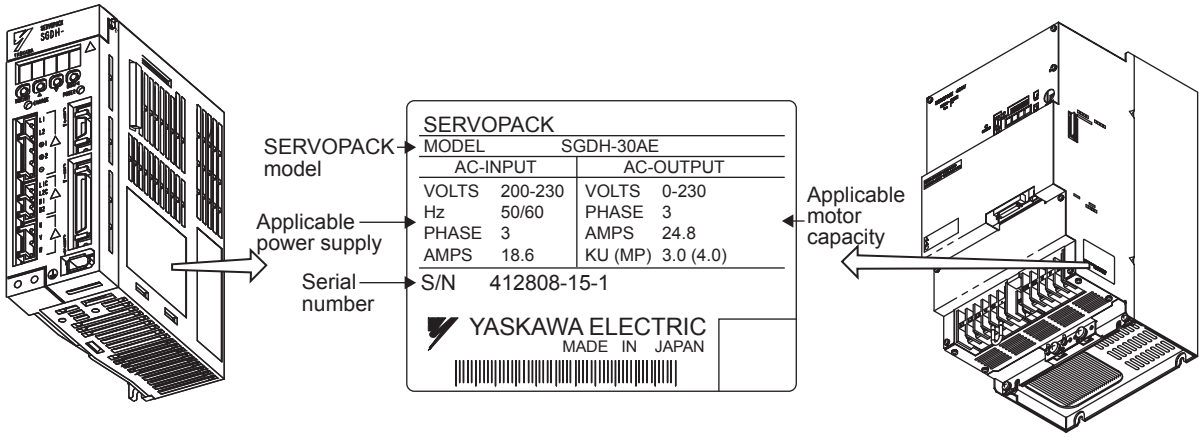


Note: The location of the nameplate varies depending on the model and capacity of the linear servomotor.

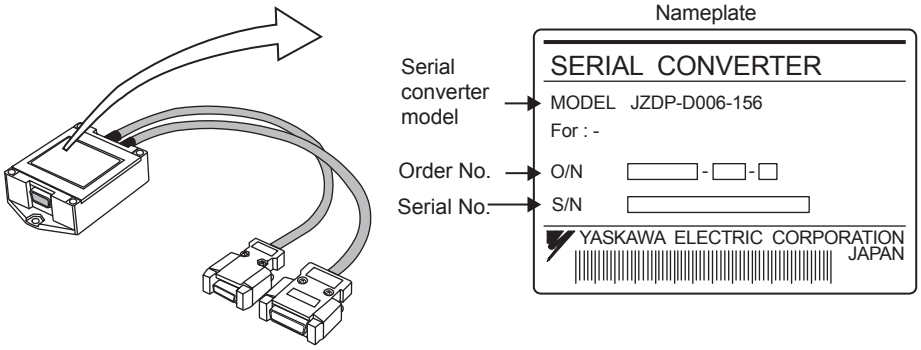
1.1.3 SERVOPACKs

• SGDH for 50 W to 5.0 kW

• SGDH for 7.5 kW



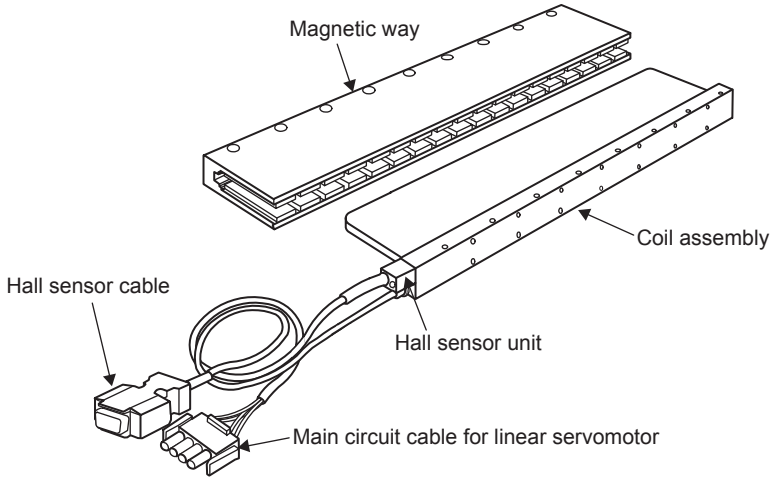
1.1.4 Serial Converter Units



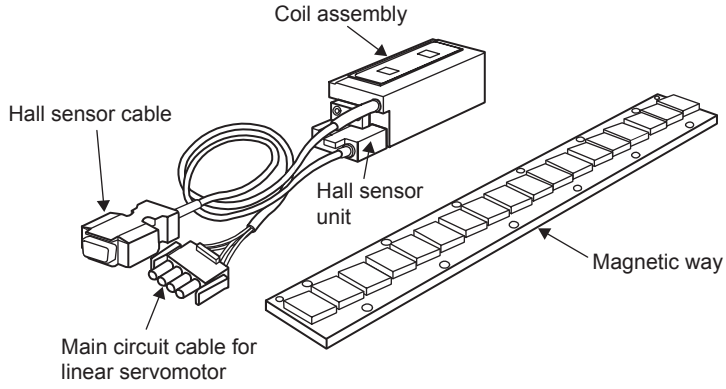
1.2 Product Part Names

1.2.1 Linear Servomotors

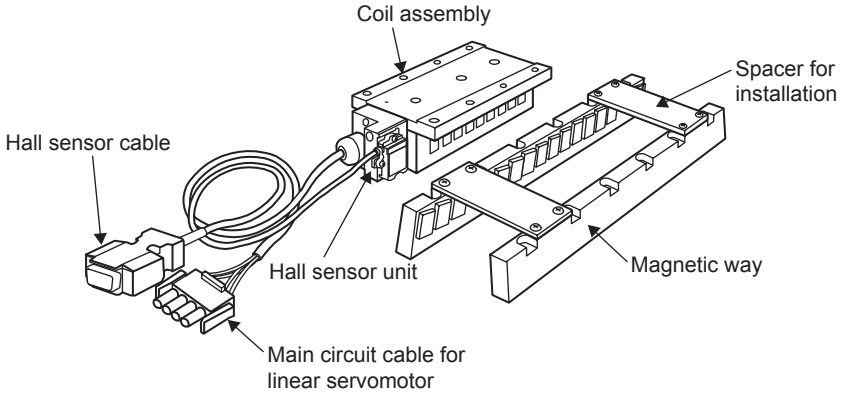
(1) Coreless SGLGW and SGLGM



(2) SGLFW and SGLFM With F-type Iron Core

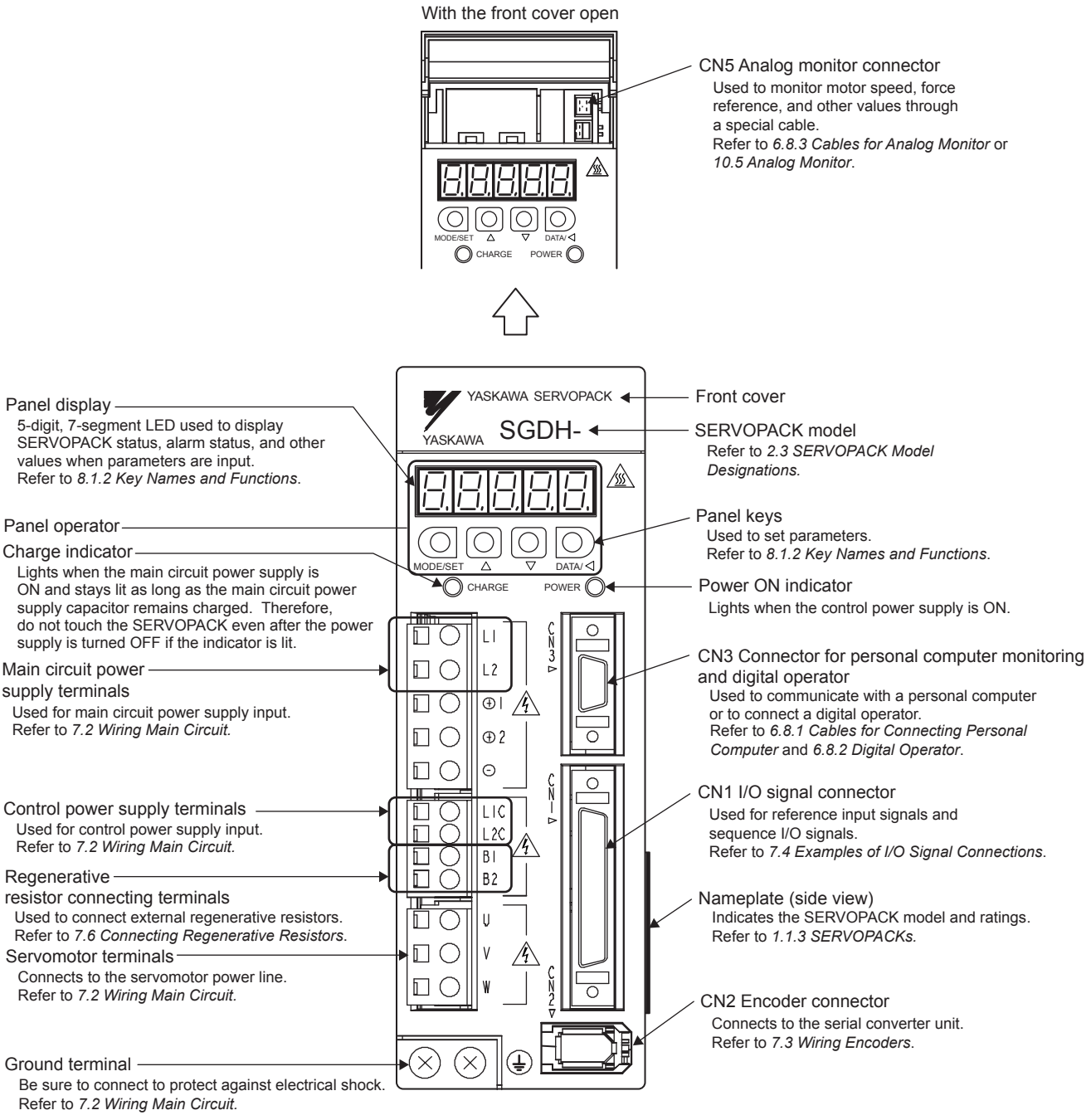


(3) SGLTW and SGLTM With T-type Iron Core



1.2.2 SERVOPACKs

(1) SGDH for 50 W to 5.0 kW

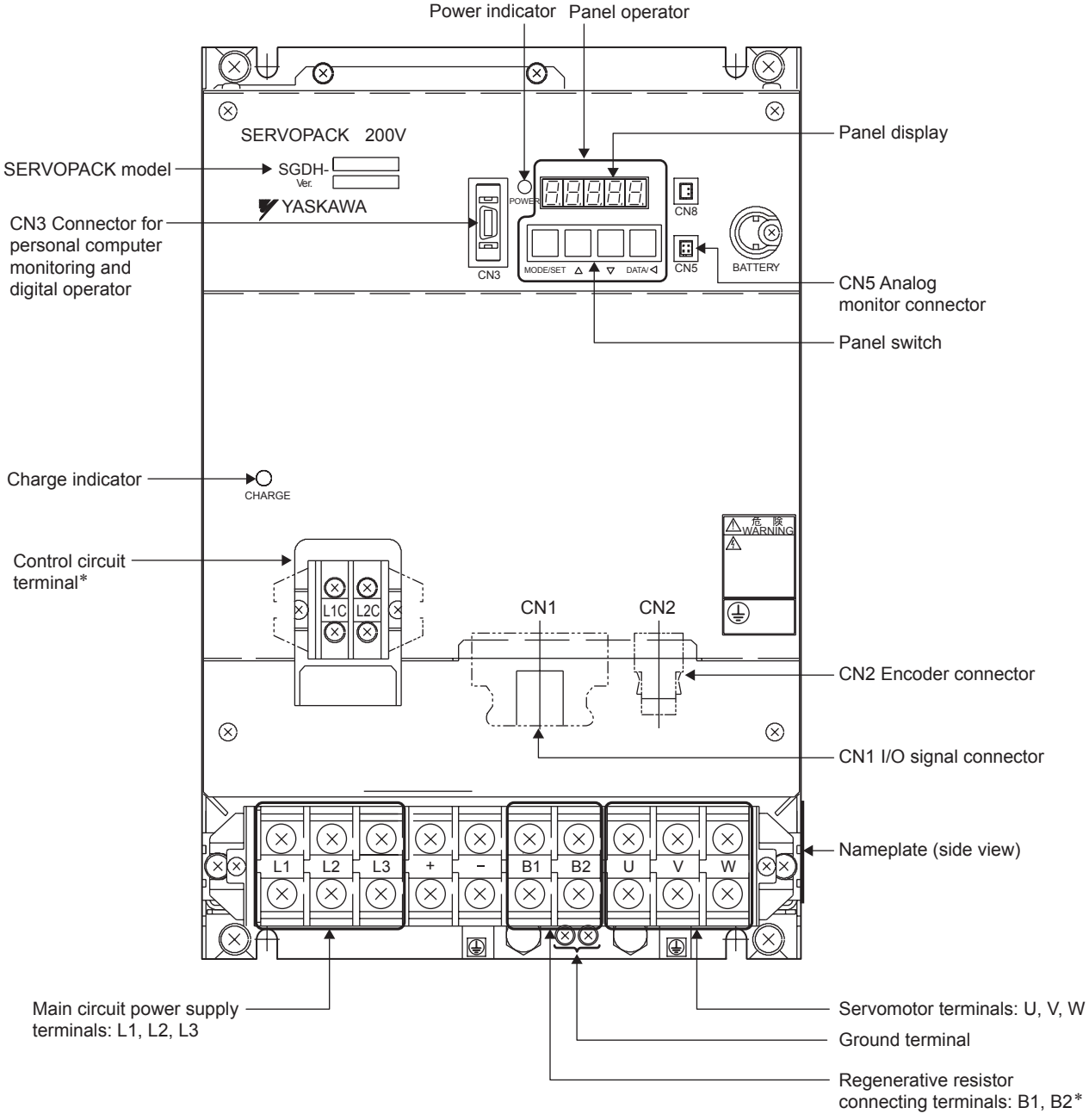


INFO

■ Connecting terminal of DC Reactor

For connecting a reactor, refer to *7.5.5 DC Reactor for Harmonic Suppression*.

(2) SGDH for 7.5 kW



* Control circuit terminal and regenerative resistor connecting terminals differ the position of the terminal block by the SERVOPACK model.
Refer to *Chapter 4 SERVOPACK Specifications and Dimensional Drawings* for details.

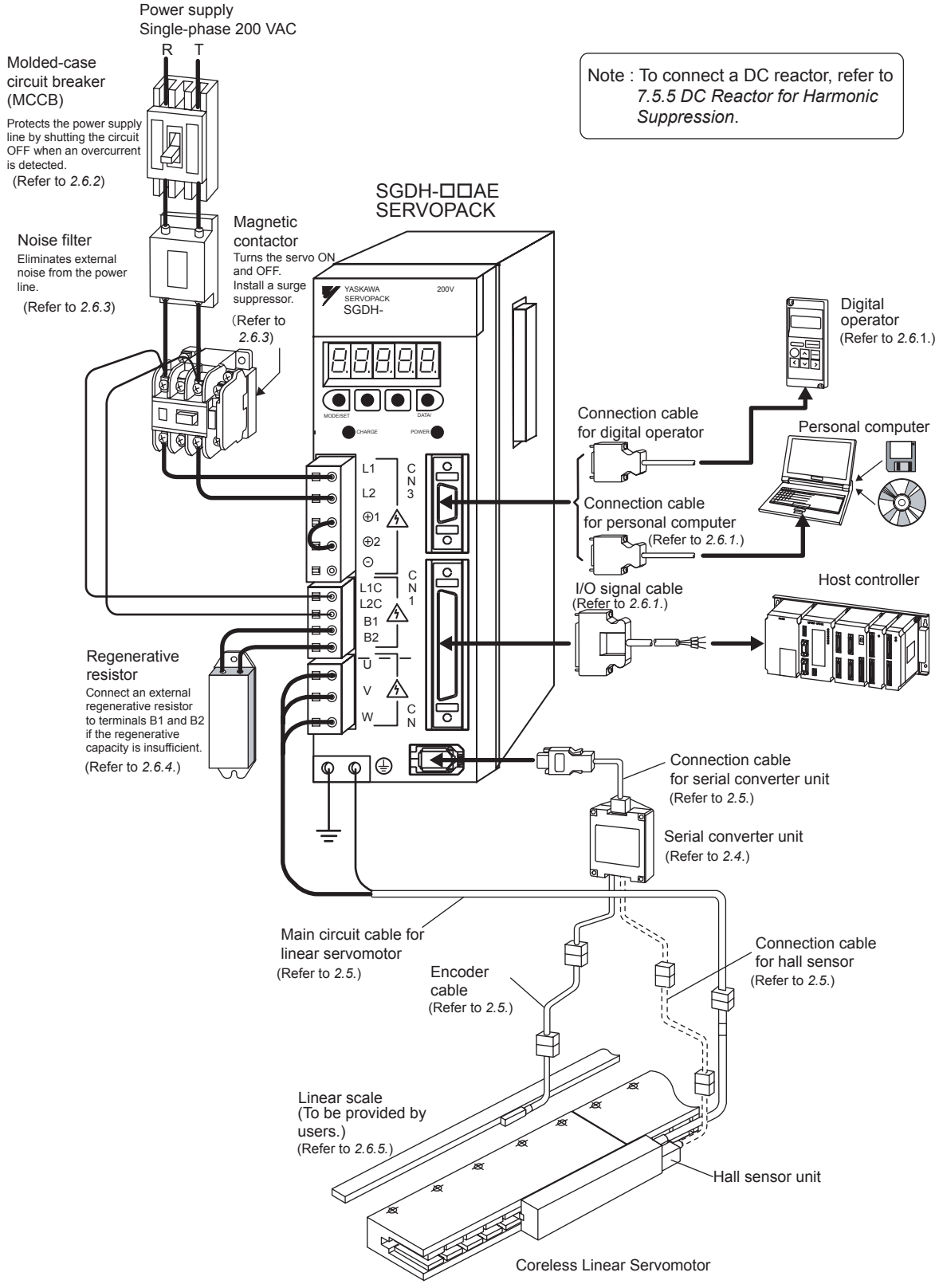
SERVOPACK model SGDH-75AE: Refer to *4.7.7 Three-phase 200 V: 7.5 kW (75AE)* and *4.9.1 Three-phase 200 V: 7.5 kW (75AE-P)*.

SERVOPACK model SGDH-75DE: Refer to *4.7.8 Three-phase 400 V: 7.5 kW (75DE)* and *4.9.2 Three-phase 400 V: 7.5 kW (75DE-P)*.

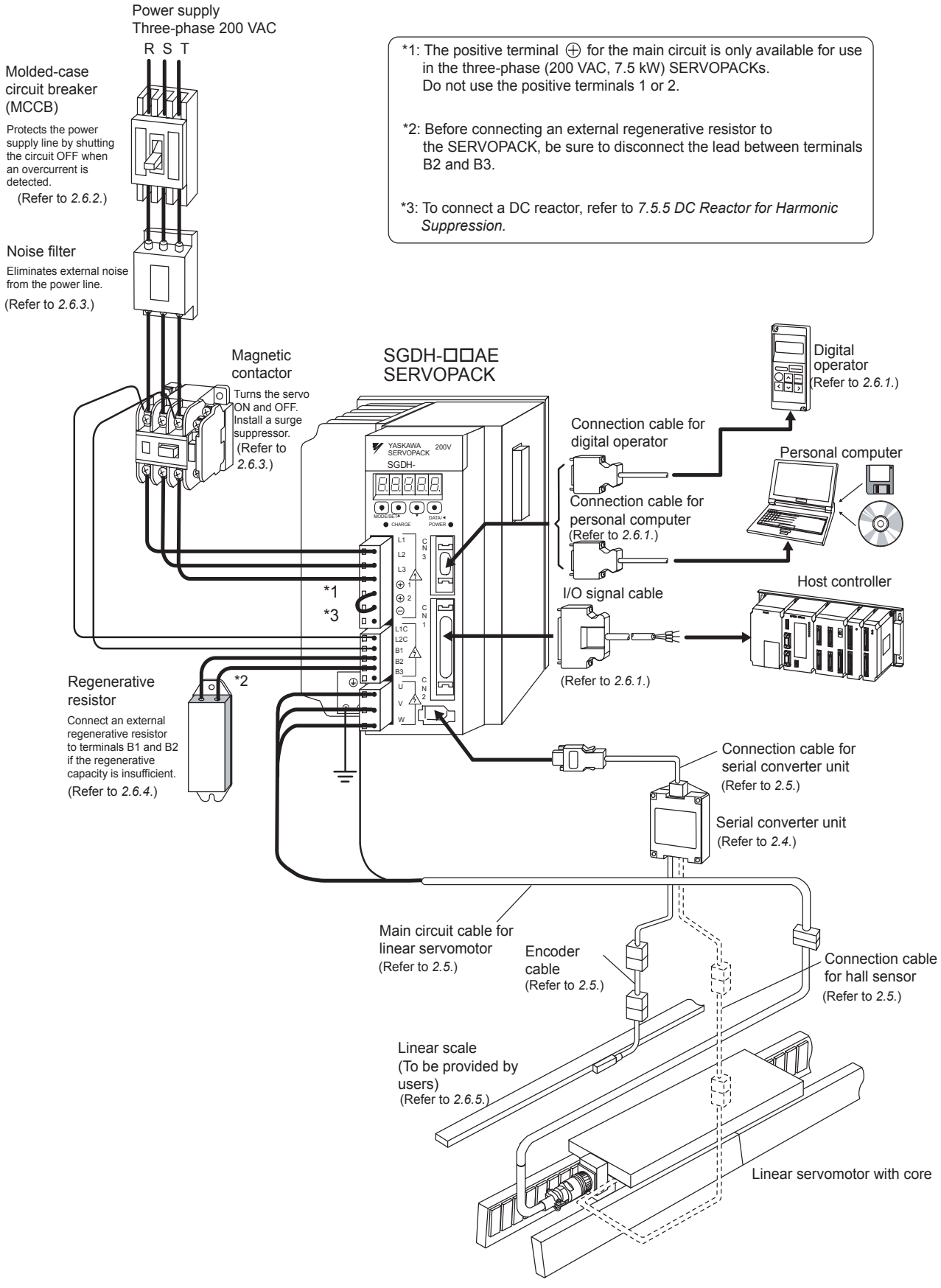
1.3 Examples of Servo System Configurations

This section describes examples of basic servo system configuration.

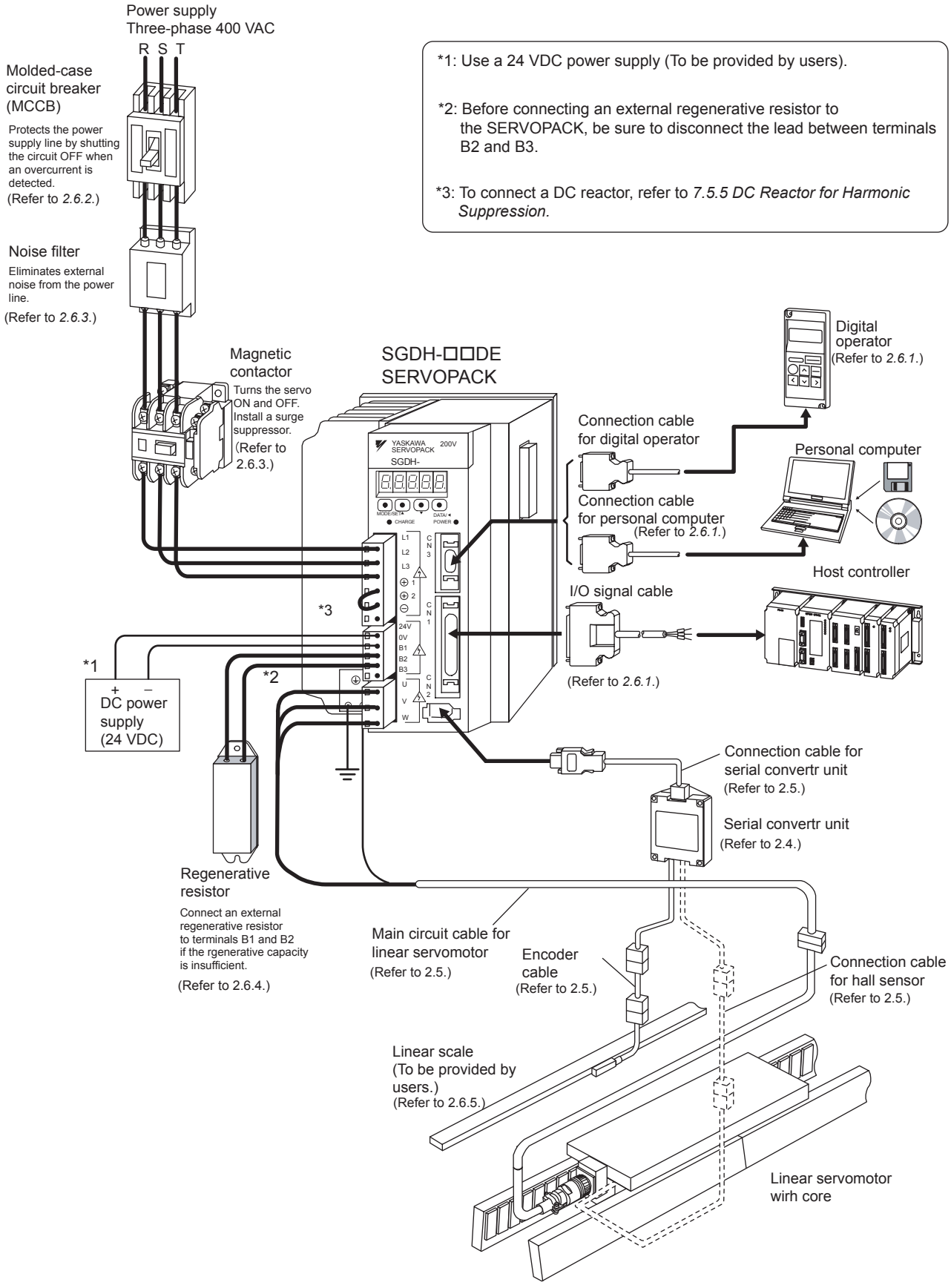
1.3.1 Single-phase, 200 V Main Circuit



1.3.2 Three-phase, 200 V Main Circuit



1.3.3 Three-phase, 400 V Main Circuit



1.4 Applicable Standards

Σ-II Series servodrives conform to the following overseas standards.

1.4.1 North American Safety Standards (UL, CSA)





Model		UL*1 Standards (UL File No.)	CSA*2 Standards	Certifications
SERVOPACK	• SGDH	UL508C(E147823)	CSA C22.2 No.14	UL

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

1.4.2 CE Marking



Model		Low Voltage Directive	EMC Directive		Certifications
			EMI	EMS	
SERVOPACK	• SGDH	EN50178	EN55011 class A group 1	EN50082-2 or EN61000-6-2	TÜV PS*

* TÜV Product Services GmbH

Note: For installation conditions, refer to *7.5.2 Wiring for Noise Control.*
Because SERVOPACKs and linear servomotors are built-in type, reconfirmation is required after being installed in the final product.

2

Selections

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2.1 Linear Servomotor Model Designation

This section describes how to check the model and ratings of the linear servomotor. The alphanumeric codes after SGL□□- indicate the specifications.

2.1.1 Coil Assembly

SGL G W — 40 A 140 A P D

Linear Σ Series
Linear servomotor

Servomotor Model	
Code	Specifications
G	Coreless
F	F-type iron core
T	T-type iron core

W : Coil assembly

Magnet height

Voltage
A : 200 VAC
D : 400 VAC

Design revision order
A,B,C •••

Length of coil assembly

Cable Connector for Main Circuit Cable		
Code	Specifications	Applicable Model
–	MS connector or connector made by Tyco Electronics AMP K.K. (Standard)	All motor models
D	Connector made by Interconnectron	• SGLGW-30A, -40A, -60A • SGLFW-35D, -50D, -1ZD • SGLTW-35D□□□H, -50D□□□H

Hall Sensor/Cooling		
Code	Specifications	Applicable models
P	With hall sensor (standard)	All motor models
C	Forced cooling	• SGLGW-40A, -60A, -90A
H	With hall sensor and forced cooling	
–	Without hall sensor	All motor models

2.1.2 Magnetic Way

SGL G M — 40 225 A C

Linear Σ Series
Linear servomotor

Model	
Code	Specifications
G	Coreless
F	F-type iron core
T	T-type iron core

M : Magnetic way

Magnet height

Length of magnetic way

Design revision order
A,B,C •••
Note: The coreless linear servomotor has revision CT.

Options		
Code	Specifications	Applicable Model
–	Standard	All motor models
C	With magnet cover	Only for all Iron-core types • SGLFM • SGLTM
- M	High thrust force	Only for the following coreless types • SGLGM-40, -60
Y	With base and magnetic cover	Only for the T-type iron core types • SGLTM-20, -35, -40, -80 Note: The magnetic ways with base for SGLTM-35□□□H, -50□□□□H are not available.

2.2 SERVOPACK Model Designation

Select the SERVOPACK according to the applied linear servomotor.

SGDH - 10 A E □

Σ-II Series SGDH SERVOPACK

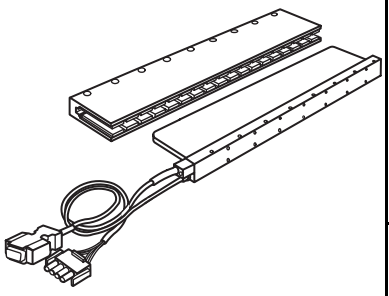
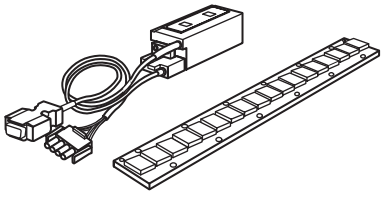
Rated Output of Applicable Servomotor (kW)			
Code	Rated Output	Code	Rated Output
A5	0.05	10	1.0
01	0.10	15	1.5
02	0.20	20	2.0
04	0.40	30	3.0
05	0.45	50	5.0
08	0.75	75	7.5

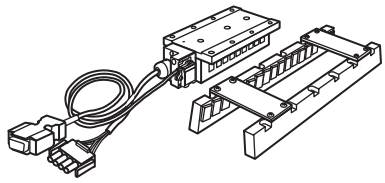
Mounting Method		
Code	Specifications	Rated Output of Applicable Servomotor (kW)
-	Base-mounted	0.05 to 7.5
-P	Duct-ventilated	7.5
-R	Rack-mounted	0.05 to 5.0

Power Supply Voltage	
Code	Voltage
A	Single/Three-phase, 200V
D	Three-phase, 400V

Model (Fixed)	
Code	Remarks
E	・For force, speed, and position control ・Applicable for various application modules

2.3 Σ-II Series SERVOPACKs and Applicable Linear Servomotors

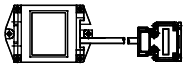
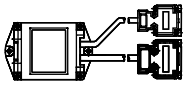
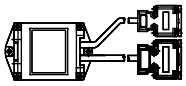
Linear Σ Series Linear Servomotor			Σ-II Series SGDH SERVOPACK		
			Single-phase 200 VAC	Three-phase 200 VAC	Three-phase 400 VAC
SGLGW (Coreless)  17 models	When a Standard-force Magnetic Way is used.	30A050C	A5AE	–	–
		30A080C	01AE	–	–
		40A140C	01AE	–	–
		40A253C	02AE	–	–
		40A365C	04AE	–	–
		60A140C	02AE	–	–
		60A253C	04AE	–	–
		60A365C	–	08AE	–
		90A200C	–	15AE	–
		90A370C	–	20AE	–
		90A535C	–	30AE	–
	When a High-force Magnetic Way is used.	40A140C	02AE	–	–
		40A253C	04AE	–	–
		40A365C	–	05AE	–
		60A140C	02AE	–	–
		60A253C	–	05AE	–
		60A365C	–	10AE	–
SGLFW (With F-type iron core)  14 models		20A090A	02AE	–	–
		20A120A	02AE	–	–
		35A120A	02AE	–	–
		35A230A	–	05AE	–
		50A200B	–	08AE	–
		50A380B	–	15AE	–
		1ZA200B	–	15AE	–
		1ZA380B	–	30AE	–
		35D120A	–	–	05DE
		35D230A	–	–	05DE
		50D200B	–	–	10DE
		50D380B	–	–	15DE
		1ZD200B	–	–	15DE
		1ZD380B	–	–	30DE

Linear Σ Series Linear Servomotor		Σ-II Series SGDH SERVOPACK		
		Single-phase 200 VAC	Three-phase 200 VAC	Three-phase 400 VAC
SGLTW (With T-type iron core)  22 models	20A170A	–	05AE	–
	20A320A	–	10AE	–
	20A460A	–	15AE	–
	35A170A	–	08AE	–
	35A320A	–	15AE	–
	35A460A	–	20AE	–
	35A170H	–	08AE	–
	35A320H	–	15AE	–
	50A170H	–	08AE	–
	50A320H	–	15AE	–
	40A400B	–	20AE	–
	40A600B	–	50AE	–
	80A400B	–	50AE	–
	80A600B	–	75AE	–
	35D170H	–	–	10DE
	35D320H	–	–	20DE
	50D170H	–	–	10DE
	50D320H	–	–	20DE
	40D400B	–	–	30DE
	40D600B	–	–	50DE
	80D400B	–	–	50DE
	80D600B	–	–	75DE

Note: The model combinations shown in this table are used when the maximum rated force of the applicable linear servomotor is required. To suppress rises in temperature, larger linear servomotors are used in some cases. If so, the SERVOPACK capacity can be lowered if using a motor at a lower force than the rated force. Calculate the required current and select a model with a margin of approximately 20%. An allowance can be made for up to 1/3 of the combined capacity of the linear servomotor and SERVOPACK in the table.

2.4 Serial Converter Units Models

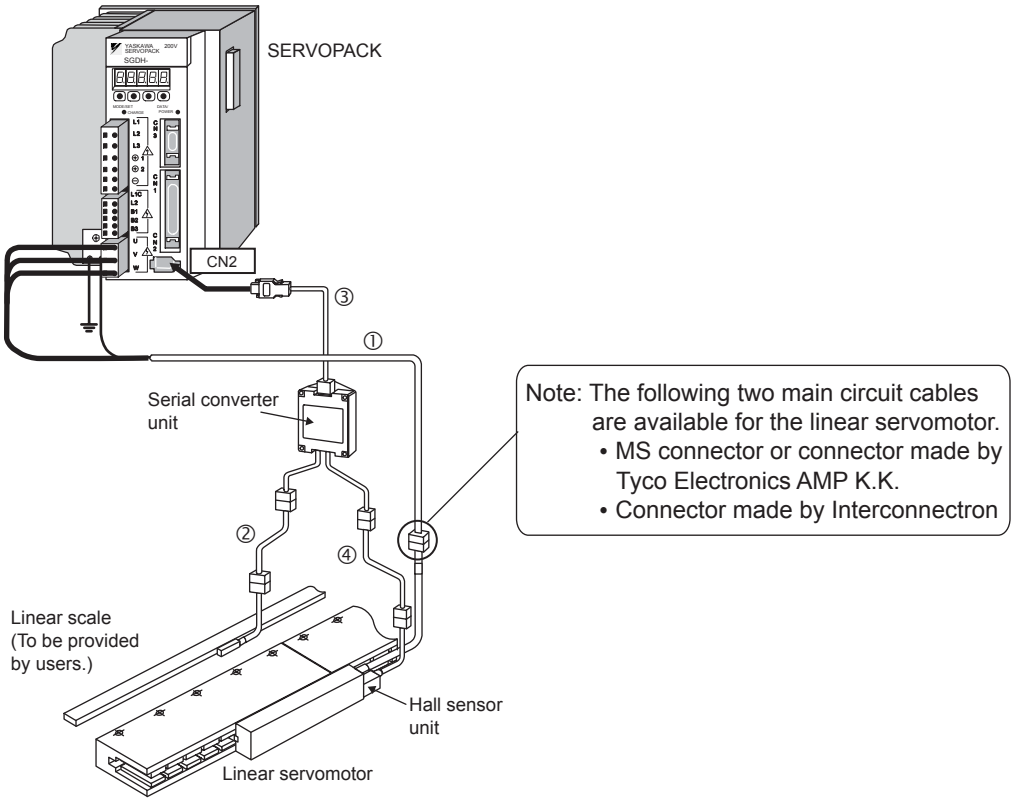
JZDP − D003 − 001

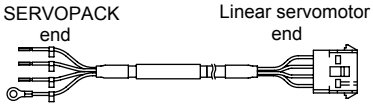
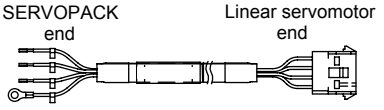
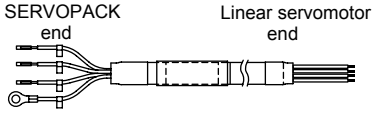
Serial Converter Unit Model			
Symbol	Appearance	Applicable Linear Scale	Hall Sensor
D003		Made by Heidenhain	None
D005		Made by Renishaw	None
D006		Made by Heidenhain	Yes
D008		Made by Renishaw	Yes

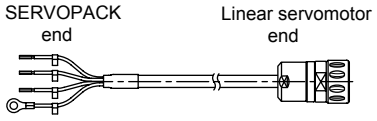
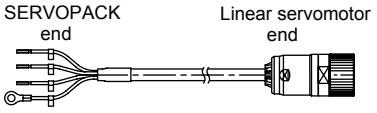
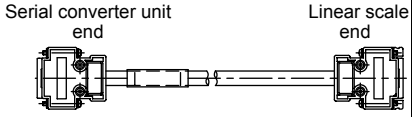
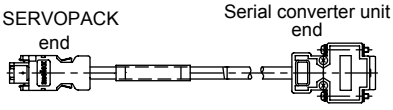
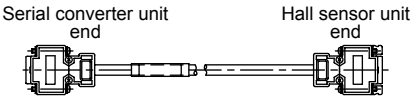
Applicable Linear Servomotor					
Servomotor Model		Symbol	Servomotor Model		Symbol
SGLGW- (Coreless) When a standard-force magnetic way is used.	30A050C	250	SGLTW- (Iron core, T-type)	20A170A	011
	30A080C	251		20A320A	012
	40A140C	252		20A460A	013
	40A253C	253		35A170A	014
	40A365C	254		35A320A	015
	60A140C	258		35A460A	016
	60A253C	259		35A170H	105
	60A365C	260		35A320H	106
	90A200C	264		50A170H	108
	90A370C	265		50A320H	109
	90A535C	266		40A400B	185
SGLGW- + SGLGM- □ -M (Coreless) When a high-force magnetic way is used.	40A140C	255		40A600B	186
	40A253C	256		80A400B	187
	40A365C	257		80A600B	188
	60A140C	261		35D170H	193
	60A253C	262		35D320H	194
	60A365C	263		50D170H	195
SGLFW- (Iron core, F-type)	20A090A	017		50D320H	196
	20A120A	018		40D400B	197
	35A120A	019		40D600B	198
	35A230A	020		80D400B	199
	50A200B	181		80D600B	200
	50A380B	182			
	1ZA200B	183			
	1ZA380B	184			
	35D120A	211			
	35D230A	212			
	50D200B	189			
	50D380B	190			
	1ZD200B	191			
	1ZD380B	192			

Note: When using a 400-V winding linear servomotor with a 200-V SERVOPACK, the parameters in the serial converter should be changed. Contact your Yaskawa representatives.

2.5 Selecting Cables



Name	Connection	Applicable Linear Servomotor Model	Cable Length	Cable Type	Specifications	Reference
① Linear Servomotor Main Circuit Cables	Between SERVOPACK and linear servomotor	SGLGW-30,-40 and -60 SGLFW-20 SGLFW-35	1 m	JZSP-CLN11-01		6.1
			3 m	JZSP-CLN11-03		
			5 m	JZSP-CLN11-05		
			10 m	JZSP-CLN11-10		
			15 m	JZSP-CLN11-15		
			20 m	JZSP-CLN11-20		
		SGLGW-90 SGLFW-50 and -1Z SGLTW-20,-35 and -50	1 m	JZSP-CLN21-01		
			3 m	JZSP-CLN21-03		
			5 m	JZSP-CLN21-05		
			10 m	JZSP-CLN21-10		
			15 m	JZSP-CLN21-15		
			20 m	JZSP-CLN21-20		
		SGLTW-40 and -80	1 m	JZSP-CLN39-01		
			3 m	JZSP-CLN39-03		
			5 m	JZSP-CLN39-05		
			10 m	JZSP-CLN39-10		
			15 m	JZSP-CLN39-15		
			20 m	JZSP-CLN39-20		

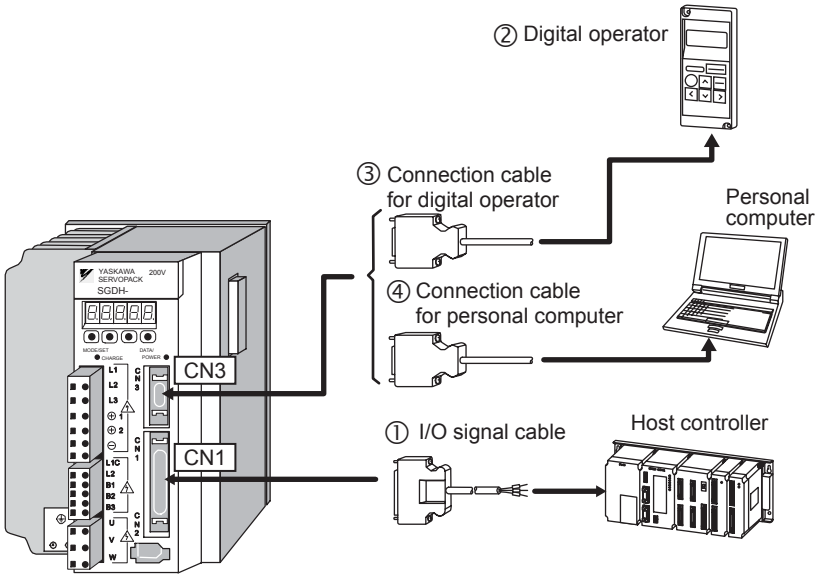
Name	Connection	Applicable Linear Servomotor Model	Cable Length	Cable Type	Specifications	Reference
① Linear Servomotor Main Circuit Cables	Between SERVOPACK and linear servomotor	SGLGW- -30A□□□□□D -40A□□□□□D -60A□□□□□D For 200 VAC *	1 m	JZSP-CLN14-01		6.1
			3 m	JZSP-CLN14-03		
			5 m	JZSP-CLN14-05		
			10 m	JZSP-CLN14-10		
			15 m	JZSP-CLN14-15		
			20 m	JZSP-CLN14-20		
		SGLFW- -35D□□□□□D -50D□□□□□D -1ZD□□□□□D SGLTW- -35D□□□H□D -50D□□□H□D For 400 VAC *	1 m	JZSP-CLN15-01		
			3 m	JZSP-CLN15-03		
			5 m	JZSP-CLN15-05		
			10 m	JZSP-CLN15-10		
			15 m	JZSP-CLN15-15		
			20 m	JZSP-CLN15-20		
② Encoder Cables	Between serial converter unit and linear scale	All models	1 m	JZSP-CLL00-01		6.3
			3 m	JZSP-CLL00-03		
			5 m	JZSP-CLL00-05		
			10 m	JZSP-CLL00-10		
			15 m	JZSP-CLL00-15		
③ Connection cables for serial converter unit	Between SERVOPACK connector CN2 and serial converter unit	All models	1 m	JZSP-CLP70-01		6.2
			3 m	JZSP-CLP70-03		
			5 m	JZSP-CLP70-05		
			10 m	JZSP-CLP70-10		
			15 m	JZSP-CLP70-15		
			20 m	JZSP-CLP70-20		
④ Connection cables for hall sensor	Between serial converter unit and hall sensor unit	All models	1 m	JZSP-CLL10-01		6.4
			3 m	JZSP-CLL10-03		
			5 m	JZSP-CLL10-05		
			10 m	JZSP-CLL10-10		
			15 m	JZSP-CLL10-15		

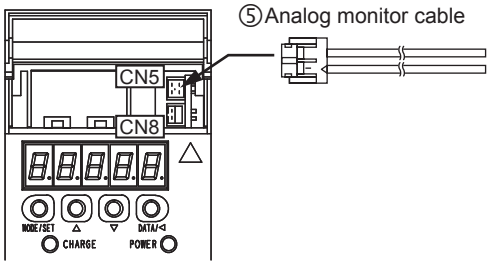
* The main circuit's cable connector is made by Interconnectron.

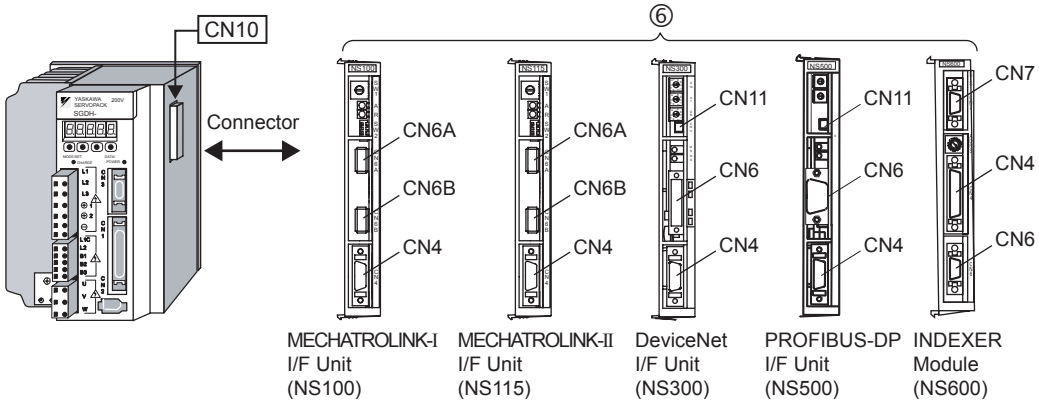
Note: A connector is not provided on the linear servomotor end of the main circuit cable, type JZSP-CLN39-□□. The user must provide the connector on the linear servomotor end. For details on the required connector, refer to *6.1 Linear Servomotor Main Circuit Cables*.

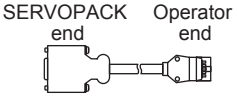
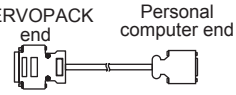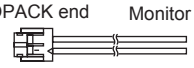
2.6 Selecting Peripheral Devices

2.6.1 Special Options







Name		Length	Type	Specifications	Refer-ence
① CN1 I/O Signal Cables	Connector terminal block converter unit		JUSP-TA50P	Terminal block and 0.5 m connection cable 	6.8.4
	Cable with loose wires at one end	1 m	JZSP-CKI01-1	Loose wires at host controller end 	6.7.1
		2 m	JZSP-CKI01-2		
		3 m	JZSP-CKI01-3		
② Digital Operator			JUSP-OP02A-2	With connection cable (1 m) 	6.8.2
③ CN3 Connection Cable for Digital Operator		1 m	JZSP-CMS00-1	Only required when using Σ series Digital Operator JUSP-OP02A-1. 	
		1.5 m	JZSP-CMS00-2		
		2 m	JZSP-CMS00-3		
④ CN3 Connection Cable for Personal Computer		2 m	JZSP-CMS02	D-Sub 9-pin (For DOS/V) 	6.8.1
⑤ CN5 Analog Monitor Cable		1 m	JZSP-CA01		6.8.3

Name		Type	Refer-ence
⑥Application Module *	MECHATROLINK-I I/F Unit (NS100)	JUSP-NS100	6.8.14
	MECHATROLINK-II I/F Unit (NS115)	JUSP-NS115	6.8.14
	DeviceNet I/F Unit (NS300)	JUSP-NS300	6.8.15
	PROFIBUS-DP I/F Unit (NS500)	JUSP-NS500	6.8.16
	INDEXER Module (NS600)	JUSP-NS600	6.8.17

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

2.6.2 Molded-case Circuit Breaker and Fuse Capacity

Main Circuit Power Supply	SERVOPACK Model		Power Supply Capacity per SERVOPACK (kVA)	Current Capacity of the Molded-case Circuit Breaker and the Fuse (A_{rms})*1, *2 (Refer to 6.8.7)		Inrush Current	
	Capacity (kW)	SGDH-		Main Circuit Power Supply	Control Circuit Power Supply	Main Circuit Power Supply	Control Circuit Power Supply
Single-phase 200 V	0.05	A5AE	0.25	4	0.13	63A	60A
	0.10	01AE	0.40				
	0.20	02AE	0.75				
	0.40	04AE	1.2	8			
Three-phase 200 V	0.45	05AE	1.4	4	0.15*4	118A	60A
	0.75	08AE	1.9	7			
	1.0	10AE	2.3				
	1.5	15AE	3.2	10			
	2.0	20AE	4.3	13		63A	
	3.0	30AE	5.9	17			
	5.0	50AE	7.5	28		67A	
	7.5	75AE	15.5	41	0.27*4	40A	
Three-phase 400 V	0.45	05DE	1.1	1.6	0.7*4	10A	(24 VDC)*3
	1.0	10DE	2.3	3.4			
	1.5	15DE	3.2	4.6			
	2.0	20DE	4.9	7.1		20A	
	3.0	30DE	6.7	9.7			
	5.0	50DE	10.3	14.9		78A	
	7.5	75DE	15.4	22.3	1.2*4	20A	

* 1. Nominal value at the rated load. The specified derating is required to select an appropriate fuse capacity.
* 2. Cutoff characteristics (25°C): 300% five seconds min. and inrush current of 20ms.
* 3. A preventive circuit for inrush current is not built in the 24 VDC control power supply. The protective circuit must be designed by the customer.
* 4. Make sure the current capacity is accurate. For the SERVOPACK with the cooling fan built-in, an inrush current flows; 200 % of the current capacity in the table above for two seconds, when turning ON the control circuit power supply to start the fan working.

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

IMPORTANT

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

2.6.3 Noise Filters, Magnetic Contactors, Surge Suppressors and DC Reactors

Main Circuit Power Supply	SERVOPACK Model		Recommended Noise Filter (Refer to 6.8.8.)		Magnetic Contactor (Refer to 6.8.9.)	Surge Suppressor (Refer to 6.8.10.)	DC Reactor (Refer to 6.8.11.)
	Capacity (kW)	SGDH-	Type	Specifications			
Single-phase 200 V	0.05	A5AE	FN2070-6/07	Single-phase 250 VAC, 6 A	HI-11J (20 A)	TU-25C240	–
	0.10	01AE					X5071
	0.20	02AE					X5070
	0.40	04AE	FN2070-10/07	Single-phase 250 VAC, 10 A			X5069
Three-phase 200 V	0.45	05AE	FN258L-7/07	Three-phase 480 VAC, 7 A	HI-11J (20 A)		X5061
	0.75	08AE	FN258L-16/07	Three-phase 480 VAC, 16 A	HI-15J (35 A)		
	1.0	10AE					
	1.5	15AE					X5060
	2.0	20AE			HI-20J (35 A)		
	3.0	30AE	FN258L-30/07	Three-phase 480 VAC, 30 A			X5059
	5.0	50AE	FMAC-0934-5010	Three-phase 440 VAC, 50 A	HI-25J (50 A)	TU-65C240	X5068
	7.5	75AE	FMAC-0953-6410	Three-phase 440 VAC, 64 A	HI-35J (65 A)		–
Three-phase 400 V	0.45	05DE	FN258L-7/07	Three-phase 480 VAC, 7 A	HI-15JCU (35 A)	Built-in	X5074
	1.0	10DE					X5075
	1.5	15DE					
	2.0	20DE	FN258L-16/07	Three-phase 480 VAC, 16 A	HI-20JCU (35 A)		X5076
	3.0	30DE					
	5.0	50DE	FS5559-35-33	Three-phase 480 VAC, 35 A	HI-25JCU (50 A)		X5077
	7.5	75DE			HI-35JCU (65 A)		–

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

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

Peripheral Device	Manufacturer
Noise Filter	FN, FS type: Schaffner Electronic FMAC type: SCHURTER (formely TIMONTA)
Magnetic Contactor	Yaskawa Controls Co., Ltd.
Surge Suppressor	Yaskawa Controls Co., Ltd.
DC Reactor	Yaskawa Controls Co., Ltd.

2.6.4 Regenerative Resistors

Main Circuit Power Supply	SERVOPACK Model		Regenerative Resistor (Refer to 6.8.5, 6.8.6, and 7.6.)		
	Capacity (kW)	SGDH-	Built-in		Externally connected
			Resistance (Ω)	Capacity (W)	
Single-phase 200 V	0.05	A5AE	–	–	–
	0.10	01AE			
	0.20	02AE			
	0.40	04AE			
Three-phase 200 V	0.45	05AE	50	60	–
	0.75	08AE			
	1.0	10AE			
	1.5	15AE	30	70	
	2.0	20AE	25	140	
	3.0	30AE	12.5	140	
	5.0	50AE	8	280	
	7.5	75AE	(3.13)*1	(1760)*1	JUSP-RA05
Three-phase 400 V	0.45	05DE	108	70	–
	1.0	10DE			
	1.5	15DE			
	2.0	20DE	45	140	
	3.0	30DE			
	5.0	50DE	32	180	
	7.5	75DE	(18)*2	(880)*2	JUSP-RA18

* 1. For the optional JUSP-RA05 Regenerative Resistor Unit.
* 2. For the optional JUSP-RA18 Regenerative Resistor Unit.

Note: 1. If the SERVOPACK cannot process the regenerative power, an external regenerative resistor is required. Refer to *6.8.5 External Regenerative Resistor*, *6.8.6 Regenerative Resistor*, and *7.6 Connecting Regenerative Resistors*.

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

Peripheral Device	Manufacturer
External Regenerative Resistor	Iwaki Wireless Research Institute
External Regenerative Unit	Yaskawa Electric Corporation

2.6.5 Linear Scales

Manufacturer	Type	Output Signal	Resolution (μm/pulse)	Scale Pitch (μm)	Max. Value of Encoder Output Resolution (Pn281)	Max. Speed of Applicable Linear Servomotor (m/s)
Renishaw Inc.	RGH22B	1Vpp Analog voltage	0.078	20	31	5
					63	4
					127	2
					255	1
Heidenhain Corp.	LIDA187		0.156	40	63	5
					127	4
					255	2
	LIDA487 LIDA489		0.078	20	31	5
					63	4
					127	2
					255	1
	LIF181		0.016	4	31	1.0
					63	0.8
					127	0.4
					255	0.2

Note: 1. The linear scale signal is multiplied by eight bits (256 segmentation) inside the serial converter unit.
2. Using the zero-point signal with a linear scale made by Renishaw Inc. may cause a deviation in the home position. If so, adjust the setting so that the zero-point is output only in one direction by using BID/DIR signal.
3. This list does not cover all the applicable types of linear scales. And, the linear scales listed in the table may not be applicable or available if their specifications have been modified or their production has been stopped.
Check the most recent catalog of the linear scale manufacturer to select a linear scale that meets the specifications described in *5.1 Serial Converter Unit Specifications*.
4. Select a linear scale so that the current consumption of the linear scale is 190 mA max.
5. At parameter (Pn280), set the scale pitch of the linear scale so that it satisfies the following condition. Otherwise, satisfactory control cannot be obtained.

$$\frac{64000}{\text{Pn280(Scale pitch (μm))}} \text{ must result in an integer number}$$

Examples
Correct: 1,2,4,8,10,16,20,40
Incorrect: 3,12,18

3

Specifications and Dimensional Drawings

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3.1 Ratings and Specifications of SGLGW/SGLGM

(1) Ratings and Specifications

- Time Rating: Continuous
- Insulation Resistance: 500 VDC, 10 MΩ min.
- Ambient Temperature: 0 to 40 °C (32 to 104°F)
- Excitation: Permanent magnet
- Dielectric Strength: 1500 VAC for 1 minute
- Protection Methods: Self-cooled, air-cooling
- Ambient Humidity: 20 to 80 % (no condensation)
- Allowable Winding Temperature: 130 °C (266°F) (Insulation class B)

(a) With Standard-force Magnetic Ways

The following table shows the ratings and specifications when the standard-force magnetic ways are used.

Linear Servomotor Model SGLGW-		30A		40A			60A			90A		
		050C	080C	140C	253C	365C	140C	253C	365C	200C	370C	535C
Rated Speed	m / s	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Peak Speed	m / s	5	5	5	5	5	5	5	5	5	5	5
Rated Force*	N	12.5	25	47	93	140	70	140	210	325	550	750
Rated Current*	Arms	0.51	0.79	0.8	1.6	2.4	1.2	2.2	3.3	4.4	7.5	10.2
Instantaneous Peak Force*	N	40	80	140	280	420	220	440	660	1300	2200	3000
Instantaneous Peak Current*	Arms	1.62	2.53	2.4	4.9	7.3	3.5	7.0	10.5	17.6	30.0	40.8
Coil Assembly Mass	kg	0.10	0.15	0.34	0.60	0.87	0.42	0.76	1.10	2.15	3.6	4.9
Force Constant	N / Arms	26.4	33.9	61.5	61.5	61.5	66.6	66.6	66.6	78	78	78
BEMF Constant	V /(m / s)	8.8	11.3	20.5	20.5	20.5	22.2	22.2	22.2	26.0	26.0	26.0
Motor Constant	N /$\sqrt{w}$	3.7	5.6	7.8	11.0	13.5	11.1	15.7	19.2	26.0	36.8	45.0
Electrical Time Constant	ms	0.2	0.4	0.4	0.4	0.4	0.5	0.5	0.5	1.4	1.4	1.4
Mechanical Time Constant	ms	7.30	4.78	5.59	4.96	4.77	3.41	3.08	2.98	3.18	2.66	2.42
Thermal Resistance With Heat Sink	K / W	5.19	3.11	1.67	0.87	0.58	1.56	0.77	0.51	0.39	0.26	0.22
Thermal Resistance Without Heat Sink	K / W	–	–	3.02	1.80	1.23	2.59	1.48	1.15			
Magnetic Attraction	N	0	0	0	0	0	0	0	0	0	0	0

(b) With High-force Magnetic Ways

The following table shows the ratings and specifications when the high-force magnetic ways are used.

Linear Servomotor Model SGLGM-□□□□□C-M + SGLGW-		40A			60A		
		140C	253C	365C	140C	253C	365C
Rated Speed	m / s	1.5	1.5	1.5	1.5	1.5	1.5
Peak Speed	m / s	5	5	5	5	5	5
Rated Force*	N	57	114	171	85	170	255
Rated Current*	Arms	0.8	1.6	2.4	1.2	2.2	3.3
Instantaneous Peak Force*	N	230	460	690	360	720	1080
Instantaneous Peak Current*	Arms	3.2	6.5	9.7	5.0	10.0	14.9
Coil Assembly Mass	kg	0.34	0.60	0.87	0.42	0.76	1.10
Force Constant	N / Arms	76.0	76.0	76.0	77.4	77.4	77.4
BEMF Constant	V /(m / s)	25.3	25.3	25.3	25.8	25.8	25.8
Motor Constant	N /$\sqrt{w}$	9.6	13.6	16.7	12.9	18.2	22.3
Electrical Time Constant	ms	0.4	0.4	0.4	0.5	0.5	0.5
Mechanical Time Constant	ms	3.69	3.24	3.12	2.52	2.29	2.21
Thermal Resistance With Heat Sink	K / W	1.67	0.87	0.58	1.56	0.77	0.51
Thermal Resistance Without Heat Sink	K / W	3.02	1.80	1.23	2.59	1.48	1.15
Magnetic Attraction	N	0	0	0	0	0	0

Note: 1. The items marked with an * and "Force and Speed Characteristics" are the values at a motor winding temperature of 100 °C (212°F) during operation in combination with a SERVOPACK. The others are at 20 °C (68°F).

2. The above specifications show the values under the cooling condition when a heat sink (aluminium board) listed in the following table is mounted on the coil assembly.

Linear Servomotor Model SGLGW-	Heat Sink Size in mm (in)
30A050C 30A080C 40A140C 60A140C	200 × 300 × 12 (7.87 × 11.81 × 0.47)
40A253C 60A253C	300 × 400 × 12 (11.81 × 15.75 × 0.47)
40A365C 60A365C	400 × 500 × 12 (15.75 × 19.69 × 0.47)
90A200C 90A370C 90A535C	800 × 900 × 12 (31.50 × 35.43 × 0.47)

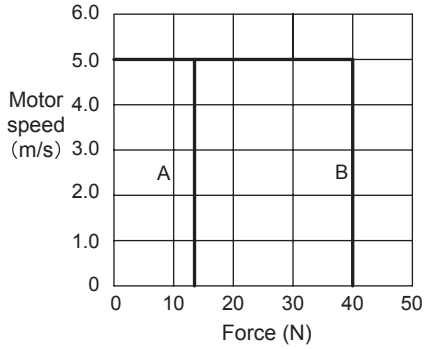
3. The values of peak speed in the table indicate the maximum speed that can be controlled from SERVOPACK. Refer to Force and Speed Characteristics for the actual motor peak speed.

(2) Force and Speed Characteristics

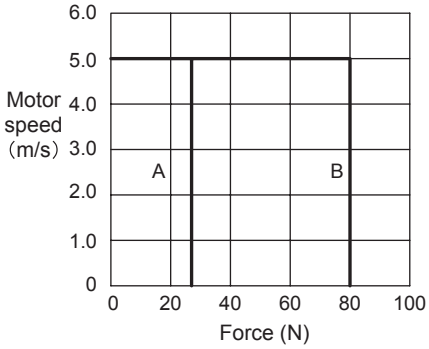
(a) With Standard-force Magnetic Ways

A : Continuous duty zone
B : Intermittent duty zone

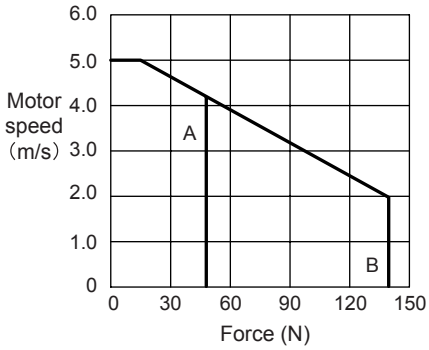
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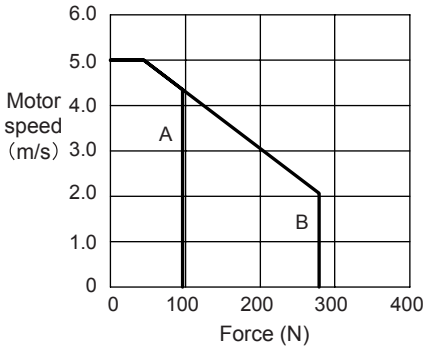
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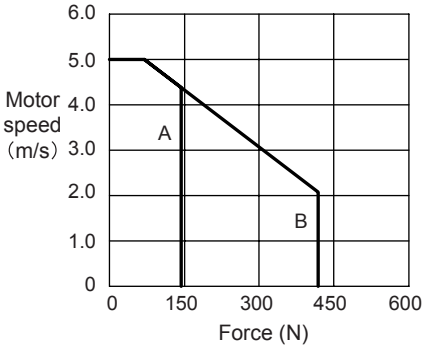
SGLGW-40A140C



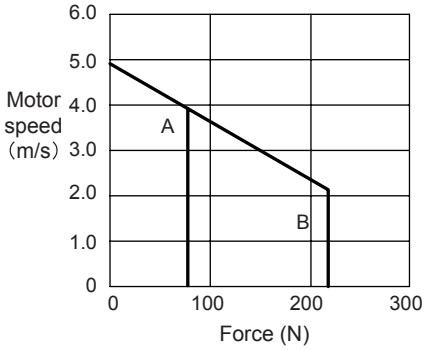
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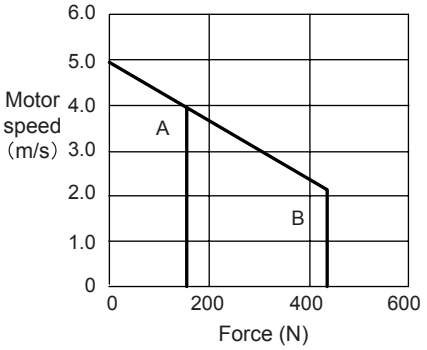
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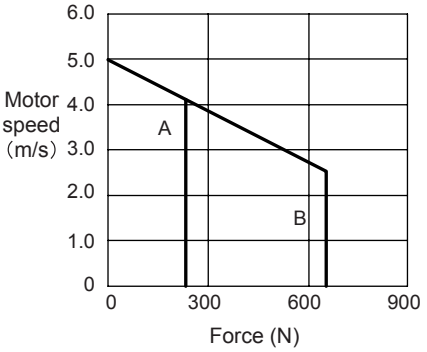
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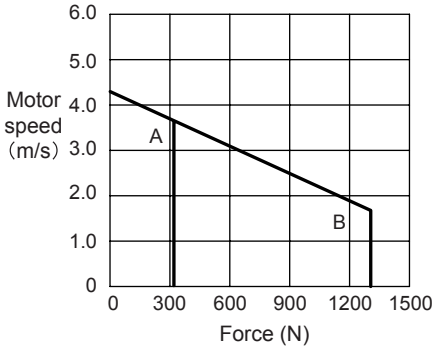
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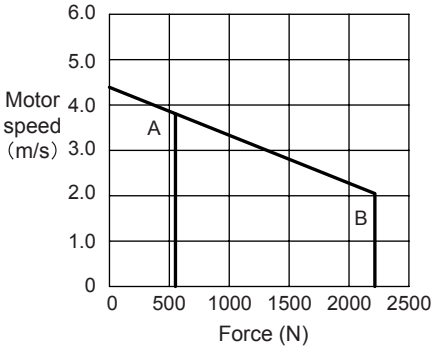
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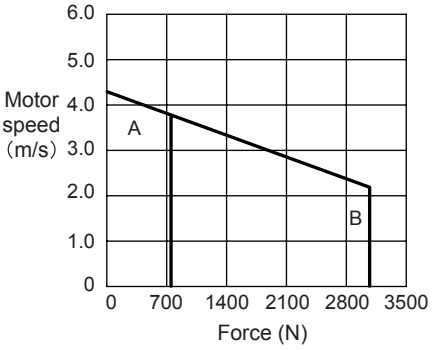
SGLGW-90A200C



SGLGW-90A370C



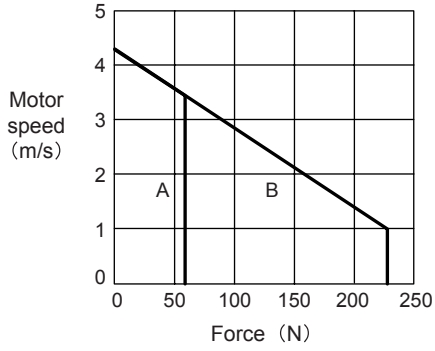
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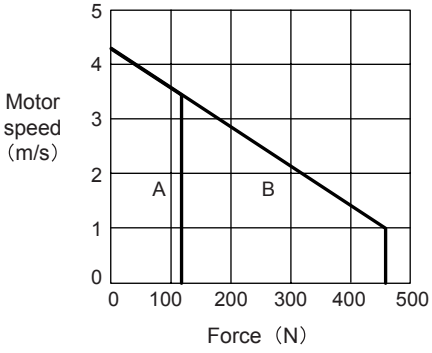
(b) With High-force Magnetic Ways

A : Continuous duty zone
B : Intermittent duty zone

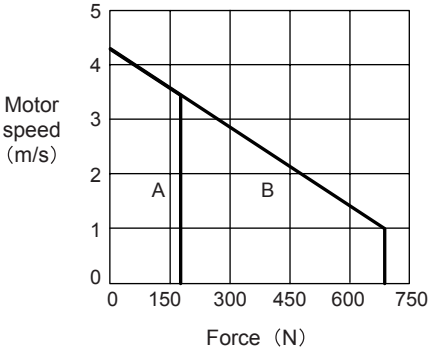
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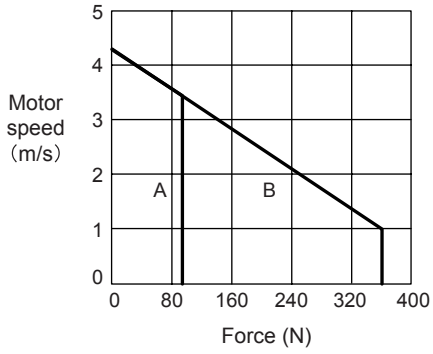
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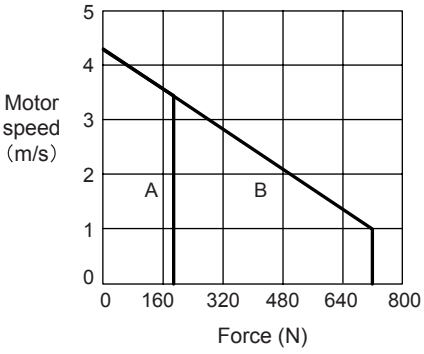
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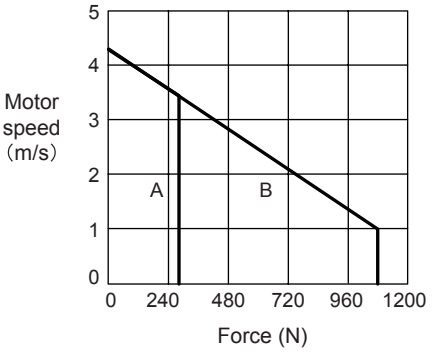
SGLGW-60A140C



SGLGW-60A253C



SGLGW-60A365C



3.2 Ratings and Specifications of SGLFW/SGLFM

(1) Ratings and Specifications

- Time Rating: Continuous
- Insulation Resistance: 500 VDC, 10 MΩ min.
- Ambient Temperature: 0 to 40 °C (32 to 104°F)
- Excitation: Permanent magnet
- Dielectric Strength: 1500 VAC for 1 minute
- Protection Methods: Self-cooled
- Ambient Humidity: 20 to 80 % (no condensation)
- Allowable Winding Temperature: 130 °C (266°F) (Insulation class B)

Ratings and Specifications of SGLFW Linear Servomotors with F-type Iron Core

Voltage		200V								400V					
Linear Servomotor Model SGLFW-		20A		35A		50A		1ZA		35D		50D		1ZD	
		090A	120A	120A	230A	200B	380B	200B	380B	120A	230A	200B	380B	200B	380B
Rated Speed	m / s	5	3.5	2.5	3	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Peak Speed	m / s	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Rated Force*	N	25	40	80	160	280	560	560	1120	80	160	280	560	560	1120
Rated Current*	Arms	0.7	0.8	1.4	2.8	5.0	10.0	8.7	17.5	0.7	1.4	2.3	4.5	4.9	9.8
Instantaneous Peak Force*	N	86	125	220	440	600	1200	1200	2400	220	440	600	1200	1200	2400
Instantaneous Peak Current*	Arms	3.0	2.9	4.4	8.8	12.4	25.0	21.6	43.6	2.3	4.6	5.6	11.0	12.3	24.6
Coil Assembly Mass	kg	0.7	0.9	1.3	2.3	3.5	6.9	6.4	11.5	1.3	2.3	3.5	6.9	6.4	11.5
Force Constant	N / Arms	36.0	54.0	62.4	62.4	60.2	60.2	69.0	69.0	120.2	120.2	134.7	134.7	122.6	122.6
BEMF Constant	V /(m / s)	12.0	18.0	20.8	20.8	20.1	20.1	23.0	23.0	40.1	40.1	44.9	44.9	40.9	40.9
Motor Constant	N /$\sqrt{w}$	7.9	9.8	14.4	20.4	34.3	48.5	52.4	74.0	13.8	19.5	33.4	47.2	51.0	72.1
Electrical Time Constant	ms	3.2	3.3	3.6	3.6	15.9	15.8	18.3	18.3	3.5	3.5	15.0	15.0	17.4	17.2
Mechanical Time Constant	ms	11.0	9.3	6.2	5.5	3.0	2.9	2.3	2.1	5.5	5.5	3.2	3.2	2.5	2.2
Thermal Resistance With Heat Sink	K / W	4.35	3.19	1.57	0.96	0.56	0.38	0.47	0.2	1.57	0.96	0.56	0.38	0.47	0.2
Thermal Resistance Without Heat Sink	K / W	7.69	5.02	4.10	1.94	1.65	0.95	1.3	0.73	4.1	1.94	1.65	0.95	1.3	0.73
Magnetic Attraction	N	314	462	809	1586	1650	3260	3300	6520	810	1590	1650	3260	3300	6520

Note: 1. The items marked with an * and "Force and Speed Characteristics" are the values at a motor winding temperature of 100 °C (212°F) during operation in combination with a SERVOPACK. The others are at 20 °C (68°F).

2. The above specifications show the values under the cooling condition when a heat sink (aluminium board) listed in the following table is mounted on the coil assembly.

Linear Servomotor Model SGLFW-	Heat Sink Size in mm (in)
20A090A 20A120A	125 × 125 × 13 (4.92 × 4.92 × 0.51)
35□120A 35□230A	254 × 254 × 25 (10.0 × 10.0 × 0.98)
50□200B 1Z□200B 50□380B	400 × 500 × 40 (15.75 × 19.69 × 1.57)
1Z□380B	609 × 762 × 50 (23.98 × 30.00 × 1.97)

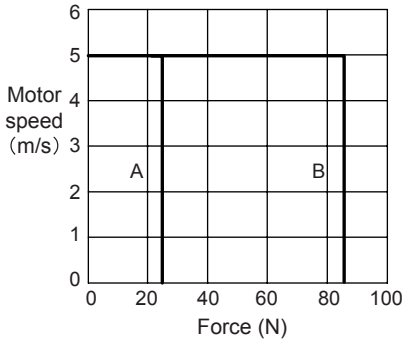
3. The values of peak speed in the table indicate the maximum speed that can be controlled from SERVOPACK. Refer to Force and Speed Characteristics for the actual motor peak speed.

(2) Force and Speed Characteristics

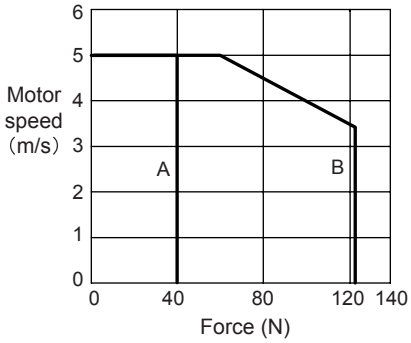
(a) 200-V Class

A: Continuous duty zone
B: Intermittent duty zone

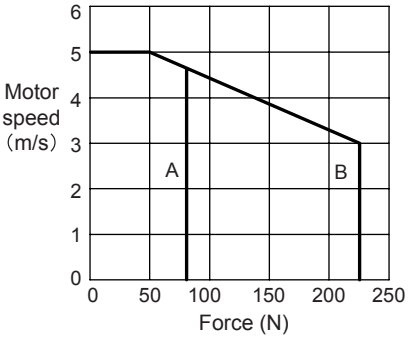
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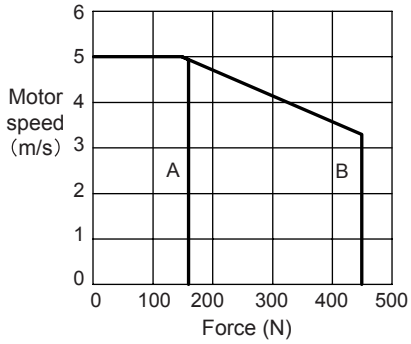
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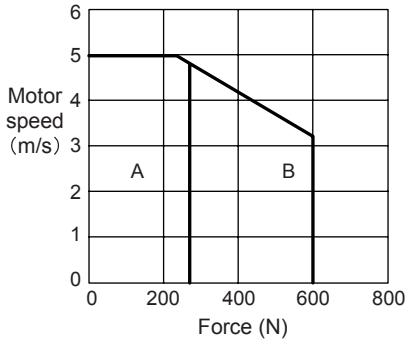
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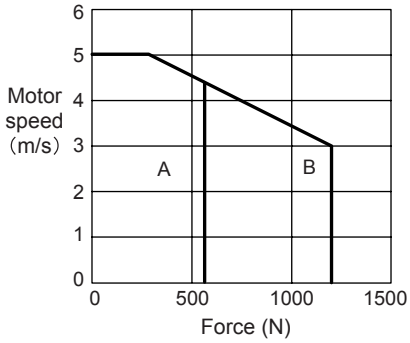
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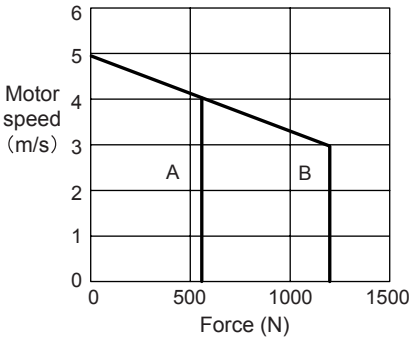
SGLFW-50A200B



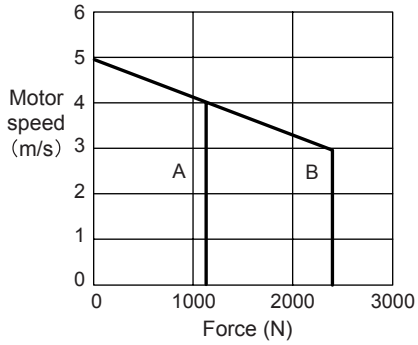
SGLFW-50A380B



SGLFW-1ZA200B



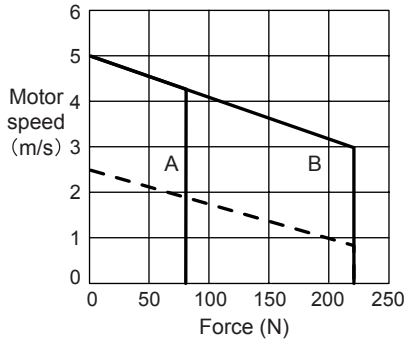
SGLFW-1ZA380B



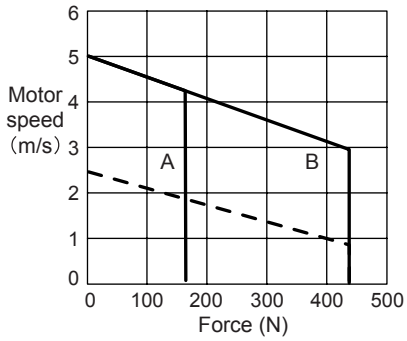
(b) 400-V Class

A: Continuous duty zone
B: Intermittent duty zone

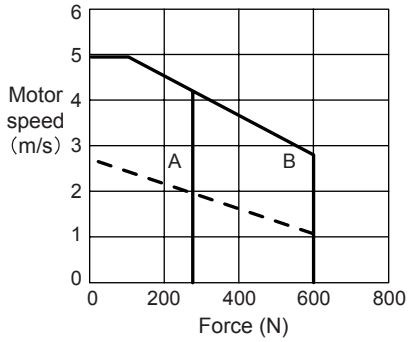
SGLFW-35D120A



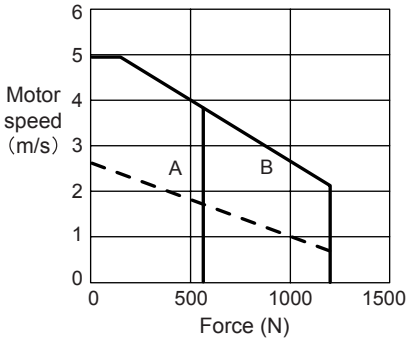
SGLFW-35D230A



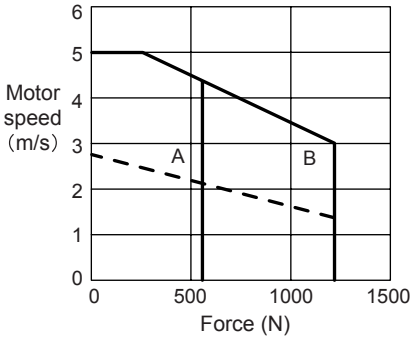
SGLFW-50D200B



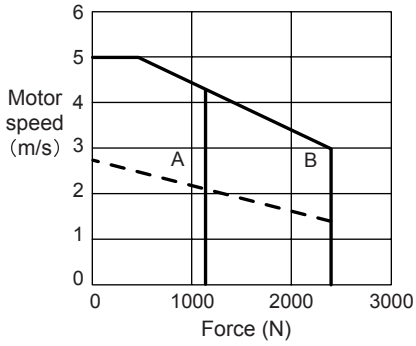
SGLFW-50D380B



SGLFW-1ZD200B



SGLFW-1ZD380B



Note: The dotted line indicates characteristics when the linear servomotor for 400 VAC is used with an input power supply for 200 VAC. In this case, the serial converter should be changed. Contact your Yaskawa representatives.

3.3 Ratings and Specifications of SGLTW/SGLTM

(1) Ratings and Specifications

- Time Rating: Continuous
- Insulation Resistance: 500 VDC, 10 MΩ min.
- Ambient Temperature: 0 to 40 °C (32 to 104°F)
- Excitation: Permanent magnet
- Dielectric Strength: 1500 VAC for 1 minute
- Protection Method: Self-cooled
- Ambient Humidity: 20 to 80% (no condensation)
- Allowable Winding Temperature: 130 °C (266°F) (Insulation class B)

Ratings and Specifications of SGLTW Linear Servomotors with T-type Iron Core

Voltage		200V									
Linear Servomotor Model SGLTW-		20A			35A			40A		80A	
		170A	320A	460A	170A	320A	460A	400B	600B	400B	600B
Rates Speed	m / s	3	3	3	2.5	2.5	2.5	1.5	1.5	1.5	1.5
Peak Speed	m / s	5	5	5	5	5	5	5	5	5	5
Rated Force*	N	130	250	380	220	440	670	670	1000	1300	2000
Rated Current*	Arms	2.3	4.4	6.7	3.5	7	10.7	7.3	10.9	11.1	17.1
Instantaneous Peak Force*	N	380	760	1140	660	1320	2000	2600	4000	5000	7500
Instantaneous Peak Current*	Arms	7.7	15.4	23.2	12.1	24.2	36.7	39.4	60.6	57.9	86.9
Coil Assembly Mass	kg	2.5	4.6	6.7	3.7	6.8	10.0	15	23	24	35
Force Constant	N / Arms	61.0	61.0	61.0	67.5	67.5	67.5	99.1	99.1	126	126
BEMF Constant	V /(m / s)	20.3	20.3	20.3	22.5	22.5	22.5	33	33	42	42
Motor Constant	N /$\sqrt{w}$	18.7	26.5	32.3	26.7	37.5	46.4	61.4	75.2	94.7	116
Electrical Time Constant	ms	5.9	5.9	5.9	6.9	6.8	7.0	15.2	15.2	17	17
Mechanical Time Constant	ms	7.5	6.5	6.4	5.2	4.8	4.6	4	4	3	3
Thermal Resistance With Heat Sink	K / W	1.01	0.49	0.38	0.76	0.44	0.32	0.24	0.2	0.22	0.18
Thermal Resistance Without Heat Sink	K / W	1.82	1.11	0.74	1.26	0.95	0.61	0.57	0.4	0.47	0.33
Magnetic Attraction*1	N	0	0	0	0	0	0	0	0	0	0
Magnetic Attraction*2	N	802	1591	2380	1403	2784	4165	3950	5890	7650	11400

Voltage		200V				400V							
Linear Servomotor Model SGLTW-		35A		50A		35D		50D		40D		80D	
		170H	320H	170H	320H	170H	320H	170H	320H	400B	600B	400B	600B
Rated Speed	m / s	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Peak Speed	m / s	5	5	5	5	5	5	5	5	5	5	5	5
Rated Force*	N	300	600	450	900	300	600	450	900	670	1000	1300	2000
Rated Current*	Arms	5.1	10.1	4.9	9.8	3.2	6.5	3.2	6.3	3.7	5.5	7.2	11.1
Instantaneous Peak Force*	N	600	1200	900	1800	600	1200	900	1800	2600	4000	5000	7500
Instantaneous Peak Current*	Arms	11.9	23.9	11.5	22.9	7.5	15.1	7.3	14.6	20.7	30.6	37.6	56.4
Coil Assembly Mass	kg	4.9	8.8	6	11	4.7	8.8	6	11	15	23	25	36
Force Constant	N / Arms	64	64	98.5	98.5	99.6	99.6	153.3	153.3	196.1	196.1	194.4	194.4
BEMF Constant	V /(m / s)	21.3	21.3	32.8	32.8	33.2	33.2	51.1	51.1	65.4	65.4	64.8	64.8
Motor Constant	N /$\sqrt{\text{W}}$	37.4	52.9	50.3	71.1	36.3	51.4	48.9	69.1	59.6	73	85.9	105.2
Electrical Time Constant	ms	15.1	15.1	16.5	16.5	14.3	14.3	15.6	15.6	14.4	14.4	15.4	15.4
Mechanical Time Constant	ms	3.3	3.3	2.8	2.8	3.5	3.5	2.5	2.5	4.2	4.2	3.2	3.2
Thermal Resistance With Heat Sink	K / W	0.76	0.4	0.61	0.3	0.76	0.4	0.61	0.3	0.24	0.2	0.22	0.18
Thermal Resistance Without Heat Sink	K / W	1.26	0.83	0.97	0.8	1.26	0.83	0.97	0.8	0.57	0.4	0.47	0.33
Magnetic Attraction*1	N	0	0	0	0	0	0	0	0	0	0	0	0
Magnetic Attraction*2	N	1400	2780	2000	3980	1400	2780	2000	3980	3950	5890	7650	11400

* 1. The unbalanced magnetic gap resulted from the coil assembly installation condition causes a magnetic attraction on the coil assembly.

* 2. The value indicates the magnetic attraction generated on one side of the magnetic way.

Note: 1. The items marked with an * and "Force and Speed Characteristics" are the values at a motor winding temperature of 100 °C (212°F) during operation in combination with a SERVOPACK. The others are at 20 °C (68°F).

2. The above specifications show the values under the cooling condition when a heat sink (aluminium board) listed in the following table is mounted on the coil assembly.

Linear Servomotor Model SGLTW-	Heat Sink Size in mm (in)
20A170A 35A170A	254 × 254 × 25 (10.0 × 10.0 × 0.98)
20A320A 20A460A 35□170H 35A320A 35□320H 35A460A 50□170H	400 × 500 × 40 (15.75 × 19.69 × 1.57)
40□400B 40□600B 50□320H 80□400B 80□600B	609 × 762 × 50 (23.98 × 30.0 × 1.97)

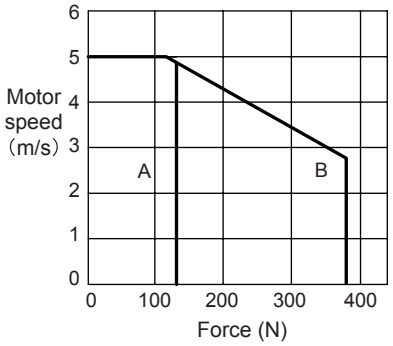
3. The values of peak speed in the table indicate the maximum speed that can be controlled from SERVOPACK. Refer to Force and Speed Characteristics for the actual motor peak speed.

(2) Force and Speed Characteristics

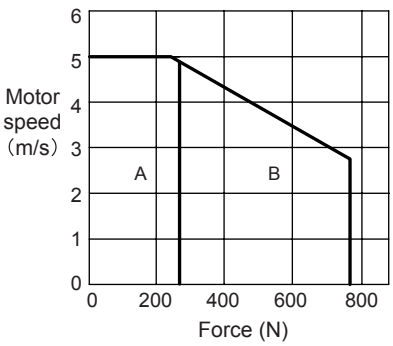
(a) 200-V Class

A: Continuous duty zone
B: Intermittent duty zone

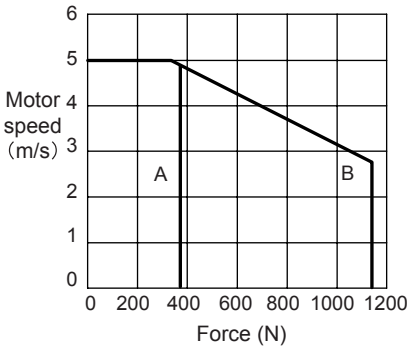
SGLTW-20A170A



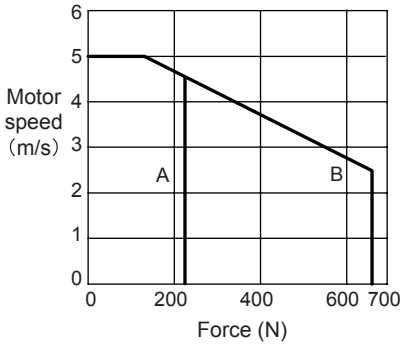
SGLTW-20A320A



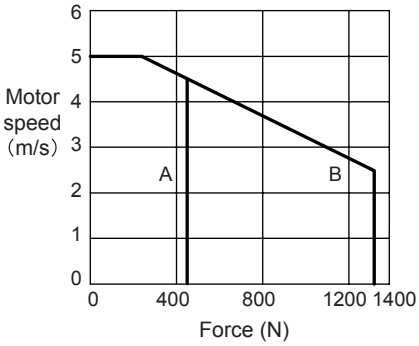
SGLTW-20A460A



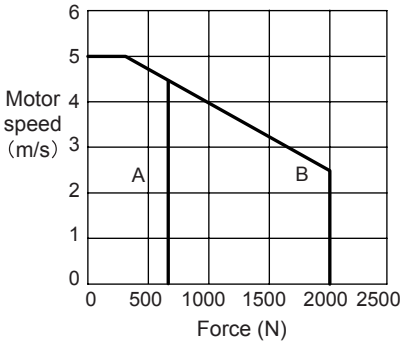
SGLTW-35A170A



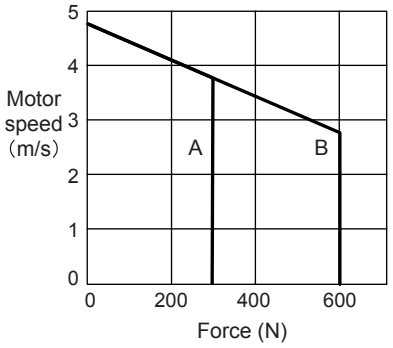
SGLTW-35A320A



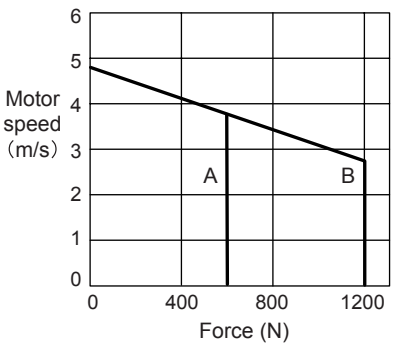
SGLTW-35A460A



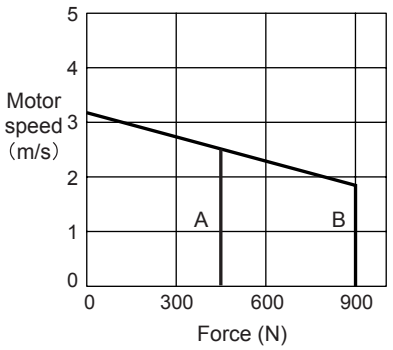
SGLTW-35A170H



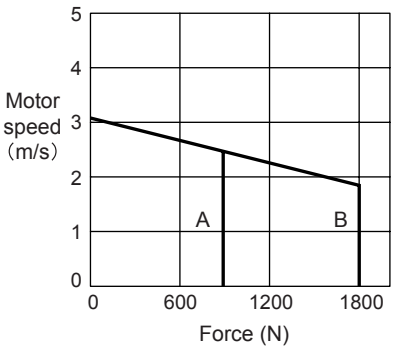
SGLTW-35A320H



SGLTW-50A170H

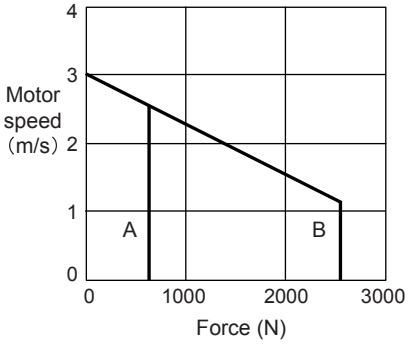


SGLTW-50A320H

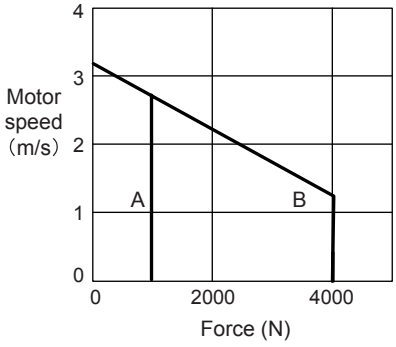


A: Continuous duty zone
B: Intermittent duty zone

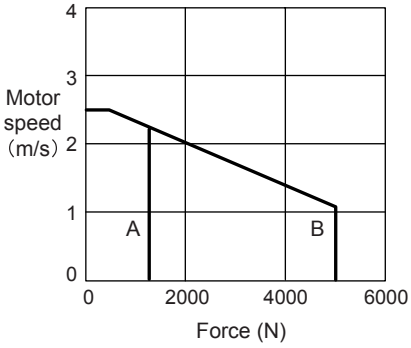
SGLTW-40A400B



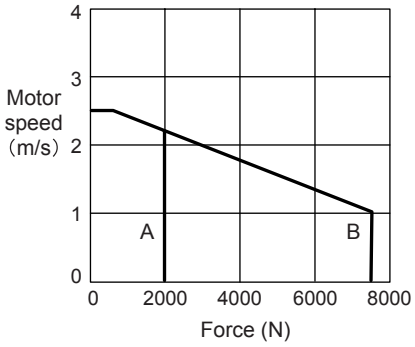
SGLTW-40A600B



SGLTW-80A400B



SGLTW-80A600B

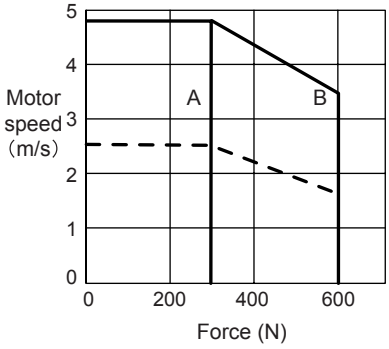


3

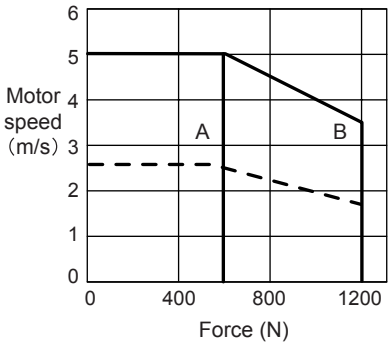
(b) 400-V Class

A: Continuous duty zone
B: Intermittent duty zone

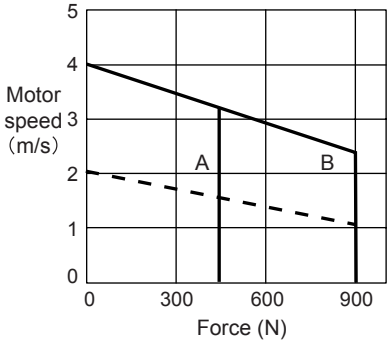
SGLTW-35D170H



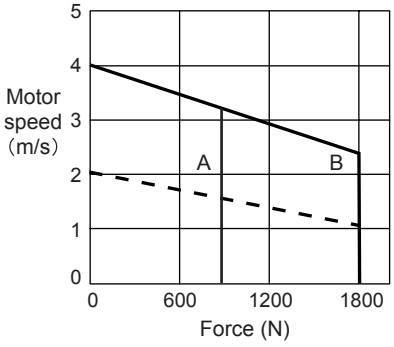
SGLTW-35D320H



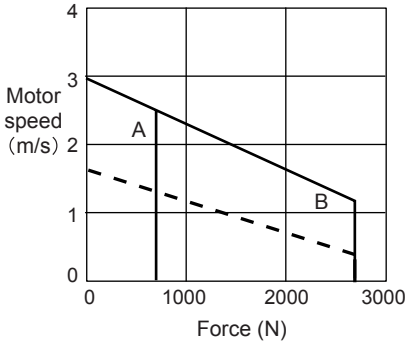
SGLTW-50D170H



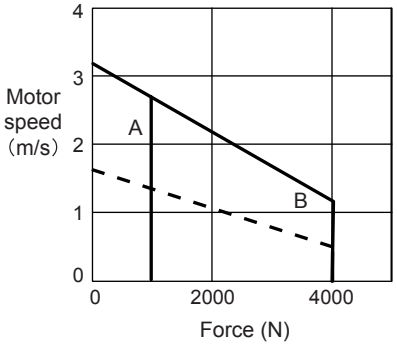
SGLTW-50D320H



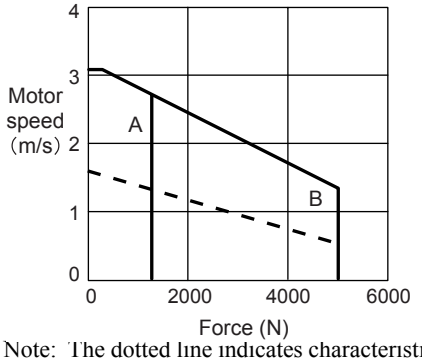
SGLTW-40D400B



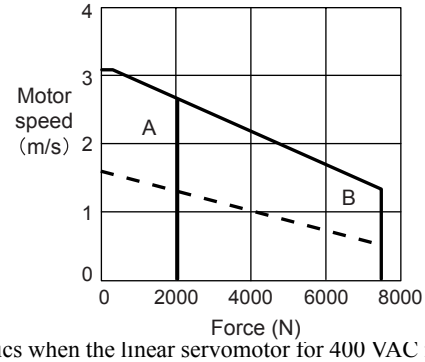
SGLTW-40D600B



SGLTW-80D400B



SGLTW-80D600B



Note: The dotted line indicates characteristics when the linear servomotor for 400 VAC is used with an input power supply for 200 VAC. In this case, the serial converter should be changed. Contact your Yaskawa representatives.

3.4 Mechanical Specifications of Linear Servomotors

(1) Impact Resistance

- Impact acceleration: 196 m/s^2
- Impact occurrences: twice

(2) Vibration Resistance

The linear servomotors will withstand the following vibration acceleration in three directions: Vertical, side to side, and front to back

- Vibration acceleration: 49 m/s^2

3.5 Quick Guide to Linear Servomotor Dimensional Drawings

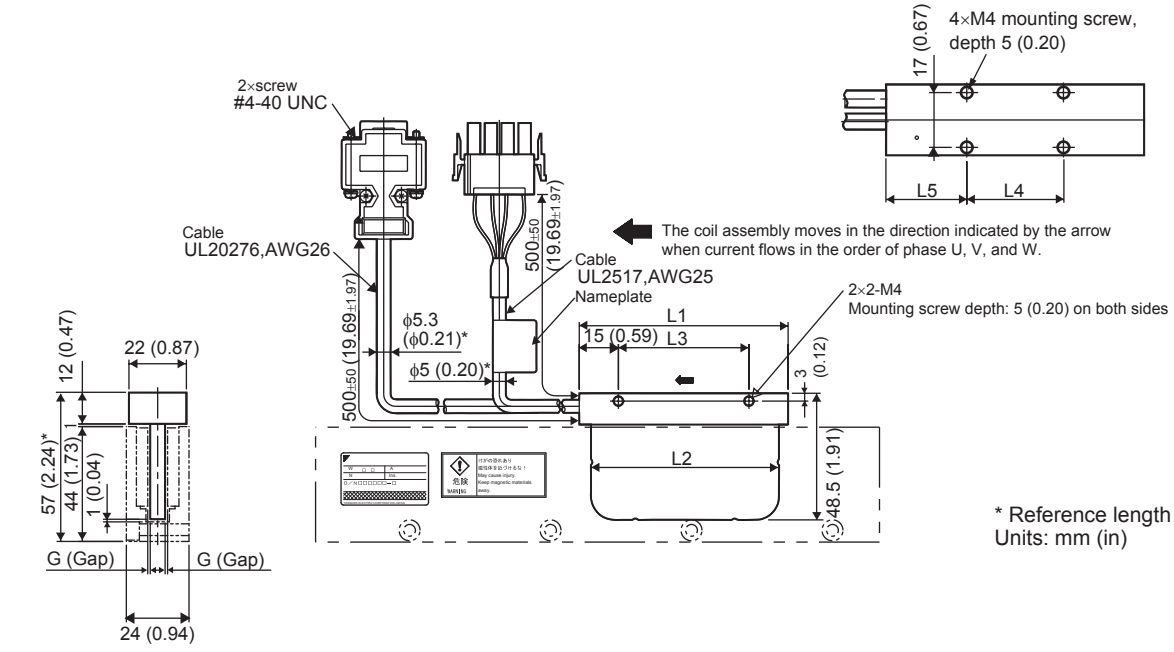
Linear Servomotor Model		Reference
SGLGW / SGLGM (Coreless type)	SGLGW-30/SGLGM-30	3.6.1
	SGLGW-40/SGLGM-40	3.6.2
	SGLGW-60/SGLGM-60	3.6.3
	SGLGW-90/SGLGM-90	3.6.4
SGLFW / SGLFM (With F-type iron core)	SGLFW-20/SGLFM-20	3.7.1
	SGLFW-35/SGLFM-35	3.7.2
	SGLFW-50/SGLFM-50	3.7.3
	SGLFW-1Z/SGLFM-1Z	3.7.4
SGLTW / SGLTM (With T-type iron core)	SGLTW-20/SGLTM-20	3.8.1
	SGLTW-35/SGLTM-35	3.8.2, 3.8.3
	SGLTW-40/SGLTM-40	3.8.4
	SGLTW-50/SGLTM-50	3.8.5
	SGLTW-80/SGLTM-80	3.8.6

3.6 Dimensional Drawings of SGLGW/SGLGM Linear Servomotors

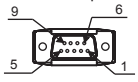
3.6.1 SGLG□-30 Linear Servomotors

(1) Coil Assembly: SGLGW-30A□□□C□
With a connector made by Tyco Electronics AMP K.K.

The following table and figures show the specifications when a main circuit's cable connector made by Tyco Electronics is used for the coil assembly.



Hall Sensor Connector Specifications



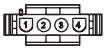
Pin connector type:
17JE-23090-02 (D8C)
made by DDK Ltd.

The mating connector

Socket connector type:
17JE-13090-02 (D8C)
Stud type:17L-002C or
17L-002C1

Pin No.	Name
1	+5V (Power supply)
2	Phase U
3	Phase V
4	Phase W
5	0V (Power supply)
6	Not used
7	Not used
8	Not used
9	Not used

Linear Servomotor Connector Specifications



Plug type: 350779-1
Pin type: 350924-1 or
770672-1
made by Tyco
Electronics AMP K.K.

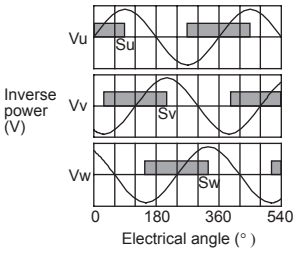
The mating connector

Cap type: 350780-1
Socket type: 350925-1 or
770673-1

Pin No.	Name	Lead Color
1	Phase U	Red
2	Phase V	White
3	Phase W	Blue
4	FG	Green

Hall Sensor Output Signals

When the coil assembly moves in the direction indicated by the arrow in the figure, the relationship between the hall sensor output signals Su, Sv, Sw and the inverse power of each motor phase Vu, Vv, Vw becomes as shown in the following figure.

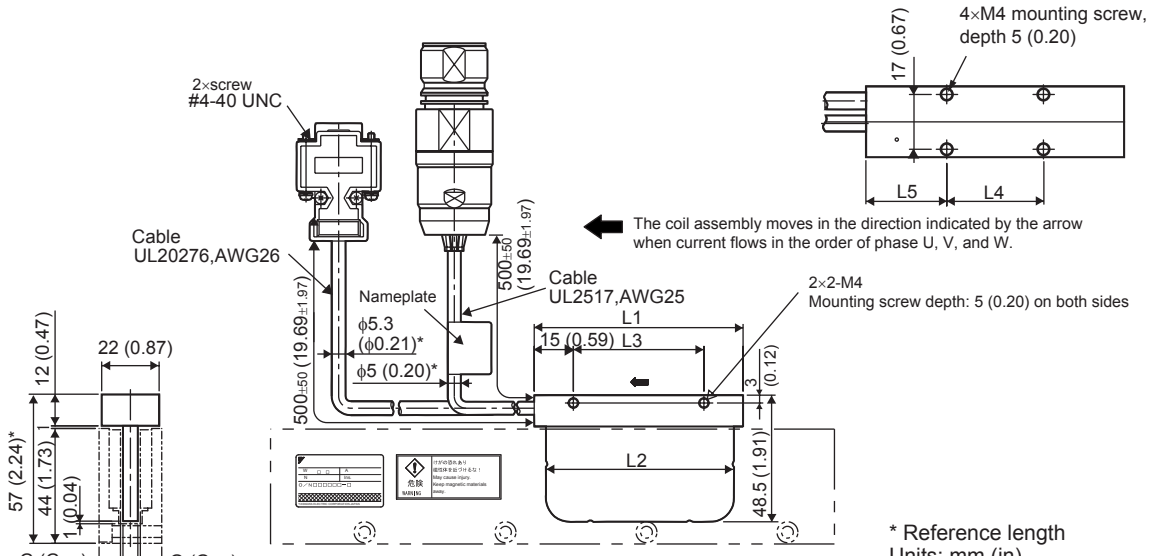


Coil Assembly Model SGLGW-	L1	L2	L3	L4	L5	G (Gap)	Approx. Mass* kg (lb)
30A050C□	50 (1.97)	48 (1.89)	30 (1.18)	20 (0.79)	20 (0.79)	0.85 (0.03)	0.14 (0.31)
30A080C□	80 (3.15)	72 (2.83)	50 (1.97)	30 (1.18)	25 (0.98)	0.95 (0.04)	0.19 (0.42)

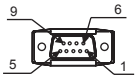
* The value indicates the mass of coil assembly with a hall sensor unit.

(2) Coil Assembly: SGLGW-30A□□□C□D With a connector made by Interconnectron

The following table and figures show the specifications when a main circuit's cable connector made by Interconnectron is used for the coil assembly.



Hall Sensor Connector Specifications



Pin connector type:
17JE-23090-02 (D8C)
made by DDK Ltd.

The mating connector

Socket connector type:
17JE-13090-02 (D8C)
Stud type:17L-002C or
17L-002C1

Pin No.	Name
1	+5V (Power supply)
2	Phase U
3	Phase V
4	Phase W
5	0V (Power supply)
6	Not used
7	Not used
8	Not used
9	Not used

Linear Servomotor Connector Specifications



Extension: SROC06JMSCN169
Pin type: 021.423.1020
made by Interconnectron

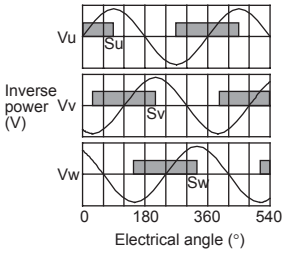
The mating connector

Plug type: SPUC06KFSDN236
Socket type: 020.030.1020

Pin No.	Name	Lead Color
1	Phase U	Red
2	Phase V	White
3	Phase W	Blue
4	Not used	–
5	Not used	–
6	FG	Green

Hall Sensor Output Signals

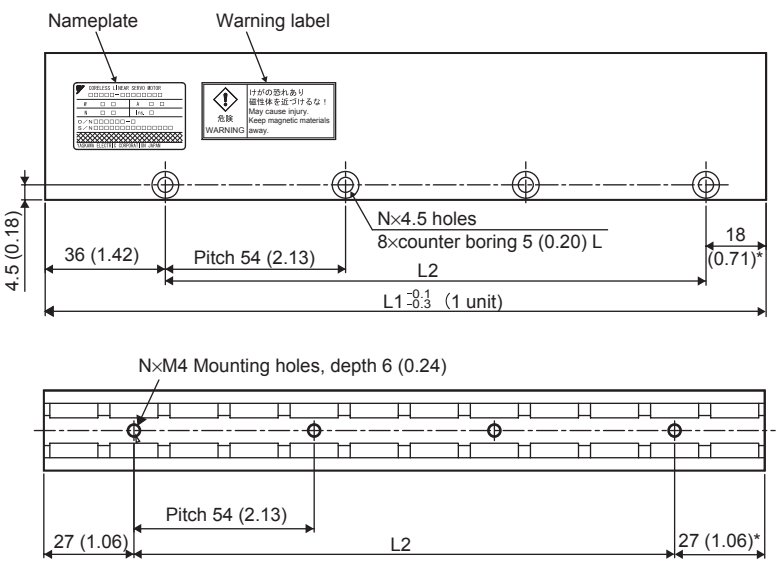
When the coil assembly moves in the direction indicated by the arrow in the figure, the relationship between the hall sensor output signals Su, Sv, Sw and the inverse power of each motor phase Vu, Vv, Vw becomes as shown in the following figure.

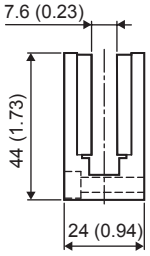


Coil Assembly Model SGLGW-	L1	L2	L3	L4	L5	G (Gap)	Approx. Mass* kg (lb)
30A050C□D	50 (1.97)	48 (1.89)	30 (1.18)	20 (0.79)	20 (0.79)	0.85 (0.03)	0.14 (0.31)
30A080C□D	80 (3.15)	72 (2.83)	50 (1.97)	30 (1.18)	25 (0.98)	0.95 (0.04)	0.19 (0.42)

* The value indicates the mass of coil assembly with a hall sensor unit.

(3) Magnetic Way: SGLGM-30□□□A





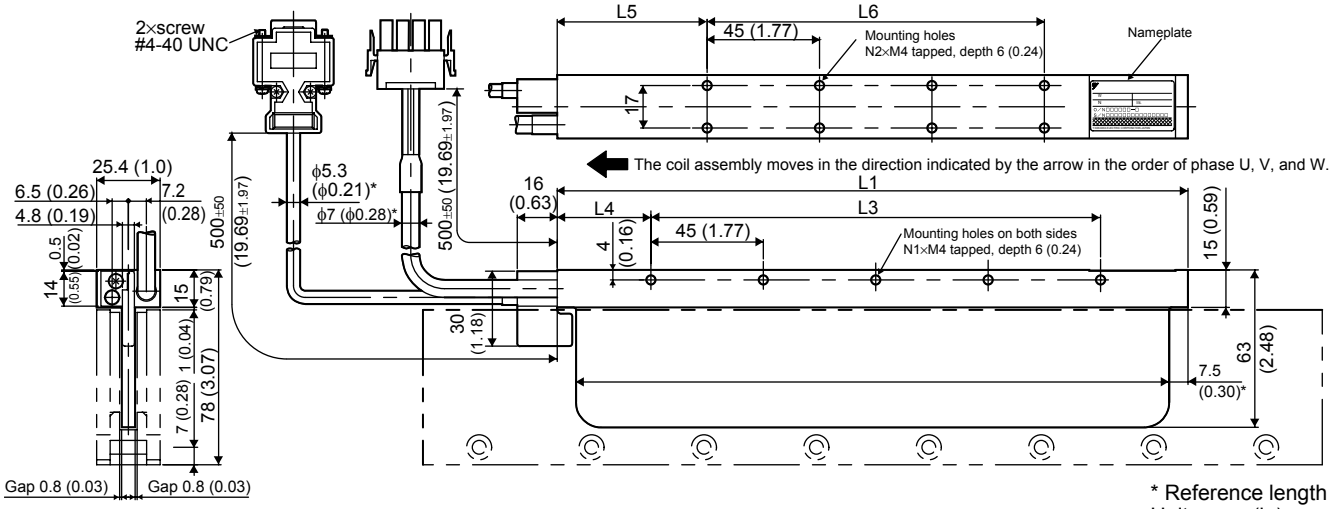
* Reference length
Units: mm (in)

Magnetic Way Model SGLGM-	L1 mm	L2 mm	N	Approx. Mass kg (lb)
30108A	108 (4.25)	54 (2.13)	2 (0.08)	0.6 (1.32)
30216A	216 (8.50)	162 (6.38)	4 (0.16)	1.1 (2.43)
30432A	432 (17.01)	378 (14.88)	8 (0.31)	2.3 (5.07)

3.6.2 SGLG□-40 Linear Servomotors

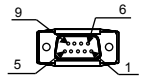
(1) Coil Assembly: SGLGW-40A□□□C□
With a connector made by Tyco Electronics AMP K.K.

The following table and figures show the specifications when a main circuit's cable connector made by Tyco Electronics is used for the coil assembly.



* Reference length
Units: mm (in)

Hall Sensor
Connector Specifications



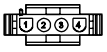
Pin connector type:
17JE-23090-02(D8C)
made by DDK Ltd.

The mating connector

Sockt connector type: 17JE-13090-02(D8C) Stud type: 17L-002C or 17L-002C1

Pin No.	Name
1	+5V (Power supply)
2	Phase U
3	Phase V
4	Phase W
5	0V (Power supply)
6	Not used
7	Not used
8	Not used
9	Not used

Linear Servomotor
Connector Specifications



Plug type: 350779-1
Pin type: 350561-3 or
350690-3(No.1 to 3)
350654-1
350669-1(No.4)
made by Tyco Electronics AMP K.K.

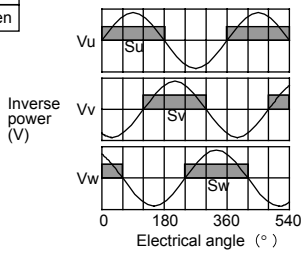
The mating connector

Cap type: 350780-1 Socket type: 350570-3 or 350689-3

Pin No.	Name	Lead Color
1	Phase U	Red
2	Phase V	White
3	Phase W	Blue
4	FG	Green

Hall Sensor Output Signals

When the coil assembly moves in the direction indicated by the arrow in the figure, the relationship between the hall sensor output signals Su, Sv, Sw and the inverse power of each motor phase Vu, Vv, Vw becomes as shown in the figure below.

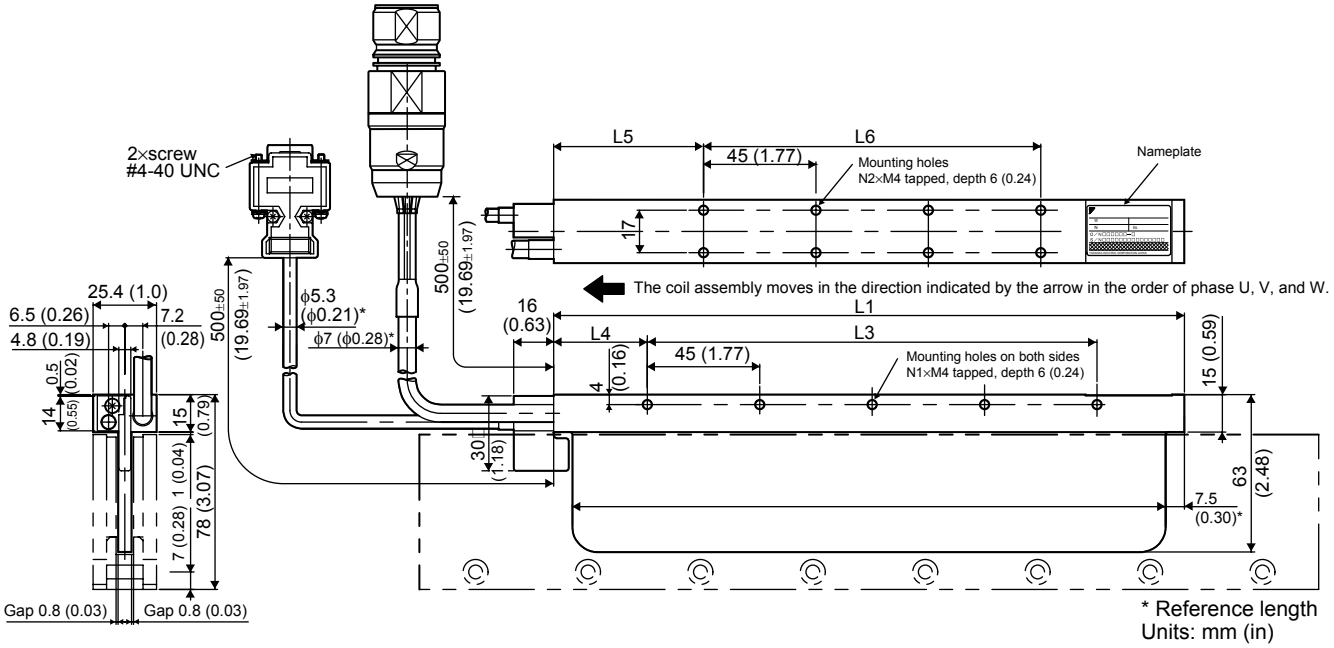


Coil Assembly Model SGLGW-	L1	L2	L3	L4	L5	L6	N1	N2	Approx. Mass* kg (lb)
40A140C□	140 (5.51)	125 (4.92)	90 (3.54)	30 (1.18)	52.5 (2.07)	45 (1.77)	3 (0.12)	4 (0.16)	0.40 (0.88)
40A253C□	252.5 (9.94)	237.5 (9.35)	180 (7.09)	37.5 (1.48)	60 (2.36)	135 (5.31)	5 (0.20)	8 (0.31)	0.66 (1.46)
40A365C□	365 (14.37)	350 (13.76)	315 (12.40)	30 (1.18)	52.5 (2.07)	270 (10.53)	8 (0.31)	14 (0.55)	0.93 (2.05)

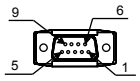
* The value indicates the mass of coil assembly with a hall sensor unit.

(2) Coil Assembly: SGLGW-40A□□□C□D With a connector made by Interconnectron

The following table and figures show the specifications when a main circuit's cable connector made by Interconnectron is used for the coil assembly.



Hall Sensor Connector Specifications



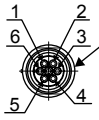
Pin connector type:
17JE-23090-02 (D8C)
made by DDK Ltd.

The mating connector

Sockt connector type:
17JE-13090-02 (D8C)
Stud type: 17L-002C or
17L-002C1

Pin No.	Name
1	+5V (Power supply)
2	Phase U
3	Phase V
4	Phase W
5	0V (Power supply)
6	Not used
7	Not used
8	Not used
9	Not used

Linear Servomotor Connector Specifications



Extension: SROC06JMSCN169
Pin type: 021.423.1020
made by Interconnectron

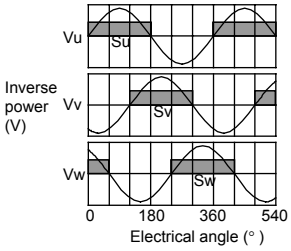
The mating connector

Plug type: SPUC06KFSDN236
Socket type: 020.030.1020

Pin No.	Name	Lead Color
1	Phase U	Red
2	Phase V	White
3	Phase W	Blue
4	Not used	–
5	Not used	–
6	FG	Green

Hall Sensor Output Signals

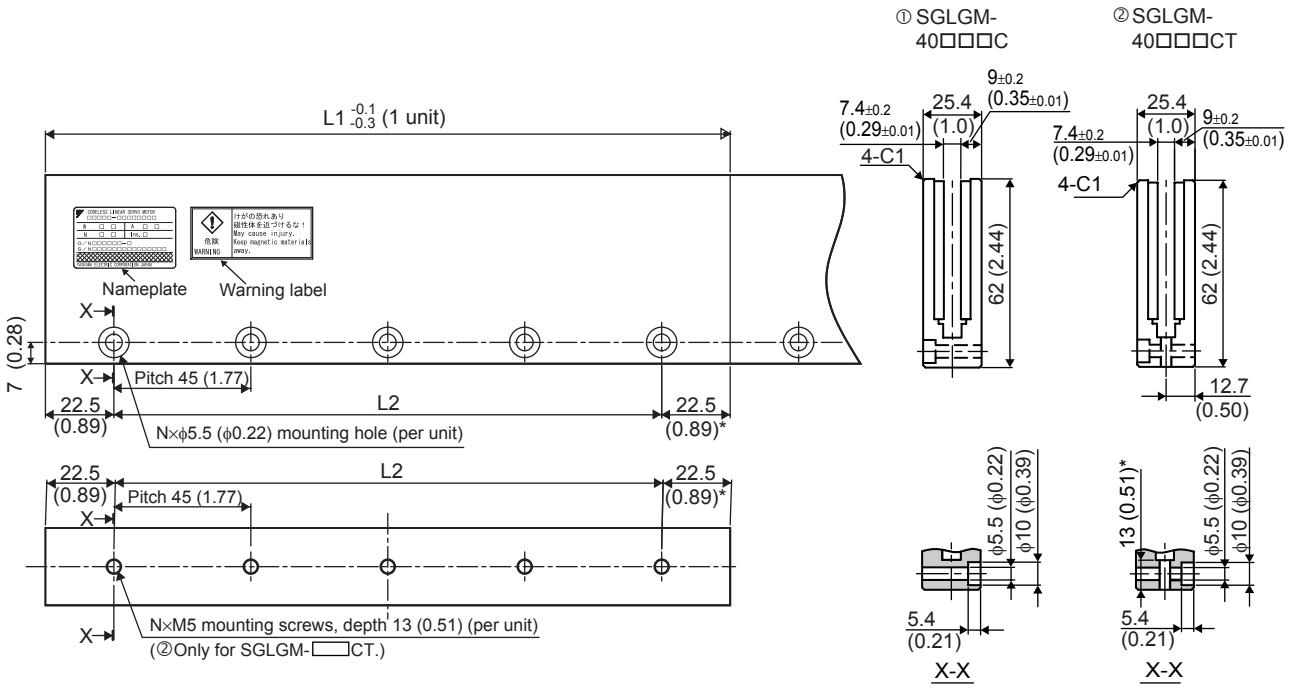
When the coil assembly moves in the direction indicated by the arrow in the figure, the relationship between the hall sensor output signals Su, Sv, Sw and the inverse power of each motor phase Vu, Vv, Vw becomes as shown in the figure below.



Coil Assembly Model SGLGW-	L1	L2	L3	L4	L5	L6	N1	N2	Approx. Mass* kg (lb)
40A140C□D	140 (5.51)	125 (4.92)	90 (3.54)	30 (1.18)	52.5 (2.07)	45 (1.77)	3 (0.12)	4 (0.16)	0.40 (0.88)
40A253C□D	252.5 (9.94)	237.5 (9.35)	180 (7.09)	37.5 (1.48)	60 (2.36)	135 (5.31)	5 (0.20)	8 (0.31)	0.66 (1.46)
40A365C□D	365 (14.37)	350 (13.76)	315 (12.40)	30 (1.18)	52.5 (2.07)	270 (10.53)	8 (0.31)	14 (0.55)	0.93 (2.05)

* The value indicates the mass of coil assembly with a hall sensor unit.

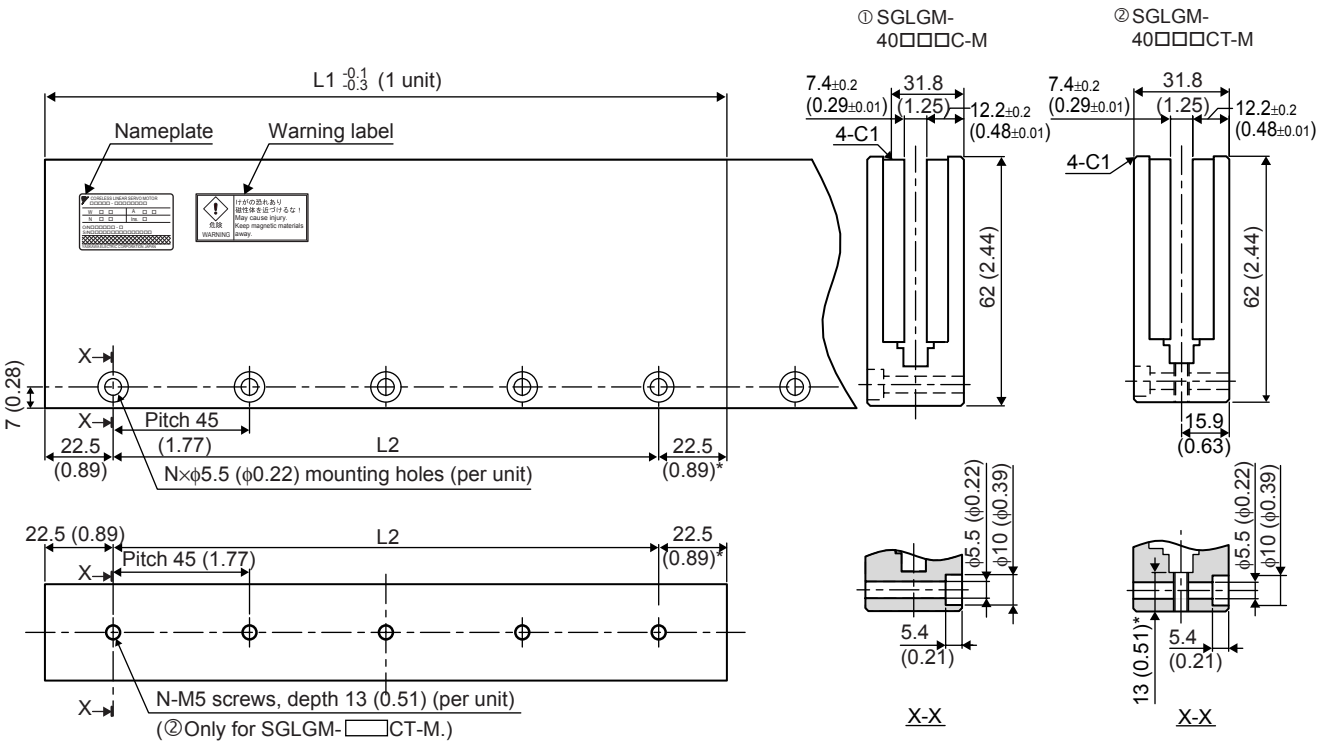
(3) Standard-force Magnetic Way: SGLGM-40□□□C / SGLGM-40□□□CT



* Reference length
Units: mm (in)

Standard-force Magnetic Way Model SGLGM-		L1	L2	N	Approx. Mass kg (lb)
Standard Force	40090C or 40090CT	90 (3.54)	45 (1.77)	2 (0.08)	0.8 (1.76)
	40225C or 40225CT	225 (8.86)	180 (7.09)	5 (0.20)	2.0 (4.41)
	40360C or 40360CT	360 (14.17)	315 (12.40)	8 (0.31)	3.1 (6.83)
	40405C or 40405CT	405 (15.94)	360 (14.17)	9 (0.35)	3.5 (7.72)
	40450C or 40450CT	450 (17.72)	405 (15.94)	10 (0.39)	3.9 (8.60)

(4) High-force Magnetic Way: SGLGM-40□□□C-M / SGLGM-40□□□CT-M



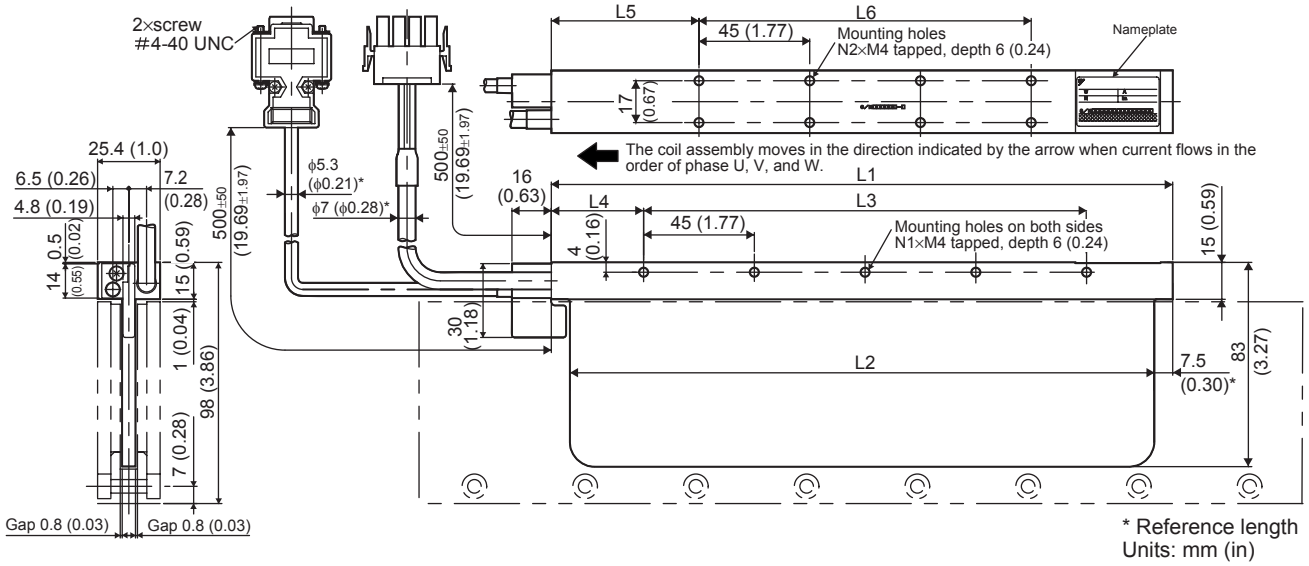
* Reference length
Units: mm (in)

High-force Magnetic Way Model SGLGM-		L1	L2	N	Approx. Mass kg (lb)
High Force	40090C-M or 40090CT-M	90 (3.54)	45 (1.77)	2 (0.08)	1.0 (2.20)
	40225C-M or 40225CT-M	225 (8.86)	180 (7.09)	5 (0.20)	2.6 (5.73)
	40360C-M or 40360CT-M	360 (14.17)	315 (12.40)	8 (0.31)	4.1 (9.04)
	40405C-M or 40405CT-M	405 (15.94)	360 (14.17)	9 (0.35)	4.6 (10.14)
	40450C-M or 40450CT-M	450 (17.72)	405 (15.94)	10 (0.39)	5.1 (11.24)

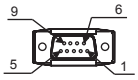
3.6.3 SGLG□-60 Linear Servomotors

(1) Coil Assembly: SGLGW-60A□□□C□
With a connector made by Tyco Electronics AMP K.K.

The following table and figures show the specifications when a main circuit's cable connector made by Tyco Electronics is used for the coil assembly.



Hall Sensor
Connector Specifications



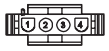
Pin connector type:
17JE-23090-02(D8C)
made by DDK Ltd.

The mating connector

Socket connector type:
17JE-13090-02(D8C)
Stud type: 17L-002C or
17L-002C1

Pin No.	Name
1	+5V (Power supply)
2	Phase U
3	Phase V
4	Phase W
5	0V (Powr supply)
6	Not used
7	Not used
8	Not used
9	Not used

Linear Servomotor
Connector Specifications



Plug type: 350779-1
Pin type: 350561-3 or
350690-3(No.1 to 3)
350654-1
350669-1 (No.4)
made by Tyco Electronics AMP K.K.

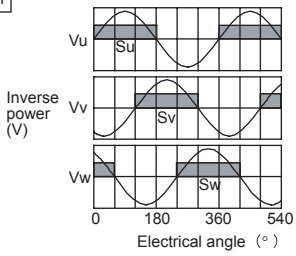
The mating connector type

Cap type: 350780-1
Socket type: 350570-3 or
350689-3

Pin No.	Name	Lead Color
1	Phase U	Red
2	Phase V	White
3	Phase W	Blue
4	FG	Green

Hall Sensor Output Signals

When the coil assembly moves in the direction indicated by the arrow in the figure, the relationship between the hall sensor output signals Su, Sv, Sw and the inverse power of each motor phase Vu, Vv, Vw becomes as shown in the figure below.

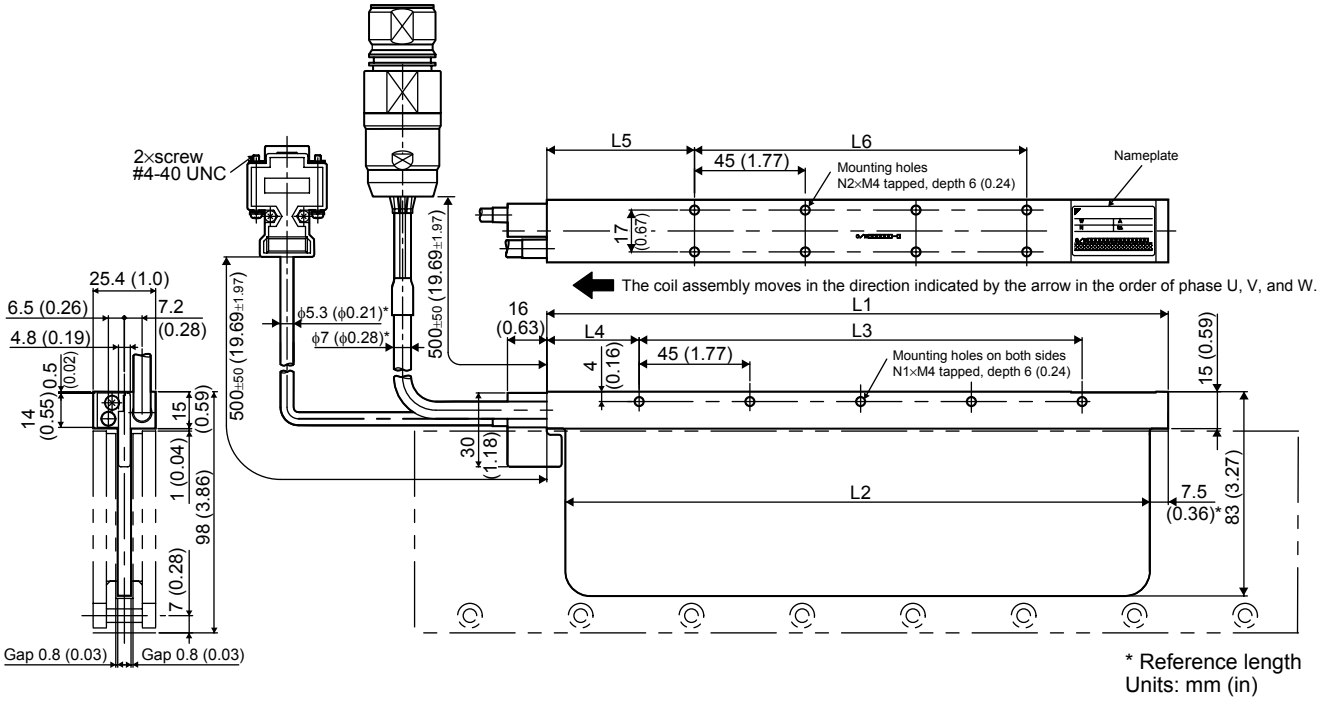


Coil Assembly Model SGLGW-	L1	L2	L3	L4	L5	L6	N1	N2	Approx. Mass* kg (lb)
60A140C□	140 (5.51)	125 (4.92)	90 (3.54)	30 (1.18)	52.5 (2.07)	45 (1.77)	3 (0.12)	4 (0.16)	0.48 (1.06)
60A253C□	252.5 (9.94)	237.5 (9.35)	180 (7.09)	37.5 (1.48)	60 (2.36)	135 (5.31)	5 (0.20)	8 (0.31)	0.82 (1.81)
60A365C□	365 (14.37)	350 (13.76)	315 (12.40)	30 (1.18)	52.5 (2.07)	270 (10.53)	8 (0.31)	14 (0.55)	1.16 (2.56)

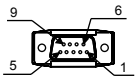
* The value indicates the mass of coil assembly with a hall sensor unit.

(2) Coil Assembly: SGLGW-60A□□□C□D With a connector made by Interconnectron

The following table and figures show the specifications when a main circuit's cable connector made by Interconnectron is used for the coil assembly.



Hall Sensor Connector Specifications



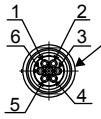
Pin connector type:
17JE-23090-02 (D8C)
made by DDK Ltd.

The mating connector

Sockt connector type:
17JE-13090-02 (D8C)
Stud type: 17L-002C or
17L-002C1

Pin No.	Name
1	+5V (Power supply)
2	Phase U
3	Phase V
4	Phase W
5	0V (Power supply)
6	Not used
7	Not used
8	Not used
9	Not used

Linear Servomotor Connector Specifications



Extension: SROC06JMSCN169
Pin type: 021.423.1020
made by Interconnectron

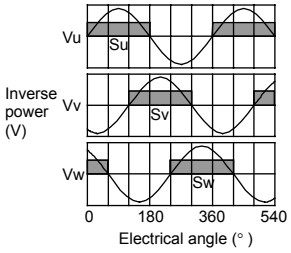
The mating connector

Plug type: SPUC06KFSDN236
Socket type: 020.030.1020

Pin No.	Name	Lead Color
1	Phase U	Red
2	Phase V	White
3	Phase W	Blue
4	Not used	–
5	Not used	–
6	FG	Green

Hall Sensor Output Signals

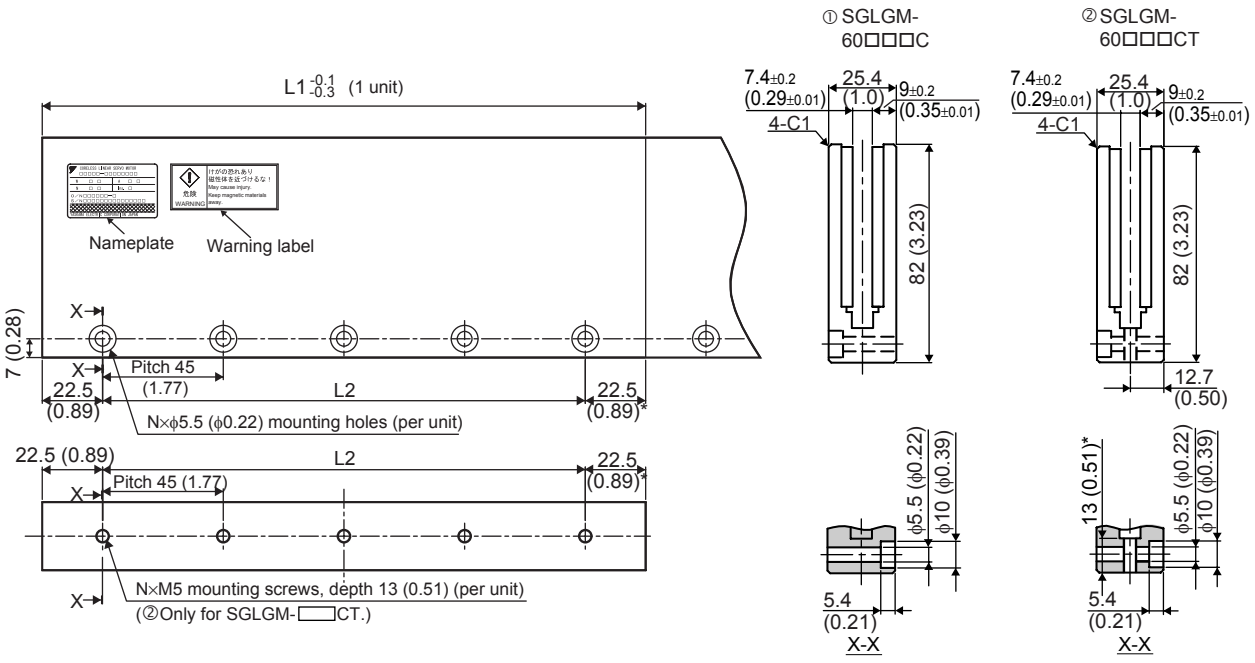
When the coil assembly moves in the direction indicated by the arrow in the figure, the relationship between the hall sensor output signals Su, Sv, Sw and the inverse power of each motor phase Vu, Vv, Vw becomes as shown in the figure below.



Coil Assembly Model SGLGW-	L1	L2	L3	L4	L5	L6	N1	N2	Approx. Mass* kg (lb)
60A140C□D	140 (5.51)	125 (4.92)	90 (3.54)	30 (1.18)	52.5 (2.07)	45 (1.77)	3 (0.12)	4 (0.16)	0.48 (1.06)
60A253C□D	252.5 (9.94)	237.5 (9.35)	180 (7.09)	37.5 (1.48)	60 (2.36)	135 (5.31)	5 (0.20)	8 (0.31)	0.82 (1.81)
60A365C□D	365 (14.37)	350 (13.76)	315 (12.40)	30 (1.18)	52.5 (2.07)	270 (10.53)	8 (0.31)	14 (0.55)	1.16 (2.56)

* The value indicates the mass of coil assembly with a hall sensor unit.

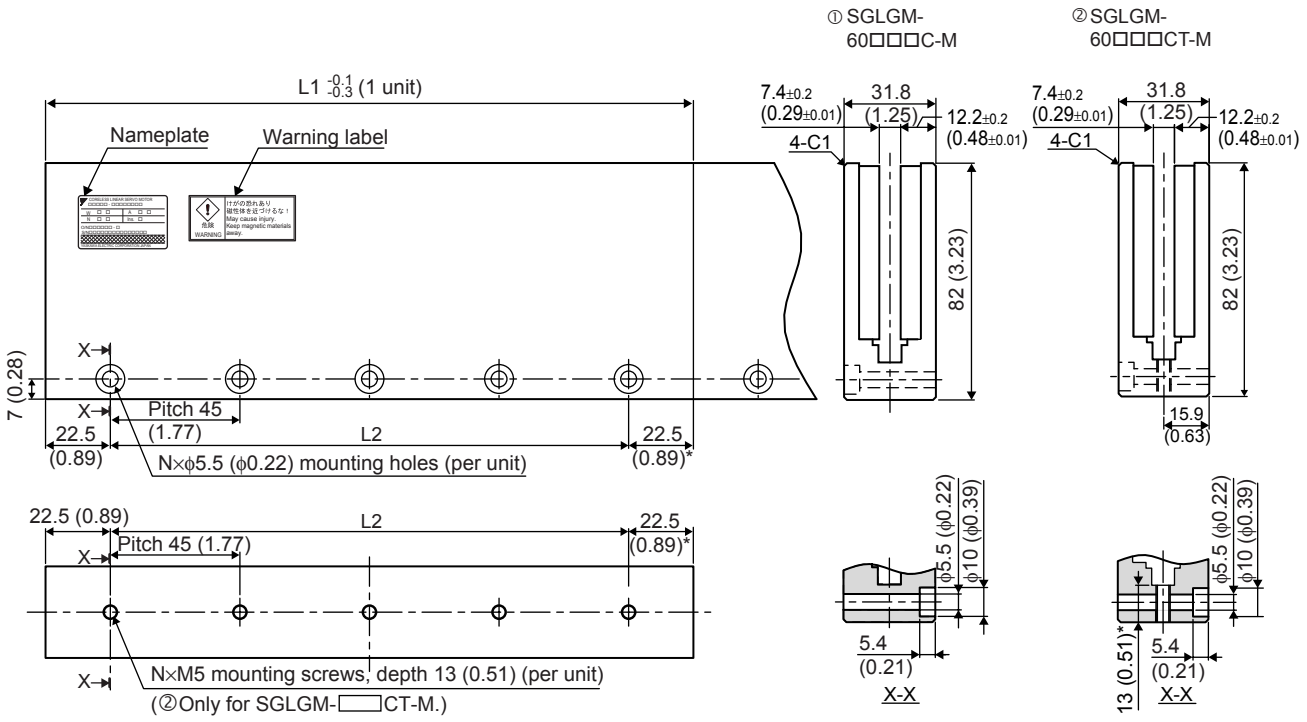
(3) Standard-force Magnetic Way: SGLGM-60□□□C / SGLGM-60□□□CT



* Reference length
Units: mm (in)

Standard-force Magnetic Way Model SGLGM-		L1	L2	N	Approx. Mass kg (lb)
Standard Force	60090C or 60090CT	90 (3.54)	45 (1.77)	2 (0.08)	1.1 (2.43)
	60225C or 60225CT	225 (8.86)	180 (7.09)	5 (0.20)	2.6 (5.73)
	60360C or 60360CT	360 (14.17)	315 (12.40)	8 (0.31)	4.1 (9.04)
	60405C or 60405CT	405 (15.94)	360 (14.17)	9 (0.35)	4.6 (10.14)
	60450C or 60450CT	450 (17.72)	405 (15.94)	10 (0.39)	5.1 (11.24)

(4) High-force Magnetic Way: SGLGM-60□□□C-M / SGLGM-60□□□CT-M

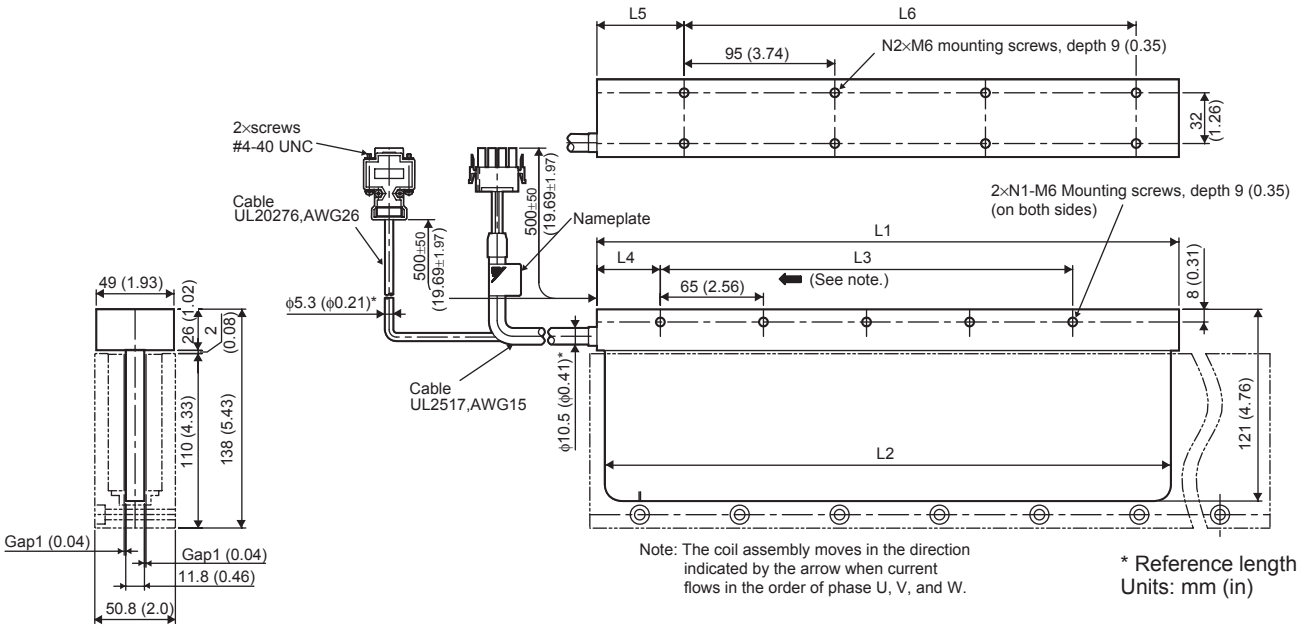


* Reference length
Units: mm (in)

High-force Magnetic Way Model SGLGM-		L1	L2	N	Approx. Mass kg (lb)
High Force	60090C-M or 60090CT-M	90 (3.54)	45 (1.77)	2 (0.08)	1.3 (2.87)
	60225C-M or 60225CT-M	225 (8.86)	180 (7.09)	5 (0.20)	3.3 (7.28)
	60360C-M or 60360CT-M	360 (14.17)	315 (12.40)	8 (0.31)	5.2 (11.46)
	60405C-M or 60405CT-M	405 (15.94)	360 (14.17)	9 (0.35)	5.9 (13.01)
	60450C-M or 60450CT-M	450 (17.72)	405 (15.94)	10 (0.39)	6.6 (14.55)

3.6.4 SGLG□-90 Linear Servomotors

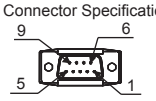
(1) Coil Assembly: SGLGW-90A□□□C□



Note: The coil assembly moves in the direction indicated by the arrow when current flows in the order of phase U, V, and W.

* Reference length
Units: mm (in)

Hall Sensor Connector Specifications



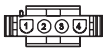
Pin connector type:
17JE-23090-02(D8C)
made by DDK Ltd.

The mating connector

Socket connector type:
17JE-13090-02(D8C)
Stud type: 17L-002C or
17L-002C1

Pin No.	Name
1	+5V (Power supply)
2	Phase U
3	Phase V
4	Phase W
5	0V (Power supply)
6	Not used
7	Not used
8	Not used
9	Not used

Linear Servomotor Connector Specifications



Plug type: 350779-1
Pin type: 350218-3 or
350547-3 (No.1 to 3)
350654-1
350669-1 (No.4)
made by Tyco Electronics AMP K.K.

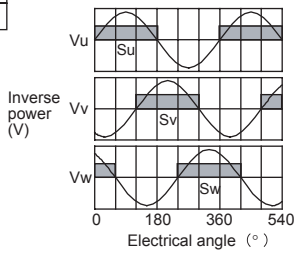
The mating connector

Cap type: 350780-1
Socket type: 350536-3 or
350550-3

Pin No.	Name	Lead Color
1	Phase U	Red
2	Phase V	White
3	Phase W	Blue
4	FG	Green

Hall Sensor Output Signals

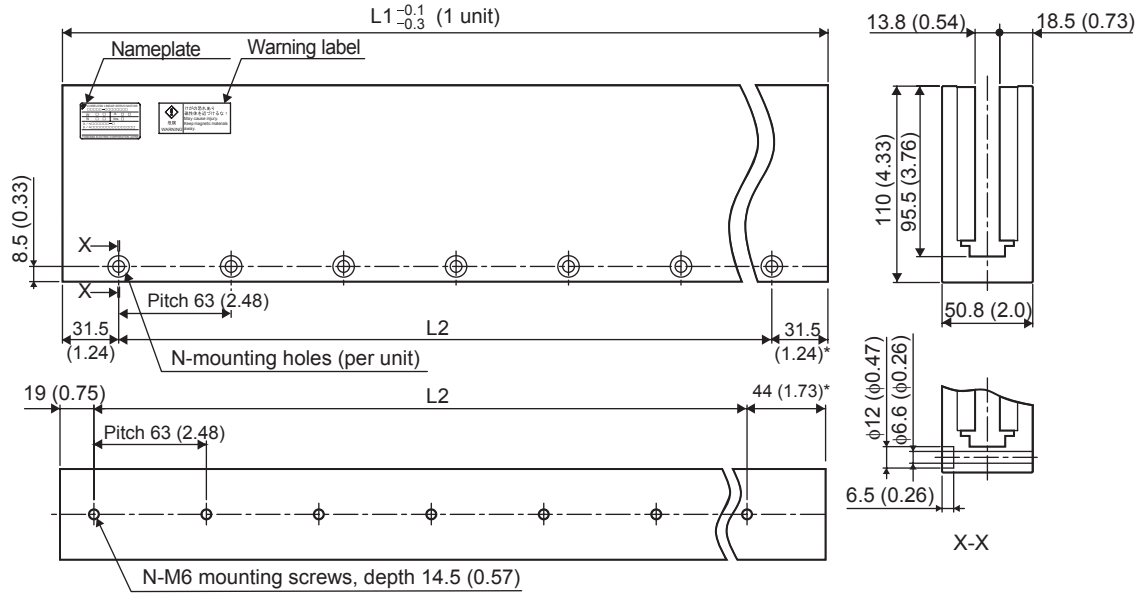
When the coil assembly moves in the direction indicated by the arrow in the figure, the relationship between the hall sensor output signals Su, Sv, Sw and the inverse power of each motor phase Vu, Vv, Vw becomes as shown in the figure below.



Coil Assembly Model SGLGW-	L1	L2	L3	L4	L5	L6	N1	N2	Approx. Mass* kg (lb)
90A200C□	199 (7.83)	189 (7.44)	130 (5.12)	40 (1.57)	60 (2.36)	95 (3.74)	3 (0.12)	4 (0.16)	2.2 (4.85)
90A370C□	367 (14.45)	357 (14.06)	260 (10.24)	40 (1.57)	55 (2.17)	285 (11.22)	5 (0.20)	8 (0.31)	3.7 (8.16)
90A535C□	535 (21.06)	525 (20.67)	455 (17.91)	40 (1.57)	60 (2.36)	380 (14.96)	8 (3.15)	10 (0.39)	5.0 (11.02)

* The value indicates the mass of coil assembly with a hall sensor unit.

(2) Magnetic Way: SGLGM-90□□□A



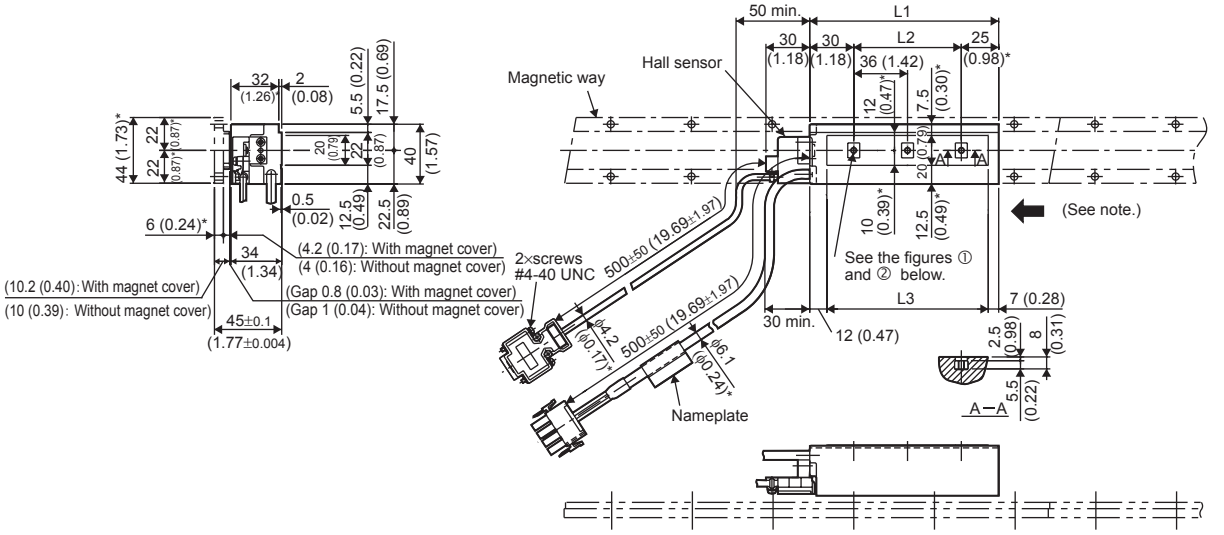
* Reference length
Units: mm (in)

Magnetic Way Model SGLGM-	L1	L2	N	Approx. Mass kg (lb)
90252A	252 (9.92)	189 (7.44)	4 (0.16)	7.3 (16.09)
90504A	504 (19.84)	441 (17.36)	8 (0.31)	14.7 (32.41)

3.7 Dimensional Drawings of SGLFW/SGLFM Linear Servomotors

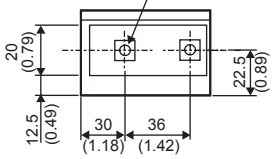
3.7.1 SGLF□-20 Linear Servomotors

(1) Coil Assembly: SGLFW-20A□□□A□

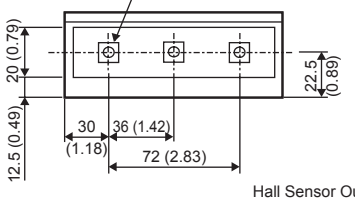


Note: The coil assembly moves in the direction indicated by the arrow, when current flows in the order of phase U, V, and W.

① SGLFW-20A090A□

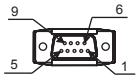


② SGLFW-20A120A□



* Reference length
Units: mm (in)

Hall Sensor Connector Specifications



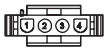
Pin connector type:
17JE-23090-02(D8C)
made by DDK Ltd.

The mating connector

Socket connectoro type:
17JE-13090-02(D8C)
Stud type: 17L-002C or
17L-002C1

Pin No.	Name
1	+5V (Power supply)
2	Phase U
3	Phase V
4	Phase W
5	0V (Power supply)
6	Not used
7	Not used
8	Not used
9	Not used

Linear Servomotor Connector Specifications



Plug type: 350779-1
Pin type: 350218-3 or
350547-3 (No.1 to 3)
350654-1
350669-1 (No.4)
made by Tyco Electronics AMP K.K.

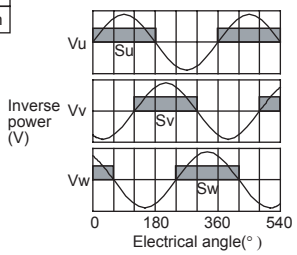
The mating connector

Cap type: 350780-1
Socket type: 350536-3 or
350550-3

Pin No.	Name	Lead Color
1	Phase U	Red
2	Phase V	White
3	Phase W	Black
4	FG	Green

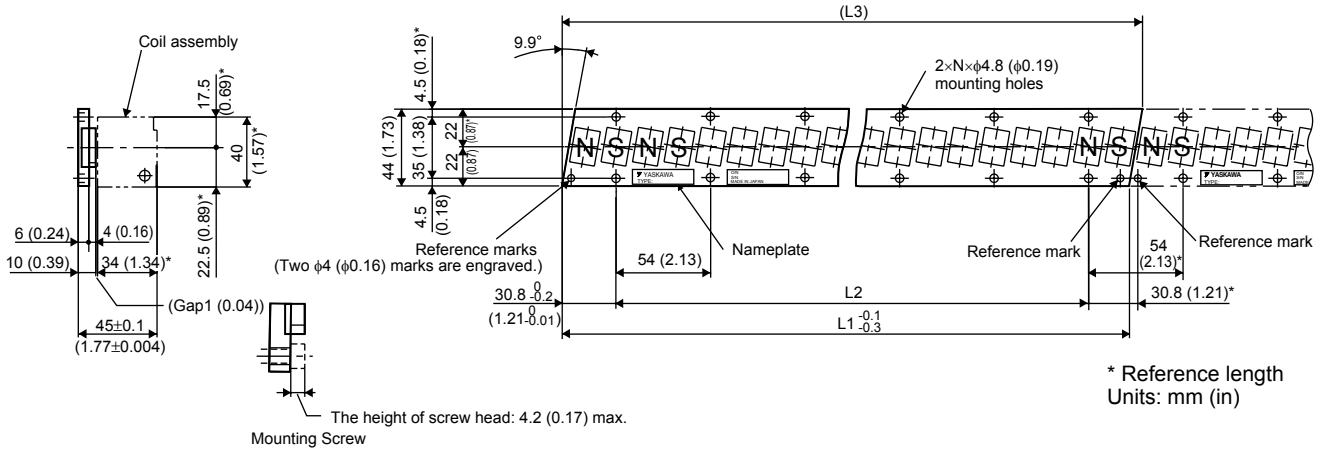
Hall Sensor Output Signals

When the coil assembly moves in the direction indicated by the arrow in the figure, the relationship between the hall sensor output signals Su, Sv, Sw and the inverse power of each motor phase Vu, Vv, Vw becomes as shown in the figure below.



Coil Assembly Model SGLFW-	L1	L2	L3	N	Approx. Mass kg (lb)
20A090A□	91 (3.58)	36 (1.42)	72 (2.88)	2 (0.08)	0.7 (1.54)
20A120A□	127 (5.0)	72 (2.83)	108 (4.25)	3 (0.12)	0.9 (1.98)

(2) Magnetic Way: SGLFM-20□□□A



Note: 1. Multiple SGLFM-20□□□A magnetic ways can be connected. Connect magnetic ways so that the reference marks match one on the other in the same direction as shown in the figure.
2. The magnet way may affect pacemakers. Keep a minimum distance of 200 mm from the magnetic way.

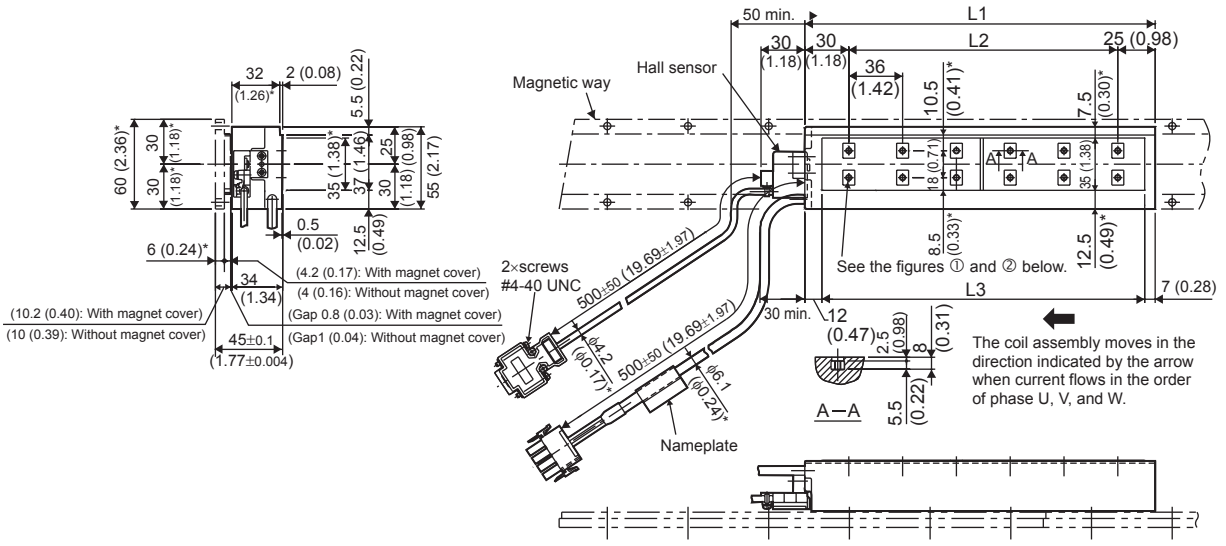
Magnetic Way Model SGLFM-	L1 -0.1 -0.3	L2	L3*	N	Approx. Mass kg (lb)
20324A	324 (12.80)	270 (10.63) (54 (2.13) × 5 (0.20))	331.6 (13.06)	6 (0.24)	0.9 (1.98)
20540A	540 (21.26)	486 (19.13) (54 (2.13) × 9 (0.35))	547.6 (21.56)	10 (0.39)	1.4 (3.09)
20756A	756 (29.76)	702 (27.64) (54 (2.13) × 13 (0.51))	763.6 (30.06)	14 (0.55)	2 (4.41)

* Reference length

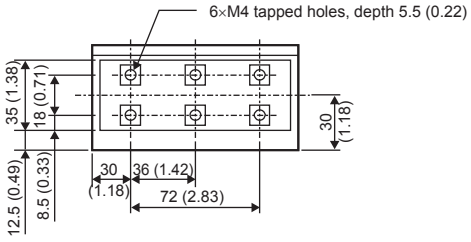
3.7.2 SGLF□-35 Linear Servomotors

(1) Coil Assembly: SGLFW-35□□□□A□
With a connector made by Tyco Electronics AMP K.K.

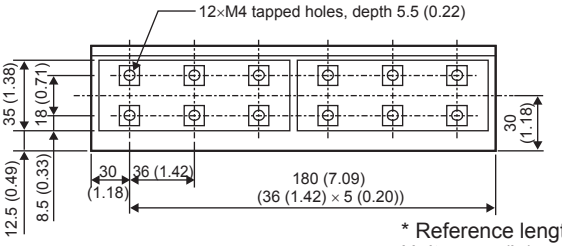
The following table and figures show the specifications when a main circuit's cable connector made by Tyco Electronics is used for the coil assembly.



① SGLFW-35□120A□

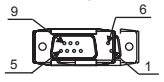


② SGLFW-35□230A□



* Reference length
Units: mm (in)

Hall Sensor Connector Specifications



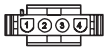
Pin connector type:
7JE-23090-02(D8C)
made by DDK Ltd.

The mating connector

Socket connector type:
17JE-13090-02(D8C)
Stud type: 17L-002C or
17L-002C1

Pin No.	Name
1	+5V (Power supply)
2	Phase U
3	Phase V
4	Phase W
5	0V (Power supply)
6	Not used
7	Not used
8	Not used
9	Not used

Linear Servomotor Connector Specifications



Plug type: 350779-1
Pin type: 350218-3 or
350547-3 (No.1 to 3)
350654-1
350669-1 (No.4)
made by Tycon Electronics AMP K.K.

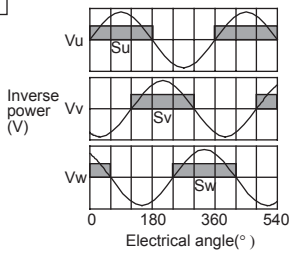
The mating connector

Cap type: 350780-1
Socket type: 350536-3 or
350550-3

Pin No.	Name	Lead Color
1	Phase U	Red
2	Phase V	White
3	Phase W	Black
4	FG	Green

Hall Sensor Output Signals

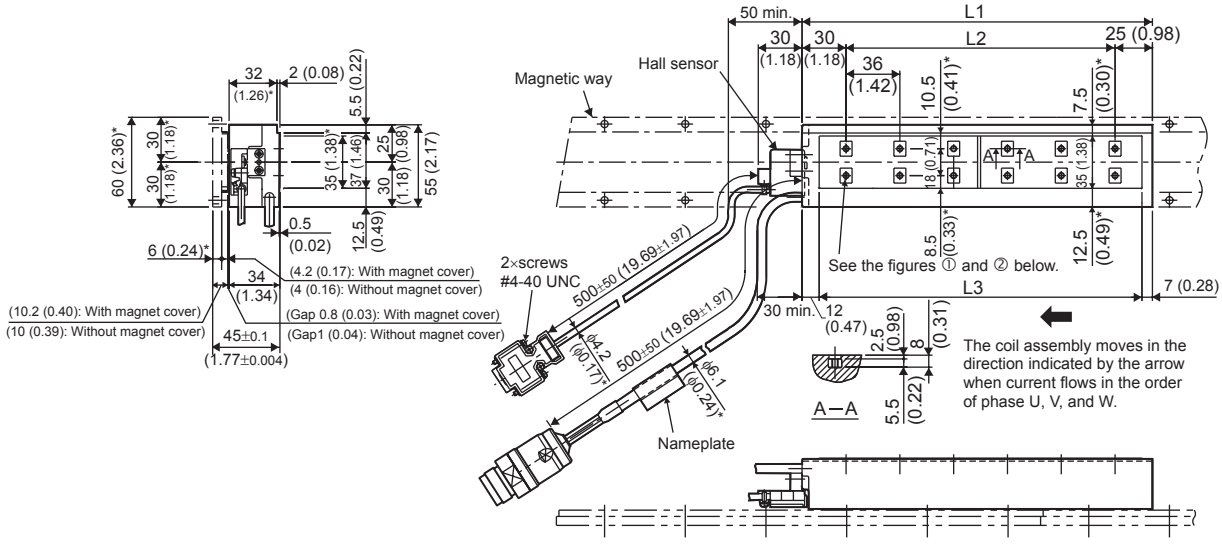
When the coil assembly moves in the direction indicated by the arrow in the figure, the relationship between the hall sensor output signals Su, Sv, Sw and the inverse power of each motor phase Vu, Vv, Vw becomes as shown in the figure below.



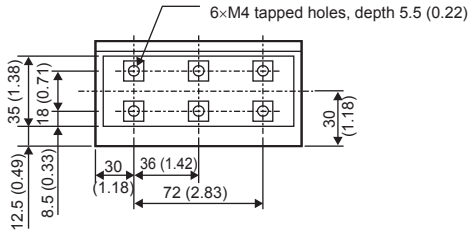
Coil Assembly Model SGLFW-	L1	L2	L3	N	Approx. Mass kg (lb)
35□120A□	127 (5.0)	72 (2.83)	108 (4.25)	6 (0.24)	1.3 (2.87)
35□230A□	235 (9.25)	180 (7.09)	216 (8.50)	12 (0.47)	2.3 (5.07)

(2) Coil Assembly: SGLFW-35D□□□A□D With a connector made by Interconnectron

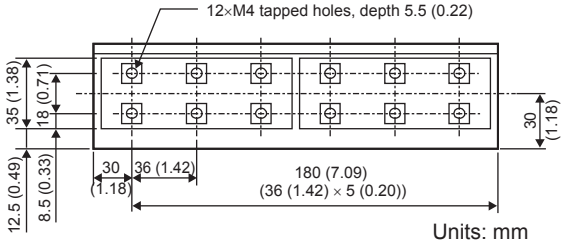
The following table and figures show the specifications when a main circuit's cable connector made by Interconnectron is used for the coil assembly.



① SGLFW-35D120A□D

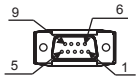


② SGLFW-35D230A□D



Units: mm

Hall Sensor Connector Specifications



Pin connector type:
7JE-23090-02 (D8C)
made by DDK Ltd.

The mating connector

Socket connector type:
17JE-13090-02 (D8C)
Stud type: 17L-002C or
17L-002C1

Pin No.	Name
1	+5V (Power supply)
2	Phase U
3	Phase V
4	Phase W
5	0V (Power supply)
6	Not used
7	Not used
8	Not used
9	Not used

Linear Servomotor Connector Specifications



Extension: LRRA06AMRPN182
Pin type: 021.279.1020
made by Interconnectron

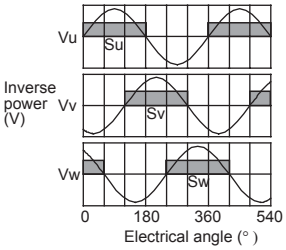
The mating connector

Plug type: LPRA06BFRDN170
Socket type: 020.105.1020

Pin No.	Name
1	Phase U
2	Phase V
4	Phase W
5	Not used
6	Not used
⏚	Ground

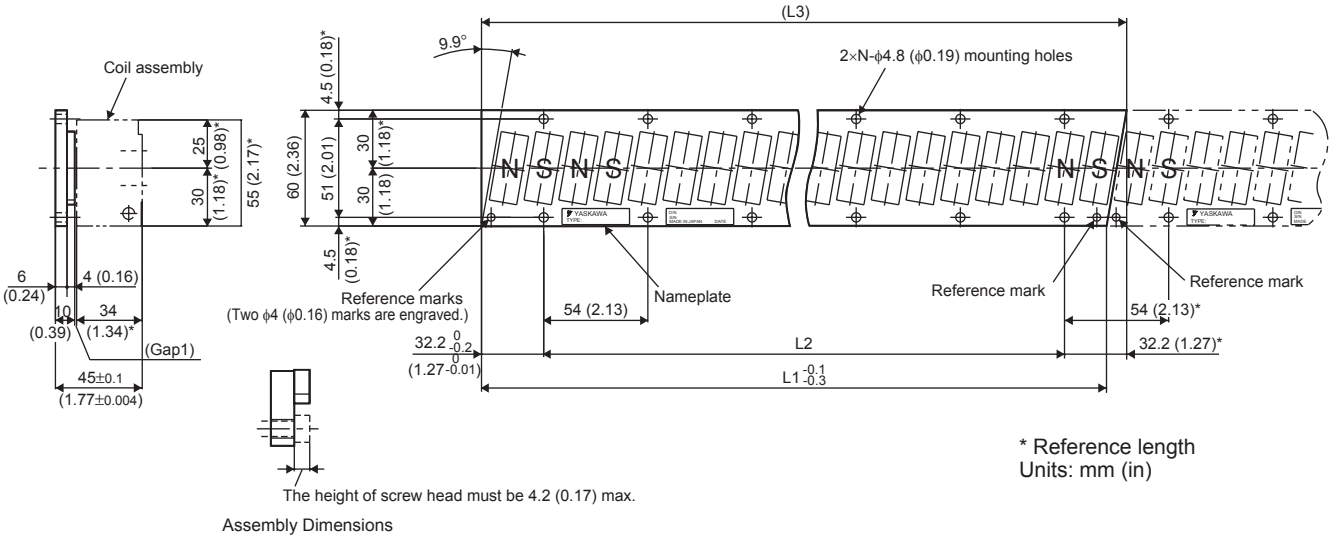
Hall Sensor Output Signals

When the coil assembly moves in the direction indicated by the arrow in the figure, the relationship between the hall sensor output signals Su, Sv, Sw and the inverse power of each motor phase Vu, Vv, Vw becomes as shown in the figure below.



Coil Assembly Model SGLFW-	L1	L2	L3	N	Approx. Mass kg (lb)
35D120A□D	127 (5.0)	72 (2.83)	108 (4.25)	6 (0.24)	1.3 (2.87)
35D230A□D	235 (9.25)	180 (7.09)	216 (8.50)	12 (0.47)	2.3 (5.07)

(3) Magnetic Way: SGLFM-35□□□A



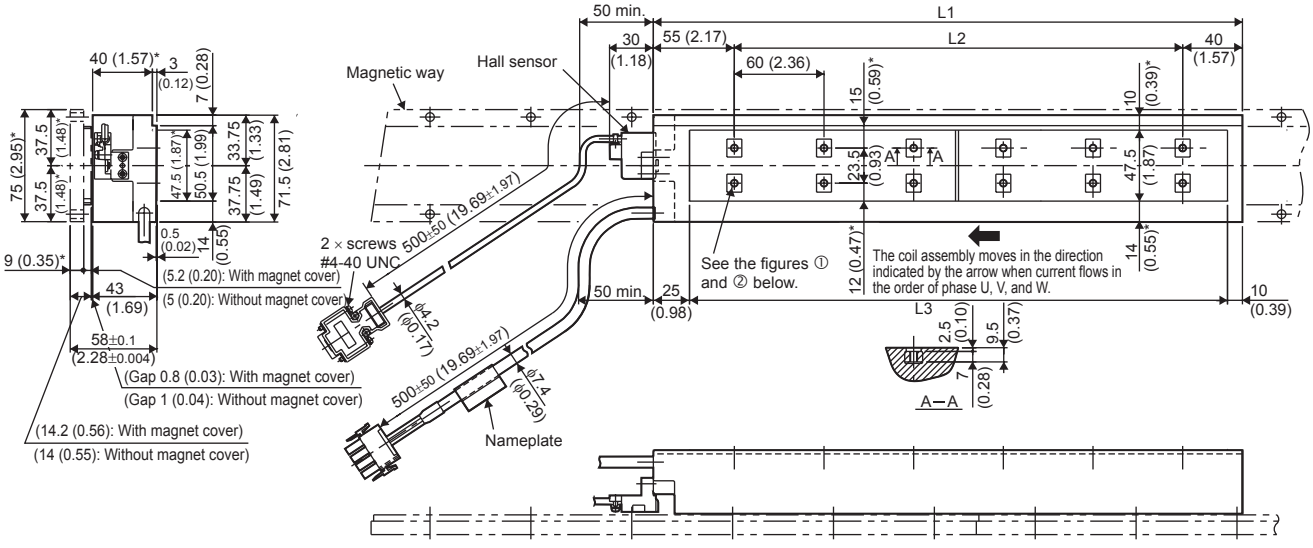
Note: 1. Multiple SGLFM-35□□□A magnetic ways can be connected. Connect magnetic ways so that the reference marks match one on the other in the same direction as shown in the figure.
2. The magnetic way may affect pacemakers. Keep a minimum distance of 200 mm from the magnetic way.

Magnetic Way Model SGLFM-	L1 -0.1 -0.3	L2	(L3)	N	Approx. Mass kg (lb)
35324A	324 (12.80)	270 (10.63) (54 (2.13) × 5 (0.20))	334.4 (13.17)	6 (0.24)	1.2 (2.65)
35540A	540 (21.26)	486 (19.13) (54 (2.13) × 9 (0.35))	550.4 (21.67)	10 (0.39)	2 (4.41)
35756A	756 (29.76)	702 (27.64) (54 (2.13) × 13 (0.51))	766.4 (30.17)	14 (0.55)	2.9 (6.39)

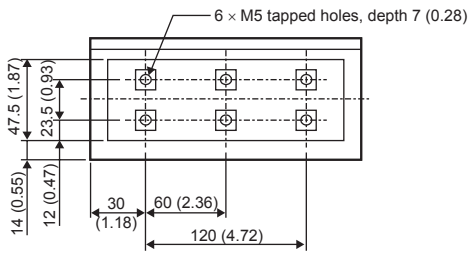
3.7.3 SGLF□-50 Linear Servomotors

(1) Coil Assembly: SGLFW-50□□□□B□
With a connector made by Tyco Electronics AMP K.K.

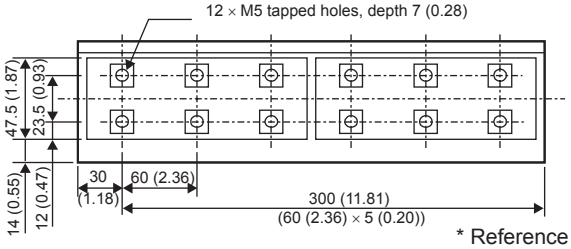
The following table and figures show the specifications when a main circuit's cable connector made by Tyco Electronics is used for the coil assembly.



① SGLFW-50□200B□

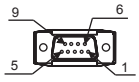


② SGLFW-50□380B□



* Reference length
Units: mm (in)

Hall Sensor
Connector Specifications



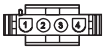
Pin connector type:
17JE-23090-02(D8C)
made by DDK Ltd.

The mating connector

Socket connector type:
17JE-13090-02(D8C)
Stud type: 17L-002C or
17L-002C1

Pin No.	Name
1	+5V (Power supply)
2	Phase U
3	Phase V
4	Phase W
5	0V (Power supply)
6	Not used
7	Not used
8	Not used
9	Not used

Linear Servomotor
Connector Specifications



Plug type: 350779-1
Pin type: 350218-3 or
350547-3 (No.1 to 3)
350654-1
350669-1 (No.4)
made by Tycon Electronics AMP K.K.

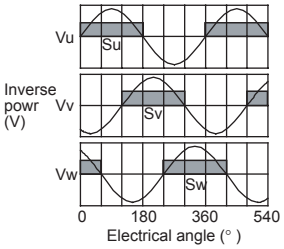
The mating connector

Cap type: 350780-1
Socket type: 350536-3 or
350550-3

Pin No.	Name	Lead Color
1	Phase U	Red
2	Phase V	White
3	Phase W	Black
4	FG	Green

Hall Sensor Output Signals

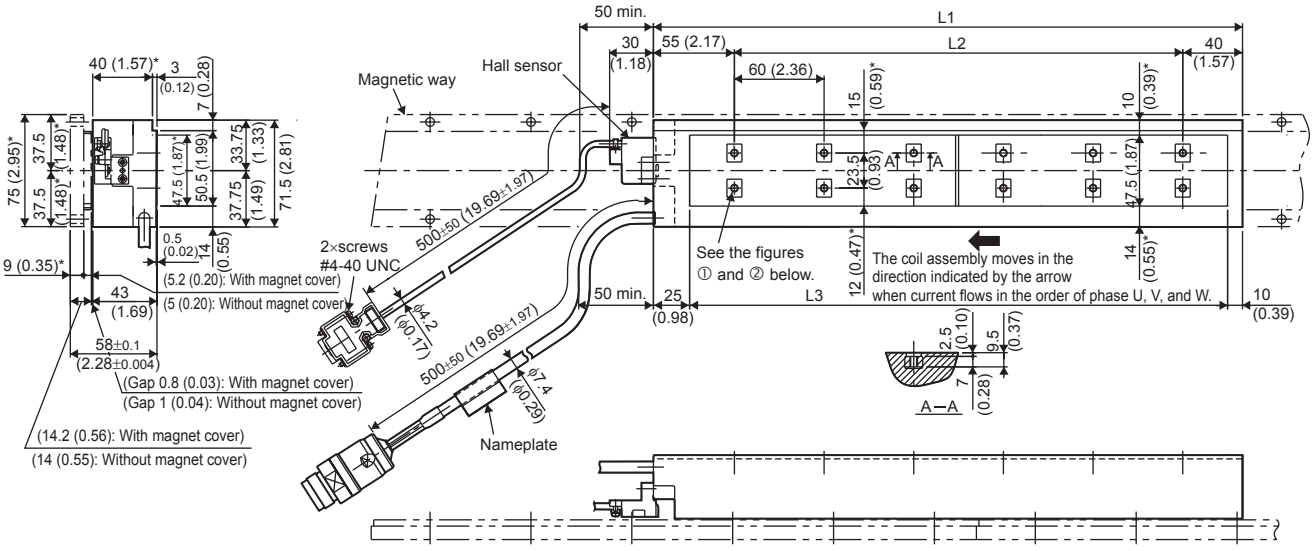
When the coil assembly moves in the direction indicated by the arrow in the figure, the relationship between the hall sensor output signals Su, Sv, Sw and the inverse power of each phase Vu, Vv, Vw becomes as shown in the figure below.



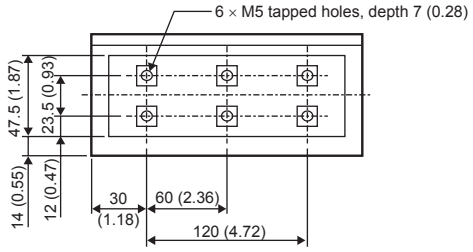
Coil Assembly Model SGLFW-	L1	L2	L3	N	Approx. Mass kg (lb)
50□200B□	215 (8.46)	120 (4.72)	180 (7.09)	6 (0.24)	3.5 (7.72)
50□380B□	395 (15.55)	300 (11.81)	360 (14.17)	12 (0.47)	6.9 (15.21)

(2) Coil Assembly: SGLFW-50D□□□B□D With a connector made by Interconnectron

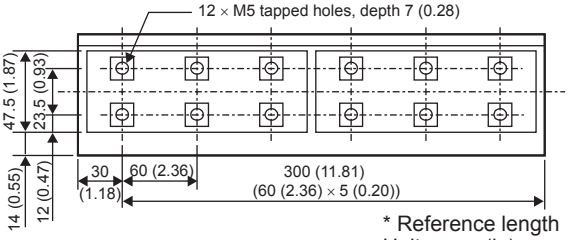
The following table and figures show the specifications when a main circuit's cable connector made by Interconnectron is used for the coil assembly.



① SGLFW-50D200B□D



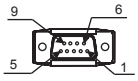
② SGLFW-50D380B□D



* Reference length

Units: mm (in)

Hall Sensor Connector Specifications



Pin connector type:
7JE-23090-02 (D8C)
made by DDK Ltd.

The mating connector

Socket connector type:
17JE-13090-02 (D8C)
Stud type: 17L-002C or
17L-002C1

Pin No.	Name
1	+5V (Power supply)
2	Phase U
3	Phase V
4	Phase W
5	0V (Power supply)
6	Not used
7	Not used
8	Not used
9	Not used

Linear Servomotor Connector Specifications



Extension: LRRA06AMRPN182
Pin type: 021.279.1020
made by Interconnectron

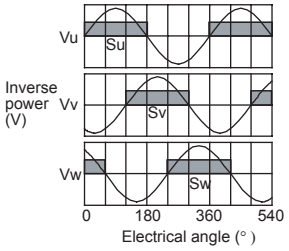
The mating connector

Plug type: LPRA06BFRDN170
Socket type: 020.105.1020

Pin No.	Name
1	Phase U
2	Phase V
4	Phase W
5	Not used
6	Not used
⏚	Ground

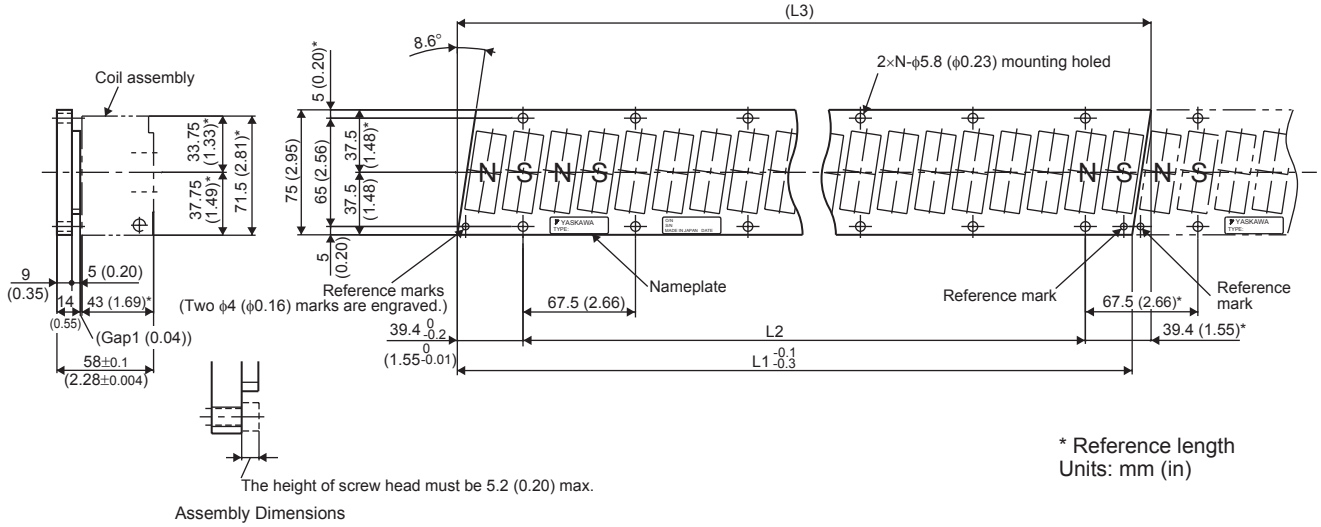
Hall Sensor Output Signals

When the coil assembly moves in the direction indicated by the arrow in the figure, the relationship between the hall sensor output signals Su, Sv, Sw and the inverse power of each motor phase Vu, Vv, Vw becomes as shown in the figure below.



Coil Assembly Model SGLFW-	L1	L2	L3	N	Approx. Mass kg (lb)
50D200B□D	215 (8.46)	120 (4.72)	180 (7.09)	6 (0.24)	3.5 (7.72)
50D380B□D	395 (15.55)	300 (11.81)	360 (14.17)	12 (0.47)	6.9 (15.21)

(3) Magnetic Way: SGLFM-50□□□A



Note: 1. Multiple SGLFM-50□□□A magnetic ways can be connected. Connect magnetic ways so that the reference marks match one on the other in the same direction as shown in the figure.
2. The magnetic way may affect pacemakers. Keep a minimum distance of 200 mm from the magnetic way.

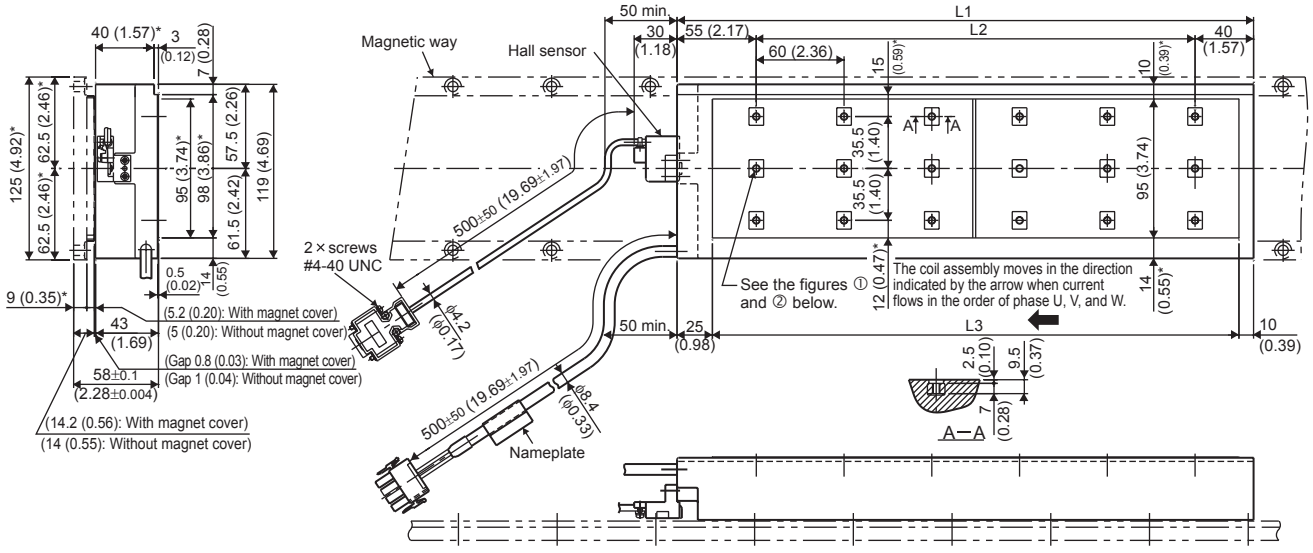
Magnetic Way Model SGLFM-	L1 -0.1 -0.3	L2	L3*	N	Approx. Mass kg (lb)
50405A	405 (15.94)	337.5 (13.29) (67.5 (2.66) × 5 (0.20))	416.3 (16.39)	6 (0.24)	2.8 (6.17)
50675A	675 (26.57)	607.5 (23.92) (67.5 (2.66) × 9 (0.35))	686.3 (27.03)	10 (0.39)	4.6 (10.14)
50945A	945 (37.20)	877.5 (34.55) (67.5 (2.66) × 13 (0.51))	956.3 (37.65)	14 (0.55)	6.5 (14.33)

* Reference length

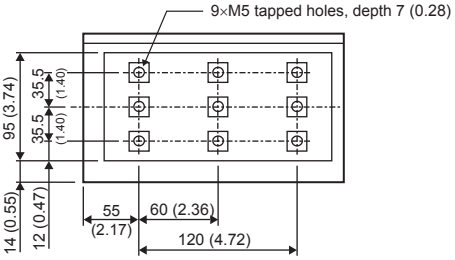
3.7.4 SGLF□-1Z Linear Servomotors

(1) Coil Assembly: SGLFW-1Z□□□□B□ With a connector made by Tyco Electronics AMP K.K.

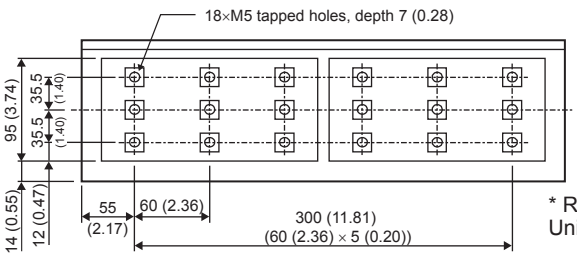
The following table and figures show the specifications when a main circuit's cable connector made by Tyco Electronics is used for the coil assembly.



① SGLFW-1Z□200B□

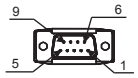


② SGLFW-1Z□380B□



* Reference length
Units: mm (in)

Hall Sensor Connector Specifications



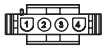
Pin connectoro type:
17JE-23090-02(D8C)
made by DDK Ltd.

The mating connector

Socket connector type:
17JE-13090-02(D8C)
Stud type: 17L-002C or
17L-002C1

Pin No.	Name
1	+5V (Power supply)
2	Phase U
3	Phase V
4	Phase W
5	0V (Power supply)
6	Not used
7	Not used
8	Not used
9	Not used

Linear Servomotor Connector Specifications



Plug type: 350779-1
Pin type: 350218-3 or
350547-3 (No.1 to 3)
350654-1
350669-1 (No.4)
made by Tyco Electronics AMP K.K.

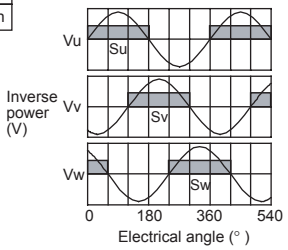
The mating connector

Cap type: 350780-1
Socket type: 350536-3 or
350550-3

Pin No.	Name	Lead Color
1	Phase U	Red
2	Phase V	White
3	Phase W	Blue
4	FG	Green

Hall Sensor Output Signals

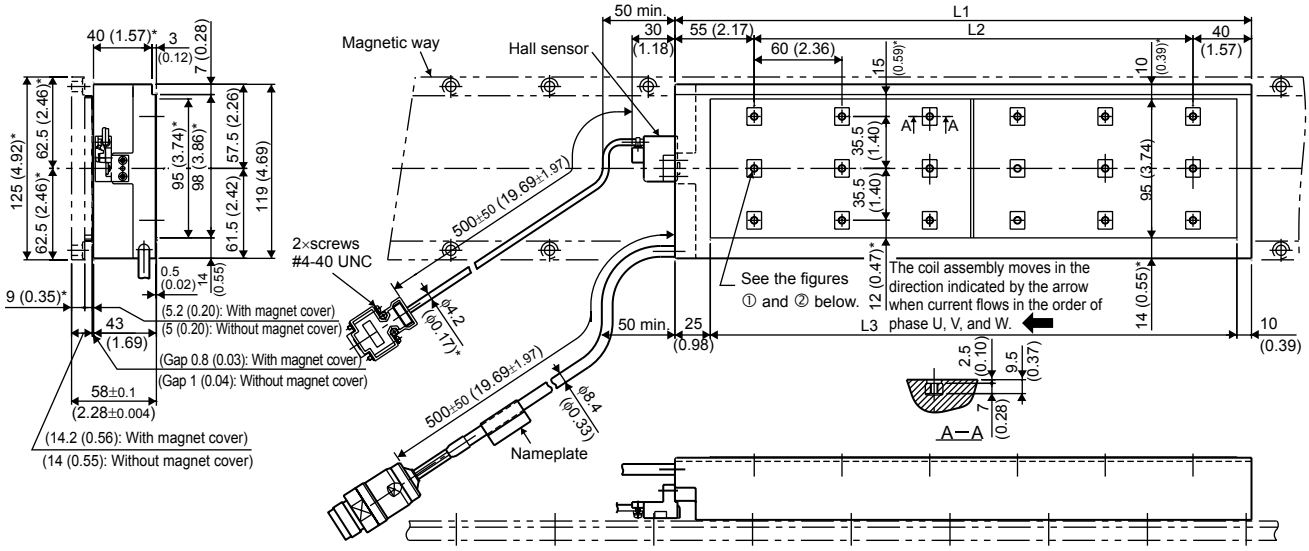
When the coil assembly moves in the direction indicated by the arrow in the figure, the relationship between the hall sensor output signals Su, Sv, Sw and the inverse power of each motor phase Vu, Vv, Vw becomes as shown in the figure below.



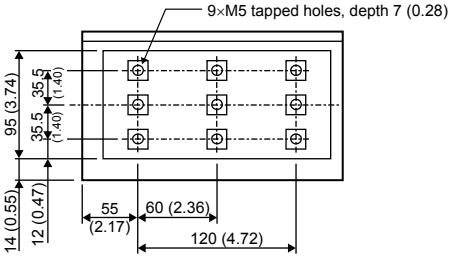
Coil Assembly Model SGLFW-	L1	L2	L3	N	Approx. Mass kg (lb)
1Z□200B□	215 (8.46)	120 (4.72)	180 (7.09)	9 (0.35)	6.4 (14.11)
1Z□380B□	395 (15.55)	300 (11.81)	360 (14.17)	18 (0.71)	11.5 (25.35)

(2) Coil Assembly: SGLFW-1ZD□□□B□D
With a connector made by Interconnectron

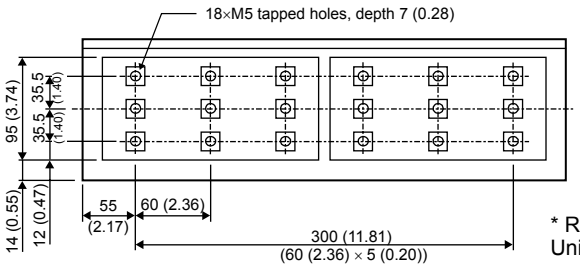
The following table and figures show the specifications when a main circuit's cable connector made by Interconnectron is used for the coil assembly.



① SGLFW-1ZD200B□D

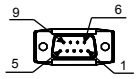


② SGLFW-1ZD380B□



* Reference length
Units: mm (in)

Hall Sensor
Connector Specifications



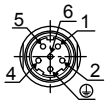
Pin connector type:
17JE-23090-02 (D8C)
made by DDK Ltd.

The mating connector

Socket connector type: 17JE-13090-02 (D8C) Stud type: 17L-002C or 17L-002C1

Pin No.	Name
1	+5V (Power supply)
2	Phase U
3	Phase V
4	Phase W
5	0V (Power supply)
6	Not used
7	Not used
8	Not used
9	Not used

Linear Servomotor
Connector Specifications



Extension: LRRA06AMRPN182
Pin type: 021.279.1020
made by Interconnectron

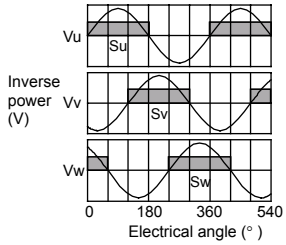
The mating connector

Plug type: LPRA06BFRDN170 Socket type: 020.105.1020

Pin No.	Name
1	Phase U
2	Phase V
4	Phase W
5	Not used
6	Not used
⏚	Ground

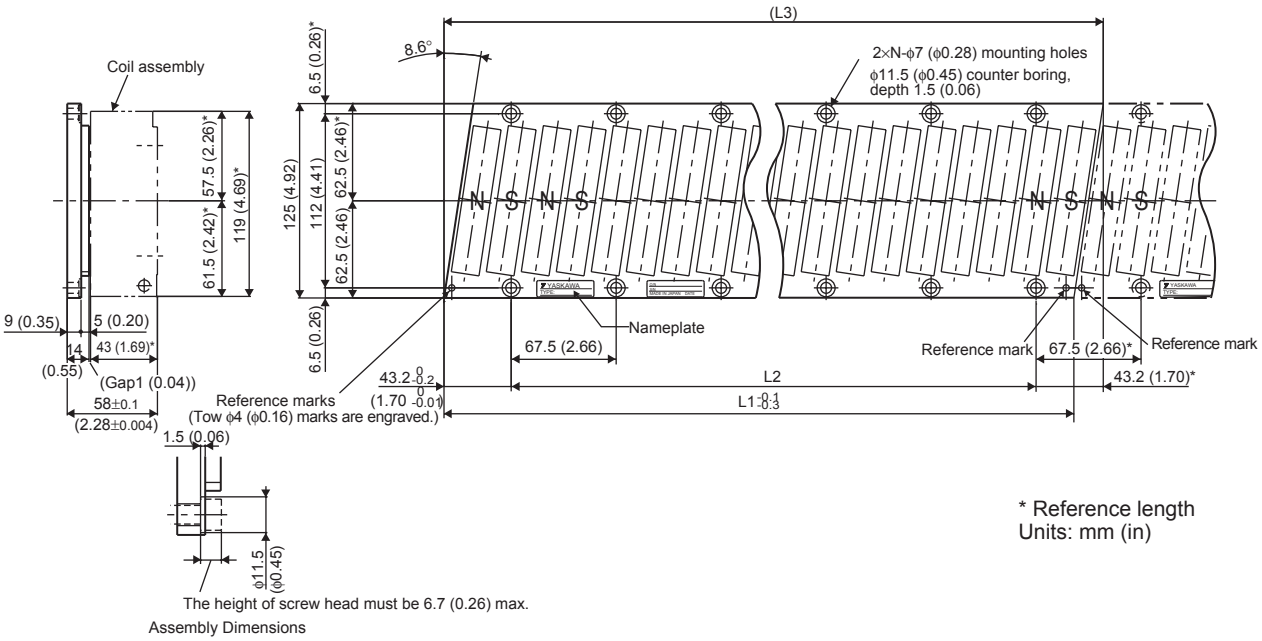
Hall Sensor Output Signals

When the coil assembly moves in the direction indicated by the arrow in the figure, the relationship between the hall sensor output signals Su, Sv, Sw and the inverse power of each motor phase Vu, Vv, Vw becomes as shown in the figure below.



Coil Assembly Model SGLFW-	L1	L2	L3	N	Approx. Mass kg (lb)
1ZD200B□D	215 (8.46)	120 (4.72)	180 (7.09)	9 (0.35)	6.4 (14.11)
1ZD380B□D	395 (15.55)	300 (11.81)	360 (14.17)	18 (0.71)	11.5 (25.35)

(3) Magnetic Way: SGLFM-1Z□□□A



Note: 1. Multiple SGFLM-1Z□□□A magnetic ways can be connected. Connect magnetic ways so that the reference marks match one on the other in the same direction.
2. The magnetic way may affect pacemakers. Keep a minimum distance of 200 mm from the magnetic way.

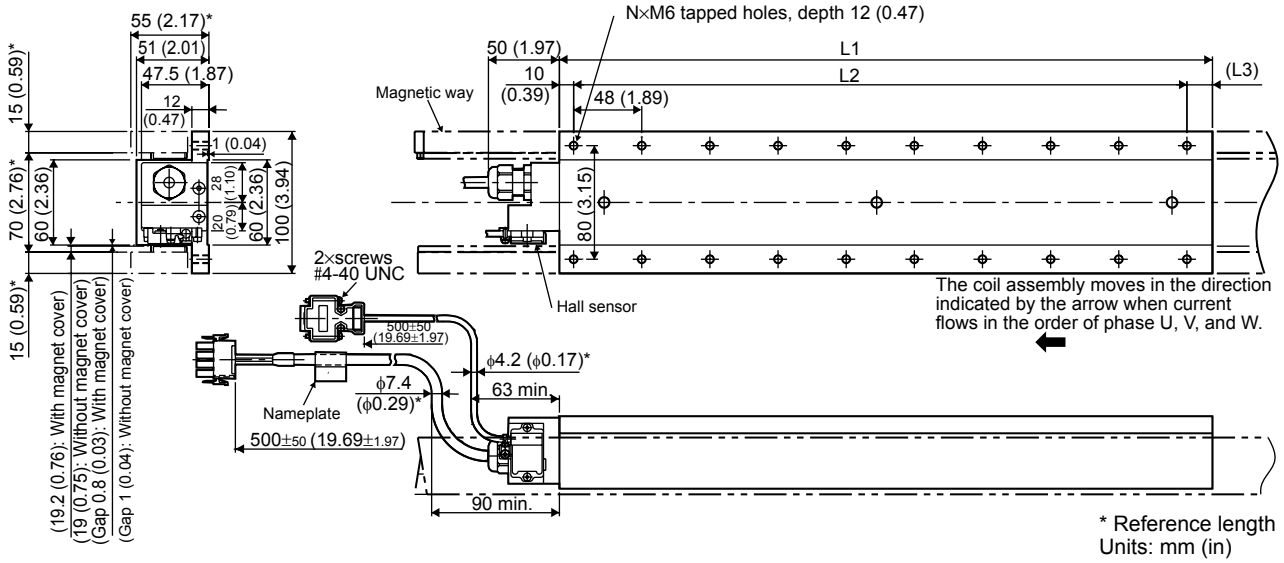
Magnetic Way Model SGLFM-	L1 -0.1 -0.3	L2	L3*	N	Approx. Mass kg (lb)
1Z405A	405 (15.94)	337.5 (13.29) (67.5 (2.66) × 5 (0.20))	423.9 (16.69)	6 (0.24)	5 (11.02)
1Z675A	675 (26.57)	607.5 (23.92) (67.5 (2.66) × 9 (0.35))	693.9 (27.32)	10 (0.39)	8.3 (18.30)
1Z945A	945 (37.20)	877.5 (34.55) (67.5 (2.66) × 13 (0.51))	963.9 (37.95)	14 (0.55)	12 (26.46)

* Reference length

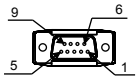
3.8 Dimensional Drawings of SGLTW / SGLTM Linear Servomotors

3.8.1 SGLT□-20 Linear Servomotors

(1) Coil Assembly: SGLTW-20A□□□A□



Hall Sensor Connector Specifications



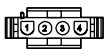
Pin connector type:
17JE-23090-02(D8C)
made by DDK Ltd.

The mating connector

Socket connector type: 17JE-13090-02(D8C) Stud type: 17L-002C or 17L-002C1

Pin No.	Name
1	+5VDC
2	Phase U
3	Phase V
4	Phase W
5	0V
6	Not used
7	Not used
8	Not used
9	Not used

Linear Servomotor Connector Specifications



Plug type: 350779-1
Pin type: 350218-3 or 350547-3 (No.1 to 3) 350654-1 350669-1(No.4)
made by Tycon Electronics AMP K.K.

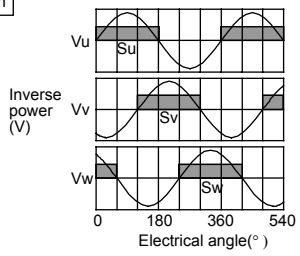
The mating connector

Cap type: 350780-1 Socket type: 350536-3 or 350550-3

Pin No.	Name	Lead Color
1	Phase U	Red
2	Phase V	White
3	Phase W	Black
4	Ground	Green

Hall Sensor Output Signals

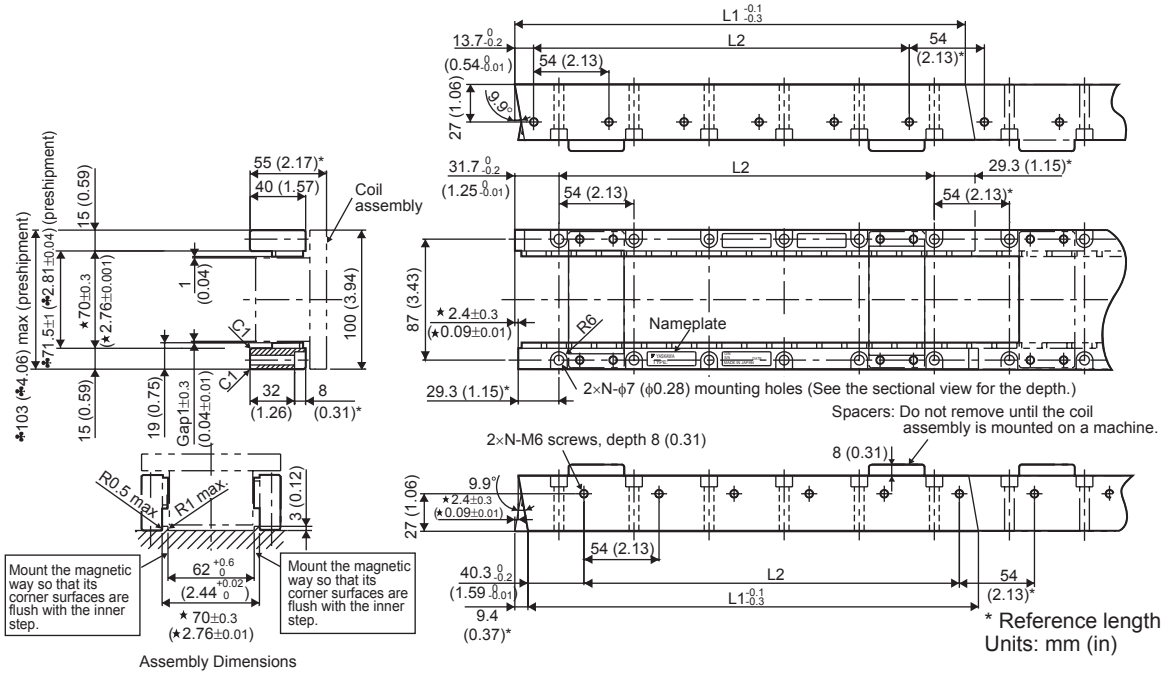
When the coil assembly moves in the direction indicated by the arrow in the figure, the relationship between the hall sensor output signals Su, Sv, Sw and the inverse power of each motoro phase Vu, Vv, Vw becomes as shown in the figure below.



Coil Assembly Model SGLTW-	L1	L2	L3*	N	Approx. Mass kg (lb)
20A170A□	170 (6.69)	144 (5.67) (48 (1.89) × 3 (0.12))	16 (0.63)	8 (0.31)	2.5 (5.51)
20A320A□	315 (12.40)	288 (11.34) (48 (1.89) × 6 (0.24))	17 (0.67)	14 (0.55)	4.6 (10.14)
20A460A□	460 (18.11)	432 (17.01) (48 (1.89) × 9 (0.35))	18 (0.71)	20 (0.79)	6.7 (14.77)

* Reference length

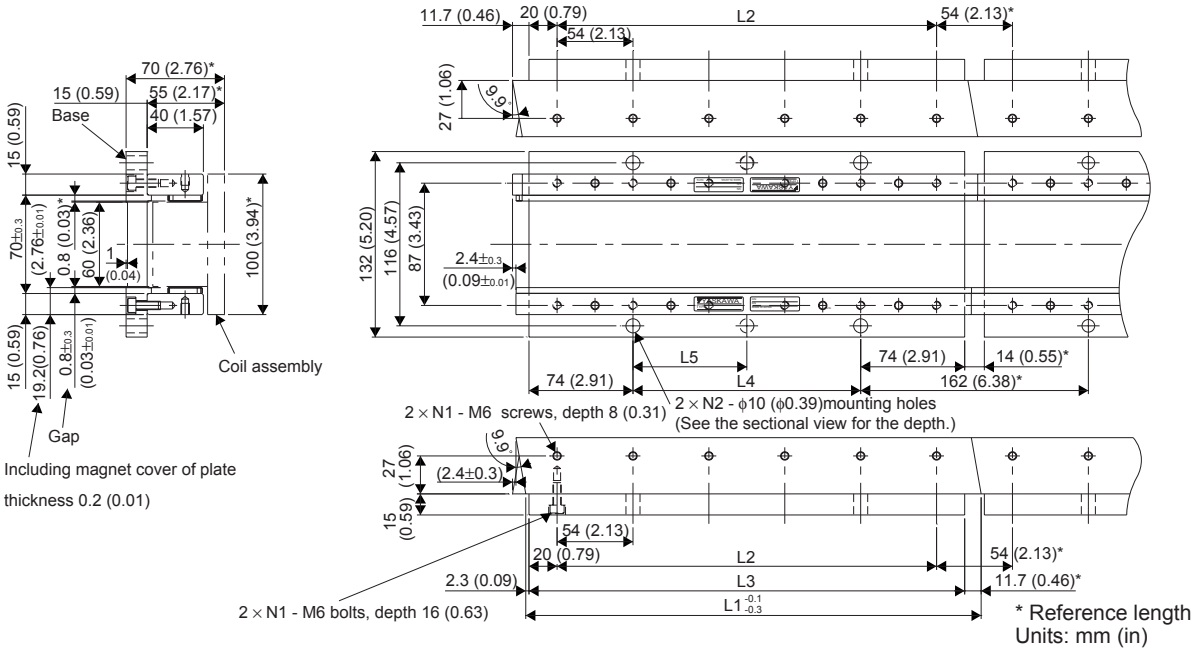
(2) Magnetic Way: SGLTM-20□□□A



Note: 1. Two magnetic ways for both ends of coil assembly make one set. Spacers are mounted on magnetic ways for safety during transportation. Do not remove the spacers until the coil assembly is mounted on a machine.
2. The magnetic way may affect pacemakers. Keep a minimum distance of 200 mm from the magnetic way.
3. Two magnetic ways in a set can be connected to each other.
4. The dimensions marked with an ★ are the dimensions between the magnetic ways. Be sure to follow exactly the dimensions specified in the figure above. Mount magnetic ways as shown in Assembly Dimensions. The values with an ♣ are the dimensions at preshipment.
5. Use socket headed screws of strength class 10.9 minimum for magnetic way mounting screws. Do not use stainless steel screws.

Magnetic Way Model SGLTM-	L1 -0.1 -0.3	L2	N	Approx. Mass kg (lb)
20324A	324 (12.76)	270 (10.63) (54 (2.13) × 5 (0.20))	6 (0.24)	3.4 (7.50)
20540A	540 (21.26)	486 (19.13) (54 (2.13) × 9 (0.35))	10 (0.39)	5.7 (12.57)
20756A	756 (29.76)	702 (27.64) (54 (2.13) × 13 (0.51))	14 (0.55)	7.9 (17.42)

(3) Magnetic Way with Base: SGLTM-20□□□AY

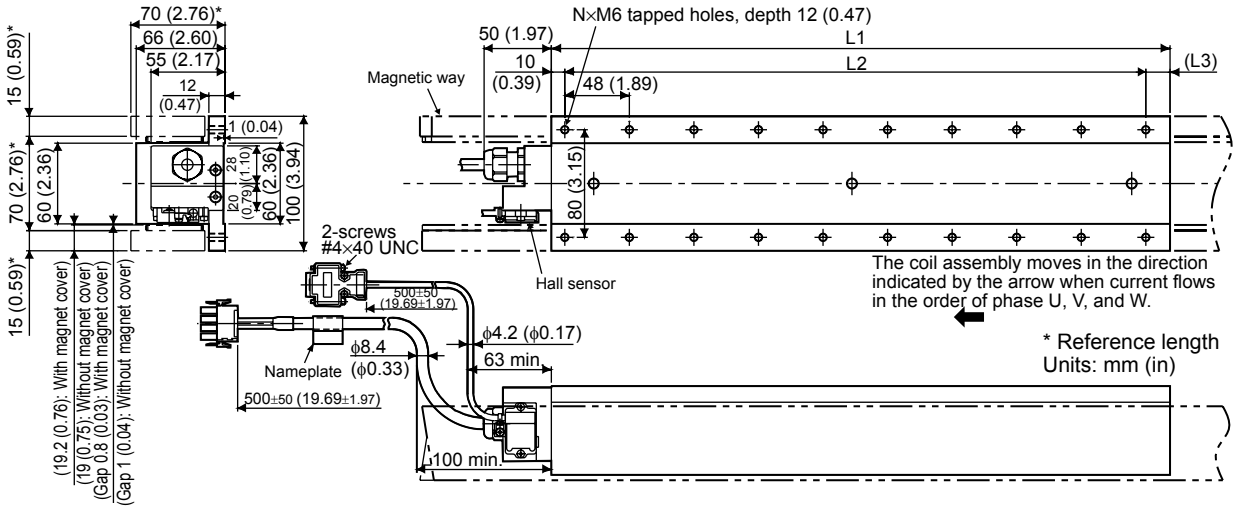


Note: 1. The magnetic way may affect pacemakers. Keep a minimum distance of 200 mm (7.87 in) from the magnetic way.
2. Two magnetic ways in a set can be connected to each other.
3. The magnetic way with base has the same characteristics as those of the magnetic way without base. (SGLTM-20□□□A)

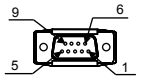
Magnetic Way Model SGLTM-	L1 -0.1 -0.3	L2	L3	L4	L5	N1	N2	Approx. Mass kg (lb)
20324AY	324 (12.76)	270 (10.63)	310 (12.20)	162 (6.38)	162 (6.38)	6 (0.24)	2 (0.08)	5.1 (11.24)
20540AY	540 (21.26)	486 (19.13)	526 (20.71)	378 (14.88)	189 (7.44)	10 (0.39)	3 (0.12)	8.5 (18.74)
20756AY	756 (29.76)	702 (27.64)	742 (29.21)	594 (23.39)	198 (7.80)	14 (0.55)	4 (0.16)	12 (26.46)

3.8.2 SGLT□-35□□□□A□ Linear Servomotors

(1) Coil Assembly: SGLTW-35□□□□A□



Hall Sensor Connector Specifications



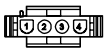
Pin connector type:
17JE-23090-02(D8C)
made by DDK Ltd.

The mating connector

Socket connector type:
17JE-13090-02(D8C)
Stud type: 17L-002C or
17L-002C1

Pin No.	Name
1	+5VDC
2	Phase U
3	Phase V
4	Phase W
5	0V
6	Not used
7	Not used
8	Not used
9	Not used

Linear Servomotor Connector Specifications



Plug type: 350779-1
Pin type: 350218-3 or
350547-3 (No.1 to 3)
350654-1
350669-1 (No.4)
made by Tyco Electronics AMP K.K.

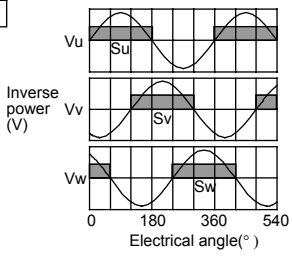
The mating connector

Cap type: 350780-1
Socket type: 350536-3 or
350550-3

Pin No.	Name	Lead Color
1	Phase U	Red
2	Phase V	White
3	Phase W	Black
4	Ground	Green

Hall Sensor Output Signals

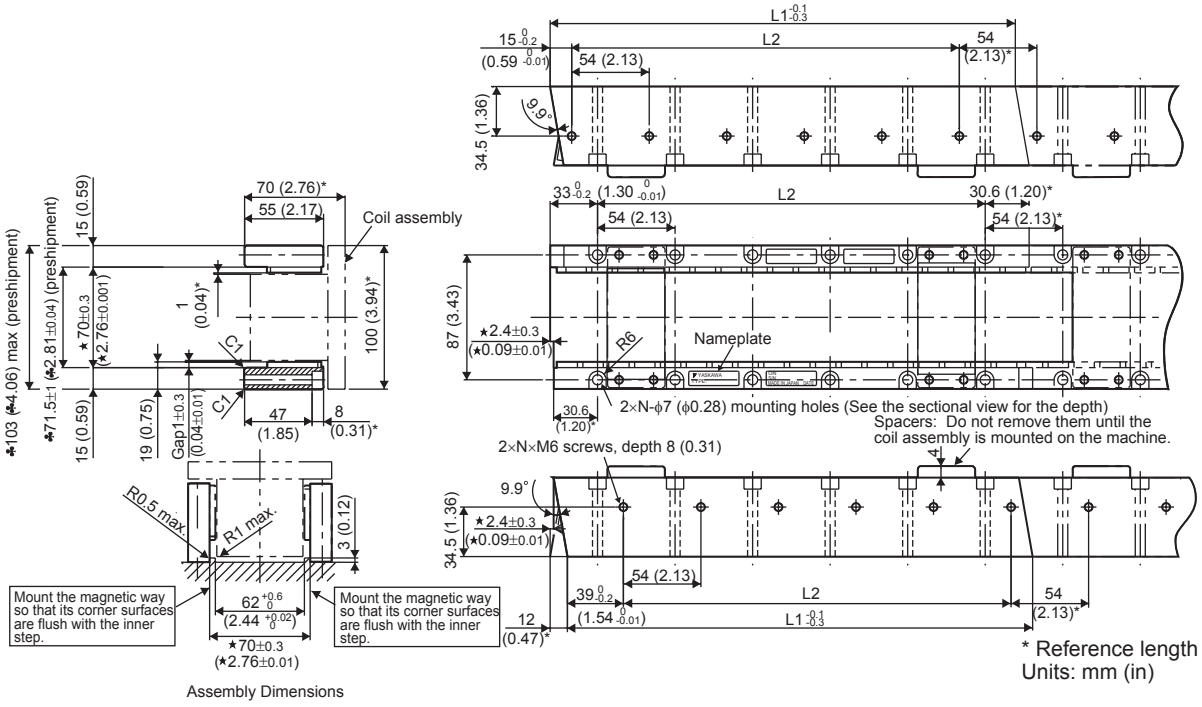
When the coil assembly moves in the direction indicated by the arrow in the figure, the relationship between the hall sensor output signals Su, Sv, Sw and the inverse power of each motor phase Vu, Vv, Vw becomes as shown in the figure below



Coil Assembly Model SGLTW-	L1	L2	L3*	N	Approx. Mass kg (lb)
35□170A□	170 (6.69)	144 (5.67) (48 (1.89) × 3 (0.12))	16 (0.63)	8 (0.31)	3.7 (8.16)
35□320A□	315 (12.40)	288 (11.34) (48 (1.89) × 6 (0.24))	17 (0.67)	14 (0.55)	6.8 (14.99)
35□460A□	460 (18.11)	432 (17.01) (48 (1.89) × 9 (0.35))	18 (0.71)	20 (0.79)	10 (22.05)

* Reference length

(2) Magnetic Way: SGLTM-35□□□A

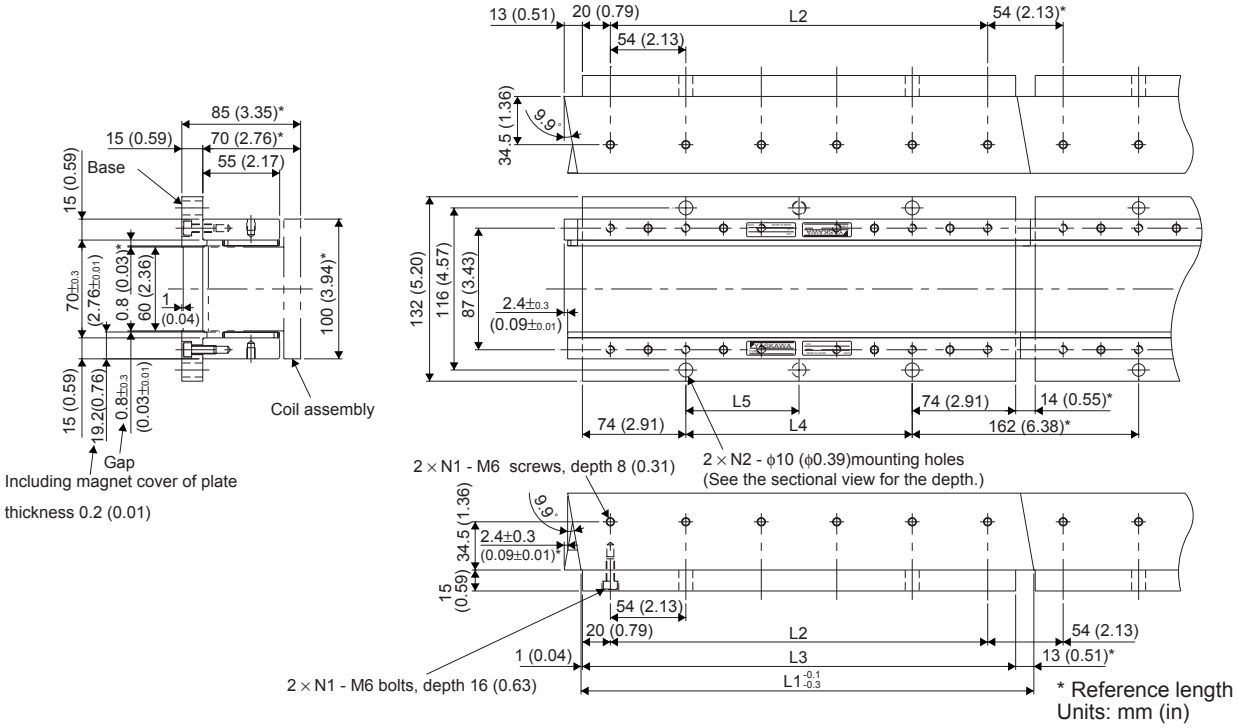


Note: 1. Two magnetic ways for both ends of coil assembly make one set. Spacers are mounted on magnetic ways for safety during transportation. Do not remove the spacers until the coil assembly is mounted on a machine.

2. The magnetic way may affect pacemakers. Keep a minimum distance of 200 mm (7.87 in) from the magnetic way.
3. Two magnetic ways in a set can be connected to each other.
4. The dimensions marked with an ★ are the dimensions between the magnetic ways. Be sure to follow exactly the dimensions specified in the figure above. Mount magnetic ways as shown in Assembly Dimensions. The values with an ♣ are the dimensions at preshipment
5. Use socket headed screws of strength class 10.9 minimum for magnetic way mounting screws. Do not use stainless steel screws..

Magnetic Way Model SGLTM-	L1 $^{-0.1}_{-0.3}$	L2	N	Approx. Mass kg (lb)
35324A	324 (12.76)	270 (10.63) (54 (2.13) × 5 (0.20))	6 (0.24)	4.8 (10.56)
35540A	540 (21.26)	486 (19.13) (54 (2.13) × 9 (0.35))	10 (0.39)	8 (17.64)
35756A	756 (29.76)	702 (27.64) (54 (2.13) × 13 (0.51))	14 (0.55)	11 (24.25)

(3) Magnet Way with Base: SGLTM-35□□□AY



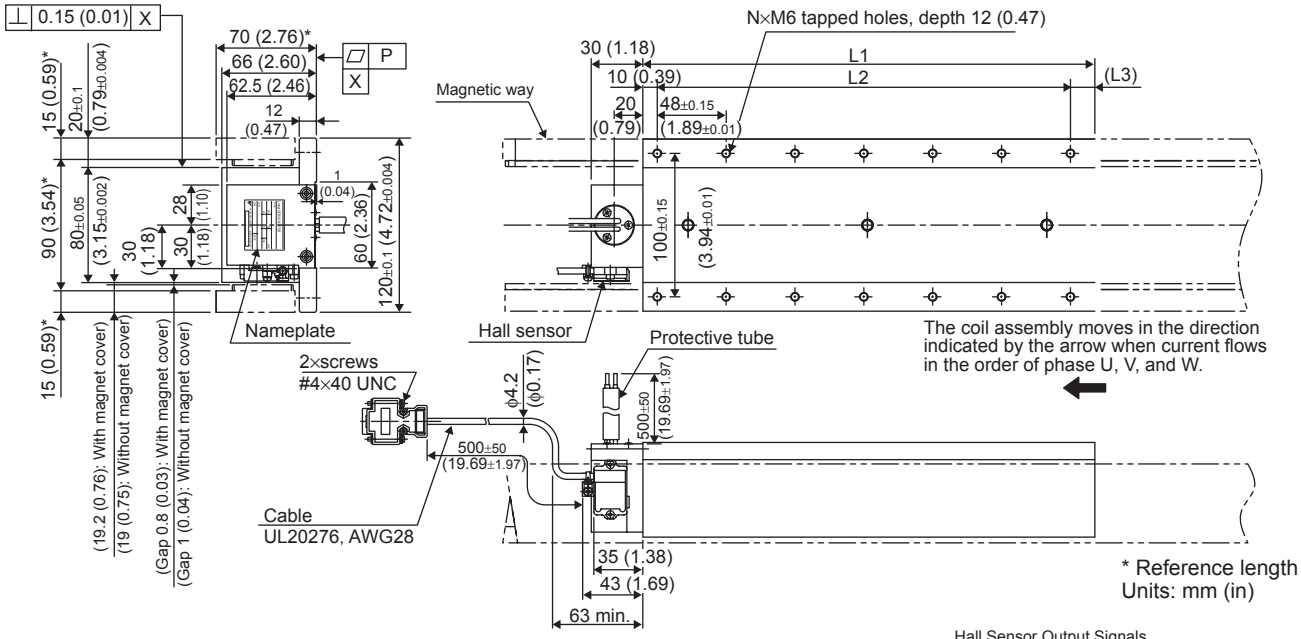
Note: 1. The magnetic way may affect pacemakers. Keep a minimum distance of 200 mm (7.87 in) from the magnetic way.
2. Two magnetic ways in a set can be connected to each other.
3. The magnetic way with base has the same characteristics as those of the magnetic way without base. (SGLTM-35□□□A)

Magnetic Way Model SGLTM-	L1 -0.1 -0.3	L2	L3	L4	L5	N1	N2	Approx. Mass kg (lb)
35324AY	324 (12.76)	270 (10.63)	310 (12.20)	162 (6.38)	162 (6.38)	6 (0.24)	2 (0.08)	6.4 (14.11)
35540AY	540 (21.26)	486 (19.13)	526 (20.71)	378 (14.88)	189 (7.44)	10 (0.39)	3 (0.12)	11 (24.25)
35756AY	756 (29.76)	702 (27.64)	742 (29.21)	594 (23.39)	198 (7.80)	14 (0.55)	4 (0.16)	15 (33.07)

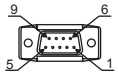
3.8.3 SGLT□-35□□□□H□ Linear Servomotors

(1) Coil Assembly: SGLTW-35□□□□H□ With a connector made by Tyco Electronics AMP K.K.

The following table and figures show the specifications when a main circuit's cable connector made by Tyco Electronics is used for the coil assembly.



Wiring specifications of hall sensor cable



Pin connector:
17JE-23090-02(D8C)
made by DDK Ltd.

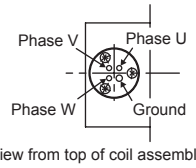
The mating connector

Socket connector type: 17JE-13090-02(D8C) Stud type: 17L-002C or 17L-002C1

Pin No.	Name
1	+5VDC
2	Phase U
3	Phase V
4	Phase W
5	0V
6	Not used
7	Not used
8	Not used
9	Not used

Lead specifications of coil assembly

- If this cable is bent repetitively, the cable will disconnect.

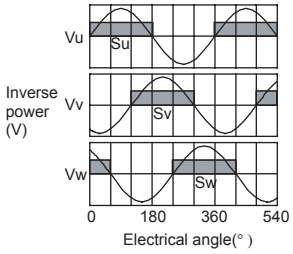


View from top of coil assembly

Name	Color	Code	Wire size
Phase U	Black	U	2mm²
Phase V		V	
Phase W		W	
Ground	Green	-	2mm²

Hall Sensor Output Signals

When the coil assembly moves in the direction indicated by the arrow in the figure, the relationship between the hall sensor output signals Su, Sv, Sw and the inverse power of each motor phase Vu, Vv, Vw becomes as shown in the figure below

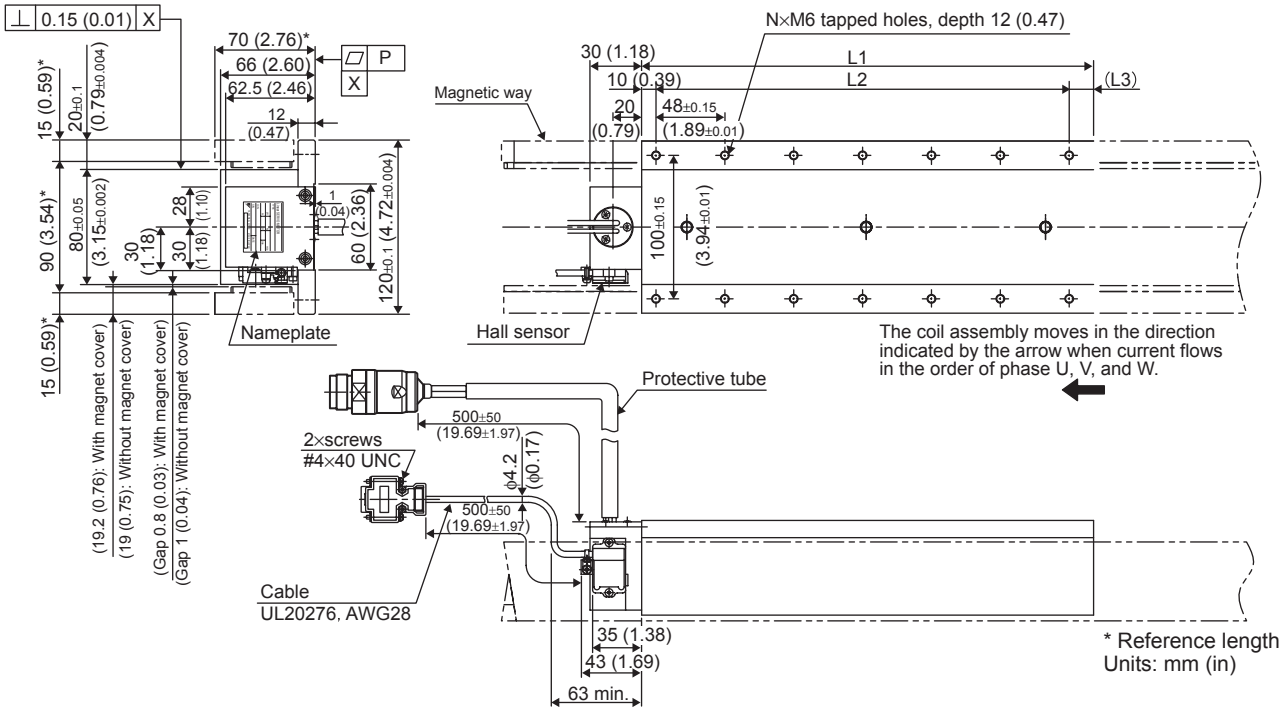


Coil Assembly Model SGLTW-	L1	L2	L3*	N	Approx. Mass kg (lb)
35□170H□	170 (6.69)	144 (5.67) (48 (1.89) × 3 (0.12))	16 (0.63)	8 (0.31)	4.7 (10.36)
35□320H□	315 (12.40)	288 (11.34) (48 (1.89) × 6 (0.24))	17 (0.67)	14 (0.55)	8.8 (19.40)

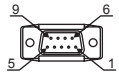
* Reference length

(2) Coil Assembly: SGLTW-35D□□□H□D With a connector made by Interconnectron

The following table and figures show the specifications when a main circuit's cable connector made by Interconnectron is used for the coil assembly.



Wiring specification of hall sensor cable



Pin connector type:
17JE-23090-02(D8C)
made by DDK Ltd.

The mating connector

Socket connector type:
17JE-13090-02(D8C)
Stud type: 17L-002C or 17L-002C1

Pin No.	Name
1	+5VDC
2	Phase U
3	Phase V
4	Phase W
5	0V
6	Not used
7	Not used
8	Not used
9	Not used

Linear Servomotor Connector Specifications



Extension: LRRA06AMRPN182
Pin type: 021.279.1020
made by Interconnectron

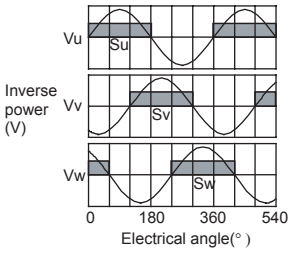
The mating connector

Plug type: LPRA06BFRDN170
Socket type: 020.105.1020

Pin No.	Name
1	Phase U
2	Phase V
4	Phase W
5	Not used
6	Not used
⏚	Ground

Hall Sensor Output Signals

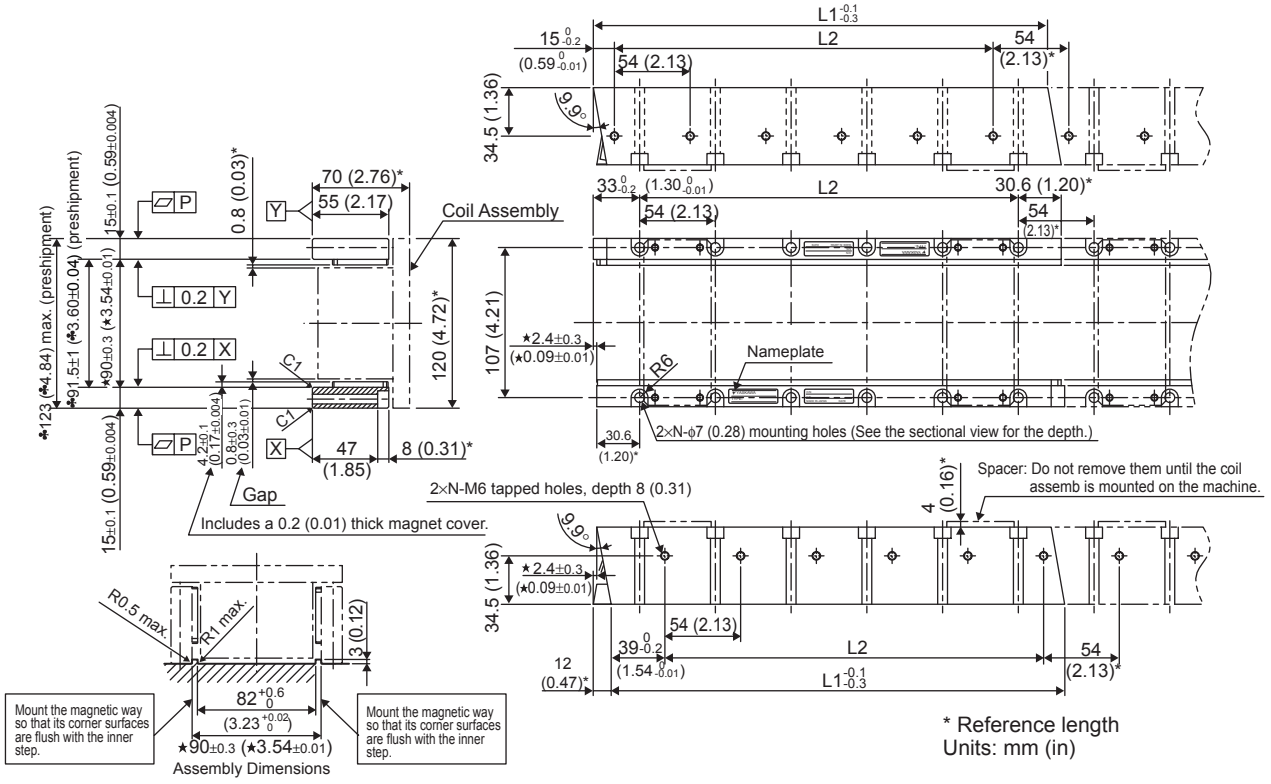
When the coil assembly moves in the direction indicated by the arrow in the figure, the relationship between the hall sensor output signals Su, Sv, Sw and the inverse power of each motor phase Vu, Vv, Vw becomes as shown in the figure below



Coil Assembly Model SGLTW-	L1	L2	L3*	N	Approx. Mass kg (lb)
35D170H□D	170 (6.69)	144 (5.67) (48 (1.89) × 3 (0.12))	16 (0.63)	8 (0.31)	4.7 (10.36)
35D320H□D	315 (12.40)	288 (11.34) (48 (1.89) × 6 (0.24))	17 (0.67)	14 (0.55)	8.8 (19.40)

* Reference length

(3) Magnetic Way: SGLTM-35□□□H



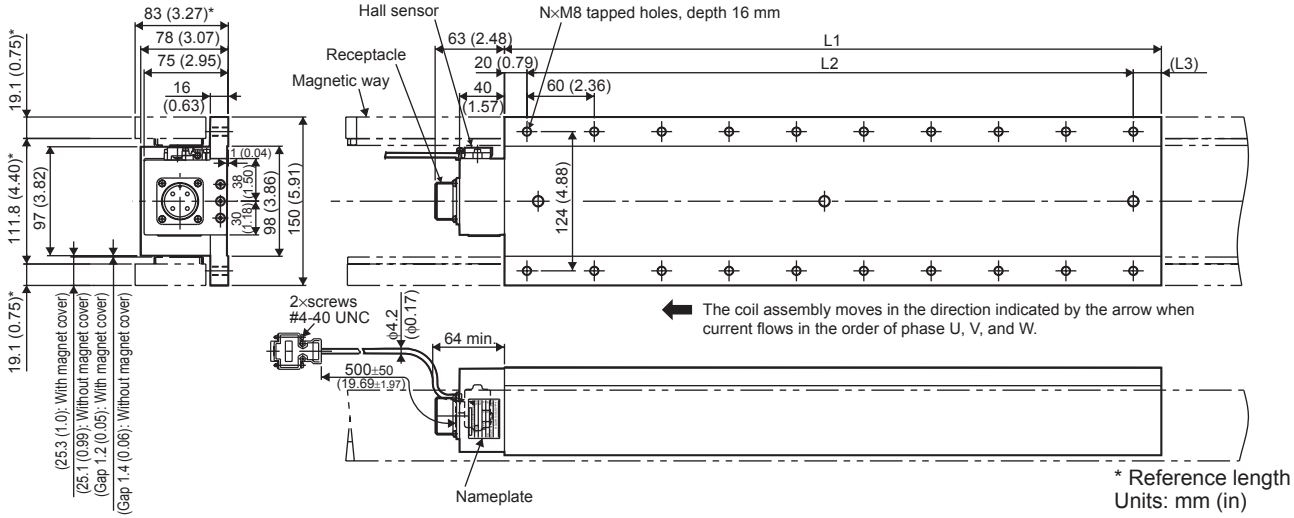
Note: 1. Two magnetic ways for both ends of coil assembly make one set. Spacers are mounted on magnetic ways for safety during transportation. Do not remove the spacers until the coil assembly is mounted on a machine.

2. The magnetic way may affect pacemakers. Keep a minimum distance of 200 mm (7.87 in) from the magnetic way.
3. Two magnetic ways in a set can be connected to each other.
4. The dimensions marked with an ★ are the dimensions between the magnetic ways. Be sure to follow exactly the dimensions specified in the figure above. Mount magnetic ways as shown in Assembly Dimensions. The values with an ♣ are the dimensions at preshipment.
5. Use socket headed screws of strength class 10.9 minimum for magnetic way mounting screws. Do not use stainless steel screws.

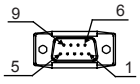
Coil Assembly Model SGLTM-	L1 $^{-0.1}_{-0.3}$	L2	N	Approx. Mass kg (lb)
35324H	324 (12.76)	270 (10.63) (54 (2.13) × 5 (0.20))	6 (0.24)	4.8 (10.56)
35540H	540 (21.26)	486 (19.13) (54 (2.13) × 9 (0.35))	10 (0.39)	8 (17.64)
35756H	756 (29.76)	702 (27.64) (54 (2.13) × 13 (0.51))	14 (0.55)	11 (24.25)

3.8.4 SGLT□-40 Linear Servomotors

(1) Coil Assembly: SGLTW-40□□□□B□



Hall Sensor Connector Specifications



Pin connector type:
17JE-23090-02(D8C)
made by DDK Ltd.

The mating connector

Socket connector type:
17JE-13090-02(D8C)
Stud type: 17L-002C or
17L-002C1

Pin No.	Name
1	+5V (Power supply)
2	Phase U
3	Phase V
4	Phase W
5	0V (Power supply)
6	Not used
7	Not used
8	Not used
9	Not used

Linear Servomotor Connector Specifications



Receptacle type: MS3102A-22-22P
made by DDK Ltd.

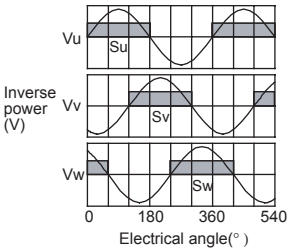
The mating connector

L-shaped plug type: MS3108B22-22S
Straight plug type: MS3106B22-22S
Cable clamp type: MS3057-12A

Pin No.	Name
A	Phase U
B	Phase V
C	Phase W
D	Ground

Hall Sensor Output Signals

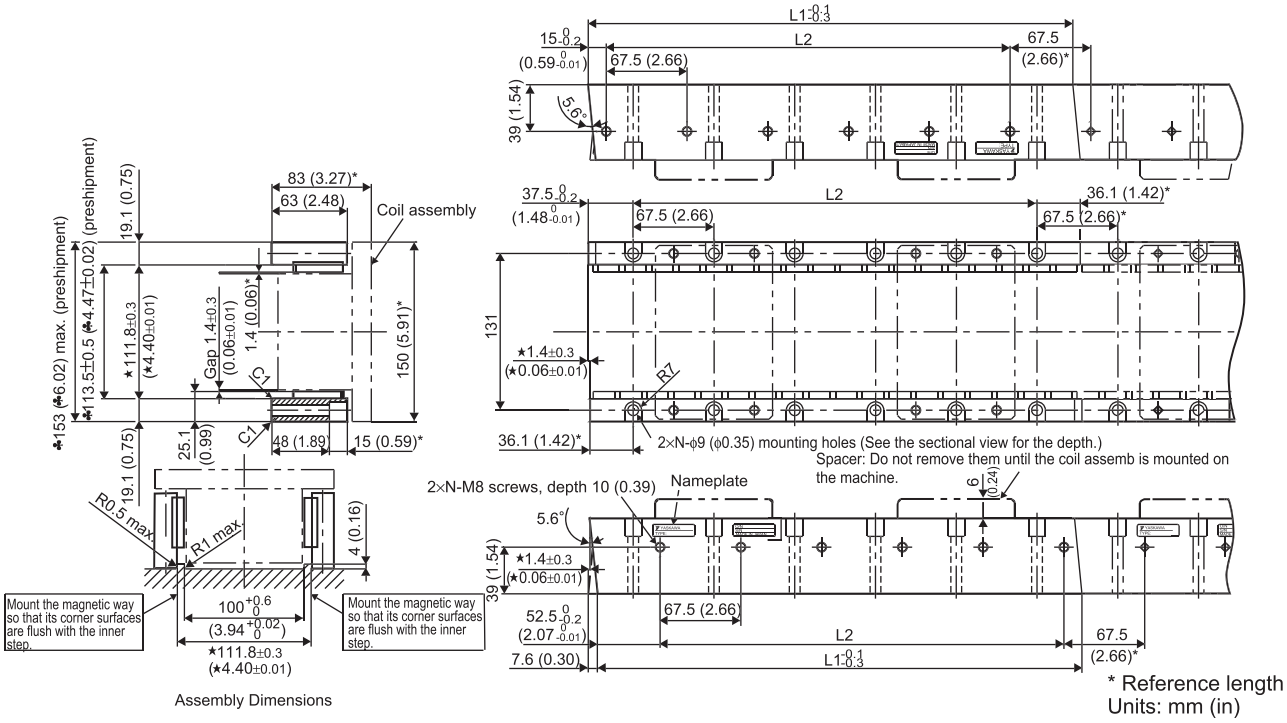
When the coil assembly moves in the direction indicated by the arrow in the figure, the relationship between the hall sensor output signals Su, Sv, Sw, and the inverse power of each motor phase Vu, Vv, Vw becomes as shown in the figure below.



Coil Assembly Model SGLTW-	L1	L2	L3*	N	Approx. Mass kg (lb)
40□400B□	395 (15.55)	360 (14.17) (60 (2.36) × 6 (0.24))	15 (0.59)	14 (0.55)	20 (44.09)
40□600B□	585 (23.03)	540 (21.26) (60 (2.36) × 9 (0.35))	25 (0.98)	20 (0.79)	30 (66.14)

* Reference length

(2) Magnetic Way: SGLTM-40□□□A

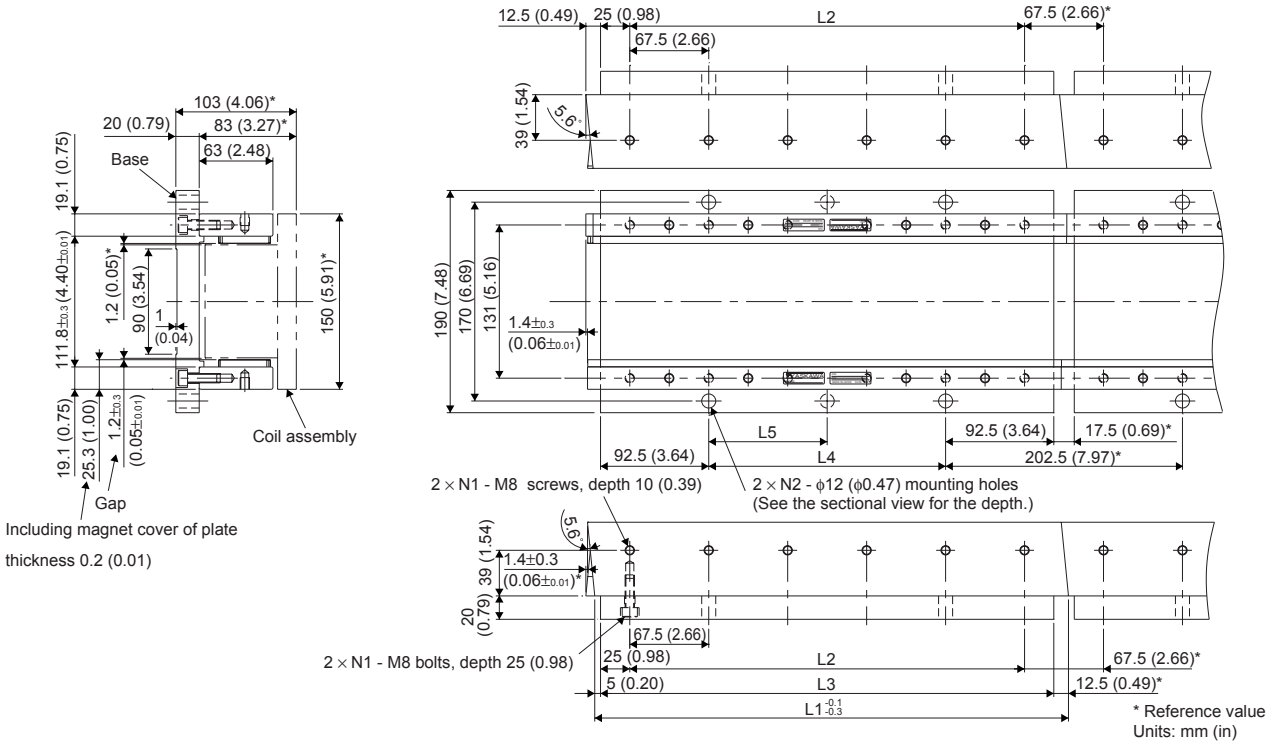


Note: 1. Two magnetic ways for both ends of coil assembly make one set. Spacers are mounted on magnetic ways for safety during transportation. Do not remove the spacers until the coil assembly is mounted on a machine.

2. The magnetic way may affect pacemakers. Keep a minimum distance of 200 mm (7.87 in) from the magnetic way.
3. Two magnetic ways in a set can be connected to each other.
4. The dimensions marked with an ★ are the dimensions between the magnetic ways. Be sure to follow exactly the dimensions specified in the figure above. Mount magnetic ways as shown in Assembly Dimensions. The values with an ♣ are the dimensions at preshipment.
5. Use socket headed screws of strength class 10.9 minimum for magnetic way mounting screws. Do not use stainless steel screws.

Magnetic Way Model SGLTM-	L1 $^{-0.1}_{-0.3}$	L2	N	Approx. Mass kg (lb)
40405A	405 (15.94)	337.5 (13.29) (67.5 (2.66) × 5 (0.20))	6 (0.24)	9 (19.34)
40675A	675 (26.57)	607.5 (23.92) (67.5 (2.66) × 9 (0.35))	10 (0.39)	15 (33.07)
40945A	945 (37.20)	877.5 (34.55) (67.5 (2.66) × 13 (0.51))	14 (0.55)	21 (46.30)

(3) Magnetic Way with Base: SGLTM-40□□□AY



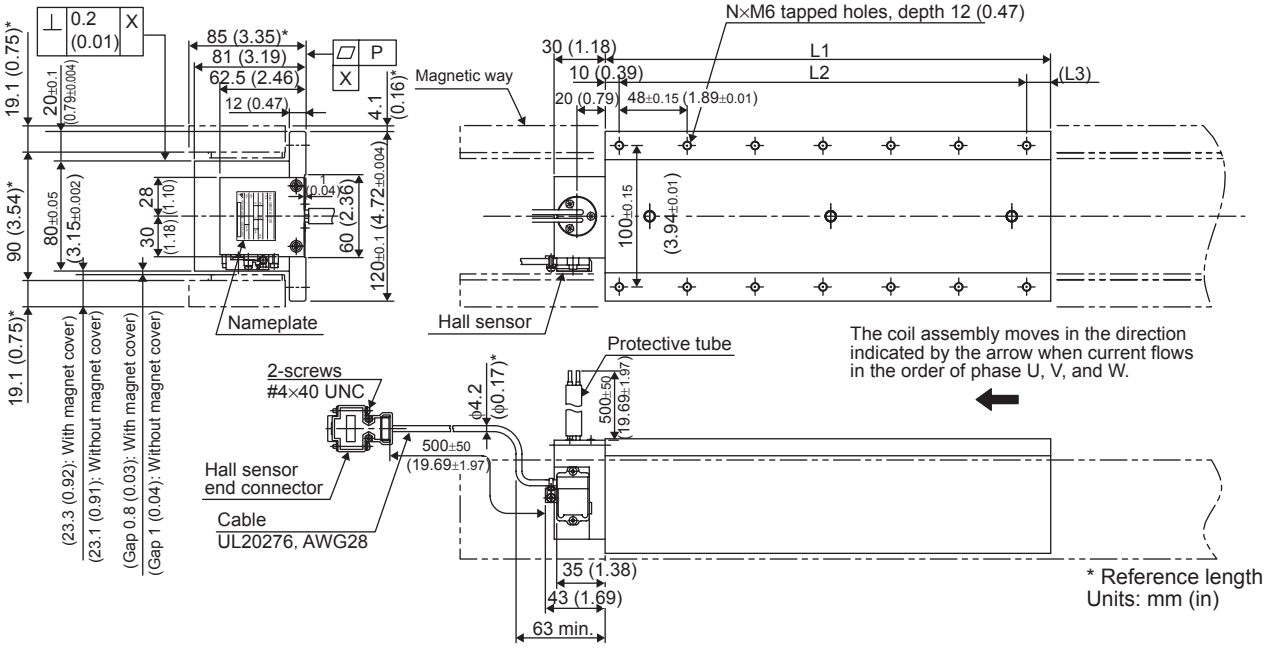
Note: 1. The magnetic way may affect pacemakers. Keep a minimum distance of 200 mm (7.87 in) from the magnetic way.
2. Two magnetic ways in a set can be connected to each other.
3. The magnetic way with base has the same characteristics as those of the magnetic way without base. (SGLTM-40□□□A)

Magnetic Way Model SGLTM-	L1 -0.1 -0.3	L2	L3	L4	L5	N1	N2	Approx. Mass kg (lb)
40405AY	405 (15.94)	337.5 (13.29)	387.5 (15.26)	202.5 (7.97)	202.5 (7.97)	6 (0.24)	2 (0.08)	13 (28.67)
40675AY	675 (26.57)	607.5 (23.92)	657.5 (25.89)	472.5 (18.60)	236.25 (9.31)	10 (0.39)	3 (0.12)	21 (46.30)
40945AY	945 (37.20)	877.5 (34.55)	927.5 (36.52)	742.5 (29.23)	247.5 (9.74)	14 (0.55)	4 (0.16)	30 (66.14)

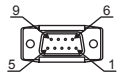
3.8.5 SGLT□-50 Linear Servomotors

(1) Coil Assembly: SGLTW-50□□□□H□
With a connector made by Tyco Electronics AMP K.K.

The following table and figures show the specifications when a main circuit's cable connector made by Tyco Electronics is used for the coil assembly.



Wiring specifications of hall sensor cable



Pin connector:
17JE-23090-02(D8C)
made by DDK Ltd.

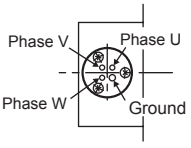
The mating connector

Socket connector type:
17JE-13090-02(D8C)
Stud type: 17L-002C or
17L-002C1

Pin No.	Name
1	+5VDC
2	Phase U
3	Phase V
4	Phase W
5	0V
6	Not used
7	Not used
8	Not used
9	Not used

Lead specifications of coil assembly

- If this cable is bent repetitively, the cable will disconnect.

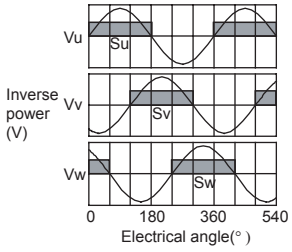


View from top of coil assembly

Name	Color	Code	Wire size
Phase U	Black	U	2mm²
Phase V		V	
Phase W		W	
Ground	Green	–	2mm²

Hall Sensor Output Signals

When the coil assembly moves in the direction indicated by the arrow in the figure, the relationship between the hall sensor output signals Su, Sv, Sw and the inverse power of each motor phase Vu, Vv, Vw becomes as shown in the figure below

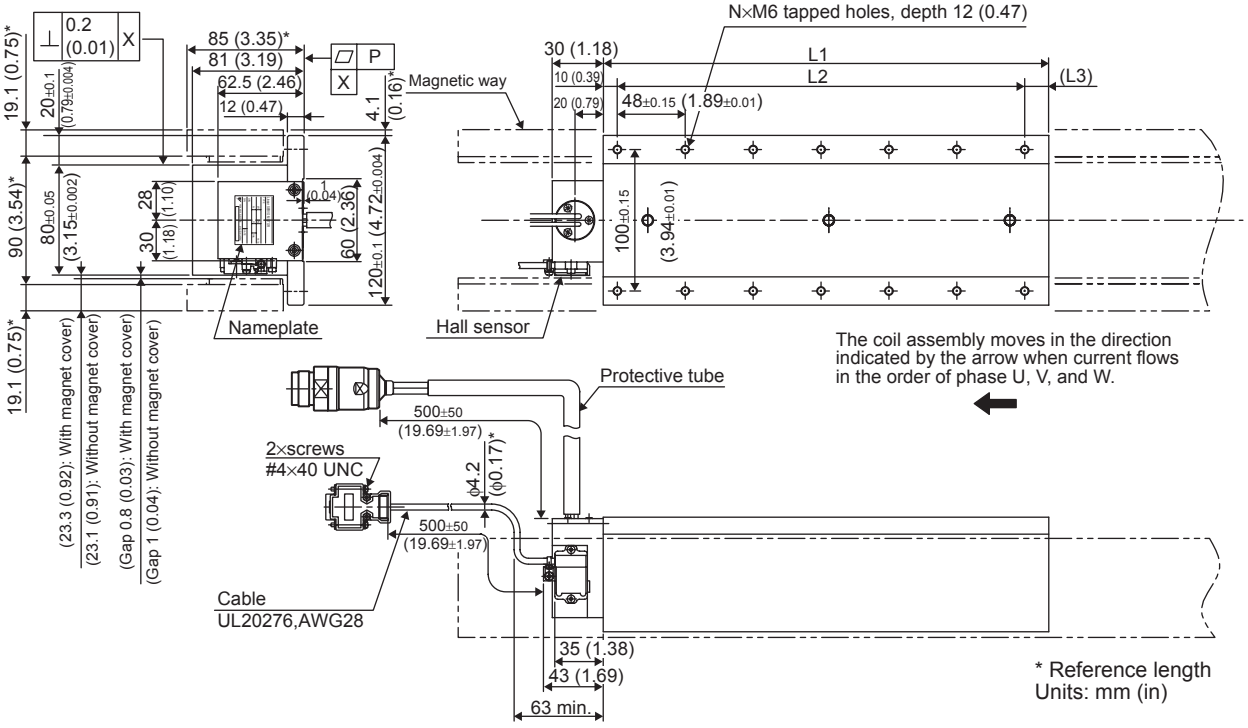


Coil Assembly Model SGLTW-	L1	L2	L3*	N	Approx. Mass kg (lb)
50□170H□	170 (6.69)	144 (5.67) (48 (1.89) × 3 (0.12))	16 (0.63)	8 (0.31)	6 (13.23)
50□320H□	315 (12.40)	288 (11.34) (48 (1.89) × 6 (0.24))	17 (0.67)	14 (0.55)	11 (24.25)

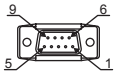
* Reference length

(2) Coil Assembly: SGLTW-50D□□□H□D With a connector made by Interconnectron

The following table and figures show the specifications when a main circuit's cable connector made by Interconnectron is used for the coil assembly.



Wiring specification of hall sensor cable



Pin connector type:
17JE-23090-02(D8C)
made by DDK Ltd.

The mating connector

Socket connector type: 17JE-13090-02(D8C) Stud type: 17L-002C or 17L-002C1

Pin No.	Name
1	+5VDC
2	Phase U
3	Phase V
4	Phase W
5	0V
6	Not used
7	Not used
8	Not used
9	Not used

Linear Servomotor Connector Specifications



Extension: LRRA06AMRPN182
Pin type: 021.279.1020
made by Interconnectron

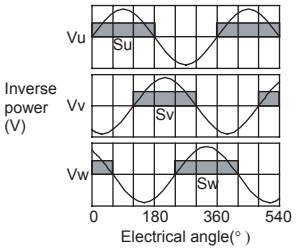
The mating connector

Plug type: LPRA06BFRDN170 Socket type: 020.105.1020

Pin No.	Name
1	Phase U
2	Phase V
4	Phase W
5	Not used
6	Not used
⏚	Ground

Hall Sensor Output Signals

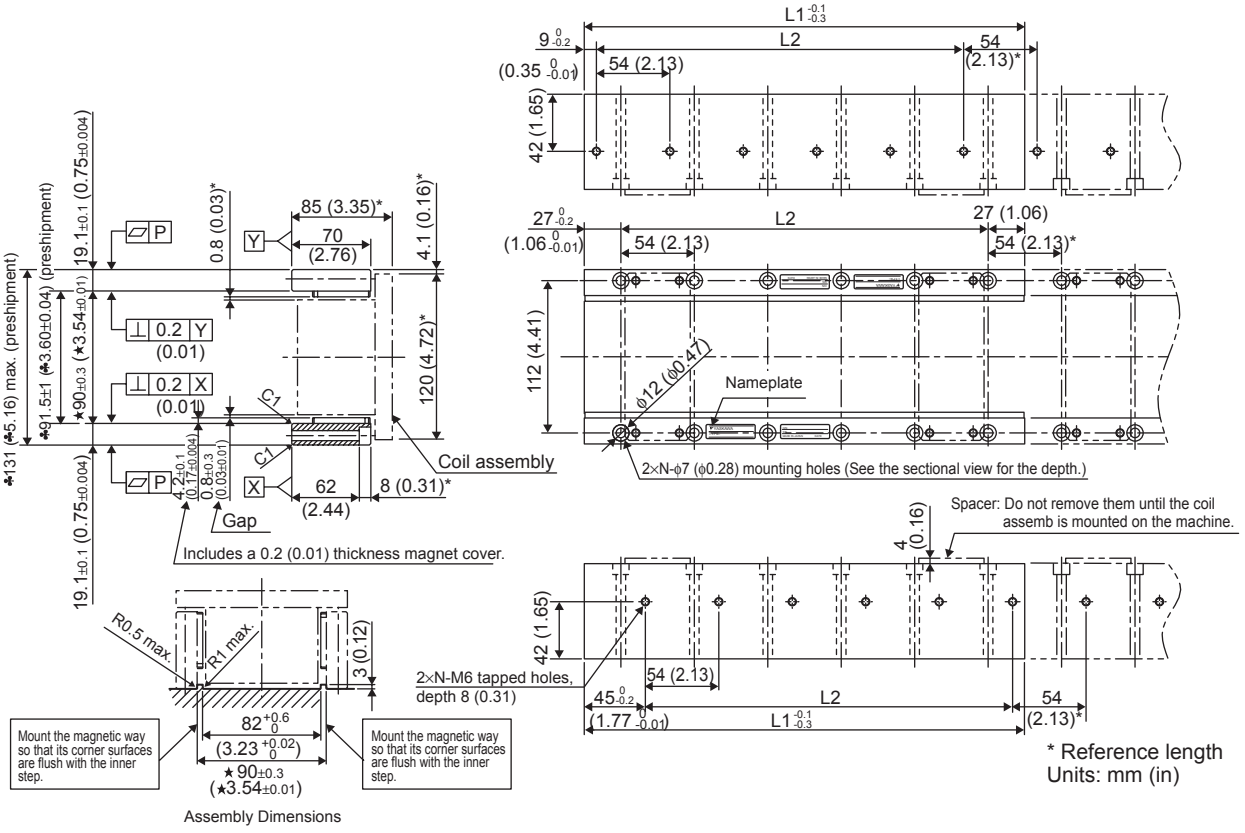
When the coil assembly moves in the direction indicated by the arrow in the figure, the relationship between the hall sensor output signals Su, Sv, Sw and the inverse power of each motor phase Vu, Vv, Vw becomes as shown in the figure below



Coil Assembly Model SGLTW-	L1	L2	L3*	N	Approx. Mass kg (lb)
50D170H□D	170 (6.69)	144 (5.67) (48 (1.89) × 3 (0.12))	16 (0.63)	8 (0.31)	6 (13.23)
50D320H□D	315 (12.40)	288 (11.34) (48 (1.89) × 6 (0.24))	17 (0.67)	14 (0.55)	11 (24.25)

* Reference length

(3) Magnetic Way: SGLTM-50□□□H



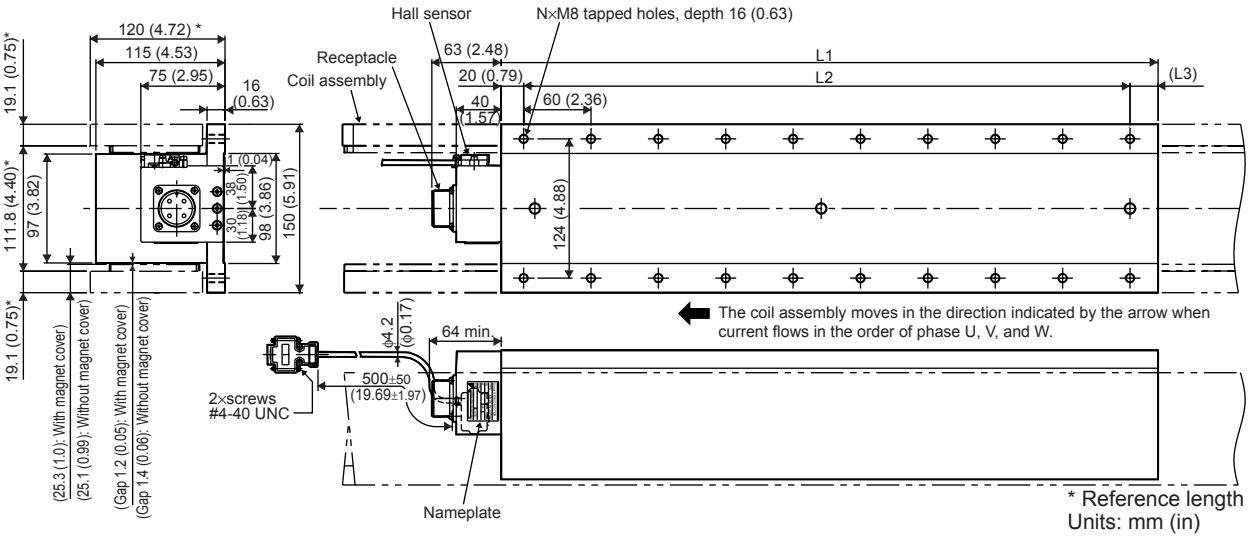
Note: 1. Two magnetic ways for both ends of coil assembly make one set. Spacers are mounted on magnetic ways for safety during transportation. Do not remove the spacers until the coil assembly is mounted on a machine.

2. The magnetic way may affect pacemakers. Keep a minimum distance of 200 mm (7.87 in) from the magnetic way.
3. Two magnetic ways in a set can be connected to each other.
4. The dimensions marked with an ★ are the dimensions between the magnetic ways. Be sure to follow exactly the dimensions specified in the figure above. Mount magnetic ways as shown in Assembly Dimensions. The values with an ♣ are the dimensions at preshipment.
5. Use socket headed screws of strength class 10.9 minimum for magnetic way mounting screws. Do not use stainless steel screws.

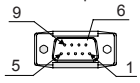
Magnetic Way Model SGLTM-	L1 -0.1 -0.3	L2	N	Approx. Mass kg (lb)
50324H	324 (12.76)	270 (10.63) (54 (2.13) × 5 (0.20))	6 (0.24)	8 (17.64)
50540H	540 (21.26)	486 (19.13) (54 (2.13) × 9 (0.35))	10 (0.39)	13 (28.66)
50756H	756 (29.76)	702 (27.64) (54 (2.13) × 13 (0.51))	14 (0.55)	18 (39.68)

3.8.6 SGLT□-80 Linear Servomotors

(1) Coil Assembly: SGLTW-80□□□□B□



Hall Sensor Connector Specifications



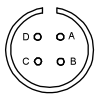
Pin connector type:
17JE-23090-02(D8C)
made by DDK Ltd.

The mating connector

Socket connector type: 17JE-13090-02(D8C) Stud type: 17L-002C or 17L-002C1

Pin No.	Name
1	+5VDC
2	Phase U
3	Phase V
4	Phase W
5	0V
6	Not used
7	Not used
8	Not used
9	Not used

Linear Servomotor Connector Specifications



Receptacle type: MS3102A-22-22P
made by DDK Ltd.

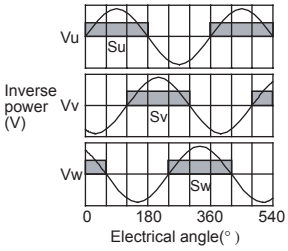
The mating connector

L-shaped plug type: MS3108B22-22S Straight plug type: MS3106B22-22S Cable clamp type: MS3057-12A

Pin No.	Name
A	Phase U
B	Phase V
C	Phase W
D	Ground

Hall Sensor Output Signals

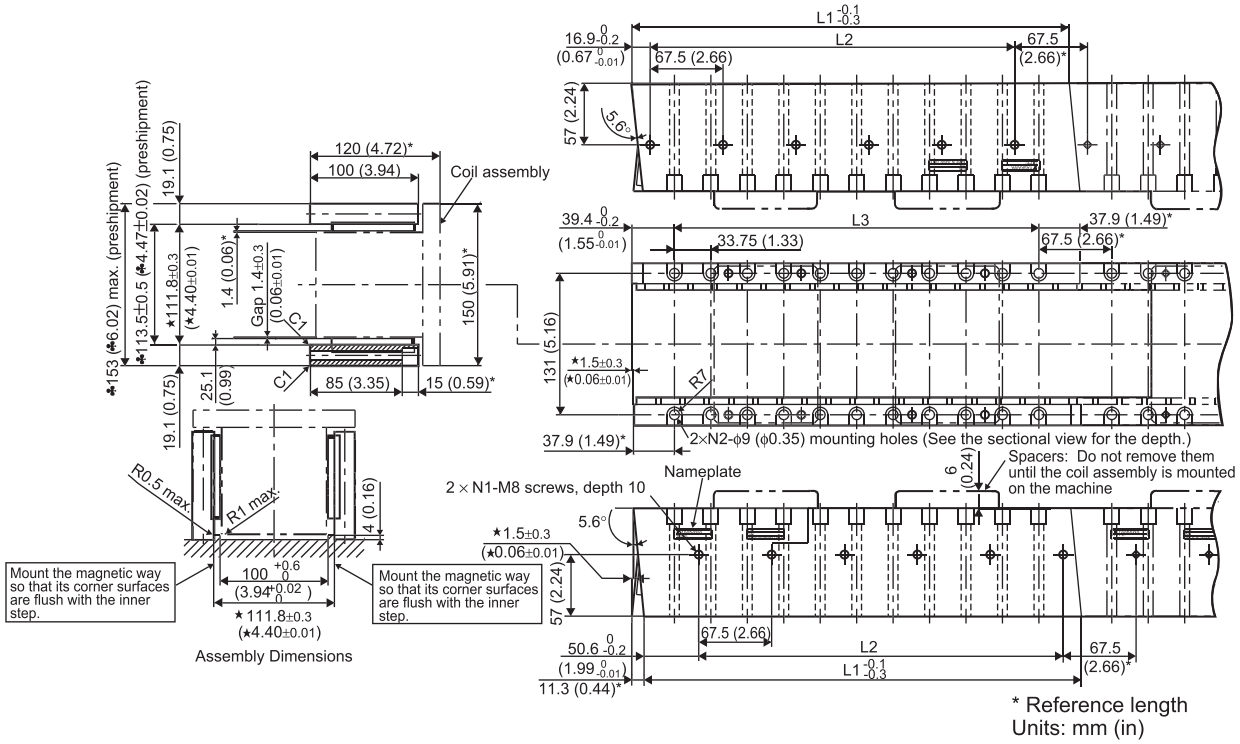
When the coil assembly moves in the direction indicated by the arrow in the figure, the relationship between the hall sensor output signals Su, Sv, Sw and the inverse power of each motor phase Vu, Vv,Vw becomes as shown in the figiure below



Coil Assembly Model SGLTW-	L1	L2	L3*	N	Approx. Mass kg (lb)
80□400B□	395 (15.55)	360 (14.17) (60 (2.36) × 6 (0.24))	15 (0.59)	14 (0.55)	30 (66.14)
80□600B□	585 (23.03)	540 (21.26) (60 (2.36) × 9 (0.35))	25 (0.98)	20 (0.79)	43 (94.80)

* Reference length

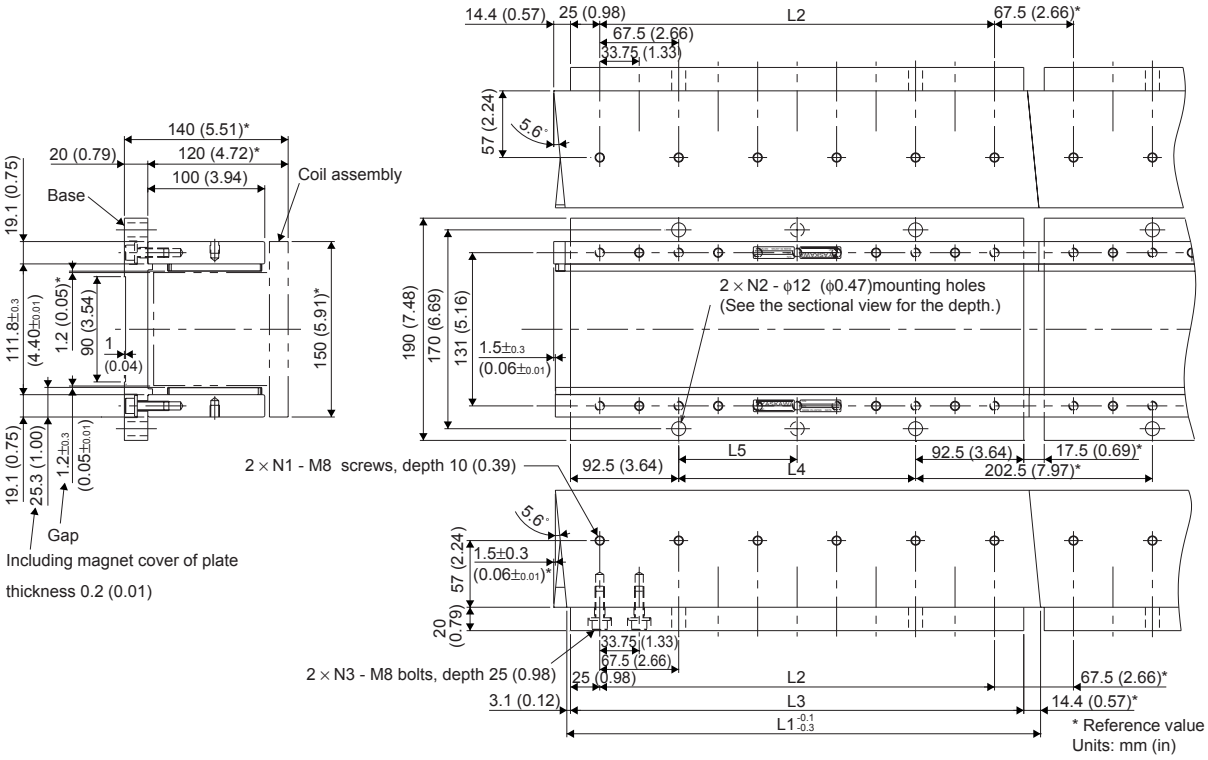
(2) Magnetic Way: SGLTM-80□□□A



Note: 1. Two magnetic ways for both ends of coil assembly make one set. Spacers are mounted on magnetic ways for safety during transportation. Do not remove the spacers until the coil assembly is mounted on a machine.
2. The magnetic way may affect pacemakers. Keep a minimum distance of 200 mm (7.87 in) from the magnetic way.
3. Two magnetic ways in a set can be connected to each other.
4. The dimensions marked with an ★ are the dimensions between the magnetic ways. Be sure to follow exactly the dimensions specified in the figure above. Mount magnetic ways as shown in Assembly Dimensions. The values with an ♣ are the dimensions at preshipment.
5. Use socket headed screws of strength class 10.9 minimum for magnetic way mounting screws. Do not use stainless steel screws.

Magnetic Way Model SGLTM-	L1 $^{-0.1}_{-0.3}$	L2	L3	N1	N2	Approx. Mass kg (lb)
80405A	405 (15.94)	337.5 (13.29) (67.5 (2.66) × 5 (0.20))	337.5 (13.29) (33.75 (1.33) × 10 (0.39))	6 (0.24)	11 (0.43)	14 (30.86)
80675A	675 (26.57)	607.5 (23.92) (67.5 (2.66) × 9 (0.35))	607.5 (23.92) (33.75 (1.33) × 18 (0.71))	10 (0.39)	19 (0.75)	24 (52.91)
80945A	945 (37.20)	877.5 (34.55) (67.5 (2.66) × 13 (0.51))	877.5 (34.55) (33.75 (1.33) × 26 (1.02))	14 (0.55)	27 (1.06)	34 (74.96)

(3) Magnetic Way with Base: SGLTM-80□□□AY



Note: 1. The magnetic way may affect pacemakers. Keep a minimum distance of 200 mm (7.87 in) from the magnetic way.
2. Two magnetic ways in a set can be connected to each other.
3. The magnetic way with base has the same characteristics as those of the magnetic way without base. (SGLTM-80□□□A)

Magnetic Way Model SGLTM-	L1 -0.1 -0.3	L2	L3	L4	L5	N1	N2	N3	Approx. Mass kg (lb)
80405AY	405 (15.94)	337.5 (13.29)	387.5 (15.26)	202.5 (7.97)	202.5 (7.97)	6 (0.24)	2 (0.08)	11 (0.43)	18 (39.68)
80675AY	675 (26.57)	607.5 (23.92)	657.5 (25.89)	472.5 (18.60)	236.25 (9.31)	10 (0.39)	3 (0.12)	19 (0.75)	31 (68.34)
80945AY	945 (37.20)	877.5 (34.55)	927.5 (36.52)	742.5 (29.23)	247.5 (9.74)	14 (0.55)	4 (0.16)	27 (1.06)	43 94.80)

4

SERVOPACK Specifications and Dimensional Drawings

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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 Single-phase/Three-phase 200 V

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

SERVOPACK Model SGDH-		A5A	01A	02A	04A	05A	08A	10A	15A	20A	30A	50A	75A
Max. Applicable Servomotor Capacity (kW)		0.05	0.1	0.2	0.4	0.45	0.75	1.0	1.5	2.0	3.0	5.0	7.5
Continuous Output Current (Arms)		0.64	0.91	2.1	2.8	3.8	5.7	7.6	11.6	18.5	24.8	32.9	54.7
Max. Output Current (Arms)		2.0	2.8	6.5	8.5	11.0	13.9	17	28	42	56	84	130
Input Power Supply	Main Circuit	Single-phase/Three-phase 200 to 230 VAC +10 to -15%, 50/60 Hz											
	Control Circuit	Single-phase 200 to 230 VAC +10 to -15%, 50/60 Hz											
Configuration		Base-mounted (Rack mounting available as an option)											Base-mounted (Duct-ventilated available as an option)
Regenerative Processing		External regenerative resistor				Built-in							External regenerative resistor

4.1.2 Three-phase 400 V

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

SERVOPACK Model SGDH-		05D	10D	15D	20D	30D	50D	75D
Max. Applicable Servomotor Capacity (kW)		0.45	1.0	1.5	2.0	3.0	5.0	7.5
Continuous Output Current (Arms)		1.9	3.5	5.4	8.4	11.9	16.5	25.4
Max. Output Current (Arms)		5.5	8.5	14	20	28	40.5	65
Input Power Supply	Main Circuit	Three-phase 380 to 480 VAC +10 to -15%, 50/60 Hz						
	Control Circuit	24 VDC ±15%						
Configuration		Base-mounted (Rack mounting available as an option)						Base-mounted (Duct-ventilated available as an option)
Regenerative Processing		Built-in						External regenerative resistor

4.1.3 SERVOPACK Ratings and Specifications

Basic Specifications	Control Method			Single or three-phase full-wave rectification IGBT-PWM (sine-wave driven)
	Feedback			1/256 data of serial converter unit sine wave pitch (incremental)
	Conditions	Ambient/Storage Temperature *1		0 to +55 °C (32 to 131 °F)/-20 to +85 °C (-4 to 185 °F)
		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 Force 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 force 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 (77 °F): ±0.1% or less (at rated speed)
		Frequency Characteristics		400 Hz (at $J_L = J_M$)
		Force 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 (servomotor forward movement with positive reference), input voltage: maximum ±12 V
			Input Impedance	About 14 kΩ
			Circuit Time Constant	About 47 μs
		Force Reference Input	Reference Voltage *3	±3 VDC (Variable setting range: ±1 to ±10 VDC) at rated force (positive force reference with positive reference), input voltage: maximum ±12 V
			Input Impedance	About 14 kΩ
			Circuit Time Constant	About 47 μs
		Contact Speed Reference	Movement Direction Selection	With P control signal
			Speed Selection	With forward/reverse current 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 mm/s (setting resolution: 1 mm/s)
		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 (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)

(cont'd)

I/O Signals	Position Output	Form	Phase-A, -B, -C line driver
		Frequency Dividing Ratio	Any
	Sequence Input	Signal allocation can be modified.	Servo ON, P control (or Control mode switching, forward/reverse motor movement by internal speed setting, zero clamping, reference pulse prohibited), forward run prohibited (P-OT), reverse run prohibited (N-OT), alarm reset, forward current limit, and reverse current limit (or internal speed selection)
	Sequence Output	Fixed Output	Servo alarm, 3-bit alarm codes
		Signal allocation can be modified.	Positioning completed (speed coincidence), during servomotor movement, servo ready, during current limiting, during speed limiting, brake released, warning, selecting three of the NEAR signals.
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 (built-in Digital Operator functions)
	CN5 Analog Monitoring		Analog monitor connector built in for monitoring speed, force and other reference signals. Speed: 1 V/1000 mm/s Force: 1 V/100% of rated force 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 and autotuning operations, speed, force reference signal and other drawing functions.
	Others		Reverse movement connection, zero-point search, automatic servomotor ID, DC reactor connection terminal for harmonic suppressions. *5

* 1. Use the SERVOPACK within the ambient 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. The forward direction indicates the direction in which the linear scale counts up (Phase-A advance).

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

* 5. The DC reactor connection terminals for power supplies designed for minimum harmonics are not included in SERVOPACKs with capacities of 7.5 kW.

4.2 SERVOPACK Installation

The SGDH SERVOPACKs can be mounted on a base, rack or duct-ventilated. Incorrect installation will cause problems. Always observe the following installation instructions.

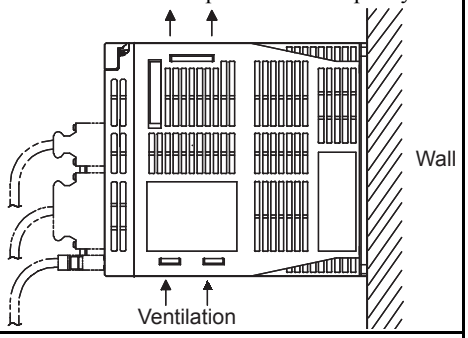
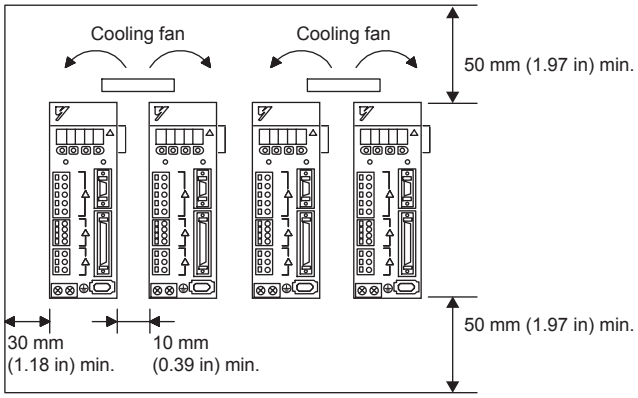
⚠ WARNING

- 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 (-4 to 185 °F) Humidity: 90%RH or less (with no condensation)
Operating Conditions	• Installation category (Overvoltage category) * : III • Pollution degree * : 2 • Protection class * : 1X • Altitude : Maximum 1000 m
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 (131 °F). 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 (131 °F). 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 excessive dust or iron powder in the air.

* Conforming to the following standards.

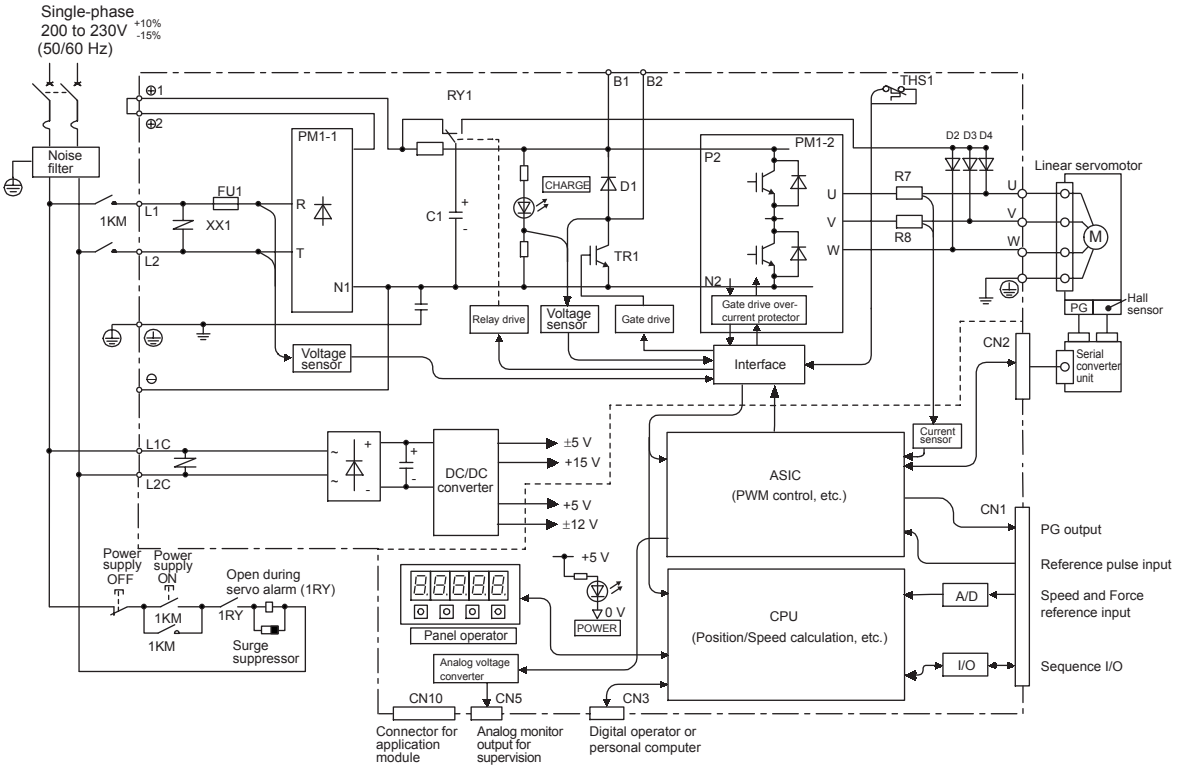
- UL508C
- CSA C22.2 No.14
- EN50178
- EN55011 group 1 class A
- EN61000-6-2

Orientation	Install the SERVOPACK perpendicular to the wall as shown in the figure. The SERVOPACK must be oriented this way because it is designed to be cooled by natural convection or a cooling fan. Secure the SERVOPACK using two to four mounting holes. The number of holes depends on the capacity. 
Installation	Follow the procedure below to install multiple SERVOPACKs side by side in a control panel.  **SERVOPACK Orientation** Install the SERVOPACK perpendicular to the wall so the front panel containing connectors faces outward. **Cooling** As shown in the figure above, allow sufficient space around each SERVOPACK for cooling by cooling fans or natural convection. **Side-by-side Installation** When installing SERVOPACKs side by side as shown in the figure above, allow at least 10 mm (0.39 in) between and at least 50 mm (1.97 in) above and below each SERVOPACK. Install cooling fans above the SERVOPACKs to avoid excessive temperature rise and to maintain even temperature inside the control panel. **Environmental Conditions in the Control Panel** Ambient Temperature:0 to 55°C (32 to 131° F) Humidity: 90% RH or less Vibration: 4.9 m/s^2 Condensation and Freezing: None Ambient Temperature for Long-term Reliability: 45 °C (113 °F) or less
Voltage Resistance Test	Conduct voltage resistance tests under the following conditions. • Voltage: 1500 Vrms AC for one minute • Braking current: 30 mA or more • Frequency: 50 or 60 Hz • Voltage applied points For SGDH-□□AE SERVOPACKs : Between the ground terminals and the point where the terminals L1, L2, (L3), L1C, L2C, U, V, W are connected. For SGDH-□□DE SERVOPACKs : Between the neutral terminals and the point where the terminals L1, L2, L3, U, V, W are connected.

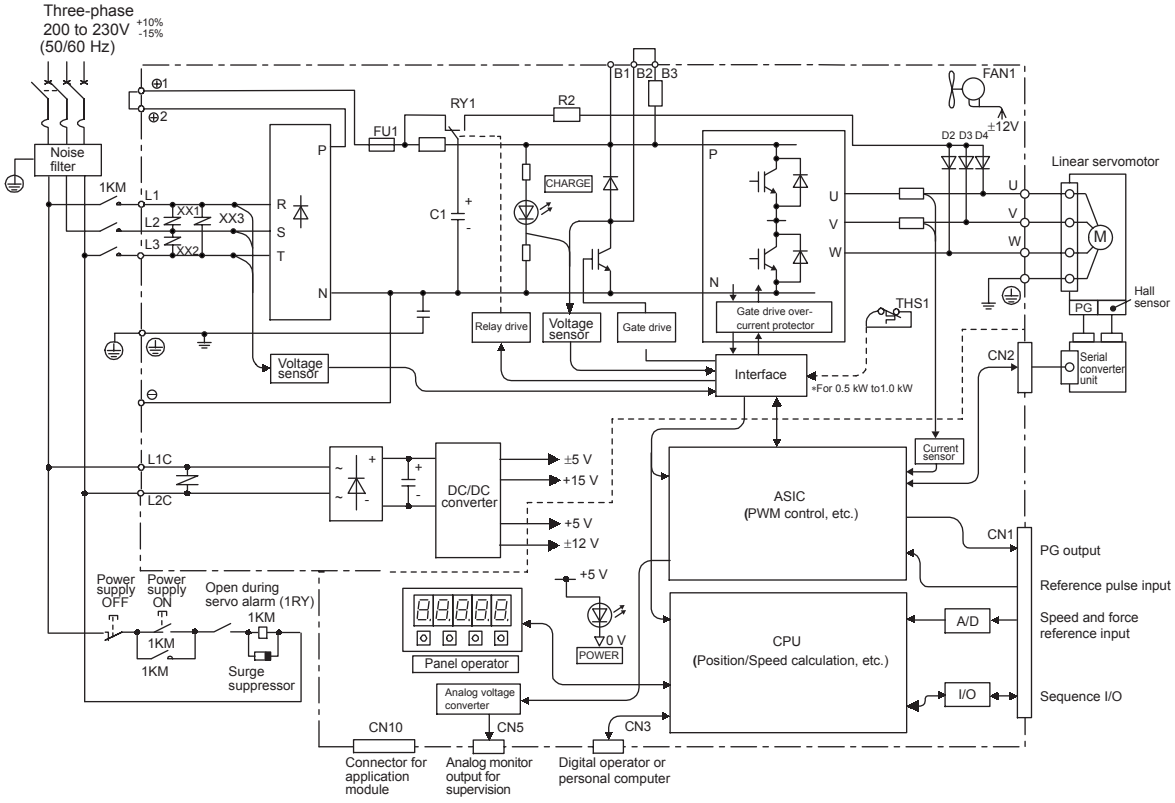
4.3 SERVOPACK Internal Block Diagrams

The following diagrams show the SERVOPACK internal blocks.

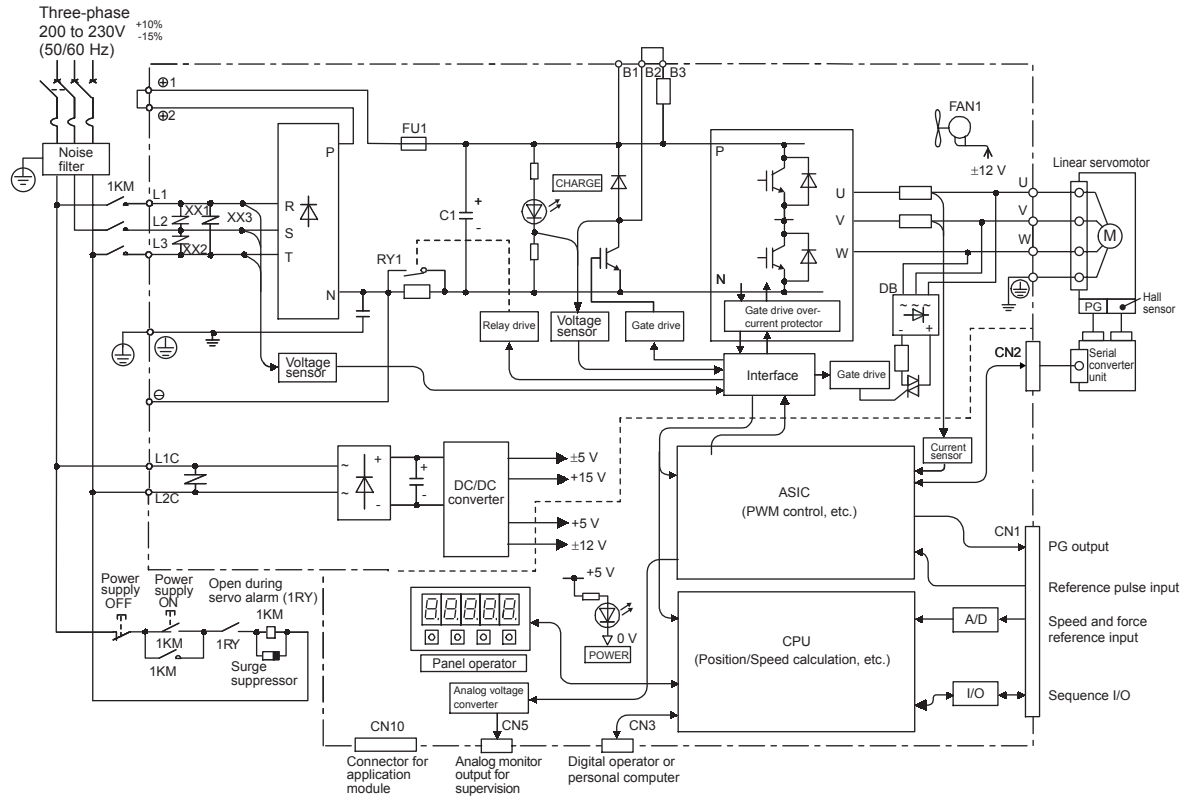
4.3.1 Single-phase 200 V, 50 W to 400 W Models



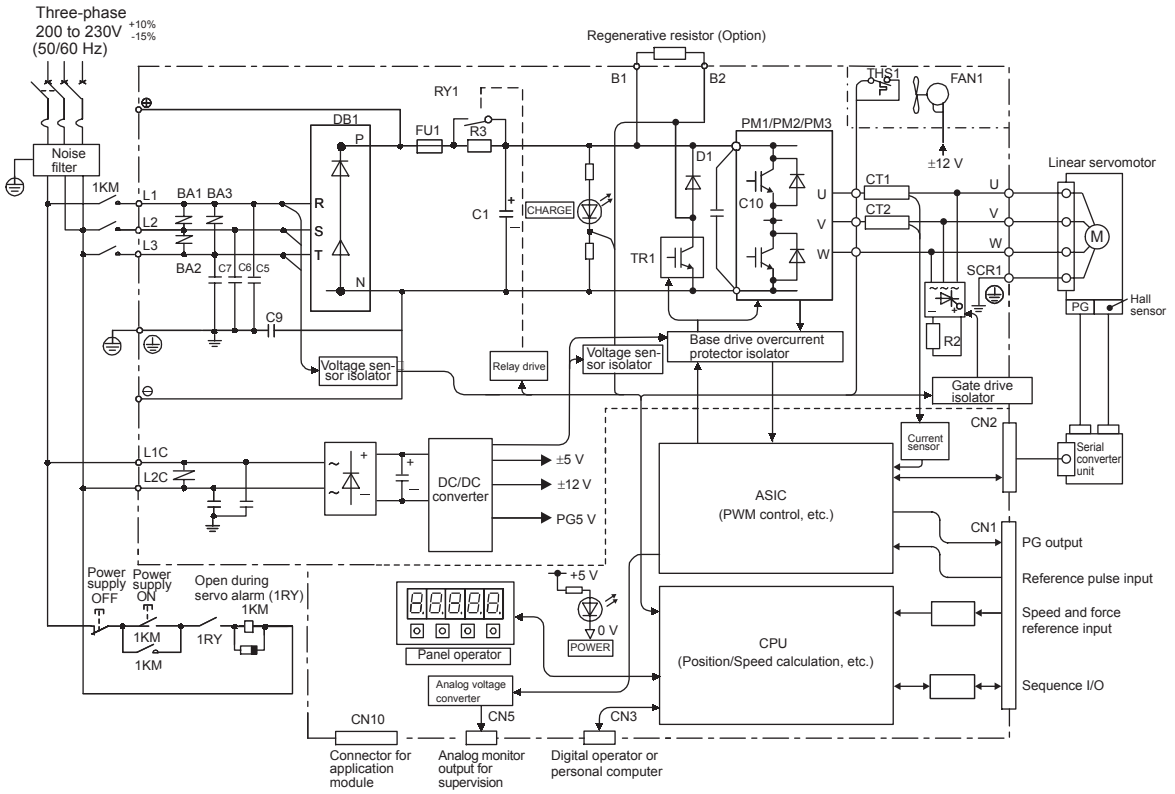
4.3.2 Three-phase 200 V, 500 W to 1.5 kW Models



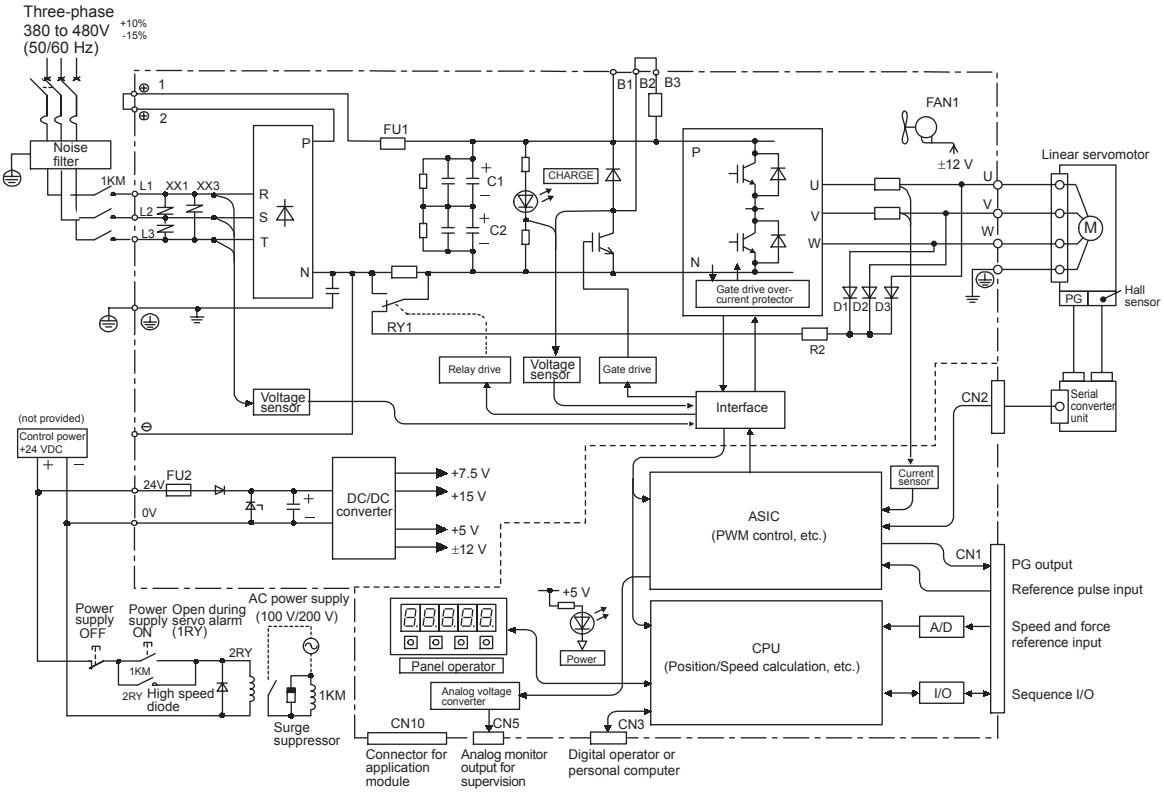
4.3.3 Three-phase 200 V, 2.0 kW to 5.0 kW Models



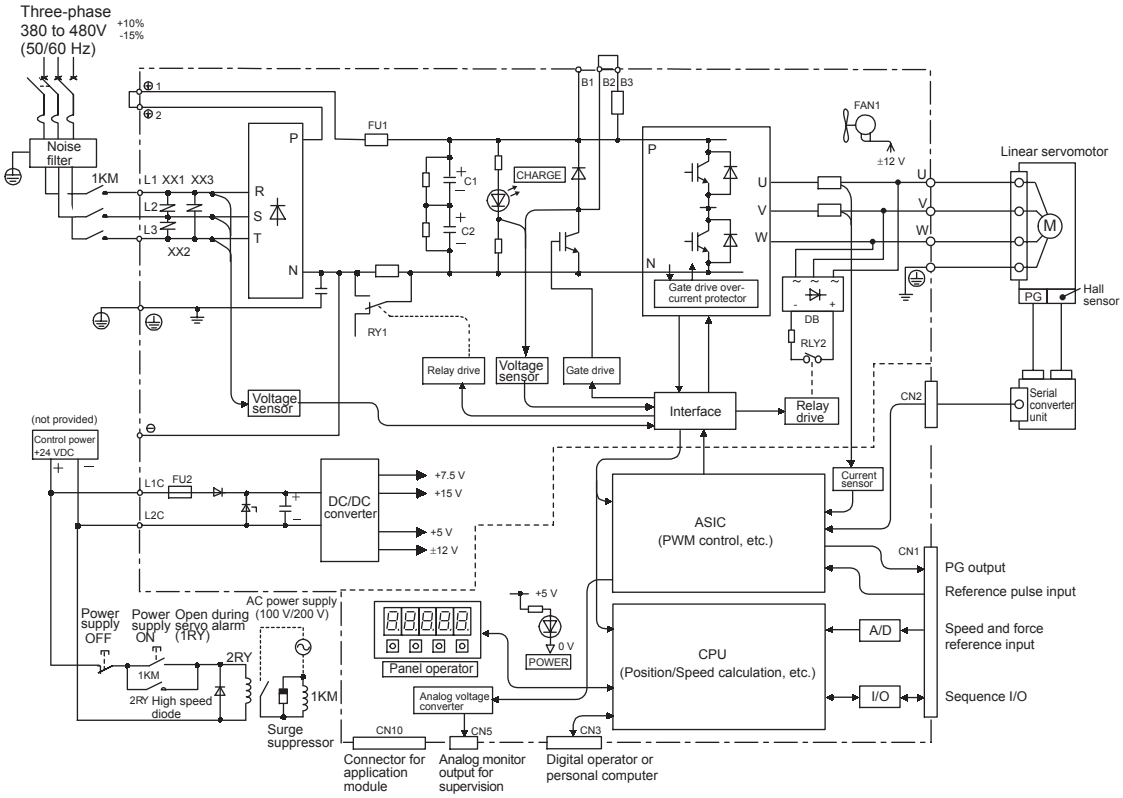
4.3.4 Three-phase 200 V, 7.5 kW Models



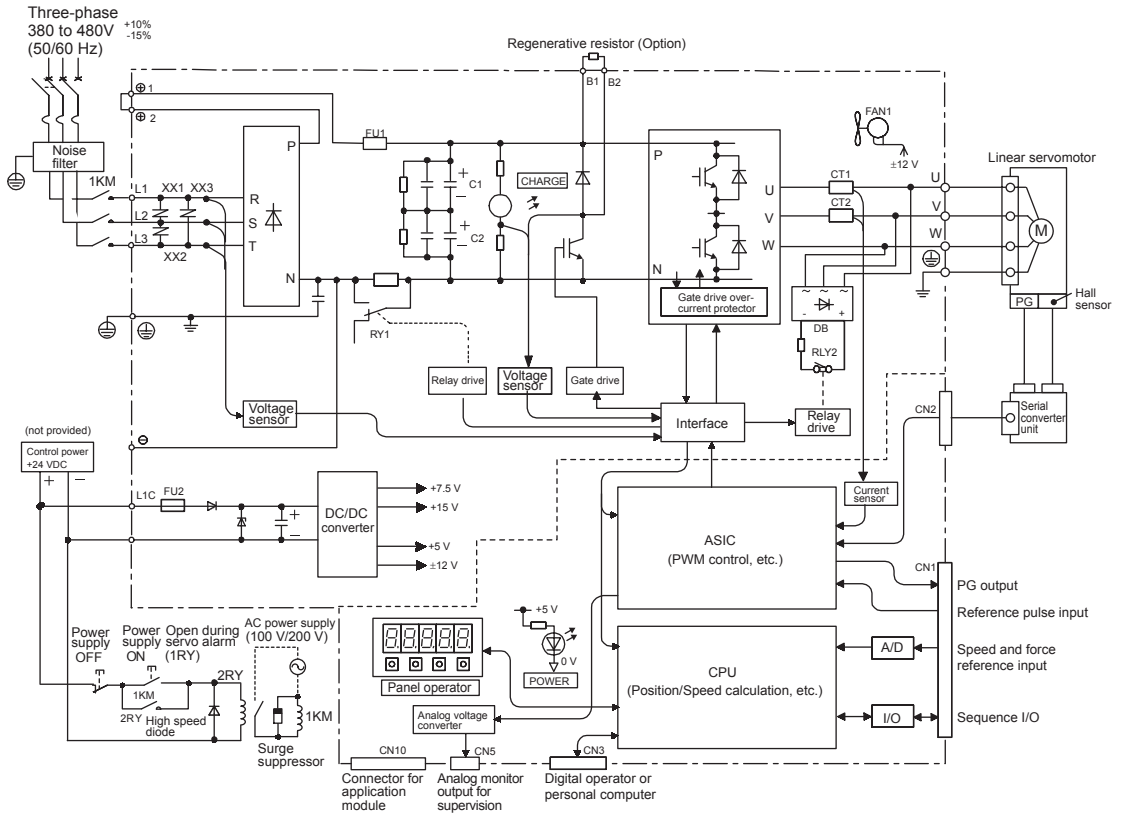
4.3.5 Three-phase 400 V, 500 W to 3.0 kW Models



4.3.6 Three-phase 400 V, 5.0 kW Model



4.3.7 Three-phase 400 V, 7.5 kW Models



4.4 SERVOPACK's Power Supply Capacities and Power Losses

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

Table 4.1 SERVOPACK Power Losses at Rated Output

Main Circuit Power Supply	Maximum Applicable Linear Servomotor Capacity kW	SERVOPACK Model SGDH-	Output Current (Effective Value) A	Main Circuit Power Loss W	Regenerative Resistor Power Loss W	Control Circuit Power Loss W	Total Power Loss W
Single-phase 200 V	0.05	A5AE	0.64	4.6	_ *1	13	17.6
	0.10	01AE	0.91	6.7			19.7
	0.20	02AE	2.1	13.3			26.3
	0.40	04AE	2.8	20			33
Three-phase 200 V	0.45	05AE	3.8	27	12 *2	15	54
	0.75	08AE	5.7	41			68
	1.0	10AE	7.6	55			82
	1.5	15AE	11.6	92	14 *2		121
	2.0	20AE	18.5	120	28 *2		163
	3.0	30AE	24.8	155			198
	5.0	50AE	32.9	240	56 *2		311
	7.5	75AE	54.7	330	_ *3	27	357
Three-phase 400 V	0.45	05DE	1.9	19	14 *2	15	48
	1.0	10DE	3.5	35			64
	1.5	15DE	5.4	53			82
	2.0	20DE	8.4	83	28 *2		126
	3.0	30DE	11.9	118			161
	5.0	50DE	16.5	192	36		243
	7.5	75DE	25.4	264	_ *3		279

* 1. SERVOPACKs with a capacity of 50 to 400W do not have built-in regenerative resistors. If the regenerative energy exceeds the specified value, connect an external regenerative resistor. Refer to *11.1.3 Alarm Display Table when the Application Module is Used.*

* 2. Regenerative resistor power losses are allowable losses. Take the following action if this value is exceeded.
  - Remove the lead from the internal regenerative resistor in the SERVOPACK.
  - Install an external regenerative resistor (optional).

* 3. An external regenerative resistor must be connected to SERVOPACKs with a capacity of 7.5 kW. The following regenerative resistor units are provided for this purpose.
  For the SGDH-75DE: JUSP-RA18 (allowable loss: 180W)
  For the SGDH-75AE: JUSP-RA05 (allowable loss: 350W)

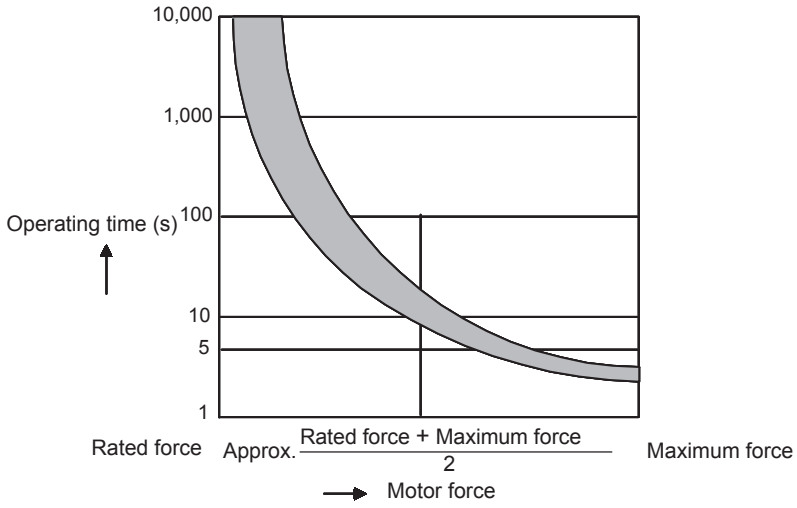
Note: Refer to *7.6 Connecting Regenerative Resistors*, *6.8.5 External Regenerative Resistor* and *6.8.6 Regenerative Resistor* for details.

4.5 SERVOPACK Overload Characteristics and Allowable Load Mass

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 ambient temperature of 40°C (104°F).



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 Time and Stopping Time

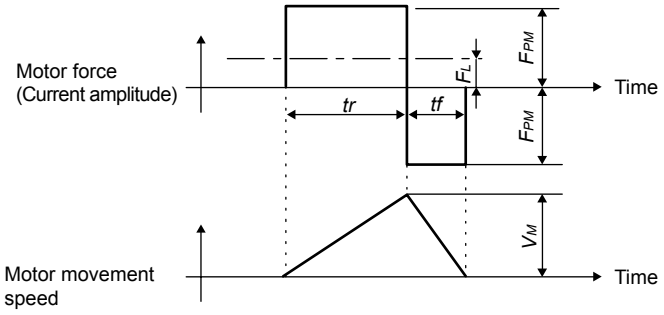
The starting time *tr* and the stopping time *tf* of linear servomotor under constant load conditions can be calculated using the following formulas.

Starting time : $tr = \frac{M \cdot V_M}{F_{PM} - F_L}$ [s] Stopping time : $tf = \frac{M \cdot V_M}{F_{PM} + F_L}$ [s]

- V_M Motor movement speed (m/s)
- M Load mass including motor (kg)
- F_{PM} Motor instantaneous peak force (N) in combination with a SERVOPACK
- F_L Load force (N)

Calculate the motor force from the motor current: Motor force = Motor force constant × Motor effective current

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



4.6 SERVOPACK Dimensional Drawings

SERVOPACK dimensional drawings are grouped according to the mounting method and the capacity.

(1) Base-mounted Type

Supply Voltage		SERVOPACK		Reference
		Capacity	Model SGDH-□□□E	
Single-phase	200 V	50 W, 100 W, 200 W	A5A, 01A, 02A	4.7.1
	200 V	400 W	04A	4.7.2
Three-phase	200 V	500 W, 750 W, 1.0 kW	05A, 08A, 10A	4.7.3
Three-phase	200 V	1.5 kW	15A	4.7.4
	400 V	500 W, 750 W, 1.0 kW, 1.5 kW	05D, 08D, 10D, 15D	
	200 V	2.0 kW, 3.0 kW	20A, 30A	4.7.5
	400 V	2.0 kW, 3.0 kW	20D, 30D	
	200 V	5.0 kW	50A	4.7.6
	400 V	5.0 kW	50D	
	200 V	7.5 kW	75A	4.7.7
	400 V	7.5 kW	75D	4.7.8

(2) Rack-mounted Type

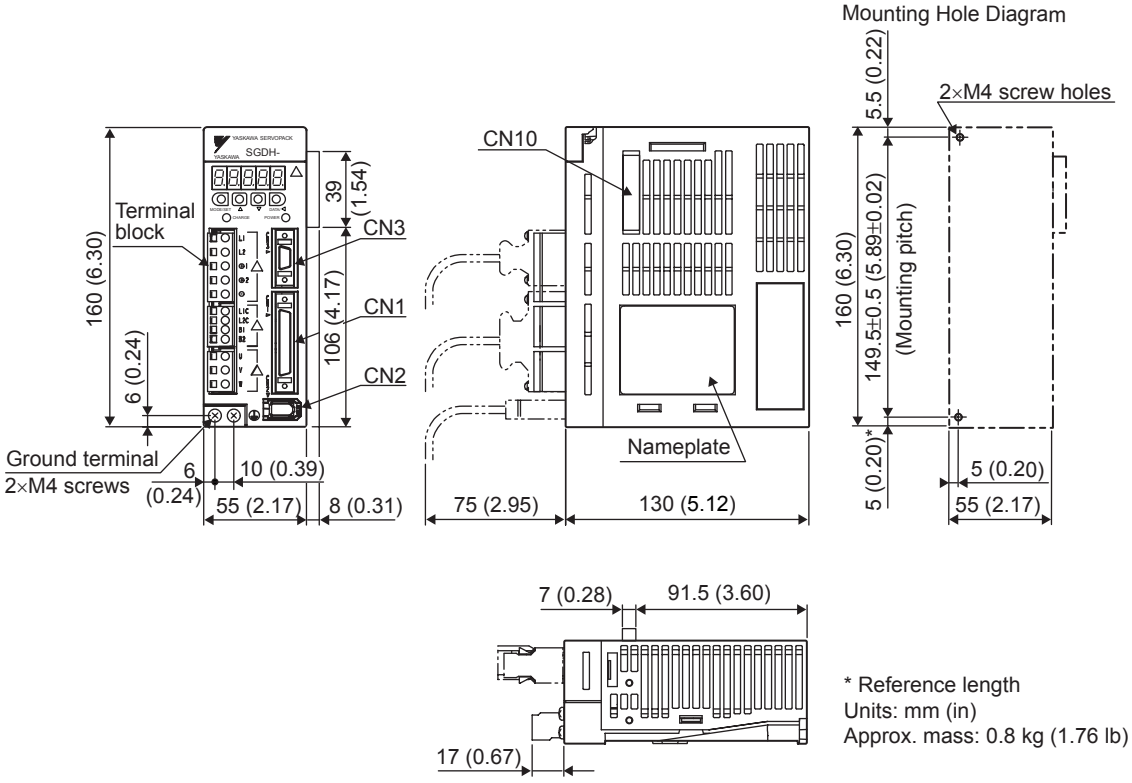
Supply Voltage		SERVOPACK		Reference
		Capacity	Model SGDH-□□□E-R	
Single-phase	200 V	50 W, 100 W, 200 W	A5A, 01A, 02A	4.8.1
	200 V	400 W	04A	4.8.2
Three-phase	200 V	500 W, 750 W, 1.0 kW	05A, 08A, 10A	4.8.3
	200 V	1.5 kW	15A	4.8.4
	400 V	500 W, 750 W, 1.0 kW, 1.5 kW	05D, 08D, 10D, 15D	
	200 V	2.0 kW, 3.0 kW	20A, 30A	4.8.5
	400 V	2.0 kW, 3.0 kW	20D, 30D	
	200 V	5.0 kW	50A	4.8.6
	400 V	5.0 kW	50D	

(3) Duct-ventilated Type

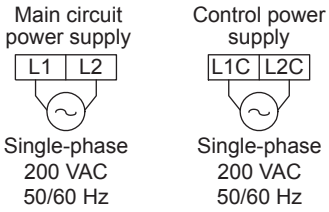
Supply Voltage		SERVOPACK		Reference
		Capacity	Model SGDH-□□□E-P	
Three-phase	200 V	7.5 kW	75A	4.9.1
	400 V	7.5 kW	75D	4.9.2

4.7 Dimensional Drawings of Base-mounted SERVOPACK Model

4.7.1 Single-phase 200 V: 50 W/100 W/200 W (A5AE/01AE/02AE)



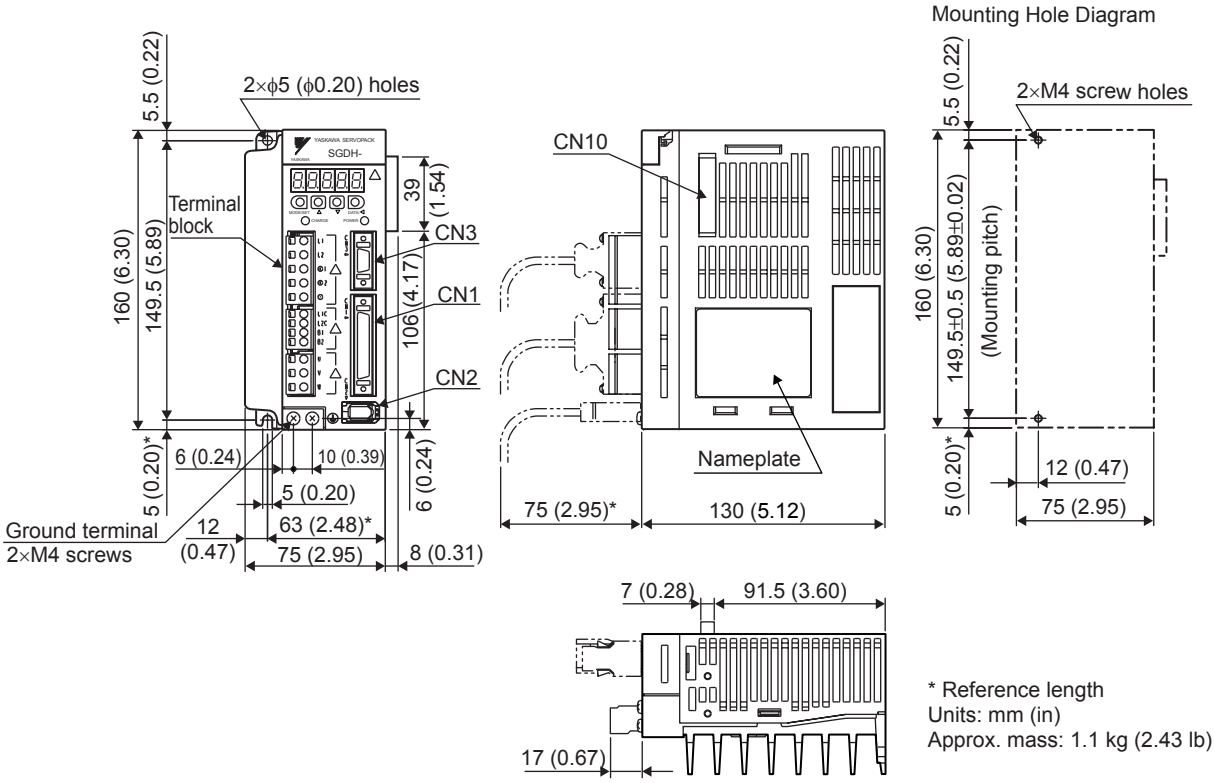
External Terminal Connector



SERVOPACK Connector

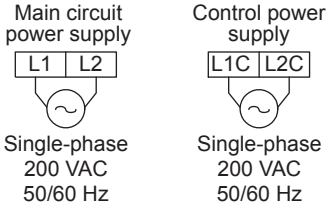
Connector Symbol	SERVOPACK Connector Model	Manufacturer
CN1	10250-52A2JL	Sumitomo 3M Co., Ltd.
CN2	53460-0611	Molex Japan Co., Ltd.
CN3	10214-52A2JL	Sumitomo 3M Co., Ltd.

4.7.2 Single-phase 200 V: 400 W (04AE)



* Reference length
Units: mm (in)
Approx. mass: 1.1 kg (2.43 lb)

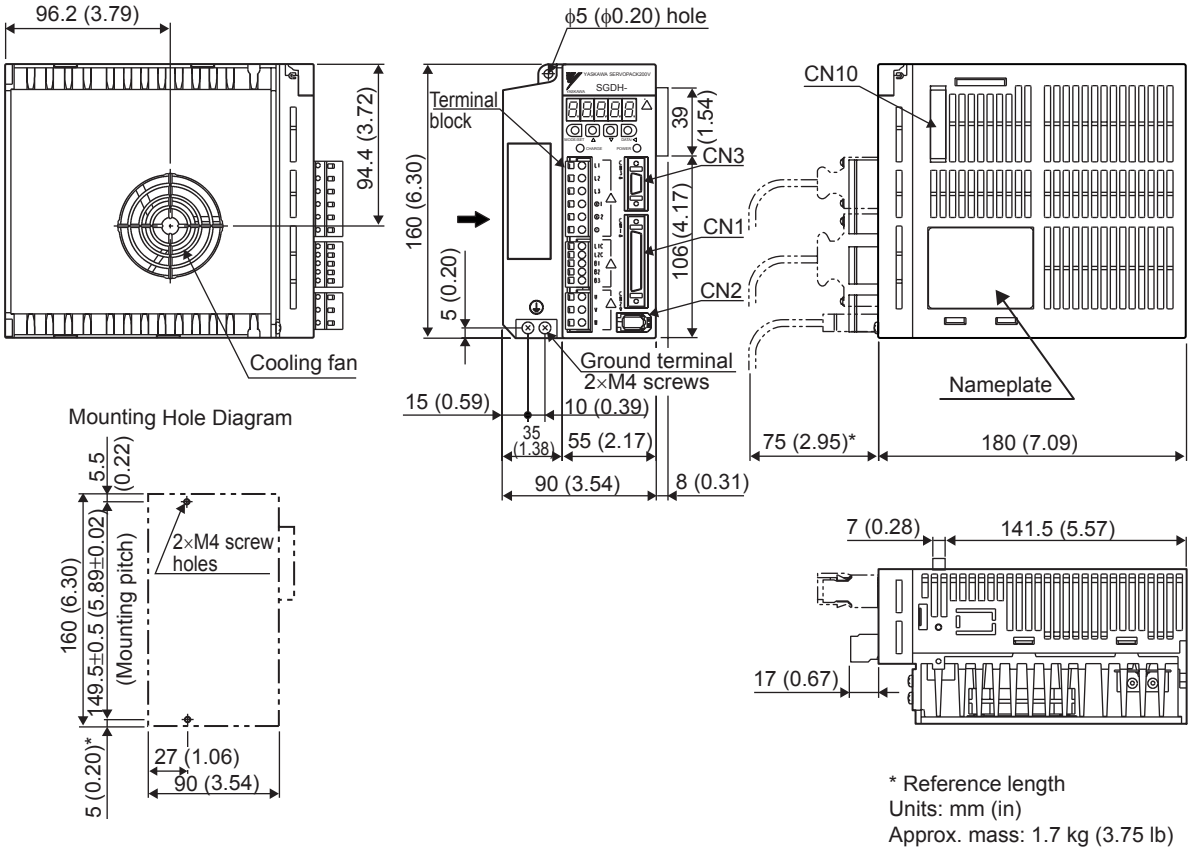
External Terminal Connector



SERVOPACK Connector

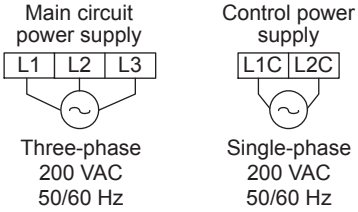
Connector Symbol	SERVOPACK Connector Model	Manufacturer
CN1	10250-52A2JL	Sumitomo 3M Co., Ltd.
CN2	53460-0611	Molex Japan Co., Ltd.
CN3	10214-52A2JL	Sumitomo 3M Co., Ltd.

4.7.3 Three-phase 200 V: 500 W/750 W/1.0 kW (05AE/08AE/10AE)



* Reference length
Units: mm (in)
Approx. mass: 1.7 kg (3.75 lb)

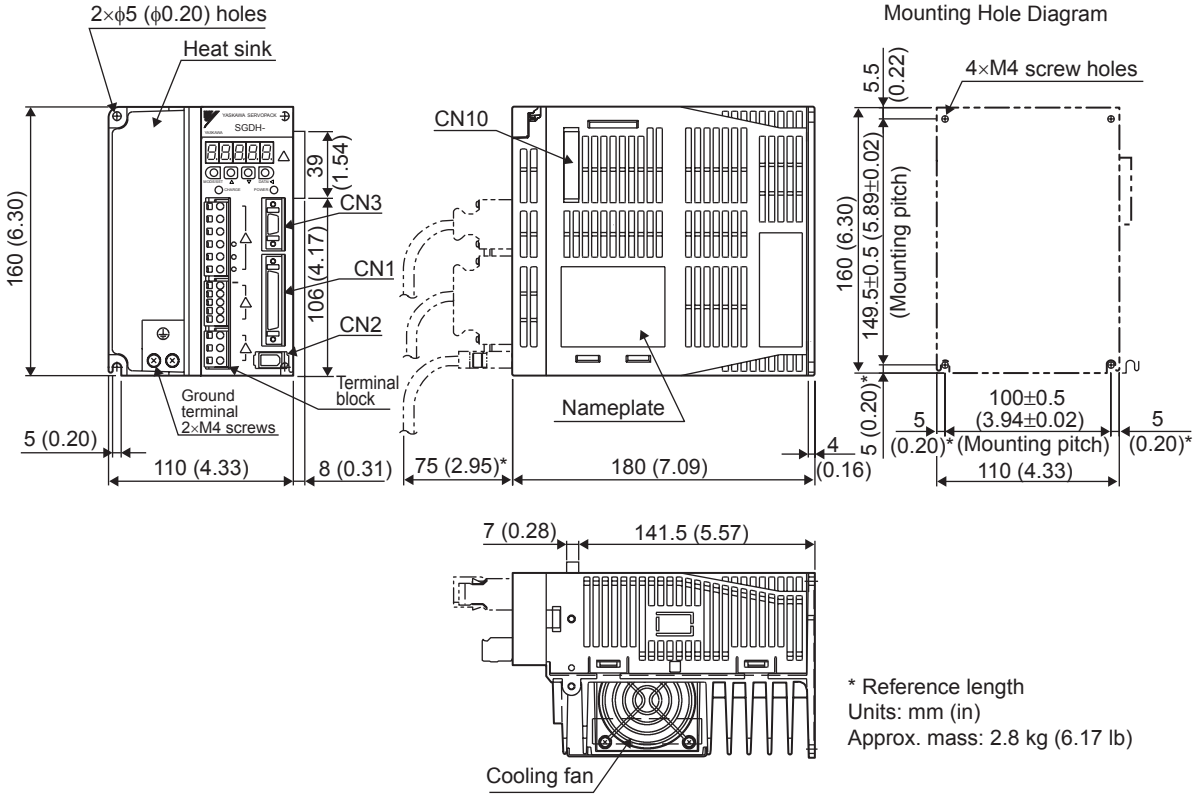
External Terminal Connector



SERVOPACK Connector

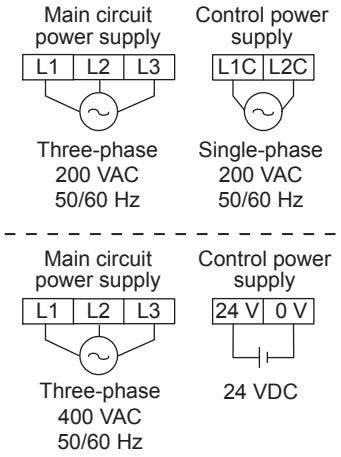
Connector Symbol	SERVOPACK Connector Model	Manufacturer
CN1	10250-52A2JL	Sumitomo 3M Co., Ltd.
CN2	53460-0611	Molex Japan Co., Ltd.
CN3	10214-52A2JL	Sumitomo 3M Co., Ltd.

4.7.4 Three-phase 200 V: 1.5 kW (15AE)
Three-phase 400 V: 500 W/750 W/1.0 kW/1.5 kW (05DE/08DE/10DE/15DE)



* Reference length
Units: mm (in)
Approx. mass: 2.8 kg (6.17 lb)

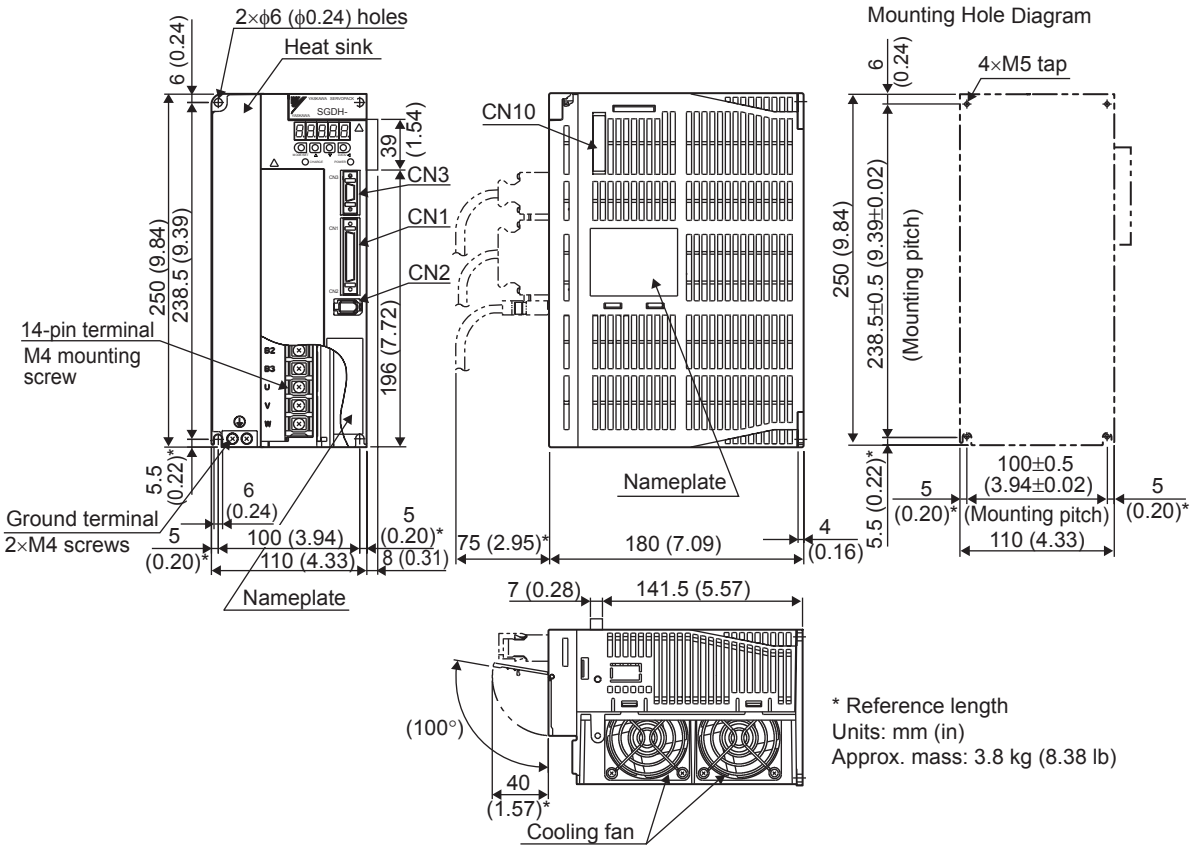
External Terminal Connector



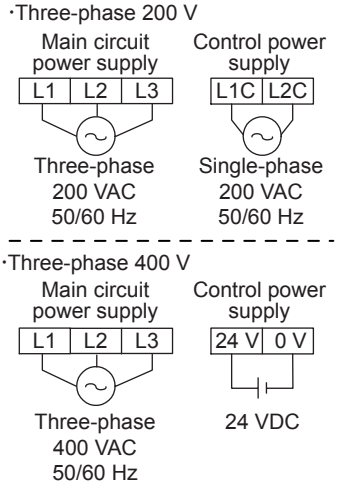
SERVOPACK Connector

Connector Symbol	SERVOPACK Connector Model	Manufacturer
CN1	10250-52A2JL	Sumitomo 3M Co., Ltd.
CN2	53460-0611	Molex Japan Co., Ltd.
CN3	10214-52A2JL	Sumitomo 3M Co., Ltd.

4.7.5 Three-phase 200 V: 2.0 kW/3.0 kW (20AE/30AE) Three-phase 400 V: 2.0 kW/3.0 kW (20DE/30DE)



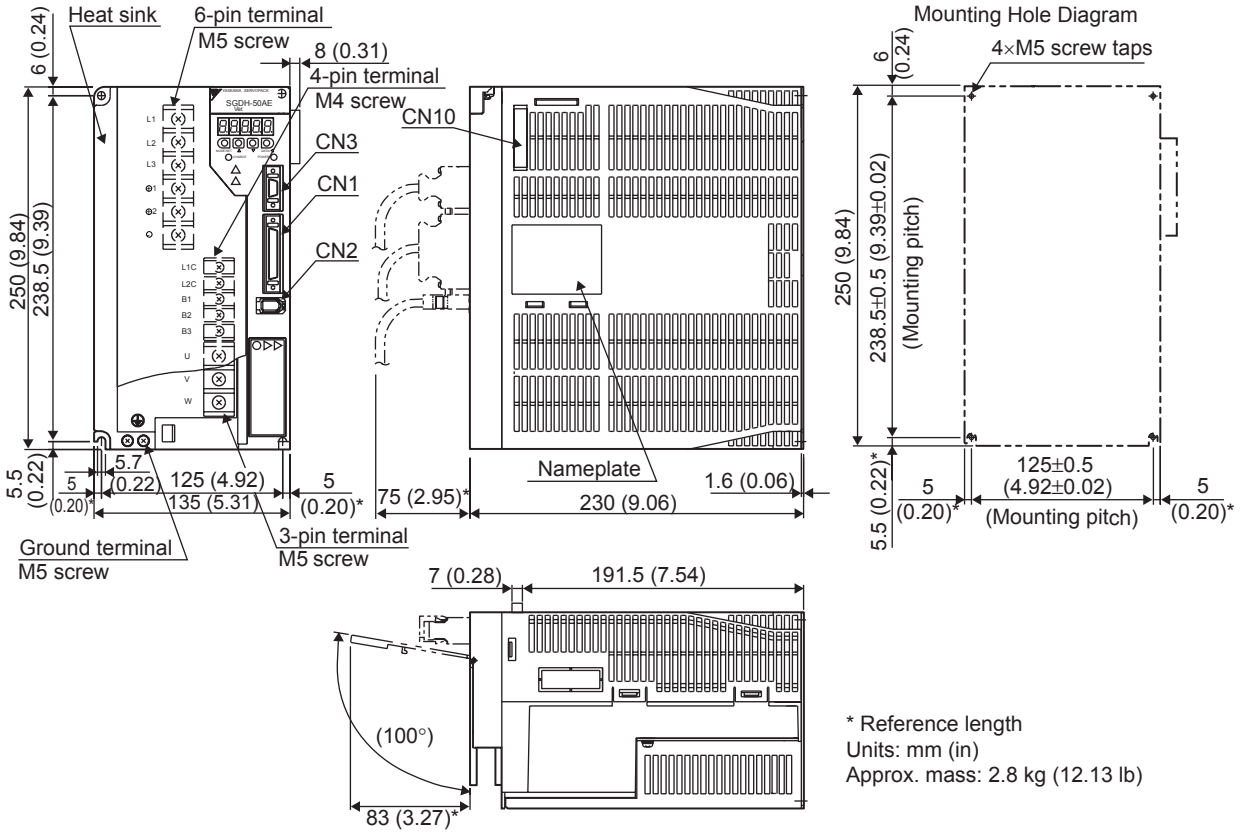
External Terminal Connector



SERVOPACK Connector

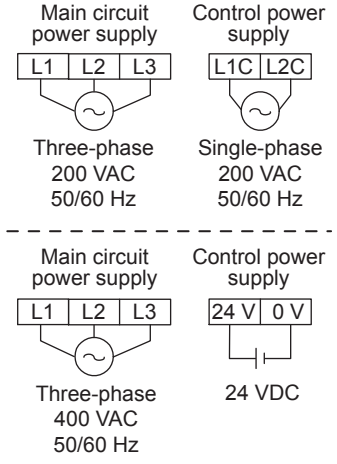
Connector Symbol	SERVOPACK Connector Model	Manufacturer
CN1	10250-52A2JL	Sumitomo 3M Co., Ltd.
CN2	53460-0611	Molex Japan Co., Ltd.
CN3	10214-52A2JL	Sumitomo 3M Co., Ltd.

4.7.6 Three-phase 200 V: 5.0 kW (50AE)
Three-phase 400 V: 5.0 kW (50DE)



* Reference length
Units: mm (in)
Approx. mass: 2.8 kg (12.13 lb)

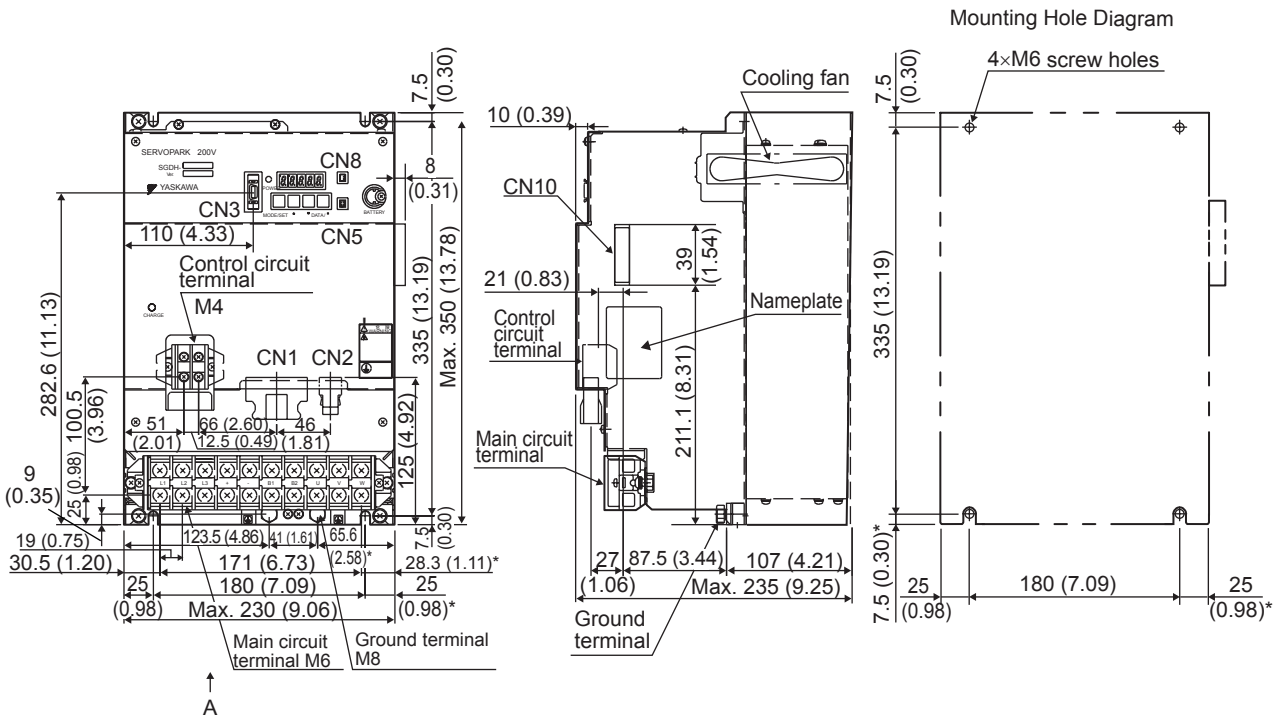
External Terminal Connector

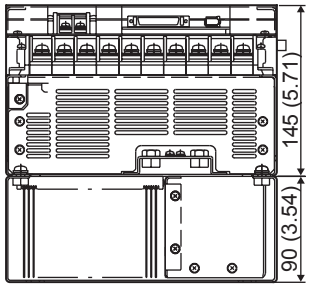


SERVOPACK Connector

Connector Symbol	SERVOPACK Connector Model	Manufacturer
CN1	10250-52A2JL	Sumitomo 3M Co., Ltd.
CN2	53460-0611	Molex Japan Co., Ltd.
CN3	10214-52A2JL	Sumitomo 3M Co., Ltd.

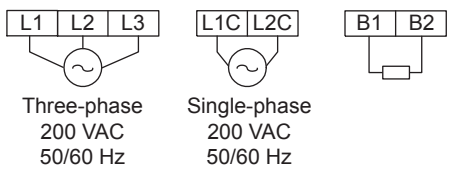
4.7.7 Three-phase 200 V: 7.5 kW (75AE)





* Reference length
Units: mm (in)
Approx. mass: 14.3 kg (31.53 lb)

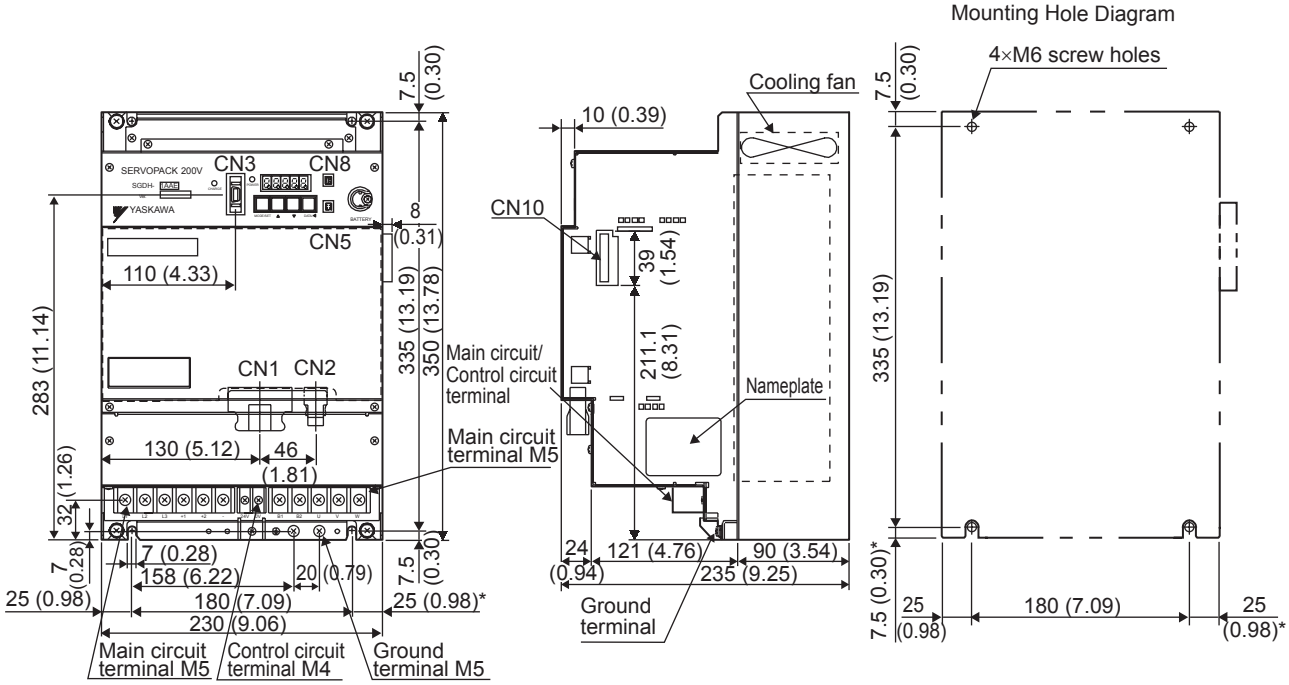
External Terminal Connector

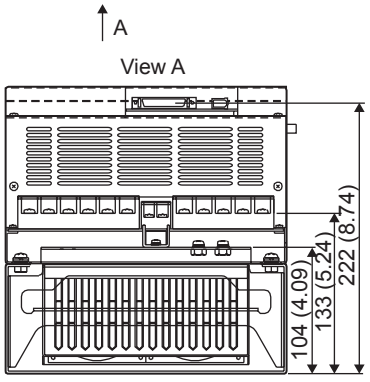


SERVOPACK Connector

Connector Symbol	SERVOPACK Connector Model	Manufacturer
CN1	10250-52A2JL	Sumitomo 3M Co., Ltd.
CN2	53460-0611	Molex Japan Co., Ltd.
CN3	10214-52A2JL	Sumitomo 3M Co., Ltd.

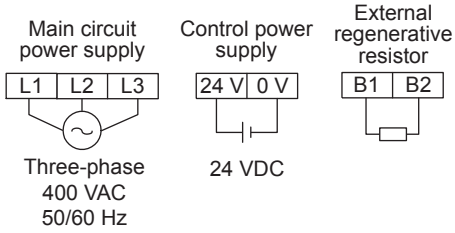
4.7.8 Three-phase 400 V: 7.5 kW (75DE)





* Reference length
Units: mm (in)
Approx. mass: 13.5 kg (29.76 lb)

External Terminal Connector

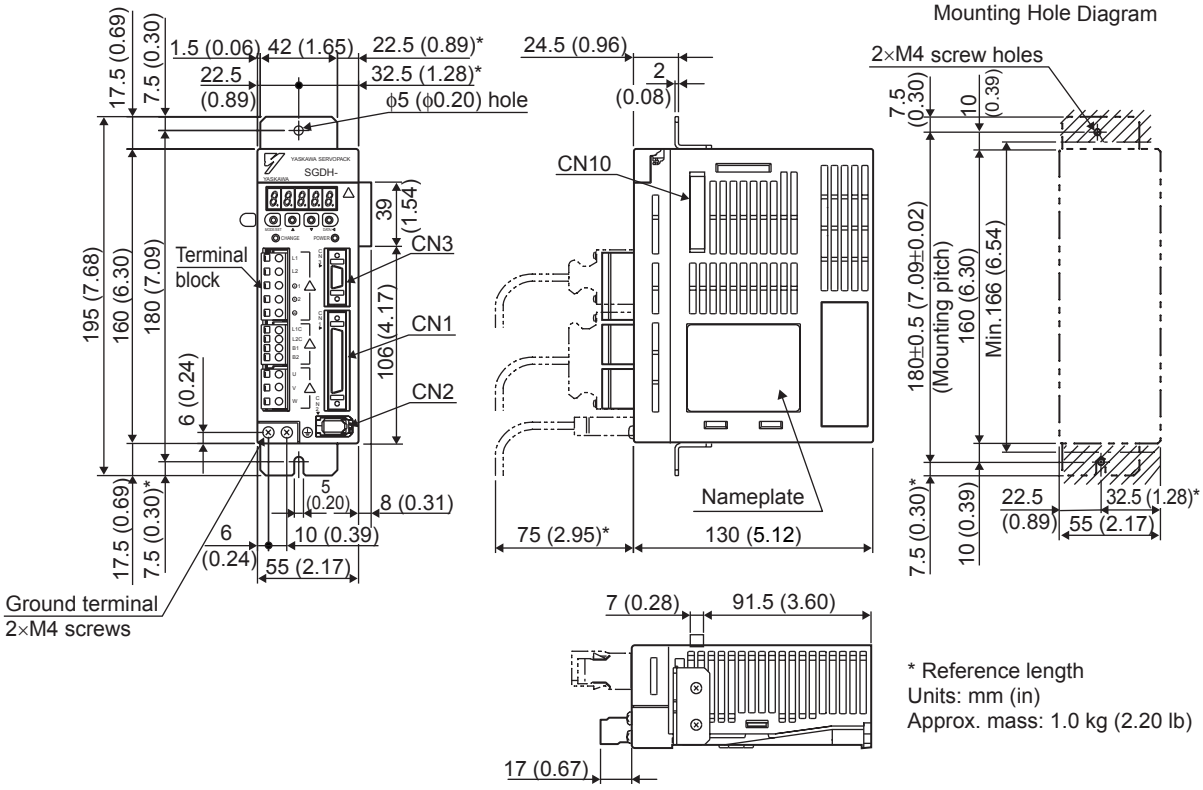


SERVOPACK Connector

Connector Symbol	SERVOPACK Connector Model	Manufacturer
CN1	10250-52A2JL	Sumitomo 3M Co., Ltd.
CN2	53460-0611	Molex Japan Co., Ltd.
CN3	10214-52A2JL	Sumitomo 3M Co., Ltd.

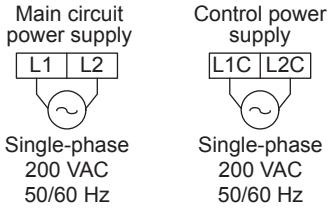
4.8 Dimensional Drawings of Rack-mounted SERVOPACK Model

4.8.1 Single-phase 200 V: 50 W/100 W/200 W (A5AE-R/01AE-R/ 02AE-R)



* Reference length
Units: mm (in)
Approx. mass: 1.0 kg (2.20 lb)

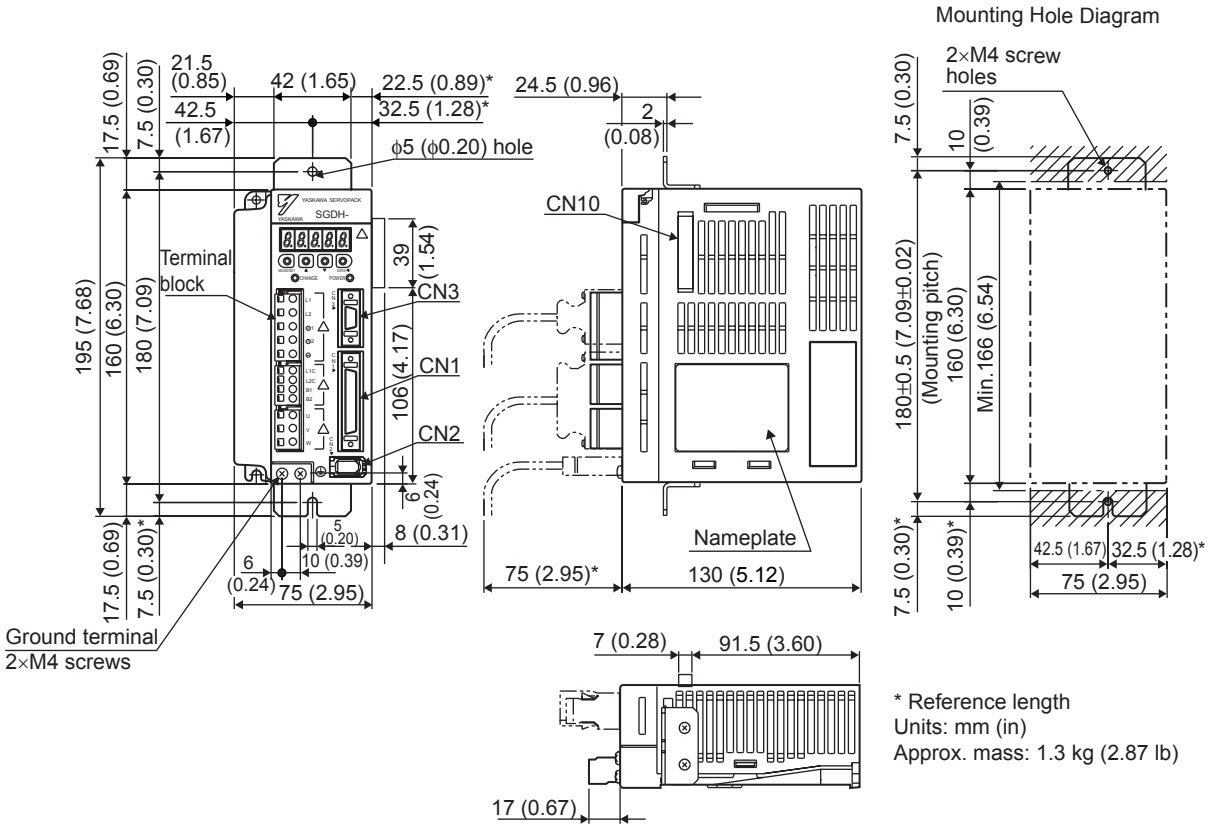
External Terminal Connector



SERVOPACK Connector

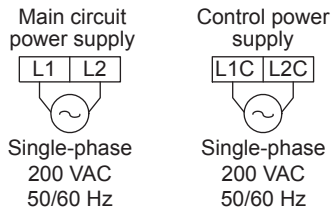
Connector Symbol	SERVOPACK Connector Model	Manufacturer
CN1	10250-52A2JL	Sumitomo 3M Co., Ltd.
CN2	53460-0611	Molex Japan Co., Ltd.
CN3	10214-52A2JL	Sumitomo 3M Co., Ltd.

4.8.2 Single-phase 200 V: 400 W (04AE-R)



* Reference length
Units: mm (in)
Approx. mass: 1.3 kg (2.87 lb)

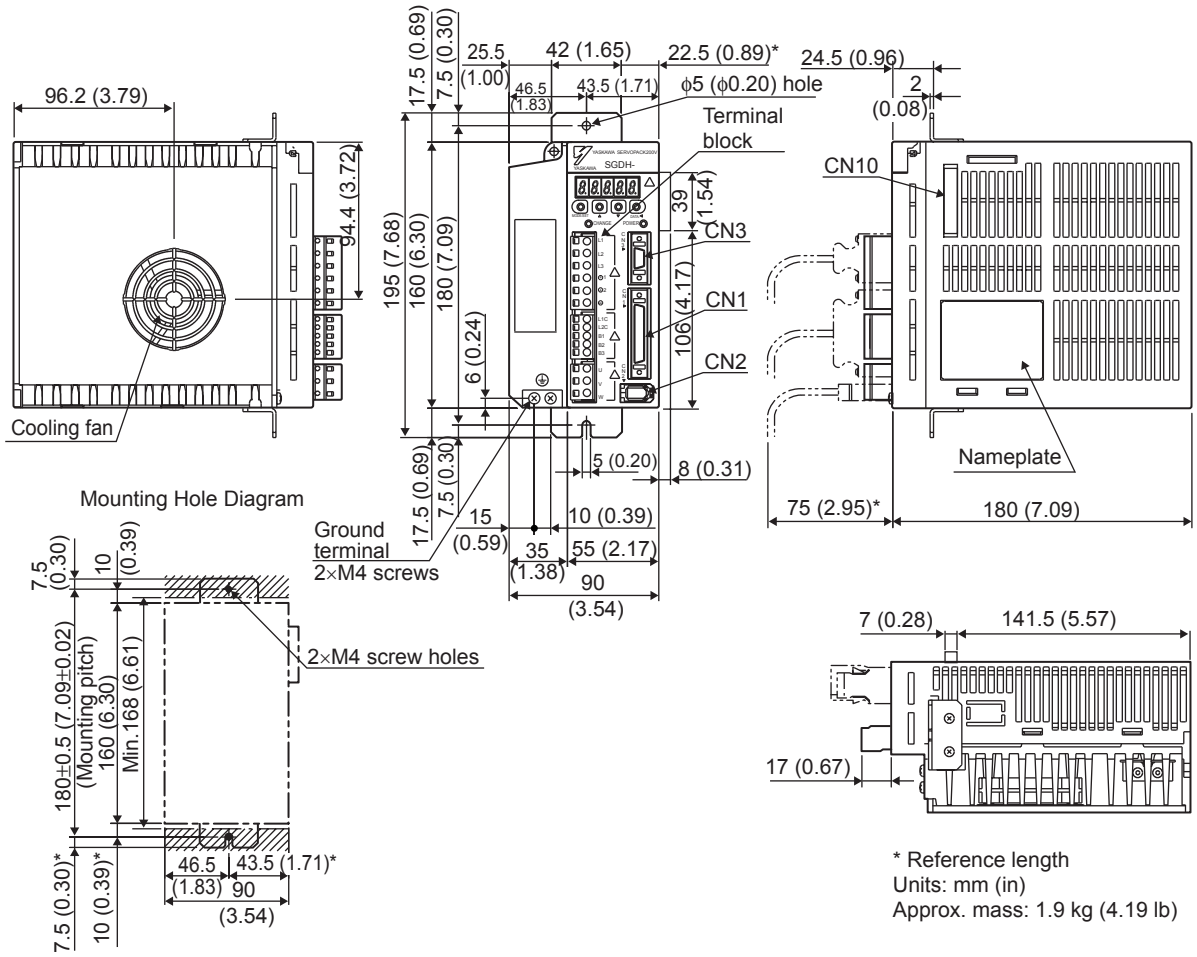
External Terminal Connector



SERVOPACK Connector

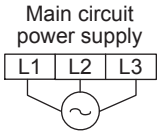
Connector Symbol	SERVOPACK Connector Model	Manufacturer
CN1	10250-52A2JL	Sumitomo 3M Co., Ltd.
CN2	53460-0611	Molex Japan Co., Ltd.
CN3	10214-52A2JL	Sumitomo 3M Co., Ltd.

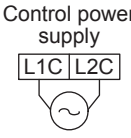
4.8.3 Three-phase 200 V: 500 W/750 W/1.0 kW (05AE-R/08AE-R/10AE-R)



* Reference length
Units: mm (in)
Approx. mass: 1.9 kg (4.19 lb)

External Terminal Connector

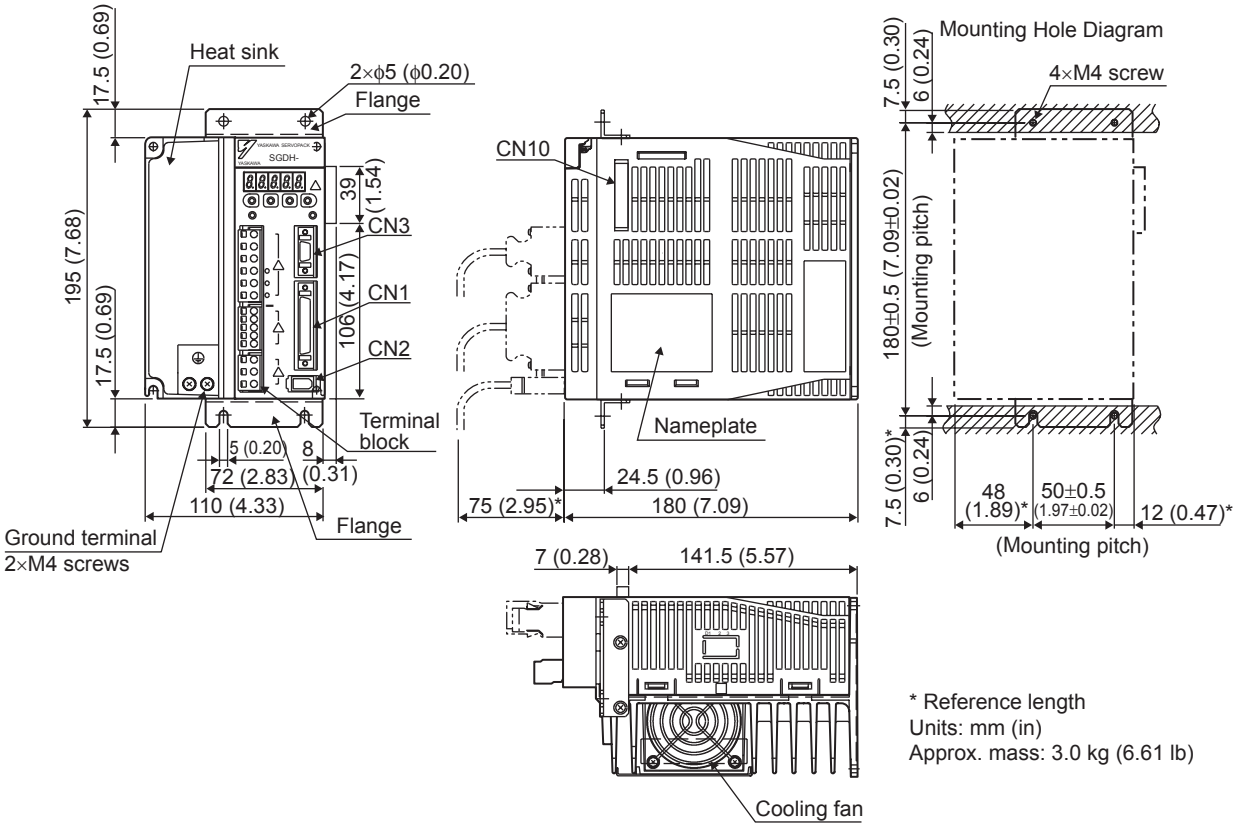




SERVOPACK Connector

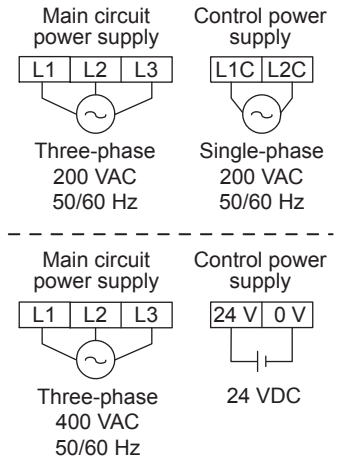
Connector Symbol	SERVOPACK Connector Model	Manufacturer
CN1	10250-52A2JL	Sumitomo 3M Co., Ltd.
CN2	53460-0611	Molex Japan Co., Ltd.
CN3	10214-52A2JL	Sumitomo 3M Co., Ltd.

4.8.4 Three-phase 200 V: 1.5 kW (15AE-R)
Three-phase 400 V: 500 W/750 W/1.0 kW/1.5 kW (05DE-R/08DE-R/10DE-R/15DE-R)



* Reference length
Units: mm (in)
Approx. mass: 3.0 kg (6.61 lb)

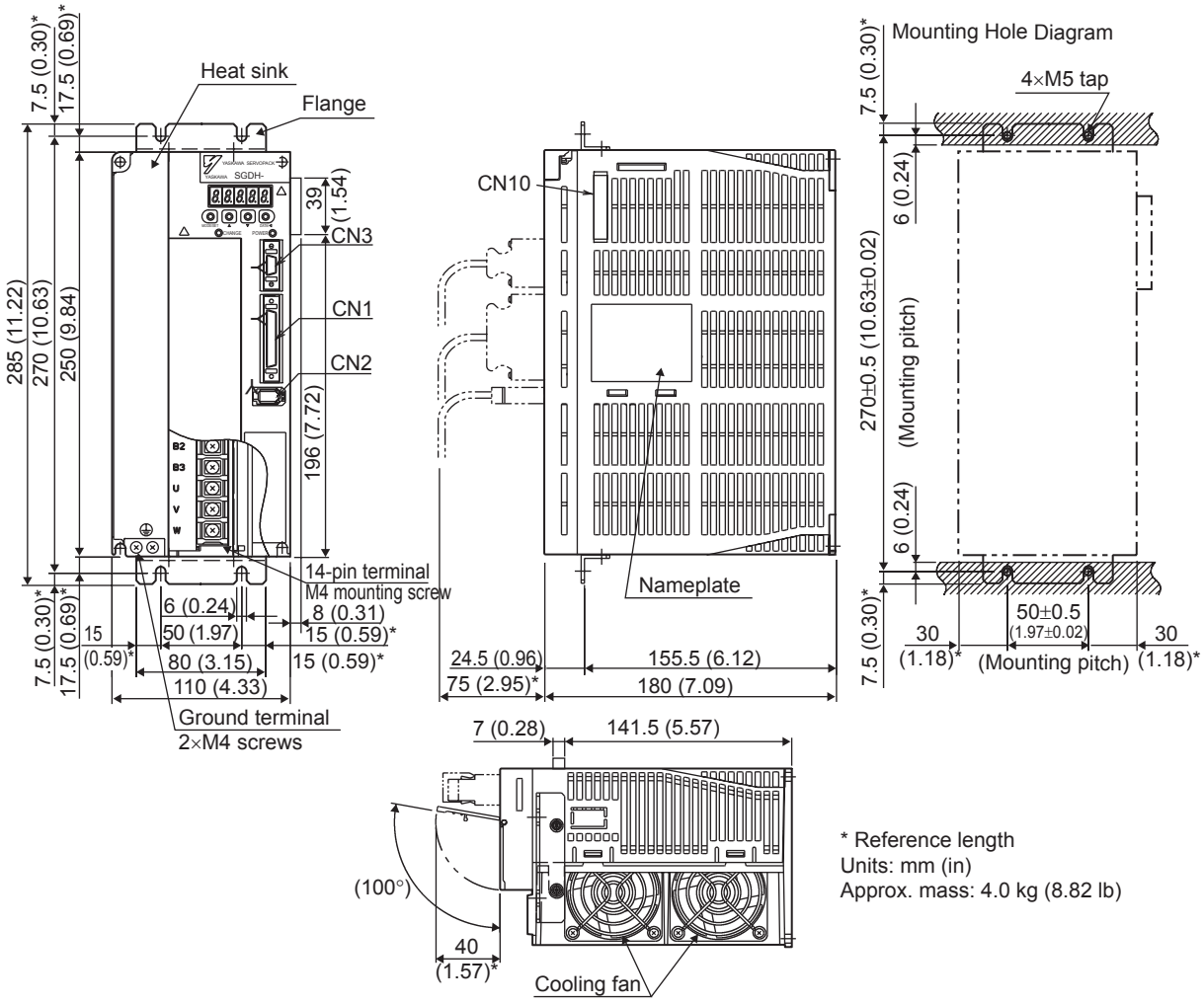
External Terminal Connector



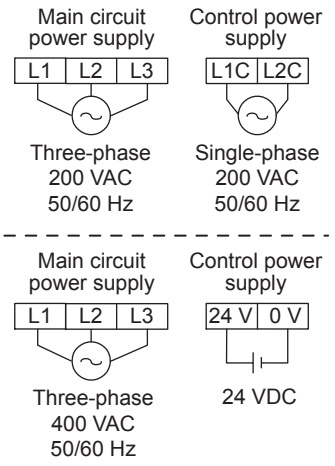
SERVOPACK Connector

Connector Symbol	SERVOPACK Connector Model	Manufacturer
CN1	10250-52A2JL	Sumitomo 3M Co., Ltd.
CN2	53460-0611	Molex Japan Co., Ltd.
CN3	10214-52A2JL	Sumitomo 3M Co., Ltd.

4.8.5 Three-phase 200 V: 2.0 kW/3.0 kW (20AE-R/30AE-R) Three-phase 400 V: 2.0 kW/3.0 kW (20DE-R/30DE-R)



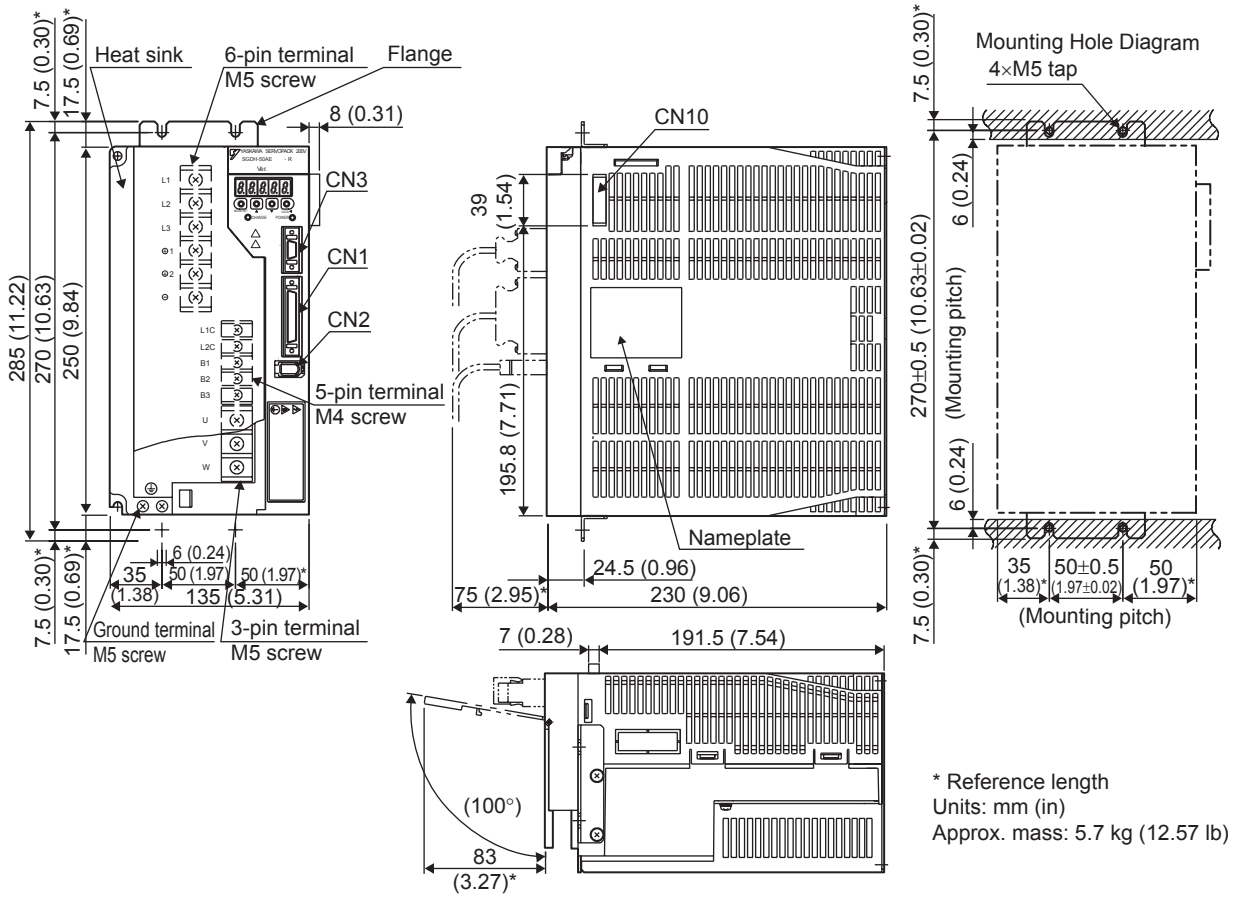
External Terminal Connector



SERVOPACK Connector

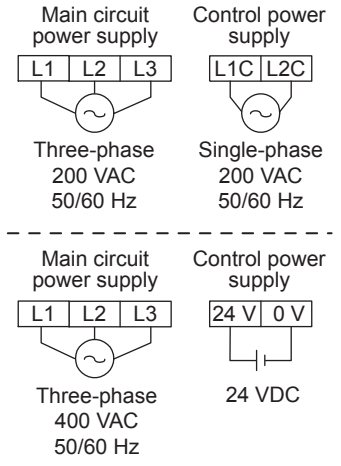
Connector Symbol	SERVOPACK Connector Model	Manufacturer
CN1	10250-52A2JL	Sumitomo 3M Co., Ltd.
CN2	53460-0611	Molex Japan Co., Ltd.
CN3	10214-52A2JL	Sumitomo 3M Co., Ltd.

4.8.6 Three-phase 200 V: 5.0 kW (50AE-R)
Three-phase 400 V: 5.0 kW (50DE-R)



* Reference length
Units: mm (in)
Approx. mass: 5.7 kg (12.57 lb)

External Terminal Connector



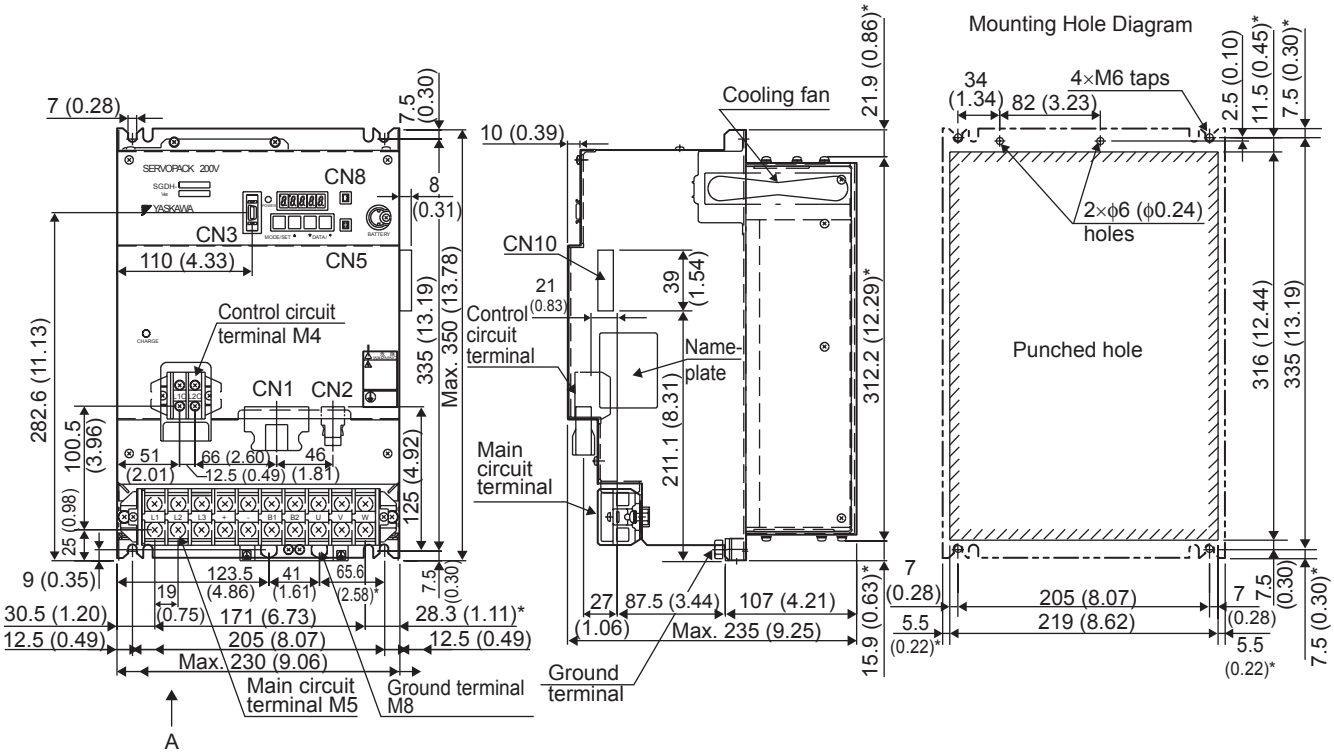
SERVOPACK Connector

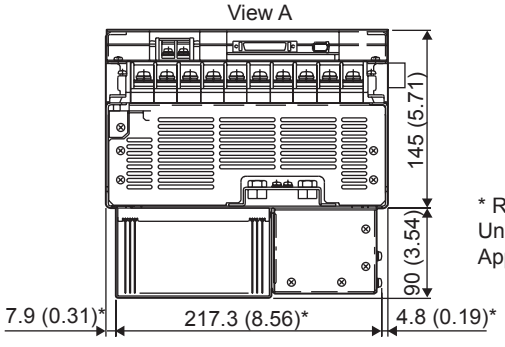
Connector Symbol	SERVOPACK Connector Model	Manufacturer
CN1	10250-52A2JL	Sumitomo 3M Co., Ltd.
CN2	53460-0611	Molex Japan Co., Ltd.
CN3	10214-52A2JL	Sumitomo 3M Co., Ltd.

4

4.9 Dimensional Drawings of Duct-ventilated SERVOPACK Model

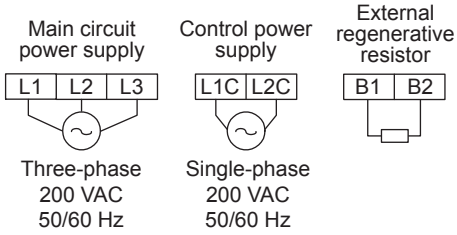
4.9.1 Three-phase 200 V: 7.5 kW (75AE-P)





* Reference length
Units: mm (in)
Approx. mass: 14 kg (30.86 lb)

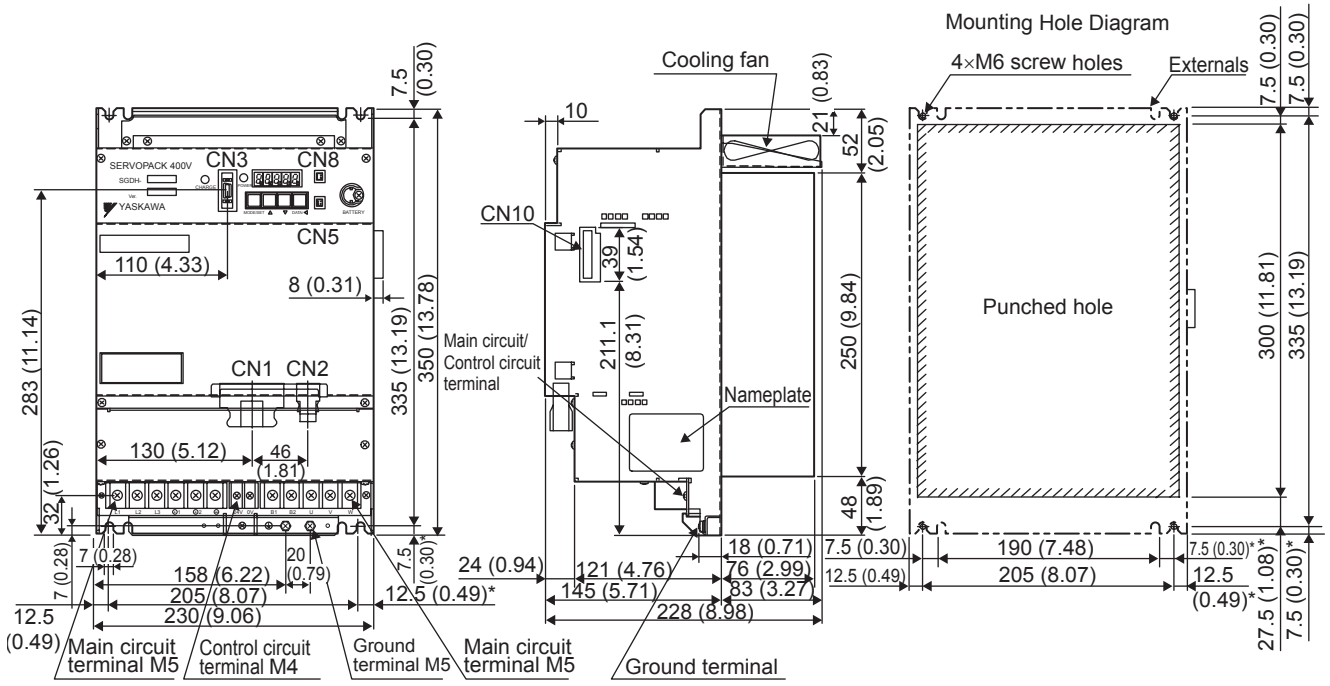
External Terminal Connector

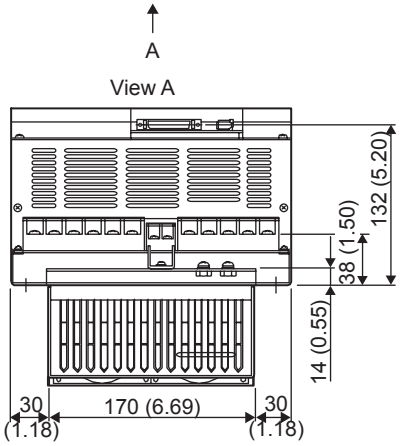


SERVOPACK Connector

Connector Symbol	SERVOPACK Connector Model	Manufacturer
CN1	10250-52A2JL	Sumitomo 3M Co., Ltd.
CN2	53460-0611	Molex Japan Co., Ltd.
CN3	10214-52A2JL	Sumitomo 3M Co., Ltd.

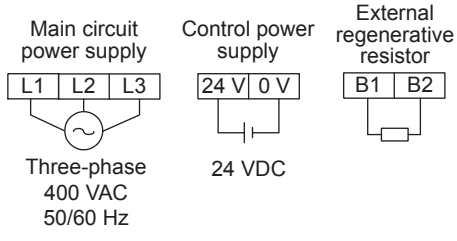
4.9.2 Three-phase 400 V: 7.5 kW (75DE-P)





* Reference length
Units: mm (in)
Approx. mass: 11.5 kg (25.35 lb)

External Terminal Connector



SERVOPACK Connector

Connector Symbol	SERVOPACK Connector Model	Manufacturer
CN1	10250-52A2JL	Sumitomo 3M Co., Ltd.
CN2	53460-0611	Molex Japan Co., Ltd.
CN3	10214-52A2JL	Sumitomo 3M Co., Ltd.

5

Specifications and Dimensional Drawings of Serial Converter Unit

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5.2 Analog Signal Input Timing ----------5-3

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5.3.4 Linear Scale with Cable for Hall Sensor by Renishaw ---------- 5-8

5.1 Serial Converter Unit Specifications

(1) Model: JZDP-D00□-□□□

(2) Characteristics and Specifications

Items		Specifications
Electrical Characteristics	Power Supply Voltage	+5.0V±5%, ripple content 5% max.
	Current Consumption*1	120 mA Typ. 350 mA Max.
	Signal Resolution	Input 2-phase sine wave: 1/256 pitch
	Max. Response Frequency	250 kHz
	Analog Input Signals *2 (cos, sin, Ref)	Differential input amplitude: 0.4 V to 1.2V Input signal level: 1.5 V to 3.5V
	Hall Sensor Input Signal	CMOS level
	Output Signals*3	Position data, hall sensor information, and alarms
	Output Method	Serial data transmission (HDLC (High-level Data Link Control) protocol format with Manchester codes)
	Transmission Cycle	62.5 µs
	Output Circuit	Balanced transceiver (SN75LBC176 or the equivalent) Internal terminal resistance: 120 Ω
Mechanical Characteristics	Approx. mass	150 g
	Vibration Resistance	98 m/s^2 max. (1 to 2500 Hz) in three directions
	Shock Resistance	980 m/s^2, (11 ms) two times in three directions
Environmental Conditions	Operating temperature	0 °C to 55 °C (32 to 131 °F)
	Storage temperature	-20 °C to +80 °C (-4 to +176 °F)
	Humidity	20 % to 90 %RH (without condensation)

* 1. The current consumption of the linear scale and hall sensor is not included in this value. The current consumption of linear scale and hall sensor must be taken into consideration for the current capacity of host controller that supplies the power. The current consumption of hall sensor: Approx. 40 mA.

* 2. Input a value within the specified range. Otherwise, incorrect position information is output, and the device may be damaged.

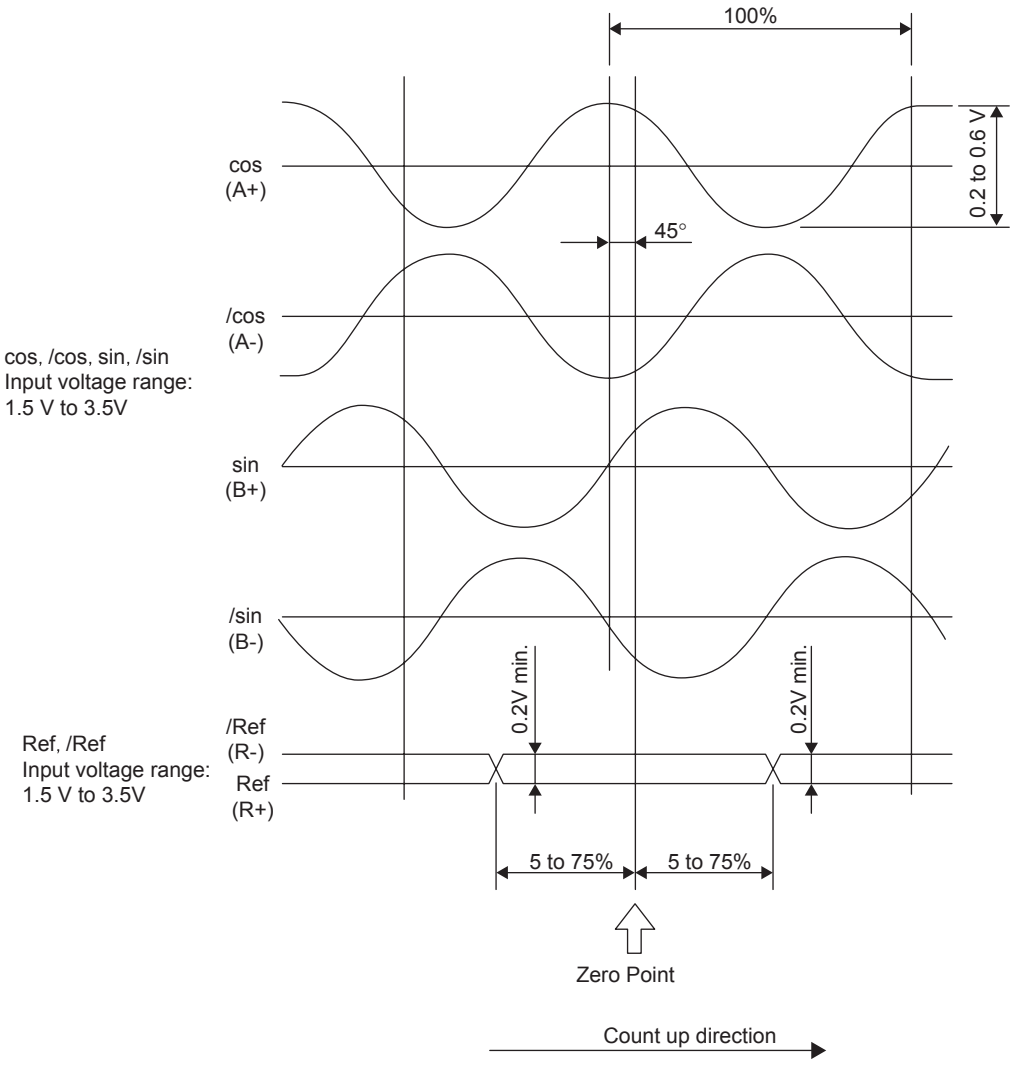
* 3. The transmission is enabled 100 to 300 ms after the power turns ON.

5.2 Analog Signal Input Timing

The following figure shows the input timing of the analog signals.

When the cos and sin signals are shifted 180 degrees, the differential signals are the /cos and /sin signals. The specifications of the cos, /cos, sin, and /sin signals are identical except for the phase.

Input the signals Ref and /Ref so that they shall cross each other as shown in the figure because they are input into the converter. When they are crossed, the output data will be counted up.



* If the analog signal amplitude declines to about 0.35 V because of differential amplitude, the serial converter outputs an alarm.

IMPORTANT

■Precautions

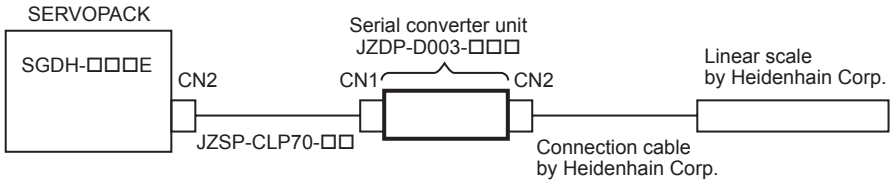
1. Never perform insulation resistance and withstand voltage tests.
2. When analog signals are input to the serial converter unit, noise influence on the analog signals affects the unit's ability to output correct position information. The analog cable must be as short as possible and shielded.
3. Use the device in an environment free from hydrogen sulfide (H_2S) and other hazardous gases.
4. Do not connect or disconnect the unit while power is being supplied, or the unit may be damaged.
5. When using multiple axes, use a shield cable for each axis. Do not use a shield cable for multiple axes.

5.3 Dimensional Drawings of Serial Converter Unit

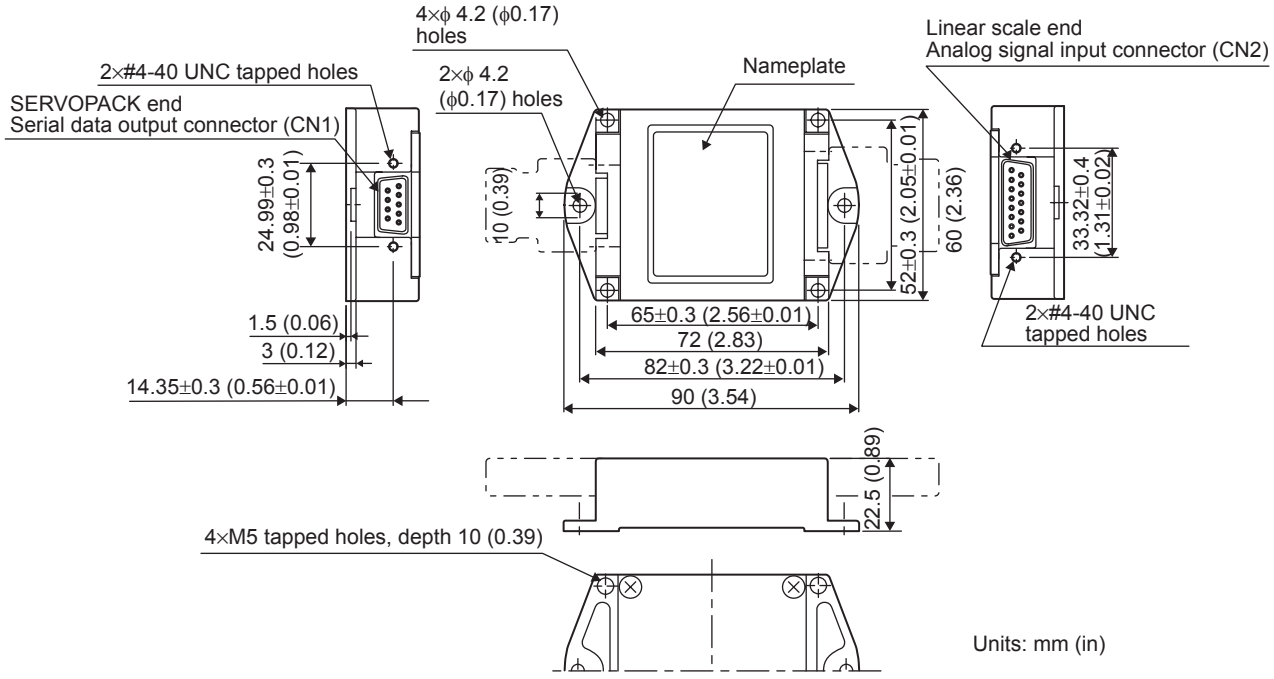
5.3.1 Linear Scale without Cable for Hall Sensor by Heidenhain

(1) Serial Converter Unit Model: JZDP-D003-□□□

(2) Connection Example



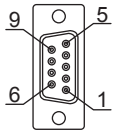
(3) Dimensional Drawing



Units: mm (in)

Pin No.	Signal
1	+5V
2	S-phase output
3	Empty
4	Empty
5	0V
6	/S-phase output
7	Empty
8	Empty
9	Empty
Case	Shield

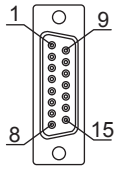
CN1
SERVOPACK end
Serial data output



17-series connector
model:
17LE-13090-27
(socket) by DDK Ltd.

Pin No.	Signal
1	cos input (A+)
2	0V
3	sin input (B+)
4	+5V
5	Empty
6	Empty
7	/Ref input (R-)
8	Empty
9	/cos input (A-)
10	0V sensor
11	/sin input (B-)
12	5V sensor
13	Empty
14	Ref input (R+)
15	Empty
Case	Shield

CN2
Linear scale end
Analog signal input



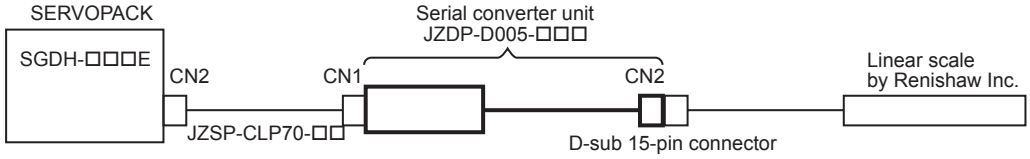
17-series connector
model:
17LE-13150-27
(socket) by DDK Ltd.

Note: 1. Do not use the empty pins.
2. The linear scale (analog $1V_{p-p}$ output, D-sub 15-pin, male) manufactured by Heidenhain Corp. can be directly connected. Contact Heidenhain Corp. for details.

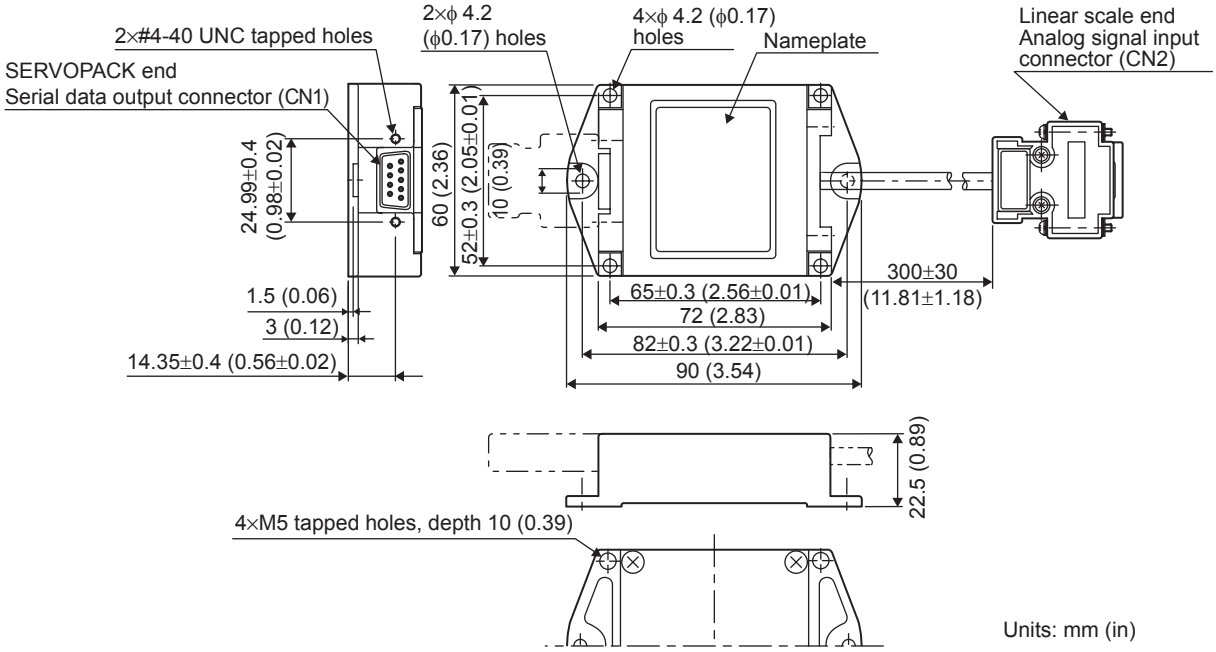
5.3.2 Linear Scale without Cable for Hall Sensor by Renishaw

(1) Serial Converter Unit Model: JZDP-D005-□□□

(2) Connection Example



(3) Dimensional Drawing



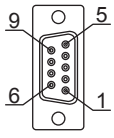
Units: mm (in)

Pin No.	Signal
1	+5V
2	S-phase output
3	Empty
4	Empty
5	0V
6	/S-phase output
7	Empty
8	Empty
9	Empty
Case	Shield

SERVOPACK does not have the function to process Vq signals.

CN1

SERVOPACK end
Serial data output

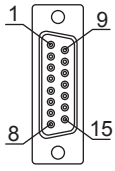


17-series connector model:
17LE-13090-27
(socket) by DDK Ltd.

Pin No.	Signal
1	/cos input (V1-)
2	/sin input (V2-)
3	Ref input (V0+)
4	+5V
5	5Vs
6	Empty
7	Empty
8	Empty
9	cos input (V1+)
10	sin input (V2+)
11	/Ref input (V0-)
12	0V
13	0Vs
14	Empty
15	Inner (0V)
Case	Shield

CN2

Linear scale end
Analog signal input



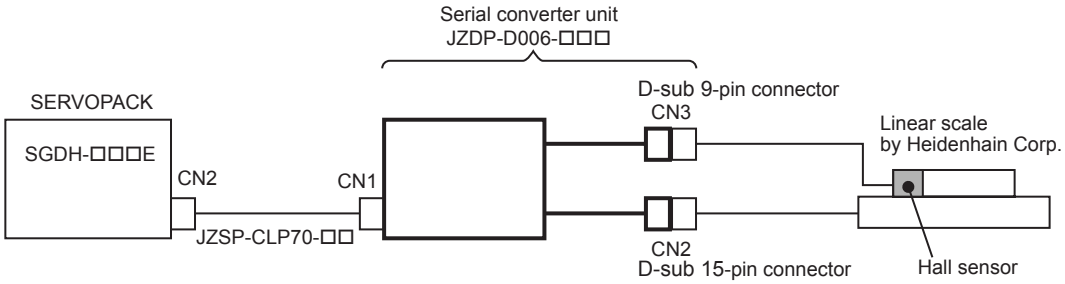
17-series connector model:
17LE-13150-27
(socket) by DDK Ltd.

Note: 1. Do not use empty pins.
2. The linear scale (analog 1Vp-p output, D-sub 15-pin, male) by Renishaw Inc. can be directly connected. However, the BID and DIR signals are not connected.
3. Use the linear scale end connector to change the zero point specifications of the linear scale.

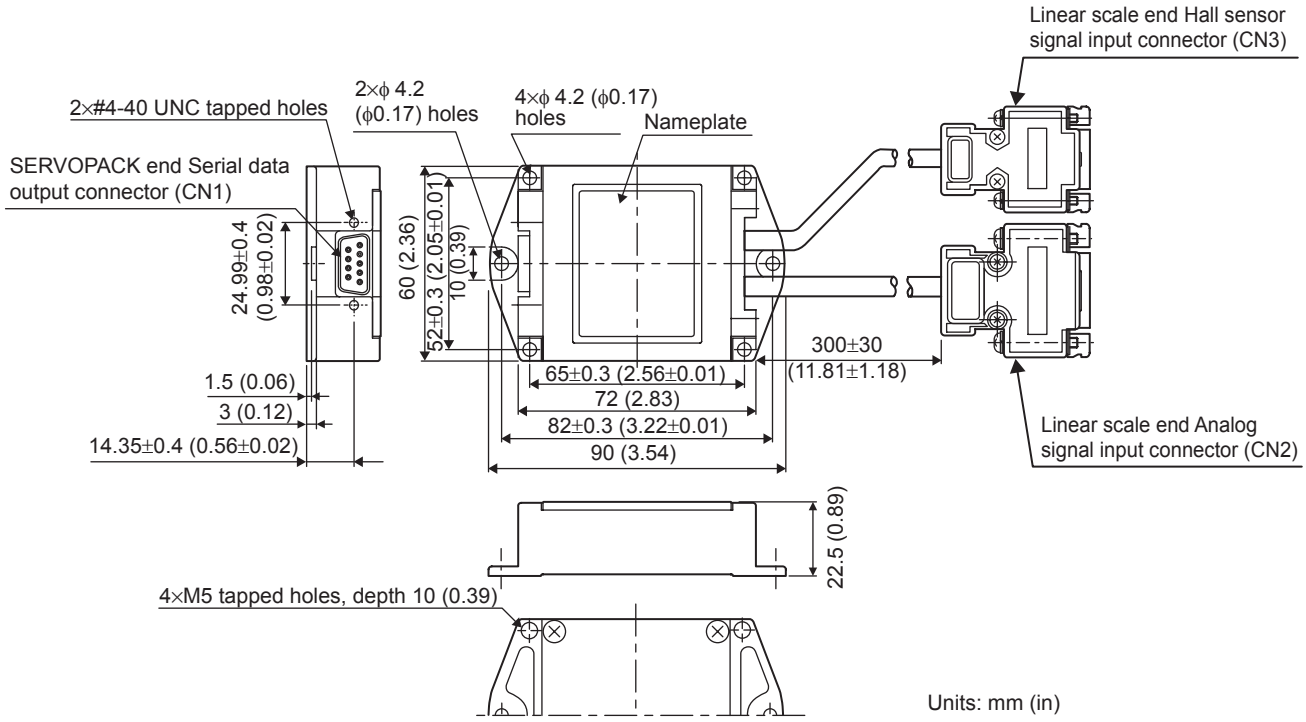
5.3.3 Linear Scale with Cable for Hall Sensor by Heidenhain

(1) Serial Converter Model: JZDP-D006-□□□

(2) Connection Example

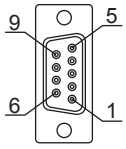


(3) Dimensional Drawing



CN1

SERVOPACK end
serial data output

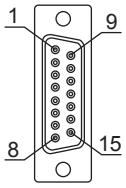


17-series connector model:
17JE-13090-27
(socket) by DDK. Ltd.

Pin No.	Signal
1	+5V
2	S-phase output
3	Empty
4	Empty
5	0V
6	/S-phase output
7	Empty
8	Empty
9	Empty
Case	Shield

CN2

Linear scale end
Analog signal input

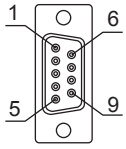


17-series connector model:
17JE-13150-02 (D8C)
(socket) by DDK. Ltd.

Pin No.	Signal
1	cos input (A+)
2	0V
3	sin input (B+)
4	+5V
5	Empty
6	Empty
7	/Ref input (R-)
8	Empty
9	/cos input (A-)
10	0V sensor
11	/sin input (B-)
12	5V sensor
13	Empty
14	Ref input (R+)
15	Empty
Case	Shield

CN3

Linear scale end
Hall sensor signal input



17-series connector model:
17JE-13090
by DDK. Ltd.

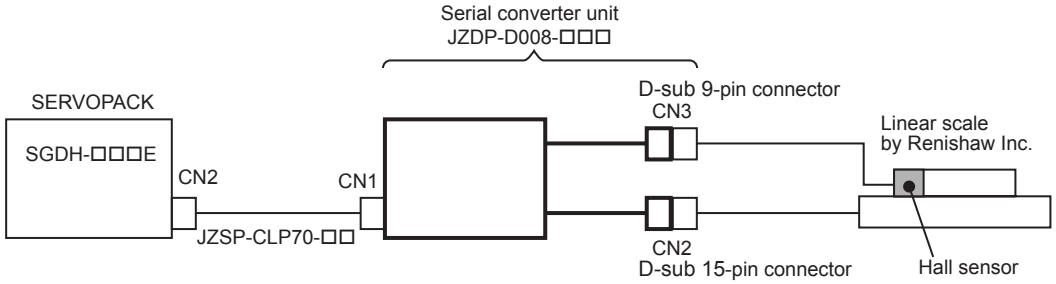
Pin No.	Signal
1	+5V
2	U-phase input
3	V-phase input
4	W-phase input
5	0V
6	Empty
7	Empty
8	Empty
9	Empty
Case	Shield

Note: 1. Do not use empty pins.
2. The linear scale (analog $1V_{P-P}$ output, D-sub 15-pin, male) by Heidenhain Corp. can be directly connected.
3. U-phase, V-phase, and W-phase input are internally pulled up at 10kΩ.

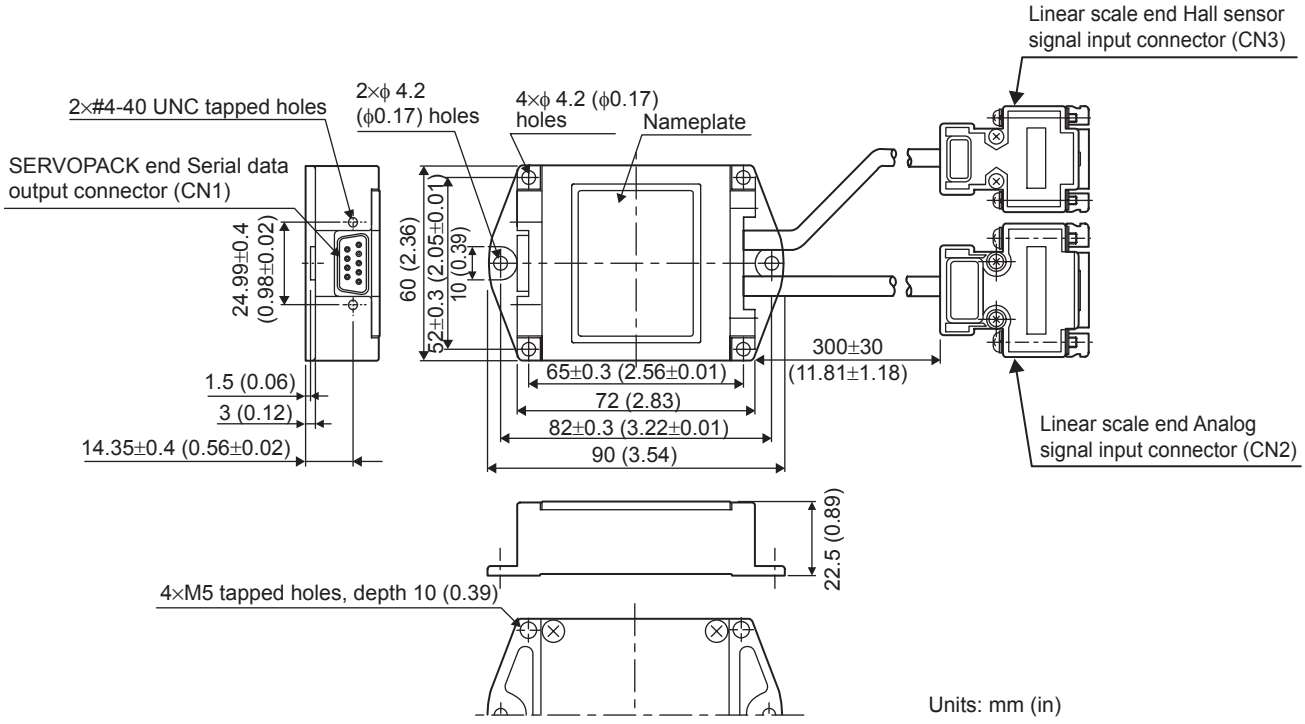
5.3.4 Linear Scale with Cable for Hall Sensor by Renishaw

(1) Serial Converter Unit: JZDP-D008-□□□

(2) Connection Example

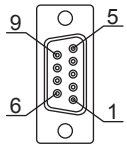


(3) Dimensional Drawing



CN1

SERVOPACK end
serial data output

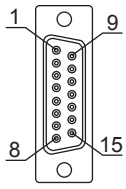


17-series connector model:
17JE-13090-27
(socket) by DDK. Ltd.

Pin No.	Signal
1	+5V
2	S-phase output
3	Empty
4	Empty
5	0V
6	/S-phase output
7	Empty
8	Empty
9	Empty
Case	Shield

CN2

Linear scale end
Analog signal input

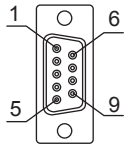


17-series connector model:
17JE-13150-02 (D8C)
(socket) by DDK. Ltd.

Pin No.	Signal
1	/cos input (V1-)
2	/sin input (V2-)
3	Ref input (V0+)
4	+5V
5	5Vs
6	Empty
7	Empty
8	Empty
9	cos input (V1+)
10	sin input (V2+)
11	/Ref input (V0-)
12	0V
13	0Vs
14	Empty
15	Inner
Case	Shield

CN3

Linear scale end
Hall sensor signal input



17-series connector model:
17JE-13090
by DDK. Ltd.

Pin No.	Signal
1	+5V
2	U-phase input
3	V-phase input
4	W-phase input
5	0V
6	Empty
7	Empty
8	Empty
9	Empty
Case	Shield

Note: 1. Do not use empty pins.
2. The linear scale (analog $1V_{P-P}$ output, D-sub 15-pin, male) by Renishaw Inc. can be directly connected. However, the BID and DIR signals are not connected.
3. U-phase, V-phase, and W-phase input are internally pulled up at 10kΩ.

6

Specifications and Dimensional Drawings of Cables and Peripheral Devices

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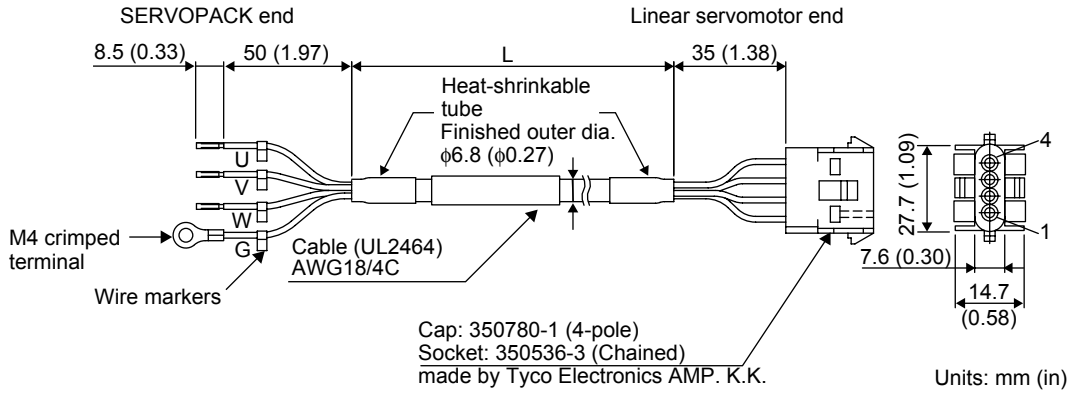
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6.1 Linear Servomotor Main Circuit Cables

(1) JZSP-CLN11 Cables



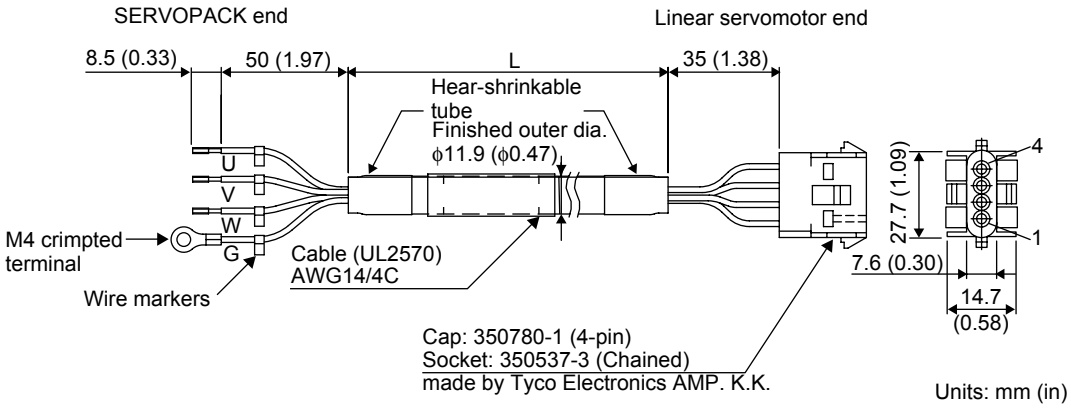
(a) Cable Type

Applicable Linear Servomotors	Cable Type	Cable Length (L)
SGLGW-30, -40, and -60 SGLFW-20 and -35	JZSP-CLN11-01	1 m (3.28 ft)
	JZSP-CLN11-03	3 m (9.84 ft)
	JZSP-CLN11-05	5 m (16.40 ft)
	JZSP-CLN11-10	10 m (32.81 ft)
	JZSP-CLN11-15	15 m (49.21 ft)
	JZSP-CLN11-20	20 m (65.62 ft)

(b) Wiring Specifications

SERVOPACK-end Leads		Linear Servomotor-end Connector	
Wire Color	Signal	Signal	Pin No.
Red	Phase U	Phase U	1
White	Phase V	Phase V	2
Blue	Phase W	Phase W	3
Green/Yellow	FG	FG	4

(2) JZSP-CLN21 Cables



(a) Cable Type

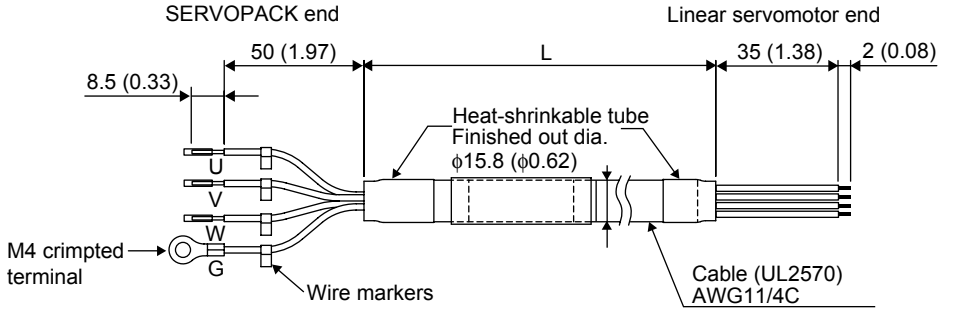
Applicable Linear Servomotors	Cable Type	Cable Length (L)
SGLGW-90 SGLFW-50 and -1Z SGLTW-20 and -35	JZSP-CLN21-01	1 m (3.28 ft)
	JZSP-CLN21-03	3 m (9.84 ft)
	JZSP-CLN21-05	5 m (16.40 ft)
	JZSP-CLN21-10	10 m (32.81 ft)
	JZSP-CLN21-15	15 m (49.21 ft)
	JZSP-CLN21-20	20 m (65.62 ft)

(b) Wiring Specifications

SERVOPACK-end Leads		Linear Servomotor-end Connector	
Wire Color	Signal	Signal	Pin No.
Red	Phase U	Phase U	1
White	Phase V	Phase V	2
Blue	Phase W	Phase W	3
Green/Yellow	FG	FG	4

(3) JZSP-CLN39 Cables

The linear servomotor end of the JZSP-CLN39 cable is not provided with a connector (loose wired).
The connector must be provided by the customer.



Units: mm (in)

(a) Cable Type

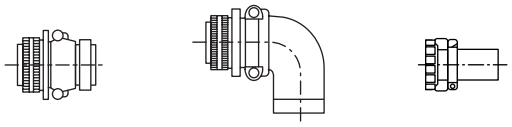
Applicable Linear Servomotor Models	Cable Type	Cable Length (L)
SGLTW-40 and -80	JZSP-CLN39-01	1 m (3.28 ft)
	JZSP-CLN39-03	3 m (9.84 ft)
	JZSP-CLN39-05	5 m (16.40 ft)
	JZSP-CLN39-10	10 m (32.81 ft)
	JZSP-CLN39-15	15 m (49.21 ft)
	JZSP-CLN39-20	20 m (65.62 ft)

(b) Wiring Specifications

SERVOPACK-end Leads		Linear Servomotor-end Connector	
Wire Color	Signal	Signal	Pin No.
Red	Phase U	Phase U	1
White	Phase V	Phase V	2
Blue	Phase W	Phase W	3
Green/Yellow	FG	FG	4

(4) JZSP-CLN39 Cable Connectors

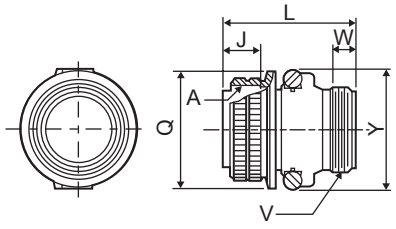
Contact Yaskawa Controls Co., Ltd.



Applicable Linear Servomotor Models	Attached Connector	Plus		Cable Clamp
		Straight	L-shaped	
SGLTW-40 and -80	MS3102A22-22P	MS3106B22-22S	MS3108B22-22S	MS3057-12A

(a) MS3106B Straight Plug with front-shell and back-shell separated

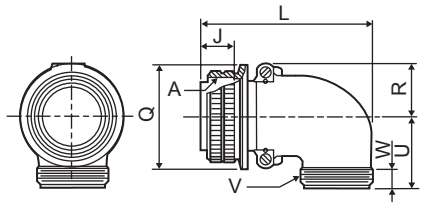
Units: mm (in)



Shell Size	Joint Screw A	Joint Length J±0.12	Max. Over-all Length L	Outer Diameter of Nut $\phi Q^{+0}_{-0.38}$	Cable Clamp Mounting Screw V	Min. Effective Screw Length W	Max. Width Y
22	1 3/8 -18UNEF	18.26 (0.72)	55.57 (2.19)	40.48 (1.59)	1 3/16-18UNEF	9.53 (0.38)	50 (1.97)

(b) MS3108B L-shaped Plug with front-shell and back-shell separated

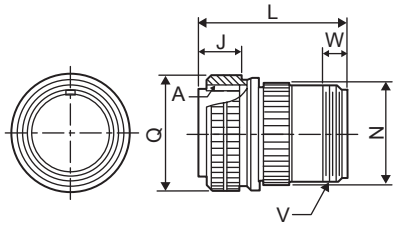
Units: mm (in)



Shell Size	Joint Screw A	Joint Length J±0.12	Max. Over-all Length L	Outer Diameter of Nut $\phi Q^{+0}_{-0.38}$	R ±0.5	U ±0.5	Cable Clamp Mounting Screw V	Min. Effective Screw Length W
22	1 3/8 - 18UNEF	18.26 (0.72)	76.98 (3.03)	40.48 (1.59)	24.1 (0.95)	33.3 (1.31)	1 3/16 - 18UNEF	9.53 (0.38)

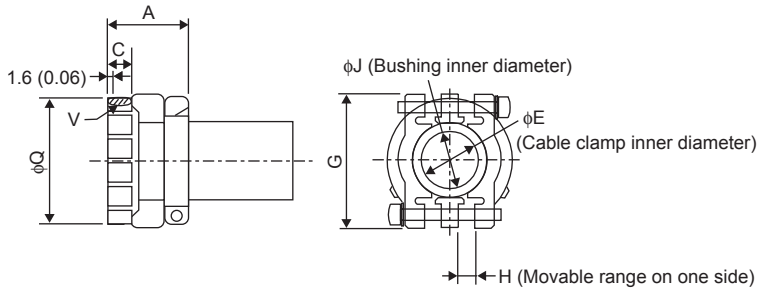
(c) MS3106A Straight Plug with solid shell

Units: mm (in)



Shell Size	Joint Screw A	Joint Length J±0.12	Max. Over-all Length L	Outer Diameter of Nut $\phi Q^{+0}_{-0.38}$	Outer Diame-ter ϕN±0.5	Cable Clamp Mounting Screw V	Min. Effective Screw Length W
10SL	5/8 -24UNEF	13.49 (0.53)	34.9 (1.37)	22.22 (0.87)	19.12 (0.75)	5/8-24UNEF	9.53 (0.38)

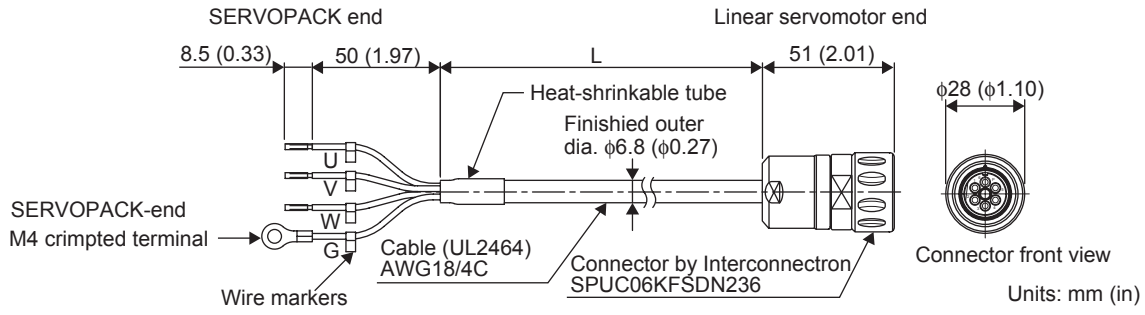
(d) MS3057A-12A Cable Clamp With Rubber Bushing



Units: mm (in)

Applicable shell size	Overall Length A±0.7	Effective Screw Length C	ϕE	G±0.7	H	ϕJ	Mounting Screw V	Outer Diameter ϕQ±0.7	Rubber Bushing Type
20, 22	23.8 (0.94)	10.3 (0.40)	19.0 (0.75)	37.3 (1.47)	4.0 (0.16)	15.9 (0.63)	1 3/16-18UNEF	35.0 (1.38)	AN3420-12

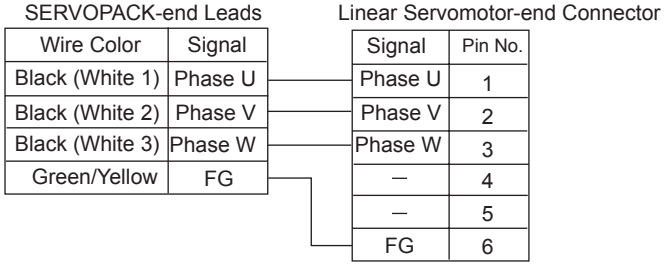
(5) JZSP-CLN14 Cables



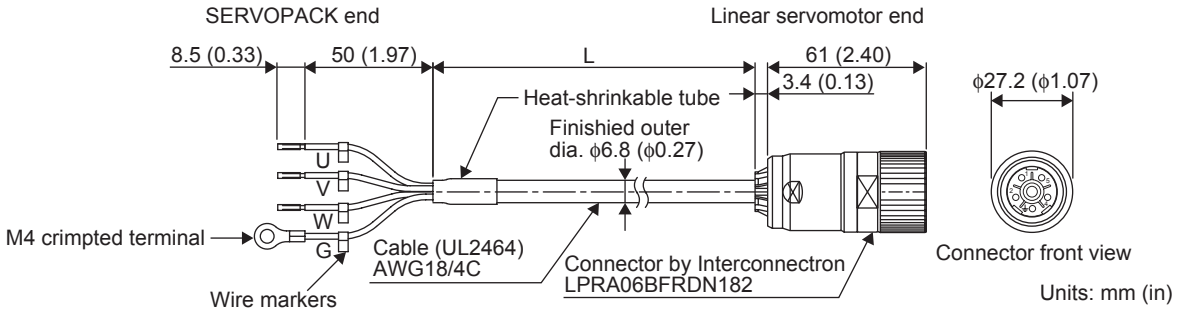
(a) Cable Type

Applicable Linear Servomotors	Cable Type	Cable Length (L)
SGLGW -30A□□□□□D -40A□□□□□D -60A□□□□□D With a connector by Interconnectron for 200 V servomotor	JZSP-CLN14-01	1 m (3.28 ft)
	JZSP-CLN14-03	3 m (9.84 ft)
	JZSP-CLN14-05	5 m (16.40 ft)
	JZSP-CLN14-10	10 m (32.81 ft)
	JZSP-CLN14-15	15 m (49.21 ft)
	JZSP-CLN14-20	20 m (65.62 ft)

(b) Wiring Specifications



(6) JZSP-CLN15 Cables



(a) Cable Type

Applicable Linear Servomotors	Cable Type	Cable Length (L)
SGLFW -35D□□□□□D -50D□□□□□D -1ZD□□□□□D SGLTW -35D□□□H□D -50D□□□H□D With a connector by Interconnectron for 400 V servomotor	JZSP-CLN15-01	1 m (3.28 ft)
	JZSP-CLN15-03	3 m (9.84 ft)
	JZSP-CLN15-05	5 m (16.40 ft)
	JZSP-CLN15-10	10 m (32.81 ft)
	JZSP-CLN15-15	15 m (49.21 ft)
	JZSP-CLN15-20	20 m (65.62 ft)

(b) Wiring Specifications

SERVOPACK-end Leads

Wire Color	Signal
Black (White 1)	Phase U
Black (White 2)	Phase V
Black (White 3)	Phase W
Green/Yellow	FG

Linear Servomotor-end Connector

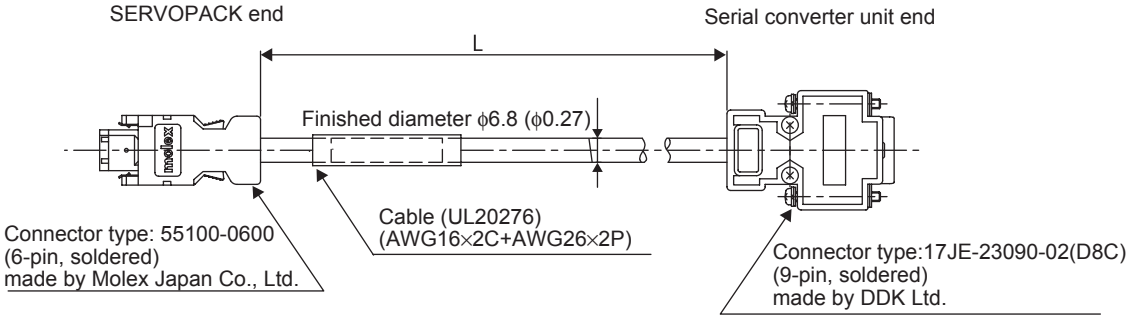
Signal	Pin No.
Phase U	1
Phase V	2
FG	3
Phase W	4
—	5
—	6

6.2 Cables for Connecting Serial Converter Units

(1) Cable Type

Type	Length (L)
JZSP-CLP70-01	1 m (3.28 ft)
JZSP-CLP70-03	3 m (9.84 ft)
JZSP-CLP70-05	5 m (16.40 ft)
JZSP-CLP70-10	10 m (32.81 ft)
JZSP-CLP70-15	15 m (49.21 ft)
JZSP-CLP70-20	20 m (65.62 ft)

(2) Dimensional Drawing



Units: mm (in)

(3) Specifications

SERVOPACK end

Pin No.	Signal	Cable Color
1	PG5V	Red
2	PG0V	Black
3	–	–
4	–	–
5	PS	Light blue
6	/PS	Light blue/ white
Shell	Shield	–

Serial converter unit end

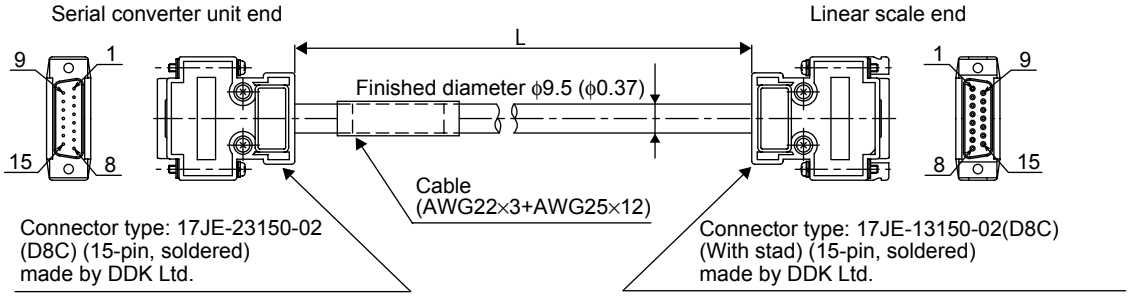
Pin No.	Signal	Cable Color
1	+5V	Red
5	0V	Black
3	–	–
4	–	–
2	Phase S output	Light blue
6	Phase /S output	Light blue/ white
Case	Shield	–
7	–	–
8	–	–
9	–	–

6.3 Cables for Connecting Linear Scales

(1) Cable Type

Type	Length (L)
JZSP-CLL00-01	1 m (3.28 ft)
JZSP-CLL00-03	3 m (9.84 ft)
JZSP-CLL00-05	5 m (16.40 ft)
JZSP-CLL00-10	10 m (32.81 ft)
JZSP-CLL00-15	15 m (49.21 ft)

(2) Dimensional Drawing



Units: mm (in)

(3) Specifications

Serial converter unit end

Pin No.	Signal
1	/Cos(V1-)
2	/Sin(V2-)
3	Ref(V0+)
4	+5V
5	5Vs
6	BID
7	Vx
8	Vq
9	Cos(V1+)
10	Sin(V2+)
11	/Ref(V0+)
12	0V
13	0Vs
14	DIR
15	Inner
Case	Shield

Linear scale end

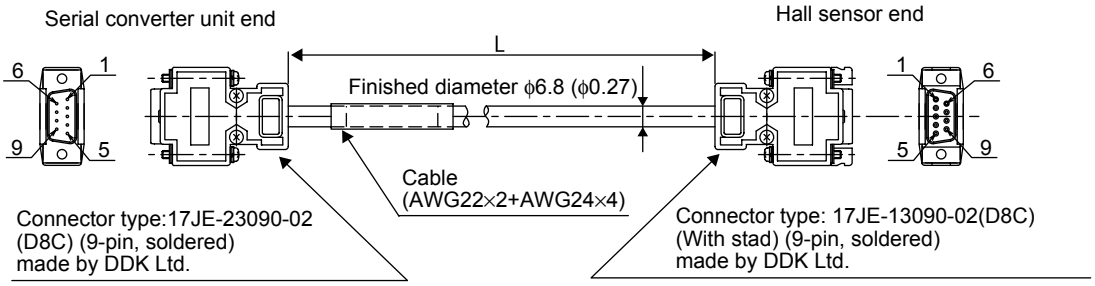
Pin No.	Signal
1	/Cos(V1-)
2	/Sin(V2-)
3	Ref(V0+)
4	+5V
5	5Vs
6	BID
7	Vx
8	Vq
9	Cos(V1+)
10	Sin(V2+)
11	/Ref(V0-)
12	0V
13	0Vs
14	DIR
15	Inner
Case	Shield

6.4 Cables for Connecting Hall Sensors

(1) Cable Type

Type	Length (L)
JZSP-CLL10-01	1 m (3.28 ft)
JZSP-CLL10-03	3 m (9.84 ft)
JZSP-CLL10-05	5 m (16.40 ft)
JZSP-CLL10-10	10 m (32.81 ft)
JZSP-CLL10-15	15 m (49.21 ft)

(2) Dimensional Drawing



Units: mm (in)

(3) Specifications

Serial converter unit end

Pin No.	Signal
1	+5V
2	Phase U input
3	Phase V input
4	Phase W input
5	0V
6	–
7	–
8	–
9	–
Case	Shield

Hall sensor end

Pin No.	Signal
1	+5V
2	Phase U input
3	Phase V input
4	Phase W input
5	0V
6	–
7	–
8	–
9	–
Case	Shield

6.5 Flexible Cables

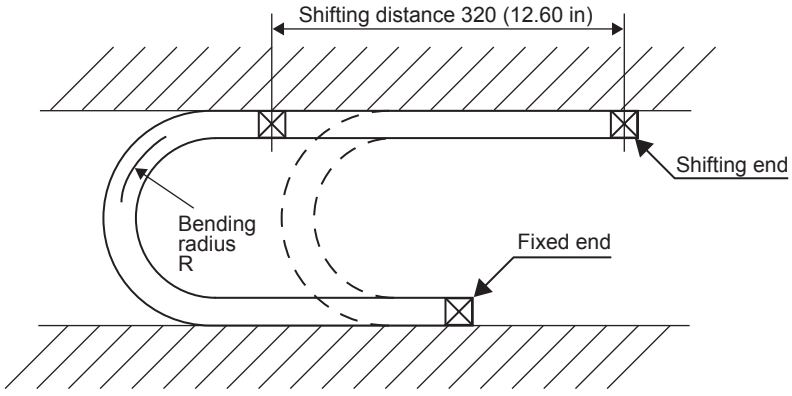
(1) Life of Flexible Cable

The flexible cable supports 10,000,000 or more operations of bending life with the recommended bending radius. The following table shows the recommended bending radius R of each cable.

Cable Type	Model	Recommended bend radius in mm (in)
Linear servomotor main circuit cables	JZSP-CLN11-□□	35 (1.38)
	JZSP-CLN21-□□	35 (1.38)
	JZSP-CLN39-□□	50 (1.97)
	JZSP-CLN14-□□	35 (1.38)
	JZSP-CLN15-□□	35 (1.38)
Cables for connecting linear scales	JZSP-CLL00-□□	60 (2.36)
Cables for connecting hall sensors	JZSP-CLL10-□□	60 (2.36)
Cables for connecting serial converter units	JZSP-CLP70-□□	60 (2.36)

- Conditions

1. Repeat moving one end of the cable forward and backward for 320 mm (12.60 in) with using the test equipment shown in the following.
2. Connect the lead wires in parallel, and count the number of cable return motion times until a lead wire is disconnected. Note that one reciprocating is counted as one test.



Note: 1. The life of flexible cable differs largely depending on the amount of mechanical shocks, mounting to the cable, and fixing methods. The life of flexible cable is limited under the specified conditions.
2. The life of flexible cable indicates the number of bending times in which lead wires are electrically conducted and by which no cracks and damages that affects the performance of cable sheathing are caused. Disconnecting the shield wire is not taken into account.

(2) Wiring Precautions

Even if the recommended bending radius R is respected in the mechanical design, incorrect wiring may cause the early disconnection. Observe the following precautions when wiring.

(a) Cable twisting

Straighten the flexible cables wiring.

Twisted cables causes the early disconnection. Check the indication on the cable surface to make sure that the cable is not twisted.

(b) Fixing method

Do not fix the moving points of the flexible cable, or stress on the fixed points may cause early disconnection. Fix the cable at the minimum number of points.

(c) Cable length

If the cable length is too long, it may cause the cable's sagging. Besides the cable length is too short, it may cause the excessive tension on the fixed points that will cause the early disconnection. Use a flexible cable with the optimum length.

(d) Interference between cables

Avoid interference between cables.

Interference limits the motion of flexible cable, which causes early disconnection. Keep enough distance between cables, or provide a partition when wiring.

6.6 SERVOPACK Main Circuit Wire Size

IMPORTANT

1. Wire sizes were selected for three cables per bundle at 40 °C (104 °F) ambient 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 ambient or panel temperatures where normal vinyl cables will rapidly deteriorate.
5. Use cables within the allowable mass.
6. Do not use cables under continuous regenerative state.

6.6.1 Cable Types

Cable Types		Allowable Conductor Temperature °C (°F)
Symbol	Name	
PVC	Normal vinyl cable	–
IV	600-V vinyl cable	60 (140)
HIV	Temperature-resistant vinyl cable	75 (167)

The following table shows the wire size and allowable current for three cables. Use a cable whose specifications meet or are less than the values in the table.

- 600-V Heat-resistant Vinyl Cables (HIV)

AWG Size	Nominal Cross Section Diameter mm^2	Configuration Number of wires/mm^2	Conductive Resistance Ω/km	Allowable Current at Ambient Temperature A		
				30°C (86°F)	40°C (104°F)	50°C (122°F)
20	0.5	19/0.18	39.5	6.6	5.6	4.5
-	0.75	30/0.18	26.0	8.8	7.0	5.5
18	0.9	37/0.18	24.4	9.0	7.7	6.0
16	1.25	50/0.18	15.6	12.0	11.0	8.5
14	2.0	7/0.6	9.53	23	20	16
12	3.5	7/0.8	5.41	33	29	24
10	5.5	7/1.0	3.47	43	38	31
8	8.0	7/1.2	2.41	55	49	40
6	14.0	7/1.6	1.35	79	70	57
4	22.0	7/2.0	0.85	91	81	66

Note: The values in the table are only for reference.

6.6.2 Single-phase 200 V

External Terminal Name	Terminal Symbol	SERVOPACK Model SGDH-			
		A5AE	01AE	02AE	04AE
Main circuit power supply input terminals	L1, L2	HIV1.25			HIV2.0
Servomotor connection terminals	U, V, W	HIV1.25			
Control power supply input terminals	L1C, L2C	HIV1.25			
External regenerative resistor connection terminals	B1, B2	HIV1.25			
Ground terminal	⏚	HIV2.0 or more			

6.6.3 Three-phase 200 V

External Terminal Name	Terminal Symbol	SERVOPACK Model SGDH-					
		05AE	08AE	10AE	15AE	20AE	30AE
Main circuit power supply input terminals	L1, L2, L3	HIV2.0				HIV3.5	
Servomotor connection terminals	U, V, W	HIV2.0				HIV3.5	HIV5.5
Control power supply input terminals	L1C, L2C	HIV1.25					
External regenerative resistor connection terminals	B1, B2	HIV1.25				HIV2.0	HIV3.5
Ground terminal	⏚	HIV2.0 or more					

External Terminal Name	Terminal Symbol	SERVOPACK Model SGDH-	
		50AE	75AE
Main circuit power supply input terminals	L1, L2, L3	HIV5.5	HIV14
Servomotor connection terminals	U, V, W	HIV8	HIV14
Control power supply input terminals	L1C, L2C	HIV1.25	
External regenerative resistor connection terminals	B1, B2	HIV5.5	HIV8.0
Ground terminal	⏚	HIV2.0 or more	

6.6.4 Three-phase 400 V

External Terminal Name	Terminal Symbol	SERVOPACK Model SGDH-				
		05DE	10DE	15DE	20DE	30DE
Main circuit power supply input terminals	L1, L2, L3 (Three-phase)	HIV1.25			HIV2.0	
Servomotor connection terminals	U, V, W	HIV1.25			HIV2.0	
Control power supply input terminals	24V, 0V	HIV1.25				
External regenerative resistor connection terminals	B1, B2	HIV1.25				
Ground terminal	⏚	HIV2.0 or more				

External Terminal Name	Terminal Symbol	SERVOPACK Model SGDH-	
		50DE	75DE
Main circuit power supply input terminals	L1, L2, L3 (Three-phase)	HIV3.5	HIV5.5
Servomotor connection terminals	U, V, W	HIV3.5	HIV5.5
Control power supply input terminals	24V, 0V	HIV1.25	
External regenerative resistor connection terminals	B1, B2	HIV2.0	HIV3.5
Ground terminal	⏚	HIV2.0 or more	

6.7 I/O Signal Cables for CN1 Connector

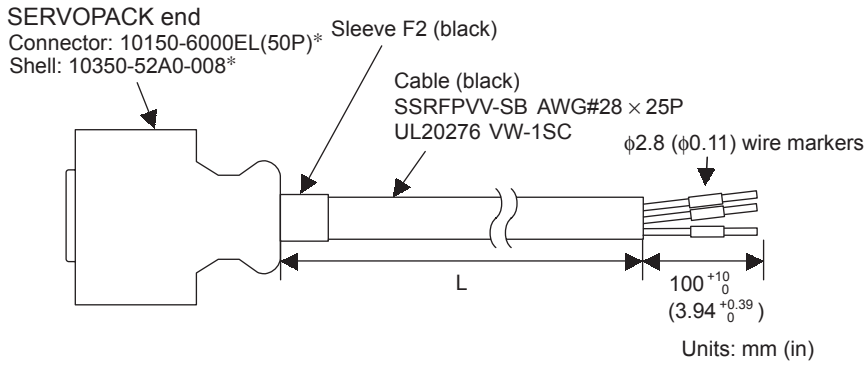
6.7.1 Standard Cables

For the connection diagram, refer to *6.7.3 Connection Diagram*.

(1) Cable Types

Cable Type	Cable Length (L)
JZSP-CKI01-1	1 m (3.28 ft)
JZSP-CKI01-2	2 m (6.56 ft)
JZSP-CKI01-3	3 m (9.84 ft)

(2) Dimensional Drawing



* Manufactured by Sumitomo 3M Ltd.

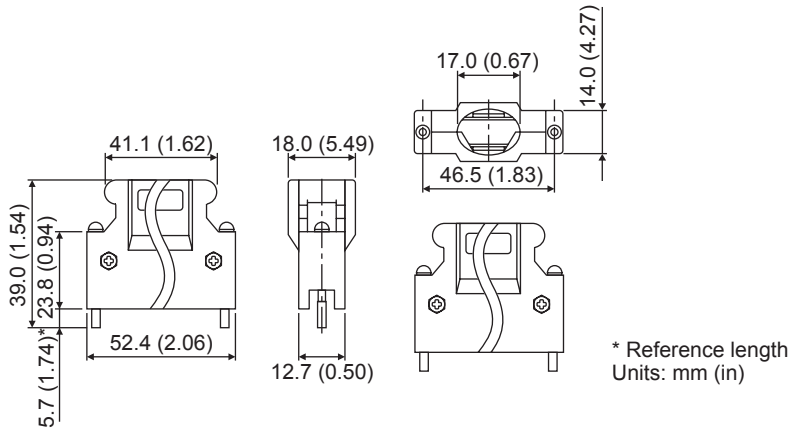
6.7.2 Connector Type and Cable Size

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

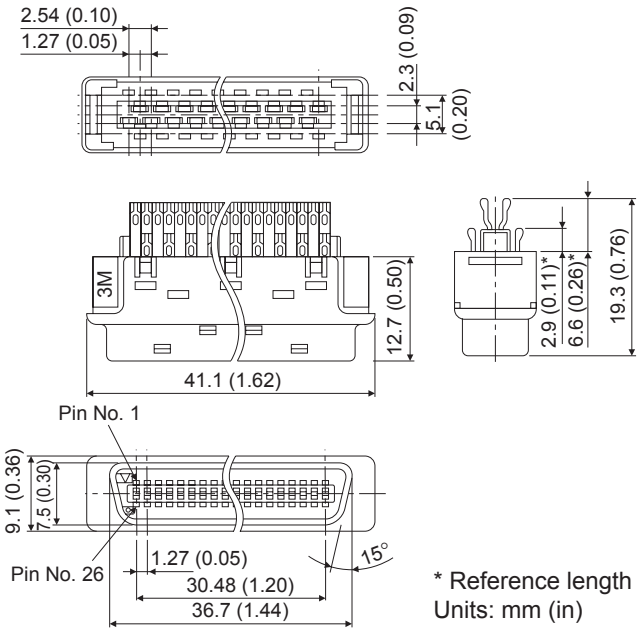
Connector Type	Case		Connector	
	Type	Qty	Type	Qty
JZSP-CKI9	10350-52A0-008*	1 set	10150-3000VE*	1

* Manufactured by Sumitomo 3M Ltd.

(1) Dimensional Drawing of Case



(2) Dimensional Drawing of Connector



(3) Cable Size

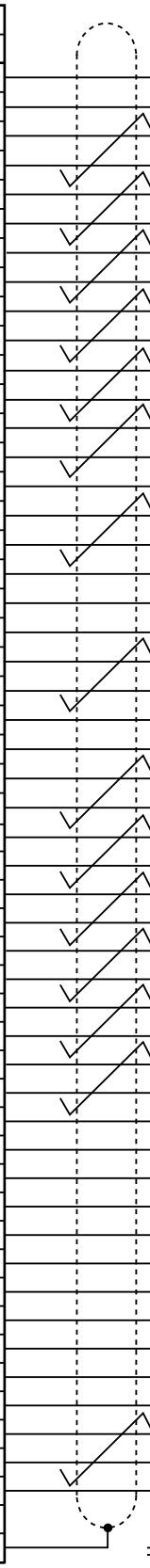
Item	Specifications
Cable	Use twisted-pair or twisted-pair shielded wire.
Applicable wires	AWG24, 26, 28, 30
Cable Finished Diameter	ϕ16 (ϕ0.63 in) mm max.

6.7.3 Connection Diagram

SERVOPACK end

Pin No.	Signal	Lead Color	Marking		Lead Marker No.
			Color	Dots	
1	SG	Orange	Red	1	1
2	SG	Orange	Black	1	2
3	–	Gray	Red	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	–	Gray	Red	2	13
14	/CLR	Gray	Black	2	14
15	CLR	White	Red	2	15
16	–	White	Black	2	16
17	–	Yellow	Red	2	17
18	–	Yellow	Black	2	18
19	PCO	Pink	Red	2	19
20	/PCO	Pink	Black	2	20
21	–	Orange	Red	3	21
22	–	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	+24V-IN	Yellow	Red	5	47
48	–	Yellow	Black	5	48
49	–	Pink	Red	5	49
50	–	Pink	Black	5	50
Case	Shield				

Host controller end

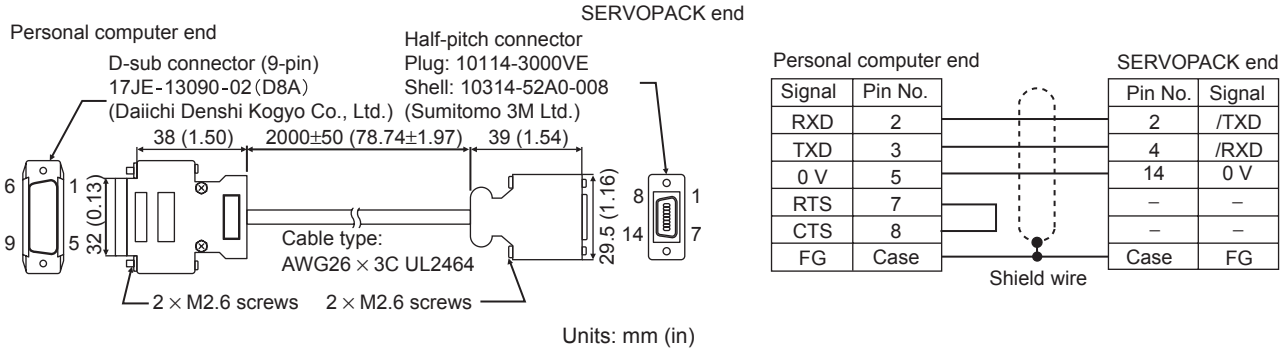


: represents twisted-pair wires.

6.8 Peripheral Devices

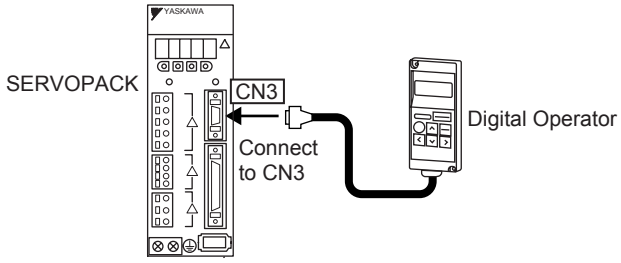
6.8.1 Cables for Connecting Personal Computers

- Cable Type: JZSP-CMS02
- Dimensional Drawing

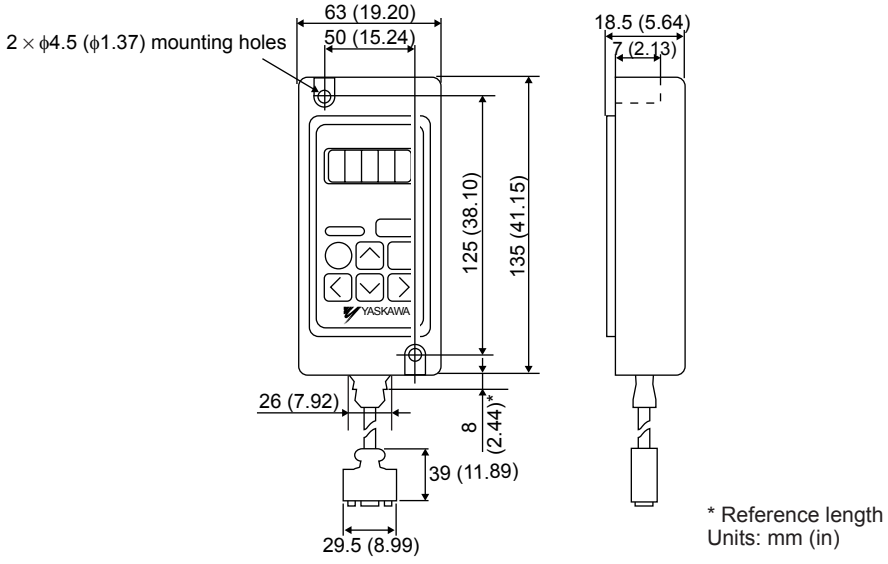


6.8.2 Digital Operator

(1) Model JUSP-OP02A-2 with a 1m (3.28 ft)-connection Cable



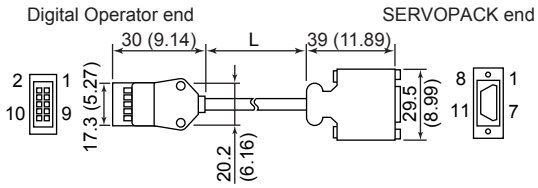
(2) Dimensional Drawing



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

The following cables are applicable for longer distance connection.

Units: mm (in)



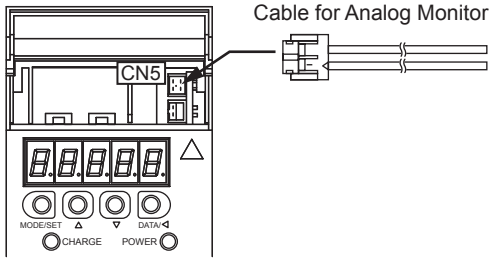
Cable Type	Cable Length (L)
JZSP-CMS00-1	1 m (3.28 ft)
JZSP-CMS00-2	1.5 m (6.56 ft)
JZSP-CMS00-3	2 m (9.84 ft)

6.8.3 Cables for Analog Monitor

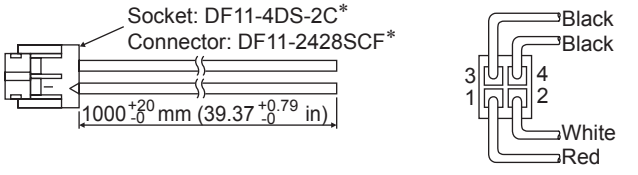
(1) Cable Type: JZSP-CA01

Connect the specified cables to CN5 connector for monitoring the analog monitor signals. For details, refer to *10.5 Analog Monitor*.

With the front cover open



(2) Dimensional Drawing



Viewed from the cable

* Manufactured by Hirose Electric Corporation.

(3) Specifications

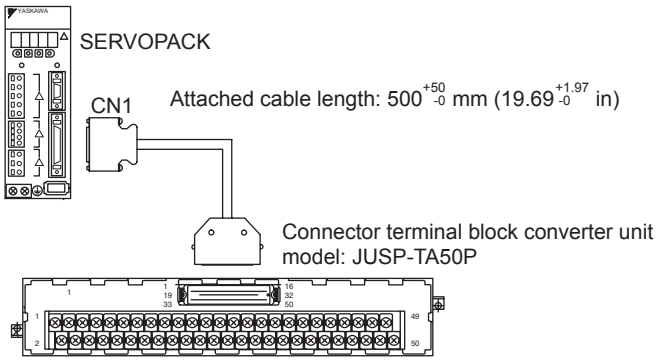
Pin No.	Cable Color	Signal	Monitoring Item
1	Red	Analog Monitor 2	Motor speed: 1V/1000 mm/s
2	White	Analog Monitor 1	Force reference: 1V/100% rated force
3 and 4	Black (2 cables)	GND (0 V)	–

Note: The above monitoring items are the factory settings. The monitoring items can be changed by setting the parameter Pn003. Refer to *10.5 Analog Monitor*.

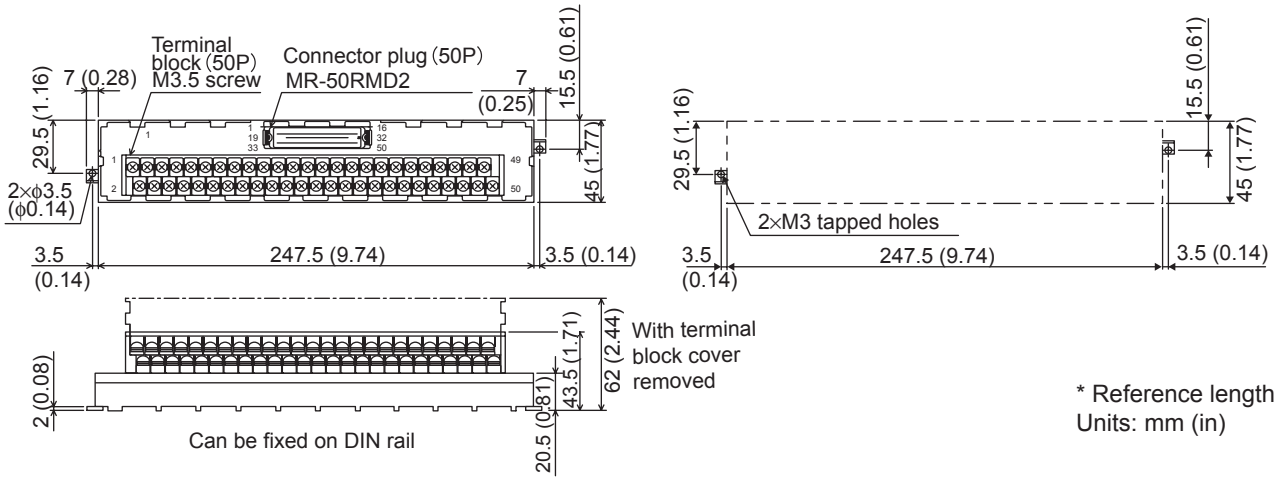
6.8.4 Connector Terminal Block Converter Unit

(1) Model: JUSP-TA50P

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

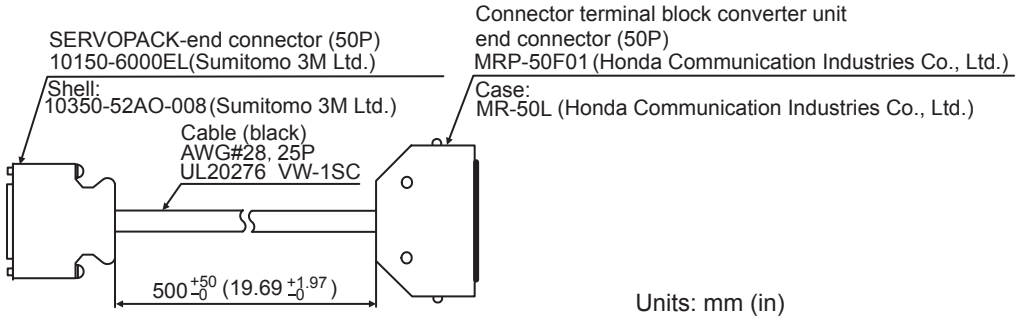


(2) Dimensional Drawings of Terminal Block



* Reference length
Units: mm (in)

(3) Dimensional Drawing of Cable



Units: mm (in)

6.8.5 External Regenerative Resistor

Regenerative resistors for SERVOPACKs are internally or externally mounted as shown in the table below. Regenerative resistors can be externally mounted on all SERVOPACKs. Connect an external regenerative resistor to the SERVOPACK if regenerative energy exceeds the capacity of the SERVOPACK.
If a regenerative resistor is to be mounted externally, the jumper between B2 and B3 for the internal regenerative resistor must be removed. Refer to *7.6 Connecting Regenerative Resistors* for the selection.
No built-in regenerative resistor is provided to 7.5 kW SERVOPACKs. Be sure to prepare the externally mounted regenerative resistor.
The following table shows examples of regenerative resistors.

Applicable SERVOPACK		Specifications for a Regenerative Resistor Mounted in a SERVOPACK		Min. Allowable Resistance (Ω)
		Resistance (Ω)	Capacity (W)	
Single-phase 200 V	SGDH-A5AE	–	–	40
	SGDH-01AE			
	SGDH-02AE			
	SGDH-04AE			
Three-phase 200 V	SGDH-05AE	50	60	40
	SGDH-08AE			
	SGDH-10AE			
	SGDH-15AE	30	70	20
	SGDH-20AE	25	140	12
	SGDH-30AE	12.5	140	12
	SGDH-50AE	8	280	8
	SGDH-75AE	(3.13)*1	(1760) *1	2.9
Three-phase 400 V	SGDH-05DE	108	70	73
	SGDH-10DE			
	SGDH-15DE			
	SGDH-20DE	45	140	44
	SGDH-30DE			
	SGDH-50DE	32	180	28
	SGDH-75DE	(18)*2	(880) *2	14.2

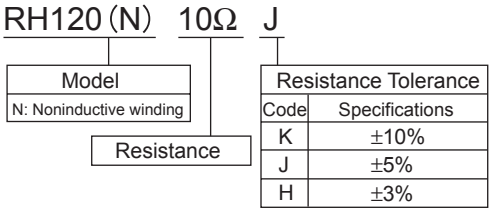
* 1. The values in parentheses are for the optional JUSP-RA05 regenerative resistor.
* 2. The values in parentheses are for the optional JUSP-RA18 regenerative resistor.

The external regenerative resistor must be purchased by customers. Refer to the table below for selecting an external regenerative resistor. Refer to *7.6 Connecting Regenerative Resistors* for the connection.

(1) References for External Regenerative Resistor

Regenerative Resistor Model	Specifications	Manufacturer
RH120	70 W, 1 to 100 Ω	Iwaki Wireless Research Institute.
RH150	90 W, 1 to 100 Ω	
RH220	120 W, 1 to 100 Ω	
RH300C	200 W, 1 to 10 kΩ	
RH500	300 W, 1 to 30 Ω	

(2) Model Designation

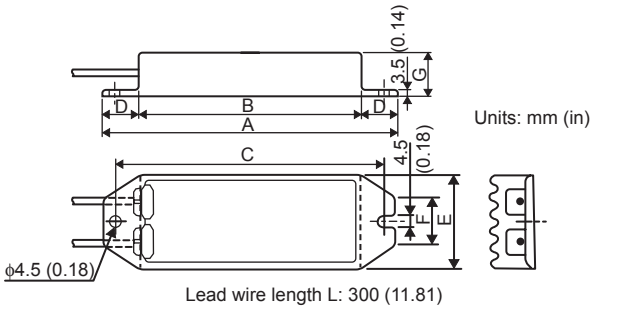


(3) Specifications

Resistance Tolerance	K: ± 10%, J: ± 5%, H: ± 3%
Temperature Resistance Characteristics	± 400 PPM / °C (less than 20Ω) , ± 260 PPM / °C (20Ω or more)
Withstand Voltage	2000 VAC/min. ΔR: ± (0.1% + 0.05Ω)
Insulation Resistance	500 VDC, 20 MΩ or more
Short-time Overload	When 10 times of rated power is applied for five seconds, ΔR: ±(2% + 0.05Ω)
Life	1000 hours of repeating the operation ON for 90 minutes and OFF for 30 minutes, ΔR: ±(5% + 0.05Ω)
Heat Resistance	Not ignite after having applied 10 times of rated electric power for one minute
Operating Temperature	-25 to 150°C (-13 to 302 °F)

(4) Dimensional Drawings

RH120/150/220



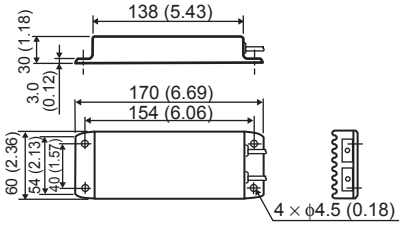
Units: mm (in)

Lead wire length L: 300 (11.81)

Model	Rated Power	Resistance
RH120	70W	1 Ω to 100 Ω
RH150	90W	1 Ω to 100 Ω
RH220	120W	1 Ω to 100 Ω

Dimensions	A	B	C	D	E	F	G
RH120	182 (7.17)	150 (5.91)	172 (6.77)	16 (0.63)	42 (1.65)	22 (0.87)	20 (0.79)
RH150	212 (8.35)	180 (7.09)	202 (7.95)	16 (0.63)	44 (1.73)	24 (0.94)	30 (1.18)
RH220	230 (9.06)	200 (7.87)	220 (8.66)	15 (0.59)	60 (2.36)	24 (0.94)	20 (0.79)

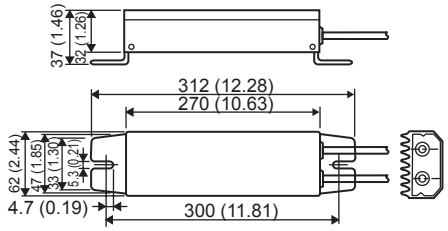
RH220B



Lead wire length L: 500 (19.69)
Rated power: 120 W
Resistance: 1 Ω to100 Ω

Units: mm (in)

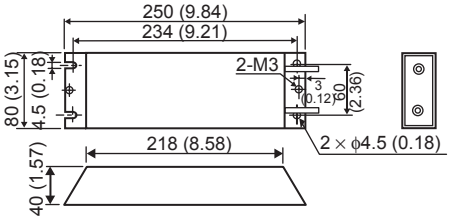
RH300C



Lead wire length L: 300 (11.81)
Rated power: 200 W
Resistance: 1 Ω to 10kΩ

Units: mm (in)

RH500



Lead wire length L: 450 (17.72)
Rated power: 300 W
Resistance: 1 Ω to 30 Ω

Units: mm (in)

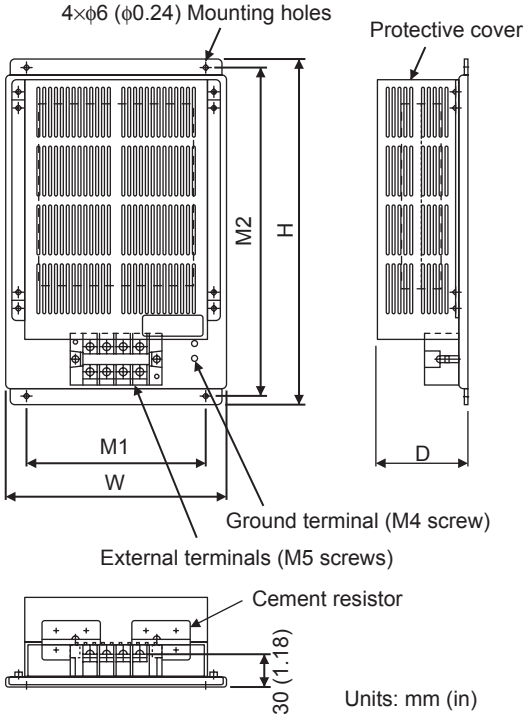
6.8.6 Regenerative Resistor

(1) Models

The SERVOPACKs with a capacity of 7.5 kW do not have a built-in regenerative resistor. The following regenerative resistor is required according to the SERVOPACK model.

SERVOPACK Model	Regenerative Resistor Model	Specifications	Allowable Power Loss
SGDH-75AE	JUSP-RA05	3.13 Ω , 1760 W	350 W
SGDH-75DE	JUSP-RA18	18 Ω , 880 W	180 W

(2) Dimensional Drawings



Units: mm (in)

Model	W	H	D	M1	M2	Approx. Mass kg (lb)
JUSP-RA05	300 (11.81)	350 (13.78)	95 (3.74)	250 (9.84)	335 (13.19)	7 (15.43)
JUSP-RA18	220 (8.66)	350 (13.78)	92 (3.74)	180 (7.09)	335 (13.19)	4 (8.82)

6.8.7 Molded-case Circuit Breaker (MCCB)

Note the following descriptions when selecting a molded-case circuit breaker.

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 approximately 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

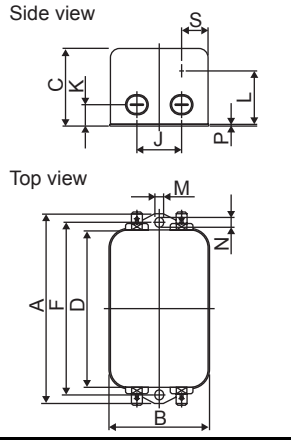
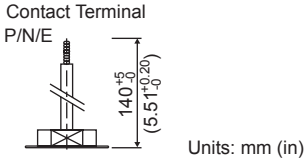
- Refer to *2.6.2 Molded-case Circuit Breaker and Fuse Capacity* for SERVOPACK inrush current.
- The allowable inrush current for a low-speed acting circuit breaker is approximately 10 times of the rated current for 0.02 seconds.
- When turning ON multiple SERVOPACKs simultaneously, select a molded-case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

6.8.8 Noise Filter

The noise filters model FN and FS manufactured by Schaffner Electronic and FMAC manufacture by SCHURTER (formely TIMONTA) AG are recommended. Contact Yaskawa Controls Co., Ltd.
Select one of the following noise filters according to SERVOPACK capacity. For more details, refer to *2.6.3 Noise Filters, Magnetic Contactors, Surge Suppressors and DC Reactors*.

Refer to *7.2.3 Typical Main Circuit Wiring Examples* for the connection method.

(1) Single-phase, 200 V

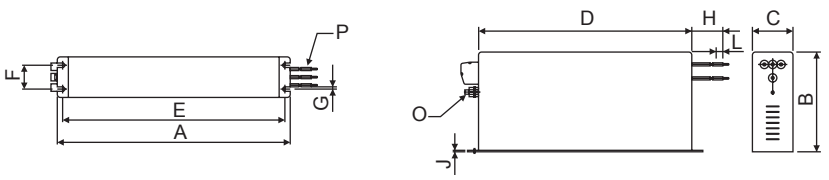
Model		FN2070-6/07	FN2070-10/07
Dimensional Drawings			
			
External Dimensions in mm (in)	Symbol	Dimensions	
	A	113.5 ± 1 (4.47±0.039)	156 ± 1 (6.14±0.039)
	B	57.5 ± 1 (2.26±0.039)	
	C	45.4 ± 1.2 (1.79±0.047)	
	D	94 ± 1 (3.70±0.039)	130.5 ± 1 (5.14±0.039)
	F	103 ± 0.3 (4.06±0.012)	143 ± 0.3 (5.63±0.012)
	J	25 ± 0.2 (0.98±0.0079)	
	K	8.4 ± 0.5 (0.33±0.020)	
	L	32.4 ± 0.5 (1.28±0.020)	
	M	4.4 ± 0.1 (0.17±0.004)	5.3 ± 0.1 (0.21±0.004)
	N	6 ± 0.1 (0.24±0.004)	
	P	0.9 ± 0.1 (0.035±0.004)	
	Q	–	
	R	–	
	S	38 ± 0.5 (1.50±0.020)	
Specifications		250 VAC,6 A	250 VAC, 10 A
Applicable SERVOPACK SGDH-	Single-phase 200 V	A5AE 01AE 02AE	04AE
Manufacturer		Schaffner Electronic	

(2) Three-phase, 200/400 V

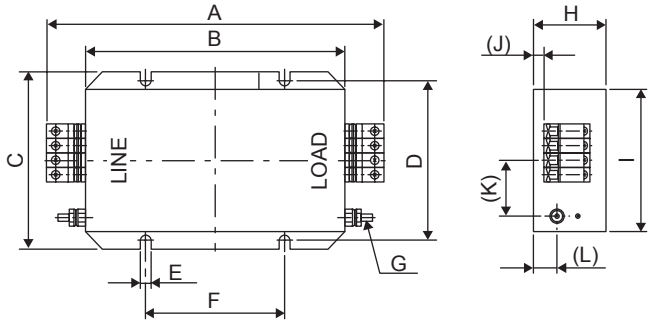
Select one of the following noise filters according to SERVOPACK capacity. For more details, refer to *2.6.3 Noise Filters, Magnetic Contactors, Surge Suppressors and DC Reactors*.

Refer to *7.2.3 Typical Main Circuit Wiring Examples* for the connection method.

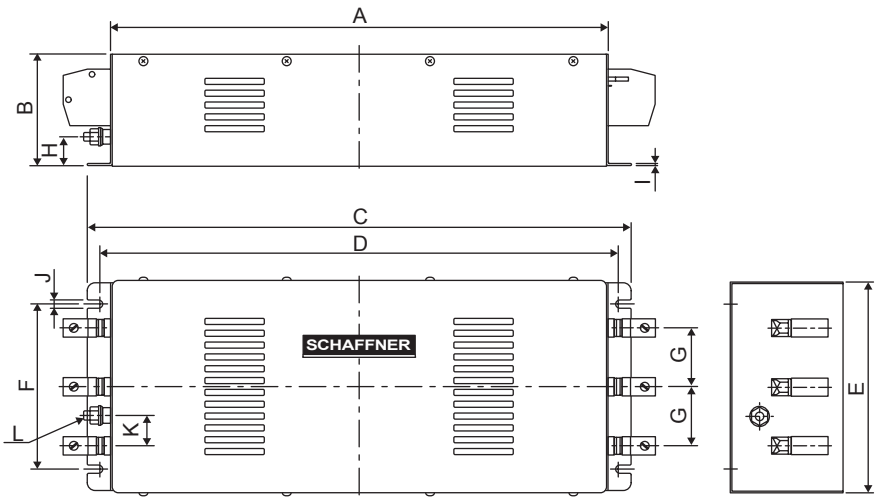
(a) FN Series

Model		FN258L-7/07	FN258L-16/07	FN258L-30/07
Dimensional Drawings		Side view / Front and side views 		
External Dimensions in mm (in)	Symbol	Dimensions		
	A	255 ± 1 (10.04 ± 0.039)	305 ± 1 (12.01 ± 0.039)	335 ± 1 (13.19 ± 0.039)
	B	126 ± 0.8 (4.96 ± 0.031)	142 ± 0.8 (5.59 ± 0.031)	150 ± 1 (5.91 ± 0.039)
	C	50 ± 0.6 (1.97 ± 0.024)	55 ± 0.6 (2.17 ± 0.024)	60 ± 0.6 (2.36 ± 0.024)
	D	225 ± 0.8 (8.86 ± 0.031)	275 ± 0.8 (10.83 ± 0.031)	305 ± 1 (12.01 ± 0.039)
	E	240 ± 0.5 (9.45 ± 0.020)	290 ± 0.5 (11.42 ± 0.020)	320 ± 0.5 (12.60 ± 0.020)
	F	25 ± 0.3 (0.98 ± 0.012)	30 ± 0.3 (1.18 ± 0.012)	35 ± 0.3 (1.38 ± 0.012)
	G	6.5 ± 0.2 (0.26 ± 0.0079)		
	H	300 ± 10 (11.81 ± 0.39)		400 ± 10 (15.75 ± 0.39)
	J	1 ± 0.1 (0.039 ± 0.0039)		
	L	9 ± 1 (0.35 ± 0.039)		
	O	M5		
	P	AWG16	AWG14	AWG10
Specifications		480 VAC, 7 A	480 VAC, 16 A	480 VAC, 30 A
Applicable SERVOPACK SGDH-	Three-phase 200 V	05AE	08AE 10AE 15AE 20AE	30AE
	Three-phase 400 V	05DE 10DE 15DE	20DE 30DE	–
Manufacturer		Schaffner Electronic		

(b) FMAC Series

Model		FMAC-0934-5010	FMAC-0953-6410
Dimensional Drawings			
External Dimensions in mm (in)	Symbol	Dimensions	
	A	251 (9.88)	308 (12.13)
	B	201 (7.91)	231 (9.09)
	C	151 (5.94)	151 (5.94)
	D	$135^{+0}_{-1}\left(5.31^{+0}_{-0.04}\right)$	$135^{+0}_{-1}\left(5.31^{+0}_{-0.04}\right)$
	E	6.5±0.3 (0.26±0.01)	6.5±0.3 (0.26±0.01)
	F	115±0.3 (4.53±0.01)	115±0.3 (4.53±0.01)
	G	M6	M6
	H	66 (2.60)	66 (2.60)
	I	121 (4.76)	121 (4.76)
	J	(10) (0.39)	(13) (0.51)
	K	(41) (1.61)	(45) (1.77)
	L	(17) (0.67)	(34) (1.34)
Specifications		440 VAC, 50 A	440 VAC, 64 A
Applicable SERVOPACK SGDH-	Three-phase 200 V	50AE	75AE
Manufacturer		SCHURTER (formely TIMONTA)	

(c) FS Series

Model		FS5559-35-33
Dimensional Drawings		
External Dimensions in mm (in)	Symbol	Dimensions
	A	330 (12.99)
	B	85 (3.35)
	C	370 (14.57)
	D	348 (13.70)
	E	110 (4.33)
	F	80 (3.15)
	G	30 (1.18)
	H	25 (0.98)
	I	1.5 (0.06)
	J	6.5 (0.26)
	K	25 (0.98)
	L	M6
Specifications		480 V, 35 A
Applicable SERVOPACK SGDH-	Three-phase 400 V	50DE 75DE
Manufacturer		Schaffner Electronic

6.8.9 Magnetic Contactor

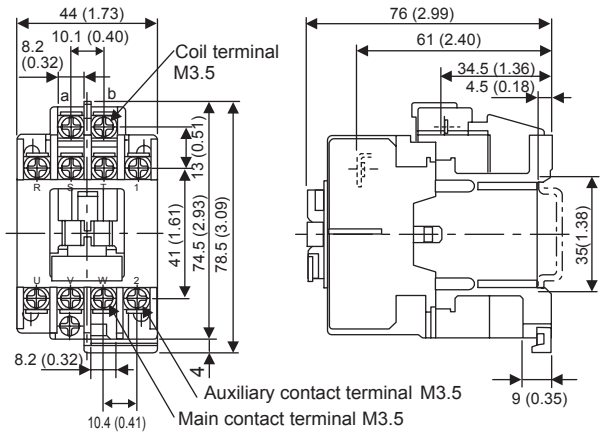
(1) Model: HI-□J

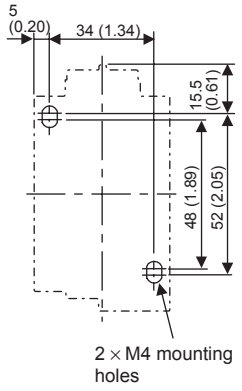
The magnetic contactor is manufactured by Yaskawa Controls Co., Ltd.
A magnetic contactor is required to make the AC power supply to SERVOPACK ON/OFF sequence externally. Be sure to attach a surge suppressor to the excitation coil of the magnetic contactor. Refer to *6.8.10 Surge Suppressor* for details of the surge suppressor.
For selecting a magnetic contactor, refer to *2.6.3 Noise Filters, Magnetic Contactors, Surge Suppressors and DC Reactors*.

(2) For Single-phase 200 V and Three-phase 200 V SERVOPACKs

(a) Model: HI-11J

Dimensions in mm (in)	Mounting Hole Dimensions in mm (in)	Terminal Symbols
Approx. mass: 0.25 kg (0.55 lb)		

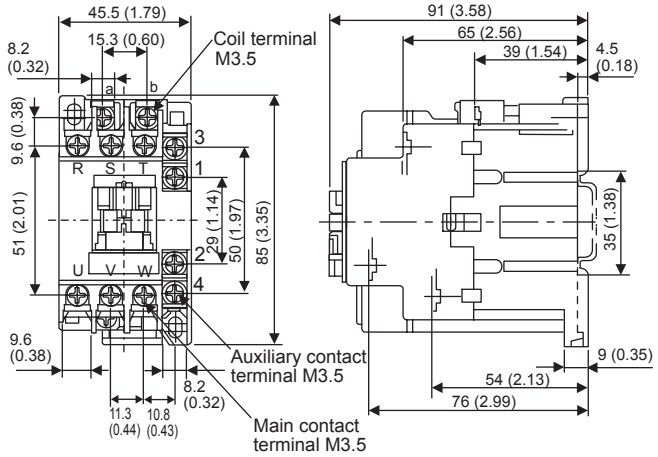


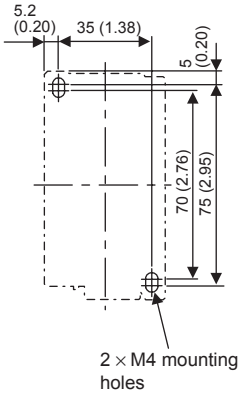


Auxiliary contact	Structure
1NO	a A1 — A2 b R 1 S 3 T 5 — 13 U 2 V 4 W 6 — 14
1NC	a A1 — A2 b R 1 S 3 T 5 — 11 U 2 V 4 W 6 — 12

(b) Model: HI-15J and HI-20J

Dimensions in mm (in)	Mounting Hole Dimensions in mm (in)	Terminal Symbols
Approx. mass: 0.38 kg (0.83 lb)		





HI-15J

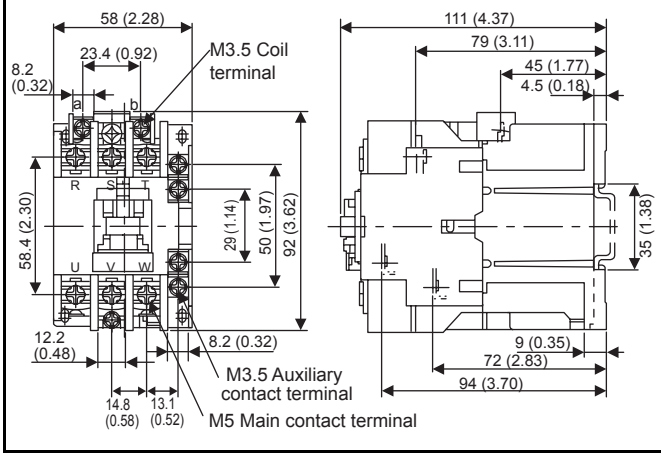
Auxiliary contact	Structure
1NO1NC	a A1 — A2 b R 1 S 3 T 5 — 21 13 U 2 V 4 W 6 — 22 14

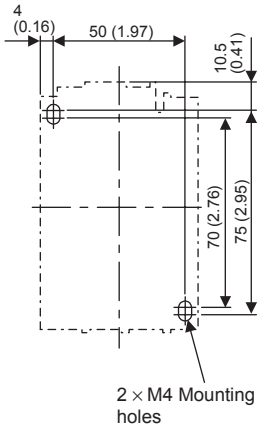
HI-20J

Auxiliary contact	Structure
1NO1NC	a A1 — A2 b R 1 S 3 T 5 — 41 23 U 2 V 4 W 6 — 42 24

(c) Model: HI-25J and HI-35J

Dimensions in mm (in)	Mounting Hole Dimensions in mm (in)	Terminal Symbols
Approx. mass: 0.68 kg (1.50 lb)		





Auxiliary contact	Structure
1NO1NC	a A1 — A2 b R 1 S 3 T 5 — 5 41 7 23 U 2 V 4 W 6 — 6 42 8 24

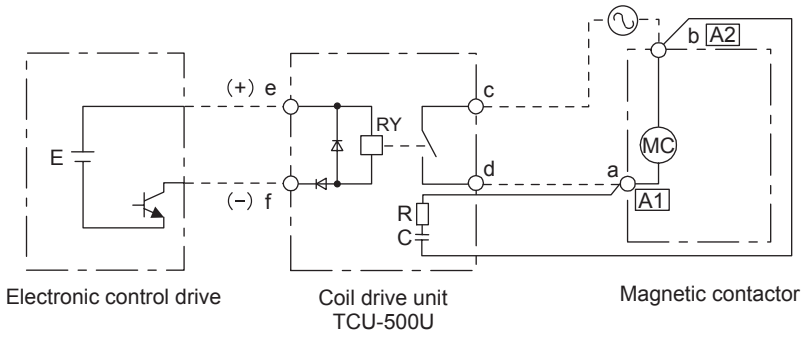
(3) Magnetic Contactor with Coil Drive Unit for Three-phase 400 V SERVOPACKs

The magnetic contactors for three-phase 400 V SERVOPACKs include coil drive unit.
The rated voltage of the operating coil in the coil drive unit is 24 VDC.
Maintain the power supply voltage within the specified range. The voltage below the allowable range causes malfunction, resulting in the magnetic contacts seizing or the coil burning out.
If a voltage above 24 V is applied, the unit will be damaged. Confirm the voltage at the trial operation after installation.

(a) Ratings and Specifications

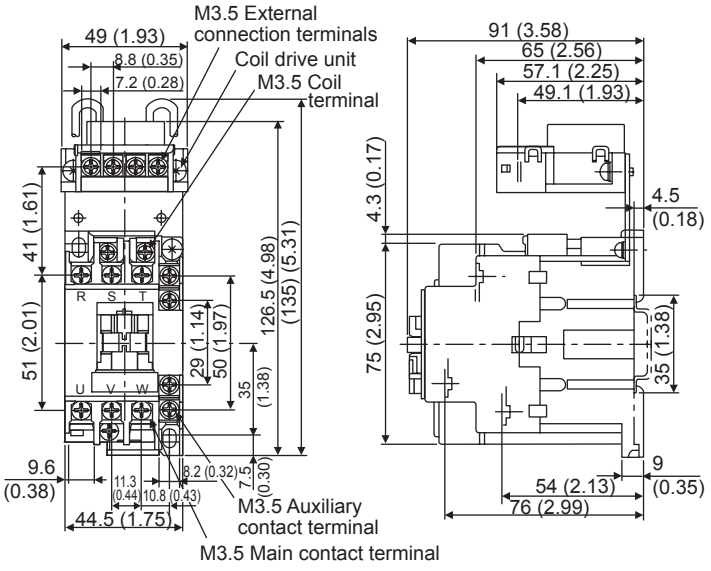
Model		TCU-500U
Input (operation) Section	Rated Voltage	24 VDC
	Allowable Voltage Fluctuation	70 to 130% of the rated voltage
	Current Range	7.3 to 9.3 mA
	Operating Voltage	Maximum 70% of the rated voltage (at 23°C) (73.40 °F)
	Open Voltage	Minimum 10% of the raged voltage (at 23°C) (73.40 °F)
Output Section	Output Method	High-sensitivity relay contacts
	Max. Rated Voltage and Current	220 VAC, 2 A
	Rated Insulation Voltage	250 VAC
	Operation Time	3 ms
	Reset Time	1 ms
Operating Temperature		-20 to +55°C (–4 to 131 °F)
Surge Suppressing Performance	Max. Rated Voltage	220 VAC
	Rated Insulation Voltage	250 VAC
	Surge Voltage Control Method	CR method
	Applicable Voltage Range for Operation Magnetic Coil	Any voltage between 100 VAC and 220 VAC Examples: • 100 V 50 Hz 100 to 110 V 60 Hz • 200 V 50 Hz 200 to 220 V 60 Hz

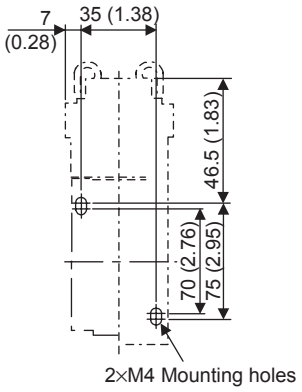
(b) Circuit Connection Diagram



(c) Model: HI-15JCU and HI-20JCU

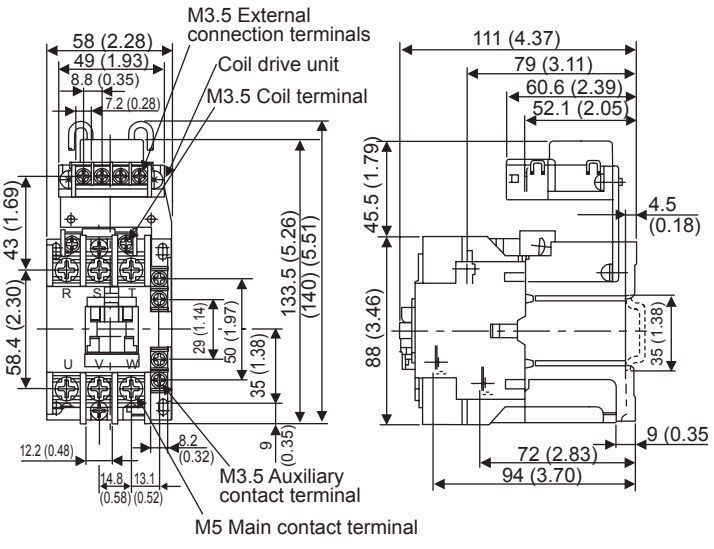
Dimensions in mm (in)	Mounting Hole Dimensions in mm (in)
Approx. mass: 0.45 kg (0.99 lb)	

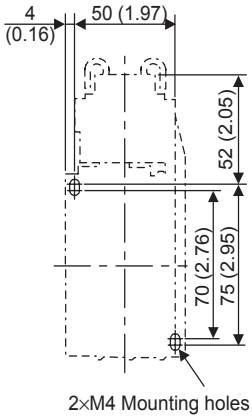




(d) Model: HI-25JCU and HI-35JCU

Dimensions in mm (in)	Mounting Hole Dimensions in mm (in)
Approx. mass: 0.75 kg (1.65 lb)	





6.8.10 Surge Suppressor

(1) Surge Suppressor for Magnetic Contactor

Contact Yaskawa Controls Co., Ltd.

(a) Model: TU-25□, TU-65□

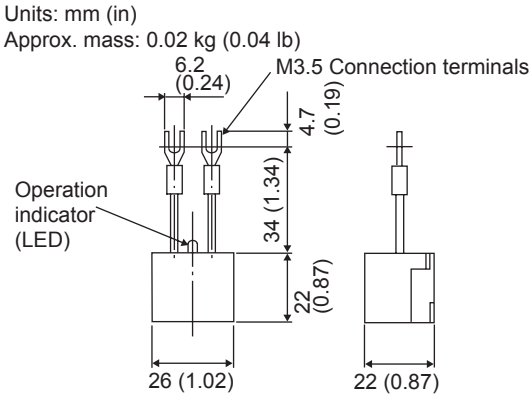
(b) Specifications

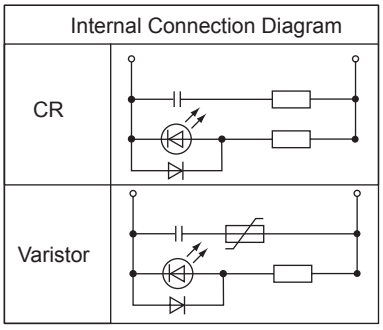
Model	Surge Absorption Method	Rated Insulation Voltage	Applicable Voltage Range for Operation Magnetic Coil AC 50/60Hz 50V 110V 127V 240V 380V 440V	Applicable Magnetic Contactor
TU-25C120	CR	150 VAC		HI-11J HI-15J HI-20J
TU-25C240	CR	300 VAC		
TU-25V440	Varistor	500 VAC		
TU-65C120	CR	150 VAC		HI-25J HI-35J
TU-65C240	CR	300 VAC		
TU-65V440	Varistor	500 VAC		

Note: ▭ : Applicable voltage range

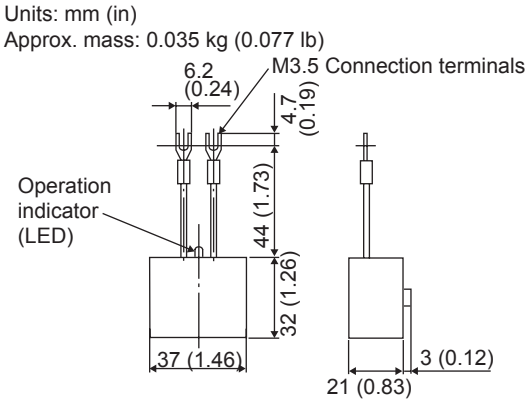
(c) Dimensional Drawings

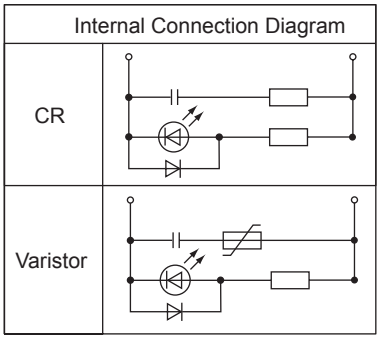
- Model TU-25□





- Model TU-65□





6.8.11 DC Reactor for Harmonic Suppression

(1) Specifications

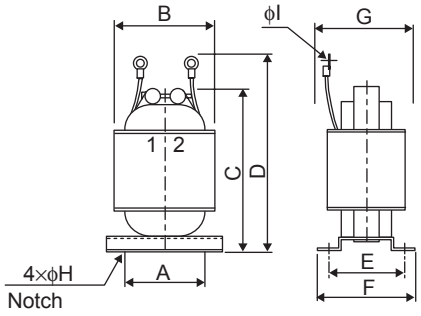
DC reactor for harmonic suppression is handled by Yaskawa Controls Co., Ltd.

If necessary for harmonic suppression, connect a DC reactor to the SERVOPACK. Note that no terminal for connecting a DC reactor is provided to the 7.5 kW SERVOPACKs.
Refer to the table below for selecting a DC reactor according to the SERVOPACK capacity. For the connection method, refer to *6.8.11 DC Reactor for Harmonic Suppression*.

Applicable SERVOPACK Model SGDH-		DC Reactor Model	DC Reactor Specifications	
			Inductance (mH)	Rated Current (A)
Single-phase 200 V	A5AE	−	−	−
	01AE	X5071	40.0	0.85
	02AE	X5070	20.0	1.65
	04AE	X5069	10.0	3.3
Three-phase 200 V	05AE	X5061	2.0	4.8
	08AE			
	10AE			
	15AE	X5060	1.5	8.8
	20AE			
	30AE	X5059	1.0	14.0
	50AE	X5068	0.47	26.8
Three-phase 400 V	05DE	X5074	4.7	1.5
	10DE	X5075	3.3	4.5
	15DE			
	20DE	X5076	2.2	8.6
	30DE			
	50DE	X5077	1.5	14.1

(2) Dimensional Drawings

Units: mm



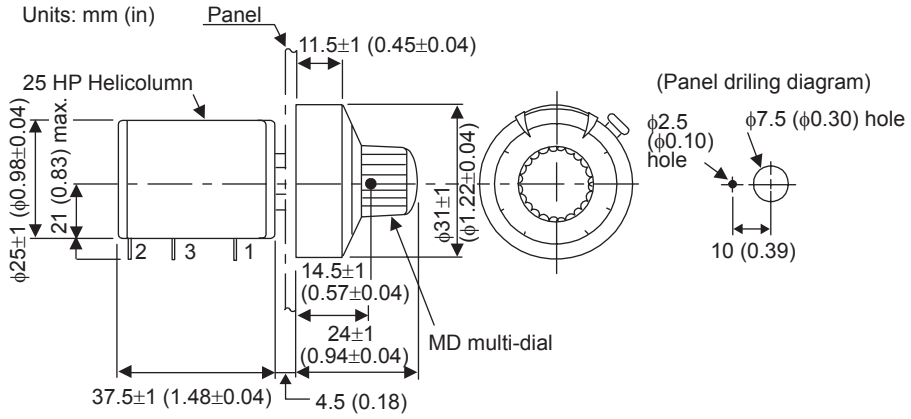
DC Reactor Model	Dimensions in mm (in)									Approx. Mass in kg (lb)
	A	B	C	D	E	F	G	ϕH	ϕI	
X5059	50 (1.97)	74 (2.91)	125 (4.92)	140 (5.51)	35 (1.38)	45 (1.77)	60 (2.36)	5 (0.20)	5.3 (0.21)	1.1 (2.43)
X5060	40 (1.57)	59 (2.32)	105 (4.13)	125 (4.92)	45 (1.77)	60 (2.36)	65 (2.56)	4 (0.16)	4.3 (0.17)	1.0 (2.20)
X5061	35 (1.38)	52 (2.05)	80 (3.15)	95 (3.74)	35 (1.38)	45 (1.77)	50 (1.97)	4 (0.16)	4.3 (0.17)	0.5 (1.10)
X5068	50 (1.97)	74 (2.91)	125 (4.92)	155 (6.1)	53 (2.09)	66 (2.6)	75 (2.95)	5 (0.20)	6.4 (0.25)	1.9 (4.19)
X5069	40 (1.57)	59 (2.32)	105 (4.13)	125 (4.92)	45 (1.77)	60 (2.36)	65 (2.56)	4 (0.16)	4.3 (0.17)	1.0 (2.20)
X5070	40 (1.57)	59 (2.32)	100 (3.94)	120 (4.72)	35 (1.38)	45 (1.77)	50 (1.97)	4 (0.16)	4.3 (0.17)	0.8 (1.76)
X5071	35 (1.38)	52 (2.05)	80 (3.15)	95 (3.74)	30 (1.18)	40 (1.57)	45 (1.77)	4 (0.16)	4.3 (0.17)	0.5 (1.10)
X5074	30 (1.18)	47 (1.85)	70 (2.76)	85 (3.35)	28 (1.10)	38 (1.50)	45 (1.77)	4 (0.16)	4.3 (0.17)	0.3 (0.66)
X5075	40 (1.57)	59 (2.32)	100 (3.94)	120 (4.72)	40 (1.57)	50 (1.97)	55 (2.17)	4 (0.16)	4.3 (0.17)	0.9 (1.98)
X5076	50 (1.97)	74 (2.91)	125 (4.92)	140 (5.51)	35 (1.38)	45 (1.77)	60 (2.36)	5 (0.20)	4.3 (0.17)	1.1 (2.43)
X5077	50 (1.97)	74 (2.91)	125 (4.92)	155 (6.1)	53 (2.09)	66 (2.6)	75 (2.95)	5 (0.20)	5.3 (0.21)	1.9 (4.19)

6.8.12 Variable Resistor for Speed and Force Setting

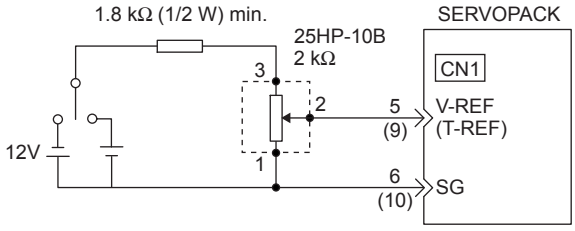
(1) Model: 25HP-10B

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



6

6.8.13 Encoder Signal Converter Unit

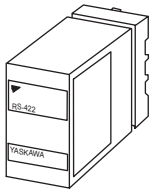
The encoder signal converter unit (the trade name "Receiver Unit") converts encoder signal output from the line driver to open-collector or voltage-pulse output.

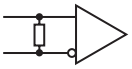
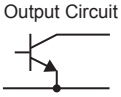
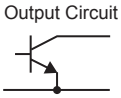
A socket model 11PFA is required to use a Receiver Unit.

(1) Model: LRX-01 / A□

Contact Yaskawa Controls Co., Ltd.

(2) Specifications



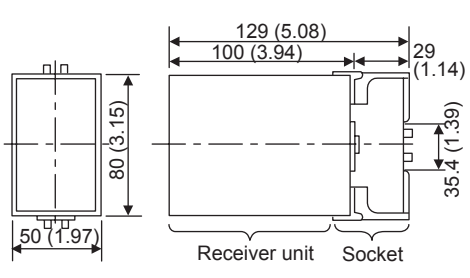
Specifications	Receiver Unit			
	LRX-01/A1	LRX-01/A2	LRX-01/A3	LRX-01/A4
Power Supply	12 VDC ±10 %, 100 mA		5 VDC ±5 %, 100 mA	
Input Signals	Balanced line driver input (RS-422) Input Circuit 			
Output Signals	Voltage pulse output Output Circuit 	Open collector output Output Circuit 	Voltage pulse output 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
Ambient Temperature	0 (32 °F) to + 60 °C (140 °F)			
IC Used	Receiver IC: AM26LS32C or the equivalent			
Response Frequency	100 kHz			

(3) Dimensional Drawings

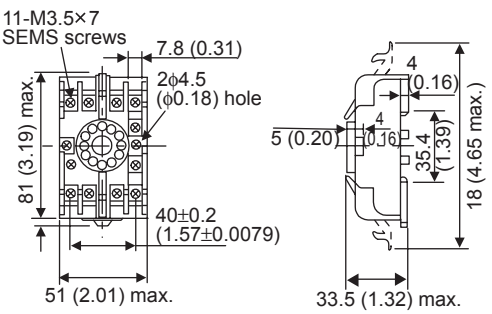
The socket is optional.

Units: mm (in)

Receiver unit and socket



Socket Type 11PFA



6.8.14 MECHATROLINK I/F Unit

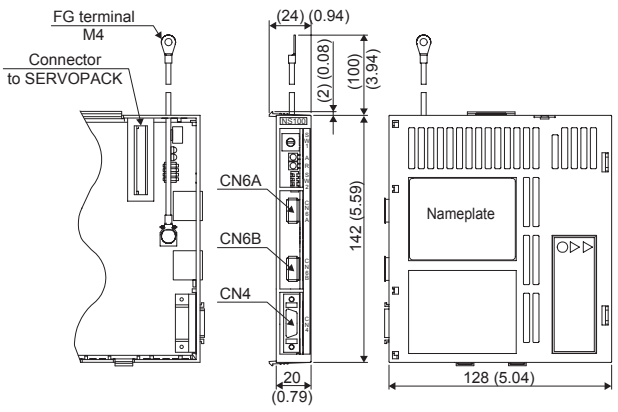
(1) Model : JUSP-NS100 (for MECHATROLINK-I communications)
: JUSP-NS115 (for MECHATROLINK-I/II communications)

(2) Specifications

Item		Details	
		JUSP-NS100	JUSP-NS115
Applicable SERVOPACK		All SGDH-□□□E models	SGDH-□□□E models (software version; *** 33 or later)
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	
MECHATROLINK Communications	Baud Rate/ Transmission Cycle	4 Mbps / 2 ms	10Mbps/500µs or more (4Mbps/2ms when using MECHATROLINK-I)
Command Format	Operation Specification	Positioning using MECHATROLINK-I communications.	Positioning using MECHATROLINK-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 force control	
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 (in) Approx. mass: 0.2 kg (0.44 lb)



6.8.15 DeviceNet I/F Unit

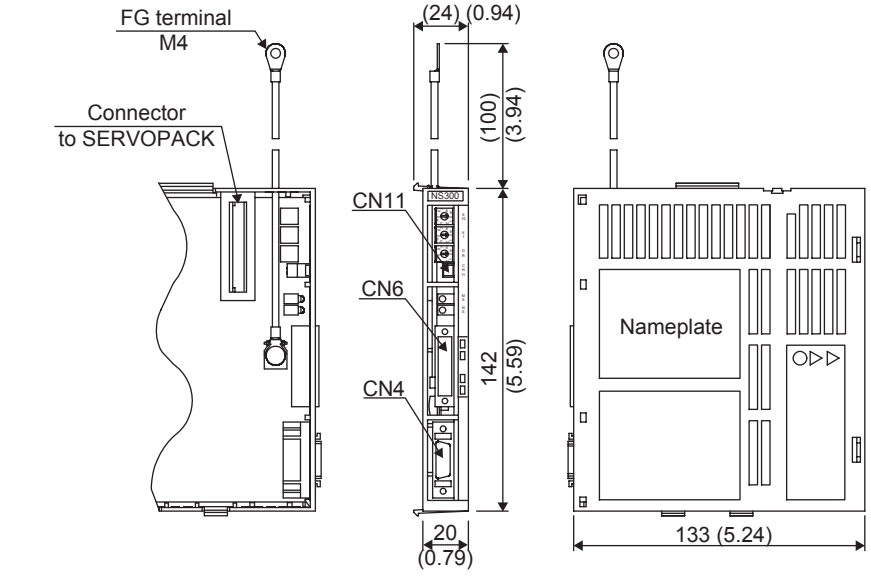
(1) Model: JUSP-NS300

(2) Specifications

Item		Details
Applicable SERVOPACK		All SGDH-□□□E 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	Impossible
Input Signals	Fixed Allocation to SERVOPACK CN1 Connector	Forward/reverse run prohibited, Zero point signal, Emergency stop signal
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 (in) Approx. mass: 0.2 kg (0.44 lb)



6.8.16 PROFIBUS-DP I/F Unit

(1) Model: JUSP-NS500

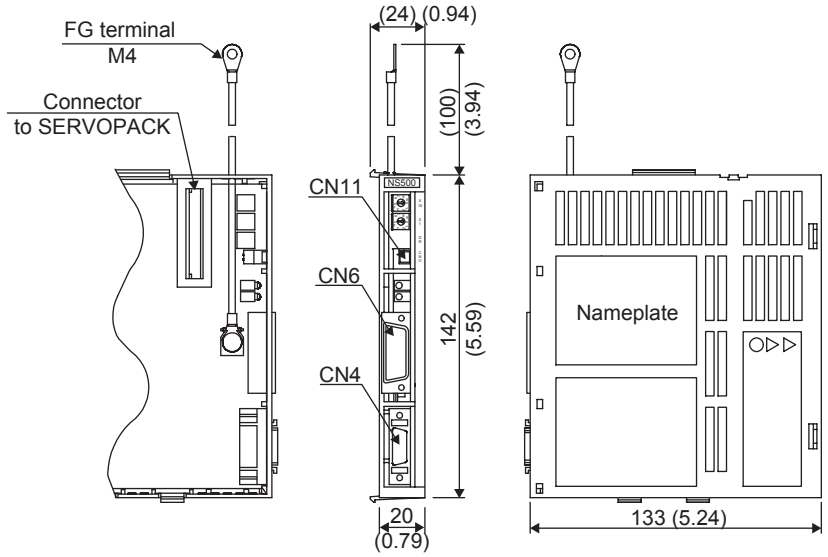
(2) Specifications

Item		Details
Applicable SERVOPACK		All SGDH-□□□E 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	Impossible
Input Signals	Fixed Allocation to SERVOPACK CN1 Connector	Forward/reverse run prohibited, Zero point return deceleration LS, Zero point signal, External positioning signal
	NS500 Unit	Emergency stop signal
Output Signals	SERVOPACK CN1 Connector*	Servo alarm, Brake interlock, Servo ready, Positioning completion
	NS500 Unit	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 (in) Approx. mass: 0.2 kg (0.44 lb)



6.8.17 INDEXER Module

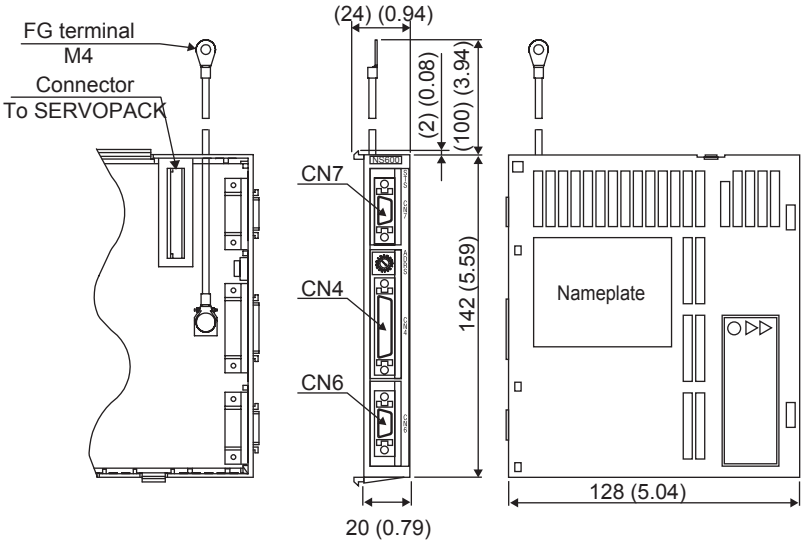
(1) Model: JUSP-NS600

(2) Specifications

Item			Details
Applicable SERVOPACK			All SGDH-□□□E SERVOPACKs
Installation Method			Mounted on the SGDH SERVOPACK side: CN10.
Basic Specifications	Power Supply Method		Supplied from the SERVOPACK control power supply
	Power Consumption		2.6 W
Control Specifications	Program Table		Program table positioning by designating the starting step by the contact input (Maximum 128 steps)
	Serial Communications		Serial commands in ASCII codes Communications specifications: RS422 / RS485 (Maximum 50 m) RS232C (Maximum 3 m) Connection: Multi-drop method (Maximum 16 axes) Baud rate: 9600, 19200, 38400bps
	Command Table		Positioning by designating the command table by the contact input (Maximum 128 points)
	Zero-Point Return		3 types
Other Functions			External positioning, JOG speed table operation (Maximum 16 speeds)
I/O Signals	Input	SERVOPACK	• S-ON (Servo ON) • P-OT (Forward Run Prohibited), N-OT (Reverse Run Prohibited) • DEC (Zero-Point Return Deceleration LS) • RTRG (External Positioning Signal)
		INDEXER Module	• MODE0/1 (Mode signal) • START/HOME (Start Signal / Zero-point Return Execution) • PGMRES/JOGP (Program Reset / Motor Forward Rotation) • SEL0/JOGN (Program Starting Step Designation / Motor Reverse Rotation) • SEL1 to SEL4 / JOG0 to JOG3 Program Starting Step Designation / JOG Speed Table Selection)
	Output	SERVOPACK	• ALM (Servo Alarm) • WARN (Warning) • BK (Brake Interlock) • S-RDY (Servo Ready) • ALO1, ALO2, ALO3 (Alarm Codes)
		INDEXER Module	• INPOSITION (Positioning Completed) • POUT0 to POUT4 (Programmable Outputs)

(3) Dimensional Drawings

Units: mm (in) Approx. mass: 0.2 kg (0.44 lb)



7

Wiring

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7.1 Linear Servomotor Installation

7.1.1 Introduction

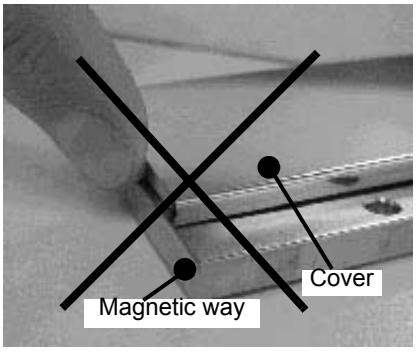
Install the linear servomotor according to the following precautions.

⚠ WARNING

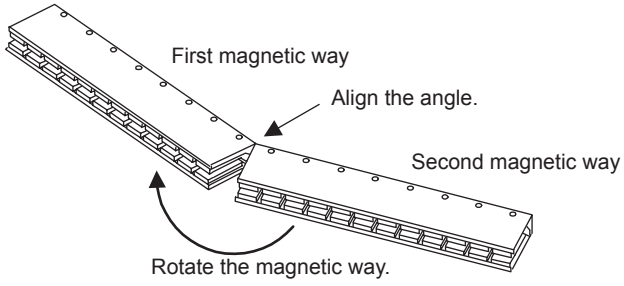
- If you have a pacemaker or any other electronic medical devices, do not approach the magnetic way of the linear servomotor.
  Failure to observe this warning may malfunction of the medical device.

⚠ CAUTION

- When unpacking and installing magnetic way, check that no metal fragments or other magnetic objects are present considering the magnetic attraction of the.
  Failure to observe this caution may result in injury or damage to the magnetic way's magnets.
- Do not use the magnetic way near metal or other magnetic objects.
  Failure to observe this caution may result in injury.
- Do not place clocks, magnetic cards, floppy disks, or measuring instruments close to the magnetic way.
  Failure to observe this caution may result in malfunction or damage to these items by the magnetic force.
- Do not hold the cover when carrying a magnetic way with an antimagnetic cover.
  Failure to observe this caution may result in injury by the cover edge, or the cover may become distorted.



- Keep fingers away from the gap between magnetic ways when connecting multiple magnetic ways together.
  Otherwise fingers may become jammed due to the magnetic attraction between magnetic ways, resulting in injury. When joining magnetic ways together, place the second magnetic way temporarily in line and at least 30 mm apart from the first magnetic way.
  Next, after aligning the angles of the bolt sockets on the magnetic way's connecting surfaces, rotate the second magnetic way to join the first magnetic way. Connect the second and first magnetic ways together. And after confirming the mounting position, secure the second magnetic way using bolts. Make sure that fingers do not get jammed due to the magnetic attraction between magnetic ways.



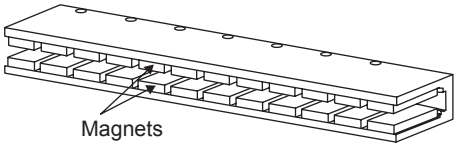
⚠ CAUTION

- When using linear servomotors with hall sensors, make sure that the hall sensor does not protrude from the servomotor's magnetic way.
  Otherwise, the linear servomotor may not operate properly. The hall sensor is built into the coil assembly in SGLGW-30 and SGLGW-90 linear servomotor. While, the hall sensor is built in the side of other models.

7.1.2 SGLGW and SGLGM Linear Servomotors (Coreless Types)

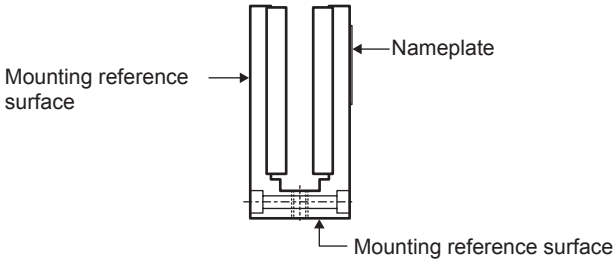
(1) Magnetic Way Installation

The SGLGM magnetic ways are U-channel steel tracks with opposing magnets attached to the inner surfaces. Make sure that no foreign particles (magnetic objects) are caught between the magnets when installing them.



Use the following procedure to install SGLGM magnetic ways.

1. After checking the magnetic way's two mounting reference surfaces, place the magnetic way on the reference surface of the machine base, making sure that hands are kept clear.

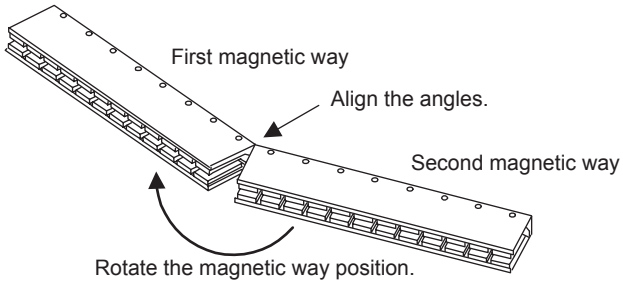


2. Press the magnetic way down closely onto the reference surface of the machine and secure it with bolts.

Magnetic Way Model SGLGM-	Bolt size	Tightening torque (N•cm)
30□□□□	M4	360 to 500
40□□□□	M5	720 to 1010
60□□□□		
90□□□□	M6	1220 to 1710

Note: Use hexagonal socket head bolts (tensile strength Class 10.9).

3. When joining magnetic ways together, place the second magnetic way temporarily in line and at least 30 mm apart from the first magnetic way.
   Next, after aligning the angles of the bolt sockets on the magnetic way's connecting surfaces, rotate the second magnetic way to join the first magnetic way. Connect the second and first magnetic ways together. And after confirming the mounting position, secure the second magnetic way using bolts. Make sure that fingers do not get jammed due to the magnetic attraction between magnetic ways.

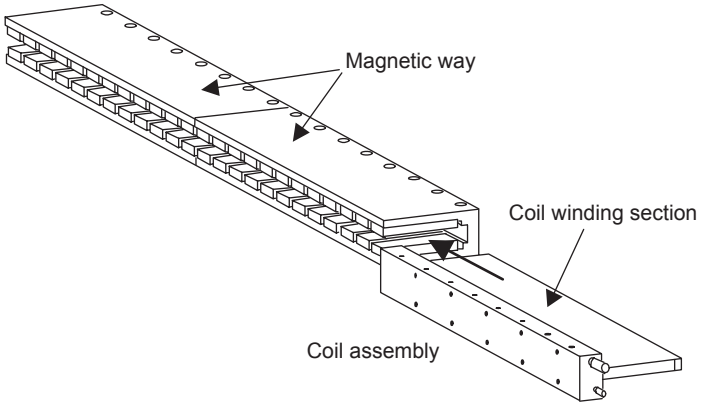


(2) Coil Assembly Installation

The coil assembly of SGLGW linear servomotor is constructed of an aluminum base and a resin-coated coil winding section. Handle the coil assembly with care and do not subject the coil winding section to shock. Doing so may cause injury or damage to the coil assembly.

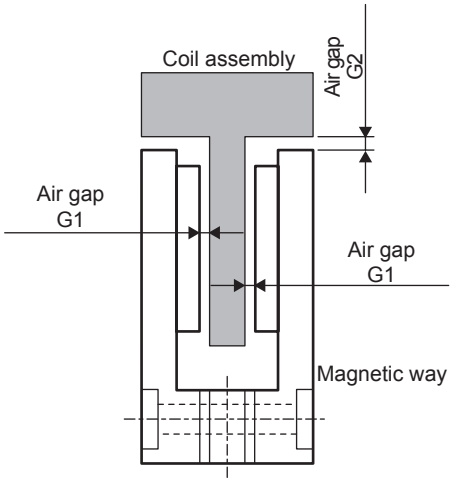
Use the following procedure to install the coil assembly of SGLGW linear servomotor.

1. Insert the coil winding section of the coil assembly between the magnets of the magnetic way that has already been installed. Next, install the movable table supported by the coil assembly's linear guide. Make sure that the air gap between the coil assembly's coil winding section and magnetic way magnets is the specified distance.



The relationship between the dimensions and positioning between the coil assembly's coil winding section and magnetic way's magnets is shown here.
Maintain the following air gaps when installing. Make sure that the coil assembly and magnetic way do not interfere during the stroke.

Coil Assembly Model SGLGW-	Dimensions in mm (in)	
	Air gap G1	Air gap G2
30A050□□	0.85 ± 0.3 (0.03 ± 0.01)	1 ± 0.3 (0.04 ± 0.01)
30A080□□	0.95 ± 0.3 (0.03 ± 0.01)	1 ± 0.3 (0.04 ± 0.01)
40A□□□□□	0.8 ± 0.3 (0.03 ± 0.01)	1 ± 0.3 (0.04 ± 0.01)
60A□□□□□	0.8 ± 0.3 (0.03 ± 0.01)	1 ± 0.3 (0.04 ± 0.01)
90A□□□□□	1.1 ± 0.3 (0.04 ± 0.01)	2 ± 0.3 (0.08 ± 0.01)



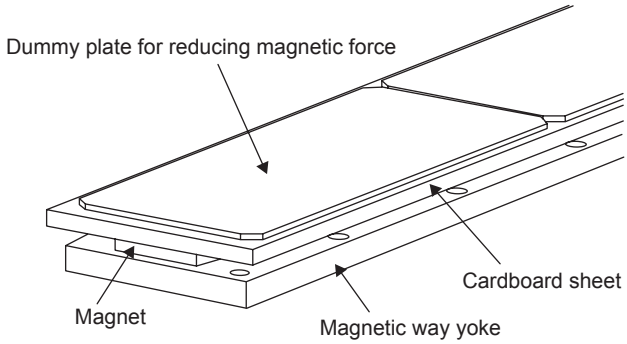
2. Move the coil assembly back and forth several times over the magnetic way from end to end, making sure that the coil assembly and magnetic way are not touching each other and that no foreign objects such as magnetic particles are present.

7.1.3 SGLFW and SGLFM Linear Servomotor (F-shaped with Core)

(1) Magnetic Way Installation

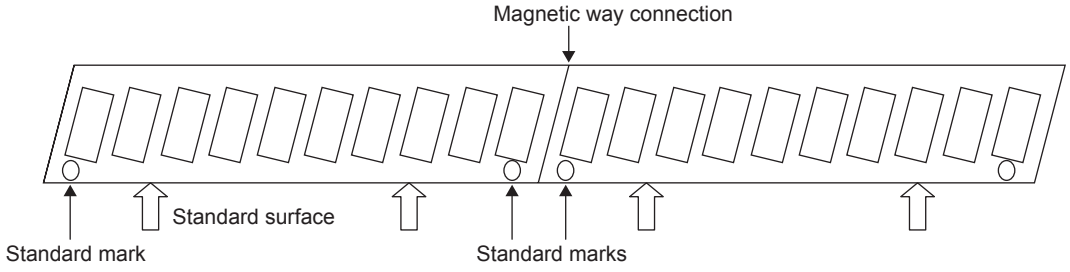
The SGLFM magnetic way is packed with a cardboard sheet covering the magnetic surface, above which is a thin, rectangular steel plate.

The steel plate is a dummy plate used to reduce the influence of magnetic force on the surrounding environment. When removing the plate, make sure that fingers are kept clear and that the magnet and magnet protection cover are not damaged.



Use the following procedure to install the SGLFM magnetic way.

1. Remove the dummy plate used to reduce magnetic force and the cardboard sheet from the magnetic way's front panel.
2. Align the side of the magnetic way with standard marks (approx. 4-mm dia. indentations) with the standard surface of the machine base, keeping fingers clear to prevent being jammed.



3. While pressing the magnetic way down closely onto the machine's standard surface, secure with bolts.

Magnetic Way Model SGLFM-	Bolt size	Tightening torque (N•cm)
20□□□□	M4	360 to 500
35□□□□		
50□□□□	M5	720 to 1010
1Z□□□□	M6	1220 to 1710

Note: Use hexagonal socket head bolts (tensile strength Class 10.9)

INFO

The magnetic way's magnets exert strong magnetic attraction. Make sure that any steel bolts or wrenches being used are kept away from the magnets. Always use bolts with a head height according to the dimensions shown in the following table.

Magnetic Way Model SGLFM-	Bolt size	Head height K is mm (in)	Reference
20□□□□	M4	4.2 (0.17) max.	Fig. 1
35□□□□			
50□□□□	M5	5.2 (0.20) max.	
1Z□□□□	M6	6.7 (0.26) max.	Fig. 2

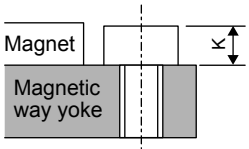


Fig. 1

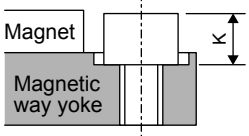
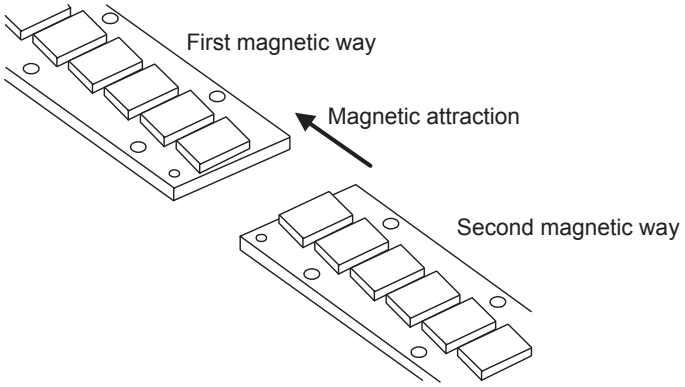


Fig. 2

4. When joining magnetic ways together, place the second magnetic way temporarily in line with and at least 30 mm apart from the first magnetic way. Next, match the direction of the magnetic ways (standard mark: Approx. 4-mm dia. indentation). (Refer to the diagrams in step 2.) Next, while holding the magnetic ways down so that they are not raised, push the second magnetic way against the first magnetic way and secure with bolts. Keep fingers clear to prevent them being jammed between the magnetic way due to the magnetic attraction pulling the magnetic ways together.



INFO

Before installing additional magnetic ways, install the coil assembly. For details, refer to *(2) Coil Assembly Installation*.

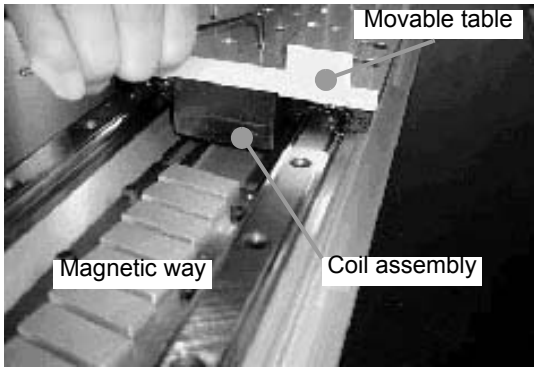
(2) Coil Assembly Installation

The SGLFW coil assembly is constructed of an aluminum or steel base and iron core, with a resin-coated coil winding section. Make sure that the coil winding section is not subjected to shock during installation. Shock may cause injury or damage to the coil assembly.

Use the following procedure to install the SGLFW coil assembly.

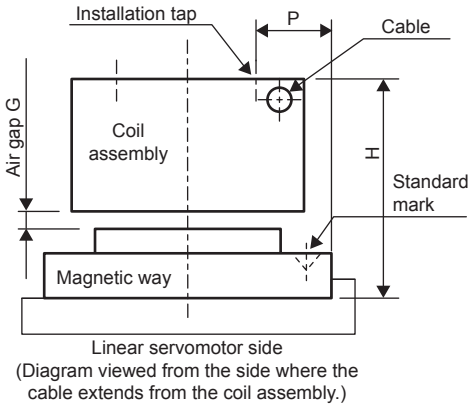
1. Install the coil assembly on the movable table supported by the linear guide in line with the previously installed magnetic way.

   Make sure that the air gap between the coil assembly and magnetic way magnets is the specified distance.



   Maintain the following air gaps when installing. Make sure that the coil assembly and magnetic way do not interfere during the stroke.

Coil Assembly Model SGLFW-	Dimensions is mm (in)		
	H	P	Air gap G
20□□□□□□	45 ± 0.1 (1.77 ± 0.004)	22 ± 0.2 (0.87 ± 0.004)	1 ± 0.3 (0.04 ± 0.01) (0.8 (0.03)) *
35□□□□□□		21 ± 0.2 (0.83 ± 0.004)	
50□□□□□□	58 ± 0.1 (2.28 ± 0.004)	25.8 ± 0.2 (1.02 ± 0.004)	
1Z□□□□□□		27 ± 0.2 (1.06 ± 0.004)	

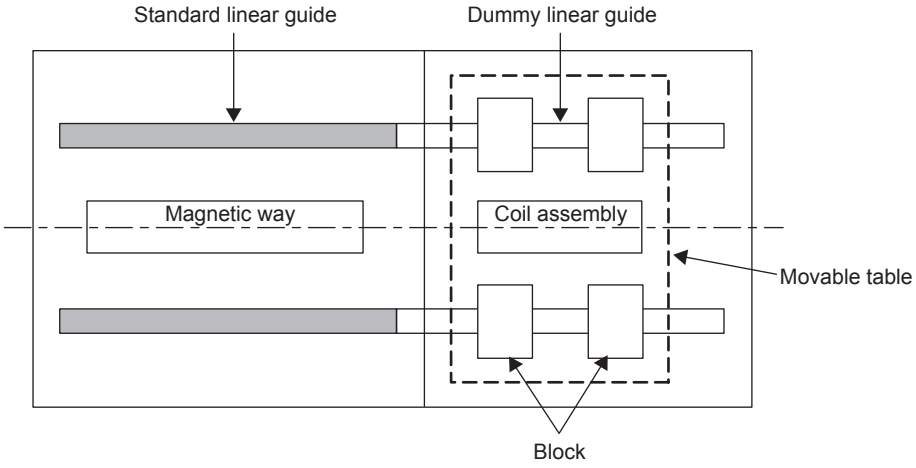


* The value in parentheses is the dimension when the magnet protection cover is used.

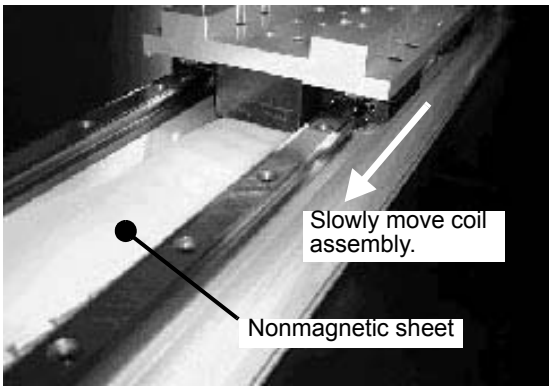
IMPORTANT

When two or more magnetic ways are used, first secure one of the magnetic ways only, and then install the coil assembly in the available space. If using one magnetic way only with insufficient space to extend the linear guide up to the position of the coil assembly, temporarily mount a dummy linear guide in line with the magnetic way's.

- Simplified diagram showing installation of dummy linear guide.



2. Insert a thin nonmagnetic (preferably resin) sheet (approximately 0.5-mm thick) in the air gap between the coil assembly and magnetic way, and move the coil assembly toward the magnetic way.



IMPORTANT

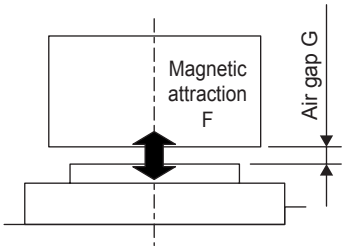
Make sure that hands or tools are not jammed due to the magnetic attraction from the magnetic way when the coil assembly approaches the end of the magnetic way. When the air gap between the coil assembly and the magnetic way is fixed, the nonmagnetic sheet is not required. (Refer to the table of dimensions in step 1.)

3. Move the coil assembly back and forth several times over the magnetic way from end to end, making sure that the coil assembly is not touching the magnetic way and that no foreign objects (such as magnetic particles) are present. Use a nonmagnetic (brass or stainless steel) gap gauge to check that the air gap between the coil assembly and the magnetic way is even.

(3) Magnetic Attraction

The linear servomotor is constructed of an opposing coil assembly and magnetic way. Therefore, the coil assembly is subject to magnetic attraction as shown in the following table (calculated values). Consider the magnetic attraction when designing the device.

Coil Assembly Model SGLFW-	Air gap G*1 is mm (in)	Magnetic attraction F*2 (N)
20A090A□	0.7 (0.03)	410
20A120A□		600
35□120A□		1100
35□230A□		2100
50□200B□		2700
50□380B□		5200
1Z□200B□		5300
1Z□380B□		10400



* 1. Indicates an air gap value of -0.3 mm (-0.012 in) relative to the design value.
* 2. Indicates the magnetic attraction for the maximum force.

7.1.4 SGLTW and SGLTM Linear Servomotor (T Type with Iron Core)

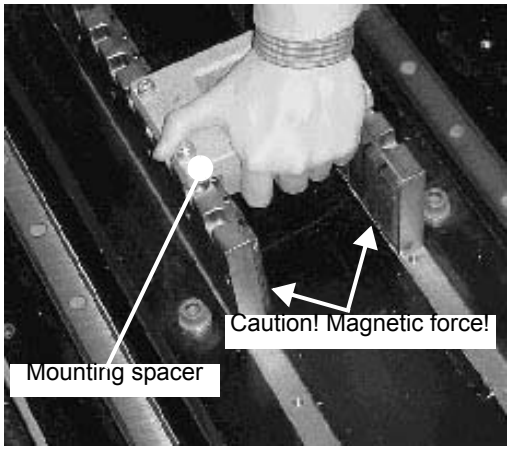
(1) Magnetic Way Installation

The SGLTM magnetic way is packaged with two magnetic way yokes secured with aluminum mounting spacers.

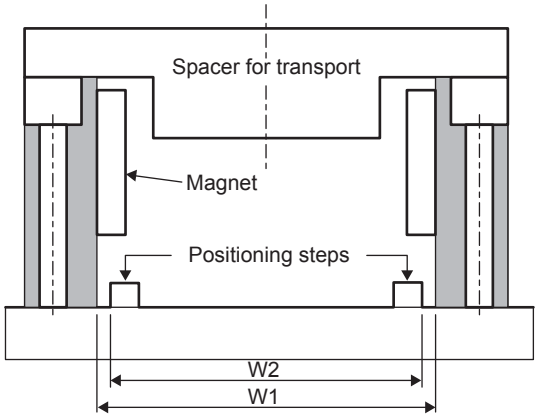
IMPORTANT Do not remove the installation spacers until the magnetic way is temporarily fixed to the device.

Use the following procedure to install the SGLTM magnetic way.

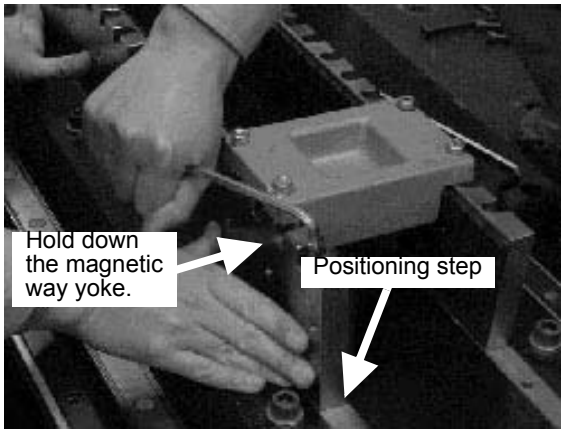
1. With the mounting spacers attached, place the magnetic way on both positioning steps. Make sure that the machine and magnetic way are not scratched or dented when positioning the magnetic way. Set the dimensions of these positioning steps to match the W2 dimensions in the following table.



Magnetic Way Model SGLTM-	Dimensions in mm (in)	
	W1 (Dimensions at shipment)	W2 (Recommended machine base value)
20□□□□	71.5 ± 1 (2.81 ± 0.04)	70 ± 0.15 (2.76 ± 0.01)
35□□□□		
40□□□□	113 ± 1 (4.45 ± 0.04)	111.8 ± 0.15 (4.40 ± 0.01)
80□□□□		
35□□□H	91.5 ± 1 (3.60 ± 0.04)	90 ± 0.15 (3.54 ± 0.01)
50□□□H		



2. Insert the mounting bolts into one side of the magnetic way yoke and tighten lightly by hand. Next, while firmly holding down the magnetic way yoke onto the positioning step, tighten the bolts firmly.



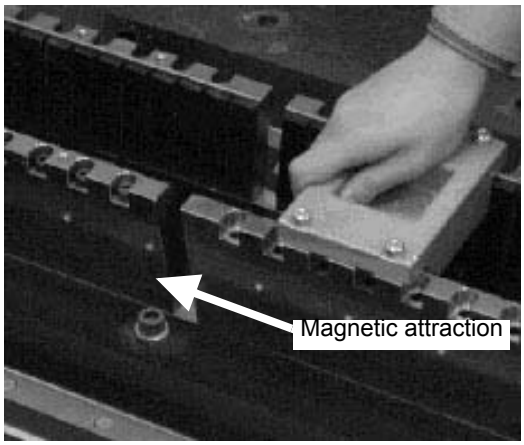
Magnetic Way Model SGLTM-	Bolt size	Tightening torque (N•cm)
20□□□□	M6	1220 to 1710
35□□□□		
40□□□□	M8	2970 to 4150
80□□□□		
35□□□H	M6	1220 to 1710
50□□□H		

Note: The following conditions apply to these values.

- Machine material: Steel
- Hexagonal socket head bolts (tensile strength Class 10.9)

3. After removing the mounting spacer bolts on the side of the magnetic way yoke installed first, firmly hold down the other magnetic way yoke onto the positioning step, while tightening the bolts firmly. Make sure that the magnetic way yoke does not slip into the path of the coil assembly.
4. Fully remove the spacer used for transport. If the bolt holes used for mounting the magnetic way are in the position where the mounting spacer was mounted, tighten the bolts at these locations.
5. When joining magnetic ways together, place the second magnetic way temporarily in line with and at least 30 mm apart from the first magnetic way. Next, while pushing the second magnetic way against the first magnetic way, secure with bolts. Keep fingers clear to prevent them being jammed between the magnetic ways due to the magnetic attraction pulling the magnetic ways together.

   Follow the same procedure as in steps 1 to 4 to install the second and subsequent magnetic ways.



INFO

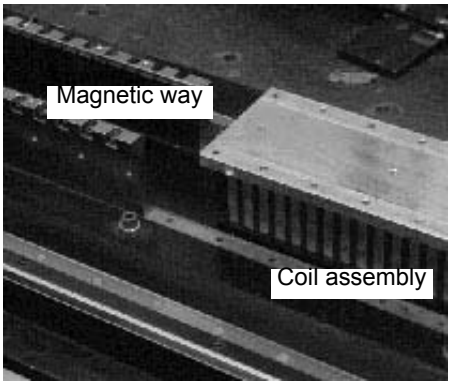
For safety, install the coil assembly before installing the second or subsequent magnetic way. Refer to *(2) Coil Assembly Installation* for details.

(2) Coil Assembly Installation

The SGLTW coil assembly is constructed of an aluminum or steel base and iron core, with a resin-coated coil winding section. Make sure that the coil winding section is not subjected to shock during installation. Shock may damage the coil assembly.

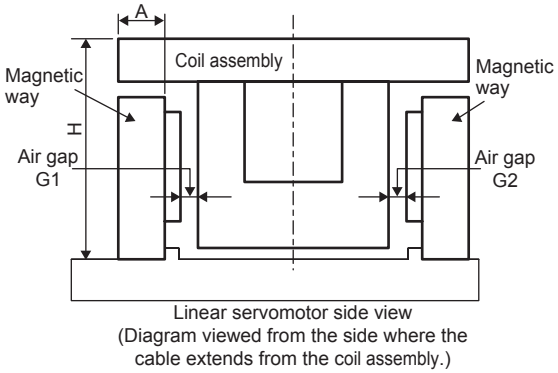
Use the following procedure to install the SGLTW coil assembly.

1. Install the coil assembly on the movable table supported by the linear guide in line with the previously installed magnetic way.



The relationship between the dimensions and positioning between the coil assembly and magnetic way is shown here.
Maintain the following air gaps when installing. Make sure that the coil assembly and magnetic way do not intervene during the stroke.

Coil Assembly Model SGLTW-	Dimensions in mm (in)		
	H	A	Air gaps G1,G2
20A□□□A□	55 ± 0.3 (2.17 ± 0.01)	15 ± 0.1 (0.59 ± 0.004)	1 ± 0.3 (0.04 ± 0.01) (0.8 (0.03)) *
35□□□□A□	70 ± 0.3 (2.76 ± 0.01)		
40□□□□A□	83 ± 0.3 (3.27 ± 0.01)	19.1 ± 0.1 (0.75 ± 0.004)	1.4 ± 0.3 (0.06 ± 0.01) (1.2 (0.05)) *
80□□□□A□			
35□□□□H□	70 ± 0.3 (2.76 ± 0.01)	15 ± 0.1 (0.59 ± 0.004)	1 ± 0.3 (0.04 ± 0.01) (0.8 (0.03)) *
50□□□□H□	85 ± 0.3 (3.35 ± 0.01)	19.1 ± 0.1 (0.75 ± 0.004)	



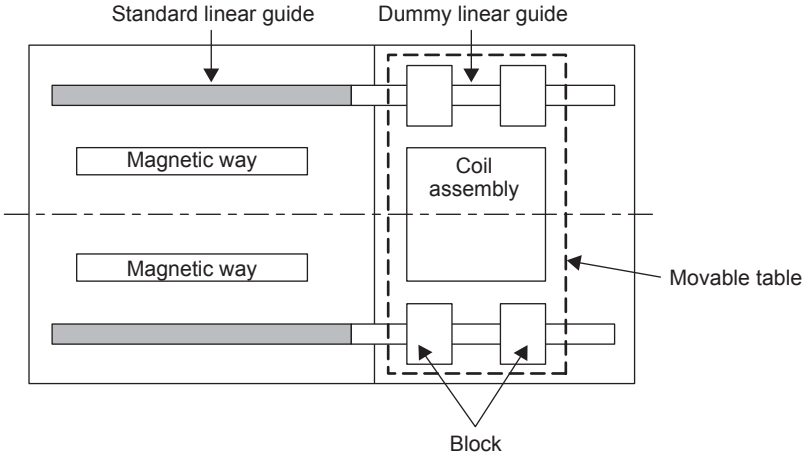
Linear servomotor side view
(Diagram viewed from the side where the cable extends from the coil assembly.)

* The value in parentheses is the dimension when the magnet protection cover is used.

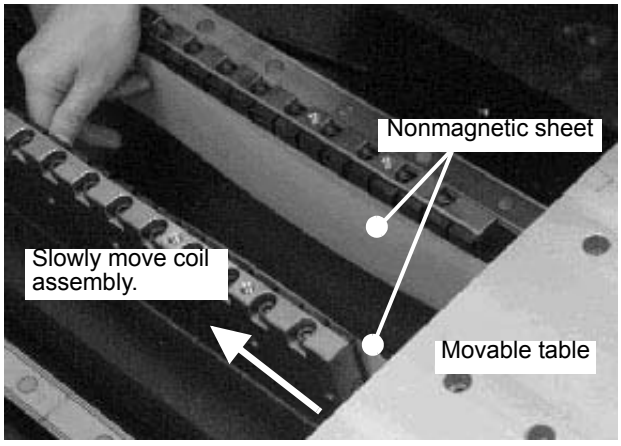
IMPORTANT

When two or more magnetic way are used, first secure one of the magnetic way only, and then install the coil assembly in the available space. If using one magnetic way only with insufficient space to extend the linear guide up to the position of the coil assembly, temporarily mount a dummy linear guide in line with the magnetic way's.

- Simplified diagram showing installation of dummy linear guide.



2. Insert a thin nonmagnetic (preferably resin) sheet (approximately 0.5-mm thick) in the air gap between the coil assembly and magnetic way, and move the coil assembly slowly toward the magnetic way.



INFO

Make sure that hands or tools are not jammed or caught due to the attraction of the magnetic way when the coil assembly approaches the end of the magnetic way. When the air gap between the coil assembly and the magnetic way is fixed, the nonmagnetic sheet is not required. (Refer to the table of dimensions in step 1.)

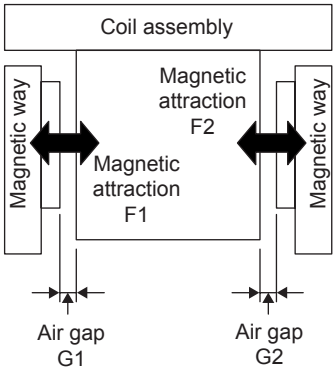
3. Move the coil assembly back and forth several times over the magnetic way from end to end, making sure that the coil assembly is not touching the magnetic way and that no foreign objects (such as magnetic particles) are present. Use a nonmagnetic (brass or stainless steel) gap gauge to check that the air gap between the coil assembly and the magnetic way is even (estimated gap: ±0.3 mm (0.012 in)).

(3) Magnetic Attraction

The linear servomotor is constructed of an opposing coil assembly and magnetic way. Therefore, magnetic attraction is offset when the air gap between the coil assembly and both magnetic ways is even.

However, achieving an even air gap is difficult due to the accuracy of the linear servomotor itself and the device, and error in the assembly of the linear servomotor at installation. Consider the magnetic attraction values shown in the following table when designing the device to account for the effect of magnetic attraction (calculated values).

Coil Assembly Model SGLTW-	Air gap G1*1 in mm (in)	Air gap G2*1 in mm (in)	Magnetic attraction F1*2 (N)	Magnetic attraction F2*2 (N)	Attraction difference ΔF (N)
20A170A□	1.3 (0.05)	0.7 (0.03)	760	1030	270
20A320A□			1510	2040	530
20A460A□			2260	3050	790
35A170A□	1.3 (0.05)	0.7 (0.03)	1330	1800	470
35□170H□					
35A320A□			2650	3570	920
35□320H□					
35□460A□			4000	5400	1400
40□400B□	1.7 (0.07)	1.1 (0.04)	4700	5900	1200
40□600B□			7000	8700	1700
50□170H□	1.3 (0.05)	0.7 (0.03)	1990	2600	700
50□320H□			3750	5100	1350
80□400B□	1.7 (0.07)	1.1 (0.04)	9200	11400	2200
80□600B□			13600	16900	3300



* 1. Indicates an air gap value when one side is +0.3 mm (0.012 in) and the other side is –0.3 mm (–0.012 in) relative to the design values.
* 2. Indicates the magnetic attraction at maximum force.

7.2 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 (11.81 in).
  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 (118.11 in) for reference input lines and is 20 m (787.40 in) 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. Do not turn the power ON or OFF more than once per minute.
  Since the SERVOPACK has a capacitor in the power supply, a high charging current flows for 0.2 seconds when 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.

7.2.1 Names and Functions of Main Circuit Terminals

Terminal Symbol	Name	Main Circuit Voltage (V)	Maximum Applicable Servomotor Capacity (kW)	Functions
L1, L2	Main circuit power supply input terminal	200	0.05 to 0.4	Single-phase 200 to 230 VAC$^{+10\%,-15\%}$ (50/60 Hz) *
L1, L2, L3		200	0.5 to 7.5	Three-phase 200 to 230 VAC$^{+10\%,-15\%}$ (50/60 H) *
		400	0.5 to 7.5	Three-phase 380 to 480VAC$^{+10\%,-15\%}$ (50/60 Hz) *
U, V, W	Servomotor connection terminals	–	–	Connects to the servomotor.
L1C, L2C	Control circuit power supply input terminal	200	0.05 to 7.5	Single-phase 200 to 230 VAC$^{+10\%,-15\%}$ (50/60 Hz) *
24V, C0V		400	0.5 to 7.5	24 VDC (±15%)
⏚	Ground terminals	–	–	Connects to the power supply ground terminals and servomotor ground terminal.
B1, B2	External regenerative resistor connection terminal	200	0.05 to 0.4	Normally not connected. Connect an external regenerative resistor (provided by customer) between B1 and B2 if the regenerative capacity is insufficient.
B1, B2, B3		200	0.5 to 5.0	Normally short B2 and B3 (for an internal regenerative resistor). Remove the wire between B2 and B3 and connect an external regenerative resistor (provided by customer) between B1 and B2 if the capacity of the internal regenerative resistor is insufficient.
		400	0.5 to 5.0	
B1, B2		200	7.5	Connect an external regenerative resistor (provided by customer) between B1 and B2. Refer to *7.6 Connecting Regenerative Resistors* for details.
		400	7.5	

* If using the main circuit power supply and the control power supply with DC power supply input, refer to *7.2.3 Typical Main Circuit Wiring Examples (4) DC Power Supply Input* for more information on wiring.

(cont'd)

Terminal Symbol	Name	Main Circuit Voltage (V)	Maximum Applicable Servomotor Capacity (kW)	Functions
⊕1, ⊕2	DC reactor for harmonic suppression terminal	200	0.05 to 5.0	Normally short ⊕1 and ⊕2 . If a countermeasure against power supply harmonic waves is needed, connect a DC reactor between ⊕1 and ⊕2.
		400	0.5 to 7.5	
		200	7.5	These terminals do not exist.
⊕	Main circuit plus terminal	200	7.5	Normally not connected. Note: This terminal is on the SERVOPACK with a capacity of 7.5 kW only.
⊖	Main circuit minus terminal	–	–	Normally not connected.

7.2.2 Wiring Main Circuit Power Supply Connector (Spring Type)

⚠ CAUTION

- Observe the following precautions when wiring main circuit connector.
  - Remove the connector from the SERVOPACK prior to wiring.
  - Insert only one wire per terminal on the connector.
  - Make sure that the core wire is not electrically shorted to adjacent core wires.

SERVOPACKs with a capacity below 1.5 kW have a removable connector for the main circuit power supply or the control power supply terminal. Use the following procedure when connecting the SERVOPACK to the connector.

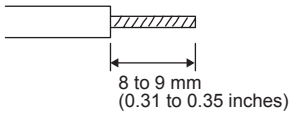
(1) Wire Size

Wire can be used simply by stripping back the outer coating. The following is applicable wire sizes.

- Single wire: ϕ0.5 to ϕ1.6 mm
- Braided wire: AWG28 to AWG12

(2) Connection Procedure

1. Strip the end of the wire.



2. Open the wire terminal on the power supply connector housing (plug) with the tool using the procedure shown in Fig. A or B.
   - Insert the connection hook end of the provided tool into the slot as shown in Fig. A.
   - Use a standard flat-blade screwdriver (blade width of 3.0 to 3.5 mm (0.12 to 0.14 in)) or type 54932-0000 manufactured by Molex Japan Co., Ltd. Put the blade into the slot, as shown in Fig. B, and press down firmly to open the wire terminal.

   Either the procedure shown in Fig. A or B can be used to open the wire insert opening.

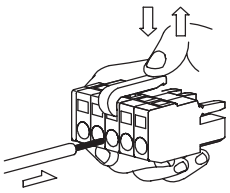


Fig. A

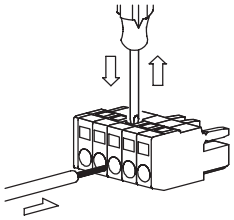


Fig. B

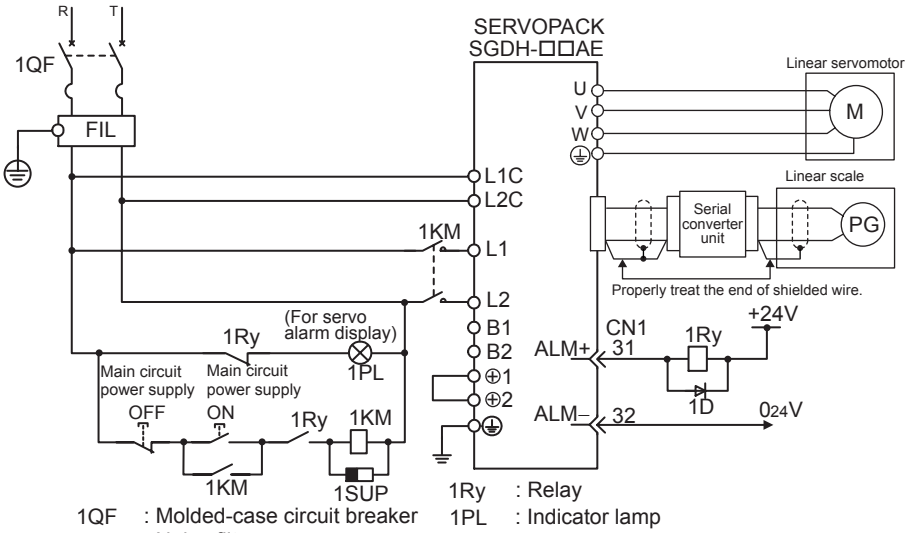
3. Insert the wire core into the opening and then close the opening by releasing the lever connection or removing the screwdriver.

INFO

The terminal block for SERVOPACK SGDH-□DE for 400 V 500 W to 1.5 kW, has an indication "300 V, 15 A". This is a rating recognition of UL authorization, which means that the terminal blocks are authorized for "limited rating for industrial use" and applicable up to 600 V. Accordingly, these terminal blocks are applicable for 400 V SERVOPACK.

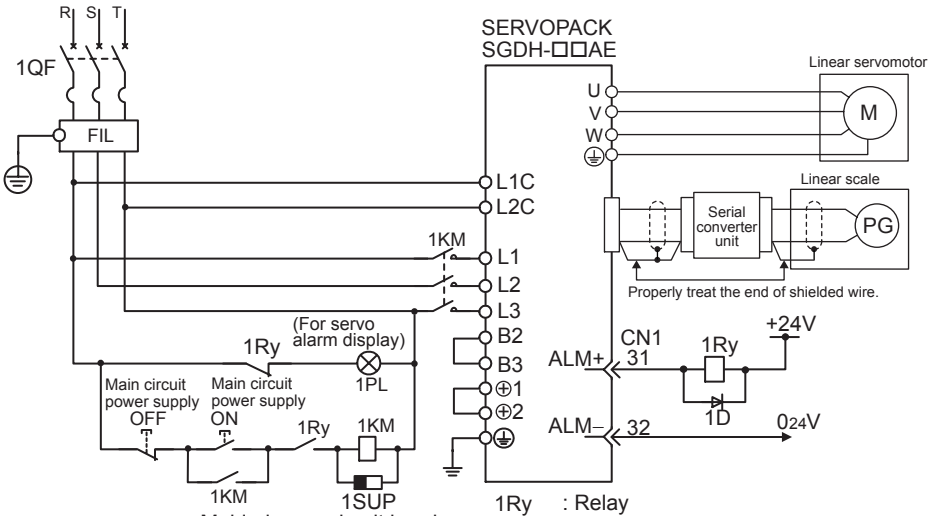
7.2.3 Typical Main Circuit Wiring Examples

(1) Single-phase, 200 V



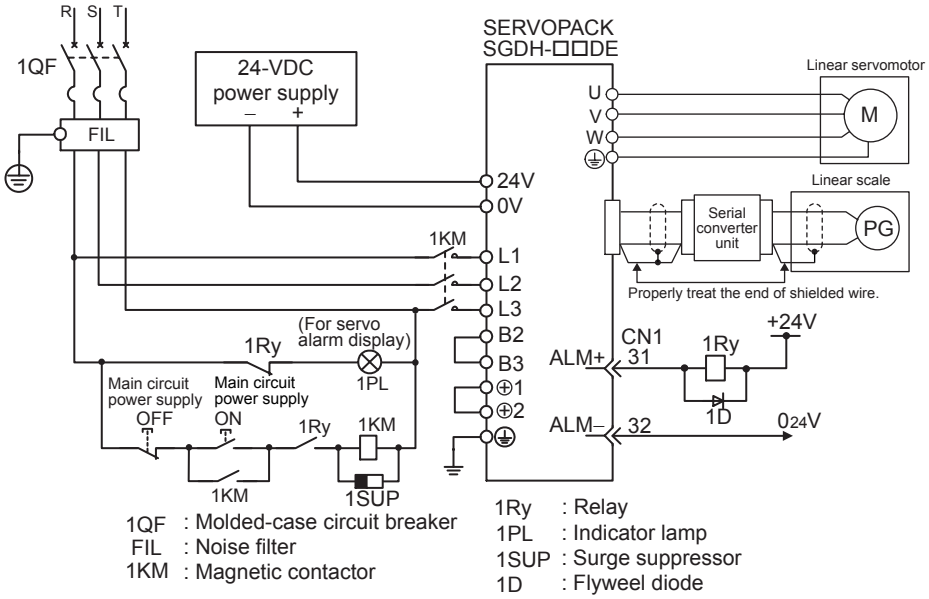
1QF : Molded-case circuit breaker
FIL : Noise filter
1KM : Magnetic contactor
1Ry : Relay
1PL : Indicator lamp
1SUP : Surge suppressor
1D : Flyweel diode

(2) Three-phase, 200 V



1QF : Molded-case circuit breaker
FIL : Noise filter
1KM : Magnetic contactor
1Ry : Relay
1PL : Indicator lamp
1SUP : Surge suppressor
1D : Flyweel diode

(3) Three-phase 400 V

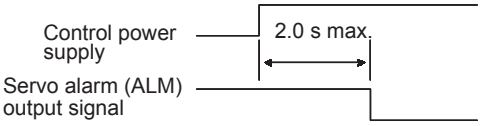


IMPORTANT

■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.
- When designing the power ON sequence, note that the SERVOPACK will output (1Ry is OFF) a servo alarm signal for two seconds or less when the control power is turned ON. And, use this relay to turn OFF the main power supply to the SERVOPACK.



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

■Harmonic Suppression

If another device requires for harmonic suppression, connect the DC reactor to the DC main circuit side on the SERVOPACK. For connecting examples, refer to *7.5.5 DC Reactor for Harmonic Suppression*.

(4) DC Power Supply Input

⚠ WARNING

- SGDH SERVOPACK is applicable for both AC and DC power supply input.
  However, if the DC power supply input supplies a voltage without setting '1' (for DC power supply input) in the parameter Pn001.2, the SERVOPACK's internal elements will burn and may cause fire or malfunction.
  When using the SERVOPACK with DC power supply input, confirm the following setting of parameters.

When using the SGDH SERVOPACK with DC power supply input, use the following power supply and set the parameter Pn001.2 to 1. Also, read carefully to the following 'Important' section.

IMPORTANT

1. Servomotor returns the regenerative energy to the power supply when regenerating. SERVOPACK does not regenerate with DC power supply input specifications, so regenerate the energy on the power supply side.
2. Take appropriate measures to ensure that a high charging current stays inside the SERVOPACK when power is OFF.

(a) Main Circuit and Control Power Supply Input

The following shows the connection for the main power supply and the control power supply.

Terminal Symbol	Name	Main Circuit Power Supply Voltage when AC Power Supply input	Functions
⊕1 or ⊕	Main circuit plus terminal	AC200V (SGDH-**AE)	270 to 310 VDC
		AC400V (SGDH-**DE)	513 to 648 VDC
⊖	Main circuit minus terminal	Common to all models	0 V
L1C, L2C	Control power supply input terminal	AC200V (SGDH-**AE)	Single-phase 200 to 230 VAC +10%, -15% (50/60Hz) or 270 to 310 VDC, without polarity
24V, 0V		AC400V (SGDH-**DE)	24VDC (±15%)

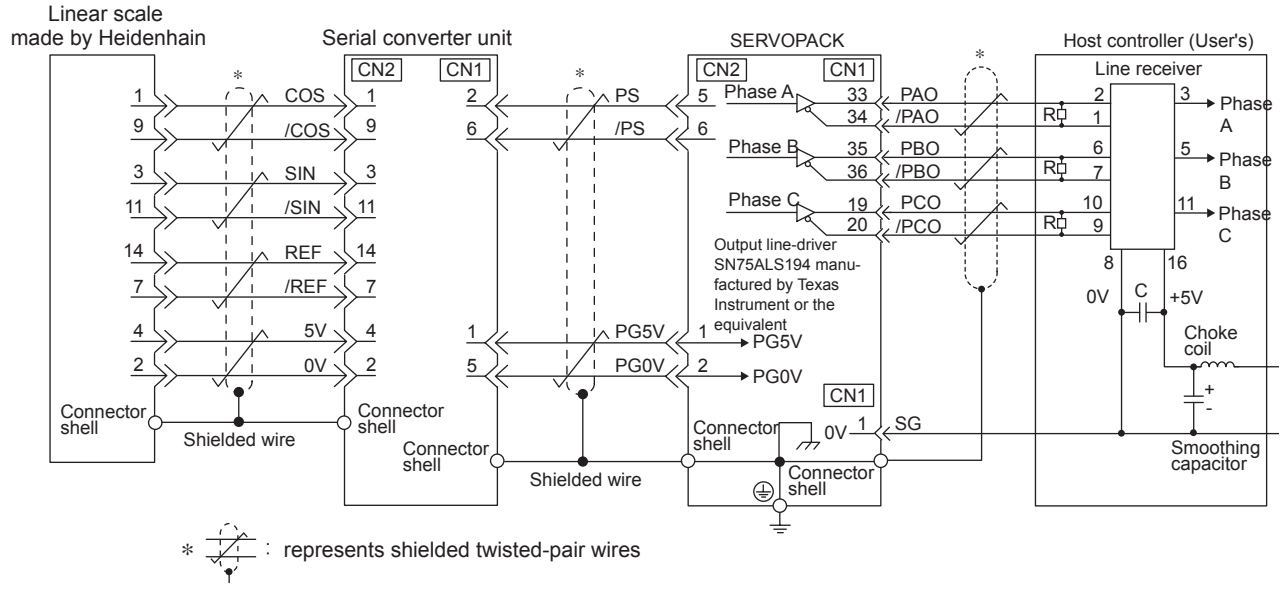
(b) Setting Parameters

Parameter		Meaning
Pn001	n.□0□□	Not applicable for DC power supply input: Input the AC power supply for the terminal L1, L2 or L3.
	n.□1□□	Applicable for DC power supply input: Input the DC power supply between the terminal ⊖ and the terminal ⊕1, or the terminal ⊖ and the terminal ⊕.
• When changing the parameters, turn the power ON again for the necessity of the effective setting.		

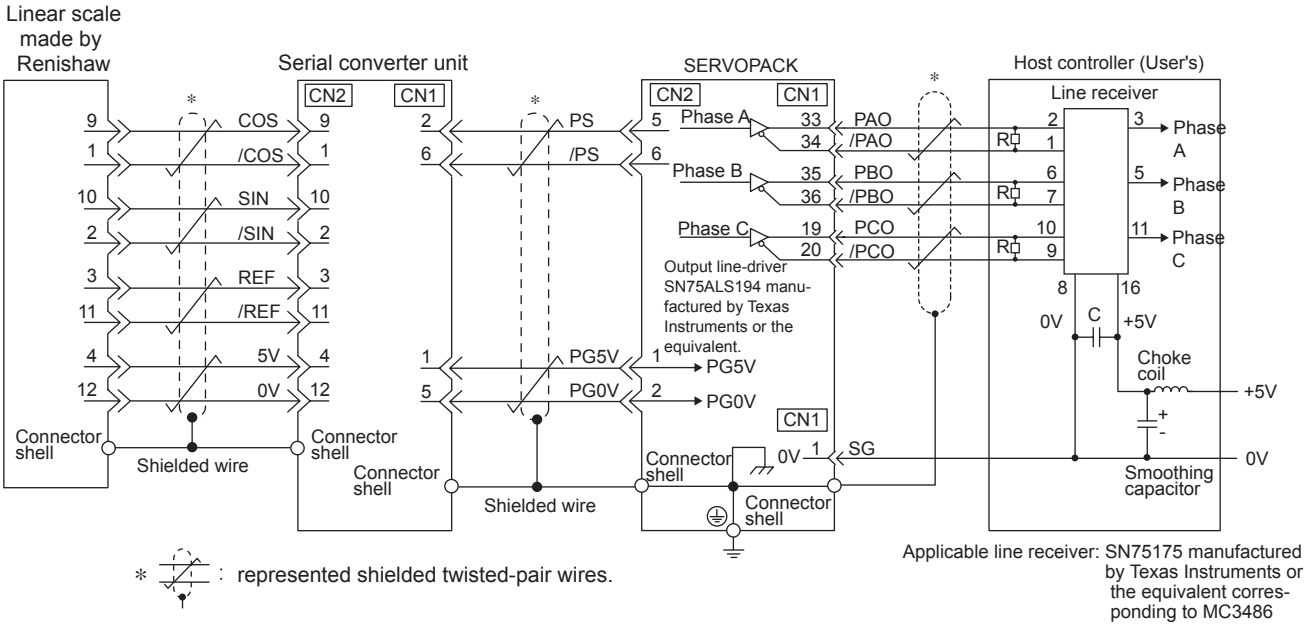
7.3 Wiring Encoders

7.3.1 Connecting an Encoder (CN2) and Output Signals from the SERVOPACK

(1) Connecting a Linear Scale Made by Heidenhain



(2) Connecting a Linear Scale Made by Renishaw

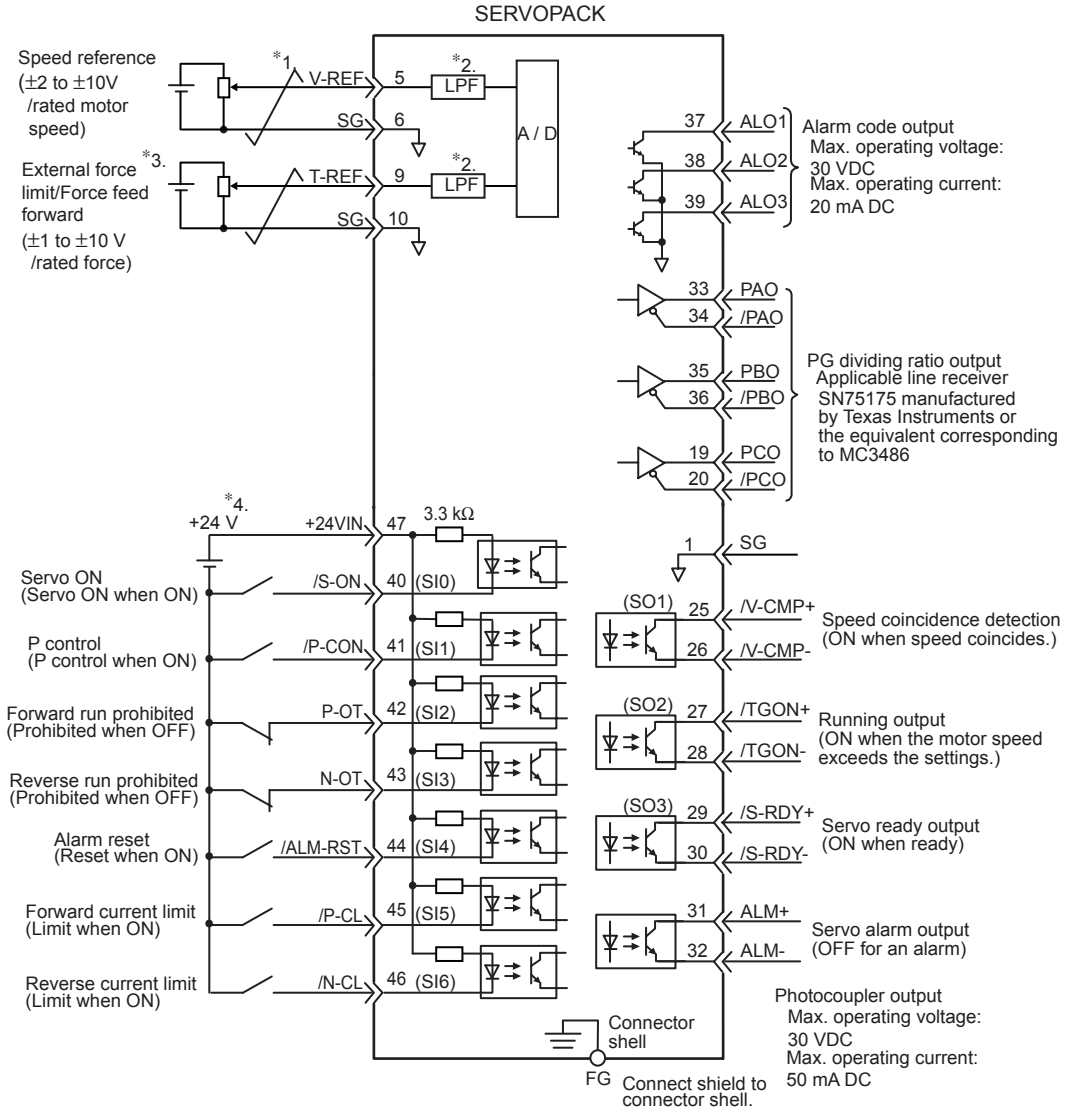


7.3.2 Encoder Connector (CN2) Terminal Layout

1	PG5V	PG power supply +5 V	2	PG 0 V	PG power supply 0 V
3	–	–	4	–	–
5	PS	PG serial signal input	6	/PS	PG serial signal input
SHELL	Shield	–	–	–	–

7.4 Examples of I/O Signal Connections

7.4.1 Speed Control Mode



* 1. represents twisted-pair wires.

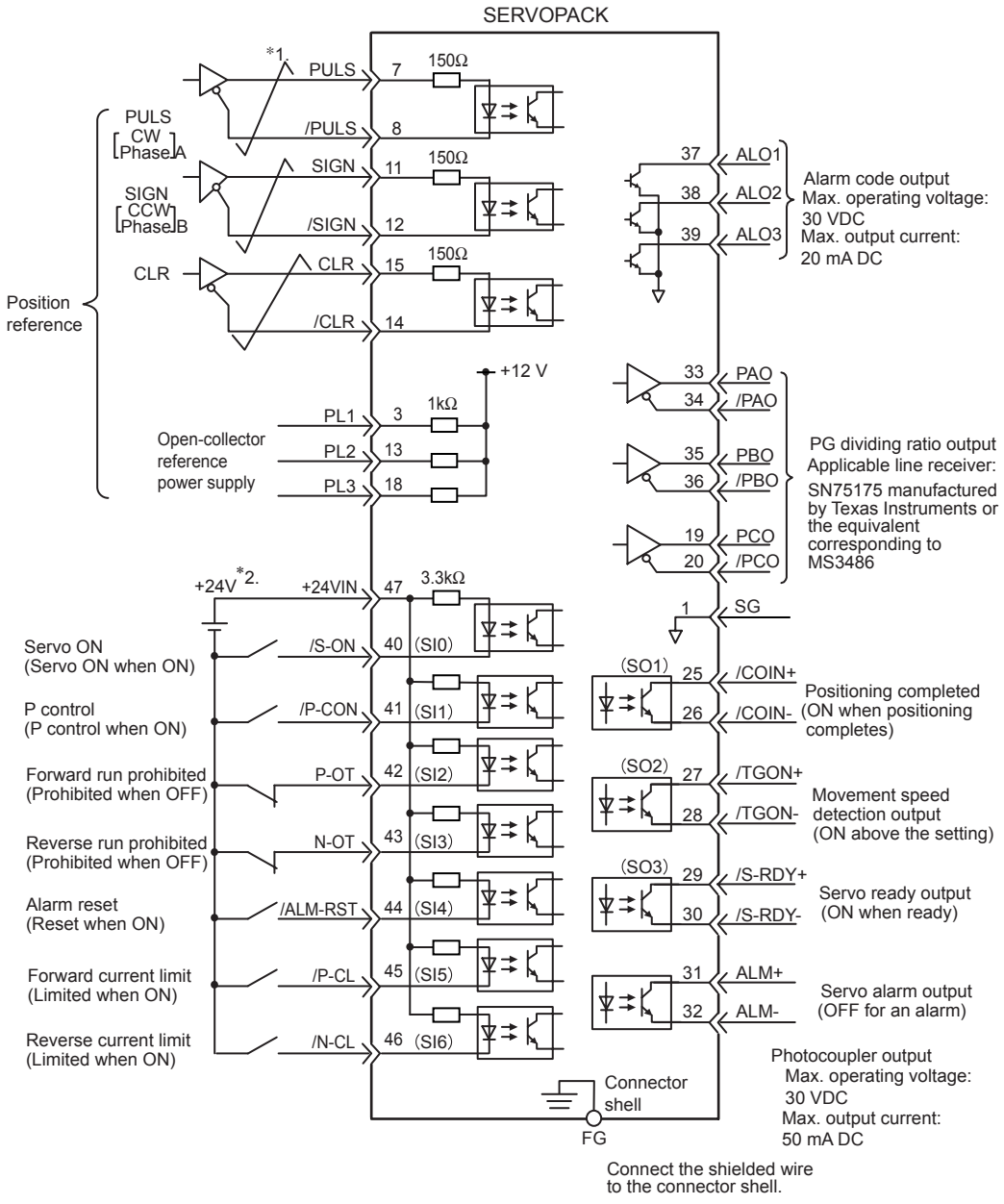
* 2. The time constant for the primary filter is 47 μs.

* 3. Enabled by the parameter setting.

* 4. Customers must purchase a 24 VDC power supply with double-shielded enclosure.

Note: The functions allocated to the input signals SI0 to SI6 and the output signals SO1 to SO3 can be changed by using the parameters. Refer to *8.3.2 Input Circuit Signal Allocation* and *8.3.3 Output Circuit Signal Allocation*.

7.4.2 Position Control Mode

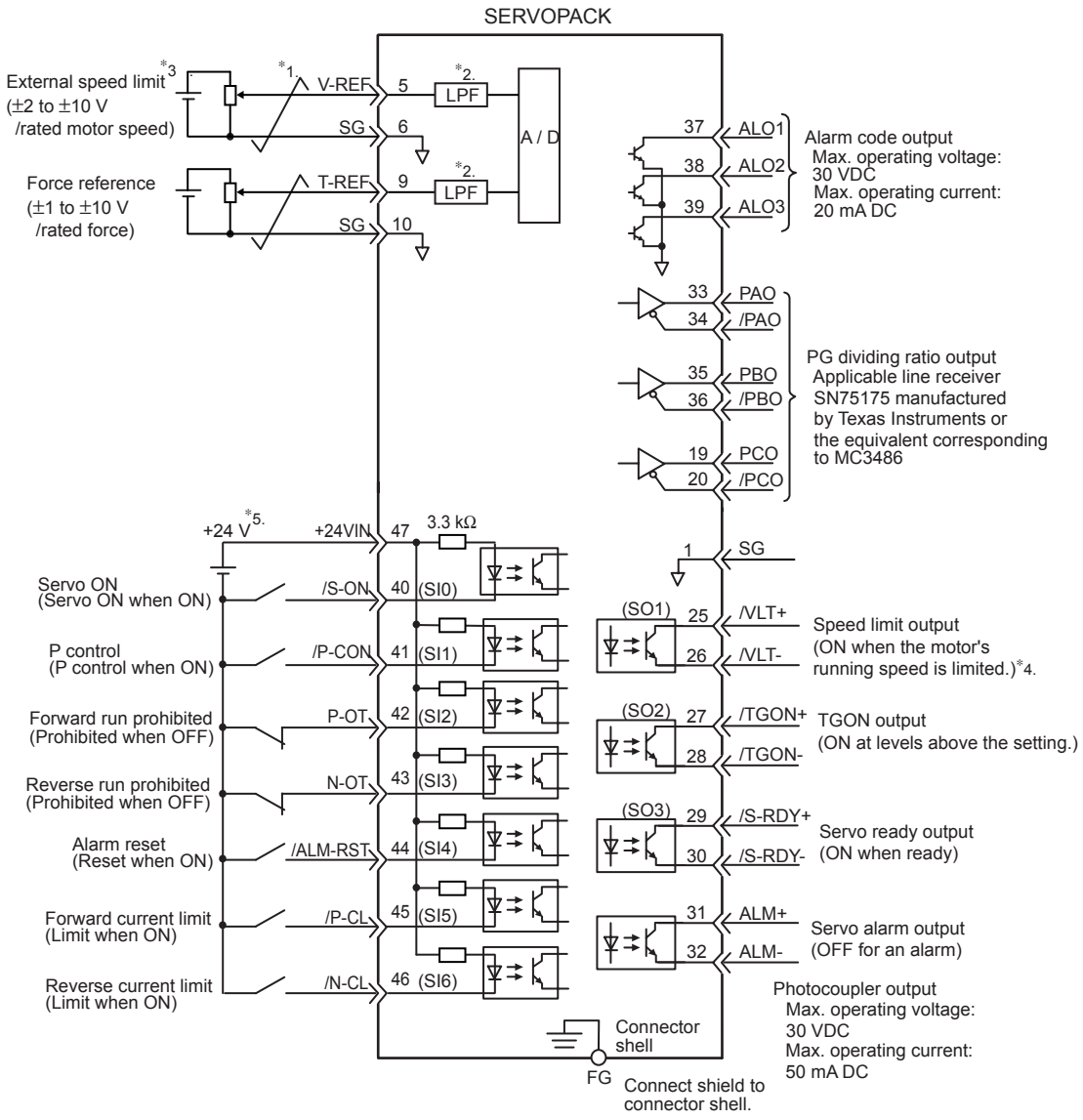


* 1. : represents twisted-pair wires.

* 2. Customers must purchase a 24 VDC power supply with double-shielded enclosure.

Note: The functions allocated to the input signals SI0 to SI6 and the output signals SO1 to SO3 can be changed by using the parameters. Refer to *8.3.2 Input Circuit Signal Allocation* and *8.3.3 Output Circuit Signal Allocation*.

7.4.3 Force Control Mode



* 1. : represents twisted-pair wires.
* 2. The time constant for the primary filter is 47 μs.
* 3. Enabled by the parameter setting.
* 4. Enabled by the parameter setting.
* 5. Customers must purchase a 24 VDC power supply with double-shielded enclosure.

Note: The functions allocated to the input signals SI0 to SI6 and the output signals SO1 to SO3 can be changed by using the parameters. Refer to *8.3.2 Input Circuit Signal Allocation* and *8.3.3 Output Circuit Signal Allocation*.

7.4.4 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
2	SG	GND
4	–	–
6	SG	GND
8	/PULS	Reference pulse input
10	SG	GND
12	/SIGN	Reference sign input
14	/CLR	Clear input
16	–	–
18	PL3	Open-collector reference power supply
20	/PCO	PG dividing pulse output Phase C
22	–	–
24	–	–

1	SG	GND
3	PL1	Open-collector reference power supply
5	V-REF	Speed reference input
7	PULS	Reference pulse input
9	T-REF	Force reference input
11	SIGN	Reference sign input
13	PL2	Open-collector reference power supply
15	CLR	Clear input
17	–	–
19	PCO	PG dividing pulse output Phase C
21	–	–
23	–	–
25	/V-CMP+ (/COIN+)	Speed coincidence detection output

27	/TGON+	Moving signal output
29	/S-RDY+	Servo ready output
31	ALM+	Servo alarm output
33	PAO	PG dividing pulse output Phase A
35	PBO	PG dividing pulse output Phase B
37	ALO1	Alarm code output
39	ALO3	Alarm code output
41	/P-CON	P control input
43	N-OT	Reverse run prohibit input
45	/P-CL	Forward external force limit input
47	+24V IN	External input power supply
49	–	–

26	/V-CMP- (/COIN-)	Speed coincidence detection output
28	/TGON-	Moving signal output
30	/S-RDY-	Servo ready output
32	ALM-	Servo alarm output
34	/PAO	PG dividing pulse output Phase A
36	/PBO	PG dividing pulse output Phase B
38	ALO2	Alarm code output
40	/S-ON	Servo ON input
42	P-OT	Forward run prohibit input
44	/ALM-RST	Alarm reset input
46	/N-CL	Reverse external force limit input
48	–	–
50	–	–

Note: 1. Do not use unused terminals for relays.

2. Connect the shield of the I/O signal cable to the connector shell.
   Connect to the FG (frame ground) at the SERVOPACK-end connector.
3. The functions allocated to the following input and output signals can be changed by using the parameters. Refer to *8.3.2 Input Circuit Signal Allocation* and *8.3.3 Output Circuit Signal Allocation.*
   - Input signals: /S-ON, /P-CON, P-OT, N-OT, /ALM-RST, /P-CL, and /N-CL
   - Output signals: /TGON, /S-RDY, and /V-CMP (/COIN)
   - The above output signals can be changed to /CLT, /VLT, /BK, /WARN, and /NEAR.

7.4.5 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 linear servomotor when the gate block in the inverter is released.		9.6.1
	/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.	9.7.2 10.4.4
			Direction reference	With the internal set speed selected: Switch the movement direction.	9.10.2
			Control mode switching	Position ↔ speed Position ↔ force Force ↔ speed } Enables control mode switching.	9.12
			Zero-clamp reference	Speed control with zero-clamp function: Reference speed is zero when ON.	9.7.6
			Reference pulse block	Position control with reference pulse stop: Stops reference pulse input when ON.	9.8.7
	P-OT N-OT	42 43	Forward run prohibited Reverse run prohibited	Overtravel prohibited: Stops linear servomotor when movable part travels beyond the allowable range of motion.	9.6.3
	/P-CL /N-CL	45 46	Function selected by parameter.		–
			Forward external force limit ON Reverse external force limit ON	Current limit function enabled when ON.	9.11.2 9.11.4
			Internal speed switching	With the internal set speed selected: Switches the internal speed settings.	9.10
	/ALM-RST	44	Alarm reset: Releases the servo alarm state.		9.13.1
	+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		7.4.6
Speed	V-REF	5 (6)	Speed reference speed input: ±2 to ±10 V/rated motor speed (Input gain can be modified using a parameter.)		9.7.2 9.9.4
Force	T-REF	9 (10)	Force reference input: ±1 to ±10 V/rated motor force (Input gain can be modified using a parameter.)		9.9.2 9.11.3 9.11.4
Position	PULS /PULS SIGN /SIGN	7 8 11 12	Reference pulse input for only line driver	Input mode is set from the following pulses. • Sign + pulse string • CCW/CW pulse • Two-phase pulse (90° phase differential)	9.8.1
	CLR /CLR	15 14	Positional error pulse clear input: Clears the positional error pulse during position control.		9.8.1

Note: 1. Pin numbers in parentheses () indicate signal grounds.
2. The functions allocated to /S-ON, /P-CON. P-OT, N-OT, /ALM-RST, /P-CL, and /N-CL input signals can be changed by using the parameters. Refer to *8.3.2 Input Circuit Signal Allocation*.
3. The voltage input range for speed and force 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.		9.13.1
	/TGON+ /TGON-	27 28	Detection during linear servomotor movement: Detects when the linear servomotor is moving at a speed higher than the motor speed setting. Detection speed can be set by using the parameters.		9.13.3
	/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. If "without hall sensor" is set, the magnetic polarity detection must be completed.		9.13.4
	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.)	7.3 7.4.1 9.7.7
	PBO /PBO	35 36	Phase-B signal		
	PCO /PCO	19 20	Phase-C signal		
	ALO1 ALO2 ALO3	37 38 39 (1)	Alarm code output: Outputs 3-bit alarm codes. Open-collector: 30 V and 20 mA rating maximum		9.13.1
	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.		9.7.8
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).		9.8.5
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.		9.11.5 9.9.4 – 9.13.2 9.8.6
	–	3 4 13 16 17 18 21 22 23 24 48 49 50	Terminals not used Do not connect relays to these terminals.		–

Note: 1. Pin numbers in parentheses () indicate signal grounds.

2. The functions allocated to /TGON, /S-RDY, and /V-CMP (/COIN) can be changed by using the parameters. /CLT, /VLT, /BK, /WARN, and /NEAR signals can also be changed. Refer to *8.3.3 Output Circuit Signal Allocation*.

7.4.6 Interface Circuit

This section shows examples of SERVOPACK I/O signal connection to the host controller.

(1) Interface for Reference Input Circuits

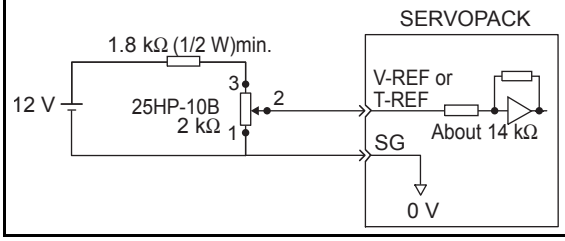
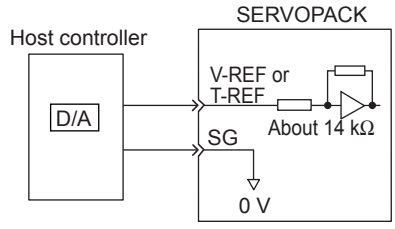
(a) Analog Input Circuit

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

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

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

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

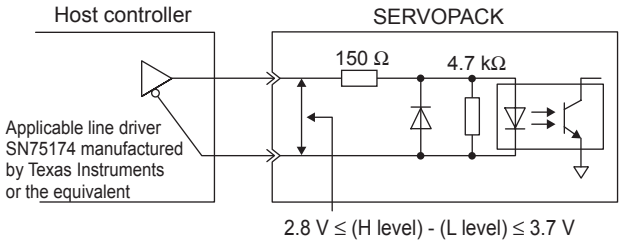
Analog Voltage Input Circuit	Analog Voltage Input Circuit (D/A)
	

(b) Position Reference Input Circuit

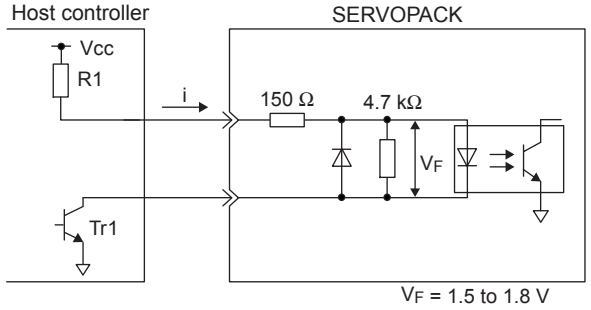
CN1 connector terminals, 7-8: Reference pulse input, 11-12: Reference code input and 15-14: Clear input are explained below.

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



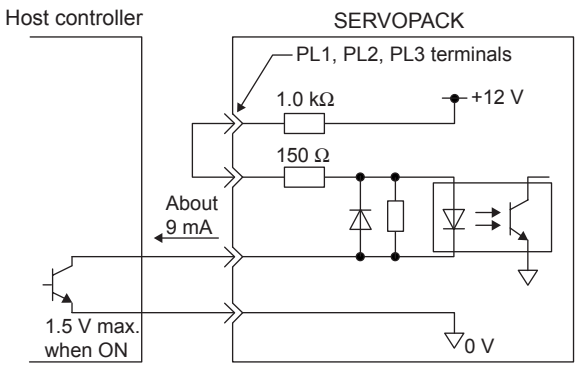
Open-collector Output, Example 1: Power Supply Provided by User



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%

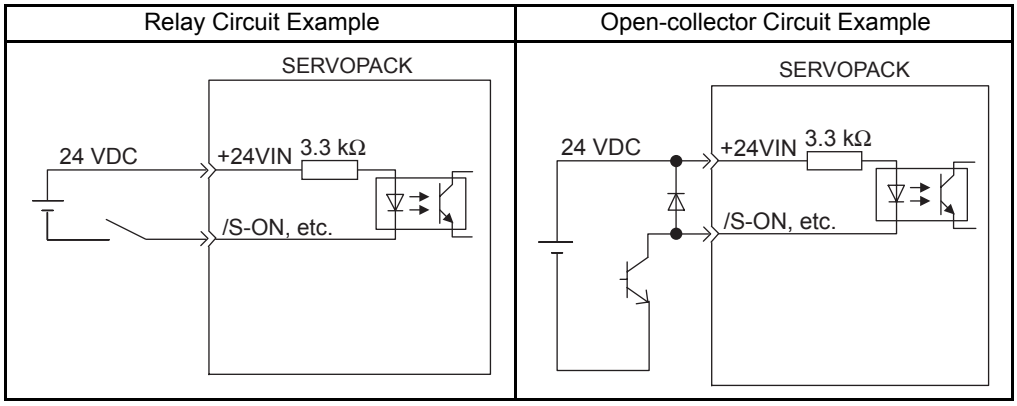
Open-collector Output, Example 2: Using 12-V Power Supply Built into SERVOPACK



(2) Sequence Input Circuit Interface

CN1 connector terminals 40 to 47 is explained below.

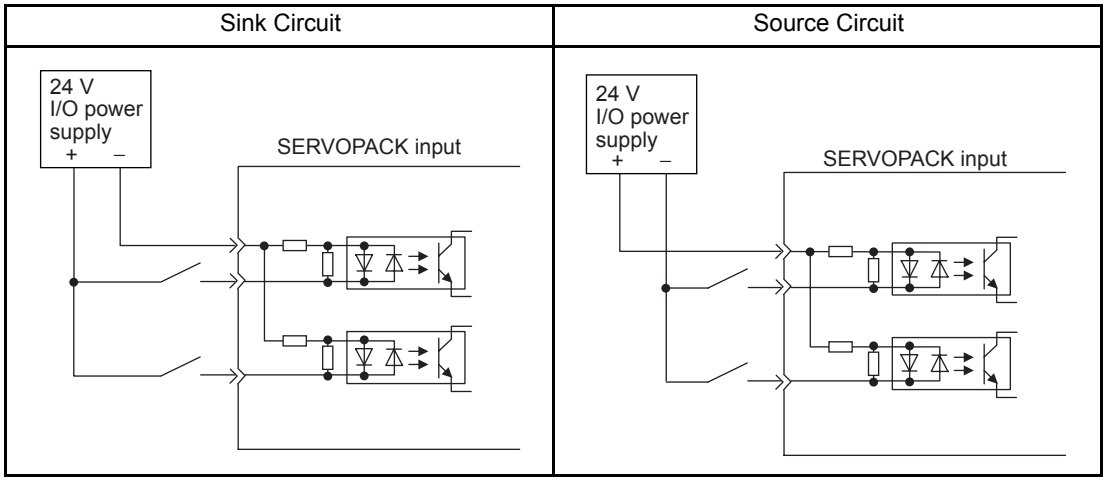
The sequence input circuit interface connects through a relay or open-collector transistor circuit. Select a low-current relay otherwise a faulty contact will result.



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

(3) Sink Circuit and Source Circuit

The SERVOPACK's I/O circuit uses a bidirectional photocoupler. Select either the sink circuit or the source circuit according to the specifications required for each machine.



(4) Output Circuit Interface

There are three types of SERVOPACK output circuits:

(a) Line-driver Output Circuit

CN1 connector terminals, 33-34: phase-A signal, 35-36: phase-B signal and 19-20: phase-C signal are explained below.

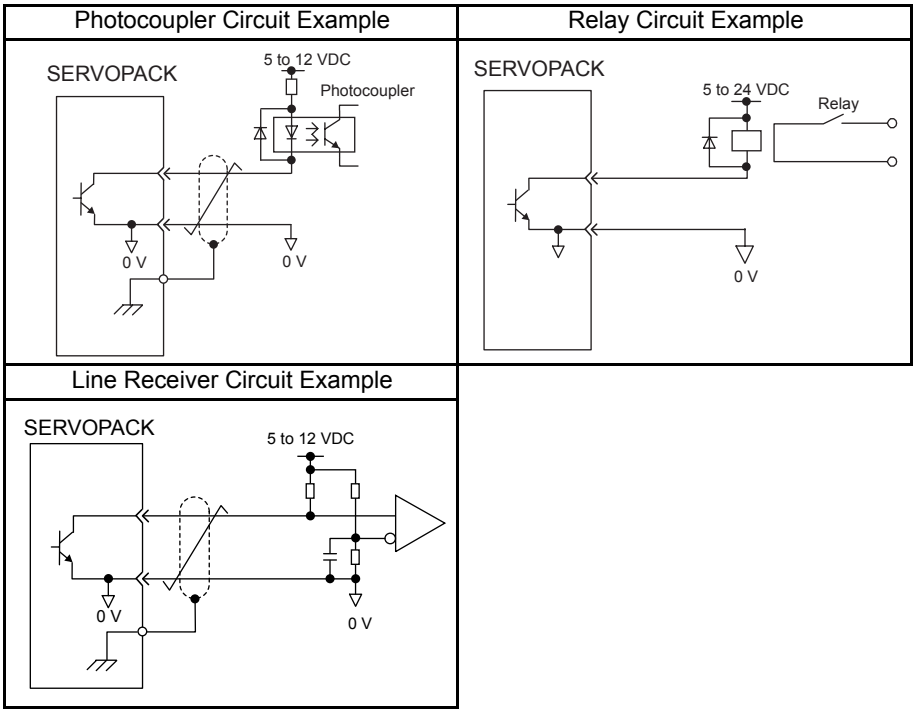
Encoder serial data converted to two-phase (phases A and B) pulse output signals (PAO, /PAO, PBO, /PBO) and zero-point pulse signals (PCO, /PCO) are output via line-driver output circuits. Normally, the SERVOPACK uses this output circuit in speed control to comprise the position control system at the host controller. Connect the line-driver output circuit through a line receiver circuit at the host controller.

(b) Open-collector Output Circuit

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

Alarm code signals (ALO1, ALO2, ALO3) are output from open-collector transistor output circuits.

Connect an open-collector output circuit through a photocoupler, relay circuit, or line receiver circuit.

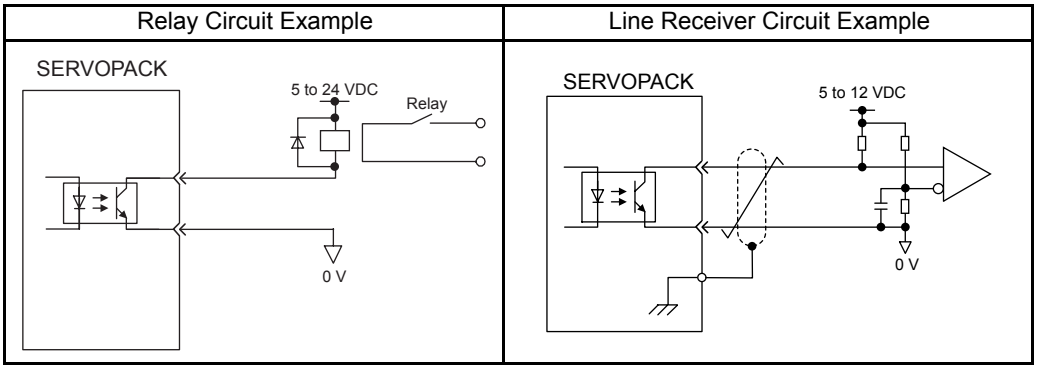


Note: The maximum allowable voltage and current capacities for open-collector output circuits are as follows:

- 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.



Note: The maximum allowable voltage and current capacities for photocoupler output circuits are as follows:

- Voltage: 30 VDC
- Current: 50 mA DC

7.5 Others

7.5.1 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 *6 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 (0.0047 to 0.012 in)), so handle the cables carefully.
4. Use a noise filter to prevent noise interference.
   (For details, refer to *7.5.2 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:
   - The wiring distance between the linear scale and serial converter unit must be as short as possible.
   - Always install a surge suppressor 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.

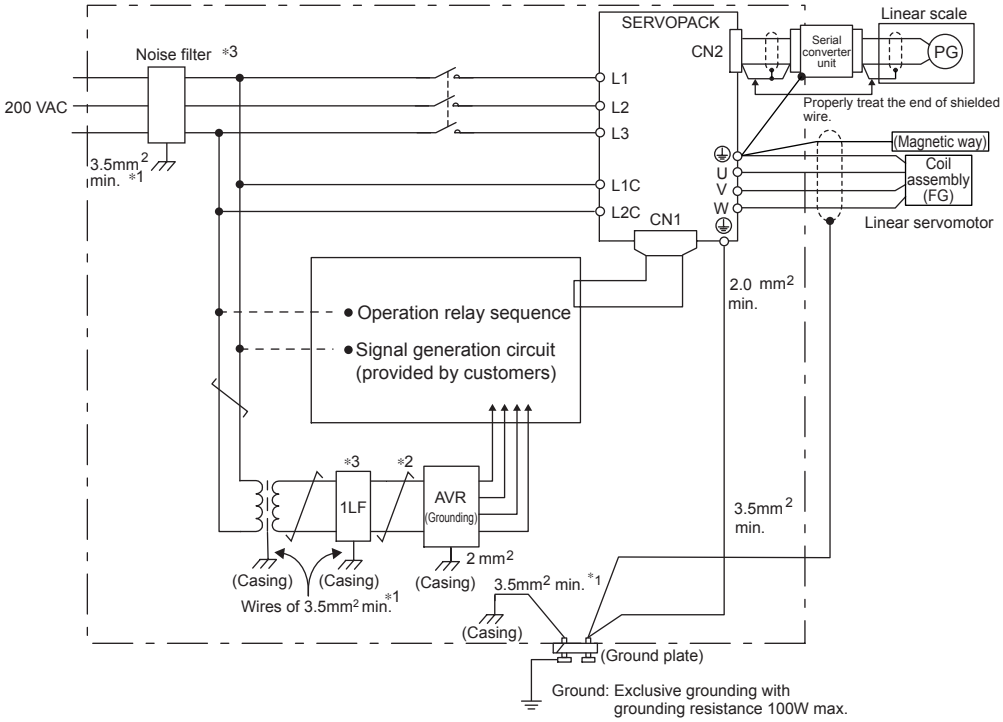
7.5.2 Wiring for Noise Control

(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.



*1 For grounding wires connected to the casing, use a thick wire with a thickness of at least 3.5mm^2 (equivalent to a copper braided flat conductor)

*2 ⫽ : represents twisted-pari wires.

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

(2) Correct Grounding

(a) Grounding the Motor Frame

Always connect the linear servomotor frame terminal FG to the SERVOPACK ground terminal ⏚.

Also be sure to ground the ground terminal ⏚.

Ground both coil assembly and magnetic way of the linear servomotor.

If the linear servomotor is grounded via the machine, a switching noise current will flow from the SERVOPACK power unit through the linear 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 linear servomotor is accommodated in a metal conduit, ground the conduit and its junction box.

For all grounding, ground at one point only.

(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.

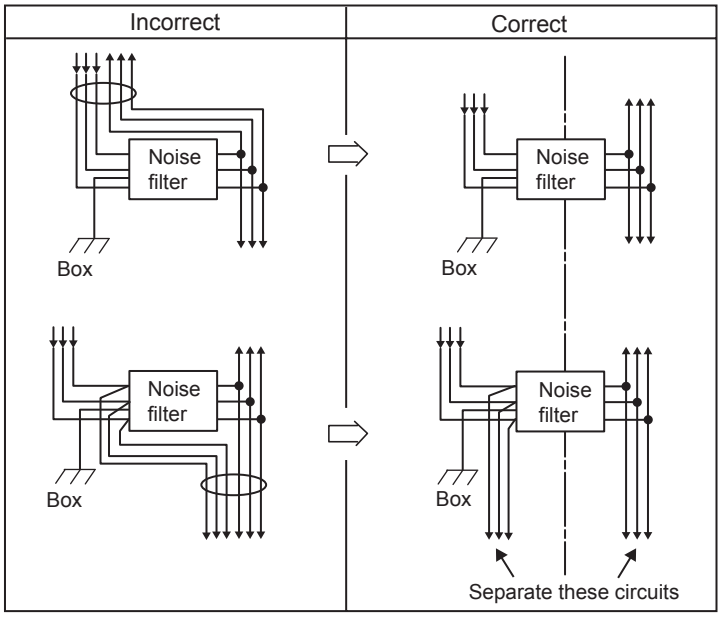
Voltage	SERVOPACK Model	Recommended Noise Filters		
		Model	Specifications	Manufacturer
Single-phase 200 V	SGDH-A5AE to -02AE	FN2070-6/07	Single-phase 250 VAC, 6A	SCHAFFNER
	SGDH-04AE	FN2070-10/07	Single-phase 250 VAC, 10A	
Three-phase 200 V	SGDH-05AE	FN258L-7/07	Three-phase 480 VAC, 7A	
	SGDH-08AE to -20AE	FN258L-16/07	Three-phase 480 VAC, 16A	
	SGDH-30AE	FN258L-30/07	Three-phase 480 VAC, 30A	
	SGDH-50AE	FMAC-0934-5010	Three-phase 440 VAC, 50A	SCHURTER (formely TIMONTA)
	SGDH-75AE	FMAC-0953-6410	Three-phase 440 VAC, 64A	
Three-phase 400 V	SGDH-05DE to -15DE	FN258L-7/07	Three-phase 480 VAC, 7A	SCHAFFNER
	SGDH-20DE, -30DE	FN258L-16/07	Three-phase 480 VAC, 16A	
	SGDH-50DE, -75DE	FS5559-35-33	Three-phase 480 VAC, 35A	

IMPORTANT

■Precautions when using noise filter

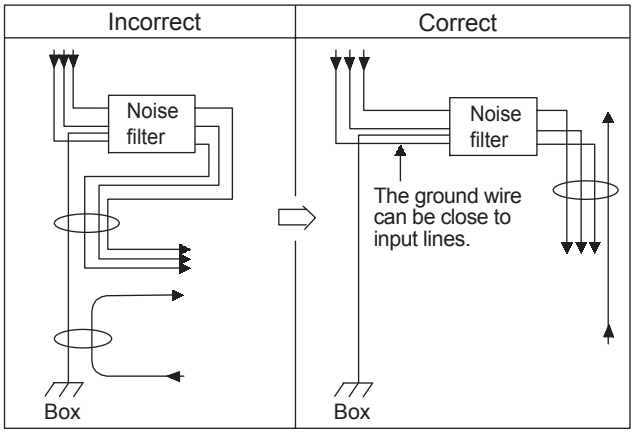
Always observe the following installation and wiring instructions. Incorrect use of a noise filter halves its benefits.

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



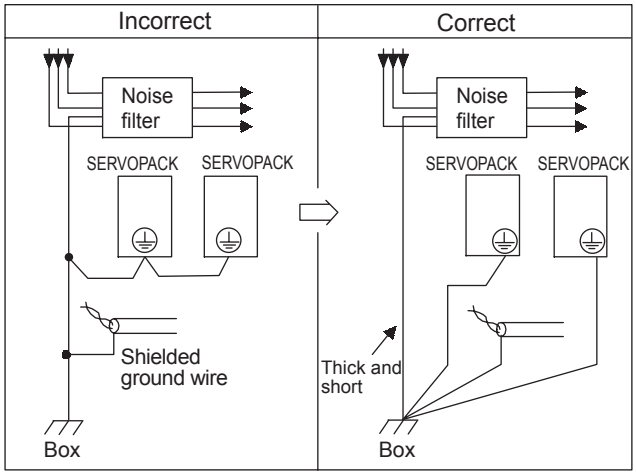
2. Separate the noise filter ground wire from the output lines.

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



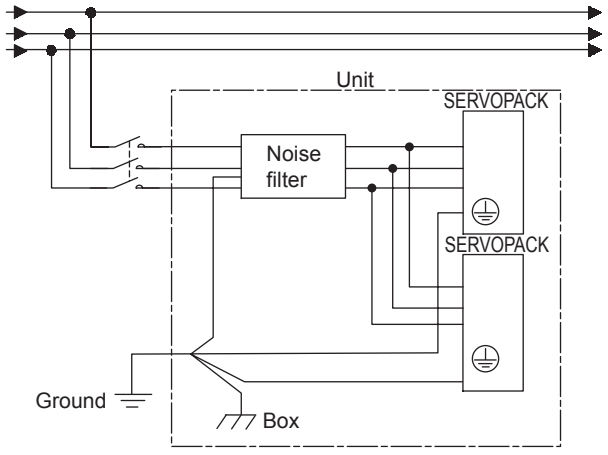
3. Connect the noise filter ground wire directly to the ground plate.

   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.



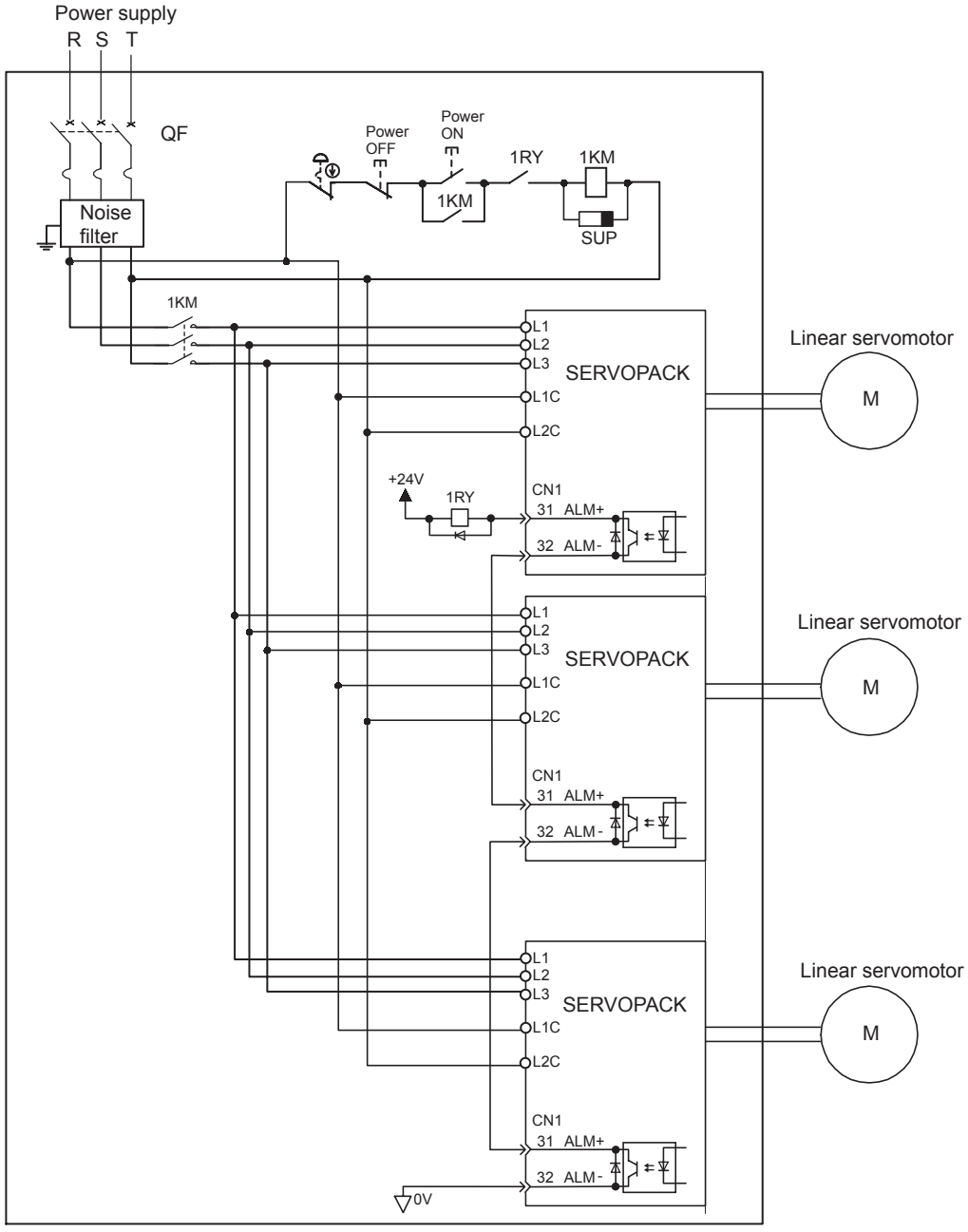
7.5.3 Using More Than One SERVOPACK

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 *2.6.2 Molded-case Circuit Breaker and Fuse Capacity*.



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

7.5.4 Operating Conditions on 400-V Power Supply Voltage

⚠ CAUTION

- Do not connect the SERVOPACK for 200 V directly to a voltage of 400 V.

  The SERVOPACK will be destroyed.
- Control the AC power supply ON and OFF sequence at the primary side of voltage conversion transfer.

  Voltage conversion transfer inductance will cause a surge voltage if the power is turned ON and OFF at the secondary, damaging the SERVOPACK.

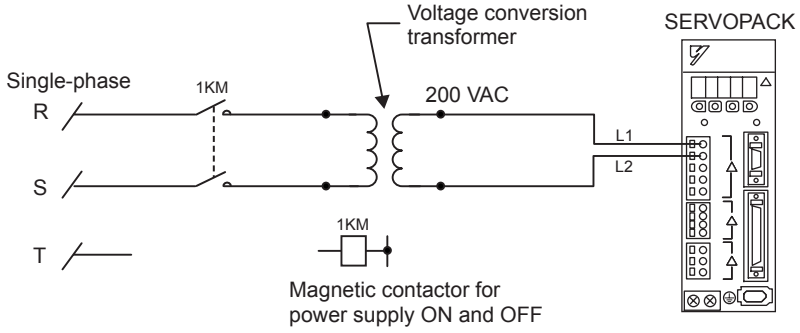
There are three types of SGDH SERVOPACKs, for the power supply voltages: Single-phase 200 VAC, three-phase 200 VAC, and three-phase 400 VAC. When using the SERVOPACK for 200 V with the three-phase 400-VAC class (380 to 480 V), prepare the following voltage conversion transformers (single-phase or three-phase)

Primary Voltage		Secondary Voltage
380 to 480 VAC	→	200 VAC

When selecting a voltage conversion transformer, refer to the capacities shown in the following table.

Voltage	SERVOPACK Model SGDH-	Voltage Capacity per SERVOPACK * (kVA)	Current Capacity of Circuit Breaker or Fuse (Arms)
Single-phase 200 V	A5AE	0.25	4
	01AE	0.40	
	02AE	0.75	
	04AE	1.2	8
Three-phase 200 V	05AE	1.4	4
	08AE	1.9	7
	10AE	2.3	
	15AE	3.2	10
	20AE	4.3	13
	30AE	5.9	17
	50AE	7.5	28
	75AE	15.5	41

* This is the net value at the rated load.



Single-phase Power Supply Connection Example

7.5.5 DC Reactor for Harmonic Suppression

(1) Reactor Types

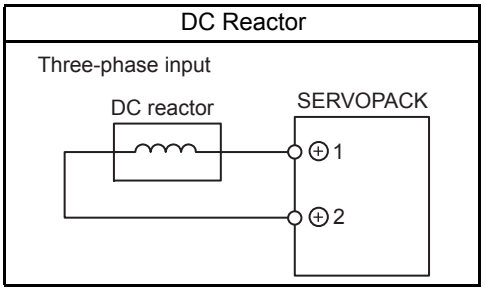
The SERVOPACK has the DC reactor connection terminals for power supply harmonic suppression. However, SERVOPACKs with capacity of 7.5 kW do not have these terminals. The type of DC reactor to be connected differs depending on the SERVOPACK capacity. Refer to the following table.

Applicable SERVOPACK Model SGDH-		DC Reactor Model	Reactor Specifications	
			Inductance (mH)	Rated Current (A)
Single-phase 200 V	A5AE	–	–	–
	01AE	X5071	40.0	0.85
	02AE	X5070	20.0	1.65
	04AE	X5069	10.0	3.3
Three-phase 200 V	05AE	X5061	2.0	4.8
	08AE			
	10AE			
	15AE	X5060	1.5	8.8
	20AE			
	30AE	X5059	1.0	14.0
	50AE	X5068	0.47	26.8
Three-phase 400 V	05DE	X5074	4.7	1.5
	10DE	X5075	3.3	4.5
	15DE			
	20DE	X5076	2.2	8.6
	30DE			
	50DE	X5077	1.5	14.1

Note: Select a proper DC reactor for the input current to the SERVOPACK.
Refer to *2.6.2 Molded-case Circuit Breaker and Fuse Capacity* for input current to each SERVOPACK. For the kind of reactor, refer to *7.5.5 DC Reactor for Harmonic Suppression*.

(2) Connecting a Reactor

Connect a DC reactor as shown in the following diagram. The DC reactor is connected in series to the rectifier circuit's output side.



Note: 1. The SERVOPACK ⊕1 and ⊕2 terminals for the DC reactor are short-circuited before shipment. Remove the lead wire between these two terminals and connect the DC reactor with SERVOPACK.
2. DC reactor is an option (Provided by customer).

7.6 Connecting Regenerative Resistors

7.6.1 Regenerative Power and Regenerative Resistance

The kinetic energy of driven machine such as linear servomotor is returned to the SERVOPACK. This is called regenerative power. The regenerative power is absorbed by charging the smoothing capacitor, but when the power exceeds the capacitor's chargeable energy, the regenerative power is further consumed by the regenerative resistor.

The servomotor is driven in regeneration state in the following circumstances:

- While decelerating to a stop during acceleration and deceleration operation.
- Continuous falling operation on the vertical axis.
- During continuous operation with the servomotor moved from the load side (negative load).

The SERVOPACKs with a capacity of the single-phase 200 V with 50 to 400 W do not have built-in regenerative resistors. If the value calculated in *12.2 Calculating the Required Capacity of Regenerative Resistors* needs an external regenerative resistor, connect an external regenerative resistor.

7.6.2 Connecting External Regenerative Resistors

(1) Necessity of External Regenerative Resistors

SERVOPACK Capacity	Necessity of External Regenerative Resistors	Description
400 W or less	Not Required	No built-in regenerative resistor is provided, however, normally an external regenerative resistor is not required. Install external regenerative resistors when the smoothing capacitor in SERVOPACK cannot process all the regenerative power.
500 W to 5.0 kW	Not Required	A built-in regenerative resistor is provided as standard. Install external regenerative resistors when the built-in regenerative resistor cannot process all the regenerative power.
7.5 kW	Required	No built-in regenerative resistor is provided, so the external regenerative resistor is required. If the external regenerative resistor is not connected with the SERVOPACK, the alarm A.30 is detected as a regeneration error alarm.

(2) Specifications of Built-in Regenerative Resistor

If the amount of regenerative energy exceeds the processing capacity of the SERVOPACK, then install an external regenerative resistor. The following table shows the specifications of the SERVOPACK's built-in resistor and the amount of regenerative power (average values) that it can process.

Applicable SERVOPACKs SGDH-		Specifications of Build-in Resistor		Regenerative Power Processed by Built-in Resistor *1 (W)	Minimum Allowable Resistance (Ω)
		Resistance (Ω)	Capacity (W)		
Single-phase 200 V	A5AE, -04AE	–	–	–	40
Three-phase 200 V	05AE to -10AE	50	60	12	40
	15AE	30	70	14	20
	20AE	25	140	28	12
	30AE	12.5	140	28	12
	50AE	8	280	56	8
	75AE	(3.13) *2	(1760) *2	(350) *2	2.9
Three-phase 400 V	05DE to -15DE	108	70	14	73
	20DE, -30DE	45	140	28	44
	50DE	32	180	36	28
	75DE	(18) *3	(880) *3	(180) *3	18

* 1. The average regenerative power that can be handled is 20% of the rated capacity of the regenerative resistor built into the SERVOPACK.
* 2. The values in parentheses are for the optional JUSP-RA05 Regenerative Resistor.
* 3. The values in parentheses are for the optional JUSP-RA18 Regenerative Resistor.

(3) Precautions on Selecting External Regenerative Resistors

A built-in regenerative resistor is provided for 500 W to 5.0 kW SGDH SERVOPACKs as standard.

When installing an external regenerative resistor with the SERVOPACK, make sure that the resistance is the same as that of the SERVOPACK's built-in resistor.

If combining multiple small-capacity regenerative resistors to increase the regenerative resistor capacity (W), select resistors so that the resistance value including error is at least as high as the minimum allowable resistance shown in the following table.

Connecting a regenerative resistor with the resistance smaller than the minimum allowable resistance may increase the current flow in the regeneration circuit, resulting in damage to the circuit.

(4) Related Parameter

Pn600	Regenerative Resistor Capacity		Speed	Position	Force
	Setting Range	Unit	Factory Setting	Setting Validation	
	0 to SERVOPACK capacity	10 W	0	Immediately	

Be sure to set this parameter when installing an external regenerative resistor with the SERVOPACK.

With the factory setting of "0," the SERVOPACK's built-in resistor is used.

Set the regenerative resistor capacity within tolerance value. When the set value is improper, alarm A.32 is not detected correctly. Also, do not set other than 0 without connecting the regenerative resistor because alarm A.30 or A.33 may be detected.

The set value differs depending on the cooling method of external regenerative resistor:

- For natural air cooling method: Set the value maximum 20% of the actually installed regenerative resistor capacity (W).
- For forced air cooling method: Set the value maximum 50 % of the actually installed regenerative resistor capacity (W).

For example, set 20 W (100 W × 20%) for the 100 W external regenerative resistor with natural cooling method: Pn600 = 2 (units: 10 W)

IMPORTANT

1. When resistors for power are used at the rated load ratio, the resistor temperature increases to between 200 °C (392 °F) and 300 °C (572 °F) . The resistors must be used at or below the rated values. Check with the manufacturer for the resistor's load characteristics. Use the regenerative resistors at no more than 20% of the rated load ratio with natural convection cooling, and no more than 50% of the rated load ratio with forced air cooling.
2. For safety's sake, use the resistors with thermoswitches.

(5) Connecting Regenerative Resistors

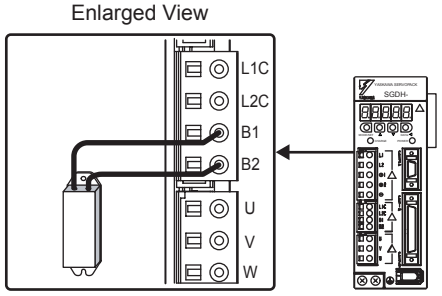
IMPORTANT

Do not touch the regenerative resistors because they reach high temperatures. Use heat-resistant, non-flammable wiring and make sure that the wiring does not touch the resistors. Refer to *6.6 SERVOPACK Main Circuit Wire Size* for connecting wire size when connecting an external regenerative resistor.

(a) SERVOPACKs with Capacities of 400W or Less

Connect an external regenerative resistor between B1 and B2 terminals.

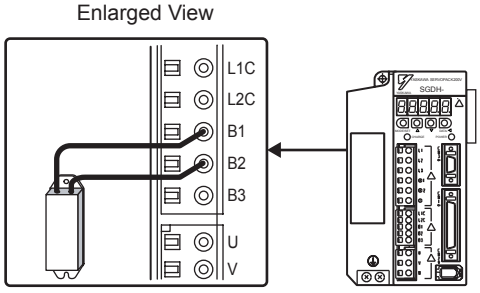
Note: The user must provide the regenerative resistor.



(b) SERVOPACKs with Capacities of 0.5 to 5.0 kW

Disconnect the wiring between the SERVOPACK's B2 and B3 terminals and connect an external regenerative resistor between the B1 and B2 terminals.
The user must provide the regenerative resistor.

Note: Be sure to remove the lead wire between the B2 and B3 terminals.

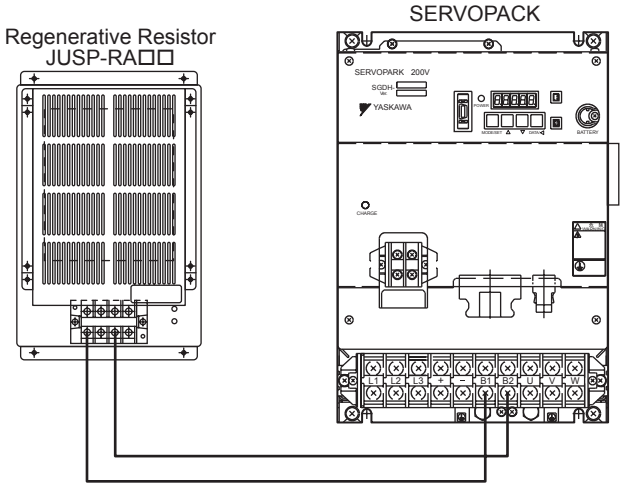


(c) SERVOPACK's with Capacity of 7.5 kW

No built-in regenerative resistor is provided, so the external regenerative resistor is required. The special regenerative resistors are as follow:

Main Circuit Power Supply	Applicable SERVOPACK Model SGDH-	Applicable Regenerative Resistor	Resis-tance (Ω)	Specifications
Three-phase 200 V	75AE	JUSP-RA05	3.13	25 Ω (220 W) × 8 (parallel connection)
Three-phase 400 V	75DE	JUSP-RA18	18	18 Ω (220 W) × 4 (direct/parallel connection)

The following diagram shows the connection method between the SERVOPACK and the regenerative resistor.



Note: Connect a regenerative resistor between B1 and B2 terminals. The regenerative resistor is provided by the customer.

8

Digital Operator/Panel Operator

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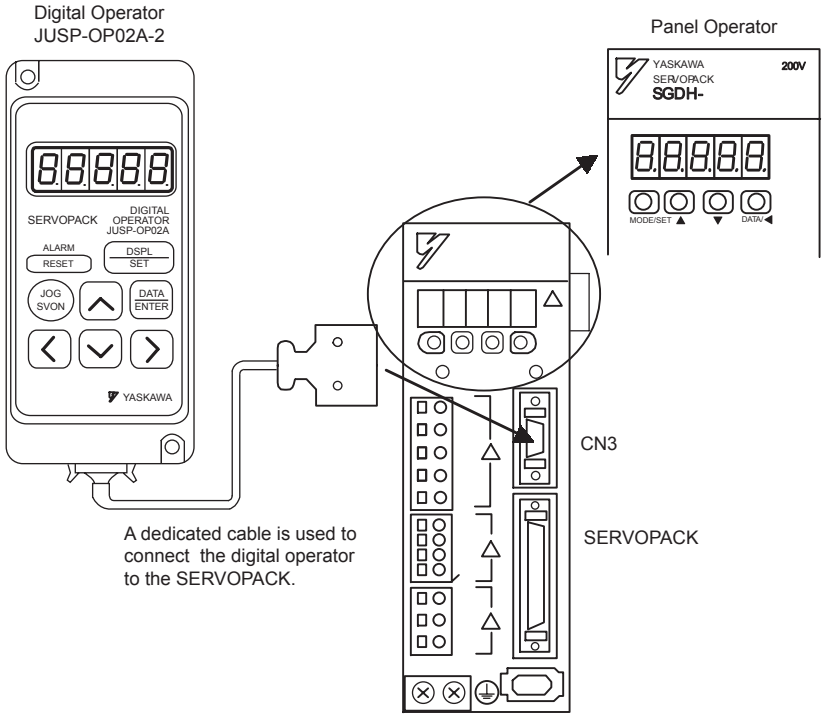
8.1 Functions on Digital Operator/Panel Operator

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/SGDM Digital Operator Operation Manual* (TOE-S800-34).

8.1.1 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.



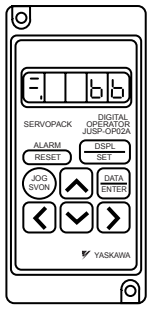
IMPORTANT	If the digital operator is connected to the SERVOPACK, the panel operator does not display anything.

8.1.2 Key Names and Functions

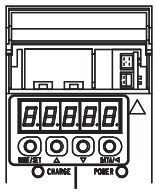
Key names and functions for the digital operator and the panel operator are explained below.

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

Digital Operator



SERVOPACK



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 Reserve 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 *11.1 Troubleshooting*.

8

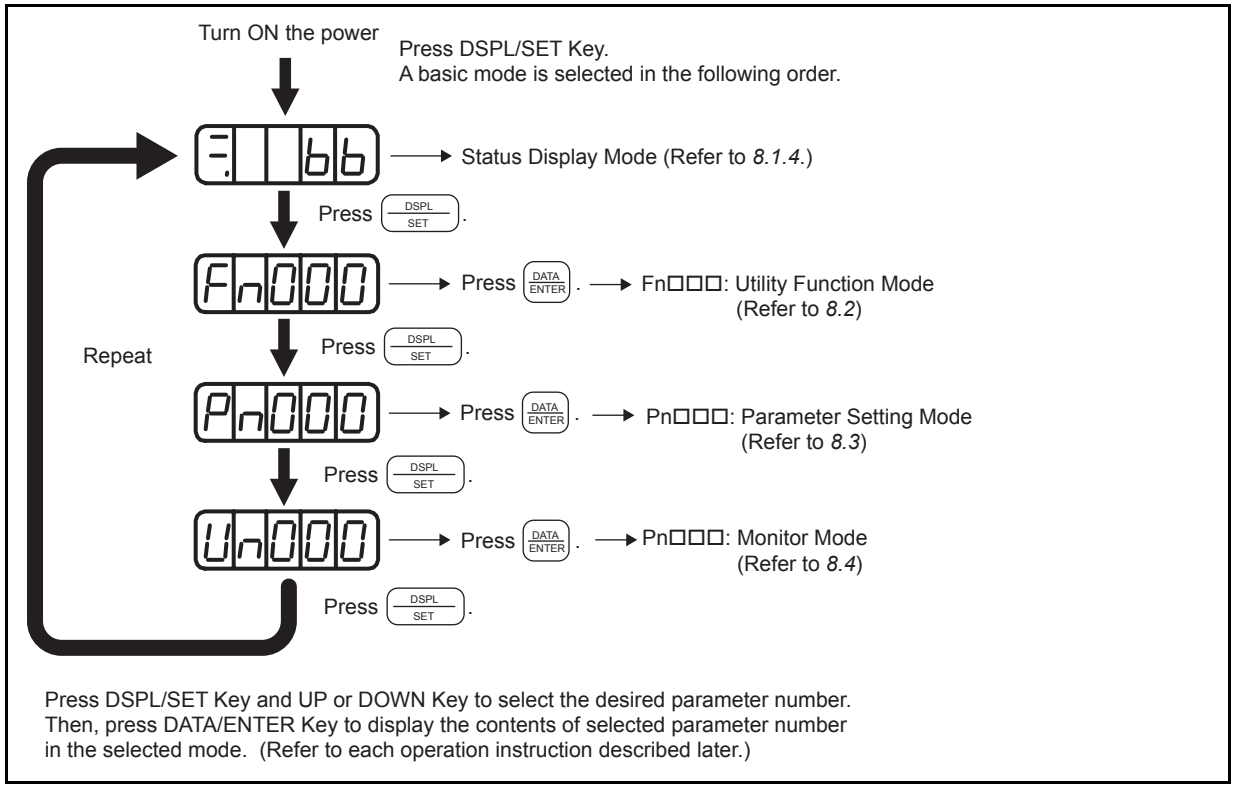
8.1.3 Basic Mode Selection and Operation

The basic modes include: Status display mode, Utility Function Mode, Parameter Setting Mode, and Monitor Mode.

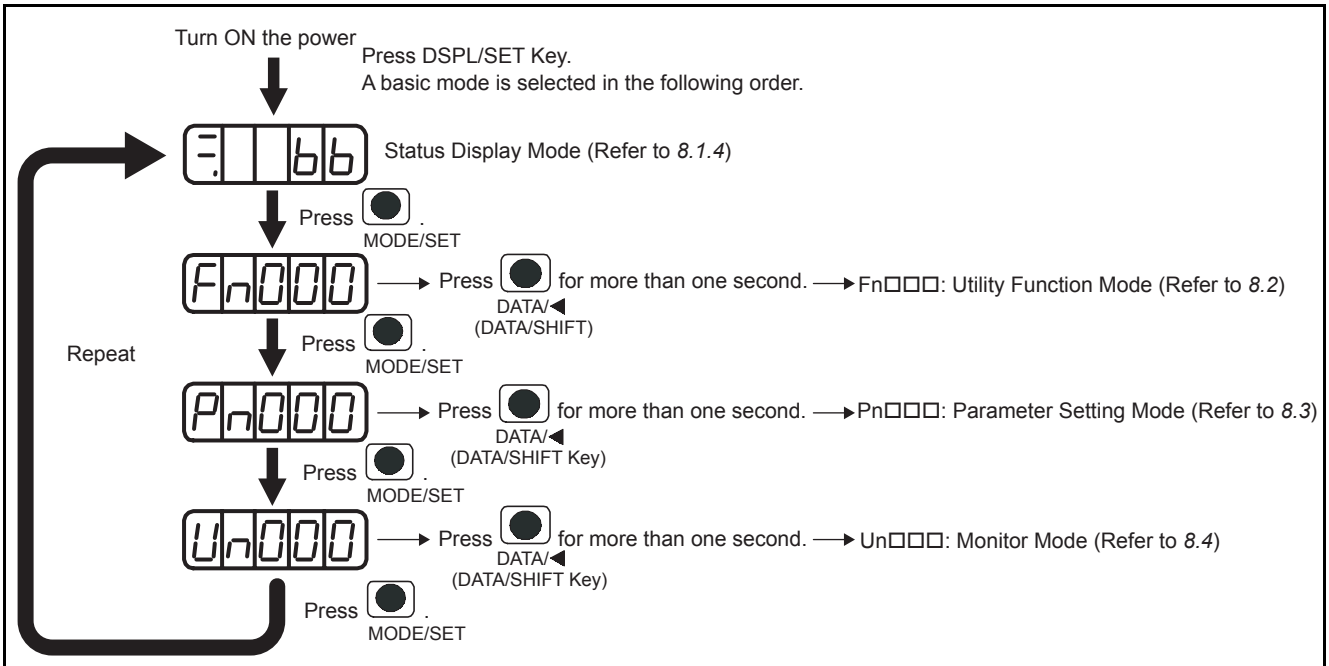
Select a basic mode to display the operation status, set parameters and operation references.

The basic mode is selected in the following order.

(1) Using the Digital Operator

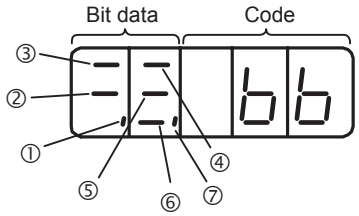


(2) Using the Panel Operator



Press MODE/SET 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.)

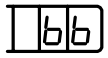
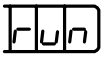
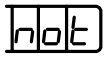
8.1.4 Status Display



(1) Bit Data and Meanings

Item	Speed or Force 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 Pn582. (Factory setting is 10 mm/s.) ∗ Always lit in force 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 pulses.)
④	Movement Detection (/TGON)	Lit if motor speed exceeds preset value. Not lit if motor speed is below preset value. Preset value: Set in Pn581 (Factory setting is 20 mm/s.)	Movement Detection (/TGON)	Lit if motor speed exceeds preset value. Not lit if motor speed is below preset value. Preset value: Set in Pn581 (Factory setting is 20 mm/s.)
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 Pn581 (Factory setting is 20 mm/s.)	Reference Pulse Input	Lit if reference pulse is input. Not lit if no reference pulse is input.
⑥	Force Reference Input	Lit if input force reference exceeds preset value. Not lit if input force reference is below preset value. Preset value: 10% of rated force	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.

(2) Codes and Meanings

Code	Meaning
	Baseblock Servo OFF (motor power OFF)
	Run Servo ON (motor power ON)
	Forward Run Prohibited CN1-42 (P-OT) is OFF.
	Reverse Run Prohibited CN1-43 (N-OT) is OFF.
	Alarm Status Displays the alarm number.
 :	

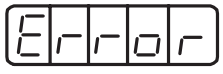
8.2 Operation in Utility Function Mode (Fn□□□)

8.2.1 List of Utility Function Modes

This section describes how to apply the basic operations using the panel operator to run and adjust the motor.
The following table shows the parameters in the utility function mode.

Parameter No.	Function	Remarks	Reference Section
Fn000	Alarm traceback data display	–	8.2.2
Fn001	Rigidity setting during online autotuning	○	10.2.5
Fn002	JOG mode operation	○	8.2.3
Fn003	Zero-point search mode	○	8.2.4
Fn005	Parameter setting initialization	○	8.2.5
Fn006	Alarm traceback data clear	○	8.2.6
Fn007	Writing to EEPROM mass ratio data obtained from online autotuning	○	10.2.7
Fn008	Fixed parameter	○	–
Fn009	Automatic tuning of analog (speed, force) reference offset	○	9.7.3 9.9.3
Fn00A	Manual adjustment of speed reference offset	○	9.7.3
Fn00B	Manual adjustment of force reference offset	○	9.9.3
Fn00C	Manual zero-adjustment of analog monitor output	○	–
Fn00D	Manual gain-adjustment of analog monitor output	○	–
Fn00E	Automatic offset-adjustment of motor current detection signal	○	8.2.7
Fn00F	Manual offset-adjustment of motor current detection signal	○	8.2.8
Fn010	Password setting (protects parameters from being changed)	–	8.2.9
Fn011	Motor models display	–	8.2.10
Fn012	Software version display	–	8.2.11
Fn013	Fixed parameter	○	–
Fn014	Application module detection results clear	○	8.2.12

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

8.2.2 Alarm Traceback Data Display (Fn000)

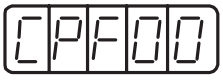
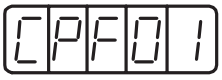
The alarm traceback display can display up to 10 previously occurred alarms. The alarm data is displayed on Fn000, which is stocked in the alarm traceback data. The data can be cleared using an utility function mode "Alarm Traceback Data Clear." For details, refer to *8.2.6 Alarm Traceback Data Clear (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.



Alarm Sequence Number
The higher the number, the older the alarm data is.

Alarm Code
See the alarm table.

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

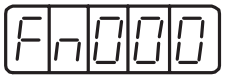
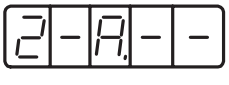
Display	Description
	Digital operator transmission error 1
	Digital operator transmission error 2

Refer to *11.1 Troubleshooting* for alarm number and contents.

INFO

1. Alarm traceback data will not be updated when the same alarm occurs repetitively.
2. The display "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		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		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		(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		(UP Key)	(UP Key)	Press the UP Key to display value in order. Note: "A.--" means no alarm occurs.
5		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.

8.2.3 JOG Mode Operation (Fn002)

⚠ CAUTION

- Forward run prohibited (P-OT) and reverse run prohibited (N-OT) signals are disabled during JOG mode operation.

The JOG mode operation is designed to move a linear servomotor without connecting to the host controller when performing the trial operation. The JOG mode operation is used to confirm the movement direction and motor speed setting.

(1) Precautions

Observe the following precautions when performing JOG mode operation.

- The SERVOPACK must be in servo ready state. The JOG mode operation cannot be performed while the SERVOPACK is in servo ON state.
- The servo ON (/S-ON) input signal must be OFF.
- If the parameter Pn50A.1 (/S-ON Signal Mapping) is set to "7 (Sets signal ON)," change the setting to "8 (Sets signal OFF)."

(2) Related Parameter

Pn383	JOG Speed		Speed Position Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 10000 mm/s	1 mm/s	50 mm/s	Immediately
Sets the motor speed reference value of the utility function Fn002 "JOG Mode Operation."				

(3) Operation Procedure

Use the following procedure to execute the JOG mode operation.

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 the Fn002. Note: The enabled digit blinks.
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 at least one second, and the display will be as shown on the left. The operator enters JOG operation mode.
4	. .JOG	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key. The servo turns ON.
5	Forward direction Reverse direction	∧ ∨		Press the UP Key for the forward direction or DOWN Key for the reverse direction. The linear servomotor moves 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. The servo turns OFF. Or, press the DATA/SHIFT Key at least one second to turn the servo OFF.
7	Fn002	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER once or DATA/SHIFT Key at least one second to return to the utility function mode display Fn002.

INFO The linear servomotor movement direction differs depending on the setting of parameter Pn000.0 “Direction Selection.” The above example shows the case of factory setting.

8.2.4 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 linear scale that outputs the zero-point signal and to clamp at the position.

This mode is used to confirm that the linear scale outputs the zero-point signal correctly.

When the maximum speed is set to 5 m/s, the movement speed for executing the zero-point search is 60 mm/s.

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 run the motor in the forward direction. Pressing the DOWN Key will run the motor in the reverse direction. When the parameter is set to Pn000.0 = 1, the movement 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.

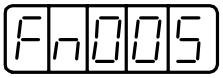
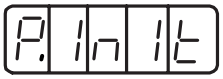
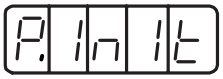
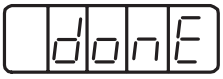
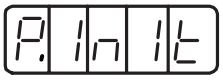
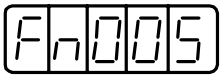
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8.2.5 Parameter Settings Initialization (Fn005)

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

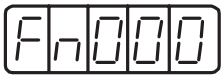
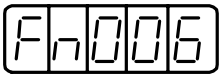
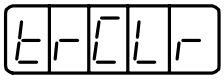
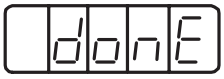
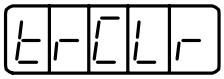
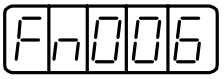
Initialize the parameter settings with the servo OFF.

Step	Display after Operation	Digital Operator	Panel Operator	Description
1		 (DSPL/SET Key)	 MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
2				Press the UP or DOWN Key to select Fn005. Note: The enabled digit blinks.
3		 (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		 (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		End of initialization		When the initialization of parameter setting completes, the display shown on the left blinks for about one second.
6		After about one second		The display changes from “donE” to the display shown on the left.
7		 (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.

8.2.6 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		 (DSPL/SET Key)	 MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
2				Press the UP or DOWN Key to select Fn006. Note: The enabled digit blinks.
3		 (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		 (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		After about one second		The display changes from "donE" to the display shown on the left.
6		 (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.

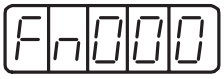
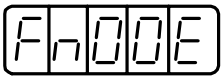
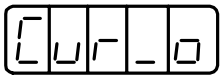
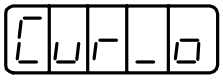
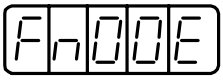
8.2.7 Automatic Offset-adjustment of Motor Current Detection Signal (Fn00E)

Automatic 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 force ripple caused by current offset. Automatic adjustment is possible only with power supplied to the main circuit power supply and with the servo OFF.

IMPORTANT

Execute the automatic offset adjustment if the force ripple is too big when compared with that of other SERVOPACKs.

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 utility function mode.
2				Press the UP or DOWN Key to select Fn00E. Note: The enabled digit blinks.
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, and the display will be as shown on the left.
4		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		After about one second		The display changes from “donE” to the display shown on the left.
6		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.

8.2.8 Manual Offset-adjustment of Motor Current Detection Signal (Fn00F)

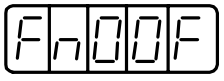
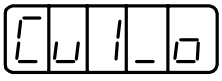
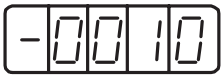
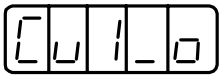
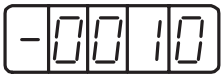
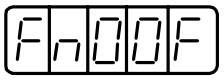
The adjusting range of the motor current detection offset is -512 to +511.

To adjust the offset, perform the automatic adjustment (Fn00E) first.

And if the force 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 mm/s, and adjust the operator until the force monitor ripple is minimized. (Refer to *10.5 Analog Monitor*.) Adjust the phase-U and phase-V offsets alternately several times until these offsets are well balanced.

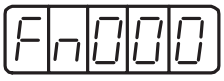
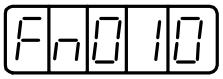
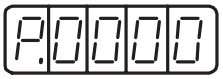
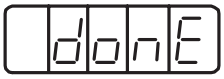
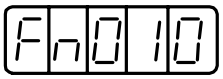
Step	Display after Operation	Digital Operator	Panel Operator	Description
1		DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
2		∧ ∨	▲ ▼	Press the UP or DOWN Key to select Fn00F. Note: The enabled digit blinks.
3		DATA ENTER (DATA/ENTER 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, and the display will be as shown on the left (phase U).
4		< >	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the LEFT or RIGHT or DATA/SHIFT Key for less than one second to display the phase-U offset amount.
5		∧ ∨	▲ ▼	Press the UP or DOWN Key to adjust the offset. Carefully adjust the offset while monitoring the force reference monitor signal.
6		< >	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the LEFT or RIGHT or DATA/SHIFT Key for less than one second. The display shown on the left appears.
7		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		< >	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the LEFT or RIGHT or DATA/SHIFT Key for less than one second to display the phase-V offset amount.
9		∧ ∨	▲ ▼	Press the UP or DOWN Key to adjust the offset. Carefully adjust the offset while monitoring the force reference monitor signal.
10		< >	DATA◀ (DATA/SHIFT Key) (Press at least 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		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.

8.2.9 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 *8.2.1 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		 (DSPL/SET Key)	 MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
2				Press the UP or DOWN Key to select Fn010. Note: The enabled digit blinks.
3		 (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				Press the UP or DOWN Key to set a value: "0000": Write permitted, "0001": Write prohibited
5		 (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		After about one second		The display changes from "donE" to "P.000□."
7		 (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.

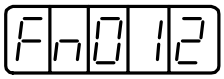
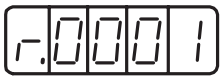
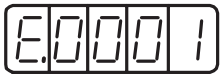
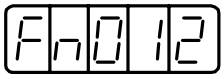
8.2.10 Motor Models Display (Fn011)

This mode is used for motor maintenance, 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.

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	Fn011	▲ ▼	▲ ▼	Press the UP or DOWN Key to select Fn011. Note: The enabled digit blinks.
3	F.0140	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 linear servomotor model and voltage code. F.0140 Linear Servomotor Voltage: Data 01 = 200 VAC or 280 VDC; Data 02 = 400 VAC or 560 VDC Linear Servomotor Type: Data 40 = Linear servomotor
4	P.0010	DSPL/SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	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.
5	E.0017	DSPL/SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key, and the linear scale type and resolution code will be displayed. E.0013 Linear Scale Type: Data 00 = Incremental Scale Pitch Multiplication: Data 8 = 8-bit
6	y.0010	DSPL/SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	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
7	Fn011	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 Fn011.

8.2.11 Software Version Display (Fn012)

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

Step	Display after Operation	Digital Operator	Panel Operator	Description
1		 (DSPL/SET Key)	 MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
2				Press the UP or DOWN Key to select Fn012. Note: The enabled digit blinks.
3		 (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 number.
4		 (DSPL/SET Key)	 MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to display the encoder software version number.
5		 (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.

8.2.12 Application Module Detection Results Clear (Fn014)

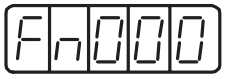
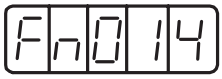
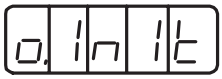
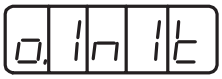
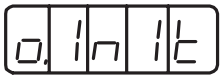
The alarm A.E7 (application module detection error) occurs when turning ON the power for the first time when the SERVOPACK is used without application module after the SERVOPACK has been used with application module.

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		 (DSPL/SET Key)	 MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
2				Press the UP or DOWN Key to select the Fn014. Note: The enabled digit blinks.
3		 (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	 Blinks ↓ 	 (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		After about one second		The display changes from “donE” to the display shown on the left.
6		 (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.

8

8.3 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.

8.3.1 Setting Parameters

(1) Value Setting Parameters

(a) Types of Value Setting Parameters

Refer to *12.4.2 List of Parameters.*

(b) Example of Changing Value Setting Parameter

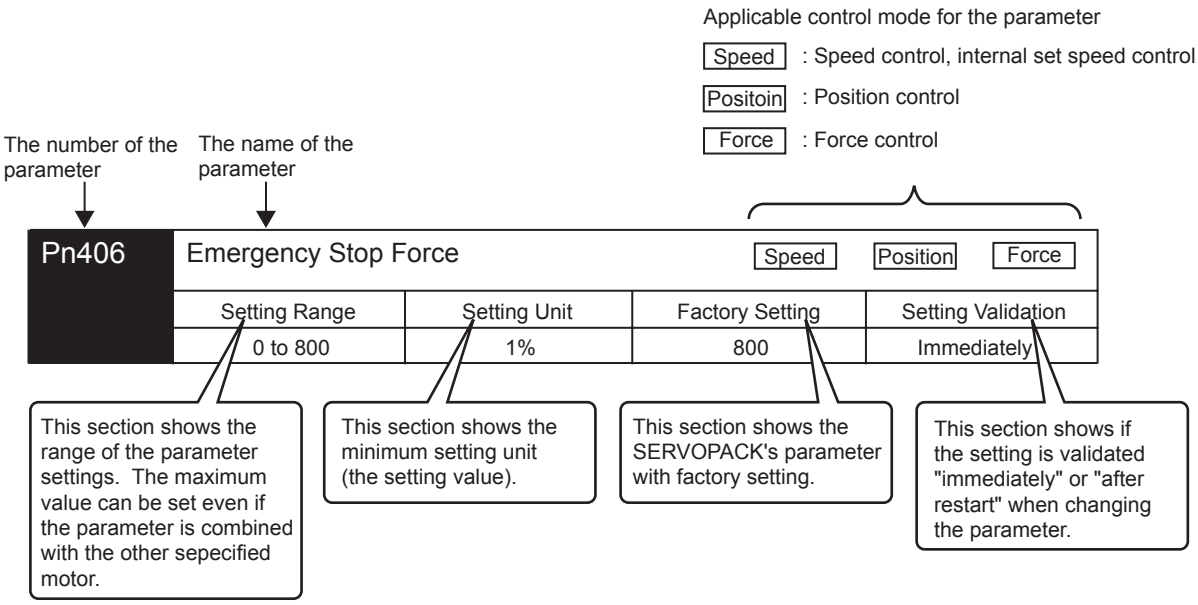
The parameter settings can be used for changing parameter data. Before changing the data, check the permitted range of the parameter.

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

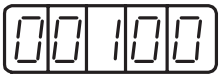
Step	Display after Operation	Digital Operator	Panel Operator	Description
1	Pn100	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the parameter setting mode. If a parameter other than Pn100 is displayed, press the UP or DOWN Key to select Pn100. Note: The enabled 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

8

(2) Function Selection Parameters

(a) Types of Function Selection Parameters

Refer to *12.4.2 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 and Pn110.0 require the power to be reset as mentioned above.
- Pn10B.0, Pn110.1, and Pn110.2 are enabled with the off-line, so the power does not have to be reset.

Category	Parameter No.	Name	Factory Setting	Setting Validation
Function Selection Parameter	Pn000	Function Selection Basic Switch	0000	After restart
	Pn001	Function Selection Application Switch 1	0000	After restart
	Pn002	Function Selection Application Switch 2	0000	After restart
	Pn003	Function Selection Application Switch 3	0002	Immediately
	Pn080	Function Selection Application Switch 80	0000	After restart
Servo Gain Related Parameter	Pn10B	Gain Application Switches	0000	After restart/ Immediately
	Pn110	Online Autotuning Switches	0010	After restart/ Immediately
Position Control Related Parameter	Pn200	Position Control References Selection Switches	0000	After restart
	Pn207	Position Control Function Switches	0000	After restart
	Pn218	Reference Pulse Multiplication Function Selection (For the software version 32 or later)	0000	After restart
Force Control Related Parameter	Pn408	Force Function Switches	0000	Immediately
Sequence Related Parameter (Input Signal Selection)	Pn50A	Input Signal Selection 1	2100	After restart
	Pn50B	Input Signal Selection 2	6543	After restart
	Pn50C	Input Signal Selection 3	8888	After restart
	Pn50D	Input Signal Selection 4	8888	After restart
	Pn513	Input Signal Selection 5 (For the software version 32 or later)	0088	After restart
Sequence Related Parameter (Output Signal Selection)	Pn50E	Output Signal Selection 1	3211	After restart
	Pn50F	Output Signal Selection 2	0000	After restart
	Pn510	Output Signal Selection 3	0000	After restart
	Pn512	Output Signal Reversal Setting	0000	After restart

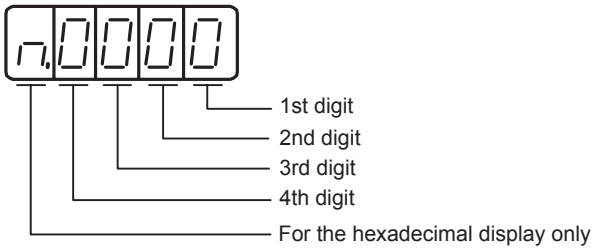
(b) Example of Changing Function Selection

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)		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 *12.4.2 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.

8.3.2 Input Circuit Signal Allocation

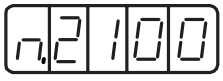
Each input signal is allocated to a pin of the input connector CN1 by setting the parameter.

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: 

Pn50B: 

(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	Valid-ity Level	Input Signal	CN1 Input Pin Allocation							Connection Not Required (SERVOPACK judges the connection)	
Parameter Setting Allocation			40	41	42	43	44	45	46	Always ON	Always OFF
Servo ON Pn50A.1 = n.xx□x	L	/S-ON	0	1	2	3	4	5	6	7	8
	H	S-ON	9	A	B	C	D	E	F		
Proportional Operation Reference Pn50A.2 = n.x□xx	L	/P-CON	0	1	2	3	4	5	6	7	8
	H	P-CON	9	A	B	C	D	E	F		
Forward Run Prohibited Pn50A.3 = n.□xxx	H	P-OT	0	1	2	3	4	5	6	7	8
	L	/P-OT	9	A	B	C	D	E	F		
Reverse Run Prohibited Pn50B.0 = n.xxx□	H	N-OT	0	1	2	3	4	5	6	7	8
	L	/N-OT	9	A	B	C	D	E	F		
Alarm Reset Pn50B.1 = n.xx□x	L	/ARM-RST	0	1	2	3	4	5	6	–	8
	H	ARM-RST	9	A	B	C	D	E	F		
Forward External Force 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 Force 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		
Internal 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		
Internal Set Speed Selection Pn50C.1 = n.xx□x	L	/SPD-A	0	1	2	3	4	5	6	7	8
	H	SPD-A	9	A	B	C	D	E	F		
Internal Set Speed Selection Pn50C.2 = n.x□xx	L	/SPD-B	0	1	2	3	4	5	6	7	8
	H	SPD-B	9	A	B	C	D	E	F		
Control Method Selection Pn50C.3 = n.□xxx	L	/C-SEL	0	1	2	3	4	5	6	7	8
	H	C-SEL	9	A	B	C	D	E	F		
Zero Clamp Pn50D.0 = n.xxx□	L	/ZCLAMP	0	1	2	3	4	5	6	7	8
	H	ZCLAMP	9	A	B	C	D	E	F		
Reference Pulse Inhibit Pn50D.1 = n.xx□x	L	/INHIBIT	0	1	2	3	4	5	6	7	8
	H	INHIBIT	9	A	B	C	D	E	F		
Gain Changeover 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		
Polarity Detection Pn50D.3 = n.□xxx	L	/P-DET	0	1	2	3	4	5	6	7	8
	H	P-DET	9	A	B	C	D	E	F		
Reference Pulse Input Multiplication* Pn513.0 = n.xxx□	L	/P-SEL	0	1	2	3	4	5	6	7	8
	H	P-SEL	9	A	B	C	D	E	F		

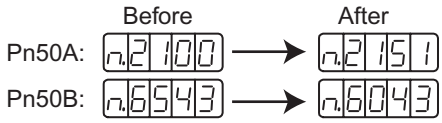
* This function is valid for the software version 32 or later.

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 Force Limit (/P-CL) allocated to CN1-45 is shown below.



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)	DATA/◀ (DATA/SHIFT 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).			

8.3.3 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)		Remark
Parameter Setting Allocation		Pn512=n.xxx□		Pn512=n.xx□x		Pn512=n.x□xx		
		0	1	0	1	0	1	
Positioning Completion (/COIN) Pn50E.0 = n.xxx□	0	Invalid						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.
	1	L	H					
	2			L	H			
	3					L	H	
Speed Coincidence Detection (/V-CMP) Pn50E.1 = n.xx□x	0	Invalid						
	1	L	H					
	2			L	H			
	3					L	H	
Movement Detection (/TGON) Pn50E.2 = n.x□xx	0	Invalid						
	1	L	H					
	2			L	H			
	3					L	H	
Servo Ready (/S-RDY) Pn50E.3 = n.□xxx	0	Invalid						
	1	L	H					
	2			L	H			
	3					L	H	
Force Limit Detection (/CLT) Pn50F.0 = n.xxx□	0	Invalid						
	1	L	H					
	2			L	H			
	3					L	H	
Speed Limit Detection (/VLT) Pn50F.1 = n.xx□x	0	Invalid						
	1	L	H					
	2			L	H			
	3					L	H	
Brake (/BK) Pn50F.2 = n.x□xx	0	Invalid						
	1	L	H					
	2			L	H			
	3					L	H	
Warning (/WARN) Pn50F.3 = n.□xxx	0	Invalid						
	1	L	H					
	2			L	H			
	3					L	H	
Near (/NEAR) Pn510.0 = n.xxx□	0	Invalid						
	1	L	H					
	2			L	H			
	3					L	H	
Reference Pulse Input Multiplication (/PSELA)* Pn510.2 = n.x□xx	0	Invalid						
	1	L	H					
	2			L	H			
	3					L	H	

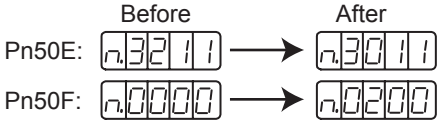
* This function is valid for the software version 32 or later.

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 Movement 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.



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 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).			

8.4 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.

8.4.1 List of Monitor Modes

Parameter No.	Content of Display	Unit
Un000	Actual motor speed	mm/s
Un001	Input speed reference (Valid only in speed control mode)	mm/s
Un002	Internal force reference (in percentage to the rated force)	%
Un003	Electrical angle 1 (16-bit decimal code)	Number of pulses from the phase-U (0°)
Un004	Electrical angle 2 (Angle from 0 (zero) degree of phase-U))	deg
Un005 *1	Input signal monitor	−
Un006 *1	Output signal monitor	−
Un007	Input reference pulse speed (valid only in position control mode)	mm/s
Un008	Error counter value (amount of position error) (valid only in position control mode)	reference unit
Un009	Accumulated load rate (value for the rated force as 100 %. Displays effective force 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 *2	Input reference pulse counter (32-bit hexadecimal code) (valid only in position control mode)	−
Un00D *2	Feedback pulse counter (32-bit hexadecimal code)	−
Un010	Allowable maximum motor speed and dividing ratio monitor (For the software version 32 or later)	100 mm/s or pulse/ scale pitch (Pn280)
Un011	Hall sensor signal monitor (For the software version 32 or later)	−

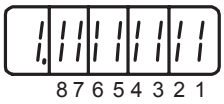
* 1. Refer to *8.4.2 Sequence I/O Signal Monitor Display*.
* 2. Refer to *8.4.4 Monitor Display of Reference Pulse Counter and Feedback Pulse Counter*.

8.4.2 Sequence I/O Signal Monitor Display

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

(1) Input Signal Monitor Display

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

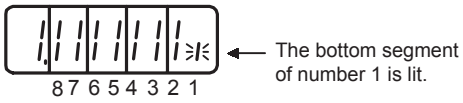


Refer to *8.3.2 Input Circuit Signal Allocation* for the relation between input terminals and signals.

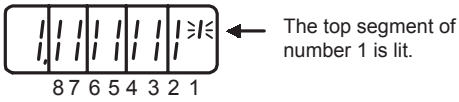
Display LED Number	Input Terminal Name	Factory Setting
1	CN1-40	/S-ON
2	CN1-41	/P-CON
3	CN1-42	P-OT
4	CN1-43	N-OT
5	CN1-44	/ALM-RST
6	CN1-45	/P-CL
7	CN1-46	/N-CL

◀ EXAMPLE ▶

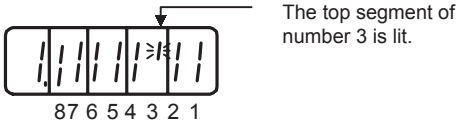
- When /S-ON signal is ON (Servo ON at L level)



- When /S-ON signal is OFF



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



8

(2) Output Signal Monitor Display

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



Refer to *8.3.3 Output Circuit Signal Allocation* for the relation between output terminals and signals.

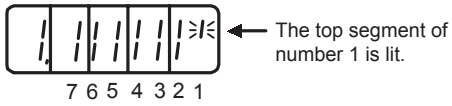
Display LED Number	Output Terminal Name	Factory Setting
1	CN1-31, -32	ALM
2	CN1-25, -26	/COIN or /V-CMP
3	CN1-27, -28	/TGON
4	CN1-29, -30	/S-RDY
5	CN1-37	AL01
6	CN1-38	AL02
7	CN1-39	AL03

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.)



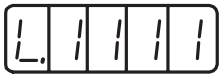
8.4.3 Operation in Monitor Mode

The example below shows how to display the contents of monitor number Un000 when the linear servomotor runs at 1500 mm/s.

Step	Display after Operation	Digital Operator	Panel Operator	Description
1		 (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 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 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.

8.4.4 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		 (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 “Un00C” or “Un00D.”
3	 The upper 16-bit data	 (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	 The lower 16-bit data			Press the UP or DOWN Key to display the lower 16-bit data.
5		 (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		 (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.

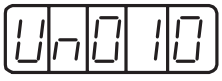
When the control power supply is turned ON, reference pulse and feedback pulse will be “0.” The pulse numbers will increase when the servomotor moves in the counting-up direction of the linear scale (phase-A progression) and decrease when the servomotor moves in the counting-down direction of the linear scale (phase-B progression).

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

When using the 8-bit serial converter unit, the feedback pulse will be 256 pulses/scale pitch.

8.4.5 Allowable Maximum Motor Speed for Dividing Ratio Monitor (For the software version 32 or later)

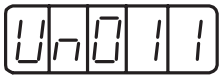
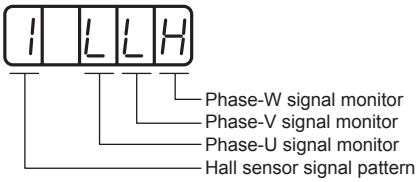
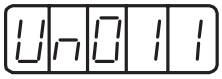
This section describes the monitor display for determining the maximum speed (Pn384) for the PG Divider (Pn281). Adjust the setting of Pn080.3 to select the location to be monitored. This function is available for Servopack Software version 32 or later.

Step	Display after Operation	Digital Operator	Panel Operator	Description
1		 (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 “Un010.”
3		 (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 motor maximum speed that can be set.
4		 (DSPL/SET Key)	 MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to display the maximum dividing ratio that can be set.
5		 (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.

8.4.6 Hall Sensor Signal Monitor (For the software version 32 or later)

This section describes the monitor display for the signal patterns of the hall sensor.

This function is available for Servopack Software version 32 or later.

Step	Display after Operation	Digital Operator	Panel Operator	Description
1		 (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 “Un011.”
3		 (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 hall sensor signal pattern. 
4		 (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.

Hall Sensor Signal Pattern	Signal Monitor		
	Phase-U	Phase-V	Phase-W
0	L	L	L
1	L	L	H
2	L	H	L
3	L	H	H
4	H	L	L
5	H	L	H
6	H	H	L
7	H	H	H

8

9

Operation

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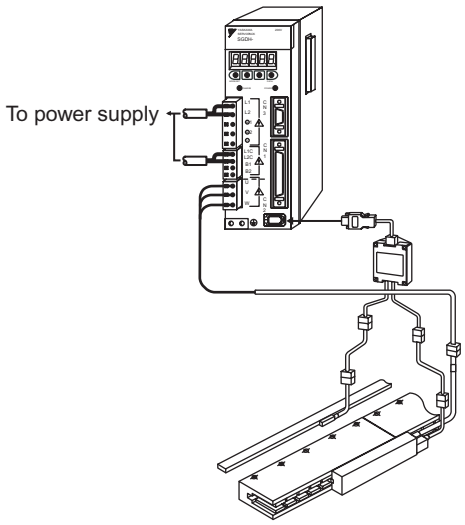
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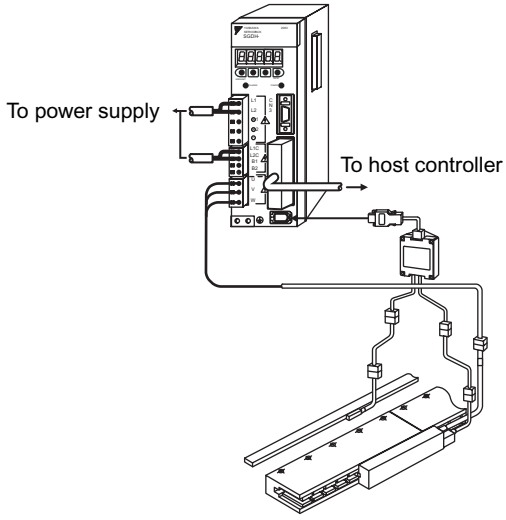
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9.1 Trial Operation

Perform a trial operation after wiring is completed.

Use the following procedure to perform a trial operation. The procedures for Speed Control Mode (standard setting) and Position Control Mode are described in this chapter. When a specific explanation is not provided, use the default parameters.

(1) Trial Operation Using SERVOPACK Internal References (Refer to *9.2 Trial Operation Using SERVOPACK Internal References*.)	
	■ Purpose Run the linear servomotor without host reference input. Check that the following wiring and settings are correct. • Power supply circuit wiring • Linear servomotor wiring • Serial converter unit wiring • Linear scale wiring • Hall sensor wiring • Scale pitch setting • Scale signal count direction and count quantity • Motor movement direction and movement speed • Force limit parameter setting • Polarity detection operation (only if polarity detection is used.)

(2) Trial Operation Using Host References (Refer to *9.3 Trial Operation for Linear Servomotor without Load from Host Reference*.)	
	■ Purpose Run the linear servomotor with host reference input. Check that the following wiring and settings are correct. • I/O signal wiring with the host controller • Linear servomotor movement direction, movement speed, and movement distance • Operation of brake, overtravel, and other protective functions • Required parameter settings

Step	Item	Description	Reference
1	Installation and mounting	Install the linear servomotor and SERVOPACK according to the installation conditions.	–
↓			
2	Wiring and connections	Wire and connect the power supply circuit (L1, L2, or L1, L2, L3), linear servomotor (U, V, W), input signal (CN1), and serial converter unit (CN2). Disconnect the CN1 connector during trial operation using SERVOPACK internal references (Refer to *9.2 Trial Operation Using SERVOPACK Internal References*).	–
↓			
3	Turn ON the power.	Turn ON the power. Check the panel operator to make sure that the SERVOPACK is running normally. The alarm A.08 does not indicate an error.	–
↓			
4	Linear scale check	Set the linear scale pitch (Pn280). After setting validation, check the linear scale status using the panel operator.	–
↓			
5	Polarity detection operation check (only for detection)	Check whether the polarity is being correctly detected.	–
↓			
6	Jog operation	After setting the mass ratio (Pn103), perform jog operation.	Jog operation
↓			
7	Connect input signals.	Connect I/O signals (CN1) necessary for the trial operation to the SERVOPACK.	–
↓			
8	Check input signals.	Check the input signals using the internal monitor function. Turn ON the power, and check that the emergency stop, brake, overtravel, and other protective functions are operating correctly.	–
↓			
9	Input servo ON signal.	Input the servo ON signal, and turn ON the linear servomotor.	Host reference
↓			
10	Input reference	Input the reference for the control mode being used, and check that the linear servomotor is operating normally.	Host reference
↓			
11	Set necessary parameters.	Run the linear servomotor from the host controller in the same way as in step 10, and set the required parameters so that the machine movement direction, movement distance, and movement speed are the same as the references.	Host reference
↓			
12	Operation	The linear servomotor can now be run. Adjust the servo gain if necessary. Refer to *10.1 Autotuning*. If an error occurs, refer to *Section 11 Inspection, Maintenance, and Troubleshooting*.	Host reference

9.2 Trial Operation Using SERVOPACK Internal References

9.2.1 SERVOPACK Setup Procedure

The setup procedures for combinations of a linear servomotor with hall sensor and those for combinations of a linear servomotor without a hall sensor are different. Use the setup procedure appropriate for the system being used.

Category	Setup procedure for linear servomotors with hall sensors	Setup procedure for linear servomotors without hall sensors
Procedure	1. Install and wire the linear servomotor and linear scale. 2. Adjust the linear scale. 3. Connect the cables. 4. Set the linear scale pitch. 5. Check the feedback signal. 6. Perform jog operation from the panel operator. 7. Set the force limit.	1. Install and wire the linear servomotor and linear scale. 2. Adjust the linear scale. 3. Connect the cables. 4. Set the linear scale pitch. 5. Select *No Hall Sensor* in the parameters. 6. Check the feedback signal. 7. Assign polarity detection start input (/P-DET). 8. Set the mass ratio. 9. Set the overtravel signal. 10. Set the force limit. 11. Check the polarity detection operation. 12. Adjust the polarity detection. 13. Perform a jog operation from the panel operator.

9.2.2 Setup Procedure Using Linear Servomotors with Hall Sensors

Perform the following steps 1 to 7 in order.

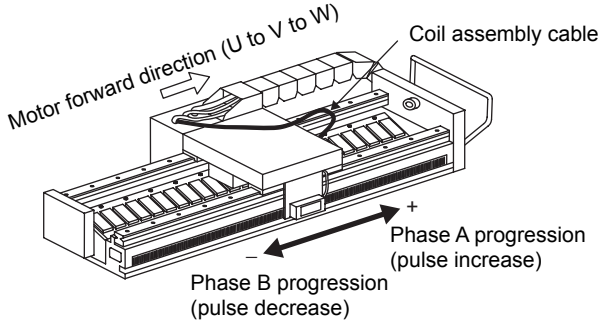
(1) Installation and Wiring of the Linear Servomotor and Linear Scale

Install the coil assembly and linear scale so that the motor forward direction and linear scale count up direction are the same.

IMPORTANT

If the motor forward direction and linear scale count up direction do not match and the linear servomotor is run in this state, the linear servomotor may not operate or overrun may occur.

When using linear Σ-series servomotors, the motor forward direction (coil assembly's movement direction when current flows through phases U, V, and W, in that order) is toward the side from which the motor cable is extended.
The analog 1-V p-p voltage input from the linear scale to the serial converter unit is counted during phase A (cos signal) progression.



INFO

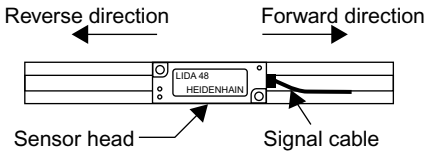
■ Motor Forward Direction and Linear Scale Count Direction Do Not Match

If the motor forward direction and linear scale count direction are opposite due to wiring or other factors, set the parameter Pn080.1=1 (B-phase progression, U, V, W-phase in order : Available only for the software version 32 or later).

■ Linear Scale Count Direction

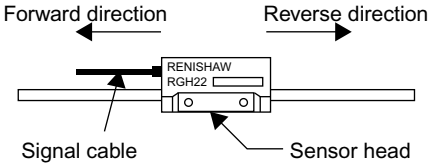
The Heidenhain or Renishaw linear scale counts pulses when the sensor head is operated to the side attached the signal cable. However, the direction in which the signal cable is extended is different, so the count direction is different. (Viewed from above).

• Heidenhain linear scale



When installed as shown in the diagram on the left, operation is performed in the forward direction when the sensor head is moved to the right.

• Renishaw linear scale



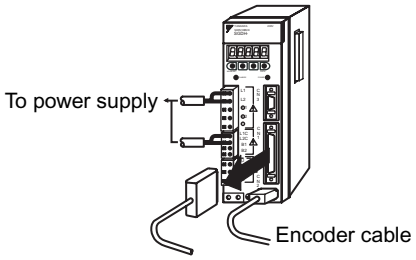
When installed as shown in the diagram on the left, operation is performed in the forward direction when the sensor head is moved to the left.

(2) Adjusting the Linear Scale

When the linear scale is an open type, adjust the head installation. For details on the adjustment method, contact the manufacturer of the scales.
When the linear scale is a sealed type, adjustment is not required. But the dimensional tolerances for installation must be maintained.

(3) Connecting the Cables

Check the power supply circuit, linear servomotor and encoder wirings. Do not connect the I/O signal connector (CN1).
For main circuit wiring examples, refer to *7.2 Wiring Main Circuit*.
For details on the linear servomotor's main circuit cable and encoder cable, refer to *2.6 Selecting Peripheral Devices*.



9

(4) Setting the Linear Scale Pitch (Grating)

Turn ON the control power supply.

When the power is supplied normally, the panel operator on the front panel of the SERVOPACK will show the following display. A linear scale pitch setting error (A.08) will be displayed, but does not indicate an error. Set the scale pitch (Pn280) according to the scale being used. After setting validation of the control power, the A.08 alarm will be cleared, and the settings will be enabled.

Normal status



If an alarm other than A.08 is displayed, as shown in the following diagram, the power supply circuit, linear servomotor main circuit cable or encoder cable wiring is the probable cause. Shut down the power supply, specify the location causing the alarm, and take corrective measures so that the display returns to the above normal status. For details on alarms, refer to *11.1 Troubleshooting*.

Example of alarm display



Pn280	Linear Scale Pitch		Speed / Position / Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 65535	1 μm	0 μm	After restart

If the linear scale pitch (Pn280) is not set correctly, the linear servomotor cannot be controlled. Make sure that the correct value is set before operating the linear servomotor.

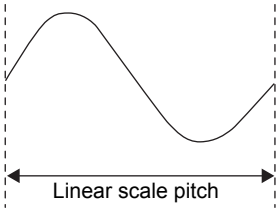
When using a SERVOPACK right after factory shipment, the alarm A.08 (Linear Scale Pitch Setting Error) will be displayed but does not indicate an error. This alarm is generated to remind the user to set Pn280. After setting the correct value and setting validation, the alarm A.08 is cleared.

Control is performed the SERVOPACK using 1/256 the distance of the scale pitch as a minimum feedback pulse. The count is performed in the serial converter unit using 1/256 of the linear scale pitch.

Make sure that the scale pitch satisfies the following conditions.

$$\text{Value of } \frac{64000}{\text{Scale pitch } (\mu m)} = \text{Integer}$$

Examples
Corrent: 1, 2, 4, 8, 10 ,16, 40
Incorrect: 3, 12, 18



Linear scale pitch (Pn280) =
Distance of one cycle of the analog voltage feedback signal.

(5) Checking the Feedback Signal

Check the following feedback signals to the SERVOPACK.

- Check whether the signals from the linear scale are correctly received.
- Check whether the motor forward direction and linear scale count direction are the same.

IMPORTANT

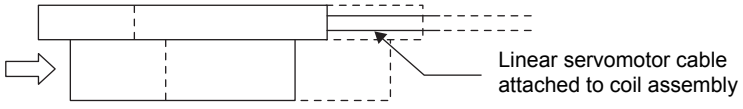
1. Before checking the feedback signals, be sure to set Pn000.0 to 0 (counting-up direction of the linear scale (phase-A progression) as forward direction). If Pn000.0 is set to a value other than zero, the linear servomotor may not run.
2. Be sure to check the feedback signals before operating the linear servomotor. If the linear servomotor is operated without checking the feedback signals, the linear servomotor may not run, or overrun may occur.

(a) Checking the Signals from the Linear Scale

1. Turn ON the control power to the SERVOPACK and set to servo OFF status.
2. Displays the monitor mode parameter Un00D (Feedback Pulse Counter) on the panel operator or digital operator.
3. Move the linear servomotor from end to end of the stroke by hand, and check whether the correct number of feedback pulses is returned.

◀ EXAMPLE ▶

Using a linear scale with a scale pitch of 20 μm, if the linear servomotor is moved only 1 cm by hand in the linear scale's count direction, the number of feedback pulses will be as follows:
1 cm/ (20 μm/256) = 12,800 pulses



When the linear servomotor is moved by hand to the side with the cable and the value of Un00D is 1F400 or FFFE0C00, confirmation is completed.

Note: The actual monitor display will deviate by the error in movement distance only, so a value that is close to the above value is acceptable.

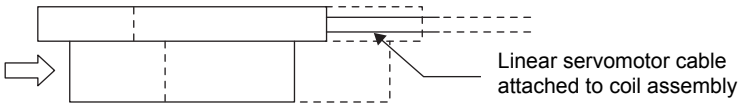
INFO

■ When the Value of the Un00D is incorrect

- If the Un00D value is not displayed correctly, the following conditions may be present. Check the conditions and take appropriate countermeasures.
- The scale pitch of the linear scale does not match.
  If the scale pitch set in Pn280 is different from the actual scale pitch, the assumed number of feedback pulses will not be returned. Check the specifications of the linear scale.
- The linear scale has not been adjusted.
  If the linear scale is not adjusted, the linear scale's output signal level will drop and the count will not be correct. Check that the linear scale is correctly adjusted. For details, contact the scale's manufacturer.
- The wiring between the linear scale and serial converter unit is not correct.
  If the wiring is not correct, a normal count will not be performed. Rewire the devices correctly.

(b) Checking the Concurrence between the Linear Scale Count Direction and the Linear Servomotor Forward Direction

Next, move the coil assembly by hand in the direction of the side with the cable, and check that the Un00D monitor is counting up.



When the linear servomotor is moved by hand to the side with the cable, if the value of Un00D is a countup value, confirmation is completed.

INFO

■ When the Value of the Un00D is counted down

When the value of the Un00D is a counted down, set the parameter Pn080.1 = 1 (B-phase progression, U, V, W-phase in order). Enable the setting by setting validation.

With this setting, the SERVOPACK performs current control by treating the linear scale countup direction as the motor forward direction.

(c) Related Parameters

Pn080.1 is available for software version 32 or later.

Parameter		Description
Pn080	n.☐☐**0**☐	Phase-A progression, phase-U, V, W order (factory setting)
	n.☐☐**1**☐	Phase-B progression, phase-U, V, W order

(6) Jog Operation from the Panel Operator

IMPORTANT

When turning ON the servo for the first time after installation and wiring, stand away from the motor moving part as overrun may occur.

1. To perform a trial operation with a load attached, set mass ratio (Pn103) before running.
   When the calculated mass ratio exceeds 20000%, set 20000 in the parameter and adjust loop gains.

Pn103	Mass Ratio		Speed / Position / Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 20000 %*	1 %	0 %	Immediately

Use the following formula to obtain the mass ratio.

$$\text{Mass ratio (Pn103)} = \left(\frac{\text{Load mass (including mass of coil assembly)}}{\text{Coil assembly mass}} - 1 \right) \times 100 \ [\%]$$

* This setting range is applicable for software version 32 or later. The range for software earlier than version 32 is 0% to 10,000%.

INFO

Perform trial operations without a load attached, where possible.

2. Turn ON the control power supply and main circuit power supply.
3. Operate the panel operator or digital operator and move the linear servomotor using jog operation. For details on jog operation, refer to *8.2.3 JOG Mode Operation (Fn002)*.
4. Check that the linear servomotor moves normally from end to end of the stroke.

INFO

■ Unsuccessful Trial Operations

An unsuccessful trial operation could be attributed to the following conditions. Check the conditions and take appropriate measures.

- The load is too heavy, or the jog speed is too fast, resulting in force reference saturation.
  Set the force limit referring to *(7) Setting Force Limit*. If the force reference remains saturated, lighten the load or lower the jog speed.
- The linear servomotor is moving slightly and then stops.
  The linear servomotor, hall sensor, and linear scale are out of alignment. Check the wiring, scale pitch setting, linear scale count, and whether the motor forward direction matches the scale countup direction.
- The alarm A.C2 (phase error detection) occurs when the linear servomotor moves.
  The count direction of the linear scale signal is not correct, or the count may not be normal. Perform *(5) Checking the Feedback Signal* again.
- If the count is normal, the malfunction may be caused by noise. Check the wiring and ground conditions of the SERVOPACK, serial converter unit, and linear servomotor.

(7) Setting Force Limit

To prevent danger during setup of the linear servomotor, the factory settings for the forward force limit (Pn483) and reverse force limit (Pn484) parameters are set to small value (factory setting: 30%).
When the linear servomotor moves normally in jog operation mode, increase the value set for parameters Pn483 and Pn484 to the force required. Set the value to the maximum value if no particular restricting conditions apply.

Pn483	Forward Force Limit		Speed	Position	Force
	Setting Range	Setting Unit	Factory Setting	Setting Validation	
	0 to 800 %	1 %	30 %	Immediately	
Pn484	Reverse Force Limit		Speed	Position	Force
	Setting Range	Setting Unit	Factory Setting	Setting Validation	
	0 to 800 %	1 %	30 %	Immediately	

9.2.3 Setup Procedure Using Linear Servomotors without Hall Sensors

Perform the following steps 1 to 13.

(1) Checking Operating Conditions

Make sure that the following conditions are satisfied when performing polarity detection.

- No problems when linear servomotor is moved approximately 2 mm.
- Scale pitch must be within 100 μm (within 40 μm recommended).
- Minimum unequal external force on the linear servomotor (5% max. of rated force is recommended).
- Mass ratio less than 30 times.
- On a horizontal axis.
- Friction on the guide is a percentage of the rated force (air slide not used).

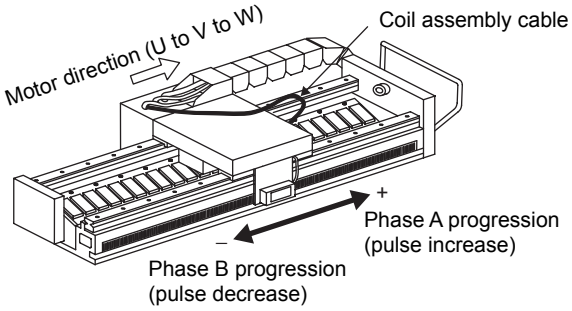
(2) Installation and Wiring the Linear Servomotor and Linear Scale

Install the coil assembly and linear scale so that the motor forward direction and linear scale count direction are the same.

IMPORTANT

If the motor forward direction and linear scale count directions do not match and the linear servomotor is run in this state, the linear servomotor may not operate or overrun may occur.

When using linear Σ-series servomotors, the motor forward direction (coil assembly's direction of progression when current flows in phase order U, V, and W) is toward the side from which the cable is extended. The analog 1-V p-p voltage input from the linear scale to the serial converter unit is counted up during phase A (cos signal) progression.



INFO

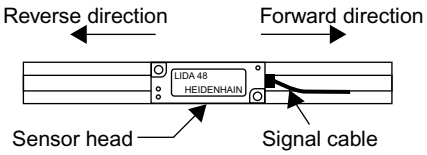
■ When Motor Forward Direction and Linear Scale Count Direction Do Not Match

When the motor forward direction and linear scale count direction are reversed due to wiring or other factors, set so that parameter Pn080.1 = 1 (B-phase progression, U, V, W-phase in order).

■ Linear Scale Count Direction

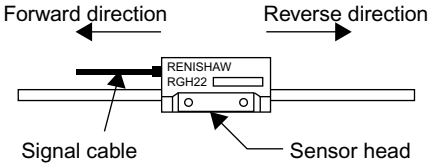
The Heidenhain or Renishaw linear scale counts pulses when the sensor head is operated to the side attached the signal cable. However, the direction in which the signal cable is extended is different, so the count direction is different. (Viewed from above).

• Heidenhain linear scale



When installed as shown in the diagram on the left, operation is performed in the forward direction when the sensor head is moved to the right.

• Renishaw linear scale



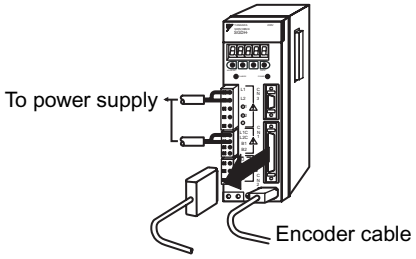
When installed as shown in the diagram on the left, operation is performed in the forward direction when the sensor head is moved to the left.

(3) Adjusting the Linear Scale

When the linear scale is an open type, adjust the head installation. For details on the adjustment method, contact the manufacturer of the scales.
When the linear scale is a sealed type, adjustment is not required. But the dimensional tolerances for installation must be maintained.

(4) Connecting the Cables

Check the power supply circuit, linear servomotor and encoder wirings. Do not connect the I/O signal connector (CN1).
For main circuit wiring examples, refer to *7.2 Wiring Main Circuit*.
For details on the linear servomotor's main circuit cable and encoder cable, refer to *2.6 Selecting Peripheral Devices*.



9

(5) Setting the Linear Scale Pitch

Turn ON the control power supply.

When the power is supplied normally, the panel operator on the front panel of the SERVOPACK will show the following display. A linear scale pitch setting error (A.08) will be displayed, but does not indicate an error. Set the scale pitch (Pn280) according to the scale being used. After setting validation of the control power, the A.08 alarm will be cleared, and the settings will be enabled.

Normal status



If an alarm other than A.08 is displayed, as shown in the following diagram, the power supply circuit, linear servomotor main circuit cable or encoder cable wiring is the probable cause. Shut down the power supply, specify the location causing the alarm, and take corrective measures so that the display returns to the above normal status. For details on alarms, refer to *11.1 Troubleshooting*.

Example of alarm display



Pn280	Linear Scale Pitch		Speed Position Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 65535	1 μm	0 μm	After restart

If the linear scale pitch (Pn280) is not set correctly, the linear servomotor cannot be controlled. Make sure that the correct value is set before operating the linear servomotor.

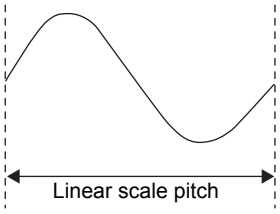
When using a SERVOPACK right after factory shipment, the alarm A.08 (Linear Scale Pitch Setting Error) will be displayed but does not indicate an error. This alarm is generated to remind the user to set Pn280. After setting the correct value and setting validation, the alarm A.08 is cleared.

Control is performed the SERVOPACK using 1/256 the distance of the scale pitch as a minimum feedback pulse. The count is performed in the serial converter unit using 1/256 of the linear scale pitch.

Make sure that the scale pitch satisfies the following conditions.

$$\text{Value of } \frac{64000}{\text{Scale pitch } (\mu m)} = \text{Integer}$$

Examples
Corrent: 1, 2, 4, 8, 10 ,16, 40
Incorrect: 3, 12, 18



Linear scale pitch (Pn280) =
Distance of one cycle of the analog voltage feedback signal.

(6) Selecting No Hall Sensor

Select *No Hall Sensor* for the parameter Pn080.0. The factory setting is Pn080.0 = 0 (With hall sensor), so the setting will change to Pn080.0 = 1 (No hall sensor). The setting validation is required to enable the settings.

Parameter		Description
Pn080	n.□□□**0**	With hall sensor (factory setting)
	n.□□□**1**	No hall sensor

When Pn080.0 = 0 is set without connecting a hall sensor, the alarm A.C2 (phase error detection) alarm will occur when the power is turned ON.

(7) Checking the Feedback Signal

Check the following feedback signals to the SERVOPACK.

- Check whether the signals from the linear scale are correctly received.
- Check whether the motor forward direction and linear scale count direction are the same.

IMPORTANT

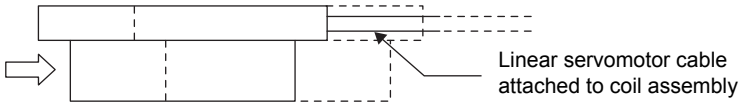
1. Before checking the feedback signals, be sure to set Pn000.0 to 0 (counting-up direction of the linear scale (phase-A progression) as forward direction). If Pn000.0 is set to a value other than zero, the linear servomotor may not run.
2. Be sure to check the feedback signals before operating the linear servomotor. If the linear servomotor is operated without checking the feedback signals, the linear servomotor may not run, or overrun may occur.

(a) Checking the Signals from the Linear Scale

1. Turn ON the control power to the SERVOPACK and set to servo OFF status.
2. Displays the monitor mode parameter Un00D (Feedback Pulse Counter) on the panel operator or digital operator.
3. Move the linear servomotor from end to end of the stroke by hand, and check whether the correct number of feedback pulses is returned.

◀ EXAMPLE ▶

Using a linear scale with a scale pitch of 20 μm, if the linear servomotor is moved only 1 cm by hand in the linear scale's count direction, the number of feedback pulses will be as follows:
1 cm/ (20 μm/256) = 12,800 pulses



When the linear servomotor is moved by hand to the side with the cable and the value of Un00D is 1F400 or FFFE0C00, confirmation is completed.

Note: The actual monitor display will deviate by the error in movement distance only, so a value that is close to the above value is acceptable.

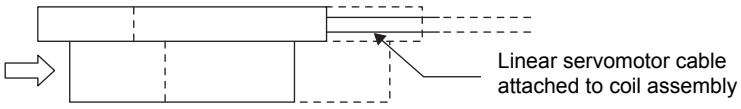
INFO

■ When the Value of the Un00D is incorrect

- If the Un00D value is not displayed correctly, the following conditions may be present. Check the conditions and take appropriate countermeasures.
- The scale pitch of the linear scale does not match.
  If the scale pitch set in Pn280 is different from the actual scale pitch, the assumed number of feedback pulses will not be returned. Check the specifications of the linear scale.
- The linear scale has not been adjusted.
  If the linear scale is not adjusted, the linear scale's output signal level will drop and the count will not be correct. Check that the linear scale is correctly adjusted. For details, contact the scale's manufacturer.
- The wiring between the linear scale and serial converter unit is not correct.
  If the wiring is not correct, a normal count will not be performed. Rewire the devices correctly.

(b) Checking the Concurrence between the Linear Scale Count Direction and the Linear Servomotor Forward Direction

Next, move the coil assembly by hand in the direction of the side with the cable, and check that the Un00D monitor is counting up.



When the linear servomotor is moved by hand to the side with the cable, if the value of Un00D is a countup value, confirmation is completed.

INFO

■ When the Value of the Un00D is counted down

When the value of the Un00D is a counted down, set the parameter Pn080.1 = 1 (B-phase progression, U, V, W-phase in order). Enable the setting by setting validation.

With this setting, the SERVOPACK performs current control by treating the linear scale countup direction as the motor forward direction.

(c) Related Parameters

Parameter		Description
Pn080	n.☐☐**0**☐	Phase-A progression, phase-U, V, W order (factory setting)
	n.☐☐**1**☐	Phase-B progression, phase-U, V, W order

(8) Assigning Polarity Detection Start Input (/P-DET)

When using a linear servomotor without a hall sensor, polarity detection must be performed after turning ON the power. When the input signal assignment mode is set to the factory setting (Pn50A.0=0), polarity detection starts at the same time as the Servo ON (/S-ON) signal, and when the polarity detection is completed, the Servo Ready (/S-RDY) signal turns ON.

To incorporate a sequence at the host controller that monitors the Servo Ready signal and outputs servo ON signals or to perform polarity detection using different timing from the servo ON signal, the polarity detection start signal (/P-DET) must be assigned to a user-set input.

After setting the parameter Pn50A.0 to 1 (the input signal assignments can be changed for each signal), set Pn50D.3 (/P-DET signal mapping) and assign the /P-DET signal to any input terminal. The setting validation is required to enable the settings.

Type	Name	Connector Pin Number	Setting	Meaning
Input	/S-ON	CN1-40	ON (low level)	Turning the servo ON and the polarity detection function ON (enabled).
			OFF (high level)	Turning the servo ON and the polarity detection function OFF (disabled).
	/P-DET	Must be allocated	ON (low level)	Turning the polarity detection function ON (enabled).
			OFF (high level)	Turning the polarity detection function OFF (disabled).
This input signal is used to start polarity detection. Either the /S-ON or /P-DET signal can be used to start polarity detection. When the /P-DET signal is used, input signal must be allocated. For details on assignment methods, refer to *8.3.2 Input Circuit Signal Allocation*.				

(9) Setting the mass ratio

Set the mass ratio (Pn103) before starting the polarity detection.

Pn103	Mass Ratio		Speed Position Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 20000 %*	1 %	0 %	Immediately

Use the following formula to obtain the mass ratio.

$$\text{Mass ratio (Pn103)} = \left(\frac{\text{Load mass (including mass of coil assembly)}}{\text{Coil assembly mass}} - 1 \right) \times 100 \ [\%]$$

* This setting range is applicable for software version 32 or later. The range for software earlier than version 32 is 0% to 10,000%.

(10) Setting the Overtravel Signal

Polarity detection cannot start in overtravel state.
When using the overtravel function, connect the signal wires and use in base block status.
When not using the overtravel function, set the parameters Pn50A.3 to 8 and Pn50B.0 to 8 (OT signal disabled).
The setting validation is required to enable the settings. For details, refer to *9.6.3 Setting the Overtravel Limit Function*.

(11) Setting Force Limit

To prevent danger during setup of the linear servomotor, the factory settings for the forward force limit (Pn483) and reverse force limit (Pn484) parameters are set to small value (factory setting: 30%).

If the force limit is set after (5) Setting the Linear Scale Pitch and (7) Checking the Feedback Signal, overrun will not occur. Increase the value in the parameters up to the required force. Set the value to the maximum value if no particular restricting conditions apply.

Pn483	Forward Force Limit		Speed Position Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 800 %	1 %	30 %	Immediately
Pn484	Reverse Force Limit		Speed Position Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 800 %	1 %	30 %	Immediately

INFO

If the force limit is set too high, polarity detection may not operate normally.

(12) Checking or Adjusting Polarity Detection

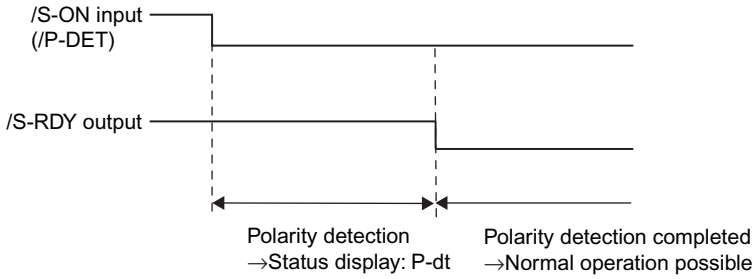
Check whether the polarity detection is operating normally.

IMPORTANT

1. The linear servomotor is turned ON during polarity detection, so take measures to avoid electric shock. The linear servomotor will make large movements during detection, so do not stand near the coil assembly.
2. Polarity detection depends on many factors, such as mass ratio, friction, and cable tension. If any error occurs because of one of these factors, the setting may be incorrect.

(a) Polarity Detection Completion Timing

Polarity detection is performed when the /S-ON signal (/P-DET signal for /P-DET signal assignment) is input after turning ON the control power and main circuit power. During detection, the status display is *P-dt*, and the /S-RDY signal turns ON when completed.



(b) Checking whether Detection is Normal

- Simple Confirmation

After turning ON both the control power and main circuit power, input the /S-ON signal (Use /P-DET signal when using the polarity detection start signal) and perform polarity detection. When the display on the panel operator or digital operator is *bb* when the power is turned ON, the display will change to *P-dt* during polarity detection, and return to *bb* after completion.
After detection is completed, push the linear servomotor down on the stroke end and check the electrical angle in monitor mode parameter Un004 (electrical angle 2: Phase U, angle from 0°). After confirmation, remove the linear servomotor from the stroke end (10 mm min.) Then execute the setting validation, and restart polarity detection. Repeat this procedure three times. If the deviation of the electrical angle is within ±10°, the polarity detection is normal. However, the polarity detection operation will change slightly depending on the detection location, perform the following detailed check at the end.

- Detailed Confirmation

Based on the user-set position, measure the electrical angles using monitor mode parameter Un004 (electrical angle 2: Phase U, angle from 0) when polarity detection is performed at 30 points each 1.5 mm apart. If the electrical angles are in the relationship 12° ±10, the measurement results indicate the normal polarity detection.

INFO

The following table shows the position intervals used to perform polarity detection when the following linear servomotor models are used.

Linear Servomotor Model	Position Interval
SGLGW-30 SGLFW-20 SGLTW-20	1.2 mm (0.047 in)
SGLGW-90	2.8 mm (0.11 in)

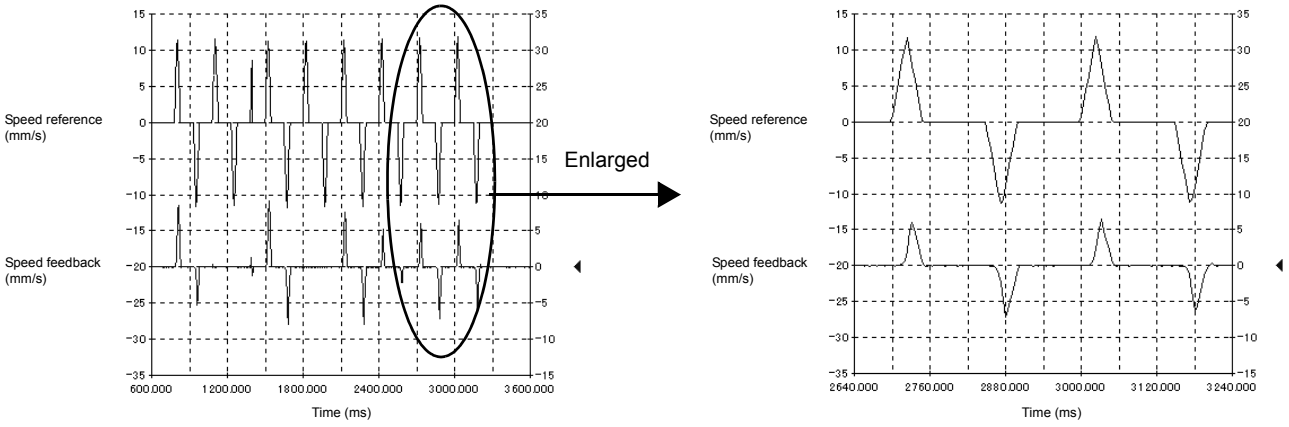
(c) Detection Waveforms

The Sigma Win+ trace function can be used to check whether detection is normal.

- Normal Detection

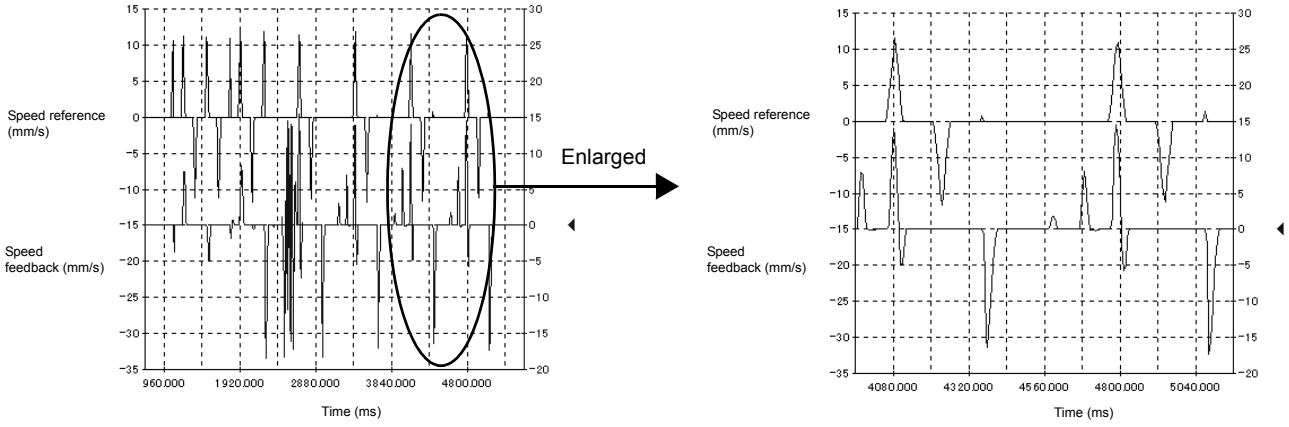
The detection result is normal if the speed feedback for the speed reference for the last detection waveform (unspecified number of detections) is traced. The following criteria are used to determine whether a trace is being performed.

- The feedback polarity is not inverse to the reference (speed is in same direction).
- The feedback speed range is 2 mm/s up to the maximum reference speed.



- Detection Error

The detection result is an error if the speed feedback for speed reference for the last detection waveform (unspecified number of detections) is not traced.



INFO

The detection waveform is not always the same, so the waveform may be different from those shown above even though the detection has completed normally.

(d) Troubleshooting for Polarity Detection Errors

Refer to the following table for troubleshooting if polarity detection is not completed normally.

No.	Problem	Cause	Countermeasure
1	The linear servomotor does not move during polarity detection (speed feedback is 0).	Polarity detection is not being performed.	Check whether the status display is *P-dt* when the /S-ON (/P-DET) signal is input. If *P-dt* is not displayed, check whether the parameters for input signal selection Pn50A and Pn50D are set correctly, and check whether signal input is being performed correctly.
		A force limit is activated.	To prevent danger during setup, the SGDH SERVOPACK's factory settings for the force limit parameters are 30%. Check the set values for Pn483 and Pn484, and change to a user-set value if the setting is initial value. Increase the value to the maximum value if no particular restrictions are required.
		The mechanical friction is large.	When the mechanical friction is relatively larger than the linear servomotor's rated force (10% or more), the linear servomotor may stop operating during polarity detection if factory settings are used. First, check whether the mass ratio (Pn103) is set correctly. If Pn103 is set correctly, increase the value set for polarity detection speed loop gain (Pn481). If the load is heavy and the mechanical friction is very large, a large gain will cause an alarm. The gain cannot be increased under this condition, so reduce the mechanical friction. If the mechanical friction cannot be reduced without difficulty and the situation does not improve even if the gain is reduced, consider using the hall sensor for polarity detection.
		Overtravel signal is detected during polarity detection.	If the OT signal is detected during polarity detection, polarity detection will be ended and the status will be returned to previous status. Before performing polarity detection, move the linear servomotor to a position where the OT signal is not detected.
2	Polarity detection error alarm (A.C5) has occurred.	Parameter settings are incorrect.	The settings for scale pitch (Pn280) and motor phase selection (Pn080.1) may not be appropriate for the device. Check the linear scale specifications and feedback signal conditions.
		Noise is present in the scale signal.	When the detection reference is repeatedly output several times in the same direction, noise may occur in the scale signal, resulting in malfunction. Check that the FG of the serial converter unit and linear servomotor is connected to FG of the SERVOPACK, and that FG of the SERVOPACK is connected to the power supply FG. Also check that the encoder cable is securely sealed.
		The coil assembly is being subjected to an external force.	If the coil assembly is subjected to an external force such as cable tension, and the speed feedback is not 0 regardless of a 0 detection reference, polarity detection will be poor. Reduce the external force and make the speed feedback 0.
		The linear scale precision is rough.	When the linear scale pitch is 100 µm min, the SERVOPACK cannot detect correct speed feedback. Use a linear scale with good scale pitch precision (within 40 µm is recommended).
		Linear servomotor traceability for the polarity detection reference is poor.	When the size of the speed feedback for the polarity detection reference is 2 mm/s max, detection may be poor. First, check that the mass ratio (Pn103) is set correctly. If Pn103 is set correctly, increase the value of polarity detection speed loop gain (Pn481). When the load is heavy, a large gain will cause an alarm. The gain cannot be increased under this condition, so reduce the mechanical friction. If the mechanical friction cannot be reduced without difficulty, consider using the hall sensor for polarity detection.
		The travel distance during polarity detection has exceeded 10 mm.	An alarm will occur if the linear servomotor movement distance exceeds 10 mm during polarity detection. The linear servomotor may have moved during detection for some reason, so check other causes and take appropriate countermeasures.

(e) Related Parameters

Parameters	Description			
Pn481	Polarity Detection Speed Loop Gain		Speed Position Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 2000	1 Hz	40 Hz	Immediately
Pn482	Polarity Detection Speed Loop Time Constant		Speed Position Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	15 to 51200 (0.15 to 512.00 ms)	0.01 ms	3000 (30.00 ms)	Immediately

(13) Jog Operation from the Panel Operator

After checking steps (1) to (12), perform a trial operation as follows:

Note: Perform trial operations without a load attached, if possible.

1. Turn ON the control power and main circuit power.
2. Operate the panel operator or digital operator and move the linear servomotor using jog operation. For details on jog operation, refer to *8.2.3 JOG Mode Operation (Fn002)*.

IMPORTANT

When turning ON the servo for the first time after installation and wiring, stand away from the linear servomotor as overrun may occur.

3. Check that the linear servomotor is moving normally from end to end of the stroke.

INFO

■ Unsuccessful Trial Operations

An unsuccessful trial operation could be attributed to the following conditions. Check the conditions and take appropriate measures.

- The force reference is saturated because the load is too heavy, or the jog speed is too fast.
  Lower the jog speed or lighten the load.
- The linear servomotor is moving slightly and then stops.
  The linear servomotor and linear scale are out of alignment. Check the wiring, scale pitch setting, linear scale count, and whether the motor forward direction matches the scale count direction.
- Polarity detection is not being performed normally.
  Perform step *(12) Checking or Adjusting Polarity Detection*.

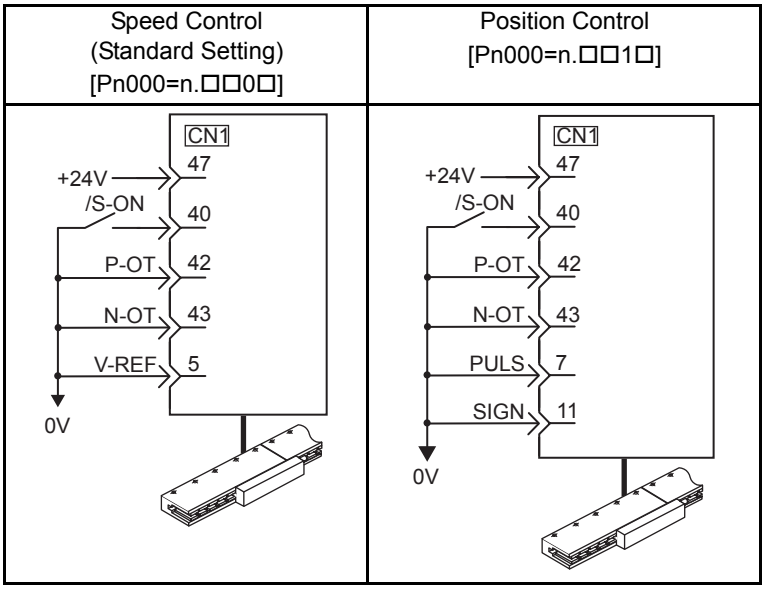
Setup is finished when all these checks have been completed.

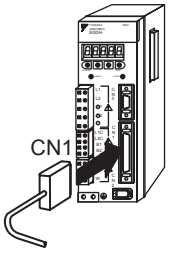
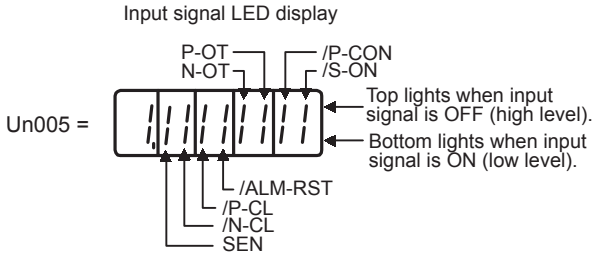
9.3 Trial Operation for Linear Servomotor without Load from Host Reference

Check that the linear 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 linear servomotor to the machine.

9.3.1 Servo ON Command from the Host

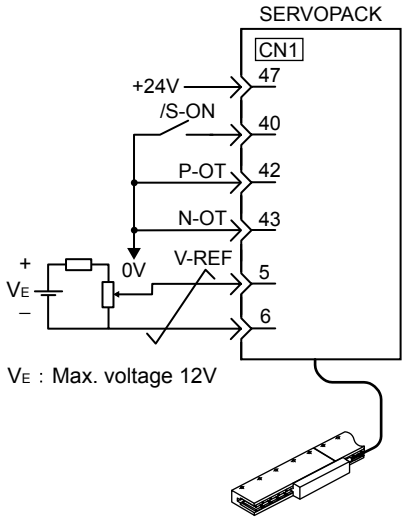
The following circuits are required: External input signal circuit or equivalent.



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 *8.3.2 Input Circuit Signal Allocation*.
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. Un005 =  Check input signal wiring in monitor mode using the digital operator or panel operator. Refer to *8.4.1 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. 
3	Input the /S-ON signal, then make sure that the display of the panel operator is as shown below. 	If an alarm display appears, correct it according to *11.1 Troubleshooting*. If there is noise in the reference voltage during speed control, the horizontal line (–) at the far left edge of the panel operator display may blink. Also the linear servomotor may run very slowly. Refer to *7.6 Connecting Regenerative Resistors* and take a preventive measure.

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

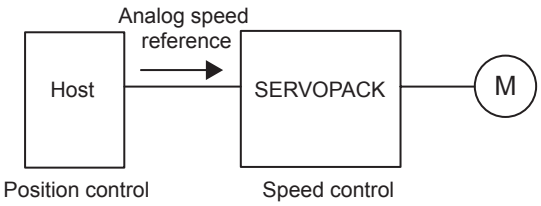
The following circuit is required: External input signal circuit or equivalent.



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 linear servomotor moves with the speed reference input 0V, refer to *9.7.3 Adjusting Offset*, and use the reference voltage offset to keep the linear 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 speed.
4	Check the speed reference input to the SERVOPACK (Un000 [mm/s]).	Refer to *8.1.3 Basic Mode Selection and Operation* for how it is displayed.
5	Check the Un000 (motor speed [mm/s].	Refer to *8.1.3 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 movement direction.	Refer to the following equation to change the Pn300 (speed reference input gain). Un001=(voltage between V-REF) [V] × Pn300 [rated speed/6V] To change the motor movement direction without changing polarity for speed reference input gain, refer to *9.6.2 Switching the Linear Servomotor Movement 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

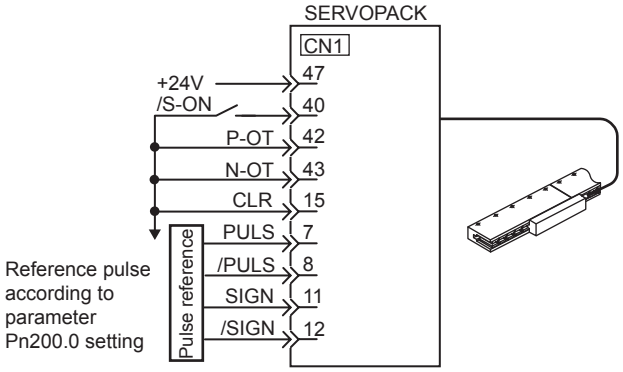


When the SERVOPACK conducts speed control and position control is conducted at the host controller, perform the operations below, following the operations in *9.3.2 Operating Procedure in Speed Control Mode (Pn000 = n.□□0□)* on the previous page.

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 linear servomotor moves at extremely slow speed, refer to *9.7.3 Adjusting Offset*, and use the reference voltage offset to keep the servomotor from moving.
11	Send the command for the movement amount easy to check (for example, 1 cm) from the host controller in advance, and check the sent movement amount and actual movement distance by visual inspection and the Un00D (feedback pulse counter)[pulse].	Refer to *8.1.3 Basic Mode Selection and Operation* for how it is displayed. Un00D (feedback pulse counter) [pulse]
12	If the sent movement amount and actual movement distance in step 11 are not equal, correctly set the Pn281 (PG divider) outputting the encoder pulse from the SERVOPACK.	Refer to *9.7.7 Encoder Signal Output* for how to set. Encoder output resolution (Pn281 [P/Pn280]): The number of encoder pulses per scale pitch
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.	–

9.3.3 Operating Procedure in Position Control Mode (Pn000 = n.□□1□)

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



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 *9.8.1 (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 *9.8.2 Setting the Electronic Gear*.
3	Turn ON the power and the servo ON (/S-ON) input signal.	–
4	Send the pulse reference for the motor movement amount easy to check (for example, 1 cm) and with slow speed from the host controller in advance.	Set the motor speed of several 10 mm/s 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 *8.1.3 Basic Mode Selection and Operationeration* for how it is displayed. Un00C (input reference pulse counter) [pulse]
6	Check the actual motor movement amount [pulse] by the change in Un00D (feedback pulse counter) [pulse] before and after executing the sent pulse reference.	Refer to *8.1.3 Basic Mode Selection and Operation* for how it is displayed. Un00D (feedback pulse counter) [pulse]
7	Check that steps 5 and 6 satisfy the following equation: Un00D=Un00C × (Pn202/Pn203)	–
8	Check that the motor movement direction is the same as the reference.	Check the input pulse polarity and input reference pulse form. Refer to *9.8.1 (2) Setting a Reference Pulse Form*.
9	Input the pulse reference with the bigger motor movement amount from the host controller to obtain the constant speed.	Set the motor speed of several 10 mm/s 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) [mm/s].	Refer to *8.1.3 Basic Mode Selection and Operation* for how it is displayed. Un007 (input reference pulse speed) [mm/s]
	The number of input reference pulses (Un00C) can be obtained from the following equation. $\text{Un007 (Input reference pulse)} = \underbrace{\text{Input reference pulse [pulse/s]}}_{\text{Reference input pps}} \times \underbrace{\frac{\text{Pn202}}{\text{Pn203}}}_{\substack{\text{Electronic}\\ \text{gear ratio}}} \times \underbrace{\frac{\text{Pn280}}{10^6(1000000)} \times \frac{1}{2^8(256)}}_{\text{Encoder pulse}}$ * The encoder pulse differs depending on the model of the servomotor used.	

(cont'd)

Step	Description	Check Method and Remarks
11	Check the motor speed using the Un000 (motor speed) [mm/s].	Refer to *8.1.3 Basic Mode Selection and Operation* for how it is displayed. Un000 (motor speed) [mm/s]
12	Check that the Un007 and Un000 values in steps 9 and 10 are equal.	–
13	Check the motor movement direction.	To change the motor movement direction without changing input reference pulse form, refer to *9.6.2 Switching the Linear Servomotor Movement Direction*. Perform the operation from step 9 again after the motor movement 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.	–

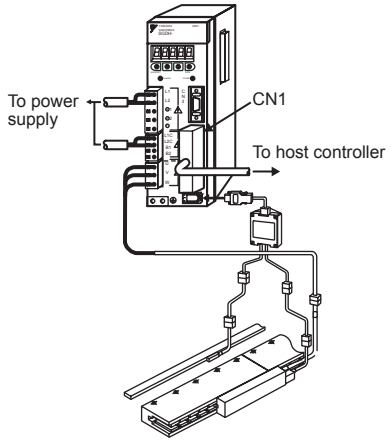
9.4 Trial Operation with the Linear Servomotor Connected to the Machine

⚠ WARNING

- Follow the procedure below for trial operation precisely as given.
  Malfunctions that occur after the linear 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.

1. Set the necessary parameters according to the machine configuration.
2. Match the direction of movement and speed to equipment specifications.



Step	Description	Check Method and Remarks
1	Turn ON the power and make the settings for mechanical configuration related to protective function such as overtravel and brake.	Refer to *9.6 Setting Common Basic Functions*.
2	Set the necessary parameters for control mode used.	Refer to *9.7 Operating Using Speed Control with Analog Reference*, *9.8 Operating Using Position Control*, and *9.9 Operating Using Force Control* for control mode used.
3	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 *9.6 Setting Common Basic Functions*. For steps 3 to 8, take advance measures for emergency stop so that the servomotor can stop safely when an error occurs during operation.
4	Adjust the servo gain and improve the linear servomotor response characteristics, if necessary.	Refer to *10.1 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.
5	Write the parameters set for maintenance in *12.5 Parameter Recording Table*.	The servodrive supporting tool “Sigma Win+” serves for the file management of parameters.

9.5 Control Mode Selection

The control modes supported by the SGDH SERVOPACK are described below.

Parameter		Control Mode	Reference Section
Pn000	n.☐☐**0**☐ (Factory setting)	Speed Control (Analog voltage speed reference) Controls servomotor speed by means of an analog voltage speed reference. Use in the following instances. • To control speed • For position control using the encoder feedback division output from the SERVOPACK to form a position loop in the host controller.	9.7
	n.☐☐**1**☐	Position Control (Pulse train position reference) Controls the position of the machine by means of a pulse train position reference. Controls the position with the number of input pulses, and controls the speed with the input pulse frequency. Use when positioning is required.	9.8
	n.☐☐**2**☐	Force Control (Analog voltage speed reference) Controls the linear servomotor's output force by means of an analog voltage force reference. Use to output the required amount of force for operations such as pressing.	9.9
	n.☐☐**3**☐	Speed Control (Contact input speed control) Uses the three input signals /P-CON (/SPD-D), /P-CL (/SPD-A), and /N-CL (/SPD-B) to control the speed as set in advance in the SERVOPACK. Three operating speeds can be set in the SERVOPACK. (In this case, an analog reference is not necessary.)	9.10
	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.	9.12

9.6 Setting Common Basic Functions

9.6.1 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)	Linear servomotor power ON. Linear servomotor can be operated.
			OFF (high level)	Linear servomotor power OFF. Linear servomotor cannot be operated.

■ IMPORTANT

Always input the servo ON signal before inputting the input reference to start or stop the linear servomotor. Do not input the input reference first and then use the /S-ON signal to start or stop. Doing so will degrade internal elements and lead to malfunction.

Note: A parameter can be used to re-allocate the input connector number for the /S-ON signal. Refer to *8.3.2 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.

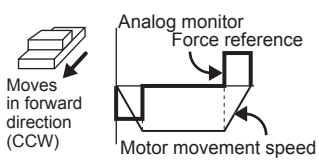
- After changing these parameters, turn OFF the main circuit and control power supplies and then turn them ON again to enable the new settings.
- When the parameter is set to constantly "enable" the signal, resetting an alarm can only be done by turning the power OFF and ON. (Alarm reset is disabled.)

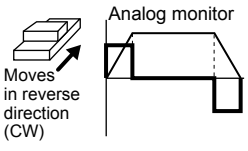
9.6.2 Switching the Linear Servomotor Movement Direction

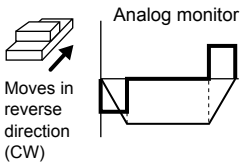
The movement direction of the linear servomotor can be switched without changing the reference pulse to the SERVOPACK or the reference voltage polarity.

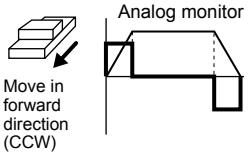
This causes the travel direction (+, -) of the shaft reverse. The output signal polarity such as encoder pulse output and analog monitor signal from the SERVOPACK does not change.

The standard setting for "forward movement" is the linear scale counting up direction.

<table>
<tr><th colspan="2" rowspan="2">Parameter</th><th rowspan="2">Name</th><th colspan="2">Reference</th></tr>
<tr><th>Forward Reference</th><th>Reverse Reference</th></tr>
<tr><td>Pn000</td><td>n.□□□0</td><td>Standard setting
(CCW = Forward)
(Factory setting)</td><td> 

Encoder pulse divided output
PAO
PBO Phase B progression</td><td> 

Encoder pulse devided output
PAO Phase A progression
PBO</td></tr>
<tr><td></td><td>n.□□□1</td><td>Reverse Direction Mode
(CW = Reverse)</td><td> 

Encoder pulse divided output
PAO
PBO Phase B progression</td><td> 

Encoder pulse divided output
PAO Phase A progression
PBO</td></tr>
<tr><td colspan="5">The direction of P-OT and N-OT change. For Pn000 = n.□□□0 (standard setting), counterclockwise is P-OT. For Pn000 = n.□□□1 (Reverse Direction Mode), clockwise is P-OT.</td></tr>
</table>

9.6.3 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.

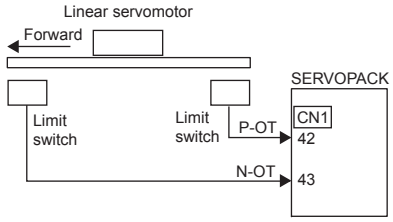
(1) Connecting the Overtravel Signal

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

Connect limit switches as shown below to prevent damage to the devices during linear motion.

Movement in the opposite direction is possible during overtravel. For example, reverse run is possible during forward overtravel



■ IMPORTANT

When the linear 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.

(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 run.)
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 run.)

- Applicable control methods: Speed control, position control, and force 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 *8.3.2 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	Dynamic Brake	Stops the linear servomotor by applying dynamic brake (DB), then holds it in Dynamic Brake Mode. (Factory setting)
	n.☐☐**01**		Coast	Coasts the linear servomotor to a stop, then places it into Coast (power OFF) Mode.
	n.☐☐**02**	Coast to a stop		Stops the linear servomotor in the same way as when the servo is OFF (coasts to a stop), then places it into Coast (power OFF) Mode.
	n.☐☐**1**☐	Decelerate to stop	Zero Clamp	Decelerates the linear servomotor with emergency stop force (Pn406), then places it into Zero Clamp (Servolock) Mode.
	n.☐☐**2**☐		Coast	Decelerates the linear servomotor with emergency stop force (Pn406), then places it into Coast (power OFF) Mode.

- During force control, the linear servomotor enters DB Stop Mode or Coast Mode regardless of the setting of Pn001.1.
- 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 (with short-circuiting by a circuit of SERVOPACK).
- Coast to a stop: Stops naturally, with no brake, by using the friction resistance of the motor in operation.
- Decelerate to stop: Stops by using deceleration (braking) force.
- 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 *9.6.4 Selecting the Stopping Method After Servo OFF*.

(4) Setting the Stop Force for Overtravel

Pn406	Emergency Stop Force		Speed / Position / Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 800	1 %	800	Immediately

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

9.6.4 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 linear 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 (L1, L2, L3) is OFF. (Some linear servomotor models are forcibly stopped by dynamic braking.)

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 runs at very low speed.

■ TERMS

- Stop by dynamic brake: Stops by using the dynamic brake (with short-circuiting by a circuit of SERVOPACK).
- Coast to a stop: Stops naturally, with no brake, by using the friction resistance of the motor in operation.

■ IMPORTANT

The linear servomotor is **forced to stop by dynamic braking, regardless of the settings of this parameter**, when the main circuit power supply (L1, L2, L3) or control power supply (L1C, L2C) turns OFF.

- SGDH-A5AE to -15AE (50 W to 1.5 kW for 200 V)
- SGDH-10DE to -75DE (1.0 kw to 7.5 kW for 400 V)

If the linear servomotor must be stopped by coasting rather than by dynamic braking when the main circuit power supply (L1, L2, L3) or the control power supply (L1C, L2C) turns OFF, arrange the sequence externally so the linear servomotor wiring (U, V, W) will be interrupted.

IMPORTANT

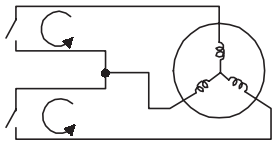
The dynamic brake (DB)[1] is an emergency stop function.

If the servomotor is frequently started and stopped by turning the power ON/OFF or using the servo ON signal (/S-ON), the DB circuit will also be repeatedly operated, degrading the SERVOPACK's internal elements. Use the speed input reference and position reference to control the starting and stopping of the servomotor.

TERMS

[1] Dynamic brake (DB)

A common method for quickly stopping a servomotor. The servomotor is stopped by short-circuiting the servomotor circuit. This circuit is built into the SERVOPACK.



9.6.5 Instantaneous Power Loss Settings

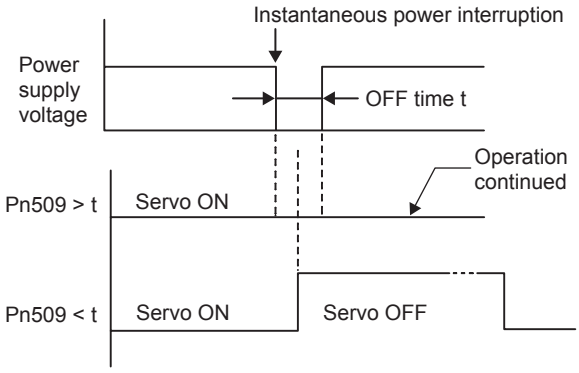
Determines whether to continue operation or turn the servo OFF when the power supply voltage to the SERVOPACK main circuit is instantaneously interrupted.

Pn509	Instantaneous Power Cut Hold Time		Speed	Position	Force
	Setting Range	Setting Unit	Factory Setting	Setting Validation	
	20 to 1000	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.

9.6.6 Motor Maximum Speed (For the software version 32 or later)

Sets the linear servomotor maximum speed.

Setting a lower speed realizes more delicate speed control and more strict protection by generating the overspeed alarm (A.51.) Also, setting a lower speed allows the upper limit of PG divider (Pn281) to be set higher. Refer to *9.7.7 Encoder Signal Output* for details.

Pn384	Motor Maximum Speed		Speed	Position	Force
	Setting Range	Setting Unit	Factory Setting	Setting Validation	
	1 to 100 (0.1 to 10.0 m/s)	0.1 m/s	50 (5.0 m/s)	After Restart	

- If a value lower than the rated speed is set for Pn384, the rated speed becomes the same value as the setting of Pn384.
- The detection level for the overspeed alarm A.51 is "the set value of Pn384 × 1.1."

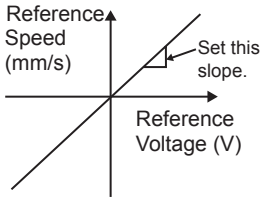
9.7 Operating Using Speed Control with Analog Reference

9.7.1 Setting Parameters

Parameter		Description
Pn000	n.□□**0**□	Control mode selection: Speed control (analog reference) (factory setting)

Pn300	Speed Reference Input Gain		Speed Position Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1.50 to 30.00 V/Rated speed)	0.01 V/Rated speed	6.00 V/Rated speed	Immediately

Sets the analog voltage level for the speed reference (V-REF) necessary to operate the linear 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.

9.7.2 Setting Input Signals

(1) Speed Reference Input

Input the speed reference to the SERVOPACK using the analog voltage reference to control the linear servomotor speed in proportion to the input voltage.

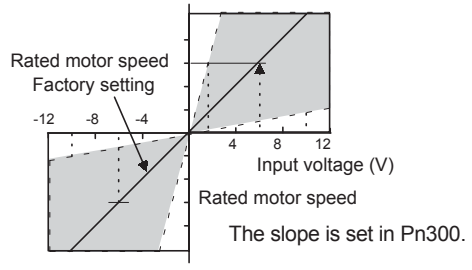
Type	Signal Name	Connector Pin Number	Name
Input	V-REF	CN1-5	Speed Reference Input
	SG	CN1-6	Signal Ground for Speed Reference Input

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 *9.7.1 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

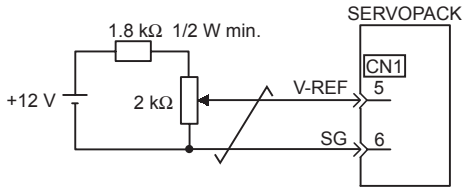
  Actual examples are shown below.

Speed Reference Input	Movement Direction	Motor Speed	SGLGW Linear Servomotor
+6 V	Forward	Rated motor speed	1500 mm/s
+1 V	Forward	(1/6) rated motor speed	250 mm/s
-3 V	Reverse	(1/2) rated motor speed	750 mm/s

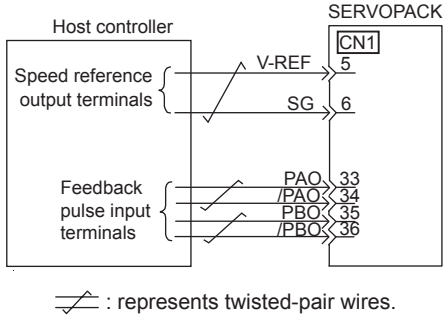
Parameter Pn300 can be used to change the voltage input range.

■ 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 linear servomotor movement 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.

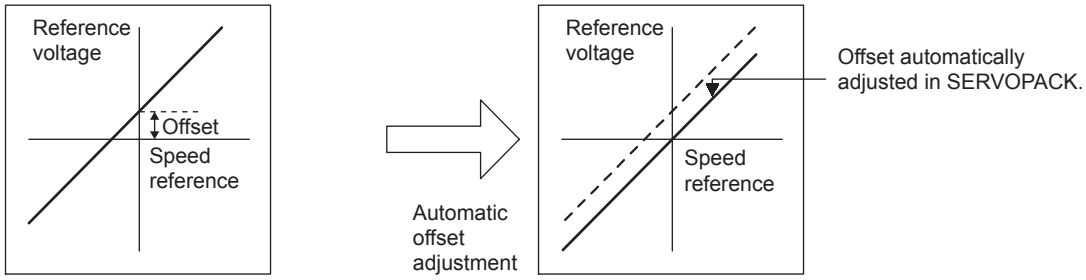
Note: A parameter can be used to reallocate the input connector number for the /P-CON signal. Refer to *8.3.2 Input Circuit Signal Allocation*.

9.7.3 Adjusting Offset

When using the speed control, the servomotor may run 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 *8.2 Operation in Utility Function Mode (Fn□□□)*.

The automatic adjustment of the analog (speed, force) 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).

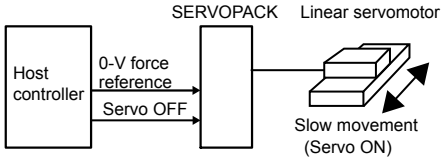
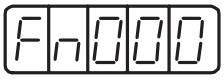
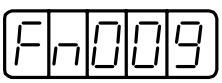
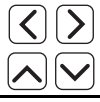
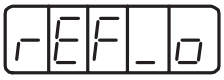
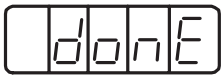
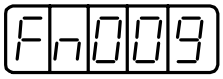
(1) Automatic Adjustment of the Speed Reference Offset

The automatic adjustment of reference offset (Fn009) cannot be used when a position loop has been formed with a host controller. 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 *9.7.6 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		 (DSPL/SET Key)	 MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
3				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		 (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		 (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		About one second later		After “donE” is displayed, “rEF_o” will be displayed again.
7		 (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.

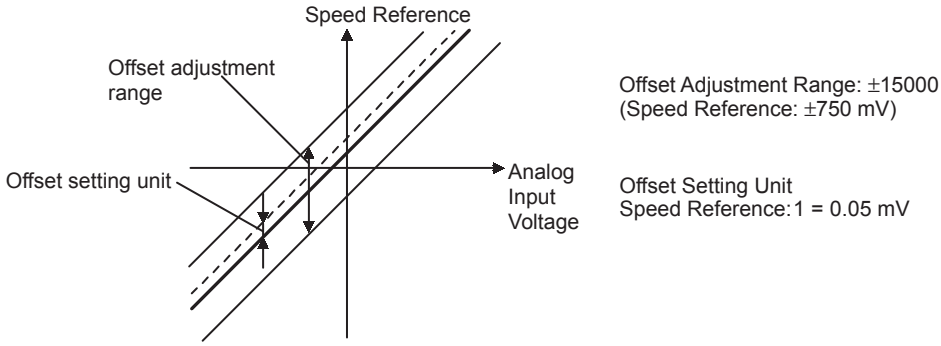
(2) Manual Adjustment of the Speed Reference Offset

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	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 speed reference offset amount.
6		▲ ▼	▲ ▼	Press the UP or DOWN Key to adjust the amount of offset.
7	-.-SPd	◀ ▶	MODE/SET (MODE/SET Key) (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.

9.7.4 Soft Start

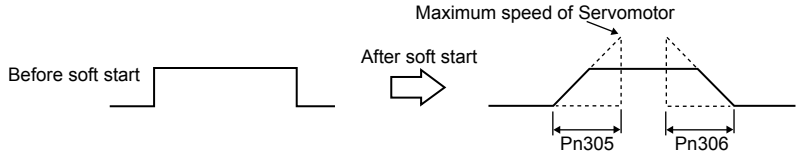
The soft start function converts the stepwise speed reference inside the SERVOPACK to a consistent rate of acceleration and deceleration.

Pn305	Soft Start Acceleration Time		Speed	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 10000	ms	0	Immediately
Pn306	Soft Start Deceleration Time		Speed	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 10000	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.



9.7.5 Speed Reference Filter

Pn307	Speed Reference Filter Time Constant		Speed	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 65535 (0.00 to 655.35 ms)	0.01 ms	40 (0.40 ms)	Immediately

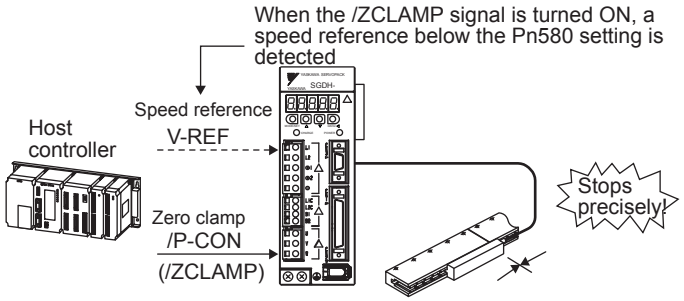
This smoothens the speed reference by applying a 1st-order delay filter to the analog speed reference (V-REF) input. A value that is too large, however, will slow down response.

9.7.6 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 (Pn580). 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 moved by external force.



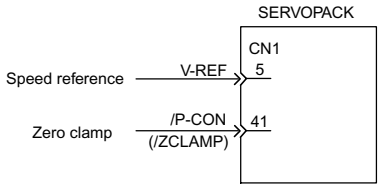
(2) Parameter Setting

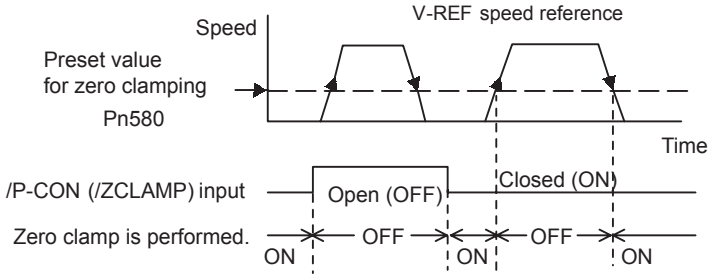
Parameter		Meaning
Pn000	n.☐☐**A**☐	Control mode selection: Speed control (analog voltage reference) ⇔ Zero clamp

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 Pn580.





Pn580	Zero Clamp Level		Speed	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 10000	1 mm/s	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, an input signal must be allocated. Refer to *8.3.2 Input Circuit Signal Allocation* for more details.

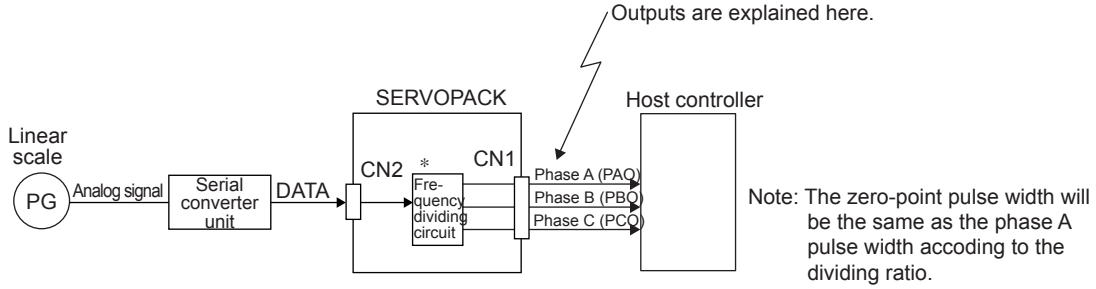
■ IMPORTANT

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

9.7.7 Encoder Signal Output

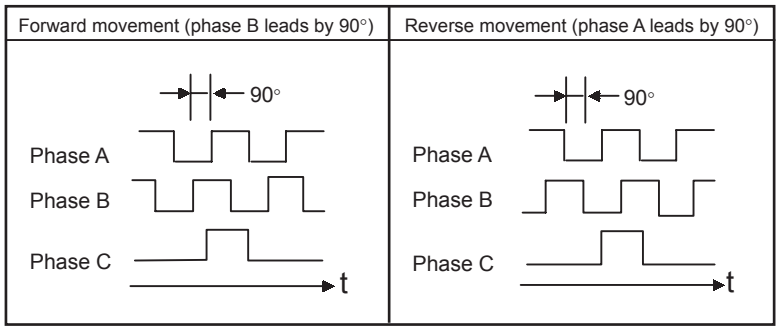
Encoder feedback pulses processed inside the SERVOPACK can be output externally.

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)



* Even in reverse movement mode (Pn000.0 = 1), the dividing output phase form is the same as that for the standard setting (Pn000.0 = 0).

■ Output Phase Form



IMPORTANT

- When returning the machine to its home position by using the zero-point signal of linear scale, the home return speed should be 50 mm/s or less. If the speed is higher than 50 mm/s, the phase C pulse may not be output correctly.
- When using a linear scale with more than one zero-point signal, the phase C pulse width of 2nd and onward zero-point signal will be half of the phase A pulse width.

TERMS

Dividing

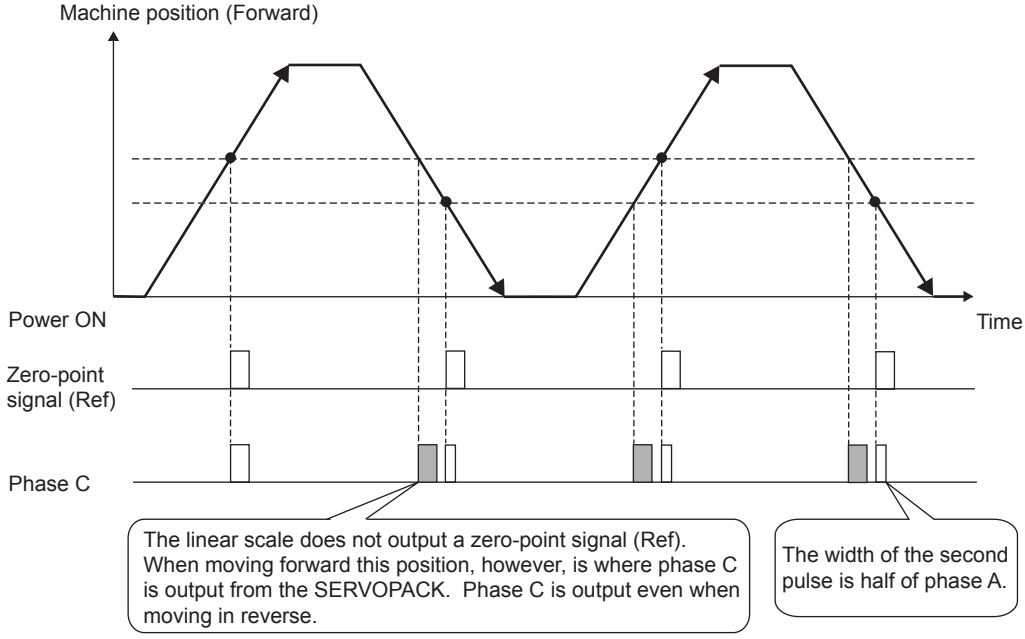
The dividing means that the divider converts data into the pulse density set in the parameter Pn281, on the base of the scale pitch of linear scale installed on the linear servomotor, and outputs it. The setting unit is the number of edges/scale pitch.

IMPORTANT

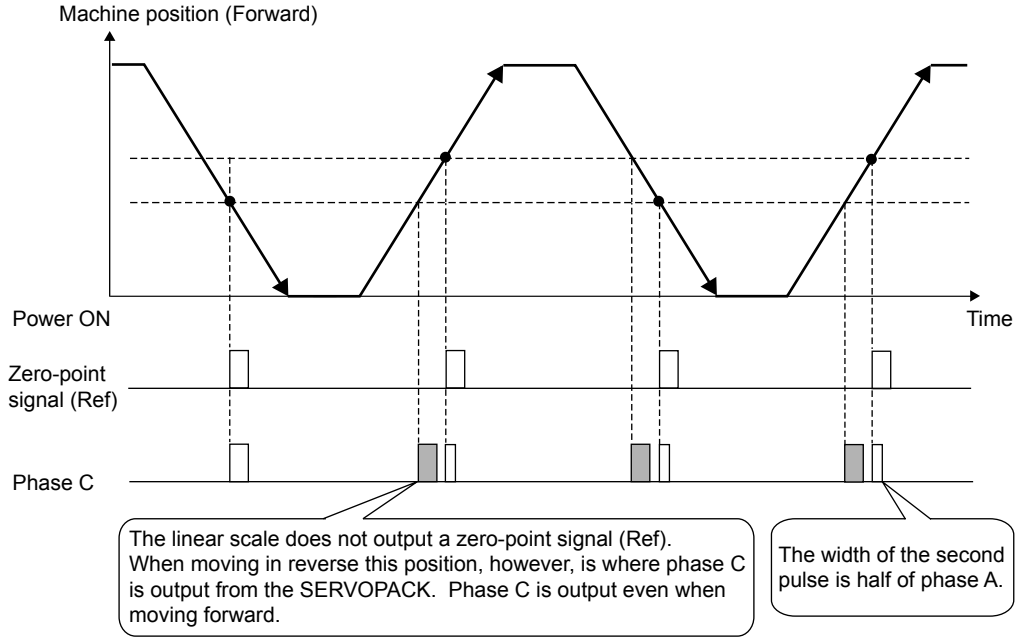
■Relation between Linear Scale by Renishaw and Encoder Output Signals from the SERVOPACK

For some models of the Renishaw linear scales, the position at which the zero-point signal (Ref) is output varies in accordance with the direction of movement.
If combining the SERVOPACK with one of those models, phase C pulses are output from the SERVOPACK in two places.
For more details of the linear scale zero-point signals, refer to the instruction manual for the linear scale being used.

- When passing the first zero-point signal (Ref) forward after the power supply is turned ON



- When passing the first zero-point signal (Ref) in reverse after the power supply is turned ON



• Pulse Dividing Ratio Setting

Pn281	Encoder Output Resolution		Speed Position Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 255P/{Pn280)×4}	1P/{(Pn280)×4}	20P/{(Pn280)×4}	After restart

Set the output pulse resolution for PG output signals (PAO, /PAO, PBO, /PBO) externally from the SERVOPACK.
Feedback pulses per linear scale pitch (Pn280) are divided inside the SERVOPACK by the value set in Pn281 before being output. (Set according to the system specifications of the machine or host controller.)
The setting range varies with the linear servomotor maximum speed (Pn384) and linear scale pitch (Pn280). Refer to the table below for details.

Scale Pitch (Pn280) (μm)	Motor Max. Speed (Pn384) (0.1m/s)	Encoder Output Resolution (Pn281)
40	50	1 to 63
	40	1 to 127
	20	1 to 255
20	50	1 to 31
	40	1 to 63
	20	1 to 127
	10	1 to 255
4	10	1 to 31
	8	1 to 63
	4	1 to 127
	2	1 to 255

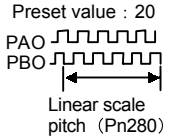
Note: 1. When the scale pitch is 4 μm, the motor maximum speed is limited to 1 m/s because of the maximum response frequency of serial converter unit.
2. The SERVOPACK with the software version 32 or higher outputs the alarm “Dividing Pulse Output Setting Error (A.09)” if the set value does not satisfy the above setting range or the setting conditions.
The SERVOPACK with the software version before 32 cannot output correctly the divided pulses if the set value does not satisfy the above setting range or the setting condition.
3. The upper limit of encoder output resolution is limited by the frequency dividing specification of serial converter unit.

■ Setting Example

When the linear scale pitch = 20 μm (Pn280=20) and the motor maximum speed = 5 m/s (Pn384=50), Pn281 = 31 is accepted, but Pn281 = 32 is not accepted and A.09 is output.

■ Output Example

When Pn281 = 20 (20-edge output (5-pulse output) per linear scale pitch),



9.7.8 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 *8.3.3 Output Circuit Signal Allocation* for details.				

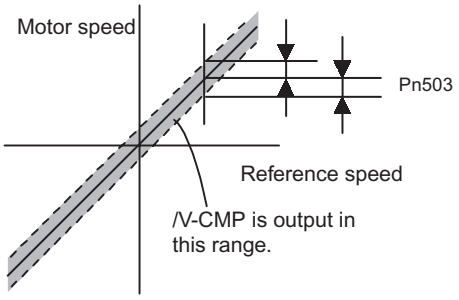
Pn582 Speed Coincidence Signal Output Width [Speed]

Setting Range	Setting Unit	Factory Setting	Setting Validation
0 to 100	1 mm/s	10	Immediately

The /V-CMP signal is output when the difference between the speed reference and actual motor speed is the same as the pn582 setting or less.

■ EXAMPLE

The /V-CMP signal turns ON at 1900 to 2100 mm/s if the Pn582 is set to 100 and the reference speed is 2000 mm/s.



/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.

9.8 Operating Using Position Control

9.8.1 Setting Parameters

Set the following parameters for position control using pulse trains.

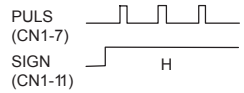
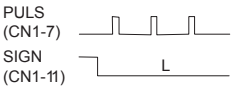
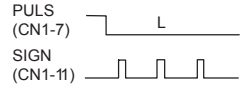
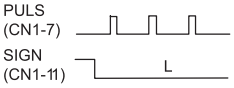
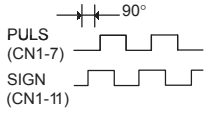
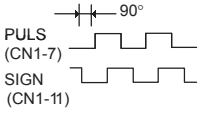
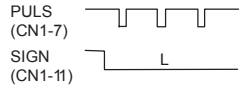
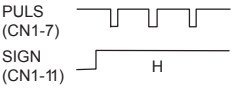
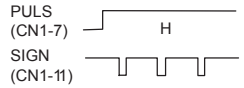
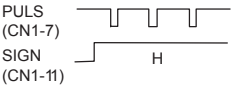
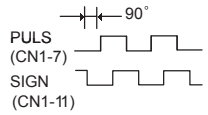
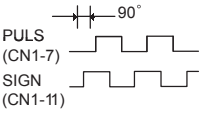
(1) Control Mode Selection

Parameter		Meaning
Pn000	n.□□**1**□	Control mode selection: Position control (pulse train reference)

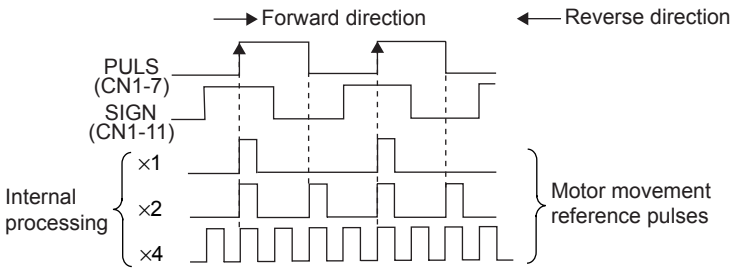
(2) Setting a Reference Pulse Form

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 Movement Reference	Reverse Movement Reference
Pn200	n.□□□**0**	Sign + pulse train (Positive logic) (Factory setting)	–		
	n.□□□**1**	CW pulse + CCW pulse (Positive logic)	–		
	n.□□□**2**	Two-phase pulse train with 90° phase differential (Positive logic)	×1		
	n.□□□**3**		×2		
	n.□□□**4**		×4		
	n.□□□**5**	Sign + pulse train (Negative logic)	–		
	n.□□□**6**	CW pulse + CCW pulse (Negative logic)	–		
	n.□□□**7**	Two-phase pulse train with 90° phase differential (Negative logic)	×1		
	n.□□□**8**		×2		
	n.□□□**9**		×4		

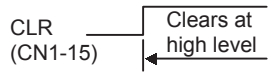
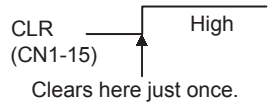
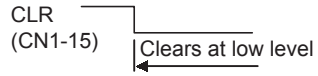
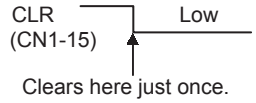
The input pulse multiplier can be set for the 2-phase pulse train with 90° phase differential reference pulse form.



(3) Clear Signal Form Selection

Type	Signal Name	Connector Pin Number	Name
Input	CLR	CN1-15	Clear Input
	/CLR	CN1-14	Clear Input

The internal processing of the SERVOPACK for the clear signal can be set to either of four types by parameter Pn200.1. Select according to the specifications of the machine or host controller.

Parameter		Description	Timing
Pn200	n.☐☐**0**☐	Clears at high level. Position error pulses do not accumulate while the signal is at high level. (Factory setting)	
	n.☐☐**1**☐	Clears at the rising edge.	
	n.☐☐**2**☐	Clears at low level. Position error pulses do not accumulate while the signal is at low level.	
	n.☐☐**3**☐	Clears at the falling edge.	

The following are executed when the clear operation is enabled.

- The SERVOPACK error counter is set to 0.
- Position loop operation is disabled.
  → Holding the clear status may cause the servo clamp to stop functioning and the servomotor to rotate slowly due to drift in the speed loop.

When the clear signal (CLR) is not wired: Because position error pulses will be cleared when Pn200 is set to n.☐☐2☐, the linear servo motor does not run even if a pulse-train command is entered.

(4) Clear Operation Selection

This parameter determines when the error pulse should be cleared according to the condition of the SERVOPACK, in addition to the clearing operation of the clear signal (CLR). Either of three clearing modes can be selected with Pn200.2

Parameter		Description
Pn200	n.☐**0**☐☐	Clear the error pulse during the baseblock. (Factory setting) "During the baseblock" means when the SVON 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.

9.8.2 Setting the Electronic Gear

(1) Scale Feedback Resolution

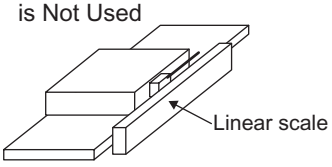
The scale feedback resolution from the SERVOPACK is 1/256 of the scale pitch (Pn280).

Scale Pitch	Pulse Resolution
40 μm	0.156 μm
20 μm	0.078 μm
4 μm	0.016 μm

(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.

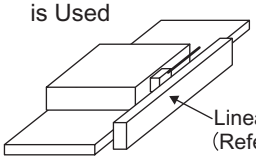
When the Electronic Gear is Not Used



To move a workpiece 10 mm (0.39 in.)

The scale pitch is 20 mm. Therefore,
10 × 1000 ÷ 20 × 256=128000 pulses
128000 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

1 reference unit is 1 μm.
To move a workpiece 10 mm (10000 μm),
1 pulse = 1 μm,
10000/1=10000 pulses.
Input 10000 pulses as reference input.

(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

The electronic gear ratio to be set can be calculated by the following equation:

$$\text{Electronic gear ratio: } \frac{B}{A} = \frac{Pn202}{Pn203} = \frac{\text{Workpiece travel distance per reference u}}{\text{Scale pitch}}$$

* 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.

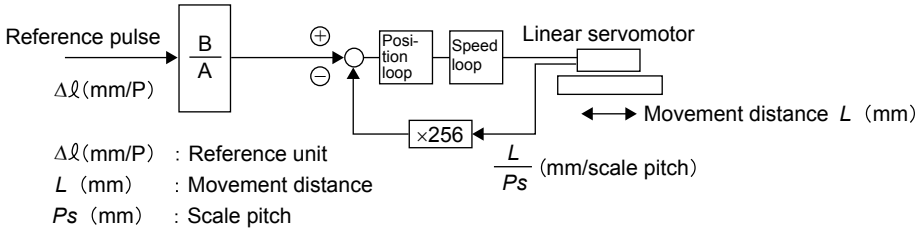
Step	Operation	Description
1	Check the scale pitch.	Check the scale pitch of linear scale used.
2	Determine the reference unit used.	Determine the reference unit from the host controller, considering the machine specifications and positioning accuracy.
3	Calculate the electronic gear ratio.	Use the electronic gear ratio equation to calculate the ratio (B/A).
4	Set parameters.	Set parameters using the calculated values.

(5) Electronic Gear Ratio Setting Example

An example of electronic gear ratio setting is given below.

Step	Operation	Load Configuration	
1	Check the scale pitch.	0.02 mm (20 μm)	
2	Determine the reference unit.	1 reference unit: 0.001 mm (1 μm)	
3	Calculate the electronic gear ratio.	$\frac{B}{A} = \frac{1(\mu m)}{20(\mu m)} \times 256$	
4	Set parameters.	Pn202	256
		Pn203	20

(6) Electronic Gear Ratio Equation



Δℓ(mm/P) : Reference unit
L (mm) : Movement distance
Ps (mm) : Scale pitch

$$\frac{L}{\Delta \ell} \times \left(\frac{B}{A}\right) = 256 \times \frac{L}{Ps}$$

$$\left(\frac{B}{A}\right) = \frac{256 \times L \times \Delta \ell}{Ps \times L} = \frac{256 \times \Delta \ell}{Ps}$$

Set A and B with the following parameters.

A : Pn203 B : Pn202

9.8.3 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

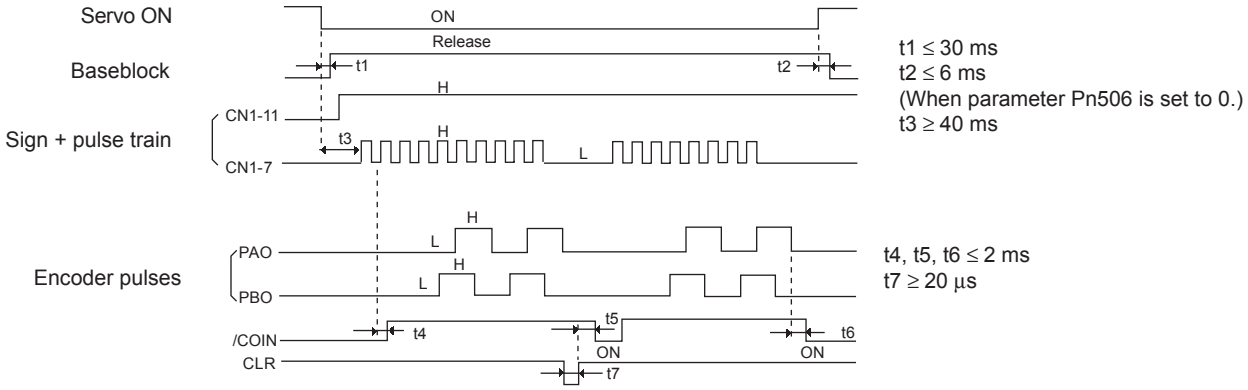
IMPORTANT

■Precautions for Open-collector Output

When the open-collector output is used, input signal noise margin lowers. Change the parameter as follows:

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

(1) Input/Output Signal Timing Example



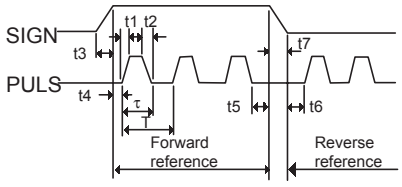
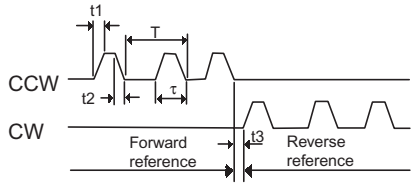
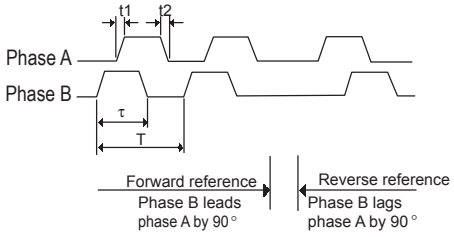
Note: 1. The interval from the time the servo ON signal is turned ON until a reference pulse is input must be at least 40 ms, otherwise the reference pulse may not be received by the SERVOPACK.

2. The error counter clear signal must be ON for at least 20 µs.

(2) Reference Pulse Input Signal Timing

The reference pulse input signal timing is shown below.

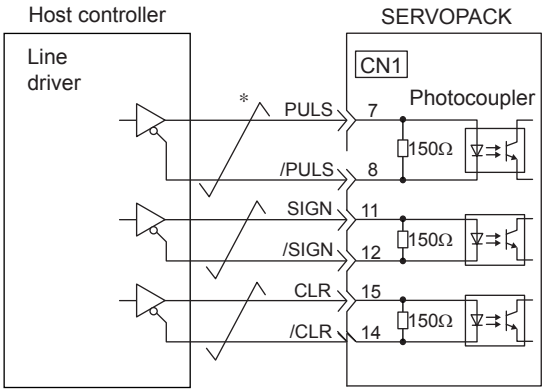
Table 9.1 Reference Pulse Input Signal Timing

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 ms t3, t7 ≤ 0.1 ms 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.

(3) Connection Example

(a) Connection Example for Line-driver Output

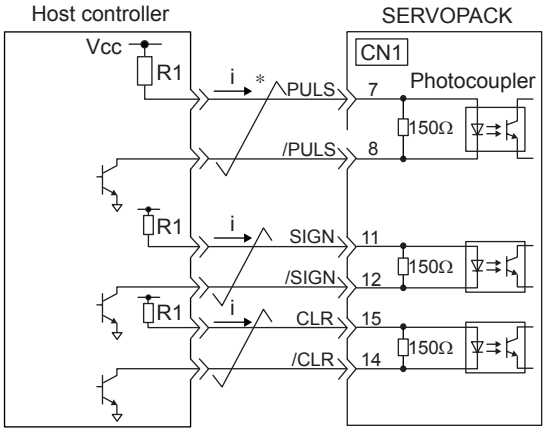
Applicable line driver: SN75174 manufactured by Texas Instruments Inc., or MC3487 or equivalent



* : 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.



* : Represents twisted-pair wires.

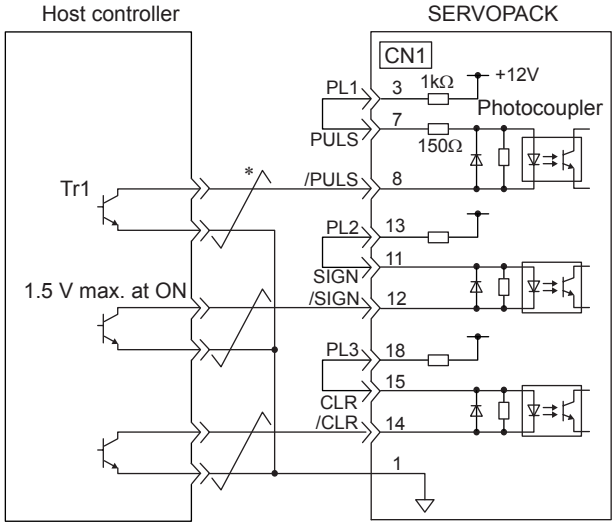
■Example

- 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 equivalent
When Tr1 is OFF	Low level input or equivalent

When the external power supply is used, the circuit will be isolated by a photocoupler. When the SERVOPACK internal power supply is used, the circuit will not be isolated.



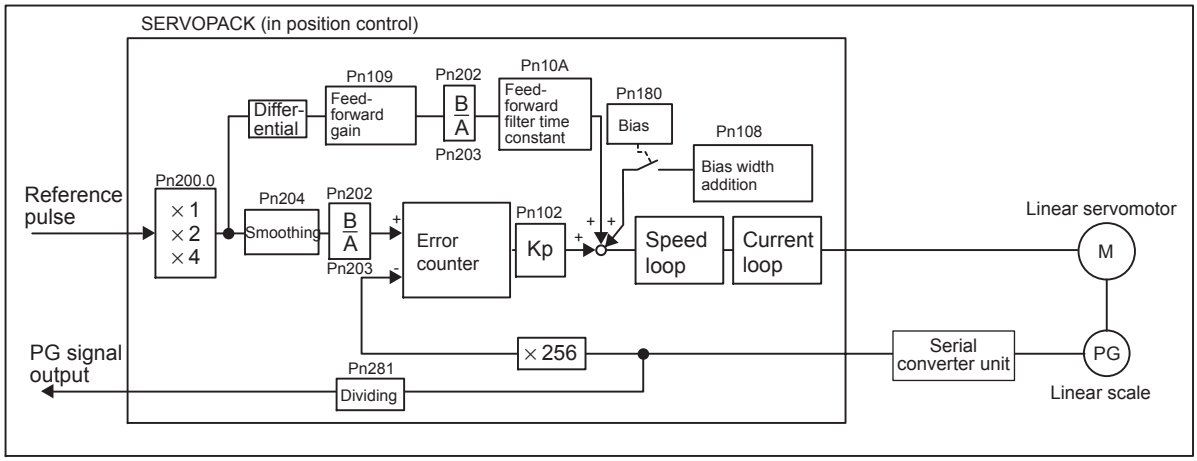
* : Represents twisted-pair wires.

IMPORTANT

When the open-collector output is used, input signal noise margin lowers. Set the parameter Pn200.3 to 1.

(4) Position Control Block Diagram

A block diagram for position control is shown below.



9.8.4 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 (0.00 to 64.00 ms)	0.01 ms	0	Immediately

Pn208	Average Movement Time of Position Reference			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 6400 (0.00 to 64.00 ms)	0.01 ms	0	Immediately

■ IMPORTANT

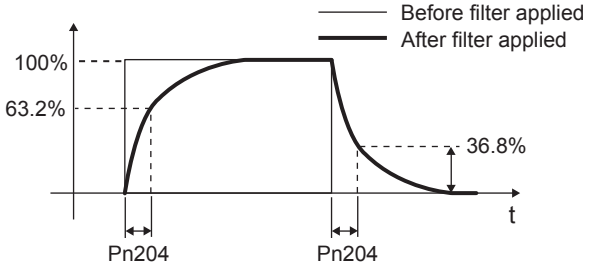
When the position reference acceleration/deceleration time constant (Pn204) is changed, a value with no reference pulse input and a position error of 0 will be enabled. To ensure that the setting value is correctly reflected, stop the reference pulse from the host controller and input the clear signal (/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).

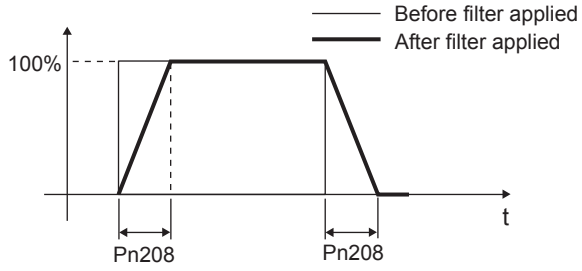
- When the host controller that outputs a reference cannot perform acceleration/deceleration processing.
- When the reference pulse frequency is too low.
- When the reference electronic gear ratio is too high (i.e., 10× or more).

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

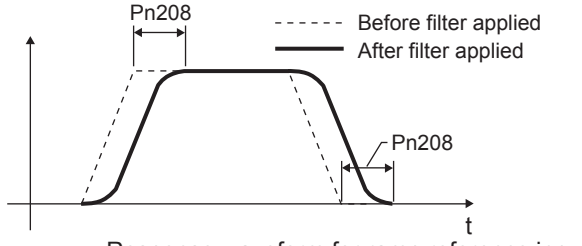
Acceleration/Deceleration Filter	Average Movement Time Filter
Pn207=n.□□□0	Pn207=n.□□□1



Response waveform for stepwise input



Response waveform for stepwise input



Response waveform for ramp reference input

9.8.5 Positioning Completed Output Signal

This signal indicates that servomotor movement has been completed during position control. Use the signal as an interlock to confirm at the host controller that positioning has been completed.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/COIN	CN1-25, 26 (Factory setting)	ON (low level)	Positioning has been completed.
			OFF (high level)	Positioning is not completed.
This output signal can be allocated to an output terminal with parameter Pn50E. The factory setting is allocated to CN1-25, 26.				

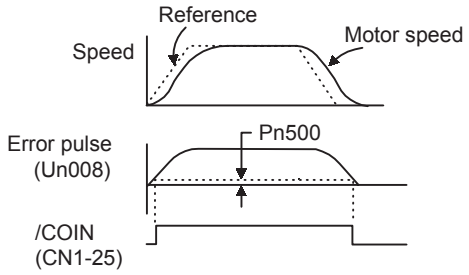
Pn500 Positioning Completed Width — Position

Setting Range	Setting Unit	Factory Setting	Setting Validation
0 to 250	Reference units	7	Immediately

The positioning completed (/COIN) signal is output when the difference (position error pulse) between the number of reference pulses output by the host controller and the travel distance of the servomotor is less than the value set in this parameter.

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

Too large a value at this parameter may output only a small error during low-speed operation that will cause the /COIN signal to be output continuously.



If a servo gain is set that keeps the position error small even when the positioning completed width is large, use Pn207 = n.1□□□ to enable correct output timing for the COIN signal.

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

/COIN is a position control signal.

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 force control.

9.8.6 Positioning Near Signal

This signal indicates that the positioning of the linear 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.

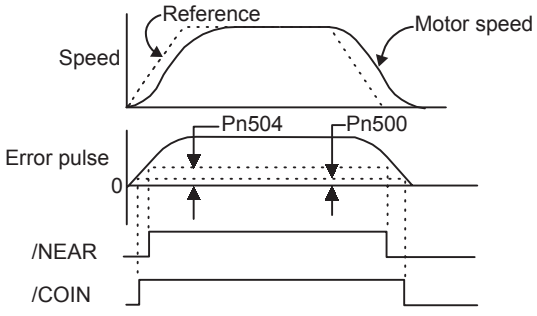
Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/NEAR	Must be allocated	ON (low level)	The servomotor has reached a point near to positioning completed.
			OFF (high level)	The servomotor has not reached a point near to positioning completed.
The output terminal must be allocated with parameter Pn510 in order to use positioning near signal. Refer to *8.3.3 Output Circuit Signal Allocation* for details.				

Pn504	NEAR Signal Width			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 250	Reference units	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.)

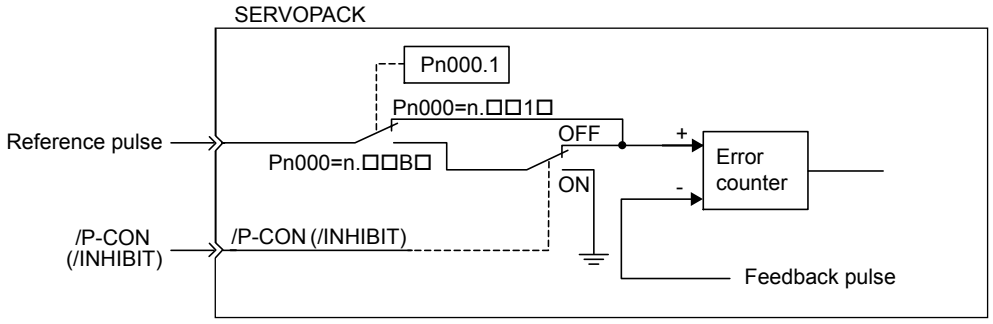
Normally, the setting should be larger than that for the positioning completed width (Pn500).



9.8.7 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.

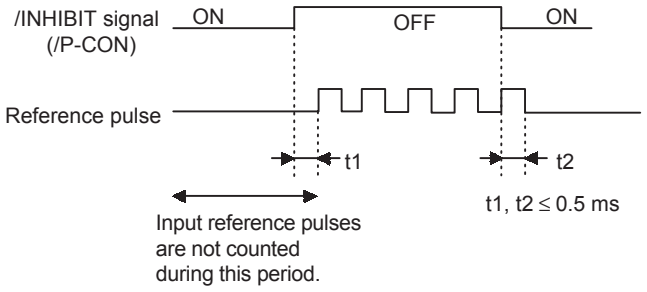


(2) Setting Parameters

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 *8.3.2 Input Circuit Signal Allocation*.				

9.9 Operating Using Force Control

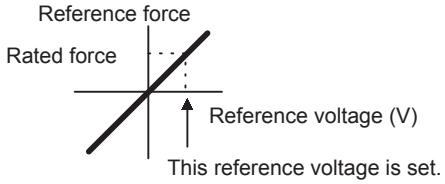
9.9.1 Setting Parameters

The following parameters must be set for force control operation with analog voltage reference.

Parameter		Meaning
Pn000	n.□□2□	Control mode selection: Force control (analog voltage reference)

Pn400	Force Reference Input Gain		Speed / Position / Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	10 to 100 (1.0 to 10.0 V/Rated force)	0.1V/rated force	30 (3.0 V/Rated force)	Immediately

This sets the analog voltage level for the force reference (T-REF) that is necessary to operate the linear servomotor at the rated force.



■ EXAMPLE

Pn400 = 30: The linear servomotor operates at the rated force with 3-V input (factory setting).

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

Pn400 = 20: The linear servomotor operates at the rated force with 2-V input.

9.9.2 Force Reference Input

By applying a force reference determined by the analog voltage reference to the SERVOPACK, the linear servomotor force can be controlled in proportion with the input voltage.

Type	Signal Name	Connector Pin Number	Name
Input	T-REF	CN1-9	Force Reference Input
	SG	CN1-10	Signal Ground for Force Reference Input

Used during force control (analog voltage reference). (Pn000.1 = 2, 6, 8, 9)

The force reference gain is set in Pn400. For setting details, refer to *9.9.1 Setting Parameters*.

■ Input Specifications

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

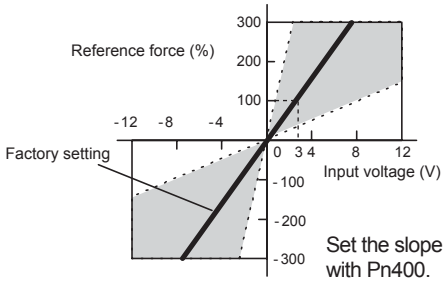
  Pn400 = 30: Rated force at 3 V

  +3-V input: Rated force in forward direction

  +9-V input: 300% rated force in forward direction

  -0.3-V input: 10% rated force in reverse direction

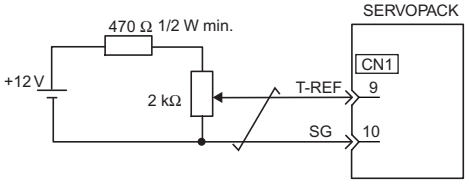
  The voltage input range can be changed with parameter Pn400.



■ 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 Force Reference

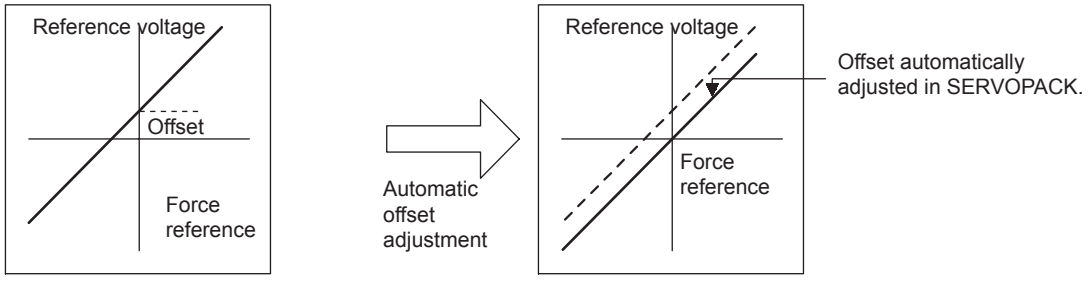
1. Checking the internal force reference with the panel operator:
   Use the Monitor Mode (Un-002). Refer to *8.4 Operation in Monitor Mode (Un□□□)*.
2. Checking the internal force reference with an analog monitor:
   The internal force reference can also be checked with an analog monitor. Refer to *10.5 Analog Monitor*.

9.9.3 Adjusting the Force Reference Offset

When using force control, the linear servomotor may move 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, force) 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 force reference offset (Fn00B).

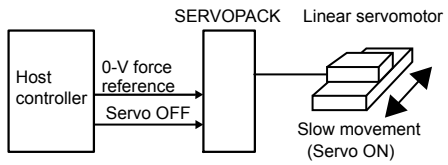
(1) Automatic Adjustment of the Force Reference Offset

The automatic adjustment of analog reference offset (Fn009) cannot be used when a position loop has been formed with the host controller. Use the force 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 force 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.

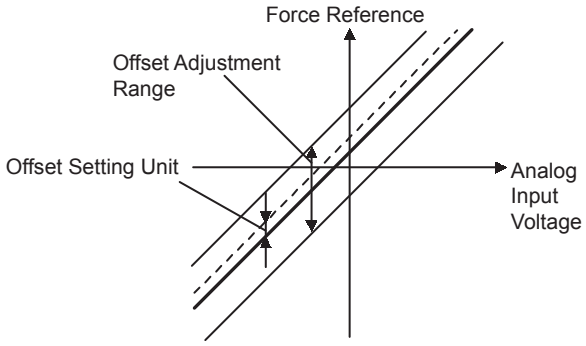
(2) Manual Adjustment of the Force Reference Offset

Manual adjustment of the force 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 force 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
(Force reference: -1881.6 mV to +1866.9 mV)

Offset Setting Unit
Force reference: 1 = 14.7 mV

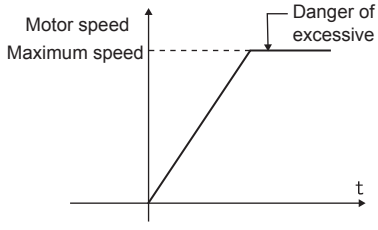
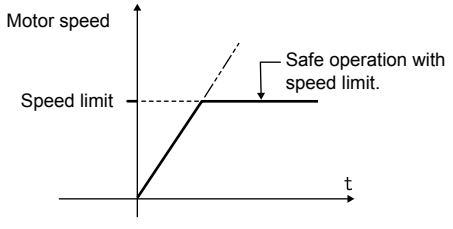
Use the following procedure to manually adjust the force reference offset.

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 force 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 force 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.

9.9.4 Limiting Linear Servomotor Speed during Force Control

During force control, the linear servomotor is controlled to output the specified force, which means that the linear servomotor speed is not controlled. Accordingly, when an excessive reference force is set for the mechanical load force, it will prevail over the mechanical load force and the linear servomotor speed will greatly increase.

This function serves to limit the linear servomotor speed during force control to protect the machine.

With No Speed Limit	With Speed Limit
	

(1) Speed Limit Mode Selection (Force Limit Option)

Parameter		Description
Pn002	n.☐☐**0**☐	Uses the value set in Pn480 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

Pn480	Speed Limit During Force Control			Force
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 5000	1 mm/s	5000	Immediately

Sets the linear servomotor speed limit value during force 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 linear servomotor speed limit value during force control.
The smaller value is enabled, the speed limit input from V-REF or the Pn480 (Speed Limit during Force 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 Force
	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 (6.00 V/rated speed)	Immediately

Sets the voltage level for the speed that is to be externally limited during force 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 force 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

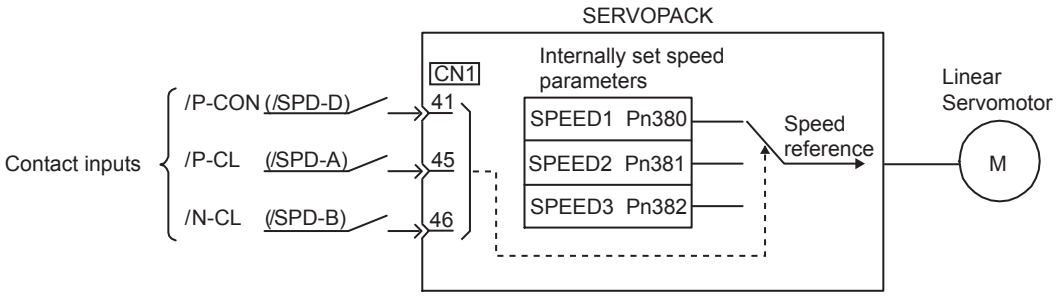
Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/VLT	Must be allocated CN1-□□	ON (low level)	Servomotor speed limit being applied.
			OFF (high level)	Servomotor speed limit not being applied.

This signal is output when the linear servomotor speed reaches the speed limit value set in Pn480 or set by the analog voltage reference.
For use, this output signal must be allocated with parameter Pn50F. For details, refer to *8.3.3 Output Circuit Signal Allocation*.

9.10 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.



9.10.1 Setting Parameters

Parameter		Meaning
Pn000	n.☐☐**3**☐	Control mode selection: Internally set speed control (contact reference)

Pn380	Internally set speed 1 (SPEED1)		Speed	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 5000	1 mm/s	10	Immediately
Pn381	Internally set speed 2 (SPEED2)		Speed	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 5000	1 mm/s	20	Immediately
Pn382	Internally set speed 3 (SPEED3)		Speed	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 5000	1 mm/s	30	Immediately

Note: The maximum speed of linear servomotor is used whenever a speed settings for the Pn380 to Pn382 exceed the maximum speed.

9.10.2 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 linear servomotor movement 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 *8.3.2 Input Circuit Signal Allocation*.

9.10.3 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 Movement 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)		Pn380: Internally Set Speed 1 (SPEED1)
	ON (low)	ON (low)		Pn381: Internally Set Speed 2 (SPEED2)
	ON (low)	OFF (high)		Pn382: Internally Set Speed 3 (SPEED3)
ON (low)	OFF (high)	OFF (high)	Reverse	Stop at 0 of the internally set speed
	OFF (high)	ON (low)		Pn380: Internally Set Speed 1 (SPEED1)
	ON (low)	ON (low)		Pn381: Internally Set Speed 2 (SPEED2)
	ON (low)	OFF (high)		Pn382: 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:

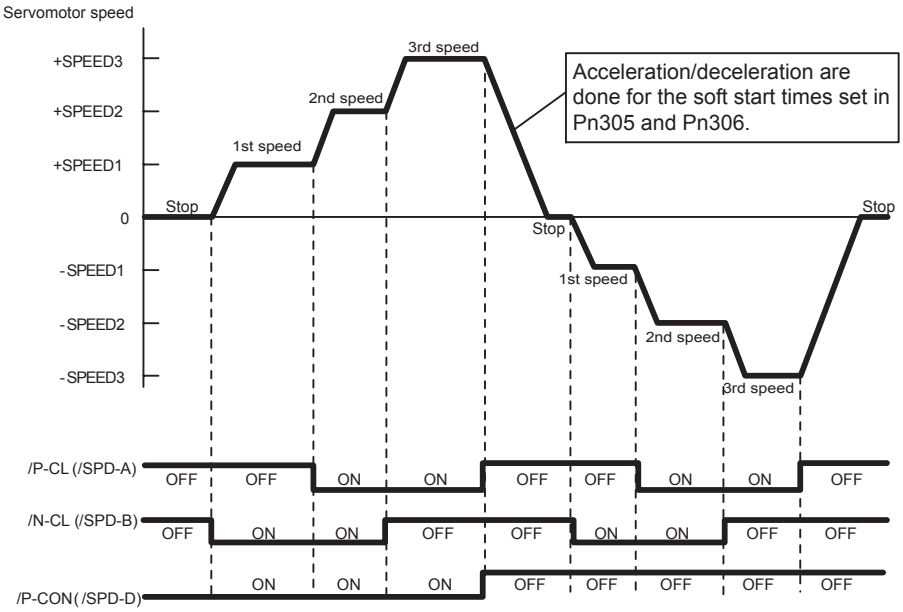
When Pn000.1=5: Internally set speed selection ⇔ Position control (pulse train)

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)	Pn380: Internally Set Speed 1 (SPEED1)
ON (low)	ON (low)	Pn381: Internally Set Speed 2 (SPEED2)
ON (low)	OFF (high)	Pn382: 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 *9.7.4 Soft Start*.

Example: Operation with an Internally Set Speed and Soft Start

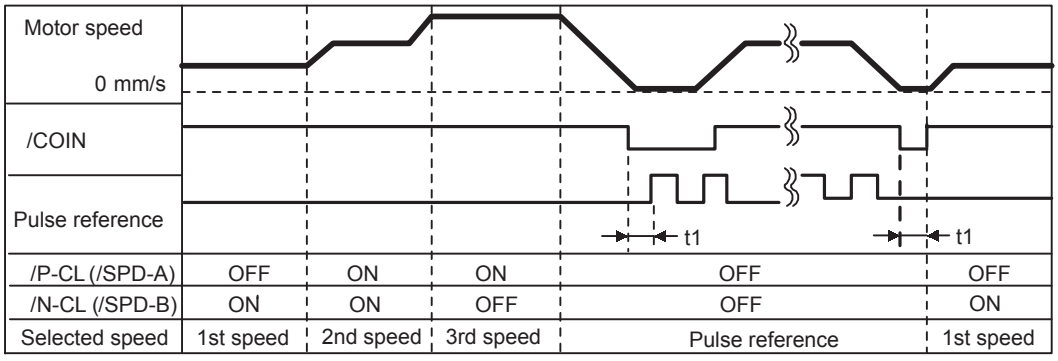


IMPORTANT

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).

9.11 Limiting Force

The SERVOPACK provides the following four methods for limiting output force to protect the machine.

Setting Level	Limiting Method	Reference Section
1	Internal force limit	9.11.1
2	External force limit	9.11.2
3	Force limiting by analog voltage reference	9.11.3
4	External force limit + Force limiting by analog voltage reference	9.11.4

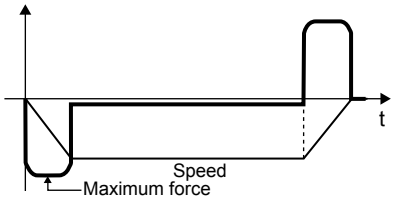
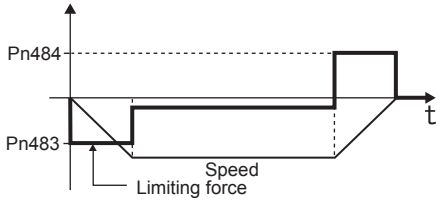
9.11.1 Internal Force Limit (Limiting Maximum Output Force)

Maximum force is always limited to the values set in the following parameters.

Pn483	Forward Force Limit		Speed	Position	Force
	Setting Range	Setting Unit	Factory Setting	Setting Validation	
	0 to 800	%	30	Immediately	
Pn484	Reverse Force Limit		Speed	Position	Force
	Setting Range	Setting Unit	Factory Setting	Setting Validation	
	0 to 800	%	30	Immediately	

The settings in these parameters are constantly enabled. The setting unit is a percentage of rated force.

If the force limit is set higher than the maximum force of the linear servomotor, the maximum force of the linear servomotor is used.

No Internal Force Limit (Maximum force can be output.)	Internal Force Limit
	

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

IMPORTANT

For safe operation at setup of linear servomotor, the factory setting of Pn483 and Pn484 are 30%, which are relatively low. After having set up the linear servomotor, increase the settings of Pn483 and Pn484 to the desired level. (Set to 800% if there is no restriction.)

9.11.2 External Force Limit (Output Force Limiting by Input Signals)

This function allows the force 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 force limits previously set in parameters.

(1) Related Parameters

Pn404	Forward External Force Limit		Speed Position Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 800	%	100	Immediately
Pn405	Reverse External Force Limit		Speed Position Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 800	%	100	Immediately

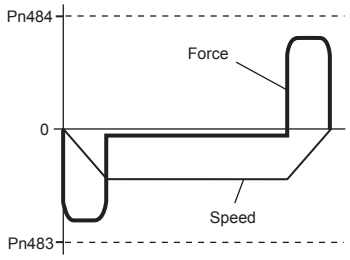
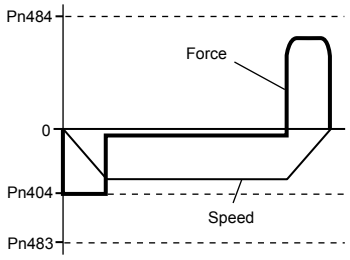
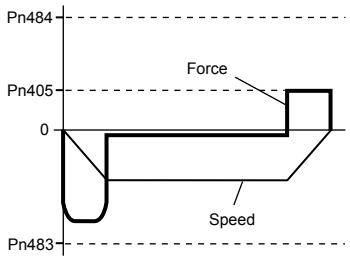
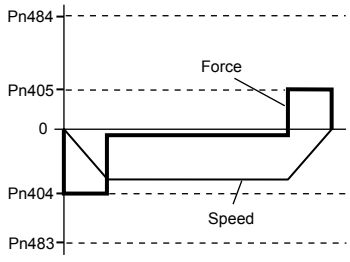
Note: The setting unit is a percentage of rated force (i.e., the rated force is 100%).

(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 force limit ON	The value set in Pn483 or Pn404 (whichever is smaller)
			OFF (high level)	Forward external force limit OFF	Pn483
Input	/N-CL	CN1-46 (Factory Setting)	ON (low level)	Reverse external force limit ON	The value set in Pn484 or Pn405 (whichever is smaller)
			OFF (high level)	Reverse external force limit OFF	Pn484
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 *8.3.2 Input Circuit Signal Allocation*.					

(3) Changes in Output Force during External Force Limit

Example: External force limit (Pn483, Pn484) set to 800%

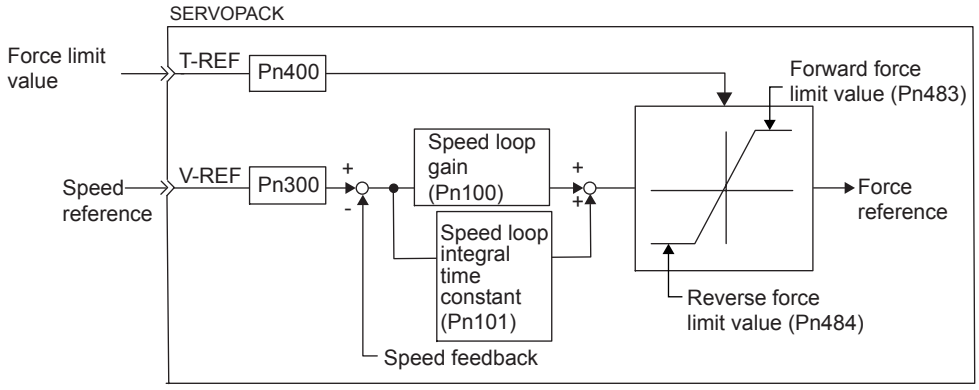
<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="2">/P-CL (Forward External Force Limit Input)</td></tr>
<tr><td>High level</td><td>Low level</td></tr>
<tr><td rowspan="2">/N-CL (Reverse External Force Limit Input)</td><td>High level</td><td> 
</td><td> 
</td></tr>
<tr><td>Low level</td><td>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

Note: In this example, the linear servomotor movement direction is Pn000 = n.□□□0 (standard setting, CCW = forward).

9.11.3 Force Limiting Using an Analog Voltage Reference

Force limiting by analog voltage reference limits force by assigning a force 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 force control.

Refer to the following block diagram when the force 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 force limiting. The absolute values of both + and - voltages are input, and a force 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 force limit input.
When n.□□□2 is set, the T-REF terminal is used for force 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	Force reference input
	SG	CN1-10	Signal ground for force reference input

The force limit input gain is set at parameter Pn400. Refer to *9.9.1 Setting Parameters*.

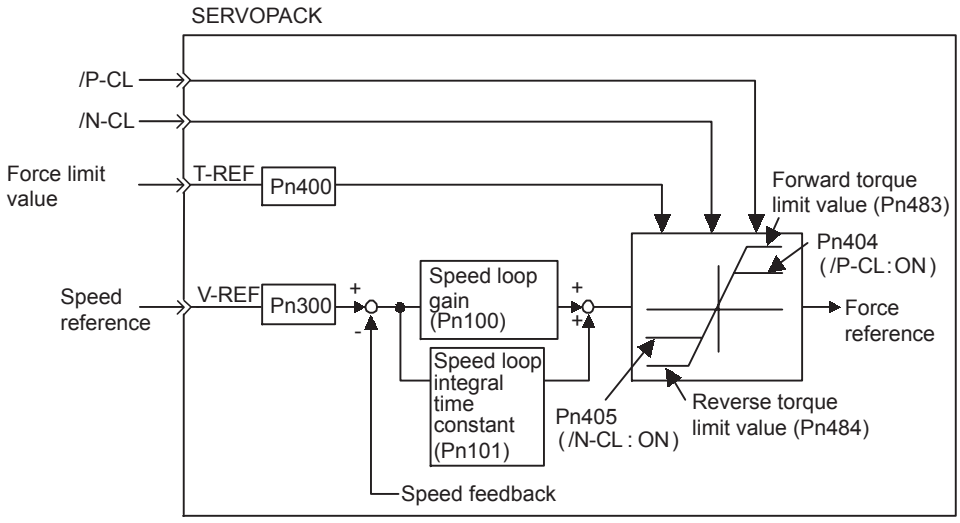
■ Input Specifications

- Input range: ±1 VDC to ±10 VDC/rated force
- Maximum allowable input voltage: ±12 VDC

9.11.4 Force Limiting Using an External Force Limit and Analog Voltage Reference

This function can be used to combine force limiting by an external input signal and by analog voltage reference. Because the force limit by analog voltage reference is input from T-REF (CN1-9, 10), this function cannot be used during force control. Use /P-CL (CN1-45) or /N-CL (CN1-46) for force limiting by external input signal.

When /P-CL (or /N-CL) is ON, either the force limit by analog voltage reference or the setting in Pn404 (or Pn405) will be applied as the force 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 force feed-forward input, but the functions cannot be used together.		

Pn404	Forward External Force Limit		Speed Position Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 800	%	100	Immediately
Pn405	Reverse External Force Limit			
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 800	%	100	Immediately

* The setting unit is a percentage of rated force (i.e., the rated force is 100%).

(2) Input Signals

Type	Signal Name	Connector Pin Number	Name
Input	T-REF	CN1-9	Force reference input
	SG	CN1-10	Signal ground for force reference input
The force limit input gain is set in parameter Pn400. Refer to *9.9.1 Setting Parameters*. ■ Input Specifications • Input range: ±1 VDC to ±10 VDC/rated force • Maximum allowable input voltage: ±12 VDC			

Type	Signal Name	Connector Pin Number	Setting	Meaning	Limit Value
Input	/P-CL	CN1-45 (Factory setting)	ON (low level)	Forward external force limit ON	The analog voltage reference limit or the value set in Pn483 or Pn404 (whichever is smaller)
			OFF (high level)	Forward external force limit OFF	Pn483
Input	/N-CL	CN1-46 (Factory setting)	ON (low level)	Reverse external force limit ON	The analog voltage reference limit or the value set in Pn484 or Pn405 (whichever is smaller)
			OFF (high level)	Reverse external force limit OFF	Pn484
When using the force limiting with the external force 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 *8.3.2 Input Circuit Signal Allocation*.					

9.11.5 Checking Output Force Limiting during Operation

The following signal can be output to indicate that the servomotor output force is being limited.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/CLT	Must be allocated	ON (low level)	Servomotor output force is being limited.
			OFF (high level)	Force is not being limited.
The output terminal must be allocated with parameter Pn50F to use this output signal. Refer to *8.3.3 Output Circuit Signal Allocation* for details.				

9.12 Control Mode Selection

The methods and conditions for switching SERVOPACK control modes are described below.

9.12.1 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) ⇔ Force control (analog voltage reference)
	n.☐☐**7**☐	Position control (pulse train reference) ⇔ Speed control (analog voltage reference)
	n.☐☐**8**☐	Position control (pulse train reference) ⇔ Force control (analog voltage reference)
	n.☐☐**9**☐	Force 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)

9.12.2 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 *8.3.2 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	Force	Speed	Zero clamp	Inhibit
			OFF (high level)	Position	Position	Force	Speed	Position
(Input)	(/C-SEL)	Must be allocated	ON (low level)	Speed	Force	Speed	Zero clamp	Inhibit
			OFF (high level)	Position	Position	Force	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 *8.3.2 Input Circuit Signal Allocation*.								

9.13 Other Output Signals

The following output signals, which have no direct connection with the control modes, are used for machine protection.

9.13.1 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 *8.3.2 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 *8.1.2 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 *11.1.5 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 *11.1.1 Alarm Display Table* for details on alarm code output.			

9.13.2 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 *8.3.3 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 *9.13.1 Servo Alarm Output (ALM) and Alarm Code Output (ALO1, ALO2, ALO3)* for alarm code descriptions. • Refer to *11.1.2 Warning Display* for the ON/OFF combinations of ALO1, ALO2, and ALO3 when a warning code is output.		

9.13.3 Running Output Signal (/TGON)

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/TGON	CN1-27, 28 (Factory setting)	ON (low level)	Linear servomotor is operating (Motor speed is above the setting in Pn581).
			OFF (high level)	Linear servomotor is not operating (Motor speed is below the setting in Pn581).
This signal is output to indicate that the linear servomotor is currently operating above the setting in parameter Pn581. The /TGON signal can be allocated to another output terminal with parameter Pn50E. For details, refer to *8.3.3 Output Circuit Signal Allocation*.				

- Related Parameter

Pn581	Zero-Speed Level		Speed Position Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 5000	1 mm/s	20	Immediately
Set the range in which the running output signal (/TGON) is output in this parameter. When the linear servomotor movement speed is above the value set in the Pn581, it is judged to be linear servomotor moving and the running output signal (/TGON) is output. The movement detection signal can also be checked on the digital operator. For details, refer to *8.1.4 Status Display* and *8.4.1 List of Monitor Modes*.				

9.13.4 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.

If no hall sensor is set, the polarity detection must be completed.

The servo ready signal condition can also be checked on the digital operator. For details, refer to *8.1.4 Status Display* and *8.4.1 List of Monitor Modes*.

The /S-RDY signal can be allocated to another output terminal with parameter Pn50E. For details, refer to *8.3.3 Output Circuit Signal Allocation*.

10

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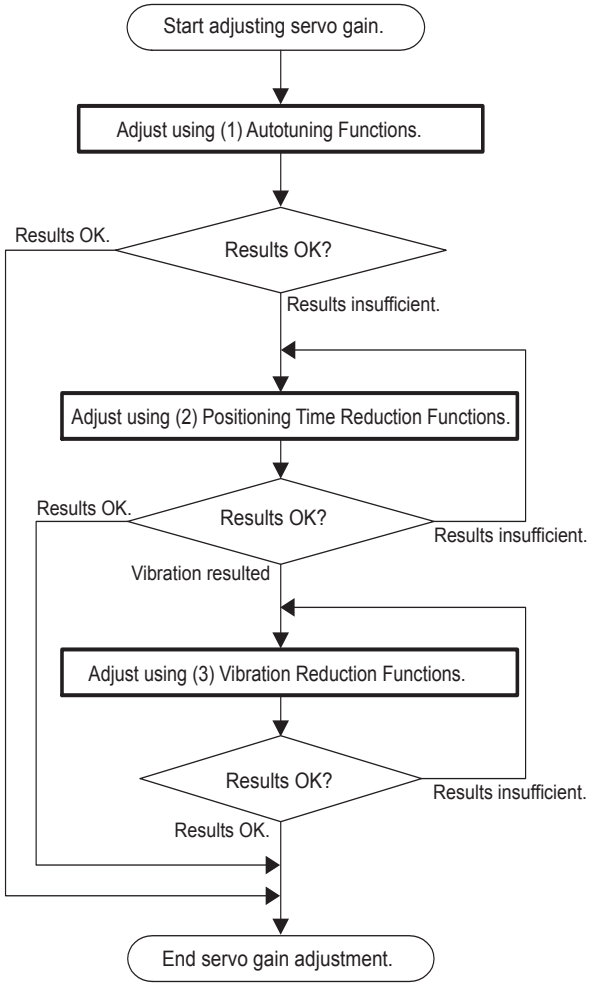
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10.1 Autotuning

10.1.1 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 *10.1.2 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. The following flowchart shows an overview procedure for adjusting the servo gains to reduce the positioning time for position control. Follow this flowchart to effectively adjust the servo gains. For functions in bold lines in the flowchart, select the adjustment method according to the client's intent using *10.1.2 List of Servo Adjustment Functions*.



If the desired responsiveness cannot be achieved adjusting according to the servo gain adjustment methods, consider the following possible causes.

- Autotuning does not suit the operating conditions.
  Adjust the servo gains manually. Refer to *10.3 Manual Tuning*.
- The selection of settings for the positioning time reduction functions or vibration reduction functions are not appropriate.
  Each function may not be effective for all machines due to machine characteristics or operating conditions.
  Use other positioning time reduction function or vibration reduction function.

10.1.2 List of Servo Adjustment Functions

(1) Autotuning Functions

Autotuning calculates the load mass, which determines the servo responsiveness, and automatically adjusts parameters, such as the Speed Loop Gain Kv (Pn100), Speed Loop Integral Time Constant Ti (Pn101), Position Loop Gain Kp (Pn102), and Force Reference Filter Time Constant Tf (Pn401). Refer to the following table to select the appropriate autotuning function for your desired purpose and adjust the servo gains.

Function Name and Related Parameters	Description	Guidelines for Selection	Reference Section
Online Autotuning Pn110.0 Fn001 Fn007	This function automatically measures the machine characteristics and sets the required servo gains accordingly. This function allows beginners to adjust the servo gains easily. The load mass is calculated during operation for a user reference, and the servo gains (Kv, Ti, Kp, and Tf) are set according to the Machine Rigidity Setting (Fn001).	Only the minimum number of parameters must be set for autotuning using a normal operation reference.	10.2

(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	10.4.1
Force feed-forward Pn002 Pn400	Inputs force feed-forward to the force reference input terminal and adds to the internal force reference at the speed control.		Speed	10.4.2
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	10.4.3
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 (force, speed, acceleration, or position error) as a threshold value.	The setting for automatic switching between PI and P control is easy.	Position Speed	10.4.5
Speed Feedback Compensation Pn110 Pn111	Compensates the motor speed using an observer.	Adjustment is easy because the compensation can be set as a percentage. If the speed loop gain increases, the position loop gain also increases, however sometimes the servo rigidity decreases.	Position Speed	10.4.8
Gain Switching Pn100 Pn101 Pn102 Pn104 Pn105 Pn106	Uses the external signals to change each parameter for speed loop gain (Kv), speed loop integral time constant (Ti), and position loop gain (Kp.)	–	Position Speed	10.4.9

(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	9.7.4
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	9.8.4
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	9.8.4
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	10.4.7
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	9.7.5
Force Reference Filter Pn401	A 1st-order delay filter for the force reference.	This filter is effective in essentially all frequency bands. The response is delayed if a large value (low frequency) is set.	Position Speed Force	10.4.10
Notch Filter Pn409 Pn40B*	Notch filters can be set for the force reference.	Mainly effective for vibration between 500 and 2,000 Hz. Instability will result if the setting is not correct.	Position Speed Force	10.4.10

* Pn40B is valid for the software version 32 or later.

10.2 Online Autotuning

10.2.1 Online Autotuning

Online autotuning calculates the load mass during operation of the SERVOPACK and sets parameters so that the servo gains consistent with the Machine Rigidity (Fn001) are achieved.

Online autotuning may not be effective in the following cases.

- The load mass varies in less than 200 ms.
- The motor speed is lower than 100 mm/s or the acceleration reference is very even.
- Load rigidity is low and mechanical vibration occurs easily or friction is high.
- The speed reference is a stepwise reference.

If the condition meets one of the above cases or the desired operation cannot be achieved by the online autotuning, calculate the load mass on the basis of the machine specifications or using the mass detection function of Yaskawa's servodrive supporting tool "SigmaWin+." Set the value in Pn103 and perform the adjustment manually.

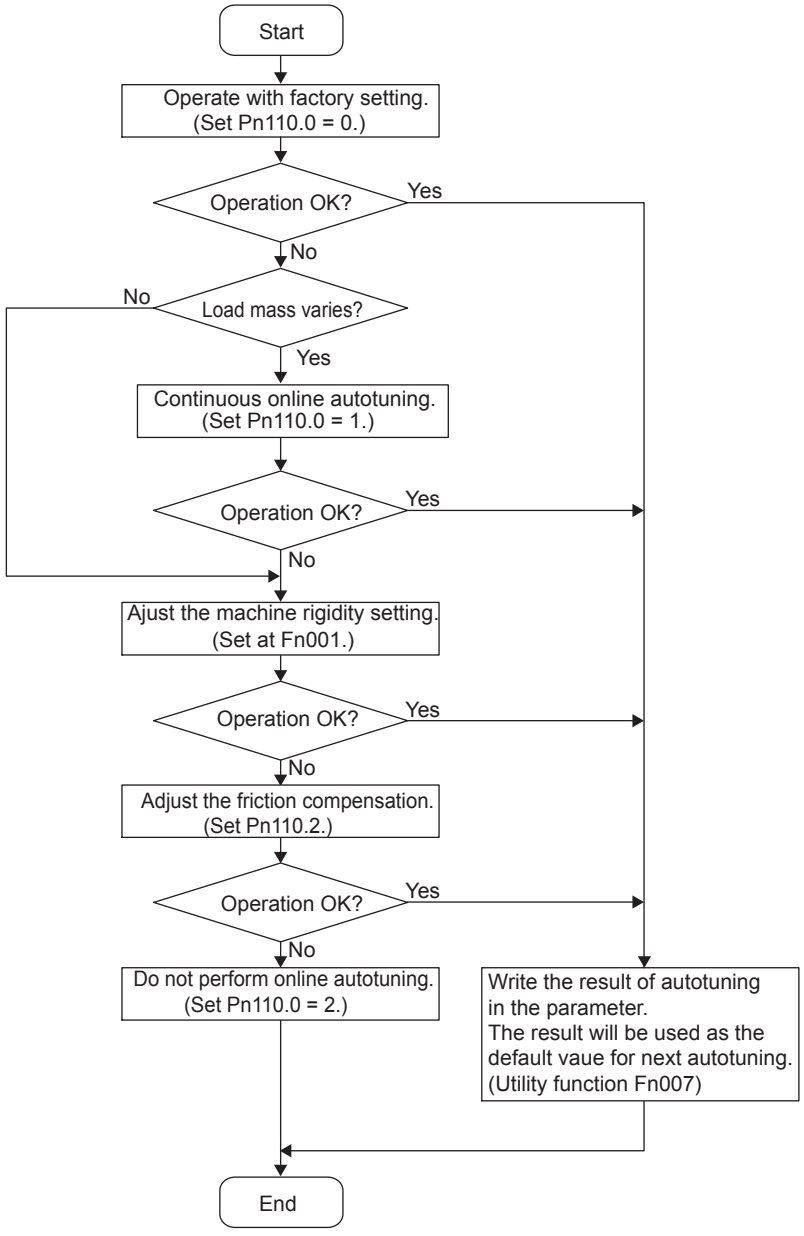
The following utility function is also available for the online autotuning.

Fn007: Writes the load mass calculated by the online autotuning in Pn103 and uses as the default value for the next calculation.

10.2.2 Online Autotuning Procedure

⚠ WARNING

- Do not perform extreme adjustment or setting changes causing unstable servo operation.
  Failure to observe this warning may result in injury and damages to the machine.
- Adjust the gains slowly while confirming motor operation.



10.2.3 Selecting the Online Autotuning Execution Method

There are three methods that can be used for online autotuning: At start of operation, constantly, and none. The selection method is described next.

Pn110	Online Autotuning Switches		Speed	Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	–	–	0010	After restart

Parameter		Meaning
Pn110	n.□□□**0**	Online autotuning is performed only after the first time power is turned ON. (Factory Setting)
	n.□□□**1**	Online autotuning (mass calculations) is performed continuously.
	n.□□□**2**	Online autotuning is not performed.

The factory setting is n.□□□0. This setting is recommended for applications in which the load mass does not change much or if the load mass is not known. The mass calculated at the beginning of operation is used continuously. In this case, differences in machine status and operation references at the beginning of operation may cause minor differences in the calculation results of the load mass, causing differences in the servo responsiveness each time the power supply is turned ON. If this occurs, overwrite the mass ratio in Pn103 using the utility function Fn007 (Writing to EEPROM mass ratio data obtained from online autotuning), and set Pn110 to n.□□□2 to disable online autotuning.

The setting n.□□□1 is used when the load mass varies constantly. This setting enables a consistent responsiveness even when the load mass changes. If the load mass changes in less than 200 ms, however, the autotuning accuracy will deteriorate, in which case Pn110.0 should be set to 0 or 2.

The setting n.□□□2 is used when online autotuning is not possible, when the load mass is known and the mass ratio is set in Pn103 to perform the adjustment manually, or any other time the online autotuning function is not going to be used.

10.2.4 Machine Rigidity Setting for Online Autotuning

There are ten machine rigidity settings for online autotuning. When the machine rigidity setting is selected, the servo gains (Speed Loop Gain, Speed Loop Integral Time Constant, Position Loop Gain, and Force Reference Filter Time Constant) are determined automatically. The factory setting for the machine rigidity setting is 4. The speed loop is suitable for PI or I-P control.

When parameter Pn10B.1 is 0, PI control will be used and when Pn10B.1 is 1, I-P control will be used. To validate the setting, however, the power supply must be turned OFF and then back ON.

After having validated the setting, always set the machine rigidity setting.

When setting the machine rigidity after having changed the position loop gain (Pn102), the value closest to the set position loop gain is displayed as the initial value of machine rigidity.

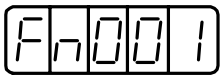
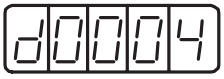
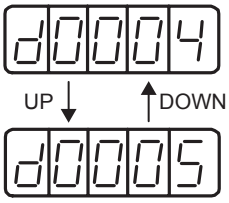
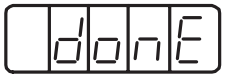
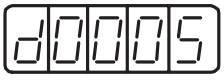
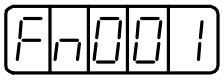
- Speed Loop PI Control

Machine Rigidity Setting Fn001	Position Loop Gain [s^{-1}] Pn102	Speed Loop Gain [Hz] Pn100	Speed Loop Integral Time Constant [0.01 ms] Pn101	Force Reference Filter Time Constant [0.01 ms] Pn401
1	15	15	6000	250
2	20	20	4500	200
3	30	30	3000	130
4	40	40	2000	100
5	60	60	1500	70
6	85	85	1000	50
7	120	120	800	30
8	160	160	600	20
9	200	200	500	15
10	250	250	400	10

If the machine rigidity setting is greater, the servo gain will increase and positioning time will decrease. If the setting is too large, however, vibration may result depending on the machine configuration. Set the machine rigidity starting at a low value and increasing it within the range where vibration does not occur.

10.2.5 Method for Changing the Machine Rigidity Setting

The machine rigidity setting is changed in utility function mode using parameter Fn001. The procedure is given below.

Step	Display after Operation	Digital Operator	Panel Operator	Description
1		 (DSPL/SET Key)	 MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
2				Press the Up or Down Cursor Key to select Fn001. *The digit that can be set will blink.
3		 (DATA/ENTER Key)	 DATA/◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER or DATA/SHIFT Key for one second or more. The display shown at the left will appear and the rigidity for online autotuning can be set.
4	 UP DOWN			Press the Up or Down Cursor Key to select the machine rigidity setting.
5		 (DSPL/SET Key)	 MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key. The rigidity setting will be changed and “donE” will blink on the display for about one second.
6		About one second later		After “donE” is displayed, the setting will be displayed again.
7		 (DATA/ENTER Key)	 DATA/◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER or DATA/SHIFT Key for more than one second to return to the Fn001 display of the utility function mode.

This completes changing the machine rigidity setting for online autotuning.

10.2.6 Saving the Results of Online Autotuning

⚠ CAUTION

- Always set the correct mass ratio when online autotuning is not used.
  If the mass ratio is set incorrectly, vibration may occur.

For online autotuning, the most recent load mass is calculated and the control parameters are adjusted to achieve response suitable for the machine rigidity setting. When online autotuning is performed, the Position Loop Gain (Pn102), Speed Loop Gain (Pn100), and Speed Loop Integral Time Constant (Pn101) are saved. When the power supply to the SERVOPACK is turned OFF, however, the calculated load mass is lost and the factory setting is used as the default value to start autotuning the next time the power supply is turned ON.
To use the calculated load mass as the default value the next time the power supply is turned ON, the utility function mode parameter Fn007 (Writing to EEPROM mass ratio data obtained from online autotuning) can be used to save the most recent value in parameter Pn103 (Mass Ratio). The mass ratio is given as the mass ratio (%) of the coil assembly mass of the linear servomotor.

Pn103	Mass Ratio		Speed / Position / Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 10,000 (0 to 20,000)*	1%	0	Immediately

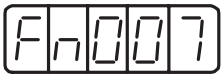
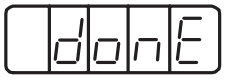
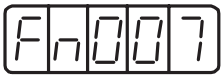
$$\text{Mass ratio} = \left(\frac{\text{Load mass } (M_L) \text{ (includes coil assembly)}}{\text{Linear servomotor coil assembly mass } (M_M)} - 1 \right) \times 100\ (\%)$$

The factory setting for the mass ratio is 0% (no-load operation of linear servomotor without connecting a machine).

* The setting range for the software version 32 or later.

10.2.7 Procedure for Saving the Results of Online Autotuning

The following procedure is used to save the results of online autotuning.

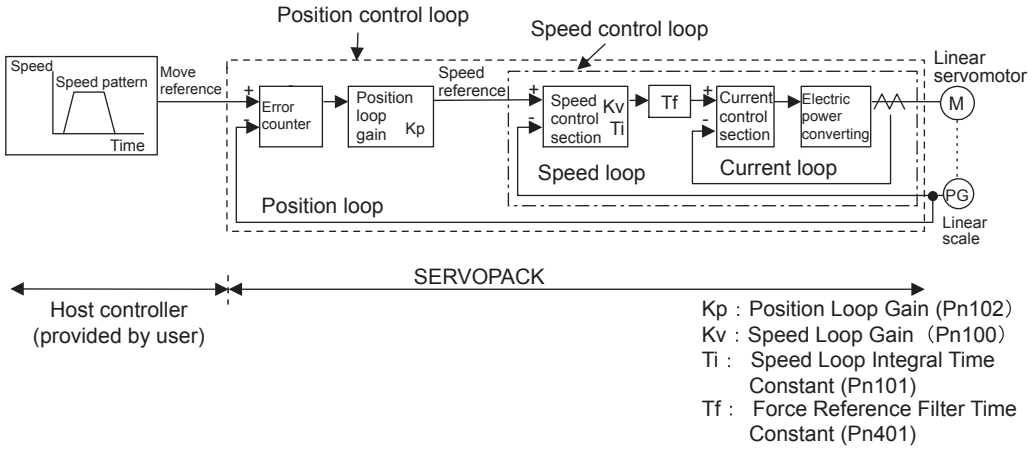
Step	Display after Operation	Digital Operator	Panel Operator	Description
1		DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
2				Press the Up or Down Cursor Key to select parameter Fn007. *The digit that can be set will blink.
3		DATA ENTER (DATA/ENTER Key)	DATA/◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER or DATA/SHIFT Key for one second or more. The display at the left will appear for a mass ratio of 200%.
4		DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key. The mass ratio will be saved. When completed, “donE” will blink for about one second.
5		About one second later		After “donE” is displayed, the mass ratio will be displayed again.
6		DATA ENTER (DATA/ENTER Key)	DATA/◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER or DATA/SHIFT Key for one second or more to return to the Fn007 display of the utility function mode.

This completes saving the default value for the mass ratio for online autotuning. The next time the power supply is turned ON, the value that was saved for the Mass Ratio (Pn103) will be used to start online autotuning.

10.3 Manual Tuning

10.3.1 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.

10.3.2 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: Force 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 mass ratio (Pn103). The utility function Fn007 can be used after the online autotuning.
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 force 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.

Perform the manual tuning in the following cases.

- To increase the servo gains more than the values set by the online autotuning.
- To determine the servo gains and mass ratio by the user.

Start the manual tuning from the factory setting or the values set by the online autotuning. Prepare measuring instruments such as memory recorder so that the signals can be observed from the analog monitor (CN5) such as "Force Reference" and "Motor Speed," and "Position Error Monitor" for the position control. (Refer to *10.5 Analog Monitor*.) The servodrive supporting tool "SigmaWin+" allows you to observe such signals. Prepare either of them.

10.3.3 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.

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

10.3.4 Speed Loop Gain

Pn100	Speed Loop Gain (Kv)		Speed	Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 2,000	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	Mass Ratio		Speed	Position	Force
	Setting Range	Setting Unit	Factory Setting	Setting Validation	
	0 to 10,000 (0 to 20,000)*	%	0	Immediately	

$$\text{Pn103 set value} = \left(\frac{\text{Load mass } (M_L) \text{ (includes coil assembly)}}{\text{Linear servomotor coil assembly mass } (M_M)} - 1 \right) \times 100\ (\%)$$

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

* The setting range for the software version 32 or later

10.3.5 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)

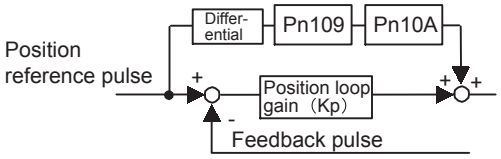
Generally, I-P control is more effective in high-speed positioning or high-speed/precision manufacturing applications. The position loop gain is lower than it would be in PI control, so shorter positioning times and smaller arc radii can be achieved. On the other hand, PI control is generally used when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

10.4 Servo Gain Adjustment Functions

10.4.1 Feed-forward Reference

Pn109	Feed-forward			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 100	%	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.



10.4.2 Force Feed-forward

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

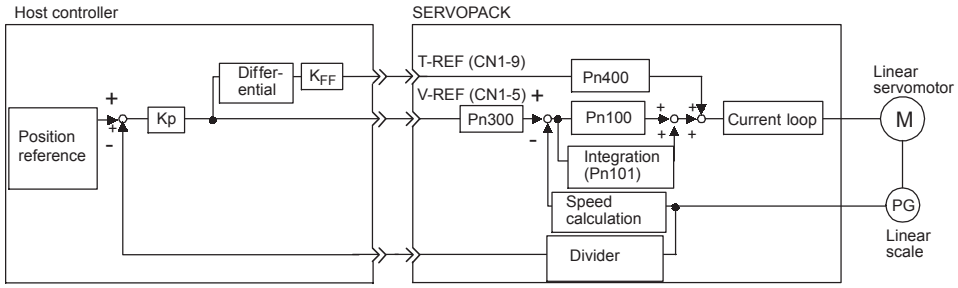
Pn400	Force Reference Input Gain		Speed Position Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	10 to 100 (1.0 to 10.0V/Rated force)	0.1V/Rated force	30 (3.0 V/Rated force)	Immediately

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

The force feed-forward function shortens positioning time, differentiates a speed reference at the host controller to generate a force feed-forward reference, and inputs the force feed-forward reference together with the speed reference to the SERVOPACK.

Too high a force 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 force forward-feed reference to T-REF (CN1-9 and -10) from the host controller.



Kp: Position loop gain

K_{FF}: Feed-forward gain

Force feed-forward is set using the parameter Pn400.

The factory setting is Pn400 = 30. If, for example, the force feed-forward value is ±3V, then, the force is limited to ±100% of the rated force.

The force feed-forward function cannot be used with force limiting by analog voltage reference described in *9.11.3 Force Limiting Using an Analog Voltage Reference*.

10.4.3 Speed Feed-forward

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

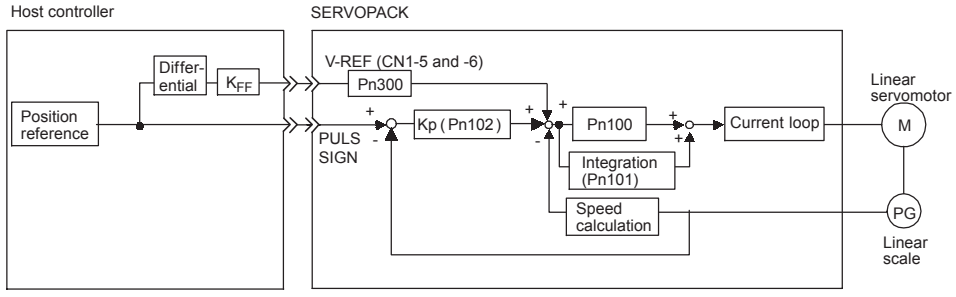
Pn300	Speed Reference Input Gain		Speed Position Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	150 to 3,000 (1.50 to 30.00 V/Rated speed)	0.01 V/Rated speed	600 (6.00 V/Rated speed)	Immediately

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.

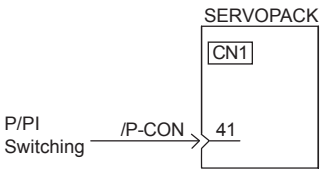
The factory setting is Pn300 = 600. If, for example, the speed feed-forward value is ±6V, then the speed is limited to the rated speed.

10.4.4 Proportional Control Operation (Proportional Operation Reference)

(1) PI/P Control

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.
CN1-41 is OFF (H level). — PI control
CN1-41 is ON (L level). — P control</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 10.4.5 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 linear servomotor may move 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 linear servomotor.</td></tr>
</table>

(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 linear servomotor movement 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 *8.3.2 Input Circuit Signal Allocation*.				

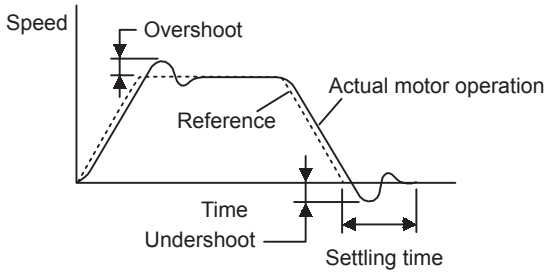
(3) Related Parameter

Parameter		Function
Pn50A	n.☐☐☐**1**	Enables the input signal allocation for the sequence.
Set to allocate the gain switching signal (/P-CON) to an input terminal.		

10.4.5 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 force reference level for detection point. (Factory Setting)	Pn10C	Percentage to the rated force
	n.□□□**1**	Use a speed reference level for detection point.	Pn181	Servomotor speed: mm/s
	n.□□□**2**	Use an acceleration level for detection point.	Pn182	Servomotor acceleration: 10 mm/s^2
	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.)				

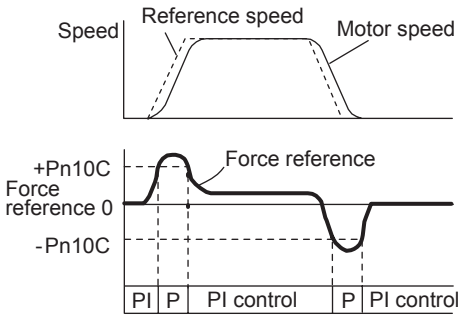
TERMS

[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.

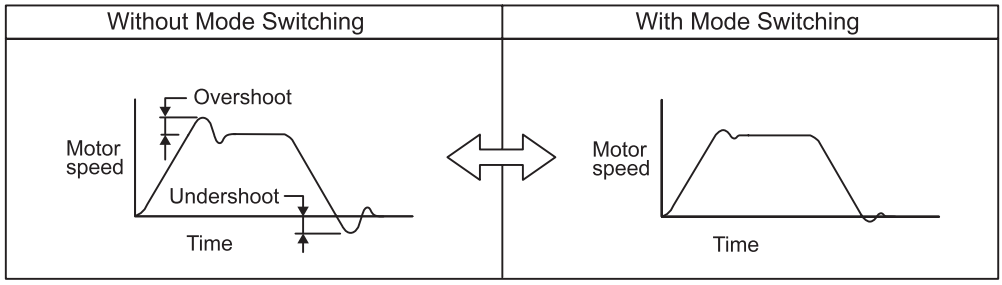
Using the Force Reference Level to Switch Modes (Factory Setting)

With this setting, the speed loop is switched to P control when the value of force reference input exceeds the force set in parameter Pn10C. The factory default setting for the force reference detection point is 200% of the rated force (Pn10C = 200).



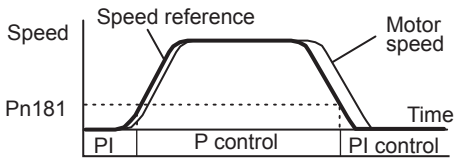
■ Operating Example

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 force saturation during acceleration or deceleration. The mode switch function suppresses force saturation and eliminates the overshooting or undershooting of the motor speed.



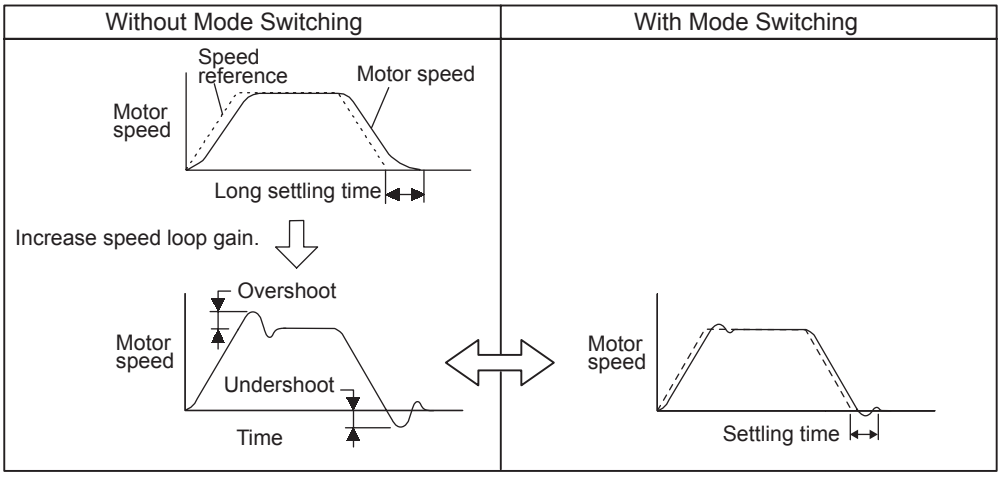
Using the Speed Reference Level to Switch Modes

With this setting, the speed loop is switched to P control when the value of speed reference input exceeds the speed set in parameter Pn181.



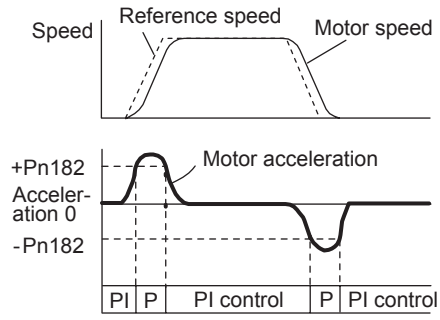
■ Operating Example

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.



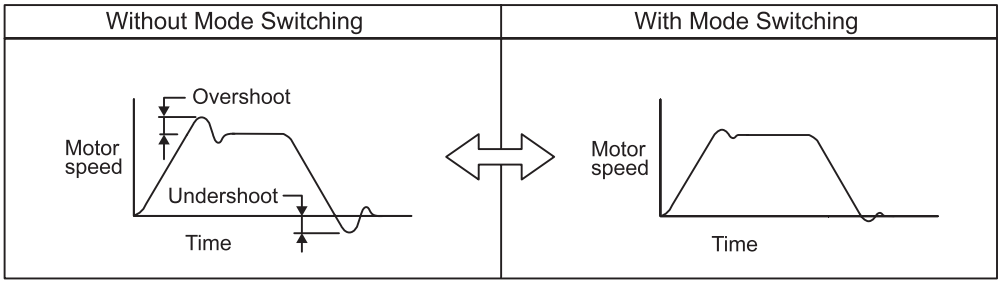
Using the Acceleration Level to Switch Modes

With this setting, the speed loop is switched to P control when the motor's acceleration rate exceeds the acceleration rate set in parameter Pn182.



■ Operating Example

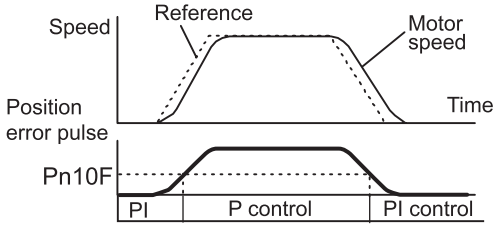
If the mode switch function is not being used and the SERVOPACK is always operated with PI control, the speed of the motor may overshoot or undershoot due to force saturation during acceleration or deceleration. The mode switch function suppresses force saturation and eliminates the overshooting or undershooting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



Using the Error Pulse Level to Switch Modes

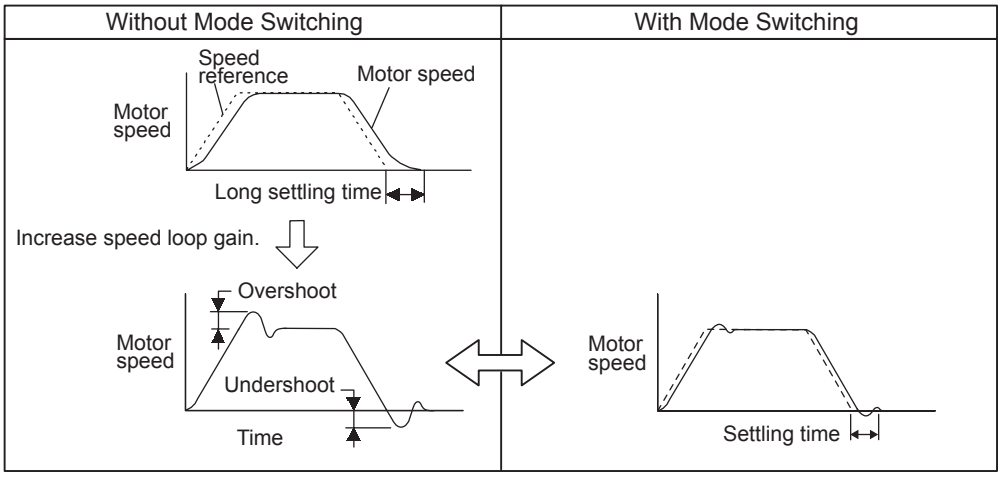
This setting is effective with position control only.

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.



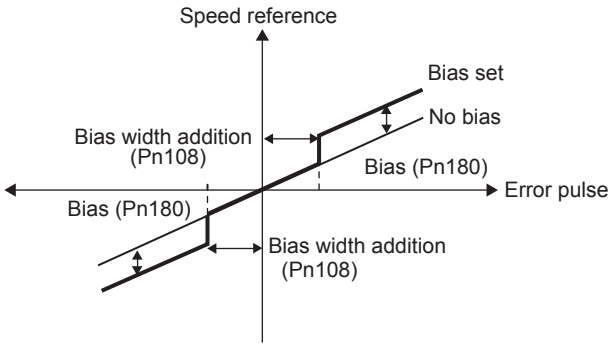
10.4.6 Setting the Speed Bias

The settling time for positioning can be reduced by setting the following parameters to add bias in the speed reference block in the SERVOPACK.

Pn180	Bias			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 450	1 mm/s	0	Immediately
Pn108	Bias Width Addition			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 250	1 Reference units	7	Immediately

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

The Bias Width Addition (Pn108) specifies when the Bias (Pn180) 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.



10.4.7 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.				

10.4.8 Speed Feedback Compensation

The speed feedback compensation can be used to reduce vibration and allow a higher speed loop gain to be set. In the end, the speed feedback compensation allows the positioning settling time to be reduced because the position loop gain can also be increased if the speed loop gain can be increased.

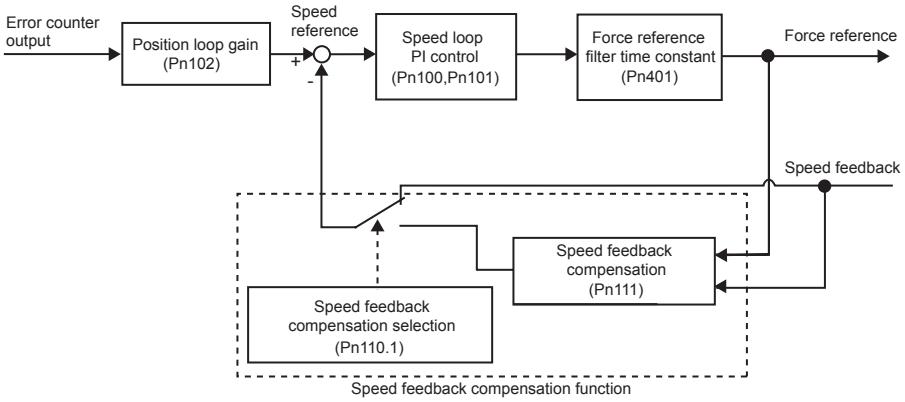
Pn110	Online Autotuning Switches		Speed	Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	–	–	0010	After restart

Pn111	Speed Feedback Compensation		Speed	Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 500	%	100	Immediately

Parameter		Function
Pn110	n.□□**0**□	Speed feedback compensation is used.
	n.□□**1**□	Speed feedback compensation is not used. (Standard speed feedback)

IMPORTANT

When this function is used, it is assumed that the mass ratio set in Pn103 is correct. Verify that the mass ratio has been set correctly.



(1) Adjustment Procedure

The following procedure explains how to adjust when the speed loop gain cannot be increased due to vibrations in the mechanical system. When adding a speed feedback compensation, observe the position error and torque reference with the analog monitor while adjusting the servo gain. Refer to *10.5 Analog Monitor* on monitoring the position error and force reference.

1. Set parameter Pn110 to “0002” so that the following conditions are satisfied.
   - To use the speed feedback compensation
   - Not to use the online autotuning function
2. With PI control, gradually increase the Speed Loop Gain in Pn100 and reduce the Speed Loop Integral Time Constant Pn101, so that the setting the Position Loop Gain in Pn102 to the same value as that of the Speed Loop Gain in Pn100.

   Use the result from the following equation as an initial estimate when setting the Speed Loop Integral Time Constant in Pn101.

   $$\text{Speed loop integral time constant (Pn101)} = \frac{4000}{2\pi \times \text{Pn100}}$$

   Speed loop gain units: Hz

   Check the units when setting the Speed Loop Integral Time Constant in Pn101. The value in Pn101 is set in units of 0.01 ms.

   Set the same value for the speed loop gain and position loop gain even though the speed loop gain units (Hz) are different form the position loop gain units (1/s).
3. Repeat step 2 to increase the speed loop gain while monitoring the settling time with the analog monitor’s position error and checking whether vibration occurs in the force reference. If there is any vibrating noise or noticeable vibration, gradually increase the Force Reference Filter Time Constant in Pn401.
4. Gradually increase only the position loop gain. When it has been increased about as far as possible, then decrease the Speed Feedback Compensation in Pn111 from 100% to 90%. Then repeat steps 2 and 3.
5. Decrease the speed feedback compensation to a value lower than 90%. Then repeat steps 2 through 4 to shorten the settling time. If the speed feedback compensation is too low, however, the response waveform will oscillate.
6. Find the parameter settings that yield the shortest settling time without causing vibration or instability in the position error or force reference waveform being observed with the analog monitor.
7. The servo gain adjustment procedure is complete when the positioning time cannot be reduced any more.

IMPORTANT

The speed feedback compensation usually makes it possible to increase the speed loop gain and position loop gain. Once the speed loop gain and position loop gain have been increased, the machine may vibrate significantly and may even be damaged if the compensation value is changed significantly or Pn110.1 is set to “1” (i.e., speed feedback compensation disabled).

10.4.9 Switching Gain Settings

Gain switching by the external signal is possible with the 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 by the external signal.

(1) 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 terminal must be allocated in the parameter Pn50D. Refer to *8.3.2 Input Circuit Signal Allocation*.				

(2) 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

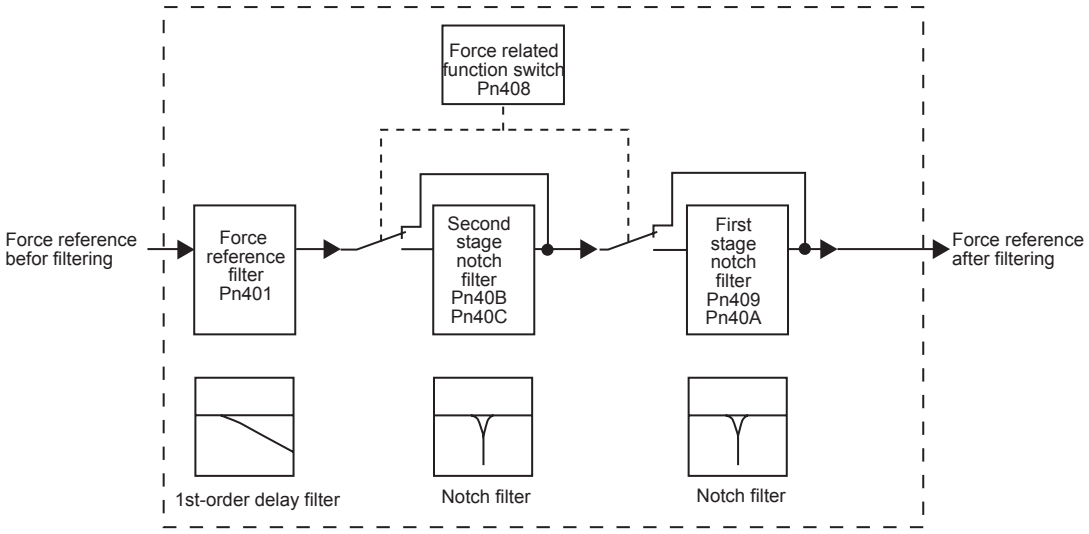
(3) Related Parameters

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 Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 2,000	Hz	40	Immediately
Pn101	Speed Loop Integral Time Constant		Speed Position Force	
	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
Pn102	Position Loop Gain		Speed Position Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 2,000	1/s	40	Immediately
Pn104	2nd Speed Loop Gain		Speed Position Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 2,000	Hz	40	Immediately
Pn105	2nd Speed Loop Integral Time Constant		Speed Position Force	
	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
Pn106	2nd Position Loop Gain		Speed Position Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 2,000	1/s	40	Immediately

10.4.10 Force Reference Filter

As shown in the following diagram, the force reference filter contains one force reference filter and two notch filters arrayed in series, and each filter operates independently. The notch filters can be enabled and disabled using the parameters.



IMPORTANT

Software version earlier than 32 does not have the parameters for the First Stage Notch Filter Q Value (Pn40A) and the Second Stage Notch Filter (Pn40B and Pn40C).

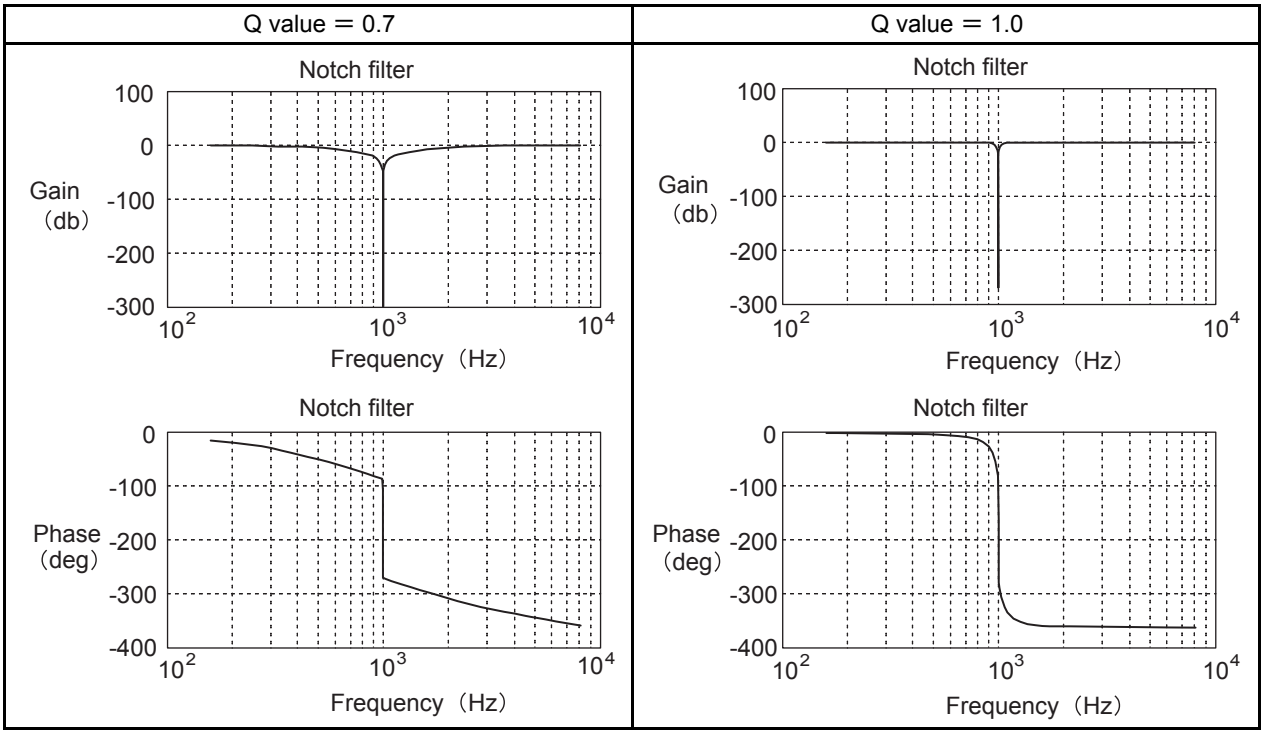
(1) Force Reference Filter

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

Pn401	Force Reference Filter Time Constant		Speed / Position / Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 65,535 (0.00 to 655.35 ms)	0.01 ms	100 (1.00 ms)	Immediately

(2) Notch Filter

The notch filter can eliminate specific frequency vibration generated by sources such as resonances of ball screw axes. The notch filter puts a notch in the gain curve at the specific vibration frequency. The frequency components near the notch frequency can be eliminated with this characteristics. A higher notch filter Q value produces a sharper notch and phase delay.



Parameter		Meaning
Pn408	n.□□□**0**	Disables the first stage notch filter.
	n.□□□**1**	Enables the first stage notch filter.
	n.□**0**□□	Disables the second stage notch filter.*
	n.□**1**□□	Enables the second stage notch filter.*
Enables the notch filter to be used. (The setting is validated immediately.)		

* Used for software version 32 or later.

Set the machine's vibration frequency in the parameter of a notch filter to be used.

Pn409	First Stage Notch Filter Frequency		Speed / Position / Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	50 to 2,000	Hz	2,000	Immediately
Pn40B	Second Stage Notch Filter Frequency *		Speed / Position / Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	50 to 2,000	Hz	2,000	Immediately

* Used for software version 32 or later.

When the vibration is suppressed but overshooting occurs, increase the Q value and check whether the overshooting is corrected.

Pn40A	First Stage Notch Filter Q Value *		Speed	Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	50 to 400 (0.50 to 4.00)	0.01	70 (0.70)	Immediately
Pn40C	Second Stage Notch Filter Q Value *		Speed	Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	50 to 400 (0.50 to 4.00)	0.01	70 (0.70)	Immediately

* Used for software version 32 or later.

IMPORTANT

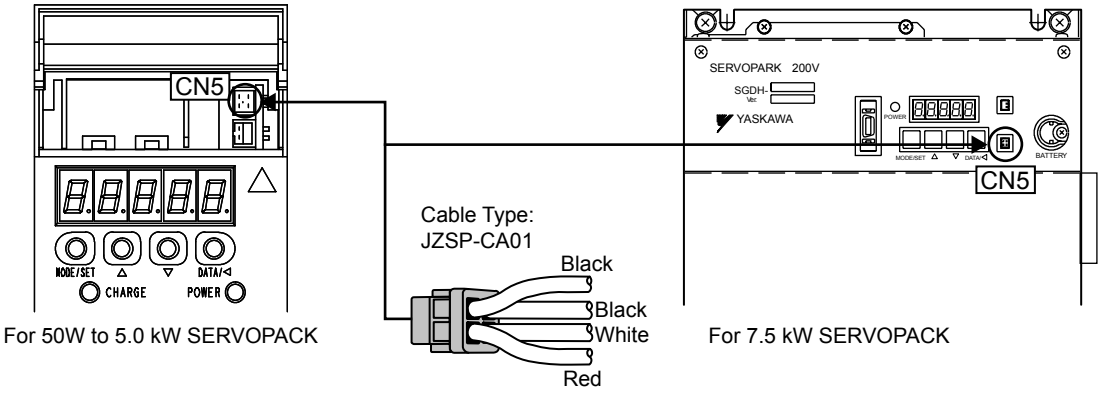
1. Sufficient precautions must be taken when setting the notch frequencies. Do not set the notch frequencies (Pn409 or Pn40B) that is close to the speed loop's response frequency. Set the frequencies at least four times higher than the speed loop's response frequency. Setting the notch frequency too close to the response frequency may cause vibration and damage the machine. The speed loop response frequency is the value of the Speed Loop Gain (Pn100) when the Mass Ratio (Pn103) is set to the correct value.
2. Change the Notch Filter Frequency (Pn409 or Pn40B) only when the linear servomotor is stopped. Vibration may occur if the notch filter frequency is changed when the linear servomotor is moving.

10.5 Analog Monitor

Signals for analog voltage references can be monitored.

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

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 mm/s
2	White	Analog monitor 1	Force reference: 1 V/100% rated force
3, 4	Black (2 lines)	GND (0 V)	–

- Related Parameters

The following signals can be monitored.

	Parameter		Function		
	Monitor 1	Monitor 2	Monitor Signal	Observation Gain	Remarks
Pn003	n.□□□**0**	n.□□**0**□	Motor speed	1 V / 1000 mm/s	Factory setting for Monitor 2
	n.□□□**1**	n.□□**1**□	Speed reference	1 V / 1000 mm/s	–
	n.□□□**2**	n.□□**2**□	Internal force reference	1 V / 100% rated force	Factory setting for Monitor 1
	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 mm/s	–
	n.□□□**6**	n.□□**6**□	Motor speed	1 V / 250 mm/s	–
	n.□□□**7**	n.□□**7**□	Motor speed	1 V / 125 mm/s	–
	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 force control, the position error monitor signal is not specified.



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.

11

Inspection, Maintenance, and Troubleshooting

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11.1 Troubleshooting

11.1.1 Alarm Display Table

The relation between alarm displays and alarm code outputs is shown in Table 11.1.
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.
- Coasting to a stop: Stops the servomotor naturally with friction when the motor is running and not braking.

Table 11.1 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 (Not detected for the SERVOPACKs with the capacity of 7.5 kW or more.)	Detection data for power circuit is abnormal.	Available				
A.04	Parameter Setting Error	• The parameter setting is outside the allowable setting range. • Pn080.0=1 was set though a hall sensor was connected.	N/A				
A.05	Combination Error	• SERVOPACK and servomotor capacities do not match each other. • The linear servomotor and SERVOPACK voltage specifications do not correspond to each other.	Available				
A.08	Linear Scale Pitch Setting Error	The initial value (0 μm) is set for the linear scale pitch (Pn280).	N/A				
A.09	Dividing Ratio Setting Error *1	• A value higher than the motor peak speed that can be obtained from the dividing ratio was set for Pn384. • When connecting the linear servomotor, a value higher than the maximum dividing ratio that can be obtained from the linear servomotor peak speed was set for Pn281.	N/A				
A.0A	Encoder Type Mismatching *1	The mounted serial encoder is not supported by Σ-II series.	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 *2	Main circuit DC voltage is excessively high.	Available	H	H	L	H
A.41	Undervoltage *2	Main circuit DC voltage is excessively low.	Available				

Table 11.1 Alarm Displays and Outputs (Cont'd)

Alarm Display	Alarm Name	Meaning	Alarm Reset	Alarm Code Output			Servo Alarm (ALM) Output
				ALO1	ALO2	ALO3	
A.51	Overspeed	• The motor speed is excessively high. • The divided output frequency exceeds 15 MHz.	Available	L	H	L	H
A.55	Linear Servomotor Peak Speed Setting Error*1	When connecting the linear servomotor, a value higher than the linear servomotor peak speed was set for Pn384.	Available				
A.71	Overload: High Load	The motor was operating for several seconds to several tens of seconds under a force largely exceeding ratings.	Available	L	L	L	H
A.72	Overload: Low Load	The motor was operating continuously under a force largely exceeding ratings.	Available				
A.73	Dynamic Brake Overload (Not detected for the SERVOPACKs with the capacity of 50 W to 1.0 kW.)	When the dynamic brake was applied, kinetic 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 (Not detected for the SERVOPACKs with the capacity of 50 W to 1.0 kW.)	The heat sink of SERVOPACK overheated.	Available				
A.82	Encoder Checksum Error	The checksum results of encoder memory is abnormal.	N/A	H	H	H	H
A.84	Encoder Data Error	Data in the encoder is abnormal.	N/A				
A.b1	Reference Speed Input Read Error	The A/D converter for reference speed input is faulty.	Available				
A.b2	Reference Force Input Read Error	The A/D converter for reference force input is faulty.	Available				
A.b3	Current Detection Error *1	Current sensor error was detected or linear servomotor line was 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	L	H	L	H
A.C2	Phase Faulty Detection Alarm	• The electrical angle at the hall sensor phase-U edge deviated for ±40 degrees or more. • Hall sensor signal error was detected.	N/A				
A.C5	Linear Servomotor Pole Detection Error	The polarity of linear servomotor can not be detected.	Available				
A.C9	Encoder Communications Error	Communications between SERVOPACK and encoder is not possible.	N/A				
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				

Table 11.1 Alarm Displays and Outputs (Cont'd)

Alarm Display	Alarm Name	Meaning	Alarm Reset	Alarm Code Output			Servo Alarm (ALM) Output
				ALO1	ALO2	ALO3	
A.d0	Position Error Pulse Overflow	Position error pulse exceeded parameter (Pn505).	Available	L	L	H	H
A.d3	Exceeded Position Data	Position data is 32-bit or more.	N/A				
A.F1	Power Line Open Phase	One phase is not connected in the main power supply.	Available	H	L	H	H
A.F6	Servomotor Line Disconnection *1	The power is not supplied to the linear servomotor while the SERVOPACK received a servo ON command.	Available				
CPF00	Digital Operator Transmission Error	Digital operator (JUSP-OP02A-2) fails to communicate with SERVOPACK (e.g., CPU error).	N/A	Not decided			
CPF01			N/A				
A.– –	Not an error	Normal operation status	–	H	H	H	L

* 1. These alarm occur only for the software version 32 or later.
* 2. For the SERVOPACK with a capacity of 7.5 kW:
A.40: Alarm detecting excessively high/low voltage in the main circuit
A.41: Not used

11.1.2 Warning Display

The relation between warning displays and warning code outputs is shown in table 11.2.

Table 11.2 Warning Displays and Outputs

Warning Display	Warning Name	Meaning	Warning Code Output		
			ALO1	ALO2	ALO3
A.90	Excessive Position Deviation *	The position deviation exceeds the value of 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

* The warning occurs only for the software version 32 or higher.

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

11.1.3 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 11.3.

Table 11.3 Alarm Displays and Outputs when the SERVOPACK and an Application Module Is 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	NS 600			ALO1	ALO2	ALO3	
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	○	○	○	–	–	NS100/115 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 WDC error				
A.ED	○	○	○	○	–	Command Execution Incomplete	Command was interrupted.				
A.EF	–	–	–	–	○	Application Module Error	Some kind of alarm occurred in the NS600.				

Note: 1. The following types of application modules are available:
NS100 (JUSP-NS100): MECHATROLINK I/F application module
NS115 (JUSP-NS115): MECHATROLINK-II I/F application module
NS300 (JUSP-NS300): Device Net I/F application module
NS500 (JUSP-NS500): PROFIBUS-DP I/F application module
NS600 (JUSP-NS600): INDEXER application module

2. For troubleshooting application module alarms, refer to relevant application module manual. Manual numbers are described in *Related Manuals* on *page v*.

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 commands, an A.ED alarm (Command execution incomplete) occurs and the MECHATROLINK-II commands are not successfully sent.
PRM_RD, PRM_WR, PPRM_WR, CONFIG, ALM_RD, ALM_CLR,
SENS_ON, ADJ, ID_RD

11.1.4 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 11.4.

Table 11.4 Warning Displays and Outputs when the SERVOPACK and an Application Module Is 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	NS 600			ALO1	ALO2	ALO3	
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
A.9F	−	−	−	−	○	NS600 Error	Some error occurred in the NS600. Check the NS600 Error Display for details.	L	L	L	L

Note: 1. The following types of application modules are available:
NS100 (JUSP-NS100): MECHATROLINK I/F application module
NS115 (JUSP-NS115): MECHATROLINK-II I/F application module
NS300 (JUSP-NS300): DeviceNet I/F application module
NS500 (JUSP-NS500): PROFIBUS-DP I/F application module
NS600 (JUSP-NS600): INDEXER application module

2. For troubleshooting application module alarms, refer to relevant application module manual. Manual numbers are described in *Related Manuals* 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 commands can not be carried out unconditionally (command warning: A.95) and the MECHATROLINK-II commands are not successfully sent.
PRM_RD, PRM_WR, PPRM_WR, CONFIG, ALM_RD, ALM_CLR,
SENS_ON, ADJ, ID_RD

11.1.5 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 11.5 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 control power supply ranged from 30 VAC to 60 VAC.	Correct the power supply, and set Fn005 to initialize the parameter.
			The power supply was turned OFF while changing the parameter setting. 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 (Not detected for the SERVOPACK with the capacity of 7.5 kW)	Occurred when the control power supply was turned ON or during operation	The control power supply ranged from 30 VAC to 60 VAC. A SERVOPACK fault occurred.	Correct the power supply. 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.
			Pn080.0 = 1 was set though a hall sensor was connected.	Check and correct the hall sensor wiring. Correct the set value of parameter Pn080.0.
			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 linear servomotor and SERVOPACK voltage specifications do not correspond to each other.	Select the proper combination of SERVOPACK and linear servomotor voltages.
			The parameter that is written in the serial converter unit is incorrect.	Replace the serial converter unit.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
A.08	Linear Scale Pitch Setting Error	Occurred when the control power supply was turned ON.	The initial value is set for Pn280.	Correct the set value of parameter Pn280.
A.09	Dividing Ratio Setting Error (For the software version 32 or later)	Occurred when the control power supply was turned ON.	A value higher than the motor peak speed that can be obtained from the dividing ratio was set for Pn384.	Change the set value to a value within the allowable peak speed, referring to Un010. Then set validation of the control power supply.
			A value higher than the maximum dividing ratio that can be obtained from the linear servomotor peak speed was set for Pn281.	Change the set value to a value within the allowable dividing ratio, referring to Un010. Then set validation of the control power supply.
A.0A	Encoder Type Mismatching (For the software version 32 or later)	Occurred when the control power supply was turned ON.	The mounted serial encoder is not supported by Σ-II series.	Replace the linear servomotor with the Σ-II series supported model.

Table 11.5 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	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 board fault occurred.	
		Occurred when the main circuit power supply was turned ON or when an overcurrent occurred 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.	
			The wiring of the regenerative resistor is incorrect.	Check and then correct the wiring.
			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).	
			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.	
			The dynamic brake was activated too frequently, so a DB overload alarm occurred.	Replace the SERVOPACK, and reduce the DB operation frequency.
			The overload alarm has been reset by turning OFF the power too many times.	Change the method to reset the alarm.
			The excessive change was given to the position/ speed reference.	Recheck the reference value.
			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. Heat radiation of the panel or heat around the panel occurred.	The ambient 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 (Detected when the power to the main circuit was turned ON.)	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred when the main circuit power supply was turned ON.	An external regenerative resistor is not connected for a servomotor of 7.5 kW.	Connect an external regenerative resistor.
			Pn600 is set to a value other than 0 for a servomotor of 400 W or less, and an external regenerative resistor is not connected.	Connect an external regenerative resistor, or set Pn600 to 0 if an external regenerative resistor is not connected.
			Check for incorrect wiring or a disconnected wire in the regenerative resistor.	Correct the wiring for the external regenerative resistor.
			A SERVOPACK fault occurred, such as regenerative transistor or a voltage sensor fault.	Replace the SERVOPACK.
			The jumper between B2 and B3 is removed for a servomotor of 500 W or more, and 5.0 kW or less.	Correct the wiring.
		Occurred during normal operation.	Check for incorrect wiring and disconnection of the regenerative resistor.	Correct the wiring for the external regenerative resistor.
			The regenerative resistor is disconnected, so the regenerative energy became excessive.	Replace the regenerative resistor or replace the SERVOPACK. Reconsider the load and operation conditions.
			A SERVOPACK fault, such as regenerative transistor and voltage sensor fault, occurred.	Replace the SERVOPACK.

Table 11.5 Alarm Display and Troubleshooting (Cont'd)

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.32	Regenerative Overload (Detected when the power to the main circuit is turned ON.)	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred when the main circuit power supply was turned ON.	The power supply voltage is 270 V or more.	Correct the input voltage.
		Occurred during normal operation (large increase of regenerative resistor temperature).	The regenerative energy is excessive.	Select a proper regenerative resistance capacity, or reconsider the load and operation conditions.
			The regenerating state continued.	
		Occurred during normal operation (small increase of regenerative resistor temperature).	The setting of parameter Pn600 is smaller than the external regenerative resistor's capacity.	Correct the set value of parameter Pn600.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred at servomotor deceleration.	The regenerative energy is excessive.	Select a proper regenerative resistance capacity, or reconsider the load and operation conditions.
A.33	Main Circuit Wiring Error (Detected when the power to the main circuit is turned ON.)	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred when the main circuit power supply was turned ON.	In the DC power input mode, AC power is supplied through L1 and L2 or L1, L2, and L3.	For AC power input, Pn001.2=0. For DC power input, Pn001.2=1.
			In the AC power input mode, DC power is supplied through ⊕1 and ⊖ terminals.	
			Pn600 is set to 0 if the regenerative resistance is disconnected.	Set Pn600 to 0.
A.40	Overvoltage (Detected when the SERVOPACK's main circuit DC voltage is 420 V or more.) (Detected when the power to the main circuit is turned ON.)	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred when the main circuit power supply was turned ON.	The AC power voltage is too high.	The AC power voltage must be within the specified range.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred during normal operation.	Check the AC power voltage (check if there is no excessive voltage change.)	The AC power voltage must be within the specified range.
			The motor speed is high and load mass is excessive, resulting in insufficient regenerative capacity.	Check the load mass and minus load specifications. Reconsider the load and operation conditions.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred at servomotor deceleration.	The motor speed is high, and the load mass is excessive.	Reconsider the load and operation conditions.

Table 11.5 Alarm Display and Troubleshooting (Cont'd)

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.41	Undervoltage (Detected when the SERVOPACK's main circuit DC voltage is 170 V or less.) (Detected when the power to the main circuit is turned ON.)	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred when the main circuit power supply was turned ON.	The AC power supply voltage is low.	The AC power supply voltage must be within the specified range.
			The fuse of the SERVOPACK is blown out.	Replace the SERVOPACK.
			The surge current limit resistor is disconnected, resulting in an abnormal power supply voltage or in an overload of the surge current limit resistor.	Replace the SERVOPACK. Check the power supply voltage, and reduce the number of times that the main circuit is turned ON or OFF.)
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred during normal operation.	The AC power supply voltage was lowered, and large voltage drop occurred.	The AC power supply voltage must be within the specified range.
			A temporary power failure occurred.	Clear and reset the alarm, and restart the operation.
			The servomotor main circuit cable is short-circuited.	Repair or replace the servomotor main circuit cable.
			The servomotor is short-circuited.	Replace the servomotor.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.51	Overspeed (Detected when the feedback speed is the maximum motor speed)	Occurred when the control power supply was turned ON.	A SERVOPACK board 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 movement.	The order of phases U, V, and W in the servomotor wiring is incorrect.	Correct the servomotor wiring.
			The encoder wiring is incorrect.	Correct the encoder wiring.
			Malfunction occurred due to noise interference in the encoder wiring.	Take measures against noise for the encoder wiring.
			The position or speed reference input is too large.	Reduce the reference value.
			The setting of the reference input gain is incorrect.	Correct the reference input gain setting.
			The divided output frequency exceeds 15 MHz.	Correct the setting for dividing output. Decrease the maximum speed.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
A.55	Linear Servomotor Maximum Speed Setting Error (For the software version 32 or later)	Occurred when the control power supply was turned ON.	When connecting the linear servomotor, a value higher than the linear servomotor peak speed was set for Pn384.	Check the maximum speed of the allowable linear servomotor with Un010 and then set Pn384 to a value that is lower than the maximum speed of the linear servomotor.

Table 11.5 Alarm Display and Troubleshooting (Cont'd)

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.71 A.72	Overload A.71: High Load A.72: Low Load	Occurred when the control power supply was turned ON.	A SERVOPACK board 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.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred when the servomotor did not run by the reference input.	The servomotor wiring is incorrect or the connection is faulty.	Correct the servomotor wiring.
			The encoder wiring is incorrect or the connection is faulty.	Correct the encoder wiring.
			The starting force exceeds the maximum force.	Reconsider the load and operation conditions, or reconsider the servomotor capacity.
			The polarity detection is not performed properly (when Pn080.0 = 1 is set.)	Correct the settings for the polarity detection related parameter.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred during normal operation.	The actual force exceeds the rated force or the starting force largely exceeds the rated force.	Reconsider the load and operation conditions, or reconsider the linear servomotor capacity.
			Temperature in the SERVOPACK panel is high.	Reduce the in-panel temperature to 55° or less.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.73	Dynamic Brake Overload	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred when the servomotor was running and in a status other than servo OFF.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred when the servomotor was running in servo OFF status.	The kinetic energy at a DB stop exceeds the DB resistance capacity.	①Reduce the motor speed, ②Reduce the load mass, or ③Reduce the number of times of the DB stop operation.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.74	Overload of Surge Current Limit Resistor (Detected when the number of times that the main circuit's power is turned ON or OFF more than 10 times/2 seconds.)	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred during operations other than the turning ON/OFF of the main circuit.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred at the main circuit power supply ON/OFF operation.	The surge current limit resistor operation frequency at the main circuit power supply ON/OF operation exceeds the allowable range.	Reduce the number of times that main circuit's power supply can be turned ON/OFF to 5 times/min. or less.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.7A	Heat Sink Overheated (Detected when the heat sink temperature exceeds 100 × °C.)	Occurred when the control power supply was turned ON.	A SERVOPACK fault occurred.	Replace the SERVOPACK.
			The overload alarm has been reset by turning OFF the power too many times.	Change the method to reset the alarm.
		Occurred when the main circuit power supply was turned ON or while the servomotor was running.	The load exceeds the rated load.	Reconsider the load and operation conditions, or reconsider the servomotor capacity.
			The SERVOPACK ambient temperature exceeds 55°C.	The ambient temperature must be 55°C or less.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.

Table 11.5 Alarm Display and Troubleshooting (Cont'd)

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.82	Encoder Checksum Error (Detected on the encoder side.)	Occurred when the control power supply was turned ON or during an operation.	A fault occurred in the serial converter unit and was detected by the serial converter unit self-diagnosis.	If this alarm occurs frequently, replace the serial converter unit.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.84	Encoder Data Error (Detected on the encoder side.)	Occurred when the control power supply was turned ON.	The linear scale's signal is weak.	Check if the linear scale is correctly mounted.
			A malfunction occurred in the serial converter unit.	Turn the control power supply OFF and then ON again. If this alarm occurs frequently, replace the serial converter unit.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred during normal operation.	The linear scale's signal is weak.	Check if the linear scale is correctly mounted.
			A malfunction occurred in the serial converter unit due to external noise.	Correct the wiring around the serial converter unit by separating the serial converter unit cable from the power line, or by checking the grounding and other wiring.)
			A serial converter unit fault occurred.	If this alarm occurs frequently, replace the serial converter unit.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
A.b1	Reference Speed Input Read Error (Detected when the Servo is ON.)	Occurred when the control power supply was turned ON.	A SERVOPACK board 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 board fault occurred.	Replace the SERVOPACK.
A.b2	Reference Force Input Read Error (Detected when the servo is ON.)	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
			A malfunction occurred in the reading section of the force reference input.	Clear and reset the alarm and restart the operation.
		Occurred during normal operation.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
A.b3	Current Detection Error (For the software version 32 or later)	Occurred during normal operation.	Current sensor error is detected or servomotor line is disconnected.	Check and correct the servomotor power line, or replace the SERVOPACK.
A.bF	System Alarm (Program error) • Software operation time exceeded • Stack overflow • Micro program error	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred during normal operation.	A program is incorrect.	Replace the SERVOPACK. (Contact your Yaskawa representative.)
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
A.C1	Servo Overrun Detected	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred when the servo was ON or a reference was input.	The order of phase U, V, and W in the servomotor wiring is incorrect.	Correct the servomotor wiring.
			The polarity detection is not performed properly (When Pn080.0 = 1 is set).	Correct the settings for the polarity detection related parameter.
			A serial converter unit fault occurred.	Replace the serial converter unit.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.

Table 11.5 Alarm Display and Troubleshooting (Cont'd)

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.C2	Phase Faulty Detection (Occurs when using a hall sensor.)	Occurred when the control power supply was turned ON.	When Pn080.0 = 0 is set though no hall sensor is mounted.	Connect correctly the hall sensor cable to the serial converter unit. Correct the setting of parameter Pn080.0.
			The hall sensor is protruding from the linear servomotor magnetic way.	Reconsider the linear servomotor installation.
			A hall sensor fault occurred.	Replace the linear servomotor coil assembly.
			A serial converter unit fault occurred.	Replace the serial converter unit.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred when the servo is turned ON or during operation.	The linear servomotor coil assembly direction and linear scale direction do not match.	Correct the setting of parameter Pn080.1.
			The hall sensor is protruding from the linear servomotor magnetic way.	Reconsider the linear servomotor installation.
			Noise interference on the hall sensor signals	Take a noise prevention measure for the hall sensor wiring. Connect the case of serial converter unit to FG.
			The linear scale installation does not meet the requirements of the scale specifications.	Reconsider the installation.
			Dust and dirt accumulate on the linear scale.	Remove dust and dirt on the linear scale.
			A linear scale fault occurred.	Replace the linear scale.
A.C5	Polarity Detection Faulty	Occurred during polarity detection.	The polarity detection failed.	Refer to *9.2.3 (d) Troubleshooting for Polarity Detection Errors.*
A.C9	Encoder Communications Error	Occurred when the control power supply was turned ON or during operation.	The serial converter unit wiring and the contact are incorrect.	Correct the serial converter unit wiring.
			Noise interference occurred due to incorrect serial converter unit cable specifications.	Use tinned annealed copper twisted-pair or twisted-pair shielded wire with a core of at least 0.12 mm^2 (0.0002 in^2).
			Noise interference occurred because the wiring distance for the serial converter unit cable is too long.	The wiring distance must be 20m (65.6 ft) max.
			The noise interference occurred on the signal line because the serial converter unit cable is bent and the sheath is damaged.	Correct the serial converter unit cable layout.
			The serial converter unit cable is bundled with a high-current line or near a high-current line.	Correct the serial converter unit cable layout so that no surge is applied.
			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 serial converter unit.	Take a measure against noise for the serial converter unit wiring.
			Excessive vibration and shocks were applied to the serial converter unit.	Reduce the machine vibration or mount the serial converter unit securely.
			A serial converter unit fault occurred.	Replace the serial converter unit.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
A.CA	Encoder Parameter Error	Occurred when the control power supply was turned ON.	A serial converter unit fault occurred.	Replace the serial converter unit.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.

Table 11.5 Alarm Display and Troubleshooting (Cont'd)

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.Cb	Encoder Echoback Error	Occurred when the control power supply was turned ON or during operation.	The serial converter unit wiring and contact are incorrect.	Correct the serial converter unit wiring.
			Noise interference occurred due to incorrect serial converter unit cable specifications.	Use tinned annealed copper twisted-pair or twisted-pair shielded wire with a core of at least 0.12 mm^2 (0.0002 in^2).
			Noise interference occurred because the wiring distance for the serial converter unit cable is too long.	The wiring distance must be 20m (65.6 ft) max.
			Noise interference occurred on the signal line, because the serial converter unit cable is bent and the sheath is damaged.	Correct the serial converter unit cable layout.
			The serial converter unit cable is bundled with a high-current line or near a high-current line.	Correct the serial converter unit cable layout so that no surge is applied.
			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 serial converter unit.	Take measures against noise for the serial converter unit wiring.
			Excessive vibration and shocks to the serial converter unit was applied.	Reduce the machine vibration or mount the serial converter unit securely.
			A serial converter unit fault occurred.	Replace the serial converter unit.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
A.d0	Position Error Pulse Overflow (In servo ON status, the position error pulses exceed the overflow level set in the parameter Pn505.)	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 board fault occurred.	Replace the SERVOPACK.
		Occurred at the servomotor high-speed movement.	The contact in the servomotor U, V, and W wirings is faulty.	Correct the servomotor wiring.
				Correct the encoder wiring.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		The servomotor did not run with position reference input.	Wirings of the servomotor U, V, and W are incorrect.	Correct the servomotor wiring.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Normal movement, but occurred with a long distance reference input.	The SERVOPACK gain adjustment is improper.	Increase the speed loop gain (Pn100) and position loop gain (Pn102).
			The V-REF input voltage and the Pn300 setting are incorrect.	Lower the reference speed to the speed limit value.
			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 servomotor specifications do not meet the load conditions such as force and mass.	Reconsider and correct the load and servomotor capacity.
A.d3	Exceeded Position Data	Occurred when the control power supply was turned ON or during operation.	Position data is 32-bit or more.	Narrow the movable range of the linear servomotor.
A.F1	Power Line Open Phase (In the main power supply ON status, the voltage stays low for 1 second or more at one of the phases R, S, and T.) (Detected when the main circuit power supply turns ON.)	Occurred when the control power supply was turned ON.	A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred when the main circuit power supply was turned ON.	The three-phase power supply wiring is incorrect.	Correct the power supply wiring.
			The three-phase power supply is unbalanced.	Balance the power supply by changing phases.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred when the servomotor was running.	The contact in three-phase power supply wiring is faulty.	Correct the power supply wiring.
			Three-phase power supply is unbalanced.	Balance the power supply.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.

Table 11.5 Alarm Display and Troubleshooting (Cont'd)

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.F6	Servomotor Line Disconnection (For the software version 32 or later)	Occurred when the servo was turned ON.	The power is not supplied to the linear servomotor while the SERVOPACK received a servo ON command.	Check and then correct the linear servomotor power line wiring, or replace the SERVOPACK.
CPF00	Digital Operator Transmission Error 1 *1	Occurred when the power supply was turned ON with digital operator connected or when connecting digital operator with the power supply was turned ON.	The contact between the digital operator and the SERVOPACK is faulty.	Insert securely the connector, or replace the cable.
			The external noise interference occurred to the digital operator or cable. (The digital operator cable is near noise source.)	Do not lay the cable near noise source.
				Install digital operator far from noise source.
CPF01	Digital Operator Transmission Error 2 *2		A digital operator fault occurred.	Replace the digital operator.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.

* 1. This alarm occurs when the communications is still disabled five seconds after digital operator power supply is ON, or when digital operator communications disabled status stays while an application module is connected.

* 2. This alarm occurs when digital operator received data error occurs consecutively five times, or when the state that digital operator receives no data from SERVOPACK for one second or more occurs consecutively three times.

(2) Warning Display and Troubleshooting

Table 11.6 Warning Display and Troubleshooting

Warning Display	Warning Name	Situation at Warning Occurrence	Cause	Corrective Actions
A.90	Excessive Potion Error	Occurred during normal operation.	The position error exceeded the setting of parameter Pn51E.	When the position error becomes within the setting of Pn51E, the SERVOPACK will be automatically restored.
A.91	Overload: Warning for the alarms A71 and A72 In either of the following cases: 1. 20% of the overload detection level of A71 2. 20% of the overload detection level of A72.	Occurred when the control power supply was turned ON.	When the control power was previously turned OFF, an overload alarm occurred.	No problem exists because the SERVOPACK saves the previous value.
		Occurs when the servo was ON.	Wiring is incorrect and the contact in servomotor wiring is faulty.	Correct the servomotor wiring.
			Wiring is incorrect and the contact in encoder wiring is faulty.	Correct the encoder wiring.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		The servomotor did not run with a reference input.	Servomotor wiring is incorrect and the contact is faulty.	Correct the servomotor wiring.
			Encoder wiring is incorrect and the contact is faulty.	Correct the encoder wiring.
			The starting force exceeds the maximum force.	Reconsider the load and operation conditions. Or, check the servomotor capacity.
			The polarity detection is not performed properly. (When Pn080.0 = 1 is set.)	Correct the settings for the polarity detection related parameter.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred during normal operation.	The effective force exceeds the rated force.	Reconsider the load and operation conditions. Or, check the servomotor capacity.
			Temperature in the SERVOPACK panel is high.	Reduce the in-panel temperature to 55°C or less.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.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 is excessive.	Check the regenerative resistor capacity, or reconsider the load and operation conditions.
			Regenerative status continues.	
		Occurred during normal operation (Small increase of regenerative resistor temperature).	The setting of parameter Pn600 is smaller than the external regenerative resistor capacity.	Correct the setting of parameter Pn600.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred at servomotor deceleration.	Regenerative energy is excessive.	Check the regenerative resistor capacity, or reconsider the load and operation conditions.

11.1.6 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 11.7 Troubleshooting for Malfunction without Alarm Display

Symptom	Cause	Inspection	Corrective Actions
		■: Turn OFF the servo system before executing operations.	
Linear Servomotor Does Not Start	The control power supply is not ON.	Check voltage between control power supply terminals.	Correct the control power circuit.
	The main circuit power supply is not ON.	Check the voltage between power supply terminals.	Correct the power circuit.
	Wrong wiring or disconnection of I/O signal connector CN1	Check if the connector CN1 is properly inserted and connected.	Correct the connector CN1 connection.
	Linear servomotor or serial converter unit wiring disconnected.	Check the wiring.	Correct the wiring.
	Overloaded	Run under no load.	Reduce load or replace with larger capacity servomotor.
	Speed/position references not input	Check reference input pins.	Input speed/position references correctly.
	Setting for Pn50A to Pn50D "Input Signal Selection" is incorrect.	Check settings of parameters Pn50A to Pn50D.	Correct the settings for Pn50A to Pn50D "Input Signal Selection."
	/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.
	Control method selection is incorrect.	Check parameter Pn000.1.	Set parameters to match the application.
	Reference pulse mode selection is incorrect.	Check the parameter setting for the reference pulse mode (Pn200.0).	Correct setting of parameter Pn200.0.
	Speed control: Speed reference input is incorrect.	Check V-REF and SG to confirm if the control method and the input are agreed.	Correct the control mode selection parameter, or the input.
	Force control: Force 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.
	Position control: Reference pulse input is incorrect.	Check Pn200.0 reference pulse form or sign + pulse signal.	Correct the setting of Pn200.0 or the input.
	The error clear counter (CLR) input is turned ON.	Check CLR or /CLR input pins (CN1-14 and -15).	Turn CLR or /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.
	The polarity detection is not executed.	Check the parameter Pn080.	Correct the setting of Pn080.
		Check /S-ON or /P-DET input signal.	Turn /S-ON or /P-DET input signal ON.
	A SERVOPACK fault occurred.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
Linear Servomotor Moves Instantaneously, and then Stops	Servomotor wiring is incorrect.	Check the servomotor wiring.	Correct the servomotor wiring.
	Serial converter unit wiring is incorrect.	Check the serial converter unit wiring.	Correct the serial converter unit wiring.
	Linear scale wiring is incorrect.	Check the linear scale wiring.	Correct the linear scale wiring.
	Linear scale pitch (Pn280) is incorrect.	Check the setting of Pn280.	Correct the setting of Pn280.
	Linear scale counting up direction and linear servomotor coil assembly forward direction are not agreed.	Check the directions.	Change the setting of Pn080.1 (Servomotor Phase Order Selection). Match the linear scale direction and coil assembly direction.
	Polarity detection is not performed correctly.	Check if the value of Un004 (Electrical Angle 2) at an arbitrary position is between ±10 degrees.	Correct the settings for the polarity detection related parameter.
Linear 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.

Table 11.7 Troubleshooting for Malfunction without Alarm Display (Cont'd)

Symptom	Cause	Inspection	Corrective Actions
		: Turn OFF the servo system before executing operations.	
Linear 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.
	Force control: Force 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.	The SERVOPACK offset is adjusted incorrectly.	Adjust the SERVOPACK offset correctly.
	Position control: Reference pulse input is incorrect.	Check Pn200.0 reference pulse form or sign + pulse signal.	Correct the control mode selection parameter, or the input correctly.
	A SERVOPACK fault occurred.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
	Linear scale counting up direction and linear servomotor coil assembly forward direction do not agree.	Check the directions.	Change the setting of Pn080.1 (Motor Phase Order Selection). Match the linear scale direction and servomotor direction.
	Polarity detection is not performed correctly.	Check if the value of Un004 (Electrical Angle 2) at an arbitrary position is between ±10 degrees.	Correct the polarity detection related parameter settings.
DB (dynamic brake) Does Not Operate	Improper parameter setting	Check the setting of parameter Pn001.0 (Servo OFF or Alarm Stop Mode).	Correct the setting of parameter Pn001.1.
	DB resistor disconnected	Check if excessive mass, motor overspeed, or DB frequently activated occurred.	Replace the SERVOPACK, and reconsider the load.
	DB drive circuit fault	DB circuit parts are faulty.	Replace the SERVOPACK.
Abnormal Noise from Servomotor	Mounting not secured	Check if there are any loosen mounting screws.	Tighten the mounting screws.
	Vibration source on the driven machine	Any foreign matter, damages, or deformation on the machine movable section.	Contact the machine manufacturer.
	Noise interference due to incorrect input signal wire specifications	The specifications of input signal wires must be: Twisted-pair or twisted-pair shielded wire with core 0.12 mm^2 (0.0002 in^2) min. and tinned annealed copper twisted wire.	Use the specified input signal wires.
	Noise interference due to long distance of input signal line	The wiring distance must be 3 m (9.84 ft) 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 serial converter unit cable specifications	The specifications of encoder cable must be: Twisted-pair or twisted-pair shielded wire with core 0.12 mm^2 (0.0002 in^2) min. and tinned annealed copper twisted wire.	Use the specified serial converter unit cable.
	Noise interference due to long serial converter unit cable wiring distance	The wiring distance must be 20 m(65.6 ft) max.	Shorten the serial converter unit cable wiring distance to the specified value.
	Noise due to damaged serial converter unit cable	Check if the serial converter unit cable is not damaged or bent.	Modify the serial converter unit cable layout.
	Excessive noise to the serial converter unit cable	Check if the serial converter unit cable is bundled with high-current line or near the high-current line.	Install a surge suppressor to the serial converter unit 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 the serial converter unit.	Take measure against noise for the serial converter unit wiring.
	Excessive vibration and shock to the serial converter unit	Vibration from the machine occurred or servomotor installation is incorrect. (Mounting surface accuracy, fixing, or alignment.)	Reduce vibration from the machine, or correct the linear servomotor installation.
	Serial converter unit fault	–	Replace the serial converter unit.
	Linear scale fault	–	Replace the linear scale.

Table 11.7 Troubleshooting for Malfunction without Alarm Display (Cont'd)

Symptom	Cause	Inspection	Corrective Actions
		: Turn OFF the servo system before executing operations.	
Servomotor Vibrates at about 200 to 400 Hz	Speed loop gain value (Pn100) too high.	Factory setting: Kv=40.0 Hz Refer to *9.3.2 Operating Procedure in Speed Control Mode (Pn000 = n.□□0□)*.	Reduce speed loop gain (Pn100) preset value.
	Position loop gain value (Pn102) too high	Factory setting: Kp=40.0/s Refer to *9.3.2 Operating Procedure in Speed Control Mode (Pn000 = n.□□0□)*.	Reduce position loop gain (Pn102) preset value.
	Incorrect speed loop integral time constant (Pn101) setting	Factory setting: Ti=20.00 ms Refer to *9.3.2 Operating Procedure in Speed Control Mode (Pn000 = n.□□0□)*.	Correct the speed loop integral time constant (Pn101) setting.
	Mass ratio data is incorrect.	Check the setting of Pn103 (Mass Ratio).	Correct the setting of Pn103 (Mass Ratio).
	When the autotuning is used: Incorrect mass ratio data setting	Check the setting of Pn103 (Mass Ratio).	Correct the setting of Pn103 (Mass Ratio).
	When the autotuning is used: Incorrect machine rigidity setting	Check the setting of Fn001 (Machine Ridigity Setting).	Correct the setting of Fn001 (Machine Ridigity Setting).
High Speed Overshoot on Starting and Stopping.	Speed loop gain value (Pn100) too low	Factory setting: Kv=40.0 Hz Refer to the gain adjustment in User's Manual.	Reduce the speed loop gain (Pn100) preset value.
	Position loop gain value (Pn102) too high	Factory setting: Kp=40.0/s Refer to the gain adjustment in User's Manual.	Reduce the position loop gain (Pn102) preset value.
	Incorrect speed loop integral time constant (Pn101) setting	Factory setting: Ti=20.00 ms Refer to the gain adjustment in User's Manual.	Correct the speed loop integral time constant (Pn101) setting.
	When the autotuning is used: Incorrect mass ratio data	Check the setting of Pn103 (Mass Ratio).	Correct the setting of Pn103 (Mass Ratio).
	When the autotuning is not used: Incorrect machine rigidity setting	Check the setting of Fn001 (Machine Ridigity Setting).	Correct the setting of Fn001 (Machine Ridigity Setting).
	Mass ratio data is incorrect.	Check the setting of Pn103 (Mass Ratio).	Correct the setting of Pn103 (Mass Ratio).
	The force reference is saturated.	Check the force reference wave form.	Use the mode switch function.
	The force limit (Pn483, Pn484) is set to the initial value.	Initial value of force limit: Pn483 = 30% Pn484 = 30%	Set a appropriate value for Pn483 and Pn484 (Force Limit).

Table 11.7 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)	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 or loosen screws.)	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 force control mode is selected.	Check Pn001.0 and Pn001.1.
	Improper overtravel position setting	The distance to the position of OT (overtravel) is too short considering the coasting distance.	Correct the OT position.
	Noise interference due to improper serial converter unit cable specifications	The serial converter unit cable specifications must be: Twisted-pair or twisted-pair shielded wire with core 0.12 mm^2 (0.0002 in^2) min. and tinned annealed copper twisted wire.	Use serial converter unit cable with the specified specifications.
	Noise interference because the serial converter unit cable distance is too long.	The wiring distance must be 20 m (65.6 ft) max.	The serial converter unit cable distance must be within the specified range.
	Noise influence due to damaged serial converter unit cable	Check if the serial converter unit cable is bent or its sheath is damaged.	Correct the serial converter unit cable layout.
	Excessive noise interference to serial converter unit cable	Check if the serial converter unit cable is bundled with a high-current line or near high-current line.	Change the serial converter unit 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 serial converter unit is influenced by noise.	Take a measure against noise for the serial converter unit wiring.
	Excessive vibration and shock to the serial converter unit	Machine vibration occurred or servomotor mounting such as mounting surface precision, fixing, alignment is incorrect.	Reduce the machine vibration or mount the servomotor securely.
	Serial converter unit fault	–	Replace the serial converter unit.
	SERVOPACK fault	–	Replace the SERVOPACK.
Position error (without alarm)	Noise interference due to improper input signal cable specifications	The input signal cable specifications must be: Twisted-pair or twisted-pair shielded wire with core 0.12 mm^2 (0.0002 in^2) min. and tinned annealed copper twisted wire.	Use input signal cable with the specified specifications.
	Noise interference because the input signal cable distance is too long.	The wiring distance must be 3 m (9.84 ft) max. and the impedance several hundreds ohm max.	The input signal cable distance must be within the specified range.
	Reference pulse frequency is too high.	Check Un00C (Reference Pulse Counter.)	Reduce the reference pulse frequency to a value within the specification.
	Serial converter unit fault (pulse count does not change)	–	Replace the serial converter unit.

Table 11.7 Troubleshooting for Malfunction without Alarm Display (Cont'd)

Symptom	Cause	Inspection	Corrective Actions
		: Turn OFF the servo system before executing operations.	
Servomotor Overheated	Ambient temperature too high	Measure servomotor ambient temperature.	Reduce ambient temperature to 40°C (104 °F) 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.

11.2 Inspection and Maintenance

11.2.1 Linear Servomotor Inspection

⚠ CAUTION

- Do not disassemble the linear servomotor.
  Failure to observe this caution may result in electric shock or injury.

Simple, daily inspection is sufficient. The inspection and maintenance frequencies in Table 11.8 are only guidelines. Increase or decrease the frequency to suit the operating conditions and environment.

If disassembly of the linear servomotor is required because of the linear servomotor failure, contact your Yaskawa representative.

Table 11.8 Linear Servomotor Inspections

Item	Frequency	Procedure	Comments
Vibration and Noise	Daily	Touch and listen from safe position.	Levels higher than normal?
Exterior	According to degree of contamination	Clean with cloth or compressed air.	Use alcohol solvent.
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. Do not perform insulation resistance measurement and withstand voltage test for the sensors.
GAP between Coil Assembly and Magnetic Way	At least once a year	Disconnect the linear servomotor from the SERVOPACK, and then check the gap.	The GAP dimension stays unchanged from its initial value.
Overhaul	At least once every 5 years	Contact your Yaskawa representative.	The user should not disassemble and clean the servomotor.

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

11.2.2 SERVOPACK Inspection

For inspection and maintenance of the SERVOPACK, follow the inspection procedures in Table 11.9 at least once every year. Other routine inspections are not required.

Table 11.9 SERVOPACK Inspections

Item	Frequency	Procedure	Comments
Clean Interior and Circuit Boards	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.
Defective Parts in Unit or on Circuit Boards		Check for discoloration, damage, or discontinuities due to heating.	Contact your Yaskawa representative.

11.2.3 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.

The parameters of any SERVOPACKs overhauled by Yaskawa are reset to the factory settings before shipping. Be sure to confirm that the parameters are properly set before starting operation.

Table 11.10 Periodical Part Replacement

Part	Standard Replacement Period	Replacement Method	Operating Conditions
Cooling Fan	4 to 5 years	Replace with new part.	• Ambient Temperature: Annual average of 30°C • Load Factor: 80% max. • Operation Rate: 20 hours/day max.
Smoothing Capacitor	7 to 8 years	Test. Replace with new part if necessary.	
Relays	–	Test. Replace if necessary.	
Fuses	10 years	Replace with new part.	
Aluminum Electrolytic Capacitor on Circuit Board	5 years	Test. Replace with new circuit board if necessary.	

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Appendix

12.1 Linear Servomotor Capacity Selection Examples - - - - - - - 12-2

12.2 Calculating the Required Capacity of Regenerative Resistors - 12-4

12.2.1 Simple Calculation - 12-4

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12.3 Connection to Host Controller - 12-16

12.3.1 Example of Connection to MP2200/MP2300 2-axes Motion Module SVA-01 - 12-16

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12.3.4 Example of Connection to OMRON's Position Control Unit C500-NC221 (SERVOPACK in Speed Control Mode) - - - - - - - - - - 12-19

12.3.5 Example of Connection to OMRON's Position Control Unit C500-NC112 (SERVOPACK in Position Control Mode) - - - - - - - - 12-20

12.3.6 Example of Connection to Mitsubishi's AD72 positioning Unit (SERVOPACK in Speed Control Mode)- 12-21

12.3.7 Example of Connection to Mitsubishi's AD75 positioning Unit (SERVOPACK in Position Control Mode)- - - - - - - - - - - - - - - - - - - 12-22

12.4 List of Parameters - 12-23

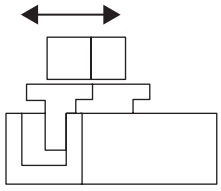
12.4.1 Utility Functions List - 12-23

12.4.2 List of Parameters - 12-24

12.4.3 Monitor Modes - 12-40

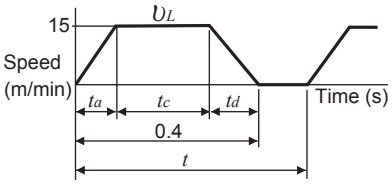
12.5 Parameter Recording Table - 12-41

12.1 Linear Servomotor Capacity Selection Examples



- Load speed: v_L =120 m/min
- Workpiece mass: W_W = 1 kg
- Table mass: W_T = 2 kg
- Feeding times: n = 120 times/min
- Feeding distance: ℓ = 0.76 m
- Feeding time: t_m = 0.4 s max.
- Acceleration time: t_a = 0.02 s
- Friction coefficiency: μ = 0.2

(1) Speed Diagram



$$t = \frac{60}{n} = \frac{60}{120} = 0.5 \text{ (s)}$$

where $t_a = t_d$

$t_c = 0.4 - (0.02 \times 2) = 0.36$ (s)

(2) Force Under Constant Load

$$F_L = 9.8 \cdot \mu \cdot (W_W + W_T) = 9.8 \times 0.2 \times (1+2) = 5.88 \text{ (N)}$$

(3) Force at Load Acceleration

$$F_P = (W_M + W_T) \cdot \frac{v_L}{60 \cdot t_a} + F_L = (1+2) \times \frac{120}{60 \times 0.02} + 5.88 = 305.88 \text{ (N)}$$

(4) Linear Servomotor Provisional Selection

(a) Selecting Conditions

- $F_P \leq$ Linear servomotor maximum force

The following models satisfy the conditions.

- SGLGW-60A253BP linear servomotor coil assembly
- SGDH-04AE SERVOPACK

(b) Specifications of the Provisionally Selected Linear Servomotor and SERVOPACK

- Rated output: 400 (W)
- Rated speed: 1500 (mm/s)
- Rated force: 147 (N)
- Instantaneous peak force: 440 (N)
- Linear servomotor coil assembly mass: W_M = 0.82 (kg)

(5) Verification on the Provisionally Selected Linear Servomotor

- Force under constant load

$$F_L = 9.8\ \mu\ (W_W + W_T + W_M) = 9.8 \times 0.2 \times (1 + 2 + 0.82) = 7.5\ (\mathrm{N})$$

- Force at load acceleration

$$F_P = \frac{\upsilon_L\ (W_W + W_T + W_M)}{60 t_a} + F_L = \frac{120 \times (1 + 2 + 0.92)}{60 \times 0.02} + 7.5$$

$= 389.5$ (N) < Instantaneous peak force $\times 0.9$ ⋯Satisfactory

- Force at load deceleration

$$F_S = \frac{\upsilon_L\ (W_W + W_T + W_M)}{60 t_a} - F_L = \frac{120 \times (1 + 2 + 0.82)}{60 \times 0.02} - 7.$$

$= 374.5$ (N) < Instantaneous peak force $\times 0.9$ ⋯Satisfactory

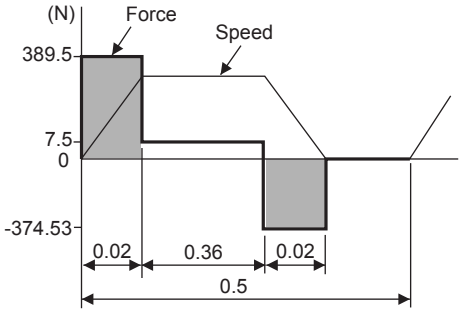
- Effective force

$$F_{rms} = \sqrt{\frac{F_P{}^2 \cdot t_a + F_L{}^2 \cdot t_c + F_S{}^2 \cdot t_d}{t}} = \sqrt{\frac{(389.5)^2 \times 0.02 + (7.5)^2 \times 0.36 + (374.5)^2 \times 0.02}{0.5}}$$

$\fallingdotseq 108.3$ (N) < Rated force $\times 0.9$ ⋯Satisfactory

(6) Result

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



12.2 Calculating the Required Capacity of Regenerative Resistors

12.2.1 Simple Calculation

When driving a linear servomotor with the horizontal axis, check the external regenerative resistor requirements using the calculation method shown below.

(1) SERVOPACKs with Capacities of 400 W or Less

SERVOPACKs with capacities of 400 W or less do not have built-in regenerative resistors. The energy that can be charged with capacitors is shown in the following table. If the kinetic energy in the linear servomotor exceeds these values, then connect an external regenerative resistor.

Voltage	Applicable SERVOPACKs	Regenerative Energy that Can be Processed (joules)	Remarks
200 V	SGDH -A5AE	18.5	Value when main circuit input voltage is 200 VAC
	SGDH-01AE to -04AE	37.1	

Calculate the kinetic energy (E_S) in the linear servomotor from the following equation.

$E_S = MV_M{}^2 / 2$

M : Load mass (kg)

V_M : Speed used by linear servomotor (m/s)

(2) SERVOPACKs with Capacities of 500 W to 5.0 kW

SERVOPACKs with capacities of 500 W to 5.0 kW have built-in regenerative resistors. The allowable frequencies for just the servomotor in acceleration and deceleration operation, during the motor speed cycle from 0 (m/s) to the maximum speed to 0, are summarized in the following table.

Convert the data into the values obtained with actual rotation speed and load mass to determine whether an external regenerative resistor is needed.

Linear Servomotor Model		Allowable Frequencies in Regenerative Mode (times/min.)	Load Condition (Including Coil Assembly)
SGLGW-	40A365C (-M)	4	15 times of coil assembly mass
	60A253C (-M)	4	
	60A365C	3	
	60A365C (-M)	3	
	90A200C	1	
	90A370C	1	
	90A535C	6	
SGLFW-	35A230A	8	Twice of coil assembly mass
	50A200B	6	
	50A380B	2	
	1ZA200B	2	
	1ZA380B	2	

Linear Servomotor Model		Allowable Frequencies in Regenerative Mode (times/min.)	Load Condition (Including Coil Assembly)
SGLTW-	20A170A	8	Twice of coil assembly mass
	20A320A	4	
	20A460A	2	
	35A170A	6	
	35A320A	2	
	35A460A	2	
	35A170H	3	
	35A320H	1	
	50A170H	4	
	50A320H	1	
	40A400B	1	

Note: The model with (-M) is the combination model with a standard-type coil assembly and a high-force-type magnetic way.

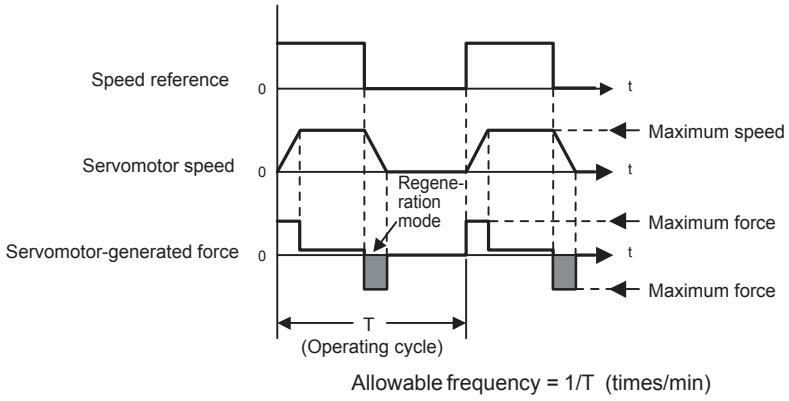


Fig. 12.1 Operating Conditions for Allowable Regenerative Frequency Calculation

Use the following equation to calculate the allowable frequency for regenerative mode operation.

$$\text{Allowable frequency} = \frac{\text{Allowable frequency in regenerative mode (times)}}{n} \times \left(\frac{\text{Peak speed}}{\text{Used speed}} \right)^2 \text{(times/min)}$$

• n : For SGLGW, $n = \left(\frac{W}{W_M} \right) / 15$

For SGLTW and SGLFW, (excluding SGLTW-40 and -80) $n = \left(\frac{W}{W_M} \right) / 3$

For SGLTW-40 and -80, $n = \frac{W}{W_M}$

• W_M : Linear servomotor coil assembly mass

• W : Load mass (including coil assembly)

(3) SERVOPACKs with Capacity of 7.5 kW

SERVOPACKs with capacity of 7.5 kW do not have built-in regenerative resistors. The following table shows the allowable regenerative frequencies when the following regenerative resistor is used together with an applicable SERVOPACK.

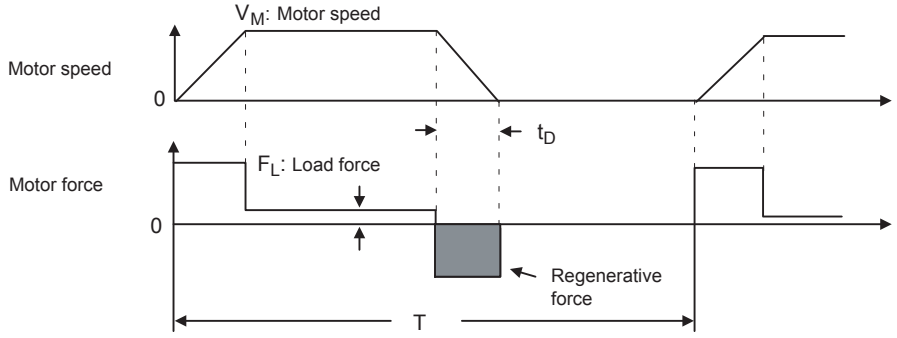
- 200-V Class : JUSP-RA05
- 400-V Class : JUSP-RA18

The linear servomotor driven conditions and the conversion equation of the allowable regenerative frequencies to the speed and load mass are the same as *(2) SERVOPACKs with Capacities of 500 W to 5.0 kW*.

Linear Servomotor Model		Allowable Frequencies in Regenerative Mode (times/min.)	Load Condition
SGLTW-	80A600B	8	× 1
	80D600B	4	

12.2.2 Calculating the Regenerative Energy

This section shows the procedure for calculating the regenerative resistor capacity when acceleration and deceleration operation is as shown in the following diagram.



(1) Calculation Procedure

The procedure for calculating the regenerative capacity is as follows:

Step	Item	Symbol	Equation
1	Calculate the kinetic energy of the linear servomotor.	E_S	$E_S = MV_M^2/2$
2	Calculate the energy consumed by friction loss during the deceleration period.	E_L	$E_L = V_M F_L t_D/2$
3	Calculate the energy lost from linear servomotor winding resistance.	E_M	(Value calculated from "(2) Servomotor Winding Resistance Loss" diagrams) $\times t_D$
4	Calculate the SERVOPACK energy that can be absorbed.	E_C	Calculate from "(3) SERVOPACK's Absorbable Energy" diagrams.
5	Calculate the energy consumed by the regenerative resistor.	E_K	$E_K = E_S - (E_L+E_M+E_C)$
6	Calculate the required regenerative resistor capacity (W).	W_K	$W_K = E_K/(0.2 \times T)$

Note: 1. The "0.2" in the equation for calculating W_K is the value for when the regenerative resistor's utilized load ratio is 20%.

2. The units for the various symbols are as follows:

Symbol	Units	Meanings
E_S	J	Kinetic energy of linear servomotor
E_L		Energy consumed by friction loss during the deceleration period
E_M		Energy consumed by linear servomotor winding resistance loss
E_C		Energy that can be absorbed by SERVOPACK
E_K		Energy consumed by regenerative resistor
W_K	W	Required capacity of regenerative resistor
$M(=M_M+M_L)$	kg	Load mass including linear servomotor
V_M	m/s	Linear servomotor movement speed
F_L	N	Load force
t_D	sec	Period to decelerate to a stop
T		Repeated operation cycle of linear servomotor

If the above calculation determines that the amount of regenerative power (Wk) processed by the built-in resistor is not exceeded, then an external regenerative resistor is not required.

If the amount of regenerative power that can be processed by the built-in resistor is exceeded, then install an external regenerative resistor for the capacity obtained from the above calculation.

If the energy consumed by load loss (in step 2 above) is unknown, then perform the calculation using $E_L = 0$.

When the operation period in regeneration mode is continuous, add the following items to the above calculation procedure in order to find the required capacity (W) for the regenerative resistor.

- Energy for continuous regeneration mode operation period: E_G (joules)

Here, $E_G = V_{MG}T_Gt_G$

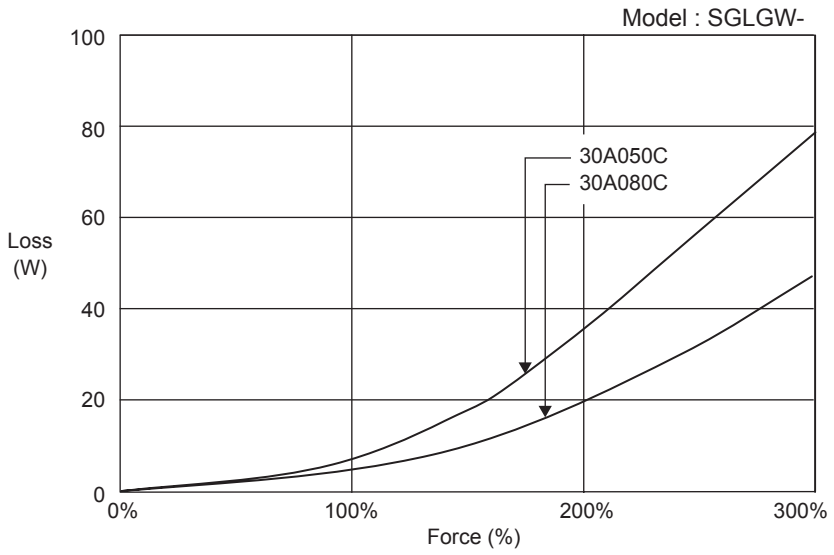
- V_{MG}: Linear servomotor speed (m/s) for same operation period as above
- T_G: Linear servomotor's generated force (N) in continuous regenerative mode operation period
- t_G: Same operation periods as above
- Energy consumed by a regenerative resistor: $E_K = E_S - (E_L + E_M + E_C) + E_G$
- Required capacity of regenerative resistor: $W_K = E_K / (0.2 \times T)$

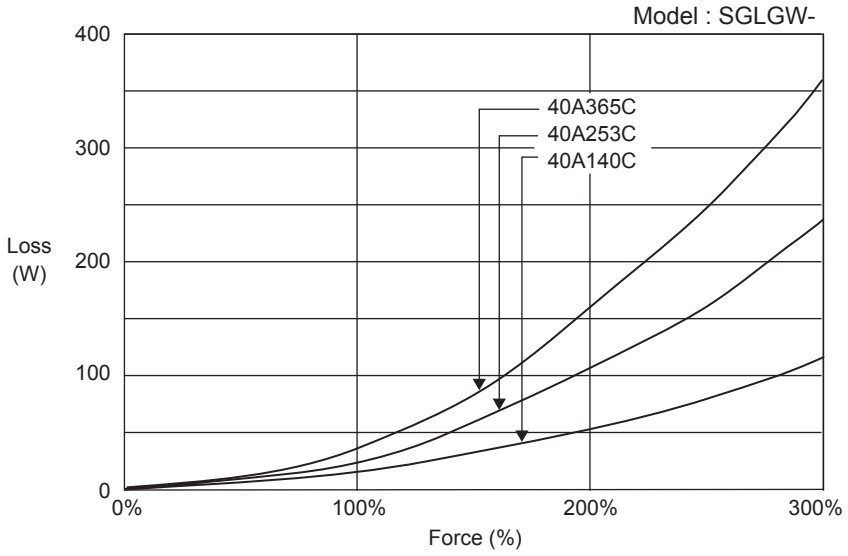
(2) Servomotor Winding Resistance Loss

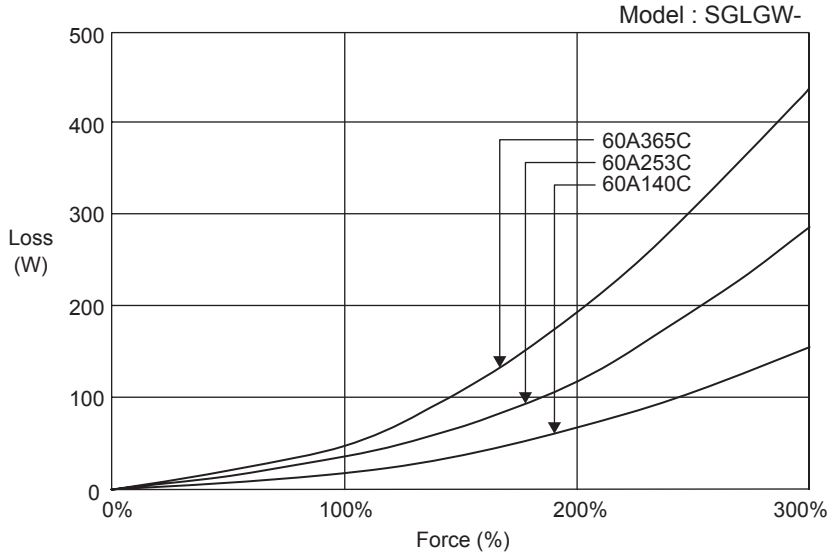
The following diagrams show the relationship, for each servomotor, between the servomotor's generated force and the winding resistance loss.

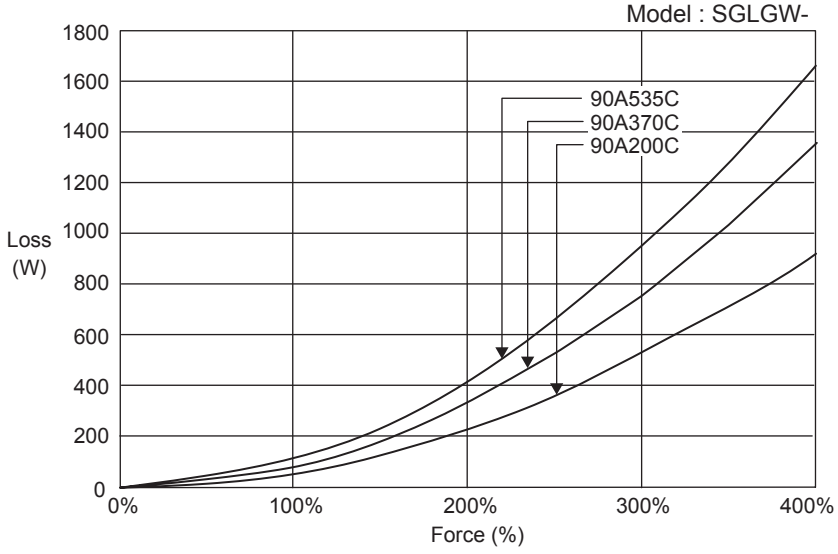
(a) SGLGW Linear Servomotors

- With Standard - force Magnetic Ways

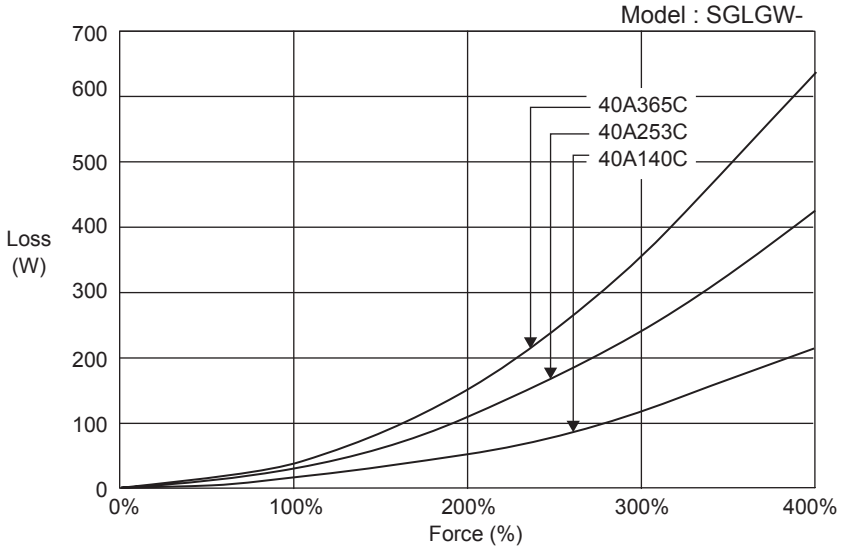


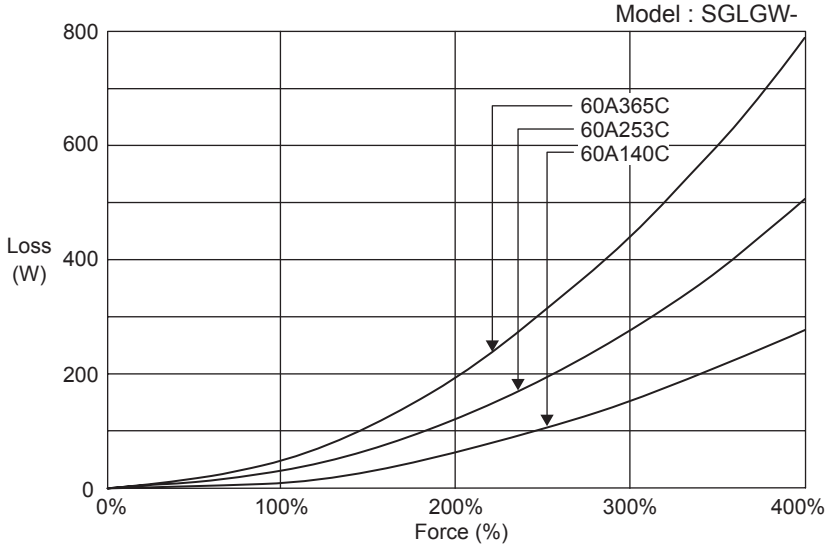



Model : SGLGW-
500
400
300
200
100
0
Loss
(W)
60A365C
60A253C
60A140C
0%
100%
200%
300%
Force (%)

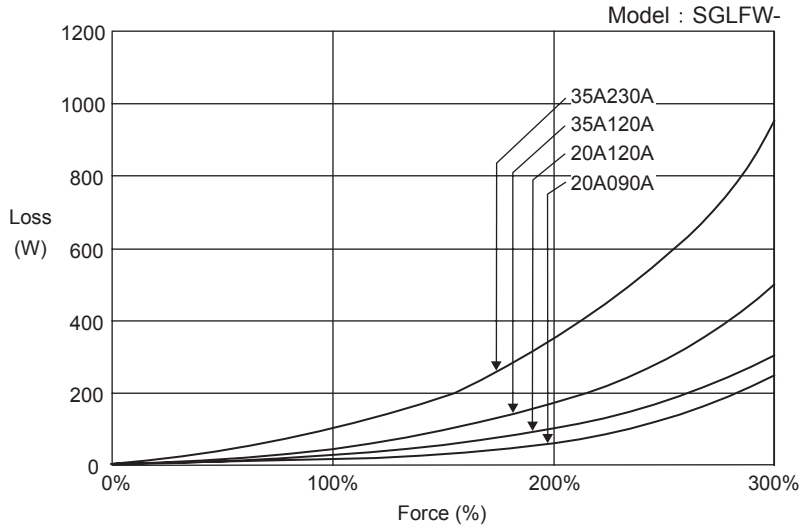

Model : SGLGW-
1800
1600
1400
1200
1000
800
600
400
200
0
Loss
(W)
90A535C
90A370C
90A200C
0%
100%
200%
300%
400%
Force (%)

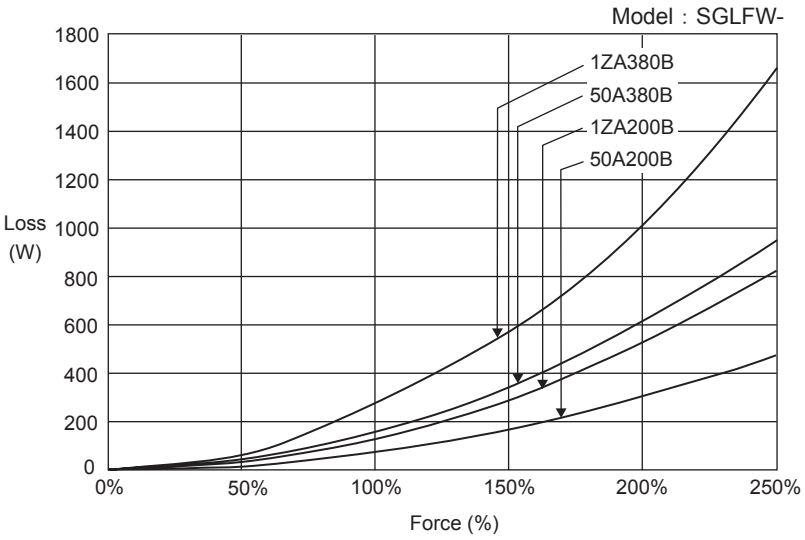
- With High - force Magnetic Ways

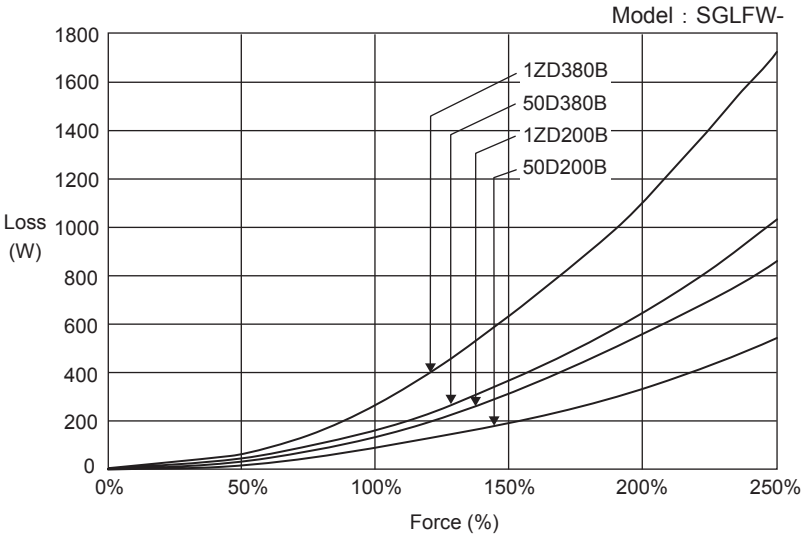




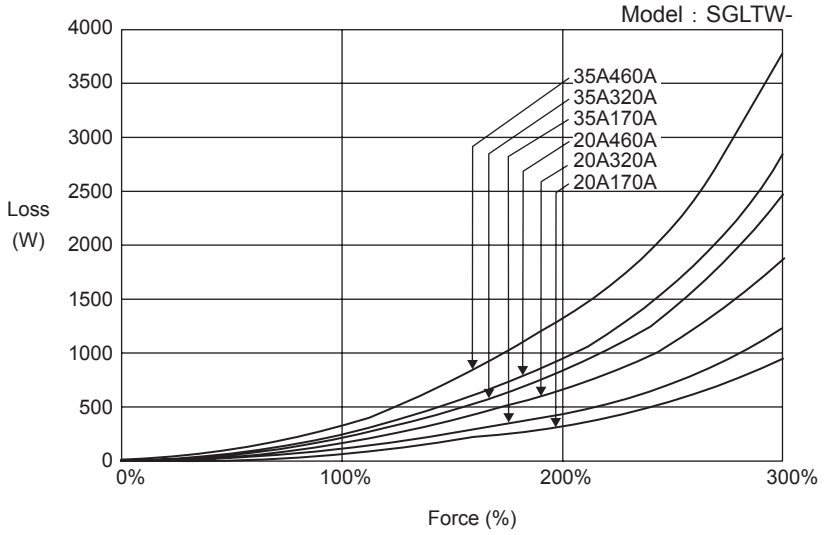
(b) SGLFW Linear Servomotors

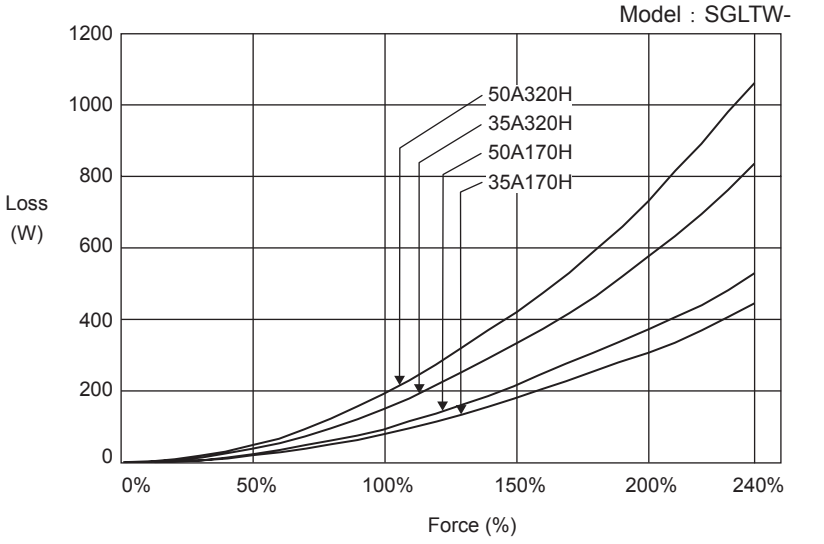


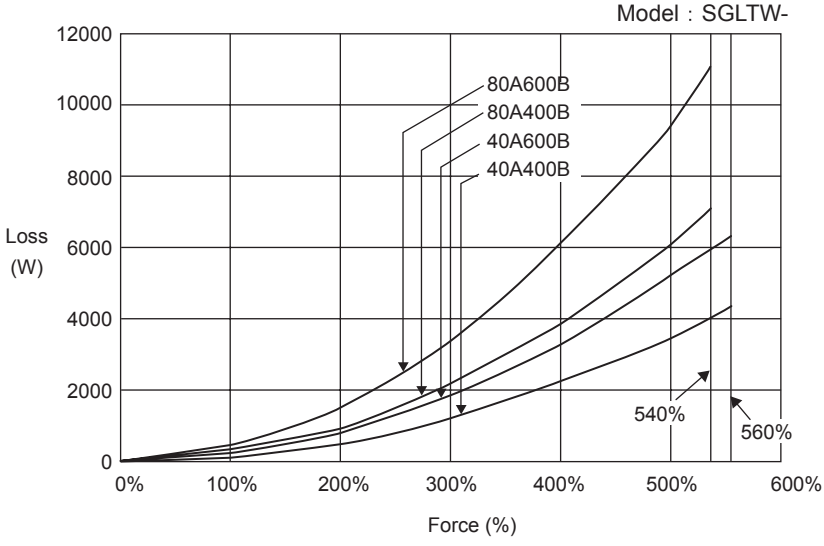


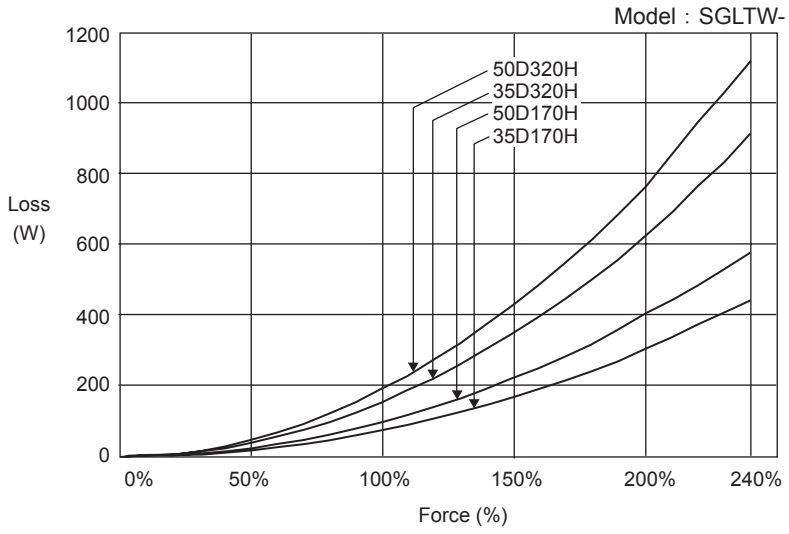


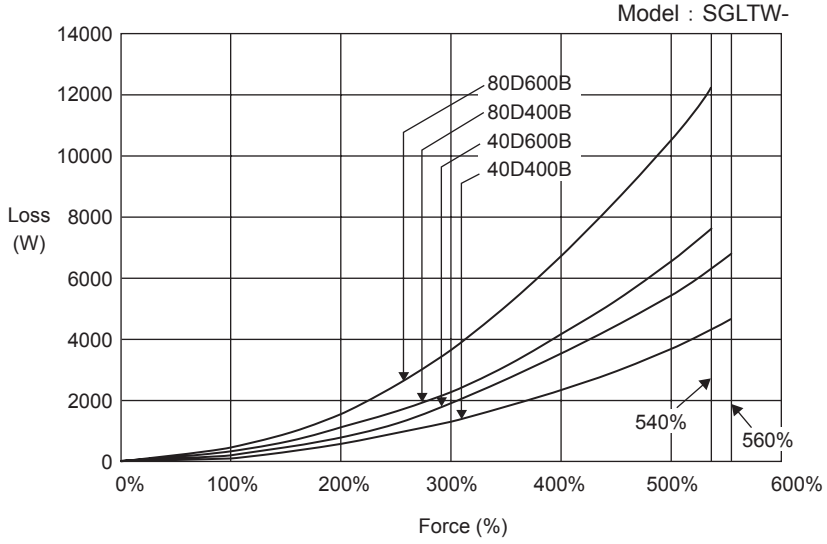
(c) SGLTW Linear Servomotors







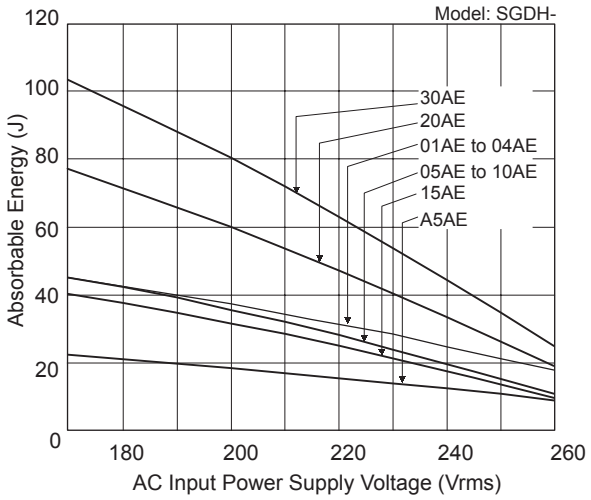

Model：SGLTW-
1200
1000
800
600
400
200
0
Loss
(W)
50D320H
35D320H
50D170H
35D170H
0%
50%
100%
150%
200%
240%
Force (%)

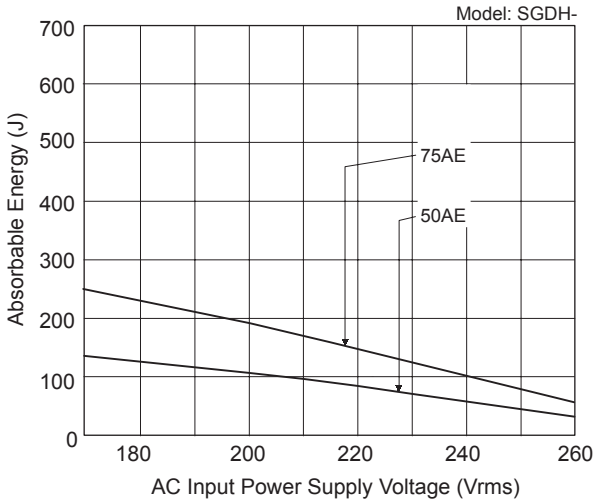

Model：SGLTW-
14000
12000
10000
8000
6000
4000
2000
0
Loss
(W)
80D600B
80D400B
40D600B
40D400B
540%
560%
0%
100%
200%
300%
400%
500%
600%
Force (%)

(3) SERVOPACK's Absorbable Energy

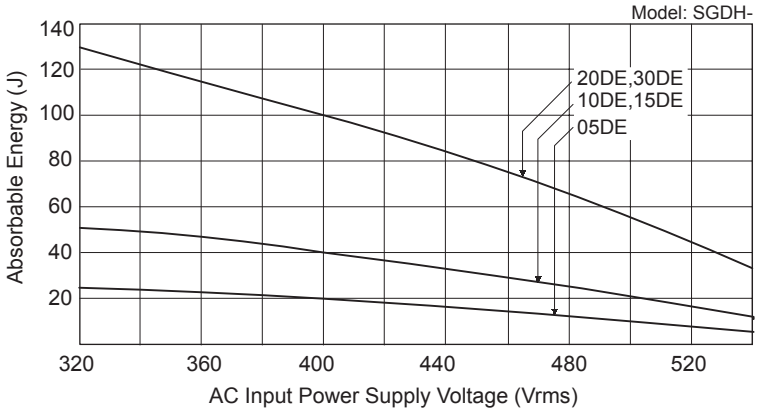
The following diagrams show the relationship between the SERVOPACK's input power supply voltage and its absorbable energy.

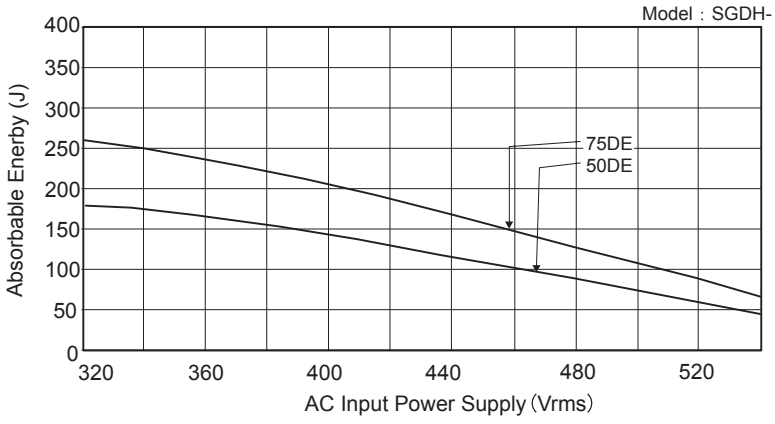
(a) 200-V SERVOPACKs





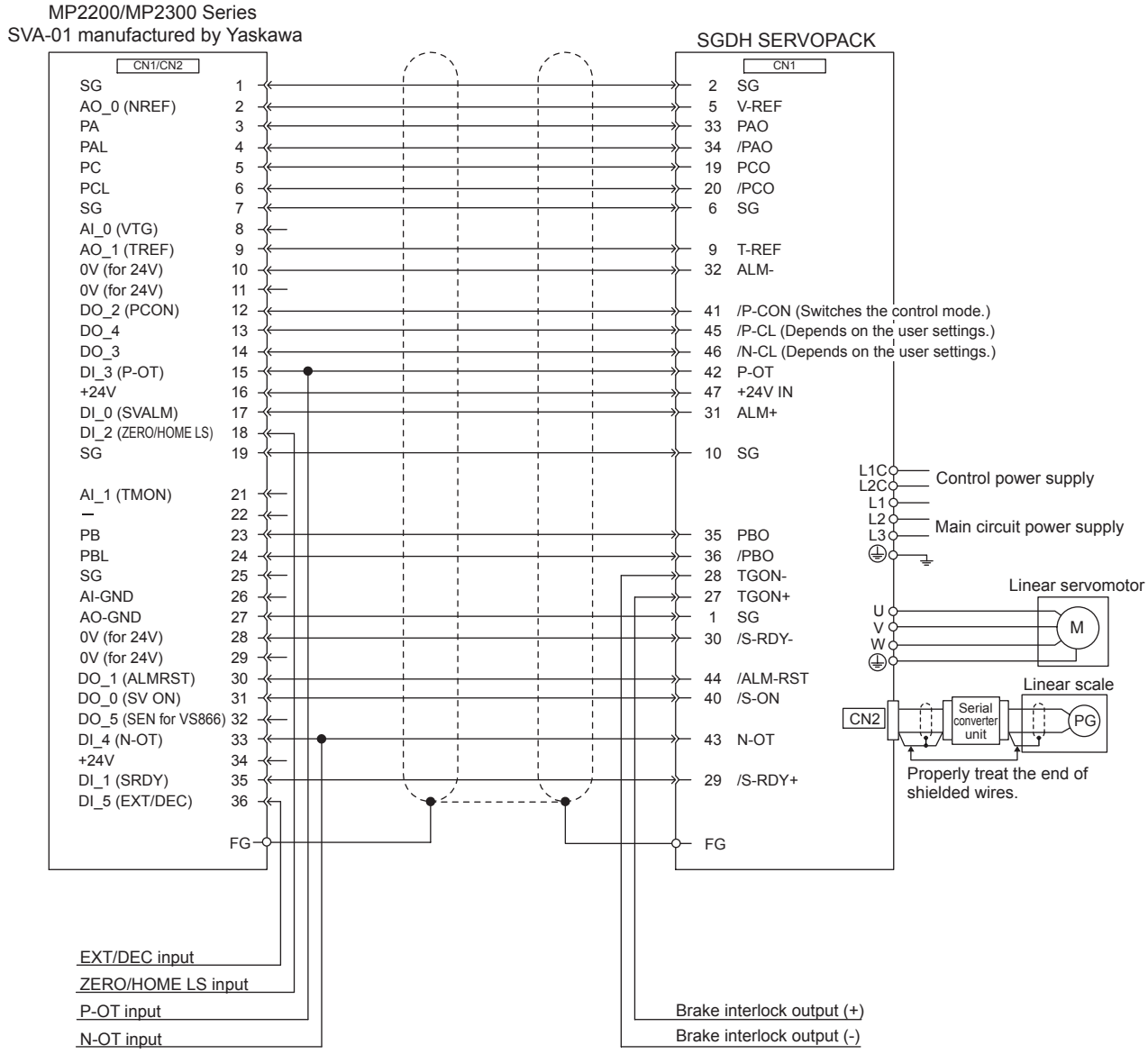
(b) 400-V SERVOPACKs





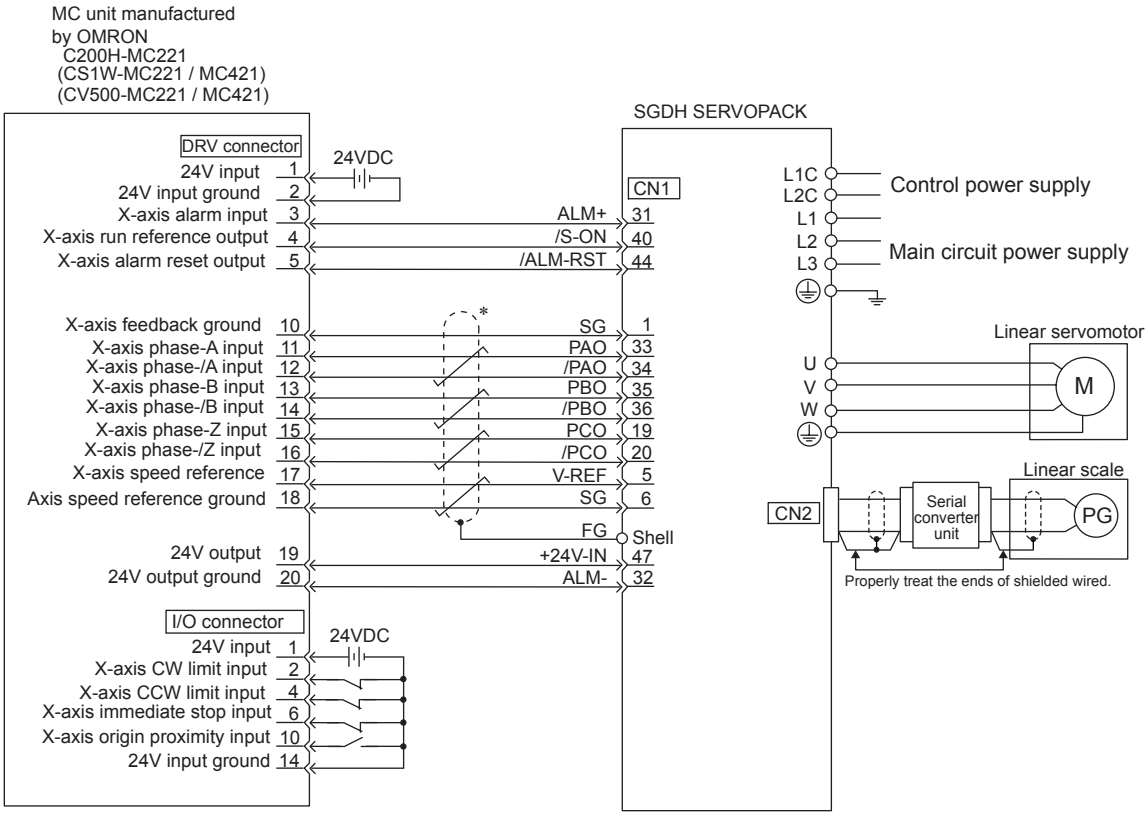
12.3 Connection to Host Controller

12.3.1 Example of Connection to MP2200/MP2300 2-axes Motion Module SVA-01



Note: Connection cables (model: JEPMC-W2040-□□) to connect the SERVOPACK to the MP2200/MP2300 are provided by Yaskawa. For details, refer to *Machine Controller MP2200/MP2300 Motion Module Uesr's Manual (manual no. SIEPC88070016)*.

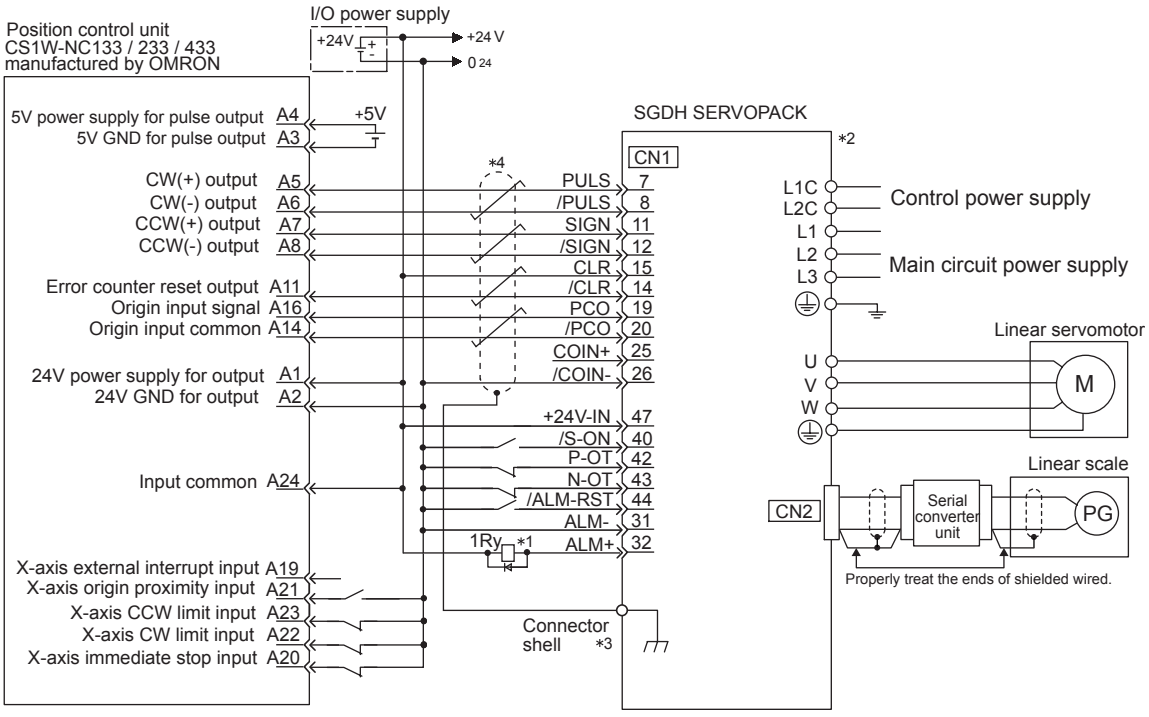
12.3.2 Example of Connection to OMRON's Motion Control Unit



* represents twisted-pair wires.

Note: 1. Only signals applicable to OMRON's MC unit and Yaskawa's 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.

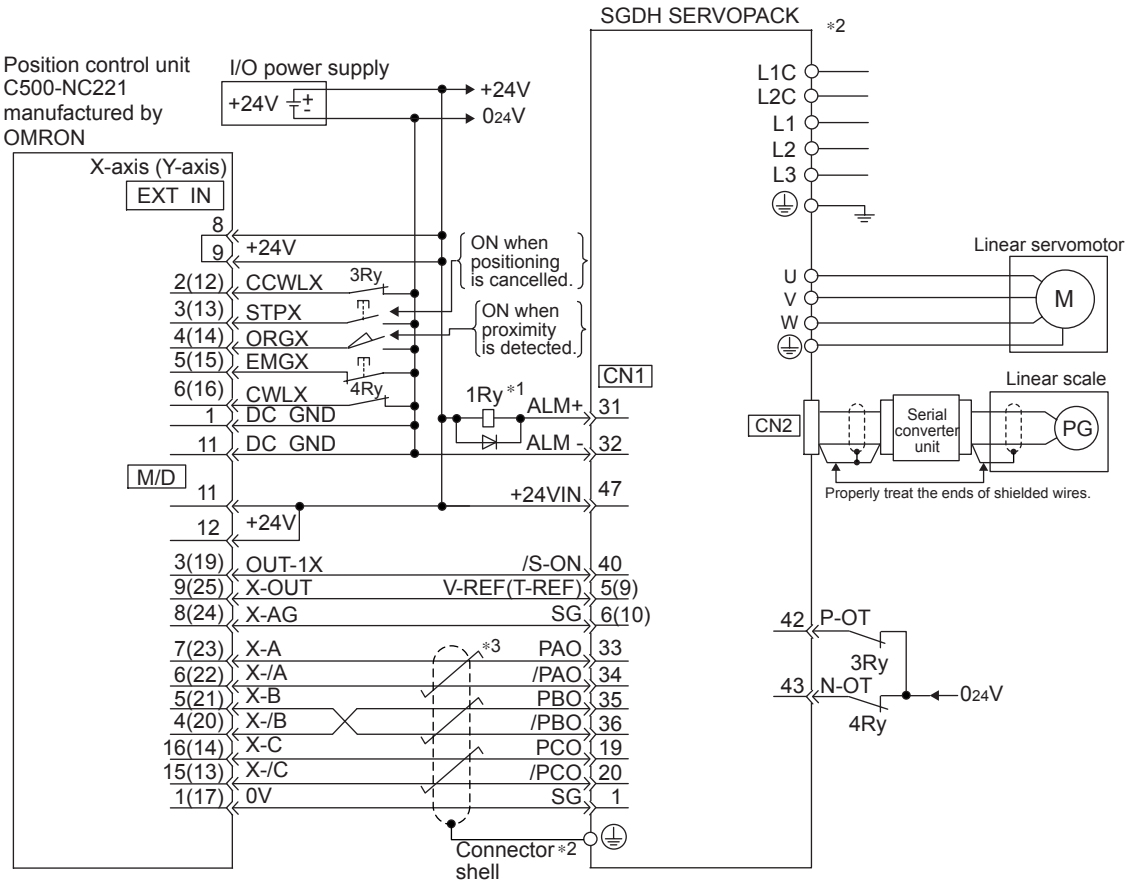
12.3.3 Example of Connection to OMRON's Position Control Unit



* 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 SGDS SERVOPACK are shown in the diagram.

12.3.4 Example of Connection to OMRON's Position Control Unit C500-NC221 (SERVOPACK in Speed Control Mode)



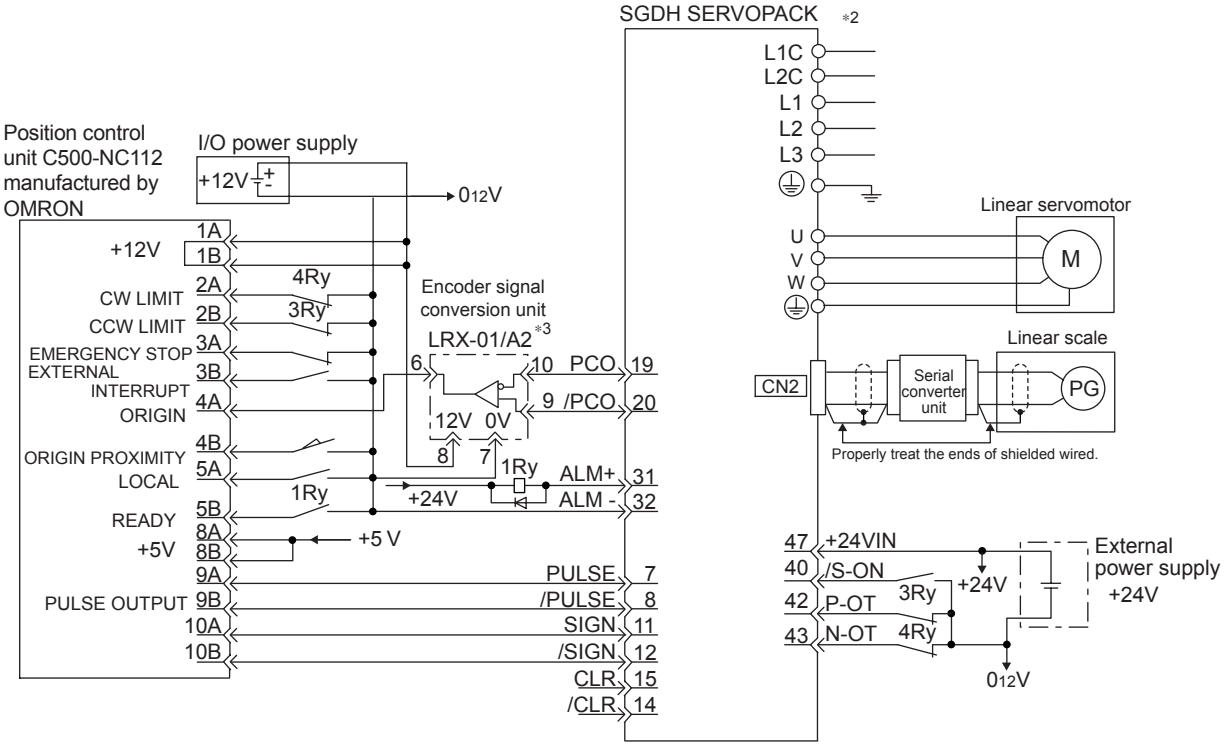
* 1. The ALM signal is output for approximately two seconds when the power is turned ON. Take this into consideration when designing the power ON sequence. The ALM signal actuates the alarm detection relay 1Ry to stop main circuit power supply to the SERVOPACK.

* 2. Connect the I/O cable's shield wire to the connector shell.

* 3. represents twisted-pair wires.

Note: Only signals applicable to OMRON's C500-NC221 position control unit and Yaskawa's SGDH SERVOPACK are shown in the diagram.

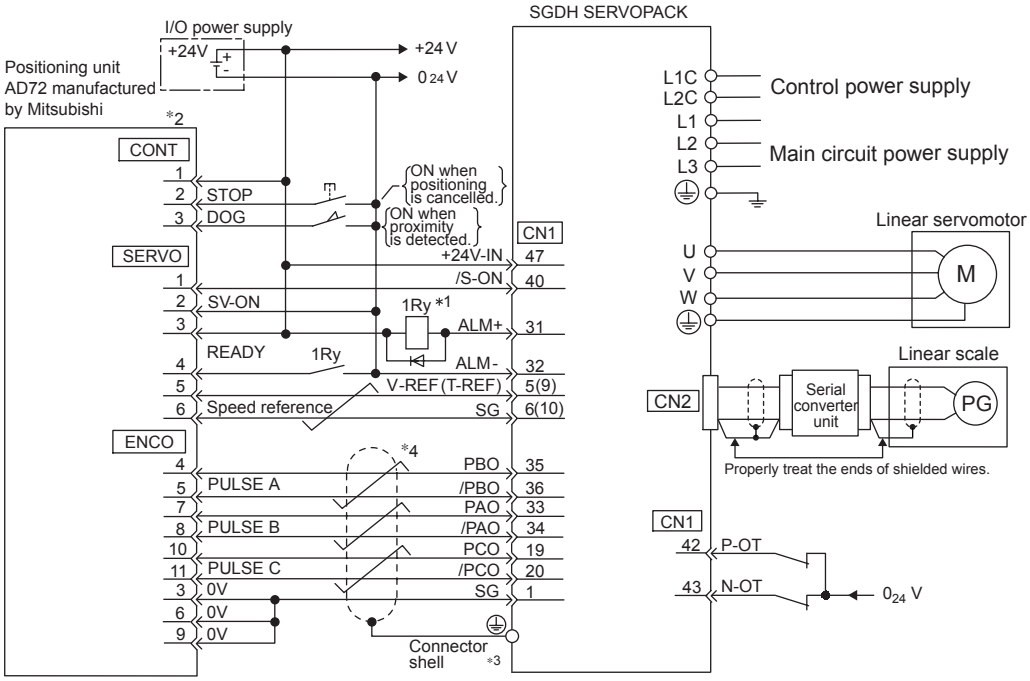
12.3.5 Example of Connection to OMRON's Position Control Unit C500-NC112 (SERVOPACK in Position Control Mode)



* 1. The ALM signal is output for approximately two seconds when the power is turned ON. Take this into consideration when designing the power ON sequence. The ALM signal actuates the alarm detection relay 1Ry to stop main circuit power supply to the SERVOPACK.
* 2. Set parameter Pn200.0 to 1.
* 3. Manufactured by Yaskawa Controls Co., Ltd.

Note: Only signals applicable to OMRON's C500-NC112 position control unit and Yaskawa's SGDH SERVOPACK are shown in the diagram.

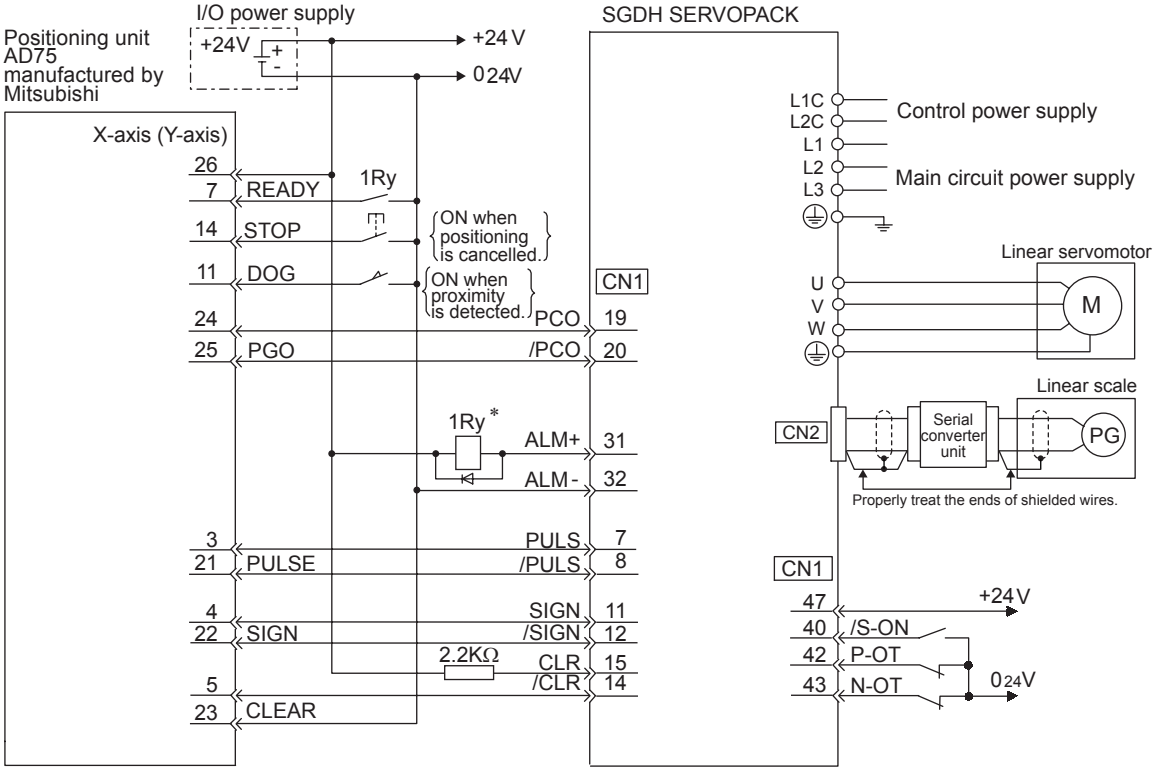
12.3.6 Example of Connection to Mitsubishi's AD72 Positioning Unit (SERVOPACK in Speed Control Mode)



* 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 SGDH SERVOPACK are shown in the diagram.

12.3.7 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 SGDH SERVOPACK are shown in the diagram.

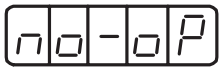
12.4 List of Parameters

12.4.1 Utility Functions List

The following list shows the available utility functions.

Parameter No.	Function	Remarks	Reference Section
Fn000	Alarm traceback data display		8.2.2
Fn001	Rigidity setting during online autotuning	○	10.2.5
Fn002	JOG mode operation	○	8.2.3
Fn003	Zero-point search mode	○	8.2.4
Fn005	Parameter setting initialization	○	8.2.5
Fn006	Alarm traceback data clear	○	8.2.6
Fn007	Writing to EEPROM mass ratio data obtained from online autotuning	○	10.2.7
Fn008	Fixed parameter	○	–
Fn009	Automatic tuning of analog (speed, force) reference offset	○	9.7.3 9.9.3
Fn00A	Manual adjustment of speed reference offset	○	9.7.3
Fn00B	Manual adjustment of force reference offset	○	9.9.3
Fn00C	Manual zero-adjustment of analog monitor output	○	–
Fn00D	Manual gain-adjustment of analog monitor output	○	–
Fn00E	Automatic offset-adjustment of motor current detection signal	○	8.2.7
Fn00F	Manual offset-adjustment of motor current detection signal	○	8.2.8
Fn010	Password setting (protects parameters from being changed)		8.2.9
Fn011	Motor models display		8.2.10
Fn012	Software version display		8.2.11
Fn013	Fixed parameter	○	–
Fn014	Application module detection results clear	○	8.2.12

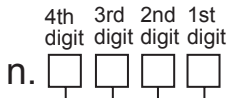
Note: When the parameters marked with "○" in remarks column are set for Password Setting (Fn010), the indication shown below appears and such parameters cannot be changed.



Blinks for one second

12.4.2 List of Parameters

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn000	Function Selection Basic Switches	–	–	0000	After restart	–



Direction Selection
(Refer to *9.6.2 Switching the Linear Servomotor Movement Direction*.)

0	Sets the counting-up direction of the linear scale (phase-A progression) as forward direction.
1	Sets the counting-down direction of the linear scale (phase-B progression) as forward direction. (Movement direction reversal mode)

Control Method Selection
(Refer to *9.5, 9.12*)

0	Speed control (analog reference)
1	Position control (pulse train reference)
2	Force control (analog reference)
3	Internal set speed control (contact reference)
4	Internal set speed control (contact reference) ⇔ Speed control (analog referene)
5	Internal set speed control (contact reference) ⇔ Position control (pulse train reference)
6	Internal set speed control (contact reference) ⇔ Force control (analog reference)
7	Position control (pulse train reference) ⇔ Speed control (analog reference)
8	Position control (pulse train reference) ⇔ Force control (analog reference)
9	Force control (analog reference) ⇔ Speed control (analog reference)
A	Speed control (analog reference) ⇔ Zero clamp
B	Position control (pulse train reference) ⇔ Position control (INHIBIT)

Axis Address

0 to F	Sets SERVOPACK axis address.

Rotation Type/Linear Type Selection (When the Encoder is not Connected)

0	Starts up as rotation type.
1	Starts up as linear type.

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn001	Function Selection Application Switches 1	–	–	0000	After restart	–

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

Servo OFF or Alarm Stop Mode (Refer to *9.6.4 Selecting the Stopping Method After Servo OFF.*)

0	Stops the linear servomotor by applying dynamic brake (DB).
1	Stops the linear servomotor by applying dynamic brake (DB) and then releases DB.
2	Makes the linear servomotor coast to a stop state without using the dynamic brake (DB).

Overtravel (OT) Stop Mode (Refer to *9.6.3 Selecting the Overtravel Limit Function.*)

0	Same setting as Pn001.0 (Stops the linear servomotor by applying DB or by coasting).
1	Sets the emergency stop force of Pn406 to the maximum value, decelerate the linear servomotor to a stop, and then sets it to servolock state.
2	Sets the emergency stop force of Pn406 to the maximum value, decelerate the linear servomotor to a stop, and then sets it to coasting state.

AC/DC Power Input Selection (Refer to *7.2.3 Typical Main Circuit Examples.*)

0	Not applicable to DC power input: Input AC power supply through L1, L2 (, and L3) terminals.
1	Applicable to DC power input: Input DC power supply between ⊕1 and ⊖.

Warning Code Output Selection (Refer to *9.13.2 Warning Display.*)

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).

Pn002	Function Selection Application Switches 2	–	–	0000	After restart	–

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

Speed Control Option (T-REF Terminal Allocation)

0	N/A
1	Uses T-REF as an external force limit input. (Refer to 9.11.3)
2	Uses T-REF as a force feed forward input. (Refer to 10.4.2)
3	Use T-REF as an external force limit input when P-CL and N-CL are ON. (Refer to 9.11.4)

Force Control Option (V-REF Terminal Allocation) (Refer to *9.9.4*)

0	N/A
1	Uses V-REF as an external speed limit input.

Reserved (Do not change)

Reserved (Do not change)

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn003	Function Selection Application Switches 3	–	–	0002	Immedi-ately	–

n. □ (4th digit) □ (3rd digit) □ (2nd digit) □ (1st digit)

Analog Monitor 1 / Analog Monitor 2 Signals
(Refer to *10.5 Analog Monitor*.)

00	Motor speed: 1V/1000 mm/s
01	Speed reference: 1V/1000 mm/s
02	Force reference: 1V/100%
03	Position error: 0.05V/1 reference unit
04	Position error: 0.05V/100 reference units
05	Reference pulse frequency: 1V/1000 mm/s
06	Motor speed × 4: 1V/250 mm/s
07	Motor speed × 8: 1V/125 mm/s

Reserved (Do not change)
(Refer to 10.5 Analog Monitor.)

Reserved (Do not change)

Pn004	Reserved (Do not change)	–	–	0000	Immedi-ately	–
Pn005	Reserved (Do not change)	–	–	0000	Immedi-ately	–
Pn080	Function Selection Application Switches 80	–	–	0000	After restart	–

n. □ (4th digit) □ (3rd digit) □ (2nd digit) □ (1st digit)

Hall Sensor Selection
(Refer to *9.2.3*)

0	With hall sensor
1	Without hall sensor

Motor Phase Order Selection*1
(Refer to *9.2.2, 9.2.3*)

0	Phase A progression in order of phase U, V, and W
1	Phase B progression in order of phase U, V, and W

Reserved (Do not change)

Calculation of Motor Max. Speed and Encoder Output Resolution Max. Value Selection*2

0	Calculates the encoder output resolution max. value by fixing the motor max. speed and the monitor displays Un010.
1	Calculates the motor max. speed by fixing the encoder output resolution max. value and the monitor displays Un010.

* 1. If the linear servomotor with a hall sensor is used, software version 32 or later can be used.
If software version earlier than 32 is used, set to zero.
* 2. Available only for the software version 32 or later.

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn100	Speed Loop Gain	1 to 2000	1 Hz	40	Immedi-ately	10.3.4
Pn101	Speed Loop Integral Time Constant	15 to 51200	0.01 ms	2000	Immedi-ately	10.3.5
Pn102	Position Loop Gain	1 to 2000	1/s	40	Immedi-ately	10.3.3
Pn103	Mass Ratio	0 to 10000 (0 to 20000)*1	1%	0	Immedi-ately	9.2.2 9.2.3 10.2.6
Pn104	2nd Speed Loop Gain	1 to 2000	1 Hz	40	Immedi-ately	10.4.9
Pn105	2nd Speed Loop Integral Time Constant	15 to 51200	0.01 ms	20.00	Immedi-ately	10.4.9
Pn106	2nd Position Loop Gain	1 to 2000	1/s	40	Immedi-ately	10.4.9
Pn108	Bias Width Addition	0 to 250	1 reference unit	7	Immedi-ately	10.4.6
Pn109	Feed-forward	0 to 100	1%	0	Immedi-ately	10.4.1
Pn10A	Feed-forward Filter Time Constant	0 to 6400	0.01 ms	0	Immedi-ately	10.4.1
Pn10B	Gain-related Application Switches	–	–	0000	After restart / Immedi-ately	–
Pn10C	Mode Switch Force Reference	0 to 800	1%	200	Immedi-ately	10.4.5

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

Mode Switch Selection (Refer to *10.4.5 Using the Mode Switch (P/PI Switching.)*) — Setting Validation: Immediately

0	Use internal force reference as the condition. (Level setting: Pn10C)
1	Use speed reference as the condition. (Level setting: Pn181)
2	Use acceleration as the condition. (Level setting: Pn182)
3	Use position error pulse as the condition. (Level setting: Pn10F)
4	No mode switch function available

Speed Loop Control Method (Refer to *10.3.5 Speed Loop Integral Time Constant.*) — Setting Validation: After restart

0	PI control
1	I-P control

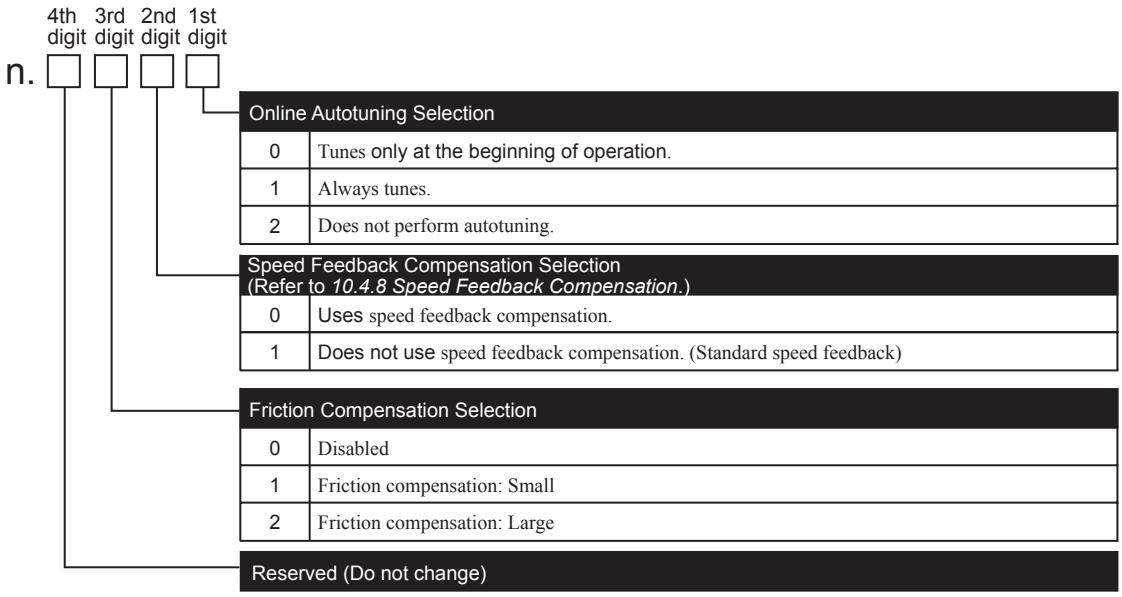
Automatic Gain Switching Selection *2 (Refer to *10.4.11*)*2 — Setting Validation: After restart

0	No automatic gain switching available
1	Position reference
2	Position error
3	Both position reference and position error

Reserved (Do not change)

* 1. The setting range for the software version 32 or later
* 2. Available only for the software version 32 or later

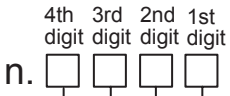
Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn10F	Mode Switch Position Error Pulse	0 to 10000	1 reference unit	0	Immedi-ately	10.4.5
Pn110	Online Autotuning Switches	–	–	0010	After restart	–



Pn111	Speed Feedback Compensation *1	1 to 500	1%	100	Immedi-ately	10.4.8
Pn124	Automatic Gain Switching Timer *2	1 to 10000	1 ms	100	Immedi-ately	–
Pn125	Automatic Gain Switching Width *2	1 to 250	1 reference unit	7	Immedi-ately	–
Pn180	Bias	0 to 450	1 mm/s	0	Immedi-ately	10.4.6
Pn181	Mode Switch Speed Reference	0 to 5000	1 mm/s	0	Immedi-ately	10.4.5
Pn182	Mode Switch Acceleration	0 to 30000	1 mm/s^2	0	Immedi-ately	10.4.5

* 1. Pn111 will be effective when Pn110.1 is set "0."
* 2. Available for the software version 32 or later

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn200	Position Control Reference Form Selection Switch	–	–	0000	After restart	9.8.1



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

Position Error Counter Clear Signal Form

0	Clears position error counter when the signal is at H level.
1	Clears position error counter at the rising edge of the signal.
2	Clears position error counter when the signal is at L level.
3	Clears position error counter at the falling edge of the signal.

Clear Operation

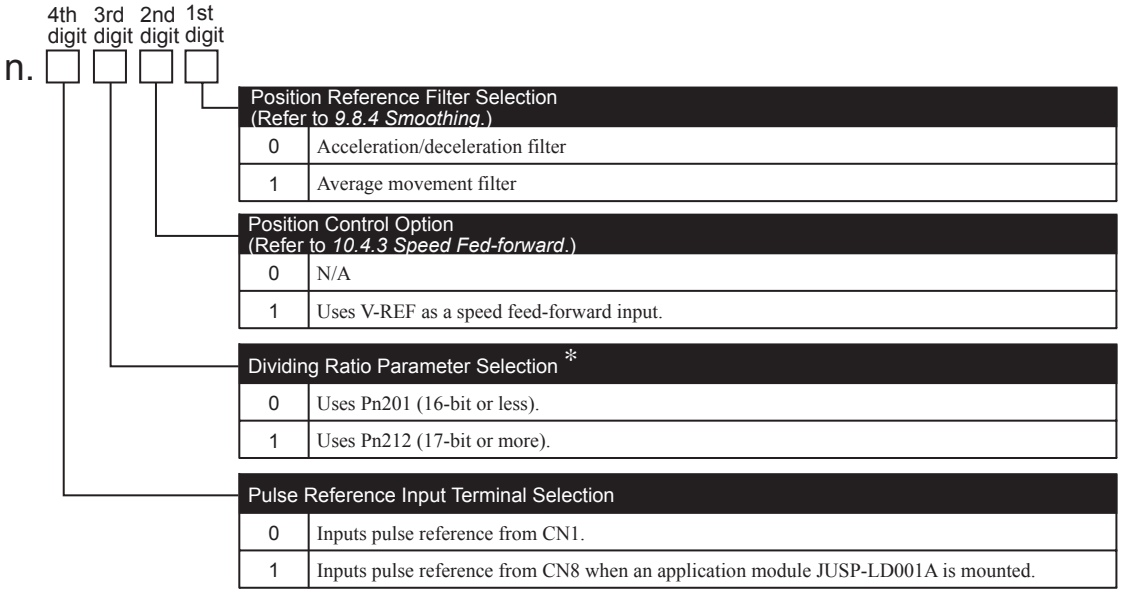
0	Clear error counter at the baseblock.
1	Does not clear error counter. (Possible to clear error counter only with CLR signal.)
2	Clear error counter when an alarm occurs.

Filter Selection

0	Reference input filter for line driver signals
1	Reference input filter for open collector signals

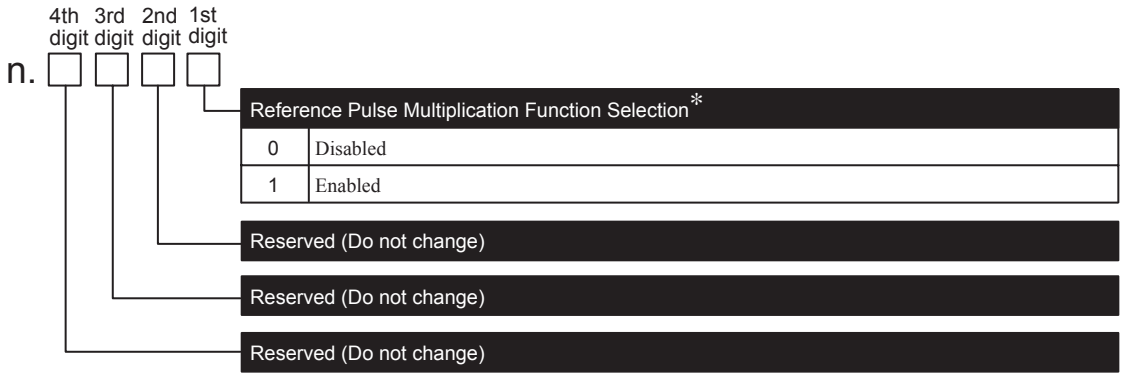
Pn202	Electronic Gear Ratio (Numerator)	1 to 65535	–	4	After restart	9.8.2
Pn203	Electronic Gear Ratio (Denominator)	1 to 65535	–	1	After restart	9.8.2
Pn204	Position Reference Accel/Decel Time Constant	0 to 6400	0.01 ms	0	Immedi-ately	9.8.4

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn207	Position Control Function Switches	–	–	0000	After restart	–



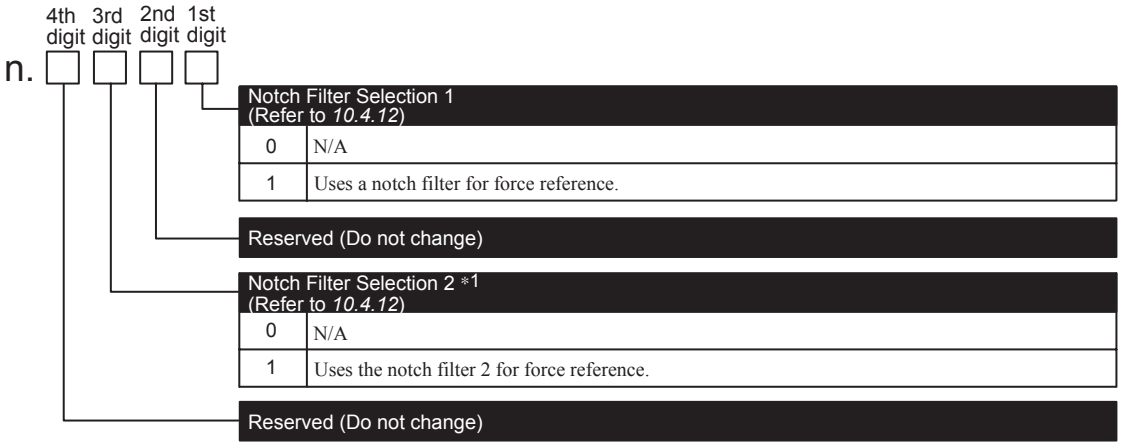
Pn208	Position Reference Movement Averaging Time	0 to 6400	0.01 ms	0	After restart	9.8.4

* Available only for the software version 32 or later

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn217	Reference Pulse Input Multiplication *	1 to 99	× 1	1	Immedi-ately	–
Pn218	Reference Pulse Input Multiplication Function Selection *	–	–	0000	After restart	–
						
Pn280	Linear Scale Pitch	0 to 65535	1 µm	0	After restart	9.2.2 9.2.3 9.7.7 9.8.2
Pn281	PG Divider	1 to 255	1P/(scale pitch)	20	After restart	9.7.7
Pn300	Speed Reference Input Gain	150 to 3000	0.01V / rated speed	600	Immeci-ately	9.7.1 9.9.4
Pn305	Soft Start Acceleration Time	0 to 10000	1 ms	0	Immedi-ately	9.7.4
Pn306	Soft Start Deceleration Time	0 to 10000	1 ms	0	Immedi-ately	9.7.4
Pn307	Speed Reference Filter Time Constant	0 to 65535	0.01 ms	40	Immedi-ately	9.7.5
Pn308	Speed Feedback Filter Time Constant	0 to 65535	0.01 ms	0	Immedi-ately	10.4.7
Pn380	Internal Set Speed 1	0 to 5000	1 mm/s	10	Immedi-ately	9.10.1
Pn381	Internal Set Speed 2	0 to 5000	1 mm/s	20	Immedi-ately	9.10.1
Pn382	Internal Set Speed 3	0 to 5000	1 mm/s	30	Immedi-ately	9.10.1
Pn383	JOG Speed	0 to 5000	1 mm/s	50	Immedi-ately	–
Pn384	Motor Maximum Speed *	1 to 100	0.1 m/s	50	After restart	9.6.6
Pn400	Force Reference Input Gain	10 to 100	0.1 V/ rated force	30	Immedi-ately	9.9.1 9.9.2 10.4.2
Pn401	Force Reference Filter Time Constant	0 to 65535	0.01 ms	100	Immedi-ately	10.4.10
Pn404	Forward External Force Limit	0 to 800	1%	100	Immedi-ately	9.11.2 9.11.4
Pn405	Reverse External Force Limit	0 to 800	1%	100	Immedi-ately	–

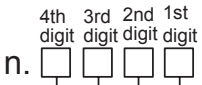
* Available for the software version 32 or later

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn406	Emergency Stop Force	0 to 800	1%	800	Immedi-ately	9.6.3
Pn408	Force Function Switches	–	–	0000	Immedi-ately	–
Pn409	Notch Filter Frequency	50 to 2000	1 Hz	2000	Immedi-ately	10.4.10
Pn40A	Notch Filter Q Value *1	50 to 400	0.01	70	Immedi-ately	10.4.10
Pn40B	Notch Filter 2 Frequency *1	50 to 2000	1 Hz	2000	Immedi-ately	10.4.10
Pn40C	Notch Filter 2 Q Value *1	50 to 400	0.01	70	Immedi-ately	10.4.10
Pn480	Speed Limit during Force Control	0 to 5000	1 mm/s	5000	Immedi-ately	9.9.4
Pn481	Polarity Detection Speed Loop Gain	1 to 2000	1 Hz	40	Immedi-ately	9.2.3
Pn482	Polarity Detection Speed Loop Integral Time Constant	15 to 51200	0.01 ms	3000	Immedi-ately	9.2.3
Pn483	Forward Force Limit *2	0 to 800	1 %	30	Immedi-ately	9.2.3 9.11.1
Pn484	Reverse Force Limit *2	0 to 800	1 %	30	Immedi-ately	
Pn500	Positioning Completed Width	0 to 250	1 reference unit	7	Immedi-ately	9.8.5
Pn504	NEAR Signal Width	1 to 250	1 reference unit	7	Immedi-ately	9.8.6
Pn505	Overflow Level	256 to 8388352	256 refer-ence units	262144	Immedi-ately	10.3.3
Pn506	Brake Reference - Servo OFF Delay Time	0 to 50	10 ms	0	Immedi-ately	–
Pn508	Servo OFF - Brake Reference Waiting Time	10 to 100	10 ms	500	Immedi-ately	–
Pn509	Momentary Hold Time	20 to 1000	1 ms	20	Immedi-ately	9.6.5



* 1. Available for the software version 32 or later
* 2. To reduce any danger while setting up the linear servomotor, the factory settings are set to low values (factory setting: 30%). After the servomotor has been set up, increase the settings of the parameters to the required force. For details, refer to *9.2 Trial Operation Using SERVOPACK Internal References*.

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn50A	Input Signal Selection 1	–	–	2100	After restart	–



Input Signal Allocation Mode
(Refer to 8.3.2 Input Circuit Signal Allocation.)

0	Uses the sequence input signal terminals with standard allocation.
1	Changes the sequence input signal allocation for each signal.

/S-ON Signal Mapping
Signal Polarity: Normal: Servo ON when ON (L-level)
Signal Polarity: Reverse: Servo ON when OFF (H-level)
(Refer to *9.6.1 Setting the Servo ON Signal*.)

0	ON when CN1-40 input signal is ON (L-level)
1	ON when CN1-41 input signal is ON (L-level)
2	ON when CN1-42 input signal is ON (L-level)
3	ON when CN1-43 input signal is ON (L-level)
4	ON when CN1-44 input signal is ON (L-level)
5	ON when CN1-45 input signal is ON (L-level)
6	ON when CN1-46 input signal is ON (L-level)
7	Sets signal ON.
8	Sets signal OFF.
9	OFF when CN1-40 input signal is OFF (H-level)
A	OFF when CN1-41 input signal is OFF (H-level)
B	OFF when CN1-42 input signal is OFF (H-level)
C	OFF when CN1-43 input signal is OFF (H-level)
D	OFF when CN1-44 input signal is OFF (H-level)
E	OFF when CN1-45 input signal is OFF (H-level)
F	OFF when CN1-46 input signal is OFF (H-level)

/P-CON Signal Mapping (P control when ON (L-level))
Refer to *10.4.4 Proportional Control Operation (Proportional Operation Reference)*.)

0 to F	Same as /S-ON

P-OT Signal Mapping (Forward run prohibited when OFF (H-level))
Refer to *9.6.3 Setting the Overtravel Limit Function*.)

0	Forward run allowed when CN1-40 input signal is ON (L-level)
1	Forward run allowed when CN1-41 input signal is ON (L-level)
2	Forward run allowed when CN1-42 input signal is ON (L-level)
3	Forward run allowed when CN1-43 input signal is ON (L-level)
4	Forward run allowed when CN1-44 input signal is ON (L-level)
5	Forward run allowed when CN1-45 input signal is ON (L-level)
6	Forward run allowed when CN1-46 input signal is ON (L-level)
7	Forward run prohibited
8	Forward run allowed
9	Forward run allowed when CN1-40 input signal is OFF (H-level)
A	Forward run allowed when CN1-41 input signal is OFF (H-level)
B	Forward run allowed when CN1-42 input signal is OFF (H-level)
C	Forward run allowed when CN1-43 input signal is OFF (H-level)
D	Forward run allowed when CN1-44 input signal is OFF (H-level)
E	Forward run allowed when CN1-45 input signal is OFF (H-level)
F	Forward run allowed when CN1-46 input signal is OFF (H-level)

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn50B	Input Signal Selection 2	–	–	6543	After restart	–

n. □ (4th digit) □ (3rd digit) □ (2nd digit) □ (1st digit)

N-OT Signal Mapping (Reverse run prohibited when OFF (H-level)
Refer to *9.6.3 Setting the Overtravel Limit Function*.)

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)

/ALM-RST Signal Mapping (Alarm Reset when ON (L-level)
(Refer to *9.13.1 Servo Alarm Output (ALM) and Alarm Code Output (ALO1, ALO2, ALO3)*.)

0 to 6	Same as /S-ON, the setting of 2nd digit of Pn50.A
7	Reserved (Do not change)
8 to F	Same as /S-ON, the setting of 2nd digit of Pn50.A

/P-CL Signal Mapping (Force Limit when ON (L-level))
(Refer to *9.10.2, 9.10.3, 9.11.2, and 9.11.4*.)

0 to F	Same as /S-ON, the setting of 2nd digit of Pn50.A

/N-CL Signal Mapping (Force Limit when ON (L-level))
Refer to 9.10.2, 9.10.3, 9.11.2, and 9.11.4.)

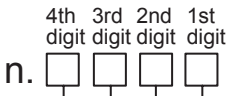
0 to F	Same as /S-ON, the setting of 2nd digit of Pn50.A

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	Reference Section
Pn50C	Input Signal Selection 3	–	–	8888	After restart	–



/SPD-D Signal Mapping
(Refer to *9.10 Operating Using Speed Control with an Internally Set Speed.*)

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)

/SPD-A Signal Mapping
(Refer to *9.10 Operating Using Speed Control with an Internally Set Speed.*)

0 to F	Same as /SPD-D

/SPD-B Signal Mapping
(Refer to *9.10 Operating Using Speed Conttol with an Internally Set Speed.*)

0 to F	Same as /SPD-D

/C-SEL Signal Mapping (Control mode change when ON (L-level))
(Refer to *9.12.2 Switching the Control Mode.*)

0 to F	Same as /SPD-D

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn50D	Input Signal Selection 4	–	–	8888	After restart	–

n. □ (4th digit) □ (3rd digit) □ (2nd digit) □ (1st digit)

/ZCLAMP Signal Mapping (Zero clamp when ON (L-level))
(Refer to *9.7.6 Using the Zero Camp Function*.)

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)

/INHIBIT Signal Mapping (Reference pulse inhibit when ON (L-level))
(Refer to *9.8.7 Reference Pulse Inhibit function (INHIBIT)*.)

0 to F	Same as /ZCLAMP

/G-SEL1 Signal Mapping (Gain change when ON (L-level))
(Refer to *10.4.9 Switching Gain Settings*.)

0 to F	Same as /ZCLAMP

/P-DET Signal Mapping (Polarity detection when ON (L-level))
(Refer to *9.2.3*)

0 to F	Same as /ZCLAMP

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn50E	Output Signal Selection 1	–	–	3211	After restart	–

n. □ (4th digit) □ (3rd digit) □ (2nd digit) □ (1st digit)

Positioning Completion Signal Mapping (/COIN)
(Refer to *9.8.5 Positioning Completed Output Signal*.)

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.

Speed Coincidence Detection Signal Mapping (/V-CMP)
(Refer to *9.7.8 Speed Coincidence Output*.)

0 to 3	Same as /COIN

Movement Detection Signal Mapping (/TGON) *(Refer to 9.13.3)*

0 to 3	Same as /COIN

Servo Ready Signal Mapping (/S-RDY)
(Refer to 9.13.4 Servo Ready (/S-RDY) Output.)

0 to 3	Same as /COIN

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn50F	Output Signal Selection 2	–	–	0000	After restart	–

n. □ (4th digit) □ (3rd digit) □ (2nd digit) □ (1st digit)

Force Limit Detection Signal Mapping (/CLT)
(Refer to *9.11.5 Checking Output Force Limiting during Operation*.)

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.

Speed Limit Detection Signal Mapping (/VLT)
(Refer to *9.9.4 Limiting Linear Servomotor Speed during Force Control*.)

0 to 3	Same as /CLT

Brake Interlock Signal Mapping (/BK)
(Refer to *8.3.3 Setting for Holding Brakes*.)

0 to 3	Same as /CLT

Warning Signal Mapping (/WARN)
(Refer to *9.13.2 Warning Output (/WARN)*.)

0 to 3	Same as /CLT

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn510	Output Signal Selection 3	–	–	0000	After restart	9.8.6

n. □ (4th digit) □ (3rd digit) □ (2nd digit) □ (1st digit)

Near Signal Mapping (/NEAR)

0	Disabled (the above signal is not used.)
1	Outputs the signal from CN1-25, -26 terminal.
2	Outputs the signal from CN1-27, -28 terminal.
3	Outputs the signal from CN1-29, -30 terminal.

Reserved (Do not change)

Reference Pulse Input Switch Signal Mapping (/P-SELA)*

0 to 3	Same as /NEAR

Reserved (Do not change)

Pn512	Output Signal Reverse Settings	–	–	0000	After restart	8.3.3

n. □ (4th digit) □ (3rd digit) □ (2nd digit) □ (1st digit)

Output Signal Reverse for CN1-25 or -26 Terminals

0	Output signal is not reversed.
1	Output signal is reversed.

Output Signal Reverse for CN1-27 or -28 Terminals

0	Output signal is not reversed.
1	Output signal is reversed.

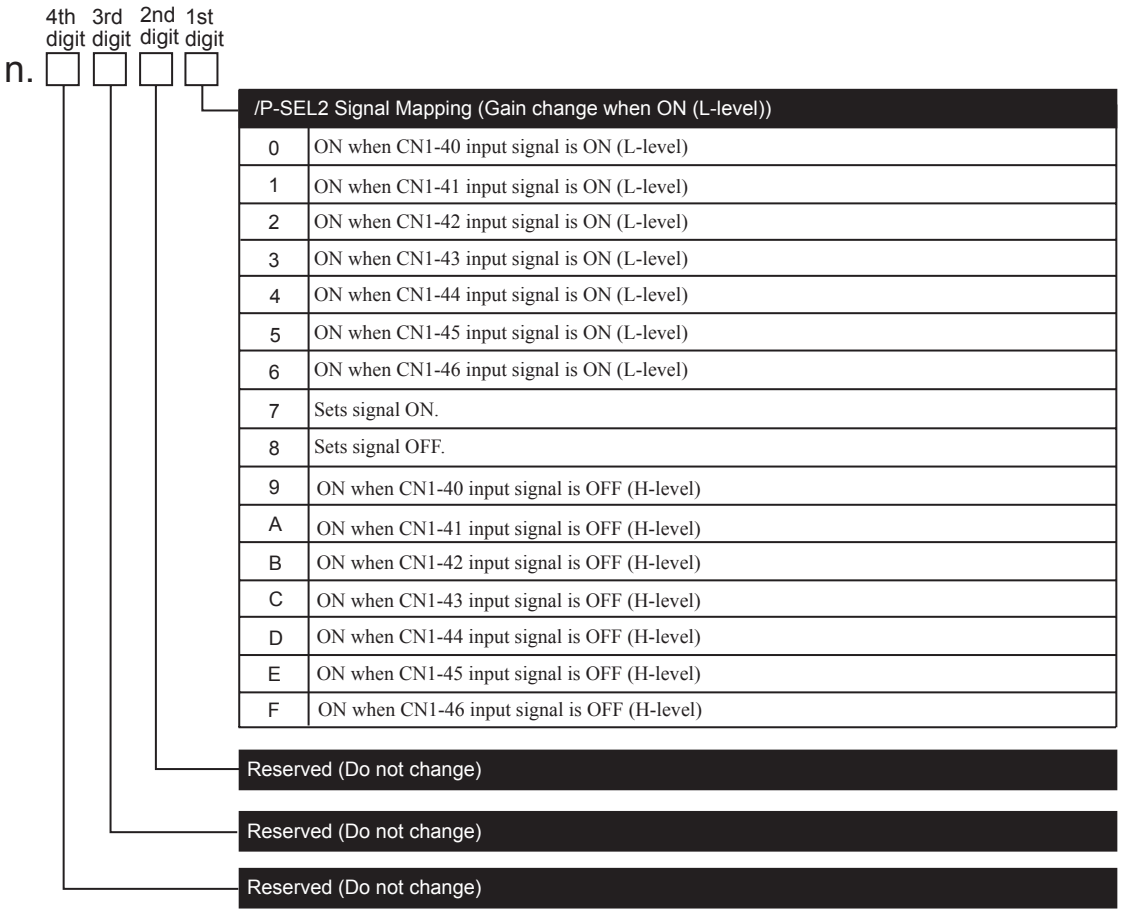
Output Signal Reverse for CN1-29 or -30 Terminals

0	Output signal is not reversed.
1	Output signal is reversed.

Reserved (Do not change)

* Available for the software version 32 or later

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn513	Input Signal Selection 5 *1	–	–	0000	After restart	8.3.2



Pn51E	Excessive Position Error Warning Level *1	0 to 100	1%	0	Immedi-ately	11.1.2
Pn580	Zero Clamp Level	0 to 5000	1 mm/s	10	Immedi-ately	9.7.6
Pn581	Zero Speed Level	1 to 5000	1 mm/s	20	Immedi-ately	9.13.3
Pn582	Speed Coincidence Signal Output Width	0 to 100	1 mm/s	10	Immedi-ately	9.7.8
Pn583	Brake Reference Output Speed Level	0 to 5000	1 mm/s	100	Immedi-ately	–
Pn584	Motor Self-cooling Ratio*1	0 to 100	1% / peak speed	0	Immedi-ately	–
Pn600	External Regenerative Resistor Capacity*2	Depending on model*3	10 W	0	Immedi-ately	7.6

* 1. Available for the software version 32 or later
* 2. Usually set to "0". If an external regenerative resistor is mounted, set the capacity(W) of the resistor so that it is the same or lower than the rated value.
* 3. The upper limit value is the maximum output capacity (W) of applied SERVOPACK.

12.4.3 Monitor Modes

The following list shows available monitor modes.

Parameter No.	Content of Display	Unit
Un000	Actual motor speed	mm/s
Un001	Input speed reference	mm/s
Un002	Internal force reference (Value for rated force)	%
Un003	Electrical angle 1 (16-bit decimal code)	number of pulses from the phase-U (0°)
Un004	Electrical angle 2 (Angle from 0 (zero) degree of phase-U)	deg
Un005	Input signal monitor	–
Un006	Output signal monitor	–
Un007	Input reference pulse speed (displayed only in position control mode)	mm/s
Un008	Error counter (amount of position error) (displayed only in position control mode)	reference unit
Un009	Accumulated load rate (Value for the rated force as 100%: Displays effective force 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 DB power consumption in 10 s cycle.)	%
Un00C	Input reference pulse counter (32-bit decimal code) (displayed only in position control mode)	–
Un00D	Feedback pulse counter (32-bit decimal code)	–
Un010*	Motor maximum speed setting upper limit or encoder output resolution setting upper limit	100mm/s or Pulse/scale pitch (Pn280)
Un011*	Hall sensor signal monitor	–

* Available for the software version 32 or later

12.5 Parameter Recording Table

Use the following table for recording parameters.

Note: Setting validation ("immediately" or "after restart") for Pn10B and Pn110 differs depending on the digit. The digits validated after restart are underlined in "Factory Setting" column.

Parameter	Factory Setting						Name	Setting Validation
Pn000	0000						Function Selection Basic Switches 0	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	Immediately
Pn080	0000						Function Selection Application Switches 80	After restart
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 %						Mass Ratio	Immediately
Pn104	40 Hz						2nd Speed Loop Gain	Immediately
Pn105	20.00 ms						2nd Speed Loop Integral Time Constant	Immediately
Pn106	40/s						2nd Position Loop Gain	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
Pn10C	200 %						Mode Switch Force Reference	Immediately
Pn10F	0 reference unit						Mode Switch Error Pulse	Immediately
Pn110	0010						Online Autotuning Switches	After restart
Pn111	100 %						Speed Feedback Compensation	Immediately
Pn124	100 ms						Automatic Gain Change Timer	Immediately
Pn125	7						Automatic Gain Change Width	Immediately
Pn180	0 mm/s						Bias	Immediately
Pn181	0 mm/s						Mode Switch Speed Reference	Immediately
Pn182	0 mm/s^2						Mode Switch Acceleration	Immediately
Pn200	0000						Position Control References Form Selection Switches	After restart

Parameter	Factory Setting						Name	Setting Validation
Pn202	4						Electronic Gear Ratio (Numerator)	After restart
Pn203	1						Electronic Gear Raio (Denominator)	After restart
Pn204	0 ms						Position Reference Accel/Decel Time Constant	Immediately
Pn207	0000						Position Control Function Switches	After restart
Pn208	0 ms						Position Reference Movement Average Time	Immediately
Pn217	1						Reference Pulse Input Multiplication	Immediately
Pn218	0000						Reference Pulse Input Multiplication Function Selection	After restart
Pn280	0 μm						Linear Scale Pitch	After restart
Pn281	20						PG Divider	After restart
Pn300	6.00 V/rated speed						Speed Reference Input Gain	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
Pn380	10 mm/s						Internal Set Speed 1	Immediately
Pn381	20 mm/s						Internal Set Speed 2	Immediately
Pn382	30 mm/s						Internal Set Speed 3	Immediately
Pn383	50 mm/s						JOG Speed	Immediately
Pn384	5.0m/s						Motor Maximum Speed	After restart
Pn400	3.0 V/rated force						Force Reference Input Gain	Immediately
Pn401	1.00 ms						Force Reference Filter Time Constant	Immediately
Pn404	100 %						Forward External Force Limit	Immediately
Pn405	100 %						Reverse External Force Limit	Immediately
Pn406	800 %						Emergency Stop Force	Immediately
Pn408	0000						Force Function Switches	Immediately
Pn409	2000 Hz						Notch Filter Frequency	Immediately
Pn40A	0.70						Notch Filter Q Value	Immediately
Pn40B	2000 Hz						Notch Filter 2 Frequency	Immediately
Pn40C	0.70						Notch Filter 2 Q Value	Immediately
Pn480	5000mm/s						Speed Limit in Force Control	Immediately

Parameter	Factory Setting						Name	Setting Validation
Pn481	40 Hz						Polarity Detection Speed Loop Gain	Immediately
Pn482	30.00 ms						Polarity Detection Speed Loop Integral Time Constant	Immediately
Pn483	30 %						Forward Force Limit	Immediately
Pn484	30 %						Reverse Force Limit	Immediately
Pn500	7						Position Completion Width	Immediately
Pn504	7						Near Signal Width	Immediately
Pn505	262144						Overflow Level	
Pn506	0 ms						Brake Reference - Servo OFF Delay Time	Immediately
Pn508	500 ms						Servo OFF - Brake Reference Waiting Time	Immediately
Pn509	20 ms						Momentary Hold Time	Immediately
Pn50A	2100						Input Signal Selection 1	After restart
Pn50B	6543						Input Signal Selection 2	After restart
Pn50C	8888						Input Signal Selection 3	After restart
Pn50D	8888						Input Signal Selection 4	After restart
Pn50E	3211						Output Signal Selection 1	After restart
Pn50F	0000						Output Signal Selection 2	After restart
Pn510	0000						Output Signal Selection 3	After restart
Pn512	0000						Output Signal Reverse Settings	After restart
Pn513	8888						Input Signal Selection 5	After restart
Pn51E	0%						Excessive Position Error Warning Level	Immediately
Pn580	10 mm/s						Zero Clamp Level	Immediately
Pn581	20 mm/s						Zero Speed Level	Immediately
Pn582	10 mm/s						Speed Coincidence Signal Output Width	Immediately
Pn583	100mm/s						Brake Reference Output Speed Level	Immediately
Pn584	0% /max. speed						Motor Self-cooling Ratio	Immediately
Pn600	0 W						External Regenrative Resistor Capacity	Immediately

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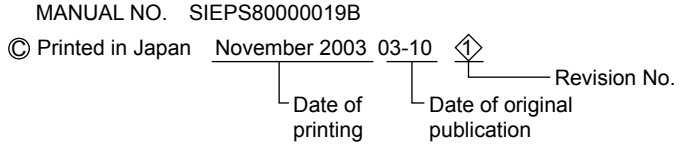
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Revision History

The revision dates and numbers of the revised manuals are given on the bottom of the back cover.



Date of Printing	Rev. No.	Section	Revised Content
October 2003	–		First edition
November 2003	①	2.3	Revision : SERVOPACKs and Applicable SGLTW Linear Servomotors
		2.4	Addition : Serial Converter Units Models JZDP-A003-211 and JZDP-A003-212
		12.2.2 (2)	Revision : SGLGW Servomotor Winding Resistance Loss
February 2004	②	2.3	Revision: Models of SGLFW servomotors with F-type iron core
		3.2 (1)	Revision: Ratings and Specifications of SGLFW-50, -1Z servomotors with F-type iron core
		3.2 (2)	Revision: Force and speed characteristics diagrams for 200-V class servomotors of SGLFW-50A200B, -50A380B, -1ZA200B, -1ZA380B models, and 400-V class servomotors of SGLFW-50D200B, -50D380B, -1ZD200B, -1ZD380B models
		12.2.1 (2)	Revision: Table for allowable frequencies in regenerative mode for the servomotor when the SERVOPACKs with capacities of 500 W to 5.0 kW are used
		12.2.2 (2) (b)	Revision: Diagrams for the SGLFW servomotor winding resistance loss
		Back cover	Revision: Address
March 2005	③	2.1	Revision: Specifications of linear servomotor
		2.4	Revision: Specifications of linear servomotor (C-type coreless motor)
		2.5 Chapter 5	Revision: Models of serial converter unit (A type to C type)
		2.7.1 6.8.3	Deletion: Types of analog monitor cable
		2.7.3 6.8.8	Revision: Manufacturer of FMAC type noise filter (TIMONTA to SCHURTER)
		3.1 3.6 12.2.2	Deletion: Ratings and specifications of SGLGW/SGLGM linear servomotors (C-type/CT-type coreless motor)
		3.2 12.2.2	Deletion: Ratings and specifications of SGLFW/SGLFM linear servomotors (Force and speed characteristics)
		3.6	Revision: Specifications of connector made by Interconnection
		3.7.4	Revision: Approx. mass of SGLFM-1Z□□□A linear servomotors
		3.8	Addition: Magnetic way of SGLTW/SGLTM linear servomotors (SGLTM-□□□□□AY)
		6.2	Revision: Specifications of cables for connecting serial converter unit
		6.3	Addition: Specifications of cables for connecting linear scale
		6.4	Addition: Specifications of cables for connecting hall sensor
		7.4.2	Revision: Examples of I/O signal connections when position control mode
		7.4.6	Revision: Position Reference Input Circuit
		9.7.7	Addition: Relation between Linear Scale by Renishaw and Encoder Output Signals from the SERVOPACK
		12.3.1	Deletion: Example of connection to MP920 4-axes analog module SVA-01
		12.3.1	Addition: Example of connection to MP2200/MP2300 2-axes Motion Module SVA-01
		12.3.2	Deletion: Example of connection to CP-9200SH Servo Controller Module SVA
		12.3.3	Deletion: Example of connection to MEMOCON GL120/130 Series Motion Module MC20
		12.3.4	Deletion: Example of connection to MEMOCON GL60/70 Series Positioning Module B2813
		Back cover	Revision: Address

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