




Sigma II Series Servo System User's Manual

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
<ul style="list-style-type: none">• WARNING: Indicates precautions that, if not heeded, could possibly result in loss of life or serious injury.

 CAUTION
<ul style="list-style-type: none">• CAUTION: Indicates precautions that, if not heeded, could result in relatively serious or minor injury, damage to the product, or faulty operation.•

 PROHIBITED
<ul style="list-style-type: none">• PROHIBITED: Indicates actions that must never be taken.

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Overview

■ Manual Outline

This manual provides the following information for the Sigma II Series SGM□H/SGDH servodrives.

- Procedures for installing and wiring the servomotor and servo amplifier.
- Procedures for trial operation of the servodrive.
- Procedures for using functions and adjusting the servodrives.
- Procedures for using the built-in panel operator and the hand-held digital operator.
- Ratings and specifications for standard models.
- Procedures for maintenance and inspection.

■ Related Manuals

Refer to the following manuals as required.

Read this manual carefully to ensure the proper use of Sigma II Series servodrives. Also, keep this manual in a safe place so that it can be referred to whenever necessary.

Manual Name	Manual Number	Contents
Sigma II Series Servo System Catalog Supplement Servo Selection and Data Sheets	G-MIAZ#99001	Describes the procedure used to select Sigma II Series servodrives and capacities.
Sigma Win Software Operation Manual	SIA-S800-1.0	Describes the applications and operation of software for the Sigma servodrive monitoring devices for use on personal computers.
Sigma II Series SGM□H/SGDH Digital Operator Operation Manual	TOE-S800-34	Provides detailed information on the operation of the JUSP-OP02A-1 digital operator, which is an optional product.

Using This Manual

■ Intended Audience

This manual is intended for the following users.

- Those designing Sigma II Series servodrive systems.
- Those installing or wiring Sigma II Series servodrives.
- Those performing trial operation or adjustments of Sigma II Series servodrives.
- Those maintaining or inspecting Sigma II Series servodrives.

■ Description of Technical Terms

In this manual, the following terms are defined as follows:

- **Servomotor** = Sigma II Series SGMAH/SGMPH/SGMGH/SGMSH servomotor.
- **Servo Amplifier** = Sigma II Series SGDH servo 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.

■ 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 equations:

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

Safety Precautions

The following precautions are for checking products upon delivery, installation, wiring, operation, maintenance and inspections.

■ Checking Products upon Delivery



CAUTION

- **Always use the servomotor and servo amplifier in one of the specified combinations.**
Not doing so may cause fire or malfunction.

■ Installation



CAUTION

- **Never use the products in an environment subject to water, corrosive gases, inflammable gases, or combustibles.**
Doing so may result in electric shock or fire.

■ Wiring



WARNING

- **Connect the ground terminal to a class 3 ground (100Ω or less).**
Improper grounding may result in electric shock or fire.
- **Required for 7.5kW amplifiers: use of Yaskawa kit Number XXX for wiring the power input and output terminals, or equivalent UL listed closed-loop ring terminals designed to accept 4 AWG wires.**



CAUTION

- **Do not connect a three-phase power supply to the U, V, or W output terminals.**
Doing so may result in injury or fire.
- **Securely fasten the power supply terminal screws and motor output terminal screws.**
Not doing so may result in fire.

■ Operation



CAUTION

- **Never touch any rotating motor parts while the motor is running.**
Doing so may result in injury



CAUTION

- **Conduct trial operation on the servomotor alone with the motor shaft disconnected from machine to avoid any unexpected accidents.**
Not doing so 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.
- **Before starting operation with a machine connected, make sure that an emergency stop can be applied at any time.**
Not doing so may result in injury.
- **Do not touch the heat sinks during operation.**
Not doing so may result in burns due to high temperatures.

■ Maintenance and Inspection



WARNING

- **Do not remove the panel cover while the power is ON.**
Doing so carries a risk of electric shock.
- **Do not touch terminals for five minutes after the power has been turned OFF.**
Residual voltage may cause electric shock.
- **Never touch the inside of the servo amplifier.**
Doing so may result in electric shock.



CAUTION

- **Do not disassemble the servomotor.**
Doing so may result in electric shock or injury
- **Do not attempt to change wiring while the power is ON.**
Doing so may result in electric shock or injury

■ 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. The edition number appears on the front and back covers.
- If the manual must be ordered due to loss or damage, inform your nearest Yaskawa representative or one of the offices listed on the back of this manual.
- Yaskawa will not take responsibility for the results of unauthorized modifications of this product. Yaskawa shall not be liable for any damages or troubles resulting from unauthorized modification.

1 Checking Product and Part Names

This chapter describes the procedure for checking products upon delivery as well as names for product parts.

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1.1 Checking the Sigma II Series Products on Delivery

The following procedure is suggested to check Sigma II series products upon delivery.

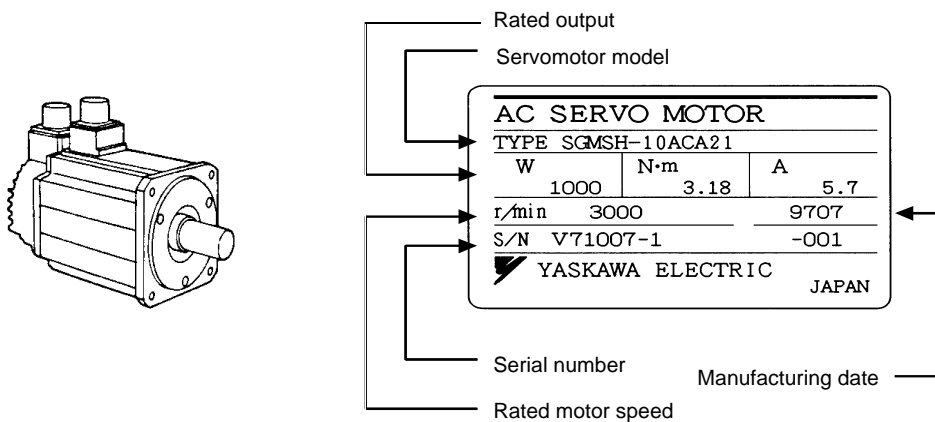
Use the following checklist when Sigma II series products are delivered.

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

If any of the above are faulty or incorrect, contact Yaskawa or an authorized distributor.

1.1.1 Servomotors

■ External Appearance and Nameplate Example



■ Model Numbers

Standard Servomotors

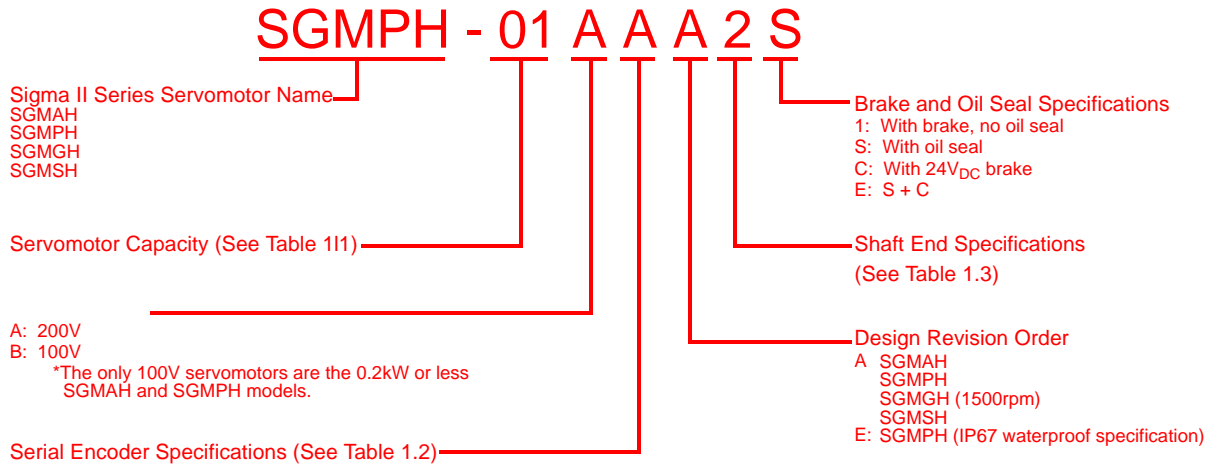


Table 1.1: Servomotor Capacity (kW)

Symbol	SGMAH	SGMPH	SGMGH	SGMSH	Symbol	SGMAH	SGMPH	SGMGH	SGMSH
	3000rpm	3000rpm	1500rpm	3000rpm		3000rpm	3000rpm	1500rpm	3000rpm
A3	0.03	—	—	—	08	0.75	0.75	—	—
A5	0.05	—	—	—	09	—	—	0.85	—
01	0.1	0.1	—	—	10	—	—	—	1.0
02	0.2	0.2	—	—	12	—	—	—	—
03	—	—	—	—	13	—	—	1.3	—
04	0.4	0.4	—	—	15	—	1.5	—	1.5
05	—	—	0.45	—	20	—	—	1.8	2.0
06	—	—	—	—	30	—	—	2.9	3.0

Table 1.2: Serial Encoders

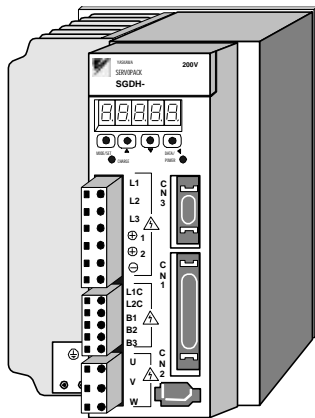
Code	Specification	SGMAH	SGMPH	SGMGH	SGMSH
1	16-bit absolute encoder	Standard	Standard	—	—
2	17-bit absolute encoder	—	—	Standard	Standard
A	13-bit incremental encoder	Standard	Standard	—	—
B	16-bit incremental encoder	Optional	Optional	—	—
C	17-bit incremental encoder	—	—	Standard	Standard

Table 1.3: Axis End Specifications (Straight)

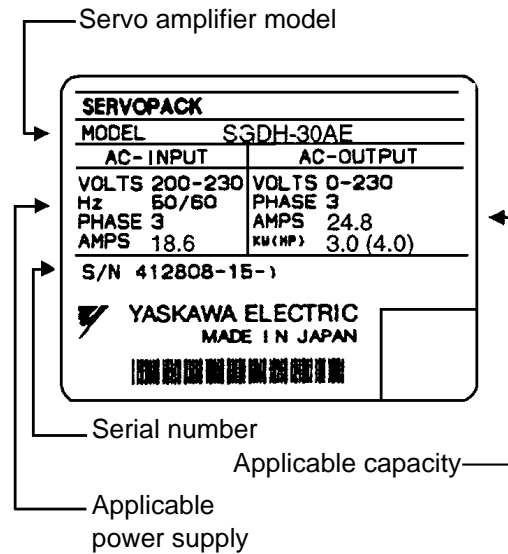
Code	Specification	SGMAH	SGMPH	SGMGH	SGMSH
2	Straight without key	Optional	Optional	Standard	Standard
4	Straight with key	Standard	Standard	—	—
6	Straight with key and tap	Optional	Optional	Optional	Optional
8	Straight with tap	Optional	Optional	—	—

1.1.2 Servo Amplifiers

External Appearance and Nameplate Examples



Sigma II series SGDH servo amplifier



Model Numbers

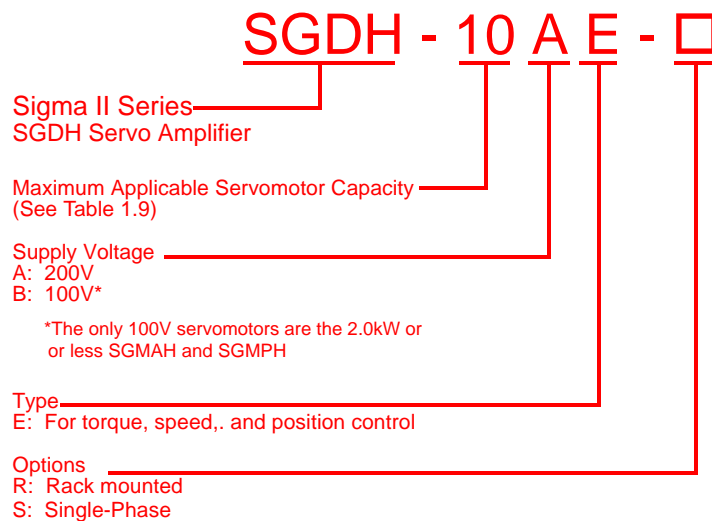


Table 1.4: Maximum Applicable Servomotor Capacity

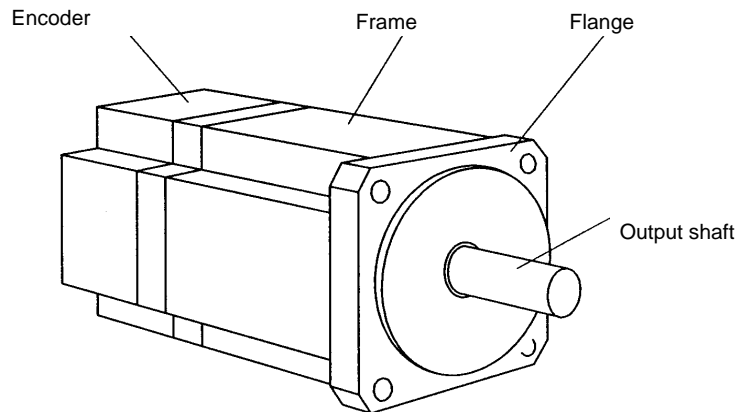
Maximum Applicable Servomotor Capacity			
Symbol	Capacity (kW)	Symbol	Capacity (kW)
A3	0.03	08	0.75
A5	0.05	10	1.0
01	0.10	15	1.5
02	0.20	20	2.0
04	0.40	30	3.0
05	0.50	—	—

1.2 Product Part Names

This section describes product part names.

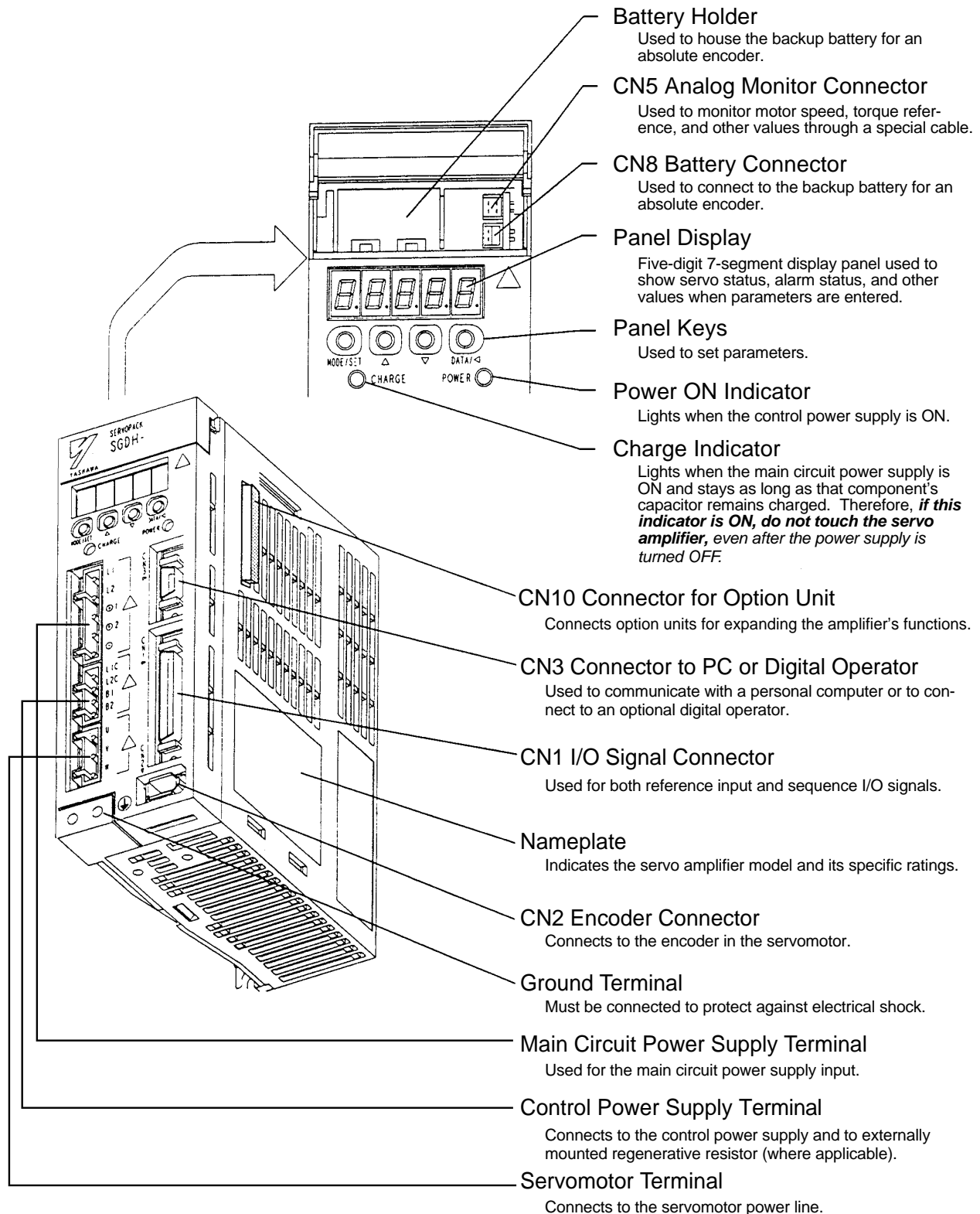
1.2.1 Servomotors

The figure below shows part names for servomotors with or without brakes.



1.2.2 Servo Amplifiers

The figure below shows the part names for servo amplifiers.



2 Installation


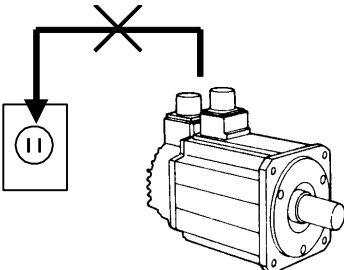
This chapter describes precautions for Sigma II Series servomotor and servo amplifier installation.

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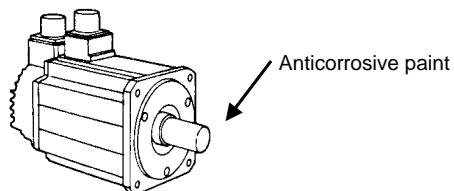
2.1 Servomotors

SGM□H servomotors can be installed either horizontally or vertically.

The service life of the servomotor can be shortened or unexpected problems might occur if it is installed incorrectly or in an inappropriate location. Follow these installation instructions carefully.

 CAUTION	
<ul style="list-style-type: none"> • Do not connect the servomotor directly to a commercial power line. This will damage the servomotor. <p>The servomotor cannot operate without the proper servo amplifier.</p>	

Note: Prior to Installation: The end of the motor shaft is coated with anticorrosive paint. Before installing, carefully remove all of the paint using a cloth moistened with paint thinner. Avoid getting thinner on other parts of the Servomotor.



2.1.1 Storage Temperature

Store the servomotor within the following temperature range if it is stored with the power cable disconnected.

-20 to 60°C

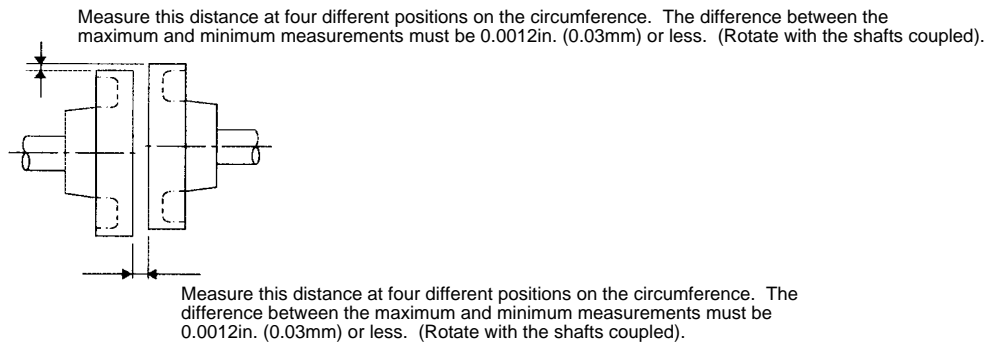
2.1.2 Installation Site

SGM□H Servomotors are designed for indoor use. Install the servomotor in environments that satisfy the following conditions.

- Free of corrosive or explosive gases.
- Well-ventilated and free of dust and moisture.
- Ambient temperature of 0 to 40°C.
- Relative humidity (r.h.) of 20 to 80% with no condensation.
- Accessible for inspection and cleaning.

2.1.3 Alignment

Align the shaft of the servomotor with the shaft of the equipment, and then couple the shafts. Install the servomotor so that alignment accuracy falls within the following range.



Note:

- Vibration that will damage the bearings will occur if the shafts are not properly aligned.
- Prevent direct impact to the shafts when installing the coupling. The encoder mounted on the opposite end of the shaft may be damaged.

2.1.4 Orientation

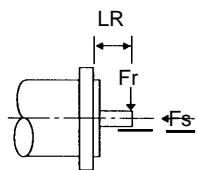
SGM□H servomotors can be installed either horizontally or vertically.

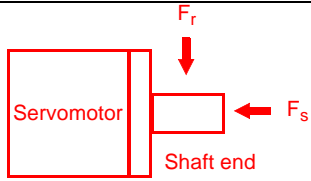
2.1.5 Allowable Shaft Loads

Design the mechanical system so thrust and radial loads applied to the servomotor shaft end during operation falls within the ranges shown in *Table 2.1*.

Allowable radial load in the table is the maximum load allowed on the end of the output shaft.

Table 2.1: Allowable Radial and Thrust Loads for the Servomotor

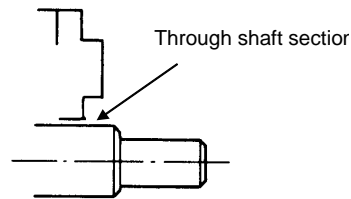
Servomotor	MODEL	Allowable Radial Load F_r Lb _f (N)	Allowable Thrust Load F_s Lb _f (N)	LR in (mm)	Reference Diagram
SGMAH	A3	15.29 (68)	12.14 (54)	0.79 (20)	
	A5	15.29 (68)	12.14 (54)		
	01	17.54 (78)	12.14 (54)		
	02	55.1 (245)	16.63 (74)	0.98 (25)	
	04	55.1 (245)	16.63 (74)		
	08	88.1 (392)	33.0 (147)	1.39 (35)	
SGMPH	01	17.54 (78)	11.02 (49)	0.79 (20)	
	02	55.1 (245)	15.29 (68)	0.98 (25)	
	04	55.1 (245)	15.29 (68)		
	08	392 (88.1)	33.0 (147)	1.39 (35)	
	15	110 (490)	33.0 (147)		
SGMGH	05A□A	110 (490)	22.0 (98)	2.28 (58)	
	09A□A	110 (490)	22.0 (98)		
	13A□A	154 (686)	77.1 (343)		
	20A□A	264.3 (1176)	110 (490)	3.11 (79)	
	30A□A	330.4 (1470)	110 (490)		
SGMSH	10A	154 (686)	44.1 (196)	1.77 (45)	
	15A	154 (686)	44.1 (196)		
	20A	154 (686)	44.1 (196)		
	30A	220 (980)	(88.1 (392))	2.48 (63)	

<p>Note: Thrust and radial loads:</p> <p> Thrust load (F_s): Shaft-end load applied parallel to the centerline of the shaft.</p> <p> Radial load (F_r): Shaft-end load applied perpendicular to the centerline of the shaft.</p>	
---	--

2.1.6 Handling Oil and Water

Install a protective cover over the servomotor if it is used in a location that is subject to water or oil mist. Also use a servomotor with an oil seal when needed to seal the through-shaft section.

Install the servomotor with the connector facing down.



Note: Through sections of the shaft: This refers to the gap where the shaft protrudes from the end of the motor

2.1.7 Cable Stress

Make sure there are no bends or tension on the power lines.

Be especially careful to wire signal line cables so that they are not subject to stress because the core wires are very thin, at only 0.0079 to 0.012in. (0.2 to 0.3mm).

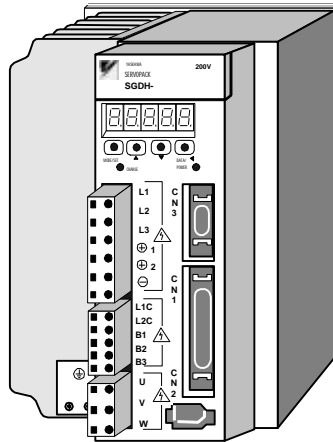
2.2 Servo Amplifiers

The SGDH servo amplifiers are base-mounted servoamps. Incorrect installation will cause problems. Follow the installation instructions below.

2.2.1 Storage Conditions

Store the servo amplifier within the following temperature range, as long as it is stored with the power cable disconnected.

-20 to 85°C



Sigma II series servo amplifier

2.2.2 Installation Site

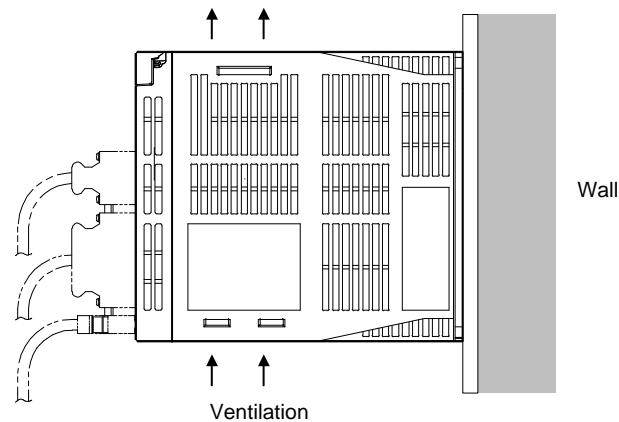
The following precautions apply to the installation site.

Situation	Installation Precaution
Installation in a Control Panel	Design the control panel size, unit layout, and cooling method so the temperature around the servo amplifier does not exceed 55°C.
Installation Near a Heating Unit	Minimize heat radiated from the heating unit as well as any temperature rise caused by natural convection so the temperature around the servo amplifier does not exceed 55°C.
Installation Near a Source of Vibration	Install a vibration isolator beneath the servo amplifier to avoid subjecting it to vibration.
Installation at a Site Exposed to Corrosive Gas	Corrosive gas does not have an immediate effect on the servo amplifier, but will eventually cause electronic components and contactor-related devices to malfunction. Take appropriate action to avoid corrosive gas.
Other Situations	Do not install the servo amplifier in hot and humid locations or locations subject to excessive dust or iron powder in the air.

2.2.3 Orientation

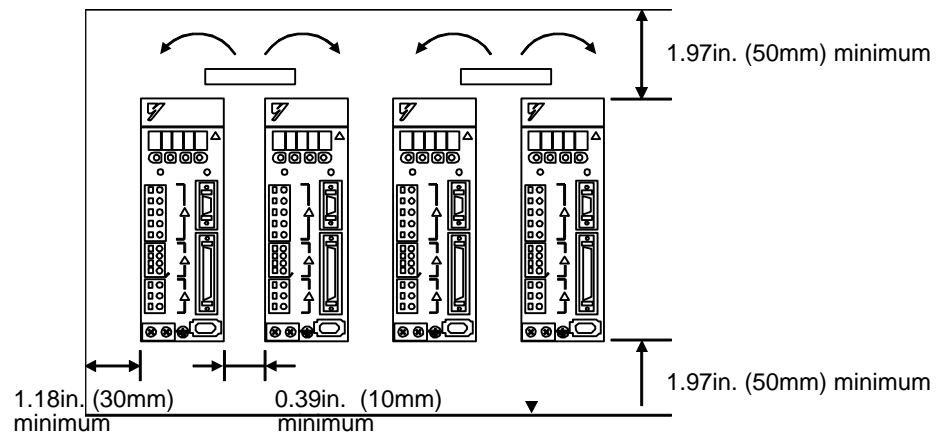
Install the servo amplifier perpendicular to the wall as shown in the figure. The servo amplifier must be oriented this way because it is designed to be cooled by natural convection or cooling fan.

Secure the servo amplifier using the mounting holes. The number of holes varies (from two to four) with the frame size of the servo amplifier.



2.2.4 Installation

Follow the procedure below to install multiple servo amplifiers side by side in a control panel.



Servo Amplifier Orientation

Install the servo amplifier perpendicular to the wall so the front panel containing connectors faces outward.

Cooling

As shown in the figure above, allow sufficient space around each servo amplifier for cooling by cooling fans or natural convection.

Side-by-side Installation

When installing servo amplifiers side by side as shown in the figure above, allow at least 0.39in. (10mm) between and at least 1.97in. (50mm) above and below each servo amplifier. Install cooling fans above the servo amplifiers to avoid excessive temperature rise and to maintain even temperature inside the control panel.

Environmental Conditions in the Control Panel

- Ambient Temperature: 0 to 55°C
- Humidity: 90% r.h., or less
- Vibration: 0.5 G (4.9 m/s²)
- Condensation and Freezing: None
- Ambient Temperature for Long-term Reliability: 45°C maximum

3 Wiring

This chapter describes the procedure used to connect Sigma II Series products to peripheral devices and gives typical examples of main circuit wiring as well as I/O signal connections.

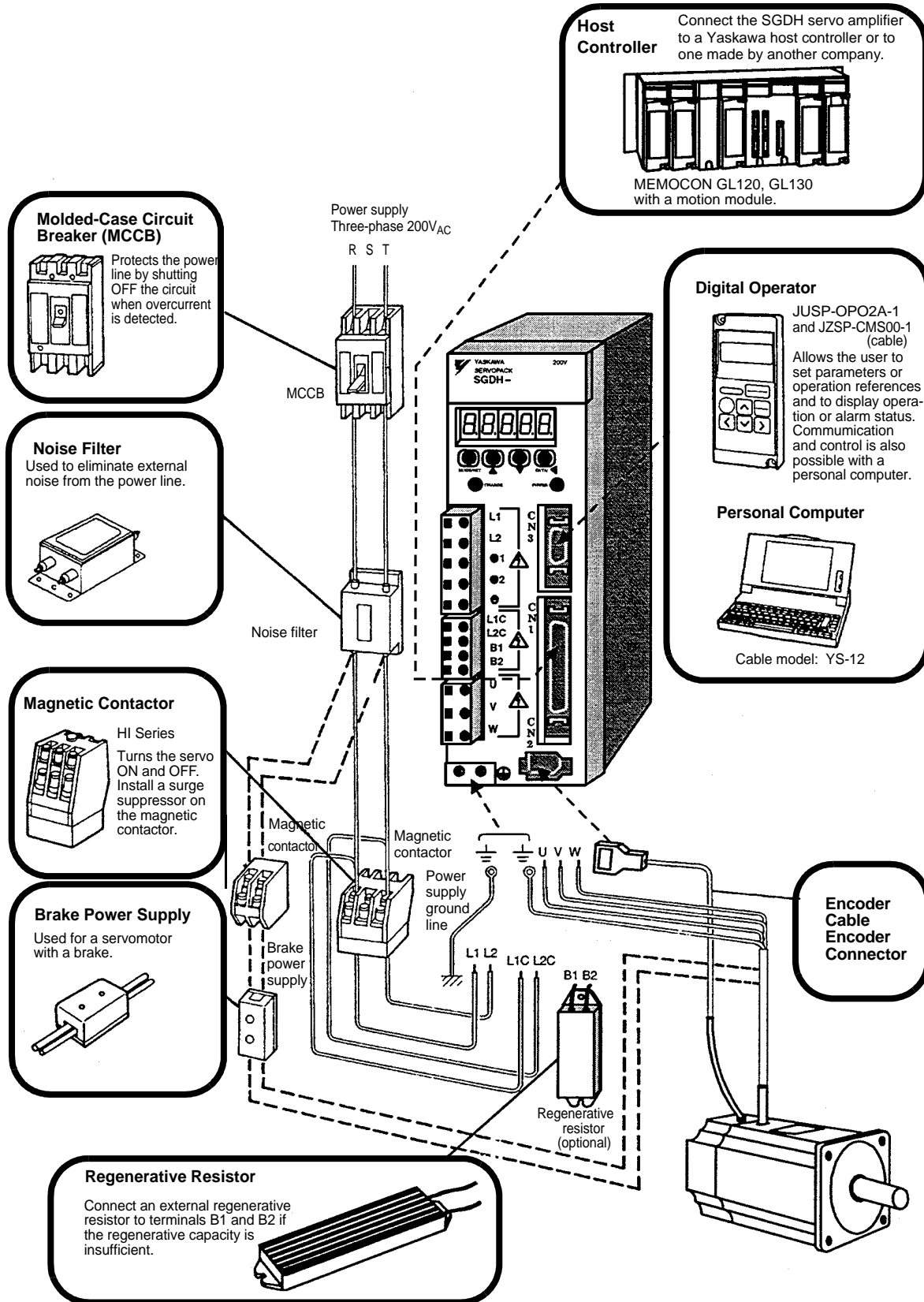
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3.1 Connecting to Peripheral Devices

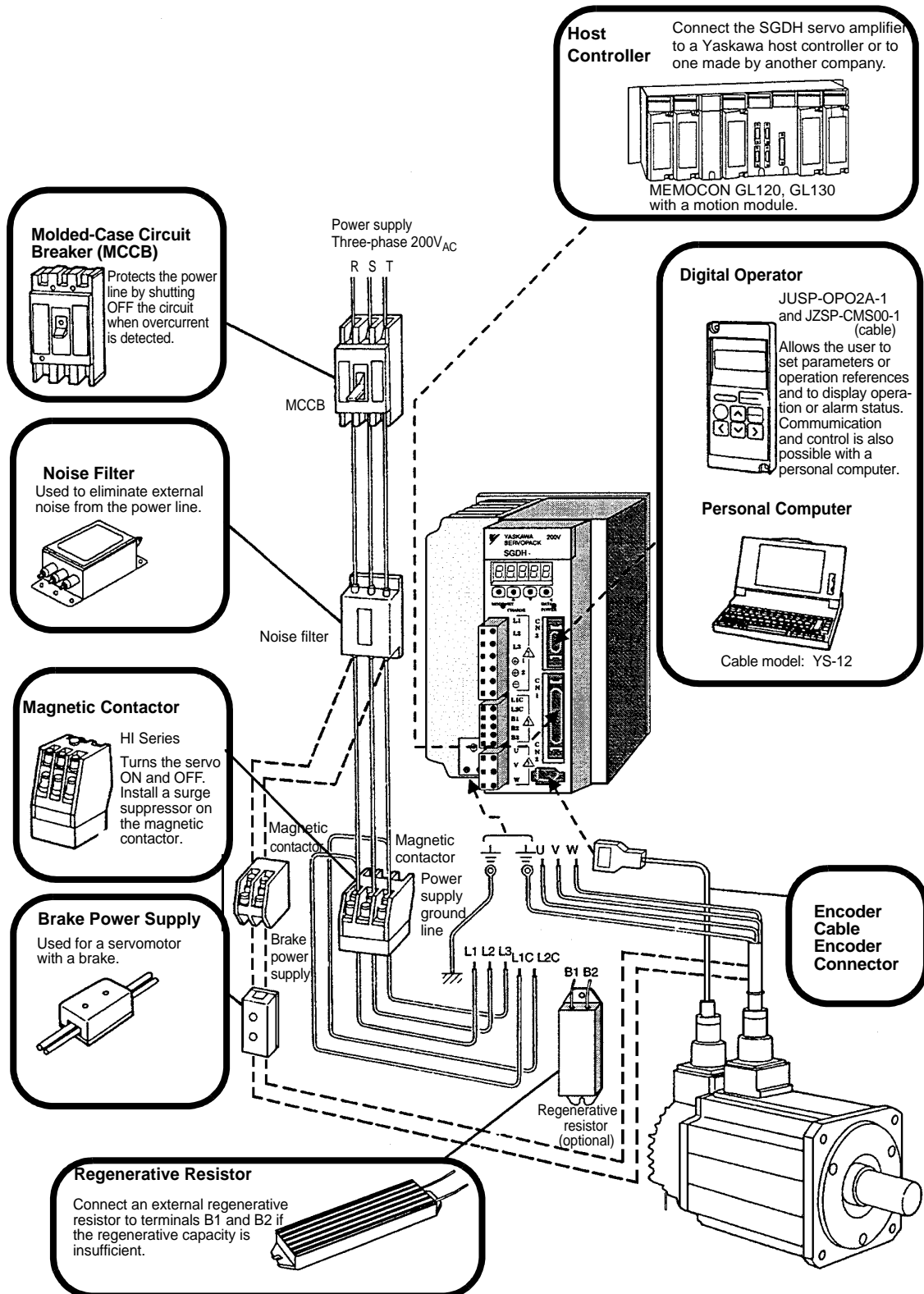
This section provides examples of standard Sigma II Series product connections to peripheral devices.

It also briefly explains how to connect each peripheral device.

3.1.1 Single-Phase (100V or 200V) Main Circuit Specifications



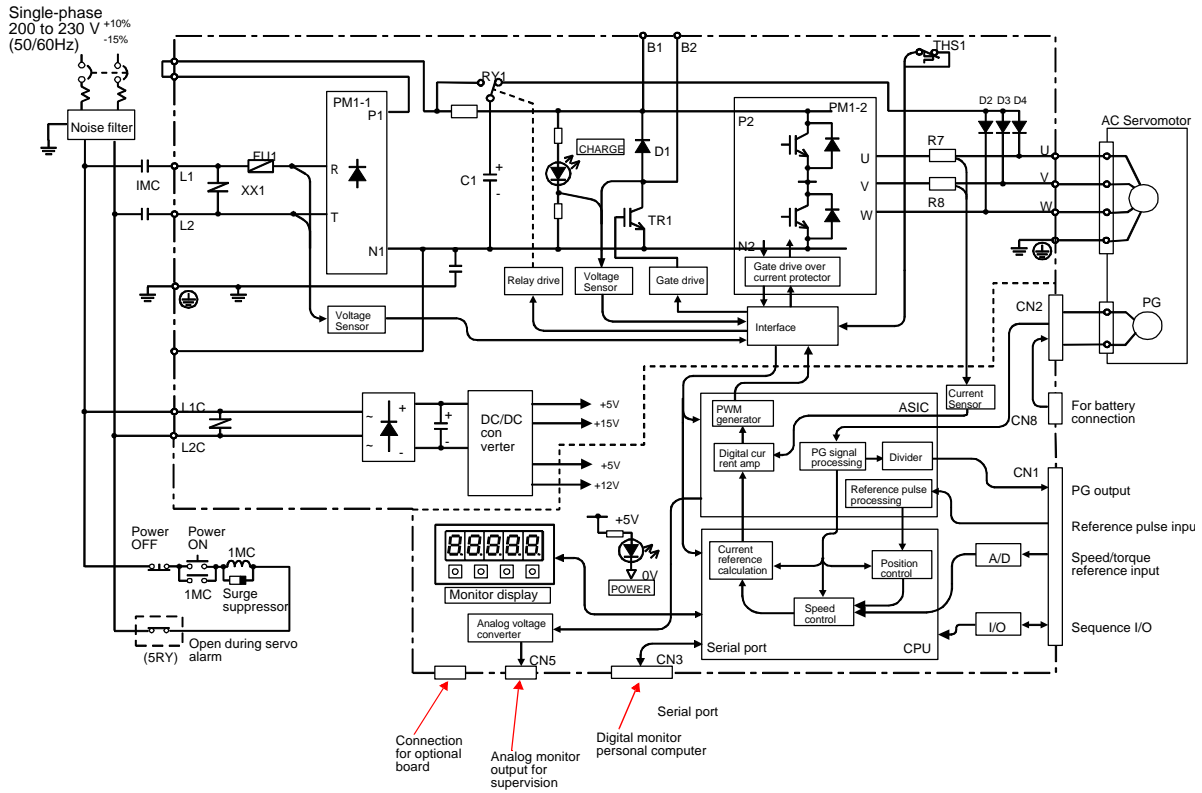
3.1.2 Three-Phase (200V) Main Circuit Specifications



3.2 Servo Amplifier Internal Block Diagrams

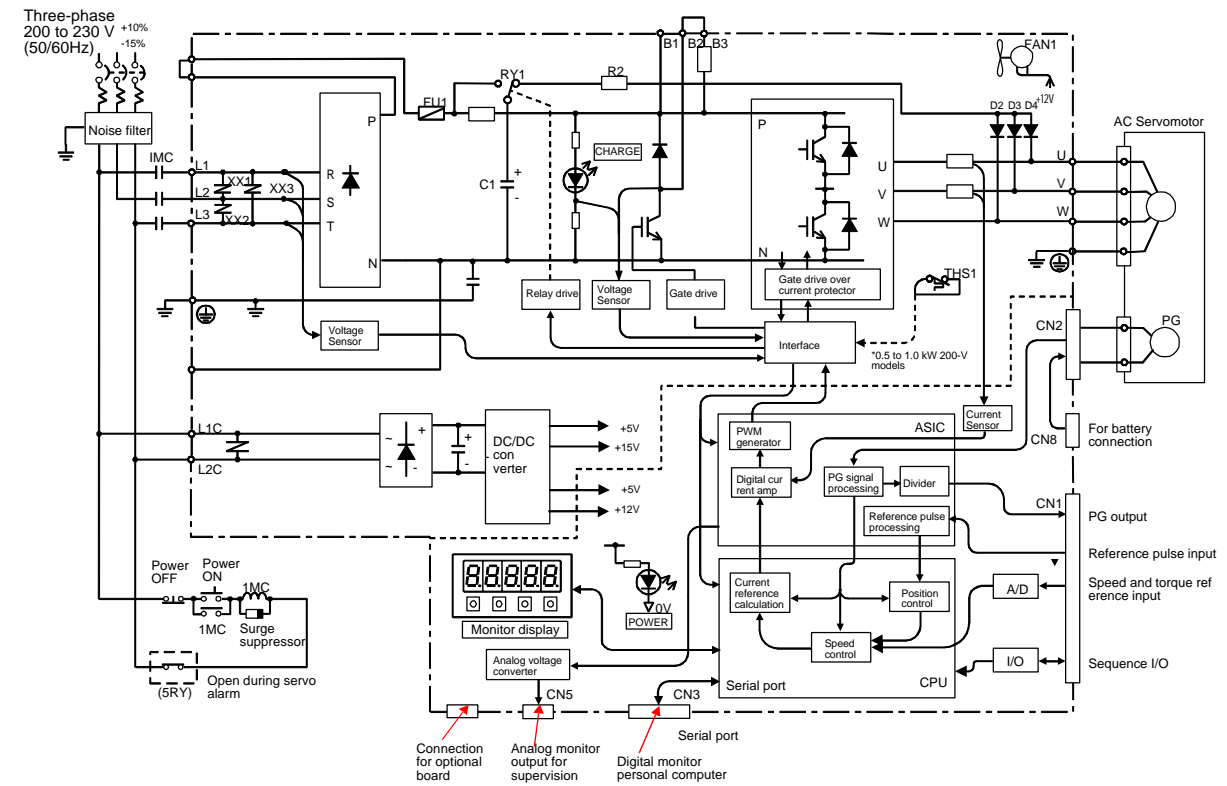
The following sections show internal block diagrams of the Servo Amplifiers.

3.2.1 30 to 400W (200V) and 30 to 200W (100V) Models

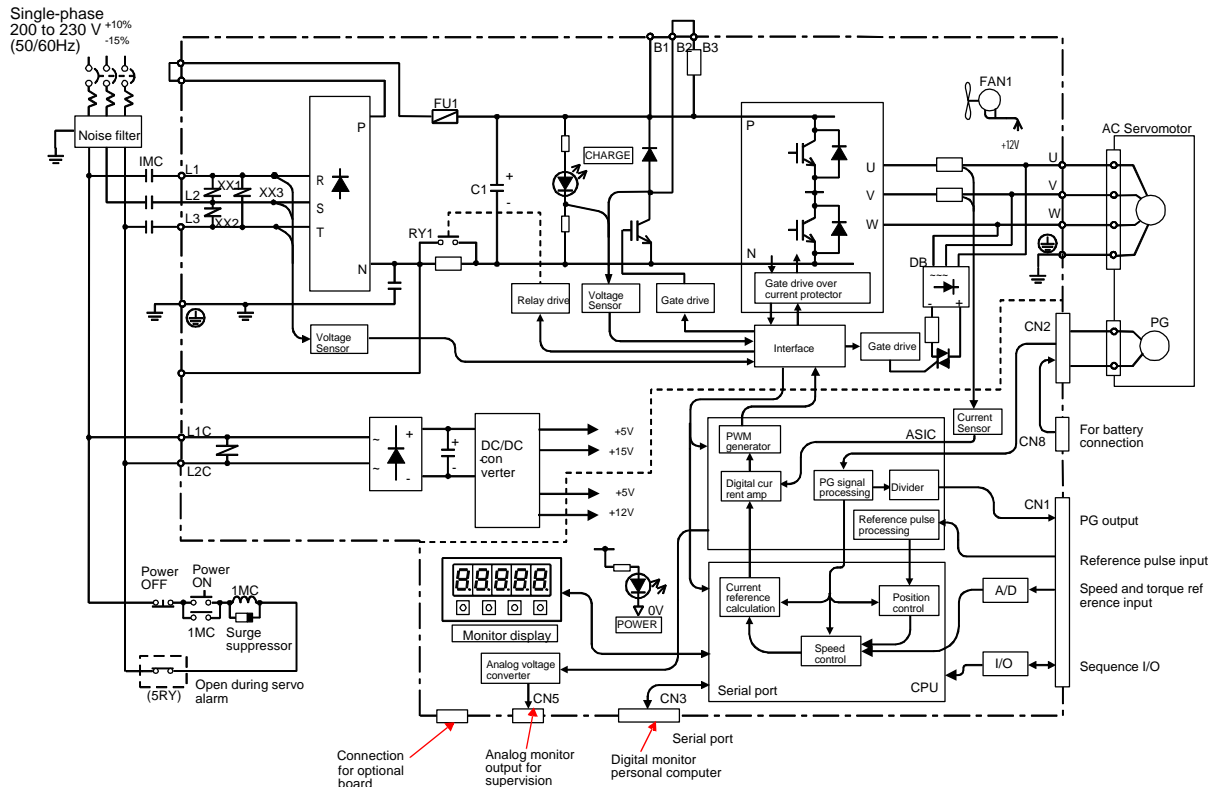


Note: The power supply voltage is 100 to 115V (+10% -15%) 50/60Hz) for the 30 to 200W 100V models.

3.2.2 0.5kW to 1.5kW (200V) Models



3.2.3 2.0 kW and 3.0kW (200V) Models



3.3 Main Circuit Wiring

This section shows typical examples of main circuit wiring for Sigma II Series servo products, functions of main circuit terminals, and the power ON sequence.

Observe the following precautions when wiring.






CAUTION

- **Do not bundle or run power and signal lines together in the same duct. Keep power and signal lines separated by at least 11.81in (30cm)**
Not doing so may cause fire or malfunction.
- **Use twisted-pair wires or multi-core shielded-pair wires for signal and encoder (PG) feedback lines.out of control or malfunction.**
The maximum length is 118.1in. (3m) for reference input lines and is (787.40in. (20m) out of control or malfunction.
- **Do not touch the power terminals for 5 minutes after turning power OFF because high voltage may still remain in the servo amplifier.**
still remain in the servo amplifier.
- **Avoid frequently turning power ON and OFF. Do not turn power ON or OFF more than once per minute.**
Since the servo amplifier has a capacitor in the power supply, a high charging current flows for 0.2 seconds when power is turned ON. Frequently turning power ON and OFF causes main power devices like capacitors and fuses to deteriorate, resulting in unexpected problems.
- **Suitable for use on a circuit capable of delivering not more than 5000A_{RMS} (symmetrical), 240V maximum.**
Must be used with UL listed fuses or circuit breakers, in accordance with the National Electrical Code.

3.3.1 Names and Descriptions of Main Circuit Terminals

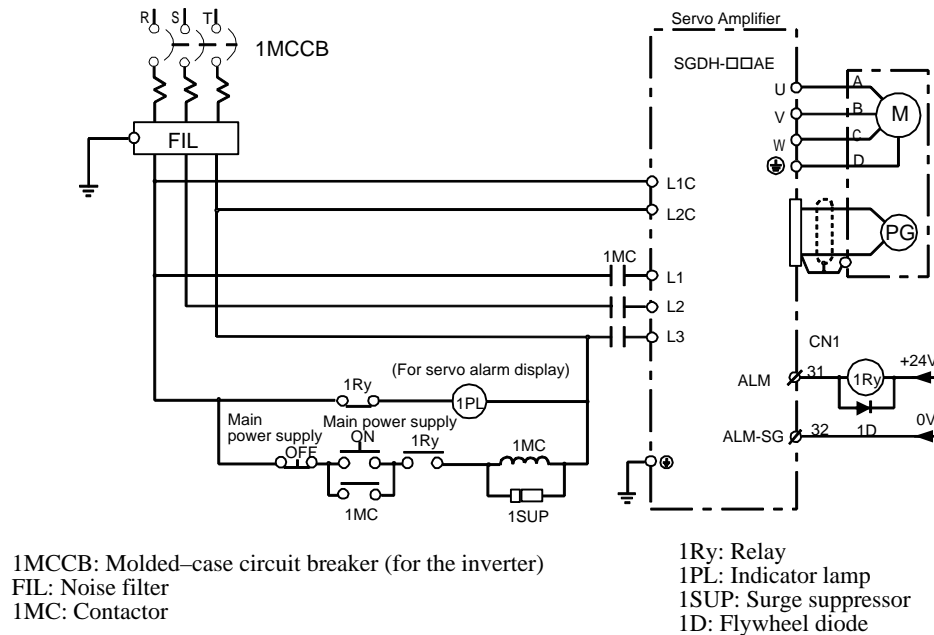
The following table gives the names and a description of main circuit terminals.

Main Circuit Names and Description

Terminal Symbol	Name	Description	
L1, L2 or L1, L2, L3	Main circuit AC input terminal	30 to 200W	Single-phase 100 to 115V ^{+10%} , ^{-15%} (50/60Hz)
		30 to 400W	Single-phase 200 to 230V ^{+10%} , ^{-15%} (50/60Hz)
		0.5 to 3.0kW	Three-phase 200 to 230V ^{+10%} , ^{-15%} (50/60Hz)
U, V, W	Servomotor connection terminal	Connects to the Servomotor.	
L1C, L2C	Control power input terminal	30 to 200W	Single-phase 100 to 115V ^{+10%} , ^{-15%} (50/60Hz)
		30 to 3.0kW	Single-phase 200 to 230V ^{+10%} , ^{-15%} (50/60Hz)
	Ground terminal	Connects to the power supply ground terminals and motor ground terminal.	
B1, B2 or B1, B2, B3	External regenerative resistor terminal	30 to 400W	Normally not connected. Connect an external regenerative resistor (provided by customer) between B1 and B2 if the regenerative capacity is insufficient. Note: No B3 terminal.
		0.5 to 3.0kW	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.
⊕1, ⊕2	DC reactor terminal connection for power supply harmonic wave countermeasure	Normally short ⊕1 and ⊕2. If a countermeasure against power supply harmonic waves is needed, connect a DC reactor between ⊕1 and ⊕2.	
	Main circuit Negative terminal	Normally not connected.	
	Main circuit Positive terminal	Normally not connected.	

3.3.2 Typical Main Circuit Wiring Example

The following figure shows a typical example of main circuit wiring.

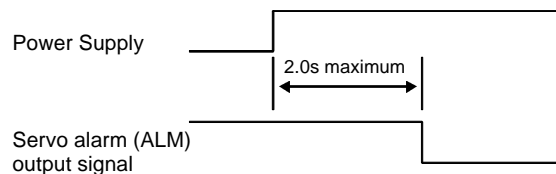


■ Designing a Power ON Sequence

Note the following points when designing the power ON sequence.

Design the power ON sequence so that power is turned OFF when a servo alarm signal is output. (See the circuit figure above.)

- Hold the power ON button for at least two seconds. The servo amplifier will output a servo alarm signal for two seconds or less when power is turned ON. This is required in order to initialize the servo amplifier.



3.3.3 Cable Specifications and Peripheral Devices

Refer to the *Sigma II Series Servo System Catalog Supplement* (No. G-MI#99001).

3.3.4 Servo Amplifier Power Losses

The following table shows servo amplifier power losses at the rated output.

Servo Amplifier Power Losses at Rated Output

Main Circuit Power Supply	Maximum Applicable Servomot or Capacity [kW]	Servo Amplifier Model	Output Current (Effective Value) [A]	Main Circuit Power Loss [W]	Regenerative Resistor Power Loss [W]	Control Circuit Power Loss [W]	Total Power Loss [W]
Single-phase 100V	0.03	SGDH-A3BE	0.66	3.5	-	13	16.5
	0.05	SGDH-A5BE	0.95	5.2	-	13	18.2
	0.10	SGDH-01BE	2.4	12	-	13	25
	0.20	SGDH-02BE	3.0	16.4	-	13	29.4
Single-phase 200V	0.03	SGDH-A3AE	0.44	3.1	-	13	16.1
	0.05	SGDH-A5AE	0.64	4.6	-	13	17.6
	0.10	SGDH-01AE	0.91	6.7	-	13	19.7
	0.20	SGDH-02AE	2.1	13.3	-	13	26.3
	0.40	SGDH-04AE	2.8	20	-	13	33
	0.75	SGDH-08AE-S	4.4	47	12	15	74
Three-phase 200V	1.50	SGDH-15AE-S	7.5	60	14	15	89
	0.50	SGDH-05AE	3.8	27	12	15	54
	0.75	SGDH-08AE	5.7	41	12	15	68
	1.0	SGDH-10AE	7.6	55	12	15	82
	1.5	SGDH-15AE	11.6	123	14	15	152
	2.0	SGDH-20AE	18.5	120	28	15	163
	3.0	SGDH-30AE	24.8	155	28	15	198


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

- Disconnect the internal regenerative resistor in the servo amplifier by removing the wire between terminals B2 and B3.
- Install an external regenerative resistor between terminals B1 and B2.

External regenerative resistors are optional. See 5.6 *Selecting a Regenerative Resistor* for more details on the resistors.

3.3.5 Wiring Main Circuit Terminal Blocks

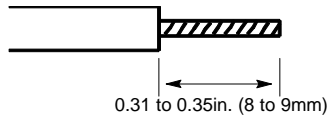
Observe the following precautions when wiring main circuit terminal blocks.

 <h2 style="margin: 0;">CAUTION</h2>
<ul style="list-style-type: none"> • Remove the terminal block from the servo amplifier 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. • Reconnect any wires that were accidentally pulled out.

Servo amplifiers with a capacity below 1.5kW will have connector-type terminal blocks for main circuit terminals. Follow the procedure below when connecting to the terminal block.

■ Connection Procedure

- Strip the end of the wire, leaving the ends twisted together.



- Open the wire insert opening of the terminal block (plug) with a tool using either of the two procedures shown in Fig. A and Fig. B on the following page.

1. **Fig. A:** Use the provided lever to open the wire insert opening .

Fig. B: Using a commercially available 1/8in. (3.0 to 3.5mm) slotted screwdriver, press down firmly on the screwdriver insert opening to release the wire insert slot.

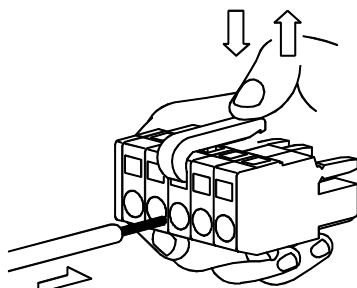


Fig. A

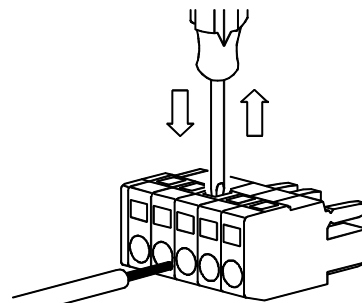


Fig. B

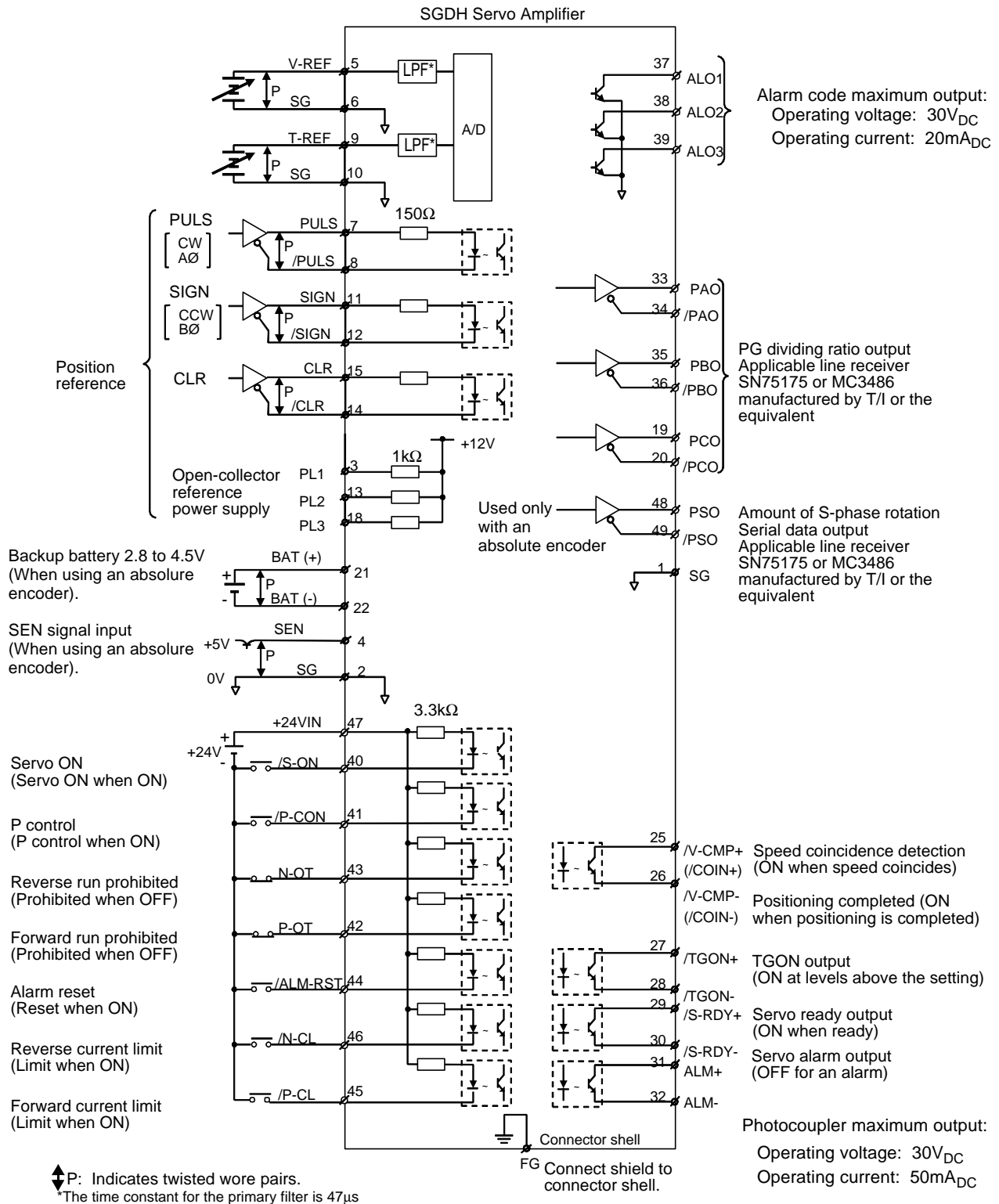
2. **Figs A and B:** Insert the wire end into the opening and then clamp it tightly by releasing either the lever or the screwdriver.

3.4 I/O Signals

This section describes I/O signals for the SGDH servo amplifier

3.4.1 Examples of I/O Signal Connections

The following shows a typical example of I/O signal connections.



3.4.2 List of CN1 Terminals

The following diagram shows the layout and specifications of CN1 terminals.

CN1 Terminal Layout

2	SG	GND	1	SG	GND	27	/TGON+	TGON signal output	26	/V-CMP- (/COIN-)	Speed coincidence detection output
4	SEN	SEN signal input	3	PL1	Open-collector reference power supply	29	/S-RDY+	Servo ready output	28	/TGON	TGON signal output
6	SG	GND	5	V-REF	Reference speed input	31	ALM+	Servo alarm output	30	/S-RDY	Servo ready output
8	/PULS	Reference pulse input	7	PULS	Reference pulse input	33	PAO	PG divided output A-phase	32	ALM	Servo alarm output
10	SG	GND	9	T-REF	Torque reference input	35	PBO	PG divided output B-phase	34	/PAO	PG divided output A-phase
12	/SIGN	Reference symbol input	11	SIGN	Reference sign input	37	AL01	Alarm code output	36	/PBO	PG divided output B-phase
14	/CLR	Clear input	13	PL2	Open-collector reference power supply	39	AL03	Open-collector output	38	AL02	Alarm code output
16	—	—	15	CLR	Clear input	41	P-CON	P operation input	40	/S-ON	Servo ON input
18	PL3	Open-collector reference power supply	17	—	—	43	N-OT	Reverse overtravel input	42	P-OT	Forward overtravel input
20	/PCO	PG divided output C-phase	19	PCO	PG divided output C-phase	45	/P-CL	Forward current limit ON input	44	/ALM-RST	Alarm reset input
22	BAT (-)	Battery (-)	21	BAT (+)	Battery (+)	47	+24V -IN	External input power supply	46	/N-CL	Reverse current limit ON input
24	—	—	23	—	—	49	*PSO	S-phase signal output	48	PSO	S-phase signal output
			25	/V-CMP+ (/COIN+)	Speed coincidence detection output				50	—	—

- Note**
1. Do not use unused terminals for relays.
 2. Connect the shield of the I/O signal cable to the connector shell.
Connect to the FG (frame ground) at the Servo Amplifier-end connector.

■ CN1 Specifications

Specifications for Servo Amplifier Connectors	Applicable Receptacles		
	Solder Type	Case	Manufacturer
10250-52A2JL or Equivalent 50-p Right Angle Plug	10150-3000VE	10350-52A0-008	Sumitomo 3M Co.

3.4.3 I/O Signal Names and Functions

The following section describes Servo Amplifier I/O signal names and functions.

■ Input Signals

Signal Name	Pin No.	Function	Reference			
Common	/S-ON	40	Servo ON: Turns ON the servomotor when the gate block in the inverter is released.	5.5.2		
	/P-CON	41	* Function selected via parameter.		5.2.1 5.2.7	
			Proportional operation reference	Switches the speed control loop from PI (proportional/integral) to P (proportional) control when ON.	5.2.1	
			Direction reference	With internal reference speed selected: Switches the direction of rotation.	5.2.6	
			Control mode switching	Position ⇔ Speed Speed ⇔ Torque Torque ⇔ Speed	Enables control mode switching	5.2.7
			Zero-clamp reference	Speed control with zero-clamp function: Reference speed is zero when ON.		
			Reference pulse block	Position control with reference pulse stop: Stops reference pulse input when ON.	5.2.10	
	P-OT	42	Forward Run prohibited	Overtravel prohibited: Stops Servomotor when movable part travels beyond the allowable range of motion.	5.1.2	
	N-OT	43	Reverse Run prohibited			
	/P-CL /N-CL	45 46	* Function selected with a parameter.		—	
			Forward current limit ON	Current limit function used when ON.	5.1.3	
			Reverse current limit ON			
			Internal speed switching	With internal reference speed selected: Switches the internal speed settings.	5.2.6	
/ALM -RST	44	Alarm reset: Releases the servo alarm state.		5.5.1		
+24V _{IN}	47	Control power supply input for sequence signals: Users must provide the +24-V power supply.		5.2.4		
SEN	4 (2)	Initial data request signal when using an absolute encoder.		5.2.3		
BATT(+) BATT(-)	21 22	Connecting pin for the absolute encoder backup battery.		5.2.3		
Speed Reference	V-REF	5 (6)	Speed reference input: ±2 to ±10V/rated motor speed (Input gain can be modified with a parameter.)	5.2.1		
Torque Reference	T-REF	9 (10)	Torque reference input: ±1 to ±10V/rated motor speed (Input gain can be modified with a parameter.)	5.2.1		

Signal Name		Pin No.	Function	Reference	
Position Reference	PULS /PULS SIGN /SIGN	7 8 11 12	Corresponds to reference pulse input Line-driver Open-collector	Input mode • Code + pulse string • CCW/CW pulse • Two-phase pulse (90° phase differential)	5.2.1
	CLR /CLR	15 14	Error counter clear: Clears the error counter during position control.		5.2.1
	PL1 PL2 PL3	3 13 18	+12V pull-up power supply when PULS, SIGN and CLR reference signals are open-collector outputs (+12V power supply is built into the servo amplifier).		5.2.1

- Note**
1. The functions allocated to /S-ON, /P-CON, P-OT, N-OT, /ALM-RST, /P-CL, and /N-CL input signals can be changed with parameters. (See 5.3.3 *Input Circuit Signal Allocation*.)
 2. Pin numbers in parenthesis () indicate signal grounds.
 3. The voltage input range for speed and torque references is a maximum of ±12V.

■ Output Signals

Signal Name		Pin Number	Function	Reference	
Common	ALM+ ALM-	31 32	Servo alarm: Turns OFF when an error is detected.		5.5.1
	/TGON+ /TGON-	27 28	Detection during servomotor rotation: Detects whether the servomotor is rotating at a speed higher than the motor speed setting. Motor speed detection can be set via parameter.		5.5.5
	/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.		5.5.6
	PAO /PAO PBO /PBO PCO /PCO	33 (1) 34 35 36 19 20	A phase signal B phase signal C phase signal	Converted two-phase pulse (A and B phase) encoder output signal and origin pulse (C phase) signal: RS-422 or the equivalent.	5.2.3
	PSO /PSO	48 49	S phase signal	With an absolute encoder: Outputs serial data corresponding to the number of revolutions (RS-422 or equivalent).	
	ALO1 ALO2 ALO3	37 38 39 (1)	Alarm code output: Outputs 3-bit alarm codes. Open-collector: 30V and 20mA rating maximum.		5.5.1
	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.	
Position	/COIN+ /COIN-	25 26	Positioning completed (output in Position Control Mode): Turns ON when the number of error pulses reaches the value set. The setting is the number of error pulses set in reference units (input pulse units defined by the electronic gear).		5.5.3
Not used.		16 17 23 24 50	These terminals are not used. Do not connect relays to these terminals.		—

- Note**
1. Pin numbers in parenthesis () indicate signal grounds.
 2. The functions allocated to /TGON, /S-RDY, and /V-CMP (/COIN) can be changed via parameters. Functions /CLT, /VCT, /BK, /WARN, and /NEAR signals can also be changed. (See 5.3.4 *Output Circuit Signal Allocation*.)

3.4.4 Interface Circuits

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

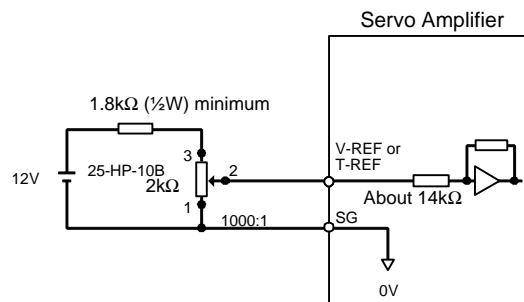
■ Interface for Reference Input Circuits

Analog Input Circuit

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

- Speed reference input: About 14kΩ
- Torque reference input: About 14kΩ

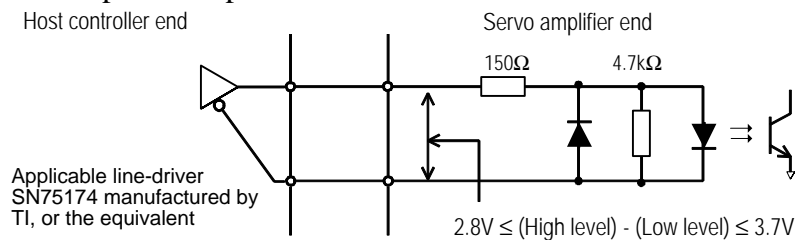
The maximum allowable voltage for input signals is ±12V.



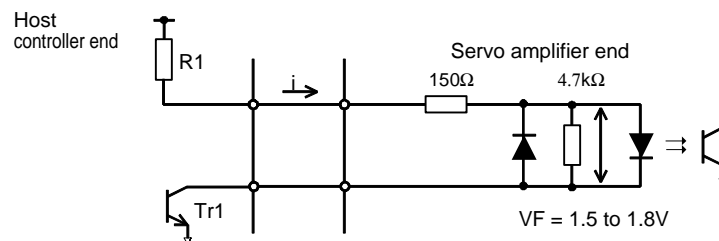
Reference Position Input Circuit

An output circuit for the reference pulse and error counter clear signal at the host controller can be either line-driver or open-collector outputs. These are shown below by type.

Line-driver Output Example:



- Open-collector Output, Example 1: External power supply

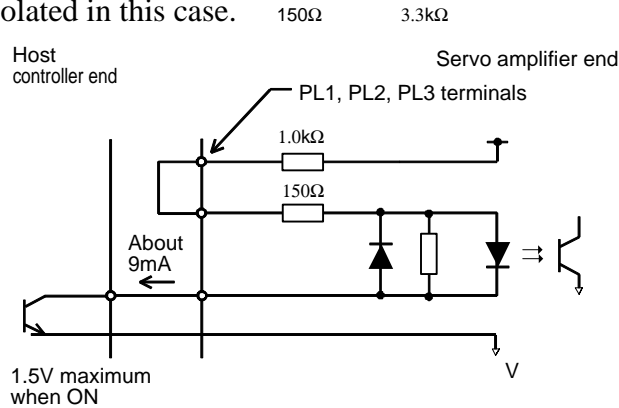


The following examples show how to select the pull-up resistor R1 so the input current, *I*, falls between 7 and 15mA.

Application Examples		
R1 = 2.2kΩ with V _{CC} = 24V ±5%	R1 = 1kΩ with V _{CC} = 12V ±5%	R1 = 180Ω with V _{CC} = 5V ±5%

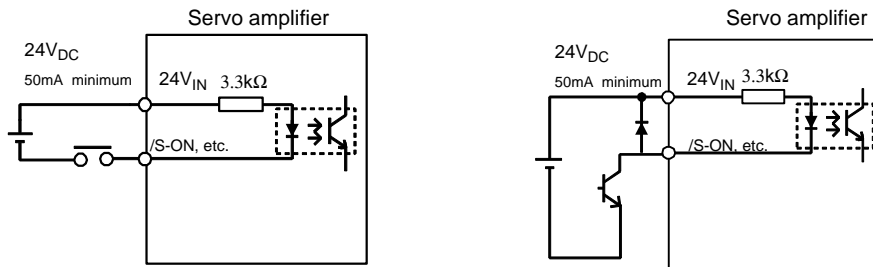
- Open-Collector Output, Example 2: Using a servo amplifier with an internal 12V power supply

This circuit uses the 12V power supply built into the servo amplifier. The input is not isolated in this case.



■ Sequence Input Circuit Interface

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.



■ Output Circuit Interfaces

Any of the following three types of servo amplifier output circuits can be used. Connect an input circuit at the host controller following one of these types.

- Connecting to a Line-driver Output Circuit

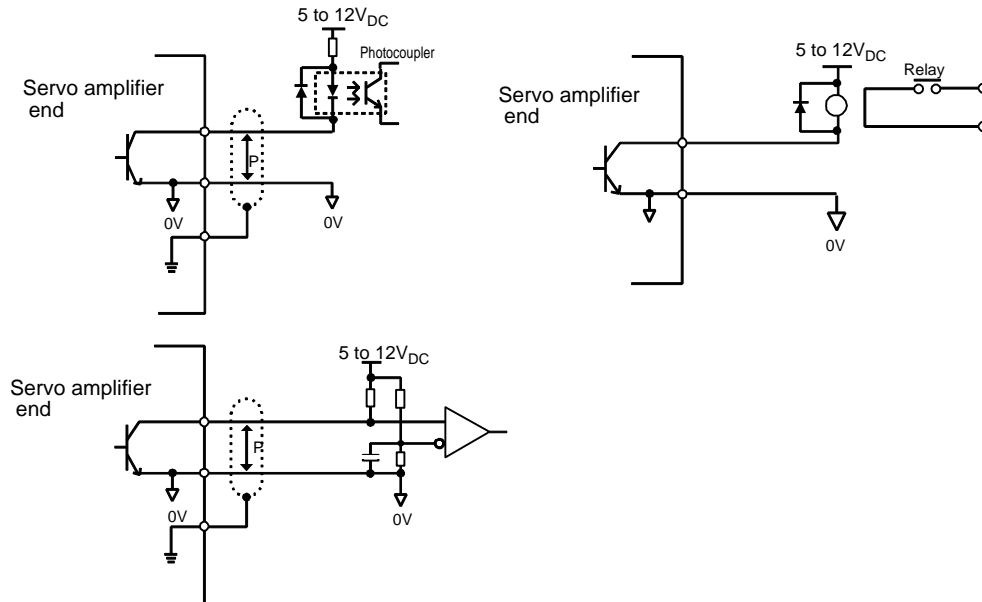
Encoder serial data converted to two-phase (A and B phase) pulse output signals (PAO, /PAO, PBO, /PBO), origin pulse signals (PCO, /PCO) and S phase rotation signals (PCO, /PCO) are output via line-driver output circuits that normally comprise the position control system at the host controller. Connect the line-driver output circuit through a line receiver circuit at the host controller.

See 3.5 Wiring to an Encoder for connection circuit examples.

- Connecting to an Open-Collector Output Circuit

Alarm code signals are output from open-collector transistor output circuits.

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



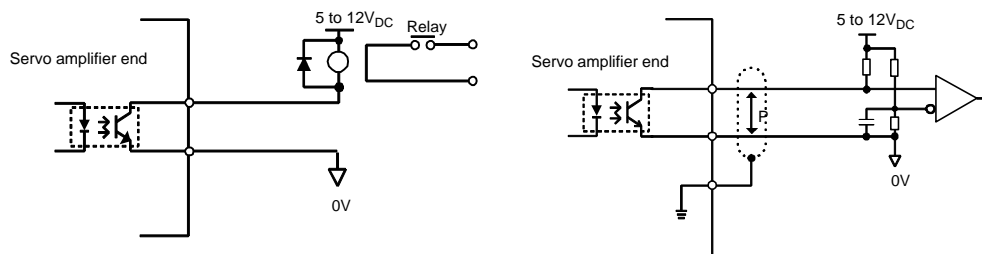
Note: The maximum allowable voltage and current capacities for open-collector circuits are:

- Voltage: $30V_{DC}$
- Current: $20mA_{DC}$

- Connecting to a Photocoupler Output Circuit

Photocoupler output circuits are used for servo alarm, servo ready, and other sequence output signal circuits.

Connect a photocoupler output circuit through a relay or line receiver circuit.



Note: The maximum allowable capacities for photocoupler output circuits are:

- Voltage: $30V_{DC}$
- Current: $50mA_{DC}$

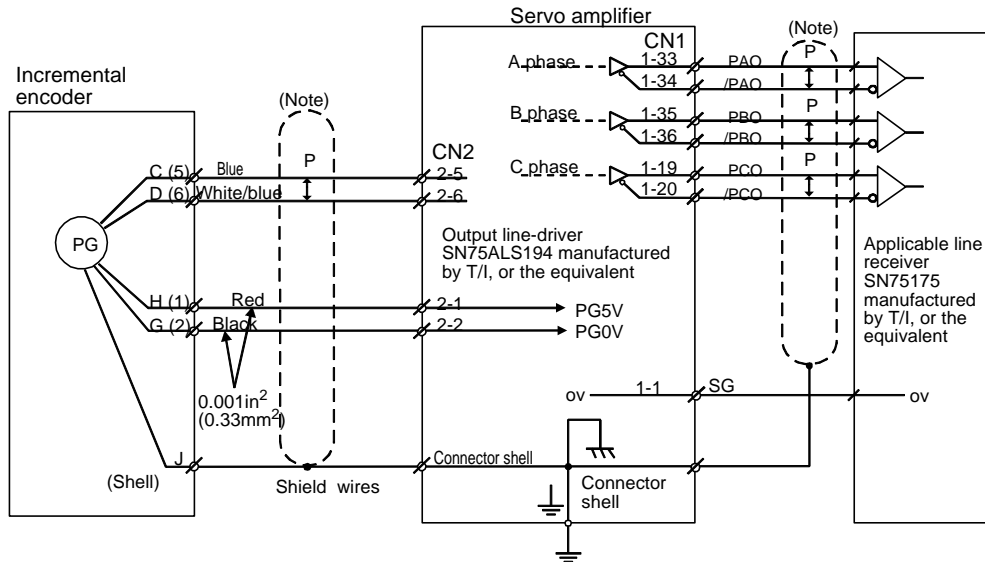
3.5 Wiring Encoders

The following sections describe the procedure for wiring a Servo Amplifier to the encoder.

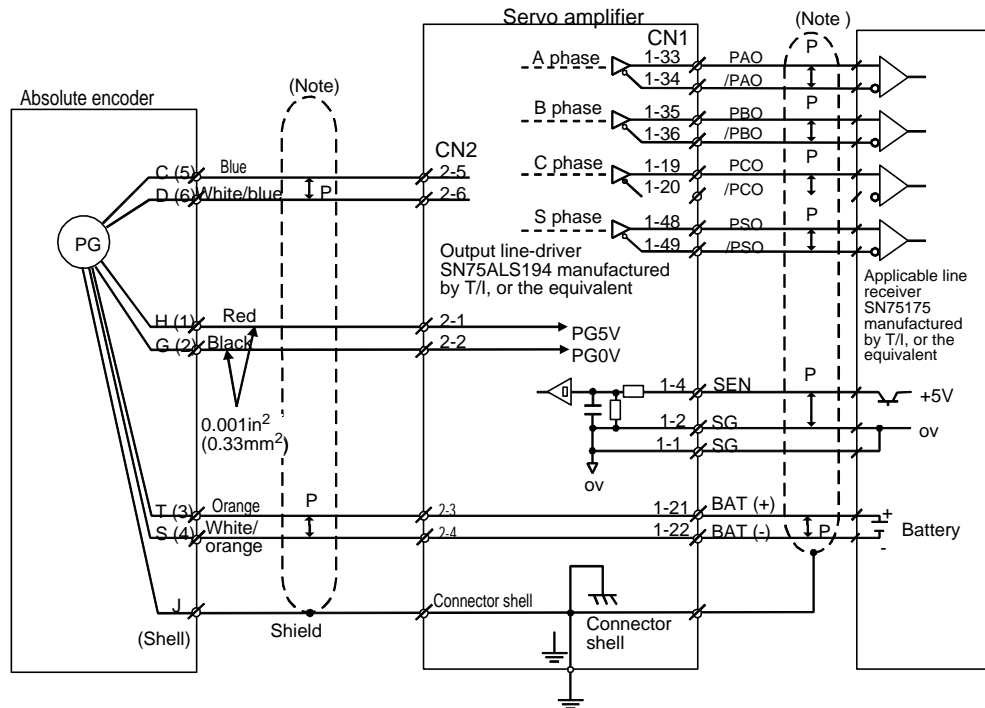
3.5.1 Connecting an Encoder (CN2) and Output Signals from the Servo Amplifier (CN1)

The following diagrams show wiring for incremental and absolute encoders.

■ Incremental Encoders



■ Absolute Encoders



3.5.2 CN2 Encoder Connector Terminal Layout and Types

The following tables describe CN2 connector terminal layout and types.

■ CN2 Connector Terminal Layout

Pin	Signal	Function	Pin	Signal	Function
1	PG 5V	PG power supply +5V	2	PG 0V	PG power supply 0V
3	BAT (+)	Battery (+) (For an absolute encoder)	4	BAT (-)	Battery (-) (For an absolute encoder)
5	PS	PG serial signal input	6	/PS	PG serial signal input

■ CN2 Connector Models

Servo Amplifier Connectors	Applicable Plug (or Socket)		
	Soldered Plug (Servo Amplifier Connector)	Soldered Plug (Servomotor Connector)	Manufacturer
53460-0611	55100-0600 (Yaskawa number: JZSP-CMP9-1)	54280-0600 (Yaskawa number: JZSP-CMP9-2)	Molex Japan Co., Ltd.

Note: 1. FA1394 is the product number for the servo amplifier end plug and the servomotor end socket set from Molex Japan Co., Ltd.

2. The servomotor-end relay socket connects to the encoder connector for the SGMAH and SGMPH servomotor.

3. The following encoder connectors are for the SGMGH and SGMSH servomotor:

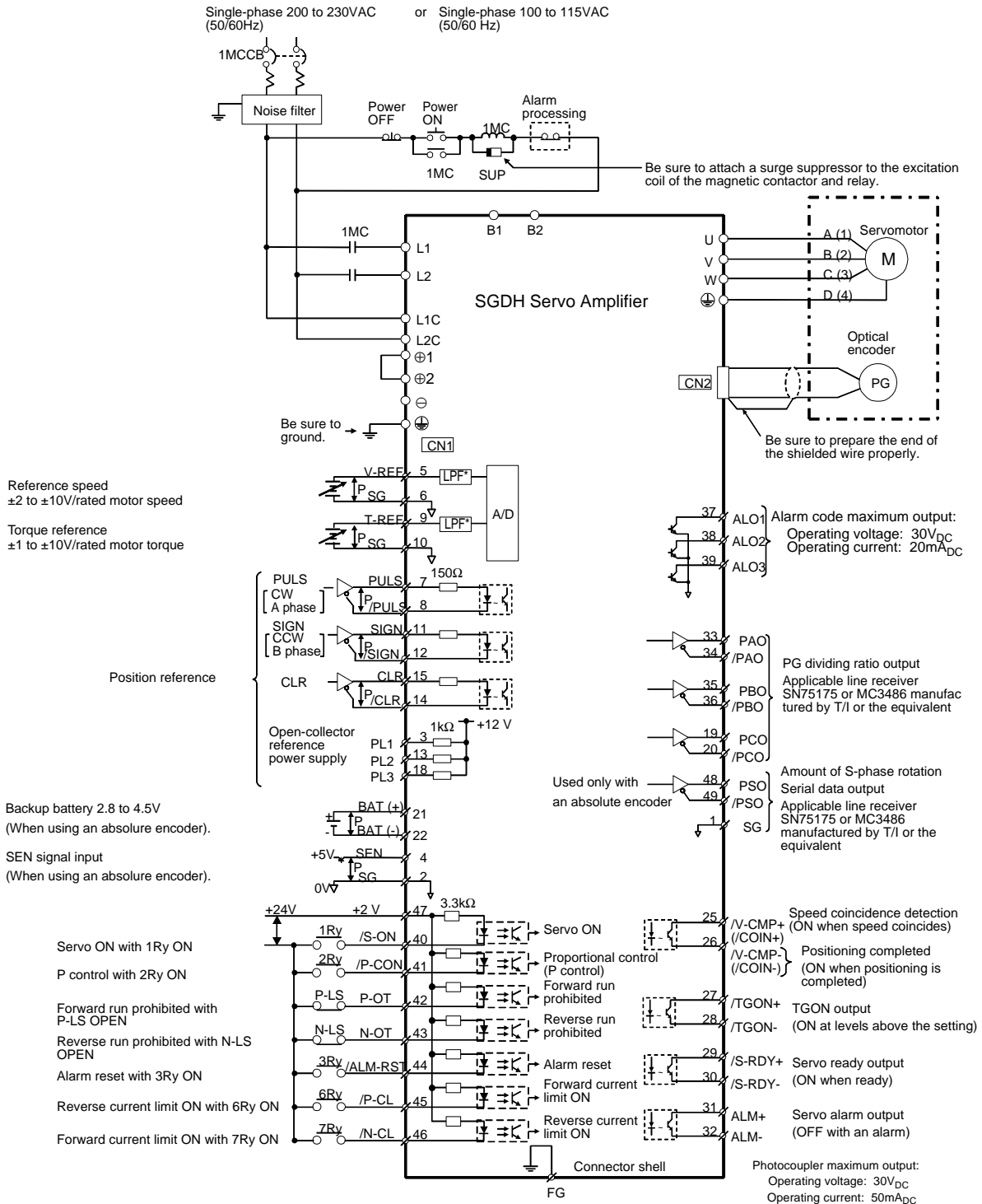
L-shaped plug: MS3108B20-29S
 Straight: MS3106B20-29S
 Cable clamp: MS3057-12A

Note: Encoder cables are available from Yaskawa. For more details on the cables, see *Sigma II Series Servo System Catalog Supplement (G-MI#99001)*.

3.6 Examples of Standard Connections

The following diagrams show examples of standard servo amplifier connections by specifications and type of control.

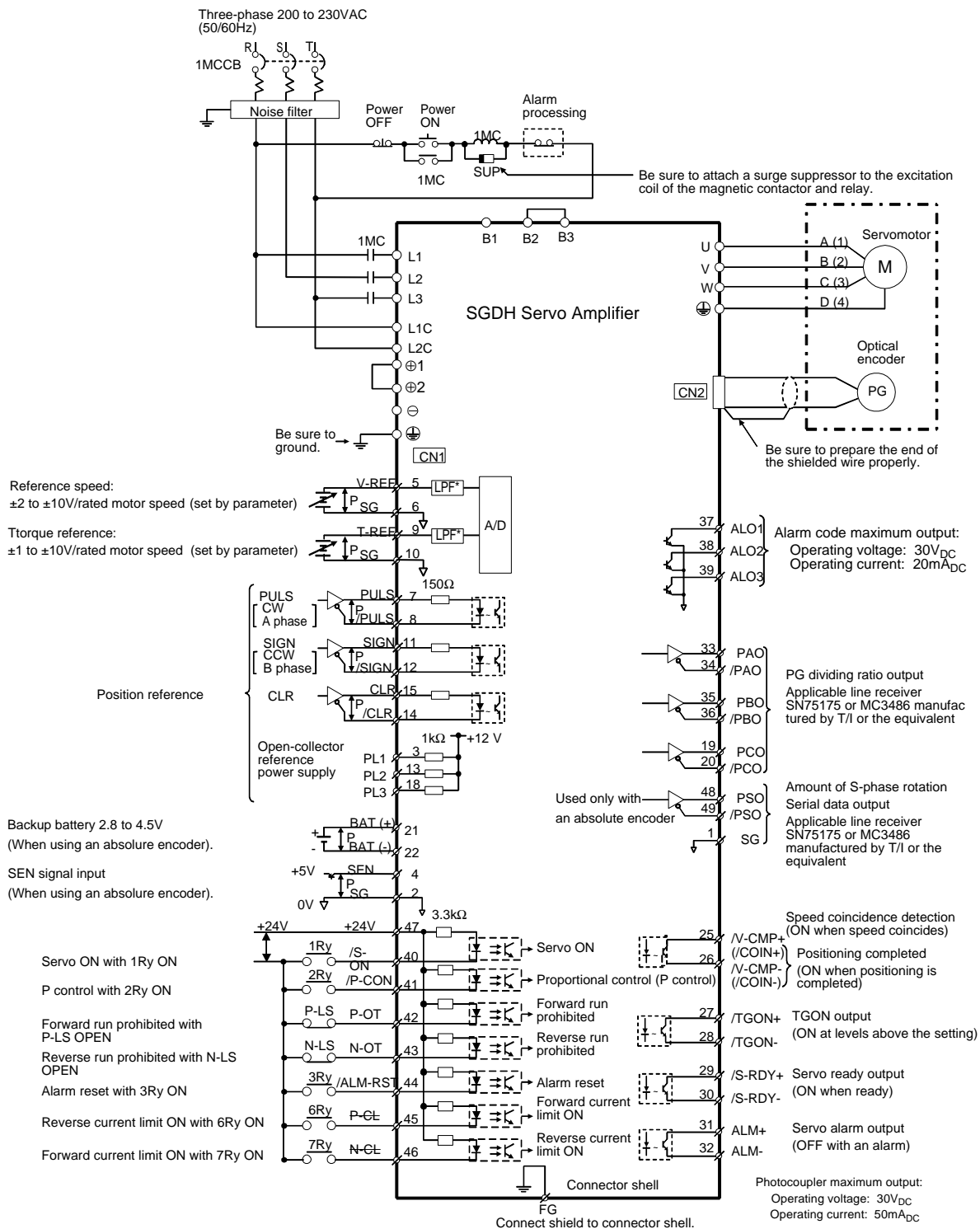
3.6.1 Single-Phase Power Supply Specifications



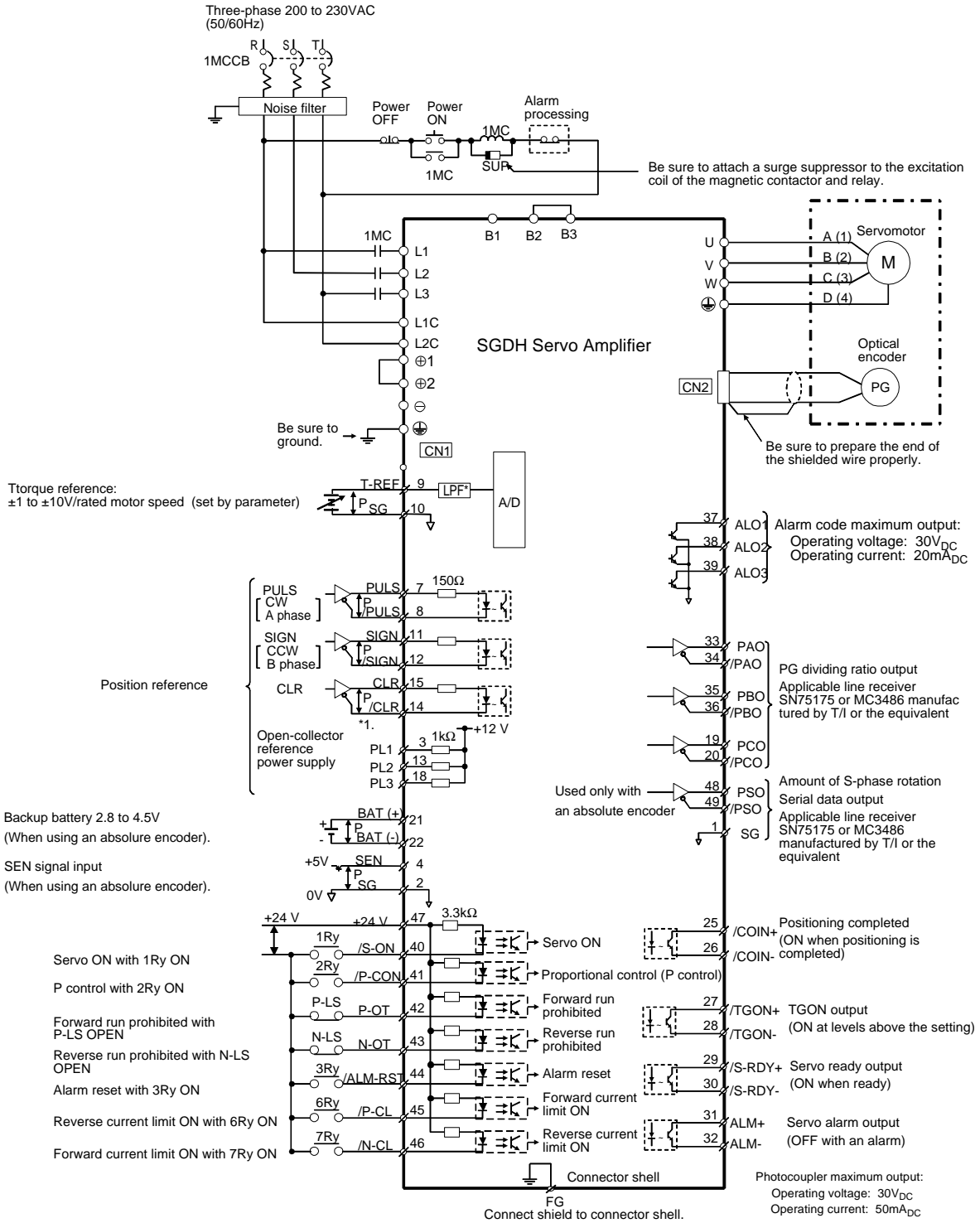
*The time constant for the primary filter is 47μs

⚡P: Indicates twisted wire pairs.

3.6.2 Three-Phase Power Supply Specifications



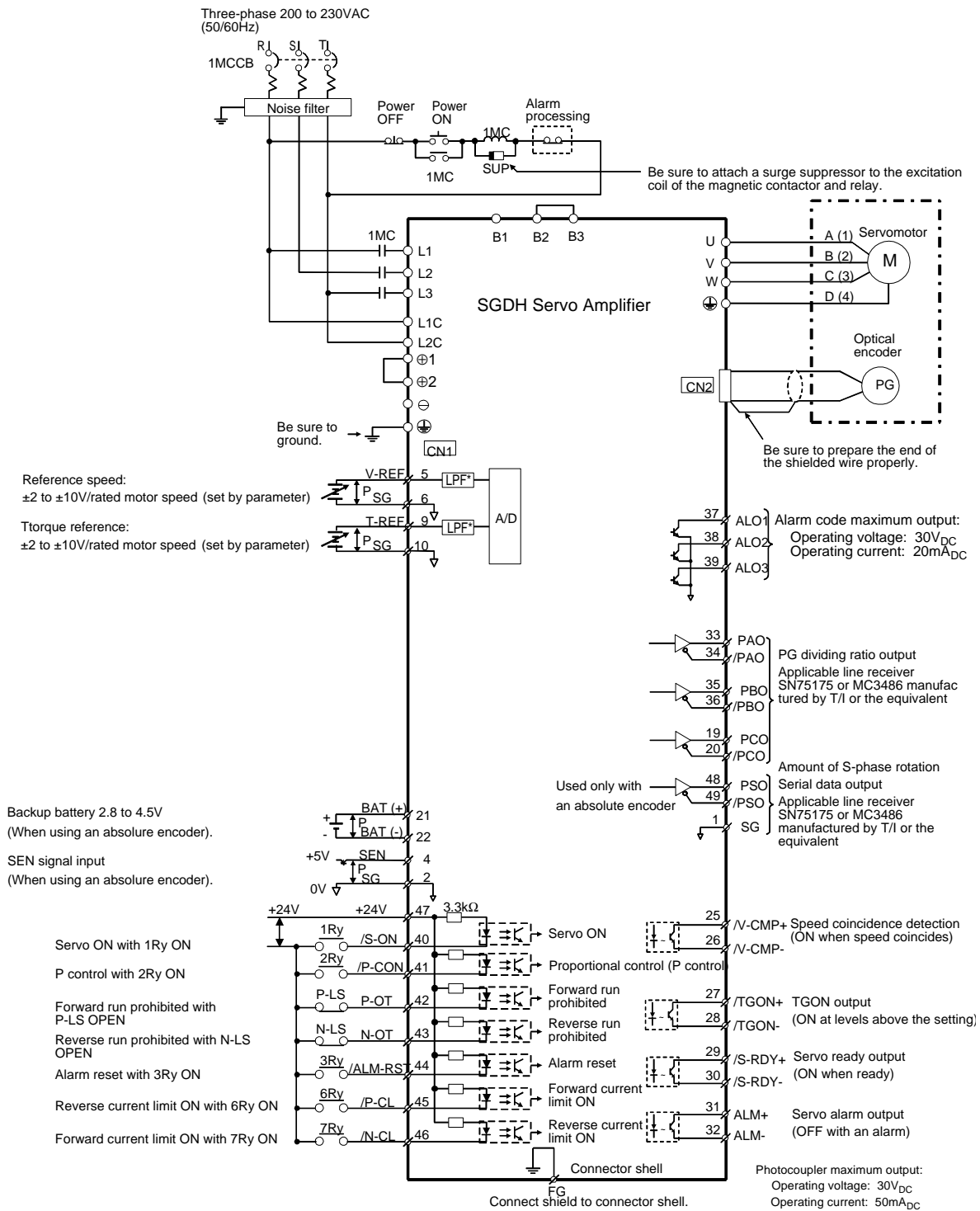
3.6.3 Position Control Mode



*The time constant for the primary filter is 47μs

⚡ P: Indicates twisted wire pairs.

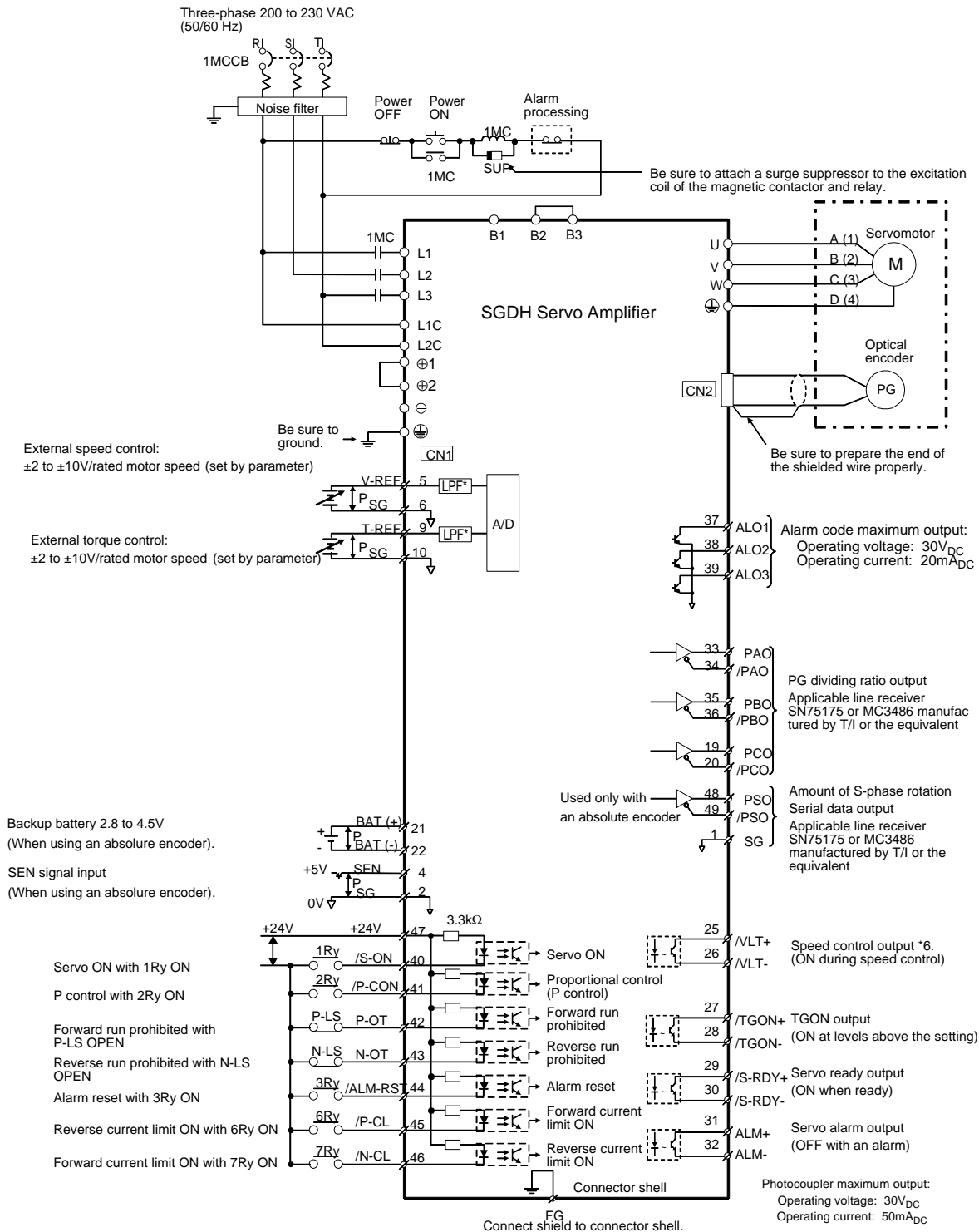
3.6.4 Speed Control Mode



*The time constant for the primary filter is 47 μ s

◆ P: Indicates twisted wire pairs.

3.6.5 Torque Control Mode



*The time constant for the primary filter is 47μs

◆ P: Indicates twisted wire pairs.

4 Trial Operation

This chapter describes a two-step trial operation. Be sure to complete step 1 before proceeding to step 2.

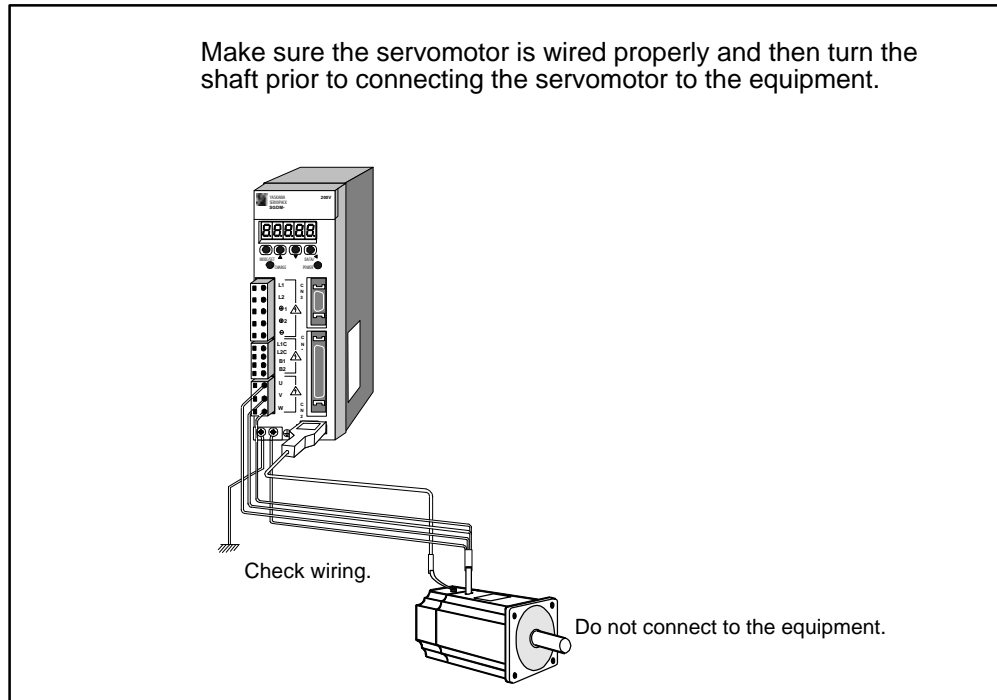
4.1	Two-Step Trial Operation	4-2
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4.1.2	Step 2: Trial Operation with the Servomotor Connected to the Machine..	4-9
4.2	Supplementary Information on Trial Operation.....	4-10
4.2.1	Servomotors with Brakes	4-10
4.2.2	Position Control by Host Controller	4-11
4.3	Minimum Parameters and Input Signals.....	4-11
4.3.1	Parameters.....	4-11
4.3.2	Input Signals	4-12

4.1 Two-Step Trial Operation

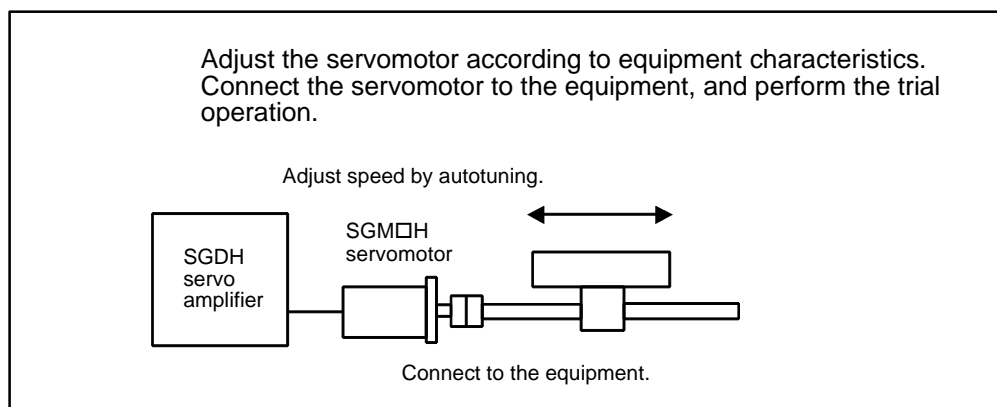
Make sure that all wiring is completed prior to starting trial operation.

Perform the trial operation in the order given below (step 1 and 2) for your safety. See 4.1.1 and 4.1.2 for more details on the trial operation.

Step 1: Trial Operation for Servomotor without Load



Step 2: Trial Operation with the Equipment and Servomotor Connected



4.1.1 Step 1: Trial Operation for Servomotor without Load



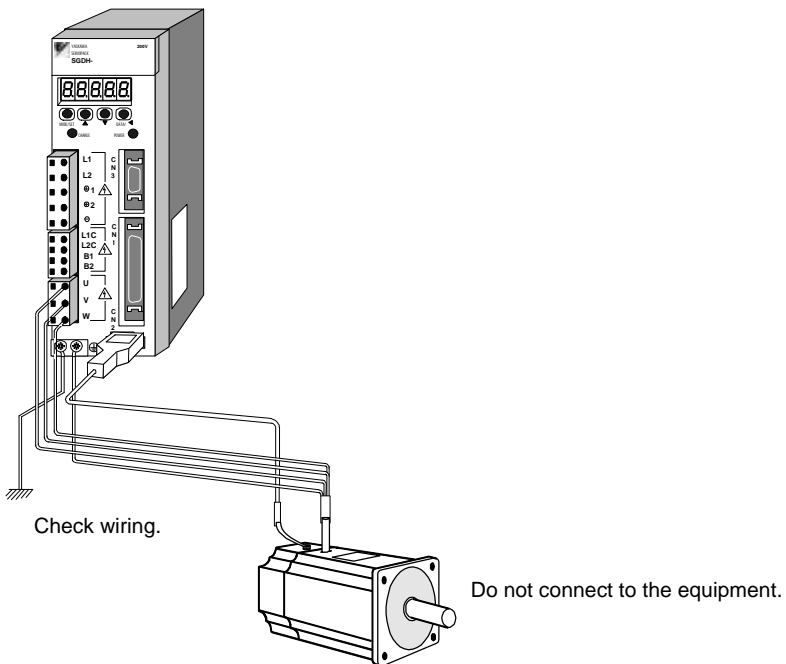
CAUTION

- **Do not operate the servomotor while it is connected to the equipment.**
To prevent accidents, initially perform step 1 where the trial operation is conducted under no-load conditions (with all couplings and belts disconnected).

In step 1, make sure that the servomotor is wired properly as shown below. Incorrect wiring is generally the reason why servomotors fail to operate properly during trial operation.

- Check main power supply circuit wiring.
- Check servomotor wiring.
- Check CN1 I/O signal wiring.

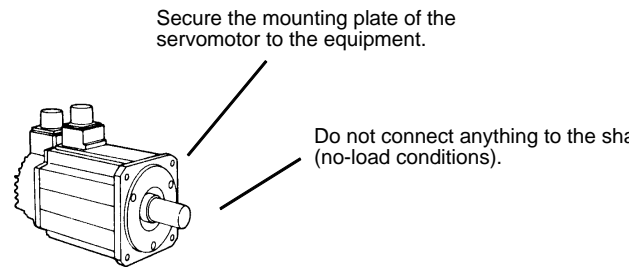
Make sure the host controller and other adjustments are completed as much as possible in step 1 (prior to connecting the servomotor to equipment).



Note Check the items on the following pages in the order given during the servomotor trial operation.

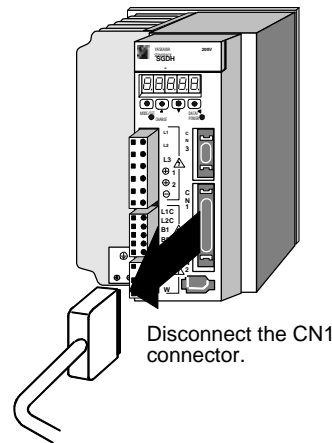
See 4.2.1 *Servomotors with Brakes*, if you are using a servomotor with brakes.

1. Secure the servomotor.



Secure the servomotor mounting plate to the equipment in order to prevent the servomotor from moving during operation.

2. Check the wiring.



Disconnect the CN1 connector and check servomotor wiring in the power supply circuit. The CN1 I/O signals are not used, so leave the connector disconnected.

3. Turn ON power.

Normal display



Alternate display

Example of Alarm Display

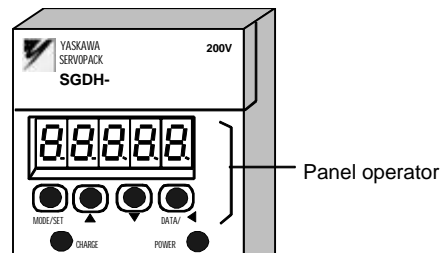


Turn ON servo amplifier power. If the servo amplifier has turned ON normally, the LED display on the front panel of the servo amplifier will appear as shown above. Power is not supplied to the servomotor because the servo is OFF.

If an alarm display appears on the LED indicator as shown above, the power supply circuit, servomotor wiring, or encoder wiring is incorrect. In this case, turn OFF power and take appropriate action. See 9.2 *Troubleshooting*.

Note If an absolute encoder is used, it must be set up. Refer to 5.7.4 *Absolute Encoder Setup*.

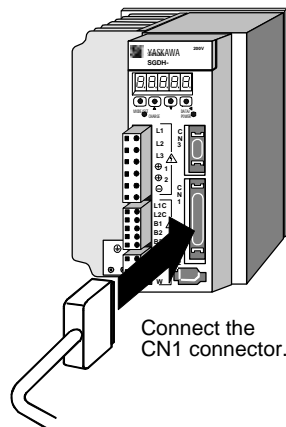
4. Operate with the Panel Operator.



Operate the servomotor using the Panel Operator. Check to see if the servomotor runs normally.

See 7.2.2 *Operation Using the Digital Operator* for more details on the procedure.

5. Connect the signal lines.



Use the following procedure to connect the CN1 connector.

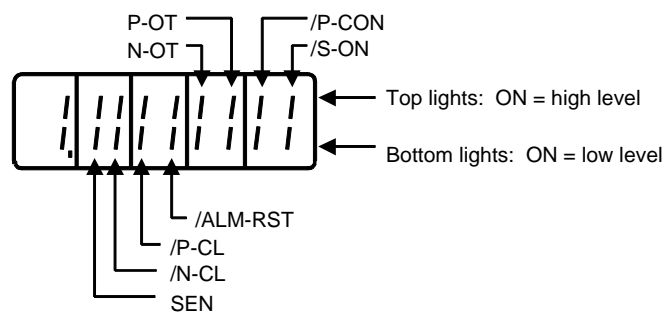
- a) Turn OFF power.
- b) Connect the CN1 connector.
- c) Turn ON power again.

6. Check the input signals.

Check input signal wiring in Monitor Mode using the panel operator. See 7.1.7 *Operation in Monitor Mode* for more details on the procedure.

Turn ON and OFF each signal line to see if the LED monitor bit display on the panel changes as shown below.

Input signal LED display



Input Signal Status	LED Display
OFF (high level)	Top LED indicators light.
ON (low level)	Bottom LED indicators light.

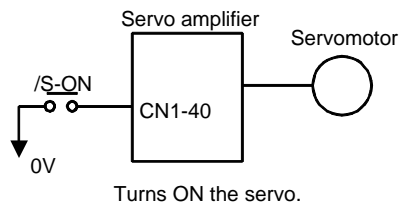
Note: The servomotor will not operate properly if the following signal lines are not wired correctly. Always wire them correctly. Short the signal lines if they will be unused. The input signal selections (parameters Pn50A to Pn50D) can be used to eliminate the need for external short circuiting.

Signal Symbol	Connector Pin No.	Description
P-OT	CN1-42	The servomotor can rotate in the forward direction when this signal line is low (0V).
N-OT	CN1-43	The servomotor can rotate in the reverse direction when this signal line is low (0V).
/S-ON	CN1-40	The servomotor is turned ON when this signal line is low (0V). Leave the servomotor OFF.
+24VIN	CN1-47	Control power supply terminal for sequence signals.

Note: IF an absolute encoder is being used, the servo will not turn ON when the servo ON signal (/S-ON) is input unless the SEN signal is also ON.

When the SEN signal is checked in monitor mode, the top of the LED will light because the SEN signal is high when ON.

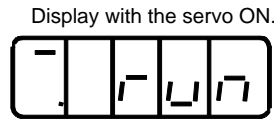
7. Turn ON the servo.



Turn ON the servo using the following procedure.

- a. Make sure there are no reference signals input.
 - Set V-REF (CN1-5) and T-REF (CN1-9) to 0V for speed and torque control.
 - Set PULS (CN1-7) and SIGN (CN1-11) to low for position control.

- b. Turn ON the servo ON signal.



Set /S-ON (CN1-40) to 0V. If normal, the servomotor will turn ON and the LED indicator on the front panel will display as shown above. If an alarm display appears, take appropriate action as described in *9.2 Troubleshooting*.

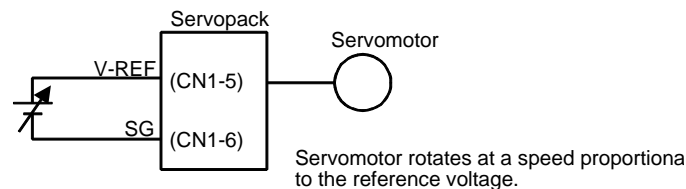
Note: If there is noise in the reference voltage for speed control, the “-” on the left of the 7-segment LED may flash.

■ Operating Using Reference Input

The operating procedure here depends on the parameter settings (control mode selection at memory switch Pn000.1). Use the following procedure for operations with speed and position control.

Operating Procedure in Speed Control Mode: Set Pn000.1 to 0

Standard speed control setting is described here.



1. Gradually increase the reference speed input (V-REF, CN1-5) voltage. The servomotor will rotate.
2. Check the following items in Monitor Mode. See *7.1.7 Operation in Monitor Mode*.

Un000	Actual motor speed
Un001	Reference speed

- Has the reference speed been input?
 - Is the motor speed as designed?
 - Does the reference speed coincide with the actual motor speed?
 - Does the servomotor stop when the speed reference is 0?
3. If the servomotor rotates at extremely slow speed with 0V specified for the reference voltage, correct the reference offset value as described in *7.2.3 Automatic Adjustment of Speed and Torque Reference Offset* or *7.2.4 Manual Adjustment of Speed and Torque Reference Offset*.

- Reset the following parameters to change the motor speed or direction of rotation.

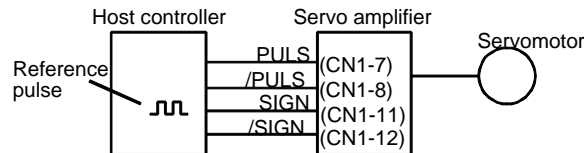
Pn300	Sets the reference speed input gain See 5.2.1 <i>Speed Reference</i> .
Pn000.0	Selects the rotation direction. See 5.1.1 <i>Switching Servomotor Rotation Direction</i> .

Operating Procedure in Position Control Mode: Set Pn000.1 to 1

- Set the parameter Pn200.0 so the reference pulse form is the same as the host controller output form.

Selecting the reference pulse form: See 5.2.2 *Position Reference*.

- Input a slow speed pulse from the host controller and execute low-speed operation.



- Check the following data in Monitor Mode. See 7.1.7 *Operation in Monitor Mode*.

Un000	Actual motor speed
Un007	Reference pulse speed display
Un008	Position offset

- Has the reference pulse been input?
 - Is the motor speed as designed?
 - Does the reference speed coincide with the actual motor speed?
 - Does the servomotor stop when the speed reference is 0?
- Reset the parameters shown below to change the motor speed or direction of rotation.

Pn202, Pn203	Electronic gear ratio See 5.2.5 <i>Using the Electronic Gear Function</i> .
Pn000.0	Selects the direction of rotation. See 5.1.1 <i>Switching Servomotor Rotation Direction</i> .

If an alarm occurs or the servomotor fails to operate during the above operation, CN1 connector wiring is incorrect or parameter settings do not match the host controller specifications. Check the wiring and review the parameter settings, then repeat step 1.

Note: References

- List of Alarms: See *9.2.3 Alarm Display Table*.
- List of Parameters: See *Appendix B List of Parameters*.

4.1.2 Step 2: Trial Operation with the Servomotor Connected to the Machine



WARNING

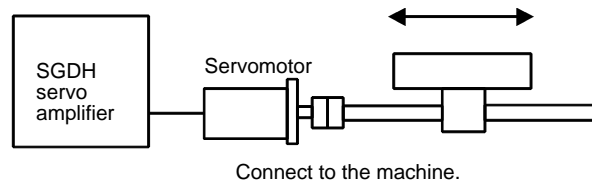
Follow the procedure below for step 2 operation precisely as given.

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.

Before proceeding to step 2, repeat step 1 (servomotor trial operation without a load) until all concerns including parameters and wiring have fully satisfied expectations.

After step 1 has been completed, proceed to step 2 for trial operation with the servomotor connected to the equipment. The servo amplifier is now adjusted in the following ways to meet the specific equipment's characteristics.

- Using autotuning to match the servo amplifier to the equipment's characteristics.
- Matching the direction of rotation and speed to the equipment's specifications.
- Checking the final control form.



Follow the procedures below to perform the trial operation.

1. Make sure power is OFF.
2. Connect the servomotor to the equipment.
See *2.1 Servomotors* for more details on connecting the servomotor.
3. Use autotuning to match the servo amplifier to equipment characteristics.
See *6.3 Autotuning*.
4. Operate the servomotor by reference input.

As in step 1 (*Servomotor trial operation with no-load*), execute operation by reference input as described in *4.1.1 Step 1: Servomotor Trial Operation*. Tune to match the host controller at this time, as well.

5. Set and record user settings.
Set parameters as required and record all settings for use later in maintenance.

Note: The servomotor will not be broken in completely during the trial operation. Therefore, let the system run for a sufficient amount of time after the trial operation has been completed to ensure that it is properly broken in.

4.2 Supplementary Information on Trial Operation

Always refer to this information before starting trial operation in the following instances:

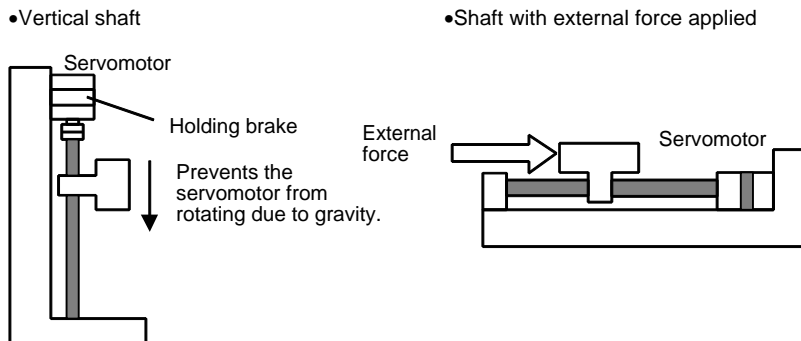
4.2.1 Servomotor with Brakes

4.2.2 Position Control by Host Controller

4.2.1 Servomotors with Brakes

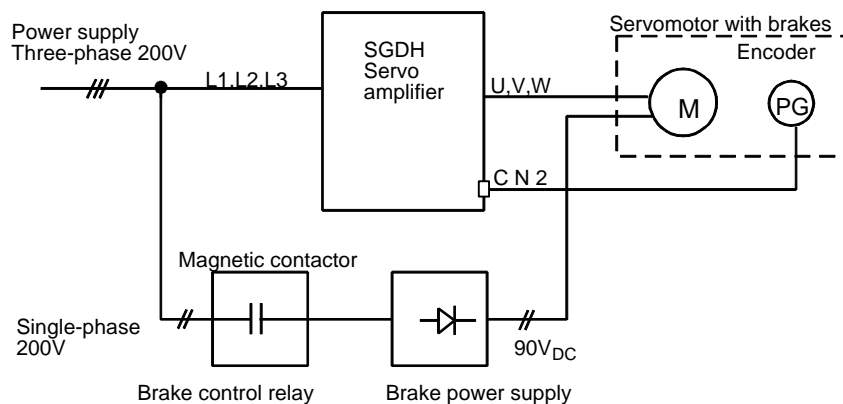
Use servomotors with brakes for vertical shaft applications or when external force must be applied to the shaft to prevent rotation due to gravity or external force during a power loss.

The servo amplifier uses the brake interlock output (/BK) signal to control the holding brake operation when using servomotors with brakes.



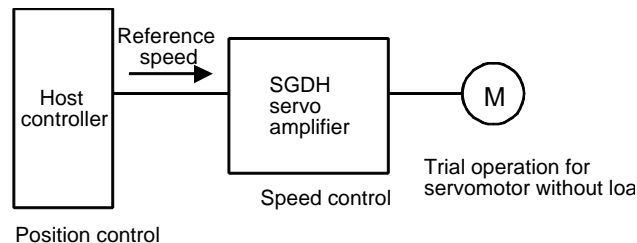
Note: To prevent faulty operation due to gravity or external force, first make sure that both the servomotor and holding brake work properly when . When assured that each operates properly, connect the servomotor to the rest of the equipment to start the trial operation.

The following figure shows wiring for a servomotor with brakes. See 5.4.4 *Using the Holding Brake* for details on wiring.



4.2.2 Position Control by Host Controller

If position control from the host controller has not been confirmed, disconnect the servomotor from the equipment and perform a trial operation, otherwise the servomotor may run out of control.



Check servomotor operation as described in the following table.

Controller Reference	Check	Procedure	Description
JOG Operation (Constant Reference Speed Input from Host Controller)	Motor speed	Check motor speed as follows: <ul style="list-style-type: none"> Use the speed monitor (Un000) on the Panel Operator. Run the servomotor at low speed. Input a reference speed of 60rpm, for example, to see if the servomotor makes one revolution per second. 	Check the parameter setting at Pn300 to see if the reference speed gain is correct.
Simple Positioning	Number of motor rotations	Input a reference equivalent to one servomotor rotation and visually check to see if the shaft makes one revolution.	Check the parameter setting at Pn201 to see if the number of dividing pulses is correct.
Overtravel (P-OT and N-OT Used)	Whether the servomotor stops rotating when P-OT and N-OT signals are applied	Check to see if the servomotor stops when P-OT and N-OT signals are input during continuous servomotor operation.	Review P-OT and N-OT wiring if the servomotor does not stop.
Overtravel (P-OT and N-OT Used)	Whether the servomotor stops rotating when P-OT and N-OT signals are applied	Check to see if the servomotor stops when P-OT and N-OT signals are input during continuous servomotor operation.	Review P-OT and N-OT wiring if the servomotor does not stop.

4.3 Minimum Parameters and Input Signals

This section describes the minimum parameters and input signals required for trial operation.

4.3.1 Parameters

See 7.1.6 *Operation in parameter Setting Mode* for more details on setting parameters.

Turn OFF power once after changing any parameter except Pn300. The change will be valid when power is restored.

Basic Parameters

Pn000.1	Function Selection Basic Switches: Control Method Selection	See 5.3.5
---------	---	-----------

Speed Control

Pn300	Speed Reference Input Gain	See 5.2.1
Pn201	PG Divider	See 5.2.3

Position Control

Pn200.0	Reference Pulse Form	See 5.2.2
Pn202	Electronic Gear Ratio (Numerator)	See 5.2.5
Pn203	Electronic Gear Ratio (Denominator)	See 5.2.5

Changing Servomotor Rotation Direction

The wiring may be incorrect if the specified direction of rotation differs from the actual direction of rotation. Recheck the wiring and correct if necessary. Use the following parameter to reverse the direction of rotation.

Pn000.0	Function Selection Basic Switches: Direction Selection	See 5.1.1
---------	--	-----------

4.3.2 Input Signals

Refer to the specified section of this manual for details on each input signal.

Input signal selection settings through parameters can be used to eliminate the need for external short circuits.

Signal Name		Pin Number	Description
/S-ON	Servo ON	CN1-40	See 5.5.2 for more details on turning ON and OFF the servomotor.
P-OT	Forward run prohibited	CN1-42	See 5.1.2 for more details on the overtravel limit switch.
N-OT	Reverse run prohibited	CN1-43	

5 Parameter Settings and Functions

This chapter describes the procedure for setting and applying parameters.

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■ Before Reading this Chapter

This chapter describes the use of each CN1 connector I/O signals in the SGDH servo amplifier as well as the procedure for setting the related parameters for the intended purposes.

The following sections can be used as references for this chapter.

- List of CN1 I/O signals: See 3.4.3 *I/O Signal Names and Functions*.
- CN1 I/O signal terminal layout See 3.4.2 *List of CN1 Terminals*.
- List of parameters: Appendix *Appendix B List of Parameters*.
- Parameter setting procedure: 7.1.6 *Operation in Parameter Setting Mode*

The CN1 connector is used to exchange signals with the host controller and external circuits.

■ Parameter Configurations

Parameters are comprised of the types shown in the following table. See *Appendix B List of Parameters*.

Type	Parameter Number	Description
Function Selection Constants	Pn000 to Pn003	Select basic and application functions such as the type of control or the stop mode used when an alarm occurs.
Servo Gain and Other Constants	Pn100 to Pn123	Set numerical values such as speed and position loop gains.
Position Control Constants	Pn200 to Pn208	Set position control parameters such as the reference pulse input form and gear ratio.
Speed Control Constants	Pn300 to Pn308	Set speed control parameters such as speed reference input gain and soft start deceleration time.
Torque Control Constants	Pn400 to Pn409	Set torque control parameters such as the torque reference input gain and forward/reverse torque limits.
Sequence Constants	Pn500 to Pn512	Set output conditions for all sequence signals and changes I/O signal selections and allocations.
Others	Pn600 to Pn601	Specify the capacity for an external regenerative resistor and reserved constants.
Auxiliary Function Execution	Fn000 to Fn013	Execute auxiliary functions such as JOG Mode operation.
Monitor Modes	Un000 to Un00D	Enable speed and torque reference monitoring, as well as monitoring to check whether I/O signals are ON or OFF.

5.1 Settings According to Device Characteristics

This section describes the procedure for setting parameters according to the dimensions and performance of the equipment used.

5.1.1 Switching Servomotor Rotation Direction

The servo amplifier has a Reverse Rotation Mode that reverses the direction of servomotor rotation without rewiring. Forward rotation in the standard setting is defined as counterclockwise as viewed from the load.

With the Reverse Rotation Mode, the direction of servomotor rotation can be reversed without changing other parameters. Only the direction (+, -) of shaft motion is reversed.

	Standard Setting	Reverse Rotation Mode
Forward Reference		
Reverse Reference		

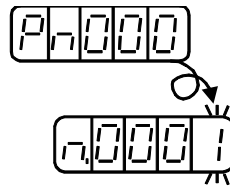
■ Setting Reverse Rotation Mode

Use the parameter Pn000.0.

Parameter	Signal	Setting	Control Mode
Pn000.0	Direction Selection	Default Setting: 0	Speed/Torque Control, Position Control

Use the following settings to select the direction of servomotor rotation.

Setting	Description
0	Forward rotation is defined as counterclockwise (CCW) rotation as viewed from the load. (Standard setting)
1	Forward rotation is defined as clockwise (CW) rotation as viewed from the load. (Reverse Rotation Mode)



5.1.2 Setting the Overtravel Limit Function

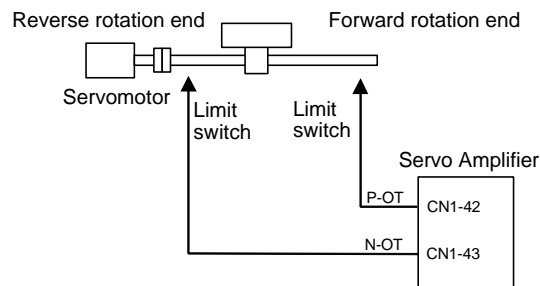
The overtravel limit function forces movable equipment parts to stop if they exceed the allowable range of motion.

■ Using the Overtravel Function

To use the overtravel function, connect the overtravel limit switch input signal terminals shown below to the correct pins of the servo amplifier CN1 connector.

Input ⇨ P-OT CN1-42	Forward Run Prohibited (Forward Overtravel)	Speed/Torque Control, Position Control
Input ⇨ N-OT CN1-43	Reverse Run Prohibited (Reverse Overtravel)	Speed/Torque Control, Position Control

Connect limit switches as shown below to prevent damage to the devices during linear motion.



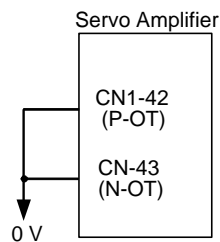
Drive status with an input signal ON or OFF is shown in the following table.

Signal	State	Input Level	Description
P-OT	ON	CN1-42: low	Forward rotation allowed, (normal operation status).
	OFF	CN1-42: high	Forward run prohibited (reverse rotation allowed).
N-OT	ON	CN1-43: low	Reverse rotation allowed, (normal operation status).
	OFF	CN1-43: high	Reverse run prohibited (forward rotation allowed).

■ Enabling/Disabling Input Signals

Set the following parameters to specify whether input signals are used for overtravel or not. The default setting is “used.”

Parameter	Signal	Setting	Control Mode
Pn50A.3	P-OT Signal Mapping (Forward Run Prohibit Input Signal)	Default Setting: 2	Speed/Torque Control, Position Control
Pn50B.0	N-OT Signal Mapping (Reverse Run Prohibit Input Signal)	Default Setting: 3	Speed/Torque Control, Position Control



The short-circuit wiring shown in the figure can be omitted when P-OT and N-OT are not used.

Parameter	Signal	Setting	Description
Pn50A.3	P-OT Signal Mapping (Forward Run Prohibit Input Signal)	Default Setting: 2	Uses the P-OT input signal to prevent forward rotation. (Forward rotation is prohibited when CN1-42 is open and is allowed when CN1-42 is at 0V).
		8	Does not use the P-OT input signal to prevent forward rotation. (Forward rotation is always allowed and has the same effect as shorting CN1-42 to 0V).
Pn50B.0	N-OT Signal Mapping (Reverse Run Prohibit Input Signal)	Default Setting: 3	Uses the N-OT input signal to prevent reverse rotation. (Reverse rotation is prohibited when CN1-43 is open and is allowed when CN1-43 is at 0V).
		8	Does not use the N-OT input signal to prevent reverse rotation. (Reverse rotation is always allowed and has the same effect as shorting CN1-43 to 0V).

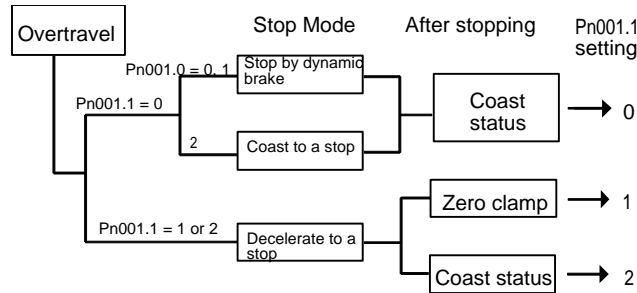
■ Servomotor Stop Mode for P-OT and N-OT Input Signals

Set the following parameters to specify the Servomotor Stop Mode when P-OT and N-OT input signals are used.

Specify the Servomotor Stop Mode when either of the following signals is input during servomotor operation.

- Forward run prohibited input (P-OT,CN1-42)
- Reverse run prohibited input (N-OT,CN1-43)

Parameter	Signal	Setting	Control Mode
Pn001.1	Overtravel Stop Mode	Default Setting: 0	Speed/Torque Control, Position Control



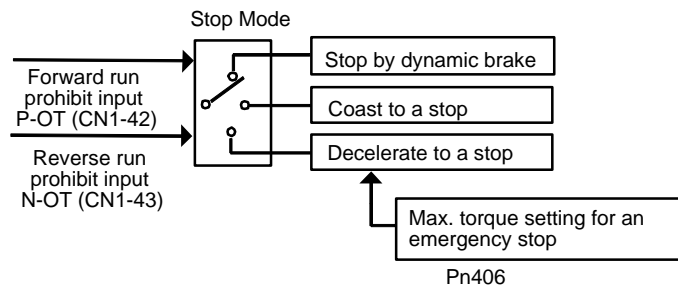
Note: For torque control, the servomotor will be placed in coast status after either decelerating or coasting to a stop (according to the stop mode set in Pn001.0), regardless of the setting of Pn001.1.

Parameter	Signal	Setting	Description
Pn001.1	Overtravel Stop Mode	0	Stops the servomotor the same way as turning the servo OFF (according to Pn001.0).
		1	Decelerates the servomotor to a stop at the preset torque, and then locks the servomotor in Zero Clamp Mode. Torque setting: Pn406 emergency stop torque
		2	Decelerates the servomotor to a stop at the preset torque, and puts the servomotor in coast status. Torque setting: Pn406 emergency stop torque

Pn406 specifies the stop torque applied for overtravel when the input signal for prohibiting forward or reverse rotation is used.

The torque limit is specified as a percentage of rated torque.

Parameter	Signal	Setting (%)	Control Mode
Pn406	Emergency Stop Torque (Valid when Pn001.1 is 1 or 2)	Range: 0% to Maximum Torque Default Setting: 800	Speed/Torque Control, Position Control



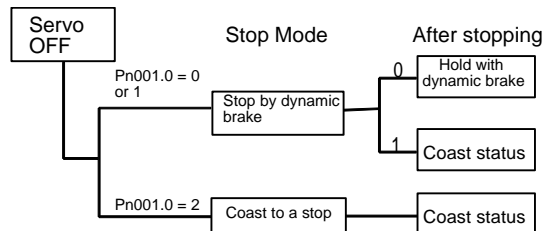
■ **Servo OFF Stop Mode Selection**

The SGDh servo amplifier turns OFF under the following conditions:

- Servo ON input signal (/S-ON, CN1-40) is turned OFF.
- Servo alarm occurs.
- Power is turned OFF.

Specify the Stop Mode if any of these occurs during operation.

Parameter	Signal	Setting	Control Mode
Pn001.0	Servo OFF or Alarm Stop Mode	Default Setting: 0	Speed/Torque Control, Position Control



The dynamic brake stops the servomotor electrically by shorting the motor windings and diverting the energy to a resistor.

Parameter	Signal	Setting	Description
Pn001.0	Servo OFF or Alarm Stop Mode	Default Setting: 0	Uses the dynamic brake to stop the servomotor, and maintains dynamic brake status after stopping.
		1	Uses the dynamic brake to stop the servomotor, and cancels dynamic brake status after stopping to go into coast status.
		2	Coasts the servomotor to a stop. The servomotor is turned OFF and stops due to equipment friction.

Note: If the Servomotor is stopped or rotating at extremely low speed when the items above are set at 0 (dynamic brake status after stopping with the dynamic brake), then braking power is not generated and the servomotor will stop the same as in coast status.

5.1.3 Limiting Torques

The SGD servo amplifier limits torques as follows:

- Level 1: Limits maximum output torque to protect the equipment or workpiece.
- Level 2: Limits torque after the servomotor moves the equipment to a specified position (internal torque limit).
- Level 3: Always limits output torque rather than speed.
- Level 4: Switches between speed and torque limit.

Application of levels 1 and 2 in the torque limit function are described below.

■ Setting Level 1: Internal Torque Limits

Maximum torque is limited to the values set in the following parameters.

Parameter	Signal	Setting (%)	Control Mode
Pn402	Forward Torque Limit	Range: 0 to 800 Default Setting: 800	Speed/Torque Control, Position Control
Pn403	Reverse Torque Limit	Range: 0 to 800 Default Setting: 800	Speed/Torque Control, Position Control

Sets the maximum torque limits for forward and reverse rotation.

Used when torque must be limited due to equipment conditions.

The torque limit function always monitors torque and outputs the signals below when the limit is reached.

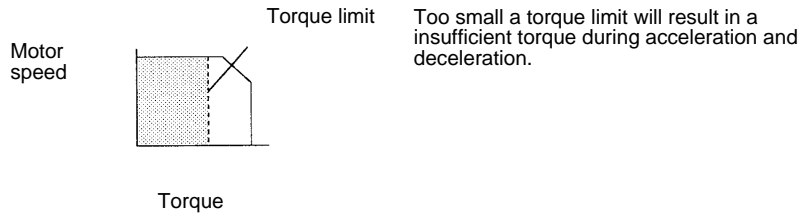
The following signals are output by the torque limit function.

Signal	Description
/CLT	Generated when Pn50F.0 allocates an output terminal from SO1 to SO3.
Monitor Mode (Un006)	-

The torque limits are specified as a percentage of the rated torque.

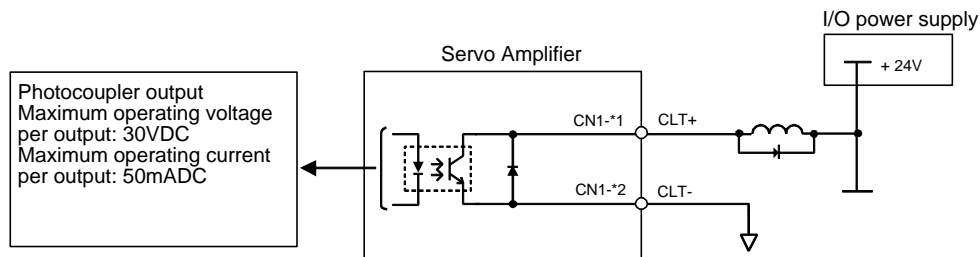
Note: If torque limit is set higher than the maximum torque of the servomotor, the maximum torque of the servomotor is the limit.

Application Example: Equipment Protection



Using the /CLT Signal

The following section describes the use of the contact output signal /CLT as a torque limit output signal.



Output ⇒ /CLT CN1-*1	Torque Limit Output	Speed/Torque Control, Position Control
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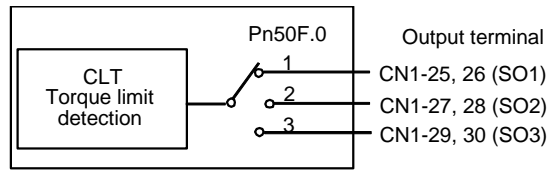
This signal indicates whether servomotor output torque (current) is being limited.

Status	Conditions	Description
ON	The circuit between CN1-*1 and *2 is closed. CN1-*1 is at low level.	Servomotor output torque is being limited. (Internal torque reference is greater than the limit setting).
OFF	The circuit between CN1-*1 and *2 is open. CN1-*1 is at high level.	Servomotor output torque is not being limited. (Internal torque reference is less than the limit setting).

- Settings: Pn402 (Forward Torque Limit)
 Pn403 (Reverse Torque Limit)
 Pn404 (Forward External Torque Limit): /P-CL input only
 Pn405 (Reverse External Torque Limit): /N-CL input only

When the /CLT signal is used, the following parameter must be used to select the output signal.

Parameter	Signal	Setting	Control Mode
Pn50F	Output Signal Selections 2	Default Setting: 0000	Speed/Torque Control, Position Control



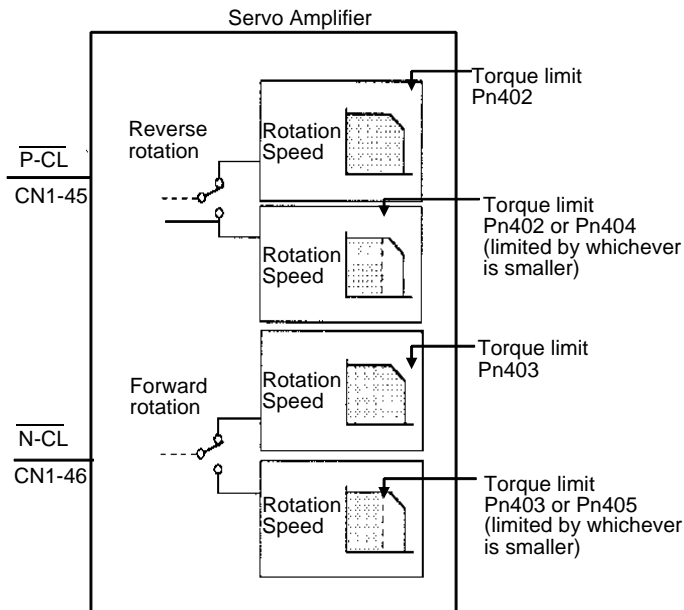
Use the following table to select which terminal will output the /CLT signal.

Parameter	Setting	Output Terminal (CN1-)	
		*1	*2
Pn50F.0	0	-	-
	1	25	26
	2	27	28
	3	29	30

Note: Multiple signals allocated to the same output circuit are output using OR logic. Set other output signals to a value other than that allocated to the /CLT signal in order to use just the /CLT output signal. See 5.3.4 Output Circuit Signal Allocation.

■ Setting Level 2: External Torque Limit

A contact input signal is used to enable the torque (current) limits previously set in parameters. Torque limits can be set separately for forward and reverse rotation.



⇒ Input P-CL CN1-45	Forward External Torque Limit Input	Speed/Torque Control, Position Control
⇒ Output N-CL CN1-46	Reverse External Torque Limit Input	Speed/Torque Control, Position Control

This is the external torque (current) limit input for forward and reverse rotation.

Check input signal allocation status when using this function. (See 5.3.3 *Input Circuit Signal Allocation*). Default settings are given in the table on the following page.

Parameter	Signal Status	Comments	Description
/P-CL	CN1-45 at low level when ON	Use forward torque limit.	Limit: Pn404
	CN1-45 at high level when OFF	Do not use forward torque limit. Normal operation.	—
/N-CL	CN1-46 at low level when ON	Use reverse torque limit.	Limit: Pn405
	CN1-46 at high level when OFF	Do not use reverse torque limit. Normal operation.	—

The following output signals and monitor methods are used when torque is being limited.

Signal	Description
/CLT	Generated when Pn50F.0 is allocated to an output terminal from SO1 to SO3.
Monitor Mode (Un006)	—
<ul style="list-style-type: none"> Un005: Numbers 6 and 7 (With Default Settings) 	Refer to 7.1.7 <i>Operation in Monitor Mode</i> .
<ul style="list-style-type: none"> Un006: Depending on output signal allocation conditions. 	—

Application Examples:

- Forced stop.
- Robot holding a workpiece.

Parameter	Signal	Setting (%)	Control Mode
Pn404	Forward External Torque Limit	Range: 0 to 800 Default Setting: 100	Speed/Torque Control, Position Control
Pn405	Reverse External Torque Limit	Range: 0 to 800 Default Setting: 100	Speed/Torque Control, Position Control

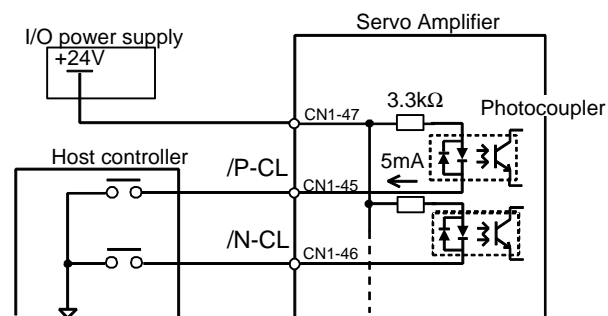
Set the torque limits when the torque is limited by an external contact input.

Setting	Description
/P-CL (CN1-45) Input	Pn404 torque limit applied.
/N-CL (CN1-46) Input	Pn405 torque limit applied.

See 5.2.9 *Using Torque Limiting by Analog Voltage Reference*.

Using /P-CL and /N-CL Signals

The procedure for using /P-CL and /N-CL as torque limit input signals is illustrated below.

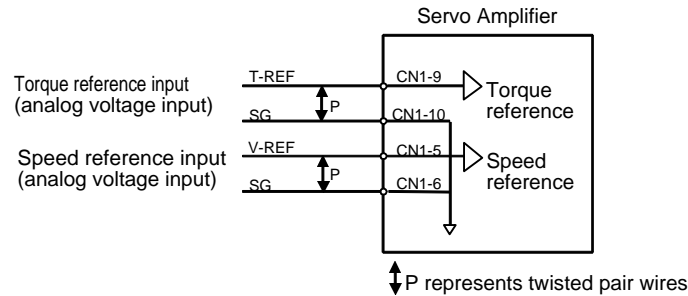


5.2 Settings According to Host Controller

This section describes the procedure for connecting a Sigma II Series servo to a host controller, including the procedure for setting related parameters.

5.2.1 Speed Reference

Input the speed reference using the input signal Speed Reference Input. Since this signal has various uses, set the optimum reference input for the system created.

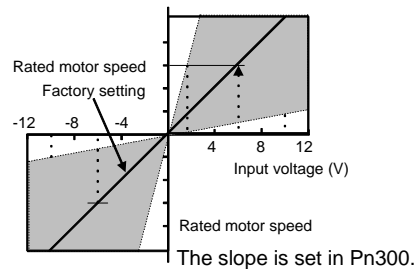


⇒ Input V-REF CN1-5	Speed Reference Input	Speed Control
⇒ Input SG CN1-6	Signal Ground	Speed Control

The above inputs are used for speed control (analog reference). (Pn000.1 = 0, 4, 7, 9, or A).

Always wire for normal speed control.

Refer to 7.1.7 *Operation in Monitor Mode*. The motor speed is controlled in proportion to the input voltage between V-REF and SG.



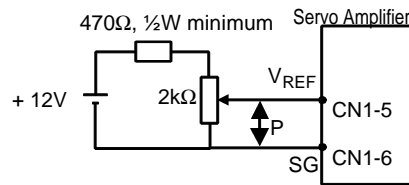
■ Setting Examples

Pn300 = 600: This setting means that 6V is equivalent to the rated motor speed.

Speed Reference Input	Rotation Direction	Motor Speed	SGMAH Servomotor
+6V	Forward rotation	Rated motor speed	3000rpm
+1V	Forward rotation	(1/6) rated motor speed	500rpm
-3V	Reverse rotation	(1/2) rated motor speed	1500rpm

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

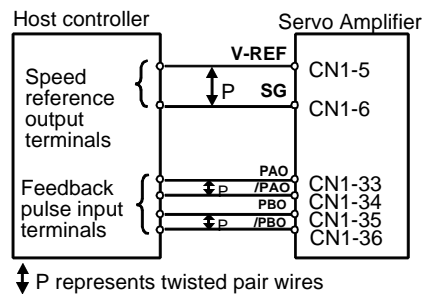
■ Input Circuit Example



- Always use twisted pair cable for noise control.

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, such as a programmable controller, for position control.

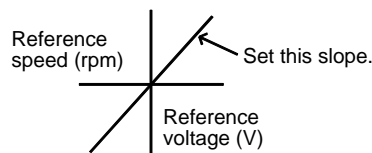


Adjust Pn300 according to the output voltage specifications of the host controller.

Adjust the speed reference input adjustment factor at the following parameter.

Parameter	Signal	Setting	Control Mode
Pn300	Speed Reference Input Adjustment Factor	Range: 150 to 3000 x (0.01V/ rated motor speed)	Speed Control

Set the voltage range for the speed reference input V-REF at CN1-5 according to host controller and external circuit output range.



The default setting is adjusted so that a 6V input is equivalent to the rated motor speed of all applicable servomotors.

Note: The maximum allowable voltage to the speed reference input (between CN1-5 and 6) is $\pm 12V_{DC}$.

Using the /P-CON Signal

⇒ Input P-CON CN1-41	Proportional Control Reference	Speed Control, Position Control
----------------------	--------------------------------	------------------------------------

The /P-CON input signal switches the Speed Control Mode from PI (proportional-integral) to P (proportional) control.

Proportional control can be used in the following two ways:

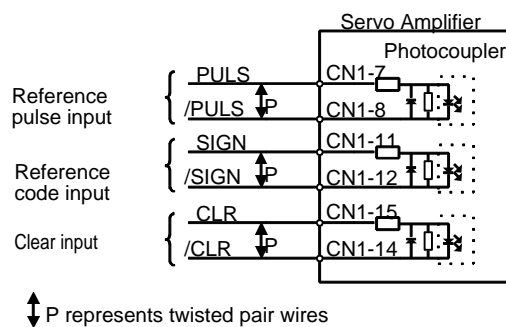
- When operation is performed by sending speed references from the host controller to the servo amplifier, the host controller can selectively use P control mode for particular conditions only. This method can prevent the occurrence of overshoot and also shorten settling time.
- If PI control mode is used when the speed reference has a reference offset, the motor may rotate at a very slow speed and fail to stop even if 0 is specified as a speed reference. In this case, use P control mode to stop the motor.

5.2.2 Position Reference

The reference pulse, reference code, and clear inputs are used for the position reference. Since this signal can be used in different ways, set the optimum reference input for the system created.

■ Reference by Pulse Input

Positioning is controlled by inputting a move reference pulse.



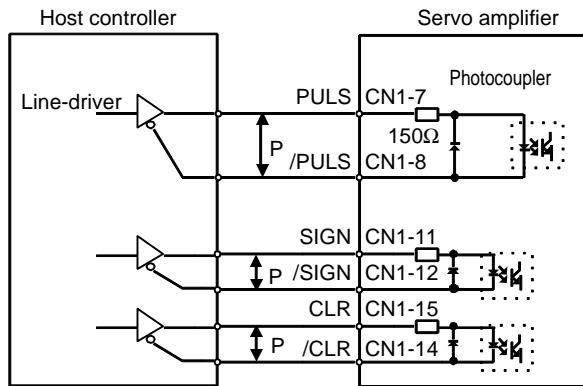
Any of the following forms can be used for the position reference:

- Line-driver output
- +12V open-collector output
- +5V open-collector output

Connection Example 1: Line-driver Output

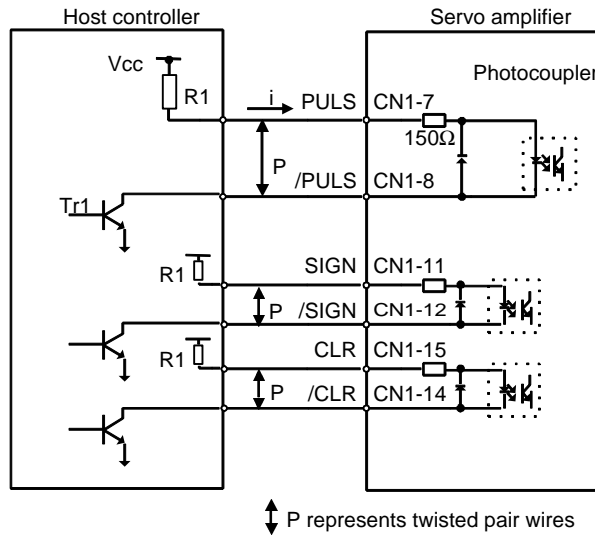
Applicable line driver: SN75174 manufactured by Texas Instruments Inc., MC3487

or equivalent



Connection Example 2: Open-collector Output

Set limiting resistor R1 so that input current, I, falls within the following range:



The examples below show how to select the pull-up resistor R1 so the input current, I, falls between 7 and 15mA.

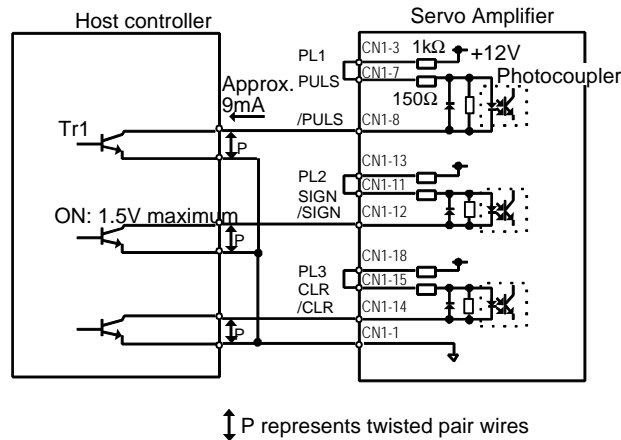
Application Examples of $V = IR$	
$R1 = 1k\Omega$ with $V_{CC} = 12V \pm 5\%$	$R1 = 180\Omega$ with $V_{CC} = 5V \pm 5\%$

Note: The following table shows the signal logic for an open-collector output.

Tr1 Output Level	Signal Logic
ON	Equivalent to high-level input
OFF	Equivalent to low-level input

This circuit uses the 12V power supply built into the servo amplifier. The input is

not isolated in this case.



Note: The noise margin of the input signal will decrease if the reference pulse is provided by an open-collector output. Set parameter Pn200.3 to 1 if the position drifts due to noise.

■ Selecting a Reference Pulse Form

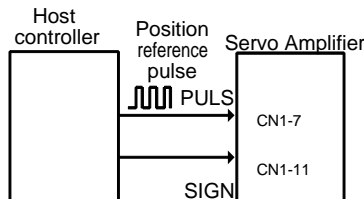
Use the following parameters to select the reference pulse form used.

⇒ Input PULS CN1-7	Reference Pulse Input	Position Control
⇒ Input /PULS CN1-8	Reference Pulse Input	Position Control
⇒ Input SIGN CN1-11	Reference Code Input	Position Control
⇒ Input /SIGN CN1-12	Reference Code Input	Position Control

The servomotor only rotates at an angle proportional to the input pulse.

Parameter	Signal	Setting Range	Control Mode
Pn200.0	Reference Pulse Form	Default Setting: 0	Position Control

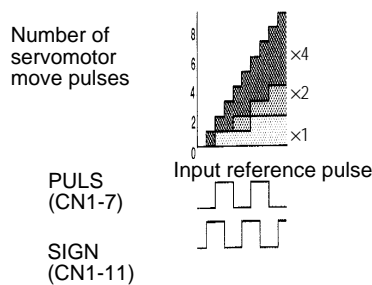
Set reference pulse form input to the servo amplifier from the host controller.



Since the reference pulse form can be selected from among those listed below, set one according to host controller specifications.

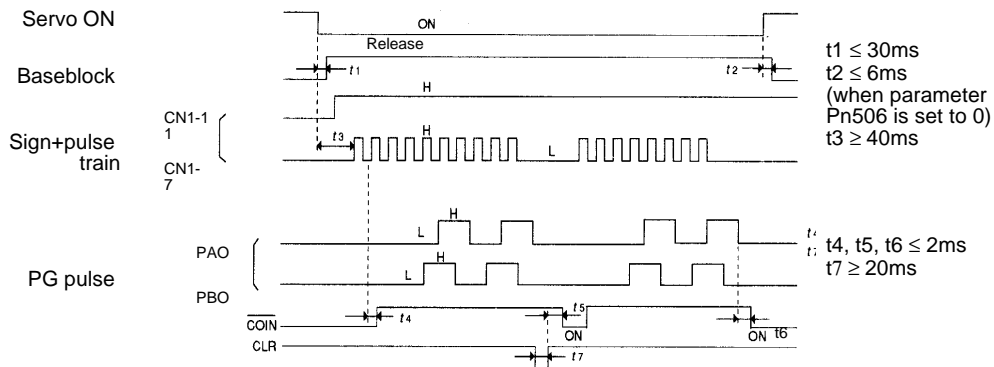
Parameter Pn200.0	Reference Pulse Form	Input Pulse Multiplier	Logic	Forward Rotation Reference	Reverse Rotation Reference
0	Sign + pulse train	-	Positive logic		
1	CW pulse + CCW pulse	-			
2	Two-phase pulse train with 90° phase differential	x1			
3		x2			
4		x4			
5	Sign + pulse train	-	Negative logic		
6	CW pulse + CCW pulse	-			
7	Two-phase pulse train with 90° phase differential	x1			
8		x2			
9		x4			

Input Pulse Multiplier



The input pulse multiplier function can be used if the reference pulse is a two-phase pulse train with a 90° phase differential. The electronic gear function can also be used to convert input pulses.

Example of I/O Signal Generation Timing



- Note:**
- In order for the input pulse to register, the interval from the time the servo ON signal is turned ON until a reference pulse is entered must be a minimum of 40ms.
 - The error counter clear signal must be on for at least 20 μs .

Reference Pulse Input Signal Timing

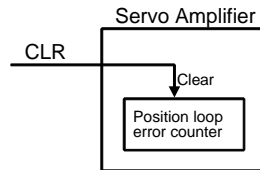
Reference Pulse Form	Electrical Specifications	
Sign + pulse train input (SIGN + PULS signal) Maximum reference frequency: 500kpps (200kpps open-collector output)	<p>$t_1, t_2 \leq 0.1\mu\text{s}$ $t_3, t_7 \leq 0.1\mu\text{s}$ $t_4, t_5, t_6 > 3\mu\text{s}$ $\tau \geq 1.0\mu\text{s}$ $(\tau/T) \times 100 \leq 50\%$</p>	Sign (SIGN) H = Forward reference L = Reverse reference
CW pulse and CCW pulse Maximum reference frequency: 500kpps (200kpps open-collector output)	<p>$t_1, t_2 \leq 0.1\mu\text{s}$ $t_3 > 3\mu\text{s}$ $\tau \geq 1.0\mu\text{s}$ $(\tau/T) \times 100 \leq 50\%$</p>	—
Two-phase pulse train with 90° phase differential (A phase + B phase) Maximum reference frequency $\times 1$: 500kpps (200kpps open-collector output) $\times 2$: 400kpps $\times 4$: 200kpps	<p>$t_1, t_2 \leq 0.1\mu\text{s}$ $\tau \geq 1.0\mu\text{s}$ $(\tau/T) \times 100 = 50\%$</p> <p>Forward reference: B phase leads A phase by 90° Reverse reference: B phase lags A phase by 90°</p>	Parameter Pn200.0 is used to switch the input pulse multiplier mode.

■ Error Counter Clear Input

The procedure for clearing the error counter is described below.

⇒ Input CLR CN1-15	Clear Input	Position Control
⇒ Input /CLR CN1-14	Clear Input	Position Control

The following occur when the CLR signal is set to high level.



- The error counter inside the servo amplifier is set to 0.
- Position loop control is prohibited.

Use this signal to clear the error counter from the host controller or select the following clear operation through parameter Pn200.1.

Parameter	Signal	Setting Range	Control Mode
Pn200.1	Error Counter Clear Signal Form	Default Setting: 0	Position Control

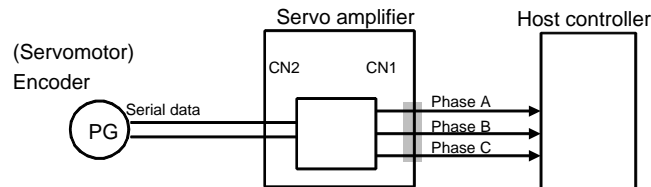
Select the pulse form for the error counter clear signal CLR (CN1-15).

Pn200.1 Setting	Description	Clear Timing
0	Clears the error counter when the CLR signal goes high. Error pulses do not accumulate as long as the signal remains high.	
1	Clears the error counter on the rising edge of the CLR signal. Clears the error counter only once on the rising edge of the CLR signal.	
2	Clears the error counter when the CLR signal goes low. Error pulses do not accumulate as long as the signal remains low.	
3	Clears the error counter on the falling edge of the CLR signal. Clears the error counter only once on the falling edge of the CLR signal.	

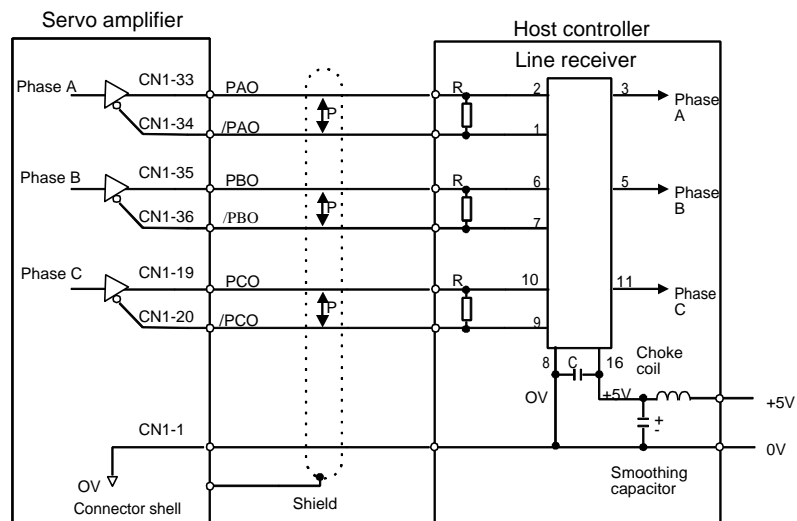
5.2.3 Using the Encoder Signal Output

Encoder output signals divided inside the servo amplifier can be output externally.

These signals can be used to form a position control loop in the host controller.



The output circuit is for line-driver output. Connect each signal line according to the following circuit diagram.



↕ P: Indicates twisted pair wires.

Note: **Dividing** means converting an input pulse train from the encoder mounted on the servomotor according to the preset pulse density and outputting the converted pulse. The units are pulses per revolution (ppr).

■ I/O Signals

I/O signals are described below.

Output ⇒ PAO CN1-33	Encoder Output Phase A	Speed/Torque Control, Position Control
Output ⇒ /PAO CN1-34	Encoder Output Phase /A	Speed/Torque Control, Position Control
Output ⇒ PBO CN1-35	Encoder Output Phase B	Speed/Torque Control, Position Control
Output ⇒ /PBO CN1-36	Encoder Output Phase /B	Speed/Torque Control, Position Control
Output ⇒ PCO CN1-19	Encoder Output Phase C	Speed/Torque Control, Position Control
Output ⇒ /PCO CN1-20	Encoder Output Phase /C	Speed/Torque Control, Position Control

Divided encoder signals are output.

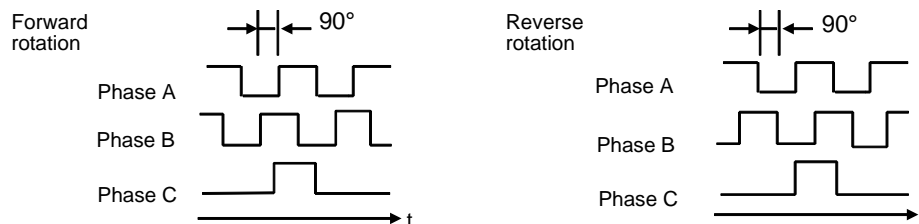
Always connect these signal terminals when a position loop is formed in the host controller for position control.

Set a dividing ratio at the following parameter.

PG Dividing Ratio	Pn201
--------------------------	-------

The dividing ratio setting is not related to the gear ratio setting (Pn202 and 203) for the servo amplifier electronic gear function during position control.

Output Phase Form



⇒ Input SEN CN1-4	SEN Signal Input	Speed/Torque Control
⇒ Input /SEN CN1-2	Signal Ground	Speed/Torque Control
Output ⇒ PSO CN1-48	Encoder Output Phase S	Speed/Torque Control, Position Control
Output ⇒ /PSO CN1-49	Encoder Output Phase /S	Speed/Torque Control, Position Control
⇒ Input BAT (+) CN1-21	Battery (+)	Speed/Torque Control, Position Control
⇒ Input /BAT (-) CN1-22	Battery (-)	Speed/Torque Control, Position Control

Use SEN to BAT (-) signals for absolute encoders. See 5.7 *Absolute Encoder* for more details.

Output ⇒ SG CN1-1	Signal ground	Speed/Torque Control, Position Control
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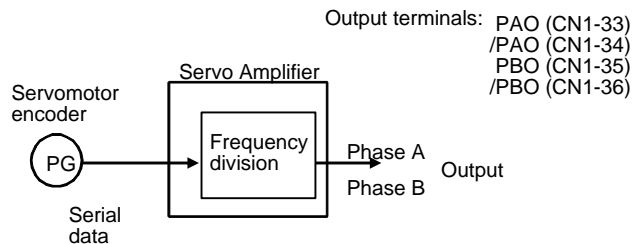
SG: Connect to 0V on the host controller.

■ Pulse Divider Setting

Set the pulse dividing ratio in the following parameter.

Parameter	Signal	Setting (p/rev)	Control Mode
Pn201	PG Divider	Range: 16 to 16384 Default Setting: 16384	Speed/Torque Control, Position Control

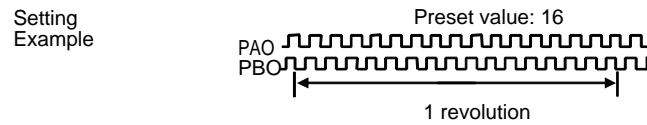
Set the number of pulses for PG output signals (PAO, /PAO, PBO, /PBO).



Pulses from the servomotor encoder (PG) are divided by the preset number before being output.

The number of output pulses per revolution is set at this parameter. Set the value using the reference units of the equipment or the controller used.

The setting range varies with the encoder used.



Servomotor Model and Encoder Specifications	Resolution (Bits)	Number of Encoder Pulses Per Revolution (p/rev)	Setting Range
A	13	2048	16 to 2048
B, 1	16	16384	16 to 16384
C, 2	17		

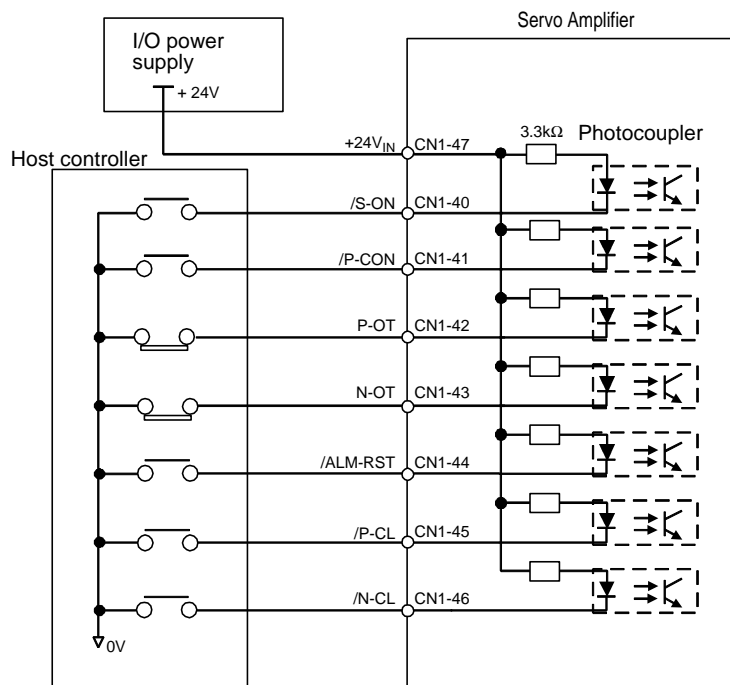
- Note:**
1. Turn OFF power once and turn ON again after changing the parameter.
 2. A 13-bit encoder will run at 2048p/rev even if the setting at Pn201 is set higher than 2049.

5.2.4 Sequence I/O Signals

Sequence I/O signals are used to control servo amplifier operation. Connect these signal terminals as required.

■ Input Signal Connections

Connect the sequence input signals as shown below.



Note: Provide a separate external I/O power supply; the servo amplifier does not have an internal 24V power supply.

- External power supply specifications: 24V \pm 1 V_{DC}, 50mA minimum.

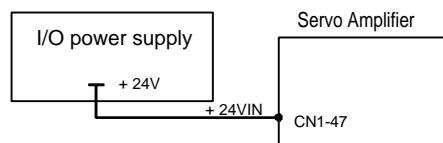
Yaskawa recommends using the same type of external power supply as that used for output circuits.

The function allocation for sequence input signal circuits can be changed.

See 5.3.3 *Input Circuit Signal Allocation* for more details.

⇒ Input +24VIN CN1-47	External I/O Power Supply Input	Speed/Torque Control, Position Control
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The external power supply input terminal is common to sequence input signals.



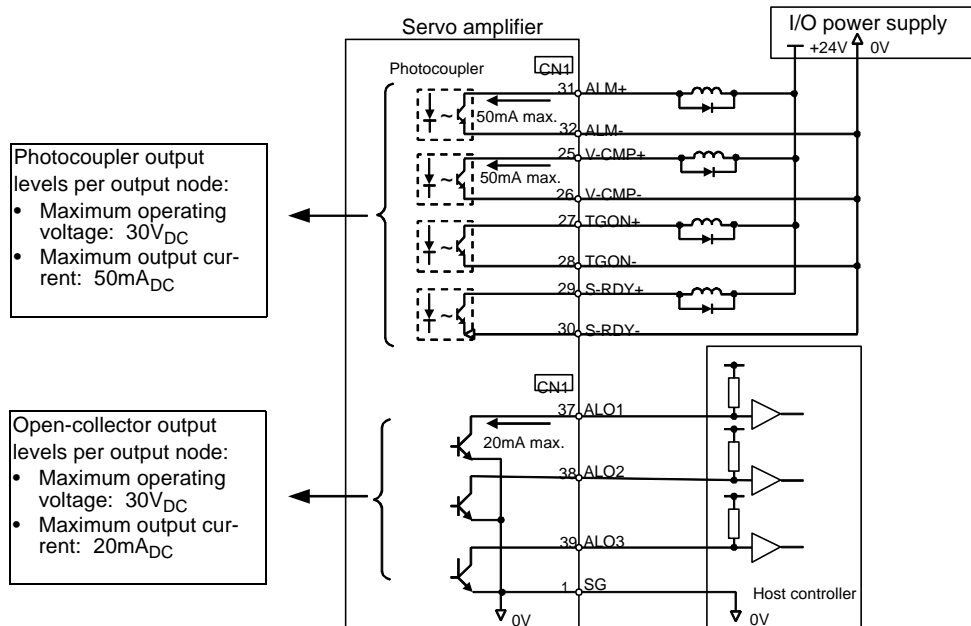
Connect an external I/O power supply.

Contact input signals:

- /S-ON (CN1-40)
- /P-CON (CN1-41)
- P-OT (CN1-42)
- N-OT (CN1-43)
- /ALM-RST (CN1-44)
- /P-CL (CN1-45)
- /N-CL (CN1-46)

■ Output Signal Connections

Connect the sequence output signals as shown in the following figure.



Note: Provide a separate external I/O power supply; the servo amplifier does not have an internal 24V power supply. Yaskawa recommends using the same type of external power supply as that used for input circuits.

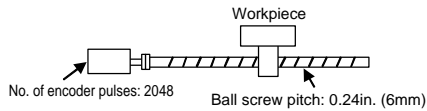
Function allocation for some sequence output signal circuits can be changed.

See 5.3.4 *Output Circuit Signal Allocation* for more details.

5.2.5 Using the Electronic Gear Function

The electronic gear function enables the servomotor travel distance per input reference pulse to be set to any value. It allows the pulses generated by the host controller to be used for control without having to consider the equipment gear ratio or the number of encoder pulses.

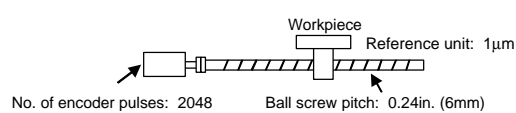
When the Electronic Gear Function is Not Used



To move a workpiece 0.39in. (10mm):

1 revolution = 6mm. Therefore,
 $10 \div 6 = 1.6667$ revolutions.
 (2048×4) pulses = 1 revolution. So,
 $(1.6667 \times 2048 \times 4) = 13653$ pulses
 13653 pulses are input as the reference.
 The equation must be calculated at the host controller.

When the Electronic Gear Function is Used



To move a workpiece 0.39in. (10mm):

Equipment conditions and reference units must be defined for the electronic gear function beforehand.

Reference unit is 1µm. Therefore,

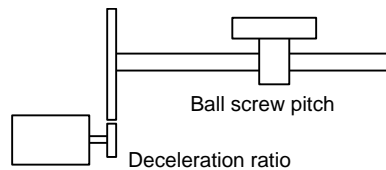
$$\frac{10\text{mm}}{1\mu\text{m}} = 10000 \text{ pulses}$$

■ Setting the Electronic Gear

Calculate the electronic gear ratio (B/A) using the following procedure, and set the values in parameters Pn202 and 203.

1. Check equipment specifications related to the electronic gear:

- Deceleration ratio
- Ball screw pitch
- Pulley diameter



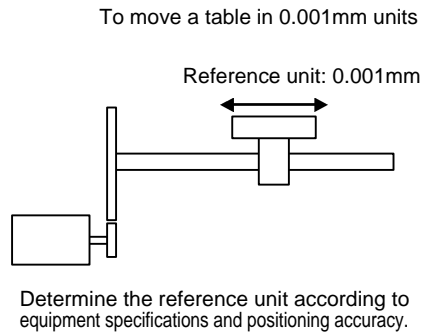
2. Check the number of encoder pulses for the SGM□H servomotor.

Servomotor Model and Encoder Specifications	Encoder Type	Number of Encoder Pulses Per Revolution (p/rev)	
A	Incremental encoder	13-bit	2048
B		16-bit	16384
C		17-bit	32768
1	Absolute encoder	16-bit	16384
2		17-bit	32768

Note: The number of bits representing the resolution of the applicable encoder is not the same as the number of encoder signal pulses (A and B phase) output from the servo amplifier.

3. Determine the reference unit used.

A reference unit is the minimum position data unit used to move a load. (Minimum unit of reference from the host controller).



Examples (in mm):

- Reference unit can be 0.1in., or 0.01in., or 0.01mm, or 0.001mm, etc. A reference unit of one pulse moves the load by one reference unit.
- When the reference unit is 1 μ m
If a reference of 50000 units is input, the load moves 50mm (1.97in.)
(50000 \times 0.001mm = 50mm).

4. Determine the load travel distance per load shaft revolution in reference units.

$$\text{Travel distance per load shaft revolution} = \frac{\text{Travel distance per load shaft revolution}}{\text{Reference Unit}}$$

- When the ball screw pitch is 0.20in. (5mm) and the reference unit is 0.00004in. (0.001mm),

$$\frac{0.20}{0.00004} = 5000(\text{reference units})$$

Ball Screw	Disc Table	Belt and Pulley
<p>Load shaft</p> <p>P: Pitch</p> <p>1 revolution = $\frac{P}{\text{reference unit}}$</p>	<p>Load shaft</p> <p>360°</p> <p>1 revolution = $\frac{360^\circ}{\text{reference unit}}$</p>	<p>Load shaft</p> <p>D: Pulley</p> <p>1 revolution = $\frac{\pi D}{\text{reference unit}}$</p>

5. Electronic gear ratio is given as: $\left(\frac{B}{A}\right)$

If the gear ratio of the motor and the load shaft is given as: $\frac{m}{n}$

where m is the rotation of the motor and n is the rotation of the load shaft,

$$\text{Electronic gear ratio } \left(\frac{B}{A}\right) = \frac{\text{Number of encoder pulses} \times 4}{\text{Travel distance per load shaft revolution (reference unit)}} \times \frac{n}{m}$$

Note: Make sure the electronic gear ratio satisfies the following condition:

$$0.01 \leq \text{Electronic gear ratio } \left(\frac{B}{A}\right) \leq 100$$

The servo amplifier will not work properly if the electronic gear ratio exceeds this range. In that case, modify either the load configuration or the reference unit.

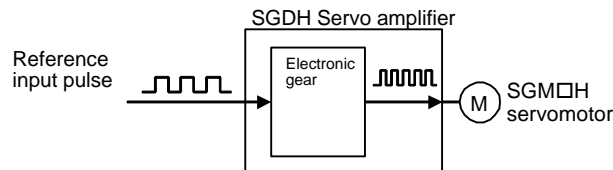
6. Set the parameters.

Reduce the electronic gear ratio to the lower terms so that both A and B are integers smaller than 65535, then set A and B in the respective parameters:

$\left(\frac{B}{A}\right)$	Pn202	Electronic Gear Ratio (Numerator)
	Pn203	Electronic Gear Ratio (Denominator)

Parameter	Signal	Setting	Control Mode
Pn202	Electronic Gear Ratio (Numerator)	Range: 1 to 65535 Default Setting: 4	Position Control
Pn203	Electronic Gear Ratio (Denominator)	Range: 1 to 65535 Default Setting: 1	Position Control

Set the electronic gear ratio according to equipment specifications.



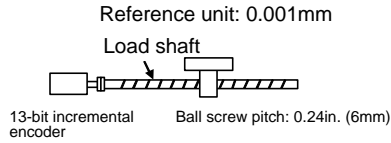
$$\text{Electronic gear ratio} = \left(\frac{B}{A}\right) = \frac{\text{Pn202}}{\text{Pn203}}$$

- $B = [(\text{Number of encoder pulses}) \times 4] \times [\text{motor speed}]$
- $A = [\text{Reference units (travel distance per load shaft revolution)}] \times [\text{load shaft revolution speed}]$

■ Electronic Gear Setting Examples

The following examples show electronic gear settings for different load mechanisms.

Ball Screws

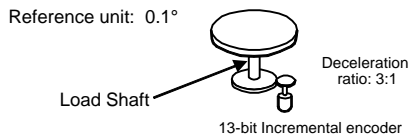


$$\text{Travel distance per load shaft revolution} = \frac{0.24\text{in.}}{0.0004\text{in.}} = 6000$$

$$\text{Electronic gear ratio} = \left(\frac{B}{A}\right) = \frac{2048 \times 4 \times 1}{6000} = \frac{\text{Pn202}}{\text{Pn203}}$$

Preset Values	Pn202	8192
	Pn203	6000

Circular Tables



$$\text{Travel distance per load shaft revolution} = \frac{360^\circ}{0.1^\circ} = 3600$$

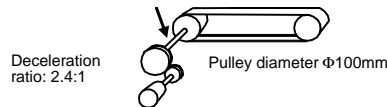
$$\text{Electronic gear ratio} = \left(\frac{B}{A}\right) = \frac{2048 \times 4 \times 1}{3600} = \frac{\text{Pn202}}{\text{Pn203}}$$

Preset Values	Pn202	24576
	Pn203	3600

Belts and Pulleys

Reference unit: 0.0010in. (0.0254mm)

Load shaft



Set a PG dividing ratio equivalent to 1024p/rev for the absolute encoder

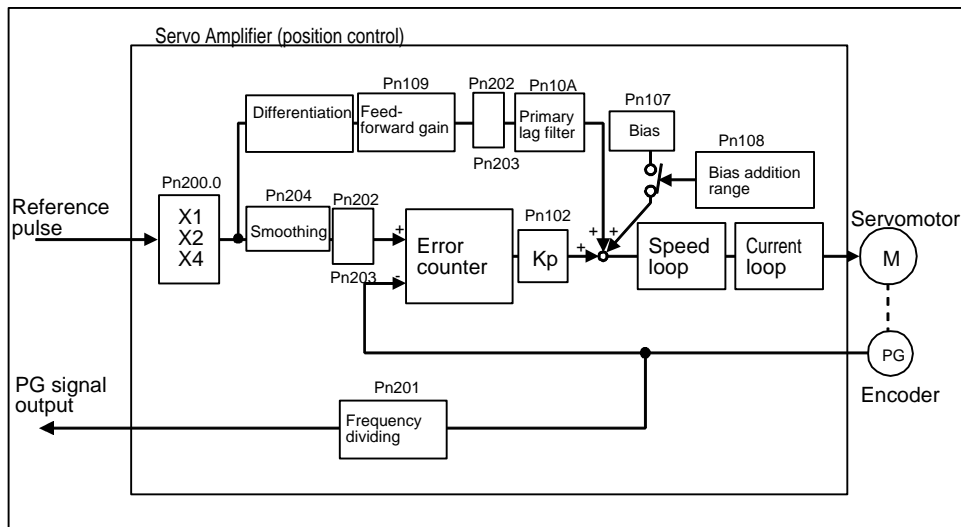
$$\text{Travel distance per load shaft revolution} = \frac{3.14 \times 0.03937\text{in.}}{0.0010\text{in.}} = 12362$$

$$\begin{aligned} \text{Electronic gear ratio} &= \left(\frac{B}{A}\right) = \frac{1024 \times 4 \times 2.4}{12362} = \frac{\text{Pn202}}{\text{Pn203}} \\ &= \frac{9830.4}{12362} = \frac{49152}{61810} \end{aligned}$$

Preset Values	Pn202	49152
	Pn203	61810

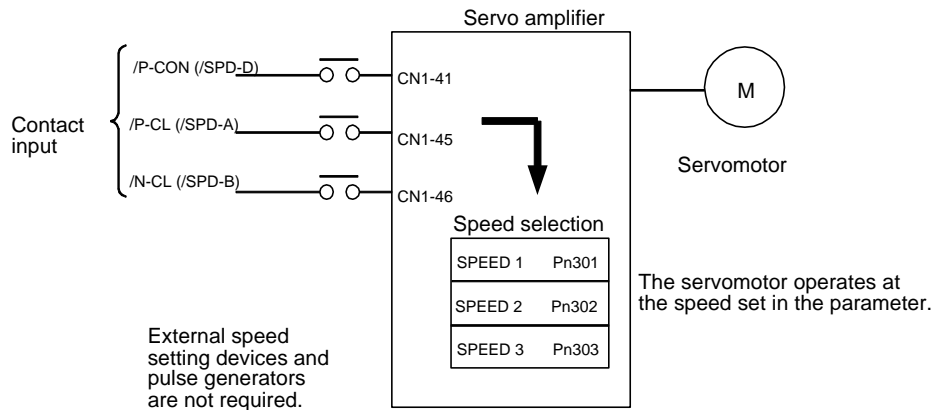
■ Control Block Diagram

The following diagram illustrates a control block for position control.



5.2.6 Contact Input Speed Control

This function provides a method for easy speed control. It allows the user to initially set three different motor speeds with parameters, and then select one of the speeds externally using a contact input.



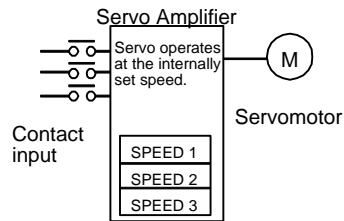
■ Using Contact Input Speed Control

Follow steps 1 to 3 below to use the contact input speed control function.

1. Set contact input speed control as shown below.

Parameter	Signal	Setting	Control Mode
Pn000.1	Control Mode Selection	Default Setting: 0	Speed/Torque Control, Position Control

The speed can be controlled via contact inputs.



Meanings for the following signals change when the contact input speed control function is used.

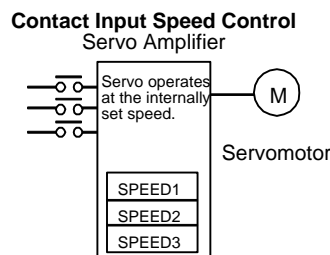
Pn000.1 Setting	Description	Input Signal			
0, 1, 2, 7, 8, 9, A, B	Contact input speed control function not used.	/P-CON (CN1-41)		Used to switch between P and PI control.	
		/P-CL (CN1-45)		Used to switch between forward external torque limit ON and OFF.	
		/N-CL (CN1-46)		Used to switch between reverse external torque limit ON and OFF.	
3, 4, 5, 6	Contact input speed control function used.	/P-CON (/SPD-D)	/P-CL (/SPD-A)	/N-CL (/SPD-B)	Speed setting
		Direction of rotation 0:Forward 1:Reverse	0	0	0 reference, etc.
			0	1	SPEED 1 (Pn301)
			1	1	SPEED 2 (Pn302)
1	0	SPEED 3 (Pn303)			

- Note:**
1. 0: OFF (high level); 1: ON (low level)
 2. /P-CON, /P-CL and /N-CL functions differ from those in the table above when Pn000.1 is set to 3, 4, 5, or 6. The function is switched automatically when Pn50A. 0 is set to 0.
 3. The /SPD-D, /SPD-A, and /SPD-B signals can be used only when signals are allocated to the input circuits. See 5.3.3 *Input Circuit Signal Allocation*.

2. Set the motor speeds with the following parameters.

Parameter	Signal	Setting (rpm)	Control Mode
Pn301	Speed 1 (SPEED 1) (Contact Input Speed Control)	Range: 0 to 10000 Default Setting: 100	Speed Control
Pn302	Speed 2 (SPEED 2) (Contact Input Speed Control)	Range: 0 to 10000 Default Setting: 200	Speed Control
Pn303	Speed 3 (SPEED 3) (Contact Input Speed Control)	Range: 0 to 10000 Default Setting: 300	Speed Control

These parameters are used to set motor speeds when the contact input speed control function is selected. If the setting is higher than the maximum motor speed of the servomotor, then the servomotor will rotate at its maximum speed.



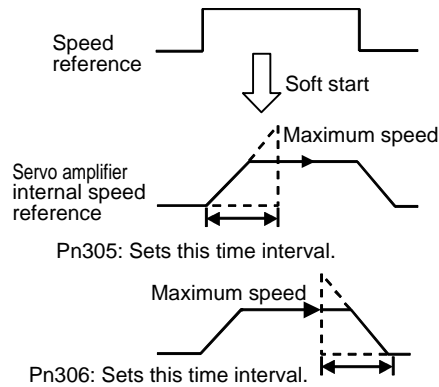
Speed selection input signals /P-CL(SPD-A)(CN1-45) and /N-CL (/SPD-B) (CN1-46) and the rotation direction selection signal /P-CON (/SPD-D)(CN1-41) enable the servomotor to run at the preset speeds.

3. Set the soft start time.

Parameter	Signal	Setting (ms)	Control Mode
Pn305	Soft Start Acceleration Time	Setting Range: 0 to 10000 Default Setting: 0	Speed Control
Pn306	Soft Start Deceleration Time	Setting Range: 0 to 10000 Default Setting: 0	Speed Control

The servo amplifier internal speed reference controls speed by applying this acceler-

ation setting.



Smooth speed control can be performed by entering a progressive speed reference or using contact input speed control. Set each constant to 0 for normal speed control.

Set each parameter to the following time intervals.

- Pn305: Time interval from when the servomotor starts until it reaches maximum speed.
- Pn306: Time interval from when the servomotor maximum speed until it stops.

■ Operation by Contact Input Speed Control

The following describes operation by contact input speed control.

Start and Stop

The following input signals are used to start and stop the servomotor.

⇒ Input /P-CL CN1-45	Speed Selection 1 (Forward External Torque Limit Input)	Speed/Torque Control, Position Control
⇒ Input /N-CL CN1-46	Speed Selection 2 (Reverse External Torque Limit Input)	Speed/Torque Control, Position Control

Use the following table when contact input speed control is used.

Contact Signal			Parameter	Selected Speed
/P-CON (/SPD-D)	/P-CL (/SPD-A)	/N-CL (/SPD-B)	Pn000.1	
-	0	0	3	Stopped by an internal speed reference of 0.
			4	Analog speed reference (V-REF) input
			5	Pulse reference input (position control)
			6	Analog torque reference input (torque control)
Direction of rotation 0: Forward 1: Reverse	0	1	3, 4, 5, 6Common	SPEED 1 (Pn301)
	1	1		SPEED 2 (Pn302)
	1	0		SPEED 3 (Pn303)

- Note:** 1. 0: OFF (high level); 1: ON (low level)
2. Input signals indicated by the horizontal bar (-) are optional.

- When contact input speed control is not used, input signals are used as external torque limit inputs.

Note: The contact input speed control function is used only when signals are allocated to /SPD-D, /SPD-A, and /SPD-B.

Direction of Rotation Selection

The input signal /P-CON(/SPD-D) is used to specify the direction of servomotor rotation.

⇒ Input /P-CON CN1-41	Proportional Control Reference, etc.	Speed/Torque Control, Position Control
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- When contact input speed control is used, the input signal /P-CON (/SPD-D) specifies the direction of Servomotor rotation.

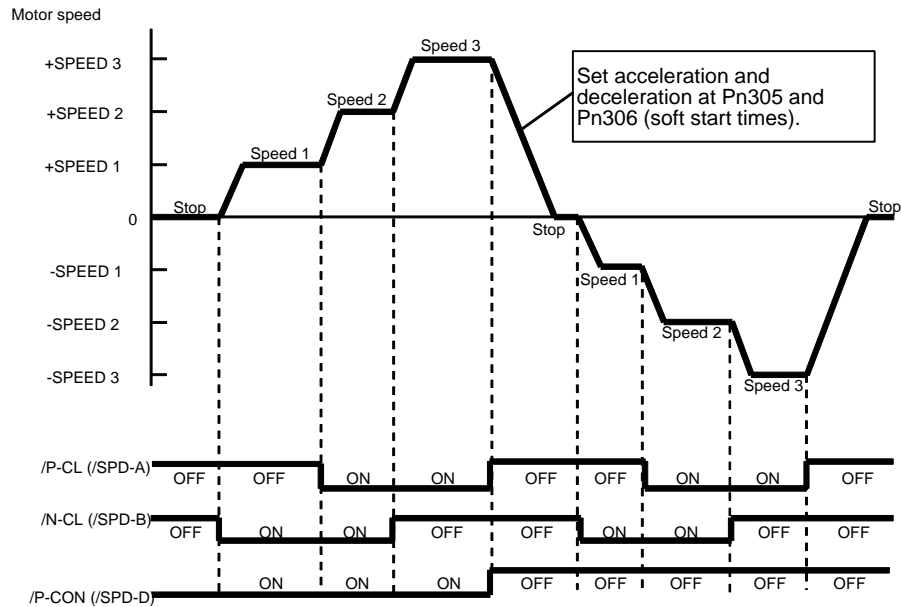
/P-CON (/SPD-D) Input Level	Signal Logic
0	Forward rotation
1	Reverse rotation

Note: 0: OFF (high level); 1: ON (low level)

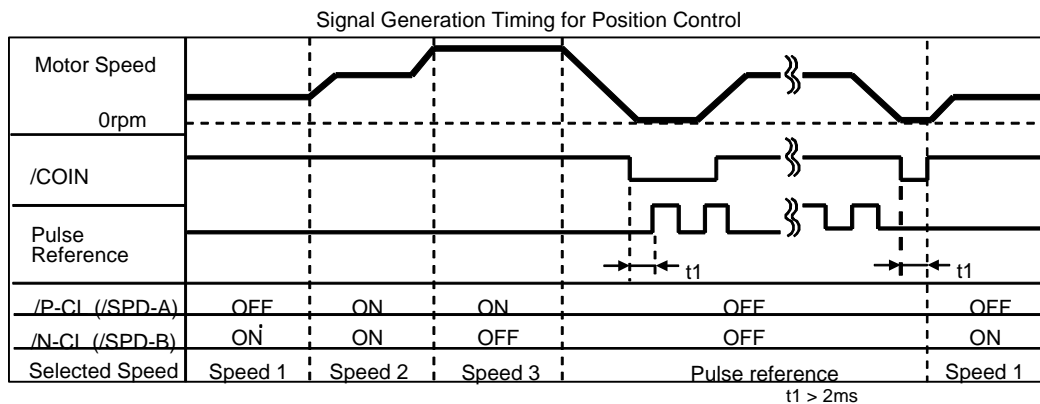
- When contact input speed control is not used, the /P-CON signal is used for proportional control, zero clamping, and torque/speed control switching.

■ Example of Contact Input Speed Control Operation

The following example shows operation by contact input speed control. Using the soft start function reduces physical shock when the speed is changed.



Note: The soft start function is available only when contact input speed control is used with Pn000.1 set to 5, and is not available when a pulse reference input is used. If the Contact Input Speed Control Mode is switched to Pulse Reference Input Mode while the servomotor is operating at speed 1, speed 2, or speed 3, the servo amplifier will not receive a reference pulse until the positioning completed signal /COIN is output. Always start pulse reference output from the host controller after a positioning completed signal is output from the servo amplifier.



1. The above figure illustrates signal generation timing when the soft start function is used.
2. The value of $t1$ is not affected by the use of the soft start function. A maximum 2ms delay occurs when the /PC-L(/SPD-A) or /N-CL(/SPD-B) signal is read. 1

5.2.7 Using Torque Control

The SGDH servo amplifier limits torque as shown below.

- Level 1: Limits maximum output torque to protect the equipment or workpiece.
- Level 2: Limits torque after the Servomotor moves the equipment to a specified position (internal torque limit).
- Level 3: Always control torque rather than speed output.
- Level 4: Switches between speed and torque control.

The following describes uses for levels 3 and 4 in the torque control function.

■ Torque Control Selection

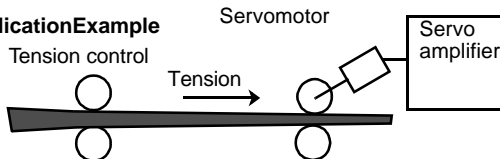
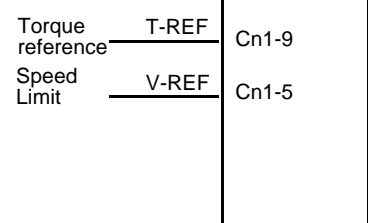
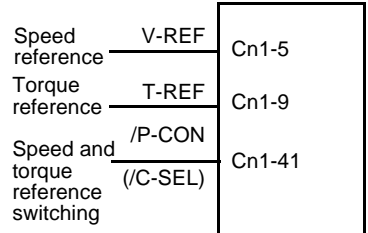
Set in the following parameters to select level 3 or 4 torque control.

Parameter	Signal	Setting	Control Mode
Pn000.1	Control Method Selection	Default Setting: 0	Speed/Torque Control, Position Control

A torque reference is entered from the host controller to the servo amplifier in order to control torque.

Application Examples

- Tension control
- Pressure control

Pn000.1	Control Mode							
2	<p>Torque Control This is a dedicated Torque Control Mode.</p> <ul style="list-style-type: none"> •A torque reference is input from T-REF (CN1-9). •Speed reference input V-REF (CN1-5) cannot be used for speed control if Pn002.1 is set to 1. •Parameter Pn407 can be used for maximum speed control. <p>Application Example</p> 	<p style="text-align: right;">Servo amplifier</p> 						
9	<p>Torque Control <-> Speed Control (Analog Reference) Switches between torque and speed control</p> <ul style="list-style-type: none"> •V-REF (CN1-5) inputs a speed reference or speed limit. •T-REF (CN1-9) inputs a torque reference, torque feed-forward reference or torque limit depending on the control mode. •/P-CON (/C-SEL)(CN1-41) is used to switch between torque and speed control. <table border="1" data-bbox="462 1060 868 1207"> <thead> <tr> <th>CN1-41 State</th> <th>Selects</th> </tr> </thead> <tbody> <tr> <td>Open</td> <td>Torque Control</td> </tr> <tr> <td>0V</td> <td>Speed Control</td> </tr> </tbody> </table> <p>Torque Control: When /P-CON (/C-SEL) is OFF</p> <ul style="list-style-type: none"> •The T-REF reference controls torque. •V-REF can be used to limit servomotor speed when Pn002.1 is set to 1. V-REF voltage (+) limit servomotor speed during forward and reverse rotation. •parameter Pn407 can be used to limit the maximum servomotor speed. 	CN1-41 State	Selects	Open	Torque Control	0V	Speed Control	<p style="text-align: right;">Servo amplifier</p> 
CN1-41 State	Selects							
Open	Torque Control							
0V	Speed Control							

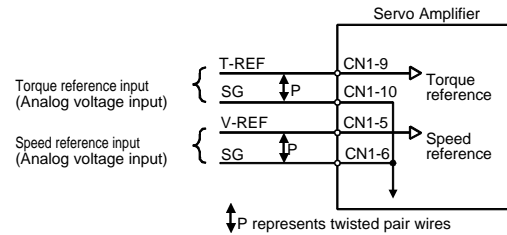
Pn000.1	Control Method																						
9	<p>Speed Control: When /P-CON (/C-SEL) is ON Set the parameter Pn002.0 as shown below.</p> <table border="1" data-bbox="431 348 1386 709"> <thead> <tr> <th>Parameter Pn002.0 State</th> <th>Speed Reference Input (V-REF) (CN1-5,6)</th> <th>Torque Reference Input (T-REF) (CN1-9,10)</th> <th>Comments</th> </tr> </thead> <tbody> <tr> <td rowspan="2">0</td> <td colspan="2">Speed Control</td> <td rowspan="2"></td> </tr> <tr> <td>Speed Reference</td> <td>Cannot be used.</td> </tr> <tr> <td rowspan="2">1</td> <td colspan="2">Torque limit speed control by analog voltage reference</td> <td rowspan="2">See 5.2.9 for more details on torque limit speed control by analog voltage reference.</td> </tr> <tr> <td>Speed Reference</td> <td>Torque Limit</td> </tr> <tr> <td rowspan="2">2</td> <td colspan="2">Speed control with torque feed-forward</td> <td rowspan="2">See 5.2.8 for more details on torque feed-forward speed control.</td> </tr> <tr> <td>Speed reference</td> <td>Torque feed-forward</td> </tr> </tbody> </table>	Parameter Pn002.0 State	Speed Reference Input (V-REF) (CN1-5,6)	Torque Reference Input (T-REF) (CN1-9,10)	Comments	0	Speed Control			Speed Reference	Cannot be used.	1	Torque limit speed control by analog voltage reference		See 5.2.9 for more details on torque limit speed control by analog voltage reference.	Speed Reference	Torque Limit	2	Speed control with torque feed-forward		See 5.2.8 for more details on torque feed-forward speed control.	Speed reference	Torque feed-forward
Parameter Pn002.0 State	Speed Reference Input (V-REF) (CN1-5,6)	Torque Reference Input (T-REF) (CN1-9,10)	Comments																				
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	Speed Reference	Torque Limit																					
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	Speed reference	Torque feed-forward																					
8	<p>Position Control ↔ Torque Control Can be used to switch between speed (contact reference) and torque control. •/P-CON (/C-SEL)(CN1-41) is used to switch control.</p> <table border="1" data-bbox="701 831 1104 978"> <thead> <tr> <th>CN1-41 State</th> <th>Selects</th> </tr> </thead> <tbody> <tr> <td>Open</td> <td>Position Control</td> </tr> <tr> <td>0V</td> <td>Torque Control</td> </tr> </tbody> </table>	CN1-41 State	Selects	Open	Position Control	0V	Torque Control																
CN1-41 State	Selects																						
Open	Position Control																						
0V	Torque Control																						
6	<p>Speed Control (Contact Reference) ↔ Torque Control Can be used to switch between speed (contact reference) and torque control. •/P-CON (/C-SEL)(CN1-45) and /N-CL(SPD-B)(CN1-46) are used to switch control.</p> <table border="1" data-bbox="454 1102 1243 1381"> <thead> <tr> <th>Parameter /P-CL (/SPD-A) CN1-45 State</th> <th>Parameter /N-CL (/SPD-N) CN1-46 State</th> <th></th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>Torque Control</td> </tr> <tr> <td>0</td> <td>1</td> <td rowspan="3">Speed Control (Contact reference)</td> </tr> <tr> <td>1</td> <td>1</td> </tr> <tr> <td>1</td> <td>0</td> </tr> </tbody> </table>	Parameter /P-CL (/SPD-A) CN1-45 State	Parameter /N-CL (/SPD-N) CN1-46 State		0	0	Torque Control	0	1	Speed Control (Contact reference)	1	1	1	0									
Parameter /P-CL (/SPD-A) CN1-45 State	Parameter /N-CL (/SPD-N) CN1-46 State																						
0	0	Torque Control																					
0	1	Speed Control (Contact reference)																					
1	1																						
1	0																						

Note: Input signal /C-SEL can be used only when a signal is allocated to the input circuit. See 5.3.3 *Input Circuit Signal Allocation*.

■ Input Signals

Torque Reference Inputs

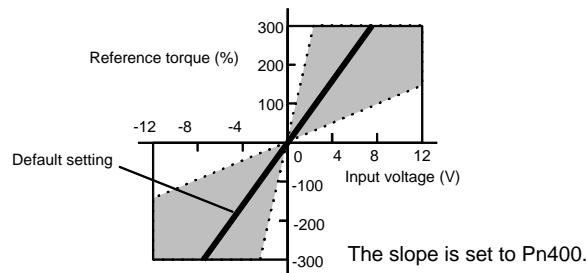
The following input signals are used for torque control.



⇒ Input T-REF CN1-9	Torque Reference Input	Speed/Torque Control
⇒ Input SG CN1-10	Signal Ground for the Torque Reference Input	Speed/Torque Control

These signals are used when torque control is selected.

Servomotor torque is controlled so that it is proportional to the input voltage between T-REF and SG.



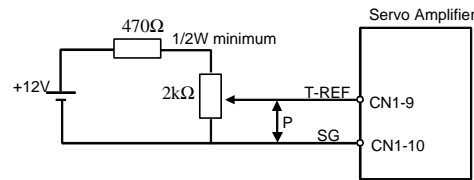
■ Default Settings

Parameter Pn400 establishes the voltage level that applies rated torque.

For example:

With Pn400 = 30	
VIN (V)	Resulting Applied Torque
+3	100% of rated torque in the forward direction
+9	300% of rated torque in the forward direction
-0.3	10% of rated torque in the reverse direction

■ Example of an Input Circuit



Note:

- Always use twisted pair cables for noise control.
- Recommended variable resistor: Model 25HP-10B manufactured by Sakae Tsushin Kogyo Co., Ltd.

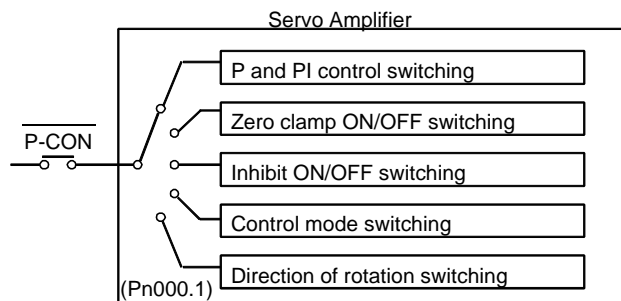
Speed Reference Inputs

Refer to Section 5.2.1.

Using the /P-CON Signal

⇒ Input /P-CON CN1-41	Proportional Control Reference, etc.	Speed/Torque Control, Position Control
-----------------------	--------------------------------------	--

The function of the input signal /P-CON varies with the setting applied to Pn000.1.



Pn000.1 Setting	/P-CON Function
0, 1	Switches between P (proportional) and PI (proportional-integral) control.
2	Not used.
3, 4, 5, 6	Switches the direction of rotation in Contact Input Speed Control Mode.
7, 8, 9	Switches the control mode.
A	Turns ON/OFF zero clamp.
B	Turns inhibit ON/OFF.

Note: The /P-CON signal function switches automatically when Pn50A.0 is set to 0.

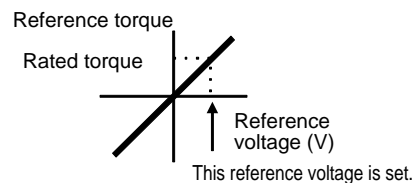
■ Torque Control Parameter

The following parameter is used for torque control. Set the parameter according to requirements of the servo system that is used.

Parameter	Signal	Setting (0.1V x rated torque)	Control Mode
Pn400	Torque Reference Input Gain	Setting Range: 10 to 100 Default Setting: 30	Speed/Torque Control

This parameter sets the voltage range for torque reference input T-REF (CN1-9) depending on the output range of the host controller or external circuit.

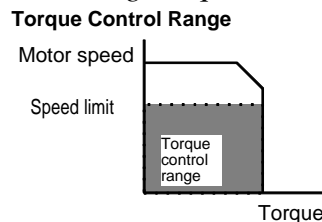
The default setting is 30, so the rated torque output is equal to 3V (30×0.1).



Parameter	Signal	Setting (rpm)	Control Mode
Pn407	Speed Limit during Torque Control	Setting Range: 0 to 10000 Default Setting: 10000	Speed/Torque Control

This parameter sets a motor speed limit when torque control is selected. It is used to prevent excessive equipment speed during torque control.

Since the speed limit detection signal /VLT functions the same in torque control as the /CLT signal, see 5.1.3 *Limiting Torque*, where the /CLT signal is described.

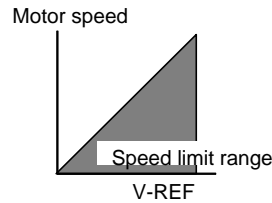


The maximum speed of the servomotor will be used if Pn407 is set to a value higher than the maximum speed of the servomotor.

Principle of Speed Limit:

When the control speed range is exceeded, torque, inversely proportional to the difference between the speed limit and the actual speed, is fed back in order to return the system to a level within the control speed range. In effect, the actual motor speed

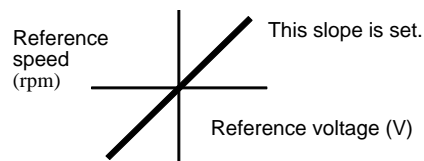
limit depends on the load condition.



Parameter	Signal	Setting (no units)	Control Mode
Pn300	Speed Reference Input Adjustment Factor (SRF) ($0.01V \times SRF = \text{Rated Speed}$)	Setting Range: 150 to 3000 Default Setting: 600	Speed/Torque Control

This parameter sets the voltage range for speed reference input V-REF (CN1-5) according to the output range of the host controller or external circuit.

When the default setting (600) is multiplied by 0.01V, the result (6V) corresponds to the rated motor speed.



5.2.8 Torque Feed-Forward Function

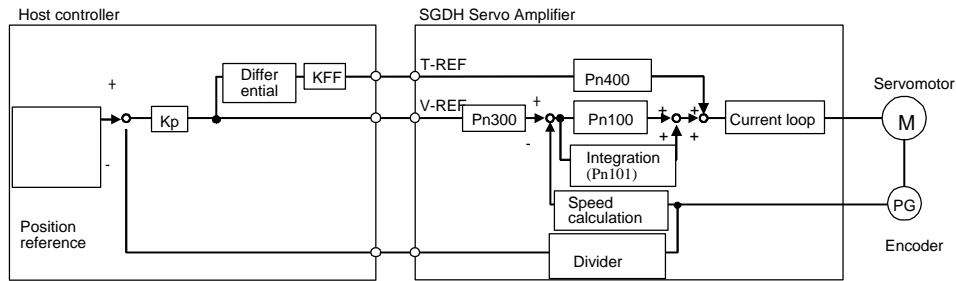
The torque feed-forward function is used only in speed control (analog reference). This function is used to:

- Shorten positioning time.
- Differentiate a speed reference at the host controller to generate a torque feed-forward reference.
- Input this reference together with the speed reference to the servo amplifier.

Too high a torque feed-forward value will result in overshooting or undershooting. To prevent this, set the optimum value while closely observing the system response.

Connect a speed reference signal to V-REF (CN1-5 and 6) and a torque feed-forward

reference signal to T-REF (CN1-9 and 10).



■ Using the Torque Feed-Forward Function

To use the torque feed-forward function, set the following parameter to 2.

Parameter	Signal	Setting (rpm)	Control Mode
Pn002.0	Speed Control Option (T-REF Terminal Allocation)	Default Setting: 0	Speed/Torque Control

This setting enables the torque feed-forward function.

Pn002.0 Setting	T-REF Function
0	None.
1	T-REF terminal used for external torque limit input.
2	T-REF terminal used for torque feed-forward input.

The torque feed-forward function cannot be used with the torque limiting by analog voltage reference function described in 5.2.9 *Using Torque Limiting by Analog Voltage Reference*.

■ Setting

Torque feed-forward is set using parameter Pn400.

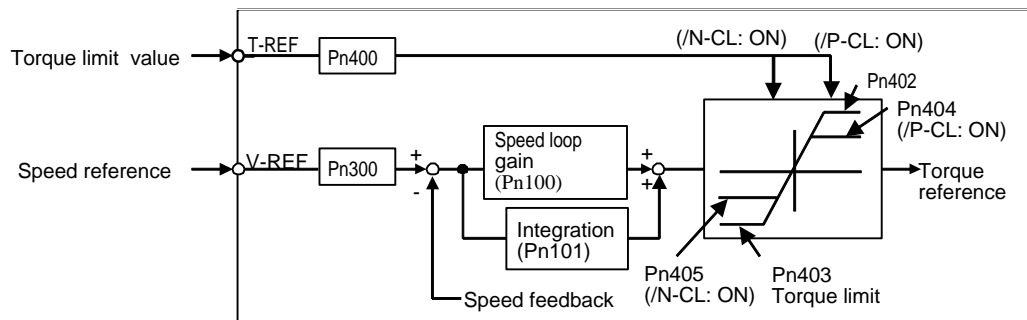
The default setting at Pn400 is 30. If, for example, the torque feed-forward value is $\pm 3V$, then torque is limited to $\pm 100\%$ of the rated torque.

Parameter	Signal	Setting (rpm)	Control Mode
Pn400	Torque Reference Input Adjustment Factor	Setting Range: 0 to 100 Default Setting: 30	Speed/Torque Control

5.2.9 Torque Limiting 2 by Analog Voltage Reference

Torque limiting 2 by analog voltage reference limits torque by assigning a torque analog voltage to the T-REF terminal (CN1-9 and 10). It cannot be used for torque control because the torque reference input terminal T-REF is used as an input terminal.

Torque is limited at the forward run side when the P-CL signal turns ON; and is limited at the reverse run side when the N-CL signal turns ON.



■ Using Torque Limiting 2 by Analog Voltage Reference

To use this function, set the following parameter to 3:

Parameter	Signal	Setting (rpm)	Control Mode
Pn002.0	Speed Control Option (T-REF Terminal Allocation)	Default Setting: 0	Speed Control Position Control

This parameter can be used to enable torque limiting 2 by analog voltage reference.

Pn002.0 Setting	T-REF Function
0	None.
1	T-REF terminal used for external torque limit input.
2	T-REF terminal used for torque feed-forward input.
3	T-REF terminal used for external torque limit input when P-CL and N-CL are valid.

This function cannot be used with the torque feed-forward function described in *5.2.8 Torque Feed-forward Function*.

To use this function, verify how input signals have been allocated. (Refer to section *5.3.3 Input Circuit Signal Allocation*). The following table outlines factory default

settings.

Input Signal	Signal Level	Description	Comments
/P-CL	CN1-45 is at "L" level when ON	Torque is limited at forward run side.	Limit value: either Pn404 or T-REF input, whichever is smaller.
	CN1-45 is at "H" level when OFF	Torque is not limited at forward run side. Normal Operation	—
/N-CL	CN1-46 is at "L" level when ON	Torque is limited at reverse run side.	Limit value: either Pn405 or T-REF input, whichever is smaller.
	CN1-46 is at "H" level when OFF	Torque is not limited at forward run side. Normal operation.	—

■ Setting

The torque limit is set at parameter Pn400.

The default setting at Pn400 is 30. If, for example, the torque limit is $\pm 3V$, then torque is limited to 100% of the rated torque. (A torque value higher than 100% torque is clamped at 100%.)

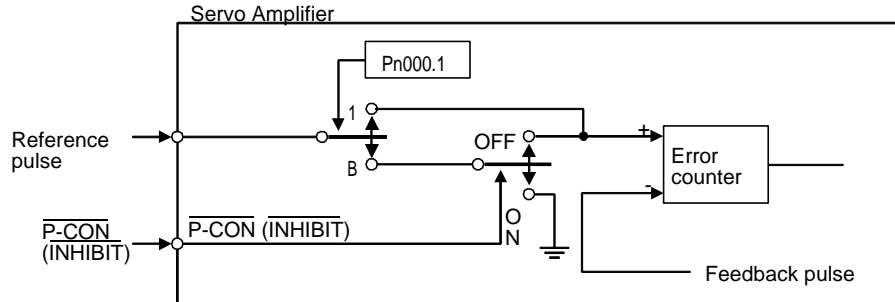
Parameter	Signal	Setting (rpm)	Control Mode
Pn400	Torque Reference Input Adjustment Factor	Setting Range: 0 to 100 Default Setting: 30	Speed/Torque Control

When either the P-CL or the N-CL signal is turned ON, the following torque limits become valid simultaneously.

Parameter	Signal	Setting (rpm)	Control Mode
Pn404	Forward Run Side External Torque Limit	Setting Range: 0 to 800 Default Setting: 100	Speed/Torque Control, Position Control
Pn405	Reverse Run Side External Torque Limit	Setting Range: 0 to 800 Default Setting: 100	Speed/Torque Control, Position Control

5.2.10 Reference Pulse Inhibit Function (INHIBIT)

This function inhibits the servo amplifier from counting input reference pulses during position control. The servomotor remains locked (clamped) while the function is in use. The /P-ON(/INHIBIT) signal is used to enable or disable the function.



■ Using Reference Pulse Inhibit Function (INHIBIT)

To use the inhibit function, set the parameter as shown below.

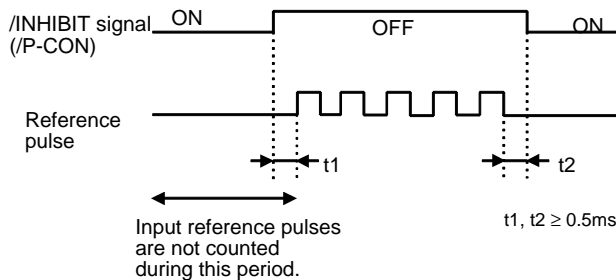
Parameter	Signal	Setting (rpm)	Control Mode
Pn000.1	Control Method Selection	Default Setting: 0	Position Control

The following settings enable the inhibit function.

Pn000.1 Setting	Description	
1	Enables the inhibit function. Always counts reference pulses.	
B	/P-CON (/INHIBIT)	Description
	OFF	Counts reference pulses.
	ON	Prohibits the servo amplifier from counting reference pulses. The servomotor remains locked.

Note: Parentheses () around an /INHIBIT signal indicate that a signal has been allocated to the input circuit. See 5.3.3 *Input Circuit Signal Allocation* for more details.

■ Relationship between Inhibit Signal and Reference Pulses

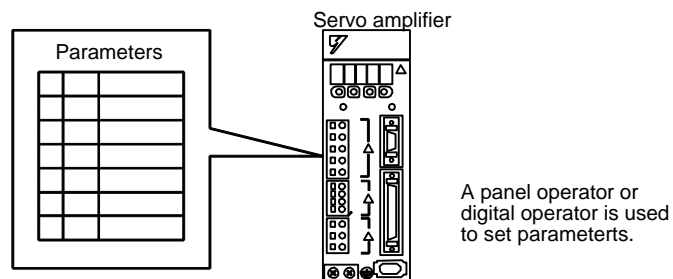


5.3 Setting Up the Servo Amplifier

This section describes the procedure for setting parameters to operate the SGD H servo amplifier.

5.3.1 Parameters

The Sigma II Series servo amplifier provides many functions and has parameters that allow the user to specify functions and perform fine adjustments.



Parameters are divided into the following three groups.

Parameter	Function
Pn000 to Pn601	Specify servo amplifier functions, set servo gains, etc.
Fn000 to Fn012	Execute auxiliary functions such as JOG Mode operations and origin searches.
Un000 to Un00D	Enable monitoring the motor speed and torque reference on the panel display.

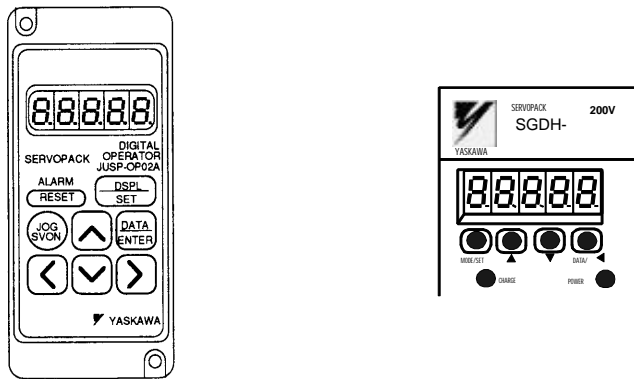
Note: Appendix B shows a list of parameters provided for reference. See 7.1.6 *Operation in Parameter Setting Mode* for more details on the procedure for setting parameters.

5.3.2 JOG Speed

Use the following parameter to set or modify motor speed when operating the servomotor from a panel or digital operator.

Parameter	Signal	Setting (rpm)	Description
Pn304	Jog Speed	Setting Range: 0 to 10000 Default Setting: 500	Speed/Torque Control, Position Control

Use this parameter to set the motor speed when operating the servomotor from a panel or digital operator. If the setting is higher than the maximum motor speed of the servomotor, then the servomotor will rotate at its maximum speed.



5.3.3 Input Circuit Signal Allocation

The functions allocated to sequence input signal circuits can be changed. CN1 connector input signals are allocated with the default settings as shown in the following table.

CN1 Connector Terminal Numbers	Input Terminal Name	Default Setting	
		Symbol	Name
40	SI0	/S-ON	Servo ON
41	SI1	/P-CON	(Proportional control reference) *
42	SI2	P-OT	Forward run prohibit
43	SI3	N-OT	Reverse run prohibit
44	SI4	/ALM-RST	Alarm reset
45	SI5	/P-CL	(Forward current limit) *
46	SI6	/N-CL	(Reverse current limit) *

Note: * The functions of these input signals are automatically switched according to the setting at parameter Pn000.1 as long as Pn50A.0 is set to 0.

The following parameter is used to enable input signal allocation.

Parameter	Signal	Setting	Description
Pn50A.0	Input Signal Allocation Mode	Default Setting: 0	Speed/Torque Control, Position Control

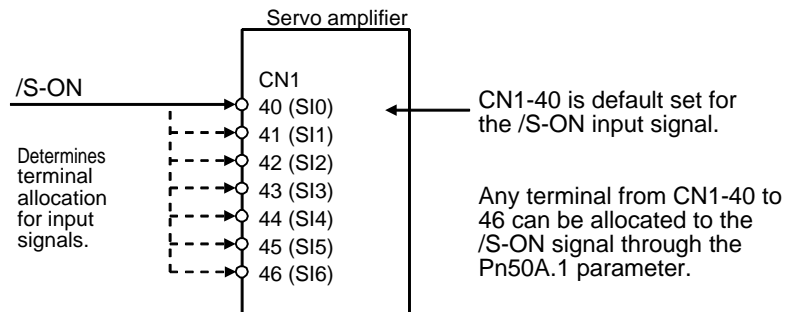
Pn50A.0 Setting	Description
0	Default setting for sequence input signal allocation. This setting is the same as Yaskawa SGDB-□AD□ servo amplifiers.
1	Enables any sequence input signal settings.

Note: The default setting for parameter Pn50A.0 is 0. Functions and applications in this manual are gener-

ally described for the factory defaults.

■ Input Signal Allocation

The following signal can be allocated when Pn50A.0 is set to 1.



The following table shows the parameter default settings for input settings 1 to 4.

Parameter	Signal	Setting (ms)	Description
Pn50A	Input Signal Selections 1	Default Setting: 2100	Speed/Torque Control, Position Control
Pn50B	Input Signal Selections 2	Default Setting: 6543	Speed/Torque Control, Position Control
Pn50C	Input Signal Selections 3	Default Setting: 8888	Speed/Torque Control, Position Control
Pn50D	Input Signal Selections 4	Default Setting: 8888	Speed/Torque Control, Position Control

Select the input terminal on the CN1 connector that will be used for each input signal.

■ Examples of Input Signal Allocation

The procedure used to allocate sequence input signals is described using the /S-ON signal as a typical example.

Pn50A.1 Setting	Description
0	Inputs the /S-ON signal from the SI0 (CN1-40) input terminal.
1	Inputs the /S-ON signal from the SI1 (CN1-41) input terminal.
2	Inputs the /S-ON signal from the SI2 (CN1-42) input terminal.
3	Inputs the /S-ON signal from the SI3 (CN1-43) input terminal.
4	Inputs the /S-ON signal from the SI4 (CN1-44) input terminal.
5	Inputs the /S-ON signal from the SI5 (CN1-45) input terminal.
6	Inputs the /S-ON signal from the SI6 (CN1-46) input terminal.
7	Sets /S-ON signal so that it is always valid.
8	Sets /S-ON signal so that it is always invalid.

Signal polarity: Normal.
Servo ON signal is valid when low (ON)

Pn50A.1 Setting	Description	
9	Inputs the S-ON signal from the SI0 (CN1-40) input terminal.	Signal polarity: Inversion. Valid at OFF (H level) with Servo ON signal
A	Inputs the/S-ON signal from the SI1 (CN1-41) input terminal.	
B	Inputs the S-ON signal from the SI2 (CN1-42) input terminal.	
C	Inputs the S-ON signal from the SI3 (CN1-43) input terminal.	
D	Inputs the S-ON signal from the SI4 (CN1-44) input terminal.	
E	Inputs the S-ON signal from the SI5 (CN1-45) input terminal.	
F	Inputs the/S-ON signal from the SI6 (CN1-46) input terminal.	

As shown in the table above, the /S-ON signal can be allocated to any input terminal from SI0 to SI6. /S-ON is always input when Pn50A.1 is set to 7, and an external signal line would therefore not be needed because the servo amplifier will determine whether the servo is ON or OFF.

The /S-ON signal is not used when Pn50A.1 is set to 8. This setting is meaningful only in the following instances.

When the factory set input signal are to be replaced by another input signal.

The signal must be left ON (low level) during normal operation to make the signal valid when OFF (high level) when forward run prohibit (P-OT) and reverse run prohibit (N-OT) are input. The input terminal signal line must be left ON even in system configurations that do not require this signal, but unnecessary wiring can be eliminated by setting Pn50A.1 to 8.

- By setting 9 to F, the signal polarity can be reversed.

Note: Several signals can be allocated to the same input circuit.

When the servo is ON, the forward run prohibit or reverse run prohibit signal is used.

At a setting with inverted polarity, the failed safe operation may not be possible in the case of signal line disconnection.

■ Allocating Other Input Signals

Input signal allocation can be changed as shown below.

Input Signal		Parameter		Description
Name	Applicable Logic	Number	Setting	
Proportional Control Reference (/P-CON)	ON (low level)	Pn50A.2	0	Inputs the signal on the left from SI0 (CN1-40).
			1	Inputs the signal on the left from SI1 (CN1-41).
			2	Inputs the signal on the left from SI2 (CN1-42).
			3	Inputs the signal on the left from SI3 (CN1-43).
			4	Inputs the signal on the left from SI4 (CN1-44).
			5	Inputs the signal on the left from SI5 (CN1-45).
			6	Inputs the signal on the left from SI6 (CN1-46).
			7	Sets the signal on the left to always enabled.
			8	Sets the signal on the left to always disabled.
			9	Inputs the inverse signal on the left from SI0 (CN1-40).
			A	Inputs the inverse signal on the left from SI1 (CN1-41).
			B	Inputs the inverse signal on the left from SI2 (CN1-42).
			C	Inputs the inverse signal on the left from SI3 (CN1-43).
			D	Inputs the inverse signal on the left from SI4 (CN1-44).
			E	Inputs the inverse signal on the left from SI5 (CN1-45).
F	Inputs the inverse signal on the left from SI6 (CN1-46).			
Forward Run Prohibit (/P-OT)	OFF (high level)	Pn50A.3	0 to F	Same as above.*
Reverse Run Prohibit (/N-OT)		Pn50B.0		
Alarm Reset (/ARM-RST)	ON (low level)	Pn50B.1		
Forward Current Limit (/P-CL)		Pn50B.2		
Reverse Current Limit (/N-CL)		Pn50B.3		
Contact Input Speed Control Selection (/SPD-D)	—	Pn50C.0		
Contact Input Speed Control Selection (/SPD-A)		Pn50C.1		
Contact Input Speed Control Selection (/SPD-B)		Pn50C.2		
Control Mode Selection (/C-SEL)	ON (low level)	Pn50C.3		
Zero Clamp (/ZCLAMP)		Pn50D.0		
Reference Pulse Inhibit (/INHIBIT)		Pn50D.1		
Gain Switching (/G-SEL)		Pn50D.2		

Note: *Same as above” means that input signals and terminals SI0 to SI6 are enabled or disabled through parameter settings 0 to 8.

5.3.4 Output Circuit Signal Allocation

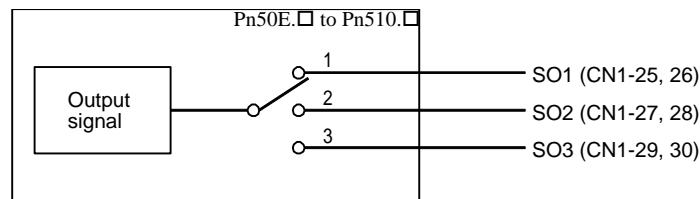
Output signal functions can be allocated to the sequence signal output circuits shown below.

CN1 Connector Terminal Numbers	Output Terminal Name	Default Setting		Comments
		Symbol	Name	
25	SO1	/V-CMP+ (/COIN+)	Speed coincidence detection (positioning completed)	The signal output will vary depending on the control mode.
26 (SG)		/V-CMP- (/COIN-)		
27	SO2	/TGON+	Rotation detection	
28 (SG)		/TGON-		
29	SO3	/S-RDY+	Servo ready	
30 (SG)		/S-RDY-		

The output signal selection parameters and their default settings are shown below.

Parameter	Signal	Setting (ms)	Description
Pn50E	Output Signal Selections 1	Default Setting: 3211	Speed/Torque Control, Position Control
Pn50F	Output Signal Selections 2	Default Setting: 0000	Speed/Torque Control, Position Control
Pn510	Output Signal Selections 3	Default Setting: 0000	Speed/Torque Control, Position Control

Select the CN1 connector terminals that will output the signals.



Output Signal	Parameter		Description
	Number	Setting	
Positioning Completed (/COIN)	Pn50E.0	0	Disabled. (Not used for the output signal on the left.)
		1	Outputs the signal on the left from the SO1 (CN1-25 and 26) output terminal.
		2	Outputs the signal on the left from the SO2 (CN1-27 and 28) output terminal.
		3	Outputs the signal on the left from the SO3 (CN1-29 and 30) output terminal.
Speed Coincidence Detection (/V-CMP)	Pn50E.1	0 to 3	Same as above*
Rotation Detection (/TGON)	Pn50E.2	0 to 3	
Servo Ready (/S-RDY)	Pn50E.3	0 to 3	
Torque Limit Detection (/CLT)	Pn50F.0	0 to 3	
Speed Limit Detection (/VLT)	Pn50F.1	0 to 3	
Brake Interlock (/BK)	Pn50F.2	0 to 3	
Warning (/WARN)	Pn50F.3	0 to 3	
Near (/NEAR)	Pn510.0	0 to 3	
Not used.	—	—	

Note: *"Same as above" means output signals are disabled or allocated to output terminals SO1 to SO3 through parameter settings 0 to 3.

Note: Signals are output with OR logic when multiple signals are allocated to the same output circuit. Signals that are not detected are invalid. For example, the positioning completed signal /COIN is invalid in Speed Control Mode.

The following parameters can be used to invert the signals on output terminals SO1 to SO3.

Parameter	Signal	Setting (ms)	Description
Pn512	Output Signal Inverted Setting	Default Setting: 0000	Speed/Torque Control, Position Control

These settings specify which of the connector CN1 output signals are to be inverted:

Output Terminal	Parameter		Description
	Number	Setting	
SO1 (CN1-25, 26)	Pn512.0	0	Does not invert the signal.
		1	Inverts the signal.
SO2 (CN1-27, 28)	Pn512.1	0	Does not invert the signal.
		1	Inverts the signal.
SO3(CN1-29, 30)	Pn512.2	0	Does not invert the signal.
		1	Inverts the signal.
Not used.	Pn512.3	—	—

5.3.5 Control Mode Selection

The SGD servo amplifier offers speed control, position control, torque control, and the other control modes shown in the following table.

The following parameter is used to set the control mode.

Parameter	Signal	Setting (ms)	Description
Pn000.1	Control Mode Selection	Default Setting: 0	Speed/Torque Control, Position Control

Pn000.1 Setting	Control Mode
0	Speed Control (Analog Reference)
1	Position Control (Pulse Train Reference)
2	Torque Control (Analog Reference)
3	Contact Input Speed Control Selection (Contact Reference)
4	Contact Input Speed Control Selection (Contact Reference) ↔ Speed Control (Analog Reference)
5	Contact Input Speed Control Selection (Contact Reference) ↔ Position Control (Pulse Train Reference)
6	Contact Input Speed Control Selection (Contact Reference) ↔ Torque Control (Analog Reference)
7	Position Control (Pulse Train Reference) ↔ Speed Control (Analog Reference)
8	Position Control (Pulse Train Reference) ↔ Torque Control (Analog Reference)
9	Torque Control (Analog Reference) ↔ Speed Control (Analog Reference)
A	Speed Control (Analog Reference) ↔ Zero Clamp Control
B	Position Control (Pulse Train Reference) ↔ Position Control (Inhibit)

■ Description of Control Modes

The control modes are described below.

Speed Control (Analog Reference)

This mode controls speed using an analog voltage input reference. See *5.2.1 Speed Reference*.

Position Control (Pulse Train Reference)

This mode controls positioning using a pulse train input reference. See *5.2.2 Position Reference*.

Torque Control (Analog Reference)

This mode controls torque using an analog voltage input reference. See *5.2.7 Using*

Torque Control.

Contact Input Speed Control Selection (Contact Reference)

This mode uses the /P-CON (/SPD-D), /P-CL (/SPD-A), and /N-CL (/SPD-B) input signals to control speed as it switches among the three preset operating speeds in the servo amplifier. See 5.2.6 *Contact Input Speed Control*.

Contact Input Speed Control Selection (Contact Reference) ↔ Speed Control (Analog Reference)

This mode controls speed by switching between contact reference and analog voltage reference speed control. Analog voltage reference speed control is enabled when both /P-CL (/SPD-A) and /N-CL (/SPD-B) input signals are OFF (high level). See 5.2.6 *Contact Input Speed Control*.

Contact Input Speed Control Selection (Contact Reference) ↔ Position Control (Pulse Train Reference)

This mode switches between contact reference speed control and pulse train reference position control. Pulse train reference position control is enabled when both /P-CL (/SPD-A) and /N-CL (/SPD-B) input signals are OFF (high level). See 5.2.6 *Contact Input Speed Control*.

Contact Input Speed Control Selection (Contact Reference) ↔ Torque Control (Analog Reference)

This mode switches between contact reference speed control and analog voltage reference torque control. Torque control using an analog voltage reference is enabled when both /P-CL (/SPD-A) and /N-CL (/SPD-B) input signals are OFF (high level). See 5.2.6 *Contact Input Speed Control*.

Position Control (Pulse Train Reference) ↔ Speed Control (Analog Reference)

This mode switches between position and speed control through the /P-CON (/C-SEL) signal.

Position Control (Pulse Train Reference) ↔ Torque Control (Analog Reference)

This mode switches between position and torque control through the /P-CON (/C-SEL) signal.

Torque Control (Analog Reference) ↔ Speed Control (Analog Reference)

This mode switches between torque and speed control through the /P-CON (/C-SEL) signal. See 5.2.7 *Using Torque Control*.

Speed Control (Analog Reference) ↔ Zero Clamp

This speed control mode is used to set the zero clamp function when the servo amplifier is stopped. Zero clamp operates when the /P-CON (/ZCLAMP) signal is ON (low level). See 5.4.3 *Using the Zero Clamp Function*.

Position Control (Pulse Train Reference) ↔ Position Control (Inhibit)

This mode controls positioning by inhibiting reference pulse input through the /P-CON (/INHIBIT) signal. See 5.2.10 *Using Reference Pulse Inhibit Function (INHIBIT)*

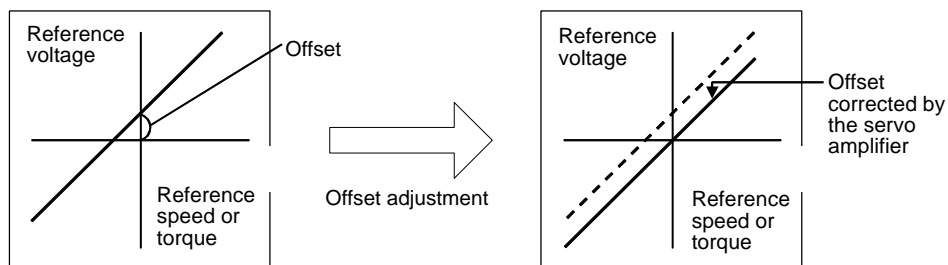
5.4 Setting Stop Functions

This section describes the procedure used to stop the servo amplifier properly.

5.4.1 Adjusting Offset

■ When the Servomotor Will Not Stop

The servomotor may rotate at very low speed and not stop even when 0V is specified as the reference voltage for servo amplifier speed and torque control (analog reference). This happens when the reference voltage from the host controller or external circuit is slightly offset (in mV units). The servomotor will stop if this offset is properly adjusted to 0V.



■ Reference Offset Adjustment

The following methods can be used to adjust the reference offset to 0V.

Adjustment Method	Result
Automatic Adjustment of Reference Offset	The reference offset is automatically adjusted to 0V.
Manual Adjustment of Reference Offset	The reference offset can be set to a specified value.

Note: Use manual rather than automatic adjustment if a position control loop is formed in the host controller.

See the following sections in *Chapter 7 Using the Digital Operator* for more details on adjustment procedures.

Adjustment Method	Reference Source
Automatic Adjustment of Reference Offset	7.2.3 Automatic Adjustment of the Speed and Torque Reference Offset
Manual Adjustment of Reference Offset	7.2.4 Manual Adjustment of the Speed and Torque Reference Offset

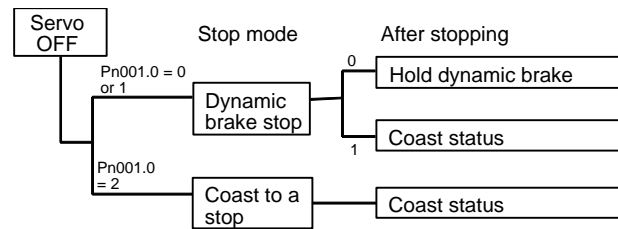
5.4.2 Using the Dynamic Brake

To stop the servomotor by applying the dynamic brake (DB), set the desired mode in the following parameter. The servomotor will stop due to equipment friction if the dynamic brake is not applied.

Parameter	Signal	Setting (ms)	Description
Pn001.0	Servo OFF or Alarm Stop Mode	Default Setting: 0	Speed/Torque Control, Position Control

The SGD servo amplifier turns OFF under the following conditions:

- The Servo ON input signal (/S-ON, CN1-40) is turned OFF.
- A servo alarm occurs.
- Power is turned OFF.



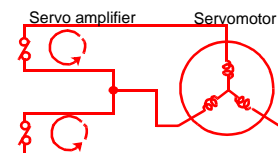
Specify the Stop Mode if any of these occurs during operation.

Pn001.0 Setting	Result
0	Uses the dynamic brake to stop the servomotor. Maintains dynamic brake after the servomotor stops.*
1	Uses the dynamic brake to stop the servomotor. Releases dynamic brake after the servomotor stops, and the servomotor coasts to a stop.
2	Coasts the servomotor to a stop. The servomotor is turned OFF and motion stops due to equipment friction.

Note: * If the servomotor is stopped or moving at extremely low speed, it will coast to a stop.

Note: The dynamic brake is an emergency stop function. Do not repeatedly start and stop the servomotor using the servo ON signal (/S-ON) or by repeatedly turning power ON and OFF.

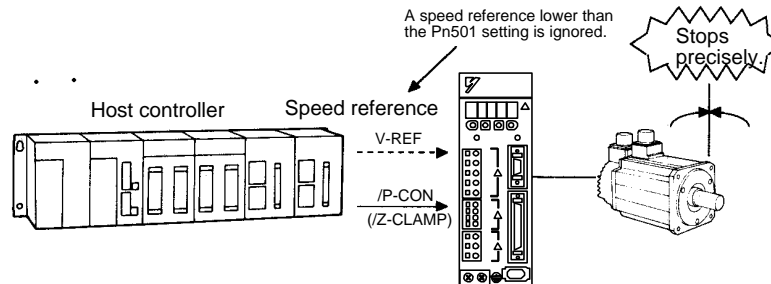
Note: Dynamic brake (DB) is a common way of quickly stopping a servomotor by electrically shorting its electrical windings. The DB circuit is incorporated into the servo amplifier.



5.4.3 Using the Zero Clamp Function

■ 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. In other words, this function is used to stop and lock the servomotor even when the input voltage of speed reference V-REF is not 0V. An internal position loop is temporarily formed to clamp the servomotor within one pulse when the zero clamp function is turned ON. Even if the servomotor is forcibly rotated by external force, it will still return to the zero clamp position.



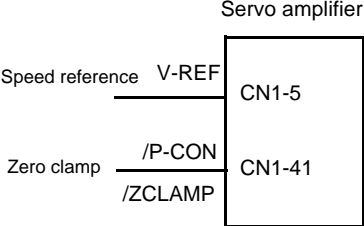
■ Parameter Setting

Set the following parameter so that the input signal /P-CON (/ZCLAMP) can be used to enable or disable the zero clamp function.

Parameter	Signal	Setting (ms)	Description
Pn000.1	Control Method Selection	Default Setting: 0	Speed Control

⇒ Input /P-CON CN1-41	Proportional Control, etc.	Speed/Torque Control, Position Control
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Note: The /ZCLAMP signal can be used when an input circuit signal is allocated. See 5.3.3 *Input Circuit Signal Allocation* for more details.

Pn000.1 Setting	Control Mode					
A	<p>Zero Clamp Control Mode This mode allows the zero clamp function to be set when the servomotor stops.</p> <ul style="list-style-type: none"> The speed reference is input from V-REF (CN1-5). /P-CON (/ZCLAMP)(CN1-41) is used to turn the zero clamp function ON and OFF. <table border="1" data-bbox="561 642 932 810"> <tr> <td>CN1-41 is open (OFF).</td> <td>Turns the zero clamp function OFF.</td> </tr> <tr> <td>CN1-41 is 0V (ON).</td> <td>Turns the zero clamp function ON.</td> </tr> </table>	CN1-41 is open (OFF).	Turns the zero clamp function OFF.	CN1-41 is 0V (ON).	Turns the zero clamp function ON.	<div style="text-align: center;">  </div> <p>Zero clamp is performed when the following two conditions are satisfied:</p> <ul style="list-style-type: none"> /P-CON (/ZCLAMP) is ON. Speed reference is below the setting designated at Pn501.
CN1-41 is open (OFF).	Turns the zero clamp function OFF.					
CN1-41 is 0V (ON).	Turns the zero clamp function ON.					

■ Setting

Use the following parameter to set the motor speed level at which zero clamp is performed.

Parameter	Signal	Setting (rpm)	Description
Pn501	Zero Clamp Level	Setting Range: 0 to 10000 Default Setting: 10	Speed Control

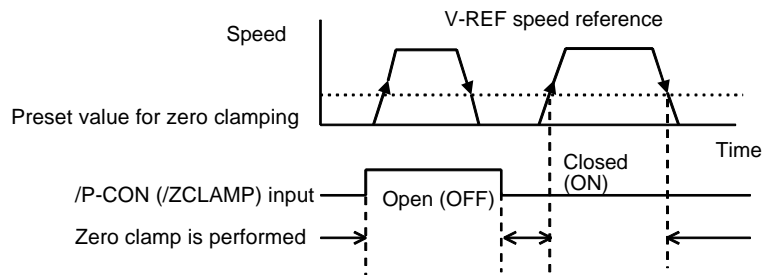
If zero clamp speed control is selected, set the motor speed at which zero clamp is to be performed. The maximum speed will be used if the value of Pn501 is set higher than the maximum speed of the servomotor.

Zero Clamp Conditions

Zero clamp is performed when all the following conditions are satisfied:

- Zero clamp speed control is selected (parameter Pn000.1 is set to A).
- /P-CON (/ZCLAMP)(CN1-41) is ON (0V).

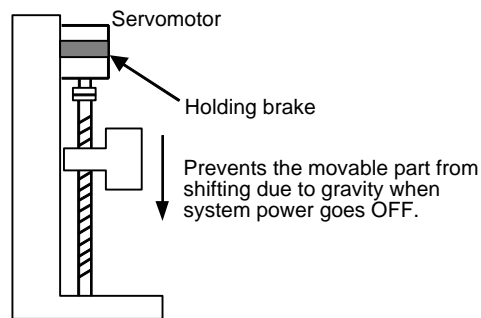
- Speed reference drops below the setting level of Pn501.



Note: When the /ZCLAMP signal is allocated, the zero clamp operation will be used even for speed control (Pn000.1 = 0).

5.4.4 Using the Holding Brake

The holding brake is used when a servodrive controls a vertical axis. In other words, a servomotor with brake prevents the movable part from shifting due to the force of gravity when system power goes OFF.

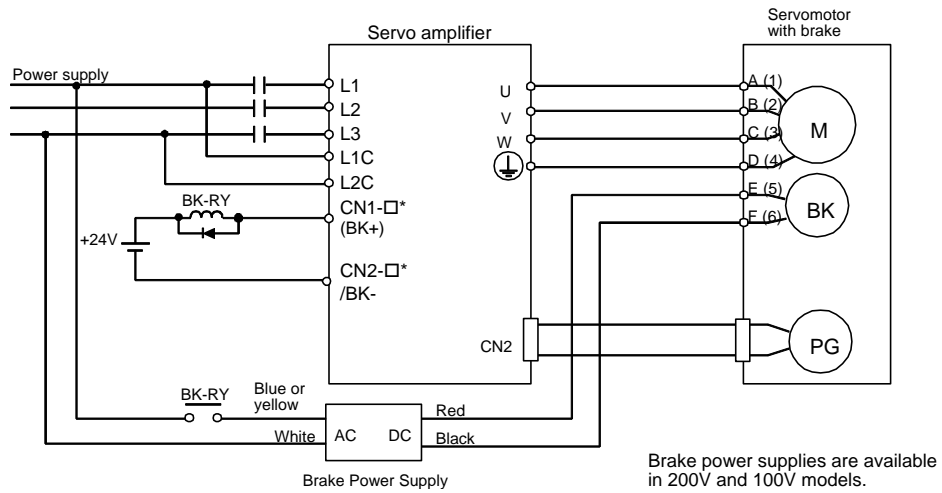


Note: The brake built into the servomotor SGM□H with brakes is a de-energization brake, which is used only to hold and cannot be used for braking. Use the holding brake only to hold a stopped motor. Brake torque is at least 120% of the rated motor torque.

■ Wiring Example

Use the servo amplifier contact output signal /BK and the brake power supply to form a brake ON/OFF circuit. The following diagram shows a standard wiring

example.



*CN1-□ and CN2-□ are the output terminals allocated at parameter Pn510.0.

Output ⇒ /BK	Brake Interlock Output	Speed/Torque Control, Position Control
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This output signal controls the brake when using a servomotor with a brake and does not have to be connected when using a servomotor without a brake.

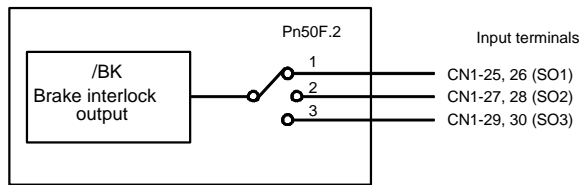
State	Status	Result
ON:	Closed or low level	Releases the brake.
OFF:	Open or high level	Applies the brake.

Related Parameters

Parameter	Description
Pn506	Time Delay from Brake Reference until Servo OFF
Pn507	Speed Level for Brake Reference Output during Motor Operation
Pn508	Timing for Brake Reference Output during Motor Operation

The following parameter must be selected to determine the location of the output signal, when the /BK signal is used.

Parameter	Signal	Setting	Description
Pn50F	Output Signal Selections 2	Default Setting: 0000	Speed/Torque Control, Position Control



Select the /BK output terminal.

Parameter	Setting	Output Terminal (CN1)	
		*1	*2
Pn50F.2	0	-	-
	1	25	26
	2	27	28
	3	29	30

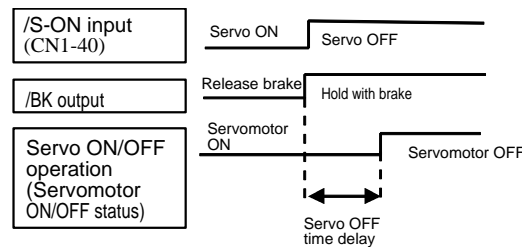
Note: Signals are output with OR logic when multiple signals are allocated to the same output circuit. Set other output signals to a value other than that allocated to the /BK signal in order to output the /BK signal alone. See 5.3.4 *Output Circuit Signal Allocation*.

■ Brake ON Timing

If the equipment moves slightly due to gravity when the brake is applied, set the following parameter to adjust brake ON timing.

Parameter	Signal	Setting (10ms)	Description
Pn506	Brake Reference Servo OFF Delay Time	Setting Range: 0 to 50 Default Setting: 0	Speed/Torque Control, Position Control

This parameter is used to set the output time from the brake control signal /BK until the servo OFF operation (servomotor output stop) when a servomotor with a brake is used.



With the standard setting, the servo is turned OFF when the /BK signal (brake operation) is active. The equipment may move slightly due to gravity depending on equipment configuration and brake characteristics. If this happens, use this parameter to delay servo OFF timing.

This setting sets the brake ON timing when the servomotor is stopped. Use Pn507 and 508 for brake ON timing during operation.

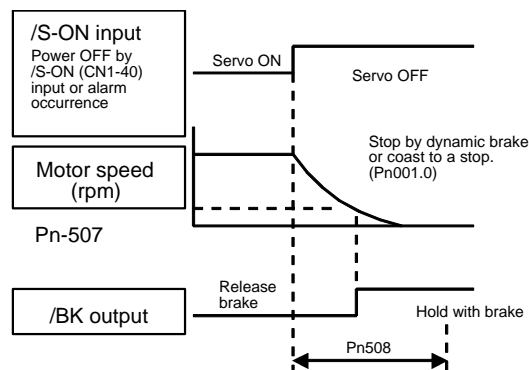
Note: The servomotor will turn OFF immediately if an alarm occurs. The equipment may move due to gravity in the time it takes for the brake to operate.

■ Holding Brake Setting

Set the following parameters to adjust brake ON timing so the holding brake is applied when the servomotor stops.

Parameter	Signal	Setting	Description
Pn507	Brake Reference Output Speed Level	Setting Range: 0 to 10000rpm Default Setting: 100rpm	Speed/Torque Control, Position Control
Pn508	Timing for Brake Reference Output during Motor Operation	Setting Range: 0 to 100 x 10ms Default Setting: 50 x 10ms	Speed/Torque Control, Position Control

Set the brake timing used when the servo is turned OFF by input signal /S-ON (CN1-40) or when an alarm occurs during motor operation.



Brake ON timing when the servomotor stops must be adjusted properly because servomotor brakes are designed as holding brakes. Adjust the parameter settings while observing equipment operation.

/BK Signal Output Conditions During Servomotor Operation

The circuit is open under either of the following conditions:

- Motor speed drops below the setting at Pn507 after servo OFF.
- The time set at Pn508 has elapsed since servo OFF.

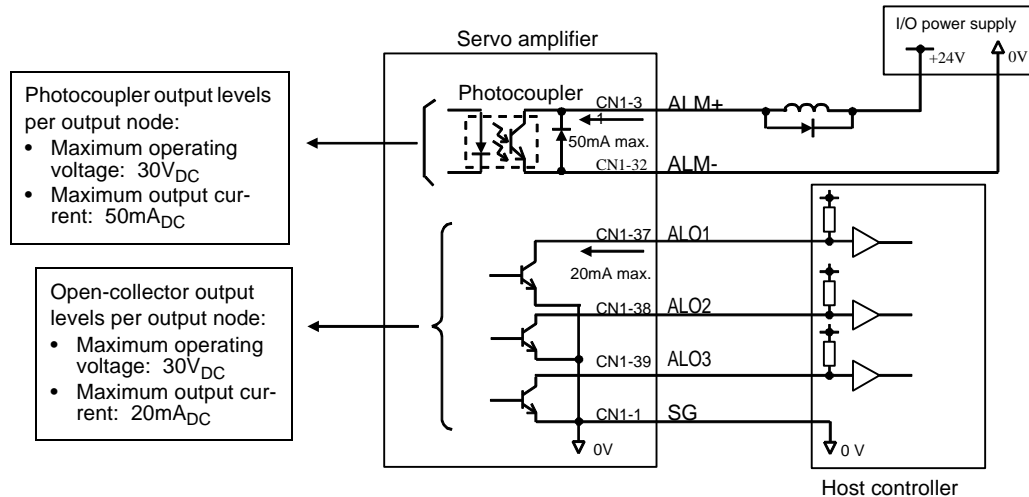
The actual speed used will be the maximum speed even if Pn507 is set higher than the maximum speed.

5.5 Forming a Protective Sequence

This section describes the procedure for using I/O signals from the servo amplifier to form a protective safety sequence.

5.5.1 Using Servo Alarm and Alarm Code Outputs

The basic procedure for connecting alarm output signals is described below.

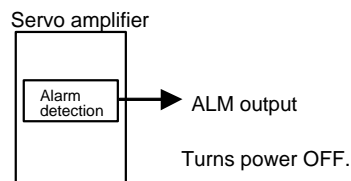


A suitable external I/O power supply must be provided by the user separately because there is no internal 24V power supply in the servo amplifier.

The use of the photocoupler output signals is described below.

Output ⇒ ALM+ CN1-31	Servo Alarm Output	Speed/Torque Control, Position Control
Output ⇒ ALM- CN1-32	Signal Ground for Servo Alarm Output	Speed/Torque Control, Position Control

These alarms are output when a servo amplifier alarm is detected.



Form an external circuit so this alarm output (ALM) turns the servo amplifier OFF.

State	Status	Result
ON	Circuit between CN1-31 and 32 is closed, and CN1-31 is at low level.	Normal state.
OFF	Circuit between CN1-31 and 32 is open, and CN1-31 is at high level.	Alarm state.

Alarm codes ALO1, ALO2 and ALO3 are output to indicate each alarm type.

The uses of open-collector output signals ALO1, ALO2 and ALO3 is described below.

Output ⇒ ALO1 CN1-37	Alarm Code Output	Speed/Torque Control, Position Control
Output ⇒ ALO2 CN1-38	Alarm Code Output	Speed/Torque Control, Position Control
Output ⇒ ALO3 CN1-39	Alarm Code Output	Speed/Torque Control, Position Control
Output ⇒ *SG CN1-1	Signal Ground for Alarm Code Output	Speed/Torque Control, Position Control

These signals output alarm codes to indicate the type of alarm detected by the servo amplifier. Use these signals to display alarm codes at the host controller. See 9.2.3 *Alarm Display Table* for more on the relationship between alarm display and alarm code output.

When a servo alarm (ALM) occurs, eliminate the cause of the alarm and set the following /ALM-RST input signal to high level (ON) to reset the alarm.

Input ⇒ /ALM-RST CN1-44	Alarm Reset	Speed/Torque Control, Position Control
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The alarm reset signal is used to reset a servo alarm.

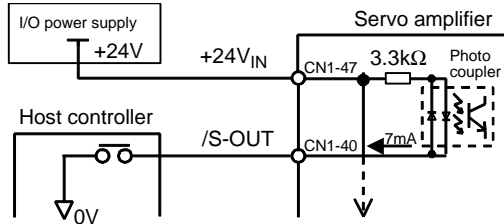
Form an external circuit so the servo amplifier turns OFF when an alarm occurs. Alarms are reset automatically when the control power supply is turned OFF.

Alarms can also be reset using a panel or digital operator.

- Note: 1. Encoder alarms cannot always be reset by inputting the /ALM-RST signal. In that case, turn the control power supply OFF to reset the alarm.
2. When an alarm occurs, always eliminate the cause before resetting the alarm. See 9.2.1 *Troubleshooting Problems with Alarm Displays* for more details on troubleshooting the system when an alarm occurs.

5.5.2 Using the Servo ON Input Signal

The basic use and wiring procedure for the Servo ON (/S-ON) input signal (sequence input signal) is described below. Use this signal to forcibly turn OFF the servomotor from the host controller.



⇒ Input /S-ON CN1-40	Servo ON	Speed/Torque Control, Position Control
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This signal is used to turn the servomotor ON and OFF.

CN1-40 State	Status	Result
ON	Closed or low level	Turns ON the servomotor: operates according to signal input. This is the default state.
OFF	Open or high level	Servomotor cannot operate. Do not turn OFF the servomotor while it is operating except in an emergency.

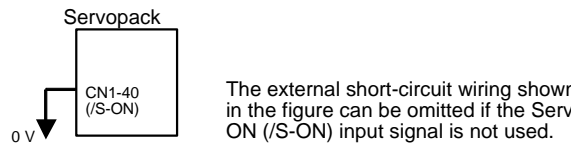


CAUTION

- **Do not use the Servo ON (/S-ON) signal to start or stop the motor. Always use an input reference signal, such as Speed Reference to start or stop the servomotor.** Doing so will shorten the life of the servo amplifier.

Set the following parameter to 7 if the /S-ON signal will not be used.

Parameter	Signal	Setting	Description
Pn50A.1	/S-ON Signal Mapping	Default Setting: 0	Speed/Torque Control, Position Control

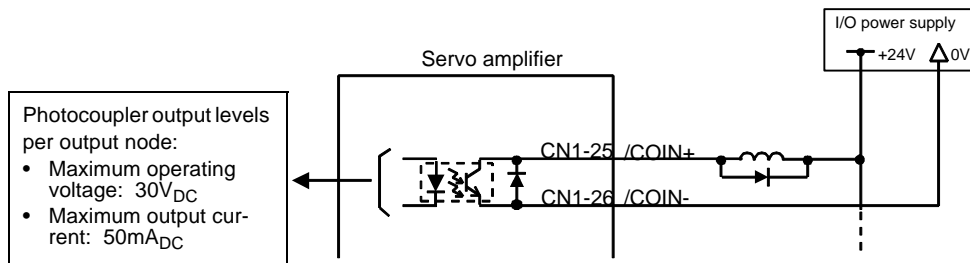


Pn50A.1 Setting	Status	Result
0	Enables the servo ON (/S-ON) input signal.	The servo is OFF when CN-40 is open, and is ON when CN1-40 is at 0V.
7	Disables the servo ON (/S-ON) input signal.	The servo is always ON, and has the same effect as shorting CN1-40 to 0V.

Note See 5.3.3 *Input Circuit Signal Allocation* for other Pn50A.1 settings.

5.5.3 Using the Positioning Completed Output Signal

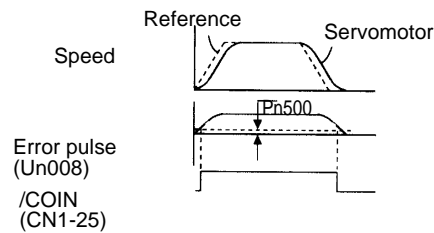
The basic use and wiring procedure for the positioning completed (/COIN) output signal (photocoupler output signal) is described below. The signal is output to indicate that servomotor operation is completed.



Output ⇒ /COIN CN1-25	Positioning Completed Output Signal	Position Control
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This signal indicates that servomotor movement has been completed during position control. The host controller uses the signal as an interlock to confirm that position-

ing is completed.



/COIN State	Status	Result
ON	Circuit between CN1–25 and 26 is closed, and CN1–25 is at low level.	Positioning is completed. (Position error is below the setting.)
OFF	Circuit between CN1–25 and 26 is open, and CN1–25 is at high level.	Positioning is not completed. (Position error is above the setting.)

The following parameter is used to change the CN1 connector terminal that outputs the /COIN signal.

Parameter	Signal	Setting (rpm)	Description
Pn50E	Output Signal Selections 1	Default Setting: 3211	Position Control

The parameter is factory set so the /COIN signal is output between CN1-25 and 26. See 5.3.4 *Output Circuit Signal Allocation* for more details on parameter Pn50E.

The following parameter is used to set the number of error pulses and to adjust the output timing of the positioning completed signal.

Parameter	Signal	Setting (reference units*)	Description
Pn500	Positioning Completed Width	Setting Range: 0 to 250 Default Setting: 7	Position Control

Note: *reference units for this parameter are the number of input pulses as defined using the electronic gear function.

This parameter is used to set output timing for the positioning completed signal (/COIN) when the position reference pulse is input and servomotor operation is completed.

Set the number of error pulses in reference units.

Too large a value set at this parameter may output only a small error during low-speed operation that will cause the /COIN signal to be output continuously.

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

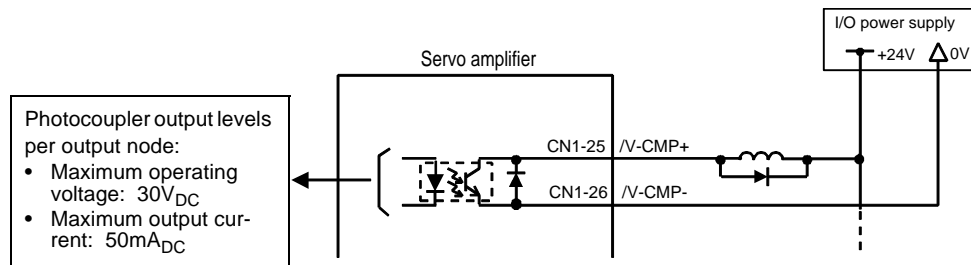
Note: /COIN is a position control signal.

With the default setting, this signal is used for the speed coincidence output /V-CMP for speed con-

trol, and it is always ON for torque control.

5.5.4 Speed Coincidence Output

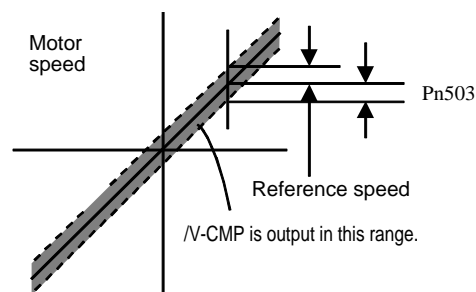
The basic use and wiring procedures for the speed coincidence (/V-CMP) output signal (photocoupler output signal), used to indicate a match with the speed reference, are described below. The host controller uses the signal as an interlock.



Output ⇒ /V-CMP CN1-25	Speed Coincidence Output	Speed Control
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This signal is output when the actual motor speed during speed control is the same as the speed reference input.

/V-CMP State	Status	Result
ON	Circuit between CN1-25 and 26 is closed, and CN1-25 is at low level.	Speed coincides. (Speed error is below the setting).
OFF	Circuit between CN1-25 and 26 is open, and CN1-25 is at high level.	Speed does not coincide. (Speed error is above the setting).



The following parameter setting is used to change the CN1 connector terminal that outputs the /V-CMP signal.

Parameter	Signal	Setting (rpm)	Description
Pn50E	Output Signal Selections 1	Default Setting: 3211	Position Control

The parameter is default set so the /V-CMP signal is output between CN1-25 and 26.

See 5.3.4 *Output Circuit Signal Allocation* for more details on parameter Pn50E.

The following parameter is used to set conditions for speed coincidence output.

Parameter	Signal	Setting (rpm)	Description
Pn503	Speed Coincidence Signal Output Width	Setting Range: 0 to 100 Default Setting: 10	Speed Control

This parameter is used to set conditions for speed coincidence signal /TGON output.

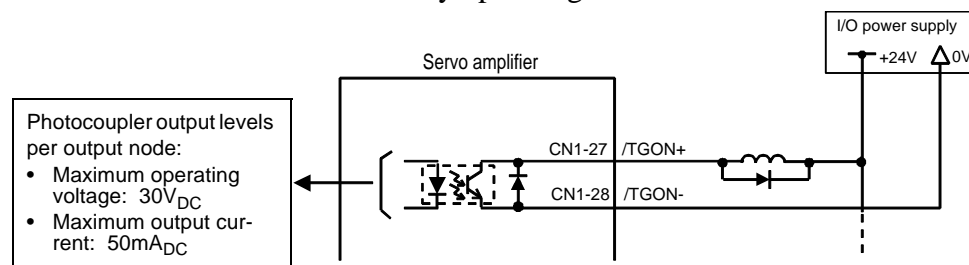
The /V-CMP signal is output when the difference between the speed reference and actual motor speed is below this setting.

Example: The /V-CMP signal turns ON at 1900 to 2100rpm if the parameter is set to 100 and the reference speed is 2000rpm.

Note: /V-CMP is a speed control signal. With the default setting, this signal is used as the positioning completed signal /COIN for position control, and it is always ON for torque control.

5.5.5 Using the Running Output Signal

The basic use and wiring procedures for the running (/TGON) output signal (photo-coupler output signal) are described below. The signal can be activated to indicate that the servomotor is currently operating. It is used as an external interlock.



Output ⇒ /TGON CN1-27	Running Output Signal	Speed/Torque Control, Position Control
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/TGON State	Status	Result
ON	Closed or low level.	Servomotor is operating. (Motor speed is above the setting level).
OFF	Open or high level.	Servomotor is not operating. (Motor speed is below the setting level).

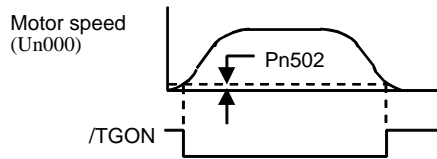
The following parameter setting is used to change the CN1 connector terminal that outputs the /TGON signal.

Parameter	Signal	Setting (rpm)	Description
Pn50E	Output Signal Selections 1	Default Setting: 3211	Position Control

The parameter is default set so the /TGON signal is output between CN1-27 and 28. See 5.3.4 *Output Circuit Signal Allocation* for more details on parameter Pn50E.

This parameter is used to set output conditions for the operation detection output signal /TGON.

Pn502 (Running Output Level)



Parameter	Signal	Setting (rpm)	Description
Pn502	Rotation Detection Level	Setting Range: 1 to 10000 Default Setting: 20	Speed/Torque Control, Position Control

This parameter is used to set the speed at which the servo amplifier determines that the servomotor is running and then to output an appropriate signal. The following signals are generated when motor speed exceeds the preset level.

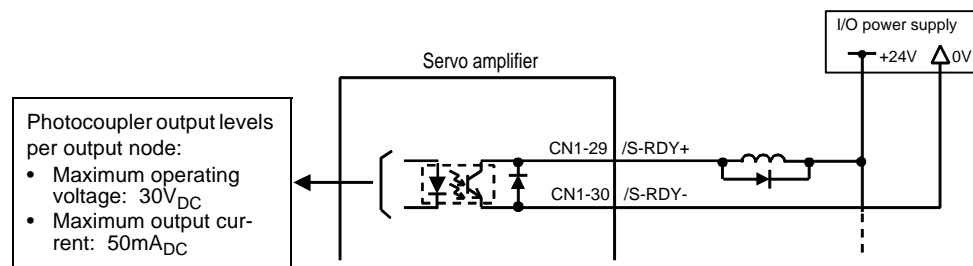
Signals generated when servomotor operation is detected:

- /TGON
- Status Indication Mode
- Monitor Mode Un006

5.5.6 Using the Servo Ready Output Signal

The basic use and wiring procedures for the Servo Ready (/S-RDY) output signal (photocoupler output signal) are described below.

Servo Ready means there are no servo alarms and the main circuit power supply is turned ON. An added condition with absolute encoder specifications is that the SEN signal is at high level and absolute data was output to the host controller.



Output ⇒ /S-RDY CN1-29	Servo Ready Output Signal	Speed/Torque Control, Position Control
------------------------	---------------------------	--

This signal indicates that the servo amplifier has received the Servo ON signal and has completed all preparations.

/S-RDY State	Status	Result
ON	Closed or low level.	Servomotor is ready.
OFF	Open or high level.	Servomotor is not ready.

The following parameter setting is used to change the CN1 connector terminal that outputs the /S-RDY signal.

Parameter	Signal	Setting)	Description
Pn50E	Output Signal Selections 1	Default Setting: 3211	Position Control

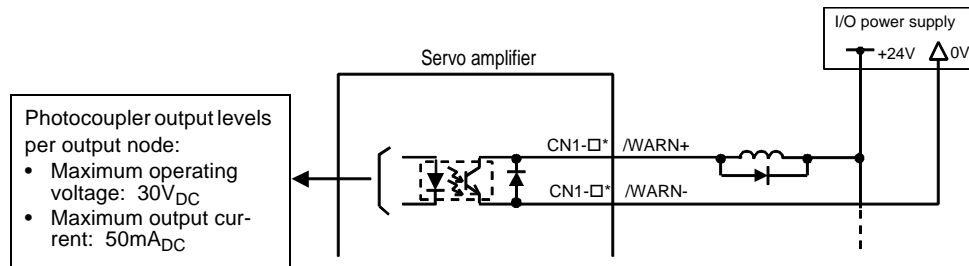
The parameter is factory set so the /V-CMP signal is output between CN1-29 and 30. See 5.3.4 *Output Circuit Signal Allocation* for more details on parameter Pn50E.

5.5.7 Using the Warning Output Signal

The basic use and wiring procedure for the warning (/WARN) output signal (photo-coupler output signal) are given below.

The signal consists of the following two output signals.

/WARN signals: Overload and regenerative overload



Note: *CN1-□ terminals are allocated using parameter Pn50F.3.

Output ⇒ /WARN	Warning Output Signal	Speed/Torque Control, Position Control
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This output signal indicates an overload or regenerative overload warning.

/WARN State	Status	Result
ON	Closed or low level.	Normal operation. No warning.
OFF	Open or high level.	Error warning.

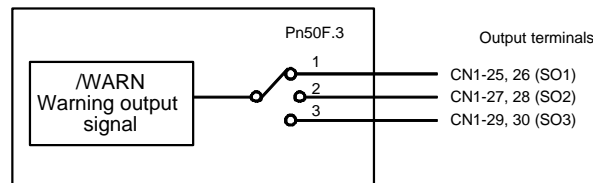
The following parameter setting is used to change the CN1 connector terminal that outputs the /WARN signal.

Parameter	Signal	Setting	Description
Pn50F	Output Signal Selections 2	Default Setting: 0000	Speed/Torque Control, Position Control

Pn50F.3 is used to allocate the /WARN output signals above.

Pn50F.3 State	Output Terminal (CN1-)	
	*1	*2
0	—	—
1	25	26
2	27	28
3	29	30

Note: Multiple signals allocated to the same output circuit are output using OR logic. Set other output signals to a value other than that allocated to the /WARN signal in order to use the /WARN output signal alone. See 5.3.4 *Output Circuit Signal Allocation*.



The following parameter is used to output warning details with an alarm code.

Parameter	Signal	Setting	Description
Pn001.3	Warning CodeOutput Selection	Default Setting: 0	Speed/Torque Control, Position Control

Pn001.3 Setting	Result
0	Outputs alarm codes alone for alarm codes ALO1, ALO2 and ALO3.
1	Outputs both alarm and warning codes for alarm codes ALO1, ALO2 and ALO3 and outputs an alarm code when an alarm occurs.

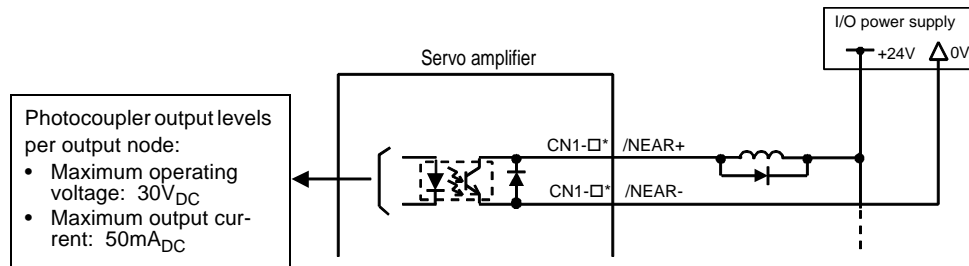
The following warning codes are output in 3 bits.

Warning Indication	Warning Code Output			Warning Description
	ALO1	ALO2	ALO3	
A.91	ON signal (low level)	OFF signal (high level)	OFF signal (high level)	Overload
A.92	OFF signal (high level)	ON signal (low level)	OFF signal (high level)	Regenerative overload

5.5.8 Using the Near Output Signal

The basic use and wiring procedures for the near (/NEAR) output signal (photocoupler output signal) are described below. The signal is a sequence signal that is generally output together with the positioning completed signal (/COIN), and it is used to indicate the servomotor is close to completing operation.

/NEAR signals: Near output signals



Note: *CN1-□ terminals are allocated using parameter Pn510.0.

Output ⇒ /NEAR	Near Output Signal	Position Control
----------------	--------------------	------------------

The host controller can use the /NEAR signal to prepare the next motion sequence before receiving the positioning completed signal. This reduces the time required to complete the desired motion profile.

/NEAR State	Status	Result
ON	Closed or low level.	The servomotor has nearly completed operation. (Position error is below the near signal setting range.)
OFF	Open or high level.	The servomotor is not close to completing operation. (Position error is above the near signal setting range.)

To use the /NEAR signal, an output terminal must be allocated with the parameter below.

Parameter	Signal	Setting	Description
Pn510	Output Signal Selections 3	Default Setting: 0000	Position Control

Pn510.0 is used to allocate the /NEAR output signals above.

Pn510.0 State	Output Terminal (CN1-)	
	*1	*2
0	—	—
1	25	26
2	27	28
3	29	30

Note: Multiple signals allocated to the same output circuit are output using OR logic. Set other output signals to a value other than that allocated to the /NEAR signal in order to use the /NEAR output signal

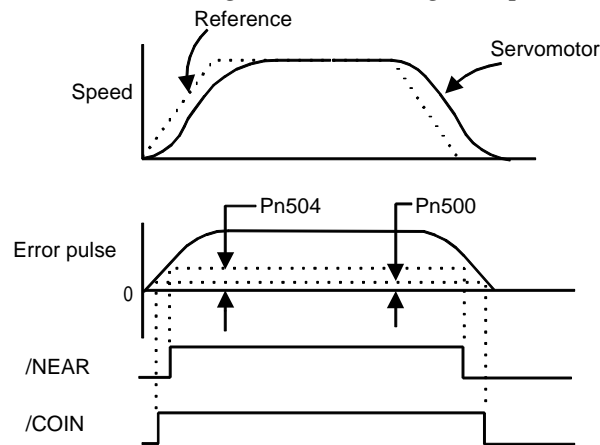
alone. See 5.3.4 *Output Circuit Signal Allocation*.

The following parameter is used to set the timing for /NEAR signal output.

Parameter	Signal	Setting (reference unit*)	Description
Pn504	NEAR Signal Width	Setting Range: 1 to 250 Default Setting: 7	Position Control

*The number of input pulses defined using the electronic gear function.

Generally set the near signal width higher than the positioning completed width. Also see 5.5.3 *Using the Positioning Completed Output Signal*.



5.5.9 Handling Power Loss

The following parameter is used to specify whether to generate an alarm when power loss occurs.

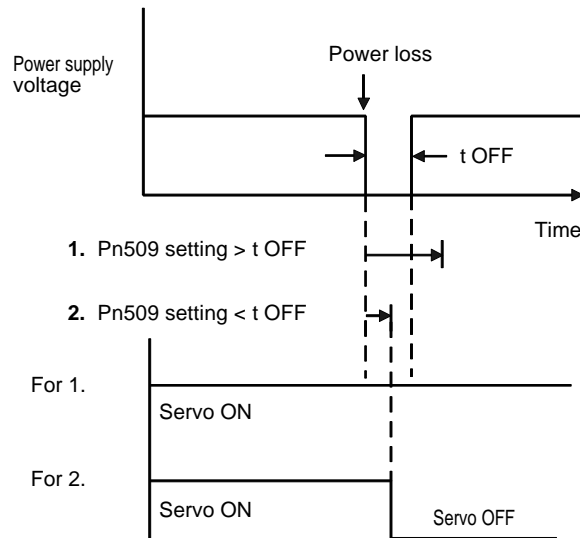
Parameter	Signal	Setting (ms)	Description
Pn509	Momentary Hold Time	Setting Range: 20 to 1000 Default Setting: 20	Speed/Torque Control, Position Control

The servo amplifier turns the servomotor OFF if it detects a voltage drop in the power supply. The default setting of 20ms means that servomotor operation will continue if power is lost for less than 20ms.

In the following instances, however, either a servo alarm is generated or control is lost (equivalent to normal power OFF operation) regardless of the parameter setting.

- When an insufficient voltage alarm (A.41) occurs during power loss with a large servomotor load.
- Loss of the control power supply is equivalent to normal power OFF operation, thus control is lost.

In power loss detection, the status of the main circuit power supply is detected but the OFF status is ignored. So servomotor operation will continuous if the servomotor turns ON again within the time limit set at parameter Pn509.



5.6 Selecting a Regenerative Resistor

When the servomotor is driven in generator mode, power is returned to the servo amplifier side. This is called regenerative power. The regenerative power is absorbed by charging the smoothing capacitor, but when the capacitor charging energy is exceeded, the regenerative power is further consumed by the regenerative resistor.

The servomotor is driven in regeneration (generator) mode in the following circumstances:

- While decelerating to a stop during acceleration/deceleration operation.
- With a load on the vertical axis.
- During continuous operation with the servomotor driven from the load side (negative load).

The capacity of the servo amplifier's built-in regenerative resistor is sufficient for short-time operation only, such as for the deceleration stop period. Operation under a negative load is not possible.

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

Applicable Servo Amplifiers		Built-in Resistor Specifications		Regenerative Power Processed by Built-in Resistor* (W)	Minimum Allowable Resistance (Ω)
		Resistance (Ω)	Capacity (W)		
100V	SGDH-A3BE to -02BE	—	—	—	40
200V	SGDH-A3AE to -04AE	—	—	—	40
	SGDH-05AE to -10AE	50	60	12	
	SGDH-15AE	30	70	14	20
	SGDH-20AE	25	140	28	12
	SGDH-30AE	12.5	140	28	12

* The amount of regenerative power (average value) that can be processed is rated at 20% of the capacity of the servo amplifier's built-in regenerative resistor.

When installing an external regenerative resistor, make sure that the resistance is the same as that of the servo amplifier'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 above table.

5.6.1 External Regenerative Resistor

When installing an external regenerative resistor, a parameter setting must be changed as shown below.

Parameter	Signal	Setting (x 10W)	Description
Pn600	Regenerative Resistor Capacity	Setting Range: 0 to maximum Default Setting: 0	Speed/Torque Control, Position Control

The default setting of “0” in the above table is the set value when the servo amplifier’s built-in resistor is used or when a servo amplifier without a built-in resistor is used.

When installing an external regenerative resistor, set the regenerative resistor’s capacity (W).

Example: When the external regenerative resistor’s actual consumable capacity is 100W, set the parameter to “10” (10 x 10W = 100W)

Note: 1. In general, when resistors for power are used at the rated load ratio, the resistor temperature increases to between 200°C and 300°C. The resistors must be used at or below the rated values. Check with the manufacturer for the resistor’s load characteristics. Use resistors at no more than 20% of the rated load ratio with natural convection cooling, and no more than 50% of the rated load ratio with forced air cooling.

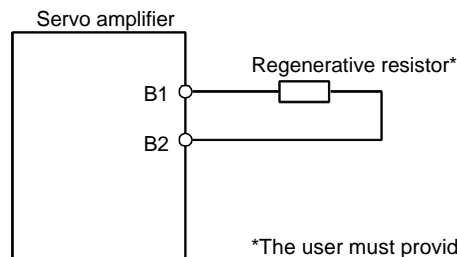
2. Use of resistors with thermo switches is recommended as a safety precaution.

■ Connecting Regenerative Resistors

The method for connecting regenerative resistors is shown below.

Servo Amplifier Capacity of 400W or Less

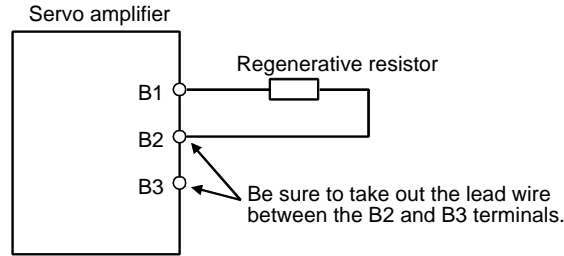
Connect an external regenerative resistor between the servo amplifier’s B1 and B2 terminals.



*The user must provide the regenerative resistor.

Servo Amplifier Capacity of 500W or More

Disconnect the wire between the servo amplifier’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: Adequate cooling must be provided for regenerative resistors because they reach very high temperatures. Also use heat-resistant, non-flammable wire and make sure that the wiring does not come into contact with the resistors.

5.6.2 Calculating the Required Capacity of Regenerative Resistors

■ By Means of a Simple Calculation

When driving a servomotor normally along the horizontal axis, check the external regenerative resistor requirements using the calculation method shown below.

Servo Amplifiers with Capacity of 400W or Less

Servo amplifiers with a capacity of 400W or less do not have built-in regenerative resistors. The energy that can be absorbed by capacitors is shown in the following table. If the rotational energy in the servo system exceeds these values, then connect a regenerative resistor externally.

Voltage	Applicable Servo Amplifiers	Regenerative Energy that Can be Processed (joules)	Remarks
100V	SGDH-A3BE	7.8	Value when input voltage is 100V _{AC}
	SGDH-A5BE to -02BE	15.7	
200V	SGDH-A3AE, -A5AE	18.5	Value when input voltage is 200V _{AC}
	SGDH-01AE to -04AE	37.1	

Calculate the rotational energy in the servo system using the following equation:

$$E_S = \frac{J \times (N_M)^2}{182 \text{ (joules)}}$$

Where: $J = J_M + J_L$

J_M : Servomotor rotor inertia ($\text{kg}\cdot\text{m}^2$) ($\text{oz}\cdot\text{in}\cdot\text{s}^2$)

J_L : Motor axis conversion load inertia ($\text{kg}\cdot\text{m}^2$) ($\text{oz}\cdot\text{in}\cdot\text{s}^2$)

N_M : Rotation speed of the servomotor (rpm)

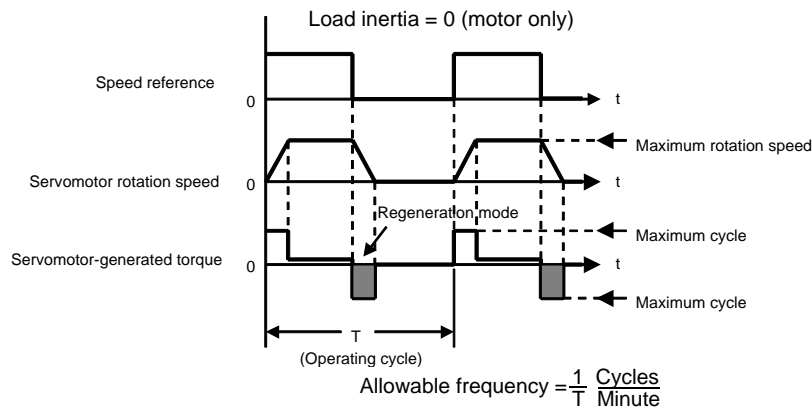
Servo Amplifier Capacity of 500W or More

Servomotors with a capacity of 500W or more have built-in regenerative resistors. The allowable frequencies for just the servomotor during acceleration/deceleration operation, in the run cycle from 0 → maximum rotation speed → 0, are summarized in the following table.

Convert the data into the values obtained with actual rotation speed used and load inertia to determine whether an external regenerative resistor is needed.

Series	Capacity Symbol	Allowable Frequencies in Regeneration Mode (times/min)										
		03	05	06	08	09	10	12	13	15	20	30
SGMAH		—	—	—	89	—	—	—	—	—	—	—
SGMPH		—	—	—	29	—	—	—	—	—	—	—
SGMGH-□A□A		—	34	—	—	13	—	—	10	—	12	8
SGMGH-□A□B		96	—	39	—	22	—	15	—	—	20	13
SGMSH		—	—	—	—	—	39	—	—	31	48	20

Operating Conditions for Allowable Regenerative Frequency Calculation



Use the following equation to calculate the allowable frequency for regeneration mode operation.

$$\text{Allowable frequency} = \frac{\text{Allowable frequency for servomotor only}}{(1 + n)} \times \left(\frac{\text{Max. rotation speed}}{\text{Rotation speed used}} \right)^2 \frac{\text{Cycles}}{\text{Minute}}$$

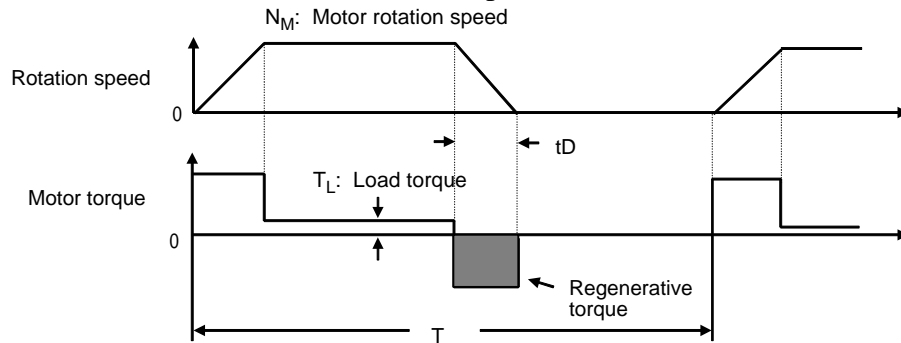
Where: $n = J_L/J_M$

J_M : Servomotor rotary inertia [oz·in·s² (kg·m²)]

J_L : Motor axis conversion load inertia [oz·in·s² (kg·m²)]

■ By Calculating the Regenerative Energy

This section shows the procedure for calculating the regenerative resistor capacity when acceleration and deceleration operation is as shown in the following diagram.



Calculation Procedure

The procedure for calculating the capacity is as follows:

Step	Procedure	Units [in. (mm)]	Equation
1	Find the rotational energy of the servo system (E_S).	$E_S =$ [Joules] = [J]= [oz·in·s ² (kg·m ² ·s ²)] $J_L =$ $N_M =$ rpm	$E_S = \frac{(J_L + J_M) \times N_M^2}{182}$ Where: $N_M =$ Motor speed $J_L =$ Load Inertia $J_M =$ Motor Inertia
2	Find the energy consumed by load system loss (E_L) during the deceleration period (t_D).	$\tau_L =$ oz·in (N·m) $E_L =$ Joules = J $N_M =$ rpm $t_D =$ s	$E_L = \frac{\pi}{60} (N_M \times \tau_L \times t_D)$ Where: $\tau_L =$ Motor torque
3	Calculate the energy lost (E_M) from servomotor winding resistance.	$t_D =$ s $E_M =$ Joules = J	$E_M =$ Value from the "Servomotor Winding Resistance Loss" graph below.
4	Calculate the servoamp energy (E_C) that can be absorbed.	$E_C =$ Joules = J	$E_C =$ Value from the "Absorbable Servo Amplifier Energy" graph below.
5	Find the energy consumed by the regenerative resistor (E_K).	$E_K =$ $E_S = E_L = E_M = E_C =$ Joules = J	$E_K = E_S - (E_L + E_M + E_C)$
6	Calculate the required regenerative resistor capacity (W_K).	$W_K =$ W $E_K =$ Joules = J $T =$ s	$W_K = \frac{E_K}{0.2 \times T}$ Where: T = Time

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%.

If the previous calculation determines that the amount of regenerative power (Wk) that can be 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, install an external regenerative resistor for the capacity obtained from the above calculation.

If the energy consumed by load system loss (in step 2 above) is unknown, then perform the calculation using $E_L = 0$.

When the operation period in regeneration mode is continuous, add the following items to the above calculation procedure in order to find the required capacity (W) for the regenerative resistor.

- Energy for continuous regeneration mode operation period: E_G (joules)
- Energy consumed by regenerative resistor: $E_K = E_S - (E_L + E_M + E_C) + E_G$
- Required capacity of regenerative resistor: $W_K = E_K / (0.2 \times T)$

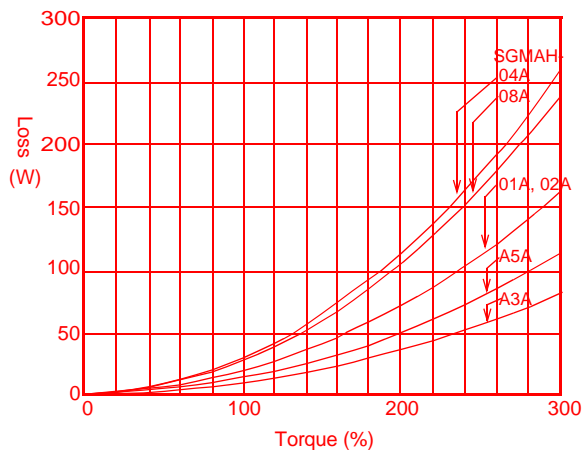
Here, $E_G = (2\pi/60) N_{MG} \times \tau_G \times t_G$

- τ_G : Servomotor's generated torque [oz-in (N·m)] in continuous regeneration mode operation period.
- N_{MG} : Servomotor rotation speed (rpm) for same operation period as above.
- t_G : Same operation period (s) as above.

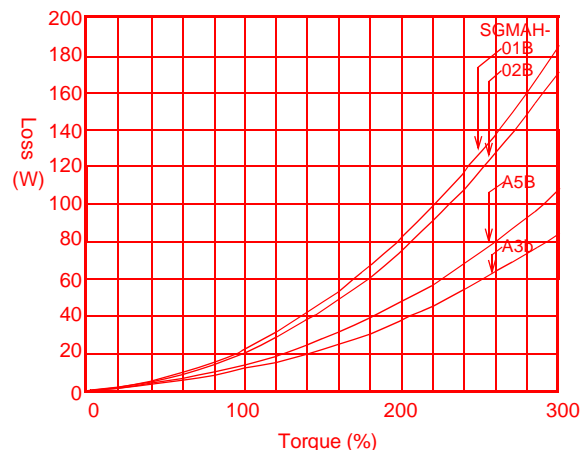
Servomotor Winding Resistance Loss

The following diagrams show the relationship between the generated torque and the winding resistance loss for each servomotor.

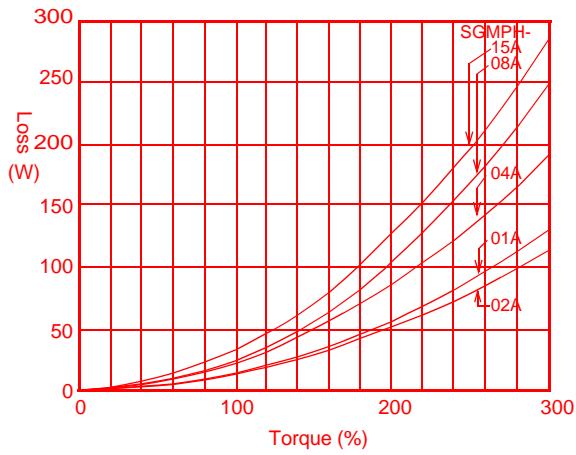
- SGMAH Servomotor, 200V



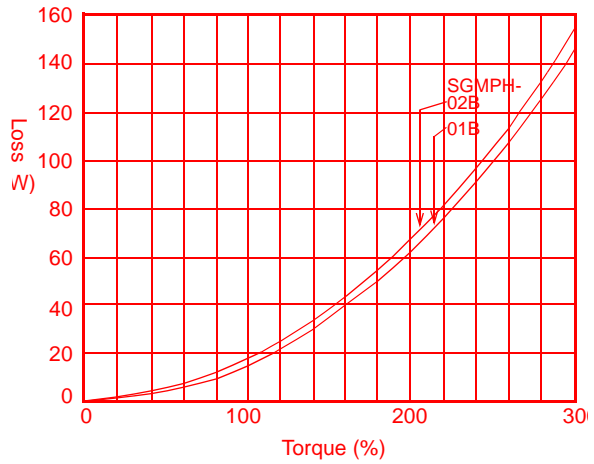
- SGMAH Servomotor, 100V



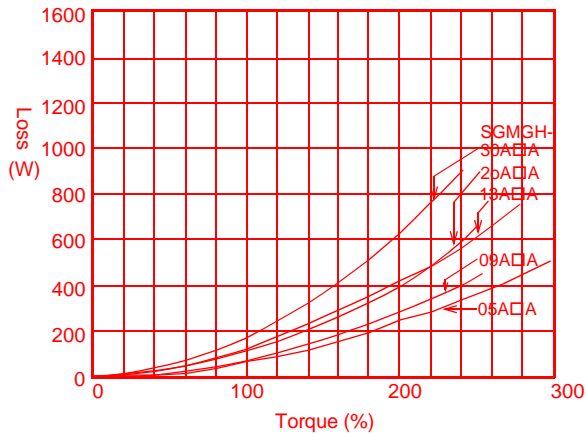
- SGMPH Servomotor, 200V



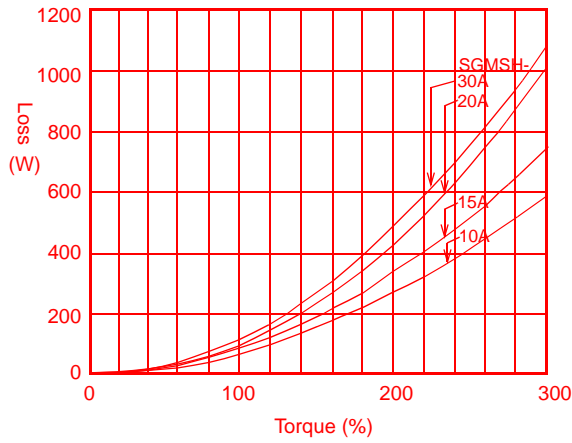
- SGMPH Servomotor, 100V



- SGMGH Servomotor, 1500rpm



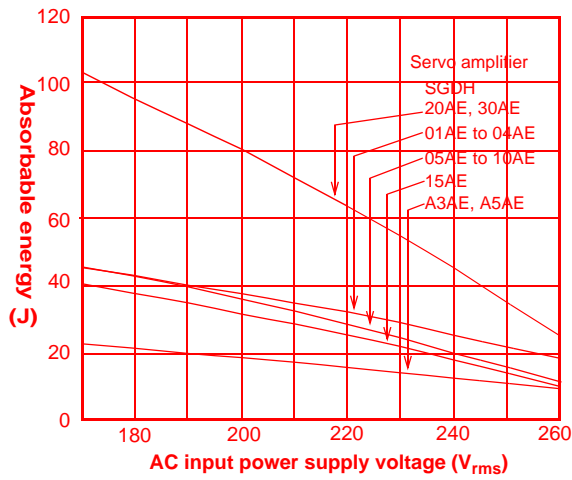
- SGMSH Servomotor



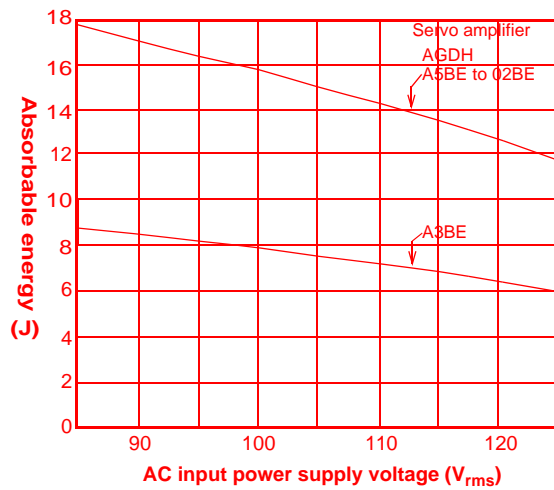
Servo Amplifier's Absorbable Energy

The following diagrams show the relationship between the servoamp's input power supply voltage and its absorbable energy.

- Servo Amplifier for 200V motor



- Servo Amplifier for 100V motor

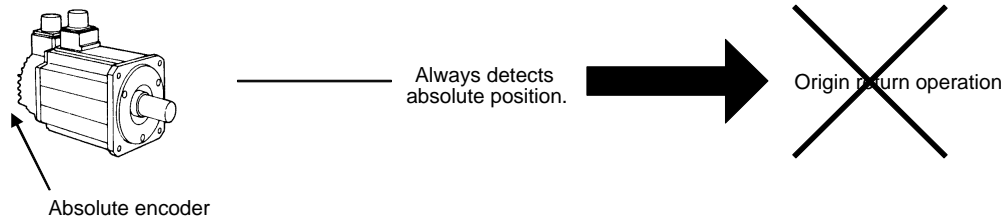


5.7 Absolute Encoders

If a motor with an absolute encoder is used, a system to detect the absolute position can be formed in the host controller. Consequently, automatic operation can be performed without zero return operation immediately after the power is turned ON.

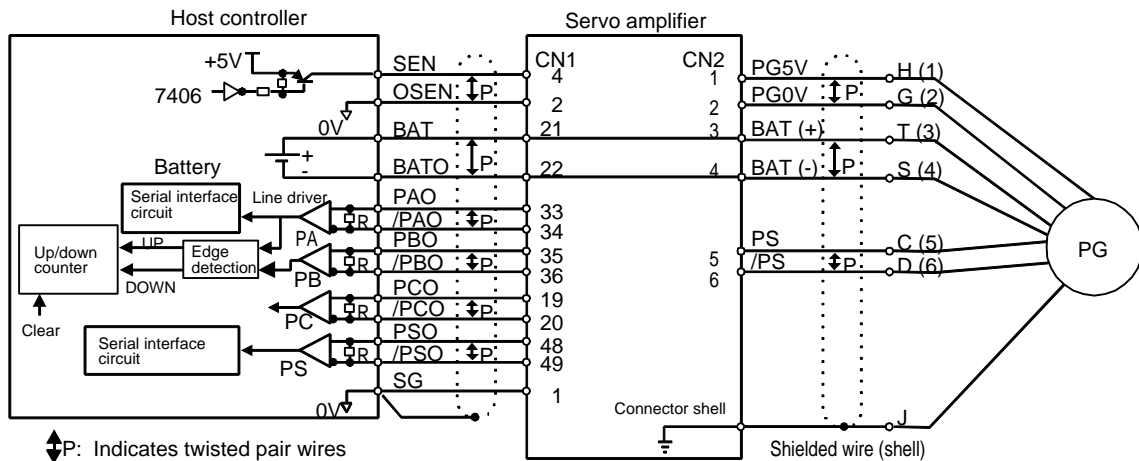
Motor SGM□H-□□□1□...With 16-bit absolute encoder

SGM□H-□□□2□...With 17-bit absolute encoder



5.7.1 Interface Circuit

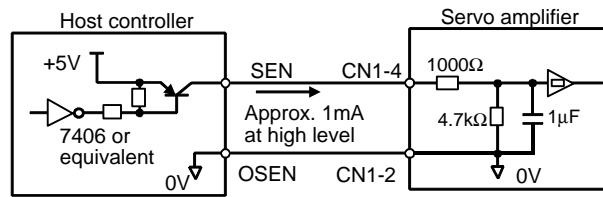
The following diagram shows the standard connections for an absolute encoder mounted to a servomotor.



Applicable line drivers: SN75175 or MC3486 by TI.

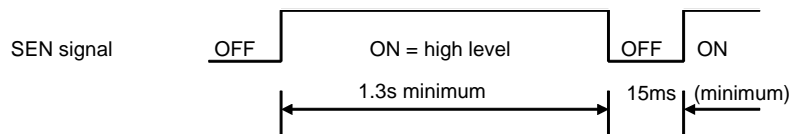
Terminating resistance R: 220 to 470Ω

■ SEN Signals



- Wait at least three seconds after turning on the power before raising the SEN signal to high level.
- When the SEN signal is changed from low level to high level, the multi-turn data and initial incremental pulses are transmitted.
- The motor cannot be operated until these operations are completed, regardless of the status of the servo ON signal (/S-ON).

Note: If for some reason it is necessary to turn OFF a SEN signal that is already ON, and then to turn it back ON again, maintain the high level for at least 1.3 seconds before turning it ON and OFF.



5.7.2 Configuring an Absolute Encoder

Select the absolute encoder's application with the following parameter.

Parameter	Signal	Setting	Description
Pn002.2	Absolute Encoder Application	Setting Range: 0 or 1 Default Setting: 0	Speed/Torque Control, Position Control

Either "0" or "1" in the following table must be set in order to enable the absolute encoder.

Pn002.2 Setting	Result
0	Uses the absolute encoder as an absolute encoder.
1	Uses the absolute encoder as an incremental encoder.

The following parameter is used to periodically clear the encoder's counter (return the setting to 0) after a designated ratio of motor to load axis revolutions. This function is called the multi-turn limit.

Note: The term **Multi-turn Limit** refers to the highest number of rotations the encoder's counter will dis-

play before returning the counter to 0.

Parameter	Signal	Setting	Description
Pn205	Multi-turn Limit Setting	Setting Range: 0 to 65535 Default Setting: 65535	Speed/Torque Control, Position Control

- When Pn205 is set to the default (65535), multi-turn data varies in the range of -32768 to $+32767$.
- With any other Pn205 value entered, data varies from 0 to the set value.

Note: To activate reassignment of this value, the user must first enter the change to the parameter, and then cycle (turn OFF and then turn ON) the power.

Since the encoder's multi-turn limit value is set as default to 65535, the following alarm occurs if the servo amplifier's power supply is cycled (turned OFF and ON) after changing parameter Pn205:


Alarm Display	Alarm Code Output			Description
	ALO1	ALO2	ALO3	
A.CC	O	X	O	Encoder multi-turn limit value does not match with that of the servo amplifier.

Note: O: ON ("L") signal
X: OFF ("H") signal

In order to set a multi-turn limit value to the encoder, perform the multi-term limit setting operation (Fn-013).

This operation can be executed using the hand-held digital operator or the servo amplifier panel operator.

Note: The multi-turn limit setting is enabled only during the multi-turn limit value mismatch alarm. Cycle the power after performing this operation.

 WARNING
<ul style="list-style-type: none"> • Connect the ground terminal to a class-3 ground (100Ω or less). Improper grounding may result in electric shock or fire.

5.7.3 Handling Batteries

In order for the absolute encoder to retain position data when the power is turned OFF, the data must be backed up by a battery.

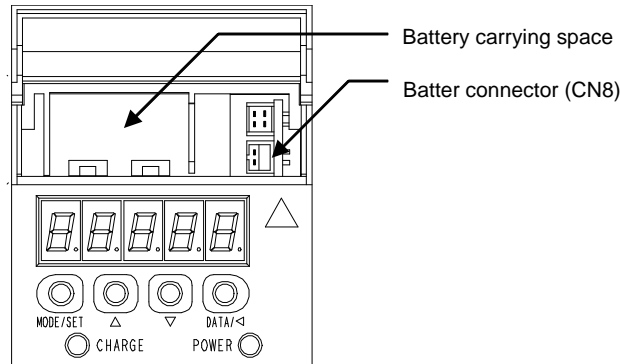
■ Installing the Battery at the Host Device

Lithium battery, by Toshiba: ER6VC3, 3.6V, 2000mAh

■ Battery Provided for Servo Amplifier

Lithium battery: JZSP-BA01 (includes battery and connector)

Battery: Toshiba, ER3 V, 3.6V, 1000mAh



WARNING

- **Install the battery at either the host controller or the servo amplifier, NEVER at both simultaneously.** Such a connection would create a circuit between the batteries, which could lead to electric shock, injury, or equipment damage.

5.7.4 Absolute Encoder Setup

Perform the setup operation for the absolute encoder in the following circumstances:

- When starting the machine for the first time.
- When an encoder backup alarm is generated.

When the servo amplifier's power supply is turned OFF and the encoder's cable is removed.





The setup operation can be performed by using the hand-held digital operator, the servo amplifier's panel operator, or with personal computer monitor software.

The setup operation procedure shown here uses the digital operator. For more details, refer to *Chapter 7: Using the Digital Operator*.

■ Setup Using the Hand-held Digital Operator

1. Press the **DSPL/SET** key to select the auxiliary function mode.

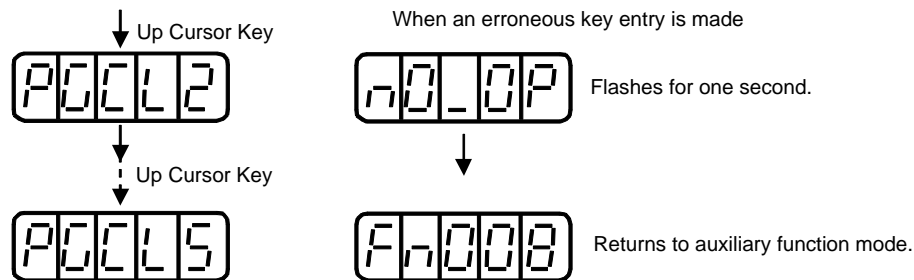


2. Select the user function Fn008. Press the **Left Arrow**  or **Right Arrow**  key to select the digit to set, and then press the **Up Arrow**  or **Down Arrow** 

key to change the number.

3. Press the **DATA/ENTER** key. The following display will appear.

4. Pressing the **Up Arrow** key will change the display as shown below. Continue pressing the **Up Arrow** key until “PGCL5” is displayed. If an erroneous key entry is made, “nO_OP” will flash for one second and the display will return to the auxiliary function mode. In that case, go back to step 3 above and perform the operation again.



5. When “PGCL5” is displayed, press the **DSPL/SET** key. The display will change as follows, and the absolute encoder's multi-turn data will be cleared.

done Flashes for 1 second. → PGCL5

6. Press the **DATA/ENTER** key to return to the auxiliary function mode.

This completes the absolute encoder's setup operation. Cycle the power to the servo amplifier.

■ Setup Using the Built-in Panel Operator


1. Press the **DSPL/SET** key to select the auxiliary function mode.

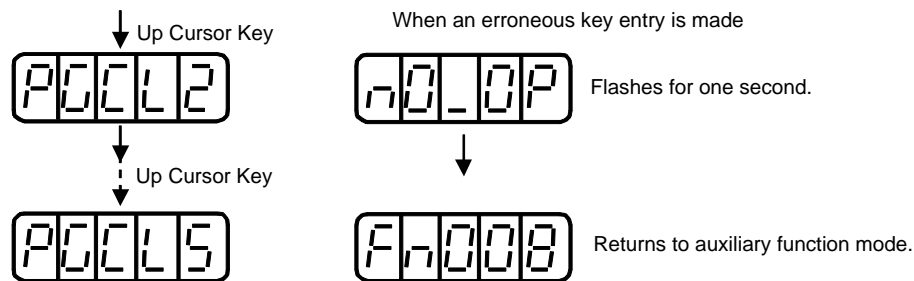
2. Press the **Up Arrow**  or **Down Arrow**  key to select the parameter Fn008.




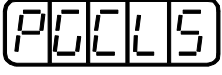
3. Press the **DATA/SHIFT** key, holding it down for at least one second. The following display will appear.



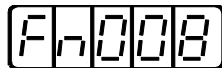
4. Press the **Up Arrow**  key, holding it down until “PGCL5” is displayed. If an erroneous key entry is made, “nO_OP” will flash for one second and the display will return to the auxiliary function mode. In that case, go back to step 3 above and perform the operation again.



5. When “PGCL5” is displayed, press the **MODE/SET** key. The display will change as follows, and the absolute encoder's multi-turn data will be cleared .

 Flashes for 1 second. → 

6. Press the **DATA/SHIFT** key to return to the auxiliary function mode.



This completes the absolute encoder's setup operation. Cycle the power to the servo amplifier.

Note: If the following absolute encoder alarms are displayed, the alarms must be cleared using the method described above for the setup operation. They cannot be cleared by the servo amplifier's alarm reset (/ARM-RST) input signal.

- Encoder backup alarm (A.81)
- Encoder sum check alarm (A.82)

In addition, if a monitoring alarm is generated in the encoder, the alarm must be cleared by turning OFF the power.

■ Multi-turn Setup Using the Hand-held Digital Operator

1. Press the **DSPL/SET** key to select the auxiliary function mode.

A digital display showing the text "Fn000" in a seven-segment font. The "Fn" is in black, and the "000" is in red.

2. Select the user function Fn013. Press the **Left Arrow** or **Right Arrow** key to select the digit to set, and then press the **Up Arrow** or **Down Arrow** key to change the number.

A digital display showing the text "Fn013" in a seven-segment font. The "Fn01" is in black, and the "3" is in red.

3. Press the **DATA/ENTER** key. The following display will appear.

A digital display showing the text "POSEt" in a seven-segment font. The "POSE" is in black, and the "t" is in red.

4. Press the **DSPL/SET** key. The display will change as follows, and the absolute encoder's multi-turn data will be cleared.

A diagram showing the transition from a "done" display to a "POSEt" display. The "done" display is shown in a box, followed by the text "Flashes for 1 second." and an arrow pointing to the "POSEt" display, which is also in a box. The "done" display has "done" in black and "E" in red. The "POSEt" display has "POSE" in black and "t" in red.

5. Press the **DATA/ENTER** key to return to the auxiliary function mode.

A digital display showing the text "Fn013" in a seven-segment font. The "Fn01" is in black, and the "3" is in red.

This completes the absolute encoder's multi-turn limit setting operation. Cycle the power.

■ Multi-turn Setup Using the Built-in Panel Operator

1. Press the **DSPL/SET** key to select the auxiliary function mode.

A digital display showing the text "Fn000" in a seven-segment font. The "Fn" is in black, and the "000" is in red.

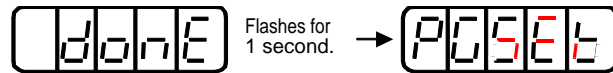
2. Press the **Up Arrow** or **Down Arrow** key to select the parameter Fn013.

A digital display showing the text "Fn013" in a seven-segment font. The "Fn01" is in black, and the "3" is in red.

3. Press the **DATA/SHIFT** key. The following display will appear.

A digital display showing the text "POSEt" in a seven-segment font. The "POSE" is in black, and the "t" is in red.

4. Press the **MODE/SET** key. The display will change as follows, and the absolute encoder's multi-turn limit setting operation will be performed.



5. Press the **DATA/SHIFT** key to return to the auxiliary function mode.



This completes the absolute encoder's multi-turn limit setting operation. Cycle the power to the servo amplifier.

! WARNING

- **The multi-turn limit value should be changed only for special applications.** Changing it inappropriately or unintentionally can be dangerous.
- **If the Multi-turn Limit Value Disagreement Alarm occurs, check the setting of parameter Pn205 in the servo amplifier to be sure that it is correct. If Fn013 is executed when an incorrect value is set in Pn205, that same incorrect value will be set in the encoder. There will not be an additional alarm, even if an incorrect value is set, but incorrect positions will be detected.** This results in a potentially dangerous situation where the machine will move to an unexpected position.

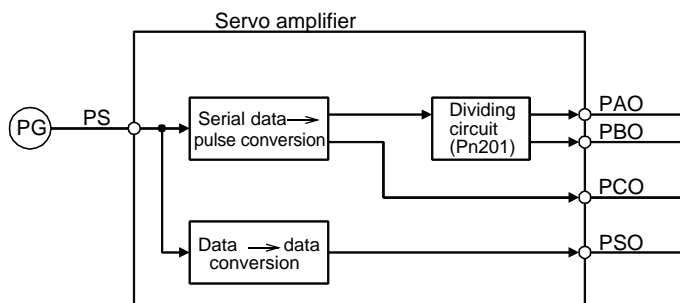
5.7.5 Absolute Encoder Reception Sequence

The sequence in which the servo amplifier receives data from the absolute encoder and transmits them to the host device is shown below.

Be sure you understand this section when designing the host device.

■ Outline of Absolute Signals

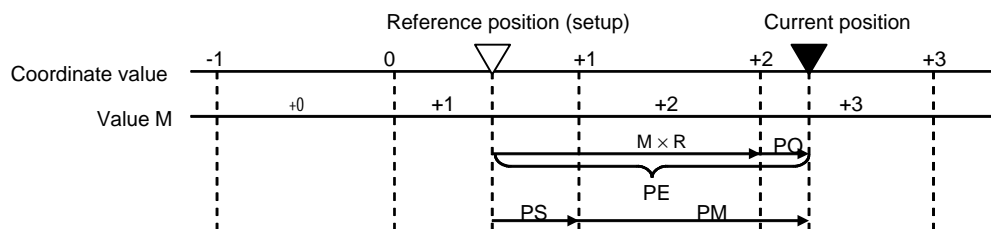
The absolute encoder's outputs are PAO, PBO, PCO, and PSO signals as shown below.



Signal	Status	Contents
PAO	Initial State	Serial data Initial incremental pulse
	Normal State	Incremental pulse
PBO	Initial State	Initial incremental pulse
	Normal State	Incremental pulse
PCO	Normal State	Home position pulse
PSO		Rotation count serial data

■ Contents of Absolute Data

- Serial data: Indicates how many turns the motor shaft has made from the reference position (position specified at setup).
- Initial incremental pulse: Outputs pulses at the same pulse rate as when the motor shaft rotates from the home position to the current position at approximately 2500rpm (for 16 bits when the dividing pulse is at the default setting).



The final absolute data P_M can be found by using the following formulae:

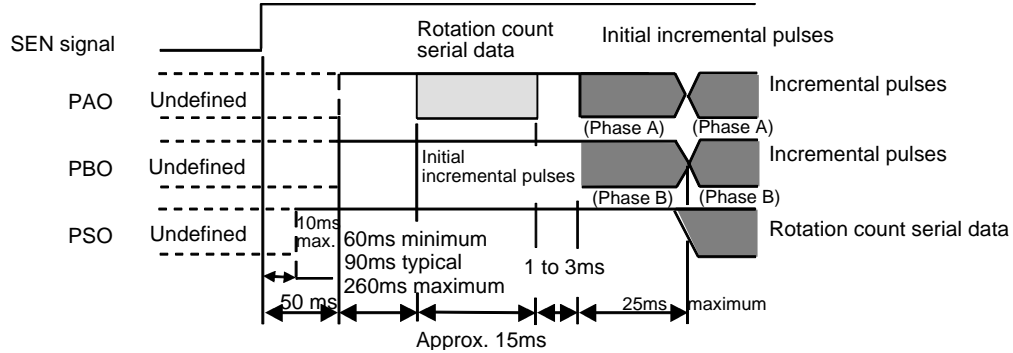
Forward rotation mode:	$P_E = M \times R + P_O$ $P_M = P_E - P_S$	Reverse rotation mode: (Pn0000.0 = 1)	$P_E = -(M \times R) + P_O$ $P_M = P_E - R_S$
------------------------	---	--	--

- Where:
- P_E = The current value read by the encoder.
 - M = The multi-turn data (rotation count data).
 - P_O = The number of initial incremental pulses.
 - P_S = The number of initial incremental pulses read at setup.
(This is saved and controlled by the host controller).
 - P_M = The current value required for the user's system.
 - R = The number of pulses per encoder revolution.
(Pulse count after dividing by the value of Pn201)

■ Absolute Encoder Transmission Sequence

1. Set the SEN signal at high level.
2. After 100ms, set the system to serial data reception-waiting-state. Clear the

- incremental pulse up/down counter to zero.
- 3. Receive eight bytes of serial data.
- 4. The system enters a normal incremental operation state approximately 50ms after the last serial data is received.

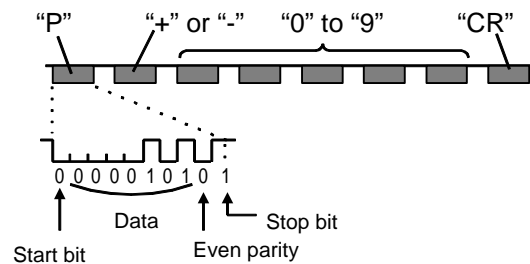


■ Detailed Signal Specifications

PAO Serial Data Specifications

The number of revolutions is output in five digits.

Data Transfer Method	Start-stop Synchronization (ASYNC)
Baud rate	9600bps
Start bits	1 bit
Stop bits	1 bit
Parity	Even
Character code	ASCII 7-bit code
Data format	8 characters, as shown below.

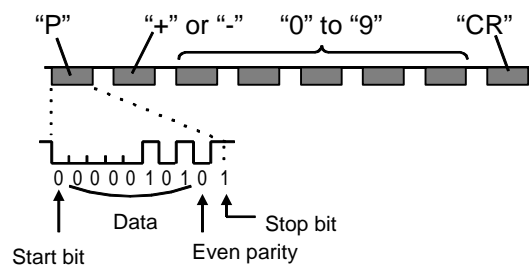


- Note:**
1. Data is "P+00000" (CR) or "P-00000" (CR) when the number of revolutions is zero.
 2. The revolution range is "+32767" to "-32768." When this range is exceeded, the data changes from "+32767" to "-32768" or from "-32768" to "+32767"

PSO Serial Data Specifications

The number of revolutions and the absolute position within one revolution are always output in five and seven digits, respectively. The data output cycle is approximately 40ms.

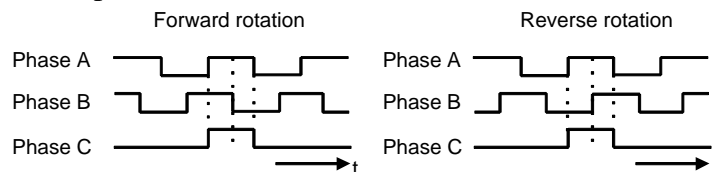
Data Transfer Method	Start-stop Synchronization (ASYNC)
Baud rate	9600 bps
Start bits	1 bit
Stop bits	1 bit
Parity	Even
Character code	ASCII 7-bit code
Data format	13 characters, as shown below.



- Note:**
1. The absolute position data within one revolution is the value before dividing.
 2. Absolute position data increases during forward rotation. (Not valid in reverse rotation mode).

Incremental Pulses and Origin Pulses

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



Setting the Pulse Dividing Ratio

Use the following parameter to set the pulse dividing ratio.

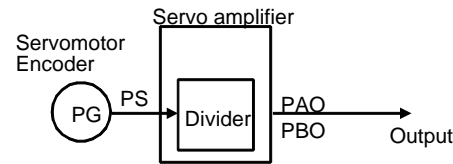
Parameter	Signal	Setting (p/rev)	Description
Pn201	PG Divider	Setting Range: 16 to 16384 Default Setting: 16384	Speed/Torque Control, Position Control

This parameter sets the number of output pulses for PG output signals (PAO, /PAO, PBO, /PBO).

Pulses from the motor encoder (PG) are divided by the number of pulses set here before being output.

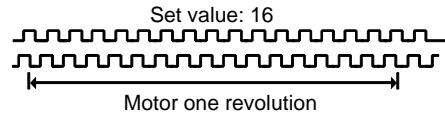
The set value is the number of output pulses per revolution. Set this value according to the reference unit of the machine or controller to be used.

The setting range varies according to the encoder used.



Output terminals:
 PAO (CN1-33)
 /PAO (CN1-34)
 PBO (CN1-35)
 /PBO (CN1-36)

Setting Example



■ Transferring Alarm Contents

When an absolute encoder is used, SEN signals can be utilized to transfer the alarm contents through PAO outputs to the host device as serial data.

Alarm Contents Output Example		
SEN Signal		
Digital Operator Display		Absolute encoder backup alarm
PAO Serial Data		ALM81

Note: Refer to 9.2.3 Alarm Display Table for a table of alarm contents.

5.8 Special Wiring

This section describes special wiring methods including the one for noise control. In addition to *5.8.1 Wiring Precautions* and *5.8.2 Wiring for Noise Control*, refer to other sections as necessary.

5.8.1 Wiring Precautions

To ensure safe and stable operation, always observe the following wiring precautions:

1. Always use the following cables for reference input and encoder wiring.

	Cable Type	Yaskawa Drawing Number	Maximum Allowable Length
Reference Input	Twisted-pair wires	JZSP-CKI01	118in (3m)
Encoder	Multiconductor shielded twisted-pair wire	JZSP-CMP00	SGMAH, SGMPH
		JZSP-CMP02	SGMGH, SGMSH

- Trim off the excess portion of the cable to minimize the cable length.
- 2. For a ground wire, use as large a wire as possible: AWG14(2.0mm²) or larger.



- At least class-3 ground (100 Ω maximum) is recommended.
- Ground to one point only.
- If the motor is insulated from the machine, ground the motor directly.
- 3. Do not bend or apply tension to cables.

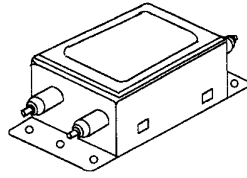
The conductor of a signal cable is very thin (0.0079 to 0.012in. (0.2 to 0.3mm)), handle the cables with care.

4. Use a noise filter to prevent noise interference.

(For details, refer to *5.8.2 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.
- Since this servo amplifier is designed as an industrial device, it provides no

mechanism to prevent noise interference.



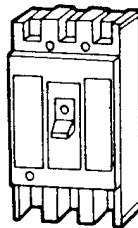
5. To prevent malfunction due to noise, take the following actions:

- Position the input reference device and noise filter as close to the servo amplifier as possible.
- Always install a surge absorber circuit in the relay, solenoid and electromagnetic contactor coils.
- The distance between a power line (such as a power supply line or motor cable) and a signal line must be at least XXin. (30cm). 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 servo amplifier is placed near a high-frequency oscillator, install a noise filter on the input side of the power supply line.

Note: 1. Since the servo amplifier uses high-speed switching elements, signal lines may receive noise. To prevent this, always take the above precautions.

2. For details on grounding and noise filters, refer to 5.8.2 *Wiring for Noise Control*.

6. Use a UL listed molded-case circuit breaker (MCCB) or fuse in accordance with the National Electrical Code (NEC) to protect the power supply line from high voltage.
- This Servo Amplifier connects directly to a commercial power supply without a transformer, so always use an MCCB or fuse to protect the servo system from accidental high voltage.
 - Select an appropriate MCCB or fuse according to the servo amplifier capacity and the number of servo amplifiers to be used as shown in the following table.



■ MCCB or Fuse According to Power Capacity

The following table shows the MCCB or fuse capacity for each power supply capacity.

Main Circuit Power Supply	Servo Amplifier Model		Applicable Motor	Power Capacity per Servo Amplifier (kVA)*	Current Capacity per MCCB or Fuse (A_{rms})* **
	Capacity (kW)	SGDH-			
Single-phase, 100V	0.03	A3BE	SGMAH-A3B	0.15	4
	0.05	A5BE	SGMAH-A5B	0.25	
	0.10	01BE	SGMAH-01B	0.40	
			SGMPH-01B		
	0.20	02BE	SGMAH-02B	0.60	6
SGMPH-02B					
Single-phase, 200V	0.03	A3AE	SGMAH-A3A	0.20	4
	0.05	A5AE	SGMAH-A5A	0.25	
	0.10	01AE	SGMAH-01A	0.40	
			SGMPH-01A		
	0.20	02AE	SGMAH-02A	0.75	
			SGMPH-02A		
	0.40	04AE	SGMAH-04A	1.2	8
SGMPH-04A					
Three-phase, 200V	0.50	05AE	SGMGH-05A□A	1.4	4
			SGMGH-03A□B		
	0.75	08AE	SGMAH-08A	1.9	7
			SGMPH-08A		
			SGMGH-06A□B		
	1.0	10AE	SGMGH-09A□A	2.3	
			SGMGH-09A□B		
			SGMSH-10A		
	1.5	15AE	SGMPH-15A	3.2	10
			SGMGH-13A□A		
			SGMGH-12A□B		
	2.0	20AE	SGMSH-15A	4.3	13
			SGMGH-20A□A		
SGMGH-20A□B					
3.0	30AE	SGMSH-20A	5.9	17	
		SGMGH-30A□A			
		SGMGH-30A□B			
			SGMSH-30A		

* This is the net value at the rated load. When actually selecting fuses, determine the capacity using the prescribed derating.

** Operating characteristics (at 25°C): 2 seconds or more for 200%, 0.01 second or more for 700%

Note: A fast-operating fuse cannot be used because the Servo Amplifier power supply is a capacitor input type. A fast-operating fuse may blow when the power is turned ON.

Note: SGDH servo amplifiers do not have built-in ground protection circuits. To configure a safer system, install a ground fault interrupter with or without a circuit breaker for protection against overload and short circuit conditions.

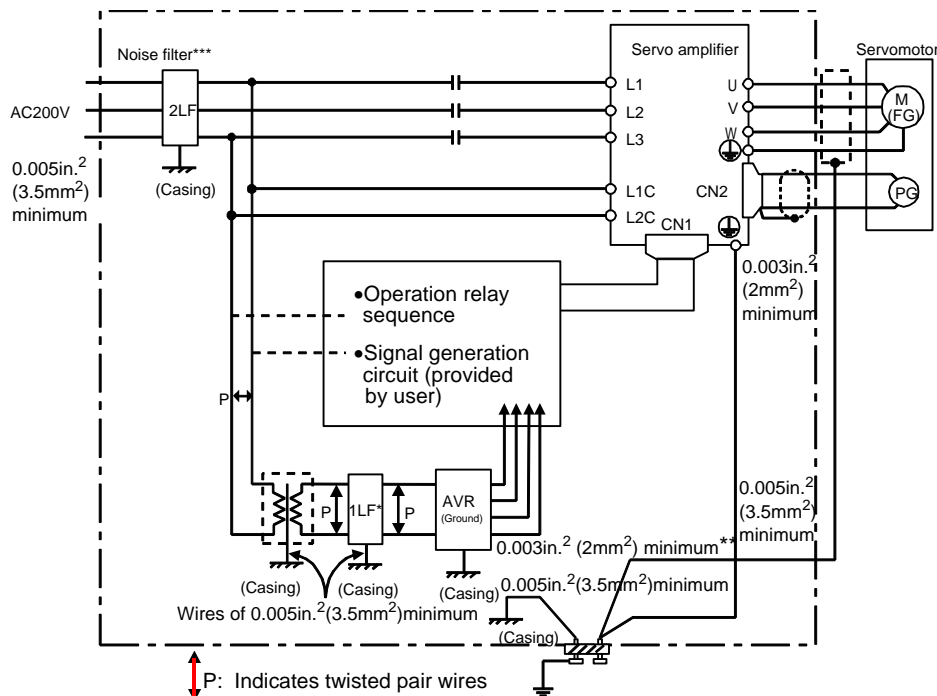
5.8.2 Wiring for Noise Control

■ Wiring Example

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

This servo amplifier has a built-in microprocessor (CPU). To protect it from external noise install a noise filter in the appropriate place.

The following is an example of wiring for noise control.



Notes: *When using a noise filter, follow the precautions in *Using a Noise Filter* on the following page.

**For ground wires connecting to the casing, use a wire with a thickness of at least 0.005in.² (3.5mm²), preferably a braided flat copper wire.

■ Correct Grounding

Grounding the Motor Frame

Always connect servomotor frame terminal FG to the servo amplifier ground terminal \oplus . Also be sure to ground the ground terminal \ominus .

If the servomotor is grounded via the machine, switching noise current will flow from the servo amplifier power unit through motor stray capacitance. The grounding of the motor frame is required to prevent the adverse effects of switching noise.

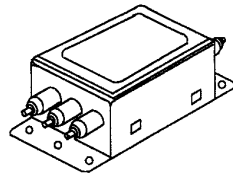
Noise on the Reference Input Line

If the reference input line is affected by noise, ground the 0V line (SG) of the reference input line. If the main circuit wiring for the motor is accommodated in a metal conduit, ground the conduit and its junction box.

All grounds must be made to only one point in the system.

■ Using Noise Filters

Use a noise suppression filter to prevent noise generated by the power supply line. Install a noise filter on the power supply line for peripheral equipment as necessary.



The following table recommends noise filters for each servo amplifier model.

Servo Amplifier Model	Recommended Noise Filter	
	Model	Manufacturer
SGDH-A3AE to -02AE SGDH-A3BE to -01BE	SUP-P5H-EPR	Okaya Electric Company
SGDH-02BE	SUP-P8H-EPR	
SGDH-04AE	SUP-P10H-EPR	
SGDH-05AE to -20AE	LF-3200	Tokin Corp.
SGDH-30AE	LF-3300	

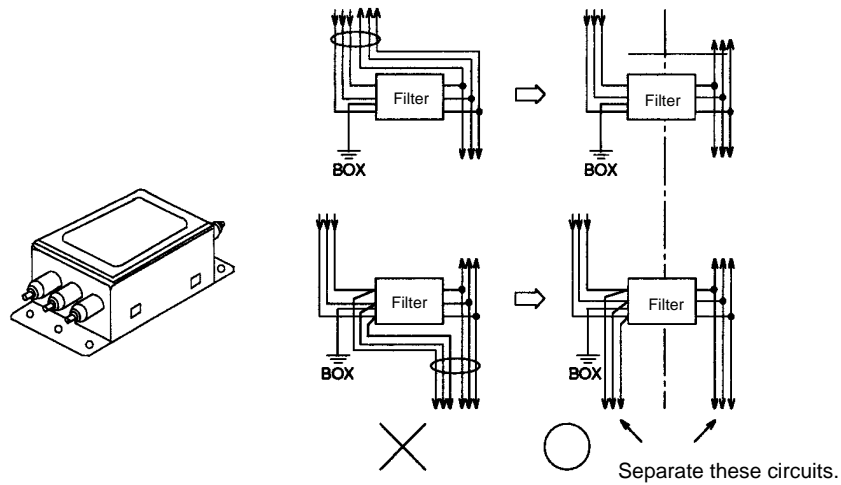
Note: Filters manufactured by Tokin Corp. are available from Yaskawa. Please contact Yaskawa or an authorized distributor.

Installation and Wiring a Noise Filter

Incorrect application of a noise filter significantly reduces its benefits. Follow these instructions for the best results.

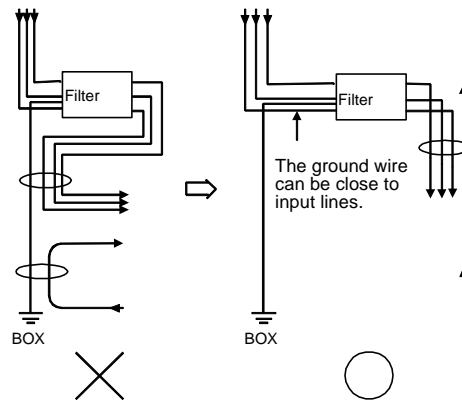
- Separate the input lines from the output lines.

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



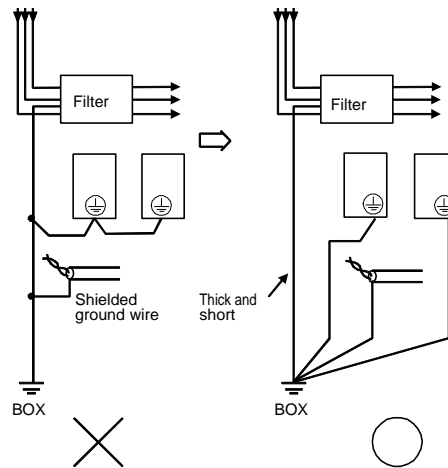
- Isolate the noise filter ground wire from the output lines.

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



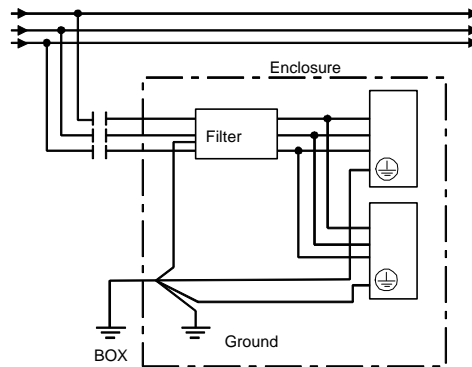
- Connect the noise filter ground wire directly to the ground plate.

Do not connect the noise filter ground wire to other ground wires.



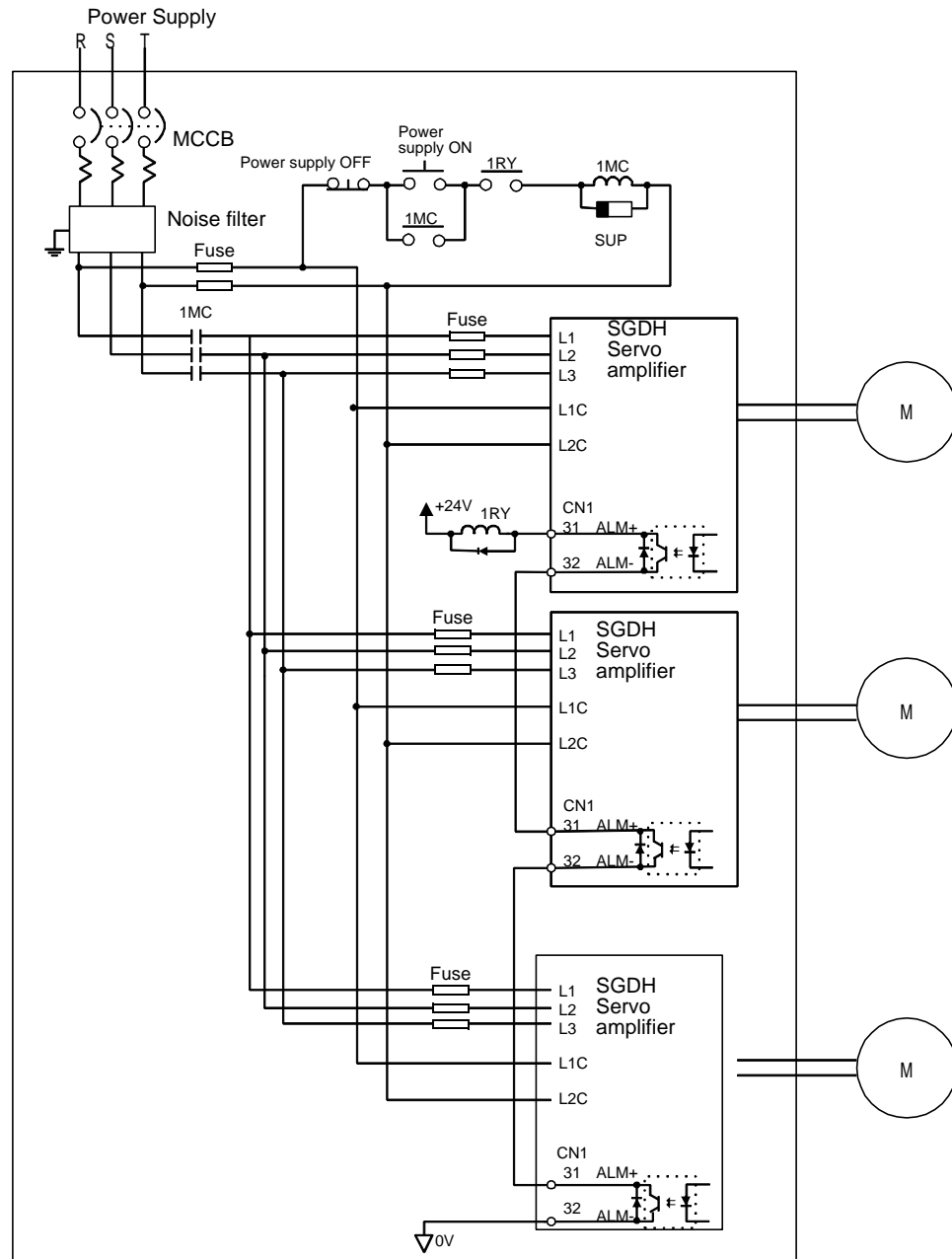
- When grounding a noise filter inside an enclosure:

If a noise filter is located inside an enclosure, connect the noise filter ground wire and the ground wires from other devices inside to the ground plate for the enclosure first, then ground these wires.



5.8.3 Using More Than One Servodrive

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



Note: Wire the system to comply to National Electrical Code.

Connect the alarm output (ALM) terminals for the three servo amplifiers in series to enable alarm detection relay 1RY to operate. The output transistor is turned OFF when the ALM output signal enters an alarm state.

Multiple servos can share a single MCCB or noise filter. Always select an MCCB or

noise filter that has enough capacity for the total power capacity (load conditions) of those servos. For details, refer to *5.8.1 Wiring Precautions*.

5.8.4 Extending Encoder Cables

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

Preparing 50m (164.0ft) Encoder Cables

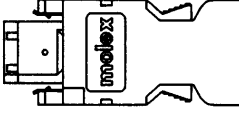
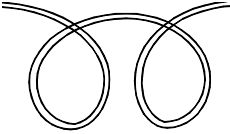
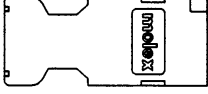
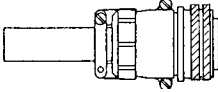
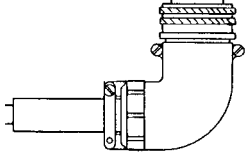
- Cable Model Number: UL2076-SB

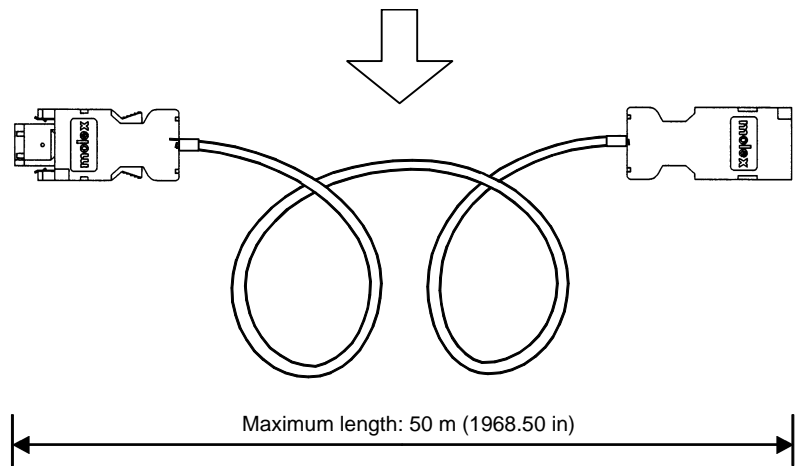
Cables are ordered in units of meters. Specify the length, when ordering.

- Connectors or Connector Kits

Connector Type		Model
Servo amplifier end	Encoder connector (CN2) socket	JZSP-CMP9-1
Servomotor end	Encoder connector socket for SGMAH and SGMPH servomotors	JZSP-CMP9-2
	Encoder connector plug and cable plug for SGMGH and SGMSH servomotors	Plug L: MS3108B20-29S Straight: MS3106B20-29S Cable clamp: MS3057-12A

- Preparing Encoder Cables

• iEncoder Connector at Servo Amplifier	• iCable Line	• iEncoder Connector at Servomotor	
			For SGMAH and SGMPH servomotors
			For SGMGH and SGMSH servomotors
			



5.8.5 400V Power Supply Voltage



CAUTION

- **Do not connect the servo amplifier directly to any level other than 400V.**
Doing so will destroy the servo amplifier.

There are three types of SGDH servo amplifiers, for the power supply voltages: single-phase 100V_{ac}, three-phase 200V_{ac}, and single-phase 200V_{ac}. For the three-phase 400V_{ac} power supply, prepare the following voltage conversion transformers (single-phase or three-phase).

Primary Voltage	Secondary Voltage
400V _{ac} or 440V	200V _{ac}
400V _{ac} or 440V	100V _{ac}

Refer to the capacities shown in the following table when selecting a voltage conversion transformer.

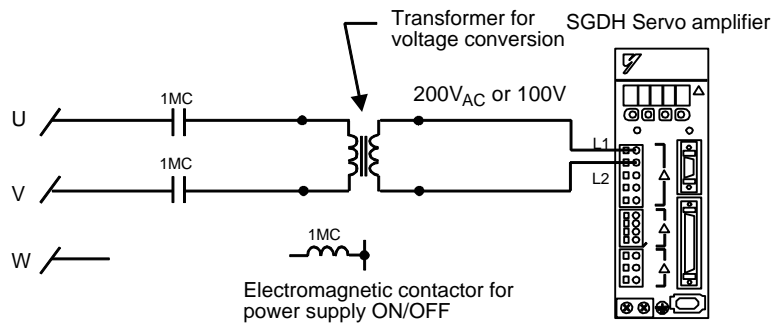
Voltage	Servo Amplifier Model	Voltage capacity per Servo Amplifier* kVA
Single-phase 100V	SGDH-A3BE	0.15
	SGDH-A5BE	0.25
	SGDH-01BE	0.40
	SGDH-02BE	0.60
Single-phase 200V	SGDH-A3AE	0.20
	SGDH-A5AE	0.25
	SGDH-01AE	0.40
	SGDH-02AE	0.75
	SGDH-04AE	1.2
Three-phase 200V	SGDH-05AE	1.4
	SGDH-08AE	1.9
	SGDH-10AE	2.3
	SGDH-15AE	3.2
	SGDH-20AE	4.3
	SGDH-30AE	5.9

* This is the net value at the rated load.

When using a 400V class power supply, turn the power supply ON and OFF at the primary side of the voltage conversion transformer.

Note: Transformer inductance will cause a surge voltage if the power is turned ON and OFF at the secondary, damaging the servo amplifier.

Single-phase Power Supply Connection Example

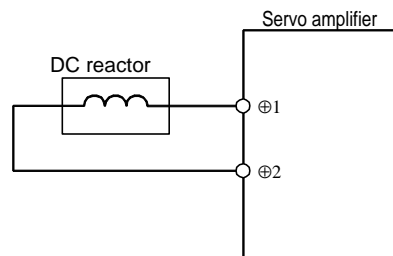


5.8.6 Reactor for Harmonic Suppression

SGDH servo amplifiers have DC reactor connection terminals for power supply harmonic suppression.

■ Connecting a DC Reactor

The DC reactor is connected in series to the rectifier circuit's output side. Refer to *3.2 Servo Amplifier Internal Block Diagrams*.



At the time of shipping, the servo amplifier's (+)1 and (+)2 are short-circuited. Remove the lead wire between the two terminals and connect the DC reactor.

■ DC Reactor Specifications

The following table shows the specifications for the DC reactors provided by Yaskawa.

Applicable Servo Amplifiers		Reactor Specifications		Reactor Model
		Inductance (mH)	Rated current (A)	
100 V	SGDH-A3BE	-	-	-
	SGDH-A5BE	-	-	-
	SGDH-01BE	10.0	1.8	X5063
	SGDH-02BE	4.7	3.5	X5062
200 V	SGDH-A3AE	-	-	-
	SGDH-A5AE	-	-	-
	SGDH-01AE	22.0	1.0	X5064
	SGDH-02AE	10.0	1.8	X5063
	SGDH-04AE	4.7	3.5	X5063
	SGDH-05AE	2.0	4.8	X5061
	SGDH-08AE			
	SGDH-10AE			
	SGDH-15AE	1.5	8.8	X5060
	SGDH-20AE	1.0	14.0	X5059
SGDH-30AE				

5.9 Reserved Parameters

The following parameters are reserved.

Do not change any of them from the default setting.

Parameter Number	Lower Limit	Upper Limit	Default Setting
Pn002.3	0	2	0
Pn004	—	—	0000
Pn005	—	—	0001
Pn110.3	0	3	0
Pn119	1	2000	60
Pn11A	1	2000	1000
Pn11B	1	150	50
Pn11C	1	150	70
Pn11D	0	150	100
Pn11E	0	150	100
Pn11F	0	2000	0
Pn120	0	51200	0
Pn206	513	32768	16384
Pn511	—	—	8888

6 Servo Adjustment

This chapter describes the functions required for servo adjustment. Find the required information by selecting the section from the following table of contents.

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6.1 Smooth Operation

This section provides technical information on the smooth operation of servomotors.

6.1.1 Using the Soft Start Function

The soft start function adjusts progressive speed reference input inside the servo amplifier so that acceleration and deceleration can be as constant as possible. To use this function, set the following parameters.

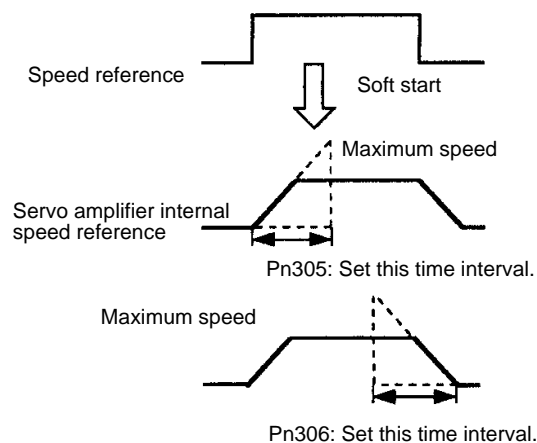
Parameter	Signal	Setting (ms)	Description
Pn305	Soft Start Acceleration Time	Setting Range: 0 to 10000 Default Setting: 0	Speed Control
Pn306	Soft Start Deceleration Time	Setting Range: 0 to 10000 Default Setting: 0	Speed Control

In the servo amplifier, a speed reference is multiplied by the acceleration or deceleration value set in Pn305 or Pn306 to provide speed control.

The soft start function enables smooth speed control when progressive speed references are input or when contact input speed control is used. 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 maximum speed is reached.
- Pn306: The time interval from the time the motor is operating at the maximum speed until it stops.



6.1.2 Smoothing

The smoothing function applies a filter inside the servo amplifier to a constant-frequency reference input so that acceleration and deceleration can be as constant as possible. To use this function, set the following parameters.

Use the following parameter to set the type of filter to be applied.

Parameter	Signal	Setting	Description
Pn207.0	Position Reference Filter Selection	Default Setting: 0	Position Control

Either an acceleration/deceleration or average movement filter can be selected.

Pn110.0 Setting	Result
0	Enables acceleration/deceleration filter.
1	Enables average movement filter.

The time constant and time for these filters are set in the following parameters.

Time constant for Acceleration/Deceleration Filter:

Parameter	Signal	Setting (x 0.01ms)	Description
Pn204	Position Reference Accel/Decel Time Constant	Setting Range: 0 to 6400 Default Setting: 0	Position Control

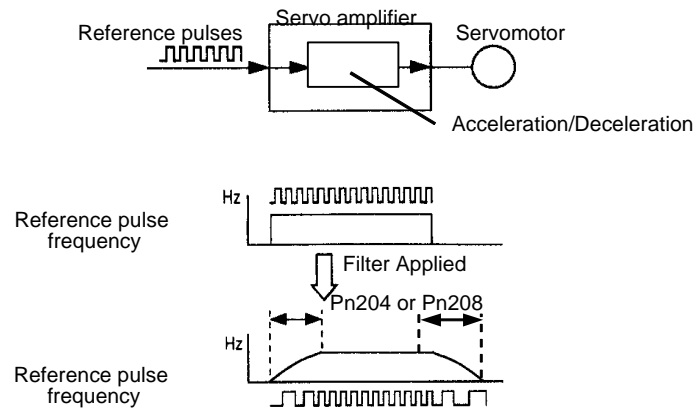
Averaging time for Average Movement Filter:

Parameter	Signal	Setting (x 0.01ms)	Description
Pn208	Position Reference Movement Averaging Time	Setting Range: 0 to 6400 Default Setting: 0	Position Control

This function provides smooth motor operating in the following cases:

- When the host device which outputs references cannot perform acceleration/deceleration processing.
- When the reference pulse frequency is too low.
- When the reference electronic gear ratio is too high (i.e., $10 \times$ or more).

This function does not affect the travel distance (i.e., the number of pulses).



6.1.3 Adjusting Gain

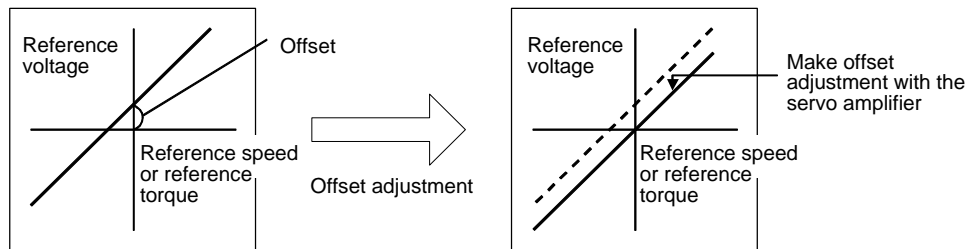
If speed loop gain or position loop gain exceeds the allowable limit for the servo system (including the machine to be controlled), the system will tend to vibrate or become too sensitive. Smooth operation is not possible under such conditions. Reduce each loop gain value to an appropriate value.

Refer to *6.2.1 Setting Servo Gain* for details regarding servo gain adjustment.

6.1.4 Adjusting Offset

The servo system does not operate smoothly if reference voltage from the host controller or external equipment has a reference offset value close to 0V. In that case, adjust the reference offset value to 0V.

■ Reference Voltage Offset from Host Controller or External Circuitry



■ Reference Offset Adjustment

The following two methods are provided to reset the reference offset value to 0V.

- Reference offset automatic adjustment
- Reference offset manual adjustment

If a position loop is formed in the host controller, be sure to make a manual offset adjustment and do not make automatic reference offset adjustment.

Refer to the following sections in *Chapter 7 Using the Digital Operator* for a detailed description of reference offset adjustment.

Adjustment Method	Detailed Description
Automatic	7.2.3 Automatic Adjustment of the Speed and Torque Reference Offset
Manual	7.2.4 Manual Adjustment of the Speed and Torque Reference Offset

6.1.5 Setting the Torque Reference Filter Time Constant

If there is machine vibration which may be caused by the servodrive, try adjusting the filter time constant in Pn401. This may stop the vibration.

Parameter	Signal	Setting (x 0.01ms)	Application
Pn401	Torque Reference Filter Time Constant	Setting Range: 0 to 65535 Default Setting: 100	Speed/Torque Control, Position Control

The above constant is the filter time constant of the torque reference to be set in the servo amplifier. The smaller the value, the faster the speed control response will be. There is, however, a limit, depending on machine conditions.

6.1.6 Notch Filter

Vibration in the machine can sometimes be eliminated by using a notch filter for the frequency at which the vibration is occurring.

Parameter	Signal	Setting	Description
Pn408.0	Notch Filter Selection	Default Setting: 0	Speed/Torque Control, Position Control

This parameter can be set to enable the notch filter.

Pn408.0 Setting	Result
0	None.
1	Enables notch filter for torque reference.

Use the following parameter to set the frequency at which the filter is effective.

Parameter	Signal	Setting (Hz)	Description
Pn409	Position Reference Accel/Decel Time Constant	Setting Range: 50 to 2000 Default Setting: 2000	Speed/Torque Control, Position Control

6.2 High-Speed Positioning

This section provides technical information on high-speed positioning.

6.2.1 Setting Servo Gain

Use the servo gain setting function in the following cases.

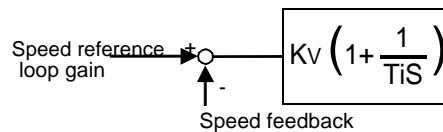
- To check each servo gain value that is automatically set after auto-tuning.
- To directly set each of the above servo gain values in another servo amplifier.
- To further refine responsiveness after auto-tuning (either to increase responsiveness or to reduce it).

■ Setting Speed Loop Gain

Set the following speed loop related parameters as required.

Parameter	Signal	Setting	Application
Pn100	Speed Loop Gain (K_v)	Setting Range: 1 to 2000Hz Default Setting: 40Hz	Speed/Torque Control, Position Control
Pn101	Speed Loop Integral Time Constant (T_i)	Setting Range: 15 to 51200 X 0.01ms Default Setting: 2000 x 0.01ms	Speed/Torque Control, Position Control

The higher the speed loop gain, or the smaller the speed loop integral time constant value, the faster the speed control response will be. There is, however, a certain limit depending on machine characteristics.



Speed loop gain K_v is adjusted in 1Hz increments provided that the following parameter is set correctly.

Parameter	Signal	Setting (%)	Application
Pn103	Inertia Ratio	Setting Range: 0 to 10000 Default Setting: 100	Speed/Torque Control, Position Control

$$\text{Inertia Ratio} = \frac{\text{Motor load inertia } (J_L)}{\text{Servomotor rotor inertia } (J_M)} \times 100\%$$

The load inertia of the servo amplifier reflected at the motor shaft is default set to the rotor inertia of the servomotor. Therefore, obtain the inertia ratio from the above formula and set parameter Pn103 properly.

The above parameters are automatically set by the auto-tuning operation.

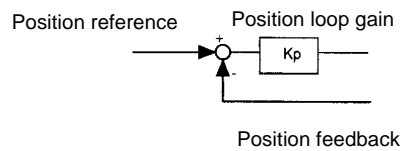
■ Setting Position Loop Gain

Set the following position loop-related parameter as required.

Parameter	Signal	Setting (s^{-1})	Application
Pn102	Position Loop Gain (K_P)	Setting Range: 0 to 2000 Default Setting: 40	Speed/Torque Control, Position Control

The above constant is the position loop gain for the servo amplifier.

The higher the position loop gain, the smaller the position control error will be. There is, however, a certain limit depending on machine characteristics.

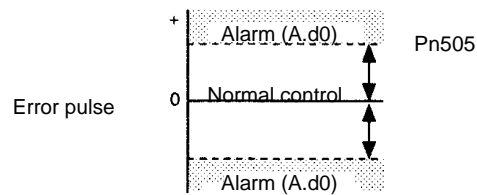


This gain setting is also valid for zero clamp operation.

The above parameter is automatically set by the auto-tuning operation.

Parameter	Signal	Setting (256 reference units)	Application
Pn505	Overflow Level	Setting Range: 1 to 32767 Default Setting: 1024	Position Control

Set in this parameter the error pulse level at which a position error pulse overflow alarm (A.d0) is detected.



If the machine permits only a small position loop gain value to be set in Pn102, an overflow alarm may arise during high speed operation. In this case, increase the value set in this parameter to avoid unnecessary alarms.

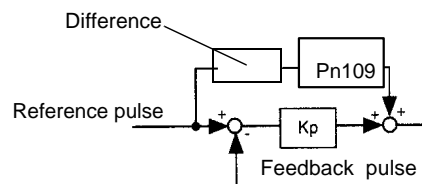
6.2.2 Using Feed-Forward Control

The time required for positioning can be shortened with feed-forward control by setting the following parameter.

Definition: Feed-forward control makes necessary corrections beforehand to prevent the control system from receiving the effects of external disturbance. By increasing the effective servo gain, feed-forward control improves the system's response.

Parameter	Signal	Setting (%)	Application
Pn109	Feed-forward	Setting Range: 0 to 100 Default Setting: 0	Speed Control, Position Control

Parameter Pn109 is set to apply feed-forward frequency compensation to position control inside the servo amplifier. Use it to shorten positioning time. Too high a value may cause machine vibration. For most applications, set Pn109 to 80% or less.

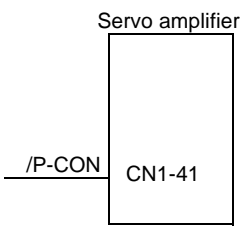


6.2.3 Using Proportional Control

If parameter Pn000.1 is set to 0 or 1 as shown below, input signal /P-CON serves as a PI/P control changeover switch.

- PI control: Proportional/integral control.
- P control: Proportional control.

Parameter	Signal	Setting (%)	Application
Pn000.1	Control Method Selection	Default Setting: 0	Speed Control, Position Control

Pn000.1 Setting	Control Mode						
0	Speed Control	Usual speed control or position control is selected. Input signal /P-CON (CN1-41) is used to select PI control or P control.					
1	Position Control	<table border="1"> <tr> <td>CN1-41 is open.</td> <td>PI control</td> </tr> <tr> <td>CN1-41 is 0V</td> <td>P control</td> </tr> </table>	CN1-41 is open.	PI control	CN1-41 is 0V	P control	P or PI control selection 
CN1-41 is open.	PI control						
CN1-41 is 0V	P control						

■ Methods for Using Proportional Control

Proportional control can be used in the following two ways.

- When operation is performed by sending speed references from the host controller to the servo amplifier, the host controller can selectively use P control mode for particular conditions only. This method can suppress overshooting and shorten setting time. Refer to 6.2.5 *Using Mode Switch* for particular conditions.
- If PI control mode is used when the speed reference has a reference offset, the motor may rotate at a very slow speed and fail to stop even if 0 is specified as a speed reference. In this case, use P control mode to stop the motor.

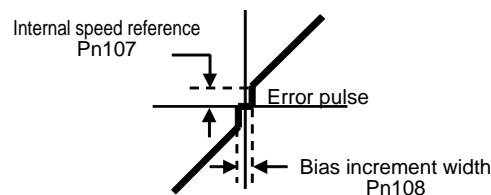
6.2.4 Setting Speed Bias

The settling time for positioning can be reduced by assigning bias to the speed reference block in the servo amplifier. To assign bias, use the following constants.

Parameter	Signal	Setting	Application
Pn107	Bias	Setting Range: 0 to 450rpm Default Setting: 0rpm	Position Control
Pn108	Bias Addition Width	Setting Range: 0 to 250 Default Setting: 7	Position Control

Set the parameters to shorten the time required for positioning according to the application.

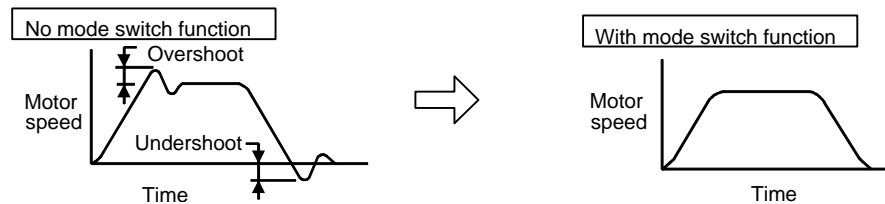
The bias increment width (Pn108) is expressed as an error pulse width that determines the time in which bias input (Pn107) takes effect. The bias input is ON if the error pulse width exceeds the value set in Pn108.



6.2.5 Using Mode Switch

Use the mode switch function for the following purposes.

- To suppress overshoot during acceleration or deceleration (for speed control).
- To suppress undershoot during positioning and to shorten the setting time (for position control).



The mode switch function makes it possible to automatically switch the servo amplifier's internal speed control mode from PI to P control mode and vice versa when specified conditions are satisfied.

Definition: **PI control** means proportional/integral control, and **P control** means proportional control. In effect, switching "from PI control to P control" reduces effective servo gain, thereby making the servo system more stable.

IMPORTANT

- The mode switch is used to fully utilize performance of a servodrive to achieve very high-speed positioning. The speed response waveform must be observed to adjust the mode switch.
- For normal use, the speed loop gain and position loop gain set by auto-tuning provide sufficient speed/position control. Even if overshoot or undershoot occurs, it can be suppressed by setting either:
 - The acceleration/deceleration time constant for the host device.
 - The soft start time constants (Pn305, Pn306)
 - The position reference acceleration/deceleration constant (Pn204) for the servo amplifier.

■ Selecting Mode Switch Setting

The servo amplifier incorporates four mode switch settings (0 to 3). Select a mode switch with the following parameter (Pn10B.0).

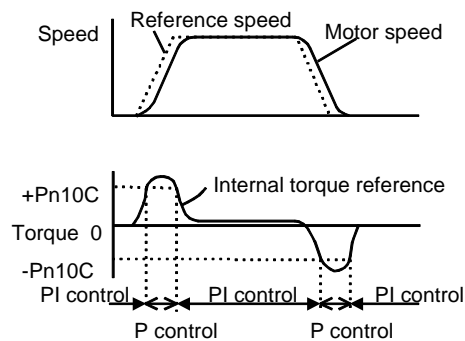
Pn10B.0 Setting	Description	Parameter Used to Set Detection Point	Setting Unit
0	Uses torque reference as the detection point. (Standard setting)	Pn10C	Percentage of rated torque (%)
1	Uses speed reference input as the detection point.	Pn10D	Motor Speed (rpm)
2	Uses acceleration as the detection point.	Pn10E	× 10rpm/s

Pn10B.0 Setting	Description	Parameter Used to Set Detection Point	Setting Unit
3	Uses error pulse input as the detection point.	Pn10F	Reference unit

Torque Reference Input Used as Detection Point (Standard Setting)

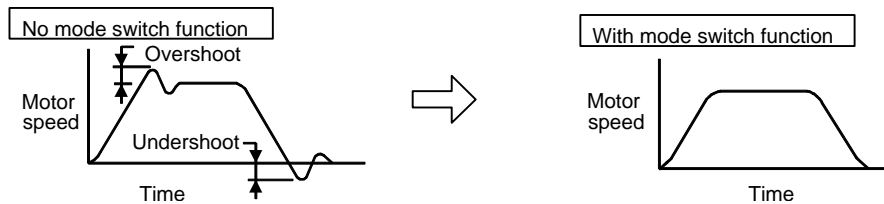
With this setting, if the value of torque reference input exceeds the torque set in parameter Pn10C, the speed loop switches to P control.

The servo amplifier is default set to this standard mode (Pn10C = 200).



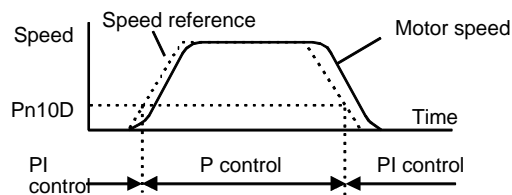
Operating Example

If the system is always in PI control without using the mode switch function, the speed of the motor may overshoot or undershoot due to torque saturation during motor acceleration or deceleration. The mode switch function suppresses torque saturation and eliminates motor speed overshoot or undershoot.



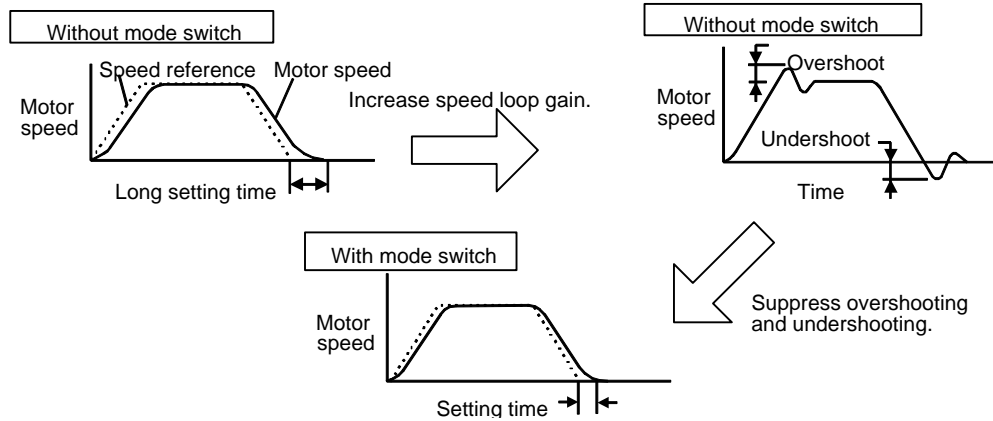
Speed Reference Used as Detection Point

With this setting, if a speed reference exceeds the value set in parameter Pn10D, the speed loop switches to P control.



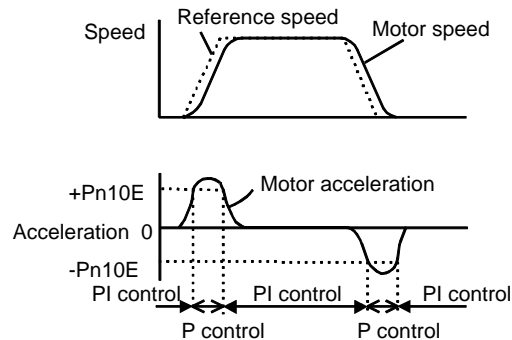
Operating Example

In this example, the mode switch is used to reduce setting time. Generally, speed loop gain must be increased to reduce setting time. Using the mode switch suppresses the occurrence of overshoot and undershoot as speed loop gain is increased.



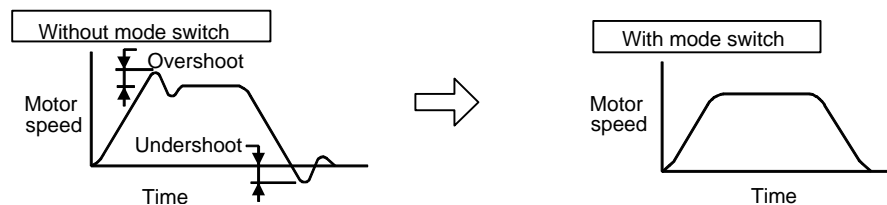
Acceleration Used as Detection Point

If motor acceleration exceeds the value set in parameter Pn10E, the speed loop switches to P control.



Operating Example

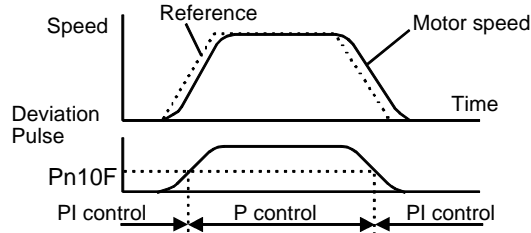
If the system is always in PI control without using the mode switch function, the speed of the motor may overshoot or undershoot due to torque saturation at the time of the acceleration or deceleration of the motor. The mode switch function suppresses torque saturation and eliminates motor speed overshoot or undershoot.



Error Pulse Used as a Detection Point

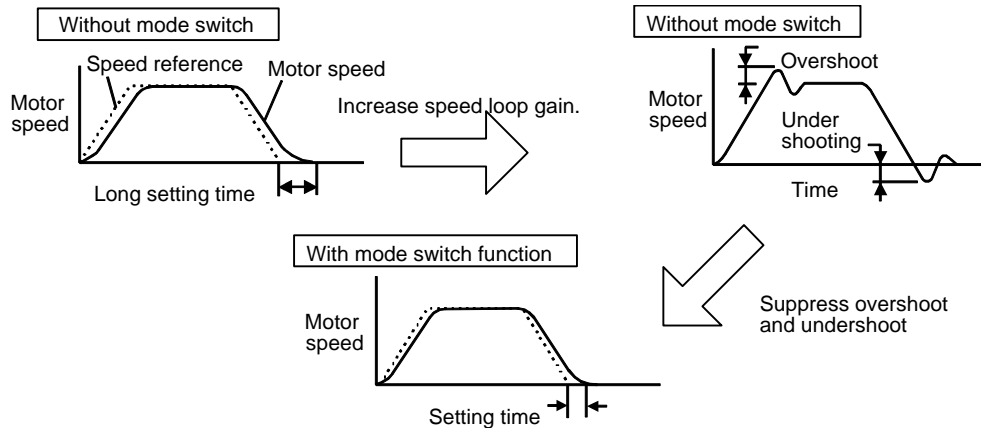
This setting is enabled for position control operation only.

If an error pulse exceeds the value set in parameter Pn10F, the speed loop switches to P control.



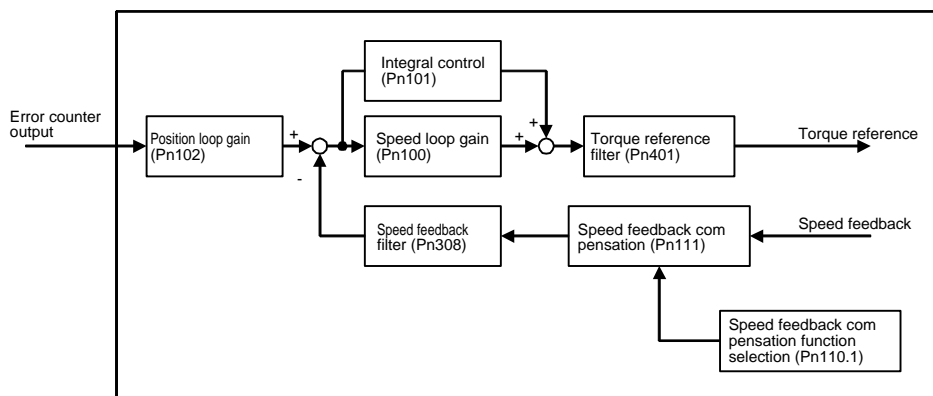
Operating Example

In this example, the mode switch is used to reduce setting time. Generally, speed loop gain must be increased to reduce setting time. Using the mode switch suppresses the occurrence of overshoot and undershoot when speed loop gain is increased.



6.2.6 Speed Feedback Compensation

Use this function to shorten the system's setting time in positioning operation.



Note: This function is available provided that the inertia ratio set in Pn103 is correct. Therefore, perform online auto-tuning to obtain and save the results as the parameters. Refer to *6.3 Auto-Tuning* for details. Otherwise, directly set the inertia ratio.

■ Adjustment Procedure

When adding the value of speed feedback compensation, be sure to follow the procedure described below and make servo gain adjustments while watching the analog monitor to observe the position error and torque reference. Refer to *6.5 Analog Monitor* for details.

1. Set parameter Pn110 to "0002" so that the online auto-tuning function will be disabled. Refer to *6.3.4 Parameters Related to Online Auto-Tuning* and *Appendix B List of Parameters* for details regarding Pn110.
2. First, make normal servo gain adjustments with no feedback compensation. In this case, gradually increase the speed loop gain in Pn100 while reducing the speed loop integral time constant Pn101, and finally set the speed loop gain in Pn100 to the same value as that of the position loop gain in Pn102.

The relationship between the speed loop gain and integral time constant is as follows:

Take the value obtained from the following formula as a reference value for setting the speed loop integral time constant in Pn101.

$$\text{Speed loop integral time constant} = \frac{4}{2p \times \text{Speed loop gain}} \text{ (s)}$$

Unit of speed loop gain: [Hz]

Check the unit when setting the speed loop integral time constant in Pn101. Pn101 is set in 0.01ms increments.

The units for speed loop gain (Hz) and position loop gain (s^{-1}) differ, nevertheless, set these gains to the same numerical value.

3. Repeat step 2 to increase the speed loop gain while watching the position error of the analog monitor to observe the setting time and the torque reference of the analog monitor to observe any occurrence of vibration. If there is any oscillating noise or noticeable vibration, gradually increase the time constant of the torque reference filter 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 setting time. If the speed feedback com-

pensation is too low, however, the response waveform will vibrate.

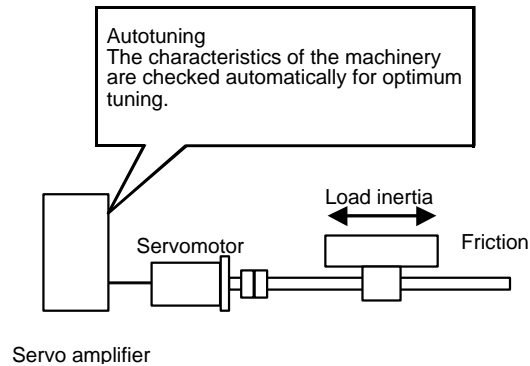
6. Find the condition in which the shortest setting time is obtainable within the range where the position error or torque reference waveform observed through the analog monitor is not vibrating or unstable.
7. The servo gain adjustment is completed when no further shortening of the positioning time is possible.

IMPORTANT

- Speed feedback compensation usually makes it possible to increase the speed loop gain and position loop gain. The machinery may vibrate excessively if the compensation value greatly changes or Pn110.1 is set to "1" (i.e., speed feedback compensation disabled) after increasing the speed loop gain or position loop gain.

6.3 Auto-Tuning

If positioning is taking a long time, the speed loop gain or position loop gain of the servo system may not be set properly. If the gain settings are wrong, set them properly in accordance with the configuration and rigidity of the machinery.



The servo amplifier incorporates an online auto-tuning function, which checks the characteristics of the machinery automatically and makes the necessary servo gain adjustments. The function is easy to use and makes it possible for even beginners to perform servo gain tuning and set all servo gains as parameters.

The following parameters can be set automatically by using the online auto-tuning function.

Parameter	Description
Pn100	Speed loop gain
Pn101	Speed loop integral time constant
Pn102	Position loop gain
Pn401	Torque reference filter time constant

6.3.1 Online Auto-Tuning

Online auto-tuning is a control function which enables the servo amplifier to check changes in the load inertia during operation in order to maintain the target value for speed loop gain or position loop gain.

Online auto-tuning may not work well in the following cases.

- When the cycle for load inertia change is 200ms or shorter (when the load changes rapidly).
- When the application has slow acceleration or deceleration using the soft start function, and the speed error of the Servomotor being driven is small.
- When adjusting the servomotor manually and operating at low gain (a machine rigidity of 1 or less).

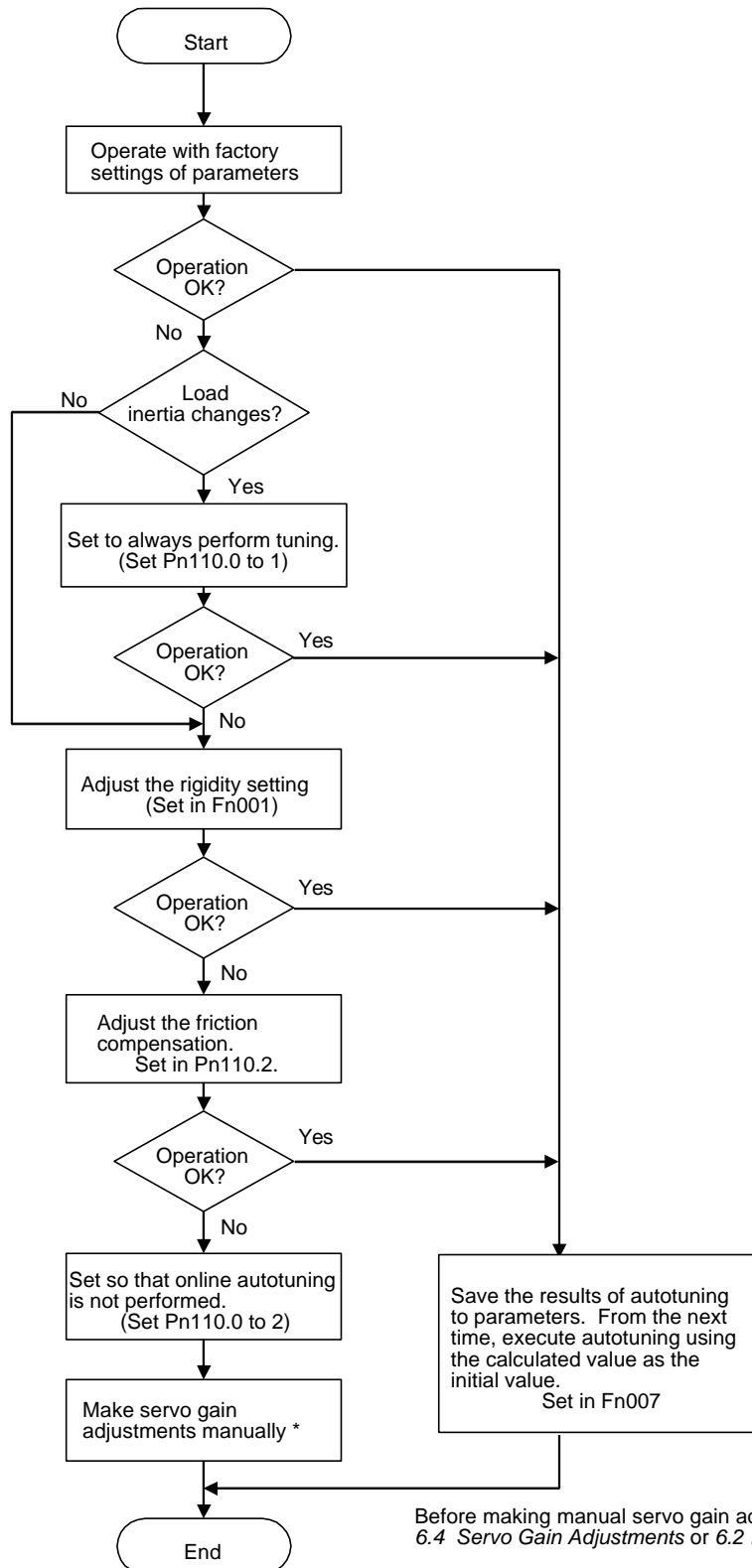
Disable the online auto-tuning function if tuning is not possible. (See 6.4.3).

IMPORTANT

- **Do not use online auto-tuning in the following cases:**
 - When using Torque Control Mode.
 - When using IP control for the speed loop.
 - When using the torque feed-forward function.
 - When switching gain using /G-SEL.

■ Setting Parameters for Online Auto-Tuning

The following flowchart shows the procedure for setting the parameters for online auto-tuning.



Before making manual servo gain adjustments, refer to 6.4 Servo Gain Adjustments or 6.2 High-Speed Positioning.

6.3.2 Mechanical Rigidity Settings for Online Auto-Tuning

For the mechanical rigidity settings at the time of online auto-tuning, select the target values for speed loop gain and position loop gain of the servo system. Any of the following ten levels of rigidity can be selected.

Fn001 Rigidity Setting	Position Loop Gain [s ⁻¹]	Speed Loop Gain [Hz]	Speed Loop Integral Time Constant [0.01ms]	Torque Reference Filter Time Constant [0.01ms]
	Pn102	Pn100	Pn101	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

Note: The Rigidity value is default set to 4.

As the rigidity value is increased, the servo system loop gain increases and the time required for positioning is shortened. If the rigidity is excessively high, however, it may cause the machinery to vibrate. In that case, decrease the set value.

The rigidity value setting automatically changes the parameters in the above table.

Note: If parameters Pn102, Pn100, Pn101, and Pn401 are set manually with the online auto-tuning function enabled, tuning is performed with the manually set values as target values.

■ Changing the Rigidity Setting

Use parameter Fn001 in the auxiliary function mode to change the rigidity setting. The procedure for changing the setting is as follows:

Using the Hand-held Digital Operator

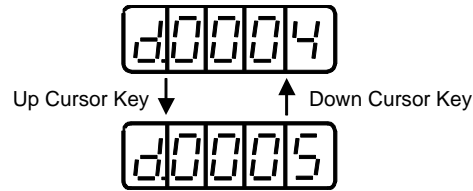
1. Press the **DSPL/SET** key and select Fn001 in the auxiliary function mode.



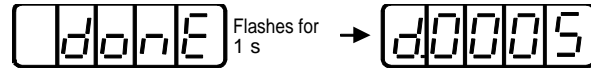
2. Press the **DATA/ENTER** key. The following data will be displayed.



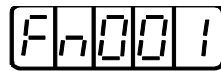
3. Press the **Up Arrow**  or **Down Arrow**  key to select the rigidity setting.



4. Press the **DSPL/SET** key. The following display will flash for 1 second and then the rigidity setting will be changed.



5. Press the **DATA/ENTER** key to return to the auxiliary function mode.



This completes the procedure for changing the rigidity setting.

Using the Built-in Panel Operator

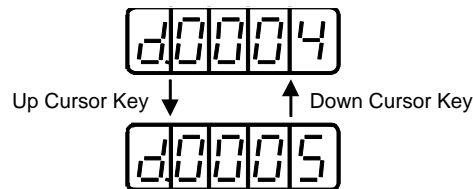
1. Press the **MODE/SET** key to select Fn007 in the auxiliary function mode.



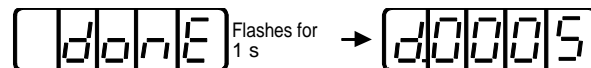
2. Press the **DATA/SHIFT** key for a minimum of 1 second. The following data will be displayed.



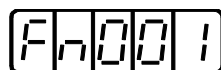
3. Press **Up Arrow**  or **Down Arrow**  key to select the rigidity setting.



4. Press the **MODE/SET** key. The following display will flash for 1 second and then the rigidity setting will be changed.



5. Press the **DATA/SHIFT** key for a minimum of one second to return to the auxiliary function mode.



This completes the procedure for changing the rigidity setting.

6.3.3 Saving Results of Online Auto-Tuning

Online auto-tuning always processes the latest load inertia to renew data so that the speed loop gain will reach the target value that has been set. When the servo amplifier is turned off, all the processed data is lost. Therefore, when the servo amplifier is turned on again, online auto-tuning is performed by processing the factory-set values in the servo amplifier.

To save the results of online auto-tuning and use them as the initial values set in the servo amplifier when the servo amplifier is turned on again, it is necessary to use constant Fn007 in the auxiliary function mode. In this case, the inertia value set in parameter Pn103 will be changed.

On the basis of the rotor inertia of the servomotor, the inertia ratio is expressed in percentage terms by the load inertia. The value set in Pn103 is used to calculate the load inertia at the time of online auto-tuning.

Parameter	Signal	Setting (%)	Description
Pn103	Inertia Ratio	Setting Range: 0 to 10000 Default Setting: 0	Speed/Torque Control, Position Control

$$\text{Inertia Ratio} = \frac{\text{Motor Load Inertia } (J_L)}{\text{Rotor Inertia } (J_M)} \times 100\%$$

The inertia ratio is default set to 0%.

IMPORTANT

- **Before making servo gain adjustments manually, be sure to set the inertia ratio in Pn103.**
If the inertia ratio is incorrect, the speed loop gain (in 1-Hz increments) set in Pn100 will be wrong.

For details on setting Pn103, refer to 7.1.6 *Operation in Parameter Setting Mode*.

■ Procedure for Saving Results of Online Auto-Tuning

The procedure for saving the results of online auto-tuning is as follows:

Using the Hand-held Digital Operator

1. Press the **DSPL/SET** key to select Fn007 in the auxiliary function mode.

A digital display showing the text "Fn007" in a seven-segment font.

2. Press the **DATA/ENTER** key. If the inertia ratio is 200%, for example, the following data will be displayed.

A digital display showing the text "d0200" in a seven-segment font.

3. Press the **DSPL/SET** key. The following display will flash for 1 second and then the inertia ratio will be saved.

A diagram showing a digital display with "done" flashing for 1 second, indicated by a right-pointing arrow, followed by a digital display showing "d0200".

4. Press the **DATA/ENTER** key to return to the auxiliary function mode.

A digital display showing the text "Fn007" in a seven-segment font.

This completes the procedure for saving the results of online auto-tuning. When the servo amplifier is turned on again, the inertia ratio set in Pn103 will be used as the default value.

Using the Built-in Panel Operator

1. Press the **MODE/SET** key and select Fn007 in the auxiliary function mode.

A digital display showing the text "Fn007" in a seven-segment font.

2. Press the **DATA/SHIFT** key for a minimum of 1 second. If the inertia ratio is 200%, for example, the following data will be displayed.

A digital display showing the text "d0200" in a seven-segment font.

3. Press the **MODE/SET** key. The following display will flash for 1 second and then the inertia ratio will be saved.

A diagram showing a digital display with "done" flashing for 1 second, indicated by a right-pointing arrow, followed by a digital display showing "d0200".

4. Press the **DATA/SHIFT** key for a minimum of 1 second to return to the auxiliary function mode.

Fn007

This completes the procedure for saving the results of online auto-tuning. When the servo amplifier is turned on again, the inertia ratio set in Pn103 will be used as the default value.

6.3.4 Parameters Related to Online Auto-Tuning

This section provides information on a variety of parameters related to online auto-tuning.

■ Online Auto-Tuning Method

The following parameter is used to set the auto-tuning conditions.

Parameter	Signal	Setting (%)	Description
Pn110.0	Online Auto-Tuning Method	Default Setting: 0	Speed control, Position Control

Pn110.0 Setting	Result
0	Auto-Tuning is performed only when the system runs for the first time after the power is turned ON. After the load inertia is calculated, the calculated data is not refreshed.
1	Auto-Tuning is continuously performed (inertia value calculation).
2	The online auto-tuning function is not used.

This parameter is default set to “0”. If the load inertia change is minimal or if the application makes few changes, there is no need to continue calculating the inertia while the system is in operation. Instead, continue to use the value that was calculated when the system was first started up.

Set this parameter to “1” if the load inertia always fluctuates due to the load conditions. Then the response characteristics can be kept stable by continuously refreshing the inertia calculation data is refreshed continuously and reflecting them in the servo gain.

If the load inertia fluctuation results within 200 ms, the inertia calculation data may not be refreshed properly. If that happens, set Pn110.0 to “0” or “2.”

Set Pn110.0 to “2” if auto-tuning is not available or if the online auto-tuning function is not used because the load inertia is already known and the servo amplifier is manually adjusted by setting the inertia ratio data in Pn103.

■ Speed Feedback Compensation Selection

Use the following parameter to enable or disable speed feedback compensation.

Refer to 6.2.6 *Speed Feedback Compensation*.

This parameter can be left as it is if online auto-tuning is performed. If this parameter is set manually, however, the setting is reflected to the operational setting made during online auto-tuning.

Parameter	Signal	Setting (%)	Description
Pn110.1	Speed Feedback Compensation Selection	Default Setting: 1	Speed control, Position Control

Pn110.0 Setting	Result
0	Speed Feedback Compensation enabled.
1	Speed Feedback Compensation disabled.

■ Friction Compensation Selection

Use the following parameter to enable or disable friction compensation to determine whether or not the friction of the servo system is to be taken into consideration for the calculation of load inertia.

If this compensation function is enabled, select small or large friction compensation according to the extent of friction in order to ensure highly precise load inertia calculation.

Parameter	Signal	Setting (%)	Description
Pn110.2	Friction Compensation Selection	Default Setting: 1	Speed control, Position Control

Pn110.0 Setting	Result
0	Friction Compensation enabled
1	Friction Compensation: Small
2	Friction Compensation: Large

- Note:**
1. Do not set friction compensation for loads with low friction (10% rated torque/speed or less).
 2. Auto-Tuning will be performed as if the load inertia is 30 times the motor inertia.

6.4 Servo Gain Adjustments

This section describes information on the basic rules of gain adjustments in the servo amplifier, adjustment methods in a variety of cases, and reference set values.

6.4.1 Servo Gain Parameters

The following parameters must be set properly for servo gain adjustments.

- Pn100: Speed loop gain
- Pn101: Speed loop integral time constant
- Pn102: Position loop gain
- Pn401: Torque reference filter time constant

If the servo amplifier is used in the speed control mode with the analog voltage reference, the position loop is controlled by the host device. Therefore, position loop gain is adjusted through the host device.

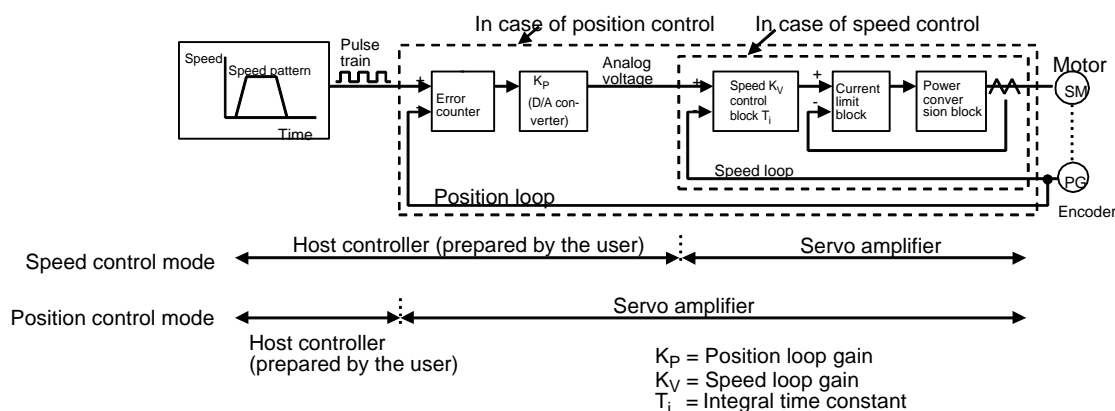
If the host is not available for adjustments of position loop gain, set the speed reference input gain in parameter Pn300. If the set value is improper, the servomotor may not run at top speed.

6.4.2 Basic Rules of Gain Adjustment

The servo system consists of three feedback loops (i.e., position loop, speed loop, and current loop). The innermost loop must have the highest response speed and the middle loop must have higher response speed than the outermost. If this principle is not followed, it will result in vibration or poor responsiveness.

The servo amplifier is designed to ensure that the current loop has good response performance. The user needs only to adjust the position loop and speed loop gain.

The servo system block diagram consists of the position, speed, and current loops, as shown below.

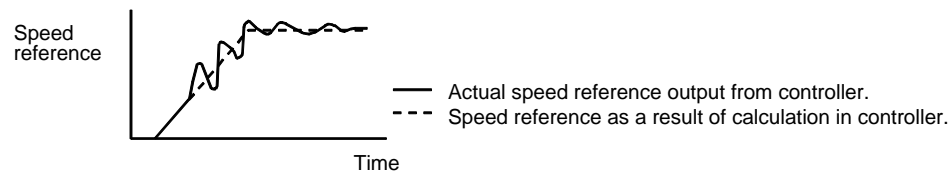


- Generally speaking, the responsiveness of the position loop cannot be higher than that of the speed loop. Therefore, to increase the position loop gain, you must first increase the speed loop gain. If only the position loop gain is increased, oscillation will result in the speed reference and positioning time will increase, not decrease.

Position loop gain can be increased only to the point where oscillation begins in the mechanical system.

- If the position loop response is faster than the speed loop response, speed reference output from the position loop cannot follow the position loop response due to the slower speed loop response. Therefore, the position loop will keep accumulating errors, thus increasing the amount of speed reference output.

As a result, the motor speed will be excessive and the position loop will try to decrease the amount of speed reference output. The speed loop responsiveness degrades, and the motor will not be able to follow. The speed reference will oscillate as shown in the following graph. If this happens, reduce the position loop gain or increase the speed loop gain.



- The position loop gain must not exceed the natural frequency of the mechanical system. For example, if the mechanical system is an articulated robot, the rigidity of the machinery mechanism is very low because the mechanism incorporates a harmonic gear reducer and the natural frequency of the mechanical system is 10 to 20Hz. In this case, the position loop gain can be set to 10 to 20(s⁻¹).

If the mechanical system is a chip mounting machine, IC bonding machine, or high-precision machining tool, the natural frequency of the system is 70Hz or more. Therefore, the position loop gain can be set to 70(s⁻¹) or higher.

When high responsiveness is required, it is not only important to ensure the responsiveness of the servo system (the controller, servo amplifier, motor, and encoder), but it is also necessary to ensure that the mechanical system have high rigidity.

6.4.3 Making Manual Adjustments

The auto-tuning function uses a gain adjustment algorithm with a comparatively large safety margin by considering a variety of mechanical systems to which the servo amplifier is applied. Therefore, the servo amplifier may not satisfy the response characteristics of some applications. The auto-tuning function is not available to machines with low rigidity or high fluctuation.

In such cases, observe the mechanical systems and make manual adjustments of parameters.

■ Speed Control

Required Parameters

The following parameters are used.

- Speed Loop Gain (Pn100)

This parameter is used for determining the responsiveness of the speed loop. For the best response, set this parameter as high as possible, without exceeding the point where the mechanical system vibrates. The value of speed loop gain is the same as the set value of Pn100 if the inertia ratio set in Pn103 is correct.

Speed loop gain $K_v = \text{Set value of Pn100 (Hz)}$

Set Pn103 to the following value.

$$\text{Pn103 Setting Value} = \frac{\text{Motor load inertia (J}_L\text{)}}{\text{Servomotor rotor inertia (J}_M\text{)}} \times 100\%$$

Note: In the case of manual adjustments of parameters, the user must set the value of parameter Pn103. The inertia ratio can be obtained if the servo gain constant is written with parameter Fn007 after auto-tuning has been performed. For details regarding Fn007, refer to 6.3 *Auto-Tuning*.

- Speed Loop Integral Time Constant (Pn101)

The speed loop has an integral element so that the speed loop can respond to minute inputs. This integral element delays the operation of the servo system, resulting in a longer positioning settling time. As the value of the time constant increases, the response becomes slower. If the load inertia is large or the mechanical system is likely to vibrate, make sure that the speed loop integral time constant is large enough. Use the following formula to calculate the optimum integral time constant.

$$T_i \geq 2.3 \times \frac{1}{2\pi \times K_v}$$

Where: $T_i = \text{Integral time constant [s]}$

$K_v = \text{Speed loop gain (calculated from the above) [Hz]}$

- Torque Reference Filter Time Constant (Pn401)

If the mechanical system uses ball screws, torsional resonance may result. In this case, the oscillation noise will be a high-pitched tone. The oscillation may be minimized by increasing the time constant of the torque reference filter. Like the integral time constant, this filter causes a delay in the operation of the servo system. Therefore, this constant must not be set to an excessively large value.

- Speed Reference Input Gain (Pn300)

Changing the speed reference input gain set in Pn300 is equivalent to changing the position loop gain. In other words, an increase in the speed reference input gain set in Pn300 is equivalent to a decrease in the position loop gain and vice versa. Use this parameter in the following cases.

- When the host controller does not have a function for adjusting the position loop gain. (The host incorporates a D/A converter to change the number of bits but cannot make fine adjustments of position loop gain.)
- When it is necessary to clamp the full range of the speed reference output of the host device to a specified rotation speed.

In normal operation, the default setting can be used as is.

Note: If the servo amplifier is used for speed control, the position loop gain set in Pn102 is enabled in zero-clamp mode only. In normal control operation, change the position loop gain through the host or change the speed reference input gain in Pn300 in the servo amplifier. The position loop gain remains the same if the setting in Pn102 is changed.

Adjustment Method

1. Set the position loop gain to a low value in the host controller. Then increase the speed loop gain set in Pn100 to within a range where there is no noise or oscillation. If the position loop gain cannot be changed through the host controller, increase the speed reference input gain set in Pn300 to a larger value.
2. Decrease the speed loop gain a little from the value set in step 1. Then increase the position loop gain through the host controller to within a range where there is no noise or oscillation. As in step 1, decrease the set value of Pn300 if the position loop gain cannot be changed through the host controller.
3. Set the speed loop integral time constant in Pn101 while observing the positioning settling time and the vibration of the mechanical system. If the constant is too large, positioning settling time will be long.
4. Set the torque reference filter to a small value in Pn401 if the mechanical system has shaft torsional resonance. If the mechanical system generates oscillation noise in a high-pitched tone, shaft torsional resonance may be occurring. In that case, set Pn401 to a larger value.
5. Finally, progressively make fine adjustments to parameters such as the position loop gain, speed loop gain, and integral time constant to find the optimal points.

■ Position Control

Parameters

The following parameters are used.

- Speed Loop Gain (Pn100)

This parameter is used for determining the response speed of the speed loop. For the best response, set this parameter as high as possible, without exceeding the point where the mechanical system vibrates. The value of speed loop gain is the same as the set value of Pn100 if the inertia ratio set in Pn103 is correct.

Speed loop gain $K_v = \text{Set value of Pn100 (Hz)}$

Set Pn103 to the following value:

$$\text{Pn103 Setting Value} = \frac{\text{Motor shaft reflected load inertia (J}_L\text{)}}{\text{Servomotor rotor inertia (J}_M\text{)}} \times 100\%$$

Note: In the case of manual adjustments of parameters, the user must set the value of parameter Pn103. The inertia ratio can be obtained if the servo gain constant is written with parameter Fn007 after auto-tuning has been performed. For details regarding Fn007, refer to *6.3 Auto-Tuning*.

- Speed Loop Integral Time Constant (Pn101)

The speed loop has an integral element so that the speed loop can respond to minute inputs. This integral element delays the operation of the servo system, resulting in longer positioning settling time. As the value of the time constant increases, the response becomes slower.

If the load inertia is large or the mechanical system is likely to vibrate, make sure that the speed loop integral time constant is large enough. Use the following formula to calculate the optimum time constant.

$$T_i \geq 2.3 \times \frac{1}{2\pi \times K_v}$$

Where: $T_i = \text{Integral time constant [s]}$

$K_v = \text{Speed loop gain (calculated from the above) [Hz]}$

- Torque Reference Filter Time Constant (Pn401)

If the mechanical system uses ball screws, torsional resonance may result. In this case, the oscillation noise will be a high-pitched tone. The oscillation may be minimized by increasing the time constant of the torque reference filter. Like the integral time constant, this filter causes a delay in the operation of the servo system. Therefore, this constant must not be set to an excessively large value.

- Position Loop Gain (Pn102)

The responsiveness of the servo system is determined by the position loop gain.

The response increases if the position loop gain is set to a high value, and the time required for positioning will be shortened. In order to set the position loop gain to a high value, the rigidity and natural frequency of the mechanical system must be high.

The responsiveness of the whole servo system may become unstable if only the position loop gain is increased. Because the speed reference, as output from the position loop, is likely to become unstable. Increase the speed loop gain while observing the response.

Adjustment Method

1. Set the position loop gain to a comparatively low value. Then increase the speed loop gain set in Pn100 to within a range where there is no noise or oscillation.
2. Decrease the speed loop gain a little from the value set in step 1. Then increase the position loop gain to within a range where there is no overshooting or oscillation.
3. Set the speed loop integral time constant in Pn101 while observing the positioning settling time and the vibration of the mechanical system. If the constant is too large, the positioning settling time will be too long.
4. Set the torque reference filter to a small value in Pn401 if the mechanical system has shaft torsional resonance. If the mechanical system generates oscillation noise in a high-pitched tone, shaft torsional resonance may occur. In that case, set Pn401 to a larger value.
5. Finally, progressively make fine adjustments to parameters such as the position loop gain, speed loop gain, and integral time constant to find the optimal points.

■ **Function to Improve Response Characteristics**

The mode switch, feed-forward, and bias functions can improve the response of the servo system only if they are used properly. If they are used improperly, they will worsen the response. Refer to the following instructions and make adjustments to these functions while observing the change in the actual response.

Mode Switch

Use the mode switch function to improve the transient characteristics of the servo system if there is torque reference saturation at the time of acceleration or deceleration. The speed loop in PI (proportional and integral) control is switched over to P (proportional) control when the operation speed exceeds the set value in this function.

Feed-forward Function

The responsiveness is increased by using the feed-forward function. This function is not effective if the position loop gain is set to a high value. Adjust the feed-forward set value of Pn109 as described below.

1. Adjust speed and position loops according to the method described on this page.
2. Gradually increase the set value of Pn109 so that the positioning completion signal (/COIN) will be output quickly.

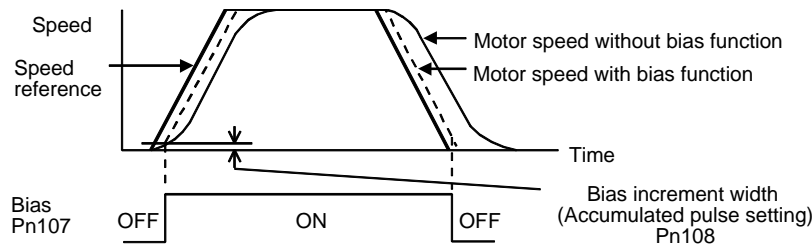
Make sure that the positioning completion signal (/COIN) does not bounce (i.e., turned on and off repeatedly within a short period) and that speed overshoot does not occur. These will likely to occur if the feed-forward value is too high.

It is possible to add a primary delay filter (to be set in Pn10A) to the feed-forward function. The primary delay filter may prevent the positioning completion signal from bouncing and the system speed from overshooting.

Bias Function

This function adds the bias set in Pn107 to the output (i.e., speed reference) of the error counter if the number of accumulated pulses of the error counter exceeds the bias increment width set in Pn108. The bias will not be added if the output is within the bias increment width. As a result, the number of accumulated pulses of the error counter decreases and the time required for positioning can be shortened.

If the bias set value of Pn107 is too large, the motor speed will be unstable. The optimum bias value varies with the load, gain, and bias increment width. Make bias adjustments while observing the response. When not using this function, set Pn107 to 0.



6.4.4 Gain Setting Reference Values

This section describes servo gain reference values.

Refer to the following for optimal gain adjustments according to the rigidity of the mechanical system. Refer to these values and use the previously mentioned methods to make gain adjustments. These values are for reference only and do not mean that the mechanical system has good response characteristics or is free from oscillation in the specified ranges.

Observe the response by monitoring the response waveform and make the optimum gain adjustments. If the rigidity of the machinery is high, gain increments exceeding the described ranges are possible.

■ Machines with High Rigidity

These machines are directly connected to ball screws.

Examples: Chip mounting machine, bonding machine, high-precision machine tool

Position Loop Gain (Pn102)	Speed Loop Gain (Pn100)	Speed Loop Integral Time Constant (Pn101)
50 to 70s ⁻¹	50 to 70Hz	5 to 20ms

■ Machines with Medium Rigidity

These machines are driven by ball screws through speed reducers or long-length machines directly driven by screws.

Examples: General machine tool, transverse robot, conveyor

Position Loop Gain (Pn102)	Speed Loop Gain (Pn100)	Speed Loop Integral Time Constant (Pn101)
30 to 50s ⁻¹	30 to 50Hz	10 to 40ms

■ Machines with Low Rigidity

These machines are driven by timing belts, chains, or machines with harmonic gear reducers.

Examples: Conveyor, articulated robot

Position Loop Gain (Pn102)	Speed Loop Gain (Pn100)	Speed Loop Integral Time Constant (Pn101)
10 to 20s ⁻¹	10 to 20Hz	50 to 120ms

IMPORTANT

- When the inertia ratio is larger than 10, start gain adjustments with the position and speed loop gains slightly below the ranges given above and the speed loop integral constant slightly over the range.
- When the inertia ratio is much larger, start the gain adjustments with the position and speed loop gains set to the smallest values and the speed loop integral constant to the large value in the ranges given above.

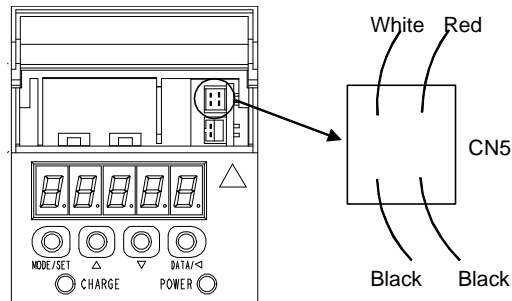
In speed control operation, the position loop gain is set through the host controller. If that is not possible, adjust the position loop gain with the speed reference input gain in Pn300 in the servo amplifier. In speed control operation, the position loop gain set in Pn102 is enabled in zero-clamp mode only. Position loop gain K_p is obtainable from the following formula.

$$K_p \geq \frac{V_s}{\varepsilon}$$

- Where:
- K_p (s⁻¹): Position Loop Gain
 - V_s (pps): Constant Speed Reference
 - ε (Pulse): Constant error: The number of accumulated pulses of the error counter at the above constant speed.

6.5 Analog Monitor

The analog monitor can be used to observe a variety of analog voltage signals. Analog monitor signals must be observed through the CN5 connector using the DE9404559 cable.



Cable Color	Signal Name	Description
White	Analog monitor 1	Torque reference: 1V/100% rated torque
Red	Analog monitor 2	motor speed:1 V/1000rpm
Black (two wires)	GND (0V)	—

Analog monitor signals can be selected with parameters Pn003.0 and Pn003.1.

Parameter	Signal	Setting	Description
Pn003.0	Analog Monitor 1	Default Setting: 2	Speed/Torque Control, Position Control
Pn003.1	Analog Monitor 2	Default Setting: 0	Speed/Torque Control, Position Control

The following monitor signals can be observed.

Settings in Pn003.0 and Pn003.1	Description	
	Monitor signal	Observation gain
0	Motor speed	1V/1000rpm
1	Speed reference	1V/1000rpm
2	Torque reference	1V/100% rated torque
3	Position error	0.05 V/1 reference unit
4	Position error	0.05 V/100 reference unit
5	Reference pulse frequency (converted to rpm)	1V/1000rpm
6	Motor speed	1V/250rpm
7	Motor speed	1V/125rpm
8	Reserved monitor signal	—
9	—	—
A	—	—

- Note:**
- In the case of torque or speed control mode, the position error monitor signal has no meaning.
 - The output voltage range of the analog monitor is $\pm 8V$ maximum. The polarity of the output voltage will be changed if $\pm 8V$ is exceeded.

7 Using the Digital Operator

This chapter describes the basic operation of the digital operator and the features it offers. All parameter settings and motor operations can be executed by simple, convenient operations. Operate the digital operator as you read through this chapter.

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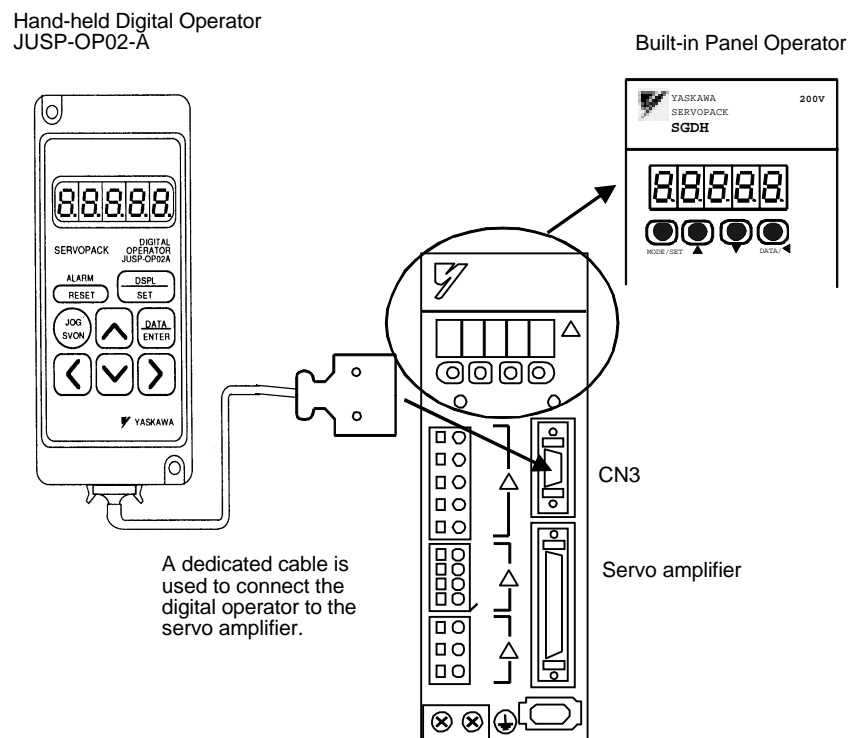
7.1 Basic Operation

This section provides information on the basic operation of the digital operator for setting operating conditions.

7.1.1 Connecting the Digital Operator

There are two types of digital operator. One is a built-in operator incorporating a panel indicator and switches located on the front panel of the servo amplifier. This type of digital operator is also called a panel operator. The other one is a hand-held operator (i.e., the JUSP-OP02A-1 digital operator), which can be connected to the servo amplifier through connector CN3 of the servo amplifier.

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

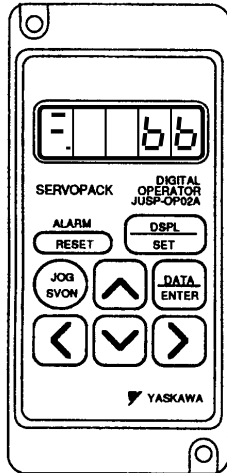










Note: If the hand-held digital operator is connected to the servo amplifier, the built-in panel operator does not display anything.

7.1.2 Functions

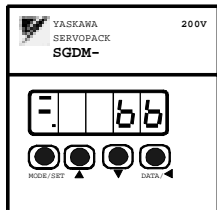
The digital operator can be used for parameter settings, operating references, and status displays.





This section provides information on the keys and their functions available from the initial displays.



Key	Name		Function
	RESET Key		Press this key to reset the servo alarm
	DSPL/SET Key		<ul style="list-style-type: none"> Press this key to select the status display mode, auxiliary function mode, parameter setting mode, or monitor mode. This key is used for data selection in parameter setting mode
	DATA/ENTER Key		Press this key to set each parameter or display the set value of each parameter.
	Value Change/ JOG Key	Up Arrow Key	Press this key to increase the set value. This key is used as a forward start key in JOG operation.
		Down Arrow Key	Press this key to decrease the set value. This key is used as a reverse start key in JOG operation.
	Digit Select Key	Right Arrow Key	<ul style="list-style-type: none"> Press this key to select the digit to be changed. The selected digit flashes. Press the Right Arrow key to shift to the next digit on the right. Press the Left Arrow key to shift to the next digit on the left.
		Left Arrow Key	
	SVON Key		Press this key to perform the JOG operation with the digital operator.

Built-in Panel Operator



Key	Name	Function
	Up Arrow Key	<ul style="list-style-type: none"> Press this key to set parameters or display the set values of parameters. Press the Up Arrow key to increase the set value. Press the Down Arrow key to decrease the set value. Press the Up and Down Arrow keys together to reset a servo alarm.
	Down Arrow Key	
	MODE/SET Key	Press this key to select the status indicator mode, auxiliary function mode, parameter setting mode, or monitor mode.
	DATA/SHIFT Key	<ul style="list-style-type: none"> Press this key to set each parameter or display the set value of each parameter. This key is used for selecting the editing (flashing) digit or data setting.

7.1.3 Resetting Servo Alarms

Servo alarms can be reset using the digital operator.

■ Using the Hand-Held Digital Operator

Press the **RESET** key in status display mode.

■ Using the Built-in Panel Operator

Press the **Up Arrow**  or **Down Arrow**  keys together in status display mode.

The alarm can be reset with CN1-44, or /ALM-RST signal input. Refer to 5.5.1 *Using Servo Alarm and Alarm Code Outputs*.

The servo alarm will be reset if the control power supply is turned OFF.

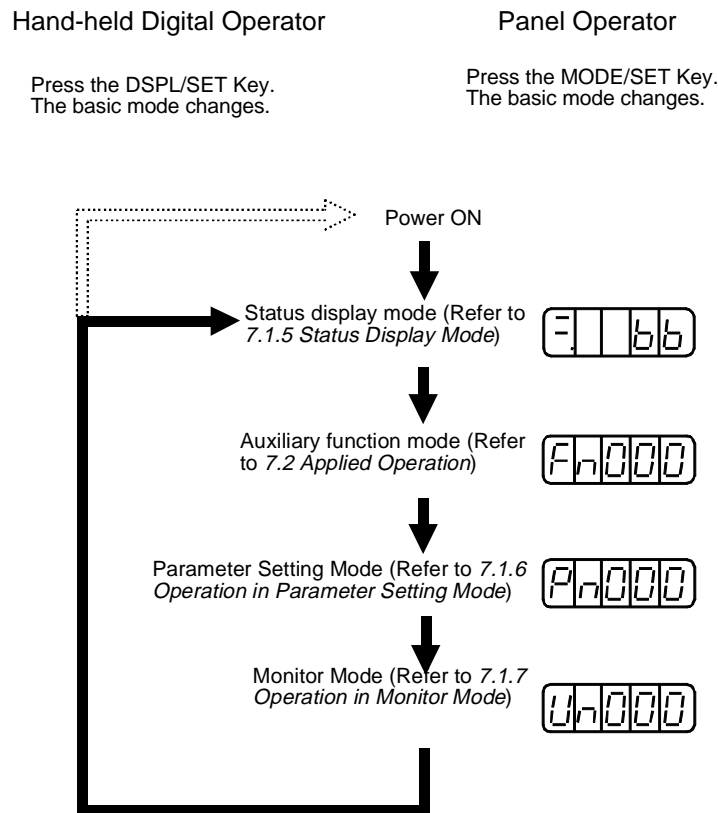
IMPORTANT

- If an alarm is ON, reset the alarm after eliminating the cause of the alarm first. Refer to 9.2 *Troubleshooting*.

7.1.4 Basic Mode Selection

The basic mode selection of the digital operator is used for indicating the status of the servo amplifier in operation and setting a variety of parameters and operation references.

The status display, auxiliary function, parameter setting, and monitor modes are the basic modes. As shown below, the mode is selected in the following order by pressing the key.



7.1.5 Status Display Mode

In status display mode, bit data and codes are displayed to indicate the status of the servo amplifier.

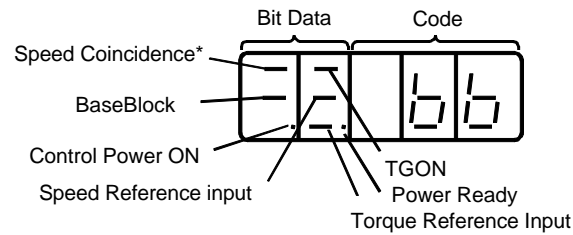
■ Selecting Status Display Mode

The digital operator goes into status display mode when the digital operation is turned ON.

■ Data in Status Display Mode

The screen contents in status display are different for speed, torque, and position control modes.

Speed and Torque Control Mode



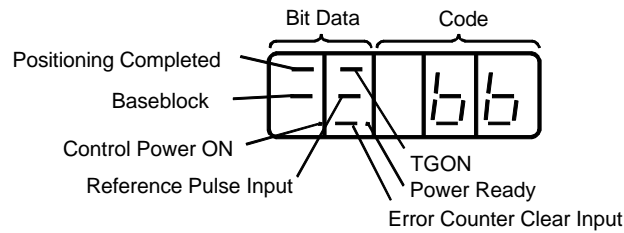
* This indicator is always lit when the Servopack is in torque control mode.

The following tables list and explain the meanings of bit data and code displays in Speed and Torque control modes.

Bit Data and Meanings in Speed and Torque Control Mode	
Bit Datum	Meaning
Control Power ON	Lit when servo amplifier control power is ON.
Baseblock	Lit for baseblock. Not lit when servo is ON.
Speed Coincidence	Lit when the difference between the motor speed and reference speed is the same as or less than the value set in Pn503. (The default value set in Pn503 is 10rpm).
/TGON	Lit if motor speed exceeds preset value Preset value: Set in Pn502. (Default setting is 20rpm).
Speed Reference Input	Lit if input speed reference exceeds preset value. Specified value: Set in Pn502. (Default setting is 20rpm)
Torque Reference Input	Lit if input torque reference exceeds preset value. Preset value: 10% rated torque is default setting
Power Ready	Lit when main power supply circuit is operating at normal level. Not lit when power is OFF.

Codes and Meanings in Speed and Torque Control Mode	
Code	Meaning
	Baseblock Servo OFF (motor power OFF)
	Run Servo ON (motor power ON)
	Forward Run Prohibited CN1-42 (P-OT) is OFF. Refer to 5.1.2 <i>Setting the Overtravel Limit Setting</i> .
	Reverse Run Prohibited CN1-43 (N-OT) is OFF. Refer to 5.1.2 <i>Setting the Overtravel Limit Setting</i> .
	Alarm Status Displays the alarm number. Refer to 9.2 <i>Troubleshooting</i> .

Position Control Mode



The following tables list and explain the meanings of bit data and code displays in Speed and Torque control modes.

Bit Data and Meanings in Position Control Mode	
Bit Datum	Meaning
Control Power ON	Lit when servo amplifier control power is ON.
Baseblock	Lit for baseblock. Not lit when servo is ON.
Positioning Completed	Lit if error between position reference and actual motor position is below preset value. Preset value: Set in PN500. (Default setting is 7 pulses).
/TGON	Lit if motor speed exceeds preset value. Preset value: Set in Pn502. (Default setting is 20rpm).
Reference Pulse Input	Lit if reference pulse is input.
Error Counter Clear Input	Lit when error counter clear signal is input.
Power Ready	Lit when main power supply circuit is operating at normal level. Not lit when power is OFF.

Codes and Meanings in Speed and Torque Control Mode	
Code	Meaning
bb	Baseblock Servo OFF (motor power OFF)
run	Run Servo ON (motor power ON)
Flot	Forward Run Prohibited CN1-42 (P-OT) is OFF. Refer to 5.1.2 <i>Setting the Overtravel Limit Setting</i> .
holr	Reverse Run Prohibited CN1-43 (N-OT) is OFF. Refer to 5.1.2 <i>Setting the Overtravel Limit Setting</i> .
A02	Alarm Status Displays the alarm number. Refer to 9.2 <i>Troubleshooting</i> .
A03	

7.1.6 Operation in Parameter Setting Mode

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.

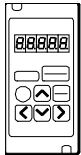
Refer to *Appendix B List of Parameters*.

■ Changing Parameter Settings

The parameter settings can be used to change parameter data. Check the permitted range of the parameters in *Appendix B List of Parameters*, before changing the data.

The example below shows how to change parameter Pn507 from 100 to 85.

Using the Hand-Held Digital Operator



1. Press the **DSPL/SET** key to select the parameter setting mode.

Pn000

2. Select the parameter number to set. (Pn507 is selected in this example.)

Press the **Left Arrow**  or **Right Arrow**  key to select the digit. The selected digit will flash.



Press the **Up Arrow**  or **Down Arrow**  key to change the value.

3. Press the **DATA/ENTER** key to display the current data for the parameter selected at step 2.

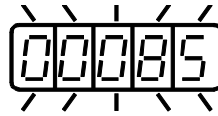
00100

4. Change the data as needed (to 85, in this example).

Press the **Left Arrow**  or **Right Arrow**  key to select the digit. The selected digit will flash.

Press the the **Up Arrow**  or **Down Arrow**  key to change the value. Continue pressing the key until "00085" is displayed.

5. Press the **DATA/ENTER** key to store the data. The display will flash.

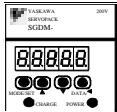


6. Press the **DATA/ENTER** key again to return to the parameter number display.





This procedure has changed the setting of the parameter Pn507 from 100 to 85. Repeat steps 2 to 6 to change the setting again.

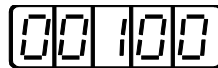
Example Using the Panel Operator





1. Press the **MODE/SET** key to select the parameter setting mode.



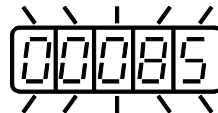
2. Press the **Up Arrow**  or **Down Arrow**  key to select the parameter number to set. (Pn507 is selected in this example.)
3. Press the **DATA/SHIFT** key for a minimum of one second to display the current data for the parameter selected in step 2.



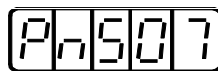
4. Press the the **Up Arrow**  or **Down Arrow**  key to change to the desired value of "00085".

As you keep pressing the **Up Arrow**  or **Down Arrow**  key, and the display changes faster.

5. Press the **DATA/SHIFT** key for a minimum of one second to save the data. The display will flash.



6. Press the **DATA/SHIFT** key once more for a minimum of one second to display the parameter number again.



This has changed the setting of the parameter Pn507 from 100 to 85.

Repeat steps 2 to 6 to change the setting again.

Note: Parameter numbers that are not defined are skipped during Operator operations.

IMPORTANT
<ul style="list-style-type: none">• Press the DATA/SHIFT Key for a maximum of one second to shift to a higher (left) digit.

■ Function Selection Parameters

Types of Function Selection Parameters

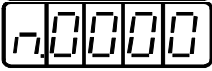
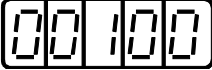
The following table shows the parameters for selecting servo amplifier functions.

Category	Parameter No.	Name	Default Setting	Important Note
Function Selection Parameters	Pn000	Function Selection Basic Switches	0000	(See 1)
	Pn001	Function Selection Application Switches 1	0000	(See 1)
	Pn002	Function Selection Application Switches 2	0000	(See 1)
	Pn003	Function Selection Application Switches 3	0002	—
Gain-related Parameters	Pn10B	Gain-related Application Switches	0000	(See 2)
	Pn110	Online Autotuning Switches	0010	(See 2)
Position Control-related Parameter	Pn200	Position Control Reference Selection Switches	0000	(See 1)
Sequence-related Parameters	Pn50A	Input Signal Selections 1	2100	(See 1)
	Pn50B	Input Signal Selections 2	6543	(See 1)
	Pn50C	Input Signal Selections 3	8888	(See 1)
	Pn50D	Input Signal Selections 4	8888	(See 1)
	Pn50E	Output Signal Selections 1	3211	(See 1)
	Pn50F	Output Signal Selections 2	0000	(See 1)
	Pn510	Output Signal Selections 3	0000	(See 1)

IMPORTANT

- 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.
- 2. Changing bits Pn10B.1 and Pn110.0 require the same sequence described in note 1 (above).

Parameter settings are displayed in two patterns as shown below.

Display Application	Display	Format
Function selection		Hexadecimal display for each digit
Parameters setting		Decimal display in five digits

Since each digit in the function selection parameters has its own meaning, the

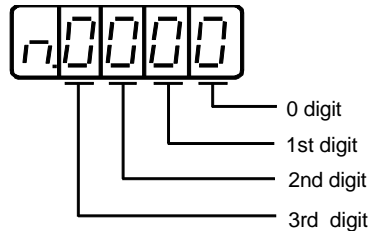
value can only be changed for each individual digit. Each digit can only display a value within its own permitted range.

Definition of Display for Function Selection Parameters

Each digit of the function selection parameters has a unique meaning.

For example, the rightmost digit of parameter Pn000 is expressed as "Pn000.0".

- Each digit of the function selection parameters is defined as shown below. The parameter displayed below shows how the digits in the display are assigned.



Distribution of parameter digits	
Designation	Meaning
Pn000.0	Indicates the value entered at the 0 digit of parameter Pn000.
Pn000.1	Indicates the value entered at the 1st digit of parameter Pn000.
Pn000.2	Indicates the value entered at the 2nd digit of parameter Pn000.
Pn000.3	Indicates the value entered at the 3rd digit of parameter Pn000.

■ Changing Function Selection Parameter Settings

Using the Hand-Held Digital Operator



1. Press the **DSPL/SET** key to select the parameter setting mode.

Pn0000

2. Select the parameter number to be set.

Press the **Left Arrow**  or **Right Arrow**  key to select the digit. The selected digit will flash.

Press the **Up Arrow**  or **Down Arrow**  key to change the value. (Pn000 is selected in this example.)

3. Press the **DATA/ENTER** key to display the current data of the parameter selected in the above step 2.

Digit to be set

n0000

4. Press the **Left Arrow**  or **Right Arrow**  key to select the digit.

Digit to be set

n.0000

5. Press the **Up Arrow**  or **Down Arrow**  key to select the value defined as a function setting for the selected digit.

Digit to be set

n00010

Repeat the above steps 4 and 5 for changing the data as required.

6. Press the **DATA/ENTER** key to save the data. The display will flash.

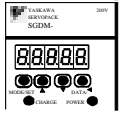
n00010

- Press the **DATA/ENTER** key once more to return to the parameter number display.





This has changed the 1st digit of parameter Pn000 to “1”.

Using the Panel Operator




- Press the **MODE/SET** key to select the parameter setting mode.




- Press the **Up Arrow**  or **Down Arrow**  key to select the parameter number to be set. (Pn000 is selected in this example.)
- Press the **DATA/SHIFT** key for a minimum of one second to display the current data for the selected parameter.

Digit to be set
↓



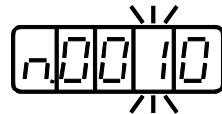
- Press the **DATA/SHIFT** key to select the digit to be set.

Digit to be set
↓



- Press the **Up Arrow**  or **Down Arrow**  key to select the value defined as a function setting for the selected digit.

Digit to be set
↓



Repeat the above steps 4 and 5 for changing the data as required.

- Press the **DATA/SHIFT** key for a minimum of one second to save the data. The display will flash.



7. Press the **DATA/SHIFT** key once more for a minimum of one second to return to the parameter number display.

A digital display showing the parameter number Pn000. The display is divided into four segments: the first segment shows 'Pn', the second shows '0', the third shows '0', and the fourth shows '0'.

This has changed the 1st digit of parameter Pn000 to “1”.

7.1.7 Operation in Monitor Mode

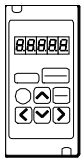
The monitor mode can be used for monitoring the reference values, I/O signal status, and servo amplifier internal status.

The monitor mode can be set during motor operation.

■ Using the Monitor Mode



The example below shows how to display 1500, the contents of monitor number Un000 when the Servomotor rotates at 1500rpm.

Example With the Hand-Held Digital Operator



1. Press the **DSPL/SET** key to select the monitor mode.

Un000

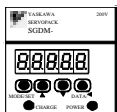
2. Press the **Up Arrow**  or **Down Arrow**  key to select the monitor number to be displayed.
3. Press the **DATA/ENTER** key to display the monitor number selected in the above step 2.

Data
1500

4. Press the **DATA/ENTER** key once more to return to the monitor number display.



Un000

With the Panel Operator

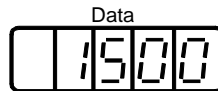


1. Press the **MODE/SET** key to select the monitor mode.

Un000

2. Press the **Up Arrow**  or **Down Arrow**  key to select the monitor number to be displayed.
3. Press the **DATA/SHIFT** key for a minimum of one second to display the monitor

number selected in the above step 2.



4. Press the **DATA/SHIFT** key once more for a minimum of one second to return to the monitor number display.



This completes the example procedure for displaying 1500, the contents of monitor number Un000.

■ Contents of Monitor Mode Display

The following table shows contents of the monitor mode display.

Monitor Number	Monitor Display	Unit	Comments
Un000	Actual motor speed	rpm	
Un001	Input speed reference	rpm	(See note 3 below)
Un002	Internal torque reference	%	Value for rated torque
Un003	Rotation angle 1	pulses	Number of pulses from the origin
Un004	Rotation angle 2	deg	Angle (electrical angle) from the origin
Un005	Input signal monitor	-	(See note 1 below)
Un006	Output signal monitor	-	(See note 1 below)
Un007	Input reference pulse speed	rpm	(See note 4 below)
Un008	Error counter value	reference unit	Positional error (See note 4 below)
Un009	Accumulated load rate	%	Value for the rated torque as 100% Displays effective torque in 10s cycle.
Un00A	Regenerative load rate	%	Value for the processable regenerative power as 100% Displays regenerative power consumption in 10s cycle.
Un00B	Power consumed by DB resistance	%	Value for the processable power when dynamic brake is applied as 100% Displays DB power consumption in 10s cycle.
Un00C	Input reference pulse counter	-	In hexadecimal (See notes 2 and 4)below
Un00D	Feedback pulse counter	-	In hexadecimal

- Note:**
1. Refer to *Sequence I/O Signal Monitor* on the next page.
 2. Refer to *Reference Pulse/Feedback Pulse Counter Monitor Display*.
 3. Displayed only in speed control mode.

4. Displayed only in position control mode.

■ Sequence I/O Signal Monitor Display

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

Input Signal Monitor Display



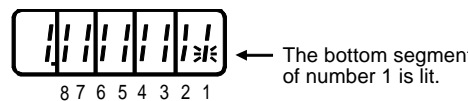
LED Number	Input Terminal Name	Default Setting
1	SI0 (CN1-40)	/S-ON
2	SI1 (CN1-41)	/P-CON
3	SI2 (CN1-42)	P-OT
4	SI3 (CN1-43)	N-OT
5	SI4 (CN1-44)	/ALM-RST
6	SI5 (CN1-45)	/P-CL
7	SI6 (CN1-46)	/N-CL
8	(CN1-4)	SEN

Note Refer to 5.3.3 *Input Circuit Signal Allocation* for details on input terminals.

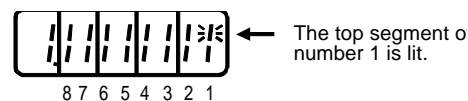
Input signals are allocated as shown above and displayed on the panel of the servo amplifier or the digital operator. They are indicated by the ON/OFF status of the vertical parts of seven-segment displays located in top and bottom rows. (The horizontal segments are not used here). These turn ON or OFF relative to the state of the corresponding input signals (ON for “L” level and OFF for “H” level).

Examples

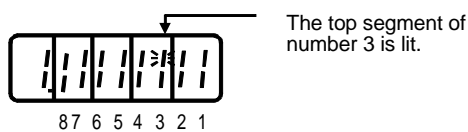
- When /S-ON signal is ON (Servo ON at “L” signal)



- When /S-ON signal is OFF



- When P-OT signal operates (Operates at “H” signal)



Output Signal Monitor Display



LED Number	Output Terminal Name	Default Setting
1	(CN1-31, -32)	ALM
2	SO1 (CN1-25, -26)	/COIN or /V-CMP
3	SO2 (CN1-27, -28)	/TGON
4	SO3 (CN1-29, -30)	/S-RDY
5	(CN1-37)	AL01
6	(CN1-38)	AL02
7	(CN1-39)	AL03

Note: Refer to 5.3.4 *Output Circuit Signal Allocation* for details on output terminals.

Output signals are allocated as shown above and displayed on the panel of the servo amplifier or the digital operator. They are indicated by the ON/OFF status of the vertical parts of seven-segment displays located in top and bottom rows. (The horizontal segments are not used here). These turn ON or OFF relative to the state of the corresponding output signals (ON for “L” level and OFF for “H” level).

Example

- When ALM signal operates (alarm at “H”)

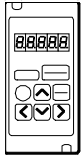




■ Reference Pulse/Feedback Pulse Counter Monitor Display

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



The display procedure is as follows:

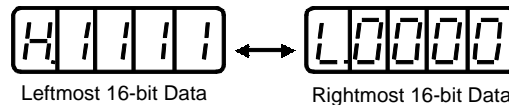
Using the Hand-Held Digital Operator





1. Press the **DSPL/SET** key to select the monitor mode.
2. Press the **Up Arrow**  or **Down Arrow**  key to select “Un00C” or “Un00D”.
3. Press the **DATA/ENTER** key to display the data for the monitor number selected in the above step.

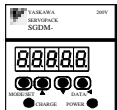




4. Press the **Up Arrow**  or **Down Arrow**  key to alternately display the leftmost and the rightmost 16-bit data.



5. Press both the **Up Arrow**  or **Down Arrow**  keys simultaneously to clear the 32-bit counter data.
6. Press the **DATA/ENTER** key once more to return to the monitor number display.

Using the Panel Operator

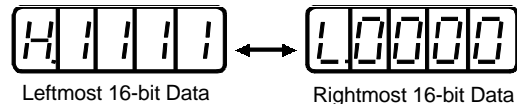




1. Press the **MODE/SET** key to select the monitor mode.
2. Press the **Up Arrow**  or **Down Arrow**  key to select “Un00C” or “Un00D”.
3. Press the **DATA/SHIFT** key for a minimum of one second to display the data for the monitor number selected in the above step.



4. Press the **Up Arrow**  or **Down Arrow**  key to alternately display the left-

most 16-bit data and rightmost 16-bit data.



5. Press both the **Up Arrow**  or **Down Arrow**  keys simultaneously to clear the 32-bit counter data.
6. Press the **DATA/SHIFT** key once more for a minimum of one second to return to the monitor number display.

7.2 Applied Operation

This section describes how to apply the basic operations using the digital operator to run and adjust the motor. Read the basic operations described in *section 7.1* before proceeding to this section.

Parameters for applied operation can be set in the auxiliary function mode. The following table shows the parameters in the auxiliary function mode.

Parameter Number	Function	Comments
Fn000	Alarm traceback data display	—
Fn001	Rigidity setting during online autotuning	(See note).
Fn002	JOG mode operation	—
Fn003	Zero-point search mode	
Fn004	(Reserved parameter)	(See note).
Fn005	Parameter settings initialization	
Fn006	Alarm traceback data clear	
Fn007	Writing to EEPROM the inertia ratio data obtained from online autotuning	
Fn008	Absolute encoder multi-turn reset and encoder alarm reset.	
Fn009	Automatic tuning of analog (speed, torque) reference offset	
Fn00A	Manual adjustment of speed reference offset	
Fn00B	Manual adjustment of torque reference offset	
Fn00C	Manual zero-adjustment of analog monitor output	
Fn00D	Manual gain-adjustment of analog monitor output	
Fn00E	Automatic offset-adjustment of motor current detection signal	—
Fn00F	Manual offset-adjustment of motor current detection signal	
Fn010	Password setting (protects from parameter changes)	—
Fn011	Motor models display	
Fn012	Software version display	
Fn013	Change Multi-Turn Limit Setting Value when a Multi-Turn Limit Disagreement Alarm occurs	(See note).

Note: These parameters and those indicated as Pn□□□ are displayed as shown below if their write protect is set (Fn010). These parameters cannot be changed.

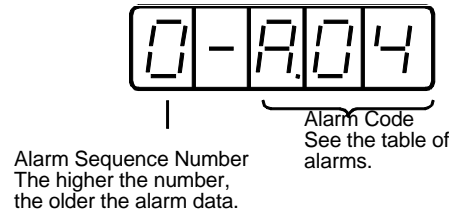


7.2.1 Operation in Alarm Traceback Mode

The alarm traceback mode can display up to ten alarms that have occurred, thus making it possible to check what kind of alarms have been generated.

The alarm traceback data is not cleared on alarm reset or when the servo amplifier power is turned OFF.

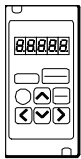
The data can be cleared using the special “clear alarm traceback mode.” Refer to *Section 7.2.5 Clearing Alarm Traceback Data* for details.



■ Checking Alarms



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

Using the Hand-Held Digital Operator



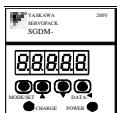
1. Press the **DSPL/SET** key to select the “Displaying alarm traceback data (Fn000)” in the auxiliary function mode.



2. Press the **DATA/ENTER** key, and the alarm traceback data will be displayed.
3. Press the **Up Arrow**  or **Down Arrow**  key to scroll the alarm sequence numbers up or down and display information on previous alarms.

The higher the leftmost digit (alarm sequence number), the older the alarm data.

Using the Panel Operator



1. Press the **MODE/SET** key to select the “Displaying alarm traceback data (Fn000)” in the auxiliary function mode.



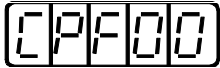
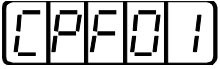
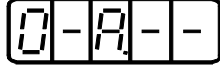
2. Press the **DATA/SHIFT** key for a minimum of one second to display the alarm traceback data.

3. Press the **Up Arrow**  or **Down Arrow**  key to scroll the alarm sequence numbers up or down and display information on previous alarms.

The higher the leftmost digit (alarm sequence number), the older the alarm data.

For descriptions of each alarm code, refer to *Section 9.2 Troubleshooting*.

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

Display	Description
	Digital operator transmission error 1
	Digital operator transmission error 2
	No error detected.

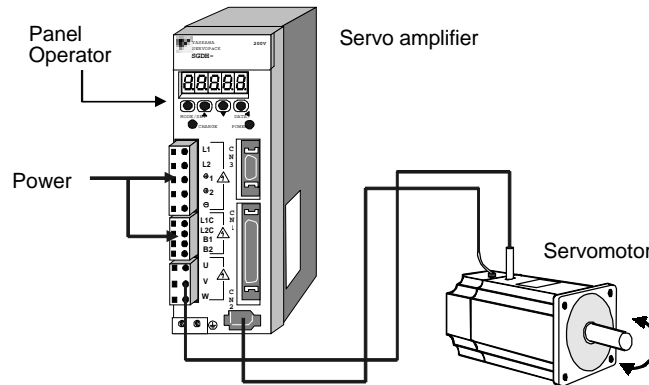
Note: Alarm traceback data is not updated when the same alarm occurs repeatedly.

7.2.2 Operation Using the Digital Operator

 CAUTION
<ul style="list-style-type: none"> • Forward run prohibited (P-OT) and reverse run prohibited (N-OT) signals are not effective during jog operations using parameter Fn002.

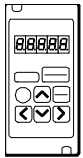
Operation from the digital operator allows the servo amplifier to run the motor. This allows rapid checking of motor's rotation direction and speed setting during machine setup and testing, without the trouble of connecting to a host controller.

For motor speed setting procedure, refer to *7.1.6 Operation in Parameter Setting Mode* and *5.3.2 Setting JOG Speed*.



Operation procedure using the digital operator is described on the following pages.

Using the Hand-Held Digital Operator



1. Press the **DSPL/SET** key to select Fn002 in the auxiliary function mode.

Fn002

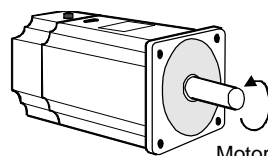
2. Press the **DATA/ENTER** key to select the digital operator operation mode. Operation is now possible using the digital operator.

F JOG

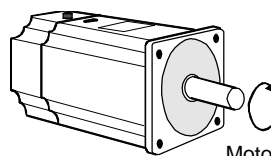
3. Press the **SVON** key to set to the servo ON state (with motor power turned ON).

1 JOG

4. Press the **Up Arrow**  or **Down Arrow**  key to operate the motor. The motor keeps operating while the key is pressed.



Motor Forward Rotation



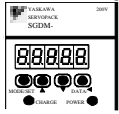
Motor Reverse Rotation

5. Press the **DSPL/SET** key, and the display will revert to Fn002. This sets to the servo OFF state (with motor power turned OFF). Alternatively, press the **SVON** Key to set to the servo OFF state.

Fn002

This ends operation under digital operator control.

Using the Panel Operator



1. Press the **MODE/SET** key to select Fn002 in the auxiliary function mode.

Fn002

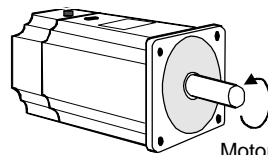
2. Press the **DATA/SHIFT** key for a minimum of one second to select the Panel Operator operation mode. Operation is now possible using the panel operator.

F. 000

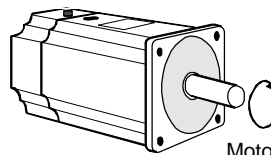
3. Press the **MODE/SET** key to set to the servo ON (with motor power turned ON).

1. 000

4. Press the **Up Arrow**  or **Down Arrow**  key to operate the motor. The motor keeps operating while the key is pressed.



Motor Forward Rotation



Motor Reverse Rotation

5. Press the **MODE/SET** key to set to the servo OFF state (with motor power turned OFF). Alternatively, press the **DATA/SHIFT** key for a minimum of one second to set to the servo OFF state.
6. Press the **DATA/SHIFT** key for a minimum of one second, and the display will revert to Fn002 in the auxiliary function mode.

Fn002

This ends operation under panel operator control.

The motor speed for operation under digital operator control can be changed with a parameter:

Parameter	Signal	Setting (rpm)	Application
Pn304	Jog Speed	Default Setting: 500	Speed Control

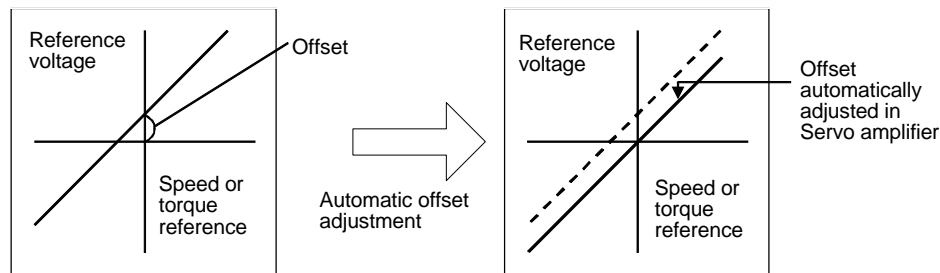
Note: The rotation direction of the servomotor depends on the setting of parameter Pn000.0 “Rotation Direction.” The above example shows a case where Pn000.0 is set to “0” as a default setting.

7.2.3 Automatic Adjustment of the Speed and Torque Reference Offset

When speed and torque control are used, the motor may rotate slowly even when 0V is specified as the analog reference voltage. This occurs when the host controller or external circuit has a small offset (measured in mV) in the reference voltage.

The automatic reference offset adjustment mode automatically measures the offset and adjusts the reference voltage. It adjusts both the speed and torque references.

The following diagram illustrates automatic adjustment of an offset in the reference voltage by the servo amplifier.



After completion of automatic offset adjustment, the amount of offset is stored in the servo amplifier.

The amount of offset can be checked in the speed reference offset manual adjustment mode. Refer to *Section 7.2.4 Manual Adjustment of the Speed and Torque Reference Offset* for details.

The automatic reference offset adjustment mode cannot be used for setting the error pulses to zero for a stopped servo amplifier when a position loop is formed with a host controller. In such cases, use the manual reference offset adjustment mode. Refer to *Section 7.2.4 Manual Adjustment of the Speed and Torque Reference Offset* for details.

The zero-clamp speed control function is available to force the motor to stop while the zero speed reference is given. Refer to *Section 5.4.3 Using the Zero Clamp Function*.

IMPORTANT

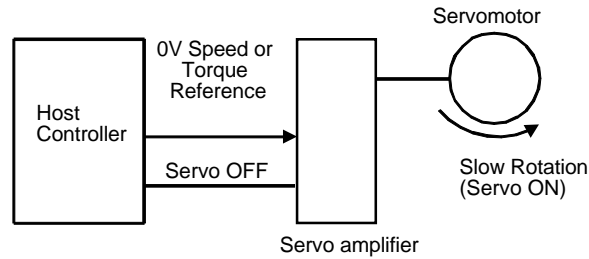
- Automatic adjustment of the speed/torque reference offset must be performed under the servo OFF state.

Follow this procedure to automatically adjust the speed/torque reference offset.

Using the Hand-Held Digital Operator



1. Input the (intended) 0V reference voltage from the host controller or external circuit.



2. Press the **DSPL/SET** key to select the auxiliary function mode.

F_n000

3. Select the parameter Fn009.

F_n009

Press the **Left Arrow**  or **Right Arrow**  key to select the digit.

Press the **Up Arrow**  or **Down Arrow**  key to change the value.

4. Press the **DATA/ENTER** key, and the display will be as shown below.

rEF_o

5. Press the **DSPL/SET** key, and the following display will flash for one second.

rEF_o

The reference offset will be automatically adjusted.

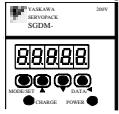
done Flashing for one second → **rEF_o**

6. Press the **DATA/ENTER** key to return to the auxiliary function mode display.

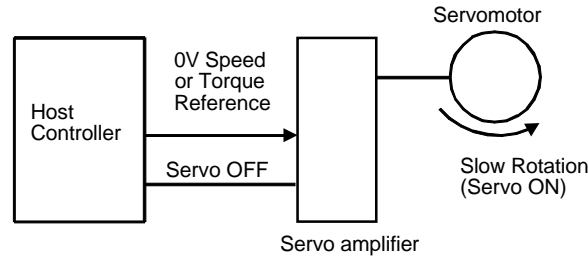
F_n009

This completes the speed/torque reference offset automatic adjustment.

Using the Panel Operator



1. Input the (intended) 0V reference voltage from the host controller or external circuit.



2. Press the **MODE/SET** key to select the auxiliary function mode.

F_n000

3. Press the **Up Arrow** or **Down Arrow** key to select the parameter Fn009.

F_n009

4. Press the **DATA/SHIFT** key for a minimum of one second, and the display will be as shown below.

rEFLo

5. Press the **MODE/SET** key, and the following display will flash for one second. The reference offset will be automatically adjusted.

done Flashing for one second → **rEFLo**

6. Press the **DATA/SHIFT** key for a minimum of one second to return to the auxiliary function mode display.

F_n009

This completes the speed/torque reference offset automatic adjustment.

7.2.4 Manual Adjustment of the Speed and Torque Reference Offset

Manual speed/torque reference offset adjustment is useful in the following situations:

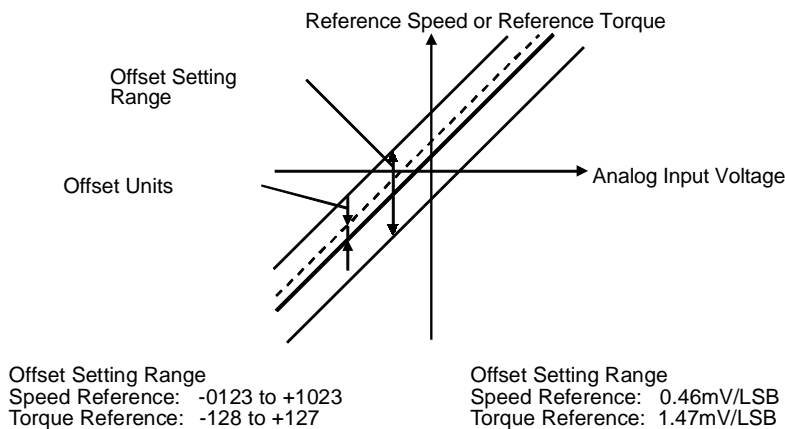
If a position loop is formed with a host controller and the error zeroed-out when the motor was stopped in servo lock (zero reference).

- To deliberately set the offset to some value.

This mode can also be used to check the data set in the automatic reference offset adjustment mode.

In principle, this mode operates in the same way as the automatic reference offset adjustment mode, except that the amount of offset is directly input during the adjustment. The offset amount can be set in the speed reference or torque reference.

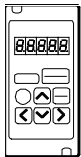
The offset setting range and setting units are as follows:



■ Manual Adjustment of Speed Reference Offset

Follow the procedure below to manually adjust the speed reference offset.

Using the Hand-Held Digital Operator



1. Press the **DSPL/SET** key to select the auxiliary function mode.

F_n000

2. Select the parameter F_n00A.

Press the **Up Arrow**  or **Down Arrow**  key to select the digit.

Press the **Up Arrow**  or **Down Arrow**  key to change the value.

F_n00A

3. Press the **DATA/ENTER** key, and the display will be as shown below. The manual adjustment mode for the speed reference offset will be entered.

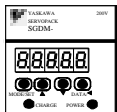
4. Turn ON the Servo ON (/S-ON) signal. The display will be as shown below.

5. Press the **Left Arrow** or **Right Arrow** key, to display the speed reference offset amount.

6. Press the **Up Arrow** or **Down Arrow** key to adjust the amount of offset (adjustment of the speed reference offset).
7. Press the Right Cursor Key to return to the display shown in the above step 4.
8. Press the **DATA/ENTER** key to return to the auxiliary function mode display.

This completes the speed reference offset manual adjustment.

Using the Panel Operator



1. Press the **MODE/SET** key to select the auxiliary function mode.



2. Press the **Up Arrow** or **Down Arrow** key to select the parameter Fn00A.

3. Press the **DATA/SHIFT** key for a minimum of one second, and the display will be as shown below. The manual adjustment mode for the speed reference offset will be entered.

4. Turn ON the Servo ON (/S-ON) signal. The display will be as shown below.

5. Press the **DATA/SHIFT** key for less than one second to display the speed reference offset amount.

A digital display showing the number 0000. The display is divided into four segments, each containing a zero.

6. Press the **Up Arrow**  or **Down Arrow**  key to adjust the amount of offset (adjustment of the speed reference offset).
7. Press the **DATA/SHIFT** key for less than one second to return to the display shown in the above step 4.
8. Press the **DATA/SHIFT** key to return to the auxiliary function mode display.

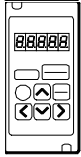
A digital display showing the text Fn00R. The display is divided into four segments: the first contains 'Fn', the second contains '00', and the third contains 'R'.

This completes the speed reference offset manual adjustment.

■ Manual Adjustment of Torque Reference Offset

Follow the procedure below to manually adjust the torque reference offset.

Using the Hand-Held Digital Operator



1. Press the **DSPL/SET** key to select the auxiliary function mode.

F_n000

2. Select the parameter **F_n00B**.

Press the **Left Arrow**  or **Right Arrow**  key to select the digit.

Press the **Up Arrow**  or **Down Arrow**  key to change the value.

F_n00b

3. Press the **DATA/ENTER** key, and the display will be as shown below. The manual adjustment mode for the torque reference offset will be entered.

- . t r 9

4. Turn ON the Servo ON (/S-ON) signal. The display will be as shown below.

□ . t r 9

5. Press the **Left Arrow**  or **Right Arrow**  key to display the torque reference offset amount.

□ 0000

6. Press the **Up Arrow**  or **Down Arrow**  key to adjust the offset amount (adjustment of torque reference offset).

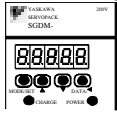
7. Press the **Left Arrow**  or **Right Arrow**  key, and the display will be as shown above in step 4.

8. Press the **DATA/ENTER** key to return to the auxiliary function mode display.

F_n00b

This completes the torque reference offset manual adjustment.

Using the Panel Operator



1. Press the **MODE/SET** key to select the auxiliary function mode.

F_n000

2. Press the **Up Arrow**  or **Down Arrow**  key to select the parameter Fn00B.

F_n00b

3. Press the **DSPL/SET** key for a minimum of one second, and the display will be as shown below. The manual adjustment mode for the torque reference offset will be entered.



- . 0 0 0

4. Turn ON the Servo ON (/S-ON) signal. The display will be as shown below.

. 0 0 0

5. Press the **DATA/SHIFT** key for less than one second, to display the torque reference offset amount.

- 0 0 0 0

6. Press the **Up Arrow**  or **Down Arrow**  key to adjust the offset amount, (Adjustment of torque reference offset).
7. Press the **DATA/SHIFT** key for less than one second, and the display will be as shown in the above step 4.
8. Press the **DATA/SHIFT** key to return to the auxiliary function mode.

F_n00b

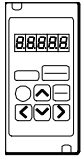
This completes the torque reference offset manual adjustment.

7.2.5 Clearing Alarm Traceback Data

This procedure clears the alarm history, which stores the alarms generated in the servo amplifier. After clearing, each alarm in the alarm history is set to A.- -, which is not an alarm code. Refer to *Section 7.2.1 Operation in Alarm Traceback Mode* for details.

Follow the procedure below to clear the alarm traceback data.

Using the Hand-Held Digital Operator



1. Press the **DSPL/SET** key to select the auxiliary function mode.

Fn000

2. Select the parameter Fn006.

Press the **Left Arrow**  or **Right Arrow**  key to select the digit.



Press the **Up Arrow**  or **Down Arrow**  key to change the value.

Fn006

3. Press the **DATA/ENTER** key, and the display will be as shown below.

ErCLr

4. Press the **DSPL/SET** key to clear the alarm traceback data. The following display will flash for one second, and, after the alarm traceback data is cleared, the display will return to the one in the above step 3.

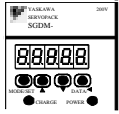
 Flashing for one second → 

5. Press the **DATA/ENTER** key to return to the parameter code display.

Fn006

This completes the alarm traceback data clearing procedure.

Using the Panel Operator



1. Press the **MODE/SET** key to select the auxiliary function mode.

Fn000

2. Press the **Up Arrow**  or **Down Arrow**  key to select the parameter Fn006.

Fn006

3. Press the **DATA/SHIFT** key for a minimum of one second, and the display will be as shown below.

ErCLr

4. Press the **MODE/SET** key to clear the alarm traceback data. The following display will flash for one second, and, after the alarm traceback data is cleared, the display will return to the one shown above in step 3.

done  → ErCLr

5. Press the **DATA/SHIFT** key for a minimum of one second to return to the parameter code display.

Fn006

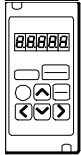
This completes the alarm traceback data clearing procedure.

7.2.6 Checking the Motor Model

Set the parameter Fn011 to select the motor model check mode. This mode is used for motor maintenance, and can also be used to check the special (Y-specification) codes of the servo amplifiers.

Follow the procedure below to check the motor model.

Using the Hand-Held Digital Operator



1. Press the **DSPL/SET** key to select the auxiliary function mode.

Fn000

2. Select the parameter Fn011.

Press the **Left Arrow**  or **Right Arrow**  key to select the digit.

Press the **Up Arrow**  or **Down Arrow**  key to change the value.

Fn011

3. Press the **DATA/ENTER** key to display the servomotor model and voltage code.

F0100

Voltage

Servomotor Mode

Voltage

Code	Voltage
00	100V _{AC} or 140V _{DC}
01	200V _{AC} or 280V _{DC}
02	400V _{AC} or 560V _{DC}

Servomotor Model

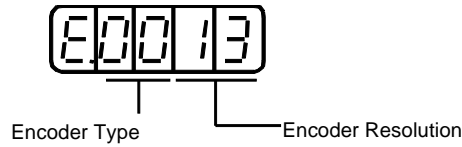
Code	Servomotor Model
00	SGMAH
01	SGMPH
02	SGMSH
03	SGMGH-□A (1500rpm)
04	SGMGH-□B (1000rpm)
05	SGMDH
06	SGMUH

4. Press the **DSPL/SET** key to display the Servomotor capacity.

P0010

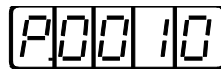
Capacity: Displayed value y 10 (W)
In this example, the capacity is 100 W

5. Press the **DSPL/SET** key to display the encoder type and resolution code.



Encoder Type		Encoder Resolution	
Code	Voltage	Code	Resolution
00	Incremental Encoder	13	13 bits
01	Absolute Encoder	16	16 bits
		17	17 bits
		20	Reserved

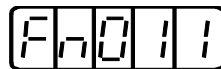
6. Press the **DSPL/SET** key to display the servo amplifier's special (Y-specification) code.



Capacity: Displayed value \times 10W.
In this example, the capacity is 100W.

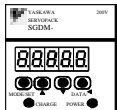
7. Press the **DATA/ENTER** key to return to the auxiliary function mode display.

Pressing the **DATA/ENTER** key after the above displays in steps 3 to 5 will also return to the auxiliary function mode display.



This ends checking motor type procedure.

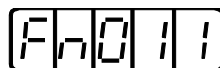
Using the Panel Operator



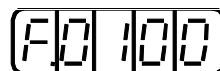
1. Press the **MODE/SET** key to select the auxiliary function mode.



2. Press the **Up Arrow**  or **Down Arrow**  key to select the parameter Fn011.



3. Press the **DATA/SHIFT** key for a minimum of one second to display the Servomotor model and voltage code.



Voltage Servomotor Mode

Code	Voltage
00	100V _{AC} or 140V _{DC}
01	200V _{AC} or 280V _{DC}
02	400V _{AC} or 560V _{DC}

Code	Servomotor Model
00	SGMAH
01	SGMPH
02	SGMSH
03	SGMGH-□A (1500rpm)
04	SGMGH-□B (1000rpm)
05	SAGMDH
06	SGMUH

4. Press the **MODE/SET** key to display the Servomotor capacity.

P0010

Capacity unit: Displayed value $\times 10$ [W]
This example shows 100 W.

5. Press the **MODE/SET** key, and the encoder type and resolution code will be displayed.

E0013

Encoder Type

Encoder Resolution

Code	Voltage
00	Incremental Encoder
01	Absolute Encoder

Code	Resolution
13	13 bits
16	16 bits
17	17 bits
20	Reserved

6. Press the **MODE/SET** key to display the servo amplifier's special (Y-specification) code.

Y0010

This example shows specification code "Y10" (indicated in decimal).

7. Press the **DATA/SHIFT** key to return to the auxiliary function mode display.

Pressing the **DATA/SHIFT** key after the above displays in steps 3 to 5 will also return to the auxiliary function mode display.

F0011

This completes the motor type checking procedure.

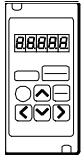
7.2.7 Checking the Software Version

Set Fn012 to select the software-version check mode.

This mode is used for motor maintenance.

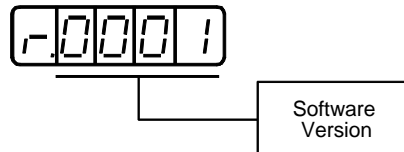
Follow the procedure below to check the software version.

Using the Hand-Held Operator



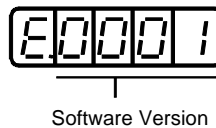
1. Select the parameter Fn012.
2. Press the **DATA/ENTER** key, and the servo amplifier software version will be displayed.

Software Version Display



3. Press the **DSPL/SET** key, and the software version of the encoder mounted on the motor will be displayed.

Software Version Display

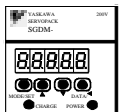


4. Press the **DATA/ENTER** key to return to the parameter code display.



This completes the checking software version procedure.

Using the Panel Operator



1. Select the parameter Fn012.
2. Press the **DATA/SHIFT** key for a minimum of one second to display the servo amplifier software version.
3. Press the **MODE/SET** key to display the encoder software version.
4. Press the **DATA/SHIFT** key for a minimum of one second to return to the parameter code display.

7.2.8 Origin Search Mode

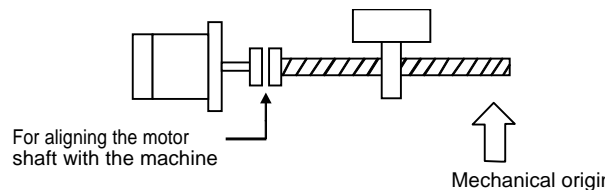


CAUTION

- Forward run prohibited (P-OT) and reverse run prohibited (N-OT) signals are not effective during jog operations using parameter Fn003.

The origin search mode is designed to position the origin pulse position of the encoder and to clamp at the position. This mode is used when the motor shaft needs to be aligned to the machine. Execute the origin search without connecting the couplings.

The speed for executing the origin search is 60rpm.

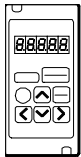


The following conditions must be met to perform the origin search operation.

- If the Servo-ON input signal (/S-ON) is ON, turn it OFF.
- Release the Servo-ON signal mask if the parameter Pn50A.1 is set to 7, and the servo has been set to be always ON.

Follow the procedure below to execute the origin search.

Using the Hand-Held Digital Operator



1. Press the **DSPL/SET** key to select the auxiliary function mode.

Fn000

2. Select the parameter Fn003.

Press the **Left Arrow**  or **Right Arrow**  key to select the digit.

Press the **Up Arrow**  or **Down Arrow**  key to change the value.

Fn003



3. Press the **DATA/ENTER** key, and the display will be as shown below.

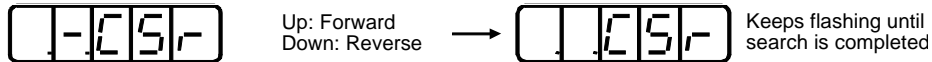
-1.05r

- Press the **SVON** key, and the display will be as shown below. Now it is ready for executing the origin search.



- Hold down the **Up Arrow**  or **Down Arrow**  key to execute the origin search.

When the parameter is set to Pn000.0 = 0 (default), pressing the **Up Arrow**  key will rotate the motor in the forward direction. Pressing the **Down Arrow**  key will rotate the motor in the reverse direction. When the parameter is set to Pn000.0 = 1, the rotation of the motor is reversed.

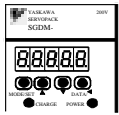


- Press the **DATA/ENTER** key to return to the auxiliary function mode display.



This completes the origin search operation.

Using the Panel Operator



- Press the **MODE/SET** key to select the auxiliary function mode.



- Press the **Up Arrow**  or **Down Arrow**  key to select the parameter Fn003.





- Press the **DATA/SHIFT** key for a minimum of one second, and the display will be as shown below.



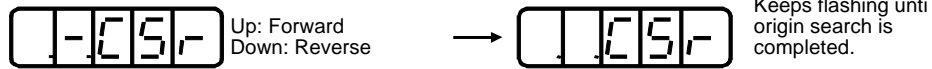
- Press the **MODE/SET** key, and the display will change as shown below. Now it is ready for executing the origin search mode.



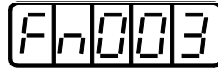
- Hold down the **Up Arrow**  or **Down Arrow**  key to execute the origin search.

When the parameter is set to Pn000.0 = 0 (default), pressing the **Up Arrow**  key will rotate the motor in the forward direction. Pressing the **Down Arrow**  key

will rotate the motor in the reverse direction. When the parameter is set to Pn000.0 = 1, the rotation of the motor is reversed.



6. Press the **DATA/SHIFT** key for a minimum of one second to return to the auxiliary function mode display.



This completes the origin search operation.

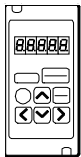
7.2.9 Initializing Parameter Settings

This function is used to restore all the parameters to the default settings (standard factory settings).

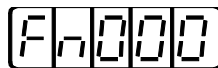
IMPORTANT
<ul style="list-style-type: none"> • Initialize the parameter settings with the servo OFF.

Follow the procedure below to initialize parameter settings.

Using the Hand-Held Digital Operator



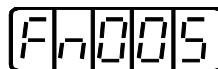
1. Press the **DSPL/SET** key to select the auxiliary function mode.



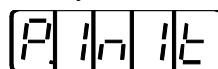
2. Select the parameter Fn005.

Press the **Left Arrow**  or **Right Arrow**  key to select the digit.

Press the **Up Arrow**  or **Down Arrow**  key to change the value.

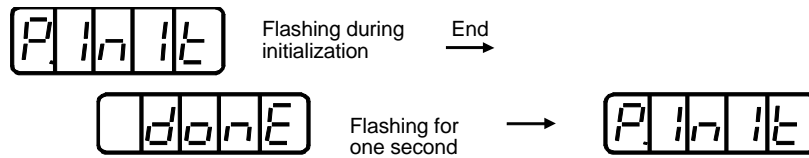


3. Press the **DATA/ENTER** key, and the display will be as shown below.



4. Press the **DSPL/SET** key, and the display will be as shown below. The param-

ters will be initialized.

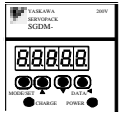


5. Press the **DATA/ENTER** key to return to the auxiliary function mode display.

Fn005

This completes the initialization of parameter settings.

Using the Panel Operator



1. Press the **MODE/SET** key to select the auxiliary function mode.

Fn000

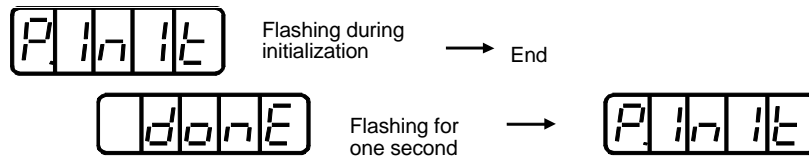
2. Press the **Up Arrow**  or **Down Arrow**  key to select the parameter Fn005.

Fn005

3. Press the **DATA/SHIFT** key for a minimum of one second, and the display will be as shown below.

P.lnIt

4. Press the **MODE/SET** key, and the display will be as shown below. The parameters will be initialized.



5. Press the **DATA/SHIFT** key for a minimum of one second to return to the auxiliary function mode display.

Fn005

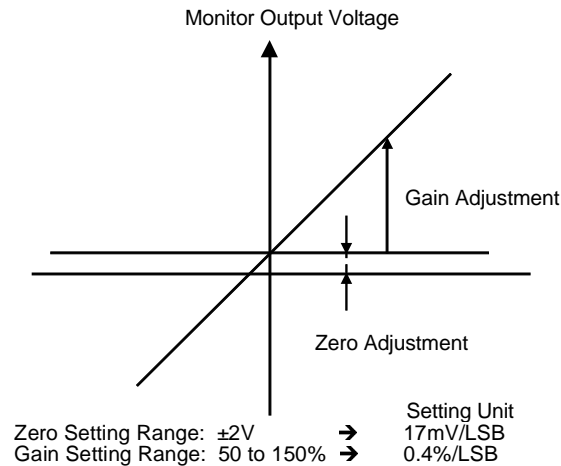
This completes the initialization of parameter settings.

Note: Parameters will not be initialized by pressing the **DSPL/SET** or **MODE/SET** key with the servo ON. Turn the power OFF and then back ON after initialization.

7.2.10 Manual Zero Adjustment and Gain Adjustment of Analog Monitor Output

Motor speed, torque reference, and position error can be monitored through the analog monitor output. Refer to *Section 6.5 Analog Monitor*.

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

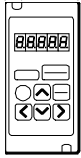


Note: The output voltage of the analog monitor is $\pm 8V$. The output voltage polarity will be reversed if $\pm 8V$ is exceeded.

■ Manual Zero Adjustment of Analog Monitor Output

Follow the procedure below to execute the manual zero adjustment of analog monitor output.

Using the Hand-Held Digital Operator



1. Press the **DSPL/SET** key to select the auxiliary function mode.

Fn000

2. Select the parameter Fn00C.

Press the **Left Arrow**  or **Right Arrow**  key to select the digit.

Press the **Up Arrow**  or **Down Arrow**  key to change the value.





Fn00C

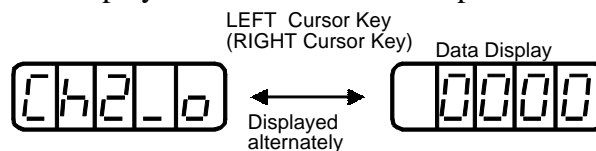
3. Press the **DATA/ENTER** key, and the display will be as shown below.

CH1_0

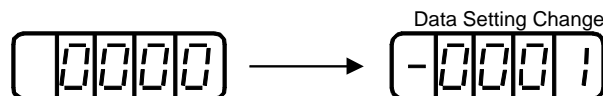
4. Press the **DSPL/SET** key. Each time the **DSPL/SET** key is pressed, the monitor output will toggle between the displays for the two channels shown below.



5. Press the **Left Arrow**  or **Right Arrow**  key to display the analog monitor output data. Pressing the **Left Arrow**  or **Right Arrow**  key again will return to the display shown in the above step 3 or 4.



6. Press the **Up Arrow**  or **Down Arrow**  key to perform zero adjustment of the analog monitor output.

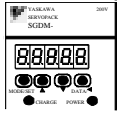


7. When zero adjustment has been completed for the two channels, press the **DATA/ENTER** key to return to the auxiliary function mode display.

Fn00C

This completes the manual zero adjustment of the analog monitor output.

Using the Panel Operator



1. Press the **MODE/SET** key to select the auxiliary function mode.

Fn000

2. Press the **Up Arrow**  or **Down Arrow**  key to select the parameter Fn00C.

Fn00C

3. Press the **DATA/SHIFT** key for a minimum of one second, and the display will be as shown below.

CH1_o

4. Press the **MODE/SET** key. Each time the **MODE/SET** key is pressed, the monitor output will toggle between the displays for the two channels shown below.

CH1_o \longleftrightarrow CH2_o
MODE/SET Key
Displayed Alternately

5. Press the **DATA/SHIFT** key for less than one second, and the analog monitor gain parameter will be displayed. Pressing the **DATA/SHIFT** key again for less than one second will return to the display shown in the above steps 3 or 4.

CH2_o \longleftrightarrow 0000
DATA/SHIFT Key
Data Display
Displayed Alternately

6. Press the **Up Arrow**  or **Down Arrow**  key to perform zero adjustment of the analog monitor output.

0000 \longrightarrow -0001
Data Setting Change

7. When zero adjustment has been completed for the two channels, press the **DATA/SHIFT** key for a minimum of one second to return to the auxiliary function mode display.

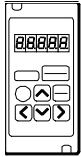
Fn00C

This completes the manual zero adjustment of the analog monitor output.

■ Manual Gain Adjustment of Analog Monitor Output

Follow the procedure below to execute the manual gain adjustment of analog monitor output.



Using the Hand-held Digital Operator



1. Press the **DSPL/SET** key to select the auxiliary function mode.

Fn000

2. Select the parameter Fn00D.

Press the **Left Arrow**  or **Right Arrow**  key to select the digit.

Press the **Up Arrow**  or **Down Arrow**  key to change the value.





Fn00d

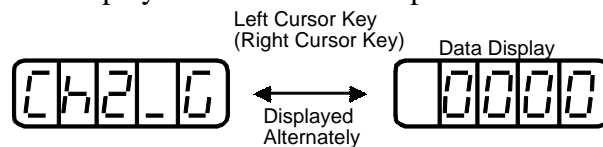
3. Press the **DATA/SHIFT** key, and the display will be as shown below.

CH1_0

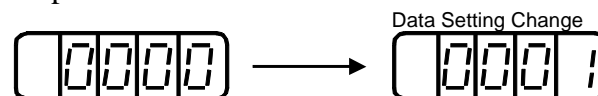
4. Press the **DSPL/SET** key. Each time the **DSPL/SET** key is pressed, the monitor output will toggle between the displays for the two channels shown below.



5. Press the **Left Arrow**  or **Right Arrow**  key to display the analog monitor gain parameter. Pressing the **Left Arrow**  or **Right Arrow**  key again will return to the display shown above in step 3 or 4.



6. Press the **Up Arrow**  or **Down Arrow**  key to adjust the gain for the analog monitor output.

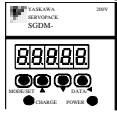


7. When the gain adjustment has been completed for the two channels, press the **DATA/ENTER** key to return to the auxiliary function mode display.

Fn00d

This completes the manual gain adjustment of the analog monitor output.

Using the Panel Operator



1. Press the **MODE/SET** key to select the auxiliary function mode.

Fn000

2. Press the **Left Arrow**  or **Right Arrow**  key to select the parameter Fn00D.

Fn00d

3. Press the **DATA/SHIFT** key for a minimum of one second, and the display will be as shown below.

CH1_0

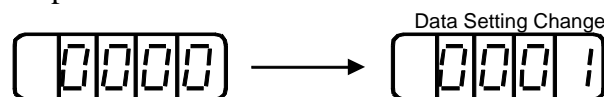
4. Press the **MODE/SET** key. Each time the **MODE/SET** key is pressed, the monitor output will toggle between the displays for the two channels shown below.



5. Press the **DATA/SHIFT** key for less than one second. The gain parameter for the analog monitor will be displayed. Pressing the **DATA/SHIFT** key again for less than one second will return to the display shown above in step 3 or 4.



6. Press the **Up Arrow**  or **Down Arrow**  key to adjust the gain for the analog monitor output.



7. When the gain adjustment has been completed for the two channels, press the **DATA/SHIFT** key for a minimum of one second to return to the auxiliary function mode display.

Fn00d

This completes the manual gain adjustment of the analog monitor output.

7.2.11 Adjusting the Motor Current Detection Offset

Motor current detection offset adjustment is performed at Yaskawa before shipping. Normally, the user does not need to perform this adjustment. Make this adjustment only if highly accurate adjustment is required to reduce torque ripple caused by current offset.

The following sections describe automatic and manual adjustment of the current

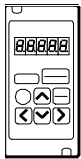
Note: If this function, particularly manual adjustment, is executed carelessly, it may degrade the performance of the servo drive.

■ Automatic Adjustment of the Motor Current Detection Offset

Follow the procedure below to perform automatic adjustment of the current detection offset.

Note: Automatic adjustment is possible only with power supplied to the main circuits and with the servo OFF.

Using the Hand-Held Digital Operator



1. Press the **DSPL/SET** key to select the auxiliary function mode.

Fn000

2. Select the parameter Fn00E.

Press the **Left Arrow**  or **Right Arrow**  key to select the digit.

Press the **Left Arrow**  or **Right Arrow**  key to change the value.

Fn00E

3. Press the **DATA/ENTER** key, and the display will be as shown below.

Cur_o

4. Press the **DSPL/SET** key. The display will change as shown below and offset will be automatically adjusted.

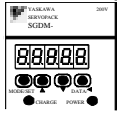
done Flashing for one second → **Cur_o**

5. Press the **DATA/ENTER** key to return to the auxiliary function mode display .

Fn00E

This completes the automatic adjustment of the motor current detection offset.

Using the Panel Operator



1. Press the **MODE/SET** key to select the auxiliary function mode.

Fn000

2. Press the **Up Arrow**  or **Down Arrow**  key to select the parameter Fn00E.

Fn00E

3. Press the **DATA/SHIFT** key for a minimum of one second, and the display will be as shown below.

Cur_o

4. Press the **MODE/SET** key. The display will change as shown below and the offset will be automatically adjusted.

done → Cur_o
Flashing for one second

5. Press the **DATA/SHIFT** key for a minimum of one second to return to the auxiliary function mode display.

Fn00E

This completes the automatic adjustment of the motor current detection offset.

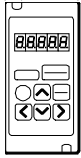
■ Manually Adjusting the Motor Current Detection Offset

Follow the procedure below to manually adjust the current detection offset.

IMPORTANT

- **When making manual adjustments, run the motor at a speed of approximately 100rpm, and adjust the Motor Current Detection Offset until the torque ripple, observed with the analog monitor, is minimized.** (Refer to *Section 6.5 Analog Monitor*.)
Adjust the U-phase and V-phase offsets alternately several times until these offsets are well balanced.

Hand-Held Digital Operator



1. Press the **DSPL/SET** key to select the auxiliary function mode.

Fn000

2. Select the parameter Fn00F.

Press the **Left Arrow**  or **Right Arrow**  key to select the digit.

Press the **Up Arrow**  or **Down Arrow**  key to change the value.





Fn00F

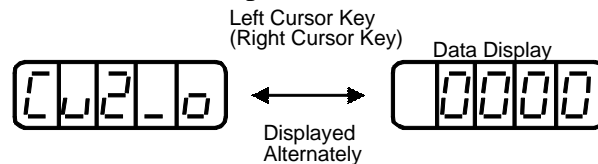
3. Press the **DATA/ENTER** key, and the display will be as shown below.



Cu1_0

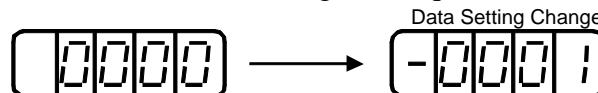
4. Press the **DSPL/SET** key to switch between the U-phase (Cu1_0) and V-phase (Cu2_0) current detection offset adjustment mode



5. Press the **Left Arrow**  or **Right Arrow**  key to display the current detection data. Pressing the **Left Arrow**  or **Right Arrow**  key again will return to the display shown above in step 3 or 4.



6. Press the **Up Arrow**  or **Down Arrow**  key to adjust the offset. Carefully adjust the offset while monitoring the torque reference monitor signal.

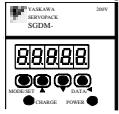


7. When the current offset adjustment has been completed for the U-phase (Cu1_0) and V-phase (Cu2_0), press the **DATA/SHIFT** key to return to the auxiliary function mode display.

Fn00F

This completes the manual adjustment of the motor current detection offset.

Using the Panel Operator



1. Press the **MODE/SET** key to select the auxiliary function mode.

Fn000

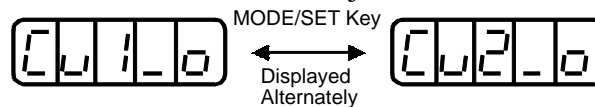
2. Press the **Up Arrow**  or **Down Arrow**  key to select the parameter Fn00F.

Fn00F

3. Press the **DATA/SHIFT** key for a minimum of one second, and the display will be as shown below.



Cu1_0

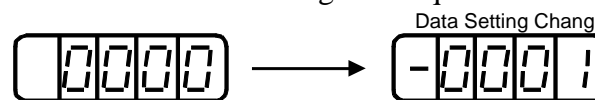
4. Press the **MODE/SET** key to switch between U-phase (Cu1_0) and V-phase (Cu2_0) current detection offset adjustment mode.



5. Press the **DATA/SHIFT** key for less than one second to display the current detection data. Press the **DATA/SHIFT** key again for less than one second, and the display will return to one shown above in step 3 or 4.



6. Press the **Up Arrow**  or **Down Arrow**  key to adjust the offset. Carefully adjust the offset while monitoring the torque reference monitor signal.



7. When the current offset adjustment has been completed for the U-phase (Cu1_0) and V-phase (Cu2_0), press the **DATA/SHIFT** key to return to the auxiliary function mode display

Fn00F

This completes the manual adjustment of the motor current detection offset.

7.2.12 Write Protected Setting

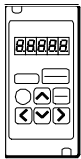
The write protect setting is used for preventing careless changes of the parameters. Parameters Pn□□□ and some of Fn□□□ become write protected by setting the parameter Fn010.

Password setting values are as follows:

- “0000”: Write enabled (Releases write prohibited mode.)
- “0001”: Write prohibited (parameters become write protected at the next power ON.)

Follow the procedure below to set the password.

Using the Hand-Held Digital Operator



1. Press the **DSPL/SET** key to select the auxiliary function mode.

Fn000

2. Select the parameter Fn010.

Press the **Left Arrow**  or **Right Arrow**  key to select the digit.



Press the **Up Arrow**  or **Down Arrow**  key to change the value.

Fn010

3. Press the **DATA/ENTER** key, and the display will be as shown below.

P0000

4. Input the value (0001) and press the **DSPL/SET** key. The display will change as shown below and the write protect will be established.

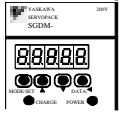
 Flashing for one second → 

5. Press the **DATA/ENTER** key to return to the auxiliary function mode display.

Fn010

This completes the write protect setting procedure. The new setting will be valid after the next power OFF/ON cycle.

Using the Panel Operator



1. Press the **MODE/SET** key to select the auxiliary function mode.

Fn0000


2. Press the **Up Arrow**  or **Down Arrow**  key to select the parameter Fn010.

Fn010

3. Press the **DATA/SHIFT** key for a minimum of one second, and the display will be as shown below.

P0000

4. Input the value (0001) and press the **MODE/SET** key. The display will change to one shown below and the write protect will be established.

done  **P0001**
Flashing for one second

5. Press the **DATA/SHIFT** key for a minimum of one second to return to the auxiliary function mode display.

Fn010

This completes the procedure for setting the write protect. The new setting password will be valid after the next power OFF/ON cycle.

8 Ratings and Characteristics

This chapter provides the ratings, torque-speed characteristics diagrams, and dimensional drawings of the Sigma II series servo drives.

8.1	Servomotors	8-2
8.1.1	Ratings, Specifications, and Dimensional Drawings	8-2
8.2	Servo Amplifiers	8-17
8.2.1	Combined Specifications	8-17
8.2.2	Ratings and Specifications	8-21
8.2.3	Dimensional Drawings	8-24

8.1 Servomotors

This section describes ratings, specifications, and dimensional drawings of the servomotors. Refer to this section for selecting an appropriate servo drive.

8.1.1 Ratings, Specifications, and Dimensional Drawings

The following sections provide the ratings specifications, and dimensional drawings of the servomotors by model.

■ SGMAH Servomotors

Ratings and Specifications for Standard Servomotors

- Time Rating: Continuous
- Vibration Class: 15 μ m or below
- Insulation Resistance: 500V_{DC}, 10M Ω minimum
- Ambient Temperature: 0 to 40°C
- Excitation: Permanent magnet
- Mounting: Flange method
- Insulation Class: Class B
- Withstand Voltage: 1500V_{AC} for one minute
- Enclosure: Totally enclosed, self-cooled, IP55 (except for through-sections of the shaft)
- Ambient Humidity: 20% to 80% (with no condensation)
- Drive Method: Direct drive

SGMAH Standard Servomotor Ratings and Specifications

Voltage		200V						100V			
Servomotor Model SGMAH		A3A	A5A	01A	02A	04A	08A	A3B	A5B	01B	02B
Rated Output *	kW	0.03	0.05	0.1	0.2	0.4	0.75	0.03	0.05	0.1	0.2
Rated Torque*,**	oz-in	13.52	22.5	45.1	90.2	180	338	13.52	22.5	45.1	90.2
	N-m	0.0955	0.159	0.318	0.637	1.27	2.39	0.0955	0.159	0.318	0.637
Instantaneous Peak Torque*	oz-in	40.6	67.6	135.2	270	541	1010	40.6	67.6	135.2	270
	N-m	0.286	0.477	0.955	1.91	3.82	7.16	0.286	0.477	0.955	1.91
Rated Current*	A _{rms}	0.44	0.64	0.91	2.1	2.8	4.4	0.66	0.95	2.4	3.0
Instantaneous Maximum Current*	A _{rms}	1.3	2.0	2.8	6.5	8.5	13.4	2.0	2.9	7.2	9.0
Rated Speed*	rpm	3000									
Maximum Speed*	rpm	5000									
Torque Constant	oz-in/A _{rms}	33.7	38.0	53.6	46.2	70.6	83.6	22.2	25.8	20.7	33.2
	N-m/A _{rms}	0.238	0.268	0.378	0.327	0.498	0.590	0.157	0.182	0.146	0.234
Moment of Inertia	oz-in-s ² x 10 ⁻³	0.235	0.312	0.515	1.501	2.45	9.52	0.235	0.312	0.515	1.501
	kg-m ² x 10 ⁻⁴	0.0166	0.0220	0.0364	0.106	0.173	0.672	0.0166	0.0220	0.0364	0.106
Rated Power Rating*	kW/s	5.49	11.5	27.8	38.2	93.7	84.8	5.49	11.5	27.8	38.2

Voltage		200V						100V			
Servomotor Model SGMAH		A3A	A5A	01A	02A	04A	08A	A3B	A5B	01B	02B
Rated Angular Acceleration*	rad/s ²	57500	72300	87400	60100	73600	35500	57500	72300	87400	60100
Inertia Time Constant	ms	1.4	0.88	0.53	0.39	0.25	0.26	1.4	0.85	0.61	0.41
Inductive Time Constant	ms	1.0	1.1	1.2	4.6	5.4	8.7	1.0	1.1	1.1	4.4

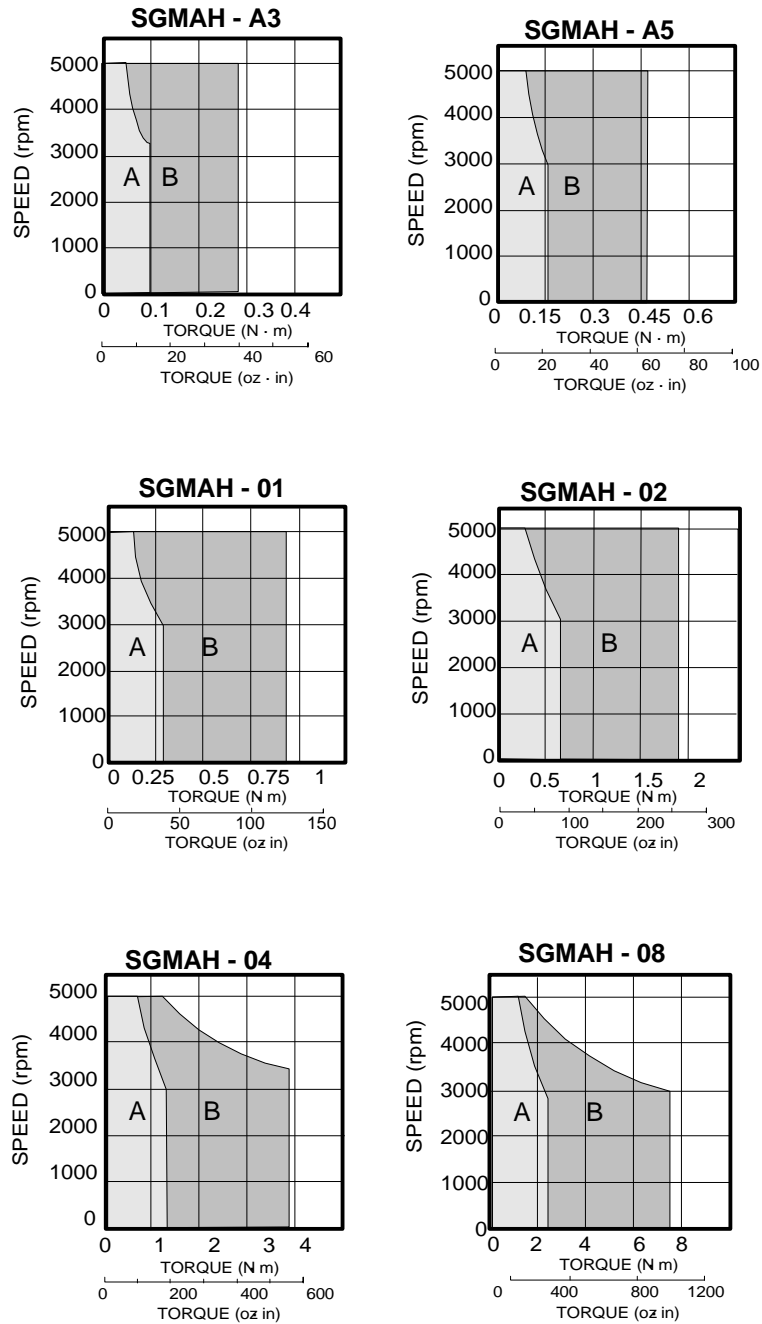
Note: * These items and torque-motor speed characteristics quoted in combination with an SGD servo amplifier are at an armature winding temperature of 100°C. Other values quoted at 20°C. All values are typical.

** Rated torques are continuous allowable torque values at 40°C with a 10 × 10 × 0.25in. (250 × 250 × 6mm) heat sink attached.

SGMAH Servomotor Torque-Motor Speed Characteristics

The torque-motor speed characteristics are shown below for SGMAH servomotors.

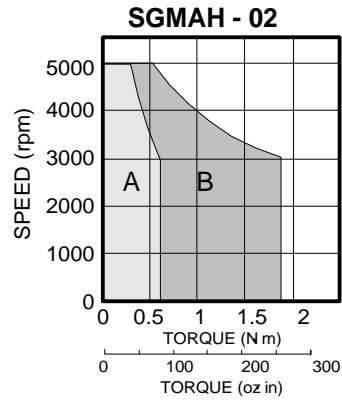
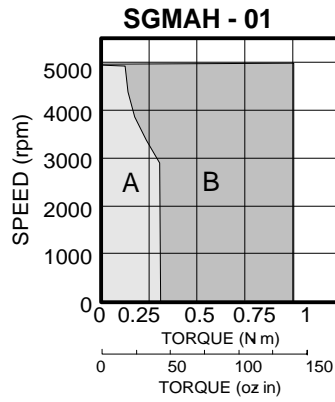
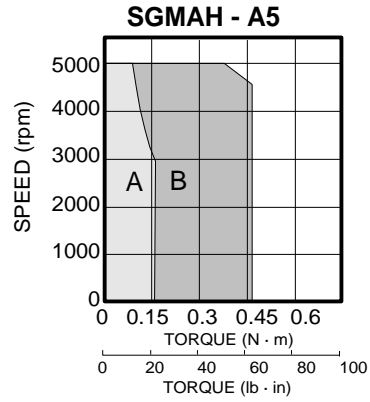
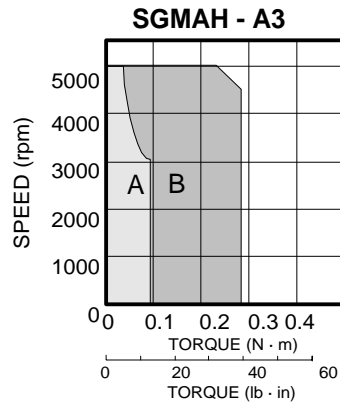
- 200V Servomotors



A : CONTINUOUS DUTY ZONE

B : INTERMITTENT DUTY ZONE

• 100V Servomotors

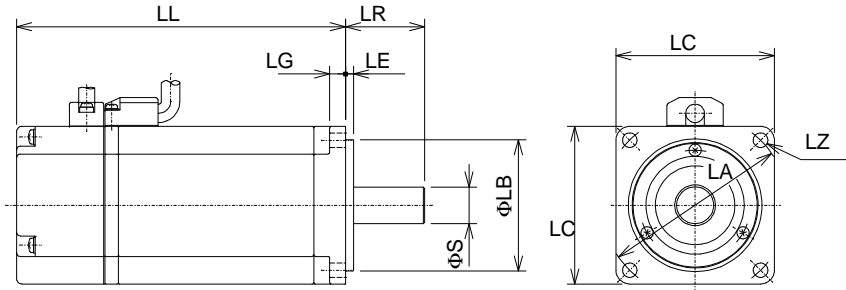


**A : CONTINUOUS
DUTY ZONE**

**B : INTERMITTENT
DUTY ZONE**

SGMAH Dimensions in inches (mm)

Drawings that provide) SGMGH servomotor dimensions are shown below.



Model	LL	LC	LA	LZ	LG	ϕLB	LE	ϕS	LR	Mass kg (lb)
SGMAH-A3A (B)	2.74 (69.5)	1.57 (40)	1.81 (46)	0.17 (4.3)	0.20 (5)	1.19 (30)	0.098 (2.5)	0.24 (6)	0.98 (25)	0.661 (0.3)
SGMAH-A5A (B)	3.03 (77.0)									0.882 (0.4)
SGMAH-01A (B)	3.72 (94.5)							0.32 (8)		1.10 (0.5)
SGMAH-02A (B)	3.80 (96.5)	2.36 (60)	2.76 (70)	0.22 (5.5)	0.24 (6)	1.98 (50)	0.12 (3)	0.56 (14)	1.18 (30)	2.43 (1.1)
SGMAH-04A	4.90 (124.5)									3.75 (1.7)
SGMAH-08A	5.71 (145)	3.15 (80)	3.54 (90)	0.28 (7)	0.31 (8)	2.78 (70)		0.64 (16)	1.57 (40)	7.50 (3.4)

Specified Tolerances				
Dimension	ϕS		ϕLB	
Unit	Diameter	Tolerance	Diameter	Tolerance
in	0.24	+0.0000-0.0004	1.19	+0.0000 -0.0008
	0.31		1.98	+0.0000 -0.0010
	0.56		2.78	+0.0000 -0.0012
	0.64			
mm	6	+0.000 -0.009	30	+0.000 -0.021
	8		50	+0.000 -0.025
	14	+0.000 -0.011	70	+0.000 -0.030
	16			

■ SGMPH Servomotors

Ratings and Specifications for Standard Servomotors

- Time Rating: Continuous
- Vibration Class: 15 μ m or below
- Insulation Resistance: 500V_{DC}, 10M Ω minimum
- Ambient Temperature: 0 to 40°C
- Excitation: Permanent magnet
- Mounting: Flange method
- Insulation Class: Class B
- Withstand Voltage: 1500V_{AC} for one minute
- Enclosure: Totally enclosed, self-cooled, IP55 (except for through-sections of the shaft)
- Ambient Humidity: 20% to 80% (with no condensation)
- Drive Method: Direct drive

SGMPH Standard Servomotor Ratings and Specifications

Voltage		200V					100V	
Servomotor Model SGMPH-		01A	02A	04A	08A	15A	01B	02B
Rated Output *	kW	0.1	0.2	0.4	0.75	1.5	0.1	0.2
Rated Torque* **	oz-in	45.1	90.2	180	338	676	45.1	90.2
	N-m	0.318	0.637	1.27	2.39	4.77	0.318	0.637
Instantaneous Peak Torque*	oz-in	135	270	541	1010	2030	135.2	270
	N-m	0.955	1.91	3.82	7.16	14.3	0.955	1.91
Rated Current*	A _{rms}	0.89	2.0	2.6	4.1	7.5	2.2	2.7
Instantaneous Max. Current*	A _{rms}	2.8	6.0	8.0	13.9	23.0	7.1	8.4
Rated Speed*	rpm	3000						
Max. Speed*	rpm	5000						
Torque Constant	oz-in/A _{rms}	55.6	49.4	75.8	91.0	97.4	22.8	36.5
	N-m/A _{rms}	0.392	0.349	0.535	0.641	0.687	0.160	0.258
Moment of Inertia	oz-in-s ² x 10 ⁻³	0.695	2.73	4.69	29.7	56.9	0.695	2.73
	kg-m ² x 10 ⁻⁴	0.0491	0.193	0.331	2.10	4.02	0.0491	0.193
Rated Power Rating*	kW/s	20.6	21.0	49.0	27.1	56.7	20.6	21.0
Rated Angular Acceleration*	rad/s ²	64800	33000	38500	11400	11900	64800	33000
Inertia Time Constant	ms	0.53	0.54	0.36	0.66	0.46	0.56	0.64
Inductive Time Constant	ms	3.7	7.4	8.6	18	22	3.6	6.3

Note: * These items and torque–motor speed characteristics quoted in combination with an SGD servo amplifier are at an armature winding temperature of 100°C. Other values quoted at 20°C. All values are typical.

** Rated torques are continuous allowable torque values at 40°C with a 10 × 10 × 0.25in. (250 × 250 × 6mm) heat sink attached.

Heat sink dimensions

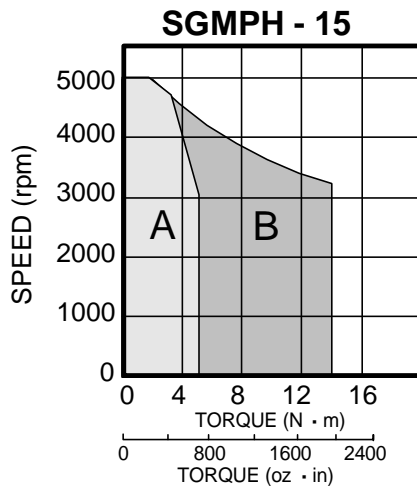
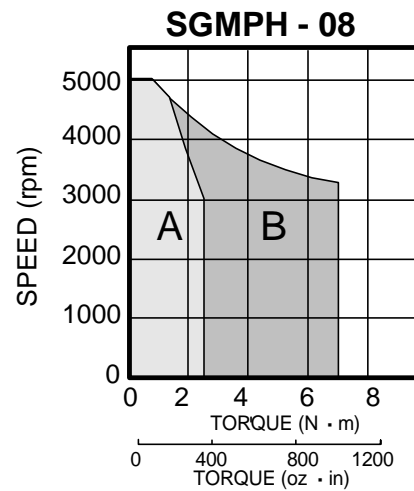
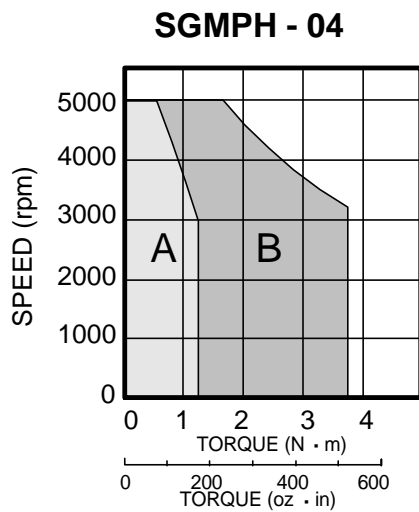
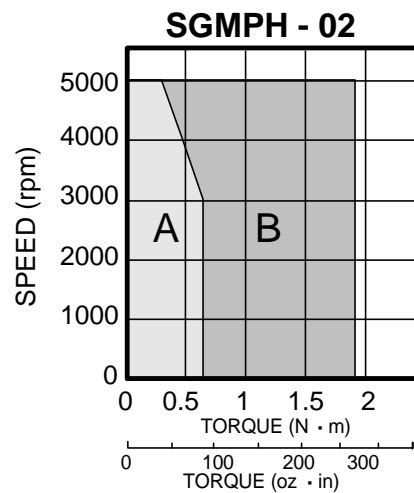
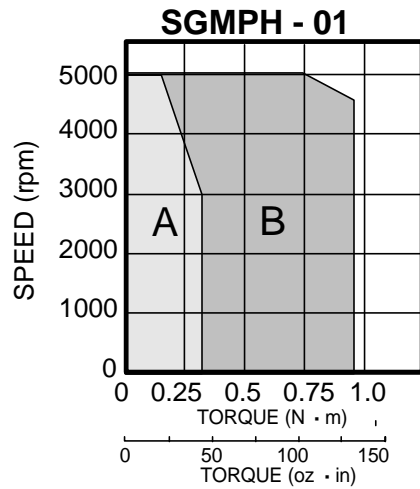
10 × 10 × 0.25in. (250 × 250 × 6mm): 0.1 to 0.4kW

12 × 12 × 0.5in. (300 × 300 × 12mm): 0.75 to 1.5 kW

SGMPH Servomotor Torque-Motor Speed Characteristics

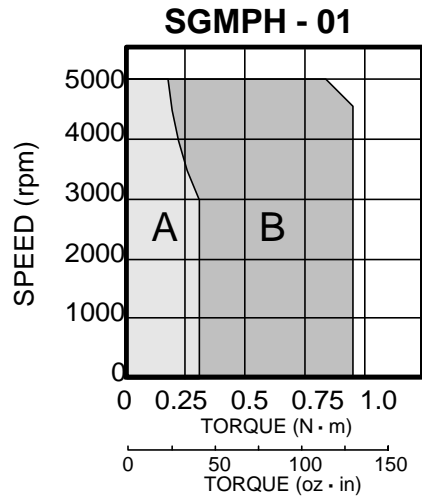
The torque-motor speed characteristics are shown below for SGMPH servomotors.

- 200V Servomotors

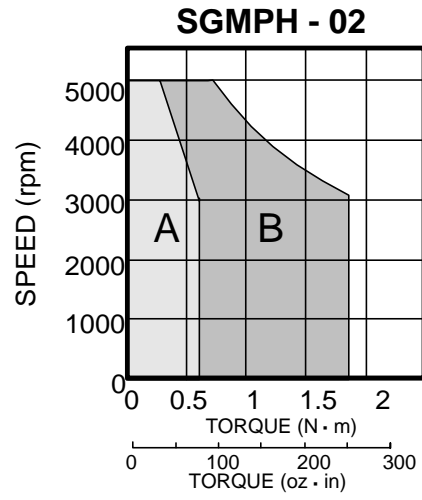


A : CONTINUOUS DUTY ZONE **B : INTERMITTENT DUTY ZONE**

- 100V Servomotors



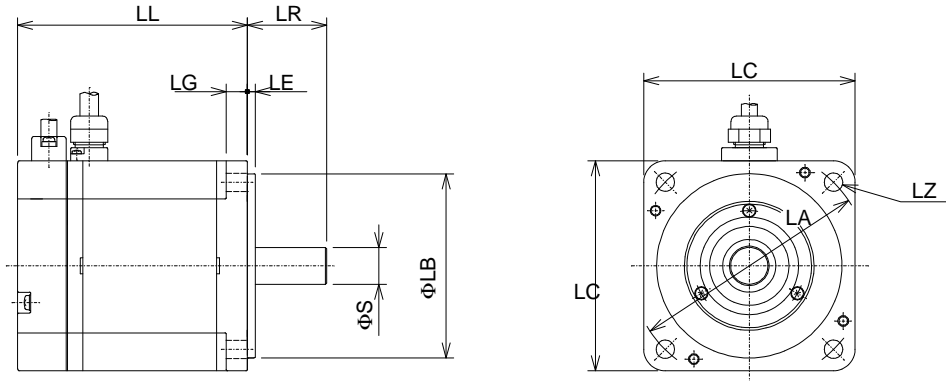
A : CONTINUOUS DUTY ZONE



B : INTERMITTENT DUTY ZONE

SGMPH Dimensions in inches (mm)

Drawings that provide SGMPH servomotor dimensions are shown below.



Model	LL	LC	LA	LZ	LG	φLB	LE	φS	LR	Mass kg (lb)
SGMPH-01A (B)	2.44 (62)	2.36 (60)	2.76 (70)	0.22 (5.5)	0.24 (6)	1.98 (50)	0.12 (3)	0.32 (8)	0.98 (25)	1.54 (0.7)
SGMPH-02A (B)	2.64 (67.0)	3.15 (80)	3.54 (90)	0.28 (7)	0.31 (8)	2.76 (70)		0.56 (14)		3.09 (1.4)
SGMPH-04A (B)	3.43 (87)							4.63 (2.1)		
SGMPH-08A (B)	3.410 (86.5)	4.72 (120)	5.71 (145)	0.39 (10)	0.39 (10)	4.37 (110)	0.14 (3.5)	0.64 (16)	1.18 (30)	9.26 (4.2)
SGMPH-15A	4.51 (114.5)							0.75 (19)		14.6 (6.6)

Specified Tolerances				
Dimension	φS		φLB	
Unit	Diameter	Tolerance	Diameter	Tolerance
in	0.32	+0.0000-0.0004	1.98	+0.0000 -0.0010
	0.56		2.78	+0.0000 -0.0012
	0.64		4.37	+0.0000 -0.0014
	0.75	+0.0000-0.0005		
mm	8	+0.000 -0.009	50	+0.000 -0.025
	14	+0.000 -0.011	70	+0.000 -0.030
	16		110	+0.000 -0.035
	19	+0.000 -0.013		

■ SGMGH Servomotors for 1500rpm

Rating and Specifications for Standard Servomotors

- Time Rating: Continuous
- Vibration Class: 15 μ m or below
- Insulation Resistance: 50 V_{DC}, 10M Ω minimum
- Ambient Temperature: 0 to 40°C
- Excitation: Permanent magnet
- Mounting: Flange method
- Insulation Class: Class F
- Withstand Voltage: 1500V_{AC} for one minute
- Enclosure: Totally enclosed, self-cooled, IP67 (except for through-sections of the shaft)
- Ambient Humidity: 20% to 80% (with no condensation)
- Drive Method: Direct drive

SGMGH Standard Servomotor Ratings and Specifications

Servomotor Model SGMGH-		05A A	09A A	13A A	20A A	30A A
Rated Output *	kW	0.45	0.85	1.3	1.8	2.9
Rated Torque*	oz·in	402	763	1181	1628	2634
	N·m	2.84	5.39	8.34	11.5	18.6
Instantaneous Peak Torque*	oz·in	1263	1954	3299	4064	6386
	N·m	8.92	13.8	23.3	28.7	45.1
Rated Current*	A _{rms}	3.8	7.1	10.7	16.7	23.8
Instantaneous Max. Current*	A _{rms}	11	17	28	42	56
Rated Speed*	rpm	1500				
Maximum Speed*	rpm	3000				
Torque Constant	oz·in/A _{rms}	116.1	117.5	118.9	103.4	117.5
	N·m/A _{rms}	0.82	0.83	0.84	0.73	0.83
Moment of Inertia	oz·in·s ² x 10 ⁻³	102.5	196.8	290	449	651
	kg·m ² x 10 ⁻⁴	7.24	13.9	20.5	31.7	46.0
Rated Power Rating*	kW/s	11.2	20.9	33.8	41.5	75.3
Rated Angular Acceleration*	rad/s ²	3930	3880	4060	3620	4050
Inertia Time Constant	ms	5.0	3.1	2.8	2.2	1.9
Inductive Time Constant	ms	5.1	5.3	6.3	12.8	12.5

Note: * These items and torque–motor speed characteristics quoted in combination with an SGD servo amplifier are at an armature winding temperature of 20°C.

Note: These characteristics have been calculated with the following heat sinks attached for cooling:

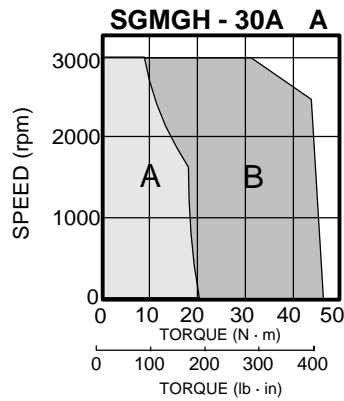
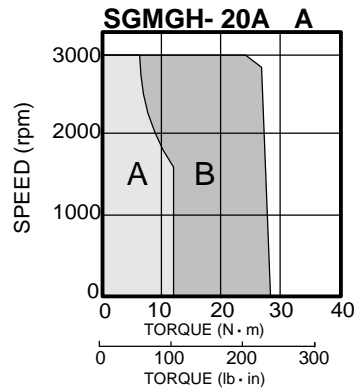
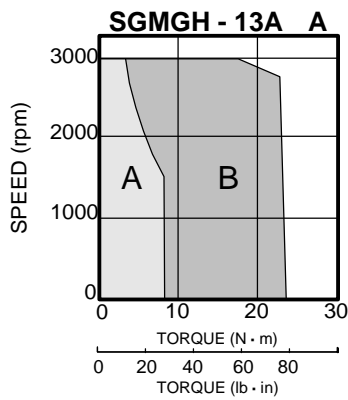
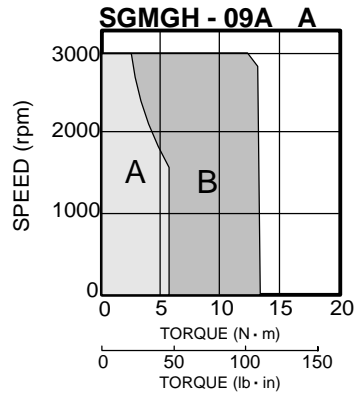
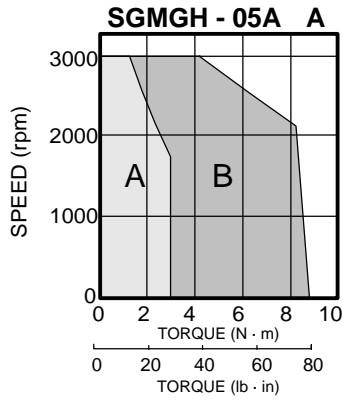
Heat sink dimensions

15.75 × 15.75 × 0.79in. (400 × 400 × 20mm): 05A A to 13A A

21.65 × 21.65 × 1.18in. (550 × 550 × 30mm): 20A A to 30A A

SGMGH Servomotor Torque-Motor Speed Characteristics

The following sections provide the torque-motor speed characteristics of the SGMGH servomotors at 1500rpm

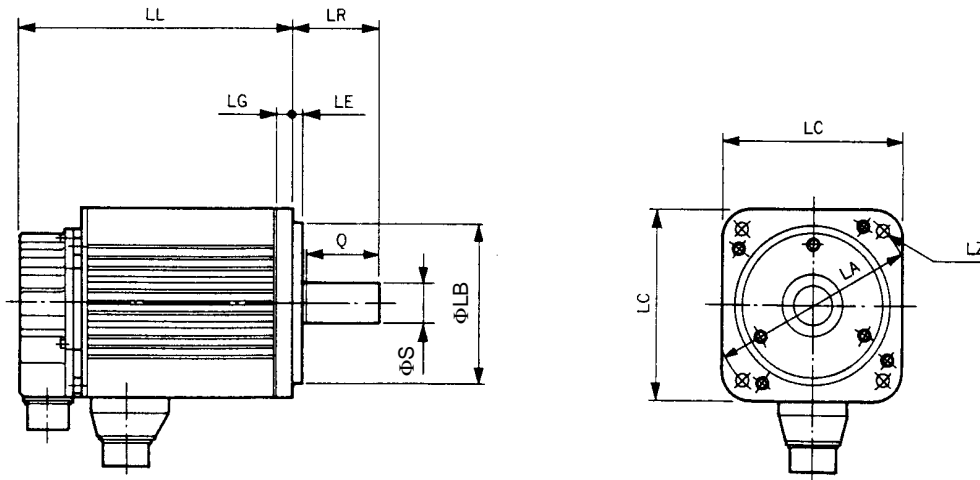


A : CONTINUOUS DUTY ZONE

B : INTERMITTENT DUTY ZONE

SGMGH Dimensions in inches (mm)

Drawings that provide (1500rpm) SGMGH servomotor dimensions are shown below.



Model	LL	LC	LA	LZ	LG	Φ LB	LE	Q	Φ S	LR	Mass lb (kg)
SGMGH-05A A	5.43 (138)	5.12 (130)	5.71 (145)	0.35 (9)	0.47 (12)	4.33 (110)	0.24 (6)	1.57 (40)	0.75 (19)	2.28 (58)	12.1 (5.5)
SGMGH-09A A	6.34 (161)								0.87 (22)		16.8 (7.6)
SGMGH-13A A	7.28 (185)								21.2 (9.6)		
SGMGH-20A A	6.54 (166)	7.09 (180)	7.87 (200)	0.53 (13.5)	0.71 (18)	4.50 (114.3)	0.13 (3.2)	2.99 (76)	1.38 (35)	3.11 (79)	30.9 (14)
SGMGH-30A A	7.56 (192)										39.7 (18)

Specified Tolerances				
Dimension	Φ LB		Φ S	
Unit	Diameter	Tolerance	Diameter	Tolerance
in	4.33	+0.0000-0.0014	0.75	+0.0000-0.0005
	4.50	+0.0000-0.0010	0.87	
			1.38	+0.0004-0.0000
mm	110	+0.000 -0.035	19	+0.000 -0.013
	114.3	+0.000 -0.025	22	
			35	+0.01 -0.00

■ SGMSH Servomotors

Rating and Specifications for Standard Servomotors

- Time Rating: Continuous
- Vibration Class: 15 μ m or below
- Insulation Resistance: 500V_{DC}, 10M Ω minimum
- Ambient Temperature: 0 to 40°C
- Excitation: Permanent magnet
- Mounting: Flange method
- Insulation Class: Class F
- Withstand Voltage: 1500V_{AC} for one minute
- Enclosure: Totally enclosed, self-cooled, IP67 (except for through-sections of the shaft)
- Ambient Humidity: 20% to 80% (with no condensation)
- Drive Method: Direct drive

SGMSH Standard Servomotor Ratings and Specifications

Servomotor Model SGMSH-		10A A	15A A	20A A	30A A
Rated Output *	kW	1.0	1.5	2.0	3.0
Rated Torque*	oz-in	450	694	901	1388
	N·m	3.18	4.9	6.36	9.8
Instantaneous Peak Torque*	oz-in	1351	2082	2705	4163
	N-m	9.54	14.7	19.1	29.4
Rated Current*	A _{rms}	5.7	9.7	12.7	18.8
Instantaneous Max. Current*	A _{rms}	17	28	42	56
Rated Speed*	rpm	3000			
Max. Speed*	rpm	5000			
Torque Constant	oz-in/A _{rms}	90.1	79.4	77.0	81.1
	N·m/A _{rms}	0.636	0.561	0.554	0.573
Moment of Inertia	oz-in·s ² x 10 ⁻³	24.6	35.0	45.2	99.1
	kg·m ² x 10 ⁻⁴	1.74	2.47	3.19	7.00
Rated Power Rating*	kW/s	57.9	97.2	127	137
Rated Angular Acceleration*	rad/s ²	18250	19840	19970	14000
Inertia Time Constant	ms	0.87	0.74	0.62	0.74
Inductive Time Constant	ms	7.1	7.7	8.3	13.0

Note: * These items and torque-motor speed characteristics quoted in combination with an SGD servo amplifier are at an armature winding temperature of 20°C.

Note: These characteristics have been calculated with the following heat sinks attached for cooling:
Heat sink dimensions

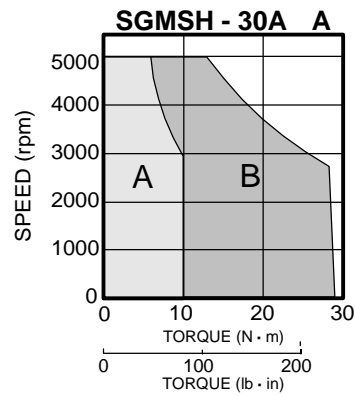
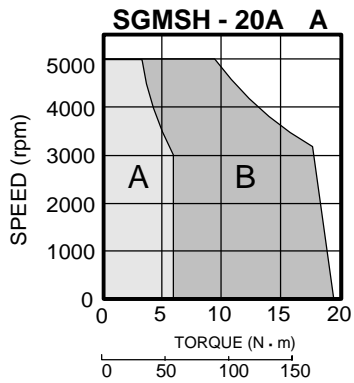
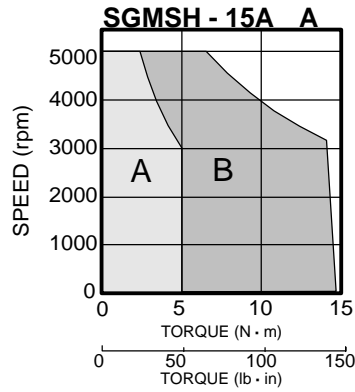
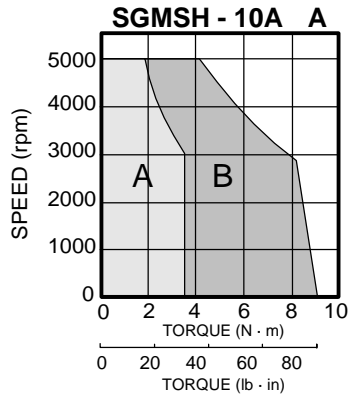
12 × 12 × 0.5in. (3400 × 300 × 12mm): 10A A to 20A A

18 × 18 × 0.8in. (400 × 400 × 20mm): 30A A

SGMSH Servomotor Torque-Motor Speed Characteristics

The following sections provide the torque-motor speed characteristics of the SGMSH servomotors.

200V Servomotors

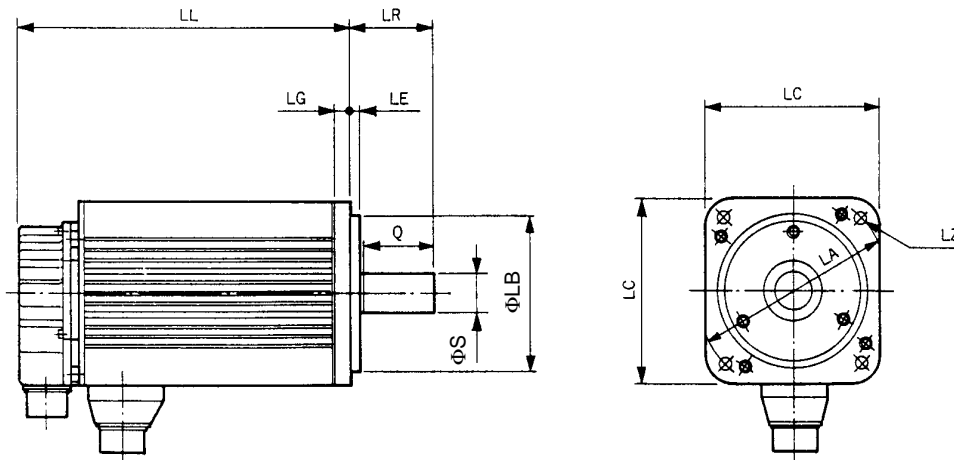


A : CONTINUOUS DUTY ZONE

B : INTERMITTENT DUTY ZONE

SGMSH Dimensions in inches (mm)

Drawings that provide SGMSH servomotor dimensions are shown below.



Model	LL	LC	LA	LZ	LG	ΦLB	LE	Q	ΦS	LR	Mass lb (kg)
SGMSH-10A A	5.87 (149)	3.94 (100)	4.53 (115)	0.28 (7)	0.39 (10)	3.74 (95)	0.12 (3)	1.57 (40)	0.94 (24)	1.77 (45)	10.1 (4.6)
SGMSH-15A A	6.89 (175)										12.8 (5.8)
SGMSH-20A A	7.80 (198)										15.4 (7.0)
SGMSH-30A A	7.83 (199)	5.12 (130)	5.71 (145)	0.35 (9)	0.47 (12)	4.33 (110)	0.24 (6)	2.17 (55)	1.10 (28)	2.48 (63)	24.3 (11)

Specified Tolerances				
Dimension	ΦLB		ΦS	
Unit	Diameter	Tolerance	Diameter	Tolerance
in	3.74	+0.0000-0.0014	0.94	+0.0000-0.0005
	4.33		1.10	
mm	95	+0.000 -0.035	24	+0.000 -0.013
	110		28	

8.2 Servo Amplifiers

This section presents tables of SGDH servo amplifier ratings and specifications.

8.2.1 Combined Specifications

The following table provides specifications of the SGDH servo amplifiers and SGMAH, SGMPH, SGMGH, and SGMSH combinations.

Servo Amplifier and Servomotor Combination Specifications at 200V

Voltage		Single-phase 200V					Three-phase 200V					
Servo Amplifier Model SGDH-		A3AE	A5AE	01AE	02AE	04AE	05AE	08AE	10AE	15AE	20AE	30AE
SGMAH Series	Model SGMAH-	A3A	A5A	01A	02A	04A	—	08A	—	—	—	—
	Applicable Servomotor	Capacity (kW)	0.03	0.05	0.1	0.2	0.4	—	0.75	—	—	—
	Motor Speed (rpm)	Rated 3000/maximum 5000										
	Applicable Encoder	Standard: 13-bit incremental encoder										
	Continuous Output Current I_{rms}	0.44	0.64	0.91	2.1	2.8	—	4.4	—	—	—	—
	Maximum Output Current I_{rms}	1.3	2.0	2.8	6.5	8.5	—	13.4	—	—	—	—
	Allowable Regenerative Energy (Joules)	18.5		37.1			—					
	Allowable Regenerative Frequency** (times/min)	—					—	89	—			

Voltage			Single-phase 200V					Three-phase 200V					
Servo Amplifier Model SGDH-			A3AE	A5AE	01AE	02AE	04AE	05AE	08AE	10AE	15AE	20AE	30AE
SGMAH Series	Appli- cable Ser- vomo- tor	Model SGMAH-	—	—	01A	02A	04A	—	08A	—	15A	—	—
		Capacity (kW)	—	—	0.1	0.2	0.4	—	0.75	—	1.5	—	—
		Motor Speed (rpm)	Rated 3000/maximum 5000										
	Applicable Encoder		Standard: 13-bit incremental encoder										
	Continuous Output Current A_{rms}		—	—	0.89	2.0	2.6	—	4.1	—	7.5	—	—
	Maximum Output Current A_{rms}		—	—	2.8	6.0	8.0	—	13.9	—	23.0	—	—
	Allowable Regener- ative Energy (Joules)		—		37.1			—					
	Allowable Regener- ative Frequency** (times/min)		—					—	29	—	17	—	
SGMGH Series	Appli- cable Ser- vomo- tor	Model SGMGH-	—	—	—	—	—	05A A	—	09A A	13A A	20A A	30A A
		Capacity (kW)	—	—	—	—	—	0.45	—	0.85	1.3	1.8	2.9
		Motor Speed (rpm)	Rated 1500/maximum 3000										
	Applicable Encoder		Standard: 17-bit incremental encoder										
	Continuous Output Current A_{rms}		—	—	—	—	—	3.8	—	7.1	10.7	16.7	23.8
	Maximum Output Current A_{rms}		—	—	—	—	—	11	—	17	28	42	56
	Allowable Regener- ative Energy (Joules)		—					34	—	13	10	12	8

Voltage			Single-phase 200V					Three-phase 100V					
Servo Amplifier Model SGDH-			A3AE	A5AE	01AE	02AE	04AE	05AE	08AE	10AE	15AE	20AE	30AE
SGMSH Series	Applicable Servo- motor	Model SGMSH-	—	—	—	—	—	—	—	10A	15A	20A	30A
		Capacity (kW)	—	—	—	—	—	—	—	1.0	1.5	2.0	3.0
		Motor Speed (rpm)	Rated 3000/maximum 5000										
	Applicable Encoder		Standard: 17-bit incremental encoder										
	Continuous Output Current A_{rms}		—	—	—	—	—	—	—	5.7	9.7	12.7	18.8
	Maximum Output Current A_{rms}		—	—	—	—	—	—	—	17	28	42	56
	Allowable Regenera- tive Frequency** (times/min)		—					—		39	31	48	20

Note: * Allowable regenerative energy is the level when the AC input power supply voltage is $200V_{rms}$. The allowable regenerative energy may vary with individual power supply tolerance.

** Allowable regenerative frequency is the number of times the servomotor is allowed to accelerate and decelerate through a $0rpm \rightarrow$ maximum motor speed $\rightarrow 0rpm$ cycle in a minute.

Servo Amplifier and Servomotor Combination Specifications at 100V

Voltage			Single-phase 100V			
Servo Amplifier Model SGDH-			A3BE	A5BE	01BE	02BE
SGMAH Series	Applicable Servomotor	Model SGMAH-	A3B	A5B	01B	02B
		Capacity (kW)	0.03	0.05	0.1	0.2
		Motor Speed (rpm)	Rated 3000/maximum 5000			
	Applicable Encoder		Standard: 13-bit incremental encoder			
	Continuous Output Current A_{rms}		0.66	0.95	2.4	3.0
	Maximum Output Current A_{rms}		2.0	2.9	7.2	9.0
	Allowable Regenerative Frequency* (times/min)		7.8	15.7		
SGMPH Series	Applicable Servo-motor	Model SGMPH-	—	—	01B	02B
		Capacity (kW)	—	—	0.1	0.2
		Motor Speed (rpm)	Rated 3000/maximum 5000			
	Applicable Encoder		Standard: 13-bit incremental encoder			
	Continuous Output Current A_{rms}		—	—	2.2	2.7
	Maximum Output Current A_{rms}		—	—	7.1	8.4
	Allowable Regenerative Frequency* (times/min)		—		15.7	

Note: * Allowable regenerative energy is the level when the AC input power supply voltage is $100V_{rms}$.
The allowable regenerative energy may vary with the individual power supply's tolerance.

Note: Refer to *Section 5.6 Selecting a Regeneration Resistor* for more details on allowable regenerative energy and frequency.

8.2.2 Ratings and Specifications

The following table shows ratings and specifications for the SGDH servo amplifier to use in selecting the appropriate servo amplifier.

Servo Amplifier Ratings and Specifications

Voltage		Single-phase 200V					Three-phase 200V						
Servo Amplifier Model SGDH-		A3	A5	01	02	04	05	08	10	15	20	30	
Applicable Servomotor	200V	SGMAH- A	A3A	A5A	01A	02A	04A	—	08A	—	—	—	—
		SGMPH- A	—	—	01A	02A	04A	—	08A	—	15A	—	—
		SGMGH- A A (1500rpm)	—	—	—	—	—	05	—	09	13	20	30
		SGMSH- A	—	—	—	—	—	—	—	10	15	20	30
100V	SGMAH- B	A3B	A5B	01B	02B	—	—	—	—	—	—	—	
	SGMPH- B	—	—	01B	02B	—	—	—	—	—	—	—	
Basic Specifications	Maximum Applicable Servomotor Capacity [kW]		0.03	0.05	0.1	0.2	0.4	0.5	0.75	1.0	1.5	2.0	3.0
	200V	Continuous Output Current [A_{rms}]	0.44	0.64	0.91	2.1	2.8	3.8	5.7	7.6	11.6	18.5	24.8
		Maximum Output Current [A_{rms}]	1.3	2.0	2.8	6.5	8.5	11.0	13.9	17	28	42	56
	100V	Continuous Output Current [A_{rms}]	0.66	0.95	2.4	3.0	—	—	—	—	—	—	—
		Maximum Output Current [A_{rms}]	2.0	2.9	7.2	9.0	—	—	—	—	—	—	—
	Input Power Supply	200 and 100V Servo Amplifier Capacity Range	For Single-phase 200V _{AC}					For Three-phase 200V _{AC}					
			For Single-phase 100V _{AC}					—					
		Main Circuit*	Three-phase (or single-phase) 200 to 230V _{AC} +10 to -15%, 50/60Hz, or single-phase 100 to 115V _{AC} +10 to -15%, 50/60Hz										
		Control Circuit	Single-phase 200 to 230V _{AC} +10 to -15%, 50/60Hz, or single-phase 100 to 115V _{AC} +10 to -15%, 50/60Hz										
		Control Method	Single or three-phase full-wave rectification IGBT-PWM (sinewave driven)										
		Feedback	Serial encoder: 13- (incremental only), 16-, or 17-bit (incremental/absolute).										
		Ambient/Storage Temperature**	0 to +55°C/-20 to +85°C										
		Ambient/Storage Humidity	90% relative humidity or less (with no condensation)										
	Vibration/Shock Resistance	4.9 m/s ² /19.6 m/s ²											
	Configuration	Base mounted (Rack mounted optional).											
Approx. Mass [lb (kg)]	For 200V	1.76 (0.8)				2.43 (1.1)	3.75 (1.7)			6.17 (2.8)	8.38 (3.8)		
	For 100V	1.76 (0.8)			2.43 (1.1)	—							

Notes: * Supply voltage must not exceed 230V +10% (253V) or 115V + 10% (127V). A step-down transformer is required if the voltage exceeds these values.

** Use the servo amplifier within the ambient temperature range. When enclosed, internal temperatures must not exceed the specified range.

Servo Amplifier Model SGDH-			A3	A5	01	02	04	05	08	10	15	20	30
Speed and Torque Control Modes	Performance	Speed Control Range		1:5000 (The lowest speed of the speed control range is the speed at which the servomotor will not stop with a rated torque load.)									
		Speed Regulation*	Load Regulation	0 to 100% load: 0.01% maximum (at rated speed)									
			Voltage Regulation	Rated Voltage $\pm 10\%$: 0% (at rated speed)									
			Temperature Regulation	$25 \pm 25^\circ\text{C}$: $\pm 0.1\%$ max. (at rated speed)									
		Frequency Characteristics		400Hz (at $J_L = J_M$)									
		Torque Control Tolerance (Repeatability)		$\pm 2\%$									
	Soft Start Time Setting		0 to 10s (Can be set individually for acceleration and deceleration)										
	Input Signals	Speed Reference Input	Reference Voltage**	$\pm 6V_{DC}$ (Variable setting range: ± 2 to $\pm 10V_{DC}$) at rated torque (positive torque reference with positive reference), input voltage: $\pm 12V$ (maximum).									
			Input Impedance	About 14k Ω									
			Circuit Time Constant	—									
		Torque Reference Input	Reference Voltage**	$\pm 3V_{DC}$ (Variable setting range: ± 1 to $\pm 10V_{DC}$) at rated torque (positive torque reference with positive reference), input volt									
			Input Impedance	About 14k Ω									
Circuit Time Constant			About 47 μs										
Contact Speed Reference	Rotation 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 Mode	Performance	Bias Setting		0 to 450rpm (setting resolution: 1rpm)									
		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 (A phase + B phase), or CCW + CW pulse train									
			Form	Line driver (+5V level), open collector (+5V or +12V level)									
			Frequency	500/200kpps maximum (line driver/open collector).									
		Control Signal		Clear Signal (input pulse form identical to reference pulse)									
Built-in Open Collector Power Supply***		+12V (1k Ω built-in resistor)											

Note: * Speed regulation is defined as follows:

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 represents speed regulation due to voltage and temperature variations.

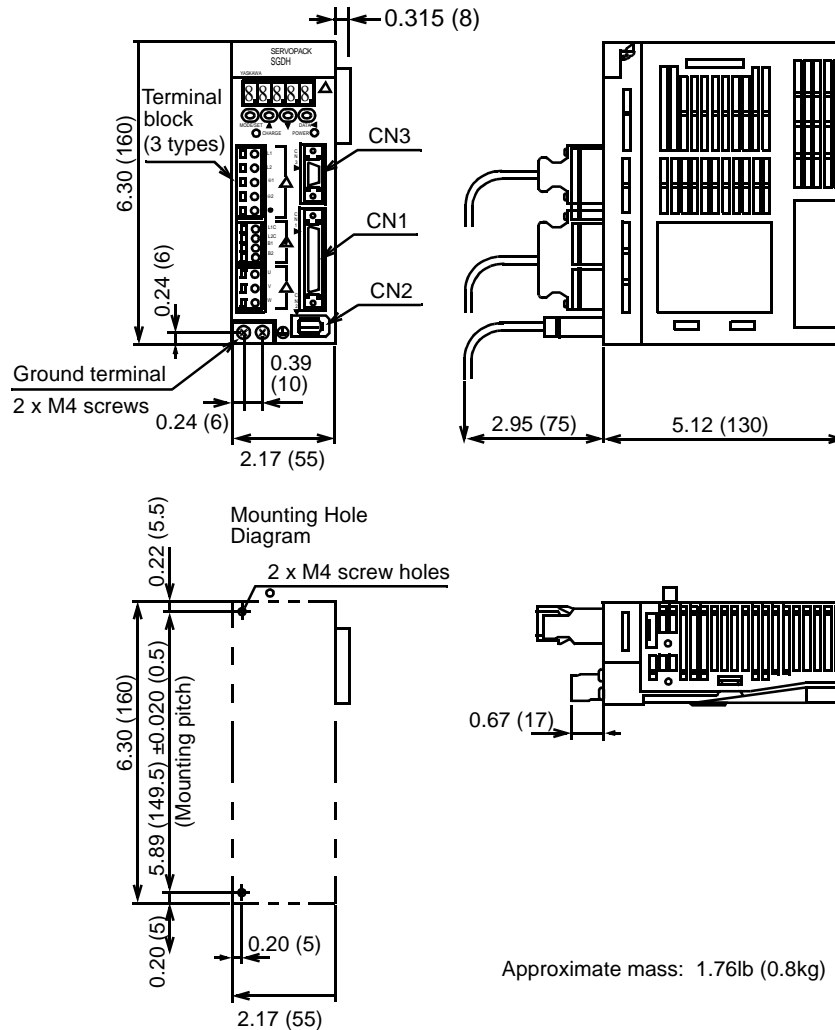
** Forward is clockwise viewed from the non-load side of the servomotor, (counterclockwise viewed from the load and shaft end).

***The built-in open collector power supply is not electrically isolated from the control circuit in the servo amplifier.

Servo Amplifier Model SGDH-			A3	A5	01	02	04	05	08	10	15	20	30	
I/O Signals	Position Output	Form	A-, B-, C-phase line driver S-phase line driver (only with an absolute encoder)											
		Frequency Dividing Ratio	Any											
	Sequence Input	Signal allocation can be modified	Servo ON, P control (or Control Mode switching, forward/reverse motor rotation by internal speed setting, zero clamping, reference pulse prohibited), forward run prohibited (P-OT), reverse run prohibited (N-OT), alarm reset, forward 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 rotation, 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.											
	Regeneration		External regenerative resistor.						Built-in.					
	Overtravel Stop		Dynamic brake stop at P-OT or N-OT, deceleration to a stop, or free run to a stop.											
	Electronic Gear		$0.01 < A/B < 100$											
	Protection		Overcurrent, overvoltage, low voltage, overload, regeneration error, main circuit voltage error, heat sink overheated, no power supply, overflow, overspeed, encoder error, overrun, CPU error, parameter error, etc.											
	LED Display		Charge, Power, five 7-segment LEDs (built-in Digital Operator functions)											
	CN5 Analog Monitoring		Analog monitor connector built in for monitoring speed, torque and other reference signals. Speed: 1V/1000rpm Torque: 1V/rated torque Pulses remaining: 0.05V/reference units or 0.05V/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, user constant setting, monitor display, alarm trace-back display, JOG and auto-tuning operations, speed, torque reference signal and other drawing functions.												
Others		Reverse rotation connection, origin search, automatic servomotor ID, DC reactor connection terminal for high power supply frequency control												

8.2.3 Base-Mounted Servo Amplifier Dimensional Drawings in inches (mm)

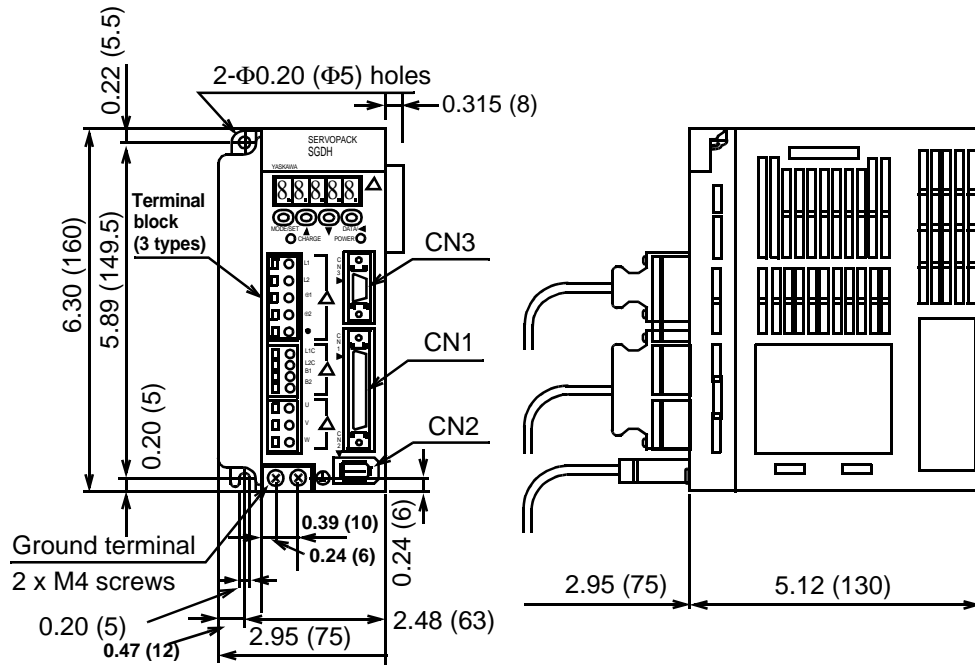
- **SGDH-A3AE to -02AE (Single-phase, 200V, 30 to 200W) and SGDH-A3BE to -01BE (Single-phase, 100V, 30 to 100W)**



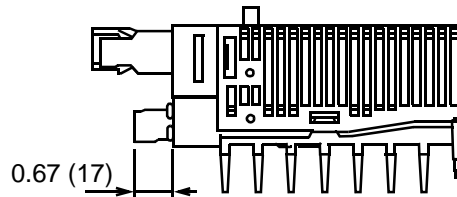
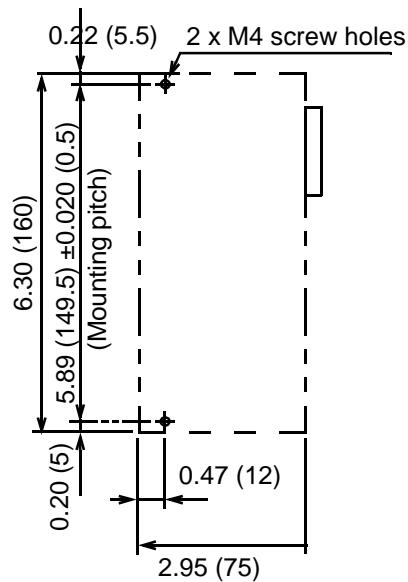
The same Servo Amplifier connector is used for SGDH-A3AE (30W) to SGDH-30AE (3.0kW) and SGDH-A3BE (30W) to SGDH-02BE (200W).

Connector Symbol	Servo Amplifier Connector Model	Manufacturer
CN1	101250-52A2JL	Sumitomo 3M Co., Ltd.
CN2	53460-0611	Molex Japan Co., Ltd.
CN3	10214-52A2JL	Sumitomo 3M Co., Ltd.

■ **SGDH-04AE (Single-phase, 200V, 400W) and
SGDH-02BE (Single-phase, 100V, 200W)**

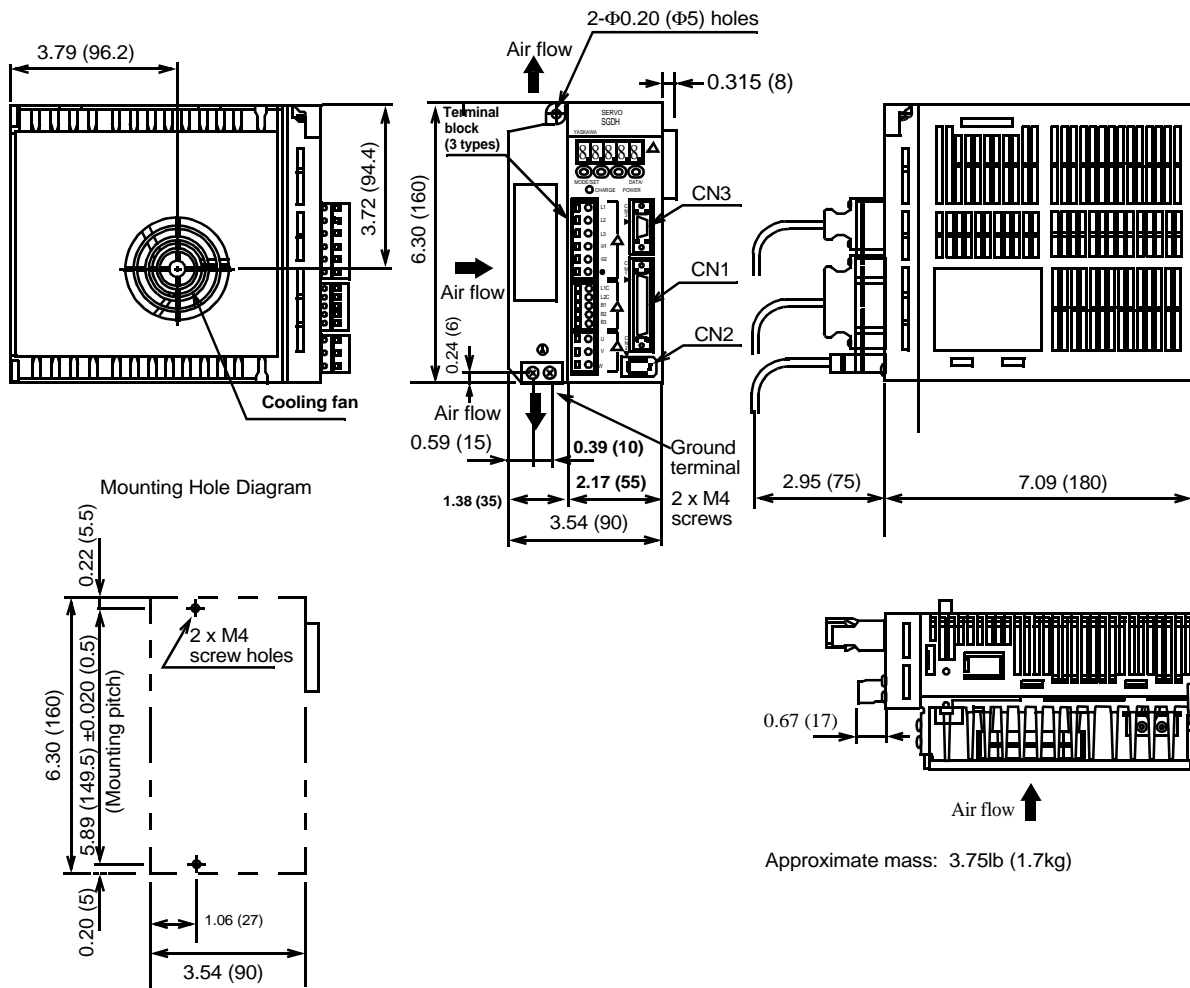


Mounting Hole Diagram

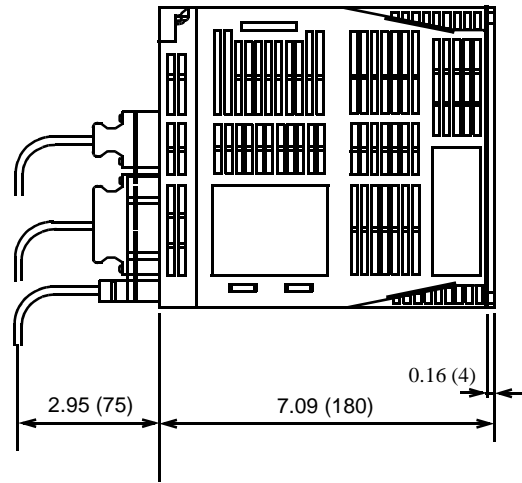
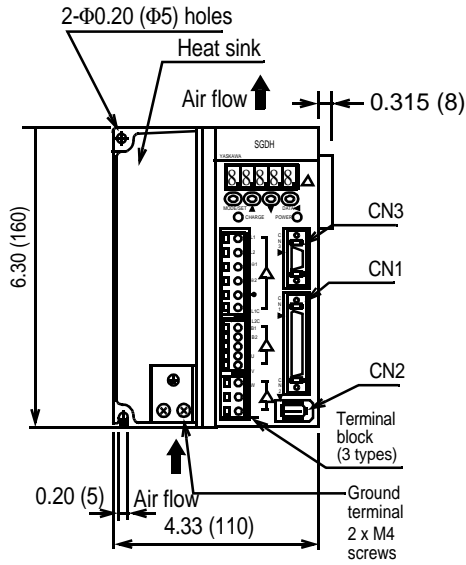


Approximate mass: 2.43lb (1.1kg)

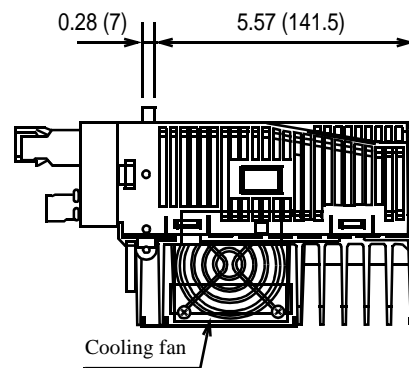
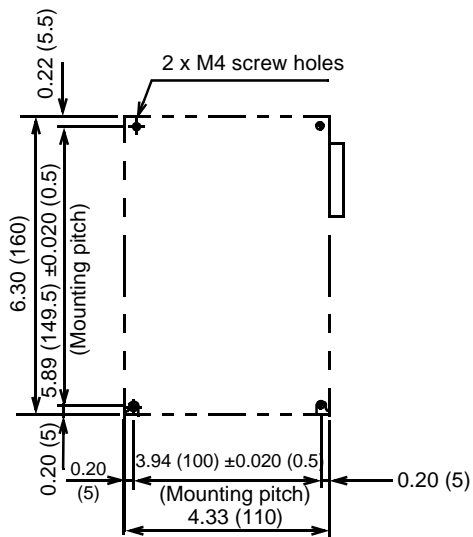
■ **SGDH-05AE to-10AE (Three-phase, 200V, 0.5 to 1.0kW)**



■ **SGDH-15AE (Three-phase, 200V, 1.5kW)**

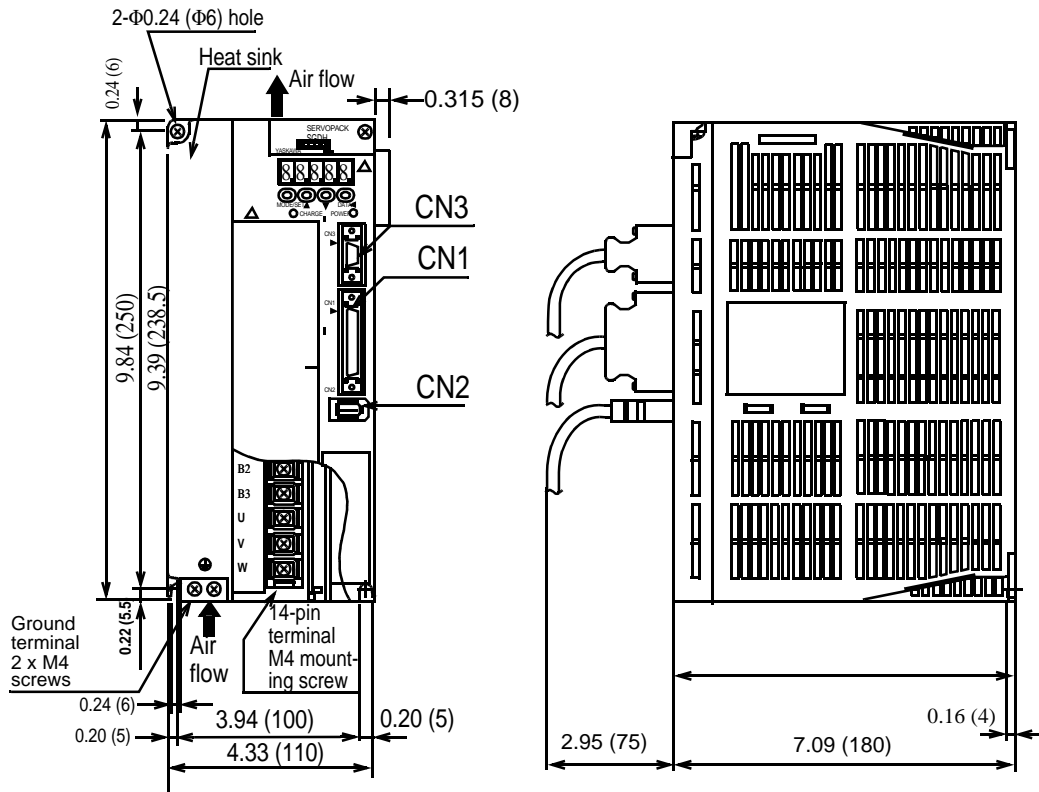


Mounting Hole Diagram

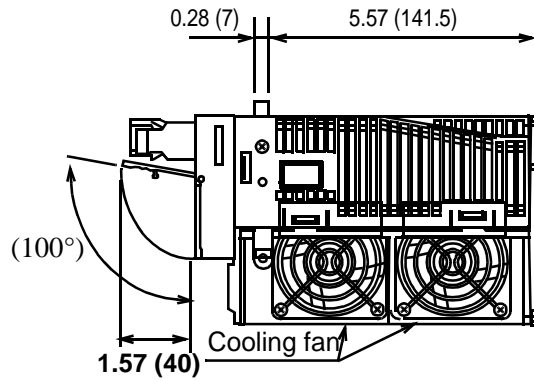
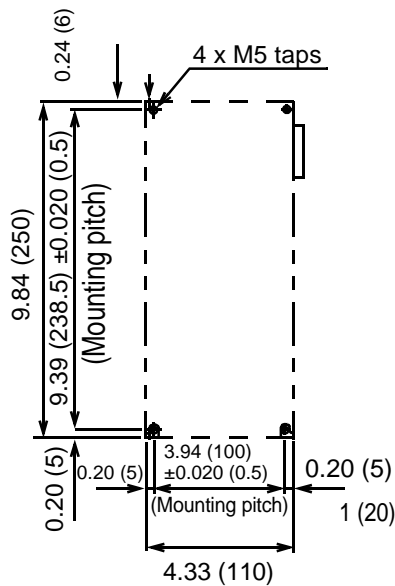


Approximate mass: 6.17lb (2.8kg)

■ **SGDH-20AE, 30AE (Three-phase 200V, 2.0kW,3.0kW)**



Mounting Hole Diagram



Approximate mass: 8.38lb (3.8kg)

9 Inspection, Maintenance, and Troubleshooting

This chapter describes the basic inspection and maintenance to be carried out by the user. In addition, troubleshooting procedures are described for problems which generate an alarm display and for problems which result in no alarm display.

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9.1 Servodrive Inspection and Maintenance

This section describes the basic inspections and maintenance of servomotors and servo amplifiers and the procedures for replacing the battery for absolute encoders.

9.1.1 Servomotor Inspection

For inspection and maintenance of servomotors, follow the simple, daily inspection procedures in the following table.

The AC servomotors are brushless. Simple, daily inspection is sufficient under most conditions. The inspection and maintenance frequencies in the table are only guidelines. Increase or decrease the frequency to suit the operating conditions and environment.

IMPORTANT
<ul style="list-style-type: none"> • During inspection and maintenance, do not disassemble the servomotor. If disassembly of the servomotor is required, contact Yaskawa.

Servomotor Inspections

Action or Problem	Frequency	Procedure	Comments
Vibration and Noise	Daily	Touch and listen.	Levels higher than normal?
Exterior Dirt	According to degree of contamination	Clean with cloth or compressed air.	—
Insulation Resistance Measurement	At least every year	Disconnect servo amplifier and test insulation resistance at 500V. Must exceed 10MΩ.*	Contact Yaskawa if the insulation resistance is below 10MΩ.
Oil Seal Replacement	At least every 5000 hours	Remove servomotor from machine and replace oil seal.	Applies only to motors with oil seals.
Servomotor Overhaul	At least every 20000 hours or 5 years	Contact Yaskawa.	The user should not disassemble and clean the servomotor.

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

9.1.2 Servo Amplifier Inspection

For inspection and maintenance of the servo amplifier, follow the inspection procedures in the following table. Perform inspection and maintenance at least once every year. Other routine inspections are not required.

Servo Amplifier Inspections

Action or Problem	Frequency	Procedure	Comments
Clean interior and circuit boards	At least every year	Check for dust, dirt, and oil on the surfaces.	Clean with compressed air.
Loose screws	At least every year	Check for loose terminal block and connector screws.	Tighten any loose screws.
Defective parts in unit or on circuit boards	At least every year	Check for discoloration, damage or discontinuities due to heating.	Contact Yaskawa.

■ Part Replacement Schedule

The following parts are subject to mechanical wear or deterioration over time. To avoid failure, replace these parts at the frequency indicated.

The parameters of any servo amplifiers overhauled by Yaskawa are reset to the default (standard factory) settings before shipping. Be sure to confirm that the parameters are set to the application's requirements before starting operation.

Periodical Part Replacement

Part	Standard Replacement Period	Replacement Method
Cooling fan	4 to 5 years	Replace with new part.
Smoothing capacitor	7 to 8 years	Test. Replace with a new part, if necessary.
Relays	—	Test. Replace if necessary.
Fuse	10 years	Replace with new part.
Aluminum electrolytic capacitor on circuit board	5 years	Test. Replace with new circuit board, if necessary.

Operating Conditions:

Ambient Temperature: Annual average of 30°C
 Load Factor: 80%, maximum.
 Operation Rate: 20 hours/day, maximum.

9.1.3 Replacing Battery for Absolute Encoder

If the voltage of the battery for an absolute encoder drops to about 2.7V or less, an Absolute Encoder Battery Alarm (A. 83) will occur in the servo amplifier. This alarm occurs when the servo amplifier receives a signal from the absolute encoder when the power to the servo amplifier is turned ON. Therefore, the servo amplifier will not give an alarm when the battery voltage drops below the minimum voltage level while the power is being supplied to the servo amplifier.

Refer to *5.7.3 Handling Batteries* for the battery type recommended for absolute encoders.

Replace the battery using the following procedure if the battery voltage drops below the minimum required battery voltage.

■ Battery Replacement Procedure

1. Replace the battery while the control power to the servo amplifier is ON.
2. After replacement, turn OFF the power to the servo amplifier in order to clear the Absolute Encoder Battery Alarm (A. 83).
3. Turn ON the power to the servo amplifier again and confirm that it operates properly.

Note: The absolute encoder data will be lost when the control power to the servo amplifier is turned OFF and the encoder cable is disconnected from the battery. If the data is lost, refer to *5.7.4 Initializing the Absolute Encoder* and follow the procedure to initialize the absolute encoder.

9.2 Troubleshooting

This section describes causes and remedies for problems which generate an alarm display and for problems which result in no alarm display.

9.2.1 Troubleshooting Problems with Alarm Displays

Problems that occur in the servodrives are displayed on the panel operator as “A.□□” or “CPF□□”. Refer to the following sections to identify the cause of an alarm and the action to be taken.

Note: “A.-”, is not an alarm.

Contact Yaskawa if the problem has not been solved after following the described procedures.

■ A.02

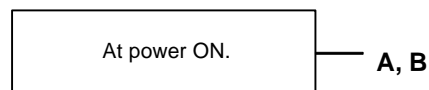
A.02: Parameter Breakdown

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
OFF	OFF	OFF	OFF

Note: OFF: Output transistor is OFF (alarm state).

Status and Remedy for Alarm



Cause of the Problem		Solution
A	Power turned OFF during parameter write. Alarm occurred at next power ON.	<ul style="list-style-type: none"> Initialize parameters using Fn005 and reinput user settings. Replace servo amplifier.
B	Circuit board (1PWB) defective.	Replace servo amplifier.

■ A.03

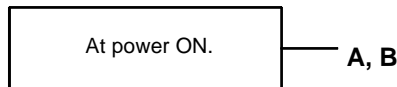
A.03: Main Circuit Encoder Error

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
OFF	OFF	OFF	OFF

Note: OFF: Output transistor is OFF (alarm state).

Status and Remedy for Alarm



Cause of the Problem		Solution
A	Circuit board (1PWB or 2PWB) defective.	Replace servo amplifier.

■ A.04

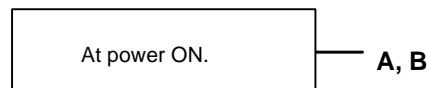
A.04: Parameter Setting Error

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
OFF	OFF	OFF	OFF

Note: OFF: Output transistor is OFF (alarm state)

Status and Remedy for Alarm



Cause of the Problem		Solution
A	An out-of-range parameter was previously set or loaded.	<ul style="list-style-type: none"> Reset all parameters in range. Otherwise, reload correct parameter.
B	Circuit board (1PWB) defective.	Replace servo amplifier.

■ A.05

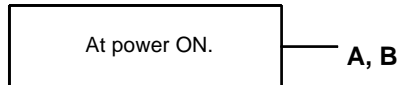
A.05: Servomotor And Amplifier Combination Error

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
OFF	OFF	OFF	OFF

Note: OFF: Output transistor is OFF (alarm state).

Status and Remedy for Alarm



Cause of the Problem		Solution
A	The range of servomotor capacities that can be combined has been exceeded.	Replace the servomotor so that an acceptable balance is achieved.
B	Encoder parameters have not been written properly.	Replace the servomotor.

■ A.10

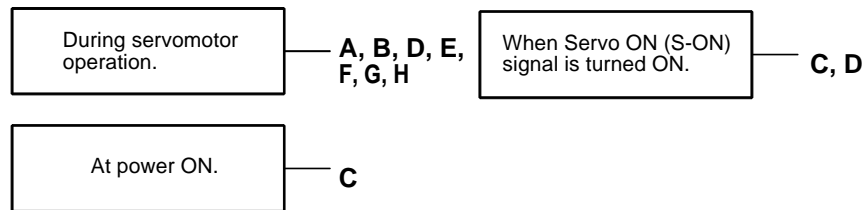
A.10: Overcurrent or Heat Sink Overheated

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
ON	OFF	OFF	OFF

Note: OFF: Output transistor is OFF (alarm state).
ON: Output transistor is ON.

Status and Remedy for Alarm



Cause of the Problem		Solution
A	Shorted wiring between servo amplifier and servomotor.	Check and correct wiring.
B	Shorted servomotor U, V, or W phase.	Replace servomotor.
C	<ul style="list-style-type: none"> Defective circuit board (1PWB) . Defective power transistor. 	Replace servo amplifier.
D	Defective current feedback circuit, power transistor, DB circuit, or circuit board.	Replace servo amplifier.
E	Ambient temperature of the servo amplifier greater than 55°C.	Alter conditions so that the ambient temperature is below 55°C.
F	Inadequate air flow around the heat sink.	Providing sufficient space as specified.
G	Fan stopped.	Replace servo amplifier.
H	Servo amplifier is operating under an overload.	Reduce load.

Note: Problems E to H can occur using a servo amplifier with a capacity of 1.5 to 3kW.

■ A.30

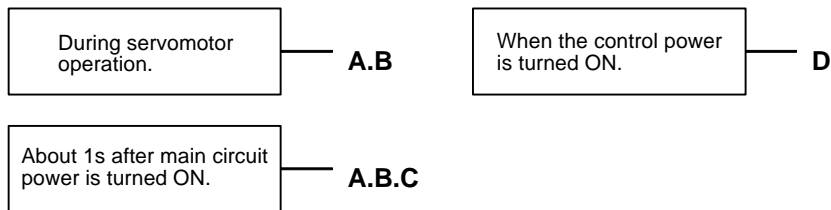
A.30: Regenerative Error Detected

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
ON	ON	OFF	OFF

Note: OFF: Output transistor is OFF (alarm state).
ON: Output transistor is ON.

Status and Remedy for Alarm



Cause of the Problem		Solution
A	Malfunctioning regenerative transistor.	Replace servo amplifier.
B	Regenerative resistor is open.	Replace servo amplifier or regenerative resistor.
C	Disconnected regenerative unit (for an external regenerative resistor).	Check the wiring of the external regenerative resistor.
D	Defective servo amplifier.	Replace servo amplifier.

■ A.32

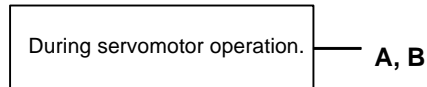
A.32: Regenerative Overload

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
ON	ON	OFF	OFF

Note OFF: Output transistor is OFF (alarm state).
 ON: Output transistor is ON.

Status and Remedy for Alarm



Cause of the Problem		Solution
A	Regenerative power exceeds the limit.	Use an external regenerative resistor that matches the regenerative power capacity.
B	Alarm occurs although an external regenerative resistor is used and the temperature rise of the regenerative resistor is small.	Correct parameter Pn600.

■ A.40

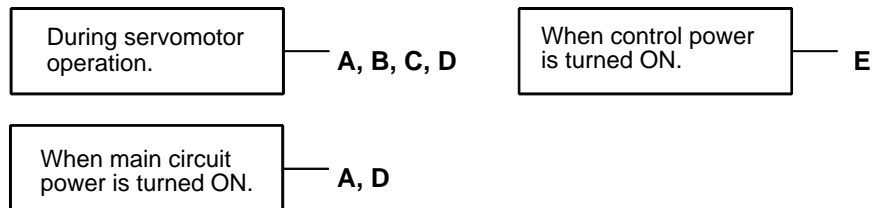
A.40: Main Circuit DC Voltage Error Detected: Overvoltage

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
OFF	OFF	ON	OFF

Note: OFF: Output transistor is OFF (alarm state).
ON: Output transistor is ON.

Status and Remedy for Alarm



Cause of the Problem		Solution
A	Power supply voltage is not within the range of specifications.	Check power supply.
B	Load exceeds capacity of the regenerative unit.	Check specifications of load inertia and overhanging load.
C	Malfunctioning regenerative transistor.	Replace servo amplifier.
D	Defective rectifying diode.	
E	Defective servo amplifier.	

■ A.41

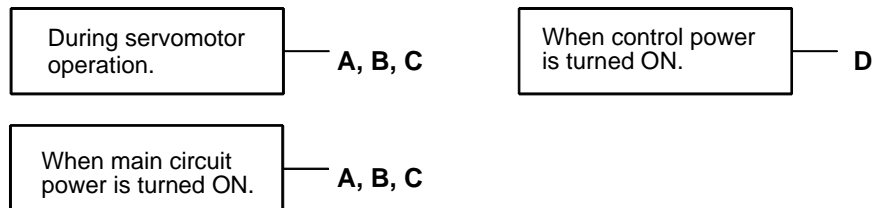
A.41: Main Circuit Voltage Error Detected: Undervoltage

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
OFF	OFF	ON	OFF

Note: OFF: Output transistor is OFF (alarm state).
ON: Output transistor is ON.

Status and Remedy for Alarm



Cause of the Problem		Solution
A	The power supply voltage exceeds specified range.	Check power supply voltage.
B	Fuse blown.	Replace servo amplifier.
C	Defective rectifying diode.	
D	Defective servo amplifier.	

■ A.51

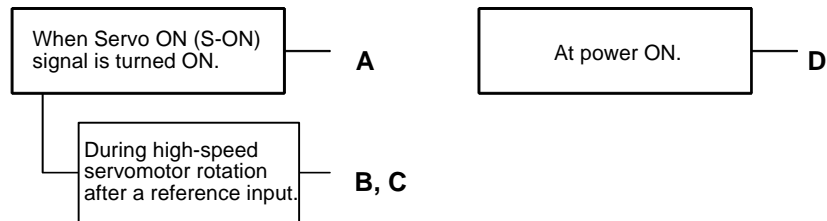
A.51: Overspeed

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
ON	OFF	ON	OFF

Note: OFF: Output transistor is OFF (alarm state).
ON: Output transistor is ON.

Status and Remedy for Alarm



	Cause of the Problem	Solution
A	Incorrect servomotor wiring.	Check and correct wiring. (Check for U-, V-, and W-phase wiring errors.)
B	Position or speed reference input is too large.	Lower the reference input values.
C	Incorrect reference input gain settings.	Check and correct parameter settings.
D	Defective circuit board (1PWB).	Replace servo amplifier.

■ **A.71**

A.71: Overload: High Load

The alarm output, status, and remedy for A.71 are the same as for A.72.

■ **A.72**

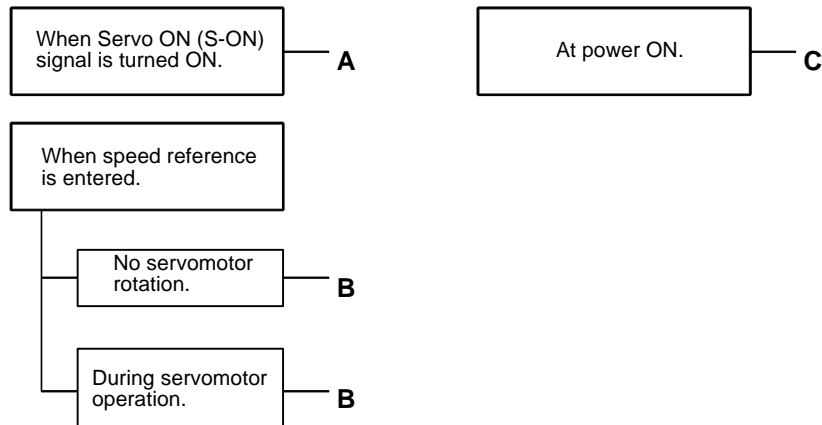
A.72: Overload: Low Load. (See the following page for details).

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
ON	ON	ON	OFF

Note: OFF: Output transistor is OFF (alarm state).
 ON: Output transistor is ON.

Status and Remedy for Alarm

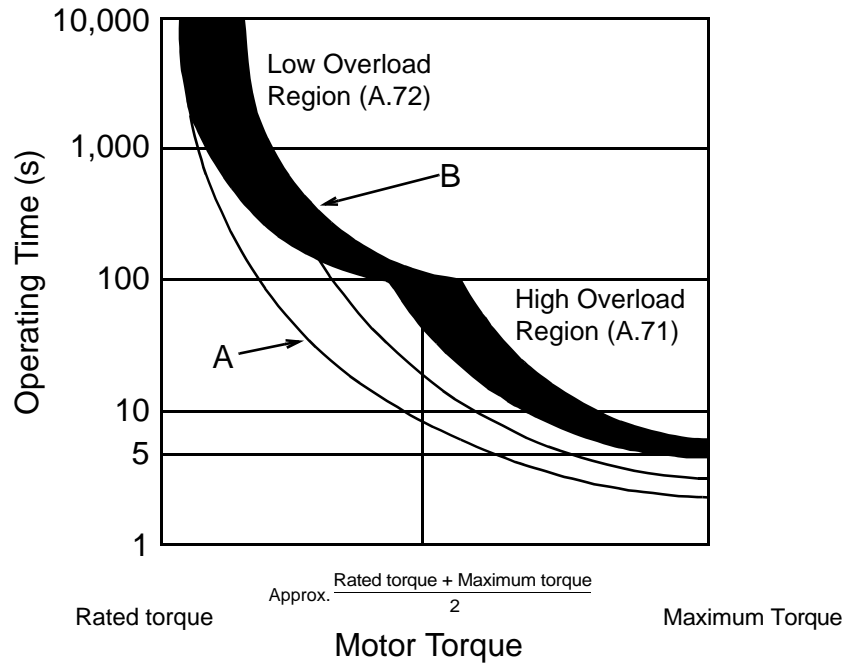


	Cause of the Problem	Solution
A	Incorrect or disconnected servomotor wiring.	Check wiring and connectors at the servomotor.
B	Load greatly exceeds rated torque.	Reduce load torque and inertia. Otherwise, replace with a larger capacity servomotor.
C	Defective circuit board (1PWB).	Replace servo amplifier.

Overload Characteristics

Servo amplifiers have a built-in overload protection function that protects the servo amplifiers and servo motors from overload. Allowable power for the servo amplifiers is limited by the overload protective function, as shown in the figure below.

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



Note: The overload protection characteristics of A and B in the figure are applicable when the servo amplifier is combined with one of the following servomotors:

A: SGMAH or SGMPH servomotor with a maximum capacity of 400W.

B: Other servomotors similar to the SGMAH, SGMPH, SGMGH, and SGMSH.

■ A.73

A.73: Dynamic Brake Overload

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
ON	ON	ON	OFF

Note: OFF: Output transistor is OFF (alarm state).
ON: Output transistor is ON.

Status and Remedy for Alarm



Cause of the Problem		Solution
A	The product of the square of rotational motor speed, the combined inertia of the motor, and load (rotation energy) exceeds the capacity of the dynamic brake resistor built into servo amplifier.	<ul style="list-style-type: none"> • Reduce the rotational speed. • Decrease the load inertia. • Minimize use of the dynamic brake.
B	Defective circuit board (1PWB).	Replace servo amplifier.

■ A.74

A.74: Overload of Surge Current Limit Resistor

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
ON	ON	ON	OFF

Note: OFF: Output transistor is OFF (alarm state).
 ON: Output transistor is ON.

Status and Remedy for Alarm



	Cause of the Problem	Solution
A	Frequently turning the main circuit power ON/OFF.	Do not repeatedly turn ON/OFF the main circuit power.
B	Defective circuit board (1PWB).	Replace servo amplifier.

■ A.7A

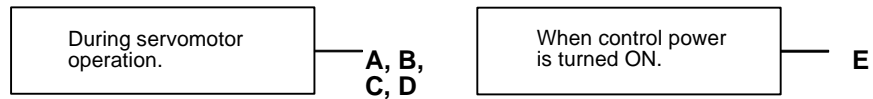
A.7A: Heat Sink Overheated

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
ON	ON	ON	OFF

Note: OFF: Output transistor is OFF (alarm state).
ON: Output transistor is ON.

Status and Remedy for Alarm



Cause of the Problem		Solution
A	The ambient temperature of the servo amplifier exceeds 55°C.	Alter conditions so that the ambient temperature goes below 55°C.
B	Inadequate air flow around the heat sink .	Provide sufficient space as specified.
C	Fan stopped.	Replace servo amplifier.
D	Servo amplifier is operating under overload.	Reduce load.
E	Defective servo amplifier.	Replace servo amplifier.

Note: This alarm tends to occur only with a servo amplifier of 30 to 1000W.

■ A.81

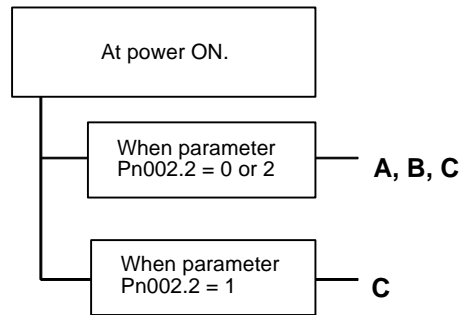
A.81: Absolute Encoder Backup Power Supply Error

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
OFF	OFF	OFF	OFF

Note: OFF: Output transistor is OFF (alarm state).

Status and Remedy for Alarm



Cause of the Problem		Solution
A	The following power supplies to the absolute encoder both failed: <ul style="list-style-type: none"> • +5V supply • Battery power 	Follow absolute encoder setup procedure.
B	Absolute encoder malfunctioned.	Replace servomotor.
C	Circuit board (1PWB) defective.	Replace servo amplifier.

■ A.82

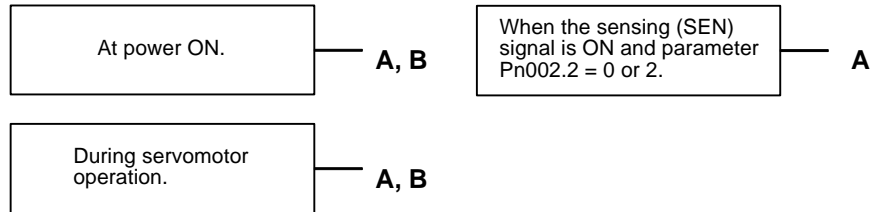
A.82: Encoder Checksum Error

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
OFF	OFF	OFF	OFF

Note: OFF: Output transistor is OFF (alarm state).

Status and Remedy for Alarm



Cause of the Problem		Solution
A	Error during encoder memory check.	<ul style="list-style-type: none"> Follow absolute encoder setup procedure. Replace servomotor if error occurs frequently.
B	Circuit board (1PWB) defective.	Replace servo amplifier.

■ A.83

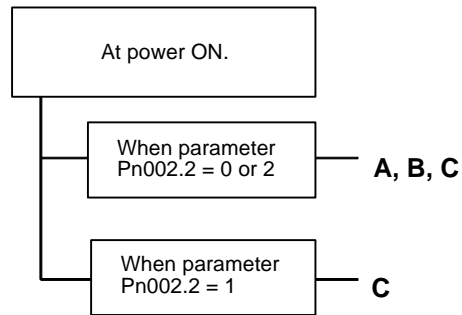
A.83: Absolute Encoder Battery Error

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
OFF	OFF	OFF	OFF

Note: OFF: Output transistor is OFF (alarm state).

Status and Remedy for Alarm



Cause of the Problem		Solution
A	<ul style="list-style-type: none"> Disconnected battery. Defective battery connection. 	Check and correct battery connection.
B	Battery voltage below specified value. Specified value: 2.7V.	Install a new battery while the control power to the servo amplifier is ON. After replacement, cycle the power OFF and ON again.
C	Defective circuit board (1PWB).	Replace servo amplifier.

Note: No alarm will occur at the servo amplifier is the battery error occurs during operation.

■ A.84

A.84: Absolute Encoder Data Error

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
OFF	OFF	OFF	OFF

Note: OFF: Output transistor is OFF (alarm state).

Status and Remedy for Alarm



Cause of the Problem		Solution
A	Malfunctioning absolute encoder.	Replace servomotor if error occurs frequently.
B	Operational error in encoder caused by external noise	Check and correct wiring around the encoder, (grounding of servomotor, separation of encoder and power cables, insertion of rotoidal cores onto cables to reduce noise, etc.)

■ A.85

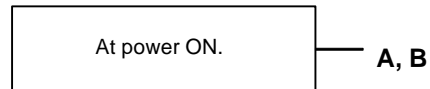
A.85: Absolute Encoder Overspeed

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
OFF	OFF	OFF	OFF

Not: OFF: Output transistor is OFF (alarm state).

Status and Remedy for Alarm



	Cause of the Problem	Solution
A	Absolute encoder turned ON at motor speed exceeding 200rpm.	Turn ON power supply with the servo-motor stopped.
B	Circuit board (1PWB) defective.	Replace servo amplifier.

■ A.86

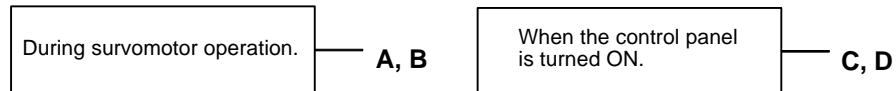
A.86: Encoder Overheated

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
OFF	OFF	OFF	OFF

Note: OFF: Output transistor is OFF (alarm state).

Status and Remedy for Alarm



Cause of the Problem		Solution
A	The ambient temperature of the servomotor is high.	Alter conditions so that the ambient temperature goes below 40°C
B	Servomotor is operating under overload.	Reduce load.
C	Circuit board (1PWB) defective.	Replace servo amplifier.
D	Encoder defective.	Replace servo amplifier.

■ **A.b1, A.b2**

A.b1: Reference Speed Input Read Error

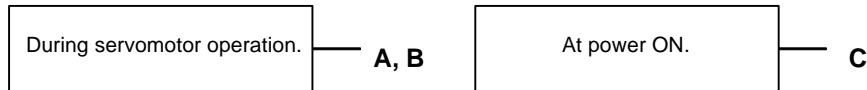
A.b2: Reference Torque Input Read Error

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
OFF	OFF	OFF	OFF

Note: OFF: Output transistor is OFF (alarm state).

Status and Remedy for Alarm



	Cause of the Problem	Solution
A	Error in reference read-in unit (A/D Converter, etc.).	Reset alarm and restart operation.
B	Faulty reference read-in unit (A/D Converter, etc.).	Replace servo amplifier.
C	Defective circuit board (1PWB).	Replace servo amplifier.

■ A.C1

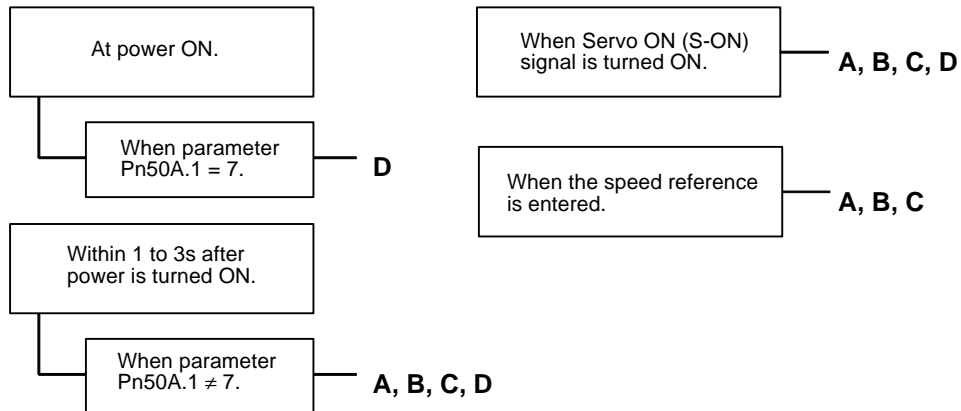
A.C1: Servo Overrun

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
ON	OFF	ON	OFF

Note: OFF: Output transistor is OFF (alarm state).
ON: Output transistor is ON.

Status and Remedy for Alarm



Cause of the Problem		Solution
A	Incorrect or disconnected servomotor wiring.	Check wiring and connectors at the servomotor.
B	Incorrect or disconnected encoder wiring.	Check wiring and connectors at the encoder.
C	Defective encoder.	Replace servomotor.
D	Defective circuit board (1PWB).	Replace servo amplifier.

■ A.C8

A.C8: Absolute Encoder Clear Error and Multi-turn Limit Setting Error

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
ON	OFF	ON	OFF

Note: OFF: Output transistor is OFF (alarm state).
ON: Output transistor is ON.

Status and Remedy for Alarm



Cause of the Problem		Solution
A	Encoder defective.	Replace servomotor.
B	Servo amplifier defective.	Replace servo amplifier.

■ A.C9

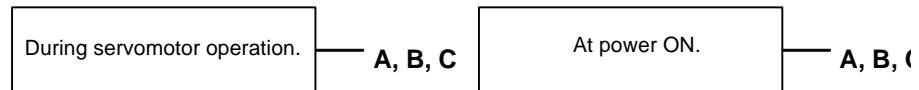
A.C9: Encoder Communications Error

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
ON	OFF	ON	OFF

Note: OFF: Output transistor is OFF (alarm state).
ON: Output transistor is ON.

Status and Remedy for Alarm



Cause of the Problem		Solution
A	Incorrect or disconnected encoder wiring.	Check wiring and connectors at the encoder.
B	Defective encoder.	Replace servomotor.
C	Defective servo amplifier.	Replace servo amplifier.

■ A.CA

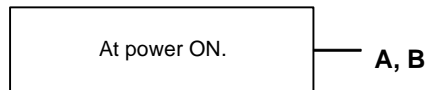
A.CA: Encoder Parameter Error

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
ON	OFF	ON	OFF

Note: OFF: Output transistor is OFF (alarm state).
ON: Output transistor is ON.

Status and Remedy for Alarm



Cause of the Problem		Solution
A	Defective encoder.	Replace servomotor.
B	Defective servo amplifier.	Replace servo amplifier.

■ A.Cb

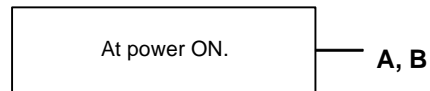
A.Cb: Encoder Echoback Error

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
ON	OFF	ON	OFF

Note: OFF: Output transistor is OFF (alarm state).
ON: Output transistor is ON.

Status and Remedy for Alarm



Cause of the Problem		Solution
A	Incorrect or disconnected encoder wiring.	Check wiring and connectors at encoder.
B	Defective encoder.	Replace servomotor.
C	Defective servo amplifier.	Replace servo amplifier.

■ A.CC

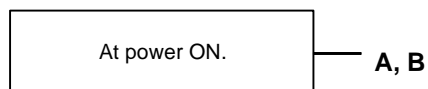
A.CC: Multi-Turn Limit Disagreement Alarm

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
ON	OFF	ON	OFF

Note: OFF: Output transistor is OFF (alarm state).
ON: Output transistor is ON.

Status and Remedy for Alarm



Cause of the Problem		Solution
A	Incorrectly set Multi-Turn Limit Setting parameter (Pn205) in the servo amplifier.	Change the value in parameter Pn205.
B	No Multi-Turn Limit value set in the encoder.	First verify that the Multi-Turn Limit Setting parameter (Pn205) is set correctly in the servo amplifier. While in the active alarm state, change the setting in the encoder Multi-Turn Limit Setting parameter (Pn205) using function Fn013.

■ A.d0

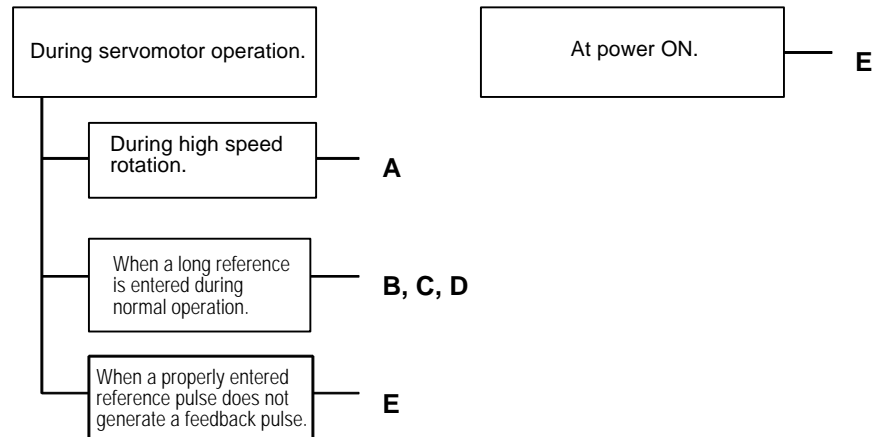
A.d0: Position Error Pulse Overflow

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
ON	ON	OFF	OFF

Note: OFF: Output transistor is OFF (alarm state).
ON: Output transistor is ON.

Status and Remedy for Alarm



	Cause of the Problem	Solution
A	Servomotor wiring incorrect or poor connection	Check wiring and connectors at encoder.
B	Servo amplifier was not correctly adjusted.	Increase speed loop gain (Pn100) and position loop gain (Pn102).
C	Motor load was excessive.	Reduce load torque or inertia. If problem persists, replace with a larger capacity motor.
D	Position reference pulse frequency was too high.	<ul style="list-style-type: none"> •Increase or decrease reference pulse frequency. •Add smoothing function. •Correct electronic gear ratio.
E	Circuit board (1PWB) defective.	Replace servo amplifier.

■ A.F1

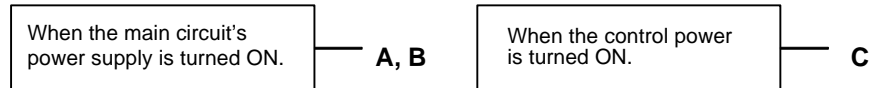
A.F1: Power Line Open Phase

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
OFF	ON	OFF	OFF

Note: OFF: Output transistor is OFF (alarm state).
ON: Output transistor is ON.

Status and Remedy for Alarm



Cause of the Problem		Solution
A	One phase (L1, L2, or L3) of the main circuit power supply is disconnected.	<ul style="list-style-type: none"> • Check power supply. • Check wiring of the main circuit power supply. • Check MCCB, noise filter, magnetic contactor.
B	There is one phase where the line voltage is low.	Check power supply.
C	Servo amplifier defective.	Replace servo amplifier.

Note: A and B tend to occur in a servo amplifier with a capacity of 500W or higher.

■ CPF00

CPF00: Digital Operator Transmission Error 1

This alarm is not stored in the alarm history.

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
Not Applicable			

Status and Remedy for Alarm

When the digital operator is connected before or after the servo amplifier has been turned ON.

A, B,
C, D

Cause of the Problem		Solution
A	Cable defective or poor contact between digital operator and servo amplifier.	<ul style="list-style-type: none"> • Check connector connections. • Replace cable.
B	Malfunction due to external noise.	Separate digital operator and cable from noise source.
C	Digital operator defective.	Replace digital operator.
D	Servo amplifier defective.	Replace servo amplifier.

■ CPF01

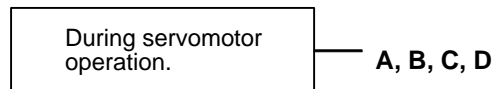
CPF01: Digital Operator Transmission Error 2

This alarm is not stored in the alarm history.

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
Not Applicable			

Status and Remedy for Alarm



Cause of the Problem		Solution
A	Cable defective or poor contact between digital operator and servo amplifier.	<ul style="list-style-type: none"> • Check connector connections. • Replace cable.
B	Malfunction due to external noise	Separate digital operator and cable from noise source.
C	Digital operator defective.	Replace digital operator.
D	Servo amplifier defective.	Replace servo amplifier.

■ A.- -

A.- -: Normal Operation

This is not an alarm display.

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
OFF	OFF	OFF	ON

Note: OFF: Output transistor is OFF (alarm state).
ON: Output transistor is ON.

9.2.2 Troubleshooting Problems with No Alarm Display

Use the tables below to identify the cause of a problem that causes no alarm display and follow the described corrective procedure.

Turn OFF the servo system power supply before starting the shaded procedures.

Contact Yaskawa if the problem cannot be solved by carefully following the described procedure.

Troubleshooting Table No Alarm Display

Symptom	Cause	Comment	Solution
Servomotor does not start	Power not connected	Check voltage between power supply terminals.	Correct the power circuit.
	Loose connection	Check terminals of connectors (CN1, CN2).	Tighten any loose parts.
	Connector (CN1) external wiring incorrect	Check connector (CN1) external wiring	Refer to connection diagram and correct wiring.
	Servomotor or encoder wiring disconnected.	—	Reconnect wiring
	Overloaded	Run under no load.	Reduce load or replace with larger capacity servomotor.
	No speed/position references input	Check reference input pins.	Correctly input speed/position references.
	/S-ON is turned OFF	Check settings of parameters Pn50A.0 and Pn50A.1.	Turn /S-ON input ON.
	/P-CON input function setting incorrect	Check parameter Pn000.1.	Refer to section 5.3.5 and set parameters to match application.
	Reference pulse mode selection incorrect.	Refer to section 5.2.2	Correct setting of parameter Pn200.0.
	Encoder type differs from parameter setting.	Incremental or absolute encoder?	Set parameter Pn002.2 to the encoder type being used.
	P-OT and N-OT inputs are turned OFF.	Refer to section 5.1.2.	Turn P-OT and N-OT input signals ON.
	CLR input is turned ON	Check status of error counter clear input.	Turn CLR input OFF.
SEN input is turned OFF.	When absolute encoder is used.	Turn SEN input ON.	
Servomotor moves suddenly, then stops	Servomotor or encoder wiring incorrect.	—	Refer to chapter 3 and correct wiring.
Suddenly stops during operation and will not restart	Alarm reset signal (/ALM-RST) is turned ON because an alarm occurred	—	Remove cause of alarm. Turn alarm reset signal (ALM-RST) from ON to OFF.
Unstable servomotor speed.	Defective wiring connection to the motor.	Check the connections of the power lead (U-, V-, and W-phases) and the encoder connectors.	Tighten any loose terminals or connectors

Symptom	Cause	Comment	Solution
Servomotor vibrates at approximately 200 to 400Hz.	Speed loop gain value too high.	—	Reduce speed loop gain (Pn100) preset value.
	Speed/position reference input wire too long.	—	Minimize length of speed/position reference input wire, with impedance not exceeding several hundred ohms
	Speed/position reference input wire is bundled with power cables.	—	Separate reference input wire at least 30cm from power cables.
High rotation speed overshoot on starting and stopping.	Speed loop gain value too high.	—	Reduce speed loop gain (Pn100) preset value. Increase integration time constant (Pn101).
	Speed loop gain is too low compared to position loop gain.	—	Increase the value of parameter Pn100 (speed loop gain). Reduce the integration time constant (Pn101).
Servomotor overheated	Ambient temperature too high	Measure servomotor ambient temperature.	Reduce ambient temperature to 40°C maximum.
	Servomotor surface dirty	Visual check	Clean dust and oil from motor surface.
	Overloaded	Run under no load.	Reduce load or replace with larger capacity servomotor.
Abnormal noise	Incorrect mechanical mounting	Servomotor mounting screws loose?	Tighten mounting screws.
		Coupling not centered?	Center coupling.
		Coupling unbalanced?	Balance coupling.
	Bearing defective	Check noise and vibration near bearing.	Consult your Yaskawa representative if defective.
Machine causing vibrations	Foreign object intrusion, damage, or deformation of sliding parts of machine.	Consult with machine manufacturer.	
Speed Reference 0V but Servomotor Rotates.	Speed reference voltage offset applied	—	Adjust reference offset. Refer to sections 7.2.4 and 7.2.5

9.2.3 Alarm Display Table

A summary of alarm displays and alarm code outputs is given in the following table.

Alarm Display Table

Alarm Display	Alarm Code Output			ALM Output	Alarm Name	Description
	ALO1	ALO2	ALO3			
A.02	OFF	OFF	OFF	OFF	Parameter Breakdown*	EEPROM data of servo amplifier is abnormal.
A.03					Main Circuit Encoder Error	Detection data for power circuit is abnormal.
A.04					Parameter Setting Error*	The parameter setting is outside the allowable setting range.
A.05					Servomotor and Amplifier Combination Error	Servo amplifier and servomotor capacities do not match each other.
A.10	ON	OFF	OFF	OFF	Overcurrent or Heat Sink Overheated ²	An overcurrent flowed through the IGBT. Heat sink of servo amplifier was overheated.
A.30	ON	ON	OFF	OFF	Regeneration Error Detected	<ul style="list-style-type: none"> Regenerative circuit is faulty Regenerative resistor is faulty.
A.32					Regenerative Overload	Regenerative energy exceeds regenerative resistor capacity.
A.40	OFF	OFF	ON	OFF	Overvoltage	Main circuit DC voltage is excessively high.
A.41					Undervoltage	Main circuit DC voltage is excessively low.
A.51	ON	OFF	ON	OFF	Overspeed	Rotational speed of the motor is excessively high.
A.71	ON	ON	ON	OFF	Overload: High Load	The motor was operating for several seconds to several tens of seconds under a torque largely exceeding ratings.
A.72					Overload: Low Load	The motor was operating continuously under a torque largely exceeding ratings.
A.73					Dynamic Brake Overload	When the dynamic brake was applied, rotational energy exceeded the capacity of dynamic brake resistor.
A.74					Overload of Surge Current Limit Resistor	The main circuit power was frequently turned ON and OFF.
A.7A					Heat Sink Overheated**	The heat sink of servo amplifier overheated.

Alarm Display	Alarm Code Output			ALM Output	Alarm Name	Description
	ALO1	ALO2	ALO3			
A.81	OFF	OFF	OFF	OFF	Absolute Encoder Backup Error*	All the power supplies for the absolute encoder have failed and position data was cleared.
A.82					Encoder Checksum Error*	The checksum results of encoder memory is abnormal.
A.83					Absolute Encoder Battery Error	Battery voltage for the absolute encoder has dropped.
A.84					Absolute Encoder Data Error*	Received absolute data is abnormal.
A.85					Absolute Encoder Overspeed	The encoder was rotating at high speed when the power was turned ON.
A.86					Encoder Overheated	The internal temperature of encoder is too high.
A.b1					Reference Speed Input Read Error	The A/D converter for reference speed input is faulty.
A.b2					Reference Torque Input Read Error	The A/D converter for reference torque input is faulty.
A.bF					System Alarm*	A system error occurred in the servo amplifier.
A.C1					ON	OFF
A.C8	Absolute Encoder Clear Error and Multi-Turn Limit Setting Error*	The multi-turn for the absolute encoder was not properly cleared or set.				
A.C9	Encoder Communications Error*	Communications between servo amplifier and encoder is not possible.				
A.CA	Encoder Parameter Error*	Encoder parameters are faulty.				
A.Cb	Encoder Echoback Error*	Contents of communications with encoder is incorrect.				
A.CC	ON	OFF	ON	OFF	Multi-Turn Limit Disagreement	Different multi-turn limits have been set in the encoder and servo amplifier.
A.d0	ON	ON	OFF	OFF	Position Error Pulse Overflow	Position error pulse exceeded parameter (Pn505).
A.F1	OFF	ON	OFF	OFF	Power Line Open Phase	One phase is not connected in the main power supply
CPF00	Not Specified				Digital Operator Transmission Error	Digital operator (JUSP-OP02A-2) fails to communicate with servo amplifier (e.g., CPU error).
CPF01						
A.--	OFF	OFF	OFF	ON	Not an error	Normal operation status

- Notes:**
1. OFF: Output transistor is OFF.
ON: Output transistor is ON.
 2. (*) These alarms are not reset for the alarm reset signal (/ALM-RST). Eliminate the cause of the alarm and then turn OFF the power supply to reset the alarms.
 3. (**) This alarm display appears only within the range of 30 to 1000W.

9.2.4 Warning Displays

The correlation between warning displays and warning code outputs is shown in the following table.

Warning Displays and Outputs

Warning Display	Warning Code Outputs			Warning Name	Meaning of Warning
	ALO1	ALO2	ALO3		
A.91	ON	OFF	OFF	Overload	This warning occurs before either of the overload alarms (A.71 or A.72) occurs. If the warning is ignored and operation continues, a regenerative overload alarm may result.
A.92	OFF	ON	OFF	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 result.

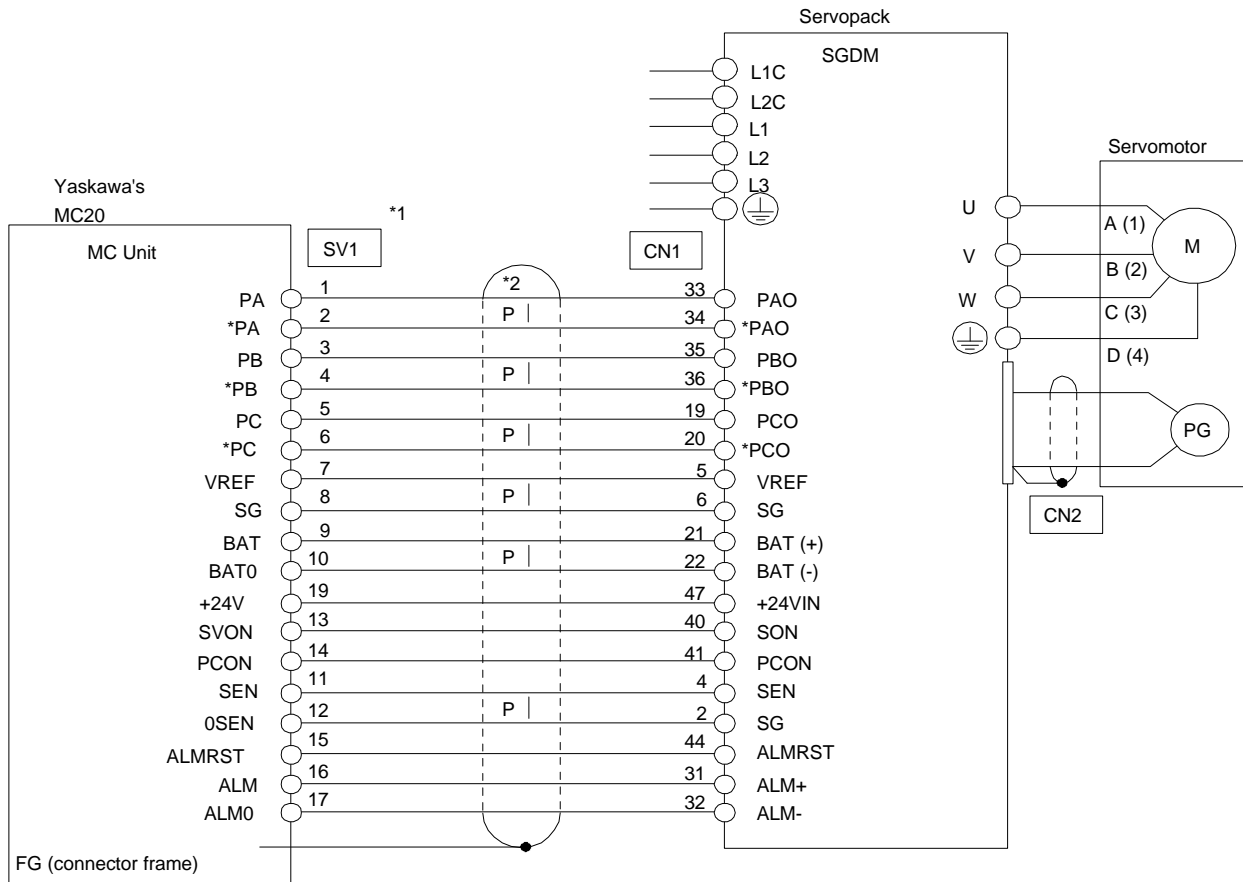
A Host Controller Connection Examples

This appendix provides examples SGDH servo amplifiers connected to typical host controllers. Refer to the manuals for the host controller when actually connecting to them.

A.1	Connecting the GL-series MC20 Motion Module	A-2
A.2	Connecting the CP-9200SH Servo Controller Module (SVA)	A-3
A.3	Connecting the GL-series B2813 Positioning Module	A-4
A.4	Connecting OMRON's C500-NC221 Position Control Unit	A-5
A.5	Connecting OMRON's C500-NC112 Position Control Unit	A-6
A.6	Connecting MITSUBISHI's AD72 Positioning Unit	A-7
A.7	Connecting MITSUBISHI's AD75 Positioning Unit	A-8

A.1 Connecting the GL-series MC20 Motion Module

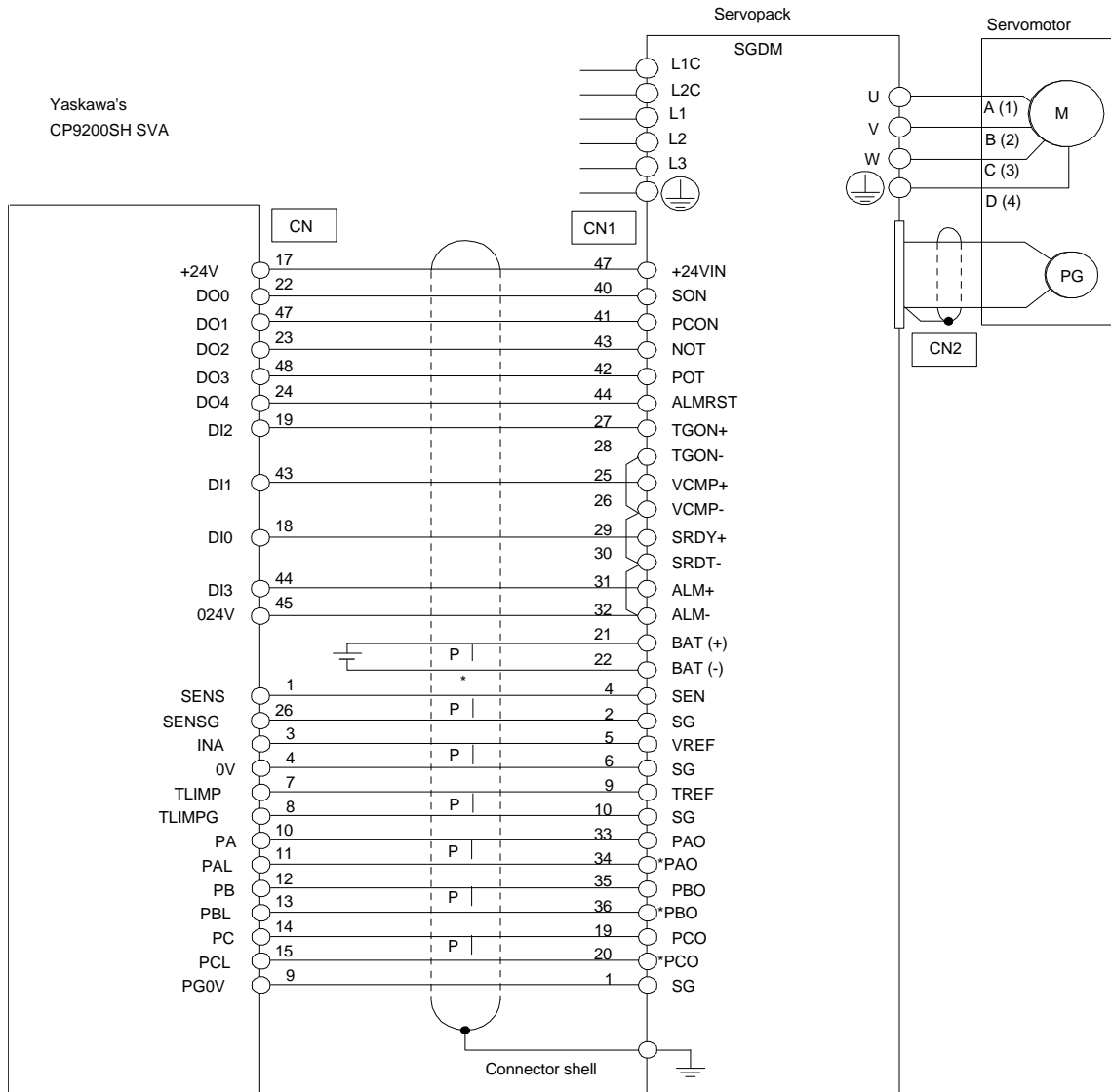
The following diagram shows an example of connecting to the GL-series MC20 Motion Module. In this example, the servo amplifier is used in Speed Control Mode.



- These pin numbers are the same for SV2 to SV4.
- P indicates twistedpair wires.

A.2 Connecting the CP-9200SH Servo Controller Module (SVA)

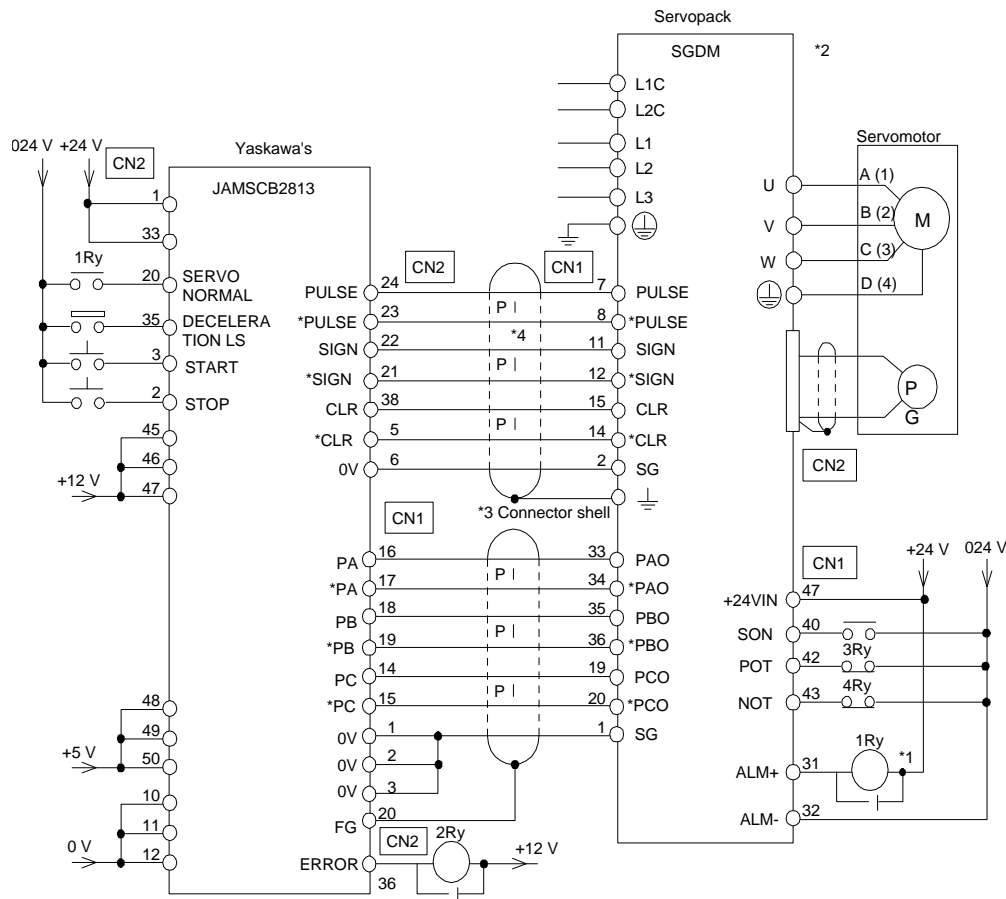
The following diagram shows an example of connecting to the CP-9200SH servo controller Module (SVA). In this example, the servo amplifier is used in Speed Control Mode.



* |P indicates twistedpair wires.

A.3 Connecting the GL-series B2813 Positioning Module

The following diagram shows an example of connecting to the GL-series B2813 Positioning Module. In this example, the servo amplifier is used in Position Control Mode.



*. 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.

*. Set user constant Pn200.0 to 1".

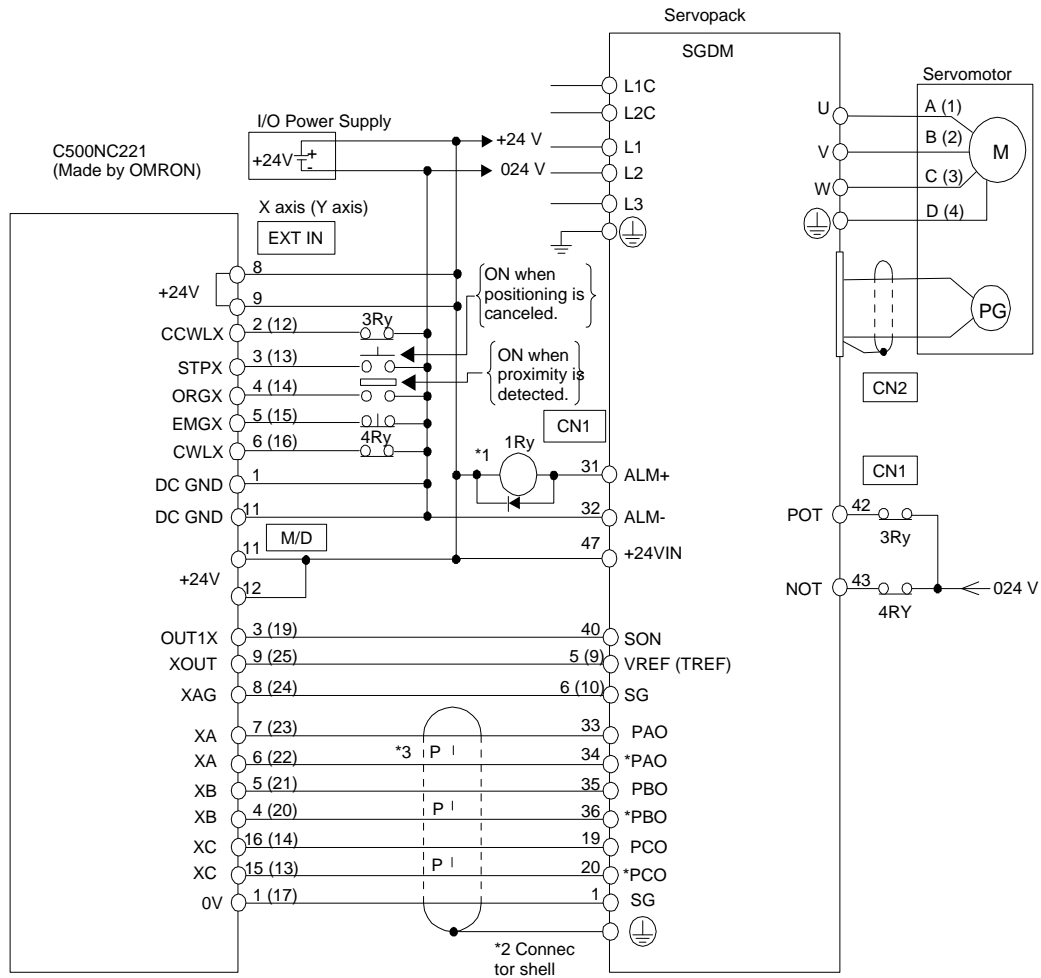
*. Connect the shield wire to the connector shell.

*. P indicates twistedpair wires.

I

A.4 Connecting OMRON's C500-NC221 Position Control Unit

The following diagram shows an example of connecting to an OMRON C500-NC221 Position Control Unit. In this example, the servo amplifier is used in Speed Control Mode.



*. 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.

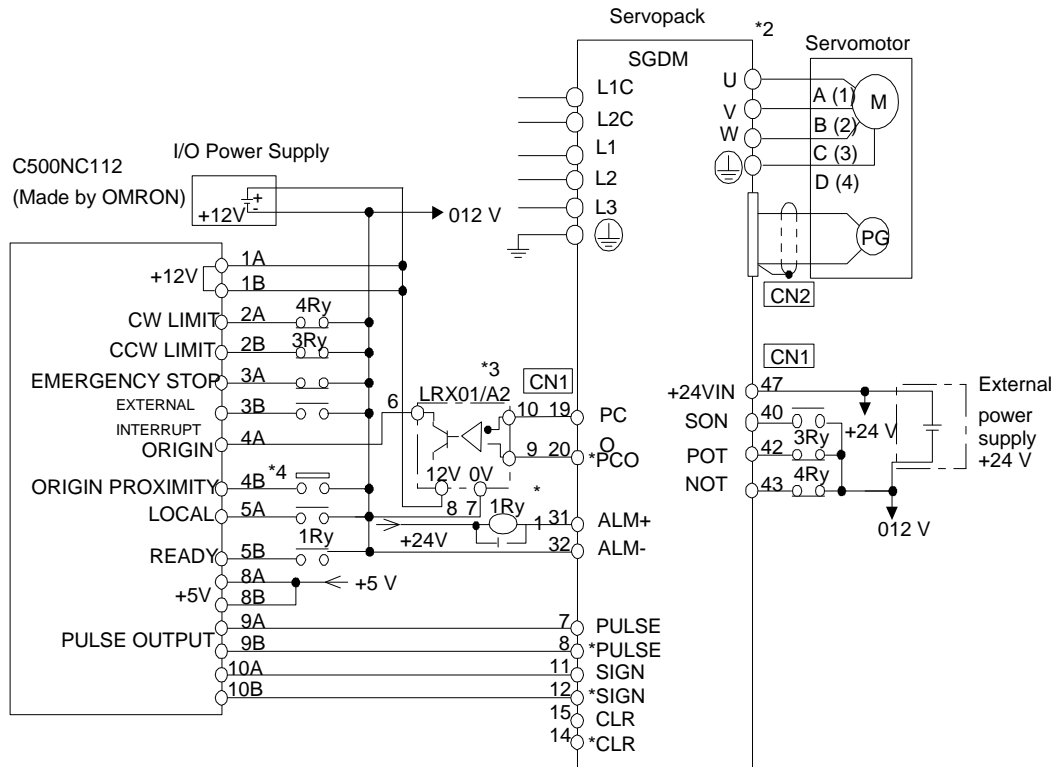
*. Connect the shield wire of the I/O cable to the connector shell.

*. P indicates twisted pair wires.

Note Only signals applicable to OMRON's C500NC221 Position Control Unit and Yaskawa's SGDM Servopack are shown here.

A.5 Connecting OMRON's C500-NC112 Position Control Unit

The following diagram shows an example of connecting to the OMRON C500-NC112 Position Control Unit. In this example, the servo amplifier is used in the position control mode.



*. 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 Servopack.

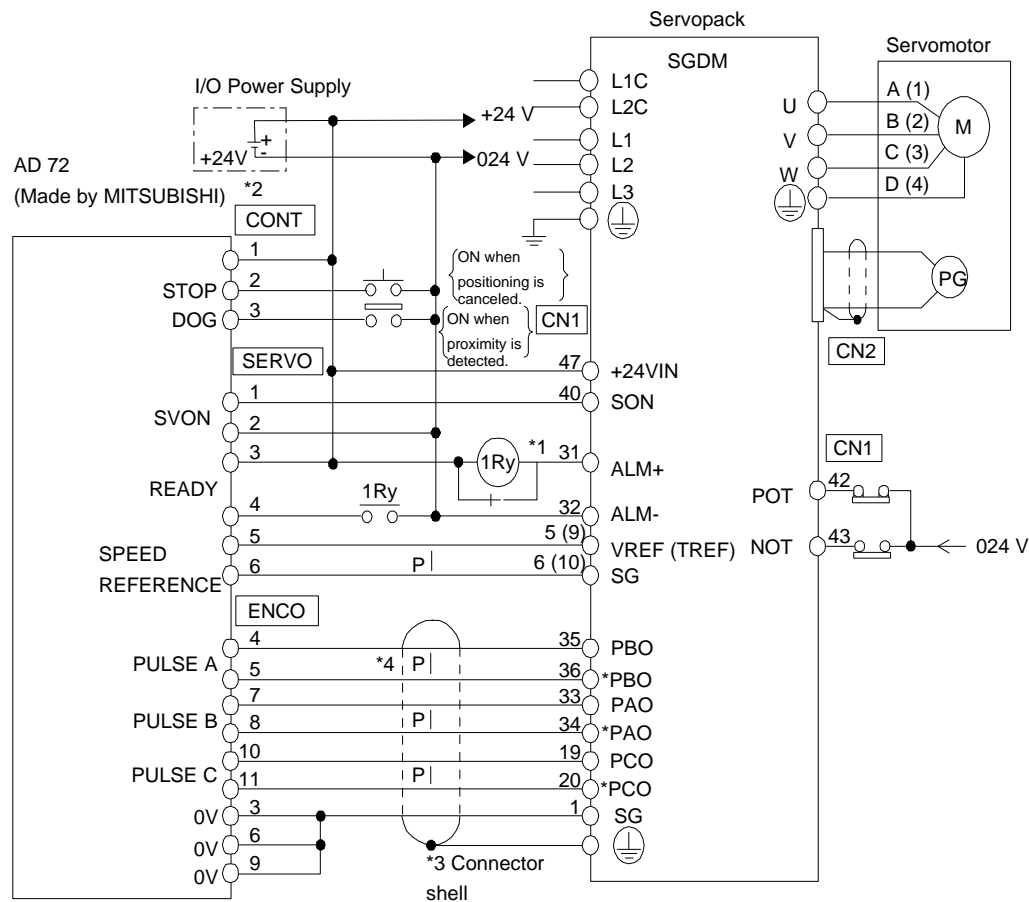
*. Set user constant Pn200.0 to 1".

*. Manufactured by Yaskawa Controls Co.

Note Only signals applicable to OMRON's C500NC112 Position Control Unit and Yaskawa's SGDM Servopack are shown here.

A.6 Connecting MITSUBISHI's AD72 Positioning Unit

The following diagram shows an example of connecting to the MITSUBISHI AD72 Positioning Unit. In this example, the servo amplifier is used in Speed Control Mode.



*. 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 Servopack.

*. Pin numbers are the same both for X axis and Y axis.

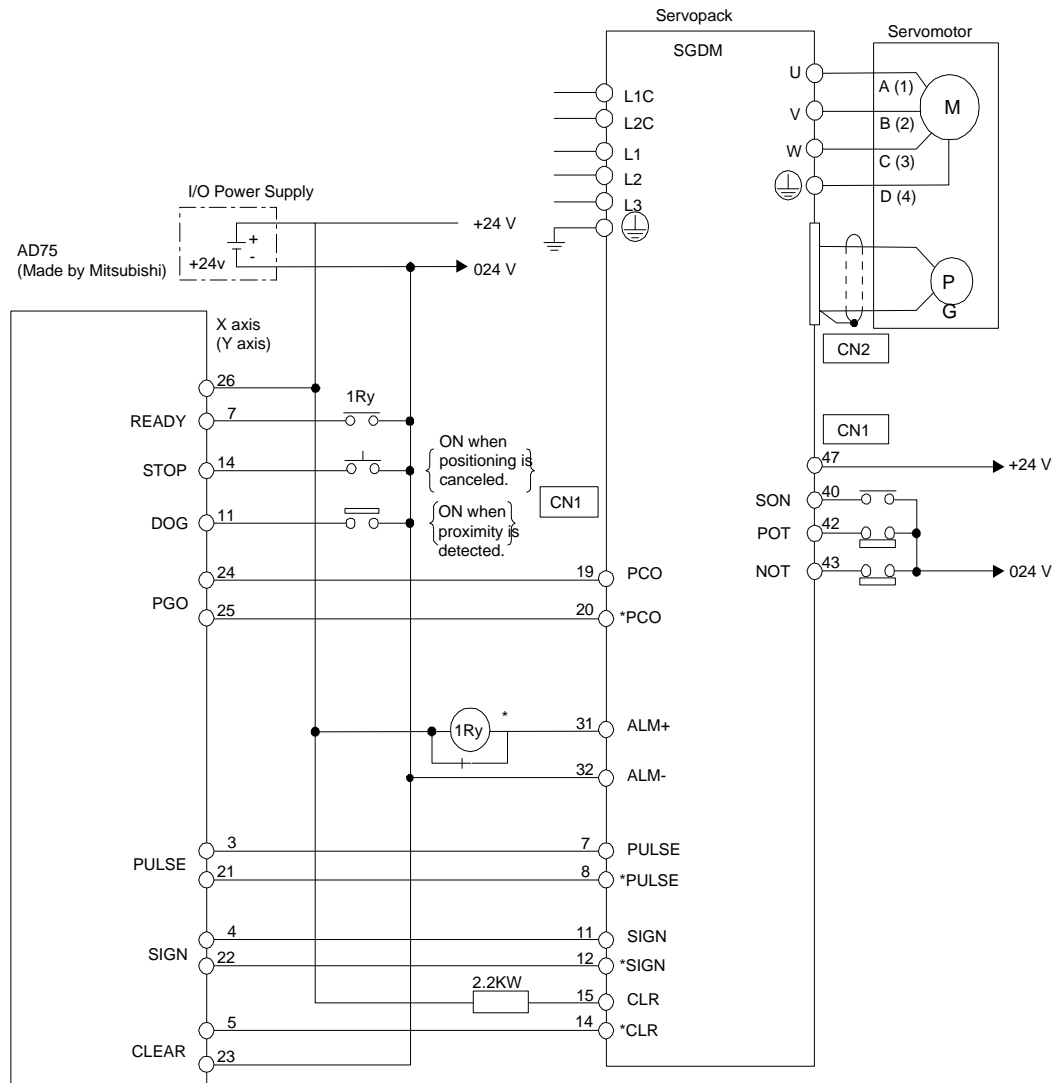
*. Connect the connector wire of the cable to the connector shell.

*. P indicates twisted pair wires.

Note Only signals applicable to Mitsubishi's AD72 Positioning Unit and Yaskawa's SGDM Servopack are shown here.]

A.7 Connecting MITSUBISHI's AD75 Positioning Unit

The following diagram shows an example of connecting to the MITSUBISHI AD75 Positioning Unit. In this example, the servo amplifier is used in Position Control Mode.



* 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 Servopack.
Note Only signals applicable to MITSUBISHI's AD75 Positioning Unit and Yaskawa's SGDM Servopack are shown here.

B List of Parameters

This appendix lists the parameters, switches, input signal selections, out put signal selections, auxiliary functions, and monitor modes for SGDH servo amplifiers.

B.1	Parameters.....	B-2
B.2	Switches	B-5
B.3	Input Signal Selections	B-9
B.4	Output Signal Selections.....	B-11
B.6	Monitor Modes	B-12

B.1 Parameters

The following list shows parameters and their settings.

Category	Parameter Number	Name	Unit	Setting Range	Default Setting	Reference
Function Selection Parameters	Pn000	Function Selection Basic Switches (See note 3).	—	—	0000	5.1.1, 5.3.5
	Pn001	Function Selection Application Switches 1 (See notes 1 and 3).	—	—	0000	5.1.2, 5.4.2, 5.5.7
	Pn002	Function Selection Application Switches 2 (See note 3).	—	—	0000	5.2.8, 5.2.9, 5.7.2
	Pn003	Function Selection Application Switches 3	—	—	0002	6.5
Gain Parameters	Pn100	Speed Loop Gain	Hz	1 to 2000	40	6.2.1
	Pn101	Speed Loop Integral Time Constant	0.01ms	15 to 51200	2000	6.2.1
	Pn102	Position Loop Gain	s ⁻¹	1 to 2000	40	6.2.1
	Pn103	Inertia Ratio	%	0 to 10000	0	6.2.1, 6.3.3
	Pn104	2nd Speed Loop Gain	Hz	1 to 2000	40	—
	Pn105	2nd Speed Loop Integral Time Constant	0.01ms	15 to 51200	2000	—
	Pn106	2nd Position Loop Gain	s ⁻¹	1 to 2000	40	—
	Pn107	Bias	rpm	0 to 450	0	6.2.4
	Pn108	Bias Width Addition	ref. units	0 to 250	7	6.2.4
	Pn109	Feed-forward	%	0 to 100	0	6.2.2
	Pn10A	Feed-forward Filter Time Constant	0.01ms	0 to 6400	0	5.2.5
	Pn10B	Gain-related Application Switches (See note 3).	—	—	0000	6.2.5
	Pn10C	Mode Switch Torque Reference	%	0 to 800	200	6.2.5
	Pn10D	Mode Switch Speed Reference	rpm	0 to 10000	0	6.2.5
	Pn10E	Mode Switch Acceleration	10rpm/s	0 to 3000	0	6.2.5
	Pn10F	Mode Switch Error Pulse	ref. units	0 to 10000	0	6.2.5
	Pn110	Online Autotuning Switches (See note 3.)	—	—	0010	6.3.4
	Pn111	Speed Feedback Compensation (See note 2).	%	1 to 100	100	6.2.6
	Pn112	Reserved parameters (Do not change.)	%	0 to 1000	100	—
	Pn113		—	0 to 10000	1000	—
	Pn114		—	0 to 400	200	—
	Pn115		—	0 to 1000	32	—
	Pn116		—	0 to 1000	16	—
	Pn117		%	20 to 100	100	—
	Pn118		%	20 to 100	100	—
	Pn119		s ⁻¹	1 to 2000	50	—
Pn11A	0.1%		1 to 2000	1000	—	
Pn11B	Hz		1 to 150	50	—	
Pn11C	Hz		1 to 150	70	—	
Pn11D	%		1 to 150	100	—	
Pn11E	%		1 to 150	100	—	

Category	Parameter Number	Name	Unit	Setting Range	Default Setting	Reference
Gain Parameters	Pn11F	Reserved parameters (Do not change).	ms	1 to 2000	0	—
	Pn120		0.01ms	1 to 51200	0	—
	Pn121		Hz	10 to 250	50	—
	Pn122		Hz	0 to 250	0	—
	Pn123		%	0 to 100	0	—
Position Parameters	Pn200	Position Control Reference Selection Switches (See note 3).	—	—	0000	5.2.2
	Pn201	PG Divider (See note 3).	p/r	16 to 16384	16384	5.2.3
	Pn202	Electronic Gear Ratio (Numerator) (See note 3).	—	1 to 65535	4	5.2.5
	Pn203	Electronic Gear Ratio (Denominator) (See note 3).	—	1 to 65535	1	5.2.5
	Pn204	Position Reference Accel/Decel Parameter	0.01ms	0 to 6400	0	6.1.2
	Pn205	Multi-turn Limit Setting (See notes 1 and 3).	rev	0 to 65535	65535	5.7.2
	Pn206	Reserved parameter (Do not change).	P/rev	513 to 65535	16384	—
	Pn207	Position Control Function Switches (See note 3).	—	—	0000	5.2.9 6.1.2
	Pn208	Position Reference Movement Averaging Time (See note 3).	0.01ms	6 to 6400	0	6.1.2
Speed Parameters	Pn300	Speed Reference Input Gain	0.01V/ rated speed	150 to 3000	600	5.2.1
	Pn301	Speed 1	rpm	0 to 10000	100	5.2.6
	Pn302	Speed 2	rpm	0 to 10000	200	5.2.6
	Pn303	Speed 3	rpm	0 to 10000	300	5.2.6
	Pn304	Jog Speed	rpm	0 to 10000	500	5.3.2
	Pn305	Soft Start Acceleration Time	ms	0 to 10000	0	6.1.1
	Pn306	Soft Start Deceleration Time	ms	0 to 10000	0	6.1.1
	Pn307	Speed Reference Filter Time Constant	0.01ms	0 to 65535	40	—
	Pn308	Speed Feed-Forward Filter Time Constant	0.01ms	0 to 65535	0	6.2.6
Torque Parameters	Pn400	Torque Reference Input Gain	0.1V/rated torque	10 to 100	30	5.2.7
	Pn401	Torque Reference Filter Time Constant	0.01ms	0 to 65535	100	6.1.5
	Pn402	Forward Torque Limit	%	0 to 800	800	5.1.3
	Pn403	Reverse Torque Limit	%	0 to 800	800	5.1.3
	Pn404	Forward External Torque Limit	%	0 to 800	100	5.1.3
	Pn405	Reverse External Torque Limit	%	0 to 800	100	5.1.3
	Pn406	Emergency Stop Torque	%	0 to 800	800	5.1.2
	Pn407	Speed Limit during Torque Control	rpm	0 to 10000	10000	5.2.7
	Pn408	Torque Function Switches	—	—	0000	6.1.6
	Pn409	Notch Filter Frequency	Hz	50 to 2000	2000	6.1.6

Category	Parameter Number	Name	Unit	Setting Range	Default Setting	Reference
Sequence Parameters	Pn500	Positioning Completed Width	ref. units	0 to 250	7	5.5.3
	Pn501	Zero Clamp Level	rpm	0 to 10000	10	5.4.3
	Pn502	Rotation Detection Level	rpm	1 to 10000	20	5.5.5
	Pn503	Speed Coincidence Signal Output Width	rpm	0 to 100	10	5.5.4
	Pn504	NEAR Signal Width	ref. units	1 to 250	7	5.5.8
	Pn505	Overflow Level	256 ref. units	1 to 32767	1024	6.2.1
	Pn506	Brake Reference Servo OFF Delay Time	10ms	0 to 50	0	5.4.4
	Pn507	Brake Reference Output Speed Level	rpm	0 to 10000	100	5.4.4
Sequence Parameters	Pn508	Timing for Brake Reference Output during Motor Operation	10ms	10 to 100	50	5.4.4
	Pn509	Momentary Hold Time	ms	20 to 1000	20	5.5.9
	Pn50A	Input Signal Selections 1 (See note 3).	—	—	2100	5.3.3
	Pn50B	Input Signal Selections 2 (See note 3).	—	—	6543	5.3.3
	Pn50C	Input Signal Selections 3 (See note 3).	—	—	8888	5.3.3
	Pn50D	Input Signal Selections 4 (See note 3).	—	—	8888	5.3.3
	Pn50E	Output Signal Selections 1 (See note 3).	—	—	3211	5.3.4
	Pn50F	Output Signal Selections 2 (See note 3).	—	—	0000	5.3.4
	Pn510	Output Signal Selections 3 (See note 3).	—	—	0000	5.3.4
	Pn511	Reserved parameter (Do not change).	—	—	8888	—
	Pn512	Output Signal Reversal Settings (See note 3).	—	—	0000	5.3.4
Other Parameters	Pn600	Regenerative Resistor Capacity (See note 4).	10 W	0 to capacity (See note 5).	0	5.6.1
	Pn601	Reserved parameter (Do not change.)	—	0 to capacity (See note 5).	0	—

- Notes:**
- The multi-turn limit is valid only when parameter Pn002.2 Absolute Encoder Usage is set to "2". The value will be processed in the range of "+32767 to -32768" for other settings even if the value is changed.
 - There is no need to change the multi-turn limit except for in special cases. Be careful not to change the setting unless necessary.
 - The setting of parameter Pn111 is valid only when parameter Pn110.1 is set to 0.
 - After changing these parameters, cycle the main circuit and control power supplies to enable the new settings.
 - Normally set to "0". When using an external regenerative resistor, set the capacity (W) of the regenerative resistor.
 - The upper limit is the maximum output capacity (W) of the servo amplifier.

B.2 Switches

The following list shows the switches and their default settings.

Parameter	Digit Place	Name	Setting	Description	Default Setting
Pn000 Function Selection Basic Switches	0	Direction Selection	0	Sets CCW as forward direction.	0
			1	Sets CW as forward direction (reverse rotation mode).	
	1	Control Method Selection	0	Speed control (analog reference).	0
			1	Position control (pulse train reference).	
			2	Torque control (analog reference).	
			3	Internal set speed control (contact reference).	
			4	Internal set speed control (contact reference)/Speed control (analog reference).	
			5	Internal set speed control (contact reference)/Position control (pulse train reference).	
			6	Internal set speed control (contact reference)/Torque control (analog reference).	
			7	Position control (pulse train reference)/Speed control (analog reference).	
2	Axis Address	0 to F	Sets servo amplifier axis address.	0	
		3	Reserved	—	0
Pn001 Function Selection Application Switches	0	Servo OFF or Alarm Stop Mode	0	Stops the motor by applying dynamic brake (DB).	0
			1	Stops the motor by applying dynamic brake (DB) and then releases DB.	
			2	Makes the motor coast to a stop state without using the dynamic brake (DB).	
	1	Overtravel Stop Mode	0	Same setting as Pn001.0 (Stops the motor by applying DB or by coasting.)	0
			1	Sets the torque of Pn406 to the maximum value, decelerates the motor to a stop, and then sets it to servo lock state.	
			2	Sets the torque of Pn406 to the maximum value, decelerates the motor to a stop, and then sets it to coasting state.	
	2	AC/DC Power Input Selection	0	Not applicable to DC power input: Input AC power supply through L1, L2, and (L3) terminals.	0
			1	Applicable to DC power input: Input DC power supply through (+)1 and (-) terminals.	
3	Warning Code Output Selection	0	ALO1, ALO2, and ALO3 output only alarm codes.	0	
		1	ALO1, ALO2, and ALO3 output both alarm codes and warning codes. While warning codes are output, ALM signal output remains ON (normal state).		

Parameter	Digit Place	Name	Setting	Description	Default Setting
Pn002 Function Selection Application Switches	0	Speed Control Option (T-REF Terminal Allocation)	0	None.	0
			1	Uses T-REF as an external torque limit input.	
			2	Uses T-REF as a torque feed-forward input.	
	1	Torque Control Option (V-REF Terminal Allocation)	0	None.	0
			1	Uses V-REF as an external speed limit input.	
	2	Absolute Encoder Usage	0	Uses absolute encoder as an absolute encoder.	0
			1	Uses absolute encoder as an incremental encoder.	
			2	Uses absolute encoder as an absolute encoder. Uses multi-turn limit.	
	3	Not used.	0	—	0
	Pn003 Function Selection Application Switches	0	Analog Monitor 1 Torque Reference Monitor	0	Motor speed: 1V/1000rpm.
1				Speed reference: 1V/1000rpm.	
2				Torque reference: 1V/100%.	
3				Position error: 0.05V/1 reference units.	
4				Position error: 0.05V/100 reference units.	
5				Reference pulse frequency (converted to rpm): 1V/1000rpm.	
6				Motor speed × 4: 1V/250rpm.	
1		Analog Monitor 2 Speed Reference Monitor	7	Motor speed × 8: 1V/125rpm.	
			8	Reserved parameter (Do not change.).	
			9		
			A		
			B		
			C		
			D		
2		Not used.	—		—
			3	Not used.	—
Pn10B Gain Application Switches	0	Mode Switch Selection	0	Uses internal torque reference as the condition (Level setting: Pn10C).	0
			1	Uses speed reference as the condition (Level setting: Pn10D).	
			2	Uses acceleration as the condition (Level setting: Pn10E).	
			3	Uses error pulse as the condition (Level setting: Pn10F).	
			4	No mode switch function available.	
	1	Speed Loop Control Method	0	PI control.	0
			1	IP control.	
	2	Not used.	0	—	0
	3	Reserved	0 to 2	Reserved parameter. (Do not change).	0

Parameter	Digit Place	Name	Setting	Description	Default Setting	
Pn110 Online Auto-tuning Switches	0	Online Autotuning Method	0	Tunes only at the beginning of operation.	0	
			1	Always tunes.		
			2	Does not perform autotuning.		
	1	Speed Feedback Compensation Selection	0	Enabled.	1	
			1	Disabled.		
	2	Friction Compensation Selection	0	Friction compensation: Disabled.	0	
			1	Friction compensation: Small.		
			2	Friction compensation: Large.		
	3	Reserved	0 - 3	Reserved parameter (Do not change).	0	
	Pn200 Position Control References Selection Switches	0	Reference Pulse Form	0	Sign + pulse, positive logic.	0
				1	CW + CCW, positive logic.	
				2	A phase + B phase (x1), positive logic.	
3				A phase + B phase (x2), positive logic.		
4				A phase + B phase (x4), positive logic.		
5				Sign + pulse, negative logic.		
6				CW + CCW, negative logic.		
7				A phase + B phase (x1), negative logic.		
8				A phase + B phase (x2), negative logic.		
9				A phase + B phase (x4), negative logic.		
1		Error Counter Clear Signal Form	0	Clears error counter when the signal goes high.	0	
			1	Clears error counter at the rising edge of the signal.		
			2	Clears error counter when the signal goes low.		
			3	Clears error counter at the falling edge of the signal.		
2		Clear Operation	0	Clears error counter at the baseblock.	0	
			1	Does not clear error counter. (Possible to clear error counter only with CLR signal).		
			2	Clears error counter when an alarm occurs.		
3		Filter Selection	0	Reference input filter for line driver signals.	0	
			1	Reference input filter for open collector signals.		
Pn207 Position Control Function Switches		0	Position Reference Filter Selection	0	Acceleration/deceleration filter.	0
				1	Average movement filter.	
		1	Position Control Option		Disabled.	
					Uses V-REF as a speed feed-forward input.	
		2		—		
3		—				
Pn408 Torque Control Function Switches	0	Notch Filter Selection	0	Disabled.	0	
			1	Uses a notch filter for torque reference.		
	1	Not used.	—	—		
	2					
3						

B.3 Input Signal Selections

The following list shows input signal selections and their default settings.

Parameter	Digit Place	Name	Setting	Description	Default Setting
Pn50A	0	Input Signal Allocation Mode	0	Sets the input signal allocation for the sequence to the same one as for the SGDh servo amplifier.	0
			1	Possible to freely allocate the input signals.	
	1	/S-ON Signal Mapping (Servo ON when low.)	0	Inputs from the SI0 (CN1-40) input terminal.	0: SI0
			1	Inputs from the SI1 (CN1-41) input terminal.	
			2	Inputs from the SI2 (CN1-42) input terminal.	
			3	Inputs from the SI3 (CN1-43) input terminal.	
			4	Inputs from the SI4 (CN1-44) input terminal.	
			5	Inputs from the SI5 (CN1-45) input terminal.	
			6	Inputs from the SI6 (CN1-46) input terminal.	
			7	Sets signal ON.	
			8	Sets signal OFF.	
			9	Inputs the reverse signal from the SI0 (CN1-40) input terminal.	
			A	Inputs the reverse signal from the SI1 (CN1-41) input terminal.	
			B	Inputs the reverse signal from the SI2 (CN1-42) input terminal.	
C	Inputs the reverse signal from the SI3 (CN1-43) input terminal.				
D	Input the reverse signals from the SI4 (CN1-44) input terminal.				
E	Inputs the reverse signal from the SI5 (CN1-45) input terminal.				
F	Inputs the reverse signal from the SI6 (CN1-46) input terminal.				
Pn50A	2	/P-CON Signal Mapping (Pcontrol when low.)	0 to F	Same as above.	1: SI1
	3	P-OT Signal Mapping (Ovetravel when high.)	0 to F	Same as above.	2: SI2
	Pn50B	0	N-OT Signal Mapping (Overtravel when high.)	0 to F	Same as above.
1		/ALM-RST Signal Mapping (Alarm reset when low.)	0 to F	Same as above.	4: SI4
2		/P-CL Signal Mapping (Torque control when low.)	0 to F	Same as above.	5: SI5
3		/N-CL Signal Mapping (Torque control when low.)	0 to 8	Same as above.	6: SI6

Parameter	Digit Place	Name	Setting	Description	Default Setting
Pn50C	0	/SPD-D Signal Mapping (Internal Set Speed Selection)	0 to F	Same as above.	8: OFF
	1	/SPD-A Signal Mapping (Internal Set Speed Selection)	0 to F	Same as above.	8: OFF
	2	/SPD-B Signal Mapping (Internal Set Speed Selection)	0 to F	Same as above.	8: OFF
	3	/C-SEL Signal Mapping (Control Mode Switching)	0 to F	Same as above.	8: OFF
Pn50D	0	/ZCLAMP Signal Mapping (Zero Clamping)	0 to F	Same as above.	8: OFF
	1	/INHIBIT Signal Mapping (Disabling Reference Pulse)	0 to F	Same as above.	8: OFF
	2	/G-SEL Signal Mapping (Gain Switching)	0 to F	Same as above.	8: OFF
	3	(Reserved)	0 to F	Same as above.	8: OFF

Note: * When Pn50A.0 is set to 0 for the SGD servo amplifier, only the following modes are compatible: Pn50A.1=7, Pn50A.3=8, and Pn50B.0=8.

B.4 Output Signal Selections

The following list shows output signal selections and their default settings.

Parameter	Digit Place	Name	Setting	Description	Default Setting
Pn50E	0	/COIN Signal Mapping	0	Disabled.	1: SO1
			1	Outputs from the SO1 (CN1-25, 26) output terminal.	
			2	Outputs from the SO2 (CN1-27, 28) output terminal.	
			3	Outputs from the SO3 (CN1-29, 30) output terminal.	
	1	/V-CMP Signal Mapping	0 to 3	Same as above	1: SO1
	2	/TGON Signal Mapping	0 to 3	Same as above	2: SO2
3	/S-RDY Signal Mapping	0 to 3	Same as above	3: SO3	
Pn50F	0	/CLT Signal Mapping	0 to 3	Same as above	0: Not used
	1	/VLT Signal Mapping	0 to 3	Same as above	
	2	/BK Signal Mapping	0 to 3	Same as above	
	3	/WARN Signal Mapping	0 to 3	Same as above	
Pn510	0	/NEAR Signal Mapping	0 to 3	Same as above	0
	1	Reserved	0 to 3	Same as above	
	2	Not used.	0	—	
	3	Not used.	0	—	
Pn512	0	Output Signal Reversal for SO1 (CN-25 and 26)	0	Output signal is not reversed.	0: Not reversed
			1	Output signal is reversed.	
	1	Output Signal Reversal for SO1 (CN-25 and 26)	0	Output signal is not reversed.	
			1	Output signal is reversed.	
	2	Output Signal Reversal for SO1 (CN-25 and 26)	0	Output signal is not reversed.	
			1	Output signal is reversed.	
3	Not used.	—	—	0	

- Note 1.** When more than one signal is allocated to the same output circuit, data is output using OR logic.
- 2.** Depending on the control mode, undetected signals are treated as OFF. For example, in the speed control mode, the /COIN signal is treated as OFF.
- 3.** Types of /WARN signals: Overload and regenerative overload.

B.5 Auxiliary Functions

The following list shows the available auxiliary functions.

Parameter	Function
Fn000	Alarm traceback data display.
Fn001	Rigidity setting during online autotuning.
Fn002	JOG mode operation.
Fn003	Zero-point search mode.
Fn004	(Reserved parameter).
Fn005	Parameter settings initialization.
Fn006	Alarm traceback data clear.
Fn007	Writing to EEPROM inertia ratio data obtained from online autotuning.
Fn008	Absolute encoder multi-turn reset and encoder alarm reset.
Fn009	Automatic tuning of analog (speed, torque) reference offset.
Fn00A	Manual adjustment of speed reference offset.
Fn00B	Manual adjustment of torque reference offset.
Fn00C	Manual zero-adjustment of analog monitor output.
Fn00D	Manual gain-adjustment of analog monitor output.
Fn00E	Automatic offset-adjustment of motor current detection signal.
Fn00F	Manual offset-adjustment of motor current detection signal.
Fn010	Password setting (protects parameters from being changed).
Fn011	Motor models display.
Fn012	Software version display.
Fn013	Multi-Turn Limit Setting: Change when a Multi-Turn Limit Disagreement Alarm (A.CC) occurs.

B.6 Monitor Modes

The following list shows monitor modes available.

Parameter	Content of Display	Unit	Remarks
Un000	Actual motor speed	rpm	—
Un001	Input speed reference	rpm	—
Un002	Internal torque reference	%	Value for rated torque
Un003	Rotation angle 1	pulse	Number of pulses from the origin
Un004	Rotation angle 2	degree	Angle from the origin (electrical angle)
Un005	Input signal monitor	—	—
Un006	Output signal monitor	—	—
Un007	Input reference pulse speed	rpm	—
Un008	Error counter value	reference units	Amount of position error
Un009	Accumulated load rate	%	Value for the rated torque as 100% Displays effective torque in 10s cycle.
Un00A	Regenerative load rate	%	Value for the processable regenerative power as 100% Displays effective torque in 10s cycle.
Un00B	Power consumed by DB resistance	%	Value for the processable power when dynamic brake is applied as 100% Displays effective torque in 10s cycle.
Un00C	Input reference pulse counter	—	Displayed in hexadecimal.
Un00D	Feedback pulse counter	—	Displayed in hexadecimal.



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