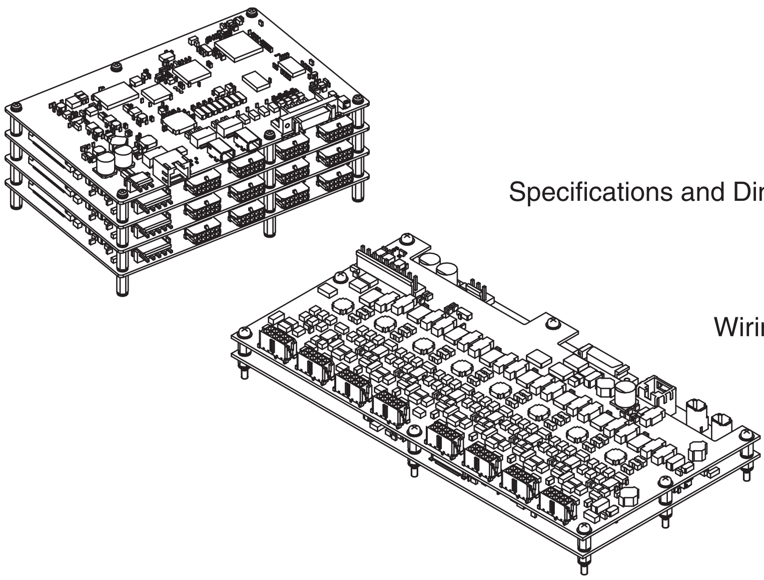
YASKAWA

AC Servo Drives
Σ-V-MD Series
USER'S MANUAL
Type A01/A02
Rotational Motor
MECHATROLINK-III Communications References

SGDV-MD SERVOPACK
SGMMV Servomotor



MANUAL NO. SIEP S800001 02B

About this Manual

This manual contains information that is required to select, design, test, adjust, and maintain Σ-V-MD-series SERVOPACKs.

Keep this manual in a location where it can be accessed for reference whenever required. Manuals outlined on the following page must also be used as required by the application.

■ Description of Technical Terms

The following table shows the meanings of terms used in this manual.

Term	Meaning
Servomotor	An SGMMV servomotor in the Σ-V Series.
SERVOPACK	An SGDV-MD servo amplifier in the Σ-V-MD Series.
Servo Drive	A set including a servomotor and SERVOPACK (i.e., a servo amplifier)
Servo System	A servo control system that includes the combination of a servo drive with a host controller and peripheral devices
M-III Model	MECHATROLINK-III communications reference used for SERVOPACK interface
Servo ON	Power to motor ON
Servo OFF	Power to motor OFF
Base Block (BB)	Power supply to motor is turned OFF by shutting off the base current to the power transistor in the current amplifier.
Servo Lock	A state in which the motor is stopped and is in position loop with a position reference of 0.

■ IMPORTANT Explanations

The following icon is displayed for explanations requiring special attention.

IMPORTANT

- Indicates important information that should be memorized, as well as precautions, such as alarm displays, that do not involve potential damage to equipment.

■ Notation Used in this Manual

• Notation for Reverse Signals

The names of reverse signals (i.e., ones that are valid when low) are written with a forward slash (/) before the signal name.

Notation Example

$\overline{\text{BK}}$ = /BK

• Notation for Parameters

The notation depends on whether the parameter requires a value setting (parameter for numeric settings) or requires the selection of a function (parameter for selecting functions).

• Parameters for Numeric Settings

Control methods for which the parameter applies.
Speed : Speed control Position : Position control Torque : Torque control

Pn406	Emergency Stop Torque		Speed Position Torque		
	Setting Range	Setting Unit	Factory Setting	When Enabled	Classification
	0% to 800%	1%	800	After change	Setup

Parameter number

Indicates the setting range for the parameter.

Indicates the minimum setting unit for the parameter.

Indicates the parameter setting before shipment.

Indicates when a change to the parameter will be effective.

Indicates the parameter classification.

• Parameters for Selecting Functions

Parameter		Meaning	When Enabled	Classification
Pn002	n.□0□□ [Factory setting]	Uses the absolute encoder as an absolute encoder.	After restart	Setup
	n.□1□□	Uses the absolute encoder as an incremental encoder.		

Parameter number

The notation "n.□□□□" indicates a parameter for selecting functions. Each □ corresponds to the setting value of that digit. The notation shown here means that the third digit is 1.

This section explains the selections for the function.

Notation Example

(Display Example for Pn002)

n.0000

1st digit
2nd digit
3rd digit
4th digit

Digit Notation		Setting Notation	
Notation	Meaning	Notation	Meaning
Pn002.0	Indicates the value for the 1st digit of parameter Pn002.	Pn002.0 = x or n.□□□x	Indicates that the value for the 1st digit of parameter Pn002 is x.
Pn002.1	Indicates the value for the 2nd digit of parameter Pn002.	Pn002.1 = x or n.□□x□	Indicates that the value for the 2nd digit of parameter Pn002 is x.
Pn002.2	Indicates the value for the 3rd digit of parameter Pn002.	Pn002.2 = x or n.□x□□	Indicates that the value for the 3rd digit of parameter Pn002 is x.
Pn002.3	Indicates the value for the 4th digit of parameter Pn002.	Pn002.3 = x or n.x□□□	Indicates that the value for the 4th digit of parameter Pn002 is x.

■ Documents Related to the Σ-V-MD Series

Refer to the following manuals as required.

Refer to these documents for ratings and characteristics.

Name	Selecting Models and Peripheral Devices	Ratings and Specifications	System Design	Panels and Wiring	Trial Operation	Trial Operation and Servo Adjustment	Maintenance and Inspection
Σ-V-MD Series User's Manual MECHATROLINK-III Standard Servo Profile Commands (No.: SIEP S800001 03)			✓		✓	✓	
Σ-V-MD Series AC SERVOPACK Type A02 Safety Precautions (No.: TOBP C710829 10)	✓			✓			✓
Σ-V-MD Series AC SERVOPACK Type A01 Safety Precautions (No.: TOBP C710829 14)	✓			✓			✓
AC SERVOMOTOR Safety Precautions (No.: TOBP C230200 00)				✓			✓

■ Trademarks

MECHATROLINK is a trademark of the MECHATROLINK Members Association.

■ Safety Information

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

⚠ WARNING

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

⚠ CAUTION

Indicates precautions that, if not heeded, could result in relatively serious or minor injury, damage to the product, or faulty operation.
In some situations, the precautions indicated could have serious consequences if not heeded.

PROHIBITED

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

MANDATORY

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

Safety Precautions

This section describes important precautions that must be followed during storage, transportation, installation, wiring, operation, maintenance, inspection, and disposal. Be sure to always observe these precautions thoroughly.

⚠ WARNING

- Never touch any rotating servomotor parts during operation.
  Failure to observe this warning may result in injury.
- Before starting operation with a machine connected, make sure that an emergency stop can be applied at any time.
  Failure to observe this warning may result in injury or damage to the equipment.
- Do not touch the SERVOPACK while power is supplied.
  Failure to observe this warning may result in electric shock.
- Do not touch the terminals soon after the power supply is turned OFF.
  Residual voltage may cause electric shock.
- Follow the procedures and instructions provided in the manuals for the products being used in the trial operation.
  Failure to do so may result not only in faulty operation and damage to equipment, but also in personal injury.
- The multiturn limit value need not be changed except for special applications.
  Changing it inappropriately or unintentionally can be dangerous.
- If the Multiturn Limit Disagreement alarm occurs, check the setting of parameter PnA48 in the SERVOPACK to be sure that it is correct.
  If PnA48 is used when an incorrect value is set in the parameter PnA48, an incorrect value will be set in the encoder. The alarm will disappear even if an incorrect value is set, but incorrect positions will be detected, resulting in a dangerous situation where the machine will move to unexpected positions.
- Do not remove the cables or connectors from the SERVOPACK while the power is ON.
  Failure to observe this warning may result in electric shock.
- Do not damage, pull, exert excessive force on, or place heavy objects on the cables.
  Failure to observe this warning may result in electric shock, stopping operation of the product, or fire.
- Do not modify the product.
  Failure to observe this warning may result in injury, damage to the equipment, or fire.
- Provide appropriate braking devices on the machine side to ensure safety. The holding brake on a servomotor with a brake is not a braking device for ensuring safety.
  Failure to observe this warning may result in injury.
- Do not come close to the machine immediately after resetting an instantaneous power interruption to avoid an unexpected restart. Take appropriate measures to ensure safety against an unexpected restart.
  Failure to observe this warning may result in injury.
- Connect the ground terminal according to local electrical codes (100 Ω or less).
  Improper grounding may result in electric shock or fire.
- Installation, disassembly, or repair must be performed only by authorized personnel.
  Failure to observe this warning may result in electric shock or injury.

■ Storage and Transportation

⚠ CAUTION

- Do not store or install the product in the following locations.
  Failure to observe this caution may result in fire, electric shock, or damage to the equipment.
  - Locations subject to direct sunlight
  - Locations subject to temperatures outside the range specified in the storage/installation temperature conditions
  - Locations subject to humidity outside the range specified in the storage/installation humidity conditions
  - Locations subject to condensation as the result of extreme changes in temperature
  - Locations subject to corrosive or flammable gases
  - Locations subject to dust, salts, or iron dust
  - Locations subject to exposure to water, oil, or chemicals
  - Locations subject to shock or vibration
- Do not hold the product by the cables, motor shaft, or encoder while transporting it.
  Failure to observe this caution may result in injury or malfunction.
- Do not place any load exceeding the limit specified on the packing box.
  Failure to observe this caution may result in injury or malfunction.
- If disinfectants or insecticides must be used to treat packing materials such as wooden frames, pallets, or plywood, the packing materials must be treated before the product is packaged, and methods other than fumigation must be used.
  Example: Heat treatment, where materials are kiln-dried to a core temperature of 56°C for 30 minutes or more.
  If the electronic products, which include stand-alone products and products installed in machines, are packed with fumigated wooden materials, the electrical components may be greatly damaged by the gases or fumes resulting from the fumigation process. In particular, disinfectants containing halogen, which includes chlorine, fluorine, bromine, or iodine can contribute to the erosion of the capacitors.

■ Installation

⚠ CAUTION

- Never use the product in an environment subject to water, corrosive gases, flammable gases, or combustibles.
  Failure to observe this caution may result in electric shock or fire.
- Do not step on or place a heavy object on the product.
  Failure to observe this caution may result in injury or malfunction.
- Do not cover the inlet or outlet ports and prevent any foreign objects from entering the product.
  Failure to observe this caution may cause internal elements to deteriorate resulting in malfunction or fire.
- Be sure to install the product in the correct direction.
  Failure to observe this caution may result in malfunction.
- Provide the specified clearances between the SERVOPACK and the control panel or with other devices.
  Failure to observe this caution may result in fire or malfunction.
- Do not apply any strong impact.
  Failure to observe this caution may result in malfunction.
- To prevent damage from static electricity, discharge any static electricity from your body before you touch the SERVOPACK.
- When working on the SERVOPACK, hold the edges of the SERVOPACK board, and never touch the surfaces of the components or the surface of the solder.
  There is a risk of injury or malfunction.
- During installation, take countermeasures against static electricity, such as using an anti-static wrist band.
  There is a risk of electric shock or failure.

■ Wiring

⚠ CAUTION

- Be sure to wire correctly and securely.
  Failure to observe this caution may result in motor overrun, injury, or malfunction.
- Do not connect a commercial power supply to the U, V, or W terminals for the servomotor connection.
  Failure to observe this caution may result in injury or fire.
- Securely connect the main circuit terminals.
  Failure to observe this caution may result in fire.
- Do not bundle the servomotor/encoder relay cable and the I/O signal cables together or run them through the same duct. Keep the servomotor/encoder cable and I/O signal cables at least 30 cm away from each other.
  Placing these cables too close to each other may result in malfunction.
- Use shielded twisted-pair cables or screened unshielded twisted-pair cables for I/O signal cables and the encoder cables.
- The maximum wiring length is 3 m for I/O signal cables, 10 m for servomotor/encoder relay cables, and 10 m for power supply cables.
- Install the battery in the battery unit of the encoder cable with a battery unit.
- Voltage remains in the SERVOPACK even after the power supply is turned OFF. To prevent electric shock, do not touch the input terminals for the main circuit power supply or those for the control power supply.
  Before wiring or inspections, confirm that the SERVOPACK has completely discharged.
- Be sure to observe the following precautions when wiring the SERVOPACK main circuit terminal blocks.
  - Do not turn the SERVOPACK power ON until all wiring, including the main circuit terminal blocks, has been completed.
  - Remove detachable power supply input connectors or motor connectors from the SERVOPACK before wiring.
- Make sure that the wiring for both the main circuit power supply and control power supply is correct.
  Incorrect wiring may cause damage.
- Make sure that the polarity of the input power supply is correct.
  Incorrect polarity may cause damage.
- Always use the specified power supply voltage.
  An incorrect voltage may result in fire or malfunction.
- Take appropriate measures to ensure that the input power supply is supplied within the specified voltage fluctuation range.
  An incorrect power supply may result in damage to the equipment.
- Install external breakers or other safety devices against short-circuiting in external wiring.
  Failure to observe this caution may result in fire.
- Take appropriate and sufficient countermeasures for each form of potential interference when installing systems in the following locations.
  - Locations subject to static electricity or other forms of noise
  - Locations subject to strong electromagnetic fields and magnetic fields
  - Locations subject to possible exposure to radioactivity
  - Locations close to power supplies

  Failure to observe this caution may result in damage to the equipment.
- Do not reverse the polarity of the battery when connecting it.
  Failure to observe this caution may damage the battery, the SERVOPACK or servomotor, or cause an explosion.
- Wiring or inspection must be performed by a technical expert.
- Use a 24-VDC or 48-VDC power supply with double insulation or reinforced insulation.
- Failures caused by incorrect wiring or wrong voltage application in the brake circuit may damage the equipment or cause an accident resulting in death or injury. Follow the procedures and instructions for wiring and trial operation precisely as described in this manual.
- When using a detector or a breaker for leakage current, select the appropriate one by considering the grounding conditions and the leakage current of noise filter. For details, contact the manufacturer of the noise filter.
- Incorrect wiring or incorrect voltage application to the output circuit may cause short-circuit.
  The above failures will prevent the holding brake from working, which may damage the machine or cause an accident resulting in death or injury.

⚠ CAUTION

- Inverting the polarity of the brake signal (/BK), i.e. positive logic, will prevent the holding brake from working in case of its signal line disconnection.
  If this setting is absolutely necessary, check the operation and confirm that there are no safety problems.
- Provide separate AC/DC converters for the main circuit power supply and the control power supply.
  Failure to observe this caution may result in malfunction.
- Do not connect devices (such as motors or solenoids) that greatly change the load or devices (such as electromagnetic switches) that generate surge voltages to the controller power line.
  Failure to observe this caution may result in deterioration of the internal elements or a blown fuse.

■ Operation

⚠ CAUTION

- Always use the servomotor and SERVOPACK in one of the specified combinations.
  Failure to observe this caution may result in fire or malfunction.
- Conduct trial operation on the servomotor alone with the motor shaft disconnected from the machine to avoid accidents.
  Failure to observe this caution may result in injury.
- During trial operation, confirm that the holding brake works correctly. Furthermore, secure system safety against problems such as signal line disconnection.
- Before starting operation with a machine connected, change the parameter 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.
- Do not turn the power ON and OFF more than necessary.
  Do not use the SERVOPACK for applications that require the power to turn ON and OFF frequently. Such applications will cause elements in the SERVOPACK to deteriorate.
  As a guideline, at least one hour should be allowed between the power being turned ON and OFF once actual operation has been started.
- When carrying out JOG operation, origin search, or EasyFFT, forcing movable machine parts to stop does not work for forward overtravel or reverse overtravel. Take necessary precautions.
  Failure to observe this caution may result in damage to the equipment.
- When using the servomotor for a vertical axis, install safety devices to prevent workpieces from falling due to alarms or overtravels. Set the servomotor so that it will stop in the zero clamp state when overtravel occurs.
  Failure to observe this caution may cause workpieces to fall due to overtravel.
- When not using the tuning-less function, set the correct moment of inertia ratio (Pn103).
  Setting an incorrect moment of inertia ratio may cause machine vibration.
- Do not touch the SERVOPACK or servomotor while power is ON or soon after the power is turned OFF.
  Failure to observe this caution may result in burns due to high temperatures.
- Do not make any extreme adjustments or setting changes of parameters.
  Failure to observe this caution may result in injury or damage to the equipment due to unstable operation.
- When an alarm occurs, remove the cause, reset the alarm after confirming safety, and then resume operation.
  Failure to observe this caution may result in damage to the equipment, fire, or injury.
- Do not use the holding brake of the servomotor for braking.
  Failure to observe this caution may result in malfunction.
- The servomotor will decelerate to a stop if the main-circuit or the control-circuit power supply turns OFF during operation without turning servo OFF.
- An alarm or warning may occur if communications are performed with the host controller while the SigmaWin+ is operating.
  If an alarm or warning occurs, it may stop the current process and stop the system.

Maintenance and Inspection

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

Disposal

⚠ CAUTION
• When disposing of the products, treat them as ordinary industrial waste.

General Precautions

Observe the following general precautions to ensure safe application.
• The products shown in illustrations 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. • 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.

Warranty

(1) Details of Warranty

■ Warranty Period

The warranty period for a product that was purchased (hereinafter called “delivered product”) is one year from the time of delivery to the location specified by the customer or 18 months from the time of shipment from the Yaskawa factory, whichever is sooner.

■ Warranty Scope

Yaskawa shall replace or repair a defective product free of charge if a defect attributable to Yaskawa occurs during the warranty period above. This warranty does not cover defects caused by the delivered product reaching the end of its service life and replacement of parts that require replacement or that have a limited service life.

This warranty does not cover failures that result from any of the following causes.

1. Improper handling, abuse, or use in unsuitable conditions or in environments not described in product catalogs or manuals, or in any separately agreed-upon specifications
2. Causes not attributable to the delivered product itself
3. Modifications or repairs not performed by Yaskawa
4. Abuse of the delivered product in a manner in which it was not originally intended
5. Causes that were not foreseeable with the scientific and technological understanding at the time of shipment from Yaskawa
6. Events for which Yaskawa is not responsible, such as natural or human-made disasters

(2) Limitations of Liability

1. Yaskawa shall in no event be responsible for any damage or loss of opportunity to the customer that arises due to failure of the delivered product.
2. Yaskawa shall not be responsible for any programs (including parameter settings) or the results of program execution of the programs provided by the user or by a third party for use with programmable Yaskawa products.
3. The information described in product catalogs or manuals is provided for the purpose of the customer purchasing the appropriate product for the intended application. The use thereof does not guarantee that there are no infringements of intellectual property rights or other proprietary rights of Yaskawa or third parties, nor does it construe a license.
4. Yaskawa shall not be responsible for any damage arising from infringements of intellectual property rights or other proprietary rights of third parties as a result of using the information described in catalogs or manuals.

(3) Suitability for Use

1. It is the customer's responsibility to confirm conformity with any standards, codes, or regulations that apply if the Yaskawa product is used in combination with any other products.
2. The customer must confirm that the Yaskawa product is suitable for the systems, machines, and equipment used by the customer.
3. Consult with Yaskawa to determine whether use in the following applications is acceptable. If use in the application is acceptable, use the product with extra allowance in ratings and specifications, and provide safety measures to minimize hazards in the event of failure.
   - Outdoor use, use involving potential chemical contamination or electrical interference, or use in conditions or environments not described in product catalogs or manuals
   - Nuclear energy control systems, combustion systems, railroad systems, aviation systems, vehicle systems, medical equipment, amusement machines, and installations subject to separate industry or government regulations
   - Systems, machines, and equipment that may present a risk to life or property
   - Systems that require a high degree of reliability, such as systems that supply gas, water, or electricity, or systems that operate continuously 24 hours a day
   - Other systems that require a similar high degree of safety
4. Never use the product for an application involving serious risk to life or property without first ensuring that the system is designed to secure the required level of safety with risk warnings and redundancy, and that the Yaskawa product is properly rated and installed.
5. The circuit examples and other application examples described in product catalogs and manuals are for reference. Check the functionality and safety of the actual devices and equipment to be used before using the product.
6. Read and understand all use prohibitions and precautions, and operate the Yaskawa product correctly to prevent accidental harm to third parties.

(4) Specifications Change

The names, specifications, appearance, and accessories of products in product catalogs and manuals may be changed at any time based on improvements and other reasons. The next editions of the revised catalogs or manuals will be published with updated code numbers. Consult with your Yaskawa representative to confirm the actual specifications before purchasing a product.

Complying with European Directives

■ European Directives

	Model	European Directives	Harmonized Standards
SERVOPACK	SGDV-MD	EMC Directive 2004/108/EC	EN 55011 /group 1, class A EN 61000-6-2 EN 61000-6-4 EN 61800-3
		Low Voltage Directive 2006/95/EC	EN 61800-5-1
Servomotor	SGMMV	EMC Directive 2004/108/EC	EN 55011 /group 1, class A EN 61000-6-2 EN 61800-3
		Low Voltage Directive 2006/95/EC	EN 60034-1 EN 60034-5

Contents

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Outline

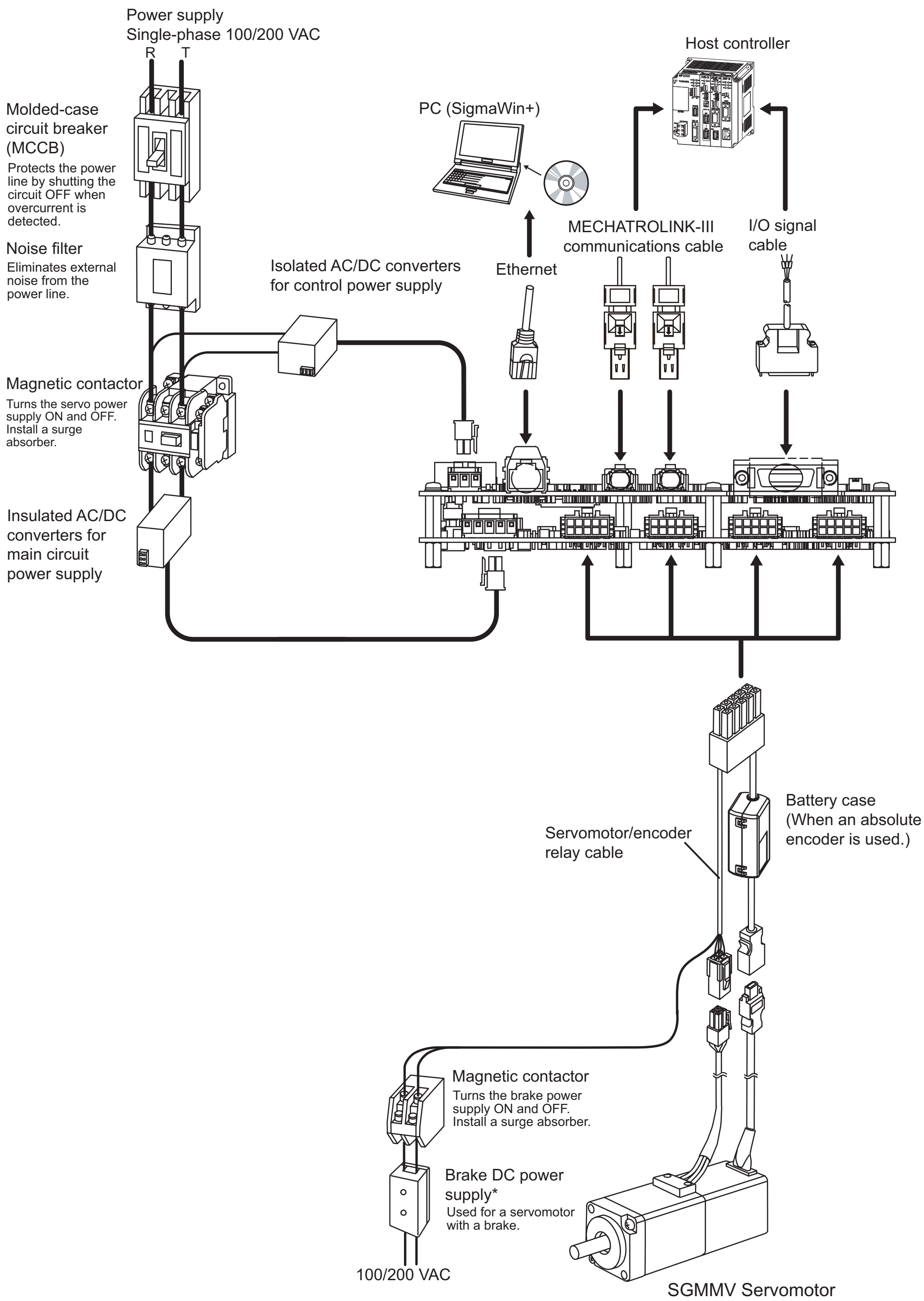
1.1 Σ-V-MD-series Type A01/A02 SERVOPACKs

A Σ-V-MD-series Type A01/A02 SERVOPACK can drive multiple servomotors (axes). The SERVOPACK makes the most of machine performance to help improve productivity.

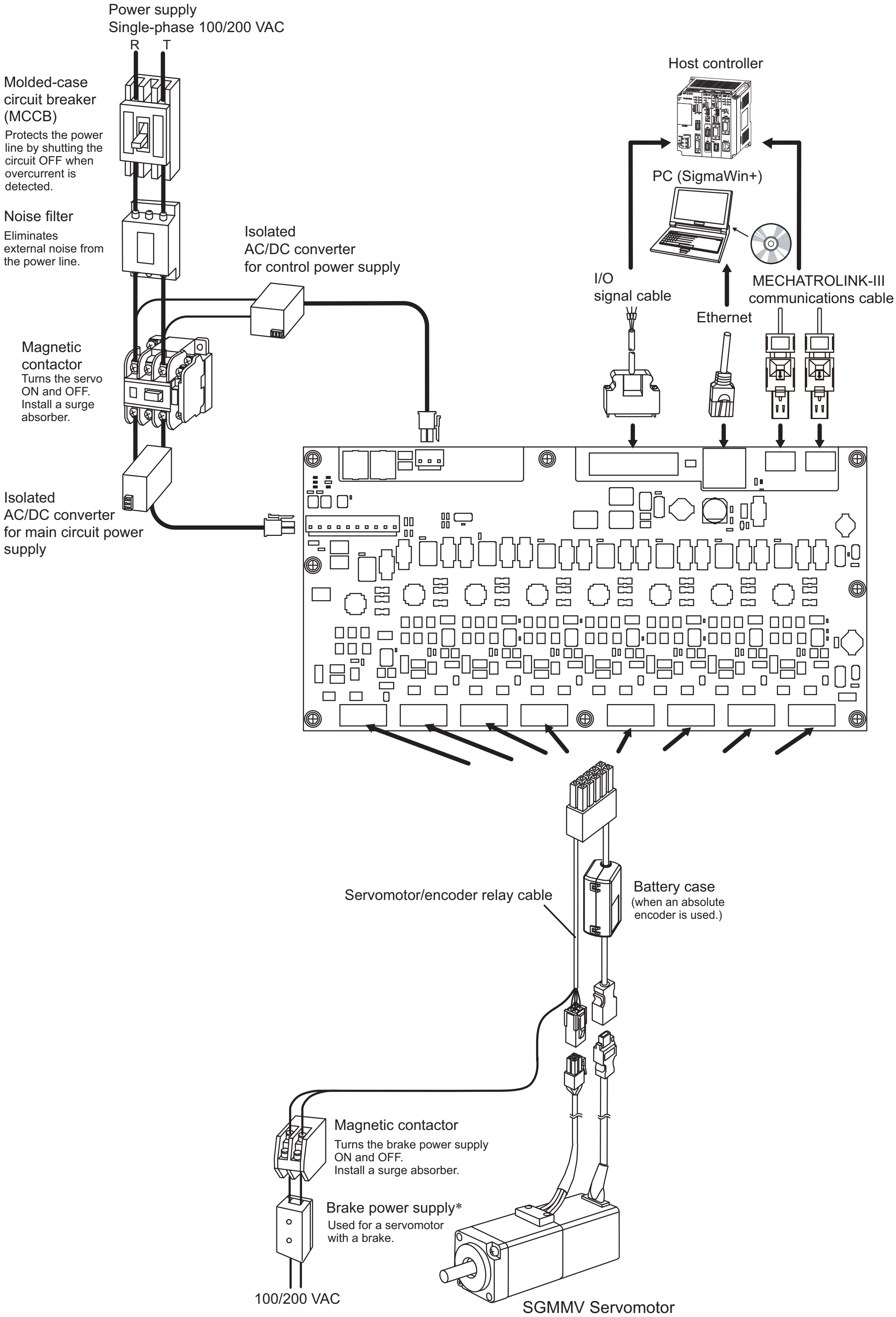
1.2 Examples of Servo System Configurations

This section describes examples of basic servo system configuration.

1.2.1 Type A01 Configurations



1.2.2 Type A02 Configurations



Outline

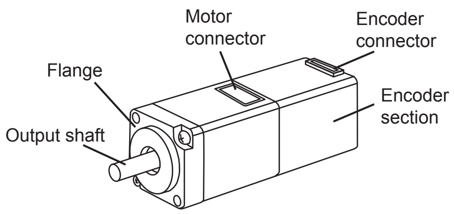
1

1.3 Part Names

This section describes the parts of an SGMMV servomotor and an SGDV-MD MECHATROLINK-III communications reference SERVOPACK.

1.3.1 Servomotor

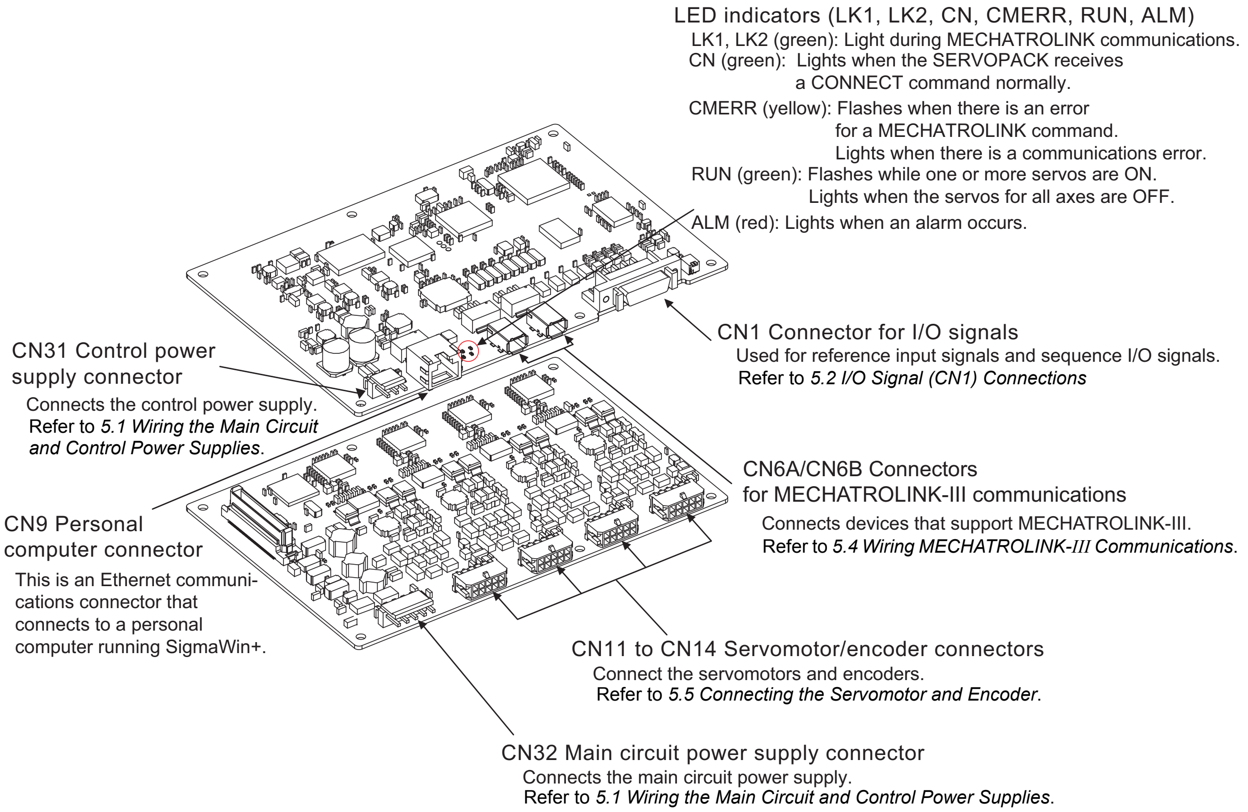
This section describes the parts of a servomotor.



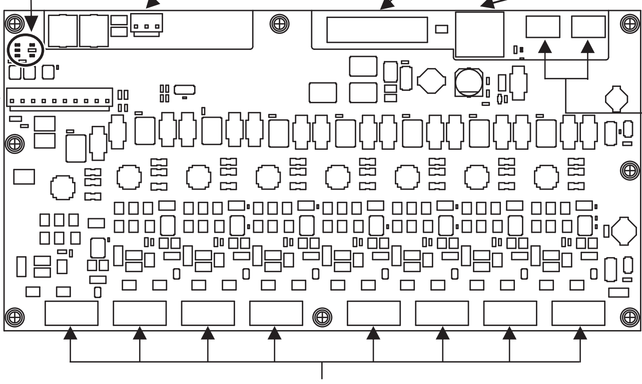
1.3.2 SERVOPACK

This section describes the parts of a SERVOPACK.

(1) Type A01 SERVOPACK

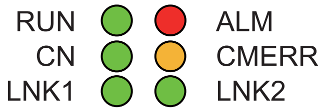


(2) Type A02 SERVOPACK



The SERVOPACK has operating status indicators and a power indicator.

• Operating Status Indicators

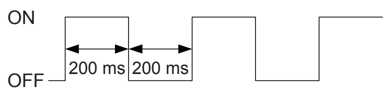
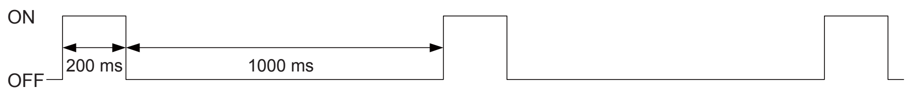
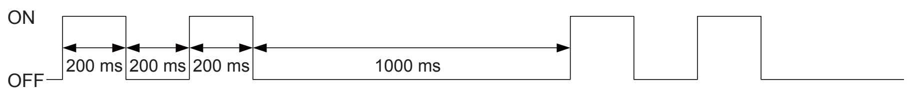


You can check the operating status of the SERVOPACK with the operating status indicators.

Indicator Name	Color	Description	Status	Operating Status
RUN	Green	Servo operating status	Not lit.	Initializing (booting)
			Flashing.	Servo ON*1
			Flashes twice.	Overtravel
			Lit.	Servo OFF for all axes.
ALM	Red	Servo error	Not lit.	Normal status for all axes
			Flashes once.	Servo warning*2
			Lit.	Servo alarm*2 or initializing
CN	Green	MECHATROLINK-III communications status	Not lit.	Power ON (phase 0)
			Flashing.	Waiting for a connection (phase 1)
			Lit.	Connection completion*3 (phases 2 and 3)
CMERR	Yellow	MECHATROLINK-III communications error status	Not lit.	Normal communications
			Flashes once.	Command error (CMD_ALM)
			Lit.	Communications error (COMM_ALM)
LK1	Green	MECHATROLINK-III port 1 link status	Not lit.	No MECHATROLINK-III link (no MECHATROLINK-III communications connection)
			Lit.	MECHATROLINK-III link (electrical connection to device)
LK2	Green	MECHATROLINK-III port 2 link status	Not lit.	No MECHATROLINK-III link (no MECHATROLINK-III communications cable connection)
			Lit.	MECHATROLINK-III link (electrical connection to device)

*1. Servo ON status is indicated if the servo is ON for even one axis.
*2. A warning or alarm is indicated if there is a warning or alarm for even one axis.
*3. Connection completion is indicated if there is a connection for even one axis.

The lighting patterns of the operating status indicates are shown in the following table.

Status	Indicator Lighting Pattern
Not lit.	Always OFF.
Flashing.	
Flashes once.	
Flashes twice.	
Lit.	Always ON.

• Power Supply Indicator

You can check the status of the power supply to the SERVOPACK with the power supply indicator.

Indicator Name	Color	Description	Status	Power Supply Status
POWER	Orange	Main circuit power supply status	Not lit.	The main circuit power supply is OFF.
			Lit.	The main circuit power supply is ON.

2

Selecting Products

2.1 Model Designations

This section describes how to interpret the model numbers of servomotors and SERVOPACKs.

2.1.1 Servomotors

This section describes how to interpret the model numbers of servomotors.

	1st + 2nd digits	3rd digit	4th digit	5th digit	6th digit	7th digit
SGMMV –	A1	A	2	A	2	1

1st + 2nd digits: Rated Output	
Code	Specification
B3	3.3 W
B5	5.5 W
B9	11 W
A1	10 W
A2	20 W
A3	30 W

3rd digit: Power Supply Voltage	
Code	Specification
E	24 or 48 VDC*

* The same model is used for either 24 or 28 VDC. Characteristics depend on the main circuit voltage of the SERVOPACK.

4th digit: Serial Encoder	
Code	Specification
2	17-bit absolute

5th digit: Design Revision Order	
Code	Specification
A	Standard

6th digit: Shaft End	
Code	Specification
2	Straight (standard)
A	Straight with flat seats (optional)

7th digit: Options	
Code	Specification
1	No options
C	With holding brake (24 VDC, flange size: 25 × 25 mm)

2.1.2 SERVOPACKs

This section describes how to interpret the model numbers of SERVOPACKs.

(1) Type A01 SERVOPACK

	1st digit	2nd digit	3rd digit	4th digit	5th digit	6th digit
SGDV – MD	A01	E	8	M3	A	02

Series	
SGDV-MD	Σ-V-MD Series

Product Type	
Code	Specification
A01	–

Power Supply Voltage	
Code	Specification
E	24 or 48 VDC

Number of Axes	
Code	Specification
4	4 axes
8	8 axes
C	12 axes

Interface Specification	
Code	Specification
M3	MECHATROLINK-III

Design Revision Order

Options	
Code	Specification
–	Without mounting option
02	With mounting option

(2) Type A02 SERVOPACK

1st digit: A02 · 2nd digit: E · 3rd digit: 8 · 4th digit: M3 · 5th digit: A · 6th digit: 01

SGDV – MD A02 E 8 M3 A 01

Series	
SGDV-MD	Σ-V-MD Series

Product Type	
Code	Specification
A02	–

Power Supply Voltage	
Code	Specification
E	24 or 48 VDC

Number of Axes	
Code	Specification
8	8 axes

Interface Specification	
Code	Specification
M3	MECHATROLINK-III

Design Revision Order

Options	
Code	Specification
–	No I/O
01	I/O provided.

Selecting Products

2

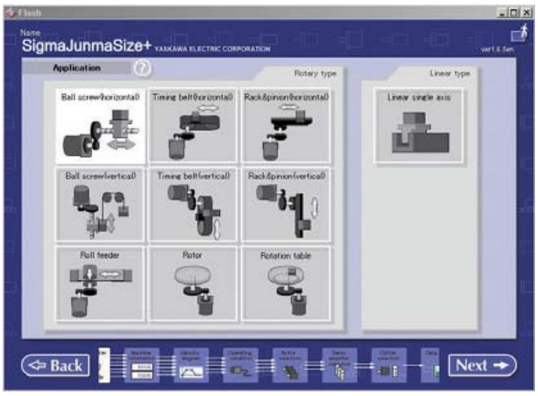
2.2 Selecting Servomotors

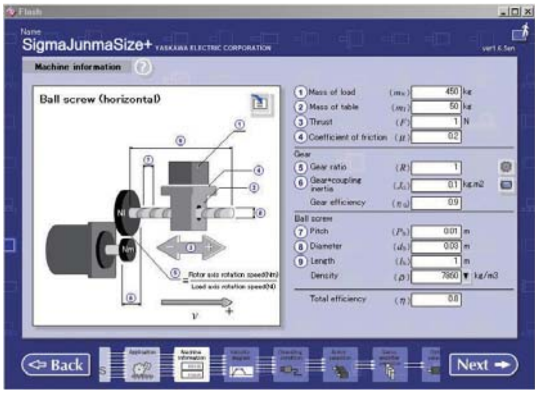
This section describes how to select servomotors.

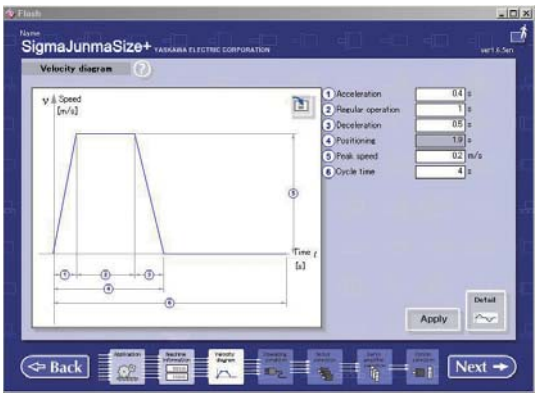
2.2.1 SigmaJunmaSize+

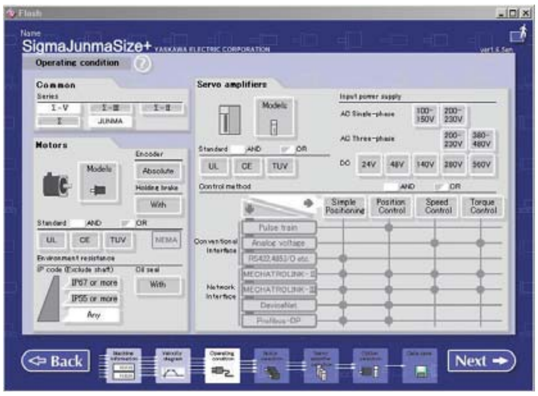
Yaskawa provides the SigmaJunmaSize+ AC servomotor capacity selection program to help you easily select AC servomotor capacities. The SigmaJunmaSize+ is a Web-based application. You can use it at the following website: http://www.e-mechatronics.com/support/tool/servo/sgmjnmsizepls/.
The SigmaJumaSize+ does not directly support making combinations with Σ-V-MD-series SERVOPACKs. To select a servomotor capacity, select a DC power input SGDV-☐☐☐E SERVOPACK.

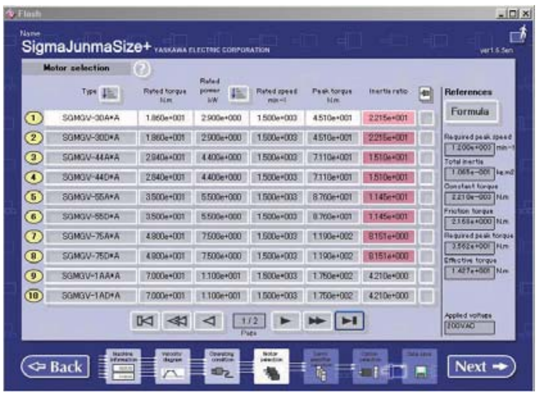
• Servo Setting View Examples







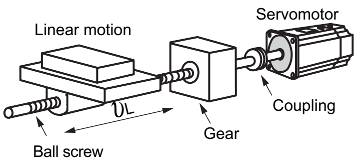




2.2.2 Selection Calculations

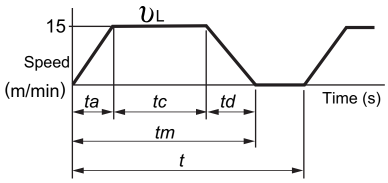
This section describes how to make the calculations and select a servomotor for the following machine specifications.

Mechanical Specifications



- Load speed: υ_L = 15 m/min
- Linear motion section mass: m = 250 kg
- Ball screw length: l_B = 1.0 m
- Ball screw diameter: d_B = 0.02 m
- Ball screw lead: P_B = 0.01 m
- Ball screw material density : $\rho = 7.87 \times 10^3$ kg/m^3
- Gear ratio : 1/2 (R = 2)
- Gear + coupling moment of inertia: $J_G = 0.40 \times 10^{-4}$ kg·m^2
- Feeding times: n = 40 times/min
- Feeding distance: l = 0.275 m
- Feeding time: tm = 1.2 s max.
- Friction coefficient: μ = 0.2
- Mechanical efficiency: η = 0.9 (90%)

(1) Speed Diagram



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

where $ta = td$

$$ta = tm - \frac{60\ell}{\upsilon_L} = 1.2 - \frac{60 \times 0.275}{15} = 1.2 - 1.1 = 0.1\text{(s)}$$

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

(2) Rotation Speed

- Load axis rotation speed $\quad n_L = \dfrac{\upsilon_L}{P_B} = \dfrac{15}{0.01} = 1500\,(\text{min}^{-1})$
- Motor shaft rotation speed $\quad$ Gear ratio 1/R = 1/2 (R=2)
  Therefore, $n_M = n_L \cdot R = 1500 \times 2 = 3000\ (\text{min}^{-1})$

(3) Load Torque

$$T_L = \frac{9.8\mu \cdot m \cdot P_B}{2\pi R \cdot \eta} = \frac{9.8 \times 0.2 \times 250 \times 0.01}{2\pi \times 2 \times 0.9} = 0.43\,(\text{N}\cdot\text{m})$$

(4) Load Moment of Inertia

- Linear motion section $\quad J_{L1} = m\left(\dfrac{P_B}{2\pi R}\right)^2 = 250 \times \left(\dfrac{0.01}{2\pi \times 2}\right)^2 = 1.58 \times 10^{-4}\,(\text{kg}\cdot\text{m}^2)$
- Ball screw $\quad J_B = \dfrac{\pi}{32}\rho \cdot \ell_B \cdot d_B{}^4 \cdot \dfrac{1}{R^2} = \dfrac{\pi}{32} \times 7.87 \times 10^3 \times 1.0 \times (0.02)^4 \cdot \dfrac{1}{2^2} = 0.31 \times 10^{-4}\,(\text{kg}\cdot\text{m}^2)$
- Coupling $\quad J_G = 0.40 \times 10^{-4}\ (\text{kg}\cdot\text{m}^2)$
- Load moment of inertia at motor shaft $\quad J_L = J_{L1} + J_B + J_G = (1.58 + 0.31 + 0.40) \times 10^{-4} = 2.29 \times 10^{-4}\ (\text{kg}\cdot\text{m}^2)$

(5) Load Moving Power

$$P_O = \frac{2\pi n_M \cdot T_L}{60} = \frac{2\pi \times 3000 \times 0.43}{60} = 135\,(\text{W})$$

(6) Load Acceleration Power

$$Pa = \left(\frac{2\pi}{60}n_M\right)^2 \frac{J_L}{ta} = \left(\frac{2\pi}{60} \times 3000\right)^2 \times \frac{2.29 \times 10^{-4}}{0.1} = 226\,(\text{W})$$

Selecting Products

2

(7) Servomotor Provisional Selection

■ Selecting Conditions

- $T_L \leqq$ Motor rated torque
- $\frac{(P_o + P_a)}{2} <$ Provisionally selected servomotor rated output $< (P_o + P_a)$
- $n_M \leqq$ Motor rated speed
- $J_L \leqq$ Allowable load moment of inertia

The followings satisfy the conditions.

- Servomotor SGMJV-02A

■ Specifications of the Provisionally Selected Servomotor

- Rated output: 200 (W)
- Rated motor speed: 3000 (min^{-1})
- Rated torque: 0.637 (N·m)
- Instantaneous peak torque: 2.23 (N·m)
- Servomotor moment of inertia: 0.259×10^{-4}(kg·m^2)
- Allowable load moment of inertia: $0.259 \times 10^{-4} \times 15 = 3.885 \times 10^{-4}$(kg·m^2)

(8) Verification on the Provisionally Selected Servomotor

Check the following items to verify that the provisionally selected servomotor is suitable for the machine specifications.

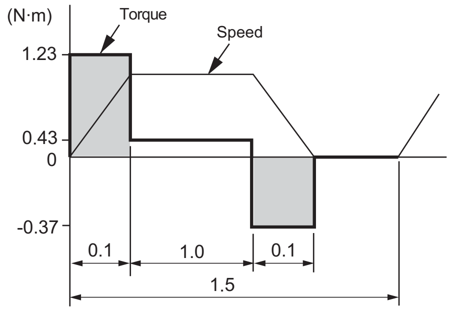
- Required acceleration torque: $T_P = \frac{2\pi n_M (J_M + J_L)}{60ta} + T_L = \frac{2\pi \times 3000 \times (0.259 + 2.29) \times 10^{-4}}{60 \times 0.1} + 0.43$
  $\fallingdotseq 1.23$ (N·m) < Instantaneous peak torque…Satisfactory

- Required deceleration torque: $T_S = \frac{2\pi n_M (J_M + J_L)}{60td} - T_L = \frac{2\pi \times 3000 \times (0.259 + 2.29) \times 10^{-4}}{60 \times 0.1} - 0.43$
  $\fallingdotseq 0.37$ (N·m) < Instantaneous peak torque…Satisfactory

- Torque effective value: $Trms = \sqrt{\frac{T_P^2 \cdot ta + T_L^2 \cdot tc + T_S^2 \cdot td}{t}} = \sqrt{\frac{(1.23)^2 \times 0.1 + (0.43)^2 \times 1.0 + (0.37)^2 \times 0.1}{1.5}}$
  $\fallingdotseq 0.483$ (N·m) < Rated torque…Satisfactory

(9) Result

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



2.3 Combinations

Rotational Servomotor			SERVOPACK Model
Model		Capacity	
SGMMV (ultra-low capacity, low inertia)	SGMMV-B3E	3.3 W	SGDV-MDA01E□M3A□□ or SGDV-MDA02E8M3A□□
	SGMMV-B5E	5.5 W	
	SGMMV-B9E	11 W	
	SGMMV-A1E	10 W	
	SGMMV-A2E	20 W	
	SGMMV-A3E	30 W	

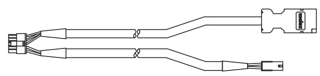
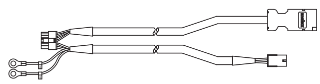
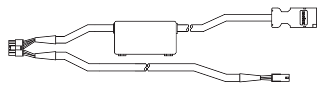
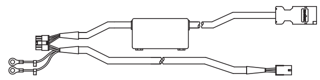
2.4 Selecting Cables

This section describes the various cables that are required to operate a SERVOPACK.

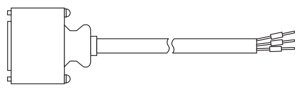
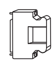
2.4.1 Power Supply Cables

The user must provide the main circuit power supply cable and control power supply cable. Refer to *5.1.2 Main Circuit and Control Power Supply Cables* for the housings, contacts, and wire sizes for the power supply cables.

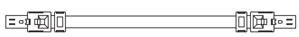
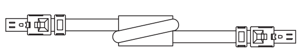
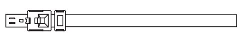
2.4.2 Servomotor/Encoder Relay Cables

Cable Name		Length	Model	Appearance
Servomotor/Encoder Relay Cables	For servomotor without holding brake and incremental encoder, no battery case	1 m	JZSP-CV1WI0-01-E	
		3 m	JZSP-CV1WI0-03-E	
		5 m	JZSP-CV1WI0-05-E	
		10 m	JZSP-CV1WI0-10-E	
	For servomotor with holding brake and incremental encoder, no battery case	1 m	JZSP-CV1WJ0-01-E	
		3 m	JZSP-CV1WJ0-03-E	
		5 m	JZSP-CV1WJ0-05-E	
		10 m	JZSP-CV1WJ0-10-E	
	For servomotor without holding brake and absolute encoder, with battery case	1 m	JZSP-CV1WA0-01-E	
		3 m	JZSP-CV1WA0-03-E	
		5 m	JZSP-CV1WA0-05-E	
		10 m	JZSP-CV1WA0-10-E	
	For servomotor with holding brake and absolute encoder, with battery case	1 m	JZSP-CV1WB0-01-E	
		3 m	JZSP-CV1WB0-03-E	
		5 m	JZSP-CV1WB0-05-E	
		10 m	JZSP-CV1WB0-10-E	

2.4.3 I/O Signal Cables

Cable Name		Length	Model	Appearance
Cables for I/O Signals	Cable with Loose wire at One End	1 m	JZSP-CSI02-1-E	
		2 m	JZSP-CSI02-2-E	
		3 m	JZSP-CSI02-3-E	
	Connector Kit	–	JZSP-CSI9-2-E	

2.4.4 MECHATROLINK Communications Cables

Name		Length	Order No.	Appearance
MECHATROLINK-III Communication Cable	Cables with Connectors at Both Ends	0.2 m to 50 m	JEPMC-W6012-□□-E	
	Cables with Connectors at Both Ends (With Ferrite Core)	10 m to 50 m	JEPMC-W6013-□□-E	
	Cable with Loose Wire at One End	0.5 m to 50 m	JEPMC-W6014-□□-E	

2.4.5 Ethernet Cables

Cable Name	Specifications
Ethernet Cable	100BASE-TX twisted-pair cable (category 5 or higher)

2.5 Selecting Peripheral Devices

The user must provide the peripheral devices.

Peripheral Device	Order No.
Molded-case circuit breakers	The user must provide suitable devices according to the system specifications.
Fuses	
Magnetic contactors	
Isolated AC/DC converters for main circuit power supply	
Isolated AC/DC converters for control power supply	
Brake power supply	
Noise filters	
Surge absorbers	

Note: When you select peripheral devices, confirm system specifications and refer to *5.1.5 Input Power Supply, Molded-case Circuit Breaker, and Fuse*.

3

Specifications and Dimensional Drawings

3.1 Servomotors

This section provides the specifications and dimensional drawings of the servomotors.

3.1.1 Ratings and Specifications

Time Rating: Continuous

Vibration Class: V15

Insulation Resistance: 500 VDC, 10 MΩ min.

Surrounding Air Temperature: 0 to 40°C

Excitation: Permanent magnet

Mounting: Flange-mounted

Thermal Class: 15 mm × 15 mm B (UL: A)
25 mm × 25 mm B

Withstand Voltage: 600 VAC for one minute

Enclosure: 15 mm × 15 mm: Totally enclosed, selfcooled, IP42 (except for shaft opening)
25 mm × 25 mm: Totally enclosed, selfcooled, IP55 (exept for shaft opening)

Surrounding Air Humidity: 20% to 80% (no condensation)

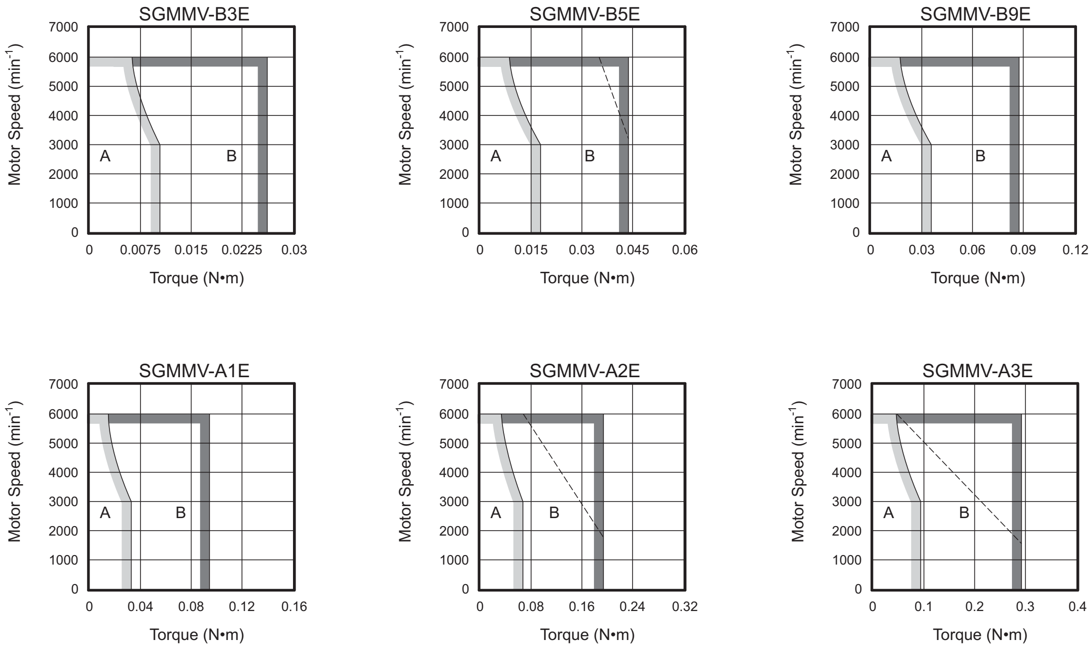
Drive Method: Direct drive

Rotation Direction: Counterclockwise (CCW) with forward run

Voltage		24 VDC/48 VDC*3					
Servomotor Model: SGMMV-□□□		B3E	B5E	B9E	A1E	A2E	A3E
Rated Output*1	W	3.3	5.5	11	10	20	30
Rated Torque*1, *2	N•m	0.0105	0.0175	0.0350	0.0318	0.0637	0.0955
Instantaneous Peak Torque*1	N•m	0.0263	0.0438	0.0875	0.0955	0.191	0.286
Rated Current*1	Arms	1.5	1.5	1.7	2.1	2.0	2.9
Instantaneous Max. Current*1	Arms	3.6	3.7	4.1	6.1	5.8	8.6
Rated Speed*1	min^{-1}	3000					
Max. Speed*1	min^{-1}	6000					
Torque Constant	N•m/Arms	0.00814	0.0132	0.0241	0.0172	0.0358	0.0358
Rotor Moment of Inertia	kg•m^2	4.41×10^{-8}	7.96×10^{-8}	2.21×10^{-7}	2.72×10^{-7} (4.07×10^{-7})	4.66×10^{-7} (6.02×10^{-7})	6.68×10^{-7} (8.04×10^{-7})
Rated Power Rate*1	kW/s	2.50	3.85	5.54	3.72	8.71	13.7
Rated Angular Acceleration*1	rad/s^2	238000	220000	158000	117000	13700	143000
Flange Size	mm	15 × 15			25 × 25		

∗1. These items and torque-motor speed characteristics quoted in combination with an SGDV SERVOPACK are at an armature winding temperature of 100°C. Other values quoted are at 20°C.
∗2. Rated torques are continuous allowable torque values at 40°C with an aluminum heat sink of the following dimensions attached.
SGMMV-B3E, -B5E, -B9E, -A1E, -A2E: 150 mm × 150 mm × 3 mm
SGMMV-A3E : 250 mm × 250 mm × 6 mm
∗3. Torque-speed characteristics differ depending on if a 24 VDC or a 48 VDC is used for the main circuit for the SERVOPACK.
Note: The values in parentheses are for servomotors with holding brakes.

(1) Torque-Motor Speed Characteristics



Note 1. The characteristics of the intermittent duty zone differ depending on the supply voltage.
Solid lines indicate characteristics when a 48-VDC power supply is applied to the main circuit of the SERVOPACK, and dotted lines indicate characteristics when a 24 VDC is applied.
2. When the effective torque is within the rated torque, the servomotor can be used within the intermittent duty zone.

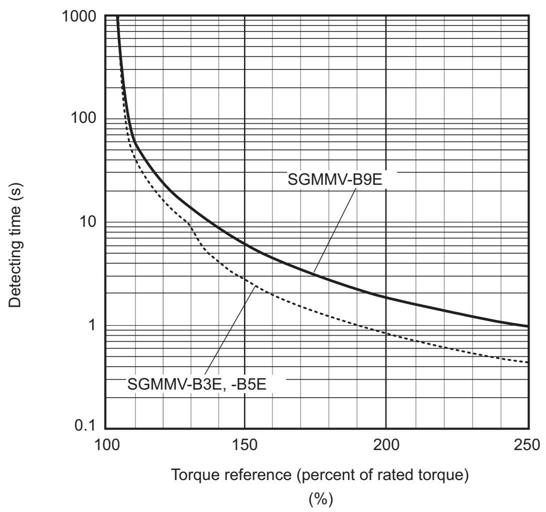
(2) Holding Brake Electrical Specifications

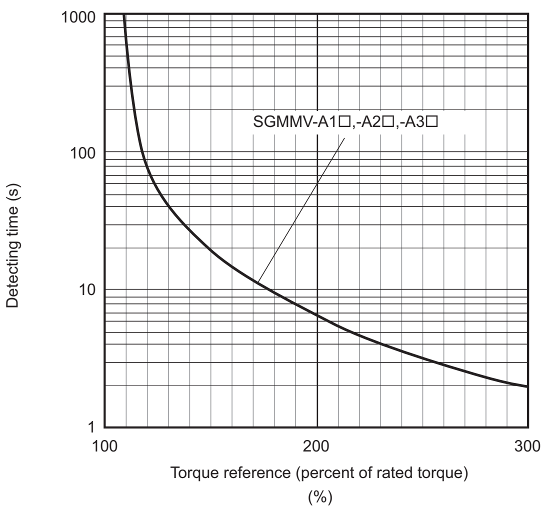
Holding Brake Rated Voltage	Servomotor Model	Servomotor Rated Output [W]	Holding Brake Specifications					
			Capacity [W]	Holding Torque [N•m]	Coil Resistance [Ω] (at 20°C)	Rated Current [A] (at 20°C)	Brake Release Time [ms]	Brake Operation Time [ms]
24 VDC $^{+10\%}_{\ \ 00}$	SGMMV–A1E SGMMV–A1A	10	2.0	0.0318	320	0.075	40	100
	SGMMV–A2E SGMMV–A2A	20	2.6	0.0637	221.5	0.108	40	100
	SGMMV–A3E SGMMV–A3A	30	2.6	0.0955	221.5	0.108	40	100

Note 1. The holding brake is only used to hold the load and cannot be used to stop the servomotor.
2. The holding brake release time and holding brake operation time vary depending on which discharge circuit is used. Make sure holding brake release time and holding brake operation time are correct for your servomotor.
3. A 24-VDC power supply is not included.

(3) Overload Characteristics

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





Note: Overload characteristics shown above do not guarantee continuous duty of 100% or more output. Use a servomotor with effective torque within the continuous duty zone of Torque-Motor Speed Characteristics.

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

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

Servomotor Model	Servomotor Rated Output		Allowable Load Moment of Inertia (Rotor Moment of Inertia Ratio)
SGMMV–	B3	3.3 W	30 times
	B5	5.5 W	
	B9	11 W	
	A1	10 W	
	A2	20 W	
	A3	30 W	

(5) Load Moment of Inertia

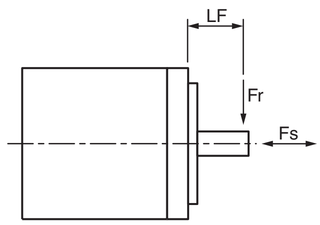
The larger the load moment of inertia, the worse the movement response.
The allowable load moment of inertia (J_L) depends on the motor capacity, as shown above. This value is provided strictly as a guideline and results may vary depending on servomotor drive conditions.
Use the AC servo drive capacity selection program SigmaJunmaSize+ to check the operation conditions.
The program can be downloaded for free from our web site (http://www.e-mechatronics.com/).

An overvoltage alarm (A.400) is likely to occur during deceleration if the load moment of inertia exceeds the allowable load moment of inertia. Take one of the following steps if this occurs.

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

(6) Allowable Radial and Thrust Loads

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

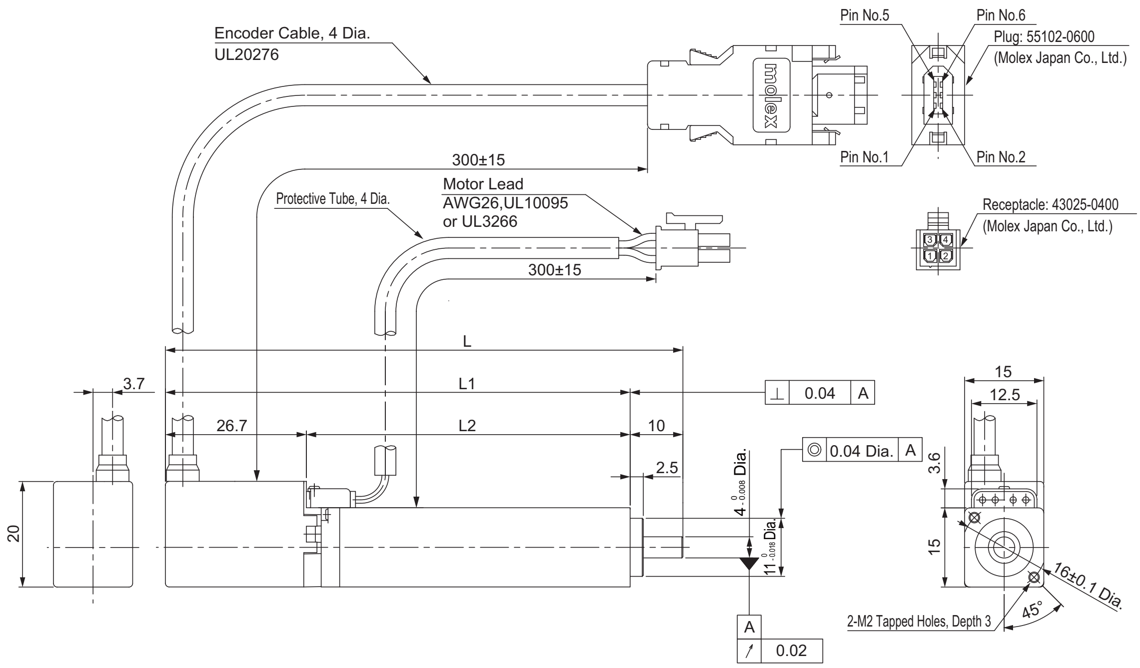
Servomotor Model		Allowable Radial Load (Fr) [N]	Allowable Thrust Load (Fs) [N]	LF [mm]	Reference Diagram
SGMMV−	B3	8	4	10	
	B5	8	4	10	
	B9	10	4	10	
	A1	34	14.5	16	
	A2	44	14.5	16	
	A3	44	14.5	16	

3.1.2 Dimensional Drawings

This section provides dimensional drawings of the servomotors.

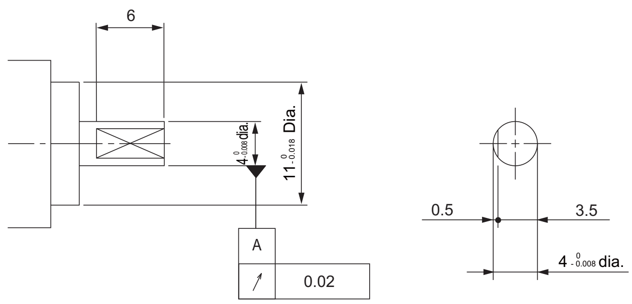
Dimensions in the dimensional drawings are in millimeters.

(1) 3.3 to 11 W



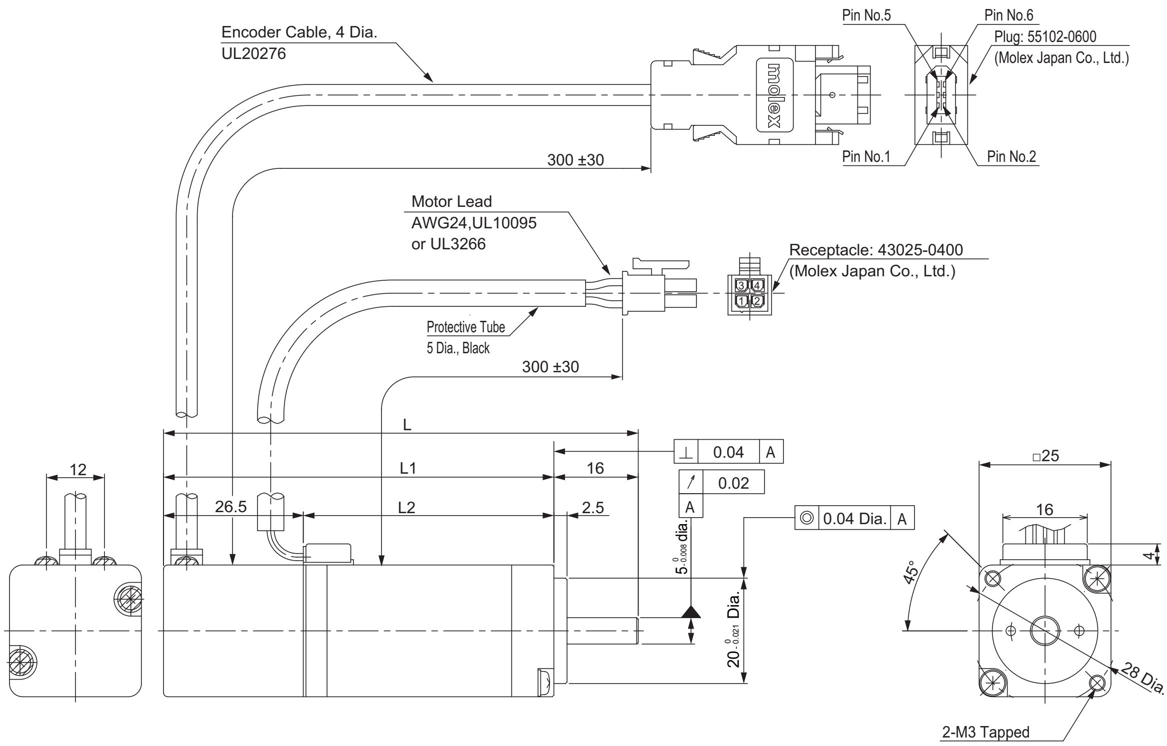
Model SGMMV–	L	L1	L2	Approx. Mass [kg]
B3E2A□1	58	48	21.3	0.055
B5E2A□1	64	54	27.3	0.06
B9E2A□1	98	88	61.4	0.1

<Shaft End>
With a Flat Seat



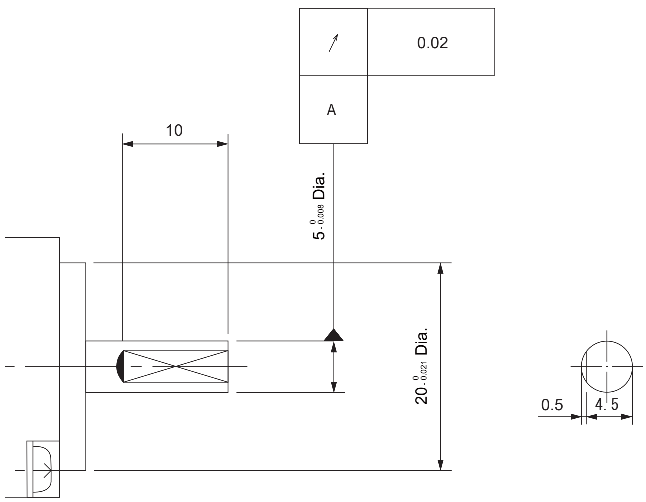
(2) 10 to 30 W

■ Servomotors without Holding Brakes

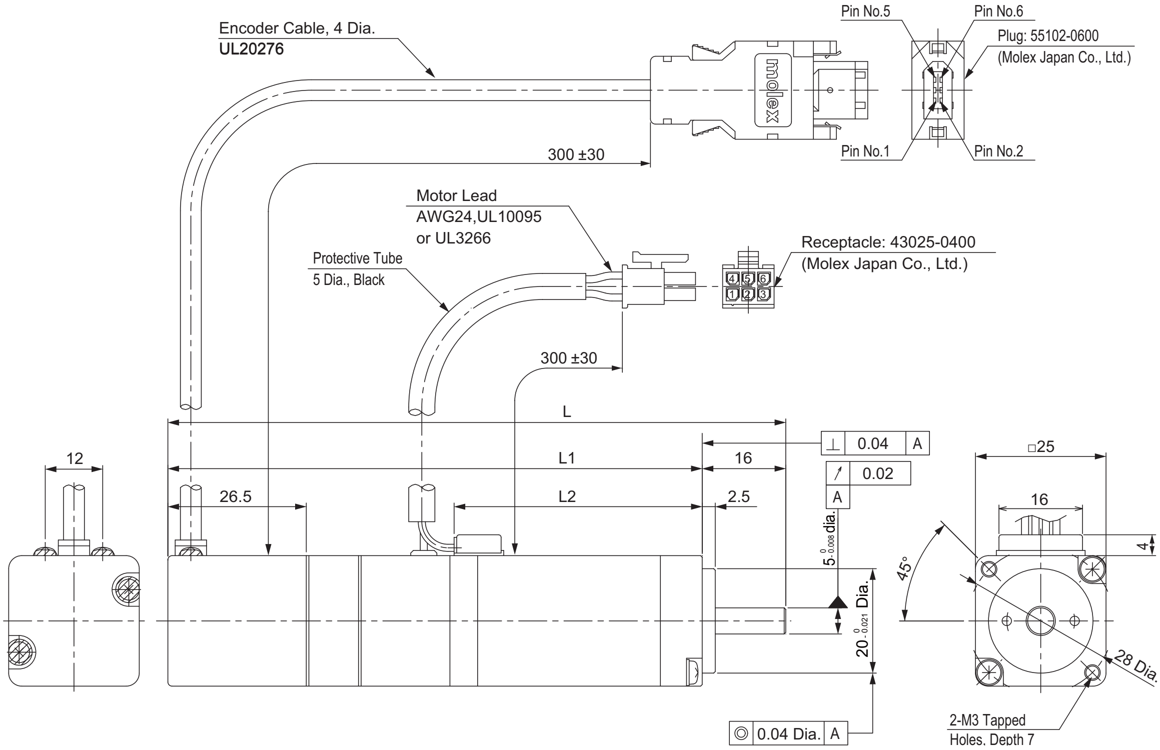


Model SGMMV–	L	L1	L2	Approx. Mass [kg]
A1□2A□1	70	54	27.5	0.13
A2□2A□1	80	64	37.5	0.17
A3□2A□1	90	74	47.5	0.21

<Shaft End>
Servomotors with a Flat Seat

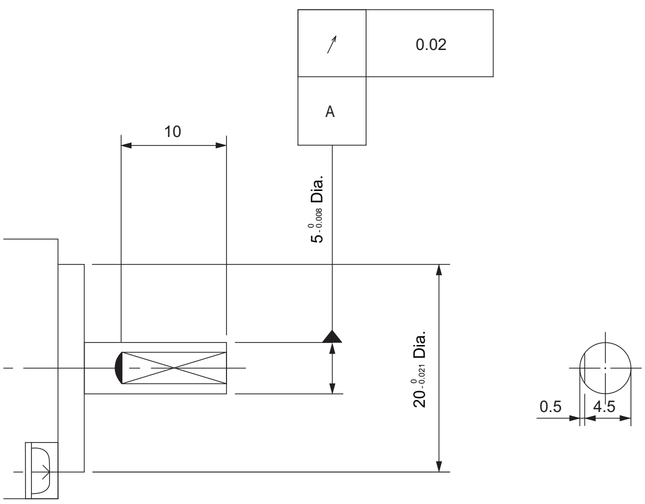


■ Servomotors with Holding Brakes



Model SGMMV–	L	L1	L2	Approx. Mass [kg]
A1□2A□C	94.5	78.5	27.5	0.215
A2□2A□C	108.5	92.5	37.5	0.27
A3□2A□C	118.5	102.5	47.5	0.31

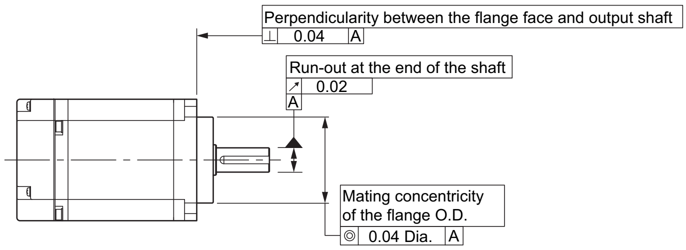
<Shaft End>
Servomotors with a Flat Seat



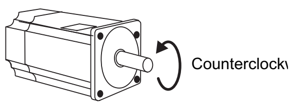
3.1.3 Mechanical Specifications

(1) Mechanical Tolerance

The following figure shows tolerances for the servomotor’s output shaft and installation area. For more details on tolerances, refer to the external dimensions of the individual servomotor.

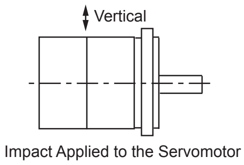


(2) Direction of Servomotor Rotation



Positive rotation of the servomotor without a gear is counterclockwise when viewed from the load. Refer to Ratings and Specifications for each series regarding rotation direction of the servomotor with a gear. The direction of rotation can be reversed by changing the SERVOPACK parameters.

(3) Shock Resistance

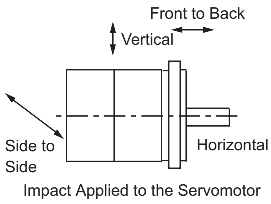


Mount the servomotor with the axis horizontal. The servomotor will withstand the following vertical impacts:

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

(4) Vibration Resistance

Mount the servomotor with the axis horizontal. The servomotor will withstand the following vibration acceleration in three directions: Vertical, side to side, and front to back.



Servomotor Model	Vibration Acceleration at Flange
SGMMV	49 m/s^2

IMPORTANT

The amount of vibration the servomotor endures will vary depending on the application. Check the vibration acceleration being applied to your servomotor for each application.

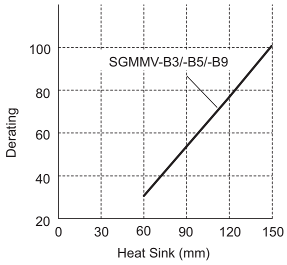
(5) Vibration Class

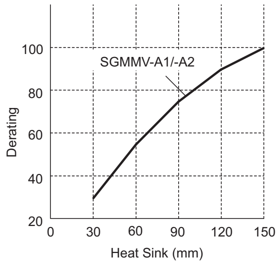
The vibration class for the servomotors at rated motor speed is V15. (A vibration class of V15 indicates a total vibration amplitude of 15 μ m maximum on the servomotor during rated rotation.)

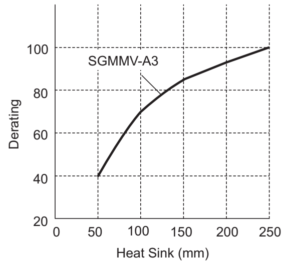
3.1.4 Heat Dissipation Conditions

The Servomotor ratings are the continuous allowable values at a surrounding air temperature of 40°C when a heat sink is installed on the Servomotor. If the Servomotor is mounted on a small device component, the Servomotor temperature may rise considerably because the surface for heat dissipation becomes smaller. Refer to the following graphs for the relation between the heat sink size and derating rate.

> **IMPORTANT**
>
> The actual temperature rise depends on how the heat sink (servomotor mounting section) is fixed on the installation surface, what material is used for the motor mounting section, and motor speed. Always check the actual motor temperature.







3.1.5 Holding Brake Delay Time

Holding brakes have motion delay time that varies depending on when the brake is open and when the brake is operating. The following table shows the brake delay time of each servomotor.

> **IMPORTANT**
>
> Make sure the holding brake delay time is correct for your servomotor.

- Example, switching the holding brakes on the DC side

Model	Voltage	Brake Release Time [ms]	Brake Operation Time [ms]
SGMMV-A1 to A3	24 V	40	100

3.2 SERVOPACKs

3.2.1 Ratings

Ratings of SERVOPACKs are as shown below.

(1) Type A01 SERVOPACK

Item	Specification
Continuous Output Current [Arms]	11.6* (2.9 per axis)
Instantaneous Max. Output Current [Arms]	34.4* (8.6 max. per axis)
Main Circuit Power Supply*	24 VDC -10% to +15% or 48 VDC -15% to +10%
Control Power Supply	24 VDC ±15%
Overvoltage Category	I

* The continuous output current and instantaneous maximum output current are the values for one power board.

(2) Type A02 SERVOPACK

Item	Specification	
Continuous Output Current [Arms]	23.2 (2.9 per axis)	
Instantaneous Max. Output Current [Arms]	50.0 (8.6 max. per axis)	
Main Circuit Power Supply*	24 VDC -10% to +15%	48 VDC -15% to +10%
Control Power Supply	24 VDC ±15%	
Overvoltage Category	I	

* You can use either 24 or 48 VDC for the main circuit power supply. If you use a 24-VDC input, the torque-motor speed characteristics of the servomotor will be less than the characteristics of a 48-VDC input. For details, refer to *3.1.1, (1) Torque-Motor Speed Characteristics*.

3.2.2 Basic Specifications

Basic specifications of SERVOPACKs are shown below.

(1) Type A01 SERVOPACK

Basic Specification (Common Specification)		SGDV-MD A01E4M3A	SGDV-MD A01E8M3A	SGDV-MD A01ECM3A
Number of Axes		4 axes	8 axes	12 axes
Drive Method		Sine-wave current drive with PWM control		
Operating Conditions	Surrounding Air Temperature	0 ℃ to +55 ℃		
	Storage Temperature	-20 ℃ to +85 ℃		
	Surrounding Air Humidity	90% RH max. (with no condensation or icing)		
	Storage Humidity	90% RH max. (with no condensation or icing)		
	Vibration Resistance	49 m/s^2 (with mounting option: 4.9 m/s^2)		
	Shock Resistance	147 m/s^2 (with mounting option: 19.6 m/s^2)		
	Protection Class	None	• Free of corrosive or flammable gases • Free of exposure to water, oil, or chemicals • Free of dust, salts, or iron dust	
	Pollution Degree	2		
	Grounding	Ground resistance: 100 Ω or less		
	Altitude	1,000 m or less		
	Other Conditions	Free of static electricity, strong electromagnetic fields, magnetic fields, and exposure to radioactivity		

(cont'd)

Basic Specification (Common Specification)			SGDV-MD A01E4M3A	SGDV-MD A01E8M3A	SGDV-MD A01ECM3A
Harmonized Standards	European Directives	Low Voltage Directive	EN61800-5-1		
		EMC Directive	EN 55011 group 1 class A, EN 61000-6-2, EN 61000-6-4, EN 61800-3		
	RoHS Directive		Compliant		
Performance	Speed Control Range		1:5000 (At the rated torque, the lower limit of the speed control range must not cause the servomotor to stop.)		
	Speed Regulation*	Coefficient of Load Fluctuation	0% to 100% load: ±0.01% max. (at rated speed)		
		Coefficient of Voltage Fluctuation	Main circuit rated voltage ±10%: 0% (at rated speed)		
	Frequency Characteristic		1,600 Hz (J_L=J_M)		
	Torque Control Tolerance (Repeatability)		±1%		
I/O Signals	Sequence Inputs		Number of points: 8 Functions: Assigned by user (external latch, overtravel, homing signal, etc.)		
	Sequence Outputs		Number of points: 8 Function: Brake (/BK) interlock output		
Communications	MECHATROLINK-III Communications		References: MECHATROLINK-III standard servo profile		
	Ethernet Communications		Connection to SigmaWin+ Engineering Tool		
LED Indicators			POWER indicator, communications indicators, ALM indicator		
Dynamic Brake			None		
Regenerative Processing			None		
Protective Functions			Overcurrent, overvoltage, overload, etc.		
Utility Functions			Servo adjustment, alarm tracebacks, JOG operation, origin search, etc.		
Service Life			50,000 hours min. (at 40°C max.)		
Approximate Mass (g) (with board mounting studs and screws, without mounting option)			262	388	517

* Speed regulation by load regulation is defined as follows:

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

(2) Type A02 SERVOPACK

Basic Specification (Common Specification)			SGDV-MD A02E8M3A	SGDV-MD A02E8M3A01
Drive Method			Sine-wave current drive with PWM control	
Operating Conditions	Surrounding Air Temperature		0°C to +55°C	
	Storage Temperature		-20°C to +85°C	
	Surrounding Air Humidity		90% RH max. (with no condensation or icing)	
	Storage Humidity		90% RH max. (with no condensation or icing)	
	Vibration Resistance		49 m/s^2	
	Shock Resistance		147 m/s^2	
	Protection Class		None	• Free of corrosive or flammable gases • Free of exposure to water, oil, or chemicals • Free of dust, salts, or iron dust
	Pollution Degree		2	
	Grounding		Ground resistance: 100 Ω or less	
	Altitude		1,000 m or less	
	Others		Free of static electricity, strong electromagnetic fields, magnetic fields, and exposure to radioactivity	
Harmonized Standards	European Directives	Low Voltage Directive	EN 61800-5-1	
		EMC Directive	EN 55011 group 1 class A EN 61800-3, EN 61000-6-2	
	RoHS Directive		Compliant	
Performance	Speed Control Range		1:5000 (At the rated torque, the lower limit of the speed control range must not cause the servomotor to stop.)	
	Speed Regulation[*1]	Coefficient of Load Fluctuation	0% to 100% load: ±0.01% max. (at rated speed)	
		Coefficient of Voltage Fluctuation	Main circuit rated voltage ±10%: 0% (at rated speed)	
	Frequency Characteristic		1,600 Hz (J_L=J_M)	
	Torque Control Tolerance (Repeatability)		±1%	
I/O Signals	Sequence Inputs[*2]		None	Number of points: 8 Functions: Assigned by user (external latch, overtravel, homing signal, etc.)
	Sequence Outputs[*2]		None	Number of points: 8 (1 per axis) Function: Brake (/BK) interlock output
Communications	MECHATROLINK-III Communications		MECHATROLINK-III standard servo profile	
	Ethernet Communications		Connection to SigmaWin+ Engineering Tool	
LED Indicators			POWER indicator, communications indicators, ALM indicator	
Dynamic Brake			None	
Regenerative Processing			None	
Protective Functions			Overcurrent, overvoltage, overload, etc.	
Utility Functions			Servo adjustment, alarm tracebacks, JOG operation, origin search, etc.	
Service Life			50,000 hours min. (at 40°C max.)	

(cont'd)

Basic Specification (Common Specification)	SGDV-MD A02E8M3A	SGDV-MD A02E8M3A01
Dimensions (mm)	$238 \times 120 \times 29$	
Approximate Mass (g)	326	335

∗1. Speed regulation by load regulation is defined as follows:

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

∗2. The SGDV-MDA02E8M3A01 provides I/O signals, but the SGDV-MDA02E8M3A does not.

3.2.3 MECHATROLINK-III Function Specifications

The following table shows the basic specifications of MECHATROLINK-III.

Function		Specifications
MECHATROLINK-III Communication	Communication Protocol	MECHATROLINK-III
	Station Address Setting (Node Address)	03H to EFH (Max. number of stations: 62) Set with parameter Pn880.
	Expansion Address Setting (Axis Address)	00H to 0BH Set in parameters Pn010 to Pn01B.
	Baud Rate	100 Mbps
	Transmission Cycle	250 µs, 500 µs, and 1.0 ms to 4.0 ms (increments of 0.5 ms)
	Number of Transmission Bytes	32 bytes per axis or 48 bytes per axis Selected with parameter Pn881.
	Communications Methods	Cyclic communications, event-driven communications, and message communications
Reference Method	Control Method	Position, speed, or torque control with MECHATROLINK-III communication
	Reference Input	MECHATROLINK commands (sequence, motion, data setting/reference, monitoring, or adjustment)
	Profile	MECHATROLINK-III standard servo profile

(1) Main Commands

Type	CMD Code (Hex)	Command	Command Name	Function
Common Commands	00	NOP	No operation	Nothing is performed.
	03	ID_RD	Read ID	Reads the device ID.
	04	CONFIG	Setup device	Enables the current parameter settings.
	05	ALM_RD	Read alarm or warning	Reads the current alarm or warning status, and the alarm history.
	06	ALM_CLR	Clear alarm or warning	Clears the current alarm or warning status, and the alarm history.
	0D	SYNC_SET	Start synchronous communications	Starts synchronous communications.
	0E	CONNECT	Establish connection	Requests the establishment of a connection and setting of the communication mode.
	0F	DISCONNECT	Disconnection	Requests disconnection.
	1D	MEM_RD	Read virtual memory	Reads data from virtual memory.
	1E	MEM_WR	Write virtual memory	Writes data to virtual memory.
Servo Commands	20	POS_SET	Set coordinates	Sets the coordinate system.
	21	BRK_ON	Apply brake	Turns the brake signal OFF and applies the holding brake.
	22	BRK_OFF	Release brake	Turns the brake signal ON and releases the holding brake.
	23	SENS_ON	Turn sensor ON	Turns the encoder power supply ON, and gets the position data.
	24	SENS_OFF	Turn sensor OFF	Turns the encoder power supply OFF.
	25	HOLD	Stop motion	Decelerates an axis to a stop at the deceleration rate set in a parameter.
	30	SMON	Servo status monitor	Monitors the SERVOPACK status.
	31	SV_ON	Servo ON	Turns the servo of the motor ON.
	32	SV_OFF	Servo OFF	Turns the servo of the motor OFF.
	34	INTERPOLATE	Interpolation	Starts interpolation feeding.
	35	POSING	Positioning	Starts positioning to the target position (TPOS) at the target speed (TSPD).
	36	FEED	Feed	Starts constant speed feeding at the target speed (TSPD).
	37	EX_FEED	External input feed	Performs constant-speed feeding at the target speed (TSPD). When the /EXT1 external signal is received during constant-speed feeding, positioning is performed to the target position from the position where the signal was input.
	39	EX_POSING	External input positioning	Positions to the target position (TPOS) at the target speed (TSPD). When the /EXT1 external signal is received during positioning, positioning is performed to the target position from the position where the signal was input.
	3A	ZRET	Zero point return	Performs zero point return.
	3C	VELCTRL	Velocity control	Controls speed.
	3D	TRQCTRL	Torque (force) control	Controls torque (force).
	40	SVPRM_RD	Read parameter	Reads the specified servo parameter.
	41	SVPRM_WR	Write parameter	Writes the specified servo parameter.

Note: Refer to the *Σ-V-MD Series User's Manual MECHATROLINK-III Standard Servo Profile Commands* (Manual No.: SIEP S800001 03) for details on the main commands.

(2) Subcommands

Type	CMD Code (Hex)	Command	Command Name	Function
Servo Commands	00	NOP	No operation	Nothing is performed.
	05	ALM_RD	Read alarm/warning	Reads the current alarm or warning status, and the alarm history.
	06	ALM_CLR	Clear alarm/ warning state	Clears the current alarm or warning status, and the alarm history.
	1D	MEM_RD	Read virtual memory	Reads data from virtual memory.
	1E	MEM_WR	Write virtual memory	Writes data to virtual memory.
	30	SMON	Monitor servo status	Monitors the SERVOPACK status.
	40	SVPRM_RD	Read parameter	Reads the specified servo parameter.

Note: Refer to the *Σ-V-MD Series User's Manual MECHATROLINK-III Standard Servo Profile Commands* (Manual No.: SIEP S800001 03) for details on the subcommands.

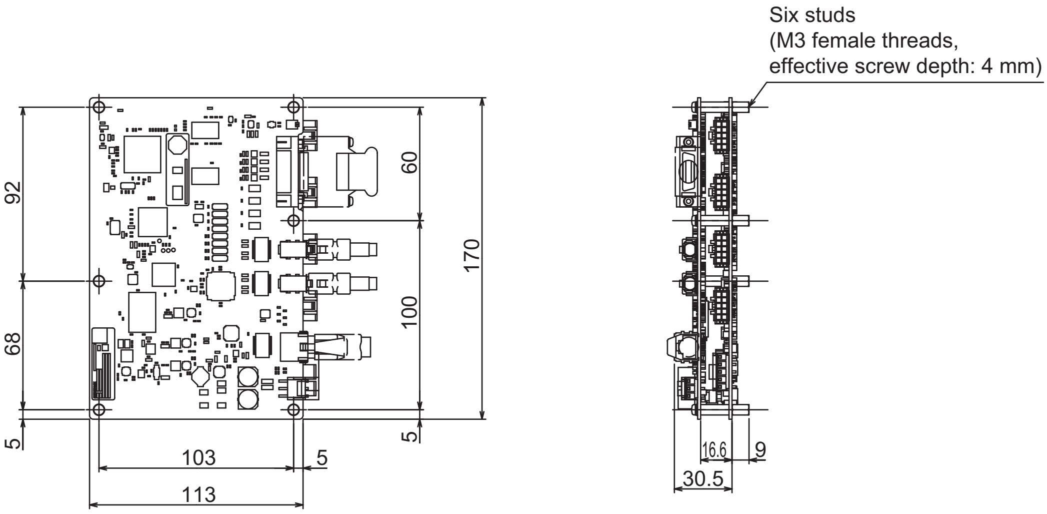
3.2.4 Dimensional Drawings

This section provides dimensional drawings.
Dimensions in the dimensional drawings are in millimeters.

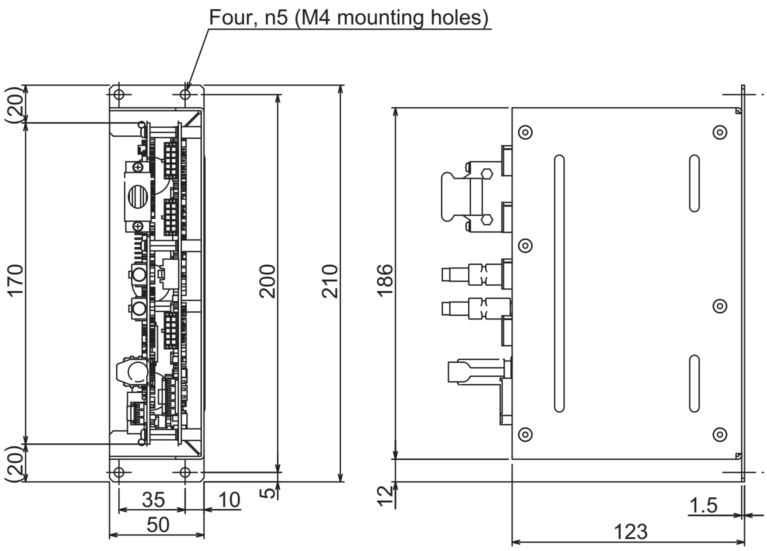
(1) Type A01 SERVOPACK

■ Board with Four Axes

• Without Mounting Option

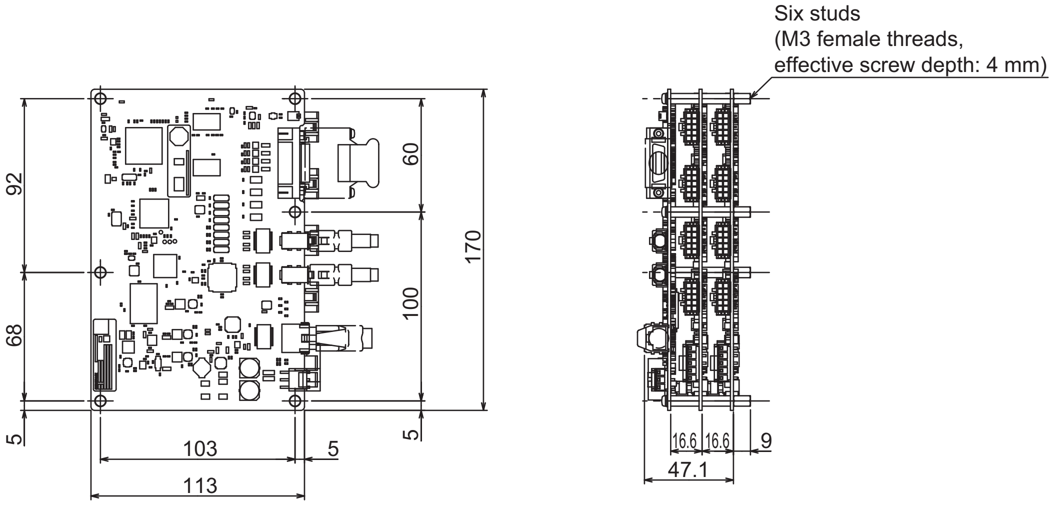


• With Mounting Option

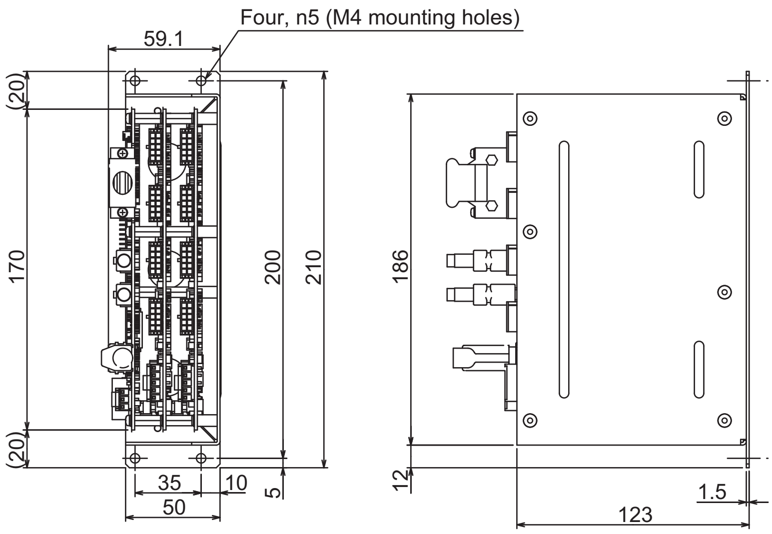


■ Board with Eight Axes

• Without Mounting Option

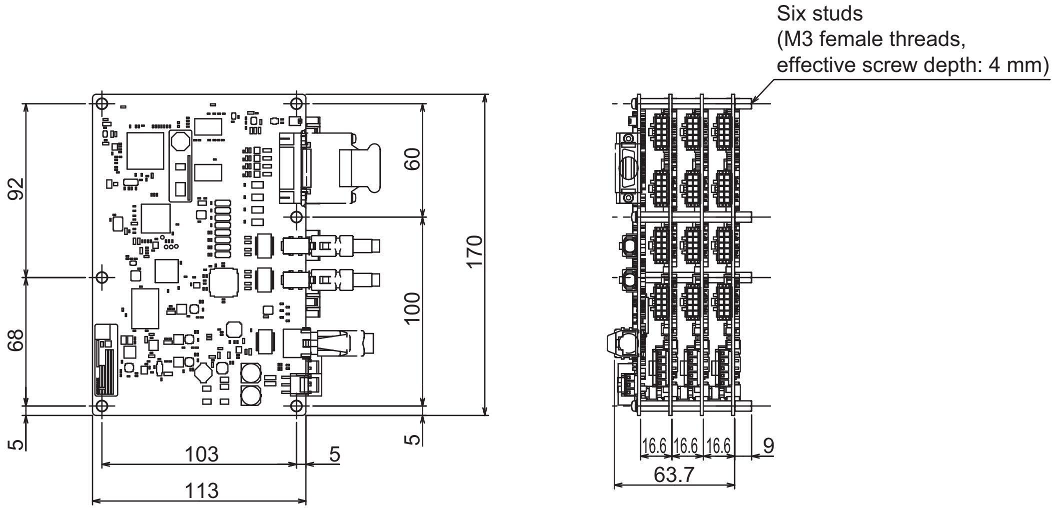


• With Mounting Option

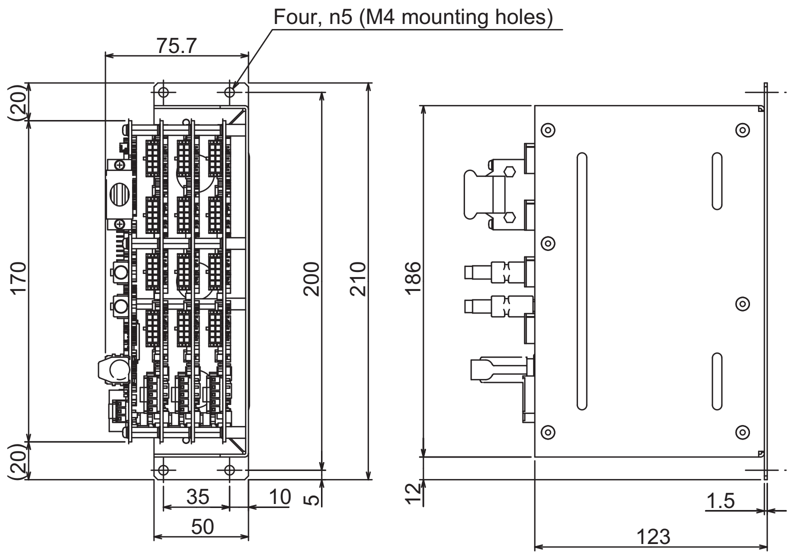


■ Board with Twelve Axes

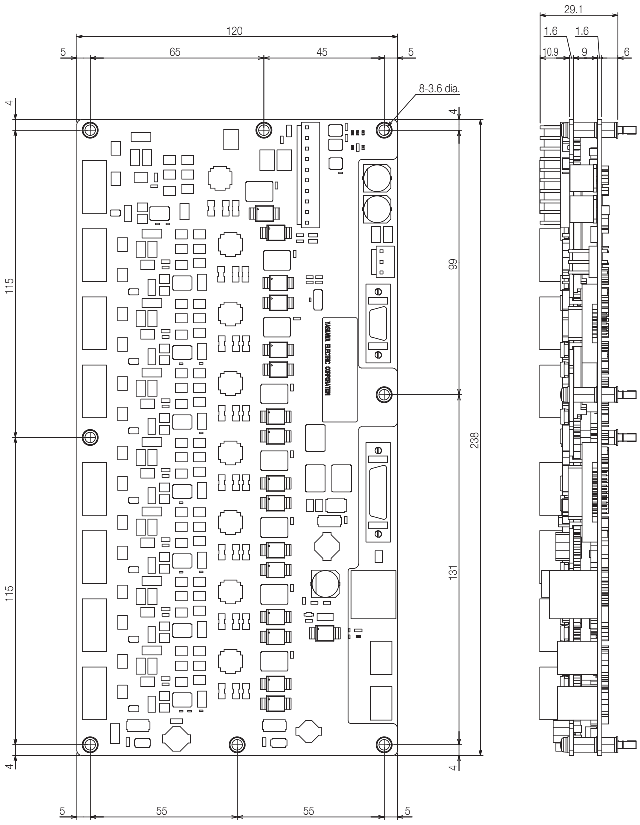
• Without Mounting Option



• With Mounting Option



(2) Type A02 SERVOPACK



4

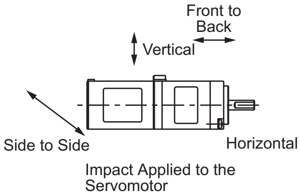
Installation

This section describes how to install servomotors and SERVOPACKs.

4.1 Servomotor Installation

4.1.1 Servomotor Installation Environment

- Surrounding air temperature: 0 to 40°C
- Surrounding air humidity: 80% RH or less (with no condensation)
- Altitude: 1, 000 m or less
- Vibration resistance: The servomotor will withstand the following vibration acceleration in three directions: vertical, side to side, and front to back.



Servomotor Model	Vibration Acceleration at Flange
SGMMV	49 m/s^2

- Shock resistance: 490 m/s^2 at servomotor flange
  Number of impacts: 2
- Installation site: An environment that satisfies the following conditions
  - Indoors and free of corrosive or explosive gases
  - Well-ventilated and free of dust and moisture
  - Facilitates inspection and cleaning
  - Free of high magnetic field

4.1.2 Orientation

You can install the servomotor either horizontally or vertically.

4.1.3 Installation Standards

The motor rated specifications (rated output, rated torque, and rated speed) are the continuous allowable values at a surrounding air temperature of 40°C when servomotors are installed with heat sinks.

When a motor is mounted on a small surface, the motor temperature may rise considerably because of the limited heat radiating abilities of the surface. To restrict the temperature rise, you should either mount a heat sink or limit the electrical, thermal, and mechanical stress on the motor (derating). Refer to *3.1.4 Heat Dissipation Conditions* for the relation between the size of the heat sink and derating. The actual temperature rise depends on how the heat sink (motor mounting section) is fixed on the installation surface and what material is used for the motor mounting section. Always check the actual motor temperature.

If the servomotor is covered, or if a heating element is installed near the servomotor, the motor temperature may rise considerably. In this case, take following countermeasures.

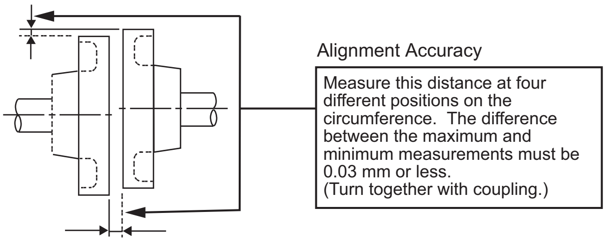
- Reduce the load ratio.
- Reconsider the motor heat dissipation.
- Install a cooling fan to forcedly cool the motor.

4.1.4 Connecting Servomotor to Machine

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

Align the shaft of the servomotor with the shaft of the machine, and then couple the shafts. Install the servomotor so that alignment accuracy falls within the following range. Vibration will damage the bearings or encoders if the shafts are not properly aligned.

Do not allow direct impact to be applied to the shafts when installing the coupling as the encoder mounted on the opposite end of the shaft may be damaged.

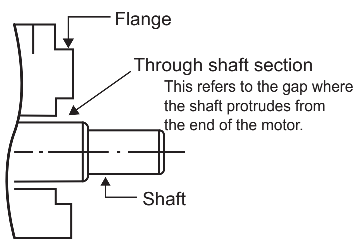


4.1.5 Protective Structure

The servomotor protective structure* is described below.

Model	Protective Structure
SGMMV-B☐E	IP42
SGMMV-A☐E	IP55

* Except through shaft section.



Installation

4

4.1.6 Other Precautions

(1) Cable Stress

Do not bend or apply tension to the servomotor/encoder relay cable.
Be especially careful to wire encoder cables so that they are not subject to stress because the core wires are very thin at only 0.2 or 0.3 mm^2.

■ Handling Precautions for Standard Cables

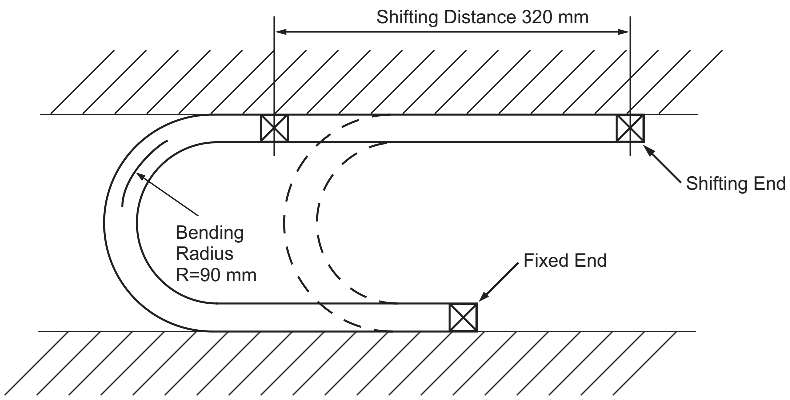
The standard servomotor/encoder relay cables cannot be used in cases where high flexibility is needed, such as when the cables themselves move or are twisted or turned. R15 min. is recommended for the bending radius of standard cables. Use flexible cables for flexible applications.

■ Handling Precautions for Flexible Cables

- Life of Flexible Cable

The flexible cable supports 10,000,000 or more operations of bending life with the recommended bending radius R = 90 mm under the following test conditions.

- Repeat moving one end of the cable forward and backward for 320 mm using the test equipment shown in the following figure.
- Connect the lead wires in parallel, and count the number of cable return motion times until a lead wire is disconnected. Note that one reciprocation is counted as one test.



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

- Wiring Precautions

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

- Cable twisting

Straighten the flexible cables wiring.
Twisted cables cause the early disconnection. Check the indication on the cable surface to make sure that the cable is not twisted.

- Fixing method

Do not fix the moving points of the flexible cable, or stress on the fixed points may cause early disconnection. Fix the cable at the minimum number of points. Do not put stress on the servomotor-end and SERVOPACK-end connectors.

- Cable length

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

- Interference between cables

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

(2) Connectors

Observe the following precautions:

- Make sure there is no foreign matters such as dust and metal chips in the connector before connecting.
- When you connect the connectors to the servomotor, connect the servomotor connector first. If you connect the encoder connector first, the encoder may be damaged due to the difference in electrical potential from the FG.
- Make sure of the pin arrangement.
- Do not apply shock to resin connectors. Otherwise, they may be damaged.
- When handling a servomotor with its cables connected, hold the servomotor or the connectors and cables will be damaged.
- Be sure not to apply stress on the connector. The connector may be damaged by stress.

(3) Radial and Thrust loads

Design the mechanical system so thrust and radial loads applied to the servomotor shaft end during operation fall within the allowable ranges of each motor. Refer to *3.1.1*, *(6) Allowable Radial and Thrust Loads* for the allowable values.

4.2 SERVOPACK Installation

4.2.1 SERVOPACK Installation Environment

- ■ Surrounding air temperature: 0 to 55°C
- ■ Surrounding air humidity: 90% RH or less (with no condensation)
- ■ Altitude: 1,000 m or less
- ■ Vibration resistance: 49 m/s^2

Note: The vibration resistance of a type A01 SERVOPACK with the mounting option is 4.9 m/s^2.

- ■ Shock resistance: 147 m/s^2

Note: The shock resistance of a type A01 SERVOPACK with the mounting option is 19.6 m/s^2.

■ Mounting in a Control Panel

- Installation in a System

To prevent the temperature around the SERVOPACK from exceeding 55°C, take into account the size of the control panel, the layout of the SERVOPACK, and the cooling method.

- Mounting Near a Heating Unit

To prevent the temperature around the SERVOPACK from exceeding 55°C, suppress radiant heat from the heating unit and temperature rise due to convection.

- Mounting to a Location Exposed to Corrosive Gas

Take measures to prevent exposure to corrosive gas. Corrosive gases will not immediately affect the SERVOPACK, but will eventually cause electronic components and contactor-related devices to malfunction.

- Other Locations

Do not mount the SERVOPACK in locations subject to high temperatures, high humidity, dripping water, cutting oil, dust, iron filings, or radiation.

<Note>

When storing the SERVOPACK with the power OFF, store it in an environment with the following temperature and humidity:

- -20 to +85°C, 90% RH or less (with no condensation)

4.2.2 Mounting the SERVOPACK

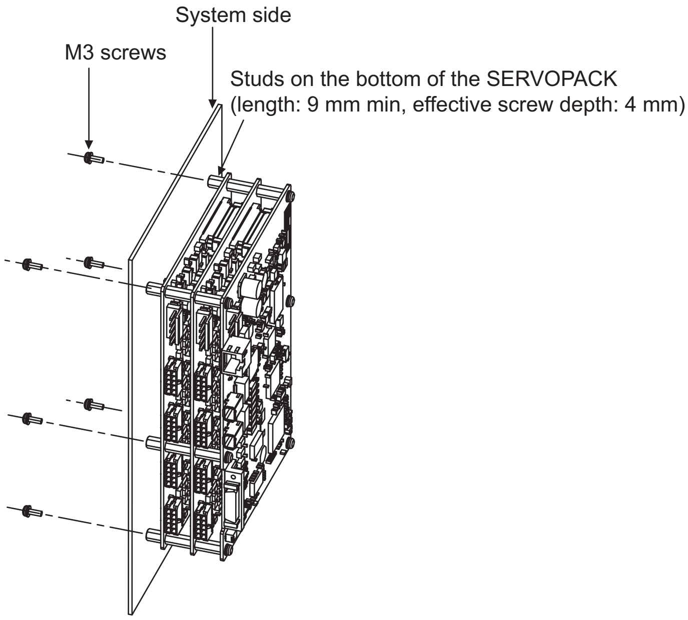
Use the following procedure to mount the SERVOPACK to the system.

(1) Mounting a Type A01 SERVOPACK

■ SERVOPACK without the Mounting Option

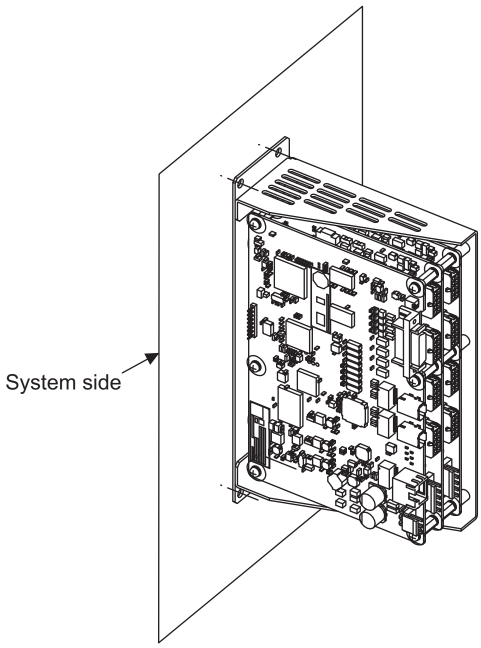
Mount the SERVOPACK to the system with M3 screws according to the mounting positions of the six studs on the bottom of the SERVOPACK.

Note: If you replace the studs on the bottom of the SERVOPACK, use metal studs with a length of at least 9 mm.



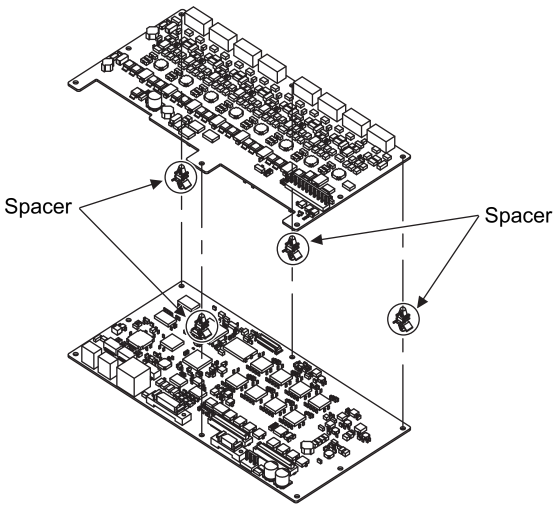
■ SERVOPACK with the Mounting Option

Mount the SERVOPACK to the system with M4 screws according to the four mounting holes in the SERVOPACK.



(2) Mounting a Type A02 SERVOPACK

1. Remove the spacers between the boards.

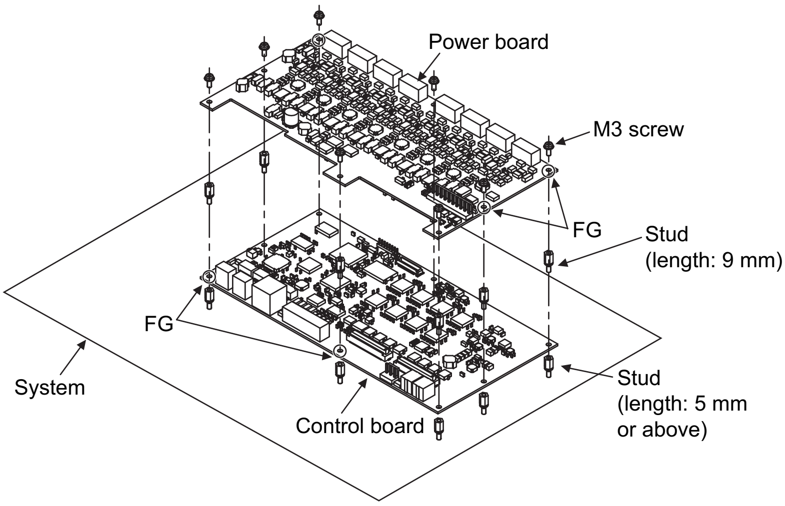


2. Attach 8 studs (length: 5 mm or above) to the system to fit in the 8 holes in the control board.

3. Align the control board with the studs, and attach 8 studs (length: 9 mm) in the 8 holes in the control board. Tighten the screws to connect the board.

4. Place the power board on the control board. Tighten the M3 screws to connect the board.
This concludes the mounting of the SERVOPACK.

Note: Use metal studs.



4.2.3 Mounting Orientation

You can install the SERVOPACK either horizontally or vertically.

Note: Secure the cable within the system so that the weight of the cable is not placed on the SERVOPACK.

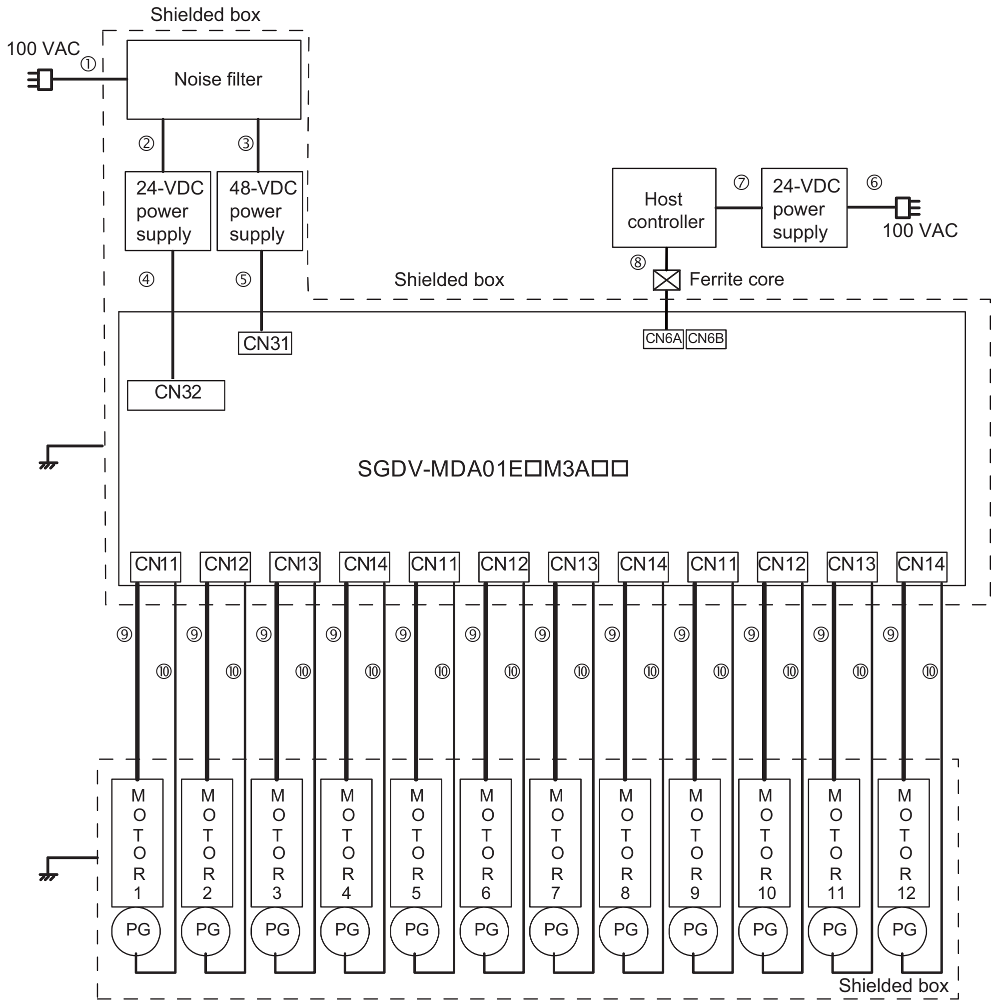
4.3 EMC Installation Conditions

This section gives the installation conditions that were used for the EMC certification testing for combinations of servomotors and a SERVOPACK.

The EMC installation conditions that are given in this section were used in passing the testing that was received by Yaskawa. The actual EMC level will depend on the actual device configuration, wiring, and other conditions. Because these products are built into a system, the user must implement EMC measures and confirm compliance for the overall system.

The applicable standards are EN 55011 group 1 class A, EN 61800-3, EN 61000-6-2, and EN61000-6-4.

4.3.1 SGDV-MDA01E☐M3A☐☐

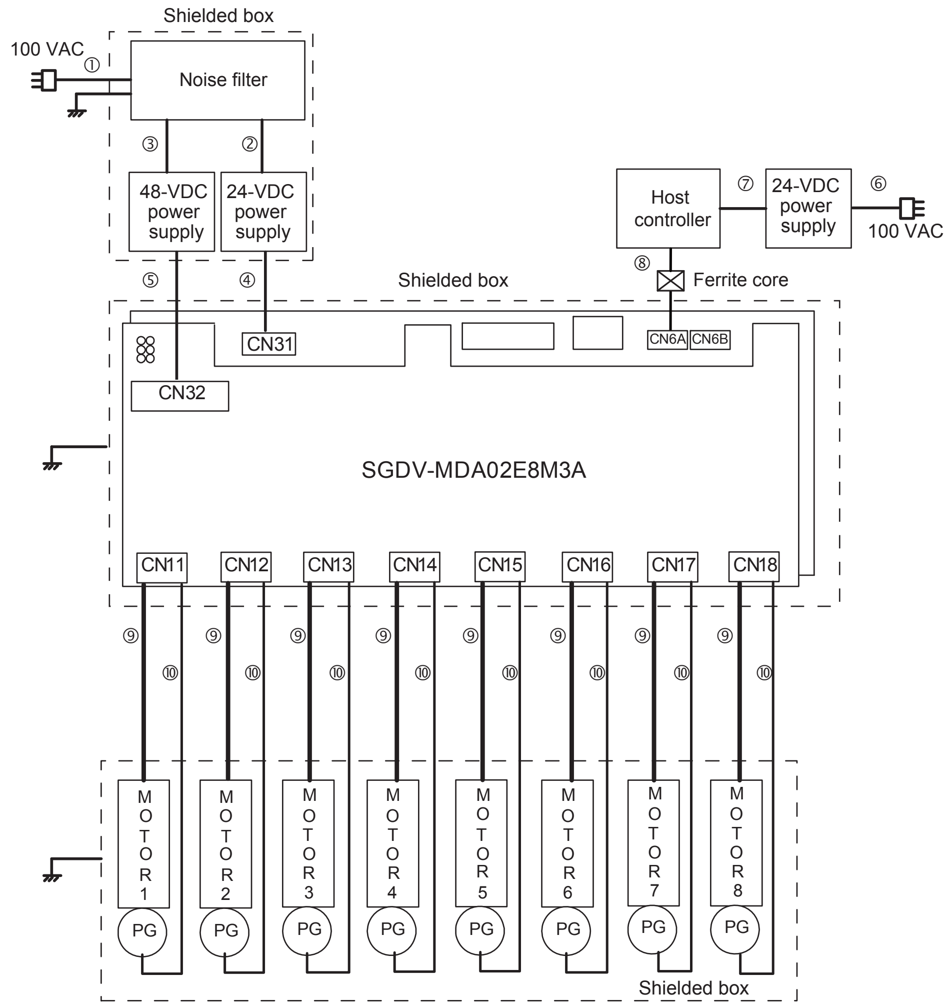


Symbol	Cable Name	Specification	Remarks
①,②,③,⑥	100-VAC power supply cable	Not shielded	–
④,⑤	24-VDC or 48-VDC power supply cable	Not shielded	–
⑦	24-VDC power supply cable	Not shielded	–
⑧	MECHATROLINK-III communications cable	Shielded	Ferrite core, 4 turns
⑨,⑩	Servomotor/encoder relay cable	Shielded	–

Installation

4

4.3.2 SGDV-MDA02E8M3A□□



Symbol	Cable Name	Specification	Remarks
①,②,③,⑥	100-VAC power supply cable	Not shielded	–
④,⑤	24-VDC or 48-VDC power supply cable	Shielded	–
⑦	24-VDC power supply cable	Not shielded	–
⑧	MECHATROLINK-III communications cable	Shielded	Ferrite core, 2 turns
⑨,⑩	Servomotor/encoder relay cable	Shielded	–

4.3.3 Other Precautions

A shield box, which is a closed metallic enclosure, is effective as reinforced shielding against electromagnetic interference (EMI) from SERVOPACKs. The structure of the box should allow the main body, door, and cooling unit to be attached to the ground. The box opening should be as small as possible.

5

Wiring and Connections

5.1 Wiring the Main Circuit and Control Power Supplies

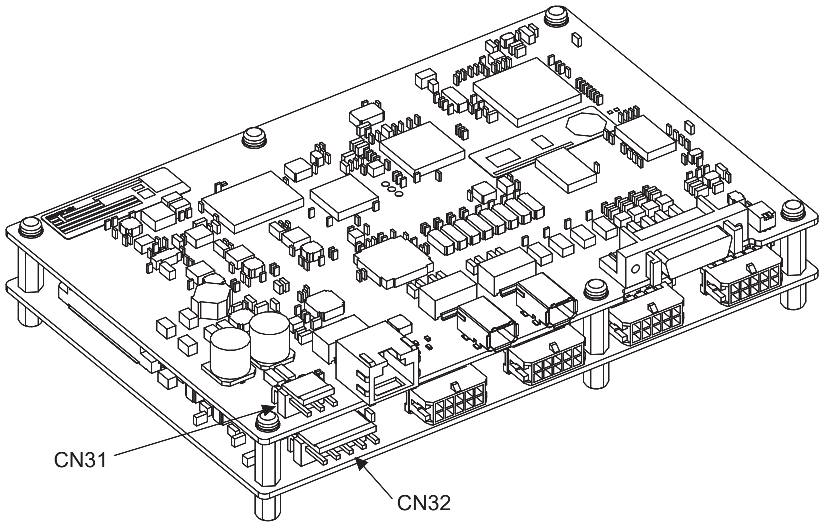
This section gives the names and specifications of the main circuit power supply terminals and control power supply terminals.

Also this section provides general precautions for wiring and precautions for application under special environments.

5.1.1 Main Circuit Power Supply Terminals (CN32) and Control Power Supply Terminals (CN31)

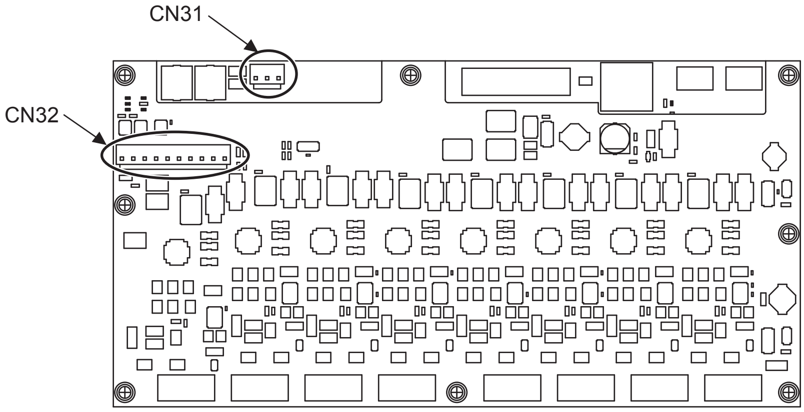
This section gives the names and specifications of the main circuit power supply terminals and control power supply terminals.

(1) Type A01 SERVOPACK



Connector No.	Signal	Pin No.	Name	Specification
CN32	L1	1, 2	Main circuit power supply input pin +	24 VDC -10% to +15% or 48 VDC -15% to +10%
	L2	3, 4	Main circuit power supply input pin -	
	⏚	5	Ground pin	–
CN31	L1C	1	Control power supply input pin +	24 VDC ±15%
	L2C	2	Control power supply input pin -	
	⏚	3	Ground pin	–

(2) Type A02 SERVOPACK



The main circuit power supply terminals and control power supply terminals are circled in the figure.

Connector No.	Signal	Pin No.	Name	Specification
CN32	L1	1 to 4	Main circuit power supply input pin +	24 VDC -10% to +15% or 48 VDC -15% to +10%
	L2	5 to 8	Main circuit power supply input pin -	
	⏚	9, 10	Ground pin	–
CN31	L1C	1	Control power supply input pin +	24 VDC±15%
	L2C	2	Control power supply input pin -	
	⏚	3	Ground pin	–

5.1.2 Main Circuit and Control Power Supply Cables

This section provides the specifications of the main circuit power supply cable and control power supply cable.

Cable	Terminals	Model
Main Circuit Power Supply Cable	L1, L2, ⏚	–
Control Power Supply Cable	L1C, L2C, ⏚	

Refer to the following cable specifications to make your own cables.

IMPORTANT

- Select a cable that can carry the rated current on three bundled lead wire pairs at a surrounding air temperature of 40°C.
- Use wires with a withstand voltage of 100 V or higher.
- Use wires with an insulator outer diameter of 1.85 mm or less. You will not be able to connect the cable to the connector if the outer diameter exceeds 1.85 mm.
- If wires are bundled in PVC or placed in metal ducts, take into account the reduction in the allowable wire current.
- Use heat-resistant wire for high surrounding air or panel temperatures.
- The main circuit power supply cable and control power supply cable must not exceed 10 m.

(1) Main Circuit Power Supply Cable Specifications

The main circuit power supply cable specifications are given below.

■ Type A01 SERVOPACK

- Main Circuit Power Supply Pins

Connector	Housing	Contacts	Manufacturer
Main circuit power supply connector	Cable side: VHR-5N, SERVOPACK side: B5PS-VH	SVH-41T-P1.1	J.S.T. Mfg. Co., Ltd.

- Parts and Functions of the Main Circuit Power Supply Connector (CN32)

Pin No.	Signal	Name	Specification
1, 2	L1	Main circuit power supply input pin +	24 VDC -10% to +15% or 48 VDC -15% to +10%
3, 4	L2	Main circuit power supply input pin -	
5	FG	Ground pin	–

Note: Connect the power supply cable to all 5 pins.

- Power Supply Capacity and Wire Size

Main Circuit Power Supply	Input Current Capacity		Wire Size
	Continuous Rating	Maximum Instantaneous Current	
24 VDC	3.5 A	8.5 A	AWG16 to AWG18
48 VDC	2.0 A	10.5 A	

Note: The input power supply capacity is the capacity per axis.
The actual input current for the main circuit power supply will be the given value multiplied by the number of servomotor axes you control. Select the wire size according to the number of axes that you will use.

■ Type A02 SERVOPACK

• Main Circuit Power Supply Pins

Connector	Housing	Contacts	Manufacturer
Main circuit power supply connector	Cable side: VHR-10N, SERVOPACK side: B10P-VH	SVH-41T-P1.1	J.S.T. Mfg. Co., Ltd.

• Parts and Functions of the Main Circuit Power Supply Connector (CN32)

Pin No.	Signal	Name	Specification
1, 2, 3, 4	L1	Main circuit power supply input terminal +	24 VDC -10% to +15% or 48 VDC -15% to +10%
5, 6, 7, 8	L2	Main circuit power supply input terminal -	
9, 10	FG	Ground terminal	–

Note: Connect the power supply cable to all 10 pins.

• Power Supply Capacity and Wire Size

Main Circuit Power Supply	Input Current Capacity		Wire Size
	Continuous Rating	Maximum Instantaneous Current	
24 VDC	3.5 A	8.5 A	AWG16 to AWG18
48 VDC	2.0 A	10.5 A	

Note: The input power supply capacity is the capacity per axis.
The actual input current for the main circuit power supply will be up to eight times the given value if you control servomotors for eight axes.
Select the wire size according to the number of axes that you will use.

(2) Control Power Supply Cable Specifications

The control power supply cable specifications are given below.

■ Control Power Supply Connector (CN31)

Connector	Housing	Contacts	Manufacturer
Control power supply connector	Cable side: VHR-3N, Type A01 SERVOPACK side: B3PS-VH, Type A02 SERVOPACK side: B3P-VH	SVH-41T-P1.1	J.S.T. Mfg. Co., Ltd.

■ Parts and Functions of the Control Power Supply Connector (CN3)

Terminals	Signal	Name	Specification
1	L1C	Control power supply input terminal +	24 VDC ±15%
2	L2C	Control power supply input terminal -	
3	FG	Ground terminal	–

■ Power Supply Capacity and Wire Size

• Type A01 SERVOPACK

SERVOPACK Model	Power Supply Capacity	Power Supply Cable Wires
SGDV-MDA01E4M3A (4 axes)	1.6 A min	AWG16 to AWG20
SGDV-MDA01E8M3A (8 axes)	1.7 A min	
SGDV-MDA01ECM3A (12 axes)	1.9 A min	

• Type A02 SERVOPACK

Current Capacity [A]	Power Supply Cable Wires
2.0 A	AWG16 to AWG20

5.1.3 Typical Main Circuit Wiring Example

Take the following points into consideration when designing the power ON sequence.

- You must design the system to turn OFF the main circuit power supply when a servo alarm is detected.
- Select the power supply specifications for the parts according to the input power supply.

IMPORTANT

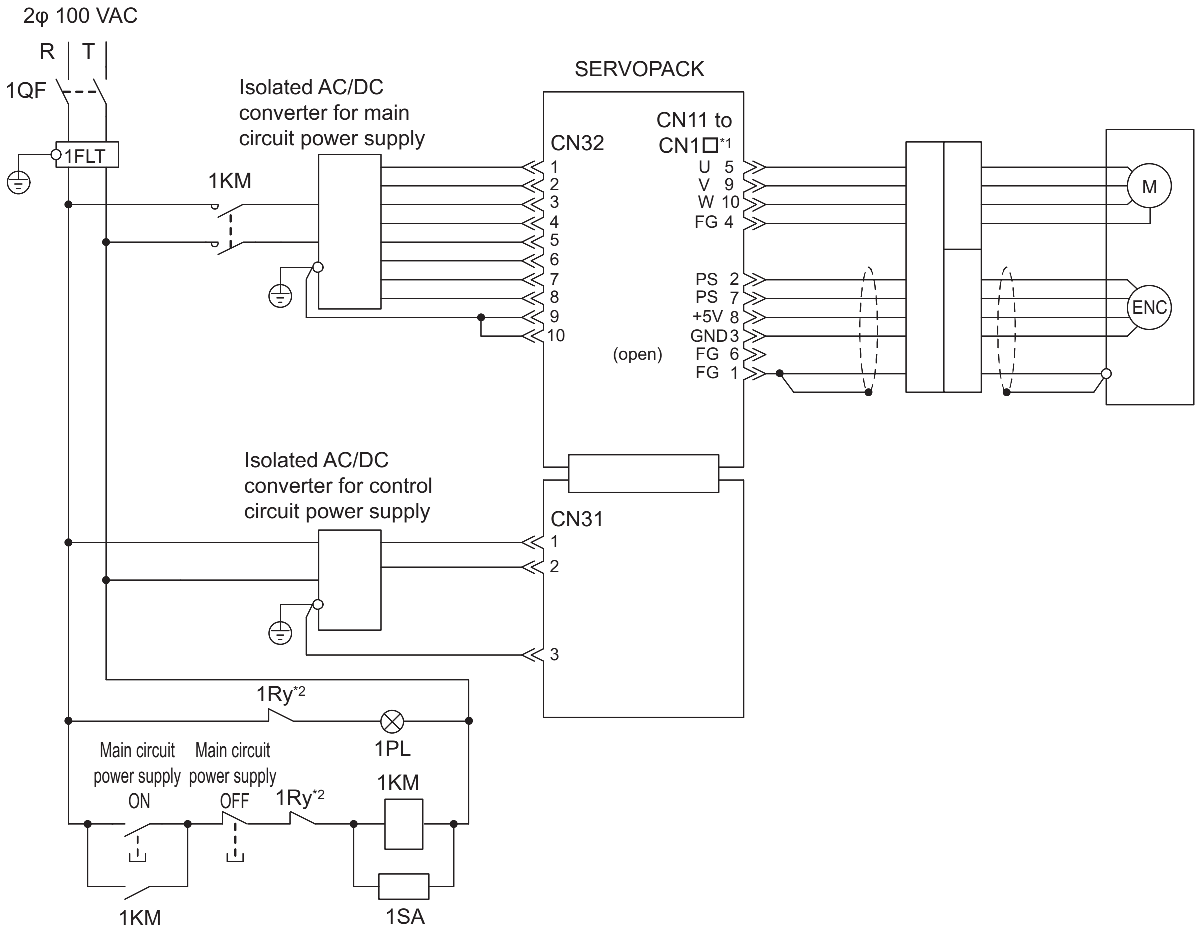
- When you turn ON the control power supply and the main circuit power supply, turn them ON at the same time or turn ON the main circuit power supply after the control power supply.
  When you turn OFF the power, first turn OFF the power for the main circuit and then turn OFF the control power.
- Provide separate AC/DC power supplies for the main circuits and for controls.
- Use a power supply with double insulation or reinforced insulation that is certified for safety standards.
- Do not connect devices to the control power line that have large load fluctuations, such as motors or solenoids, or devices that have surge voltages, such as switches. Otherwise, internal elements may deteriorate and fuses may blow.
- Design a sequence to turn OFF the power supplies to the SERVOPACK if you detect a SERVOPACK error at the host controller.
- Always use molded-case circuit breakers or fuses to protect the servo system.
- The SERVOPACK does not have a built-in protective circuit for grounding. To build a safe system, use an earth-leakage breaker for ground protection together with a molded-case circuit breaker.
- Always turn ON and OFF the power supplies to the SERVOPACK on the input (AC) sides of the main circuit power supply and the control power supply.
- Do not frequently turn ON and OFF the main circuit power supply or the control power supply.

  Frequently turning power ON and OFF will causes elements in the SERVOPACK to deteriorate.

The typical main circuit wiring examples are shown below.

⚠ WARNING

- Voltage remains in the SERVOPACK even after the power supply is turned OFF. To prevent electric shock, do not touch the input terminals for the main circuit power supply or those for the control power supply.
  Before wiring or inspections, confirm that the SERVOPACK has completely discharged.



1QF: Molded-case circuit breaker
1FLT: Noise filter
1KM: Magnetic contactor
(for main power supply)

1Ry: Relay
1PL: Indicator lamp
1SA: Surge absorber

* 1. The box (☐) is replaced by a number. For a type A01 SERVOPACK, the number is 4. For a type A02 SERVOPACK, the number is 8.
* 2. Set safety circuits to turn OFF the main circuit supply of the SERVOPACK (turn OFF 1Ry) from the host controller if an alarm occurs.

5.1.4 Power Losses

The following table shows the SERVOPACK's power losses.

(1) Main Circuit Power Supply of 24 VDC

SERVOPACK Model	Main Circuit Power Loss [W]	Control Circuit Power Loss [W]	Total Power Loss [W]	Remarks (e.g., Conditions)
SGDV-MDA01E4M3A	12	14	26	Rated operation for four axes
SGDV-MDA01E8M3A	24	16	40	Rated operation for eight axes
SGDV-MDA01ECM3A	36	18	54	Rated operation for twelve axes
SGDV-MDA02E8M3A	20	16	36	Rated operation for eight axes

(2) Main Circuit Power Supply of 48 VDC

SERVOPACK Model	Main Circuit Power Loss [W]	Control Circuit Power Loss [W]	Total Power Loss [W]	Remarks (e.g., Conditions)
SGDV-MDA01E4M3A	13	14	27	Rated operation for four axes
SGDV-MDA01E8M3A	25	16	41	Rated operation for eight axes
SGDV-MDA01ECM3A	37	18	55	Rated operation for twelve axes
SGDV-MDA02E8M3A	20	16	36	Rated operation for eight axes

5.1.5 Input Power Supply, Molded-case Circuit Breaker, and Fuse

Use input power supplies that meet the following conditions.

- The main circuit power supply must be a 24-VDC or a 48-VDC power supply.
- The control circuit power supply must be a 24-VDC power supply.
- The main circuit power supply and the control power supply must be two separate input power supplies.
- Power supplies must have double or reinforced insulation that conforms to safety standards.

- Power Supply Capacity and Wire Size

Main Circuit Power Supply	Maximum Applicable Servomotor Capacity [W]	Main Circuit Power Supply Capacity per Axis* [W]	Current Capacity per Axis		Power Supply Cable Wires
			Continuous Rating [A]	Maximum Instantaneous Current [A]	
24 VDC	11	169	2.0	8.5	AWG16 to AWG18
	30	165	3.5	8.5	
48 VDC	11	169	1.0	4.5	
	30	411	2.0	10.5	

* The value that is given is for the maximum instantaneous load.

Note: The specified maximum applicable servomotor capacity, specified power supply capacity, and specified input current capacity for the main circuit power supply are per axis. The power supply capacity will be the given value multiplied by the number of controlled motor axes.

- Molded-case Circuit Breaker and Fuse Capacities

Select the molded-case circuit breaker and fuse for the AC side of the input power supply according to the power supply specifications that you will use.

Wiring and Connections

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5.1.6 General Precautions for Wiring

IMPORTANT

- Always use a molded-case circuit breaker (1QF) or a fuse to protect the servo system from intersystem faults.
- Install a ground fault detector.
  The SERVOPACK does not have a built-in protective circuit for grounding.
  To configure a safer system, install a ground fault detector against overloads and short-circuiting, or install a ground fault detector combined with a molded-case circuit breaker.
- Do not turn the power ON and OFF more than necessary.
  - Do not use the SERVOPACK for applications that require the power to turn ON and OFF frequently. Such applications will cause elements in the SERVOPACK to deteriorate.
  - As a guideline, at least one hour should be allowed between the power being turned ON and OFF once actual operation has been started.

To ensure safe, stable application of the servo system, observe the following precautions when wiring.

Design and arrange the system so that each cable will be as short as possible.

- Use shielded twisted-pair cables or screened shielded twisted-pair cables for I/O signal cables and encoder cables.
- The maximum wiring length is 3 m for I/O signal cables, 10 m for servomotor/encoder relay cables, and 10 m for power supply cables.

Observe the following precautions when wiring the ground.

- Use a cable as thick as possible.
- Ground to a ground resistance of 100 Ω or less.
- Be sure to ground at only one point.
- Ground the servomotor directly if the servomotor is insulated from the machine.

The signal cable conductors are as thin as 0.2 mm^2 or 0.3 mm^2. Do not impose excessive bending force or tension.

5.2 I/O Signal (CN1) Connections

This section gives the names and functions of the I/O signal pins, as well as connection examples.

Note: This information applies only to the SGDV-MD A01E☐M3A☐☐ and SGDV-MD A02E8M3A01.

5.2.1 I/O Signal Names and Functions

The I/O signals are used for the following functions.

- Homing
- Overtravel
- Latching the feedback position with an external signal input
- Controlling the servomotor brake power supply

(1) Input Signals

Signal	Pin No.	Name	Function	Reference Section
/DEC	Can be allocated.	Homing deceleration switch signal	Connects the deceleration limit switch for homing.	*5.3.1*
P-OT N-OT	Can be allocated.	Forward run prohibited, Reverse run prohibited	With overtravel prevention: Stops servomotor when movable part travels beyond the allowable range of motion.	*5.3.1*
/EXT1 to /EXT3	Can be allocated.	External latch signals 1 to 3	Connects the external signals that latch the current feedback pulse counter.	*5.3.1*
+24VIN	6	Control power supply for sequence signal	Control power supply input for sequence signals Operating range: +21.6 V to +26.4 V Note: The 24 VDC power supply is not included.	*5.2.4*

(2) Output Signals

Signal	Pin No.	Name	Function	Reference Section
/BK	1-2, 3-4, 14-15, 17-18, 19-20, 21-22, 23-24, 25-26	Brake output signal	Controls the brake. The brake is released when the signal turns ON.	*7.3.4*

Wiring and Connections

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5.2.2 I/O Signal Connector Specifications

This section gives the specifications of the I/O signal connector.

(1) I/O Signal Connector

Connector	Housing	Case	Manufacturer
I/O signal connector	Cable side: 10126-3000PE, SERVOPACK side: 10226-62M2PL	10326-52A0-008	3M Japan Limited

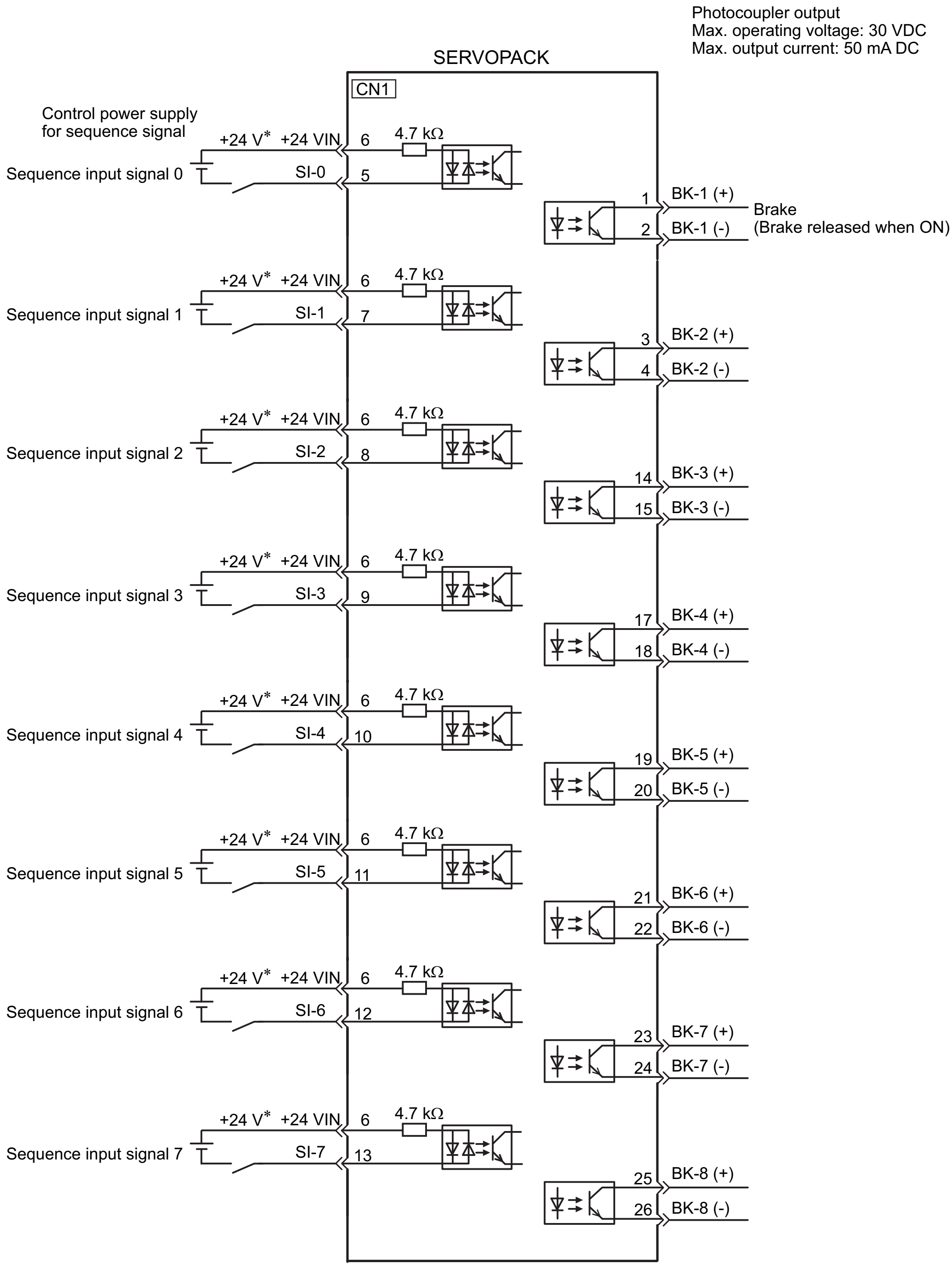
(2) I/O Signal Connector Pin Arrangement

Pin No.	Signal	I/O	Name (Applicable Axis)
1	/SO-0(+)	O	Brake output signal 0 +
2	/SO-0(-)	O	Brake output signal 0 -
3	/SO-1(+)	O	Brake output signal 1 +
4	/SO-1(-)	O	Brake output signal 1 -
5	/SI-0	I	Sequence input signal 0*
6	+24VIN	I	Control power supply input for sequence signals Operating range: +21.6 V to +26.4 V
7	/SI-1	I	Sequence input signal 1*
8	/SI-2	I	Sequence input signal 2*
9	/SI-3	I	Sequence input signal 3*
10	/SI-4	I	Sequence input signal 4*
11	/SI-5	I	Sequence input signal 5*
12	/SI-6	I	Sequence input signal 6*
13	/SI-7	I	Sequence input signal 7*
14	/SO-2(+)	O	Brake output signal 2 +
15	/SO-2(-)	O	Brake output signal 2 -
16	–	–	–
17	/SO-3(+)	O	Brake output signal 3 +
18	/SO-3(-)	O	Brake output signal 3 -
19	/SO-4(+)	O	Brake output signal 4 +
20	/SO-4(-)	O	Brake output signal 4 -
21	/SO-5(+)	O	Brake output signal 5 +
22	/SO-5(-)	O	Brake output signal 5 -
23	/SO-6(+)	O	Brake output signal 6 +
24	/SO-6(-)	O	Brake output signal 6 -
25	/SO-7(+)	O	Brake output signal 7 +
26	/SO-7(-)	O	Brake output signal 7 -

* You can use Pn590 to Pn596 to assign the POT, NOT, DEC, EXT1 to EXT3, and /BK signals to sequence I/O signals 0 to 7. For information on assigning functions to input signals, refer to *5.3 I/O Signal Assignments*.

5.2.3 Example of I/O Signal Connections

The following diagram shows a typical connection example.



* The 24-VDC power supply is not included. Use a 24-VDC power supply with double insulation or reinforced insulation.

Wiring and Connections

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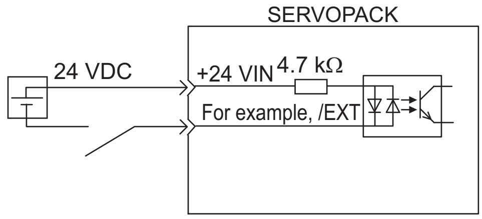
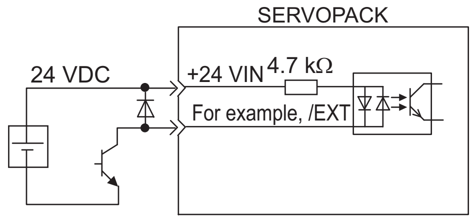
5.2.4 Sequence Input Circuit

(1) Photocoupler Input Circuit

CN1 connector pin 2 is described below.

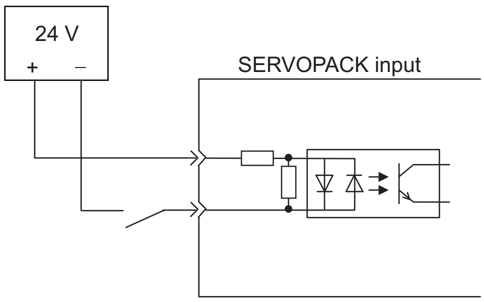
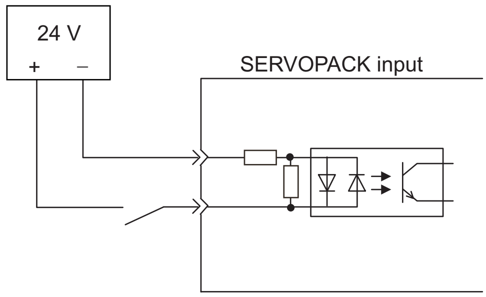
The sequence input circuit interface is connected through a relay or open-collector transistor circuit. When connecting through a relay, use a low-current relay. If a low-current relay is not used, a faulty contact may result.

Relay Circuit Example	Open-collector Circuit Example
	

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

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

Note 1. The connection examples in *5.2.3 Example of I/O Signal Connections* use sinking circuits.
2. The ON/OFF polarity differs between when a sink circuit is connected and when a source circuit is connected.

Sink Circuit	Source Circuit
	

Input Signal Polarities				Input Signal Polarities			
Signal	Level	Voltage Level	Contact	Signal	Level	Voltage Level	Contact
ON	Low (L) level	0 V	Close	ON	High (H) level	24 V	Close
OFF	High (H) level	24 V	Open	OFF	Low (L) level	0 V	Open

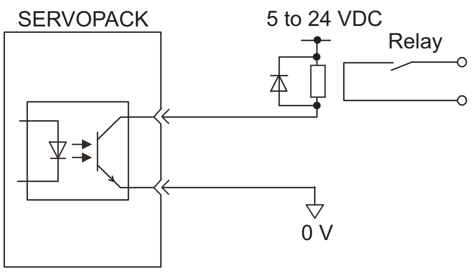
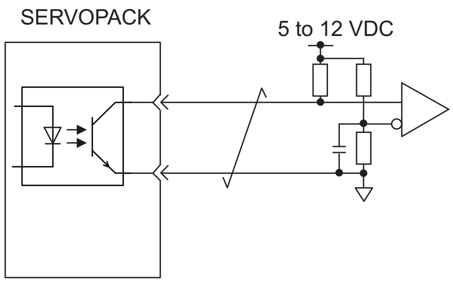
5.2.5 Sequence Output Circuit

The signal output circuit from the SERVOPACK is described below.

> **IMPORTANT**
>
> Incorrect wiring or incorrect voltage application to the output circuit may cause short-circuit.
>
> If a short-circuit occurs as a result of any of these causes, the holding brake will not work. This could damage the machine or cause an accident resulting in death or injury.

(1) Photocoupler Output Circuit

The brake signal (/BK) output signal uses a photocoupler output circuit. Connect a photocoupler output circuit through a relay circuit or line-receiver circuit.

Relay Circuit Example	Line Receiver Circuit Example
	

Note: The maximum allowable voltage and the allowable range of current capacity for photocoupler output circuits are as follows.
- Voltage: 30 VDC
- Current: 5 to 50 mA DC

5.3 I/O Signal Assignments

You can assign the overtravel signals, homing deceleration switch, external latch, and brake output signals to the CN1 sequence I/O signals.

5.3.1 I/O Signal Setting Parameters

Parameter to Set	Assigned Signal Function	Sequence Input Signal Pin Numbers
Pn590	Positive overtravel signal (P-OT)	5 or 7 to 13
Pn591	Negative overtravel signal (N-OT)	5 or 7 to 13
Pn592	Homing deceleration switch signal (/DEC)	5 or 7 to 13
Pn593	External latch signal 1 (/EXT1)	5 or 7 to 13
Pn594	External latch signal 2 (/EXT2)	
Pn595	External latch signal 3 (/EXT3)	
Pn596	Brake output signal (/BK)	1-2, 3-4, 14-15, 17-18, 19-20, 21-22, 23-24, or 25-26

Note 1. The above parameters are set for each axis.
2. Turn the power supply OFF and ON again or use the CONFIG command to enable the settings.

5.3.2 Parameter Settings

(1) Input Signal Function Assignments

The following table gives the setting of parameters Pn590 to Pn595.

Parameter		Meaning	When Enabled	Classification
Pn590	n.0□□□ [factory setting]	P-OT signal assignment disabled.	After restart	Setup
	n.1□□□	P-OT signal assigned. Positive drive is enabled when the signal is low.		
	n.2□□□	P-OT signal assigned. Positive drive is enabled when the signal is high.		
Pn591	n.0□□□ [factory setting]	N-OT signal assignment disabled.	After restart	Setup
	n.1□□□	N-OT signal assigned. Reverse drive is enabled when the signal is low.		
	n.2□□□	N-OT signal assigned. Reverse drive is enabled when the signal is high.		
Pn592	n.0□□□ [factory setting]	/DEC signal assignment disabled.	After restart	Setup
	n.1□□□	/DEC signal assigned. Signal is ON for low level.		
	n.2□□□	/DEC signal assigned. Signal is ON for high level.		
Pn593	n.0□□□ [factory setting]	/EXT1 signal assignment disabled.	After restart	Setup
	n.1□□□	/EXT1 signal assigned. Signal is ON for low level.		
	n.2□□□	/EXT1 signal assigned. Signal is ON for high level.		
Pn594	n.0□□□ [factory setting]	/EXT2 signal assignment disabled.	After restart	Setup
	n.1□□□	/EXT2 signal assigned. Signal is ON for low level.		
	n.2□□□	/EXT2 signal assigned. Signal is ON for high level.		
Pn595	n.0□□□ [factory setting]	/EXT3 signal assignment disabled.	After restart	Setup
	n.1□□□	/EXT3 signal assigned. Signal is ON for low level.		
	n.2□□□	/EXT3 signal assigned. Signal is ON for low level.		

(2) Input Signal Pin Assignments

Use parameters Pn590 to Pn595 to assign I/O signal connector pins 5 and 7 to 13.

Parameter		Meaning	Pin No.	When Enabled	Classification
Pn590 to Pn595	n.□□□0	Selects sequence input signal /SI-0.	5	After restart	Setup
	n.□□□1	Selects sequence input signal /SI-1.	7	After restart	Setup
	n.□□□2	Selects sequence input signal /SI-2.	8	After restart	Setup
	n.□□□3	Selects sequence input signal /SI-3.	9	After restart	Setup
	n.□□□4	Selects sequence input signal /SI-4.	10	After restart	Setup
	n.□□□5	Selects sequence input signal /SI-5.	11	After restart	Setup
	n.□□□6	Selects sequence input signal /SI-6.	12	After restart	Setup
	n.□□□7	Selects sequence input signal /SI-7.	13	After restart	Setup

(3) Output Signal Function Assignments

The following table gives the setting of the Pn596 parameter.

Parameter		Meaning	When Enabled	Classification
Pn596	n.0□□□ [factory setting]	/BK signal assignment disabled.	After restart	Setup
	n.1□□□	/BK signal assignment enabled.		

(4) Output Signal Pin Assignments

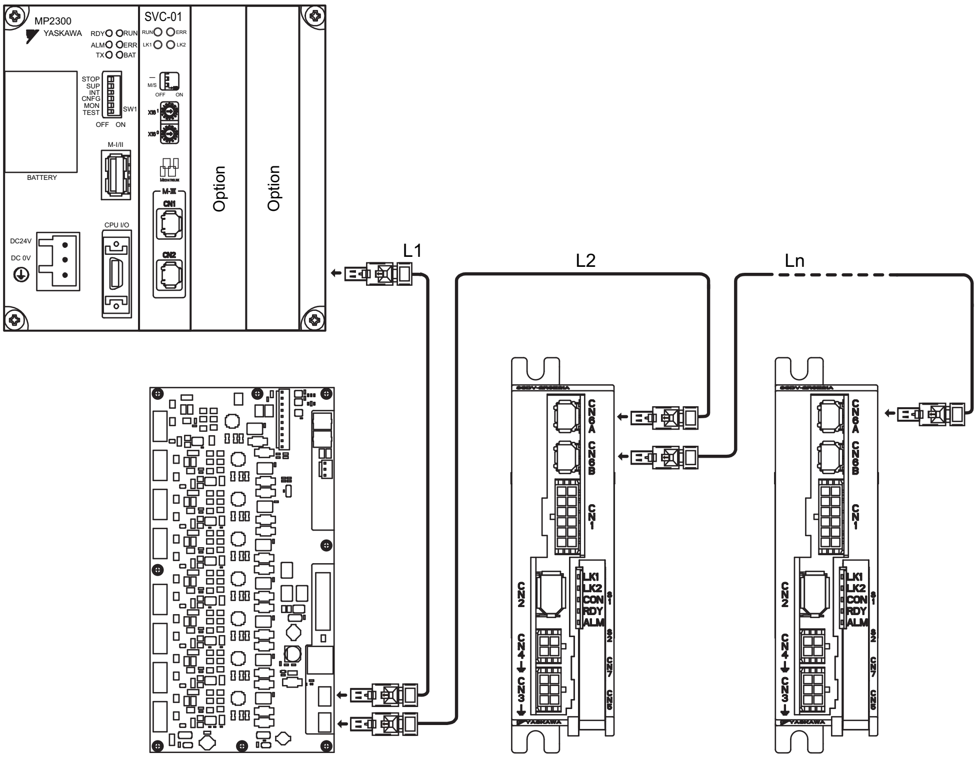
The assignments for the /BK-0 to /BK-7 sequence output signals are set with the Pn596 parameter.

Parameter		Meaning	Pin No.	When Enabled	Classification
Pn596	n.□□□0	Selects sequence input signal /SO-0.	1-2	After restart	Setup
	n.□□□1	Selects sequence input signal /SO-1.	3-4		
	n.□□□2	Selects sequence input signal /SO-2.	14-15		
	n.□□□3	Selects sequence input signal /SO-3.	17-18		
	n.□□□4	Selects sequence input signal /SO-4.	19-20		
	n.□□□5	Selects sequence input signal /SO-5.	21-22		
	n.□□□6	Selects sequence input signal /SO-6.	23-24		
	n.□□□7	Selects sequence input signal /SO-7.	25-26		

5.4 Wiring MECHATROLINK-III Communications

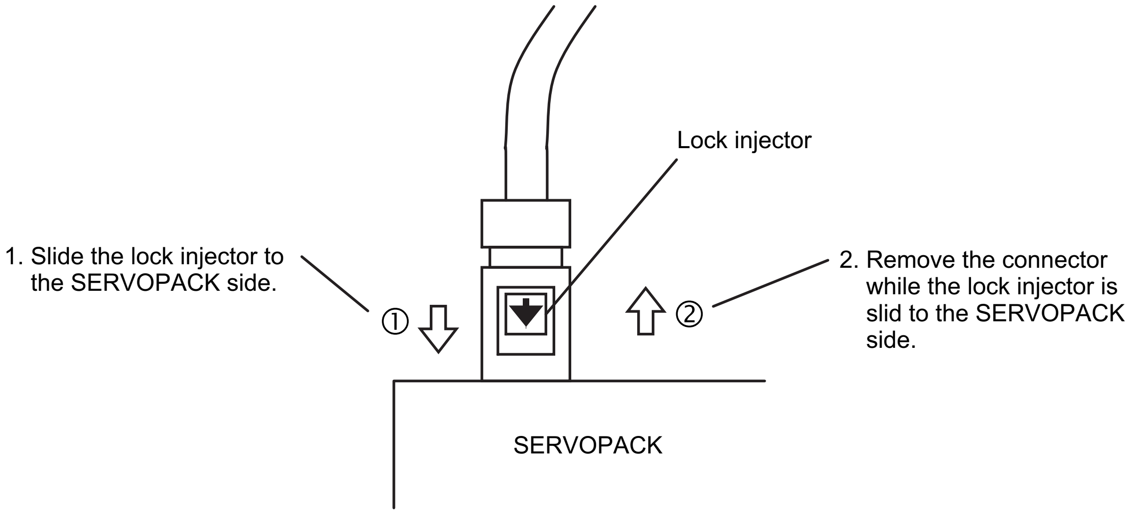
The following diagram shows an example of connections between a host controller and a SERVOPACK using.

MECHATROLINK-III communications cables (CN6A, CN6B).



Note: The length of the cable between stations (L1, L2 ... Ln) must be 50 m maximum.

For removing the MECHATROLINK-III communications cable connectors from the SERVOPACK, refer to the following procedure.
Slide the lock injector of the connector to the SERVOPACK side to unlock and remove the MECHATROLINK-III communications cable connectors.



Note: The MECHATROLINK-III communications cable connector may be damaged if it is removed without being unlocking.

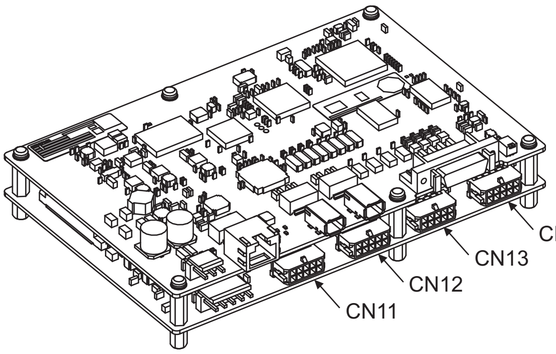
5.5 Connecting the Servomotor and Encoder

This section describes the connection signal (CN11 to CN18) names and functions and cable specifications for the servomotor and encoder. It also provides connection examples.

5.5.1 Names and Functions of Servomotor and Encoder Connection Signals

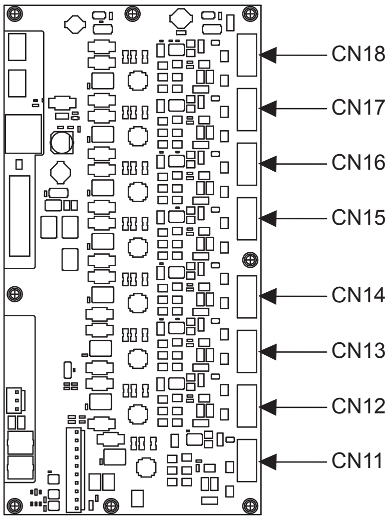
This section provides the names and functions of servomotor and encoder connection signals (CN11 to CN1□).

(1) Type A01 SERVOPACK



Connector No.	Symbol	Pin No.	Name	Specification
CN11 to CN14	PS	2	Differential serial signal +	Encoder differential serial signal input
		7	Differential serial signal -	
	PG 5V	8	Encoder power supply +	Encoder power supply (+5 V)
	GND	3	Encoder power supply -	
	U	5	Servomotor connection pin for phase U	Connect these pins to the servomotor.
	V	9	Servomotor connection pin for phase V	
	W	10	Servomotor connection pin for phase W	
	FG	6	Ground pin	Connect these pins to the harness shield and servomotor ground terminal.
		1		
		4		

(2) Type A02 SERVOPACK



Connector No.	Symbol	Pin No.	Name	Specification
CN11 to CN18	PS	2	Differential serial signal +	Encoder differential serial signal input
		7	Differential serial signal -	
	PG 5V	8	Encoder power supply +	Encoder power supply (+5 V)
	GND	3	Encoder power supply -	
	U	5	Servomotor connection pin for phase U	Connect these pins to the servomotor.
	V	9	Servomotor connection pin for phase V	
	W	10	Servomotor connection pin for phase W	
	FG	6	Ground pin	Connect these pins to the harness shield and servomotor ground terminal.
		1		
		4		

5.5.2 Servomotor/Encoder Relay Cable Specifications

This section gives the servomotor/encoder relay cable specifications.

Refer to *2.4.2 Servomotor/Encoder Relay Cables* for the model numbers of the servomotor/encoder relay cables.

■ Servomotor Connectors

Connectors	Housing	Contacts	Manufacturer
Servomotor Connectors	Cable side: 43025-1000, Type A01 SERVOPACK side: 43045-1002, Type A02 SERVOPACK side: 43045-1014	43030-0003	Molex Japan Co., Ltd.

■ Wire Sizes and Lengths

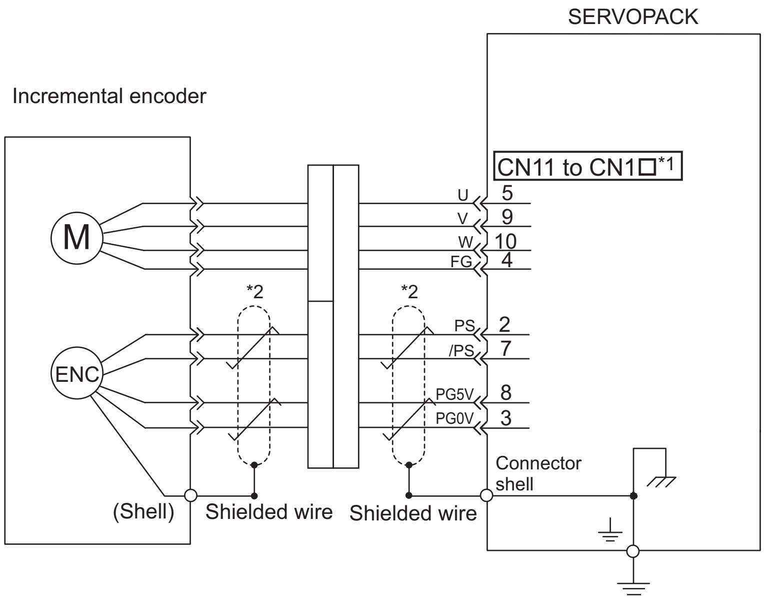
We recommend a wire size of AWG20 to AWG24.

The wire length must be 10 m max.

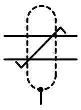
5.5.3 Servomotor and Encoder Connection Examples

This section provides examples of connections between the SERVOPACK and encoder.

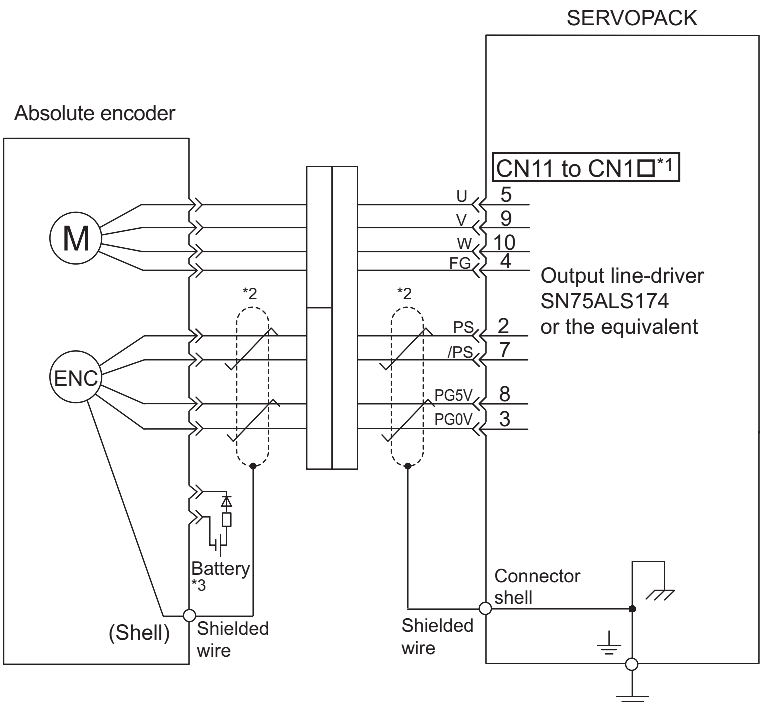
(1) Using as an Incremental Encoder



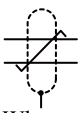
∗1. The box (□) is replaced by a number. For a type A01 SERVOPACK, the number is 4. For a type A02 SERVOPACK, the number is 8.

∗2.  : represents shielded twisted-pair wires.

(2) Using as an Absolute Encoder



∗1. The box (□) is replaced by a number. For a type A01 SERVOPACK, the number is 4. For a type A02 SERVOPACK, the number is 8.

∗2.  : represents shielded twisted-pair wires.

∗3. When using an absolute encoder, provide power by installing an encoder cable with a JUSP-BA01-E Battery Case.

IMPORTANT

- If you use the encoder as an absolute encoder, use one of the encoder cables with a battery case specified by Yaskawa. Refer to *2.4.2 Servomotor/Encoder Relay Cables* for the model numbers of the cables.

5.5.4 Battery Replacement

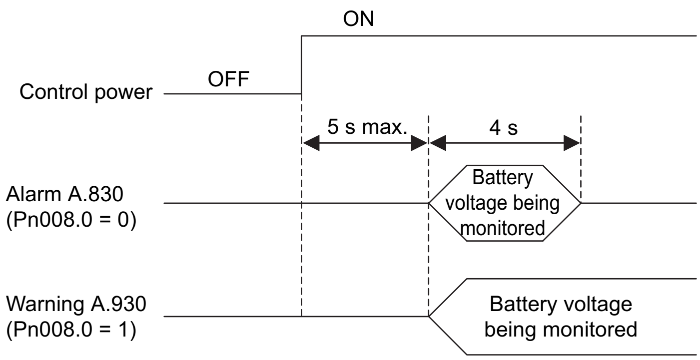
If the battery voltage drops to approximately 2.7 V or less, an absolute encoder battery error alarm (A.830) or an absolute encoder battery error warning (A.930) will be displayed.

If this alarm or warning is displayed, replace the batteries using the following procedure.

Use Pn008.0 to set either an alarm (A.830) or a warning (A.930).

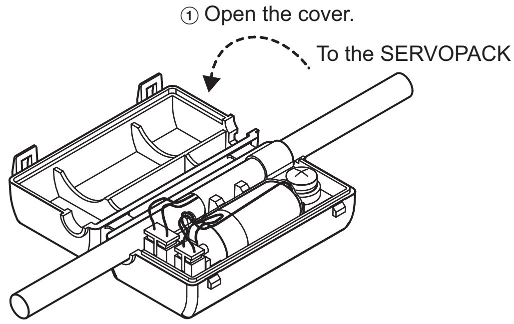
Parameter		Meaning	When Enabled	Classification
Pn008	n.□□□0 [Factory setting]	Outputs the alarm A.830 when the battery voltage drops.	After restart	Setup
	n.□□□1	Outputs the warning A.930 when the battery voltage drops.		

- If Pn008.0 is set to 0
  The battery voltage is monitored for approx. 4 seconds after the control power supply has been ON for approx. 5 seconds.
  No battery-related alarm will be displayed even if the battery voltage drops below the specified value after these 4 seconds.
- If Pn008.0 is set to 1
  The battery voltage is monitored for continuously after the control power supply has been ON for approx. 5 seconds.

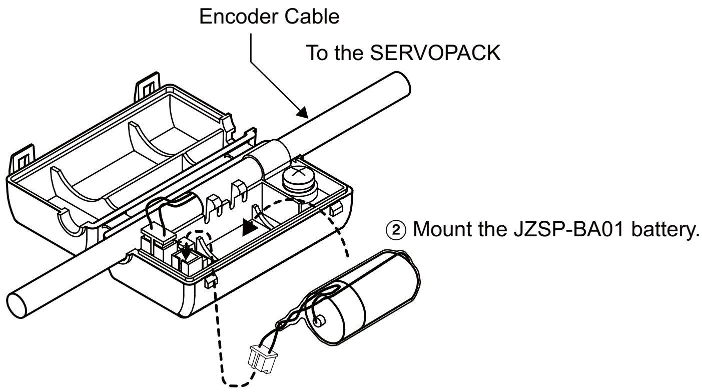


(1) Battery Replacement Procedure

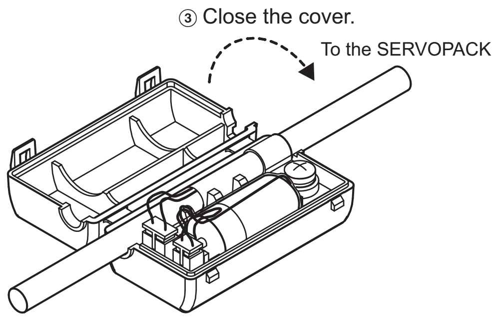
1. Turn ON the control power supply of the SERVOPACK only.
2. Open the battery case cover.



3. Remove the old battery and mount the new JZSP-BA01 battery as shown below.



4. Close the battery case cover.



5. After replacing the battery, turn OFF the control power supply to clear the absolute encoder battery error alarm (A.830).
6. Turn ON the control power supply again.
7. Check that the alarm display has been cleared and that the SERVOPACK operates normally.

IMPORTANT	If the SERVOPACK control power supply is turned OFF and the battery is disconnected (which includes disconnecting the encoder cable), the absolute encoder data will be deleted.

5.6 Noise Control and Measures for Harmonic Suppression

This section describes the wiring for noise control and the DC reactor for harmonic suppression.

5.6.1 Wiring for Noise Control

IMPORTANT

- Because the SERVOPACK is designed as an industrial device, it provides no mechanism to prevent noise interference.
- The SERVOPACK uses high-speed switching elements in the main circuit. Therefore peripheral devices may receive switching noise. If the equipment is to be used near private houses or if radio interference is a problem, take countermeasures against noise.

The SERVOPACK uses microprocessors. Therefore it may receive switching noise from peripheral devices.

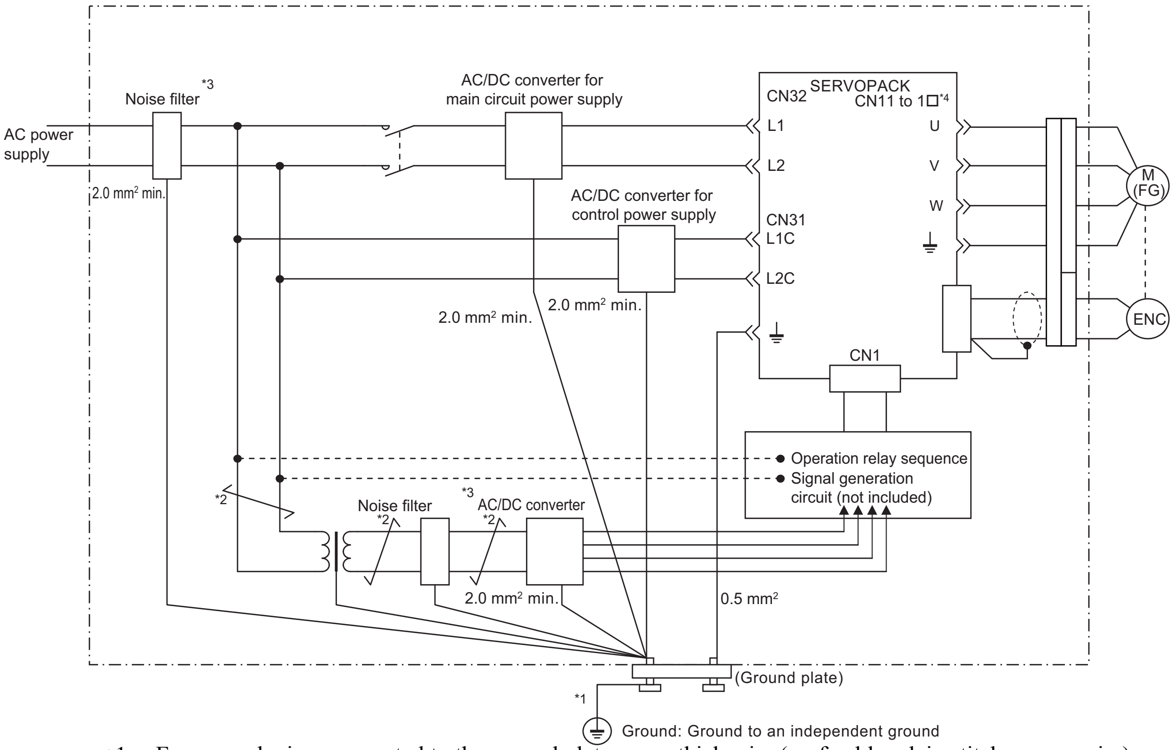
To prevent the noise from the SERVOPACK or the peripheral devices from causing a malfunction of any one of these devices, take the following precautions against noise as required.

- Position the input reference device and noise filter as close to the SERVOPACK as possible.
- Always install a surge absorber in the relay, solenoid and electromagnetic contactor coils.
- Do not share the power supply with an electric welder or electrical discharge machine. When the SERVOPACK is placed near a high-frequency generator, install a noise filter on the input side of the power supply cables. For the connection method for the noise filter, refer to *5.6.1*, *(1) Noise Filter*.
- Perform the grounding measures correctly. For the grounding measures, refer to *5.6.1*, *(2) Correct Grounding*.

(1) Noise Filter

The SERVOPACK has a built-in microprocessor (CPU), so protect it from external noise as much as possible by installing a noise filter in the appropriate place.

The following is an example of wiring for noise control.



∗1. For ground wires connected to the ground plate, use a thick wire (preferably, plain stitch copper wire).

∗2. (twisted-pair symbol) should be twisted-pair wires.

∗3. When using a noise filter, follow the precautions in *5.6.2 Precautions on Connecting Noise Filter*.

∗4. The box (□) is replaced by a number. For a type A01 SERVOPACK, the number is 4. For a type A02 SERVOPACK, the number is 8.

(2) Correct Grounding

Take the following grounding measures to prevent the malfunction due to noise.

■ Grounding the Motor Frame

If the servomotor is grounded through the machine, switching noise current will flow from the main circuit of the SERVOPACK through the floating capacitance of the servomotor. To prevent the adverse effects of switching noise, always connect the motor frame terminal (FG) on the servomotor to the ground pin ⏚ on the servomotor connector.

■ Noise on the I/O Signal Cable

If the I/O signal cable picks up noise, ground the 0 V line (SG) of the I/O signal cable. If the servomotor/ encoder relay cable is placed in a metal conduit, ground the conduit and its junction box. For all grounding, ground at one point only.

5.6.2 Precautions on Connecting Noise Filter

This section describes the precautions on installing a noise filter.

(1) Noise Filter Brake Power Supply

If using a servomotor with a holding brake, use the following noise filter on the brake power supply input.

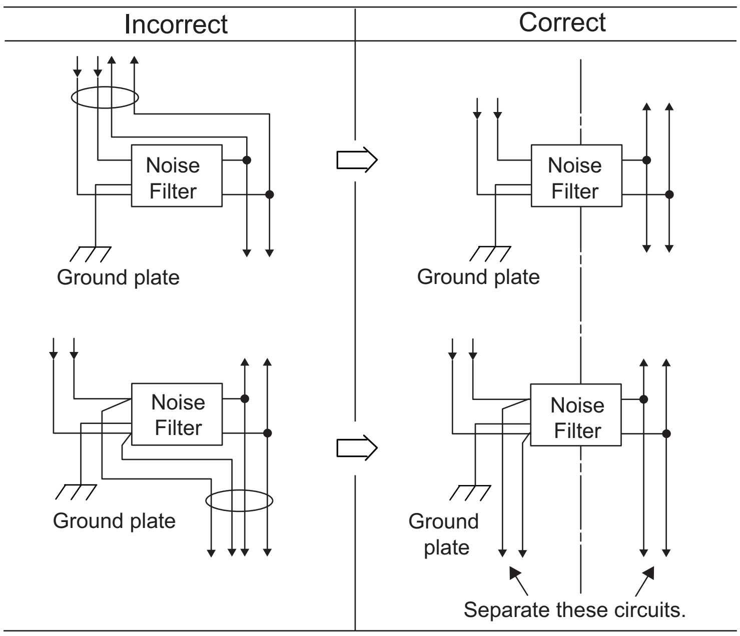
Model: FN2070-6/07 (Manufactured by SCHAFFNER Electronic.)

(2) Precautions on Using Noise Filters

Always observe the following installation and wiring instructions.

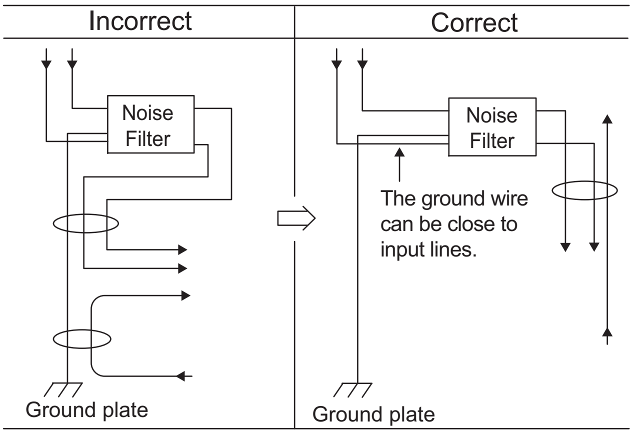
IMPORTANT	Some noise filters have large leakage currents. The grounding measures taken also affects the extent of the leakage current. If necessary, select an appropriate leakage current detector or leakage current breaker taking into account the grounding measures that are used and leakage current from the noise filter. Contact the manufacturer of the noise filter for details.

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

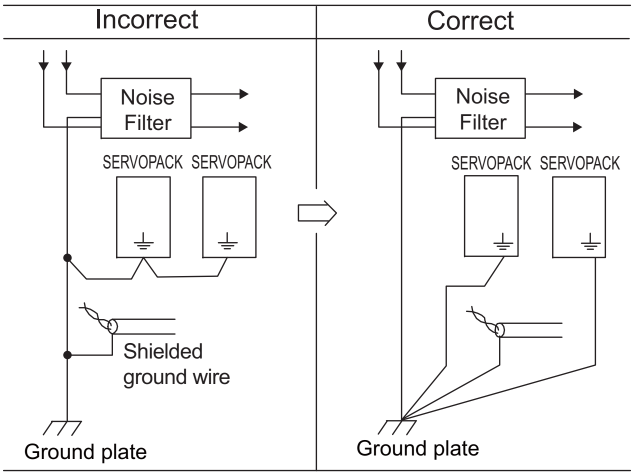


Separate the noise filter ground wire from the output lines.

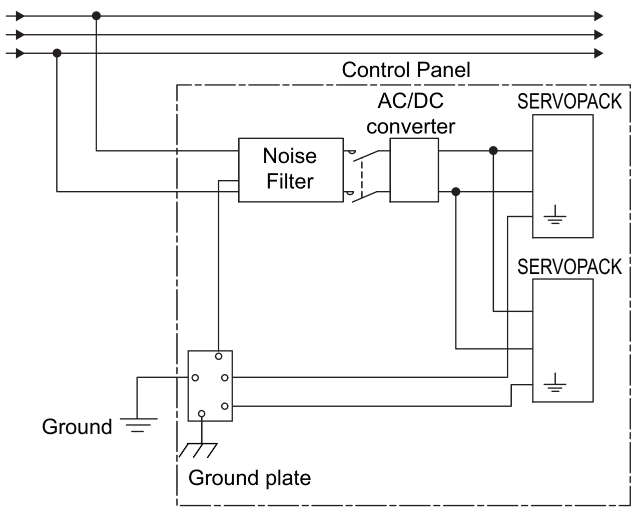
Do not accommodate the noise filter ground wire, output lines and other signal lines in the same duct or bundle them together.



Connect the noise filter ground wire directly to the ground plate.
Do not connect the noise filter ground wire to other ground wires.



If a noise filter is located inside a control panel, first connect the noise filter ground wire and the ground wires from other devices inside the control panel to the ground plate for the control panel, then ground the plates.



6

SigmaWin+

6.1 SigmaWin+

SigmaWin+ is a software application that can be used to view SERVOPACK status, set parameters, and perform setup tuning.

6.2 Preparing SigmaWin+

Install SigmaWin+ after downloading the software application from the following Yaskawa website.
SigmaWin+ software version 5.62 or higher is required for the Σ-V-MD SERVOPACKs.

6.3 Connecting a PC with SigmaWin+

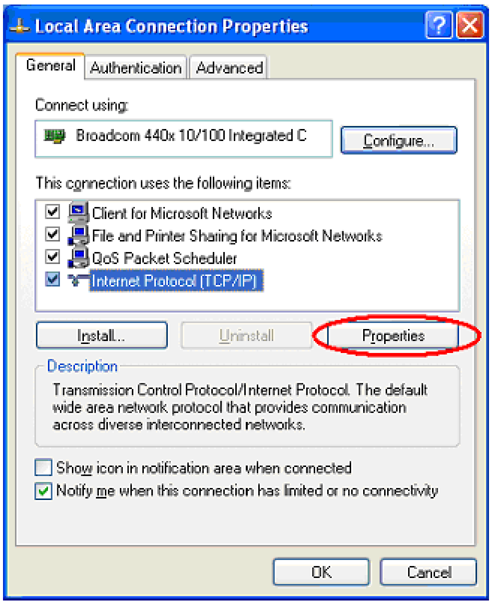
Use Ethernet to connect the computer where the SigmaWin+ is installed to the SERVOPACK. Before you make the Ethernet connection, you must set the IP address in the computer. The setting procedures for the IP addresses in the computer and SERVOPACK are given in the following sections.

Note: Use either a straight or cross cable to connect the computer.

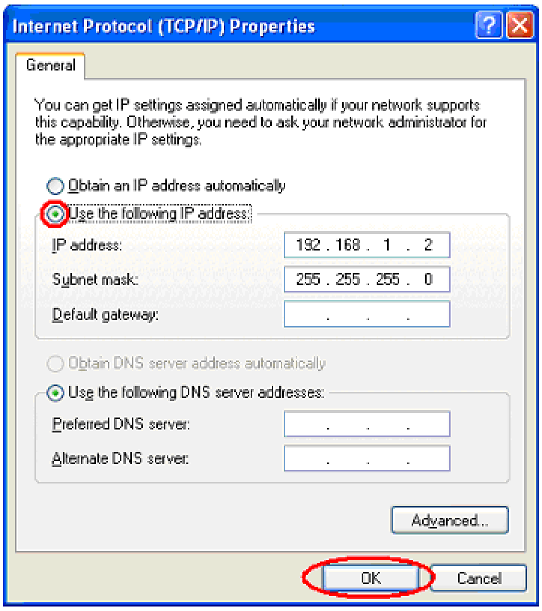
6.3.1 Setting the IP Address in the Computer

Use the following procedure to set the IP address in the computer.

1. Select ***Control Panel*** – ***Network Connections*** – ***Local Area Connection*** – ***Properties*** from the Windows Start Menu on the desktop of the computer.
2. Double-click **Internet Protocol (TCP/IP)** in the list.



3. Select **Internet Protocol (TCP/IP)** and click **Properties**.
The following dialog box appears.



4. Select the **Use the following IP address** option, enter any IP address in the **IP address** box and enter "255 255 255 0" in the **Subnet mask** box.
Click **OK** to close the dialog box.

6.3.2 Setting the IP Address in the SERVOPACK

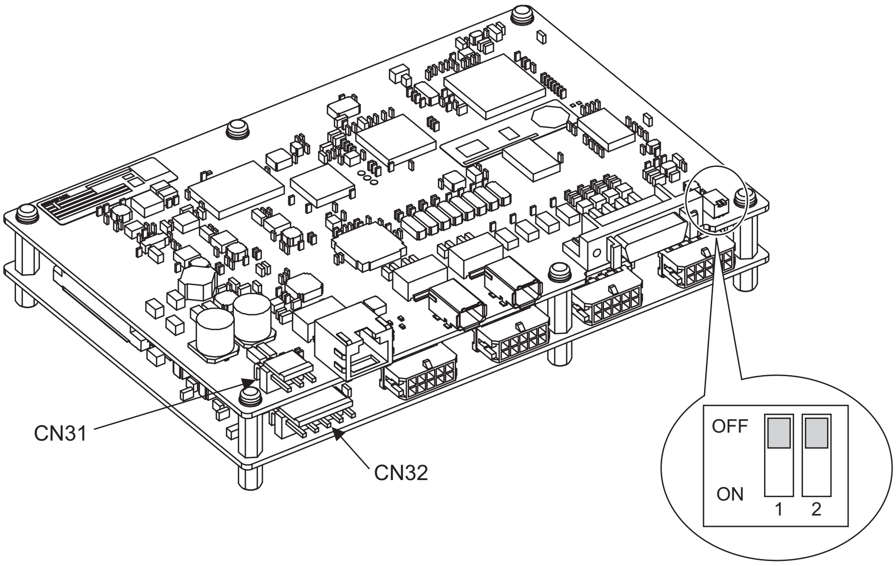
Use the parameter to set the IP address.

Parameter	Factory	Remarks
Pn030: Ethernet IP Address Setting	192.168.1.1	Setting Method: 192.168.1.2 Pn030, byte 1 Pn030, byte 2 Pn030, byte 3 Pn030, byte 4 Example for 192.168.1.2 Pn030 = C0A80102H

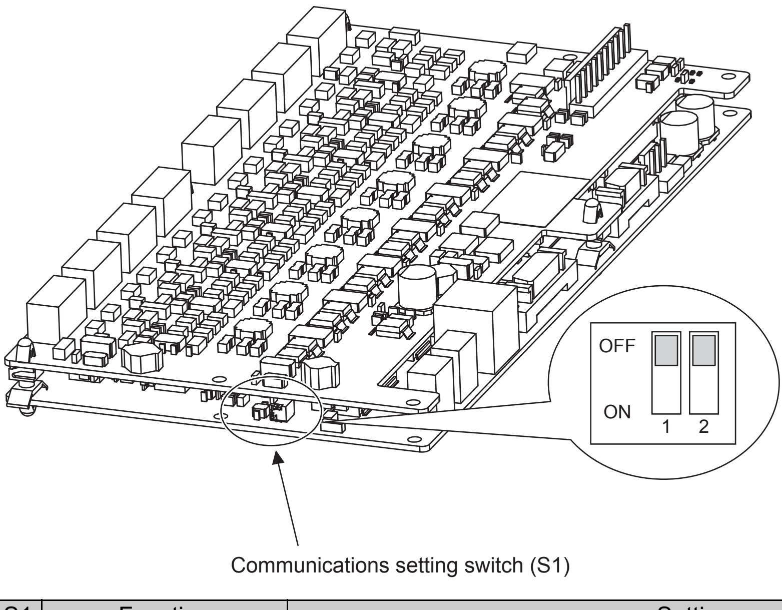
6.3.3 Initializing the Communications Settings

You use the communications setting switch (S1) to restore the Ethernet and MECHATROLINK-III communications settings to their factory settings.

• Type A01 SERVOPACK



• Type A02 SERVOPACK



Pin on S1	Function	Setting	
1	Initializing the communications settings	OFF	Normal mode (factory setting)
		ON	Initializes the communications settings.
2	Reserved (Do not use.)	OFF (Do not change.)	

If you turn ON the communications initialization pin, the SERVOPACK will start with the following communications settings.

Parameter	Factory setting
IP Address	192.168.1.1
Station Address	0003H
Number of Transmission Bytes	0048

Note: Pn880, Pn881, and Pn030 are not initialized.

6.4 Starting and Operating the SigmaWin+

Use the following procedure to display the main window of the SigmaWin+.

1. Connect a SERVOPACK to a computer which has SigmaWin+ installed.
For the connection method, refer to the figure in *1.2 Examples of Servo System Configurations*.

2. Turn on the SERVOPACK.

3. Turn on the computer.

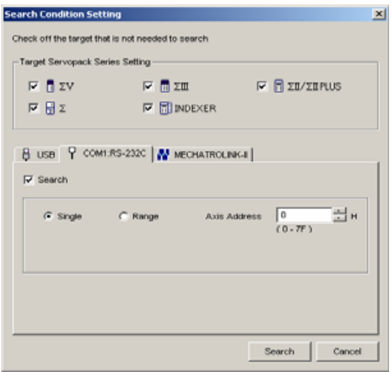
4. Double click the **YE_Applications** icon.

5. Double click the **SigmaWin+ English Edition** icon.
The SigmaWin+ startup window will appear. When the startup of SigmaWin+ has been completed, the **Connect** window will appear

Setup Window

Connect Window

6. Click **Search**.
The **Search Condition Setting** box will appear



Search Condition Setting box

Note:Use the offline mode when running SigmaWin+ without connecting to the SERVOPACK.

7. Select the ΣV.

8. Click **Search**.

A message will appear first to indicate that a search is being carried out, and then the search results will be shown in the **Connect** window.

9. Select the SERVOPACK to be connected.

10. Click **Connect**.

The SigmaWin+ main window will appear.

6.5 Parameters (Pn□□□)

This section describes the classifications, methods of notation, and settings for parameters given in this manual.

6.5.1 Parameter Classification

Parameters of the Σ-V Series SERVOPACK are classified into two types of parameters. One type of parameters is required for setting up the basic conditions for operation and the other type is required for tuning parameters that are required to adjust servomotor characteristics

Classification	Meaning	Setting Method
Setup Parameters	Parameters required for setup.	Set each parameter individually.
Tuning Parameters	Parameters for tuning control gain and other parameters.	There is no need to set each parameter individually.

There are two types of notation used for parameters, one for parameter that requires a value setting (parameter for numeric settings) and one for parameter that requires the selection of a function (parameter for selecting functions).

The notation and settings for both types of parameters are described next.

6.5.2 Notation for Parameters

(1) Parameters for Numeric Settings

The control methods for which the parameters applies.
Speed : Speed control Position : Position control Torque : Torque control

Pn406	Emergency Stop Torque			Speed Position Torque	
	Setting Range	Setting Unit	Factory Setting	When Enabled	Classification
	0% to 800%	1%	800	After change	Setup

Parameter number

Indicates the setting range for the parameter.

Indicates the minimum setting unit for the parameter.

Indicates the parameter setting before shipment.

Indicates when a change to the parameter will be effective.

Indicates the parameter classification.

(2) Parameters for Selecting Functions

Parameter		Meaning	When Enabled	Classification
Pn002	n.□0□□ [Factory setting]	Uses the absolute encoder as an absolute encoder.	After restart	Setup
	n.□1□□	Uses the absolute encoder as an incremental encoder.		

Parameter number

The notation "n.□□□□" indicates a parameter for selecting functions. Each □ corresponds to the setting value of that digit. The notation shown here means that the third digit is 1.

This section explains the selections for the function.

SigmaWin+

6

6.5.3 Setting Parameters

There are two ways to set parameters. These are as follows:
- Using the Parameter Editing dialog box
- Using the Online Parameter Editing dialog box

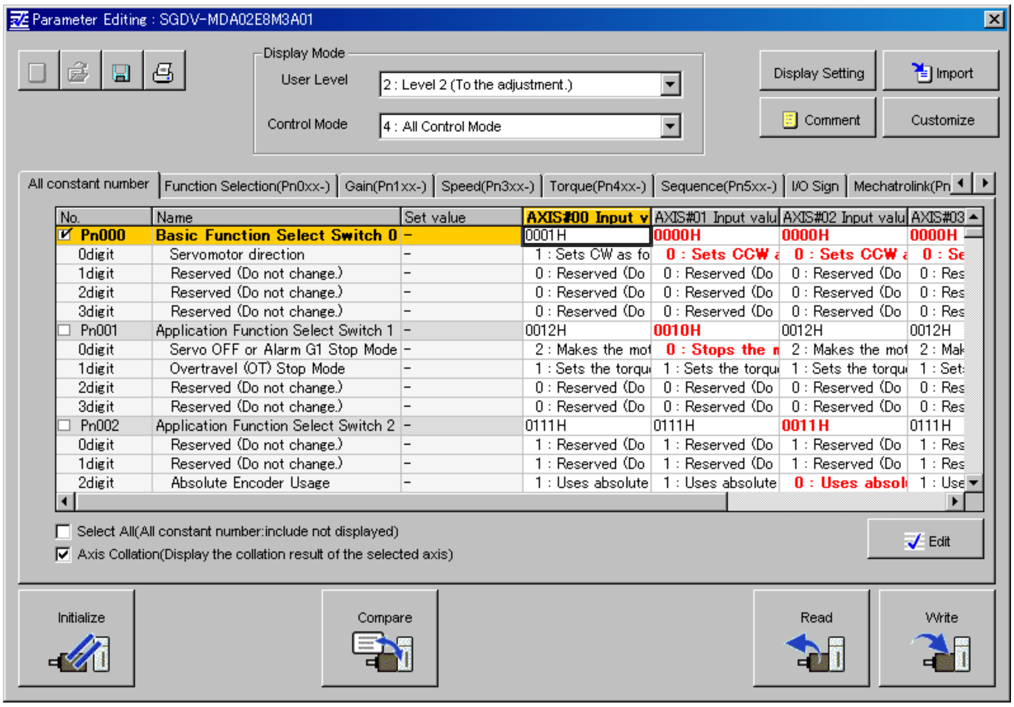
These methods are described below.

(1) Using the Parameter Editing Dialog Box

1. In the SigmaWin+ main window, click **Parameters** - **Edit Parameters**.

2. Select a parameter to edit.

If the parameter cannot be seen in the **Parameter Editing** dialog box, click the arrows to view the parameter.



3. Click **Edit**.

The **Edit** box for the selected parameter will appear.

4. Change the value of the parameter.

<For parameters for numeric settings>
Enter the value to be set.

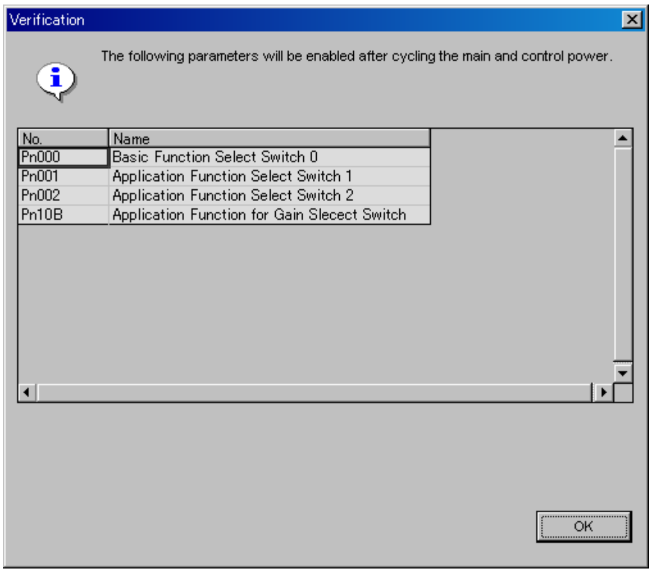
<For parameters for selecting functions>
Click the arrow to open the setting list for each digit and select one item in each list.

5. Click **OK**.

6. Click **Write**.

The new parameter settings will be saved in the SERVOPACK.

This completes the editing of the parameter. If the following window appears, go to step 7.



7. Click **OK**.

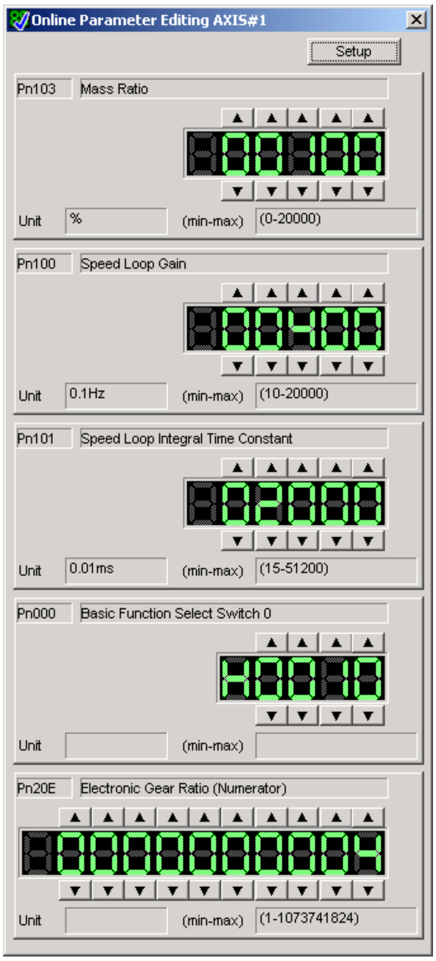
8. To enable the change in the setting, restart the SERVOPACK.

(2) Using the Online Parameter Editing Dialog Box

IMPORTANT	• Values edited in the Online Parameter Editing dialog box are immediately changed in the SERVOPACK. • If the power to the SERVOPACK is turned OFF or the communication between the SERVOPACK and the SigmaWin+ is interrupted while editing parameters online, the edited values will not be saved in the SERVOPACK.

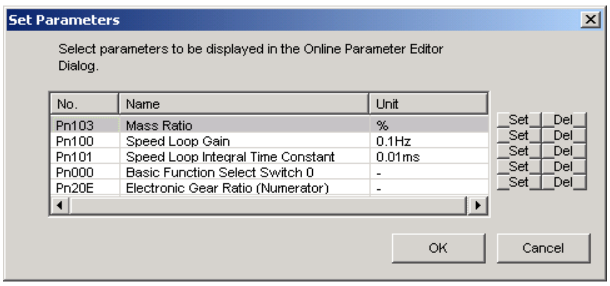
1. In the SigmaWin+ main window, click **Parameters** - **Edit Online Parameters**.

The **Online Parameter Editing** dialog box will appears



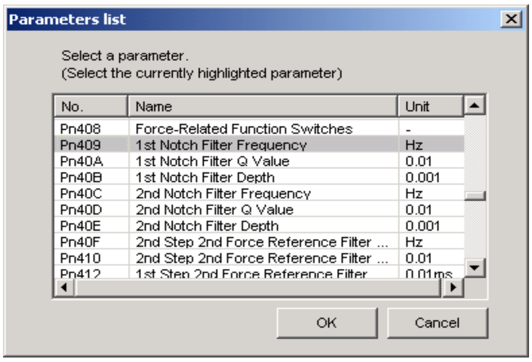
2. Click **Setup**.

The **Set Parameters** box will appear.



3. Click one of the **Set** buttons located on the right of the parameter list.

The **Parameters list** box will appear.



4. Select a parameter to edit, and then click **OK**.

The **Set Parameters** box will appear again.

5. Click **OK**.

The **Online Parameter Editing** dialog box will appear again.

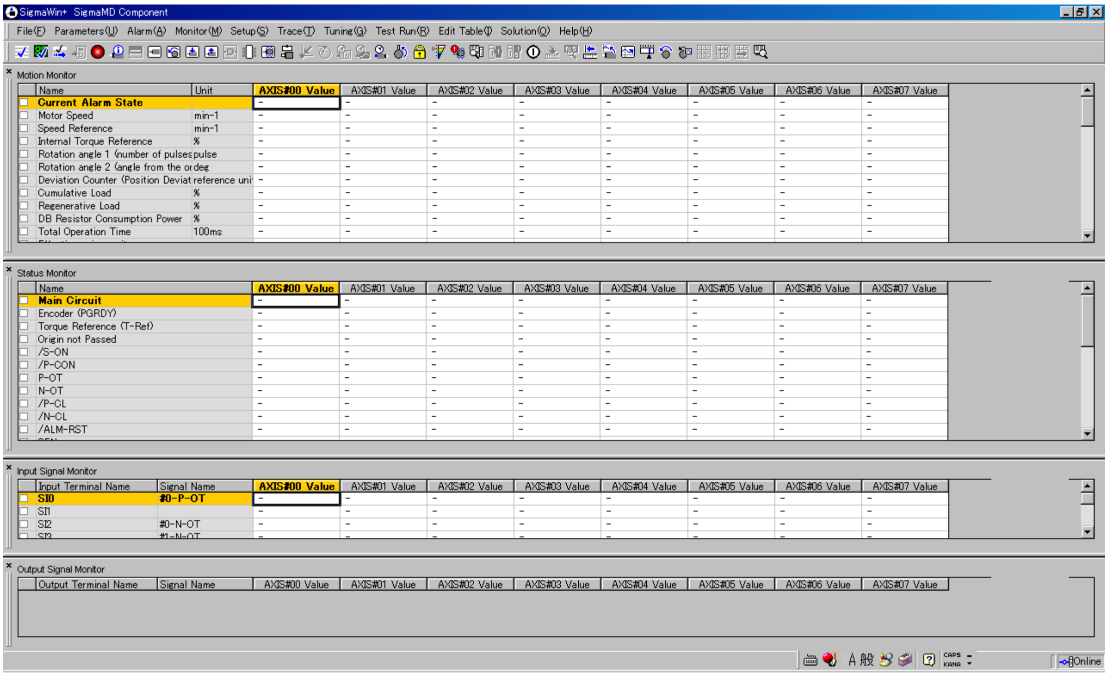
6. Click the setting arrows to change the value of the setting.

If an allowable range is specified, set the value within that range.
The value of the parameter in the SERVOPACK will immediately change to the new value.

6.6 Monitor Operations

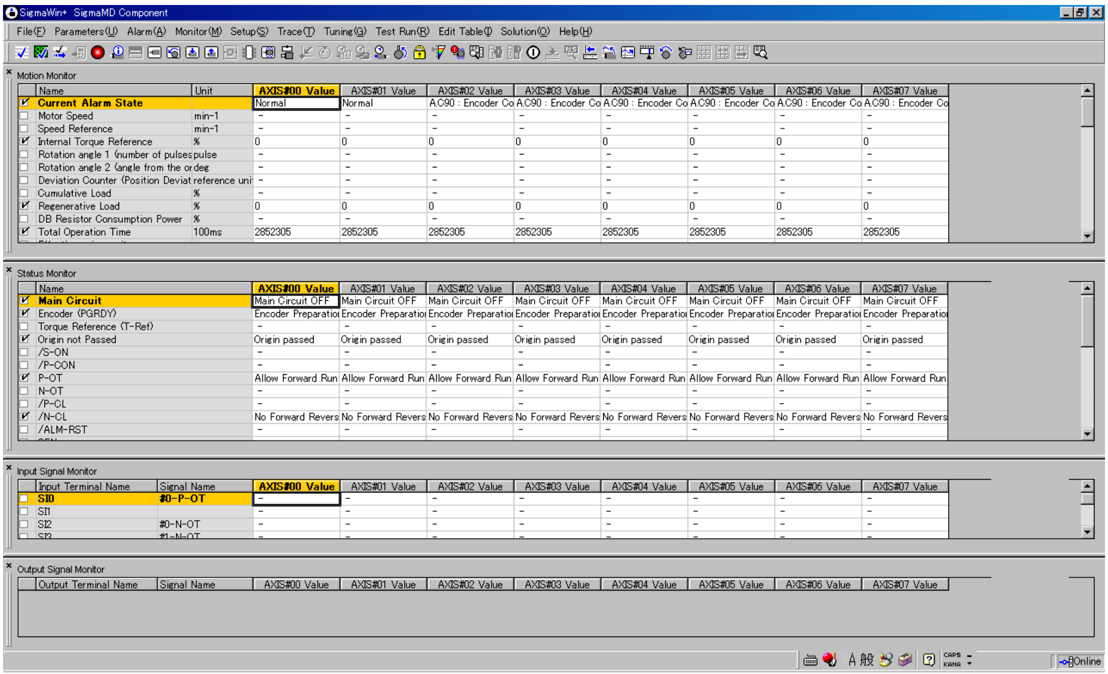
Use the following procedure to monitor values.

1. Select **Monitor - Monitor** from the menu bar of the SigmaWin+ main window.
The following window appears.



The items that you can monitor are displayed.

2. Select the check boxes on the left side of the items to monitor.
The current values are displayed in the value columns.



7

Operation

7.1 MECHATROLINK-III Communications Settings

This section describes the switch settings necessary for MECHATROLINK-III communications.

7.1.1 Setting the MECHATROLINK-III Station Address

Set the MECHATROLINK-III station address in Pn880.

Pn880	Station Address Setting		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory	When Enabled	
	3H to EFH	–	3	After restart	Setup

IMPORTANT

If you change the setting of Pn010 to Pn017, Pn880, or Pn881, turn the power OFF and ON again to enable the new setting.

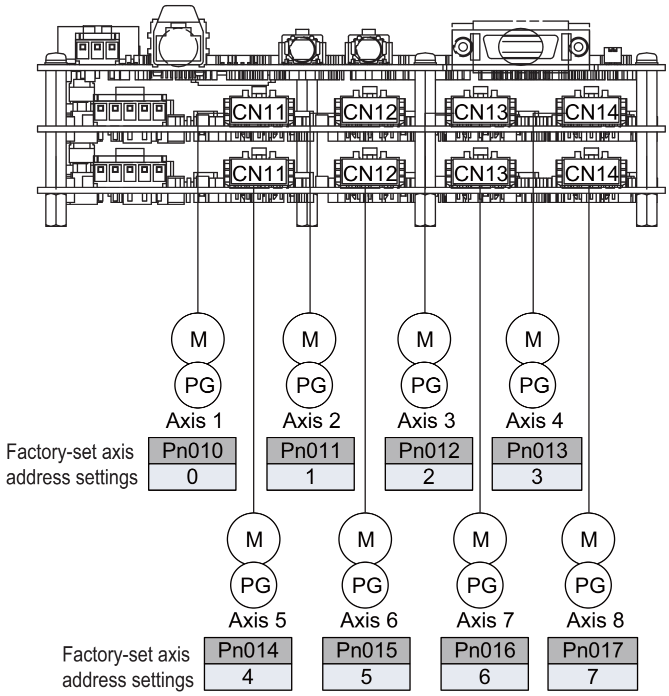
7.1.2 Setting the MECHATROLINK-III Axis Addresses

The MECHATROLINK-III axis addresses are set in Pn010 to Pn01B.

In the factory settings, axis 1 is assigned to CN11 and the rest of the axis addresses are assigned in order.

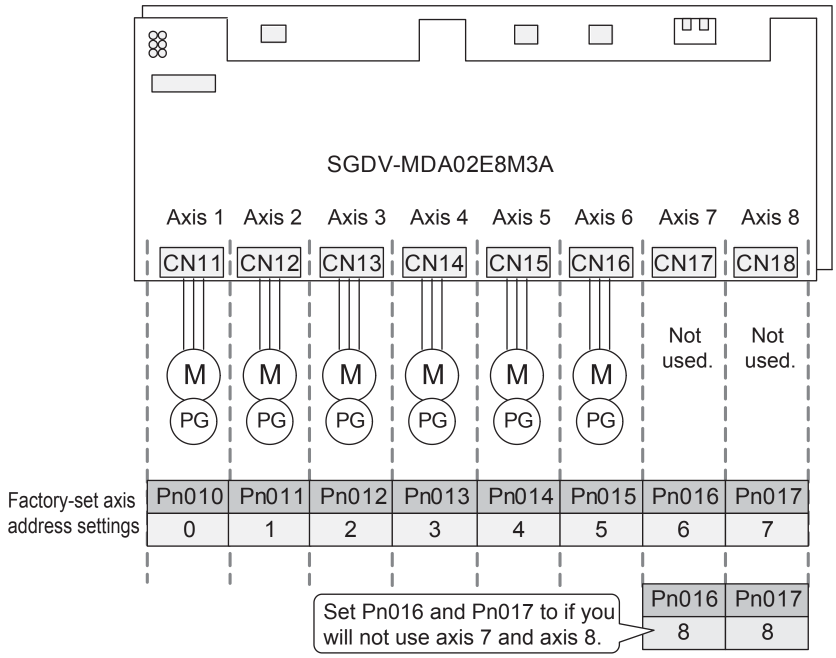
For a type A01 SERVOPACK, axis addresses are assigned in the order of the power boards. CN11 on the first power board connected to the control board is axis 1 and CN11 on the second power board is axis 5.

- Type A01 SERVOPACK



Note 1. If you have changed the settings of Pn010 to Pn01B, reset the parameters for the axes that you changed.
2. Set the axis address of any axis that you will not use to a value that is higher than the maximum number of SERVOPACKs that can be connected (e.g., 8 or higher). If you enter a value that is higher than the maximum number of SERVOPACKs that can be connected, the SERVOPACK detects that the axis is not used.
3. Set Pn010 to Pn01B in order starting from 0. Do not set the same value more than once. If the same axis address is set more than once, alarm A.E42 will occur and the factory settings will be restored.

• Type A02 SERVOPACK



Note 1. If you have changed the settings of Pn010 to Pn01B, reset the parameters for the axes that you changed.
2. Set the axis address of any axis that you will not use to a value of 8 or higher. If you enter a value of 8 or higher, the SERVOPACK detects that the axis is not used.
3. Set Pn010 to Pn01B in order starting from 0. Do not set the same value more than once. If the same axis address is set more than once, alarm A.E42 will occur and the factory settings will be restored.

7.1.3 Setting the Number of Transmission Bytes for MECHATROLINK-III

Set the number of transmission bytes in Pn881.

Pn881	Number of Transmission Bytes		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory setting	When Enabled	
	32, 48	–	48	After restart	Setup

7.2 MECHATROLINK-III Commands

Refer to the *Σ-V-MD Series User's Manual MECHATROLINK-III Standard Servo Profile Commands* (Manual No.: SIEP S800001 03) for details on MECHATROLINK-III commands.

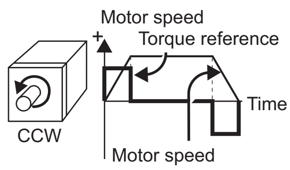
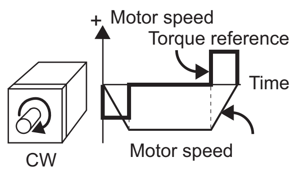
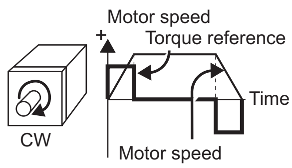
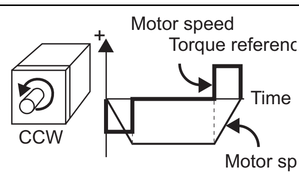
7.3 Basic Functions Settings

This section describes how to set the basic functions for operation.

7.3.1 Servomotor Rotation Direction

The servomotor rotation direction can be reversed with parameter Pn000.0 without changing the polarity of the speed/position reference.

The standard setting for forward rotation is counterclockwise (CCW) as viewed from the load end of the servomotor.

Parameter		Forward/ Reverse Reference	Direction of Motor Rotation
Pn000	n.□□□0 Sets CCW as forward direction. [Factory setting]	Forward Reference	
		Reverse Reference	
	n.□□□1 Sets CW as forward direction. (Reverse Rotation Mode)	Forward Reference	
		Reverse Reference	

Note: SigmaWin+ trace waveforms are shown in the above table.

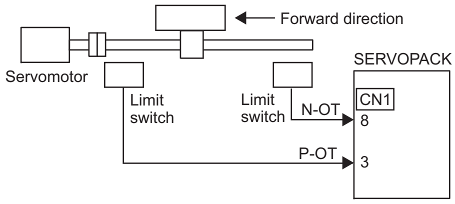
7.3.2 Overtravel

The overtravel limit function forces movable machine parts to stop if they exceed the allowable range of motion and turn ON a limit switch.

For rotating application such as disc table and conveyor, overtravel function is not necessary. In such a case, no wiring for overtravel input signals is required.

⚠ CAUTION

- Installing limit switches
  For machines that move using linear motion, connect limit switches to P-OT and N-OT of CN1 as shown below to prevent machine damage. To prevent a contact fault or disconnection from causing accidents, make sure that the limit switches are normally closed.



- Axes to which external force is applied in overtravel
  Vertical axes:
  Occurrence of overtravel may cause a workpiece to fall, because the /BK signal is on, that is when the brake is released. Set the parameter (Pn001 = n.□□1□) to bring the servomotor to zero clamp state after stopping to prevent a workpiece from falling.
  Other axes to which external force is applied:
  Overtravel will bring about a baseblock state after the servomotor stops, which may cause the servomotor to be pushed back by the load's external force. To prevent this, set the parameter (Pn001 = n.□□1□) to bring the servomotor to zero clamp state after stopping.
  For details on how to set the parameter, refer to *(3) Servomotor Stopping Method When Overtravel is Used*.

(1) Signal Setting

Type	Name	Setting	Meaning
Input	P-OT	ON	Forward run allowed. Normal operation status.
		OFF	Forward run prohibited. Forward overtravel.
	N-OT	ON	Reverse run allowed. Normal operation status.
		OFF	Reverse run prohibited. Reverse overtravel.

Rotation in the opposite direction is possible during overtravel by inputting the reference.

(2) Overtravel Function Setting

You can use Pn590 and Pn591 to enable or disable the overtravel function.

If the overtravel function is not used, no wiring for overtravel input signals will be required.

Parameter		Meaning	When Enabled	Classification
Pn590	n.0□□□ [Factory setting]	P-OT signal assignment disabled.	After restart	Setup
	n.1□□□	P-OT signal assigned. Positive drive is enabled when the signal is low.		
	n.2□□□	P-OT signal assigned. Positive drive is enabled when the signal is high.		
Pn591	n.0□□□ [Factory setting]	N-OT signal assignment disabled.	After restart	Setup
	n.1□□□	N-OT signal assigned. Positive drive is enabled when the signal is low.		
	n.2□□□	N-OT signal assigned. Positive drive is enabled when the signal is high.		

• A parameter can be used to re-allocate input connector number for the P-OT and N-OT signals. Refer to *5.3 I/O Signal Assignments* for details.

(3) Servomotor Stopping Method When Overtravel is Used

There are two servomotor stopping methods when an overtravel is used.

• Decelerate to a stop
Stops by using emergency stop torque.

• Coast to a stop
Stops naturally, with no control, by using the friction resistance of the servomotor in operation.

After servomotor stopping, there are two modes.

• Coast mode
Stopped naturally, with no control, by using the friction resistance of the servomotor in operation.

• Zero clamp mode
A mode forms a position loop by using the position reference zero.

The servomotor stopping method when an overtravel (P-OT, N-OT) signal is input while the servomotor is operating can be set with parameter Pn001.

Parameter		Stop Method	Mode After Stopping	When Enabled	Classification
Pn001	n.□□02 [Factory setting]	Coast	Coast	After restart	Setup
	n.□□1□	Deceleration to a stop	Zero clamp		
	n.□□2□		Coast		

• A servomotor under torque control cannot be decelerated to a stop. Coast status is maintained after the servomotor coasts to a stop.

• For details on servomotor stopping methods after the SV_OFF command is received or an alarm occurs, refer to *7.3.5 Stopping Servomotors after SV_OFF Command or Alarm Occurrence*.

■ When Servomotor Stopping Method is Set to Decelerate to Stop

Emergency stop torque can be set with Pn406

Pn406	Emergency Stop Torque Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 800	1%	800%	Immediately	Setup

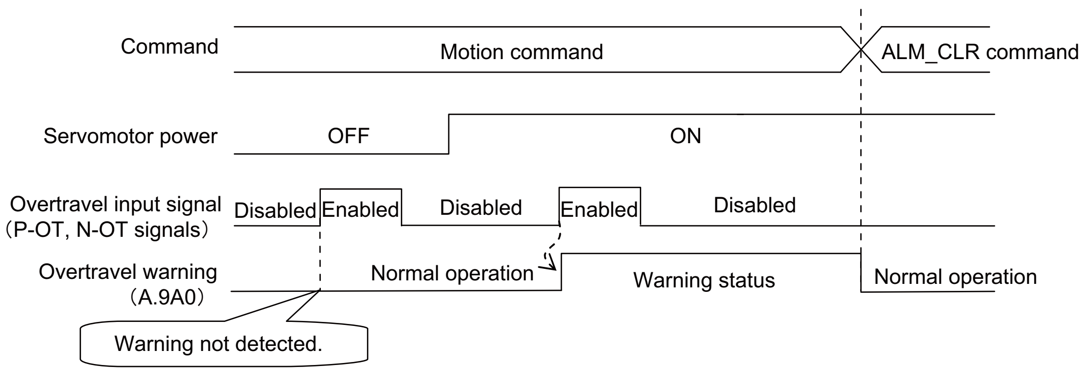
- The setting unit is a percentage of the rated torque.
- The factory setting is 800% so that the setting is large enough a value to operate the servomotor at maximum torque. The maximum value of emergency stop torque that is actually available, however, is limited to the maximum torque of the servomotor.

(4) Overtravel Warning Function

This function detects an overtravel warning (A.9A0) if overtravel occurs while the servomotor power is ON. Using this function enables notifying the host controller when the SERVOPACK detects overtravel even if the overtravel signal is ON only momentarily.

To use this function, perform the following settings.
- Set Pn00D = n.1□□□ (overtravel warning function).
- Allocate one of the output signals to the warning signal.

■ Warning Output Timing



<Notes>
- Warnings are detected for overtravel in the same direction as the reference.
- Warnings are not detected for overtravel in the reverse direction from the reference.
  Example:A warning will not be output for a forward reference even if the N-OT signal (reverse run prohibited) turns ON.
- A warning can be detected in either the forward or reverse direction, when there is no reference.
- A warning will not be detected when the servomotor power is OFF even if overtravel occurs.
- A warning will not be detected when the servomotor power changes from OFF to ON even if overtravel status exists.
- To clear the overtravel warning, send a Clear Warning or Alarm command (ALM_CLR) regardless of the status of the servomotor power and the overtravel signal. If the warning is cleared by this method during an overtravel state, the occurrence of the warning will not be indicated until the overtravelling is corrected and reset.
- The overtravel warning will be detected when the software limit is in effect.

⚠ CAUTION

- The overtravel warning function only detects warnings. It does not affect on stopping for overtravel or motion operations at the host controller. The next step (e.g., the next motion or other command) can be executed even if an overtravel warning exists. However, depending on the processing specifications and programming for warnings in the host controller, operation may be affected when an overtravel warning occurs (e.g., motion may stop or not stop). Confirm the specifications and programming in the host controller.
- When an overtravel occurs, the SERVOPACK will perform stop processing for overtravel. Therefore, when an overtravel warning occurs, the servomotor may not reach the target position specified by the host controller. Check the feedback position to make sure that the axis is stopped at a safe position.

■ Related Parameter

Parameter		Meaning	When Enabled	Classification
Pn00D	n.0□□□ [Factory setting]	Does not detect overtravel warning.	Immediately	Setup
	n.1□□□	Does not detect overtravel warning.		

7.3.3 Software Limit Settings

Software limits are used to force the moving part of the machine to stop if it exceeds a preset limit value. If a reference to a target position that exceeds a software limit is given during position control, the target position in the SERVOPACK is clamped to the value of the software limit and positioning is completed. If the feedback position exceeds a software limit during speed control or torque control, the same stopping method as for overtravel is used to stop the motor.

(1) Software Limit Settings

The software limit function can be enabled or disabled.
Use the parameter Pn801.0 to enable the software limit function.
The software limit function can be enabled under the following conditions. Under all other circumstances, the software limits will not be enabled even if a software limit is exceeded.

- The ZRET command has been executed.
- REFE = 1 using the POS_SET command.

Enable or disable the software limits using one of the following settings.

Parameter		Description	When Enabled	Classification
PnA4A	n.□□0□	Software limits disabled in both directions. [factory setting]	Immediately	Setup
	n.□□1□	Forward software limit enabled.		
	n.□□2□	Reverse software limit enabled.		
	n.□□3□	Software limits enabled in both directions.		

(2) Software Limit Setting

Set software limits value in the forward and reverse directions.

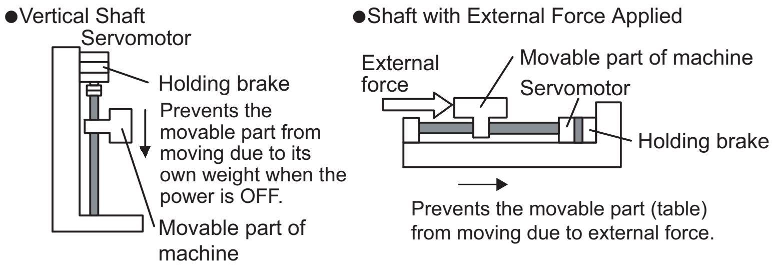
Because the limit zone is set according to the forward or reverse direction, the reverse limit must be less than the forward limit.

PnA4C	Forward Software Limit			Position	Classification
	Setting Range	Setting Range	Factory Setting	Factory Setting	
	-1073741823 to 1073741823	1 Reference Unit	1073741823	Immediately	Setup
PnA50	Reverse Software Limit			Position	Classification
	Setting Range	Setting Range	Factory Setting	Factory Setting	
	-1073741823 to 1073741823	1 Reference Unit	-1073741823	Immediately	Setup

7.3.4 Holding Brakes

A holding brake is a brake used to hold the position of the movable part of the machine when the SERVOPACK is turned OFF so that movable part does not move due to gravity or external forces. Holding brakes are built into servomotors with brakes.

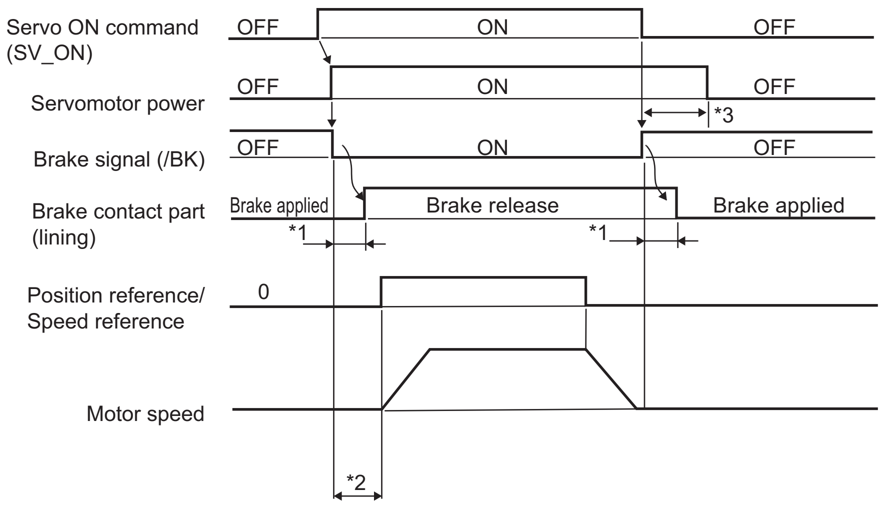
The holding brake is used in the following cases.



IMPORTANT

- The brake built into the servomotor 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 servomotor.

There is a delay in the braking operation. Set the following ON/OFF timing.



*1. The delay time in brake operation is given in the following table. This is just example of the operation delay time for switching with a direct current. Always evaluate performance on the actual equipment before actual operation.

Model	Voltage	Brake Release Time (ms)	Brake Applied Time (ms)
SGMMV	24 VDC	40	100

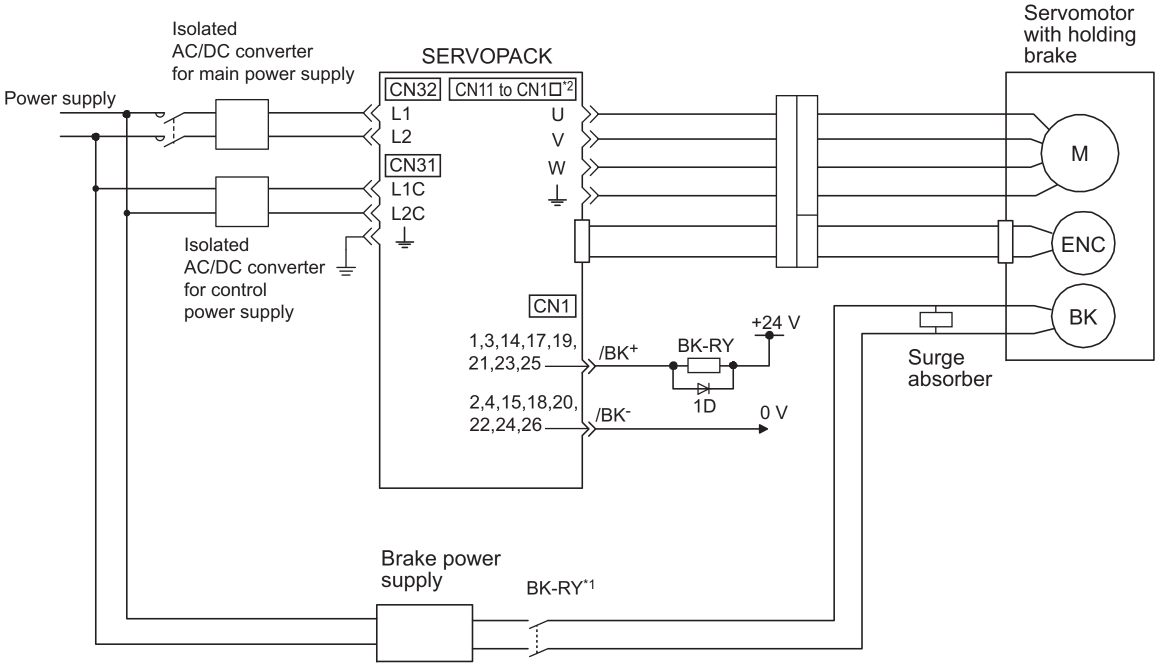
*2. After the SV_ON command has been sent and 50 ms has passed since the brake was released, output the reference from the host controller to the SERVOPACK.

*3. Use Pn506, Pn507, and Pn508 to set the timing of when the brake will be activated and when the servomotor power will be turned OFF.

(1) Wiring Example

Use the brake signal (/BK) and the brake power supply to form a brake ON/OFF circuit. The following diagram shows a standard wiring example.

The timing can be easily set using the brake signal (/BK).



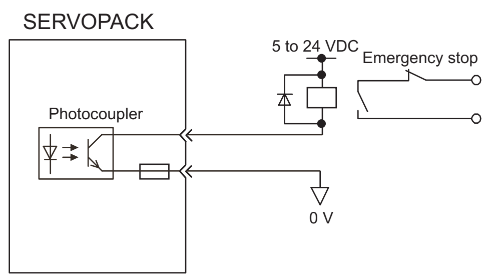
*1. BK-RY: Brake control relay
Brake power supply for 24 VDC is not included.

*2. The box (□) is replaced by a number. For a type A01 SERVOPACK, the number is 4.
For a type A02 SERVOPACK, the number is 8.

IMPORTANT

- Always connect a surge absorber.
- After the surge absorber is connected, check the total time the brake is applied for the system. Depending on the surge absorber, the total time the brake is applied can be changed.
- Configure the relay circuit to apply the holding brake by the emergency stop.

Relay Circuit Example



- Always separate the brake power supply from other power supplies, such as the control or I/O signal (CN1) power supplies. If the power supply is shared, the I/O signals might malfunction.

(2) Brake Signal (/BK) Setting

This output signal controls the brake.
The /BK signal turns OFF (applies the brake) when an alarm is detected or the SV_OFF command is received. The brake OFF timing can be adjusted with Pn506.

Type	Name	Connector Pin Number	Setting	Meaning
Output	/BK	1, 3, 14, 17, 19, 21, 23, 25	ON (closed)	Releases the brake.
			OFF (open)	Applies the brake.

Note: Set the brake signal assignment in Pn596.

IMPORTANT

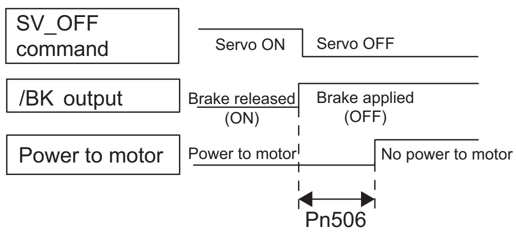
The /BK signal is still ON during overtravel and the brake is still released.

(3) Brake ON Timing after the Servomotor Stops

When the servomotor stops, the /BK signal turns OFF at the same time as the SV_OFF command is received. Use parameter Pn506 to change the timing to turn OFF the servomotor power after the SV_OFF command has been received.

Pn506	Brake Reference-Servo OFF Delay Time (Speed, Position, Torque)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 50	10 ms	0	Immediately	Setup

- When using the servomotor to control a vertical axis, the machine movable part may shift slightly depending on the brake ON timing due to gravity or an external force. To eliminate this slight shift, set parameter so that the power to the servomotor turns OFF after the brake is applied.
- This parameter changes the brake ON timing while the servomotor is stopped.



IMPORTANT

The servomotor will turn OFF immediately when an alarm occurs, regardless of the setting of this parameter. The machine movable part may shift due to gravity or external force before the brake operates.

(4) Brake Signal (/BK) Output Timing during Servomotor Rotation

If an alarm occurs while the servomotor is rotating, the servomotor will come to a stop and the brake signal (/BK) will be turned OFF. The timing of brake signal (/BK) output can be adjusted by setting the brake reference output speed level (Pn507) and the waiting time for brake signal when motor running (Pn508).

Note: If the servomotor is set so that it comes to a zero-speed stop for an alarm, follow the information in *(3) Brake ON Timing after the Servomotor Stops* after the servomotor comes to a stop for a zero position reference.

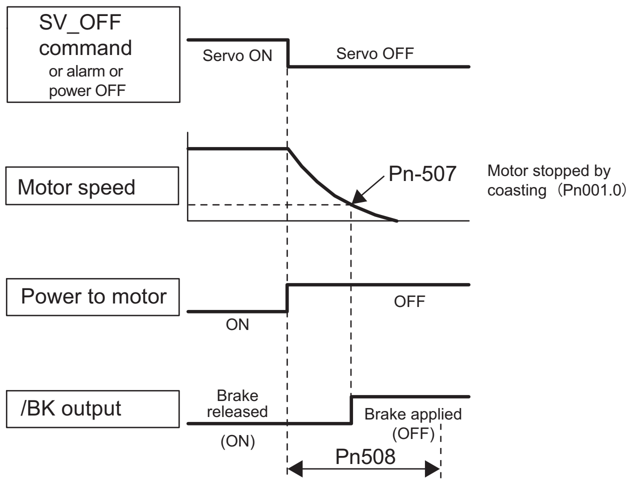
Pn507	Brake Reference Output Speed Level	Speed Position Torque			Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 min^{-1}	100	Immediately	Setup

Pn508	Waiting Time for Brake Signal When Motor Running	Speed Position Torque			Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 100	10 ms	50	Immediately	Setup

/BK Signal Output Conditions When Servomotor Rotating

The /BK signal goes to high level (brake ON) when either of the following conditions is satisfied:

- When the motor speed falls below the level set in Pn507 after the power to the servomotor is turned OFF.
- When the time set in Pn508 is exceeded after the power to the servomotor is turned OFF.



IMPORTANT

- The servomotor will be limited to its maximum speed even if the value set in Pn507 is higher than the maximum speed.

7.3.5 Stopping Servomotors after SV_OFF Command or Alarm Occurrence

The servomotor stopping method can be selected after the SV_OFF command is received or an alarm occurs.

IMPORTANT

- The elements in the SERVOPACK will deteriorate if turning the power supply ON and OFF or starting and stopping the servomotor during the servo ON status while there is a reference input. Use a speed reference or position reference to start and stop the servomotor.
- If turning OFF the main circuit power supply or the control power supply during operation without turning OFF the servo, the servomotor will coast to a stop. In this case, the stop method cannot be set in a parameter.
- To minimize the coasting distance of the servomotor to come to a stop when an alarm occurs, the zero-speed stopping method is factory-set for alarms to which the zero-speed stopping method is applicable. However, in some applications, coasting to a stop may be more suitable than the zero-speed stopping method.

  For example, for multiple shafts in coupled operation (e.g., a twin-drive operation), machinery may damage due to differences in the stopping operation if a zero-speed stop alarm occurs for one of the coupled shafts and the other coupled shaft coasts to a stop. In such cases, change the stopping method so that the servomotor coasts to a stop.

(1) Stopping Method for Servomotor after SV_OFF Command is Received

The servomotor coasts to a stop when the servo is turned OFF.

(2) Stopping Method for Servomotor When an Alarm Occurs

There are two types of alarms, Gr.1 and Gr.2, that vary in the stopping method when the alarm occurs.

When a Gr.1 alarm occurs, the servomotor coasts to a stop.

When a Gr.2 alarm occurs, the stopping method that is set in Pn00B.1 is used.

Refer to the information on alarm stopping methods in *10.2.1 List of Alarms*.

■ Stopping Method for Servomotor for Gr.2 Alarms

Parameter		Stop Mode	Mode After Stopping	When Enabled	When Enabled
Pn00B	n.□□0□ [Factory setting]	Zero-speed stopping*	Coast	After restart	Setup
	n.□□1□	Coast	Coast		

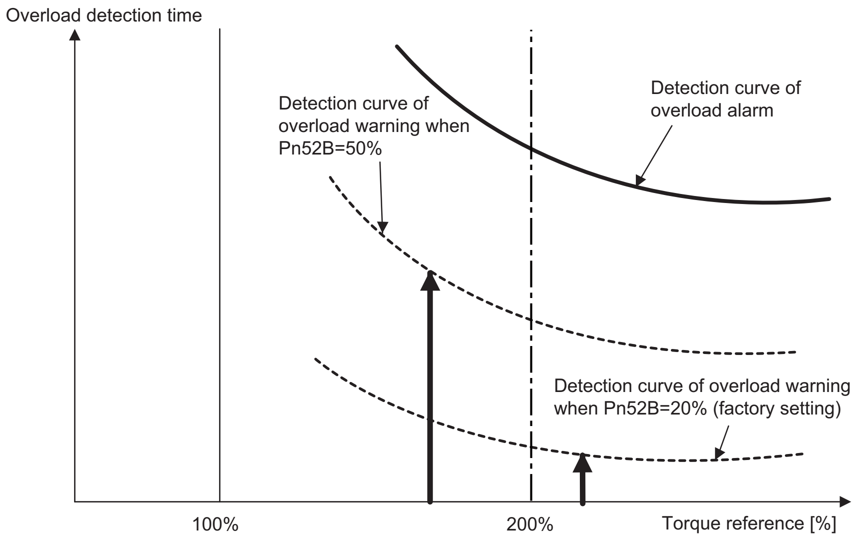
* Zero-speed stopping: The speed reference is set to 0 to stop quickly.
Note: The setting of Pn00B.1 is effective for position control and speed control. The setting of Pn00B.1 is ignored for torque control and the servomotor coasts to a stop.

7.3.6 Setting Motor Overload Detection Level

In this SERVOPACK, the detection timing of the warnings and alarms can be changed by changing how to detect an overload warning (A.910) and overload (low load) alarm (A.720).
The overload characteristics and the detection level of the overload (high load) alarm (A.710) cannot be changed.

(1) Changing Detection Timing of Overload Warning (A.910)

The overload warning level is set by default to 20% so that an overload warning is detected in 20% of the time required to detect an overload alarm. The time required to detect an overload warning can be changed by changing the setting of the overload warning level (Pn52B). This protective function enables the warning output signal (/WARN) to serve as a protective function and to be output at the best timing for your system.
The following graph shows an example of the detection of an overload warning when the overload warning level (Pn52B) is changed from 20% to 50%. An overload warning is detected in half of the time required to detect an overload alarm.



Note: For details, refer to *3.1.1*, *(3) Overload Characteristics*.

Pn52B	Overload Warning Level Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 100	1%	20	Immediately	Setup

(2) Changing Detection Timing of Overload (Low Load) Alarm (A.720)

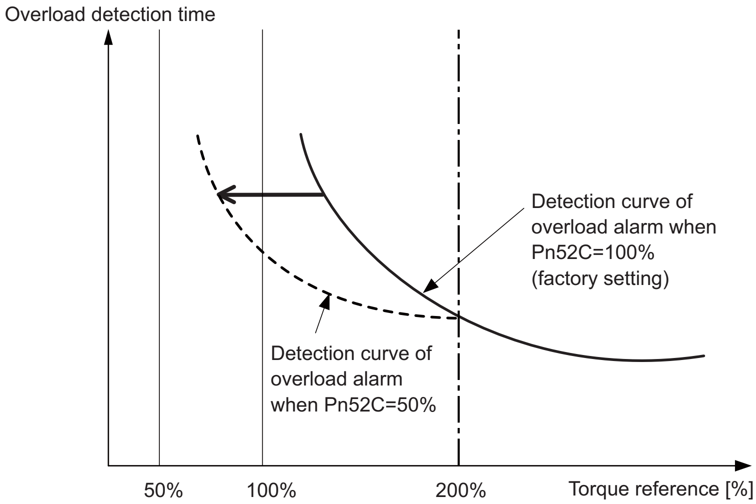
An overload (low load) alarm (A.720) can be detected earlier to protect the servomotor from overloading. The time required to detect an overload alarm can be shortened by using the derated motor base current obtained with the following equation.

Note: The detection level of the overload (high load) alarm (A.710) cannot be changed.

Motor base current × Derating of base current at detecting overload of motor (Pn52C)
= Derated motor base current

Motor base current: Threshold value of motor current to start calculation for overload alarm
Derating of base current at detecting overload of motor (Pn52C): Derating of motor base current

A graph of the relation between the size of the heat sink and derating is provided in *3.1.4 Heat Dissipation Conditions*. Use this graph as a guild for the heat dissipation conditions of the motor. Changing the setting of Pn52C will change the detection timing of the overload alarm, so the time required to detect the overload warning will also be changed.



Note: For details, refer to *3.1.1*, *(3) Overload Characteristics*.

Pn52C	Derating of Base Current at Detecting Overload of Motor Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 100	1%	100	After restart	Setup

7.4 Trial Operation

This section describes a trial operation using MECHATROLINK-III communications.

7.4.1 Inspection and Checking before Trial Operation

To ensure safe and correct trial operation, inspect and check the following items before starting trial operation.

(1) Servomotors

Inspect and check the following items, and take appropriate measures before performing trial operation if any problem exists.

- Are all wiring and connections correct?
- Are all nuts and bolts securely tightened?

Note: When performing trial operation on a servomotor that has been stored for a long period of time, perform the inspection according to the procedures described in *AC Servomotor Safety Precautions* (Manual No.: TOBP C230200 00).

(2) SERVOPACKs

Inspect and check the following items, and take appropriate measures before performing trial operation if any problem exists.

- Are all wiring and connections correct?
- Is the correct power supply voltage being supplied to the SERVOPACK?

7.4.2 Trial Operation via MECHATROLINK-III

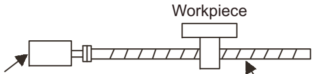
The following table provides the procedures for trial operation via MECHATROLINK-III.

Step	Description	Reference
1	Confirm that the wiring is correct, and then connect the I/O signal connector (CN1 connector).	*Chapter 5 Wiring and Connections*
2	Turn ON the power supply to the SERVOPACK, and then turn ON the power supply to the host controller. When a communications connection is established, the LED lamp (LK1 or LK2) for the connector to which the MECHATROLINK-III cable is connected (CN6A or CN6B) will light. If the LK1 or LK2 indicator does not light, check the MECHATROLINK-III communications settings (Pn880 and Pn881) and turn the power supply OFF and ON again.	–
3	Send the CONNECT command from the host controller. If the SERVOPACK correctly receives the CONNECT command, the CN, LED indicator will light up. If the CN does not light up, the set value of the CONNECT command is incorrect. Reset the CONNECT command, and then resend it from the host controller.	Σ-V-MD Series User's Manual MECHATROLINK-III Standard Servo Profile Commands (Manual No.: SIEP S800001 03)
4	Check the product type using an ID_RD command. A reply showing the product type, such as SGDV-MDA02E8M3A, is received from the SERVOPACK.	
5	Set the following items to the necessary settings for a trial operation. • Electronic gear settings • Rotational direction of servomotor • Overtravel	*7.4.3 Electronic Gear* *7.3.1 Servomotor Rotation Direction* *7.3.2 Overtravel*
6	Save these settings (step 5). • If saving the settings in the host controller, use the SVPRM_WR command (set the mode to RAM area). • If saving the settings in the SERVOPACK, use the SVPRM_WR command (set the mode to the non-volatile memory area).	Σ-V-MD Series User's Manual MECHATROLINK-III Standard Servo Profile Commands (Manual No.: SIEP S800001 03)
7	Send the CONFIG command to enable the settings.	
8	Send the SENS_ON command to obtain the position data (encoder ready response).	
9	Send the SV_ON command. A response showing that the servomotor has switched to Drive status and that SVON=1 (servomotor power is ON) is received.	
10	Run the servomotor at low speed. <Example using a positioning command> Command used: POSING Command setting: Positioning position =10000 (If using the absolute encoder, add 10000 to the present position), rapid traverse speed= 400	–
11	Check the following points while running the servomotor at low speed (step 10). • Confirm that the rotational direction of the servomotor correctly coincides with the forward rotation or reverse rotation reference. If they do not coincide, reset the direction. • Confirm that no unusual vibrations, noises, or temperature rises occur. If any abnormalities are seen, correct the conditions. Note: Because the running-in of the load machine is not sufficient at the time of the trial operation, the servomotor may become overloaded.	*7.3.1 Servomotor Rotation Direction* *10.4 Troubleshooting Malfunction Based on Operation and Conditions of the Servomotor*

7.4.3 Electronic Gear

The electronic gear enables the workpiece travel distance per reference unit input from the host controller. The minimum unit of the position data moving a load is called a reference unit.

The section indicates the difference between using and not using an electronic gear when a workpiece is moved 10 mm in the following configuration.



When the Electronic Gear is Not Used:

A Calculate the revolutions.
1 revolution is 6 mm. Therefore, 10/6 revolutions.

B Calculate the required reference units.
131072 reference units is 1 revolution. Therefore, 10/6 × 131072 = 218453.33··· reference units.

C Input 218453 references as reference units.

Reference units must be calculated per reference. → complicated

When the Electronic Gear is Used:

The reference unit is 1 µm. Therefore, to move the workpiece 10 mm (10000 µm),
1 reference unit = 1 µm, so 10000 ÷ 1 = 10000 reference units.
Input 10000 pulses as reference units.

Calculation of reference units per reference is not required. → simplified

(1) Electronic Gear Ratio

Set the electronic gear ratio using PnA42 and PnA44.

PnA42	Electronic Gear Ratio (Numerator) Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 1073741824	1	1	After restart	Setup
PnA44	Electronic Gear Ratio (Denominator) Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 1073741824	1	1	After restart	Setup

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

$$\text{Electronic gear ratio: } \frac{B}{A} = \frac{A42}{A44} = \frac{\text{Encoder resolution}}{\text{Travel distance per load shaft revolution (reference units)}} \times \frac{m}{n}$$

■ Encoder Resolution

Encoder resolution can be checked with servomotor model designation.

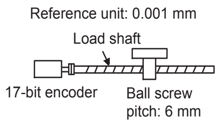
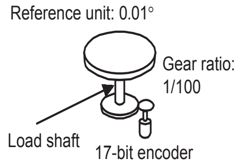
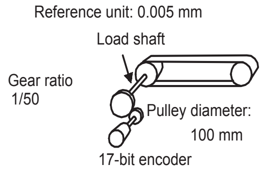
SGMMV −□□□□□□□

Symbol	Specification	Encoder Resolutions
2	17-bit absolute	131072

> **IMPORTANT**
>
> Electronic gear ratio setting range: 0.001 ≤ Electronic gear ratio (B/A) ≤ 4000
>
> If the electronic gear ratio is outside this range, a parameter setting error 1 (A.040) will be output.

(2) Electronic Gear Ratio Setting Examples

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

Step	Operation	Load Configuration		
		Ball Screw	Disc Table	Belt and Pulley
				
1	Check machine specifications.	• Ball screw pitch: 6 mm • Gear ratio: 1/1	Rotation angle per revolution: 360° Gear ratio: 1/100	Pulley diameter: 100 mm (pulley circumference: 314 mm) • Gear ratio: 1/50
2	Check the encoder resolution.	131072 (17-bit)	131072 (17-bit)	131072 (17-bit)
3	Determine the reference unit used.	Reference unit: 0.001 mm (1 μm)	Reference unit: 0.01°	Reference unit: 0.005 mm (5 μm)
4	Calculate the travel distance per load shaft revolution. (Reference unit)	6 mm/0.001 mm=6000	360°/0.01°=36000	314 mm/0.005 mm=62800
5	Calculate the electronic gear ratio.	$\frac{B}{A} = \frac{131072}{6000} \times \frac{1}{1}$	$\frac{B}{A} = \frac{131072}{36000} \times \frac{100}{1}$	$\frac{B}{A} = \frac{131072}{62800} \times \frac{50}{1}$
6	Set parameters.	PnA42: 131072	PnA42: 13107200	PnA42: 6553600
		PnA44: 6000	PnA44: 36000	PnA44: 62800

7.5 Limiting Torque

The SERVOPACK provides the following three methods for limiting output torque to protect the machine.

Limiting Method	Description	Reference Section
Internal torque limit	Always limits torque by setting the parameter.	*7.5.1 Internal Torque Limit*
Torque limit with the command data (TLIM)*	Limits torque by using the command data (TLIM) for torque limiting function settable commands.	–
Torque limit with P_CL and N_CL signals of the servo command output signals (SVCMD_IO)*	Limits torque by using P_CL and N_CL signals of the servo command output signals (SVCMD_IO).	–

* Refer to the *Σ-V-MD Series User's Manual MECHATROLINK-III Standard Servo Profile Commands* (Manual No.: SIEP S800001 03) for details.

Note: The maximum torque of the servomotor is used when the set value exceeds the maximum torque.

7.5.1 Internal Torque Limit

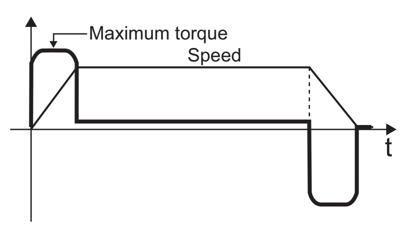
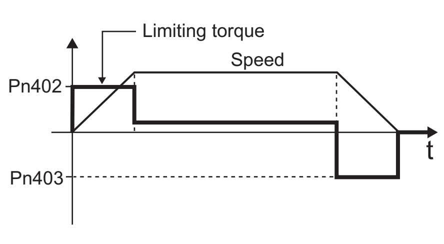
This function always limits maximum output torque by setting values of following parameters.

Pn402	Forward Torque Limit Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 800	1%	800	Immediately	Setup
Pn403	Reverse Torque Limit Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 800	1%	800	Immediately	Setup

The setting unit is a percentage of the rated torque.

Note: If the settings of Pn402 and Pn403 are too low, the torque may be insufficient for acceleration or deceleration of the servomotor.

Torque waveform

No Internal Torque Limit (Maximum torque can be output)	Internal Torque Limit
	

7.5.2 Checking the Torque Limit

Use a servo profile command to check the motor output torque limit status.

Refer to the *Σ-V-MD Series User's Manual MECHATROLINK-III Standard Servo Profile Commands* (Manual No.: SIEP S800001 03) for details on the servo profile commands.

7.6 Absolute Encoder Setting

If using an absolute encoder, a system to detect the absolute position can be designed for use with the host controller. As a result, an operation can be performed without a zero point return operation immediately after the power is turned ON.

A battery case is required to save position data in the absolute encoder.
The battery is attached to the battery case of the encoder cable.

Set Pn002.2 to 0 (factory setting) to use the absolute encoder.

Parameter		Meaning	When Enabled	Classification
Pn002	n.□0□□ [Factory setting]	Uses the absolute encoder as an absolute encoder.	After restart	Setup
	n.□1□□	Uses the absolute encoder as an incremental encoder.		

A battery is not required if you use an absolute encoder as an incremental encoder.

Refer to *5.5.3 Servomotor and Encoder Connection Examples* for absolute encoder connections.

7.6.1 Absolute Encoder Setup

⚠ CAUTION

- The rotational data will be a value between -2 and +2 rotations when the absolute encoder setup is executed. The reference position of the machine system will change. Set the reference position of the host controller to the position after setup.
  If the machine is started without adjusting the position of the host controller, unexpected operation may cause injury or damage to the machine. Take sufficient care when operating the machine.

Setting up the absolute encoder is necessary in the following cases.

- When starting the machine for the first time
- When an encoder backup error alarm (A.810) is generated
- When an encoder checksum error alarm (A.820) is generated
- When initializing the rotational serial data of the absolute encoder

(1) Precautions on Setup

- If the following absolute encoder alarms are displayed, cancel the alarm by using the same method as the absolute encoder setup. They cannot be canceled with the SERVOPACK Clear Warning or Alarm command (ALM_CLR).
  - Encoder backup error alarm (A.810)
  - Encoder checksum error alarm (A.820)
- Any other alarms (A.8□□) that monitor the inside of the encoder should be canceled by turning OFF the power.

(2) Preparation

Always confirm that the servo is OFF before you set up (initialize) the absolute encoder or reset encoder alarms.

(3) Operating Procedure

Use the following procedure.

Supplemental Information

This setting can be performed using the write memory command (MEM_WR). Refer to the *Σ-V-MD Series User's Manual MECHATROLINK-III Standard Servo Profile Commands* (Manual No.: SIEP S800001 03) for details on the Write Memory (MEM_WR) command.

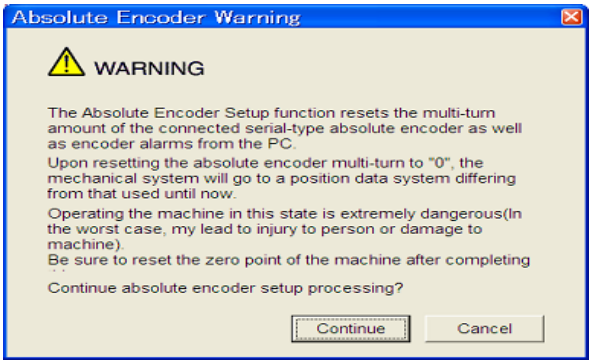
1. Make sure that the motor power is OFF.

2. In the SigmaWin+ main window, click **Setup** – **Set Absolute Encoder** – **Reset Absolute Encoder**.

Supplemental Information

If you are using more than one axis, the Axis Selection Dialog Box is displayed.
Follow the instructions in the Axis Selection Dialog Box to select the axis to adjust before you continue.

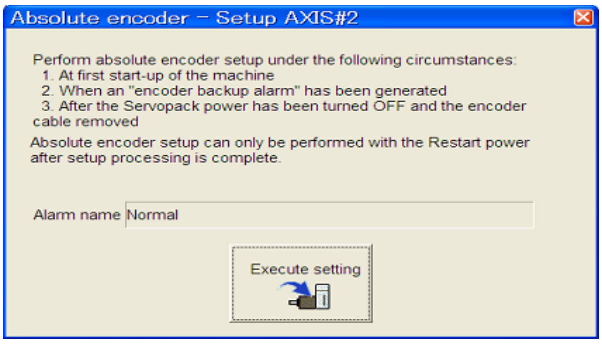
A warning message will appear confirming if you want to continue the processing.



Click **Cancel** to return to the main window without resetting the absolute encoder.

3. Click **Continue**.

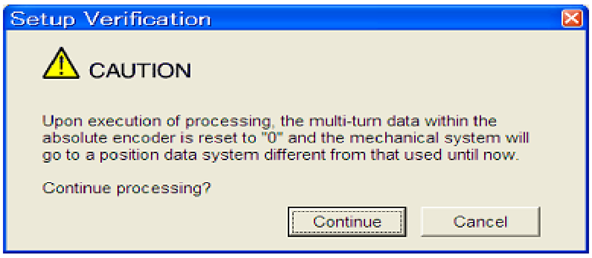
The Absolute encoder Setup box will appear.



The Alarm Name box displays the code and name of the alarm that is occurring now.

4. Click **Execute setting**.

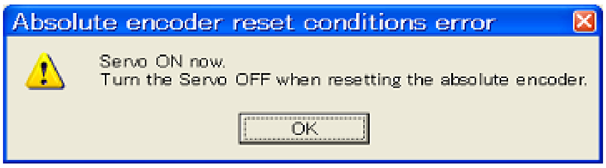
A verification message will appear confirming if you want to continue although the coordinate system will change.



Click **Cancel** to return to the previous window without resetting the absolute encoder.

5. Click **Continue** to set up the encoder.

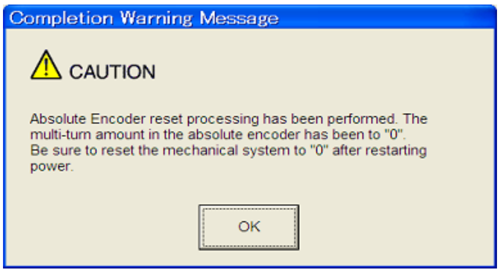
<If Setup is Unsuccessful>
If setting up is attempted with the servo ON, a reset conditions error occurs, and the processing is aborted.



Click **OK** to return to the main window.

<If Setup Completes Normally>

If the encoder is set up successfully, a warning message will appear reminding you that the coordinate system has changed and must also be reset.

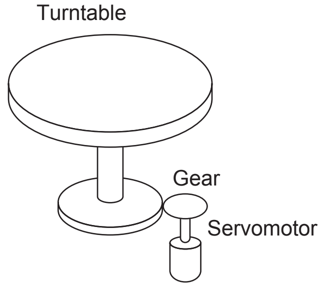


6. Click **OK** to return to the main window.

7. To perform an origin search, restart the SERVOPACK.

7.6.2 Multiturn Limit Setting

The multiturn limit setting is used in position control applications for a turntable or other rotating device. For example, consider a machine that moves the turntable in the following diagram in only one direction.



Because the turntable moves in only one direction, the upper limit for revolutions that can be counted by an absolute encoder will eventually be exceeded. The multiturn limit setting is used in cases like this to prevent fractions from being produced by the integral ratio of the motor revolutions and turntable revolutions.

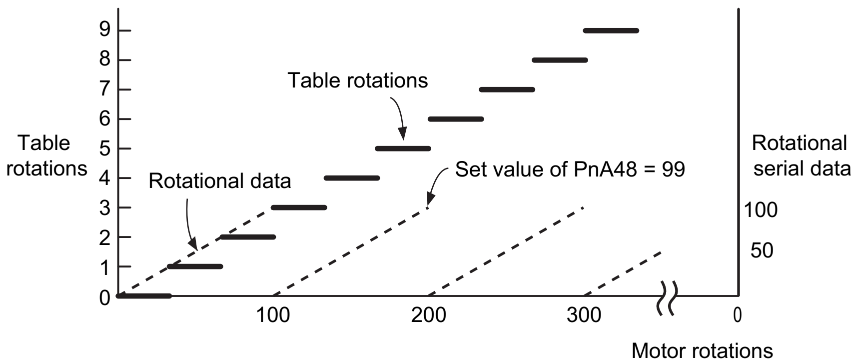
For a machine with a gear ratio of n:m, as shown above, the value of m minus 1 will be the setting for the multiturn limit setting (Pn48).

Multiturn limit setting (Pn48) = m-1

The case in which the relationship between the turntable revolutions and motor revolutions is m = 100 and n = 3 is shown in the following graph.

Pn48 is set to 99.

Pn48 = 100 − 1 = 99



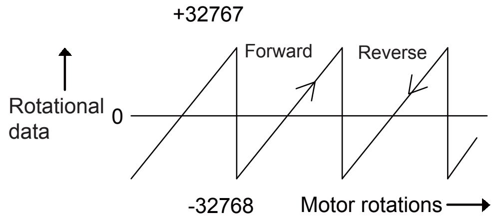
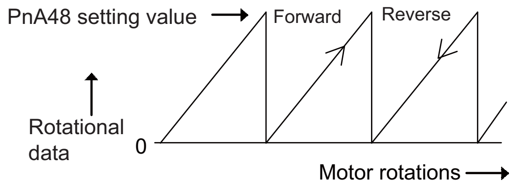
PnA48	Multiturn Limit Setting Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	1 Rev	65535	After restart	Setup

Note: This parameter is valid when the absolute encoder is used.

The range of the data will vary when this parameter is set to anything other than the factory setting.

1. When the motor rotates in the reverse direction with the rotational data at 0, the rotational data will change to the setting of PnA48.
2. When the motor rotates in the forward direction with the rotational data at the PnA48 setting, the rotational data will change to 0.

Set the vale, the desired rotrational amount -1, to Pn205.

<table>
<tr><th>Factory Setting</th><th>Other Setting</th></tr>
<tr><td>
</td><td>
</td></tr>
</table>

7.6.3 Multiturn Limit Disagreement Alarm (A.CC0)

When the multiturn limit set value is changed with parameter PnA48, a multiturn limit disagreement alarm (A.CC0) will be displayed because the value differs from that of the encoder.

Alarm Display	Alarm Name	Alarm Output	Meaning
A.CC0	Multiturn Limit Disagreement	OFF (H)	Different multiturn limits have been set in the encoder and SERVOPACK.

If this alarm is displayed, perform the procedure given in *(2) Operating Procedure* to change the multiturn limit value in the encoder to the value set in PnA48.

(1) Preparation

Before you set the multiturn limit for the Multiturn Limit Disagreement (A.CC0) alarm, make sure that the write prohibited setting parameter (Fn010) is set to Write permitted.

(2) Operating Procedure

Use the following procedure.

Supplemental Information

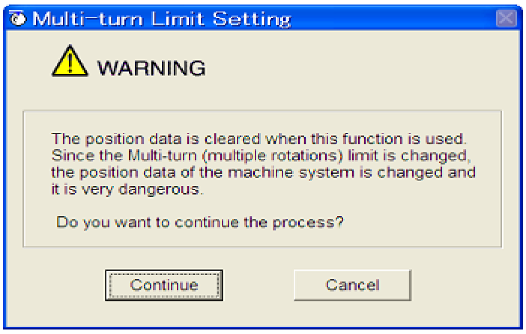
This setting can be performed with the write memory command (MEM_WR). Refer to the *Σ-V-MD Series User's Manual MECHATROLINK-III Standard Servo Profile Commands* (Manual No.: SIEP S800001 03) for details on the Write Memory (MEM_WR) command.

1. In the SigmaWin+ main window, click **Setup** – **Set Absolute Encoder** – **Multi-Turn Limit Setting**.

Supplemental Information

If you are using more than one axis, the Axis Selection Dialog Box is displayed.
Follow the instructions in the Axis Selection Dialog Box to select the axis to adjust before you continue.

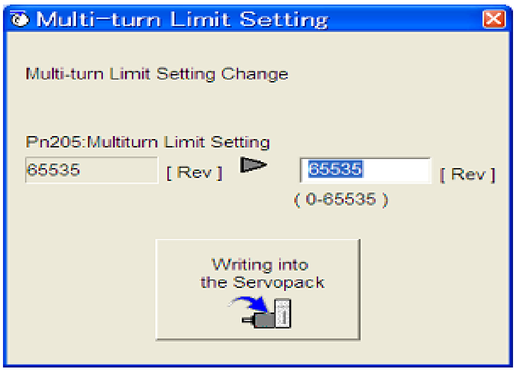
A verification message will appear confirming if you want to continue although the position data will change.



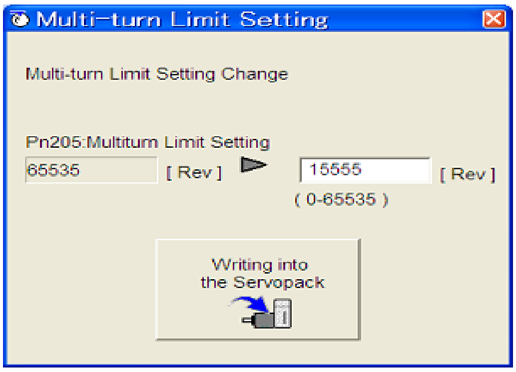
Click **Cancel** to return to the main window without setting the multi-turn limit.

2. Click **Continue**.

The Multi-Turn Limit Setting box will appear.

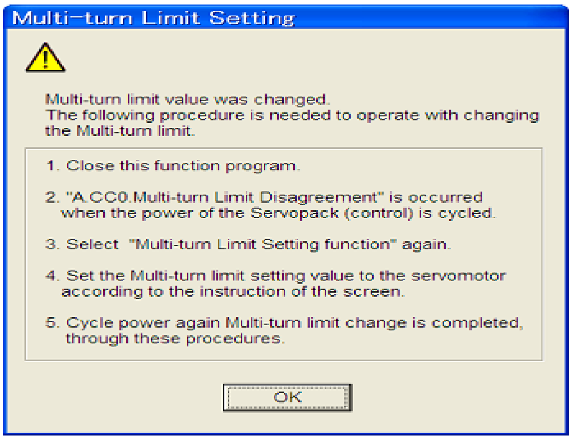


3. Change the setting to the desired number of revolutions.



4. To save the settings, click **Writing into the Servopack**.

A warning message will appear.



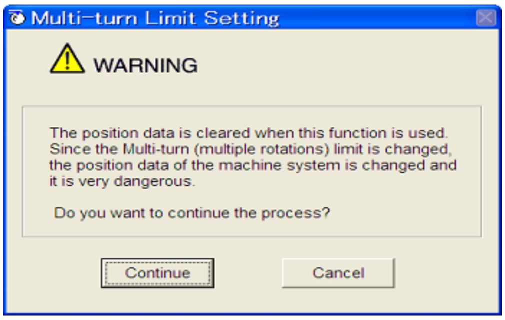
5. Click **OK** and the settings are changed to the new ones.

6. Restart the SERVOPACK.

Because only the settings for the SERVOPACK were made, the settings for the servomotor are still incomplete and an alarm occurs.

7. Return to the SigmaWin+ main window. To make the settings for the servomotor, click **Setup** – **Multi-Turn Limit Setting** again.

A verification message will appear confirming if you want to continue although the position data will change.

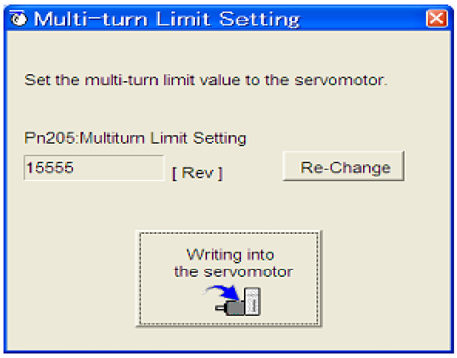


Operation

7

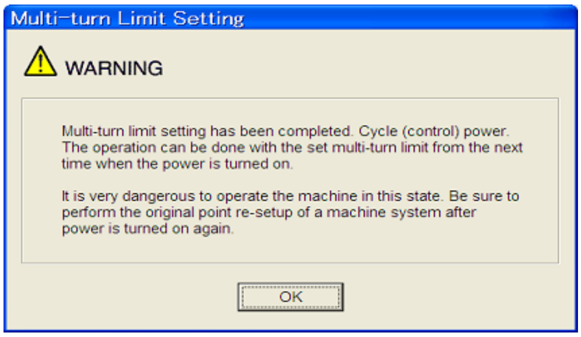
8. Click **Continue**.

The Multi-Turn Limit Setting box will appear. To change the settings, click **Re-Change**.



9. To save the settings, click **Writing into the Motor**.

A warning message will appear



10. Click **OK**.

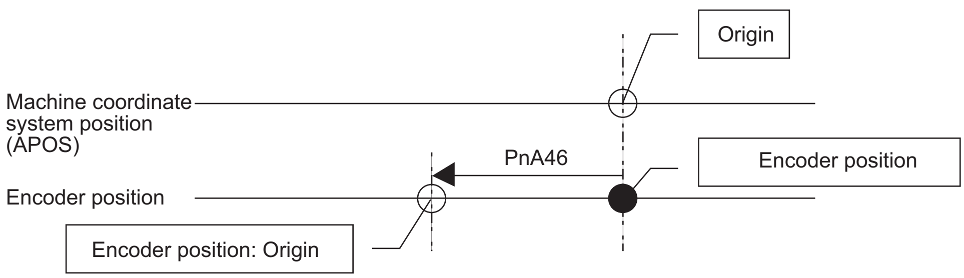
7.6.4 Absolute Encoder Origin Offset

If using the absolute encoder, the positions of the encoder and the offset of the machine coordinate system (APOS) can be set. Use PnA46 to make the setting. After the SENS_ON command is received by MECHATROLINK communications, this parameter will be enabled.

PnA46	Absolute Encoder Origin Offset			Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	-1073741823 to 1073741823	1 reference unit	0	Immediately	Setup

<Example>

If the encoder position (X) is set at the origin of the machine coordinate system (0), PnA46 = X.



8

Adjustments

8.1 Type of Adjustments and Basic Adjustment Procedure

This section describes type of adjustments and the basic adjustment procedure.

8.1.1 Adjustments

Adjustments (tuning) are performed to optimize the responsiveness of the SERVOPACK.

The responsiveness is determined by the servo gain that is set in the SERVOPACK.

The servo gain is set using a combination of parameters, such as speed loop gain, position loop gain, filters, friction compensation, and moment of inertia ratio. These parameters influence each other. Therefore, the servo gain must be set considering the balance between the set values.

Generally, the responsiveness of a machine with high rigidity can be improved by increasing the servo gain. If the servo gain of a machine with low rigidity is increased, however, the machine will vibrate and the responsiveness may not be improved. In such case, it is possible to suppress the vibration with a variety of vibration suppression functions in the SERVOPACK.

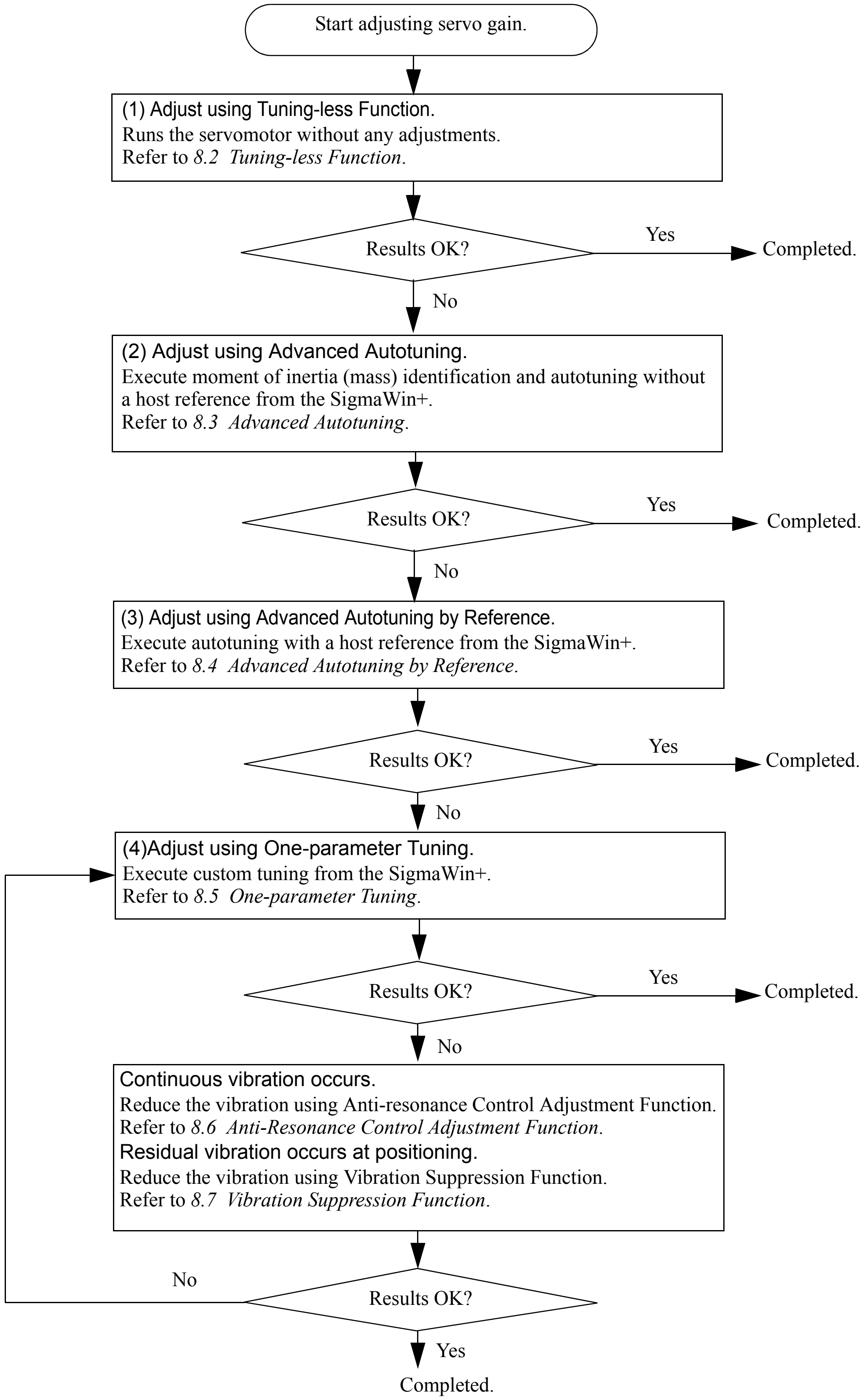
The servo gains are factory-set to appropriate values for stable operation. The following utility function can be used to adjust the servo gain to increase the responsiveness of the machine in accordance with the actual conditions. With this function, parameters related to adjustment above will be adjusted automatically and the need to adjust them individually will be eliminated.

This section describes the following utility adjustment functions.

Utility Function for Adjustment	Outline	Applicable Control Method
Tuning-less Levels Setting	This function is enabled when the factory settings are used. This function can be used to obtain a stable response regardless of the type of machine or changes in the load.	Speed and Position
Advanced Autotuning	You can automatically adjust the following from the SigmaWin+ by executing moment of inertia (mass) identification and autotuning without a host reference. • Moment of inertia ratio • Gains (position loop gain, speed loop gain, etc.) • Filters (torque reference filter, notch filter) • Friction compensation • Anti-resonance control adjustment function • Vibration suppression function	Speed and Position
Advanced Autotuning by Reference	After you set the moment of inertia ratio, you can automatically adjust the following from the SigmaWin+ by executing autotuning with a host reference. • Gains (position loop gain, speed loop gain, etc.) • Filters (torque reference filter, notch filter) • Friction compensation • Anti-resonance control adjustment function • Vibration suppression function	Position
One-parameter Tuning	You can adjust the following by executing custom tuning from the SigmaWin+. • Gains (position loop gain, speed loop gain, etc.) • Filters (torque reference filter, notch filter) • Friction compensation • Anti-resonance control adjustment function	Speed and Position
Anti-Resonance Control Adjustment Function	This function effectively suppresses continuous vibration.	Speed and Position
Vibration Suppression Function	This function effectively suppresses residual vibration if it occurs when positioning.	Position

8.1.2 Basic Adjustment Procedure

The basic adjustment procedure is shown in the following flowchart. Make suitable adjustments considering the conditions and operating requirements of the machine



8.1.3 Monitoring Operation during Adjustment

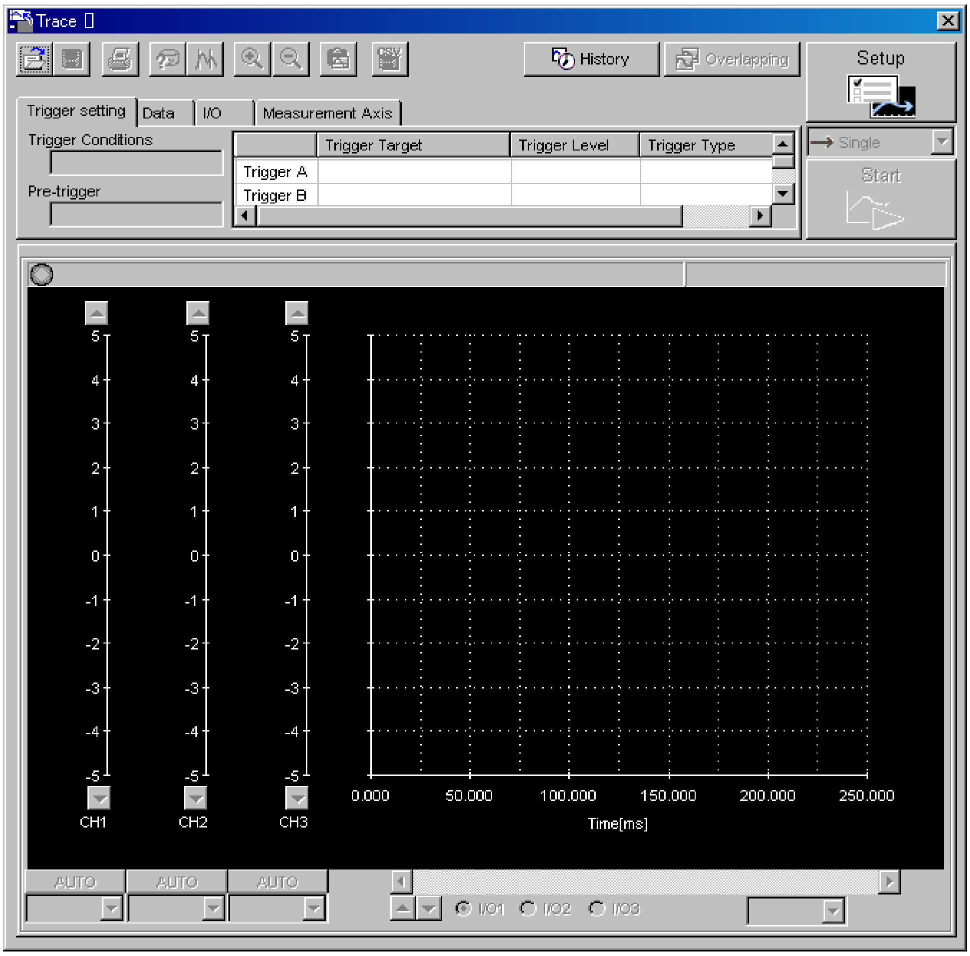
While adjusting the servo gain, always monitor the operating status of the machine and the signal waveform. Use data tracing from the SigmaWin+ to monitor signal waveforms from the SERVOPACK.

This section describes data tracing from the SigmaWin+.

Refer to the *SigmaWin+ Online Manual* for details.

(1) Trace Main Window

Select ***Trace*** – ***Trace*** from the menu bar of the SigmaWin+ Component main window. The following dialog box appears.



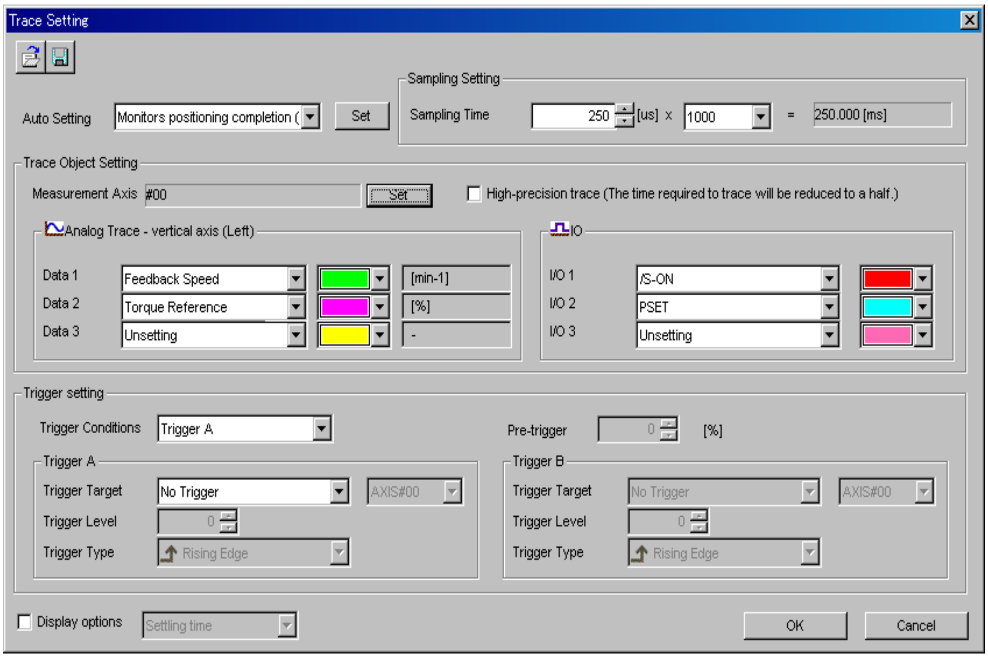
Trace Main Window

(2) Trace Setting

In the Trace main window, click **SETUP**, and the Trace Setting box appears. Select the objects and conditions for the trace.

The settings from the previous trace, if any, are displayed.

Refer to the *SigmaWin+ Online Manual* for detailed trace settings.



Trace Setting Dialog Box

■ Sampling Setting

The setting for the allowable interval time for getting trace data can be made here. Data will be obtained every 250 µs if the sampling time is set to 250 µs. The total trace time is the sampling time multiplied by the number of data items.

■ Trace Object Setting

- Data 1/Data 2/Data3

Select content such as "Torque Reference," "Feedback Speed," etc., identical to the analog monitor as trace objects from the data boxes. The line color for Data1/Data2/Data3 can be set here. The settings are as follows.

Name	Unit
Not set	–
Torque reference	%
Feedback speed	min^{-1}
Reference speed	min^{-1}
Position reference speed	min^{-1}
Position error	Reference unit
Position amplifier error	pulse
Speed feed forward	min^{-1}
Torque feed forward	%
Effective gain	–

- I/O 1 / I/O 2 / I/O 3

You can select input signals, such as /EXT1, P-OT, or N-OT, and output signals, such as /BK, as the data to trace. You can also specify the line colors for I/O traces 1, 2, and 3.

■ Trigger Setting

A trigger is a device for designating the timing of data access. For example, if you set the condition that the speed feedback exceeds 100 min^{-1}, you can check detailed servo operation after the point where that condition is satisfied.

• Trigger (Trigger Conditions)

Set two trigger conditions: Trigger A and Trigger B.

By combining Trigger A and Trigger B, a total of three conditions can be set as follows.

Trigger Condition	Description
Trigger A	Trigger A is satisfied
Trigger A AND Trigger B	Both Trigger A and Trigger B are satisfied
Trigger A OR Trigger B	Either Trigger A or Trigger B is satisfied

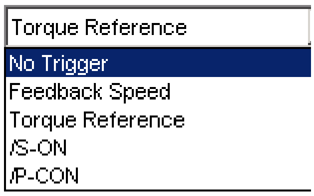
• Pre-trigger (0% to 99%)

Designate to what degree data is displayed in the graph before a trigger is applied.

• Trigger Target

Designate the object to which the trigger is applied. The selected objects can either be from the designated in Data 1, 2, and 3, and I/O 1, 2, and 3, or "No Trigger".

If "No Trigger" is selected, the trigger will be applied at the time the **START** button is clicked. Also the settings for "Trigger Level", "Trigger" (trigger type), and "Pre-Trigger" will be unavailable.



Box Selection List for Triggers

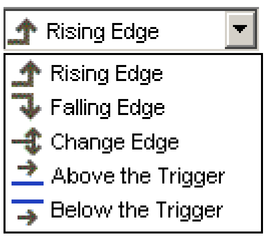
• Trigger Level

Designate the standard for determining when the trigger starts. The units for the setting are the same as those of the trigger object selected.

The trigger level cannot be set if the trigger object is "I/O 1 / I/O 2 / I/O 3" or "No Trigger."

• Trigger (Trigger Type)

Designate the trigger judgement method when the trigger is applied. Select **Rising Edge**, **Falling Edge**, **Change Edge**, **Above the Trigger** (above the trigger level) or **Below the Trigger** (below the trigger level)



Box Selection List for Trigger Types

Rising Edge: The trigger is detected when the trigger object data rises from below the trigger level to above the trigger level.
When the change is from LO to HI in I/O

Falling Edge: The trigger is detected when the trigger object data falls from above the trigger level to below the trigger level.
When the change is from HI to LO in I/O

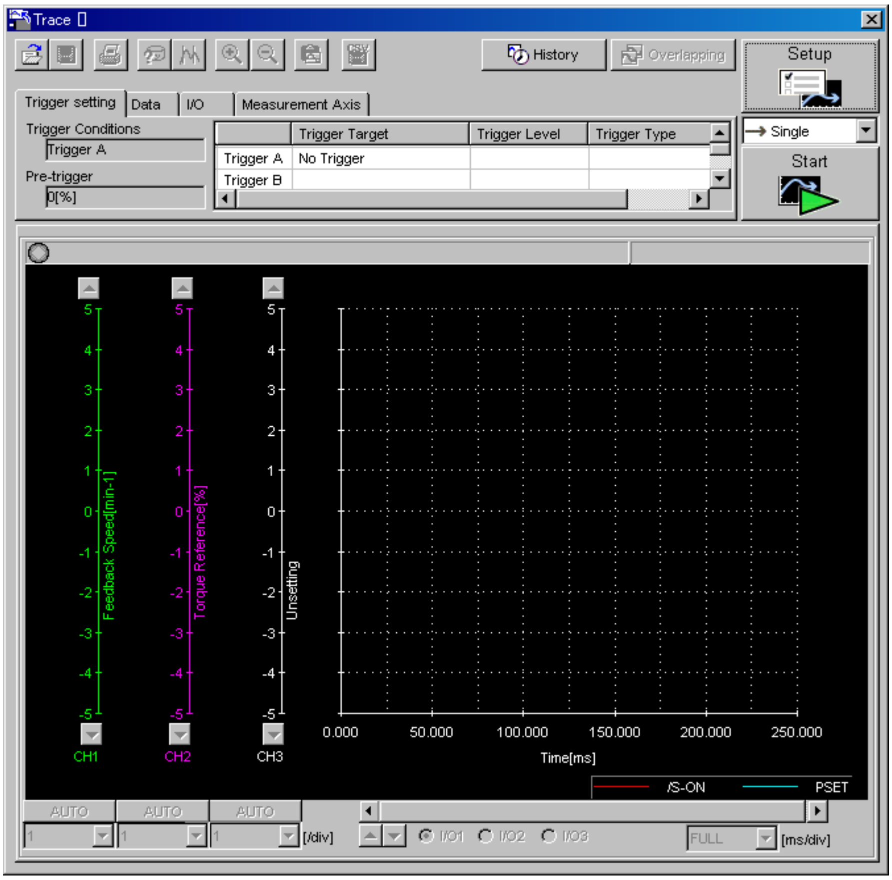
Change Edge: The trigger is detected if the trigger object crosses the "Trigger Level " in any way.
When the signal level changes in I/O

Above the Trigger: The trigger is detected when the trigger object data is above the trigger level.
Cannot be selected for I/O.

Below the Trigger: The trigger is detected when the trigger object data is below the trigger level.
Cannot be selected for I/O.

Rising Edge	Falling Edge	Change Edge	Above the Trigger Level	Below the Trigger Level

(3) Starting the Trace



■ Setting the Trace Mode

Select whether to executing tracing only one time or repeatedly from the **Trace mod**e box.

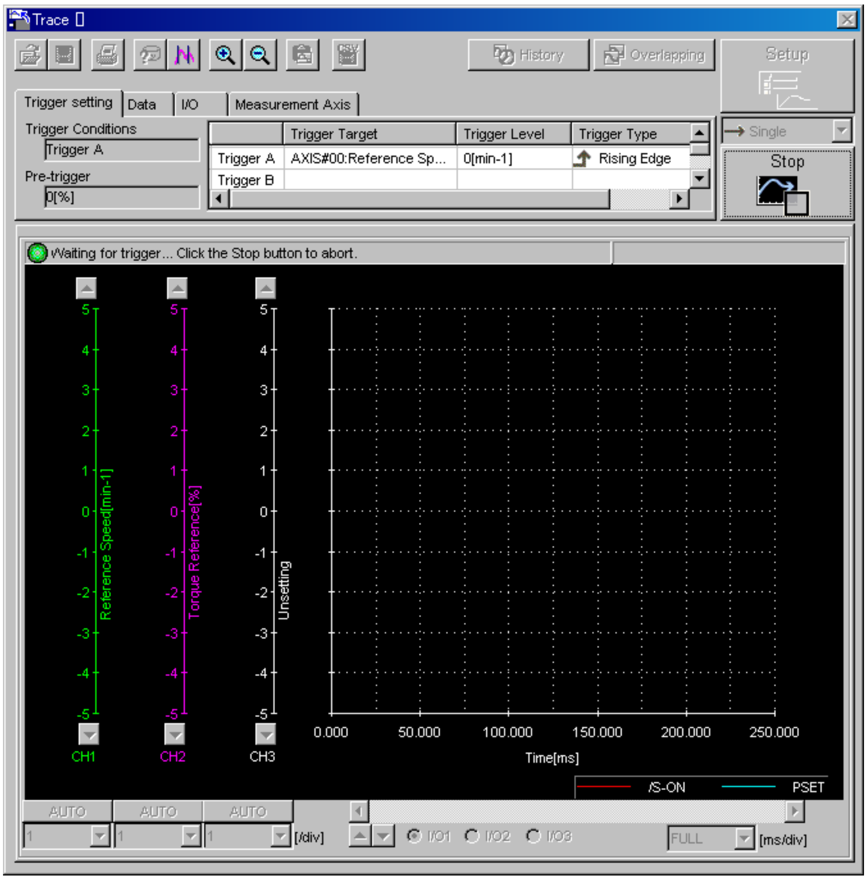
Single: Executes the trace process once. Waiting for the trigger - Trigger conditions are met - Graphic display, and then ends the trace.

Continuous: Repeats the trace process until **Stop** is clicked.

■ Starting on a Trigger

Click **Start** in the Trace main window, and the SigmaWin+ will wait for the trigger.

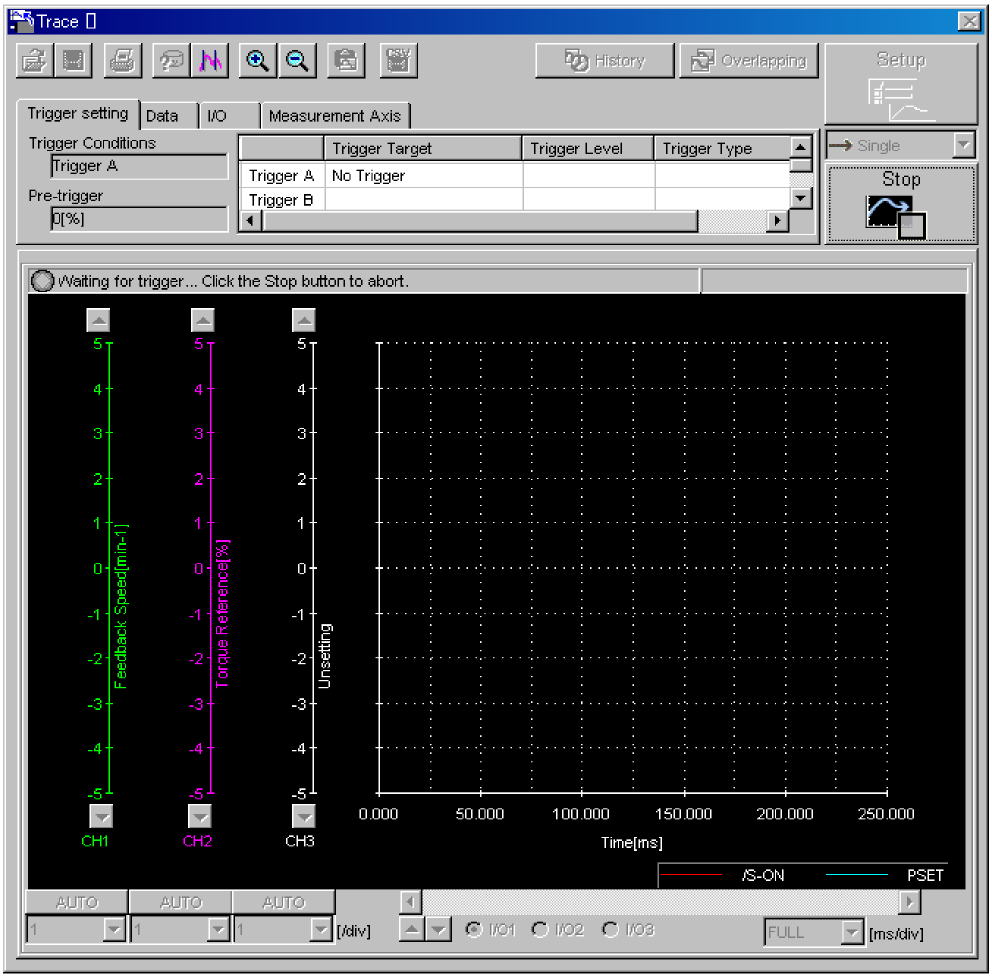
The window below appears while waiting for the trigger.



Dialog Box While Waiting for a Trigger

■ Transferring Data

The message remains until the set trigger conditions are met. Click **Stop** to stop waiting for the trigger



Dialog Box While Transferring Data

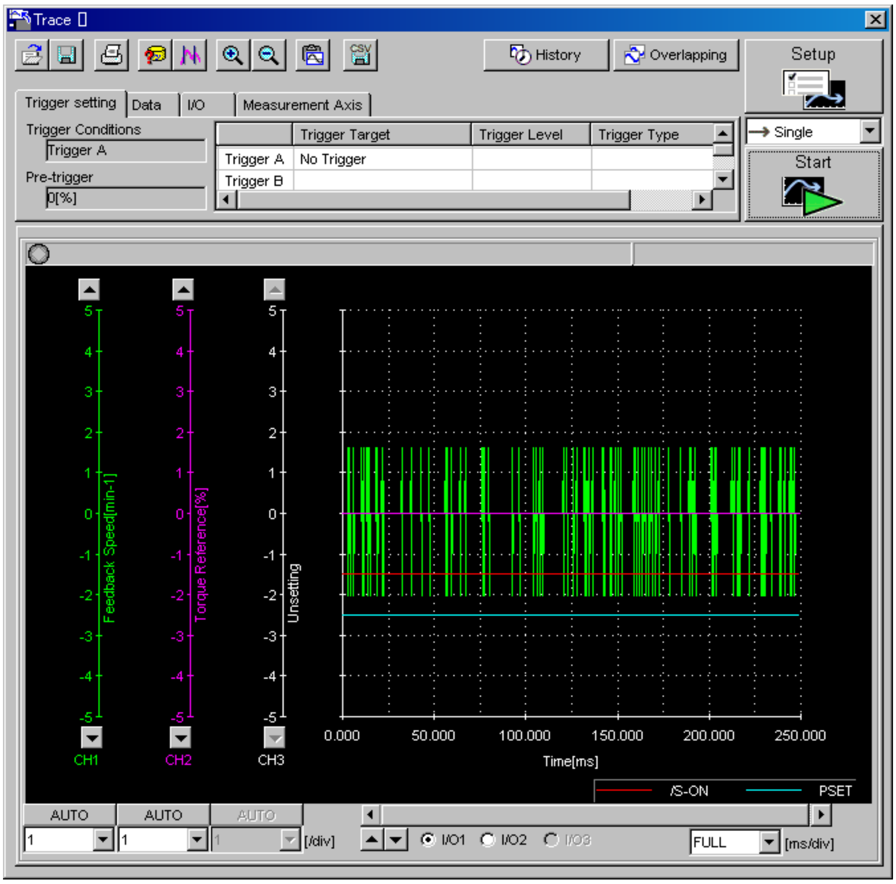
Once the trigger condition is satisfied, the SERVOPACK starts transferring data to the SigmaWin+. When the data transfer is completed, the Trace main window appears.

Note 1. The trigger sometimes cannot be detected in less than 2ms due to the relationship of the detection period.

2. If the sampling time is lengthened, SigmaWin+ may continue to wait for the trigger even after the trigger has been applied. SigmaWin+ waits because data for the sampling time is saved in the SERVOPACK after the trigger has been applied.

(4) Displaying Trace Results

This Trace main window displays a graph based on the trace settings.



Dialog Box Showing Trace Results

8.1.4 Safety Precautions on Adjustment of Servo Gains

⚠ CAUTION

- If adjusting the servo gains, observe the following precautions.
  - Do not touch the rotating section of the servomotor while power is being supplied to the motor.
  - Before starting the servomotor, make sure that the SERVOPACK can come to an emergency stop at any time.
  - Make sure that a trial operation has been performed without any trouble.
  - Install a safety brake on the machine.

Set the following protective functions of the SERVOPACK to the correct settings before starting to adjust the servo gains.

(1) Torque Limit

The torque limit calculates the torque required to operate the machine and sets the torque limits so that the output torque will not be greater than required. Setting torque limits can reduce the amount of shock applied to the machine when troubles occur, such as collisions or interference. If a torque limit is set lower than the value that is needed for operation, overshooting or vibration can be occurred.
For details, refer to *7.5 Limiting Torque*.

(2) Excessive Position Error Alarm Level

The excessive position error alarm is a protective function that will be enabled when the SERVOPACK is used in position control.

The excessive position error alarm is a protective function that will be enabled when the SERVOPACK is used in position control.

If this alarm level is set to a suitable value, the SERVOPACK will detect an excessive position error and will stop the servomotor if the servomotor does not operate according to the reference. The position error indicates the difference between the position reference value and the actual motor position.
The position error can be calculated from the position loop gain (PnAC6) and the motor speed with the following equation.

$$\text{Position Error [reference unit]} = \frac{\text{Motor Speed [min}^{-1}\text{]}}{60} \times \frac{\text{Encoder Resolution}^{*}}{\text{PnAC6 [0.1/s]/10}} \times \frac{\text{PnA44}}{\text{PnA42}}$$

Excessive Position Error Alarm Level (Pn520 [1 reference unit])

$$\text{Pn520} > \frac{\text{Max. Motor Speed [min}^{-1}\text{]}}{60} \times \frac{\text{Encoder Resolution}^{*}}{\text{PnAC6 [0.1/s]/10}} \times \frac{\text{PnA44}}{\text{PnA42}} \times \underline{\underline{(1.2 \text{ to } 2)}}$$

* Refer to *7.4.3 Electronic Gear*.

At the end of the equation, a coefficient is shown as "× (1.2 to 2)." This coefficient is used to add a margin that prevents a position error overflow alarm (A.d00) from occurring in actual operation of the servomotor.

Set the level to a value that satisfies these equations, and no position error overflow alarm (A.d00) will be generated during normal operation. The servomotor will be stopped, however, if it does not operate according to the reference and the SERVOPACK detects an excessive position error.

The following example outlines how the maximum limit for position deviation is calculated. These conditions apply.

- Maximum speed = 6000
- Encoder resolution = 131072 (17 bits)
- PnAC6 = 400
- $\frac{\text{PnA44}}{\text{PnA42}} = \frac{1}{1}$

Under these conditions, the following equation is used to calculate the maximum limit (Pn520).

$$\begin{aligned}\text{Pn520} &= \frac{6000}{60} \times \frac{131072}{400/10} \times \frac{1}{1} \times 2 \\ &= 327680 \times 2 \\ &= 655360\end{aligned}$$

If the acceleration/deceleration of the position reference exceeds the capacity of the servomotor, the servomotor cannot perform at the requested speed, and the allowable level for position error will be increased as not to satisfy these equations. If so, lower the level of the acceleration/deceleration for the position reference so that the servomotor can perform at the requested speed or increase the excessive position error alarm level (Pn520).

■ Related Parameter

Pn520	Excessive Position Error Alarm Level		Position		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 1073741823	1 reference unit	5242880	Immediately	Setup

■ Related Alarm

Alarm Display	Alarm Name	Meaning
A.d00	Position Error Overflow	Position errors exceeded parameter Pn520.

(3) Vibration Detection Function

Set the vibration detection function to an appropriate value with the vibration detection level initialization. For details on how to set the vibration detection function, refer to *9.10 Vibration Detection Level Initialization*.

8.2 Tuning-less Function

The tuning-less function is enabled in the factory settings. If resonance is generated or excessive vibration occurs, refer to *8.2.2 Tuning-less Levels Setting Procedure* and change the set value of Pn170.2 for the rigidity level and the set value in Pn170.3 for the load level.

⚠ CAUTION

- The tuning-less function is enabled in the factory settings. A sound may be heard for a moment when the SV_ON command is received for the first time after the servo drive is mounted to the machine. This sound does not indicate any problems; it means that the automatic notch filter was set. The sound will not be heard from the next time the SV_ON command is received. For details on the automatic notch filter, refer to *(3) Automatically Setting the Notch Filter* on the next page.
- If vibration occurs, set the load level to tuning-less load level 2 in parameter Pn170 or lower the rigidity level.

8.2.1 Tuning-less Function

The tuning-less function obtains a stable response without manual adjustment regardless of the type of machine or changes in the load.

(1) Enabling/Disabling Tuning-less Function

The following parameter is used to enable or disable the tuning-less function.

Parameter		Meaning	When Enabled	Classification
Pn170	n.□□□0	Disables tuning-less function.	After restart	Setup
	n.□□□1 [Factory setting]	Enables tuning-less function.		
	n.□□0□ [Factory setting]	Used as speed control.		
	n.□□1□	Used as speed control and host controller used as position control.		

(2) Application Restrictions

The tuning-less function can be used in position control or speed control. This function is not available in torque control. The following application restrictions apply to the tuning-less function.

Function	Availability	Remarks
Vibration detection level initialization	Available	–
Advanced autotuning	Not available	Disable the tuning-less function by setting Pn170.0 to 0 before executing advanced autotuning.
Advanced autotuning by reference	Not available	–
One-parameter tuning	Not available	–
Anti-resonance control adjustment function	Not available	–
Vibration suppression function	Not available	–
EasyFFT	Available	While this function is being used, the tuning-less function cannot be used. After completion of the EasyFET, it can be set again.
Friction compensation	Not available	–
Gain switching	Not available	–
Offline moment of inertia calculation	Not available	Disable the tuning-less function by setting Pn170.0 to 0 before executing this function.
Mechanical analysis	Available	While this function is being used, the tuning-less function cannot be used. After completion of the analysis, it can be used again.

* Operate using SigmaWin+.

(3) Automatically Setting the Notch Filter

Usually, set this function to Auto Setting. (The notch filter is factory-set to Auto Setting.)
If this function is set to Auto Setting, vibration will be detected automatically and the notch filter will be set when the tuning-less function is enabled.

Set this function to Not Auto Setting only if you do not change the notch filter setting before executing tuning-less function.

Parameter		Meaning	Meaning	Classification
Pn460	n.□0□□	Does not set the 2nd notch filter automatically with utility function.	Immediately	Tuning
	n.□1□□ [Factory setting]	Set the 2nd notch filter automatically with utility function.		

(4) Tuning-less Level Settings

Two tuning-less levels are available: the rigidity level and load level. Both levels can be set in the Pn170 parameter.

■ Rigidity Level

Parameter		Meaning	When Enabled	Classification
Pn170	n.□0□□	Tuning-less level 0	Immediately	Tuning
	n.□1□□	Tuning-less level 1		
	n.□2□□	Tuning-less level 2		
	n.□3□□	Tuning-less level 3		
	n.□4□□ [Factory setting]	Tuning-less level 4		

■ Load Level

Parameter		Meaning	When Enabled	Classification
Pn170	n.0□□□	Tuning-less load level 0	Immediately	Tuning
	n.1□□□ [Factory setting]	Tuning-less load level 1		
	n.2□□□	Tuning-less load level 2		

8.2.2 Tuning-less Levels Setting Procedure

⚠ CAUTION
• To ensure safety, perform the tuning-less function in a state where the SERVOPACK can come to an emergency stop at any time.

The procedure to use the tuning-less function is given below.

The SigmaWin+ is required to execute this function.

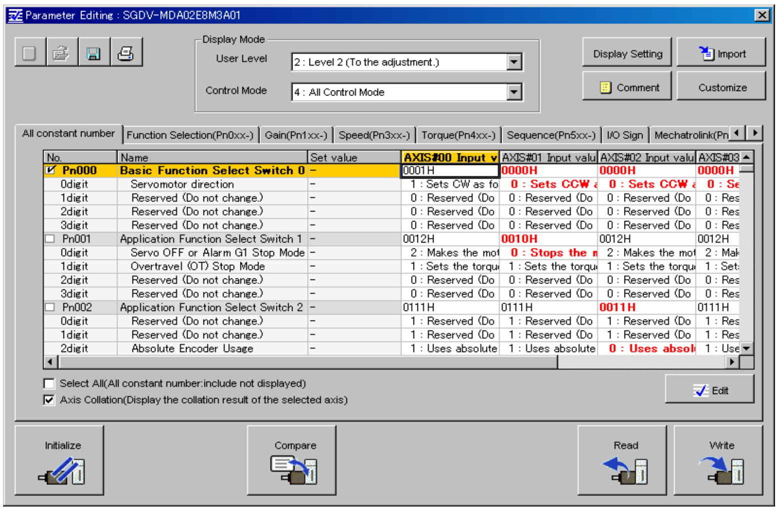
(1) Preparation

Confirm that the tuning-less function is enabled (Pn170.0 = 1) before you set the tuning-less levels.

(2) Operating Procedure

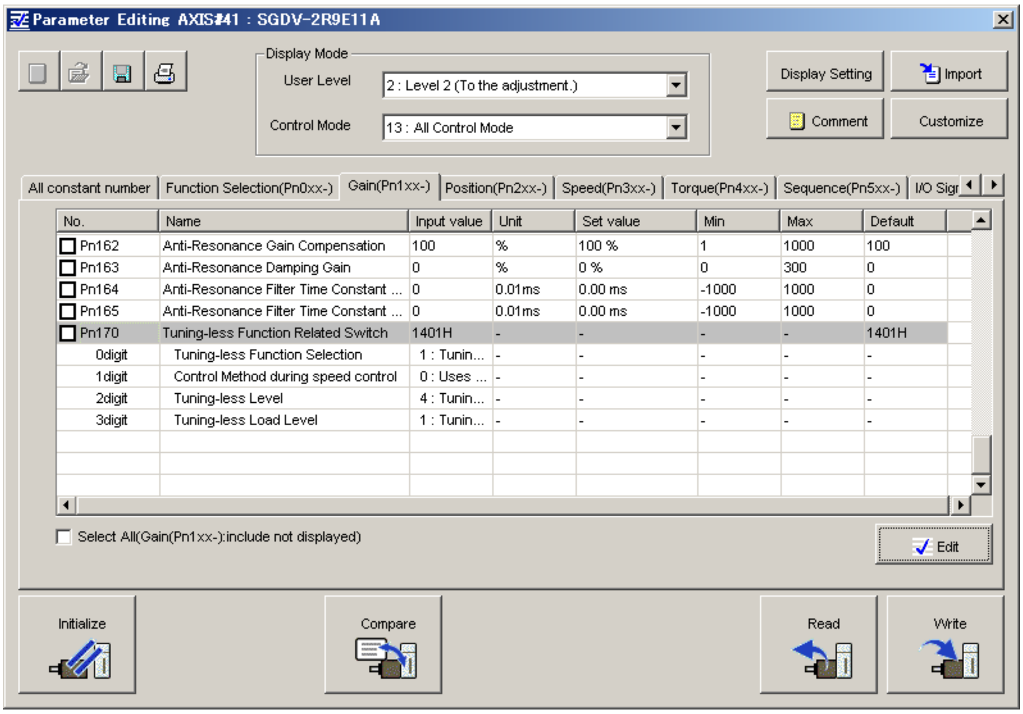
Use the following procedure.

1. In the SigmaWin+ main window, click **Parameters** - **Edit Parameters**.
The **Parameter Editing** dialog box will appear.



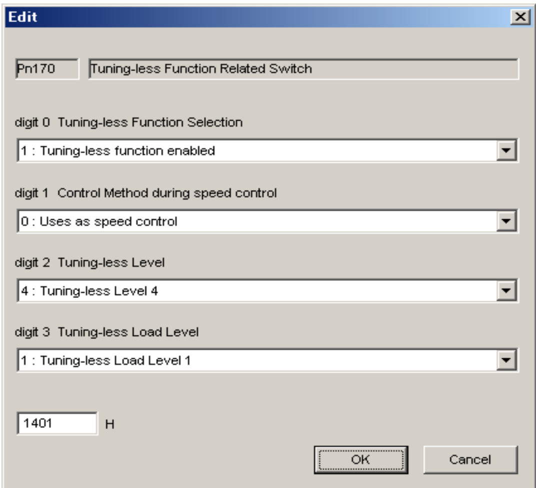
2. Select **Pn170** in the **Parameter Editing** dialog box.

If Pn170 cannot be seen in the **Parameter Editing** dialog box, click the arrows to view the parameter.



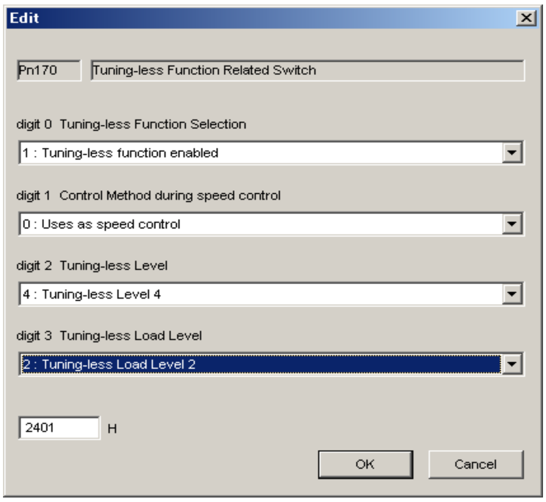
3. Click **Edit**.

The **Edit** box for Pn170 will appear.



4. For 3rd digit, select one of the load levels in the **Tuning-less Load Level** list.

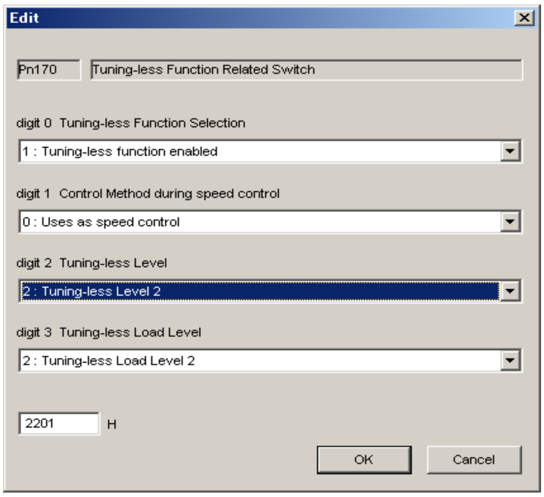
- If the response waveform results in overshooting or if the load moment of inertia exceeds the allowable level, select **2: Tuning-less Load Level 2**. (If any damage caused when the load moment of inertia exceeds the allowable level, these conditions are regarded as being outside the scope of the warranty.)
- If a high-frequency noise is heard, select **0: Tuning-less Load Level 0**



5. For 2nd digit, select one of the tuning-less levels in the **Tuning-less Level** list.

The higher the value of the level is, the higher the gain will be. A higher gain means better response.

Note 1. If the tuning-less level is too high, vibration might occur. Lower the level if vibration occurs.
2. If the tuning-less level is changed, the automatically set notch filter will be canceled (disabled). If any vibration occurs, the notch filter will automatically be set again.



6. Click **OK**.

7. To enable the change in the setting, restart the SERVOPACK.

(3) Alarm and Corrective Actions

The autotuning alarm (A.521) will occur if resonance sound is generated or excessive vibration occurs during position control. If that occurs, increase the setting of parameter Pn170.3 or decrease the setting of parameter Pn170.2.

(4) Parameters Disabled by Tuning-less Function

When the tuning-less function is enabled in the factory settings, the settings of these parameters are not available: PnAC2, PnAC4, PnAC6, Pn103, Pn104, Pn105, Pn106, Pn160, Pn139 and Pn408. These gain-related parameters, however, may become effective depending on the executing conditions of the functions specified in the following table. For example, if EasyFFT is executed when the tuning-less function is enabled, the settings in PnAC2, Pn104, PnAC4, Pn105, PnAC6, Pn106, and Pn103, as well as the manual gain switch setting, will be enabled, but the settings in Pn408.3, Pn160.0, and Pn139.0 will be not enabled.

Parameters Disabled by Tuning-less Function			Related Functions and Parameters*		
Item	Pn Number	Pn Number	Mechanical Analysis (Vertical Axis Mode)	Easy FFT	Mechanical Analysis (Vertical Axis Mode)
Gain	Speed Loop Gain 2nd Speed Loop Gain	PnAC2 Pn104	○	○	○
	Speed Loop Integral Time Constant 2nd Speed Loop Integral Time Constant	PnAC4 Pn105	×	○	○
	Position Loop Gain 2nd Position Loop Gain	PnAC6 Pn106	×	○	○
	Moment of Inertia Ratio	Pn103	○	○	○
Advanced Control	Friction Compensation Function Selection	Pn408.3	×	×	×
	Anti-resonance Control Adjustment Selection	Pn160.0	×	×	×
Gain Switching	Gain Switching Selection Switch	Pn139.0	×	×	×

* ○: Parameter enabled
×: Parameter disabled

8.2.3 Related Parameters

The following parameters are automatically adjusted when the tuning-less function is executed.

After you enable the tuning-less function, do not change the following parameters, e.g., from the SigmaWin+.

Parameter	Name
Pn401	Torque Reference Filter Time Constant
Pn40C	2nd Notch Filter Frequency
Pn40D	2nd Notch Filter Q Value

8.3 Advanced Autotuning

This section describes the adjustment using advanced autotuning

IMPORTANT

- Advanced autotuning starts adjustments based on the set speed loop gain (PnAC2). Therefore, precise adjustments cannot be made if there is vibration when starting adjustments. In this case, make adjustments after lowering the speed loop gain (PnAC2) until vibration is eliminated.
- You cannot execute advanced autotuning if the tuning-less function is enabled (Pn170.0 = 1 (factory setting)). Disable the tuning-less function by setting Pn170.0 to 0 first.
- If the operating conditions, such as the machine-load or drive system, are changed after advanced autotuning, then change the following related parameters to disable any values that were adjusted before performing advanced autotuning once again with the setting to calculate the moment of inertia. If advanced autotuning is performed without changing the parameters, machine vibration may occur, resulting in damage to the machine.

  Pn140.0=0 (Does not use model following control.)
  Pn160.0=0 (Does not use anti-resonance control.)
  Pn408=n.00□0 (Does not use friction compensation, 1st notch filter, or 2nd notch filter.)

8.3.1 Advanced Autotuning

Advanced autotuning automatically operates the servo system (in reciprocating movement in the forward and reverse directions) within set limits and adjust the SERVOPACK automatically according to the mechanical characteristics while the servo system is operating.

The following are tuned automatically.

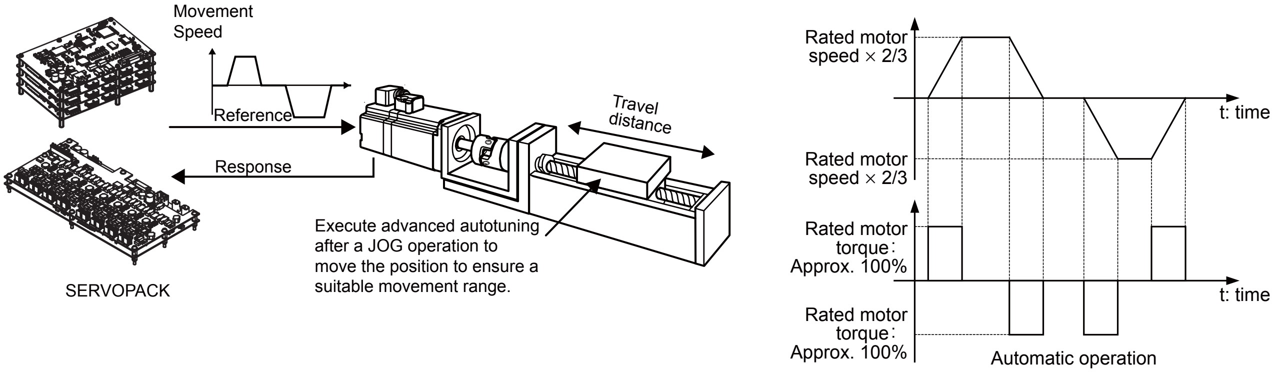
- Moment of inertia ratio
- Gains (e.g., position loop gain and speed loop gain)
- Filters (torque reference filter and notch filter)
- Friction compensation
- Anti-resonance control
- Vibration suppression (only when mode selection is 2 or 3)

Refer to *8.3.3 Related Parameters* for parameters used for adjustments.

For advanced autotuning, use the SigmaWin+ to execute moment of inertia (mass) identification and autotuning without a host reference.

The following automatic operation specifications apply.

- Maximum speed: Rated motor speed × 2/3
- Acceleration torque: Approximately 100% of rated motor torque
  The acceleration torque varies with the influence of the moment of inertia ratio (Pn103), machine friction, and external disturbance.
- Travel distance: The travel distance can be set freely. The distance is factory-set to a value equivalent to 3 motor rotations.



⚠ CAUTION

- Because advanced autotuning adjusts the SERVOPACK during automatic operation, vibration or overshooting may occur. To ensure safety, perform advanced autotuning in a state where the SERVOPACK can come to an emergency stop at any time.

(1) Preparation

The following conditions must be met to perform advanced autotuning.

- The main circuit power supply must be ON.
- There must be no overtravel.
- The servomotor power must be OFF.
- The control method must not be set to torque control.
- The gain selection switch must be in manual switching mode (Pn139.0 = 0).
- Gain setting 1 must be selected.
- All alarms and warning must be cleared.
- The write prohibited setting parameter must be set to Write permitted.
- The tuning-less function must be disabled (Pn170.0 = 0).

Supplemental Information

- If advanced autotuning is started while the SERVOPACK is in speed control, the mode will change to position control automatically to perform advanced autotuning. The mode will return to speed control after completing autotuning. To execute advanced autotuning in speed control, set the mode selection to 1.

(2) When Advanced Autotuning Cannot Be Performed

Advanced autotuning cannot be performed normally under the following conditions. Refer to *8.4 Advanced Autotuning by Reference* and *8.5 One-parameter Tuning* for details.

- The machine system can work only in a single direction.
- The operating range is within 0.5 rotation.

Refer to *8.4 Advanced Autotuning by Reference* for details on advanced autotuning with a reference input.
Refer to *8.5 One-parameter Tuning* for details on one-parameter tuning.

(3) When Advanced Autotuning Cannot Be Performed Successfully

Advanced autotuning cannot be performed successfully under the following conditions. Refer to *8.4 Advanced Autotuning by Reference* and *8.5 One-parameter Tuning* for details.

- The operating range is not applicable.
- The moment of inertia changes within the set operating range.
- The machine has high friction.
- The rigidity of the machine is low and vibration occurs when positioning is performed.
- The position integration function is used.
- P control operation (proportional control) is used.

Note: If a setting is made for calculating the moment of inertia, an error will result when P control operation is selected using /V_PPI of the servo command output signals (SVCMD_IO) while the moment of inertia is being calculated.

- The mode switch is used.

  Note:If a setting is made for calculating the moment of inertia, the mode switch function will be disabled while the moment of inertia is being calculated. At that time, PI control will be used. The mode switch function will be enabled after calculating the moment of inertia.
- Speed feedforward or torque feedforward is input.
- The positioning completed width (PnACC) is too narrow.

IMPORTANT

- Advanced autotuning makes adjustments by referring to the positioning completed width (PnACC). If the SERVOPACK is operated in position control, set the electronic gear ratio (PnA42/PnA44) and positioning completed width (PnACC) to the actual values during operation. If the SERVOPACK is operated in speed control, set the mode selection to 1 to perform advanced autotuning.

Change only the overshoot detection level (Pn561) to finely adjust the amount of overshooting without changing the positioning completed width (PnACC). Because Pn561 is set by default to 100%, the allowable amount of overshooting is the same amount as that for the positioning completed width.
When Pn561 is set to 0%, the amount of overshooting can be adjusted to prevent overshooting the positioning completed width. If the setting of Pn561 is changed, however, the positioning time may be extended.

Pn561	Overshoot Detection Level Speed Position Torque				Classification
	Setting Range	Setting Unit	When Enabled	When Enabled	
	0 to 100	1%	100	Setup	Setup

8.3.2 Advanced Autotuning Procedure

The following procedure is used for advanced autotuning.

CAUTION

- When using the SERVOPACK without calculating the load moment of inertia, be sure to set a suitable value for the moment of inertia ratio (Pn103). If the setting greatly differs from the actual moment of inertia ratio, normal control of the SERVOPACK may not be possible, and vibration may result.
- If you use phase control with an MP2000-series Controller, set the mode selection to 1. If the mode selection is set to 2 or 3, correct phase control may not be possible.

(1) Moment of Inertia (Mass) Identification Procedure

Use the following procedure to set the moment of inertia.

CAUTION

Advanced autotuning involves motor operation, and it is therefore hazardous.
Refer to the SigmaWin+ Operation Manual before performing autotuning without reference input.
Be particularly careful of the following point.

- Ensure safety near all moving parts.
  Vibration may occur during autotuning. Provide an emergency stop means to shut OFF the power supply during implementation. The motor will move in both directions within the movement range. Check the movement range and direction, and provide overtravel prevention means and other safety measures as required.

CAUTION

Two methods are available to stop advanced autotuning while the motor is running, and the motor will stop according to the method selected. Make sure to select the best method for the situation.

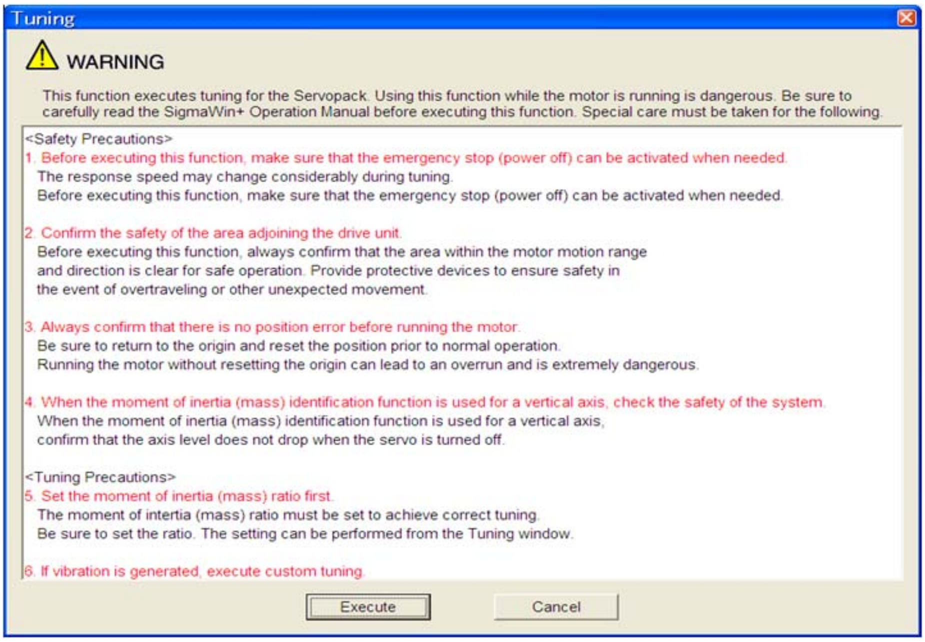
- If the SERVO OFF button is used, the motor will stop according to the stopping method after servo off specified by the parameters.
- If the CANCEL button is used, the motor will decelerate to a stop and then enter a zero clamp state.
  Note: The CANCEL button may be invalid in some SERVOPACKs.

1. In the SigmaWin+ main window, click **Tuning** – **Tuning**.

<Supplemental Information>

If you are using more than one axis, the Axis Selection Dialog Box is displayed. Follow the instructions in the Axis Selection Dialog Box to select the axis to adjust before you continue.

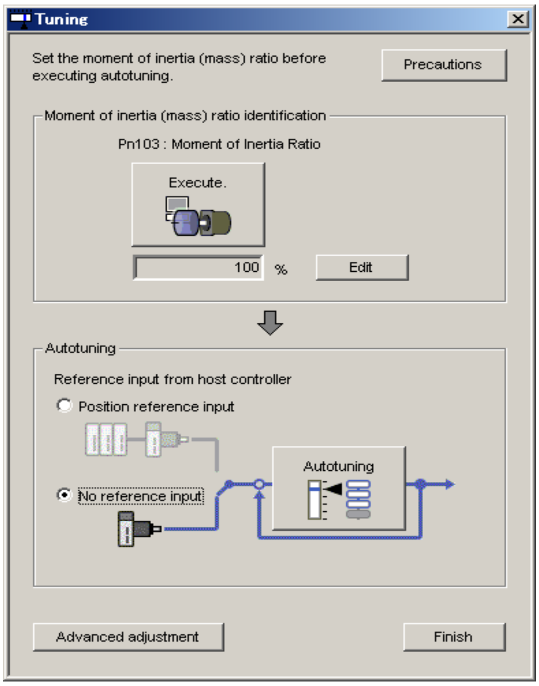
The following window will appear.



Click **Cancel** to return to the SigmaWin+ main window without executing tuning.

2. Click **Execute**.

The following window will appear.

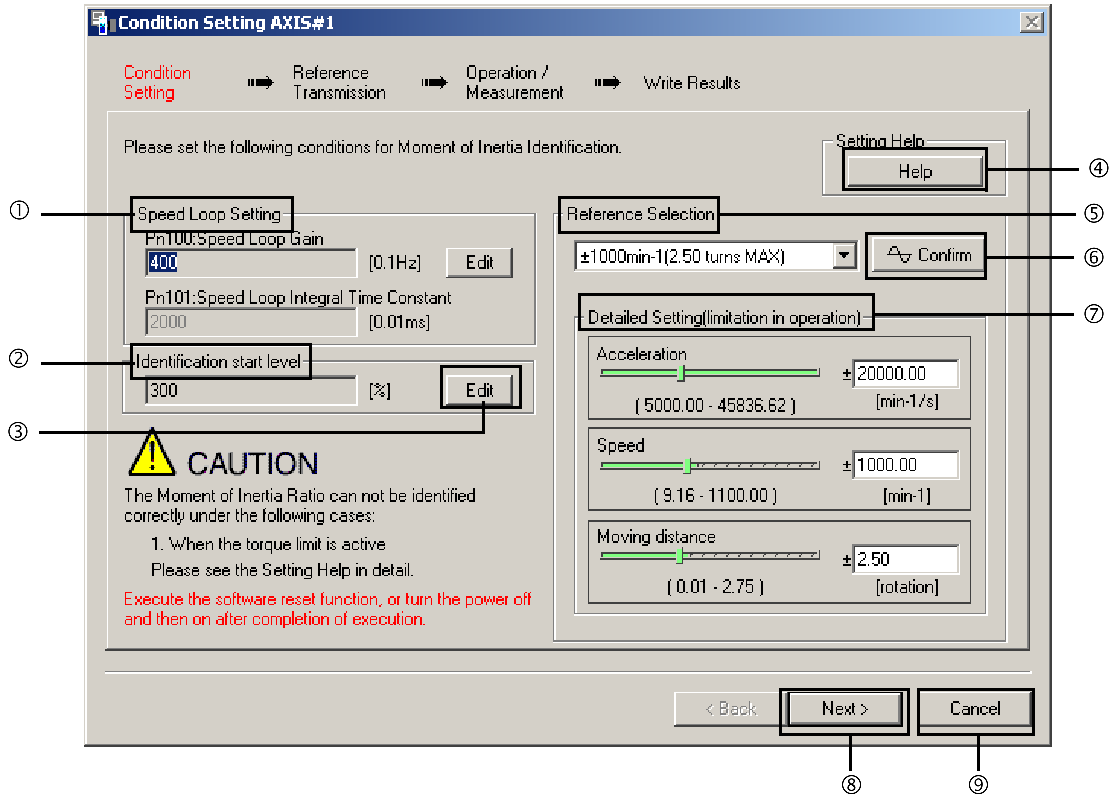


<Supplemental Information>

If the moment of inertia ratio is already decided, click **Edit** and enter the moment of inertia.

3. Click **Execute**.

The following window will appear.



①Speed Loop Setting

Set the speed loop gain and integral time constant.

If the response of the speed loop is poor, the moment of inertia (mass) ratio cannot be measured accurately.

The speed loop setting to get the required response for the moment of inertia (mass) setting is already set to the default setting. Normally, this setting does not have to be changed.

If this speed loop gain is too high, and is causing excitation in the mechanism, lower the setting. However, do not set it to a value that is higher than the default setting.

②Identification Start Level

Set the moment of inertia (mass) identification start level.

With a heavy load or low-rigidity machine, torque limit may be applied and the moment of inertia identification may fail.

In this case, double the identification start level and execute identification again.

③Edit

Click **Edit** to view the Speed Loop-Related Setting Change box or the Identification Start Level Setting Change box.

④Help

Click **Help** to open the window for guidelines on the reference condition settings.

•Run the motor to measure the load's inertial moment (mass) of the machine to compare it with the rotor's inertial moment of the motor in the moment of inertia (mass) ratio.

•Set the driving mode, reference pattern (maximum acceleration, maximum speed, and maximum moving distance), and parameters related to the speed loop.

•Accurate measurement of the moment of inertia (mass) ratio depends on the settings. See the measurement results to determine the proper settings.

⑤Reference Selection

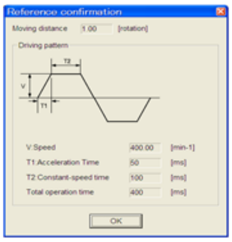
Select a reference pattern from the Reference Selection box or create the reference pattern by directly entering the values.

As the setting for maximum acceleration increases, the accuracy of the inertia identification tends to improve.

Consider the pulley diameter or the speed reduction ratio such as the ball screw pitches, and set the maximum acceleration within the operable range.

⑥Confirm

Click **Confirm** to view the driving pattern



⑦Detailed Setting

Create the reference pattern for setting the moment of inertia (mass) by changing the values with the slider or by directly entering the values.

⑧Next

Click **Next** to view the Reference Transmission box.

⑨Cancel

Click **Cancel** to return to the main window without changing the conditions.

⚠ CAUTION

- The amount of movement is the value for each operation (a forward run or a reverse run). After several operations, the operation starting position may have moved in either direction. Confirm the operable range before each measurement and operation.
- Certain settings for the parameters or inertia size of the mechanism may result in overshooting or undershooting, and cause the speed to temporarily exceed the maximum speed. Allow a margin when making the settings.

<If the moment of inertia (mass) ratio cannot be measured accurately>

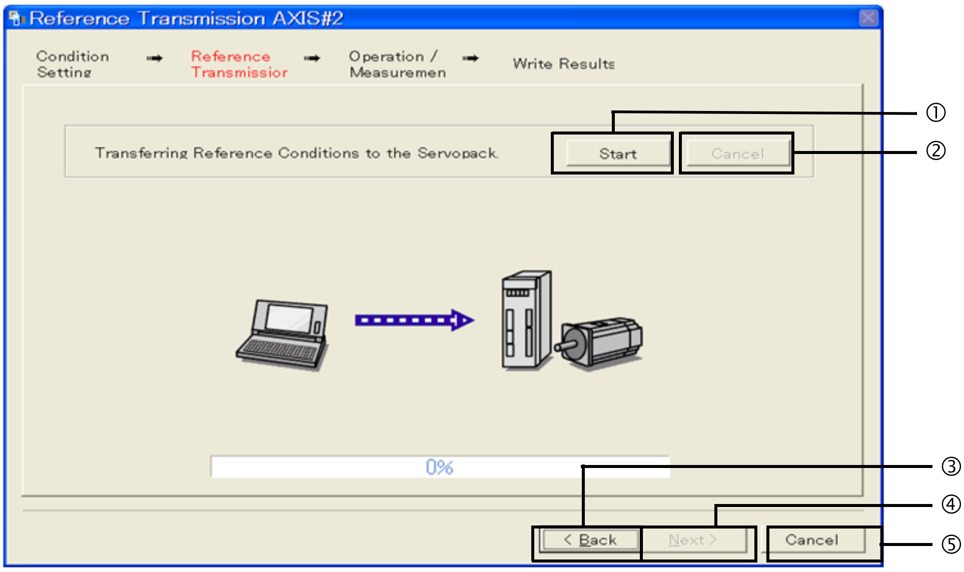
If the torque (force) is limited, the moment of inertia (mass) ratio identification cannot be made correctly. Adjust the setting of the limit or decrease the acceleration in Reference Selection so that the torque (force) will not be limited.

Adjustments

8

4. Click **Next**.

The following window will appear.



①Start

Click to **Start** to transfer the reference conditions to the SERVOPACK. A progress bar displays the progress status of the transfer.

②Cancel

The **Cancel** button is available only during the transfer to the SERVOPACK. After the transmission is finished, it is unavailable and cannot be selected.

③Back

Click **Back** to return to the Condition Setting box. The **Back** button is unavailable during a data transfer.

④Next

The **Next** button is available if the data is transferred successfully. If an error occurs or if the transmission is interrupted, it is unavailable and cannot be selected.

Click **Next** to view the Operation/Measurement box.

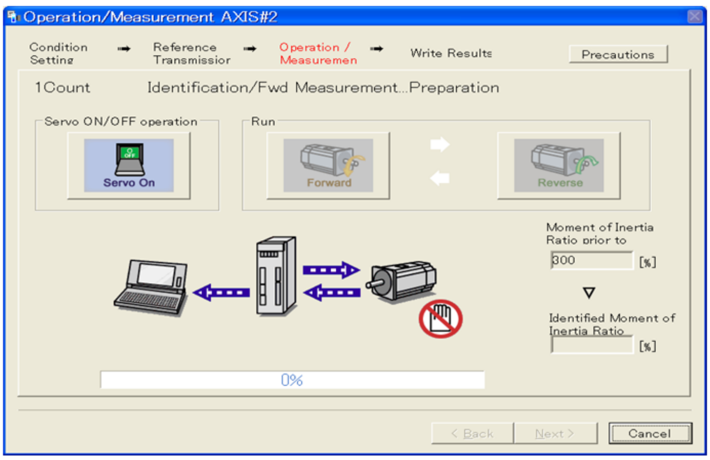
⑤Cancel

Click **Cancel** to stop processing and return to the main window.

5. Click **Start** to transfer the reference conditions to the SERVOPACK.

6. Click **Next**.

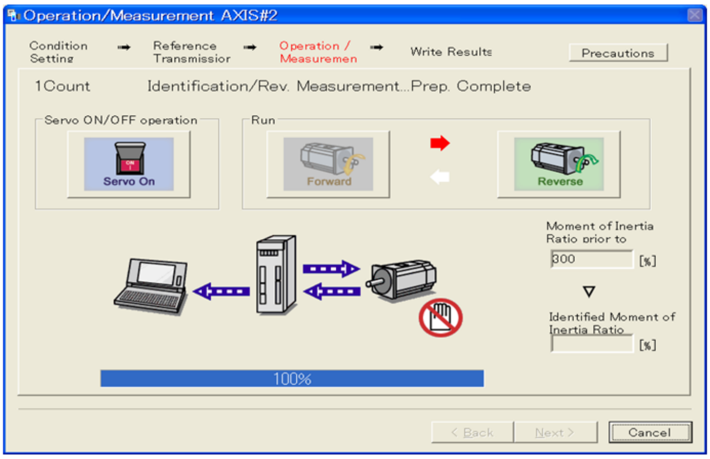
The following window will appear.



7. Click **Servo On**.

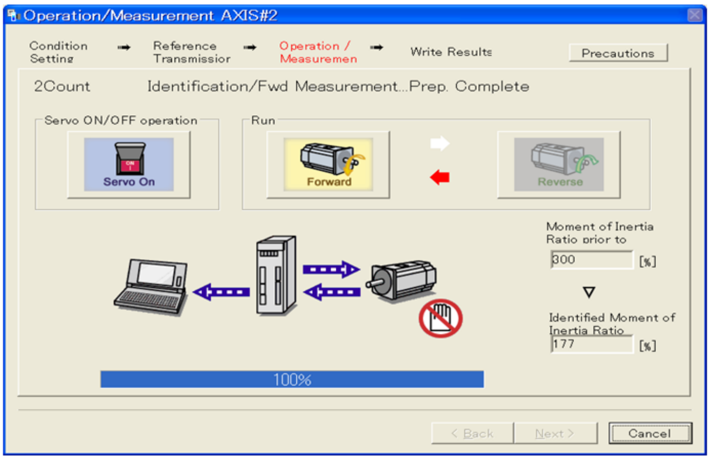
8. Click **Forward** to take measurements by turning (moving) the motor forward.

After the measurements and the data transmission are finished, the following window will appear.



9. Click **Reverse** to take measurements by turning (moving) the motor in reverse.

After the measurements and the data transmission are finished, the following window will appear.



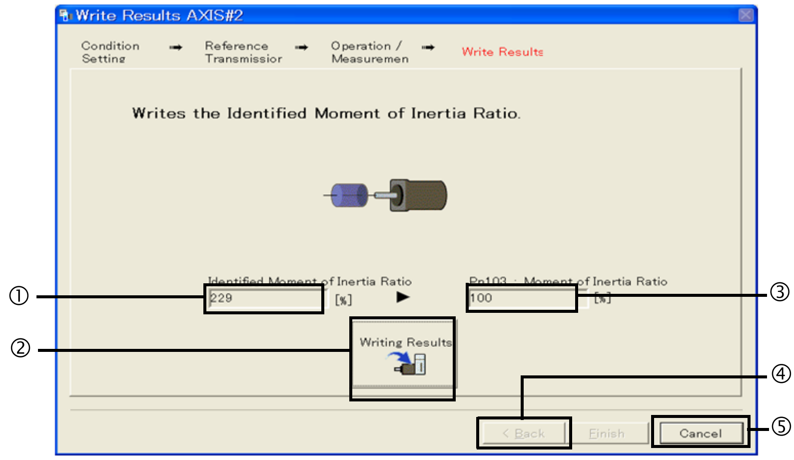
10. Repeat steps 7 through 9 until all the measurements have been taken.

Measurements will be made from two to seven times and then verification will be performed. The actual number of times the measurements have been taken is displayed in the upper left part on the screen. The progress bar displays the percentage of data that has been transferred.

11. After the measurement has been successfully completed, click **Servo ON** to turn to the servo OFF status.

12. Click **Next**.

The following window will appear.



①Identified Moment of Inertia (Mass) Ratio

Displays the moment of inertia (mass) ratio calculated in the operation/measurement.

②Writing Results

Click **Writing Results** to assign the value displayed in the identified moment of inertia (mass) ratio to SERVOPACK parameter Pn103.

③Pn103: Moment of Inertia (Mass) Ratio

Displays the value assigned to the parameter.

Click **Writing Results**, and the new ratio calculated from the operation/measurement will be displayed.

④Back

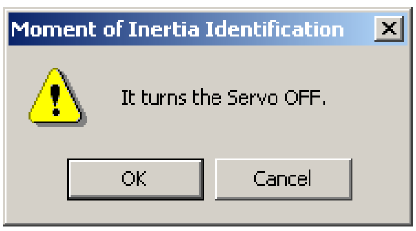
The **Back** button is unavailable.

⑤Cancel

Click **Cancel** to return to the main window.

<Supplement>

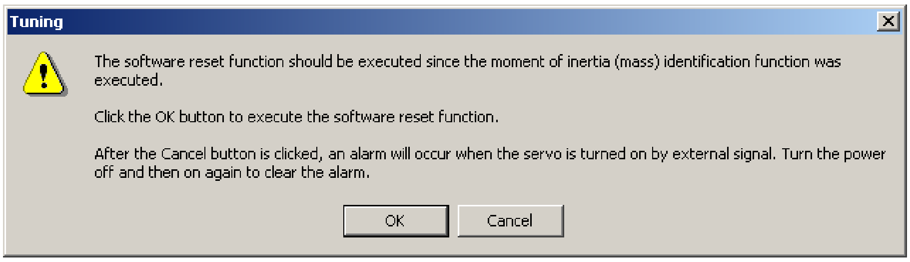
When **Next** is clicked without turning to the servo OFF status, the following message appears. Click **OK** to turn to the servo OFF status.



13. Click **Writing Results** to set the moment of inertia (mass) ratio calculated in the operation/measurement to the parameters.

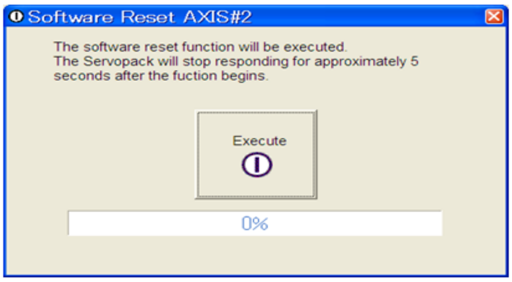
14. After confirming that the value displayed in the identified moment of inertia (mass) ratio and the value displayed in the Pn103: Moment of Inertia Ratio are the same, click **Finish**.

The following window will appear.



15. Click **OK**.

The following window will appear



16. Click **Execute** to save the change of Pn103 (Moment of Inertia (Mass) Ratio) to SERVOPACK.

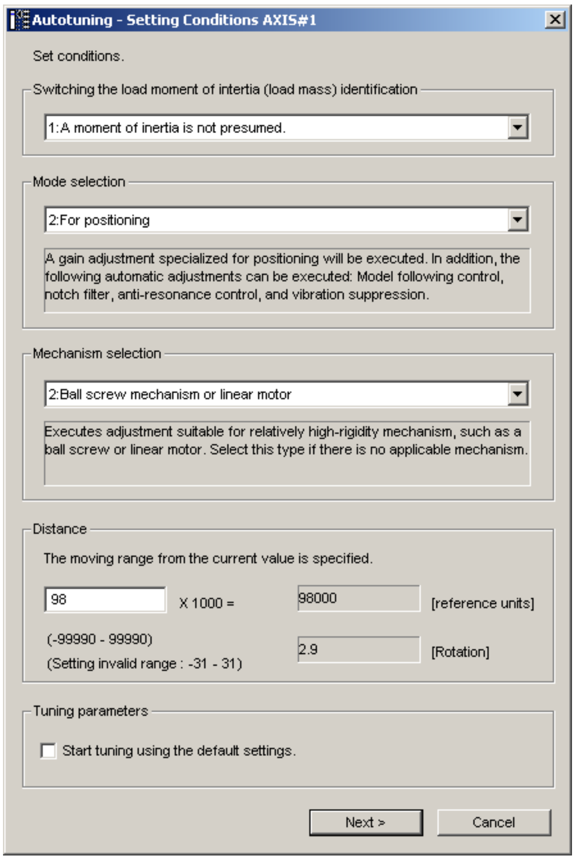
After the saving is finished, the tuning main window will appear.

This completes the moment of inertia (mass) identification procedure.

(2) Procedure for Autotuning without a Host Reference

Use the following procedure to execute autotuning without a host reference.

1. Select the **No reference input** option under **Reference input from host controller** in the Tuning main window, and then click **Autotuning**.
The following window will appear



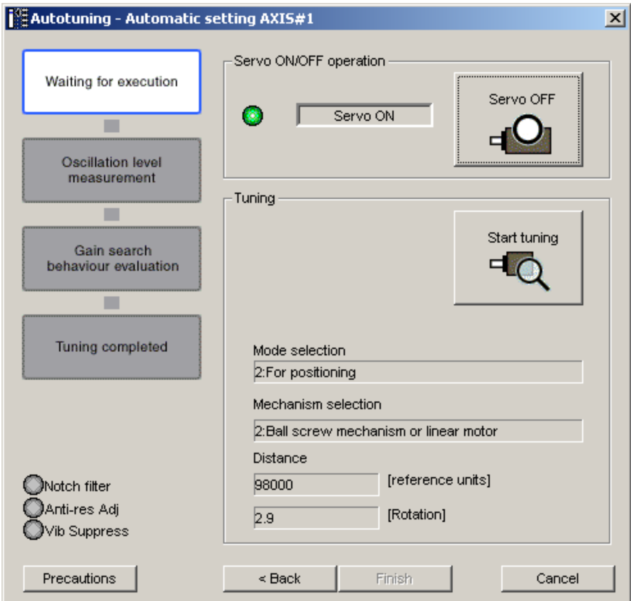
<Supplemental Information>
To execute moment of inertia (mass) identification, set the Load Moment of Inertia (Load Mass) Identification Switch parameter to 0 (identify moment of inertia).

2. Select whether or not to use the load moment of inertia (load mass) identification from the **Switching the load moment of inertia (load mass) identification** box, the mode from the **Mode selection** box, the mechanism from the **Mechanism selection** box, and enter the moving distance. Then, click **Next.**

When the **Start tuning using the default settings**. check box is selected in the Autotuning-Setting Conditions box, tuning will be executed using the tuning parameters set to the default values

3. Click **Servo ON**.

The following window will appear.

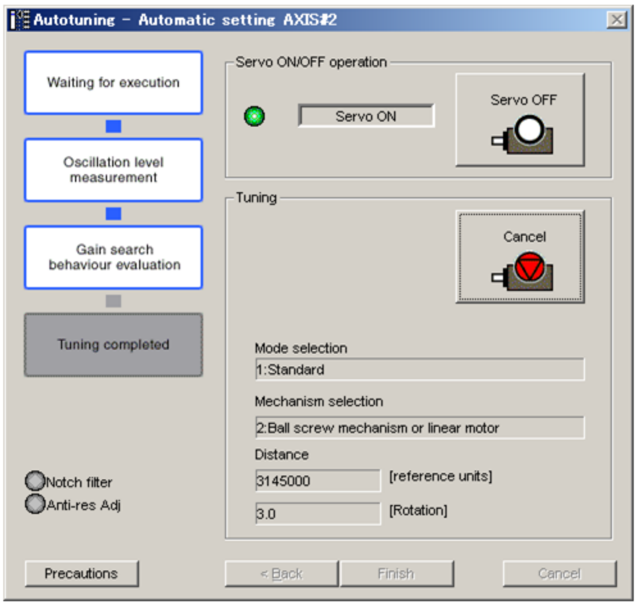


4. Click **Start tuning.**

The following box will appear.

5. After confirming the safety of the area adjoining the drive unit, click **Yes**.

The motor will start rotating and tuning will start.



Vibration generated during tuning is automatically detected, and the optimum setting for the detected vibration will be made. When the setting is complete, the LED indicator lamps (bottom left of the box) of the functions used for the setting will light up.

6. When tuning is completed, click **Finish** to return to the main window.

The results of tuning will be written in the parameters.

(3) Troubleshooting Problems with Advanced Autotuning

Use the following tables to troubleshoot problems with advanced autotuning.

■ Inability to Execute Advanced Autotuning

Probable Cause	Corrective Actions
The main circuit power supply was OFF.	Turn ON the main circuit power supply.
An alarm or warning occurred.	Remove the cause of the alarm or the warning.
Overtraveling occurred.	Remove the cause of the overtravel.
Gain setting 2 was selected by gain switching.	Disable the automatic gain switching.

■ When an Error Occurs

Error	Probable Cause	Corrective Actions
The gain adjustment was not successfully completed.	Machine vibration is occurring or the positioning completed signal is not stable when the servomotor is stopped.	• Increase the set value for PnACC. • Change the setting of the mode selection from 2 to 3. • If machine vibration occurs, suppress the vibration with the anti-resonance control adjustment function and the vibration suppression function.
The gain adjustment was not successfully completed.	Refer to the following table ■ *When an Error Occurs during Calculation of Moment of Inertia*.	
Travel distance setting error	The travel distance is set to approximately 0.5 rotation or less, which is less than the minimum adjustable travel distance.	Increase the travel distance. It is recommended to set the number of motor rotations to around 3.
The positioning was not completed within approximately 10 seconds after positioning adjustment was completed.	The positioning completed width is too narrow or proportional control (P control) is being used.	• Increase the set value for PnACC. • Set 0 to V_PPI in the servo command output signals (SVCMD_IO).

■ When an Error Occurs during Calculation of Moment of Inertia

The following table shows the probable causes of errors that may occur during the calculation of the moment of inertia with the Jcalc set to ON, along with corrective actions for the errors.

Probable Cause	Corrective Actions
The SERVOPACK started calculating the moment of inertia, but the calculation was not completed.	• Increase the speed loop gain (PnAC2). • Increase the STROKE (travel distance).
The moment of inertia fluctuated greatly and did not converge within 10 tries.	Set the calculation value based on the machine specifications in Pn103 and execute the calculation without calculating the moment of inertia.
Low-frequency vibration was detected.	Double the set value of the moment of inertia calculating start level (Pn324).
The torque limit was reached.	• When using the torque limit, increase the torque limit. • Double the set value of the moment of inertia calculating start level (Pn324).
While calculating the moment of inertia, the speed control was set to proportional control by setting 1 to V_PPI in the servo command output signals (SVCMD_IO).	Operate the SERVOPACK with PI control while calculating the moment of inertia.

(4) Related Functions on Advanced Autotuning

■ Notch Filter

Usually, set this function to Auto Setting. (The notch filter is factory-set to Auto Setting.)
If this function is set to Auto Setting, vibration will be detected automatically during advanced autotuning and the notch filter will be set.

Set this function to Not Auto Setting only if you do not change the notch filter setting before executing advanced autotuning.

Parameter		Function	When Enabled	Classification
Pn460	n.□□□0	Does not set the 1st notch filter automatically with the utility function.	Immediately	Tuning
	n.□□□1 [Factory setting]	Sets the 1st notch filter automatically with the utility function.		
	n.□0□□	Does not set the 2nd notch filter automatically with the utility function.		
	n.□1□□ [Factory setting]	Sets the 2nd notch filter automatically with the utility function.		

■ Anti-Resonance Control Adjustment

This function reduces low vibration frequency, which the notch filter does not detect.

Usually, set this function to Auto Setting. (The anti-resonance control is factory-set to Auto Setting.)
When you set this function to Auto Setting, vibration will be automatically detected during execution of autotuning without a host reference and anti-resonance control will be automatically adjusted and set.

Parameter		Function	When Enabled	Classification
Pn160	n.□□0□	Does not use the anti-resonance control automatically with the utility function.	Immediately	Tuning
	n.□□1□ [Factory setting]	Uses the anti-resonance control automatically with the utility function.		

■ Vibration Suppression

The vibration suppression function suppresses transitional vibration at frequency as low as 1 to 100 Hz that is generated mainly when positioning if the machine stand vibrates.

Usually, set this function to Auto Setting. (The vibration suppression function is factory-set to Auto Setting.)
When you set this function to Auto Setting, vibration will be automatically detected during execution of autotuning without a host reference and vibration suppression control will be automatically adjusted and set. Set this function to Not Auto Setting if you do not change the setting for vibration suppression before executing autotuning without a host reference.

Note: This function uses model following control. Therefore, the function can be executed only if the mode selection is set to 2 or 3.

Parameter		Function	When Enabled	Classification
Pn140	n.□0□□	Does not use the vibration suppression function automatically with the utility function.	Immediately	Tuning
	n.□1□□ [Factory setting]	Uses the vibration suppression function automatically with the utility function.		

■ Friction Compensation

This function compensates for changes in the following conditions.

- Changes in the viscous resistance of the lubricant, such as the grease, on the sliding parts of the machine
- Changes in the friction resistance resulting from variations in the machine assembly
- Changes in the friction resistance resulting from variations in the machine assembly

The conditions to which friction compensation is applicable depend on the mode selection.

Mode Selection Setting	Set to 1.	Set to 2.*1	Set to 3.*1
Friction Compensation	According to Pn408.3.*2	Adjusted with the friction compensation function.	

∗1. The friction compensation function is always enabled regardless of the friction compensation setting in Pn408.3.
∗2. For details on Pn408.3, refer to *8.8.2 (1) Required Parameter Settings*.

■ Feedforward

If Model Following Control Related Switch (Pn140) is set to the factory setting and the mode selection is set to 2 or 3 when autotuning is executed, the feedforward gain (PnAC8), speed feedforward (VFF) input, and torque feedforward (TFF) input will be disabled after autotuning.

Set Pn140.3 to 1 if model following control is used together with the speed feedforward (VFF) input and torque feedforward (TFF) input from the host controller.

Parameter		Function	When Enabled	Classification
Pn140	n.0□□□ [Factory setting]	Model following control is not used together with the speed/torque feedforward input.	Immediately	Tuning
	n.1□□□	Model following control is used together with the speed/torque feedforward input.		

Refer to the *Σ-V-MD Series User's Manual MECHATROLINK-III Standard Servo Profile Commands* (Manual No.: SIEP S800001 03) for information on the speed feedforward (VFF) input and torque feedforward (TFF) input.

IMPORTANT

- Model following control is used to make optimum feedforward settings in the SERVOPACK when model following control is used with the feedforward function. Therefore, model following control is not normally used together with either the speed feedforward (VFF) input or torque feedforward (TFF) input from the host controller. However, model following control can be used with the speed feedforward (VFF) input or torque feedforward (TFF) input if required. An improper feedforward input may result in overshooting.

8.3.3 Related Parameters

The following parameters are either referenced or automatically changed during execution of advanced autotuning.

Do not change the settings of these parameters from the SigmaWin+ during execution of advanced autotuning.

Parameter	Name	Automatic changes
PnAC2	Speed Loop Gain	Yes
PnAC4	Speed Loop Integral Time Constant	Yes
PnAC6	Position Loop Gain	Yes
Pn103	Moment of Inertia Ratio	Yes
Pn121	Friction Compensation Gain	Yes
Pn123	Friction Compensation Coefficient	Yes
Pn124	Friction Compensation Frequency Correction	No
Pn125	Friction Compensation Gain Correction	Yes
Pn401	Torque Reference Filter Time Constant	Yes
Pn408	Torque Related Function Switch	Yes
Pn409	1st Notch Filter Frequency	Yes
Pn40A	1st Notch Filter Q Value	Yes
Pn40C	2nd Notch Filter Frequency	Yes
Pn40D	2nd Notch Filter Q Value	Yes
Pn140	Model Following Control Related Switch	Yes
Pn141	Model Following Control Gain	Yes
Pn142	Model Following Control Gain Compensation	Yes
Pn143	Model Following Control Bias (Forward Direction)	Yes
Pn144	Model Following Control Bias (Reverse Direction)	Yes
Pn145	Vibration Suppression 1 Frequency A	Yes
Pn146	Vibration Suppression 1 Frequency B	Yes
Pn147	Model Following Control Speed Feedforward Compensation	Yes
Pn160	Anti-Resonance Control Related Switch	Yes
Pn161	Anti-Resonance Frequency	Yes
Pn163	Anti-Resonance Damping Gain	Yes
Pn531	Program JOG Movement Distance	No
Pn533	Program JOG Movement Speed	No
Pn534	Program JOG Acceleration/Deceleration Time	No
Pn535	Program JOG Waiting Time	No
Pn536	Number of Times of Program JOG Movement	No

8.4 Advanced Autotuning by Reference

Adjustments with advanced autotuning by reference are described below.

IMPORTANT	• Advanced autotuning by reference starts adjustments based on the set speed loop gain (PnAC2). Therefore, precise adjustments cannot be made if there is vibration when starting adjustments. In this case, make adjustments after lowering the speed loop gain (PnAC2) until vibration is eliminated.

8.4.1 Advanced Autotuning by Reference

Advanced autotuning by reference is used to automatically achieve optimum tuning of the SERVOPACK in response to the user reference inputs from the host controller.

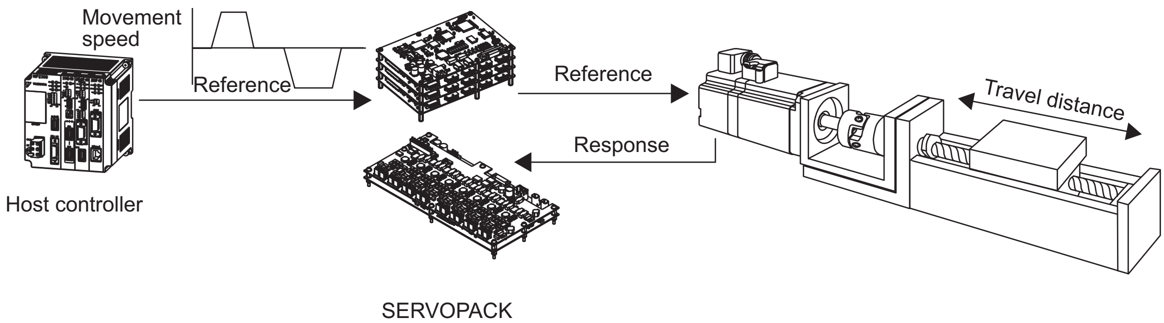
The following are tuned automatically.

- Gains (e.g., position loop gain and speed loop gain)
- Filters (torque reference filter and notch filter)
- Friction compensation
- Anti-resonance control
- Vibration suppression

Refer to *8.4.3 Related Parameters* for parameters used for adjustments.

Advanced autotuning by reference is performed generally to fine-tune the SERVOPACK after advanced autotuning of the SERVOPACK has been performed.

For advanced autotuning with a reference input, set the moment of inertia ratio (Pn103) and then use the SigmaWin+ to execute autotuning with a host reference.



⚠ CAUTION
• Because advanced autotuning by reference adjusts the SERVOPACK during automatic operation, vibration or overshooting may occur. To ensure safety, perform advanced autotuning by reference in a state where the SERVOPACK can come to an emergency stop at any time.

(1) Preparation

The following conditions must be met to perform advanced autotuning by reference.

- The SERVOPACK must be in Servo Ready status
- There must be no overtravel.
- The servomotor power must be OFF.
- The position control must be selected when the servomotor power is ON.
- The gain selection switch must be in manual switching mode (Pn139.0 = 0).
- Gain setting 1 must be selected.
- All warnings must be cleared.
- The tuning-less function must be disabled (Pn170.0 = 0).
- The write prohibited setting parameter must be set to Write permitted.

(2) When Advanced Autotuning by Reference Cannot Be Performed Successfully

Advanced autotuning by reference cannot be performed successfully under the following conditions. If the result of autotuning is not satisfactory, perform one-parameter tuning.

- The travel distance in response to references from the host controller is smaller than the set positioning completed width (PnACC).
- The motor speed in response to references from the host controller is smaller than the set rotation detection level (PnB1C).
- The stopping time was 10 ms or shorter.
- The rigidity of the machine is low and vibration occurs when positioning is performed.
- The position integration function is used.
- P control operation (proportional control) is performed.
- The mode switch is used.
- The positioning completed width (PnACC) is too small.

Refer to *8.5 One-parameter Tuning* for details on one-parameter tuning.

IMPORTANT

- Advanced autotuning by reference starts adjustments based on the positioning completed width (PnACC). Set the electronic gear ratio (PnA42/PnA44) and positioning completed width (PnACC) to the actual value during operation.

Change only the overshoot detection level (PnACC) to finely adjust the amount of overshooting without changing the positioning completed width (Pn522). Because Pn561 is set by default to 100%, the allowable amount of overshooting is the same amount as that for the positioning completed width.
When Pn561 is set to 0%, the amount of overshooting can be adjusted without any overshooting in the positioning completed width. If the setting of Pn561 is changed, however, the positioning time may be extended.

Pn561	Overshoot Detection Level	Speed Position Torque			Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 100	1%	100	Immediately	Setup

8.4.2 Advanced Autotuning by Reference Procedure

The following procedure is used for advanced autotuning by reference.

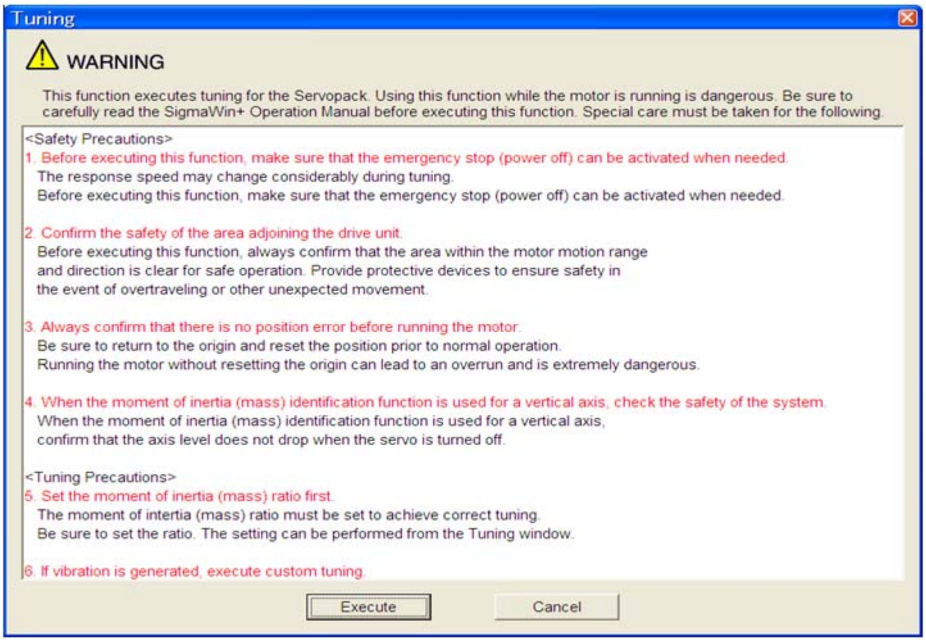
Always set the moment of inertia ratio before you execute autotuning with a host reference.

⚠ CAUTION
• If you use phase control with an MP2000-series Controller, set the mode selection to 1. If the mode selection is set to 2 or 3, correct phase control may not be possible.

(1) Procedure for Autotuning with a Host Reference

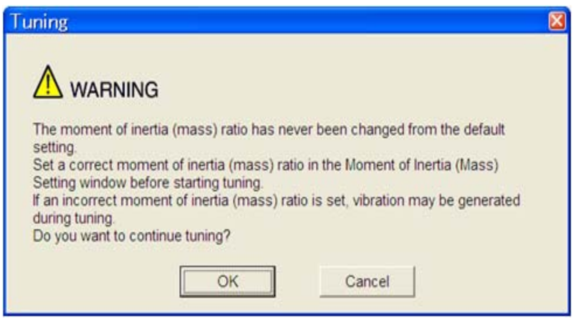
Use the following procedure.

1. Confirm that the correct moment of inertia ratio in Pn103 is set by using the advanced autotuning.
2. In the SigmaWin+ main window, click **Tuning** - **Tuning**.



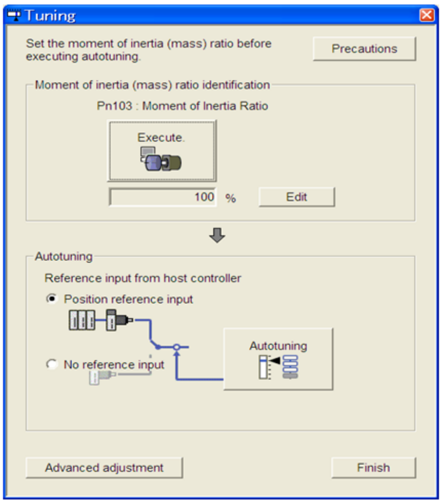
Click **Cancel** to return to the SigmaWin+ main window without executing tuning.

3. Click **Execute**.
The following window will appear.



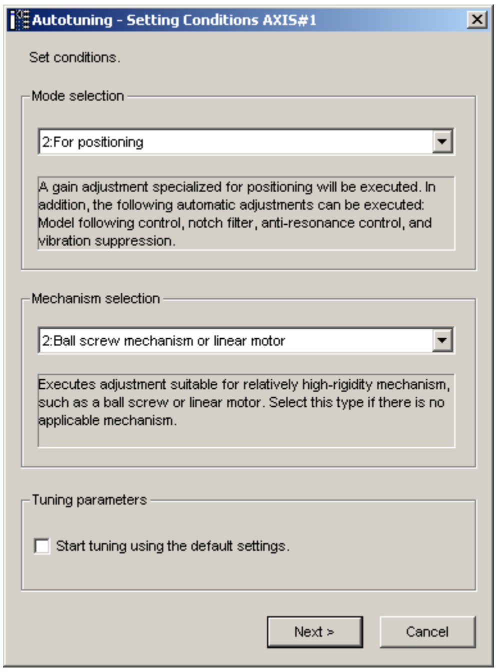
4. Click **OK**.

The following window will appear.



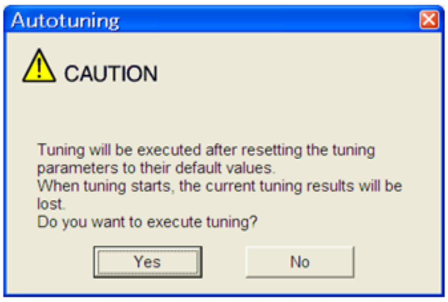
5. Select the **Position reference input** option under **Reference input from host controller** in the Tuning main window, and then click **Autotuning**.

The following window will appear.



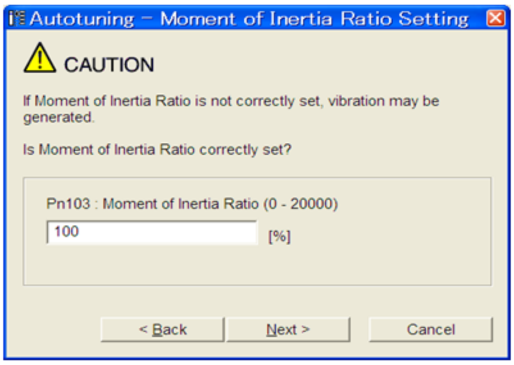
6. Select the mode from the **Mode selection** combo box and the mechanism from **Mechanism selection** combo box, and then click **Next**.

When the **Start tuning using the default settings**. check box is selected in the Autotuning-Setting Conditions box, tuning will be executed using tuning parameters set to the default value



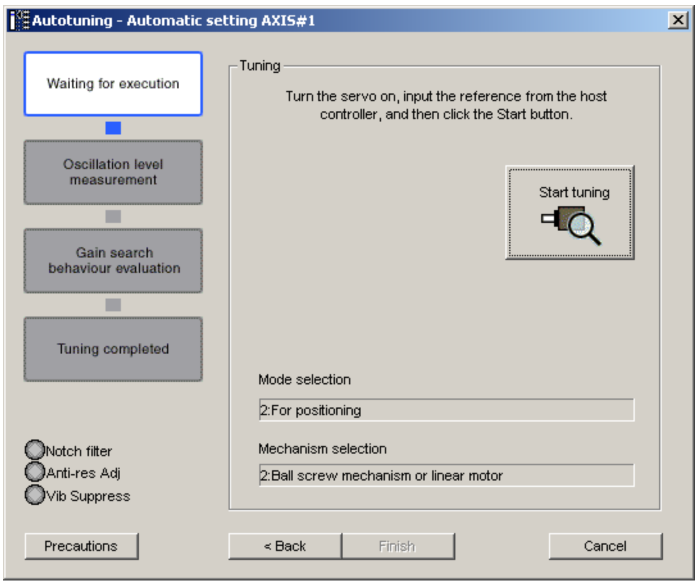
7. Click **Yes**.

The following box will appear.

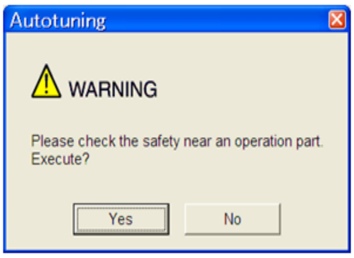


8. Enter the correct moment of inertia ratio and then click **Next**.

The following window will appear.

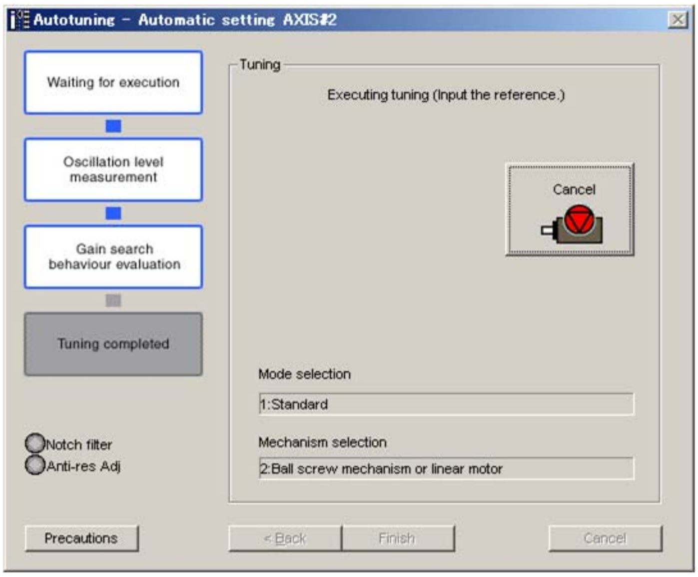


9. Turn the servo on and then input the reference from the host controller. Click **Start tuning**.



10. After confirming the safety of the area adjoining the drive unit, click **Yes**.

The motor will start rotating and tuning will start.



Vibration generated during tuning is automatically detected, and the optimum setting for the detected vibration will be made. When the setting is complete, the LED indicator lamps (bottom left of the box) of the functions used for the setting will light up.

11. When tuning is completed, click **Finish** to return to the main window.

The results of tuning will be written in the parameters.

(2) Troubleshooting Problems with Advanced Autotuning by Reference

Use the following tables to troubleshoot problems with advanced autotuning by reference.

■ Inability to Execute Advanced Autotuning by Reference

Probable Cause	Corrective Actions
The main circuit power supply was OFF.	Turn ON the main circuit power supply.
An alarm or warning occurred.	Remove the cause of the alarm or the warning.
Overtraveling occurred.	Remove the cause of the overtravel.
Gain setting 2 was selected by gain switching.	Disable the automatic gain switching.

■ When an Error Occurs

Error	Probable Cause	Corrective Actions
The gain adjustment was not successfully completed.	Machine vibration is occurring or positioning completion is not stable when the servomotor is stopped.	• Increase the set value for PnACC. • Change the setting of the mode selection from 2 to 3. • If machine vibration occurs, suppress the vibration with the anti-resonance control adjustment function and the vibration suppression function.
The positioning was not completed within approximately 10 seconds after positioning adjustment was completed.	The positioning completed width is too narrow or proportional control (P control) is being used.	• Increase the setting of PnACC. • Set 0 to V_PPI in the servo command output signals (SVCMD_IO).

(3) Related Functions on Advanced Autotuning by Reference

■ Notch Filter

Usually, set this function to Auto Setting. (The notch filter is factory-set to Auto Setting.)
When you set this function to Auto Setting, vibration will be automatically detected during execution of autotuning with a host reference and the notch filter will be adjusted.

Set this function to Not Auto Setting only if you do not change the notch filter setting before executing advanced autotuning by reference.

Parameter		Function	When Enabled	Classification
Pn460	n.□□□0	Does not set the 1st notch filter automatically with the utility function.	Immediately	Tuning
	n.□□□1 [Factory setting]	Sets the 1st notch filter automatically with the utility function.		
	n.□0□□	Does not set the 2nd notch filter automatically with the utility function.		
	n.□1□□ [Factory setting]	Sets the 2nd notch filter automatically with the utility function.		

■ Anti-Resonance Control Adjustment

This function reduces low vibration frequency, which the notch filter does not detect.

Usually, set this function to Auto Setting. (The anti-resonance control is factory-set to Auto Setting.)
When you set this function to Auto Setting, vibration will be automatically detected during autotuning with a host reference and anti-resonance control will be automatically adjusted and set.

Parameter		Function	When Enabled	Classification
Pn160	n.□□0□	Does not use the anti-resonance control automatically with the utility function.	Immediately	Tuning
	n.□□1□ [Factory setting]	Uses the anti-resonance control automatically with the utility function.		

■ Vibration Suppression

The vibration suppression function suppresses transitional vibration at frequency as low as 1 to 100 Hz that is generated mainly when positioning if the machine stand vibrates.

Usually, set this function to Auto Setting. (The vibration suppression function is factory-set to Auto Setting.) When you set this function to Auto Setting, vibration will be automatically detected during autotuning with a host reference and vibration suppression will be automatically adjusted and set. Set this function to *Not Auto Setting* only if you do not change the setting for vibration suppression before executing autotuning with a host reference.

Note: This function uses model following control. Therefore, the function can be executed only if the mode selection is set to 2 or 3.

Parameter		Function	When Enabled	Classification
Pn140	n.□0□□	Does not use the vibration suppression function automatically.	Immediately	Tuning
	n.□1□□ [Factory setting]	Uses the vibration suppression function automatically.		

■ Friction Compensation

This function compensates for changes in the following conditions.

- Changes in the viscous resistance of the lubricant, such as the grease, on the sliding parts of the machine
- Changes in the friction resistance resulting from variations in the machine assembly
- Changes in the friction resistance due to aging

Conditions to which friction compensation is applicable depend on the mode.

Mode Selection Setting	Set to 1.	Set to 2.*1	Set to 3.*1
Friction Compensation	According to Pn408.3.*2	Adjusted with the friction compensation function.	

*1. The friction compensation function is always enabled regardless of the friction compensation setting in Pn408.3.
* 2. For details on Pn408.3, refer to *8.8.2 (1) Required Parameter Settings*.

■ Feedforward

If Model Following Control Related Switch (Pn140) is set to the factory setting and the mode selection is set to 2 or 3 when autotuning is executed, the feedforward gain (PnAC8), speed feedforward (VFF) input, and torque feedforward (TFF) input will be disabled.

Set Pn140.3 to 1 if model following control is used together with the speed feedforward (VFF) input and torque feedforward (TFF) input from the host controller.

Parameter		Function	When Enabled	Classification
Pn140	n.0□□□ [Factory setting]	Model following control is not used together with the speed/torque feedforward input.	Immediately	Tuning
	n.1□□□	Model following control is used together with the speed/torque feedforward input.		

Refer to the *Σ-V-MD Series User's Manual MECHATROLINK-III Standard Servo Profile Commands* (Manual No.: SIEP S800001 03) for information on the speed feedforward (VFF) input and torque feedforward (TFF) input.

IMPORTANT

- Model following control is used to make optimum feedforward settings in the SERVOPACK when model following control is used with the feedforward function. Therefore, model following control is not normally used together with either the speed feedforward (VFF) input or torque feedforward (TFF) input from the host controller. However, model following control can be used with the speed feedforward (VFF) input or torque feedforward (TFF) input if required. An improper feedforward input may result in overshooting.

8.4.3 Related Parameters

The following parameters are either referenced or automatically changed during execution of advanced autotuning by reference.

Do not change the settings of these parameters from the SigmaWin+ during execution of advanced autotuning by reference.

Parameter	Name	Automatic changes
PnAC2	Speed Loop Gain	Yes
PnAC4	Speed Loop Integral Time Constant	Yes
PnAC6	Position Loop Gain	Yes
Pn103	Moment of Inertia Ratio	No
Pn121	Friction Compensation Gain	Yes
Pn123	Friction Compensation Coefficient	Yes
Pn124	Friction Compensation Frequency Correction	No
Pn125	Friction Compensation Gain Correction	Yes
Pn401	Torque Reference Filter Time Constant	Yes
Pn408	Torque Related Function Switch	Yes
Pn409	1st Notch Filter Frequency	Yes
Pn40A	1st Notch Filter Q Value	Yes
Pn40C	2nd Notch Filter Frequency	Yes
Pn40D	2nd Notch Filter Q Value	Yes
Pn140	Model Following Control Related Switch	Yes
Pn141	Model Following Control Gain	Yes
Pn142	Model Following Control Gain Compensation	Yes
Pn143	Model Following Control Bias (Forward Direction)	Yes
Pn144	Model Following Control Bias (Reverse Direction)	Yes
Pn145	Vibration Suppression 1 Frequency A	Yes
Pn146	Vibration Suppression 1 Frequency B	Yes
Pn147	Model Following Control Speed Feedforward Compensation	Yes
Pn160	Anti-Resonance Control Related Switch	Yes
Pn161	Anti-Resonance Frequency	Yes
Pn163	Anti-Resonance Damping Gain	Yes

8.5 One-parameter Tuning

Adjustments with one-parameter tuning are described below.

8.5.1 One-parameter Tuning

One-parameter tuning is used to manually make tuning level adjustments during operation with a position reference or speed reference input from the host controller.

The following are tuned automatically.

- Gains (e.g., position loop gain and speed loop gain)
- Filters (torque reference filter and notch filter)
- Friction compensation
- Anti-resonance control

One-parameter tuning allows you to automatically set related servo gain settings to balanced conditions by adjusting one or two tuning levels.

Refer to*8.5.4 Related Parameters* for parameters used for adjustments.

For one-parameter tuning, execute custom tuning from the SigmaWin+.

Supplemental Information

Perform one-parameter tuning if satisfactory response characteristics is not obtained with advanced autotuning or advanced autotuning by reference.

To fine-tune each servo gain after one-parameter tuning, refer to *8.8 Additional Adjustment Function*.

⚠ CAUTION
• Vibration or overshooting may occur during adjustment. To ensure safety, perform one-parameter tuning in a state where the SERVOPACK can come to an emergency stop at any time.

■ Preparation

The following conditions must be met to perform one-parameter tuning.

- The tuning-less function must be disabled (Pn170.0 = 0).
- The tuning mode must be set to 0 or 1 when performing speed control.
- The write prohibited setting parameter must be set to Write permitted.

8.5.2 One-parameter Tuning Procedure

The following procedure is used for one-parameter tuning.

There are the following two operation procedures depending on the tuning mode that you use.
①When the tuning mode is set to 0 or 1, model following control will be disabled and one-parameter tuning will be used as the tuning method for applications other than positioning.
②When the tuning mode is set to 2 or 3, model following control will be enabled and one-parameter tuning will be used as the tuning method for positioning.

This section provides the procedure for when the tuning mode is set to 0 (set servo gains with priority given to stability) or 2 (set servo gains with priority given to positioning application).

To execute one-parameter tuning, use custom tuning from the SigmaWin+.

⚠ CAUTION
• If you use phase control with an MP2000-series Controller, set the tuning mode to 0 or 1. If the tuning mode is set to 2 or 3, correct phase control may not be possible.

(1) Procedure for Custom Tuning

Use the following procedure to execute custom tuning when the tuning mode is set to 0 (set servo gains with priority given to stability).

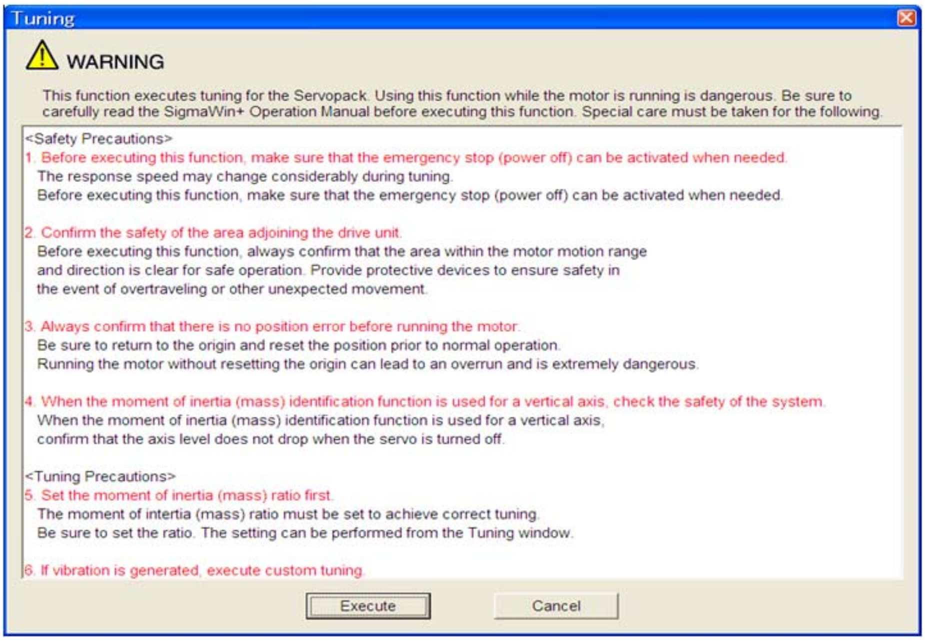
⚠ WARNING

Be sure to carefully read the SigmaWin+ Operation Manual before executing this function.
Special care must be taken for the following.

- Before executing this function, make sure that the emergency stop (power off) can be activated when needed.
  When tuning is initiated by this function, some parameters will be overwritten with the recommended values. As a result, the response speeds may change considerably. Before executing this function, make sure that the emergency stop (power off) can be activated when needed.
- Set a correct moment of inertia (mass) ratio to execute this function.
  If not correctly set, vibration may be generated.
- If you change the feedforward level, the new setting is not used immediate. It is used after the completion of positioning.

1. Confirm that the correct moment of inertia ratio in Pn103 is set by using the advanced autotuning.
2. In the SigmaWin+ main window, click **Tuning** - **Tuning**.
   Supplemental Information
   If you are using more than one axis, the Axis Selection Dialog Box is displayed. Follow the instructions in the Axis Selection Dialog Box to select the axis to adjust before you continue.

   The following window will appear.



   Click **Cancel** to return to the SigmaWin+ main window without executing tuning.

Adjustments

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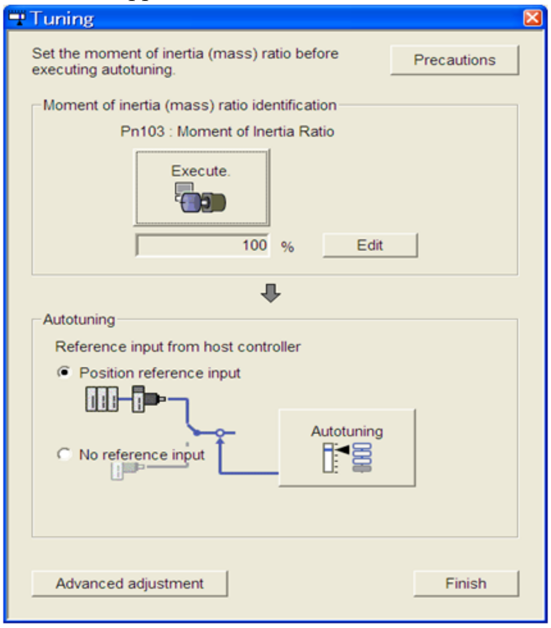
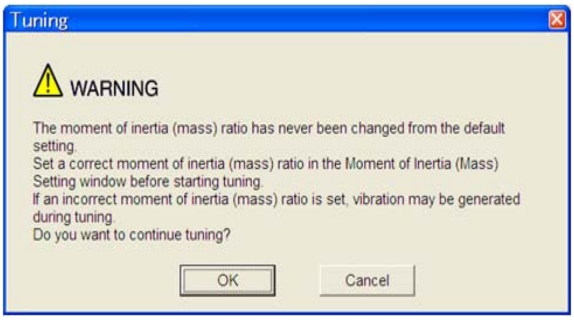
3. Click **Execute**.

The following window will appear



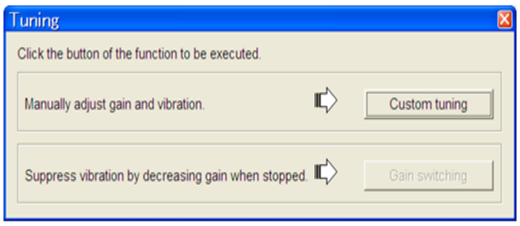
<Supplement>

If the following window will appear, click **OK** and confirm that the correct moment of inertia ratio in Pn103 is set by using the **Moment of Inertia (Mass) Setting** window.



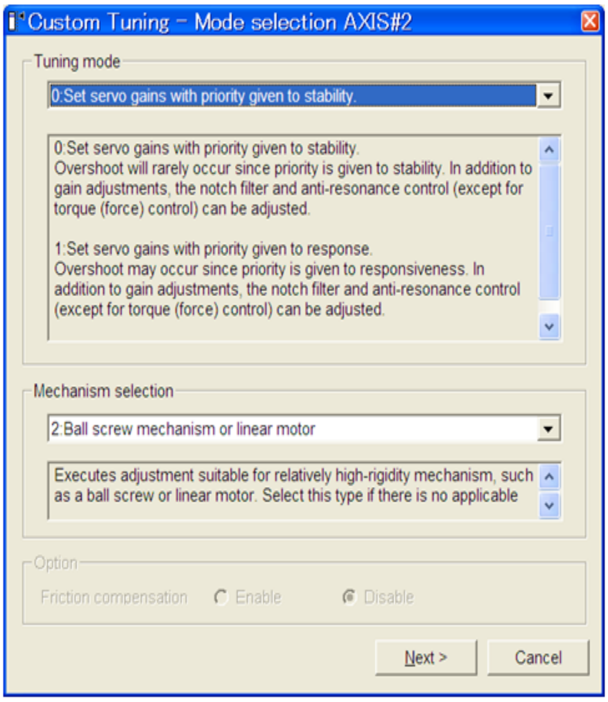
4. Click **Advanced adjustment**.

The following box will appear.



5. Click **Custom tuning**.

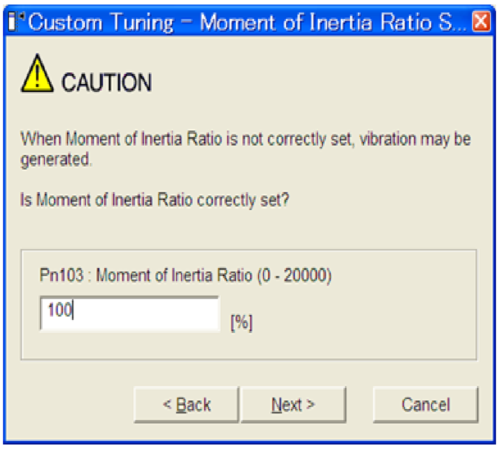
The following box will appear.



The tuning modes that can be selected will vary according to the SERVOPACK setting.

6. Select the tuning mode from the **Tuning mode** box and the mechanism from the **Mechanism selection** box, and then click **Next**.

The following box will appear.



Adjustments

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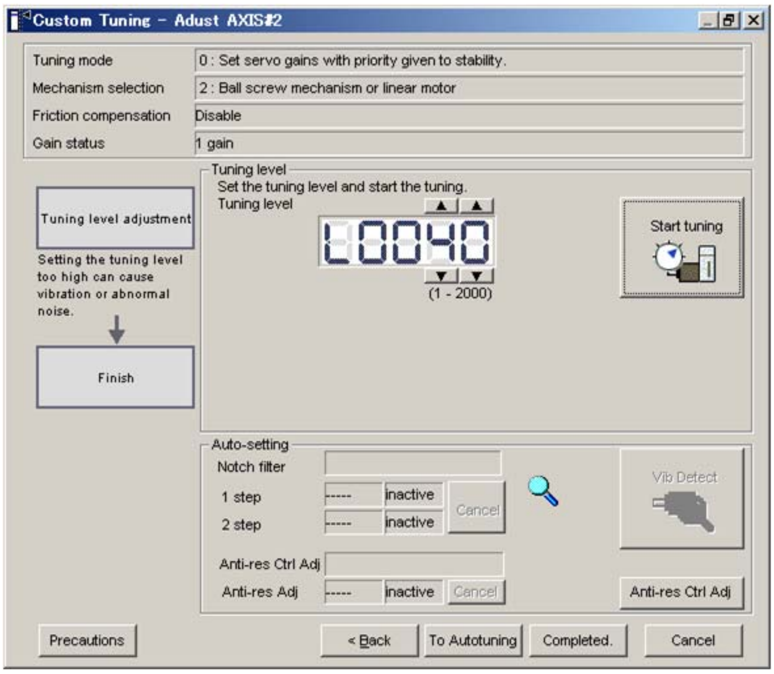
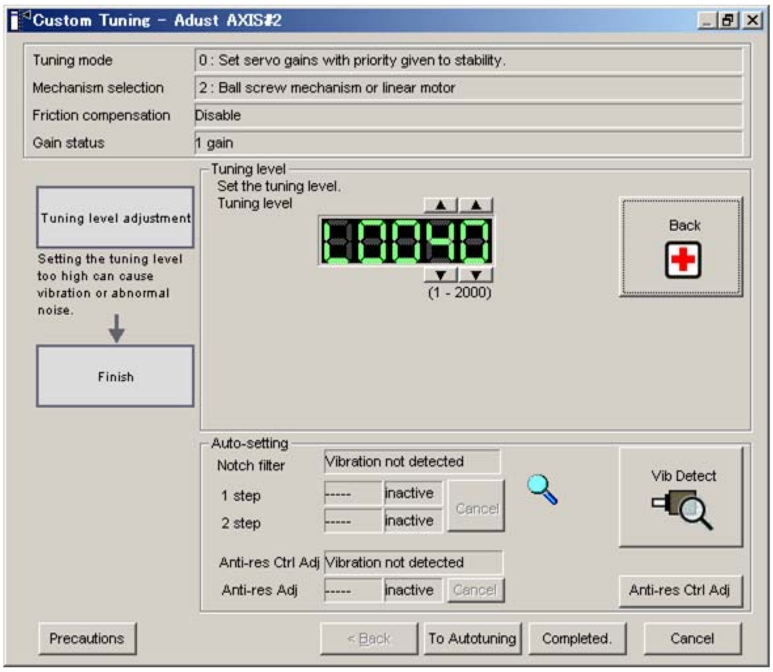
7. Enter the correct moment of inertia ratio and then click **Next**.

The following window will appear.



8. Turn the servo on and then input the reference from the host controller. Click **Start tuning**.

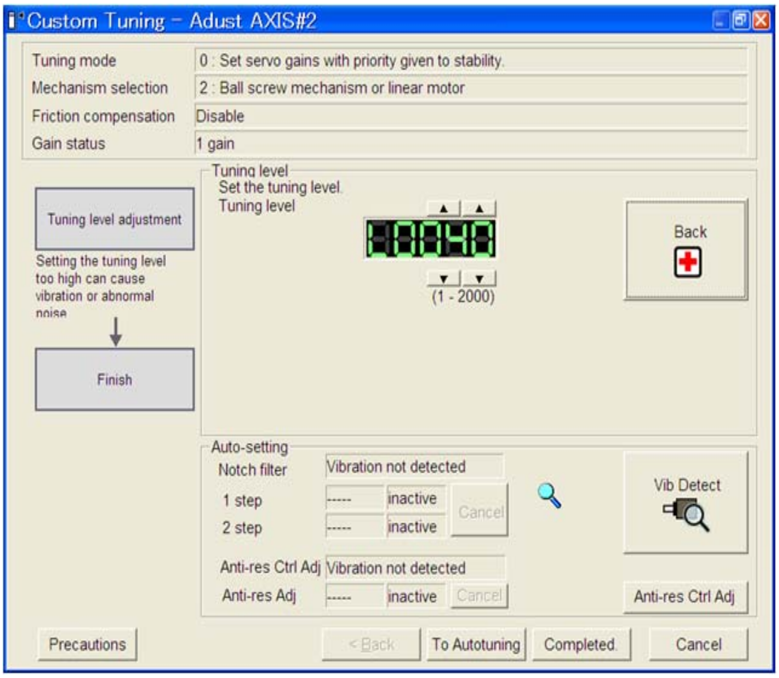


9. Change the tuning level by clicking the setting arrows. Continue to raise the level until an overshoot occurs.

Note:The set feedforward level will not be applied until the Positioning Completion signal is output.

The notch filter/anti-resonance control auto setting function, the anti-resonance control adjustment function, or autotuning by reference can be used as required.
See ■ *Functions To Suppress Vibration* for details.

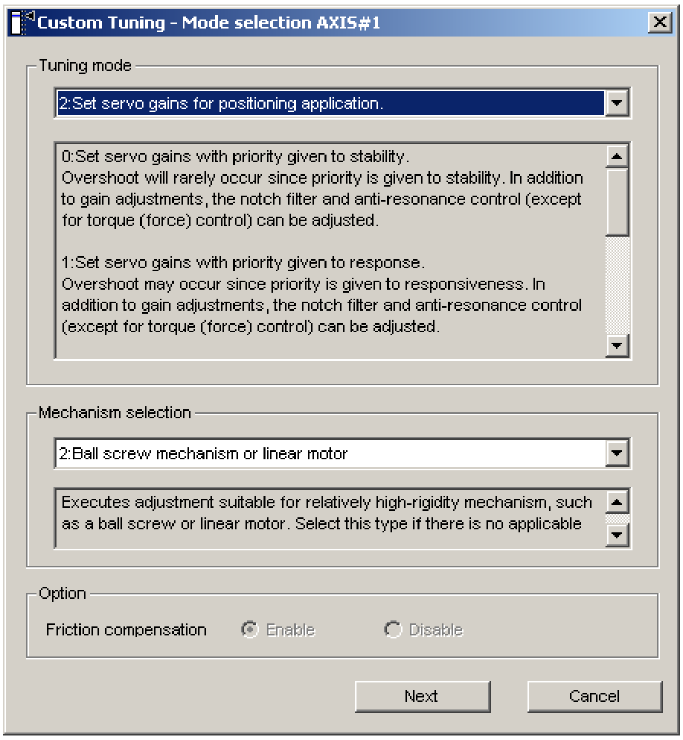
To reset to the original settings and status, click **Back**.



10. When tuning is complete, click **Completed** to return to the main window.
The settings will be written in the SERVOPACK.

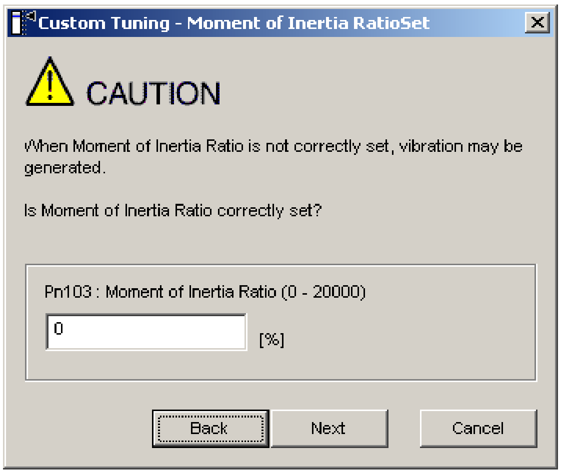
Use the following procedure to execute custom tuning when the tuning mode is set to 2 (set servo gains with priority given to positioning application).

1. Click **Advanced adjustment** in the Tuning main window, and then click **Custom tuning** in the Tuning box that will appear.
   The Custom Tuning - Mode selection box will appear.



   The tuning modes that can be selected will vary according to the SERVOPACK setting.

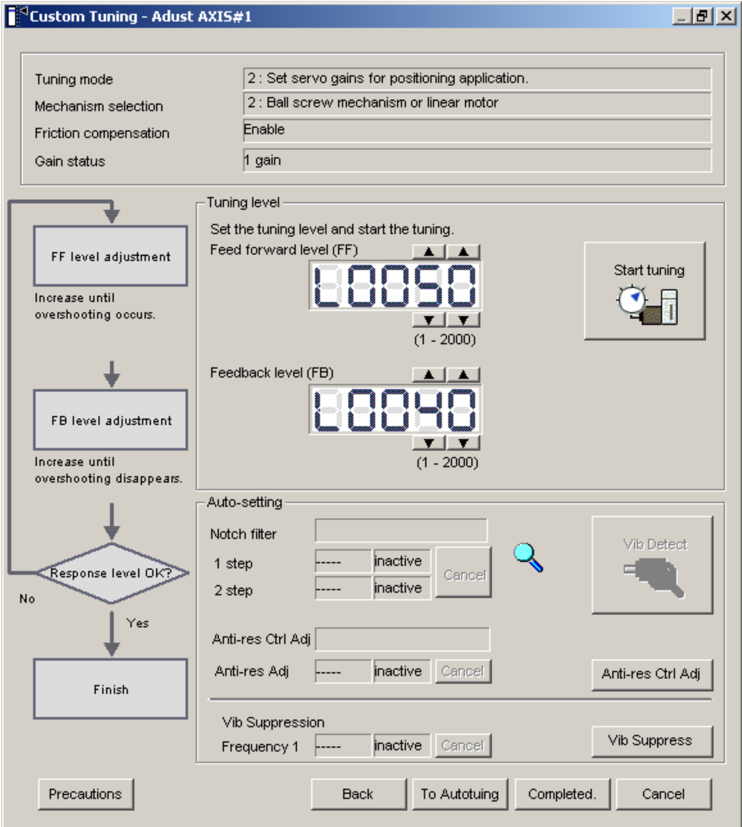
2. Select the tuning mode from the **Tuning mode** box and the mechanism from the **Mechanism selection** box, and then click **Next**.
   The **Friction compensation** option is available only when the tuning mode is set to 0 or 1.
   The Custom Tuning - Moment of Inertia Ratio Set box will appear.



   Enter the correct moment of inertia ratio.

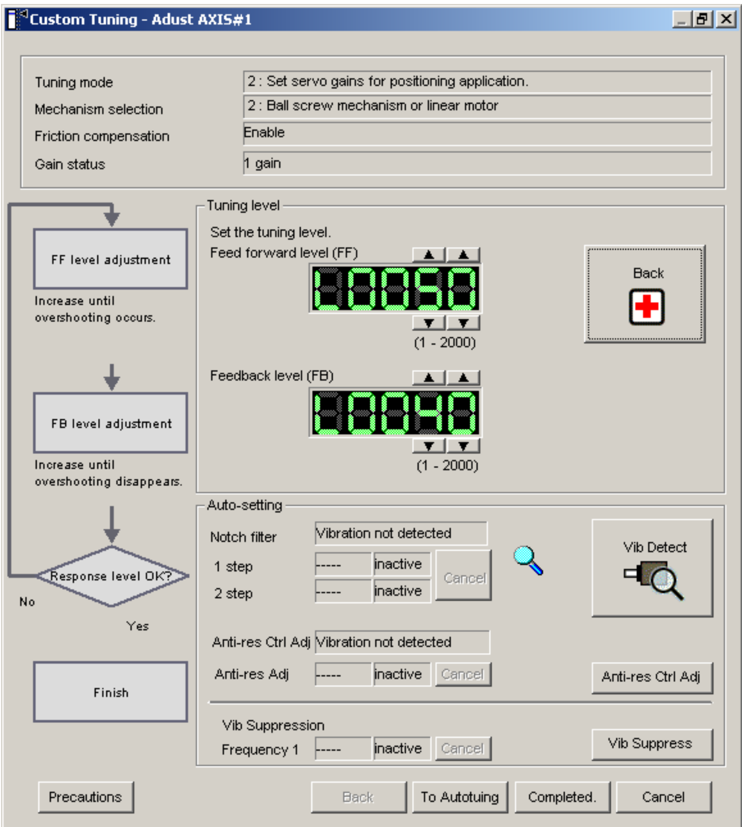
3. Click **Next**.

The Custom Tuning - Adjust box will appear.



4. Turn the servo on and input the reference from the host controller.

Then, click **Start tuning** to begin tuning.



Adjustments

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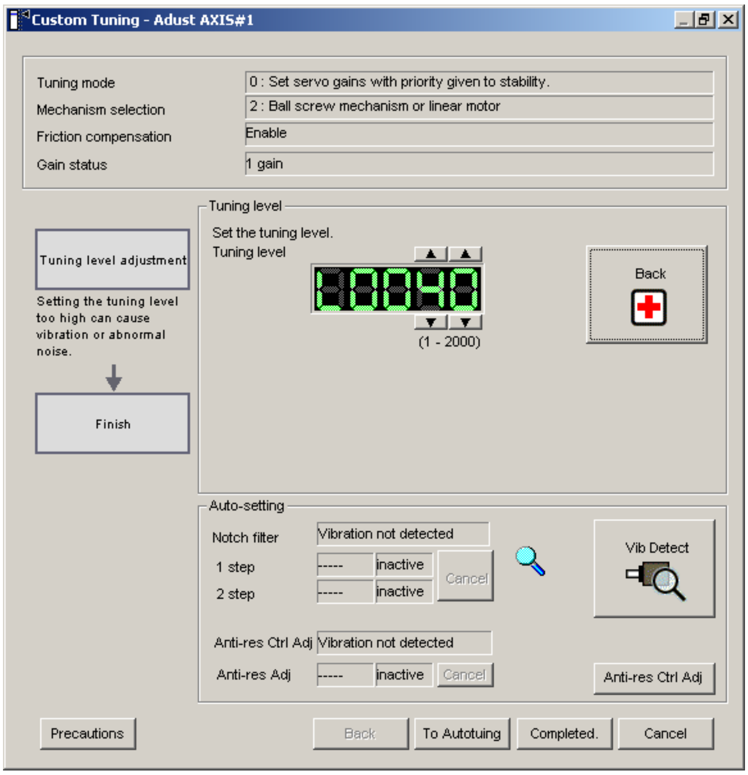
5. Change the feed forward level by clicking the setting arrows.

Continue to raise the level until an overshoot occurs.

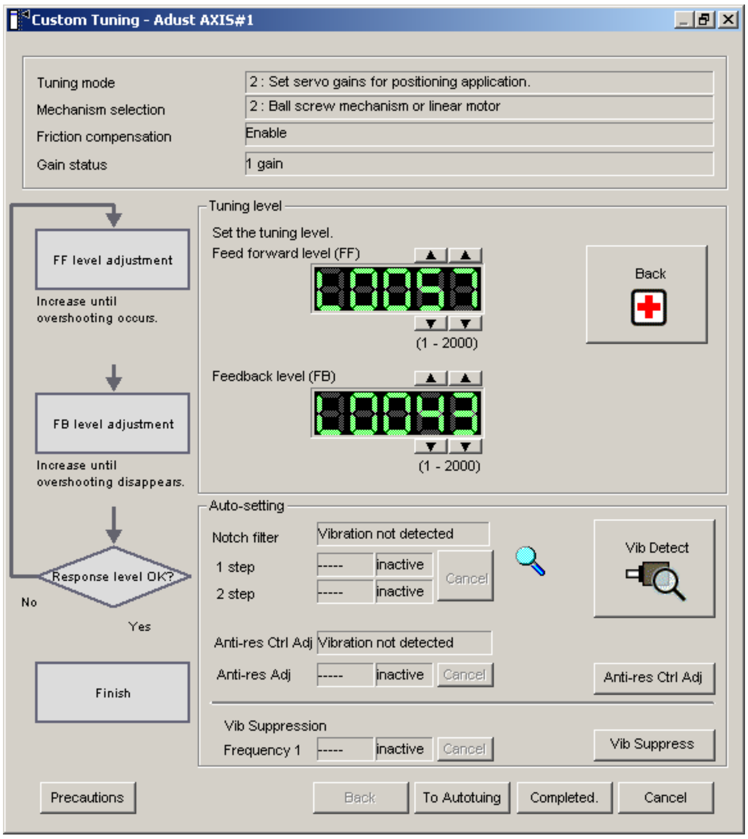
<Supplemental Information>

1. The feed forward level is not applied until the positioning completed signal is output.
2. When the tuning mode is set to 0 or 1, change the tuning level by clicking the setting arrows. After you change the tuning level, proceed to step 7.



6. Change the feedback level by clicking the setting arrows.

Continue to raise the level until no overshoot occurs



7. Repeat steps 5 and 6 to continue tuning.

Supplemental Information

1. The notch filter/anti-resonance control auto setting function, the anti-resonance control adjustment function, the vibration suppression function, or autotuning by reference can be used as required.
2. To reset to the original settings and status, click **Back**.

8. When tuning is complete, click **Completed**.

The settings will be written in the SERVOPACK.

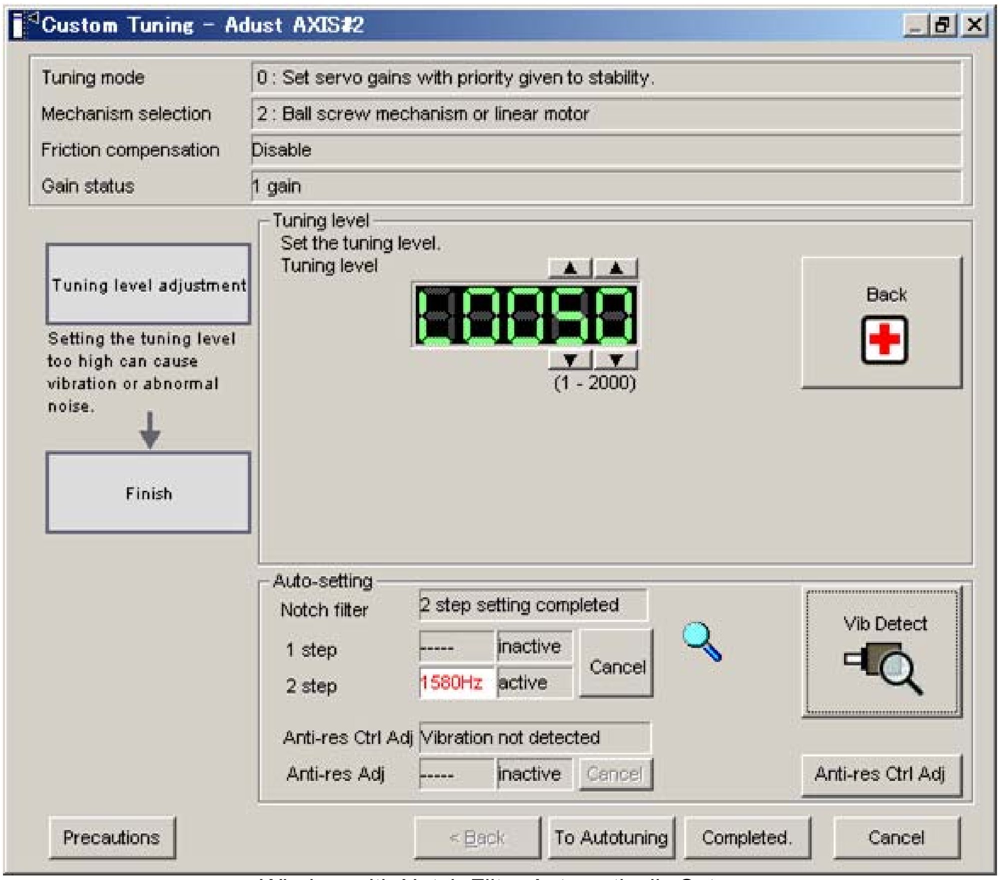
■ Functions To Suppress Vibration

- Notch Filter/Anti-resonance Control Adjustment Auto Setting Function

For vibration frequencies above 1,000 Hz when servo gains are increased, the notch filter auto setting function provides effective suppression. For vibration frequencies between 100 and 1,000 Hz, the anti-resonance control adjustment auto setting function is effective.

- Auto Setting

To use auto setting, enable the notch filter/anti-resonance control adjustment auto setting function by using parameters.
During tuning, the notch filter frequency (anti-resonance control frequency for the anti-resonance control adjustment auto setting function) effective for the detected vibration is automatically set and displayed in **1 step** or **2 step** (in **Anti-res Adj** when using the anti-resonance control adjustment auto setting function).



Window with Notch Filter Automatically Set

- Cancel
  If the automatically set notch filter frequency (or anti-resonance control frequency) does not effectively suppress vibration, click **Cancel** to reset to the preceding frequency.
  When the frequency is reset, vibration detection will restart.
- Vib Detect (vibration detection)
  While the notch filter/anti-resonance control adjustment auto setting function is enabled, click **Vib Detect** (vibration detection) to manually detect vibration. The SERVOPACK detects vibration at the moment **Vib Detect** (vibration detection) is clicked, and the notch filter frequency (or anti-resonance control frequency) effective for the detected vibration is set and displayed in **1 step** or **2 step** (or in **Anti-res Adj**). Manual vibration detection can also be executed when the SERVOPACK does not detect vibration.
- Anti-res Ctrl Adj (anti-resonance control)
  Click **Anti-res Ctrl Adj** (anti-resonance control) to execute the anti-resonance control function if further adjustment is required. See *8.6 Anti-Resonance Control Adjustment Function* for details.

- Autotuning by Reference

Click **To Autotuning** to execute autotuning using reference inputs from the host controller. Refer to *8.4 Advanced Autotuning by Reference* for details.

(2) Related Functions on One-parameter Tuning

This section describes functions related to one-parameter tuning.

■ Notch Filter

Usually, set this function to Auto Setting. (The notch filter is factory-set to Auto Setting.)

When you set this function to Auto Setting, vibration will be automatically detected during custom tuning with a host reference and the notch filter will be adjusted.

Set this function to Not Auto Setting only if you do not change the notch filter setting before executing one-parameter tuning

Parameter		Function	When Enabled	Classification
Pn460	n.□□□0	Does not set the 1st notch filter automatically with the utility function.	Immediately	Tuning
	n.□□□1 [Factory setting]	Sets the 1st notch filter automatically with the utility function.		
	n.□0□□	Does not set the 2nd notch filter automatically with the utility function.		
	n.□1□□ [Factory setting]	Sets the 2nd notch filter automatically with the utility function.		

■ Anti-Resonance Control Adjustment

This function reduces low vibration frequency, which the notch filter does not detect.

Usually, set this function to Auto Setting. (The anti-resonance control is factory-set to Auto Setting.)
When you set this function to Auto Setting, vibration will be automatically detected during custom tuning and anti-resonance control will be automatically adjusted and set.

Parameter		Function	When Enabled	Classification
Pn160	n.□□0□	Does not use the anti-resonance control automatically with the utility function.	Immediately	Tuning
	n.□□1□ [Factory setting]	Uses the anti-resonance control automatically with the utility function.		

■ Friction Compensation

This function compensates for changes in the following conditions.

- Changes in the viscous resistance of the lubricant, such as the grease, on the sliding parts of the machine
- Changes in the friction resistance resulting from variations in the machine assembly
- Changes in the friction resistance due to aging

Conditions to which friction compensation is applicable depend on the tuning mode.

Tuning Mode Setting	Set to 0.	Set to 1.	Set to 2.*1	Set to 3.*1
Friction Compensation	According to Pn408.3.*2		Adjusted with the friction compensation function.	

* 1. The friction compensation function is always enabled regardless of the friction compensation setting in Pn408.3.
* 2. For details on Pn408.3, refer to *8.8.2 (1) Required Parameter Settings*.

■ Feedforward

If Model Following Control Related Switch (Pn140) is set to the factory setting and the tuning mode is set to 2 or 3 when custom tuning is executed, the feedforward gain (PnAC8), speed feedforward (VFF) input, and torque feedforward (TFF) input will be disabled.

Set Pn140.3 to 1 if model following control is used together with the speed feedforward (VFF) input and torque feedforward (TFF) input from the host controller.

Parameter		Function	When Enabled	Classification
Pn140	n.0□□□ [Factory setting]	Model following control is not used together with the speed/torque feedforward input.	Immediately	Tuning
	n.1□□□	Model following control is used together with the speed/torque feedforward input.		

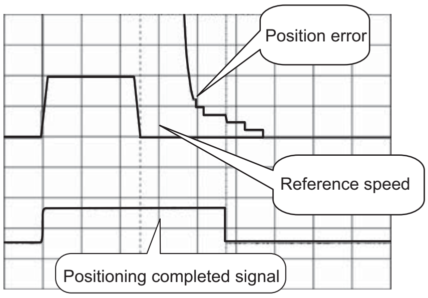
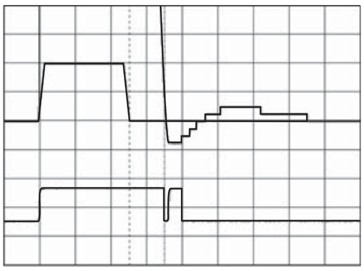
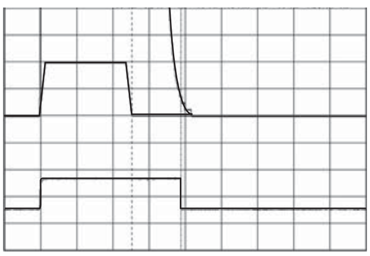
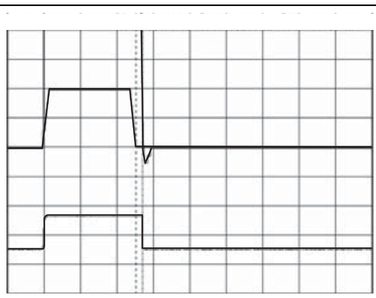
Refer to the *Σ-V-MD Series User's Manual MECHATROLINK-III Standard Servo Profile Commands* (Manual No.: SIEP S800001 03) for information on the speed feedforward (VFF) input and torque feedforward (TFF) input.

IMPORTANT

- Model following control is used to make optimum feedforward settings in the SERVOPACK when model following control is used with the feedforward function. Therefore, model following control is not normally used together with either the speed feedforward (VFF) input or torque feedforward (TFF) input from the host controller. However, model following control can be used with the speed feedforward (VFF) input or torque feedforward (TFF) input if required. An improper feedforward input may result in overshooting.

8.5.3 One-parameter Tuning Example

This section provides a tuning example when the tuning mode is set to 2 or 3. This mode is used to reduce positioning time.

Step	Measuring Instrument Display Example	Operation
1		Measure the positioning time after setting the moment of inertia ratio (Pn103) correctly. Tuning will be completed if the specifications are met here. The tuning results will be saved in the SERVOPACK.
2		The positioning time will become shorter if the FF level is increased. The tuning will be completed if the specifications are met. The tuning results will be saved in the SERVOPACK. If overshooting occurs before the specifications are met, go to step 3.
3		Overshooting will be reduced if the FB level is increased. If the overshooting is eliminated, go to step 4.
4		The graph shows overshooting generated with the FF level increased after step 3. In this state, the overshooting occurs, but the positioning settling time is shorter. The tuning will be completed if the specifications are met. The adjustment results are saved in the SERVOPACK. If overshooting occurs before the specifications are met, repeat steps 3 and 4. If vibration occurs before the overshooting is eliminated, the vibration will be suppressed by the automatic notch filter and anti-resonance control.
5		The adjustment results are saved in the SERVOPACK.

8.5.4 Related Parameters

The following parameters are either referenced or automatically changed during execution of one-parameter tuning.

Do not change the settings of these parameters from the SigmaWin+ during execution of one-parameter tuning.

Parameter	Name	Automatic changes
PnAC2	Speed Loop Gain	Yes
PnAC4	Speed Loop Integral Time Constant	Yes
PnAC6	Position Loop Gain	Yes
Pn103	Moment of Inertia Ratio	No
Pn121	Friction Compensation Gain	Yes
Pn123	Friction Compensation Coefficient	Yes
Pn124	Friction Compensation Frequency Correction	No
Pn125	Friction Compensation Gain Correction	Yes
Pn401	Torque Reference Filter Time Constant	Yes
Pn408	Torque Related Function Switch	Yes
Pn409	1st Notch Filter Frequency	Yes
Pn40A	1st Notch Filter Q Value	Yes
Pn40C	2nd Notch Filter Frequency	Yes
Pn40D	2nd Notch Filter Q Value	Yes
Pn140	Model Following Control Related Switch	Yes
Pn141	Model Following Control Gain	Yes
Pn142	Model Following Control Gain Compensation	Yes
Pn143	Model Following Control Bias (Forward Direction)	Yes
Pn144	Model Following Control Bias (Reverse Direction)	Yes
Pn145	Vibration Suppression 1 Frequency A	No
Pn146	Vibration Suppression 1 Frequency B	No
Pn147	Model Following Control Speed Feedforward Compensation	Yes
Pn160	Anti-Resonance Control Related Switch	Yes
Pn161	Anti-Resonance Frequency	Yes
Pn163	Anti-Resonance Damping Gain	Yes

8.6 Anti-Resonance Control Adjustment Function

This section describes the anti-resonance control adjustment function.

8.6.1 Anti-Resonance Control Adjustment Function

The anti-resonance control adjustment function increases the effectiveness of the vibration suppression after one-parameter tuning. This function is effective in supporting anti-resonance control adjustment if the vibration frequencies are from 100 to 1000 Hz.

This function rarely needs to be used because it is automatically set by the advanced autotuning or advanced autotuning by reference input. Use this function only if fine-tuning is required, or vibration detection is failed and readjustment is required.

Perform one-parameter tuning or use another method to improve the response characteristics after performing this function. If the anti-resonance gain is increased with one-parameter tuning performed, vibration may result again. If that occurs, perform this function again to fine-tune the settings.

⚠ CAUTION

- If this function is executed, related parameters will be set automatically. Therefore, there will be a large response change after this function is executed. Enable the function in a state where the machine can come to an emergency stop at any time to ensure the safety operation of the machine.
- Be sure to set a suitable value for the moment of inertia ratio (Pn103) using advanced autotuning before executing the anti-resonance control adjustment function. If the setting greatly differs from the actual moment of inertia ratio, normal control of the machine may not be possible, and vibration may result.

IMPORTANT

- This function detects vibration between 100 and 1000 Hz. Vibration will not be detected for frequencies outside of this range, and instead, "F----" will be displayed. If that occurs, use custom tuning with tuning mode 2 to automatically set a notch filter or use the vibration suppression function.
- Vibration can be reduced more effectively by increasing the anti-resonance damping gain (Pn163). The amplitude of vibration may become larger if the damping gain is excessively high. Increase the damping gain from about 0% to 200% in 10% increments while checking the effect of vibration reduction. If the effect of vibration reduction is still insufficient at a gain of 200%, cancel the setting, and lower the control gain using a different method, such as one-parameter tuning.

■ Before Performing Anti-Resonance Control Adjustment Function

The following conditions must be met to perform anti-resonance control adjustment function.

- The tuning-less function must be disabled (Pn170.0 = 0).
- The control must not be set to torque control.
- The write prohibited setting parameter must be set to Write permitted.

8.6.2 Anti-Resonance Control Adjustment Function Operating Procedure

With this function, an operation reference is sent, and the function is executed while vibration is occurring.

The SigmaWin+ is required to execute this function.
The following methods can be used for the anti-resonance control adjustment function.

- With undetermined vibration frequency
- With determined vibration frequency

The following describes the operating procedures.

⚠ CAUTION

Be sure to carefully read the SigmaWin+ Operation Manual before executing this function.
Special care must be taken for the following.

- Before executing this function, make sure that the emergency stop (power off) can be activated when needed.
  This function will automatically set parameters when used. As a result, the response speeds may change considerably after execution. Before executing this function, make sure that the emergency stop (power off) can be activated when needed.
- The moment of inertia (mass) must be correctly set to execute this function.
  If it is not correctly set, satisfactory anti-resonance control cannot be achieved.
- If the frequency is changed while the anti-resonance control adjustment function is being used, the current anti-resonance control effect will be lost. Care must be taken when automatic frequency detection is executed in Auto Detect mode.
- If vibration cannot be suppressed by executing this function, cancel execution and reduce the servo gain by other methods such as custom tuning.
- Use an adjustment method such as custom tuning to improve response characteristics after executing this function.
  When the servo gain is increased during an adjustment such as custom tuning, vibration may be generated again. In this case, execute the anti-resonance control adjustment function again for fine adjustment.

The anti-resonance control adjustment function supports the adjustment of anti-resonance control effective for vibration frequencies from 100 to 1,000 Hz when servo gain is increased. Vibration can be suppressed by setting vibration frequency by auto detection or by manual setting to adjust damping gain. Input a reference and execute this function when there is vibration.

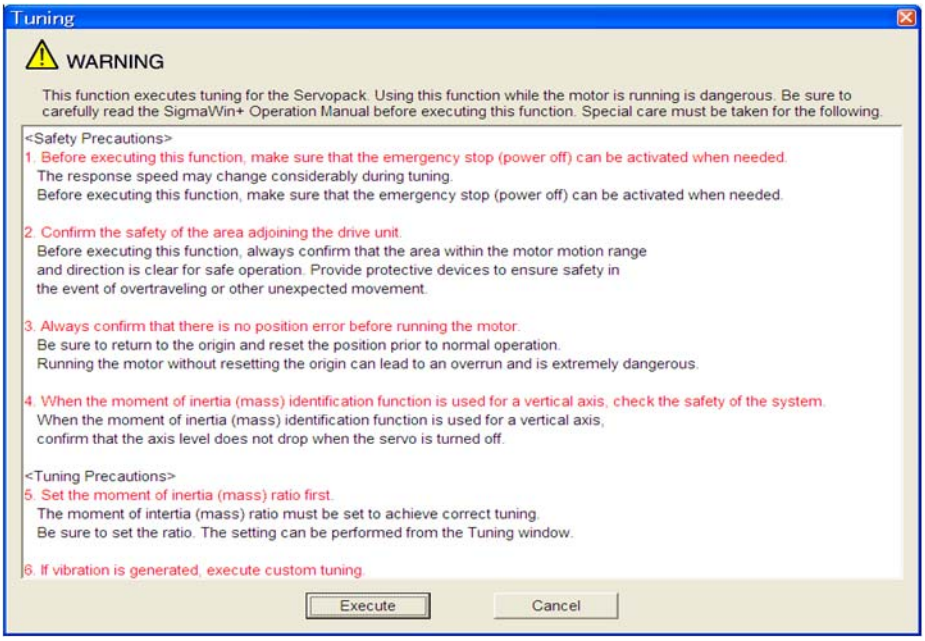
(1) With Undetermined Vibration Frequency

1. In the SigmaWin+ main window, click **Tuning** - **Tuning**.

Supplemental Information

If you are using more than one axis, the Axis Selection Dialog Box is displayed. Follow the instructions in the Axis Selection Dialog Box to select the axis to adjust before you continue.

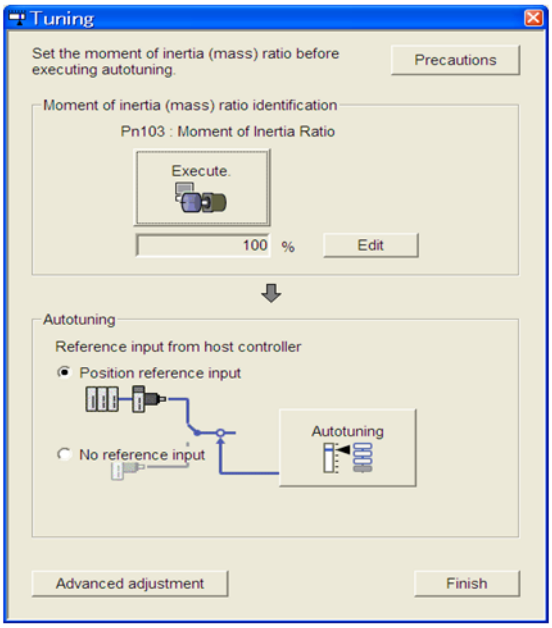
The following window will appear.



In the SigmaWin+ main window, click **Tuning** - **Tuning**.

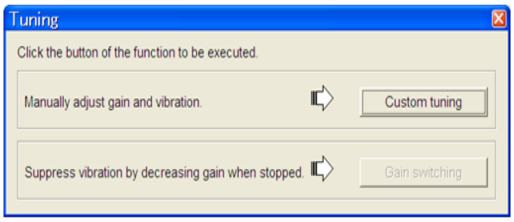
2. Click **Execute**.

The following window will appear.



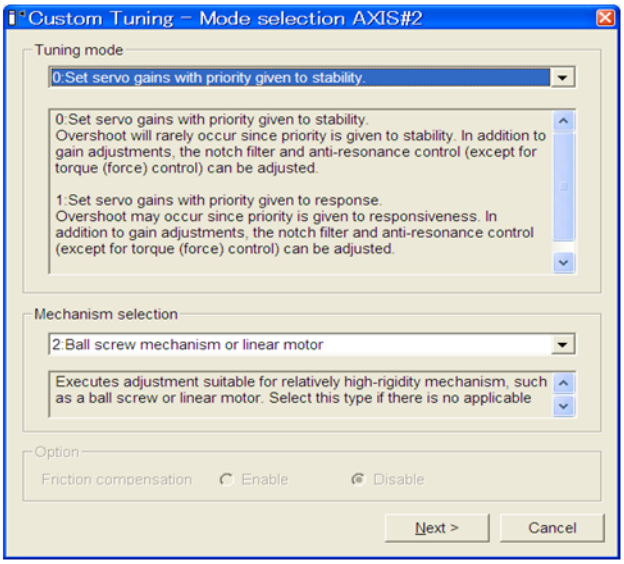
3. Click **Advanced adjustment**.

The following box will appear



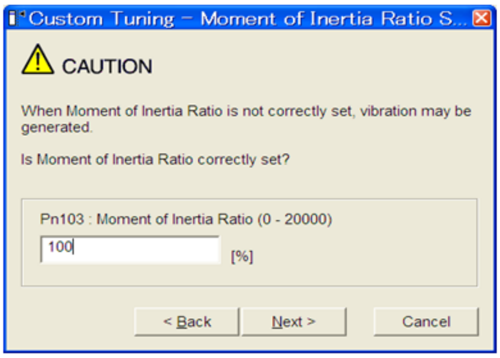
4. Click **Custom tuning**.

The following box will appear.



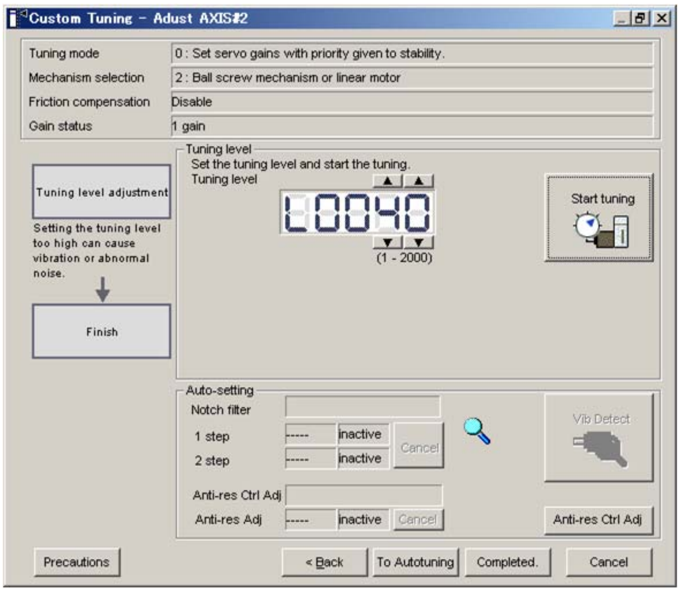
5. Select the tuning mode from the **Tuning mode** box and the mechanism from the **Mechanism selection** box, and then click **Next**.

The following box will appear.



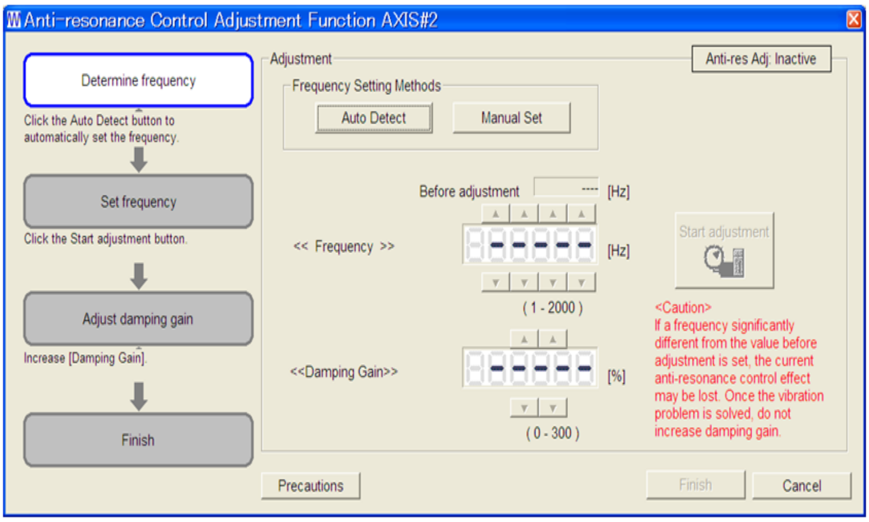
6. Enter the correct moment of inertia ratio and then click **Next**.

The following window will appear.



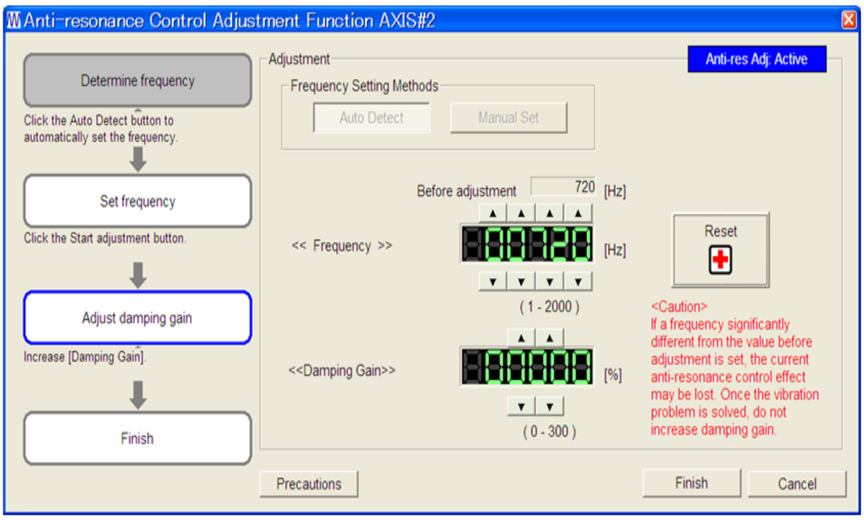
7. Click **Anti-res Ctrl Adj**.

The following window will appear.

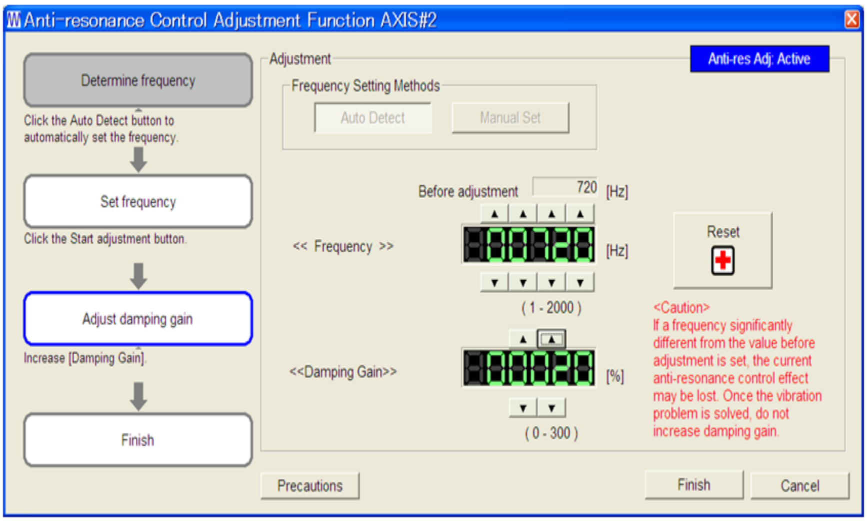


8. Click **Auto Detect** to set the frequency and click **Start adjustment**.

The following window will appear.



9. Adjust the damping gain by clicking the setting arrows.



Click **Reset** to reset the settings to their original values during adjustment.

10. When the adjustment is complete, click **Finish** to return to the main window.

The set values will be written in the SERVOPACK.

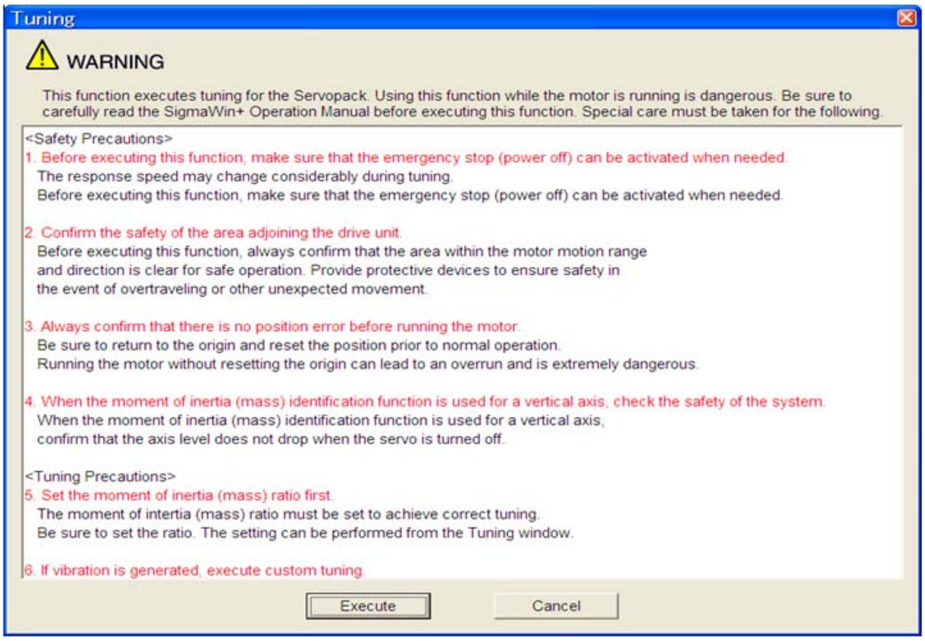
(2) With Determined Vibration Frequency

1. In the SigmaWin+ main window, click **Tuning** - **Tuning**.

Supplemental Information

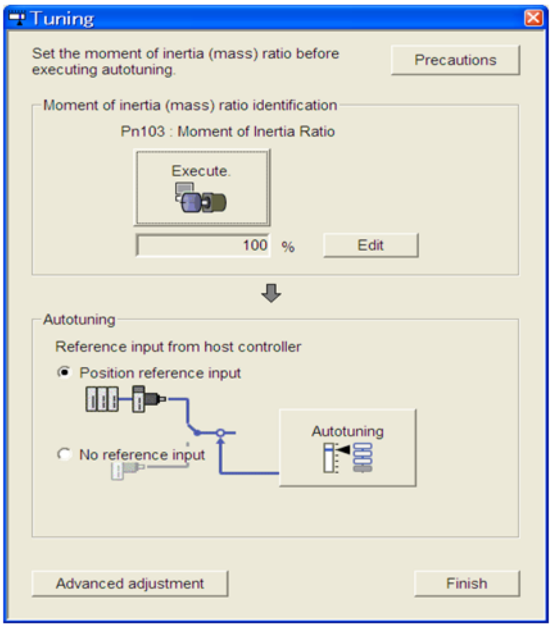
If you are using more than one axis, the Axis Selection Dialog Box is displayed. Follow the instructions in the Axis Selection Dialog Box to select the axis to adjust before you continue.

The following window will appear.

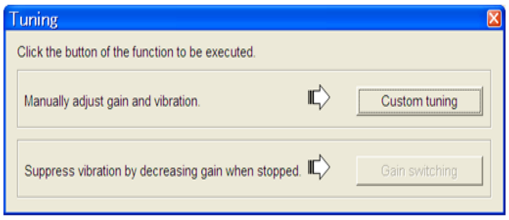


Click **Cancel** to return to the SigmaWin+ main window without executing tuning.

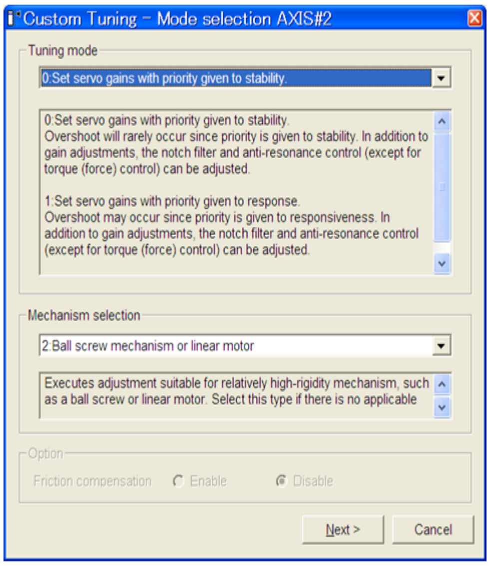
2. Click **Execute**.
The following window will appear.



3. Click **Advanced adjustment**.
The following box will appear.



4. Click **Custom tuning**.
The following box will appear.



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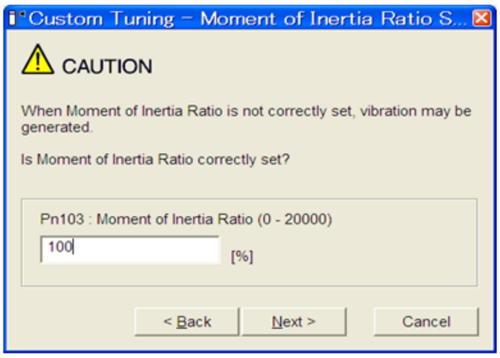
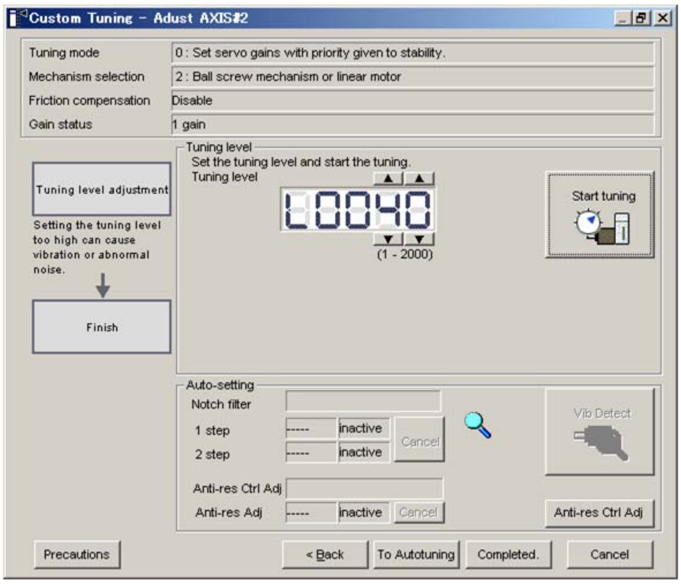
5. Select the tuning mode from the **Tuning mode** box and the mechanism from the **Mechanism selection** box, and then click **Next**.

The following box will appear.



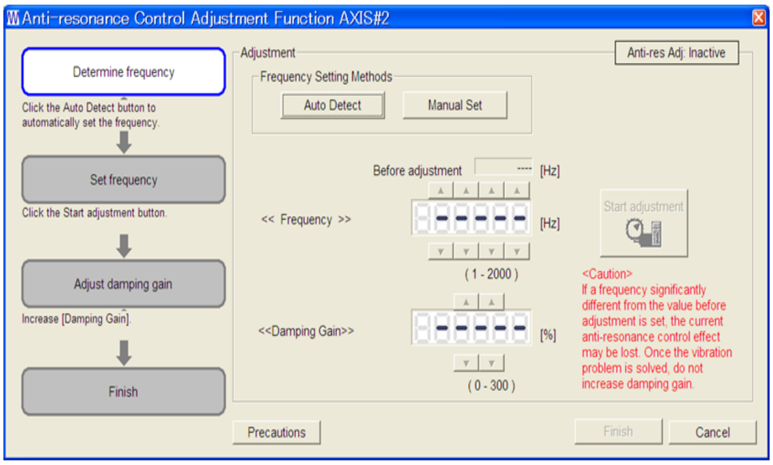
6. Enter the correct moment of inertia ratio and then click **Next**.

The following window will appear



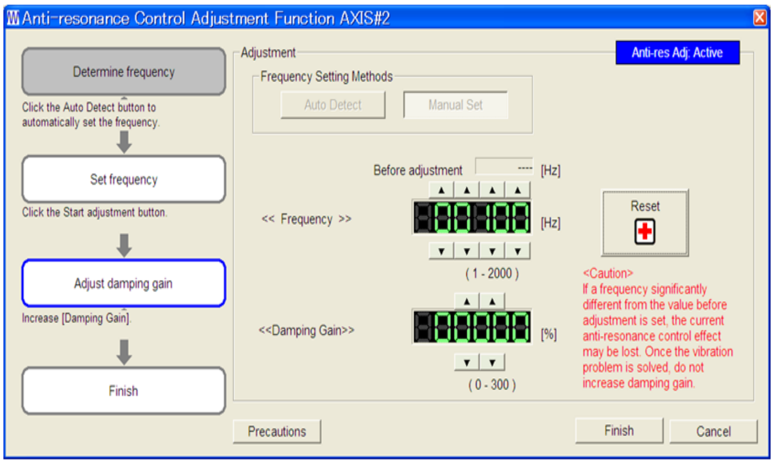
7. Click **Anti-res Ctrl Adj**.

The following window will appear.



8. Click **Manual Set** to set the frequency and click **Start adjustment**.

The following window will appear.



9. Adjust the frequency by clicking the setting arrows.

Click **Reset** to reset the settings to their original values during adjustment.

10. Adjust the damping gain by clicking the setting arrows.

Click **Reset** to reset the settings to their original values during adjustment.

11. When the adjustment is complete, click **Finish** to return to the main window.

The set values will be written in the SERVOPACK.

8.6.3 Related Parameters

The following parameters are either referenced or automatically changed during execution of the anti-resonance control adjustment function.

Do not change the settings of these parameters from the SigmaWin+ during execution of the anti-resonance control adjustment function.

Parameter	Name
Pn160	Anti-Resonance Control Related Switch
Pn161	Anti-Resonance Frequency
Pn163	Anti-Resonance Damping Gain

8.7 Vibration Suppression Function

The vibration suppression function is described in this section.

8.7.1 Vibration Suppression Function

The vibration suppression function suppresses transitional vibration at frequency as low as 1 to 100 Hz that is generated mainly when positioning if the machine stand vibrates. This function is effective for vibration frequencies for which notch filter and anti-resonance control adjustment functions are not applicable.

This function is set automatically when advanced autotuning or advanced autotuning by reference is executed. In most cases, this function is not necessary. Use this function only if fine-tuning is required or readjustment is required as a result of a failure to detect vibration. Before executing this function, input an operation reference to create vibration.

Perform one-parameter tuning if required to improve the response characteristics after performing this function.

⚠ CAUTION

- If this function is executed, related parameters will be set automatically. Therefore, there will be a large response change after this function is enabled or disabled. Enable the function in a state where the machine can come to an emergency stop at any time to ensure the safety operation of the machine.
- If you change parameters during operation, the parameters will change after the completion of positioning.
- Be sure to set a suitable value for the moment of inertia ratio (Pn103) using advanced autotuning before executing the vibration suppression function. If the setting greatly differs from the actual moment of inertia ratio, normal control of the SERVOPACK may not be possible, and vibration may result.
- Phase control of the MP2000 Series may not be possible, if the vibration suppression function is performed when using the MP2000 Series with phase control.

IMPORTANT

- This function detects vibration frequency between 1 to 100 Hz. Vibration will not be detected for frequencies outside of this range, and instead, "F-----" will be displayed.
- Frequency detection will not be performed if no vibration results from position error or the vibration frequencies are outside the range of detectable frequencies. If so, use a device, such as a displacement sensor or vibration sensor, to measure the vibration frequency.
- If vibration frequencies automatically detected are not suppressed, the actual frequency and the detected frequency may differ. Fine-tune the detected frequency if necessary.

(1) Preparation

The following conditions must be met to perform the vibration suppression function.

- The control must be set to position control.
- The tuning-less function must be disabled (Pn170.0 = 0).
- The write prohibited setting parameter must be set to Write permitted.

(2) Items Influencing Performance

If continuous vibration occurs when the servomotor is not rotating, the vibration suppression function cannot be used to suppress the vibration effectively. If the result is not satisfactory, perform anti-resonance control adjustment function or one-parameter tuning.

(3) Detection of Vibration Frequencies

No frequency detection may be possible if the vibration does not appear as a position error or the vibration resulting from the position error is too small.

The detection sensitivity can be adjusted by changing the setting for the remained vibration detection width (Pn560) which is set as a percentage of the positioning completed width (PnACC). Perform the detection of vibration frequencies again after adjusting the remained vibration detection width (Pn560).

Pn560	Remained Vibration Detection Width			Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 3000	0.1%	400	Immediately	Setup

Note: As a guideline, change the setting 10% at a time. The smaller the set value is, the higher the detection sensitivity will be. If the value is too small, however, the vibration may not be detected accurately.

Supplemental Information

The vibration frequencies that are automatically detected may vary somewhat with each positioning operation. Perform positioning several times and make adjustments while checking the effect of vibration suppression.

8.7.2 Vibration Suppression Function Operating Procedure

The following procedure is used for vibration suppression function.

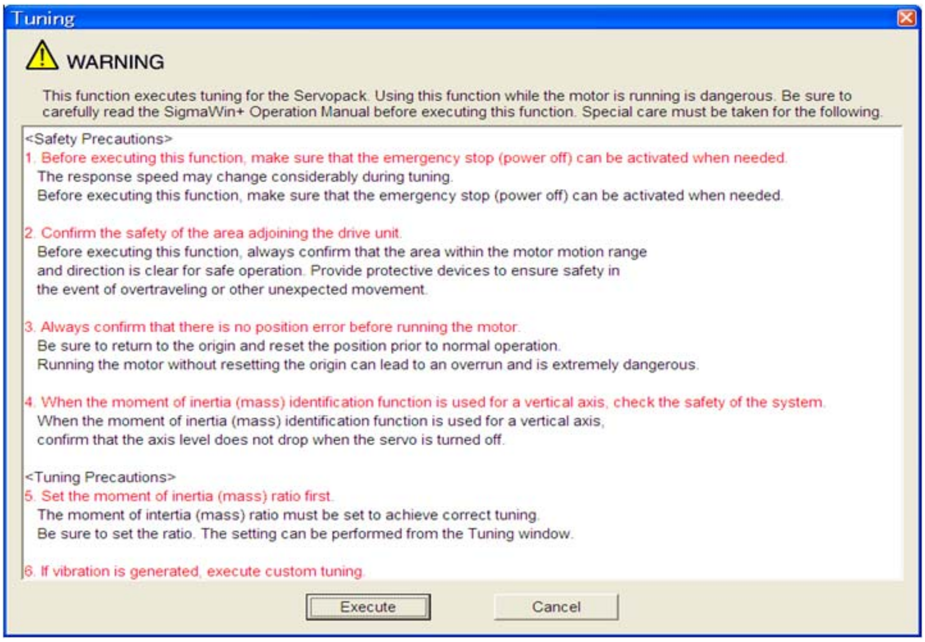
(1) Operating Procedure

1. In the SigmaWin+ main window, click **Tuning** - **Tuning**.

Supplemental Information

If you are using more than one axis, the Axis Selection Dialog Box is displayed. Follow the instructions in the Axis Selection Dialog Box to select the axis to adjust before you continue.

The following box will appear.



Click **Cancel** to return to the SigmaWin+ main window without executing tuning.

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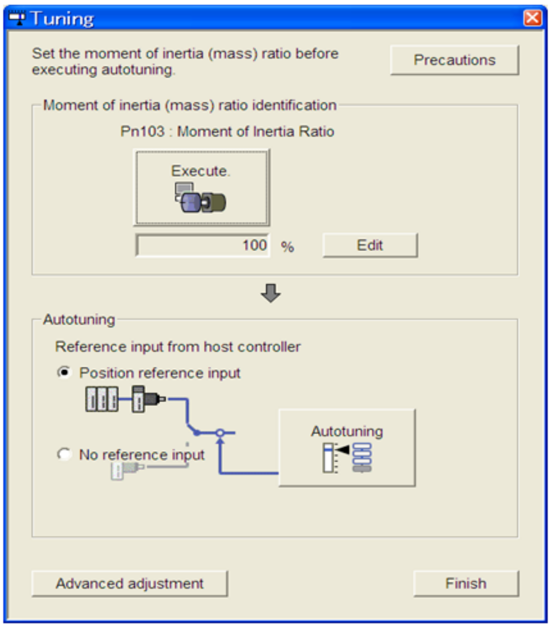
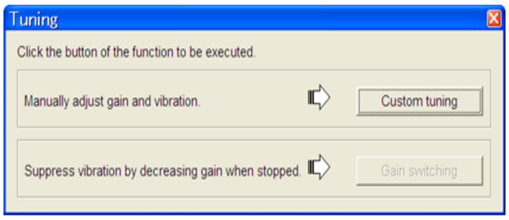
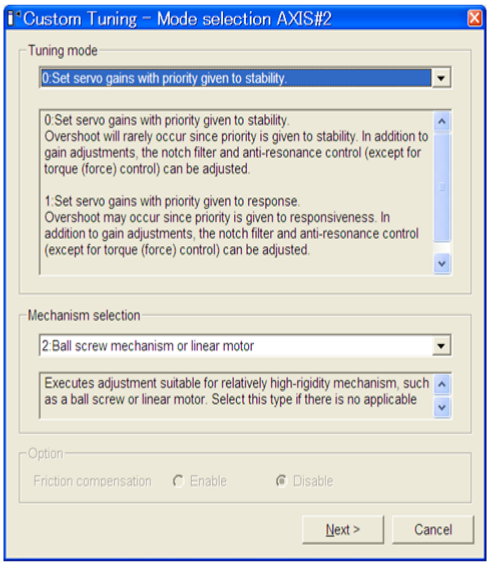
2. Click **Execute**.
The following window will appear.



3. Click **Advanced adjustment**.
The following box will appear.

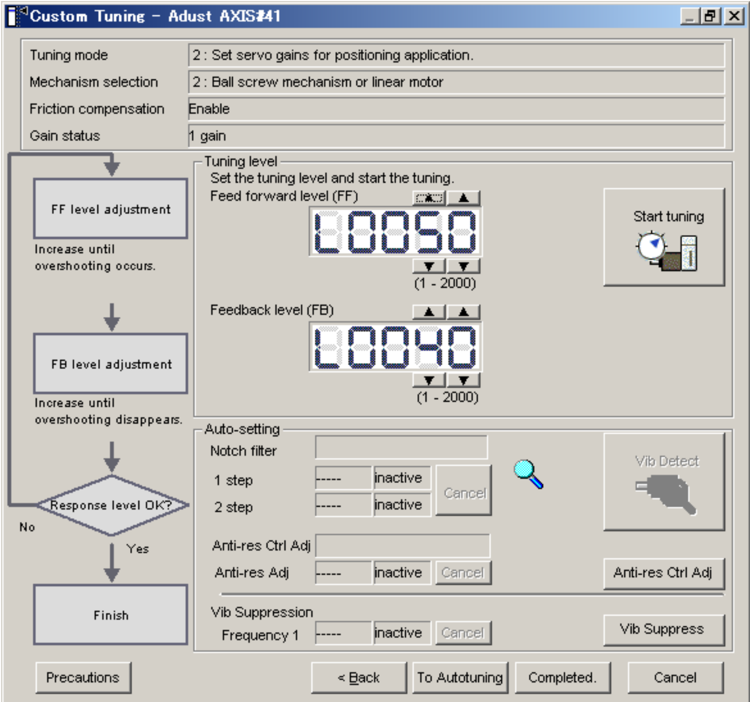


4. Click **Custom tuning**.
The following box will appear.



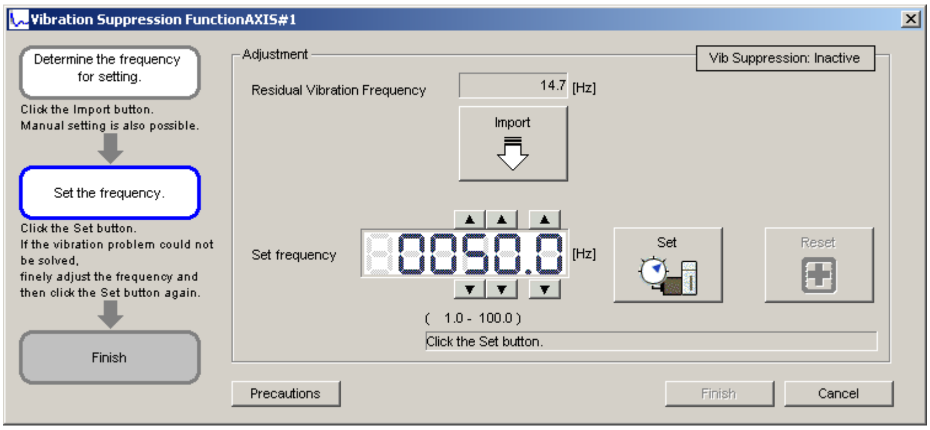
5. Select the **2** or **3** of tuning mode from the **Tuning mode** box and the mechanism from the **Mechanism selection** box, and then click **Next**.

The following box will appear.



6. Click **Vib Suppress**.

The **Vibration suppression Function** box will appear.



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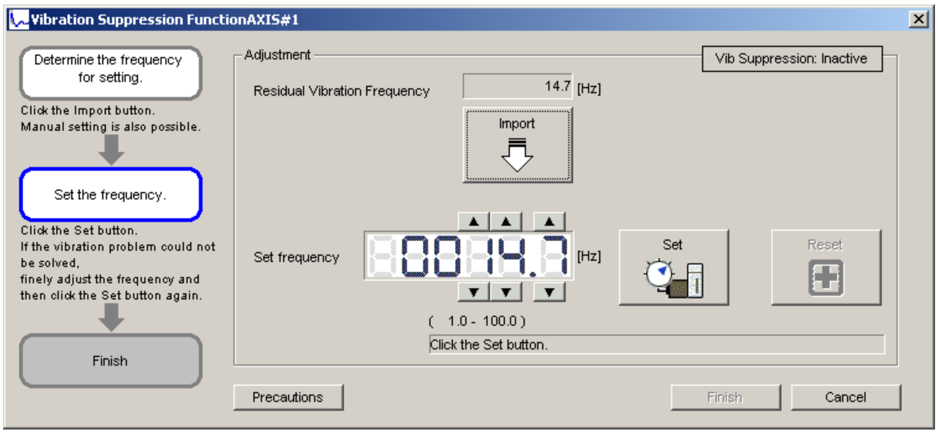
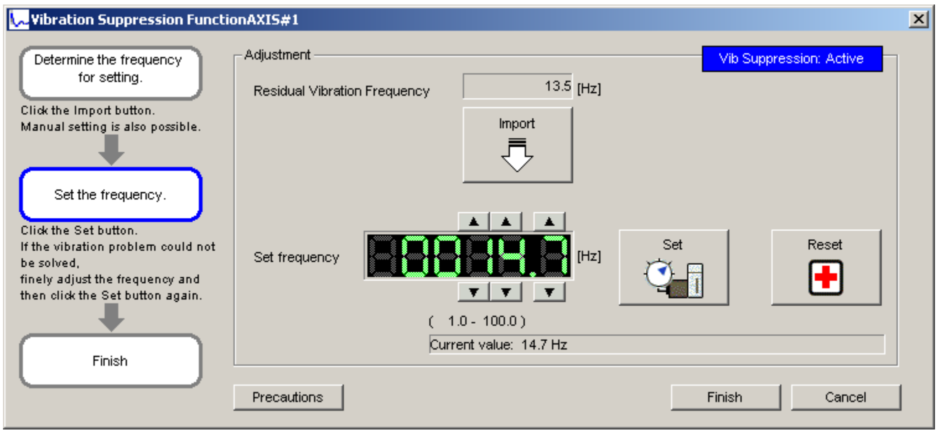
7. Set a frequency by using the **Import** function or by manually selecting the frequency.

Click **Import**. The value of the residual vibration frequency being monitored will be imported to the **Set frequency** box. This function, however, is effective only when the residual vibration frequency is between 1.0 and 100.0.

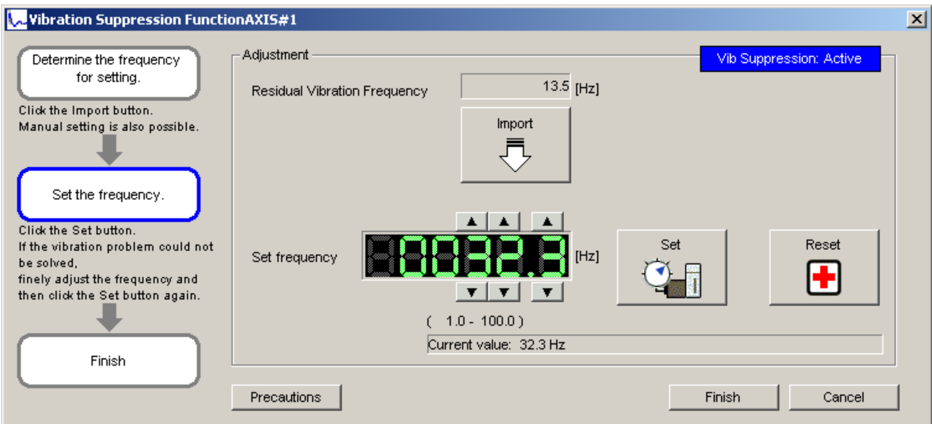
The **Set frequency** can be manually selected by clicking the setting arrows.



8. Click **Set**.



If any vibration still occurs, manually make fine adjustments to the **Set frequency**, and click **Set**.



If you need to undo the change you made while making adjustments, click **Reset**. The setting will be restored to the original value.

9. After the vibration has been successfully suppressed, click **Finish**.
The value of the **Set frequency** will be transferred to and saved in the SERVOPACK.

> **IMPORTANT**
>
> No settings related to the vibration suppression function will be changed during operation.
>
> If the servomotor does not stop approximately 10 seconds after the setting changes, a timeout error will result and the previous setting will be automatically enabled again.
>
> The vibration suppression function will be enabled in step 9. The motor response, however, will change when the servomotor comes to a stop with no reference input.

(2) Related Function on Vibration Suppression Function

This section describes functions related to vibration suppression function.

■ Feedforward

The feedforward gain (PnAC8), speed feedforward (VFF) input, and torque feedforward (TFF) input will be disabled in the factory setting.

Set Pn140.3 to 1 if model following control is used together with the speed feedforward (VFF) input and torque feedforward (TFF) input from the host controller

Parameter		Function	When Enabled	Classification
Pn140	n.0□□□ [Factory setting]	Model following control is not used together with the speed/torque feedforward input.	Immediately	Tuning
	n.1□□□	Model following control is used together with the speed/torque feedforward input.		

Refer to the *Σ-V-MD Series User's Manual MECHATROLINK-III Standard Servo Profile Commands* (Manual No.: SIEP S800001 03) for information on the speed feedforward (VFF) input and torque feedforward (TFF) input.

> **IMPORTANT**
>
> • Model following control is used to make optimum feedforward settings in the SERVOPACK when model following control is used with the feedforward function. Therefore, model following control is not normally used together with either the speed feedforward (VFF) input or torque feedforward (TFF) input from the host controller. However, model following control can be used with the speed feedforward (VFF) input or torque feedforward (TFF) input if required. An improper feedforward input may result in overshooting.

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8.7.3 Related Parameters

The following parameters are either referenced or automatically changed during execution of vibration suppression.

Do not change the settings of these parameters from the SigmaWin+ during execution of vibration suppression.

Parameter	Name	Automatic changes
Pn140	Model Following Control Related Switch	Yes
Pn141	Model Following Control Gain	Yes
Pn142	Model Following Control Gain Compensation	No
Pn143	Model Following Control Bias (Forward Direction)	No
Pn144	Model Following Control Bias (Reverse Direction)	No
Pn145	Vibration Suppression 1 Frequency A	Yes
Pn146	Vibration Suppression 1 Frequency A	Yes
Pn147	Model Following Control Speed Feedforward Compensation	No
Pn14A	Vibration Suppression 2 Frequency	No
Pn14B	Vibration Suppression 2 Compensation	No

8.8 Additional Adjustment Function

This section describes the functions that can be used for additional fine tuning after making adjustments with advanced autotuning, advanced autotuning by reference, or one-parameter tuning.

- Switching gain settings
- Friction compensation
- Current control mode selection
- Current gain level setting
- Speed detection method selection

8.8.1 Switching Gain Settings

Two gain switching functions are available, manual switching and automatic switching. The manual switching function uses an external input signal to switch gains, and the automatic switching function switches gains automatically.
By using the gain switching function, the positioning time can be shortened by increasing the gain during positioning and vibration can be suppressed by decreasing the gain while it is stopped.

Parameter		Function	When Enabled	Classification
Pn139	n.□□□0 [Factory setting]	Manual gain switching	Immediately	Tuning
	n.□□□2	Automatic gain switching		

Note: n.□□□1 is reserved. Do not use.

For the gain combinations for switching, refer to *(1) Gain Combinations for Switching*.
For the manual gain switching, refer to *(2) Manual Gain Switching*.
For the automatic gain switching, refer to *(3) Automatic Gain Switching*.

(1) Gain Combinations for Switching

Setting	Speed Loop Gain	Speed Loop Integral Time Constant	Position Loop Gain	Torque Reference Filter	Model Following Control Gain	Model Following Control Gain Compensation	Friction Compensation Gain
Gain Setting 1	PnAC2 Speed Loop Gain	PnAC4 Speed Loop Integral Time Constant	PnAC6 Position Loop Gain	Pn401 Torque Reference Filter Time Constant	Pn141* Model Following Control Gain	Pn142* Model Following Control Gain Compensation	Pn121 Friction Compensation Gain
Gain Setting 2	Pn104 2nd Speed Loop Gain	Pn105 2nd Speed Loop Integral Time Constant	Pn106 2nd Position Loop Gain	Pn412 1st Step 2nd Torque Reference Filter Time Constant	Pn148* 2nd Model Following Control Gain	Pn149* 2nd Model Following Control Gain Compensation	Pn122 2nd Gain for Friction Compensation

* The switching gain settings for the model following control gain and the model following control gain compensation are available only for manual gain switching. To enable the gain switching of these parameters, a gain switching input signal must be sent, and the following conditions must be met.
- No command being executed.
- Motor having been completely stopped.

If these conditions are not satisfied, the applicable parameters will not be switched although the other parameters shown in this table will be switched.

(2) Manual Gain Switching

Manual gain switching uses G-SEL of the servo command output signals (SVCMD_IO) to switch between gain setting 1 and gain setting 2.

Type	Command Name	Setting	Meaning
Input	G-SEL of the servo command output signals (SVCMD_IO)	0	Switches to gain setting 1.
		1	Switches to gain setting 2.

(3) Automatic Gain Switching

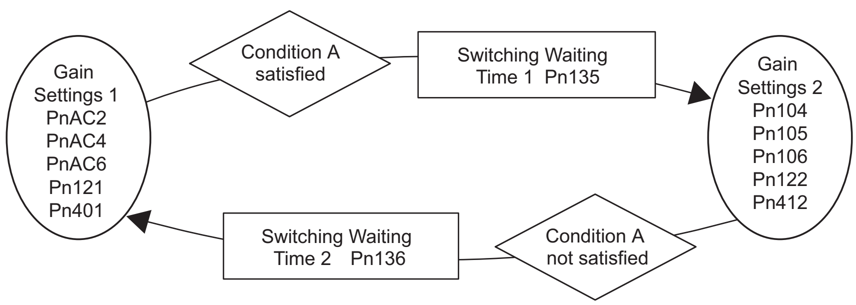
Automatic gain switching is enabled only in position control. The switching conditions are specified using the following settings.

Parameter Setting		Switching Condition	Setting	Switching Wait Time
Pn139	n.□□□2	Condition A satisfied.	Gain setting 1 to gain setting 2	Pn135 Gain Switching Waiting Time 1
		Condition A not satisfied.	Gain setting 2 to gain setting 1	Pn136 Gain Switching Waiting Time 2

Select one of the following settings for switching condition A

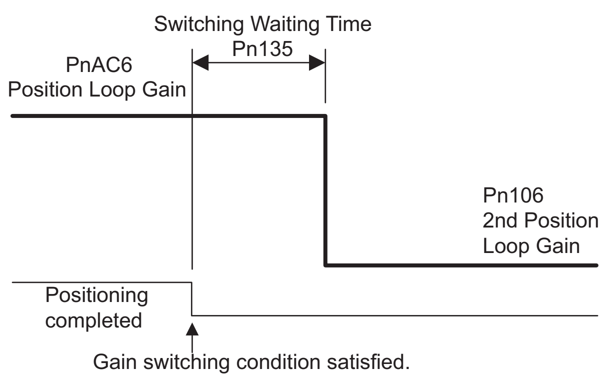
Parameter		Switching Condition A for Position Control	For Other than Position Control (No Switching)	When Enabled	Classification
Pn139	n.□□0□ [Factory setting]	Positioning completed signal ON	Fixed in gain setting 1	Tuning	Tuning
	n.□□1□	Positioning completed signal OFF	Fixed in gain setting 2		
	n.□□2□	Positioning near signal ON	Fixed in gain setting 1		
	n.□□3□	Positioning near signal OFF	Fixed in gain setting 2		
	n.□□4□	No output for position reference filter and position reference input OFF	Fixed in gain setting 1		
	n.□□5□	Position reference input ON	Fixed in gain setting 2		

Automatic switching pattern 1 (Pn139.0 = 2)



■ Gain Switching Waiting Time

In this example, the completion of positioning is set as the condition for automatic gain switching. The position loop gain is switched from the value in PnAC6 (position loop gain) to the value in Pn106 (2nd position loop gain). The switching condition is the completion of positioning, and the switching operation begins after the waiting time set in Pn135. The switching operation changes the position loop gain from PnAC6 to Pn106.



Note: Automatic gain switching is available in the PI and I-P controls (Pn10B).

(4) Related Parameters

PnAC2	Speed Loop Gain		Speed Position		Classification
	Factory Setting	Factory Setting	Factory Setting	When Enabled	
	10 to 20000	0.1 Hz	400	Immediately	Tuning
PnAC4	Speed Loop Integral Time Constant		Speed Position		Classification
	Factory Setting	Factory Setting	Factory Setting	When Enabled	
	15 to 51200	0.01 ms	2000	Immediately	Tuning
PnAC6	Position Loop Gain			Position	Classification
	Factory Setting	Factory Setting	Factory Setting	When Enabled	
	10 to 20000	0.1/s	400	Immediately	Tuning
Pn401	Torque Reference Filter Time Constant		Speed Position	Torque	Classification
	Factory Setting	Factory Setting	Factory Setting	When Enabled	
	0 to 65535	0.01 ms	100	Immediately	Tuning
Pn141	Model Following Control Gain			Position	Classification
	Factory Setting	Factory Setting	Factory Setting	When Enabled	
	10 to 20000	0.1/s	500	Immediately	Tuning
Pn142	Model Following Control Gain Compensation			Position	Classification
	Factory Setting	Factory Setting	Factory Setting	When Enabled	
	500 to 2000	0.1%	1000	Immediately	Tuning
Pn121	Friction Compensation Gain		Speed Position		Classification
	Factory Setting	Factory Setting	Factory Setting	When Enabled	
	10 to 1000	1%	100	Immediately	Tuning
Pn104	2nd Speed Loop Gain		Speed Position		Classification
	Factory Setting	Factory Setting	Factory Setting	When Enabled	
	10 to 20000	0.1 Hz	400	Immediately	Tuning
Pn105	2nd Speed Loop Integral Time Constant		Speed Position		Classification
	Factory Setting	Factory Setting	Factory Setting	When Enabled	
	15 to 51200	0.01 ms	2000	Immediately	Tuning
Pn106	2nd Position Loop Gain			Position	Classification
	Factory Setting	Factory Setting	Factory Setting	When Enabled	
	10 to 20000	0.1/s	400	Immediately	Tuning
Pn412	1st Step 2nd Torque Reference Filter Time Constant		Speed	Position Torque	Classification
	Factory Setting	Factory Setting	Factory Setting	When Enabled	
	0 to 65535	0.01 ms	100	Immediately	Tuning
Pn148	2nd Model Following Control Gain			Position	Classification
	Factory Setting	Factory Setting	Factory Setting	When Enabled	
	10 to 20000	0.1/s	500	Immediately	Tuning
Pn149	2nd Model Following Control Gain Compensation			Position	Classification
	Factory Setting	Factory Setting	Factory Setting	When Enabled	
	500 to 2000	0.1%	1000	Immediately	Tuning
Pn122	2nd Gain for Friction Compensation		Speed Position	Compensation	Classification
	Factory Setting	Factory Setting	Factory Setting	When Enabled	
	10 to 1000	1%	100	Immediately	Tuning

(5) Parameters for Automatic Gain Switching

Pn135	Gain Switching Waiting Time 1			Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	1 ms	0	Immediately	Tuning

Pn136	Gain Switching Waiting Time 2			Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	1 ms	0	Immediately	Tuning

8.8.2 Manual Adjustment of Friction Compensation

Friction compensation rectifies the viscous friction change and regular load change.

The friction compensation function can be automatically adjusted with advanced autotuning, advanced autotuning by reference input, or one-parameter tuning. This section describes the steps to follow if manual adjustment is required.

(1) Required Parameter Settings

The following parameter settings are required to use friction compensation.

Parameter		Function	When Enabled	Classification
Pn408	n.0□□□ [Factory setting]	Does not use friction compensation.	Immediately	Setup
	Uses friction compensation.	Uses friction compensation.		

Pn121	Friction Compensation Gain (Speed, Position)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 1000	1%	100	Immediately	Tuning

Pn123	Friction Compensation Coefficient (Speed, Position)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 100	1%	0	Immediately	Tuning

Pn124	Friction Compensation Frequency Correction (Speed, Position)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	-10000 to 10000	0.1 Hz	0	Immediately	Tuning

Pn125	Friction Compensation Gain Correction (Speed, Position)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 1000	1%	100	Immediately	Tuning

(2) Operating Procedure for Friction Compensation

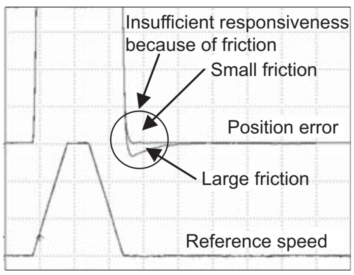
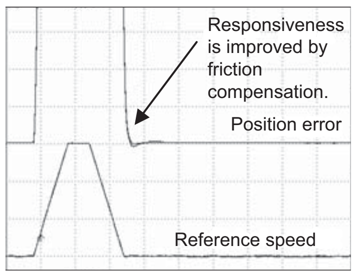
The following procedure is used for friction compensation.

⚠ CAUTION

- Before using friction compensation, set the moment of inertia ratio (Pn103) as accurately as possible. If the wrong moment of inertia ratio is set, vibration may result.

Step	Operation
1	Set the following parameters for friction compensation to the factory setting as follows. Friction compensation gain (Pn121): 100 Friction compensation coefficient (Pn123): 0 Friction compensation frequency correction (Pn124): 0 Friction compensation gain correction (Pn125): 100 Note: Always use the factory-set values for friction compensation frequency correction (Pn124) and friction compensation gain correction (Pn125).

(cont'd)

Step	Operation
2	To check the effect of friction compensation, gradually increase the friction compensation coefficient (Pn123). Note: Usually, set the friction compensation coefficient value to 95% or less. If the effect is insufficient, increase the friction compensation gain (Pn121) by 10% increments until it stops vibrating. **Effect of Parameters for Adjustment** Pn121: Friction Compensation Gain This parameter sets the responsiveness for external disturbance. The higher the set value is, the better the responsiveness will be. If the equipment has a resonance frequency, however, vibration may result if the set value is excessively high. Pn123: Friction Compensation Coefficient This parameter sets the effect of friction compensation. The higher the set value is, the more effective friction compensation will be. If the set value is excessively high, however, the vibration will occur easily. Usually, set the value to 95% or less.
3	**Effect of Adjustment** The following graph shows the responsiveness with and without proper adjustment.  Without friction compensation ⇒  With friction compensation

8.8.3 Current Gain Level Setting

This function reduces noises by adjusting the parameter value for current control inside the SERVOPACK according to the speed loop gain (PnAC2). The noise level can be reduced by reducing the current gain level (Pn13D) from its factory setting of 2000% (disabled). If the set value of Pn13D is decreased, the level of noise will be lowered, but the response characteristics of the SERVOPACK will also be degraded. Adjust the current gain level within the allowable range at which SERVOPACK response characteristics can be secured.

Pn13D	Current Gain Level Speed Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	100 to 2000	1%	2000	Immediately	Tuning

IMPORTANT

- If the parameter setting of the current gain level is changed, the responses characteristics of the speed loop will also change. The SERVOPACK must, therefore, be readjusted again.

8.8.4 Speed Detection Method Selection

This function can ensure smooth movement of the servomotor while the servomotor is running. Set the value of Pn009.2 to 1 and select speed detection 2 to smooth the movement of the servomotor while the servomotor is running.

Parameter		Meaning	When Enabled	Classification
Pn009	n. □0□□ [Factory setting]	Selects speed detection 1.	After restart	Tuning
	n. □1□□	Selects speed detection 2.		

IMPORTANT

- If the speed detection method is changed, the response characteristics of the speed loop will change and the SERVOPACK must be readjusted again.

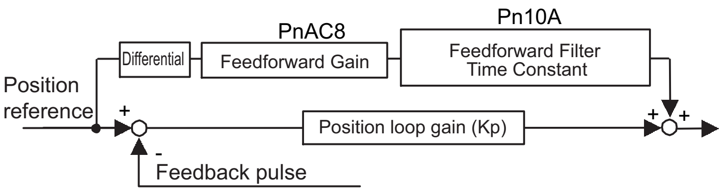
8.9 Compatible Adjustment Function

The SERVOPACKs have adjustment functions as explained in sections *8.1 Type of Adjustments and Basic Adjustment Procedure* to *8.8 Additional Adjustment Function* to make machine adjustments.

This section explains compatible functions provided by earlier models, such as the S-III Series SERVOPACK.

8.9.1 Feedforward Reference

This function applies feedforward compensation to position control and shortens positioning time.



PnAC8	Feedforward Gain		Position		Classification
	Setting Unit	Setting Unit	Factory Setting	When Enabled	
	0 to 100	1%	0	Immediately	Tuning

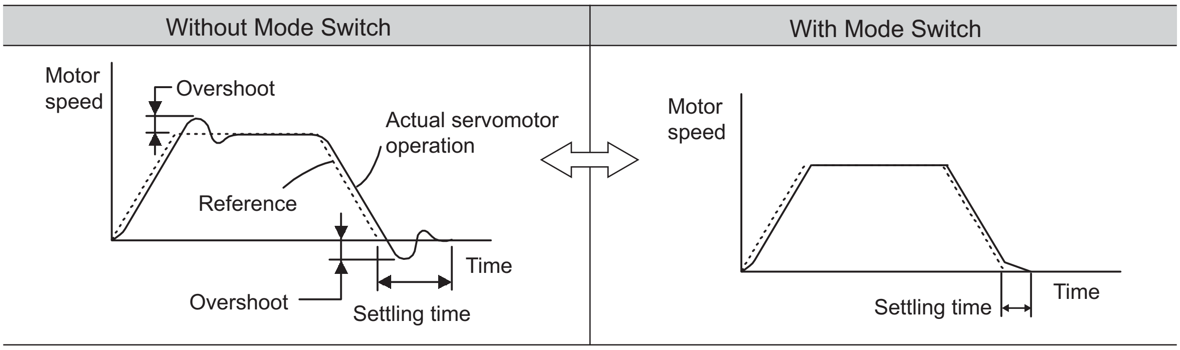
Pn10A	Feedforward Filter Time Constant		Position		Classification
	Setting Unit	Setting Unit	Factory Setting	When Enabled	
	0 to 6400	0.01 ms	0	Immediately	Tuning

Note: Too high value may cause the machine to vibrate. For ordinary machines, set 80% or less in this parameter.

8.9.2 Mode Switch (P/PI Switching)

The mode switch automatically switches between proportional and PI control. Set the switching condition with Pn10B.0 and set the level of detection points with Pn10C, Pn10D, Pn10E, and Pn10F.

Overshooting caused by acceleration and deceleration can be suppressed and the settling time can be reduced by setting the switching condition and detection points.



(1) Related Parameters

Select the switching condition of the mode switch with Pn10B.0.

Parameter		Mode Switch Selection	Parameter Containing Detection Point Setting	When Enabled	Classification
Pn10B	n.□□□0 [Factory setting]	Uses an internal torque reference level for the switching conditions.	Pn10C	Immedi-ately	Setup
	n.□□□1	Uses a speed reference level for the switching conditions.	Pn10D		
	n.□□□2	Uses an acceleration level for the switching conditions.	Pn10E		
	n.□□□3	Uses a position error level for the switching conditions.	Pn10F		
	n.□□□4	Does not use mode switch function.	-		

■ Parameters to Set the Level of Detection Points

Pn10C	Mode Switch (Torque Reference) Speed Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 800	1%	200	Immediately	Tuning

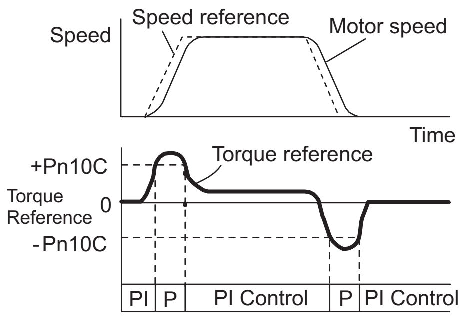
Pn10D	Mode Switch (Speed Reference) Speed Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 min^{-1}	0	Immediately	Tuning

Pn10E	Mode Switch (Acceleration) Speed Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 30000	1 min^{-1}/s	0	Immediately	Tuning

Pn10F	Mode Switch (Position Error) Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 reference unit	0	Immediately	Tuning

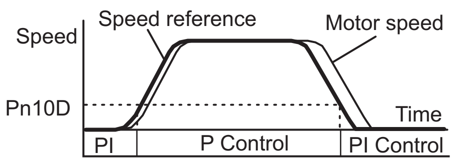
■ Using the Torque Reference [Factory Setting]

With this setting, the speed loop is switched to P control when the value of torque reference input exceeds the torque set in Pn10C. The factory setting for the torque reference detection point is 200% of the rated torque.



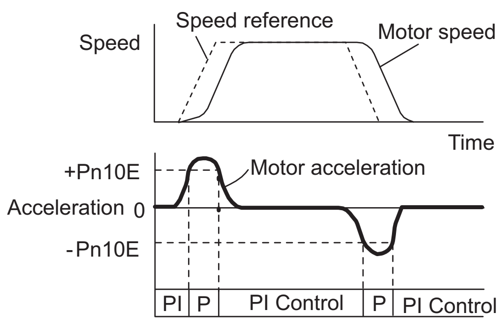
■ Using the Speed Reference

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



■ Using Acceleration

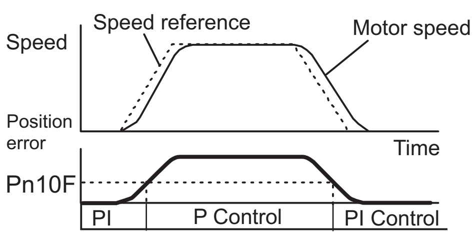
With this setting, the speed loop is switched to P control when the speed reference exceeds the acceleration set in Pn10E.



■ Using the Position Error

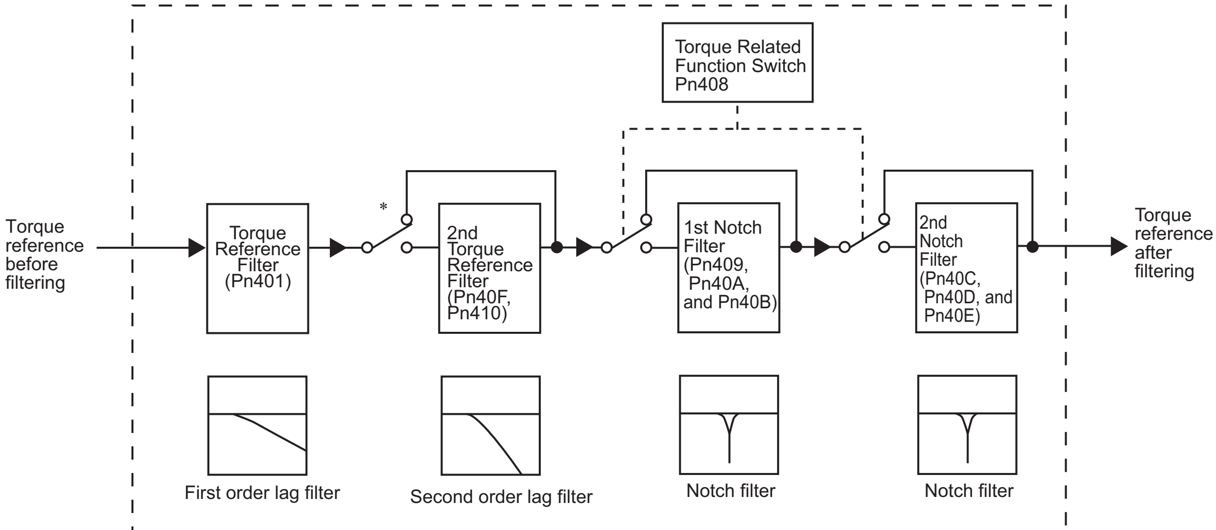
With this setting, the speed loop is switched to P control when the position error exceeds the value set in Pn10F.

This setting is effective with position control only.



8.9.3 Torque Reference Filter

As shown in the following diagram, the torque reference filter contains first order lag filter and notch filters arrayed in series, and each filter operates independently. The notch filters can be enabled and disabled with the Pn408.



* The 2nd torque reference filter is enabled when Pn40F is set to a value less than 5000 and disabled when Pn40F is set to 5000 (factory setting).

(1) Torque Reference Filter

If you suspect that machine vibration is being caused by the servo drive, try adjusting the filter time constants with Pn401. This may stop the vibration. The lower the value, the better the response will be, but there may be a limit that depends on the machine conditions.

Pn401	Torque Reference Filter Time Constant Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	0.01 ms	100	Immediately	Tuning

■ Torque Reference Filter Setting Guide

Use the speed loop gain (PnAC2 [Hz]) and the torque filter time constant (Pn401 [ms]) to set the torque reference filter.

Adjusted value for stable control: Pn401 [ms] $\leq$ 1000/ (2$\pi \times$ PnAC2 [Hz] $\times$ 4)
Critical gains: Pn401 [ms] < 1000/ (2$\pi \times$ PnAC2 [Hz] $\times$ 1)

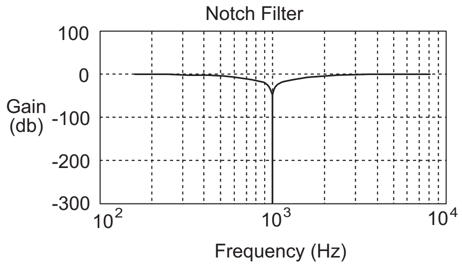
Pn40F	2nd Step 2nd Torque Reference Filter Frequency Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	100 to 5000	1 Hz	5000*	Immediately	Tuning
Pn410	2nd Step 2nd Torque Reference Filter Q Value Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 100	0.01	50	Immediately	Tuning

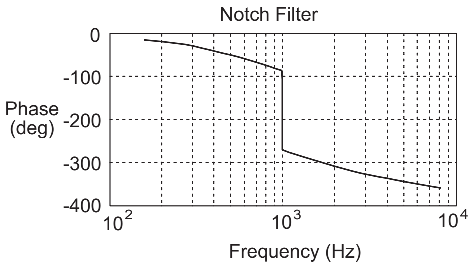
* The filter is disabled if 5000 is set.

(2) Notch Filter

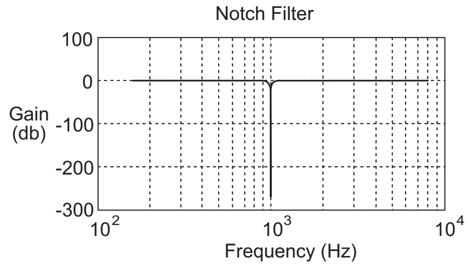
The notch filter can eliminate specific frequency elements generated by the vibration of sources such as resonance of the shaft of a ball screw. The notch filter puts a notch in the gain curve at the specific vibration frequency. The frequency characteristics near the notch can be reduced or removed with this filter. A higher Q value produces a sharper notch and phase delay.

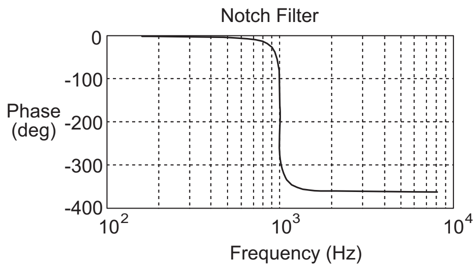
Q value = 0.7





Q value = 1.0





The notch filter can be enabled or disabled with Pn408.

Parameter		Meaning	When Enabled	Classification
Pn408	n.□□□0 [Factory setting]	Disables 1st notch filter.	Immediately	Setup
	n.□□□1	Enables 1st notch filter.		
	n.□0□□ [Factory setting]	Disables 2nd notch filter.		
	n.□1□□	Enables 2nd notch filter.		

Set the machine's vibration frequency as a parameter of the notch filter.

Pn409	1st Notch Filter Frequency		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 5000	1 Hz	5000	Immediately	Tuning

Pn40A	1st Notch Filter Q Value		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 1000	0.01	70	Immediately	Tuning

Pn40B	1st Notch Filter Depth		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 1000	0.001	0	Immediately	Tuning

Pn40C	2nd Notch Filter Frequency		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 5000	1 Hz	5000	Immediately	Tuning

Pn40D	2nd Notch Filter Q Value		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 1000	0.01	70	Immediately	Tuning

(cont'd)

Pn40E	2nd Notch Filter Depth Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 1000	0.001	0	Immediately	Tuning

IMPORTANT

- Sufficient precautions must be taken when setting the notch filter frequencies. Do not set the notch filter frequencies (Pn409 or Pn40C) that is close to the speed loop's response frequency. Set the frequencies at least four times higher than the speed loop's response frequency. Setting the notch filter frequency too close to the response frequency may cause vibration and damage the machine.
- Change the notch filter frequencies (Pn409 or Pn40C) only when the servomotor is stopped. Vibration may occur if the notch filter frequency is changed when the servomotor is rotating.

9

Utility Functions

9.1 List of Utility Functions

Utility functions are used to execute the functions related to servomotor operation and adjustment. Each utility function has a number starting with Fn.

The following table lists the utility functions and reference section.

Function	Reference Section	Comment: SigmaWin+ function names
Alarm history display	9.2	Alarm Display
JOG operation	9.3	JOG Operation
Origin search	9.4	Origin Search
Program JOG operation	9.5	Program JOG Operation
Initializing parameter settings	9.6	Editing Parameters
Clearing alarm history	9.7	Alarm Display
Absolute encoder multiturn reset and encoder alarm reset	7.6.1	Setting the Absolute Encoder
Automatic offset-signal adjustment of the motor current detection signal	9.8	Adjusting Motor Current Detection Offset
Write prohibited setting	9.9	Write Prohibited Setting
Multiturn limit value setting change when a multiturn limit disagreement alarm occurs	7.6.2	Setting the Multi-Turn Limit
Vibration detection level initialization	9.10	Initializing Vibration Detection Level
Confirmation of SERVOPACK and servomotor model information	9.11	Product Information
Software reset	9.12	Software Reset
EasyFFT	9.13	EasyFFT
Online vibration monitor	9.14	Online Vibration Monitor

Note: Execute the utility function with SigmaWin+.

9.2 Alarm History Display

This function displays the last ten alarms that have occurred in the SERVOPACK.

(1) Preparation

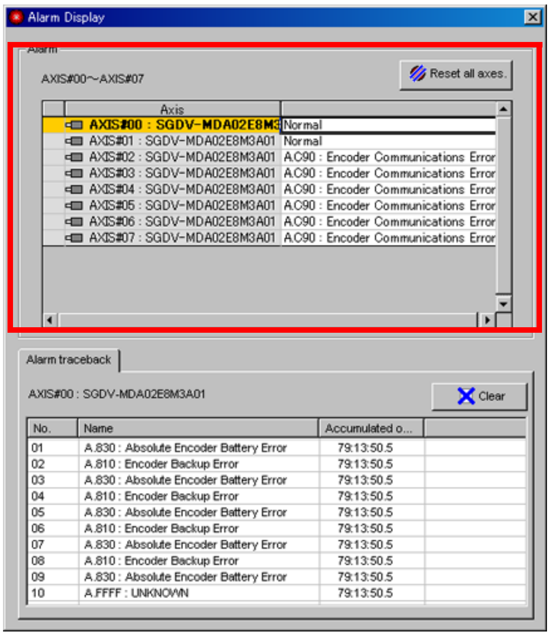
There are no tasks that must be performed before displaying the alarm history.

(2) Operating Procedure

Use the following procedure.

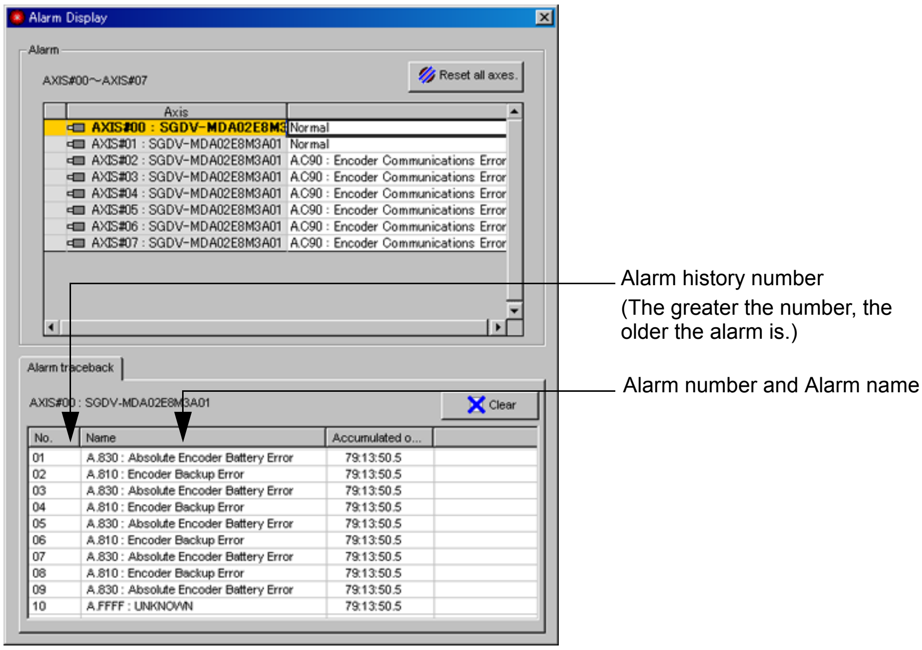
1. In the SigmaWin+ main window, click **Alarm - Display Alarm**.

The **Alarm Display** dialog box will appear.



2. Select the axis for which to display the alarm history.

The alarm history for the specified axis is displayed on the **Alarm traceback** tab page.



Note: • If the same alarm occurs after more than one hour, the alarm will be saved. If it occurs in less than one hour, it will not be saved.
• Delete the alarm history by clicking **Clear**. The alarm history is not cleared on alarm reset or when the SERVOPACK main circuit power is turned OFF.

Utility Functions

9

9.3 JOG Operation

JOG operation is used to check the operation of the servomotor under speed control without connecting the SERVOPACK to the host controller.

CAUTION
• While the SERVOPACK is in JOG operation, the overtravel function will be disabled. Consider the operating range of the machine when performing JOG operation for the SERVOPACK.

(1) Preparation

The following conditions must be met to perform a jog operation.

- The write prohibited setting parameter must be set to Write permitted.
- The main circuit power supply must be ON.
- All alarms must be cleared.
- The servomotor power must be OFF.
- The JOG speed must be set considering the operating range of the machine.
  Set the jog speed in Pn304.

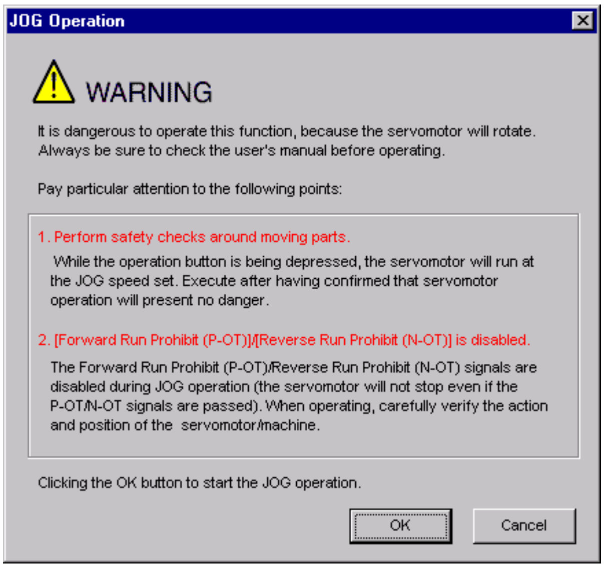
Pn304	Jog Speed		Speed	Position Torque	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 min^{-1}	500	Immediately	Setup

(2) Operating Procedure

Use the following procedure. The following example is given when the rotating direction of servomotor is set as Pn000.0=0 (Forward rotation by forward reference).

1. In the SigmaWin+ main window, click **Test Run - JOG Operation**.

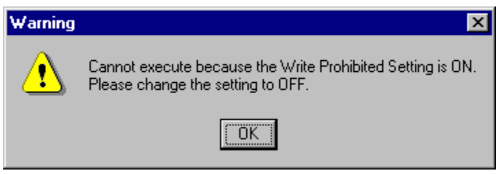
A warning message about possible dangers will appear and ask if you want to continue.



If these conditions are not acceptable and you do not want to continue, click **Cancel** to return to the main window without performing a JOG operation.

<When the Write Prohibited Setting Parameter (Fn010) is enabled.>

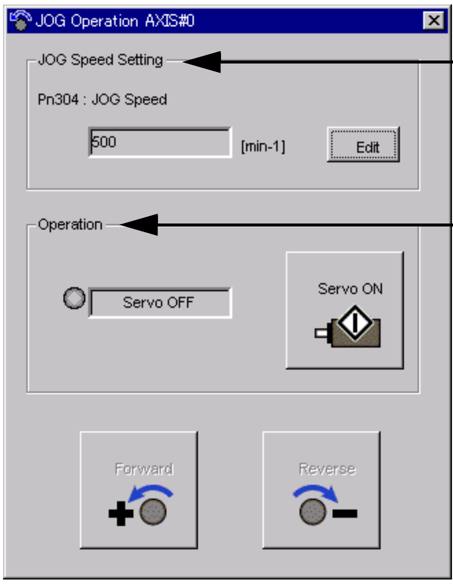
If writing is prohibited by the Fn010, the following message will appear and tell you to change the setting.



Click **OK** and then change the setting of the Fn010 to allow writing.
For details on how to change the setting, refer to *9.9 Write Prohibited Setting*.

2. Click **OK**.
The **JOG Operation** box will appear.

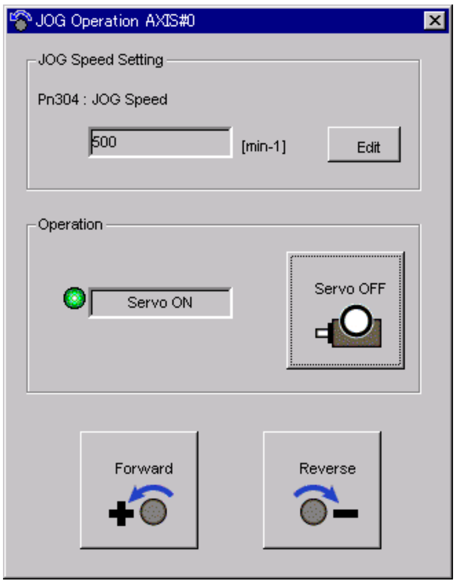
If the power to the servomotor is on, an error message will appear. Make sure that the power to the servomotor is off.



The speed set in Pn304 will be shown. Click **Edit** if you want to change the speed.

On the left side of the **Operation** group, the color of the button and the text in the box changes to indicate if the power to the servomotor is on or off. The name of the square button will change to reflect the current status of the servomotor's power. When the power to the servomotor is off, the square button is labeled **Servo ON**. When the power to the servomotor is on, it is labeled **Servo OFF**.

3. Click **Servo ON**.
The JOG Operation box will appear.



4. Press the **Forward** or **Reverse** and hold it down. A JOG operation is performed at the speed set at step 2 only while one of the buttons is pressed.

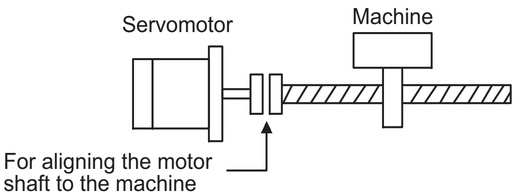
5. After the JOG operation has been successfully completed, restart the SERVOPACK.

9.4 Origin Search

The origin search is designed to position the origin pulse position of the incremental encoder (phase C) and to clamp at the position.

⚠ CAUTION
• Perform origin searches without connecting the coupling. The forward run prohibited (P-OT) and reverse run prohibited (N-OT) signals are not effective in origin search mode.

This function is used when the motor shaft needs to be aligned to the machine.
Motor speed at the time of execution: 60 min^{-1}



(1) Preparation

The following conditions must be met to perform the origin search.

• The write prohibited setting parameter must be set to Write permitted.
• The main circuit power supply must be ON.
• All alarms must be cleared.
• The servomotor power must be OFF.

(2) Operating Procedure

Use the following procedure.

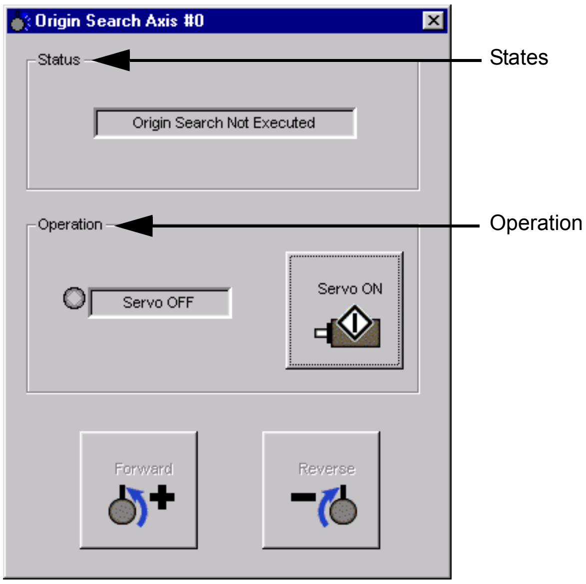
1. In the SigmaWin+ main window, click **Setup** - **Search Origin**.

A warning message about possible dangers will appear and ask if you want to continue.

If these conditions are not acceptable and you do not want to continue, click **Cancel** to return to the main window without performing an origin search.

2. Click **OK**.

The **Origin Search** box will appear.
If the power to the servomotor is on, an error message will appear. Make sure that the power to the servomotor is off.



Status

This shows the run status of the servomotor.

Origin Search Not Executed: The motor did not turn.

Origin Search Executing: Searching for the origin by turning forward or in reverse.

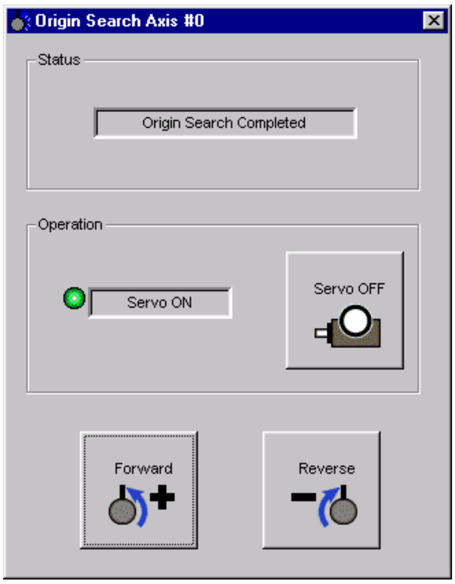
Origin Search Stopped: The **Forward** or **Reverse** button was released during the origin search, so the motor stopped.

Origin Search Completed: The point of origin was found, and the motor was stopped (clamped) at the point.

Operation

On the left side of the **Operation** group, the color of the button and the text in the box changes to indicate if the power to the servomotor is on or off. The name of the square button will change to reflect the current status of the servomotor's power. When the power to the servomotor is off, the square button is labeled **Servo ON**. When the power to the servomotor is on, it is labeled **Servo OFF**.

3. Click Servo **ON**.
The **Origin Search** box will appear.



4. Press the **Forward** or **Reverse** and hold it down until the servomotor stops.
The servomotor will stop after the origin search has been successfully completed.

5. After the origin search has been successfully completed, restart the SERVOPACK.

9.5 Program JOG Operation

The program JOG operation is a utility function, that allows continuous operation determined by the preset operation pattern, movement distance, movement speed, acceleration/deceleration time, waiting time, and number of times of movement.
This function can be used to move the servomotor without it having to be connected to a host controller for the machine as a trial operation in JOG operation mode. Program JOG operation can be used to confirm the operation and for simple positioning operations.

(1) Preparation

The following conditions must be met to perform the program JOG operation.

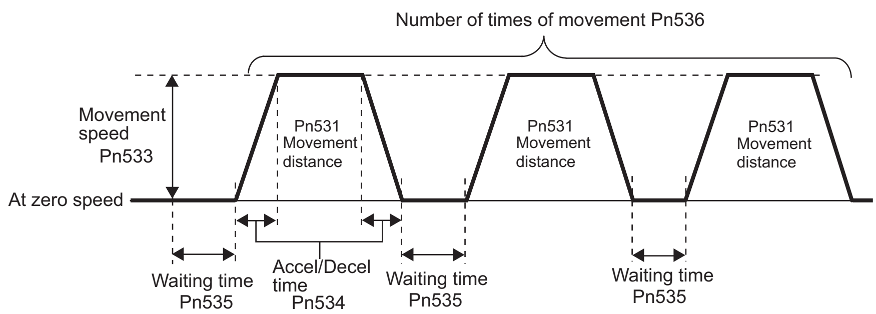
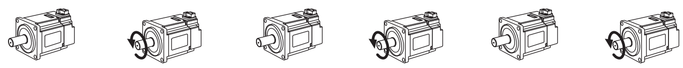
- The write prohibited setting parameter must be set to Write permitted.
- The main circuit power supply must be ON.
- All alarms must be cleared.
- The servomotor power must be OFF.
- The travel distance and speed must be set correctly considering the machine operation range and safe operation speed.
- There must be no overtravel.

(2) Additional Information

- The functions that are applicable for position control, such as position reference filter, can be used.
- The overtravel function is enabled in this function.

(3) Program JOG Operation Patterns

The following describes an example of program JOG operation pattern. The following example is given when the rotating direction of the servomotor is set as Pn000.0 = 0 (Forward rotation by forward reference).

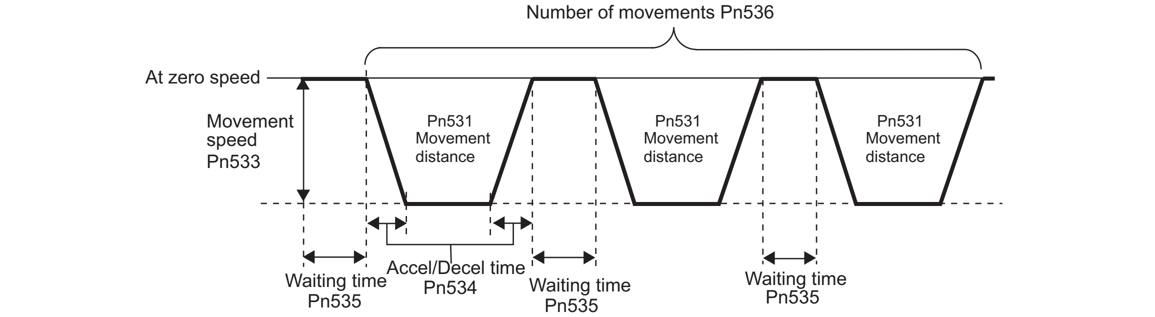
Pn530.0 = 0	
(Waiting time Pn535 → Forward movement Pn531) × Number of movements Pn536	
Speed Diagram	
Servomotor Run Status	 (Stop) (Forward) (Stop) (Forward) (Stop) (Forward)

Note: When Pn536 (number of times of program JOG movement) is set to 0, infinite time operation is enabled. To stop infinite time operation, press the **cancel** or **Servo OFF** of program JOG operation dialog box to turn OFF the servomotor power.

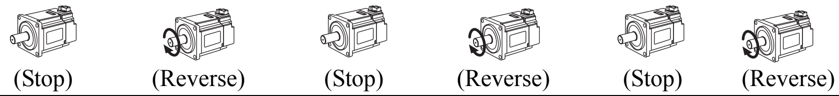
Pn530.0 = 1

(Waiting time Pn535 → Reverse movement Pn531) × Number of movements Pn536

Speed Diagram



Servomotor Run Status

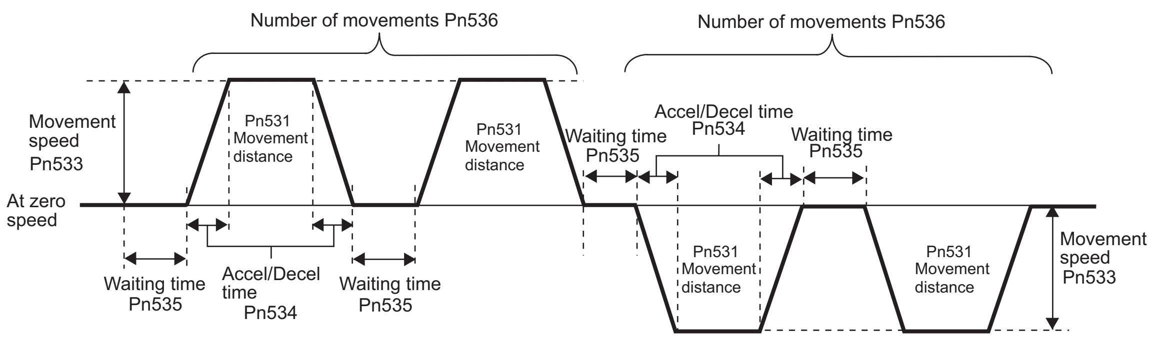


Note: When Pn536 (Number of Times of Program JOG Movement) is set to 0, infinite time operation is enabled. To stop infinite time operation, press the **cancel** or **Servo OFF** of program JOG operation dialog box to turn OFF the servomotor power.

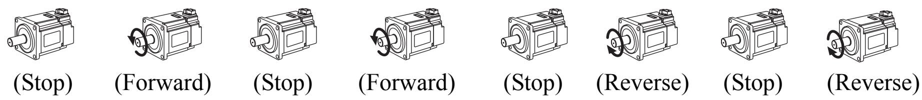
Pn530.0 = 2

(Waiting time Pn535 → Forward movement Pn531) × Number of movements Pn536
(Waiting time Pn535 → Reverse movement Pn531) × Number of movements Pn536

Speed Diagram



Servomotor Run Status

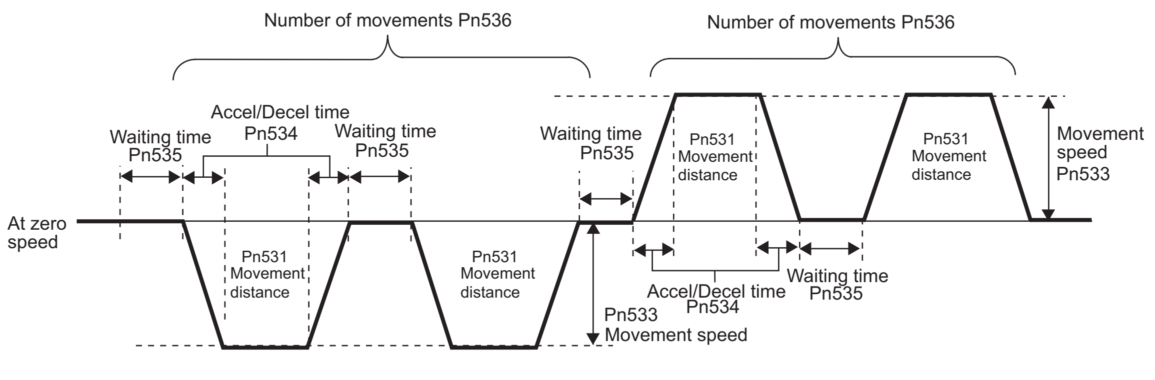


Note: When Pn530.0 is set to 2, infinite time operation is disabled.

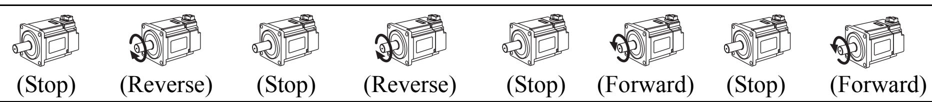
Pn530.0 = 3

(Waiting time Pn535 → Reverse movement Pn531) × Number of movements Pn536
(Waiting time Pn535 → Forward movement Pn531) × Number of movements Pn536

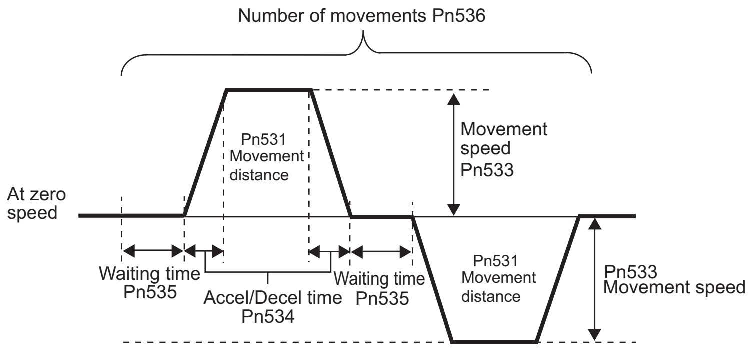
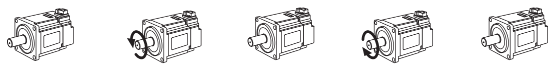
Speed Diagram



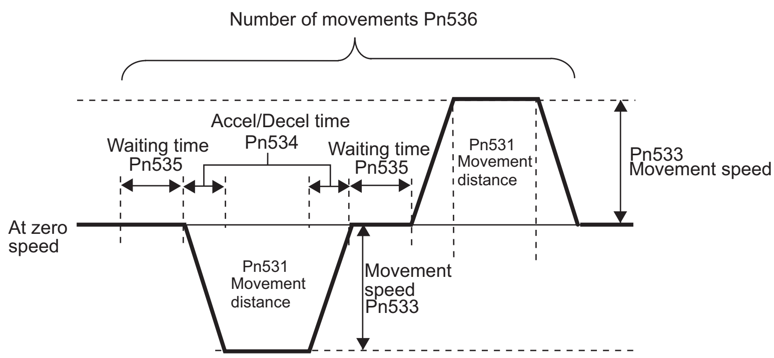
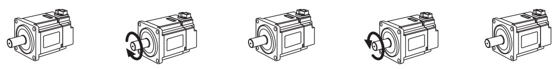
Servomotor Run Status



Note: When Pn530.0 is set to 3, infinite time operation is disabled.

<table>
<tr><th colspan="2">Pn530.0 = 4</th></tr>
<tr><th colspan="2">(Waiting time Pn535 → Forward movement Pn531 → Waiting time Pn535 → Reserve movement Pn531)
× Number of movements Pn536</th></tr>
<tr><td>Speed Diagram</td><td>
</td></tr>
<tr><td>Servomotor Run Status</td><td>
(Stop) (Forward) (Stop) (Reverse) (Stop)</td></tr>
</table>

Note: When Pn536 (number of times of program JOG movement) is set to 0, infinite time operation is enabled. To stop infinite time operation, press the **cancel** or **Servo OFF** of program JOG operation dialog box to turn OFF the servomotor power.

<table>
<tr><th colspan="2">Pn530.0 = 5</th></tr>
<tr><th colspan="2">(Waiting time Pn535 → Reverse movement Pn531 → Waiting time Pn535 → Forward movement Pn531)
× Number of movements Pn536</th></tr>
<tr><td>Speed Diagram</td><td>
</td></tr>
<tr><td>Servomotor Run Status</td><td>
(Stop) (Reverse) (Stop) (Forward) (Stop)</td></tr>
</table>

Note: When Pn536 (number of times of program JOG movement) is set to 0, infinite time operation is enabled. To stop infinite time operation, press the **cancel** or **Servo OFF** of program JOG operation dialog box to turn OFF the servomotor power.

(4) Related Parameters

The following parameters set the program JOG operation pattern. Do not change the settings while the program JOG operation is being executed.

Pn530	Program JOG Operation Related Switch		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0000 to 0005	–	0000	Immediately	Setup
Pn531	Program JOG Movement Distance		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 1073741824	1 reference unit	32768	Immediately	Setup
Pn533	Program JOG Movement Speed		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 10000	1 min^{-1}	500	Immediately	Setup
Pn534	Program JOG Acceleration/Deceleration Time		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	2 to 10000	1 ms	100	Immediately	Setup
Pn535	Program JOG Waiting Time		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 ms	100	Immediately	Setup
Pn536	Number of Times of Program JOG Movement		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 1000	1 time	1	Immediately	Setup

(5) Operating Procedure

Use the following procedure to perform the program JOG operation after setting a program JOG operation pattern.

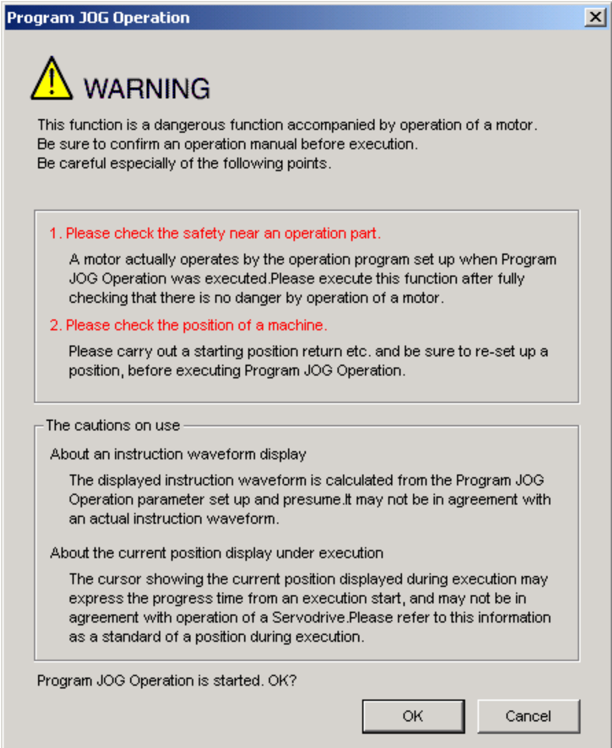
⚠ CAUTION

Two methods are available to interrupt a program JOG operation and stop the motor. The motor will stop according to the method selected. Make sure to select the best method for the situation.

- When using the **Servo OFF** button to turn off the power to the servomotor and stop the motor, the motor will coast to a stop.
- When using the **Cancel** button to cancel the program JOG operation and stop the motor, the motor will decelerate to a stop and then be put in a zero clamp state.
  Note: With some models of SERVOPACKs, the **Cancel** button cannot be used to stop the motor.

1. In the SigmaWin+ main window, click **Test Run - Program JOG Operation**.

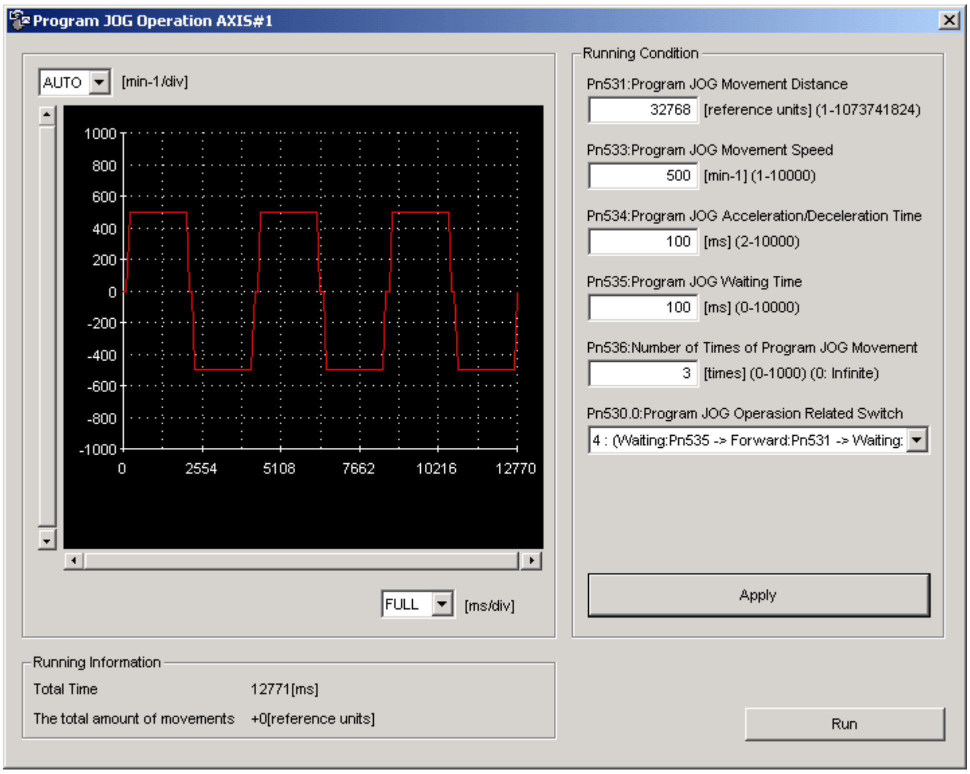
A warning message about possible dangers will appear and ask if you want to continue.



If these conditions are not acceptable and you do not want to continue, click **Cancel** to return to the main window without programming JOG operation.

2. Click **OK**.

The **Program JOG Operation** box will appear.

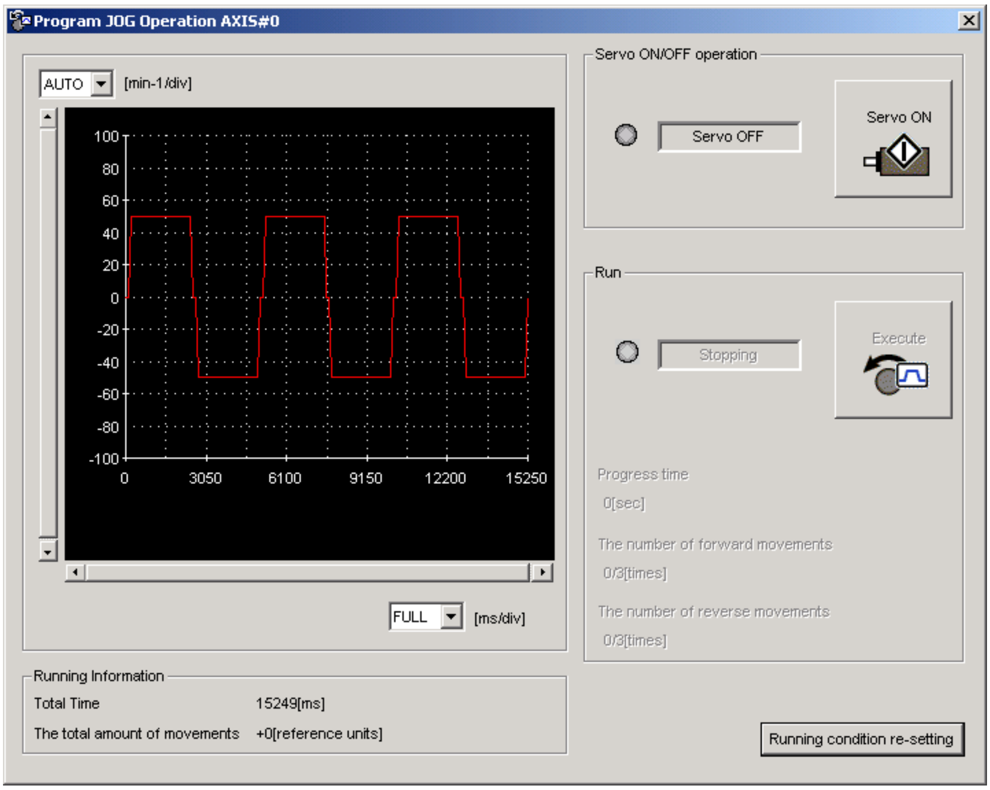


3. For each running condition in the **Program JOG Operation** box, enter or select the same value that have been used for the **Running Condition** group, and then click **Apply**.

The running pattern for the condition will be shown as a graph.

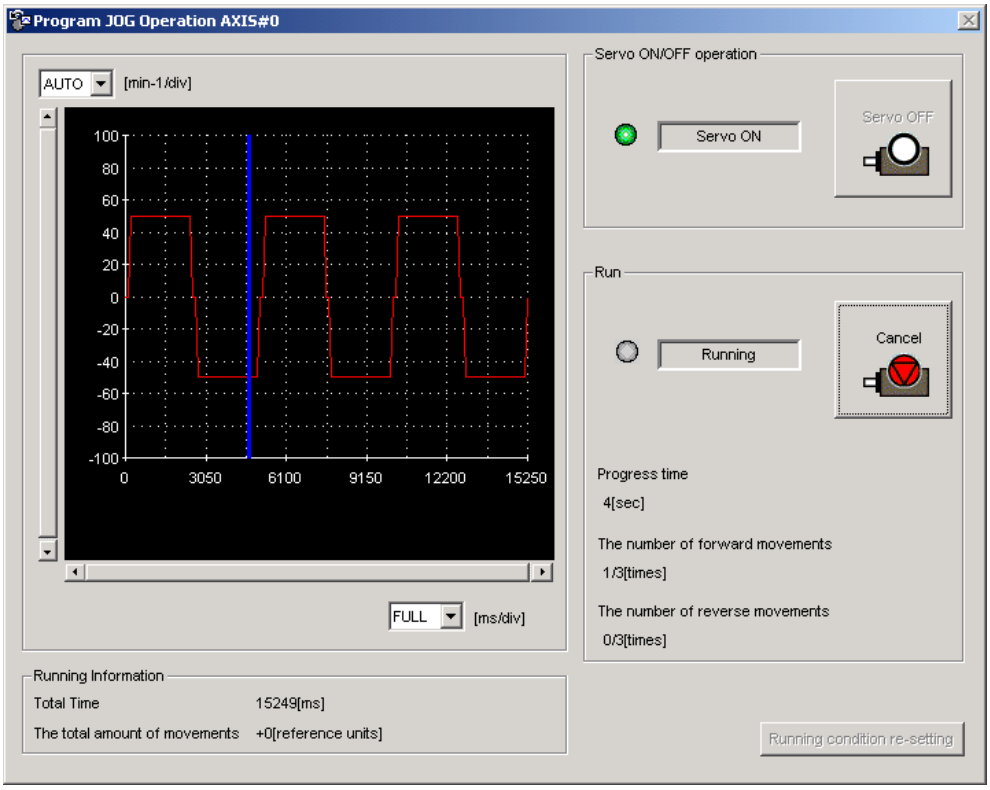
4. Click **Run**.

The contents of the **Program JOG Operation** box will change to the following display.



5. Click Servo **ON** and then click **Execute**.

After the amount of time set in Pn535 has passed, the programmed JOG operation will start.



6. After the programmed JOG operation has been successfully completed, restart the SERVOPACK.

9.6 Initializing Parameter Settings

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

> **IMPORTANT**
> - Be sure to initialize the parameter settings while the servomotor power is OFF.
> - After initialization, restart the SERVOPACK to validate the settings.

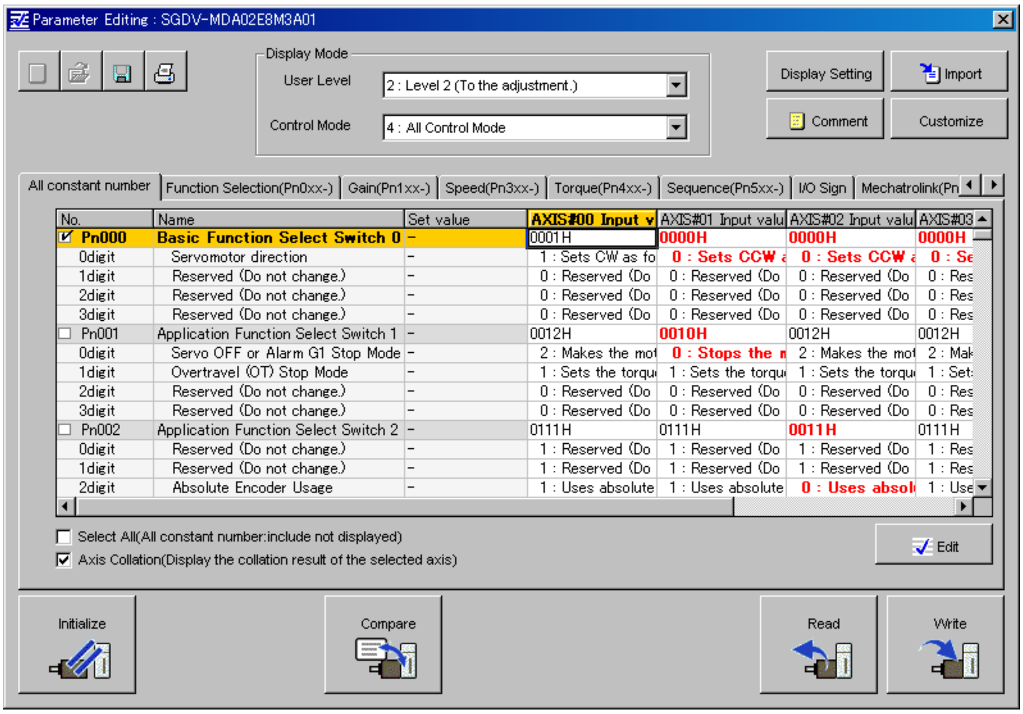
(1) Preparation

The following conditions must be met to initialize the parameter values.
- The write prohibited setting parameter must be set to Write permitted.
- The servomotor power must be OFF.

(2) Operating Procedure

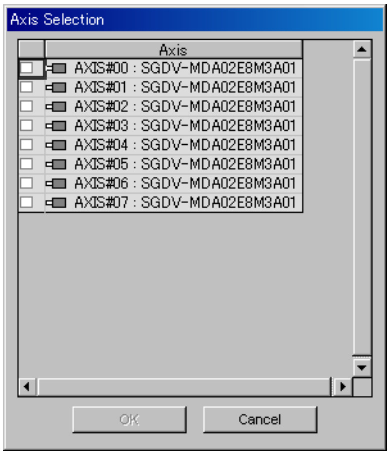
Use the following procedure.

1. In the SigmaWin+ main window, click **Parameters** - **Edit Parameters**.
The **Parameter Editing** dialog box will appear.



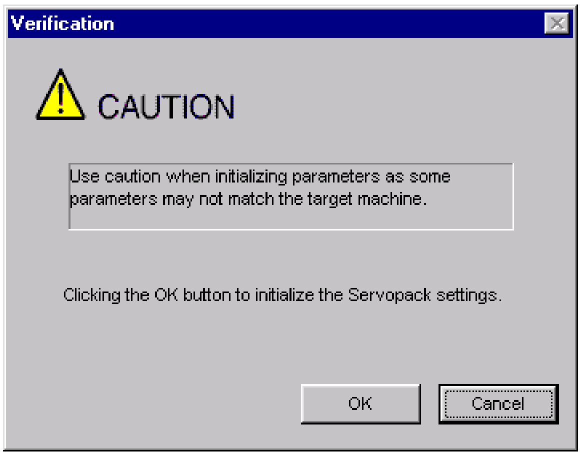
2. Click **Initialize**.

If you are using more than one axis, the following dialog box is displayed.



3. Select the axis to initialize and click **OK**.

The following dialog box is displayed.



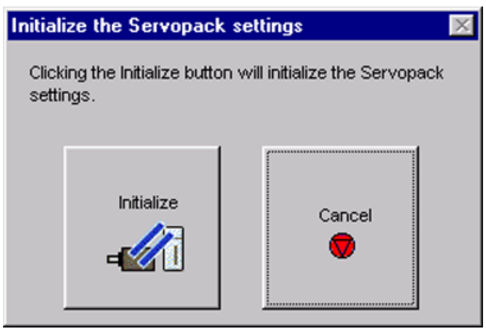
A message will appear as a warning to say that changes to settings might not correspond with other settings and it will then ask if you want to continue.

If these conditions are not acceptable and you do not want to continue, click **Cancel** to return to the **Parameter Editing** dialog box without initializing the parameter settings.

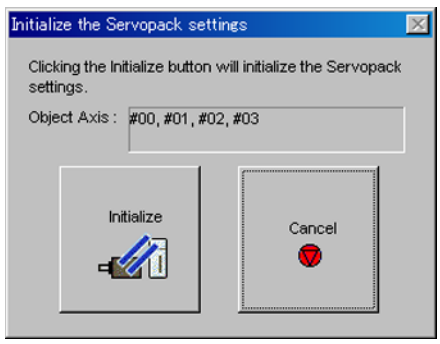
4. Click **OK**.

The Initialize the **Servopack** settings box will appear and ask if you want to continue.

When Using Only One Axis



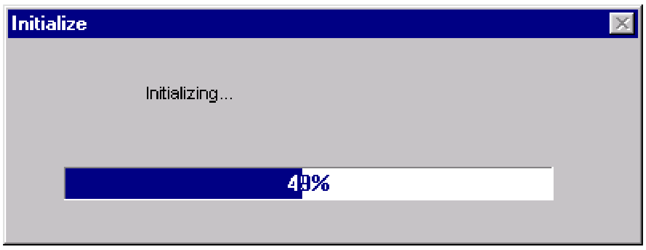
When Using Two or More Axes



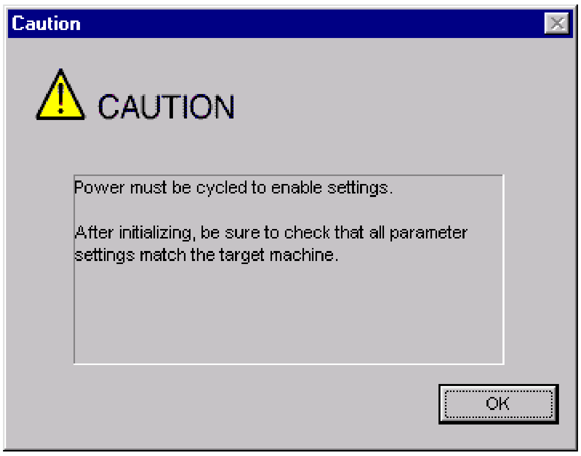
If you do not want to continue, click **Cancel** to return to the **Parameter Editing** dialog box without initializing the parameter settings.

5. Click **Initialize** to start initialization.

A progress indicator will show what percentage of the process has been completed.



After the settings are successfully initialized, the following message will appear to prompt you to verify that all parameter settings are correct for the target machine.



6. Click **OK**.

7. Restart the SERVOPACK.

9.7 Clearing Alarm History

The clear alarm history function deletes all of the alarm history recorded in the SERVOPACK.

Note: The alarm history is not deleted when the alarm reset is executed or the main circuit power supply of the SERVOPACK is turned OFF.

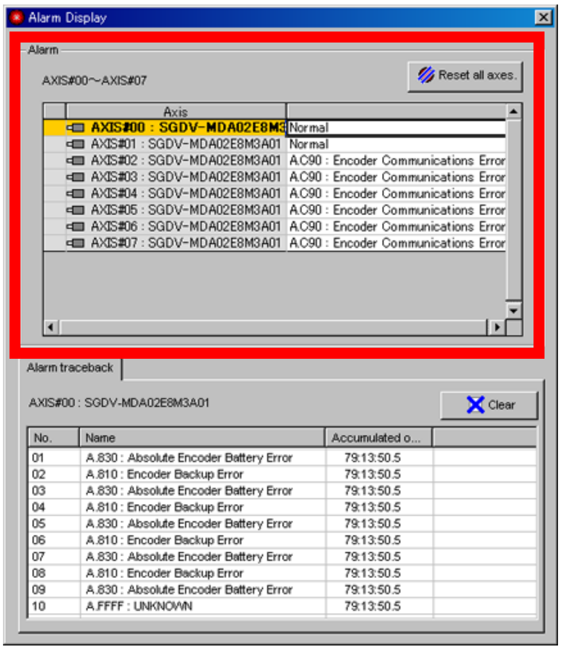
(1) Preparation

The Write Prohibited Setting parameter must be set to permit writing.

(2) Operating Procedure

Use the following procedure.

1. In the SigmaWin+ main window, click **Alarm** - **Display Alarm**.
The **Alarm Display** box will appear.



2. Select the axis for which to delete the alarm history.

3. Click **Clear**.
The alarm history will be cleared.

9.8 Automatic Offset-Signal Adjustment of the Motor Current Detection Signal

Perform this adjustment only if highly accurate adjustment is required for reducing torque ripple caused by current offset. The user need not usually use this function.

> **IMPORTANT**
> - Be sure to perform this function while the servomotor power is OFF.
> - Execute the automatic offset adjustment if the torque ripple is too big when compared with those of other SERVOPACKs.

Note: The adjusted value is not initialized by executing the function (Initializing Parameter Settings).

(1) Preparation

The following conditions must be met to automatically adjust the offset of the motor current detection signal.

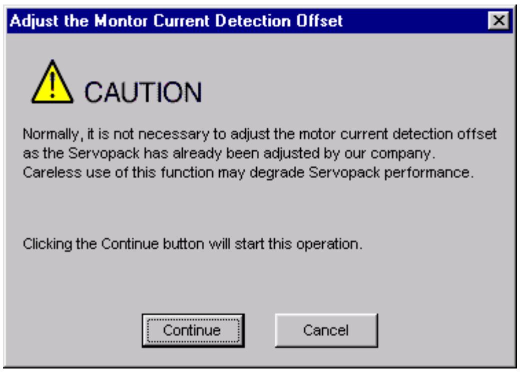
- The write prohibited setting parameter must be set to Write permitted.
- The SERVOPACK must be in Servo Ready status.
- The servomotor power must be OFF.

(2) Operating Procedure

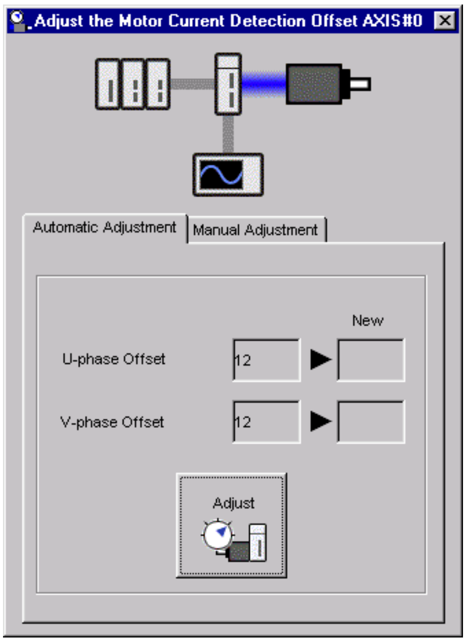
Use the following procedure.

1. In the SigmaWin+ main window, click **Setup** - **Adjust Offset - Adjust the Motor Current Detection Offset.**

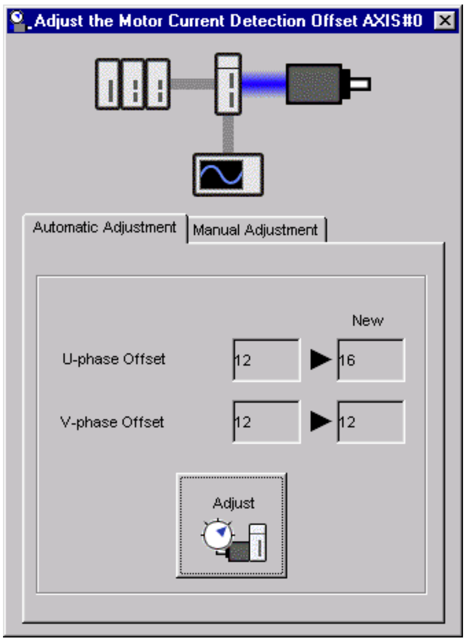
The following message will appear and ask if you want to continue. The message informs you that the offset is set to the factory settings and that the SERVOPACK's performance might be affected if these settings are changed.



2. Click **Continue** to adjust the motor detection offset. The **Adjust the Motor Current Detection Offset** box will appear. Click the **Automatic Adjustment** tab.
   The settings for **Automatic Adjustment** will appear.



3. Click **Adjust**.
   The offset value automatically adjusted will be shown in the **New** box.



9.9 Write Prohibited Setting

This function prevents changing parameters by mistake and sets restrictions on the execution of the utility function.

Parameter changes and execution of the utility function become restricted in the following manner when Write prohibited (P.0001) is assigned to the write prohibited setting parameter (Fn010).

- Parameters: Parameters can be changed from the SigmaWin+.
- Utility Function: Some functions cannot be executed. (Refer to the following table.) If you attempt to execute these utility functions a warning dialog box will appear.

Function	Write Prohibited Setting	Reference Section
Alarm history display	Executable	9.2
JOG operation	Cannot be executed	9.3
Origin search	Cannot be executed	9.4
Program JOG operation	Cannot be executed	9.5
Initializing parameter settings	Cannot be executed	9.6
Clearing alarm history	Cannot be executed	9.7
Absolute encoder multiturn reset and encoder alarm reset	Cannot be executed	7.6.1
Automatic offset-signal adjustment of the motor current detection signal	Cannot be executed	9.8
Write prohibited setting	–	9.9
Multiturn limit value setting change when a multiturn limit disagreement alarm occurs	Cannot be executed	7.6.2
Vibration detection level initialization	Cannot be executed	9.10
Confirmation of SERVOPACK and servomotor model information	Executable	9.11
Software reset	Executable	9.12
EasyFFT	Cannot be executed	9.13
Online vibration monitor	Cannot be executed	9.14

(1) Preparation

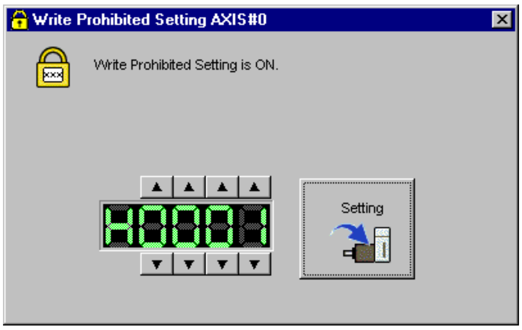
There are no tasks that must be performed before the execution.

(2) Operating Procedure

Follow the steps to set enable or disable writing.
Setting values are as follows:

- "P.0000": Write permitted (Releases write prohibited mode.) [Factory setting]
- "P.0001": Write prohibited (Parameters become write prohibited from the next power ON.)

1. In the SigmaWin+ main window, click **Setup** - **Write Prohibited Setting**.
The **Write Prohibited Setting** box will appear.



Set the parameter to enable or prohibit writing. Click the setting arrows to increase or decrease the number on the far right.

Writing enabled (factory setting): 0000
Writing prohibited: 0001

2. Click **Setting**.
The following message appears and informs you that the write prohibited setting has been changed and the new setting will become valid the next time the SERVOPACK is restarted.

3. Click **OK**.
The new setting will be saved in the SERVOPACK.

4. To enable the change in the setting, restart the SERVOPACK.

9.10 Vibration Detection Level Initialization

This function detects vibration when servomotor is connected to a machine in operation and automatically adjusts the vibration detection level (Pn312) to output more exactly the vibration alarm (A.520) and the vibration warning (A.911).

The vibration detection function detects vibration elements according to the motor speed.

Parameter		Meaning	When Enabled	Classification
Pn310	n.□□□0 [Factory setting]	Does not detect vibration.	Immediately	Setup
	n.□□□1	Outputs the warning (A.911) when vibration is detected.		
	n.□□□2	Outputs the alarm (A.520) when vibration is detected.		

If the vibration exceeds the detection level calculated by the following formula, the alarm or warning will be output according to the setting of vibration detection switch (Pn310).

$$\text{Detection level} = \frac{\text{Vibration detection level (Pn312 [min}^{-1}\text{])} \times \text{Vibration detection sensitivity (Pn311 [\%])}}{100}$$

- Use this function if the vibration alarm (A.520) or the vibration warning (A.911) is not output correctly when a vibration at the factory setting of the vibration detection level (Pn312) is detected. In other cases, it is not necessary to use this function.
- The vibration alarm or warning detection sensibility differs depending on the machine conditions. In this case, fine-tune the setting of the vibration detection sensitivity (Pn311) using the above detection level formula as a guide.

Pn311	Vibration Detection Sensitivity		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 500	1%	100	Immediately	Tuning

IMPORTANT

- The vibration may not be detected because of improper servo gains. Also, not all kinds of vibrations can be detected. Use the detection result as a guideline.
- Set a proper moment of inertia ratio (Pn103). Improper setting may result in the vibration alarm, warning misdetection, or non-detection.
- The references that are used to operate your system must be input to execute this function.
- Execute this function under the operating condition for which the vibration detection level should be set.
- Execute this function while the motor speed reaches at least 10% of its maximum.

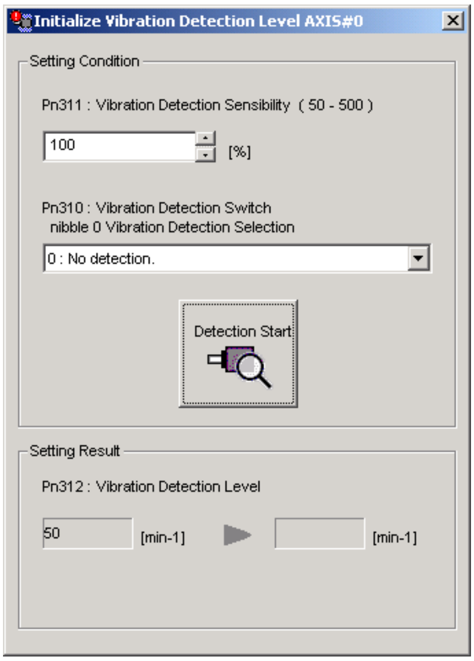
(1) Preparation

The Write Prohibited Setting parameter must be set to permit writing.

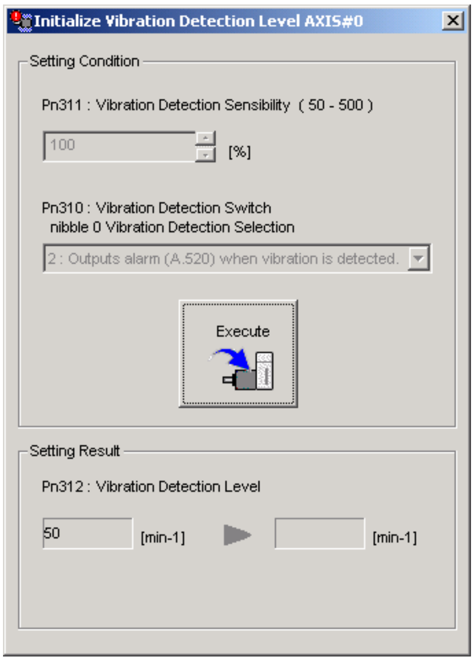
(2) Operating Procedure

Use the following procedure.

1. In the SigmaWin+ main window, click **Setup - Initialize Vibration Detection Level**.
   The **Initialize Vibration Detection Level** box will appear.



2. Select a percentage for **Pn311: Vibration Detection Sensibility** and one condition in **Pn310: Vibration Detection Switch**, and then click **Detection Start**.
   The name of the button will change from **Detection Start** to **Execute** to indicate that detection is ready to be executed.



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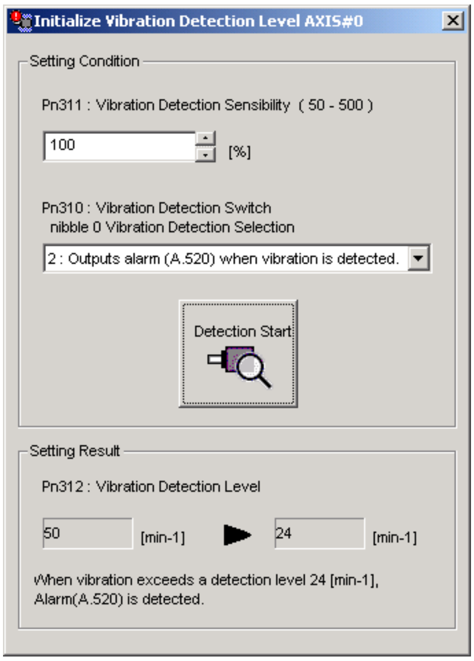
3. Click **Execute**.

The new settings for the vibration detection level will be shown in the boxes in lower section of the box. The new settings will be saved in the SERVOPACK.



9.11 Confirmation of SERVOPACK and Servomotor Model Information

You can display model information on SERVOPACKs, servomotors, and encoders.

The SigmaWin+ is required to perform this function.

The following items can be displayed.

ID	Items to be Displayed
SERVOPACK ID	• SERVOPACK model • SERVOPACK serial number • SERVOPACK manufacturing date • Software version
Servomotor ID	• Servomotor model • Servomotor serial number • Servomotor manufacturing date
Encoder ID	• Encoder model • Encoder serial number • Encoder manufacturing date • Encoder type/resolution

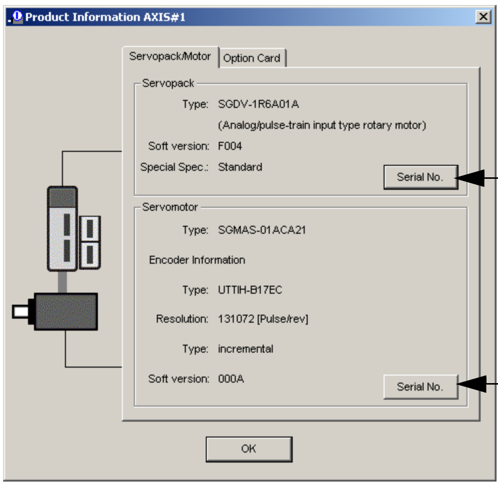
(1) Preparation

There are no tasks that must be performed before the execution.

(2) Operating Procedure

Use the following procedure.

1. In the SigmaWin+ main window, click **Monitor - Product Information**.
The **Product Information** box will appear.



Click these buttons to view the serial number and date of manufacture for each device used.

2. Click **OK**.
The SigmaWin+ main window will appear.

9.12 Software Reset

This function enables resetting the SERVOPACK internally from software. This function is used when resetting alarms and changing the settings of parameters that normally require restarting the SERVOPACK. This function can be used to change those parameters without restarting the SERVOPACK.

IMPORTANT

- Start software reset operation after the servomotor power is OFF.
- This function resets the SERVOPACK independently of the host controller. The same processing is performed by the SERVOPACK as when you turn the power supply OFF and ON again.
- The SERVOPACK will not respond for 5 seconds after the reset begins.
  Always check the status of the SERVOPACK and motor before you execute a reset.

(1) Preparation

Make sure that the servo is OFF before you execute a software reset.

(2) Operating Procedure

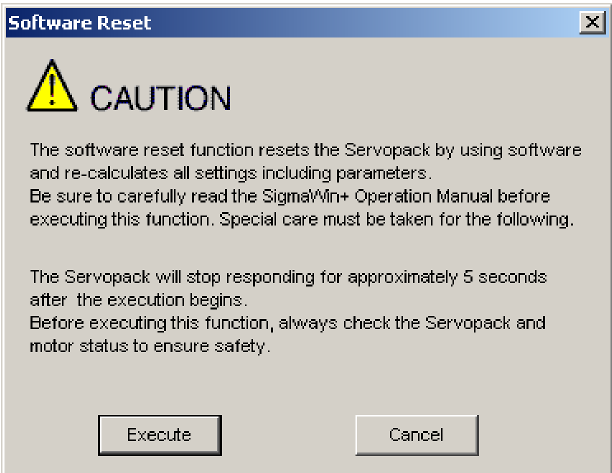
Use the following procedure.

■ Conventional connection

1. In the SigmaWin+ main window, click **Setup** - **Software Reset**.

The following message will appear and remind you to check the status of the SERVOPACK and the motor for safety reasons because the SERVOPACK will stop responding for about 5 seconds after the software reset has been executed.

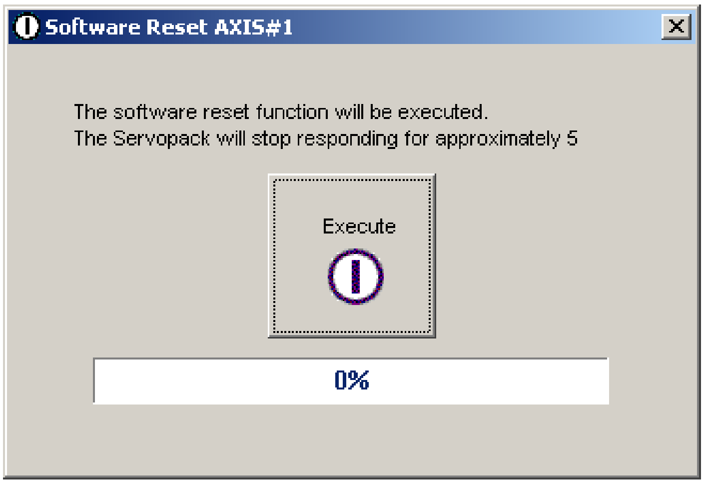
Note: If the moment of inertia is calculated as described in *8.3 Advanced Autotuning*, the **Software Reset** box shown in step 2 will appear.



If you do not want to continue, click **Cancel**. The SigmaWin+ main window will appear.

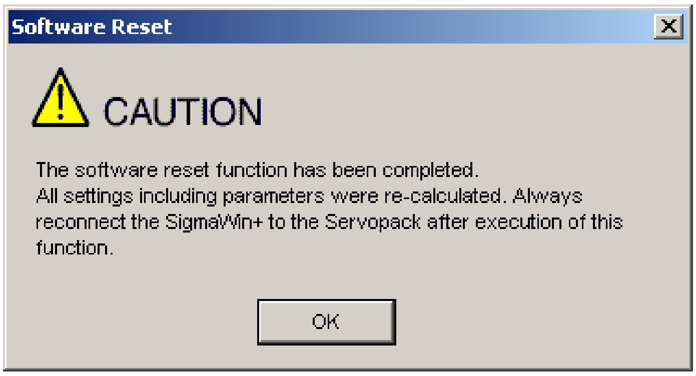
2. Click **Execute**.

The **Software Reset** box will appear.



3. Click **Execute**.

After resetting of software has been completed, the following message will appear.



4. Click **OK** to close the **Software Reset** box.

All settings including parameters have been re-calculated. Disconnect the SigmaWin+ from the SERVOPACK, and then reconnect to validate the new settings.

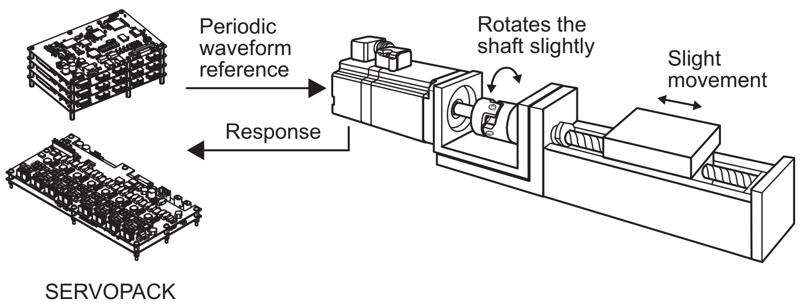
9.13 EasyFFT

EasyFFT sends a frequency waveform reference from the SERVOPACK to the servomotor and slightly rotates the servomotor several times over a certain period, thus causing machine vibration. The SERVOPACK detects the resonance frequency from the generated vibration and makes notch filter settings according to the resonance frequency detection. The notch filter is effective for the elimination of high-frequency vibration and noise.

Execute this function after the servomotor power is turned OFF if operation of the SERVOPACK results in high-frequency noise and vibration.

⚠ WARNING
• The servomotor automatically will move less than a quarter of a turn several times in the specified direction when EasyFFT is executed. Do not touch the servomotor or machine during execution of EasyFFT, otherwise injury may result.

⚠ CAUTION
• Use the EasyFFT when the servo gain is low, such as in the initial stage of servo adjustment. If EasyFFT is executed after increasing the gain, the servo system may vibrate depending on the machine characteristics or gain balance.



In addition to this function, online vibration monitor can be used to detect machine vibration and automatically make notch filter settings.

If a SERVOPACK is used to make adjustments, it is recommended to use advanced autotuning. This built-in EasyFFT function is used to maintain interchangeability with previous models. There is normally no need to use it.

(1) Preparation

The following conditions must be met to perform EasyFFT.

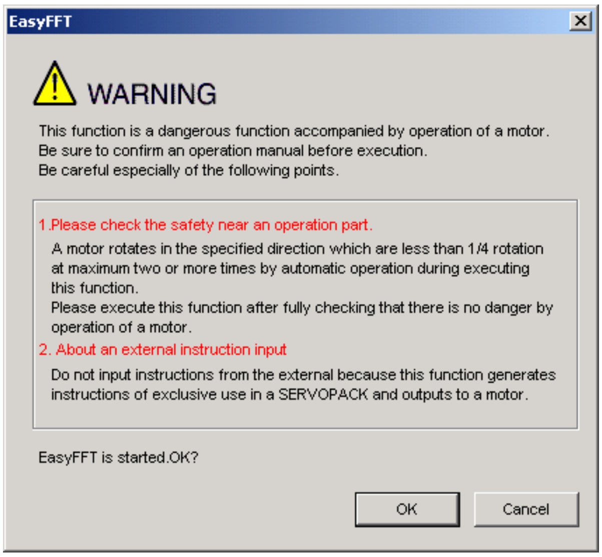
- The write prohibited setting parameter must be set to Write permitted.
- The main circuit power supply must be ON.
- All alarms must be cleared.
- The servomotor power must be OFF.
- There must be no overtravel.
- An external reference must not be input.

(2) Operating Procedure

Use the following procedure.

1. In the SigmaWin+ main window, click **Setup** - **EasyFFT**.

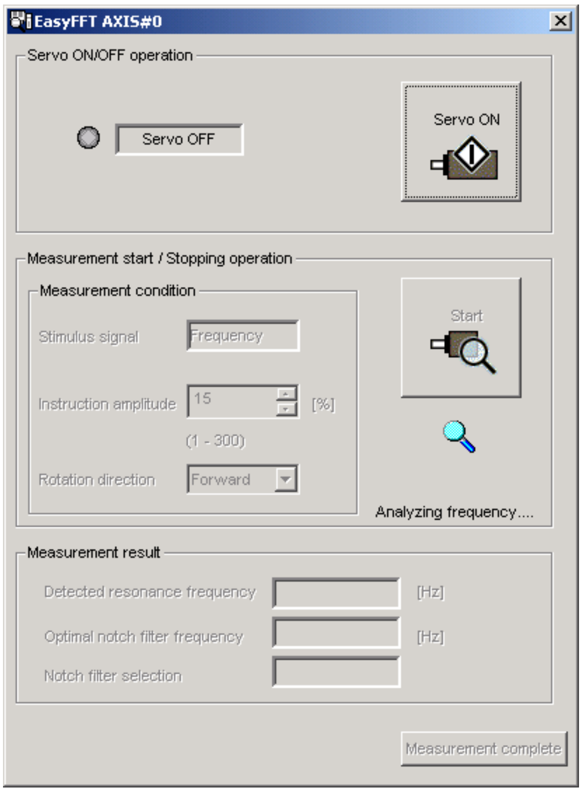
A warning message will appear and remind you of possible dangers.



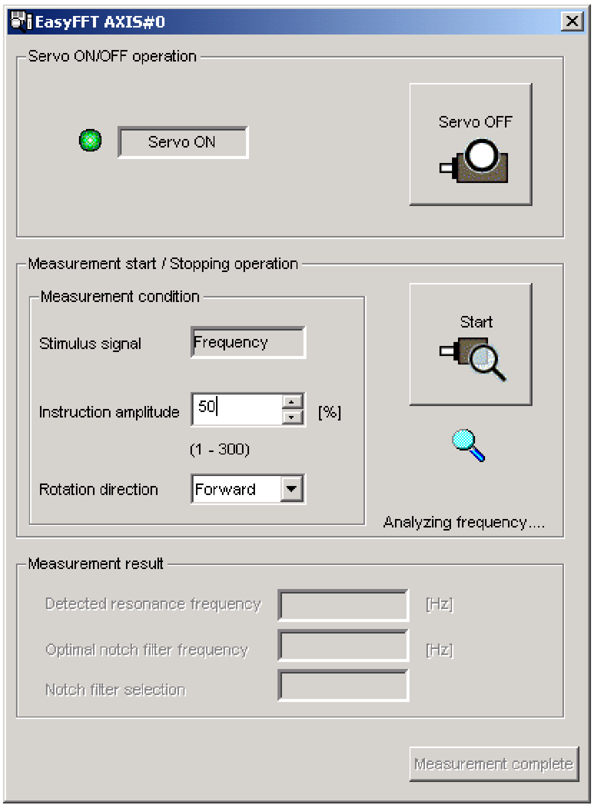
If you do not want to continue, click **Cancel**. The **SigmaWin+** main window will appear.

2. Click **OK**.

The **EasyFFT** box will appear.

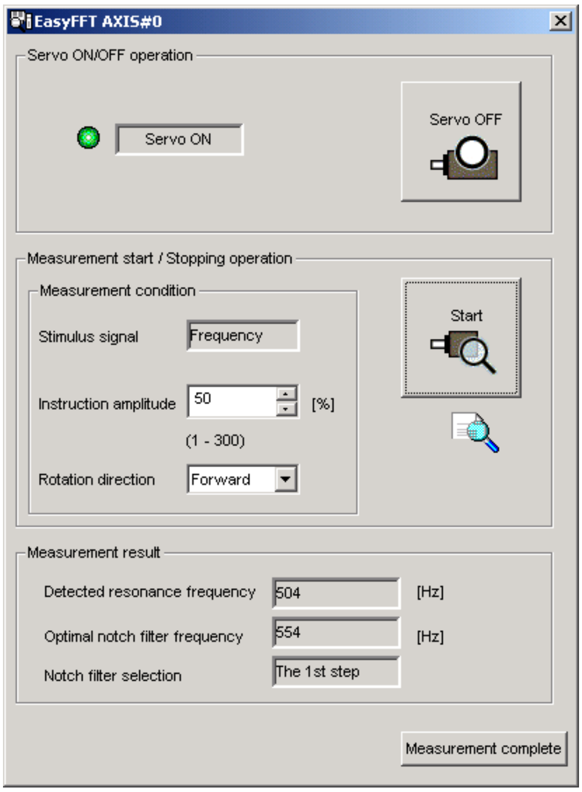


3. Click **Servo ON**.

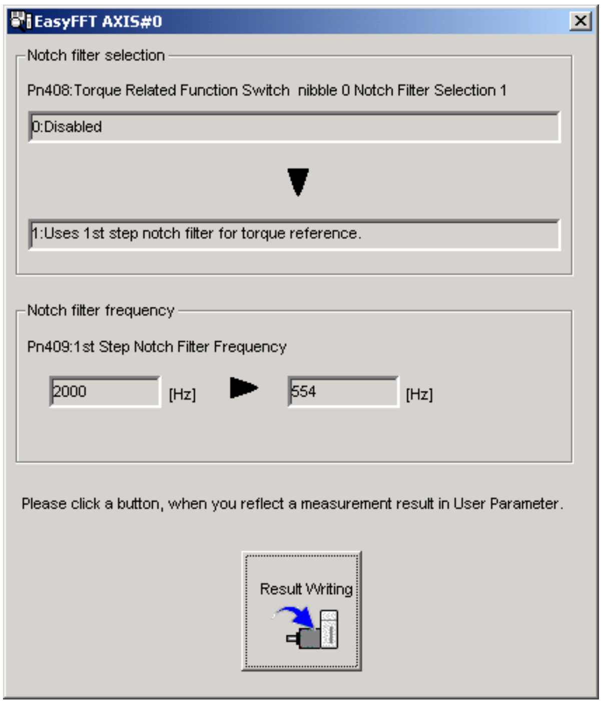


4. Select the percentage in the **Instruction amplitude** box and the rotational direction in the **Rotation direction**. Click **Start**.

The motor will begin to rotate, and the frequency will be measured. After the frequency has been measured, the results will be shown in the lower area of the box.



5. Click **Measurement complete**.



6. If setting the parameters to the values shown in the measurement results, click **Result Writing**.

(3) Related Parameters

The following parameters are either referenced or automatically changed during execution of EasyFFT.

Do not change the settings of these parameters from the SigmaWin+ or any other means during execution of EasyFFT.

Parameter	Name	Automatic changes
Pn408	Torque Related Function Switch	Yes
Pn409	1st Notch Filter Frequency	Yes
Pn40A	1st Notch Filter Q Value	No
Pn40C	2nd Notch Filter Frequency	Yes
Pn40D	2nd Notch Filter Q Value	No
Pn456	Sweep Torque Reference Amplitude	No

9.14 Online Vibration Monitor

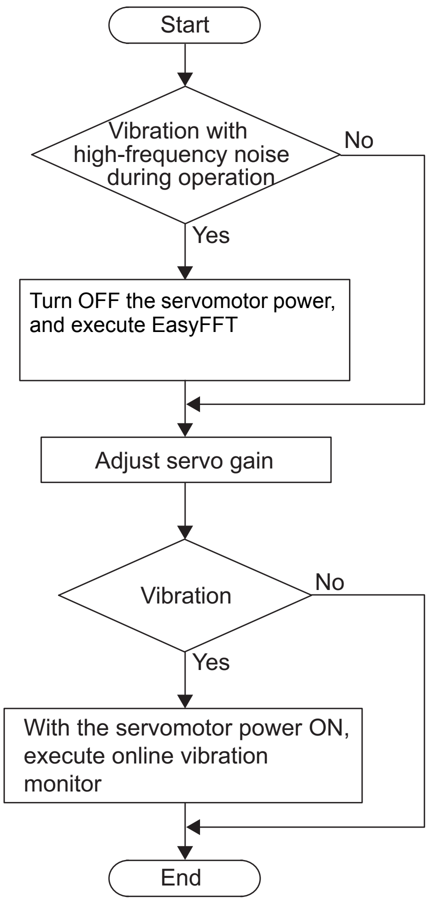
If vibration is generated during operation and this function is executed while the servomotor power is still ON, the machine vibration can sometimes be suppressed by setting a notch filter or torque reference filter for the vibration frequencies.

When online, vibration frequency caused by machine resonance will be detected and the frequency that has the highest peak will be displayed on the panel operator. The effective torque reference filter or notch filter frequency for the vibration frequencies will be automatically selected and the related parameters will be automatically set.

In addition to this function, EasyFFT (Fn206) can be used to detect machine vibration and automatically make notch filter settings. Use the following flowchart to determine how these functions should be used.

We recommend that you use advanced autotuning to adjust (tune) the SERVOPACK. This built-in function is used to maintain interchangeability with previous models. There is normally no need to use it.

How to use EasyFFT and online vibration monitor,
when they are mainly used for servo gain adjustment.



(1) Preparation

The following conditions must be met to perform online vibration monitoring.

- The write prohibited setting parameter must be set to Write permitted.
- The servomotor power must be ON.
- There must be no overtravel.
- The correct moment of inertia (Pn103) must be set.

(2) Operating Procedure

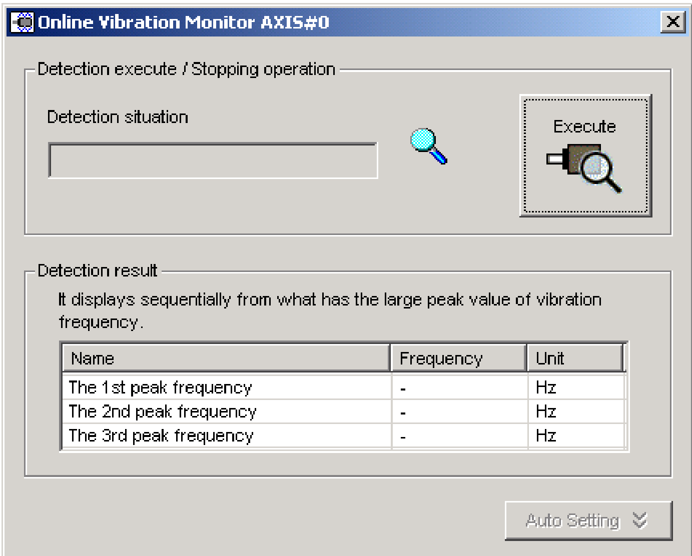
Use the following procedure.

1. In the SigmaWin+ main window, click **Monitor** - **Online Vibration Monitor**.

A message will appear as a warning to say that any changes to parameter settings might greatly affect the operation of the motor, and then ask if you want to continue.

2. Click **OK**.

The **Online Vibration Monitor** box will appear.



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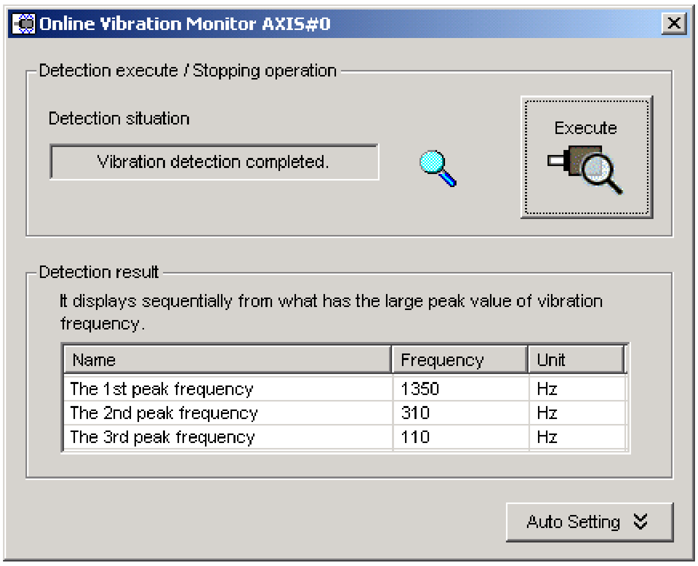
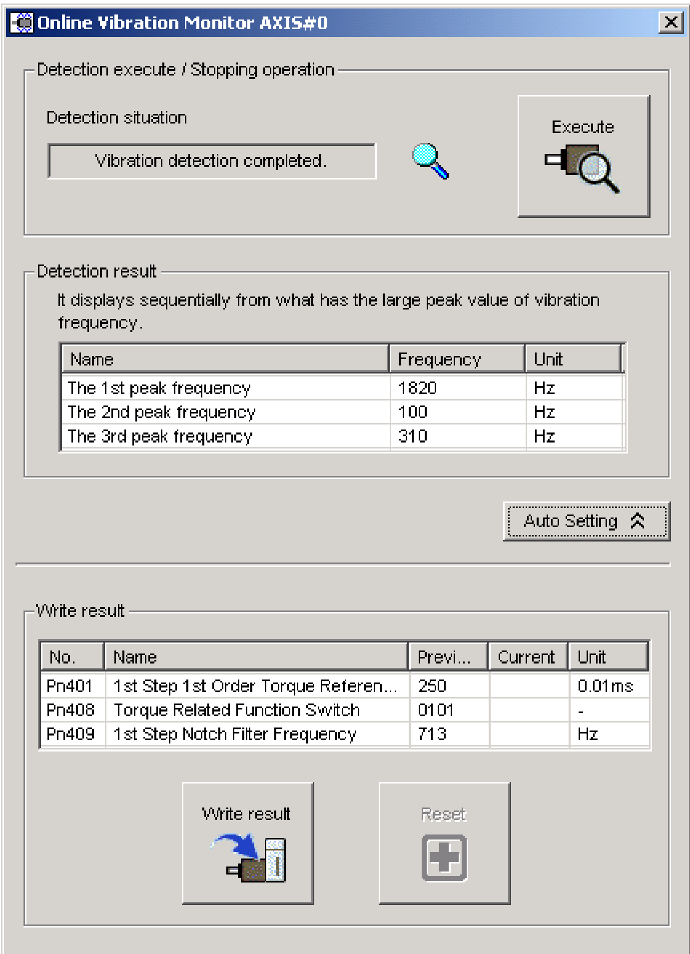
3. Click **Execute** to activate the vibration sensor.

The vibrations are detected, and the peak frequencies of the vibrations will be shown in the **Detection result** table.



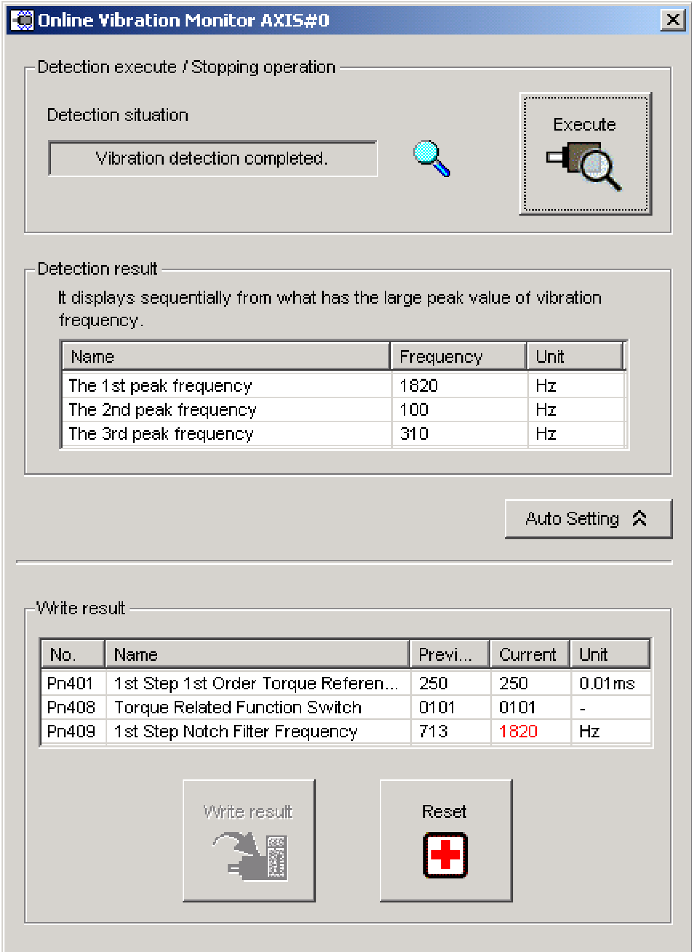
4. Click **Auto Setting**.

The pre-adjustment parameter settings will be shown in the **Previous** column in the **Write result** table.



5. Click **Write result.**

The parameter values those are most effective for the measured frequencies will be shown in the **Current** column in the **Write result** table, and then saved in the SERVOPACK.



If you do not want to save the new parameter settings in the SERVOPACK, click **Reset**.

(3) Related Parameters

The following parameters are either referenced or automatically changed during execution of online vibration monitoring.

Do not change the settings of these parameters from the SigmaWin+ or any other means during execution of online vibration monitoring.

Parameter	Name	Automatic changes
Pn401	Torque Reference Filter Time Constant	Yes
Pn408	Torque Related Function Switch	Yes
Pn409	1st Notch Filter Frequency	Yes
Pn40A	1st Notch Filter Q Value	No
Pn40C	2nd Notch Filter Frequency	No
Pn40D	2nd Notch Filter Q Value	No

10

Maintenance, Inspections, and Troubleshooting

10.1 Maintenance and Inspections

This section describes the inspection and maintenance of SERVOPACK.

(1) SERVOPACK Inspection

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

Item	Frequency	Procedure	Comments
Exterior	At least once a year	Check for dust, dirt, and oil on the surfaces.	Clean with compressed air.

(2) SERVOPACK's Parts Replacement Schedule

The electric or electronic parts are subject to deterioration over time. To avoid failure, replace these parts at the frequency indicated.

Refer to the standard replacement period in the following table and contact your Yaskawa representative. After an examination of the part in question, we will determine whether the parts should be replaced or not.

IMPORTANT

The parameters of any SERVOPACKs overhauled by Yaskawa are reset to the factory settings before shipping. Be sure to confirm that the parameters are properly set before starting operation.

Part	Standard Replacement Period	Operating Conditions
Smoothing Capacitor (Aluminum Electrolytic Capacitor)	7 to 8 years	• Surrounding Air Temperature: Annual average of 30°C • Load Factor: 80% max. • Operation Rate: 20 hours/day max.

Note: If the above operating conditions are not used, replacement may be required sooner than the standard replacement period. To extend the life of the parts, reduce the surrounding air temperature. Contact your Yaskawa representative if you require more-detailed information.

10.2 Alarm Displays

The following sections describe troubleshooting in response to alarm displays.

The alarm name, alarm meaning, alarm stopping method, and alarm reset capability are listed in order of the alarm numbers in *10.2.1 List of Alarms*.

The causes of alarms and troubleshooting methods are provided in *10.2.2 Troubleshooting of Alarms*.

10.2.1 List of Alarms

This section provides list of alarms.

■ Servomotor Stopping Method

If an alarm occurs, the servomotor can be stopped by doing either of the following operations.

Gr.1: The servomotor coasts to a stop when an alarm occurs.

Gr.2: The servomotor is stopped according to the setting in Pn00B.1 if an alarm occurs. Pn00B.1 is factory-set to stop the servomotor by setting the speed reference to "0." The servomotor under torque control will always use the Gr.1 method to stop. By setting Pn00B.1 to 1, the servomotor stops using the same method as Gr.1. When coordinating a number of servomotors, use this stopping method to prevent machine damage that may result due to differences in the stop method.

■ Alarm Reset

Available: Removing the cause of alarm and then executing the alarm reset can clear the alarm.
N/A: Executing the alarm reset cannot clear the alarm.

Alarm Number	Alarm Name	Meaning	Servo-motor Stopping Method	Alarm Reset
A.020	Parameter error 1	The parameter data in the SERVOPACK is incorrect.	Gr.1	N/A
A.021	Parameter error 2	The parameter data in the SERVOPACK is incorrect.	Gr.1	N/A
A.022	Parameter error 3	The parameter data in the SERVOPACK is incorrect.	Gr.1	N/A
A.023	Parameter error 4	The parameter data in the SERVOPACK is incorrect.	Gr.1	N/A
A.030	Main Circuit Detector Error	Detection data for main circuit is incorrect.	Gr.1	Available
A.040	Parameter Setting Error 1	The parameter setting is outside the setting range.	Gr.1	N/A
A.042	Parameter Combination Error	Combination of some parameters exceeds the setting range.	Gr.1	N/A
A.050	Combination Error	The SERVOPACK and the servomotor capacities do not match each other.	Gr.1	Available
A.051	Unsupported Device Alarm	The device unsupported was connected.	Gr.1	N/A
A.0b0	Cancelled Servo ON Command Alarm	The servo ON command (SV_ON) was sent from the host controller after executing a utility function that turns ON servomotor.	Gr.1	Available
A.100	Overcurrent or Heat Sink Overheated	An overcurrent flowed through the IGBT.	Gr.1	N/A
A.400	Overvoltage	Main circuit DC voltage is excessively high.	Gr.1	Available
A.510	Overspeed	The servomotor speed is above the maximum rotational speed.	Gr.1	Available
A.520	Vibration Alarm	Incorrect vibration at the motor speed was detected.	Gr.1	Available

(cont'd)

Alarm Number	Alarm Name	Meaning	Servo-motor Stopping Method	Alarm Reset
A.521	Autotuning Alarm	Vibration was detected while performing tuning-less function.	Gr.1	Available
A.710	Overload: High Load	The servomotor was operating for several seconds to several tens of seconds under a torque largely exceeding ratings.	Gr.2	Available
A.720	Overload: Low Load	The servomotor was operating continuously under a torque exceeding ratings.	Gr.1	Available
A.7A3	Control Board Overheat	The temperature of the control board exceeded 95°C.	Gr.2	Available
A.810	Encoder Backup Error	The power supplies to the encoder all failed and position data was lost.	Gr.1	N/A
A.820	Encoder Checksum Error	The checksum results of encoder memory is incorrect.	Gr.1	N/A
A.830	Absolute Encoder Battery Error	The battery voltage was lower than the specified value after the control power supply was turned ON.	Gr.1	Available
A.840	Encoder Data Error	Data in the encoder is incorrect.	Gr.1	N/A
A.850	Encoder Overspeed	The encoder was rotating at high speed when the power was turned ON.	Gr.1	N/A
A.860	Encoder Overheated	The internal temperature of encoder is too high.	Gr.1	N/A
A.b31	Current Detection Error 1	The current detection circuit for phase U is faulty.	Gr.1	N/A
A.b32	Current Detection Error 2	The current detection circuit for phase V is faulty.	Gr.1	N/A
A.b33	Current Detection Error 3	The detection circuit for the current is faulty.	Gr.1	N/A
A.b6A	MECHATROLINK Communications ASIC Error 1	ASIC error occurred in the MECHATROLINK communications.	Gr.1	N/A
A.b6b	MECHATROLINK Communications ASIC Error 2	ASIC error occurred in the MECHATROLINK communications.	Gr.2	N/A
A.bF0	System Alarm 0	"Internal program error 0" of the SERVOPACK occurred.	Gr.1	N/A
A.bF1	System Alarm 1	"Internal program error 1" of the SERVOPACK occurred.	Gr.1	N/A
A.bF2	System Alarm 2	"Internal program error 2" of the SERVOPACK occurred.	Gr.1	N/A
A.bF3	System Alarm 3	"Internal program error 3" of the SERVOPACK occurred.	Gr.1	N/A
A.bF4	System Alarm 4	"Internal program error 4" of the SERVOPACK occurred.	Gr.1	N/A
A.C10	Servo Overrun Detected	The servomotor ran out of control.	Gr.1	Available
A.C80	Absolute Encoder Clear Error and Multiturn Limit Setting Error	The multiturn for the absolute encoder was not properly cleared or set.	Gr.1	N/A
A.C90	Encoder Communications Error	Communications between the SERVOPACK and the encoder is not possible.	Gr.1	N/A
A.C91	Encoder Communications Position Data Error	An encoder position data calculation error occurred.	Gr.1	N/A
A.C92	Encoder Communications Timer Error	An error occurs in the communications timer between the encoder and the SERVOPACK.	Gr.1	N/A
A.CA0	Encoder Parameter Error	Encoder parameters are faulty.	Gr.1	N/A

(cont'd)

Alarm Number	Alarm Name	Meaning	Servo-motor Stopping Method	Alarm Reset
A.Cb0	Encoder Echoback Error	Contents of communications with encoder are incorrect.	Gr.1	N/A
A.CC0	Multiturn Limit Disagreement	Different multiturn limits have been set in the encoder and the SERVOPACK.	Gr.1	N/A
A.d00	Position Error Overflow	Position error exceeded the value of excessive position error alarm level (Pn520) when the servomotor power is ON.	Gr.1	Available
A.d01	Position Error Overflow Alarm at Servo ON	The position error is too large.	Gr.1	Available
A.E02	MECHATROLINK Internal Synchronization Error 1	Synchronization error during MECHATROLINK communications with the SERVOPACK.	Gr.1	Available
A.E40	MECHATROLINK Transmission Cycle Setting Error	The setting of the MECHATROLINK transmission cycle is out of the allowable range.	Gr.2	Available
A.E41	MECHATROLINK Communications Data Size Setting Error	The setting of the MECHATROLINK communications data size is incorrect.	Gr.2	Available
A.E42	MECHATROLINK Station Address Setting Error	The setting of the MECHATROLINK station address is incorrect.	Gr.2	N/A
A.E50	MECHATROLINK Synchronization Error	A synchronization error occurs during MECHATROLINK communications.	Gr.2	Available
A.E51	MECHATROLINK Synchronization Failed	A synchronization failure occurs in MECHATROLINK communications.	Gr.2	Available
A.E60	MECHATROLINK Communications Error (Reception error)	A communications error occurs continuously during MECHATROLINK communications.	Gr.2	Available
A.E61	MECHATROLINK Transmission Cycle Error (Synchronization interval error)	The transmission cycle fluctuates during MECHATROLINK communications.	Gr.2	Available
A.E63	MECHATROLINK Synchronization Frame Not Received Alarm	Synchronization frames are not received continuously during MECHATROLINK communications.	Gr.2	Available
A.Ed1	Command Execution Timeout	A timeout error occurred when using a MECHATROLINK command.	Gr.2	Available

Note: For any of the following alarm numbers, an alarm will be detected for all of the axes at the same time: A.030, A.400, A.7A3, A.b6A, A.b6b, A.E02, A.E40, A.E41, A.E42, A.E61, and A.E63. For all other alarm numbers, alarms are detected individually for each axis.

10.2.2 Troubleshooting of Alarms

When a problem occurs in the servo drive, you can detect it by reading the alarm with the MECHATROLINK ALM_RD command. You can check the alarm that occurs in the **Alarm Display** dialog box of the SigmaWin+.

Refer to the following table to identify the cause of an alarm and the action to be taken.
Contact your Yaskawa representative if the problem cannot be solved by the described corrective action.

Alarm Number: Alarm Name (Alarm Description)	Cause	Investigative Actions	Corrective Actions
A.020: Parameter error 1	The power supply went OFF while changing a parameter setting.	Check the circumstances when the power supply went OFF.	Set Fn005 to initialize the parameter and then set the parameter again.
	The number of times that parameters were written exceeded the limit.	Check to see if the parameters were frequently changed through the host controller.	The SERVOPACK may be faulty. Replace the SERVOPACK. Reconsider the method of writing parameters.
	Malfunction caused by noise from the AC power supply or grounding line, static electricity noise, etc.	Restart the SERVOPACK several times. If the alarm still occurs, there may be noise interference.	Take countermeasures against noise.
	Gas, water drops, or cutting oil entered the SERVOPACK and caused failure of the internal components.	Check the installation conditions.	The SERVOPACK may be faulty. Replace the SERVOPACK.
	A SERVOPACK fault occurred.	Restart the SERVOPACK several times. If the alarm still occurs, the SERVOPACK may be faulty.	The SERVOPACK may be faulty. Replace the SERVOPACK.
A.021: Parameter error 2	The software version of SERVOPACK that caused the alarm is older than that of the written parameter.	Check if the set software version agrees with that of the SERVOPACK. If not, an alarm may occur.	Write the parameter of another SERVOPACK of the same model with the same software version. Restart the SERVOPACK.
	A SERVOPACK fault occurred.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.
A.022: Parameter error 3	The power supply went OFF while setting a utility function.	Check the circumstances when the power supply went OFF.	The SERVOPACK may be faulty. Replace the SERVOPACK.
	A SERVOPACK fault occurred.	Restart the SERVOPACK several times. If the alarm still occurs, the SERVOPACK may be faulty.	The SERVOPACK may be faulty. Replace the SERVOPACK.
A.023: Parameter error 4	The power board is not connected.	–	Make sure the control board and power board are mounted properly.
	A SERVOPACK fault occurred.	–	Replace the SERVOPACK.
A.030: Main Circuit Detector Error	A SERVOPACK fault occurred.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.
A.040: Parameter Setting Error 1 (The parameter setting was out of the setting range.)	The SERVOPACK and servomotor capacities do not match each other.	Check the combination of SERVOPACK and servomotor capacities.	Select the proper combination of SERVOPACK and servomotor capacities.
	A SERVOPACK fault occurred.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.
	The parameter setting is out of the setting range.	Check the setting ranges of the parameters that have been changed.	Set the parameter to a value within the setting range.
	The electronic gear ratio is out of the setting range.	Make sure the gear ratio satisfies the following conditions: 0.001 < (PnA42/PnA44) < 4,000.	Set the gear ratio so that it satisfies the following conditions: 0.001 < (PnA42/PnA44) < 4,000.

(cont'd)

Alarm Number: Alarm Name (Alarm Description)	Cause	Investigative Actions	Corrective Actions
A.042: Parameter Combination Error	The speed of program JOG operation is lower than the setting range after changing the electronic gear ratio (PnA42/PnA44) or the servomotor.	Check if the detection conditions*1 are satisfied.	Decrease the gear ratio (PnA42/PnA44).
	The speed of program JOG operation is lower than the setting range after having changed the setting of the program JOG movement speed (Pn533).	Check if the detection conditions*1 are satisfied.	Increase the setting of the program JOG movement speed (Pn533).
	The travel speed for advanced autotuning is lower than the setting range after changing the electronic gear ratio (PnA42/PnA44) or the servomotor.	Check if the detection conditions*2 are satisfied.	Decrease the gear ratio (PnA42/PnA44).
A.050: Combination Error (The SERVOPACK and servomotor capacities do not correspond.)	The SERVOPACK and servomotor capacities do not match each other.	Check the capacities to see if they satisfy the following condition: $\frac{1}{4} \leq \frac{\text{Servomotor capacity}}{\text{SERVOPACK capacity}} \leq 4$	Select the proper combination of SERVOPACK and servomotor capacities.
	An encoder fault occurred.	Replace the servomotor and see if the alarm occurs again.	Replace the servomotor (encoder).
A.051: Unsupported Device Alarm	An unsupported encoder is connected to the SERVOPACK.	Check the product specifications, and select the correct model.	Select the correct combination of units.
A.0b0: Cancelled Servo ON Command Alarm	After executing the utility function to turn ON the power to the motor, the servo ON command (SV_ON) was sent from the host controller.	–	Restart the SERVOPACK or execute a software reset.

*1. Detection conditions
If one of the following conditions detected, an alarm occurs.

- $\text{Pn533 [min}^{-1}] \times \frac{\text{Encoder resolution}}{6 \times 10^5} \leq \frac{\text{PnA42}}{\text{PnA44}}$
- $\text{Max Motor Speed [min}^{-1}] \times \frac{\text{Encoder resolution}}{\text{About } 3.66 \times 10^{12}} \geq \frac{\text{PnA42}}{\text{PnA44}}$

*2. Detection conditions
If one of the following conditions detected, an alarm occurs.

- $\text{Rated Motor Speed [min}^{-1}] \times \frac{1}{3} \times \frac{\text{Encoder resolution}}{6 \times 10^5} \leq \frac{\text{PnA42}}{\text{PnA44}}$
- $\text{Max Motor Speed [min}^{-1}] \times \frac{\text{Encoder resolution}}{\text{About } 3.66 \times 10^{12}} \geq \frac{\text{PnA42}}{\text{PnA44}}$

(cont'd)

Alarm Number: Alarm Name (Alarm Description)	Cause	Investigative Actions	Corrective Actions
A.100: Overcurrent or Heat Sink Overheated (An overcurrent flowed through the IGBT or heat sink of SERVOPACK overheated.)	The servomotor/encoder relay cable is either incorrectly wired or has a contact fault.	Check the wiring. Refer to *5.1 Wiring the Main Circuit and Control Power Supplies*.	Correct the wiring.
	The servomotor/encoder relay cable is either internally shorted or has a ground fault.	Check for short-circuits across the servomotor terminal phases U, V, and W, or between the grounding and servomotor terminal phases U, V, or W. Refer to *5.1 Wiring the Main Circuit and Control Power Supplies*.	The cable may be short-circuited. Replace the cable.
	Short-circuit or ground fault inside the servomotor.	Check for short-circuits across the servomotor terminal phases U, V, and W, or between the grounding and servomotor terminal phases U, V, or W. Refer to *5.1 Wiring the Main Circuit and Control Power Supplies*.	The servomotor may be faulty. Replace the servomotor.
	Short-circuit or ground fault inside the SERVOPACK.	Check for short-circuits across the servomotor connection terminals U, V, and W on the SERVOPACK, or between the grounding and terminal U, V, or W. Refer to *5.1 Wiring the Main Circuit and Control Power Supplies*.	The SERVOPACK may be faulty. Replace the SERVOPACK.
	A heavy load was applied while the servomotor was stopped or running at a low speed.	Check to see if the operating conditions are outside servo drive specifications.	Reduce the load applied to the servomotor or increase the operating speed.
	Malfunction caused by noise interference.	Improve the wiring or installation environment, such as by reducing noise, and check to see if the alarm recurs.	Take countermeasures for noise, such as correct wiring of the FG. Use an FG wire size equivalent to the SERVOPACK main circuit wire size.
	A SERVOPACK fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.400: Overvoltage (Detected in the SERVOPACK main circuit power supply section.)	The DC power supply voltage exceeded 60 V.	Measure the power supply voltage.	Set DC power supply voltage within the specified range.
	The power supply is unstable, or was influenced by a lightning surge.	Measure the power supply voltage.	Improve the power supply conditions by installing a surge absorber, etc. Then, restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
	Voltage for DC power supply was too high during acceleration or deceleration.	Check the power supply voltage and the speed and torque during operation.	Set DC power supply voltage within the specified range.
	The moment of inertia ratio exceeded the allowable value.	Confirm that the moment of inertia ratio is within the allowable range.	Increase the deceleration time, or reduce the load.
A.510: Overspeed (The servomotor speed exceeds the maximum.)	The order of phases U, V, and W in the servomotor wiring is incorrect.	Check the motor wiring.	Confirm that the servomotor is correctly wired.
	A reference value exceeding the overspeed detection level was input.	Check the input value.	Reduce the reference value or adjust the gain.
	The motor speed exceeded the maximum.	Check the motor speed waveform.	Reduce the speed reference input gain, adjust the servo gain, or reconsider the operating conditions.

(cont'd)

Alarm Number: Alarm Name (Alarm Description)	Cause	Investigative Actions	Corrective Actions
A.520: Vibration Alarm	Abnormal vibration was detected at the motor speed.	Check for abnormal noise from the servomotor, and check the speed and torque waveforms during operation.	Reduce the motor speed or reduce the speed loop gain (PnAC2).
	The moment of inertia ratio (Pn103) value is greater than the actual value or is greatly changed.	Check the moment of inertia ratio.	Set the moment of inertia ratio (Pn103) to an appropriate value.
A.521: Autotuning Alarm (Vibration was detected while executing the one-parameter tuning, EasyFFT, or tuning-less function.)	The servomotor vibrated considerably while performing tuning-less function.	Check the motor speed waveform.	Reduce the load so that the moment of inertia ratio falls within the allowable value, or raise the load level using the tuning-less levels setting or reduce the rigidity level.
	The servomotor vibrated considerably during one-parameter tuning or EasyFFT.	Check the motor speed waveform.	Check the operation procedure of corresponding function and take a corrective action.
A.710: A.720: Overload A.710: High Load A.720: Low Load	Incorrect wiring or contact fault of servomotor and encoder.	Check the wiring.	Confirm that the servomotor and encoder are correctly wired.
	Operation beyond the overload protection characteristics.	Check the servomotor overload characteristics and executed run command.	Reconsider the load conditions and operating conditions. Or, increase the motor capacity.
	Excessive load was applied during operation because the servomotor was not driven due to mechanical problems.	Check the executed operation reference and motor speed.	Remove the mechanical problems.
A.7A3: Control Board Overheat	The surrounding air temperature of the SERVOPACK is too high.	Measure the surrounding air temperature of the SERVOPACK.	Improve the installation conditions of the SERVOPACK to reduce the surrounding air temperature.
A.810: Encoder Backup Error (Only when an absolute encoder is connected.) (Detected on the encoder side.)	Alarm occurred when the power to the absolute encoder was initially turned ON.	Check to see if the power was turned ON initially.	Set up the encoder.
	The encoder cable disconnected, and connected again.	Check to see if the power was turned ON initially.	Confirm the connection and set up the encoder.
	The power from both the control power supply (+5 V) from the SERVOPACK and the battery power supply is not being supplied.	Check the encoder connector battery or the connector contact status.	Replace the battery or take similar measures to supply power to the encoder, and set up the encoder.
	An absolute encoder fault occurred.	–	If the alarm cannot be reset by setting up the encoder again, replace the servomotor.
A.820: Encoder Checksum Error (Detected on the encoder side.)	An encoder fault occurred.	–	• Absolute encoder Set up the encoder again using Fn008. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor. • One-turn absolute encoder or incremental encoder The servomotor may be faulty. Replace the servomotor.
A.830: Absolute Encoder Battery Error (The absolute encoder battery voltage is lower than the specified value.)	The battery connection is incorrect.	Check the battery connection.	Reconnect the battery.
	The battery voltage is lower than the specified value 2.7 V.	Measure the battery voltage.	Replace the battery.

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Alarm Number: Alarm Name (Alarm Description)	Cause	Investigative Actions	Corrective Actions
A.840: Encoder Data Error (Detected on the encoder side.)	An encoder malfunctioned.	–	Restart the SERVOPACK. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor.
	Malfunction of encoder because of noise interference, etc.	–	Correct the wiring around the encoder (e.g., grounding).
A.850: Encoder Overspeed (Detected when the control power supply was turned ON.) (Detected on the encoder side.)	The servomotor speed is higher than 200 min^{-1} when the control power supply was turned ON.	Check the motor rotating speed to confirm the servomotor speed when the power is turned ON.	Reduce the servomotor speed to a value less than 200 min^{-1}, and turn ON the control power supply.
	An encoder fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor.
A.860: Encoder Overheated (Only when an absolute encoder is connected.) (Detected on the encoder side.)	The surrounding air temperature around the servomotor is too high.	Measure the surrounding air temperature around the servomotor.	The surrounding air temperature must be 40°C or less.
	The motor load is greater than the rated load.	Check the accumulated load ratio to see the load.	The motor load must be within the specified range.
	An encoder fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor.
A.b31: Current Detection Error 1	The servomotor/encoder relay cable is disconnected.	Check the servomotor/encoder relay cable.	Correct the motor wiring.
	The current detection circuit for phase U is faulty.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.b32: Current Detection Error 2	The servomotor/encoder relay cable is disconnected.	Check the servomotor/encoder relay cable.	Correct the motor wiring.
	The current detection circuit for phase V is faulty.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.b33: Current Detection Error 3	The servomotor/encoder relay cable is disconnected.	Check the servomotor/encoder relay cable.	Correct the servomotor wiring.
	The detection circuit for the current is faulty.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.b6A: MECHATROLINK Communications ASIC Error 1	SERVOPACK MECHATROLINK communication section fault.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.b6b: MECHATROLINK Communications ASIC Error 2	MECHATROLINK data reception error occurred due to noise interference.	–	Take measures against noise. Check the MECHATROLINK communications cable and FG wiring and take measures such as adding ferrite core on the MECHATROLINK communications cable.
	SERVOPACK MECHATROLINK communication section fault.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.bF0: System Alarm 0	A SERVOPACK fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.

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Alarm Number: Alarm Name (Alarm Description)	Cause	Investigative Actions	Corrective Actions
A.bF1: System Alarm 1	A SERVOPACK fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.bF2: System Alarm 2	A SERVOPACK fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.bF3: System Alarm 3	A SERVOPACK fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.bF4: System Alarm 4	A SERVOPACK fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.C10: Servo Overrun Detected (Detected when the servomotor power is ON.)	The order of phases U, V, and W in the servomotor wiring is incorrect.	Check the motor wiring.	Confirm that the servomotor is correctly wired.
	An encoder fault occurred.	–	If the alarm still occurs after restarting the SERVOPACK, even though the servomotor is correctly wired, the servomotor may be faulty. Replace the servomotor.
	A SERVOPACK fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.C80: Absolute Encoder Clear Error and Multiturn Limit Setting Error	An encoder fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor.
A.C90: Encoder Communications Error	Contact fault of connector or incorrect wiring for encoder cable.	Check the connector contact status for encoder cable.	Re-insert the connectors and confirm that the encoder is correctly wired.
	Cable disconnection for encoder cable or short-circuit. Or, incorrect cable impedance.	Check the encoder cable.	Use the cables with the specified rating.
	Corrosion caused by improper temperature, humidity, or gas, short-circuit caused by intrusion of water drops or cutting oil, or connector contact fault caused by vibration.	Check the operating environment.	Improve the operating environmental conditions, and replace the cable. If the alarm still occurs, replace the SERVOPACK.
	Malfunction caused by noise interference.	–	Correct the wiring around the encoder (e.g., grounding).
A.C91: Encoder Communications Position Data Error	Noise interference occurred on the I/O signal line because the encoder cable is bent and the sheath is damaged.	Check the encoder cable and connector.	Confirm that there is no problem with the cable layout.
	The encoder cable is bundled with a high-current line or near a high-current line.	Check the cable layout for encoder cable.	Confirm that there is no surge voltage on the cables.
	The FG potential varies because of influence from machines on the servomotor side, such as the welder.	Check the cable layout for encoder cable.	Properly ground the machines to separate from the encoder FG.

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Alarm Number: Alarm Name (Alarm Description)	Cause	Investigative Actions	Corrective Actions
A.C92: Encoder Communications Timer Error	Noise interference occurred on the I/O signal line from the encoder.	–	Take countermeasures against noise for the encoder wiring.
	Excessive vibration and shocks were applied to the encoder.	Check the operating environment.	Reduce the machine vibration or correctly install the servomotor.
	An encoder fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor.
A.CA0: Encoder Parameter Error	An encoder fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor.
A.Cb0: Encoder Echoback Error	The wiring and contact for encoder cable are incorrect.	Check the wiring.	Correct the wiring.
	Noise interference occurred due to incorrect cable specifications of encoder cable.	–	Use tinned annealed copper shielded twisted-pair or screened unshielded twisted-pair cable with a core of at least 0.12 mm^2.
	Noise interference occurred because the wiring distance for the encoder cable is too long.	–	The wiring distance must be 10 m max.
	The FG potential varies because of influence from machines on the servomotor side, such as the welder.	Check the cable layout for encoder cable.	Properly ground the machines to separate from encoder FG.
	Excessive vibration and shocks were applied to the encoder.	Check the operating environment.	Reduce the machine vibration or correctly install the servomotor.
	An encoder fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor.
A.CC0: Multiturn Limit Disagreement	The multiturn limit value of the encoder is different from that of the SERVOPACK. Or, the multiturn limit value of the SERVOPACK has been changed.	Check the value of the PnA48 of the SERVOPACK.	Execute Fn013 at the occurrence of alarm.
A.d00: Position Error Overflow (Position error exceeded the value set in the excessive position error alarm level (Pn520).)	The servomotor U, V, and W wirings is faulty.	Check the servomotor main circuit cable connection.	Confirm that there is no contact fault in the motor wiring or encoder wiring.
	The position reference speed is too high.	Reduce the reference speed, and operate the SERVOPACK.	Reduce the position reference speed or acceleration of position reference. Or, reconsider the electronic gear ratio.
	The acceleration of the position reference is too high.	Reduce the reference acceleration, and operate the SERVOPACK.	Reduce the reference acceleration of the position reference using a MECHATROLINK command, or smooth the acceleration of the position reference by selecting the position reference filter (ACCFIL) using a MECHATROLINK command.
	Setting of the excessive position error alarm level (Pn520) is low against the operating condition.	Check the alarm level (Pn520) to see if it is set to an appropriate value.	Set the Pn520 to proper value.
	A SERVOPACK fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.

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Alarm Number: Alarm Name (Alarm Description)	Cause	Investigative Actions	Corrective Actions
A.d01: Position Error Overflow Alarm at Servo ON	The position error is too large.	Check the position error amount while the servomotor power is OFF.	Set the Pn520 to proper value.
A.E02: MECHATROLINK Internal Synchronization Error 1	MECHATROLINK transmission cycle fluctuated.	–	Remove the cause of transmission cycle fluctuation at host controller.
	A SERVOPACK fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVO-PACK may be faulty. Replace the SERVOPACK.
A.E40: MECHATROLINK Transmission Cycle Setting Error	Setting of MECHATROLINK transmission cycle is out of specifications range.	Check the MECHATROLINK transmission cycle setting.	Set the transmission cycle to the proper value.
A.E41: MECHATROLINK Communications Data Size Setting Error	The setting of the number of transmission bytes (Pn881) is wrong.	Check the MECHATROLINK communications data size of the host controller.	Set the number of transmission bytes (Pn881) correctly.
A.E42: MECHATROLINK Station Address Setting Error	The station address is out of the allowable setting range.	Make sure that the station address (Pn880) is set between 03 and EF.	Check the setting of the station address of the host controller, and reset the setting of the station address (Pn880) to a proper value between 03 and EF.
	Two or more stations on the communications network have the same address.	Check that two or more stations on the communications network have the same address.	Check the setting of the station address of the host controller, and reset the setting of the station address (Pn880) to a proper value between 03 and EF.
	The axis address setting is wrong.	Check the axis address setting (Pn010 to Pn01B).	Set the axis address setting (Pn010 to Pn01B) to proper value.
A.E50: MECHATROLINK Synchronization Error	WDT data of host controller was not updated correctly.	Check the WDT data updating for the host controller.	Update the WDT data at the host controller correctly.
	A SERVOPACK fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVO-PACK may be faulty. Replace the SERVOPACK.
A.E51: MECHATROLINK Synchronization Failed	WDT data of host controller was not updated correctly at the synchronization communications start, and synchronization communications could not start.	Check the WDT data updating for the host controller.	Update the WDT data at the host controller correctly.
	A SERVOPACK fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVO-PACK may be faulty. Replace the SERVOPACK.
A.E60: MECHATROLINK Communications error (Reception error)	MECHATROLINK wiring is incorrect.	Check the MECHATROLINK wirings.	Correct the MECHATROLINK wiring. Connect the terminator correctly.
	MECHATROLINK data reception error occurred due to noise interference.	–	Take measures against noise. Check the MECHATROLINK communications cable and FG wiring and take measures such as adding ferrite core on the MECHATROLINK communications cable.
	A SERVOPACK fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVO-PACK may be faulty. Replace the SERVOPACK.

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Alarm Number: Alarm Name (Alarm Description)	Cause	Investigative Actions	Corrective Actions
A.E61: MECHATROLINK Transmission Cycle Error (Synchronization interval error)	MECHATROLINK transmission cycle fluctuated.	Check the MECHATROLINK transmission cycle setting.	Remove the cause of transmission cycle fluctuation at host controller.
	A SERVOPACK fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.E63: MECHATROLINK Synchronization Frame Not Received Alarm	MECHATROLINK wiring is incorrect.	Check the MECHATROLINK wirings.	Correct the MECHATROLINK wiring.
	MECHATROLINK data reception error occurred due to noise interference.	–	Take measures against noise. Check the MECHATROLINK communications cable and FG wiring and take measures such as adding ferrite core on the MECHATROLINK communications cable.
	A SERVOPACK fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.Ed1: Command Execution Timeout	A timeout error occurred when using an MECHATROLINK command.	Check the motor status when the command is executed.	Execute the SV_ON or SENS_ON command only when the motor is not running.

10.3 Warning Displays

The following sections describe troubleshooting in response to warning displays.

The warning name and warning meaning are listed in order of the warning numbers in *10.3.1 List of Warnings*.

The causes of warnings and troubleshooting methods are provided in *10.3.2 Troubleshooting of Warnings*.

10.3.1 List of Warnings

This section provides list of warnings.

Warning Number	Warning Name	Meaning	Reset
A.900	Position Error Overflow	Position error exceeded the parameter setting (Pn520×Pn51E/100).	Required
A.910	Overload	This warning occurs before the overload alarms (A.710 or A.720) occur. If the warning is ignored and operation continues, an overload alarm may occur.	Required
A.911	Vibration	Abnormal vibration at the motor speed was detected. The detection level is the same as A.520. Set whether to output an alarm or warning by the vibration detection switch (Pn310).	Required
A.930	Absolute Encoder Battery Error	This warning occurs when the voltage of absolute encoder's battery is lowered.	Required
A.94A[*1]	Data Setting Warning 1 (Parameter Number Error)	Incorrect command parameter number was set.	Automatic reset[*2]
A.94B[*1]	Data Setting Warning 2 (Out of Range)	Command input data is out of range.	Automatic reset[*2]
A.94C[*1]	Data Setting Warning 3 (Calculation Error)	Calculation error was detected.	Automatic reset[*2]
A.94D[*1]	Data Setting Warning 4 (Parameter Size)	Data size does not match.	Automatic reset[*2]
A.94E[*1]	Data Setting Warning 5 (Latch Mode Error)	Latch mode error is detected.	Required
A.95A[*1]	Command Warning 1 (Unsatisfying Command)	Command was sent although the conditions for sending a command were not satisfied.	Automatic reset[*2]
A.95B[*1]	Command Warning 2 (Non-supported Command)	Unsupported command was sent.	Automatic reset[*2]
A.95D[*1]	Command Warning 4 (Command Interference)	Command, especially latch command, interferes.	Automatic reset[*2]
A.95E[*1]	Command Warning 5 (Subcommand Disable)	Subcommand and main command interfere.	Automatic reset[*2]
A.95F[*1]	Command Warning 6 (Undefined Command)	Undefined command was sent.	Automatic reset[*2]
A.960[*1]	MECHATROLINK Communications Warning	Communications error occurred during MECHATROLINK communications.	Required
A.97A[*1]	Command Warning 7 (Phase Error)	A command that cannot be executed in the current phase was sent.	Automatic reset [*2]
A.97B[*1]	Data Clamp (Out of Range)	The set command data was clamped to a minimum or maximum value out of the allowable setting range.	Automatic reset [*2]
A.9A0[*1]	Overtravel	Overtravel is detected while the servomotor power is ON.	Required

∗1. Use Pn800.1 to activate or not the warning detection.
∗2. If using the commands for the MECHATROLINK-III standard servo profile, the warning will automatically be cleared after the correct command is received.

10.3.2 Troubleshooting of Warnings

Refer to the following table to identity the cause of a warning and the action to be taken. Contact your Yaskawa representative if the problem cannot be solved by the described corrective action.

Warning Number: Warning Name (Warning Description)	Cause	Investigative Actions	Corrective Actions
A.900: Position Error Overflow	The servomotor U, V, and W wirings is faulty.	Check wiring of the servomotor/ encoder relay cable.	Confirm that there is no contact fault in the motor wiring or encoder wiring.
	The SERVOPACK gain is too low.	Check the SERVOPACK gain.	Increase the servo gain by using the function such as advanced autotuning.
	The acceleration of the position reference is too high.	Reduce the reference acceleration, and operate the SERVOPACK.	Reduce the reference acceleration of the position reference using a MECHATROLINK command, or smooth the acceleration of the position reference by selecting the position reference filter (ACCFIL) using a MECHATROLINK command.
	Setting of the excessive position error alarm level (Pn520) is low against the operating condition.	Check the alarm level (Pn520) to see if it is set to an appropriate value.	Set the Pn520 to proper value.
A.910: Overload (Warning before alarm A.710 or A.720 occurs)	Incorrect wiring or contact fault of servomotor and encoder.	Check the wiring.	Confirm that the servomotor and encoder are correctly wired.
	Operation beyond the overload protection characteristics.	Check the motor overload characteristics and executed run command.	Reconsider the load conditions and operating conditions. Or, increase the motor capacity.
	Excessive load was applied during operation because the servomotor was not driven due to mechanical problems.	Check the executed operation reference and motor speed.	Remove the mechanical problems.
A.911: Vibration	Abnormal vibration was detected at the motor speed.	Check for abnormal noise from the servomotor, and check the speed and torque waveforms during operation.	Reduce the motor speed or reduce the servo gain by using the function such as one-parameter tuning.
	The moment of inertia ratio (Pn103) value is greater than the actual value or is greatly changed.	Check the moment of inertia ratio.	Set the moment of inertia ratio (Pn103) to an appropriate value.
A.930: Absolute Encoder Battery Error (The absolute encoder battery voltage is lower than the specified value.) (Only when an absolute encoder is connected.)	The battery connection is incorrect.	Check the battery connection.	Reconnect the battery.
	The battery voltage is lower than the specified value 2.7 V.	Measure the battery voltage.	Replace the battery.

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Warning Number: Warning Name (Warning Description)	Cause	Investigative Actions	Corrective Actions
A.94A Data Setting Warning 1 (Parameter Number Error)	Disabled parameter number was used.	Check the command that caused the alarm.	Use the correct parameter number.
A.94B Data Setting Warning 2 (Out of Range)	Attempted to send values outside the range to the command data.	Check the command that caused the alarm.	Set the value of the parameter within the allowable range.
A.94C Data Setting Warning 3 (Calculation Error)	Calculation result of set value is incorrect.	Check the command that caused the alarm.	Set the value of the parameter within the allowable range.
A.94D Data Setting Warning 4 (Parameter Size)	Parameter size set in command is incorrect.	Check the command that caused the alarm.	Use the correct parameter size.
A.94E Data Setting Warning 5 (Latch mode error)	Latch mode error is detected.	Check the command that caused the alarm.	Change the LT_MOD data for the LTMOD_ON command sent by the host controller to the proper value. (When using the MECHATROLINKII-compatible profile.)
A.95A Command Warning 1 (Unsatisfying Command)	Command sending condition is not satisfied.	Check the command that caused the alarm.	Send a command after command sending condition is satisfied.
A.95B Command Warning 2 (Non-supported Command)	SERVOPACK received unsupported command.	Check the command that caused the alarm.	Do not sent an unsupported command.
A.95D Command Warning 4 (Command Interference)	Command sending condition for latch-related commands is not satisfied.	Check the command that caused the alarm.	Send a command after command sending condition is satisfied.
A.95E Command Warning 5 (Subcommand Disable)	Subcommand sending condition is not satisfied.	Check the command that caused the alarm.	Send a command after command sending condition is satisfied.
A.95F Command Warning 6 (Undefined Command)	Undefined command was sent.	Check the command that caused the alarm.	Do not use an undefined command.

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Warning Number: Warning Name (Warning Description)	Cause	Investigative Actions	Corrective Actions
A.960 MECHATROLINK Communications Warning	MECHATROLINK wiring is incorrect.	Confirm the wiring.	Correct the MECHATROLINK wiring.
	MECHATROLINK data reception error occurred due to noise interference.	Confirm the installation conditions.	Take measures against noise. Check the MECHATROLINK communications cable and FG wiring and take measures such as adding ferrite core on the MECHATROLINK communications cable.
A.97A Command Warning 7 (Phase Error)	A command that cannot be executed in the current phase was sent.	–	Send a command after command sending condition is satisfied.
A.97B Data Clamp (Out Of Range)	The set command data was clamped to a minimum or maximum value out of the allowable setting range.	–	Set the value of the command data within the allowable range.
A.9A0: Overtravel (Overtravel status is detected.)	When the servomotor power is ON, overtravel status is detected.	Check the input signal monitor to check the status of the overtravel signals.	Refer to *10.4 Troubleshooting Malfunction Based on Operation and Conditions of the Servomotor*. Even if overtravel signals were not shown by the input signal monitor, momentary overtravel may have been detected. Take the following precautions. • Do not specify movements that would cause overtravel from the host controller. • Check the wiring of the overtravel signals. • Take countermeasures for noise.

10.4 Troubleshooting Malfunction Based on Operation and Conditions of the Servomotor

Troubleshooting for the malfunctions based on the operation and conditions of the servomotor is provided in this section.

Be sure to turn OFF the servo system before troubleshooting items shown in bold lines in the table.

Problem	Probable Cause	Investigative Actions	Corrective Actions
Servomotor Does Not Start	The control power supply is not ON.	Check voltage between control power input terminals.	Correct the wiring.
	The main circuit power supply is not ON.	Check the voltage between main circuit power input terminals.	Correct the wiring.
	Wiring of I/O signal connector CN1 is faulty or disconnected.	Check if the connector CN1 is properly inserted and connected.	Correct the connector CN1 connection.
	The servomotor/encoder relay cable or encoder cable is disconnected.	Check the wiring.	Correct the wiring.
	Overloaded	Run under no load and check the load status.	Reduce load or replace with larger capacity servomotor.
	Encoder type differs from parameter setting (Pn002.2).	Check the settings for parameter Pn002.2.	Set parameter Pn002.2 to the encoder type being used.
	SV_ON command is not sent.	Check the command sent from the host controller.	Send the SV_ON command.
	SENS_ON command is not sent.	Check the command sent from the host controller.	Send the command in the correct SERVOPACK sequence.
	The forward run prohibited (P-OT) and reverse run prohibited (N-OT) input signals are turned OFF.	Check P-OT or N-OT input signal.	Turn P-OT or N-OT input signal ON.
	A SERVOPACK fault occurred.	–	Replace the SERVOPACK.
Servomotor Moves Instantaneously, and then Stops	Servomotor wiring is incorrect.	Check the wiring.	Correct the wiring.
	Encoder wiring is incorrect.	Check the wiring.	Correct the wiring.
The SERVOPACK suddenly entered baseblock status during servomotor operation.	The main circuit power supply voltage is 15 V or lower.	Check voltage between main circuit power input terminals during operation.	Set the power supply voltage to within the specified range.
			Increase the capacity of the main circuit AC/DC power supply.
	The fuse in the SERVOPACK is blown.	–	Replace the SERVOPACK.
	A SERVOPACK fault occurred.	–	A fault occurred in the SERVOPACK. Replace the SERVOPACK.
Servomotor Speed Unstable	Wiring connection to servomotor is defective.	Check connections of power line (phases U, V, and W) and encoder connectors.	Tighten any loose terminals or connectors and correct the wiring.
Servomotor Rotates Without Reference Input	A SERVOPACK fault occurred.	–	Replace the SERVOPACK.

(cont'd)

Problem	Probable Cause	Investigative Actions	Corrective Actions
Abnormal Noise from Servomotor	The servomotor largely vibrated during execution of tuning-less function.	Check the motor speed waveform.	Reduce the load so that the moment of inertia ratio becomes within the allowable value, or increase the load level or lower the tuning level for the tuning-less levels setting.
	Mounting is not secured.	Check if there are any loose mounting screws.	Tighten the mounting screws.
		Check if there is misalignment of couplings.	Align the couplings.
		Check if there are unbalanced couplings.	Balance the couplings.
	Bearings are defective.	Check for noise and vibration around the bearings.	Replace the servomotor.
	Vibration source at the driven machine.	Check for any foreign matter, damage, or deformations on the machinery's movable parts.	Contact the machine manufacturer.
	Noise interference due to incorrect I/O signal cable specifications.	The I/O signal cable must be tinned annealed copper shielded twisted-pair or screened unshielded twisted-pair cable with a core of 0.12 mm^2 min.	Use the specified I/O signal cable.
	Noise interference due to length of I/O signal cable.	Check the length of the I/O signal cable.	The I/O signal cable length must be no more than 3 m.
	Noise interference due to incorrect cable specifications of encoder cable.	The encoder cable must be tinned annealed copper shielded twisted-pair or screened unshielded twisted-pair cable with a core of 0.12 mm^2 min.	Use the specified encoder cable.
	Noise interference due to length of encoder cable.	Check the length of the encoder cable.	The encoder cable must be no more than 10 m.
	Noise interference due to damaged encoder cable.	Check if the encoder cable is bent and the sheath is damaged.	Replace the encoder cable and correct the cable layout.
	Excessive noise to the encoder cable.	Check if the encoder cable is bundled with a high-current line or near a high-current line.	Correct the cable layout so that no surge is applied.
	The FG potential varies because of influence from machines on the servomotor side, such as the welder.	Check if the machines are correctly grounded.	Properly ground the machines to separate from the encoder FG.
	SERVOPACK pulse counting error due to noise interference	Check if there is noise interference on the I/O signal line from the encoder.	Take measures against noise in the encoder wiring.
	Excessive vibration and shock to the encoder	Check if vibration from the machine occurred or servomotor installation is incorrect (mounting surface accuracy, fixing, alignment, etc.).	Reduce vibration from the machine, or secure the servomotor installation.
	An encoder fault occurred.	–	Replace the servomotor.

(cont'd)

Problem	Probable Cause	Investigative Actions	Corrective Actions
Servomotor Vibrates at Frequency of Approx. 200 to 400 Hz.	Unbalanced servo gains	Check to see if the servo gains have been correctly adjusted.	Execute the advanced autotuning.
	Speed loop gain value (PnAC2) too high.	Check the speed loop gain (PnAC2). Factory setting: Kv = 40.0 Hz	Reduce the speed loop gain (PnAC2).
	Position loop gain value (PnAC6) too high.	Check the position loop gain (PnAC6). Factory setting: Kp = 40.0/s	Reduce the position loop gain (PnAC6).
	Incorrect speed loop integral time constant (PnAC4)	Check the speed loop integral time constant (PnAC4). Factory setting: Ti = 20.0 ms	Correct the speed loop integral time constant (PnAC4).
	Incorrect moment of inertia ratio (Pn103)	Check the moment of inertia ratio (Pn103).	Correct the moment of inertia ratio (Pn103).
High Motor Speed Overshoot on Starting and Stopping	Unbalanced servo gains	Check to see if the servo gains have been correctly adjusted.	Execute the advanced autotuning.
	Speed loop gain value (PnAC2) too high	Check the speed loop gain (PnAC2). Factory setting: Kv = 40.0 Hz	Reduce the speed loop gain (PnAC2).
	Position loop gain value (PnAC6) too high	Check the position loop gain (PnAC6). Factory setting: Kp = 40.0/s	Reduce the position loop gain (PnAC6).
	Incorrect speed loop integral time constant (PnAC4)	Check the speed loop integral time constant (PnAC4). Factory setting: Ti = 20.0 ms	Correct the speed loop integral time constant (PnAC4).
	Incorrect moment of inertia ratio data (Pn103)	Check the moment of inertia ratio (Pn103).	Correct the moment of inertia ratio (Pn103).

(cont'd)

Problem	Probable Cause	Investigative Actions	Corrective Actions
Absolute Encoder Position Difference Error (The position saved in the host controller when the power was turned OFF is different from the position when the power was next turned ON.)	Noise interference due to incorrect cable specifications of encoder cable.	The encoder cable must be tinned annealed copper shielded twisted-pair or screened unshielded twisted-pair cable with a core of 0.12 mm^2 min.	Use the specified encoder cable.
	Noise interference due to length of encoder cable.	Check the length of the encoder cable.	The encoder cable must be no more than 10 m.
	Noise interference due to damaged encoder cable.	Check if the encoder cable is bent and the sheath is damaged.	Replace the encoder cable and correct the cable layout.
	Excessive noise to the encoder cable.	Check if the encoder cable is bundled with a high-current line or near a high-current line.	Correct the cable layout so that no surge is applied.
	FG potential varies because of influence of machines such as welders at the servomotor.	Check if the machines are correctly grounded.	Ground machines correctly, and prevent diversion to the FG on the encoder side.
	SERVOPACK pulse counting error due to noise interference	Check if there is noise interference on the I/O signal line from the encoder.	Take measures against noise in the encoder wiring.
	Excessive vibration and shock to the encoder	Check if vibration from the machine occurred or servomotor installation is incorrect (mounting surface accuracy, fixing, alignment, etc.).	Reduce vibration from the machine, or secure the servomotor installation.
	An encoder fault occurred.	–	Replace the servomotor.
	A SERVOPACK fault occurred. (The pulse count does not change.)	–	Replace the SERVOPACK.
	Host controller multiturn data reading error	Check the error detection section of the host controller.	Correct the error detection section of the host controller.
		Check if the host controller is executing data parity checks.	Execute a multiturn data parity check.
		Check noise in the cable between the SERVOPACK and the host controller.	Take measures against noise, and again execute a multiturn data parity check.
Overtravel (OT)	Forward or reverse run prohibited signal is input.	Check the external power supply (+24 V) voltage for the input signal.	Correct the external power supply (+24 V) voltage.
		Check if the overtravel limit switch operates properly.	Correct the overtravel limit switch.
		Check if the overtravel limit switch is wired correctly.	Correct the overtravel limit switch wiring.
		Check the settings for parameters Pn590 and Pn591.	Correct the settings for parameters Pn590 and Pn591.
	Forward or reverse run prohibited signal malfunctioning.	Check the fluctuation of the external power supply (+24 V) voltage for the input signal.	Stabilize the external power supply (+24 V) voltage.
		Check if the overtravel limit switch operates correctly.	Correct the overtravel limit switch.
		Check if the overtravel limit switch wiring is correct. (check for damaged cables or loose screws.)	Correct the overtravel limit switch wiring.
	Incorrect forward or reverse run prohibited signal (P-OT/N-OT) allocation (parameters Pn590.3, Pn591.3)	Check if the P-OT signal is allocated in Pn590.3.	If another signal is allocated in Pn590.3, allocate P-OT.
		Check if the N-OT signal is allocated in Pn591.3.	If another signal is allocated in Pn591.3, allocate N-OT.
Improper Stop Position by Overtravel (OT) Signal	Improper limit switch position and dog length	–	Install the limit switch at the appropriate position.
	The overtravel limit switch position is too short for the coasting distance.	–	Install the overtravel limit switch at the appropriate position.

(cont'd)

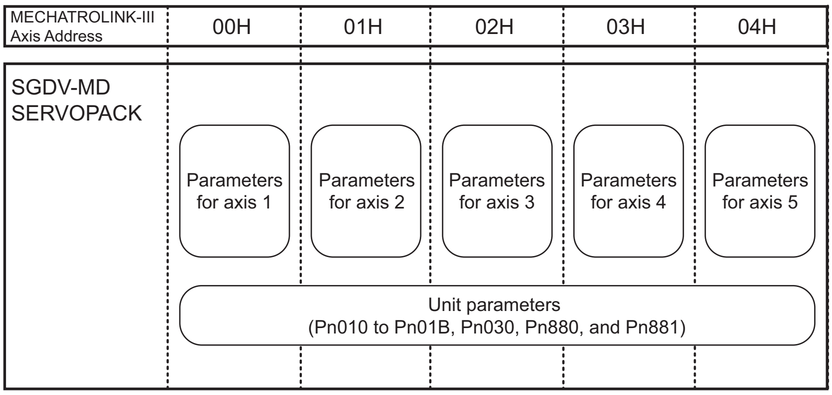
Problem	Probable Cause	Investigative Actions	Corrective Actions
Position Error (Without Alarm)	Noise interference due to incorrect encoder cable specifications	The encoder cable must be tinned annealed copper shielded twisted-pair or screened unshielded twisted-pair cable with a core of 0.12 mm^2 min.	Use the specified encoder cable.
	Noise interference due to length of encoder cable.	Check the length of the encoder cable.	The encoder cable must be no more than 10 m.
	Noise influence due to damaged encoder cable.	Check if the encoder cable is bent and the sheath is damaged.	Replace the encoder cable and modify the cable layout.
	Excessive noise to encoder cable.	Check if the encoder cable is bundled with a high-current line or near a high-current line.	Change the cable layout so that no surge is applied.
	The FG potential varies because of influence from machines on the servomotor side such as the welder.	Check if the machines are correctly grounded.	Properly ground the machines encoder FG.
	SERVOPACK pulse count error due to noise	Check if the I/O signal line from the encoder is influenced by noise.	Take measures against noise in the encoder wiring.
	Excessive vibration and shock to the encoder	Check if vibration from the machine occurred or servomotor installation is incorrect (mounting surface accuracy, fixing, alignment, etc.).	Reduce the machine vibration or mount the servomotor securely.
	Unsecured coupling between machine and servomotor	Check if a position error occurs at the coupling between machine and servomotor.	Secure the coupling between the machine and servomotor.
	Noise interference due to improper I/O signal cable specifications	The I/O signal cable must be tinned annealed copper shielded twisted-pair or screened unshielded twisted-pair cable with a core of 0.12 mm^2 min.	Use input signal cable with the specified specifications.
	Noise interference due to length of I/O signal cable	Check the I/O signal cable length.	The I/O signal cable length must be no more than 3 m.
	An encoder fault occurred. (The pulse count does not change.)	–	Replace the servomotor.
	A SERVOPACK fault occurred.	–	Replace the SERVOPACK.
Servomotor Overheated	Surrounding air temperature too high	Measure the servomotor surrounding air temperature.	Reduce the surrounding air temperature to 40°C or less.
	Servomotor surface dirty	Visually check the surface.	Clean dust and oil from the surface.
	Servomotor overloaded	Check the load status with monitor.	If overloaded, reduce load or replace with larger capacity SERVOPACK and servomotor.

11

Appendix

11.1 Parameter Configuration

The Σ-V-MD-series SERVOPACKs have unit parameters that are used for all axes and parameters that are used for each individual axis.



11.1.1 Unit Parameters

The unit parameters are used by all of the axes. If you change any of these parameters, the change applies to all of the axes.

Pn010 to Pn01B, Pn030, Pn880, and Pn881

11.1.2 Axis Parameters

These parameters are set for each individual axis. They include all of the parameters that are not unit parameters.

If you access parameters through MECHATROLINK-III communications, use the SVPRM_RD and SVPRM_WR commands to access the parameters for the desired axis addresses in the same way as for normal commands.

11.2 List of Parameters

This section contains a tables of parameters.

Note: Do not change the following parameters from the factory settings.
- Reserved parameters
- Parameters not described in this manual

11.2.1 List of Parameters

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Profile	Reference Section
Pn000	2	Basic Function Select Switch 0	0000 to 00B3	–	0000	After restart	Setup	–	–

n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit:

Direction Selection		Reference Section
0	Sets CCW as forward direction.	7.3.1
1	Sets CW as forward direction. (Reverse Rotation Mode)	
2 and 3	Reserved (Do not use.)	

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Profile	Reference Section
Pn001	2	Application Function Select Switch 1	0000 to 1122	–	0012	After restart	Setup	–	–

n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Reserved (Do not change.)

2nd digit:

Overtravel (OT) Stop Mode		Reference Section
0	Stops the motor by coasting.	7.3.3
1	Sets the torque of Pn406 to the maximum value, decelerates the servomotor to a stop, and then sets it to servolock state.	
2	Sets the torque of Pn406 to the maximum value, decelerates the servomotor to a stop, and then sets it to coasting state.	

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Profile	Reference Section
Pn002	2	Application Function Select Switch 2	0000 to 4113	–	0011	After restart	Setup	–	–

n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit:

Position/Speed Control Torque Limit Option		Reference Section
0	Do not use torque limit TLIM in position or speed control commands.	*1
1	Use torque limit TLIM in position or speed control commands.	

2nd digit:

Torque Control Speed Limit Option		Reference Section
0	Do not use speed limit VLIM in torque control commands.	*1
1	V_LIM operates as the speed limit value.	

3rd digit:

Absolute Encoder Usage		Reference Section
0	Uses absolute encoder as an absolute encoder.	7.6
1	Uses absolute encoder as an incremental encoder.	

4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Profile	Reference Section
Pn008	2	Application Function Select Switch 8	0000 to 7121	–	4000	After restart	Setup	–	–

n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit:

Lowered Battery Voltage Alarm/Warning Selection		Reference Section
0	Outputs alarm (A.830) for lowered battery voltage.	5.5.4
1	Outputs warning (A.930) for lowered battery voltage.	

2nd digit: Reserved (Do not change.)

3rd digit:

Warning Detection Selection		Reference Section
0	Detects warning.	10.3.1
1	Does not detect warning.	

4th digit: Reserved (Do not change.)

*1. Refer to the *Σ-V-MD Series User's Manual MECHATROLINK-III Standard Servo Profile Commands* (Manual No.: SIEP S800001 03) for details.

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Profile	Reference Section
Pn009	2	Application Function Select Switch 9	0000 to 0111	–	0010	After restart	Tuning	–	–

n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

- 1st digit: Reserved (Do not change.)
- 2nd digit: Reserved (Do not change.)
- 3rd digit: Speed Detection Method Selection

	Speed Detection Method Selection	Reference Section
0	Speed detection 1	8.8.4
1	Speed detection 2	

- 4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Profile	Reference Section
Pn00B	2	Application Function Select Switch B	0000 to 1111	–	0000	After restart	Setup	–	–

n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

- 1st digit: Reserved (Do not change.)
- 2nd digit: Alarm Gr.2 Stop Method Selection

	Alarm Gr.2 Stop Method Selection	Reference Section
0	Stops the motor by setting the speed reference to "0".	7.3.5
1	Stops the motor by coasting.	

- 3rd digit: Reserved (Do not change.)
- 4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Profile	Reference Section
Pn00D	2	Application Function Select Switch D	0000 to 1001	–	0000	Immediately	Setup	–	6.3.2

n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

- 1st digit: Reserved (Do not change.)
- 2nd digit: Reserved (Do not change.)
- 3rd digit: Reserved (Do not change.)
- 4th digit: Overtravel Warning Detection Selection

	Overtravel Warning Detection Selection	Reference Section
0	Does not detect overtravel warning.	7.3.2
1	Detects overtravel warning.	

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Profile	Reference Section
Pn010	2	Slot 1 Axis Address	0 to 15	–	0	After restart	Setup	–	7.1.2
Pn011	2	Slot 2 Axis Address	0 to 15	–	1	After restart	Setup	–	7.1.2
Pn012	2	Slot 3 Axis Address	0 to 15	–	2	After restart	Setup	–	7.1.2
Pn013	2	Slot 4 Axis Address	0 to 15	–	3	After restart	Setup	–	7.1.2
Pn014	2	Slot 5 Axis Address	0 to 15	–	4	After restart	Setup	–	7.1.2
Pn015	2	Slot 6 Axis Address	0 to 15	–	5	After restart	Setup	–	7.1.2
Pn016	2	Slot 7 Axis Address	0 to 15	–	6	After restart	Setup	–	7.1.2

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Profile	Reference Section
Pn017	2	Slot 8 Axis Address	0 to 15	–	7	After restart	Setup	–	7.1.2
Pn018	2	Slot 9 Axis Address	0 to 15	–	8	After restart	Setup	–	7.1.2
Pn019	2	Slot 10 Axis Address	0 to 15	–	9	After restart	Setup	–	7.1.2
Pn01A	2	Slot 11 Axis Address	0 to 15	–	10	After restart	Setup	–	7.1.2
Pn01B	2	Slot 12 Axis Address	0 to 15	–	11	After restart	Setup	–	7.1.2
Pn030	2	Ethernet IP Address	00000000 to FFFFFFFF	–	C0A80101	After restart	Setup	–	6.3.2
Pn103	2	Moment of Inertia Ratio	0 to 20000	1%	100	Immediately	Tuning	–	8.8.1
Pn104	2	2nd Speed Loop Gain	10 to 20000	0.1 Hz	400	Immediately	Tuning	–	8.8.1
Pn105	2	2nd Speed Loop Integral Time Constant	15 to 51200	0.01 ms	2000	Immediately	Tuning	–	8.8.1
Pn106	2	2nd Position Loop Gain	10 to 20000	0.1/s	400	Immediately	Tuning	–	8.8.1
Pn10A	2	Feedforward Filter Time Constant	0 to 6400	0.01 ms	0	Immediately	Tuning	–	8.9.1
Pn10B	2	Application Function for Gain Select Switch	0000 to 5334	–	0000	–	–	–	–

Pn10B

4th digit 3rd digit 2nd digit 1st digit
n.□□□□

1st digit:

Mode Switch Selection		When Enabled	Classification	Reference Section
0	Uses internal torque reference as the condition (Level setting: Pn10C).	Immediately	Setup	8.9.2
1	Uses speed reference as the condition (Level setting: Pn10D).			
2	Uses acceleration as the condition (Level setting: Pn10E).			
3	Uses position error as the condition (Level setting: Pn10F).			
4	No mode switch function available.			

2nd digit:

Speed Loop Control Method		When Enabled	Classification	Reference Section
0	PI control	After restart	Setup	–
1	I-P control			
2 and 3	Reserved (Do not use.)			

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Profile	Reference Section
Pn10C	2	Mode Switch (torque reference)	0 to 800	1%	200	Immediately	Tuning	–	8.9.2
Pn10D	2	Mode Switch (speed reference)	0 to 10000	1 min^{-1}	0	Immediately	Tuning	–	8.9.2
Pn10E	2	Mode Switch (acceleration)	0 to 30000	1 min^{-1}/s	0	Immediately	Tuning	–	8.9.2
Pn10F	2	Mode Switch (position error)	0 to 10000	1 reference unit	0	Immediately	Tuning	–	8.9.2
Pn121	2	Friction Compensation Gain	10 to 1000	1%	100	Immediately	Tuning	–	8.8.2

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Profile	Reference Section
Pn122	2	2nd Gain for Friction Compensation	10 to 1000	1%	100	Immediately	Tuning	–	8.8.2
Pn123	2	Friction Compensation Coefficient	0 to 100	1%	0	Immediately	Tuning	–	8.8.2
Pn124	2	Friction Compensation Frequency Correction	-10000 to 10000	0.1 Hz	0	Immediately	Tuning	–	8.8.2
Pn125	2	Friction Compensation Gain Correction	1 to 1000	1%	100	Immediately	Tuning	–	8.8.2
Pn135	2	Gain Switching Waiting Time 1	0 to 65535	1 ms	0	Immediately	Tuning	–	8.8.1
Pn136	2	Gain Switching Waiting Time 2	0 to 65535	1 ms	0	Immediately	Tuning	–	8.8.1
Pn139	2	Automatic Gain Change-over Related Switch 1	0000 to 0052	–	0000	Immedi-ately	Tuning	–	8.8.1

Pn139

n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Gain Switching Selection Switch

0	Manual gain switching Changes gain manually using G-SEL of the servo command output signals (SVCMD_IO).
1	Reserved (Do not use.)
2	Automatic gain switching pattern 1 Changes automatically 1st gain to 2nd gain when the switching condition A is satisfied. Changes automatically 2nd gain to 1st gain when the switching condition A is not satisfied.

2nd digit: Gain Switching Condition A

0	Positioning completion signal (/COIN) ON
1	Positioning completion signal (/COIN) OFF
2	Near signal (/NEAR) ON
3	Near signal (/NEAR) OFF
4	Position reference filter output = 0 and reference pulse input OFF
5	Position reference pulse input ON

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Profile	Reference Section
Pn13D	2	Current Gain Level	100 to 2000	1%	2000	Immediately	Tuning	–	8.8.3

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Profile	Reference Section
Pn140	2	Model Following Control Related Switch	0000 to 1121	–	0100	Immediately	Tuning	–	–

4th digit 3rd digit 2nd digit 1st digit

n.□□□□

1st digit:

Model Following Control Selection	
0	Does not use model following control.
1	Uses model following control.

2nd digit:

Vibration Suppression Selection	
0	Does not perform vibration suppression.
1	Performs vibration suppression over the specified frequency.
2	Performs vibration suppression over two different kinds of frequencies.

3rd digit:

Vibration Suppression Adjustment Selection		Reference Section
0	Does not adjust vibration suppression automatically using utility function.	8.3.1, 8.4.1, 8.5.1, 8.6.1
1	Adjusts vibration suppression automatically using utility function.	

4th digit:

Selection of Speed Feedforward (VFF) / Torque Feedforward (TFF)		Reference Section
0	Does not use model following control and speed/torque feedforward together.	8.3.1, 8.4.1
1	Uses model following control and speed/torque feedforward together.	

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Profile	Reference Section
Pn141	2	Model Following Control Gain	10 to 20000	0.1/s	500	Immediately	Tuning	–	–
Pn142	2	Model Following Control Gain Compensation	500 to 2000	0.1%	1000	Immediately	Tuning	–	–
Pn143	2	Model Following Control Bias (Forward Direction)	0 to 10000	0.1%	1000	Immediately	Tuning	–	–
Pn144	2	Model Following Control Bias (Reverse Direction)	0 to 10000	0.1%	1000	Immediately	Tuning	–	–
Pn145	2	Vibration Suppression 1 Frequency A	10 to 2500	0.1 Hz	500	Immediately	Tuning	–	–
Pn146	2	Vibration Suppression 1 Frequency B	10 to 2500	0.1 Hz	700	Immediately	Tuning	–	–
Pn147	2	Model Following Control Speed Feedforward Compensation	0 to 10000	0.1%	1000	Immediately	Tuning	–	–
Pn148	2	2nd Model Following Control Gain	10 to 20000	0.1/s	500	Immediately	Tuning	–	–
Pn149	2	2nd Model Following Control Gain Compensation	500 to 2000	0.1%	1000	Immediately	Tuning	–	–
Pn14A	2	Vibration Suppression 2 Frequency	10 to 2000	0.1 Hz	800	Immediately	Tuning	–	–
Pn14B	2	Vibration Suppression 2 Compensation	10 to 1000	1%	100	Immediately	Tuning	–	–

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Profile	Reference Section
Pn160	2	Anti-Resonance Control Related Switch	0000 to 0011	–	0010	Immediately	Tuning	–	8.3.1, 8.4.1, 8.5.1, 8.7.1

Pn160: n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit:

Anti-Resonance Control Selection	
0	Does not use anti-resonance control.
1	Uses anti-resonance control.

2nd digit:

Anti-Resonance Control Adjustment Selection	
0	Does not adjust anti-resonance control automatically using utility function.
1	Adjusts anti-resonance control automatically using utility function.

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Profile	Reference Section
Pn161	2	Anti-Resonance Frequency	10 to 20000	0.1 Hz	1000	Immediately	Tuning	–	–
Pn162	2	Anti-Resonance Gain Compensation	1 to 1000	1%	100	Immediately	Tuning	–	–
Pn163	2	Anti-Resonance Damping Gain	0 to 300	1%	0	Immediately	Tuning	–	–
Pn164	2	Anti-Resonance Filter Time Constant 1 Compensation	-1000 to 1000	0.01 ms	0	Immediately	Tuning	–	–
Pn165	2	Anti-Resonance Filter Time Constant 2 Compensation	-1000 to 1000	0.01 ms	0	Immediately	Tuning	–	–
Pn170	2	Tuning-less Function Related Switch	0000 to 2411	–	1401	–	–	–	–

Pn170: n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit:

Tuning-less Function Selection		When Enabled	Classification	Reference Section
0	Disables tuning-less function.	After restart	Setup	8.2
1	Enables tuning-less function.			

2nd digit:

Control Method during Speed Control		When Enabled	Classification	Reference Section
0	Uses as speed control.	After restart	Setup	8.2
1	Uses as speed control and uses the host controller for position control.			

3rd digit:

Tuning-less Tuning Level		When Enabled	Classification	Reference Section
0 to 4	Sets tuning-less tuning level.	Immediately	Setup	8.2

4th digit:

Tuning-less Load Level		When Enabled	Classification	Reference Section
0 to 2	Sets tuning-less load level.	Immediately	Setup	8.2

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Profile	Reference Section
Pn304	2	JOG Speed	0 to 10000	1 min^{-1}	500	Immediately	Setup	–	9.3

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Profile	Reference Section
Pn305	2	Soft Start Acceleration Time	0 to 10000	1 ms	0	Immediately	Setup	–	–
Pn306	2	Soft Start Deceleration Time	0 to 10000	1 ms	0	Immediately	Setup	–	–
Pn310	2	Vibration Detection Switch	0000 to 0002	–	0000	Immediately	Setup	–	–

Pn310

4th digit 3rd digit 2nd digit 1st digit

n. □ □ □ □

1st digit:

Vibration Detection Selection		Reference Section
0	Does not detect vibration.	9.10
1	Outputs warning (A.911) when vibration is detected.	
2	Outputs alarm (A.520) when vibration is detected.	

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Profile	Reference Section
Pn311	2	Vibration Detection Sensibility	50 to 500	1%	100	Immediately	Tuning	–	9.10
Pn312	2	Vibration Detection Level	0 to 5000	1 min^{-1}	50	Immediately	Tuning	–	9.10
Pn324	2	Moment of Inertia Calculating Start Level	0 to 20000	1%	300	Immediately	Setup	–	8.3.2
Pn401	2	Torque Reference Filter Time Constant	0 to 65535	0.01 ms	100	Immediately	Tuning	–	8.9.3
Pn402	2	Forward Torque Limit	0 to 800	1%	800	Immediately	Setup	–	7.5.1
Pn403	2	Reverse Torque Limit	0 to 800	1%	800	Immediately	Setup	–	7.5.1
Pn406	2	Emergency Stop Torque	0 to 800	1%	800	Immediately	Setup	–	7.3.3
Pn407	2	Speed Limit during Torque Control	0 to 10000	1 min^{-1}	10000	Immediately	Setup	–	–

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Profile	Reference Section
Pn408	2	Torque Related Function Switch	0000 to 1111	–	0000	–	–	–	–

4th digit 3rd digit 2nd digit 1st digit

n.□□□□

1st Step Notch Filter Selection		When Enabled	Classification	Reference Section
0	N/A	Immediately	Setup	8.9.3
1	Uses 1st step notch filter for torque reference.			

Speed Limit Selection		When Enabled	Classification	Reference Section
0	Uses the smaller of the maximum motor speed and the value of Pn407 as the speed limit value.	After restart	Setup	–
1	Uses the smaller of the overspeed detection speed and the value of Pn407 as the speed limit value.			

2nd Step Notch Filter Selection		When Enabled	Classification	Reference Section
0	N/A	Immediately	Setup	8.9.3
1	Uses 2nd step notch filter for torque reference.			

Friction Compensation Function Selection		When Enabled	Classification	Reference Section
0	Disables friction compensation function.	Immediately	Setup	8.8.2
1	Enables friction compensation function.			

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Profile	Reference Section
Pn409	2	1st Notch Filter Frequency	50 to 5000	1 Hz	5000	Immediately	Tuning	–	8.9.3
Pn40A	2	1st Notch Filter Q Value	50 to 1000	0.01	70	Immediately	Tuning	–	8.9.3
Pn40B	2	1st Notch Filter Depth	0 to 1000	0.001	0	Immediately	Tuning	–	8.9.3
Pn40C	2	2nd Notch Filter Frequency	50 to 5000	1 Hz	5000	Immediately	Tuning	–	8.9.3
Pn40D	2	2nd Notch Filter Q Value	50 to 1000	0.01	70	Immediately	Tuning	–	8.9.3
Pn40E	2	2nd Notch Filter Depth	0 to 1000	0.001	0	Immediately	Tuning	–	8.9.3
Pn40F	2	2nd Step 2nd Torque Reference Filter Frequency	100 to 5000	1 Hz	5000	Immediately	Tuning	–	8.9.3
Pn410	2	2nd Step 2nd Torque Reference Filter Q Value	50 to 100	0.01	50	Immediately	Tuning	–	8.9.3
Pn412	2	1st Step 2nd Torque Reference Filter Time Constant	0 to 65535	0.01 ms	100	Immediately	Tuning	–	8.9.3
Pn424	2	Reserved (Do not change.)	–	–	50	–	–	–	–
Pn425	2	Reserved (Do not change.)	–	–	100	–	–	–	–
Pn456	2	Sweep Torque Reference Amplitude	1 to 800	1%	15	Immediately	Tuning	–	9.13

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Profile	Reference Section
Pn460	2	Notch Filter Adjustment Switch	0000 to 0101	–	0101	Immediately	Tuning	–	8.2.1, 8.3.1, 8.5.1
		n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit) **1st digit – Notch Filter Adjustment Selection 1** 0: Does not adjust 1st step notch filter automatically using utility function. 1: Adjust 1st step notch filter automatically using utility function. **2nd digit – Reserved (Do not change.)** **3rd digit – Notch Filter Adjustment Selection 2** 0: Does not adjust 2nd step notch filter automatically using utility function. 1: Adjust 2nd step notch filter automatically using utility function. **4th digit – Reserved (Do not change.)**							
Pn506	2	Brake Reference - Servo OFF Delay Time	0 to 50	10 ms	0	Immediately	Setup	–	7.3.4
Pn507	2	Brake Reference Output Speed Level	0 to 10000	1 min^{-1}	100	Immediately	Setup	–	7.3.4
Pn508	2	Waiting Time for Brake Signal When Motor Running	10 to 100	10 ms	50	Immediately	Setup	–	7.3.4
Pn509	2	Reserved (Do not change.)	–	–	20	–	–	–	–
Pn51E	2	Excessive Position Error Warning Level	10 to 100	1%	100	Immediately	Setup	–	10.3.1
Pn520	4	Excessive Position Error Alarm Level	1 to 1073741823	1 reference unit	5242880	Immediately	Setup	–	8.1.4, 10.2.1
Pn52B	2	Overload Warning Level	1 to 100	1%	20	Immediately	Setup	–	7.3.6
Pn52C	2	Derating of Base Current at Detecting Overload of Motor	10 to 100	1%	100	After restart	Setup	–	7.3.6

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Profile	Reference Section
Pn530	2	Program JOG Operation Related Switch	0000 to 0005	–	0000	Immediately	Setup	–	9.5
		n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit) **1st digit – Program JOG Operation Switch** 0: (Waiting time Pn535 → Forward movement Pn531) × Number of movements Pn536 1: (Waiting time Pn535 → Reverse movement Pn531) × Number of movements Pn536 2: (Waiting time Pn535 → Forward movement Pn531) × Number of movements Pn536 (Waiting time Pn535 → Reverse movement Pn531) × Number of movements Pn536 3: (Waiting time Pn535 → Reverse movement Pn531) × Number of movements Pn536 (Waiting time Pn535 → Forward movement Pn531) × Number of movements Pn536 4: (Waiting time Pn535 → Forward movement Pn531 → Waiting time Pn535 → Reverse movement Pn531) × Number of movements Pn536 5: (Waiting time Pn535 → Reverse movement Pn531 → Waiting time Pn535 → Forward movement Pn531) × Number of movements Pn536 **2nd digit** – Reserved (Do not change.) **3rd digit** – Reserved (Do not change.) **4th digit** – Reserved (Do not change.)							
Pn531	4	Program JOG Movement Distance	1 to 1073741824	1 reference unit	32768	Immediately	Setup	–	9.5
Pn533	2	Program JOG Movement Speed	1 to 10000	1 min^{-1}	500	Immediately	Setup	–	9.5
Pn534	2	Program JOG Acceleration/Deceleration Time	2 to 10000	1 ms	100	Immediately	Setup	–	9.5
Pn535	2	Program JOG Waiting Time	0 to 10000	1 ms	100	Immediately	Setup	–	9.5
Pn536	2	Number of Times of Program JOG Movement	0 to 1000	1 time	1	Immediately	Setup	–	9.5
Pn560	2	Remained Vibration Detection Width	1 to 3000	0.1%	400	Immediately	Setup	–	8.7.1
Pn561	2	Overshoot Detection Level	0 to 100	1%	100	Immediately	Setup	–	8.3.1, 8.4.1

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Profile	Reference Section
Pn590	2	Input Signal Selection (P-OT Signal Assignment)	0000 to 2007	–	0000	After restart	Setup	–	–

Pn590: n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: P-OT Signal Pin Number Assignment (Reference Section: 7.3.2)

	P-OT Signal Pin Number Assignment	Reference Section
0	Selects sequence input signal /SI-0.	7.3.2
1	Selects sequence input signal /SI-1.	
2	Selects sequence input signal /SI-2.	
3	Selects sequence input signal /SI-3.	
4	Selects sequence input signal /SI-4.	
5	Selects sequence input signal /SI-5.	
6	Selects sequence input signal /SI-6.	
7	Selects sequence input signal /SI-7.	

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit:

	P-OT Signal Assignment Selection	Reference Section
0	P-OT signal assignment disabled. [factory setting]	7.3.2
1	P-OT signal assigned. Positive drive is enabled when the signal is low.	
2	P-OT signal assigned. Positive drive is enabled when the signal is high.	

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Profile	Reference Section
Pn591	2	Input Signal Selection (N-OT Signal Assignment)	0000 to 2007	–	0000	After restart	Setup	–	–

Pn591: n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit:

	N-OT Signal Pin Number Assignment	Reference Section
0	Selects sequence input signal /SI-0.	7.3.2
1	Selects sequence input signal /SI-1.	
2	Selects sequence input signal /SI-2.	
3	Selects sequence input signal /SI-3.	
4	Selects sequence input signal /SI-4.	
5	Selects sequence input signal /SI-5.	
6	Selects sequence input signal /SI-6.	
7	Selects sequence input signal /SI-7.	

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit:

	N-OT Signal Assignment Selection	Reference Section
0	N-OT signal assignment disabled. [factory setting]	7.3.2
1	N-OT signal assigned. Reverse drive is enabled when the signal is low.	
2	N-OT signal assigned. Reverse drive is enabled when the signal is high.	

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Profile	Reference Section
Pn592	2	Input Signal Selection (/DEC Signal Assignment)	0000 to 2007	–	0000	After restart	Setup	–	–
Pn593	2	Input Signal Selection (/EXT1 Signal Assignment)	0000 to 2007	–	0000	After restart	Setup	–	–

Pn592

n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: /DEC Signal Pin Number Assignment

0	Selects sequence input signal /SI-0.
1	Selects sequence input signal /SI-1.
2	Selects sequence input signal /SI-2.
3	Selects sequence input signal /SI-3.
4	Selects sequence input signal /SI-4.
5	Selects sequence input signal /SI-5.
6	Selects sequence input signal /SI-6.
7	Selects sequence input signal /SI-7.

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit: /DEC Signal Assignment Selection

0	/DEC signal assignment disabled. [factory setting]
1	/DEC signal assigned. Signal is ON for low level.
2	/DEC signal assigned. Signal is ON for high level.

Pn593

n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: /EXT1 Signal Pin Number Assignment

0	Selects sequence input signal /SI-0.
1	Selects sequence input signal /SI-1.
2	Selects sequence input signal /SI-2.
3	Selects sequence input signal /SI-3.
4	Selects sequence input signal /SI-4.
5	Selects sequence input signal /SI-5.
6	Selects sequence input signal /SI-6.
7	Selects sequence input signal /SI-7.

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit: /EXT1 Signal Assignment Selection

0	/EXT1 signal assignment disabled. [factory setting]
1	/EXT1 signal assigned. Signal is ON for low level.
2	/EXT1 signal assigned. Signal is ON for high level.

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Profile	Reference Section
Pn594	2	Input Signal Selection (/EXT2 Signal Assignment)	0000 to 2007	–	0000	After restart	Setup	–	–

4th digit 3rd digit 2nd digit 1st digit
n.□□□□

/EXT2 Signal Pin Number Assignment	
0	Selects sequence input signal /SI-0.
1	Selects sequence input signal /SI-1.
2	Selects sequence input signal /SI-2.
3	Selects sequence input signal /SI-3.
4	Selects sequence input signal /SI-4.
5	Selects sequence input signal /SI-5.
6	Selects sequence input signal /SI-6.
7	Selects sequence input signal /SI-7.

Reserved (Do not change.)

Reserved (Do not change.)

/EXT2 Signal Assignment Selection	
0	/EXT2 signal assignment disabled. [factory setting]
1	/EXT2 signal assigned. Signal is ON for low level.
2	/EXT2 signal assigned. Signal is ON for high level.

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Profile	Reference Section
Pn595	2	Input Signal Selection (/EXT3 Signal Assignment)	0000 to 2007	–	0000	After restart	Setup	–	–

4th digit 3rd digit 2nd digit 1st digit
n.□□□□

/EXT3 Signal Pin Number Assignment	
0	Selects sequence input signal /SI-0.
1	Selects sequence input signal /SI-1.
2	Selects sequence input signal /SI-2.
3	Selects sequence input signal /SI-3.
4	Selects sequence input signal /SI-4.
5	Selects sequence input signal /SI-5.
6	Selects sequence input signal /SI-6.
7	Selects sequence input signal /SI-7.

Reserved (Do not change.)

Reserved (Do not change.)

/EXT3 Signal Assignment Selection	
0	/EXT3 signal assignment disabled. [factory setting]
1	/EXT3 signal assigned. Signal is ON for low level.
2	/EXT3 signal assigned. Signal is ON for high level.

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Profile	Reference Section
Pn596	2	Output Signal Selection (/BK Signal Assignment)	0000 to 1007	–	0000	After restart	Setup	–	–

n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: /BK Signal Pin Number Assignment

0	Selects sequence input signal /SO-0.
1	Selects sequence input signal /SO-1.
2	Selects sequence input signal /SO-2.
3	Selects sequence input signal /SO-3.
4	Selects sequence input signal /SO-4.
5	Selects sequence input signal /SO-5.
6	Selects sequence input signal /SO-6.
7	Selects sequence input signal /SO-7.

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit: /BK Signal Assignment Selection

0	/BK signal assignment disabled. [factory setting]
1	/BK signal assignment enabled.

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Profile	Reference Section
Pn800	2	Communications Control	–	–	1040	Immediately	Setup	–	–

4th digit 3rd digit 2nd digit 1st digit

n.□□□□

1st digit: MECHATROLINK-III Communications Check Mask (for debug)

0	No mask
1	Ignores MECHATROLINK communications error (A.E60).
2	Ignores WDT error (A.E50).
3	Ignores both MECHATROLINK communications error (A.E60) and WDT error (A.E50).

2nd digit: Warning Check Mask

0	No mask
1	Ignores data setting warning (A.94□).
2	Ignores command warning (A.95□).
3	Ignores both data setting warning (A.94□) and command warning (A.95□).
4	Ignores communications warning (A.96□).
5	Ignores both data setting warning (A.94□) and communications warning (A.96□).
6	Ignores both command warning (A.95□) and communications warning (A.96□).
7	Ignores data setting warning (A.94□), command warning (A.95□) and communications warning (A.96□).
8	Ignores command warning 7 (A.97A) and data clamp (A.97B).
9	Ignores data setting warning (A.94□), command warning 7 (A.97A) and data clamp (A.97B).
A	Ignores command warning (A.95□) and command warning 7 (A.97A) and data clamp (A.97B).
B	Ignores data setting warning (A.94□), command warning (A.95□), command warning 7 (A.97A) and data clamp (A.97B).
C	Ignores communications warning (A.96□), command warning 7 (A.97A) and data clamp (A.97B).
D	Ignores data setting warning (A.94□), communications warning (A.96□), command warning 7 (A.97A) and data clamp (A.97B).
E	Ignores command warning (A.95□), communications warning (A.96□), command warning 7 (A.97A) and data clamp (A.97B).
F	Ignores data setting warning (A.94□), command warning (A.95□), communications warning (A.96□), command warning 7 (A.97A) and data clamp (A.97B).

3rd digit: Reserved (Do not change.)

4th digit: Warning Automatic Clear Selection (for debugging)

0	No warning-clear (for debug)
1	Automatic warning-clear (for MECHATROLINK-III specifications)

Pn820	4	Forward Latching Allowable Area	-2147483648 to 2147483647	1 reference unit	0	Immediately	Setup	–	*1
Pn822	4	Reverse Latching Allowable Area	-2147483648 to 2147483647	1 reference unit	0	Immediately	Setup	–	*1

*1. Refer to the *Σ-V-MD Series User's Manual MECHATROLINK-III Standard Servo Profile Commands* (Manual No.: SIEP S800001 03) for details.

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Profile	Reference Section
Pn824	2	Option Monitor 1 Selection	–	–	0000	Immediately	Setup	–	*1
		0010H Motor rotating speed [min^{-1}]							
		0011H Speed reference [min^{-1}]							
		0012H Torque reference [%]							
		0013H Rotational angle 1 (encoder pulses from the phase-C origin: decimal display)							
		0014H Rotational angle 2 [deg]							
		0015H Reserved (Do not use.)							
		0016H Reserved (Do not use.)							
		0017H Input reference pulse speed [min^{-1}]							
		0018H Position error [reference unit]							
		0019H Accumulated load ratio [%]							
Pn825	2	Option Monitor 2 Selection	–	–	0000	Immediately	Setup	–	*1
		0000H to 0084H Same as Option Monitor 1 Selection.							
Pn829	2	SVOFF Waiting Time (SVOFF at deceleration to stop)	0 to 65535	10 ms	0	Immediately	Setup	–	*1
Pn840	4	Linear Deceleration Constant for Stopping	1 to 20971520	10000 reference unit/s^2	100	Immediately *4	Setup	–	*1
Pn846	2	POSING Command S-curve Acceleration/Deceleration Rate	0 to 50	1%	0	Immediately	Setup	–	*1
Pn880	2	Station Address Setting	3H to EFH	–	3	After restart	Setup	–	–
Pn881	2	Number of Transmission Bytes	32 or 48	–	48	After restart	Setup	–	–

*1. Refer to the *Σ-V-MD Series User's Manual MECHATROLINK-III Standard Servo Profile Commands* (Manual No.: SIEP S800001 03) for details.

*4. Change the setting when the reference is stopped (DEN is set to 1), because the change will affect the output during operation.

11.2.2 MECHATROLINK-III Common Parameters

The following list shows the common parameters used by all devices for MECHATROLINK-III. These common parameters are used to make settings from the host controller via MECHATROLINK communications. Do not change settings with the SigmaWin+ or any other device.

<table>
<tr><th>Parameter No.</th><th>Size</th><th colspan="2">Name</th><th>Setting Range</th><th>Units [Resolution]</th><th>Factory Setting</th><th>When Enabled</th><th>Classification</th></tr>
<tr><td rowspan="3">01
PnA02</td><td rowspan="3">4</td><td colspan="2">Encoder Type (read only)</td><td>0 and 1</td><td>–</td><td>–</td><td rowspan="3">–</td><td rowspan="12">Device Information Related Parameters</td></tr>
<tr><td>0000H</td><td colspan="4">Absolute encoder</td></tr>
<tr><td>0001H</td><td colspan="4">Incremental encoder</td></tr>
<tr><td rowspan="3">02
PnA04</td><td rowspan="3">4</td><td colspan="2">Motor Type (read only)</td><td>0 and 1</td><td>–</td><td>–</td><td rowspan="3">–</td></tr>
<tr><td>0000H</td><td colspan="4">Rotational servomotor</td></tr>
<tr><td>0001H</td><td colspan="4">Linear servomotor</td></tr>
<tr><td rowspan="3">03
PnA06</td><td rowspan="3">4</td><td colspan="2">Reserved (Do not use.)</td><td>–</td><td>–</td><td>–</td><td rowspan="3">–</td></tr>
<tr><td>0000H</td><td colspan="4">Semi-closed</td></tr>
<tr><td>0001H</td><td colspan="4">Fully-closed</td></tr>
<tr><td>04
PnA08</td><td>4</td><td colspan="2">Rated Speed (read only)</td><td>0 to FFFFFFFFH</td><td>min^{-1}</td><td>–</td><td>–</td></tr>
<tr><td>05
PnA0A</td><td>4</td><td colspan="2">Maximum Output Speed (read only)</td><td>0 to FFFFFFFFH</td><td>min^{-1}</td><td>–</td><td>–</td></tr>
<tr><td>06
PnA0C</td><td>4</td><td colspan="2">Speed Multiplier (read only)</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>07
PnA0E</td><td>4</td><td colspan="2">Rated Torque (read only)</td><td>0 to FFFFFFFFH</td><td>N·m</td><td>–</td><td>–</td><td></td></tr>
<tr><td>08
PnA10</td><td>4</td><td colspan="2">Maximum Output Torque (read only)</td><td>0 to FFFFFFFFH</td><td>N·m</td><td>–</td><td>–</td><td></td></tr>
<tr><td>09
PnA12</td><td>4</td><td colspan="2">Torque Multiplier (read only)</td><td>–</td><td>–</td><td>–</td><td>–</td><td></td></tr>
<tr><td>0A
PnA14</td><td>4</td><td colspan="2">Resolution (read only)</td><td>0 to FFFFFFFFH</td><td>pulse/rev</td><td>–</td><td>–</td><td></td></tr>
<tr><td>0B
PnA16</td><td>4</td><td colspan="2">Scale Pitch</td><td>–</td><td>–</td><td>–</td><td>–</td><td></td></tr>
<tr><td>0C
PnA18</td><td>4</td><td colspan="2">Pulses per Scale Pitch</td><td>–</td><td>–</td><td>–</td><td>–</td><td></td></tr>
<tr><td>21
PnA42</td><td>4</td><td colspan="2">Electronic Gear Ratio (Numerator)</td><td>1 to 1073741824</td><td>–</td><td>1</td><td>After restart</td><td rowspan="4">Machine Specification Related Parameters</td></tr>
<tr><td>22
PnA44</td><td>4</td><td colspan="2">Electronic Gear Ratio (Denominator)</td><td>1 to 1073741824</td><td>–</td><td>1</td><td>After restart</td></tr>
<tr><td>23
PnA46</td><td>4</td><td colspan="2">Absolute Encoder Origin Offset</td><td>–1073741823 to 1073741823</td><td>1 reference unit</td><td>0</td><td>Immediately*1</td></tr>
<tr><td>24
PnA48</td><td>4</td><td colspan="2">Multiturn Limit Setting</td><td>0 to 65535</td><td>Rev</td><td>65535</td><td>After restart</td></tr>
</table>

*1. Available after the SENS_ON command is input.

Note: When using parameters that are enabled after restarting the SERVOPACK, a CONFIG command must be input or the power must be turned OFF and then ON again.

(cont'd)

Parameter No.	Size	Name	Setting Range	Units [Resolution]	Factory Setting	When Enabled	Classification
25 PnA4A	4	Limit Setting	0 to 33H	0000H	0000H	After restart	Machine Specification Related Parameters
		Bit 0 Reserved					
		Bit 1 Reserved					
		Bit 2 Reserved					
		Bit 3 Reserved					
		Bit 4 P-SOT (0: Disabled, 1: Enabled)					
		Bit 5 N-SOT (0: Disabled, 1: Enabled)					
		Bit 6 Reserved					
		Bit 7 to 31 Reserved					
26 PnA4C	4	Forward Software Limit	–1073741823 to 1073741823	1 reference unit	1073741823	Immediately	
27 PnA4E	4	Reserved (Do not use.)	–	–	0	Immediately	
28 PnA50	4	Reverse Software Limit	–1073741823 to 1073741823	1 reference unit	–1073741823	Immediately	
29 PnA52	4	Reserved (Do not use.)	–	–	0	Immediately	
41 PnA82	4	Speed Unit	0 to 4	–	0	After restart	Unit System Related Parameters
		0000H reference unit/sec					
		0001H reference unit/min					
		0002H Percentage (%) of rated speed*2					
		0003H min^{-1}*2					
		0004H Max. motor speed/40000000H*3					
42 PnA84	4	Speed Base Unit (Set the value of "n" used as the exponent in 10^n when calculating the Speed Unit (41).)*2*3	–3 to 3	–	0	After restart	
43 PnA86	4	Position Unit	0	–	0	After restart	
		0000H reference unit					
44 PnA88	4	Position Base Unit (Set the value of "n" used as the exponent in 10^n when calculating the Position Unit (43).)	0	–	0	After restart	
45 PnA8A	4	Acceleration Unit	–	–	0	After restart	
		0000H reference unit/sec^2					
		0001H Not supported					
46 PnA8C	4	Acceleration Base Unit (Set the value of "n" used as the exponent in 10^n when calculating the Acceleration Unit (45).)	4 to 6	–	4	After restart	

*2. When 0003H is selected for the Speed Unit (parameter 41), set the Speed Base Unit (parameter 42) to a number between -3 and 0.
*3. When 0004H is selected for the Speed Unit (parameter 41), set the Speed Base Unit (parameter 42) to 0.
Note: When using parameters that are enabled after restarting the SERVOPACK, a CONFIG command must be input or the power must be turned OFF and then ON again.

(cont'd)

<table>
<tr><th>Parameter No.</th><th>Size</th><th colspan="2">Name</th><th>Setting Range</th><th>Units [Resolution]</th><th>Factory Setting</th><th>When Enabled</th><th>Classification</th></tr>
<tr><td rowspan="4">47
PnA8E</td><td rowspan="4">4</td><td colspan="2">Torque Unit</td><td>1 and 2</td><td>–</td><td rowspan="4">1</td><td rowspan="4">After restart</td><td></td></tr>
<tr><td>0000H</td><td colspan="3">Not supported</td><td></td></tr>
<tr><td>0001H</td><td colspan="3">Percentage (%) of rated torque</td><td></td></tr>
<tr><td>0002H</td><td colspan="3">Max. torque/40000000H*4</td><td></td></tr>
<tr><td>48
PnA90</td><td>4</td><td colspan="2">Torque Base Unit*4
(Set the value of "n" used as the exponent in 10^n when calculating the Torque Unit (47).)</td><td>–5 to 0</td><td>–</td><td>0</td><td>After restart</td><td></td></tr>
<tr><td>61
PnAC2</td><td>4</td><td colspan="2">Speed Loop Gain</td><td>1000 to 2000000</td><td>0.001 Hz [0.1 Hz]</td><td>40000</td><td>Immediately</td><td rowspan="6">Adjustment Related Parameters</td></tr>
<tr><td>62
PnAC4</td><td>4</td><td colspan="2">Speed Loop Integral Time Constant</td><td>150 to 512000</td><td>μs [0.01 ms]</td><td>20000</td><td>Immediately</td></tr>
<tr><td>63
PnAC6</td><td>4</td><td colspan="2">Position Loop Gain</td><td>1000 to 2000000</td><td>0.001/s [0.1/s]</td><td>40000</td><td>Immediately</td></tr>
<tr><td>64
PnAC8</td><td>4</td><td colspan="2">Feedforward Compensation</td><td>0 to 100</td><td>1%</td><td>0</td><td>Immediately</td></tr>
<tr><td>65
PnACA</td><td>4</td><td colspan="2">Position Loop Integral Time Constant</td><td>0 to 5000000</td><td>μs [0.1 ms]</td><td>0</td><td>Immediately</td></tr>
<tr><td>66
PnACC</td><td>4</td><td colspan="2">Positioning Completed Width</td><td>0 to 1073741824</td><td>1 reference unit</td><td>7</td><td>Immediately</td></tr>
<tr><td>67
PnACE</td><td>4</td><td colspan="2">NEAR Signal Width</td><td>1 to 1073741824</td><td>1 reference unit</td><td>1073741824</td><td>Immediately</td><td>Adjustment Related Parameters</td></tr>
</table>

*4. When 0002H is selected for the Torque Unit (parameter 47), set the Torque Base Unit (parameter 48) to 0.
*5. Change the setting when the reference is stopped (DEN is set to 1), because the change will affect the output during operation.

Note: When using parameters that are enabled after restarting the SERVOPACK, a CONFIG command must be input or the power must be turned OFF and then ON again.

(cont'd)

<table>
<tr><th>Parameter No.</th><th>Size</th><th colspan="2">Name</th><th>Setting Range</th><th>Units [Resolution]</th><th>Factory Setting</th><th>When Enabled</th><th>Classification</th></tr>
<tr><td>81
PnB02</td><td>4</td><td colspan="2">Exponential Function Accel/Decel Time Constant</td><td>0 to 510000</td><td>μs
[0.1 ms]</td><td>0</td><td>Immedi-ately*5</td><td rowspan="23">Command Related Parameters</td></tr>
<tr><td>82
PnB04</td><td>4</td><td colspan="2">Movement Average Time</td><td>0 to 510000</td><td>μs
[0.1 ms]</td><td>0</td><td>Immedi-ately*5</td></tr>
<tr><td>83
PnB06</td><td>4</td><td colspan="2">Final Travel Distance for External Positioning</td><td>–1073741823 to 1073741823</td><td>1 reference unit</td><td>100</td><td>Immedi-ately</td></tr>
<tr><td>84
PnB08</td><td>4</td><td colspan="2">Homing Approach Speed</td><td>0 to 3FFFFFFFH</td><td>10^{-3} min^{-1}</td><td>500
Value converted reference/s into $10^{-3}min^{-1}$</td><td>Immedi-ately</td></tr>
<tr><td>85
PnB0A</td><td>4</td><td colspan="2">Homing Creep Speed</td><td>0 to 3FFFFFFFH</td><td>10^{-3} min^{-1}</td><td>500
Value converted reference/s into $10^{-3}min^{-1}$</td><td>Immedi-ately</td></tr>
<tr><td>86
PnB0C</td><td>4</td><td colspan="2">Final Travel Distance for Homing</td><td>–1073741823 to 1073741823</td><td>1 reference unit</td><td>100</td><td>Immedi-ately</td></tr>
<tr><td rowspan="17">87
PnB0E</td><td rowspan="17">4</td><td colspan="2">Monitor Selection 1</td><td>0 to F</td><td>–</td><td rowspan="17">1</td><td rowspan="17">Immedi-ately</td></tr>
<tr><td>0000H</td><td colspan="3">APOS</td></tr>
<tr><td>0001H</td><td colspan="3">CPOS</td></tr>
<tr><td>0002H</td><td colspan="3">PERR</td></tr>
<tr><td>0003H</td><td colspan="3">LPOS1</td></tr>
<tr><td>0004H</td><td colspan="3">LPOS2</td></tr>
<tr><td>0005H</td><td colspan="3">FSPD</td></tr>
<tr><td>0006H</td><td colspan="3">CSPD</td></tr>
<tr><td>0007H</td><td colspan="3">TRQ</td></tr>
<tr><td>0008H</td><td colspan="3">ALARM</td></tr>
<tr><td>0009H</td><td colspan="3">MPOS</td></tr>
<tr><td>000AH</td><td colspan="3">Reserved (Undefined value)</td></tr>
<tr><td>000BH</td><td colspan="3">Reserved (Undefined value)</td></tr>
<tr><td>000CH</td><td colspan="3">CMN1 (Common monitor 1)</td></tr>
<tr><td>000DH</td><td colspan="3">CMN2 (Common monitor 2)</td></tr>
<tr><td>000EH</td><td colspan="3">OMN1 (Optional monitor 1)</td></tr>
<tr><td>000FH</td><td colspan="3">OMN2 (Optional monitor 2)</td></tr>
<tr><td rowspan="2">88
PnB10</td><td rowspan="2">4</td><td colspan="2">Monitor Selection 2</td><td>–</td><td>–</td><td rowspan="2">0</td><td rowspan="2">Immedi-ately</td><td rowspan="2">Command Related Parameters</td></tr>
<tr><td>0000H to 000FH</td><td colspan="3">Same as Monitor Selection 1.</td></tr>
</table>

*5. Change the setting when the reference is stopped (DEN is set to 1), because the change will affect the output during operation.

Note: When using parameters that are enabled after restarting the SERVOPACK, a CONFIG command must be input or the power must be turned OFF and then ON again.

Appendix

11

(cont'd)

<table>
<tr><th>Parameter No.</th><th>Size</th><th colspan="2">Name</th><th>Setting Range</th><th>Units [Resolution]</th><th>Factory Setting</th><th>When Enabled</th><th>Classification</th></tr>
<tr><td rowspan="8">89
PnB12</td><td rowspan="8">4</td><td colspan="2">Monitor Selection for SEL_MON1 (CMN1)</td><td>0 to 6</td><td>–</td><td rowspan="8">0</td><td rowspan="8">Immediately</td><td rowspan="8">Command Related Parameters</td></tr>
<tr><td>0000H</td><td colspan="3">TPOS (Target position in the reference coordinates)</td></tr>
<tr><td>0001H</td><td colspan="3">IPOS (Reference position in the reference coordinates)</td></tr>
<tr><td>0002H</td><td colspan="3">POS_OFSET (Offset value set in the set coordinates command (POS_SET))</td></tr>
<tr><td>0003H</td><td colspan="3">TSPD (Target speed)</td></tr>
<tr><td>0004H</td><td colspan="3">SPD_LIM (Speed limit value)</td></tr>
<tr><td>0005H</td><td colspan="3">TRQ_LIM (Torque limit value)</td></tr>
<tr><td>0006H</td><td colspan="3">SV_STAT
Monitor
Byte 1: Current communications phase
00H: Phase 0
01H: Phase 1
02H: Phase 2
03H: Phase 3
Byte 2: Current control mode
00H: Position control mode
01H: Speed control mode
02H: Torque control mode
Byte 3: Reserved
Byte 4: Expansion signal monitor
<table>
<tr><th>Bit</th><th>Name</th><th>Contents</th><th>Value</th><th>Setting</th></tr>
<tr><td rowspan="2">Bit 0</td><td rowspan="2">LT_RDY1</td><td rowspan="2">Processing status for latch detection specified by SVCMD_CTRL, LT_REQ1</td><td>0</td><td>Latch detection not processed</td></tr>
<tr><td>1</td><td>During latch detection processing</td></tr>
<tr><td rowspan="2">Bit 1</td><td rowspan="2">LT_RDY1</td><td rowspan="2">Processing status for latch detection specified by SVCMD_CTRL, LT_REQ2</td><td>0</td><td>Latch detection not processed</td></tr>
<tr><td>1</td><td>During latch detection processing</td></tr>
<tr><td rowspan="4">Bit 2, Bit 3</td><td rowspan="4">LT_SEL1R</td><td rowspan="4">Latch signal</td><td>0</td><td>Phase C</td></tr>
<tr><td>1</td><td>External input signal 1</td></tr>
<tr><td>2</td><td>External input signal 2</td></tr>
<tr><td>3</td><td>External input signal 3</td></tr>
<tr><td rowspan="4">Bit 4, Bit 5</td><td rowspan="4">LT_SEL2R</td><td rowspan="4">Latch signal</td><td>0</td><td>Phase C</td></tr>
<tr><td>1</td><td>External input signal 1</td></tr>
<tr><td>2</td><td>External input signal 2</td></tr>
<tr><td>3</td><td>External input signal 3</td></tr>
<tr><td>Bit 6</td><td colspan="4">Reserved (0)</td></tr>
</table></td></tr>
</table>

(cont'd)

<table>
<tr><th>Parameter No.</th><th>Size</th><th colspan="2">Name</th><th>Setting Range</th><th>Units [Resolution]</th><th>Factory Setting</th><th>When Enabled</th><th>Classifica-tion</th></tr>
<tr><td rowspan="2">8A PnB14</td><td rowspan="2">4</td><td colspan="2">Monitor Selection for SEL_MON2 (CMN2)</td><td>0 to 6</td><td>–</td><td rowspan="2">0</td><td rowspan="2">Immedi-ately</td><td rowspan="23">Command Related Parameters</td></tr>
<tr><td>0000H to 0006H</td><td colspan="3">Same as Monitor Selection for SEL_MON1.</td></tr>
<tr><td>8B PnB16</td><td>4</td><td colspan="2">Origin Detection Range</td><td>0 to 250</td><td>1 reference unit</td><td>10</td><td>Immedi-ately</td></tr>
<tr><td>8C PnB18</td><td>4</td><td colspan="2">Forward Torque Limit</td><td>0 to 800</td><td>1%</td><td>100</td><td>Immedi-ately</td></tr>
<tr><td>8D PnB1A</td><td>4</td><td colspan="2">Reverse Torque Limit</td><td>0 to 800</td><td>1%</td><td>100</td><td>Immedi-ately</td></tr>
<tr><td>8E PnB1C</td><td>4</td><td colspan="2">Zero Speed Detection Range</td><td>1000 to 10000000</td><td>10^{-3} min^{-1}</td><td>20000</td><td>Immedi-ately</td></tr>
<tr><td>8F PnB1E</td><td>4</td><td colspan="2">Speed Coincidence Signal Output Width (read only)</td><td>0 to 100000</td><td>10^{-3} min^{-1}</td><td>10000</td><td>Immedi-ately</td></tr>
<tr><td rowspan="16">90 PnB20</td><td rowspan="16">4</td><td colspan="2">Servo Command Control Field Enabled/Disabled (read only)</td><td>–</td><td>–</td><td rowspan="16">0FFF3F3FH</td><td rowspan="16">–</td></tr>
<tr><td>Bit 0</td><td colspan="3">CMD_PAUSE (1: Enabled)</td></tr>
<tr><td>Bit 1</td><td colspan="3">CMD_CANCEL (1: Enabled)</td></tr>
<tr><td>Bit 2, 3</td><td colspan="3">STOP_MODE (1: Enabled)</td></tr>
<tr><td>Bit 4, 5</td><td colspan="3">ACCFIL (1: Enabled)</td></tr>
<tr><td>Bit 6, 7</td><td colspan="3">Reserved (0: Disabled)</td></tr>
<tr><td>Bit 8</td><td colspan="3">LT_REQ1 (1: Enabled)</td></tr>
<tr><td>Bit 9</td><td colspan="3">LT_REQ2 (1: Enabled)</td></tr>
<tr><td>Bit 10, 11</td><td colspan="3">LT_SEL1 (1: Enabled)</td></tr>
<tr><td>Bit 12, 13</td><td colspan="3">LT_SEL2 (1: Enabled)</td></tr>
<tr><td>Bit 14, 15</td><td colspan="3">Reserved (0: Disabled)</td></tr>
<tr><td>Bit 16 to 19</td><td colspan="3">SEL_MON1 (1: Enabled)</td></tr>
<tr><td>Bit 20 to 23</td><td colspan="3">SEL_MON2 (1: Enabled)</td></tr>
<tr><td>Bit 24 to 27</td><td colspan="3">SEL_MON3 (1: Enabled)</td></tr>
<tr><td>Bit 28 to 31</td><td colspan="3">Reserved (0: Disabled)</td></tr>
</table>

Note: When using parameters that are enabled after restarting the SERVOPACK, a CONFIG command must be input or the power must be turned OFF and then ON again.

(cont'd)

Parameter No.	Size	Name		Setting Range	Units [Resolution]	Factory Setting	When Enabled	Classification
91 PnB22	4	Servo Command Status Field Enabled/Disabled (read only)		–	0	0FFF3F33H	–	Command Related Parameters
		Bit 0	CMD_PAUSE_CMP (1: Enabled)					
		Bit 1	CMD_CANCEL_CMP (1: Enabled)					
		Bit 2, 3	Reserved (0: Disabled)					
		Bit 4, 5	ACCFIL (1: Enabled)					
		Bit 6, 7	Reserved (0: Disabled)					
		Bit 8	L_CMP1 (1: Enabled)					
		Bit 9	L_CMP2 (1: Enabled)					
		Bit 10	POS_RDY (1: Enabled)					
		Bit 11	PON (1: Enabled)					
		Bit 12	M_RDY (1: Enabled)					
		Bit 13	SV_ON (1: Enabled)					
		Bit 14, 15	Reserved (0: Disabled)					
		Bit 16 to 19	SEL_MON1 (1: Enabled)					
		Bit 20 to 23	SEL_MON2 (1: Enabled)					
		Bit 24 to 27	SEL_MON3 (1: Enabled)					
		Bit 28 to 31	Reserved (0: Disabled)					
92 PnB24	4	I/O Bit Enabled/Disabled (Output) (read only)		–	–	000001F0H	–	
		Bit 0 to 3	Reserved (0: Disabled)					
		Bit 4	V_PPI (1: Enabled)					
		Bit 5	P_PPI (1: Enabled)					
		Bit 6	P_CL (1: Enabled)					
		Bit 7	N_CL (1: Enabled)					
		Bit 8	G_SEL (1: Enabled)					
		Bit 9 to 11	G_SEL (0: Disabled)					
		Bit 12 to 15	Reserved (0: Disabled)					
		Bit 16 to 19	Reserved (0: Disabled)					
		Bit 20 to 22	Reserved (0: Disabled)					
		Bit 23	Reserved (0: Disabled)					
		Bit 24 to 31	Reserved (0: Disabled)					

Note: When using parameters that are enabled after restarting the SERVOPACK, a CONFIG command must be input or the power must be turned OFF and then ON again.

(cont'd)

Parameter No.	Size	Name		Setting Range	Units [Resolution]	Factory Setting	When Enabled	Classification
93 PnB26	4	I/O Bit Enabled/Disabled (Input) (read only)		–	–	000FFEFEH	–	Command Related Parameters
		Bit 0	Reserved (0: Disabled)					
		Bit 1	DEC (1: Enabled)					
		Bit 2	P-OT (1: Enabled)					
		Bit 3	N-OT (1: Enabled)					
		Bit 4	EXT1 (1: Enabled)					
		Bit 5	Reserved (1: Enabled)					
		Bit 6	Reserved (1: Enabled)					
		Bit 7	ESTP (1: Enabled)					
		Bit 8	Reserved (0: Disabled)					
		Bit 9	BRK_ON (1: Enabled)					
		Bit 10	P-SOT (1: Enabled)					
		Bit 11	N-SOT (1: Enabled)					
		Bit 12	DEN (1: Enabled)					
		Bit 13	NEAR (1: Enabled)					
		Bit 14	PSET (1: Enabled)					
		Bit 15	ZPOINT (1: Enabled)					
		Bit 16	T_LIM (1: Enabled)					
		Bit 17	V_LIM (1: Enabled)					
		Bit 18	V_CMP (1: Enabled)					
		Bit 19	ZSPD (1: Enabled)					
		Bit 20 to 23	Reserved (0: Disabled)					
		Bits 20 to 31	Reserved (0: Disabled)					

Note: When using parameters that are enabled after restarting the SERVOPACK, a CONFIG command must be input or the power must be turned OFF and then ON again.

Appendix

11

11.3 Parameter Recording Table

Use the following table for recording parameters.

Note: Pn10B, Pn170, and Pn408 have two kinds of digits: the digit which does not need the restart after changing the settings and the digit which needs the restart. The underlined digits of the factory setting in the following table show the digit which needs the restart.

A table of the SERVOPACK parameters is provided below.

Parameter	Factory Setting						Name	When Enabled
Pn000	0000						Basic Function Select Switch 0	After restart
Pn001	0012						Application Function Select Switch 1	After restart
Pn002	0011						Application Function Select Switch 2	After restart
Pn008	4000						Application Function Select Switch 8	After restart
Pn009	0010						Application Function Select Switch 9	After restart
Pn00B	0000						Application Function Select Switch B	After restart
Pn00D	0000						Application Function Select Switch D	After restart
Pn010	0						Slot 1 Axis Address	After restart
Pn011	1						Slot 2 Axis Address	After restart
Pn012	2						Slot 3 Axis Address	After restart
Pn013	3						Slot 4 Axis Address	After restart
Pn014	4						Slot 5 Axis Address	After restart
Pn015	5						Slot 6 Axis Address	After restart
Pn016	6						Slot 7 Axis Address	After restart
Pn017	7						Slot 8 Axis Address	After restart
Pn018	8						Slot 9 Axis Address	After restart
Pn019	9						Slot 10 Axis Address	After restart
Pn01A	10						Slot 11 Axis Address	After restart
Pn01B	11						Slot 12 Axis Address	After restart
Pn030	C0A80101h						Ethernet IP address	Immediately
Pn103	100						Moment of Inertia Ratio	Immediately
Pn104	400						2nd Speed Loop Gain	Immediately
Pn105	2000						2nd Speed Loop Integral Time Constant	Immediately
Pn106	400						2nd Position Loop Gain	Immediately
Pn10A	0						Feedforward Filter Time Constant	Immediately
Pn10B	0000						Application Function for Gain Select Switch	–
Pn10C	200						Mode Switch (torque reference)	Immediately
Pn10D	0						Mode Switch (speed reference)	Immediately
Pn10E	0						Mode Switch (acceleration)	Immediately
Pn10F	0						Mode Switch (position error)	Immediately
Pn121	100						Friction Compensation Gain	Immediately
Pn122	100						2nd Gain for Friction Compensation	Immediately
Pn123	0						Friction Compensation Coefficient	Immediately
Pn124	0						Friction Compensation Frequency Correction	Immediately
Pn125	100						Friction Compensation Gain Correction	Immediately

Note: When using parameters that are enabled after restarting the SERVOPACK, a CONFIG command must be input or the power must be turned OFF and then ON again.

(cont'd)

Parameter	Factory Setting						Name	When Enabled
Pn135	0						Gain Switching Waiting Time 1	Immediately
Pn136	0						Gain Switching Waiting Time 2	Immediately
Pn139	0000						Automatic Gain Changeover Related Switch 1	Immediately
Pn13D	2000						Current Gain Level	Immediately
Pn140	0100						Model Following Control Related Switch	Immediately
Pn141	500						Model Following Control Gain	Immediately
Pn142	1000						Model Following Control Gain Compensation	Immediately
Pn143	1000						Model Following Control Bias (Forward Direction)	Immediately
Pn144	1000						Model Following Control Bias (Reverse Direction)	Immediately
Pn145	500						Vibration Suppression 1 Frequency A	Immediately
Pn146	700						Vibration Suppression 1 Frequency B	Immediately
Pn147	1000						Model Following Control Speed Feedforward Compensation	Immediately
Pn148	500						2nd Model Following Control Gain	Immediately
Pn149	1000						2nd Model Following Control Gain Compensation	Immediately
Pn14A	800						Vibration Suppression 2 Frequency	Immediately
Pn14B	100						Vibration Suppression 2 Compensation	Immediately
Pn160	0010						Anti-Resonance Control Related Switch	Immediately
Pn161	1000						Anti-Resonance Frequency	Immediately
Pn162	100						Anti-Resonance Gain Compensation	Immediately
Pn163	0						Anti-Resonance Damping Gain	Immediately
Pn164	0						Anti-Resonance Filter Time Constant 1 Compensation	Immediately
Pn165	0						Anti-Resonance Filter Time Constant 2 Compensation	Immediately
Pn170	1401						Tuning-less Function Related Switch	–
Pn304	500						JOG Speed	Immediately
Pn305	0						Soft Start Acceleration Time	Immediately
Pn306	0						Soft Start Deceleration Time	Immediately
Pn310	0000						Vibration Detection Switch	Immediately
Pn311	100						Vibration Detection Sensibility	Immediately
Pn312	50						Vibration Detection Level	Immediately
Pn324	300						Moment of Inertia Calculating Start Level	Immediately
Pn401	100						Torque Reference Filter Time Constant	Immediately
Pn402	800						Forward Torque Limit	Immediately
Pn403	800						Reverse Torque Limit	Immediately
Pn406	800						Emergency Stop Torque	Immediately

Note: When using parameters that are enabled after restarting the SERVOPACK, a CONFIG command must be input or the power must be turned OFF and then ON again.

(cont'd)

Parameter	Factory Setting						Name	When Enabled
Pn407	10000						Speed Limit during Torque Control	Immediately
Pn408	0000						Torque Related Function Switch	–
Pn409	5000						1st Notch Filter Frequency	Immediately
Pn40A	70						1st Notch Filter Q Value	Immediately
Pn40B	0						1st Notch Filter Depth	Immediately
Pn40C	5000						2nd Notch Filter Frequency	Immediately
Pn40D	70						2nd Notch Filter Q Value	Immediately
Pn40E	0						2nd Notch Filter Depth	Immediately
Pn40F	5000						2nd Step 2nd Torque Reference Filter Frequency	Immediately
Pn410	50						2nd Step 2nd Torque Reference Filter Q Value	Immediately
Pn412	100						1st Step 2nd Torque Reference Filter Time Constant	Immediately
Pn424	50						Reserved	–
Pn425	100						Reserved	–
Pn456	15						Sweep Torque Reference Amplitude	Immediately
Pn460	0101						Notch Filter Adjustment Switch	Immediately
Pn506	0						Brake Reference - Servo OFF Delay Time	Immediately
Pn507	100						Brake Reference Output Speed Level	Immediately
Pn508	50						Waiting Time for Brake Signal When Motor Running	Immediately
Pn509	20						Reserved	–
Pn51E	100						Excessive Position Error Warning Level	Immediately
Pn520	5242880						Excessive Position Error Alarm Level	Immediately
Pn52B	20						Overload Warning Level	Immediately
Pn52C	100						Derating of Base Current at Detecting Overload of Motor	After restart
Pn530	0000						Program JOG Operation Related Switch	Immediately
Pn531	32768						Program JOG Movement Distance	Immediately
Pn533	500						Program JOG Movement Speed	Immediately
Pn534	100						Program JOG Acceleration/Deceleration Time	Immediately
Pn535	100						Program JOG Waiting Time	Immediately
Pn536	1						Number of Times of Program JOG Movement	Immediately
Pn560	400						Remained Vibration Detection Width	Immediately
Pn561	100						Overshoot Detection Level	Immediately
Pn590	0000						Input Signal Selection (P-OT Signal Assignment)	After restart
Pn591	0000						Input Signal Selection (N-OT Signal Assignment)	After restart

∗1. Enabled after the SENS_ON command is input.

Note: When using parameters that are enabled after restarting the SERVOPACK, a CONFIG command must be input or the power must be turned OFF and then ON again.

(cont'd)

Parameter	Factory Setting						Name	When Enabled
Pn592	0000						Input Signal Selection (/DEC Signal Assignment)	After restart
Pn593	0000						Input Signal Selection (/EXT1 Signal Assignment)	After restart
Pn594	0000						Input Signal Selection (/EXT2 Signal Assignment)	After restart
Pn595	0000						Input Signal Selection (/EXT3 Signal Assignment)	After restart
Pn596	0000						Output Signal Selection (/BK Signal Assignment)	After restart
Pn800	1040						Communications Control	Immediately
Pn820	0						Forward Latching Allowable Area	Immediately
Pn822	0						Reverse Latching Allowable Area	Immediately
Pn824	0000						Option Monitor 1 Selection	Immediately
Pn825	0000						Option Monitor 2 Selection	Immediately
Pn829	0						SVOFF Waiting Time (SVOFF at deceleration to stop)	Immediately
Pn840	100						Linear Deceleration Constant 2 for Stopping	Immediately *2
Pn846	0						POSING Command S-curve Acceleration/Deceleration Rate	Immediately
Pn880	3						Station Address Setting	After restart
Pn881	48						Number of Transmission Bytes	After restart
01 PnA02	–						Encoder Type (read only)	–
02 PnA04	–						Motor Type (read only)	–
03 PnA06	–						Reserved (Do not use.)	–
04 PnA08	–						Rated Speed (read only)	–
05 PnA0A	–						Maximum Output Speed (read only)	–
06 PnA0C	–						Speed Multiplier (read only)	–
07 PnA0E	–						Rated Torque (read only)	–
08 PnA10	–						Maximum Output Torque (read only)	–
09 PnA12	–						Torque Multiplier (read only)	–
0A PnA14	–						Resolution (read only)	–
0B PnA16	–						Scale Pitch	
0C PnA18	–						Pulses per Scale Pitch	After restart

*2. Change the setting when the reference is stopped (DEN is set to 1), because the change will affect the output during operation.

Note: When using parameters that are enabled after restarting the SERVOPACK, a CONFIG command must be input or the power must be turned OFF and then ON again.

(cont'd)

Parameter	Factory Setting						Name	When Enabled
21 PnA42	1						Electronic Gear Ratio (Numerator)	After restart
22 PnA44	1						Electronic Gear Ratio (Denominator)	After restart
23 PnA46	0						Absolute Encoder Origin Offset	Immediately*1
24 PnA48	65535						Multiturn Limit Setting	After restart
25 PnA4A	0000H						Limit Setting	After restart
26 PnA4C	1073741823						Forward Software Limit	Immediately
27 PnA4E	0						Reserved (Do not use.)	Immediately
28 PnA50	-1073741823						Reverse Software Limit	Immediately
29 PnA52	0						Reserved (Do not use.)	Immediately
41 PnA82	0						Speed Unit	After restart
42 PnA84	0						Speed Base Unit	After restart
43 PnA86	0						Position Unit	After restart
44 PnA88	0						Position Base Unit	After restart
45 PnA8A	0						Acceleration Unit	After restart
46 PnA8C	4						Acceleration Base Unit	After restart
47 PnA8E	1						Torque Unit	After restart
48 PnA90	0						Torque Base Unit	After restart
49 PnA92	0601011FH						Compliance Unit System (read only)	–
61 PnAC2	40000						Speed Loop Gain	Immediately
62 PnAC4	20000						Speed Loop Integral Time Constant	Immediately
63 PnAC6	40000						Position Loop Gain	Immediately
64 PnAC8	0						Feedforward Compensation	Immediately
65 PnACA	0						Position Loop Integral Time Constant	Immediately
66 PnACC	7						Positioning Completed Width	Immediately

*1. Enabled after the SENS_ON command is input.

Note: When using parameters that are enabled after restarting the SERVOPACK, a CONFIG command must be input or the power must be turned OFF and then ON again.

(cont'd)

Parameter	Factory Setting						Name	When Enabled
67 PnACE	1073741824						NEAR Signal Width	Immediately
81 PnB02	0						Exponential Function Accel/Decel Time Constant	Immediately*2
82 PnB04	0						Movement Average Time	Immediately*2
83 PnB06	100						Final Travel Distance for External Positioning	Immediately
84 PnB08	5000						Homing Approach Speed	Immediately
85 PnB0A	500						Homing Creep Speed	Immediately
86 PnB0C	100						Final Travel Distance for Homing	Immediately
87 PnB0E	1						Monitor Selection 1	Immediately
88 PnB10	0						Monitor Selection 2	Immediately
89 PnB12	0						Monitor Selection for SEL_MON1 (CMN1)	Immediately
8A PnB14	0						Monitor Selection for SEL_MON2 (CMN2)	Immediately
8B PnB16	10						Origin Detection Range	Immediately
8C PnB18	100						Forward Torque Limit	Immediately
8D PnB1A	100						Reverse Torque Limit	Immediately
8E PnB1C	20000						Zero Speed Detection Range	Immediately
8F PnB1E	10000						Speed Coincidence Signal Output Width (read only)	Immediately
90 PnB20	0FFF3F3FH						Servo Command Control Field Enabled/Disabled (read only)	–
91 PnB22	0FFF3F33H						Servo Command Status Field Enabled/Disabled (read only)	–
92 PnB24	007F01F0H						I/O Bit Enabled/Disabled (Output) (read only)	–
93 PnB26	FF0FFEFEH						I/O Bit Enabled/Disabled (Input) (read only)	–

*2. Change the setting when the reference is stopped (DEN is set to 1), because the change will affect the output during operation.

Note: When using parameters that are enabled after restarting the SERVOPACK, a CONFIG command must be input or the power must be turned OFF and then ON again.

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Revision History

The revision dates and numbers of the revised manuals are given on the bottom of the back cover.

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Revision number

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Date of publication

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July 2016	<1>	1	Front cover	Revision: Format
			5.1.2 (1)	Revision: Housing model numbers for main circuit power supply cables.
			5.2.2 (1)	Revision: Sumitomo 3M Ltd. → 3M Japan Limited
			5.5.3 (2)	Revision: Information on battery for encoder
			6.5.1	Deletion: Display method for parameter types
			10.2.2	Revision: Information of A.E42 alarm
			11.2	Revision: Information on reserved parameters
			Back cover	Revision: Address and format
September 2014		0	All chapters	Addition: Information on type A01 SERVOPACKs
February 2014	–	–	–	First edition

AC Servo Drives

Σ-V-MD Series

USER'S MANUAL

Type A01/A02
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In the event that the end user of this product is to be the military and said product is to be employed in any weapons systems or the manufacture thereof, the export will fall under the relevant regulations as stipulated in the Foreign Exchange and Foreign Trade Regulations. Therefore, be sure to follow all procedures and submit all relevant documentation according to any and all rules, regulations and laws that may apply.

Specifications are subject to change without notice for ongoing product modifications and improvements.

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