YASKAWA

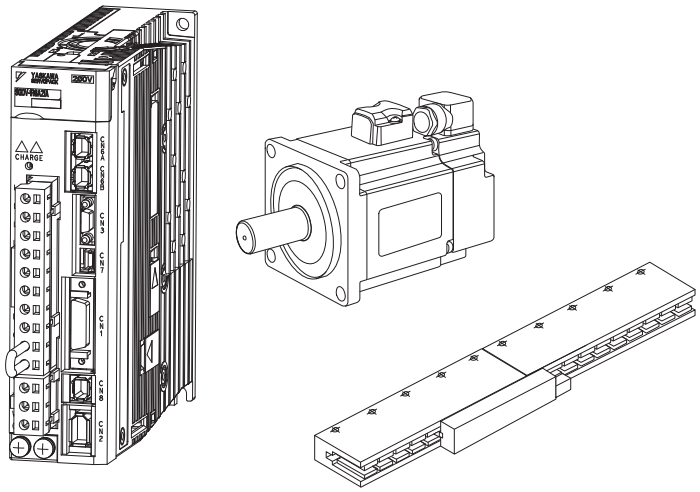
AC Servo Drives

Σ-V-EX Series

USER'S MANUAL

Model: EX001
MECHATROLINK-III Communications Reference

SGDV-□□□□2□□□□□□EX001 SERVOPACK
SGMMV/SGMJV/SGMAV/SGMPS/SGMGV/SGMSV/SGMCV/SGMCS/
SGLGW/SGLFW/SGLTW/SGLC/SGT Servomotor



MANUAL NO. SIEP S800000 91F

About this Manual

This manual contains information that is required to design, test, adjust, and maintain Σ-V-EX-series EX001 servo system. An EX001 servo system provides a MECHATROLINK-III communications reference interface with a 125-μs communications cycle.

Keep this manual in a location where it can be accessed for reference whenever required.

When you use a Σ-V-EX-series EX001 servo system, read this manual together with the Σ-V Series User's Manual Design and Maintenance, MECHATROLINK-III Communications Reference.

Also read the documents that are listed on the next page as required by the application.

> **IMPORTANT**
>
> The communications cycle of the Σ-V-EX-series EX001 can also be set to a value of 250 μs or higher. If you set the communications cycle to 250 μs or higher, operation will be the same as for a MECHATROLINK-III Communications Reference-type Σ-V-series SERVOPACK. If you use a communications cycle of 250 μs or higher, refer to the Σ-V Series User's Manual Design and Maintenance, MECHATROLINK-III Communications Reference.

■ Reference Table

Information on different items is provided in different user's manuals. Read the correct user's manual as given in the following table.

Item		This Manual	Σ-V Series User's Manual Design and Maintenance, MECHATROLINK-III Communications Reference	
			For Rotation Motors (Manual No.: SIEP S800000 64)	For Linear Motors (Manual No.: SIEP S800000 65)
Outline	Σ-V-EX-series EX001	1.1	–	
	Part Names	–	1.2	
	SERVOPACK Ratings and Specifications	1.2	–	
	SERVOPACK Internal Block Diagrams	–	1.4	
	Examples of Servo System Configurations	–	1.5	
	SERVOPACK Model Designation	1.3	–	
	Inspection and Maintenance	–	1.7	
Panel Display and Operation of Digital Operator		–	Chapter 2	
Wiring and Connection		–	Chapter 3	
Operation		–	Chapter 4	
Communications Cycle of 125 μs		Chapter 2	–	
Operation Sequence		2.4	–	
Standard Servo Profile Commands for MECHATROLINK-III		2.5	–	

(cont'd)

Item		This Manual	Σ-V Series User's Manual Design and Maintenance, MECHATROLINK-III Communications Reference	
			For Rotation Motors (Manual No.: SIEP S800000 64)	For Linear Motors (Manual No.: SIEP S800000 65)
Adjustments	Type of Adjustments and Basic Adjustment Procedure	3.1	–	
	Moment of Inertia Ratio Calculation	3.2	–	
	One-parameter Tuning (Fn203)	–	5.5	
	Anti-Resonance Control Adjustment Function (Fn204)	–	5.6	
	Vibration Suppression Function (Fn205)	–	5.7	
Utility Functions (Fn□□□)		–	Chapter 6	
Monitor Displays (Un□□□)		–	Chapter 7	
Trouble-shooting	For Problems Unique to Σ-V-EX-series EX001	Chapter 4	–	
	For Other Problems	–	Chapter 9	Chapter 8
List of Utility Functions		Chapter 5	–	
List of Parameters		–	10.1.2	9.1.2
List of MECHATROLINK-III Common Parameters		–	10.1.3	9.1.3
List of Monitor Displays		–	10.2	9.2
Parameter Recording Table		–	10.3	9.3

■ Description of Technical Terms

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

Term	Meaning
Cursor	Input position indicated by Digital Operator
Servomotor	Σ-V Series rotary servomotors (SGMMV, SGMJV, SGMAV, SGMPS, SGMGV, or SGMSV), and Σ-V Series direct drive servomotors (SGMCV or SGMCS)
Linear Servomotor	Σ-V Series SGLGW, SGLFW, SGLTW, SGLCW linear servomotor or SGT linear slider
SERVOPACK	Σ-V-EX Series EX001 servo amplifier
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.

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Term	Meaning
Main Circuit Cable	Cables which connect to the main circuit terminals, including main circuit power supply cables, control power supply cables, servomotor main circuit cables, and others.
Linear Scale Connection Cables	A set of cables including a cable for connecting serial converter unit, a cable for connecting linear scale, and a cable for connecting hall sensor

■ Specific Technical Terms

Different technical terms are used for rotational motors and linear motors, and the terms for rotational motors are used in this manual.

Rotational Motors	Linear Motors
torque	force
rotation	movement
moment of inertia	mass
motor speed [min^{-1}]	moving speed [mm/s]
forward rotation, reverse rotation	forward direction, reverse direction

■ IMPORTANT Explanations

The following icon is displayed for explanations requiring special attention.

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.

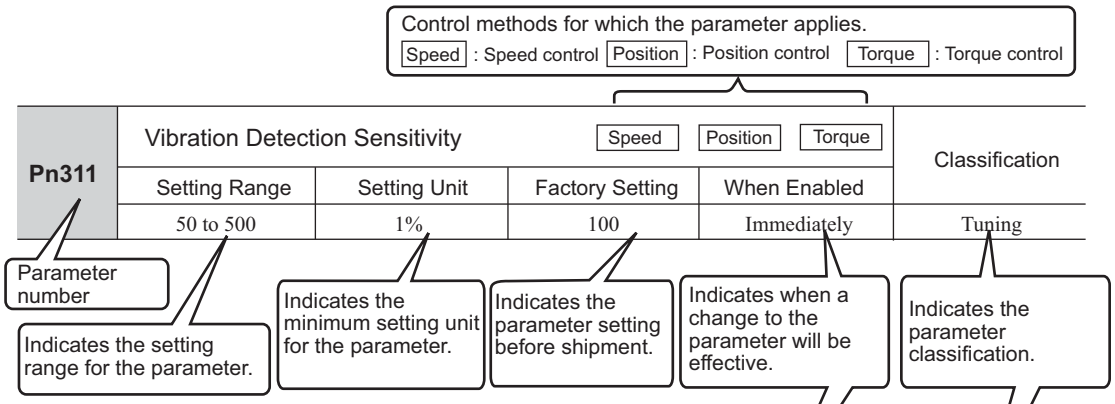
Notation Example

$\overline{BK}$ = /BK

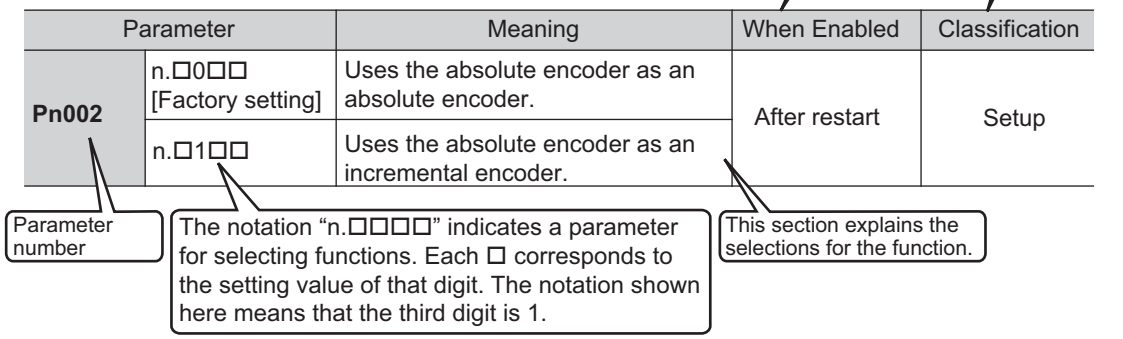
- Notation for Parameters

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

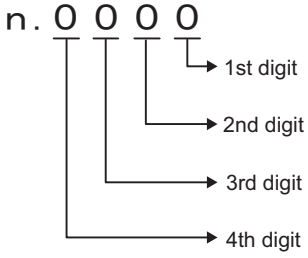


- Parameters for Selecting Functions



Notation Example

Digital Operator Display (Display Example for Pn002)



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.

■ Related Manuals

Refer to the following manuals as required.

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 Series User's Manual Setup Rotational Motor (No.: SIEP S800000 43)				✓	✓		
Σ-V Series User's Manual Setup Linear Motor (No.: SIEP S800000 44)				✓	✓		
Σ-V Series Product Catalog (No.: KAEP S800000 42)	✓	✓	✓				
Σ-V-EX Series User's Manual Model: EX001 MECHATROLINK-III Communications Reference (This Manual)			✓			✓	
Σ-V Series User's Manual Design and Maintenance Rotational Motor/ MECHATROLINK-III Communications Reference (No.: SIEP S800000 64)			✓		✓	✓	✓
Σ-V Series User's Manual Design and Maintenance Linear Motor/ MECHATROLINK-III Communications Reference (No.: SIEP S800000 65)			✓		✓	✓	✓
Σ-V Series User's Manual MECHATROLINK-III Standard Servo Profile Commands (No.: SIEP S800000 63)			✓		✓	✓	
Σ-V Series User's Manual Operation of Digital Operator (No.: SIEP S800000 55)					✓	✓	✓
Σ-V Series AC SERVOPACK SGDV Safety Precautions (No.: TOBP C710800 10)	✓			✓			✓
Σ Series Digital Operator Safety Precautions (No.: TOBP C730800 00)							✓
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 the servomotor, any rotating servomotor parts, or the machine 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.
- Install the SERVOPACK and servomotor before you wire them.
  Failure to observe this caution may result in electric shock.
- Never touch the inside of the SERVOPACKs.
  Failure to observe this warning may result in electric shock.
- Do not remove the cover of the power supply terminal block while the power is ON.
  Failure to observe this warning may result in electric shock.
- After the power is turned OFF or after a voltage resistance test, do not touch terminals while the CHARGE lamp is ON.
  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.
- Do not remove the top front cover, cables, connectors, or optional items 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 for a SERVOPACK with a 100 V, 200 V power supply, 10 Ω or less for a SERVOPACK with a 400 V power supply).
  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.
- The person who designs a system using the safety function (Hard Wire Baseblock function) must have full knowledge of the related safety standards and full understanding of the instructions in this manual.
  Failure to observe this warning may result in injury or damage to the equipment.

Rotational Servomotors

- The output range of the rotational serial data for the Σ-V-EX absolute position detecting system is different from that of earlier systems for 12-bit and 15-bit encoders. As a result, the infinite-length positioning system of the Σ Series must be changed for use with products in the Σ-V-EX Series.
- 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 Pn205 in the SERVOPACK to be sure that it is correct.
  If Fn013 is executed when an incorrect value is set in Pn205, an incorrect value will be set in the encoder. The alarm will disappear even if an incorrect value is set, but incorrect positions will be detected, resulting in a dangerous situation where the machine will move to unexpected positions.

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⚠ WARNING
Linear Servomotors • If you have a pacemaker or any other electronic medical device, do not go near the magnetic way of the servomotor. Failure to observe this warning may result in the malfunction of the medical device. • Be sure to use nonmagnetic tools when installing or working close to the servomotor. (Example: a beryllium-copper alloy hexagonal wrench set, made by NGK Insulators, Ltd.)

■ 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 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.
Rotational Servomotors • 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.
Linear Servomotors • Be sure to store the magnetic way in the package that was used for delivery. • Do not hold the servomotor by the cables while transporting it. Failure to observe this caution may result in injury or malfunction.

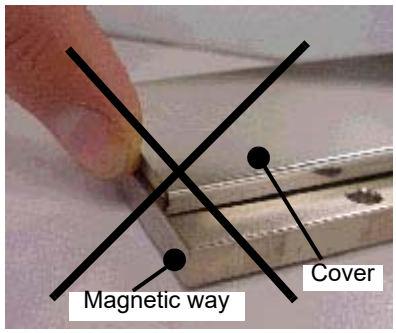
■ Installation

⚠ 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.

Linear Servomotors

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



- When removing the dummy plate for reducing magnetic force used for the SGLFW magnetic way, pay attention to the magnetic attraction of the magnetic way. Do not place the removed plate close to the magnetic way.
  Failure to observe this caution may result in injury or damage to the magnetic way’s magnets or the magnet protection cover.
- Install SERVOPACKs, servomotors, and regenerative resistors on nonflammable objects.
  Installation directly onto or near flammable objects may result in fire.

■ Wiring

⚠ CAUTION

- Be sure to wire correctly and securely.
  Failure to observe this caution may result in motor overrun, injury, or malfunction.
- Securely tighten the cable connector screws and securing mechanism.
  If the connector screws and securing mechanism are not secure, they may loosen during operation.
- Use cables with a radius, heat resistance, and flexibility suitable for the system.
- If the SERVOPACK malfunctions, turn OFF the main circuit's power supply of the SERVOPACK.
  The continuous flow of a large current may cause fire.
- Use a noise filter to minimize the effects of electromagnetic damage.
  Failure to observe this caution may result in electromagnetic damage to electronic devices used near the SERVOPACK.
- Do not connect a 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 touch the power supply terminals while the CHARGE lamp is ON after turning power OFF because high voltage may still remain in the SERVOPACK.
  Make sure the charge indicator is OFF first before starting to do wiring or inspections.
- 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 main circuit terminals from the SERVOPACK prior to wiring.
  - Insert only one power line per opening in the main circuit terminals.
  - Make sure that no part of the core wire comes into contact with (i.e., short-circuits) adjacent wires.
- Do not connect a power supply that exceeds the power supply specifications.
  Failure to observe this warning may result in damage to the SERVOPACK.
- When connecting an External Regenerative Resistor to the SGDV-3R8A, -5R5A, -7R6A, -120A, -180A, -200A, -330A, -1R9D, -3R5D, -5R4D, -8R4D, -120D, or -170D, first remove the lead wire between the B2 and B3 terminals on the SERVOPACK, and then connect the External Regenerative Resistor.
  There is a risk of SERVOPACK failure.
- Always use the specified power supply voltage.
  An incorrect voltage may result in fire or malfunction.
- Make sure that the polarity is correct.
  Incorrect polarity may cause ruptures or damage.
- Take appropriate measures to ensure that the input power supply is supplied within the specified voltage fluctuation range. Be particularly careful in places where the power supply is unstable.
  An incorrect power supply may result in damage to the 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.
- Wiring or inspection must be performed by a technical expert.
- Use a 24-VDC power supply with double insulation or reinforced insulation.

⚠ CAUTION

Rotational Servomotors

- Do not bundle or run the main circuit cables together with the I/O signal cables or the encoder cables in the same duct. Keep the main circuit cables separated from the I/O signal cables and the encoder cables with a gap of at least 30 cm.
  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, 50 m for encoder cables or servomotor main circuit cables, and 10 m for control power supply cables for the SERVOPACK with a 400-V power supply (+24 V, 0 V).
- Install a battery at either the host controller or the SERVOPACK, but not both.
  It is dangerous to install batteries at both ends simultaneously, because that sets up a loop circuit between the batteries.
- 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.

Linear Servomotors

- Do not bundle or run the main circuit cables together with the I/O signal cables or the linear scale connection cables in the same duct. Keep the main circuit cables separated from the I/O signal cables and the linear scale connection cables with a gap of at least 30 cm.
  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 linear scale connection cables.
- Make sure that the length of each cable is equal to or shorter than the maximum wiring length listed here.
  - I/O signal cables: 3 m
  - Connection cables for linear servomotor main circuit: 20 m
  - Connection cables for serial converter unit: 20 m
  - Connection cables for linear scale: 15 m
  - Connection cables for hall sensor: 15 m
  - Control power supply cables for the SERVOPACK with a 400-V power supply (+24 V, 0 V):10 m

■ Operation

⚠ CAUTION

- Do not stand within the machine's range of motion during operation.
  Failure to observe this caution may result in injury.
- Always use the servomotor and SERVOPACK in one of the specified combinations.
  Failure to observe this caution may result in fire or malfunction.
- Before operation, install a limit switch or stopper on the end of the slider to prevent unexpected movement.
  Failure to observe this caution may result in injury.
- 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 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.
- Do not touch the SERVOPACK heat sinks, regenerative resistor, or servomotor while power is ON or soon after the power is turned OFF.
  Failure to observe this caution may result in burns due to high temperatures.
- Do not make any extreme adjustments or setting changes of parameters.
  Failure to observe this caution may result in injury or damage to the equipment due to unstable operation.
- If an alarm occurs, shut down the main circuit power supply.
  Failure to observe this caution may result in fire due to regenerative resistor overheating caused by regenerative transistor failure.
- 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.

Rotational Servomotors

- 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.
- When carrying out JOG operation (Fn002), origin search (Fn003), or EasyFFT (Fn206), 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 not using the turning-less function, set the correct moment of inertia ratio (Pn103).
  Setting an incorrect moment of inertia ratio may cause machine vibration.
- Do not use the holding brake of the servomotor for braking.
  Failure to observe this caution may result in malfunction.

Linear Servomotors

- When carrying out JOG operation (Fn002), origin search (Fn003), or EasyFFT (Fn206), 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 not using the turning-less function, set the correct mass ratio (Pn103).
  Setting an incorrect mass ratio may cause machine vibration.

■ 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 Precautions

⚠ CAUTION

- Correctly discard the product as stipulated by regional, local, and municipal laws and regulations. Be sure to include these contents in all labelling and warning notifications on the final product as necessary.

■ 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.

Compliance with UL Standards, EU Directives, UK Regulations, Other Safety Standards and China Energy Efficiency Regulations

■ North American Safety Standards (UL)

Product	Model	North American Safety Standards (UL File No.)
SERVOPACK	SGDV	UL508C (E147823)
Rotary Servomotor	• SGMMV • SGMJV • SGMAV • SGMPS • SGMGV • SGMSV	UL 1004-1 UL 1004-6 (E165827) CSA C22.2 No.100
Direct Drive Servomotor	SGMCV	UL 1004-1 UL 1004-6 (E165827) CSA C22.2 No.100
Linear Servomotor	• SGLG*1 • SGLF*1 • SGLT*1*2	UL 1004-1 UL 1004-6 (E165827) CSA C22.2 No.100

∗1. Only products with derating specifications are in compliance with the UL Standards. Estimates are available for those products. Contact your Yaskawa representative for details.
∗2. SGLTW-35A□□□H and -50A□□□H (high-force type) are not in compliance with the UL Standards.

■ EU Directives

CE

Product	Model	EU Directives	Harmonized Standards
SERVOPACK	SGDV	Machinery Directive 2006/42/EC	EN ISO 13849-1: 2015
		EMC Directive 2014/30/EU	EN 55011 Group 1, Class A EN 61000-6-2 EN 61000-6-4 EN 61800-3 (Category C2, Second environment)
		Low Voltage Directive 2014/35/EU	EN 61800-5-1
		RoHS Directive 2011/65/EU (EU)2015/863	EN IEC 63000
Rotary Servomotor	• SGMGV • SGMSV	EMC Directive 2014/30/EU	EN 55011 Group 1, Class A EN 61000-6-2 EN 61800-3 (Category C2, Second environment)
		Low Voltage Directive 2014/35/EU	EN 60034-1 EN 60034-5
		RoHS Directive 2011/65/EU (EU)2015/863	EN IEC 63000
	• SGMJV • SGMAV • SGMMV • SGMPS	EMC Directive 2014/30/EU	EN 55011 Group 1, Class A EN 61000-6-2 EN 61000-6-4 EN 61800-3 (Category C2, Second environment)
		Low Voltage Directive 2014/35/EU	EN 60034-1 EN 60034-5
		RoHS Directive 2011/65/EU (EU)2015/863	EN IEC 63000
Direct Drive Servomotor	• SGMCV • SGMCS -□□B -□□C -□□D -□□E (Small-capacity, Coreless servomotors) *1	EMC Directive 2014/30/EU	EN 55011 Group 1, Class A EN 61000-6-2 EN 61000-6-4 EN 61800-3 (Category C2, Second environment)
		Low Voltage Directive 2014/35/EU	EN 60034-1 EN 60034-5
		RoHS Directive 2011/65/EU (EU)2015/863	EN IEC 63000
Linear Servomotor	• SGLG*2 • SGLF*2 • SGLT*2	EMC Directive 2014/30/EU	EN 55011 Group 1, Class A EN 61000-6-2 EN 61000-6-4 EN 61800-3 (Category C2, Second environment)
		Low Voltage Directive 2014/35/EU	EN 60034-1
		RoHS Directive 2011/65/EU (EU)2015/863	EN IEC 63000

∗1. For SGMCS, only models with "-E" at the end of model numbers are in compliance with the standards.

∗2. Only Moving Coils of EU Directive-certified products (models with "-E" at the end of model numbers) are in compliance with the EU Directives. Estimates are available for those products. Contact your Yaskawa representative for details. For EU Directive-certified products for SGL□M (models with "-E" at the end of model numbers), the content of substances specified in 2011/65/EU as amended by (EU)2015/863 is below the standard value. However, these products are not marked since they are not subject to CE Marking requirements because they are not energized.

■ UK Conformity Assessed (UKCA)

Product	Model	UK Regulations	Designated Standards
SERVOPACK	SGDV	Supply of Machinery (Safety) Regulations S.I. 2008/1597	EN ISO 13849-1: 2015
		Electromagnetic Compatibility Regulations S.I. 2016/1091	EN 55011 Group 1, Class A EN 61000-6-2 EN 61000-6-4 EN 61800-3 (Category C2, Second environment)
		Electrical Equipment (Safety) Regulations S.I. 2016/1101	EN 61800-5-1
		Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations S.I. 2012/3032	EN IEC 63000
Rotary Servomotor	• SGMGV • SGMSV	Electromagnetic Compatibility Regulations S.I. 2016/1091	EN 55011 Group 1, Class A EN 61000-6-2 EN 61800-3 (Category C2, Second environment)
		Electrical Equipment (Safety) Regulations S.I. 2016/1101	EN 60034-1 EN 60034-5
		Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations S.I. 2012/3032	EN IEC 63000
	• SGMJV • SGMAV • SGMMV • SGMPS	Electromagnetic Compatibility Regulations S.I. 2016/1091	EN 55011 Group 1, Class A EN 61000-6-2 EN 61000-6-4 EN 61800-3 (Category C2, Second environment)
		Electrical Equipment (Safety) Regulations S.I. 2016/1101	EN 60034-1 EN 60034-5
		Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations S.I. 2012/3032	EN IEC 63000
Direct Drive Servomotor	• SGMCV • SGMCS -□□B -□□C -□□D -□□E (Small-capacity, Coreless servomotors) *1	Electromagnetic Compatibility Regulations S.I. 2016/1091	EN 55011 Group 1, Class A EN 61000-6-2 EN 61000-6-4 EN 61800-3 (Category C2, Second environment)
		Electrical Equipment (Safety) Regulations S.I. 2016/1101	EN 60034-1 EN 60034-5
		Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations S.I. 2012/3032	EN IEC 63000

(cont'd)

Product	Model	UK Regulations	Designated Standards
Linear Servomotor	• SGLG*2 • SGLF*2 • SGLT*2	Electromagnetic Compatibility Regulations S.I. 2016/1091	EN 55011 Group 1, Class A EN 61000-6-2 EN 61000-6-4 EN 61800-3 (Category C2, Second environment)
		Electrical Equipment (Safety) Regulations S.I. 2016/1101	EN 60034-1
		Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations S.I. 2012/3032	EN IEC 63000

∗1. For SGMCS, only models with "-E" at the end of model numbers are in compliance with the standards.
∗2. Only Moving Coils of EU Directive-certified products (models with "-E" at the end of model numbers) are in compliance with the EU Directives. Estimates are available for those products. Contact your Yaskawa representative for details. For EU Directive-certified products for SGL□M (models with "-E" at the end of model numbers), the content of substances specified in S.I. 2012/3032 is below the standard value. However, these products are not marked since they are not subject to UKCA Marking requirements because they are not energized.

Note: We declared the UKCA marking based on the designated standards in the above table.

■ Safety Standards

Product	Model	Safety Standards	Standards
SERVOPACK	SGDV	Safety of Machinery	EN ISO 13849-1: 2015 EN 60204-1
		Functional Safety	EN 61508 series EN 61800-5-2
		Functional Safety EMC	EN 61326-3-1

• Safety Performance

Items	Standards	Performance Level
Safety Integrity Level	EN 61508	SIL2
Probability of Dangerous Failure per Hour	EN 61508	PFH = 1.7×10^{-9} [1/h] (0.17% of SIL2)
Performance Level	EN ISO 13849-1	PL d (Category 3)
Mean Time to Dangerous Failure of Each Channel	EN ISO 13849-1	MTTFd: High
Average Diagnostic Coverage	EN ISO 13849-1	DCavg: Low
Stop Category	EN 60204-1	Stop category 0
Safety Function	EN 61800-5-2	STO
Proof test Interval	EN 61508	10 years

■ China Energy Label for Permanent-Magnet Synchronous Motors

Product	Model	Application Range	Laws and Standards
Rotary Servomotor	SGMJV SGMAV SGMGV SGMSV SGMPS	Rated Voltage 1000 V max. Rated Output 0.55 kW to 90 kW Rated Motor Speed 500 to 3000 min^{-1}	law CEL 038-2020 regulation GB 30253-2013

Note: The following products do not comply with the China Energy Label for permanent-magnet synchronous motors.
- Models with holding brakes
- Models with gears

Contents

1

Outline

1.1 Σ-V-EX-series EX001

A Σ-V-EX-series EX001 SERVOPACK provides a MECHATROLINK-III communications reference interface with a 125-µs communications cycle.

Using a 125-µs communications cycle enables faster and more detailed references and monitoring than is possible with a Σ-V-series SERVOPACK. Faster response also increases the throughput of the host controller.

1.2 SERVOPACK Ratings and Specifications

This section describes the ratings and specifications of SERVOPACKs.

1.2.1 Ratings

Ratings of SERVOPACKs are as shown below.

(1) SGDV with Single-phase, 100-V Rating

SGDV (Single Phase, 100 V)	R70	R90	2R1	2R8
Continuous Output Current [Arms]	0.66	0.91	2.1	2.8
Instantaneous Max. Output Current [Arms]	2.1	2.9	6.5	9.3
Regenerative Resistor	None or external			
Main Circuit Power Supply	Single-phase, 100 to 115 VAC $^{+10\%}_{-15\%}$, 50/60 Hz			
Control Power Supply	Single-phase, 100 to 115 VAC $^{+10\%}_{-15\%}$, 50/60 Hz			
Overvoltage Category	III			

(2) SGDV with Single-phase, 200-V Rating

SGDV (Single Phase, 200 V)	120 *
Continuous Output Current [Arms]	11.6
Instantaneous Max. Output Current [Arms]	28
Regenerative Resistor	Built-in or external
Main Circuit Power Supply	Single-phase, 220 to 230 VAC $^{+10\%}_{-15\%}$, 50/60 Hz
Control Power Supply	Single-phase, 220 to 230 VAC $^{+10\%}_{-15\%}$, 50/60 Hz
Overvoltage Category	III

* The official model number is SGDV-120A21A008000.

(3) SGDV with Three-phase, 200-V Rating

SGDV (Three Phase, 200 V)	R70	R90	1R6	2R8	3R8	5R5	7R6	120	180	200	330	470	550	590	780
Continuous Output Current [Arms]	0.66	0.91	1.6	2.8	3.8	5.5	7.6	11.6	18.5	19.6	32.9	46.9	54.7	58.6	78.0
Instantaneous Max. Output Current [Arms]	2.1	2.9	5.8	9.3	11.0	16.9	17	28	42	56	84	110	130	140	170
Regenerative Resistor	None or external				Built-in or external							External			
Main Circuit Power Supply	Three-phase, 200 to 230 VAC $^{+10\%}_{-15\%}$, 50/60 Hz														
Control Power Supply	Single-phase, 200 to 230 VAC $^{+10\%}_{-15\%}$, 50/60 Hz														
Overvoltage Category	III														

(4) SGDV with Three-phase, 400-V Rating

SGDV (Three Phase, 400 V)	1R9	3R5	5R4	8R4	120	170	210	260	280	370
Continuous Output Current [Arms]	1.9	3.5	5.4	8.4	11.9	16.5	20.8	25.7	28.1	37.2
Instantaneous Max. Output Current [Arms]	5.5	8.5	14	20	28	42	55	65	70	85
Regenerative Resistor	Built-in or external						External			
Main Circuit Power Supply	Three-phase, 380 to 480 VAC $^{+10\%}_{-15\%}$, 50/60 Hz									
Control Power Supply	24 VDC ±15%									
Overvoltage Category	III									

1.2.2 Basic Specifications

Basic specifications of SERVOPACKs are shown below.

Drive Method			Sine-wave current drive with PWM control of IGBT	
Feedback			Encoder: 13-bit (incremental), 17-bit, 20-bit (incremental/absolute)	
Operating Conditions	Surrounding Air Temperature		0°C to +55°C	
	Storage Temperature		-20°C to +85°C	
	Ambient Humidity		90% RH or less	With no freezing or condensation
	Storage Humidity		90% RH or less	
	Vibration Resistance		4.9 m/s^2	
	Shock Resistance		19.6 m/s^2	
	Protection Class		IP10	An environment that satisfies the following conditions. • Free of corrosive or flammable gases • Free of exposure to water, oil, or chemicals • Free of dust, salts, or iron dust
	Pollution Degree		2	
	Altitude		1000 m or less	
	Others		Free of static electricity, strong electromagnetic fields, magnetic fields or exposure to radioactivity	
Harmonized Standards			Refer to *Compliance with UL Standards, EU Directives, UK Regulations, Other Safety Standards and China Energy Efficiency Regulations* in the preface for details.	
Mounting			Standard: Base-mounted Optional: Rack-mounted or duct-ventilated	
Performance	Speed Control Range		1:5000 (The lower limit of the speed control range must be lower than the point at which the rated torque does not cause the servomotor to stop.)	
	Speed Regulation*1	Load Regulation	0% to 100% load: ±0.01% max. (at rated speed)	
		Voltage Regulation	Rated voltage ±10%: 0% (at rated speed)	
		Temperature Regulation	25 ± 25 °C: ±0.1% max. (at rated speed)	
	Torque Control Tolerance (Repeatability)		±1%	
	Soft Start Time Setting		0 to 10 s (Can be set individually for acceleration and deceleration.)	

(cont'd)

I/O Signals	Encoder Output Pulse		Phase A, B, C: line driver Encoder output pulse: any setting ratio (Refer to *4.4.5*[*2].)	
	Sequence Input	Input Signals which can be allocated	Number of Channels	7 ch
			Functions	• Homing deceleration switch (/DEC) • External latch (/EXT 1 to 3) • Forward run prohibited (P-OT), reverse run prohibited (N-OT) • Forward external torque limit (/P-CL), reverse external torque limit (/N-CL) Signal allocations can be performed, and positive and negative logic can be changed.
	Sequence Output	Fixed Output	Servo alarm (ALM) output	
		Output Signals which can be allocated	Number of Channels	3 ch
			Functions	• Positioning completion (/COIN) • Speed coincidence detection (/V-CMP) • Rotation detection (/TGON) • Servo ready (/S-RDY) • Torque limit detection (/CLT) • Speed limit detection (/VLT) • Brake (/BK) • Warning (/WARN) • Near (/NEAR) Signal allocations can be performed, and positive and negative logic can be changed.
Communications Function	RS422A Communications (CN3)	Interface	Digital operator (JUSP-OP05A-1-E), personal computer (can be connected with SigmaWin+)	
		1:N Communications	N = Up to 15 stations possible at RS422A	
		Axis Address Setting	Set by parameter	
	USB Communications (CN7)	Interface	Personal computer (can be connected with SigmaWin+)	
		Communications Standard	Complies with standard USB1.1. (12 Mbps)	
LED Display			Panel display (seven-segment), CHARGE, L1, L2, and CN indicators	
MECHATROLINK-III Communications Setting Switches			Rotary Switch (S1, S2)	Position: 16 positions × 2 (Refer to *4.1.1*[*2])
			DIP Switch (S3)	Number of pins: Four pins (Refer to *4.1.1*[*2])
Analog Monitor (CN5)			Number of points: 2 Output voltage: ± 10VDC (linearity effective range ± 8 V) Resolution: 16 bits Accuracy: ± 20 mV (Typ) Max. output current: ± 10 mA Settling time (± 1%): 1.2 ms (Typ)	
Dynamic Brake (DB)			Activated when a servo alarm or overtravelling occurs or when the power supply for the main circuit or servomotor is OFF.	
Regenerative Processing			Included [*3]	
Overtravel Prevention (OT)			Dynamic brake stop, deceleration to a stop, or free run to a stop at P-OT or N-OT	
Protective Function			Overcurrent, overvoltage, insufficient voltage, overload, regeneration error, and so on.	
Utility Function			Gain adjustment, alarm history, JOG operation, origin search, and so on.	

(cont'd)

Safety Function	Input	/HWBB1, /HWBB2: Baseblock signal for power module
	Output	EDM1: Monitoring status of internal safety circuit (fixed output)
	Standards *4	EN ISO13849-1 PL d (Category 3), IEC61508 SIL2
Option Module		Fully-closed module, safety module

∗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. Refer to the Σ-V Series User's Manual Design and Maintenance, MECHATROLINK-III Communications Reference. (No.: SIEP S800000 64/65)
∗3. Refer to *1.2.1 Ratings* for details on regenerative resistors.
∗4. Perform risk assessment for the system and be sure that the safety requirements are fulfilled.

1.2.3 MECHATROLINK-III Function Specifications

The following table shows the specifications of MECHATROLINK-III.

Function		Specifications
MECHATROLINK-III Communication	Communication Protocol	MECHATROLINK-III
	Station Address	03H to EFH (Max. number of stations: 62) Use the rotary switches S1 and S2 to set the station address.
	Baud Rate	100 Mpbs
	Transmission Cycle	125 µs, 250 µs, 500 µs, 750 µs, and 1.0 ms to 4.0 ms (increments of 0.5 ms)
	Number of Transmission Bytes	16, 32, or 48 bytes per station Use the DIP switch S3 to select the number of words.
	Minimum Communications Cycle	125 µs
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

1.3 SERVOPACK Model Designation

This section shows SERVOPACK model designation.

1st + 2nd + 3rd digits	4th digit	5th + 6th digits	7th digit	8th + 9th + 10th digits	11th + 12th + 13th + 14th + 15th digits
SGDV – 2R8	A	21	A	000	00

Series	
SGDV	Σ-V Series
	Σ-V-EX Series

7th digit: Design Revision Order	
A	Other than below
B	• SGDV-R70A□□ • SGDV-R90A□□ • SGDV-1R6A□□ • SGDV-2R8A□□

11th + 12th + 13th + 14th + 15th digits: Function Specification	
Code	Specification
EX001	For communications cycle of 125 μs

1st + 2nd + 3rd digits: Current		
Voltage	Code	Max. Allowable Motor Capacity (kW)
100 V	R70	0.05
	R90	0.1
	2R1	0.2
	2R8	0.4
200 V	R70*1	0.05
	R90*1	0.1
	1R6*1	0.2
	2R8*1	0.4
	3R8	0.5
	5R5*1	0.75
	7R6	1
	120*2	1.5
	180	2
	200	3
	330	5
	470*3	6
	550*3	7.5
	590*3	11
	780*3	15
400 V	1R9	0.5
	3R5	1
	5R4	1.5
	8R4	2
	120	3
	170	5
	210*3	6
	260*3	7.5
	280*3	11
	370*3	15

4th digit: Voltage	
Code	Voltage
F	100 V
A	200 V
D	400 V

5th + 6th digits: Interface Specifications	
Code	Interface
21	MECHATROLINK-III communications reference, rotational servomotor
25	MECHATROLINK-III communications reference, linear servomotor

8th + 9th + 10th digits: Hardware Specifications	
Code	Specifications
000	Base-mounted (standard)
001	Rack-mounted*3
002	Varnished
003	Rack-mounted*3 and Varnished
008	Single-phase, 200-V Power Supply (SGDV-120A□1A008000)
020	Dynamic brake (DB)*4

∗1. These amplifiers can be powered with single or three-phase.
∗2. SGDV-120A□1A008000, a special version of the 1.5 kW amplifier can be used for single-phase operation.
∗3. SGDV-470A, -550A, -590A, -780A, -210D, -260D, -280D, and -370D are duct-ventilated types.
∗4. A resistor for the dynamic brake is not included. An external resistor for the dynamic brake can only be used with 400-V SERVOPACKs.

2

Communications Cycle of 125 μs

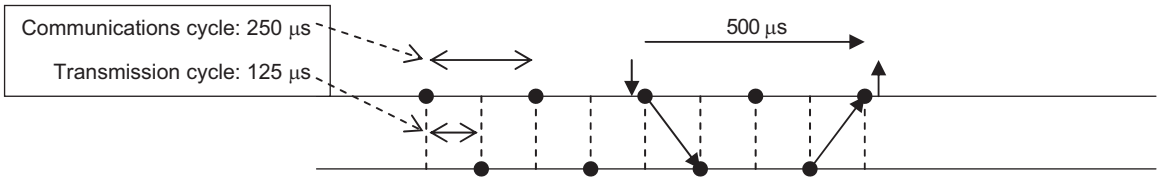
2.1 Overview

In the 125-μs communications cycle mode, MECHATROLINK communications are performed with a communications cycle of 125 μs. In comparison to operation with a 250-μs communications cycle, response is faster by 125 μs, which enables faster and more precise references and monitoring.

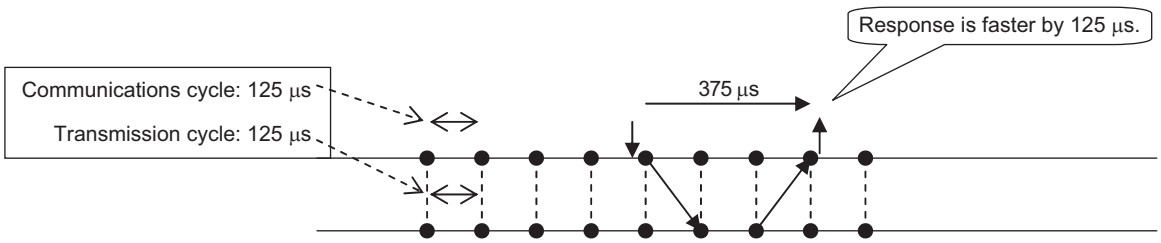
Communications cycle: The cycle in which the host controller creates and sends references.
Transmission cycle: The cycle in which the host controller sends data to the SERVOPACK.

Examples of the response are given below.

<Response for a Communications Cycle of 250 μs>



<Response for a Communications Cycle of 125 μs>



2.2 Application Restrictions

2.2.1 Restrictions for Option Modules

The following option modules cannot be used in the 125-µs communications cycle mode.

Name	Model
Safety module	SGDV-OSA01A
Fully-closed module	SGDV-OFA01A

2.2.2 Functional Restrictions

The following functions cannot be used in the 125-µs communications cycle mode.

Function	Reference*1	Restriction
Tuning-less	5.2	Cannot be used.
Advanced Autotuning (Fn201)	5.3	Only calculating of moment of inertia is possible.
Advanced Autotuning by Reference (Fn202)	5.4	Cannot be used.
Vibration suppression	5.7	2 cannot be set to Pn140.1.
2nd step torque reference filter	5.9.3	Cannot be used.
Automatic gain switching	5.8.1	Cannot be used.
Position integration	5.9.4	Cannot be used.
Backlash compensation	5.8.6*2	Cannot be used.
Electronic gears	4.4.3	Cannot be used.
Changing the speed unit	–	The speed unit must be set to reference units/s.
Changing the torque unit	–	The torque unit must be set to a percentage of the rated torque.
2-stage acceleration/deceleration	–	Cannot be used.
Continuous latch mode	–	Cannot be used.
High-speed switching of acceleration/deceleration parameters	–	Cannot be used.
Software limits	4.3.3	Cannot be used.

∗1. Refer to the Σ-V Series User's Manual Design and Maintenance, MECHATROLINK-III Communications Reference. (No.: SIEP S800000 64/65)
∗2. SERVOPACKs for linear motors do not have a backlash compensation function.

2.2.3 Restrictions for Engineering Tool SigmaWin+

The following functions cannot be used in the 125-µs communications cycle mode.

Function	Restriction	Remarks
Communications through a USB connection between SigmaWin+ and SERVOPACK	The SigmaWin+ cannot be used.	–
Tracing when the SigmaWin+ and SERVOPACK are connected through a host controller	Data tracing for the SERVOPACK is not possible from the SigmaWin+.	–
	Automatic tuning adjustments cannot be used.	Only calculating of moment of inertia is possible.

2.3 Setting Procedure

Use the following procedure to set the 125-µs communications cycle mode.

1. Change the Tuning-less Function Related Switch (Pn170.0) to 0 to disable the tuning-less function.
2. Make sure that the following parameters are set to their factory settings.

Parameter Name	Specified Value
Model Following Control Related Switch	Pn140.1 = 0 or 1
2nd Step 2nd Torque Reference Filter Frequency	Pn40F = 5000
Automatic Gain Changeover Related Switch 1	Pn139.0 = 0
Position Integral Time Constant	Pn11F = 0
Backlash Compensation Value	Pn231 = 0
Electronic Gear Ratio (Numerator)	Pn20E = 1
Electronic Gear Ratio (Denominator)	Pn210 = 1
Acceleration Constant Switching Speed	Pn80C = 0
Deceleration Constant Switching Speed	Pn80F = 0
Acceleration Constant Switching Speed 2	Pn838 = 0
Deceleration Constant Switching Speed 2	Pn83E = 0
Latch Sequence Number	Pn850 = 0
Parameter Bank Number	Pn900 = 0
Application Function Select 6 (Software LS)	Pn801.0 = 3
Speed Unit	PnA82 = 0
Speed Base Unit	PnA84 = 0
Torque Unit	PnA8E = 1
Torque Base Unit	PnA90 = 0

3. Cycle the power supply to the SERVOPACK.
4. Set the communications cycle of the host controller to 125 µs.
5. Set COM_TIME (communications cycle) in the Connection command (CONNECT: OE hex) to 1 at the host controller.
6. Execute the Connection command (CONNECT: 0E hex) at the host controller.
7. Confirm that the SERVOPACK is operating in 125-µs communications cycle mode. Check the values of the following parameters.

Parameter	Value	Remarks
Pn882: Transmission Cycle Setting Monitor	1F4H (=500)	The setting increment is 0.25 µs. Therefore, 0.25 × 500 = 125 [µs].
Pn883: Communications Cycle Setting Monitor	1	The setting increment is the transmission cycle. Therefore, (Communications cycle of 125 [µs])/ (Transmission cycle of 125 [µs]) = 1.

This completes the settings.

2.4 Operation Sequence

For the operation sequences, refer to the Σ-V Series User's Manual MECHATROLINK-III Standard Servo Profile Commands (No.: SIEP S800000 63).

However, the ordinary operation sequence for the Σ-V-EX-series EX001 SERVOPACK using with a 125-µs communications cycle is different from that for the SERVOPACK using the MECHATROLINK-III communications reference. This sequence is shown below.

Step	Operation	Command to Send
1	Turn ON the control and main circuit power supplies.	NOP
2	Reset the previous communications status.	DISCONNECT*1
3	Establish communications connection and starts WDT count.	CONNECT
4	Check information such as device ID.	ID_RD
5	Get device setting data such as parameters.	SVPRM_RD
6*2	Enable the prameter settings (Setup).	CONFIG
7	Turn ON the encoder power supply to obtain the position data.	SENS_ON
8	Turn the servo ON.	SV_ON
9	Start operation.	POSING, INTERPOLATE, etc.
10	Turn the servo OFF.	SV_OFF
11	Disconnect the communications connection.	DISCONNECT
12	Turn OFF the control and main circuit power supplies.	–

∗1. If the connection cannot be released normally, send a DISCONNECT command for 2 or more communication cycles, and then send a CONNECT command.

∗2. If step 6 is omitted, the values for the following parameters will be 50% less than the values that have already been set.

- Common parameter 81 (Pn811: Exponential Function Acceleration/Deceleration Time Constant)
- Common parameter 82 (Pn812: Movement Average Time)

2.5 Standard Servo Profile Commands for MECHATROLINK-III

For the standard servo profile commands for MECHATROLINK-III, refer to the Σ-V Series User's Manual MECHATROLINK-III Standard Servo Profile Commands (No.: SIEP S800000 63).

However, the read ID command (ID_RD: 03H) for the Σ-V-EX-series EX001 SERVOPACK is different from that for the SERVOPACK using the MECHATROLINK-III communications reference. This command is shown below.

2.5.1 Data Format of Read ID Command (ID_RD: 03H)

Phases in which the Command can be Executed		2, 3	Command Classification	Common command	Asynchronous command
Processing Time		Within communication cycle	Subcommand	Can be used	

Byte	ID_RD		Description
	Command	Response	
0	03H	03H	• The ID_RD command reads the ID of a device. This command reads the product information as ID data. • The ID data is selected in detail by specifying ID_CODE. • Confirm the completion of the command execution by checking that RCMD = ID_RD (= 03H) and CMD_STAT.CMDRDY = 1, and also checking the setting for ID_CODE, OFFSET and SIZE. In the following cases, an alarm will occur. Do not read ID in the response in those cases because the ID value will be indefinite. • When the ID_CODE data is invalid: CMD_ALM = 9H (A.94A) • When the OFFSET data is invalid or the SIZE data do not match: CMD_ALM = 9H (A.94D) If the OFFSET or SIZE data is invalid for the specified ID_CODE, an alarm occurs. Example: Setting OFFSET = 3 and SIZE = 4 for reading the device version (4-byte data) specifies reading of data outside the device version data (4 bytes) and generates an alarm.
1	WDT	RWDT	
2	CMD_CTRL	CMD_STAT	
3			
4	ID_CODE*	ID_CODE	
5	OFFSET	OFFSET	
6	SIZE	SIZE	
7			
8	Reserved	ID	
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			

* The minimum value of the communications cycle (19H) differs from the value of the SERVOPACK using the MECHATROLINK-III communications reference.

2.5.2 Command Parameters for Read ID Command (ID_RD: 03H)

ID_CODE: ID data selection code
OFFSET: ID read offset
SIZE: Read data size [bytes]

The following tables describe details of the ID_CODE.

ID_CODE	Description	Data Size	Data Type	Compliance
01H	Vendor ID Code	4 bytes	Binary Data	○
	00000000H (YASKAWA ELECTRIC CORPORATION) An ID code used to specify the vendor. Vendor ID codes are managed by the MECHATROLINK Members Association.			
02H	Device Code	4 bytes	Binary Data	○
	02200000H (Σ-V series SERVOPACKs model SGDV-□□□□21 and 25). 02200003H (DC power input Σ-V series SERVOPACKs model SGDV-□□□E21). This is a code specific to each device.			
03H	Device Version	4 bytes	Binary Data	○
	Returns the firmware version of this product. Example: 00160000H Version information of device			
04H	Device Information File Version	4 bytes	Binary Data	○
	This is the version information of the device information (MDI) file supported by this product. bit7 bit6 bit5 bit4 bit3 bit2 bit1 bit0 Revision No. bit15 bit14 bit13 bit12 bit11 bit10 bit9 bit8 Major version / Minor version Major version: When there are major changes to the MDI associated with function additions and function changes, such as addition of profiles. Minor version: When there are changes to the MDI associated with minor function additions or function changes. Revision No.: Normally returns "0." Bit 16 to 31: Reserved (0)			
05H	Extended Address Setting (for Future Use)	4 bytes	Binary Data	○
	1 This is the number of extended addresses used. The value is always "1" because this product comprises a single axis.			
06H	Serial No.	32 bytes	ASCII Code (Delimiter: 00)	○
	Serial number specific to each device			
10H	Profile Type 1 (Primary)	4 bytes	Binary Data	○
	00000010H (Standard servo profile) Profile type (primary) that the device supports This product supports the following two profile types. (1) Profile type 1: Servo profile (this ID_CODE) (2) Profile type 2: MECHATROLINK-II compatible profile (12H) (3) Profile type 3: None (14H)			
11H	Profile Version 1 (Primary)	4 bytes	Binary Data	○
	00000030H Profile version (primary) that the device supports.			
12H	Profile Type 2	4 bytes	Binary Data	○
	00000000H (MECHATROLINK-II compatible profile)			
13H	Profile Version 2	4 bytes	Binary Data	○
	00000021H			

(cont'd)

ID_CODE	Description	Data Size	Data Type	Compliance
14H	Profile Type 3	4 bytes	Binary Data	○
	000000FFH (Not supported code)			
15H	Profile Version 3	4 bytes	Binary Data	○
	00000000H			
16H	Minimum Value of Transmission Cycle	4 bytes	Binary Data	○
	12500 [0.01 µs unit] (0.125 ms) The minimum transmission cycle that the device can support in the granularity level of the transmission cycle increment (18H)			
17H	Maximum Value of Transmission Cycle	4 bytes	Binary Data	○
	400000 [0.01 µs unit] (4 ms) The maximum transmission cycle that the device can support in the granularity level of the transmission cycle increment (18H)			
18H	Transmission Cycle Increment (Granularity)	4 bytes	Binary Data	○
	00000003H There are the following four levels of transmission cycle increment that the device supports. This product supports level 03H. 00H: 31.25, 62.5, 125, 250, 500 (µsec), 2 to 64 (msec) (2 msec increment) 01H: 31.25, 62.5, 125, 250, 500 (µsec), 1 to 64 (msec) (1 msec increment) 02H: 31.25, 62.5, 125, 250, 500 (µsec), 1 to 64 (msec) (0.5 msec increment) 03H: 31.25, 62.5, 125, 250, 500, 750 (µsec), 1 to 64 (msec) (0.5 msec increment)			
19H*	Minimum Value of Communication Cycle	4 bytes	Binary Data	○
	12500 [0.01 µs unit] (0.25 ms) The minimum communication cycle that the device supports			
1AH	Maximum Value of Communication Cycle	4 bytes	Binary Data	○
	3200000 [0.01 µs unit] (32 ms) The maximum communication cycle that the device supports			
1BH	Number of Transmission Bytes	4 bytes	Binary Data	○
	0000000EH The number of transmission bytes that the device supports The numbers of bytes to be transmitted are allocated to the following bits. (Supported: 1, Not supported: 0)			

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
Reserved	Reserved	Reserved	64 bytes	48 bytes	32 bytes	16 bytes	8 bytes
0	0	0	0	1	1	1	0

bit 5 to 63: Reserved (0)

1CH	Number of Transmission Bytes (Current Setting)	4 bytes	Binary Data	○
	0000000xH The number of transmission bytes that is currently set with DIP switch (S3). One of the bits indicated by "–" will be set to "1." The numbers of bytes to be transmitted are allocated to the following bits.			

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
Reserved	Reserved	Reserved	64 bytes	48 bytes	32 bytes	16 bytes	8 bytes
0	0	0	0	–	–	–	0

bit 5 to 63: Reserved (0)

* The minimum value of the communications cycle is 25000 for the SERVOPACK using the MECHATROLINK-III communications reference.

(cont'd)

<table>
<tr><th>ID_CODE</th><th>Description</th><th>Data Size</th><th>Data Type</th><th>Compliance</th></tr>
<tr><td rowspan="2">1DH</td><td>Profile Type (Current Selection)</td><td>4 bytes</td><td>Binary Data</td><td>○</td></tr>
<tr><td colspan="4">This is the profile selected with the CONNECT command.</td></tr>
<tr><td rowspan="2">20H</td><td>Supported Communication Mode</td><td>4 bytes</td><td>Binary Data</td><td>○</td></tr>
<tr><td colspan="4">00000002H (Cyclic communication)
The communication mode that the device supports
The communication modes are allocated to the following bits. (Supported: 1, Not supported: 0)
bit 1: Cyclic communication</td></tr>
<tr><td rowspan="2">21H</td><td>MAC Address</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td colspan="4">Not supported</td></tr>
<tr><td rowspan="2">30H</td><td>List of Supported Main Commands</td><td>32 bytes</td><td>Array</td><td>○</td></tr>
<tr><td colspan="4">The list of the main commands that the device supports
The commands are allocated as shown below.

bit 0 to 255: 0: Command not supported
1: Command supported</td></tr>
</table>

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
Reserved (0)	ALM_ CLR	ALM_ RD	CONFIG	ID_RD	PRM_ WR	PRM_RD	NOP
0	1	1	1	1	0	0	1

bit15	bit14	bit13	bit12	bit11	bit10	bit9	bit8
DISCON-NECT	CON-NECT	SYNC_ SET	Reserved (0)	Reserved (0)	Reserved (0)	Reserved (0)	Reserved (0)
1	1	1	0	0	0	0	0

bit 16 to 23: Reserved (0)

bit31	bit30	bit29	bit28	bit27	bit26	bit25	bit24
Reserved (0)	MEM_ WR	MEM_ RD	PPRM_ WR	PPRM_ RD	Reserved (0)	Reserved (0)	Reserved (0)
0	1	1	0	0	0	0	0

bit39	bit38	bit37	bit36	bit35	bit34	bit33	bit32
Reserved (0)	Reserved (0)	Reserved (0)	SENS_ OFF	SENS_ ON	BRK_ OFF	BRK_ON	POS_ SET
0	0	0	1	1	1	1	1

bit 40 to 47: Reserved (0)

bit55	bit54	bit53	bit52	bit51	bit50	bit49	bit48
EX_ FEED	FEED	POSING	INTER-POLATE	Reserved (0)	SV_OFF	SV_ON	SMON
1	1	1	1	0	1	1	1

bit63	bit62	bit61	bit60	bit59	bit58	bit57	bit56
Reserved (0)	Reserved (0)	TRQCTRL	VELCTRL	Reserved (0)	ZRET	EX_ POSING	Reserved (0)
0	0	1	1	0	1	1	0

bit71	bit70	bit69	bit68	bit67	bit66	bit65	bit64
Reserved (0)	Reserved (0)	Reserved (0)	Reserved (0)	Reserved (0)	Reserved (0)	SVPRM_ WR	SVPRM_ RD
0	0	0	0	0	0	1	1

bit 72 to 255: Reserved (0)

(cont'd)

<table>
<tr><th>ID_CODE</th><th>Description</th><th>Data Size</th><th>Data Type</th><th>Compliance</th></tr>
<tr><td rowspan="2">38H</td><td>List of Supported Subcommands</td><td>32 bytes</td><td>Array</td><td>○</td></tr>
<tr><td colspan="4">
The list of the subcommands that the device supports
The commands are allocated as shown below.

bit 0 to 255: 0: Command not supported
1: Command supported
<table>
<tr><th>bit7</th><th>bit6</th><th>bit5</th><th>bit4</th><th>bit3</th><th>bit2</th><th>bit1</th><th>bit0</th></tr>
<tr><td>Reserved (0)</td><td>ALM_ CLR</td><td>ALM_ RD</td><td>Reserved (0)</td><td>Reserved (0)</td><td>PRM_ WR</td><td>PRM_RD</td><td>NOP</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td></tr>
</table>
bit 8 to 23: Reserved (0)
<table>
<tr><th>bit31</th><th>bit30</th><th>bit29</th><th>bit28</th><th>bit27</th><th>bit26</th><th>bit25</th><th>bit24</th></tr>
<tr><td>Reserved (0)</td><td>MEM_ WR</td><td>MEM_ RD</td><td>PPRM_ WR</td><td>PPRM_ RD</td><td>Reserved (0)</td><td>Reserved (0)</td><td>Reserved (0)</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
</table>
bit 32 to 47: Reserved (0)
<table>
<tr><th>bit55</th><th>bit54</th><th>bit53</th><th>bit52</th><th>bit51</th><th>bit50</th><th>bit49</th><th>bit48</th></tr>
<tr><td>Reserved (0)</td><td>Reserved (0)</td><td>Reserved (0)</td><td>Reserved (0)</td><td>Reserved (0)</td><td>Reserved (0)</td><td>Reserved (0)</td><td>SMON</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td></tr>
</table>
bit 56 to 63: Reserved (0)
<table>
<tr><th>bit71</th><th>bit70</th><th>bit69</th><th>bit68</th><th>bit67</th><th>bit66</th><th>bit65</th><th>bit64</th></tr>
<tr><td>Reserved (0)</td><td>Reserved (0)</td><td>Reserved (0)</td><td>Reserved (0)</td><td>Reserved (0)</td><td>Reserved (0)</td><td>SVPRM_ WR</td><td>SVPRM_ RD</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td></tr>
</table>
bit 72 to 255: Reserved (0)
</td></tr>
<tr><td rowspan="2">40H</td><td>List of Supported Common Parameters</td><td>32 bytes</td><td>Array</td><td>○</td></tr>
<tr><td colspan="4">
The list of the common parameter numbers that the device supports
The common parameters are allocated as shown below.

bit 0 to 255: 0: Common parameter not supported
1: Common parameter supported
<table>
<tr><th>bit7</th><th>bit6</th><th>bit5</th><th>bit4</th><th>bit3</th><th>bit2</th><th>bit1</th><th>bit0</th></tr>
<tr><td>07</td><td>06</td><td>05</td><td>04</td><td>03</td><td>02</td><td>01</td><td>Reserved (0)</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td></tr>
</table>
<table>
<tr><th>bit15</th><th>bit14</th><th>bit13</th><th>bit12</th><th>bit11</th><th>bit10</th><th>bit9</th><th>bit8</th></tr>
<tr><td>Reserved (0)</td><td>Reserved (0)</td><td>Reserved (0)</td><td>0C</td><td>0B</td><td>0A</td><td>09</td><td>08</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
</table>
</td></tr>
</table>

(cont'd)

<table>
<tr><th>ID_CODE</th><th>Description</th><th>Data Size</th><th>Data Type</th><th>Compliance</th></tr>
<tr><td>40H
(Continued)</td><td>
bit 16 to 31: Reserved (0)
<table>
<tr><th>bit39</th><th>bit38</th><th>bit37</th><th>bit36</th><th>bit35</th><th>bit34</th><th>bit33</th><th>bit32</th></tr>
<tr><td>27</td><td>26</td><td>25</td><td>24</td><td>23</td><td>22</td><td>21</td><td>Reserved (0)</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td></tr>
<tr><th>bit47</th><th>bit46</th><th>bit45</th><th>bit44</th><th>bit43</th><th>bit42</th><th>bit41</th><th>bit40</th></tr>
<tr><td>Reserved (0)</td><td>Reserved (0)</td><td>Reserved (0)</td><td>Reserved (0)</td><td>Reserved (0)</td><td>Reserved (0)</td><td>29</td><td>28</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td></tr>
</table>
bit 48 to 63: Reserved (0)
<table>
<tr><th>bit71</th><th>bit70</th><th>bit69</th><th>bit68</th><th>bit67</th><th>bit66</th><th>bit65</th><th>bit64</th></tr>
<tr><td>47</td><td>46</td><td>45</td><td>44</td><td>43</td><td>42</td><td>41</td><td>Reserved (0)</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td></tr>
<tr><th>bit79</th><th>bit78</th><th>bit77</th><th>bit76</th><th>bit75</th><th>bit74</th><th>bit73</th><th>bit72</th></tr>
<tr><td>Reserved (0)</td><td>Reserved (0)</td><td>Reserved (0)</td><td>Reserved (0)</td><td>Reserved (0)</td><td>Reserved (0)</td><td>49</td><td>48</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td></tr>
</table>
bit 80 to 95: Reserved (0)
<table>
<tr><th>bit103</th><th>bit102</th><th>bit101</th><th>bit100</th><th>bit99</th><th>bit98</th><th>bit97</th><th>bit96</th></tr>
<tr><td>67</td><td>66</td><td>65</td><td>64</td><td>63</td><td>62</td><td>61</td><td>Reserved (0)</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td></tr>
<tr><th>bit111</th><th>bit110</th><th>bit109</th><th>bit108</th><th>bit107</th><th>bit106</th><th>bit105</th><th>bit104</th></tr>
<tr><td>Reserved (0)</td><td>Reserved (0)</td><td>Reserved (0)</td><td>Reserved (0)</td><td>Reserved (0)</td><td>Reserved (0)</td><td>Reserved (0)</td><td>Reserved (0)</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
</table>
bit 112 to 127: Reserved (0)
<table>
<tr><th>bit135</th><th>bit134</th><th>bit133</th><th>bit132</th><th>bit131</th><th>bit130</th><th>bit129</th><th>bit128</th></tr>
<tr><td>87</td><td>86</td><td>85</td><td>84</td><td>83</td><td>82</td><td>81</td><td>Reserved (0)</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td></tr>
<tr><th>bit143</th><th>bit142</th><th>bit141</th><th>bit140</th><th>bit139</th><th>bit138</th><th>bit137</th><th>bit136</th></tr>
<tr><td>8F</td><td>8E</td><td>8D</td><td>8C</td><td>8B</td><td>8A</td><td>89</td><td>88</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
<tr><th>bit151</th><th>bit150</th><th>bit149</th><th>bit148</th><th>bit147</th><th>bit146</th><th>bit145</th><th>bit144</th></tr>
<tr><td>Reserved (0)</td><td>Reserved (0)</td><td>Reserved (0)</td><td>Reserved (0)</td><td>93</td><td>92</td><td>91</td><td>90</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
</table>
bit 152 to 255: Reserved (0)
</td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">80H</td><td>Main Device Name</td><td>32 bytes</td><td>ASCII Code
(Delimiter: 00)</td><td>○</td></tr>
<tr><td colspan="4">Product model Example: SGDV-1R6A21A
The main device name (ASCII code)
<Notice>
To judge the device with the host device, use the device code (02H) instead of this ID_CODE.</td></tr>
</table>

(cont'd)

ID_CODE	Description	Data Size	Data Type	Compliance
90H	Sub Device 1 Name	32 bytes	ASCII Code (Delimiter: 00)	○
	Motor model Example: SGMJV-01ADA21 The name of sub device 1 (ASCII code)			
98H	Sub Device 1 Version	4 bytes	Binary Data	○
	Firmware version of the motor encoder Example: 00000001H The version number of sub device 1			
A0H	Sub Device 2 Name	32 bytes	ASCII Code (Delimiter: 00)	○
	External encoder model Example: The name of sub device 2 (ASCII code)			
A8H	Sub Device 2 Version	4 bytes	Binary Data	○
	The software version of the external encoder Example: 0000001H The version number of sub device 2			
B0H	Sub Device 3 Name	32 bytes	ASCII Code (Delimiter: 00)	○
	Not supported: NULL The name of sub device 3 (ASCII code)			
B8H	Sub Device 3 Version	4 bytes	Binary Data	○
	Not supported: 0000000H The version number of sub device 3			
BCH to BFH	Reserved			
C0H	Sub Device 4 Name	32 bytes	ASCII Code (Delimiter: 00)	○
	The safety option module model The name of sub device 4 (ASCII code)			
C8H	Sub Device 4 Version	4 bytes	Binary Data	○
	The software version of the safety option module Example: 00000001H The version number of sub device 4			
D0H	Sub Device 5 Name	32 bytes	ASCII Code (Delimiter: 00)	○
	The feedback option module model The name of sub device 5 (ASCII code)			
D8H	Sub Device 5 Version	4 bytes	Binary Data	○
	The software version of the feedback option module Example: 00000001H The version number of sub device 5			
E0H	Sub Device 6 Name	32 bytes	ASCII Code (Delimiter: 00)	○
	Reserved The name of sub device 6 (ASCII code)			
E8H	Sub Device 6 Version	4 bytes	Binary Data	○
	Reserved The version number of sub device 6			

Note: The ID_CODE values of C0H and above are the vendor-specific area.

3

Adjustments

3.1 Type of Adjustments and Basic Adjustment Procedure

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

3.1.1 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.

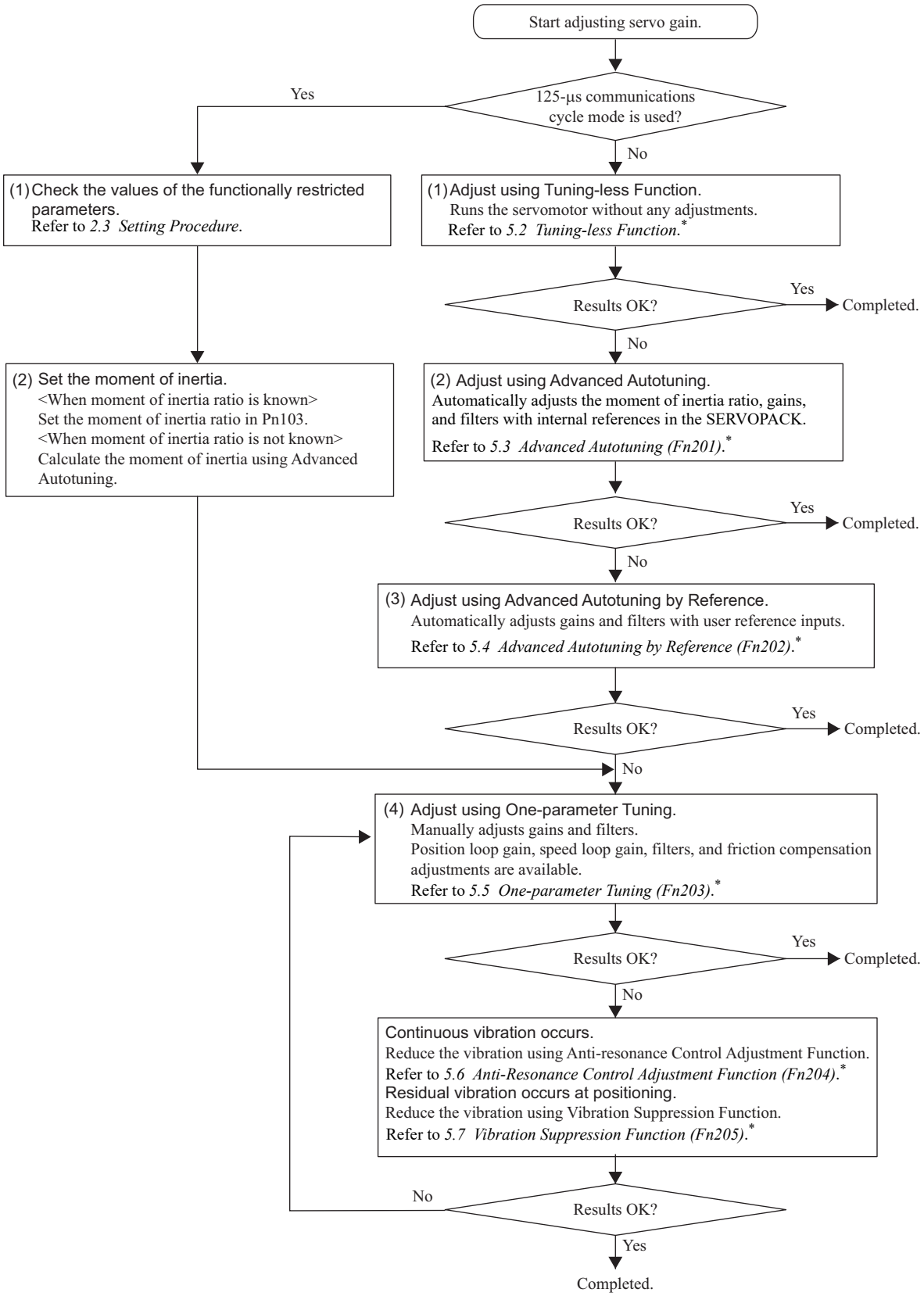
The servo gains are factory-set to appropriate values for stable operation. The following utility function can be used to adjust the servo gain to increase the responsiveness of the machine in accordance with the actual conditions. With this function, parameters related to adjustment above will be adjusted 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
Moment of Inertia Ratio	The moment of inertia ratio is automatically calculated using internal references in the SERVOPACK during automatic operation.	Speed and Position
One-parameter Tuning (Fn203)	The following parameters are manually adjusted with the position or speed reference input from the host controller while the machine is in operation. • 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 (Fn204)	This function effectively suppresses continuous vibration.	Speed and Position
Vibration Suppression Function (Fn205)	This function effectively suppresses residual vibration if it occurs when positioning.	Position

3.1.2 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.



* Refer to the Σ-V Series User's Manual Design and Maintenance, MECHATROLINK-III Communications Reference. (No.: SIEP S800000 64/65)

3.2 Moment of Inertia Ratio Calculation

This section describes moment of inertia ratio calculation. You can calculate the moment of inertia ratio by setting Jcalc to ON (Moment of inertial calculated) in the Advanced Autotuning (Fn201).

⚠ CAUTION

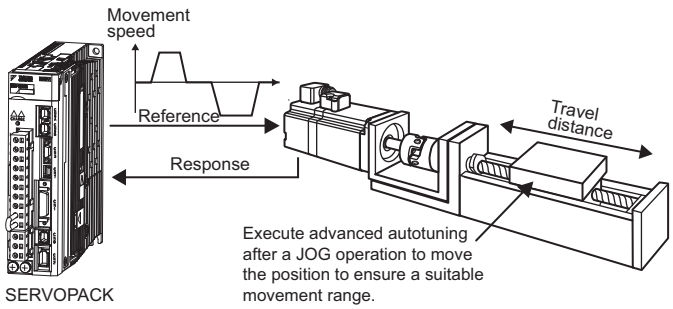
- If the moment of inertia ratio cannot be calculated automatically, manually calculate the moment of inertia ratio accurately from the mechanical properties and set it correctly in the Moment of Inertia Ratio parameter (Pn103). If the setting of the moment of inertia ratio is not correct, normal control may not be possible and vibration may occur.

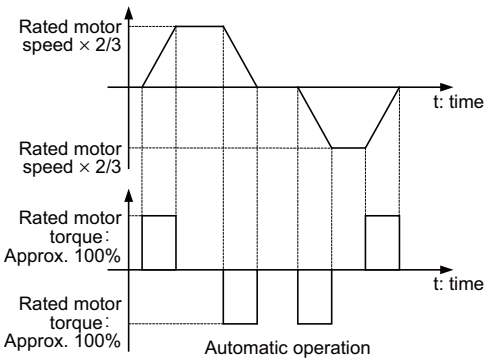
3.2.1 Calculating the Moment of Inertia Ratio

The moment of inertia ratio is automatically calculated (roundtrip operation in forward and reverse) within the specified range. During operation, the SERVOPACK automatically calculates the moment of inertia ratio between the motor rotor and the load.

Calculating the moment of inertia ratio can be performed without connecting the host controller.
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: <For rotational motors>
  The travel distance can be set freely. The distance is factory-set to a value equivalent to 3 motor rotations.
  For a direct drive servomotor (SGMCV or SGMCS), the distance is factory-set to a value equivalent to 0.3 motor rotations.
  <For linear motors>
  The travel distance can be set freely with 1000 reference unit as the unit of measurement. The factory setting is 90 mm.





⚠ CAUTION
• Because the moment of inertia ratio is calculated 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

Check the following settings before calculating the moment of inertia ratio.
The message "NO-OP" indicating that the settings are not appropriate will be displayed, if all of the following conditions are not met.

- 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.
- The test without a motor function must be disabled (Pn00C.0 = 0).
- All alarms and warning must be cleared.
- The hardwire baseblock (HWBB) must be disabled.
- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).
- Jcalc must be set to ON to calculate the load moment of inertia when the tuning-less function is enabled (Pn170.0 = 1: factory setting) or the tuning-less function must be disabled (Pn170.0 = 0).

(2) When the Moment of Inertia Ratio Cannot Be Calculated

The moment of inertia ratio cannot be calculated normally under the following conditions.

<For rotational motors>
- The machine system can work only in a single direction.
- The operating range is within 0.5 rotation. (Also for SGMCV or SGMCS direct drive motors, the operating range is within 0.05 rotation.)

<For linear motors>
- The machine system can work only in a single direction.
- The operating range is within 5 mm.

(3) When the Moment of Inertia Ratio Cannot Be Calculated Successfully

The moment of inertia ratio cannot be calculated successfully under the following conditions.

- 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: An error will result when P control operation is selected using /V_PPI of the servo command output signals (SVC-MD_IO) while the moment of inertia is being calculated.
- The mode switch is used.

  Note: 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 (Pn522) is too small.

3.2.2 Moment of Inertia Ratio Calculation Procedure

The following procedure uses advanced autotuning to calculate the moment of inertia ratio.

Advanced autotuning is performed from the digital operator (option) or SigmaWin+.

The operating procedure from the digital operator is described here.

Refer to the *Σ-V Series User's Manual, Operation of Digital Operator* (No.: SIEP S800000 55) for basic key operations of the digital operator.

⚠ CAUTION

- When using the SERVOPACK with Jcalc = OFF (load moment of inertia is not calculated), 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.
- When using the MP2000 Series with phase control, select the mode = 1 (standard level). If 2 or 3 is selected, phase control of the MP2000 Series may not be possible.

(1) Operating Procedure

Step	Display after Operation	Keys	Operation
1	BB —FUNCTION— Fn200:TuneLvl Set Fn201:AAT Fn202:Ref-AAT Fn203:OnePrmTun	MODE/SET ∧ ∨	Press the MODE/SET Key to view the main menu for the utility function. Use the ∧ or ∨ Key to move through the list, select Fn201.
2	Status Display BB Advanced AT Jcalc=ON Mode=2 Type=2 Stroke=+00800000 (0003.0)rev	DATA	Press the DATA Key to display the initial setting screen for advanced autotuning.
3	BB Advanced AT Jcalc=ON Mode=2 Type=2 Stroke=+00800000 (0003.0)rev	∧ ∨ SCROLL	Press the ∧, ∨, or SCROLL Key and set the items in steps 3-1 to 3-2.
3-1	■Calculating Moment of Inertia Set Jcalc to ON. Jcalc = ON: Moment of inertia calculated [Factory setting] Jcalc = OFF: Moment of inertia not calculated		
3-2	■STROKE (Travel Distance) Setting Travel distance setting range: The travel distance setting range is from -99990000 to +99990000 [reference unit]. Specify the STROKE (travel distance) in increments of 1000 reference units. The negative (-) direction is for reverse rotation, and the positive (+) direction is for forward rotation. Initial value: About 3 rotations*1 Notes: • Set the number of motor rotations to at least 0.5*2; otherwise, "Error" will be displayed and the travel distance cannot be set. • To calculate the moment of inertia and ensure precise tuning, it is recommended to set the number of motor rotations to around 3*3. The maximum number of motor rotations is 3 regardless of attempts to increase the number. • For a direct drive servomotor (SGMCV or SGMCS), the factory setting for distance is set to a value that is equivalent to 0.3 motor rotations.		
4	BB Advanced AT Pn103=00100 Pn100=0040.0 Pn101=0020.00 Pn102=0040.0	DATA	Press the DATA Key. The advanced autotuning execution screen will be displayed.

(cont'd)

Step	Display after Operation	Keys	Operation
5	RUN Advanced AT Pn103=00100 Pn100=0040.0 Pn101=0020.00 Pn141=0050.0	JOG SVON	Press the JOG SVON Key. The servomotor power will be ON and the display will change from "BB" to "RUN."
6	ADJ Advanced AT Pn103=00300 Pn100=0040.0 Pn101=0020.0 Pn141=0050.0 Display example: After the moment of inertia is calculated.	∧ ∨	Calculates the moment of inertia. Press the ∧ Key if a positive (+) value is set in STROKE (travel distance), or press the ∨ Key if a negative (-) value is set. Calculation of the moment of inertia will start. While the moment of inertia is being calculated, the set value for Pn103 will flash and "ADJ" will flash instead of "RUN." When calculating the moment of inertia is completed, the display will stop flashing and the moment of inertia is displayed. The servomotor will remain ON, but the auto run operation will be stopped temporarily. Notes: • The wrong key for the set travel direction is pressed, the calculation will not start. • If "NO-OP" or "Error" is displayed during operation, press the MODE/SET Key to cancel the function. Refer to *(2) Failure in Operation* and take a corrective action to enable operation.
7		DATA MODE/SET	After the servomotor is temporarily stopped, press the DATA Key to save the calculated moment of inertia ratio in the SERVOPACK. "DONE" will flash for one second, and "ADJ" will be displayed again. Press the MODE/SET Key to end operation.
8	Turn ON the SERVOPACK power supply again.		

∗1. About 90 mm for linear motors
∗2. Set 5 mm or more as the travel distance for linear motors.
∗3. The travel distance is 90 mm for linear motors.

(2) Failure in Operation

■ When "NO-OP" Flashes on the Display

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.
The HWBB function operated.	Disable the HWBB function.

■ When "Error" Flashes on the Display

Error	Probable Cause	Corrective Actions
An error occurred during the calculation of the moment of inertia.	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[*1] (0.05 rotation for SGMCV or SGMCS servomotor) 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.[*2]
The positioning completed signal (/COIN) did not turn ON 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 Pn522. • Set 0 to V_PPI in the servo command output signals (SVCMD_IO).
The moment of inertia cannot be calculated when the tuning-less function was activated.	When the tuning-less function was activated, Jcalc was set to OFF so the moment of inertia was not calculated.	• Turn OFF the tuning-less function. • Set Jcalc to ON, so the moment of inertia will be calculated.

∗1. About 5 mm or less for linear motors
∗2. About 90 mm for linear motors

■ 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.

Error Display	Probable Cause	Corrective Actions
Err1	The SERVOPACK started calculating the moment of inertia, but the calculation was not completed.	• Increase the speed loop gain (Pn100). • Increase the STROKE (travel distance).
Err2	The moment of inertia fluctuated greatly and did not converge within 10 tries.	Set the calculation value based on the machine specifications in Pn103.
Err3	Low-frequency vibration was detected.	Double the set value of the moment of inertia calculating start level (Pn324).
Err4	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).
Err5	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

Troubleshooting

4.1 Troubleshooting of Alarms

If an error occurs in servo drives, an alarm display such as A.□□□ and CPF□□ will appear on the panel display.

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.04B: Functionally Restricted Parameter Setting Error	The Connection command (CONNECT: 0E hex) was executed with the SERVOPACK parameters set to values that are outside the specifications. Note: The connection will be completed.	–	Use one of the following methods to clear the alarm. • Change the parameters to the specified values and then execute the Configuration command (CONFIG/ 04 hex). Then clear the alarm. • Change the parameters to the specified values and then cycle the power supply.
	The Configuration command (CONFIG: 04 hex) was executed with the SERVOPACK parameters set to values that are outside the specifications.	–	

4.2 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.97D: Functional Restriction Warning	The values of the functionally restricted parameters that were received from the host controller for MECHATROLINK communications in the 125-µs communications cycle mode were not the specified values.	Make sure that the functionally restricted parameters are at the specified values. Refer to *2.2.2 Functional Restrictions*. Check to see if the 125-µs communications cycle mode is set. Check the settings at the host controller or in the communications-related parameters of the SERVOPACK.	Set the functionally restricted parameters to the specified values from the host controller. Refer to *2.2.2 Functional Restrictions*.
	A communications connection in the 125-µs communications cycle mode was attempted when one of the option modules was mounted.	–	Remove the option module. An option module cannot be used with a communications cycle of 125 µs.

4.3 Troubleshooting of Errors for SigmaWin+ and Digital Operator

Error Location	Error Description	Corrective Actions
SigmaWin+	If the 125-µs communications cycle mode is used when the SigmaWin+ and SERVOPACK are communicating through a USB connection, a timeout communications error will be displayed by the SigmaWin+.*	Perform communications with a MECHATROLINK-III connection through the host controller.
	If an attempt is made to use a function that cannot be used (servo tracing or automatic tuning adjustments) when the SigmaWin+ and SERVOPACK are connected through a host controller, a dialog box will be displayed.*	Use only the applicable functions.
	If you write any of the parameters that are given in *2.2.2 Functional Restrictions* to any value other than the specified value when the SigmaWin+ and SERVOPACK are connected through a host controller, a dialog box will be displayed and writing the parameter will be canceled.*	Use the Compare button on the Parameter Editing Window of the SigmaWin+ to see which parameters were not written. Then set the parameters to the specified values and write them again.
Digital Operator	ERROR is displayed on the digital operator if an attempt is made to use it to change the value of a parameter for a function that cannot be used in 125-µs communications cycle mode.	Use the parameters at the specified values.
	NO_OP will be displayed if an attempt is made to execute any utility functions (Fn functions) that cannot be used.	

* This is not a SigmaWin+ error.

5

List of Utility Functions

The following list shows the available utility functions.

Parameter No.	Function	Reference: Σ-V Series User's Manual Design and Maintenance, MECHATROLINK-III Communications Reference	
		For rotational motors (No.: SIEP S800000 64)	For linear motors (No.: SIEP S800000 65)
Fn000	Alarm history display	6.2	
Fn002	JOG operation	6.3	
Fn003	Origin search	6.4	
Fn004	Program JOG operation	6.5	
Fn005	Initializing parameter settings	6.6	
Fn006	Clearing alarm history	6.7	
Fn008*1	Absolute encoder multiturn reset and encoder alarm reset	4.7.4	–
Fn00C	Offset adjustment of analog monitor output	6.8	
Fn00D	Gain adjustment of analog monitor output	6.9	
Fn00E	Automatic offset-signal adjustment of the motor current detection signal	6.10	
Fn00F	Manual offset-signal adjustment of the motor current detection signal	6.11	
Fn010	Write prohibited setting	6.12	
Fn011	Servomotor model display	6.13	
Fn012	Software version display	6.14	
Fn013*1	Multiturn limit value setting change when a multiturn limit disagreement alarm occurs	4.7.7	–
Fn014	Resetting configuration error in option modules	6.15	
Fn01B	Vibration detection level initialization	6.16	
Fn01E	Display of SERVOPACK and servomotor ID	6.17	
Fn01F*1	Display of servomotor ID in feedback option module	6.18	–
Fn020	Origin setting	6.19	
Fn030	Software reset	6.20	
Fn080*2	Polarity Detection	–	6.20
Fn201	Advanced autotuning	*3	
Fn203	One-parameter tuning	5.6.2	
Fn204	Anti-resonance control adjustment function	5.7.2	
Fn205	Vibration suppression function	6.21	
Fn206	EasyFFT	6.22	
Fn207	Online vibration monitor	6.22	

Note: Execute the utility function with either a digital operator or SigmaWin+. If they are used together, "no_oP" or "NO-OP" will be displayed when the utility function is executed.

∗1. Available only for rotational motors

∗2. Available only for linear motors

∗3. Refer to *3.2 Moment of Inertia Ratio Calculation* in this manual.

Index

Numerics

A

B

C

E

H

L

M

N

O

P

S

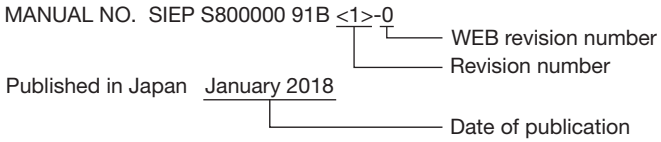
T

U

V

Revision History

The revision dates and numbers of the revised manuals are given on the bottom of the back cover.



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AC Servo Drives

Σ-V-EX Series

USER'S MANUAL

Model: EX001
MECHATROLINK-III Communications Reference

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Specifications are subject to change without notice for ongoing product modifications and improvements.

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