YASKAWA

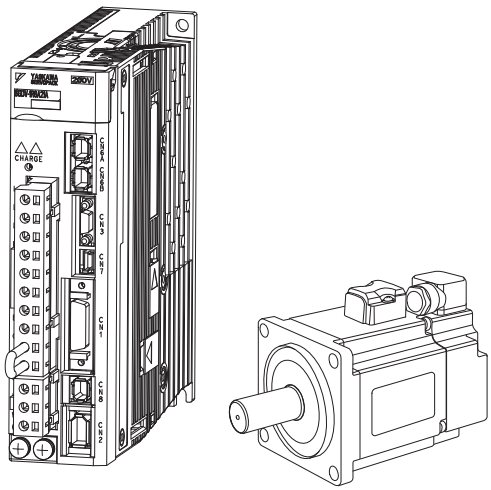
AC Servo Drives

Σ-V-FT Series

USER'S MANUAL

Model: FT001
Rotational Motor
MECHATROLINK-III Communications Reference

SGDV-□□□□21□□□□FT001 SERVOPACK
SGMMV/SGMJV/SGMAV/SGMPS/SGMGV/SGMSV/SGMCV/SGMCS Servomotor



Outline 1

Adjustments 2

List of Σ-V-FT-series FT001 Parameters 3

MANUAL NO. SIEP S800001 16F

About this Manual

This manual contains information that is required to design and adjust Σ-V-FT-series FT001 servo system. An FT001 rotational servo system provides MECHATROLINK-III Communications Reference and improved vibration suppression.

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

When you use a Σ-V-FT-series FT001 servo system, read this manual together with the Σ-V Series User's Manual Design and Maintenance, Rotational Motor/MECHATROLINK-III Communications Reference.

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

■ 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, Rotational Motor/ MECHATROLINK-III Communications Reference
Outline	Σ-V-FT-series FT001	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

(cont'd)

Item		This Manual	Σ-V Series User's Manual Design and Maintenance, Rotational Motor/ MECHATROLINK-III Communications Reference
Adjustments	Type of Adjustments and Basic Adjustment Procedure	2.1	–
	Tuning-less Function	–	5.2
	Advanced Autotuning (Fn201)	–	5.3
	Advanced Autotuning by Reference (Fn202)	–	5.4
	One-parameter Tuning (Fn203)	–	5.5
	Anti-Resonance Control Adjustment Function (Fn204)	–	5.6
	Vibration Suppression Function (Fn205)	–	5.7
	Additional Adjustment Function	–	5.8
	Compatible Adjustment Function	–	5.9
	Suppression Method for Continuous Vibration	2.2	–
	Suppression Method for Residual Vibration during Positioning	2.3	–
Utility Functions (Fn□□□)		–	Chapter 6
Monitor Displays (Un□□□)		–	Chapter 7
Fully-closed Loop Control		–	Chapter 8
Troubleshooting		–	Chapter 9
Utility Functions		–	10.1.1
List of Parameters	Σ-V-FT Series FT001 Parameters	Chapter 3	–
	Other Parameters	–	10.1.2
List of MECHATROLINK-III Common Parameters		–	10.1.3
List of Monitor Displays		–	10.2
Parameter Recording Table		–	10.3

■ 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)
SERVOPACK	Σ-V-FT Series FT001 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.
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.

■ 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.

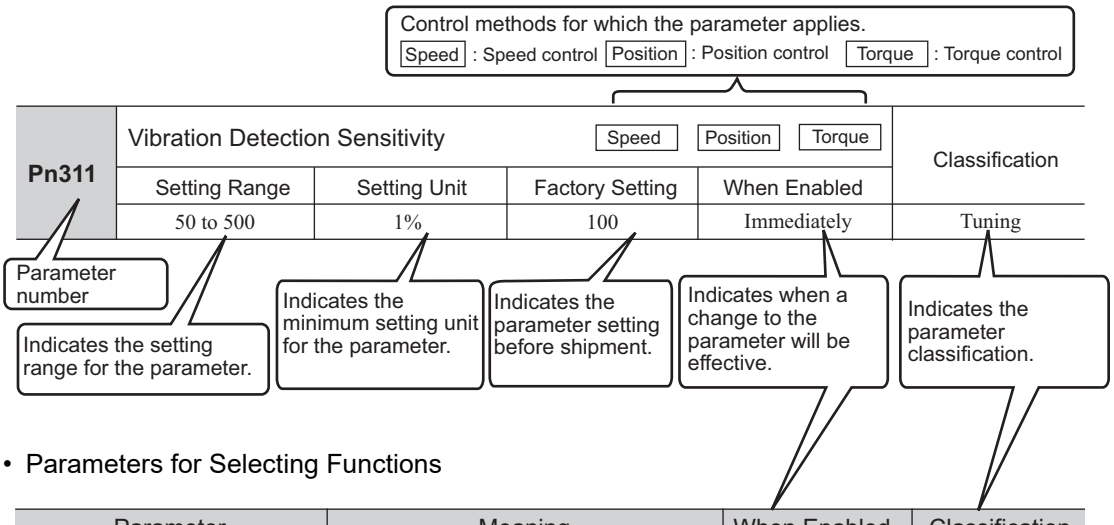
Notation Example

$\overline{BK}$ = /BK

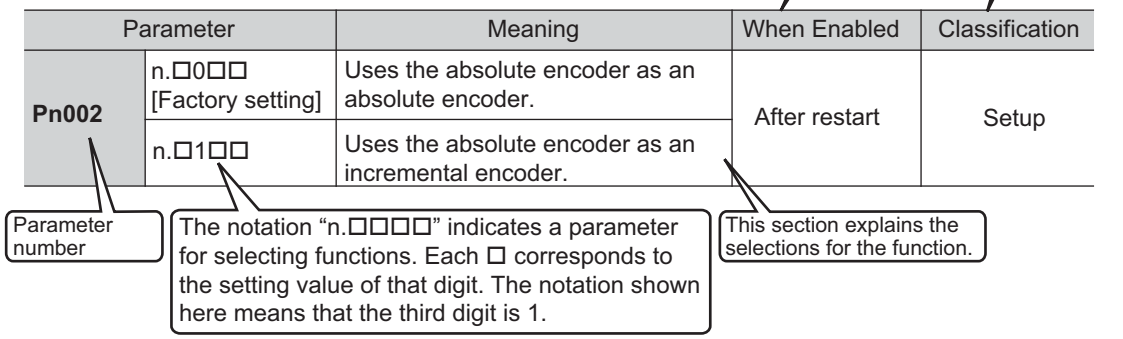
- Notation for Parameters

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

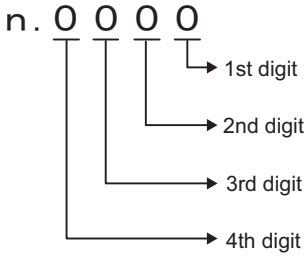


- Parameters for Selecting Functions



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.

■ Manuals Related to the Σ-V Series

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 Product Catalog (No.: KAEP S800000 42)	✓	✓	✓				
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 MECHATROLINK-III Standard Servo Profile Commands (No.: SIEP S800000 63)			✓		✓	✓	
Σ-V-FT Series User's Manual Model: FT001, Rotational Motor/ MECHATROLINK-III Communications Reference (this manual)			✓			✓	
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)				✓			✓

■ Safety Information

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

⚠ WARNING	Indicates precautions that, if not heeded, could possibly result in loss of life or serious injury.
⚠ CAUTION	Indicates precautions that, if not heeded, could result in relatively serious or minor injury, damage to the product, or faulty operation. In some situations, the precautions indicated could have serious consequences if not heeded.
⃠ PROHIBITED	Indicates prohibited actions that must not be performed. For example, this symbol would be used to indicate that fire is prohibited as follows: 
❗ MANDATORY	Indicates compulsory actions that must be performed. For example, this symbol would be used to indicate that grounding is compulsory as follows: 

Safety Precautions

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

⚠ WARNING

- Never touch any rotating servomotor parts during operation.
  Failure to observe this warning may result in injury.
- Before starting operation with a machine connected, make sure that an emergency stop can be applied at any time.
  Failure to observe this warning may result in injury or damage to the equipment.
- 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.
- The output range of the rotational serial data for the Σ-V-FT 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-FT 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.
- 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.

■ Storage and Transportation

⚠ CAUTION

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

■ Installation

⚠ CAUTION

- Never use the product in an environment subject to water, corrosive gases, flammable gases, or combustibles.
  Failure to observe this caution may result in electric shock or fire.
- Do not step on or place a heavy object on the product.
  Failure to observe this caution may result in injury or malfunction.
- Do not cover the inlet or outlet ports and prevent any foreign objects from entering the product.
  Failure to observe this caution may cause internal elements to deteriorate resulting in malfunction or fire.
- Be sure to install the product in the correct direction.
  Failure to observe this caution may result in malfunction.
- Provide the specified clearances between the SERVOPACK and the control panel or with other devices.
  Failure to observe this caution may result in fire or malfunction.
- Do not apply any strong impact.
  Failure to observe this caution may result in malfunction.

■ Wiring

⚠ CAUTION

- Be sure to wire correctly and securely.
  Failure to observe this caution may result in motor overrun, injury, or malfunction.
- Do not connect a commercial power supply to the U, V, or W terminals for the servomotor connection.
  Failure to observe this caution may result in injury or fire.
- Securely connect the main circuit terminals.
  Failure to observe this caution may result in fire.
- Do not bundle 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).
- 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.
- 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.
- 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.
- Do not reverse the polarity of the battery when connecting it.
  Failure to observe this caution may damage the battery, the SERVOPACK or servomotor, or cause an explosion.
- Wiring or inspection must be performed by a technical expert.
- Use a 24-VDC power supply with double insulation or reinforced insulation.

■ Operation

⚠ CAUTION

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

■ Maintenance and Inspection

⚠ CAUTION

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

■ Disposal 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

■ 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 servomo-tors)*	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

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

■ 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)*	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

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

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

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1.1 Σ-V-FT-series FT001

A Σ-V-FT-series FT001 SERVOPACK provides improved vibration suppression over a Σ-V-series SERVOPACK.
Vibration is suppressed when stopping and during operation, and positioning time is shortened.

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-120A□1A008FT001.

(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 (*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 (*4.1.1*[*2])
			DIP Switch (S3)	Number of pins: Four pins (*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, Rotational Motor/MECHATROLINK-III Communications Reference* (No.: SIEP S800000 64).
∗3. For details on regenerative resistors, refer to *1.3.1 Ratings* in the *Σ-V Series User's Manual Design and Maintenance, Rotational Motor/MECHATROLINK-III Communications Reference* (No.: SIEP S800000 64).
∗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.
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 MECHATROLINK-II-compatible 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	B	000	FT001

Series	
SGDV	Σ-V Series
	Σ-V-FT Series

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

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
01	Analog voltage and pulse train reference, rotational servomotor
21	MECHATROLINK-III communications reference, rotational 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□1A008FT001)
020	Dynamic brake (DB)*4

11th + 12th + 13th + 14th + 15th digits: Function Specification	
Code	Specification
FT001	For improved vibration suppression

∗1. These amplifiers can be powered with single or three-phase.
∗2. SGDV-120A□1A008FT001, 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

Adjustments

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2.1 Type of Adjustments and Basic Adjustment Procedure

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

2.1.1 Adjustments

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

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

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

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

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

This section describes the following utility adjustment functions.

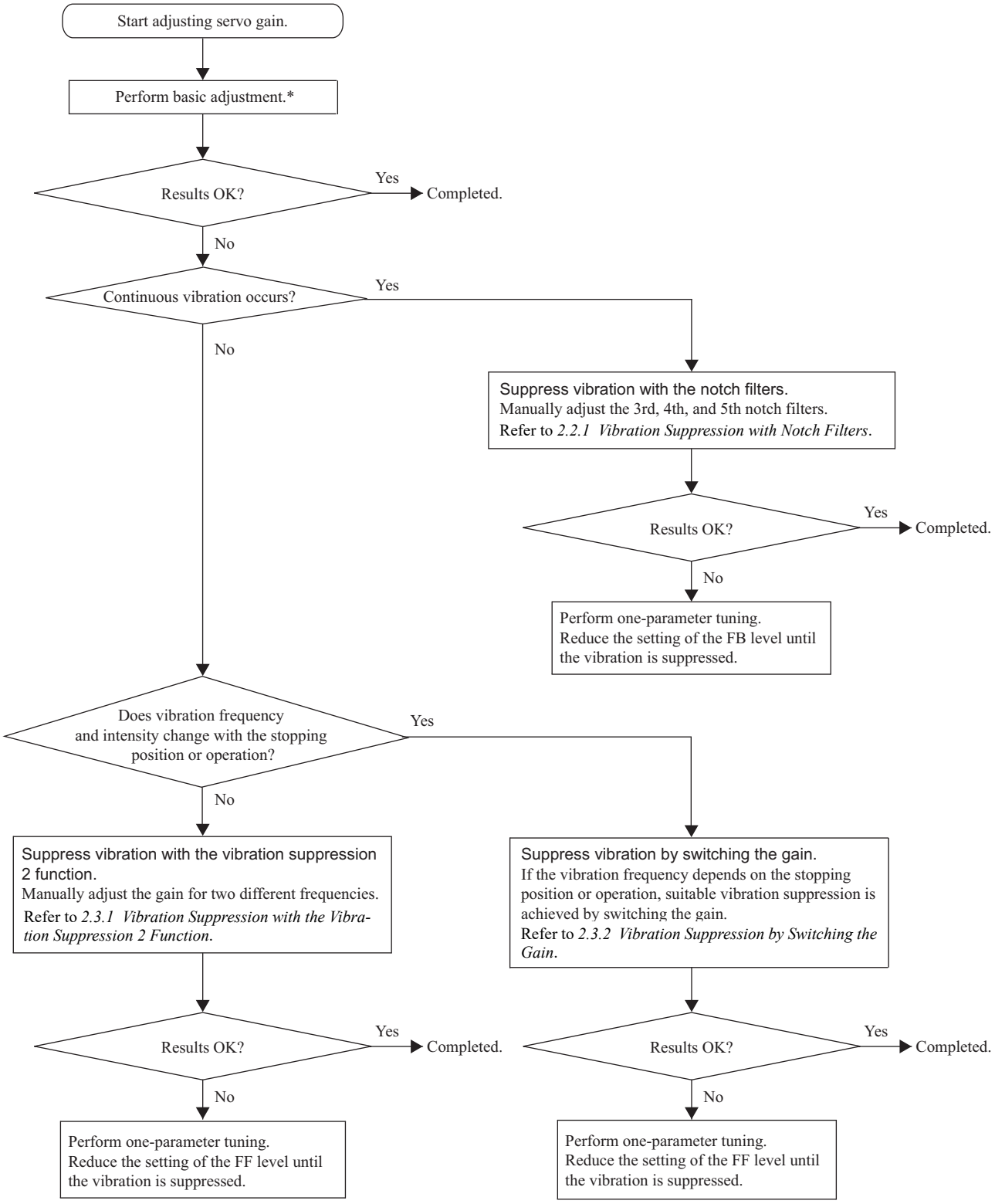
Utility Function for Adjustment	Outline	Applicable Control Method
Tuning-less Levels Setting (Fn200)	This function is enabled when the factory settings are used. This function can be used to obtain a stable response regardless of the type of machine or changes in the load.	Speed and Position
Advanced Autotuning (Fn201)	The following parameters are automatically adjusted using internal references in the SERVOPACK during automatic operation. • Moment of inertia ratio • Gains (position loop gain, speed loop gain, etc.) • Filters (torque reference filter, notch filter) • Friction compensation • Anti-resonance control adjustment function • Vibration suppression function	Speed and Position
Advanced Autotuning by Reference (Fn202)	The following parameters are automatically adjusted with the position 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 • Vibration suppression function	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
Suppression Method for Continuous Vibration	Vibration that cannot be handled with the anti-resonance control adjustment function (Fn204) is suppressed.	Speed and Position

(cont'd)

Utility Function for Adjustment	Outline	Applicable Control Method
Suppression Method for Residual Vibration during Positioning	Vibration that cannot be handled with the vibration suppression function (Fn205) is suppressed.	Position

2.1.2 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.



* For details, refer to *5.1.2 Basic Adjustment Procedure* in the *Σ-V Series User's Manual Design and Maintenance, Rotational Motor/MECHATROLINK-III Communications Reference* (No.: SIEP S800000 64).

2.1.3 Monitoring Operation during Adjustment

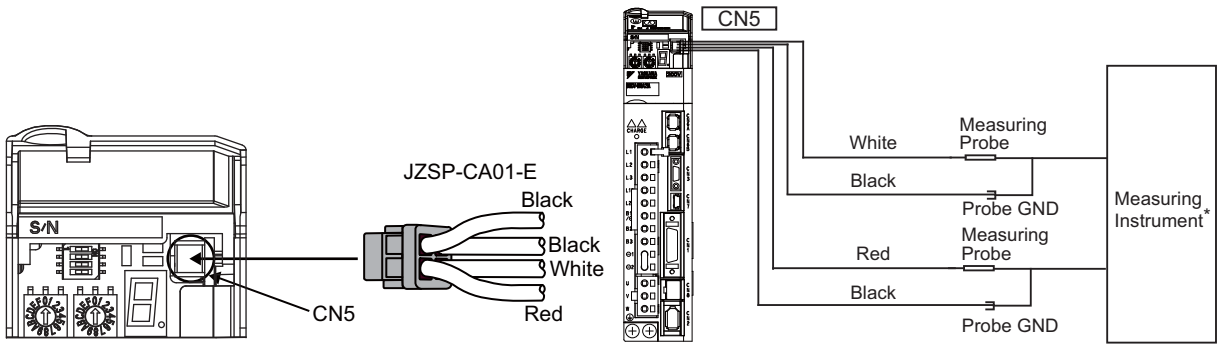
Check the operating status of the machine and signal waveform when adjusting the servo gain. Connect a measuring instrument, such as a memory recorder, to connector CN5 analog monitor connector on the SERVOPACK to monitor analog signal waveform.

The settings and parameters for monitoring analog signals are described in the following sections.

(1) Connector CN5 for Analog Monitor

To monitor analog signals, connect a measuring instrument with cable (JZSP-CA01-E) to the connector CN5.

■ Connection Example



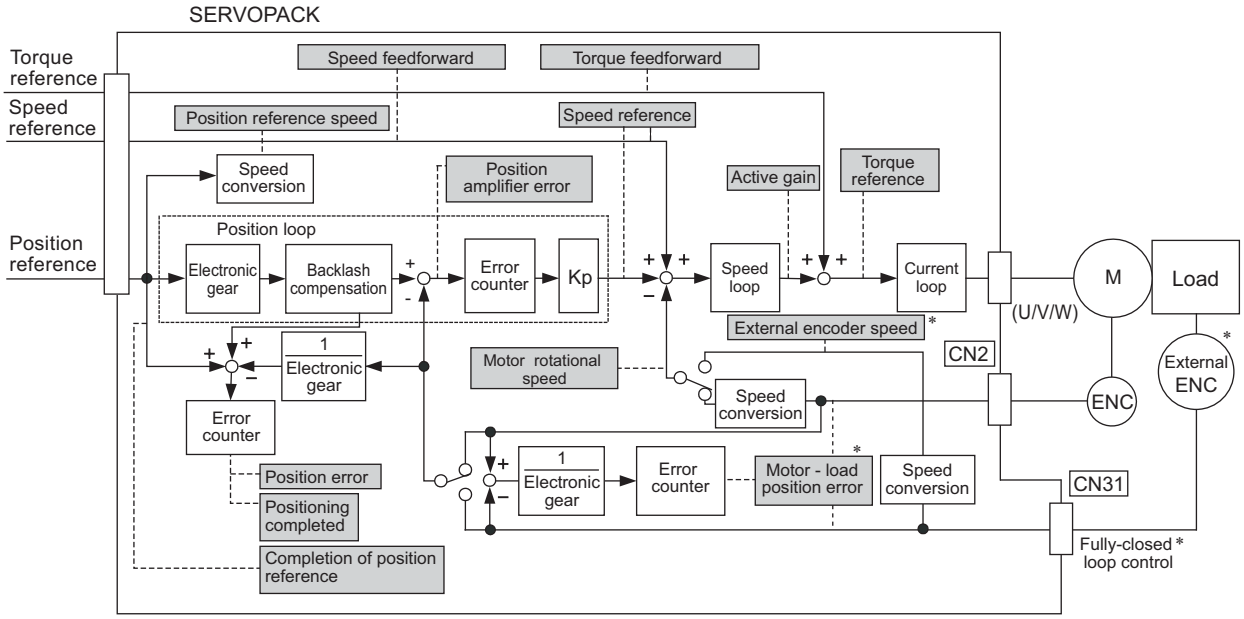
* Measuring instrument is not included.

Line Color	Signal Name	Factory Setting
White	Analog monitor 1	Torque reference: 1 V/100% rated torque
Red	Analog monitor 2	Motor speed: 1 V/1000 min^{-1} *
Black (2 lines)	GND	Analog monitor GND: 0 V

* When using a direct drive motor (SGMCV or SGMCS), the motor speed will be automatically set to 1 V/100 min^{-1}.

(2) Monitor Signal

The shaded parts in the following diagram indicate analog output signals that can be monitored.



* Available when the fully-closed loop control is being used.

The following signals can be monitored by selecting functions with parameters Pn006 and Pn007.
Pn006 is used for analog monitor 1 and Pn007 is used for analog monitor 2.

Parameter		Description		
		Monitor Signal	Unit	Remarks
Pn006 Pn007	n.☐☐00 [Pn007 Factory Setting]	Motor rotating speed	1 V/1000 min^{-1} *1	–
	n.☐☐01	Speed reference	1 V/1000 min^{-1} *1	–
	n.☐☐02 [Pn006 Factory Setting]	Torque reference	1 V/100% rated torque	–
	n.☐☐03	Position error	0.05 V/1 reference unit	0 V at speed/torque control
	n.☐☐04	Position amplifier error	0.05 V/1 encoder pulse unit	Position error after electronic gear conversion
	n.☐☐05	Position reference speed	1 V/1000 min^{-1} *1	The input reference pulses will be multiplied by n to output the position reference speed.
	n.☐☐06	Reserved (Do not set.)	–	–
	n.☐☐07	Motor-load position error	0.01 V/1 reference unit	–
	n.☐☐08	Positioning completed	Positioning completed: 5 V Positioning not completed: 0 V	Completion indicated by output voltage.
	n.☐☐09	Speed feedforward	1 V/1000 min^{-1} *1	–
	n.☐☐0A	Torque feedforward	1 V/100% rated torque	–
	n.☐☐0B	Active gain *2	1st gain: 1 V 2nd gain: 2 V	Gain type indicated by output voltage.
	n.☐☐0C	Completion of position reference	Completed: 5 V Not completed: 0 V	Completion indicated by output voltage.
	n.☐☐0D	External encoder speed	1 V/1000 min^{-1}	Value at motor shaft

∗1. When using a direct drive motor (SGMCV or SGMCS), the motor speed will be automatically set to 1 V/100 min^{-1}.
∗2. For details, refer to *5.8.1 Switching Gain Settings* in the *Σ-V Series User's Manual Design and Maintenance, Rotational Motor/MECHATROLINK-III Communications Reference* (No.: SIEP S800000 64).

(3) Setting Monitor Factor

The output voltages on analog monitors 1 and 2 are calculated by the following equations.

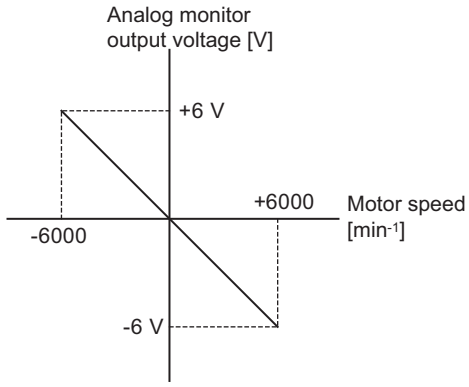
Analog monitor 1 output voltage = (-1) × (Signal selection (Pn006=n.00□□) × Multiplier (Pn552) + Offset voltage [V] (Pn550))

Analog monitor 2 output voltage = (-1) × (Signal selection (Pn007=n.00□□) × Multiplier (Pn553) + Offset voltage [V] (Pn551))

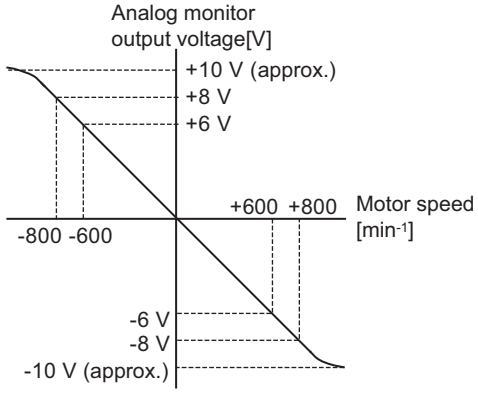
<Example>

Analog monitor output at n.□□00 (motor rotating speed setting)

When multiplier is set to × 1:



When multiplier is set to × 10:



Note: Linear effective range: within ± 8 V
Output resolution: 16-bit

(4) Related Parameters

Use the following parameters to change the monitor factor and the offset.

Pn550	Analog Monitor 1 Offset Voltage			Speed Position Torque	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	-10000 to 10000	0.1 V	0	Immediately	Setup
Pn551	Analog Monitor 2 Offset Voltage			Speed Position Torque	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	-10000 to 10000	0.1 V	0	Immediately	Setup
Pn552	Analog Monitor Magnification (× 1)			Speed Position Torque	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	-10000 to 10000	× 0.01	100	Immediately	Setup
Pn553	Analog Monitor Magnification (× 2)			Speed Position Torque	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	-10000 to 10000	× 0.01	100	Immediately	Setup

2.1.4 Safety Precautions on Adjustment of Servo Gains

⚠ CAUTION

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

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

(1) Overtravel Function

Set the overtravel function. For details on how to set the overtravel function, refer to *4.3.2 Overtravel* in the *Σ-V Series User's Manual Design and Maintenance, Rotational Motor/MECHATROLINK-III Communications Reference* (No.: SIEP S800000 64).

(2) Torque Limit

The torque limit calculates the torque required to operate the machine and sets the torque limits so that the output torque will not be greater than required. Setting torque limits can reduce the amount of shock applied to the machine when troubles occur, such as collisions or interference. If a torque limit is set lower than the value that is needed for operation, overshooting or vibration can be occurred.
For details, refer to *4.6 Limiting Torque* in the *Σ-V Series User's Manual Design and Maintenance, Rotational Motor/MECHATROLINK-III Communications Reference* (No.: SIEP S800000 64).

(3) Excessive Position Error Alarm Level

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

If this alarm level is set to a suitable value, the SERVOPACK will detect an excessive position error and will stop the servomotor if the servomotor does not operate according to the reference. The position error indicates the difference between the position reference value and the actual motor position.
The position error can be calculated from the position loop gain (Pn102) and the motor speed with the following equation.

$$\text{Position Error [reference unit]} = \frac{\text{Motor Speed [min}^{-1}\text{]}}{60} \times \frac{\text{Encoder Resolution}^{*1}}{\text{Pn102 [0.1/s]}/10^{*2*3}} \times \frac{\text{Pn210}}{\text{Pn20E}}$$

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

$$\text{Pn520} > \frac{\text{Max. Motor Speed [min}^{-1}\text{]}}{60} \times \frac{\text{Encoder Resolution}^{*1}}{\text{Pn102 [0.1/s]}/10^{*2*3}} \times \frac{\text{Pn210}}{\text{Pn20E}} \times \underline{\underline{(1.2 \text{ to } 2)^{*4}}}$$

∗1. Refer to *4.4.3 Electronic Gear* in the *Σ-V Series User's Manual Design and Maintenance, Rotational Motor/MECHATROLINK-III Communications Reference* (No.: SIEP S800000 64).
∗2. When model following control is enabled (Pn140 = n.□□□1), use the setting of Pn141 instead of Pn102.
∗3. To check the Pn102 setting, change the parameter display setting to display all parameters (Pn00B.0 = 1).
∗4. This coefficient "× (1.2 to 2)" is used to add a margin that prevents a position error overflow alarm (A.d00).

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

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

- Maximum speed = 6000
- Encoder resolution = 1048576 (20 bits)
- Pn102 = 400
- $\frac{\text{Pn210}}{\text{Pn20E}} = \frac{1}{1}$

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

$$\text{Pn520} = \frac{6000}{60} \times \frac{1048576}{400/10} \times \frac{1}{1} \times 2$$
$$= 2621440 \times 2$$
$$= 5242880 \text{ (The factory setting of Pn520)}$$

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

■ Related Parameter

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

■ Related Alarm

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

(4) Vibration Detection Function

Set the vibration detection function to an appropriate value with the vibration detection level initialization (Fn01B). For details on how to set the vibration detection function, refer to *6.16 Vibration Detection Level Initialization (Fn01B)* in the *Σ-V Series User's Manual Design and Maintenance, Rotational Motor/ MECHATROLINK-III Communications Reference* (No.: SIEP S800000 64).

(5) Excessive Position Error Alarm Level at Servo ON

If position errors remain in the error counter when turning ON the servomotor power, the servomotor will move and this movement will clear the counter of all position errors. Because the servomotor will move suddenly and unexpectedly, safety precautions are required. To prevent the servomotor from moving suddenly, select the appropriate level for the excessive position error alarm level at servo ON (Pn526) to restrict operation of the servomotor.

■ Related Parameters

Pn526	Excessive Position Error Alarm Level at Servo ON [Position]				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 1073741823	1 reference unit	5242880	Immediately	Setup

Pn528	Excessive Position Error Warning Level at Servo ON [Position]				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 100	1%	100	Immediately	Setup

Pn529	Speed Limit Level at Servo ON [Position]				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 min^{-1}	10000	Immediately	Setup

■ Related Alarms

Alarm Display	Alarm Name	Meaning
A.d01	Position Error Overflow Alarm at Servo ON	This alarm occurs if the servomotor power is turned ON when the position error is greater than the set value of Pn526 while the servomotor power is OFF.
A.d02	Position Error Overflow Alarm by Speed Limit at Servo ON	When the position errors remain in the error counter, Pn529 limits the speed if the servomotor power is turned ON. If Pn529 limits the speed in such a state, this alarm occurs when reference pulses are input and the number of position errors exceeds the value set for the excessive position error alarm level (Pn520).

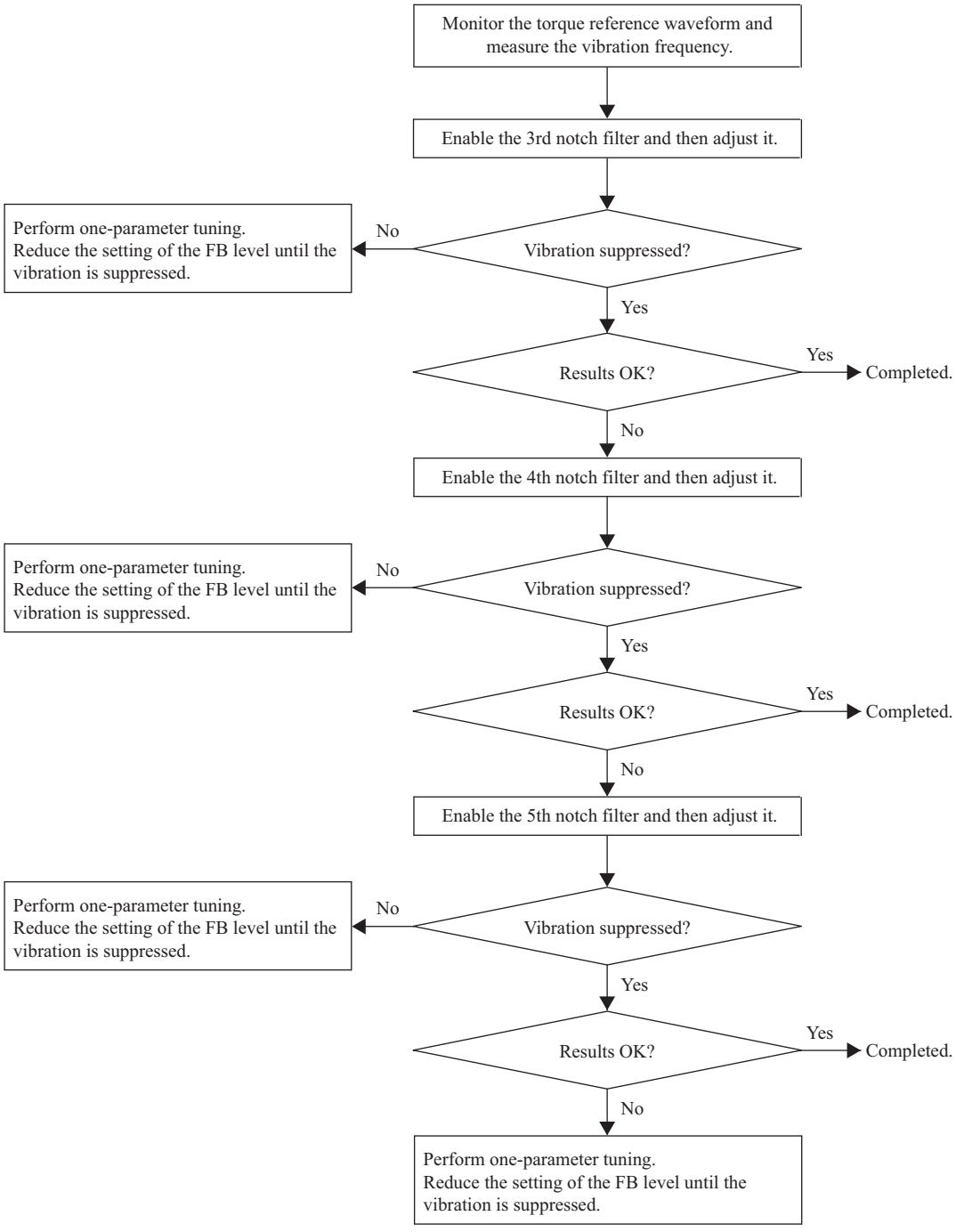
When an alarm occurs, refer to *9 Troubleshooting* in the *Σ-V Series User's Manual Design and Maintenance, Rotational Motor/MECHATROLINK-III Communications Reference* (No.: SIEP S800000 64).

2.2 Suppression Method for Continuous Vibration

This section describes the method to suppress continuous vibration that results from machine resonance. There are 3rd, 4th, and 5th notch filters that you can use after the 1st and 2nd notch filters. With more notch filters, you can suppress vibration for more machine resonance points.

2.2.1 Vibration Suppression with Notch Filters

The procedure to suppress vibration with the notch filters is given below.



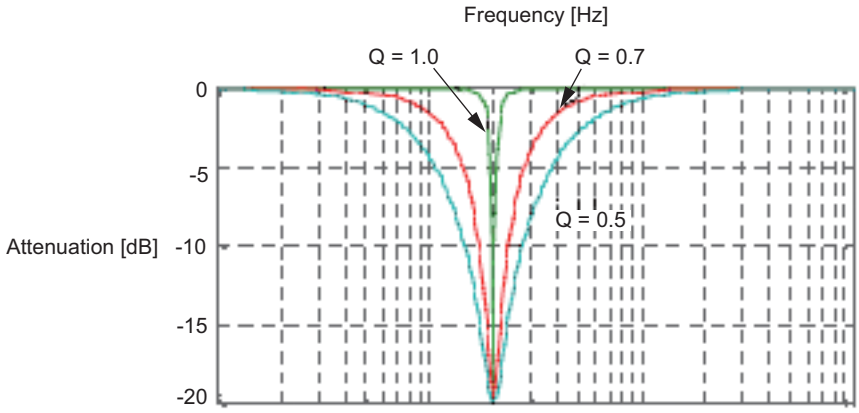
2.2.2 Notch Filter Settings

Three parameters are used to set the notch filters: notch filter frequency, notch filter Q value, and notch filter depth. This section describes the notch filter Q value and notch filter depth.

(1) Notch Filter Q Value

The notch filter Q value specifies the width of the frequencies to filter around the specified notch filter frequency. The width of the depression in the graph changes with the notch filter Q value. As the notch filter Q value increases, the depression becomes more abrupt and the width of the filtered frequencies becomes narrower.

The notch filter frequency characteristic for changes in the notch filter Q value is shown in the following graph.



Notch Filter Frequency Characteristic*

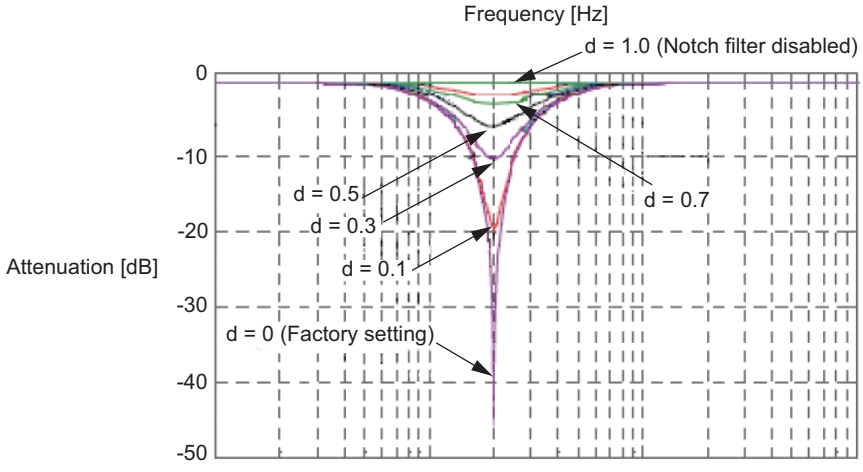
* In the above graph, the notch filter frequency characteristic represents calculated values and may differ from the actual characteristic.

(2) Notch Filter Depth

The notch filter depth specifies the depth of the frequencies that are filtered around the specified notch filter frequency. The depth of the depression changes with the notch filter depth. As the notch filter depth decreases, the depression becomes deeper and the vibration suppression becomes stronger. However, the vibration may actually become stronger if you decrease the depth too much.

The notch filter is disabled if the notch filter depth is set to 1.0 (example: Pn418 = 1000).

The notch filter frequency characteristic for changes in the notch filter depth is shown in the following graph.



Notch Filter Frequency Characteristic*

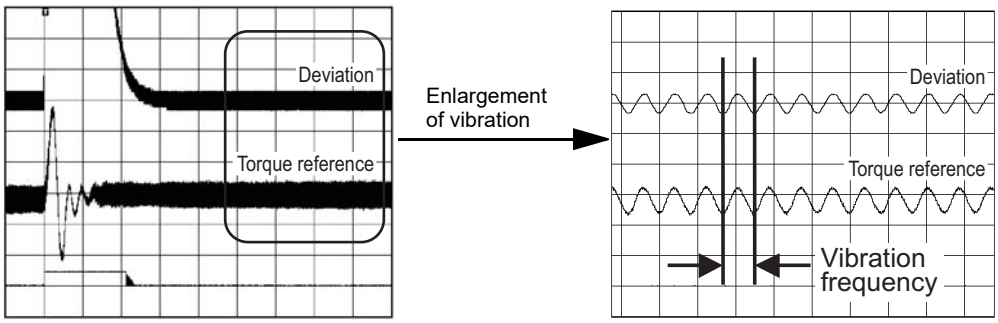
* In the above graph, the notch filter frequency characteristic represents calculated values and may differ from the actual characteristic.

2.2.3 Notch Filter Adjustment Procedure

Always monitor the operating status of the machine and the torque reference waveform while you adjust the notch filter. You can measure the torque reference waveform with an analog monitor output or with the SigmaWin+.

> **IMPORTANT**
>
> Before performing this procedure, make sure to adjust the 1st and 2nd notch filters by advanced autotuning (Fn201), advanced autotuning by reference (Fn202), or one-parameter tuning (Fn203).

The procedure for adjusting the 3rd notch filter with the panel operator is given below.

Step	Operation
1	Use the analog monitor output or the SigmaWin+ to monitor the torque reference waveform and the deviation. 
2	Measure the vibration frequency from the torque reference waveform and the deviation.
3	Set the measured vibration frequency as the 3rd notch filter frequency (Pn416). (Example: If the vibration frequency is 500 Hz, set Pn416 to 500.)
4	Set the 3rd notch filter Q value (Pn417) to 200.
5	Set the 3rd notch filter depth (Pn418) to 1000.
6	Enable the 3rd notch filter by setting Pn41F.0 to 1.
7	Decrease the setting of the 3rd notch filter depth (Pn418) by 100 at a time while monitoring the torque reference waveform. Note: The vibration may actually become stronger if you decrease the value of Pn418 too much.
8	Check to see if the vibration is suppressed. If the vibration has not been suppressed by the time the 3rd notch filter depth is set to 0.5 (Pn418 = 500), disable the 3rd notch filter by setting Pn41F.0 to 0. If the vibration is suppressed, this completes adjustment of the 3rd notch filter.

Use the same procedure as for the 3rd notch filter to adjust the 4th and 5th notch filters.

2.2.4 Related Parameters

Parameter		Meaning	When Enabled	Classification
Pn41F	n.□□□0 [Factory Setting]	Disables 3rd notch filter.	Immediately	Setup
	n.□□□1	Enables 3rd notch filter.		
	n.□□0□ [Factory Setting]	Disables 4th notch filter.		
	n.□□1□	Enables 4th notch filter.		
	n.□0□□ [Factory Setting]	Disables 5th notch filter.		
	n.□1□□	Enables 5th notch filter.		

Pn416	3rd Notch Filter Frequency				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 5000	1 Hz	5000	Immediately	Tuning
Pn417	3rd Notch Filter Q Value				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 1000	0.01	70	Immediately	Tuning
Pn418	3rd Notch Filter Depth				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 1000	0.001	0	Immediately	Tuning
Pn419	4th Notch Filter Frequency				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 5000	1 Hz	5000	Immediately	Tuning
Pn41A	4th Notch Filter Q Value				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 1000	0.01	70	Immediately	Tuning
Pn41B	4th Notch Filter Depth				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 1000	0.001	0	Immediately	Tuning
Pn41C	5th Notch Filter Frequency				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 5000	1 Hz	5000	Immediately	Tuning
Pn41D	5th Notch Filter Q Value				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 1000	0.01	70	Immediately	Tuning
Pn41E	5th Notch Filter Depth				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 1000	0.001	0	Immediately	Tuning

2.3 Suppression Method for Residual Vibration during Positioning

This section describes the method to suppress residual vibration that occurs during positioning.

There are the following two vibration suppression methods.

- Vibration suppression with the vibration suppression 2 function
- Vibration suppression by switching the gain

2.3.1 Vibration Suppression with the Vibration Suppression 2 Function

This section describes vibration suppression with the vibration suppression 2 function.

(1) Vibration Suppression 2 Function

The vibration suppression 2 function suppresses vibration at two frequencies.

This function is used if residual vibration occurs during positioning after the vibration suppression function (Fn205) is enabled.

To enable this function, set Pn140.1 to 2.

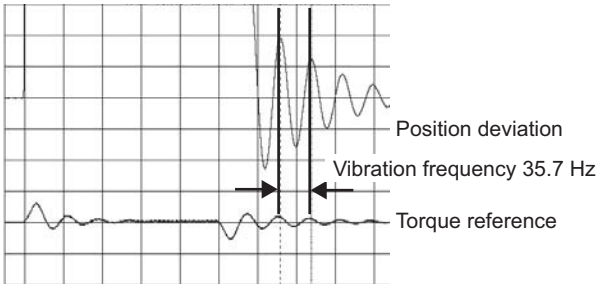
Parameter		Meaning	When Enabled	Classification
Pn140	n.□□0□ [Factory Setting]	Does not perform vibration suppression.	After Restart	Tuning
	n.□□1□	Performs vibration suppression over the specified frequency.		
	n.□□2□	Performs vibration suppression over two different kinds of frequencies.		

(2) Operating Procedure for Vibration Suppression 2 Function

IMPORTANT

Before performing this procedure, make sure to enable the vibration suppression function by advanced autotuning (Fn201), advanced autotuning by reference (Fn202), or vibration suppression function (Fn205).

The operating procedure for this function is given below.

Step	Operation
1	Use the analog monitor output or the SigmaWin+ to monitor the position deviation waveform[*1]. 
2	Measure the vibration frequency from the position deviation waveform[*2].
3	Set the measured vibration frequency as the vibration suppression 2 frequency (Pn14A). (Example: If the vibration frequency is 35.7 Hz, set Pn41A to 357.)
4	Set the vibration suppression 2 compensation (Pn14B) to 100.
5	Set Pn140.1 to 2 to suppress the vibration suppression 2 frequency (Pn14A) [*3].
6	Fine-tune the vibration suppression 2 frequency (Pn14A) as required.

(cont'd)

Step	Operation
7	Increase the setting of the vibration suppression 2 compensation (Pn14B) by 10% at a time while monitoring the position deviation waveform. Note: The vibration may actually become stronger if you increase the value of Pn14B too much.
8	Check to see if the vibration is suppressed. If the vibration is suppressed, this completes adjustment of the vibration suppression 2 function.

∗1. If vibration does not occur in the position deviation, use a measurement device such as a displacement meter or vibration meter to measure the vibration frequency.
∗2. You can also use the vibration suppression function (Fn205) to measure the vibration frequency. For information on the vibration suppression function (Fn205), refer to *5.7 Vibration Suppression Function (Fn205)* in the *Σ-V Series User's Manual Design and Maintenance, Rotational Motor/MECHATROLINK-III Communications Reference* (No.: SIEP S800000 64).
∗3. If the vibration was not suppressed, set Pn140.1 to 1 to disable the function. Then, perform one-parameter tuning and reduce the setting of the FF level until the vibration is suppressed.

(3) Related Parameters

Parameter		Meaning	When Enabled	Classification
Pn140	n.□□0□ [Factory Setting]	Does not perform vibration suppression.	After Restart	Tuning
	n.□□1□	Performs vibration suppression over the specified frequency.		
	n.□□2□	Performs vibration suppression over two different kinds of frequencies.		

Pn14A	Vibration Suppression 2 Frequency				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 2000	0.1 Hz	800	Immediately	Tuning
Pn14B	Vibration Suppression 2 Compensation				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 1000	1%	100	Immediately	Tuning

2.3.2 Vibration Suppression by Switching the Gain

If the vibration frequency depends on the stopping position or operation, suitable vibration suppression can be achieved by switching the gain to switch vibration frequency setting.

There are the following two methods for vibration suppression by switching the gain.

- Switching the gain manually to suppress vibration by using an external input signal
- Switching the gain automatically according to the travel direction to suppress vibration

Parameter		Meaning	When Enabled	Classification
Pn139	n.□□□0 [Factory Setting]	Manual gain switching	Immediately	Tuning
	n.□□□2	Automatic gain switching		

Note: n.□□□1 is reserved. Do not use.

The suppress vibration by switching the gain, set Pn139.0 to 0.

Parameter		Meaning	When Enabled	Classification
Pn14F	n.□0□□ [Factory Setting]	Manual gain switching	After Restart	Tuning
	n.□1□□	Travel direction gain switching		

The parameter settings that are related to switching the gain are given below.

Vibration Suppression by Switching the Gain	Parameter	
	Pn139	Pn14F
Switching the gain manually	Pn139.0 = 0	Pn14F.2 = 0
Switching the gain automatically according to the travel direction	Pn139.0 = 0	Pn14F.2 = 1

(1) Gain Combinations for Switching

Setting	Speed Loop Gain	Speed Loop Integral Time Constant	Position Loop Gain	Torque Reference Filter	Model Following Control Gain*	Model Following Control Gain Compensation*	Friction Compensation Gain	Vibration Suppression 1 Frequency A*	Vibration Suppression 1 Frequency B*
Gain Setting 1	Pn100 Speed Loop Gain	Pn101 Speed Loop Integral Time Constant	Pn102 Position Loop Gain	Pn401 Torque Reference Filter Time Constant	Pn141 Model Following Control Gain	Pn142 Model Following Control Gain Compensation	Pn121 Friction Compensation Gain	P145 Vibration Suppression 1 Frequency A	P146 Vibration Suppression 1 Frequency B
Gain Setting 2	Pn104 2nd Speed Loop Gain	Pn105 2nd Speed Loop Integral Time Constant	Pn106 2nd Position Loop Gain	Pn412 1st Step 2nd Torque Reference Filter Time Constant	Pn148 2nd Model Following Control Gain	Pn149 2nd Model Following Control Gain Compensation	Pn122 2nd Gain for Friction Compensation	P14C 2ndVibration Suppression 1 Frequency A	P14D 2ndVibration Suppression 1 Frequency B

* • The gain is changed according to these parameters if the following conditions are met simultaneously. If the conditions are not met, these parameters will not change even if other parameters shown above are changed.
  • Manual gain switching is enabled (Pn139.0 = 0).
  • There is no reference.
  • The motor is stopped.
• If travel direction gain switching is enabled (i.e., Pn14F.2 = 1), these parameters are not changed by the G-SEL of the servo command output signals (SVCMD_IO).

(2) Vibration Suppression by Manually Switching the Gain

Manual gain switching uses G-SEL of the servo command output signals (SVCMD_IO) to switch between gain setting 1 and gain setting 2.
When the motor is stopped, input the G-SEL signal and wait 2 ms or more to input a command (e.g., positioning).

Type	Command Name	Setting	Meaning
Input	G-SEL of the servo command output signals (SVCMD_IO)	0	Switches to gain setting 1.
		1	Switches to gain setting 2.

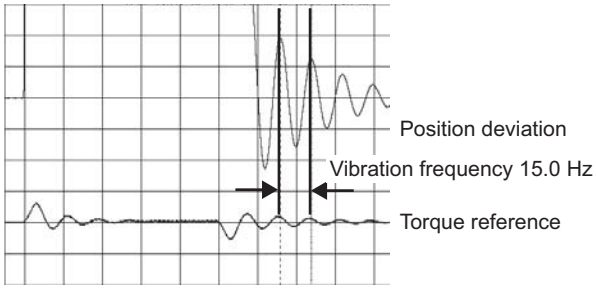
■ Procedure for Vibration Suppression by Manually Switching the Gain

IMPORTANT

Before performing this procedure, make sure to set the following parameters for the gain 1 by advanced autotuning (Fn201), advanced autotuning by reference (Fn202), or one-parameter tuning (Fn203).

- Speed Loop Gain (Pn100)
- Speed Loop Integral Time Constant (Pn101)
- Position Loop Gain (Pn102)
- Friction Compensation Gain (Pn121)
- Torque Reference Filter Time Constant (Pn401)
- Model Following Control Gain (Pn141)
- Model Following Control Gain Compensation (Pn142)
- Vibration Suppression 1 Frequency A (Pn145)
- Vibration Suppression 1 Frequency B (Pn146)

The procedure for vibration suppression by manually switching the gain is given below.

Step	Operation
1	Set the switching gain setting to manual gain switching by setting Pn139.0 to 0.
2	Set the setting for the model following control gain switching to manual gain switching by setting Pn14F.2 to 0.
3	Use the analog monitor output or the SigmaWin+ to monitor the position deviation waveform*1. 
4	Measure the vibration frequency from the position deviation waveform*2.
5	Set the measured vibration frequency as the 2nd vibration suppression 1 frequency A (Pn14C) and the 2nd vibration suppression 1 frequency B (Pn14D). (Example: If the vibration frequency is 15.0 Hz, set Pn14C and Pn14D to 150.)
6	Set the setting of the speed loop gain (Pn100) as the 2nd speed loop gain (Pn104).
7	Set the setting of the speed loop integral time constant (Pn101) as the 2nd speed loop integral time constant (Pn105).
8	Set the setting of the position loop gain (Pn102) as the 2nd position loop gain (Pn106).
9	Set the setting of the friction compensation gain (Pn121) as the 2nd gain for friction compensation (Pn122).
10	Set the setting of the torque reference filter time constant (Pn401) as the 1st step 2nd torque reference filter time constant (Pn412).
11	Set the setting of the model following control gain (Pn141) as the 2nd model following control gain (Pn148).
12	Set the setting of the model following control gain compensation (Pn142) as the 2nd model following control gain compensation (Pn149).
13	Set gain 2 by setting the G-SEL of the servo command output signals (SVCMD_IO) to 1*3.
14	Fine-tune the 2nd vibration suppression 1 frequency A (Pn14C) and the 2nd vibration suppression 1 frequency B (Pn14D) as required.
15	Check to see if the vibration is suppressed. If the vibration is suppressed, this completes adjustment of manual gain switching.

∗1. If vibration does not occur in the position deviation, use a measurement device such as a displacement meter or vibration meter to measure the vibration frequency.

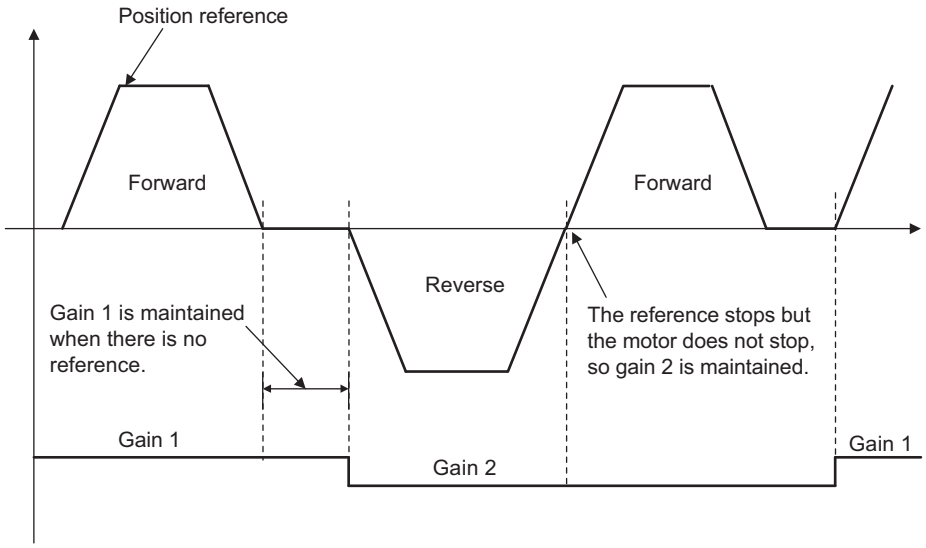
∗2. The vibration frequency for gain 1 is set automatically by advanced autotuning, advanced autotuning by reference, or one-parameter tuning. You can also use the vibration suppression function (Fn205) to measure the vibration frequency. For information on the vibration suppression function (Fn205), refer to *5.7 Vibration Suppression Function (Fn205)* in the *Σ-V Series User's Manual Design and Maintenance, Rotational Motor/MECHATROLINK-III Communications Reference* (No.: SIEP S800000 64).

∗3. If the vibration was not suppressed, set gain 1 by setting the G-SEL of the servo command output signals (SVCMD_IO) to 0. Then, perform one-parameter tuning and reduce the setting of the FF level until the vibration is suppressed.

(3) Vibration Suppression by Travel Direction Gain Switching

Travel direction gain switching is used to switch the gain between gain 1 and gain 2 according to the travel direction (i.e., according to the direction of the reference input).

■ Operation Example for Travel Direction Gain Switching



Note 1. The travel direction is determined from the direction of the position reference. The settings in the direction selection (Pn000.0) are not affected.
2. The gain is not changed while stopped.
3. The gain is not changed while the motor is operating. To change the gain, make sure that there is no reference for a sufficiently long enough period of time before the next travel reference.

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification
Pn14F	2	Control Related Switch	0000 to 0011	—	0011	After restart	Tuning

n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

Model Following Control Type Selection

0	Model Following Control 1
1	Model Following Control 2

Tuning-less Type Selection

0	Tuning-less type 1
1	Tuning-less type 2

Model Following Control Gain Switching Selection

0	Manual gain switching
1	Travel direction gain switching* (Gain 1 is used for forward travel and gain 2 is used for reverse travel.)

Reserved (Do not change.)

* If you set travel direction gain switching (Pn14F.2 = 1), only the following parameters are changed when the status of the G-SEL of the servo command output signals (SVCMD_IO) changes.
  - Speed loop gain
  - Speed loop integral time constant
  - Position loop gain
  - Friction compensation gain
  - Torque reference filter

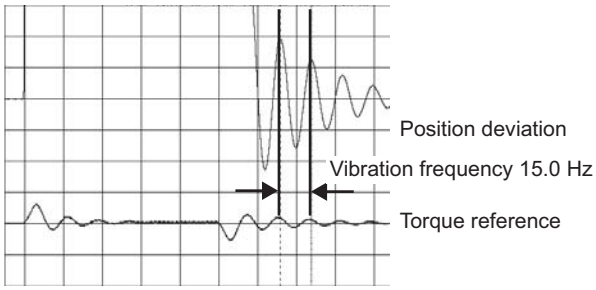
■ Procedure for Vibration Suppression by Travel Direction Gain Switching

IMPORTANT

Before performing this procedure, make sure to set the following parameters for the gain 1 by advanced autotuning (Fn201), advanced autotuning by reference (Fn202), or one-parameter tuning (Fn203).

- Speed Loop Gain (Pn100)
- Speed Loop Integral Time Constant (Pn101)
- Position Loop Gain (Pn102)
- Friction Compensation Gain (Pn121)
- Torque Reference Filter Time Constant (Pn401)
- Model Following Control Gain (Pn141)
- Model Following Control Gain Compensation (Pn142)
- Vibration Suppression 1 Frequency A (Pn145)
- Vibration Suppression 1 Frequency B (Pn146)

The procedure for vibration suppression with travel direction gain switching is given below.

Step	Operation
1	Set the switching gain setting to manual gain switching by setting Pn139.0 to 0.
2	Use the analog monitor output or the SigmaWin+ to monitor the position deviation waveform[*1]. 
3	Measure the vibration frequency during reverse travel from the position deviation waveform[*2].
4	Set the measured vibration frequency as the 2nd vibration suppression 1 frequency A (Pn14C) and the 2nd vibration suppression 1 frequency B (Pn14D). (Example: If the vibration frequency is 15.0 Hz, set Pn14C and Pn14D to 150.)
5	Set the setting of the speed loop gain (Pn100) as the 2nd speed loop gain (Pn104).
6	Set the setting of the speed loop integral time constant (Pn101) as the 2nd speed loop integral time constant (Pn105).
7	Set the setting of the position loop gain (Pn102) as the 2nd position loop gain (Pn106).
8	Set the setting of the friction compensation gain (Pn121) as the 2nd gain for friction compensation (Pn122).
9	Set the setting of the torque reference filter time constant (Pn401) as the 1st step 2nd torque reference filter time constant (Pn412).
10	Set the setting of the model following control gain (Pn141) as the 2nd model following control gain (Pn148).
11	Set the setting of the model following control gain compensation (Pn142) as the 2nd model following control gain compensation (Pn149).
12	Enable travel direction gain switching by setting Pn14F.2 to 1[*3].
13	Fine-tune the 2nd vibration suppression 1 frequency A (Pn14C) and the 2nd vibration suppression 1 frequency B (Pn14D) as required.
14	Check to see if the vibration is suppressed. If the vibration is suppressed, this completes adjustment of travel direction gain switching.

∗1. If vibration does not occur in the position deviation, use a measurement device such as a displacement meter or vibration meter to measure the vibration frequency.

∗2. The vibration frequency at forward travel is set automatically by advanced autotuning, advanced autotuning by reference, or one-parameter tuning. You can also use the vibration suppression function (Fn205) to measure the vibration frequency. For information on the vibration suppression function (Fn205), refer to *5.7 Vibration Suppression Function (Fn205)* in the *Σ-V Series User's Manual Design and Maintenance, Rotational Motor/MECHATROLINK-III Communications Reference* (No.: SIEP S800000 64).

*3. If the vibration was not suppressed, enable manual gain setting by setting Pn14F.2 = 0 and set gain 1 by setting the G-SEL of the servo command output signals (SVCMD_IO) to 0. Then, perform one-parameter tuning and reduce the setting of the FF level until the vibration is suppressed.

(4) Related Parameters

Parameter		Meaning	When Enabled	Classification
Pn139	n.□□□0 [Factory Setting]	Manual gain switching	Immediately	Tuning
	n.□□□2	Automatic gain switcing		

Parameter		Meaning	When Enabled	Classification
Pn14F	n.□0□□ [Factory Setting]	Manual gain switching	After Restart	Tuning
	n.□1□□	Travel direction gain switching		

Pn100	Speed Loop Gain				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 20000	0.1 Hz	400	Immediately	Tuning
Pn101	Speed Loop Integral Time Constant				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	15 to 51200	0.01 ms	100	Immediately	Tuning
Pn102	Position Loop Gain				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 20000	0.1/s	400	Immediately	Tuning
Pn121	Friction Compensation Gain				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 1000	1%	100	Immediately	Tuning
Pn401	Torque Reference Filter Time Constant				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	0.01 ms	100	Immediately	Tuning
Pn141	Model Following Control Gain				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 20000	0.1/s	500	Immediately	Tuning
Pn142	Model Following Control Gain Compensation				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	500 to 2000	0.1%	1000	Immediately	Tuning
Pn145	Vibration Suppression 1 Frequency A				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 2500	0.1 Hz	500	Immediately	Tuning
Pn146	Vibration Suppression 1 Frequency B				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 2500	0.1 Hz	700	Immediately	Tuning
Pn104	2nd Speed Loop Gain				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 20000	0.1 Hz	400	Immediately	Tuning
Pn105	2nd Speed Loop Integral Time Constant				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	15 to 51200	0.01 ms	2000	Immediately	Tuning

(cont'd)

Pn106	2nd Position Loop Gain				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 20000	0.1/s	400	Immediately	Tuning
Pn122	2nd Gain for Friction Compensation				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 1000	1%	100	Immediately	Tuning
Pn412	1st Step 2nd Torque Reference Filter Time Constant				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	0.01 ms	100	Immediately	Tuning
Pn148	2nd Model Following Control Gain				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 20000	0.1/s	500	Immediately	Tuning
Pn149	2nd Model Following Control Gain Compensation				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	500 to 2000	0.1%	1000	Immediately	Tuning
Pn14C	2nd Vibration Suppression 1 Frequency A				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 2500	0.1 Hz	500	Immediately	Tuning
Pn14D	2nd Vibration Suppression 1 Frequency B				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 2500	0.1 Hz	700	Immediately	Tuning

3

List of Σ-V-FT-series FT001 Parameters

Here, the parameters that are added to the Σ-V-FT-series FT001 and the parameters that have different default settings than those of the Σ-V Standard SERVOPACKs are given. All parameters that are not given here are the same as for the Σ-V Standard SERVOPACKs. For details, refer to the *Σ-V Series User's Manual Design and Maintenance, Rotational Motor/ MECHATROLINK-III Communications Reference* (No.: SIEP S800000 64).

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3.1 Special Parameters

The following table lists the parameters that differentiate the FT001 from the Σ-V Series standard SERVOPACKs.

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Profile	Reference Section
Pn14F	2	Control Related Switch	0000 to 0011	–	0011	After restart	Tuning	–	*2.3.2*
Pn14C	2	2nd Vibration Suppression 1 Frequency A	10 to 2500	0.1 Hz	500	Immediately	Tuning	–	*2.3.2*
Pn14D	2	2nd Vibration Suppression 1 Frequency B	1 to 2500	0.1 Hz	700	Immediately	Tuning	–	*2.3.2*
Pn41F	2	Torque Related Function Switch 2	0000 to 1111	–	0000	Immediately	Setup	–	*2.2.3*

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit – Model Following Control Type Selection

		Reference Section
0	Model Following Control 1	*5.3.1*, 5.4.1*, 5.5.1**
1	Model Following Control 2	

2nd digit – Tuning-less Type Selection

		Reference Section
0	Tuning-less Type 1	*5.2.2**
1	Tuning-less Type 2	

3rd digit – Model Following Control Gain Switching Selection

0	Manual gain switching
1	Travel direction gain switching

4th digit – Reserved (Do not change.)

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit – 3rd Step Notch Filter Selection

0	Disables 3rd notch filter.
1	Enables 3rd notch filter.

2nd digit – 4th Step Notch Filter Selection

0	Disables 4th notch filter.
1	Enables 4th notch filter.

3rd digit – 5th Step Notch Filter Selection

0	Disables 5th notch filter.
1	Enables 5th notch filter.

4th digit – Reserved (Do not change.)

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

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classi-fication	Profile	Reference Section
Pn416	2	3rd Notch Filter Frequency	50 to 5000	1 Hz	5000	Immediately	Tuning	–	
Pn417	2	3rd Notch Filter Q Value	50 to 1000	0.01	70	Immediately	Tuning	–	
Pn418	2	3rd Notch Filter Depth	0 to 1000	0.001	0	Immediately	Tuning	–	
Pn419	2	4th Notch Filter Frequency	50 to 5000	1 Hz	5000	Immediately	Tuning	–	
Pn41A	2	4th Notch Filter Q Value	50 to 1000	0.01	70	Immediately	Tuning	–	*2.2.3*
Pn41B	2	4th Notch Filter Depth	0 to 1000	0.001	0	Immediately	Tuning	–	
Pn41C	2	5th Notch Filter Frequency	50 to 5000	1 Hz	5000	Immediately	Tuning	–	
Pn41D	2	5th Notch Filter Q Value	50 to 1000	0.01	70	Immediately	Tuning	–	
Pn41E	2	5th Notch Filter Depth	0 to 1000	0.001	0	Immediately	Tuning	–	

3.2 Precaution When Copying Parameters

The digital operator can be used to copy parameters between two FT001 SERVOPACKs in the Σ-V-FT series.

If you copy parameters between a Σ-V-FT-series FT001 SERVOPACK and a different model of SERVOPACK, an alarm A.040 (Parameter setting Error 1) will occur because different numbers of parameters are used.

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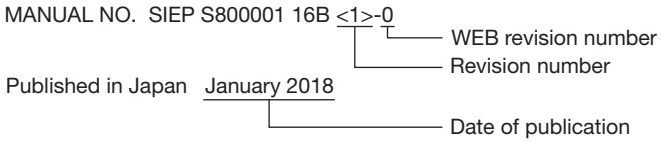

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Σ-V-FT Series

USER'S MANUAL

Model: FT001
Rotational Motor
MECHATROLINK-III Communications Reference

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